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PAPER 66-16

UPPER CRETACEOUS AND TERTIARY STRATIGRAPHY,
NORTHERN YUKON TERRITORY AND
NORTHWESTERN DISTRICT OF MACKENZIE

(Report, 2 figures, appendix)

E. W. Mountjoy



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ABSTRACT

The Upper Cretaceous and Tertiary stratigraphy of five widely scattered areas of the northern Yukon Territory and adjoining Northwest Territory is described, based on a reconnaissance study of this region in 1962. Early Upper Cretaceous rocks are restricted to the Eagle Plain and Porcupine River areas and comprise a sequence of non-marine sandstones herein named the Eagle Plain Formation. Late Cretaceous and early Tertiary rocks occur in three areas; northwest Ogilvie Mountains, southern Richardson Mountains and west side of Mackenzie Delta. In all three areas these sequences comprise a series of non-marine sandstones named Monster, Bonnet Plume and Moose Channel Formations respectively. The youngest beds of middle Tertiary age outcrop on the east side of the Mackenzie Delta in the Caribou Hills. They consist of non-marine, poorly consolidated sands and silts with some clay shales and conglomerates and are named the Reindeer Formation.

The distribution of these rocks and their non-marine nature suggests that much of the region was emergent during the late Cretaceous and Tertiary with the last marine incursion taking place in Upper Cretaceous Santonian or Coniacian time. Deformation and uplift of the Richardson Mountains probably took place during late Cretaceous (Santonian?) time. Moderate, local deformation during latest Cretaceous and early Tertiary times formed three small basins of deposition in which relatively thick, non-marine clastic sequences accumulated, two of which developed across north-south structural trends of the Richardson Mountains. Uplift, thrusting and folding of the northern Ogilvie and Mackenzie Mountains probably took place during the early Tertiary. During the remainder of the Tertiary, sediments were not deposited in this region, except for Middle Tertiary shallow water sediments of the Caribou Hills.

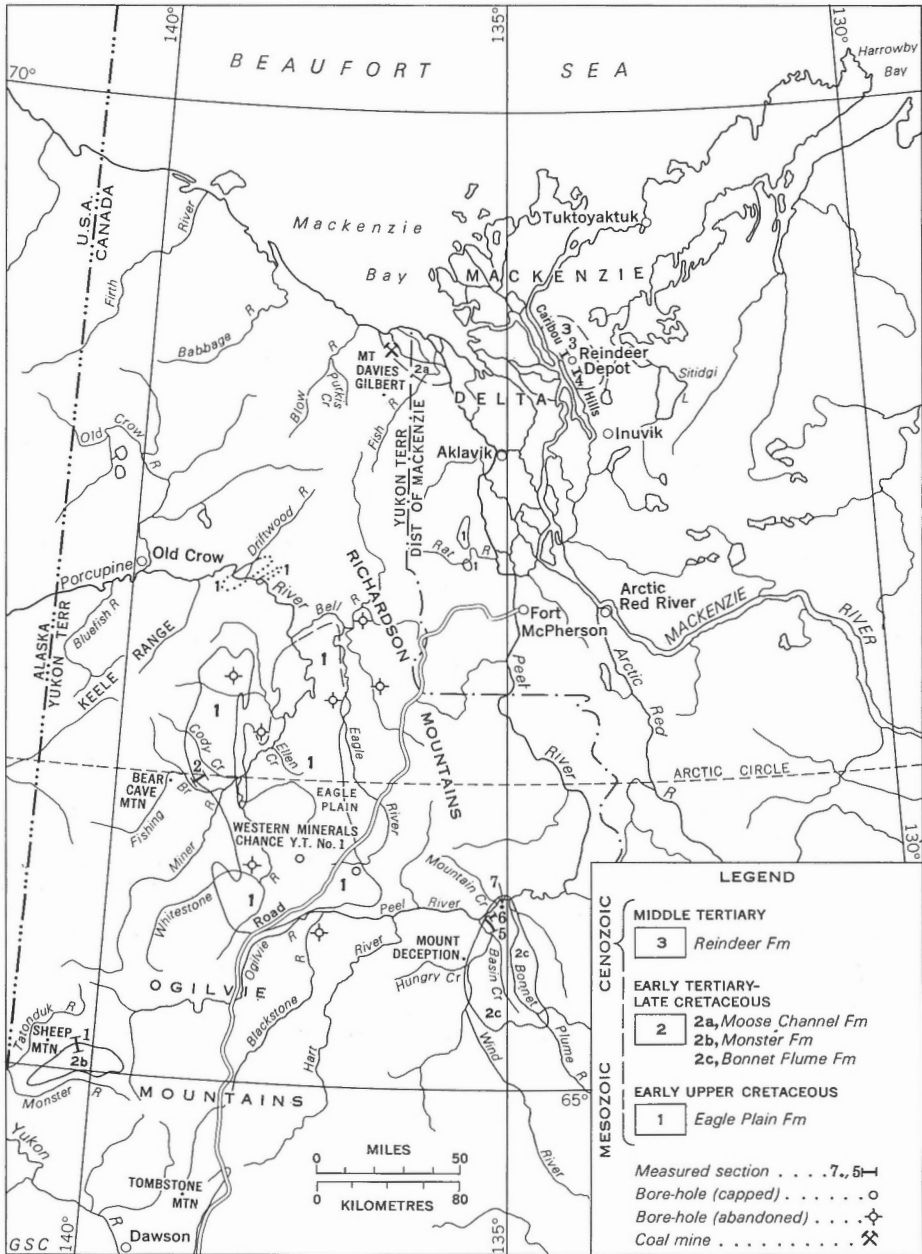


Figure 1. Distribution of Upper Cretaceous and Tertiary rocks, northern Yukon Territory and northwestern District of Mackenzie.

UPPER CRETACEOUS AND TERTIARY STRATIGRAPHY NORTHERN YUKON TERRITORY AND DISTRICT OF MACKENZIE

INTRODUCTION

This report is based on field work done during the summer of 1962 as part of Operation Porcupine under the direction of D.K. Norris, a helicopter-supported reconnaissance geologic study of the northern part of Yukon Territory and District of Mackenzie between 65 degrees north latitude and Beaufort Sea and 132 degrees west longitude and the Yukon-Alaska boundary. It also incorporates some data in the adjoining area to the south observed by Green and Roddick (1962, and personal communication, 1963).

An outline of the distribution of Upper Cretaceous and Tertiary rocks in northern Yukon and northwestern District of Mackenzie was published in a generalized geologic map prepared in conjunction with Operation Porcupine (Norris, et al., 1963). Palaeontological data which have become available since the preparation of this map necessitate revisions in dating of some of these rocks, particularly those of Bonnet Plume basin and the Caribou Hills (Fig. 1).

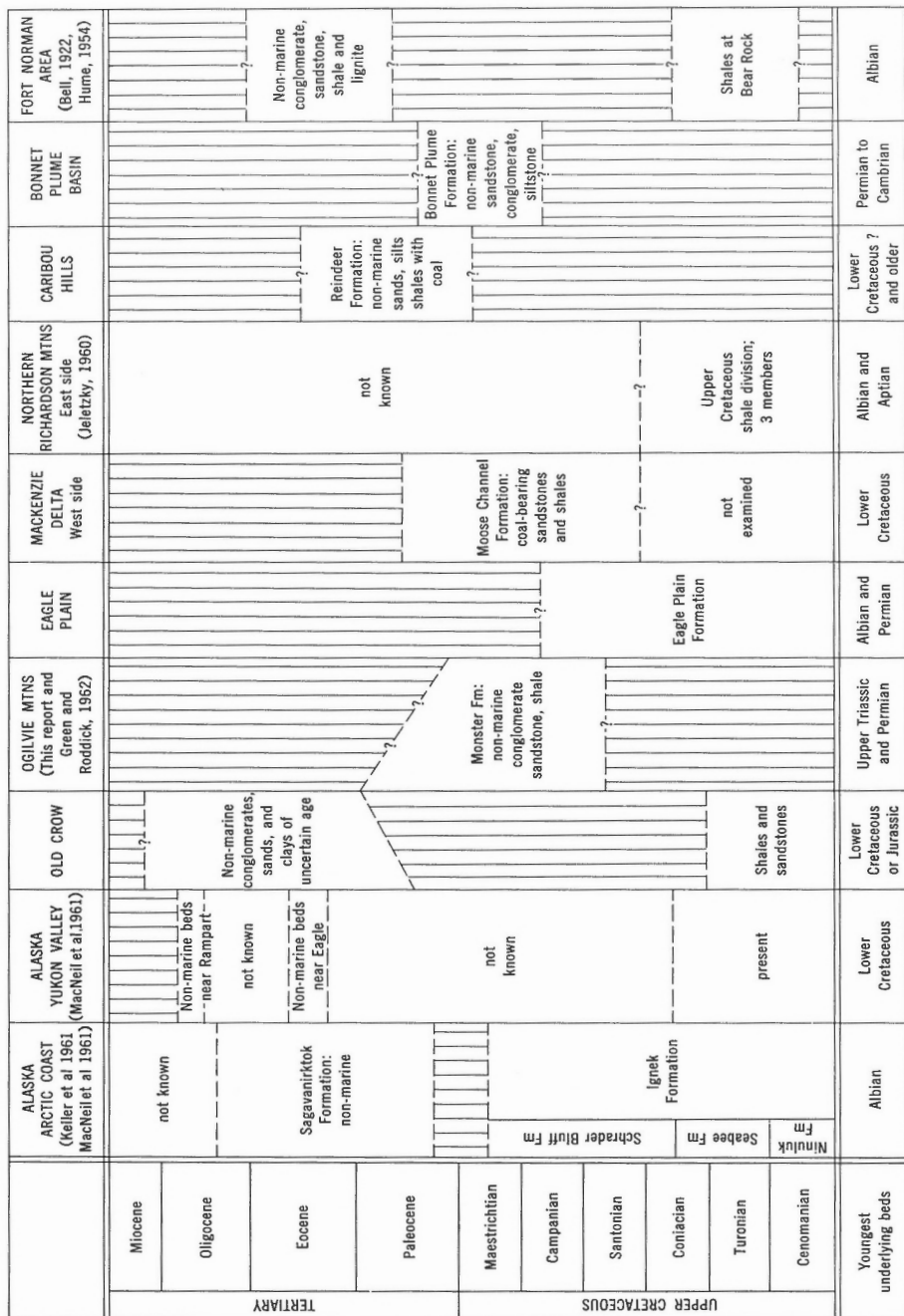
Upper Cretaceous and Tertiary rocks outcrop in five main areas: western Ogilvie Mountains (Monster syncline), Porcupine River and Eagle Plains, Wind-Bonnet Plume basin, west margin of Mackenzie Delta, and the Caribou Hills on the east side of the Mackenzie Delta. Upper Cretaceous strata outcrop most extensively along the Porcupine River and in the Eagle Plain (Figs. 1 and 2). Since these rocks are of somewhat different ages and represent sediments deposited in separate basins they are herein referred to five new formations: Monster Formation, Eagle Plain Formation, Bonnet Plume Formation, Moose Channel Formation and Reindeer Formation respectively. Because of the reconnaissance objectives of Operation Porcupine and the limited time available the investigation of these rocks was necessarily incomplete. More field data are required in a number of areas, especially along Mackenzie Delta and Babbage River and that east of the delta.

Acknowledgments

The writer was capably assisted by student assistants N.L. Ball, A. Jenik, W. Kisluk, D. Mayes and G.R. Turnquist. Grateful acknowledgment is extended to J.G. Fyles, L.H. Green, O.L. Hughes, D.K. Norris and R.A. Price of the Geological Survey for additional stratigraphic information. Upper Cretaceous invertebrate fossils were identified by J.A. Jeletzky, plant megafossils by W.A. Bell, and F.M. Hueber (Smithsonian Institute), spores and pollen by G.E. Rouse (University of British Columbia) and D.C. McGregor (G.S.C.).

Previous Work

In northern Canada and Alaska Upper Cretaceous and Tertiary



GSC

Figure 2. Correlation of Upper Cretaceous and Tertiary rocks of northwestern Canada and Alaska.

strata are preserved in local basins or other structurally low areas and have been studied by a number of geologists. R.G. McConnell of the Geological Survey of Canada (1891) in the course of a long exploratory trip that took him down the Mackenzie River, across the Richardson Mountains, and down the Bell and Porcupine Rivers studied parts of the Late Cretaceous and Tertiary sequence of this region and collected *Inoceramus* along Porcupine River. The poorly consolidated rocks of the Wind-Bonnet Plume Basin were discovered by de Sainville and have been described by Camsell (1906, p. 27 CC) who considered them to be of Tertiary age. Additional data on these rocks have been presented by Stelck (in Hume, 1954). The Mesozoic and younger sedimentary rocks in the vicinity of the Mackenzie Delta and the region westward to the Firth River were studied by O'Neill (1915 and 1924) during the Canadian Arctic Expedition. More recently, MacKay (1963) has discussed the physical geography of the Mackenzie Delta in considerable detail. Jeletzky (1958 and 1960) has studied the Mesozoic stratigraphy of the eastern part of northern Richardson Mountains and has discussed a number of widely scattered Mesozoic localities in adjoining areas including portions of the Porcupine River. Green and Roddick (1962) mapped the Ogilvie Mountains south of the region covered by Operation Porcupine. A general summary of the geology of northern Canada has been compiled by Douglas and MacLean (1963).

The Cretaceous stratigraphy and correlation of Alaska have been summarized by Imlay and Reeside (1954) and the Tertiary stratigraphy by MacNeil et al. (1961). More detailed stratigraphic studies of the Arctic Slope and eastern Brooks Range have recently been published (Keller et al., 1961; Detterman et al., 1963; Tappan, 1962). The adjoining part of Alaska to the west is currently being studied by the United States Geological Survey (Brabb, 1962 and 1964; Brosge, 1962).

STRATIGRAPHY

The stratigraphy of the five main areas is presented in the following order: Ogilvie Mountains, Eagle Plain, Arctic Coast, northern Richardson Mountains, Caribou Hills and Bonnet Plume Basin. The oldest Upper Cretaceous rocks occur along the Porcupine River in the Eagle Plain and the youngest known strata occur in the Caribou Hills and are dated as Middle Tertiary (Fig. 2).

Western Ogilvie Mountains

Upper Cretaceous rocks occur in two main areas in this region: in the central part of the Monster syncline in the vicinity of west longitude 140 degrees, and about 20 miles to the northwest, west of Sheep Mountain and the Tatonduk River. The large area farther northwest along the Alaska-Yukon boundary between 65°30' and 65° designated as Upper Cretaceous on GSC Map 10-1963 is known to contain considerable areas of Lower Cretaceous rocks. Cairnes (1914, p. 106) reported only Lower Cretaceous fossils from these rocks and until such time as Upper Cretaceous fossils are discovered in this region, it seems wiser to tentatively assign these strata to the Lower Cretaceous. A large portion of the Mesozoic rocks in the adjoining part of Alaska have been dated Early Cretaceous (Brabb, 1962 and

1964, and personal communication, 1964).

Monster Formation

Mesozoic strata are well exposed in the mountain range between Parapet Creek and Monster River and outcrop for a distance of about 20 miles along the length of Monster syncline. The name Monster Formation is proposed here for a sequence of alternating resistant 20-to 80-foot subarkosic and lithic sandstone units and considerably thicker, recessive, and largely covered units presumably consisting of mudstones and argillaceous siltstones. Over 3,000 feet of this sequence were measured on the north side of the syncline near its western end (Appendix I, Section 1). Abundant plant fragments and occasional well-preserved leaves suggest that these sediments are predominantly non-marine. The sandstones are generally dark coloured varying from brown to grey, medium to coarse grained, moderately well sorted and contain up to 20 per cent feldspar. Many of the sandstones are crossbedded and contain plant fragments. Occasional shale or clay fragments are present and some intervals of fine pebble-conglomerate occur in the upper part. The more recessive weathering mudstones and siltstones are generally medium to dark brown or grey and contain plant fragments which are very abundant in some of these units. Two conglomerates form very resistant units 50 to 100 feet thick at the top of the mountain and are informally assigned to a 550-foot conglomerate member. The conglomerates comprise well rounded quartz and chert pebbles up to 3 inches diameter. On the south side of the Monster syncline, Green and Roddick (1962, p. 14) estimated the thickness of the Monster Formation to be at least 4,000 feet.

These strata are underlain by an 800-foot covered recessive unit which can be traced eastward and across the Monster syncline to Upper Triassic shales and argillaceous limestones (Mountjoy, in press). The non-marine Cretaceous strata overlap the Triassic beds westward and rest on Permian carbonates of the Tahkandit Formation indicating that the lower contact is a regional unconformity. No younger strata are known in this area.

Age and correlation: The Monster Formation is dated as late Upper Cretaceous by means of fossil leaves collected from the lower half of the formation (units 16 and 36, section 1). W.A. Bell identified these fossils and commented as follows: unit 16 (GSC loc. 6502 fossils listed in section 1) - "Dicotyledonous leaves, although abundant in collections from this locality are fragmentary and not wholly satisfactory for identification. As a whole, however, the assemblage is considered to be late Upper Cretaceous"; unit 36 (GSC loc. 6503) "Nymphaeites exemplaris Hollick occurs in the upper Yukon region and beds containing it there are correlated by Hollick with the Kaltag Formation. It occurs also in the Dunvegan Formation of Alberta, and by itself would not seem to be diagnostic of any particular age in the Upper Cretaceous. Phyllites marshallensis Knowlton occurs in the Laramie of the United States, but the only two specimens referred doubtfully to it here are too fragmentary for correct identification. The most that may be said of the above meagre assemblage is that it probably represents Upper Cretaceous".

Green and Roddick (1962, and personal communication, 1963) also obtained several fossil collections from the Monster Formation. These were studied by Dr. F.M. Hueber who stated that most of the collections were too fragmentary for specific identification and could only be given a general Upper Cretaceous to Tertiary dating. One of these collections from the upper part of the Monster Formation is suggestive of a Tertiary age. It contains *Taxodium dubium* (GSC loc. 5803) which is known from the early Tertiary but may range down into latest Cretaceous.

The Monster Formation appears to be of approximately the same age as the late Cretaceous Bonnet Plume Formation 130 miles to the east, and the upper part of the Moose Channel Formation to the north on the west side of Mackenzie Delta (Fig. 1). It appears to be the same age as the Schrader Bluff Formation and upper part of the Ignek Formation of the Arctic slope on the north side of the Brooks Range (see Figure 2; Keller, et al., 1961). In the Arctic Islands late Upper Cretaceous strata are represented by the Eureka Sound Formation of Banks Island and possibly by the upper part of the Kanguk Formation on the more northeasterly islands (Tozer, 1960, 1963 and Douglas et al., 1963). In Alberta the Wapiti, Belly River and Edmonton Formations are of approximately the same age as the Monster Formation.

The age of the Monster Formation is significant as it is the youngest unit involved in the east-west trending folding and faulting in the Ogilvie Mountains. These non-marine sediments appear to reflect late Cretaceous uplift and erosion of the region to the south and southwest.

The deformation of this portion of the Ogilvie Mountains on the basis of plant fossils therefore appears to be post-Cretaceous and is probably of Laramide age. Intrusions which truncate thrust faults in the Tombstone Mountain area (D. Templeman-Kluit, personal communication, 1965) a few miles to the south suggests that much of the thrusting and intrusion took place somewhat earlier in mid-Cretaceous time, on the basis of radioactive dating of similar intrusions about 10 miles farther southeast. These mid-Cretaceous mountains may well have been a source for the Monster beds. Deformation in this part of the southwestern Ogilvie Mountains appears to be earlier than that of the Monster syncline area.

Eagle Plain

Predominantly non-marine Upper Cretaceous sandstones outcrop extensively in the Eagle Plain between the Keele Range and the Ogilvie River and extend eastward to the Eagle River (Norris, et al., 1963). Good exposures occur along and on the ridges near the Porcupine, Whitestone (East Porcupine), and Fishing Branch Rivers and Cody Creek. These beds have also been penetrated by the Western Minerals Chance No. 1 well. They were studied along the Fishing Branch River in the western part of the outcrop area and along the Porcupine River between East Porcupine and Bell Rivers.

Eagle Plain Formation

The sandstones which outcrop extensively in the Eagle Plain are here named Eagle Plain Formation. The type section is immediately north of the Fishing Branch River about 15 miles above its junction with the

Porcupine River (Section 2, Appendix) and 9 miles due east of Bear Cave Mountain (Fig. 1). At the type section over 2,000 feet of the Eagle Plain Formation were measured. The sequence consists of a series of sandstone units 10 to 40 feet separated by 10-to 100-foot covered intervals presumably underlain by silty shales and argillaceous siltstones with minor, thin interbeds of sandstone. The sandstone units form prominent marker beds on the air photographs which can be traced for several miles. These sandstones are generally fine- to medium-grained, light brownish grey, crossbedded and contain poor impressions of plant fragments. They contain abundant dark chert grains and some feldspar grains. A few crossbed orientations were measured and these suggest a northeasterly direction of transport and a possible source area to the southwest. However, insufficient data were obtained from which good statistical inferences could be drawn. The Western Minerals Chance well located in the central part of Eagle Plain penetrated about 2,500 feet of Eagle Plain Formation and this appears to be the thickest known development. The presence of both marine and non-marine fossils suggests deposition in a transitional lacustrine to fluvial, probably deltaic environment. The presence of abundant chert grains together with some feldspar suggests derivation from an area of sedimentary rocks with minor igneous intrusions.

Along Fishing Branch River the Eagle Plain Formation is underlain gradationally by over 1,200 feet of silty shale with thin interbeds of siltstone and sandstone. These shales are similar to those which occur on the East Porcupine above Albian sandstones and siltstones (Jeletzky, 1960) and have the same thickness and stratigraphic position. Elsewhere the basal contact is poorly exposed. Regional mapping suggests that the Eagle Plain Formation and/or the underlying Albian clastics unconformably overlies older beds both to the east and north. In the area north of Peel River and near the head of Eagle River as well as in the Chance Well the Eagle Plain Formation overlies Permian beds and near the mouth of the Bell River it overlies Jurassic rocks (Norris et al., 1963).

Age and correlation: Several collections of plant fossils were obtained by G.R. Turnquist at various localities along the Porcupine River near Ellen Creek about 10 miles north of the Arctic Circle. These collections (GSC locs. 6589 and 6590) occur at between 500 and 1,000 feet above the base of the Eagle Plain Formation. The plants were reported by Dr. W.A. Bell to be of Upper Cretaceous Cenomanian age. Similar plant fossils occur in the Cenomanian Lance and Dunvegan Formations. Some marine fossils were also obtained by W. Wuest of Western Minerals Co. Ltd. These fossils were collected from near the base of the Eagle Plain Formation at two localities: 10 miles southwest of the junction of the Bell and Porcupine Rivers (GSC loc. 52632; 138°03', 67°12') and south of Bell River 9 miles west of Lapierre House (GSC loc. 52633; 137°22', 67°22'). Pelecypods from both localities were identified as Inoceramus ex gr. dunveganensis. J.A. Jeletzky considers that their age may possibly be Cenomanian but that an Albian age cannot be ruled out. The age of the upper part of the formation is not known but could be in part Turonian.

Spores and pollen were obtained from three of the above megaplant localities (GSC loc. 6589, 6590, and 6592; see Appendix II). This material was studied and identified by Dr. G.E. Rouse and dated as Upper Cretaceous, probably Maestrichtian (GSC Report F 1-2-1965). Later

Dr. Rouse reported (personal communication, Oct. 7, 1966) that since these assemblages are very poorly representative and preserved, they are not applicable for precise dating. The megaflora contains species which are correlative with Cenomanian-Santonian fossils and therefore are much more authoritative than the pollen assemblage. Trochodendroides nebraskensis Dorf is abundant in the Maestrichtian lower Medicine Bow and lower Denver Formations, and therefore the Eagle Plain Formation may be somewhat younger than Cenomanian, possibly even as young as Santonian-Campanian. There is not enough fossil evidence to give a more precise dating than Upper Cretaceous-Cenomanian to Santonian(?) to these rocks.

The Eagle Plain Formation is the youngest unit present in the Eagle Plains and is approximately equivalent to the Ninluk, Seabee and Schrader Bluff Formations and the Ignek Formation of the northern Alaska coast (Fig. 2). Equivalent rocks also occur in Jeletzky's (1958, 1960) marine Upper Cretaceous shale division on the eastern flank of the Northern Richardson Mountains. In the Arctic Islands the base of the Kanguk Formation is the same age as the Eagle Plain Formation.

The Eagle Plain Formation is correlated with the Fort Nelson and Dunvegan Formations of northeastern British Columbia (Stott, 1960 and 1963).

Porcupine River

A few miles upstream and downstream from the mouth of the Driftwood River soft dark grey shales and sandstones containing plant fossils occur in three structurally complex down-faulted zones. Exposures are discontinuous and relationships to older strata are difficult to determine. In the vicinity of the mouth of Rat Indian Creek, about 4 miles upstream from the mouth of Driftwood River (138°20', 67°33 1/2') dark grey shales, with concretions and plant fragments occur immediately downstream from Carboniferous and Devonian (?) and Silurian (Norford, 1964, p. 119) strata. About 1 1/2 miles downstream from the mouth of the Driftwood River on the south side of the Porcupine River about 40 feet of dark grey shales with concretions and sandstone interbeds are present. These strata contain plant fragments as well as marine pelecypods. The pelecypods (GSC loc. 55187) were identified by J. A. Jeletzky as Inoceramus ex gr. lamarki or inconstans presumably indicating a Turonian or Cenomanian age. Underlying beds are not definitely dated but appear to be Lower Cretaceous or Jurassic, as poorly preserved Buchia? were observed in light grey sandstones 2 1/2 miles downstream. Crinoidal carbonates, presumably Palaeozoic, outcrop 4 miles downstream where the Porcupine changes course from northwest to northeast. Five miles farther downstream several outcrops of dark grey concretionary shale are present. Some sandstones occur as interbeds and one outcrop contains large Inoceramus, originally noted by McConnell (1891, p. 127D and map sheet No. 8).

Recessive weathering concretionary shales with bentonite layers outcrop intermittently as far downstream as Old Crow. Occasional sandstones and conglomerates are present, some of which contain plant fragments. These rocks are folded and faulted. No invertebrate fossils were observed. These shales have a general Mesozoic appearance but it is not known whether they might include Tertiary strata as inferred by McConnell (1891, p. 127D).

Along Porcupine River poorly consolidated sands and silts occur at three localities above these concretionary shales and beneath Pleistocene (?) sands and gravels. O.L. Hughes (personal communication, 1964) who examined these sediments and the Pleistocene deposits suggested that they might be Tertiary (?) and that in most of the stream cuts only Pleistocene (?) sands and gravels are exposed. The possible Tertiary (?) localities are as follows. Two miles upstream from Cadzou Lake (about 23 miles east of Old Crow) a few feet of brown silty clay occur beneath about 70 feet of Pleistocene (?) sand and gravel. Farther east just upstream from the mouth of Bluefish River about 55 feet of silt and argillaceous silt occur beneath the Pleistocene (?). Pollen from a section of the lower sands and silts downstream and 5 1/2 miles SSW of Old Crow, has been examined (section 228 HH of Hughes) by J. Terasmae (personal communication, 1965, palynological report 65-6). The pollen assemblages obtained are similar to those found in the Pleistocene beds elsewhere in this region and therefore a Tertiary age is rejected. Thus most of the beds assigned to the Tertiary by McConnell (1891) are younger.

Mackenzie Delta, west side

Moose Channel Formation

The Moose Channel Formation is herein designated for about 1,200 feet of non-marine, loosely consolidated sandstones occurring along the Arctic Coast in a belt extending for about 10 miles on either side of the mouth of Fish River. These sandstones are here named the Moose Channel Formation. The sandstones are fine- to coarse-grained, feldspathic, laminated, light greenish grey to brown, with ripple marks, occasional lignite and plant fragments. The sandstones are interbedded with silty, brownish grey shale containing abundant plant remains in places and some beds and lenses of fine conglomerate loosely cemented and poorly sorted. Some large calcareous concretions are also present. They contain plant fragments and several thin coal seams. A 7-foot seam of subbituminous to bituminous coal outcrops in a shale sequence on the south side of Coal Mine Lake south of Moose Channel (68°43' and 136°23'), and is being mined by Moose River Mines Ltd. The coal is used at Inuvik and Aklavik. Along a creek 3 miles to the southeast several grey shale layers with plant impressions were baked to bright yellow and red colours adjacent to burned thin coal beds. These layers contain abundant plant fragments (GSC locs. 6613 to 6615). It was difficult to determine the thickness of these layers because of slumping. Three beds of burnt shale between 15 and 20 feet thick were observed. Although no detailed measurements are available the best exposures of the Moose Channel Formation occur along Fish River and are designated the type section. The Moose Channel Formation is overlain unconformably by the Pleistocene and Recent deposits of the Mackenzie Delta. Underlying beds comprise a thick shale sequence which has not been dated but which on a stratigraphic basis appears to be Albian or younger.

The plant fragments referred to above indicate a general Upper Cretaceous to early Tertiary age. W.A. Bell identified the following in these collections (GSC locs. 6613 to 6615).
Trochodendroides (Cercidiphyllum?) arctica (Heer) Berry forma richardsoni Heer

Equisetum sp.

?Taxodium gracile Heer

Bell stated that: "T. arctica is a long-ranging species in both Upper Cretaceous and early Tertiary, but large leaves e.g., forma richardsoni are especially common in the Paleocene".

Spores and pollen were extracted from samples of coal obtained by B.A. Latour of the Geological Survey from Moose River Mines, south of Moose Channel. According to D.C. McGregor the plant microfossils from this material indicate that the rocks are younger than early Cretaceous. The assemblage has a pre-Tertiary aspect, and an age within the upper half of the Upper Cretaceous is considered most likely. These are the youngest strata present in the northern Richardson Mountains and thus help date the latest uplift and deformation of these mountains. They have a northwest-southeast strike in contrast to the north-south structural grain of the Richardson Mountains. Their relationships to underlying beds have not been clearly established because of poor exposures. The Moose Channel Formation and underlying shales appear to overlap the structures of the northern end of the Richardson Mountains suggesting that these structures represent pre-late Cretaceous deformation. The Bonnet Plume Formation to the south shows similar relationships to the structures of the Richardson Mountains (see below).

Similar rocks probably occur northwest of the Blow River but are poorly exposed and so far only one locality has been accurately dated. Geologists of Triad Oil Company collected Inoceramus cf. pictus Sowerby (GSC loc. 44199, 68°33' and 137°08') from a thick shale sequence in an eastern tributary of Purkis Creek, which is about 10 miles west of Mount Davies Gilbert. According to J.A. Jeletzky this Inoceramus is poorly preserved but resembles the Cenomanian index fossil I. pictus and is tentatively dated as Cenomanian. The thick shale sequence in which this fossil was found probably includes younger Cretaceous strata.

Also of interest is the occurrence of Albian rocks in an eastern tributary of Blow River about 21 miles north-northeast of Bonnet Lake and southwest of the above Purkis Creek locality. Geologists of Texaco Co. Ltd. collected Sonneratia (s. lato) sp. indet. (GSC loc. 39512, 60°27 1/2 and 137°31') from argillaceous strata considered by Jeletzky to be late lower to early middle Albian. A considerable thickness of argillaceous strata occurs above these beds suggesting that Upper Cretaceous rocks may also be present along the middle portion of the Blow River.

Northern Richardson Mountains

The geology and stratigraphy of the eastern flank of the northern Richardson Mountains has been studied and outlined in considerable detail by Jeletzky (1958, 1960, 1961). The Upper Cretaceous rocks occur in two areas and have been assigned to an informal Upper Cretaceous shale division (Jeletzky, 1960, p. 20). The largest area occurs in the vicinity of Treeless Creek north of the Rat River where approximately 1,000 feet of these strata are present. They consist of poorly consolidated, soft, light to dark grey shales and contain numerous concretions. These shales contain Cenomanian and Turonian fossils in the lower and middle parts but no fossils were

observed in the upper part. The other locality is on the north side of the Rat River at a prominent U-shaped bend about 22 miles northwest of Fort McPherson where only the basal few feet of this sequence are present. Jeletzky (1960) subdivided these shales into a lower dark grey shale, a middle orange to yellow-weathering, laminated shale and an upper bluish weathering shale. These shales rest unconformably on the Aptian upper sandstone division of Jeletzky. Younger overlying beds are not present.

Caribou Hills

The Caribou Hills form a northwest-trending escarpment along the east side of the Mackenzie Delta. On their southwest side these hills are being actively eroded by the Mackenzie River and form a series of cliffs exposing up to 700 feet of section. The Caribou Hills are underlain by a series of poorly exposed clays, silts, sands and gravels which are only partially consolidated; fresh exposures were not observed. Some thin coal beds are also present.

Reindeer Formation

The poorly consolidated Tertiary sediments of the Caribou Hills are assigned to a new formation, the Reindeer Formation. It consists of non-marine silty shales, siltstones, coarse sands, conglomerates and coal. No measured section can be designated as a type since these strata are poorly exposed. The type locality is considered to be the southwestern face of the Caribou Hills. Sections 3 and 4 (Appendix) are representative of the lithology of the Reindeer Formation. The upper limit of the formation is considered to be the top of the quartzite and chert conglomerate exposed at the north end of the hills. The lower limit was not observed but is inferred to be the base of the non-marine beds which presumably overlie Cretaceous shales or older beds near the south end of the Caribou Hills. These strata appear to dip gently northward.

The sediments of the Caribou Hills were first described by O'Neill (1915; 1924, p. 17A) who measured over 530 feet of beds about two miles northwest of Reindeer Depot. During the summer of 1962, G.R. Turnquist measured two sections of the Reindeer Formation, one about 4 1/2 miles northwest of Reindeer Depot (Section 3) and another about 4 miles southeast of Reindeer Depot (Section 4). Overlying beds consist of Pleistocene glacial deposits and non-marine interglacial deposits (personal communication, O.L. Hughes, 1964 and J.G. Fyles, 1966). The interglacial deposits have been dated as greater than 44,000 years (L552, MacKay, 1963, p. 15). Underlying beds may consist of Cretaceous shales since Albian fossils are known to occur east of Sitidgi Lake and along the Anderson River 150 miles to the east (MacKay, 1958; Jeletzky, 1960, p. 19). Some Upper Cretaceous rocks may also occur beneath the Tertiary Reindeer Formation as Upper Cretaceous fossils have been collected from Harrowby Bay near the mouth of Horton River, 200 miles to the east (MacKay, 1958). It seems reasonable to assume that the Moose Channel Formation and underlying Lower Cretaceous and Jurassic strata of the northern Richardson Mountains extend northeastward beneath the Mackenzie Delta.

Red weathering layers (e.g. unit 15, section 4) appear to be the result of burnt lignite or carbonaceous shales. Southward the red zones gradually disappear.

Arctica? sp. indet. (GSC loc. 39495) was identified by Jeletzky in a collection submitted by Texaco Exploration Company from beds now assigned to the Reindeer Formation at a locality about 1 1/2 miles northwest of section 4, or 3 miles southwest of Reindeer Depot. The pelecypods were collected approximately 460 feet above river level near the top of the exposure. Eleven samples collected from sections 3 and 4 have yielded abundant fossil pollen which were studied by Dr. G.E. Rouse (see Appendix II). Most of these spore and pollen collections have been assigned to the early Tertiary, and dated as probably Paleocene or probably Eocene (GSC Report F1-2-1965-DCM).

"However in a personal communication, November 8, 1966, Dr. Rouse after re-examination of all the samples would suggest that the closest age assignment possible is Paleocene. Previously Dr. Rouse had no idea as to the relative stratigraphic position and hence referred some samples to the Eocene rather than the Paleocene on the basis of the absence of Paleocene forms."

The Reindeer Formation is partly equivalent to the upper portion of the Eureka Sound Formation of the Arctic Islands and also to the non-marine Eocene sediments near Fort Norman (Hume, 1954). The Reindeer Formation is lithologically very similar to the Eureka Sound Formation of Banks Island according to J.G. Fyles (personal communication, 1966). The Reindeer Formation is the youngest pre-Pleistocene unit known in the northern Yukon and probably represents a Tertiary delta of the Mackenzie or other rivers.

Bonnet Plume Basin

In 1893 Count V.E. de Sainville surveyed the Peel River upstream to the Wind River (Camsell, 1906). He reported the presence of burning lignite beds in poorly consolidated silts and sands between the Bonnet Plume and Wind Rivers and stated that according to the Indians it had been burning for several years. Burning lignite was also mentioned by Camsell (1906) and could still be observed on the south side of the Peel River at west longitude 135°06' in 1962. Camsell assigned these strata to the Tertiary without diagnostic fossil evidence, presumably on the basis of weak consolidation and poorly developed lignite. More recent investigators have continued to refer these beds to the Tertiary (Stelck in Hume, 1954; Norris et al., 1963). Stelck (in Hume, 1954, p. 55) demonstrated that this succession is more than 1,000 feet thick. Analysis of pollen and spores collected from the lignite beds during the present study suggests that these beds are of late Upper Cretaceous or Paleocene age.

Bonnet Plume Formation

The name Bonnet Plume Formation is herein proposed for the thick succession of poorly consolidated sediments which unconformably overlies Permian and older rocks of the southern Richardson Mountains. The Bonnet Plume Formation occupies a topographic depression between the

Bonnet Plume and Wind Rivers just south of the Peel River which developed across the axis of the older Richardson Mountains. These sediments are best exposed along the east side of the Wind River between its mouth and Basin Creek and along the south side of Peel River between Mountain Creek and the mouth of the Wind. Stelck (Canol Report, Upper Peel River 1944) also indicated that similar rocks outcrop near the mouth of Hungry Creek southwest of Mount Deception but this area was not visited. Three partial composite sections were studied; one along the east side of Wind River (Section 5) and the other two along the south side of the Peel River (Sections 6 and 7). The Bonnet Plume Formation is over 5,000 feet thick along the Wind River, assuming that the interval represented by a covered interval more than 2,000 feet thick near the base has been calculated correctly. A section of the Bonnet Plume Formation along Peel River is over 4,000 feet thick but also includes several thick covered intervals. Stratification in the Bonnet Plume Formation strikes nearly north-south and dips uniformly between 10 and 30 degrees east indicating that the basin has been tilted eastward and suggesting that the east side is faulted with downthrow to the west. Such a fault would be parallel with the faults along which the east side of the Richardson Mountains is uplifted.

The Bonnet Plume Formation consists predominantly of sandstones, medium- to coarse-grained, with minor thin lenses and layers of fine pebble-conglomerate, light grey to light brown; and they generally contain some plant fragments and are crossbedded. The sandstones occur in units between 10 and 70 feet thick separated by somewhat thicker covered intervals or by grey, fissile shale. Minor amounts of siltstone, conglomerate and lignite are also present. The lignite beds are much more abundant in the upper part of the Bonnet Plume Formation.

Over 600 feet of pebble conglomerate occurs at the base of the Bonnet Plume Formation about 1 mile above the mouth of Wind River and rests with angular unconformity on Cambrian black shales which dip 40 degrees to the west (Section 1). There is 50 feet of local relief along this contact, which dips steeply southeast suggesting moderate relief along the north-west side of the basin. The steep southeast dip of this contact and its north-east linear continuation across both the Wind and Peel Rivers also suggests that this contact may be fault controlled. The pebbles vary in size up to 6 inches diameter and appear to consist predominantly of quartz and chert with rock fragments of siltstone, sandstone and shale. A 110-foot conglomerate also occurs near the top of the sequence in the Peel River section (Section 6, unit 68).

Some megaplant fragments were collected from the carbonaceous and lignite layers but were too poorly preserved for identification. However, abundant pollen and spores have been recovered and these have been dated as Campanian or Paleocene by G.E. Rouse (see Sections 5 and 6, Appendix).

The Bonnet Plume Formation post-dates most of the folding and faulting which characterizes the Richardson Mountains. Thus it provides an upper limit for the age of the deformation in the Richardson Mountains. The youngest marine beds involved in northern Richardson Mountains are Coniacian shales of Jeletzky's Upper Cretaceous shale division (Jeletzky, 1960). On the basis of the palynological dates most of the deformation of the Richardson Mountains must have occurred in latest Cretaceous, possibly Santonian times. The Moose Channel Formation of the western Mackenzie

Delta and the Monster Formation of the western Ogilvie Mountains also range in age from late Cretaceous to early Tertiary and are probably products of this late Cretaceous orogeny.

SUMMARY

The distribution and predominantly coarse clastic non-marine nature of the late Cretaceous and Tertiary sediments strongly suggests that much of northern Yukon and adjoining District of Mackenzie were emergent during this time. The last marine encroachment took place in early Santonian or Coniacian time. Deformation and uplift of the Richardson Mountains probably took place during late Cretaceous (Santonian?) time. During latest Cretaceous and early Tertiary times moderate, local deformation of the land formed three small basins in which relatively thick sequences of non-marine clastics were deposited (Monster, Bonnet Plume and Moose Channel Formations). Two of these basins lie athwart the structural head of the Richardson Mountains.

Uplift, thrusting and folding of the northern Ogilvie and Mackenzie Mountains probably took place in early Tertiary times. During middle Tertiary time this region received no sediment except for shallow water sediments on the east side of the present Mackenzie Delta (Reindeer Formation). Essentially similar conditions appear to have continued to the present except for moderate and irregular uplift and deposition of a thin veneer of Pleistocene glacial and fluvial-glacial sediments.

The late Cretaceous and Tertiary history of Alaska (Gates and Gryc, 1963; MacNeil et al., 1961) is essentially similar to that of northern Yukon. At the end of the Cretaceous most of Alaska was emergent and has remained this way to the present time. During the Tertiary several elongate basins received non-marine sediments of claystone, sandstone, conglomerate and lignite totalling as much as 5,000 feet in thickness. Marine Tertiary rocks were deposited east of Colville River on the northern Arctic coast of Alaska and at several localities along the southern coast. These sediments were gently to moderately deformed during the late Tertiary and Quaternary.

The Bonnet Plume, Monster and Moose Channel Formations were deposited at approximately the same time as the Edmonton and Paskapoo Formations of western and central Alberta. The Edmonton and Paskapoo Formations represent quartz clastic detritus shed from the rising Rocky Mountains to the west and deposited in alluvial fans, deltas, swamps and discontinuous shallow basins (Taylor et al., 1965). The late Eocene/early Oligocene Kishenehn Formation of the Flathead Valley provides an upper limit for the deformation in the southern Alberta Rocky Mountains (MacKenzie, 1922; Russell, 1954; Price, 1962) in much the same way as the local basins in northern Yukon provide upper limits for the age of deformation in the Richardson Mountains.

ECONOMIC GEOLOGY

Non-marine and transitional sequences of marine and non-marine strata are becoming increasingly important with respect to possible petroleum reservoirs because of the recent increase in the number of petroleum fields discovered in these rocks (Hedberg, 1964, p. 1772). Some of the

Eagle Plain sandstones appear to be porous but contain some argillaceous material and finer grains of feldspar and chert which fill much of the intergranular spaces. The Upper Cretaceous and Tertiary rocks occur too close to the surface and are not covered by suitable impermeable strata which would assist in trapping of any petroleum present. No oil or gas shows, springs or seepages were observed in these rocks.

These rocks are economically important however in terms of their tectonic history. They record to some extent the amount and time of uplift and tilting of the underlying beds. These movements are important for determining times at which migration and accumulation of fluids including petroleum took place in some of the porous and permeable underlying strata which are covered by impermeable rocks.

The lignite in the Bonnet Plume Formation may be as much as 45 feet thick (section 7), sufficient thickness to warrant economic consideration. However the difficulty of transporting this material down the Peel River to the Mackenzie River and the rather short navigation period suggest that mining could not be achieved on an economic basis. Coal has been mined on a small scale from the Moose Channel Formation; Latour (1956) estimated that the maximum total cost of this coal landed at Aklavik would be about \$15.00 per ton which would be competitive with the cost of fuel oil delivered from Norman Wells.

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ADDENDUM

Upper Cretaceous foraminifera occur in samples at the base of the sequence exposed near Reindeer Depot (T.P. Chamney, personal communication, June 1967). This suggests that the Reindeer Formation is probably underlain by Upper Cretaceous marine sediments and that it is only about 700 feet thick at this locality.

APPENDICES

APPENDIX I - STRATIGRAPHIC SECTIONS

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MONSTER FORMATION, NORTHWESTERN OGILVIE MOUNTAINS

Section 1. Upper Cretaceous terrigenous sediments outcrop extensively in the core of a broad southwest-northeast trending synclinal structure near the west end of the Ogilvie Mountains. The Monster syncline occurs between Parapet Creek on the north and Monster River on the south, both tributaries of the Tatonduk River.

The following section is the type section of the Monster Formation and was measured by staff and tape on the north side of the Monster syncline near its western end (65°03N and 140°14W Air Photograph A13231-161). The base of the section includes the upper part of the Permian Tahkandit Formation and the top is marked by a prominent resistant conglomerate unit. The section was measured by E. Mountjoy and U. Uptius in August, 1962.

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
<u>Monster Formation - (3140 feet)</u>			
Conglomerate Member			
51	Conglomerate, pebbles, up to 2" diameter, average 1/4 to 1/2", predominantly dark grey chert, subrounded, some light grey-green, white quartz, in matrix of sandstone, very coarse grained, light to medium grey, breaks across pebbles, weathers brown, covered with medium grey lichens, 1 to 5' beds, forms resistant ridge on top of mountain. Interbeds of coarse grained sandstone, few plant fragments. Photograph taken (Mountjoy 8-5, 1962). Dip 105°. Altimeter at top 6310', at base 4300'. Unit forms crest of mountain.	97	4277
50	Covered. Some talus of mudstone, silty, dark grey and siltstone, medium to dark grey, finely laminated. On northwest spur the upper 200 to 250' is 50% exposed. Predominantly mudstone, silty. Microfossil samples 50aF, 50bF, 50cF at approximately 250, 350 and 400 feet above base.	408	4180
49	Conglomerate, pebbles up to 3", average 1/2" to 3/4", subrounded to well rounded, mostly dark grey chert, some white quartz, green chert, in a matrix of very		

Unit	Description	Unit Thickness (feet)	Height Above Basin (feet)
	coarse grained quartz sand, light to medium grey, with angular to sub-angular grains, breaks across pebbles, weathers brown, covered with light grey lichens. Indistinct 1 to 5' beds. Forms a very resistant cliff. Prominent joints strike 125° and 35°, dip 80° NE and 80° NW respectively.	46	3772
48	Basal 25 ft. scattered outcrop of very thin bedded dark grey siltstone and silty mudstone.	84	3726
47	Sandstone, very coarse grained conglomeratic, and fine conglomerate, light to medium grey, pebbles mostly dark grey chert, some green and light grey, pebbles up to 2", average 1/4" diameter. Unit weathers brown, covered with light grey lichen, forming a resistant massive cliff. Some coarse crossbedding. Upper 20' is medium grained sandstone, no conglomerate observed.	49	3642
46	Covered.	192	3598
45	Sandstone, medium grained, arkosic, medium grey, weathers brown, in part finely laminated, crossbedded, in 1/2 to 2' beds, with 1/4 to 2" partings, talus in underlying cover suggests that sandstone may form one thick unit.	20	3406
	Covered	38	3386
	Sandstone, medium grained, arkosic, medium grey, similar to underlying sandstone.	4	3348
44	Covered (by grass).	88	3344
43	Mudstone, medium to dark brownish-grey, in part silty, interbedded with 1 to 3' intervals of siltstone, medium brown-grey, part finely laminated, abundant plant fragments in siltstone and mudstone. <u>Microfossil samples:</u>		
	43aF 0-25'		
	43bF 25'-50'		
	43cF 50'-87'	87	3256

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
42	Sandstone, medium to coarse grained, medium grey, similar to underlying sandstone units, weathers brown, indistinct 1 to 5' beds, crossbedded, top 5 to 10 feet fine grained, platy weathering, few plant fragments.	63	3169
41	Shale and mudstone, dark grey, abundant plant fragments, in part silty, interbeds of siltstone, medium grey, weathers brown to greenish grey in 1/2 to 3' interbeds. <u>Microfossil</u> samples: 41aF 0-30' 41bF 30'-69'	69	3106
40	Sandstone, medium to coarse grained, medium grey, subrounded to subangular, similar to underlying sandstone units, in part finely laminated, very coarse crossbedding, weathers brown with light grey lichens, forms one massive unit, traces of plant fragments.	38	3037
39	Covered.	33	2999
38	Mudstone and shale, medium to dark grey, abundant plant fragments, weathers dark grey, interbeds of siltstone, medium greyish brown, in part finely laminated, weathers light to medium grey-brown, siltstones predominantly between 27 to 95'. <u>Microfossil</u> samples: 38aF 0'-20' 38bF 20'-40'	95	2966
37	Sandstone, medium to coarse grained, medium grey, arkosic, subangular grains, similar to units 32 and 35, coarsely crossbedded, weathers medium brown to brown-grey, 1/2 to 5' beds, very resistant tending to part in 1/2" to 4" plates and blocks. Traces of plant fragments. Gradational in lower 5' to underlying siltstones. Upper 10' gradually becomes fine grained.	40	2871
36	40% covered. In top 25' mudstone, silty, dark grey, and siltstone, argillaceous, dark grey, fairly abundant plant fragments, good leaf impressions at several horizons,		

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	small collection, weathers medium brown-grey, recessive. GSC Plant loc. 6503, identified by Dr. W.A. Bell who reported as follows:		
	<p>"<u>Nymphaeites exemplaris</u> Hollick <u>marshallensis?</u> Knowlton <u>Phyllites</u>, <u>Nymphaeites exemplaris</u> occurs in the upper Yukon region and beds containing it there are correlated by Hollick with the Kaltag Formation. It occurs also in the Dunvegan Formation of Alberta, and by itself could not seem to be diagnostic of any particular age in the Upper Cretaceous. <u>Phyllites marshallensis</u> occurs in Laramie of U.S.A., but the only two specimens referred doubtfully to it here are too fragmentary to be sure of correct identification. The most that may be said of the above meagre assemblage is that it probably represents Upper Cretaceous".</p>	82	2831
35	Sandstone, medium grained, similar to unit 32, crossbedded, weathers brown in 2" to 2' beds, some finer interbeds, also dark grey siltstone, forms prominent cliff, traces of plant fragments.	29	2749
34	Mudstone, silty, medium grained, weathers medium grey in irregular small chips with several interbeds of siltstone, medium brown-grey, traces of laminations, weathers brownish grey in 1/4 to 2" beds. <u>Microfossil</u> samples: 0-30' 34aF.	31	2720
33	Covered by grass and talus.	58	2689
32	Sandstone, medium to coarse grained, medium grey, arkosic, 15 to 20% light feldspar, 40% dark grains, subrounded to subangular, 2 layers of 2 to 4" of fine conglomerate, between 30 to 35' above base, occasional plant fragments, some coarse crossbeds, weathers medium brown, in part light grey, indistinct 1/2 to 3' beds, tending to weather in 1 to 3" plates, forms prominent resistant cliffs.	68	2631

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
31	Covered by grass. <u>Microfossil</u> samples: 31bF, 31cF, 31dF (unit D) • (above 75')	99	2563
30	Sandstone, medium grained, medium grey, arkosic (?), signs of crossbedding, weathers grey, moderately resistant, obscure 1 to 4' beds	9	2464
29	Covered by grass.	67	2455
28	Sandstone, medium grained, few very coarse grains, light brown-grey, weathers medium brown-grey, resistant 1 to 3' beds, trace of crossbeds in upper half.	49	2388
27	Covered.	66	2339
26	Sandstone, fine grained, medium to dark grey, weathers greenish grey, poor 1/2 to 1' beds, minor crossbedding, tendency to part in 1/2 to 1" plates, partially covered (20%).	20	2273
25	Covered.		
24	Sandstone, medium grained, arkosic, % constituents similar to unit 22 below, medium grey, rounded clay fragments, few ironstone concretions, occasional crossbeds, weathers medium brown-grey, resistant, plant fragments present.	28	2144
23	Covered, forming bench, scattered outcrop in talus of siltstone, dark grey and mudstone, silty. <u>Microfossil</u> samples: 23aF at 15	56	2116
22	Sandstone, medium grained, arkosic, 20% white feldspar, 30 to 40% dark grains, medium grey, rounded clay fragments, few ironstone concretions, up to 2" in diameter, occasional crossbeds, weathers bluish grey, beds 1 to 3', resistant, tending to part in 1 to 3" slabs. Strike 110°, dip 20°S.	53	2060
21	Covered.	117	2007

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	Crossed axis of anticline and syncline, correlation of sandstone units across these structures not positive, possible duplication or omission of up to 100 feet of section.		
19	Sandstone, fine to medium grained, medium to dark grey, arkosic, 15% light grains, 40 to 50% dark grains, weathers light grey-brown, traces of laminations, crossbedded, weathers very resistant, <u>bark</u> fragments, unit forms top of small ridge.	17	1890
18	Covered, forming bench. Few scattered outcrops of siltstone, medium to dark grey, weathering light greenish grey, appears to be interbedded with silty mudstone.	58	1873
17	Sandstone, fine grained, dark grey, arkosic argillaceous (?), trace of laminations, crossbedded, weathers light greyish brown, few plant fragments, 1 to 2' beds with prominent 1/2 to 2" partings, moderately resistant.	29	1815
16	Predominantly siltstone, medium dark grey, weathers green-grey, in beds less than 1", some interbeds of mudstone and very fine grained sandstone. Recessive unit, mostly covered. Covered (0-34'). <u>Microfossil samples 16aF at 39'</u> . Scattered outcrops of siltstone, light to medium grey, weathers green-grey in beds less than 1", covered intervals between appear to be mudstone, dark grey, silty. Sandstone, very fine grained, light to medium grey, weathers light grey to light brown, essentially 1 bed, tending to part in 1/2" to 2" plates. (54 to 59'). Complete exposure 151' above base. Excellent leaf impressions, collection made 172 feet above base, GSC Plant loc. 6502 identified by Dr. W.A. Bell who reported as follows: <u>Metasequoia cuneata?</u> (Newberry) Chaney <u>Nymphaeites exemplaris</u> Hollick <u>Laurophyllum</u> sp. cf. <u>insigne</u> Dawson <u>Platanus newberryana</u> Heer <u>Pseudoprotophyllum</u> ? sp. <u>Leguminosites rhamnifolioides</u> Bell		

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	<p><u>Sapotacites? sp.</u> <u>Aralia sp. cf. veatchii Knowlton and A.? serrata Knowlton</u> <u>Remarks:</u> Dicotyledonous leaves, although abundant in collections from this locality are fragmentary and not wholly satisfactory for identification. As a whole, however, the assemblage is considered to be late Upper Cretaceous.</p>	187	1786
15	Sandstone, medium grained, arkosic, about 20% feldspar, 30% dark grains, weathers greenish brown in 1/2 to 3' beds with 1/2 to 2" partings, mostly formed by cross-bedding, very resistant forming knob.	35	1599
14	40% outcrop, mudstone, very silty or siltstone, medium grey, in part finely laminated, with few interbeds of siltstones and very fine grained sandstone, greenish grey <u>Microfossil samples 14aF, 10 to 15'.</u>	24	1564
13	Siltstone, dark grey slightly siliceous, poor bedding 1/8 to 1/2" (0 to 4') sandstone, fine grained, arkosic, medium grey, weathers medium grey, in part brown, minor crossbedding, beds 1" to 12", prominent vertical joints perpendicular to bedding with quartz crystals along them. Upper 5' grades upward into siltstones, medium green-grey, weathering brownish green.	26	1540
12	Covered, at 15' outcrop of sandstone, very silty, with interbeds of siltstone, dark grey. <u>Microfossil samples 12aF.</u>	34	1514
11	Sandstone, fine grained, arkosic, weathers medium brown, beds obscure 1 to 2', with 1/2 to 2" partings, occasional interbed of dark grey siltstone as below, few plant fragments. Top 10' prominently cross-bedded (3' to 33'). Siltstone, medium brownish grey, in part argillaceous, weathers dark grey in beds less than 1", recessive. (3')	33	1480
10	Taping across covered unit. In first tape interval, sandstone rubble, fine to medium grained, arkosic. Few frost boils of		

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	mudstone, silty and siltstone, argillaceous, medium grey with abundant ironstone concretionary fragments. In about the last 130', talus of siltstone and argillaceous, very fine grained sandstone, medium to dark grey, weathering in beds less than 1", few plant fragments.	187	1447
9	Sandstone, similar to below, prominent crossbedding, forms small knob (116 to 122'). Recessive bench (101 to 116'), sandstone, arkosic (?), medium brown-grey, prominent crossbedding, weathers light grey to light brown, in 1/2 to 2' beds with crossbeds breaking into 1/4 to 1" plates. Traces of rounded mud fragments and wood fragments abundant along some layers. Unit forms a resistant knob. (81 to 101').	41	1260
8	Sandstone, arkosic, fine grained, medium grey, occasional lenses and interbeds which are slightly calcareous and light brown. Traces of mud fragments and rare wood fragments. Beds 1/2 to 2' tending to part in 1 to 2" slabs. In part finely laminated. (0 to 17') partially covered (17 to 81'), few outcrops of sandstone as below, mostly sandstone rubble, 25% outcrop. The upper 10' forming a recessive bench. Strike 95°, dip 25°S.	81	1219
<u>Shublik Formation</u>			
7	Covered interval, grass and trees. Occupies the same stratigraphic position as the Upper Triassic map-unit 18 (Green and Roddick) in adjoining areas to the south. (GSC Map 13-1962). Mapped as map-unit 10 on GSC Map 10-1963.	780	1138
<u>Tahkandit Formation (Permian)</u>			
6	Change from underlying unit takes place in middle of cliff, and is marked by a darker covering of lichens. Chert, calcareous, medium brown-grey, with lenses and		

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	<p>nodules of purer chert, generally lighter in colour, some of chert is white with fine crenulated banding, weathers light brown in indistinct 1/2 to 2' beds, with covering of dark grey, fine crystalline in lower half of unit, in part coquina. Chert in upper half, light grey, with darker grey patches. Castellated weathering.</p>	27	358
5	<p>Limestone, and chert as below with lenses and nodules of limestone light grey, very fine crystalline, beds 1/2' to 3'. Prominent laminated chert structure 142' to 160'. Above 160' most of limestone is light grey, microcrystalline to very fine crystalline. At 208' some of limestone is fine to medium crystalline, possibly dolomite. <u>Fossils 237 MJ5aF</u> at 222' to 226'. Forms a recessive bench from 255' to 272'. Fossils fairly abundant up to 255'. <u>Fossils 5bF</u> from upper 10' of unit. Strike 100°, dip 25°S. <u>Fossils 5cF</u> from 45' to 60' from top. These brachiopods have been dated as Leonardian or Early Gaudalopian by E. W. Bamber (personal communication, 1965).</p>		
4	<p>Covered, forms a prominent bench in cliff.</p>	2	117
3	<p>Limestone, very siliceous, medium to dark grey, with numerous thin interbeds, lenses and nodules of dark grey chert, predominantly 1/4 to 2" thick and form 30 to 40% of rock, with lenses and nodules of limestone, light grey, very fine crystalline to microcrystalline. Unit weathers light grey, poor beds 2" to 18" forming a resistant cliff. Strike 80°, dip 20°S. <u>Fossils 3aF</u> at 104'. These brachiopods have been dated as Leonardian or Early Gaudalopian by E. W. Bamber (personal communication).</p>	68	115
2	<p>Covered by grass.</p>	11	47

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
1	Limestone, microcrystalline, medium grey, suggestion of fine laminations, with thin interbeds 1 to 4", and lenses of chert, dark grey, grades laterally into limestone, one very large nodule at base of exposure 3' by 6', unit weathers light grey in 1 to 12" beds, moderately resistant. Chert forms 20 to 30% of rock lowest exposure on hillside, underlying rocks are covered by moss and trees.	36	36

EAGLE PLAIN FORMATION, FISHING BRANCH RIVER

Section 2. Upper Cretaceous sandstones and shales outcrop over much of the Eagle Plains in the vicinity of the Porcupine River. Good outcrops occur infrequently except along portions of the larger rivers.

The type section of the Eagle Plain Formation was measured on the northeast side of Fishing Branch River about 9 miles east of Bear Cave Mountain (66°29N, 139°01W, Air Photograph A13230-118). The section begins at river level and ends at the top of a prominent hill. Underlying and overlying strata are not exposed. Measurement was by E. Mountjoy in mid-August 1962.

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
<u>Eagle Plain Formation (2223 + feet)</u>			
32	Sandstone, fine to medium grained, light brownish grey, arkosic, white feldspar 20%, 20 to 25% dark minerals, dirty, poorly sorted sandstone with subangular grains. Weathers light greyish brown with light grey, black and yellow lichens. Prominent parting 1/4 to 4 inches at top of unit. Talus consists of thick 4 to 5 inch slabs and thin small plates. Bedding 8 to 12 inches thick. Poor impressions of plant stems. The top of this unit forms top of ridge. Down the dip slope is about 20 to 30 ft. covered. Then 15 to 20 ft. of sandstone similar to above description (130/7 NE).	32	3502
31	Covered, some talus of siltstone.	38	3470
30	Sandstone, medium grained, light brownish grey, arkosic, 15 to 25% white feldspar, 20% dark minerals, traces of lamination, coarsely crossbedded. Weathers light brownish grey. Crossbeds 1 to 5 feet thick, parting in 1 to 4 inch slabs. Photograph of crossbeds (8-2, 1962). Traces of plant fragments in upper 5 feet.	22	3432
29	Covered.	10	3410

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
28	Sandstone, very fine grained, finely laminated light to medium grey. Weathers light brownish grey to brown in 1/2 to 2 inch partings forming platy talus. Few small concretionary nodules.	24	3400
27	Covered, 58 to 66 feet above base - small base spot with talus of siltstones and sandstone. Light to medium greenish grey containing traces of plant fragments. Weathers light greenish grey, mostly rubble.	99	3376
26	Sandstone, slightly calcareous, fine to medium grained, light brownish grey, weathers light brown with light grey lichens, some white, yellow and green. In large slabs and plates 1 to 3 inches thick. 40% exposure, poor outcrop. Tree trunk or branch impression in upper part of unit; some silty shale and siltstone interbeds in upper 10 feet.	24	3277
25	Covered.	81	3253
24	Sandstone, fine grained, medium brownish grey arkosic, 5% white feldspar grains, 40 to 50% dark grains. Weathers light brownish grey in small plates 1 to 2 inches thick. May be continuous with underlying unit. Dark red weathering small siltstone concretions less than 1 inch across present in upper 2 feet.	8	3172
23	Covered.	5	3164
22	Poor outcrop, 40% rubble of sandstone, fine grained arkosic, trace of laminations light to medium brownish grey, 5 to 10% white feldspar, 20% dark grains, weathers greyish brown with light grey lichens, some yellow and black ones and white. In plates and slabs 1 to 4 inches thick. Few plant stems in upper 2 feet.	12	3159
21	Covered, some siltstone talus near base.	71	3147
20	Sandstone, fine grained, medium brownish grey, arkosic, 5 to 10% white feldspar,		

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	50 to 60% dark grains. Weathers greenish brown to brown with light grey to black lichens. Poorly defined 1 to 3 ft. beds parting in plates less than 1 inch thick. Few coarse crossbeds and a few plant fragments. Forms platy to blocky talus and second prominent sandstone ridge.		
	Above basal 15 feet sandstone is lighter, medium grained and tends to part in 2 inch beds. Lamination in sandstone found near top of unit contains some plant fragments.	40	3076
19	Some talus of silty shale and dark grey siltstone.	40	3036
18	Poor outcrop, sandstone fine grained, medium grey, traces of plant fragments, arkosic 10 to 20% white feldspar, 30 to 40% dark grains, weathers light brownish grey with light grey and black lichens, parts in 1 to 2 inch slabs.	5	2996
17	Covered	137	2991
16	Sandstone, medium grained, light grey to light brownish grey, non-calcareous, arkosic, 15% white feldspar grains, about 30% dark grains. Subrounded grains, poorly sorted. Traces of large plant fragments, few coarse laminations and a few crossbeds. Weathers light brown with white to light grey lichens. Also some yellow-green lichens; in beds 1 inch to 2 feet forming platy to slabby talus. Upper 3 feet is very thin-bedded less than 1 inch thick.	26	2854
	Continued section by following spur of ridge southwest to prominent river cliff.		
15	Covered, calculated using barometer and scaling distances from air photograph, and using strike and dip of 130/7 NE.		
	Three prominent sandstones outcrop as ribs on ridge. Highest sandstone occurs about 810 feet above base and is about 50 feet thick; in part slightly calcareous,		

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	fine grained, arkosic with 15 to 20% white feldspar and 15% dark grains; trace of laminations and prominent crossbedding throughout, most crossbeds dip towards the north; weathers light brownish grey covered with white lichen, tends to part in 1/2 to 2 inch layers along crossbed laminations.		
	Middle sandstone occurs about 230 feet above base, mostly outcrops as rubble. Sandstone, fine grained, quartzose, light grey to brownish grey, finely laminated; weathers light grey to light brown in 1/2 to 2 inch irregular plates.		
	Lower sandstone occurs about 90 feet above base, mostly outcrops as rubble. Sandstone, fine grained, quartzose, light grey, 5% light feldspar, 10% dark grains; weathers light grey to light brown forming 1/2 to 2 inch platy talus.	1400	2828
14	Sandstone, fine grained, quartzose, light greyish brown, finely laminated, weathers brown in 1 to 12 inch beds, crossbedded and some ripple-marks (forms top of river cliff).	10	1428
13	Covered, basal 30 feet interbedded sandstone and silty shale similar to Unit 10.	125	1418
12	Sandstone, fine grained, quartzose, light grey, finely laminated and crossbedded; weathers light yellow-brown in 2 to 12 inch beds, resistant. (Base of type section).	14	1293
<u>Shale and Siltstone Unit</u>			
11	Shale, dark brownish grey, thin interbeds of siltstone, dark grey, argillaceous generally less than 1 inch thick, occasionally up to 3 inches thick, weathers dark grey, recessive.		
	45 to 65 feet above base sandstone, light grey, finely laminated, weathers light yellow-brown, 1 to 2 inch beds. Essentially two sandstone units, the basal about 8 feet thick		

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	and the upper 6 feet, separated by 5 feet of shale.		
	Above 65 feet, siltstone more abundant and forms 50% of rock.	105	1279
10	Siltstone (60 to 70%), dark grey-brown argillaceous and silty shale with 1 to 12 inch interbeds of sandstone, very fine grained, medium brown, finely laminated and crossbedded, spaced 1 inch to 3 feet apart, predominantly 1/2 to 1 foot spacing. Sandstone weathers light yellow-brown.		
	62 feet above base 50 to 60% sandstone generally in 1/2 to 3 foot beds.	186	1174
9	Sandstone, fine grained, quartzose, light yellow-brown, trace of lamination, weathers light yellow-brown, forming second resistant cliff with prominent jointing. (165°/90 90°/75 S).	30	988
8	Siltstone, coarse, light greyish brown, finely laminated and crossbedded with interbeds of very silty shale, dark brown weathering yellowish brown to dark grey-brown in 1/4 to 6 inch beds; upper 5 feet gradational to overlying sandstone cliff, with upper 2 feet containing penecontemporaneous slump structures.	34	858
7	Shale silty, dark brownish grey, with 1/4 to 1 inch interbeds of siltstone, finely laminated, argillaceous, medium brownish grey, weathers medium to dark brownish grey.		
	51 feet above base 1 foot bed of sandstone fine grained, light greyish brown, finely laminated, crossbedded, weathers light yellow-brown.	73	924
6	Siltstone, in part very fine grained sandstone, with thin interbeds and lenses of very silty shale; siltstone is medium brownish grey, finely laminated and crossbedded, weathers yellowish brown in obscure beds less than 1 inch thick.		

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	<p>25 feet above base gradually changes to sandstone, fine grained, quartzose, finely laminated, light brownish grey with upper part slightly coarser grained; weathers yellow-brown in 1/2 to 4 foot beds. Capped by a 5 to 10 foot bed. Western limit of this unit is slightly contorted and appears to be overlain by a thrust fault? with the fault occurring somewhere in Unit 7 and repeating this sandstone unit.</p>	70	851
5	<p>Shale, silty, dark brownish grey, with light grey silt laminations, interbeds of siltstone light— dark brown finely laminated, in lensing, 1/2 to 2 inch beds spaced 1 to 4 inches apart.</p> <p>Microfossil samples every 20 ft. above 75 feet.</p> <p>Siltstone interbeds more predominant at 75 feet, and above forming 30 to 50% of the rock.</p> <p>Top of Unit 5 forms base of cliff. Above 220 feet interbeds of siltstone and very fine grained sandstone more abundant in 1/2 to 2 inch beds, finely laminated and crossbedded. Slightly more resistant than lower part and has a more prominent ribboned appearance.</p>	270	781
4	<p>Covered, appears to be shale as below with a few siltstone interbeds.</p>	92	511
3	<p>Shale, slightly silty, dark brownish grey, weathers medium to dark grey, very thin bedded tending to be fissile, rare siltstone interbeds, more recessive; dominantly a shale unit. Between 65 and 105 feet, above 1 to 2 inch siltstone interbeds. Microfossil samples for basal 25 feet.</p>	105	419
2	<p>Cover, few outcrops of silty shale with interbeds of siltstone as described below.</p>	134	314
1	<p>Hard shale and mudstone, silty, dark grey with light grey laminae and lenses less than</p>		

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	1/4 inch of silty finely laminated and crossbedded with 1/2 to 3 inch interbeds of siltstone giving outcrop a poor banded appearance. Unit weathers a medium greyish brown, moderately resistant, tends to weather in pieces less than 1/8 inch. Microfossil samples every 20 feet for basal 100 feet.		
	19 feet above base, sandstone interbed, very fine grained, quartzose, light grey, weathers medium brown-grey, 2 feet thick forming resistant layer.		
	33 to 34 feet above base, mudstone in 1/4 to 1/2 inch layers interbedded with shale forms resistant bed.		
	42 to 59 feet above base sandstone, very fine grained, quartzose, light grey, finely laminated and crossbedded, weathers light brown in 2 to 6 inch beds, interbedded with 1 to 3 inch beds of siltstone and silty shale, dark grey.		
	150 to 163 feet above base, sandstone, very fine grained as below, light grey quartzose interbedded with siltstone and silty shale. Top of unit is approximate top of river cliff. Some contortion in upper 50 feet, suggests slumping.	180	180
	Began measuring section at river level. Underlying beds are exposed near the junction of the East Porcupine and Porcupine Rivers and contain Lower Cretaceous Albian <u>Lemuroceras</u> sp. (Jeletzky, 1960, p. 19).		

REINDEER FORMATION, CARIBOU HILLS

Section 3. The section is located on the east side of Mackenzie Delta $4\frac{1}{2}$ miles northwest of Reindeer Depot on the southwest side of the Caribou Hills opposite the north end of Williams Island. It appears to represent the middle part of the Reindeer Formation.

It was measured by G.R. Turnquist, in July 1962, using a barometer and pogo stick. The section begins at river level and ends at the top of the prominent cliff in this area. (Section 107D6)

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
<u>Reindeer Formation</u>			
22	Boulder gravel up to 1 foot diameter, pebbles subangular, most quartzite, some chert and rare green chert. Forms top of cliff.	55	507
21	Silt, bright orange to orange-brown.	10	452
20	Mostly covered, exposed by digging, siltstone, soft.	10	442
19	Coal, hard, very thin bedded, with plant fragments. Appears to be in angular contact with underlying beds. G.S.C. loc. 6626.	7	432
18	Clay silty light brown, weathers dark brown, partly covered.	5	425
17	Coal, brown, hard, very thin bedded, poorly exposed. G.S.C. loc. 6624.	10	420
16	Partly covered exposed by digging, siltstone soft, brown weathering.	9	410
15	Pebble gravel, considerable dark pebbles, a few of green chert.	5	401
	Shift in section to west.		
14	Siltstone, brown, fine-grained, thin-bedded, weathers white, with abundant plant stems perpendicular to bedding. G.S.C. loc. 6625	15	396
13	Siltstone, weathers white.	5	381

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
12	Gravel, fine, mainly white and black chert pebbles with a few green coloured.	5	376
11	Partially covered, siltstone, dark brown, soft carbonaceous, brownish grey weathering. G.S.C. loc. 6632.	12	371
10	Siltstone with a few pebbles, very light brownish grey, weathers white with a reddish brown stain.	12	359
9	Pebble gravel and white silt interbedded.	3	347
8	Gravel coarse and boulders, up to 1 foot diameter of quartzite and chert, becomes finer upwards.	7	344
7	Silt, partially covered, dark grey, soft with a minor amount of lignite at top. G.S.C. loc. 6631.	20	337
6	Sand, partially covered coarse-grained, reddish brown.	12	317
5	Sand, partially covered, fine to medium-grained.	30	305
4	Covered by brush.	115	275
3	Partially covered, exposed by digging-brown coal. G.S.C. loc. 6636.	55	160
2	Gravel, pebbles of chert, quartzite and limestone in a loose pile.	55	105
1	Covered by trees to river level.	50	50

REINDEER FORMATION, CARIBOU HILLS

Section 4. Section was measured on east side of Mackenzie Delta 4 miles southeast of Reindeer Depot on the southwest side of the Caribou Hills opposite Harrison Island. As these strata dip gently north this section represents strata beneath those exposed at section 3 in the middle to lower part of the formation.

It was measured by G.R. Turnquist, in July 1962 by means of a barometer and pogo stick. The section begins at river level and ends at top of prominent cliff which extends north and south from Reindeer Depot. (Section 107D3)

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	Top of cliff.		
15	Rubble, shale, burnt, bright red.	5	692
14	Covered, appears to be sand and silt.	70	687
13	Partly covered, sand and silt exposed by digging. One inch layer of lignite at top in silty clay. G.S.C. loc. 6634.	35	617
12	Shale, silty, becoming more argillaceous upward, dark brown, carbonaceous. G.S.C. loc. 6633.	13	582
11	Covered.	20	569
10	Partially covered, sand and silt exposed by digging, a few thin carbonaceous intervals.	60	549
9	Siltstone, dark grey, very thin bedded, weathers grey. G.S.C. loc. 6638.	7	489
8	Partially covered, exposed by digging, siltstone carbonaceous similar to unit 3. 3 inch layer of bright orange clay at top.	5	482
7	Sand, light brown.	1	477
6	Mainly talus, argillaceous brown coal. G.S.C. loc. 6637.	1	476
5	Sand, coarse grained, with black to light brown grains, some silt and gravel, organic material near top, 45 feet above base,		

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	thin layer of argillaceous silt. Forms steep slope.	110	475
4	Gravel, very fine.	20	365
3	Mostly covered, soft carbonaceous shale exposed by digging.	35	345
2	Covered slope of clay, sandy near top.	200	310
1	Covered by trees and bush to river level.	110	110

BONNET PLUME FORMATION, WIND RIVER

Section 5. Late Cretaceous to Early Tertiary non-marine terrigenous sediments occupy a depressed area near the mouths of the Bonnet Plume and Wind Rivers. The following section is designated as the type and was measured by staff and tape in May 1962 along the east side near the mouth of the Wind River. (65°47'-50'N, 135°12'-17'W).

The base of the section occurs about 1 mile above the mouth of the Wind River where coarse conglomerates overlie steeply dipping Palaeozoic sediments. The top of the section occurs about a mile downstream from Basin Creek.

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	Covered.		
	Inaccessible outcrop - appears to be shale, grey, non-calcareous with a few 1 to 3 foot interbeds of sandstone and siltstones, weathers light grey to light brown, slightly less resistant than underlying unit. Estimated 50+		
58	Sandstone, 50% quartz grains, 50% dark, very coarse grained, subrounded, occasional pebbles 1/4 inch diameter, every one to three feet series of pyritized nodules and lenses with wood and other plant fragments in centre; fine to coarse crossbedding.		
	Crossbed units 1 to 3 feet thick with 1/4 to 1/2 inch crossbed laminations are composed of a thick dark coarse part separated by a thin light fine part; forms a resistant cliff, few boulders at base.	23	5040
57	Siltstone, micaceous, light grey with some brown parts, 11 feet from top is 1 foot of fine to medium grained grey sandstone; unit weathers slightly recessive, bedding is obscure.	23	5017
56	Sandstone, non-calcareous, coarse grained, medium grey, prominent crossbedding striking 70/20N, also prominent current cross-bone, few crossbeds dip to the south, some contortion in crossbed laminations, few layers of small pebbles		

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	and few fragments of light grey siltstone and shale, trace of plant remains.	18	4994
55	Shale, black and lignite 1 inch at top, 2 feet. at base and middle, remainder of unit is shale and clay, micaceous, light to medium grey, very soft and contains numerous plant fragments.	6	4976
54	Sandstone, medium to coarse grained, medium grey, not cemented, few plant fragments, weathering recessive, base of exposure.	4	4970
53	Covered interval.	144	4966
52	Sandstone, coarse-grained, light yellowish brown, very soft, few crossbeds, resistant.	10	4822
51	Lignite, black shale, interbedded with clay and shale, grey to yellow-grey, occasional plant remains, base is covered.	4	4812
50	Covered interval.	98	4808
49	Sandstone, very coarse grained, light grey to grey-brown, poor crossbeds, weathers light grey, resistant, occasional conglomerate layer.	50	4710
48	Covered interval, lower 50 feet consists of sandstone.	374	4660
47	Sandstone, grey.	39	4286
46	Sandstone, very fine grained, and siltstone light to medium grey, indistinct bedding about every foot, weathers light grey to light brown.	17	4247
	Inaccessible cliff corner, thickness of next two units estimated.		
45	Sandstone, light brown, resistant.	15 ₊	4230
44	Sandstone and siltstone, medium grey, recessive.	20 ₊	4215

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
43	Sandstone, medium to coarse grained, brown, trace of crossbeds, weathers light grey, very resistant.	25+	4195
42	Sandstone, medium to coarse grained, light brown, prominent fine laminations with occasional thin partings of lignite, weathers light orange-brown, essentially part of overlying resistant unit.	10	4170
41	Shale, medium grey, soft, weathers light grey.	20	4160
40	Shale, slightly calcareous, very light grey, tends to be fissile, zone of siltstone, concretions in upper foot, weathers light grey to yellow to orange, forms prominent yellow beds along bank.	11	4140
39	Shale, non-calcareous, dark grey to dark brownish grey, obscure bedding, plant fragments, weathers to light medium grey. Base becomes sandy.	22	4129
38	Sandstone, very fine grained and siltstone medium grey, bedding obscure, predominantly siltstone, few interbeds of sandstone fine to medium grained, brown, 30 to 36 feet above base; weathers to light grey.	62	4107
37	Sandstone, non-calcareous, coarse-grained, light grey to reddish brown, loosely cemented, few pebbles, occasional concretions, some crossbedding, weathers light grey to light purple to light yellow.	12	4045
36	Covered interval, at top are outcrop of dark grey shale and one of brown sandstone, lower unit contains scattered exposures of siltstone and shale, very soft, dark, grey to dark brown, with thin sandy layers bedding obscure, weathers medium grey.	256	4033
35	Sandstone, medium to coarse grained, light grey to brown, few crossbeds, partings 1 to 6 inches, few thin layers of siltstone, few plant fragments in some beds, weathers		

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	to light grey to orange-brown, resistant.	30	3777
34	Shale, dark grey to dark brownish grey, traces of plant fragments, weathers dark grey, recessive, mostly covered, base grades to sandstone.	15	3747
33	Sandstone, coarse-grained, light grey to brown, parting 1 to 6 inches, trace of fine laminations, weathers to light grey to light brown.	21	3732
32	Covered interval, appears to be sandstone along strike, few outcrops of sandstone medium to coarse grained, grey, 11 feet from base is 1 foot of dark grey shale with plant fragments. Basal 10 feet forms resistant sandstone cliff, weathers light grey, some coarse crossbeds.	53	3711
31	Shale, medium brownish grey, soft, few plant fragments, abundant in some layers, weathers light grey with prominent light brown bands near top.	37	3658
30	Sandstone, fine to coarse grained, dark grey to brownish grey, has dark fine-grained and light coarse-grained layers which form fine laminations, weathers to light brown-grey and light brown, resistant.	4	3621
29	Shale, predominantly medium grey, becomes sandy at base, distinct lignite layer in middle, dark grey to black, abundant plant fragments, 1 inch of light grey clay and shale at top.	3	3617
28	Sandstone, medium to coarse grained, light brown, occasional 1 to 1/2 inch layer very coarse grained with a few pebbles up to 1 inch in diameter and traces of lignite and plant fragments, occasional laminations and crossbeds, moderately well cemented, concretions in lower 5 feet, weathers light grey to light brown, very resistant.	26	3614
27	Covered interval to prominent dark band in upper part of prominent sandstone underneath, following along strike top of sandstone.	47	3588

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
26	Sandstone, medium coarse grain, brown, trace of crossbeds, one massive unit except for upper 8 feet with 1 foot of shale dark grey with lignite 8 feet below top, weathers light brown.	48	3541
25	Sandstone between 18 to 23 feet, lignite 15 feet below top about 1 foot thick, main part is shale, black, abundant plant fragments, some thin layers of lignite, approximately 2 feet of lignite at base, also light grey clay near base.	42	3493
	<p>G.S.C. Loc. 6489, spores and pollen identified by Dr. G.E. Rouse as follows: "Extratropipollenites sp. (Trudopollis) <u>Aquilapollenites quadrilobus</u> Rouse cf. <u>Trudopollis</u> type <u>Sphagnum antiquasporites</u> Wilson and Webster, plus angiosperm pollens and fern endospores. The age of these beds is either late Upper Cretaceous (Campanian-Danian) or Paleocene".</p>		
24	Sandstone, medium-grained, light grey, traces of laminations, weathers light grey to light brown, base forms resistant 30 to 40 foot cliff, upper 15 feet is slightly finer grained and contains a series of brown weathering indurated layers 1 to 2 inches thick spaced 1 to 3 feet. 5-foot covered interval in the middle. Traced base of this sandstone 1/4 mile north, underlain with extensive cover, sandstone may be up to 10 feet thicker.	60	3451
23	Covered interval, prominent bank or hillside assumed to be bedding above 15 to 20 feet of brown sandstone, coarse-grained, becomes finer grained and argillaceous toward top, weathers light brown to light grey.	70	3391
22	Shale, medium grey to black, few plant fragments, upper 2 feet contains abundant plant fragments and very thin lignite interbeds, this unit forms recessive bench.	12	3321
21	Estimate 20 to 40 feet of section (sandstone) inaccessible.	30	3309

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
20	Sandstone, fine- to medium-grained, medium grey, traces of laminations and coarse crossbeds, weathers light grey with some brown beds. Basal 20 feet contains reddish brown weathering concretions.	67	3279
19	Sandstone, fine- to medium-grained, light brown with siltstone interbeds 1 to 4 inches, weathers light grey, beds 1/2 to 2 feet thick, recessive.	38	3212
18	Cover of slump, base of cover consists of siltstone, light grey.	15	3174
17	Sandstone, fine- to medium-grained, orange brown, trace of fine laminations and crossbeds, few plant fragments, weathers light medium brown.	8	3159
16	Covered interval.	29	3151
15	Shale and lignite, black, partly covered, recessive.	6	3122
14	Sandstone, fine- to medium-grained, soft light orange-brown, trace of crossbeds, traces of plant fragments in finer portions, weathers light grey to light brown.	18	3116
13	Cover, basal 30 feet partially covered, grey shale.	59	3098
12	Sandstone, medium-to coarse-grained, light brown, trace of crossbeds, bedding obscure, weathers light brown, forms resistant cliff.	32	3039
11	Covered, small outcrop of shale, black in upper 10 feet, 15 feet of sandstone unit about 10 to 20 feet above base.	60	3007
10	Sandstone, medium-grained, non-calcareous, light grey, indurated, bedding obscure, minor crossbedding with concretions of plant fragments along some laminations, forms light grey massive cliff.	42	2947
9	Covered, probably shale.	10	2905

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
8	Very fine conglomerate or grit with layers of pebbles up to 1 inch diameter, weathers light grey, very resistant forming vertical cliffs. Becomes coarser in lower half with pebbles up to 2 inches across, average 1 inch. Coarse crossbeds with interbeds 1 to 2 feet thick of coarse grit which forms caps for some small hoodoos, weathers very light grey. Most crossbeds dip east. Conglomerate cliff exposed for about 1/2 mile to north.	125+	2895
7	Covered, no exposures for between 3 1/2 and 4 miles downstream. Using strike of 27 degrees dip of 20°E, calculate thickness of cover to be about 2,900 feet. If dip of 15° is used covered interval is only 2,100 feet thick.	2100 to 2900	2770+
Station 10MJ			
6	Sandstone, non-calcareous, fine- to medium-grain, greenish brown colour, no prominent bedding, exposure covered with red stain coming from layer directly beneath top soil. Between 21 and 36 feet below top, talus of siltstone light greyish green. Most of this unit is slump covered. Base appears to be sandstone fine- to medium-grained and siltstone, weathers light greenish grey.	50	670
5	Shale, dark brownish red, non-calcareous, bedding obscure, well indurated, forms a distant dark reddish brown unit.	5	620
4	Conglomerate, pebbles from 1/4 to 6 inches across, average 1 to 2 inches; matrix forms 50 to 70% of rock, occasional lens of sandstone fine-grained, light greenish grey up to 6 inches thick. Conglomerate has crude stratification parallel to bedding, unit weathers resistant, light greenish grey in places with reddish tinge from overlying unit. Pebbles of white to grey quartz sandstone, red shale, dark grey siltstone, light green fine grain sandstone of type		

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	<p>observed in overlying beds along strike to north. Between 26 to 31 feet from top lenses of siltstone, light greenish grey, moderately well bedded. From 50 to 115 feet from top conglomerate forms about 70% of unit, some boulders of up to 8 inches, average about 2 inches. At 115 feet from top, 4 foot lens of red and green siltstone at one locality. At 256 feet matrix of fine to very coarse grained sandstone, pebbles and cobbles make up 70% of rock, some up to 8 inches.</p>	280	615
3	<p>Estimate 50 feet more conglomerate below this level.</p>	50	335
2	<p>Unknown interval between stations 12 and 10 MJ, estimate 0 to 100 feet.</p>	50 ₊	285
	<p>Station 12 MJ</p>		
1	<p>Conglomerate, essentially same as above, matrix of fine to coarse grain sandstone with considerable silt and clay, greenish brown pebbles from 1/16 to 6 inches, form about 50% of rock. Predominantly light green. Unit forms 200 foot cliffs, weathers red to reddish brown with some green coloration. No stratification evident. 110 feet above base matrix is shale, dark red with considerable fine pebbles, makes up about 70% of rock. Overlain by 50 to 100 feet of very sandy till.</p>	235	235
	<p>Unconformity with palaeozoic black shales exposed downstream. Local relief of 50 feet observed. Palaeozoic altitude 30/40 W.</p>		

BONNET PLUME FORMATION, PEEL RIVER

Section 6. River bluffs form a series of outcrops on the south side of the Peel River (65°51'-52'N, 135°09'-15W). The section was measured by staff and tape in late May between 2 and 5 miles downstream from the mouth of Wind River: Extensive covered intervals occur and these were estimated in the field or calculated using distances measured from air photographs.

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
72	Lignite, dark brown to black, thin bedded, many plant fragments on bedding planes; some light grey to white clay beds up to 2 inches thick at intervals of 2 feet throughout. The unit weathers black, fairly resistant.	40.0	4314
	<p>GSC loc. 6491, spores and pollen identified by Dr. G.E. Rouse as follows: <u>"Alnus sp.; Myrica sp.; Carya juxtaporipites (Wodehouse) Rouse;</u> <u>Ulmus sp.; Salix spp. (2)</u> <u>Liliacidites variegatus Couper</u> <u>Castanea minutapollenites Rouse</u> <u>Tricolpopollenites divergens Rouse</u> <u>Sphagnum antiquasporites Wilson and Webster</u> <u>Lycopodium sp.</u> The sample is late Upper Cretaceous (Campanian-Danian) or Paleocene, correlative to Nos. 6490 and 6489".</p>		
71	Covered.	50.0	4274
70	Sandstone, fine to medium grained, brown, abundant plant fragments, very hard and resistant.	1.0	4224
69	Shale, silty, and siltstone, grey, some lignite fragments; some fine grained sandstone.	12.0	4223
68	Conglomerate, light grey, pebbles subrounded of size 1/4 inch to 3 inches; matrix of coarse grained sandstone and forms 60% of the rock. There are some sand lenses. The unit weathers light grey and is cliff forming, although it is crumbly.	110.0	4211
67	Shale, light grey, mostly covered.	19.0	4101

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
66	Lignite, black, thin bedded, abundant wood and other plant fragments; a few thin light grey to white clay partings up to 1/2 inch thick. This unit weathers dark grey to black.	12.0	4082
	<p>GSC loc. 6490, spores and pollen identified by Dr. G.E. Rouse as follows: <u>"Carpinus sp.; Corylus sp.; Salix cf. minutissima Chlonova; Betula spp. (2 spp.); Alnus sp. (heavy arci); Ulmus sp.; ?Liquidambar sp.; Ginkgo sp. Taxodiaceae (undifferentiated) ?Expressipollenites (Triporina sp.) Triorites harrissii Couper Aquilapollenites sp. cf. quadrilobus Rouse Sphagnum antiquasporites Wilson and Webster Laevigatosporites albertensis Rouse</u> The age is within late Upper Cretaceous (Campanian) or Paleocene, with a decided preference for the Upper Cretaceous".</p>		
65	Conglomerate, light grey to brown, sandy, estimated.	25 ₊	4070
	Lower part of section covered. Following units estimated.		
64	Siltstone and silty shales, weathering yellow-brown, estimated.	100 ₊	4045
63	Sandstone, grey-brown.	50 ₊	3945
62	Inaccessible mostly recessive weathering silts and silty shales with a 25-foot light grey sandstone bed near the top.	200 ₊	3895
61	Shale and siltstone - grey as below. Starts at unconformity with pleistocene sandy gravel till.	10.0 ₊	3695
60	Sandstone, coarse grained, light yellow-brown to yellow-grey, coarse current crossbeds present, dipping. There are a few rusty weathering concretions in the upper half of the unit. The unit weathers light grey to light brown.	29.0	3685

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
59	Shale, greenish grey, in part silty, a few concretions present. The unit weathers light grey.	4.0	3656
58	Sand, coarse grained, yellow-brown; the unit weathers light yellow-brown.	5.0	3652
57	Shale, medium to dark grey, some plant fragments; the unit weathers light grey.	8.0	3647
56	Covered, probably shale, green, some exposure at its base.	13.0	3639
55	Shale, silty, medium grey as below, with traces of plant fragments.	7.0	3626
54	Shale, silty, greyish green, same as below.	4.0	3619
53	Covered, but probably shale, greyish green as below.	18.0	3615
52	Shale, silty, medium to dark grey, contains some interbeds of greenish shale as below.	19.0	3597
51	Shale, silty, greenish grey, weathers yellow-brown.	7.0	3578
50	Sand, medium grained, medium yellow-grey, in part siltstone with organic fragments.	3.0	3571
49	Shale, in part silty, medium grey to dark grey at the top, weathers light grey to yellow-brown. This unit was mostly covered.	40.0	3568
48	Covered, a few outcrops of shale and siltstone, grey.	25.0	3528
47	Sandstone, coarse grained, yellowish brown, and weathers light yellowish grey.	8.0	3503
46	Shale, silty, medium greyish brown.	3.0	3495
45	Cover not measured; calculated using altitudes and measured distance on air photos.	424	3492
44	Sandstone, coarse grained, yellow-brown, some light grey parts. There are a few		

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	pebbles and traces of plant fragments. The unit weathers light grey with upper 5 feet to 10 feet light yellow. The unit very noticeable from the air; it appears to be due to weathering. The unit is coarsely crossbedded. It is underlain by yellow-grey shale, and lenses of conglomerate 1 inch to 2 inches in the lower belt, with pebbles up to 2 inches, and the average being 1/2 inch.	30.0	3068
43	Covered, estimated between stations 21 and 22 MJ. Slump and Pleistocene cover.	40 ₊	3038
	Station MJ. Next gully to west of station 21 MJ.		
42	Shale, black.	7.0	2998
41	Sandstone, coarse grained, brown, finely laminated and prominent crossbedding, a few pebbles. The unit weathers light reddish brown. There are traces of plant fragments, and interbeds of lighter weathering sandstone, fine grained, and siltstone. The unit is jointed.	13.0	2991
40	Covered, but shale, dark grey at top.	12.0	2978
39	Shale, green, with some grey shale interbeds.	12.0	2966
38	Sandstone, medium grained, brown, abundant plant fragments along some beds. There are fine laminations and crossbeds.	10.0	2954
37	Covered.	25.0	2944
36	Sandstone, medium grained, yellow-grey, soft, weathers light grey.	20.0	2919
35	Covered, not measured; calculated using altitudes and measured distances on air photographs.	900 ₊	2899
	Station 15 MJ.		
34	Sandstone, coarse grained, brown, a few plant fragments, and lignite fragments, crossbedded, weathers brown.	7.0	1999

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
33	Shale, silty, and siltstone, medium grey, grading into sandstone in the upper 5 feet.	10.0	1992
32	Sandstone, medium to coarse grained, light grey to light brown, scattered lignite and plant fragments, with a unit of 6 inch concretions at the base. Fine and coarse crossbeds present, dipping northeast. Some layers have clay and concretion fragments. It becomes finer grained towards the top, a few layers of siltstone being present. The unit weathers light brown resistant. A 6-inch bed 2 feet above base has abundant clay fragments and a few pebbles.	12.0	1982
31	Shale, and clay, dark grey, silty.	8.0	1970
30	Sandstone, light brownish grey, fine to medium grained, a few plant fragments crossbedded with occasional clay and concretionary pebbles up to 1/2 inch. A few small reddish brown concretions present. The unit weathers light brown, resistant. The crossbeds present dip east.	10.0	1962
29	Shale and clay, dark grey becoming sandy and silty towards the top.	10.0	1952
28	Sandstone, fine to medium grained, soft, poorly consolidated, mostly covered, medium to dark grey in color.	25.0	1942
27	Covered a series of sandstone cliffs 20 to 40 feet thick separated by 20 to 50 feet covered intervals.	205±	1917
Station 16 MJ			
26	Sandstone, medium grained, medium grey, a few plant fragments, the unit weathers light grey, massive. Crossbedding present. This unit overlain by grey shale.	20.0	1712
25	Covered interval.	10.0	1692
24	Shale and clay, medium grey, partly covered.	5.0	1682

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	Sandstone, coarse grained, light rusty brown clay fragments and plant fragments present. The unit weathers light brown, partly covered.	15.0	1677
23	Covered interval, at its base is a layer of shale, medium grey in color.	8.0	1662
21	Sandstone, fine to medium grained, light grey, fairly abundant plant fragments, fine laminations and crossbedding. Jointing prominent with strikes of 130° to 180° and with dips varying from 30° to 70°E. The unit weathers light grey with a reddish brown tinge.	13.0	1654
20	Sandstone and silt, interbedded, fine grained, brown and shale, silty, grey, in beds 1/2 inch to 2 inches. The unit is more argillaceous at its base. The unit is partly covered.	23.0	1641
19	Shale and silty shale, light to dark grey, with 1-inch to 2-inch lignite and plant fragment beds.	3.0	1618
18	Sandstone, predominantly coarse grained, brown to light grey, some crossbeds, a few organic fragments, concentrated in some of the crossbed laminations. The unit becomes finer grained at the base with some grey siltstone interbeds. The unit weathers light grey to light brown. There are a few rusty concretions and clay fragments. There are also fairly prominent laminations and jointing.	23.0	1615
17	Covered.	10.0	1592
16	Shale, light to medium grey, with traces of plant fragments.	2.0	1582
15	Lignite, black, fairly soft.	1.0	1580
14	Sandstone, fine grained, light grey to finely laminated with traces of plant fragments. The unit weathers light grey resistant.	8.0	1579
13	Covered.	30.0	1571

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
12	Shale, silty, light to dark grey, partly covered.	30.0	1541
11	Sandstone, fine to medium grained, light grey to light brown. Some layers 1/2 inch to 3 inches more indurated and concretionary. There are occasional laminations of plant fragments. The unit weathers light grey.	20.0	1511
10	Clay, medium grey, a few thin lignite and plant fragment beds. The unit is mostly covered.	15.0	1491
9	Large unmeasured covered section. Calculated using altitudes of measured distance on air photos.	348 ₊	1476
	Station 17 MJ. Lat. 120° Long. 15° NE		
8	Interbedded sandstone, very coarse grained, light to medium grey, with scattered pebbles up to 1/2 inch. The unit is well indurated and hard; with conglomerate, pebbles subrounded up to 1 inch, average 1/4 inch in size, in a light grey, very coarse grained sandstone matrix. Bedding is 1 foot to 3 feet thick. The unit weathers light grey. This unit was overlain by grey silty clay, mostly covered with abundant lignite present in the talus.	10.0	1128
7	Covered unmeasured, calculated using altitudes and measured distance on air photos.	200 ₊	1118
	Station 18 MJ.		
6	Sandstone, fine to medium grained, greyish brown, with a few interbeds of siltstone and silty shale in the upper half. The unit weathers recessive, very poorly exposed.	20.0	918
5	Covered, unmeasured calculated using altitudes and measured distance on air photos.	400 ₊	898
	Station 19 MJ.		

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
4	Siltstone and clay, in part silty, light grey to brown with plant fragments, which are abundant at the base. The unit is partly covered.	15.0	498
3	Shale, light grey to greenish grey, weathers light cream to white. Samples taken.	8.0	483
2	Conglomerate, upper 5 feet with light grey clay matrix, pebble size 1/2 inch to 8 inches, subrounded and mostly light greyish green siltstone, abundant plant and lignite fragments in the matrix. The matrix is of fine pebbled conglomerate, greenish grey, and clay. The unit weathers rusty brown. There is a trace of red weathering near the base. The unit is very poorly consolidated. Pebbles and cobbles make up 50% to 70% of the rock. Sample taken.	75.0	475
1	Additional exposure of conglomerate upstream, weathers red and yellow, calculated from altitudes and air photos. Followed by extensive cover to Palaeozoic rocks.	400+	400

BONNET PLUME FORMATION (upper part), PEEL RIVER

Section 7. This section was measured on the south side of the Peel River about 8 miles downstream from the mouth of Wind River (65°53'N, 135°107'W) in the vicinity of the burning lignite locality. The lignite seams in this section probably correspond to those in the upper part of section 6. Measurement was made by staff and tape in late May.

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	Cover of Pleistocene.		
26	Sandstone.	20.0	543
25	Recessive zone, probably shales, weathers light yellow to grey.	50.0	523
24	Shale, light to dark grey, with abundant plant fragments. One partial tree trunk observed.	10.0	473
23	Sandstone, medium to coarse grained, light grey, weathers light grey, very resistant.	7.0	463
22	Conglomerate, grey, pebbles up to 2 inches and with an average of 1/2 inch; soft, crossbedded. There are a few interbeds of sandstone. The unit weathers grey. The matrix of coarse grained sandstone forms about 30% of the rock.	26.0	456
21	Covered, with talus of shale, grey, and lignite. One bed of lignite at the top.	21.0	430
20	Shale and siltstone, light grey to light brown, weathers the same.	8.0	409
19	Sandstone, light brown, medium grained, weathers light grey, brown at base.	2.0	401
18	Sandstone and conglomerate, light grey, finely laminated, and crossbedded, pebbles up to 1 inch, average 1/2 inch. There is a layer of clay balls 1/3 of the way up. The conglomerate makes up about 60% of the unit.	65.0	399
	Covered - 0-50'.	0-50.0	334

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
17	Shale, light to dark grey, traces of plant fragments, weathers light grey.	8.0	284
16	Covered.	10.0	276
15	Shale, grey, in parts has abundant plant fragments.	1.0	266
14	Sandstone, fine grained, grey, abundant plant fragments.	3.0	265
13	Lignite, in part burning, dark grey, plant stems, branches, trunks, giving off carbon monoxide and other fumes. According to Camsell (1906, p. 10cc) this has been burning since before 1890.	3.0	262
12	Covered - between 30 and 45 feet is the prominent burning lignite seam.	45.0	259
11	Shale and clay, basal 5 feet dark grey, remainder white to yellow pink. It weathers light yellow to red.	25.0	214
10	Lignite, black; the upper 2 feet is very argillaceous.	5.0	189
9	Shale and clay, grey to red (the red being probably a weathering feature along the fracture) a few traces of plant fragments, weathers light grey. The shale is predominantly light grey. The upper 5 feet is light in color.	32.0	184
8	Conglomerate and sandstone, light grey; sandstone is coarse grained, crossbedded pebbles in the conglomerate up to 2 inches, with the average being 1/2 inch to 3/4 inch. The conglomerate is restricted to 1 inch to 1 foot layers, lenticular; the unit weathers light grey and forms a very resistant cliff. There are some lignite fragments. The upper 2 feet is slightly more resistant yellow sandstone, coarse grained.	35.0	152
7	Conglomerate, brown, pebbles up to 2 inches, with the average of 1/4 inch to 1/2 inch; it is 60%-70% pebbles; the matrix is of fine		

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
	conglomerate and sandstone, coarse grained, of mostly chert and quartz. There are abundant clay balls and clay fragments in the upper 5 feet. The unit weathers light grey-brown, resistant.	16.0	117
6	Covered.	8.0	101
5	Siltstone and sandstone, brown, with abundant white specks, weathers brown, very hard, forming a prominent unit which caps underlying sandstone.	2.0	93
4	Sandstone, coarse grained, grey, conglomerate in part in the basal 10 feet. There is finely laminated crossbedding. The unit weathers light grey resistant, and has a 1-foot bed of silty shale on top.	24.0	91
3	Shale, dark grey, some layers with abundant plant fragments. The unit weathers light brown, partly covered.	21.0	67
2	Sandstone, coarse grained, light grey in part conglomeratic, especially in the basal 5 feet, crossbedded. Some contortion structure present, and also wood fragments. At 18 feet there is a 1-foot shale bed, dark grey. The unit weathers light grey.	36.0	46
1	Shale and siltstone, possibly some sandstone, brown to dark grey, capped by a 1-foot shale interval containing abundant plant and lignite fragments. In the cliff face to the northeast there is an additional 50 to 100 feet of section exposed beneath here. This unit weathers light grey.	+10.0	10
25 MJ Tertiary Peel River			
1	Shale and siltstone, brown, a few fine sandstone interbeds and a few concretions.	25.0	
2	Sandstone, medium brownish grey, coarse grained, weathers light grey.	9.0	

Unit	Description	Unit Thickness (feet)	Height Above Base (feet)
3	Conglomerate and conglomeratic sandstone, brown, some lignite fragments, pebbles up to 1 inch, with an average of 1/4 of an inch. Crossbedding present. The unit weathers light grey to light brown.	35.0	5.0
4	Shale, medium grey.	5.0	
5	Sandstone, brownish grey, coarse grained with minor amounts of conglomerate.		

Base of section at river.

APPENDIX II - PALAEOONTOLOGY

Some of the fossil determinations for the late Mesozoic rocks of northern Yukon are compiled below with comments obtained from reports by D. C. McGregor and W. A. Bell (WAB) of the Geological Survey of Canada and G. E. Rouse (GER), Department of Biology and Botany, University of British Columbia. Location and approximate stratigraphic position of these collections are given.

EAGLE PLAIN FORMATION

- Location: GSC loc. 6587 (WAB) 66° 39½'N 138° 05'W Porcupine River, about 2 miles below Burnthill Creek.
- Identification: Nymphaeites exemplaris Hollick
- Remarks: It is generally poor practice to accept occurrence of a single plant species as a basis for refined age correlation. N. exemplaris occurs in the Kaltag Formation of Alaska and the Dunvegan Formation of Alberta, both assigned by the writer a Cenomanian age. It occurs also at locality 6590 in association with other species that are considered to denote a Cenomanian age.
- Location: GSC loc. 6589 (WAB) 66° 42'N 137° 58'W Porcupine River, at mouth of Ellen Creek.
- Identification: Tumion gracillimum Hollick
Metasequoia cuneata (Newberry) Chaney pars
Pseudoprotophyllum boreale (Dawson) Hollick
- Remarks: In addition to above the plant collection includes many fragments of platanoid leaves that, owing to lack of base and essential marginal features, are unidentifiable. Early Cretaceous beds have such leaves, which include the genera Platanus, Protophyllum, Pseudoprotophyllum, Credneria etc., in particular abundance. T. gracillimum and Pseudoprotophyllum are so far as known, characteristic early Upper Cretaceous species, and the age of the beds at this locality is considered to be Cenomanian.
- Location: GSC loc. 6589 (GER) 66° 42'N 137° 58'W.
- Identification: Anemia sp.
Sphagnum antiquasporites Wilson & Webster
Gleichenia concavisporites Rouse
bladdered conifer pollen
- Range: Upper Cretaceous; probably Maestrichtian

Location: GSC loc. 6590 (WAB) 66° 43'N 137° 56'W Porcupine River, 2½ miles southeast of Shaeffer Lake.

Identification: Tumion gracillimum Hollick
Cephalotaxopsis heterophylla Hollick
Nilssonina alaskana Hollick
Pseudoprotophyllum boreale (Dawson) Hollick
Viburnum sp. cf. simile Hollick (non Knowlton)
Trochodendroides nebrascensis (Newberry) Dorf
Nymphaeites exemplaris Hollick
Carpites sp.

Remarks: Of the named species in this collection Cephalotaxopsis heterophylla, Tumion gracillimum, Pseudoprotophyllum boreale, and Nymphaeites exemplaris occur in the Kaltag Formation of Alaska, while Nilssonina alaskana occurs in both Kaltag and stratigraphically higher beds of the Chignick Formation. Trochodendroides nebrascensis occur in both Lance and Dunvegan (Cenomanian) Formations. The age of the beds at locality 6590 is considered to be Cenomanian.

Location: GSC loc. 6590 (GER) 66° 43'N 137° 56'W.

Identification: Podocarpidites sp.
Vitreisporites sp.
cf. Rhamnus sp.
cf. Gleichenia concavisporites Rouse

Range: Upper Cretaceous; probably Maestrichtian

Location: GSC loc. 6591 (WAB) 66° 53'N 137° 42'W Porcupine River, near mouth of Shaeffer Creek.

Identification: Myrtophyllum boreale ? Seward

Remarks: This form being doubtfully identified is not in itself diagnostic of age within the Upper Cretaceous. The type specimen was derived from the Atane series of Greenland, from beds apparently of Cenomanian age.

Location: GSC loc. 6592 (GER) 66° 56'N 137° 43'W Porcupine River.

Identification: Gleichenia concavisporites Rouse

Tricolpopollenites sp.

syncolpate pollen

Cicatricosisporites sp.

Proteacidites cf. mollis Samoilovitch

Deltoidospora cf. diaphana Wilson & Webster

Tricolpites sp. (Sam. & Mtch.) Upper Maestrichtian

Lycopodium sp. clavatoides Couper

Sphagnum antiquasporites Wilson & Webster

Vitreisporites sp.

Range: Upper Cretaceous; probably Maestrichtian

REINDEER FORMATION

The following spores and pollen have been prepared from rock samples collected from sections 3 and 4 (Appendix I) and identified by Dr. Glenn E. Rouse, Department of Botany, University of British Columbia. More recently (November 8, 1966) Dr. Rouse would suggest that the closest age assignment possible for all the material studied from sections 3 and 4 is Palaeocene. Section 3 is on east side of Mackenzie Delta 4½ miles northwest of Reindeer Depot (134° 13'W 69° 45'N). Section 4 is on east side of Mackenzie Delta 4 miles southeast of Reindeer Depot (134° 03'W 68° 38'N).

Location: Section 3, unit 19 GSC loc. 6626.

Identification: Castanea sp.

Myrica sp.

Pinus sp.

Sphagnum sp.

Osmunda sp.

Ericaceae tetrad.

Range: Early Tertiary; probably Paleocene.

Location: Section 3 unit 17 GSC loc. 6624.

Identification: Betula sp.

Corylus sp.

Myrica sp.

Pterocarya sp.

Salix granopollenites Rouse

cf. Rhamnus sp.

Liliacidites variegatus Couper

cf. Gleichenia angulata Naumova

Sphagnum sp.

Anemia striosporites Rouse

Osmundacidites primarius (Couper) Wolff

Deltoidospora diaphana Wilson & Webster

Triplanosporites minimus

Pinus sp.

Ericaceae tetrad

Range: Maestrichtian to Paleocene; probably Paleocene

Location: Section 3, unit 14 GSC loc. 6625.

Identification: Aquilapollenites (Projectoporites) spinulosus Mchedlishvili

Alnus sp.

Corylus sp.

Tilia sp.

Carya sp.

Range: Maestrichtian to Paleocene; probably Paleocene.

Location: Section 3, unit 11 GSC loc. 6632.

Identification: Ulmus sp.

Salix minutapollenites Rouse

Carya juxtaporipites Wodehouse

Pinus sp.

Deltoidospora sp.

Range: Early Tertiary; probably Eocene.

Location: Section 3, unit 7 (from top) GSC loc. 6631.

Identification: Ulmus sp.

Alnus sp.

Ericaceae tetrad

Pinus sp.

Salix minutapollenites Rouse

Tilia sp.

cf. Gleichenia cf. angulata Naumova

small tricolpate - cf. Rhamnus

Carpinus sp.

Pterocarya sp.

Corylus sp.

Betula sp.

Carya tripollenites Rouse

Taxodium or Metasequoia

Range: Late Paleocene to Oligocene; probably Eocene.

Location: Section 3, units 4 to 6 ? GSC loc. 6635.

- Identification: Triplanosporites sp.
Osmundacidites primarius Wolff
Carya juxtaporipites Wodehouse
Betula claripites Wodehouse
- Range: Early Tertiary; probably Eocene.
- Location: Section 3, unit 3 GSC loc. 6636.
- Identification: Pinus sp.
Deltoidospora diaphana Wilson & Webster
Corylus tripollenites Rouse
Quercus granopollenites Rouse
Salix minutapollenites Rouse
- Range: Early Tertiary; probably Eocene.
- Location: Section 4, unit 13 GSC loc. 6634.
- Identification: Carpinus sp.
Betula sp.
Pinus sp.
Glyptostrobus sp.
- Range: Early Tertiary; probably Eocene.
- Location: Section 4, unit 12 GSC loc. 6633.
- Identification: Osmundacidites primarius Wolff
Sphagnum antiquasporites Wilson & Webster
Pinus sp.
Glyptostrobus sp.
Alnus sp.
- Range: Early Tertiary; probably Eocene.

Location: Section 4, unit 9 GSC loc. 6638.

Identification: Sphagnum antiquasporites Wilson & Webster

Sphagnum reginum Drozh.

Extratripoporopollenites sp. cf. major Mart.

Extratripoporopollenites menneri (Boch) Mart.

Myrica sp.

Castanea minutapollenites Rouse

Ulmus sp.

Ericaceae tetrad

Carpinus sp.

Glyptostrobus sp.

Larix - Pseudotsuga

Taxodium - Metasequoia

Podocarpus sp.

Pinus sp.

cf. Dacrydium sp.

Picea grandivescipites Wodehouse

Sciadopitys sp.

Range: Maestrichtian to Paleocene; probably Paleocene.

Location: Section 4, unit 6 GSC loc. 6637.

Identification: Aquilapollenites (Triprojectus) cf. dispositus
Mtchedlishvili (Danian)

Alnus sp.

Ginkgo sp.

Pinus sp.

Taxodium - Metasequoia

Larix - Pseudotsuga

Ulmus sp.

Betula sp.

Salix minutapollenites Rouse

Glyptostrobus sp.

Azolla microspores

Range: Maestrichtian to Paleocene; probably Paleocene.