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MESOZOIC DEPOSITS OF THE HUDSON BAY LOWLANDS AND COAL DEPOSITS OF THE ONAKAWANA AREA, ONTARIO

L.L. PRICE

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ABSTRACT

A thin sequence of Lower Cretaceous rocks, the Mattagami Formation, underlies the southern part of Moose River Basin adjacent to the Canadian Shield of northern Ontario. The sequence consists of non-indurated quartzose sand, clay and, in the lower part, lignitic coal. These sediments are mainly first-cycle and were derived from deep weathering of crystalline basement rocks. They have been deposited in association with a large river system flowing out of the Precambrian upland, well upstream from marine estuary or tidal influence.

A small deposit of non-indurated Jurassic clay and quartzose sand lies near the northeastern limit of the Mattagami Formation. It is lithologically distinguishable from Mattagami material by the greater maturity of the well-sorted multi-cycle Jurassic sand.

Mattagami sands, of nearly pure, angular, coarse-grained quartz, are recognized as a potential source of industrial silica. The consistently high kaolinite content of Mattagami clays produces a material with good refractory qualities. Some of the kaolinite may have potential as a commercial source of kaolin.

Lignite deposits are relatively thick and sulphur-free, but of low rank and have a large content of water. Approximately 200 million tons of lignite have been delineated in the Onakawana area. Two prospective lignite areas separated from the Onakawana field by deep Pleistocene channels have not been explored.

RÉSUMÉ

Une mince succession de roches du Crétacé inférieur, la formation de Mattagami, est sous-jacent à la partie méridionale du bassin de la rivière Moose, à proximité du Bouclier canadien dans le nord de l'Ontario. Cette succession est constituée de sable quartzeux non induré, d'argile, et, dans sa partie inférieure, de lignite. Ces sédiments ont été pour la plupart formés au cours d'un premier cycle d'érosion, par altération profonde de roches cristallines du soubassement. Le dépôt de sédiments a eu lieu alors qu'un vaste réseau fluvial drainait les hautes-terres précambriennes, bien en amont de tout estuaire marin, ou de toute zone soumise aux marées.

Il existe un mince dépôt d'argile plastique d'âge Jurassique et de sable quartzeux, près de la limite nord-est de la formation de Mattagami. Lithologiquement, ce dépôt se distingue du matériau de Mattagami par la plus grande maturité du sable jurassique bien trié au cours de nombreux cycles d'érosion.

Les sables de Mattagami, constitués de quartz presque pur, anguleux, à grains grossiers, sont reconnus comme une source potentielle de silice industrielle. En raison de leur teneur toujours élevée en kaolinite, les argiles de Mattagami fournissent un matériau possédant de bonnes qualités réfractaires. Une partie de la kaolinite pourrait être exploitée comme source commerciale de kaolin.

Les gisements de lignite sont relativement épais et pauvres en soufre, mais ils ont une forte teneur en eau, et un rang inférieur. On a découvert dans la région d'Onakawana un gisement d'environ 200 millions de tonnes de lignite. On n'a pas encore exploré deux zones qui pourraient contenir des réserves substantielles de lignite, et qui sont séparées du bassin lignitifère d'Onakawana par de profonds chenaux datant du Pléistocène.

MESOZOIC DEPOSITS OF THE HUDSON BAY LOWLANDS AND COAL DEPOSITS OF THE ONAKAWANA AREA, ONTARIO

INTRODUCTION

One of the objectives of Operation Winisk was to map the Cretaceous sediments of the southern part of the Hudson Bay Lowlands. Exposures of the Cretaceous deposits in Moose River Basin, Ontario, were examined in conjunction with this comprehensive helicopter-supported survey during the summer of 1967. The exposures are sparse, confined mainly to the banks of the principal streams and were accessible easily by rubber boat, although some were covered by high water when visited in May and early June.

In addition to outcrop data obtained during the 1967 field season, drill cuttings were collected and examined on site during a drilling program initiated by the Alberta Coal Company in February 1968, which yielded subsurface material for mineral and palynology studies. This material, supplemented by logs of nearly 300 holes drilled for the Ontario Department of Mines between 1930 and 1942 and further drilling in 1972 by Manalta Coal Limited, provided the outline of the isolated body of lignite at Onakawana. Further subsurface material from 6 holes drilled by the Ontario Division of Mines in 1975 furnished additional stratigraphic information. In this report, localities where Mattagami beds have been encountered at surface exposures or by drilling are numbered for reference to the map in Figure 1, locality numbers appearing in brackets in the text. (Numbers correspond to field station numbers and are not necessarily sequential.)

ACKNOWLEDGMENTS

The author is grateful to A.W. Norris for facilitating access to outcrop areas, for geological discussion and a comprehensive critique of the manuscript. Manalta Coal Limited provided assistance in acquiring subsurface study material at the drillsite. The author is indebted also to the Ontario Division of Mines for access to unpublished files; R. Skinner of the Geological Survey supplied valuable discussion; R. Hillary acted as field assistant during the 1967 field season.

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Author's address: Institute of Sedimentary and Petroleum Geology
3303 - 33rd Street N.W.
Calgary, Alberta
T2L 2A7

PREVIOUS WORK

A long succession of discerning geologists has examined the Mesozoic deposits along the Missinaibi, Mattagami and Abitibi Rivers. These early investigations were carried out by provincial and federal government agencies in search of coal resources and raw materials for ceramics and glass industries. More recently, industries have introduced their own investigative programs. The first reports on the area were based on geological and general resource surveys conducted by such pioneers as Robert Bell (1877), E.B. Borron (1891), W.J. Wilson (1903), J.M. Bell (1904) and M.B. Baker (1911). In many instances, where the all-too-scarce exposures are now covered, flooded, or otherwise inaccessible, it is necessary to rely entirely on the observations of these early workers. They were attracted during early reconnaissance by carbonaceous beds in the southern part of the Moose River Basin along Missinaibi River and its tributaries, along Mattagami River, Abitibi River, and in outlying areas, notably along Kwataboahegan River as well as other (interglacial) localities outside the area of this report. No distinction was drawn at first between interglacial peat and Cretaceous lignite, although the superior quality of the lignite at Coal River and Blacksmith Rapids was recognized by J.M. Bell (1904). Cretaceous beds were similarly distinguished in early reports by superior ceramic properties of the clays, but it was not until Keele (1920b, p. 46) submitted fragmentary fossil plants from Curran Bend on Mattagami River to paleobotanists of the United States Geological Survey in 1919 that the bedrock nature and Mesozoic age of the Mattagami beds were recognized.

F.H. McLearn (1927) visited all of the important Cretaceous exposures except Onakawana and summarized geological information up to that date, treating the sand-clay facies and the lignitic "grey" facies separately. McLearn collected plant specimens from lignite on the Mattagami River from which W.A. Bell (1928) confirmed the Jurassic-Cretaceous age of the Mattagami Formation and published detailed descriptions of species.

A drilling program was initiated by the Ontario Department of Mines in 1930 for the evaluation of the Onakawana lignite deposits and the geological results were reported by W.S. Dyer (1930b) while drilling was still in progress. Dyer (1931) summarized some results of later drilling in comments on structural and contact relationships of the Mattagami Formation in a paper that included information from Drill Hole "A", a core hole located near the deepest part of the Onakawana coal basin, that reached the Precambrian basement.

Twenty holes were drilled the following year near the outcrop area at Blacksmith Rapids and an additional six around the Portage Island lignite showing at the confluence of Mattagami and Missinaibi Rivers. Dyer and Crozier (1933) presented an analysis of the geology of the Onakawana field including data from new drilling and sinking of shaft W, in conjunction with a report on feasibility of coal production by Ontario Research Foundation (1933).

The exploration program was reactivated with the beginning of the war in September 1939, resulting in an additional 182 shallow holes in the northeastern part of the coal field. None of the original subsurface material from any of this early activity survives, but Dyer and colleagues have left reliable logs, however limited by the context of geological experience up to the time of their observations.

Martison (1953) published results of a survey of the area southwest of James Bay, along with earlier data, including two logs of Drill Hole "A". An accompanying report (Satterly, 1953) contains logs of the Moose River Oils and Dewson Mines holes on Mattagami River.

A continuing interest in the silica sand, ceramic clays and lignite of the Mattagami Formation has resulted in other drilling programs. An Ontario Department of Mines unpublished report contains a summary of the MR and MRA series of holes drilled as part of an industrial exploration venture initiated for kaolin in 1959. An investigation of the silica and kaolin prospects along Missinaibi River by Algocen Mines in 1967-68 was extended to the petrography and mineralogy of the Mattagami sands and clays (Smith and Murthy, 1970).

STRATIGRAPHY

Non-indurated Mesozoic claystone, sandstone and lignite outcrop at scattered localities along river valleys in the southern part of Moose River Basin. This part of the basin is bounded on the south and east by Precambrian rocks and younger sedimentary strata abut southward against a Precambrian fault scarp. All authenticated exposures of Mesozoic rocks lie within a short distance of the southern or eastern Precambrian boundary. Although Mesozoic deposits probably continue farther to the north and west toward the centre of the basin, there are few data at present that would indicate the precise lateral extent. The Lower Cretaceous Mattagami Formation embraces the entire Mesozoic sequence outcropping in Moose River Basin except for the sideritic fissure fill material at Grant Rapids. It does not include a subsurface wedge of Jurassic sand and clay a short distance northwest of the nearest known Cretaceous sediments. Mature fine-grained sand characterizes the Jurassic sediments. Petrography of the Mattagami sand indicates little transport and much weathering of arkosic outwash of detritus from the Precambrian highland and around inliers within the basin. The original depositional configuration has been modified by channelling and successive episodes of glacial erosion and ice thrusting which render present subsurface distribution difficult to predict.

TABLE 1.

Table of Formations

ERA	PERIOD		LITHOLOGY
CENOZOIC	QUATERNARY		Post-glacial: peat, calcareous lacustrine and marine clay and shell-bearing sand
			Glacial and interglacial: calcareous till, peat, largely calcareous lacustrine and marine clay and shell-bearing sand
MESOZOIC	CRETACEOUS	*MATTAGAMI FORMATION*	Clay, in part carbonaceous and laminated, in part variegated "fire clay"; sandstone, non-indurated, quartzose, coarse "silica sand"; lignite
		Unconformity	
		Jurassic beds	Sand, non-indurated, quartzose, fine, well-rounded; clay, grey-green, calcareous in part
		Unconformity [1]	
PALEOZOIC	UPPER DEVONIAN	*LONG RAPIDS FORMATION*	Clay, poorly indurated, non-calcareous; interbedded pale green, soft, and harder, dark grey shale
	MIDDLE DEVONIAN	*WILLIAMS ISLAND and older FORMATIONS*	Limestone, partly fossiliferous, and dolomite with some gypsum and red beds
	LOWER DEVONIAN	*SEXTANT FORMATION*	Coarse clastic rocks, red beds, arkose, plant remains

GSC

[1] The Mattagami Formation rests locally on Paleozoic rocks ranging from Ordovician to Upper Devonian. It is in contact with Precambrian rocks where outliers are exposed through Paleozoic strata and probably also along the southern scarp boundary

JURASSIC BEDS

Two of six holes drilled in 1975 by the Ontario Division of Mines encountered non-indurated clay and mature quartzose sand unlike the angular-grained quartzose sand known from the Mattagami Formation. The deposit is 17.7 m (59 ft) thick in Hole 75-11-02 (Fig. 8), and at least 12 m (40 ft) thick in Hole 75-11-03, 12.8 km (8 miles) to the northwest. A deep trench filled with glacial till lies between this deposit and the nearest known Cretaceous sediments in Hole 75-11-01, 26.3 km (16.7 miles) to the southeast.

These Jurassic beds rest on unfossiliferous carbonate strata, probably Middle Devonian, in Hole 02, and on unfossiliferous clay in Hole 03. This clay is probably Mesozoic, despite its resemblance to Upper Devonian clay of the Long Rapids Formation. Jurassic sand in Hole 03 contains chertified fossil fragments probably derived from the Lower Devonian Stooping River Formation (A.W. Norris, pers. com., 1976). The Jurassic beds in both holes appear to underlie stratified Quaternary sediments.

The clay and sand are non-indurated and both are calcareous in part. Most of the clays are greyish green, although some are red. Sand grains are in the size range from 0.2 to 0.6 mm, are well sorted and well rounded.

G. Norris (*in* Telford *et al.*, 1975, p. 8) reports, from Hole 03, from between the depths of 387 and 418 feet (118-127.4 m), a Middle Jurassic palynoflora having elements in common with that of the Upper Gravelbourg and Sawtooth Formations of the Williston Basin.

MATTAGAMI FORMATION

Nomenclature

During the field season of 1919, Keele (1920a) collected fossil plants that determined the preglacial, Mesozoic age of the lignite and associated sands and refractory clays previously considered to be a part of the extensive interglacial deposits of the region. Subsequently, he designated as the Mattagami series (Keele, 1920b, p. 46, 47) the Lower Cretaceous beds comprising fireclays with accompanying lignite and quartzose sand that overlie the Upper Devonian on the Mattagami River. Dyer (1928, p. 30) referred to the unindurated Mesozoic beds as the Mattagami Formation, a designation which is applicable under present rules of nomenclature.

Distribution and thickness

All known surface and subsurface intersections of the Mattagami Formation lie within a distance of 32 km (20 miles) of the Precambrian rocks that bound the southern part of Moose River Basin on the south and east. Little-worn quartz with residual clay suggest an igneous source with a minimum of mechanical reworking, thus indicating a depositional limit at no great distance from the Precambrian provenance area. One or more topographically high areas in the pre-Mesozoic surface may have limited the distribution of Mattagami sediments locally.

The greatest known thickness of 52 m (170 ft)[1] is measured in boreholes in the Onakawana coal field, but glacial drag and scour in the same area modify the unindurated Mattagami deposits to produce abrupt thickness variations over short distances. A thick blanket of muskeg-covered till masks all bedrock surfaces to the north and west for a distance of 96 km (60 miles) to where deeply incised stream valleys again expose erosionally truncated Devonian strata on the northwest side of Moose River Basin. The Aquitaine Sogepet *et al.* Sandbank Lake No. 1 hole, locality 52 in the intervening area, yielded samples so contaminated with surface material as to give no reliable evidence of the presence or absence of Cretaceous rocks (B.V. Sanford and A.W. Norris, pers. com., 1972). Carbonaceous deposits reported by early workers on nearby Kwataboahegan River itself (Loc. 51) were not seen by the writer, but a careful examination of early reports and notebooks leaves no doubt that they are interglacial sediments with beds of peat. The same conclusion was reached by Martison (1953, p. 49).

The outline of the broader area (area 3 on Fig. 1) of possible occurrence of Mattagami beds is based on the shape of Moose River Basin, inferred from the surface configuration of Paleozoic rocks drawn by Sanford *et al.* (1968). No definite data exist to indicate the presence (or absence) of Mesozoic rocks over the greater part of the area, 32 km (20 miles) or more from the Precambrian boundary, although it may contain a few scattered or isolated bodies of Mesozoic rocks. Areas 1 and 2 (Fig. 1) are areas where the occurrence of Cretaceous rocks is considered to be most probable, based on the following assumptions, the arbitrary nature of which is emphasized:

1. Straight-line surface features not obviously related to glacial activity are reflections of structure of indurated pre-Mesozoic bedrock (either cuestas of unevenly eroded sedimentary strata, or tectonic lineaments or fault scarps related to the regional structure of the basement rocks).

2. The unconsolidated Mattagami sediments tend to mask underlying structural features. Strong linear surface features are lacking in areas of known Cretaceous bedrock. (Quaternary marine clay deposits also effectively obliterate preexisting patterns over large areas, however, and parts of these areas have been included arbitrarily in the areas of greater possibility where no independent negative evidence is available.)

3. Non-indurated Mattagami sediments are unlikely to form topographically prominent features capable of influencing the processes of glacial deposition. (Hummocky terrain and other areas bounded by abandoned beaches are, again arbitrarily, thus relegated to a lower category of possibility.)

4. Cretaceous rocks are likely to be recessive, occupying structurally low areas. (Known Mattagami sediments are found adjoining the downfaulted southern boundary with the Precambrian and, at Onakawana, on the eastern flank of a depression sloping from outcrops on Abitibi River downward toward the Mattagami River (*see* cross-section, Fig. 7).

[1] Since this writing, a thickness of 119 m (390 ft) has been demonstrated in the Aquitaine Sogepet Hambly No. 1 well, 13.6 km (8.5 miles) south, 3.2 km (2 miles) west of the mouth of Soweska River, at Latitude 50°15'16"N, Longitude 82°35'48"W.

FIGURE 2. Coarse sand showing large-scale cross-bedding, Mattagami Formation (Loc. 13), Missinaibi River, 0.6 km (1 mile) below the mouth of Soweska River. GSC 199324

FIGURE 3. Photomicrograph of sand from locality 13 showing layered tabular crystals of authigenic kaolinite. Several grains of quartz display embayments and planar surfaces typical of Mattagami sand. GSC 199323

5. Preglacial channelling, where it occurs, is likely to have removed the relatively thin Mattagami beds. (Several minor channels have removed the lignite and clay locally at Onakawana, but a more extensive negative area may exist in the vicinity of the major channel postulated by Sanford *et al.* (1968) on the basis of the single hole drilled in the Campbell Lake region.

Lithology

Mattagami sediments consist basically of quartzose sand[1] and kaolinitic clay[1] enclosing, in places, large accumulations of plant remains in the form of lignite. The sands are consistently medium to coarse grained, and the clays, whether light-coloured or carbon-darkened underclays, have in common high melting point and high kaolin content. In the Onakawana coalfield, the only area with lateral control, coal and carbonaceous beds are relatively continuous. They are enclosed by clay beds, some of which have carbonaceous laminae and such clay and coal probably are interchangeable laterally. Sand bodies are less predictable, changing in stratigraphic level or disappearing over short distances in the carbonaceous facies.

Sand

Sands in the Mattagami are remarkably pure, non-indurated, and quartzose, with grains that are nearly all angular to subangular, and coarse to very coarse. Most grains fall within the 0.5 to 2.0 mm range, but there are subordinate amounts of

[1] The entirely non-indurated sand-size detritus of the Mesozoic deposits here will be referred to as sand and the non-indurated clay mineral deposits as clay. In addition to the Cretaceous "clay", amorphous greenish argillaceous material found in the underlying Devonian Long Rapids Formation is included under the same term. This is the "mudstone" of Norris *in* Sanford *et al.* (1968). "Clay" is soft and plastic when wet and lacks the horizontal cleavage and the jointing common to shales. The variegated, generally light-coloured (except where carbonaceous) Cretaceous clay is the "fireclay" of McLearn, Dyer and others.

fine material as small as 0.16 mm and beds with scattered pebbles over 2.0 mm in diameter. The sands are porous, but typically contain some interstitial clay. Clay forms a uniform coating on quartz grains in the upstream exposure of white sand at locality 10 and on Adam Creek at locality 28. Tabular crystals of authigenic kaolinite occur in a slightly coarser sandstone farther downstream at locality 10 and also at locality 13 (Fig. 3), below the mouth of Soweska River (downstream exposure), in the upper sand. In all exposures seen, some quartz grains retained white or yellow-brown clay in embayments in the irregular quartz surface. This adhering clay is entirely non-calcareous with the exception of some beds at locality 13 where calcareous and non-calcareous adhering clay are found together. Also, a 15 cm (6 in) bed of calcareous clay occurs 0.9 m (3 ft) below the contact of the sand with overlying calcareous sandy till (Fig. 2). Calcareous clay in Mattagami Formation sediments would be exceptional, unless calcite were introduced from the overlying till by illuviation. The upper part of the sand exposure does not appear to have been reworked.

Quartz grains (Fig. 3) are typically irregular, with numerous embayments and slightly rounded edges. Many exhibit flat surfaces intersecting at random angles which, in some angular embayments, are close to 90 degrees. A few flat surfaces are imprinted with finely striated zones (Loc. 13, upstream outcrop). The coarsest quartz grains and pebbles are multi-crystalline clasts, with subrounded outline. At the sandstone (farthest downstream outcrop) at locality 13 (Fig. 2), narrow, elongate quartz pebbles range up to 10 or 20 mm in length. Smaller pebbles at this point have many intercrystalline pits or voids, and large quartz pebbles which occur along with chert on Adam Creek (Loc. 28) are described by R.G. Skinner (pers. com., 1972) as porous.

Feldspar grains are absent at Curran Bend (Loc. 10) but present below the mouth of Soweska River (Loc. 13) as rare opaque-surfaced grains (<1%) in both exposures here and across the river at locality 15 (downstream outcrop). Feldspar is reported by McLearn (1927) in the sand below Smoky Falls (Loc. 26). Sands directly overlying Devonian Long Rapids clay near Grand Rapids (Loc. 33) contain pink and white feldspar grains and pebbles of granite with extremely weathered feldspar; a few of the pebbles also contain weathered mafic grains.

Mafic grains are rare, and doubtfully determinable in outcropping Mattagami sands because of the possibility of contamination by hornblende from overlying Quaternary sands. A single grain of extremely weathered mafic material was found at the farthest downstream outcrop at locality 13 below the mouth of Soweska River, and rare grains of little-weathered hornblende appear in the sand at Grand Rapids (Loc. 33) on Mattagami River. Tabular crystals and cleavage fragments of a black mineral resembling ilmenite, but non-magnetic, occur at Curran Bend (Loc. 10) in both sand and red-mottled clay exposed farthest downstream at an exposure encountered at high water.

Ferruginous cement occurs in lenses on Missinaibi River, below the mouth of Soweska River (Loc. 13) and at two localities on Missinaibi River downstream from this point (Locs. 15, 17). At the last two localities, interstitial clay is speckled with limonitic stain and contains minute limonitic spheres 0.5 mm in diameter that resemble the siderite spherules seen in unweathered nonmarine clays and coal underclays of areas outside Moose River Basin. Similar spheres are found in sand at Curran Bend (Loc. 10) and in clay inclusions in sand at one of the localities on Missinaibi River (Loc. 15). Silt or clay ironstone is not typical of Mattagami sediments.

Clay

Clays of the Mattagami Formation are nearly white, or variegated where carbon is absent, and usually contain quartz grains. Clay bodies of importance occur on Missinaibi River (Loc. 10) and nearby on Pivabiska (Wabiskagami) River (Loc. 11), on Mattagami River (Locs. 26, 24), and on Abitibi River at Onakawana (Loc. 48) as coal underclays or similar material. They are typically non-calcareous, and have consistently good refractory firing qualities, the result of a high kaolin content. The coal underclays, whether or not carbonaceous, are not significantly different mineralogically from Mattagami Formation clays found outside coal-bearing areas.

Table 2 shows three clays containing kaolinite and quartz only, from the upstream exposure at Curran Bend (Loc. 10) and at Onakawana, in one hole as a coal underclay and, in another, in a pure, nearly white clay bed.

A 10.7 m (35 ft) clay bed between two coal seams at Onakawana contains small amounts of feldspar, and carbonates of iron, calcium and magnesium, and chlorite as well. A middle clay bed at the exposure below the mouth of Soweska River (Loc. 13) contains significant quantities of the same minerals and, in addition, much feldspar. Samples of marine and interglacial clay in Table 2 show feldspar and carbonate fractions of the same order of magnitude as the clay near the mouth of Soweska River. The comparison is discussed in a later section.

The soft, greenish clays of the Upper Devonian Long Rapids Formation are consistent also in mineralogical composition, containing much siderite and a little feldspar, chlorite and illite. The biotitic and bentonitic clay in Hole 68-39 is an exception.

Clay was observed in outcropping sand at Curran Bend coating sand grains and as scattered authigenic crystals of kaolinite (Fig. 3). The tabular kaolinite crystals are "pinched" between grains of quartz. A relatively few small flakes of muscovite occur in the same sample and a small quantity of muscovite was identified by the powder camera (Debye-Scherrer method) in the material from the kaolinite crystals. Some "kaolinite" crystals in thin section display poorly defined central layers of a high birefringence mineral, probably muscovite.

Smith and Murthy (1970, p. 802), as a result of their study of drill hole material in the same area, point out that the kaolin content of the sands is many times higher in the subsurface sands than the

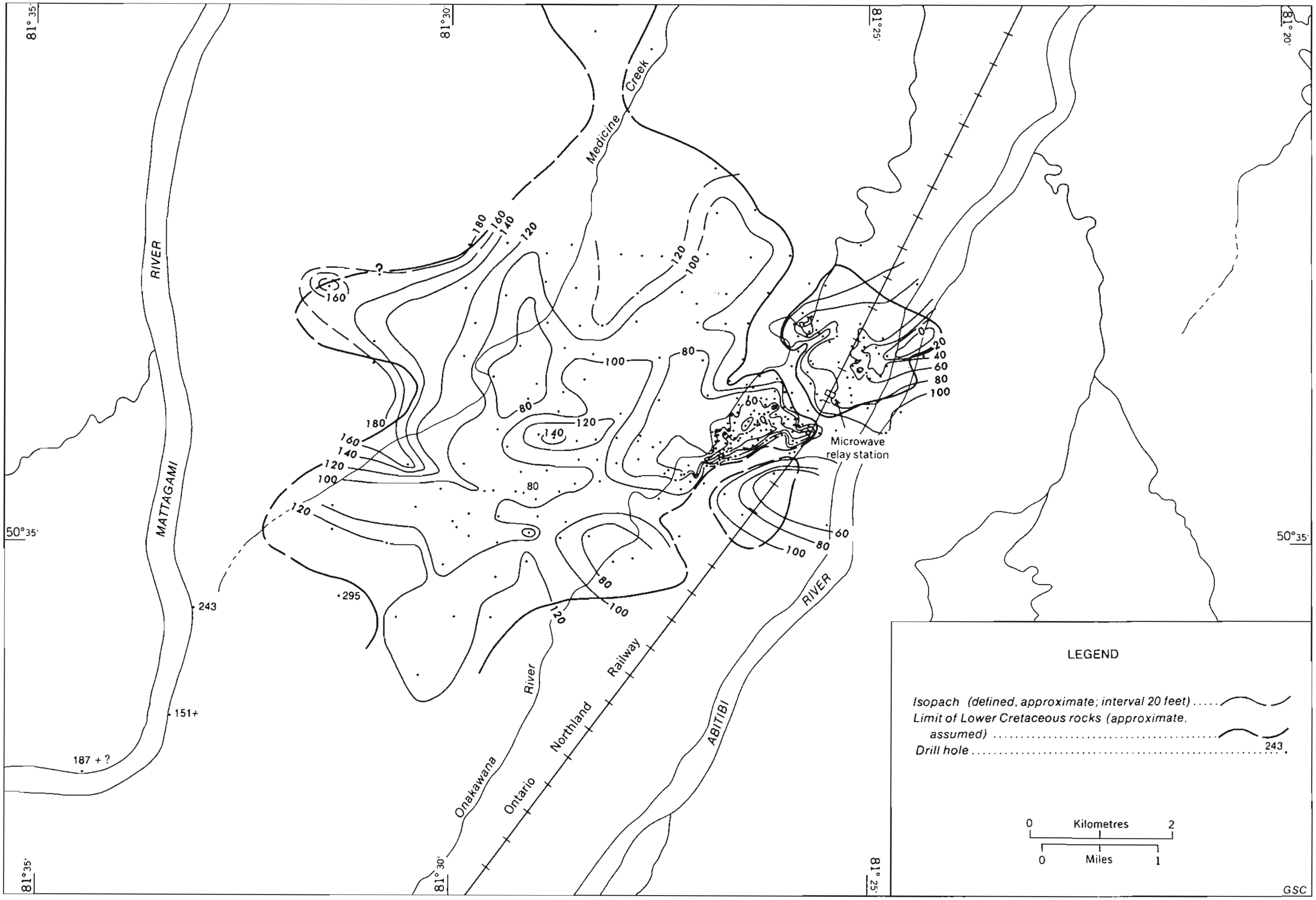

FIGURE 4. Isopach map showing thickness of overburden on Mattagami Formation (present erosion surface to top of Mattagami Formation), Moose River Basin

TABLE 2.

X-ray mineral analyses[1] from Mattagami Formation and adjacent sediments (per cent[2] of minerals)

LOCALITY	STRATUM, FACIES	Illite	Kaolinite	Kaolinite + chlorite	Montmorillonite	Quartz	Feldspars	Calcite	Dolomite	Siderite	Gypsum	Pyrite	Hornblende
10	Mattagami Formation; red clay	1	68	-	-	31	-	-	-	-	-	-	-
13	Mattagami Formation; upper sandstone (interstitial)	2	39	-	-	57	2	-	-	-	-	-	-
	Mattagami Formation; middle clay bed	Tr	-	2	-	30	14	26	28	-	-	-	-
48	Mattagami Formation; Hole 68-38; 120′ coal underlay	-	25	-	-	75	-	-	-	-	-	-	-
	Mattagami Formation; Hole 68-42; 120′ between coal seams	6	-	33	-	55	2	2	1	1	-	-	-
	Mattagami Formation; Hole 68-42; 130′ between coal seams	7	-	20	-	62	4	3	2	2	-	-	-
	Mattagami Formation; Hole 68-43; 124.5′ brownish-white clay	2	43	-	-	55	-	-	-	-	-	-	-
1	Mattagami Formation; Quaternary marine clay	1	-	2	-	36	12	22	27	-	-	-	-
6	Mattagami Formation; Quaternary bedded clay	2	-	3	-	30	8	28	29	-	-	-	Tr
25	Mattagami Formation; Quaternary interglacial	1	-	3	-	60	24	3	9	-	-	-	Tr
32	Devonian Long Rapids Formation	10	-	11	-	59	4	3	2	3	4	4	-
46	Devonian Long Rapids Formation; Hole 68-38; 141′ dark shale	4	-	8	-	79	Tr	4	2	2	-	1	-
	Devonian Long Rapids Formation; Hole 68-38, 190′ green clay	9	-	9	-	50	4	4	3	19	-	2	-
	Devonian Long Rapids Formation; Hole 68-38; 195′ green clay	7	-	8	-	41	3	3	2	35	-	1	-
	Devonian Long Rapids Formation; Hole 68-39; 253′ green clay	2	-	-	30	41	27	-	-	-	-	-	-
	Devonian Long Rapids Formation; Hole 68-40; 191′ green clay	13	-	18	-	52	4	4	3	5	-	1	-
	Devonian Long Rapids Formation; Hole 68-40; 255′ green clay	13	-	17	-	50	5	5	3	4	-	-	-

GSC

1 X-ray determinations of clay minerals here and elsewhere in this report were supplied by A.E. Foscolos of the Institute of Sedimentary and Petroleum Geology in Calgary

2 Percentages are based upon peak heights which in turn depend upon the degree of crystallinity, the size of each mineral in rock sample, amorphous material and organic matter present

3 to 5 per cent found in the water-washed surface exposures. They describe the kaolinite-rich zones as distinct from the two or three beds of predominantly red, mottled to variegated "fireclay" which are persistent in the subsurface over much of the area, although kaolinite-rich zones are associated locally with "fireclay" beds.

The upper of the three clay beds of Smith and Murthy (1970) occurs directly beneath the till over much of the area and its Cretaceous age is questioned by these authors. It is 1.8 to 3.6 m (6-12 ft) thick, and overlies a few feet of buff to rusty-coloured sand. The lower clay beds are somewhat thicker, with a few inches of discoloured sand on either side, and occur at uniform levels within the sand.

Lignite and carbonaceous beds

Carbonaceous beds are reported from the Mattagami Formation in four areas: on Coal River where it joins Missinaibi River (Loc. 7), on Mattagami River and Adam Creek near the confluence (Loc. 28), at Blacksmith Rapids on Abitibi River near Onakawana (Loc. 46), and a geologically related area at Portage Island at the confluence of Missinaibi and Mattagami Rivers. (The Blacksmith Rapid-Onakawana and Portage Island areas are described in a later section.)

An important occurrence of what may be glacially transported lignite is evident at an additional locality (Loc. 47) in Drill Hole 80 on the west side of Mattagami River above the bend southwest of Onakawana (Fig. 6). Another occurs nearby "at the mouth of Little Grand Creek on Mattagami River" (Dyer and Crozier, 1933, p. 74).

The exposures on Coal River (Loc. 7) were explored by Robert Bell (1877), who found a seam of lignite 0.9 m (3 ft) thick beneath till overlying "blue clay". Borron (1891, p. 66) drilled six boreholes in the vicinity of the outcrop that intersected Cretaceous material. Three of these encountered gravel lower down, demonstrating slump or glacial thrust structures or both. The other three holes show 0.9 m (3 ft) or less of lignite overlying 12.2 m (40 ft) of clay with carbonaceous partings. This is underlain by white sand.

Smith and Murthy (1970, p. 800, 803) report five boreholes in the vicinity of Coal River that did not reach below the base of till. The depth was not stated but, if these holes were drilled to a depth comparable with the depth of other holes of this exploration program [over 46 m (150 ft)], the Coal River exposures would seem to be an isolated remnant or a rootless glacial thrust block.

On Mattagami River, upstream from the mouth of Adam Creek (Loc. 24), near the Kipling-Sanbord township line, Baker (1911, p. 234) found "two narrow (coal) seams", in sand and clay beds "absolutely free from .... glacial material" and illustrated tree trunks up to 43 cm (17 in) in diameter (*see* Appendix, Loc. 24). He noted much glacial distortion and erosion and observed lignite inclusions in drift. Erosion and slumping of the river bank probably have removed or covered these exposures since Baker's visit.

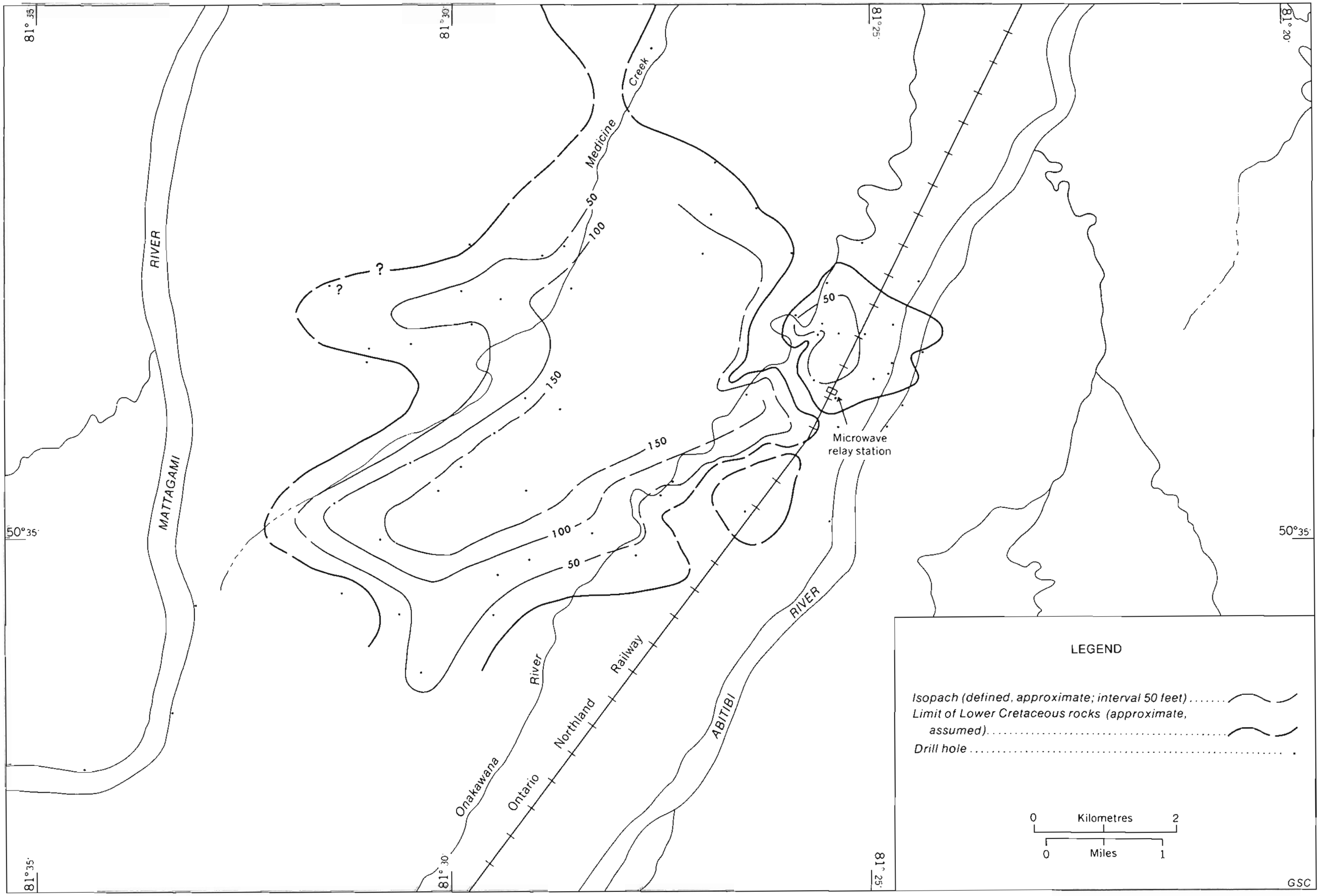

FIGURE 5. Isopach map showing thickness of Mattagami Formation, Moose River Basin

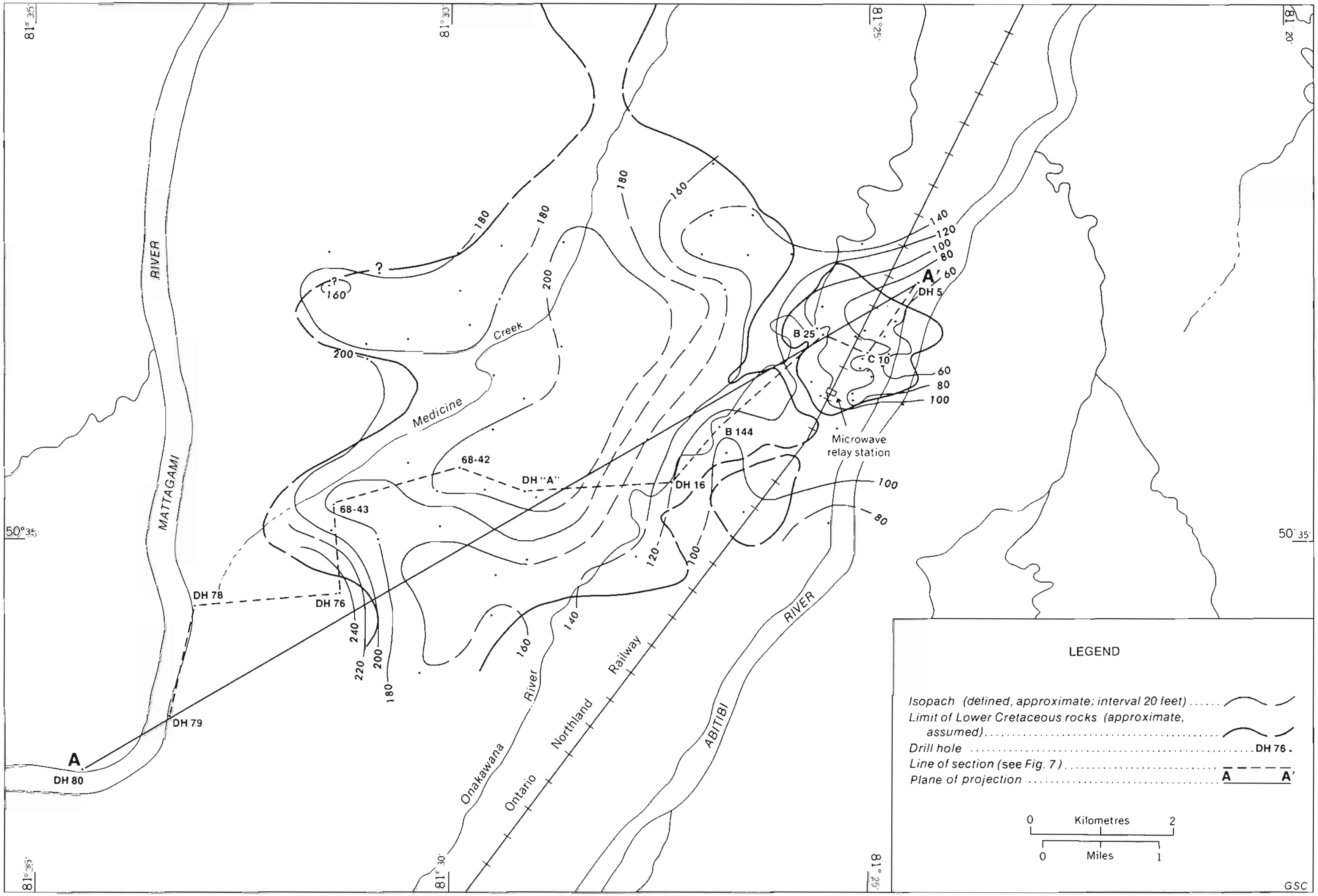

FIGURE 6. Isopach map showing thickness of post-Paleozoic sediments, Onakawana area, Moose River Basin

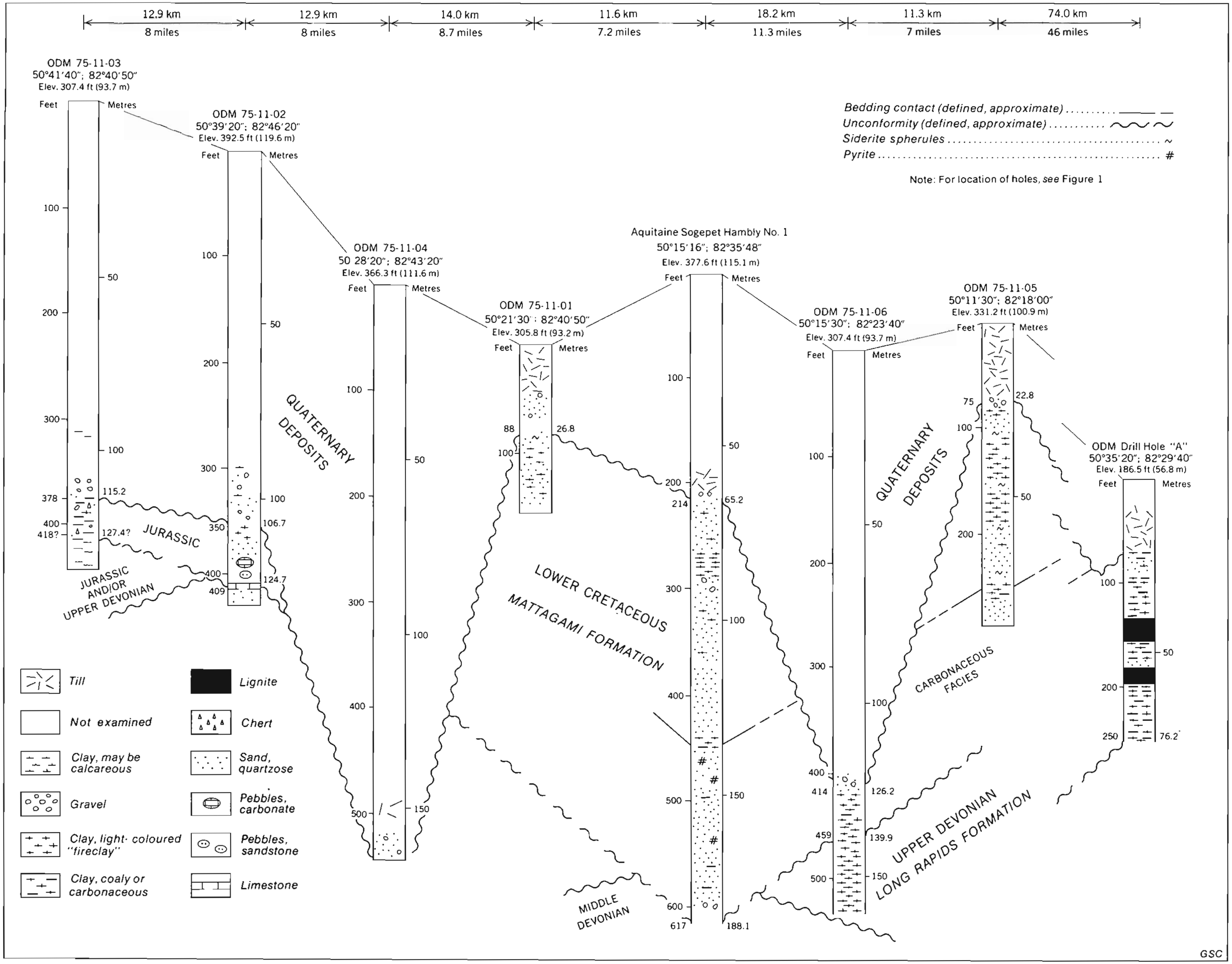

FIGURE 8. Correlation of Mattagami Formation in boreholes shown on Figure 1

Bedded sand and clay of the Mattagami Formation in the same general area, but on the opposite side of the river, were described by Keele (1921a, b) and McLearn (1927), who found lignite interbeds no more than 18 cm (6 in) thick. These layers yielded flattened tree trunks and fossil plant remains that indicated a Mesozoic age for the rocks. Three drill holes and a shaft sunk nearby revealed only carbonaceous partings or thin interbeds containing well-preserved plant remains but no significant coal seams. The steep attitude of exposed lignite beds observed by Keele and McLearn also suggests slump faulting and possibly glacial deformation. An extension of the same facies appears on Adam Creek (Loc. 28) where Skinner (1971) reported lignite less than 40 cm (1.5 ft) thick in the form of flattened logs 30 cm (12 in) in diameter in small exposures of Mattagami beds beneath the till, 1 to 2 km (1.6-3.2 miles) above the mouth.

The only sedimentary structure observed in the Mattagami Formation was the large-scale crossbedding (Fig. 3) below the mouth of Soweska River (Loc. 13). Skinner (pers. com., 1972) considered these beds to be indicative of current direction of about 280 degrees. Skinner also had an opportunity to observe crossbedding in silica sand on Missinaibi River (Loc. 10), with current directions toward the northwest.

Contact relationships

The Mattagami Formation rests unconformably on Upper Devonian clay and shale of the Long Rapids Formation at all locations where the base of the formation is known. However, the presence of sand and carbonaceous material at various localities (notably at Grand Rapids on Mattagami River) in cavernous inclusions in Lower and Middle Devonian carbonates infers contact at some places with much older Paleozoic rocks. Mattagami sediments also may be expected in contact with Precambrian crystalline rocks in a narrow band along the southern limit of deposition and in places where Precambrian inliers either now emergent, or buried, rise through Paleozoic strata.

Non-indurated sand overlying clay in the small outcrop at locality 32 (Fig. 1) is believed to represent an exposure of the Cretaceous-Devonian interface. The sand is quartzose, very coarse grained, with pebbles of quartz, and is non-calcareous. The Devonian Long Rapids clay beneath is pale blue-grey, non-calcareous, contains aggregates of pyrite crystals and indefinite limonitic banding. Ironstone concretions, believed to have come from the clay, were found in float below but none were seen in place. The sand contains pebbles and cobbles of the underlying clay and displays very coarse, inclined bedding, marked in part by iron oxide. The sandstone is atypical of Mattagami sands in containing a small amount of chlorite and feldspar (less than 10%). The iron oxide and possibly the chlorite and some of the feldspar may be evidence of surface contamination from Quaternary material.

Much data from the lower contact is found in boreholes in the Onakawana area where soft, light-coloured Mattagami clay overlies equally soft, light-coloured clay of the Devonian Long Rapids Formation. Mattagami clay in general has a brown cast, whereas Long Rapids clay has a consistent contrasting green cast. Exceptional variegated effects occur at the top of Devonian clays in Manalta Hole 68-43, together with oxidation of siderite aggregates. Small aggregates (0.02-0.16 mm in diameter) of siderite crystals are common to some zones of Long Rapids clay and sideritic concretions; minute pyrite crystals are typical of some beds. The Long Rapids clays constitute a monotonous succession during drilling, in the western part of the Onakawana field, through pale green clay and, in the east (possibly lower in the section), through alternating pale clay with dark brown, sometimes shaly, interbeds. In contrast, the overlying Mattagami contains much carbonized wood, and irregularly spaced lignitic partings.

X-ray analyses (Table 2) show consistently more illite, feldspar and carbonates, particularly siderite, in the Devonian clays, which probably accounts for their comparatively low fusion temperatures in firing tests for ceramics. Much montmorillonite, associated with hexagonal biotite flakes, was found in green sub-Cretaceous clay in Manalta Hole 68-39.

Along the southern boundary of the Mattagami sediments, the fault scarp of Precambrian rocks forms a "fall line" where north-flowing rivers drop from the Precambrian Shield to the Hudson Bay Lowlands which is the topographic expression of the underlying Phanerozoic sedimentary rocks. Mattagami beds, by inference, are in contact here with crystalline rocks, although actual contact is nowhere exposed. Pebbles and cobbles of pure quartz are reported by Skinner (1971) from exposures on Adam Creek (Loc. 28) and from reports of quartzose gravel in a hole immediately northwest of Kipling Dam (Loc. 26). Similar quartz pebbles were observed below the mouth of Soweska River (Loc. 13) which may point to a buried outlier of Precambrian rocks in that vicinity.

Jurassic sand and clay that occur near the northwestern limit of Cretaceous rocks are not in direct contact with Mattagami beds where encountered in ODM Holes 75-11-02 and 75-11-03 (Fig. 8), drilled on tributaries of Rabbit River. Mattagami strata probably overlie Jurassic in the vicinity, however. Jurassic and Cretaceous sediments are alike in general appearance; both contain unindurated white quartzose sand and non-calcareous clay. Jurassic sand is recognized easily by its better sorting, finer grain size with greater sphericity and, generally, very much more mature appearance in contrast to the angularity and poor sorting of grains of sand in the Mattagami Formation.

Two deep channels appear in the cross-section in Figure 8. The channel at South River (ODM Hole 75-11-04) contains much till, whereas the other channel, in Hole 06, at Opasatika River, is filled largely with bedded sediments reworked from Cretaceous bedrock and from which G. Norris (*in* Telford *et al.*, 1975, p. 17) reports a sparsely represented Cretaceous palynoflora between depths of 175 and 403 feet (52.5-120.9 m).

Some pre-existing structure is inferred in the cross-section of the Onakawana area (Fig. 7) with thickening of the clays below the lower coal seam to over 9 m (30 ft) in what is now the lowest part of the sub-Cretaceous surface in that area, compared with less than 3 m (10 ft) at the eastern margin. Present structure seems to be a surviving configuration of the original local sedimentary basin, perhaps modified by the ice thrust in the shallow eastern area penetrated by ODM Hole C10.

The upper contact, with Quaternary material, is notable for its extreme irregularity as part of the channelled and glacially scoured bedrock surface. In the Onakawana area, large lenses of the soft bedrock are caught up as inclusions in overlying till. Much of the basal part of the till is carbonaceous and lignite forms the contact material over wide areas in the eastern and southeastern parts of the field. Coal seams are anomalously thick at places in this region and the north flank of the buried channel, running east-northeast through the bend in the Ontario Northland Railway (Fig. 3), is extremely steep compared to the southern flank. The contour map also shows sharp ridges or folds with approximately east-west alignment. A sharp depression southeast of Drill Hole "A" represents a narrow inclusion of Quaternary gravel in a similar area of anomalously thick coal (Manalta Hole 68-49).

This topography suggests an upland drainage pattern modified by glacial drag operating from the north or north-northwest. Some of the lignite bodies have acted as glide planes accommodating part of the glacial thrust. The poorly indurated rocks forming the upland surface may have been protected by the diversionary effect on ice movement of the very deep channel or scarp face to the northwest.

Tectonic setting and history of sedimentation

Cape Henrietta-Maria Arch separates Moose River Basin in the southwest from the rest of Hudson Bay Sedimentary Basin in the north. The southern boundary with Precambrian rocks is an escarpment representing a fault line along which the basin margin subsided, thereby truncating Ordovician and younger rocks. Episodes of reactivation along the fault permitted arkosic sediments to spread into the basin from shield areas preceding deposition of the Sextant Formation in Early Devonian time and again preceding Mattagami sedimentation in Early Cretaceous time. In their preliminary compilation of the geology of Hudson Bay Basin, Sanford *et al.* (1968) inferred a broad syncline in Paleozoic strata northeast of Onakawana. A minor axis of the main body of Cretaceous lignite coincides with the axis of this syncline. Southward from Onakawana, Paleozoic beds are more closely folded where they are exposed east of Abitibi River above the Little Abitibi confluence. The nearby boundary of Moose River Basin deflects from a nearly north-south trend at this point to northeast, and the projection from here of a line of Precambrian inliers in the Paleozoic sediments passes through the arched Grand Rapids structure. [Projected in the opposite direction, this line coincides with the strike of the schistosity in a narrow band extending for 53.6 km (35 miles) across the Precambrian Shield.] Similar outliers are exposed east of Pike River and on Pivabiska River and another, now buried, is indicated near Missinaibi River below the mouth of Soweska River where fragments of siderite are found in drift (Skinner, pers. com., 1972) near partly ferruginous bedrock sands. The ferruginous sands are overlain by quartzose sand with cigar-shaped pebbles of quartz up to 20 cm (8 in) long, believed to have been derived from igneous rocks that were exposed above the Cretaceous terrain. If the ferruginous sands here are basal sand of the Mattagami Formation (similar ferruginous sand is present at the sub-Cretaceous surface at Grand Rapids), then a low and probably discontinuous barrier may be inferred to extend from Grand Rapids to the vicinity of the linear section of Missinaibi River below the mouth of Soweska River. The deflection of the Missinaibi River below the Soweska confluence may be a reflection of the inferred structure.

Inliers of Precambrian rocks are found over an area from the Grand Rapids-Soweska trend southward to the Precambrian escarpment and from the eastern boundary of the basin to Pivabiska River indicating that Precambrian rocks beneath this part of Moose River Basin are relatively close to the surface. Apparently this is not the case to the north, and this line may mark the southern boundary of the down-faulted basement underlying thick Paleozoic sediments shown by Sanford *et al.* (1968, Fig. 4). Mesozoic beds found north of the Grand Rapids-Soweska line would be expected to differ in facies from the known Cretaceous deposits of weathered detritus from Precambrian rocks along the scarp front, because of a difference in the pre-existing topography and the nature of the underlying rocks. The difference is evident in the contrasting depositional pattern of lignitic beds and clay at Onakawana, which lies north of the Soweska-Grand Rapids line, and outside the area of Precambrian inliers.

In the southwestern area of the Cretaceous part of the Moose River Basin, in the Pivabiska-Missinaibi River area, are kaolin-rich sands composed of consistently coarse quartz grains and, on the east flank of this body, on Coal River, are bedded clays with flattened logs of trees and carbonaceous partings. Farther east along the escarpment, on Mattagami River, are quartzose sand with interstitial kaolin and variegated clays, with bedded clay containing carbonaceous partings and logs to the east, on Adam Creek. These deposits are exposed downstream on the Missinaibi and Mattagami Rivers as sands. On Mattagami River (at Grand Rapids), the downstream sands are evidently the basal sediments of the Mattagami Formation; downstream on the Missinaibi, this proximity of basal sediments is indicated but the evidence is indirect. In the northeastern corner of the area of distribution, in the Onakawana-Portage Island area, is a discontinuous deposit of bedded clay and thick lignite which is elongate in a direction parallel to the eastern boundary of Moose River Basin with Precambrian rocks.

Conspicuous features of the Mattagami sands are the high content of quartz grains, their coarseness, abundant embayments in grain surfaces, lack of much abrasion and the large number of planar surfaces (Fig. 3), all of which point to a first-cycle sand that has been transported a relatively short distance from igneous source rocks. Grains of mature, round quartz are present, but rare. The staurolite, tourmaline and ilmenite traces reported by Smith and Murthy (1970, p. 806) are, in part, derivatives of nearby contemporary Precambrian Shield or monadnock exposures. A granitic pebble at Mattagami Grand Rapids (Loc. 33) with extremely weathered feldspar may originate from a monadnock source. The high incidence of planar surfaces and angular re-entrants in quartz grains seen in the thin section of Mattagami sand (Fig. 2) suggests contact with euhedral feldspar and other minerals from the original granitic or gneissic rock (in addition to the apparent weathering effects on the quartz discussed in the following paragraph). That the sediment was originally an arkose is indicated by the pebbles of the pure quartz gravels reported to occur on Adam Creek (Skinner, pers. com., 1972), which are porous, ostensibly as a result of complete weathering out of the feldspar and mafic minerals from granite or pegmatite clasts. The idea of an origin from arkosic sediments has been advanced previously by Keele (1921a, p. 39) and others.

The shape of some Mattagami quartz grains (Fig. 3) is in many respects similar to the angular embayed grains illustrated by Cleary and Conolly (1973, p. 903) for quartz-rich soils of the present Carolina piedmont and coastal plain. The authors compare rounding of protuberances of embayed grains in streams over very short distances of transport, citing in situ origin for angular embayed material. They attribute the embayment of quartz grains to processes of soil genesis that begin with dissolution of the parent rock, the degree of embayment and proportion of embayed quartz being a measure of the intensity of weathering.

The pebbles at Adam Creek are coated with clay and the clay coating is a feature of the sand grains at Curran Bend and other places. Smith and Murthy (1970, p. 802) report that kaolin occurs as clay-rich bands in sand, both in exposures and in drill hole sections. This distribution suggests that clay has filtered through the sand with descending or migrating water to accumulate in selective zones. The crystals of authigenic kaolinite (Fig. 3) may have formed during this process by complete or partial alteration of the larger flakes of mica trapped between the quartz grains. Some smaller mica flakes adjacent to quartz grains survive, probably protected by an initial accumulation of clay (none appear in the photograph). R.G. Skinner, who had an opportunity to examine cores and the outcrops at low-water stage, suggested (pers. com., 1972) that the clay-rich bands accumulated by such a process of illuviation during weathering of the original arkosic "granite wash" sediment.

In contrast to clay-rich zones in the sand, the three "fireclay" layers of Smith and Murthy (1970) are probably beds of clay derived through winnowing of a part of the residual weathered material and deposited as waterlain sediment. The difference in origin between the interstitial clay in the coarse sand and the clay interbeds is emphasized by the presence of much coarse silt-size quartz displayed in thin-section of the red clay bed at the top of the exposure at Curran Bend (Loc. 10), compared to the virtual absence of fine quartz in the clay-rich coarse sand. The uppermost of the clay beds is described by Skinner as red in colour, forming the present interface between Cretaceous beds and the overlying till. Non-indurated clays are eroded with difficulty by comparison with non-indurated sands, and the Mattagami upper red clay seems to have survived by preferential erosion, possibly as a preglacial surface, to serve as a glide plane for glacial movement similar to that provided by some coal seams in the Onakawana area.

The Mattagami deposits are the result of climatic conditions that were widespread in stable areas of the craton in Cretaceous time, during which prolonged weathering produced residual deposits in widely separated areas. Source material of this type preserved in the Moose River area is described by Cross (1920, p. 17) from the bottom of a ravine entering Mattagami River from the east in Precambrian terrain below the head of Long Rapids, where partly kaolinized syenite gneiss has been protected from glacial scour.

A parallel to Mattagami weathering is found where rocks of approximately equivalent age and stratigraphic position form the basal strata of the Cretaceous System in the Williston Basin of Saskatchewan. In a part of that basin, a north-facing scarp of partly chertified Mississippian limestone is the source of residual silica detritus, some of which is reworked to spread northward by mixing with nonmarine Cretaceous sand. Some large, undisturbed residual fragments have adhering spherules of siderite like those found in the sand at Curran Bend (Loc. 10).

The similarity of Mattagami clays to the Musquodubois nonmarine clays of Nova Scotia has been pointed out by Keele (1920b, p. 46).

The silica sand appears to be the weathered residue of a series of coalescing river channel arkosic deposits and, although very little evidence is available to determine the distribution of environmental associations, it should be pointed out that the sediments of the Mattagami Formation encountered so far contain no sign whatever of salt or brackish water sediments that would indicate the presence of any lower deltaic or tidal channel facies.

The exposed lignitic beds are related to lacustrine sediments filling depressions along the front of the Precambrian escarpment. Whether this ponding was structurally controlled, that is by a reversal of the general slope by a slight upwarp within the basin to the north, or was the result of aggrading of downstream sediments below an upper deltaic or fluvial plain of the river system that drained the Cretaceous surface toward the north, or a combination of both, is not known.

In summary, coarse arkosic material emanating from Precambrian terrain accumulated as coalescing channel or low-gradient fan deposits along the front of a Precambrian scarp and part of it weathered in situ in the Missinaibi-Pivabiska and Mattagami-Long Rapids areas. Concurrent depressions on the eastern flanks of both localities received reworked clay and sand and produced some swamp-derived carbonaceous layers at Coal River and Adam Creek, respectively. The Onakawana-Portage Island depression to the northeast contains reworked, bedded clay and extensive accumulations of lignitized swamp growth. The thin beds of coarse first-cycle sand which are more prominent in the western side of the Onakawana lignite field probably are subordinate channel or spillover deposits from the river system draining the southern Precambrian terrain. The Onakawana area lies on the eastern flank of this system. There is no evidence in this area of detritus from Precambrian terrain to the east of Onakawana; this probably drained toward the north in Cretaceous time as it does today.

Carbonaceous deposits, as presently known, would result from swampy depressions close to a faulted Precambrian escarpment on the south and parallel with the eastern Precambrian margin of Moose River Basin on the east. The depressions are related in part to basinward aggrading of fluvial plain or upper deltaic deposits of a northward-flowing drainage system to the west of Onakawana. Some evidence exists for contemporaneous subsidence of the basin margin along the southern boundary with Precambrian rocks, but is lacking for similar movement along the eastern boundary. Possibly the Onakawana area was depressed by concomitant downwarping. It is suggested that the downthrow along the faulted southern boundary left a parallel, low, east-west arch with axis passing through the Mattagami Grand Rapids structure. This barrier would have been breached by the main Cretaceous drainage system. A similar, but shorter positive axis, parallel to the eastern boundary of Moose River Basin may intersect the first in the vicinity of the Grand Rapids structure. Present data are insufficient to establish the structural features with certainty.

Age and correlation

Keele (1920a, b, 1921b) collected plants from below the foot of Long Rapids on Mattagami River which were submitted to paleontologists of the United States Geological Survey. Based on these fossils, the beds were considered to be not younger than Kootenay and not older than Permian. Rouse (1956), on his correlation chart, indicated the Mattagami beds to be Neocomian, approximately equivalent to the Kootenay Formation of Crowsnest Pass.

Hopkins and Sweet (1976), from a study of the palynology of the coal, have confirmed the Early Cretaceous age of the beds but revised the dating to Early Albian, although the possibility of an early Middle Albian or Aptian age is not excluded.

SIDERITE DEPOSITS

Siderite is known from several localities (Cross, 1920, p. 16) in Moose River Basin, filling channels, caverns or sink holes in Paleozoic carbonate; siderite deposits are reported also from adjoining areas of the Canadian Shield.

The largest and best known siderite body is at Grand Rapids on Mattagami River. Only the siderite on the north bank of Mattagami Grand Rapids was examined in 1967, during the period of high water. Part of this siderite is massive to botryoidal with laminations of dark goethite or limonite. The exposure at the head of the rapid revealed a contact with the limestone that was typically irregular, essentially vertical, obscured by large fragments of fossiliferous limestone and a zone, 2.4 m (8 ft) wide, of coarse quartz sand grains in siderite adjoining the east wall. At a similar contact on the south side of the river, Keele (1920b, p. 51) reported clay between the siderite and limestone.

Cross (1920, p. 9) found the largest exposures of siderite on the south side of the river below the high-water line, and reported various amounts of carbon resembling lignite or charcoal which, along with the coarse quartz grains, is common to the Mattagami Formation.

Siderite was reported along with quartzose sand in till on Missinaibi River below the mouth of Soweska River by R.G. Skinner (pers. com., 1972), who suggested the likelihood of a siderite deposit of the Grand Rapids type nearby. Lenses with iron oxide cement were found in 1967, in Lower Cretaceous sand exposed in the same area, lending support to this thesis. The significance of the major deflection of Missinaibi River below this area, and its alignment with the Grand Rapids structure on Mattagami River is discussed elsewhere in this report, in the section on tectonic setting and history of sedimentation.

The lignite and charcoal reported by Cross (*ibid.*), together with sand, in siderite from the south side of the river, have led to the assumption of contemporaneity with the Mattagami beds, which were presumed to have been stripped away from the Grand Rapids outcrop site. Samples of the darker material taken from the siderite on the north side of the rapids for palynology proved barren of organic matter, however, and direct paleontological evidence for contemporaneity is lacking.

LIGNITE DEPOSITS (ONAKAWANA AREA)

Much attention has centred around the Onakawana coalfield between the Abitibi and Mattagami Rivers where lignite is found in expoitable seams. The Ontario Department of Mines mounted a drilling exploration program under the supervision of W.S. Dyer who published (Dyer, 1930b) all subsurface information available to May, 1930. Later, Dyer (1931, p. 85) summarized the results of subsequent drilling, including the deep cored test at Drill Hole "A", which outlined a westward extension of the coalfield. Further wartime drilling by the Ontario Department of Mines and more recent activity by the Alberta Coal Company and Manalta Coal Limited have indicated a further extension. Carbonaceous palynological material from the area studied by W.S. Hopkins and A.R. Sweet (1976) indicate an Early Cretaceous, probably Early Albian age, for the coal beds. A part of the 1972 drilling program of Manalta was devoted to the area intervening between Portage Island and Onakawana, which demonstrated a discontinuous extension of the Onakawana deposit northward as far as Portage Island, as predicted by Dyer and Crozier (1933, p. 78).

Drilling on a tributary of Bigcedar Creek, east of Abitibi River (Hole EA 1) shows the lignite deposit terminated by erosion at the present bedrock surface near the outcrop area on Abitibi River. The lignite dips westward to reach a depth of a little over 60.8 m (200 ft) near Mattagami River, a distance of approximately 8 km (5 miles), where it is again terminated by erosion, to be replaced laterally by 91 m (300 ft) or more of till and preglacial or interglacial sand and clay (Fig. 7). West of Mattagami River, Drill Hole 80 penetrates carbonaceous beds in interglacial sediments that probably are peat, or lignite that has been reworked from Cretaceous bedrock. The limit of a narrow southward extension is not yet defined by drilling. A similar extension northward is discontinuous, but the trend is represented by an elongate area (Fig. 1), about 1.6 km (1 mile) long, by approximately 0.8 km (0.5 mile) wide, which is bounded on the west by thick till. Following the same trend northward, lignite appears in two holes on opposite sides of Moose River at the downstream end of Portage Island (Loc. 50). Drilling (Manalta Hole P3, Loc. 50a) shows this lignite area to be isolated from the lignite bodies to the south and confined to narrow limits of a few hundred metres to the east and west (ODM Holes P1 and P4). Clay that underlies the lower lignite seam is encountered in the last two holes beyond the lateral limit of the lignite body and can be expected to extend a short distance only [commensurate with its thickness - average at Onakawana 6-10 m (20-30 ft)], beyond the Portage Island area.

Both thickness and depth of overburden increase in a westerly direction from the outcrop area on Abitibi River and the Mattagami Formation reaches a maximum thickness in the Onakawana area of about 51 m (170 ft) slightly east of the erosional truncation near Mattagami River.

The sequence in the lignite area consists of a basal clay, a lower lignite seam of consistent thickness, an intermediate clay, and a more variable upper seam with overlying clay. Small bodies of sand become more prominent toward the west. Clay beds between the lower seam and the Devonian erosion surface range in thickness from 5.8 to 6 m (19-20 ft) near Abitibi River, to 16.5 m (55 ft) at Drill Hole "A", but they become much thinner toward the western erosional terminus. The basal clay near Abitibi River is described by Dyer in the original Ontario Department of Mines drill hole logs (unpubl.) as light coloured in the lower part, but dark grey to black, and apparently carbonaceous upward. Coaly or carbonaceous partings are common in the light-coloured basal clay westward, where the section is thicker, and also increase, along with carbonaceous clay, higher up in the section.

The lower lignite seam has an average thickness of 4.2 m (14 ft) and reaches a maximum of slightly over 6 m (20 ft) along the southeastern limit of coal near Onakawana River. The upper seam averages 5.4 m (18 ft) southeast of the buried channel near Abitibi River (Fig. 5). Clay between the seams is nearly indistinguishable from the clay beneath the lower seam. At Drill Hole "A", it is 6.6 m (22 ft) thick, but this clay disappears and the two seams merge near Abitibi River and around the southeastern limit of coal near Onakawana River. West and north of Drill Hole "A", one or two partings develop in the upper seam. Thin seams and coaly partings are found in clay below the coal in this area and, although apparently recognizable, the two main seams are not as well defined as in the eastern part of the field. Some question of correlation arises in Manalta Hole 68-43 where the spore assemblage in the lowest coal resembles that found in the upper seam in all of the other holes (A.R. Sweet, pers. com., 1974). This problem is discussed further in the section on age and correlation.

Typically coarse quartzose sand is found below the lower seam near the base of the formation in Hole 68-38, and doubtfully in Hole 68-39. A silty zone is reported near the base of the formation in Drill Hole "A" in assocation with a 7.5 cm (3 in) concretion. A thin bed of "quartz sand" is reported from immediately above the lower seam in the same hole, and a 0.6 m (2 ft) bed of coarse quartzose sand with iron salts occurs immediately below the upper seam in Hole 68-43. Quartzose sand is again found 12.2 m (40 ft) above the upper seam in beds 3.0 and 0.9 m (10 and 3 ft) thick in Holes 68-39 and 68-42, the only holes with complete data where these beds are uneroded.

The lignite itself consists mainly of flattened carbonized wood, partly as recognizable tree trunks and branches, with brown earthy layers containing spores(?) and resinous lenses. Published reports (Dyer, 1930b, p. 6; Dyer and Crozier, 1933, p. 67) have indicated that the lignite seen in shafts and drifts is clean and uniform. About 50 per cent moisture was reported from analyses of undried samples, with relatively low ash and sulphur content. From underground observations, Dyer (1930b) reported pockets of "fines" and a clay body 0.18 to 0.6 m (0.5-2 ft) wide crossing the seam diagonally.

Proven[1] coal resources estimated from Ontario Division of Mines unpublished logs amounts to 210 million tons. This does not include the northern extension of relatively shallow coal outlined in 1972.

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[1] For definition of measured or proven coal resources, *see* Latour (1970, p. 2).

PROSPECTIVE COAL DEPOSITS

Several areas with favourable prospects for additional coal remain unexplored because of the necessity of drilling through extensive unbroken Quaternary cover. One such area lies along the east side of Mattagami River, from the southeastern boundary of the Onakawana field to the vicinity of Grand Rapids. The northern part of this prospective area may have been subject to preglacial channelling as it lies in the path of the major lineament followed by Little Abitibi River and there is a possibility that a preglacial Abitibi River reached a confluence with Mattagami River near the present large bend southwest of the coalfield. Negative results in that part of the prospect nearest the coalfield probably would not be representative of the entire area.

Another prospective area lies across Mattagami River from Onakawana following westward the extrapolation of the east-west synclinal sub-axis through the Onakawana field. Two sets of carbonaceous beds in Drill Hole 80 and lignite fragments in nearby exposures of Quaternary clay indicate reworked lignite along Mattagami River in till and possibly also in preglacial sediments. Carbonaceous material is associated with coarse mica in the sub-till sediments, indicative of the large variation in topography and lithology of the bedrock surface. Known preglacial channelling along the Mattagami valley necessitates prospecting well westward of the vicinity of the river.

Two prospects northwest of Missinaibi River, on both sides of Rabbit River, are considerably less promising. They do, however, fulfill two of the conditions found on Onakawana, in that they are probably on the (opposite) flank of the Cretaceous river system and lie north of the area where Precambrian rocks are close to the surface.

Any Cretaceous rocks that may be found along the lower reaches of Missinaibi River away from immediate sources of Precambrian arkosic detritus can be expected to follow a pattern of finer sedimentation, diverging from the coarse sand and clay found on Missinaibi River from locality 15 upstream and possibly closer to the lithology at Portage Island and, therefore, are worthy of investigation.

BIBLIOGRAPHY

Baker, M.B.
1911: Iron and lignite in the Mattagami Basin, Ontario; Ont. Bur. Mines Ann. Rept., v. 20, pt. 1, p. 214-246.

Bell, J.M.
1904: Economic resources of Moose River Basin; Ont. Bur. Mines, v. 13, pt. 1, p. 135-179.

Bell, R.
1877: Report on exploration in 1875 between James Bay and Lakes Superior and Huron; Geol. Surv. Can., Rept. Prog. 1875-1876, p. 294-342.

Bell, W.A.
1928: Mesozoic plants from the Mattagami series, Ontario; Nat. Mus. Can., Bull. 49, Contribution to Canadian paleontology, Geol. Series, no. 48, p. 27-30, 59-67.

Borron, E.B.
1891: Report on the basin of Moose River; Ont. Legislative Assembly Sessional Papers, no. 87.

Cleary, W.J. and Connolly, J.R.
1972: Embayed quartz grains in soils and their significance; J. Sediment. Petrol., v. 42, no. 4, p. 899-904.

Cross, J.G.
1920: Precambrian rocks and iron ore deposits in Abitibi-Mattagami area; Ont. Dept. Mines, v. 29, pt. 2, p. 1-18.

Crozier, A.R.
1933: Refractory clay deposits on the Missinaibi River; Ont. Dept. Mines, v. 42, pt. 1, p. 81-101.

Dyer, W.S.
1928: Geology and economic deposits of the Moose River Basin; Ont. Dept. Mines, v. 37, p. 1-69.

1930a: General review of non-metallic mineral resources; Ont. Dept. Mines, v. 38, pt. 4, p. 10, 11.

1930b: The Onakawana lignite deposit, Moose River Basin; Ont. Dept. Mines, v. 39, pt. 6, p. 1-14. Also published as The lignite deposits of Onakawana, Moose River Basin, northern Ontario; Bull. Can. Inst. Mining Met., v. 33, p. 450-472.

1931: Stratigraphy and structural geology of the Moose River Basin, northern Ontario; Trans. Roy. Soc. Can., 3rd Ser., v. 25, sec. 4, p. 85-99.

Dyer, W.S. and Crozier, A.R.
1933: Lignite and refractory clay deposits of the Onakawana lignite field; Ont. Dept. Mines, v. 42, pt. 3, p. 46-78.

Dyer, W.S. and Gerrie, W.
1953: Relog of Onakawana Drill Hole A; Ont. Dept. Mines, v. 61, pt. 6, appendix C, p. 87-95.

Dyer, W.S. and Montgomery, R.J.
1930: Semi-commercial tests on northern Ontario fire-clays; Ont. Dept. Mines, v. 38, pt. 4, p. 19-21.

Gilmore, R.E.
1930: Lignite coal from Blacksmith Rapids, Abitibi River; Ont. Dept. Mines, v. 38, pt. 6, p. 34-40.

Guillet, G.R.
1964: Industrial minerals of the James Bay Lowland; Can. Mining J., v. 85, no. 6, p. 49-52.

Hopkins, W.S., Jr. and Sweet, A.R.
1976: Miospores and megaspores from the Lower Cretaceous Mattagami Formation on Ontario; Geol. Surv. Can., Bull. 256, p. 55-71.

Keele, J.
1920a: Mesozoic clays in northern Ontario; Geol. Surv. Can., Sum. Rept. 1919, pt. G, p. 13-19.

1920b: Clay and shale deposits of the Abitibi and Mattagami Rivers; Ont. Dept. Mines, v. 29, pt. 2, p. 31-51.

1921a: Mesozoic clays and sands in northern Ontario; Geol. Surv. Can., Sum. Rept. 1920, pt. D, p. 35-40.

1921b: Mesozoic clays and sands in northern Ontario; Trans. Roy. Soc. Can., v. 15, sec. 4, p. 25-46.

1922: Notes on clays of the Missinaibi River; Ont. Dept. Mines, v. 31, pt. 10, p. 95, 96.

Kublicki, G. and Millot, G.
1963: Diagenesis of clays in sedimentary and petroliferous series; Clays and Clay Minerals, v. 10, p. 329-332.

Latour, B.A.
1970: Preliminary estimate of measured coal resources including reassessment of indicated and inferred resources in Western Canada; Geol. Surv. Can., Paper 70-58.

MacLaren, A.S., Anderson, D.T., Fortesque, J.A.C., Gaucher, E.G., Hornbrook, E.H.W. and Skinner, R.
1968: A preliminary study of the Moose River Belt, northern Ontario; Geol. Surv. Can., Paper 67-38.

McLearn, F.H.
1927: The Mesozoic and Cenozoic deposits of the lower Missinaibi, Opazatika and Mattagami Rivers, Ontario; Geol. Surv. Can., Sum. Rept. 1926, pt. C, p. 16-44.

Martison, N.W.
1953: Petroleum possibilities of the James Bay Lowland area; Ont. Dept. Mines, v. 61, pt. 6, p. 1-58.

Montgomery, R.J.
1930a: Laboratory tests on northern Ontario fire clays; Ont. Dept. Mines, v. 38, pt. 4, p. 23-25.

1930b: A survey of the ceramic industry in Ontario (interim report); Ont. Dept. Mines, v. 38, pt. 4, p. 27-30.

Montgomery, R.J.
1930c: Testing of fire brick made from Mattagami River fire clay; Ont. Dept. Mines, v. 39, pt. 6, p. 15-31

1933: Laboratory classification of refractory clays; Appendix to "Onakawana lignite and refractory clay deposits"; Ont. Dept. Mines, v. 42, pt. 3, p. 79-87.

Montgomery, R.J. and Watson, R.J.
1930: Fire clay, kaolin and silica sand deposits of the Mattagami and Missinaibi Rivers; Ont. Dept. Mines, v. 38, pt. 6, p. 81-120.

Norris, A.W. and Sanford, B.V.
1969: Paleozoic and Mesozoic geology of the Hudson Bay Lowlands; Geol. Surv. Can., Paper 68-53, p. 169-205.

Ontario Department of Mines
1960: Unpublished report on exploration by Ventures-American Nepheline Ltd.

Ontario Research Foundation
1933: A technical and economic investigation of northern Ontario lignite; Ont. Dept. Mines, v. 42, pt. 3, p. 46-78.

Parks, W.A.
1899: The Nipissing-Algoma boundary; Ont. Dept. Mines, v. 8, pt. 2, p. 188, 189.

Radforth, N.W.
1958: Paleobotanical evaluation of fossil wood in Onakawana lignites; Trans. Roy. Soc. Can., ser. 3, sec. 5, v. 52, p. 41-53.

Radforth, N.W. and Rouse, G.E.
1956: Floral transgression of major geological time zone; Trans. Roy. Soc. Can., ser. 3, sec. 5, v. 50, p. 17-26.

Sanford, B.V. and Norris, A.W.
1970: Geology of the Canadian Shield (Hudson Platform) *in* Geology and economic minerals of Canada, R.J.W. Douglas, ed.; Geol. Surv. Can., Econ. Geol. Rept. No. 1, p. 137-145.

Sanford, B.V., Norris, A.W. and Bostock, H.H.
1968: Geology of the Hudson Bay Lowlands (Operation Winisk); Geol. Surv. Can., Paper 67-60, p. 1-45.

Satterly, J.
1953: Drilling in the James Bay Lowland, Part II; Ont. Dept. Mines, v. 61, pt. 6, p. 141-157.

Skinner, R.G.
1971: Quaternary stratigraphy of Moose River Basin, Ontario, Canada; unpubl. Ph.D. thesis, University of Washington.

1973: Quaternary stratigraphy of the Moose River Basin, Ontario, Canada; Geol. Surv. Can., Bull. 225.

Smith, D.E. and Murthy, M.K.
1970: Silica-kaolin deposits of Algocen Mines Limited; Bull. Can. Inst. Mining Met., v. 63, no. 699, p. 799-809.

Telford, P.G., Vos, M.A. and Norris, G.
1975: Geology and mineral deposits of the Moose River Basin, James Bay Lowlands, preliminary report; Ont. Div. Mines, Open File Report 5158.

Williams, M.Y.
1920a: Paleozoic rocks of Mattagami and Abitibi Rivers, Ontario; Geol. Surv. Can., Sum. Rept. 1919, pt. G, p. 1-12.

Williams, M.Y.
1920b: Paleozoic geology of the Mattagami and Abitibi Rivers; Ont. Bur. Mines, v. 29, pt. 2, p. 19-30.

Wilson, W.J.
1903: Reconnaissance surveys of four rivers southwest of James Bay; Geol. Surv. Can., Sum. Rept. 1902-3, v. 15, pt. A, p. 222-243.

APPENDIX

SUMMARY OF FIELD DATA 1875-1974

Locality 7 - Coal River

Bell, R.
1877

Outcrop, west bank of Coal River 0.75 mile from its mouth. According to McLearn (1927) this exposure is no longer accessible because of changes in the stream channel.

(Top)

0' - 1'	Gravel
1' -71'	Till
71' -74'	Lignite
74' -84'	Clay "blue, sticky"

Borron, E.G.
1891

Auger holes, 6 with bedrock data, bored in the vicinity of outcrop described by Robert Bell (above) (depths quoted are approximate; stratigraphic designations in brackets added by L.L. Price).

No. 2 (4' above river level)

	Quaternary
0' - 3'	Sand
3' -13'	Clay, gravel
	Cretaceous, Mattagami Formation
13' -18'	Lignite, clay
	Quaternary
18' -23'	Gravel, boulders

No. 3 (5' above river level)

	Quaternary (Till)
0' -20'	Clay, calcareous, pebbles
	Cretaceous, Mattagami Formation
20' -39'	Clay, carbonaceous, lignite; 3 bands of light grey clay
39' 47'	Clay, non-calcareous, red, grey, variegated

No. 19 (4' above river level)

	Cretaceous, Mattagami Formation
4' - 5.5'	Lignite
5.5'-12'	Clay
12' -30'	Lignite, clay, black, grey, reddish, interbedded
30' -40'	Clay, variegated, white, grey
40' -40.5'	Sand, white

The following holes comprise a composite section.

No. 8 (45' above river level)

	Quaternary
0' -12'	Sand, calcareous, clayey
12' -17'	Clay, calcareous
	Cretaceous, Mattagami Formation
17' -19'	Clay, variegated, non-calcareous
19' -20'	Lignite
	Quaternary
20' -22'	Sand, clay, gravel

No. 7 (23' above river level)

	Quaternary
0' -5.8'	Clay, calcareous
	Cretaceous, Mattagami Formation
5.8'-8.3'	Lignite, carbonaceous clay
8.3'-18.5'	Clay, grey, variegated
18.5'-20.2'	Lignite
20.2'-24.2'	Clay, grey
24.2'-25'	Lignite
25' -27.5'	Clay, grey
27.5'-34.2'	Lignite, carbonaceous clay
34.2'-37'	Clay, white, variegated at top

No. 6 (1.5' above river level)

	Quaternary
0' - 5'	Clay, calcareous
	Cretaceous, Mattagami Formation
5' -12'	Lignite, clay, black, carbonaceous (visible in stream under water)
12' -14'	Clay, grey
14' -15'	Lignite and black clay
15' -18'	Clay, grey, variegated
18' -21'	Sand, clay
21' -23'	Lignite

	Quaternary?
23' -25'	Sand, gravel
	Cretaceous, Mattagami Formation
25' -34.5'	Clay, white, variegated at top

McLearn, F.H.
1927

Outcrop, Coal River, left bank, 1200 feet from mouth: clay, black, fragments of lignite; pinkish-grey clay

Drill hole (downstream end of outcrop, stratigraphic interpretation by L.L. Price)

	Cretaceous, Mattagami Formation
0' - 4'	Clay, pinkish-grey, brown, black
	Quaternary
4' - 6'	Gravel, sand or till
	Mattagami Formation
6' -11'	Clay, black, brown
	Quaternary
11' -16'	Clay, brown-grey, green, pebbles; a boulder clay
	Mattagami Formation
16' -17'	Clay, black

Outcrop, Coal River, left bank, about 1 mile from mouth

(Top)

0' - 4'	Clay, non-calcareous, mottled green, yellow, red; feldspar(?)
4' -	Clay, green-grey

(River level)

Ontario Division of Mines
1960

Hole MRA 6A, Coal River, about 3000 feet from mouth

0' -44.5'	"Cretaceous fire clay"

Smith, D.E. and Murthy, M.K.
1970, p. 800, 803

Five drill holes, vicinity of Coal River, depth of holes not stated: "Did not reach below base of till"

Locality 10 - Missinaibi River, "Curran Bend", 6 miles below Coal River

Borron, E.B.
1891

Thickness	Lithology
	Drift
?	Sand, white (thickness not stated)
12'	Clay, white, bright red
?	Sand, yellowish-white (base covered)

Keele, J.
1921

"Cretaceous beds are exposed for half a mile along the lower part of the river bank and in places they rise to 30 feet above low water line.

"The greater part of the deposit is made up of quartz sand, the particles of which are coated with white clay, but the sand is stained in places to a pink or yellow colour

"The clay is of various colours, white, pink, grey and yellow, but most of the exposed part is a mottled pink and white

"....glacial, stony clay .... is pressed into and intermixed with the Cretaceous clay for a depth of several feet

"Although the sands are stratified in places, they generally form lense-like masses

"The clay likewise occurs in lenses, although such lenses may be banded in different colours. This banding does not appear to be related to bedding ... In the great masses of mottled clay, however, the discoloured portion and the white clay are mixed without any banding.

"Sands: The quartz sand particles are of rather coarse texture with angular outline and coated with white clay." Washing yielded 5% clay. Sieve analysis indicated medium to very coarse grain sizes, and a negligible amount of finer material except clay

McLearn, F.H.
1927, p. 21

Missinaibi River, right bank at Curran Bend.

Composite section

(Top)

0' -11'	Clay, white, mottled, red buff
11' -21+'	Sand, quartz grains, angular, clear, milky, smoky, and a small proportion iron-stained

"A peculiarity of this deposit is its presence at different levels, 11 to 60 feet above low river level, in different parts of the area of outcrop, the result of slumping, or more likely, of glacial transportation."

Crozier, A.R.
1933, p. 97

About 5 miles above Wabiskagami (Pivabiska) River

"...light-coloured refractory clays and silica sand outcrop above water level for a distance of 2000 feet. .... At one exposure the silica sand is between 55 and 65 feet above summer water level, while at another, the bottom of a 9-foot clay seam is about 27 feet above.

The clay and silica sand occurrences at this locality are of the light-coloured, mottled red and grey type. The clay seam appears to be fairly continuous and extensive, flat-lying and well above water level. Although the thickness of the seam is uncertain, it appears to range from 3.5 to 9 feet."

Two sections are given, each showing about 20.5 feet of variegated clayey sand and sandy clay.

Smith, D.E. and Murthy, M.K.
1970, p. 802, 803

Area south of Curran Bend. Drilling program to maximum depth of 168 feet. Cross-sections show the following composite section:

0' -120'	Till
4' -12'	Clay, red, grey, mottled "very dry"
40±'	Sandstone, clayey, unindurated, grains almost entirely of fine- to coarse-grained subangular quartz; impurities in upper part, feldspar, limestone, mica, mafic particles and iron oxide
20±'	Clay, variegated
60±'	Sandstone, clayey, unindurated, coarse-grained, buff, rusty coloured at top, white below
20±'	Clay, variegated
40+'	Sandstone, clayey, coarse-grained

Sands are reported to contain "enriched" kaolinitic bands, clay forming up to 50% of rock

Smith, D.E. and Murthy, M.K.
1970, p. 801, 802

Surface exposures show crossbedding and are distorted by slumping

This report

Missinaibi River, right bank, 6 miles below mouth of Coal River

0' - 3'	Sandstone, unindurated, white, with indefinite bright red lens 1 foot thick, quartzose, coarse (0.16-1.6 mm), angular, with straight and indented surfaces of contact with euhedral feldspar from original granite; porous, quartz grains thinly coated with white clay; lenses with sparse ferruginous spheres 0.25 mm in diameter (altered to limonite); lenses or discontinuous bedding with brown ferruginous stain; slight slumping

About 500 feet downstream from 3-foot sand outcrop:

Lower Cretaceous,
Mattagami Formation

(Top)

0' - 1'	Clay, silty to finely sandy, pale grey; red, yellow mottling and some layering; quartz grains 0.04 to 0.24 mm, black grains of ilmenite(?)
1' - 1.5'	Sand, white, slightly clayey, quartzose, porous, fine- to very coarse grained (0.16-2.4 mm), subangular; platelets of pearly-lustred clay mineral, identified in thin sections as kaolinite; grains (in part, cleavage fragments) of ilmenite(?)

Skinner, R.G.
Pers. com., 1972

Sedimentary structures such as tabular sets of crossbedded strata suggesting alluvial deposition were noted with current directions toward the northwest

Locality 11 - Pivabiska (Wabiskagami) River

Bell, J.M.
1904, p. 143 (11 BE, Fig. 1)

Location indefinite

Lignitic shale, as much as 60 feet thick, with "lignite" only a few feet thick, glacial origin inferred.

p. 161

"....coal measures are well exposed for miles along the course of the stream, practically no lignite beds are visible, although many very thin seams are interstratified with hard, very evenly bedded clays"

p. 160 (11 BE2, Fig. 1)

Eight miles above mouth of river, on right bank, traceable for about 400 feet. Exposed thickness - 10 feet.

"The kaolinitic clay is soft, plastic ....generally almost white in colour, but sometimes stained hematite red, or yellow ochre....

"Much of it is remarkably free from sand but other parts contain lenses and small pocket-like areas of grains of clear glassy quartz sand mixed with pure white kaoline."

A comparative chemical analysis is given.

McLearn, F.H.
1927 (11 M, Fig. 1)

Right bank 4 miles from mouth (about 2.5 miles north of Loc. 10)

Outcrop "....extends along a low flat for about 1/6 mile and rises to 13 or 14 feet above river level....sand below, clay above."

Sand outcrops on left bank.

Pit:

0' - 4'	Clay, white, red, yellow mottled
4' -10'	Sand, white

Locality 12 (Quaternary) - Missinaibi River, right bank, 19 miles below Coal River, and Soweska River, 2.5 to 5.5 miles from mouth

Bell, R.
1879, p. 4 (12 BR, Fig. 1)

"Seam of lignite in the midst of a bank of till 125 feet high. It is from 1.5 to 2 feet thick and is made up principally of sticks and rushes. Below the lignite is 80 feet of yellow-weathering clay and above it 45 feet of blue clay. Both varieties of clay are full of pebbles and....boulders"

Bell, J.M.
1940 (12 BE, Fig. 1)

Soweska River, 3 miles north of 12 BR1 at "Ells' Bend"

p. 164

"The (lignite) seam is about forty feet above the summer water level, and overlaid by boulder clay and post-glacial stratified beds, and underlaid by hard blue clay"

p. 166

"....hard, boulder-filled stratum beneath the lignite"

"The lignite at Ells' Bend is almost entirely formed of moss, though at a few points along the seam a few sticks appear between the layers"

Locality 13 - Vicinity of mouth of unnamed stream, left bank of Missinaibi River, 0.25 to 0.75 mile below Soweska River

Crozier, A.R.
1933, p. 96

Test pit, left bank of Missinaibi River, 1400 feet below Soweska River

(Top)

0' - 7'	Glacial till
7' -15'	Sand, badly iron stained
15' -16.2'	Clay, grey-brown, plastic
16.2'-20.2'	Sand, with some kaolin, cream and grey-white

Hole bottomed in sand

Tests of clay from 15' to 16.3' showed high fusion point (cone 33)

Ontario Department of Mines
1960

Two holes drilled near the mouth of Soweska River, one north (MRA26), one south (MRA26A), of river:

Reported to have encountered "Cretaceous sand" from near surface to 48 feet (bottom of hole in each drilling)

This report

3000 feet below mouth of Soweska River

(Top)

0' - 2'	Sandstone, weathered yellow-brown, unindurated, largely coarse-grained, with lenses grading to fine-grained (0.2-1.2 mm), angular, quartz grains coated with white clay; clear or white feldspar among the coarser fractions; platelets of white clay; rare muscovite; large lenses with dark

	ferruginous cement, in part marking bedding planes or "deposition fronts"; large-scale crossbedding
2' - 3.5'	Covered

Skinner, R.G.
Pers. com., 1972

On the Missinaibi, below the mouth of Soweska River

Measured cross-strata indicating a current direction toward 280°.

Along this stretch of river, noted abundant quartz sand in the lower till; associated with the quartz, siderite which suggests a Grand Rapids-type iron deposit nearby

This report

Mouth of unnamed stream, 4000 feet downstream from mouth of Soweska River (Fig. 3). Exposure near river level

(Top)

0' - 3'	Till, dark grey, green-grey weathering
3' - 5.5'	Till, dark grey, sandy in part; yellow-brown stain
5.5'- 8.5'	Sandstone, clayey, white to yellow-brown, very coarse grained, poorly sorted, with quartz grains of grit to pebble size, some elongate or cigar-shaped, up to 20 cm long, finer grains subangular, some with original outline from granitic rock; fragment of non-calcareous white silty clay (matrix); adhering clay on quartz grains almost entirely non-calcareous; some aggregates of quartz grains with calcareous clay matrix; platelets of pearly-lustred clay mineral; massive crossbedding
8.5'- 9'	Clay, silty, white, calcareous; beds with coarse and medium silt-size quartz grains (<0.04 mm); minute crossbedding; laminae of pale grey, calcareous clay; very coarse sandstone with matrix of white silty clay
9' -14'	Sandstone, white, coarse-grained, quartzose, unindurated, with indefinite yellow-stained beds; similar to underlying sandstone
14' -17'	Sandstone, yellow-brown, stained, quartzose, unindurated, coarse-grained (0.12-1.2 mm), angular (after original igneous grains); dark ferruginous stain along indefinite bedding planes about 3 feet apart; ferruginous concretion 0.5' in diameter
17' -19.5'	Covered

(River level)

Unnamed tributary stream, left bank, 100 feet from mouth, two small pits, both exposing:

Sandstone, coarse-grained, with indurated brown ferruginous laminae and interbeds, similar to sandstone on nearby bank of Missinaibi River

<u>Locality 15</u> - Missinaibi River, right bank, downstream outcrop, 1 mile below Locality 13

Bell, R.
1877, p. 4 (Quaternary)

At....9 miles above the mouth of the Opasatika River,....a bed of lignite occurs in the bank.... It is 6 feet thick but diminishes to the east and is shaly in character, being made up of laminae of moss and sticks

This report

(Top)

0' -22.5'	Till, grey-green, with peat bed at top. (This is the carbonaceous bed described by Bell, 1877, p. 4)
	Lower Cretaceous, Mattagami Formation
22.5'-23'	Sandstone, non-calcareous, yellow-weathering and ferruginous in part; very coarse, subangular quartz grains; interstitial white clay and about 5% porosity; clay speckled with limonitic stain apparently following channels of permeability, probably the path of meteoric water; inclusion of white clay with limonitic spheres resembling oxidized siderite spherules in size and shape
23' -25'	Covered

Locality 17 - Missinaibi River, 2 miles below Locality 13

McLearn, F.H.
1927, p. 22

Left bank, in pit

0' - 5'	Clay, almost white, with patches of red and greenish brown; no sand layer visible

Reported to extend along the river bank for about 500 feet at low water.

Crozier, A.R.
1933, p. 91

"Exposures are quite numerous and can be traced intermittently on both sides of the river for a distance of 4000 feet."

One (upstream) exposure on the right bank together with an auger hole revealed the following section:

0' - 7'	Glacial till
7' -33'	Silica sand (poor colour)
33' -36' (water level)	Clay, black and brownish-grey, plastic
36' -38.5'	Black and brownish-grey clay with thin sand seams (0.06-0.25")
38.5'-38.9'	Clay, grey-brown, sandy
38.9'-39.3'	Silica sand with some kaolin

Tests of clay from 33' to 36' showed a high fusion point

An auger hole starting 2 feet above water level, 520 feet farther downstream on the right bank penetrated 12 feet of clay, mainly brown to grey, but variegated at base.

A third auger hole 190 feet farther downstream on the same bank penetrated 24 feet of variegated clay and brown-grey clay. Tests showed high fusion clays (fusion cones 31-35).

A pit, 1415 feet farther downstream, revealed 16 feet of clayey sand, all of which was rusty weathered except the basal 1 foot below water level.

Auger holes about 1200 feet farther downstream, right bank, penetrated up to 23 feet of variegated clay, sandy at base, overlying kaolinitic sand.

An exposure about 1600 feet farther downstream on the right bank exposed 7.25 feet of variegated clay.

An exposure on the left bank opposite this section revealed lignitic beds overlying variegated clay, 3.5 feet thick.

An auger hole revealed the following section:

0' - 2' (water level)	Clay, black-grey, plastic
2' - 4'	Clay and lignite; clay black and plastic, lignite about 40%
4' -6.5'	Lignite and black plastic clay, mixed
6.5'-7.5'	Clay, light grey, plastic

Bedding in the dark clays was tilted and disturbed and they were considered to have slumped, from their original position. The contact with the variegated clays could not be observed.

Sections of variegated clay were encountered on the left bank at 300 feet (18.5' thick) and 2100 feet (21' thick) upstream from the preceding section. All fusion tests of clay from this locality revealed high fusion refractory material.

This report

Right bank, exposure

0' - 2.7'	Sandstone, clayey, brownish-white, unindurated, very coarse grained, poorly sorted (0.32-3.2 mm), angular; grains entirely of quartz; clay matrix non-calcareous, with flecks of limonite possibly oxidized after siderite spherules
2.7'- 6.2'	Covered

(River level)

Locality 18 (Quaternary) - Missinaibi River about 5.5 miles above the mouth of Opasatika River

Bell, R.
1877, p. 4 (18 BR1, Fig. 1)

Rapid 6 miles above the mouth of the Opasatika, and half a mile below foot of rapids, "small seams of lignite"

(18 BR2, Fig. 1)

In the interval from 1 to 2 miles above the Opasatika, the whole river appears to be underlain by lignite. When sounded with a heavy pole, it has an elastic feel and gives off a large volume of gas

Crozier, A.R.
1933, p. 89 (18 C, Fig. 1)

"Approximately 5 1/2 miles upstream from the Opasatika River, or 1200 feet upstream from the township of Mahoney, grey, sandy clay and silica sand are exposed on the right (south) bank, and white, grey and red mottled clays on the left."

A pit on the right bank exposed 5 feet of rusty sand with 6 feet of grey-white clayey sand below. An auger hole on the left bank penetrated 6 feet of white to variegated clay.

Locality 22 (Quaternary) - Opasatika River

Bell, J.M.
1904, p. 162

Several seams of impure lignite occur on the lower Opasatika River, the most important being at 2.5, 3 and 3.75 miles above the mouth. The lowest outcrop shows two small seams in a bank of stratified clay and boulder clay about 20 feet in height on the western side of the river.

p. 164

"The second bed on the western side....shows lignite....composed chiefly of moss and rushes"

Crozier, A.R.
1933, p. 100

"This river was covered on foot for 3 miles aobve the mouth and then by canoe as far as Friday Creek, 15 miles upstream. No exposures of preglacial clay or sand were observed, although water level was extremely low. The only occurrences of geological interest are the interglacial clay and peat beds exposed along the river bank just above water level."

This report

The Pleistocene age of the sediments described by J.M. Bell (1904) was confirmed and no Mesozoic beds were encountered during an examination of the lower part of Opasatika River extending to a point 10 miles (measured in a straight line) from the mouth.

Locality 23 - Campbell Lake, Sanborn Township, point, east shore of lake

Satterly, J.
1953, p. 116

Campbell Lake Drill Hole (approx. Lat. 50°18'20"N, Long. 82°09'40"W)

(Abbreviated summary of log)

0' -255'	Clay, sand, gravel, boulders, with red material at base
255' -700'	Boulder clay, blue-grey, with a little stratified clay and sand

Locality 24 - Mattagami River, bend, about the Kipling-Sanborn Township line (approx. Lat. 50°13'15"N, Long. 82°08'40"W)

Baker, M.B.
1911, p. 234

Mattagami River, east bank, about 1 mile above Big Bend, outcrop visible only at lowest water stage

Outcrop and borehole; beds dipping 50°, strike 210°

0' - 6'	Lignite, described as "one of two narrow seams" and "six feet thick at the thickest part"
6' -10'	Clay, dark and lignitic in places
10' -26' (borehole)	Clay, lead-blue

p. 235, 236

Illustrated tree trunks, 17 inches in diameter, from beds of lignite with "beds of greyish white sand, beds of lignitic clay and lignite itself....absolutely free from boulders and other glacial material".

Reported much glacial deformation of lignitic beds with folds "often cut off by glaciation" and beds of boulder clay both above and below lignite.

"In the glacial drift immediately overlying or to the south are found boulders of lignite like other boulders in the drift."

Keele, J.
1920a, p. 15; 1920b, p. 43 (24K, Fig.)

Three boreholes; composite section:

(Top)

2'	Clay, bright red, grey mottled
2'	Clay, yellow, grey mottled
3'	Clay, black or dark grey
2'	Clay, white
10+'	Sand, white, with clay band

1920a, p. 17; 1920b, p. 46

Mattagami River, about 6 miles below the foot of Long Rapids

Fossil plant remains were collected from a bed of sandstone included in the clay beds. Paleobotanists of the United States Geological Survey stated that these beds are certainly not younger than Kootenay, but may be older.

McLearn, F.H.
1927, p. 22, 23 (24M1, Fig. 1)

Left bank, 0.25 mile upstream from Kipling-Sanborn Township Line

McCarthy shafts

0' -12'	Till
12' -20' (river level, low water)	Clay, grey, black ("Fire-clay")
20' -39±'	Clay, grey, black ("Fire-clay)
39±' -60'	Sand
60' -65'	Clay, black
65' -87' (base shaft, top borehole)	Clay, black, dark brown, carbonaceous; grey clay
76' -122'	Clay, black; dark brown, carbonaceous clay; grey clay
122' -137'	Silt
	Indurated rock(?) at base

Detailed lithology is available only from material excavated from the shafts:

Clay, light grey, non-calcareous, with a variable content of carbonized plant material (more common than carbonaceous clay)

Clay, more or less carbonaceous, black, very dark grey or dark brown, non-calcareous, containing lignitized wood, stems, flattened trunks of small trees and other organic matter

Clay, hard, indurated (small proportion of excavated clay); specimen of indurated clay with conifer branches and fern fronds

Silt, non-calcareous, laminated, fairly well indurated, micaceous, non-plastic, consisting mainly of sericite and small quartz grains

p. 23, 24 (24M2)

Right bank, both sides of township boundary

Micaceous sand, consisting of small quartz grains and small flakes of sericite mica; concretionary areas containing wood fragments and large fronds of the cycad *Nilssonia densinerve* (Fontaine) identified by W.A. Bell. Probably the same locality as 24K

Lignite, 3-foot bed of flattened, lignitized tree trunks, carbonized wood fragments; matrix of smaller fragments or shreds of carbonized wood; quartz grains, selenite(?), clay(?), fine organic detritus; *Nilssonia densinerve* (Fontaine)

Lignite, thin-bedded, interbedded with clay; thickest bed 0.6 foot thick, containing fragments of flattened tree trunks 2 feet long, parallel to bedding, in clay and matrix of twigs, leaves and cones of *Brachyphyllum*, leaves(?) of *Pityophyllum* and (rarer) fronds of *Cladophlebis*; a little clay and much quartz sand; matrix contains *Brachyphyllum mclearni* W.A. Bell, *Cladophlebis* cf. *albertsii* (Dunker), *Pityophyllum graminaefolium* (Knowlton), *Onychiopsis?* sp.

p. 24 (24M3)

Right bank, nearly 1 mile below 24M2, beneath gravel, a few inches above low river level

"Fireclay" with lignitized wood fragments

Bell, W.A.
1928 (24M2)

Thin-bedded lignite and micaceous sand, Sections E-F and A-B of McLearn's diagram (1927, p. 24)

Detailed description of flora identified from collections by McLearn from 24M2:

Nilssonia cf. *densinerve*
Brachyphyllum mclearni n. sp.
Cladophlebis cf. *albertsii* (Dunker)
Pityophyllum graminaefolium (Knowlton)
Onychiopsis? sp.

"The age of the deposit, as inferred from this assemblage is considered to be either Upper Jurassic or early Lower Cretaceous, with preference towards the latter on account of the presence of the species *Pityophyllum graminaefolium* that is abundant and widespread in the Kootenay."

Dyer, W.S.
1931, p. 89

Lists additional fossils from the Mattagami River identified by W.A. Bell:

Cladophlebis virginiensis
Sphenopteris sp.
Geinitzia Reichenbachii (Geinitz)
Elatocladus (Sequoia) *smittiana* (Heer)

Locality 26 - Mattagami River, vicinity of Long Rapids. Locations are listed in order beginning upstream.

Bell, J.M.
1904, p. 174 (Quaternary)

About 1.25 miles above foot of Long Rapids, 38 feet above summer level, 77 feet back:

"A small seam of rather argillaceous lignite has a maximum thickness of 3'6", is overlain by sandy clay and underlain by interstratified beds of fine sand, bluish clay and coarse, gravelly sand overlying Devonian shale. The seam is a mere lens, dying out in either direction."

McLearn, F.H.
1927, p. 20 (26M1)

Mattagami River, right bank, from 1500 feet below the foot of Long Rapids, continuing downstream for 4000 feet. Observed in pits and natural outcrop, in one place rising to a height of 14 feet above low water (September, 1926). Much of it is covered during high water.

Composite section, upstream area of locality

9'	Sand, white, kaolinitic, a little iron stain (top)
18'	Clay, yellow, cream, buff, with sparse quartz, mica, feldspar; sand, white, 10 to 20% kaolin

Scattered outcrop, downstream area

1'	Clay, black, with lignite fragments
2'	Sand, white (upper sand)
2'	Clay, mottled, yellow, cream

p. 21 (26M2)

Mattagami River, about 0.6 mile below the second island below Long Rapids

3'	Sand, white (small exposure)
3'	Clay (in pit)

Ontario Division of Mines
1960

Log and summaries are presented with stratigraphy, essentially as indicated in the original report, except for minor editing.

Ventures Limited Drill Hole MR1 (Summary) (approx. Lat. 50°09'00"N, Long. 82°13'10"W, about 1500' below the foot of Long Rapids)

0' - 15.0'	Muskeg, silt, sand
15.0'- 82.0'	Till
82.0'-176.0'	Interglacial clay
176.0'-208.0'	Till
208.0'-218.3'	Cretaceous sand
218.3'-221.5'	Cretaceous clay

Ventures Limited Drill Hole MR3 (approx. Lat. 50°09'48"W, Long. 82°08'28"W, opposite the second island below Long Rapids)

Drill collar (datum) 1.5' above ground level

Log by V.A. Haw, D.E. Craig, G.R. Guillet, Feb. 22, 1960

(Percentages of mineral content are visual estimates)

0' - 9.5'	Surface vegetation, roots, muskeg
	Quaternary
10.0'- 11.7'	Till, matrix, uniform medium olive-grey to buff, silty, non-plastic, moderately dense, massive, moderately calcareous, carbonate pebbles; inclusions, moderate amount of sand and pebbles up to 1.5", average 0.0125"; moderate number of small dark brown to black, vertical roots or stems, 0.0125 by 0.75"
	Till, inclusions mostly pebbles
25.0'- 27.0'	Stoneless clay, uniform medium buff-grey, silty to sandy, non-plastic, porous, thinly laminated (laminations 0.006-0.003"), highly calcareous
35.0'- 37.0'	Sand, light coloured, medium to coarse, angular, mostly quartz, lesser carbonate and dark grains; low content of buff clay
47.0'- 47.5'	Sand, light coloured, mostly coarse, angular, about 50% quartz, rest is carbonate and dark grains; negligible clay content
	Till, moderate number of boulders
68.0'- 69.5'	Stoneless clay, mottled dark and light grey-blue, smooth, plastic, dense, laminated (varved), calcareous
77.0'- 78.0'	Carbonaceous clay, black with light-coloured clay inclusions, smooth, moderately plastic, dense, slightly laminated, calcareous; hair-like inclusions; inclusions of non-calcareous clay
88.0' (Bit sample)	Carbonaceous clay, mottled black, smooth, moderately plastic, dense, laminated, weakly calcareous; inclusions of roots and coarse sand grains (mostly quartz, some carbonate), and, rarely, light grey, smooth, plastic, calcareous clay
	Cretaceous, Mattagami Formation
98.0'- 99.5'	Sand, light-coloured, coarse grained, angular to subangular, 80+% quartz, with minor carbonate, dark and feldspathic constituents; some clay content (dirty)

108.0'-110.0' Sand, light coloured, medium grained, sub-angular, 95+% quartz, 1-2% dark grains, minor feldspar; very low content of grey-brown clay

110.0'-112.4' Sand, light coloured, very coarse grained - up to 0.25", uniform, 75% quartz, balance dark, feldspathic and carbonate grains; low to medium content of grey-brown (possibly caved) material. (This sample is in doubt because of carbonate grains and abrupt change in grain size.)

117.0'-118.0' Sand, clayey, white, medium to coarse grained, angular, 98% quartz, a few feldspar grains, fragments of clayey sand; very plastic, high proportion of white plastic clay. (This sample was an incoherent mass and is probably contaminated with drilling mud.)

120.0'-121.5' Sand, clayey, with inclusion of light grey pure clay, medium to very coarse grained, 99% quartz; a few feldspar grains; moderately high clay content, light bluish grey when wet, drying white; clay inclusions are very plastic, dense and smooth

124.0'-125.0' Sand, white, medium to coarse grained, sub-angular, 98% quartz, some feldspar and dark grains; very low clay content, clay in sample mostly drilling mud

125.0'-126.5' Sand, white, medium grained, sub-angular to angular, 98% quartz with a few grains of feldspar; medium amount of clay, incoherent, light buff in colour

126.5'-128.0' Sand, white, fine to medium grained, probably nearly 100% quartz with a few flakes of reddish-brown material, possibly rust from the drill rods; clay content very low, clay in sample mostly drill mud

128.0'-138.0' Sand (sample settled in a drum from water return), white, medium grained, almost pure silica except for grains of feldspar and dark material

138.0'-147.0' Sand (sample washed from mud return), white, medium to coarse grained, angular, some dark specks but almost 100% silica

151.0'-156.5' Sand, clayey, white to medium grey, fine to coarse grained up to 0.25", rounded to subrounded, 80% quartz with feldspar and dark grains, moderately high clay content, light grey, plastic and dense

156.5'-160.5' Sand, light brownish grey with sections of dark grey (brownish tint probably drilling mud), fine grained with rare coarse grains up to 0.125", rounded, mostly quartz with some dark grains; clay content is low and incoherent

160.5'-165.0' Sand (sample washed from mud return), white, fine grained, 99% quartz with rare dark grains and shiny flakes of mica; also hair-like inclusions

170.0'-175.0' Sand, white, medium grained, subangular, 98% quartz, with feldspar grains; very low content of orange-coloured clay, probably mostly drilling mud

198' Clay facies

201.0' Fireclay(?) - interpreted from drilling characteristics - no sample

End of hole.

Drill Hole MR4 (Summary) (approx. Lat. 50°10'12"N, Long. 82°13'35"W; west side of river about 1.7 miles below foot of Long Rapids)

0' - 11.0'	Muskeg, silt, sand
11.0'- 38.0'	Till
38.0'- 51.0'	Interglacial clay
51.0'- 60.0'	Till
60.0'- 65.2'	Quaternary clay
65.2'-190.0'	Cretaceous sand with thin bed of clay at 132.0'

Drill Hole MRA34 (Summary) (approx. Lat. 50°11'15"N, Long. 82°11'15"W; east side of river opposite third island below foot of Long Rapids)

0' - 6'	Muskeg, silt, sand
6' - 20'	Interglacial clay
20' - 36'	Till
36' - 48'	Quaternary clay

Skinner, K.G.
Pers. com., 1972

Indusman Limited Hole

"Immediately northwest of Kipling Dam"

This hole is reported to have penetrated quartzose gravels in "silica sand"

Locality 28 - Mattagami River, right bank, about 1 mile west of Sanborn-Hecla township boundary (mouth of Adam Creek)

McLearn, F.H.
1927, p. 24

Boulder clay, black, plastic, with lignitized wood fragments at river level possibly indicating subjacent Cretaceous bedrock

Skinner, R.G.
Unpubl. thesis and pers. com., 1971

Adam Creek, at low water level, beneath till

1.6 to 2.3 miles upstream from mouth:

Lignite, with compressed logs up to 30 cm; grey and yellow underclays

2.6 to 3.1 miles upstream from mouth:

Pebbly sand and gravel, clasts entirely of silica, many vuggy, coated with a film of kaolin. Pebbles range up to 3.5 cm across. Observed thickness of Cretaceous beds is over 6 feet. The lower part of the till on Adam Creek contains a number of displaced inclusions of Mattagami material

Locality 32 - Mattagami River, about 4 miles above Pike River

Williams, M.Y.
1920b, p. 26

Small exposure

	Till
	Upper Devonian, Long Rapids Formation
0' -0.25±'	Shale, black
0.25±'-1.25'	Shale, pea green
1.25' -2.25'	Shale, blue-grey (with limestone concretions, pyrite, fossils)

Satterly, J.
1953, p. 157

Moose River Oils No. 3 (approx. Lat. 50°20'28"N, Long. 81°48'12"W)

	Pleistocene
0' -40'	Clay (till?)
	Upper Devonian, Long Rapids Formation
40' -54'	Sandy shale, slightly calcareous, banded, grey in lower part

This report

Mattagami River, outcrop right bank

	Top, covered
	Cretaceous, Mattagami Formation
0' - 4.5'	Sandstone, quartzose, yellow-brown, very coarse grained (0.2-1.5 mm), poorly sorted, unindurated, non-calcareous; feldspar grains (<10%); scattered chlorite; pebble of quartz; inclusions (pebbles and cobbles) of clay, very coarse inclined bedding, marked in part by brown iron oxide
4.5'- 5.1'	Covered
	Devonian, Long Rapids Formation
5.1'- 6.6'	Clay, pale blue-grey, non-calcareous; indefinite yellow-brown (limonitic) banding, more prominent at top; ironstone concretions up to 15 cm long (on surface - none found in place); aggregates of pyrite crystals, pyritic aggregates, wood
6.6'- 9.0' (river level)	Covered

Locality 33 - Mattagami River, right side, about 0.5 mile from river

Satterly, J.
1953, p. 156

Moose River Oils Hole No. 2 (approx. Lat. 50°20'48"N, Long. 81°48'43"W)

	Quaternary
0' -14'	Clay
	Quaternary and/or Cretaceous, Mattagami Formation
14' -30'	Sand, coarse
30' -55'	Sand, fine

This report

Mattagami River, outcrop, right bank

0' - 2±'	Sandstone, limonitic, brown, unindurated, non-calcareous, with pebble beds, very coarse grained; angular quartz, feldspar, rare mafic grains; pebbles and larger grains entirely of quartz; small pebble of granite with

feldspar partly weathered to clay; band of very fine grained sandstone with ferruginous cement, much chlorite and fine cross-bedding; crossbedded material is slightly calcareous

Locality 34 - Mattagami River, above and below Grand Rapids

Bell, R.
1877, p. 321

Foot of rapids, left bank

Iron ore with an exposed breadth of 20 to 25 yards, highest point 15 feet above the level of the river. At the surface, compact brown hematite, sometimes botryoidal, resulting from the weathering of iron carbonate that occurs below a depth of up to 3 inches.

Bell, J.M.
1904, p. 152

Foot of rapids

Limonite appears at intervals for 1166 feet along the north bank, almost continuously for 327 feet on the south, greatest width of a single body about 45 feet. Much of the limonite along the river bank forms a rich breccia or conglomerate containing unreplaced limestone, quartz and small bodies of clay

The upward limit of limonite is irregular; vertical contact may be abrupt with limonite in contact with "pure" limestone. At other places, the contact is transitional through partly oxidized iron carbonates to limestone. Iron enrichment tends to follow jointing planes

Baker, M.B.
1911, p. 238

Right and left banks, above and below Grand Rapids

Describes several aspects of the ferruginous material:

Limonite, soft, botryoidal, vuggy, or in radiating masses. Hematite, or limonite, hard compact. Breccia, coarse, of fluted and rounded fragments of limestone and siderite, with siderite matrix

Excavations show fluted, water-worn cavities, containing ferruginous deposit, mainly in the form of limonite, in contact with limestone walls. Baker considers cavities to pre-date iron deposits

Cross, J.G.
1920, p. 11

Map shows distribution of ferruginous material. Ferruginous bodies trend slightly west of north

p. 13

Ferruginous material occupies irregular openings, possibly jointing planes in limestone

Notes that sediments at Grand Rapids appear to form a very gentle anticline

p. 14

Places age of ferruginous deposits (in collaboration with J. Keele and M.Y. Williams) as Cretaceous, simultaneous with Mattagami Formation

Keele, J.
1920b, p. 51

Notes that ferruginous bodies filling sink-holes are mainly sideritic cement with inclusions of other sedimentary material:

Sand, gravel, silt, clay; an irregular seam of lignite 2 feet wide, included in sandy clay in a vertical crevice below ferruginous material; wavy bands and partings of sand in the upper part, among concretionary ferruginous bodies

This report

Mattagami River, at Grand Rapids, traverse downstream along left bank, begins at downstream side of cliff along upper part of rapid, at large riffle in river. (Intervals given below measure horizontal distances.)

0' - 20'	Vertical body of limonitic material
20' -170'	Covered
170' -220'	Limonitic clay (or ironstone) with lenses of yellow-green clay with massive botryoidal appearance; botryoidal body observed with goethite in centre; in contact with yellow-weathering limestone at downstream end; 8-foot zone next to contact contains angular fragments of coralline limestone and coarse grains of quartz, quartz pebbles, feldspar grains
220' -620'	Limestone
620' -645±'	Vertical body of limonitic material; contains steeply dipping beds of micritic limestone with interlayered yellow-brown carbonate, breccia; strike of one such inclusion(?), N60°W

None of the lignitic or plant material reported by earlier workers was seen during the 1967 field season

Locality 46 - Abitibi River at Onakawana, foot of Blacksmith Rapids

Park, W.A.
1899, p. 188

Lignite....presents....a roughly bedded aspect, striking E10°S, dipping 15°N

Bell, J.M.
1904, p. 169, 173

Right bank

Lignite bed up to 10'7" thick but lenticular and distorted. Diagram shows anticlinal outcrop 22'10" long of varying thickness in contact with boulder clay above and dark brown and green (Devonian) fusible claystone below. Strike of anticline is N65°E, attributed to ice thrust

Locality 46 - Abitibi River, Onakawana

Bell, J.M.
1904, p. 170

Left bank, beginning 1200' upstream from foot of Blacksmith Rapids

Lignite outcropping in a few places through talus and exposed in pits over two separate sectors of river bank

Downstream sector exposes lignite over a distance of 166 feet. Upstream, till is barren of carbon for 128 feet, becomes increasingly carbonaceous for 177 feet, passing into lignite for a further 46.5 feet. Lignite "dips rapidly below boulder clay" at upstream end

Locality 46 - Onakawana coalfield, between Abitibi River, vicinity of Blacksmith Rapids and Mattagami River

Dyer, W.S.
1930b, p. 1-14

Approximately 3 square miles of territory, underlain by lignite seam or seams, averaging 20 to 25 feet thick (only 50 of an ultimate 390 holes having been drilled up to the point of writing). The report contains maps showing depth to lignite, structure contours on top of Cretaceous, structure contours on base of lignite

1931, p. 86

Summarizes Drill Hole "A" from detailed log of core, outlining stratigraphy:

0'	- 6'	Muskeg
6'	- 22'	Clay (marine Champlainian)
22'	- 80'	Till
		Lower Cretaceous, Mattagami Formation
80'	-123'	Clay, dark grey
123'	-146'	Lignite
146'	-148'	Clay
148'	-151'	Lignite
151'	-173'	Clay and white quartz sand
173'	-194'	Lignite
194'	-212'	Clay, dark grey, lignitic
212'	-250'	Clay, light grey and cream
		Upper Devonian, Long Rapids Formation
250'	-283'	Clay, pale greenish grey, interbedded with grey shale

p. 87

Onakawana area

"At drill hole 'A', the Mattagami Formation consists of two seams of lignite, an upper and a lower. The upper is 28 feet thick with 28 feet of fire-clay near the bottom and the lower 21 feet thick. The seams are separated by 17 feet of dark grey fire-clay and five feet of white quartz sand. The upper seam is overlain by 43 feet of dark grey fire-clay and the lower seam is underlain by 16 feet of dark grey lignitic clay, followed by an alternating series 38 feet thick of light grey, cream, and banded grey and cream clay, with a small proportion of lignite particles. The section through the Mattagami Formation is rather typical of the Onakawana lignite field, except that the lignite is nearer the surface between 50 and 100 feet, and the lignite is often immediately overlain by boulder clay".

p. 88

The lignite varies greatly in thickness owing to irregular truncation by the ice sheet. The average thickness is about 23 feet over 5.5 square miles (the area of the field as outlined by drilling to April 1931). The parting between the seams shown in drill hole "A" runs continuously through a large part of the field, but other partings were found which do not agree in position with these two.

p. 89

The lower contact with the Long Rapids Formation is peculiar in that the lower part of the Cretaceous Mattagami and the upper part of the Devonian Long Rapids are lithologically similar. The lower part of the Mattagami consists of pale grey and cream clays, whereas the upper part of the Long Rapids Formation is made up of pale greenish grey clay with thin bands of grey shale.

p. 87

Above the coalfield, each of the two till sheets varies greatly in thickness but the average for each is 30 feet; the interglacial series, where present, averages about 15 feet.

At drill hole 76, near the Mattagami River, the glacial deposits are much thicker, 265 feet in all, including interglacial sands and gravels.

At drill hole 78 on the Mattagami River, glacial deposits were approximately 280 feet thick, apparently consisting of three till sheets with two series of interglacial sands and clays. Thickening of the Pleistocene at the Mattagami is attributed to differential erosion rather than to a buried drainage channel, unless such a channel should prove to be more than 5 miles wide.

p. 90

Species from the various collections of plant material from the Mattagami Formation are enumerated, including *Pityophyllum graminaefolium* collected at Onakawana

p. 94-96

In a summary of structural features, a flat broad fold is noted at Grand Rapids on the Mattagami River, and a prominent fold at the lower part of Long Rapids on the Abitibi. Bedding in the Onakawana lignite field dips westward at the rate of 50 to 75 feet per mile from exposures on the surface at Abitibi River. The dip appears to flatten out in the vicinity of the Mattagami River. Whether the broad arch at Grand Rapids extends west or northwest is conjectural; it may plunge northwestward. The axis of the fold at Long Rapids runs nearly northeast; beds on the flank dip from 5 to 35 degrees away from the axis. Northeast of this fold, an outlier of Precambrian gneiss lies in a direct line with the axis.

p. 97

Evidence is presented from drilling that Cretaceous beds are separated from Devonian at most by an erosional disconformity. The two coal seams and the parting between are thought to have been deposited on a flat or gently sloping surface and to have been folded together afterward.

It is assumed that Cretaceous sands and clays have been affected by the fault at the foot of Long Rapids suggesting important movement after Cretaceous time.

Dyer, W.S. and Crozier, A.R.
1933, p. 65

Drilling results summarized for Onakawana coalfield:

Table lists field areas by acreage, thickness of overburden, thickness of lignite and overburden to coal ratios

p. 66, 67

Cross-section and detailed log of Shaft W (approx. Lat. 50°35'48"N, Long. 81°27'20"W)

Summary of log:

0' - 4'	Moss, muskeg
4' - 12.1'	Clay, silt, with sand and gravel at base (marine); sand contains roots and branches of trees, shells
12.1'- 31.5'	Till, sandy at base, with stronger water flow
31.5'- 49'	Clay, sand: clay, sandy, grey, bedded; irregular water-bearing sand, up to 4' thick at top
49' - 59'	Clay, sandy, with sand lenses, more massive than above
59' - 71.6'	Till, with sharp, undulating upper contact; becomes dark grey to black at base, with increasing amounts of reworked Mattagami clay; extremely hard layer near base
	Lower Cretaceous, Mattagami Formation
71.6'- 83.3'	Clay, black with white silt partings; sandy, containing fossil plants near base; upper contact uneven, dipping 1 to 10 inches to the southeast
83.3'-103.5'	Lignite
103.5'-112'	Lignite and clay, mixed; upper and lower contacts irregular
112' -113.5'	Clay, black, lower contact sharp, even, horizontal
113.5'-136.2'	Clay, dark grey, becoming light grey at base

p. 69-73

Glacial disturbance of coal seams:

Comprehensive analysis shows that some alteration in thickness of lignite results from ice thrust, but other areas are undisturbed. The two lignite seams separated by clay are part of an original stratigraphic sequence and not structural repetition of a single seam

p. 73

Further coal prospects

Recommends prospecting to the south of present field and in the vicinity of Portage Island

This report

Manalta Hole 68-38

0' - 5'	Muskeg
	Marine
5' - 12'	Clay, grey with blue-green cast
	Till
12' - 50'	Clay, grey, green, silty to sandy; pebbles and boulders
50' - 74'	Clay, sandy, green-grey; pebbles and boulders; gravel stringers
74' - 75'	Clay; much organic matter (peat?); gravel; boulders
	Cretaceous, Mattagami Formation
75' -104'	Clay(?) (from drill behaviour; no information from cuttings or circulated sample); possibly some loose sand or silt (*see* below)
104' -113'	Coal, black, earthy at top, woody below; fragments with adhering silt and sand grains, from overlying(?) silt or sand
113' -115'	Coal, brown; minute amount of pyrite
115' -120'	Coal, black; trace of underlying(?) brown-grey clayey(?) non-calcareous silt
120' -125'	Clay, light brown-grey, non-calcareous, silty; a little carbonized organic matter
125' -130'	Clay, medium brown-grey, and medium to dark grey, with abundant comminuted vegetable matter, a little pale brown-grey, non-calcareous clay typical of coal underclay (trace only in sample)
130' -135'	Silt, clayey, or clayey siltstone, medium grey-brown with abundant comminuted plant carbon
135' -141'	Sandstone, quartzose, coarse to very coarse grained (0.5-1.2 mm), angular, well-sorted; grains with adhering carbon
141' -145'	Shale and clay; shale, medium grey, fissile to blocky, slightly carbonaceous (resembling marine or brackish shale); clay carbonaceous, dark grey, very soft
145' -150'	Clay, light grey, very soft; rare carbon; shale fissile to blocky as above
150' -162'	Poor samples (lost circulation through muskeg)
162' -170'	Poor sample
170' -175'	Clay, grey-brown, with imbedded angular quartz grains 0.3 mm across; laminae or interbeds of medium grey clay; silty zones; specks of carbon
175' -190'	Poor samples
	Devonian, Long Rapids Formation
190' -195'	Clay, pale green, non-calcareous, soft, massive; rare inclusions up to 0.25 mm across of earthy carbon
195' (circulated sample)	Clay, pale green, soft, non-calcareous, earthy; traces of pale brown and light grey clay with yellow-brown laminae
195' -200'	Clay, pale green, soft, non-calcareous, massive

Manalta Hole 68-39

Samples are poor due to caving from sand intervals and Quaternary beds; where indicated, data are supplemented by information from Hole H-9-72, 250' northwest of Hole 68-39, which was cased from surface to 134'

0' - 4'	Muskeg
	Quaternary. marine deposits
4' - 10'	Clay, calcareous?, light green-grey; no pebbles
	Till
10' - 25'	Clay, light green-grey with rocks and boulders
25' - 30'	Clay, brown, silty; boulders
30' - 35'	Gravel, pebbles 6 to 25 mm in diameter; green and brown clay; large boulders
35' - 52'	Clay, calcareous?, green-grey; pebbles, gravel stringers, boulders
52' - 55'	Sand, medium grained
55' - 85'	Clay, green-grey, sandy with fine gravel stringers
	Cretaceous, Mattagami Formation (possibly disturbed)
85' - 93'	Clay, green; coarse sand; carbonized wood at top

93' - 96'	Sandstone, unindurated, very coarse grained, angular, 0.3 to 4.0 mm; scattered white feldspar grains; quartz grains with adhering pyrite
96' -102'	Clay, brown-grey, with comminuted plant carbon; black carbonaceous clay
102' -105'	Clay, black, carbonaceous, or soft shale
105' -112'	Coal, woody, brown; coarse sand in samples probably caved from sand at 93' to 96' (H-9-72)
112' -115'	Clay (brown-grey?)
115' -125'	Clay, dark grey, soft; much calcareous clay and some sand from upper part of hole; possibly some silty brown-grey clay
125' -132'	Sand, clayey(?), very coarse grained; rare pyritic aggregates; carbonized wood; coal at base
132' -153'	Coal, brown to black, woody, becomes brown, softer toward base
153' -155'	Sand, coarse grained, largely quartz; much feldspar, some clay?
155' -162'	Clay (?possibly with some coarse sand), very poor samples

Drill speeds at 162'

162' -162.5'	Coal brown to black, woody
162.5'-185'	Clay, light brown-grey, very soft (non-calcareous); seams and partings of coal up to 2.8' thick (H-9-72)
185' -190'	Coal, brown, woody
190' -198'	Coal, brown, woody; melanterite
198' -205'	Very poor sample (drill indicates clay)
205' -209'	Coal, woody (H-9-72)
209' -228'	Very poor samples (80% calcareous Pleistocene clay)
228' -245'	Sand, very coarse grained; stringers of pale green clay; much feldspar (sand may be caving from 93'-96' interval above)

Devonian,
Long Rapids Formation

245' -253'	Clay, pale grey with green cast, very soft, massive, non-calcareous (small quantity in sample only)
255' bit sample	Clay, pale green-grey, bentonitic(?); fine flakes of biotite with hexagonal outline; rare spherule-like bodies about 0.25 mm in diameter with oxidized, hematitic interior, clay(?) outside

Manalta Hole 68-40

0' - 7'	Muskeg

Marine

7' - 12'	Clay, light grey; rare pebbles

Till

12' - 88'	Till; boulders, possible gravel lens at 60 to 63'
88' -112'	Gravel, boulders and sand
112' -130'	Till; coarse sand lens at 121-127'
130' -132'	Large boulder
132' -135'	Till, green-grey, sandy near base; boulder, base of interval
135' -182'	Till, green-grey, sandy; boulders at base

Cretaceous or Devonian

182' -191'	Clay, soft (from drill behaviour; all material in sample from Quaternary)

Upper Devonian,
Long Rapids Formation

191' bit sample	Clay, pale grey with green cast, soft, plastic, non-calcareous, waxy, non-bentonitic; no biotite
191' -195'	Clay, soft, as above (from drill behaviour; samples contain only Quaternary material)
195' -255'	Clay, very soft, pale green (colour of mud), possibly bentonite (mud thickens); no samples of rock (cavings only)
255' circulate	Clay, pale green-grey
255' bit	Clay, pale green-grey, very soft; non-calcareous; non-bentonitic; possible laminae of grey clay

Manalta Hole 68-42

Cavings from Quaternary beds flood samples in some intervals; where indicated, data are supplemented by information from Hole H-20-72, 800' southeast of 68-42, which was cased from surface to 120'

0' - 3'	Muskeg

Pleistocene,
marine deposits

5' - 9'	Clay, brown
9' - 30'	Clay, grey-green

Till

30' - 35'	Clay, brown-grey, silty; pebbles-boulders, cobbles
35' - 45'	Clay, fine gravel, boulders
45' - 51'	Clay, green-grey; sandy; boulders
51' - 55'	Gravel, coarse sand
55' - 66'	Clay, sandy, grey with green cast; boulder at 63'
66' - 68'	Sand, coarse gravel
68' - 75'	Clay, green-grey, non-sandy, faintly laminated
75' - 85'	Clay, sandy; scattered boulders and pebbles
	Lower Cretaceous, Mattagami Formation
85' - 92'	Clay, sandy, dark brown-grey, carbonaceous (abundant carbonized vegetable matter); abundant chlorite; dark grey carbonaceous clay
92' - 95'	Sandstone, very coarse grained (0.16-1.2 mm), largely quartz, scattered grains of feldspar
95' -100'	Clay, finely sandy (0.04-0.2 mm), carbonaceous (comminuted vegetable matter) in part
100' -105'	Clay, dark grey, banded, carbonaceous partings of woody coal
105' -120'	Clay, carbonaceous, dark grey, sandy brown-grey clay; coaly partings
120' -125'	Clay, carbonaceous, dark grey, silty, with fragments of carbonized wood; abundant chlorite; possibly some medium grey clay
125' -130'	Clay, dark grey, plastic, slightly carbonaceous, silty in part; a little wood carbon; brownish-white chlorite (?mixed from sandy clay above)
130' -137'	Clay, dark grey, carbonaceous (resembling marine shale); finely divided carbon; medium grey clay
137' -140'	Clay, with coaly partings, medium to dark grey as above
140' -146'	Coal, brown, earthy to woody
146' -148'	Poor sample (possible parting of silty clay)
148' -159'	Coal, brown-black, earthy
159' -161'	Clay, silty to sandy, grey-brown, soft, with much comminuted vegetable matter
161' -170'	Coal, brown-black, earthy to woody
170' -172'	Clay; carbonaceous partings
172' -175'	Poor samples (sand is reported from this interval in H-20-72)
175' circulate	Clay, pale brown, soft
175' -188'	Clay, light brown to dark grey, carbonaceous in part; coaly partings
188' -195'	Coal, woody
195' -197'	Coal, woody
197' -199'	Clay, brown to dark grey; coal at top?
199' -205'	Clay, light brown to grey-brown; coaly partings
205' circulate	Clay, black, carbonaceous, a little woody coal; pale brown clay
205' -213'	Clay, black, carbonaceous, and brown coaly partings
213' -213.5'	Coal, woody
213.5'-215'	Clay, pale brown, and/or light grey
215' -220'	Clay, light to medium brown, and grey; carbonaceous partings
220' -225'	Clay, light to medium grey, with some brown cast; carbonaceous partings or very thin coal seams
225' -230'	Clay, pale brown, soft; grey carbonaceous clay; poor sample
	Devonian(?), Long Rapids Formation
230' -235'	Clay, pale grey with green cast, very soft; sideritic spherule, largely oxidized
235' bit sample	Clay, pale grey, with abundant siderite spherules; possibly some interbedded carbonaceous grey clay (much contamination of green-grey, calcareous, marine clay from surface)

Alberta Coal Onakawana 68-43

	Quaternary, subsoil(?)
0' - 5'	Clay, brown
	Marine
5' - 30'	Clay, grey-green, soft
	Till
30' - 32'	Clay, sandy, light brown-grey; pebbles and boulders
32' - 38'	Clay, sandy, grey-green
38' - 53'	Sand, boulders; a little gravel
53' - 55'	Gravel, boulders, some sandy green clay
55' - 57'	Sand, coarse; boulders at top and base
57' - 77'	Clay, dark grey, calcareous, sandy; slightly carbonaceous; carbonized wood, coal fragment;

	pebbles, boulders; large boulder at 73'; small boulder at 77'
	Lower Cretaceous, Mattagami Formation
77' - 85'	Clay (driller - no Cretaceous material in samples)
85' - 89'	Clay, dark grey, soft; fragments of carbonized wood
89' -102'	Coal, black, earthy at top, woody below
102' -105'	Poor sample; possibly soft, dark grey, carbonaceous clay with coaly partings
105' -109'	Clay, light brown; very soft; coaly partings
109' -111'	Clay, light brown-grey, very soft, carbonaceous
111' -115'	Coal, woody, brown to black; clay at base
115' -122'	Poor sample; probably clay, medium brown-grey, very soft, non-calcareous with plant carbon; thin coal layer
122' -124.5'	Coal, woody (breaks into fine chips)
124.5' bit sample	Clay, pale to light grey-brown, non-calcareous, very soft, plastic
124.5'-127'	Clay and sand: clay, pale grey-brown, soft; carbonized wood(?); sandstone unindurated, very coarse grained (0.16-2.4 mm), angular, poorly sorted; trace of white acicular iron salt crystals (*see below*)
127' -134'	Clay (silty?), dark grey, carbonaceous; fine flakes of chlorite(?); coal layer; fragment of white iron salt containing abundant pyrite or marcasite from interval above
134' -137'	Coal, poor sample (driller reports)
137' -145'	Clay, dark grey to brown-grey, soft, non-calcareous; possible thin layer of coal
145' -150'	Clay, dark grey, carbonaceous; slight shaly cleavage
150' -155'	Clay, black, carbonaceous; coaly at base
155' -174'	Coal, woody, brown in part; melanterite about 167'
174' -176'	Clay, medium brown-grey, carbonaceous; pale green clay, non-calcareous
176' -177'	Coal
177' -185'	Clay, light brown, very soft, with comminuted vegetable matter; a little pale green clay; a little very soft, pale grey clay with much wood carbon
	Devonian(?), Long Rapids Formation
185' -195'	Clay, pale green, non-calcareous, soft; minute (0.02-0.16 mm), red-brown, ferruginous spherulites at top, possibly interbedded with medium brown-grey clay
195' -205'	Clay, pale green, non-calcareous; minute pyrite crystals; minute ferruginous grains or spherulites; red or pink clay, pale with abundant grains of hematite; yellow and yellow-green clay, coloured by (oxidized?) ferruginous grains; minute aggregate of fine pyrite grains, oxidized
205' bit sample	Clay, pale green; abundant minute ferruginous spherulites; (thinly interbedded with?) brown and grey clay containing carbonized wood

Samples for palynological examination were submitted to W.S. Hopkins of the Institute of Sedimentary and Petroleum Geology, Calgary. Relatively uncontaminated material was taken from the stockpile next to the open pit at Blacksmith Rapids and from drill cuttings of coal seams in four Manalta drill holes. A summary of Dr. Hopkin's report follows:

Flora and age (GSC loc. C-17225 to C-17233)

Deltoidospora sp.
Biretisporites sp.
Osmundacidites wellmanii Couper
Cyathidites minor Couper
Lycopodiumsporites sp.
Gleicheniidites senonicus Ross
Sphagnum antiquasporites Wilson and Webster
Cingulatisporites sp.
Matonisporites sp.
cf. *Eucommiidites* sp.
miscellaceous, abundant bisaccate conifer pollen
cf. *Araucariacites* sp.
cf. Taxodiaceae
Glyptostrobus sp.
Sciadopitys sp.
Baculatisporites sp.
Podocarpidites sp.
Classopollis torosus (Reissinger) Couper
Tsugaepollenites mesozoicus Couper
Schizosporus cf. *S. parvus* Cookson and Dettmann
Lycopodiumsporites sp.
Cicatricosisporites cf. *C. hallei* Del. and Sprum.
Cicatricosisporites sp.
Trilobosporites apiverrucatus Couper
Trilobosporites sp.

Vitreisporites pallidus (Reissinger) Nilsson
Monosulcites sp.
age: Cretaceous
comments: "These nine samples, taken as a whole, are definitely of Lower Cretaceous age. The overwhelming abundance of conifer pollen, with associated fern spores, suggests a conifer-fern swamp, growing under temperate conditions."

Locality 46a - East of Abitibi River

Manalta Hole No. EA-1 (drilled 1972)

Company reports that the hole encountered Long Rapids Formation of green clay with brown interbeds below till at 91 feet

Locality 46b - Mouth of Onakawana River

Two drill holes, Nos. 94 and 95

(Logs by Dyer, 1931) - Holes reached base of till at depths of 48 and 75 feet, respectively, overlying Long Rapids clay, light grey or greenish-grey with many thin bands of dark shale

Locality 46c

Manalta Hole P25 (drilled 1972)

Company reports lignite in till, overlying 40 feet of sand and gravel to T.D. of 165 feet

Locality 47 - Mattagami River, upstream end of large bend southwest of coalfield "mouth of Friday Creek"

Drill Hole No. 80

Interpreted from lithology by Dyer (1931)

0' - 4'	Ice and water
	Quaternary, Tyrrell sea sediments
4' - 30'	Clay, light grey, plastic; no boulders
	Post-glacial lake sediments
30' - 45'	Sand, dirty, very soft
	Till
45' -100'	Boulder clay, sandy
	Preglacial sediments and/or inclusions of Cretaceous bedrock
100' -115'	Sand, dirty; fragments of dark minerals
115' -115.5'	Lignite, hard
115.5'-118'	Gravel, fine
118' -126'	Lignite
	(Hole flowing water from overlying sands, reported by driller to be salt water)
	Preglacial channel-fill sediments
126' -133'	Sand, limestone and quartz (grains)
133' -135'	(Concretion?) - hard buff material resembling sandy clay
135' -140'	Clay, silty, brownish
140' -149'	Sand, fine grained, limestone and quartz (grains); much mica
149' -156'	Clay, black, lignitic; mica
156' -158'	Clay, black; less lignite
158' -187'	Clay, black, sticky; flakes of muscovite up to 3 mm across
187' -194'	Clay, light grey

Locality 49 - Littlecedar Creek, 1 mile above mouth

Park, W.A.
1899, p. 188

Isolated fragments of lignite, largest 2 feet long by 10 inches wide by 13 inches thick

Locality 50 - Moose River, below Portage Island

McLearn, F.H.
1927, p. 25

Specimens of lignite and dark grey fine clay, said to have come from Moose River, were seen at Portage Island

Dyer, W.S. and Crozier, A.R.
1933, p. 78

Three exposures, on north bank:

"A", opposite the foot of Portage Island

0' - 20'	Clay, black (refractory), divided by three beds of white quartz sand, siderite and lignite
20' - 37' (Auger hole)	Clay (refactory)

"B", 1600 feet downstream from "A"

Small exposure, auger hole:

0' - 12.5'	Clay, black (refractory)

"C", 3100 feet downstream from "A"

Small exposure, auger hole:

0' - 17'	Clay, black
17' - 19'	Lignite

"....drill holes located not 100 feet from these exposures passed through thicknesses of overburden up to 100 feet before reaching clay.

"However drilling did prove Cretaceous clay exposures are actually 'in place'.... Moreover, two drill holes, P3 and P6 found lignite seams aggregating 15 feet in two seams. These lignite seams are very probably extensions of the seam of the Onakawana lignite field 6 miles to the south."

Ontario Department of Mines
Unpubl. logs, 1932

Six drill holes:

Hole No. P1, left bank, 100 feet north of outcrop A (clay outcrop 800 feet N70°E of downstream tip of island)

0' - 1'	Muskeg
	Quaternary deposits
1' - 12'	Sandy clay
12' - 16'	Gravel and sand
16' - 28'	Till, sandy, hard
28' - 32'	Sand; a few fragments of lignite
32' - 52'	Till, black to dark grey
52' - 62'	Till, sandy, black; sand, grains angular, half limestone, half quartz

Hole No. P2, 300 feet northwest of outcrop A

	Quaternary
1' - 28'	Clay, yellow, sandy; sand, gravel
28' - 31'	Gravel
31' - 50'	Till, dark grey, sandy; gravel and sand layers
50' -112'	Till, dark grey; sand layers; lignite fragments
	Cretaceous, Mattagami Formation
112' -123.5'	Clay, grey, ironstone at base
123.5'-128'	Sand, kaolin at base
	Devonian?
128' -129'	Clay, green-grey

Hole No. P3, outcrop B (400 feet east of outcrop A)

	Quaternary
0' - 6'	Till
6' - 12'	Sand, grey, fine-grained
	Cretaceous, Mattagami Formation
12' - 32.5'	Clay, black and grey; pyrite concretion and (?)lignite at base
32.5'- 40.5'	Lignite, woody
40.5'- 51'	Clay, black-grey
51' - 55'	Lignite, earthy
55' - 57'	Lignite, woody, hard
57' - 59'	Clay, grey to light grey

Hole No. P4, at outcrop C, 1200 feet N7°E of outcrop B

	Quaternary
0' - 8'	Clay, yellow, sandy
8' - 13'	Till
13' - 20'	Gravel
20' - 40'	Till, dark grey sand, gravel layers
40' - 51'	Till, dark grey, "reworked Cretaceous"
	Cretaceous, Mattagami Formation
51' - 52'	Sand, white
52' - 69'	Clay, black, silty (reworked at top?)
69' - 70'	Clay, light grey, silty

Hole No. P5, 200 feet west of P3

	Quaternary
0' - 4'	Clay, yellow, silty
4' - 18'	Gravel, sand
18' - 52'	Till, black, dark grey, sandy in part, reworked Cretaceous in part
	Mattagami Formation(?)
52' - 58'	Clay, grey, silty

Hole No. P6, 1800 feet south of P3

	Quaternary
0' - 4'	Ice, water
4' - 24'	Gravel, sand
24' - 42'	Till, dark grey; seams of fine sand
	Cretaceous, Mattagami Formation
42' - 51'	Clay, dark grey to black
51' - 58'	Lignite, woody
58' - 64'	Clay, black-grey
64' - 72'	Lignite, woody
72' - 74'	Clay, light grey

Locality 50a - About 8000 feet south of Hole P6 (1931)

Manalta Hole P3 (drilled 1972)

Company reports Long Rapids green clay below till, at 199 feet subsurface

Locality 51 (Quaternary) - Kwataboahegan River, 60 to 65 miles above mouth

Wilson, W.J.
1903, p. 230A

Solid peaty material 6 feet thick; can be traced for 430 feet, dark brown, burns with much ash. Thin layers of the same material intercalated with clay are exposed for several miles up river

Bell, J.M.
1904, p. 168, 169

Argillaceous lignite with maximum thickness of 2.5 feet, outcrops almost continuously for 450 feet. "Below the seam is a hard stony clay containing many shells"

About 0.5 mile above the first outcrop, a bed of argillaceous lignite, "probably a continuation" of the first bed, "overlain by bluish clay and underlain by hard, stony grey clay"

Traces of narrow black seams appear for 2 miles upstream from first exposures

Broken lenses of lignite interstratified with blue clay and hardpan begin 1 mile above the preceding series of exposures and continue for 2 miles

The lignite is arenaceous and argillaceous. It consists of indurated moss with partings of clay or sand. It burned with difficulty

Locality 52 - Aquitaine Sogepet *et al.* Sandbank Lake No. 1 (Lat. 51°01'00"N, Long. 82°33'30"W, elev. 357 K.B.)

Norris, A.W.
Pers. com., 1972

Samples contaminated by drift; interpretation impossible