Watts, Griffis and McOuat Limited

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SUMMARY REPORT
1983 WINTER DRILL PROGRAM
JAMES BAY LOWLAND
FOR ONEXCO MINERALS LTD.
VOLUME I

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1. EXECUTIVE SUMMARY

A winter drilling program was carried out by Watts, Griffis and McOuat Limited for ONEXCO Minerals Limited, from late February through mid-April, 1983. A total of 29 holes were completed; this included 26 holes in the main overland (Nodwell) program and three reconnaissance holes in the helicopter-supported, regional drilling portion of the program. Drilling totaled 9,299 feet (2,834 m), of which 8,489 feet (2,587 m) was done using reverse-circulation drilling, whereas the remainder was cored. Fourteen of the drillholes, totalling 4,187 feet (1,276 m), were surveyed with wireline geophysical probes. The main field camp was set up in south-central Gentles Township, with a second camp 9 km north of Smoky Falls, established to support the helicopter program.

The main goal of the drilling program was to outline broadly the lignite bodies discovered in the vicinity of Gentles Township during the 1981 and 1982 programs. Secondary goals included completing a few reconnaissance drillholes in the west end of the main licence area and to confirm an important pyrope garnet anomaly discovered in the 1982 summer program.

Results indicate that the East Gentles lignite occurrence is quite limited in areal extent, whereas the occurrence west of Gentles Township has much better tonnage potential. Drilling in the West Gentles area produced two thick lignite intersections; one, in hole ONEX-W83-02, is 22.5 feet thick (from 286.0 to 308.5 feet), whereas the intersection in ONEX-W83-09 is 18 feet thick (266–284 feet). Other holes in this area produced erratic results and indicate a complex pattern of lignite distribution. The drilling indicates areas in the southern part of the reduced licence area have good lignite potential and that areas north of the Missinaibi River must also be considered as having good lignite potential.

From a cost viewpoint it is clear that an overland drill program is considerably less costly than a helicopter-supported program. Overland access to the Gentles Township area is quite good and therefore makes an overland program feasible and cost-efficient. However, in areas where forestation is thick and river banks are steep, an overland program could prove as costly as a helicopter program. The winter climatic conditions posed no great problems although the occasional snowstorm prevented some helicopter flying. Towards the end of the drill program, the late winter thawing made overland travel slow and physically demanding.

The three reconnaissance drillholes in Mahoney and Lambert Townships resulted in no significant lignite indications; subsequently, the main licence area was reduced in May 1983 from approximately 230,000 to 122,000 acres. In addition, the second part of the licence area, surrounding the 1982 discovery in McBrien Township, was reduced from approximately 50,000 to 28,000 acres.

Analytical analyses of the lignite indicate heat values up to 9,619 Btu (dry basis), whereas some of the carbonaceous clays had values of less than 2,000 Btu. Moisture contents were as high as approximately 50%, although it is expected that the average real moisture of most of the lignite seams will probably be in the range of 40–45%. Ash contents (largely clay, iron sulphide, and quartz grains) varied from 6% to 51% (dry basis); the sulphur values ranged from less than 1% to approximately 5% (dry basis).

The sedimentological model developed from the 1982 and 1983 examinations suggests that the lignite seams accumulated in a vertically accreting river system which was generally northwest flowing. The thickest lignite deposits probably accumulated along and adjacent to the stream levees. Thin but laterally extensive deposits could have accumulated in the swampy interchannel floodplains, in a fashion very similar to the modern-day peat deposits that blanket the James Bay Lowland.

The pyrope garnet anomaly from the 1982 program was fully confirmed. This anomaly occurs in a calcareous, clay-rich sand/silt that appears to represent the base of a Jurassic section. The pink to violet pyropes are fine-grained, rounded, and somewhat flattened. Microprobe analyses on several grains confirm that the garnets are dominated by the magnesium garnet end-member (pyrope) and that the Cr_2O_5 content is 2–4 wt%. This relatively high chromium content indicates that the garnets very likely have a kimberlite source. The kimberlite must have been Jurassic or older in age and it could be located not very far from the alluvial garnet occurrence.

Although lignite is the industrial commodity currently of most interest in this area, other important industrial resources occur in the James Bay Lowland. These include extensive but thin peat bogs, abundant Cretaceous quartz sands, and widespread Cretaceous kaolinitic and other clays, as well as extensive gypsum and limestone units of Paleozoic age. Many of these resources occur in close proximity to the Ontario Northland Railway line between Cochrane and Moosonee.

Recommendations for additional work comprise:

1. Follow-up drilling (detailed and semi-reconnaissance) in the vicinity of the West Gentles lignite occurrence. This work would best be carried out in the winter.

2. Detailed drilling in the immediate area of the pyrope anomaly. A sizeable bulk sample of the anomalous sand/silt should be taken for detailed heavy mineral analysis. A high-sensitivity aeromagnetic survey should be carried out in the eastern part of the licence area and in Mulholland and Pickett Townships, east of the licence area.

3. A thorough evaluation of various energy recovery schemes should be undertaken. This evaluation should include the relative costs of the various recovery methods.

4. A detailed inventory of other industrial resources in the James Bay Lowland, which would be needed if any large-scale regional development program is to be considered. The Government of Ontario should be approached at the highest levels in order to seek their involvement in any regional development program.

2. INTRODUCTION

2.1 GENERAL

The 1983 ONEXCO winter drilling program involved overland drilling to further delineate the lignite discoveries in eastern and west of Gentles Township; a few helicopter-supported reconnaissance drillholes were included in the program. The general exploration area for drilling activities in the James Bay Lowland is shown in Figure 1. Exploration in the 1983 program was limited to the reduced licence area, totalling approximately 280,000 acres, as is illustrated in Figure 2.

This report summarizes the field results and analytical data on all aspects of the program. The program was managed by Watts, Griffis and McOuat Limited (WGM).

ONEXCO Minerals Ltd. is a wholly-owned subsidiary of Ontario Energy Corporation (OEC).

2.2 LOCATION AND ACCESS

The ONEXCO licence area comprises approximately 280,000 acres east and south of the Missinaibi River. Since the 1983 winter drilling program was land-supported, access to drillsites and field camp was available along winter roads constructed for the purpose. The principal winter road, which provided a means of access to the all-weather hydro road, extends northwest from the Kipling Dam (see Figures 3 and 4).

The base camp for the overland program was situated in south-central Gentles Township, approximately 55 km north-northeast of Smoky Falls (see Drawing 10 in map pocket). From this site, additional winter roads were constructed to facilitate access to the drillholes located in Gentles Township and west of Gentles Township. These winter roads were satisfactory for most of the program; however, a thaw in early April

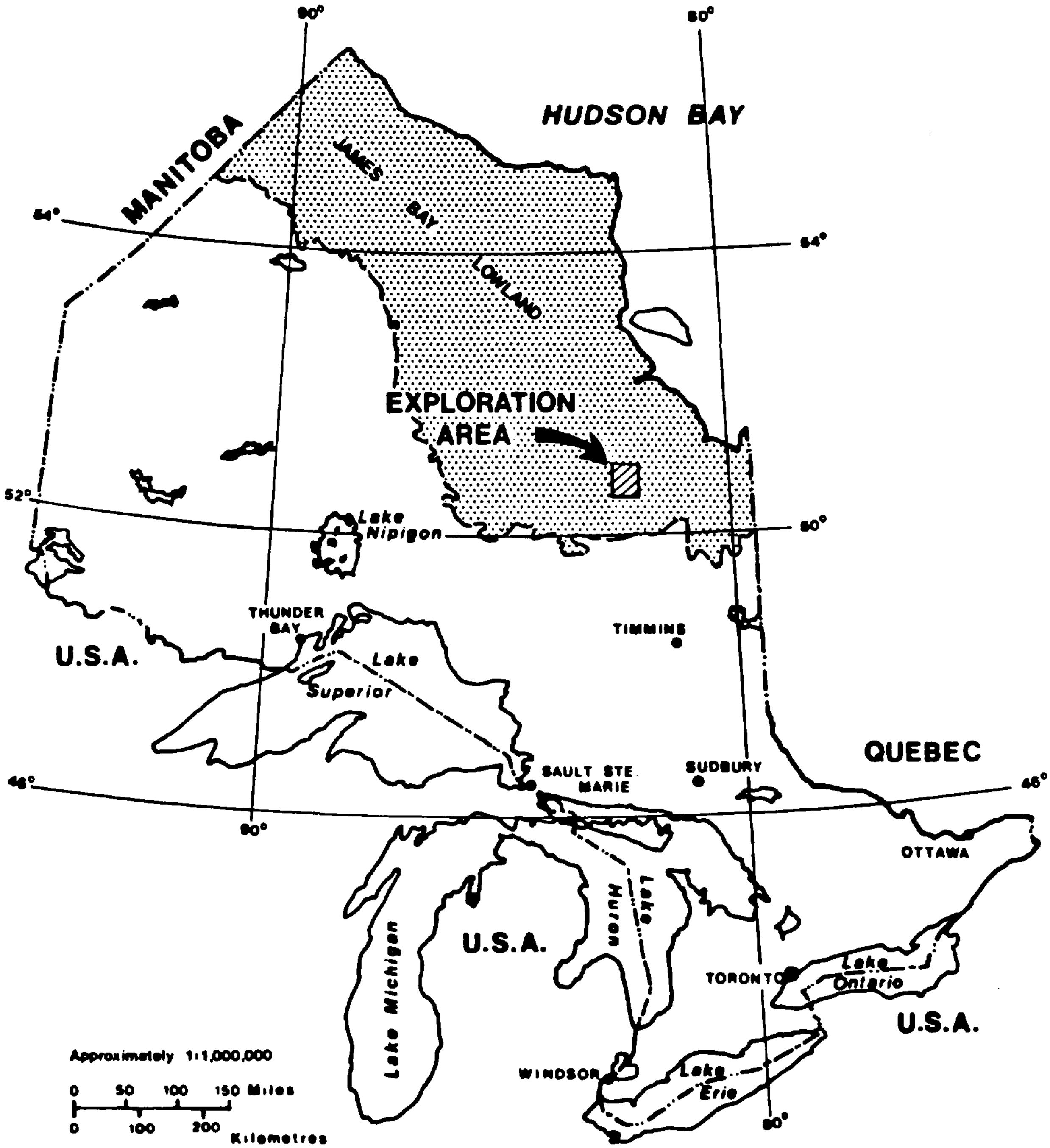


FIGURE 1: Location of exploration area.

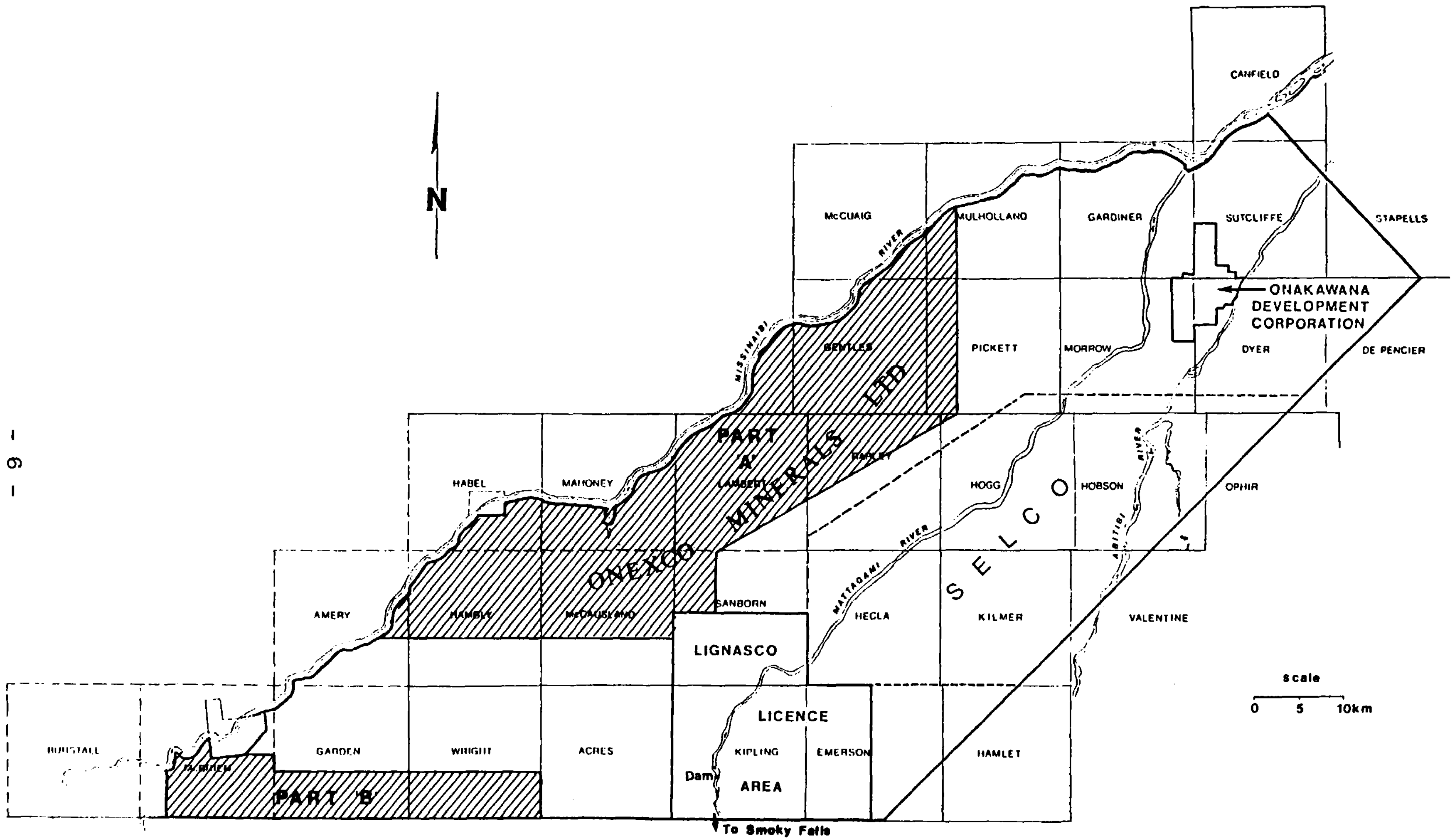


FIGURE 2: Ontario Energy Corporation licence area. In 1980, the Ontario Energy Resources Limited licence area totalled 1,050,000 acres. The licence area was transferred to ONEXCO Minerals Limited in 1982; subsequently, the area was reduced to Parts A and B, totalling approximately 280,000 acres.

FIGURE 3: Winter road into Gentles Township. The Missinaibi River is visible in the distance.

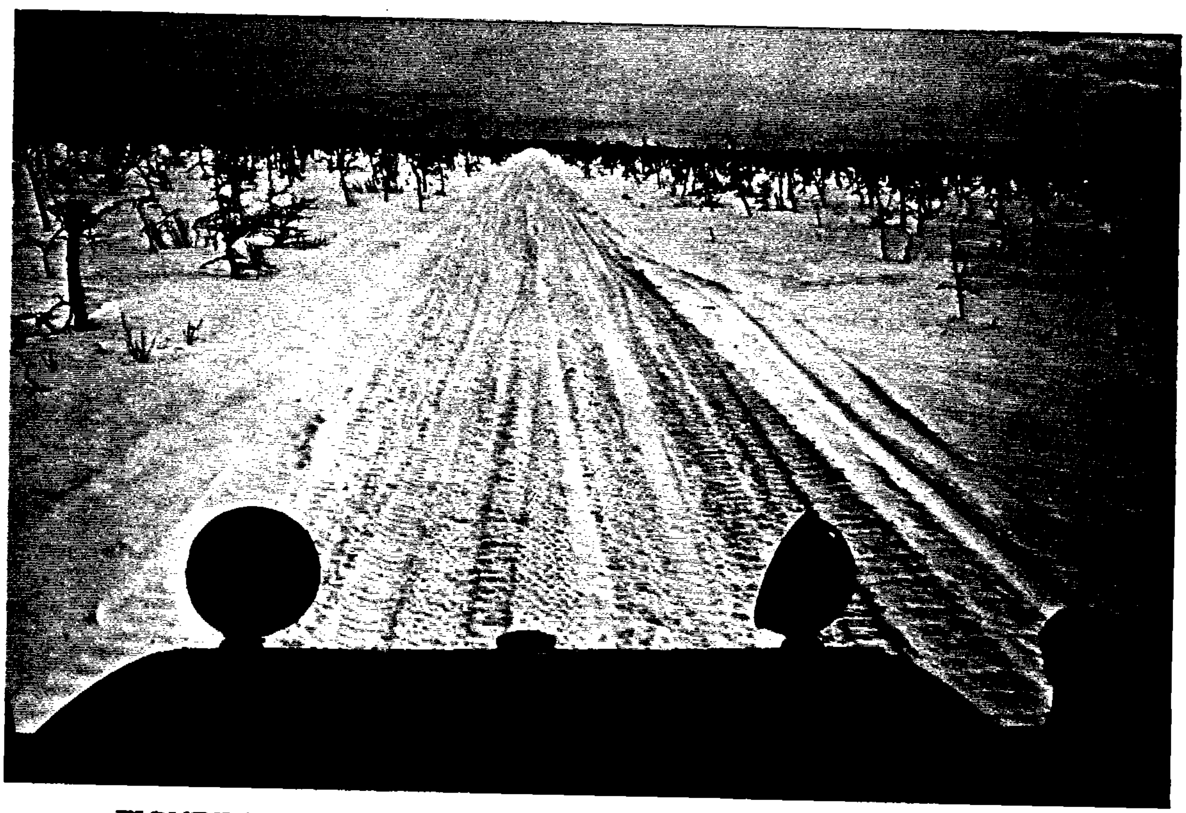


FIGURE 4: The principal winter road, as seen from a Bombardier.

made transportation along these roads time-consuming and uncomfortable for the crew members. At this point, a switch to helicopter-supported shift changes was deemed necessary.

Although it was not crucial to the program, the availability of the Bell 205 and 206-B helicopters proved to be particularly useful in ferrying fuel, core boxes, and miscellaneous supplies to the base camp in Gentles Township. In the summer, helicopters provide the best access to the entire region; this may be supplemented by small shallow draft boats, which can navigate the major rivers such as the Missinaibi and Mattagami.

The all-terrain vehicles and snowmobiles which were operated in the 1983 program are discussed in detail in Chapter 3.

2.3 TOPOGRAPHY, VEGETATION, AND CLIMATE

The licence area is an extensive, flat, swampy region with a very gentle northeastern regional slope of approximately 1 m/km.

Elevations are in the 75–125 m range and relief is generally minimal. However, many of the rivers and major streams are characterized by steep banks that may rise 20 m above the river beds.

The James Bay Lowland is extremely swampy, with stunted black spruce and moss constituting the most prevalent forms of vegetation. The edges of streams are able to sustain denser vegetation, such as spruce, pine, birch, and poplar.

Moderate summer temperatures (20–30°C) contrast with the severe low temperatures (-20° to -30°C) encountered during the 1983 winter drilling program. The average mean daily temperature on an annual basis is in the range of 10–14°C.

The mean annual precipitation of 350–400 mm (approximately 15 inches) is uniformly distributed throughout the year. Heavy snowstorms, which occurred quite often throughout the winter field program, had minor adverse affects on the helicopter-supported program. Fog seldom presents a problem in the winter, but in one case was responsible for leaving one crew out on a 24-hour shift on the modified "fly Acker" P38 drill.

2.4 PREVIOUS WORK

A summary of previous work on lignite exploration in the James Bay Lowland is available in earlier reports prepared by WGM (1981, 1982ab). The history of exploration and assessment of lignite deposits and associated commodities spans 50–60 years, during which time approximately 300 boreholes have been drilled. Verma (in Telford and Verma 1982) has also provided a detailed review of the exploration history of this region.

Regional exploration of the lignite potential in recent years includes the operation of two major drilling programs by the Ontario Division of Mines (ODM) in 1975 and 1978. Six and eight widely spaced holes were drilled, respectively, with most intersecting the underlying Paléozoic strata. Moreover, a helicopter-supported drilling program in 1977 entailed drilling three holes in the easternmost end of the basin.

To-date, WGM has managed several drilling programs on behalf of the Ontario Energy Corporation: 1) in 1981, 12 holes were drilled in the original OEC licence area (1,050,000 acres); 2) in 1982, a summer field program involved drilling 18 holes, several of which were placed in the vicinity of OEC-81-12, the site of a significant lignite discovery in 1981; 3) in 1983, ONEXCO opted for an overland winter drilling program, during which a total of 28 holes were drilled, principally within and west of Gentles Township. Drillsites for the 1983 program were based on lignite discoveries in previous seasons.

While investigations on the lignite potential within the ONEXCO licence area were in progress, the Ontario Geological Survey (OGS) operated a regional helicopter-supported program in 1983. The drilling was carried out in a previously unexplored territory located north of the Missinaibi, in the northeast part of the Cretaceous Basin. Results from this program are as yet unpublished.

2.5 CONDITIONS AND RIGHTS

Results obtained during the 1982 summer drilling program led to a reduction in the original OEC licence area, from 1,050,000 acres to approximately 280,000 acres in two main areas of interest, Parts A and B (as depicted in Figure 2). By relinquishing rights to the greater part of the original licence area, ONEXCO reduced its obligatory expenditures ($2.50 per acre in the third year), allowing a more detailed assessment of areas known to contain lignite.

At present, the permit for exploration within the main licence area includes all minerals and certain fossil fuels — lignite, oil shale, and peat. In May 1983, ONEXCO further reduced its licence area to approximately 150,000 acres, shown as Parts 1 and 2 on Figure 5.

Further conditions and rights that are imposed on exploration activity in the licence area are recounted in the 1981 summary report by WGM; this includes information concerning letters of credit, securities, and licence fees.

2.6 OBJECTIVES AND SCOPE OF THE PROGRAM

On the strength of data accumulated from 1981 and 1982 drilling, the principal objectives of the 1983 winter overland project were to delineate, on a relatively broad scale, the East Gentles and the West Gentles lignite discoveries (see Figure 5).

The program involved detailed drilling of 25 holes with 2–3 km spacing on the above-mentioned East and West Gentles grids to better define the geometry and extent of earlier discoveries. Additionally, regional drilling, consisting of three holes, was conducted to explore for new lignite occurrences.

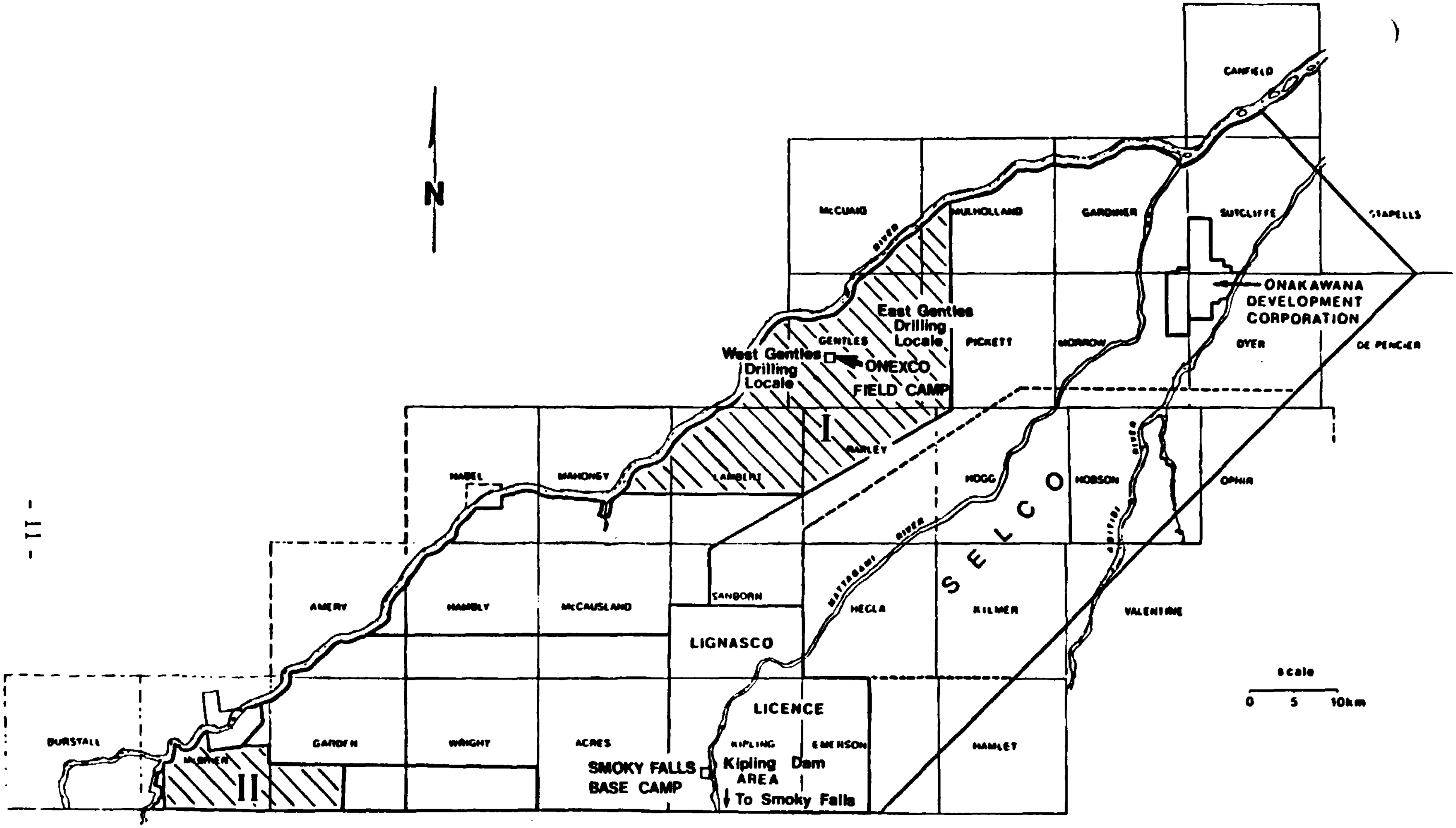


FIGURE 5: The May 1983 ONEXCO licence area. Part I covers approximately 122,000 acres; Part II covers 28,000 acres.

Specific objectives of the program were:

1) The completion of 25–30 drillholes ranging in depth from 60 to 125 m.
2) Obtaining quality samples of any new lignite discoveries.
3) Obtaining descriptive geological logs of each drillhole, along with geophysical logs of each drillhole to assist in geological interpretation.
4) Follow-up drilling to reconfirm the pyrope anomaly, west of Gentles Township; this involved drilling another hole nearby and taking a relatively large sample in the anomalous zone.
5) Preparation of a report summarizing the results of the work.

2.7 ACKNOWLEDGEMENTS

Representatives of ONEXCO involved in the 1983 drilling program were: W. Brush, Manager; D. McLean, Technical Coordinator; and C. McCue, Project Officer. All of the aforementioned were very cooperative in assisting the project operations during the winter program.

WGM personnel included on this project were: J. F. McOuat, Senior Consultant; R. J. Griffis, Project Manager; J. M. Stratman, Project Engineer; K. Krykylwy, Project Geologist; D. Hoy, G. Shelp, J. Dumouchel, and S. Young, field geologists; J. Rae, field engineer; and D. Jackson and M. Smaill, field technicians. This report was written principally by Griffis, Hoy, and Young. Also instrumental in the preparation of this report were L. Waterman, J. Michalik, F. Pietras, and L. Christiansen.

Drilling was contracted to Heath and Sherwood Drilling of Kirkland Lake. Key personnel involved were A. Atwater, R. Whyte, and W. Moore.

Helicopter-support was provided by Huisson Aviation Limited. Pilots John Hall and John Leonard performed exceptionally in all weather conditions; furthermore, T. Grimstead serviced and maintained the machines very effectively.

The contract for geophysical logging was awarded to Century Geophysical Corporation of Calgary, Alberta. Representing Century was R. Berkley, who carried out the logging efficiently.

All-Terrain Track Sales and Service Limited of Timmins, Ontario, represented by A. Boundreau, provided ground support vehicles and constructed winter roads.

3. LOGISTICS

3.1 FIELD CAMP, SUPPLIES, AND COMMUNICATIONS

The 1983 winter field camp was located in south-central Gentles Township, approximately 55 km north-northeast of the settlement of Smoky Falls (Figure 5). The campsite was located fairly central to the planned locations of the drillholes, minimizing the amount of time spent in transit between the drill rigs and base camp.

Materials for the camp were supplied by Heath and Sherwood Drilling and consisted of seven insulated sleeping tents, a kitchen–dining tent, a washing and showering tent, and a tent that housed the generator (Figure 6). Electricity was provided by a 15 kW diesel generator supplying power to all tents; heating and cooking stoves were fueled by oil and propane, respectively.

The base camp for the helicopter-supported program was situated on the main Ontario Hydro road 9 km north of Smoky Falls (Figures 5 and 7; Drawing 10). Camp facilities consisted of four trailers: two provided accommodation for both drilling and WGM personnel; another contained a 15 kW diesel generator; and the remaining trailer housed the kitchen and dining area. Heath and Sherwood supplied three trailers; an additional trailer, to serve as an office and sleeping quarters for WGM personnel, was rented from Woodgreen Trailers in South Porcupine for this purpose.

The helicopters and helicopter crew were based in the nearby settlement of Smoky Falls (Figure 8).

Heath and Sherwood supplied meals to WGM personnel on a cost-per-meal basis. Foodstuffs, fuel, camp supplies, and miscellaneous goods were purchased in Kapuskasing, Kirkland Lake, and Timmins, and delivered on a fairly regular basis from Kapuskasing via Smoky Falls, via a combination of truck and tracked vehicle.

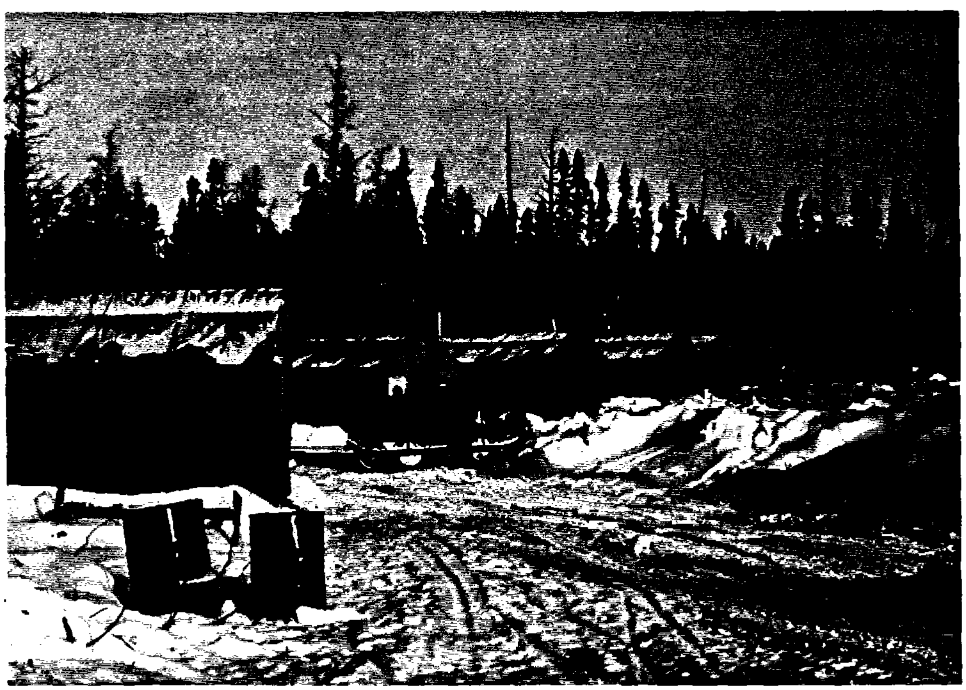


FIGURE 6: Aerial and close-up views of the 1983 ONEXCO field camp.

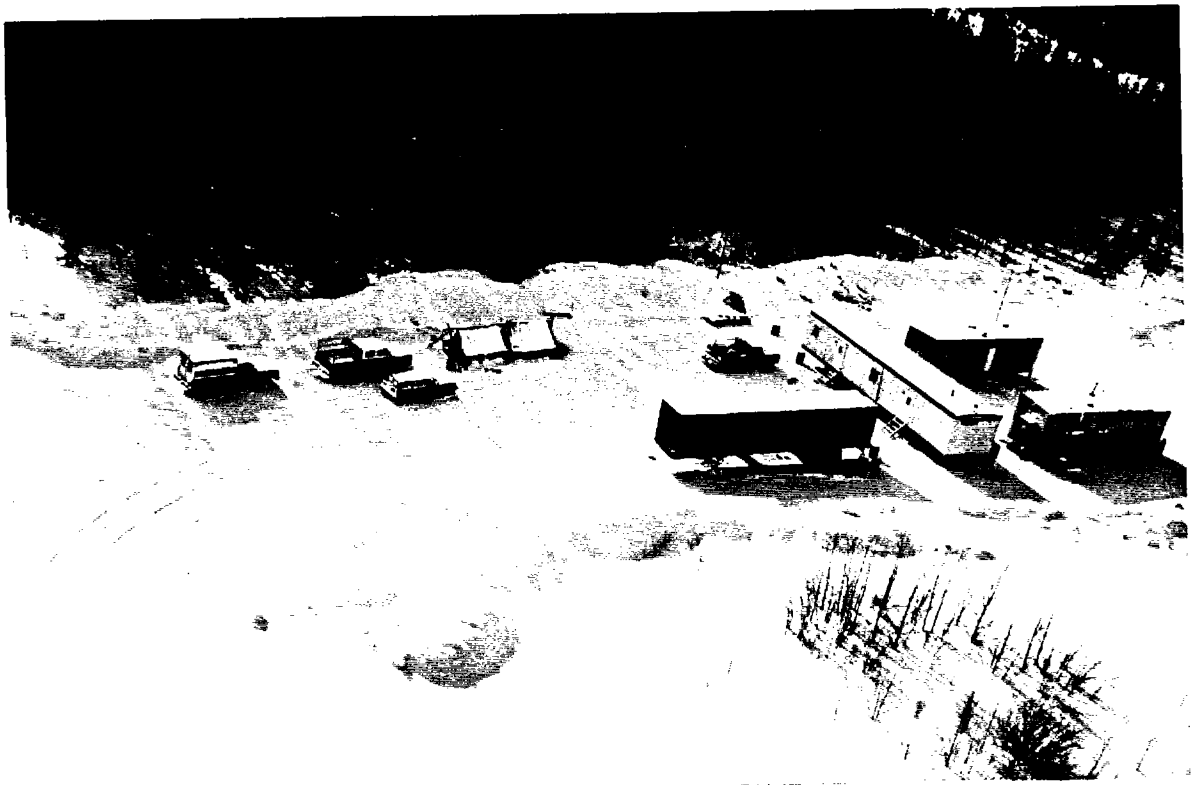


FIGURE 7: Aerial view of camp near Smoky Falls.

FIGURE 8: Helicopter support, 1983. The Bell 206 Jet Ranger and the Bell 205 were based at Smoky Falls.

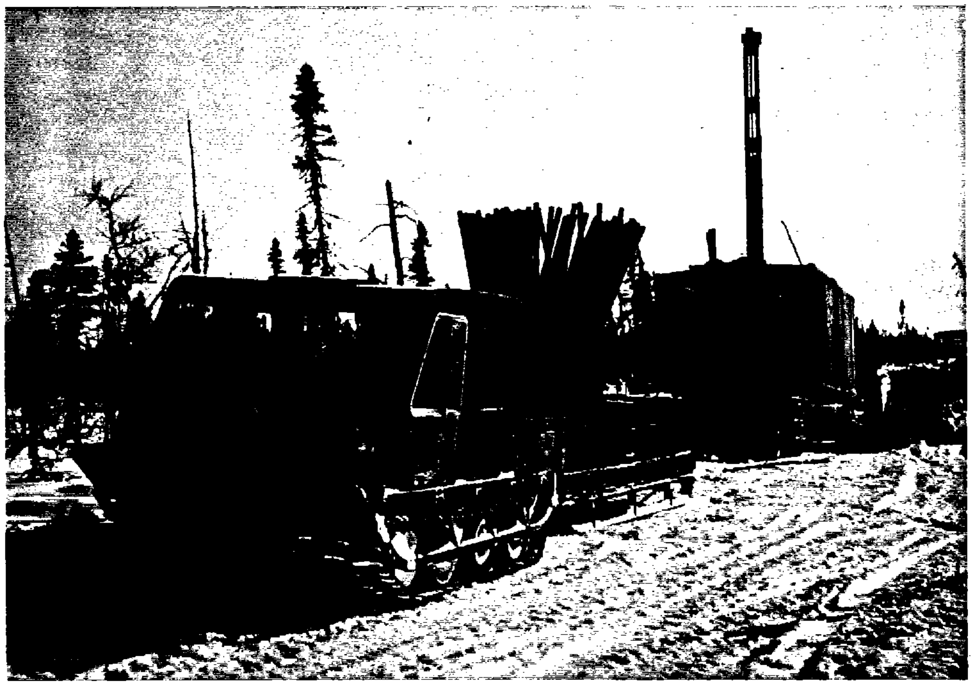
Ground vehicles for transporting personnel and equipment among the field camp, drill rig, and Smoky Falls included two GM diesel Muskegs, a 12-passenger Bombardier snowmobile, two Elan skidoos, an Argo all-terrain vehicle, and a Honda three-wheel 250 hp motorcycle (Figure 9).

Communications were maintained 24 hours a day between the drill rig and the base camp with the use of portable high-frequency radios supplied by Heath and Sherwood. This set-up worked particularly well and helped to minimize the amount of downtime resulting from breakdowns and equipment shortages. Additionally, radio schedules were routinely kept between the ONEXCO base camp and Heath and Sherwood's office in Kirkland Lake. Contact with WGM's head office in Toronto was maintained by telephone from Kapuskasing, or by a radio telephone available at the Spruce Falls power station at Smoky Falls. Generally, the radio signals were satisfactory, although occasionally atmospheric conditions would prevent clear communication.

3.2 WINTER ROAD AND MOBILIZATION

Given the accessibility of the proposed drilling locale in Gentles Township and the detailed nature of the drilling, WGM recommended overland support for the drilling. Before mobilizing this type of program, a winter road had to be prepared from a point of road access to the planned location of the field camp. Additionally, drill access roads and drillsites must be prepared and maintained throughout the program, linking them to the base camp.

In late January, WGM subcontracted A. Boudreau (All Terrain Track Sales and Services) of Timmins, Ontario, to undertake the preparation and maintenance of the winter road. During the first week of February, Mr. Boudreau transported a Caterpillar D-4 tractor, two GM diesel Muskegs, fuel, and a mobile camp unit mounted on skids, from Timmins to the Kipling Dam, situated on the Mattagami River north of Smoky Falls. From the dam, Mr. Boudreau commenced packing an existing road a distance of approximately 16 km to its termination, after which a new road was broken and packed over open swamp and marsh, a distance of 40 km through Kipling Township northward into Gentles Township (Figure 10). During the course of the program, and



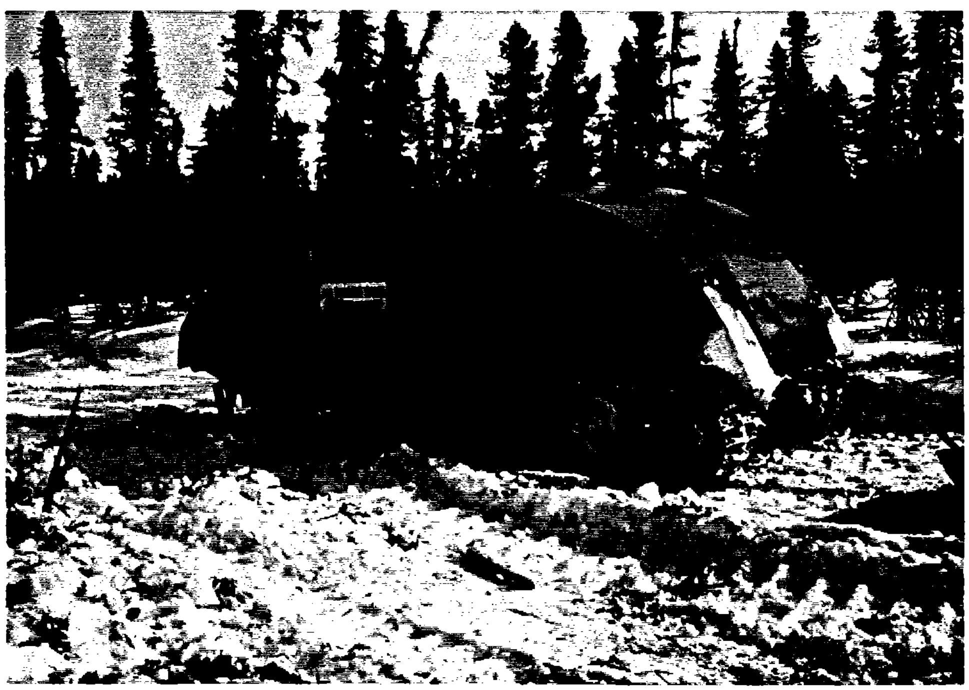


FIGURE 9: Ground support vehicles. Above, the diesel Muskeg assists in moving drill equipment during a move. Below, the Bombardier snowmobile, utilized primarily for passenger transport.

particularly during the construction of the camp access road, it was necessary to construct and pack sevral ice bridges across small streams and hollows: a D-4 tractor cleared a track with its blade; the weight of the diesel Muskegs and other vehicles following did the packing (Figure 11). It was found that the tractor was most effective when temperatures were below -20°C; at higher temperatures, bushes and small trees would not break off cleanly.

Drill access roads were cleared and packed in one area within and one west of Gentles Township, referred to as the East Gentles grid and the West Gentles grid, respectively (Drawing No. 4, map pocket). Access to drillsites included 35.8 km of packed winter road on the East Gentles grid, and 25.2 km on the West Gentles.

Generally, aside from minor mechanical problems, the preparation of the winter road proceeded smoothly. The only significant problem encountered was the sinking of the Caterpillar tractor in open muskeg, during construction of the road from Kipling Dam to the ONEXCO base camp in Gentles Township. Fortunately, Heath and Sherwood were mobilizing their equipment at the same time and managed to winch out the tractor using one of the Nodwells. It would be preferable to pack and clear the roads earlier in the year, so that better advantage could be taken of the cold spells that are common in January and early February.

Heath and Sherwood commenced mobilization of one Nodwell (Rig No. 1), two tractors, fuel, and camp supplies on February 17th (Figure 12). By that time, the road to the ONEXCO base camp had been completed and the preparation of drill access roads was well underway. Construction of the base camp was undertaken by both Heath and Sherwood and WGM personnel; it was completed during the last week of February. All WGM personnel had arrived in base camp by this time.

The first hole was collared on February 25th. The second Nodwell was undergoing repairs at the Heath and Sherwood shop in Kirkland Lake, and did not arrive at the job site until the end of the second week in March. The overland-supported drilling program was terminated on April 9th, and demobilization took place soon after. The helicopter-supported segment of the program (ONEX-W83-25 to -27 inclusive) commenced on April 4th and ended April 17th.

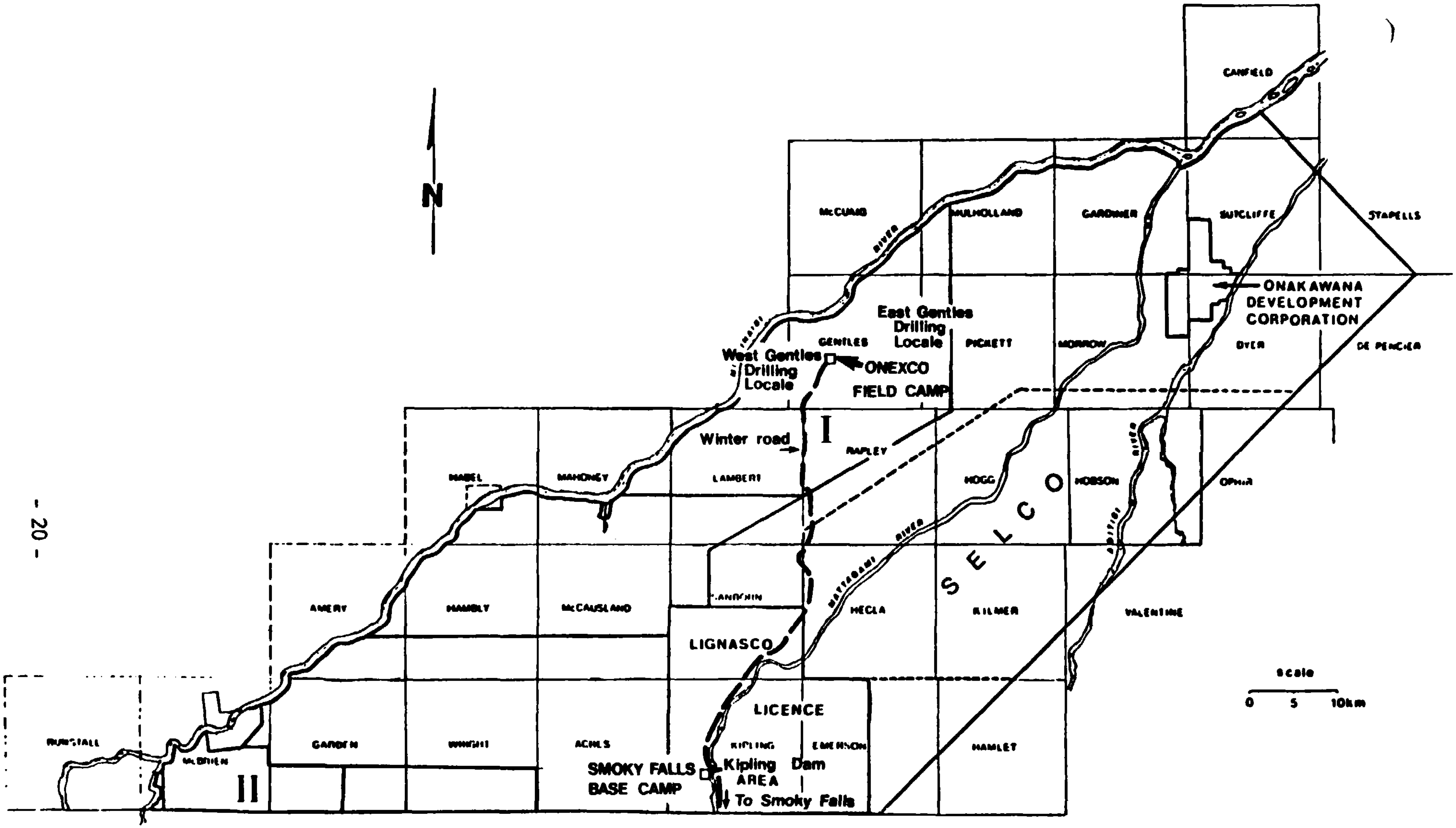


FIGURE 10: Approximate route of the 1983 winter road.

FIGURE 11: Breaking the winter road. Aerial view of All Terrain Track Sales and Services vehicles.

FIGURE 12: Mobilization of camp support. WGM personnel mustering equipment for the field camp.

3.3 HELICOPTER SUPPORT

A large part of the main licence area is difficult to reach by overland routes because of steeply banked rivers (the Waboose and Opasatika) and fairly dense forests on the river banks. It was therefore decided that several widely spaced drillholes in this area would best be supported by using the Bell 205 and 206 helicopters that were conveniently available at Smoky Falls. These reconnaissance holes were intended, in part, to examine areas that were not considered prime lignite exploration ground (based on the results of the 1982 summer drill program), but which nevertheless required some drilling before they could be dropped from the licence area.

With the arrival of warmer weather during the last few weeks of the program, the the snow-packed drill access roads deteriorated rapidly. With distances between the base camp and the drill rigs of up to 15 km, ground support by tracked vehicles and all-terrain vehicles became impractical, particularly with the time spent in transit between the drill rigs and base camp.

These conditions prompted WGM to utilize helicopter support for the remainder of the program (Figure 13). Subsequently, Huisson Aviation Limited of Timmins, Ontario, were subcontracted to provide transportation for personnel and drilling equipment, employing both a Bell 206 Jet Ranger and the larger Bell 205 helicopter. The Jet Ranger conveyed personnel and drill supplies on the overland drill program. During reconnaissance drilling moves, both helicopters were use, the Bell 205 principally in slinging the heavier drill components and fuel, while the Jet Ranger carried personnel and lighter equipment. As in previous WGM programs, the "fly Acker" (a modified Acker P38 drill) was used for the regional drilling. This rig can be readily broken down into helicopter-portable components.

Both helicopters also assisted with camp mobilization, primarily by transporting personnel and light equipment between the ONEXCO base camp and Smoky Falls.

Generally, the helicopters and helicopter personnel performed professionally. Downtime from mechanical problems was kept to a minimum.

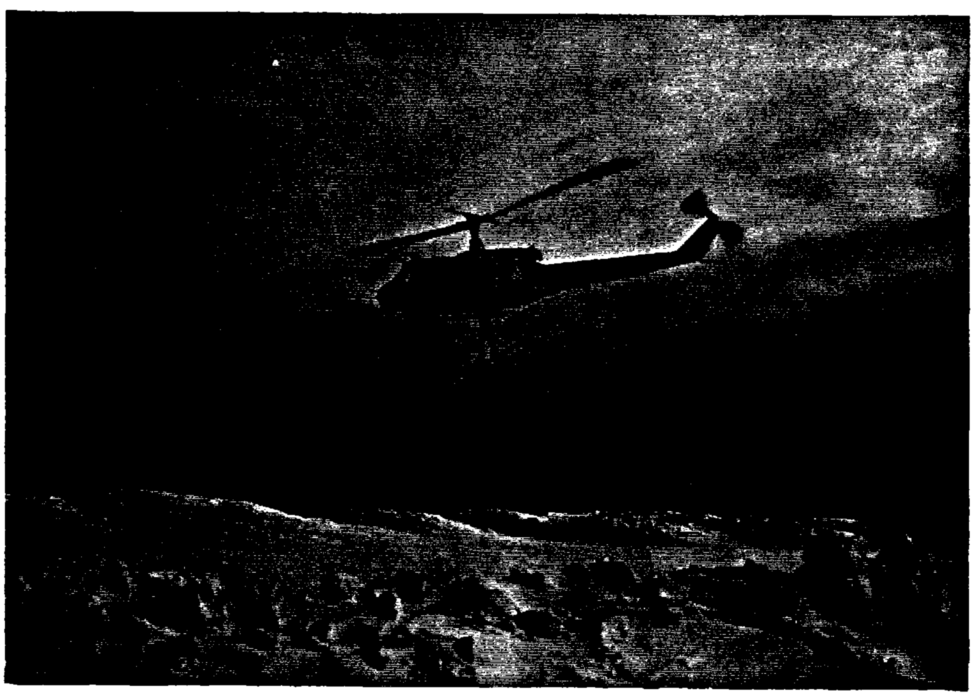


FIGURE 13: Bell 205 helicopter. Above, bringing supplies into field camp. Below, the 205 slinging drill equipment.

Drillholes on the helicopter-supported program took approximately five days to complete including drill moves. Fortunately, drill moves took considerably less time to complete than in the previous summer program, due to the greater load capacity of the Bell 205 than that of the Astar 350-D operated in the 1982 drilling season (3,000–4,200 lb vs. 1,500–1,800 lb). Moreover, the 1983 drillholes were located much closer to one another than the holes of the 1982 program. As the last three holes were closely spaced, the drill moves were usually completed in half a day; however, a night shift was often lost since drill moves were restricted to daylight hours.

4. DRILLING

4.1 GENERAL

A total of 29 holes were drilled during the 1983 program: 26 on the overland (Nodwell) supported program, and three on the helicopter-supported, regional drilling segment of the program. Drilling footage on the overland segment totalled 2,474 m (8,116 feet), whereas on the helicopter-supported segment, 360 m (1,181 feet) were drilled, for a total footage of 2,834 m (9,298 feet). Reverse-circulation and coring footages are summarized in Table 1.

Drilling on the overland portion was carried out by Acker P38 drillrigs, on two 12-hour shifts. Drill crews consisted of four people: a driller, a driller's helper, a tractor driver (who was required when hauling water), and a geologist. Fuel and equipment for both drills were supplied via Bombardier snowmobile, by diesel Muskeg, and, later in the program, by helicopter.

Previous drill programs have shown that drilling in the Mesozoic sediments of the James Bay Lowland is technically demanding. Despite the difficulties, recent experience has indicated that a combination of reverse-circulation and triple-tube coring is an effective method, given the unconsolidated nature of the sediments.

Generally, the following procedure was used when switching from one mode of drilling to the other: Recent, Pleistocene, and Cretaceous sediments were drilled using reverse-circulation, with character samples being taken at approximately 10-foot intervals. When significant thicknesses of carbonaceous clay and/or lignite were encountered, triple-tube coring would be commenced. Coring would continue until the end of the lignite intersection, or until units of less competent sand were encountered; at this point, we would revert back to reverse-circulation methods, until another seam of lignite was encountered. An attempt was also made to core geological features such as solution-collapse breccias or other interesting structures.

TABLE 1

SUMMARY OF DRILLING FOOTAGE

Hole Number	Hole Depth		Reverse-Circulation Footage		Coring Footage		Overall Core Recovery
	Metres	Feet	Metres	Feet	Metres	Feet	
ONEX-W83-01	115.2	378	67.0	220	48.2	158	66.8%
ONEX-W83-02	102.4	336	102.4	336	—	—	—
ONEX-W83-03	116.4	382	116.4	382	—	—	—
ONEX-W83-04	129.5	425	129.5	425	—	—	—
ONEX-W83-05	71.6	235	71.6	235	—	—	—
ONEX-W83-06	97.0	318	89.9	295	7.0	23	62.2%
ONEX-W83-07	89.6	294	75.0	246	14.6	48	86.7%
ONEX-W83-08	80.8	265	80.8	265	—	—	—
ONEX-W83-09	114.3	375	101.5	333	12.8	42	72.9%*
ONEX-W83-10	108.2	355	93.3	306	14.9	49	79.6%
ONEX-W83-11	121.9	400	109.1	358	12.8	42	32.3%
ONEX-W83-12	123.4	405	111.9	367	11.6	38	60%**
ONEX-W83-13	120.7	396†	87.2	286	27.4	90	72.6%
ONEX-W83-14	71.6	235	71.6	235	—	—	—
ONEX-W83-15	111.3	365	111.2	365	—	—	—
ONEX-W83-16	84.1	276	84.1	276	—	—	—
ONEX-W83-17	67.1	220	67.1	220	—	—	—
ONEX-W83-18	47.2	155	47.2	155	—	—	—
ONEX-W83-19	42.7	140	42.7	140	—	—	—
ONEX-W83-20	121.3	398	121.3	398	—	—	—
ONEX-W83-21	62.5	205	62.5	205	—	—	—
ONEX-W83-22	98.1	322	76.8	252	21.4	70	75.8%
ONEX-W83-23	93.9	308	62.8	206	31.1	102	62.1%
ONEX-W83-23A	80.8	265	80.8	265	—	—	—
ONEX-W83-24	81.7	268	70.1	230	11.6	38	62%
ONEX-W83-25	120.4	395	120.4	395	—	—	—
ONEX-W83-26(H1)	106.7	350	106.7	350	—	—	—
ONEX-W83-27(H2)	131.1	430	131.1	430	—	—	—
ONEX-W83-28(H3)	122.5	402	95.1	312	27.4	90	44.0%††
TOTALS	2,834.0	9,298	2,587.1	8,488	240.8	790	64.8%

*This excludes a section from 269–284 feet (82.0–86.6 m), in which there was evidence of grinding of the core.
**This excludes sand sections at 238–253 feet (72.5–77.1 m) and at 274–278 feet (83.5–84.7 m), from which no core was recovered.
†Casing was driven 20 feet (6.1 m) below the rods, accounting for the discrepancy between the hole depth (396 feet) and the combined reverse-circulation and coring footage (376 feet).
††This excludes a sand section from 340–390 feet (103.6–118.9 m), from which no core was recovered.

In some cases, because of time restrictions or equipment problems, carbonaceous clays or lignite intervals were deliberately not cored. It was felt that, because wireline geophysics would be carried out, the contacts and character of any lignite seams would be accurately ascertained.

4.2 DRILLING EQUIPMENT

The overland program utilized Acker P38 drills mounted on Nodwells (see Figures 14 and 15). The arrangement of drilling components on the Nodwell is quite compact, with the mast, diesel motor, water pump, compressor, mud tanks, and sample cyclone, all mounted on a platform of approximate dimensions 10 feet by 25 feet (Figure 16). The platform is enclosed in a shack of steel and plywood construction and is mounted on the tracked vehicle, attaining a height of 11.5 feet.

The machine has a tower, approximately 20 feet in length, capable of drilling 10-foot runs. The drill is powered by a diesel motor (GM model, 73 series, 90 hp) and is fully serviced by a hydraulic system.

An air compressor is often required when the reverse-circulation method of drilling is utilized; drills on the current program employed Booge BT15 compressor engines that have a capacity of 75 cfm at 220 psi. When coring or when reverse-circulation drilling was employed, a Bean 435 water-pump was used. This particular pump is hydraulically driven by an Orbit motor and has a capacity of 30 gallons/minute at 350 psi.

Support equipment included two International Harvester 500 crawler tractors, which were used primarily to haul water. The tractors were also used to haul sleds during drill moves, and to assist in preparing drillsites. Two large sleds were usually hauled behind the Nodwells during drill moves, transporting drill rods, casing, plastic pipe, drilling mud, and other drill accessories from site to site.

The regional drilling segment of the winter program employed a "fly Acker" — an Acker P38 drill that has been adapted by Heath and Sherwood engineers to suit a helicopter-supported program (Figures 17 and 18). The components on this drill rig are

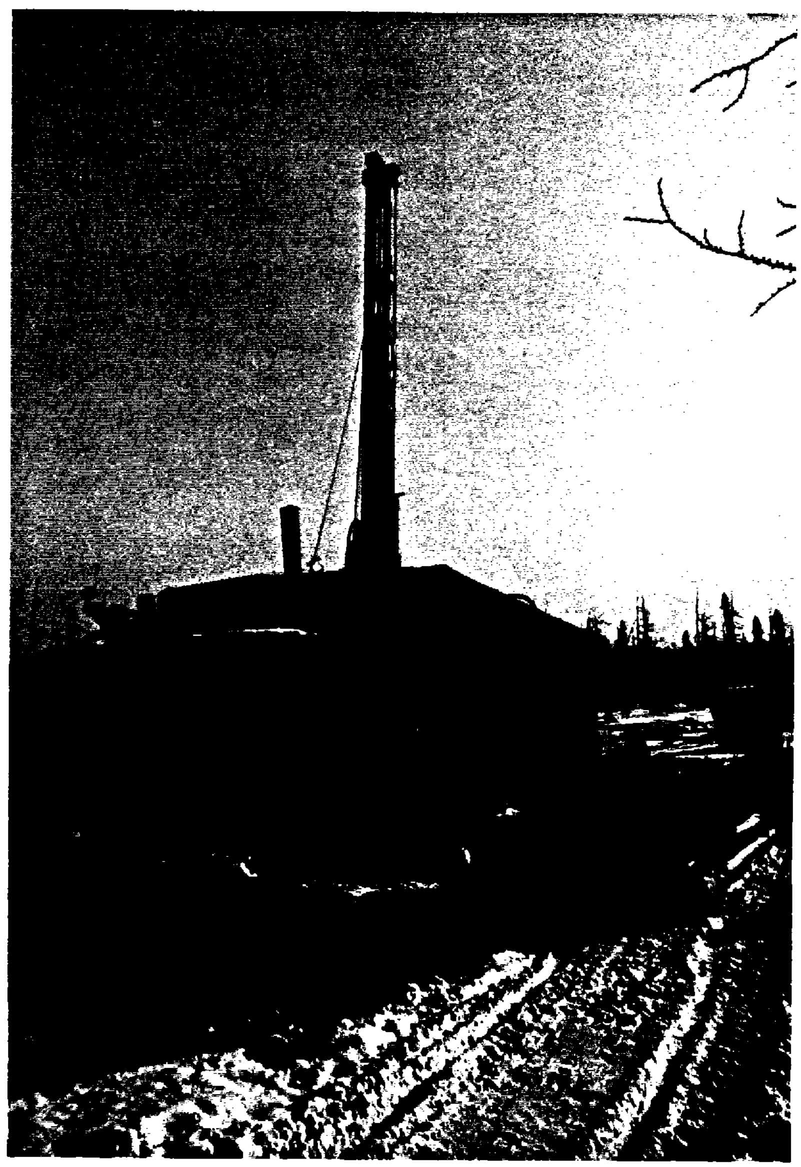


FIGURE 14: Nodwell drill rigs.

FIGURE 15: View of a typical drillsite on the overland program.

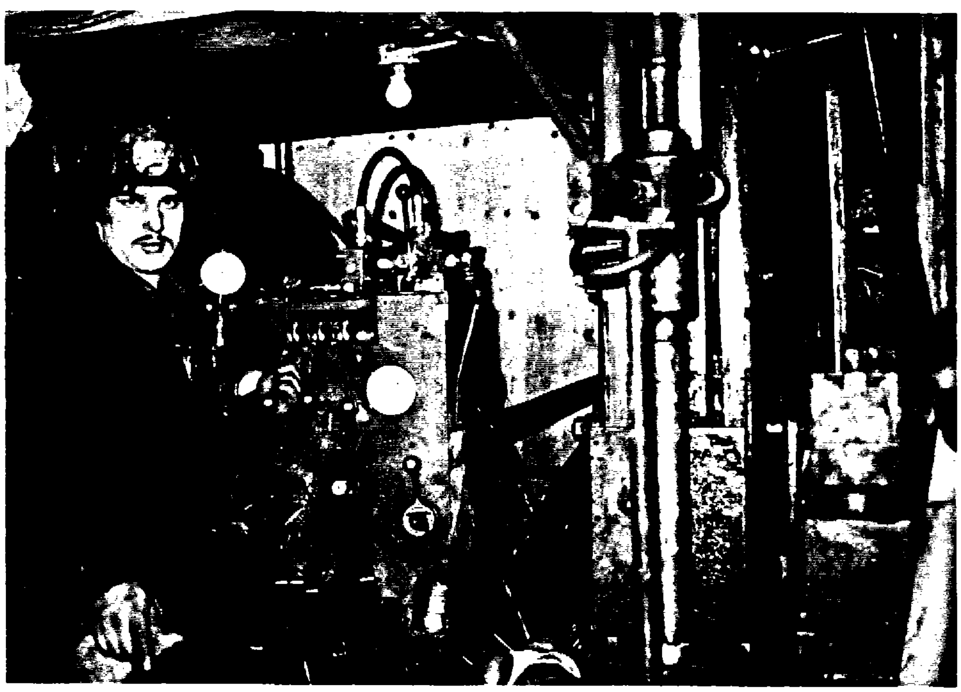


FIGURE 16: Interior of the Nodwell rig. Drill control panel and mast are shown.

the same as those specified above, except that the drill can readily be broken down into parts (3,500–4,000 lb or less) easily airlifted by a Bell 205 helicopter. This drill unit can also be further broken down into components (1,600 lb or less) that can be transported by smaller aircraft.

A polyethelene "sock" was used to enclose the drill shack on the fly Acker (Figure 17); this, in combination with an oil stove, provided tolerable working conditions. A diesel-fueled heater prevented shutdowns resulting from water freezing in the pump and in the waterlines.

The three rigs utilized 2 15/16" dual-tube rods for reverse-circulation drilling, and standard NQ diamond drill rods when employing triple-tube coring methods. Standard NW casing was used to case-off drillholes when required.

4.3 DRILLING TECHNIQUES

4.3.1 REVERSE-CIRCULATION DRILLING

Since the program to study the lignite potential of the James Bay Lowland requires drilling in unconsolidated Pleistocene and Mesozoic sediments, the most effective and cost-efficient drilling technique is reverse-circulation.

The components of the reverse-circulation method are depicted in Figure 19. The system is equipped with special dual-tube rods with an outside chamber through which high-pressure air and water are pumped to the tricone bit (either a carbide button or steel milltooth bit); the cuttings are then washed up the interior chamber to the surface. The slurry is directed into a cyclone, which impedes the high velocity of the return, and exits through a sieve and double-bucket sample collector. At this point, cuttings are identified, logged, and sampled at regular intervals of approximately 10 feet. The system on the fly Acker unit substitutes a single bucket and a trough for the double-bucket method of collecting samples; this is a useful alternative when large samples are not needed, because it continuously discharges cuttings outside the drill shack.

FIGURE 17: Aerial view of the helicopter-adapted "fly Acker" drill rig.

FIGURE 18: Interior view of the "fly Acker".

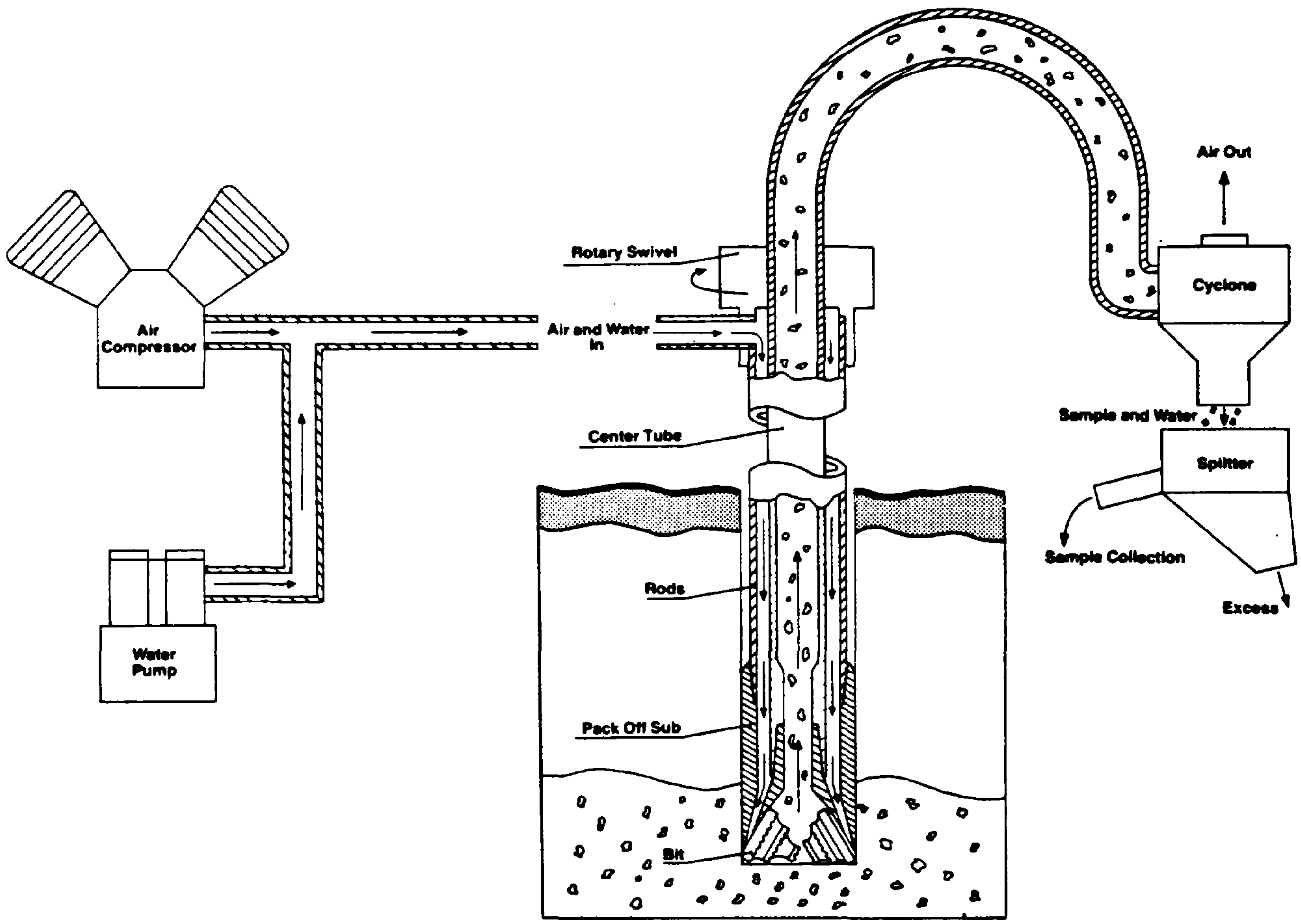


FIGURE 19: Diagram of a reverse-circulation drill system (modified from Heath & Sherwood Drilling).

Since there is very little lag time from the cutting of the rock material to its arrival at the surface, careful logging of the cuttings can give very accurate geological information; this has been verified by comparing results obtained at the site with geophysical logs. Unfortunately, cuttings may mix and minor contamination may result, especially when a rapid transition from a sand to a clay occurs.

Reverse-circulation drilling requires metal casing to be placed down the holes to reduce the risk of contamination, protect the drill string, and facilitate the change to the triple-tube coring method. Casing was particularly useful in deeper holes where conditions, such as the host sediments tightening around the rods, necessitated inserting casing to relieve the torque pressure on the rods. Also, if a sand seam is intersected while drilling, it must be cased off before switching to triple-tube coring. This prevents Cretaceous sands from packing in around and behind the core barrel (in the triple-tube system) and making it difficult, if not impossible, to retrieve the barrel.

The unconsolidated nature of the Mesozoic and Quaternary sediments makes necessary the insertion of plastic casing if wireline geophysical logging is required. In most cases, the plastic casing can be inserted successfully only if metal casing has been drilled past any highly unconsolidated sections. Once the plastic casing is in place, the metal casing is removed.

4.3.2 TRIPLE-TUBE CORING

The objectives of the 1983 drilling program included obtaining core of lignite and carbonaceous material, with a minor emphasis on the recovery of Cretaceous clays and Devonian sediments. This involved a switch from reverse-circulation drilling to the triple-tube coring technique.

Triple-tube coring consists of a standard diamond drill set-up, including a thin-walled split tube inside the core barrel. A diamond step-bit was able to penetrate the relatively soft sediments occurring in the James Bay region easily, and proved extremely durable.

Core may be recovered from a variety of sediments, including Pleistocene tills; Cretaceous clays and lignite; and Paleozoic shale, mudstone, and various highly fractured and porous limestones. Unfortunately, a competent clay matrix is required for sediments to be cored successfully; otherwise, the core may become lodged in the rods due to sand breaching the space between the split-tube and interior chamber.

4.4 DRILLING PROBLEMS ENCOUNTERED

Throughout the 1983 drilling program, a variety of problems were encountered, primarily technical and mechanical. The following brief discussion of these problems hopefully will be of assistance in planning future programs.

The major difficulties encountered in drilling in the James Bay Lowland pertain to the unconsolidated silica sands that are widespread in many parts of the basin. These sands cannot be cored. Generally, reverse-circulation drilling of sands is effective: returns are good, and the rate of progress is satisfactory. However, thick successions of sand and gravel can cause the drill rods to stop rotating, as pressure from caving around the rods increases the torque. This was the case in most holes drilled through thick sands in past programs. In some instances, the torque required to keep the rods rotating surpasses the specifications of the drill; the rods become stuck as a result, and the rods or casing may shear off. Driving casing well into the sand unit can usually reduce the torque pressure on the drill rods.

Given the porous and unconsolidated nature of sand and gravelly units, another common problem was loss of water-return in these sediments, preventing the return of material to the surface. The use of bentonite mud and liquid polymer, to build a "wall" between the dual-tube rods and the sand, helped to ensure constant water return by sealing the porous units. Driving casing through sands and gravels achieve similar results.

Clogging and plugging of reverse-circulation bits and bit adapters occurred occasionally when sand and clay horizons were being drilled. This necessitated the pulling of rods in some cases. This problem is sometimes unavoidable, but clearing the reverse-circulation rods after each run is a good preventative measure. If the water pressure is carefully monitored, a skilled and alert driller can also decrease or increase the pressure on the hydraulic head accordingly, when drilling units of varying competence.

When employing triple-tube coring methods, problems with poor core recovery were evident. On one occasion, this unfortunately occurred in the middle of a lignite intersection; thus, the coring of lignite in ONEX-W83-09 is incomplete. (Hole locations are shown on Drawings 4 and 10.) In general, poor core recovery was probably due to sandy intervals; however, there was some evidence of grinding of core. To minimize such losses, an alternative would be to utilize a 5-foot core barrel instead of the standard 10-foot core barrel. This would also be more practical on the Nodwells, given the size constraints imposed by the small drill shack.

In several holes, particularly those with significant sand, it was found that the plastic casing could not be lowered to the depth at which the drilling terminated. This was probably due to hydrostatic pressure forcing sand up the metal casing. Unfortunately, this prevented the completion of full geophysical logs and only partial logs are available for some holes. Depending on the hydrostatic pressure, this problem is at times unavoidable; however, if the plastic casing is lowered down the hole immediately upon completion of the drilling, this difficulty should be lessened. Conducting the geophysical survey without inserting the plastic casing reduces time for the sands to rise up the metal casing; this would, however, entail a minor adjustment to the geophysical data and would also require the geophysicist to be on-site immediately following completion of the hole. Logging through metal casing also reduces the sensitivity of the instrumention.

In a few holes, there was breakage at the joints of strings of plastic casing, especially in very cold weather, which makes the plastic pipe brittle. Inspection of casing joints and careful insertion by the drillers usually remedies this situation.

It was discovered that spillage from the water return was undermining the ice and snow at a few drillsites, and also caused freezing of the Nodwell tracks to the pack. This necessitated chopping the ice with hammers and axes to free the tracks. Additionally, there were minor problems with the Nodwells sinking in softer surfaces, particularly the ground during periods of warmer weather. When this occurred, the alignment of the drill mast and rods became offset, risking the snapping of drill rods. Subsequent set-ups utilized logs underneath the Nodwell tracks, preventing freezing of the tracks to the ground and distributing the weight of the Nodwells over a greater surface area, minimizing sinking.

The cold weather caused a few other problems, such as freezing the equipment and discomfort to personnel, particularly during night shifts. Propane space-heaters and torches provided heat at the drill, which was sufficient except during the coldest nights (-20° to -30°C). The polyethylene sock that was used to enclose the fly Acker drill could be adapted for use on the Nodwell-mounted rigs, retaining the heat that would otherwise escape through the roof, and minimizing fuel consumption.

The drill rigs and support vehicles underwent various mechanical breakdowns during the program. The compressor unit on Acker No. 1 was replaced a number of times. The Bean water pump also broke down on several occasions. These problems were due in part to freezing; thorough examination of these components in the shop prior to mobilization will ensure that malfunctioning equipment is repaired and operating efficiently when shipped into the field.

The support vehicles, specifically the Bombardier passenger snowmobile and the diesel Muskegs, experienced numerous mechanical difficulties, including blocked fuel lines, malfunctioning starter motors, impurities in the fuel, and components breaking under excessive vibration. It may be advantageous in future winter programs to utilize 4-wheel drive trucks for transporting personnel and light-weight equipment to supplement the heavier-duty tracked vehicles; these lighter vehicles could negotiate most of the winter roads, if they are kept well packed and properly cleared.

The problems encountered during the 1983 program did not severely hinder the progress of the program, but were an inconvenience, resulting in some downtime. It is inevitable that some problems will arise, however, particularly in a winter program.

4.5 DRILLING SUMMARY

Statistics on drilling hours and footages are summarized in Tables 2 and 3. Generally, moving and set-up times were kept to a minimum on the overland program, given the relative ease of moving from hole to hole.

The cost of consumable goods used on both the overland and helicopter-supported portions of the 1983 program are summarized in Tables 4 and 6. Similarly, summaries of drill costs appear on Tables 5 and 7.

The program terminated on April 17th, with the completion of ONEX-W83-28(H3).

TABLE 2

SUMMARY OF NODWELL-SUPPORTED DRILLING TIME

Hole Number	R-C Drilling Hours	NQ Drilling Hours	Rod Handling Hours	Casing Hours	Service and Mechanical Hours	Standby Hours	Misc. Hours	Moving Hours	Total Hours	Rig Number
Mobilization								186.0[1]	186.0	
ONEX-W83-01	11.0	33.75	9.75	13.25	8.25	8.75	3.75	—	88.5	2
ONEX-W83-02	28.75	9.25	11.75	9.5	5.25	3.25	9.25	1.5	78.5	2
ONEX-W83-03	22.0	—	4.75	9.5	1.25	—	29.75[2]	6.0	73.25	2
ONEX-W83-04	25.5	—	3.75	24.5	16.5	27.5[3]	5.75	2.5	106.0	2
ONEX-W83-05	31.75	—	6.75	—	3.0	1.5	1.5	—	44.5	1
ONEX-W83-06	18.0	9.25	2.5	17.0	6.25	—	5.0	5.75	63.75	2
ONEX-W83-07	18.75	8.0	4.75	13.75	1.75	—	9.0	4.5	60.5	2
ONEX-W83-08	9.25	—	1.0	—	6.5	1.25	.5	6.5	25.0	1
ONEX-W83-09	54.5	21.0	28.5	19.5	49.0[4]	29.0	19.0	4.0	224.5	1
ONEX-W83-10	8.0	20.0	4.0	—	1.5	—	3.75	6.0	43.25	2
ONEX-W83-11	33.5	11.0	9.0	11.0	17.5	5.5	5.5	5.25	98.25	2
ONEX-W83-12	57.75	14.75	10.75	24.75	16.25	3.0	5.0	4.5	136.75	1
ONEX-W83-13	14.0	19.75	10.0	28.0	8.0	1.0	14.75	8.0	103.5	2
ONEX-W83-14	18.0	—	1.0	8.5	3.0	—	1.5	5.0	37.0	2
ONEX-W83-15	17.0	—	1.0	12.5	.5	—	5.0	4.5	40.5	2
ONEX-W83-16	18.0	—	—	13.5	—	1.5	3.0	3.0	39.0	2
ONEX-W83-17	11.0	—	.5	—	.5	—	—	4.0	16.0	2
ONEX-W83-18	5.75	—	2.25	—	3.0	—	—	10.75	21.75	1
ONEX-W83-19	9.0	—	1.25	—	—	—	—	2.75	13.0	2
ONEX-W83-20	30.75	—	3.0	12.5	4.25	—	3.75	4.0	58.25	2
ONEX-W83-21	12.75	—	1.0	—	.5	—	—	4.75	19.0	1
ONEX-W83-22	15.5	14.25	5.75	10.25	3.5	1.5	1.0	5.75	57.5	1
ONEX-W83-23	9.0	26.0	5.0	10.5	.5	5.0	9.0	11.0	76.0	2
ONEX-W83-23A	19.25	—	1.0	—	—	—	4.75	1.5	26.5	2
ONEX-W83-24	9.75	6.25	6.0	6.75	9.0	3.0	3.0	3.5	47.25	1
ONEX-W83-25	21.75	—	2.75	14.0	1.75	2.0	2.0	8.25	52.5	1
Demobilization								192.0[5]	192.0	
Totals	530.25	193.25	137.75	259.25	167.50	93.75	145.50	501.25	2,028.50	

[1]Both rigs; Smokey Falls to ready-to-drill at ONEX-W83-01, 32 miles; conversion to rig hours, $557.5 \div 3 = 185.8$.
[2]Recovering dual tubes and NW casing.
[3]Broken shaft between power pack and hydraulic pump; wait for parts.
[4]Multiple compressor failure.
[5]Both rigs; OEC camp to Smokey Falls; conversion to rig hours, $576 \div 3 = 192.0$.

TABLE 3

SUMMARY OF HELICOPTER-SUPPORTED DRILLING TIME

Hole Number	R-C Drilling Hours	NQ Drilling Hours	Rod Handling Hours	Casing Hours	Service and Mechanical Hours	Standby Hours	Misc. Hours	Moving Hours	Total Hours	Rig Number
ONEX-W83-26(H1)	40.5	—	8.75	26.25	1.5	19.5	24.75*	8.0	129.25	5
ONEX-W83-27(H2)	30.75	—	5.25	30.00	.75	8.0	15.75	10.0	100.5	5
ONEX-W83-28(H3)	20.0	18.25	14.5	12.25	3.25	12.0	15.5	30.75**	126.5	5
Totals	91.25	18.25	28.5	68.5	5.5	39.5	56.0	48.75	356.25	

*Includes mobilization.
**Includes demobilization of drill rig to Smokey Falls and disassembly of drill.

TABLE 4

COSTS OF CONSUMABLES
1983 NODWELL-SUPPORTED DRILL PROGRAM

Carbide Button Bits, Tricone (32)	$24,832.00
Bit Subs (13)	3,406.00
Head Rods (5)	1,250.00
2 15/16" Dual-Tube Rod (1)	325.00
NW Casing — 10-foot (50)	6,727.50
NW Casing Shoes (24)	1,275.60
Drilling Mud — 50 lb (283)	2,999.80
Liquid Polymer — 20 L (11)	1,815.00
Core Trays	546.25
	$43,177.15

TABLE 5

DRILL COST SUMMARY
FOR NODWELL-SUPPORTED DRILLHOLES

Mobilization and Demobilization	$ 45,265.62
Drilling	144,554.85
Moving	11,783.40
Service and Mechanical Costs	20,094.05
Standby	2,554.67
Travel Time	8,950.00
Consumable Costs	43,177.15
	$276,379.74

Total Footage	8,116 feet (2,473.8 m)
Average Cost Per Foot (Metre)	$34.05 ($111.72)
Average Cost Per Hole	$10,629.99

TABLE 6

COST OF CONSUMABLES
1983 HELICOPTER-SUPPORTED DRILL PROGRAM

Carbide Button Bits, Tricone (4)	$ 3,104.00
Bit Subs (2)	524.00
Head Rod (1)	250.00
2 15/16" Dual-Tube Rod (1)	325.00
NW Casing — 10-foot (5)	672.75
NW Casing — Shoes (3)	159.45
Bentonite — 50 lb (80)	848.00
Liquid Polymer — 20 L (2)	330.00
	$ 6,213.20

TABLE 7

DRILL COST SUMMARY
FOR HELICOPTER-SUPPORTED DRILLHOLES

Mobilization and Demobilization	$ 2,812.50
Drilling	22,195.63
Footage	3,287.40
Moving	1,531.25
Service and Mechanical Costs	469.97
Standby	1,668.00
Travel Time	1,050.00
Consumables	6,213.20
	$39,227.95

Total Footage	1,182 feet (360.3 m)
Average Cost per Foot (Metre)	$33.19 ($108.88)
Average Cost per Hole	$13,075.98

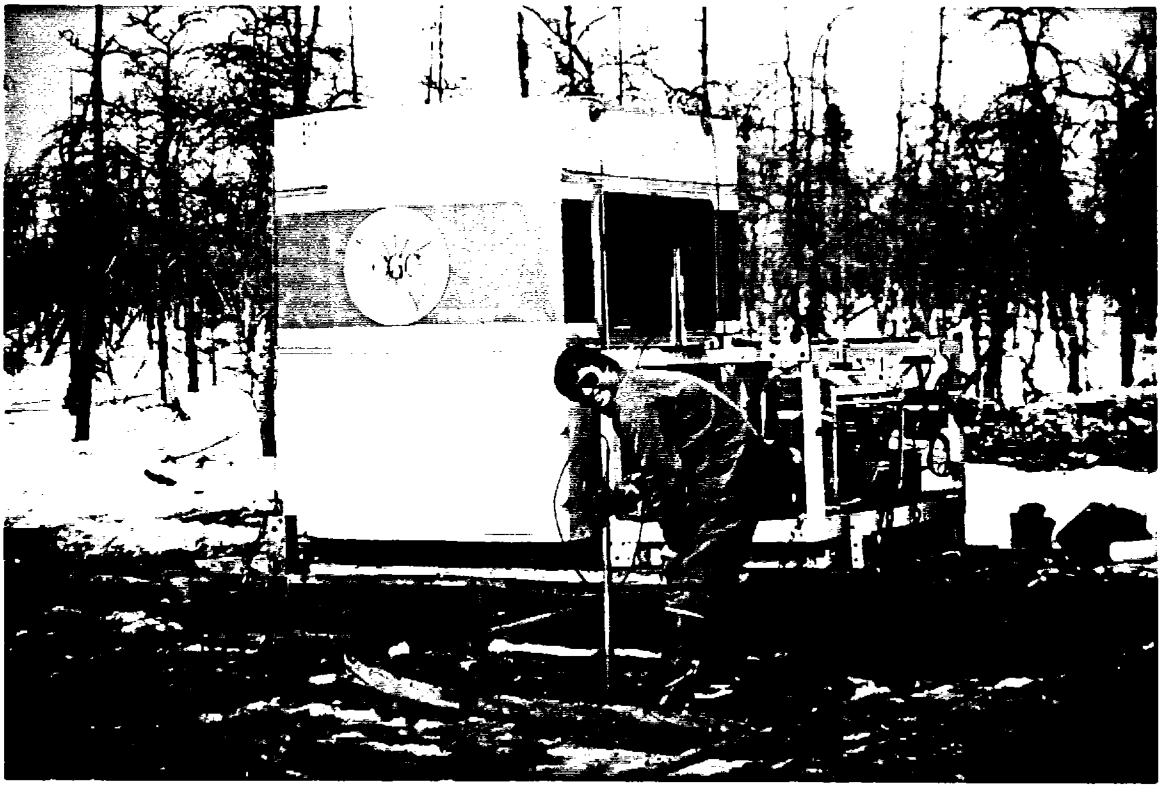


FIGURE 20: Century's helicopter compu-log unit. Both components are mounted on a sled for overland transport.

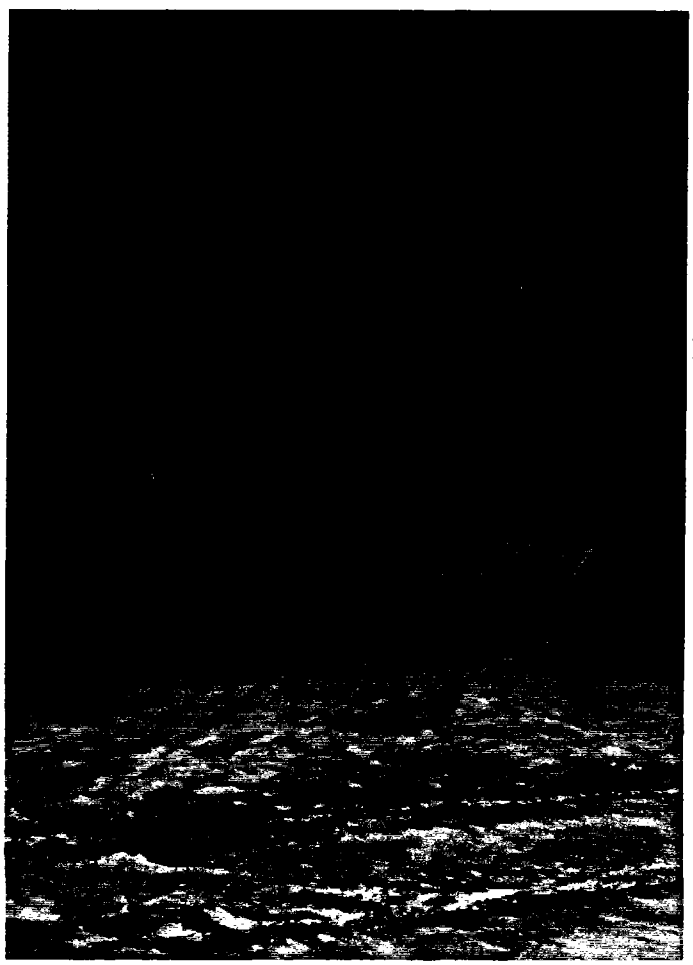


FIGURE 21: Bell 205 slinging the entire geophysical unit.

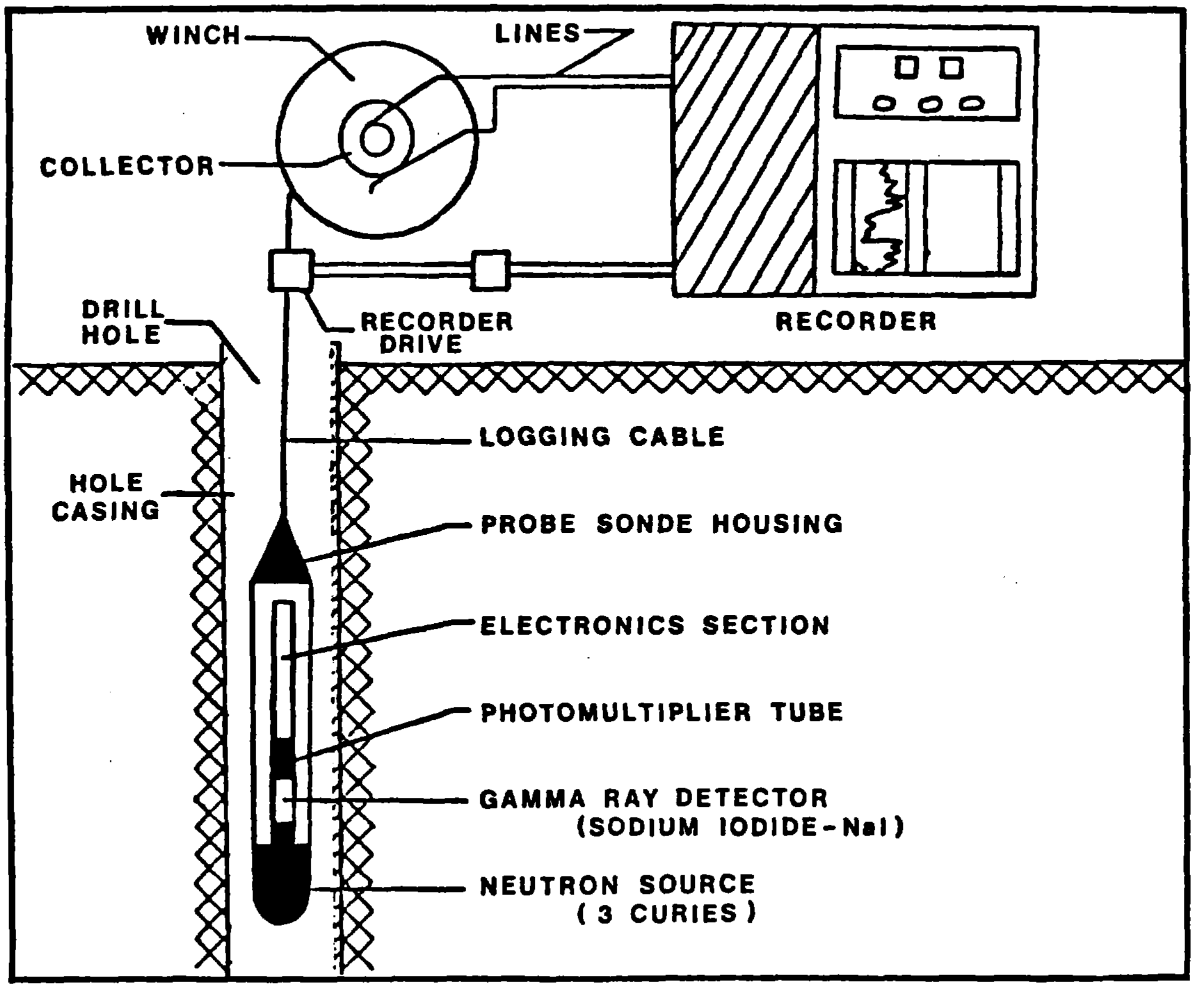


FIGURE 22: Diagram of a wireline electric logging system.

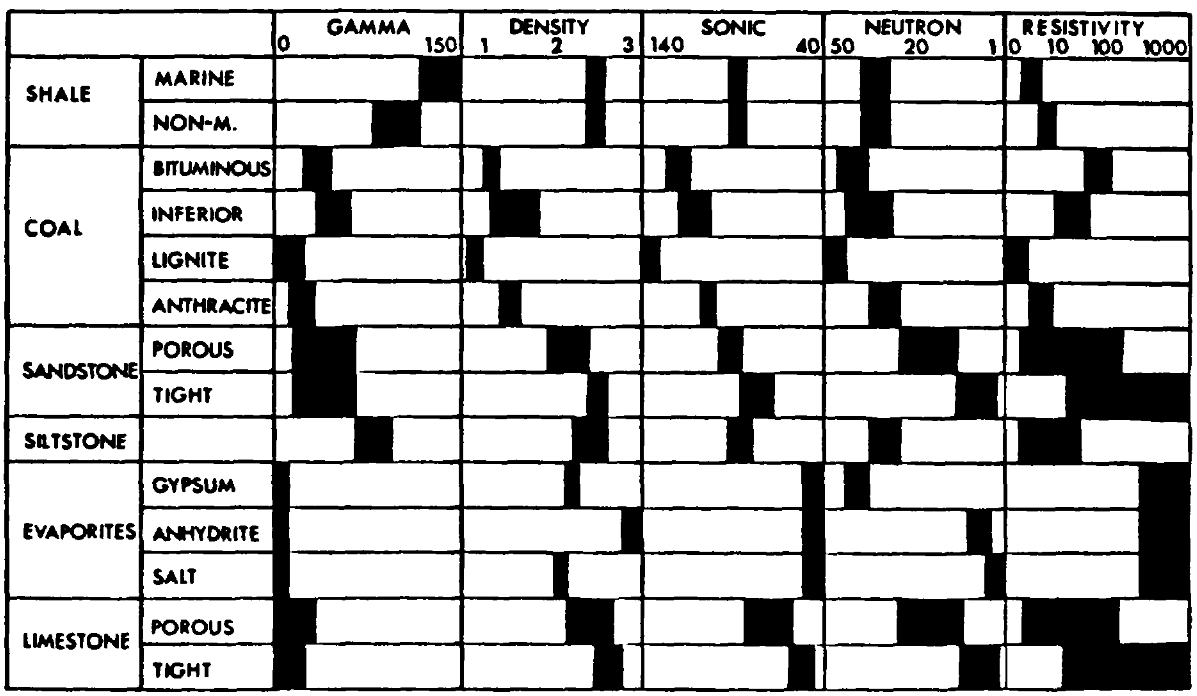


FIGURE 23: Lithology vs. tool response summary (from BPB 1981 Coal Interpretation Manual).

Although the density log itself is not diagnostic of lithology, when coupled with the gamma log, they become very useful in analyzing sediments such as those in the James Bay region.

The neutron log responds to hydrogen in the formation, and therefore measures the water present in each formation. For example, shale gives a high reading due, in part, to the water content of mica and clay, but largely due to free water in pores and parting planes. Lignite also gives a strong response due to its high moisture and hydrogen contents, and tends to produce higher readings than the shale. Both sandstone and limestone have variable porosities, and neutron measurements will vary accordingly.

A summary of the range of responses from various types of lithologies is illustrated in Figure 23. The system used by Century Geophysics is depicted in Figure 24.

The logging unit consists of two principle pieces: an aluminum shack (6 x 6 x 5 feet) that contains all the logging equipment (computer equipment, recorder, heater, and supply space), as in Figure 24; and a steel framework with winching gear, power plant, and the "pigs" that house the radioactive sources.

Geophysical logging was carried out through plastic casing, which was inserted into the drillholes upon completion of the hole. Unfortunately, several of the problems that were encountered in the previous field season recurred during the winter drilling program. The hole often collapsed below the base of the metal casing, or hydrostatic pressure caused sand to rise up the metal casing, preventing the plastic pipe from reaching the full depth of the hole. Also, plastic pipe would become lodged at the base of the metal casing; consequently, when the metal casing was removed, the plastic casing would slip several feet below the collar. Drillhole ONEX-W83-02 was not logged because of this particular problem.

Despite occasional difficulties experienced with the plastic pipe (including its increasingly brittle nature in cold weather), geophysical work can be conducted very effectively through the casing. Metal casing can also serve as a suitable conduit for geophysical probes, although the sensitivity is significantly reduced.

FIGURE 24: The computerized geophysical recording system.

A total of 14 holes were surveyed by geophysics. Total footage covered by each probe was 4,187 feet (1,276 m). Geophysical logs are included in Volume II of this report.

6. REGIONAL GEOLOGY

6.1 GENERAL STATEMENT

Lithologies underlying and forming the Moose River Basin range in age from Archean to Recent (Table 8). The general geology of the Moose River Basin, excluding Quaternary geology, is summarized in Figure 25. The following section summarizes salient features of the general geology.

6.2 PRECAMBRIAN GEOLOGY

Metavolcanic and metasedimentary rocks of Archean age underlie the Moose River Basin. These rocks range from mafic to felsic and are intruded largely by granites and to a lesser extent by mafic intrusives and diabase dykes. High-grade metamorphic rocks are exposed immediately southeast of the basin and are associated with a broad northeast-trending fractured zone.

Structurally, the southern margin of the Moose River Basin is bounded by an east–west-trending escarpment, marking a buried normal fault. The rocks have undergone extensive faulting and uplift. This boundary fault likely was intermittently active over a long period of time, and was probably active when the Cretaceous sediments were being deposited. Upper Precambrian rocks of probable Proterozoic age are represented by diabasic dyke swarms and carbonatite complexes, which are associated with major structural lineaments in the area.

6.3 PALEOZOIC GEOLOGY

Paleozoic rocks in the licence area are represented by the Middle Devonian Williams Island Formation and the Upper Devonian Long Rapids Formation.

TABLE 8

TABLE OF FORMATIONS

ERA	PERIOD	FORMATION	LITHOLOGY
CENOZOIC	RECENT	Post Glacial Deposits	Post-glacial: peat, calcareous lucustrine and marine clay, and shell-bearing sand.
	PLEISTOCENE	Glacial Deposits	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, sandstone, non-indurated, quartzose, coarse "silica sand", lignite.
		Unconformity	
	JURASSIC	MISTUSKWIA BEDS	Well-sorted calcareous quartz sands and silty clays.
		Unconformity	
PALEOZOIC	UPPER DEVONIAN	LONG RAPIDS FORMATION	Dark shales, siltstone and clays, grey–green and chocolate-coloured mudstones, minor limestone and dolomite.
	MIDDLE DEVONIAN	WILLIAMS ISLAND FORMATION	Oolitic fossiliferous limestone, argillaceous limestone, and calcareous shales.

Modified after Price (1975).

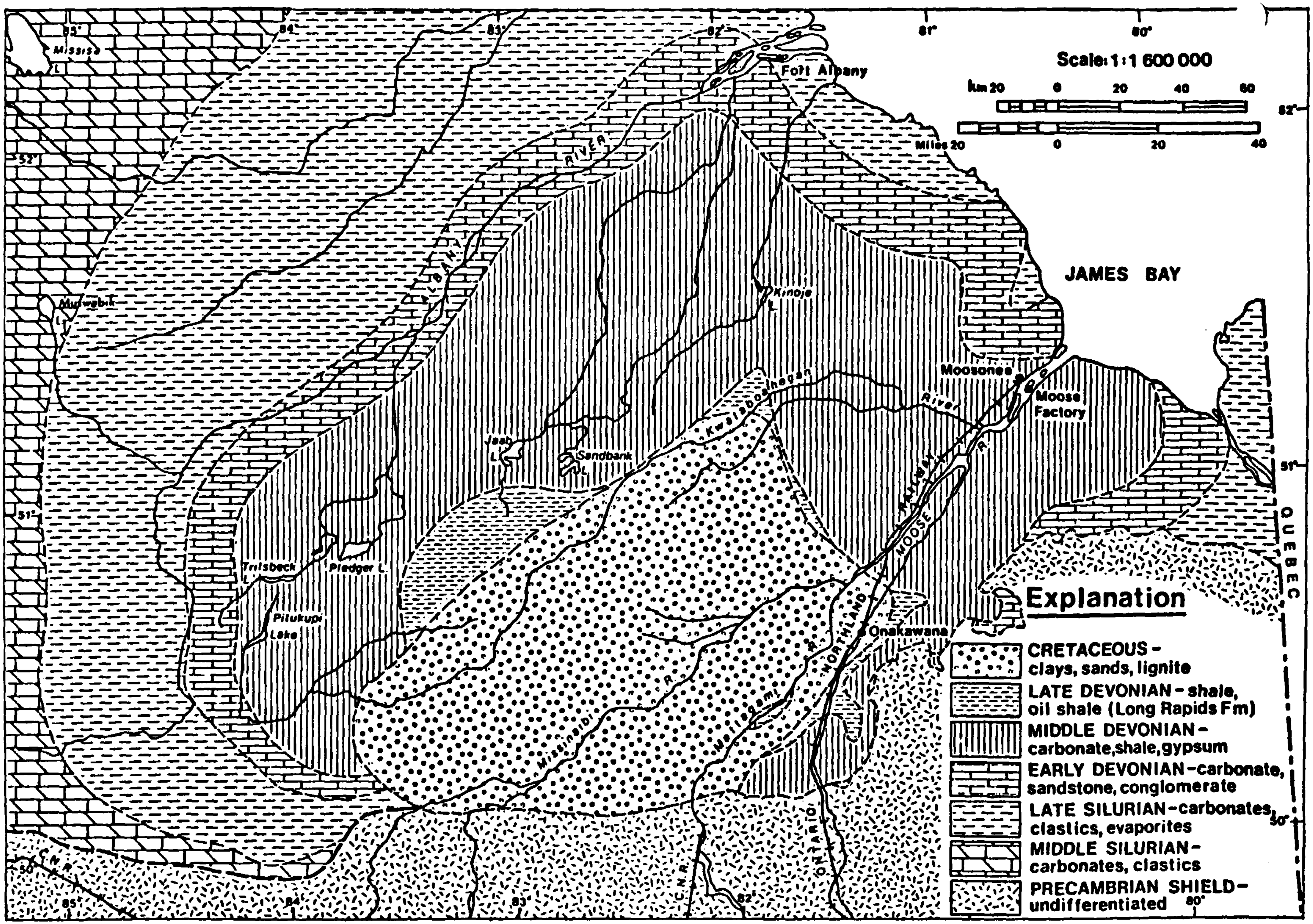


FIGURE 25: General geology of the Moose River Basin.

Limestones and calcareous shales of the Williams Island Formation underlie the Long Rapids Formation. The carbonates are characteristically oolitic and fossiliferous (biosparites and biomicrites) and are locally argillaceous. The Williams Island Formation shales are bluish-grey, contrasting with the dark grey to black bituminous shales characteristic of the younger Long Rapids Formation. Angular blocks associated with Cretaceous solution-collapse breccias are included in the upper beds of the Williams Island Formation.

The Long Rapids Formation in the Moose River Basin composes the uppermost Paleozoic unit, and consists largely of dark shales, siltstones, and clays, interbedded with grey-green and chocolate-coloured mudstones, in addition to minor bands of limestone and dolostone. The dark shales commonly contain pyrite, and occasionally feature iron nodules. Palynological studies obtained from earlier work have yielded assemblages of spores and microplankton consistent with an Upper Devonian (Frasnian–Famenian) age. The Long Rapids Formation has potential economic importance as a source of oil shale (WGM 1982, 1981).

6.4 MESOZOIC GEOLOGY

Mesozoic sediments in the license area consist of two lithostratigraphic units, the Middle Jurassic Mistuskwia Beds and the Cretaceous Mattagami Formation. The Mistuskwia Beds are separated from the overlying Mattagami Formation and the underlying Long Rapids Formation by major unconformities.

Drilling programs conducted by the Ontario Division of Mines in 1975 confirmed the presence of Mistuskwia sediments in the western part of the Moose River Basin (Telford and Verma 1982). According to these studies, the Mistuskwia Beds consist largely of unconsolidated quartz sands and clays. Lithologically, these sediments are similar to the overlying Mattagami Formation, and sometimes can be differentiated from the latter only through palynological analyses and petrographic studies. Texturally, the Middle Jurassic sands are more mature (well sorted, rounded, high sphericity) than the subangular–angular, often poorly sorted sands of the Mattagami Formation. Clays belonging to the Mistuskwia Beds often display a silty–sandy texture, as opposed to the less gritty clays of the Mattagami Formation. In addition, the Jurassic units are generally calcareous, whereas the Cretaceous sediments are rarely so.

Originally it was thought that none of the sediments drilled in the licence area were Jurassic, although a sequence in ONEX-82-14 (McBrien Township) is possibly of Jurassic age. On closer examination of material from ONEX-W83-23 (McCuaig Township), it was decided that a thin sequence of calcareous clays and sands are probably extensions of the Jurassic Mistuskwia Beds. This occurrence contains a concentration of pyrope garnets, and is further discussed in Chapter 7. It has also been unofficially reported that 1983 drilling by the OGS north of the Missinaibi River indicated some probable Jurassic beds.

Uncomformably overlying the Jurassic Mistuskwia Beds are the Lower Cretaceous sediments that constitute the Mattagami Formation (Dyer and Crozier 1933). Intersections of Cretaceous sediments obtained during the 1983 ONEXCO drilling program revealed quite variable lithologies. Two distinct facies associations are present: one comprises interbedded units of quartz sands and pebble sands, light grey to white kaolinitic clays, and sequences of variegated clays; the other contains dark grey to black, carbonaceous clay, commonly interbedded with quartzose clastic units and lignite seams.

Brown et al. (1967) have reported a number of kimberlite-like intrusions and sills in the general vicinity of the southern boundary of the James Bay Lowland at Coral Rapids. The age relationships of these intrusions have not clearly been defined; however, they apparently post-date the Paleozoic sediments and pre-date Cretaceous sediments. As indicated in Section 7.3.1, evidence now indicates that the kimberlites may be Jurassic or older.

6.5 QUATERNARY GEOLOGY

The Quaternary geology of the Moose River Basin has been described by Skinner (1973). A thorough summary of Quaternary stratigraphy was included in WGM's 1982

TABLE 9

QUATERNARY ROCK-STRATIGRAPHIC UNITS AND INFERRED EVENTS, MOOSE RIVER BASIN (from Skinner 1973)

ROCK-STRATIGRAPHIC UNIT	INFERRED EVENT	AGE C^{14} years B.P.
Terrestrial unit	weathering; peat and forest growth eolian activity stream incision and deposition	
Marine unit	marine recession marine incursion	7,800
Glaciolacustrine unit	glacial retreat	
KIPLING TILL	glacial advance	
Friday Creek sediments	retreat	
ADAM TILL	glacial advance	
MISSINAIBI FORMATION: Lacustrine member	lacustrine transgression	
MISSINAIBI FORMATION: Forest-peat member (buried soil)	weathering; peat and forest growth	>54,000
MISSINAIBI FORMATION: Fluvial member	stream incision and deposition	
MISSINAIBI FORMATION: Marine member	marine recession marine incursion	
	glacial retreat	
TILL III	advance	
Intertill sediments II-III	retreat	
TILL II	advance (glaciation)	
Intertill sediments I-II	retreat	
TILL I	advance	

summary report for ONEXCO and need not be repeated here. Quaternary rock-stratigraphic units of the Moose River Basin are summarized in Table 9. The predominant units are tills, quite calcareous, and possessing clayey matrixes with varying amounts of sand. The tills contain a wide range of clasts, predominantly of Precambrian and Paleozoic lithologies.

Overlying the Pleistocene sediments of the Moose River Basin is a thin veneer of Recent deposits. These deposits consist of three distinct units: a glaciolacustrine unit, a marine unit, and a terrestrial unit (Skinner 1973; Figure 26).

6.6 STRATIGRAPHIC RESULTS

The following section summarizes the stratigraphic units intersected in the 1983 drilling program. A more detailed examination of the stratigraphy is depicted in the geological and geophysical logs included in the Appendix. Local thicknesses of Pleistocene and Cretaceous units, in addition to depths to the Paleozoic, are illustrated in Drawings 1, 2, and 3 (see map pocket). Cross-sections across the East and West Gentles grids are depicted in the map pocket of Volume II.

6.6.1 QUATERNARY

All of the 1983 drillholes penetrated a relatively thin veneer of Recent deposits. Each hole also intersected a layer of peat, ranging in thickness from 0.6 m to 3.4 m. Most of the holes intersected a unit of light green-grey calcareous clay that is relatively soft, and contains abundant bivalve fragments locally. These clays are representative of the marine unit described by Skinner (1973; Figure 26). The maximum thickness of this marine clay measured during 1983 drilling was 7.9 m.

Polymictic sand and gravel units underlying the marine clays were encountered in five holes. In hole ONEX-W83-24, a sand and gravel horizon attaining a thickness of 8.5 m was intersected. This coarse clastic unit could be Pleistocene, but has tentatively been assigned a Recent age.

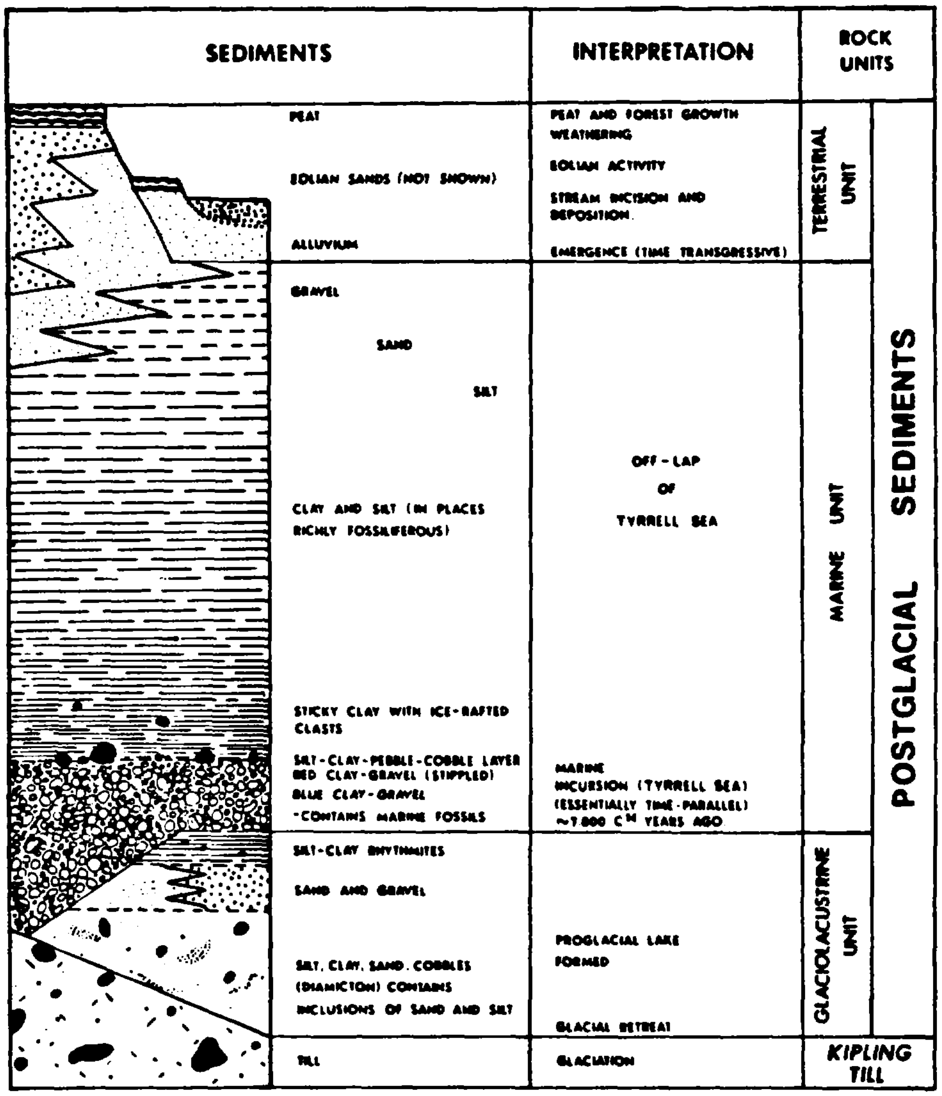


FIGURE 26: Hypothetical composite late- and post-glacial section (from Skinner 1973).

Pleistocene units are dominated by the presence of tills and clays. For convenience in the field, the top of the Pleistocene section was denoted by the first appearance of obvious tills. The base of the section was designated by the first intersection of quartz sands (Cretaceous), non-calcareous clays (Cretaceous), calcareous clays (Devonian), or limestones (Devonian).

As illlustrated on Drawing No. 1, thicknesses of Pleistocene units in the vicinity of the drilling locale are quite variable. The thickest intersection (124.7 m) was obtained from ONEX-W83-04, and the thinnest (23.2 m) from ONEX-W83-07.

The various Pleistocene till units were not differentiated in the field. As indicated by reverse-circulation cuttings, they are largely light grey-green clay–sand–pebble tills, invariably calcareous, containing clasts typical of Precambrian and Paleozoic lithologies. They are generally similar in nature, with varying proportions of sand, silt, and clay in the matrix. Thin successions of light- to dark-grey calcareous clay are commonly interbedded with the till horizons. Other units intersected in the Pleistocene section include polymictic gravels, "salt and pepper" calcareous sands, and pebble sands.

More regional work is required before a detailed pattern of the Pleistocene glaciation emerges. Results obtained from the drilling of the East and West Gentles grids tentatively suggest a northwest-trending structural high transecting Gentles Township, with two marginal valleys containing substantial thicknesses of Pleistocene sediments flanking it. This inferred high, with its relatively thin blanket of Pleistocene deposits, may be representative of the Grand Rapids Arch, a pre-Quaternary uplands region less affected by glaciation than the adjacent valleys. Isopach maps, depicting Cretaceous sediment thicknesses and depths to the Devonian, are also consistent with this hypothesis.

Future regional work should take note of the distribution of Quaternary sediments, which has significance with regard to lignite exploration. Several of the holes drilled in the current program contain minor to appreciable chips of lignite in the till horizons. This suggests that reworking of surface exposures of lignite occurred during the Pleistocene, and that the lignite clasts were not transported great distances.

6.6.2 CRETACEOUS

Cretaceous sediments were intersected in all but seven of the holes drilled in the current program. Previous regional drilling programs (WGM 1982a, b) indicated that the Mattagami Formation is diverse in thickness and distribution. This was affirmed during 1983 drilling, on a much more detailed scale. The Mattagami Formation was intersected in several of the 1983 drillholes, but is noticeably absent in holes drilled short distances away. The maximum thickness of the Mattagami Formation as disclosed by 1983 drilling is 81.1 m (ONEX-W83-03) and the minimum, 2.9 m (ONEX-W83-06).

The Cretaceous sediments examined during 1983 drilling consist of clays, sands, gravels, and lignite. The clays are largely medium to dark grey, and occur occasionally as variegated sequences. The Cretaceous sands are generally quartz-rich, although they can vary in appearance. Colours range from off-white (almost pure quartz) to medium grey (quartz-rich, but containing lithic fragments), and grain size varies from very fine to pebble sands. The sands usually display poor sorting, although there are intervals of good sorting; the clastic material is normally subangular to subrounded, and bedding is ill-defined. Fine-grained equivalents of the silica sands commonly contain moderate amounts of fine-to-medium muscovite flakes. Coarse-grained and pebble sands often contain well-indurated aggregates of detrital pyrite and clastic quartz, and often contain a small clay component binding the clastics. Detrital lignite chips and woody fragments were found in many of the sands.

Lignite seams are associated with dark grey to black units of carbonaceous clay, but occasionally were interbedded with sands. A more detailed discussion of lignite is included in the following section on Economic Geology.

6.6.3 JURASSIC

Earlier regional work conducted in 1975 by the Ontario Geological Survey (OGS) was the first to identify sediments of Jurassic age (Telford and Verma 1982). These sediments, informally named the Mistuskwia Beds (Telford et al. 1975) were encountered in holes drilled in 1975. These sediments consist of variegated, silty clays with thin interbeds of calcareous quartz-rich sands. These units have been assigned a Middle Jurassic age on the basis of palynological studies (Norris in Telford and Verma 1982).

Readily identifiable Mistuskwia Beds were not encountered during the recent drill program; however, a relatively thick succession (64 feet) of light- to pale-green silty clays, green to brown claystones, and interbedded units of calcareous quartz sands was intersected in ONEX-W83-23. These sediments are similar to descriptions of Mistuskwia Beds; thus, they have tentatively been assigned a Middle Jurassic age indicative of the Mistuskwia Beds. However, palynological and petrographic examinations are required to further define the age and nature of these sediments.

6.6.4 DEVONIAN

Devonian units were intersected in 15 of the 29 holes drilled in 1983.

Holes ONEX-W83-05, -07, -14, -19, and -23 intersected units of light to medium grey and tan limestone, dominantly fine-grained and relatively thinly bedded. The carbonates are characteristically well indurated, generally non-porous, and contain occasional thin beds of calcareous claystone. These units have numerous similarities to and are tentatively correlated with the Middle Devonian Williams Island Formation. Micropaleontological age determinations would fully confirm these correlations.

A number of holes intersected dark grey and chocolate-brown clays interbedded with pale green clay; these clay sequences are commonly intercalated with thin horizons of limestone and, to a lesser extent, dolomite. These units are very similar to occurrences of known Upper Devonian Long Rapids Formation, nearby. The thickest unit of these sediments (39.9 m) was obtained from ONEX-W83-07.

6.7 GENERAL STRUCTURE

The Moose River Basin is bounded on the northwest by the Cape Henrietta–Maria Arch, a structure that separates it from the rest of the Hudson Bay sedimentary basin. It is similarly bounded on the south by the Fraserdale Arch, which separates the Moose River Basin from the Williston and Alleghany Basins.

The southern boundary of the Moose River Basin is marked by a major east-trending escarpment, suggesting faulting and uplift of the Precambrian rocks relative to the rocks in the basin. This is evidenced by the apparent truncation of Paleozoic and Mesozoic sediments along its length. Price (1975) has suggested that there were probable episodes of reactivation along the fault resulting in the deposition of arkosic sediments in the basin from the adjacent Shield, followed by Devonian and Cretaceous sedimentation. Previous work in the region has shown that the Cretaceous sediments of the Mattagami Formation are thickest at the southern margin of the basin and thin northwards.

Major lineaments and faults in the general area occur along two main strike trends, north to northwest, and northeast. Southeast of the basin, diabase dyke swarms and occasional carbonatite complexes are associated with the northeast-trending faults. This implies that faulting and the emplacement of these intrusive complexes may be contemporaneous, indicating a Late Proterozoic age.

A broad, northwest-trending structural high has been recorded in earlier literature on the structural geology of the Moose River Basin (Sanford et al. 1967; Sanford and Norris 1975). This structure, known as the Grand Rapids Arch, likely influenced sedimentation patterns, as indicated by the distribution and thickness of Cretaceous and possibly Pleistocene sediments in various areas of the Moose River Basin. In Gentles Township, the area drilled in the recently completed program, a structural high transects the township in an apparent northerly trend. This inferred high may be an extension of the Grand Rapids Arch. This structural high is overlain by a relatively thin veneer of Cretaceous sediments; in some holes, Cretaceous units are absent. Flanking the arch are two marginal valleys containing substantial Cretaceous sediments.

Other structural features in the Moose River Basin include the northwest-trending Moose River Arch and the east–northeast-trending Williams Island anticline.

Typically, kimberlite intrusions are associated with deep structures that provide access for these complex, mantle-derived intrusions. It is not clear as to exactly what structures in the southern James Bay Lowland could control the distribution of kimberlites; possibly, the east–west Cretaceous boundary fault and/or the northeast structures associated with the Kapuskasing high-grade metamorphic belt could be relevant control structures.

5. GEOPHYSICS

During the 1983 winter drilling program, slim-hole wireline logging through plastic casing was used to verify the geological results obtained through visual logging. Responses from natural gamma, density (gamma–gamma), and neutron logging proved to be particularly useful in interpreting the unconsolidated sediments that comprise the strata of the Moose River Basin.

The geophysical work was contracted to Century Geophysical Corporation of Calgary, Alberta, who had also conducted the wireline logging in the 1982 summer program. Since the program was primarily overland-supported, the geophysical equipment was transported to drillhole locations on a sled (5 x 8 feet) pulled by the 12-passenger Bombardier (Figure 20). It was necessary to sling the equipment to the base camp from Smoky Falls, using the Bell 205 helicopter. To log the last three drillholes (ONEX-W83-26–28), helicopter transportation was likewise required (Figure 21).

Geophysical logging was essential to the drilling program: it confirmed the visual logging, and furthermore enabled the geologist to interpret the lithology of missing intervals of sample. Moreover, it is hoped that eventually geophysical logs may be used in the correlation of various stratigraphic units in a regional sense. Figure 22 illustrates the wireline electric logging system that was used to log the 1983 drillholes.

Natural gamma measurements are an assessment of the uranium concentrations (natural radioactivity) in rocks. Because shale has a fairly high natural radiation, the test is essentially an evaluation of shale content. Low responses generally correspond to the presence of limestone, sand, or lignite, whereas high measurements usually indicate clay containing minor radioactive material.

The electron density of a unit is measured by recording the gamma rays back-scattered from a source. This measurement is in turn calibrated directly into formation bulk density. Shale and compact limestone produce a lot of backscattering, and hence produce higher density values, whereas lignite and porous sands result in significantly lower readings.

7. ECONOMIC GEOLOGY

7.1 INTRODUCTION

Several commodities in the James Bay Lowland are of potential economic interest; a summary is available in Table 15 of Section 8. This year's project sought to further delineate known lignite occurrences on a more detailed scale.

Although in previous years the program included heavy mineral analyses of Pleistocene and Cretaceous sediments, this particular aspect of exploration was less emphasized in the 1983 program. However, drilling and sampling was carried out adjacent to ONEX-82-03 in an effort to confirm a pyrope anomaly.

Drilling continued in the vicinity of the 1982 lignite discoveries in and west of Gentles Township. Geophysical logging of lignite-bearing drillholes was included in the program to verify geological results. Also, three reconnaissance holes were drilled in Lambert, Mahoney, and Habel Townships to better evaluate the west-central part of the licence area.

7.2 LIGNITE

7.2.1 DRILLING RESULTS

The major and minor lignite occurrences in the Gentles Township area are located on Drawing No. 4 (map pocket). Table 10 lists the lignite encountered during the 1983 drilling program.

The Onakawana lignite deposit has been extensively drilled over the years (at least 300 holes). To-date, its reserves have been estimated to be approximately 190 million tons. Two principal seams have been recognized: a lower seam with an average thickness of 4.2 m (14 feet) and a maximum thickness of 6 m (20 feet), and an upper

TABLE 10

LIGNITE OCCURRENCES

1983 DRILL PROGRAM

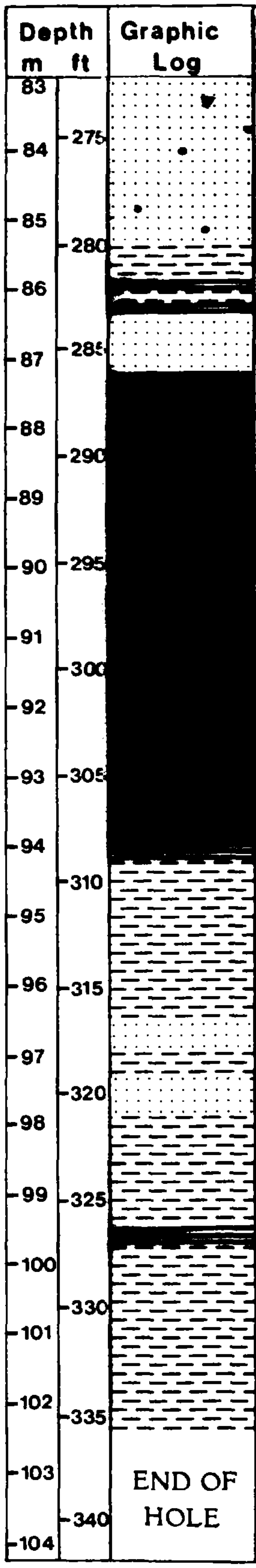
Hole Number	INTERVAL From (feet)	INTERVAL To (feet)	Thickness (feet)	Comments
ONEX-W83-01	233.0	238.5	5.5	Mostly fragmental lignite and wood chips with considerable carbonaceous clay.
	238.5	239.5	1.0	Lignite seam.
	239.5	244.8	5.3	Mostly fragmental lignite and wood chips with considerable carbonaceous clay.
ONEX-W83-02	286.0	308.5	22.5	Lignite occurring with minor quartz sands and fine-grained pyrite. Minor clay-rich intervals.
ONEX-W83-03	304.0	307.0	3.0	Pyritiferous lignite with minor interbed of carbonaceous clay.
	308.5	312.0	3.5	Pyritiferous lignite.
	314.0	316.0	2.0	Lignite containing minor pyrite and quartz grains.
ONEX-W83-09	256.0	258.0	2.0	Soft fragmental lignite and wood chips with minor carbonaceous clay.
	266.0	284.0(?)	18.0	Black compact lignite; finely disseminated pyrite is pervasive throughout interval. Core recovery is low, with evidence of grinding of sample.
ONEX-W83-10	293.5	294.5	1.0	Small seam of lignite is integrated in silica sand unit from 276.0–299.0 feet.
	299.0	302.0	3.0	Lignite seam overlies unit of carbonaceous clays.
	306.0	314.0	8.0	Lignite interval includes interbed of carbonaceous clay and minor pyrite-rich bands, up to Ç" thick.
ONEX-W83-11	202.0	246.0	7.1	Six seams of lignite distributed over a 44-foot interval of Cretaceous clays and quartz-rich sands.
ONEX-W83-12	231.0	234.0	3.0	Minor lignite interbedded with carbonaceous clays.
	247.5	252.4	4.9	Well indurated, brittle lignite; black to orange-brown, slightly woody.
ONEX-W83-16	175.0	187.0	1.5	Approximately two seams of lignite interbedded with carbonaceous clay over a 12-foot interval.
	205.5	213.5	4.0	Pyritiferous lignite comprises four seams of an 8-foot interval rich in carbonaceous material; the lignite tends to be soft and woody.
ONEX-W83-22	210.0	212.0	2.0	Minor seam of soft lignite.
	213.6	217.6	4.0	Mostly fragmental lignite in a micaceous dark brown to black clay.
	225.8	231.6	5.8	Compact unit of dark brown woody to black lignite.
ONEX-W83-24	145.0	146.0	1.0	Minor lignite seam included in 3.2-foot unit of carbonaceous clay.
	155.0	157.0	2.0	Lignite seam occurs with dominantly light to medium grey non-carbonaceous, silty clay.
	163.0	165.0	2.0	Thin seams of compact lignite interbedded with carbonaceous clays; clay is earthy and rich in fragmental lignite.
ONEX-W83-26	237.0	239.0	0.5	Minor lignite integrated with silica sand and carbonaceous clay over 2.0 feet. Essentially detrital lignite occurring in a 108-foot quartz-rich sand and gravel unit.
ONEX-W83-28	326.0	332.0	6.0	Abundant lignite and wood chips contained in a dark grey to black, silty, micaceous mudrock.

seam averaging 5.4 m (18 feet). A clay unit usually separates the two seams, although in places the lignite seams merge as the clay parting becomes negligible. The extent of the deposit is approximately 40 km^2; lateral variations are abrupt, a feature characteristic of other deposits in the basin.

Results from the 1983 winter drilling program are depicted in a fence diagram (see Drawing No. 5 in map pocket), which presents a three-dimensional interpretation of the data. Significant intersections were encountered in drillholes ONEX-W83-02 (Figure 27) and -09 (Figure 28), both located in the West Gentles grid of the 1983 drilling region. One lignite seam intersected in ONEX-W83-02 exhibited a thickness of 22.5 feet. This seam was penetrated by reverse-circulation and, as a result, the detailed features of the lignite are not known. However, the reverse-circulation drilling did indicate that the lignite occurs with minor seams of carbonaceous clay, in addition to minor quartz sands and fine-grained pyrite. Drillhole ONEX-W83-09 penetrated two lignite seams, the first of which occurs at 256.0–258.0 feet and includes minor carbonaceous clay; the second intersection was thicker (18.0 feet?), at 266.0–284.0(?) feet. The uppermost intersection comprised black, soft lignite fragments with minor carbonaceous clay, whereas the lower is characterized by black, compact lignite containing finely disseminated pyrite. Unfortunately, geophysical logs are available for neither hole. This presents a problem in both instances: dual-tube rods were used to drill through the lignite in ONEX-W83-02, so the thickness of the seam cannot be fully verified; poor core recovery in ONEX-W83-09 also leaves the thickness of the seam unconfirmed.

All significant lignite seams are summarized in Table 10. Figures 27 through 33 illustrate visual and, in some cases, geophysical logs of the more important lignite seams discovered in the 1983 program.

It is evident from the fence diagram that two seams merge into a single and somewhat thicker lignite seam. This is typical of the lignite occuring in both grids of the 1983 program. Also, results from previous drilling (81-12, 82-1, -2, -3, -5, -6, and -8) correlate well with the new discoveries. From the limited data currently available, it appears that seams display abrupt lateral variations, and, in plan view, tend to be irregular in shape.



Description

CLAY: 280.0–282.0'
Very dark brown–grey stiff clay.

CARBONACEOUS CLAY: 282.0–282.5'
Black carbonaceous clay with 'onion peel' like layering.

CLAY: 282.5–283.0'
Grey stiff clay.

CARBONACEOUS CLAY: 283.0–283.5'

SAND: 283.5–286.0'
Very fine quartz sand with minor lignite fragments; lignite fragments; quartz pebbles up to 0.25" diameter at 285.5'.

LIGNITE: 286.0–308.5'
286.0–293.5': contains rounded, broken quartz fragments up to 0.25" diameter and fine-grained pyrite nodules up to 0.25" diameter; fine-grained silica sand and clay.
293.5': silty, sandy.
300.0–302.0': abundant quartz sand.
302.0': approximately 5% pyrite occurs as fine-grained nodules up to 0.25" diameter.
306.0': some silica sand.
306.5–307.0': black carbonaceous clay with abundant lignite fragments.
307.0–308.5': abundant pyrite nodules.

CARBONACEOUS CLAY: 308.5–309.0'

CLAY: 309.0–316.5'
309.0–309.5': dark brown, stiff, non-gritty clay.
309.5–315.5': clay becomes lighter coloured (to a light tan colour), coarse-grained, stiffer with depth.
314.0': minor lignite fragments up to 0.25" diameter.
315.5–316.5': light tan to white, soft, non-gritty clay.

SAND: 316.5–318.0'
Fine-grained sand–silt with coarser grains of quartz and pyrite up to 0.25" diameter.

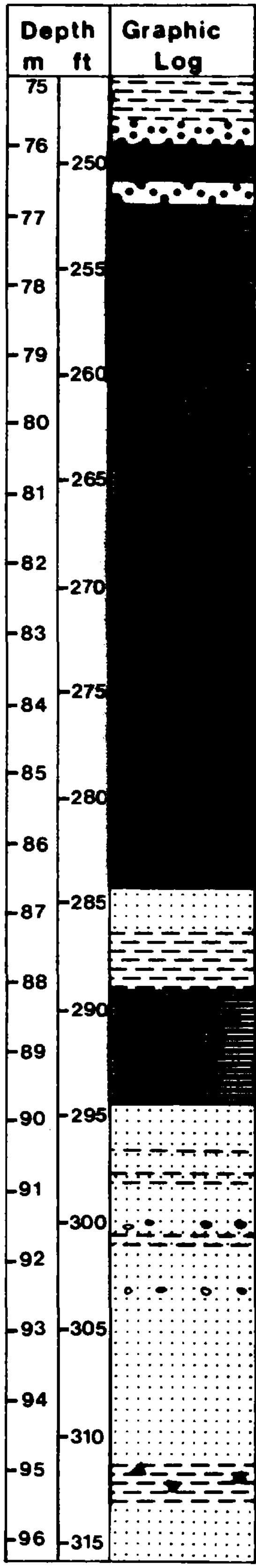
CLAY: 318.0–319.0'
Light brown–grey stiff clay with no grit; 'onion skin' layering.

SAND: 319.0–321.0'
Fine-grained silica sand with minor black rock fragments and pebbles up to 0.25" diameter.

CLAY: 321.0–326.0'
321.0–323.0': dark grey to black clay with 'onion skin' like layering.
323.0–325.0': soft medium grey clay with abundant lignite fragments (5–10%) from 324.5–325.0'.
325.0–325.5': very fine sand–silt; lignite fragments.
325.5–326.0': stiff, non-gritty grey clay with 'onion skin' layering.

CARBONACEOUS CLAY: 326.0–327.0'
Dark grey–black, stiff carbonaceous clay with a few light brown clay interlayers up to 1/16" thick.

FIGURE 27: Lignite in drillhole ONEX-W83-02.



Description

MICACEOUS CLAY: 246.0–247.5'
Medium to dark grey, soft.

CLAY: 247.5–248.0'
Dark grey, stiff, sandy–silty clay.

CARBONACEOUS CLAY: 248.0–256.0'
Black, earthy, containing approximately 25% woody lignite fragments.
248.0–249.0': pebbly, sandy interval.
251.0–251.5': pebble horizon.
255.0–256.0': abundance of woody lignite chips increases to approximately 25–40%, minor plant root material.

LIGNITE: 256.0–258.5'
Black, soft, broken up into aggregates of woody fragments and large chips (5–7 cm), minimal fine, black, carbonaceous clay content (<5%).

CARBONACEOUS CLAY: 258.5–266.0'
Black, soft, earthy carbonaceous clay rich in lignite and wood chips; micaceous in places, pyritiferous.

LIGNITE: 266.0–284.0'
Black, compact, high quality competent lignite, finely disseminated pyrite is pervasive throughout.
267.8': pyritic horizon (≈2 cm) gobby and fine-grained aggregates.
269.0': pyrite stringers and fine disseminations.
269.0–289.0': evidently core tube was blocked, core recovery extremely low with evidence of grinding of core. Thus, possibility of additional 20' of lignite in addition to above interval from 266.0–269.0'.

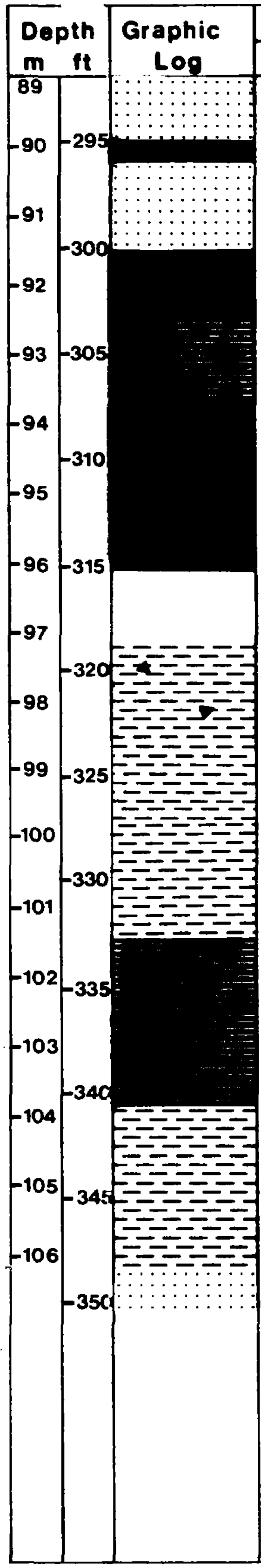
SAND: 284.0–286.0'
Medium brown, sand and pebbles with clay binding, abundant lignite chips.

CLAY: 286.0–288.5'
Tan, stiff, non-calcareous, non-gritty, contains slip surfaces (roots).

CARBONACEOUS CLAY: 288.5–294.0'
Black with occasional pieces of brown wood, pieces and occasional thin lignite (beds?), possibililty of up to 3" clay and lignite ground up.

SAND/CLAY/DETRITAL PYRITE: 294.0–375.0'
Interbedded units of very fine-grained micaceous sand and non-gritty, soft, non-calcareous clay, and indurated aggregates of fine-grained quartz and pyrite; minor woody lignite chips, minor detrital quartz.
301.0': dominantly very fine-grained micaceous sand >70%.

FIGURE 28: Lignite occurrences in ONEX-W83-09.



Geophysical Logging

Natural Gamma Density

LIGNITE: 293.5–294.5'
SAND: 294.5–299.0'
Fine- to medium-grained silica sand (>95% quartz), minor lignite.
LIGNITE: 299.0–302.0'
CARBONACEOUS CLAY: 302.0–306.0'
Black, soft, carbonaceous clay with abundant lignite fragments (up to 75%).

LIGNITE: 306.0–314.0'

309.5–310.0': seam of carbonaceous clay with minor pyritiferous beds attaining thicknesses of 0.25".
NO CORE RECOVERY: 314.0–317.5'

CLAY SEQUENCE: 317.5–331.0'
Largely medium to dark brown, stiff clay, containing abundant fragments of lignite, locally micaceous.
317.5–317.9': seam of pebbly, medium-grained silica sand.
322.0–326.0': no core recovery; suspected sand or mud washed away.

329.0': thin (0.5") seam of lignite.
CARBONACEOUS CLAY: 331.0–339.5'
Black, very stiff, carbonaceous clay with abundant woody pieces of lignite (up to 75%) locally.
CLAY: 339.5–347.0'
Light grey to white, stiff, silty–clay, micaceous. Contains minor lignite fragments (<1%).
NO CORE RECOVERY: 347.0–349.0'
Suspected sand.
END OF HOLE: 349.0'
HOLE PLASTIC CASED TO 320.0'

FIGURE 29: Lignite intersections in ONEX-W83-10.

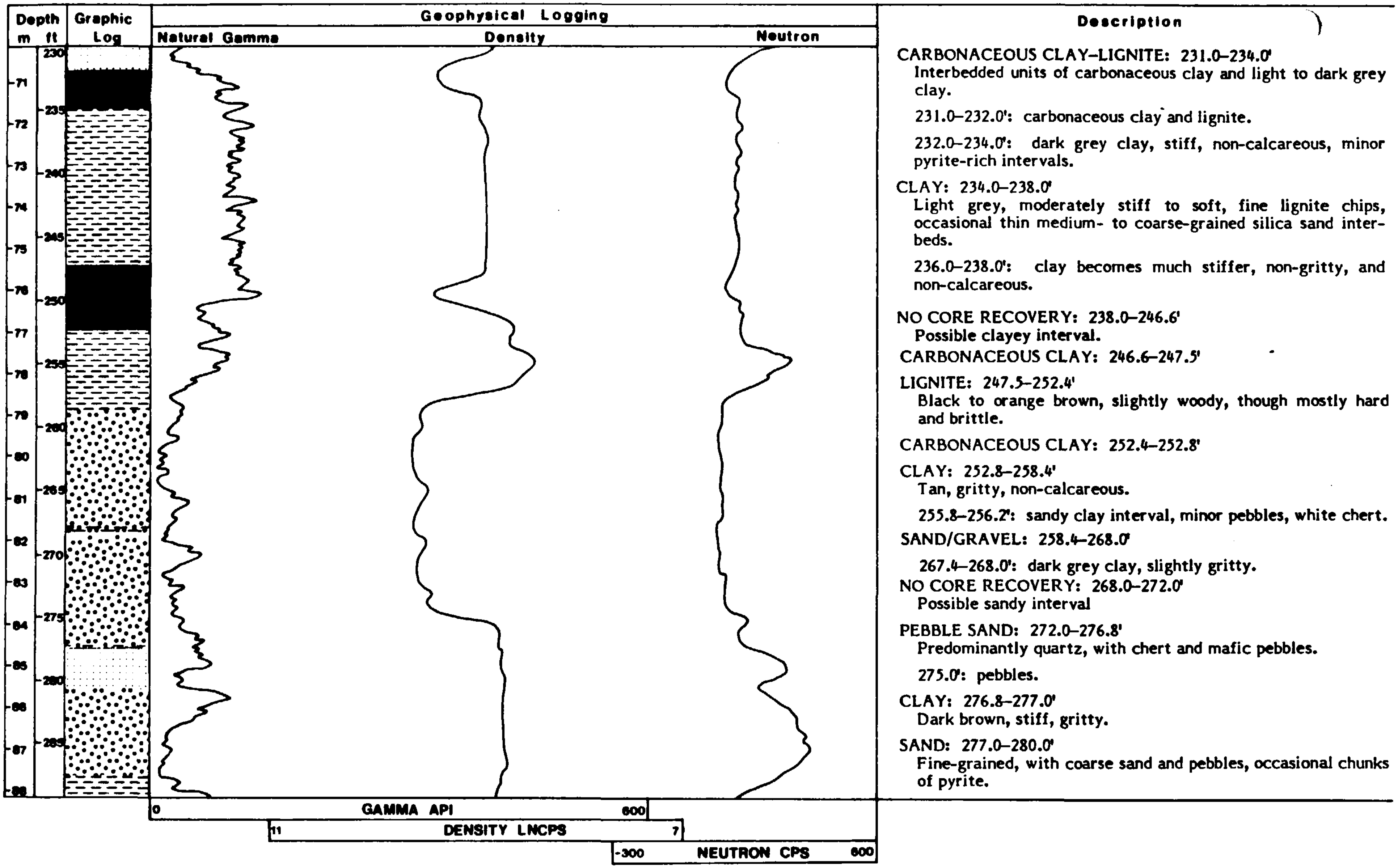
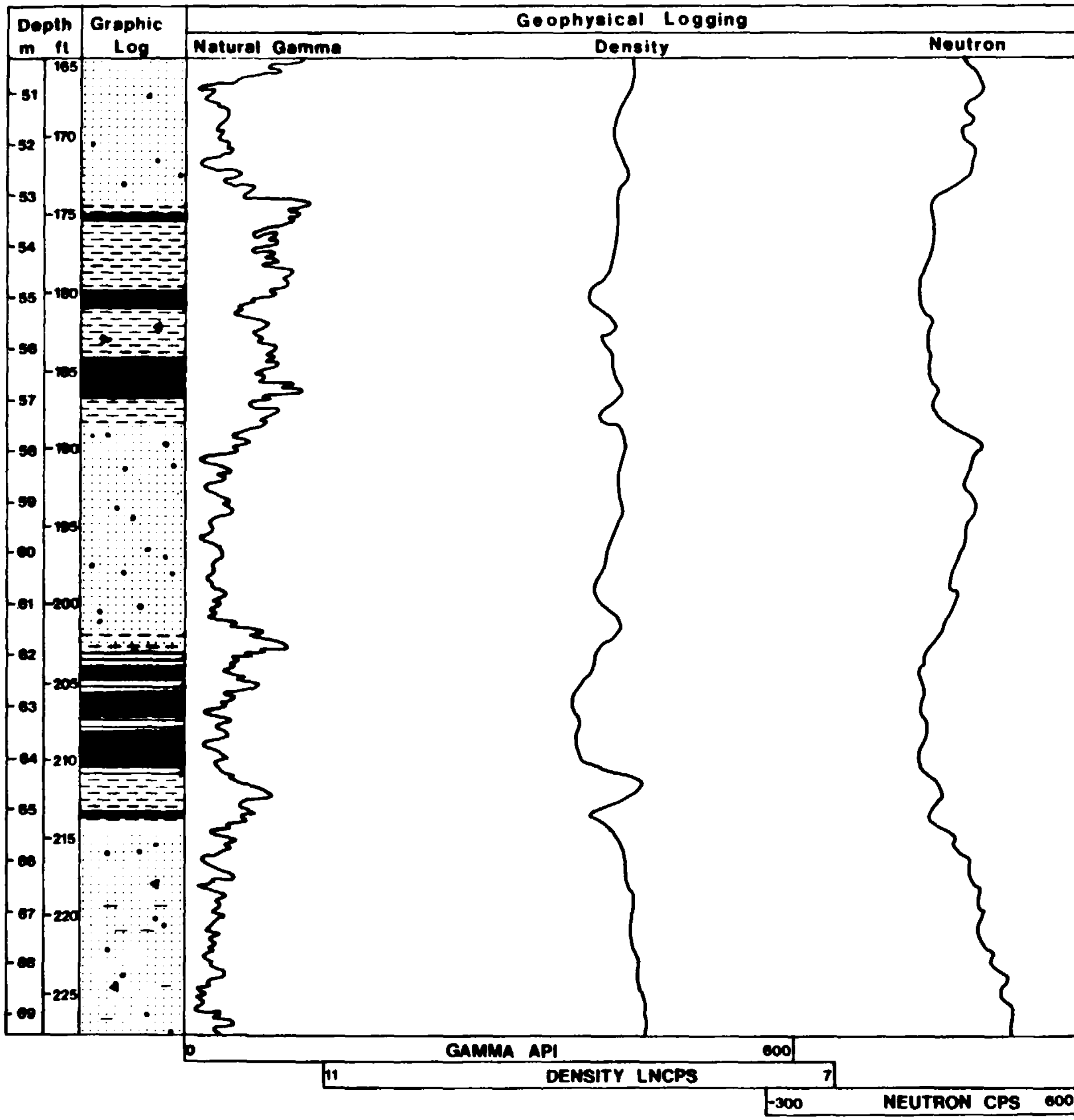


FIGURE 30: Lignite occurrences in ONEX-W83-12.



Description

CLAY: 174.0–184.0'
Dark brown sandy clay grading into a dark grey stiff, non-calcareous, non-gritty clay; contains minor lignite by 176.0'.

LIGNITE: 175.0–175.5'

LIGNITE: 180.0–181.0'
Lignite seam interbedded with approximately 20% dark grey stiff clay.

CARBONACEOUS CLAY: 184.0–187.0'
Black to dark grey carbonaceous clay; stiff, non-gritty.

CLAY: 187.0–188.5'
Dark grey slightly silty clay grading into a yellow-brown, soft clay.

SILICA SAND: 188.5–201.5'
Very fine silty sand; well-rounded clasts, well-sorted. Trace lignite and occasional pyrite nodules. Becoming much coarser by 193.0'; also, includes white silty clay 20%, black silt pebble 10%, subangular to subrounded grains.

CLAY: 201.5–202.0'
White beige silty clay.

SAND: 202.0–202.5'
Very fine white silica.

CLAY: 202.5–205.5'
Dark grey to black, carbonaceous with 10% lignite fragments. Minor lignite seam (<.25') at 204.0'.

LIGNITE: 205.5–207.0'
Black soft woody with 70% black carbonaceous clay.

CARBONACEOUS CLAY: 207.0–208.0'
Black carbonaceous clay approximately 20% lignite.

LIGNITE: 208.0–210.0'
Lignite containing approximately 10% black carbonaceous clay. At 209.0' pyrite nodule 5%.

CARBONACEOUS CLAY: 210.0–211.0'

CLAY: 211.0–213.0'
Dark grey stiff clay.

LIGNITE: 213.0–213.5'

SAND: 213.5–233.0'
Fine-grained silica sand, well-rounded and moderately sorted with 20% cream silty clay and abundant white shell fragments, and lignite chips. Becoming coarser with depth.

FIGURE 31: Lignite occurrences in ONEX-W83-16.

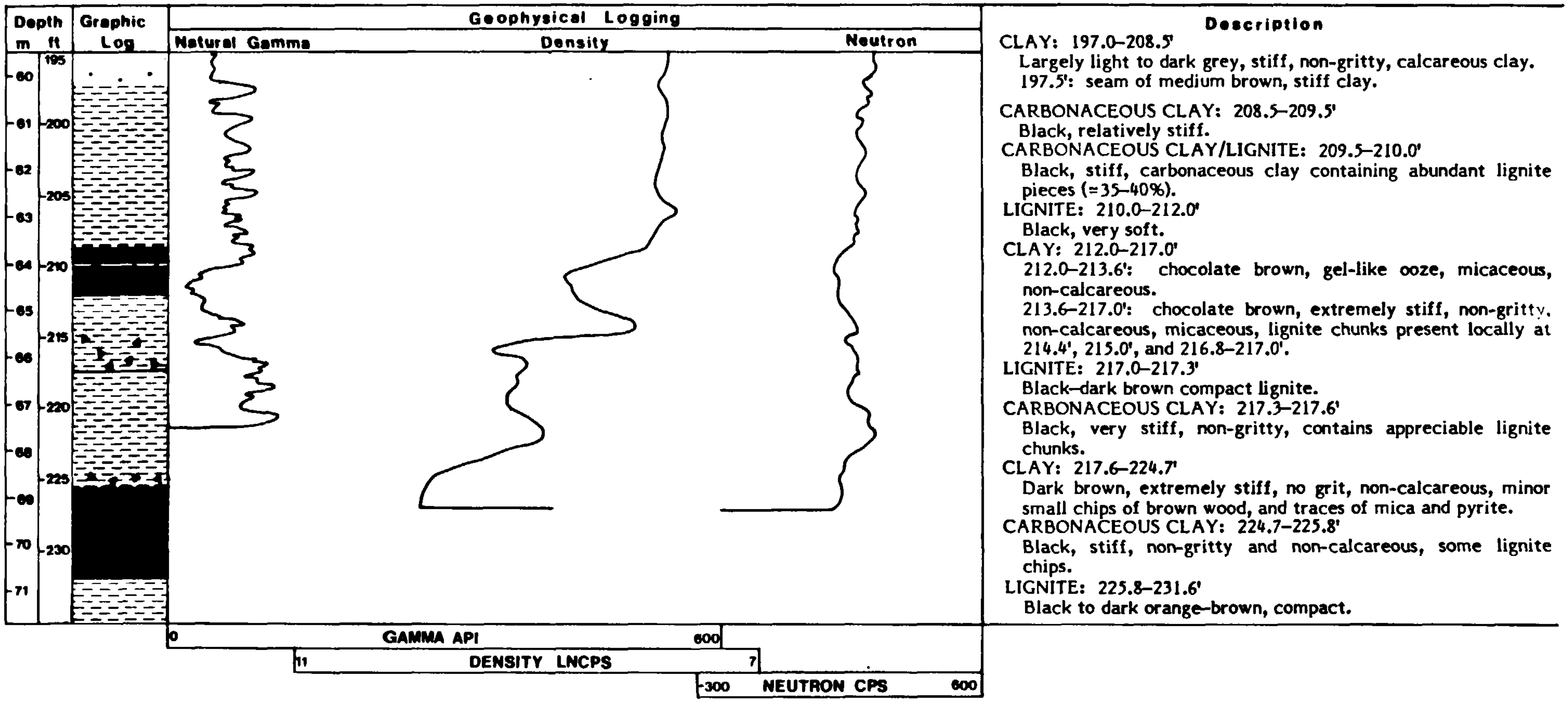
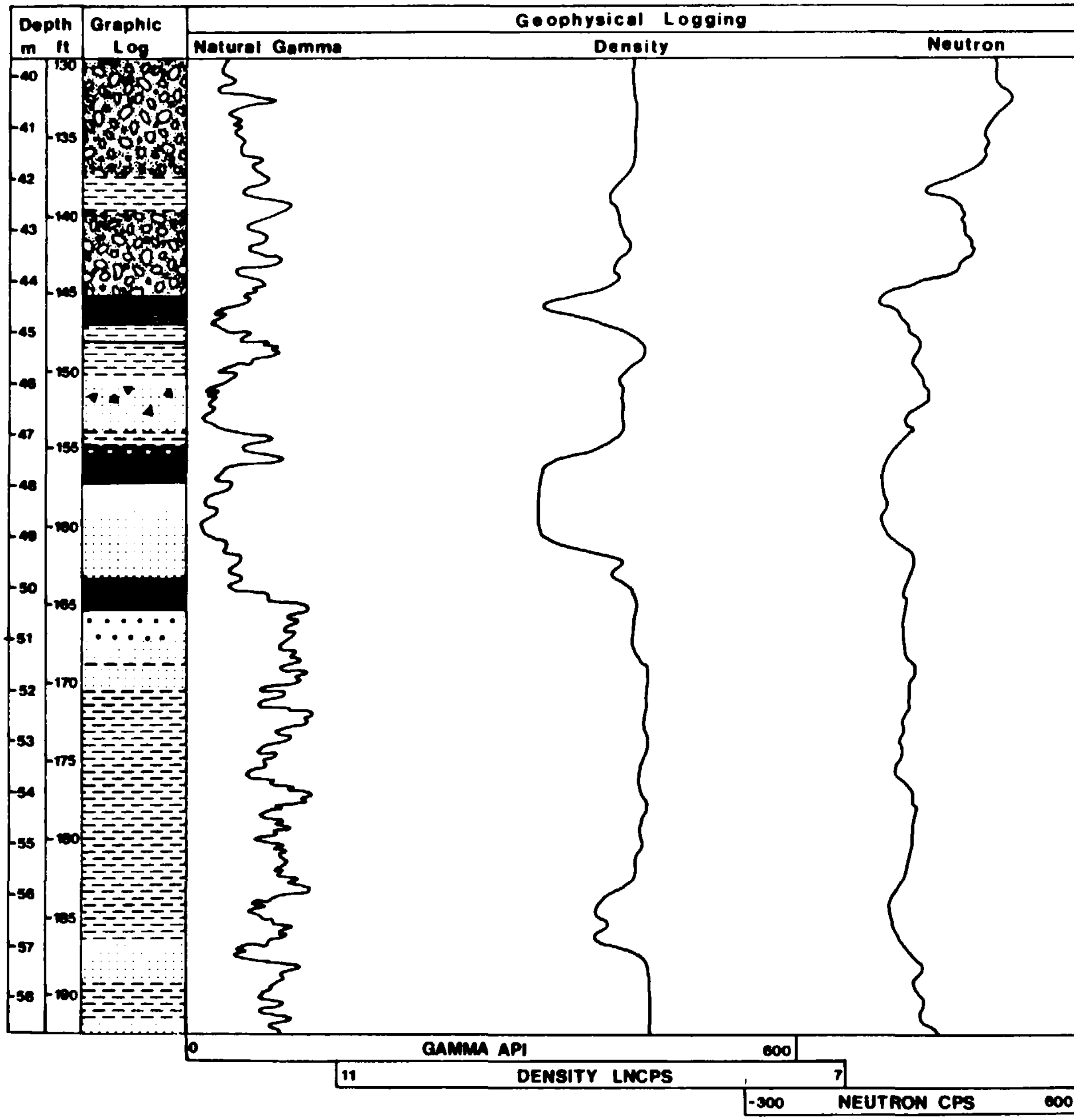


FIGURE 32: Lignite occurrences in ONEX-W83-22.



Description

CLAY: 137.0–139.5'
Dark brown, stiff, calcareous, trace of grit, occasional rock fragments.

CLAY TILL: 139.5–144.8'
Medium brown to grey, moderately stiff, gritty clay matrix, calcareous, numerous limestone fragments and subrounded to angular pebbles of black siltstone, chert, and limestone.
142.0': changes to green-grey in colour.

CARBONACEOUS CLAY: 144.8–145.0'

LIGNITE: 145.0–146.0'

CARBONACEOUS CLAY: 146.0–146.8'

CLAY: 146.8–147.5'
Dark grey, stiff, non-calcareous, and non-gritty.

CARBONACEOUS CLAY: 147.5–148.0' Black, stiff.

CLAY: 148.0–150.0'
Dark grey, stiff, non-calcareous, slight grit, dark brown patches at 149.0'.

SAND: 150.0–153.5'
Fine-grained quartz sand, micaceous with lignite chips and pyrite chunks.

CLAY: 153.5–154.8'
153.5–154.5': light grey, stiff, non-calcareous, and non-gritty.
154.5–154.8': medium grey, gritty, non-calcareous, with brown patches becoming increasingly carbonaceous.

LIGNITE: 154.8–157.0'
Contains minor carbonaceous clay from 154.9–155.0'.

SILT/CLAY: 157.0–163.0'
Medium brown, relatively soft, non-calcareous silty-clay, micaceous and non-gritty.

LIGNITE/CARBONACEOUS CLAY: 163.0–165.0'
Thin seams of black compact lignite, interbedded with carbonaceous clay; the clay is black and earthy, and contains abundant chunks of soft crumbly lignite.

SAND: 165.0–169.8'
Fine-grained, micaceous (≈2–3%) sand, with minor clay interbed from 168.1–168.3'.

CLAY: 169.8–183.2'
169.8–181.7': medium brown to green, non-calcareous and non gritty, occasional small chips of lignite, stiff, broken core surfaces resembling slip surfaces.
181.7–183.2': becoming darker brown in colour with some lignite chips, non-gritty, more calcareous.

CARBONACEOUS CLAY: 183.2–186.0'
Carbonaceous clay with orange/brown woody pieces and lignite chips; abundant thin (<2") lignite layers.

186.0–188.9'?: Sand? No core recovery.

FIGURE 33: Lignite occurrences in ONEX-W83-24.

The lignite seams that have been intersected in the drilling programs are discontinuous over the region depicted in the fence diagram. This is possibly due to the northwest-trending Grand Rapids Arch between the East and West grids, the presence of which is suggested by the drilling results.

Lignite deposits flanking the Grand Rapids Arch are believed to be associated with vertically-accreting river channels (WGM 1982). Long's depositional model suggests that Cretaceous lignites developed along channel and basin margins and behind channel levees, which could sustain dense vegetation. He believes that if the rivers were constrained within their channels and accreted vertically, then thick, sinuous, linear lignite deposits would form. Blanket-like lignite accumulations are indicative of an inter-channel flood-plain environment, similar to our present-day peat layers.

A detailed description of the sedimentological model for the Cretaceous sediments is available in Volume III of the WGM 1982 report. Although the conclusions are based upon drilling results obtained prior to the 1983 field season, data from the most recent program conform to the depositional model.

7.2.2 ANALYTICAL RESULTS

A number of analyses were carried out on nine core samples of lignite and carbonaceous clay from ONEX-W83-10 and -09. These analyses included proximate analysis, heat value, ultimate analysis, major constituents of ash, total sulphur content, and sulphur forms. The analyses were conducted by Chemex Labs Limited of Vancouver, BC, under the direction of Dr. R. D. Morse. The results of the analyses are tabulated in Tables 11 through 14.

The moisture content of lignite was carried out on an "as received" basis. Moisture values range from 28.56 wt% to 50.15 wt%. The in-situ moisture content of the lignite is difficult to evaluate, given that water is used in the drilling, and that the samples cannot be perfectly sealed. The lignite samples obtained from the recent program were left unsealed, and their moisture values will be low due to evaporation. Samples OEC-1 to OEC-8 inclusive are representative of good, competent lignite, yielding an average moisture content of 44 wt%. These values are consistent with moisture contents characteristic of the nearby Onakawana lignite deposit and with results from the 1982 program.

Ash contents are quite variable (Table 11). The values (analyzed as received) range from 6.13 wt% to 51.03 wt%. The best-quality samples have the lowest ash values, as evidenced by samples OEC-1 to OEC-3 inclusive; the ash contents for these samples are 9.30, 6.13, and 8.76 wt%, respectively, and the corresponding heat values are 9,275, 9,619, and 9,270 Btu (dry basis). Conversely, the sample that contained the greatest amount of ash (OEC-9, 51.03 wt% as received), represents a sample of interbedded carbonaceous clay and lignite with a very low heat value of 1,715 Btu (dry basis). All samples, with the exception of OEC-8 and OEC-9, were analyzed for the major constituents of ash. Sample OEC-3 contains abundant iron sulphide in the ash (Tables 11 and 14), reflecting the relative enrichment of iron sulphide in the lignite. In fact, samples OEC-1 to OEC-7, which are representative of a complete lignite seam from ONEX-W83-10, contain appreciable to abundant pyrite in thin seams.

The samples contain moderate Al_2O_3, ranging from 5.97 to 15.88 wt% (Table 13). This suggests that the ash from the lignite samples contains moderate amounts of clay minerals. Additionally, the amounts of CaO and MgO in the ash, coupled with the abundance of volatiles, indicates the presence of some calcite and dolomite.

Analyses for total sulphur and sulphur forms were performed on the lignite samples (Table 14). On a dry basis (Table 11), total sulphur values ranged from 0.18 to 5.28 wt%. Generally, samples characterized by high heat values also had high sulphur values (e.g., OEC-3). This is evidenced by the relative abundance of pyrite in the lignite intersections. The results obtained for the various sulphur forms are somewhat surprising. Given the abundance of visible pyrite in some of the samples, particularly in OEC-3 (total sulphur 5.28 wt%, dry basis), values for pyritic sulphur are definitely low. In all of the samples analyzed, organic sulphur exceeds pyritic sulphur, which is unexpected in light of results from the 1981 and 1982 programs.

TABLE 11

ANALYTICAL DATA ON LIGNITE AND CARBONACEOUS CLAY

Sample* Number	Proximate Analysis				Calorific Content		Sulphur Content	
	Moisture (as received)	Ash (as received)	Volatile (as received)	Fixed Carbon (as received)	Btu/lb (as received)	Btu/lb (dry)	Total Sulphur (as received)	Total Sulphur (dry)
OEC-1	47.76	9.30	21.40	21.54	4,845	9,275	0.85	1.63
OEC-2	50.15	6.13	21.23	22.49	4,824	9,619	0.24	0.48
OEC-3	48.48	8.76	21.22	21.54	4,776	9,270	2.72	5.28
OEC-4	43.93	17.37	19.59	19.11	4,097	7,307	0.36	0.64
OEC-5	40.52	20.68	19.11	19.69	4,087	6,871	0.20	0.34
OEC-6	42.41	18.51	20.56	18.52	4,254	7,387	0.61	1.06
OEC-7	36.39	30.37	17.58	15.66	3,562	5,600	0.20	0.31
OEC-8	45.28	10.78	21.62	22.32	4,713	8,613	0.10	0.18
OEC-9	28.56	51.03	14.26	6.15	1,715	2,401	0.59	0.83

*Locations and Remarks

OEC-1	West Gentles Tp; ONEX-W83-10; 306.0–307.0'	
OEC-2	West Gentles Tp; ONEX-W83-10; 307.0–308.0'	
OEC-3	West Gentles Tp; ONEX-W83-10; 308.0–309.0'	
OEC-4	West Gentles Tp; ONEX-W83-10; 309.0–310.0'	Samples are representative of a complete lignite seam.
OEC-5	West Gentles Tp; ONEX-W83-10; 310.0–311.0'	
OEC-6	West Gentles Tp; ONEX-W83-10; 311.0–312.0'	
OEC-7	West Gentles Tp; ONEX-W83-10; 312.0–313.0'	
OEC-8	West Gentles Tp; ONEX-W83-09; 266.0–267.0'	Compact, good quality lignite.
OEC-9	West Gentles Tp; ONEX-W83-09; 289.0–290.0'	Sample of carbonaceous clay–lignite.

TABLE 12

ULTIMATE ANALYSIS OF LIGNITE AND CARBONACEOUS CLAY

(weight percent)

Sample Number	Carbon (as received)	Hydrogen (as received)	Nitrogen (as received)	Oxygen (as received)	Sulphur (Bomb)	Sulphur (Leco)
OEC-1	30.86	6.77	0.27	51.95	0.90	0.80
OEC-2	30.96	6.98	0.28	55.41	0.24	0.24
OEC-3	29.20	6.89	0.26	52.17	2.75	2.69
OEC-4	27.57	6.08	0.33	48.29	0.36	0.36
OEC-5	27.48	5.66	0.34	45.64	0.21	0.19
OEC-6	28.81	6.23	0.37	45.47	0.62	0.60
OEC-7	23.69	5.02	0.25	40.47	0.19	0.20
OEC-8	NA	NA	NA	NA	0.10	0.10
OEC-9	NA	NA	NA	NA	0.58	0.59

NA: Not analyzed.

TABLE 13

MAJOR CONSTITUENTS OF ASH

Oxides*	OEC-1	OEC-2	OEC-3	OEC-4	OEC-5	OEC-6	OEC-7
SiO_2	46.64	46.73	15.86	60.64	64.99	59.00	84.55
Al_2O_3	9.10	13.76	11.49	13.57	15.88	9.60	5.97
CaO	8.76	13.94	8.94	7.76	7.06	7.67	3.18
Fe_2O_3	13.14	7.22	32.45	5.32	3.99	7.32	2.24
K_2O	0.31	0.36	0.42	0.47	0.42	0.53	0.20
MgO	2.04	3.35	2.10	1.59	1.44	1.58	0.70
MnO_2	0.06	0.09	0.06	0.06	0.06	0.07	0.03
Na_2O	0.30	0.53	0.31	0.16	0.13	0.16	0.07
P_2O_5	0.07	0.09	0.07	0.05	0.05	0.05	0.02
TiO_2	1.33	1.47	0.38	1.53	1.50	1.26	0.95
Pt†	<100	<100	<100	<100	<100	<100	<100

*Oxide values are in weight percent.
†Pt in ppb.

TABLE 14

TOTAL SULPHUR AND SULPHUR FORMS

(weight percent)

Sample Number	Total Sulphur (as received)	Sulphur Forms		
		Sulphate S	Pyritic S	Organic S
OEC-1	0.85	<0.01	0.12	0.73
OEC-2	0.24	<0.01	0.03	0.21
OEC-3	2.72	<0.01	0.70	2.02
OEC-4	0.36	<0.01	0.04	0.32
OEC-5	0.20	<0.01	0.01	0.19
OEC-6	0.61	<0.01	0.14	0.47
OEC-7	0.20	<0.01	<0.01	0.20
OEC-8	0.10	<0.01	<0.01	0.10
OEC-9	0.59	NA	NA	NA

NA: Not analyzed.

The samples contain negligible amounts (less than 0.01 wt%) of sulphate sulphur, which is comparable to analyses in the 1982 program.

Very preliminary analytical work by Kronberg and others (1981) on selected North American coal/lignite deposits revealed platinum enrichment in some deposits. In the 1982 analytical work (WGM 1982b), the lignite samples indicated a range of 0.008 to 0.012 oz/ton Pt. All of the 1983 lignite/carbonaceous clay samples submitted were also analysed for platinum (Table 13). The analytical method used by Chemex Labs Limited has a detection limit of 100 ppb; none of the samples exceeded this limit. To properly evaluate such trace amounts of platinum in the lignite, a more sensitive analytical method is required. However, present results indicate that there is no enrichment in platinum that would be of economic significance.

7.2.3 DISCUSSION OF RESULTS

Results from the 1983 winter exploration program seem to indicate that the 1981 lignite discovery along the eastern boundary of Gentles Township has limited tonnage potential. However, the lignite discovery immediately west of Gentles Township appears to have considerably more tonnage potential. In addition, the relatively thick lignite intersection in ONEX-W83-02 in the southwest corner of Gentles Township may represent a new lignite field.

The lignite discoveries over the past several years support a sedimentological model that involves vertically accreting river channels and the development of lignite deposits along the margins of the major streams and along the edges of broad valleys. In general, the lignite seams display rapid lateral changes and are irregular in plan view. As at Onakawana, the lignite may occur in large fields but may also include numerous smaller satellite deposits.

Most, if not all, of the lignite discoveries in the central part of the basin will be at depths of at least 150 feet; most may be deeper than 200 feet.

The lignite sampled in 1983 varies considerably in heat values; the best intersections exceed 9,000 Btu (dry basis), although the high ash content (largely clay) reduces the heat content of many samples to less than 7,000 Btu. Moisture contents appear to be in the range 40–50 wt%. Sulphur is present largely in the form of iron sulphide and is relatively abundant in many samples. Ash values are largely within 10–50 wt%.

The West Gentles lignite occurrences appear to be open to the south of the present drill locations. It is also apparent that the lignite occurrences in the Gentles Township area have been influenced and localized by a Paleozoic bedrock high. This feature, presumably a subsurface expression of the Grand Rapids Arch, probably extends north of the Missinaibi River and therefore may have also localized lignite accumulations north of the river.

7.3 HEAVY MINERAL STUDIES

In the 1982 reconnaissance drill program, a concentration pf pyrope garnet was discovered over a narrow intersection in drillhole ONEX-82-03. The pyrope is relatively coarse-grained (0.5–1.5 mm) and distinct from the more common almandine garnets contained in the same sediments. Pyrope is a key indicator mineral of kimberlite intrusions. In 1982, it was recommended that the pyrope anomaly be verified by obtaining a larger sample of the sand in order to concentrate a substantial amount of the heavy minerals and to examine these optically.

Drillhole ONEX-83-23 was to be drilled at the same location as ONEX-82-03. Because of the deep snow and possible settling of the plastic casing, we were unable to locate the 1982 hole exactly. Therefore, ONEX-W83-23 was drilled in the same cleared area, within some 50 feet of the 1982 hole.

The reverse-circulation drill log from the 1982 drillhole indicates that the pyrope anomaly was from a thin, sandy unit at a depth of 265–267 feet. This sand was overlain by a thick calcareous clay sequence containing a few large clasts of limestone and a few sandy interbeds. Underlying the anomaly is a section of abundant carbonate clasts in a sandy clay matrix, which is probably a solution-collapse breccia.

The 1983 hole was intended to core the above intersection in order to better evaluate its character and to use reverse-circulation to obtain a larger bulk sample of the anomalous intersection.

After coring the clays and sands, the wireline rods were removed and the reverse-circulation dual tubes inserted. However, the dual tubes were not able to obtain a large sample, perhaps because the walls had been fairly well packed when coring. Therefore, it was decided to redrill the hole using only reverse-circulation after moving the drill head over only about one foot; this worked well and approximately 340 kg of sample material was recovered from the intersection 255– 265 feet.

7.3.1 RESULTS

From the drillcore available, the clays and sands at depths of 198.5 to 262.5 feet could be Jurassic in age, although these units appear similar to Cretaceous beds (Mattagami Formation). They are almost invariably calcareous and the sands contain well sorted and rounded grains. In most cases, Cretaceous sands/silts are more poorly sorted and the grains much more angular; only rarely are Cretaceous clays and sands calcareous.

Before a Jurassic age is accepted, a detailed evaluation of the palynofloral assemblages should be carried out.

The sandy section from which the bulk sample was taken is dominated by rounded quartz grains in a whitish or pale green-grey calcareous clay matrix. These clastics overlie a limestone breccia that is interpreted as a solution-collapse feature formed as a result of karstification in underlying Williams Island Formation limestones.

The bulk sample was sent to Overburden Drilling Management Limited in Ottawa, whose brief report on the testwork is included in Volume II. The wet bulk sample was sieved, and the +10 mesh material examined and stored. The -10 mesh material was concentrated on a shaking table and the heavy mineral fraction separated using methylene iodide (specific gravity: 3.3). Those minerals heavier than the methylene iodide were separated magnetically, and the nonmagnetic portion examined with a binocular microscope.

No diamonds were identified, but the pyrope anomaly was confirmed. Most of the pyrope was concentrated in the +32 to -10 mesh size range, although the +50 to -32 mesh fraction contained abundant pyrope grains as well. The pyrope is well rounded, and light pink to violet in colour; most grains are frosted and many grains appear flattened in comparison to normal "spherical" garnet crystals.

In order to confirm the nature of these garnets, samples were dispatched to the Department of Geology at the University of Toronto, where Dr. Cermignani prepared two polished grain mounts for microprobe analyses. Dr. Cermignani's complete analyses and brief report are included in Volume II of this report. The microprobe analyses substantiate that the garnets are pyrope and that they have a high chronium content indicative of a kimberlite origin. Table 15 compares two typical analyses from the present study with that of a pyrope garnet from the Tanzanian diamond fields; the compositions are extremely similar.

TABLE 15

COMPARISON OF SELECTED GARNET ANALYSES

Category	Tanzanian[1] Sample	James Bay[2] +32 mesh	James Bay[3] +50 mesh
Element			
SiO_2	41.83	38.96	41.30
Al_2O_3	20.15	19.17	20.18
TiO_2	0.09	0.00	—
Cr_2O_3	**3.12**	**3.42**	**3.45**
Fe_2O_3	—	1.21	2.86
FeO	9.02	4.74	5.20
MgO	20.15	19.83	20.35
CaO	5.46	4.87	5.74
Total	100.22	92.45	99.63
Garnet End Members			
Pyrope (Mg)	**70.4**	**75.4**	**70.6**
Grossularite (Ca)	—	—	—
Andradite (Ca, Fe)	5.0	3.5	7.8
Warovite (Ca, Cr)	8.9	9.9	7.1
Spessartite (Mn)	0.8	0.5	1.1
Almandine (Fe)	**14.2**	**10.2**	**10.5**
Total	99.3	99.5	97.1

[1] Pyrope garnet from Tanzanian diamond fields: reported in Wolfe et al. 1975.
[2] Analysis No. 5 by Dr. Cermignani: garnet grain from the +32 mesh fraction. Although the stoichiometry of this analysis is good, the low oxide total is due to improper carbon coating on grain as a result of heavy liquid treatment.
[3] Analysis No. 16 by Dr. Cermignani: garnet grain from the +52 mesh fraction.

7.3.2 DISCUSSION

In the 1975 regional drill program sponsored by the OGS, Jurassic sands and clays were discovered in two drillholes north of the Missinaibi River. These units, referred to by Telford and Verma (1982) as the Mistuskwia Beds, are quite similar to the calcareous sands and clays in ONEX-W83-23. In discussing these sediments, Hamblin (1976) speculated that they may have had a deltaic origin and that their distribution (though based on very limited data) suggested a source area to the northwest.

In previous drilling, as well as in the 1983 program, stratigraphic data indicated that the Grand Rapids Arch was a prominent feature in the Cretaceous period and may have been a topographic high in the Jurassic, although this is conjecture. It is also possible that the source may have been south and east of ONEX-82-23; this area lies on the edge of the Kapuskasing high-grade metamorphic belt (also the Kapuskasing gravity high). This complex structural zone could be a controlling factor in kimberlite intrusions in northern Ontario.

The high chromium content of the pyrope suggests a kimberlite source for the garnets. Although the pyropes are relatively small and rounded, they have not necessarily been transported a great distance. Wolfe and others (1975) mention that "it is important to stress here that pyrope garnets in kimberlite occur not as angular grains but as spherical nodules. Because kimberlite-associated pyropes are already partially rounded at the primary source, roundness and sphericity cannot be confidently used to estimate the distance of secondary transport by alluvial or glacial processes." The pyrope occurs in a sandy–silty sediment dominated by rounded quartz grains imbedded in a matrix of clay (kaolin?) and carbonate (largely $CaCO_3$). The rounded quartz grains may be indicative of a distant source rock or they may represent reworking of an older sandstone unit (Paleozoic?) nearby. The clay could be the result of in-situ weathering of feldspathic grains under favourable climatic and geomorphological conditions (see Vos 1982). The carbonate content could be the result of minor marine incursions in a deltaic environment or by percolating groundwaters that transported $CaCO_3$ from underlying limestone units.

Overall, the sedimentary environment may well have been that of an aggrading delta being fed from rivers draining off of the Precambrian Craton, which would have been covered, at least in part, by Paleozoic sediments. There may have been local highs, such as the Grand Rapids Arch in the south, and others farther to the northwest. It is possible that the fault bounding the present Cretaceous units and the adjacent Precambrian Craton may have played a similar role in the Jurassic, and the Jurassic sediments may have been deposited on a bordering lowland area similar to the present day James Bay Lowland or perhaps even more like the Piedmont Plain in the southeastern USA (Vos 1982).

Although pyrope is perhaps the best kimberlite indicator mineral, magnesian ilmenite and diopside are also used in many cases. In tropical, semi-arid countries where kimberlites are found, such as a large part of Africa, chemical and (in part) physical weathering break down the diopside within a short distance of the kimberlite source, whereas garnet and ilmenite persist much farther. In the James Bay Lowland, it is likely that Mesozoic climate was much more tropical than today, which could have eliminated the diopside quite effectively. In the present survey, there appears to be no ilmenite present. This may be due to a simple lack of ilmenite, or the ilmenite may have been removed with the magnetic separation, perhaps because it may have been attached to magnetite grains. This warrants closer examination; should any suspected ilmenite grains be discovered, then microprobe analyses would be needed to evaluate the magnesium content of the grains.

Overburden Drilling Management Ltd. concluded (see report in Volume II) that "the pyropes identified in the present study are probably derived from a kimberlite that is not diamond-bearing," based on the fact that no diamonds were discovered in the bulk sample. In our opinion, this statement is not justified because the bulk sample is really not sufficiently large to tell whether there are or are not diamonds present in the alluvial sample, much less within the kimberlite source. In addition, only a portion of the heavy mineral concentrate was examined optically and, even though great care was taken to observe possible diamonds, the main intent was to verify the existence of pyrope. Diamonds can be quite difficult to identify in their raw state. In traditional diamond exploration, the heavy minerals are passed over a grease table; the diamonds adhere, whereas the other heavy minerals do not.

In the report by Wolfe and others (1975), there is a very large-scale (1 inch = 16 miles or approximately 1 : 1,000,000), but detailed, aeromagnetic map. This aeromagnetic work was carried out by Aquitaine in 1972 in conjunction with their oil/gas drilling program in the James Bay Lowland. Although results of this work are in the OMNR assessment files, that portion of the aeromagnetic map covering Gentles and Pickett Townships is not included. Nevertheless, on the large-scale map, distinctive anomalies are shown to occur in Pickett and Mulholland Townships. These anomalies appear too large and too strong for a kimberlite intrusion. However, straddling the Pickett–Mulholland Township line, there is one circular anomaly, approximately 3 km in diameter, that could be a Precambrian carbonatite or possibly a kimberlite intrusion hosted by Paleozoic sediments. A kimberlite hosted by Paleozoic carbonates and shales would likely have a stronger magnetic signature than comparable intrusions in the Precambrian basement. Attempts are now being made to obtain access to the original aeromagnetic data in order to better evaluate these anomalies.

If the circular anomaly represents a kimberlite, it is close enough to the drill area that one would certainly expect to find abundant ilmenite and perhaps chrome diopside. This may indicate a somewhat more distant source rock for the pyrope garnets.

The apparent fact that kimberlite tracer minerals have not been found in the Cretaceous sands suggests that the kimberlite(s) were covered during this period. The concentration of pyrope garnets in basal Middle Jurassic(?) sediments suggests kimberlite(s) of pre-Middle Jurassic, but probably post-Paleozoic, age. It is possible that the kimberlite or kimberlites were exposed for a considerable period of time, providing the opportunity to develop secondary alluvial concentrations of kimberlite heavy minerals, including diamonds.

The 1982 and 1983 work strongly indicates that the pyrope anomaly in the McCuaig Township drillholes (ONEX-82-03 and ONEX-W83-23) is very significant and certainly warrants additional detailed investigations.

8. MINERAL DEVELOPMENT IN THE JAMES BAY LOWLAND

8.1 INTRODUCTION

Various aspects of the economic geology of the James Bay Lowland have been discussed in several Ontario government reports (see OGS OFR 5427, 1983; Vos 1975, 1982; Telford and Verma 1982; Guillet 1979; Bennett et al. 1967). This chapter summarizes important features of the regional economic geology and discusses the need for coordinated planning in the resource development of the region.

8.2 LIGNITE

Most of the exploration in the region has been directed towards the lignite in the Cretaceous sediments. Although lignite occurrences had been reported in this region before the turn of the century, it was not until the 1920s that the Ontario Bureau of Mines drilled known occurrences in the vicinity of Onakawana at the east end of the Cretaceous Basin. From then until the mid 1970s, approximately 300 holes were drilled in the Onakawana area, and lignite reserves of approximately 190 million tons have been established in one main field plus two smaller satellite fields. Onakawana lignite occurs at depths that are generally less than 150 feet and therefore can probably be mined by conventional surface techniques. At present, future development of the Onakawana lignite deposits is uncertain. The Onakawana Development Corporation (a subsidiary of Manalta Limited) and Ontario Hydro had hoped to develop a sizeable mine-mouth electrical generating plant at Onakawana. However, the current oversupply of electricity in Ontario has caused the postponement of this development, indefinitely.

Regional drilling programs in the 1970s and 1980s resulted in the discovery of several important new lignite occurrences in other parts of the Cretaceous Basin. The new occurrences, shown on Figure 33, are summarized in Table 16. The results of the most recent reconnaissance drill program by the OGS in the northeastern part of the basin

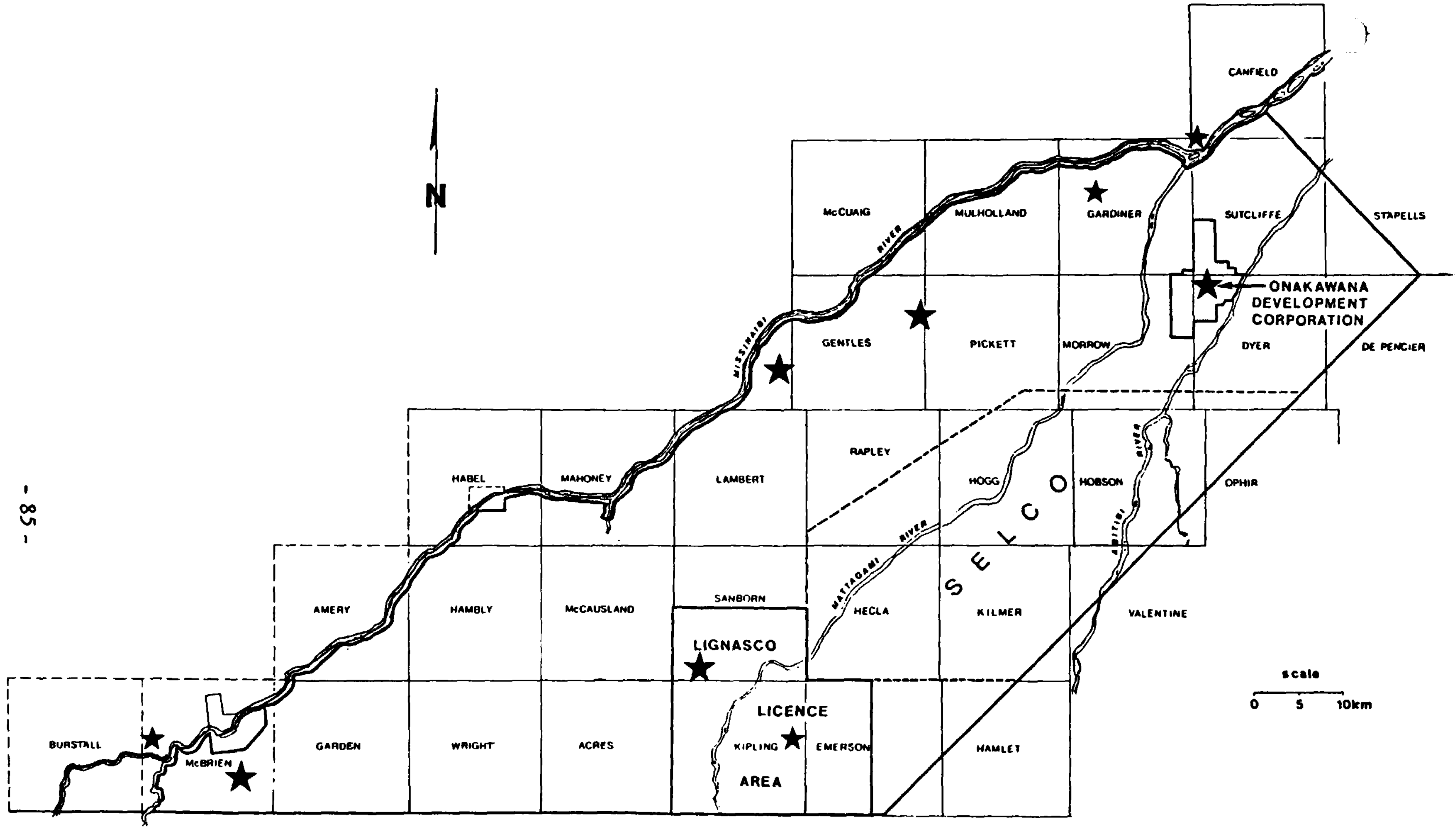


FIGURE 34: Lignite occurrences in the James Bay Lowland. Large stars mark relatively thick lignite occurrences, whereas small stars mark thinner occurrences.

TABLE 16

POSSIBLE ECONOMIC COMMODITIES IN THE JAMES BAY LOWLAND

COMMODITY	MAIN OCCURRENCES	GEOLOGICAL ASSOCIATION	COMMENTS
Lignite	Onakawana Sanborn Township (1978 discovery by the MNR) Gentles Township (1981 discovery by the OEC) West Gentles Township (1982 discovery by ONEXCO) McBrien Township (1982 discovery by ONEXCO)	Most known occurrences appear to be associated with fluvial, nonmarine sequences of late Early Cretaceous (Albian) age; probably formed along banks of major tributaries and in swamplands between river channels.	Recent discoveries confirm significant regional tonnage potential. More drilling required to better define regional potential as well as extent of new discoveries.
Oil Shale	Extensive occurrences near the Abitibi and Mattagami Rivers.	Upper Devonian Long Rapids Formation.	The best occurrences appear to be in the vicinity of Williams Island.
Clay	Known virtually everywhere that Cretaceous sediments occur.	Mattagami Formation: frequently in silica sands, but also as discrete beds.	Abundant kaolin; vast reserves of impure clays, but great potential for high-quality products.
Silica Sand	Known virtually everywhere that Cretaceous sediments occur.	Mattagami Formation.	Great variety of quite pure sands that are suitable for a wide range of industrial needs.
Mica	Associated with some Cretaceous sands.	Mattagami Formation: usually as a coarse and/or fine accessory mineral in silica sands.	Apparently not very widespread, but little is known of extent; possible industrial use.
Diamonds	No occurrences authenticated; kimberlite-like exposures and pyrope indicators known in the area.	Kimberlites are post-Late Devonian and apparently pre-Aptian.	The small size and widespread cover makes exploration for the kimberlite very difficult.
Gypsum	Widespread exposures in the general vicinity of Moose River.	Associated with a sequence of Middle Devonian marine sediments belonging to the Moose River Formation.	Large tonnages occur near-surface and near the railway; could be a significant resource of the future.
Limestone	Limestone cliffs near Grand Rapids (Mattagami River) and Coral Rapids (Abitibi River); many other occurrences known as well.	A variety of limestones occur within various members of Middle and Upper Devonian marine sediments.	Could be of real economic significance if lignite deposits are exploited.
Peat	Covers virtually the entire James Bay Lowland.	These Recent deposits are generally less than 6 feet thick, but are very extensive laterally.	Draining not necessarily a problem; could be of great economic significance if other commodities were exploited.
Metals	None known, although a large columbium-bearing carbonatite occurs east of the area.	A variety of precious, base, and strategic minerals could occur in the Precambrian basement rocks; some base metals could be associated with Devonian carbonates.	Very difficult to explore for, due to extensive cover.
Sulphur	The lignite contains minor native sulphur; iron sulphide is abundant in the lignite and in the Devonian oil shales.	Mostly in the form of pyrite associated with the Cretaceous lignites and Long Rapids Formation shales.	If the lignite and/or oil shale was exploited, then sulphur could be an important byproduct.

are not yet available, but it has been reported to the OEC that some of the results were positive.

As yet we have no real idea as to the lignite reserve potential in the James Bay Lowland. Accurate reserve estimates cannot be based on the numerous isolated occurrences indicated in Table 16. From the extensive drilling done in the Onakawana area, plus the limited drilling carried out in this program, it is clear that the lignite deposits can display sharp lateral variations and that detailed drilling is necessary to establish proven reserves. Although the main Onakawana deposit has aproximately 165 million tons, the nearby satellite deposits each contain less than 15 million tons. Similarly, drilling in the vicinity of the East Gentles Township discovery has indicated that this lignite field is probably quite limited in tonnage potential, compared to nearby occurrences.

If lignite were present in a 3-metre thick (average) seam over one complete township area (15 x 15 km), the tonnage would amount to about 700 million tons. This would not appear to be an unrealistic tonnage for the Cretaceous units outside the Onakawana area. Should such a reserve be realized, it would probably occur in at least 5–7 deposits scattered along the southern margin and in the east-central part of the Cretaceous Basin.

8.3 KAOLIN AND SILICA SANDS

For several decades, the kaolin clay and silica (quartz) sands in the James Bay Lowland have attracted numerous exploration companies. Most of the attention has centered around the area immediately north of Long Rapids on the Mattagami River and along the Missinaibi River near the Pivabiska River and Coal Creek. In virtually all of the regional drilling programs, the Cretaceous sediments consist largely of quartz-rich sands and interbedded clay units. In most cases, the quartz sands contain a considerable amount of kaolin and this accessory kaolin is often quite pure.

Algoma Central Railway Limited has carried out considerable drilling and testwork on a claim block that straddles the Missinaibi River in McBrien Township. This work was originally directed towards assessing the silica-sand potential. Later, it was realized that the kaolin clay associated with the sands was of relatively good quality, and a limited amount of work was then carried out on the feasibility of a clay operation. It would appear that the clay was not entirely suitable for the highest-quality products used in the paper industry, and testing and evaluation was terminated.

There would seem to be little doubt that vast reserves both of good-quality silica sand and kaolin exist in the Cretaceous Basin. In most cases, beneficiation would likely be needed if products of the highest quality were to be marketed.

The major stumbling blocks to the exploitation of these industrial commodities are the relatively remote, inaccessible location, and the system of mining the deposits. The OGS recently funded a prefeasibility study on mining the silica sands and kaolinitic clays using borehole mining techniques. This study (OFR 5427, 1983, by Derry, Michener, Booth and Wahl) concluded that a borehole mining system is technically feasible, and, under certain conditions, economically interesting for mining kaolin. However, with the existing infrastructure, it would not be profitable to recover the silica sands because they have a relatively low unit value in today's marketplace.

8.4 OTHER MINERAL COMMODITIES

Gypsum is widely exposed in a broad, northwest-trending belt that forms the axis of the Moose River Arch. Although the gypsum is associated with numerous Paleozoic formations, the major occurrences are in the Middle Devonian Moose River Formation (see G. R. Guillet in ODM Misc. Paper No. 10, p. 82–87). The gypsum is variable in appearance and geological setting, but the better-known deposits occur as massive units (20–40 feet thick) interbedded with shales. The best surface exposures occur along the Cheepash River in Roebuck Township, along the banks of the Moose River where the ONR line crosses the Moose River, and farther south in Stapells Township where massive gypsum outcrops (known as Gypsum Mountain) have been weathered to produce several natural arches.

The quality of many of the occurrences has been described as very good and large tonnages appear to be available at or near the surface. In the 1960s, some effort was apparently made to evaluate the gypsum deposits in this area (see Guillet 1979), but to our knowledge no exploration effort has been made in recent years. The lack of adequate existing infrastructure would inhibit the establishment of any large gypsum mining operation because of the relatively low unit value of the mining product.

Paleozoic **limestones** are widespread in the James Bay Lowland and are well-exposed in several rivers; the best known exposures are in the small cliffs at Grand Rapids on the Mattagami River, and at Coral Rapids on the Abitibi River. No systematic evaluation of these limestones is known to have been carried out, although Guillet (in Bennet et al. 1967) reports one limestone analysis from Coral Rapids that is over 95% $CaCO_3$ and only about 1% $MgCO_3$. The remoteness of these northern limestones limits the development of any limestone-based industry. However, should other major mining operations be established in the James Bay Lowland, a limestone operation would become much more plausible.

8.5 PEAT

The James Bay Lowland is blanketed with thin deposits of peat. Until very recently, Ontario has paid scant attention to these resources; however, the trauma experienced in the 1970s as a result of our dependence on foreign fuel supplies forced the consideration of alternative domestic sources. Belatedly, a review of the Ontario lignite resources by Monenco Ontario Limited (1981) indicated the vast potential of the lignite.

No attempt has been made to fully evaluate the peat resources in the ONEXCO licence area. However, the Ontario Ministry of Natural Resources has undertaken a detailed classification of the northern wetlands, largely using remote sensing techniques (see Pala and Boissonneau 1982). Results for the Mattagami–Missinaibi Rivers area in the James Bay Lowland have not been published, but extensive bogs are manifest throughout the area. (Figures 35 and 36 illustrate typical peat bogs.) Very limited work by WGM (see WGM 1982a) in the eastern part of the original licence area indicated that many of the bogs are 1.5–2.5 m thick and yield peat with calorific values close to 9,000 Btu (dry basis).

Traditionally, peat bogs have been harvested by dry methods, which involve cutting sod or milling thin layers that are left to dry in the summer months. Both Finland and Ireland have used these methods for many decades, and peat-derived energy is important in meeting their energy needs. However, dry harvesting methods are entirely dependent on weather conditions, and, as happened in Finland recently, an entire year's harvest can be jeopardized by bad weather. Under such conditions, it is also difficult to plan in advance without constructing extensive storage facilities. Furthermore, dry milling methods tie up large bog areas for a long time, require considerable maintenance, and produce dust that can be environmentally unacceptable.

In northern Ontario, large-scale industrial peat development is not likely unless the peat is recovered by wet-mining schemes and the peat processed to yield a product with a high heat value. This product should be easily transported and usable for a variety of industrial applications. Such a process and product is currently being pioneered by a Finnish engineering organization, the Jaakko Poyry Group of Helsinki. The system involves a wet carbonization process that converts raw peat into dense pellets that can be used in place of coal or wood, as well as a feedstock for the production of methanol or other synthetic fuels. The technology and principles involved in this process have been known for many years, but previous processes required so much energy that the final product was far too expensive to compete with other fossil fuels. The Finnish engineering group claims that the peat product contains 72% of all the available energy in the wet peat entering the process plant — a very efficient energy recovery.

Wet-mining and processing methods can be carried out year-round, are environmentally sound, and permit almost immediate rehabilitation of mined bogs.

Mined out bogs can have a variety of uses, which may, in part, help justify peat operations. For example, in Finland, spent bogs are used for agricultural purposes or for reforestation. Spent bogs can spur exceptionally high plant growth rates, if properly drained and if the lower few inches of peat is mixed with the underlying

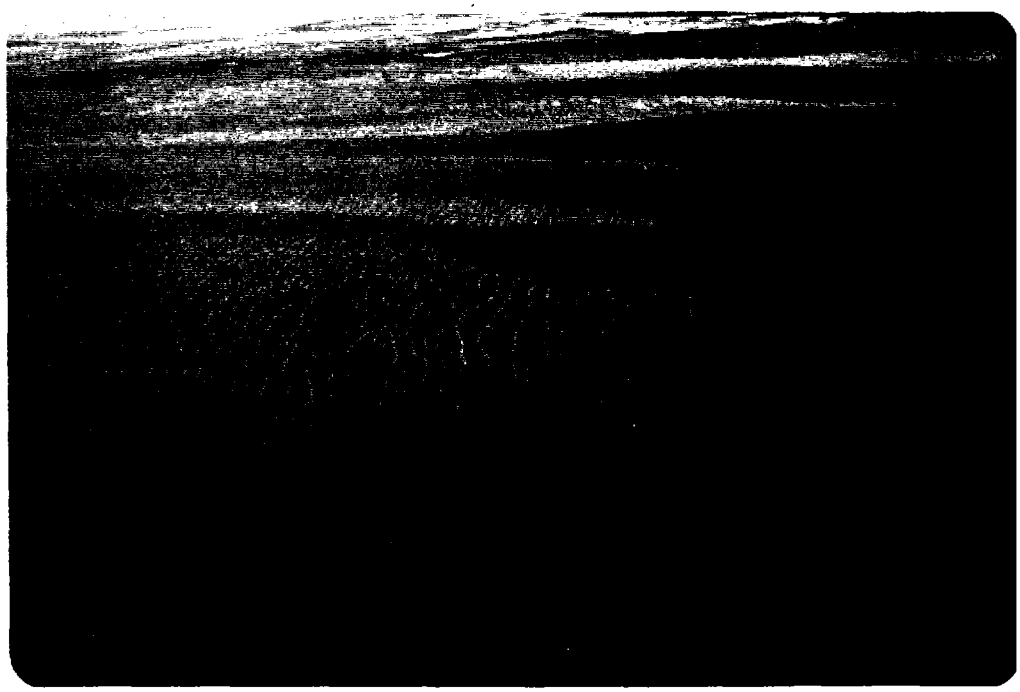


FIGURE 35: Typical peat bogs in the James Bay Lowland.

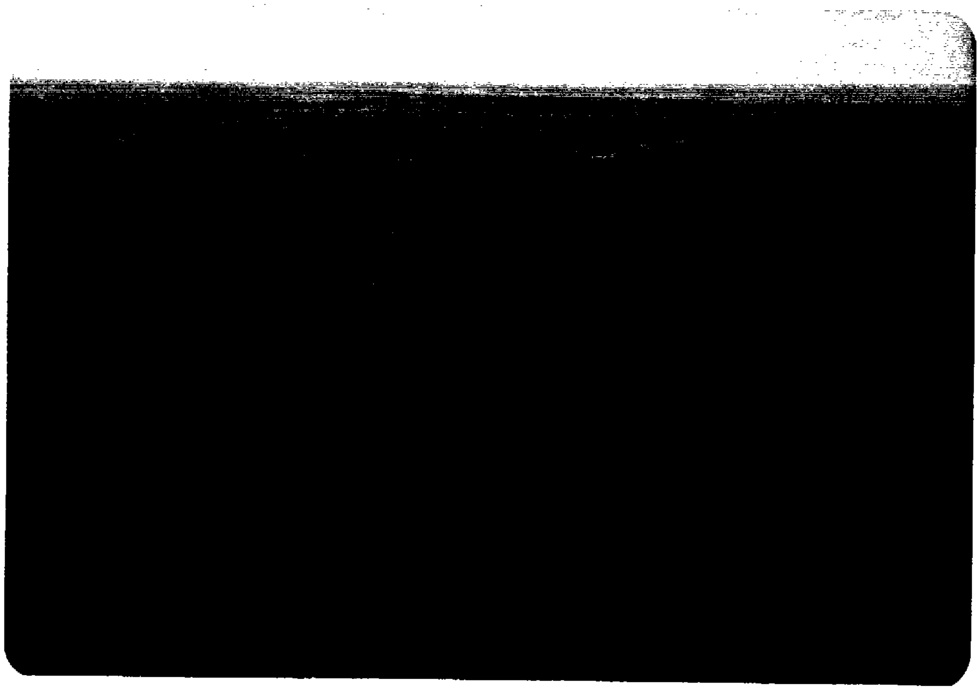


FIGURE 36: Partially forested peat bogs.

sediment (sand/clay/gravel are experienced in most common in Ontario and Finland). In a climate such as that experienced in most of northern Ontario, a variety of vegetables could be grown in spent bogs. Reforestation growth rates in the James Bay Lowland could be excellent, as demonstrated by the large trees fringing most of the major streams, where the banks are well-drained and feature a thin layer of peat.

The existence of the ONR between Moosonee and Cochrane could be critical in the establishment of any peat operations, as well as other mining ventures, in the James Bay Lowland. Several very large bogs occur immediately adjacent to the railway line and in close proximity to the Onakawana lignite deposits.

8.6 OIL SHALE

The 1983 winter drill program made no attempt to evaluate the oil shales associated with the Long Rapids Formation of Late Devonian age. However, preliminary evaluations carried out in 1981 and 1982 confirmed that these oil shales are extensive in the east end of the Moose River Basin. However, total organic contents of most samples did not exceed 7–10 wt% over significant thicknesses and the Fischer assays indicated oil yields only as high as 8 US gallons per short ton. These yields would be insufficient to support an independent oil shale mining operation in this region under present world economic conditions.

Recently, very preliminary physical beneficiation testing was carried out on selected samples from the Long Rapids Formation, to produce an oil shale concentrate that would result in high oil yields. Test results were mixed, but production of a relatively high-grade concentrate through inexpensive physical beneficiation is technically sound and warrants further investigation.

Should a large mining–industrial complex emerge in the James Bay Lowland, then the possibility of utilizing the local oil shale as a source for synfuel feedstock could be attractive.

8.7 REGIONAL APPROACH TO DEVELOPMENT

Without a coordinated, far-sighted approach to regional development, it is unlikely that the full mineral potential of this undeveloped region will be realized.

Northeastern Ontario is renowned for its mineral and forest wealth. Most of the major communities of the area exist as the result of mining operations or pulp and paper mills. However, despite this great natural wealth, the region suffers from chronic unemployment. This unsettling social condition is a result of the normal ups and downs characteristic of the mining and forestry industries, but it is also in part the result of negligible manufacturing activity related to the two main industries. Unless more broad-based industrial activity is established in the northern communities, economic and social conditions are unlikely to change. Some possibilities that would have a very positive impact on the economic welfare of northeastern Ontario are described below.

The development of a lignite mining operation could be critical in establishing a more broad-based regional economy. The 190 million tons of proven ore reserves at Onakawana are not large enough to support a long-term, broad-based industrial complex in northern Ontario. However, if reserves were in the range 500–1,000 million tons, then a number of options become much more realistic — such as the establishment of electrical generating plants, synfuel production, in-situ gasification, and the export of lignite to industrial and urban centres in southern Ontario.

It is therefore important that the lignite tonnage potential of the James Bay Lowland be determined. On the basis of the lignite discoveries in recent years, the 500–1,000 million ton potential is clearly realistic. However, it is apparent that much of this tonnage will be at depths greater than 60 m and will occur in numerous deposits, large and small. Recovery of the energy potential from some of the deeper deposits may be difficult and should be carefully evaluated in terms of present-day technology.

The peat bogs of the James Bay Lowland and northern Shield areas are an extensive resource. Despite the remote location, a large-scale wet-mining and processing operation may be economically feasible in the near future. Any peat operation should also be coordinated with reforestation and agricultural development in areas of spent bogs. A prefeasibility study on such an operation is warranted at this time.

Should a major lignite and/or peat mining development proceed in this area, a number of spin-off industries become feasible. First of all, the establishment of a more comprehensive infrastructure would almost certainly ensure the development of kaolin clay and silica sand mining operations.

The presence of the ONR railway line plus a plentiful supply of power (lignite or peat) would perhaps justify the exploitation of the large known gypsum deposits. Even the limestone beds could be quarried for cement and other construction products. In fact, recovery of lower-grade clays from kaolin or lignite mining operations could be considered for the local manufacture of a broad range of construction products. Access to the nearby railway could make these construction products competitive in other eastern Canadian markets as well as possibly in the United States. Should a variety of high-unit-value products be manufactured, it is possible that they could be transported to western European markets through a small port at Moosonee. Such a port would also provide the opportunity to ship forestry and agricultural products from northeastern Ontario.

The establishment of an energy-related industry in the James Bay Lowland would spur the development of numerous mineral deposits in nearby Shield areas that at present are uneconomic due to lack of infrastructure and because of high energy costs. As possible examples, the known carbonatites at Martison Lake and in Cargill Township contain large reserves of apatite, niobium, and ilmenite that may be economic in the near future. The recovery of pyrite from the James Bay lignite deposits could be used in conjunction with phosphate from the apatite deposits for phosphate fertilizer products. These products would be marketed in eastern North America, but they also could be marketed in Europe via a port in Moosonee.

Should any significant mining development (lignite or other) be initiated, then a major peat mining and processing operation becomes possible, especially if the potential benefits in agriculture and reforestation are considered. With proper planning and management, the spent bogs could become economically important.

Implementation of such large-scale regional development plans would enhance current industry in the area, but also would greatly encourage further development in manufacturing and processing of raw materials into finished products.

9. CONCLUSIONS

9.1 INTRODUCTION

The 1983 winter drilling program was a success in both a technical and non-technical sense. The following outlines the most important conclusions from the 1983 field program.

9.2 TECHNICAL CONCLUSIONS

1. The unconsolidated Quaternary and Mesozoic sediments of the Moose River Basin can be successfully drilled using a combination of reverse-circulation and triple-tube coring techniques. In a few cases, the drilling did encounter mechanical and technical problems that prevented proper sampling and logging from being carried out. Some modifications in drilling procedures should be of assistance in future drilling programs. As always, the experience and patience of the driller is critical to the success of the drilling.

2. As a result of the relatively good access to the central part of the licence area, a ground-supported winter program utilizing Nodwells is seen as the most cost-efficient and practical method of conducting a drill program.

3. The regional drilling segment of the program was carried out effectively using helicopter support. The "fly Acker", a modified version of the Acker P38 drill, performed well, and was efficient for reconnaissance drilling in areas where overland access is difficult. The Bell 205 and Bell 206 Jet Ranger helicopters provide an efficient, but costly means of support.

4. Wireline geophysical logging is a useful tool in supplementing visual logging of drillholes, praticularly when employing reverse-circulation methods. Technical problems were encountered during the course of drilling that prevented complete

geophysical logs from being performed, because plastic casing was not successfully inserted in every hole. Careful insertion of the plastic pipe, in addition to attentive drillers while pulling casing, will help to ensure that these problems are minimized.

5. There were a number of mechanical problems encountered on both the ground support vehicles and the drill rigs. The cold weather is much more demanding on equipment and mechanical problems are more common. However, thorough examinations of equipment in the shop, prior to mobilization, will ensure that malfunctioning equipment is repaired and operating efficiently when shipped into the field.

6. Reverse-circulation techniques can be very effective in obtaining bulk samples for heavy mineral studies.

9.3 GEOLOGICAL CONCLUSIONS

1. Significant intersections of lignite were encountered in ONEX-W83-02 and ONEX-W83-09 on the West Gentles grid, with thicknesses of 22.5 feet and 18.0 feet, respectively. Additionally, a number of thinner seams of lignite were discovered during the course of the drilling. These new discoveries, in addition to results obtained during the 1981 and 1982, confirm the existence of satellite lignite fields in the locale of Gentles Township, and further enhances the potential for establishing significant lignite reserves in the general area. The West Gentles occurrence appears to have considerable tonnage potential, whereas the East Gentles seams are more restricted in area.

2. Drilling has indicated that there is an apparent merging of two lignite seams into a single, thicker seam on both the East and West Gentles grids. The seams display abrupt lateral variations and tend to be irregular in shape.

3. The lignite discoveries in and near Gentles Township indicate that areas north of the Missinaibi River have very good lignite potential.

4. Analytical results show that the lignite has relatively high heat values. Results from the ash content analyses are variable.

5. Drilling results suggest the presence of a northwest-trending structural–paleotopographic high transecting Gentles Township; this is probably an extension of the Grand Rapids Arch and could have influenced sedimentation and lignite formation in the Moose River Basin.

6. Drilling in the southeast corner of McCuaig Township revealed calcareous sands and clays that probably correlate with the Jurassic Mistuskwia Beds identified north of the Missinaibi River. Confirmation of the age of these units by palynology will be needed.

7. An important pyrope garnet anomaly was confirmed. The garnets occur at the base of a section of poorly sorted silts and sands that are probably Jurassic in age. Underlying units are interpreted to be a clay–limestone breccia formed by slumping into karst cavities; these cavities are probably hosted by Devonian limestones (Williams Island Formation). The chromium content of the pyrope is indicative of a kimberlite source rock. This is considered to be an important anomaly and additional work is clearly warranted; this area remains a good diamond prospecting target. The diamond targets should include both kimberlite source rocks and secondary alluvial concentrations.

8. Although lignite is perhaps the most important industrial commodity in the James Bay Lowland, other significant industrial resources are also present. These include peat, kaolin and other clays, silica sand, gypsum, and limestone. Any regional development must be considered in the context of the entire resource package available, since exploitation of only one resource will make it difficult to justify the extensive infrastructure that would be needed. Any such development will require close cooperation among a number of industrial and government groups if the real potential of this region is to be realized. Without the active support and assistance of the Government of Ontario, it is unlikely that any major regional development scheme would be feasible.

10. RECOMMENDATIONS

The following general recommendations can be made:

1. Considerable drilling is warranted on the West Gentles lignite discovery, but limited additional drilling only is needed on the East Gentles discovery. Drillholes should be spaced no more than 1–2 km apart; lignite-bearing holes should be surveyed with wireline geophysics. This work can best be carried out during a winter drill program.

2. Semi-reconnaissance drilling for lignite is warranted in Lambert and Rapley Townships along the southern part of the main 1983 reduced licence area. Drillholes should be spaced every 3–5 km. Most of this swampy area is accessible by winter roads, and therefore it will be cost-efficient to do the drilling in the winter.

3. Any regional exploration drilling by the Ontario Geological Survey in the area north of the Missinaibi River should be closely monitored. Results from such work could have important implications to work carried out in the ONEXCO licence area. As concluded in previous reports to ONEXCO Minerals Ltd., it is WGM's opinion that the Cretaceous units north of the Missinaibi River have good potential for lignite reserves.

4. The depth and character of the new lignite discoveries indicate the need for a careful evaluation of mining schemes that can recover the energy potential of the lignite.

5. The pyrope anomaly in drillholes ONEX-82-03 and ONEX-W83-23 should be rigorously followed up. Several drillholes should be drilled in the immediate vicinity in order to obtain good core samples that will permit sedimentological and palynological studies of the relevant sedimentary units. Large bulk samples (about 1,000 kg per drillhole) of the anomalous sands/silts should be taken, for heavy mineral concentration. Heavy mineral concentrates should be passed over grease

tables in order to capture any diamonds present in the sands. Closely-spaced high-sensitivity aeromagnetic surveying should be carried out over the southern and eastern part of the current licence area, and those parts of Mulholland and Pickett Townships not in the Selco exploration licence area.

6. A more thorough evaluation of other resources in the James Bay Lowland is warranted. This examination should include the peat, clay, silica sand, gypsum, and limestone resources of the area. Although considerable information is available on these resources, no integrated, regional assessment has been done. The Ontario Ministry of Natural Resources should be contacted at the highest levels in order to determine the goverment's interest in such a large regional development program.

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Watts, Griffis and McOuat Limited

SUMMARY REPORT
1983 WINTER DRILL PROGRAM
JAMES BAY LOWLAND
FOR ONEXCO MINERALS LTD.
VOLUME II

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Toronto, Canada
August 29, 1983

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LIST OF DRAWINGS

DRILL LOGS

ONEXCO MINERALS LTD.

1983 WINTER DRILL PROGRAM – JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-01 **Location:** West Gentles Township (**lat.** 50°30'18" **long.** 82°06'19")

Elev. of collar: ≈279 ft **Total depth:** 385 ft **Sheet** 1 **of** 6

DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	Sampling	Description
0–3	0–10		NS	MUSKEG: 0–4.0' CLAY: 4.0–10.0' Light grey calcareous clay with shell fragments. RECENT / PLEISTOCENE
3–18	10–60		CS CS CS CS CS	CLAY TILL: 10.0–60.0' Light grey–green calcareous, clay-rich till with tan-coloured limestone/dolomite and black siltstone pebbles; pebbles are predominantly rounded. 34.0': light grey chert cobble. 37.0': fossiliferous, with increased clay content. 43.0': clay becoming slightly stiffer. 46.0': boulder. 52.0': clay is very stiff.
18–20	60–65		CS	SAND/GRAVEL: 60.0–70.0' Silty/sandy, polymictic gravel; lithic fragments include quartz, chert, limestone, and black siltstone. Sand is brown, calcareous, and dominantly fine-grained.

Depth scale (m): 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

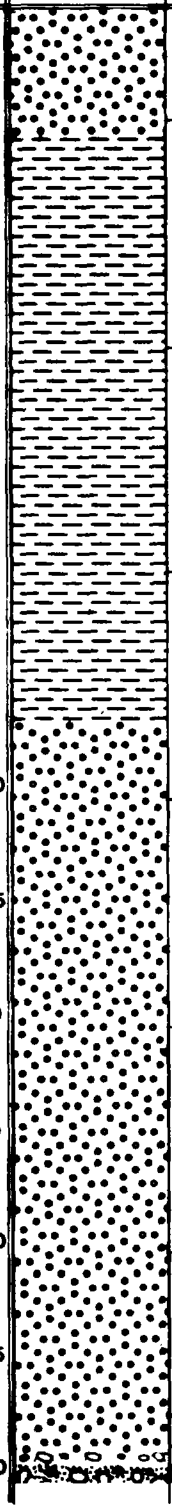
Depth scale (ft): 5 10 15 20 25 30 35 40 45 50 55 60 65

Sampling sub-columns: reverse, interval, X core, Number

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-01

Sheet 2 of 6

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
20–40	65–130		CS CS CS CS CS CS CS			see below

m: 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

ft: 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130

Description

68.0–69.0': grey clay interbed.

CLAY: 70.0–96.0'

Grey clay; calcareous, stiff containing occasional sandy or pebbly interbeds.

73.0': limestone fragments.

80.0–81.0': brown calcareous sand.

83.0': minor silt/sand.

SAND AND GRAVEL: 96.0–128.0'

Graded polymictic sand and gravel. Clasts are poorly sorted; fine- to coarse-grained; generally rounded to subrounded fragments of varied lithology; limestone, dolomite, siltstone, quartz, and basement material. Minor interbeds of fine- to medium-grained white–grey sand occur in gravel.

115.0–116.0': gravel is moderately to well sorted.

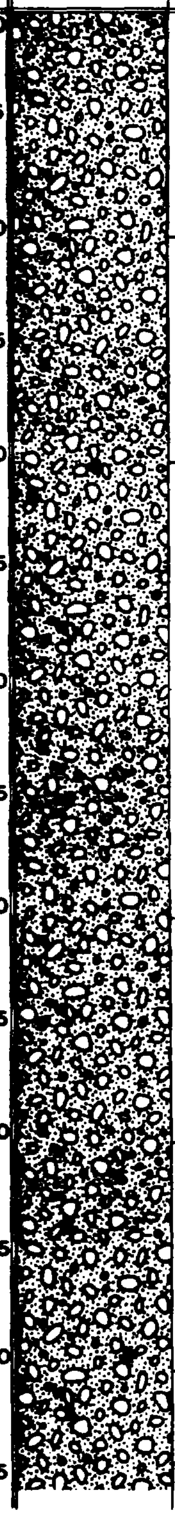
125.0–126.0': coarse pebble–cobble layer containing minor sand.

CLAY TILL: 128.0–215.5'

Grey sandy–pebbly clay-rich till; polymictic sand with pebble clasts of varied lithology; calcareous as usual.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-01

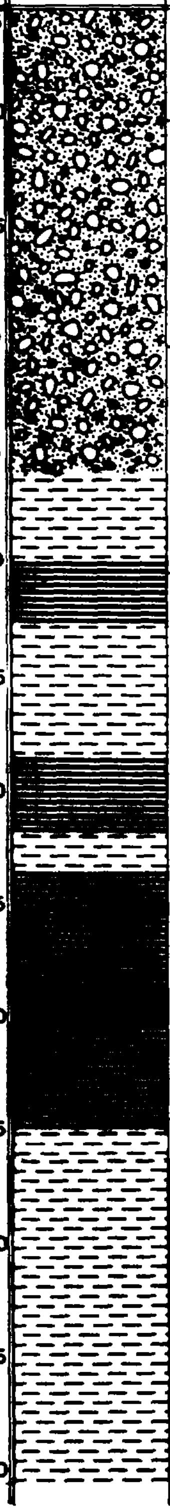
DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
40–60	130–195					136.0': possible basement cobble. 143.0': diabase cobble. 150.0': first appearance of detrital lignite chips. 153.0': quartzite boulder. By 166.0', sandy fraction has increased. 186.0': gravel bed. 189.0–190.0': sandy gravel interbed.

Depth scale (m): 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60

Depth scale (ft): 130, 135, 140, 145, 150, 155, 160, 165, 170, 175, 180, 185, 190, 195

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-01

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number
60–80	195–260		CS, CS, CS	60, 100, 100, 25	

Depth scale (m): 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80

Depth scale (ft): 195, 200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260

Description

195.0–215.5': medium to dark grey sandy till, containing abundant quartz-rich gravels; heterolithic, calcareous with a minor clay fraction. Significant carbonaceous material contained in interval.

<u>PLEISTOCENE</u>

CRETACEOUS

CLAY: 215.5–219.0'
Medium grey clay grading into dark grey and black carbonaceous clay by 219.0'; stiff, non-calcareous.

CARBONACEOUS CLAY: 219.0–220.0'
Black, stiff, carbonaceous clay.

CLAY: 222.0–228.0'
As 215.5–219.0'.

CARBONACEOUS CLAY: 228.0–231.0'

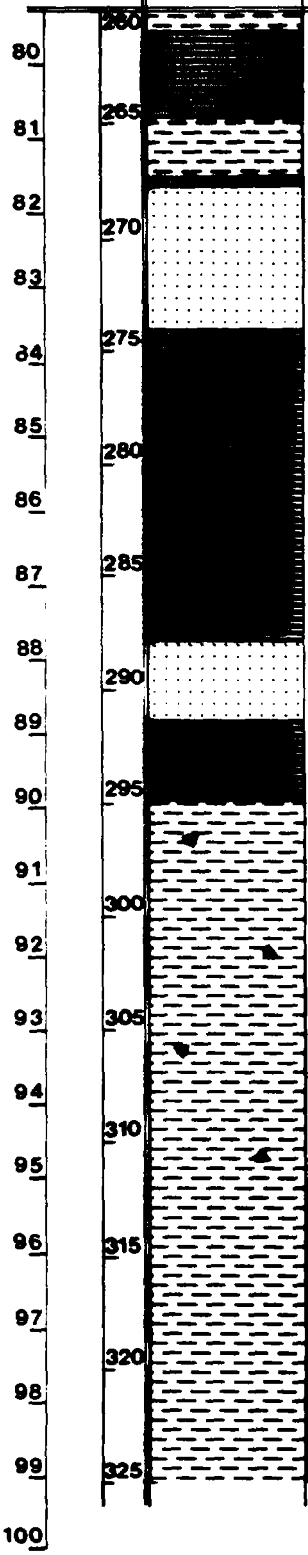
CLAY: 231.0–233.0'
As above.

CARBONACEOUS CLAY: 233.0–244.8'
As above with intervals rich in carbonaceous material: wood chips and lignite.
234.0': brown woody chips.
235.0–238.0': abundant lignite and wood chips.
238.5–239.5': lignite seam.

CLAY: 244.8–261.0'
Dark grey/brown, clay containing minor lignite. By 258.0', clay is quite muddy grading into a black carbonaceous clay by 259.0'.

Drill Hole No: ONEX-W83-01

DEPTH (m, ft)	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description



% core recovered: 40, 40, 100, 70, 100, 95, 100

CARBONACEOUS CLAY: 261.0–265.0'
As above.

CLAY: 265.0–267.5'
Very stiff grey clay.

CARBONACEOUS CLAY: 267.5–268.0'

SAND(?): 268.0–274.0'
Possible sand seam as inferred from missing core.

CARBONACEOUS CLAY: 274.0–288.0'
Black, earthy, carbonaceous clay with minor grey, silty, and somewhat micaceous layers; contains lignite chips and minor pyrite.

SAND(?): 288.0–291.5'
Approximately 2" of sand retrieved from run; interval of sand suggested by poor recovery.

CARBONACEOUS CLAY: 291.5–295.0'
As 274.0–288.0', except pyrite is absent.

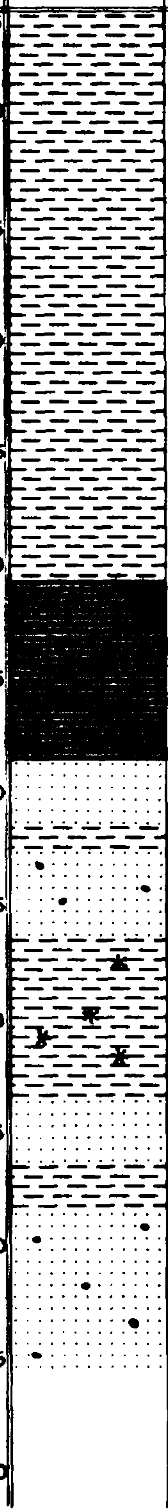
CLAY: 295.0–350.0'
Light brown micaceous clay with very minor seams of carbonaceous clay, grades into a dark brown–grey clay by 296.0'; contains minor wood chips; stiff, non-calcareous.

By 309.0', clay is a light brown–grey and quite soft.

312.0': 1/8" seam of white kaolinitic clay.

312.0–350.0': very dark grey–brown clay; stiff, containing lignite fragments and minor pyrite.

Drill Hole Nº: ONEX-W83-01

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number
100–119	325–390		? ? ?	70, 10, 80, 30, 40, CS?	

Depth scale (m): 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119

Depth scale (ft): 325, 330, 335, 340, 345, 350, 355, 360, 365, 370, 375, 380, 385, 390

Description

CARBONACEOUS CLAY: 350.0–358.0'
Black carbonaceous clay with pyrite nodules occurring throughout. Minor light brown clay seams appear intermittently.

357.2': sandstone interbed approximately 0.5" thick.

SAND(?): 358.0–361.0'
Possible sand seam implied by missing core.

CLAY: 361.0–378.0'
Light to medium grey clay with possible sandy interbeds; contains moderate pyrite and occasional pebble-sized quartz and chert clasts. Generally non-gritty and non-calcareous as usual.

By 369.0', clay is dark grey, sandy, and pyritiferous; pyrite occurs as finely disseminated grains and in a band at 373.0'.

376.0': lignite chips appear in dark brown clay.

SAND(?): 378.0–385.0'
Dirty quartz-rich sandstone; medium- to coarse-grained, moderately sorted. Sand consists of subangular quartz grains with lesser amounts of subrounded chert clasts. Includes light grey clay interbeds.

END OF HOLE: 385.0'

PLASTIC CASING TO 240.0'

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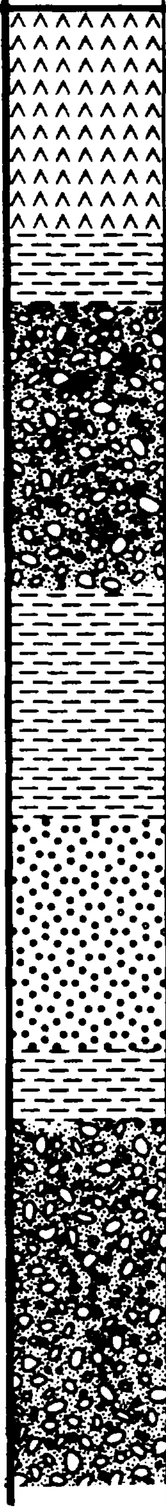
1983 WINTER DRILL PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-02 **Location:** West Gentles Township **(lat.** 50°30'18" **long.** 82°04'26" **)**

Elev. of collar: ≈285 ft **Total depth:** 335.5 ft **Sheet** 1 **of** 6

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: X core	Sampling: Number	Description
1–3	5–10		NS			MUSKEG: 0–10.0'
3–4	10–15		CS			CLAY/SAND: 10.0–13.0' Grey, silty–sandy calcareous clay. RECENT PLEISTOCENE CLAY TILL: 13.0–26.0' Grey calcareous clay with limestone fragments, sand. Quartz pebbles occur at 14.0'.
7–9	25–30		CS			CLAY: 26.0–36.0' Grey calcareous clay.
10–13	35–45		CS			GRAVEL: 36.0–46.0' Sandy, silty gravel; calcareous sand. Rock fragments predominantly angular, tan limestone fragments; also rounded black siltstone pebbles.
13–14	45		CS			CLAY: 46.0–49.0' Grey calcareous clay.
15–20	50–65		CS CS			CLAY TILL: 49.0–73.5' Dominantly grey calcareous clay (≈80%); 15–20% sand–silt, <5% pebble. Predominantly limestone pebbles, also granite. 49.0–50.0': limestone fragments. 55.0–56.0': granite pebbles. 61.0–62.0': limestone fragments.

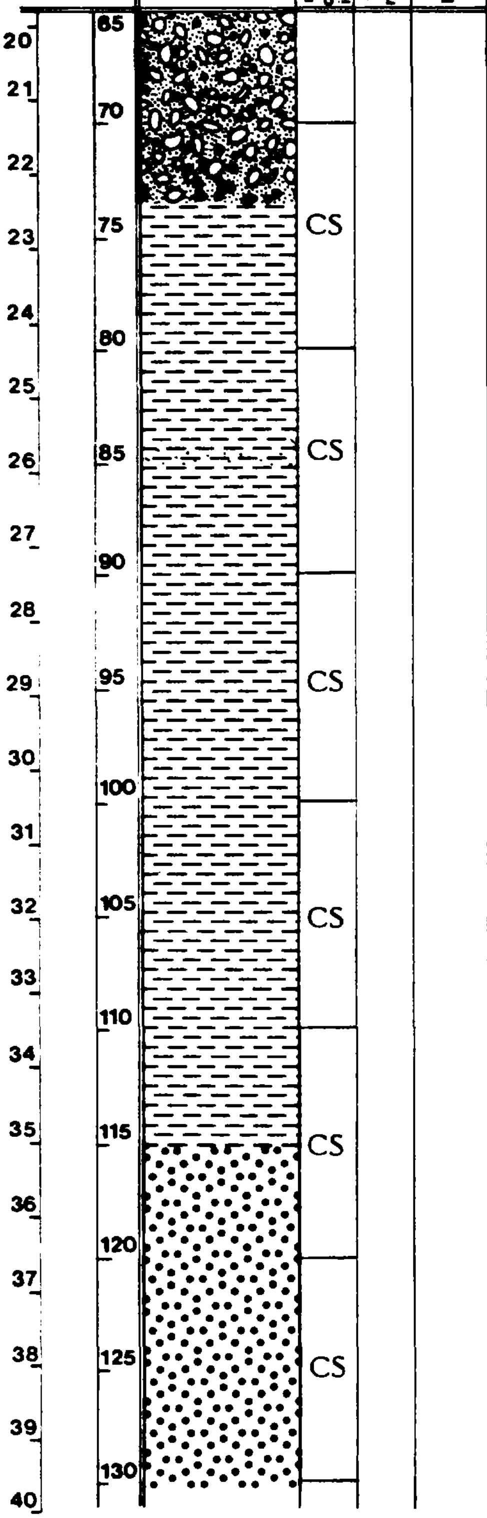
Depth scale: m 1–20; ft 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-02

Sheet 2 of 6

DEPTH (m, ft)	GRAPHIC LOG	Sampling (reverse circulation interval, % core recovered, Number)	Description



66.5': minor granitic fragments.

CLAY: 73.5–115.0'
Medium to dark grey, moderately stiff calcareous clay; less than 5% sand–silt. Light–dark mottled colouring in clay.

86.0–86.5': sand, silt, and minor limestone pebbles.

97.0': finely laminated clay.

103.0–106.0': soft, light to medium grey clay; non-gritty.

106.0–116.0': clay unit grades transitionally into underlying gravel unit.

SANDY GRAVEL: 115.0–128.0'
116.0': fine pebbles grading into medium-grained brown sand.
116.0–116.5': fine- to medium-grained, salt- and pepper-like sand.
116.5–117.0': rounded to subrounded pebbles of limestone, dolostone, black siltstone, jasper, greenstone, granitic gneiss.
117.0': medium-grained, dirty calcareous sand pebbles and cobbles.
118.0': pebbles and cobbles as above.

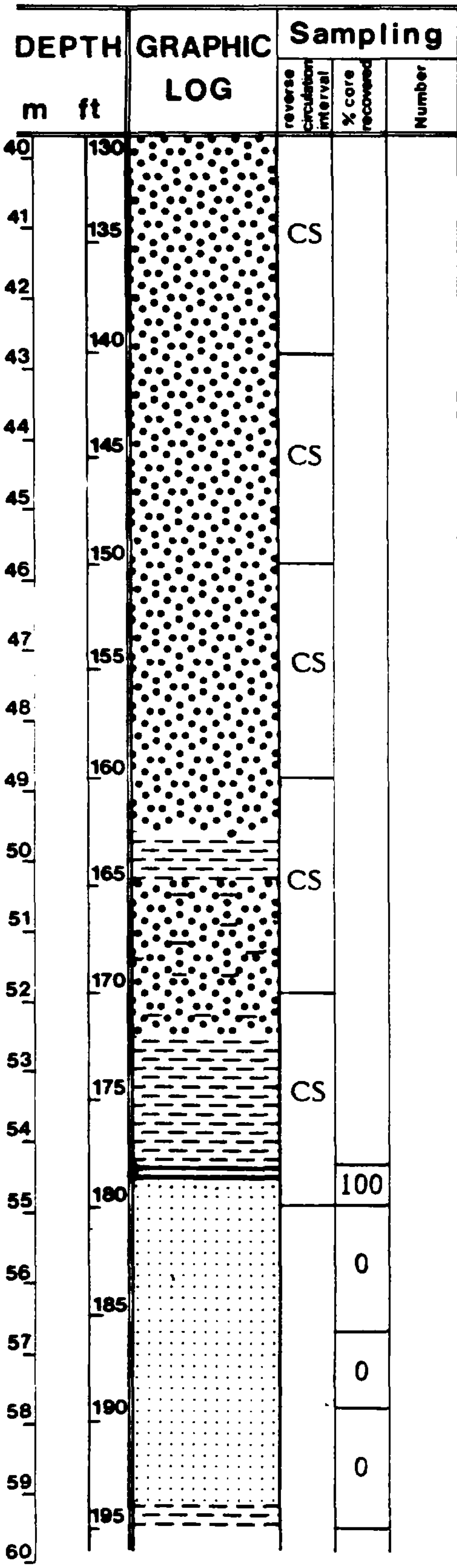
120.0–122.0': fine calcareous salt and pepper sand with 10% pebbles and cobbles.

122.0–128.0': sandy gravel with sand content increasing from 20–50%.

PEBBLY SAND: 128.0–150.0'
Fine-grained calcareous sand with up to 15% pebbles (limestone, quartz, black siltstone).

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole №: ONEX-W83-02



Description

136.0': gravel bed.

PEBBLE GRAVEL: 150.0–163.0'
Pebbly gravel of varied lithology; tan limestone, quartz, and black siltstone; pebbles rounded, up to 0.5" diameter.

156.0': boulder.

160.0': jasper fragments.

PLEISTOCENE
CRETACEOUS

CLAY: 163.0–165.0'
163.0–164.0': brown clay.
164.0–165.0': grey, non-calcareous clay with minor grit.

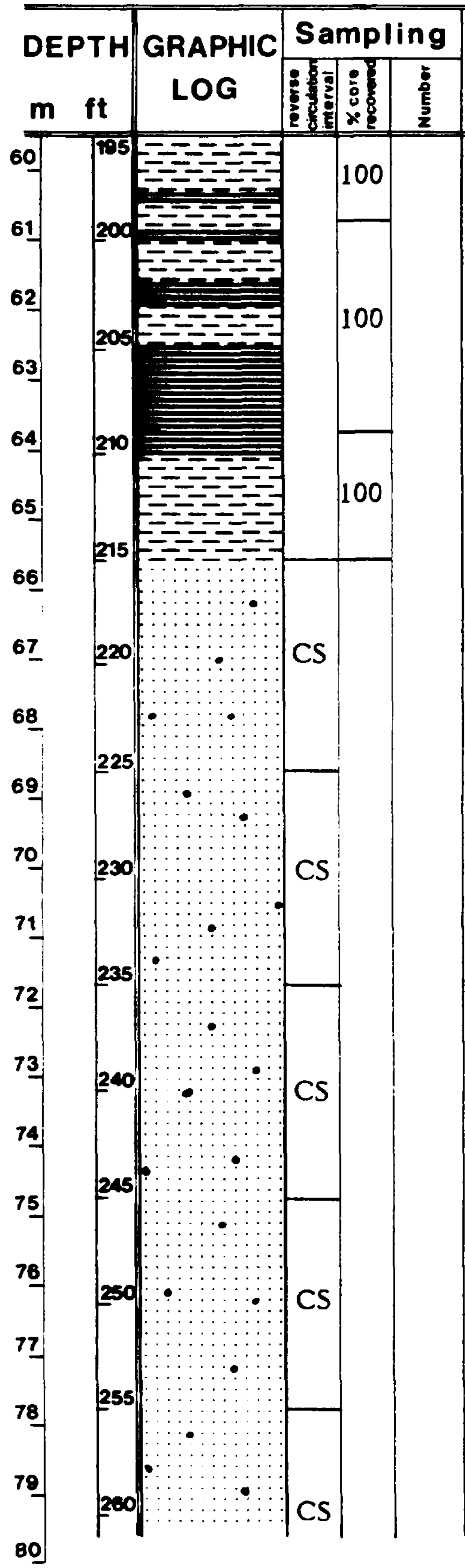
PEBBLY SANDY GRAVEL: 165.0–172.5'
Pebbly sandy gravel with interbeds of brown and grey, non-calcareous, non-gritty clay as above.

CLAY: 172.0–178.5'
172.0–173.0': grey, non-calcareous, stiff clay.
173.0–175.0': dark grey–black, very stiff clay.
175.0–178.0': beige to medium grey very stiff clay.
178.0–178.5': dark grey to black clay interbedded with beige to medium grey clay.

CARBONACEOUS CLAY: 178.5–179.0'
Black, carbonaceous, stiff, finely laminated clay with a slight woody texture; minor brown–beige chips.

SAND(?): 179.0–194.0'
Possible sandy interval implied by missing core.

CLAY: 194.0–197.5'
Interbedded, soft, light grey clay with minor dark brown to black clay horizons (≈1/16" thick).



Description

196.5–197.0': silty clay, micaceous.

CARBONACEOUS CLAY: 197.5–198.0'
Black, silty–sandy, micaceous carbonaceous clay, minor lignite fragments.

CLAY: 198.0–199.5'
198.0–198.5': silty–sandy micaceous medium grey clay.
198.5–199.5': medium grey clay.

CARBONACEOUS CLAY: 199.5–200.5'
Black carbonaceous clay, minor lignite fragments at 199.7'.

CLAY: 200.5–202.0'
Dark grey–brown, 'slippage surface' layering.

CARBONACEOUS CLAY: 202.0–203.0'
Black carbonaceous clay with 'slippage surface' layering and minor (<5%) prismatic pieces of lignite.

CLAY: 203.0–205.0'
Alternating layers medium–dark grey clay with brown clay, wood chip impressions.

CARBONACEOUS CLAY: 205.0–210.0'
Dark brown to black, prominant black prismatic wood chip impressions (to 5% locally).
205.0–206.5': very fine-grained silty layers.
208.0–208.5': 3" long woody roof(?).
209.3': lignite seam (1" thick), black–brown, woody texture.
209.3–209.5': abundant lignite fragments.

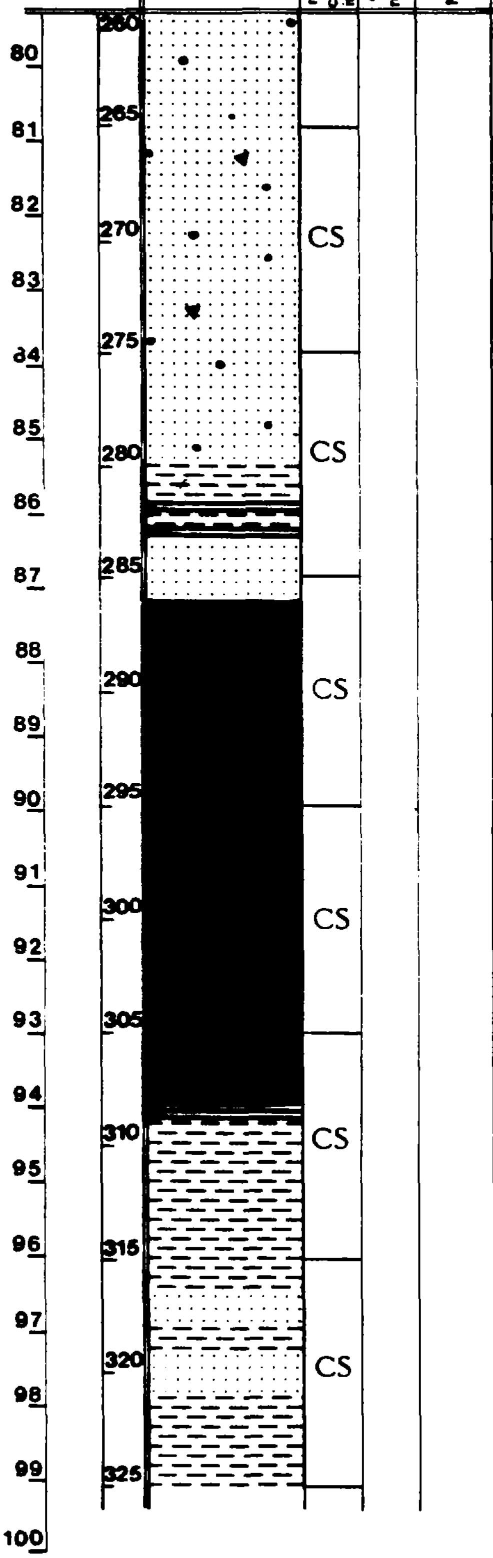
CLAY: 210.0–215.0'
210.0–212.0': medium brown clay containing minor (<1%) lignite chips.
212.0–215.0': dark brown–grey clay with fine micaceous silty layers, prominant 'slippage surface' layering, appreciable wood chip impressions (≈5%).

SILICA SAND: 215.0–280.0'
Largely fine- to coarse-grained quartz sands (>90%) with minor lithic fragments (10%), of varied lithology. Minor interbeds of medium grey silty clay, abundant lignite fragments.
242.5–243.0': layer of fine-grained quartz sand.
243.0–248.0': pebble-sized lithic fragments in quartz sand, lignite fragments.
248.0–250.0': alternating coarse-grained sand with numerous fine-grained interbeds.
251.0–256.0': medium brown silty clay, coarsening to fine-grained sand and pebbles.
256.0–266.0': light brown–grey quartz-rich silty clay with minor pebbles and lignite.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-02

DEPTH m ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description



266.0–272.0': very fine silica sand–silt; lignite fragments.
272.0–279.5': coarse-grained silica sand with 10–20% lithic fragments and lignite; interbeds of brown clay–silt at 277.5' and 279.5'.
279.5–280.0': dark brown very fine sand–silt–clay.

CLAY: 280.0–282.0'
Very dark brown–grey stiff clay.

CARBONACEOUS CLAY: 282.0–282.5'
Black carbonaceous clay with 'onion peel' like layering.

CLAY: 282.5–283.0'
Grey stiff clay.

CARBONACEOUS CLAY: 283.0–283.5'

SAND: 283.5–286.0'
Very fine quartz sand with minor lignite fragments; lignite fragments; quartz pebbles up to 0.25" diameter at 285.5'.

LIGNITE: 286.0–308.5'
286.0–293.5': contains rounded, broken quartz fragments up to 0.25" diameter and fine-grained pyrite nodules up to 0.25" diameter; fine-grained silica sand and clay.
293.5': silty, sandy.
300.0–302.0': abundant quartz sand.
302.0': approximately 5% pyrite occurs as fine-grained nodules up to 0.25" diameter.
306.0': some silica sand.
306.5–307.0': black carbonaceous clay with abundant lignite fragments.
307.0–308.5': abundant pyrite nodules.

CARBONACEOUS CLAY: 308.5–309.0'

CLAY: 309.0–316.5'
309.0–309.5': dark brown, stiff, non-gritty clay.
309.5–315.5': clay becomes lighter coloured (to a light tan colour), coarse-grained, stiffer with depth.
314.0': minor lignite fragments up to 0.25" diameter.
315.5–316.5': light tan to white, soft, non-gritty clay.

SAND: 316.5–318.0'
Fine-grained sand–silt with coarser grains of quartz and pyrite up to 0.25" diameter.

CLAY: 318.0–319.0'
Light brown–grey stiff clay with no grit; 'onion skin' layering.

SAND: 319.0–321.0'
Fine-grained silica sand with minor black rock fragments and pebbles up to 0.25" diameter.

CLAY: 321.0–326.0'
321.0–323.0': dark grey to black clay with 'onion skin' like layering.
323.0–325.0': soft medium grey clay with abundant lignite fragments (5–10%) from 324.5–325.0'.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-02

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
100	325					325.0–325.5': very fine sand–silt; lignite fragments. 325.5–326.0': stiff, non-gritty grey clay with 'onion skin' layering.
101	330		CS			CARBONACEOUS CLAY: 326.0–327.0' Dark grey–black, stiff carbonaceous clay with a few light brown clay interlayers up to 1/16" thick.
102	335					CLAY: 327.0–335.5' Dark grey–brown, stiff clay; 6" fine silica sand seam at 335.0'.
103						
104	340					END OF HOLE: 335.5'
105	345					HOLE PLASTIC CASED TO 185.0'
106						
107	350					
108	355					
109						
110	360					
111	365					
112						
113	370					
114	375					
115						
116	380					
117	385					
118						
119	390					

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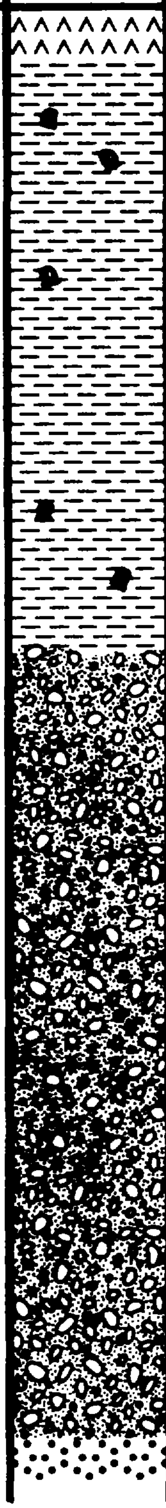
1983 WINTER DRILL PROGRAM – JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-03 **Location:** West Gentles Township (**lat.** 50°31'19" **long.** 82°07'11")

Elev. of collar: ≈272 ft **Total depth:** 382 ft **Sheet** 1 **of** 6

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling
1			
2	5		NS
3	10		
4	15		CS
5			
6	20		CS
7			
8	25		
9	30		
10			
11	35		CS
12	40		
13			
14	45		CS
15	50		
16			
17	55		CS
18	60		
19			
20	65		CS

Sampling columns: reverse circ., interval, X core, number

Description

ICE AND MUSKEG: 0–2.0'

MARINE CLAY: 2.0–17.0'

2.0–5.0': grey to beige to light brown, soft, non-gritty, weakly calcareous increasing to strongly calcareous clay; shell fragments at 5.0'.

5.0–8.0': medium grey, gritty, calcareous, oxidized clay with abundant shell fragments.

8.0–17.0': medium to dark grey, non-gritty, stiff, calcareous clay with shell fragments from 8.0–9.0'.

CLAY: 17.0–28.0'

Medium to dark grey, calcareous, very soft clay with occasional rock fragments.

18.0': diabase fragments.

22.0': shell fragments, black siltstone chips, and diabase.

22.0–25.0': bivalve shell fragments.

28.0': black volcanic fragments.

RECENT
PLEISTOCENE

CLAYEY TILL: 28.0–47.0'

Medium brown to grey, matrix extremely muddy; clasts include limestone (60%), black siltstone (10%), black volcanic (10%), diabase (5%), red jasper (2–3%), silt and sand (<5%).

29.0': percentage of carbonate clasts increases to 75%.

31.0': percentage of clasts increasing.

35.0': increasing silt and pebble content.

CLAY–PEBBLE TILL: 47.0–57.0'

CLAY TILL: 57.0–63.0'

Brown, moderately stiff, slightly gritty, calcareous clay with a few pebbles.

60.0': diabase cobble.

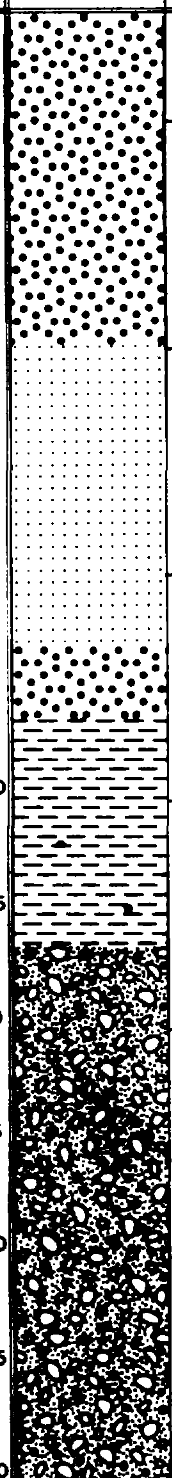
SAND/GRAVEL: 63.0–80.0'

Fine brown sand with pebbles of limestone, black siltstone, black volcanics, diabase.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-03

DEPTH m ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description



65.0–67.0': diabase and brown limestone boulders.

70.0': boulder.

SAND: 80.0–93.0'
Polymictic, medium- to coarse-grained sand with a few pebbles.

88.0': fine sand.

GRAVEL: 93.0–96.0'
Medium- to coarse-grained sand with rounded pebbles.

PEBBLE CLAY: 96.0–106.0'
Light brown, calcareous, moderately stiff clay; angular pebbles as above (10%); minor grit.

100.0–101.0': very pebbly.

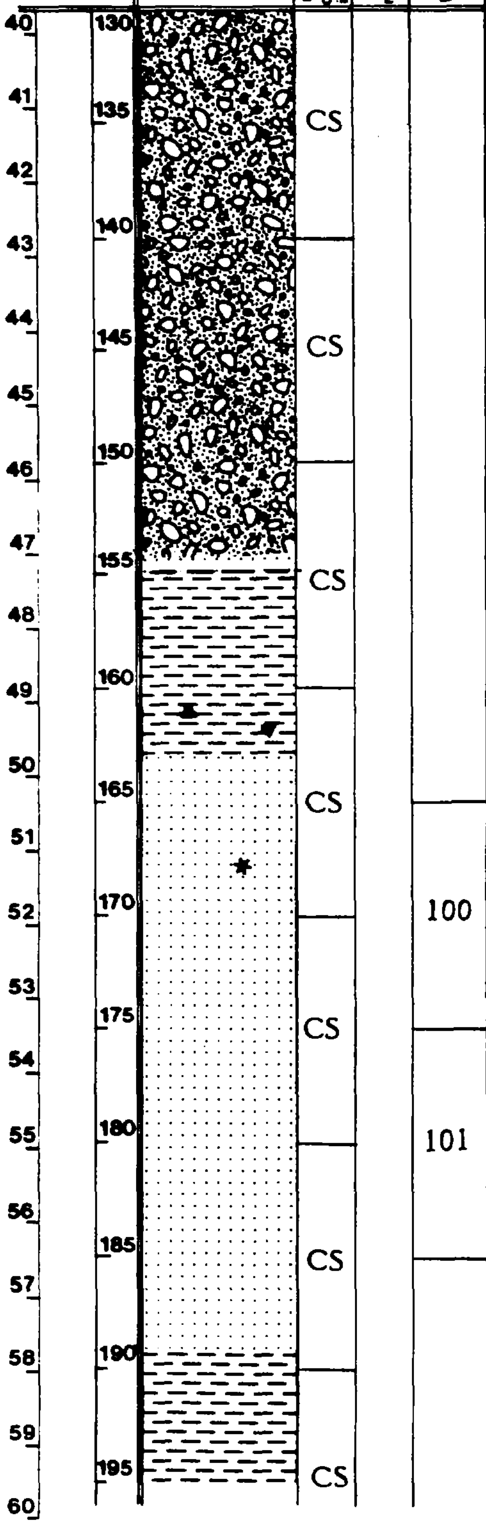
CLAY TILL: 106.0–154.0'
106.0–123.0': medium grey, moderately stiff, calcareous, slightly gritty clay with 1–2% tan limestone pebbles.

123.0–154.0': green–grey, moderately stiff, gritty, calcareous clay with 5% pebbles.

128.0': increasingly gritty.

Drill Hole Nº: ONEX-W83-03

DEPTH (m, ft)	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description



131.0–131.5': polymictic sand and gravel.

SAND: 154.0–154.5'

Fine- to coarse-grained white quartz sand with minor light grey non-calcareous clay.

PLEISTOCENE
CRETACEOUS

CLAY: 154.5–163.0'

154.5–158.4': interlayered dark brown and light grey, moderately stiff, non-calcareous clay.

158.9–163.0': dark grey, stiff, non-calcareous clay with lignite chips.

SAND: 163.0–189.0'

163.0–168.0': predominantly fine-grained, micaceous quartz sand with minor kaolinite clay.

168.0–169.0': medium- to coarse-grained quartz sand with minor pyrite.

169.0–184.0': fine-grained, micaceous quartz sand.

184.0–189.0': coarse quartz sand and pebbles (rounded smoky quartz) with kaolin clay and very fine-grained mica.

CLAY: 189.0–200.5'

189.0–191.0': yellow, light grey, and tan, stiff, non-gritty clay.

191.0–200.5': dark grey, stiff, non-calcareous clay with fine lignite chips from 198.0–200.5'.

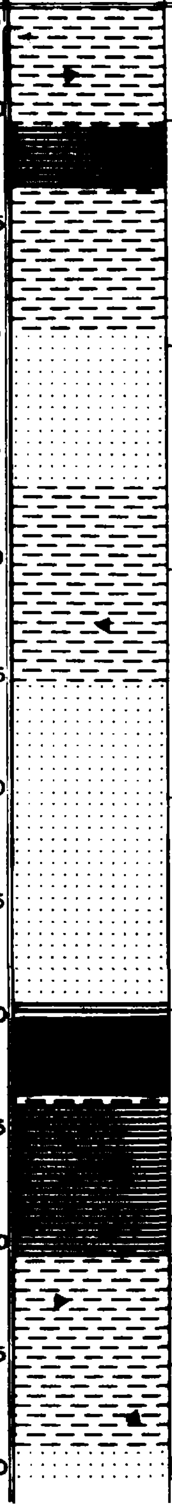
1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-03

DEPTH (m): 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80

DEPTH (ft): 195, 200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260

GRAPHIC LOG



Sampling (reverse circulation interval / % core recovered / Number): CS, 102, CS, 103, CS, 104, CS, 105, 106, CS, CS

Description

CARBONACEOUS CLAY: 200.5–203.2'
Stiff black carbonaceous clay with lignite chips up to 1" long by 0.25" wide.

CLAY: 203.2–209.7'
Dark brown changing to light brown/tan, stiff clay with very fine-grained micaceous quartz sand.

SAND: 209.7–216.5'
Medium- to coarse-grained quartz sand with minor kaolinite clay.

216.0': boulder.

CLAY: 216.5–225.0'
216.5–222.0': white clay.

222.0–225.0': medium grey, stiff clay with occasional white clay interbeds; lignite chips from 222.0–223.0'.

SAND: 225.0–239.0'
Very fine-grained silica sand with minor clay and the occasional layer of medium- to coarse-grained sand.

CARBONACEOUS CLAY: 239.0–239.5'
Carbonaceous clay with lignite and quartz sand.

LIGNITE: 239.5–243.0'

CLAY: 243.0–243.5'
Medium grey to brown to very dark grey clay.

CARBONACEOUS CLAY: 243.5–250.0'
Black carbonaceous stiff clay with interlayers of dark grey clay at 244.0' and 248.0'.

247.0–248.0': earthy dark brown to black clay.

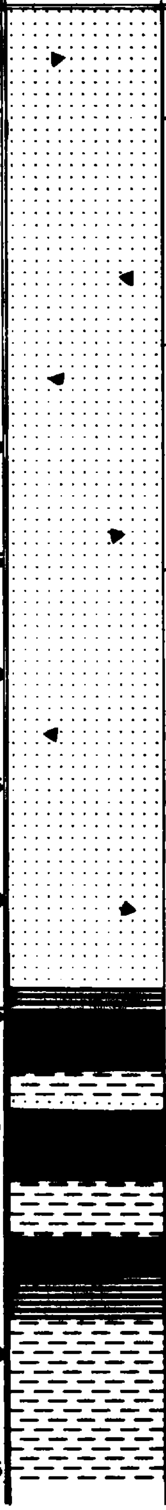
248.5–250.0': black lignite and brown woody fragments.

CLAY: 250.0–258.5'
250.0–253.0': medium to dark grey clay with minor brown wood and black lignite fragments up to 0.5" long.

253.0–256.0': light grey to white, very stiff clay with minor lignite fragments.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-03

DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number
80–100	260–325		CS		
			NS		107
			NS		108
			NS		109
			CS		
			CS		

Depth scale (m): 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100

Depth scale (ft): 260, 265, 270, 275, 280, 285, 290, 295, 300, 305, 310, 315, 320, 325

Description

256.0–257.5': light brown clay with 'slip surface' layering changing to medium brown to steely grey.

257.5–258.5': clay becoming micaceous, silty with black lignite fragments up to 0.5" long.

SAND: 258.5–303.0'

258.5–261.0': very fine-grained micaceous silica sand with black lignite fragments up to 1" long.

261.0–275.0': micaceous silica sand becomes fine- to medium-grained with minor clay and lignite fragments.

275.0–303.0': silica sand becoming much coarser-grained with pebbles of quartz, black chert, and pyrite up to 0.25" diameter; poorly sorted from fine- to coarse-grained; lignite fragments throughout.

CARBONACEOUS CLAY: 303.0–304.0'

LIGNITE: 304.0–307.0'
Black lignite with up to 5% pyrite.
305.0–305.5': black carbonaceous clay.

CLAY: 307.0–308.0'
Dark brown soft clay.

SAND: 308.0–308.5'
Medium-grained silica sand.

LIGNITE: 308.5–312.0'
Black lignite with pyrite nodules up to 0.25" diameter.

CLAY: 312.0–314.0'
312.0–312.5': dark brown, very stiff clay.
312.5–314.0': dark grey, very stiff clay, non-gritty.

LIGNITE: 314.0–316.0'
Black lignite with 5% pyrite and 5% medium-grained quartz grains.

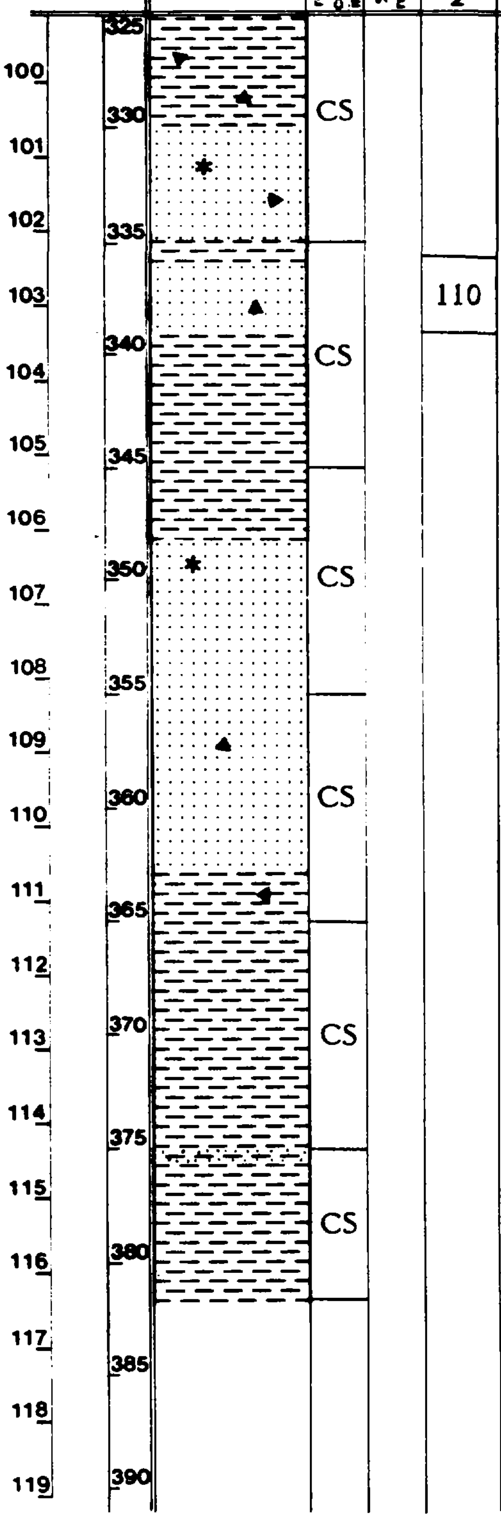
CARBONACEOUS CLAY: 316.0–318.0'
Black carbonaceous clay becoming very stiff at 317.0'.

CLAY: 318.0–330.0'
318.0–325.0': abrupt change from light brown to tan, very stiff clay.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-03

DEPTH (m / ft)	GRAPHIC LOG	Sampling (reverse circulation interval / % core recovered / Number)	Description



326.0–327.0': changes from medium grey clay with black and brown woody lignite fragments to rusty brown, earthy clay.

327.0–328.0': soft grey clay with abundant lignite fragments.

328.0–330.0': dark grey, moderately stiff clay.

SAND: 330.0–335.0'
Fine-grained silica sand with minor lignite and pyrite.

CLAY: 335.0–336.0'
Dark grey clay.

SAND: 336.0–339.0'
Fine-grained silica sand with minor lignite fragments.

CLAY: 339.0–348.0'
Dark grey clay, moderately stiff becoming darker grey, carbonaceous from 347.0–348.0'.

SAND: 348.0–363.0'
Very fine-grained silica sand with minor lignite and pyrite nodules up to 0.5" diameter.

CLAY: 363.0–375.5'
Dark grey to black stiff clay with minor (<1%) lignite fragments less than 1/16" diameter from 363.0–364.0'.

SAND: 375.5–376.0'
Medium- to fine-grained silica sand.

CLAY: 378.0–382.0'
Dark grey, stiff clay.

END OF HOLE: 382.0'

NO PLASTIC CASING

ONEXCO MINERALS LTD.

1983 WINTER DRILL PROGRAM – JAMES BAY LOWLANDS

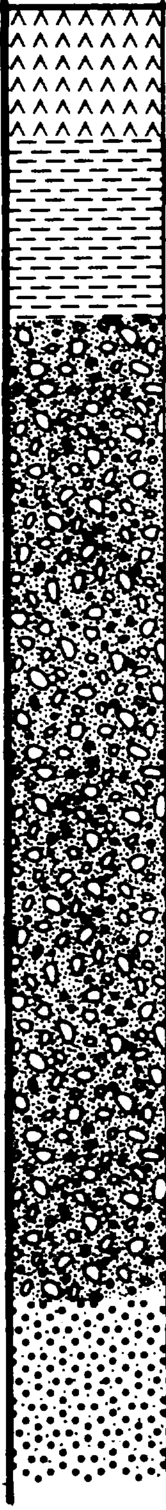
Drill Hole Nº: ONEX-W83-04 Location: West Gentles Township (lat. 50°31'38" long. 82°05'42")

Elev. of collar: ≈272 ft Total depth: 425 ft Sheet 1 of 7

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: Reverse circulation / Interval / X core	Number	Description

m: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

ft: 5 10 15 20 25 30 35 40 45 50 55 60 65



Sampling: CS CS CS CS CS CS CS CS

ICE AND MUSKEG: 0–6.0'

CLAY: 6.0–14.0'

6.0–9.0': medium green to grey, soft, non-gritty, and calcareous.

9.0–14.0': changing to medium grey in colour, soft, and calcareous.

RECENT
PLEISTOCENE

CLAY TILL: 14.0–57.0'

Light to medium grey, calcareous, clasts include basement and sedimentary fragments (limestone, chert, granite, and diabase); minor fine-grained clastic interbeds.

14.0': fossil occurrences.

28.0': minor clay interbed, light grey, minor grit.

32.0–47.0': minor amounts of fine sand present in till matrix.

47.0–57.0': light yellow to grey, non-calcareous, minor grit with very minor sedimentary fragments.

50.0': presence of minor basement clasts.

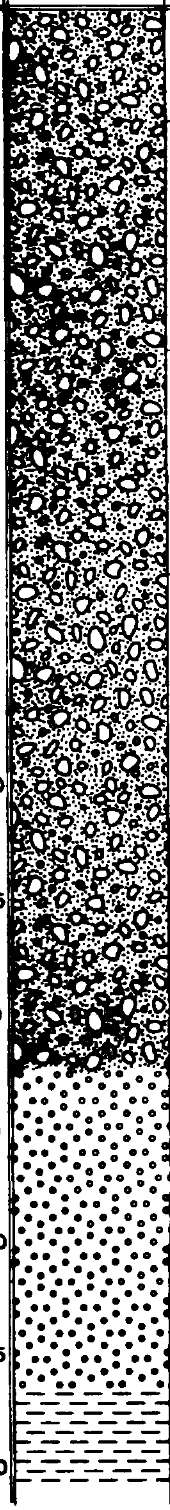
52.0–57.0': clay matrix calcareous in this interval.

SANDY GRAVEL: 57.0–65.0'

Polymictic with fine sand, angular to subangular clasts which include limestone, jasper, granite, diabase, and other mafics.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-04

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
20–40	65–130		CS; CS; CS			see below

Depth scale (m): 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

Depth scale (ft): 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130

CLAY–SAND TILL: 65.0–112.0'
Medium grey, prominent sedimentary clasts, non-calcareous, matrix contains minor grit, gravel, and sand interbeds present locally.

70.0–80.0': matrix of calcareous clay.

80.0–81.0': seam of fine sand and gravel, coarse clastics approximately 2 cm in width.

81.0–85.0': matrix of dark grey clay and sand.

85.0–85.6': limestone boulder.

95.0–96.0': fine- to medium-grained sand seam, polymictic.

97.0–98.0': sand seam as immediately above.

102.0–104.0': coarse sand–pebble gravel, subrounded to angular clasts of limestone, chert, granite, and diabase.

105.0–110.0': basement and sedimentary clasts more prominent (10–15%) with more abundant sand in matrix.

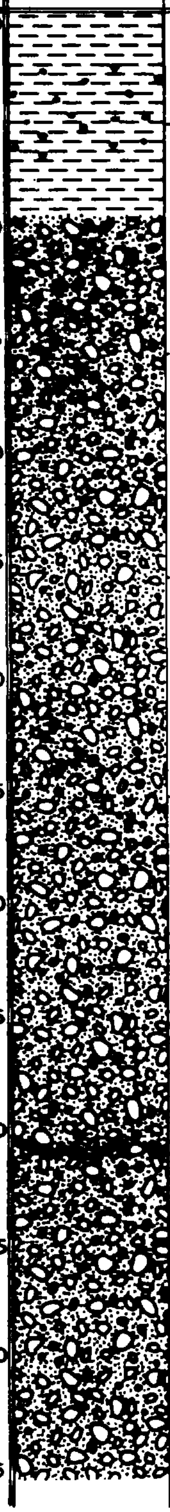
111.0–112.0': modal percent of clasts decrease to approximately 5%.

SAND–GRAVEL: 112.0–126.0'
Polymictic, fine sand to gravel, salt and pepper appearance.
112.0–112.6': fine-grained sand.

113.0–126.0': sandy–pebbly gravel, consisting of limestone, quartz, and black siltstone chips.

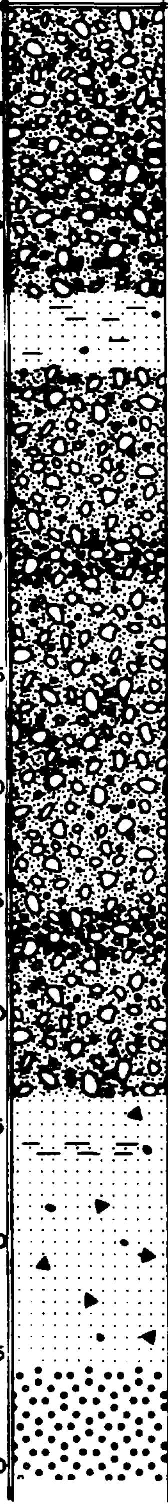
CLAY: 126.0–139.0'
126.0–132.0': green to grey, calcareous, non-gritty.

Drill Hole Nº: ONEX-W83-04

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description
40	130		CS			132.0–137.0': green to grey, non-gritty, appreciable pebble fragments of limestone and black siltstone.
41	135					137.0–139.0': medium grey, calcareous, non-gritty.
42						CLAY TILL: 139.0–207.0'
43	140		CS			Medium grey, calcareous clay, non-gritty, containing minor to appreciable (5–10%) clastic fragments which include limestone, siltstone, and minor white chert and granite. Seams of coarse clastic material are prominent locally.
44	145					
45						
46	150		CS			157.0': clast content in till increased to approximately 30%.
47	155					
48						
49	160		CS			
50	165					
51						
52	170		CS			
53	175					
54						176.0': limestone boulder.
						177.0': black siltstone boulder.
55	180		CS			180.0–180.5': seam of gravelly sand.
56	185					
57						
58	190		CS			
59	195					
60						

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-04

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
60–80	195–260		CS, CS, CS, CS, CS, CS, CS			

205.0–207.0': fine-grained seam of salt and pepper-like sand.

SAND: 207.0–211.0'
Very fine-grained sand–silt, containing minor pebbles and clay binding.

CLAY TILL: 211.0–243.0'
Medium grey to green, moderately stiff, calcareous clay, containing moderate (10%) angular clastic fragments of tan limestone, black siltstone, and minor chert, quartz, and granite. Matrix contains a minor sandy component additionally.

218.0': granitic boulder.

218.5–220.0': gravel horizon consisting of rounded pebbles (0.5") and coarse sand.

222.0–223.0': granitic boulder.

231.0': limestone boulder.

233.0': granite boulder.

233.5': dark grey siltstone boulder.

235.0–237.0': pebble–cobble gravel bed with minor coarse sand and silt. Clastics include limestone, siltstone, granite, chert, and jasper; and are predominantly rounded to subrounded in shape.

SAND: 243.0–255.0'
Fine- to medium-grained polymictic sand containing minor pebbles.

243.5–245.0': abundant lignite fragments (2%).

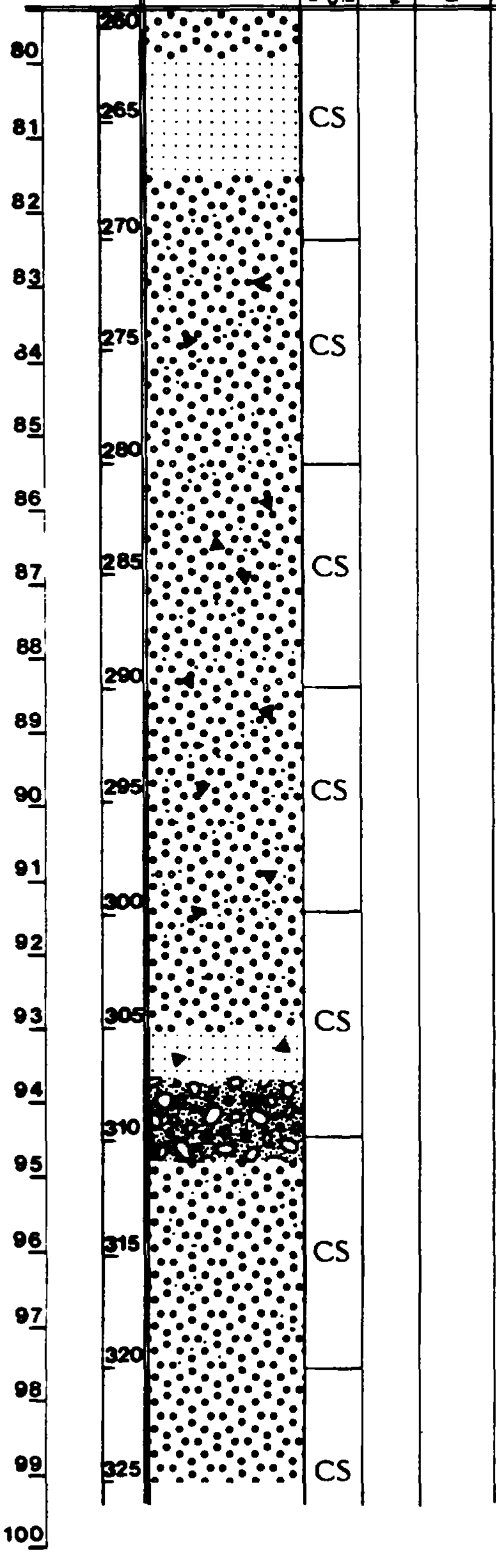
247.0–248.0': thin bed of green–grey clay till, calcareous.

251.0–255.0': abundant lignite fragments.

GRAVEL: 255.0–262.0'
Largely coarse sand and pebbles of varied lithology. Clastics are predominantly angular to subrounded pebbles of chert, quartz, diabase, limestone, and diorite. Sand fraction is polymictic, minor lignite fragments.

Drill Hole Nº: ONEX-W83-04

DEPTH (m, ft)	GRAPHIC LOG	Sampling (reverse circulation interval, % core recovered, Number)	Description



SAND: 262.0–267.0'
Fine- to medium-grained polymictic sand, with minor rounded to angular sedimentary and basement pebbles.

SAND–PEBBLE GRAVEL: 267.0–305.0'
Dominantly angular to subrounded pebbles of varied lithology in addition to a coarse, polymictic sand fraction, trace to minor lignite pieces occur locally.

SAND: 305.0–307.0'
Fine- to medium-grained, polymictic sand, trace to minor pieces of lignite.

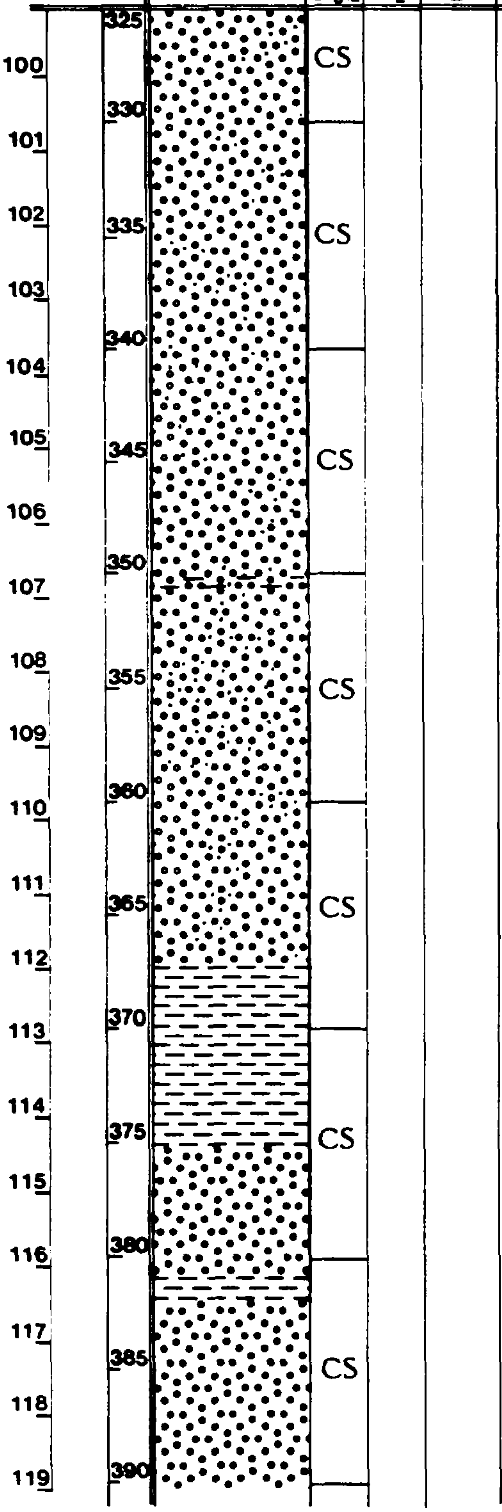
CLAY TILL: 307.0–311.0'
Dark green to grey, calcareous clay, containing minor grit and clasts. Clasts are largely sedimentary chips with minor mafic intrusive and granitic fragments.

SAND–PEBBLE GRAVEL: 311.0–357.0'
As per 255.0–262.0'.

323.0': seam of coarse-grained sand.

Drill Hole Nº: ONEX-W83-04

DEPTH (m, ft)	GRAPHIC LOG	Sampling (reverse circulation interval, % core recovered, Number)	Description



331.0': coarse-grained sand seam approximately 1' thick.

333.0': coarse-grained sand seam as above; approximately 1.5' thick.

338.0': trace lignite.

350.0–350.5': medium to dark green–grey clay interbed; calcareous with minor grit.

351.0': polymictic sand seam; fine- to medium-grained.

353.0': boulders/cobbles.

357.0': minor grey clay.

PLEISTOCENE
CRETACEOUS

PEBBLY SAND: 357.0–365.0'
Polymictic sand; pebbles comprise approximately 10% of sample.

GRAVEL: 365.0–367.0'
Pebbles comprise 95% of sample; limestone clasts predominate; pebbles tend to be rounded to subrounded; minor sandy fraction.

CLAY: 367.0–375.0'
Grey clay: calcareous, soft containing minor grit and occasional lithic fragments.

373.5–375.0': lignite chips comprise approximately 25% of clay sample; includes brown wood chips.

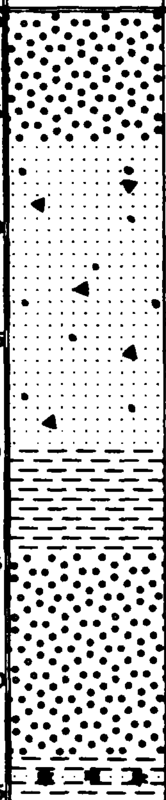
GRAVEL: 375.0–381.0'
Polymictic sand and gravel; pebbles comprise approximately 75% and are generally rounded; varied lithology. Minor grey clay appears at 379.0'.

CLAY: 381.0–382.0'
As above.

PEBBLY SAND: 382.0–383.0'
As 357.0–365.0'.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-04

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
119–139	390–455		CS; CS; CS; CS			see below

Depth scale (m): 119, 120, 121, 122, 23, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139

Depth scale (ft): 390, 395, 400, 405, 410, 415, 420, 425, 430, 435, 440, 445, 450, 455

GRAVEL: 383.0–396.0'
Polymictic with pebbles constituting approximately 50% of the sample. Minor clay and lignite chips.

PEBBLY SAND: 396.0–409.0'
As above with minor black lignite and brown woody chips.

405.0–406.0': abundant cobbles and boulders.

CLAY: 409.0–414.5'
Grey calcareous clay containing minor lithic fragments and carbonaceous material.

413.0–414.0': minor seam of coarse-grained silica sand.

GRAVEL: 414.5–423.0'
As above.

CLAY: 423.0–423.5'
Grey to brown clay, non-calcareous.

SAND: 423.5–424.0'
Fine-grained silica sands containing pyrite nodules (0.5") and minor lignite fragments.

CLAY: 424.0–425.0'
Dark grey–brown, stiff, non-gritty clay.

END OF HOLE: 425.0'

NO PLASTIC CASING

ONEXCO MINERALS LTD.

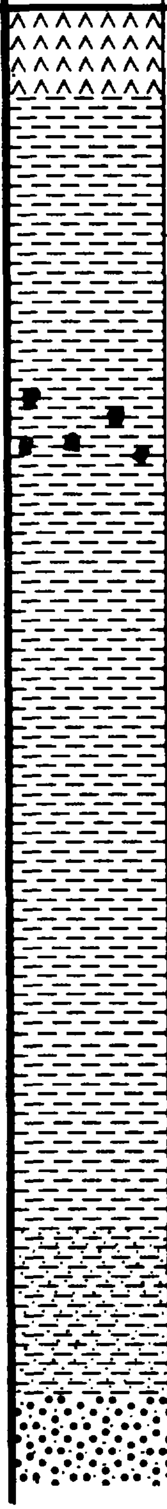
1983 WINTER DRILL PROGRAM – JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-05 **Location:** West Gentles Township **(lat.** 50°32'36" **long.** 82°06'03" **)**

Elev. of collar: ≈272 ft **Total depth:** 235 ft **Sheet** 1 **of** 4

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core	Number	Description

Depth scale — m: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20; ft: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65



Sampling (top to bottom): NS, CS, CS, NS, NS, CS, CS

Description

MUSKEG AND ICE: 0–4.0'

CLAY: 4.0–54.0'
Medium brown to grey, soft, non-gritty, non-calcareous.

11.0–27.0': medium to dark grey, relatively stiff, non-gritty, extremely calcareous.

15.0–22.0': medium grey, extremely soft, muddy, calcareous, minor pebbles and bivalve fragments.

27.0–54.0': medium brown to grey, little to no recovery except for volcanic pebbles and bivalve fragments, contains minor grit.

36.0': minor limestone and basement pebbles.

41.0': appreciable carbonate and chert fragments.

SILT/CLAY: 54.0–61.0' RECENT
Medium brown, moderately gritty, relatively stiff, calcareous, minor (<5%) rock chips including limestone and black siltstone.
PLEISTOCENE

58.0': clay softer, less gritty.

SAND/GRAVEL: 61.0–75.0'
Polymictic, although largely limestone and dolostone (60%), diabase–gabbro (≈20%), granitic gneiss (≈10%), other (10%), subrounded to subangular pebbles with a minor muddy matrix binding.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-05

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
20–40	65–130		CS, NS, NS, CS, CS, CS			

68.0–69.0': coarse sand horizon, heterolithic, rounded to subrounded clastics.

71.0–73.0': prominent, thin, fine-grained salt and pepper sand interbeds.

SAND/CLAY TILL: 75.0–115.0'

Light to medium brown, muddy, gritty matrix, calcareous, appreciable sand fraction; clasts make up <5% of unit, clay horizons prominent.

85.0–87.0': gritty, sandy clay, very calcareous.

96.0–97.0': as above.

104.0': matrix is extremely gritty, modal percent of clasts 2–3%.

SAND TILL: 115.0–163.0'

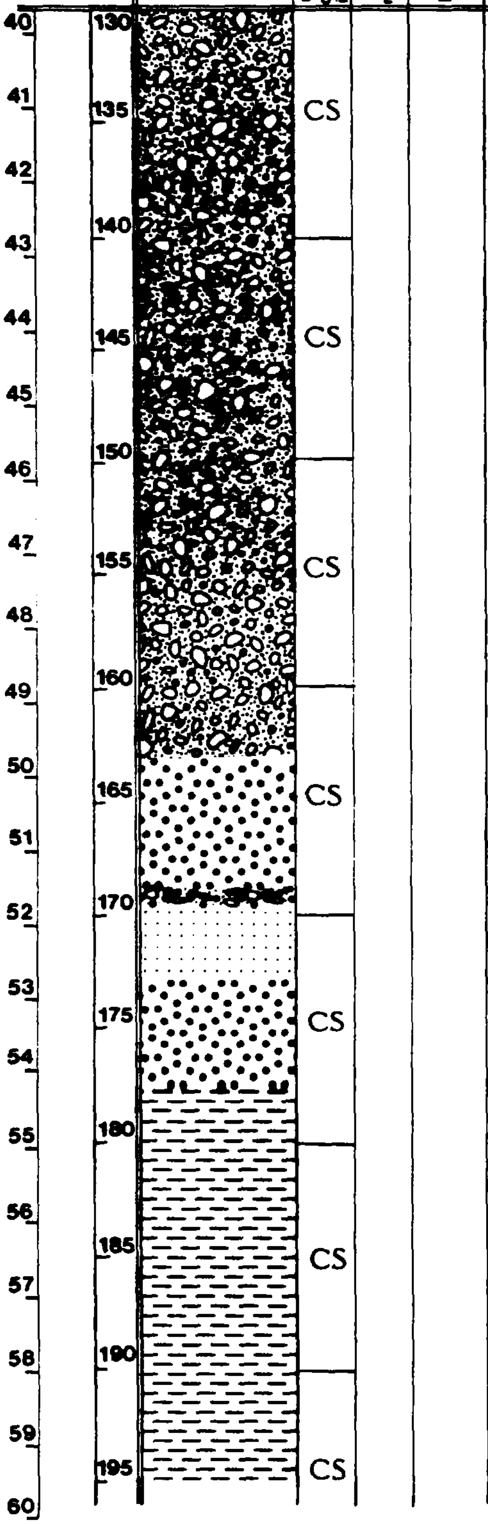
Medium brown, extremely gritty, calcareous matrix, largely sand, minor silt and clay; modal percent of clasts <5% including carbonates, andesite, mafic volcanics, and minor jasper; relatively poor recovery where clay is soft.

118.0': recovery of cuttings substantially greater; stiffer matrix.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-05

DEPTH (m / ft)	GRAPHIC LOG	Sampling (reverse circulation interval / % core recovered / Number)	Description



158.0–163.0': green to grey, gritty clay, occasional rock fragments, calcareous, moderately stiff.

PEBBLE SAND: 163.0–169.0'
Fine- to medium-grained quartz sand; clastics include chert pebbles, occasional jasper, basement pebbles, tan limestone, large lignite fragments, sand fragments are subrounded to subangular.

SAND TILL: 169.0–169.5'
Similar to 158.0–163.0'.

SILT/SAND: 169.5–173.0'
Polymictic, very fine-grained, calcareous, rare pebbles.

PEBBLE SAND: 173.0–177.5'
Polymictic, coarse-grained.

PLEISTOCENE
DEVONIAN

CLAY: 177.5–195.0'

177.5–179.5': dark brown, moderately stiff, non-calcareous, and non-gritty.

179.5–182.5': brown to grey, stiff, non-calcareous, and non-gritty.

182.0': mottling of brown and grey clay.

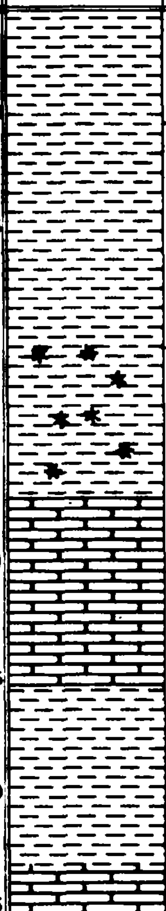
182.5–183.0': light grey, stiff, slightly calcareous, non-gritty.

183.0–183.5': medium brown, relatively stiff, very finely laminated, non-calcareous.

183.5–195.0': interbedded units of light grey, stiff, non-calcareous clay and medium to chocolate brown, moderately stiff, non-calcareous clay, minor to moderate grit, mottling of clays common.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-05

DEPTH (m / ft)	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
60–80 m / 195–260 ft		CS CS CS			

Depth scale: m 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80; ft 195, 200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260

Description

SILT/CLAY: 195.0–202.0'
Light to medium grey, gritty, appreciable silt fraction, moderately stiff, non-calcareous.

CLAY: 202.0–216.5'
Interbedded and mottled units of light to medium grey, stiff, non-gritty, non-calcareous clay with light to dark brown, stiff, gritty, pyritiferous clay.

208.0–215.0': clay contains from 2–5% pyrite as disseminations and chunks up to 0.25".

LIMESTONE: 216.5–225.0'
Tan, occasionally banded, interbedded with very thin dark calcareous beds.

218.2': thin dark grey clay interbed.

CLAY: 225.0–233.0'
225.0–225.1': mottled white and light grey clay, soft.
225.1–225.9': dark grey, soft clay.
225.9–226.2': medium grey to blue grey, calcareous.

226.2–233.0': light to medium grey, calcareous, occasional thin, medium grey or tan limestone interbeds.

LIMESTONE: 233.0–235.0'
Tan; possible fossils present.

END OF HOLE: 235.0'

NO PLASTIC CASING

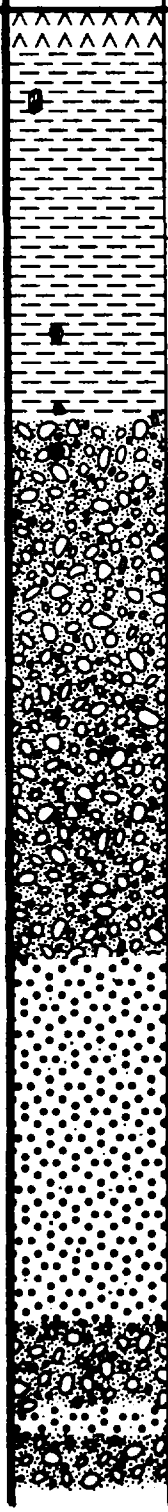
ONEXCO MINERALS LTD.

1983 WINTER DRILL PROGRAM – JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-06 Location: West Gentles Township (lat. 50°33'33" long. 82°04'06")

Elev. of collar: ≈272 ft Total depth: 314 ft Sheet 1 of 5

DEPTH m / ft	GRAPHIC LOG	Sampling (reverse circulation interval / X core / Number)	Description



Depth scale: m 1–20; ft 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65

Sampling: CS, CS, CS, CS, CS, CS, CS, CS

MUSKEG: 0–2.0'

MARINE CLAY: 2.0–18.0'
Yellow–brown to medium grey, soft to moderately stiff, largely non-gritty and calcareous, abundant bivalve fragments.

5.0': bivalve fragments.

15.0–18.0': abundant bivalve fragments.

RECENT
PLEISTOCENE

CLAY TILL: 18.0–23.0'
Medium grey, soft, calcareous clay matrix, containing minor angular to subrounded pebble clasts of mafic composition, minor bivalves.

TILL: 23.0–42.0'
Tan, soft, calcareous clay matrix containing minor grit, clasts of mixed lithology including limestone, chert, granite, diabase, and siltstone fragments.

SAND/GRAVEL: 42.0–58.0'
Prominent fine- to medium-grained polymictic sand component and angular to subrounded pebble-sized clasts of varied lithology.

52.0–53.0': seam of medium grey, soft, calcareous clay till.

57.0–57.5': sedimentary boulder.

CLAY TILL: 58.0–65.0'
Medium grey, calcareous, relatively soft clay matrix, containing minor angular pebble fragments.

62.0–63.0': sand–pebble gravel horizon.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

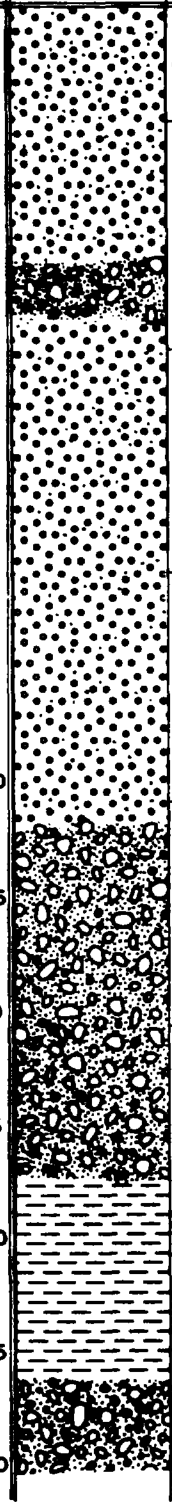
Drill Hole Nº: ONEX-W83-06

Sheet 2 of 5

DEPTH (m): 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

DEPTH (ft): 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130

GRAPHIC LOG



Sampling (reverse circulation interval / % core recovered / Number): CS, CS, CS, CS, CS, CS, CS

Description

SAND PEBBLE GRAVEL: 65.0–102.0'
Largely pebble-sized, angular to subrounded clasts of mixed lithology and fine- to medium-grained polymictic sand, numerous thin sand interbeds.

76.0–78.0': medium grey, calcareous clay till bed.

78.0–79.0': fine- to medium-grained sand horizon, polymictic.

91.0–92.0': basement boulder.

92.0–93.0': polymictic sand unit.

93.0–94.0': granitic boulder.

97.0–98.0': fine- to coarse-grained polymictic sand.

CLAY TILL: 102.0–117.0'
Medium grey, clay matrix, calcareous, containing angular sedimentary and basement pebble fragments.

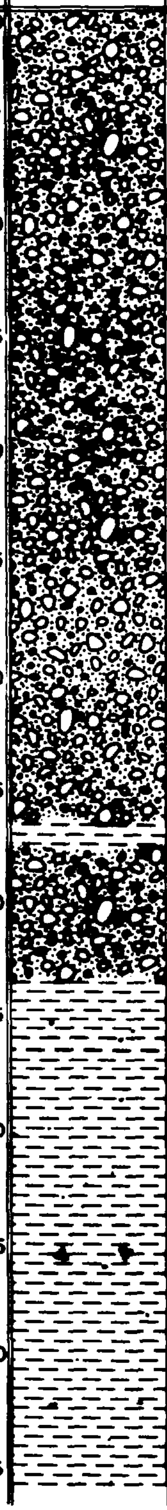
CLAY: 117.0–126.0'
Dark grey, calcareous, containing minor grit, relatively stiff, minor (<5%) limestone and black siltstone chips.

CLAY TILL: 126.0–173.0'
Medium to dark grey, stiff, slightly gritty clay, containing minor to appreciable (10–15%) coarse sand and angular pebble fragments. Abundance of clasts varies locally.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-06

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description



Depth scale: m 40–60; ft 130–195. Sampling: CS intervals.

130.0': quartzite boulder.

148.0': limestone boulder.

157.0': limestone boulder.

158.0': siltstone boulder.

166.0–167.0': thin bed of grey clay, stiff, and calcareous.

CLAY: 173.0–265.0'

Largely grey, calcareous, relatively stiff, non-gritty clay, containing pebble-rich horizons locally. Prominent boulder horizons in the clay.

179.0': black siltstone boulder.

185.0': abundant lignite fragments.

186.0': limestone boulder.

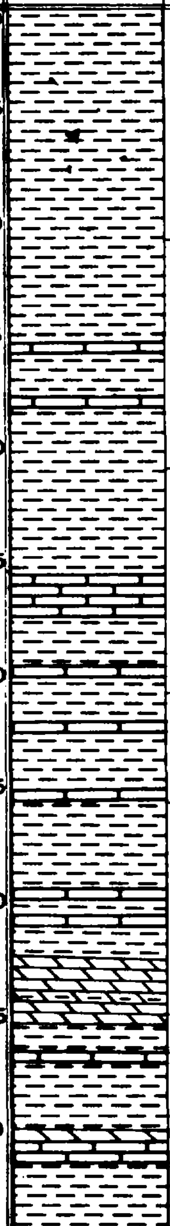
1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-06

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
60	195					195.0': quartzite boulder.
			CS			
61	200					
62						204.0': granitic boulder.
	205		CS			
63						
64	210					
						212.0': limestone boulder.
65						214.0': limestone boulder.
	215		CS			
66						
67	220					
68						
	225		CS			
69						
70	230					
						232.0': volcanic boulder, dark green.
71						
	235		CS			
72						
73	240					
74						243.0': granitic boulder.
	245		CS			
75						
76						
	250					
77						
	255					
78			CS			
79						
	260					
80						

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-06

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number
80–100	260–325		CS (approx. 261–270'); CS (approx. 270–280'); CS (approx. 280–290'); CS (approx. 290–295')	70; 63; 50	302'; 310'; 314'

Description

263.0': green volcanic boulder.

265.0': minor lignite fragments.

PLEISTOCENE / CRETACEOUS

VARIEGATED CLAY SEQUENCE: 265.0–274.5'
Interbedded units of stiff, calcareous to non-calcareous clays. Various clays are light to medium grey, off-white, yellowish brown, reddish, and light blue in colour.

271.5–273.0': slickensides prominent.

CRETACEOUS / DEVONIAN

CLAY/LIMESTONE SEQUENCE: 274.5–295.0'
Alternating beds of multi-coloured, largely calcareous, moderately stiff clay, and tan to medium brown limestone.

276.0–276.5': lignite fragments.

CALCAREOUS CLAY/LIMESTONE: 295.0–302.0'
Intercalated units of grey calcareous clay and grey limestone.

DOLOSTONE: 302.0–304.9'
Light grey to tan banded dolostone, minor thin bands of grey, calcareous clay.

304.0–304.1': thin seam of grey, calcareous clay.

CLAY/LIMESTONE/DOLOSTONE: 304.9–314.0'
Alternating, relatively thin units of multi-coloured, largely soft, and non-gritty calcareous clays with grey–brown limestone and light grey dolostone.

END OF HOLE: 314.0'

HOLE PLASTIC CASED TO 314.0'

ONEXCO MINERALS LTD.

1983 WINTER DRILL PROGRAM - JAMES BAY LOWLANDS

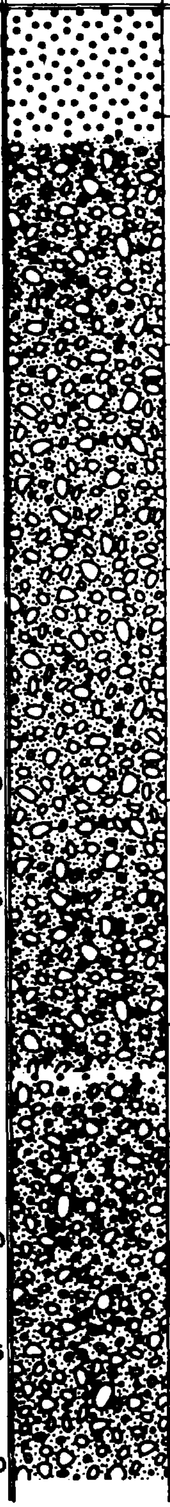
Drill Hole Nº: ONEX-W83-07 Location: West Gentles Township (lat. 50°33'25" long. 82°07'58")

Elev. of collar: ≈269 ft Total depth: 294 ft Sheet 1 of 5

DEPTH (ft)	Sampling	Description
0–10	NS	MUSKEG: 0–4.0' CLAY: 4.0–43.0' 4.0–10.0': green–grey calcareous clay.
10–20	CS	10.0–43.0': medium to dark grey, calcareous, non-gritty, moderately stiff clay.
20–30	CS	20.0': clay becoming soft.
30–40	CS	
40–50	CS	GRAVEL: 43.0–50.0' Polymictic, angular to rounded pebbles up to 0.5" diameter of predominantly tan limestone and black siltstone. 48.0': abundant light grey calcareous clay.
50–60	CS	CLAY: 50.0–58.0' White, soft, calcareous clay with minor sand and pebbles. 53.0': pebble content increases to 10%.
60–	CS	GRAVEL: 58.0–71.0' 90% pebbles, 10% sand, minor clay; polymictic; 85% tan limestone, 10% black siltstone, 5% others (quartz, chert, granite); pebbles are up to 0.25", rounded to subangular.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº :ONEX-W83-07

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description
20–40	65–130		CS, CS, CS, CS, CS, CS			see below

Depth scale (m): 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

Depth scale (ft): 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130

Description

66.0': clay content has increased to 25%; white, calcareous.

RECENT
PLEISTOCENE

CLAY TILL: 71.0–147.0'

71.0–94.5': light grey, soft, gritty calcareous clay with approximately 10% sand and minor polymictic pebbles.

73.0': dark green–black siltstone(?) boulder.
73.5': light green volcanic boulder.

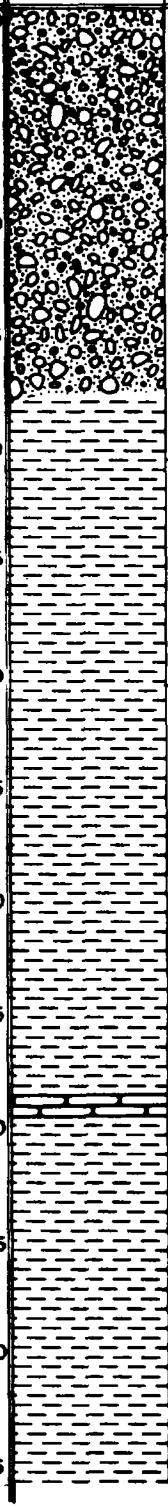
92.0': clay becoming much stiffer.

96.0–147.0': medium grey, moderately stiff, calcareous clay with 10% sand–pebbles; mainly siltstone–limestone pebbles.

112.0–112.5': gravel seam.

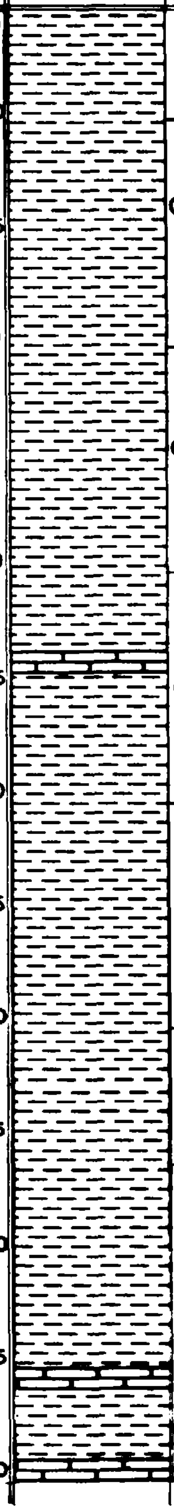
118.0': clay becoming stiffer.

Drill Hole Nº: ONEX-W83-07

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description
40	130					130.0': 6" sedimentary boulder.
41	135		CS			132.0–132.5': gravel seam.
42						134.0': 6" sedimentary boulder.
43	140					136.0': 6" sedimentary boulder.
44	145		CS			138.0': 6" fine- to medium-grained, polymictic sand seam.
45						140.0': 6" sedimentary boulder.
46	150					142.0': 1' mafic boulder.
47	155		CS			146.0': 6" sand seam.
48						146.5': pebbles.
49	160					PLEISTOCENE / DEVONIAN
50	165		CS			CLAY: 147.0–277.5' Alternating light green–grey and dark grey, non-gritty, moderately to very stiff, predominantly non-calcareous clay.
51						
52	170					
53	175		CS			
54						178.0–179.0': dark brown limestone.
55	180					
56	185		CS			
57						
58	190					
59	195		CS			
60						

Drill Hole Nº: ONEX-W83-07

Sheet 4 of 5

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
60–80	195–260		CS	70		212.0': clay becomes predominantly calcareous. 223.5–224.5': light green limestone. 246.0–255.0': minor pyrite (<2%) occurs as fine stringers or fine-grained concentric rings. 255.0–256.0': light green, pyritiferous limestone. Minor vugs up to 0.5" diameter; cubic pyrite nodules up to 0.25"; crosscutting calcite stringer 1/16" thick. 259.0–260.0': light green, fine-grained limestone with minor fossils replaced by sparry calcite; trace pyrite.

Reverse circulation intervals (CS): ~200–210 ft, 210–220 ft, 220–230 ft, 230–240 ft, 240–246 ft. Core (70% recovered): ~246–259 ft.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-07

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description

Depth (m): 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99

Depth (ft): 260, 265, 270, 275, 280, 285, 290, 295, 300, 305, 310, 315, 320, 325

% core recovered (top to bottom): 100, 100, 100, 100, 50, 70

260.0–263.5': dark green to dark green-brown, calcareous, waxy clay with a web-like intrastructure of white sparry calcite; minor fossils; limestone layer 2" thick at 260.5'.

263.5–264.0': light green limestone with <1% pyrite and abundant shell fragments (up to 25% locally).

264.0–277.5': light green, very stiff, calcareous clay with minor fossil fragments (altered to sparry calcite) and minor thin limestone beds up to 2". Also, minor interbeds of dark brown pyritiferous clay up to 4" thick and approximately 10% fossils up to 0.5" diameter.

LIMESTONE: 277.5–294.0'
Light to medium grey, fine-grained limestone.

277.5–279.0': very broken core.

279.0': dark grey calcareous clay.

279.0–285.0': algal mat sequence with good to excellent vuggy fracture porosity; styolites throughout.

283.0–283.5': dark grey, stiff clay.

285.0–289.0': limestone breccia consisting of brecciated calcilutite and calcarenite fragments; abundant slump structures; good porosity.

289.0–294.0': light to dark grey calcareous limestone with interbeds up to 6" thick of dark clay; poor porosity.

END OF HOLE: 294.0'

HOLE PLASTIC CASED TO 294.0'

ONEXCO MINERALS LTD.

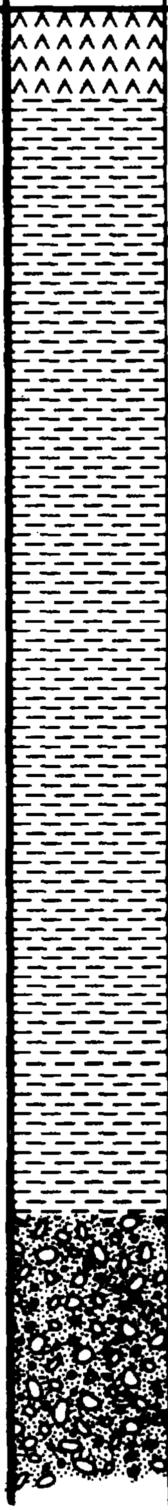
1983 WINTER DRILL PROGRAM – JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-08 Location: West Gentles Township (lat. 50°34'12" long. 82°05'23")

Elev. of collar: ≈276 ft Total depth: 265 ft Sheet 1 of 5

DEPTH (m, ft) | GRAPHIC LOG | Sampling (interval, X core, Number) | Description

Depth scale: m 1–20; ft 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65



Sampling: CS (≈12–20 ft), CS (≈20–30 ft), NS (≈30–40 ft), CS (≈40–50 ft), CS (≈50–60 ft), CS (≈60–66 ft)

MUSKEG AND ICE: 0–4.0'

CLAY: 4.0–53.0'

4.0–12.0': light grey, soft, calcareous, and non-gritty.

12.0–27.0': dark grey, extremely calcareous, moderately stiff, non-gritty.

18.0–27.0': clay turns extremely soft.

27.0–35.0': dark grey, calcareous, non-gritty, little to no recovery.

35.0–53.0': medium brown to light grey, extremely soft, non-gritty, calcareous, contains carbonate fragments.

RECENT

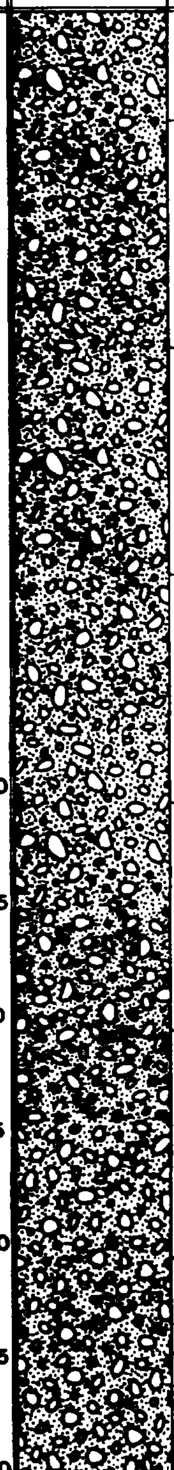
PLEISTOCENE

SAND/CLAY TILL: 53.0–152.0'

Light to medium brown, gritty, calcareous matrix, very low modal percent of clasts (<5%), including limestone, dolostone, black siltstone, dark volcanics; matrix 10–15% sand, 80–90% silt and clay.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-08

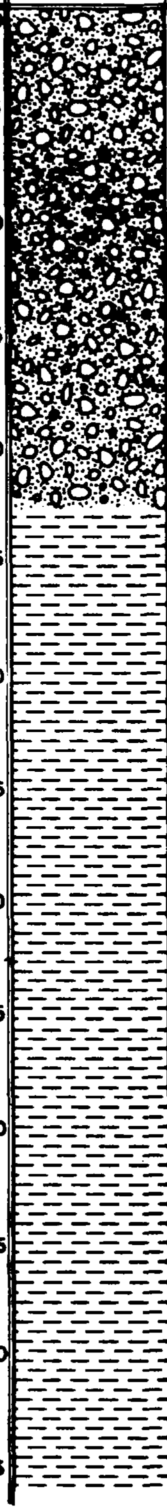
DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
20–40	65–130		CS CS CS CS CS CS			73.0': granitic fragments. 96.0': dacite boulder. 102.0–105.0': abundance of clasts increases 10–15%, largely carbonates, dacite, granite, and dark volcanic fragments. 105.0–114.0': muddy interval, very little recovery, minor sand and grit recovered. 121.0': diorite and limestone pebbles and cobbles. 123.0–125.0': matrix predominantly clay, very little sand.

Depth scale (m): 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

Depth scale (ft): 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130

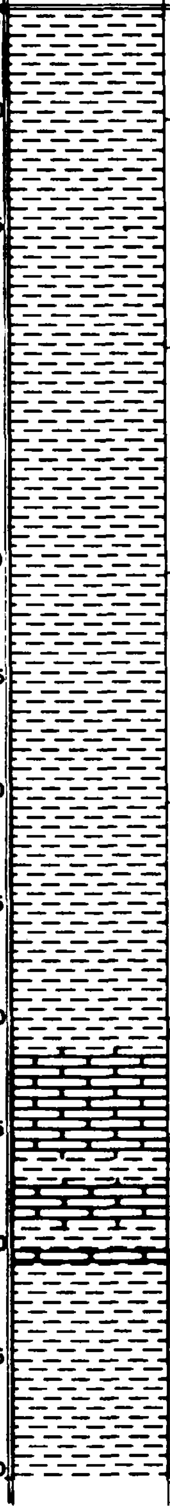
1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-08

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
40	130					
41	135		CS			
42						
43	140					
44	145		CS			
45						
46	150					CLAY: 152.0–241.0' Medium brown to grey, moderately soft, calcareous, slightly gritty, occasional limestone pebbles.
47	155		CS			
48						
49	160					
50	165		CS			
51						
52	170					
53	175		CS			
54						
55	180					
56	185		CS			
57						
58	190					
59	195		CS			
60						

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-08

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description
60–80	195–260		CS, CS, CS, CS, CS, CS			

PLEISTOCENE

DEVONIAN

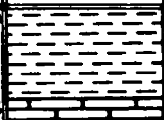
LIMESTONE: 241.0–250.5'
Tan, minor thin beds of dark grey clay, occasionally banded.

CLAY: 250.5–264.0'
250.5–253.0': dark grey, soft clay.
253.0–253.5': light grey, soft, calcareous.
253.5–259.5': light brown, soft, and calcareous.
259.5–260.5': light brown clay immediately followed by dark grey, calcareous, stiff clay.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-08

DEPTH (m, ft)	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description



260.5–264.0': medium grey, soft, calcareous.

By 263.0', becomes light grey.

LIMESTONE: 264.0–264.5'
Medium grey, with greenish tinge, very thin black calcareous rock layers interbedded.

LIMESTONE/MARL: 264.5–265.0'
Dark grey, gritty, calcareous, vigorously effervescent.

END OF HOLE: 265.0'

HOLE PLASTIC CASED TO 265.0'

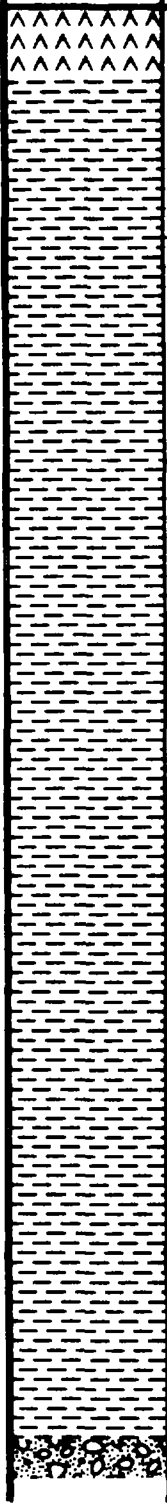
ONEXCO MINERALS LTD.

1983 WINTER DRILL PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-09 Location: West Gentles Township (lat. 50°32'46" long. 82°07'35")

Elev. of collar: ≈276 ft Total depth: 375 ft Sheet 1 of 6

DEPTH (m / ft)	GRAPHIC LOG	Sampling (reverse circulation interval / X core / Number)	Description



Depth (m): 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Depth (ft): 5 10 15 20 25 30 35 40 45 50 55 60 65

Sampling: CS, NS, NS, NS, NS

MUSKEG AND ICE: 0–3.0'

CLAY: 3.0–17.0'

3.0–15.0': light to medium grey, calcareous, very soft, gritty.

13.0–17.0': dark to medium grey, relatively stiff, calcareous, and non-gritty.

MUDDY CLAY: 17.0–62.0'

Medium grey, calcareous, rounded chips of more competent clayey material contained within a softer clay; also rare limestone chips.

CLAY: 62.0–63.0'

Medium to dark grey, calcareous, stiff, and non-gritty.

RECENT
PLEISTOCENE

SAND/CLAY TILL: 63.0–84.0'

Light brown, gritty, calcareous matrix, modal percent of clasts approximately 5–10% including limestone, dolostone, black siltstone and granitic fragments.

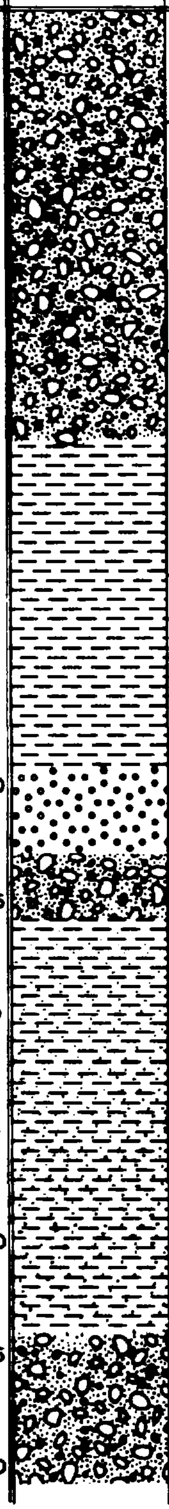
1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-09

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description

DEPTH m: 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

DEPTH ft: 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130



Sampling: CS, CS, CS, CS, NS, NS

70.0–84.0': much of clay in matrix washed away, extremely gritty matrix.

77.0': diabase fragments.

CLAY: 84.0–98.0'
Light to medium brown, very soft, non-gritty, and calcareous.

94.0': abundant limestone chips.

SAND/GRAVEL: 98.0–102.0'
Polymictic, although dominantly subrounded carbonates (60%), diabasic fragments (15%), black siltstone (10%); also granite, jasper, and volcanics

SAND/CLAY TILL: 102.0–105.0'
Medium brown to grey, gritty matrix, calcareous, clasts abundant approximately 20%, which are predominantly carbonates.

SANDY CLAY: 105.0–123.0'
Medium grey, calcareous, very gritty, carbonate pebbles present (2–3%).

122.0': diabase and carbonates prevalent (5%).

SAND/CLAY PEBBLE TILL: 123.0–142.0'
Medium brown to grey, extremely calcareous, abundant clasts (15–20%), largely carbonates, matrix gritty and sand rich.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

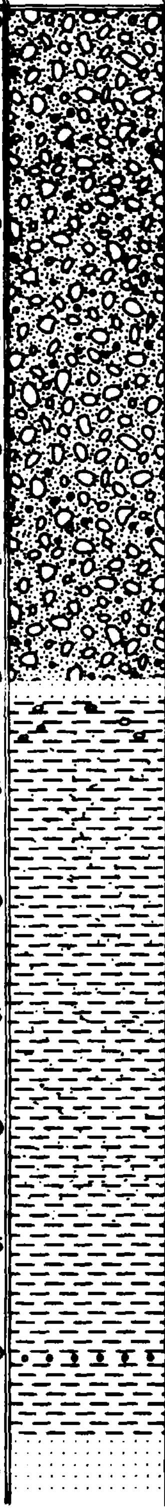
Drill Hole Nº: ONEX-W83-09

Sheet 3 of 6

DEPTH m	ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description

Depth (m): 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60

Depth (ft): 130, 135, 140, 145, 150, 155, 160, 165, 170, 175, 180, 185, 190, 195



Sampling: CS, CS, CS, CS, CS, CS, CS

CLAY/SAND PEBBLE TILL: 142.0–159.3'
Green to grey, moderately stiff, gritty, matrix, calcareous, occasional rock fragments (up to 10%), largely carbonates.
154.0–154.5': cobbles of tan limestone and dark grey siltstone.

SAND: 159.3–160.2'
Brown, polymictic, very fine-grained, calcareous, occasional pebble layers.

CLAY: 160.2–189.0'
160.2–183.0': medium to dark grey, stiff and calcareous, moderately gritty, limestone pebbles contained locally.

166.0': clay becoming increasingly gritty, more frequent limestone chips.

169.0': clay softer, dark volcanic chips prominent.

183.0–186.5': medium to dark grey ,stiff, non-gritty, calcareous, very finely laminated, rare pebbles, clay softer.

186.0': abundant limestone pebles, clay softer.

186.5–189.0': medium brown, extremely soft and vigorously calcareous. Slightly gritty,abundant carbonate chips.

SAND/GRAVEL: 189.0–189.5'
Polymictic, largely limestone and quartz, minor black siltstone, black volcanic fragments, appreciable woody lignite chips, rounded to subrounded clastics.

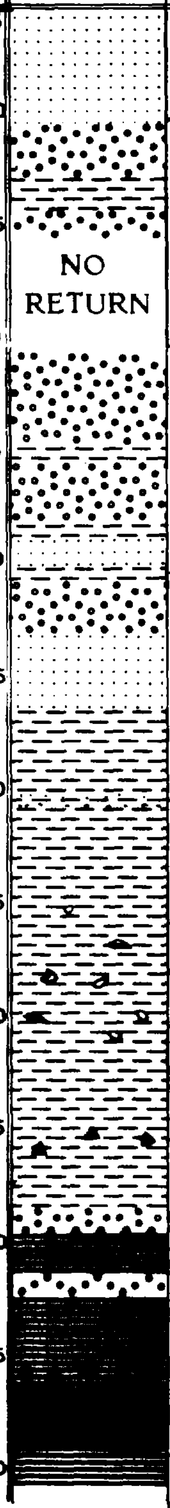
CLAY: 189.5–192.5'
189.5–192.0': dark brown to grey, very stiff, non-gritty and non-calcareous. Slightly carbonaceous, slickenslided, trace to minor lignite.

192.0–192.5': medium brown to grey, relatively soft, non-gritty and non-calcareous.
192.3': dark brown clay seam, soft, non-gritty.

SAND/FINE GRAVEL: 192.5–202.5'
Polymictic, although largely carbonates, other clasts include subrounded quartz, andesite, intermediate mafic volcanics and chert, contains appreciable lignite chips (up to 5%).

Drill Hole Nº: ONEX-W83-09

Sheet 4 of 6

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number
60–80	195–260		CS (200.0–210.0'); CS (210.0–220.0'); CS (220.0–230.0'); CS (230.0–240.0'); CS (240.0–243.0')	75; 60; 100; 100	500

Description

195.0': fine sand fraction, salt and pepper sand.

200.0–201.0': polymictic conglomerate.

CLAY: 202.5–204.0'
Tan to light grey, moderately stiff, non-gritty, lightly calcareous.

SAND/GRAVEL: 204.0–217.5'
Polymictic, sand fraction dominantly quartz, appreciable woody lignite chips.
205.0–210.0': no return, lost water circulation in sand and gravels.
214.0': dark brown, gritty clay seam, carbonaceous, lignite chips.

CLAY: 217.5–218.0'
Dark brown, soft, non-calcareous, moderately gritty, numerous small chert, limestone and quartz pebbles throughout.

PLESITOCENE

CRETACEOUS

SAND: 218.0–219.5'
Fine- to coarse-grained quartz-rich, minor clay, small lignite chips.

CLAY: 219.5–220.0'
Dark brown clay as per 217.5–218.0'.

SAND/GRAVEL: 220.0–222.0'
Polymictic, fine- to coarse-grained, predominantly quartz.

SAND: 222.0–226.0'
Fine-grained, quartz-rich sand.

CLAY: 226.0–230.5'
226.0–228.5': brown to grey, stiff, semi-brittle, non-calcareous, and non-gritty.
228.5–230.5': light to medium brown, stiff, non-calcareous, and non-gritty.

CLAY: 230.6–246.0'
Medium to dark brown, grey, and olive green layered clays; moderatley stiff, non-calcareous slip surfaces present. Occasional angular pebbles.

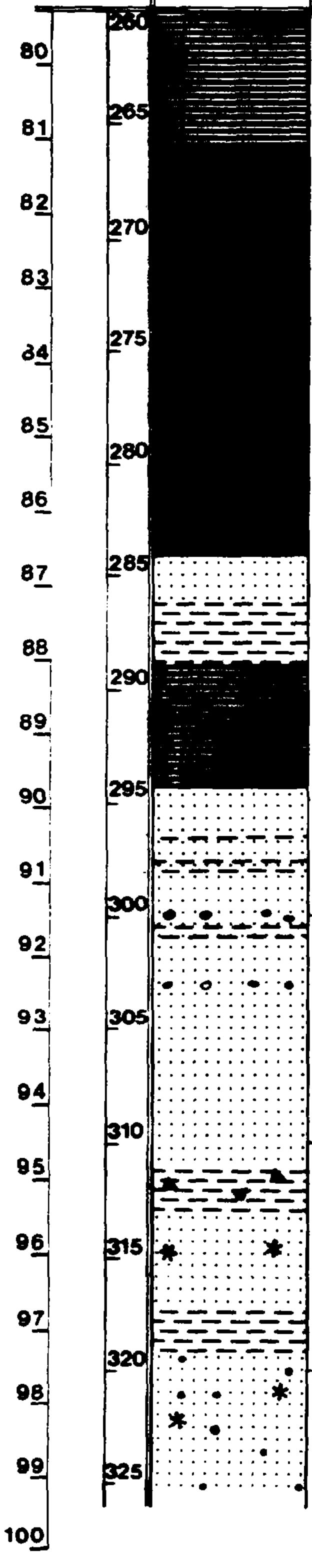
MICACEOUS CLAY: 246.0–247.5'
Medium to dark grey, soft.

CLAY: 247.5–248.0'
Dark grey, stiff, sandy–silty clay.

CARBONACEOUS CLAY: 248.0–256.0'
Black, earthy, containing approximately 25% woody lignite fragments.
248.0–249.0': pebbly, sandy interval.
251.0–251.5': pebble horizon.
255.0–256.0': abundance of woody lignite chips increases to approximately 25–40%, minor plant root material.

LIGNITE: 256.0–258.5'
Black, soft, broken up into aggregates of woody fragments and large chips (5–7 cm), minimal fine, black, carbonaceous clay content (<5%).

Drill Hole Nº: ONEX-W83-09



Sampling

reverse circulation interval	% core recovered	Number
	36	
	100	
	4	
	15	
	100	
	50	
	85	
	70	
CS		501
CS		502
CS		503

Description

CARBONACEOUS CLAY: 258.5–266.0'
Black, soft, earthy carbonaceous clay rich in lignite and wood chips; micaceous in places, pyritiferous.

LIGNITE: 266.0–284.0'
Black, compact, high quality competent lignite, finely disseminated pyrite is pervasive throughout.
267.8': pyritic horizon (≈2 cm) gobby and fine-grained aggregates.
269.0': pyrite stringers and fine disseminations.
269.0–289.0': evidently core tube was blocked, core recovery extremely low with evidence of grinding of core. Thus, possibility of additional 20' of lignite in addition to above interval from 266.0–269.0'.

SAND: 284.0–286.0'
Medium brown, sand and pebbles with clay binding, abundant lignite chips.

CLAY: 286.0–288.5'
Tan, stiff, non-calcareous, non-gritty, contains slip surfaces (roots).

CARBONACEOUS CLAY: 288.5–294.0'
Black with occasional pieces of brown wood, pieces and occasional thin lignite (beds?), possibililty of up to 3" clay and lignite ground up.

SAND/CLAY/DETRITAL PYRITE: 294.0–375.0'
Interbedded units of very fine-grained micaceous sand and non-gritty, soft, non-calcareous clay, and indurated aggregates of fine-grained quartz and pyrite; minor woody lignite chips, minor detrital quartz.
301.0': dominantly very fine-grained micaceous sand >70%.
311.0–313.0': dark brown, moderately stiff, gritty, non-calcareous, minor to appreciable fragments of lignite and minor detrital quartz.
313.0': tan, very fine-grained, micaceous sand.

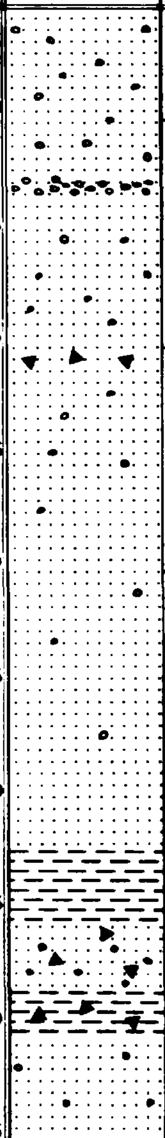
317.0–318.0': seam of dark brown to grey, stiff, non-calcareous clay and abundant fragments of lignite.

Drill Hole Nº: ONEX-W83-09

DEPTH (m): 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119

DEPTH (ft): 325, 330, 335, 340, 345, 350, 355, 360, 365, 370, 375, 380, 385, 390

GRAPHIC LOG



Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number
		503
CS		504
CS		
CS		505
CS		506

Description

330.0–332.0': dark brown, soft, non-gritty, non-calcareous, abundant lignite chips.

335.0–338.0': tan to light grey, non-calcareous and non-gritty, soft to moderately stiff.

END OF HOLE: 375.0'

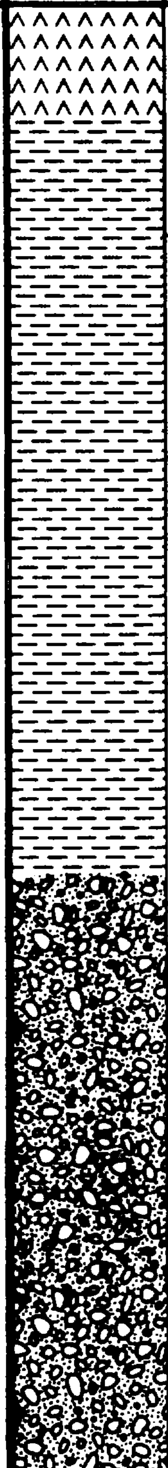
NO PLASTIC CASING

ONEXCO MINERALS LTD.

1983 WINTER DRILL PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-10 Location: West Gentles Township (lat. 50°32'00" long. 82°08'31")

Elev. of collar: ≈271 ft Total depth: 349 ft

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling	Description
0–20	0–65		NS, CS, CS, CS, CS, CS, CS, CS	see below

MUSKEG: 0–5.0'

SANDY CLAY: 5.0–10.0'
Light green–grey, sandy, calcareous clay; minor pebbles.

CLAY: 10.0–38.0'
Dark grey, moderately stiff, calcareous clay; minor grit.

16.0': limestone pebbles.

23.0': rounded black siltstone pebbles.

35.0': clay becoming stiffer, gritty.

36.0–37.0': black siltstone boulder.

37.0–38.0': beige, soft, calcareous clay.

RECENT
PLEISTOCENE

CLAY TILL: 38.0–150.0'
Light brown, soft, gritty, calcareous clay with approximately 40% sand and pebbles (limestone, black siltstone, quartz).

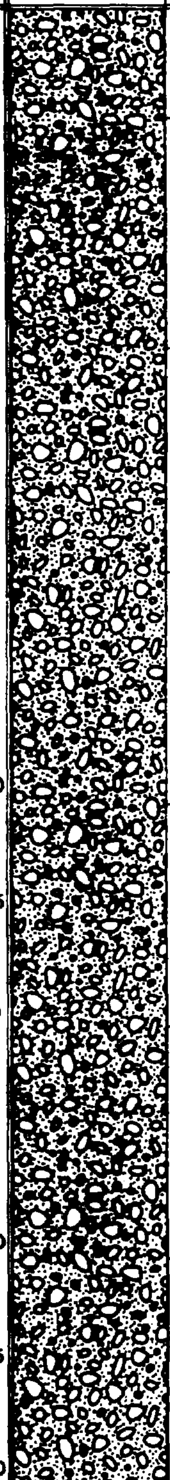
41.0': sand and pebble content has decreased to <10%.

43.0': small limestone boulder.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-10

Sheet 2 of 6

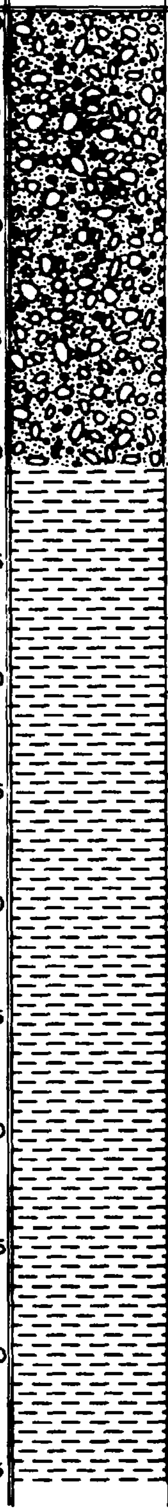


DEPTH m	DEPTH ft	Sampling: reverse circulation interval	% core recovered	Number	Description
20	65				
21	70				
22					
23	75	CS			
24	80				
25					
26	85	CS			
27	90				
28					
29	95	CS			
30	100				
31					
32	105	CS			
33	110				
34					
35	115	CS			115.0': clay has gradually become light brown to grey; still gritty, calcareous, moderately stiff, <5% sand–pebbles.
36	120				
37					
38	125	CS			
39	130				
40					

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-10

Sheet 3 of 6

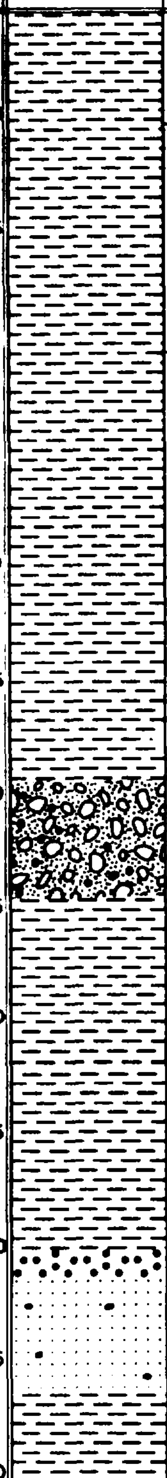


DEPTH m	DEPTH ft	Sampling: reverse circulation interval	% core recovered	Number	Description
40	130				
41	135	CS			
42					139.0': boulder.
43	140				
44	145	CS			
45					
46	150				CLAY: 150.0–229.0' Grey, stiff, calcareous, gritty clay with <1% pebbles and grit.
47	155	CS			155.0–156.0': clay is very gritty with minor lignite fragments (<1%).
48					
49	160				
50	165	CS			
51					
52	170				
53	175	CS			175.5': black siltstone boulder.
54					
55	180				
56	185	CS			
57					
58	190				
59	195	CS			
60					

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-10

Sheet 4 of 6

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description
60–80	195–260		CS, CS, CS, CS, CS, CS			

CLAY TILL: 229.0–234.0'
Grey, gritty, calcareous clay with 5% sand–pebbles.

CLAY: 234.0–250.0'
Same as above.

GRAVEL: 250.0–251.0'
Polymictic (quartz, siltstone, limestone, jasper, volcanics); 90% pebbles, 10% sand.

PEBBLY SAND: 251.0–256.0'
Fine- to coarse-grined quartz sand with 10% polymictic pebbles.

PLEISTOCENE
CRETACEOUS

254.0': minor lignite fragments.

255.5': 99% fine-grained silica sand; 1% pebbles.

CLAY: 256.0–262.0'
White to medium grey, non-calcareous clay, locally micaceous, minor pebbles.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

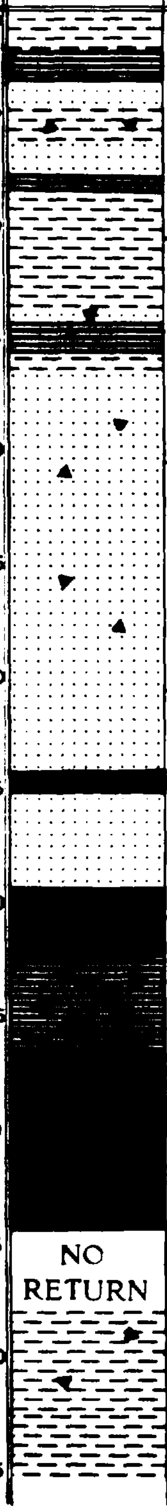
Drill Hole Nº: ONEX-W83-10

Sheet 5 of 6

DEPTH (m, ft) | GRAPHIC LOG | Sampling (reverse circulation interval, % core recovered, Number) | Description

Depth (m): 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100

Depth (ft): 260, 265, 270, 275, 280, 285, 290, 295, 300, 305, 310, 315, 320, 325



Sampling — reverse circulation interval: CS, CS, CS, CS, CS; % core recovered: 100, 65, 60; Number: 111, 112

CARBONACEOUS CLAY: 262.0–263.0'

CLAY-SAND: 263.0–267.0'
Interbedded fine-grained, micaceous silica sand and medium to dark grey clay, appreciable to moderate occurrences of lignite chips (15%) locally.

CARBONACEOUS CLAY: 267.0–268.5'
Black, stiff, carbonaceous clay with minor lignite fragments.

CLAY: 268.5–273.5'
Light to dark grey, moderately stiff, contains minor lignite fragments (<1%).
273.0–273.5': very fine-grained silica sand, micaceous, minor lignite fragments.

CARBONACEOUS CLAY: 273.5–275.5'
Black, stiff, carbonaceous clay containing appreciable chips of lignite (5%).

CLAY: 275.5–276.0'
Dark brown to grey stiff clay.

SILICA SAND: 276.0–293.5'
Fine- to coarse-grained silica sand, abundant pebbles occur locally; abundant lignite fragments throughout (to 15%), minor pyrite.
293.0–293.5': poorly sorted fine- to coarse-grained sand with pebbles; abundant lignite fragments.

LIGNITE: 293.5–294.5'

SAND: 294.5–299.0'
Fine- to medium-grained silica sand (>95% quartz), minor lignite.

LIGNITE: 299.0–302.0'

CARBONACEOUS CLAY: 302.0–306.0'
Black, soft, carbonaceous clay with abundant lignite fragments (up to 75%).

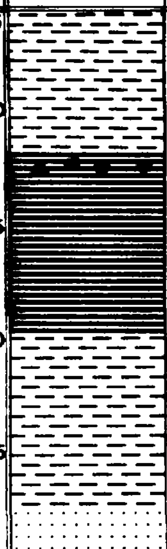
LIGNITE: 306.0–314.0'

309.5–310.0': seam of carbonaceous clay with minor pyritiferous beds attaining thicknesses of 0.25".

NO CORE RECOVERY: 314.0–317.5'

CLAY SEQUENCE: 317.5–331.0'
Largely medium to dark brown, stiff clay, containing abundant fragments of lignite, locally micaceous.
317.5–317.9': seam of pebbly, medium-grained silica sand.
322.0–326.0': no core recovery; suspected sand or mud washed away.

Drill Hole Nº: ONEX-W83-10

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
	325					
100	330					
101						329.0': thin (0.5") seam of lignite.
102	335			90		CARBONACEOUS CLAY: 331.0–339.5' Black, very stiff, carbonaceous clay with abundant woody pieces of lignite (up to 75%) locally.
103	340					CLAY: 339.5–347.0' Light grey to white, stiff, silty–clay, micaceous. Contains minor lignite fragments (<1%).
104						
105	345			70		NO CORE RECOVERY: 347.0–349.0' Suspected sand.
106						END OF HOLE: 349.0'
						HOLE PLASTIC CASED TO 320.0'
107	350					
108	355					
109						
110	360					
111	365					
112						
113	370					
114	375					
115						
116	380					
117	385					
118						
119	390					

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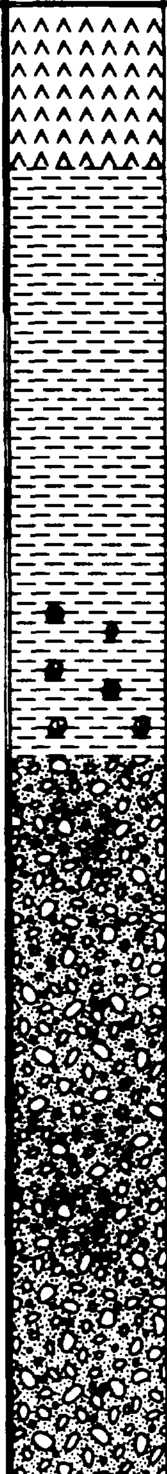
1983 WINTER DRILL PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-11 Location: West Gentles Township (lat. 50°30'42" long. 82°08'18")

Elev. of collar: ≈276 ft Total depth: 400 ft Sheet 1 of 7

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling	Description
1–20	5–65		NS, CS, CS, CS, CS, CS, CS	see below

MUSKEG: 0–7.0'

MARINE CLAY: 7.0–33.0'
Green–grey, soft, containing bivalve shell fragments, black pebbles, black woody fragments; calcareous.

15.0': grey, no pebbles, moderately stiff, calcareous, non-gritty.

26.0–33.0': shell fragments.

RECENT

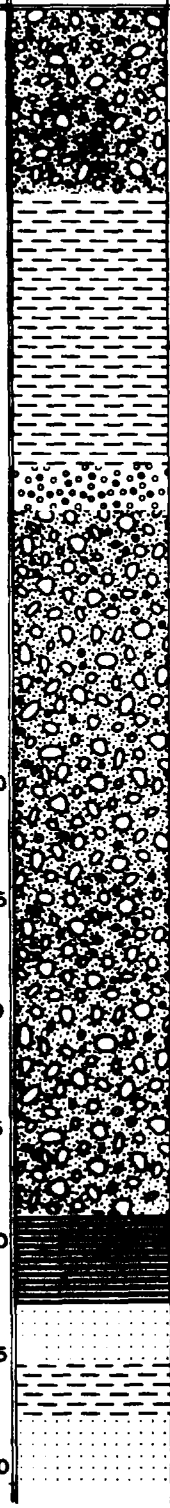
CLAY TILL: 33.0–73.0'
50% clay, 30% pebbles, 20% fine sand–silt. Clay is light grey–brown, calcareous. Pebbles consist of black siltstone, tan limestone, granites and jasper; subangular clasts up to 0.25" diameter; 75% limestone, 20% siltstone, 5% other.

PLEISTOCENE

47.0': clay decreases to approximately 25%.

60.0': approximately 75% clay, 25% pebbly sand.

Drill Hole Nº: ONEX-W83-11

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
20–40	65–130		CS CS CS CS CS CS CS		113	see below

70.0': pebbles and sand decrease to 10%; clay becoming stiffer (moderately stiff).

CLAY: 73.0–85.0'
Light grey-brown, calcareous, moderately stiff clay with minor sand–grit (<5%).
76.0': pebble bed, 1' thick, consists of siltstone 60%, limestone 30%, others 10%.
79.0': softer clay.
83.0': 20% silt and limestone pebbles.

GRAVEL: 85.0–87.0'
Polymictic pebbles; 50% siltstone, 25% limestone, 15% chert, 10% fine sand matrix.

CLAY TILL: 87.0–90.0'
Brown calcareous clay-rich till with approximately 40% small pebbles, sand, and silt.

PEBBLE TILL: 90.0–93.0'
60% pebbles, 40% of which consists of tan limestone.

CLAY TILL: 93.0–118.0'
Brown calcareous clay-rich till as above; 40% small pebbles, limestone, sand, chert.
97.0': decrease in pebbles to 20%; also 20% fine sand in matrix.
107.0': decrease in pebbles to 10%; clay very calcareous, stiff.
116.0': appearance of white limestone pebbles, 5%.

CARBONACEOUS CLAY: 118.0–122.0'
Black carbonaceous clay; stiff, non-calcareous.

SAND: 122.0–124.5'
White, fine- to coarse-grained, moderately well rounded with 5% limestone and 5% green chert pebbles.

PLEISTOCENE
CRETACEOUS

SILTY–CLAY: 124.5–127.0'
Beige, very fine sand–silt 50%; clay 50%.

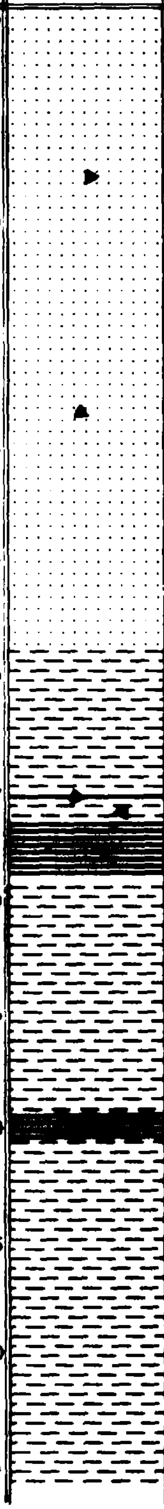
SILICA SAND: 127.0–158.0'
Coarse to fine quartz, sand well sorted, subrounded. Repeating fining upward cycles from pebbly base to white silty–clay; 70% of fraction within the medium to coarse size; contains minor lignite fragments <5%, 20% fine fraction, 10% very fine fraction.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-11

DEPTH m	DEPTH ft	Sampling: reverse circulation interval	% core recovered	Number
40–41	130–135	CS		113
41–43	135–140	CS		114
43–44.5	140–146	CS		115
44.5–48	146–160	CS		
48–51	160–170	CS		
51–54	170–180	CS		
54–58	180–190	CS		
58–60	190–197			

GRAPHIC LOG



Description

154.0': coarse pebbly horizon with 5% quartz pebble (0.5 to 1 cm); fining upward sequence.

158.0': coarse pebbly base of fining upward cycle.

CLAY: 158.0–164.5'
158.0–159.5': yellow, stiff clay with 20% silt and fine sand.

159.5–164.5': grey–purple stiff clay.

CARBONACEOUS CLAY: 164.5–165.0'
Black carbonaceous clay, with minor lignite fragments.

CLAY: 165.0–166.0'
Sandy–silty clay: grey, stiff, with 10% lignite fragments from 165.5–166.0'.

CARBONACEOUS CLAY: 166.0–168.5'
Stiff, black, carbonaceous clay.

168.0': clay is soft and earthy.

CLAY: 168.5–179.0'
Light brown–grey, stiff clay with <1% lignite fragments.

171.0–171.5': pyrite nodules up to 0.5", minor lignite.

173.0–179.0': medium grey clay, moderately stiff, minor lignite from 176.0–177.0'.

CARBONACEOUS CLAY: 179.0–180.0'
Black, stiff, carbonaceous clay.

CLAY: 180.0–197.0'
180.0–187.0': dark grey, stiff.

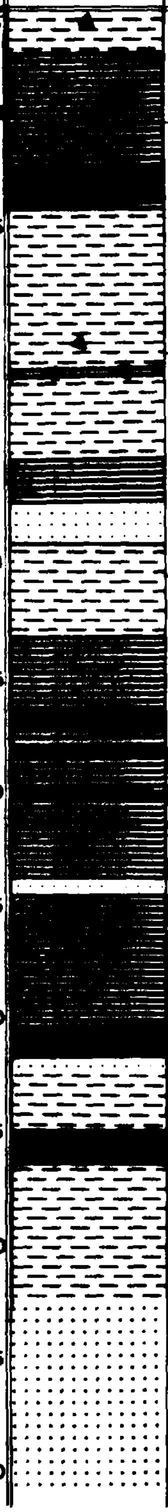
187.0–190.0': brown–purple, stiff.

190.0–197.0': light grey–whitish silts (10% silt), 5% small lignite fragments.

CARBONACEOUS CLAY: 197.0–202.0'
Dark brown, carbonaceous clay becoming black by 201.0'; stiff.

Drill Hole Nº: ONEX-W83-11

DEPTH (m: 60–80; ft: 195–260) | GRAPHIC LOG | Sampling (reverse circulation interval; % core recovered; Number) | Description



Sampling — reverse circulation interval: CS, CS, CS, CS, CS; % core recovered: 55, 41, 0

LIGNITE: 202.0–203.5'
Black with 10% black clay interbeds.

CARBONACEOUS CLAY: 203.5–204.0'
Black, carbonaceous, stiff.

CLAY: 204.0–211.0'
Alternating brown and grey, silty clays (10–40% silt) with 2% pyrite nodules, 2% small lignite fragments.

CARBONACEOUS CLAY: 211.0–211.5'
Dark grey, carbonaceous, with 20% lignite fragments.

CLAY: 211.5–215.0'
Dark brown, stiff clay.

CARBONACEOUS CLAY: 215.0–217.0'
Black, carbonaceous, platy.

SAND: 217.0–218.5'
Siliceous, medium- to fine-grained, subrounded, well sorted.

CARBONACEOUS CLAY: 218.5–219.0'
Black, carbonaceous, platy with minor lignite fragments.

CLAY: 219.0–222.5'
Dark grey, silty (20% silt), stiff.

CARBONACEOUS CLAY: 222.5–240.0'
Black, carbonaceous, stiff clay; pyritiferous in places. Contains minor lignite interbeds up to 1' thick. Minor coarse-grained silica sand at 233.5'.

LIGNITE: 240.0–241.5'
Black with less than 5% clay, no pyrite observed.

SAND: 241.5–242.0'
Brownish white, medium- to coarse-grained with pyrite; kaolinite cement, subrounded; moderately sorted.

CLAY: 242.0–244.0'
Dark brown, with 10% sand, 10–20% lignite fragments; minor pyrite.

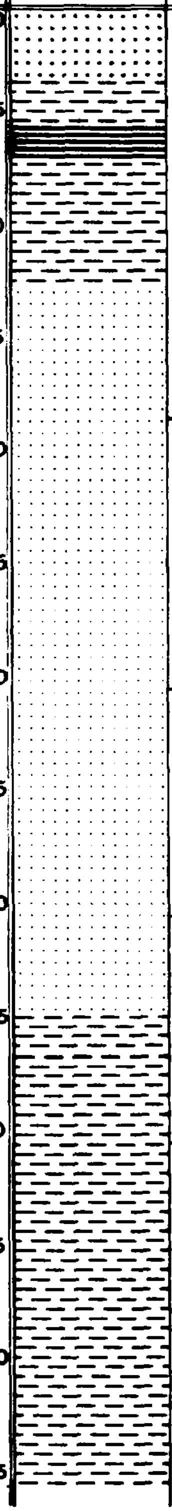
LIGNITE: 244.0–246.1'
Black with 10% black clay, no pyrite observed.

CLAY: 246.1–252.0'
1% recovery, dark brown, sandy.

SAND?: 252.0–263.0'
252.0–262.0': no recovery; sand seam implied by missing core.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-11

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number
80–100	260–325		CS, CS, CS, CS, CS	75, 5	116, 117, 118

Depth scale, m: 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100

Depth scale, ft: 260, 265, 270, 275, 280, 285, 290, 295, 300, 305, 310, 315, 320, 325

Description

262.0–263.0': fine-grained, micaceous silica sand.

CLAY: 263.0–265.0'
Stiff, dark brown clay, <1% lignite fragments.

CARBONACEOUS CLAY: 265.0–266.5'
Black, sandy, carbonaceous clay with 15–20% lignite fragments up to 1" long.

CLAY: 266.5–272.0'
Light grey–beige, sandy clay; abundant fracturing at 45° to core axis.

SAND: 272.0–304.0'
Silica sand, fine-grained with minor quartz pebbles pyrite, subrounded to subangular, pebbles up to 0.25" interbedded with white clay.

290.0–293.0': minor white clay interbeds.

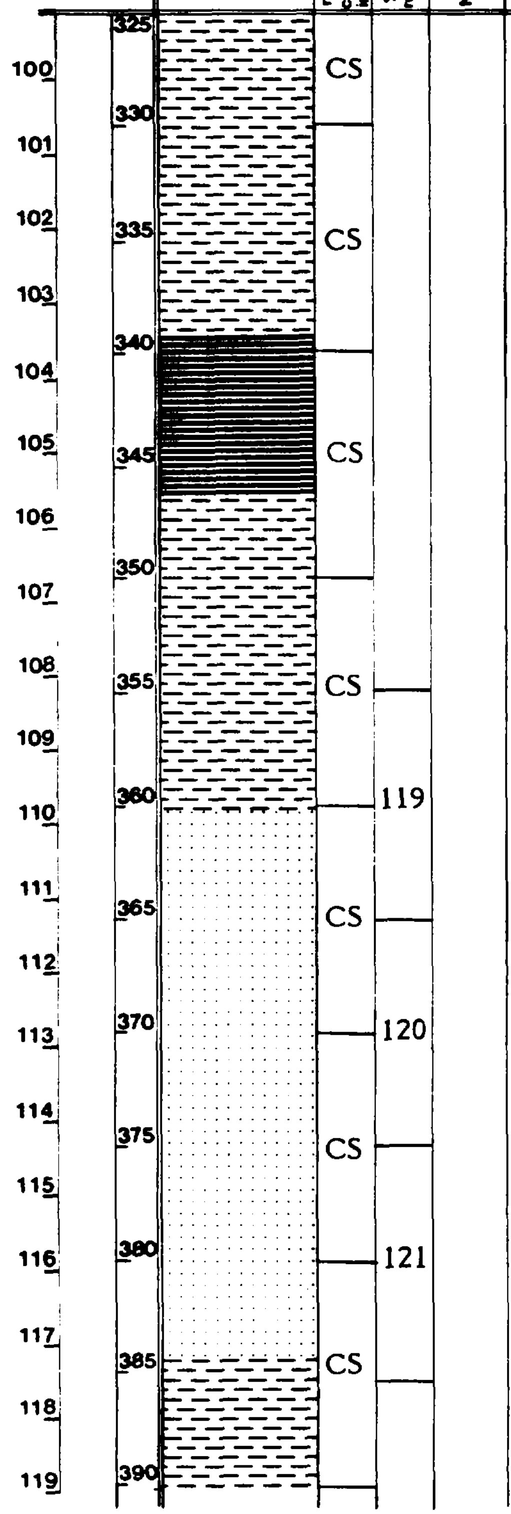
296.0–296.5': clay interbed; white, soft, silty clay.

VARIEGATED CLAYS: 304.0–339.0'
Alternating beds of stiff, white, light to dark brown, olive green, yellowish brown, and reddish brown clay.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-11

DEPTH (m, ft)	GRAPHIC LOG	Sampling (reverse circulation interval, % core recovered, Number)	Description



CARBONACEOUS CLAY: 339.0–346.0'
Dark grey to black carbonaceous clay; very stiff.

CLAY: 346.0–360.0'
346.0–347.0': dark grey stiff clay.

347.0–359.0': alternating light and medium grey clay; quite stiff.

359.0–360.0': white kaolinitic clay; silty with approximately 10% sand.

SAND: 360.0–384.0'
Silica sand, very fine-grained with abundant pebbles; also contains minor black siltstone, minor pyrite and quartz.

363.0–365.0': sand is becoming coarser.

365.0–369.0': sand is fine- to medium-grained with 10% pebbles.

376.0': 80% pebbles, 20% coarse sand.

380.0': medium- to coarse-grained sand with 10–25% pebbles (black siltstone and claystone).

381.0': fine-grained silica sand; minor coarse-grained and pebbly fraction.

383.0': coarse-grained silica sand with 50–75% pebbles.

CRETACEOUS

DEVONIAN ?

CLAY: 384.5–400.0'
384.5–385.0': light green, non-calcareous clay.

385.0–385.5': dark grey clay, soft with small sand interbed.

385.5–400.0': interbedded light green and dark grey, stiff clays.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-11

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
119	390					
120						
	395		CS			
121						END OF HOLE: 400.0'
						HOLE PLASTIC CASED TO 210.0'
122	400					
23						
	405					
124						
125	410					
126						
	415					
127						
128	420					
129						
	425					
130						
131	430					
132						
	435					
133						
134	440					
135						
	445					
136						
137	450					
138						
	455					
139						

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1983 WINTER DRILL PROGRAM – JAMES BAY LOWLANDS

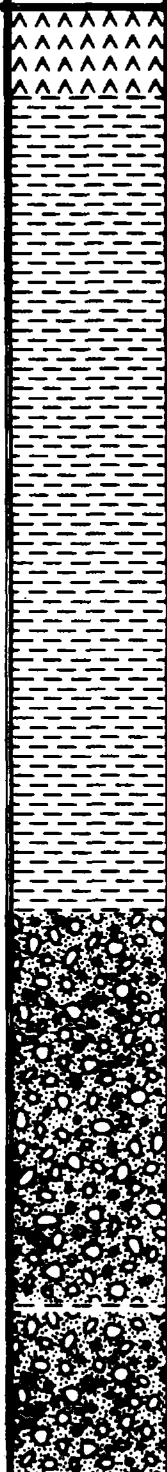
Drill Hole Nº: ONEX-W83-12 Location: West Gentles Township (lat. 50°31'42" long. 82°07'41")

Elev. of collar: ≈276 ft Total depth: 403.5 ft Sheet 1 of 7

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	X core	Number	Description

Depth scale (m): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

Depth scale (ft): 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65



Sampling: CS, CS, CS, CS, CS, CS

MUSKEG AND ICE: 0–4.0'

CLAY: 4.0–40.0'

4.0–12.0': green to grey, extremely soft, non-gritty, calcareous.

12.0–27.0': medium to dark grey, soft to moderately stiff, slightly gritty, vigorously calcareous.

15.0': bivalve fragments.

16.0–18.0': clay extremely stiff, dark grey in colour.

18.5': mottled with light grey clay.

19.5': clay somewhat softer to 24.0'.

27.0–36.0': dark grey, very little return, vigorously calcareous, prominent black grit.

27.0–35.0': bivalve fragments and black siltstone chips abundant.

36.0–40.0': light brown to grey, extremely soft and calcareous, slightly gritty, abundant pebbles which are largely carbonates and dark volcanics.

RECENT
PLEISTOCENE

CLAY PEBBLE TILL: 40.0–66.0'

Light brown to grey, calcareous, soft clay-rich till; gritty matrix; clasts include (30–40%) carbonates, white chert, granite, dark volcanics, and grey–black siltstone.

50.0': much of clay matrix washed away.

57.0': 6" light brown, calcareous, clay interbed.

58.0': abundance of clasts decreased to 10–15%.

59.0–60.0': dominantly calcareous clay and minor pebbles.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

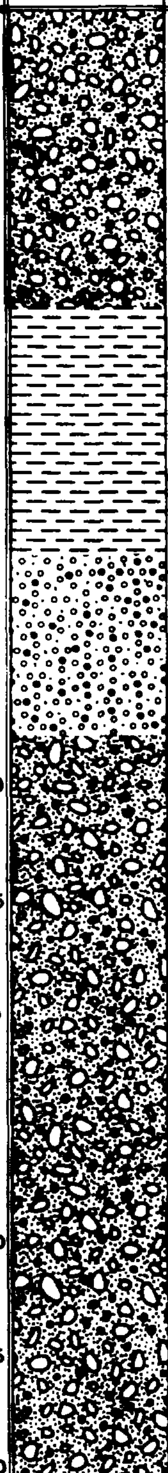
Drill Hole Nº: ONEX-W83-12

Sheet 2 of 7

DEPTH (m / ft)	GRAPHIC LOG	Sampling (reverse circulation interval / % core recovered / Number)	Description

Depth (m): 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

Depth (ft): 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130



Sampling: CS, CS, CS, CS, CS, CS

SAND CLAY TILL: 66.0–69.5'
Light brown to grey, calcareous, gritty matrix, pebble content <5% dominantly carbonates, numerous clay interbeds, appreciable sand fraction.

68.0': abundant carbonate fragments.

CLAY PEBBLE TILL: 69.5–78.0'
As per 40.0–66.0'; clasts dominantly white to tan limestone.

71.0': abundant white and light brown carbonate chips.

72.0': light brown to grey, calcareous, moderately gritty matrix, pebbles (2–3%) largely carbonates.

72.5–73.0': grey limestone boulder.

73.0–74.0': extremely muddy matrix, most washed away, abundant tan to grey limestone.

CLAY TILL: 77.0–78.0'
Medium brown to grey, gritty, calcareous, moderately stiff, minor pebbles (2–3%).

CLAY: 78.0–89.0'
Medium brown, calcareous, non-gritty, soft.

SAND/GRAVEL: 89.0–97.0'
Polymictic, although dominantly angular limestone (50%), diabase, chert, and diorite fragments, minor clay binding, minor sand fraction, poorly sorted.

92.5': polymictic, medium-grained, salt and pepper sand.

94.0': thin polymictic sand interbed.

94.5–95.0': diorite boulder.

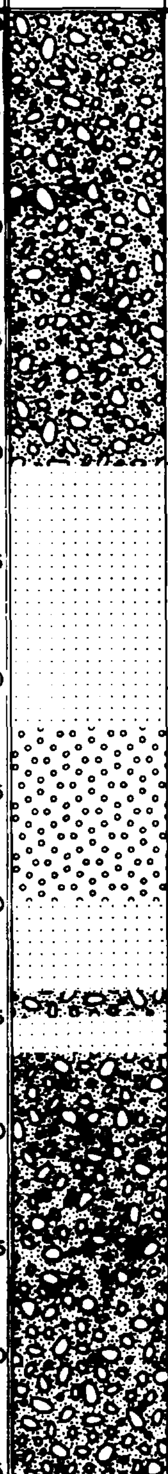
96.5': minor lignite pieces.

SAND PEBBLE TILL: 97.0–150.0'
Medium brown to grey, gritty, soft, calcareous matrix; abundant carbonate fragments; other clastics include diorite, granite, minor chert, jasper, and pink quartz.

115.0–128.5': matrix extremely soft, gritty, clay muddy matrix.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-12

DEPTH (m / ft)	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description
40–60 m / 130–195 ft		CS; CS			

140.5–141.0': sand and gravel.

145.5–145.8': black siltstone cobble.

SAND/GRAVEL: 150.0–157.0'
Polymictic (60–80%), fine–coarse-grained subangular–subrounded quartz, also rounded limestone, chert, and black siltstone pebbles.

SAND: 157.0–161.5'
Polymictic, medium- to coarse-grained, predominantly quartz.

160.0–161.5': sand becoming medium- to fine-grained with occasional pebbles.

PEBBLE SAND: 161.5–169.0'
Polymictic, usual pebble suite.

167.5': boulder(?).

SAND: 169.0–173.1'
Fine-grained, polymictic, minor medium- to coarse-grained and pebbly fraction.

CLAY TILL: 173.1–174.2'
Green to grey, soft to moderately stiff, gritty.

SAND: 174.2–176.0'
Polymictic, fine- to medium-grained.

SAND TILL: 176.0–183.0'
Green to grey, soft, very minor clay fraction; dominantly fine sand; minor lignite chips.

CLAY PEBBLE TILL: 183.0–196.0'
Gritty with sand and pebble-sized fragments.

By 186.0', matrix becomes very sandy.

187.0': pyrite chunks to 0.25".

190.5': sand and gravel layer.

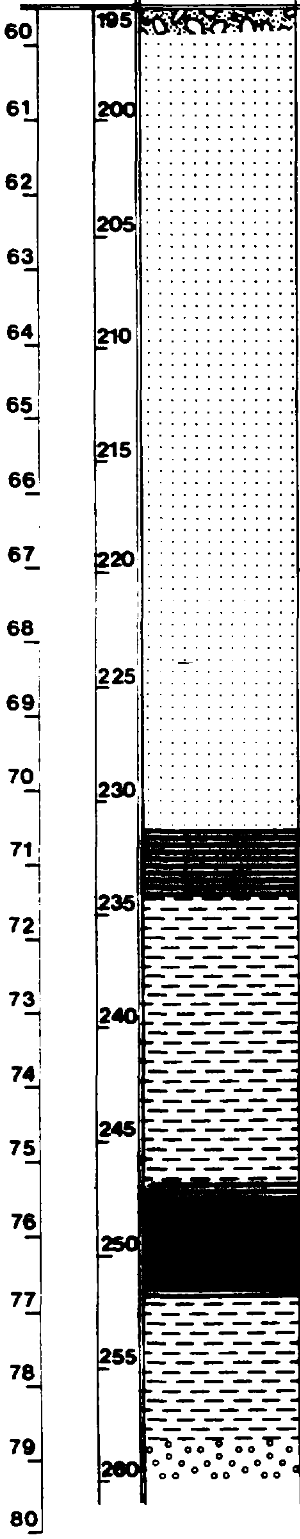
191.0': clay matrix increases.

192.0': diabase boulder.

193.0': sand and gravel layer.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-12

DEPTH (m / ft)	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
60–80 m / 195–260 ft		CS; CS	0; 100; 100	520	see below

PEBBLE SAND: 196.0–198.0'
Polymictic, containing a thin light grey clay layer.

SAND: 198.0–218.0'
198.0–201.0': medium- to coarse-grained, containing numerous pebbles.
201.0–207.0': fine-grained, some pebbles and minor medium to coarse sand; approximately 5% mafics.
207.0–218.0': fine- to coarse-grained, polymictic sand; abundant pebbles present; poorly sorted.

PLEISTOCENE
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MICACEOUS SAND: 218.0–231.0'
Fine-grained, quartz-rich sand; minor calcite present.
228.0': thin layers of white and light brown clay.

CARBONACEOUS CLAY–LIGNITE: 231.0–234.0'
Interbedded units of carbonaceous clay and light to dark grey clay.
231.0–232.0': carbonaceous clay and lignite.
232.0–234.0': dark grey clay, stiff, non-calcareous, minor pyrite-rich intervals.

CLAY: 234.0–238.0'
Light grey, moderately stiff to soft, fine lignite chips, occasional thin medium- to coarse-grained silica sand interbeds.
236.0–238.0': clay becomes much stiffer, non-gritty, and non-calcareous.

NO CORE RECOVERY: 238.0–246.6'
Possible clayey interval.

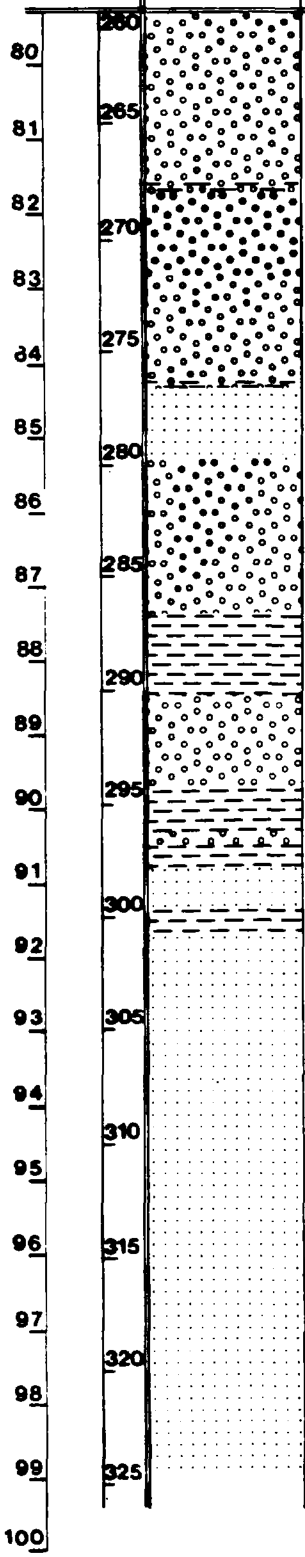
CARBONACEOUS CLAY: 246.6–247.5'

LIGNITE: 247.5–252.4'
Black to orange brown, slightly woody, though mostly hard and brittle.

CARBONACEOUS CLAY: 252.4–252.8'

CLAY: 252.8–258.4'
Tan, gritty, non-calcareous.
255.8–256.2': sandy clay interval, minor pebbles, white chert.

Drill Hole No: ONEX-W83-12

DEPTH (m, ft) / GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description
		36, 13, 0		See below

SAND/GRAVEL: 258.4–268.0'

267.4–268.0': dark grey clay, slightly gritty.

NO CORE RECOVERY: 268.0–272.0'
Possible sandy interval

PEBBLE SAND: 272.0–276.8'
Predominantly quartz, with chert and mafic pebbles.

275.0': pebbles.

CLAY: 276.8–277.0'
Dark brown, stiff, gritty.

SAND: 277.0–280.0'
Fine-grained, with coarse sand and pebbles, occasional chunks of pyrite.

PEBBLE SAND: 280.0–287.0'
Abundant fine sand layers, abundant pyrite at 290.0–292.0'.

CLAY: 287.0–290.5'
Dark grey to brown.

PEBBLE SAND: 290.5–294.5'
Fine-grained to pebble sand, occasional thin clay interbeds.

CLAY: 294.5–296.5'
294.5–296.0': dark grey, stiff, non-calcareous, very slightly gritty.

296.0–296.5': medium grey, moderately stiff, slight grit.

PEBBLE SAND: 296.5–297.0'

CLAY: 297.0–298.0'
Medium grey, moderately stiff, non-gritty, non-calcareous.

QUARTZ SAND: 298.0–298.5'
Fine- to coarse-grained grey sand, dominantly quartz.

PEBBLE SAND: 298.5–299.0'
Polymictic, thin tan clay interbeds, fine sand fraction approximately 50%.

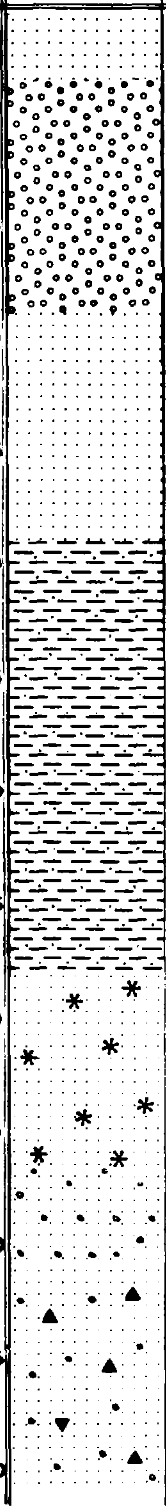
SAND: 299.0–300.0'
Fine- to coarse-grained, pebble horizons and interbedded tan clay interbeds.

CLAY: 300.0–301.0'
Tan to light grey, extremely stiff, slightly gritty, non-calcareous.

QUARTZ SANDS: 301.0–329.0'
Fine-grained silica sand with whitish return in the water (kaolinite?); 2–3% mafics.

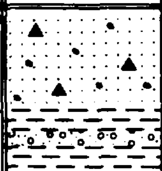
Drill Hole No: ONEX-W83-12

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
	325					
100						
101	330					PEBBLE SAND: 329.0–339.0' Rounded pebbles and coarse sand, including grey and white chert, diabase, limestone.
102	335					
103						
104	340					SAND: 339.0–349.0' Sporadic material return, although predominantly fine sand, some pebbles.
105	345					
106						
107	350					QUARTZ SAND/CLAY: 349.0–368.0' Largely interbedded units of fine- to coarse-grained quartz sand, with thinner units of tan to white gritty clay; clay is soft to stiff and non-calcareous.
108	355					
109						
110	360				507	
111	365					
112						QUARTZ SAND/PYRITE: 368.0–374.0' Largely very fine-grained silica sand with abundant well indurated chunks of detrital pyrite and quartz, minor tan clay interbeds, and quartz pebble horizons.
113	370				508	
114	375					QUARTZ SAND/CLAY/PYRITE: 374.0–376.5' Largely very fine-grained, micaceous quartz sand and prominent interbedded tan to grey clay; abundant pieces of indurated pyrite and quartz (5–10%); pebble sand horizons present with clay binding.
115						
116	380					QUARTZ PEBBLE SAND: 376.5–381.0' Very poorly sorted quartz pebble sand with clay binding and abundant pyrite (5–10%; substantial fine-grained micaceous quartz sand fraction (≈30%).
117	385					
118						QUARTZ SANDS: 381.0–395.0' Fine- to coarse-grained, white to grey silica sands (>90% quartz); abundant pieces of lignite, minor light grey–tan clay interbeds.
119	390				509	



1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-12

DEPTH (m / ft)	GRAPHIC LOG	Sampling: Number	Description
119–121 m / 390–397.5 ft		510	CLAY: 395.0–396.0' Medium grey, stiff, non-calcareous, finely laminated. SILICA SANDS: 396.0–396.5' White to grey silica sands. CLAY: 396.5–396.7' Dark grey, gritty, stiff, non-calcareous. SILICA SANDS: 396.7–397.0' Silica sands as above. CLAY: 397.0–397.5' Dark–medium grey clay; stiff, slight gritty, and non-calcareous.

END OF HOLE: 397.5'

HOLE PLASTIC CASED TO 340.0'

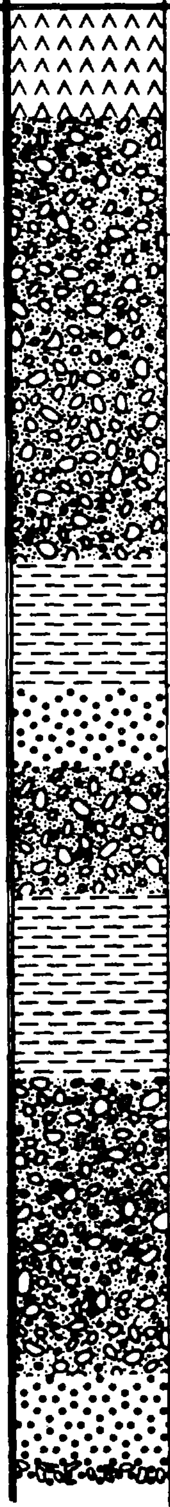
ONEXCO MINERALS LTD.

1983 WINTER DRILL PROGRAM – JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-13 Location: West Gentles Township (lat. 50°29'21" long. 82°04'28")

Elev. of collar: ≃299 ft Total depth: 396 ft Sheet 1 of 7

DEPTH (m, ft)	GRAPHIC LOG	Sampling (reverse circulation interval / X core / Number)	Description



Sampling: NS; CS; CS; CS; CS; CS; CS

MUSKEG: 0–4.5'

RECENT
PLEISTOCENE

CLAY TILL: 4.5–24.0'
Gritty, sandy, light green–grey clay, soft; minor limestone fragments, minor black siltstone, contains 10% sand and pebbles.

10.0': clay has changed to light brown in colour.

CLAY: 24.0–30.0'
Grey, moderately stiff clay; calcareous with minor sand.

29.0': granitic gneiss boulder (1.5' thick).

GRAVEL: 30.0–33.5'
Polymictic gravel composed of 80% pebbles, 20% sand; clasts consist of black siltstone (50%), granite (25%), chert (25%), subrounded to subangular in shape.

33.0': granite boulder.
33.5': limestone boulder.

CLAY TILL: 33.5–39.0'
Calcareous, soft, grey clay with appreciable pebbly sand fraction (25%).

38.0': pebble–sand fraction decreases to 5%.

CLAY: 39.0–47.0'
Light green–grey, calcareous, gritty clay with minor sand (<1%).

CLAY TILL: 47.0–60.0'
Light green–grey, calcareous, gritty clay as above, with abundant limestone chips.

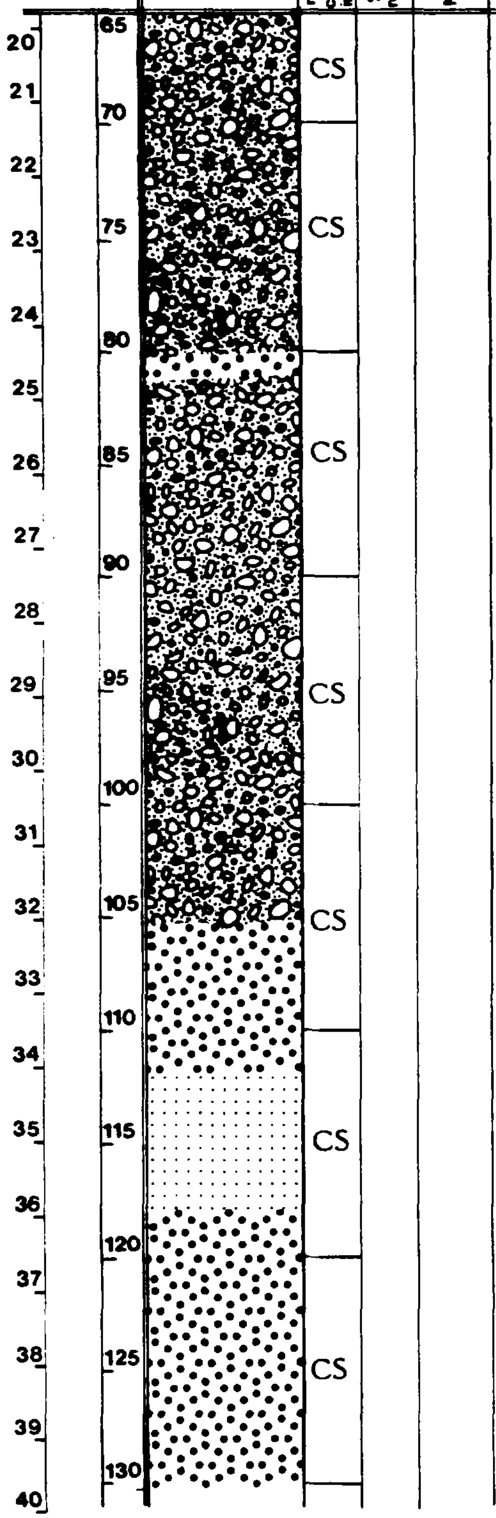
SANDY GRAVEL: 60.0–64.0'
Consists largely of coarse-grained salt and pepper sand (75%) and subrounded, broken pebbles (25%) including limestone, black siltstone, shell fragments, chert.

CLAY TILL: 64.0–80.0'
Soft, calcareous, gritty, green clay with 5% pebbles and sand consisting of black siltstone and tan limestone.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-13

DEPTH (m, ft)	GRAPHIC LOG	Sampling (reverse circulation interval, % core recovered, Number)	Description



71.0': abundance of sand and pebble fraction increased to 15%.

SANDY GRAVEL: 80.0–81.0'

CLAY TILL: 81.0–105.0'
Soft, calcareous, gritty, green clay with a moderate pebble–sand fraction (5%).

88.0': pebble–sand fraction increases to 25%.

91.0': pebble–sand fraction increases to 50% and consists mostly of tan limetone, black siltstone as angular fragments.

93.0': siltstone boulder.
93.5': decrease in sandy pebbles to 10%.

100.0–100.5': sandy gravel interval.
100.5': increase in pebble–sand fraction to 75%.

SANDY GRAVEL: 105.0–112.0'
Composed of calcareous salt and pepper sand (50%) and 50% pebbles; predominantly white–tan limestone, black siltstone, chert, minor clay.

PEBBLY SAND: 112.0–118.0'
Salt and pepper sand, calcareous, with shell fragments; 25% pebbles, minor clay; poorly sorted, rounded to subangular pebbles, polymictic.

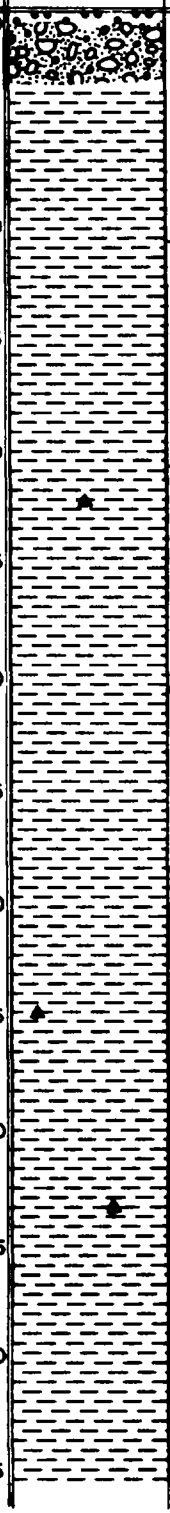
PEBBLY GRAVEL: 118.0–130.0'
Polymictic gravel consisting of 90% pebbles and 10% sand; limestone, chert, jasper, siltstone, quartzite.

127.5': gravel composed of 50% sand, 50% pebbles.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-13

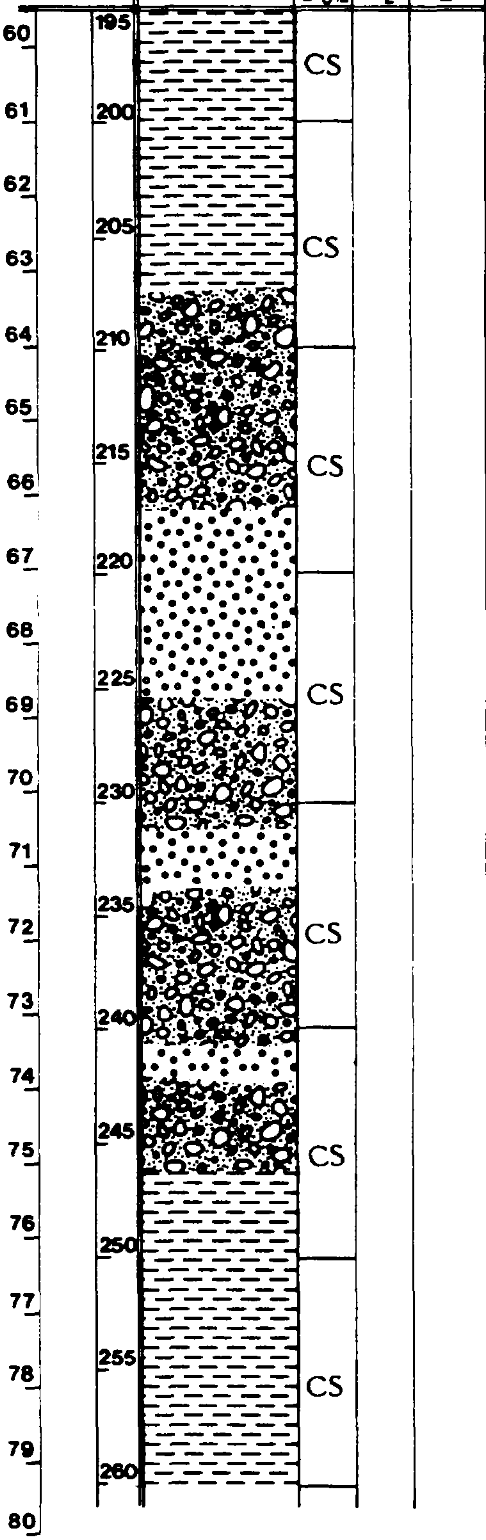
Sheet 3 of 7

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
40–41	130–133					CLAY TILL: 130.0–133.0' Grey, soft, calcareous clay with 50–75% pebble–sand.
41–42	133–138		CS			PEBBLY SAND: 133.0–207.0' Composed of 75% fine-grained sand and approximately 25% pebbles. 136.5': white–yellow limestone boulder.
43–45	138–148		CS			140.0': 10% pebbles, 90% salt and pepper fine-grained sand. 148.0': lignite fragments.
46–48	148–158		CS			154.0': decrease to 5% pebbles.
49–51	158–168		CS			167.0–190.0': minor lignite fragments.
52–54	168–178		CS			
55–57	178–188		CS			
58–60	188–197					

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-13

DEPTH (m, ft)	GRAPHIC LOG	Sampling (reverse circulation interval, % core recovered, Number)	Description



CLAY TILL: 207.0–217.0'
Soft, grey, calcareous, gritty clay with approximately 5% pebbles and sand.

215.0': chert boulder.

GRAVEL: 217.0–225.5'
Consists of 75% unsorted salt and pepper sand; 25% polymictic pebbles.

CLAY TILL: 225.5–231.0'
Grey, calcareous, soft clay with 5–10% pebbles–sand.

229.0': sand–gravel bed approximately 1' thick.

GRAVEL: 231.0–234.0'
Polymictic gravel consisting of 85% pebbles, 15% sand; rounded broken clasts (0.5").

CLAY TILL: 234.0–240.5'
Same as above.

239.0': 0.5' of pebbly gravel.
240.0': minor lignite fragments.

SANDY GRAVEL: 240.5–242.0'

CLAY TILL: 242.0–246.0'
Same as above; grey, calcareous, soft clay with 5–10% pebble–sand.

244.0': clay becoming darker, stiff.

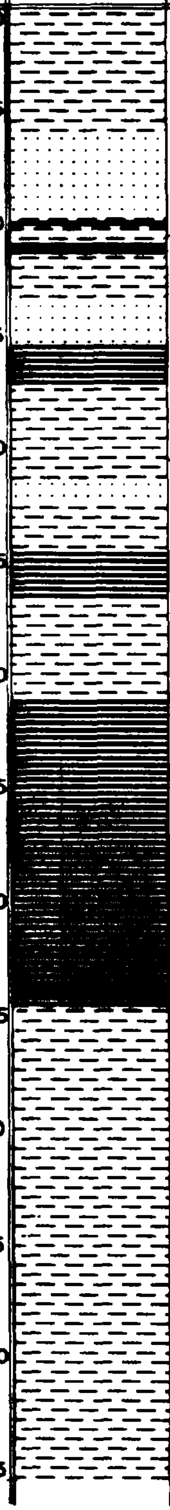
CLAY: 246.0–265.5'
246.0–257.0': medium to dark grey calcareous clay, stiff, slightly gritty, minor sand (<1%).

257.0–260.0': medium grey, non-calcareus, stiff clay, non-gritty.

PLEISTOCENE
CRETACEOUS

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-13

DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
80–100	260–325		CS; CS	60; 47; 84; 100		see below

Depth scale: m: 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100; ft: 260, 265, 270, 275, 280, 285, 290, 295, 300, 305, 310, 315, 320, 325

Description

260.0–260.5': black, carbonaceous, stiff clay.
260.5–261.5': dark grey, carbonaceous, soft clay.
261.5–264.0': white–beige, soft, micaceous clay.
264.0–265.5': chocolate brown, soft, micaceous clay.

SILTY SAND: 265.5–269.0'
Beige–grey, micaceous silty–clay with 40% black woody fragments (0.5–1 cm in size), 20% very fine-grained sand, 10% white indurated clay fragments.
268.0': 10% lignite, 10% pyrite nodules.

CLAY: 269.0–273.0'
Chocolate brown, soft clay containing small woody fragments and 5% fine-grained sand.
269.5': small lignite seam.
270.5–271.0': small lignite seam, black, soft, woody texture.
271.0': increase in lignite fragments to 20%.

SAND: 273.0–275.0'
Very fine-grained, well sorted, and rounded sand; beige–chocolate brown, micaceous, with 5% detrital pyrite, 30% black woody lignite fragments.

CARBONACEOUS CLAY: 275.0–276.6'
Black, stiff, carbonaceous clay, lignite chips.

CLAY: 276.6–281.0'
Dark grey–black clay.
278.6': stiff clay with fine lignite fragments.
279.0': clay is medium grey.

SAND: 281.0–281.5'

CLAY: 281.5–284.0'

CARBONACEOUS CLAY: 284.0–286.0'
Black, carbonaceous clay.

CLAY: 286.0–290.5'
Dark brown–grey, stiff clay.

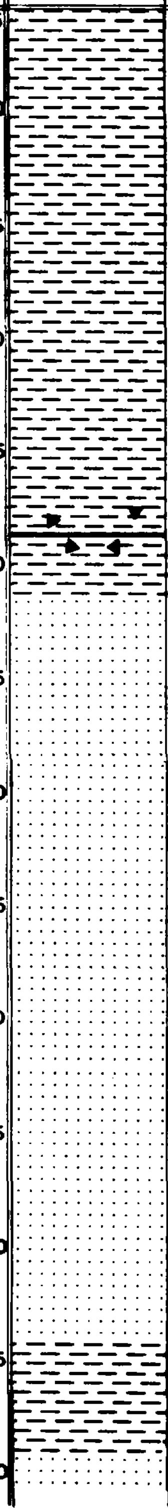
CARBONACEOUS CLAY: 290.5–303.0'
Black, stiff clay with 10% woody lignite fragments with one small seam (≈3 cm thick) occurring at approximately 291.3'.
293.0–303.0': increase in soft, brown, woody lignite to 40%; may occur in 2 cm thick bands.

LIGNITE: 303.0–303.6'
Black to brown, soft, woody lignite chips embedded in black carbonaceous clay.

CLAY: 303.6–347.0'
303.6–308.8': light brown to cream coloured, silty clay, 60% silt and clay, 40% very fine-grained micaceous sand.
308.8–312.5': light grey–brown, soft, silty clay, silt content decreases towards the bottom of the interval.
312.5–347.0': dark grey brown–black, stiff clay with up to 5% lignite in 0–25" seams, minor muscovite flakes, minor slickenslides (<2%). Contains abundant fine muscovite, light brown silty layers or mottles <1/16" thick.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-13

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
	325					
100				100		
101	330					
102	335					
103				100		
104	340					LIGNITE/SAND/CLAY: 347.0–349.0' Light brown–grey clay with abundant lignite fragments and seams up to 0.25" thick (50–75% lignite). 348.0': lignite seam (4" thick).
105	345					
106				90		CLAY: 349.0–351.0' Light grey, moderately stiff, silty clay. 349.3–349.8': dark grey–brown clay bed with minor lignite fragments.
107	350					
108	355					NO CORE RECOVERY: 351.0–358.0' Suspected sand.
109				30		
110	360					SILICA SAND: 358.0–360.0' Very fine-grained, sandy silt with minor grey clay beds up to 2" thick.
111	365					CLAY: 360.0–365.0' Light grey–white, silty clay, stiff with slickenslides; less silt after 361.0'.
112				40		
113	370					SAND: 365.0–370.6' Sandy interval implied by poor recovery.
114	375					
115						
116	380					
117						
118	385					
119	390					

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-13

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
119	390					
120						END OF HOLE: 396.0'
	395					HOLE PLASTIC CASED TO 396.0'
121						
122	400					
23						
	405					
124						
125	410					
126						
	415					
127						
128	420					
129						
	425					
130						
131	430					
132						
	435					
133						
134	440					
135						
	445					
136						
137	450					
138						
	455					
139						

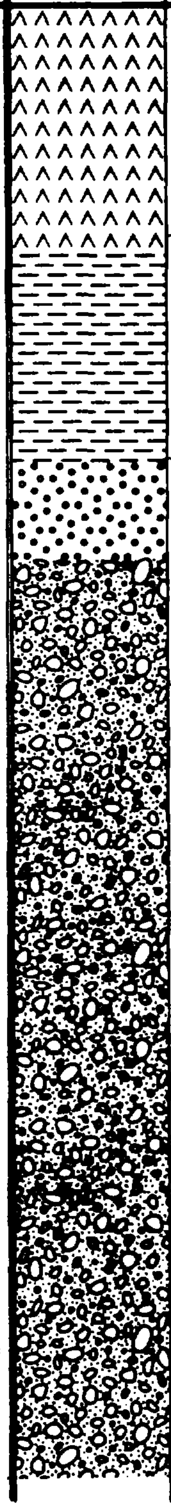
ONEXCO MINERALS LTD.

1983 WINTER DRILL PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-14 Location: West Gentles Township (lat. 50°31'28" long. 82°03'10")

Elev. of collar: ≈282 ft Total depth: 235 ft Sheet 1 of 4

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: Recovery	Sampling: Interval	Sampling: % core	Sampling: Number	Description
0–3	0–11		NS				MUSKEG: 0–11.0'
3–5	11–16		CS				MARINE CLAY: 11.0–16.0' Light green, pebbly, sandy, soft, calcareous with shell fragments; pebbles consist of black siltstone, tan limestone, and chert.
5–6	16–20						CLAY: 16.0–20.0' Light grey, soft, calcareous clay with minor (25%) sand and pebbles.
6–7	20–24		CS				GRAVEL: 20.0–24.0' Rounded polymictic pebbles (40%), sand (40%), and calcareous clay (20%) as above. RECENT / PLEISTOCENE
7–20	24–65		CS, CS, CS, CS				CLAY TILL: 24.0–153.0' Grey, soft to moderately stiff, calcareous clay with approximately 10% sand and pebbles; mainly tan limestone, minor black siltstone, chert; subrounded to subangular clasts up to 1/8". 33.0–39.0': limestone boulders. 62.0': limestone boulder.



Depth scale: m 1–20; ft 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº : ONEX-W83-14

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
20–40	65–130		CS, CS, CS, CS, CS, CS, CS			

Depth scale: m 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40; ft 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130

66.0–73.0': clay has become very sandy, soft; pebble and sand content increase to 50%.

75.5': limestone boulder.

77.0': limestone boulder.

80.0': limestone cobble.

94.0': limestone boulder.

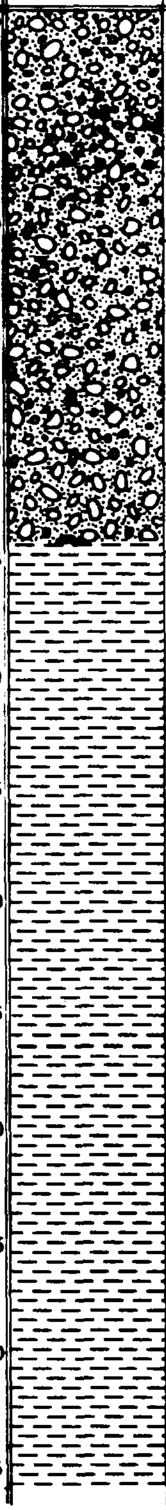
95.0–120.0': increase to 50–60% pebbles, cobbles, sand; mainly black siltstone, limestone, minor jasper, granite, chert.

110.0–111.0': minor lignite and woody fragments.

113.0–114.0': sandy gravel layer; approximately 50% sand–silt, 40% pebbles, 10% clay.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole No: ONEX-W83-14

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
40–60	130–195		CS CS CS CS CS CS CS			

Depth scale (m): 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60

Depth scale (ft): 130, 135, 140, 145, 150, 155, 160, 165, 170, 175, 180, 185, 190, 195

Description

143.0': clay becoming a darker grey; stiffer, still gritty, sandy, calcareous.

PLEISTOCENE
DEVONIAN

CLAY: 153.0–209.0'
Medium grey, moderately stiff to very stiff, mildly calcareous, non-gritty clay.

155.0': clay becomes weakly to non-calcareous.

183.0': clay becomes stiffer.

190.0': clay becomes softer.

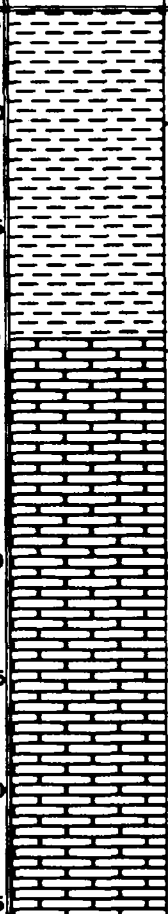
1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-14

DEPTH (m / ft)	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description

DEPTH m: 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80

DEPTH ft: 195, 200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260



Sampling: CS, CS, CS, CS, CS

207.0': clay becomes stiffer and darker grey in colour, with slickenslides.

LIMESTONE: 209.0–235.0'

Tan to dark brown, calcareous limestone containing black specks, low porosity.

216.0–218.0': white fossiliferous limestone.

218.0': dark brown, fine-grained, micritic limestone containing minor clasts and interbeds of white limestone, minor fossil fragments (<1%).

224.5': fossil fragments; bivalves(?).

228.0–229.0': minor fossil fragments cylindrical in shape, altered to sparry calcite (0.25" in size).

230.0': minor grey, calcareous clay nodules.

232.0': limestone becoming a lighter brown–tan colour, non-porous, with minor grey clay nodules; appears to be a very fine-grained calcarenite.

END OF HOLE: 235.0'

HOLE PLASTIC CASED TO 235.0'

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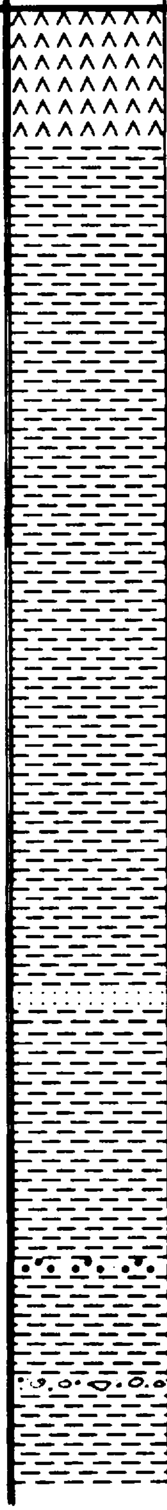
1983 WINTER DRILL PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-15 **Location:** East Gentles Township (**lat.** 50°34'02" **long.** 81°57'10")

Elev. of collar: ≈280 ft **Total depth:** 365 ft **Sheet** 1 **of** 6

DEPTH (m / ft)	GRAPHIC LOG	Sampling	Description
0–20 m / 0–65 ft		CS (sample intervals at approx. 10–20, 20–30, 30–40, 40–50, 50–60, 60–66 ft)	see below

MUSKEG: 0–6.0'

MARINE CLAY: 6.0–8.0'
Light grey, abundant black siltstone pebbles, shell fragments.

RECENT
PLEISTOCENE

CLAY: 8.0–56.0'
Dark grey, calcareous, soft to moderately stiff, locally gritty, appreciable white limestone and granitic pebble fragments (10%).

9.0': granitic boulder.

43.0': clay becomes grittier, sand fraction more prominent, abundant limestone and black siltstone pebbles.

55.0–56.0': gravel horizon, consisting modally of black siltstone (40%), limestone (20%), granitic and other (40%).

CLAY: 56.0–60.0'
Light grey, soft, calcareous, containing abundant pebbles including grey–black siltstone and limestone. Fine sand fraction up to 5%.

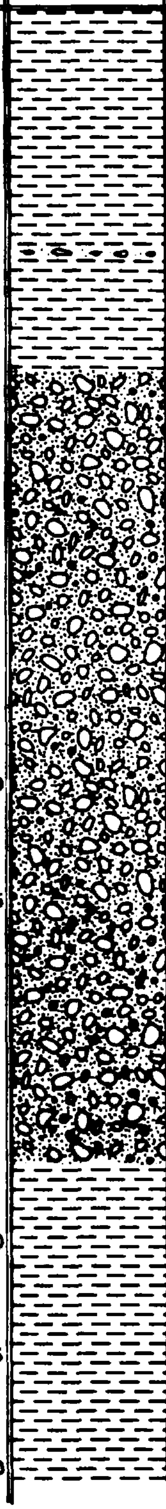
PEBBLE TILL: 60.0–61.0'
Light grey, soft calcareous clay matrix, containing abundant pebble clasts including black siltstone (50%) and limestone (≈20%).

CLAY: 61.0–81.0'
Light grey, soft calcareous, containing numerous thin till horizons and pebble pavements.

64.0': pebble till bed, 60% grey–black siltstone, 10% others.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-15

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
20–40	65–130		CS (×6)			

76.0': pebble till bed as above.

79.0': limestone boulder.

80.0': sandy till horizon, largely fine- to medium-grained quartz sand (≈80%), black siltstone and other pebbles (≈20%).

PEBBLE TILL: 81.0–88.0'
Fine to medium sand matrix (≈20%) containing largely black siltstone and carbonate pebbles.

83.0': sand fraction in till substantially increased to approximately 60%, limestone and siltstone fragments abundant (≈40%).

CLAY TILL: 88.0–116.0'
Light grey, soft, calcareous clay matrix, with appreciable coarse sand fraction (10%), abundant siltstone, and limestone, pebbles locally.

95.0': limestone boulder.

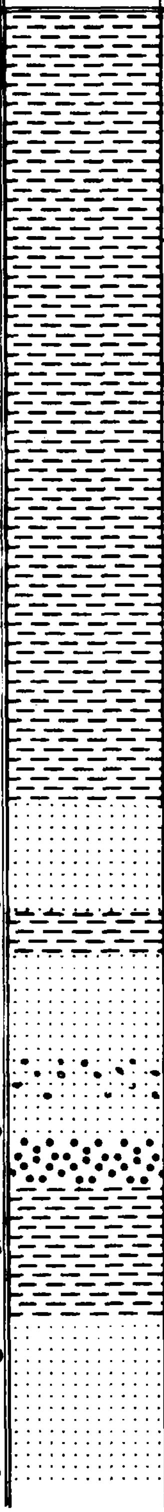
103.0–106.0': clay pebble till interval; increased abundance of black siltstone, limestone, and sedimentary clasts to approximately 50%.

CLAY: 116.0–165.0'
Medium to dark grey, moderately stiff, mildly to very calcareous, locally gritty.

120.0': dark grey, stiff clay horizon.

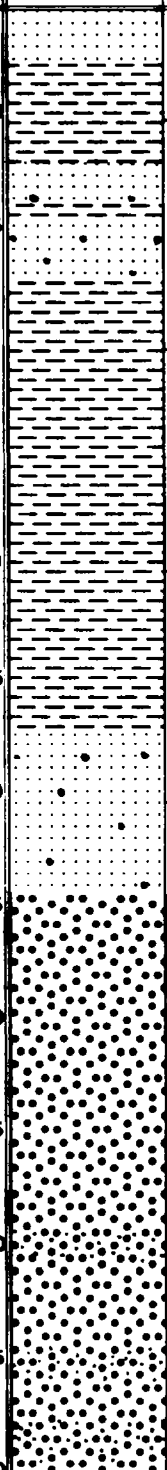
1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-15

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
40	130					
41	135		CS			
42						
43	140					140.0': clay becoming dark grey to black.
44	145		CS			143.0': clay has become moderately stiff, medium grey.
45						
46	150					
47	155		CS			155.0': clay has become light to medium green to grey, mildly to very calcareous.
48						
49	160					
50	165		CS			SAND: 165.0–170.0' Very fine-grained, salt and pepper sand, calcareous, approximately 70% quartz.
51						CLAY: 170.0–172.0' Medium to dark grey, moderately stiff, calcareous clay.
52	170					SAND: 172.0–180.0' Similar to 165.0–170.0'.
53	175		CS			175.0': becomes pebbly with rounded to subangular siltstone, quartz, chert, and limestone; minor lignite fragments.
54						GRAVEL: 180.0–182.0' Polymictic, consisting of siltstone, quartz, chert, and limestone (75%), and coarse sand granules (≈25%).
55	180					CLAY: 182.0–188.0' Medium grey, moderately stiff, calcareous clay, minor grit.
56	185		CS			
57						187.0': clay becomes non-gritty and stiffer.
58	190					SAND: 188.0–198.0' Very fine-grained with minor pebbles.
59	195		CS			194.0–195.0': <1% pebbles.
60						

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-15

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description
60–80	195–260		CS, CS, CS, CS, CS, CS			

196.0–197.0': approximately 10% pebbles.

197.0': <5% pebble content and sand.

CLAY: 198.0–202.5'
Grey, calcareous, soft clay, minor grit.

SAND: 202.5–204.0'
Fine-grained salt and pepper sand, approximately 90% quartz, calcareous, minor pebbles.

CLAY: 204.0–204.5'
As per 198.0–202.5'.

SAND: 204.5–207.0'
Polymictic, pebbly sand composed of (≈25%) pebbles and 75% sand.

CLAY: 207.0–227.0'
Grey, calcareous, soft clay, minor grit.

208.0': granite boulder.

213.0': clay has become stiffer.

214.5': granitic boulder.

PLEISTOCENE
CRETACEOUS

SAND: 227.0–234.0'
Fine-grained quartz sand (>90% quartz), minor pebbles and coarse sand; polymictic.

GRAVEL: 234.0–268.0'
Polymictic subrounded pebbles (up to .5") and coarse sand fraction, pebbles include limestone, siltstone, granite, jasper, and quartz.

237.0': sandy gravel horizon, sand (90%), pebbles (10%).

242.0': increase in pebbles to 25%.

249.0': 50% pebbles, 50% coarse sand.

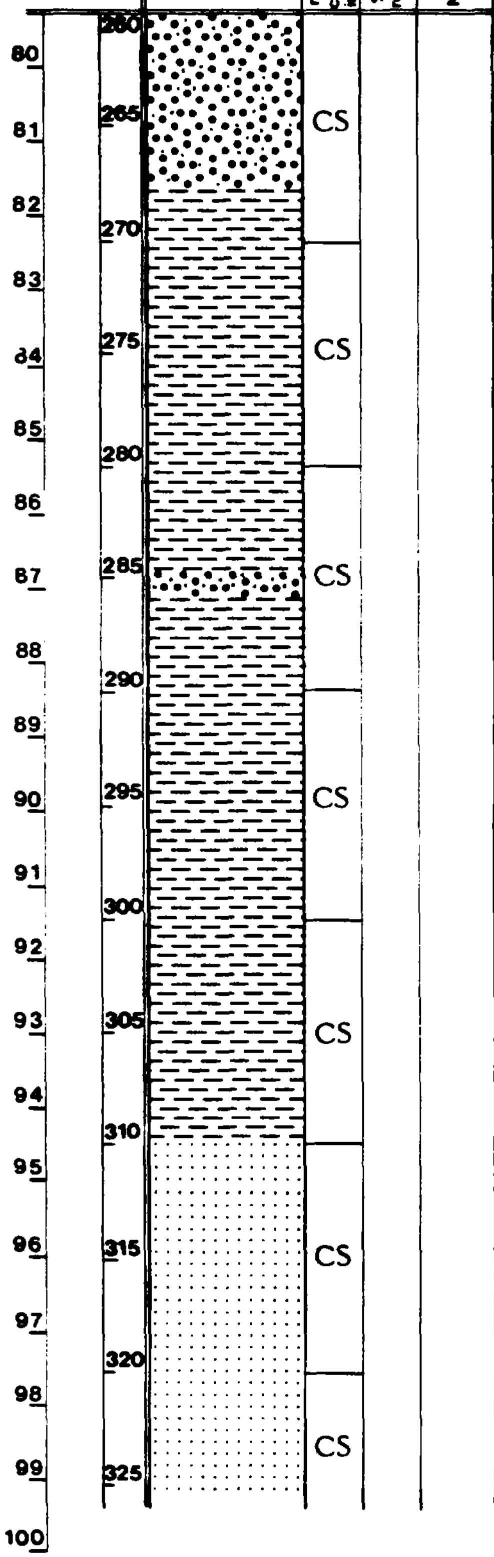
254.0': 90% sand, 10% pebbles.

258.0': 95% sand, 5% pebbles.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-15

DEPTH (m, ft)	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description



CLAY: 268.0–359.0'
Medium grey, soft, gritty, calcareous with minor sand-rich portions.

285.0': increase in pebbles and sand to 5%, pebbles include black siltstone, tan limestone.

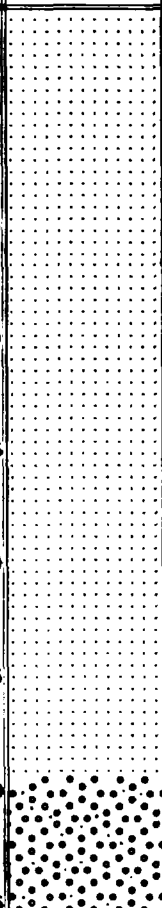
287.0': clay becomes stiffer, no sand.

297.0': clay becomes very soft.

SILT: 310.0–359.0'
Light grey, calcareous silt.

321.0': most of material is washed away.

Drill Hole Nº: ONEX-W83-15

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
	325					
100						
101	330					
102	335		CS			
103						
104	340					
105	345		CS			
106						
107	350					
108	355		CS			
109						
110	360					GRAVEL: 359.0–365.0' Polymictic subrounded pebbles consisting of tan limestone, black siltstone, granite, quartz, and minor lignite fragments, coarse sand component prominent (up to 25%), pebbles up to .25" in size.
111	365					END OF HOLE: 365.0'
112						HOLE PLASTIC CASED TO 280.0'
113	370					
114	375					
115						
116	380					
117	385					
118						
119	390					

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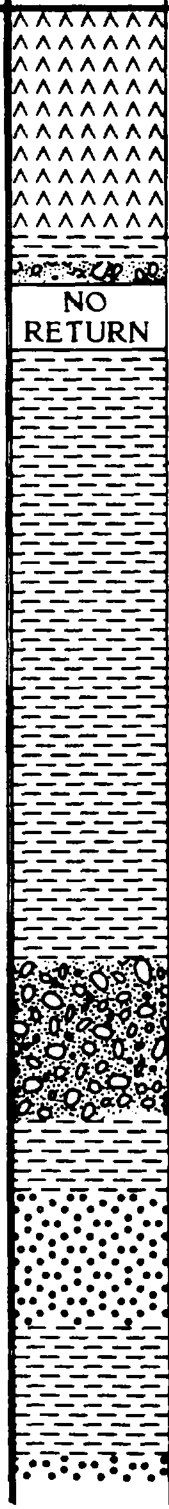
1983 WINTER DRILL PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-16 Location: East Gentles Township (lat. 50°33'89" long. 81°54'14")

Elev. of collar: ≃273 ft Total depth: 276 ft Sheet 1 of 5

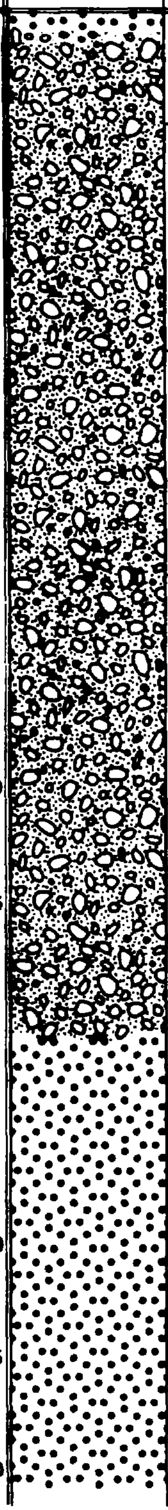
DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling	Description
0–3	0–10		NS	MUSKEG/PEAT: 0–10.0'
3	10			CLAY: 10.0–11.0' Green–grey clay; calcareous, soft.
			NS	PEBBLY TILL: 11.0–12.0' Polymictic; approximately 75% pebbles, 25% sand, subrounded to angular clasts ranging up to .25" in size.
4	15	NO RETURN		NO RETURN: 12.0–15.0'
5–12	15–42		CS, CS	CLAY: 15.0–42.0' Light green–grey calcareous clay; soft, non-gritty.
13–15	42–49		CS	TILL: 42.0–49.0' Sandy–pebbly–clay till; clay is soft, gritty, calcareous. Pebbles have a varied lithology and are dominantly angular (possibly includes cobbles).
15	49–52			CLAY: 49.0–52.0' Medium grey–green clay; very gritty, moderately stiff, calcareous as usual. Occasional pebbly interval.
16–17	52–58		CS	SAND/GRAVEL: 52.0–58.0' Polymictic clasts; sedimentary to basement occur in ratio of approximately 50/50; dominantly subrounded although all grades exist, generally moderate sphericity.
18–19	58–64			CLAY: 58.0–64.0' Medium grey–green, stiff, somewhat silty clay, minor grit; non-calcareous, often dark brown–black-coloured in places with carbonaceous material included.
20	64–66			SAND/GRAVEL: 64.0–66.0' Polymictic; both sedimentary and basement clasts in proportions of 50/50; dominantly rounded clasts.

RECENT

PLEISTOCENE

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-16

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
20–40	65–130		CS, CS, CS, CS, CS, CS			see below

CLAY TILL: 66.0–110.0'
Light grey–green sandy–pebbly–clayey till; contains predominantly sedimentary clasts, quite small (<.25") and generally quite angular. Clay fraction although very gritty tends to be soft. Polymictic sand and only a minor pebbly fraction.

By 85.0', pebble content has increased; dominantly angular clasts with poor sphericity.

90.0': conspicuous lignite clast included in clay till as above.

96.0': limestone cobble.

99.0': limestone boulder approximately 8" thick.

102.0–105.0': sand-rich interval in till, medium-grained polymictic sand with abundant clay; calcareous.

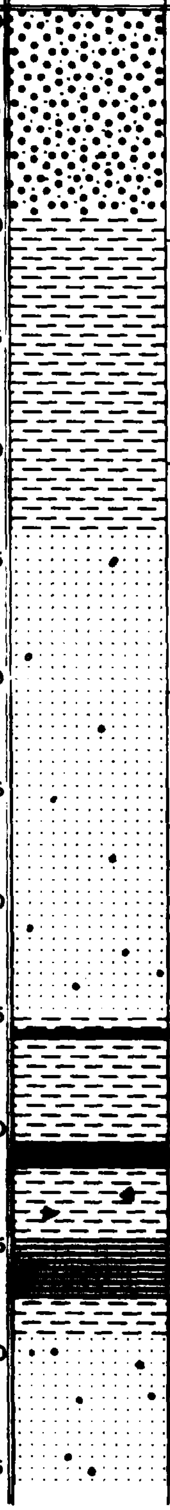
PLEISTOCENE

SAND: 110.0–139.0'   CRETACEOUS
Quartz-rich sand containing abundant lignite clasts and siltstone. Coarse becoming fine-grained by 115.0'. Interbeds of medium grey and white kaolinitic clay occur throughout. Poorly sorted angular clasts; submature sand.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-16

Sheet 3 of 5

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number
40–60	130–195		CS, CS, CS, CS, CS, CS		122, 123, 124

Depth scale, m: 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60

Depth scale, ft: 130, 135, 140, 145, 150, 155, 160, 165, 170, 175, 180, 185, 190, 195

Description

CLAY: 139.0–153.0'
Dark brown and grey clay; moderately soft to stiff, sandy, non-calcareous.

SAND: 153.0–174.0'
Very fine-grained silica sand containing minor white clay interbeds.

162.0–164.0': sand grains are now medium-grained.

173.0': minor pebbles predominantly quartz although other lithologies present.

CLAY: 174.0–184.0'
Dark brown sandy clay grading into a dark grey stiff, non-calcareous, non-gritty clay; contains minor lignite by 176.0'.

LIGNITE: 175.0–175.5'

LIGNITE: 180.0–181.0'
Lignite seam interbedded with approximately 20% dark grey stiff clay.

CARBONACEOUS CLAY: 184.0–187.0'
Black to dark grey carbonaceous clay; stiff, non-gritty.

CLAY: 187.0–188.5'
Dark grey slightly silty clay grading into a yellow–brown, soft clay.

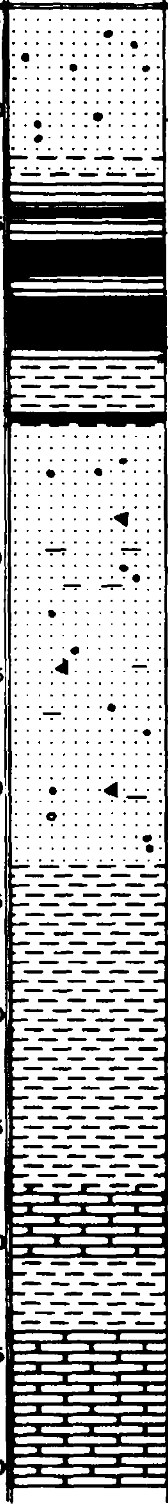
SILICA SAND: 188.5–201.5'
Very fine silty sand; well-rounded clasts, well-sorted. Trace lignite and occasional pyrite nodules. Becoming much coarser by 193.0'; also, includes white silty clay 20%, black silt pebble 10%, subangular to subrounded grains.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-16

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description

Depth scale: m 60–80; ft 195–260



Sampling: CS (125); CS; CS; CS (126); CS (127); CS; CS; CS

CLAY: 201.5–202.0'
White beige silty clay.

SAND: 202.0–202.5'
Very fine white silica.

CLAY: 202.5–205.5'
Dark grey to black, carbonaceous with 10% lignite fragments. Minor lignite seam (<.25') at 204.0'.

LIGNITE: 205.5–207.0'
Black soft woody with 70% black carbonaceous clay.

CARBONACEOUS CLAY: 207.0–208.0'
Black carbonaceous clay approximately 20% lignite.

LIGNITE: 208.0–210.0'
Lignite containing approximately 10% black carbonaceous clay. At 209.0' pyrite nodule 5%.

CARBONACEOUS CLAY: 210.0–211.0'

CLAY: 211.0–213.0'
Dark grey stiff clay.

LIGNITE: 213.0–213.5'

SAND: 213.5–233.0'
Fine-grained silica sand, well-rounded and moderately sorted with 20% cream silty clay and abundant white shell fragments, and lignite chips. Becoming coarser with depth.

CRETACEOUS
DEVONIAN

CLAY: 233.0–247.0'
Dark blue-grey, light grey, white, and brown, silty clays; very stiff, non-calcareous to 243.5' then very calcareous.

246.0': pyrite nodules.

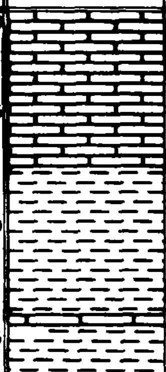
LIMESTONE: 247.0–250.0'
Buff coloured, poorly indurated limestone.

CLAY: 250.0–253.0'
As 233.0–247.0' except very calcareous.

LIMESTONE: 253.0–267.0'
Tan indurated limestone including approximately 10% brown silty clay; clay appears to be somewhat organic.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-16

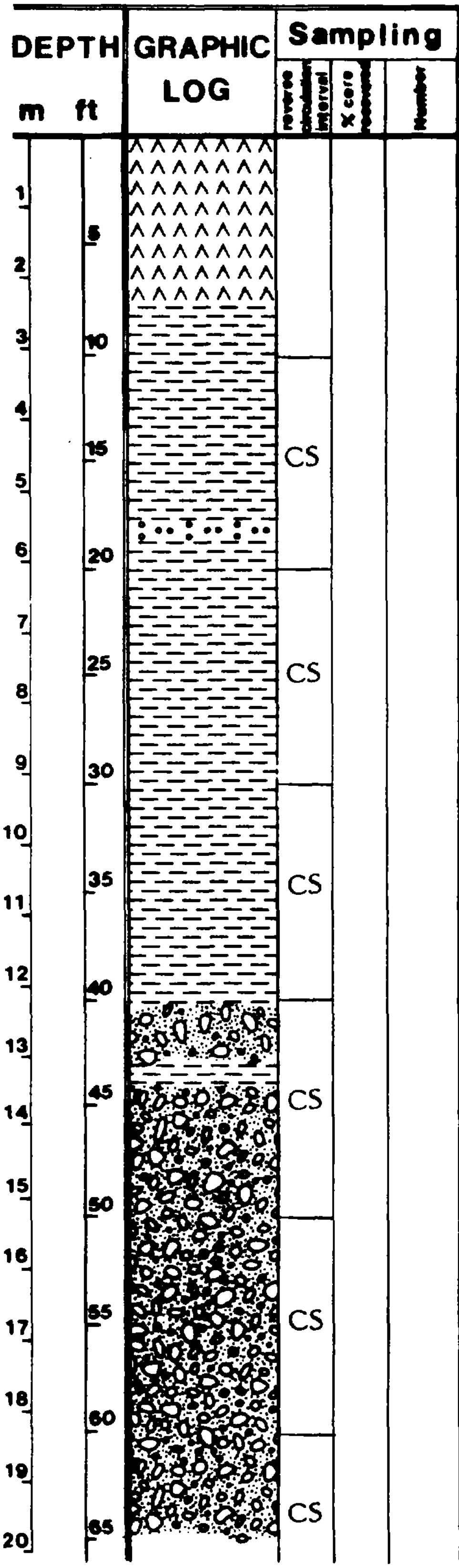
DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description
80–100	260–325					CLAY: 267.0–271.0' Light blue-grey, tan, chocolate brown, and light green clays; moderately stiff, calcareous. LIMESTONE: 273.5–274.0' Grey fine-grained, non-fossiliferous limestone. CLAY: 274.0–276.0' Grey, silty, brittle, non-calcareous claystone. END OF HOLE: 276.0' PLASTIC CASING : 275.0'

ONEXCO MINERALS LTD.

1983 WINTER DRILL PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-17 Location: East Gentles Township (lat. 50°34'25" long. 81°53'45")

Elev. of collar: ≈260 ft Total depth: 220 ft Sheet 1 of 4



Description

MUSKEG: 0–8.0'

CLAY: 8.0–18.0'
Light green to grey, calcareous soft clay with minor pebbles and sand. By 17.0', clay becoming stiffer.

GRAVEL: 18.0–19.0'
Polymictic, although predominantly angular tan limestone fragments, with minor sand component and shell fragments.

CLAY: 19.0–40.0'
Light green to grey, moderately stiff, calcareous, contains minor grit.

31.0–31.5': seam of stiff, calcareous green–brown clay, mottled.

37.0–40.0': clay becomes mud brown in colour, less stiff, calcareous and non-gritty.

RECENT
PLEISTOCENE

CLAY PEBBLE TILL: 40.0–43.0'
Light to medium grey, extremely pebbly and gravelly (≈75% pebbles, 25% clay). Pebbles include black siltstone, limestone, granite, quartz. Till matrix consists of soft calcareous clay.

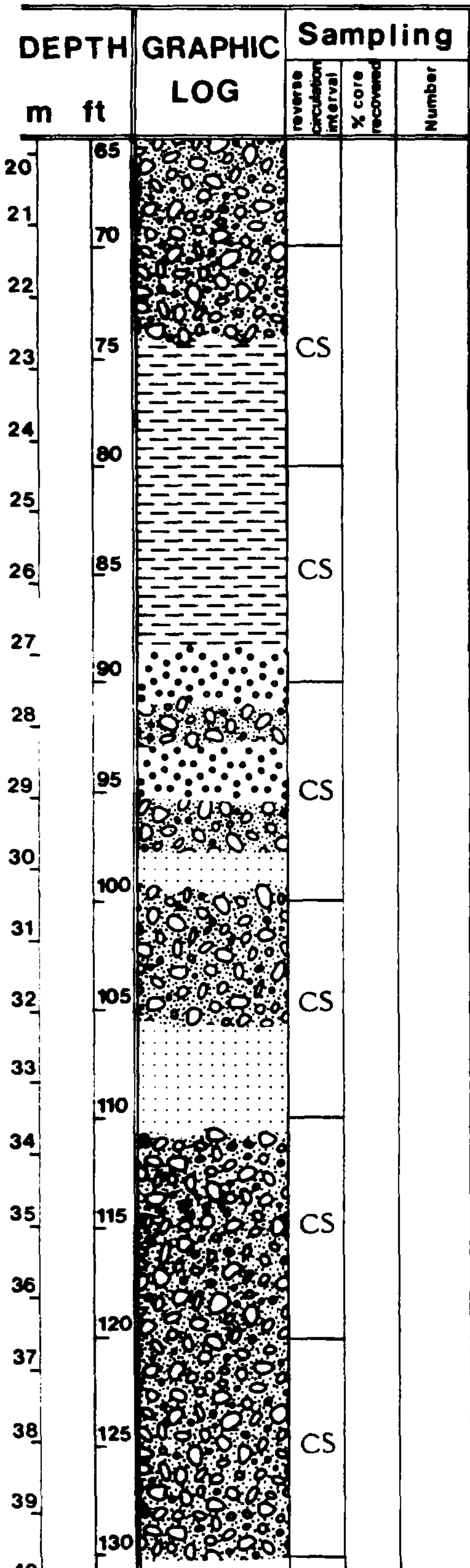
CLAY: 43.0–44.0'
Light grey, stiff, calcareous, minor grit, minor sand.

CLAY TILL: 44.0–74.5'
Grey, moderately stiff calcareous clay, minor grit with 5–10% pebbles and coarse sand, pebbles include limestone, siltstone, quartz, and chert.

49.0': clay has become very soft.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-17



Description

73.0': black siltstone boulder.

CLAY SEQUENCE: 74.5–88.0'

74.5–77.0': medium grey stiff, non-calcareous, and non-gritty.

77.0–81.0': chocolate brown, earthy coloured.

81.0–86.0': light grey, stiff, calcareous clay with minor sand and grit.

86.0–88.0': clay turns very soft, abundant silt in the clay.

GRAVEL: 88.0–91.0'

Polymictic subrounded pebbles and cobbles (up to .5") consisting of black siltstone (35%), white limestone (35%), greenstone (15%), granite (10%), quartz, chert, and others (≈5%).

88.0': fine-grained granitic gneiss boulder.

CLAY TILL: 91.0–93.0'

Light grey, soft calcareous clay with approximately 10–20% pebble and coarse sand clasts.

GRAVEL: 93.0–95.5'

As per 88.0–91.0'.

CLAY TILL: 95.5–170.0'

Light grey, soft calcareous clay with approximately 10–20% pebble and coarse sand clasts. Silt–sand horizons are prominent locally.

97.5–99.0: very fine-grained sand–silt, with minor clay and pebbles.

104.0': minor lignite fragments.

106.0–110.0': abundant fine-grained sand–silt in till matrix.

110.0–116.0': abundance of clasts increases to 25–30%.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-17

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description

Depth scale (m): 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60

Depth scale (ft): 130, 135, 140, 145, 150, 155, 160, 165, 170, 175, 180, 185, 190, 195

Sampling: CS, CS, CS, CS, CS, CS, CS, CS

137.0': clast abundance decreases to <10%.

145.0–158.0': high silt content contained in the till matrix.

147.0': pebble/sand clast abundance increases to 10–20%.

151.0–152.0': greenstone boulder.

152.0': clast abundance decreases to <10%.

By 161.0', silt content increases in matrix.

SANDY TILL: 170.0–174.5'
Fine- to medium-grained calcareous sand matrix, with minor polymictic pebbles, minor clay component to the matrix.

172.0': granite boulder.

SILICA SANDS: 174.5–181.0'
Medium- to coarse-grained silica sands.

PLEISTOCENE
CRETACEOUS

175.5–179.0': coarse-grained to pebbly quartz, minor siltstone.

179.0–181.0': medium- to coarse-grained, abundant lignite fragments, minor pebbles.

CLAY SEQUENCE: 181.0–187.5'
181.0–182.0': grey, non-calcareous, soft clay.
182.0–182.5': medium grey, very stiff, non-calcareous, and non-gritty.
182.5–184.0': dark grey–brown, soft clay with abundant sand grains.
184.0–184.5': coarse to pebbly quartz sand horizon.
184.5–187.5': light grey, stiff clay.

CRETACEOUS
DEVONIAN

DOLOSTONE: 187.5–188.5'
Dark grey, fine-grained dolostone, with minor interbeds of tan dolostone of up to .25" thick.

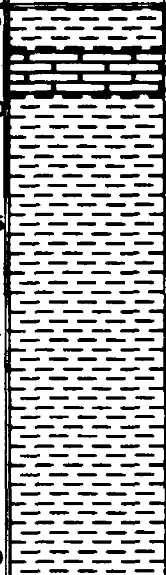
CLAYS: 188.5–197.0'
Medium grey, soft, calcareous clay, non-gritty. By 193.0', clay becomes slightly gritty and sandy.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-17

DEPTH (m, ft) | GRAPHIC LOG | Sampling (reverse circulation interval, % core recovered, Number) | Description

Depth scale: m 60–80; ft 195–260



Sampling: CS (approx. 200.5–208.5 ft); CS (approx. 208.5–220.0 ft)

LIMESTONE: 197.0–199.0'
Light grey to brown, calcarenite, calcareous, porous.

CLAY: 199.0–220.0'
Light green to grey, moderately stiff clay, calcareous.

END OF HOLE: 220.0'

NO PLASTIC CASING

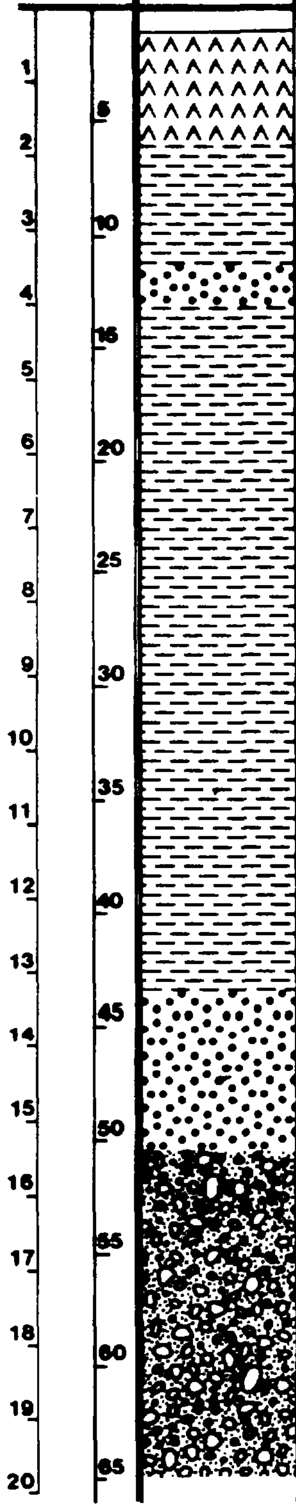
ONEXCO MINERALS LTD.

1983 WINTER DRILL PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-18 **Location:** East Gentles Township (**lat.** 50°34'31" **long.** 81°52'36")

Elev. of collar: ≈255 ft **Total depth:** 155 ft **Sheet** 1 **of** 3

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling	Description



Sampling: CS, CS, CS, CS, CS, CS, CS, CS

NO RETURN: 0–1.0'
MUSKEG/PEAT: 1.0–6.0'

MARINE CLAY: 6.0–11.0'
Light blue to green, soft, minor limestone chips, possible fossils.

SAND/GRAVEL: 11.0–13.0'
Polymictic, subangular clasts of Paleozoic sediments and basement clasts.

CLAY: 13.0–43.0'
Light blue to green, quite stiff and gritty, very slightly calcareous, minor sedimentary clasts. By 15.0', clasts no longer included.

25.0': clay medium to dark brown, moderately stiff.

39.0': medium to light brown, very calcareous, soft and non-gritty.

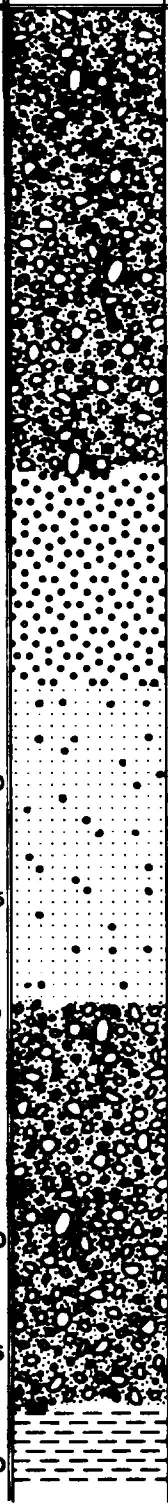
SAND/GRAVEL: 43.0–50.0'
Polymictic, including both Paleozoic sediments and Precambrian basement clasts, predominantly pebble-sized and rounded.

RECENT
PLEISTOCENE

SAND/CLAY TILL: 50.0–86.0'
Light grey to green, very soft, gritty matrix, pebble-sized clasts are predominantly sediments (<1 cm in size), calcareous as usual.
50.5': limestone boulder approximately 8" thick.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

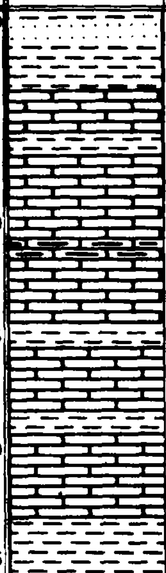
Drill Hole Nº: ONEX-W83-18

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
20–21	65–70					70.0–74.0': till becoming more clay rich, with decreased pebble content.
22–23	75		CS			By 75.0', greater abundance of basement pebble clasts.
26–28	85–90		CS			GRAVEL: 86.0–95.0' Polymictic, angular clasts, predominantly pebble-sized clasts of limestone, black siltstone and chert, and abundant basement clasts, pebbles appear to be more rounded at depth. Sand fraction is polymictic and angular.
29–30	95–100		CS			SAND: 95.0–109.0' Polymictic, medium- to coarse-grained, extremely calcareous containing minor pebbles, clastics predominantly angular with low to medium sphericity. 101.0': conspicuous chips of lignite in sand, very abundant at
32	105		CS			105.0' (≈15%).
33–34	110					SAND TILL: 109.0–127.0' Light to medium grey, sandy, clay-rich, extremely calcareous, pebbles and sand are of mixed lithology and angular in shape.
35	115		CS			
36–37	120					By 120.0', abundant quartz pebbles in till.
38	125		CS			PLEISTOCENE / DEVONIAN
39–40	130					CLAY: 127.0–130.5' Light green to grey, moderately stiff, vigorously calcareous, non-gritty. By 128.0', clay becomes non-calcareous.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-18

Sheet 3 of 3

DEPTH (m / ft)	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description
40 m / 130 ft – 60 m / 195 ft					see below

SANDSTONE: 130.5–131.5'
Light to medium brown, non- or very slightly calcareous.

CLAY: 131.5–133.5'
131.5–131.7': light green.
131.7–132.5': dark brown, gritty clay.
132.5–133.5': light green to grey, stiff, calcareous, and gritty.

LIMESTONE: 133.5–135.5'
Tan to light grey micritic limestone, minor interbedded(?) light green–grey, stiff, calcareous clay.

CLAY: 135.5–136.5'
Light green to grey, stiff, calcareous clay, slight grit.

LIMESTONE: 136.5–140.0'
Tan to light grey, micritic limestone, minor soft, grey calcareous clay.

LIMESTONE/CLAY: 140.0–140.5'
Light to medium grey, calcareous grit and gritty clay.

LIMESTONE: 140.5–144.0'
Tan, fragmented micritic limestone, minor light green to grey calcareous clay.

CLAY: 144.0–145.0'
Light green to grey, moderately stiff, calcareous, non-gritty.

LIMESTONE: 145.0–148.0'
Tan limestone as above.

CLAY: 148.0–148.5'
Grey, soft, calcareous.

LIMESTONE: 148.5–152.5'
Tan micritic limestone, thin grey, calcareous clay interbeds.

CLAY: 152.5–155.0'
Medium green to grey, relatively stiff, slightly calcareous.

END OF HOLE: 155.0'

NO PLASTIC CASING

ONEXCO MINERALS LTD.

1983 WINTER DRILL PROGRAM – JAMES BAY LOWLANDS

Drill Hole №: ONEX-W83-19 **Location:** East Gentles Township (lat. 50°33'06" long. 81°52'25")

Elev. of collar: ≈260 ft **Total depth:** 140 ft **Sheet** 1 **of** 3

DEPTH (m, ft) | GRAPHIC LOG | Sampling (% core, Number [illegible sub-headings]) | Description

Sampling: CS, CS, CS, CS, CS, CS

MUSKEG: 0–2.0'

CLAY: 2.0–5.0'
2.0–4.0': grey, soft, slightly calcareous.
4.0–5.0': medium brown, soft, calcareous.

RECENT
PLEISTOCENE

PEBBLE SAND TILL: 5.0–6.0'
Brown calcareous clay matrix, pebbles and sand (≈70%), limestone pebble fragments abundant (20%).

CLAY: 6.0–77.0'
Light grey, very calcareous, limestone pebble fragments (<10%), gritty, soft to very stiff.

33.0': clay becomes gritty.

41.0': clay becomes stiffer.
42.0': clay becomes less stiff.

48.0': limestone boulder.

51.0': extremely stiff clay.

53.0': gritty clay, clay is softer.

60.0': clay is very stiff, medium grey in colour.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-19

DEPTH (m, ft)	GRAPHIC LOG	Sampling (reverse circulation interval, % core recovered, Number)	Description

m: 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

ft: 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130

Sampling: CS, CS, CS, CS, CS, CS

SAND TILL: 77.0–103.0'
Fine- to medium-grained sand matrix, containing polymictic pebble clasts, subrounded to subangular in shape, including quartz, black siltstone, limestone, and granite.

84.0–86.0': gravel seam, consisting largely of rounded pebbles and cobbles of limestone, black siltstone, and quartz; minor coarse sand fraction.

86.0': sand pebble till; 50% fine to medium sand, 50% coarse sand and pebbles.

90.0': largely sand 70%, 30% pebble fragments.

97.0–100.0': sandy interval >90% fine- to medium-grained sand.

CLAY: 103.0–106.0'
Grey to brown, calcareous, soft to slightly stiff.

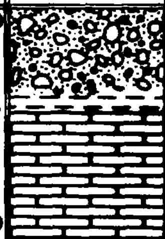
CLAY TILL: 106.0–115.0'
Grey to brown, soft to moderately stiff, calcareous clay matrix, minor to appreciable sand fraction (up to 20%), polymictic pebble suite as clasts including limestone, siltstone, quartz, and granite.

SAND–GRAVEL TILL: 115.0–134.5'
Fine- to medium-grained sandy matrix (60%) containing polymictic pebble clasts (40%). Similar to above units.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole No: ONEX-W83-19

Sheet 3 of 3

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
40–43	130–140		CS			131.0': limestone boulder. 133.0': proportionately 50% pebbles and 50% sand. 134.0': white silty clay. PLEISTOCENE LIMESTONE: 134.5–140.0' DEVONIAN Tan to white, well-indurated, massive limestone. 136.0': limestone is dark brown, gritty, calcarenite. 138.0': tan coloured limestone.
						END OF HOLE: 140.0'
						NO PLASTIC CASING

Depth scale: m 40–60; ft 130–195

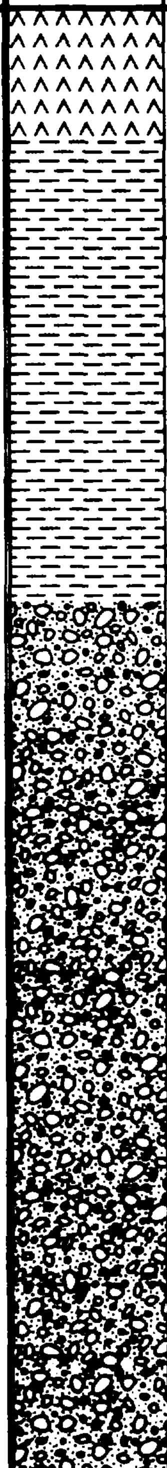
ONEXCO MINERALS LTD.

1983 WINTER DRILL PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-20 **Location:** East Gentles Township (**lat.** 50°35'09" **long.** 81°55'48")

Elev. of collar: ≈260 ft **Total depth:** 398 ft **Sheet** 1 **of** 7

DEPTH (m / ft)	GRAPHIC LOG	Sampling	Description



MUSKEG AND ICE: 0–6.0'

MARINE CLAY: 6.0–26.0'
Light green to grey, soft to moderately stiff, calcareous, gritty, minor sand and pebbles, minor shell fragments.

RECENT
PLEISTOCENE

CLAY TILL: 26.0–73.0'
Light grey, moderately stiff, gritty, calcareous matrix, sand and pebbles constitute about 5% of unit, including limestone, siltstone, quartz, and granite.

35.5': small black siltstone boulder.

45.0': limestone boulder.
By 46.0', sand and pebble content has decreased to <5%.

56.0': very soft silty clay approximately 5–10% sand and pebbles.

60.0': clay has become a dirty white colour.

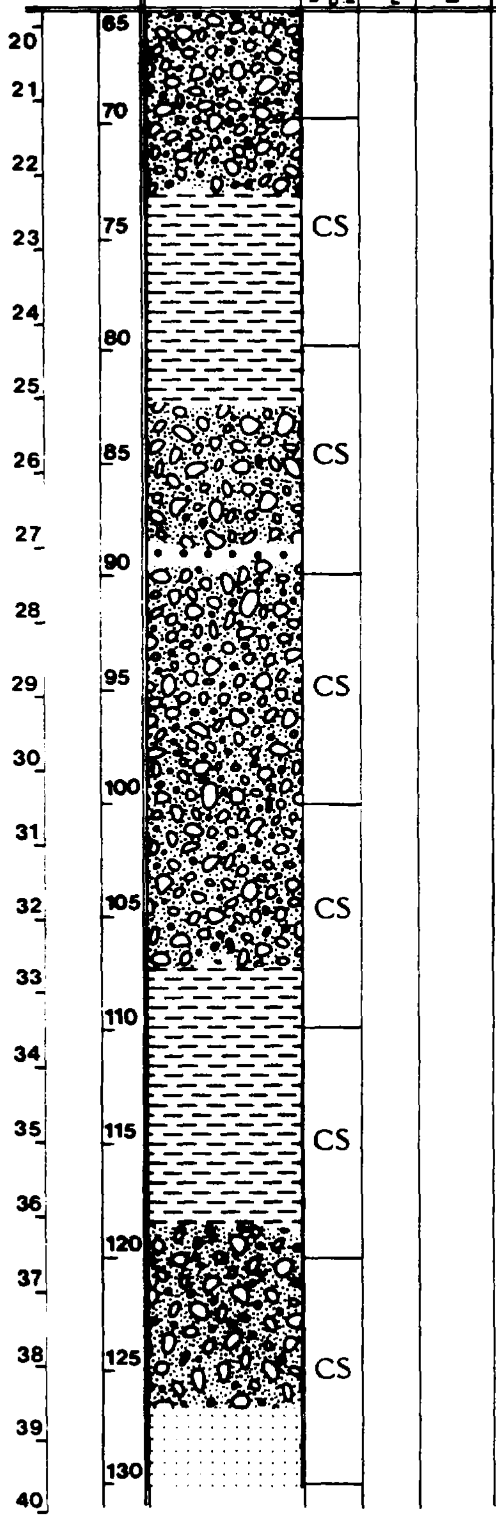
64.0': black siltstone boulder.

By 65.0', pebbles and clast content <5%.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-20

DEPTH m ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description



CLAY: 73.0–82.0'
Medium grey, moderately stiff, calcareous clay, minor grit.

By 76.0', clay has become very stiff and non-gritty.

CLAY TILL: 82.0–107.0'
Light to medium grey, moderately stiff clay matrix, containing approximately 5% pebble clasts and sand. Clasts are predominantly limestone and siltstone, and include minor granite, quartz, and volcanics.

88.0–89.0': gravel bed consisting of subrounded to subangular limestone and siltstone clasts; also granite, quartz, volcanics.

93.0': limestone cobble.

96.0': small boulder.
97.0': small granite boulder.

CLAY: 107.0–118.0'
Medium grey, stiff calcareous clay, minor grit.

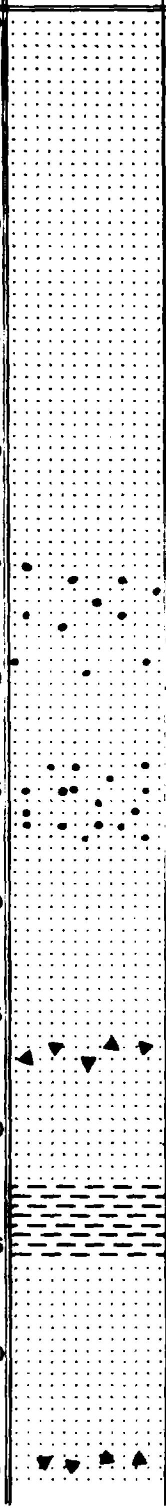
SANDY TILL: 118.0–126.0'
Very fine-grained, calcareous, salt and pepper sand matrix, minor pebble content which includes limestone, siltstone, quartz, and granite.

125.0–126.0': pebbly till horizon containing approximately 25% sand.

SAND: 126.0–213.5'
Very fine-grained sand and silt: calcareous, with >90% silica.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

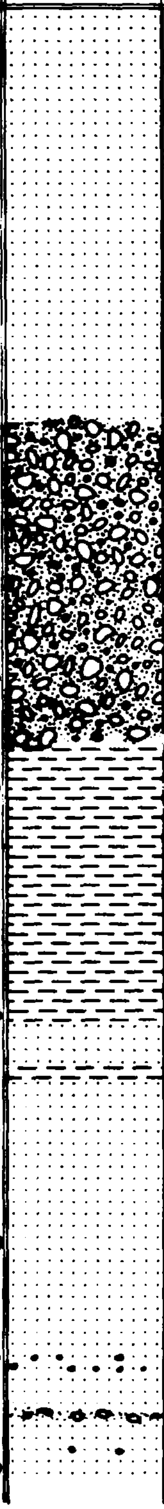
Drill Hole Nº: ONEX-W83-20

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
40–60	130–195		CS; CS; CS; CS; CS; CS; CS			155.0–160.0': minor polymictic pebbles. 163.0–166.0': medium- to coarse-grained sand, abundant pebbles. 176.0': minor lignite fragments. 182.0–185.0': minor clay seam, calcareous, minor pebbles. 186.0': minor stiff grey clay seam. 194.0': black lignite fragments.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-20

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description



Depth scale: m 60–80; ft 195–260. Sampling intervals: CS, CS, CS, CS, CS, CS.

CLAY TILL: 213.5–228.0'
Medium grey, soft, calcareous matrix, coarse sand and pebbles constitute approximately 5–10% of the unit; polymictic clasts.

By 220.0', pebble content decreases to <5%.

CLAY: 228.0–240.0'
Medium grey, moderately stiff, calcareous, and non-gritty.

SAND: 240.0–256.5'
Largely very fine-grained, white to grey sand–silt, calcareous, minor pebbles.

242.0–242.5': small clay seam.

247.0–250.0': sand becomes fine- to medium-grained with abundant polymictic pebbles, minor clay and lignite.

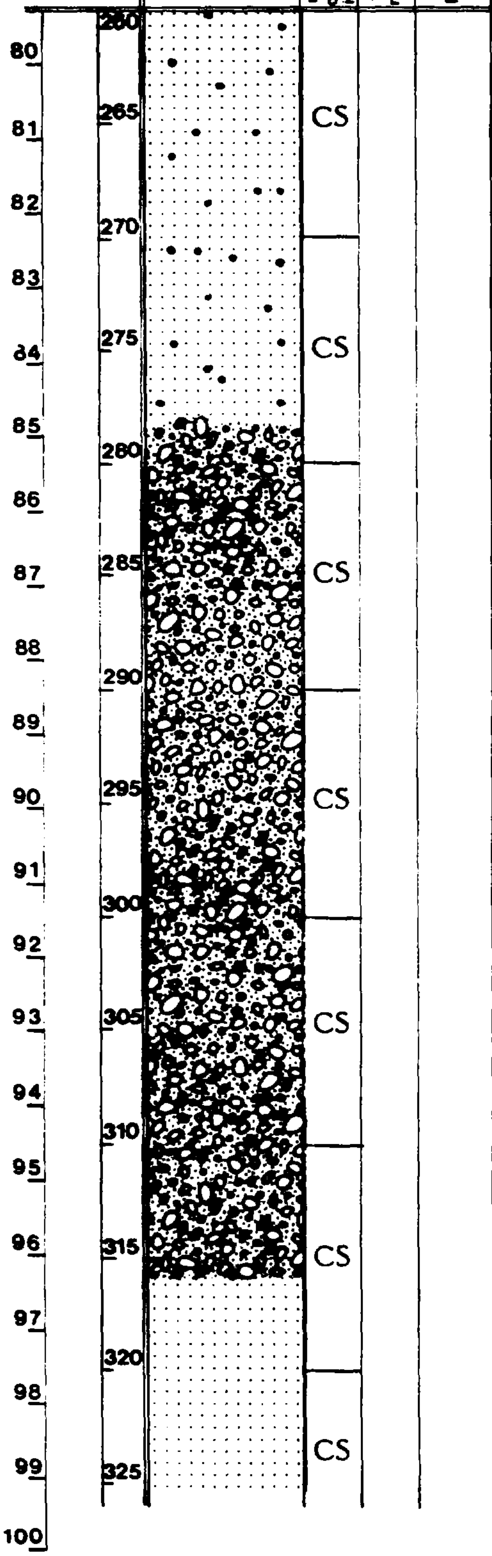
255.0': abundant polymictic pebbles and clay.

CLAY TILL: 256.5–257.0'
As per 213.5–228.0'.

PEBBLE SAND: 257.0–263.0'
Consists largely of fine- to coarse-grained calcareous sand and subangular to subrounded polymictic pebbles; pebbles constitute approximately 25% of unit and consist predominantly of limestone and siltstone. Unit is poorly sorted.

Drill Hole Nº: ONEX-W83-20

DEPTH (m, ft)	GRAPHIC LOG	Sampling (reverse circulation interval, % core recovered, Number)	Description



SAND: 263.0–278.0'
Very fine-grained sand–silt, calcareous, minor to appreciable pebbles.

266.0–267.0': abundant pebbles and clay.

276.0': boulder.

SAND/CLAY TILL: 278.0–286.0'
Calcareous, silty clay matrix, consisting of 60% very fine-grained sand and approximately 20% silt–clay, clasts constitute approximately 20% of unit and consist of subrounded pebbles of limestone, black siltstone, granite, and metavolcanics.

PEBBLE SAND TILL: 286.0–297.0'
Dominantly subrounded to subangular pebble clasts in a fine–medium sand matrix. Clasts include limestone, black siltstone, and granite. Minor lignite fragments also present (<1%).

285.0–290.0': limestone boulders.

SAND–CLAY TILL: 297.0–304.0'
Brown to grey calcareous soft clay matrix (20%) with fine- to medium-grained polymictic sand (60%). Pebbles constitute approximately 10% of till and include limestone, black siltstone, granitic fragments, and maroon sandstone.

304.0': limestone boulder.

PEBBLE SAND TILL: 304.0–316.0'
As per 286.0–297.0'.

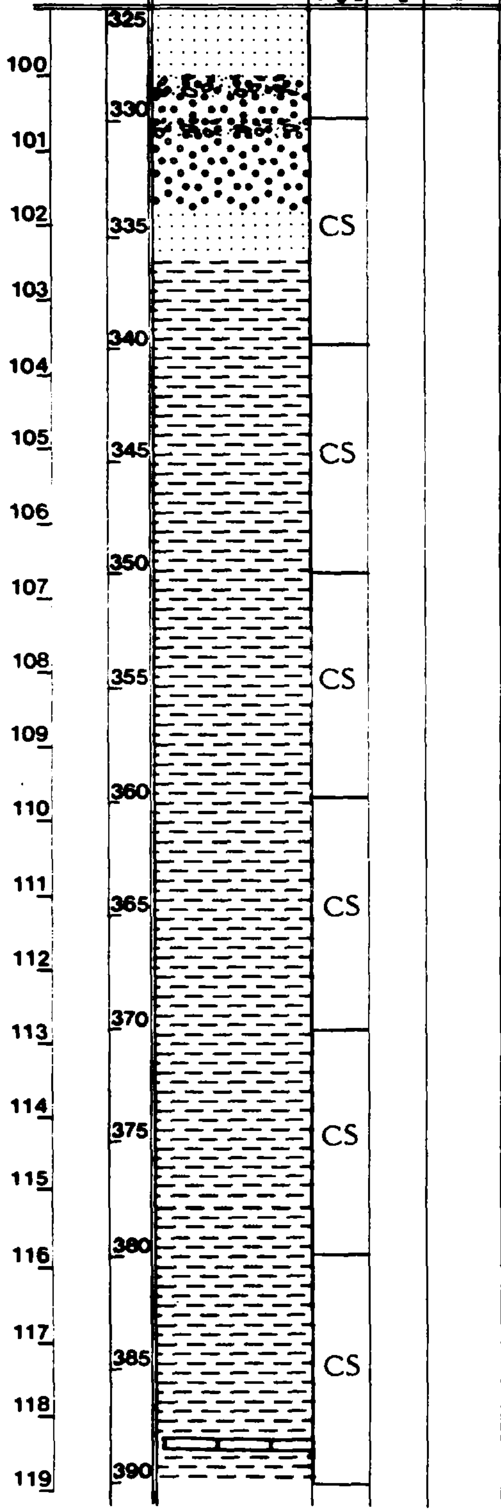
SILT–SAND: 316.0–328.0'
Fine sand and silt (60%) with polymictic pebbles (≈40%), minor lignite fragments.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-20

Sheet 6 of 7

DEPTH (m, ft)	GRAPHIC LOG	Sampling (reverse circulation interval, % core recovered, Number)	Description



CLAY TILL: 328.0–329.0'
Medium grey, moderately stiff calcareous clay, modal percentage of pebbles (5–10%), pebbles are predominantly white limestone.

SAND: 329.0–330.0'
Coarse-grained quartz sand with 10–20% polymictic pebbles.

CLAY TILL: 330.0–330.5'
As per 328.0–329.0'.

PLEISTOCENE
CRETACEOUS

GRAVEL: 330.5–334.0'
Subrounded to subangular polymictic pebbles up to .25", including quartz, limestone, siltstone, chert, granite, minor lignite.

SILT–CLAY: 334.0–335.0'
Medium grey, soft, non-calcareous, with 30% clay and 70% very fine-grained sand.

SAND: 335.0–336.0'
Fine sand, consisting of >80% quartz. Pebbles (20%) consisting of limestone, black siltstone, and granite.

CLAY: 336.0–342.0'
Chocolate brown, stiff, non-calcareous.

CLAY SEQUENCE: 342.0–388.0'
342.0–356.0': grey–brown silt with minor clay interbeds, locally rich in lignite fragments (.5–2 cm in size) up to 40%.

356.0–357.5': medium blue to grey, stiff, <5% silt.
357.5–358.0': dark grey, moderately stiff clay.
358.0–371.0': alternating beds of blue–grey clay and dark grey, moderately stiff clay.

371.0–376.0': medium grey, moderately stiff.

376.0–380.0': light grey, stiff, non-calcareous clay, interbedded with dark grey clay.

380.0–383.0': dark grey, moderately stiff.

383.0–388.0': interbedded horizons of light to dark grey and brown clay, soft to stiff, largely non-calcareous.

LIMESTONE: 388.0–389.0'
Light grey, calcareous, non-porous limestone.

CLAY: 389.0–396.5'
Light green to grey, soft, calcareous.

CRETACEOUS

389.5': becomes medium to dark grey, moderately stiff.
390.0': light grey, moderately stiff, calcareous, interbedded with thin units of medium to dark brown, calcareous clay.

DEVONIAN

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-20

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
119	390					LIMESTONE: 396.5–397.0' Light grey, calcareous, non-porous.
120	395					CLAY: 397.0–398.0' Alternating thin beds of dark grey and brown–light grey clay, clays are calcareous and moderately stiff.
121						
122	400					END OF HOLE: 398.0'
23						NO PLASTIC CASING

Depth scale (m): 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139

Depth scale (ft): 405, 410, 415, 420, 425, 430, 435, 440, 445, 450, 455

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1983 WINTER DRILL PROGRAM - JAMES BAY LOWLANDS

Drill Hole №: ONEX-W83-21 **Location:** East Gentles Township (**lat.** 50°32'07" **long.** 81°54'10")

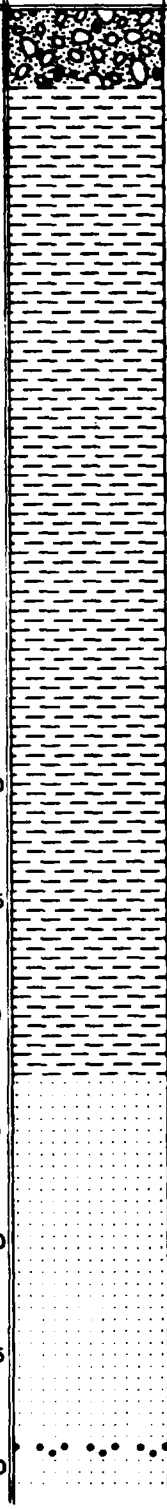
Elev. of collar: ≈285 ft **Total depth:** 205 ft **Sheet** 1 **of** 4

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling	Description
1, 2	5			MUSKEG AND ICE: 0–3.5' CLAY: 3.5–5.0' Dark brown, soft, calcareous, no grit. GRAVEL/SAND: 5.0–7.0' Polymictic, rounded pebbles, largely limestone and basement pebbles, minor clay binding.
3, 4	10, 15		CS	CLAY: 7.0–15.0' Medium to dark grey, soft to moderately stiff, calcareous and gritty, abundant limestone chips. RECENT PLEISTOCENE
5–13	20, 25, 30, 35, 40		CS, CS, CS	CLAY TILL: 15.0–44.0' Medium grey, relatively stiff, slightly gritty clay till, calcareous, minor limestone chips and basement pebbles (mafic metavolcanics and granitic gneiss), soft gritty clay horizons present locally.
14–19	45, 50, 55, 60		CS, CS	CLAY: 44.0–63.5' Medium grey, soft to moderately stiff, calcareous clay, non-gritty. 52.5–54.0': clay extremely muddy, very little material return.
20	65		CS	CLAY TILL: 63.5–68.5' Medium to dark grey, gritty, calcareous till, occasional pebbles and chips which are largely limestone (≈5%) and minor basement pebbles (1–2%).

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-21

Sheet 2 of 4

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description
20–40	65–130		CS, CS, CS, CS, CS, CS			see below

Depth scale (m): 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

Depth scale (ft): 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130

Description

CLAY: 68.5–112.0'

68.5–102.0': medium to dark grey, soft to moderately stiff, extremely calcareous clay, minor grit, occasional pebble chips.

102.0–112.0': medium to dark grey, moderately stiff, non-gritty, calcareous clay.

SAND: 112.0–128.0'

Fine- to medium-grained polymictic sand; pebbles comprise approximately 5% of interval, consisting of chert, quartz, black siltstone, jasper, and trace jasper; pebbles dominantly subrounded up to 3/8". Sand fraction predominantly quartz, light grey, and calcareous.

GRAVEL/COBBLES: 128.0–129.0'

Typical polymictic suite of limestone, black siltstone, chert, jasper, minor basement pebbles. Medium-grained sand fraction also present.

SAND: 129.0–132.0'

As per 112.0–128.0, fine sand approximately 60%, medium-grained approximately 35%, pebbles approximately 5%.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole No: ONEX-W83-21

Sheet 3 of 4

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description

Depth (m): 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60

Depth (ft): 130, 135, 140, 145, 150, 155, 160, 165, 170, 175, 180, 185, 190, 195

Sampling: CS, CS, CS, CS, CS, CS, CS

CLAY PEBBLE TILL: 132.0–136.0'
Green to grey, soft, and calcareous.

SAND: 136.0–153.0'
136.0–142.0': polymictic, fine- to medium-grained sand, pebbles constitute approximately 5% of the interval, sand is light grey and predominantly quartz.

142.0–153.0': polymictic, medium-grained sand, subrounded to subangular, few pebbles (1–2%).

144.0–144.5': gravel bed.

148.5–153.0': gravel bed.

PEBBLE SAND: 153.0–157.5'

CLAY TILL: 157.5–159.8'
Light grey–brown, soft, calcareous, slightly gritty, few pebbles.

SAND AND PEBBLES: 159.8–161.0'

CLAY TILL: 161.0–167.0'
Light grey to brown, calcareous, slightly gritty.

164.0–164.1': extremely stiff.

SAND: 167.0–169.5'
Polymictic, medium-grained, predominantly silica.

PLEISTOCENE
CRETACEOUS

CLAY: 169.5–169.6'
Dark brown, soft, vigorously calcareous, slight grit.

CLAY TILL: 169.6–172.0'
Light brown, soft, vigorously calcareous, moderate grit and rock fragments.

CLAY: 172.0–173.5'
Medium brown, stiff, calcareous, very slightly gritty.

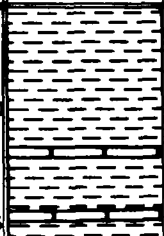
VARIEGATED CLAY SEQUENCE: 173.5–188.0'
Thinly layered sequence of various coloured clays including tan, red, rose, brown, and grey. The clays are generally non-gritty, stiff, and non-calcareous.

CRETACEOUS
DEVONIAN

CLAY SEQUENCE: 188.0–205.0'
Light grey-green and medium to dark brown, alternating clays: non-gritty, soft to stiff, becoming calcareous by 203.0'. Minor limestone interbeds included in sequence.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-21

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
60–63	195–205		CS			201.0–201.5': medium grey to green limestone. 204.0–204.1': medium grey–green limestone. 204.1–204.3': dark brown limestone. 204.3–205.0': rare orange mottles observed on dark brown clay. END OF HOLE: 205.0' NO PLASTIC CASING
63–80	205–260					

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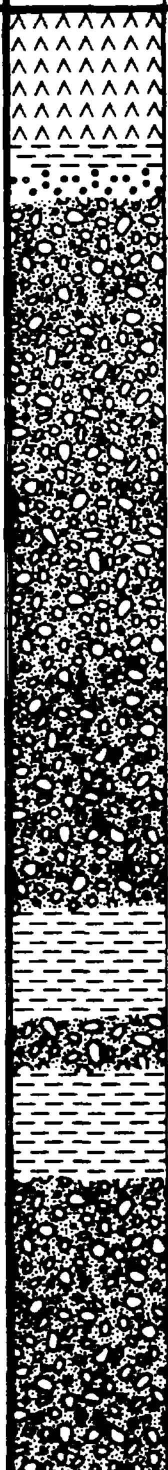
1983 WINTER DRILL PROGRAM – JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-22 Location: East Gentles Township (lat. 50°34'07" long. 81°55'55")

Elev. of collar: ≈277 ft Total depth: 321 ft

DEPTH (m, ft: 0–20 m, 0–65 ft) | GRAPHIC LOG | Sampling (CS intervals) | Description



MUSKEG AND ICE: 0–5.5'

MARINE CLAY: 5.5–7.0'
Light green, soft, calcareous, non-gritty, abundant limestone chips.
6.0–7.0': tan limestone boulder.

RECENT
PLEISTOCENE

PEBBLE GRAVEL: 7.0–8.0'
Polymictic, although dominantly angular carbonate fragments, low sphericity to clasts.

CLAY PEBBLE TILL: 8.0–23.0' (CS)
Light to medium grey, relatively soft to stiff, calcareous, moderate grit, abundant carbonate pebbles, appreciable sand fraction to matrix locally; other clasts include grey–black siltstone, rose quartz, and chert.

CLAY TILL: 23.0–33.0' (CS)
Light green to grey clay, moderately stiff, calcareous and gritty, some pebbles and fragments (≈1–2%) predominantly limestone and black siltstone.

CLAY PEBBLE TILL: 33.0–34.0'
Light grey clay, chert, limestone, and granite pebbles.

CLAY TILL: 34.0–39.5' (CS)
Medium grey, moderately stiff, calcareous, little grit, few rock fragments.

CLAY: 39.5–44.5'
Medium green–grey, extremely stiff, no grit, non-calcareous, becomes vigorously calcareous by 42.0'.

PEBBLE SAND TILL: 44.5–46.5' (CS)
Medium grey, pebbles are subrounded limestone, chert, black siltstone, and minor granite.
45.0': wood chips.

CLAY: 46.5–51.5'
Medium grey, non-calcareous, stiff, and non-gritty.

CLAY TILL: 51.5–66.0' (CS)
Medium green to grey, moderately stiff clay, calcareous and very gritty, grit portion is predominantly fine-grained polymictic sand, minor pebbles include chert, limestone, black siltstone, and pink quartz.

58.0': granite boulder.

62.5–63.0': tan limestone boulder.

64.0': gravel bed.
64.5': granite boulder. (CS)

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-22

Sheet 2 of 5

DEPTH (m / ft)	GRAPHIC LOG	Sampling (reverse circulation interval / % core recovered / Number)	Description

Depth (m): 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

Depth (ft): 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130

Sampling: CS, CS, CS, CS, CS, CS

CLAY PEBBLE TILL: 66.0–68.0'
Medium green to grey clay, calcareous, moderately stiff, gritty, pebbles include subangular limestone, chert, granite, and siltstone.

CLAY TILL: 68.0–82.0'
Similar to 51.5–66.0', occasional cobbles.

79.0': chert cobbles.

81.0': granite cobbles.

SAND AND GRAVEL: 82.0–82.5'

SANDY CLAY TILL: 82.5–101.5'
Medium grey, calcareous, moderately stiff, gritty matrix, fine-grained polymictic sand fraction, rock fragments.

94.7': diabase boulder.

96.5': boulder.

98.0': diabase boulder.

CLAY TILL: 101.5–103.0'
Light green to grey, soft, sticky clay matrix, calcareous, minor grit, few cobbles or boulders of limestone.

SAND PEBBLE TILL: 103.0–126.0'
Light brown, soft, calcareous, gritty clay matrix, moderate sandy fraction consisting of polymictic sand; rounded to subangular boulder material consisting of limestone, chert, diabase, and trace jasper.

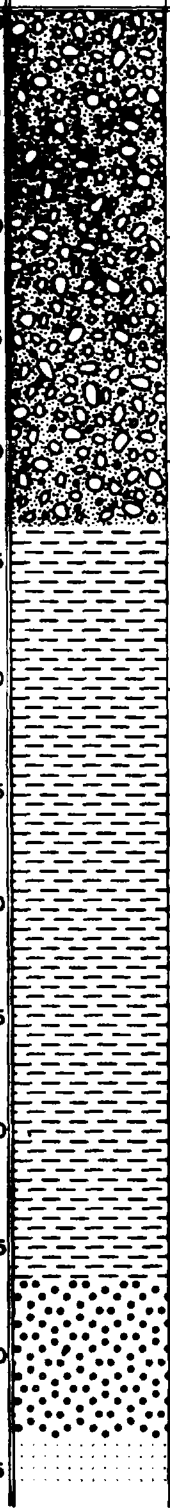
124.0': lignite chips.

PEBBLE SAND: 126.0–128.0'
Medium to coarse sand and pebbles, rock fragments.

SAND PEBBLE TILL: 128.0–129.5'

CLAY TILL: 129.5–131.0'

Drill Hole Nº: ONEX-W83-22

DEPTH m	ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number
40–60	130–195		CS, CS, CS, CS, CS, CS, CS		

Depth scale (m): 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60

Depth scale (ft): 130, 135, 140, 145, 150, 155, 160, 165, 170, 175, 180, 185, 190, 195

Description

PEBBLE TILL: 131.0–133.0'
Medium green to grey, moderately stiff and calcareous, extremely gritty with pebbles. At 131.5', diabase and limestone boulders.

CLAY TILL: 133.0–153.0'
133.0–141.0': medium green to grey clay, soft, calcareous, containing minor grit, some pebbles.

137.0–139.0': increased sand content.

141.0–153.0': light brown to grey, extremely soft, some grit, vigorously calcareous, occasional pebbles.

147.5': granite boulder.

By 152.0', increase in fine sand in matrix.

SILT/CLAY: 153.0–186.0'
Very little material return, clay is extremely soft, minor angular rock fragments.

175.0': thin layer of medium grey stiff clay.

PLEISTOCENE
CRETACEOUS

SAND AND GRAVEL: 186.0–193.1'
Largely pure medium-grained quartz sands with subrounded to subangular pebbles of quartz; pebbles possess moderate sphericity; minor lignite chips.

193.0': light grey clay seam.

SAND: 193.1–196.0'
Fine-grained.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-22

DEPTH (m): 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

DEPTH (ft): 195 200 205 210 215 220 225 230 235 240 245 250 255 260

GRAPHIC LOG

Sampling — reverse circulation interval; % core recovered: 33, 100, 100, 100, 87, 84, 30; Number: 511

Description

QUARTZ SAND: 196.0–197.0'
Medium-grained, essentially pure, angular to subrounded quartz sand, moderate amounts of detrital lignite.
196.5–197.0': interval of coarse quartz sand and pebbles.

CLAY: 197.0–208.5'
Largely light to dark grey, stiff, non-gritty, calcareous clay.
197.5': seam of medium brown, stiff clay.

CARBONACEOUS CLAY: 208.5–209.5'
Black, relatively stiff.

CARBONACEOUS CLAY/LIGNITE: 209.5–210.0'
Black, stiff, carbonaceous clay containing abundant lignite pieces (≃35–40%).

LIGNITE: 210.0–212.0'
Black, very soft.

CLAY: 212.0–217.0'
212.0–213.6': chocolate brown, gel-like ooze, micaceous, non-calcareous.
213.6–217.0': chocolate brown, extremely stiff, non-gritty, non-calcareous, micaceous, lignite chunks present locally at 214.4', 215.0', and 216.8–217.0'.

LIGNITE: 217.0–217.3'
Black–dark brown compact lignite.

CARBONACEOUS CLAY: 217.3–217.6'
Black, very stiff, non-gritty, contains appreciable lignite chunks.

CLAY: 217.6–224.7'
Dark brown, extremely stiff, no grit, non-calcareous, minor small chips of brown wood, and traces of mica and pyrite.

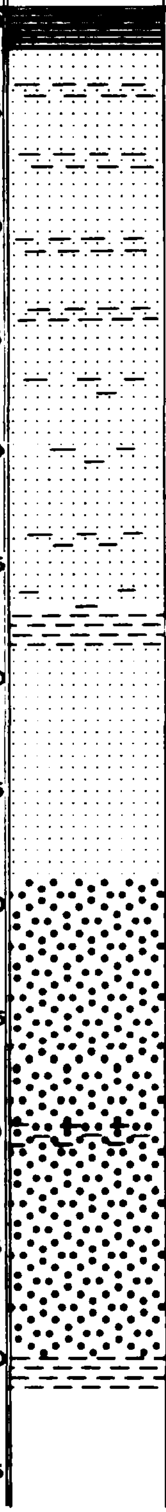
CARBONACEOUS CLAY: 224.7–225.8'
Black, stiff, non-gritty and non-calcareous, some lignite chips.

LIGNITE: 225.8–231.6'
Black to dark orange–brown, compact.

CLAY SEQUENCE: 231.6–252.0'
231.6–234.6': light brown, moderately stiff, non-calcareous, micaceous, gradually becoming darker coloured.
234.6–238.8': dark grey, stiff clay, with lignite chips, non-gritty.
238.8–248.2': medium grey to green, stiff, non-calcareous, gritty, occasional lignite chips, occasional slickenslides (slip surfaces indicating roots?), micaceous.
242.0–248.2': interval becomes increasingly sandy.
248.2–252.0': chocolate brown, stiff, non-calcareous, slightly gritty, moderate amount of lignite fragments.

SAND: 252.0–260.3'
Very fine-grained sand with clay matrix; sand is micaceous, non-calcareous; most of the interval is washed away.

Drill Hole Nº: ONEX-W83-22

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number
80–100	260–325		CS, CS, CS, CS	90, 51	

Description

CARBONACEOUS CLAY: 260.3–262.0'
Black with lignite chips, stiff, non-calcareous, and non-gritty.

INTERBEDDED CLAY AND FINE SAND: 262.0–274.2'
Clay fraction is medium grey, soft to moderately stiff, non-gritty, and non-calcareous in layers 1/8–3" thick. Lignite chips present. Sand fraction is fine-grained with brown clay matrix; micaceous and non-calcareous. Several large pyrite nodules from .5 x 1.5" found in interval from 264.0–272.0'.

SAND: 274.2–287.0'
Light grey clay grading within approximately 3" to fine-grained quartz sand interbedded with thin prominent tan silty–clay units.

CLAY: 287.0–288.0'
Beige to light grey silty clay, non-calcareous.

SAND/CLAY: 288.0–298.0'
Very fine-grained quartz sands interbedded with tan–beige silty clay, non-calcareous. Detrital pyrite is abundant locally.
289.0': detrital pyrite and lignite pieces.
297.0': thin bed of medium–coarse-grained quartz sand with broken wood pieces.

QUARTZ PEBBLE SAND: 298.0–316.0'
Largely white–grey coarse-grained sand (>90% quartz) with lignite chips, very fine-grained equivalents prominent, locally abundant pieces of pyrite.
308.0': minor gritty tan clay binding, with a rose tinge.

QUARTZ PEBBLE CONGLOMERATE: 316.0–319.5'
Largely small quartz pebbles (>90%), subrounded, other clasts include maroon siltstone, mafic volcanics, and abundant woody pieces.
316.5': abundant woody pieces (≃10%).

CLAY: 319.5–320.0'
Light brown to grey, slightly calcareous, moderately to very stiff, non-gritty.

QUARTZ PEBBLE CONGLOMERATE: 320.0–320.5'
As above 316.0–319.5'.

CLAY: 320.5–321.0'
Light brown to medium grey, soft, non-calcareous.

END OF HOLE: 321.0'

HOLE PLASTIC CASED TO 240.0'

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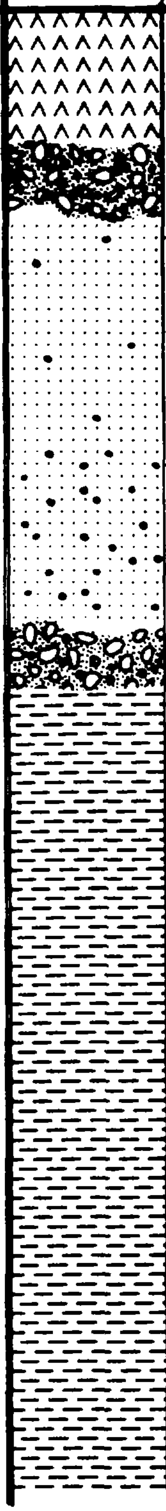
1983 WINTER DRILL PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-23 Location: East Gentles Township (lat. 50°38'16" long. 81°53'47")

Elev. of collar: ≈230 ft Total depth: 307.9 ft Sheet 1 of 5

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: X core recovered	Sampling: Number	Description
0–20	0–65		CS CS CS CS CS CS CS			MUSKEG/PEAT: 0–6.0' CLAY TILL: 6.0–9.0' SAND: 9.0–19.0' PEBBLY SAND: 19.0–27.0' CLAY TILL: 27.0–30.0' CLAY: 30.0–82.0'

RECENT
PLEISTOCENE

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-23

DEPTH (m / ft)	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description

Depth (m): 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

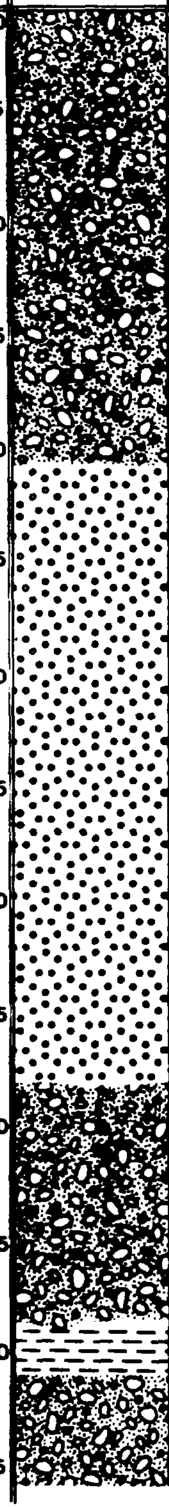
Depth (ft): 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130

Sampling: CS, CS, CS, CS, CS, CS, CS, CS

CLAY TILL: 82.0–150.0'

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-23

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
40	130					
41	135		CS			
42						
43	140					
44	145		CS			
45						
46	150					GRAVEL: 150.0–177.0'
47	155		CS			
48						
49	160					
50	165		CS			
51						
52	170					
53	175		CS			
54						CLAY TILL: 177.0–187.0'
55	180					
56	185		CS			
57						187.0–188.0': granite boulder.
58	190					CLAY: 188.0–190.0'
59	195		CS			TILL: 190.0–197.0' Pebbly–sandy till from 190.0–194.0'. Becoming a clay-rich till from 194.0–197.0'.
60						

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-23

Sheet 4 of 5

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
60–80	195–260		CS, CS	40, 90, 40, 5, 100, 100, 100	131	see below

CLAY: 197.0–198.0'
Stiff, dark chocolate brown, non-calcareous clay.

PLEISTOCENE
JURASSIC (?)

CLAY TILL: 198.0–198.5'
Grey, pebbly, clay-rich till; calcareous.

CLAY: 198.5–224.5'
Alternating layers of light green and brown/black clay; stiff, calcareous, including minor limestone clasts. Also, contains minor interbeds of light green, calcareous siltstone.

205.0–211.0': quartz sand occurs at top of run suggesting interval of sand; medium-grained, angular clasts.

BRECCIATED CLAYSTONE: 224.5–232.0'
Angular clasts of light green or brown slightly calcareous claystone included in a chocolate brown clay matrix.

CLAY: 232.0–262.4'
Light green, light and dark chocolate brown clays; very stiff, weakly calcareous, horizontally laminated. Very silty in places with occasional sand interbeds. May contain minor limestone clasts.

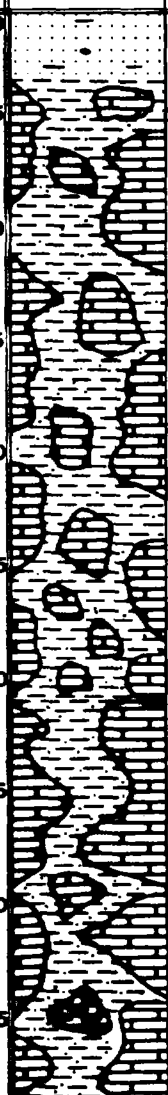
Note: Sand seam at 235.0–244.0' inferred from poor recovery.

255.4–258.8': greenish grey clayey sand; fine- to medium-grained, subrounded to rounded, decreasing silt and clay content. Small pyrope garnet and other black mineral (spinel?); occur between 256.7–256.8'.

258.8–259.8': increasing silt and clay content in sand as above.

259.8–261.5': light green silt; transitional contact with above sand.

Drill Hole Nº: ONEX-W83-23

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number
80–100	260–325			100, 100, 100, 100, 100, 40, 100, 100, 100, 100, 100, 100	131, ?

Description

JURASSIC

261.5–262.4': light grey-green sand; moderately calcareous, moderately to well-sorted. Grains are generally subrounded and medium-grained. Minor pyrope, significant black mineral.

DEVONIA

LIMESTONE BRECCIA: 262.4–303.0'

Buff and brown indurated limestone fragments with grey calcareous clay infilling angular blocks. By 266.8', chocolate brown and light green clay fragments incorporated in breccia. Minor pyrite occurs as a coating on some fractures or along bedding planes.

277.5–278.5': light brown, fine-grained calcareous with moderate fractures.

END OF HOLE: 307.9'

NO PLASTIC CASING

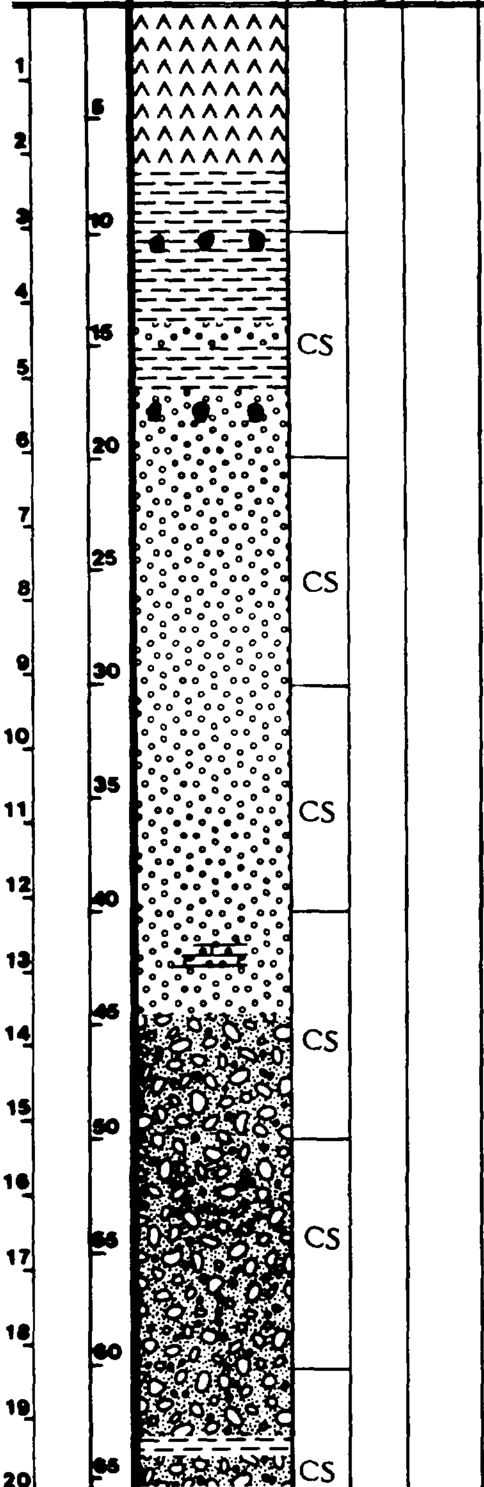
ONEXCO MINERALS LTD.

1983 WINTER DRILL PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-24 **Location:** East Gentles Township (lat. 50°37'04" long. 81°53'42")

Elev. of collar: ≈240 ft **Total depth:** 268 ft **Sheet** 1 **of** 5

DEPTH (m, ft)	GRAPHIC LOG	Sampling (reverse circulation interval, % core recovered, Number)	Description



MUSKEG AND ICE: 0–7.0'

MARINE CLAY: 7.0–14.0'
Light grey to green, soft, calcareous, shell fragments present.

CLAY: 14.0–17.0'
Medium grey, calcareous, muddy to very stiff, slight grit, some pebbles towards the top of the unit (≈14.0–15.0').

SAND AND PEBBLES: 17.0–44.5'
Polymictic, fine to pebble-sized material, some shells in the top 2–3' of the interval; pebbles include rounded to subrounded limestone, grey–black siltstone, granite, jasper, and chert. Sand fraction is dominantly light brown, calcareous, medium-grained sand with low sphericity.

43.0': tan limestone boulder.
44.0': cobble–boulder layer.

RECENT / PLEISTOCENE

SANDY TILL: 44.5–64.8'
Light brown, soft to stiff, calcareous matrix, abundant grit and pebbles including limestone and chert fragments.

48.0': diabase and red granitic cobbles.

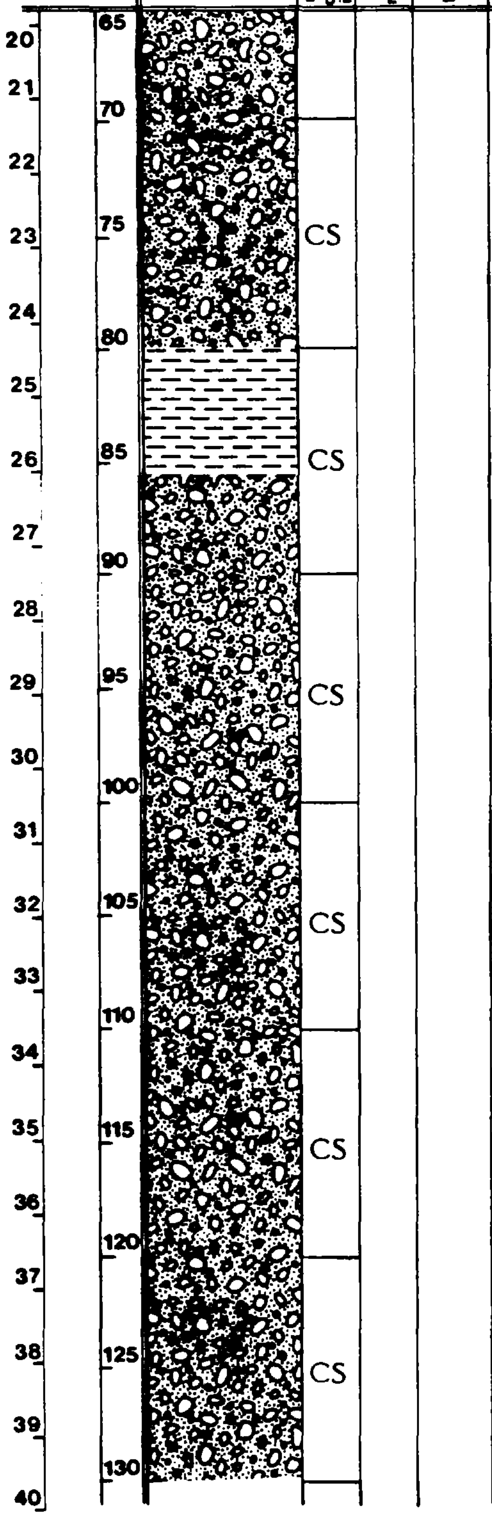
64.0': dark brown clay, stiff, little grit.

CLAY TILL: 64.8–80.0'
64.8–78.5': light green to grey changing to medium grey, very slight grit, relatively soft, calcareous.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-24

DEPTH m	ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description



78.5–80.0': medium grey to green, stiff, calcareous, more gritty than above unit, occasional rock fragments of chert.

79.5': boulder of chert.

CLAY: 80.0–86.0'
Light brown to grey, soft, vigorously calcareous, minor grit, occasional rock fragments.

PEBBLE TILL: 86.0–137.0'
Light brown to grey, soft clay calcareous matrix, significant polymictic fine sand fraction, and pebble fragments. By approximately 102.0', pebble content increases.

102.0': tan chert boulder.

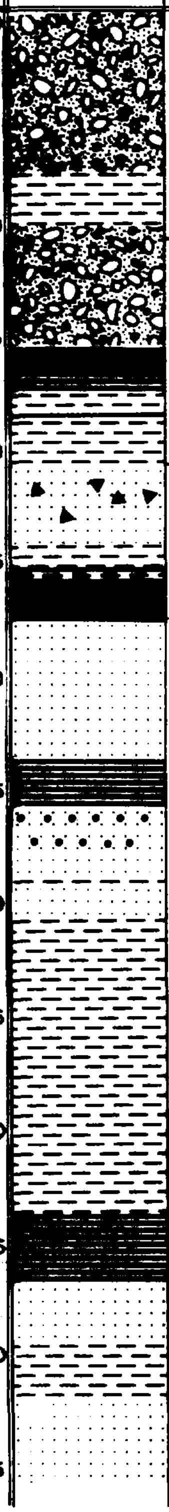
104.0': cobbles of limestone, chert, and diabase.

107.0': cobbles of diabase, chert, and limestone.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-24

Sheet 3 of 5

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number
40–60	130–195		CS, CS, CS	17, 100, 44, 100, 100, 53, 0	

Description

133.0': pink feldspar.
134.8': diabase cobbles.

CLAY: 137.0–139.5'
Dark brown, stiff, calcareous, trace of grit, occasional rock fragments.

CLAY TILL: 139.5–144.8'
Medium brown to grey, moderately stiff, gritty clay matrix, calcareous, numerous limestone fragments and subrounded to angular pebbles of black siltstone, chert, and limestone.
142.0': changes to green–grey in colour.

PLEISTOCENE
CRETACEOUS

CARBONACEOUS CLAY: 144.8–145.0'

LIGNITE: 145.0–146.0'

CARBONACEOUS CLAY: 146.0–146.8'

CLAY: 146.8–147.5'
Dark grey, stiff, non-calcareous, and non-gritty.

CARBONACEOUS CLAY: 147.5–148.0' Black, stiff.

CLAY: 148.0–150.0'
Dark grey, stiff, non-calcareous, slight grit, dark brown patches at 149.0'.

SAND: 150.0–153.5'
Fine-grained quartz sand, micaceous with lignite chips and pyrite chunks.

CLAY: 153.5–154.8'
153.5–154.5': light grey, stiff, non-calcareous, and non-gritty.
154.5–154.8': medium grey, gritty, non-calcareous, with brown patches becoming increasingly carbonaceous.

LIGNITE: 154.8–157.0'
Contains minor carbonaceous clay from 154.9–155.0'.

SILT/CLAY: 157.0–163.0'
Medium brown, relatively soft, non-calcareous silty–clay, micaceous and non-gritty.

LIGNITE/CARBONACEOUS CLAY: 163.0–165.0'
Thin seams of black compact lignite, interbedded with carbonaceous clay; the clay is black and earthy, and contains abundant chunks of soft crumbly lignite.

SAND: 165.0–169.8'
Fine-grained, micaceous (≈2–3%) sand, with minor clay interbed from 168.1–168.3'.

CLAY: 169.8–183.2'
169.8–181.7': medium brown to green, non-calcareous and non gritty, occasional small chips of lignite, stiff, broken core surfaces resembling slip surfaces.
181.7–183.2': becoming darker brown in colour with some lignite chips, non-gritty, more calcareous.

CARBONACEOUS CLAY: 183.2–186.0'
Carbonaceous clay with orange/brown woody pieces and lignite chips; abundant thin (<2") lignite layers.

186.0–188.9'?: Sand? No core recovery.

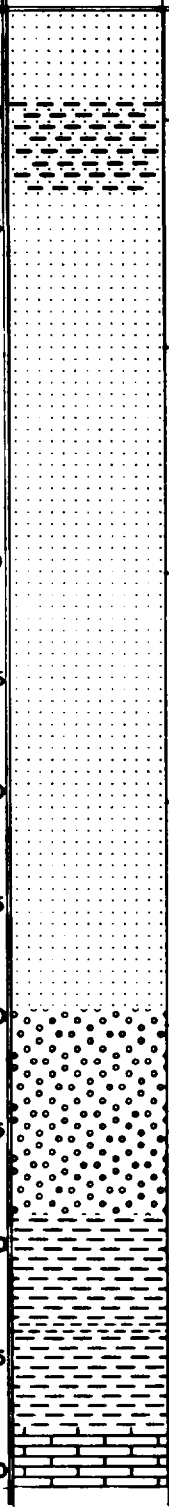
1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-24

Sheet 4 of 5

DEPTH m	DEPTH ft
60	195
61	200
62	
63	205
64	210
65	
66	215
67	220
68	
69	225
70	230
71	
72	235
73	240
74	
75	245
76	250
77	
78	255
79	260
80	

GRAPHIC LOG



Sampling: reverse circulation interval	% core recovered	Number
CS		517
CS		516
CS		515
CS		514
CS		513
CS		
CS		

Description

CLAY: 188.9–191.0'
Medium grey–brown, moderately stiff, non-calcareous, and non-gritty.

NO CORE RECOVERY: 191.0–195.0'

SILICA SAND: 195.0–198.5'
Fine-grained silica sand, white with abundant mica, occasional thin layers of light grey clay.

SANDY CLAY: 198.5–203.0'
Moderately stiff, medium brown–grey, non-calcareous.

SILICA SANDS: 203.0–248.0'
203.0–239.0': fine-grained silica sands as above, occasional layers of medium to grey clay, fine lignite fragments.

223.0–231.0': abundant lignite fragments.

239.0–248.0': fine- to coarse-grained, >90% quartz, angular to rounded, moderate to low sphericity, minor chert and other pebbles.

243.0–247.0': fine-grained quartz sands.

247.0–248.0': medium- to coarse-grained sands.

CRETACEOUS
DEVONIAN

CLAYS: 248.0–252.5'
Interbedded units of stiff, dark grey, non-gritty, non-calcareous clay and dark brown gritty, moderately stiff, non-calcareous clay.

SHALE: 252.5–253.0'
Dark grey, very fine-grained, conchoidal fracturing.

CLAY: 253.0–257.5'
Dark grey, non-calcareous, and non-gritty. By 256.0', slight brownish tinge to clay and more calcareous.

Drill Hole Nº: ONEX-W83-24

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
80–100	260–325					LIMESTONE/CALCAREOUS CLAY: 257.5–268.0' Largely brown to beige limestone and interbedded dark grey, stiff, non-gritty, calcareous clay. 265.0': light grey clay, soft to moderately stiff, calcareous, non-gritty. END OF HOLE: 268.0' HOLE PLASTIC CASED TO 268.0'

m: 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100

ft: 260, 265, 270, 275, 280, 285, 290, 295, 300, 305, 310, 315, 320, 325

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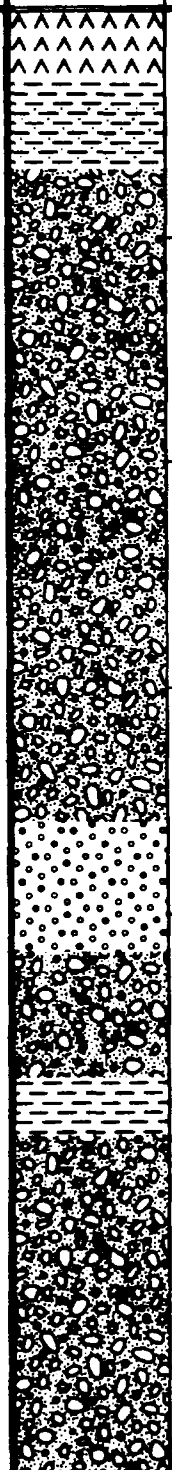
1983 WINTER DRILL PROGRAM – JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-25 Location: East Gentles Township (lat. 50°36'27" long. 81°56'12")

Elev. of collar: ≈245 ft Total depth: 395 ft Sheet 1 of 7

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	X core recovered	Number	Description

Depth scale: m 1–20; ft 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65



Sampling: CS, CS, CS, CS, CS, CS

PEAT AND MUSKEG: 0–3.0'

CLAY: 3.0–4.0'
Light to medium brown, soft, non-calcareous, non-gritty.

CLAY/SAND: 4.0–7.0'
Cinnamon brown, gritty, soft, non-calcareous.

RECENT
PLEISTOCENE

CLAY TILL: 7.0–36.0'
Medium grey, soft to moderately stiff, slight grit, calcareous, pebble chips are dominantly tan to light brown limestone (5–10%).

PEBBLE GRAVEL: 36.0–42.0'
Polymictic, although dominantly subangular limestone and grey–black siltstone, also minor granite, diabase, jasper, and maroon siltstone.

40.0': polymictic, fine-grained sand seam.

CLAY TILL: 42.0–47.5'
Light to medium grey, soft, calcareous, slight grit, abundant limestone chips.

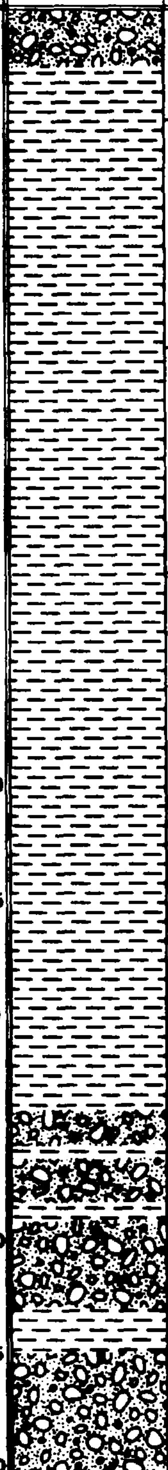
CLAY: 47.5–50.0'
Light grey, extremely soft and muddy, calcareous, contains minor grit and limestone chips.

CLAY TILL: 50.0–68.0'
Light brown to grey, extremely soft, calcareous, abundant limestone fragments; also interbedded thin seams of dark grey, stiff, calcareous clay.

60.0–60.5': diorite boulder.

Drill Hole Nº: ONEX-W83-25

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description



Depth (m): 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

Depth (ft): 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130

Sampling: CS, CS, CS, CS, CS, CS

CLAY: 68.0–114.0'
68.0–87.5': medium to dark grey, extremely stiff, non-gritty, calcareous, frequent interbeds of clay till; till is extremely soft, gritty, and calcareous.

By 76.0', virtually all dark grey clay as described above.

87.5–101.0': medium–dark brown, moderately stiff, non-gritty, mildly calcareous.

88.0–92.5': mottling of brown and dark grey clay, additionally alternately bedded.

101.0–114.0': medium to dark grey, moderately to very stiff, non-gritty, calcareous.

SAND PEBBLE TILL: 114.0–115.5'
Medium grey, gritty, calcareous matrix, abundant carbonate clastics (≈20%).

CLAY: 115.5–116.0'
Medium to dark grey, stiff, non-gritty, calcareous.

SAND PEBBLE TILL: 116.0–118.0'
As per 114.0–115.5'.

CLAY: 118.0–119.0'
Medium to dark grey, stiff, non-gritty, calcareous, minor limestone chips.

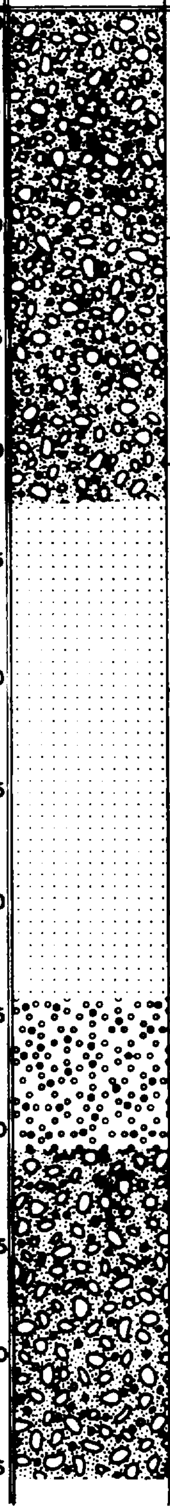
CLAY TILL: 119.0–122.0'
Medium grey, gritty, calcareous, minor pebbles.

CLAY: 122.0–124.0'
Medium to dark grey, moderately stiff, non-gritty, non-calcareous.

SAND TILL: 124.0–125.0'
Medium brown to grey, gritty, sandy matrix, calcareous, minor pebbles.

CLAY TILL: 125.0–152.0'
125.0–146.0': medium grey–green, stiff, calcareous, very minor grit, minor pebble fragments.

Drill Hole Nº: ONEX-W83-25

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
40–60	130–195					

Depth scale (m): 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60

Depth scale (ft): 130, 135, 140, 145, 150, 155, 160, 165, 170, 175, 180, 185, 190, 195

Sampling intervals: CS, CS, CS, CS, CS, CS, CS

Description

146.0–152.0': light grey, soft, vigorously calcareous, slight grit, some pebble fragments, much of material is washed away.

SAND: 152.0–174.0'

152.0–172.0': very fine-grained, polymictic, calcareous sand, minor pebbles, minor plant material and small pieces of lignite.

172.0–174.0': polymictic, fine-grained sand, moderate amount of pebbles, minor lignite.

PEBBLE SAND: 174.0–180.5'

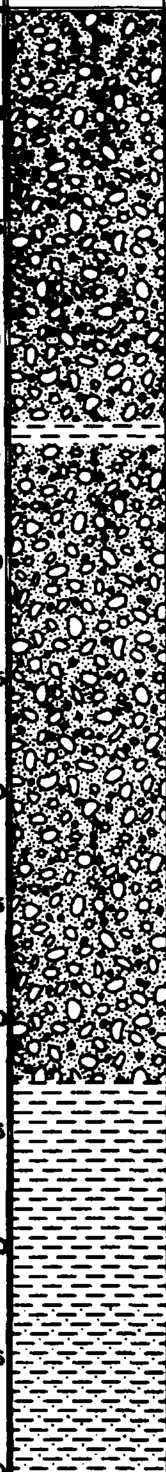
Medium- to coarse-grained polymictic sand and rounded pebbles.

CLAY TILL: 180.5–242.0'

Light brown to grey, moderate fine-grained sand fraction, vigorously calcareous, soft to moderately stiff, minor pebble fragments.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-25

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
60–80	195–260		CS, CS, CS, CS, CS, CS			

207.0': moderate amount of grit starting.

213.0': thin layer of stiff clay.

215.5': boulder, fine-grained, dark red in colour.

CLAY: 242.0–252.0'

242.0–242.5': medium to dark grey, stiff, calcareous.

242.5–252.0': light grey, moderately stiff, calcareous, and non-gritty.

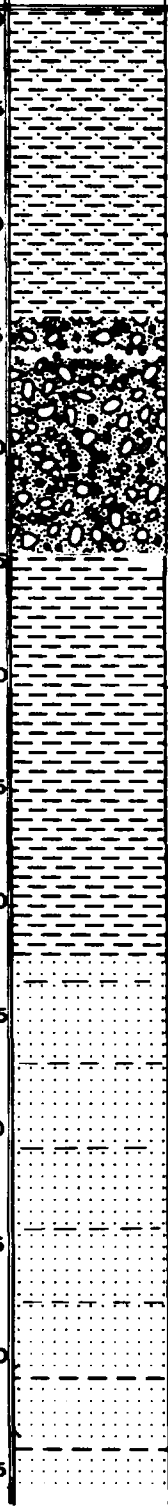
SAND/CLAY: 252.0–273.0'

Light grey to green, very soft, vigorously calcareous, non-gritty. Sand fraction is very fine-grained, light brown, and polymictic.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-25

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description
80–84	260–275		CS			
84	275		CS			273.0': tan limestone boulder. PEBBLE SAND: 273.0–273.5' CLAY SAND TILL: 273.5–275.0' Similar to 207.0–242.0'. PEBBLE CLAY TILL: 275.0–275.5' SANDY TILL: 275.5–284.0' Light grey to brown, soft clay, calcareous, gritty, predominantly very fine-grained sand, polymictic and calcareous.
87	285		CS			CLAY: 284.0–302.0' Light brown to grey clay, very soft, non-gritty, calcareous.
90	295		CS			
92–93	300–305		CS			SILT-SAND/CLAY: 302.0–368.0' Silt to very fine-grained sand interbedded with thin clay beds; most of silt is washed away. Estimated that silt beds are approximately 2' with clay beds (0.5–1').
96	315		CS			316.5': pieces of plant material.
98–99	320–325		CS			320.5': thin clay layer. 323.0–323.5': light brown calcareous clay, non-gritty.



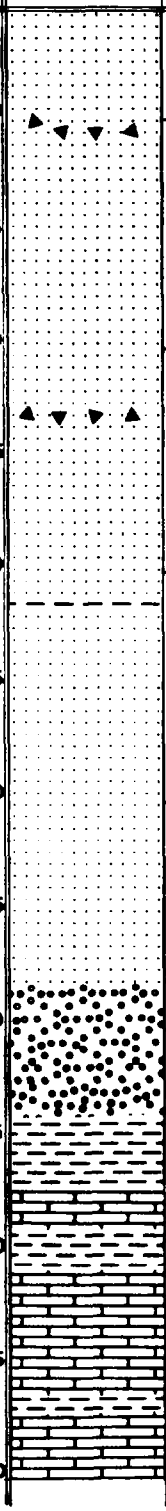
Depth scale (m): 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100

Depth scale (ft): 260, 265, 270, 275, 280, 285, 290, 295, 300, 305, 310, 315, 320, 325

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-25

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
	325					
100			CS			
101	330					330.5': detrital lignite and wood chips.
102	335		CS			
103						
104	340					
105	345		CS			343.0': detrital lignite.
106						
107	350					351.0': light grey calcareous clay, moderately stiff.
108	355		CS			
109						
110	360					
111	365		CS			
112						SAND AND GRAVEL: 368.0–374.0' Polymictic, angular to subangular, strong H_2S odour.
113	370					371.5': brown limestone boulder.
114						PLEISTOCENE / DEVONIAN
	375		CS			LIMESTONE/CLAY: 374.0–395.0' Interbedded brown limestone and light grey clay; clay is calcareous and gritty.
115						377.0': brown limestone.
116	380					379.0': light grey to green clay, moderately stiff, calcareous, and gritty.
117						380.5': mixed clay and limestone. 381.0': limestone.
	385		CS			
118						383.5': limestone.
119	390					386.0': medium grey, moderately stiff clay, calcareous. 387.0': clay and limestone.



1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-25

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
119	390					
120						END OF HOLE: 395.0'
	395					NO PLASTIC CASING
121						
122	400					
23						
	405					
124						
125	410					
126						
	415					
127						
128	420					
129						
	425					
130						
131	430					
132						
	435					
133						
134	440					
135						
	445					
136						
137	450					
138						
	455					
139						

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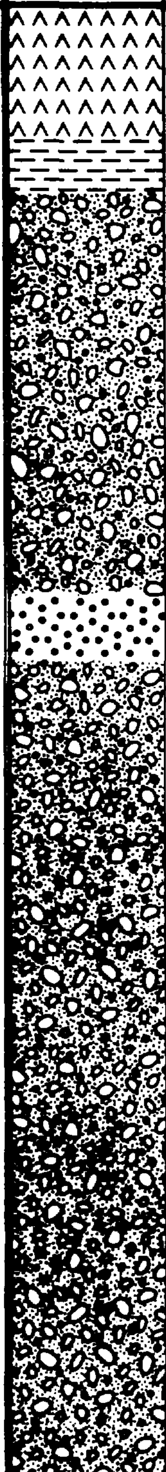
1983 WINTER DRILL PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-26 (H1) Location: Lambert Township (lat. 50°26'38" long. 82°11'38")

Elev. of collar: ≈279 ft Total depth: 350 ft Sheet 1 of 6

DEPTH (m / ft)	GRAPHIC LOG	Sampling (reverse circulation interval / X core recovered / Number)	Description



Depth m: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Depth ft: 5 10 15 20 25 30 35 40 45 50 55 60 65

Sampling: CS CS CS CS CS CS CS CS

MUSKEG: 0–6.0'

MARINE CLAY: 6.0–8.0'
Medium grey–green clay; soft, non-gritty, calcareous, containing fossils.

RECENT
PLEISTOCENE

TILL: 8.0–26.0'
Medium green–grey clay containing abundant clasts; angular to rounded, varied lithology; granite, diabase, diorite, chert, limestone, siltstone, and jasper.

15.0': minor amount of sand; polymictic.

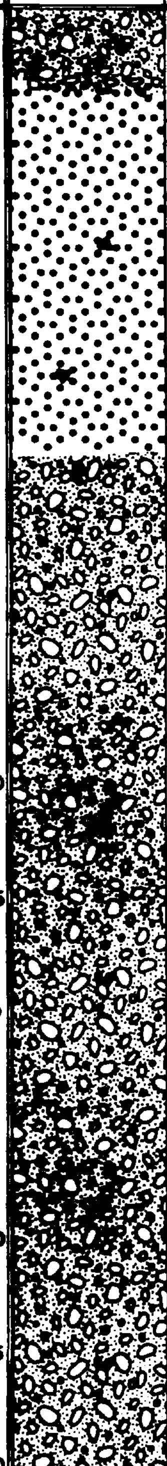
25.0': basement and sedimentary cobbles.

GRAVEL: 26.0–29.0'
Dominantly pebbles of varied lithology; both Paleozoic sedimentary and Precambrian basement clasts; angular to subrounded fragments, less than .5" in size. Minor polymictic sand.

TILL: 29.0–69.0'
Green–grey clayey–sandy–pebbly till; calcareous clay is soft to moderately stiff. By 42.0', increased sand content.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-26(H1)

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description
20–40	65–130		CS, CS, CS, CS, CS, CS, CS			see below

65.0': minor sand apparent with large sedimentary cobbles (≈6").

69.0': lignite trace.

GRAVEL: 69.0–85.0'
Minor amount of clay in a polymictic sandy gravel. Clasts predominantly pebble-sized, although commonly in the range of 1/16–1/8". By 73.0', sand comprises approximately 50% of sample. Clasts tend to be angular to subrounded of varied lithology.

78.0': trace lignite.

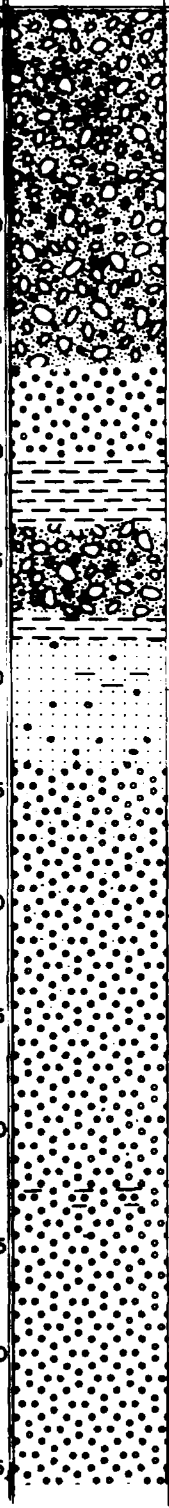
TILL: 85.0–146.0'
85.0–98.0': same as 29.0–69.0' with trace lignite. By 96.0', sample becomes extremely sandy.

98.0–146.0': medium–dark grey, sandy–pebbly clay-rich till. Pebble clasts of varied lithology. Minor sandy component. Trace lignite.

112.0–112.5': diabase boulder.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole No: ONEX-W83-26(H1)

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description
40–60	130–195		CS, CS, CS		200, 201, 202	see below

137.5': clayey component is now a medium brown.
138.0': basement cobbles.

Note: Poor return from 140.0–145.0' due to washing of hole.

SILICA SAND: 146.0–150.0'
Dominantly white quartz-rich, moderately sorted, medium- to coarse-grained sand; angular grains of low–moderate sphericity. Minor white kaolinitic clay and medium grey clay; non-calcareous. Also, contains minor intermediate intrusives and coarse carbonate clasts.

VARIEGATED CLAYS: 150.0–153.0'
Thinly layered sequence of white, yellow, pink, and red clays; soft, non-gritty, non-calcareous.

TILL: 153.0–157.0'
Medium grey sandy–pebbly clay-rich till as above. Contains abundant angular clasts of limestone and intermediate intrusives. Trace lignite. Calcareous.

PLEISTOCENE
CRETACEOUS

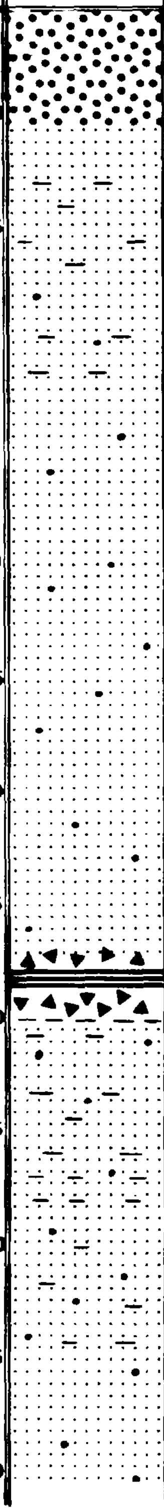
CLAY: 157.0–158.0'
Grey–white, non-calcareous, soft, gritty clay; contains minor fine-grained silica sand. Minor yellow brown clay intervals.

SILICA SAND: 158.0–266.0'
Poorly-sorted, fine- to coarse-grained, white quartz-rich sands. Grains are predominantly subangular of low to moderate sphericity. Occasional pebble-sized clasts; tends to be coarsening downward trend to 170.0'. Minor clay interbeds throughout. White kaolinitic, yellow, light–dark brown, grey; and carbonaceous clay included. Abundant lignite in places; minor muscovite and dark sedimentary or basement material.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole No: ONEX-W83-26(H1)

Sheet 4 of 6

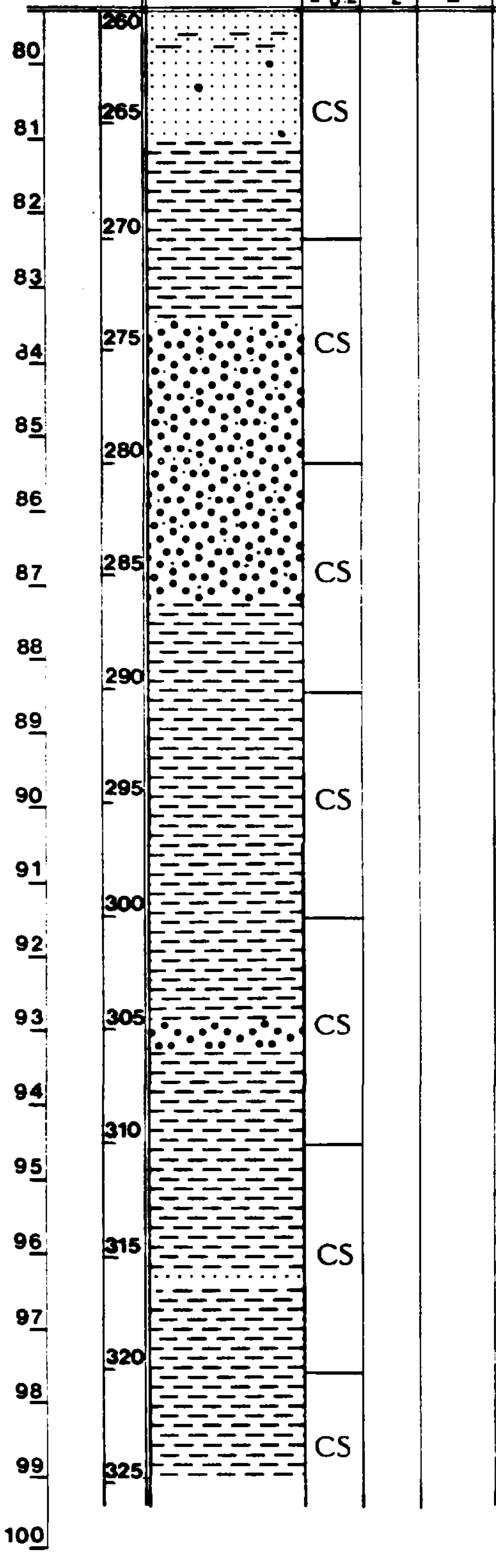
DEPTH (ft)	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
195–200		CS		202	
200–210		CS			
210–220		CS		203	
220–230		CS			
230–240		CS			237.0': approximately 50% lignite fragments in sand as above. 237.5–238.0': black carbonaceous clay including minor quartz sand and gravel. 238.5–239.0': increasing lignite; from approximately 25% at outset to approximately 75%. 239.0–239.5': carbonaceous clay grading into a light brown and chocolate brown clay.
240–250		CS		204	
250–260		CS			259.0–259.5': light brown–grey clay interbed; non-calcareous, stiff with minor grit.

Depth scale: m 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80; ft 195, 200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-26(H1)

DEPTH (m, ft) | GRAPHIC LOG | Sampling (reverse circulation interval, % core recovered, Number) | Description



CLAY: 266.0–274.0'
Light, medium, and dark grey clay; non-calcareous, non-gritty, medium soft to stiff.

SILICA SAND/GRAVEL: 274.0–287.0'
Fine- to medium-grained quartz-rich sand; <50% pebbles; both sedimentary clasts and quartz (chert) included. Light brown clay interbeds are evident in the sands. Minor lignite occurs from 274.0–276.0'; occasional pyrite clasts.

VARIEGATED CLAY SEQUENCE: 287.0–328.0'
Thinly layered sequence of various coloured clays including white, beige, tan, red, pink, blue–grey, green, brown, and grey. The clays are generally medium stiff, non-calcareous, and very gritty/sandy to non-gritty. Pebbly gravel and silica sand interbeds included in sequence.

298.0–298.5': minor amount of lignite contained in dark grey–black clay.

305.0–306.0': Pebbly gravel. Appears to be dominantly a chert-rich pebble gravel (rounded clasts) with some coarse quartz grains. White fine-grained silica sand also present; minor pyritic sandstone.

316.0–316.5': quartz-rich sand seam approximately 3" thick containing other lithologies. Medium-grained moderately sorted, immature with minor clay.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-26(H1)

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
	325–330		CS			CRETACEOUS / DEVONIAN CLAY: 328.0–350.0' Alternating layers of light green and medium to dark green, stiff, non-calcareous clay. No pyrite observed in clays.
	330–340		CS			
	340–350		CS			END OF HOLE: 350.0' HOLE PLASTIC CASED TO 330.0'

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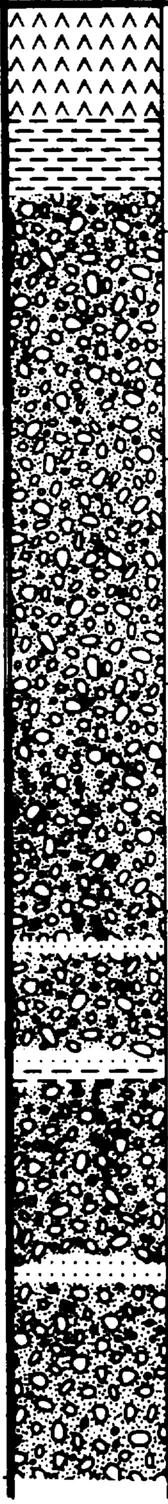
1983 WINTER DRILL PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-27 (H2) **Location:** Mahoney Township **(lat.** 50°23'54" **long.** 82°17'00" **)**

Elev. of collar: ≈285 ft **Total depth:** 430 ft **Sheet** 1 **of** 7

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling	Description
1–20	5–65		CS (×8)	see below

MUSKEG: 0–5.0'

CLAY: 5.0–8.0'
Medium brown/grey clay; soft, non-gritty, calcareous.

RECENT
PLEISTOCENE

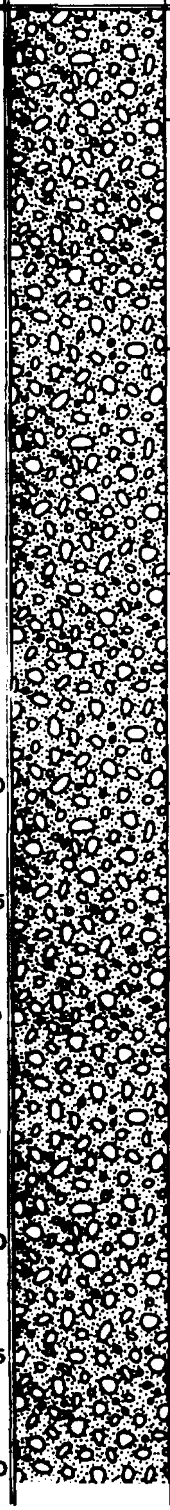
TILL: 8.0–212.0'
Medium brown–grey clay with abundant clasts; angular to subrounded, varied lithology; limestone, siltstone, jasper, granite, diabase, diorite, chert. Minor polymictic sand; fine- to medium-grained.

41.0–41.5': sand seam; fine- to medium-grained, polymictic.
42.0–42.5': limestone boulder.
45.0–45.5': limestone boulder.
46.0–46.5': sand seam; fine- to medium-grained, polymictic.
47.0–47.3': medium greenish–grey clay; calcareous, gritty.

55.0–55.5': sand seam; fine- to medium-grained, polymictic.
56.0–158.0': medium green–grey clay-rich till; calcareous, soft, gritty.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-27(H2)

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description
20	65					
21	70					
22						
23	75		CS			
24	80					
25						
26	85		CS			
27	90					
28						
29	95		CS			
30	100					
31						
32	105		CS			106.0': limestone boulder.
33	110					
34						
35	115		CS			
36	120					
37						
38	125		CS			125.0': granite boulder.
39	130					
40						

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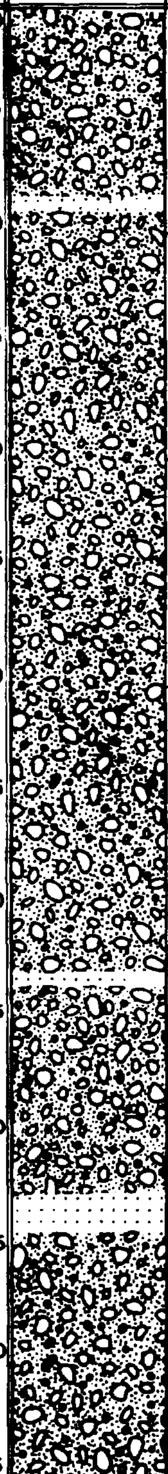
Drill Hole Nº: ONEX-W83-27(H2)

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
40–60	130–195		CS, CS, CS, CS, CS, CS, CS			

Depth marks: m 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60; ft 130, 135, 140, 145, 150, 155, 160, 165, 170, 175, 180, 185, 190, 195.

138.0–139.0': sand; fine- to medium-grained, polymictic.

158.0–165.0': medium brown–grey clay-rich till.

165.0–212.0': medium grey, sandy–pebbly clay-rich till. Both sedimentary and basement clasts in proportions of 60 : 40. Clasts tend to be angular and of moderate sphericity; poorly sorted.

172.5–173.0': extremely sandy interval in till; polymictic, medium- to coarse-grained, moderately sorted.

182.0–184.0': till is extremely sandy as 172.5–173.0'. Sandy component is polymictic, medium- to coarse-grained, poorly sorted. Clasts tend to be angular and of low to moderate sphericity. Minor pebble-sized clasts. Immature sand.

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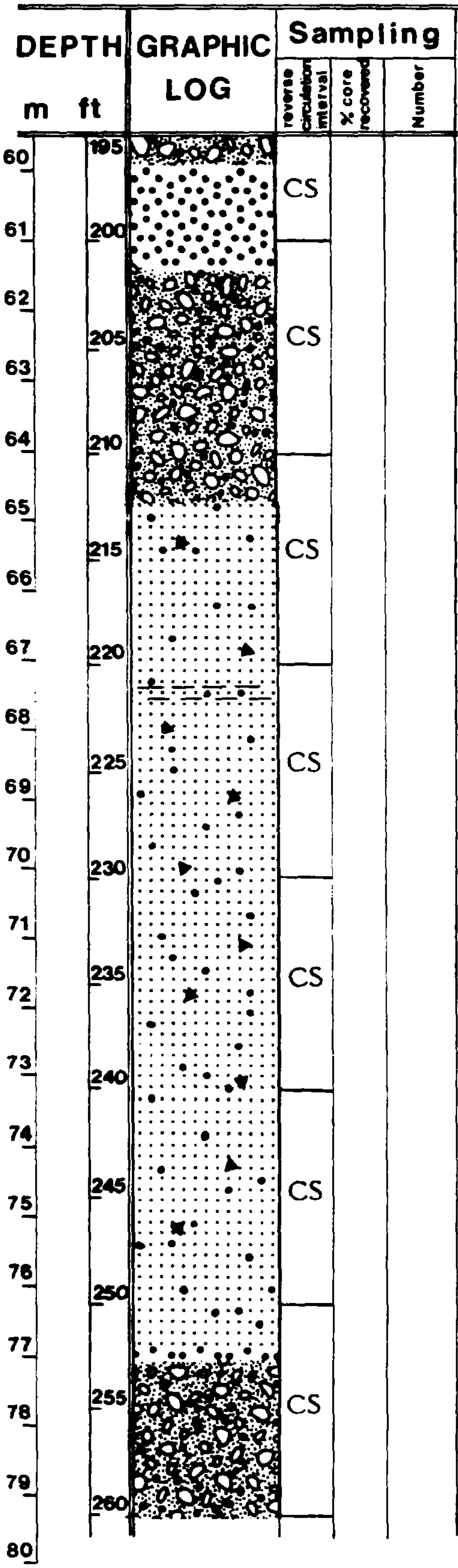
Drill Hole Nº: ONEX-W83-27(H2)



Description

196.0–201.0': interval of sandy gravel; polymictic, calcareous, poorly sorted, light beige sand. Fine-grained to pebble-sized clasts. Predominantly subangular; mode is coarse-grained sand.

SAND: 212.0–252.5'

Polymictic sand; medium grey, fine- to medium-grained, calcareous, moderately sorted, submature. Minor lignite chips.

215.0': abundant subangular pebble-sized clasts of varied lithology. Large lignite chips now present.

221.0–221.5': green–grey clay till (as above).

251.0–252.0': granite boulder.

252.0–252.5': sand as 212.0–238.0'.

TILL: 252.5–264.5'

Medium brown–grey, sandy, pebbly, clay-rich till, with poorly sorted angular clasts. Paleozoic sedimentary and Precambrian basement clasts found in proportions of approximately 60 : 40.

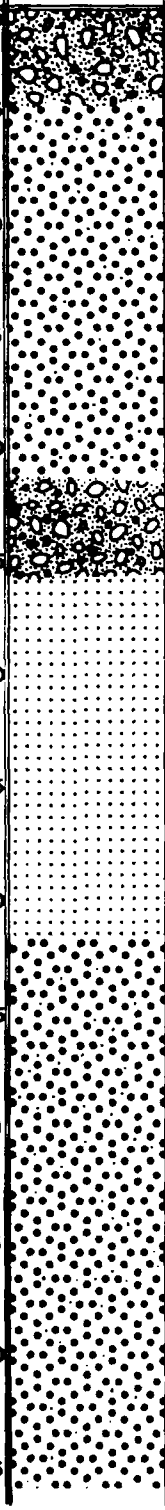
1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-27(H2)

DEPTH	GRAPHIC LOG	Sampling (reverse circulation interval / % core recovered / Number)	Description

m: 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

ft: 260 265 270 275 280 285 290 295 300 305 310 315 320 325



Sampling: CS, CS, CS, CS, CS, ?, ?

255.0–255.5': sand; fine- to medium-grained, polymictic.

256.0–257.0': increase in pebble-sized sedimentary clasts. Quartz comprises approximately 20% of clasts; clasts poorly sorted.

261.0': lignite trace.

261.5–264.5': medium green–grey clay-rich till; clay is calcareous, moderately stiff, and gritty. Minor pebble-sized angular clasts of varied lithology.

263.0–263.5': increased amount of clasts to 50% of return with the minor presence of fine- to coarse-grained, polymictic sand.

264.0–264.5': sand; fine- to coarse-grained, polymictic.

PLEISTOCENE
CRETACEOUS

SANDY GRAVEL: 264.5–281.0'
Pebble-sized clasts of varied lithology with approximately 30% quartz clasts are angular to subrounded. Trace lignite. Sand is fine- to coarse-grained; polymictic. By 267.0', lignite is no longer present.

267.0–268.0': sand; fine- to coarse-grained, poorly sorted, polymictic sand.

275.0': lignite trace.

TILL: 281.0–285.0'
Medium green–grey, calcareous, gritty clay component. Moderate amount of fine-grained, polymictic sand. Minor amounts of angular to subrounded clasts of varied lithology; approximately 80% sedimentary and 20% basement.

SAND: 285.0–392.0'
Fine- to medium-grained, 90% quartz sand, minor amount of sedimentary pebble clasts, angular to rounded in shape.

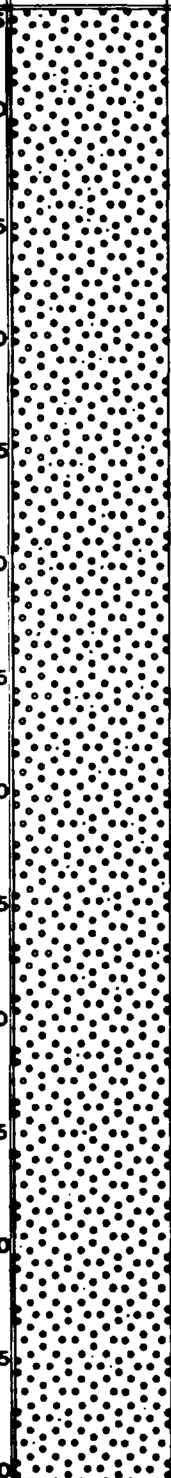
291.0–291.5': medium green–grey, calcareous clay; lignite trace.

301.0–303.0': gravel same as 264.5–281.0'.

Note: Stopped drilling at 310.0' to drive casing. Lost approximately 100.0' of sample, however drillers suspect that sediments are comprised largely of sand–gravel (as above) to approximately 392.0'. This correlates well with geophysical logs.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

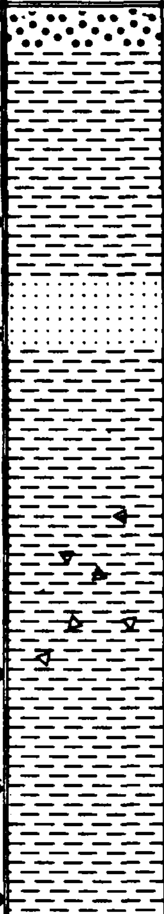
Drill Hole Nº: ONEX-W83-27(H2)

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
	325					
100			?			
	330					
101						
102	335					
103			?			
	340					
104						
105	345					
106			?			
	350					
107						
108	355					
109			?			
	360					
110						
111	365					
112						
	370		?			
113						
114	375					
115						
116	380		?			
117	385					
118						
119	390					

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-27(H2)

Sheet 7 of 7

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
119	390					
120						CLAY (?): 392.0–402.0' Clay interval inferred from geophysical log. Underlying sand(?) bed suggests that the clays may be Cretaceous.
121	395		?			
122	400					
23			?			SAND(?): 402.0–405.0' Geophysical logs suggest a possible sand interbed.
124	405					CLAY(?): 405.0–430.0' Clay as 392.0–402.0'. By 415.0', sample is available; clay is light grey, slightly calcareous, non-gritty and stiff, containing occasional limestone and claystone clasts. CRETACEOUS / DEVONIAN ?
125	410					
126						**Note:** A definite increase in the natural gamma at approximately 410.0' may indicate the Cretaceous–Devonian contact.
127	415		CS			
128	420					419.5–430.0': dark grey clay grading into alternating layers of dark chocolate brown and light green clays by 420.0'. Clays are non-calcareous, non-gritty, and predominantly stiff.
129						
130	425		CS			
131	430					END OF HOLE: 430.0' PLASTIC CASING TO 430.0'
132						
133	435					
134	440					
135						
136	445					
137	450					
138						
139	455					

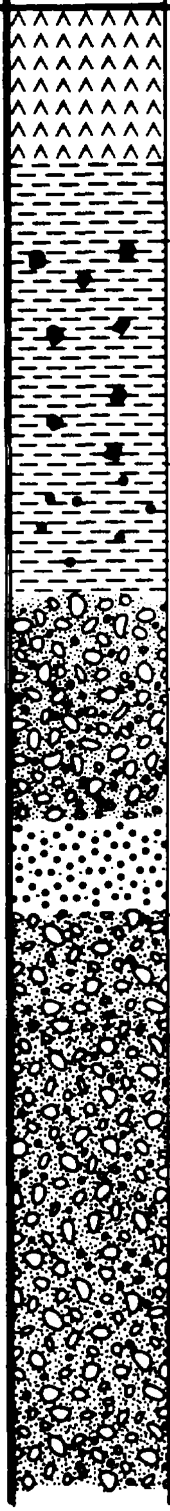
ONEXCO MINERALS LTD.

1983 WINTER DRILL PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-28 (H3) **Location:** Habel Township **(lat.** 50°23'24" **long.** 82°29'07" **)**

Elev. of collar: 289 ft **Total depth:** 402 ft **Sheet** 1 **of** 7

DEPTH (m, ft)	GRAPHIC LOG	Sampling	Description



Depth scale: m 1–20; ft 5–65. Sampling: CS (7 intervals).

MUSKEG/PEAT: 0–7.0'

MARINE CLAY: 7.0–19.0'
Green–grey clay; soft, calcareous, non-gritty. By 9.0', clay is a dark blue–grey, calcareous, soft, non-gritty.

11.0': clay is a light green–grey; soft, calcareous, fossils, non-gritty.

PEBBLY CLAY: 19.0–26.0'
Light green–grey clay as above including minor pebble-sized clasts; predominantly basement (Precambrian); pebbles may be angular to subrounded.

RECENT
PLEISTOCENE

TILL: 26.0–36.0'
Light grey sandy–pebbly clay-rich till; minor pebble clasts of varied lithology; both Precambrian basement and Paleozoic sedimentary clasts; angular to subrounded. Minor light beige clay included.

SAND AND GRAVEL: 36.0–40.0'
Pebble-sized clasts of varied lithology; basement and sedimentary clasts in relative proportions of approximately 50 : 50; clasts are angular to rounded. Sandy fraction is a fine- to coarse-grained, polymictic, and calcareous.

TILL: 40.0–86.0'
Light green–grey clay-rich till becoming grey by 45.0'. Pebble clasts are predominantly sedimentary (limestone); generally angular. Sand is medium- to coarse-grained, polymictic, and calcareous as usual.

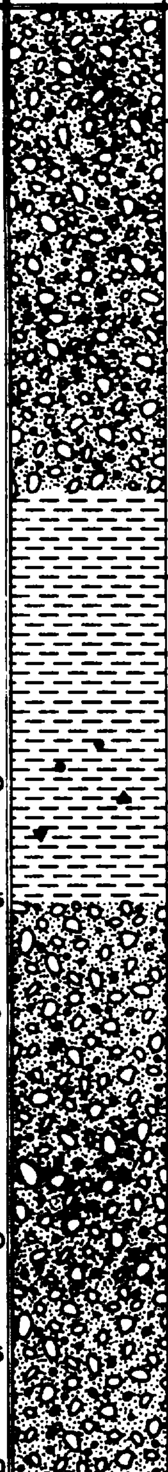
47.0–48.0': sedimentary and basement cobbles.

By 58.0', till is no longer clay-rich but extremely sandy with increased pebble content.

62.0–62.5': boulder — intermediate intrusive.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-28(H3)

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
20–40	65–130		CS, CS, CS, CS, CS, CS, CS, CS			

Depth scale (m): 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

Depth scale (ft): 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130

Description

85.0': trace lignite.

CLAY: 86.0–104.0'
Light grey clay; moderately stiff, calcareous, non-gritty.

96.0–98.0': very minor pebble-sized clasts, angular to subrounded of varied lithology; sedimentary/basement occurs in ratio of 80 : 20.

99.0': minor lignite.

TILL: 104.0–175.0'
Introduction of polymictic sand marks occurrence of clay-rich till. Medium grey with pebble-sized clasts; angular to subrounded of varied lithology; approximately 50 : 50 sedimentary basement.

By 112.0', sandy fraction is minor, occurring mainly as interbeds within the till.

114.0–114.5': basement boulder.

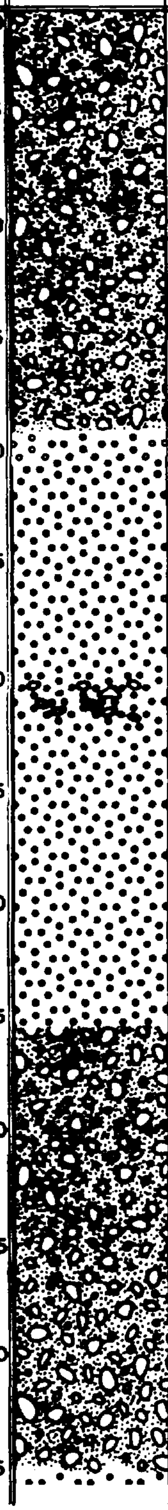
129.0–130.0': lignite traces in polymictic sand interbed.

1983 DRILLING PROGRAM-JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-28(H3)

Sheet 3 of 7

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	% core recovered	Number	Description



Depth scale: 40–60 m; 130–195 ft. Sampling: CS intervals.

SAND AND GRAVEL: 148.0–175.0'
Polymictic, calcareous, poorly sorted sand and gravel. Medium-grained to pebble-sized clasts; both angular and rounded. Varied lithology; ratio of Paleozoic sedimentary to Precambrian basement is approximately 50 : 50.

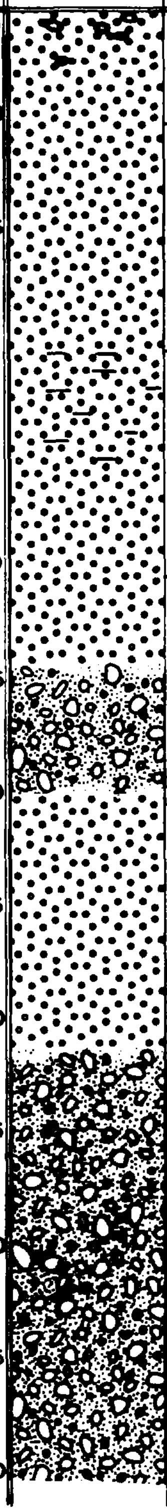
158.0–160.0': medium grey clay-rich till interbed; very sandy/pebbly with lithology similar to that of sand/gravel as above.

TILL: 175.0–194.0'
Medium grey clay till; clay component is very soft containing a very minor sandy fraction and predominantly sedimentary pebble clasts. From 182.0–185.0', pebble clasts are noticeably absent. Till is calcareous as usual.

SAND AND GRAVEL: 194.0–224.0'
Medium beige, sandy/gravel; polymictic, poorly sorted; medium-grained to pebble-sized clasts. Clasts tend to be quite angular although rounded pebbles are observable. Includes minor medium grey, very gritty clay.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-28(H3)

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
60–80	195–260		CS, CS, CS, CS, CS, CS, CS			See below

Depth scale (m): 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80

Depth scale (ft): 195, 200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260

Description

196.0–196.5': till as 175.0–194.0'.

By 210.0', still predominantly a sandy/gravel as at 194.0', however medium to light grey clay interbeds included; clay is soft, non-gritty, and calcareous.

TILL: 224.0–229.0'
Medium brown–grey sandy–pebbly clay-rich till. Abundant clasts of varied lithology; both rounded and angular clasts of moderate sphericity. Polymictic sandy component. Calcareous as usual.

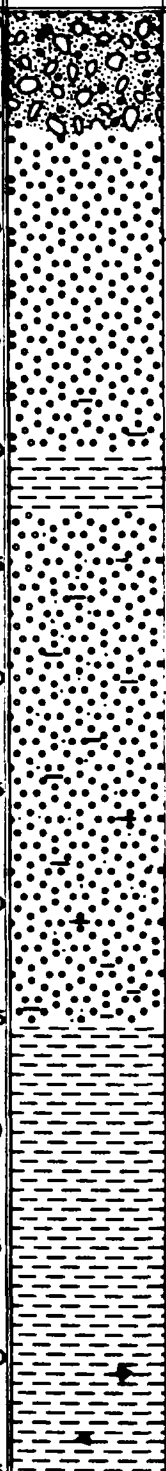
SAND AND GRAVEL: 229.0–241.0'
Same as 194.0–224.0'.

TILL: 241.0–265.0'
Medium grey, sandy–pebbly clay-rich till as 106.0–140.0'. Includes several very sandy–pebbly sections with characteristics as above.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole No: ONEX-W83-28(H3)

Sheet 5 of 7

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
80	260					
81	265		CS			PLEISTOCENE / CRETACEOUS SILICA SAND/GRAVEL: 265.0–305.0' Very coarse-grained and pebble-sized clasts comprised predominantly of quartz, although other lithologies present; abundant chert and lesser quantities of dark clastic or basement material included. Clasts are generally quite angular of low to moderate sphericity. As finer-grained material is introduced, sorting is poor. By 275.0', very fine-grained silica sand included in sand–gravel; contains minor flecks of muscovite. Also minor interbeds of white (kaolinitic), grey, and tan clay; gritty, soft to moderately stiff, non-calcareous.
82	270					
83						
84	275		CS			
85	280					
86					270–300	
87	285		CS			
88						
89	290					
90	295		CS			
91						
92	300				300–305	
93	305		CS			VARIEGATED CLAYS: 305.0–313.0' Grey, white, yellow, and red massive mudrocks; soft to moderately stiff, non-calcareous, very plastic, non-gritty. Abundant slickenslides evident throughout.
94						
95	310					SILTY CLAY: 313.0–326.0' Light blue–grey, extremely silty clay; may contain minor muscovite; clay is soft, very plastic, non-gritty. Minor amount of carbonaceous material.
96	315			28		
97						
98	320					
99	325			60		
100						

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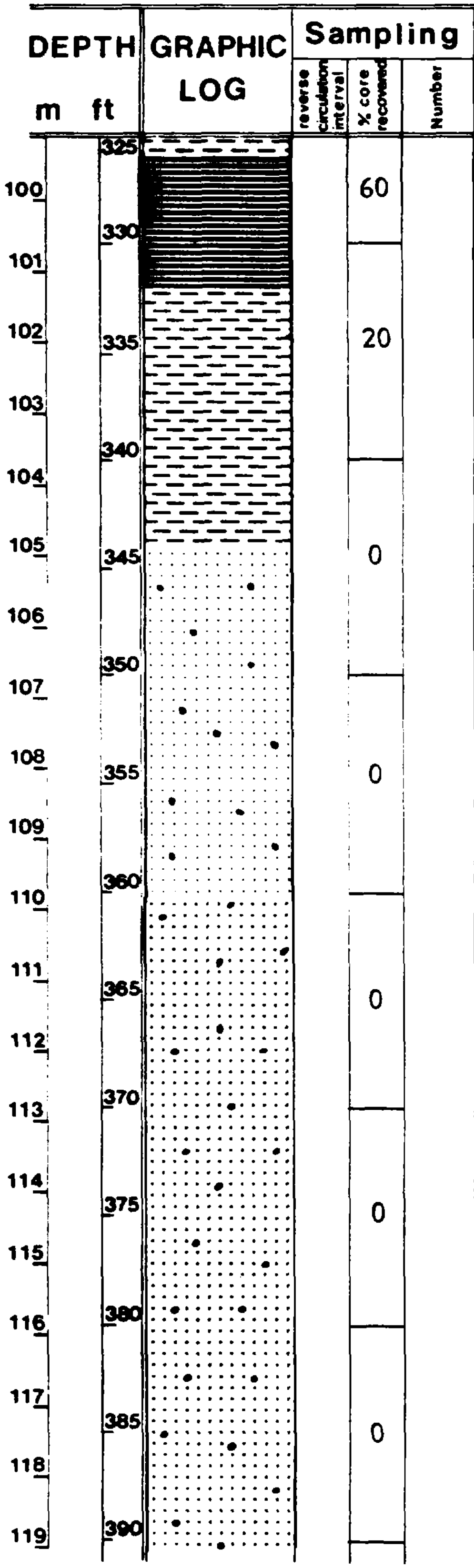
Drill Hole Nº: ONEX-W83-28(H3)



Description

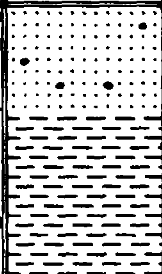
BLACK ORGANIC-RICH CLAY: 326.0–332.0'
Dark grey–black, silty, micaceous mudrock; contains abundant lignite and wood chips to 330.0', then conspicuous carbonaceous material is absent. Slickenslides still abundant.

Note: Geophysical logs indicate that clay interval extends to 344.0', although no sample was available.

SAND/SILT: 344.0–395.0'
Very fine sand and silt, calcareous, micaceous, polymictic. Sample collected from casing return; only minor amount available.

1983 DRILLING PROGRAM - JAMES BAY LOWLANDS

Drill Hole Nº: ONEX-W83-28(H3)

DEPTH m	DEPTH ft	GRAPHIC LOG	Sampling: reverse circulation interval	Sampling: % core recovered	Sampling: Number	Description
119–122	390–400			40 / 100		CLAY SEQUENCE: 395.0–402.0' Light beige and dark brown–black, silty clay containing limestone clasts grading into a light green marine clay by 396.6'; calcareous, stiff, non-gritty.
						END OF HOLE: 402.0'
						HOLE PLASTIC CASED TO 402.0'

Depth scale: m 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139; ft 390, 395, 400, 405, 410, 415, 420, 425, 430, 435, 440, 445, 450, 455

KIMBERLITE INDICATOR MINERALS

REPORT BY

OVERBURDEN DRILLING MANAGEMENT LTD.

WATTS, GRIFFIS AND MCOUAT / ONTARIO ENERGY CORPORATION
MOOSE RIVER BASIN
JAMES BAY LOWLANDS, ONTARIO

KIMBERLITE INDICATOR MINERALS
IN A BULK SAMPLE OF CRETACEOUS SEDIMENTS

BY
S.A. AVERILL
OVERBURDEN DRILLING MANAGEMENT LIMITED
JUNE 07, 1983

INTRODUCTION

In 1982, Overburden Drilling Management Limited (ODM) recovered 43 pyrope grains from three Cretaceous sand samples collected by Watts, Griffis and McOuat (WGM) and the Ontario Energy Corporation from a reverse circulation drill hole in the Moose River Basin. In 1983, on the recommendations of ODM (Averill, 1982), WGM employed a reverse circulation drill to "mine" a bulk sample from the anomalous sand zone. ODM prepared a heavy mineral concentrate from the bulk sample and searched the concentrate for pyrope and diamonds.

PROCEDURES

The following procedures were used:

1. A minus 10 mesh concentrate of Specific Gravity greater than 3.3 was prepared using the flow sheet of Figure 1.

2. The concentrate was screened to -10+32, -32+50, -50+80 and -80 fractions (Table 1).

3. The two coarsest heavy mineral fractions and the +10 mesh fraction of the whole sample were thoroughly searched with a binocular microscope for diamonds and pyrope, both of which tend to crystallize as coarse phenocrysts in their parent kimberlites.

4. Ten-gram splits of the two finest heavy mineral fractions were also searched to determine whether any fine pyrope was present.

5. The three finest heavy mineral fractions were re-combined, and a 400 grain line count was made to determine the average mineralogy of the concentrate (Table 2).

OBSERVATIONS

The following were established:

1. The proportion of heavy minerals in the bulk sample (932.7 g from 339.0 kg of feed, or 0.28 percent) is 50 percent lower than that for the 1982 samples (85 grams from 15.3 kg, or 0.56 percent), indicating that the samples are not identical.

2. The sand grains have a maximum size of about 32 mesh (500 microns). Most particles coarser than 32 mesh are aggregates of quartz sand cemented with secondary minerals (pyrite with subordinate siderite and rare hematite and goethite).

3. The -32 mesh heavies consist mainly of detrital sedimentary minerals (70 percent garnet with trace to 1 percent zircon, rutile, staurolite and kyanite). Cementing siderite and pyrite constitute only 20 percent of the fine heavies. Traces of contaminating epidote and pyroxene from overlying Quaternary sediments are also present.

4. No diamonds were found in any of the sample fractions.

5. No pyrope is present in the +10 mesh fraction of the sample.

6. The -10+32 mesh heavies contain 1 percent garnet, and approximately 15 percent of this garnet (101 grains) is pyrope.

7. The -32+50 mesh heavies contain approximately 70 percent garnet, and less than 0.01 percent of this garnet (168 grains) is pyrope.

8. Most of the above pyrope grains are between 400 microns (40 mesh) and 1000 microns (16 mesh) in diameter. The maximum diameter is 1500 microns (11 mesh).

9. The -50+80 mesh heavies also contain 70 percent garnet, but only 2 pyrope grains were found in a representative 10-gram split. An estimated 44 pyrope grains (less than 0.002 percent of the garnet) are present in this heavy fraction, which weighs 220 grams. No pyrite was found in a 10 gram split of the -80 mesh heavies (total weight 375 grams).

10. The proportion of pyrope in the bulk sample (313 grains in 339 kg, or 0.92 grains/kg), like that of total heavy minerals to bulk sample, is 50 percent lower than that for the 1982 samples (43 grains in 17.7 kg, or 2.43 grains/kg).

11. As in the 1982 samples, most of the detrital minerals occur as rounded grains. The pyrope grains are rounded (except where chipped), flattened and frosted and are mauve to violet in colour.

CONCLUSIONS

Three principal conclusions can be drawn from the above observations and from ODM's 1982 findings:

1. The Cretaceous sands of the Moose River Basin can be used effectively to prospect for kimberlites.

2. The most suitable heavy mineral size range for detecting pyrope is between 50 mesh (300 microns) and 10 mesh (1700 microns).

3. The pyropes identified in the present study are probably derived from a kimberlite that is not diamond-bearing.

S. Averill, President

REFERENCES

AVERILL, S.A.
1982: Kimberlite Indicator Minerals in Quaternary and Cretaceous Sediments; confidential report by Overburden Drilling Management Limited to Watts, Griffis and McOuat and the Ontario Energy Corporation, November 15, 1982, 14 pp.

OVERBURDEN DRILLING MANAGEMENT LIMITED
SAMPLE PROCESSING FLOW SHEET

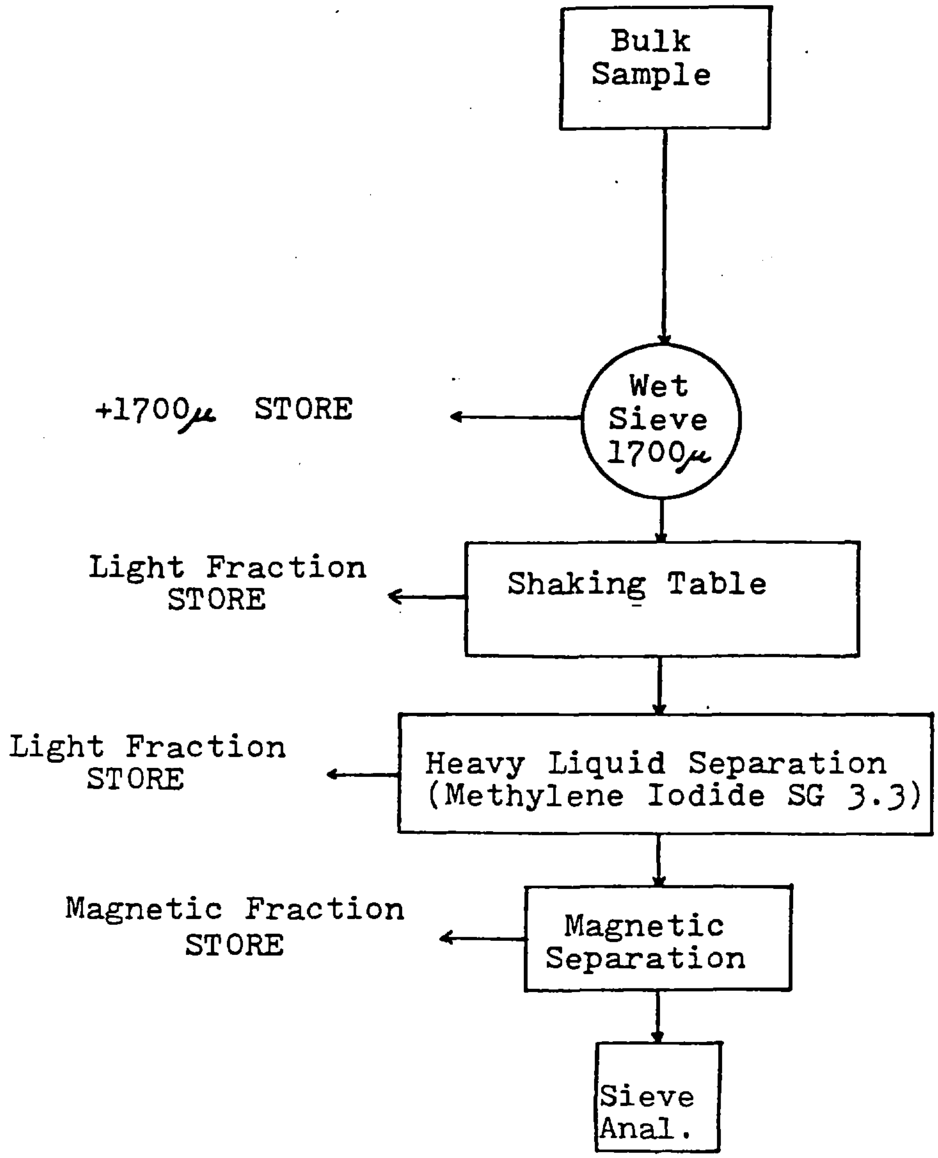


Figure 1 - Sample Processing Flow Sheet

OVERBURDEN DRILLING MANAGEMENT LIMITED

LABORATORY SAMPLE LOG

Sample Number	Weight (kg. wet)			Conc. Wt. (grams dry)					Description		Classification
	Bulk	+10 Rock Chips	-10 Table Feed	-10 +32	-32 +50	-50 +80	-80	-10 mag.	+10	Matrix	
WG-83 Bulk	339.0	5.7	333.3	102.8	192.9	220.8	375.3	40.9	Pyrite-cemented quartz sand; gray-green clay lumps	White sand	Cret. or Jurassic Sand

Table 1 - Sample Weights.

ABBREVIATIONS USED IN HEAVY MINERAL LOGS

Abbreviation	Mineral
GAR	Garnet
EP	Epidote
PX	Pyroxene
HB	Hornblende
ILM	Ilmenite
HEM	Hematite
PY	Pyrite
Q/F	Quartz/Feldspar (Low percentages of these light minerals rust to drill steel and hitchike into concentrates. Steel is separated from quartz/feldspar by rolling and removed magnetically)
CARB	Cabonate (Siderite)
RUT	Rutile
ZIR	Zircon
SPH	Sphene
STAUR	Staurolite
UN	Unidentified. (Mainly poor specimens of common minerals rather than unidentified rare minerals).

Index to Table 2

HOLE NO.	SAMPLE NO.	CLASS.	VOLUME PERCENT																											
			GAR		EP		PX		HB		ILM		HEM		PY		Q/F		CARB		RUT		ZIR		SPH		STAUR		UN	
			+125	-125	+125	-125	+125	-125	+125	-125	+125	-125	+125	-125	+125	-125	+125	-125	+125	-125	+125	-125	+125	-125	+125	-125	+125	-125	+125	-125
	WG-83 Bulk	Cretaceous or Jurassic sand		74		1		0.25		0		0		0.25		15.25		3		3.75		0.75		0.25				0.25		0.75
			REMARKS: NOTE: Fraction logged in -32 mesh. Also 0.25%, kyanite, 0.25% goethite																											
			REMARKS:																											
			REMARKS:																											
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Table 2 - Mineralogy of -32 mesh heavy minerals.

Watts, Griffis and McOuat Limited

ELECTRON PROBE X-RAY MICROANALYSIS

OF GARNET SAMPLES

REPORT BY

DR. C. CERMIGNANI

REPORT

Electron probe X-ray microanalysis of garnet samples.

Two samples of garnet mineral grains (WG-83, +32 mesh; WG-83, +50 mesh) submitted to me by Dr. R.J. Griffis have been analyzed quantitatively with an electron probe X-ray microanalyzer.

Two polished thin sections have been prepared, using five grains from each sample. Residual heavy liquid coatings on the grains have resulted in poor adhesion of the epoxy to the grains and have caused some difficulties in the preparation of the sections and their subsequent carbon coating, preliminary to the analysis.

Analytical conditions. Using an ETEC Autoprobe, fitted with a solid state detector, analyses have been obtained at 20 KV accelerating voltage, 0.2 nA probe current, and on-line data reduction with full ZAF correction. Garnet and chromite specimens from the lab collection have been used as standards.

The analyses have been recalculated into atomic and garnet end-members proportions using a computer program written by Prof. J.C. Rucklidge, Department of Geology, University of Toronto. The program also estimates the amounts of Fe^{3+} and Fe^{2+}. The %RESID figure (last printout line) is indicative of the accuracy of the recalculated stoichiometries, with values below 5 being tipical of good stoichiometries.

Results. All analyses, except one (#3), are of dominantly pyrope-almandine garnets, with Cr_2O_3 contents between 2 and 4 wt%, approximately.

The analyses for sample WG-83,+32 mesh (#3 to #9) have low totals, but good stoichiometries. Because of the observed anomalously low specimen current values, those results can be explained by inadequate carbon coating. However, attempts to obtain a better coating (#21, with additional coating; #24, newly coated) have not been successful.

Dr. C. Cermignani

Toronto, June 21, 1983

WEIC ERCENT	1	2	3	4	5	6	7	8	9	10	
SIO2	38.98	0.00	35.76	39.44	38.96	37.91	37.72	38.49	39.86	35.12	SIO2
AL2O3	21.95	16.60	19.61	19.82	19.17	19.10	19.12	19.67	20.33	19.12	AL2O3
TIO2	0.00	0.53	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	TIO2
CR2O3	0.00	41.33	0.00	2.48	3.42	2.34	2.30	2.73	2.71	0.00	CR2O3
FE2O3	1.80			1.81	1.21	1.06	0.97	0.78	0.92		FE2O3
FEO	20.43	26.43	19.44	5.00	4.74	4.39	4.42	4.79	5.37	19.89	FEO
V2O5		0.34									V2O5
MGO	11.49	9.97	5.56	20.01	19.83	19.55	19.65	19.72	20.16	5.13	MGO
MNO	0.30	0.00	0.48	0.37	0.25	0.26	0.25	0.30	0.38	0.59	MNO
NIO		0.00									NIO
CAO	4.21	0.00	7.06	4.77	4.87	4.55	4.33	4.51	4.66	6.76	CAO
SUM	99.16	95.20	87.91	93.70	92.45	89.16	88.92	90.99	94.39	86.61	SUM

ATOMIC PROPORTIONS

SI	2.965	0.000	3.094	2.989	2.993	3.003	2.995	2.992	2.994	3.097	SI
AL	1.968	2.012	2.000	1.771	1.736	1.784	1.789	1.802	1.800	1.988	AL
TI	0.000	0.041	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.000	TI
CR	0.000	3.360	0.000	0.149	0.209	0.147	0.144	0.168	0.161	0.000	CR
FE3+	0.103			0.103	0.070	0.063	0.058	0.046	0.052		FE3+
FE2+	1.299	2.273	1.407	0.317	0.305	0.291	0.293	0.311	0.337	1.467	FE2+
V		0.023									V
MG	1.303	1.529	0.717	2.261	2.271	2.309	2.326	2.285	2.257	0.674	MG
MN	0.019	0.000	0.035	0.024	0.016	0.017	0.017	0.020	0.024	0.044	MN
NI		0.000									NI
CA	0.343	0.000	0.654	0.387	0.401	0.386	0.368	0.376	0.375	0.639	CA
O	12.000	12.000	12.000	12.000	12.000	12.000	12.000	12.000	12.000	12.000	O
CATSUM	8.000	9.238	7.907	8.000	8.000	8.000	8.000	8.000	8.000	7.909	CATSUM
PYROPE	43.9		25.5	75.6	75.4	76.8	77.3	76.4	75.4	23.9	PYROPE
GROSSU	6.4		23.3	0.3		2.4	2.2	1.9	1.8	22.6	GROSSU
ANDRAD	5.2			5.2	3.5	3.2	2.6	2.3	2.6		ANDRAD
UVAROV				7.5	9.9	7.4	7.2	8.4	8.1		UVAROV
SPESSA	0.7		1.3	0.8	0.5	0.6	0.6	0.7	0.8	1.6	SPESSA
ALMAND	43.8		50.0	10.6	10.2	9.7	9.8	10.4	11.3	51.9	ALMAND
SCHORL							0.3				SCHORL
KNORRI					0.5						KNORRI
%RESID	1.2		5.1	0.4	0.2	0.3	0.4	0.3	0.2	4.8	%RESID

1. PS-83 "GARNET" STD.
2. PS-97 CHROMITE "SPINEL"
3. WG-83 +32 "GARNET"
4. WG-83 +32, 2ND, "GARNET"
5. WG-83 +32, 3RD "GARNET"
6. WG-83 +32, 4TH "GARNET"
7. 4TH/A "GARNET"
8. WG-83 +32, 4TH/B "GARNET"
9. WG-83 +32, 5TH "GARNET"
10. WG-83 +32, 1ST"GARNET", REPEAT

WEIG. ERCENT	11	12	13	14	15	16	17	18	19	20	
SIO2	39.74	39.00	0.27	41.24	41.93	41.30	42.18	41.77	39.02		SIO2
AL2O3	22.13	22.06	15.53	19.91	20.34	20.18	21.11	20.64	22.01	16.47	AL2O3
TIO2	0.00	0.00	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.48	TIO2
CR2O3	0.00	0.00	41.44	3.93	3.69	3.45	2.89	3.00	0.00	41.46	CR2O3
FE2O3	1.04	1.96		3.99	3.33	2.86	2.67	3.92	2.05		FE2O3
FEO	21.50	20.29	26.02	4.21	5.11	5.20	5.79	4.76	20.20	26.36	FEO
V2O5			0.53							0.35	V2O5
MGO	11.19	11.53	10.04	20.90	20.80	20.35	20.79	21.09	11.54	10.60	MGO
MNO	0.55	0.40	0.30	0.36	0.40	0.55	0.52	0.52	0.50	0.00	MNO
NIO			0.21								NIO
CAO	4.30	4.20		5.84	5.89	5.74	5.51	5.51	4.20	0.00	CAO
SUM	100.45	99.45	94.95	100.38	101.48	99.63	101.46	101.21	99.52	95.72	SUM

ATOMIC PROPORTIONS

SI	2.989	2.958	0.028	2.944	2.962	2.969	2.972	2.952	2.958		SI
AL	1.962	1.972	1.892	1.675	1.694	1.710	1.753	1.720	1.967	1.984	AL
TI	0.000	0.000	0.048	0.000	0.000	0.000	0.000	0.000	0.000	0.037	TI
CR	0.000	0.000	3.387	0.222	0.206	0.196	0.161	0.168	0.000	3.349	CR
FE3+	0.059	0.112		0.215	0.177	0.155	0.142	0.208	0.117		FE3+
FE2+	1.353	1.287	2.249	0.251	0.302	0.312	0.341	0.282	1.281	2.252	FE2+
V			0.036							0.024	V
MG	1.255	1.304	1.547	2.224	2.190	2.181	2.184	2.222	1.304	1.615	MG
MN	0.035	0.026	0.026	0.022	0.024	0.033	0.031	0.031	0.032	0.000	MN
NI			0.017								NI
CA	0.347	0.341		0.447	0.446	0.442	0.416	0.417	0.341	0.000	CA
O	12.000	12.000	12.000	12.000	12.000	12.000	12.000	12.000	12.000	12.000	O
CATSUM	8.000	8.000	9.230	8.000	8.000	8.000	8.000	8.000	8.000	9.261	CATSUM
PYROPE	42.0	44.1		68.5	69.6	70.6	72.2	75.3	44.1		PYROPE
GROSSU	8.6	5.9							5.6		GROSSU
ANDRAD	3.0	5.7		10.9	9.0	7.8	7.1	5.6	5.9		ANDRAD
UVAROV				4.2	6.1	7.1	6.9	8.5			UVAROV
SPESSA	1.2	0.9		0.7	0.8	1.1	1.0	1.1	1.1		SPESSA
ALMAND	45.3	43.5		8.5	10.2	10.5	11.5	9.5	43.3		ALMAND
KNORRI				7.1	4.3	2.8	1.3				KNORRI
%RESID	0.4	1.4		1.9	1.3	1.0	0.9	1.6	1.4		%RESID

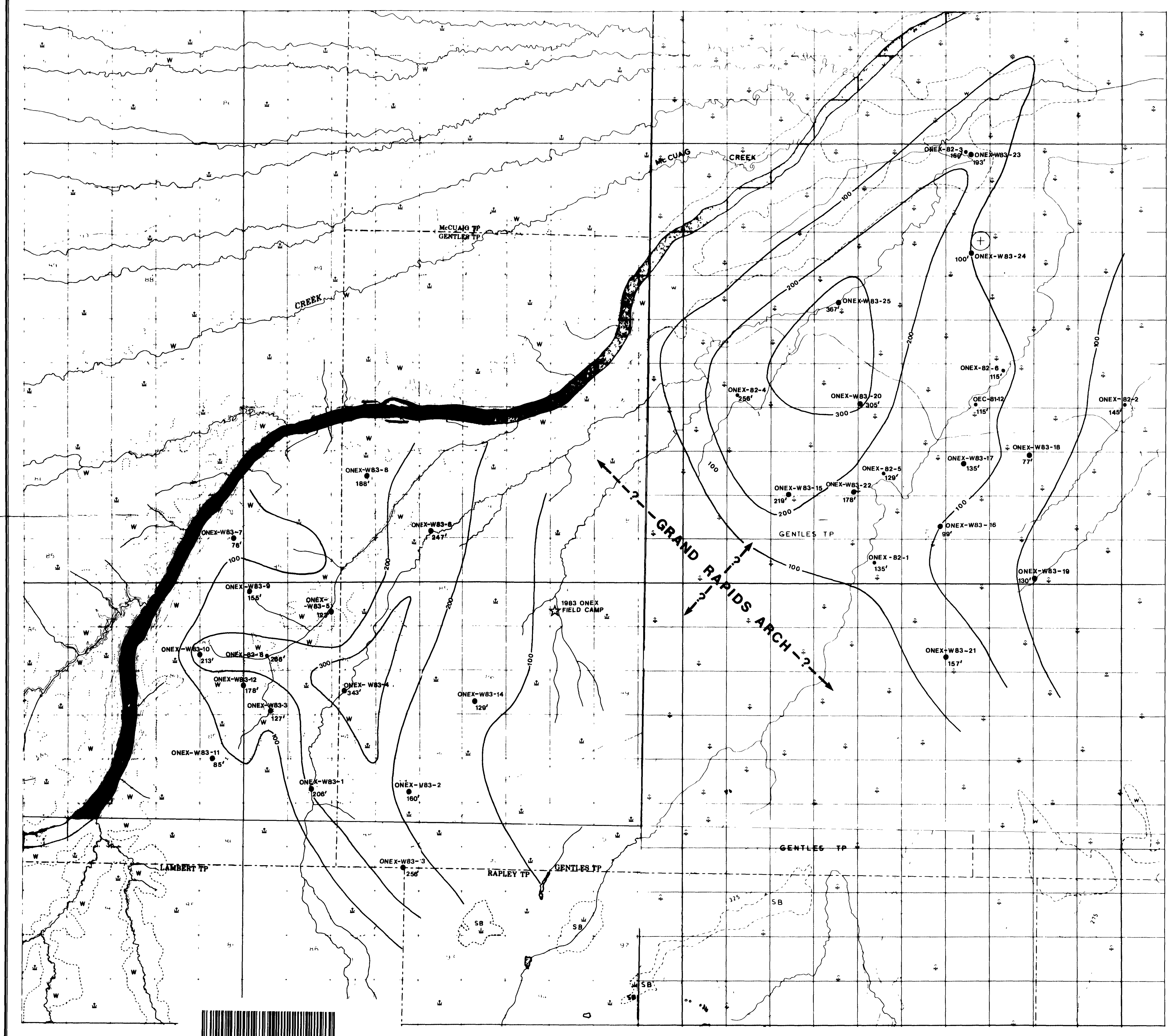
11. PS-03 "GARNET" STD
12. PS-03 "GARNET" STD.
13. PS-97 CHROMITE STD.
14. WG-83 +50, 1ST "GARNET"
15. WG-83 +50, 2ND "GARNET"
16. WG-83 +50, 3RD "GARNET"
17. WG-83 +50, 4TH "GARNET"
18. WG-83 +50, 4TH/B "GARNET"
19. PS-03 "GARNET" STD.
20. PS-03 CHROMITE STD.

WEIGHT PERCENT	21	22	23	24	25	
SIO2	36.59	39.01		38.50	38.33	SIO2
AL2O3	19.00	22.10	17.12	20.05	19.87	AL2O3
TIO2	0.00	0.00	0.52	0.00	0.00	TIO2
CR2O3	1.97	0.00	41.45	2.36	2.56	CR2O3
FE2O3	0.86	2.16		2.64	3.31	FE2O3
FEO	4.36	20.08	26.66	4.02	3.52	FEO
V2O5			0.25			V2O5
MGO	19.20	11.58	10.65	20.27	20.24	MGO
MNO	0.32	0.55	0.62	0.28	0.30	MNO
NIO			0.00			NIO
CAO	3.78	4.19		4.37	4.63	CAO
SUM	86.08	99.67	97.27	92.48	92.75	SUM

ATOMIC PROPORTIONS

SI	2.994	2.953		2.948	2.932	SI
AL	1.832	1.972	2.029	1.810	1.791	AL
TI	0.000	0.000	0.040	0.000	0.000	TI
CR	0.127	0.000	3.295	0.143	0.155	CR
FE3+	0.053	0.123		0.152	0.190	FE3+
FE2+	0.298	1.271	2.242	0.257	0.225	FE2+
V			0.016			V
MG	2.342	1.307	1.597	2.314	2.308	MG
MN	0.022	0.035	0.053	0.018	0.019	MN
NI			0.000			NI
CA	0.331	0.340		0.359	0.379	CA
O	12.000	12.000	12.000	12.000	12.000	O
CATSUM	8.000	8.000	9.272	8.000	8.000	CATSUM
PYROPE	78.2	44.3		78.5	78.7	PYROPE
GROSSU	2.0	5.3				GROSSU
ANDRAD	2.6	6.3		4.9	5.0	ANDRAD
UVAROV	6.4			7.3	7.9	UVAROV
SPESSA	0.7	1.2		0.6	0.7	SPESSA
ALMAND	10.0	43.0		8.7	7.7	ALMAND
%RESID	0.2	1.6		1.7	2.3	%RESID

21. WG-83 +32, 2ND"GARNET" REPEAT
22. PS-03 "GARNET" STD
23. PS-03 CHROMITE STD
24. WG-83 +32, 2ND "GARNET" REPEAT
25 WG- +32, 2ND"GARNET" AVERAGE



LEGEND

- ● 1983 drill hole location
- • 1982 and earlier drillings
- contour interval 100 feet

1 0 1 2 3
KILOMETRES

63.4219

Watts, Griffis & McOuat Limited

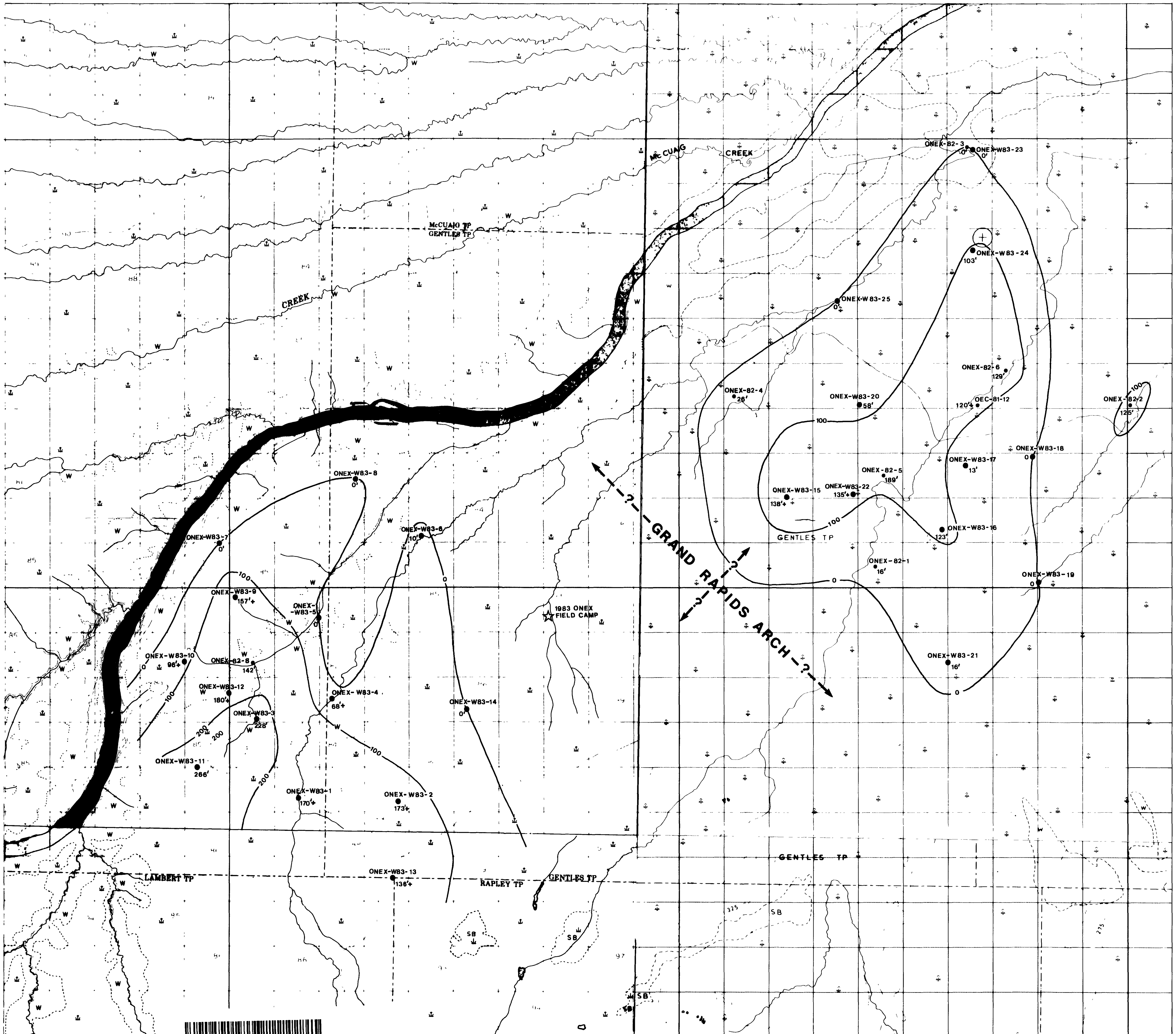
ONEXCO MINERALS LIMITED

PLEISTOCENE ISOPACH MAP

OMEP 82-171

SCALE 1:50 000		APPROVED: D.H.
DRAFTING FAP	DATE 1983-06-10	PROJECT Nº 618-1 DWG Nº 1

200



LEGEND

- ● 1983 drill hole location
- • 1982 and earlier drillings
- ⊂ contour interval 100 feet

1 0 1 2 3
KILOMETRES

63.4219

Watts,Griffis & McOuat Limited

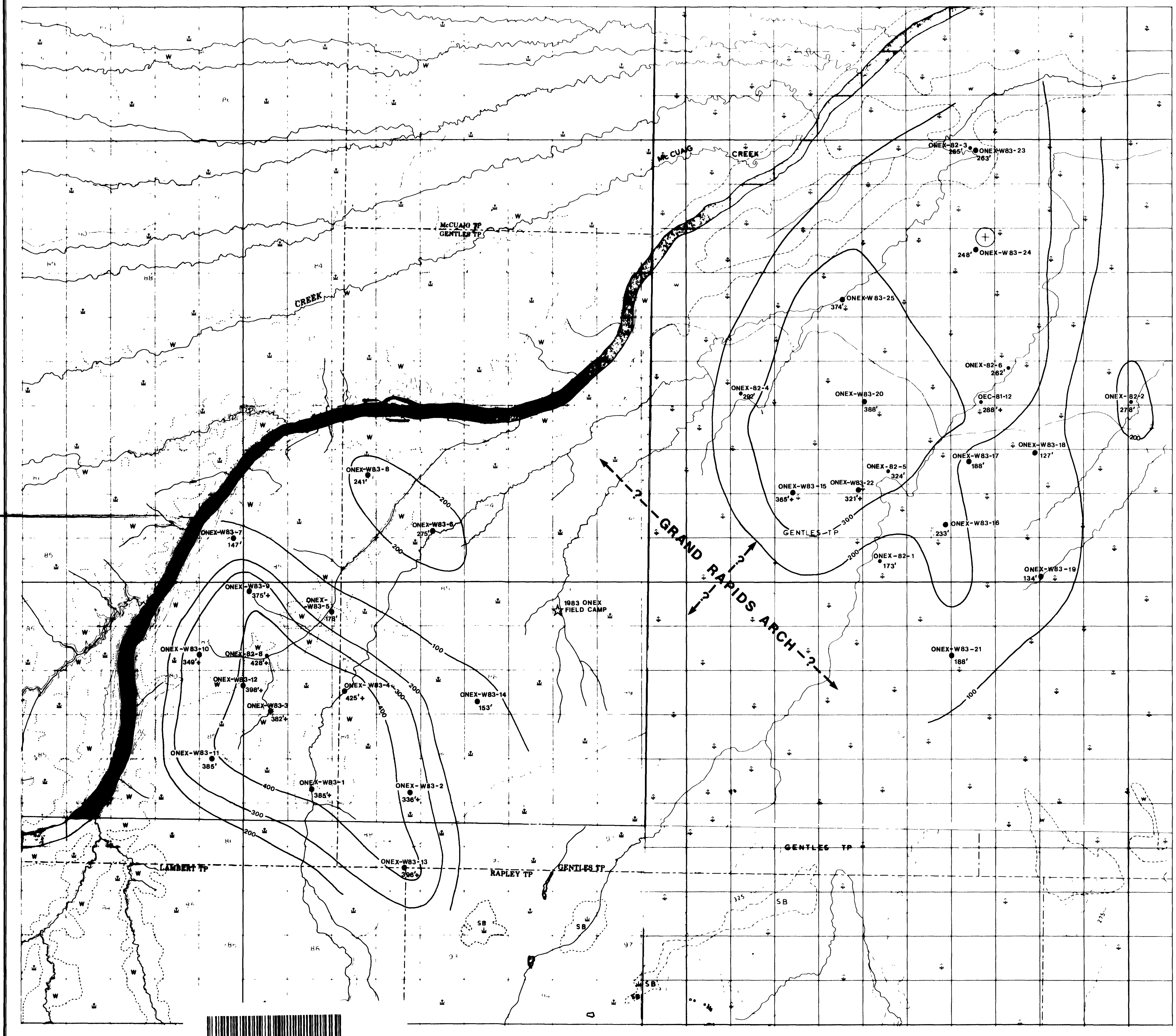
ONEXCO MINERALS LIMITED

CRETACEOUS ISOPACH MAP

OMEP 82-171

SCALE 1:50000		APPROVED: D. H.
DRAFTING FAP	DATE 1983-06-10	PROJECT № 618-1 DWG № 2

42J09SE0001 63.4219 WEST OF GENTLES TWP. 210



N

LEGEND

- ● 1983 drill hole location
- • 1982 and earlier drillings
- contour interval 100 feet

1 0 1 2 3
KILOMETRES

63.4219

Watts, Griffis & McOuat Limited

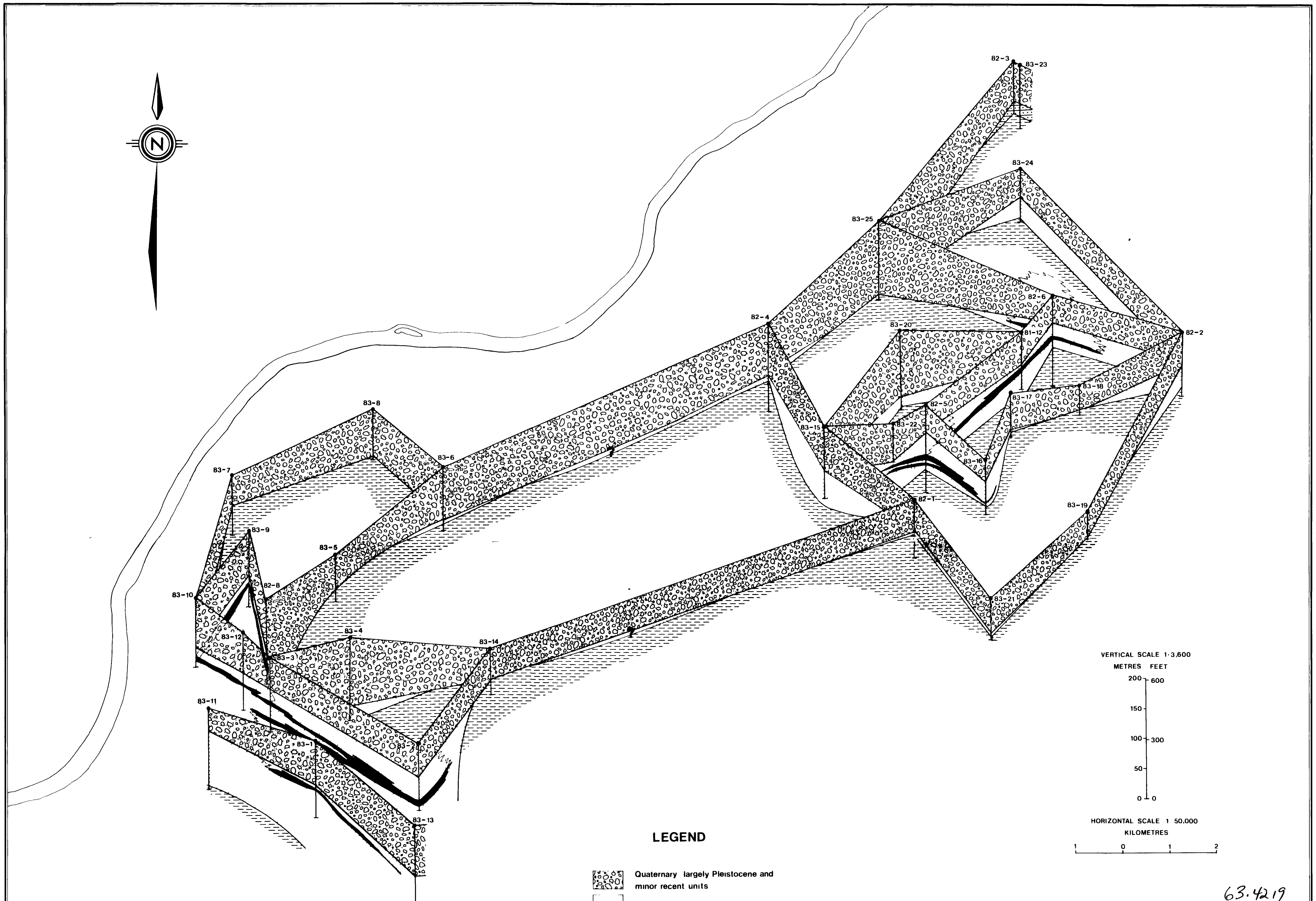
ONEXCO MINERALS LIMITED

DEPTH TO PALEOZOIC SURFACE

OMEP 82-171

SCALE 1:50000		APPROVED D.H.
DRAFTING FAP	DATE 1983-06-10	PROJECT No 618-1 DWG No 3


McCUAG CREEK
CREEK
McCUAIG TP
GENTLES TP
ONEX-82-3
ONEX-W83-23
ONEX-W83-24
ONEX-W83-5
ONEX-82-6
ONEX-82-4
ONEX-W83-20
OEC-81-12
ONEX-82-2
ONEX-82-5
ONEX-W83-17
ONEX-W83-18
ONEX-W83-15
ONEX-W83-22
ONEX-W83-16
ONEX-82-1
ONEX-W83-19
ONEX-W83-21
ONEX-W83-8
ONEX-W83-6
ONEX-W83-7
ONEX-W83-9
ONEX-W83-10
ONEX-82-8
ONEX-W83-12
ONEX-W83-4
ONEX-W83-3
ONEX-W83-14
ONEX-W83-11
ONEX-W83-1
ONEX-W83-2
ONEX-W83-13
1983 ONEXCO FIELD CAMP
LAMBERT TP
RAPLEY TP
GENTLES TP
A
A'
B
B'
C
C'
D
D'
N
LEGEND
1983 lignite discoveries
1982 and earlier lignite discoveries
1983 drill hole location
1982 and earlier drill hole location
Route of drill access roads
B——B' Drill cross section
KILOMETRES
63.4219
Watts, Griffis & McOuat Limited
ONEXCO MINERALS LIMITED
LIGNITE OCCURRENCES -
EAST & WEST GENTLES GRID
OM 82-171
SCALE 1:50 000
APPROVED D.H.
DRAFTING F.A.P.
DATE 1983-06-10
PROJECT Nº 618-1
DWG Nº 4
42J09SE0001 63.4219 WEST OF GENTLES TWP.
230



LEGEND

- Quaternary largely Pleistocene and minor recent units
- Cretaceous
- Jurassic may demonstrate karst features
- Devonian
- Lignite
- 3- Dimensional interpretation

63.4219

Watts, Griffis & McOuat Limited

ONEXCO MINERALS LTD

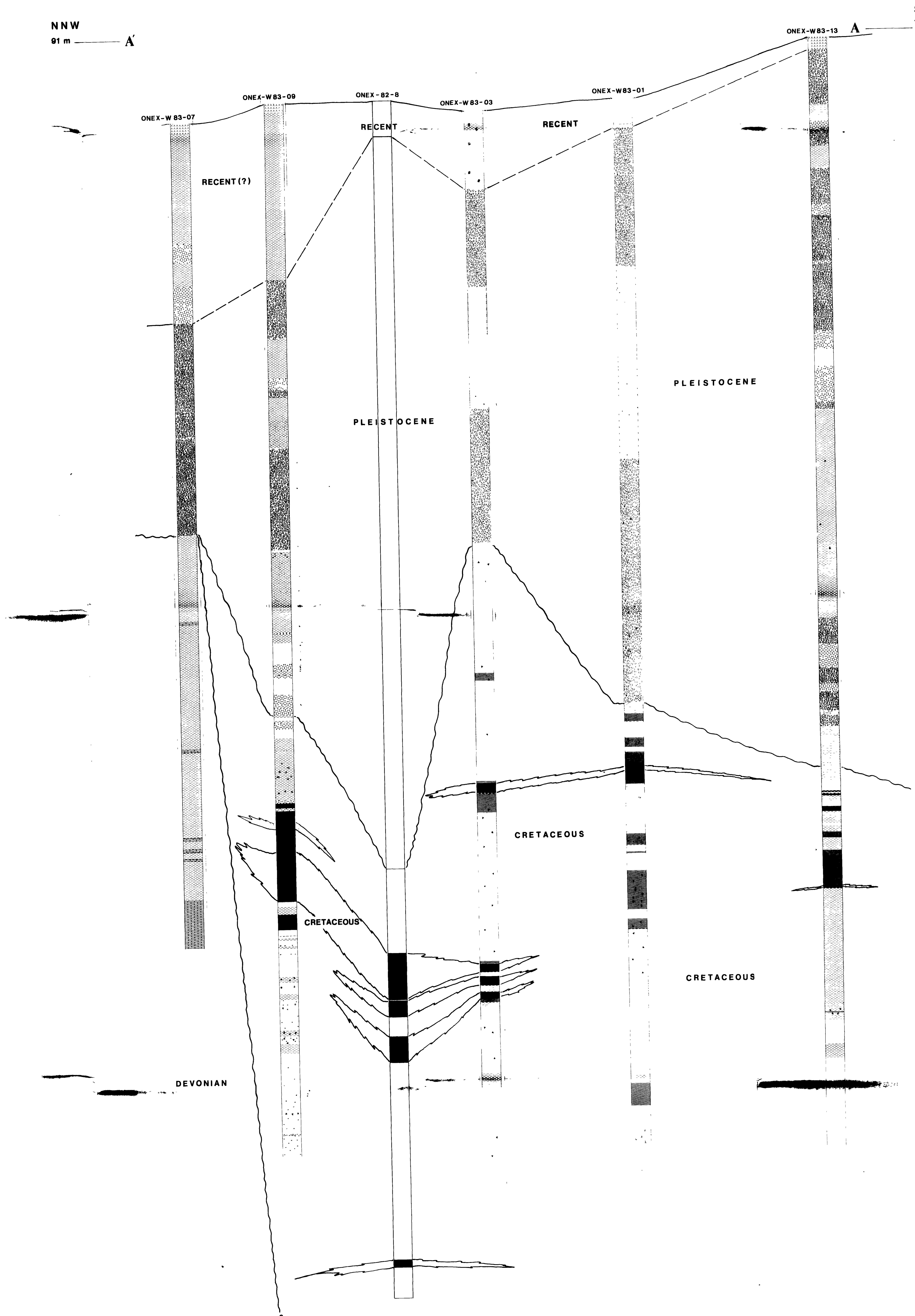
FENCE DIAGRAM ILLUSTRATING QUATERNARY AND MESOZOIC SEDIMENTS IN THE JAMES BAY LOWLAND

OMEP 82-171

SCALE AS SHOWN		APPROVED S.A.Y.
DRAFTING FIONA	DATE 1983-06-03	PROJECT Nº 618-1 DWG Nº 5

42J08SE0001 63.4219 WEST OF GENTLES TWP

240



LEGEND

Muskeg	Gravel	Shale
Clay (may include shale)	Black carbonaceous clay	Breccia
Till	Lignite – relatively massive	Fossils
Fine to medium sands	Lignite chips	Pyrite
Medium to coarse sands	Limestone	Unconformity

VERTICAL SCALE 1:200
FEET METRES
0 – 0, 10, 20, 30, 40; 2, 4, 6, 8, 10, 12, 14

HORIZONTAL SCALE 1:25,000
KILOMETRES
0 0.5 1.0 1.5 2.0

63.4219

Watts,Griffis & McOuat Limited
ONEXCO MINERALS LTD

DRILL HOLE SECTION A-A'

JAMES BAY LOWLANDS

OMEP 82-171

SCALE AS INDICATED		APPROVED R.J.G.,D.H.	
DRAFTING JAN	DATE 1983-6-03	PROJECT NO 618-1	DWG NO 6

LEGEND

Muskeg	Gravel	Shale
Clay (may include shale)	Black carbonaceous clay	Breccia
Till	Lignite – relatively massive	Fossils
Fine to medium sands	Lignite chips	Pyrite
Medium to coarse sands	Limestone	Unconformity

VERTICAL SCALE 1:200

FEET / METRES: 0–40 feet; 0–14 metres

HORIZONTAL SCALE 1:25,000

KILOMETRES: 0 0.5 1.0 1.5 2.0

63.4219

Watts, Griffis & McOuat Limited

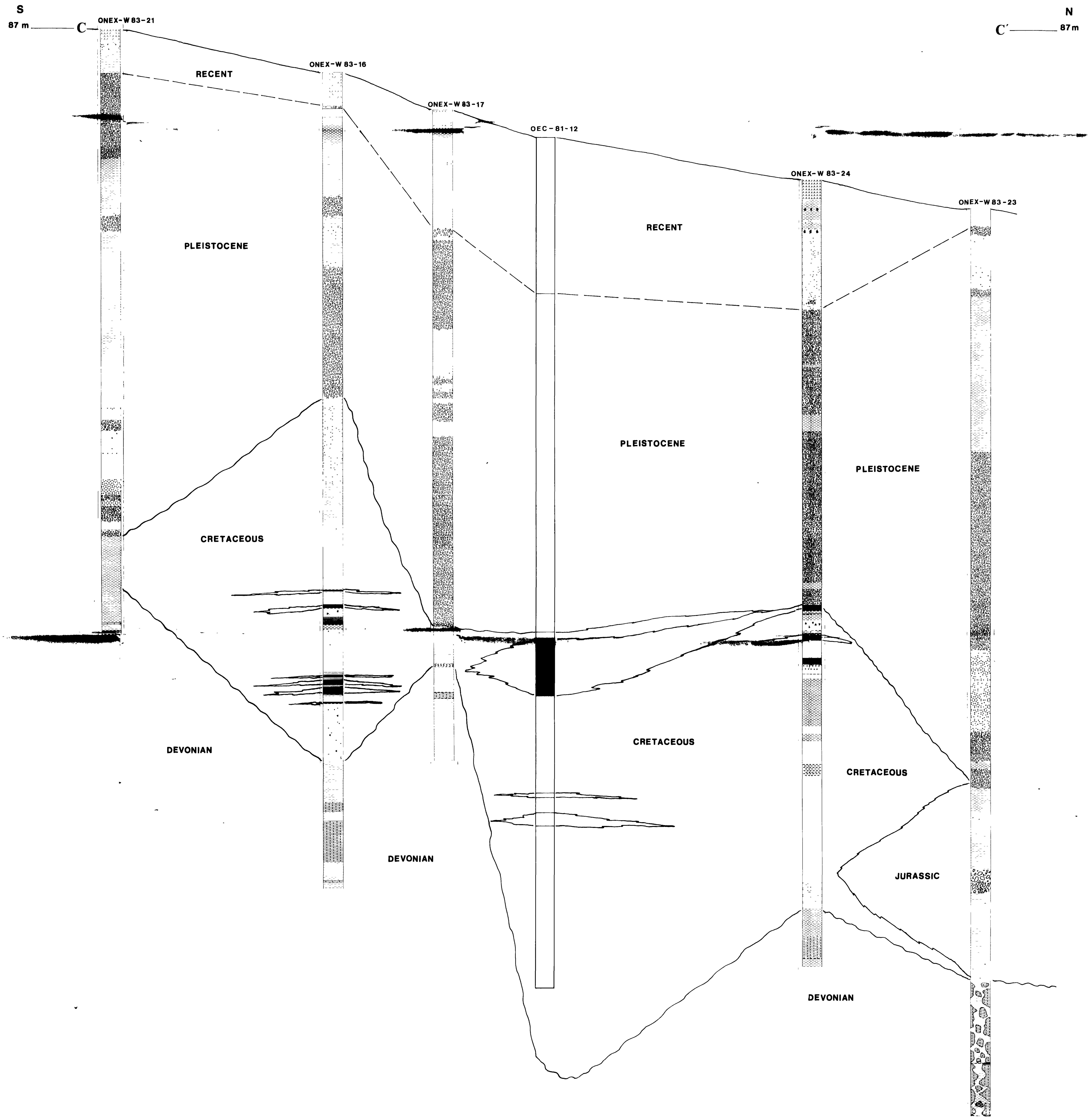
ONEXCO MINERALS LTD

DRILL HOLE SECTION B–B'

JAMES BAY LOWLANDS

OMEP 82-171

SCALE AS INDICATED		APPROVED R.J.G., D.H.
DRAFTING JAN	DATE 1983-6-03	PROJECT Nº 618-1 DWG Nº 7



LEGEND

- Muskeg
- Clay (may include shale)
- Till
- Fine to medium sands
- Medium to coarse sands
- Gravel
- Black carbonaceous clay
- Lignite – relatively massive
- Lignite chips
- Limestone
- Shale
- Breccia
- Fossils
- Pyrite
- Unconformity

VERTICAL SCALE 1:200

FEET 0, 10, 20, 30, 40 — METRES 0, 2, 4, 6, 8, 10, 12, 14

HORIZONTAL SCALE 1:25,000

KILOMETRES 0, 0.5, 1.0, 1.5, 2.0

63.4219

Watts, Griffis & McOuat Limited

ONEXCO MINERALS LTD

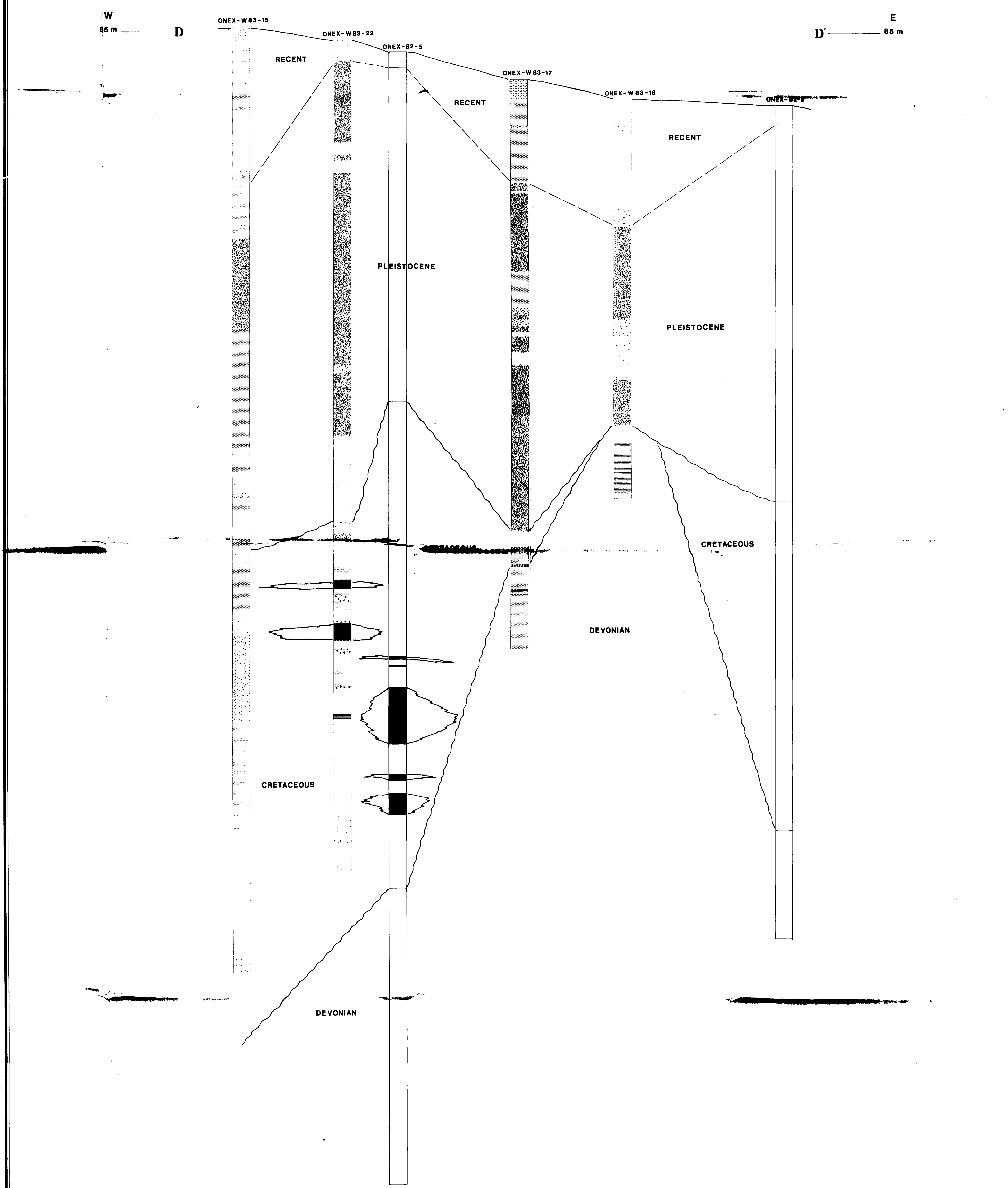
DRILL HOLE SECTION C-C′

JAMES BAY LOWLANDS

OMEP 82-171

SCALE AS INDICATED		APPROVED: R.J.G.D.H.
DRAFTING JAN	DATE: 1983-6-03	PROJECT No 616-1 DWG No 8

42J09SE0001 63.4219 WEST OF GENTLES TWP.



LEGEND

- Muskeg
- Clay (may include shale)
- Till
- Fine to medium sands
- Medium to coarse sands
- Gravel
- Black carbonaceous clay
- Lignite - relatively massive
- Lignite chips
- Limestone
- Shale
- Breccia
- Fossils
- Pyrite
- Unconformity

VERTICAL SCALE 1:200

FEET 0, 10, 20, 30, 40 — METRES 0, 2, 4, 6, 8, 10, 12, 14

HORIZONTAL SCALE 1:25,000

KILOMETRES 0, 0.5, 1.0, 1.5, 2.0

63.4219

Watts, Griffis & McOuat Limited

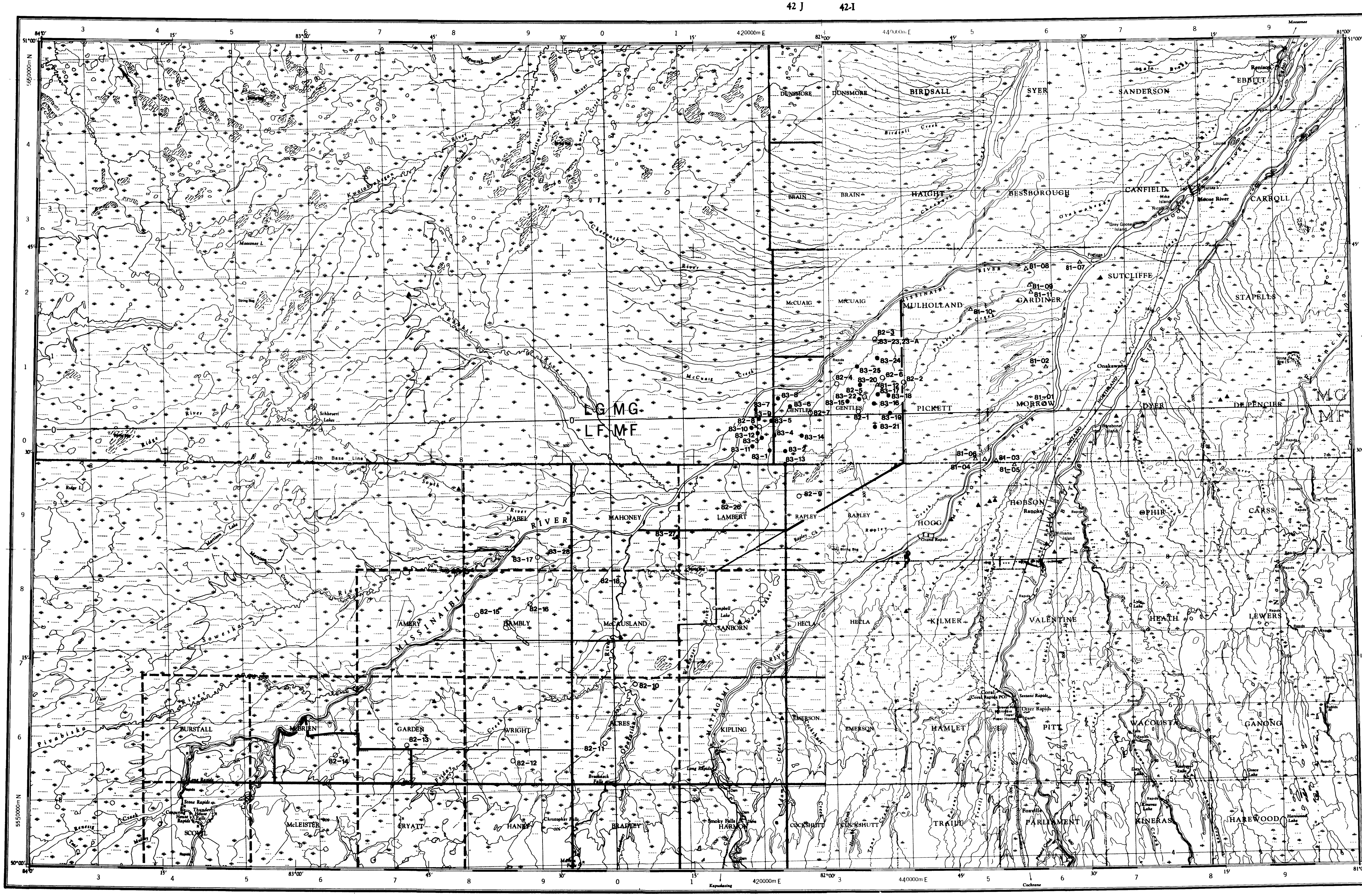
ONEXCO MINERALS LTD

DRILL HOLE SECTION D-D'

JAMES BAY LOWLANDS

OMEP 82-171

SCALE AS INDICATED		APPROVED: R.J.G., D.H.
DRAFTING: JAN	DATE: 1983-6-03	PROJECT NO. 618-1 DWG NO. 9



COCHRANE DISTRICT
ONTARIO

Scale 1:250,000 Échelle

LEGEND

- △ 1981 holes - OEC
- ○ 1982 holes - ONEXCO
- ● 1983 holes - ONEXCO
- ▲ Previous drilling by Ontario MNR and various oil companies
- Area marking 1982 ONEXCO licence area (2 parts total approx. 280,000 acres)
- Area marking May 1983 ONEXCO licence area (2 parts total approx. 150,000 acres)

63.4219

Watts,Griffis & McOuat Limited
ONEXCO MINERALS LTD

DRILL HOLE LOCATION MAP

OM 82-171

SCALE AS SHOWN		APPROVED: R.J.G.
DRAFTING:	DATE: 1983-07-04	PROJECT Nº 619-1 DWG Nº: 10

42J09SE0001 63.4219 WEST OF GENTLES TWP. 290

COMPU-LOG VEL2 PLOT 04-03-83

W83-1

ONEXCO MINERALS LTD.

WEST OF GENTLES TWP.

COMPU-LOG VEL2 PLOT 04-03-83

W83-1

ONEXCO MINERALS LTD.

WEST OF GENTLES TWP.

63.4219

300

W83-7
ONEXCO MINERALS LTD.
WEST OF GENTLES TWP.

W83-7
ONEXCO MINERALS LTD.
WEST OF GENTLES TWP.

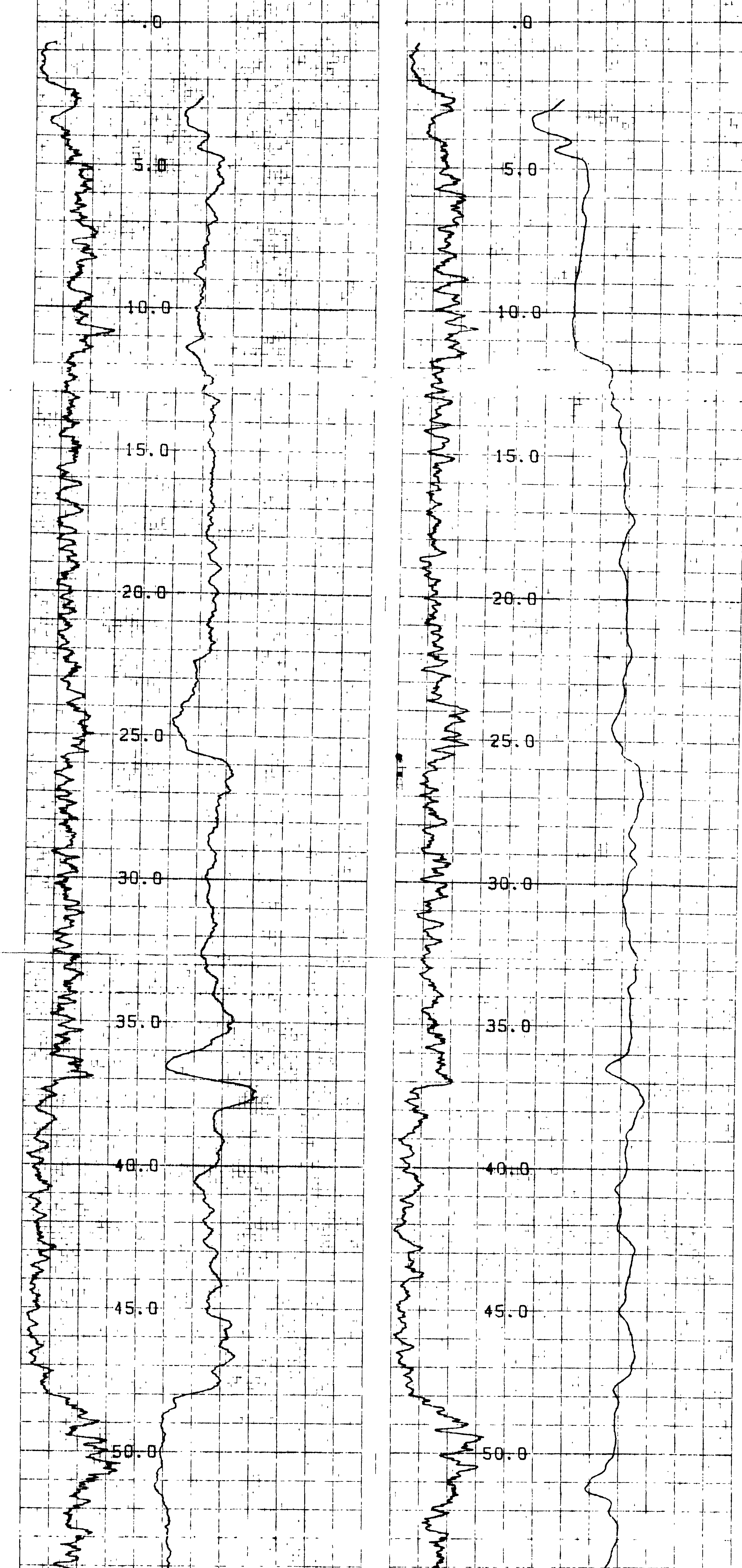
63.4219

42J08SE0001 63.4219 WEST OF GENTLES TWP.

CENTURY GEOPHYSICAL CORP. PART NO. 786-0038

63.4219

320



CENTURY GEOPHYSICAL CORP. PART NO. 786-0038

W83-11
ONEXCO MINERALS LTD.
WEST OF GENTLES TWP.

W83-11
ONEXCO MINERALS LTD.
WEST OF GENTLES TWP.

63.4219

330

COMPU-LOG VOL2 PLOT 01-02-83

W83-12
ONEXCO MINERALS LTD.
WEST OF GENTLES TWP.

HOLE DIAMETER : 05.0
PROBE # 8067 - 613
SENSOR #2 CAL STD CPS = 166
SENSOR #2 CAL RUN CPS = 171
SENSOR #2 CAL BIAS = 0
DATA VOL2vA TRUCK # F811
R.BERKLEY

COMPU-LOG VOL2 PLOT 01-02-83

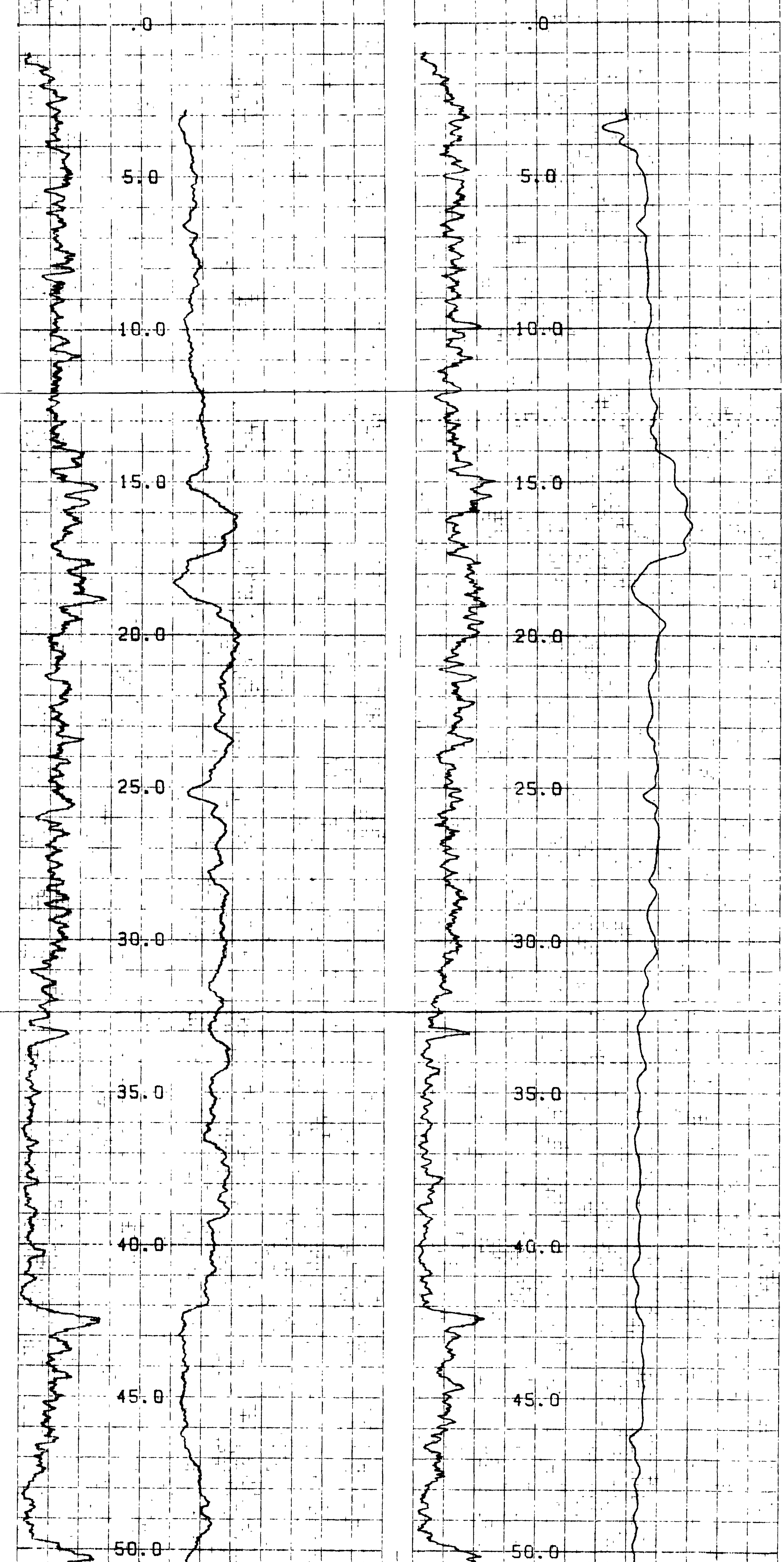
W83-12
ONEXCO MINERALS LTD.
WEST OF GENTLES TWP.

63.4219

42J09SE0001 63.4219 WEST OF GENTLES TWP.

340

CENTURY GEOPHYSICAL CORP. PART NO. 786-0038



COMPU-LOG VEL2 PLOT 04-07-83

W83-16
ONEXCO MINERALS LTD.
E CENTRAL GENTLES TP

COMPU-LOG VEL2 PLOT 04-07-83

W83-16
ONEXCO MINERALS LTD.
E CENTRAL GENTLES TP

HOLE DIAMETER : 05.0
SENSOR #2 CAL STD CPS = 2283
SENSOR #2 CAL RUN CPS = 3640
SENSOR #2 CAL BIAS = 0
DATA VEL2v0 TRUCK # P811
R.BERKLEY

63.4219

42J09SE0001 63.4219 WEST OF GENTLES TWP. 350


0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
100.0
105.0
110.0
115.0
120.3
GAMMA API
N-N CPS
G-G LNCPS
W83-13
ONEXCO MINERALS LTD.
SW BORDER GENTLES TP
CENTURY GEOPHYSICAL CORP. PART NO. 786-0038
63.4219
42J09SE0001 63.4219 WEST OF GENTLES TWP.
360

COMPU-LOG VEL2 PLOT [illegible]

W83-14
ONEXCO MINERALS LTD.
SW GENTLES TWP.

HOLE DIAMETER = [illegible]
PROBE [illegible]
SENSOR [illegible] CAL STD CPS = [illegible]
SENSOR [illegible] CAL RUN CPS = [illegible]
SENSOR [illegible] CAL BIAS = [illegible]
DATA [illegible] TRUCK [illegible]
[illegible] APPL [illegible]

COMPU-LOG VEL2 PLOT [illegible]

W83-14
ONEXCO MINERALS LTD.
SW GENTLES TWP.

HOLE DIAMETER = [illegible]
PROBE [illegible]
SENSOR #2 CAL STD CPS = 2263
SENSOR #2 CAL RUN CPS = 9640
SENSOR #2 CAL BIAS = 0
DATA VEL2vA TRUCK # F611
[illegible] APPL [illegible]

63.4219

COMPU-LOG VAL2 PLOT 04-06-83

W83-15

ONEXCO MINERALS LTD.

CENTRAL GENTLES TWP.

HOLE DIAMETER : 03.0

SENSOR #2 CAL STD CPS = 168

SENSOR #2 CAL RUN CPS = 171

SENSOR #2 CAL BIAS = 0

TRUCK # F011

R.BERKLEY

COMPU-LOG VAL2 PLOT 04-06-83

W83-15

ONEXCO MINERALS LTD.

CENTRAL GENTLES TWP.

HOLE DIAMETER : 03.0

SENSOR #2 CAL BIAS = 0

TRUCK # F011

R.BERKLEY

CENTURY GEOPHYSICAL CORP. PART NO. 786-0038

63.4219

63.4219 WEST OF GENTLES TWP.

380

COMPU-LOG VSL2 PLOT 04-10-83

W83-22
ONEXCO MINERALS LTD.
E CENTRAL GENTLES TP
HOLE DIAMETER : 03.0
PROBE # 3087 - 813
SENSOR #2 CAL STD CPS = [illegible]
SENSOR #2 CAL RUN CPS = [illegible]
SENSOR #2 CAL BIAS = [illegible]
DATA VSL2#A TRUCK # FS11
R. BERKLEY APPL. [illegible]

COMPU-LOG VSL2 PLOT 04-10-83

W83-22
ONEXCO MINERALS LTD.
E CENTRAL GENTLES TP
HOLE DIAMETER : 03.0
PROBE # 3066 - 644
SENSOR #2 CAL STD CPS = [illegible]
SENSOR #2 CAL RUN CPS = [illegible]
SENSOR #2 CAL BIAS = [illegible]
DATA VSL2#A TRUCK # FS11
R. BERKLEY APPL. [illegible]

63.4219

W83-24
ONEXCO MINERALS LTD.
NE GENTLES TWP.

COMPU-LOG V8L2 PLOT 04-06-83
W83-24
ONEXCO MINERALS LTD.
NE GENTLES TWP.
SENSOR #2 CAL BIAS = 0
A. BERKLEY

63.4219

42J09SE0001 63.4219 WEST OF GENTLES TWP.

400

COMPU-LOG VOL2 PLOT 04-18-83

ONEX-W83-27
ONEXCO MINERALS LTD.
N CENTRAL LAMBERT TP

COMPU-LOG VOL2 PLOT 04-18-83

ONEX-W83-27
ONEXCO MINERALS LTD.
N CENTRAL LAMBERT TP

63.4219

42J09SE0001 63.4219 WEST OF GENTLES TWP.

410

ONEX-W83-28
ONEXCO MINERALS LTD.
SE MAHONEY TWP.

ONEX-W83-28
ONEXCO MINERALS LTD.
SE MAHONEY TWP.

63.4219

420

COMPU-LOG VOL2 PLOT 04-19-83
ONEX-W83-29
ONEXCO MINERALS LTD.
SW MAHONEY TWP.
HOLE DIAMETER : 03.0
DATA VOL2vA TRUCK # F811
R.BERKLEY

COMPU-LOG VOL2 PLOT 04-19-83
ONEX-W83-29
ONEXCO MINERALS LTD.
SW MAHONEY TWP.
HOLE DIAMETER : 03.0
DATA VOL2vA TRUCK # F811
R.BERKLEY

63.4219

42J09SE0001 63.4219 WEST OF GENTLES TWP.

430