THE OIL SHALES OF SOUTHAMPTON ISLAND, NORTHWEST TERRITORIES

by

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A report submitted to

SOQUIPET LIMITED
(Societe Generale des Petroles)

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CONTENTS

ILLUSTRATIONS

SUMMARY

On Southampton Island, N.W.T. a 50-foot Oil Shale Interval occurs at the very top of Upper Ordovician limestone. The interval is represented almost everywhere by rubble which suggests the internal constitution is interbedded oil shale and limestone. Lateral extent of the interval is interpreted to be at least 50 miles.

It is recommended:

(1) that further work be done on the Oil Shale Interval to determine its internal constitution, whether it thickens basinward into Hudson Bay, and if it occurs on Coates and Mansel Islands.

(2) explore the petroleum possibilities of the overlying Silurian.

INTRODUCTION

In August, 1963, R.D. Johnson, W. Atkins, and the present writer examined the geology of Southampton and adjacent Coates and Mansel Islands during a brief aerial reconnaissance. At this time a rumour regarding a "rock that burns" was heard and a reward was offered for samples. In the winter of 1963 samples were brought in and determined as oil shale. Shortly thereafter Sogepet Limited dispatched a geologist to find the shale. Travel was by dog team and because of the snow and ice very little oil shale could be found except in rubble.

Subsequently, an agreement was made between Sogepet Limited and an oil company whereby the company was to carry out reconnaissance work directed at delineating the shale occurrences.

The present writer was sent to Southampton Island to independently learn as much as possible regarding the shale, and to act as observer and liaison officer with the oil company.

The present report is based primarily upon the writer's observations and conclusions, although additional data has been obtained from the oil company particularly for the Duke of York Bay, and the Junction Bay areas.

Most of his work was done by 22-foot canoe along the coast southward from Coral Harbour to near Bonny Point, and a short distance east of Coral Harbour in the Ford River area. About a week was spent fly camping in the area adjacent to Sixteen Mile Brook where one of the very few exposures of oil shale occurs (see Figures 3, 8, 12). This work was done by the writer alone, in company with a very capable Coral Harbour Eskimo guide, Timothy Kalai.

GEOLOGIC SETTING

Figure 1 is a geologic sketch map of Southampton Island. The northeastern portion of the island is formed by rather rolling hills of Precambrian crystallines which have elevations generally in the order of 1000 feet. From the air this Precambrian can be sharply delineated from the adjacent Palaeozoic because of its dark colour, in contrast to the light of the latter (figures 4 - 6).

Palaeozoic underlies much of the western and southern part of the Island and, so far as known, consists of Ordovician and Silurian, with the latter areally the most extensive. Almost all of the Ordovician and Silurian appears to be carbonates with the former predominantly limestone and the latter dolomite or dolomitic limestone.

ORDOVICIAN

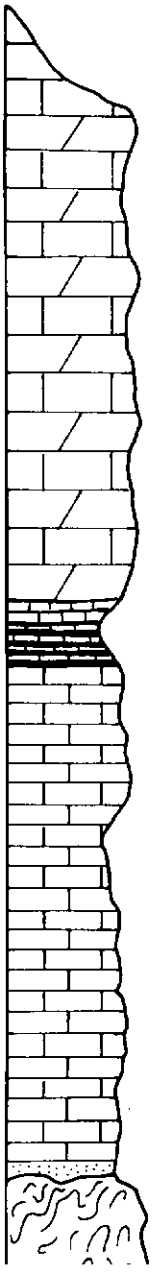
The Ordovician is represented mainly by limestone probably 300 to 500 feet thick. The oil shales occur over a 50-foot interval at the very top of this limestone sequence.

Although the limestones appear to be lithologically homogenous throughout, two distinct faunal divisions are recognised. The lower half of the limestones correlate with the Bad Cache Rapids Group of the northern Hudson Bay Lowland and date as Late Middle or early Late Ordovician - probably the latter. Fossils identified from this horizon on Southampton Island are as follows:

Receptaculites sp.
Soffordophyllum? portagechutensis Nelson
Catenipora rubra Sinclair and Bolton
C. agglomeratiformis (Whitfield)
Favistella alveolata (Goldfuss)
Plasmopora lambei Schuchert
? Lobocorallium gonionhylloides (Teichert)
? Narthecoceras crassisiphonatium (Whiteaves)
Winnipegoceras laticurvatum (Whiteaves)
Diestoceras sp.

The upper limestones correlate with the Churchill River Group of the Lowland and are very Late Ordovician, probably Richmondian and Gamachian in age. Fossils identified from these limestones on Southampton Island are listed below.

Stromatoporoid indet.
Favosites wilsonae Nelson



SILURIAN (undivided)
limestone, dolomite
thickness unknown

Oil Shale Interval - about 50' thick - Interbedded oil shale and limestone, with beds of shale probably more numerous and/or thicker in lower part of interval.

Upper Upper Ordovician
(Churchill River Group)
- mainly limestone

ORDOVICIAN
300' - 500'
thick

Upper Middle or Lower Upper Ordovician
(Bad Cache Rapids Group)
- mainly limestone

Precambrian Crystallines (undivided)

Palaeofavosites canax (Billings)
P. alveolaris (Lonsdale)?
Catenipora robusta (Wilson)
Favistella alveolata minor (Bassler) s. l.
Protrochiscolithus kaeiri Troedsson
? Meramvonia ceres (Billings)
Liospira sp., cf. L. parva Wilson
Kochoceras sp.
"Nionoceras" sp.
Diestoceras sp.
? Lambeoceras sp.
Digenuoceras okulitchi Nelson
Antiplectoceras shemaltawaense (Parks)

The oil shales occur in the uppermost 50 feet of the limestones, and are interpreted as occurring immediately below the Silurian contact. They are extremely recessive and almost never outcrop. The writer has seen only two small outcrops of thinly interbedded oil shales, and these only in the Sixteen Mile Brook area (figures 7, 8, 12). Both are in the very upper part of the interval and consist of several 1" - 3" beds of oil shale interbedded with limestone. These outcrops, and the oil shale problem, are discussed in detail on pages 7 - 9.

The writer bases most of his ideas regarding the shale upon rubble. In his opinion it occupies an interval about 50 feet thick extending from the Sixteen Mile Brook area eastward to the East Bay area (figure 2). It apparently extends intermittently northward to the Duke of York Bay area as suggested by rubble occurrences. Rubble also indicates that it extends southeastward from East Bay to near the Junction Bay area. Rubble occurrences suggest that the shale is interbedded with limestone although it is not known in what thickness and quantities. Drilling by the oil company failed to pierce the shale. The lower beds of shale appear to be calcareous and contain less oil than in the upper beds.

The shale is considered to be Ordovician on rather tenuous fossil evidence. Rubble from the lower part of the interval, along the beach immediately south of Sixteen Mile Brook has yielded rare trilobites and graptolites. The trilobites could not be generically identified. They appear to belong to the Asaphid group and are either isotelinids or niobinids. These are mainly an Ordovician family. The graptolites belong to the genus Climacograptus but time did not permit a specific identification. The genus ranges from Ordovician into Lower Silurian but is most characteristic of the former. Thus, although there is no positive proof whether the oil shale is Silurian or Ordovician, the faunal evidence is more suggestive of an Ordovician

age. The stratigraphic position of the shale with respect to the underlying limestones of Richmondian or Camachian age (see figure 2) indicates a very late Ordovician age.

By rubble study the top beds have been traced to within about 30 feet of fossiliferous Silurian (figure 17), and contact relationships at Sixteen Mile Brook suggest the shale may be in sharp, paraconformable contact with the overlying (unfossiliferous) Silurian.

SILURIAN

Silurian strata are apparently very extensive on Southampton Island and consist generally of light grey weathering, light grey dolomite and dolomitic limestone. Such carbonates display a rather heterogeneous array of types ranging from well bedded to massive blocky, almost structureless masses interpreted as reefal material (figure 19). In several places along the coast south from Sixteen Mile Brook the Silurian carbonates were found to have a pronounced bituminous odour. The Silurian overlying the oil shale from Sixteen Mile Brook to Penny Point is generally unfossiliferous, although beds extending from 30 feet to 100 feet (estimated) above the oil shales yielded the following fossils:

Clathrodictyon striatellum (D'Orbigny)?
C. cystosum Parks?
Lyellia affinis (Billings)
Paleofavosites prolificus (Billings)?
P. sp., cf. P. kirki Stearn
Virgiana decussata (Whiteaves)?
? Brachyprion acanthopterus (Whiteaves)
? B. robustus Twenhofel
Orthocone nautiloid

The reader is referred to page 11 for a discussion of the possible thickness and oil potentialities of the Silurian on Southampton Island.

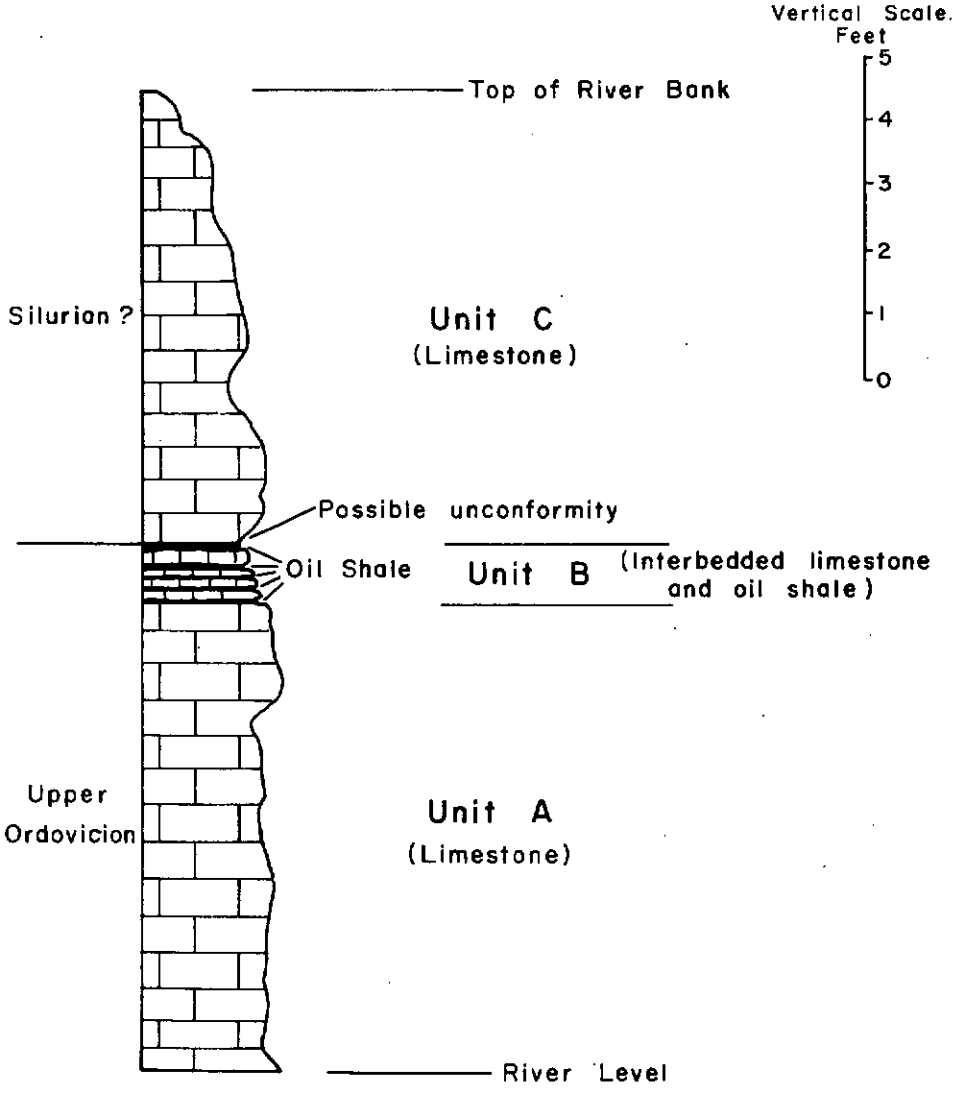


FIGURE 3. Columnar section showing the oil shale outcrops along Sixteen Mile Brook, and the interpreted stratigraphic position.

DETAILED DESCRIPTION OF THE OIL SHALE

The present writer has studied the oil shale in three areas: The Sixteen Mile Brook; Ford River; and East Bay areas.

SIXTEEN MILE BROOK AREA

The Sixteen Mile Brook area has the only outcrops of the shale known to the writer. These occur about three-quarters of a mile from the mouth of this stream on the south (right) bank (figures 7-9) and about one mile north of the Brook (see section C-D figure 20 (in pocket), figures 10-12). The outcrop which consists mainly of limestone is about 15 feet thick. Three lithologic units (A-C) are recongized, tabulated and described below (see also figure 2):

Silurian?	Unit C	Limestone, light brownish grey, rather mottled, microcrystalline, light brownish grey weathering. Unfossiliferous. Resistant..... 7'
		Paraconformity?
	Unit B	Oil shale and limestone, interbedded. Oil shale in five beds, lower four about ½" thick, upper one 2" - 3" thick..... 11"
Upper Ordovician	Unit A	Limestone, light grey microcrystalline, light grey weathering, thin bedded (1" - 2") often platy..... 7'
		river level

Regional relationships suggest that these shales occur in the very highest portion of the Oil Shale Interval; and that the contact with the overlying limestones of unit C is suggestive of a paraconformity. Thus the latter beds are tentatively referred to the Silurian, although they and the underlying units B and C have yielded no identifiable fossils.

The shale itself is reported to yield in the order of 25 gallons per ton according to the oil company representative. It will burn under its own power provided it is started by a more combustible material like wood (see figure 9) and gives off dark smoke with an intense odour of tar.

Rather abundant shale rubble occurs along the beach for about a mile south of Sixteen Mile Brook and most of it is thought to belong in the lower portion of the interval. This shale is more calcareous, and consists of dark grey calcareous oil shale which occasionally becomes so calcareous as to become a bituminous limestone. According to the oil company representative these lower shales give smaller yields of oil: in the order of 8 gallons per ton.

The area to the north about halfway between Sixteen Mile and Rocky Brook has yielded the most information about the overall shale interval. Section C-D of figure 20 is a rather diagrammatic profile extending inland from the tidal flats westward for about one-half mile to limestone and dolomite cliffs interpreted as Silurian. The tidal flats contain unfossiliferous limestone rubble very near outcrop and thought to underlie the shale. The shale interval itself extends inland for about one-half mile in gradually rising old shoreline ledges (see figure 11). Except for one thin oil shale band at the base of the cliffs, the shale is represented entirely by rubble (see figure 12). Three spot checks were made on the proportion of oil shale to limestone in the rubble by blind sampling: one was taken near the shore, presumably from the lower portion of the shale interval; the second about halfway inland, and presumably from the middle of the interval; and the third near the base of the cliffs in the upper part of the interval. The first showed nine out of fifteen samples to be oil shale; and the second three out of fifteen; and the third four out of fifteen. Levelling suggests that the interval is about 50 feet thick. From this data it is assumed that the oil shale is interbedded with limestone through the interval and that the shale is more numerous in the lower part of the interval (figure 2). The thickness of individual shale and limestone beds, of course, is not known, although the high proportion of shale in the lower part of the interval may indicate fairly thick beds.

FORD RIVER AREA

The Paleozoic area near the mouth of the Ford River is devoid of outcrop. Consequently, studies were made of rubble along the beach. This rubble suggests that the Ordovician - Silurian contact area should lie two to three miles south of the river mouth.* Oil shale rubble is rare but is more frequent near the presumed contact than elsewhere. Indeed it appears completely lacking a mile or so on either side of the presumed contact.

Although the interpretation of the Ford River area is based upon very sketchy rubble data, this data does suggest that the shale occurs in about the same stratigraphic position as at Sixteen Mile Brook, i.e. at the very top of the Ordovician sequence. Thickness of the interval is, of course, unknown.

EAST BAY AREA

The oil shales of the east bay area were very briefly studied by means of helicopter. These shales occur in a mesa about a mile south of the east end of East Bay [see figures 13-15; figure 21 (in pocket)]. Although the sequence in the mesa and adjacent to it is almost completely rubble, the physiographic expression of the various lithologies gives a clear idea of the stratigraphic succession.

The rubble below the shale appears to be Ordovician and that above displays the same lithologic types noted in the Silurian elsewhere on Southampton Island. Indeed the writer was impressed with the great stratigraphic and lithologic similarity between the East Bay sequence and that of Sixteen Mile Brook. The only difference is that the East Bay rock is devoid of fossils.

Like Sixteen Mile Brook the shale interval is about 50 feet thick and consists of mixtures of shale and limestone. Time did not permit rubble studies as the writer was principally concerned with helping to date the sequence. Drilling had been attempted by the oil company but had to be abandoned because of lack of footing.

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* A helicopter landing was made on the outcrops of Little Corner Cliff another two to three miles further south. The lithology there is highly indicative of Silurian, suggesting that the contact position is approximately correct.

CONCLUSIONS AND RECOMMENDATIONS

Stratigraphic studies of both outcrop and rubble suggest that an Oil Shale Interval about 50 feet thick occurs at the very top of the Ordovician limestone sequence on Southampton Island. This interval may extend with approximately the same thickness over a 50-mile stretch from Sixteen Mile Brook to the East Bay area. Rubble indicates that the interval extends north toward the Duke of York Bay area, and southeastward toward the Junction Bay region. No data exists for thickness of interval in the latter two areas.

The internal characteristics of the Oil Shale Interval are not known because it is almost completely represented by rubble. This rubble, however, suggests that it consists of interbedded limestone and oil shale and the rubble density indicates that oil shale interbeds are more numerous or thicker in the lower parts of the interval than in the upper.

The writer is of the opinion that further work should be done on the oil shale and adjacent rocks. He bases this conclusion on the premises (1) that the overlying Silurian shows promise as a reservoir rock and may possibly attain considerable thicknesses; and (2) that an oil shale is present and on the north flank of a postulated basin of considerable dimensions.

Accordingly, he recommends three projects described below:

(1) Determine thickness and content of the Oil Shale Interval by drilling

One of the frustrations resulting from the field work is that although a great deal of work was done on the Oil Shale Interval, no clear idea exists as to what the interval actually looks like. Does it consist of thick beds of shale or thinly interbedded ones and in what density?

It is recommended that drilling should be done in the southern parts of the island in areas like Cape Low and Cape Kendall. If there is a general southward basinal thickening toward the centre of Hudson Bay as suggested by Hood (1964) then the finding of an increased thickness of Oil Shale Interval could be very significant indeed, not only as it pertains to the petroleum possibilities of Southampton and adjacent Coates and Mansel Island, but also to the whole of the Hudson Bay basinal area.

The shale presumably was deposited in an euxinic environment, one that sometimes results in concentration of minerals like uranium, copper, vanadium. A spectroscopic analysis was made of the shale from various areas for its element content. This showed that uranium, iron, lead, manganese, molybdenum, nickel, titanium, and vanadium did occur in traces. Although such traces are to be expected in such shales the writer nevertheless feels that in future exploration the possibility should always be considered that significant concentrations may be localised.

(2) Determine if oil shale is present on Coates and Hensel Islands

The oil company made a brief shore reconnaissance of Coates Island by means of Peterhead launch. Although no oil shale was found the writer is of the opinion that this does not negate these islands. Accordingly he suggests that helicopter or penguin (see page 14) exploration be made before these islands are written off. Coates Island in particular is geologically very interesting because of the pronounced structures in the Palaeozoic (see Johnson, 1963) which may be related to basement faulting or reef draping. These structures could become very significant if shale was present.

(3) Explore the petroleum possibilities of the Silurian

This suggestion is made because there is a possibility that oil may have seeped out of the shale into the overlying Silurian. In several places the Silurian has a pronounced bituminous odour, although no oil staining was seen.

The Silurian lithology is such that it shows promise as a reservoir. The bedded dolomites are often porous, and reefal pods are fairly common (see figure 19). A considerable amount of local doming and warping was noted during aerial traverses in 1963 and the present writer felt that some may be due to draping over sub-surface reefs.

Probably the key to whether the Silurian is important as a reservoir is its total thickness. No answer is available as attitude data is very scanty. A southward dip of 7 degrees was noted in the Ordovician along the upper part of the Sutton River (locality S3) in 1963. This is not typical, however, and is probably a result of movements along or near the Ordovician - Precambrian contact. A very rough minimum attitude of between $\frac{1}{4}$ and $\frac{1}{2}$ degrees southward was calculated in the Sixteen Mile Brook area. If this continued

to the Cape Low area a Silurian thickness of perhaps 2000 feet, and 2500 feet if the Ordovician were added, might be anticipated. If basinal thickening is occurring southward toward Hudson Bay a greater thickness may well occur. R.D. Johnson (1963) is of the opinion that the regional southward dip might be in the order of one degree which would considerably increase the possible thickness. Mention should be made here of Hook's (1964) magnetometer survey. He shows a thickness of 1000 feet through the Cape Low area, but a 2500 foot one a very short distance southward.

LOGISTICS AND OTHER CONSIDERATIONS

This section is devoted to a comparison of various methods of exploration, and suggestions for dealing with that admirable human being, the Eskimo.

LOGISTICS

Float Plane

During August of 1963 the preliminary reconnaissance of Southampton Island was made by float equipped Otter landing on lakes. Although this plane was excellent, particularly in its short take-off, the basic disadvantage was in its deep draught floats. Since there are relatively few deep lakes - or perhaps more important, those that can be ascertained as such from the air - the amount of geologic work done by this method is limited.

Perhaps the best plane for such work is the shallow draught Beaver or Cessna. Both have rapid take-off. Because of their limited carrying capacity, however, all supplies - geologic and otherwise - would have to be brought to Coral Harbour by some other means.

Helicopter

Southampton Island is ideally suited for helicopter exploration because of the flat terrain. The relatively high wind, however, can sometimes be disadvantageous. The numerous lakes which dot the island will allow a float plane to set up fuel caches if operations are extensive. Otherwise the size of the island is such that a helicopter can lay out its own small caches.

Canoe

Because much of the coastal areas of Southampton Island bear outcrop, canoe traverse is feasible although inclement weather may prolong field work.

A 22- foot canoe is recommended as the ideal size because of its sea worthiness, load capacity and ease of handling. The last needs to be qualified: such a canoe is cumbersome but in the event of storms a safe landing can usually be made without hull damage during beaching.

Because of the unpredictable Eskimo outboard motors it is recommended that:

(1) travel be as close to shore as possible. If the motor breaks down and an offshore wind is blowing the canoe may be swept off into Hudson Bay. Under such conditions the large size of canoe prevents handling by paddle.

(2) the geologist bring his own auxiliary motor - preferably a 5 to 10 h.p. This should suffice to bring the canoe into shore against strong off-shore winds.

Canoe and Penguin

This method has not been tried on Southampton Island but the writer's experience with these small amphibious vehicles in the Cape Tatnam Region makes him think it is feasible.

Basically the method is this: canoes will carry penguins along the coast to designated positions, and the penguins will strike off inland, returning to move further along the coast by canoe.

The penguin is a small two man vehicle with large, low pressure tires. Both these and the boat-type construction of the body help to float the vehicle when necessary, although paddles are needed for direction and power.

A 22- foot canoe can carry one penguin, its trailer and operator, and the attendant supplies probably covering a two or three week interval. Movement along the coast can take place between winds, and inland exploration on windy days. As the penguins should travel in pairs two canoes would be needed.

Inland exploration could be done by travelling along old beach ridges, and inland rock rubble areas which abound in parts of the interior of the island. As penguins are poor travellers on tundra and marsh, air photographs must be used for guidance regarding ground conditions in the proposed line of travel.

As mentioned above the penguins should travel in pairs. This is because they are subject to minor mechanical troubles. Because of this one of the operators should also be mechanically experienced.

Peterhead

A Peterhead is a very seaworthy Eskimo launch some thirty feet by ten with deep draught. Much Eskimo travelling along the coast, and between islands and the mainland is done using this boat.

Although such a craft could be useful for ferrying supplies like penguins and 22-foot canoes across large bodies of water to Coates and Mansel Islands, its deep draught will not allow it to approach shore closely unless one of the very rare harbours is available. Because of this it may be necessary to ride out a storm, if the boat cannot be beached.

This method of travel, particularly across large bodies of water, is preferable to that by single engined aircraft, but not by a large margin. The motors are unpredictable, as the writer has experienced, and the geologist may find himself riding a powerless craft during rising waters.

OTHER CONSIDERATIONS

Relationships with the Eskimo

All field parties should have at least one Eskimo guide. Such a guide is extremely useful for his sharp eyes as parts of the islands at the north end of Hudson Bay, particularly Coates Island, abound in predatory polar bears which may not be seen by a geologist intent on studying rocks. A guide is also necessary for survival in case it may become necessary to live off the land.

Two points should be mentioned here regarding the Eskimo. One is his religion and the other his maintenance of motors.

There are no Eskimos on Mansel or Coates Islands. Nearly all of them are clustered about the Coral Harbour Department of Transport or Hudson Bay Post. A great many of the dependable guides, both Protestant and Roman Catholic, are extremely religious, and will not work on Sunday. This must be taken into account when hiring. Because these men are usually the best guides the geologist should not make demands upon them.

The writer has found that although the Eskimos are usually very good mechanics they are often very poor on preventative maintenance

Consequently he does not trust their motors. The geologist is well advised to bring his own spare outboard motor in case of breakdown. It is particularly important that he personally check to see that the necessary oil, gas, and other critical supplies are on board. Misunderstandings regarding acquisition of supplies occur even with Eskimos who appear to have a fairly fluent command of English.

The writer wishes to stress that the above must in no sense be construed as a criticism of the Eskimo. For his kindness, decency, and integrity, the Eskimo has few peers.

FOSSIL IDENTIFICATIONS

Locality M64-2A - about one-half mile south of oil shale exposures on Sixteen Mile Brook.

? Brachyprion acanthopterus (Whiteaves)
? B. robustus Twenhofel
Orthocone nautiloid

This collection is in the order of 10 to 25 feet stratigraphically higher than the oil shale beds on Sixteen Mile Brook. The aspect of the collection is Silurian but because of its poorly preserved nature this dating is not positive.

Locality M64-3A - about one mile south of Sixteen Mile Brook, and about one-quarter mile in from shore.

Clathrodictyon striatellum (D'Orbigny)?
Palaeofavosites prolificus (Billings)?
P. sp., cf. P. kiaeri Stearn
Lyellia affinis (Billings)
Virgiana decussata (Whiteaves)?

This collection is Silurian but no finer delimitation is possible.

Locality M64-9A - first small creek south of Sixteen Mile Brook (about three-quarters mile south) and about three-quarter mile up from mouth.

Stromatoporoid: indet.
Clathrodictyon striatellum (D'Orbigny)?
C. cystosum Parks?
Palaeofavosites prolificus (Billings)?
Lyellia affinis (Billings)
Virgiana decussata (Whiteaves)

This collection is Silurian but no finer delimitation is possible.

Locality M64-12A - about two miles north of Rocky Brook. This is the first cliff forming outcrop in from shore on Section C-D of Figure 20.

Cateniporа robusta (Wilson)
Palaeofavosites canax (Billings)

Favosites wilsonae (Nelson)
Favistella alveolata minor (Basaler) s.l.
Protrochiscolithus kiaeri Troedsson
? Meganyonia ceres (Billings)
Liospira sp., cf. L. parva Wilson
Digenuoceras okulitchi Nelson
Diestoceras sp.
Hochoceras sp.
"Kionoceras" sp.
? Lambeoceras sp.

Upper Upper Ordovician, correlating with the Churchill River Group of the northern Hudson Bay Lowland (see Nelson, 1963) and possibly with the Caution Creek Formation of this group. See locality M64-15A which appears to belong to the higher Chasm Creek Formation.

Locality M64-14A - mouth of Rocky Brook.

Receptaculites sp.
Saffordophyllum? portagechutensis Nelson
Catenipora rubra Sinclair and Bolton
C. agglomeratiformis (Whitfield)
Favistella alveolata (Goldfuss)
Plasmopora lambei Schuchert
Lobocorallium goniophylloides (Teichert)
Diestoceras sp.
Winnipegoceras laticurvatum (Whiteaves)
? Parthoceras crassisiphoratum (Whiteaves)
Cyrtocomphoceras sp. (not collected)

Middle or low Upper Ordovician, correlating with the Red Cache Rapids Group of the northern Hudson Bay Lowland.

Locality M64-15A - about two miles north of Rocky Brook. This is the highest outcrop of Upper Ordovician indicated on Section A-B of Figure 2.

Antiplectoceras shamattawaense (Parks)
? Diestoceras sp.

Upper Upper Ordovician, correlating with the Churchill River Group of the northern Hudson Bay Lowland (see Nelson, 1963) and possibly with the Chasm Creek Formation of this group.

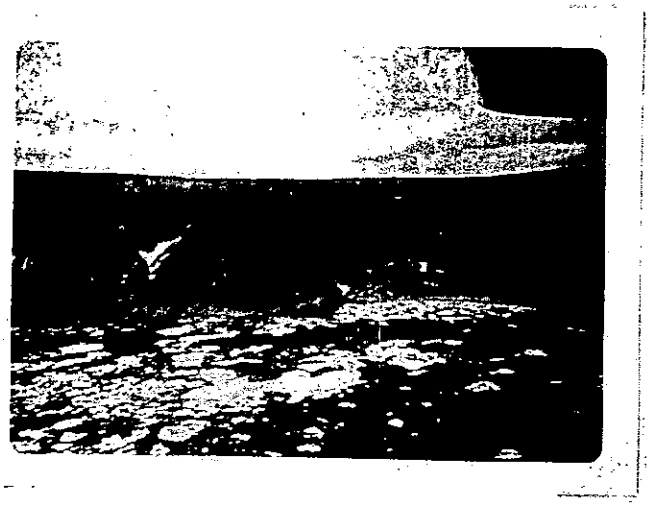


Figure 4. Steeply dipping Precambrian strata along northeast coast of Southampton Island.

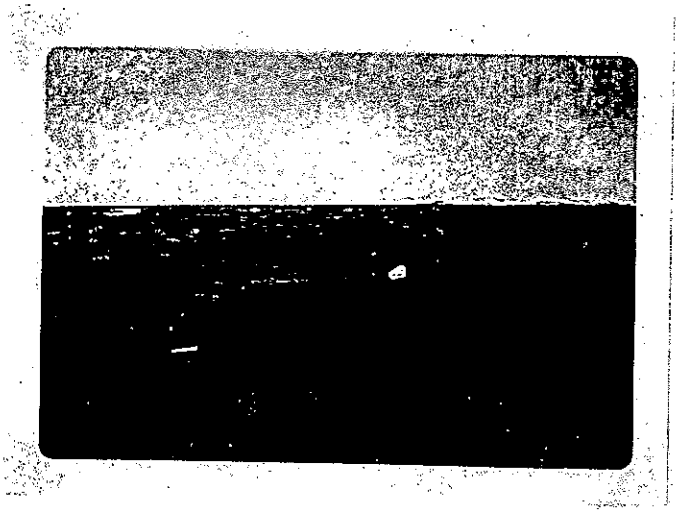


Figure 5. Precambrian topography near Coral Harbour (Hudson Bay Post), Southampton Island.

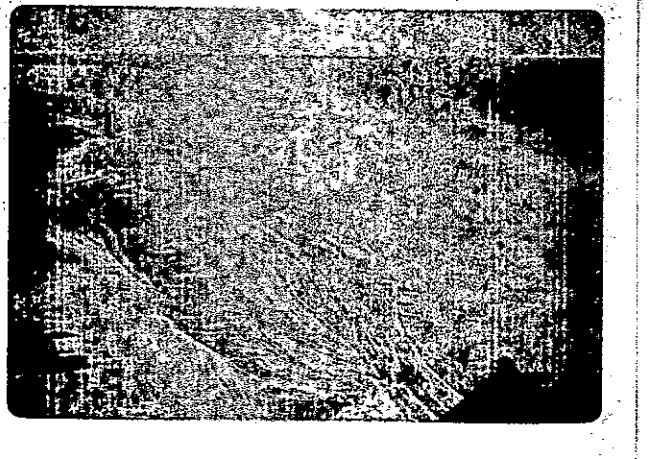


Figure 6. Palaeozoic terrain. Note light grey colour in contrast to figures 4 and 5. West Coast of Southampton Island.

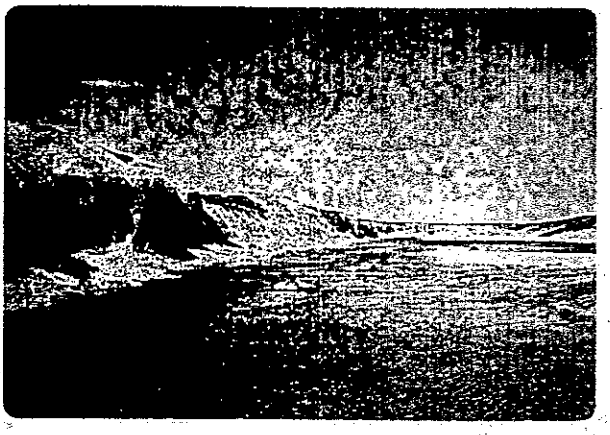


Figure 7. Sixteen Mile Brook, about ½ miles from mouth showing outcrop containing the oil shale interbeds.

Figure 8. Close-up of foreground rocks shown in Figure 7. Eskisc is pointing to Unit E containing the oil shale interbeds.

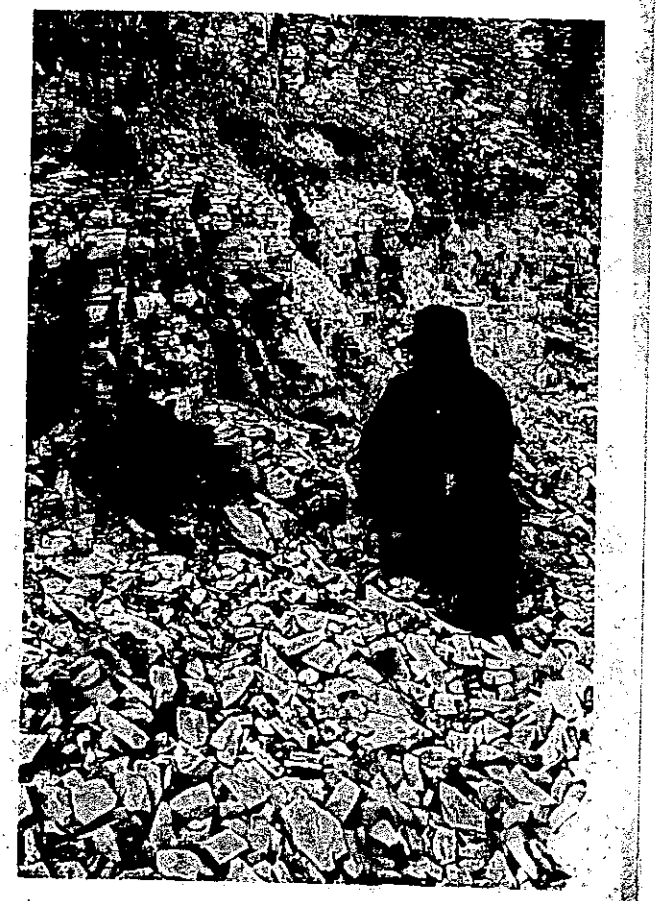


Figure 9. Eskimo burning oil shale at Sixteen Mile Brook.

Figure 10. Rubble covered Oil Shale Interval shown in section C-D of figure 20. About 3 miles north of Sixteen Mile Brook. Photo is taken from position B looking toward cliffs of Silurian limestone. See figure 12. Three out of fifteen samples are oil shale at this locality.

Figure 11. Rubble covered Oil Shale Interval shown in Section C-D of figure 20. About 3 miles north of Sixteen Mile Brook. Photo taken near shore at position A where 9 out of 15 samples were oil shale.

Figure 12. Base of Silurian cliffs shown in figure 10. See also section C-D of figure 20. One small 3" bed of oil shale occurs at very base of outcrop.

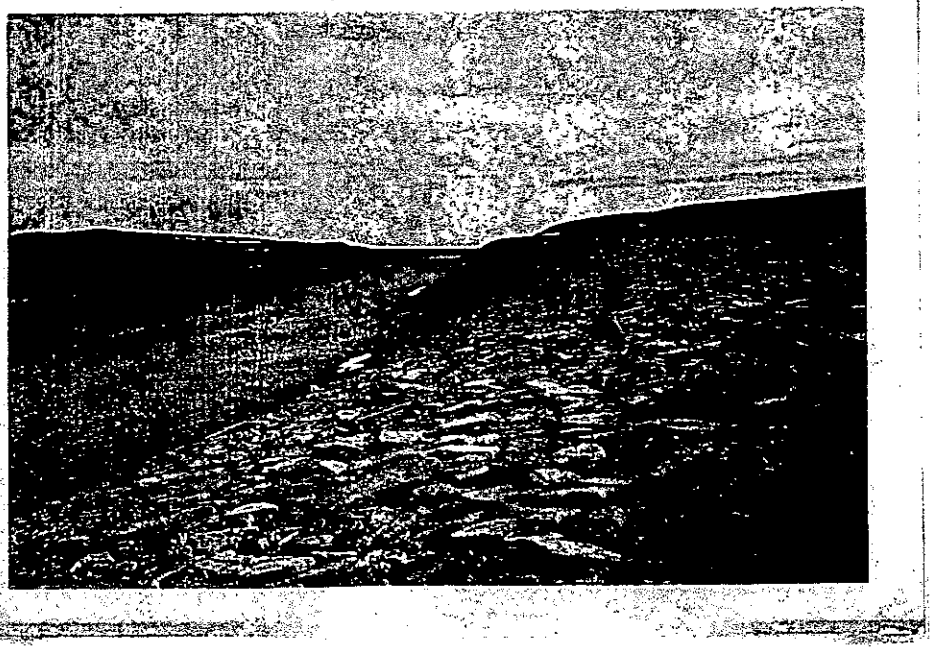


Figure 13. East Bay area, looking northeastward toward Cove Point. Oil Shale Interval is the fine brownish rubble in centre of photograph. Man is standing on overlying blocky Silurian dolomite.

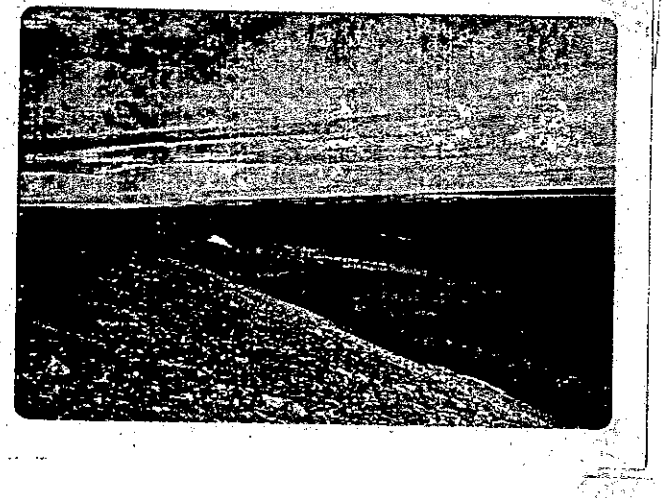


Figure 14. East Bay area looking northwestward from about same position as figure 13. Oil Shale Interval is in centre of photograph.

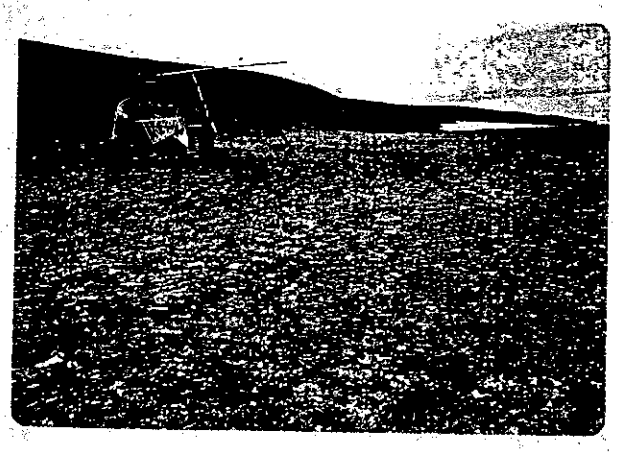


Figure 15. East Bay area. Helicopter is on Oil Shale Interval. Most of rubble is oil shale.

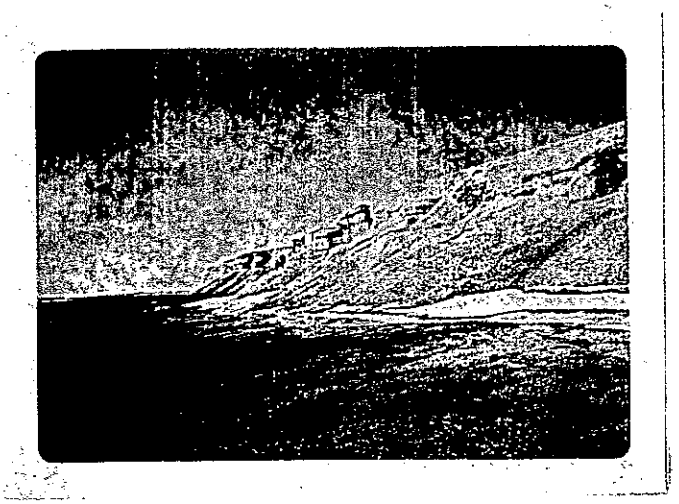


Figure 16. Rocky Brook area: about 2 miles north of Brook and about ¼ mile in from shoreline. Cliffs are Upper Ordovician limestone coeval with Churchill River group. Locality N64-12 (see section A-B of figure 20).

Figure 17. Sixteen Mile Brook area, about 1 mile south of Brook along unnamed creek. Cliffs are Silurian limestone thought to be about 30 feet stratigraphically above the Oil Shale Interval. Locality N64-9.

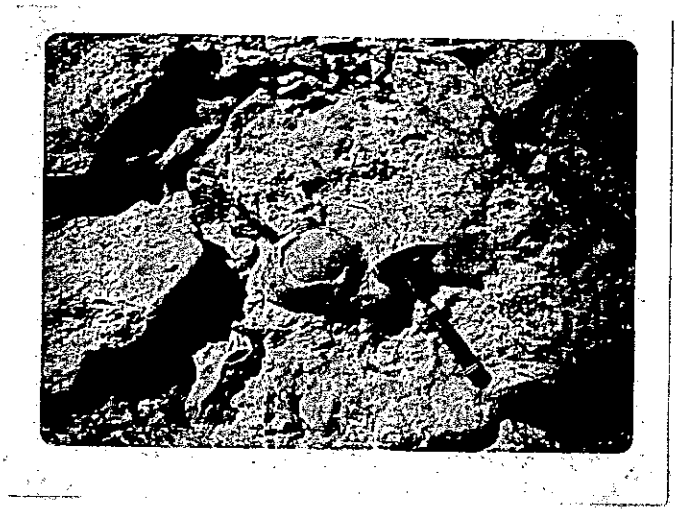


Figure 18. Silurian biostrome showing stromatoporoid colony. Cape Leyson area.

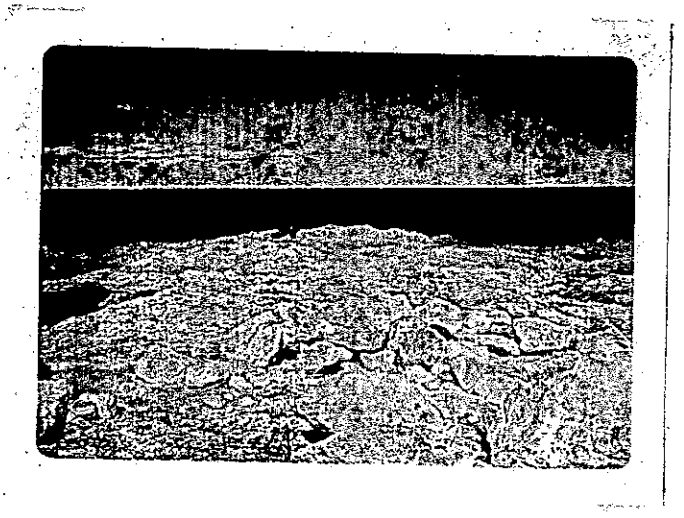
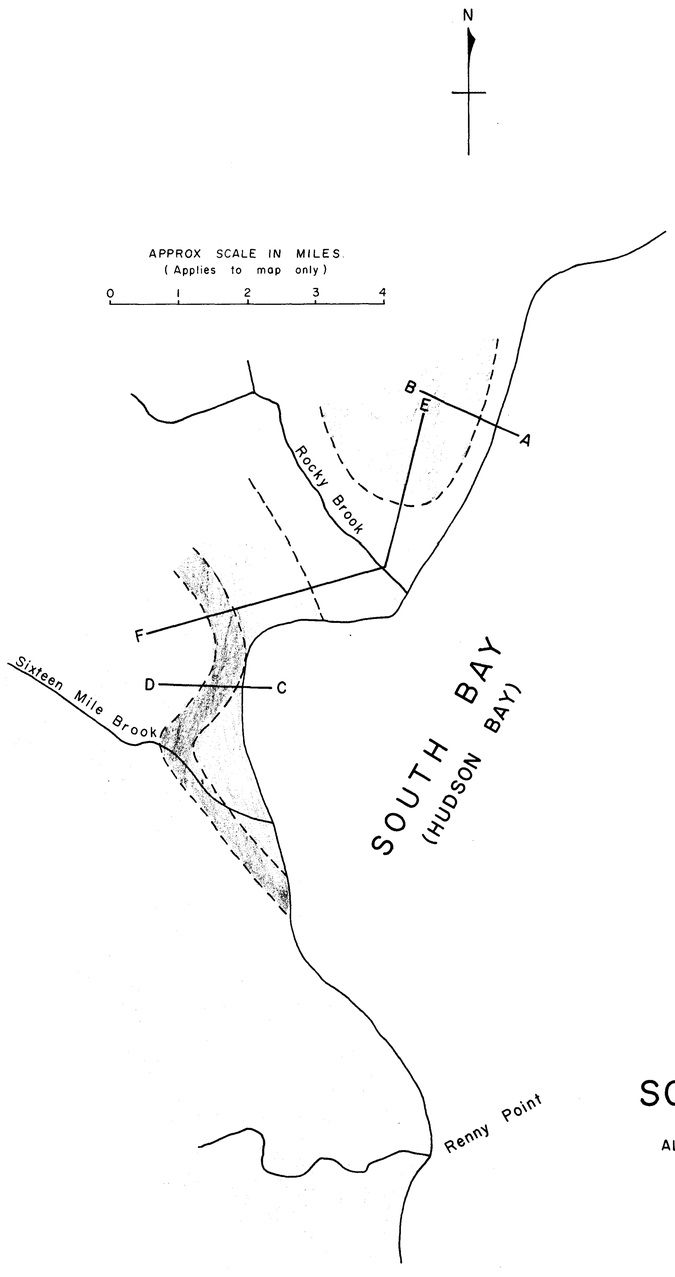
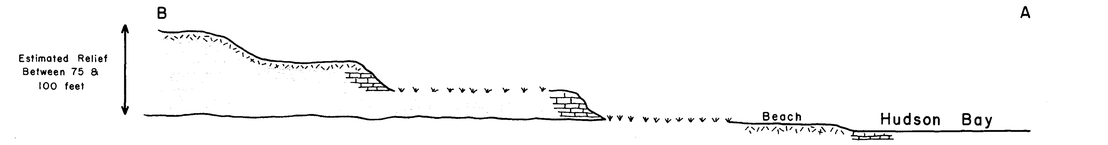


Figure 19. Massive, blocky structureless limestone interpreted as a Silurian reef. Photograph taken on small unnamed island off Emery Point.





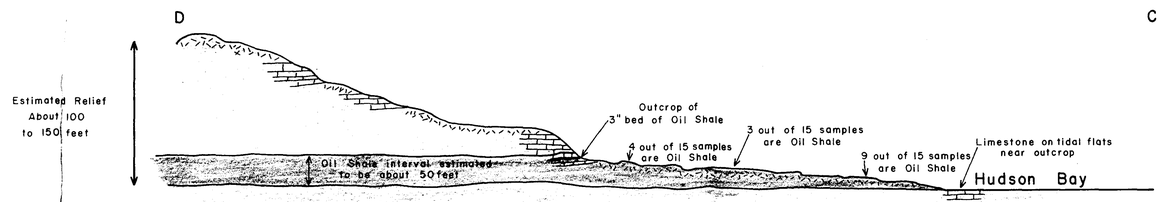


Figure 20.

GEOLOGIC SKETCH MAP & CROSS SECTION OF SIXTEEN MILE BROOK AREA. SOUTHAMPTON ISLAND, N.W.T.

ALL GEOLOGIC BOUNDARIES ARE VERY APPROXIMATE AND SOMEWHAT DIAGRAMMATIC.

LEGEND FOR SECTIONS A–B, and C–D,

OUTCROP

RUBBLE COVERED SURFACE

SWAMP

Cross–sections A–B and C–D are sketches showing geologic relationships north and south of Rocky Brook––respectively.

Cross–sections E–F shows the over––all relationships inferred from these sections, and from other observations.

GEOLOGIC LEGEND

SILURIAN (undivided): Limestone, Dolomite.

UPPER ORDOVICIAN ? Interbedded oil shale and limestone – the "Oil Shale Interval." Represented nearly everywhere by rubble.

UPPER UPPER ORDOVICIAN Limestone. (=Churchill River Group)

UPPER MIDDLE OR LOWER UPPER ORDOVICIAN limestone. (=Bad Cache Rapids Group)

Figure I.

SOUTHAMPTON ISLAND
N.W.T.
CANADA.

SCALE IN MILES
10 5 0 10 20 30 40

87° 85° 83° 81°

65°

64°

63°

Welcome Sound

Roes Welcome Sound

Wager Bay

Comer Strait

WHITE ISLAND

Frozen Strait

VANSITTART ISLAND

FOX CHANNEL

Duke Of York Bay

CLEVELAND R.

KIRCHOFFER RIVER

CORAL HARBOUR

ROCKY BR.

16 MILE BROOK

SUTTON R.

BURSTING BR.

RANGER BR.

FORD R.

South Bay

Little Corner Cliff

East Bay

GORE PT.

RENNY PT.

Native Bay

BELL PENINSULA

LAKE BR.

Junction Bay

LEYSON PT.

Ell Bay

BOAS R.

CAPE KENDALL

Bay Of Gods Mercy

CAPE LOW

WALRUS ISLAND

Evans Strait

Fisher Strait

COATS ISLAND

HUDSON BAY

LEGEND

- Palaeozoic: undivided, Probably--Ordovician and/or Silurian.
- Silurian: undivided, Limestone, Dolomite.
- Upper Ordovician. Mainly limestone. Includes Oil Shale Interval at very top.
- Precambrian (undivided)