

LEGEND

Q QUATERNARY ALLUVIUM
K_u UPPER CRETACEOUS (FT. NELSON FM.)
K_l LOWER CRETACEOUS (FT. JOHN GROUP)

D_u - UPPER DEVONIAN

D_{u1} TROUT RIVER FM.
D_{u2} KAKISA FM.
D_{u3} RED KNIFE FM.
D_{u4} TATULINA FM.
D_{u5} UPPER TWIN FALLS FM.
D_{u6} LOWER TWIN FALLS FM.
D_{u7} ESCARPMENT MEMBER OF HAY RIVER FM.
D_{u8} HAY RIVER FM.

D_{u9} - FT. SIMPSON FM.

D_m - MIDDLE DEVONIAN

D_{m1} HORN PLATEAU FM.
D_{m2} SLAVE POINT FM.
D_{m3} HORN RIVER FM.
D_{m4} WATT MTH & SULPHUR POINT FM.
D_{m5} PRESQU'ILE FM.
D_{m6} PINE POINT FM.
D_{m7} CHIRCHACK FM.
D_{m8} MIRAGE POINT FM.

D_{m9} - HORN RIVER FM.
D_{m10} - LONELY BAY FM.

D_s - ORDOVICIAN - SILURIAN
D_{sl} - CHEDABUCTO LAKE FM.
D_{sm} - LA MANTRE FALLS FM.

A1 CAMP SITES USED
A2

RABBIT LAKE
PERMIT No. 4252

TRIAD OIL CO. LTD.

GREAT SLAVE LAKE
OBSERVATION POINTS
FIELD PARTY 25

SCALE 1" = 500,000'
DATE APRIL 23, 1948 PROVINCE N.W.T.
REVISED DEPT. GEOL. SURV.
REF. DRAWN BY
AUTHOR L. T. B. B. GEO. NO. G-250

REPORT ON FIELD PARTY NO. 25

GREAT SLAVE LAKE AREA
NORTHWEST TERRITORIES

by

L. TER BERG

1967

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Abstracted for
Geo-Science Data Index

Date _____



August 17th to 31st, 1967

by

L. TER BERG

INTRODUCTION

The purpose of Field Party 25 was to obtain additional data on the Middle Devonian and on the strata immediately below and above this sequence. Understanding of the complex stratigraphy and facies relations is considered as a pre-requisite for exploration in the Northwest Territories, where Triad holds Permit 4252 in the Rabbit Lake area. The field work was therefore undertaken as the work commitment for 1967 for Permit 4252.

The field party consisted of L. Ter Berg and D. Balchin, geologists, and T. Ottoson as assistant. For the less accessible outcrops use was made of a Bell G-2 helicopter, piloted by R. Fink of Associated Helicopters. The new camping facilities established along the Hay River and the highway of Yellowknife were highly appreciated.

The prospective formations in the Rabbit Lake area were studied in outcrop around Great Slave Lake. Reports by the Geological Survey of Canada were used as a base, complemented by the experience gained in North Alberta and Northeast British Columbia.

This report is subdivided into three parts.

Part I

Pre-Middle Devonian outcrops visited.

Part II

Middle Devonian outcrops visited.

Part III

Upper Devonian outcrops visited.

Each part is accompanied by an interpretation of the stratigraphy and the facies relations.

PART 1

PRE-MIDDLE DEVONIAN

Erosional remnants of pre-Middle Devonian strata have been found in a large number of wells in the Upper Mackenzie Plain. Overlying the unconformity are the Cold Lake Salt and its equivalents. Where the salt has been dissolved the overlying Chinchaga and its equivalents rest directly on the pre-Middle Devonian surface. This situation seems to exist along the northern arm of Great Slave Lake. Here the Ordovician crops out in a facies transitional to Red Beds.

One mile northwest of Red Rock Point ($62^{\circ} 11' 20''$ N., $115^{\circ} 02' 18''$ W., observation point 7) brick red dolomitic silty shale and argillaceous siltstones are exposed in flat lying, thin, lenticular beds. Few fossils were found: some colonial and solitary corals, some strongly ribbed brachiopods, in some beds fair amounts of pentangular crinoid stems, and several chain corals. These Halysites allow dating the rock as Ordovician. No indication of gypsum was found.

Southward the nearest outcrop is on the north side of Bakers Bay ($62^{\circ} 03' 46''$ N., $114^{\circ} 57' 05''$ W., observation point 5).

There is about one mile continuous exposure along the shore formed by a cliff, which reaches a height of about 50 feet. The flat lying beds consist of brick red and apple green micromicaceous shale, containing here and there rounded fragments of gypsum and red shale. On some bedding planes ripple marks were found, on others burrows. Veins of gypsum, parallel to the bedding are numerous. No mega-fossils. These beds have been mapped as the Mirage Point formation by A. W. Norris. Although Norris implies that the Mirage Point is largely of Ordovician age, the lack of gypsum in the Red Rock Point outcrop, and the paucity of exposures have persuaded the writer of this report to consider the Mirage Point as the marginal and basal Red Bed facies of the evaporitic Middle Devonian Cold Lake and Chinchaga formations.

PART 11

MIDDLE DEVONIAN

The Middle Devonian in the Great Slave Lake area may be divided into the following units, listed from top to base:

Slave Point Formation
Pine Point Group
Chinchaga Formation and equivalents
Cold Lake Formation and equivalents.

Cold Lake and Chinchaga were not studied in outcrop.

The Pine Point Group in this report includes the Presqu'ile and Sulphur Point facies. The Pine Point Group can be sub-divided into two parts. The lower part maintains its facies throughout the area and equates to the Nahanni, Lonely Bay, Little Buffalo River, and Lower Keg River. The formation consists of crinoid and brachiopod bearing, more or less argillaceous calcilutite with bituminous shale partings, and marks a widespread transgression in a rather uniform environment. The upper part of the Pine Point Group can be sub-divided into three facies provinces: a basinal shale facies in the north, a carbonate shelf facies in the south, and an evaporitic facies further southward, near the boundary with Alberta.

For the Rabbit Lake permit the carbonate belt between the shale facies and the evaporitic facies is prospective because of the lobated form of the carbonate edge, favorably positioned with respect to the regional dip. The change from one facies to the other is generally gradational and by inter-tonguing. However in the latter part of Pine Point time the tendency increased for the carbonate-shale edge to develop as a reef-edge. This reef facies has been often called the Presqu'ile formation.

It is noted that the Nahanni-Lonely Bay is overlain in the shale facies province by a bituminous zone containing bituminous shales and limestones, correlative to the Evie member in Northeast British Columbia, and that tongues of this bituminous zone sometimes reach deeply into the carbonate shelf, thereby forming a useful marker horizon. Correlation of the latter Pine Point carbonates into the shale facies province should be done by detailed subsurface correlation.

The Slave Point formation can also be divided into three facies provinces. The northern shale facies however appears to be very thin and may be of the starved basin type. The carbonate edge is generally in reef facies and roughly parallels that of the previous cycle. Further south the Slave Point has a quiet water lagoonal carbonate facies over most of northern Alberta. Towards Ft. McMurray these carbonates thin by facies changes into the calcareous shales of the Firebag member of the Waterways formation. It appears that a comparable relation is to be found around the Prairie Lake reef, which the writer believes is of Slave Point age.

The stratigraphic position of the Horn Plateau reef has been interpreted in the light of the Ramparts reefs of the Norman Wells area.

In the following paragraphs the outcrops visited on the south side of Great Slave Lake will be described in ascending stratigraphic order.

Evie Member of the Pine Point Group

- Location:** Pine Point on the south shore of Great Slave Lake (observation point 12)
- Lithology:** Finely laminated dark brown to black argillaceous limestone and marl, with a high bituminous content. The beds are here and there slightly domed over siliceous concretions and more competent lenses of dark bituminous, argillaceous limestone. There are many delicate fossils, notably sharp carbonaceous triangles, very fine crinoid oscicles, and brachiopods with a very fine ornamentation as a fingerprint (Lingula?).

Finely Crystalline Vugular Dolomite (Shekelie) Facies of the Pine Point Group

- Location:** Point on the south shore of Great Slave Lake, $2\frac{1}{2}$ miles east of Paulette Island. (Observation point 13).
- Lithology:** There is no outcrop on the shore, but the debris on the beach here consists of finely sucrosic and microcrystalline, light yellowish grey, finely vuggy dolomite. This facies is often encountered in wells where the whole Pine Point Group consists of dolomitized clear carbonate.

Sulphur Point Facies of the Pine Point Group

Location: East side of Sulphur Point on the south shore of Great Slave Lake (Observation point 10).

Lithology: Porcellaneous calcilutite, light grey. In places numerous small vugs, some of which are pyrite casts, others are more likely fossil casts. In some places the lime mud is pelleted. On the beach are pebbles of the same material containing flat Schuchertellas.

Observation point 11 and 11A; Presqu'ile Point on the south shore of Great Slave Lake.

Observation point 11 is at the head of Presqu'ile Cove. Several springs of sulphurous water were seen in the marsh, with a luxuriant growth of reddish and green algae.

Observation point 11A is 3/4 mile east of Presqu'ile Cove.

Lithology: Slightly brownish grey microcrystalline limestone, interbedded with thin slivers of darker brownish grey marl. The bedding planes are wobbly. The limestone is a highly fossiliferous, somewhat argillaceous calcilutite. There are many branching corals (*Thamnopora*) and stick-like stromatoporoids (*Amphipora* ?), small bulbous stromatoporoids, brachiopods among which *Atrypa* predominates, and some big solitary corals. All the long fossils lie flat. Many of the bulbous stromatoporoids have a solitary coral in their centre.

The highly fossiliferous limestone occurs in patches surrounded by poorly fossiliferous, finely laminated, darker brown, argillaceous calcilutite. The patches are 15 to 20 feet across and form mounts up to 1/2 foot high.

Presqu'ile Facies of the Pine Point Group

Location: Pine Point Mines (Observation point 14).

Two representative open pits for the extraction of lead-zinc ore were visited. They are located between Pine Point Settlement and Pine Point Airstrip, or at respectively 60° 52' N., 114° 23' W. and

60° 51' N., 114° 27' W.

The sequence exposed consists of the lower part of the Slave Point formation, 4 feet Amco Shale (syn. Watt Mountain), and about 60 feet of the upper part of the Pine Point Group. The carbonates of the Slave Point and the upper Pine Point have been dolomitized, and consists to coarsely crystalline, vugular dolomite, separated by 4 feet green pyritic calcareous Amco Shale. Lenses of similar shale occur in the upper 30 feet of the Pine Point Group of the exposures. This interval has therefore been included in the Watt Mountain formation by Cominco geologists. In Northwest Alberta the Watt Mountain is generally restricted to the continuous shale break, and the underlying 30 to 60 feet of carbonate with green shale lenses have been included in the Sulphur Point or Bistcho formations of the upper part of the Pine Point Group.

In the Pine Point mines the Sulphur Point is distinctly, if sometimes lenticularly, bedded. The bedding is marked by darker and lighter bands as a result of variations in markasite and clay content. The darker bands, generally about 1 to 2 feet thick, are slightly argillaceous, medium to coarsely crystalline dolomite, containing a large percentage of disseminated pyrite, and no vugs are present. Some of the thinner beds contain abundant small white dolomite sticks, which are possibly Amphiporas. The lighter colored beds are generally somewhat thicker, and consist of very coarsely crystalline white and brown mottled dolomite, with many vugs. These cavities are often one inch high and five inches long, flat and parallel to the bedding, and occur frequently near the top and the base of the bed. The cavity wall nearest to the bedding plane is smooth and flat, the other side is irregularly lobated. The cavities are lined with dolomite crystals, and often with a later generation of calcite and sulphide ore. Their outline does not suggest corals or stromatoporoids, and neither gypsum casts. They are likely algal in origin. Algal lamination has been preserved in the richest parts of the ore bodies by replacement by sphalerite.

The type of bedding, the green shale lenses, and the variability in clay content are similar to that of the Sulphur Point equivalent in Northwest Alberta.

Dolomitization however has destroyed original structures and textures. The facies does not resemble that of a reef frame, nor that of a fore-reef talus, but could represent a very shallow marine carbonate shelf behind a barrier-reef belt.

The following observations are of the Slave Point formation, which overlies the Pine Point Group.

On the south shore of Great Slave Lake Slave Point beds are exposed 2 miles east of Breynat Point (Observation point 9)

Limestone; thinly bedded, brown, calcarenite in calcilutite matrix. There are several bulbous stromatoporoids 5 to 10 inches in diameter.

Dips are up to 5° . The strike varies around 150° (east-southeast).

On the northwest side of Great Slave Lake two reefs were studied, considered to be of Slave Point age: the Prairie Lake reef and the Horn Plateau reef.

Prairie Lake Reef

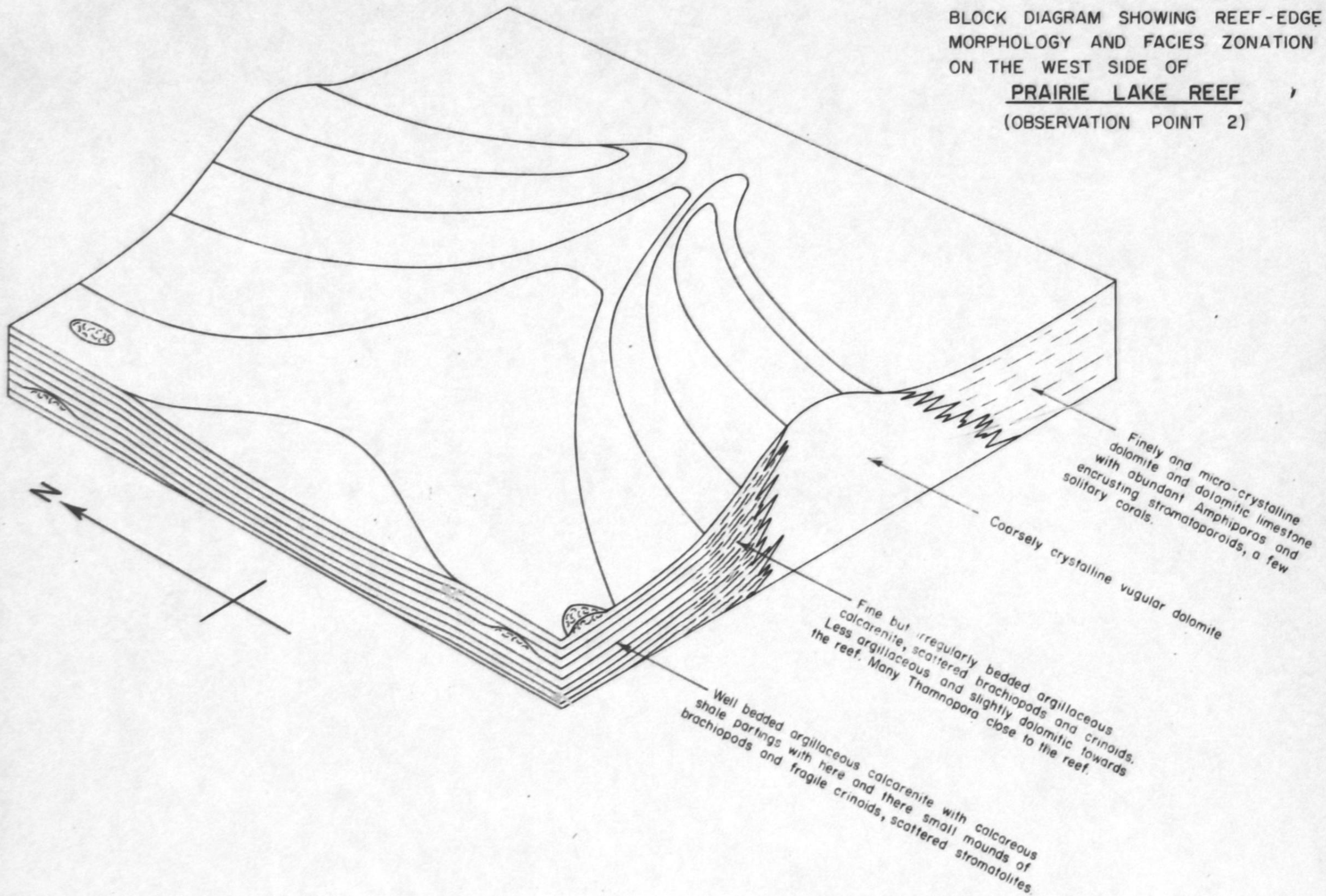
Prairie Lake Reef is exposed in a north-south trending belt about 20 miles long and up to 4 miles wide, in the area of Sulphur Bay and Prairie Lake on the west shore of Great Slave Lake. The easternmost exposure is on South Cranberry Island, and is also the east side of the reef. The west side of the reef is entirely exposed. Observation points 2 and 3 are the end points of a west-east section over the reef, located $1\frac{1}{2}$ miles north of Sulphur Bay, with co-ordinates $61^{\circ} 27' N.$ and $115^{\circ} 57' 20'' W.$ to $115^{\circ} 52' 40'' W.$

Morphology

The west side of the reef is best exposed, and follows a fairly straight north-south line bordering the east shore of Prairie Lake. The reef frame forms a hilly belt with sparse vegetation. Slight depressions on the seaward slope of the reef give this slope a somewhat lobated character. The depressions narrow towards the reef interior to shallow steep-sided channels similar to those observed by E. Klován on the Upper Devonian Redwater reef of Alberta. That these channels are not the result of erosion after exposure is shown by the reef-slope beds, which follow these depressions on the west side quite accurately. Further eastward the original reef morphology has been modified by erosion and karst, cutting deeper and deeper into the reef.

South Cranberry Island was not visited, but the aerial photographs show there is a crescent shaped barren hill forming the western $2/3$ of the island. This hill probably represents one of the reef-frame lobes. The fore-reef slope curves smoothly around it,

BLOCK DIAGRAM SHOWING REEF-EDGE
MORPHOLOGY AND FACIES ZONATION
ON THE WEST SIDE OF
PRAIRIE LAKE REEF
(OBSERVATION POINT 2)



dipping eastward. The back-reef slope is relatively steep in its upper part, a feature that is not very apparent in the exposures near Prairie Lake.

We may thus see the reef frame as a belt consisting of crescent-shaped hillocks with the convex side towards the open sea. The hillocks are separated by shallow surge channels which narrow and become shallower towards the reef interior. The reef frame belt encloses a lagoon of which the morphology is obliterated by late erosion and karst.

Lithology and Facies Belts

Three facies belts can be distinguished: the fore-reef slope, the reef frame, and the back-reef or lagoonal facies.

On the west side, the fore-reef slope consists of thin, but irregularly bedded argillaceous calcarenites, dipping 15° to the west, and containing only scattered brachiopods and crinoid oscicles. Away from the reef the dip decreases to about 5° and calcareous shale partings give a more regular appearance to the bedding, which is only interrupted by small mounds of thin-shelled brachiopods together with oscicles of very fragile crinoids. Scattered about are flat nodules with a smooth outline, lined on the inside by calcite. They may be algal in origin.

Closer towards the reef the material is less argillaceous and slightly dolomitic, but fossils are still rare up to less than a few tens of feet from the reef-frame. Here increasing amounts of flat lying *Thamnopora* sticks are found. These beds interfinger with and grade into the non-bedded coarsely crystalline vugular dolomite of the reef-frame, which constitutes the second facies belt. The vugs are up to 2 inches in diameter, almost round, and lined internally with dolomite crystals. Their distribution is similar to that of the robust brachiopods in the rim of the Horn Plateau reef. This facies also lines the bottom and the edges of the channels which penetrate the reef-frame from the seaward side.

Towards the reef-interior the coarse crystalline vugular dolomites grade into finely and microcrystalline dolomite and dolomitic limestone with abundant *Amphipora* sticks, and encrusting stromatoporoids, and rare solitary corals. This lagoonal facies forms the third facies belt. Further eastward marshy vegetation terminates the exposure.

On the western reef surface some patches are found of

black, flaky shale, which at one time must have completely covered the reef.

Age and Relation to other Formations

A. W. Norris dates the Prairie Lake reef as late Middle Devonian, and with some reservations he correlates the coarse crystalline vugular dolomite with the Presqu'ile formation of the Pine Point area. In the argillaceous limestones of the fore-reef facies Norris considers the presence of *Ladogiodes pax* McLaren to indicate a Firebag age for this facies. Nowhere did he mention observing the interfingering of the reef with these argillaceous limestones, and he appears to consider these beds as post-reef. Consequently, he assumes that there is a hiatus between the Firebag, and the "Presqu'ile" reef here, and that the Slave Point is absent. Furthermore, he states that strata outcropping between Windy Point and Burnt Point, and assigned to the Sulphur Point, contained *Emanuella* species F, considered as one of the most diagnostic fossils of the Slave Point formation. The writer of this report was unable to find these exposures back, but suspects these beds, so close to South Cranberry Island and the Windy Point exposures of the reef, to be the off-reef equivalents of the Prairie Lake reef. Also the presence of Firebag fossils in the argillaceous off-reef facies is not surprising if we consider the relation between the Firebag marls and the Slave Point carbonates in northeast Alberta. The facies boundary between these two zones steps down towards the southeast.

Underlying the Prairie Lake reef is a 600 to 700 foot sequence of more or less argillaceous limestones of the Pine Point Group, as drilled by the Northwest Territories Windy Point well. To the northeast the Pine Point Group is split into two carbonates separated by a 100 foot thick shale tongue. The total thickness as exposed along the shore Norris estimates as 435 feet, i.e. thinner than could be expected for full carbonate buildup for the Pine Point Group. On the other hand the Pine Point Group generally thins near its shale-out edge, which occurs in this case in the area of Lonely Bay.

It appears then that the Prairie Lake reef is based on a Pine Point carbonate buildup which shales out and thins laterally.

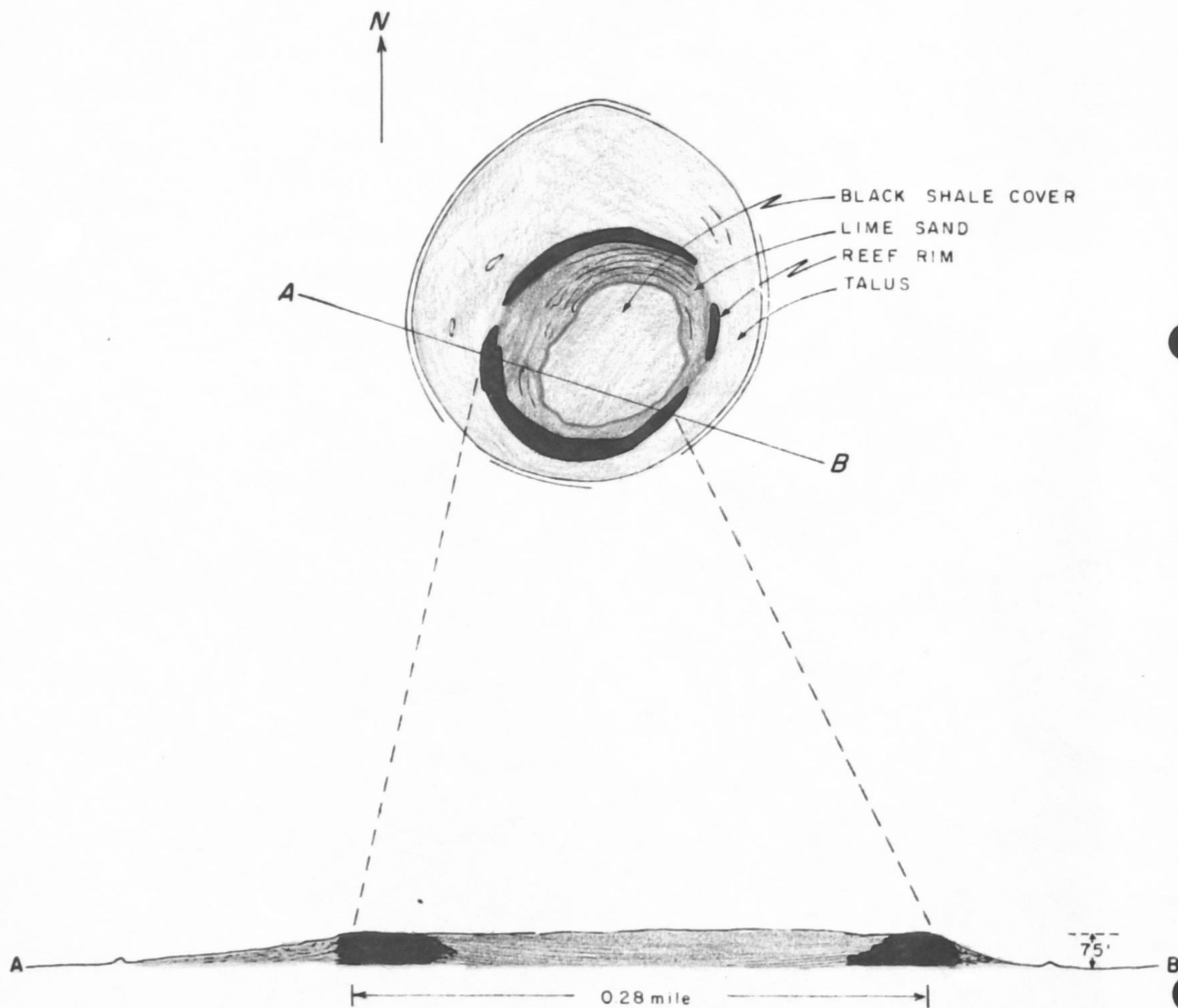
The off-reef beds coeval with the Prairie Lake reef contain Slave Point and Firebag fossils indicating the reef is of Slave Point age. Overlying the reef are black flaky shales.

FACIES DISTRIBUTION ON HORN PLATEAU REEF

N.W.T.

Lat. $62^{\circ} 7' 30''$ N

Long. $117^{\circ} 41' 31''$ W



Oil Seeps of Prairie Lake Reef (Observation point 4)

On the south shore of Windy Bay at $61^{\circ}20'$ N., and $115^{\circ}54'$ W. the coast line is dented by northeastward projecting spurs of coarsely crystalline vugular dolomite, which is jointed in that direction. Along these cracks several small seepages of light to medium gravity oil were observed. The volume of oil oozing out is very small. Although some isolated vugs contained good life oil near the seepages, the vugs opened by hammer throughout the mile of coast visited were barren, except for here and there some pyrobitumen.

Horn Plateau Reef (Observation point 1)

Location: 54 miles due north of Ft. Providence, and about 3 miles west of the southern tip of Fawn Lake, or $62^{\circ}8'$ N., $117^{\circ}41'20''$ W.

Morphology

On aerial photographs the reef stands out as a circular knob, one-third of a mile in diameter, reflecting an atoll which projects about 100 feet above its surroundings. The lagoon forms a plateau covered by dense vegetation, and surrounded by a narrow rim, marked by a series of bare knobby hillocks. The reef slope has been slightly steepened by erosion, so that the apparent assymmetric development of the reef is a secondary feature. The area around the reef is covered by muskeg and trees, with low ridges which are probably old beach ridges.

Lithology

The flank of the reef consists of thinly and irregularly bedded limestones which dip away from the reef at 5 to 20° . The limestones are composed of fossil debris among which branching colonial corals like Coenites, solitary corals, and brachiopods like Atrypa and Leptaena predominate. Stromatoporoids are notably scarce, and small. Although locally a certain fossil or association of different species appears in high concentrations, no zonation could be distinguished on the reef flank. Also it appeared that most of the corals are not in situ. The flank deposits can therefore be regarded as predominantly mechanical, reef derived, and supporting local concentrations of brachiopods.

The knobby reef rim is more massively bedded, with two organisms as important rock builders; flat lying Coenites carpets and

large robustly built brachiopods. The absence of bulbous colonial corals and of stromatoporidae is striking. The faint bedding, accentuated by weathering, is away from the reef, grading into the flank deposits described above.

On the lagoonal side of the knobby rim exposures are rare and poor. It appears that the knobby rim grades here into a coarse grained calcarenite containing a few flat-coiled gastropods and some Coenites. More towards the centre a number of dead trees were dug out. In all cases black slaty shale, which breaks easily into 2 mm. thick slabs, was found, so that one can safely assume that this material is in place.

Age and Relation to Other Formations

On the basis of the fossil content A. W. Norris (Geological Survey of Canada Memoir 322) dated the reef as late Middle Devonian. On the accompanying map the Horn Plateau reef is located on the boundary between the Hay River shales and the Horn River shales. In the opinion of the writer of this report the Horn River shales are coeval with the upper part of the Pine Point and Sulphur Point - Presqu'ile formations, and the Slave Point formation. In the Norman Wells area the equivalents are the Hare Indian River shales plus the Ramparts Reef formation of Bosworth and Kindle. In northeastern British Columbia the Evie and Otter Park formations of Gray and Kassube can be considered as time equivalents of the Horn River shale. It is further noted that the Muskwa formation of Gray and Kassube in northeastern British Columbia and the Canol formation of Bassett in the Norman Wells area both have the tendency to lose their bituminous character away from the carbonate buildup areas. Because of this one may expect the Horn River shale formation to include in its upper part also the equivalents of the Muskwa and Canol formations. On the basis of these comparisons the writer expects the Horn Plateau Reef to occupy a similar stratigraphic position as the Norman Wells Ramparts Reef; i.e. overlying Hare Indian River shales and overlain by black slaty shales analogous to Canol and Muskwa shales which grade upward into the Hay River-Simpson shales of Upper Devonian age.

PART III

UPPER DEVONIAN

The Upper Devonian was studied in Hay River Canyon and in the Heart Lake area. The stratigraphic interval exposed here is the upper part of the Hay River formation and the overlying Twin Falls formation as defined by H. R. Belyea and D. J. MacLaren (G.S.C. Paper 61-29). The interest in this part of the Upper Devonian was triggered by the analogy in facies relations with those of the Jean Marie member higher in the sequence, and to some extent with those of the Slave Point formation.

From a predominantly argillaceous facies in the south the calcareous content increases gradually northward by intercallation of more and more bioclastic and biostromal limestone tongues. These thicken at the expense of the interbedded marls into a reef belt, which thins abruptly at its seaward edge. In analogy with the Jean Marie member one would expect only a thin shale to represent the seaward equivalent of the reef.

The exposures in the Hay River Canyon represent the back reef facies, rich in bioclastic and biostromal limestones of the Alexandra member of the Twin Falls formation and of the Escarpment member of the Hay River formation. The reef belts of these members extend from Escarpment Lake to Heart Lake. The present front of the reef however has been modified by karst and erosion.

In Hay River Canyon (Observation point 8) the Alexandra member at Alexandra Falls consists of an upper part of 70 feet of thick bedded fine grained limestone interbedded with thin marls. Poorly fossiliferous, except for some *Amphiporas*. Near the top are a few lenses of calcareous sandstone. The lower 35 feet of the Alexandra member are silty and arenaceous calcarenite and very fossiliferous. The upper part here is rich in flat stromatoporoids, low colonies of *Hexagonaria*, brachiopods and burrows.

The Escarpment member of the Hay River formation has a cross-bedded calcareous sandstone at the top, underlain by a 16 foot biostromal limestone at Louise Falls. Downward this limestone grades into a 40 foot thick wobbly bedded sequence of variably argillaceous calcilutite and calcisiltite.

Further down the section consists of marly intervals alternating with bioclastic and biostromal limestones.

The 60 feet of limestone in the upper part of the Hay River formation forms a prominent cliff downstream of Louise Falls, in which several patch reefs were seen. These patch reefs are 150 to 200 feet wide and 15 to 20 feet high. One consisted entirely of flat stromatoporoids and had very low porosity. The other was made of one huge colony of *Phacellophyllum*, and had about 30% porosity. It was further noted that the coral colonies and the stromatoporoids have a flat, widespread shape. Most of the large solitary corals looked worn. Also the brachiopods were scattered so as to give the impression that they were transported.

North of Heart Lake (Observation point 15) a prominent scarp exposes about 150 feet of reef facies of the Twin Falls and Hay River formations. The reef rock consists largely of fragmented coralline red algae, associated with *Coenites*, *Thamnopora*, *Acinophyllum*, and encrusting stromatoporoids, embedded in coarse grained calcarenite. No bedding could be seen.

Although the scarp is erosional, it appears that only the reef talus has been removed, and that the frame is largely intact.

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