GEOLOGICAL RZCONNAISSANCE REPORT

P. & N. G. PERMITS NOS. 3054, 3055, 3056

FORT PROVIDENCE AREA, NORTHWEST TERRITORIES

Prepared For

T. J. Rubeo and W. R. Sheeky

October, 1961

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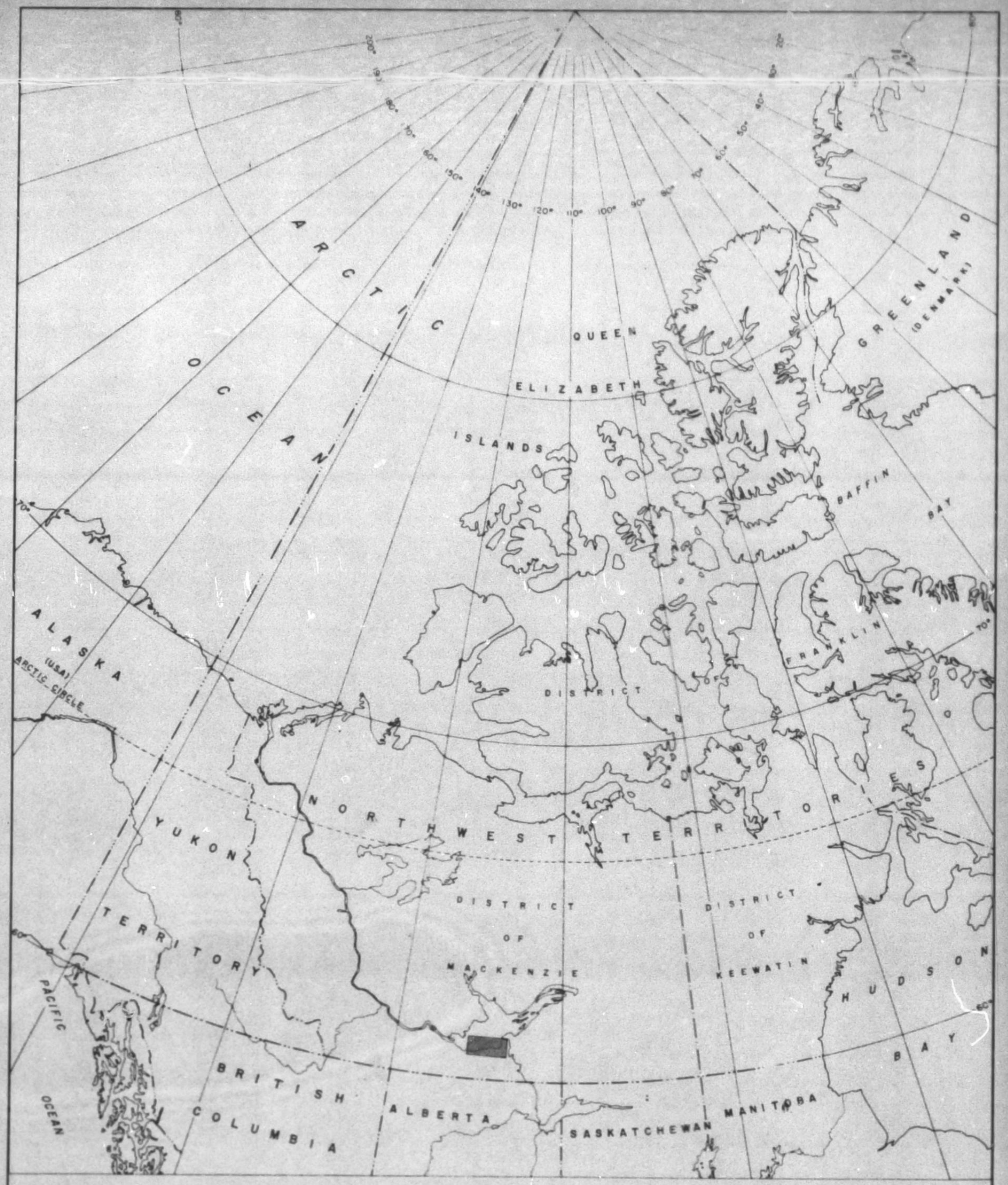
To accompany Geological Report to W.R. Sheeky, Oct. 1961

FIGURE - I



INDEX MAP

NORTHWESTERN CANADA

Area covered by report

4411

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P. & N. G. PERMITS NOS. 3054, 3055, 3056

FORT PROVIDENCE AREA, NORTHWEST TERRITORIES

INTRODUCTION

Description of Project

This report presents the results of two and one-half days' field work in the vicinity of Pine Point and Buffalo River on the south shore of Great Slave Lake, Northwest Territories. The study was made at the request of Mr. W. R. Sheeky, with the object of obtaining information on formations which occur in the subsurface of Company holdings in the Fort Providence area west of Great Slave Lake and north of the Mackenzie River.

The Petroleum and Natural Gas Permits concerned, Nos. 3054, 3055 and 3056, are held by T. J. Rubec and J. Rubec and operated by W. R. Sheeky. They are situated between 61° 15' and 61° 20' North Latitude and between 115° 50' and 118° 15' West Longitude.

Outcrops of Pine Point, Presqu'ile and Slave Point formations are good in the vicinity of some Company holdings and absent in others, but contact relations are obscure. It was, therefore, deemed advisable to examine the type sections of the Pine Point and Presqu'ile beds at Pine Point on the south shore of Great Slave Lake with a view to determining the relationship between the two units, and to examine the Slave Point formation stratigraphically above the Presqu'ile reef to determine whether the Presqu'ile reef had any noticeable effect on the lithology of the Slave Point formation.

Outcrops of the Pine Point formation on the south shore of Great Slave Lake consist of discontinuous exposures along the shore from the mouth of the Little Buffalo River, westward to Pine Point. The exposed stratigraphic thickness ranges from one foot in the Dawson Bay area to nearly 40 feet at Pine Point.

The Presqu'ile formation occurs on a low ridge with an east-northeast trend, some four miles south of Dawson Landing.

A Bell helicopter Model 47 G-3 owned by Sproule Projects Ltd. was used to examine the outcrops between Paulette Island, east of Pine Point, and Ile du Mort, west of Pine Point. Before the completion of the project the helicopter

became unserviceable. In order to avoid lost time waiting for repairs, and because of the possible onset of adverse weather, it was necessary to charter a Cessna 180 owned by Hay River Air Services. The enforced use of a fixed-wing aircraft prevented examination of the type section of the Presqu'ile formation at Presqu'ile Point, as well as small isolated outcrops inland from Dawson Landing and Pine Point; it did permit us to examine outcrops, trenches and pits south of Pine Point on the Consolidated Mining and Smelting property, where there is a landing strip.

The field party consisted of G. A. Wilson, geologist, J. D. Durkie, helicopter pilot, and H. Carmichael, helicopter engineer. The party left Calgary on Tuesday, September 19th and arrived in Hay River on Thursday, September 21st. Wilson returned to Calgary on Wednesday, September 27th. Durkie and Carmichael returned to Calgary on Saturday, September 30th.

Some supplementary time was devoted to a study of occurrences of strata equivalent to the Slave Point, Pine Point and Presqu'ile formations in the subsurface to the southwest of the type section at Pine Point and Presqu'ile Point.

This report presents the results of this field and subsurface study of the Pine Point, Presqu'ile and Slave Point strata in the vicinity of the south shore of Great Slave Lake. The report is intended to be a supplement to the report entitled "Geological Reconnaissance Report, P. & N. G. Permits Nos. 3015, 3016, 3017, 3054, 3055, 3056, Fort Providence Area, Northwest Territories", prepared for T. J. Rubeo and W. R. Sheeky in March of 1961 by J. C. Sproule and Associates Ltd.

Previous Work

Porous Middle Devonian reefs have been important as traps for hydrocarbons and as the locus of deposition of the sulphides, galena and sphalerite in economic quantities, and therefore have received considerable attention from both mine and oil exploration geologists. Various authors have studied the stratigraphy of the area south and west of Pine Point, both in the field and in the subsurface, and have published the results. A bibliography of published data is included with this report.

Physiography

The area studied is adjacent to Great Slave Lake in the vicinity of Pine Point. Relief is approximately 150 feet, the lowest elevation being 510 feet, the water level of Great Slave Lake, and the highest being 755 feet on a ridge underlain by Presqu'ile dolomite some seven miles inland. The lower areas adjacent to the lake are characterized by muskeg, sink-holes and cold sulphur springs (Plate I-B). The gentle slope up to the ridge is comparatively dry and covered by a fairly dense growth of spruce.

Outcrops on the shore of Great Slave Lake consist of isolated exposures one to four feet in stratigraphic thickness, except in the region immediately west of Pine Point. In that locality, some 40 feet of Pine Point formation are exposed.

In the wooded areas outcrops are scattered and small but trenches, pits and clearings made by the Consolidated Mining and Smelting Company Limited have exposed parts of the Presqu'ile formation (Plate III).

STRATIGRAPHY

As a result of the investigation on which this supplementary report is based, we propose to classify the Middle Devonian beds above the base of the Pine Point formation, as shown in Figure III. Attention is again drawn to the fact that this report is concerned mainly with the relationships between the Pine Point, Presqu'ile and Slave Point formations and their equivalents in the vicinity of Pine Point. A solution of the problems of stratigraphy in this area will improve our understanding of the stratigraphy of the same formations in the permit areas, because the local Pine Point structure and stratigraphy are related to the overall Great Slave tectonic trend.

In the vicinity of Pine Point, the Elk Point group above the base of the Pine Point formation includes three distinct sedimentary rock types which are laterally equivalent to one another. The central unit is a reef complex six to ten miles wide and many miles long which trends in an east-northeast direction, nearly parallel with the shore of Great Slave Lake west of Pine Point and some five to eleven miles south of it. This would appear to be a part of the much broader regional Great Slave Lake tectonic trend, which includes the Permit areas. The local Presqu'ile reef complex, approximately 600 feet thick, includes some 450 feet of fine- to medium-grained dolomite, mud and sandstone, in part cross-bedded, overlain by a coarse-grained dolomite reef with a maximum thickness in the order of 150 feet. On its north side the reef complex interfingers with the Pine Point limestone at the base of the reef complex and with the Buffalo River shale at higher levels of the complex. The south side of the reef interfingers with evaporites and carbonates of the Muskeg formation at the top of the Elk Point group. The final stage or uppermost beds of Elk Point sedimentation is represented by a light coloured fine-grained limestone deposited adjacent to and above the reef.

A break in sedimentation marks the base of the Watt Mountain member of the Slave Point formation. The Watt Mountain consists of limestones, shales and blue-green clays. The unnamed upper member of the Slave Point formation is a fine-grained partly stromatoporoidal limestone.

Table of Formations

(Including strata between the base of the Pine Point formation and the top of the Slave Point formation)

Age	Group or Formation	Lithology	Thickness Feet
PALEOZOIC			
Middle or Upper Devonian	Slave Point	Unnamed Member: Limestone, brown to grey weathering lighter, fossiliferous, bituminous; locally with	200

Age	Group or Formation	Lithology	Thickness Feet
		abundant stromatoporoids.	
		Watt Mountain Member: Limestone, brown, very fine-grained with zones of green and blue-green residual clay. Lower limestone beds are fragmental in places. The Amco shale is at the top.	40
		- UNCONFORMITY -	
Middle Devonian	Elk Point		
	Unnamed Unit	Limestone, white, light grey, grey-brown, sublithographic. In part interfingers with Presqu'ile.	10-100
	Presqu'ile	Dolomite includes three members: A member at base, white to brown, very fine; B member in centre, medium-grained, arenaceous, and C member at top, coarse-grained. Upper part interfingers with Elk Point evaporites in south and Buffalo River shale in north. Lower part interfingers with Elk Point evaporites in south and Pine Point limestone in north.	600
	Buffalo River	Shale, calcareous, bluish grey to dark green, fissile with concretionary iron sulphide.	200
	Pine Point	Limestone, brown to grey-brown, fine- to medium-grained, medium- to thick-bedded with thin laminae, nodular, fossiliferous, argillaceous in part and abundantly bituminous. In part equivalent in age to lower part of Presqu'ile and in part older than Presqu'ile.	90-450

Description of Formations

Pine Point Formation

The Pine Point formation is the oldest sedimentary unit considered in this report. It overlies a silty dolomite eight feet thick above Elk Point

evaporites which are probably part of the Muskeg formation. The thickness of the Pine Point formation ranges from 90 feet beneath the reef to approximately 450 feet north of the reef. South of the reef complex it is absent. The Pine Point formation consists of limestone, argillaceous limestone and dolomitic limestone, generally brown to dark brown in colour, weathering grey to brownish grey, and almost universally bituminous. Grain is generally fine to dense, although coarser grained beds occur. The formation is well bedded, the thickness of beds ranging from one to four feet. Near Dawson Landing most of the beds are one to three feet thick, the upper six inches being a black to dark brown petroliferous, fossiliferous, calcareous shale transitional with the limestone below. Brachiopods, trilobites and tentaculites are abundant in the shale. Vertical calcite- and dolomite-filled fractures with a strike of 040° (azimuth) are a common occurrence. In the vicinity of Pine Point, the Pine Point formation is characterized by nodules three to eighteen inches in diameter and three-quarters of an inch to six inches thick, and shaped like oblate spheroids (Plate II-B). The nodules are fine to medium grained and dominantly carbonate, and the matrix in which they are embedded is a calcareous shale to argillaceous limestone. Some of the argillaceous laminae abut against the nodules but most trend around them.

East of Ile du Mort and probably in a stratigraphic position near the top of the Pine Point formation there occur a few scattered outcrops of argillaceous limestone and calcareous shale, dark brown in colour and petroliferous. In general, the Pine Point formation seems to be characteristic of an open marine environment.

The fauna collected by our geologists from the Pine Point formation have not been studied in detail but the stratigraphic position of the Pine Point formation near the top of the Elk Point group, and the relations between the Pine Point formation and the Presqu'ile reef complex, support the conclusion that the Pine Point formation is Middle Devonian in age.

Presqu'ile Formation

The Presqu'ile formation is a reef complex with a maximum thickness of 650 feet and includes three members, all dolomite (Figure III). The basal unit, Member A of the complex, is a dark brown microcrystalline dolomite approximately 100 feet thick. It overlies Pine Point limestones but merges with them laterally, apparently by interfingering to the north. It may also occur in places as a lateral equivalent of Member B. Member B, the middle and thickest member, some 350 feet thick, is a light brownish grey, fine-grained, sugary crystalline dolomite sandstone. It is thinly laminated and crossbedded and was probably deposited in the vicinity of a dolomite reef. Members A and B are shelf-type deposits. The uppermost unit of the reef complex is Member C, referred to by Campbell (1957)(1) as the reef core and by Douglas as the Presqu'ile formation. It is 100 to 200 feet thick and consists of coarse-grained, very vuggy, grey to brownish grey dolomite which weathers grey. Member C overlies part of Member B and is younger than most of Member B. Member B, however, extends up above the

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(1) Names and dates in brackets refer to bibliography at the end of this report.

base of Member C so that it is laterally equivalent to all or most of Member C on the north side, and equivalent to the lower part of Member C on the south side of the complex (Figure III). Member A interfingers with its lateral equivalents in Member B. The entire reef complex merges by interfingering with evaporites and carbonates of the Muskeg formation of the Elk Point group along its south margin. To the north, Member A and the lower part of Member B merge by interfingering with the upper part of the Pine Point formation. The upper part of Member B has for its lateral equivalent on the north the Buffalo River Shale, with which it appears to interfinger. The stratigraphic position of the base of the Buffalo River shale relative to the base of Member C of the reef complex is unknown.

The reef core, Member C, is so completely recrystallised that fossils have not been found in it. The dolomite muds and sands of Members A and B contain stromatopora and brachiopoda. Cameron (1927) collected a Middle Devonian fauna including the brachiopod Stringocephalus burtini from dolomite beds at Presqu'ile Point, here interpreted as belonging to the upper part of Member B of the reef complex. This establishes that the age of the younger part of the Presqu'ile formation is Middle Devonian. The lower unit of the reef complex, Member A, overlies beds of the Pine Point formation, which is also Middle Devonian in age.

Attention should be drawn to the fact that the inclusion of the dolomite muds and sands beneath the reef core in the Presqu'ile formation seems to be in agreement with Campbell (1957), although Campbell did not consider them to be part of the reef complex, but is not in agreement with Douglas (1959). Douglas considered that Members A and B of the reef complex are facies or units of the Pine Point formation. Although these beds are laterally equivalent to part of the Pine Point formation, they appear to be more closely associated with the growth of the reef than with the sedimentary processes which produced the Pine Point limestone formation.

Buffalo River Shale

According to Campbell (1957) the lateral equivalent of the upper part of the reef complex on the north side of the reef is a dark green, fissile, calcareous shale with concretionary iron sulphide (Figure III). Campbell referred to the unit as the Buffalo River shale. It does not outcrop and has been penetrated by only a few diamond drill holes; consequently, very little information is available regarding the thickness of the unit. The position of the lower contact is not known.

Unnamed Limestone Unit of Elk Point

Overlying the top of the reef complex, and beneath a zone of intermittent occurrence of bluish green clay indicative of erosion and characterized by the fossil Charophyta oogonia, there is a light green to greyish brown, very fine-grained to sublithographic limestone. The boundary between the dolomite reef and the fine limestone is sharp, but alternate sections of fine-grained limestone and dolomite of the reef complex in cores just above the reef, or laterally adjacent thereto, suggest that this limestone interfingers laterally

with the reef.

According to Campbell (1957), small thin-walled brachiopods are common in this unit and small bitumen-filled cavities occur locally.

The thickness of this unit is unknown but is thought to be a minimum of less than ten feet and a maximum slightly in excess of 100 feet. The thickness probably depends partly on the configuration of the top of the reef complex. It is probably a shelf deposit.

The interfingering relations between this unnamed limestone unit and the reef complex indicate that at least part of the limestone unit is equivalent in age to the upper limits of the reef. It has been shown that the reef is equivalent to the upper part of the Muskeg formation at the top of the Elk Point group. It follows, therefore, that this unnamed fine-grained limestone is also equivalent to the Muskeg formation.

Slave Point Formation

As a result of the lack of unanimity amongst authors who have used the term "Slave Point formation", and because the stratigraphic interval assigned the name "Slave Point formation" in this report is different from that in published reports of Cameron (1922), Hunt (1954), Law (1955), Campbell (1957), Douglas (1959), it is necessary to define the stratigraphic interval meant by the term "Slave Point formation".

In this report the Slave Point formation includes all strata above the lowermost residual clay characterized by Charophyta oogonia and below the Upper Devonian Hay River shales.

The Slave Point formation is divided in this report into two members: a lower member called the Watt Mountain and an upper limestone members, unnamed at present.

Watt Mountain Member

The name "Watt Mountain member" has been assigned here to a succession of limestones and discontinuous seams of bluish green clay with fairly abundant Charophyta oogonia which overlies the unnamed fine-grained limestone immediately above the reef complex. The Watt Mountain member in this sense includes all strata above the lowest Charophyta oogonia zone and below the top of a shale eleven feet thick known as the Amco shale, or equivalent strata in other areas. The thickness of the Watt Mountain member is not definitely known but it is more than 30 and probably less than 75 feet thick. It consists of successive fine-grained grey to brown limestones and soft, discontinuous blue-grey or bluish green clay. Campbell (1957) mentioned the presence of fragments of limestone associated with the bluish green clay. These clays fill fractures and cavities in the underlying unit. The Amco shale at the top of the Watt Mountain member, is composed of dark greenish shale and argillaceous limestone.

It is our interpretation that the occurrence of successive limestones and discontinuous bluish green Charophyta shales represents a change in sedimentary conditions and marks the top of the Elk Point group. The limestones and clays are probably the result of alternate gentle erosion and shallow water deposition which took place in this area concurrent with more severe erosion in other areas.

The Watt Mountain member of this report is similar but not identical to the Watt Mountain formation of Law (1955). Law correlated the Watt Mountain formation with the entire interval between the Amco shale and the top of the vuggy dolomite (Member C of the reef complex of this report). This correlation is difficult to accept for, as noted above, it includes a fine-grained limestone which has an interfingering relationship with the reef complex. The base of the Watt Mountain formation as described by Law (1955, p. 1953) is a limestone breccia and this represents a period of uplift and erosion followed by renewed sedimentation. It seems probable that the same period of uplift and erosion was responsible for the period of gentle erosion and intermittent deposition above the unnamed limestone at the top of the Elk Point group. Hence, the base of the Watt Mountain member of this report is at the lowermost residual clay zone characterised by Charophyta oogonia. The member does not include a variable thickness of fine-grained limestone immediately above the reef complex.

Unnamed Limestone Member

The unnamed member of the Slave Point formation consists of 200 feet of irregularly bedded brown to dark brown limestones with scattered stromatoporoidal reefs (Plate I-A). A bituminous odour is faint to strong. Campbell (1957) reports incomplete to complete dolomitization with little change in the appearance of the associated constituents. In areas adjacent to the project area it appears that the top of the Slave Point formation is an unconformity.

The age of the Slave Point formation is difficult to establish, partly because insufficient work has been done on faunal assemblages from both the type section and from its correlatives. The stratigraphic interval assigned the name "Slave Point formation" in this report has been classified as Upper Devonian by one author and as Middle Devonian by others.

The significance of an unconformable contact at the base of the Slave Point formation of this report is not fully understood. Further, the importance of the unconformity at the base of the Slave Point formation relative to the questionable unconformity at the top of the Slave Point formation is unknown.

The Slave Point formation of this report can be correlated through northern Alberta to the Edmonton area, where it constitutes the basal member of the Beaverhill Lake formation. The Beaverhill Lake formation is classified by the A.S.P.G. (1960) as "Middle and/or Upper Devonian", insufficient work having been done on the fauna of the formation to permit a more precise definiation of the Middle/Upper Devonian contact. Similarly, the Manitoba group, which is the eastern plains equivalent of the Beaverhill Lake formation, comprises two formations. The Dawson Bay formation at the base of the Manitoba group is Middle Devonian and the Souris River formation at the top is Upper Devonian in age.

Probably the Slave Point formation is Middle Devonian in age, but the possibility exists that it may be partly or entirely Upper Devonian.

Presqu'ile Reef Complex

Insufficient data is at hand to permit firm conclusions regarding the growth of the Presqu'ile reef complex. Some inferences are justified. The parallelism of the faults in the Precambrian system with the reef trend and the fact that the reef complex overlies some of the faults (Douglas (1959), Map 27-1958, and Campbell, (1957) support the inference that the locus of reef growth is related to the faults. Perhaps at some point along the fault trend in late Elk Point time marine conditions were conducive to reef growth. It is suggested that at some place along the trend the growth of reef commenced and continued fairly rapidly. It is further suggested that this reef grew parallel with the long axis of the complex and that, as it grew, debris washed from the reef was deposited as an apron in front of the reef in the form of dolomite, muds and sands, partly crossbedded, such as are found in Members A and B of the reef complex. The reef complex acted as a barrier between a more open sea to the north characterized by limestone and shale deposition, and a restricted basin to the south in which the sediments are dominantly evaporites. It seems probable that this reef, or strata associated with it, extends as a chain in a southwest direction parallel with the fault trend, though perhaps not continuously.

Similar reef growths should be expected not only along the trend of the Presqu'ile reef but along similar tectonic trends on both sides of the lake.

STRUCTURE

The regional trend in the area of Pine Point is northwest and dip is fairly gentle southwest. Locally, measurable strikes and dips are different from the regional trend. Near Dawson Landing and Pine Point, strike is nearly northeast and dips generally three to eight degrees northwest, although in a few places the beds dip southeast at shallow angles. Variation in dip and strike of the Pine Point formation is probably related to the trend of several Precambrian faults which extend from the region southwest of Pine Point into the Canadian Shield. Late Precambrian gabbro or diorite dykes intersect the faults east of the project area with little evidence of Cambrian or later movement. Notwithstanding this, there is evidence of post-Middle Devonian movement on faults which extend southwest through the Presqu'ile reef complex (Campbell, 1957, and personal communication). It is probable that minor movements also occurred in early Paleozoic time, at least to Middle Devonian time.

CONCLUSIONS

The Presqu'ile reef complex, consisting of a bioherm and associated carbonate detrital beds, grew as a long narrow barrier in an east-northeast or west-southwest direction south of Pine Point between a comparatively open marine basin to the north and an evaporite basin to the south. The reef complex is

laterally equivalent on the north to marine limestones and shales and on the south to evaporites.

Growth of the reef ceased shortly before the end of Elk Point time, and the final stages of Elk Point deposition are represented by a fine limestone above and partly equivalent to the reef.

Deposition of members of the Elk Point group in the Buffalo River-Pine Point area ended with uplift and gentle erosion.

The Slave Point formation, predominantly limestones but with a basal member including shales and clays, was deposited above the Elk Point group after a period of alternate sedimentation and gentle erosion. Small stromatoporoidal reefs are present on the Slave Point limestones, but there is no conclusive evidence in this area indicating a relationship between Slave Point lithology and Elk Point reefs.

Other reefs with similar age and appearance grew on the west side of Great Slave Lake in the vicinity of Company holdings. Relationships between Pine Point, Presqu'ile and Slave Point beds, or their equivalents, are probably the same on the west side of the lake as they are near Pine Point. The possibility does exist that post-Elk Point erosion is deep enough that the unnamed fine-grained limestone at the top of the Presqu'ile reef was entirely removed, and that the Slave Point limestones were deposited unconformably over an irregular surface which included equivalents of the Presqu'ile reef.

Land on the Precambrian trend, along which the reef grew, or on similar trends, is considered prospective for the discovery of oil and gas. The exposures of Presqu'ile reef are considered part of a barrier reef which probably extended for many miles along the tectonic trend. Porosity is good and bitumen is abundant in exposures of Presqu'ile and equivalent rocks. Because the reef trend is downdip, trapping of hydrocarbons will require transverse barriers of either a permeable or structural nature.

In view of the above, it is recommended that steps be taken to acquire selected acreage in the general Hay River area, to the southwest of the Permits concerned.

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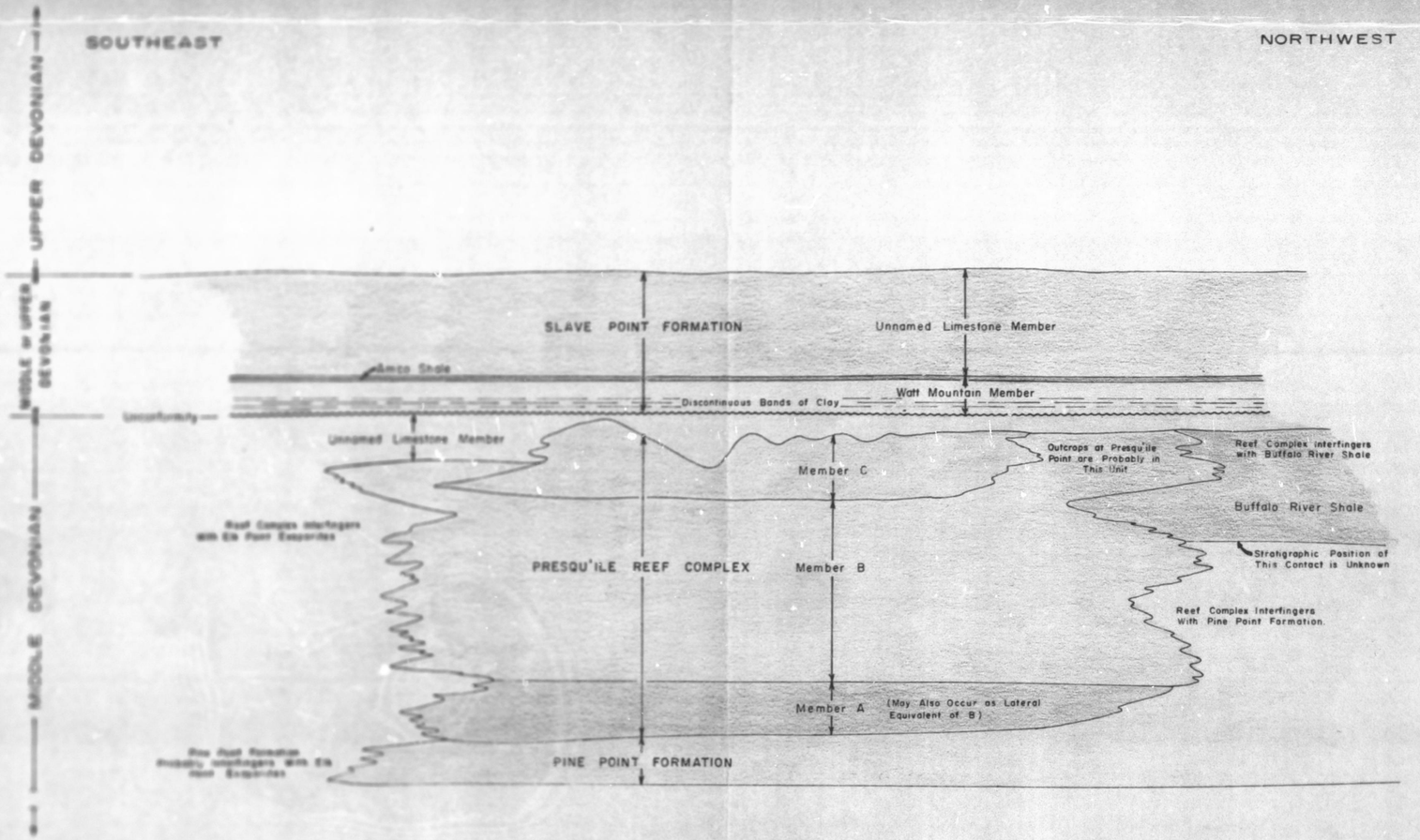

GENERALIZED SKETCH

PINE POINT AREA, N.W.T.

SHOWING

RELATIONS OF PRESQU'ILE, PINE POINT, AND SLAVE POINT FORMATIONS

HORIZONTAL SCALE:- 1"=2000' (APPROX.)
VERTICAL SCALE:- 1"= 200' (APPROX.)

Interpretation by G.A. Wilson Oct. 1961

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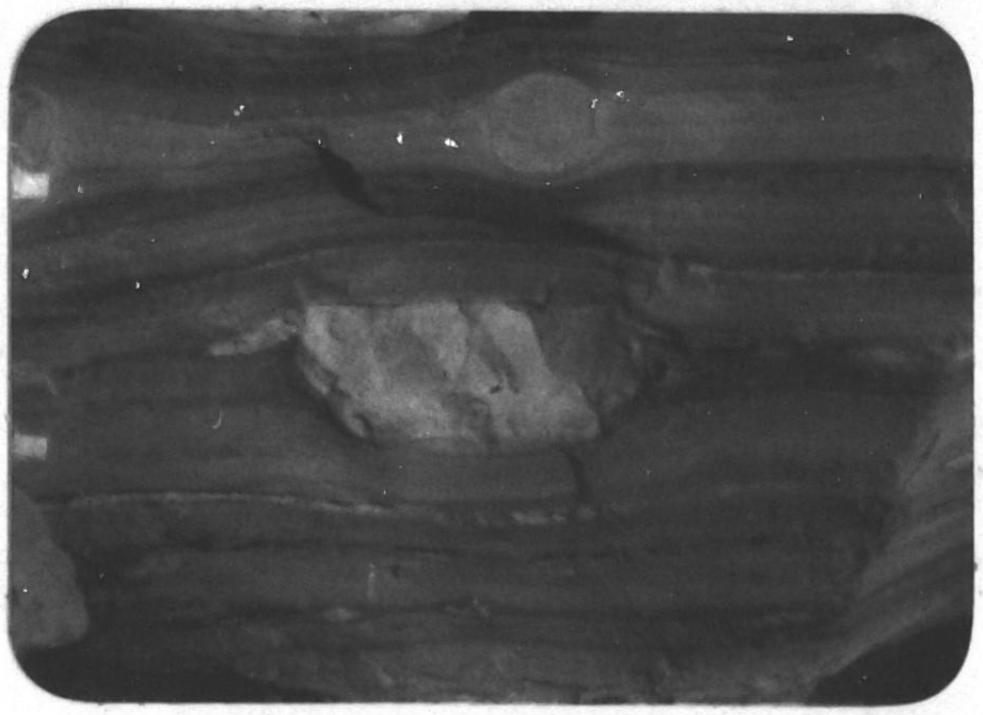
A. Part of upper limestone member of the Slave Point formation as described in this report at Mellor Rapids. A stromatoporoid reef comprises most of the section on the opposite bank.

B. Cold sulphur spring, Mellor Rapids. Springs of this type are very abundant in the area.

Photos by G. A. Wilson

A. Outcrops of Pine Point formation on Great Slave Lake near Dawson Landing, Northwest Territories.

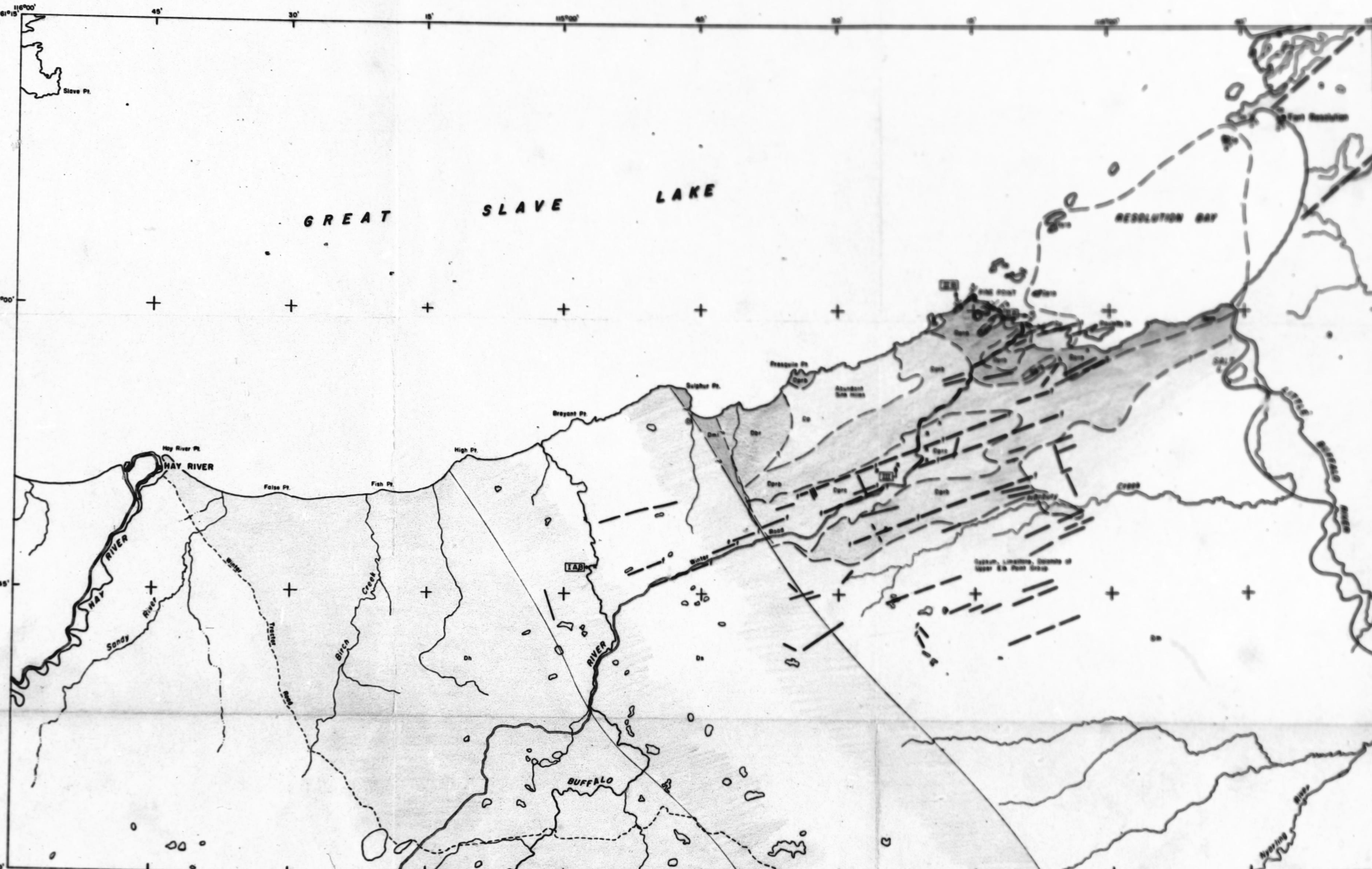


B. Fabric of Pine Point formation at Pine Point, Great Slave Lake. Some beds end against the nodules, others are continuous around them.

Photos by G. A. Wilson

Texture of Presqu'ile formation as seen in trench on Consolidated Mining and Smelting Company's property. Vertical section is approximately four feet high.

Photo by G. A. Wilson



PLEISTOCENE & RECENT

Q	Unconsolidated Sands & Silts

DEVONIAN

Upper Devonian

Dh	Greenish Grey Shale, Limestone, Sandstone

Middle or Upper Devonian

Ds	Slave Point Formation

Unconformity

Middle Devonian

Dml	Fine Grained Limestone	Dm	Middle Devonian – Gypsum, Limestone & Dolomite – Undivided
Dbr	Buffalo River Member – Green Shale		
Dpr	Presqu'ile Reef Complex		
Dprc	Coarse, Vuggy Reef Core		
Dprb	Medium to Fine Dolomite Sand		
Dpra	Fine to Very Fine Grained Dolomite		
Dp	Pine Point Limestone		

Formation Contact
Ground Observed Dip (Other Survey Parties)
Ground Observed Dip
Photo Observed Dip, 1°–3°
Lithological Contact
Fault
Alignment of Possible Geological Significance
Field Station
Number of Color Print & Direction Taken
Drill Hole

GEOLOGICAL MAP
PINE POINT AREA
NORTHWEST TERRITORIES

5 0 5 10

SCALE :– 1:250,000

Adapted from Douglas, 1959
Additions and changes by G.A. Wilson, 1961

595-1-4-3.

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