

SUMMARY GEOLOGICAL REPORT
RANWORTH EXPLORATIONS LIMITED P. & N. G. HOLDINGS
LOON LAKE AREA, N. W. T.

Prepared for
Ranworth Explorations Limited
June, 1959

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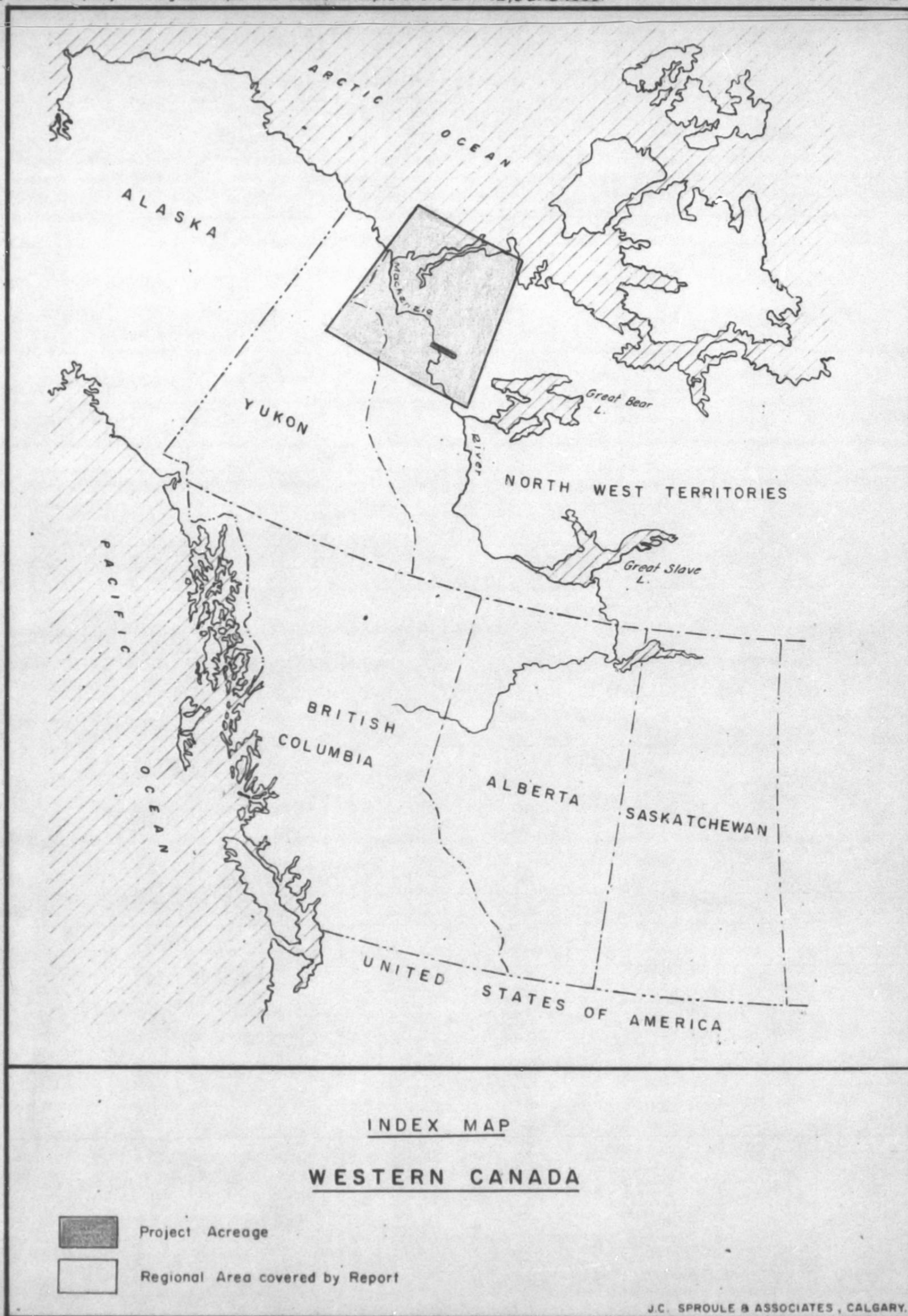


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SUMMARY GEOLOGICAL REPORT

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INTRODUCTION

Description of Project

The geological survey operation under discussion was carried out at the request of Mr. J. J. Rankin, President of Ramworth Explorations Limited, hereinafter referred to as the "Company." This report is the comprehensive summary requested under The Territorial Oil & Gas Regulations, Section 25, Sub-section (2), (e).

The Company's Petroleum and Natural Gas Permits are located in the east-central portion of the Lower Mackenzie Basin, approximately 17 miles north of Fort Good Hope, the nearest air and water transportation terminal. The Permits concerned are numbered 2107 to 2113 inclusive, and total approximately 356,622 acres. These Permits are shown on Figure II.

The primary object of the survey was to study the local and regional geology with a view to evaluating the oil and gas prospects of the Permit area. A related objective was the study of the terrain in relation to accessibility for later stages of exploration.

The survey was conducted in two parts during the 1958 field season. One field party was assigned to the Company's Permit holdings and to the area in the immediate vicinity of the holdings. At the same time other parties, working in the Mackenzie Mountains to the south and the Richardson Mountains to the west, were engaged in regional studies of the stratigraphic section, with a view to arriving at a more accurate interpretation of the character and P. & N. G. prospects of the geological section within the Permit holdings. The present report combines the results of these separate surveys.

The field work was preceded by photogeological studies and these were continued throughout the field season, supplemented by field checks of phenomena observed. Post-season supplementary photogeological and other office studies have also been carried out.

The survey party working in the Permit area was based at Fort Good Hope on the Mackenzie River. Geologists on this party were G. K. Williams and H. H. Peterson. The crew operating the J. C. Sproule & Associates' Model G-1

helicopter used on the project consisted of J. Durkie, pilot, and C. Wallace, engineer. In addition a Beaver aircraft, piloted by Ron Wells of Cascade Air Services, was used for establishing helicopter fuel caches and for long range scouting. Work on the Company Permits and adjacent areas was carried out during the month of September.

The detailed stratigraphic and other regional studies were carried out in the Mackenzie and Franklin Mountains under the supervision of S. R. L. Harding assisted by senior geologists J. Tassonyi and J. F. Lintott, and in the Richardson Mountains by R. deWit and D. L. Campbell, assisted by senior geologists K. W. Lyle and T. Madden. These parties were also serviced continuously by helicopters and/or Beaver aircraft. The regional studies were carried out for the benefit of several clients during August and September. The costs of these regional studies were charged to the various clients on a proportional basis.

Physiography

Topographically the Permits lie in a low plain of moderate relief. Altitudes range from less than 100 feet above sea level, on the Mackenzie River to slightly more than 900 feet above sea level on the highest parts of the plain in the east. The Mackenzie River flows in a northwesterly direction through the two western Permits (Nos. 2112 and 2113). The Mackenzie, at this location, varies from one-half to one and one-half miles in width. The west bank of the Mackenzie River, where it flows through the Permits, has low clay banks, whereas long sections of the eastern bank have steep cliffs, which expose bedrock and rise as high as 300 feet above the river.

The part of Permit No. 2113 which lies west of the Mackenzie River is very low and swampy. The only significant relief is a low scarp of bedrock paralleling the river.

Immediately east of the river, in the northern parts of Permits Nos. 2111, 2112 and 2113, large areas are capped by the resistant Upper Ramparts limestone member; the edges of this member have been eroded into steep scarps from 20 to over 200 feet high. Several small streams in this area have steep-walled valleys as deep as 200 feet.

Loon Lake, which is six miles long, lies in a broad northeast-trending valley. In addition to Loon Lake, this valley also contains a wide area of low, flat, quite swampy land with numerous small lakes.

East of the Loon Lake valley, glaciation has produced long, straight ridges and troughs of very low relief. Lakes and muskegs lie within the troughs. The area is drained by two southward-flowing tributaries of the Hare Indian River, the largest of which is the Bluefish River. Both of these streams have straight, narrow valleys over 100 feet deep.

The tree cover, which is locally fairly dense, consists mainly of small spruce with some poplar and tamarack and a few birch trees. Alders grow along the stream valleys.

The ground is permanently frozen from within a few feet of the surface down to an unknown depth.

Accessibility

The Permit area is accessible by both air and water. The Federal Government is planning to construct a highway connecting Whitehorse in the Yukon with Fort McPherson on the Peel River. Fort McPherson is 190 miles west-northwest of Fort Good Hope.

Fort Good Hope, which is about 17 miles south of the area, is serviced by Canadian Pacific Airlines Ltd. There are two flights a week from Edmonton to Norman Wells by C-46, and one flight weekly by Otter from Norman Wells to Fort Good Hope, except for brief periods during the Spring break-up and the Fall freeze-up.

At present the only means of access to the interior of the Permit area is by helicopter or ski- or float-equipped planes. There are about a dozen lakes large enough for a Beaver aircraft to land and take off; most of these, however, have shallow edges with swampy shores making them unsuitable for sea-plane bases. Commercial aircraft available in the vicinity during the past season were a Beaver at Aklavik, 200 miles northwest of the area, and a number of Otters, Beavers and other small planes based at Yellowknife, 530 miles southeast of the area.

The Mackenzie River is the main freight line into this part of the north. Equipment can be sent from Edmonton by rail to Grimshaw or to Waterways, in Alberta. From Grimshaw material is trucked 380 miles north to Hay River, on Great Slave Lake, Northwest Territories. From Hay River barges go down the Mackenzie. Hay River is 650 river miles from Fort Good Hope. From Waterways, Alberta, which is at the end of the railroad, equipment goes by means of the Athabasca and Slave Rivers to Great Slave Lake. The distance by water from Waterways to Fort Good Hope is about 1,150 miles.

The main rivers are navigable for a period of about three months. The Northern Transportation Company runs boats from Waterways, Alberta, and the Yellowknife Transportation Company operates from Hay River, Northwest Territories.

Aside from the long supply line, once heavy equipment is delivered to Fort Good Hope, or some other locality on the Mackenzie River, there will be no great difficulties encountered in building roads into and within the Permit area. The trees are small so trails will be easy to bulldoze. The construction of summer roads over permafrost involves special techniques which could be investigated before such a project is undertaken.

Previous Work

Some geological material has been published pertaining to the Lower Mackenzie area; most of the work was done along the Mackenzie River or in the mountain areas. The several reports of the Canol geologists in the Norman Wells area are available.

Of special interest from a regional point of view is the unpublished Doctorate thesis of Martin (1957). This report will probably be published in a more available form in the Bulletin of the American Association of Petroleum Geologists.

GENERAL GEOLOGY

Geological Setting

The subject Permits are located in what has been named the Interior Plains of the Lower Mackenzie area. Throughout a large part at least of its sedimentary history this Interior Plains area was apparently a stable shelf lying to the west of the Canadian Shield. Sedimentary basins having varying degrees of subsidence flanked the relatively stable shelf to the southwest, west and, possibly also to the northwest.

The shelf and basin areas differ principally in that the basin sediments are thicker and the section more complete. Large areas of the basin have been folded and faulted forming the Franklin, Mackenzie and Richardson Mountains.

Bedrock over most of the Permit area is formed by the Middle Devonian Ramparts formation; a thin cover of Basal Cretaceous sandstone overlies large areas of the Devonian in the central part. Pre-Ramparts beds are exposed south and east of the map-area. These consist of the Bear Rock formation and the underlying Siluro-Ordovician. Both of these rock units contain porosity.

The following table of formations summarizes that stratigraphic section that is believed to underlie the map-area (Figure II):

Table of Formations

<u>Age</u>	<u>Formation or Member</u>	<u>Lithology</u>	<u>Approximate Thickness Feet</u>
PLEISTOCENE		Boulder clay, gravel and sand.	0-50?
		- UNCONFORMITY -	
CRETACEOUS	Unnamed	Grey, soft shale, ironstone concretions.	0-100 ±
	Basal Sandstone	Poorly consolidated, white weathering quartz sand, interbedded carbonaceous and bituminous matter.	200 ±
		- UNCONFORMITY -	

Table of Formations - Continued

<u>Age</u>	<u>Formation or Member</u>	<u>Lithology</u>	<u>Approximate Thickness Feet</u>
UPPER DEVONIAN	Fort Creek	Hard, black bituminous shale, sandstone at base.	0-240 +
- DISCONFORMITY -			
MIDDLE DEVONIAN	Ramparts Upper Member	Grey limestone, in part reefal.	0-100
	Middle Member	Upper part green shale, middle part grey shale with abundant spores, lower 15 feet black bituminous shale.	700
	Lower Member	Variable lithology, bedded limestone reef bioherms, interbedded nodular limestone and shale.	500 ±
	Bear Rock	Massive tight limestone and porous dolomite beds, which are oil-stained, rare brecciation.	500
- UNCONFORMITY -			
SILURO-ORDOVICIAN	Unnamed	Massive, vuggy reef dolomite, white chert.	500 +
CAMBRIAN		If Cambrian beds are present they will probably be sandstone or quartzite.	Unknown

Geological Structure

The Permian are located in the Interior Plains area designated by Martin (1957) as a stable craton. The structural relief of the Interior Plains is relatively gentle with the regional dip to the west or southwest at less than 20 feet per mile. The area appears to be criss-crossed by a rectilinear system of faults of varying degrees of intensity. Some faults probably had hardly any movement but were sufficient to cause alignment of lakes such as Yelton, Manuel and the Loon Lake-Rorey Lake trend. Other faults are associated with folds. The largest known example of the latter in the general area is the structure along the west shore of Lac Belot and northwest of the lake. This fold produces a topographic ridge which rises 1,000 feet above the level of the plain.

Within the Permit area the regional dip is predominantly to the west over most of the area, becoming southwest in the area north of Fort Good Hope. Elevations taken by barometer at the contact of the Middle and Lower Ramparts members indicate a dip of less than 20 feet per mile to the west. There is some indication of an anticlinal structure in the northern part of Permits Nos. 2111 and 2112. Barometer readings taken on top of the Upper Ramparts limestone indicate a southward-plunging nose; this structure must be regarded as tentative, as in recording barometric elevations, it was not possible to be certain whether the tops of the limestone scarps were the same stratigraphic horizon in each case. The suggested structure is shown on the structure and geological map, Figure II. The same area is marked by areas of indicated high structural relief, on a basis of a photo interpretation. These areas are believed to be fairly reliable as to location but the exact nature of the structures and the details of their outlines should be evaluated by structure drilling or geophysical work.

OIL AND GAS POSSIBILITIES

Twenty-eight miles north of the Permit area there is an active oil seep. The seep is located a short way up the side of the hill on the east side of Rond Lake. It issues from the glacial till very near the contact of the Ramparts shale with the Basal Cretaceous sandstone. The present seep covers an area of about one-quarter of an acre. Tarry material nearby indicates that in the past the seep has reached the surface at other locations.

One of several other indications of the oil-bearing nature of the rocks in this area can be seen on the west shore of Lac Belot northeast of the Permit area. At that location about 60 feet of Basal Cretaceous sandstone are stained dark brown by oil. These oil sands apparently overlie the Bear Rock formation.

The distribution and facies variation of Siluro-Ordovician strata in the Lower Mackenzie area represent a very favourable set of conditions for the generation and entrapment of oil. Thick sections of dark shales, of a type commonly thought of as source beds, occur in the west, in the deepest part of the basin. These shales interfinger updip with carbonates. In the shelf area Silurian-Ordovician rocks contain a dolomitized reef facies in which vuggy porosity is developed. Pre-Devonian erosion removed an unknown thickness of Siluro-Ordovician strata from the shelf area, which includes the Permit area. We do not know whether or not an impermeable layer occurs about the reef beds and below the unconformity.

The Bear Rock formation overlies the Siluro-Ordovician. Porosity is found in this formation south and east of the map-area. The nature of the Bear Rock facies beneath the Permit area can only be surmised. As porous beds in the Bear Rock very often show some evidence of petroleum, the oil seeps referred to above are taken as evidence for a zone of porosity underlying the Permit area.

Reef developments in the Lower Ramparts member may also occur within the Permit area at sufficient depth to form potential oil and gas reservoirs.

Two factors may be considered as unfavourable for large oil accumulations. One is the relatively thin section indicated by the various isopach maps. The other factor is the very shallow depth of the potential reservoir rocks. Concerning the isopach maps, it must be emphasized that these maps represent only a minimum thickness. The Company Permits are situated about 200 miles west of the Canadian Shield; if the slope of the basement is only 20 feet per mile, the thickness of the sedimentary rocks beneath the Permits would be in the order of 4,000 feet.

The Bear Rock formation and the Lower Ramparts member, which are the uppermost potential reservoir beds, occur beneath the Permits at relatively shallow depths. In this regard it should be mentioned that many millions of barrels of oil have been produced in Ontario from depths of between 100 and 500 feet.

SUMMARY AND RECOMMENDATIONS

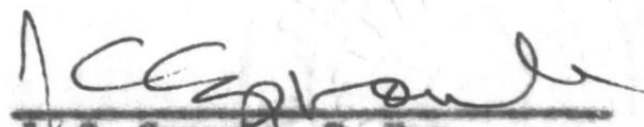
Ramworth Exploration Limited Oil and Gas Permits, totalling approximately 356,622 acres, are located approximately 17 miles north of Fort Good Hope, Northwest Territories. Physiographically the subject area and environs is covered with small evergreen trees, is fairly well drained and has moderate relief. There should be no serious difficulties in constructing temporary winter roads. The most serious problem in the construction of all-weather roads would be the permafrost. To reach the area with heavy equipment for drilling or geophysical operations one would proceed from Grimshaw, the end of steel, 380 miles by the Mackenzie Highway to Hay River, Northwest Territories, thence 650 miles by river barge on the Mackenzie River to Fort Good Hope. Looking forward to the days of marketing problems, the area is roughly 520 miles from open water at Skagway, Alaska, and is located on the Mackenzie River, thus providing access to the Arctic Ocean.

The Permits are located in the northern part of the Mackenzie Sedimentary Basin. Within this basin there is one known oil field, the Norman Wells pool. At Norman Wells, located about 80 miles south of the Company Permits, oil is produced from a reef in the upper member of the Middle Devonian Ramparts formation. A few unsuccessful wildcats were drilled near the field. Aside from Norman Wells area and a wildcat drilled on the Eagle Plains in the Yukon, approximately 260 miles west of the Permits, the basin is unexplored except for field mapping, which is far from complete.

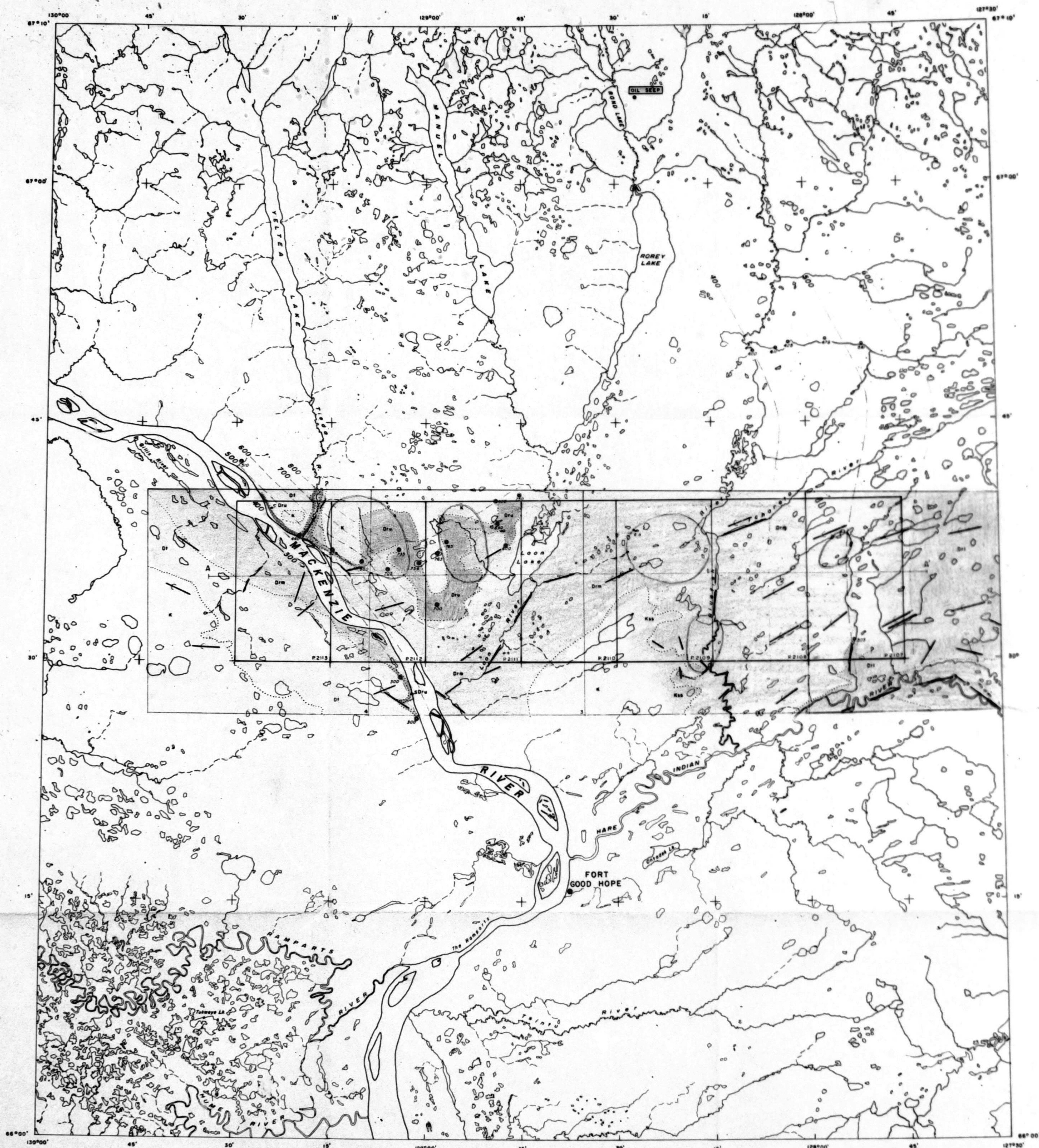
Bedrock over most of the Permit area is formed by the Middle Devonian Ramparts formation. In parts of the area the Ramparts is overlain by a thin layer of Basal Cretaceous sandstone. Beneath the Ramparts are 500 ± feet of limestone, with some dolomite, belonging to the Bear Rock formation. This formation does not outcrop within the Permits, but its depth is only a few hundred feet. Nearby exposures of this formation contain porosity and are very often bituminous. The Bear Rock formation is the probable source of the oil in the seep at Rond Lake, 28 miles north of the Permit area. Underlying the Bear Rock formation in areas south and east of the area, outcrops of up to 150 feet of reefoid dolomite were observed. The age of this dolomite is probably Ordovician. In all outcrops observed this unit exhibited fair to good vuggy porosity.

Structural relief within the Permits is very gentle; the area is comparable with the eastern portion of the Alberta Basin. The regional dip is to the west and southwest at less than 20 feet per mile. This means that the area is favourable for the development of closed structures. Field mapping has indicated a possible structural high in Permits Nos. 2111 and 2112; this interpretation must be regarded as tentative due to the unreliability of the exposed markers. Five areas, including the above, have also been indicated as areas of high structural relief on photogeological evidence.

To evaluate the indicated structures in this area in more detail we suggest the drilling of structure test holes, possibly accompanied by a limited amount of detailed surface work. The principal problem is cost of operation as the use of conventional structure drills of the Failing 1000 or Failing 1500 type would be very expensive. We are, at this time, investigating the possibility of air lifting a light portable drill and may refer the result of this study to the Company at a later date.


J. C. Sproule, P. Eng.

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June 27, 1959.



LEGEND

CRETACEOUS

- Undifferentiated
- Basal Sandstone

DEVONIAN

- Fort Creek Fm.

MIDDLE

- Ramparts Fm.
- Upper Member
- Middle Member
- Lower Member
- Bear Rock Fm.

- Geological Formation Contact
- Area of High Structural Relief
- Glacial Grooving Etc. (Arrow indicates Direction of Ice Movement)

- Fault or Joint Zone
- Contours on Top of Upper Member - Ramparts Fm.
- Contours on Top of Lower Member - Ramparts Fm.
- Control Point
- Elevation on Top of Upper Member - Ramparts Fm.
- Control Point
- Elevation on Top of Lower Member - Ramparts Fm.
- Outline of P & N.G. Permits
- Outline of Mosais
- Line of Cross-Section

NOTE: CONTROL FOR STRUCTURAL CONTOURS BASED ON REGIONAL TOPOGRAPHIC CONTOUR MAPS AND ALTIMETER READINGS. POSITION OF CONTROL POINTS RELATIVE TO TOP OF UPPER RAMPARTS MEMBER IS UNCERTAIN IN MANY CASES AND MAP MAY BE CONSIDERABLY IN ERROR.

STRUCTURE & GEOLOGICAL MAP LOON LAKE AREA NORTHWEST TERRITORIES

- Top of Upper Ramparts Mbr.
- Top of Lower Ramparts Mbr.
- Contour Interval 100 Ft. Datum Sea Level

SCALE 1:250,000

Interpretation by: N.W. Peterson, March 1959

587-1-6-1

J.C. SPROULE & ASSOCIATES, CALGARY

FIGURE II