GEOLOGICAL REPORT ON PERMITS

1337 AND 1338

PEEL RIVER AREA

YUKON TERRITORY

Prepared for

MIDLAND PETROLEUMS LTD.

by

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FRONTISPIECE

MIDNIGHT SUN
MARGARET LAKE, YUKON TERRITORY

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ABSTRACT

A reconnaissance surface geological field study was carried out on Permits 1337 and 1338 during the summer of 1958. Results of this survey indicate the presence of favorable source and reservoir materials in the stratigraphic sequence underlying the permits. Structural conditions within and adjacent to the permits offer good potential for the accumulation of hydrocarbons.

INTRODUCTION

General Statement

The area dealt with in this report is located south of the confluence of the Snake and Peel Rivers in the Yukon Territory. It lies within a portion of the Peel Plateau Area which is underlain by a thick series of sediments. Hydrocarbons represent the main economic value of the area. Over 10 million acres are held in reservations and permits in the area to the north and east.

The area concerned is strategically situated with respect to supply problems of hemispheric defense. Logical market outlets are located at tidewater only 500 miles to the southwest.

Location and Area

Yukon Territories Permits 1337 and 1338 are located twenty miles south of the junction of the Peel and Snake Rivers. The area lies between Latitudes 65° 30′ N and 65° 40′ N and between Longitudes 133° 30′ W and 133° 52½′ W. There is a total of 79,473 acres contained in the two permits.

Accessibility

Access to the area can be gained during the summer months by chartered, float-equipped aircraft from Aklavik, Northwest Territories, or Dawson City, Yukon Territory, both of which centers are served by regular commercial airlines. Supplies are available from Aklavik, Ft. McPherson or Dawson City.

During the winter, heavy equipment could be moved into the area from Dawson City over a winter tractor road which was built to supply DEW line operations. This road cuts across both permits 1337 and 1338 in a general east-west direction. The road continues eastward to the Mackenzie River. Access to the area from the east, along the tractor road, would necessitate moving equipment down the Mackenzie River during summer months.

Climate, Vegetation, and Wildlife

Low temperatures and light precipitation are characteristic of the region discussed in this report. The average mean temperature for Aklavik is reported to be 16° F. It is expected that the average mean temperature will be slightly higher for this area by virtue of its more southerly geographic position. Average total precipitation for Aklavik is approximately 9 inches.

Snow begins to fall in early September and has melted again by June 1st.

Temperatures of 80° F and higher are not uncommon in the summer time. During the field season of 1958, July proved to be the wettest month and August the dryest. Normally, wet unsettled weather occurs from September 1st to September 20th when freeze-up commences. The reader is referred to Appendix A for details of hours of daylight and related data.

As a result of low temperatures during winter months, permafrost is present throughout the entire area. During the summer months, the frost-free zone is limited to the top 10 or 12 inches of soil. This frost-free zone is composed of an upper layer of reindeer moss and lichens and a lower layer of humus soil. The moss cover seems to provide excellent insulation thereby preventing thawing beyond this surface zone. Below this the ground is permanently frozen. Areas from which the moss has been stripped thaw to considerable depth. Areas adjacent to stream channels and lakes thaw to a greater extent than do moss covered areas.

During summer months the permafrost provides excellent refrigeration for food storage. Meat stored in pits chopped into the frozen ground with an axe can be kept for two weeks without spoilage.

Vegetal cover over the area is fairly sparse. Predominant tree type is stunted black spruce. Underbrush is comprised of alder, dwarf birch, and willow. Some poplar are to be found along dry sandstone ridges.

The trees are larger and more abundant along river valleys. Spruce trees with 12 to 15 inch butts were noted along Peel and Snake Rivers. Annular growth rings of these trees are very close together making the wood very strong. Logs from these trees make excellent building material. Similar logs have been used effectively as building materials in many of the settlements throughout the north country. It is interesting to note that logs from trees of this type are used as foundations for houses and that these logs are not subject to rot because of the permafrost conditions.

The tops of most of the ridges in the area are barren of trees. The tree line is located at about the 2000 foot level. In the areas that are free of trees typical tundra-type vegetation prevails.

Wildlife is very abundant throughout the entire area. Big game animals include moose, caribou, Dall sheep, and grizzly bear. Fur bearing animals include lynx, martin, beaver, muskrat, fox, bear, and wolf. Fish common to the area include Arctic grayling, some Dolyvarden, jack fish, and whitefish. Waterfowl, except for a few

ducks, are not common. Ptarmagin and grouse were the only uplands game birds noted.

Moose are very plentiful in the area. Caribou migrate into the mountains during the early spring where their young are born and the herds remain to feed all summer. Late in August the caribou begin to migrate back into the wooded lowlands where they winter in the protection of the trees.

Drainage

The area is well drained and dissected by a predominantly dendritic pattern of drainage. Some evidence of structural control is noted in the stream patterns particularly in the north of Permit 1338 where a radial drainage pattern has developed as a result of a structural syncline. There are a few small lakes within the area. Moose Lake, located south of Permit 1338, is the only lake near the area from which float-equipped aircraft can operate.

Type and Method of Survey

The work done on the area was planned to evaluate the hydrocarbon potential of the acreage, using reconnaissance surface geological methods. The techniques employed during the survey involved the use of a helicopter-exped-

ited surface geological survey with float-equipped aircraft support. Attitudes of the beds were obtained by either measurement with a Brunton compass or strike and dip estimation from the helicopter. Where it was impossible to land in order to examine outcrops, the helicopter was flown as close as possible to the rock units consistent with safety.

Surface geological studies were supported by photogeological studies and by a compilation of published information. During the period of the field study, the party was based at Margaret and Moose Lakes. Supplies were purchased and flown in from Ft. McPherson and Dawson City.

The survey crew consisted of four geologists, helicopter pilot and engineer, fixed wing aircraft pilot, and a cook. Work was under the direction of D. Bruce Bullock, P. Eng.

It is particularly important for the reader to note that this report is of reconnaissance quality and should be regarded as preliminary in value pursuant to detailed studies.

Acknowledgements

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HISTORY OF EXPLORATION

Alexander Mackenzie was the first white man to explore the Mackenzie River. He made his first trip to the Arctic coast from Great Slave Lake via this route in 1789, making the return trip from Fort Chipewyan on Lake Athabaska in one hundred and two days! Sir John Franklin, in 1826, further explored the lower Mackenzie and Arctic coast. He was followed in 1848 by Dr. John Richardson, who had accompanied Franklin on his early trip.

Thomas Simpson and Peter Warren Dease, officers of the Hudson's Bay Company, carried on important exploration in the Arctic coast and Mackenzie River areas in 1837. Others of this same company were active in the Mackenzie River area for several years following.

William Ogilvie, sent out by the Department of Interior, Ottawa, in 1887, entered the Mackenzie Basin from Yukon by way of Porcupine and Bell Rivers, McDougall

Pass and Rat River. The Geological Survey of Canada continued this work and in 1888 R. G. McConnell descended the Mackenzie to the Peel which he ascended to Ft. McPherson. After making an exploratory trip up Rat River, he crossed to La Pierre House by way of Peel River portage, descended the Porcupine River and carried on exploration in the Yukon.

Very little information has been published on the Porcupine Plains area. Brief references are made by Isbister (1845), Petitot (1875), and Ogilvie (1887-88). Recently, however, a great deal of attention has been centered on the Porcupine Plains area. This activity was stimulated by the Federal Government who opened the area to active exploration by putting two reservations up for public bid. Surface geologic studies were carried out on these two reservations by Peel Plateau Exploration Limited during the summers of 1953 and 1954. Seismic studies of a portion of the Eagle Plains area were carried out during 1955 and 1956. This exploration program has culminated in the drilling of Peel Plateau Exploration Eagle Plains No. 1 well which is currently suspended awaiting fresh supplies.

Exploration by most of the major oil companies and many independent oil companies was carried out in the area during the field season of 1958. Plans for

the next year in addition to surface studies include the drilling of another well in the Eagle Plains area and possibly some drilling in the Peel Plateau area northeast-of the area herein reported.

PHYSIOGRAPHY AND TOPOGRAPHY

The area discussed in this report is located along the southern fringe of the Peel Plateau physiographic province. Topography of this area is generally of moderate relief. Elevations vary between 1500 and 3500 feet above sea level. Ridges and hills are rounded and valleys are generally wide. In the northeastern part of the area some stream valleys have cut into shales forming steep-sided valleys. The area forms the transition zone between the Plateau and the foothills of the Mackenzie Mountains.

GEOLOGY

General Statement

The Peel Plateau area is underlain by a thick series of sedimentary rocks which have undergone very little structural deformation throughout geologic history. Strata of Cambrian, Ordovician, Silurian, Devonian, and Cretaceous ages are represented in the section.

STRATIGRAPHY

Strata which crop out within or in the vicinity of Permits 1337 and 1338 include those of Cambrian, Ordovician, Silurian, Devonian, and Cretaceous age. Cambrian, Ordovician, and Silurian strata crop out in the Mackenzie Mountains south of the permits. These were given only a cursory examination in the field and will be dealt with only briefly in this report.

Cambrian

A thick series of highly metamorphosed limestones, quartzites, and shales crop out within the Mackenzie Mountains behind the front ranges. There were no reservoir characteristics noted in these beds and they are not considered of economic importance to the purposes of this report.

Ordovician

Dolomites and argillaceous limestones which overlie Cambrian strata, carry an Ordovician fauna. Some porosity was noted in these strata. More work is required on these beds to properly evaluate their reservoir characteristics. Ordovician strata would be important objectives in any well drilled in the area.

Silurian

Silurian age strata in this area are predominantly carbonates. The lower beds are composed of thinly bedded limestones with interbeds of black chert. The upper beds are mainly bedded dolomites with some reefal material near the top. There are several important porous horizons near the top of the Silurian section. Most of the porosity appears to be of organic origin and some definite reef horizons were noted.

The upper and lower boundaries of the Silurian have not been defined but they appear to be conformable. Considerable valuable information could be gained by more detailed studies of these strata. Sufficient porosity exists to warrant further exploration on these strata.

Middle Devonian

Middle Devonian age strata are represented by dolomites, limestones, and shales which can be divided into three main units: an upper "Mudstone" - limestone unit, a middle Shale unit, and a basal Dolomite unit. The upper "Mudstone" - limestone unit is composed of a soft, grey, clay-like shale which breaks down into a mudstone-type of deposit on weathered surface. Several beds of shaly limestone are scattered throughout the unit. The upper beds of limestone in this unit are highly

fossiliferous. There were no porous horizons noted within this unit.

The middle unit of the Middle Devonian group of strata is composed of black thinly bedded, calcareous shales. These beds are excellent source rock material for the generation of hydrocarbons.

The lower dolomite unit is composed of a thick series of bedded dolomites with minor amounts of limestone. Some porosity was noted in this zone. The porosity appears to be the result of dolomitization rather than organic agents. Detailed studies of these and older Paleozoic strata are required to adequately assess their reservoir characteristics.

Upper Devonian

Upper Devonian strata can be divided into two main units:

upper unit - Imperial sandstone

lower unit - Fort Creek shale

The lower unit is composed of thinly bedded, black, bituminous shales with a few limestone lenses and beds. An average thickness of 400 feet is expected to underlie the permit areas. These strata would provide excellent source rock material for the generation of hydrocarbons. They also form an excellent cap rock for underlying strata.

The upper and lower boundaries are believed to be conformable.

Sandstones assigned an Upper Devonian age are the stratigraphic equivalents of the Imperial formation reported from the Norman Wells area. They are composed of light brown, fine grained quartz sandstone with silty shale interbeds. The sandstones are bedded and in places cross-bedded. These sandstones are expected to be about 150 feet thick in the area of the permits. The Imperial sandstones are unconformably overlain by Lower Cretaceous strata.

Lower Cretaceous

A thick series of thinly bedded sandstones with interbeds of shales and conglomeratic sandstones overlie the Upper Devonian and have been assigned a Lower Cretaceous age on the basis of its lithology and stratigraphic position. The sandstone sequence is about 1500 feet thick and is overlain conformably by marine shales which carry a Lower Cretaceous fauna.

The marine shale unit of the Lower Cretaceous is composed of grey, thinly bedded, soft shale with lenses and nodules of ironstone scattered throughout. An occasional thin bed of shales, siltstones and sandstone occur in the section. These shales are about 2000 feet

thick in the northern portion of the permits. The shales have been removed by erosion from the southern portion of Permits 1337 and 1338.

Along the western boundary of Permit 1338 a series of sandstones cap the top of the ridges which form the southern extension of the Trevor Mountains. These sandstones are probably Upper Cretaceous in age. They overlie the shale unit with apparent conformity. There is a thickness of about 300 feet of these sandstones.

Quaternary

Glacial boulder-clays cover most of the lowland areas. Some glacial erratics were noted on the ridges. Recent gravel outwash occupies the valley floor of most streams.

STRUCTURAL GEOLOGY

Permits 1337 and 1338 are located in the transition zone between the Peel Plateau and the foothills belt of the Mackenzie Mountains. Structural deformation of the sediments in the vicinity of the permits is aligned along a general E-W direction parallel to the Mackenzie Mountains. Orogenic forces associated with the Mackenzie Mountain uplift have caused the deformation within the permit area.

The main structural feature within Permits 1337 and 1338 is a large anticlinal fold which is labelled Moose Lake Anticline on the accompanying geological map. The axial trace of the anticline is slightly arcuate in its surface expression but strikes in a general N 30° E direction. The anticline is formed in Cretaceous strata at the surface. Dips on the north flank of the anticlinal structure vary from 34° N near the axis to 8° N near the synclinal axis which marks the northern limit of the anticline. The anticline is closed along strike to the east beyond the permit boundary. Closure to the west is indicated in the vicinity of the southwest corner of Permit 1338. Additional studies would be necessary to prove the west plunge of the anticline.

The south flank of Moose Lake Anticline is complicated by the presence of structural noses which plunge northward off the front of the Mackenzie Mountains. These structural noses would have the effect of producing local crests and depressions along the axis of Moose Lake Anticline. There is effective closure on the south flank of the anticline.

Moose Lake Anticline is exposed along a length of thirteen miles within Permits 1337 and 1338. The north flank, from crest of the anticline to the trough of the syncline, is about seven miles wide. The south

flank varies in width from one to three miles. Vertical closure, measured in relation to the syncline to the north, is over 2000 feet. Vertical closure is somewhat less when measured against the syncline to the south.

Some normal faulting is expected to be present in association with Moose Lake Anticline. There was no faulting mapped on the basis of the reconnaissance study to date but detailed studies may reveal faulting. Faulting which may exist will probably not be of major significance to the main structure.

CONCLUSIONS AND RECOMMENDATIONS

Permits 1337 and 1338 are situated along the southern boundary of the Peel Plateau physiographic province in the zone of transition between the Peel Plateau and the foothills of the Mackenzie Mountains. The area is underlain by a thick series of sediments which include both source and reservoir beds. Structural deformation of the strata underlying the permits is related to the Mackenzie Mountains uplift.

Moose Lake Anticline provides structural conditions which, on the basis of the survey to date, appear to be very favorable for the accumulation of hydrocarbons in commercial quantity. Porosity, which was noted in several Paleozoic horizons, includes possible reefal zones

of very good potential. These porous zones undoubtedly underlie Moose Lake Anticline.

Additional surface studies of Paleozoic sections exposed in the Mackenzie Mountains to the south should be programmed to fully evaluate the reservoir horizons. Surface studies of the structural details of Moose Lake Anticline should be undertaken to provide an accurate measurement of the closure of the anticline.

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