GEOLOGICAL REPORT

TERRITORIAL OIL AND GAS

PERMIT 1433

N.W.T.

By:

A.G. Pentland,
and
Alfred R. Allen
Vancouver, B. C.
October, 1957

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Looking Easterly down Barrier River

8 miles from Rat River.

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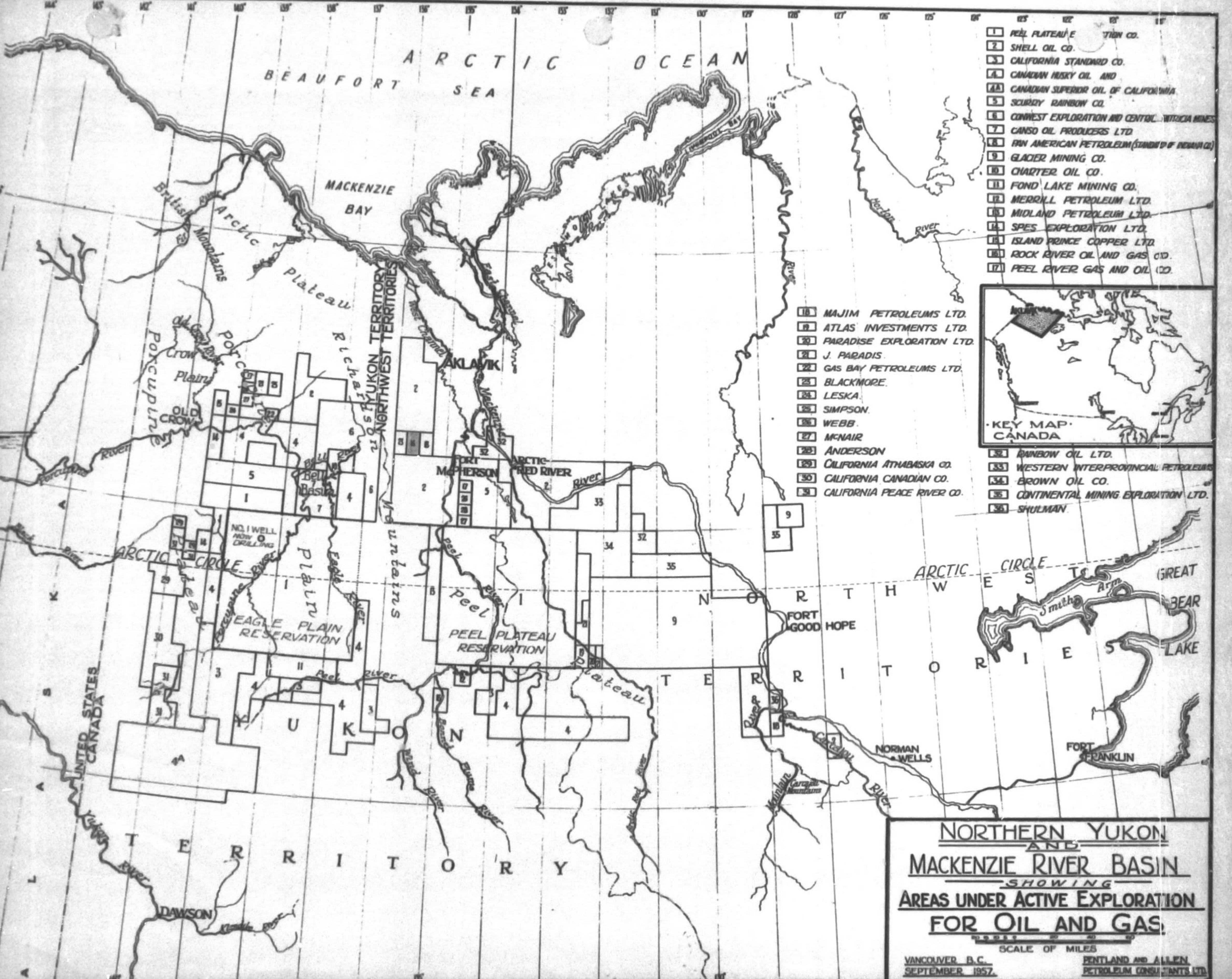
The Lower Cretaceous fossils Tancredia and Nucula were collected from the brown shaley sandstone at the top of the photograph.

Looking Easterly down the Barrier River

9 miles from the Rat River

Showing black and grey shale and the axis

of a large Synclinal structure.


NORTHERN YUKON AND MACKENZIE RIVER BASIN
SHOWING
AREAS UNDER ACTIVE EXPLORATION FOR OIL AND GAS
SCALE OF MILES
VANCOUVER B.C.
SEPTEMBER 1957
PENTLAND AND ALLEN PETROLEUM CONSULTANTS LTD.
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3 CALIFORNIA STANDARD CO.
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4A CANADIAN SUPERIOR OIL OF CALIFORNIA
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KEY MAP CANADA
ARCTIC OCEAN
BEAUFORT SEA
MACKENZIE BAY
British Mountains
Arctic Plateau
Richardson Mountains
YUKON TERRITORY
NORTHWEST TERRITORIES
AKLAVIK
FORT McPHERSON
ARCTIC RED RIVER
East Channel
West Channel
Mackenzie
Porcupine
Crow Plain
OLD CROW
Porcupine River
Bell Basin
NO. 1 WELL NOW DRILLING
ARCTIC CIRCLE
Eagle Plain
EAGLE PLAIN RESERVATION
Eagle River
Peel River
Peel Plateau
PEEL PLATEAU RESERVATION
FORT GOOD HOPE
NORMAN WELLS
FORT FRANKLIN
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YUKON TERRITORY
NORTHWEST TERRITORIES
ALASKA

Geological Report

Permit 1433

N.W.T.

1. Location

Territorial Oil and Gas Permit 1433, comprising 46,820 acres, is located 20 miles northwest of Fort McPherson N.W.T. The north boundary touches on the Rat River, the east boundary is 14 miles west of the Peel River, and the west boundary is along the lower foothills of the Richardson Mountains. The northeast corner is at north latitude 67°-40' and west longitude 135°-30'.

2. Ownership

The permit is registered in the name of John Aubrey Tregilges, representative for Rock River Gas and Oil Ltd. (N.P.L.), 611 Credit Foncier Building, Vancouver 1, B. C.

3. Accessibility

During the summer access to the area is by float-equipped aircraft, river boat, and canoe, and in the winter ski-equipped aircraft, tractor-train and dog train are used. Canadian Pacific Airlines maintain scheduled flights from Edmonton.

The transportation of heavy equipment to the permit would be most practical by railway from Edmonton to Waterways, Alberta, by barge down the Athabasca, Mackenzie

and Peel rivers to Fort McPherson, and by tractor train to the property.

4. Climate and Vegetation

Spring break-up is usually in late May or early June. Freeze-up may be expected in early October. During May, June, and July there is almost continuous daylight, whereas in November, December, and January, there is little or no sunlight. The summer climate is pleasant and warm. Winters are severe and the temperature usually drops to 60 degrees below zero for short periods.

The area is only a short distance from the northern limit of tree growth. Except for scattered stands of spruce, poplar, birch, alder, and willow along the larger creeks and rivers, the land surface is almost devoid of trees. Most of the area is covered with muskeg and the numerous grasses, mosses, and low shrubs common to the tundra of the Arctic.

5. Physiography

The permit area lies about half way between the crest of the Richardson Mountain Range and the confluence of the Peel and Mackenzie Rivers. The general gradient is easterly. From the broad flat river valley covered with numerous lakes, to the foothills of the mountains where only a few small lakes are located, there are large open plains separated by small rock-strewn ridges and hummocks, and incised deeply by the larger water courses. The Rat and Barrier Rivers and main tributary creeks flow in deep-cut valleys which in places are canyon-like.

6. Purpose of the Investigation

The investigation was undertaken in order to survey and map all available geological data on and adjoining the permit area for the purpose of ascertaining the oil and gas potential.

7. Methods of Investigation

The field work was carried out by A.G. Pentland and Alfred R. Allen. A float-equipped Cessna 170B aircraft was used. Flight lines were made over the permit area at slow speed and low altitude, suitably spaced so that all outcrops could be observed and recorded. Landings were then made and working alone each member traversed to and over the rock exposures. Maps of the Department of Mines and Technical Surveys on a scale of 8 miles to the inch, and R.A.F. aerial photographs were used. Aerial mosaics, on a scale of 1 mile to the inch, were made from the photographs.

8. Regional Geology

Permit 1433 is in an area underlain by sedimentary rocks on the east flank of a northerly plunging anticlinorium.

The general stratigraphy, worked out in detail at Norman Wells and elsewhere from preliminary surveys along the major rivers, is as follows:

Stratigraphic Table

Quaternary	Recent	Talus, landslides, river gravels, peat
Tertiary	Eocene	Imperfectly consolidated sands, clays, and conglomerates with lignite. Contain leaf and plant fragments
	Erosional Unconformity	
Cretaceous	East Fork Little Bear Slater River Sans Sault	Gray shales Sandstone and shale with coal Dark grey to black shales, some siltstones and sandstones. Fine-grained sandstone with glauconite, grey sandy shales, sandstone and conglomerate at or near the base.
Permo-Carboniferous		Dark shales, grey to brown sandstones and siltstones, conglomerate
	Erosional Unconformity	
Upper Devonian	Imperial	Green, Fine-grained sandstone and shale
	Fort Creek	Upper grey slates, thin sandstones; bituminous shales, coral reef and limestones; lower dark platy shales
	Ramparts	Heavy massive limestone at top with or without coralline beds; limestone interbedded with slates in middle part; limestone in lower part.
	Bear rock	Brecciated dolomites and limestone, gypsum and anhydrite

Stratigraphic Table (Continued)

		Erosional Unconformity	
Silurian	Ronning group	Limestone with chert.	
Ordovician		Argillites and shales	1,500
Cambrian	Macdougal group	Limestone; greenish, grey, and black shales; sandstones, gypsum, etc.	6,500
Cambrian and/or earlier	Katherine group	Interbedded quartzites and black platy shales	

Eighteen miles north of the permit area steeply dipping blue and grey mottled limestone has been classed as Cambrian by fossil evidence. Similar appearing non-fossiliferous rocks in a dome-shaped outcrop 28 miles north-west of the permit have been mapped as Cambrian ? and ? Ordovician by Perry (3) and Gabrielse (6). The Macdougal formation has been mapped on Macdougal Creek to the south by Hume (3) and there it is composed of limestones, chocolate-grey, and black shales, sandstone and gypsum. In the lower canyon of the Peel River and Mountain River Stelck (8) by lithology, has mapped 2000 feet of black argillite and chert as Cambrian.

Ordovician and Silurian grey and black shale, black siltstone and chert have been mapped by Gabrielse (6) 20 miles south of the permit area. Ordovician beds have been mapped by Stelck (8) in the lower canyon of the Peel River--these being black shale and argillite containing graptolites. Silurian rocks are known to outcrop over a widespread area in the Mackenzie River basin. They have been found from Great Slave Lake through Norman Wells and northward into the Mackenzie mountains. Hume (3, p.14) suggests that these rocks be divided into two, a lower, Ronning group and an upper, Bear Rock formation. The Ronning group consists of limestones with chert. It contains in places a Niagara fauna. The Bear rock group lies with a marked erosional disconformity above the Ronning group. The age is somewhat in doubt because fossils are scarce. It may be Silurian or Devonian. It consists of

brecciated dolomites and limestones, gypsum and anhydrite.

In the Norman Wells and Mackenzie river areas to the southeast of the permit Devonian stratigraphy has been studied in considerable detail. The Middle Devonian strata have been termed the Ramparts formation. The Upper Devonian rocks have been divided into the Fort Creek and Imperial formations. The Ramparts formation is composed of a 400-foot limestone base, a 700-foot shale middle member, and a 180-foot upper limestone. The limestones are corraline and petroliferous. The Fort Creek formation is divided into a lower shale 385 to 540 feet thick overlain by reef limestone up to 400 feet thick, a 100 to 400-foot bituminous zone, all topped by 700 to 800 feet of shale. The Imperial formation is composed of about 2000 feet of sandstones with associated shales and coraline limestone near the base and top. Twenty miles south-southwest, and 12 miles west of the permit area there are extensive outcrops of Upper Devonian rocks (Imperial formation in part). At the base there is a bed of conglomerate containing cobbles of black chert, quartzite, and siltstone; overlain by grit, sandstone, shale, and pebble conglomerate; all with a distinctive mauve colour. Estimated thickness is 5,000 and probably 7,000 feet.

Overlying the Upper Devonian strata near the permit area are rocks classed by Gabrielse (6) as Pennsylvanian, and ? Permian. The base of this rock assemblage is a red-weathering conglomerate, 150 feet thick, which lies disconformably on the Upper Devonian strata. The conglomerate is overlain by grey cliff-forming sandstone and argillaceous siltstone. The estimated total thickness is 1500 feet.

Most of the region is underlain by a thick series of cliff-forming grey, brown, and rusty sandstone and siltstone and grey and black shale, all of which has been tentatively described by Gabrielse (6) as Pennsylvanian to Cretaceous.

Easterly from the Richardson Mountain towards the Peel and Mackenzie Rivers there is a general east dip and Cretaceous rocks outcrop over most of this region. In the Peel Plateau these comprise friable buff and grey sandstone, flaggy sandstone, and soft grey shale and siltstone. To the north, on Mount Goodenough, more than 500 feet of shale and siltstone is overlain by 1000 feet buff and grey well indurated sandstone and siltstone. To the east, on the Arctic Red River, there is 500 feet of sandstone with conglomerate near the base overlain by 1500 feet of black shale with some sandstone beds, and 900 feet of heavy sandstone alternating with sandy shales.

= Tertiary buff and yellow flat lying sandstone with some basal conglomerate unconformably overlies Cretaceous sandstone and shale on the Barrier and Rat Rivers.

The general structural trend is north to northeast. The central part of the region is underlain by gently folded strata, whereas to the west there is a gradation to closer folding and some faulting, and to the east there is a cover of flat lying rocks.

9. Local Geology

Flat lying Tertiary sandstone outcrops over permit 1433 except for the southwestern part where folded Cretaceous rocks are exposed. The southeasterly trending axis of a large anticlinal fold extends across the southwestern quarter of the permit area, and a synclinal axis extends from the northwest corner to the flat lying Tertiary sandstone along the Barrier River and probably under this and the Bond Creek valley.

Upper Jurassic rocks outcrop along Little Phoebe creek 2 miles northwest of the northwest corner of the permit , and in the south side of the Rat river one half mile upstream from the creek mouth. The lowest exposure of this section is composed of soft chocolate brown shale interbedded with light gray brown-weathering sandstone. This is overlain by massive 2-foot to 8-foot beds of gray compact arenaceous sandy shale interbedded with softer gray to chocolate brown thin-bedded shale. Ripple marks occur in the sandy shale. Concretions are scattered throughout the sandstone and shale. Carbonaceous material is included throughout this rock and is most abundant along bedding planes in the gray sandstone. The fossils Aucella bronni and Monotis sp. collected from this location have been classified by C.R. Stelck (8) as Upper Jurassic.

Lower Cretaceous strata outcrop over the western part of the permit area. The lowest member exposed is a light grey massive sandstone (individual beds up to 50 feet thick) in which are a few thin strata of black shale. This

is overlain by brown well-bedded sandstone, which in turn is overlain by 300+ feet of black shale. The black shale grades upward through several hundred feet of interbedded sandstone and shale to light grey, buff-weathering, hard, flaggy to massive sandstone. The sandstone outcrops on most of the hills and ridges north of Barrier River near the northwestern part of the permit. This prominent sandstone member is overlain by a thick series of sandstone and shale generally soft and thin bedded. Near the base of this there are a few beds of grey pebble conglomerate overlain by black calcareous sandstone and carbonaceous-shale in which occur numerous casts of a poorly preserved fossil resembling inoceramus and numerous unrecognizable plant fossils and fucoidal borings. Fossils from these strata, collected from the Barrier River and creek flowing across the northwest corner of the permit are as follows:

Tancredia

Nucula

These have been identified by C.R. Stelck (8) of the University of Alberta.

Tertiary conglomerate and sandstone unconformably overlies the Lower Cretaceous sandstones and shales. The base of the Tertiary formation is composed of a thin and irregular bed of grey pebble conglomerate, poorly consolidated containing abundant carbonaceous fragments. This is overlain by uniformly flat-lying, soft, thick-bedded grey to yellow and buff sandstone. On upper Bond Creek near the base of the formation there is a 75-foot zone of very soft thin-

bedded grey sandstone and shale underlain and overlain by massive buff sandstone. The unconformable contact between the Tertiary and Lower Cretaceous formations on upper Bond Creek is clearly evident where flat-lying yellow to buff massive soft sandstone lies on well bedded grey sandstone and sandy shale dipping north at 35 degrees. As well as carbonaceous plant fragments the clamshell Mya occurs abundantly throughout the formation, and a fossil classified by C.R. Stelck of the University of Alberta as Sphaerium ? was found at one location.

The permit area is for the most part covered with flat-lying soft massive Tertiary sandstone and conglomerate. Near the western boundary, however, along Barrier River and the creek to the north, Lower Cretaceous sandstones and shales are folded and faulted. A broad synclinal structure extends southeasterly from the northwest corner of the permit to the Tertiary sandstone on the Barrier River. This clearly defined structure very likely extends diagonally across the permit under Bond Creek Valley. A parallel anticlinal structure, well exposed on Barrier River and the creek to the north extends across the southwestern part of the Permit. The crest is composed of highly contorted, and in places faulted strata, and the southwest flank is complicated by minor folds. Also on Barrier River, a mile to the southwest, a sharp anticline lies parallel to the above described structure and probably extends through the southwest corner of permit 1433.

10. Economic Possibilities

The Mackenzie River basin, by virtue of the Norman

Wells field, known oil and gas seepages, and favorable stratigraphy throughout is considered to have excellent oil and gas potentials. Tertiary and Lower Cretaceous strata, outcrop on Permit 1433 which is located within this basin. It is highly probable that the entire assemblage of older rocks known to be favorable for the occurrence of oil and gas underly the Tertiary and Cretaceous sediments. The Silurian or Devonian Bear Rock formation, containing reef limestone, porous dolomite and gypsum is considered to have the best reservoir possibilities. Overlying this, Middle Devonian Ramparts formation is coralline and suitable for the accumulations of oil and gas.

One and probably two anticlinal structures in the Lower Cretaceous strata extend across the southwestern part of the permit area.

Favorable anticlinal structure in Lower Cretaceous strata outcropping on the southwestern part of Permit 1433, and the possibility of similar folds below the Tertiary rocks overlying the remainder of the permit area, along with possible occurrences of reef limestone in the underlying Devonian and Silurian formation, warrant geophysical surveying of the sub-surface geology. It is recommended, therefore, that a seismic survey be conducted over Permit 1433.

Vancouver, B.C.
October, 1957.

A G Pentland

Alfred F. Allen

11. Bibliography

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(4) Wheeler, J.O.: A Geological Reconnaissance of the Northern Selwyn Mountains Region, Yukon and Northwest Territories; Geol. Surv., Canada , Paper 53-7, 1954.

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(6) Gabrielse, H.: Geological Reconnaissance in the Northern Richardson Mountains Yukon and Northwest Territories: Geol. Surv., Canada, Paper 56-6, 1957.

(7) Wheeler, J.O.: A Geological Reconnaissance of the Northern Selwyn Mountains Region, Yukon and Northwest Territories; Geol. Surv., Canada, Paper 53-7, 1954.

(8) Stelck, C.R., Personal Communications, October 1957.

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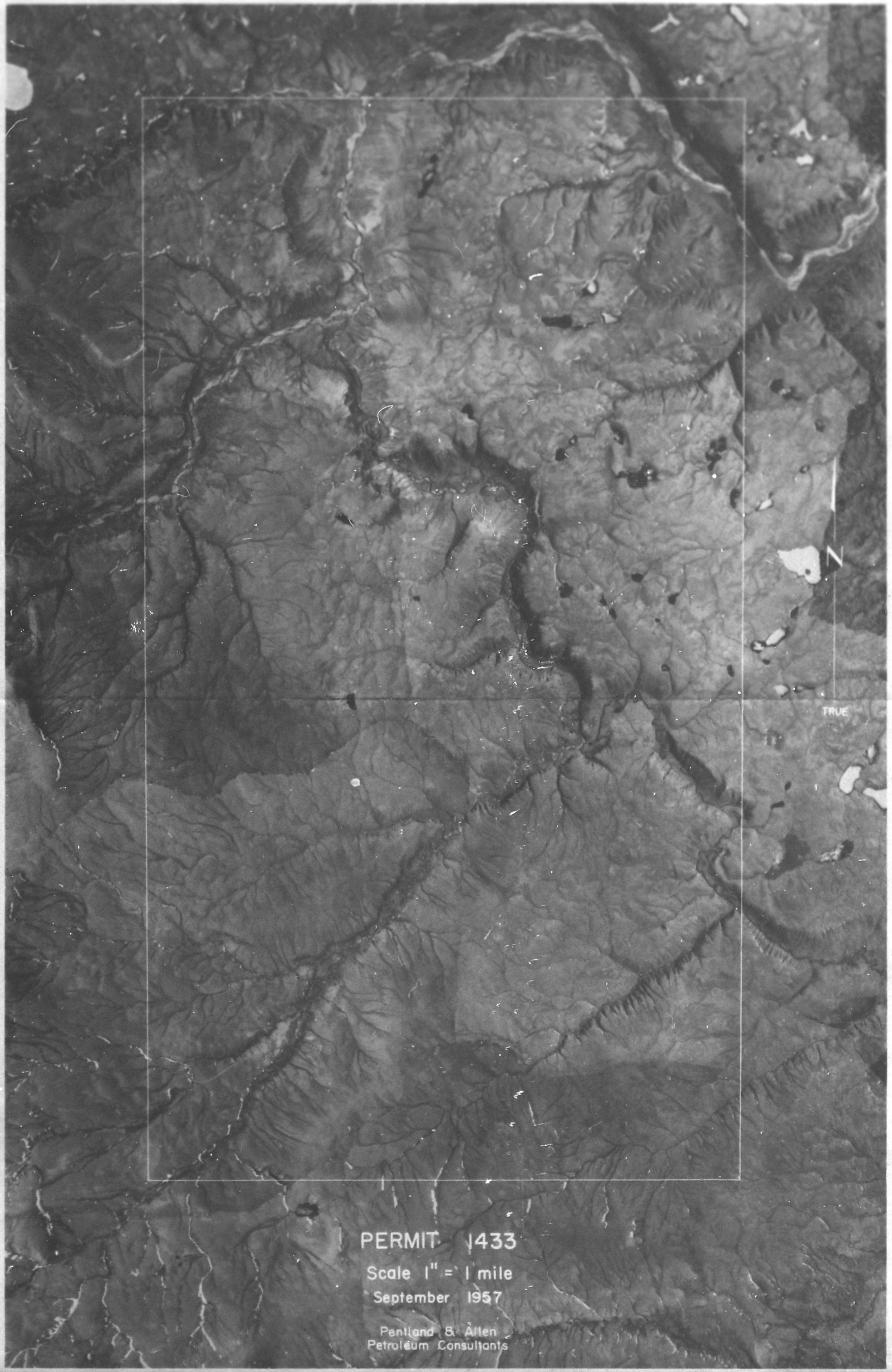


PERMIT 1433

Scale 1" = 1 mile

September 1957

Pentland & Allen
Petroleum Consultants

594-1-6-1

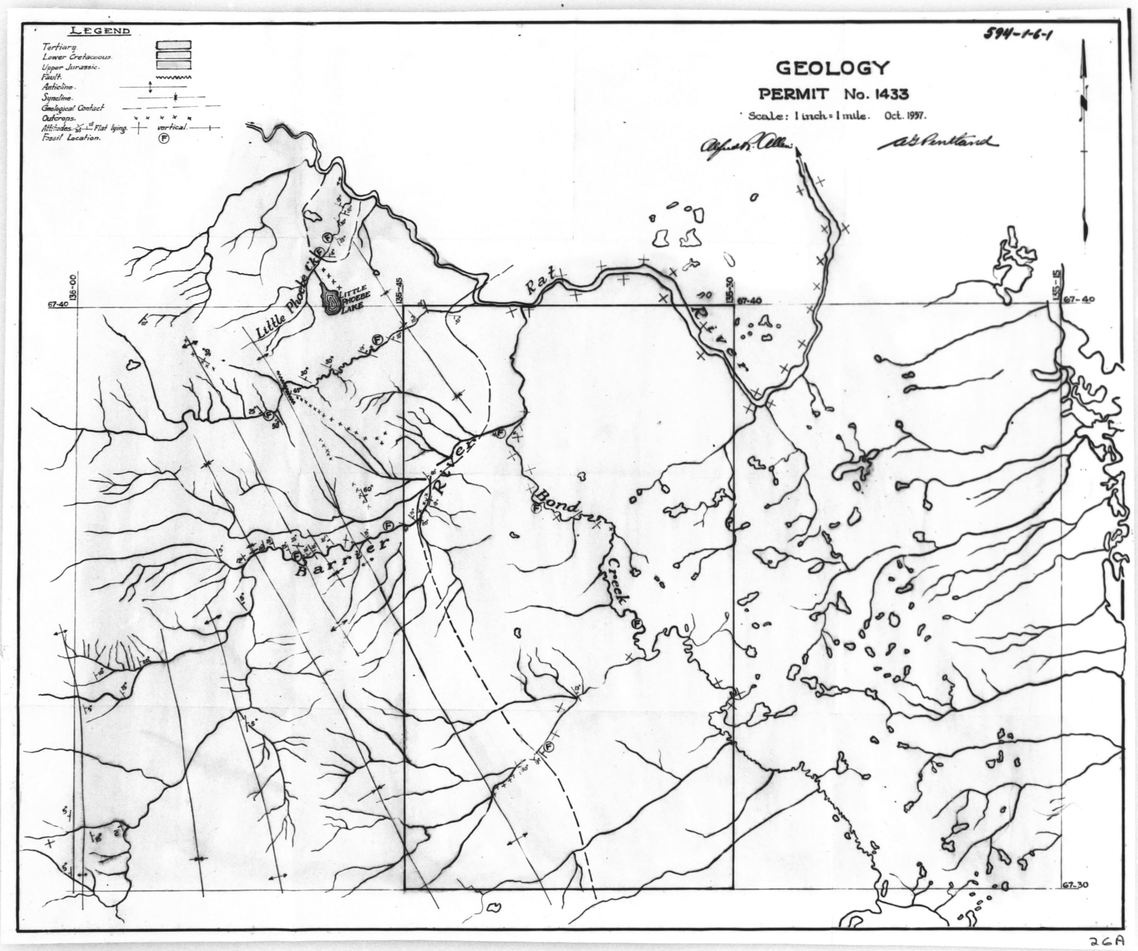
GEOLOGY

PERMIT No. 1433

Scale: 1 inch = 1 mile. Oct. 1997.

LEGEND

Tertiary.
Lower Cretaceous.
Upper Jurassic.
Fault.
Anticline.
Syncline.
Geological Contact
Outcrops.
Attitudes of Flat lying vertical
Fossil Location.



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REPORT ON THE GEOLOGY

PERMIT NO. 1438

YUKON TERRITORY

By:

A.G. Pentland
and
A.R. Allen
Vancouver, B. C.
September, 1957

CONTENTS

Report on the Geology
Permit No. 1438
Yukon Territory

1. Location

Permit No. 1438 is situated at 65°50' north and 134°45' west in the Yukon Territory. It is 175 miles northeast of Dawson or 230 miles west of Norman Wells on the Bonnet Plume River near its confluence with the Peel River. It is about 55 miles south of the Arctic Circle and 12 miles south of the southwest corner of the Peel Plateau Reservation.

Canadian Pacific Airlines operates two scheduled flights per week from Edmonton to Norman Wells, using a DC-3, and three scheduled flights per week from Norman Wells to Aklavik using an Otter. During the summer there are usually many extra flights to take care of the additional freight and passengers.

Much of the heavy freight is shipped into the country by train and barge during the summer months. Freight is shipped from Edmonton to Waterways by train, a distance of 300 miles, and thence by barge down the Athabaska River, Athabasca Lake, Slave River, Great Slave Lake, and Mackenzie River. The only interruption to navigation on this route is the 16-mile portage from Fitzgerald at the northern boundary of Alberta to Fort Smith in the Northwest Territories because of rapids in the Slave River.

LOcally, access during the summer is by float-equipped aircraft or by helicopter. Several of the lakes on the Permit are large enough for the operation of seaplanes. The transportation of heavy equipment would be facilitated during the winter when tractor-trains can be operated across the frozen lakes and swamps or runways could be kept open on the larger lakes for large freight aircraft equipped with wheels or skis.

2. Ownership

The permit consists of 52,644 acres. It is owned by Rock River Gas and Oil Ltd. (N.P.L.) 611 Credit Foncier Building, 850 West Hastings Street, Vancouver 1, B. C. Mr. John Aubrey Tregilges is President.

3. Climate and Vegetation

The rivers and creeks generally open during the latter part of May but ice may remain on some of the larger lakes until the first or second week in June. Freeze-up comes in late September or early October, but occasionally the larger rivers remain open until well into November.

During May, June, and July there is almost continuous daylight and warm summer weather. During the mid-winter months, the sun is below the horizon the greater part of the day. The result is that the length of day varies rapidly during the intervening months. The winter may be severe with temperatures as low as 50 or 60 degrees below zero.

The area is not far from the northern limit of tree growth. Generally, the trees are small and scrubby, but in a few sheltered places along the banks of streams, they may grow

to a height of 40 feet. They consist of white spruce, poplar, and birch. Willow and alder may grow in thick masses along the banks of streams. A great part of the area is covered with the various types of moss that are common to the Arctic tundra.

4. Physiography

Permit No. 1438 is situated in the angle formed by the junction of the Richardson and Mackenzie Mountains. It straddles the Bonnet Plume River for a distance of about 12 miles near the junction of this river with the Peel.

Here the Bonnet Plume Valley is one to two miles wide. The bottom is made up of numerous gravel and sand bars between which many branches of the river wind and twist in a braided fashion. The banks are generally low and show few outcrops of bedrock with the exception of the first three miles above the Peel River.

The area to the west of the river is flat and covered by numerous lakes and swamps. Its elevation is only a few feet above that of the river bottom. The area to the east of the river rises somewhat more abruptly and culminates in a hill situated near the central part of the eastern edge of the permit. This hill is some 200 to 300 feet above the river bottom.

5. Purpose of Investigation

The geological investigation of this area was undertaken in order to map the outcrops of rock and to determine their age and attitude. It was hoped that this information would furnish a sound basis upon which to recommend further

work aimed at the finding of oil and gas.

6. Methods of Investigation

The party consisted of A.R. Allen and A.G. Pentland. A Cessna aircraft, model 170B, equipped with floats was used for transportation. Full camping equipment was carried. The method used was to fly over the permit area at low elevation and at reduced cruising speed in order to observe the general topography and to spot outcrops. Flight lines were along the borders of the permit first and then several passes were made across the central part. In addition, all rivers and streams on the permit or within a radius of several miles of the permit were flown in order to locate all outcrops that might have a bearing on the structure of the area.

Control of flight lines was by means of maps and aerial photographs. The 8 miles to 1 inch map from the national topographic series, which is published by the Department of Mines and Technical Surveys, was found to be accurate and useful for the purpose of determining the limits of the permit and for locating outcrops.

The second step was to make traverses on foot to examine all outcrops, collect fossils, and determine attitudes. Generally, a landing was made on a river or lake, the party split into two, one going in each direction, and a pace and compass survey was made or the outcrops were located by means of maps and aerial photographs.

A photographic mosaic was made to the scale of 1 inch to 1 mile on which outcrops were accurately located and the whole was traced in order to have the map in a form from which additional copies could be made.

7. History of Geological Investigation

Early geological investigations in the Mackenzie River basin were carried out by McConnell,(1) Camsell,(2) and other geologists. The Northwest Company, a subsidiary of Imperial Oil Limited, began exploration and drilling in the Mackenzie River area in 1919. This work led to the discovery of the Norman Wells field in 1920. The Geological Survey of Canada sent parties into the field with the result that Hume, Kindle, Cameron, Whittaker, and Williams issued reports during the years 1921 to 1924.

The work received a great impetus during World War II when oil was considered to be of strategic importance. In the early summer of 1942 geological work was conducted over a wide area by several geologists.

Widespread interest has developed again during the past year with the result that many parties were in the field during the summer of 1957.

8. Regional Stratigraphy

The oldest rocks known in the area are quartzites and black platy shales of the Katherine group. No fossils have been found and therefore the exact age is not known. However, they underlie rocks of the Macdougal group, which have been assigned to the Middle or Upper Cambrian on the basis of fossil evidence. Therefore, they are assumed to be Cambrian or older in age.

Stratigraphic Table

Quaternary	Recent	Talus, landslides, river gravels, peat
Tertiary	Eocene	Imperfectly consolidated sands, clays, and conglomerates with lignite. Contain leaf and plant fragments
	Erosional Unconformity	
Cretaceous	East Fork	Gray shales
	Little Bear	Sandstone and shale with coal
	Slater River	Dark grey to black shales, some siltstones and sandstones.
	Sans Sault	Fine-grained sandstone with glauconite, grey sandy shales, sandstone and conglomerate at or near the base
Permo-Carboniferous		Dark shales, grey to brown sandstones and siltstones, conglomerate
	Erosional Unconformity	
Upper Devonian	Imperial	Green, fine-grained sandstone and shale
	Fort Creek	Upper grey slates, thin sandstones; bituminous shales, coral reef and limestones; lower dark platy shales
	Ramparts	Heavy massive limestone at top with or without coralline beds; limestone interbedded with shales in middle part; limestone in lower part.
	Bear rock	Brecciated dolomites and limestone, gypsum and anhydrite

Stratigraphic Table (Continued)

		Erosional Unconformity	
Silurian	Ronning group	Limestone with chert.	
Ordovician		Argillites and shales	1,500
Cambrian	Macdougal group	Limestone; greenish, grey, and black shales; sandstones, gypsum, etc.	6,500
Cambrian and/or earlier	Katherine group	Interbedded quartzites and black platy shales	

The type locality for the Macdougal group is in Macdougal Creek Valley. The rocks consist of limestones, chololate-grey and black shales, sandstones, gypsum, etc. Hume (3, p. 13) states that Stelck observed 6,500 feet of slates and shales overlain by 500 feet of argillites with chert, occurring below beds identified as Ordovician because of the presence of the graptolite, Tetragraptus. These beds are at the head of the lower canyon of Peel River and on Mountain River, a short distance north of Permit No. 1438.

The Ordovician has not been positively identified throughout a considerable part of the Mackenzie River Basin but Hume (3, p. 13) states that Stelck observed 1,500 feet of shales and argillites in the Upper Peel River area. Two zones in the middle part of the section contain graptolites of which Tetragraptus is sufficient to indicate an Ordovician age. These beds outcrop in the lower canyon of the Peel River, in an overturned section, and in the upper canyon above the mouth of the Wind River.

The Silurian rocks are known to outcrop over a wide-spread area in the Mackenzie River basin. They have been found from Great Slave Lake through Norman Wells and northward into the Mackenzie mountains. Hume (3, p.14) suggests that these rocks be divided into two, a lower, Ronning group and an upper, Bear Rock formation. The Ronning group consists of limestones with chert. It contains in places a Niagara fauna. The Bear rock group lies with a marked erosional disconformity above the Ronning group. The age is somewhat in doubt because

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The Eocene lies with erosional unconformity on the Cretaceous or older beds. It is made up of imperfectly consolidated sands, clays, and conglomerates. In many places it contains leaf and plant fragments and may contain lignite.

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The greater part of the permit is masked by the wide, gravel-covered valley of Bonnet Plume River and by the flat lake- and swamp-covered area to the west. There are very few outcrops. They are confined to Noisy Creek, which just touches on the extreme northeast corner of the permit, to a small area near the centre of the eastern boundary of the permit, and to a single outcrop on the bank of a small stream near the southern boundary. Of all the formations mentioned under Regional Geology, only two, the Silurian and Eocene were actually seen to outcrop on the Permit. However, the stratagraphic succession and the structural features have been worked out in considerable detail along the Peel River, Noisy Creek, and the various other streams that enter the Peel River in the vicinity of the Permit.

Cambrian

Cambrian beds are well exposed along the banks of the Peel River, approximately three miles north of the Permit, and in the canyon of Noisy Creek. Here they range from fairly

massive dark grey to black argillite and limy argillite to almost paper-thin shale interbedded with limy and occasional arenaceous strata. In one outcrop the sandy beds are cut by a network of calcite stringers. The average strike is between northwest and north and the dip is 55 to 65 degrees to the northeast. In a few places the beds have been contorted into small, rather tight folds with dips ranging from 75 degrees southwest to 55 degrees northeast.

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Near the base of the hill, two small outcrops were seen in which beds of limestone, two to three feet in thickness, were interbedded with shale and limy shale. This probably represents the lower part of the Silurian and may be gradational into the underlying Ordovician shales.

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Rocks of Eocene age were observed along the east bank of the Bonnet Plume from near its mouth to three miles above the junction with Noisy Creek, and in a single isolated outcrop on the bank of a small stream situated near the central part of the southern boundary of the permit. The beds consist of conglomerate interbedded with sand and poorly consolidated sandstone. The color ranges from grey and greenish grey to buff and rust. Numerous plant fragments and a few poorly preserved impressions of other fossils were observed.

A lignite seam is burning on the Peel River about a mile above the mouth of the Bonnet Plume. The Eocene beds lie with high angular unconformity on the older formations.

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The axis of a major anticline projects across Permit 1438. The anticline has been mapped(5) for a distance of 90 miles north of the permit. Hume (3, p.73) quotes Stelck who described the structure as a broad anticlinorium, the west limb of which exposes Devonian strata on Mount Reception and

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The only clue to the structure found within the limit of the permit is the easterly dipping limestone which outcrops along the eastern boundary. However, there seems little doubt that the structure continues through the permit and that the recent gravels of the Bonnet Plume River and the Eocene conglomerates and sandstones are underlain by Cambrian strata that form the crest of the anticline.

11. Economic Possibilities

Studies in the Mackenzie River basin have indicated that the Bear Rock formation of Silurian or Devonian age contains by far the most porous strata in the area. Upper beds of the Ramparts formation of Upper Devonian age are commonly coralline and so too are the upper beds of Silurian age.

Sandstones at the base of the Cretaceous and in the Imperial formation of Upper Devonian age could act as reservoir rocks.

All of the formations mentioned above have been eroded away from Permit No. 1438.

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Silurian beds, with less favourable conditions in the older Silurian and Cambrian strata."

Although the anticline described above is of sufficient size to be of importance as an oil structure, the strata that might serve as a reservoir for oil have been eroded away with the exception of those of Cambrian age. Therefore, the chances of finding oil on this permit have been reduced to the point where the expenditure of further money on exploration appears to be a poor gamble.

A.G. Pentland

Vancouver, B. C.
September, 1957.

A.R. Allen

12. Bibliography

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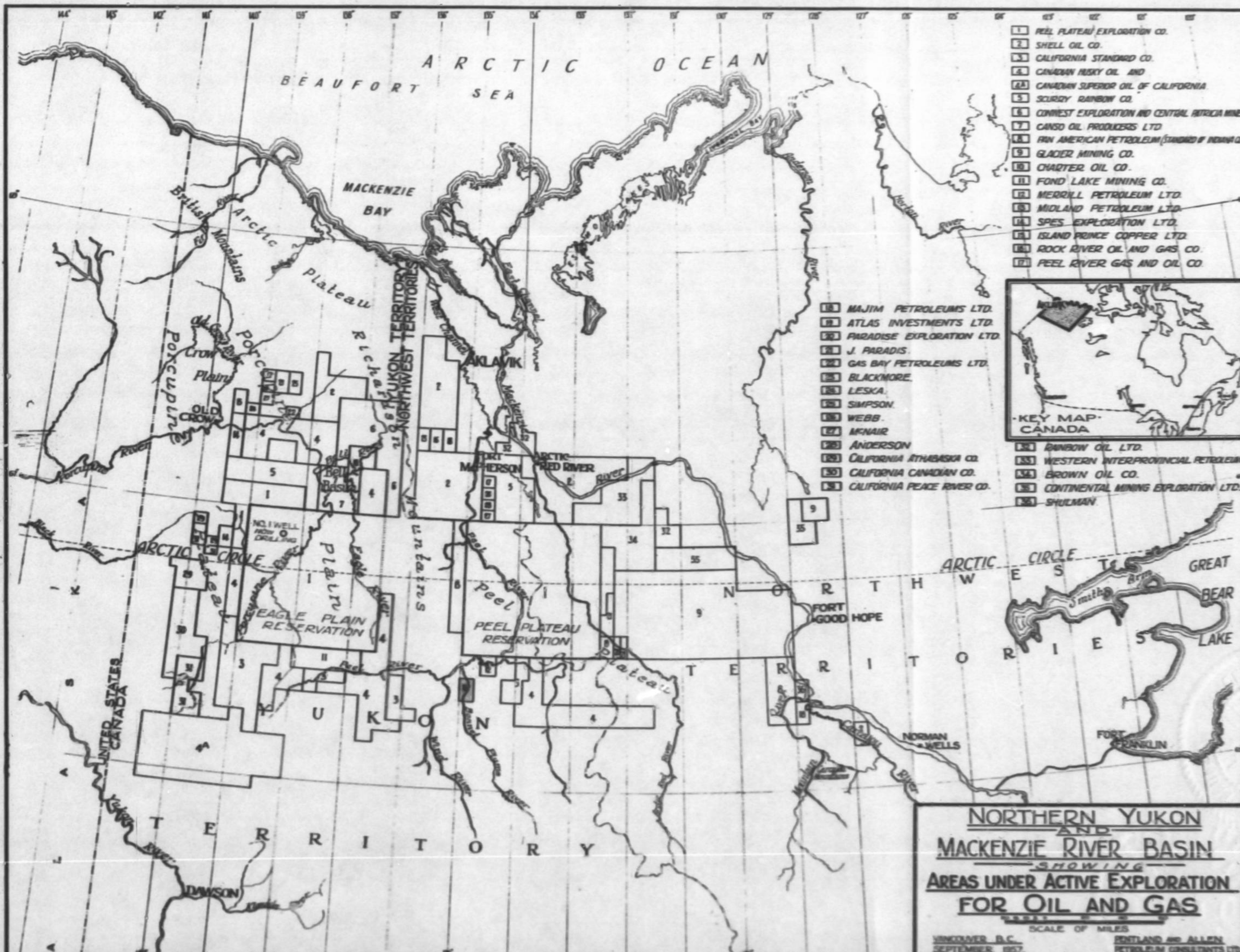
ARCTIC OCEAN
BEAUFORT SEA
MACKENZIE BAY
British Mountains
Arctic Plateau
Porcupine Plain
Old Crow
Porcupine River
Richardson Mountains
YUKON TERRITORY
NORTHWEST TERRITORIES
AKLAVIK
FORT McPHERSON
ARCTIC RED RIVER
ARCTIC CIRCLE
NO. 1 WELL NOW DRILLING
EAGLE PLAIN RESERVATION
PEEL PLATEAU RESERVATION
Peel River
FORT GOOD HOPE
NORMAN WELLS
FORT FRANKLIN
GREAT BEAR LAKE
Smith Arm
NORTHWEST TERRITORIES
YUKON TERRITORY
UNITED STATES
CANADA
ALASKA
DAWSON
1 PEEL PLATEAU EXPLORATION CO.
2 SHELL OIL CO.
3 CALIFORNIA STANDARD CO.
4 CANADIAN HUSKY OIL AND
4A CANADIAN SUPERIOR OIL OF CALIFORNIA
5 SCURRY RAINBOW CO.
6 CONWEST EXPLORATION AND CENTRAL PATRICIA MINES
7 CANSO OIL PRODUCERS LTD
8 PAN AMERICAN PETROLEUM (STANDARD OF INDIANA CO.)
9 GLACIER MINING CO.
10 CHARTER OIL CO.
11 FOND LAKE MINING CO.
12 MERRILL PETROLEUM LTD.
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14 SPES EXPLORATION LTD.
15 ISLAND PRINCE COPPER LTD.
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18 MAJIM PETROLEUMS LTD.
19 ATLAS INVESTMENTS LTD.
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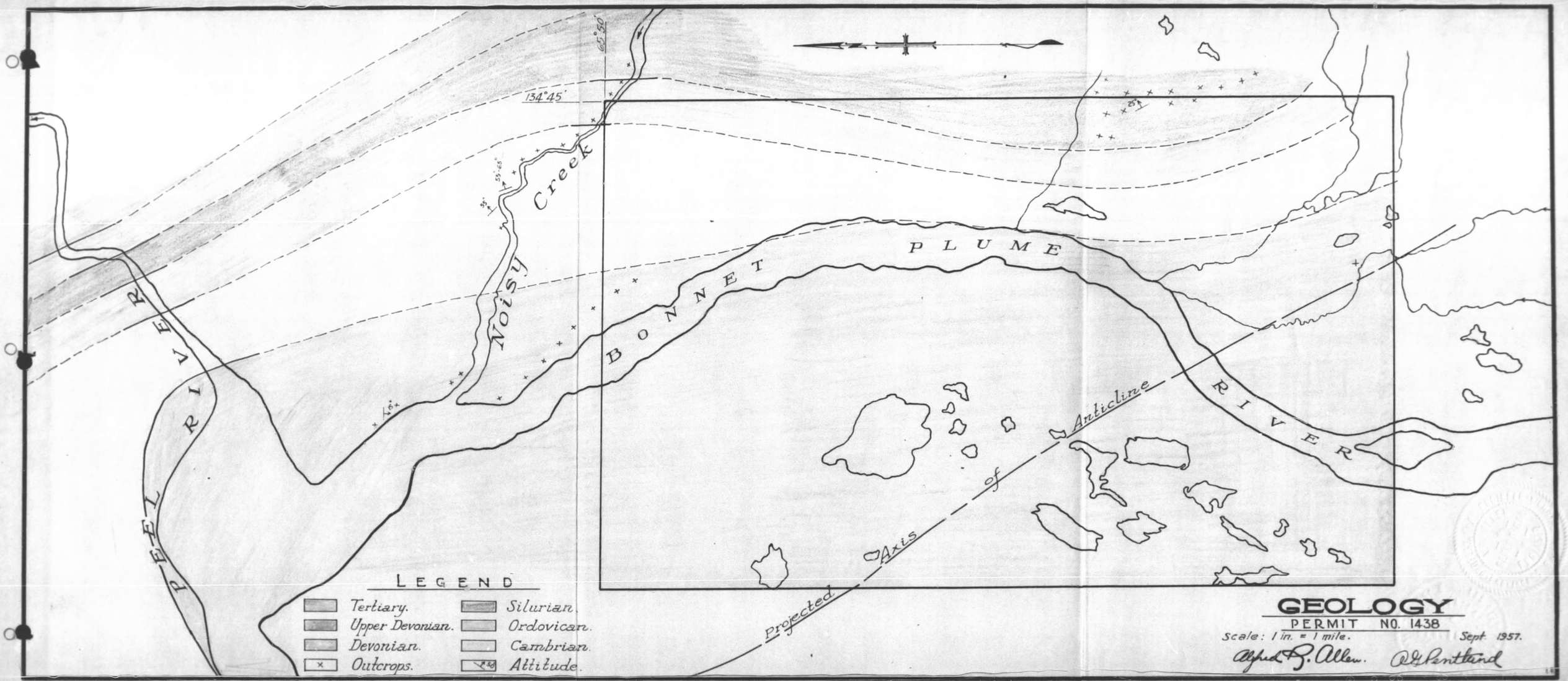
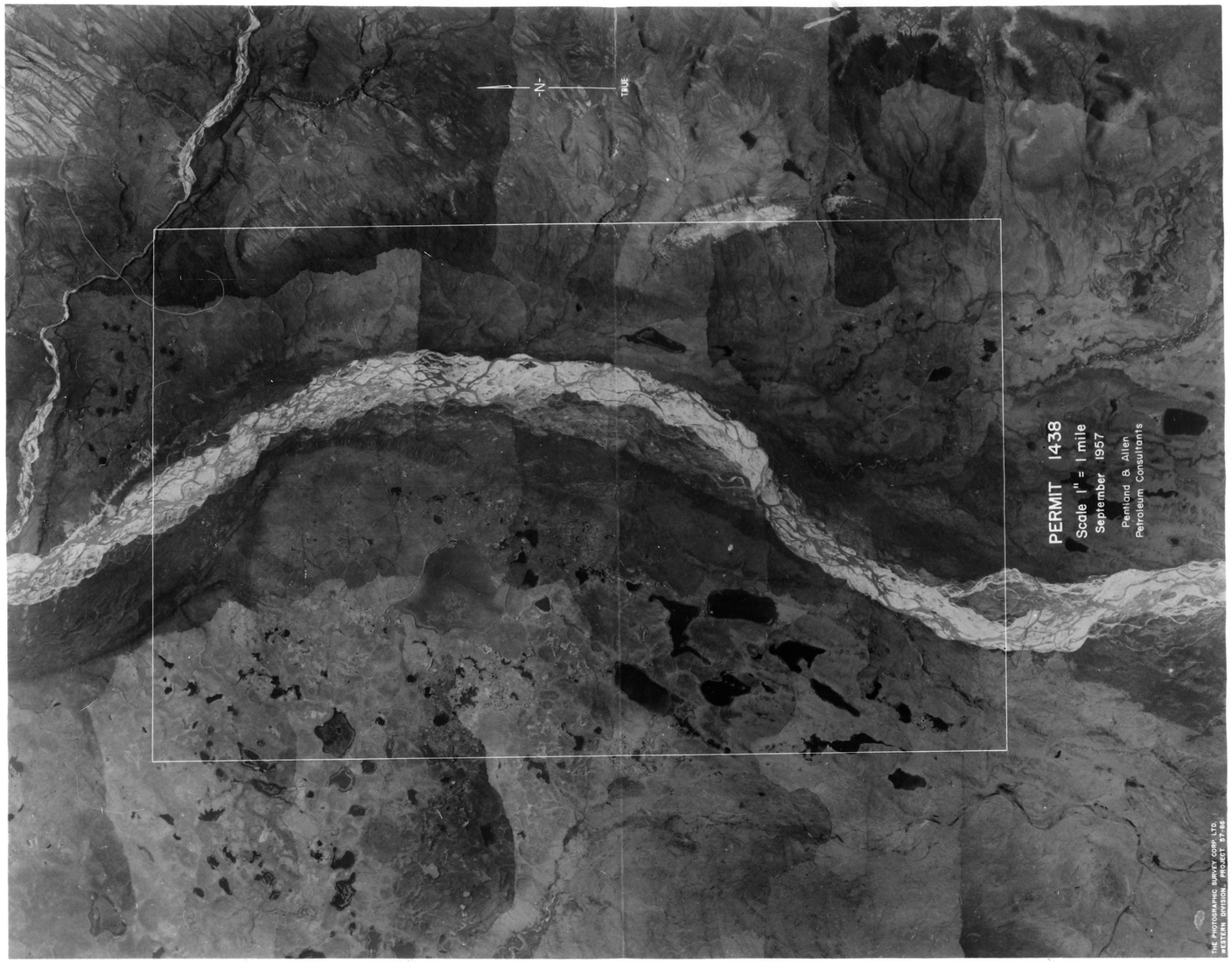
32 RAINBOW OIL LTD.
33 WESTERN INTERPROVINCIAL PETROLEUMS
34 BROWN OIL CO.
35 CONTINENTAL MINING EXPLORATION LTD.
36 SHULMAN.
KEY MAP CANADA
NORTHERN YUKON
AND
MACKENZIE RIVER BASIN
SHOWING
AREAS UNDER ACTIVE EXPLORATION
FOR OIL AND GAS
SCALE OF MILES
VANCOUVER B.C.
SEPTEMBER 1957
PENTLAND AND ALLEN
PETROLEUM CONSULTANTS LTD.


65°30'
134°45'
Noisy Creek
PEEL RIVER
BONNET PLUME
RIVER
Anticline
Axis of
Projected
LEGEND
Tertiary.
Upper Devonian.
Devonian.
Outcrops.
Silurian.
Ordovician.
Cambrian.
Attitude.
GEOLOGY
PERMIT NO. 1438
Scale: 1 in. = 1 mile.
Sept. 1957.
Alfred F. Allen.
A.G. Pentland



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REPORT ON THE GEOLOGY

PERMIT NO. 1438

YUKON TERRITORY

By:

A.G. Pentland
and
A.R. Allen
Vancouver, B. C.
September, 1957

CONTENTS

Report on the Geology
Permit No. 1438
Yukon Territory

1. Location

Permit No. 1438 is situated at 65°50' north and 134°45' west in the Yukon Territory. It is 175 miles northeast of Dawson or 230 miles west of Norman Wells on the Bonnet Plume River near its confluence with the Peel River. It is about 55 miles south of the Arctic Circle and 12 miles south of the southwest corner of the Peel Plateau Reservation.

Canadian Pacific Airlines operates two scheduled flights per week from Edmonton to Norman Wells, using a DC-3, and three scheduled flights per week from Norman Wells to Aklavik using an Otter. During the summer there are usually many extra flights to take care of the additional freight and passengers.

Much of the heavy freight is shipped into the country by train and barge during the summer months. Freight is shipped from Edmonton to Waterways by train, a distance of 300 miles, and thence by barge down the Athabaska River, Athabasca Lake, Slave River, Great Slave Lake, and Mackenzie River. The only interruption to navigation on this route is the 16-mile portage from Fitzgerald at the northern boundary of Alberta to Fort Smith in the Northwest Territories because of rapids in the Slave River.

LOcally, access during the summer is by float-equipped aircraft or by helicopter. Several of the lakes on the Permit are large enough for the operation of seaplanes. The transportation of heavy equipment would be facilitated during the winter when tractor-trains can be operated across the frozen lakes and swamps or runways could be kept open on the larger lakes for large freight aircraft equipped with wheels or skis.

2. Ownership

The permit consists of 52,644 acres. It is owned by Rock River Gas and Oil Ltd. (N.P.L.) 611 Credit Foncier Building, 850 West Hastings Street, Vancouver 1, B. C. Mr. John Aubrey Tregilges is President.

3. Climate and Vegetation

The rivers and creeks generally open during the latter part of May but ice may remain on some of the larger lakes until the first or second week in June. Freeze-up comes in late September or early October, but occasionally the larger rivers remain open until well into November.

During May, June, and July there is almost continuous daylight and warm summer weather. During the mid-winter months, the sun is below the horizon the greater part of the day. The result is that the length of day varies rapidly during the intervening months. The winter may be severe with temperatures as low as 50 or 60 degrees below zero.

The area is not far from the northern limit of tree growth. Generally, the trees are small and scrubby, but in a few sheltered places along the banks of streams, they may grow

to a height of 40 feet. They consist of white spruce, poplar, and birch. Willow and alder may grow in thick masses along the banks of streams. A great part of the area is covered with the various types of moss that are common to the Arctic tundra.

4. Physiography

Permit No. 1438 is situated in the angle formed by the junction of the Richardson and Mackenzie Mountains. It straddles the Bonnet Plume River for a distance of about 12 miles near the junction of this river with the Peel.

Here the Bonnet Plume Valley is one to two miles wide. The bottom is made up of numerous gravel and sand bars between which many branches of the river wind and twist in a braided fashion. The banks are generally low and show few outcrops of bedrock with the exception of the first three miles above the Peel River.

The area to the west of the river is flat and covered by numerous lakes and swamps. Its elevation is only a few feet above that of the river bottom. The area to the east of the river rises somewhat more abruptly and culminates in a hill situated near the central part of the eastern edge of the permit. This hill is some 200 to 300 feet above the river bottom.

5. Purpose of Investigation

The geological investigation of this area was undertaken in order to map the outcrops of rock and to determine their age and attitude. It was hoped that this information would furnish a sound basis upon which to recommend further

work aimed at the finding of oil and gas.

6. Methods of Investigation

The party consisted of A.R. Allen and A.G. Pentland. A Cessna aircraft, model 170B, equipped with floats was used for transportation. Full camping equipment was carried. The method used was to fly over the permit area at low elevation and at reduced cruising speed in order to observe the general topography and to spot outcrops. Flight lines were along the borders of the permit first and then several passes were made across the central part. In addition, all rivers and streams on the permit or within a radius of several miles of the permit were flown in order to locate all outcrops that might have a bearing on the structure of the area.

Control of flight lines was by means of maps and aerial photographs. The 8 miles to 1 inch map from the national topographic series, which is published by the Department of Mines and Technical Surveys, was found to be accurate and useful for the purpose of determining the limits of the permit and for locating outcrops.

The second step was to make traverses on foot to examine all outcrops, collect fossils, and determine attitudes. Generally, a landing was made on a river or lake, the party split into two, one going in each direction, and a pace and compass survey was made or the outcrops were located by means of maps and aerial photographs.

A photographic mosaic was made to the scale of 1 inch to 1 mile on which outcrops were accurately located and the whole was traced in order to have the map in a form from which additional copies could be made.

7. History of Geological Investigation

Early geological investigations in the Mackenzie River basin were carried out by McConnell,(1) Camsell,(2) and other geologists. The Northwest Company, a subsidiary of Imperial Oil Limited, began exploration and drilling in the Mackenzie River area in 1919. This work led to the discovery of the Norman Wells field in 1920. The Geological Survey of Canada sent parties into the field with the result that Hume, Kindle, Cameron, Whittaker, and Williams issued reports during the years 1921 to 1924.

The work received a great impetus during World War II when oil was considered to be of strategic importance. In the early summer of 1942 geological work was conducted over a wide area by several geologists.

Widespread interest has developed again during the past year with the result that many parties were in the field during the summer of 1957.

8. Regional Stratigraphy

The oldest rocks known in the area are quartzites and black platy shales of the Katherine group. No fossils have been found and therefore the exact age is not known. However, they underlie rocks of the Macdougal group, which have been assigned to the Middle or Upper Cambrian on the basis of fossil evidence. Therefore, they are assumed to be Cambrian or older in age.

Stratigraphic Table

Quaternary	Recent	Talus, landslides, river gravels, peat
Tertiary	Eocene	Imperfectly consolidated sands, clays, and conglomerates with lignite. Contain leaf and plant fragments
	Erosional Unconformity	
Cretaceous	East Fork	Gray shales
	Little Bear	Sandstone and shale with coal
	Slater River	Dark grey to black shales, some siltstones and sandstones.
	Sans Sault	Fine-grained sandstone with glauconite, grey sandy shales, sandstone and conglomerate at or near the base
Permo-Carboniferous		Dark shales, grey to brown sandstones and siltstones, conglomerate
	Erosional Unconformity	
Upper Devonian	Imperial	Green, fine-grained sandstone and shale
	Fort Creek	Upper grey slates, thin sandstones; bituminous shales, coral reef and limestones; lower dark platy shales
	Ramparts	Heavy massive limestone at top with or without coralline beds; limestone interbedded with shales in middle part; limestone in lower part.
	Bear rock	Brecciated dolomites and limestone, gypsum and anhydrite

Stratigraphic Table (Continued)

		Erosional Unconformity	
Silurian	Ronning group	Limestone with chert.	
Ordovician		Argillites and shales	1,500
Cambrian	Macdougal group	Limestone; greenish, grey, and black shales; sandstones, gypsum, etc.	6,500
Cambrian and/or earlier	Katherine group	Interbedded quartzites and black platy shales	

The type locality for the Macdougal group is in Macdougal Creek Valley. The rocks consist of limestones, chololate-grey and black shales, sandstones, gypsum, etc. Hume (3, p. 13) states that Stelck observed 6,500 feet of slates and shales overlain by 500 feet of argillites with chert, occurring below beds identified as Ordovician because of the presence of the graptolite, Tetragraptus. These beds are at the head of the lower canyon of Peel River and on Mountain River, a short distance north of Permit No. 1438.

The Ordovician has not been positively identified throughout a considerable part of the Mackenzie River Basin but Hume (3, p. 13) states that Stelck observed 1,500 feet of shales and argillites in the Upper Peel River area. Two zones in the middle part of the section contain graptolites of which Tetragraptus is sufficient to indicate an Ordovician age. These beds outcrop in the lower canyon of the Peel River, in an overturned section, and in the upper canyon above the mouth of the Wind River.

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Vancouver, B. C.
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A.R. Allen

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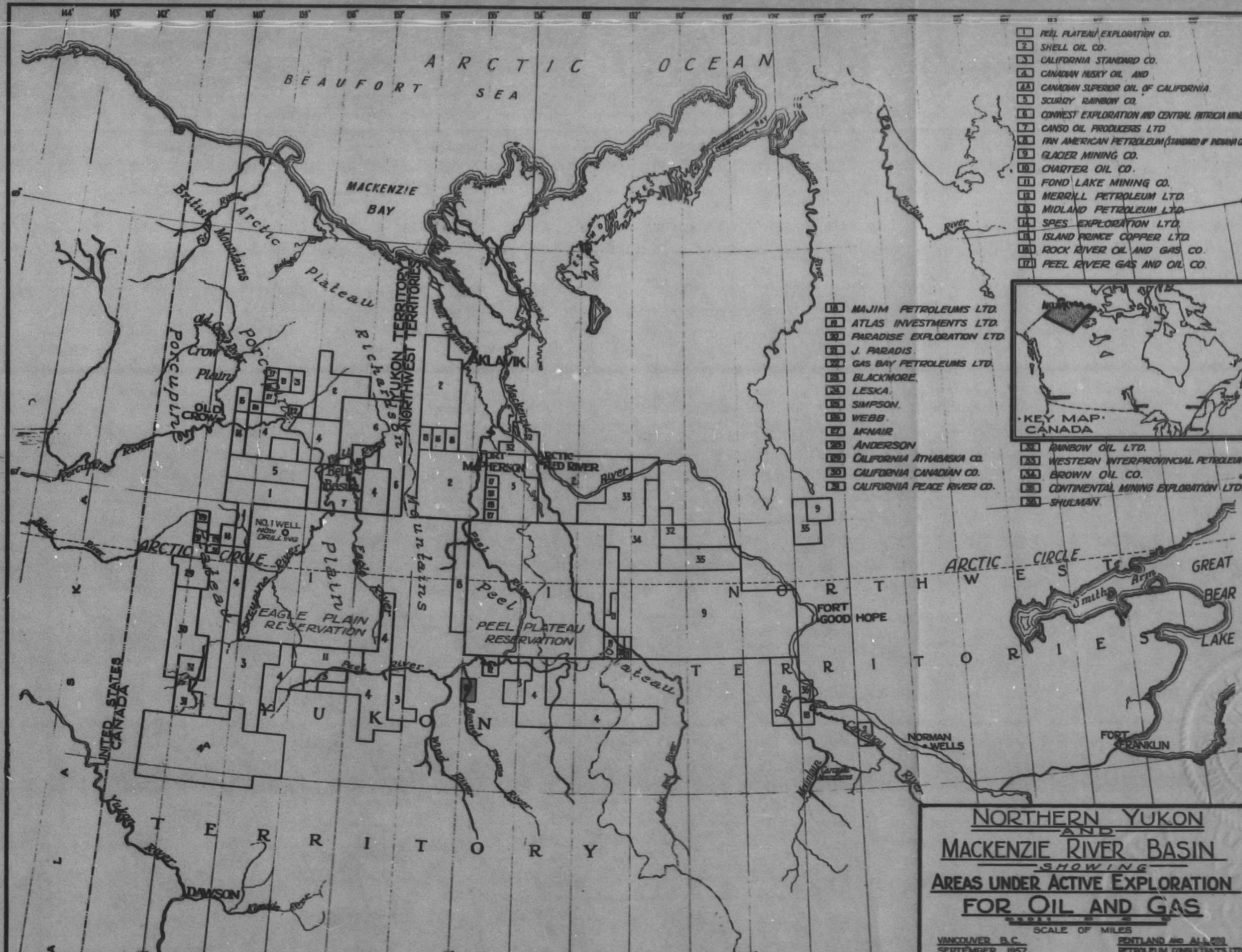

ARCTIC OCEAN
BEAUFORT SEA
MACKENZIE BAY
British Mountains
Arctic Plateau
Porcupine
Crow Plain
OLD CROW
Porcupine River
Bell Basin
Richardson Mountains
YUKON TERRITORY
NORTHWEST TERRITORIES
AKLAVIK
FORT McPHERSON
ARCTIC RED RIVER
NO. 1 WELL NOW DRILLING
ARCTIC CIRCLE
EAGLE PLAIN RESERVATION
Eagle Plain
Eagle River
Peel River
PEEL PLATEAU RESERVATION
Peel Plateau
FORT GOOD HOPE
NORMAN WELLS
FORT FRANKLIN
GREAT BEAR LAKE
Smith Arm
Anderson River
Horton River
Mackenzie River
UNITED STATES
CANADA
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
DAWSON
Yukon River
Klondike River
1 PEEL PLATEAU EXPLORATION CO.
2 SHELL OIL CO.
3 CALIFORNIA STANDARD CO.
4 CANADIAN HUSKY OIL AND
4A CANADIAN SUPERIOR OIL OF CALIFORNIA.
5 SCURRY RAINBOW CO.
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32 RAINBOW OIL LTD.
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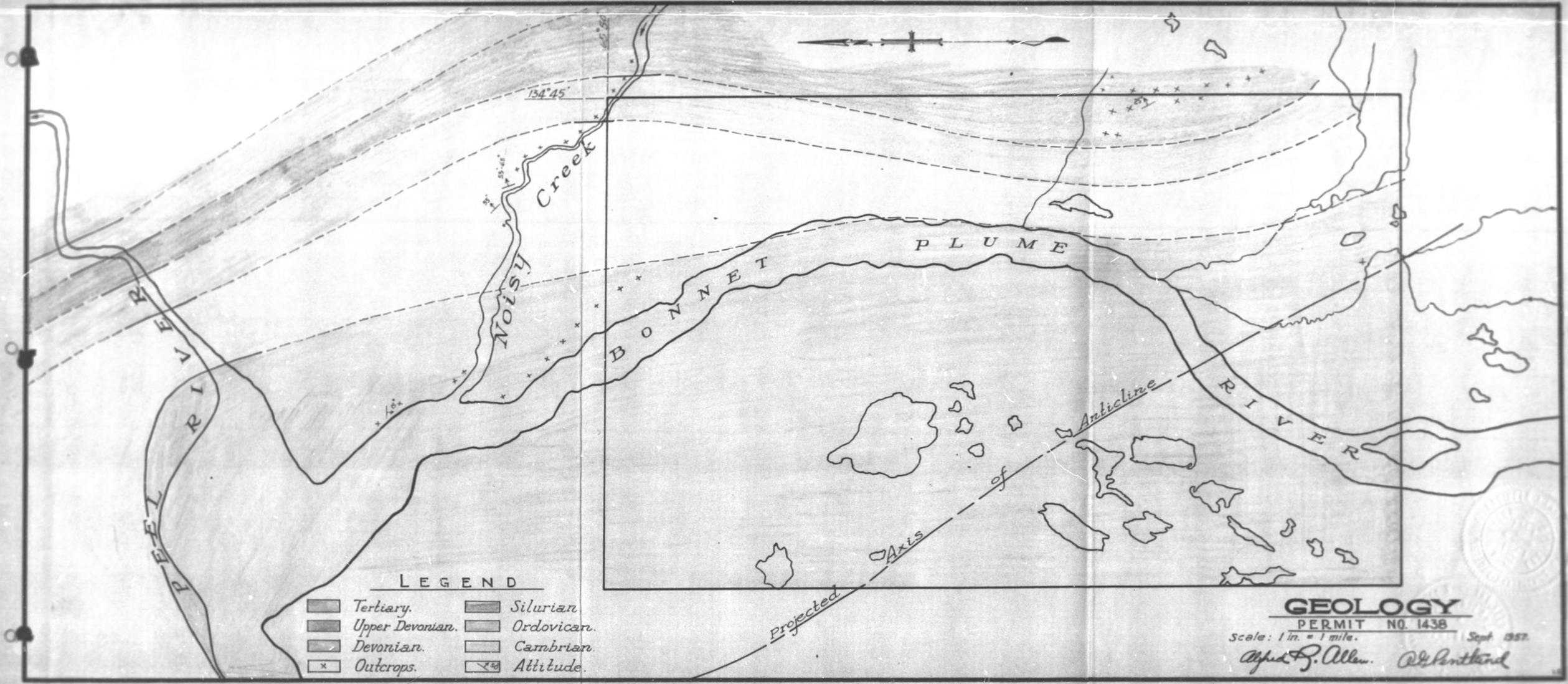
34 BROWN OIL CO.
35 CONTINENTAL MINING EXPLORATION LTD.
36 SHULMAN.
KEY MAP CANADA
NORTHERN YUKON
AND
MACKENZIE RIVER BASIN
SHOWING
AREAS UNDER ACTIVE EXPLORATION
FOR OIL AND GAS
SCALE OF MILES
VANCOUVER B.C.
SEPTEMBER 1957.
PETROLEUM CONSULTANTS LTD.


134°45'
Noisy Creek
PEEL RIVER
BONNET PLUME
RIVER
Anticline
Axis of
Projected
LEGEND
Tertiary.
Upper Devonian.
Devonian.
Outcrops.
Silurian.
Ordovician.
Cambrian.
Attitude.
GEOLOGY
PERMIT NO. 1438
Scale: 1 in. = 1 mile.
Sept. 1957.
Alfred F. Allen.
A. Pentland