GEOLOGICAL REPORT

PERMIT 1384

NORTHWEST TERRITORIES

By:

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Vancouver, B.C.

December, 1957.

C O N T E N T S

	Page
1. Summary and Conclusions	1
2. Location	2
3. Ownership	2
4. Accessibility	2
5. Climate and Vegetation	3
6. Physiography	4
7. Purpose of Investigation	4
8. Methods of Investigation	4
9. History of Geological Investigation	6
10. Stratigraphy	6
11. Local Geology	11
12. Bibliography	14

Location Map
Geological Map
Aerial Mosaic
Photographs

Geological Report

Permit 1384

Northwest Territories

1. Summary and Conclusions

Permit 1384 is situated in the Peel Plateau, 25 miles south of Fort McPherson, Northwest Territories. The western boundary is two miles from the Peel River on which shallow-draft river boats make regular trips to Fort McPherson during the summer months. Thus the transportation of heavy equipment would be comparatively simple.

The contact between the Lower Cretaceous and the underlying Devonian formations projects a short distance north of the permit. An outcrop of typical Lower Cretaceous shale was found on the banks of the Satah River at the southeast corner of the permit. Thus it seems probable that the whole of the permit is underlain by a thin layer of Lower Cretaceous sediments. Comparatively shallow holes, having a maximum depth of 5,000 feet, would test all of the most likely oil and gas horizons.

It is not possible to work out details of structure because of the lack of outcrops on this permit. However, it seems probable from a study of the outcrops along the Peel River and those a short distance southwest of the permit, that the strata have a gentle dip to the west or southwest.

The structure of the Norman Wells field is a monoclinal dip upon which is superimposed a limestone reef having a maximum thickness of 500 feet. It is conceivable that a similar

reef may be found in this part of the country. The fact that the reef at Norman Wells gives rise to good seismic reflections gives hope that geophysical methods will lead to the discovery of other reef fields.

It is recommended that a seismic survey be conducted as the next step in the exploration for oil and gas.

2. Location

Permit 1384 is situated 25 miles south of Fort McPherson and about two miles east of the Peel River in the Northwest Territories. The northeast corner of the permit is at the intersection of 67°05' north and 134°45' west.

3. Ownership

The permit consists of 25,003 acres. It is owned by Mr. Robert Webb, 404, 510 West Hastings Street, Vancouver, B. C.

4. Accessibility

Canadian Pacific Airlines operates scheduled flights to Fort McPherson using a DC-3 as far as Norman Wells and an Otter from there north. During the summer months, there are many extra flights to take care of additional freight and passengers.

Much of the heavy freight is shipped from Edmonton by train to Waterways, Alberta, and thence by barge down the Athabaska River, Athabaska Lake, Slave River, Great Slave Lake, Mackenzie River and Peel River to Fort McPherson. 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.

Local transportation is usually by light aircraft using floats in the summer and skis in the winter. The transportation of heavy equipment from the Peel River to the permit should be done during the winter when the lakes and muskegs are frozen. Winter roads are comparatively easy to build and maintain.

5. Climate and Vegetation

The permit is situated nearly fifty miles north of the Arctic Circle with the result that there is almost continuous daylight and warm summer weather during May, June, and July. During the mid-winter months, the sun is below the horizon the greater part of the day. The winter may be severe with temperatures as low as 50 or 60 degrees below zero for short periods.

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

The area is close to the northern limit of tree growth. Most of 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 spruce, poplar, birch, and larch. Willow and alder may grow in thick masses along the

banks of streams. The greater part of the area is covered by the various types of moss and grass that are common to the Arctic tundra.

6. Physiography

The permit is situated on the large Peel River Plateau near where it merges into the Mackenzie River delta on the north and into the Richardson Mountains on the west. A part of the area is covered by small lakes and most of the remaining part is covered by muskeg. It is drained by large rivers such as the Peel and Arctic Red, which flow into the Mackenzie, and by numerous small streams which meander across the flat plain. The larger rivers flow between banks that may be up to 100 or 150 feet high but the smaller streams are usually confined by low banks that are covered by muskeg and Arctic vegetation, and as a general rule do not expose bedrock. Ox-bow lakes are common near the smaller streams.

7. 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.

8. 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 a 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 separated and pace and compass surveys were 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 make a map from which additional copies could be taken.

9. 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 published 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.

10. Stratigraphy

There is only one outcrop on the permit. Therefore it is necessary to study sections that have been mapped in other parts of the country in order to predict the types of sediments that may be encountered below the surface.

Cambrian

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, and are assumed to be Cambrian or older in age.

Cambrian rocks are well exposed along the banks of the Upper Peel River. Here they range from fairly massive, grey to black argillite and limy argillite to almost paper-thin shale interbedded with limy and a few arenaceous strata. Hume (3, p. 13) states that Stelck observed 6,500 feet of slates and shales overlain by 500 feet of argillites with chert, at the head of the lower canyon of Peel River and on Mountain River. The only fossils found were Tetractinellid remains.

Steeply dipping blue and grey mottled limestones found north of the Rat River in the Richardson Mountains have been classed as Cambrian by fossil evidence. Gabrielse (5) mapped rocks of similar appearance but without fossils in a dome-shaped outcrop north of Summit Lake at the headwaters of Rat River

Ordovician

Ordovician strata appear to be absent from the greater part of the Mackenzie River basin but Stelck found 1,500 feet of shales and argillites in the lower canyon of the Peel River. Two zones in the middle part of the section contain graptolites of which Tetragraptus is sufficient to indicate an Ordovician age. Therefore, it seems probable that beds of this age underlie the permit.

Silurian

Silurian rocks are known to outcrop over a widespread area. They have been found from Great Slave Lake through Norman Wells and northward into the Mackenzie Mountains. Hume suggests

Table of Formations

Eocene		Imperfectly consolidated sands, clays, and conglomerates with lignite. Contain leaf and plant fragments.
	Erosional Unconformity	
Cretaceous	East Fork	Grey shales
	Little Bear	Sandstones 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 base.
	Erosional Unconformity	
Upper Devonian	Imperial	Green, fine-grained sandstone and shale.
	Fort Creek	Upper grey shales, 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.
Silurian or Devonian	Bear rock	Brecciated dolomites and limestones, gypsum and anhydrite.
	Erosional Disconformity	
Silurian	Ronning group	Limestone with chert
Ordovician		Argillites and shales
Cambrian	Macdougal group	Limestone; greenish grey, and black shales; sandstones, gypsum, etc.
Cambrian and/or earlier	Katherine group	Interbedded quartzite and black platy shales.

that they be divided into two groups, a lower Ronning group and an upper Bear Rock formation which overlies the Ronning with a marked erosional disconformity. The Ronning group consists of limestone with chert and contains a Niagaran fauna in places. The age of the Bear Rock formation is somewhat in doubt because fossils are scarce in it. It may be Silurian or Devonian. It consists of brecciated dolomites and limestones, gypsum, and anhydrite. The high porosity of the brecciated dolomites and limestones make them a favorable reservoir rock where they occur without anhydrite and gypsum. In places they are highly bituminous.

On the upper Peel River, the base of the Silurian is a limestone conglomerate. This is overlain by a thick series of shales and argillites followed by limestones, which are hard and dense and finely crystalline.

On Margery Creek, the upper part of the Silurian is composed of massive reefal dolomites. They are coarsely crystalline and exhibit excellent reservoir characteristics.

Middle Devonian

The Ramparts formation of Middle Devonian age is divided into upper and lower limestone members separated by a middle shale member in the type locality.

Stelck reports that no Middle Ramparts shales were seen on the Upper Peel River. A conglomerate carrying Ramparts fossils is overlain by Fort Creek shales and underlain by Silurian strata. On Margery Creek, a section 225 feet thick contains lenses and discontinuous bands of fossil detritus. Several small coral aggregates have been noted and the upper contact is marked by a

thick limestone conglomerate. Scattered accumulations of solid tar or bitumen are present and a fresh surface of limestone emits a strong odor of sulphur and gas.

Upper Devonian

The upper Devonian is usually divided into two groups, the Fort Creek and Imperial. The Fort Creek formation is exposed along the Peel River from the Lower Canyon to several miles below its junction with Snake River. The base is composed of a limestone conglomerate and this is overlain by black shales and limestones. Near the top the shales contain fewer limestones and are very bituminous. In the proven field at Norman Wells, a reef in the Fort Creek Formation forms the oil-bearing reservoir and is the source of production in that field.

Non-marine sandstones and shales of the Imperial formation have been mapped along the Peel River about three miles west of the permit and along the Mackenzie and Arctic Red Rivers to the north, east, and southeast. The section along the Peel River consists of 50 feet of grey sandstones overlain by 10 feet of sandstone made up of subangular fragments of feldspar, ferromagnesium minerals, and a little quartz. Both of these sandstones contain tiny transported fragments of asphaltites. They are overlain by 100 feet of grey shales with hard, dark grey sandstones.

A section along the Mackenzie River from ten miles above Tree River to Point Separation is as follows (3, p. 44):

Smooth, grey, crumbly, homogeneous shale; some thin, fine-grained sandstone beds	350 feet
Interbedded, fine- and medium-grained, greenish grey, blocky and flaggy sandstone and grey, silty shale	500
Grey silty shale and argillaceous siltstone; some thin sandstone beds. Base not seen.	150

11. Local Geology

Outcrops were found in only one place on the permit. These consist of typical Lower Cretaceous shale with a few sandy layers interbedded. The dip is flat. The outcrops are on the banks of the Satah River in the southeast corner of the permit.

The banks of a U-shaped lake situated five miles northwest of the permit expose the contact between the Cretaceous and the underlying Imperial formation.

At the eastern end of the lake, talus slopes are covered with grey- to rusty-colored shale. A few sandstone beds, up to one foot in thickness, are interbedded with the shale. Ripple marks were observed in the sandstone.

About 500 feet west, the top of the bank exposes massive buff-colored sandstone and fine-grained conglomerate with pebbles up to one half inch in diameter. West from here, the conglomerate outcrops at lower and lower elevations, and forms the shore of the lake at the western end. Here the sandstone and conglomerate is at least 200 feet thick. The gradual decrease in elevation of the sandstone and conglomerate indicates a dip of about five degrees to the west or southwest.

No fossils were found in this outcrop. The lithology indicates that the sandstone and conglomerate are of Lower Cretaceous age and the shale with interbedded sandstones of Imperial or Upper Devonian age.

Outcrops of Lower Cretaceous age were examined along the Peel River about two miles west of the permit. Here the bank of the river is composed of interbedded sandstone and conglomerate having a gentle dip to the south. Fossil wood and shell fragments are common. Glauconite is present and in places gives the sandstone a greenish color. The pebbles in the conglomerate are generally small but a few were found up to two inches in diameter.

The conglomerate beds are overlain by a dark grey, carbonaceous shale with interbedded sandstones up to two feet in thickness. Worm borings, plant remains, and ripple marks are common. A petrofied log was observed.

The following fossils were collected and sent to C.R. Stelck of the University of Alberta. He identified them as follows:

Tancredia two species

Pleuromya

Astarte cf. natosini Lower Cretaceous

The projection of the contact between the Lower Cretaceous and the underlying Imperial formation from the Peel River through the U-shaped lake to the Arctic Red River passes a short distance north of Permit 1384. Therefore it

seems evident that all of the permit is underlain by a thin layer of Lower Cretaceous sediments.

A. G. Pentland

Alfred R. Allen

Vancouver, B. C.

December, 1957.

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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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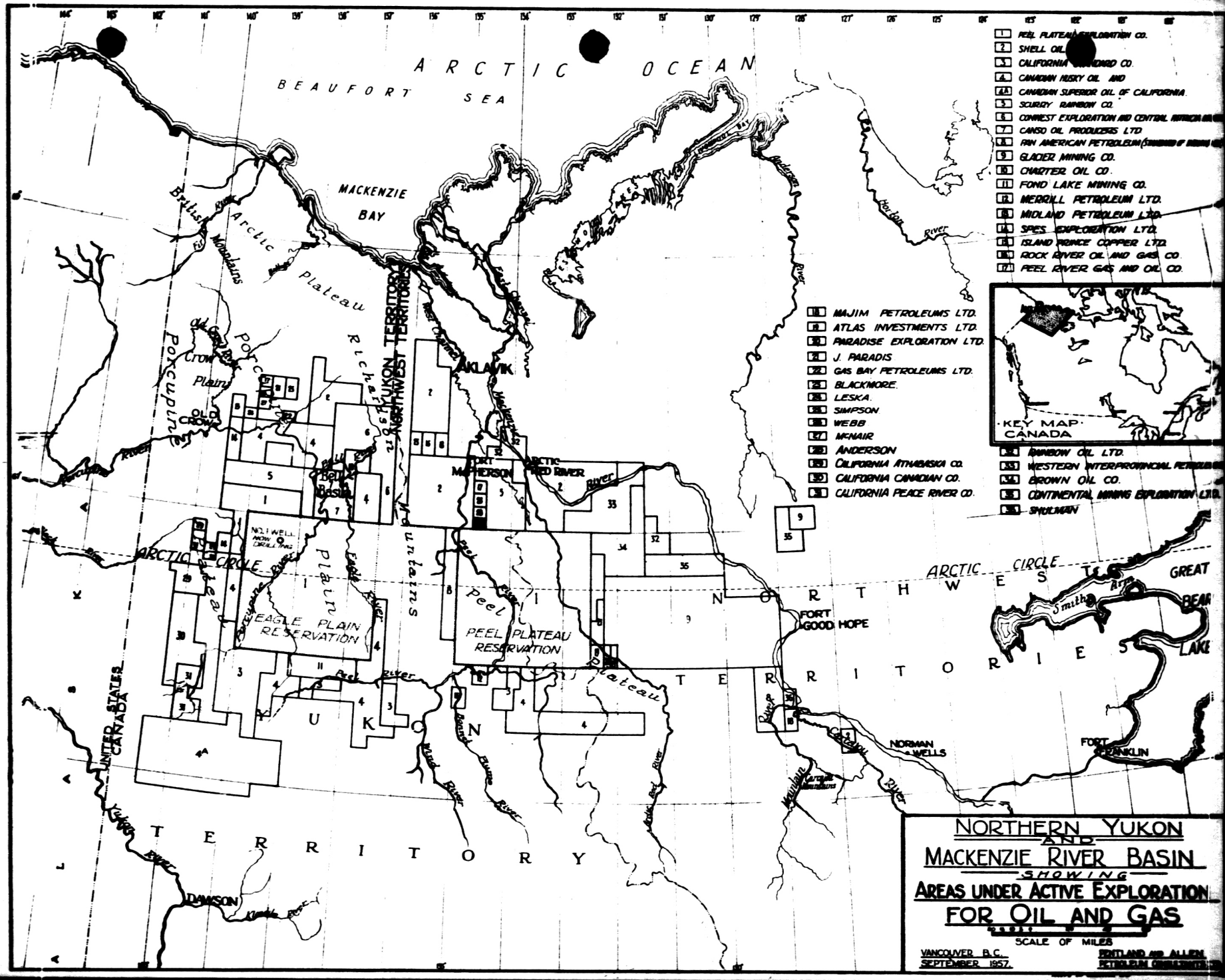


NORTHERN YUKON AND MACKENZIE RIVER BASIN

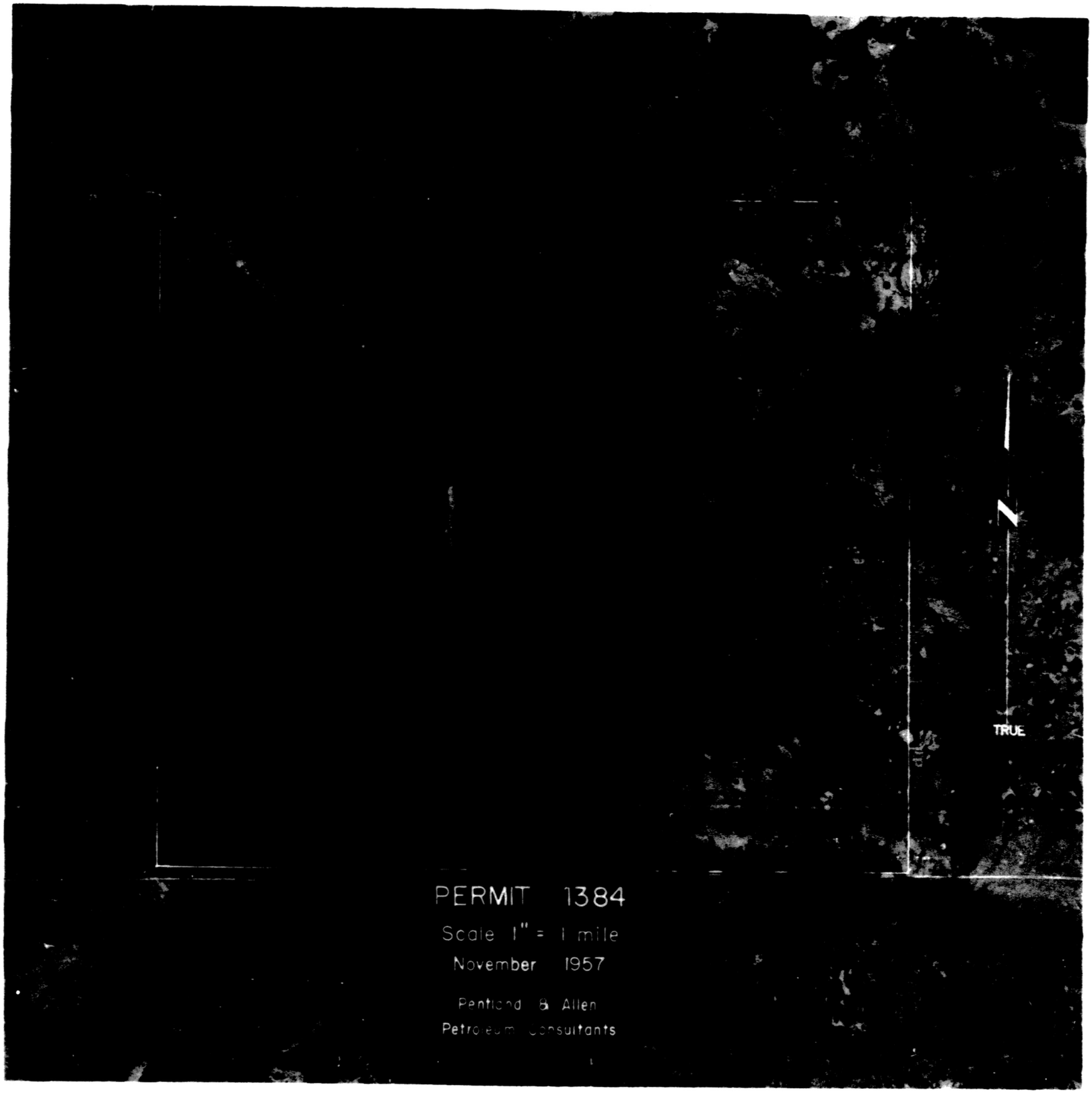
SHOWING

AREAS UNDER ACTIVE EXPLORATION FOR OIL AND GAS

SCALE OF MILES

VANCOUVER B.C.
SEPTEMBER 1957.

PENTLAND AND ALLEN
PETROLEUM CONSULTANTS


TRUE
PERMIT 1384
Scale 1" = 1 mile
November 1957
Pentland & Allen
Petroleum Consultants

PEEL RIVER

About 80 miles south of Fort McPherson.

Glauconitic sandstone and conglomerate at the base of the Lower Cretaceous.

GEOLOGY

PERMIT NO. 1384

N. W. T.

PENTLAND AND ALLEN PETROLEUM CONSULTANTS LTD.

A.G. Pentland Alfred Allen

LEGEND

- Outcrop Attitude
- Geological Contact
- Cretaceous
- Devonian

SCALE: 1 INCH = 1 MILE

OCT. 1957

564-1-6-2

REPORT ON THE GEOLOGY

PERMITS 1069E, 1070, 1071

NORTHWEST TERRITORIES

By:

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and

Alfred R. Allen

Vancouver, B. C.

July, 1938

CONTENTS

	Page
INTRODUCTION	1
LOCATION	1
OWNERSHIP	2
ACCESSIBILITY	2
CLIMATE AND VEGETATION	3
PHYSIOGRAPHY	3
REASONS FOR INVESTIGATION	4
METHODS OF INVESTIGATION	4
STRATIGRAPHY	5
LOCAL STRATIGRAPHY	8
LOCAL STRUCTURE	11
ECONOMIC POSSIBILITIES	12
* * * * * * *	
BIBLIOGRAPHY	13
* * * * * * *	
LOCATION MAP	
GEOLOGICAL MAP	
AERIAL MOSAIC	
* * * * * * *	

Report on the Geology

Permits 1069Z, 1070, 1071

Northwest Territories

INTRODUCTION

Favorable geology extending from proven oil and gas fields in northern British Columbia and Alberta to the Arctic Islands indicates that large oil and gas reserves will be discovered in this large and untested region. The Athabasca bituminous sands are considered to be one of the largest reserves of oil in the world.

The Norman Wells field was first drilled in 1920, and in 1944 1,229,310 barrels of oil were produced from 64 wells. Wildcat drilling has failed to encounter new fields in the Norman Wells area to date, but the search is rapidly spreading throughout the entire northland.

Exploration has just begun. Oil seepages have been known for many years and more are being found as the exploration tempo increases. It is reasonable to suggest that this region is in the stage of development comparable to Alberta one year before the discovery of the Leduc field.

LOCATION

The three permit areas are located adjacent to the eastern boundary of the Pearl Platform Reservation, east of the Arctic Red River, as follows:

1069Z	Northwest Corner at 66° - 30' 132° - 15'
1070	Northwest Corner at 66° - 40' 132° - 15'
1071	Northwest Corner at 66° - 30' 132° - 15'

Hooker Wells is 180 miles to the southeast.

OWNERSHIP

Permits 1069E, 1070 and 1071 are owned by Lobermann Enterprises Ltd., of 404 - 510 West Hastings Street, Vancouver, B. C.

The total area of the permits is 127,193 acres.

ACCESSIBILITY

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

The Arctic Red River flows northerly 10 to 15 miles west of the permits. Heavy drilling equipment could be transported by shallow-draft boat and barge from the village of Arctic

Red River to within 15 miles of the property and thence by land onto the chosen drillsite.

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 September or early October, but occasionally the large rivers remain open until well into November.

During May, June, and July there is almost continuous daylight with warm summer weather. During November, December, and January 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.

Trees are absent or are stunted over most of the muskeg area. They consist of white spruce, poplar, birch, and tamarack. In a few sheltered places, such as the banks of streams, trees may reach a height of 30 or 40 feet and a diameter of 12 to 18 inches. Here, too, willows and alders grow in thick masses.

The greater part of the area is covered with the various types of moss that are common to the Arctic muskeg.

PHYSIOGRAPHY

The permit is situated on the Peel Plateau. This consists of hundreds of square miles of ground that is nearly flat and is covered with lakes and muskeg. The lakes range in size from mere potholes to ten or twenty miles in length. The parts

that are not covered with water are covered with muskeg, making travel on the ground all but impossible during the summer months.

Small, meandering streams cross the area, and are confined by low banks that expose bedrock in only a few places except where the streams approach the main rivers. Here they have cut deep V-shaped valleys. The larger rivers, such as the Arctic Red River, flow between banks that range in height from 20 to 150 feet.

The land to the south rises gently for the first few miles into the foothills and thereafter more abruptly into the Mackenzie Mountains. The plateau is bounded on the west by the Richardson Mountains.

REASONS FOR THE INVESTIGATION

Geological mapping was undertaken as the first step in a comprehensive program of exploration. It was considered that a study of the formations, with particular attention to their ages, attitudes, and type of rock, was essential and would form a sound basis upon which to outline further work that might culminate in the discovery of oil or gas.

METHODS OF INVESTIGATION

The party consisted of A. R. Allen and A. C. 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 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 permits 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 the river or a lake, the party separated, each going in opposite 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 make a map from which additional copies could be taken.

STRATIGRAPHY

The Peel Plateau is underlain by rock strata ranging in age from Cretaceous to Pre-Cambrian. In the area of the permits only Upper Devonian and Lower Cretaceous rocks outcrop but outside the boundaries of the basin the older formations are evident. Since the entire assemblage underlies the permits all the known formations are briefly described below.

Cambrian rocks have been observed and mapped on the upper Arctic Red River, Mountain River and Imperial River. Quartzites, shales, sandstones and limestones constitute the rock types. C.R. Stelck (8) observed 6,500 feet of slates and shales overlain by 500 feet of argillites and chert in the upper Peel River area about 90 miles west of the permits. These are important possibilities for the accumulation of oil.

Ordovician shales and argillites have been mapped in the Upper Peel River area but no sediments of this age have been positively identified in sections to the south and east. It is probable that Ordovician rocks are lacking, or if present, are comparatively thin in the area occupied by these permits.

Silurian strata are widely distributed throughout the Mackenzie River basin. McMillan (1) P. 18, mapped 1,100 feet of limestone on the Arctic Red River. The lower unit contains 400 feet of chert in dolomite and the upper part 700 feet of limestone carrying a Niagaran fauna. The upper Niagaran coral zone is reported to be quite porous in places and capable of serving as a reservoir.

The name Bear Rock was used by Canol geologists to describe the brecciated and non-bedded dolomites and limestones lying below Middle Devonian strata and above a sharp disconformity with well-bedded Silurian limestone. The Bear Rock formation is reported to be more than 200 feet thick in the Mountain River area where it consists of brecciated limestones and dolomites. In places the beds are gypsum-bearing. The Bear Rock dolomites are generally the most porous rocks in the area except where their position is occupied by gypsum and anhydrite beds. They may be

highly bituminous.

The Middle Devonian section on Mountain River has been divided into three parts, the Lower Ramparts limestone, (180 feet), the Middle Ramparts shale (700 feet), and the Upper Ramparts limestone (445 feet). However, it seems probable that the Ramparts formation is much thinner in the area covered by the permits. On Margery Creek a section 225 feet thick contains lenses and discontinuous bands of fossil detritus. Several small coral aggregates have been noted and the upper contact is marked by a thick limestone conglomerate. Scattered accumulations of solid tar or bitumen are present and a fresh surface of limestone emits a strong odor of sulphur and gas. Stelck found a conglomerate on the Peel River carrying Ramparts fossils. It is overlain by Fort Creek shales and underlain by Silurian limestone.

The Upper Devonian is usually divided into two groups, the Fort Creek and Imperial. The Fort Creek formation is exposed along the Peel River from the Lower Canyon to several miles below its junction with Snake River. The base is composed of a limestone conglomerate and this is overlain by black shales and limestones. Near the top the shales contain fewer limestones and are very bituminous. In the proven field at Norman Wells a reef in the Fort Creek formation forms the oil-bearing reservoir and is the source of production in that field. The Imperial formation is composed essentially of fine-grained sandstones and shales. It outcrops extensively along the Arctic Red River about 15 miles west of permit 1071. Also, it has been mapped in the upper parts of the Arctic Red River and of a Peel River.

The Cretaceous overlies the older beds unconformably in the Norman Wells area, and the erosion interval is very marked. In places both the Imperial and Fort Creek formations have been eroded and the Cretaceous strata are in contact with Middle Devonian limestone. Hume divides the Cretaceous into four parts, the Sans Sault group, Slater River formation, Little Bear formation, and East Fork formation. The Sans Sault group is defined as being composed essentially of shales and sandstones of marine origin and includes all Lower [illegible] strata from the base up to the first or lowest bentonite beds. The Slater River formation overlies the Sans Sault and is composed of thin-bedded, black, friable shales with numerous limestone concretions. Typically, it contains many thin bands of bentonite 1/8 to 1 inch thick. The Little Bear formation consists of sandstone, some conglomerate, sandy shales, [illegible] and [illegible]. The East Fork formation directly overlies the [illegible] series and consists of well-bedded, grey, conchoidal and plastic marine shale. It has not been recognized north of Norman Wells.

LOCAL STRATIGRAPHY

The Upper Devonian and Lower Cretaceous formations outcrop on and near permits 1068A, 1070 and 1071 at only a few widely separated locations. To the west about 15 miles, along the Arctic Red River, however, outcrops are numerous.

The black, friable, poorly stratified Lower Cretaceous shales commonly contain limestone concretions which stand out on

TABLE OF FORMATIONS

Eocene		Imperfectly consolidated sands, clays, and conglomerates with lignite. Contain leaf and plant fragments.
		Erosional Unconformity
Cretaceous	East Fork	Gray shales
	Little Bear	Sandstones and shale with coal
	Slater River	Dark gray to black shales, some siltstones and sandstones
	Seme Smut	Fine-grained sandstone with glauconite; gray sandy shales. Sandstone and conglomerate at or near base.
		Erosional Unconformity
Upper Devonian	Imperial	Green, fine-grained sandstone and shale.
	Fort Creek	Upper gray shales, 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.
Silurian or Devonian	Bear rock	Brecciated dolomites and limestones, gypsum and anhydrite.
		Erosional Disconformity
Silurian	Running group	Limestone with chert
Ordovician		Argillites and shales
Cambrian	Mendougal group	Limestone; greenish, gray, and black shales; sandstones, gypsum, etc.
Cambrian and/or earlier	Katherine group	Interbedded quartzite and black platy shales.

the nearly vertical river banks and accumulate in the talus at the base of the outcrops. Fossil fragments are sometimes present in the concretions. A few limestone bands and sandy layers are interbedded with the shales. There is a sufficiently high sulphur content in the shales to give a detectable odor to the weathered outcrops in hot weather. Minor gypsum occurs on many outcrops as thin layers of fine crystals.

Sloughing is common along the river banks where large blocks of shale, up to 1,000 feet in length and 200 to 300 feet wide, have slid down from above. The beds are generally tilted and in some places broken and crumpled. A feature of considerable interest was observed on the north bank of the main river about fifteen miles south of the property. Here the shale is apparently on fire, throwing up a large column of smoke that can be seen from a considerable distance from an aircraft. It is not known what is being consumed. No coal seams were observed in any of the outcrops and it seems doubtful that a sufficient concentration of carbonaceous material is present in the shale to burn. It seems more probable that a concentration of a petroleum product or sulphur is being burned. A strong odor of sulphur dioxide is present but this could be due to the small amount of sulphur that is present in most of the outcrops. This type of fire appears to have been fairly common along the banks of the river. A number of places were observed where the shale had been burned to a red color or various shades of grey. Nothing was observed that would give a definite clue to the type of material that was burned in these places.

On the basis of fossil evidence the shales have been assigned to the Lower Cretaceous. C. R. Stelck (8) identified fossils collected by the writers on the Arctic Red River as Lower Cretaceous fish bones and Gastropolites lignivorus.

The contact between the Lower Cretaceous and Imperial formation is believed to strike in a nearly east-west line about three and a half miles north of the south boundary of permit 1071. There are no outcrops of Imperial sandstone or shale on the permits, but about one mile north of the northeast corner of permit 1071, near the headwaters of Tree Creek, an outcrop was observed and mapped by the writers. It is composed of interbedded sandstone and shale. The sandstone is fine-grained and greenish grey with fine black banding. In it are fossilized siphuncle tubes (?) and Mya (?) identified by C. R. Stelck (8). The siphuncle tubes (?) are about the size of a man's forefinger, all vertical, roughly ringed and marked with fine lines on the surface, but without internal structure. The interbedded shale is brown to grey, bedded, friable, and soft. In it are numerous brown hard concretions up to 18 inches in diameter and 6 inches thick. In general these rocks are similar to the Imperial sandstone and shale outcropping to the west on the Arctic Red River. Float in Tree Creek, unlike elsewhere on the permits to the south, is in part typically Devonian.

LOCAL STRUCTURE

It is not possible to work out detailed structure for the area covered by the permits because of the lack of outcrops.

To the west and south there are nearly continuous outcrops for one hundred miles along the Arctic Red River where the strata are flat-lying and rarely have dips that are measureable. No faults have been observed in this locality.

The permits lie in a large sedimentary basin. The Cretaceous-Devonian contact crosses the southern part of Permit 1071 and extensive outcrops of marine Cretaceous shale have been mapped along the Arctic Red River about ten miles south of Permit 1069%. Therefore, a low dip to the south is indicated.

ECONOMIC POSSIBILITIES

In the permits area there is no evidence of folding in the exposures of Lower Cretaceous shales. Since an erosional unconformity exists between the Cretaceous and underlying formation, however, there may be folds present in the Devonian and older formations underlying the property. Several horizons in the Devonian and Silurian strata are highly favorable for the accumulation of oil and gas, and it is possible that below the capping of black shales, oil and gas accumulations may exist. It is evident, therefore, that the area warrants further investigation.

Since seismic work is not practicable during the summer months, it is suggested that an airborne scintillometer survey be conducted over permits 1068%, 1070, and 1071.

A. G. Pentland

Alfred L. Allen

Vancouver, B. C.
July, 1958

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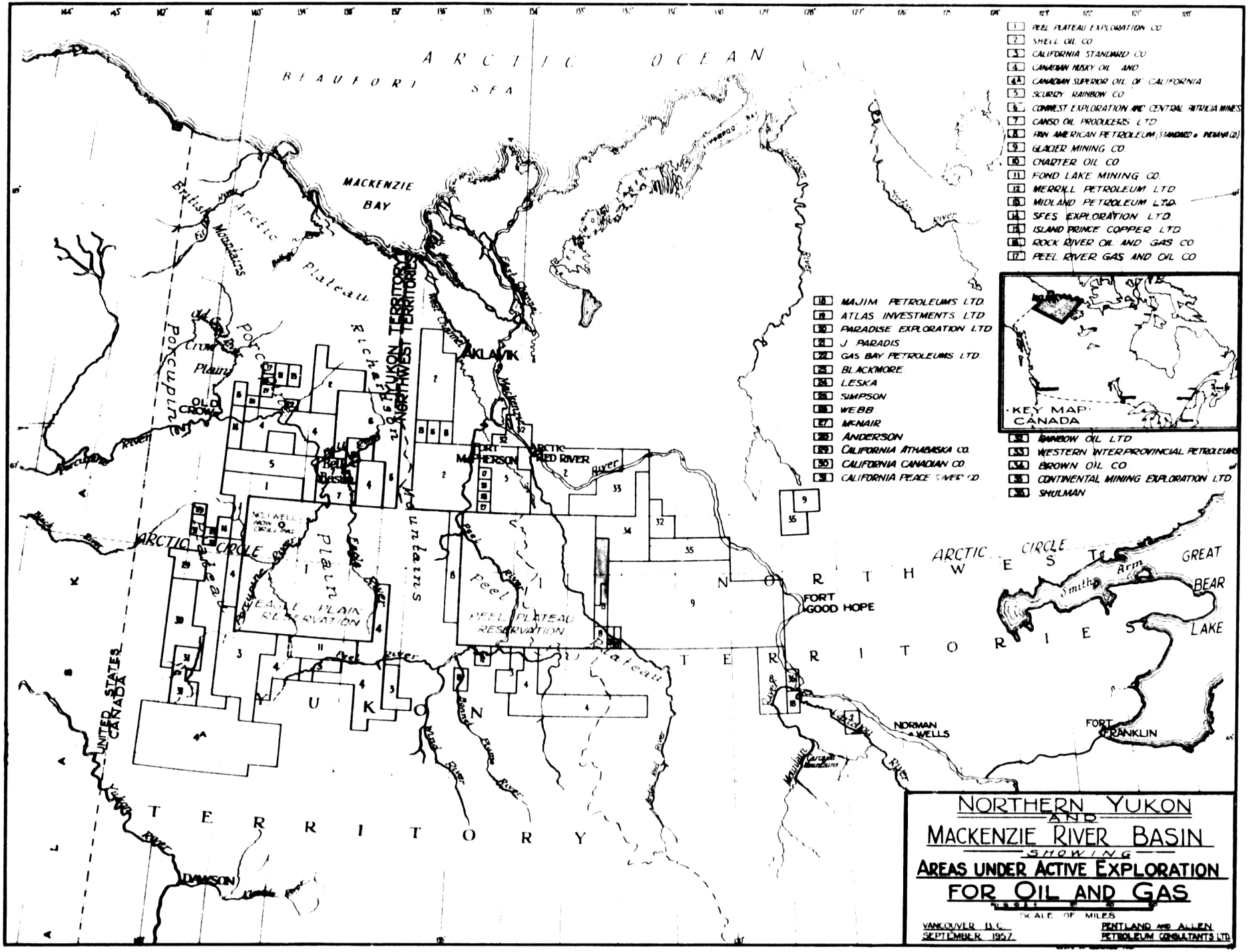

NORTHERN YUKON AND MACKENZIE RIVER BASIN SHOWING AREAS UNDER ACTIVE EXPLORATION FOR OIL AND GAS

SCALE OF MILES

VANCOUVER B.C.
SEPTEMBER 1957

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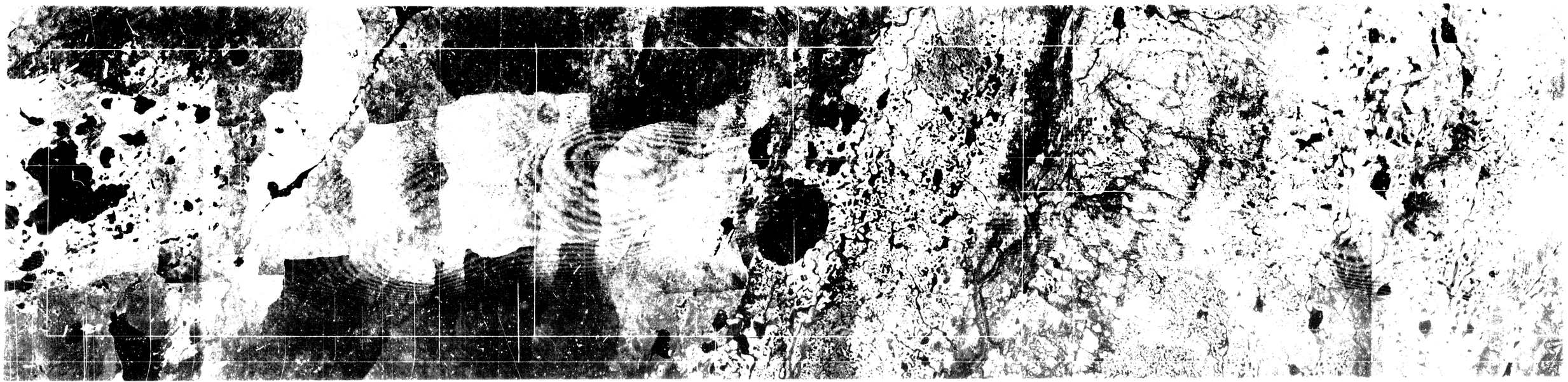

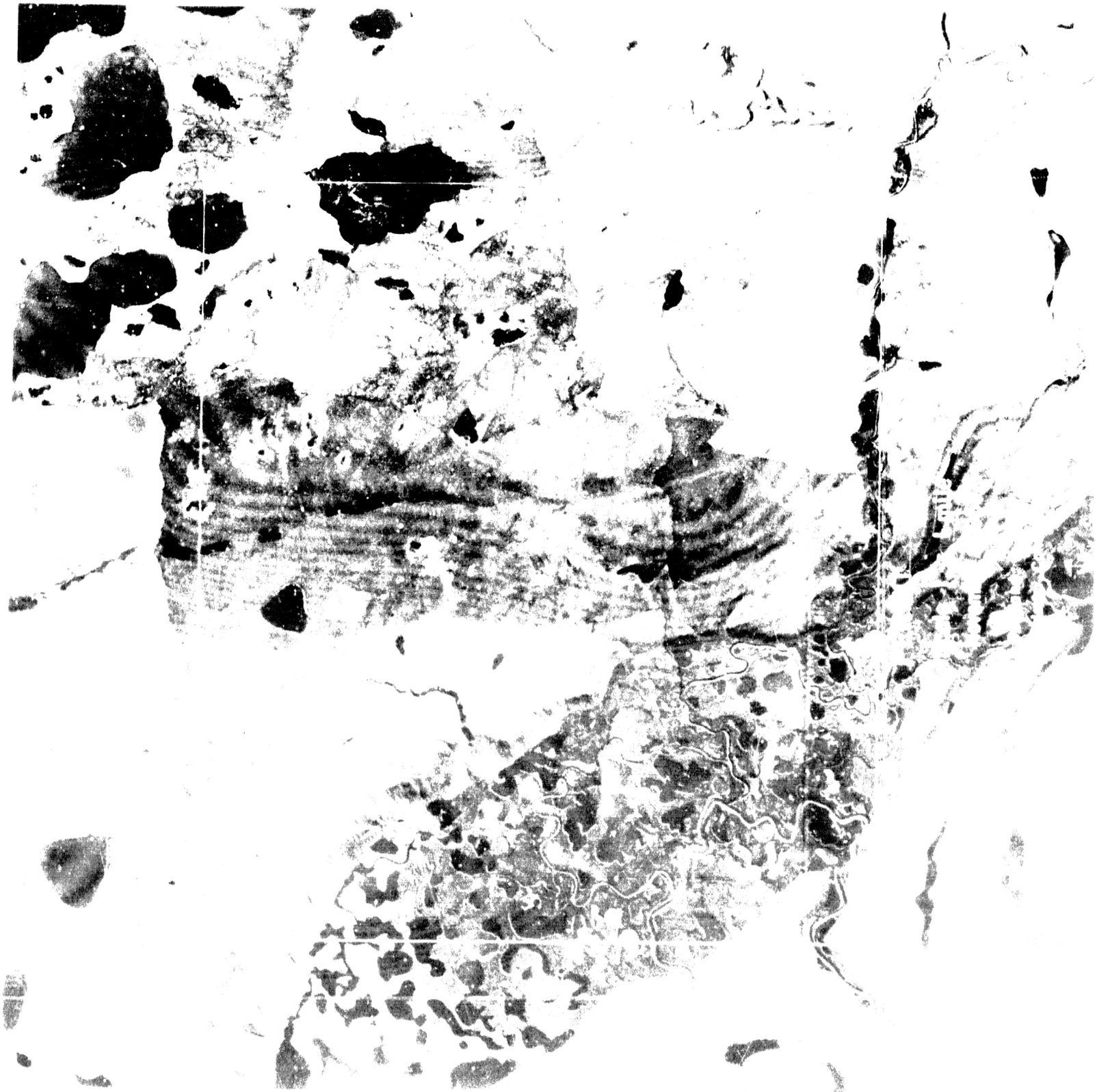

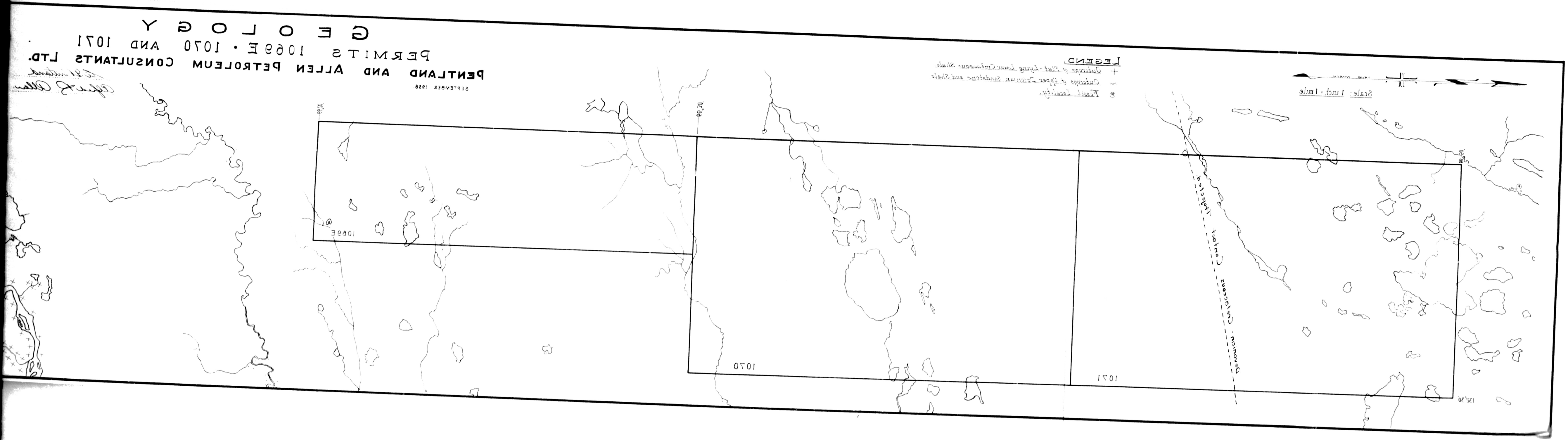
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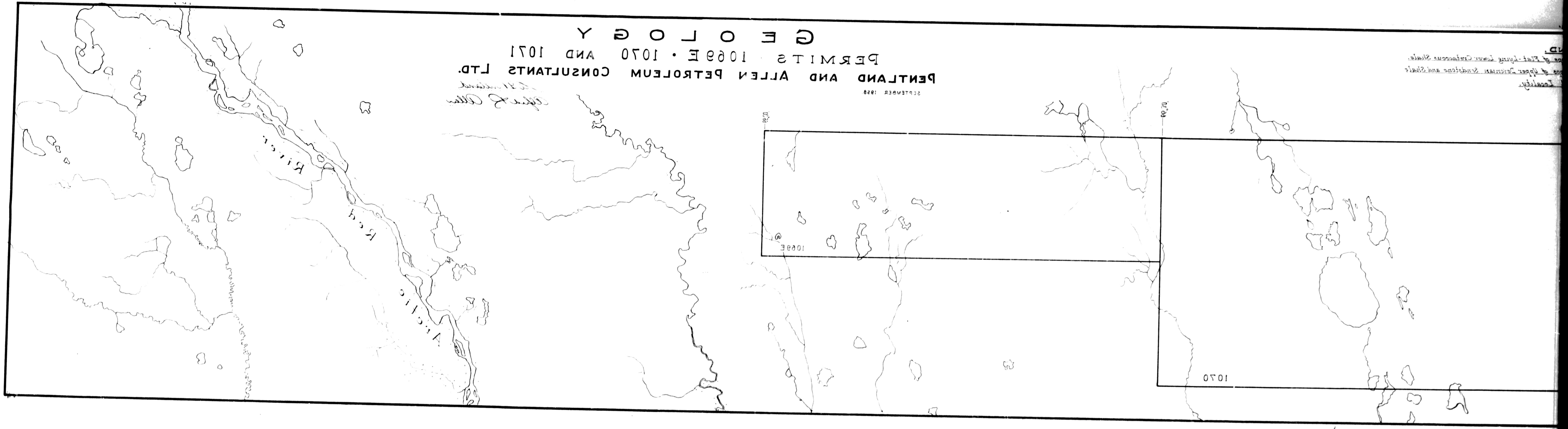
LEGEND.
Outcrops of Flat-Lying Lower Cretaceous Shale.
Outcrops of Upper Devonian Sandstone and Shale
Fossil Locality.
Scale: 1 inch = 1 mile
1069E
1070
1071
Devonian Cretaceous Contact inferred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Arctic Red River
1069E
1070