GEOPHYSICAL REPORT

PERMITS

1427 and 1431

NORTHWEST TERRITORIES

By:

A.G. Pentland
and
Alfred R. Allen

Vancouver, B.C.
December, 1958

CONTENTS

Geophysical Report
Permits 1427 and 1431
Northwest Territories

INTRODUCTION

An aerial survey was made by Pentland and Allen Petroleum Consultants Ltd. over Permits 1427 and 1431 during July, 1958. The method was based upon work that has been carried out by various exploration companies.

Lundberg Explorations Limited surveyed areas in Alberta, British Columbia, Saskatchewan, Quebec, Texas, New Mexico, Oklahoma and various other parts of the United States. Lundberg (1) found that radioactive lows generally are obtained over oil fields and that these lows are commonly surrounded by radioactivity slightly higher than normal. He states that variations in intensity may look rather erratic over broken topography, lakes, swamps, and river valleys, but that the lows above the oil fields may, as a rule, still be observed. He claims that his operations were extended into unknown territory and drill holes were put down on anomalies which looked promising with the result that new oil fields were found.

Other workers, for example Williams and Lorenz (2) do not believe that the measurement of radioactivity is a direct method of finding oil but state that it is a tool that may be used to aid in the interpretation of subsurface geology.

In order to test the method under conditions as nearly like those on the permits as possible, a check was made over the oil field at Norman Wells. It was found that low readings were obtained over the oil pool and that relatively high readings were recorded over parts of the islands and mainland away from the oil pool. As a general rule, readings were low over the Mackenzie River itself.

LOCATION

The permits are 4 to 8 miles east of the Peel River and eight miles southeast of Fort McPherson, Northwest Territories. Location of the northeast corners are:

Permit 1427	67° 15' North	134-30 West
Permit 1431	67° 20' North	134-30 West

OWNERSHIP

Permits 1427 and 1431 are owned by Laburnum Enterprises of 404, 510 West Hastings Street, Vancouver, B. C. The areas are as follows:

Permit 1427,	24,832 acres
Permit 1431,	24,746 acres
Total	49,578 acres

ACCESSIBILITY

Access to Fort McPherson is by aircraft throughout the year. During the summer months freight is transported on the MacKenzie and Peel Rivers by barge.

Canadian Pacific Airlines operates scheduled flights from Edmonton to Aklavik E 3 using C-46's. The distribution of passengers and air freight to the smaller centres such as Fort McPherson and Fort Good Hope is by Otter Aircraft. Aircraft are available for charter at Aklavik. Freight may be shipped by train during the summer from Edmonton to Waterways, thence by barge down the Athabaska River, through Lake Athabaska, down the Slave River and through Great Slave Lake, down the Mackenzie River, and thence up smaller rivers such as the Arctic Red, Peel, and other main waterways. Heavy equipment may be transported by "cat train" over most of the north country during the winter months. Plans are being made for several main access roads as far as the Arctic Ocean in order to assist in the development of the natural resources of the Yukon and the western part of the Northwest Territories.

CLIMATE AND VEGETATION

Spring break-up is usually in late May or early June. Freeze-up occurs between mid September and late October. May, June and July are the summer months when there is almost continuous daylight and the weather is pleasantly warm. The sun is not seen during the months of November, December and January and during these winter months the temperature may drop to 60 degrees below zero for short periods of time. With lakes, rivers, swamps and muskeg frozen, transportation is active by "cat train" over the many winter roads. It is during this winter season that most of the drilling rigs will be moved and ground geophysical survey work done in the search for oil and gas.

Small scattered stands of stunted spruce, poplar, birch and tamarack grow on this muskeg-covered country. In some sheltered areas, usually along the banks of streams, the trees may reach diameters of 12 to 18 inches and heights of 30 to 40 feet.

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.

GEOLOGY

Outcrops are numerous a few miles west of the permits on the banks of the Peel River. Cretaceous and the underlying devonian rocks are exposed on the west side of a small lake between the Peel River and permit 1427. The Upper Devonian Imperial formation is there composed of shale with sandstone interbeds up to one foot thick. The shale is grey to rusty

brown and the sandstone light greenish grey with ripple marks. The Cretaceous rocks are massive buff-colored sandstone and fine-grained conglomerate, glauconitic and containing fossil wood and shells. The sandstone and conglomerate dip 5 degrees southwesterly. The attitude of the underlying shale and sandstone is unknown. Projected southeasterly to outcrops along the Arctic Red River, this contact passes through the southwest corner of permit 1427.

It is evident, therefore, that permits 1427 and 1431 are underlain almost wholly by the Imperial formation of Upper Devonian age, but the contact with overlying Lower Cretaceous strata which dips southwesterly at a low angle passes across the southwest corner of 1427.

The generalized geological column for the area is as shown on page 6.

EQUIPMENT AND METHODS

Equipment consisted of a Cessna 170-B aircraft fitted with a very sensitive gamma ray detector utilizing the scintillation principle, an amplifier and a recorder synchronized to give a continuous record of all readings along each flight line.

Navigation was by means of Mosaics on the scale of one inch to one mile and standard maps on the scale of one inch to eight miles. Navigation was greatly simplified by the proximity to the large Peel River valley and the many lakes that can be seen from the aircraft for several miles. Also, the

Table of Formations

Eocene		Imperfectly consolidated sands, clays, and conglomerates with lignite. Contains 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 Unfonformity	
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.

area had been flown severa. times previously and much of it covered on foot by the writers. When each recognizable feature was crossed a mark was made on the recording tape to identify that particular landmark.

All flights were made during the late evening to midnight when flying conditions were uniform. Thus navigation along straight north-south lines, at a uniform altitude was accomplished with accuracy.

Flight lines were spaced one half mile apart.

Using readily identifiable topographic features the radioactive intensity graphs were sectioned at half-mile intervals. The average was then taken from each section and recorded in counts per second on a tracing paper overlay on the aerial mosaic. Thus a map was drawn showing only the flight lines and average readings in counts per second for each one half mile. Points of equal radioactivity were joined much the same as for the construction of a topographic map or isopatch. Intervals of five counts per second were used. The areas of "highs" and "lows" are clarified by coloring the map with the lowest readings in red and various intermediate readings in orange, yellow, and white, and the highest readings in blue, green and brown.

INTERPRETATION OF RESULTS

The area is completely covered with overburden, muskeg and lakes. There are no outcrops and little or no relief within the permit area.

along flight lines, spaced [illegible]

over 70 counts per second.

All the "lows" but one are over lakes or areas of swamp and wet muskeg. There is a long narrow area of low readings in the south central part of Permit 1431 that is not covered with water or wet muskeg. There is no surface explanation for this low, and it is conceivable that it is explainable by sub-surface conditions, such as a deep depression in the bedrock now filled with overburden, or an effect caused by an oil pool such as described by Lundberg - without the "halo" of higher reading. In any event, from the point of view the survey this low represents the most interesting featu on the property. The several highs are over topographic features such as the confluence of watercourses and ba of same where overburden is likely thin, and the blan ing effect therefore reduced.

The pattern of high and low readings i in general northwest to southeast across the permits. A trend is evident, particularly immediately to the south of permit 1427, where these lines curve from the northwest to west, ly representing folding in the Lower Cretaceous strata.

SUMMARY AND CONCLUSIONS

The results of the airborne scintillometer survey over Permits 1427 and 1431 point up two interesting features. First, the low in the south central part of Permit 1431 has

point around which future geophysical work could be planned, and second the swing in the radioactive trend from northwest to west which may represent folding in the underlying rocks.

A.G. Pentland

Alfred R. Allen

Vancouver, B. C.

December, 1958

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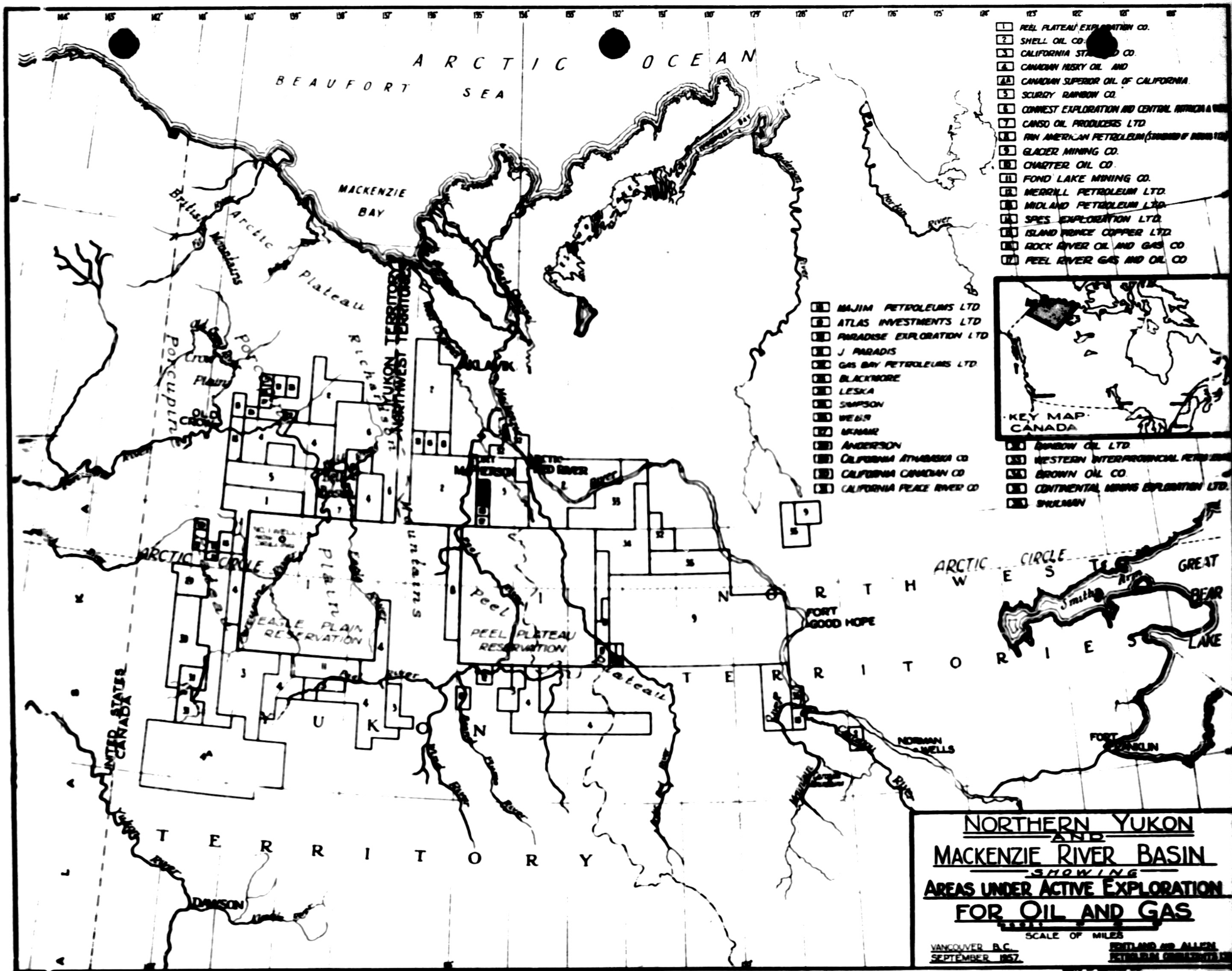
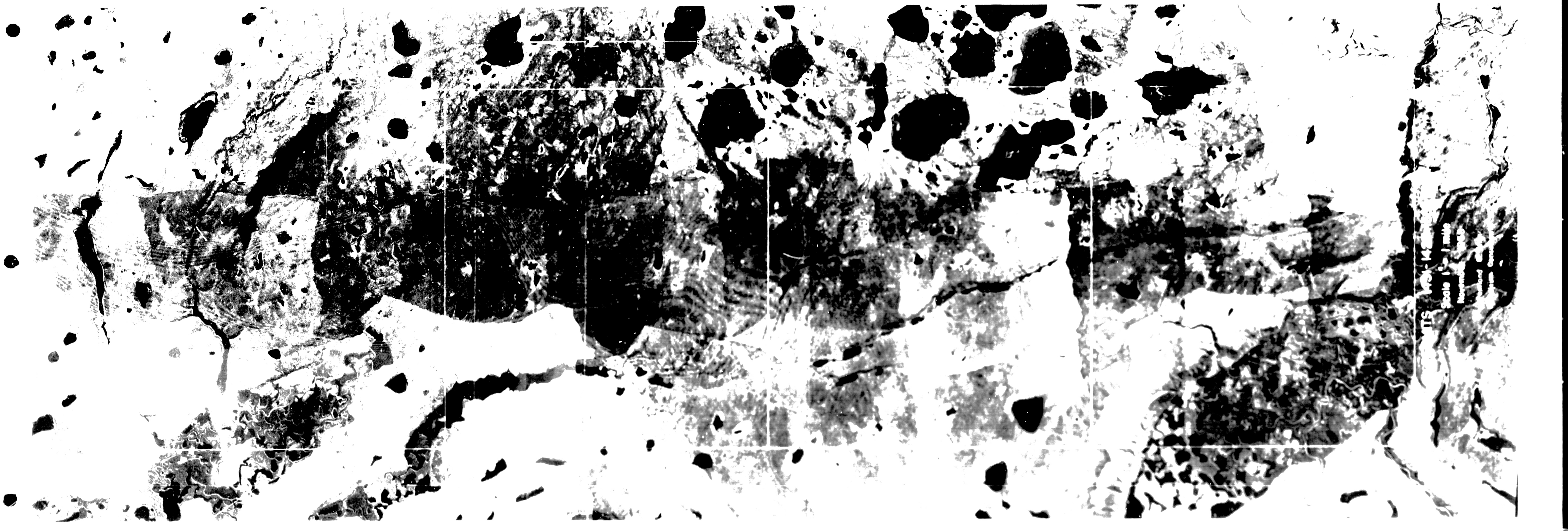

NORTHERN YUKON AND MACKENZIE RIVER BASIN
SHOWING
AREAS UNDER ACTIVE EXPLORATION FOR OIL AND GAS
SCALE OF MILES
VANCOUVER B.C. SEPTEMBER 1957
1 PEEL PLATEAU EXPLORATION CO.
2 SHELL OIL CO.
3 CALIFORNIA STANDARD CO.
4 CANADIAN HUSKY OIL AND
4A CANADIAN SUPERIOR OIL OF CALIFORNIA
5 SCURRY RAINBOW CO.
7 CANSO OIL PRODUCERS LTD
9 GLACIER MINING CO.
10 CHARTER OIL CO.
11 FOND LAKE MINING CO.
12 MERRILL PETROLEUM LTD.
13 MIDLAND PETROLEUM LTD.
14 SPES EXPLORATION LTD.
15 ISLAND PRINCE COPPER LTD.
16 ROCK RIVER OIL AND GAS CO
17 PEEL RIVER GAS AND OIL CO
MAJIM PETROLEUMS LTD
ATLAS INVESTMENTS LTD
PARADISE EXPLORATION LTD
J PARADIS
GAS BAY PETROLEUMS LTD
BLACKMORE
LESKA
SIMPSON
WEBB
ANDERSON
CALIFORNIA ATHABASKA CO
CALIFORNIA CANADIAN CO
CALIFORNIA PEACE RIVER CO
RAINBOW OIL LTD
WESTERN INTERPROVINCIAL PETROLEUM
BROWN OIL CO.
CONTINENTAL MINING EXPLORATION LTD.
SHULMAN
KEY MAP CANADA
ARCTIC OCEAN
BEAUFORT SEA
MACKENZIE BAY
British Mountains
Arctic Plateau
Richardson Mountains
YUKON TERRITORY
NORTHWEST TERRITORIES
AKLAVIK
FORT McPHERSON
OLD CROW
Porcupine
Porcupine Plain
Eagle Plain
EAGLE PLAIN RESERVATION
Peel Plateau
PEEL PLATEAU RESERVATION
Peel
ARCTIC CIRCLE
FORT GOOD HOPE
NORMAN WELLS
FORT FRANKLIN
GREAT BEAR LAKE
Smith Arm
DAWSON
UNITED STATES
CANADA
Yukon River
Anderson River
Horton River
Arctic Red River


Scale

GEOPHYSICAL SURVEY

AIRBORNE SCINTILLOMETER

PERMITS 1067 · 1068 · 1069 · 1070 · 1071 · 1072

NORTHWEST TERRITORIES

PENTLAND AND ALLEN PETROLEUM CONSULTANTS LTD.

Vancouver, B.C.
September 1958.

A.Y. Pentland
Jas. A. Allen

TRUE NORTH

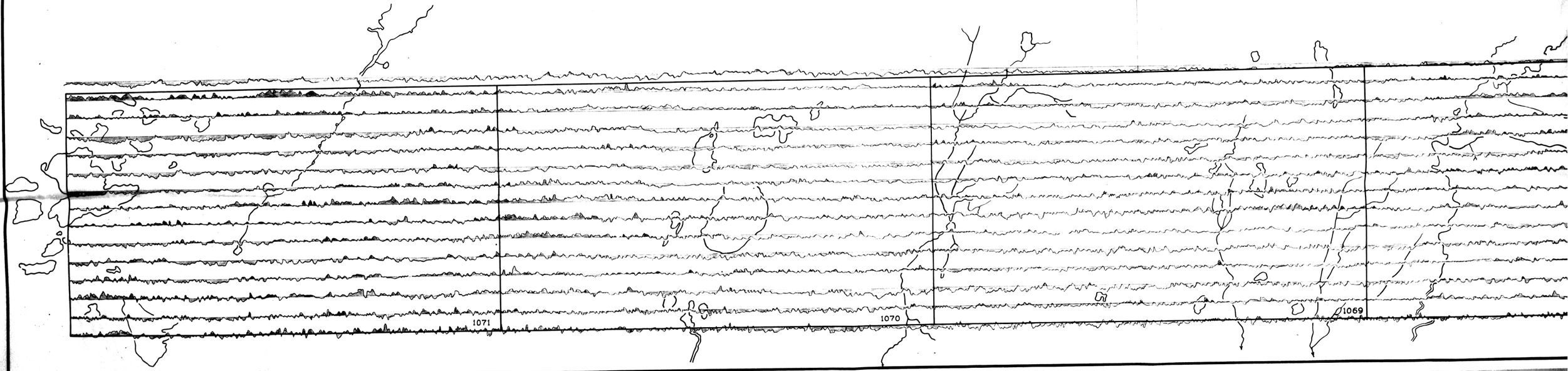
Scale: 1 inch = 1 mile

LEGEND

Flight Lines

Scintillometer Readings

Permit Boundary



GEOPHYSICAL SURVEY

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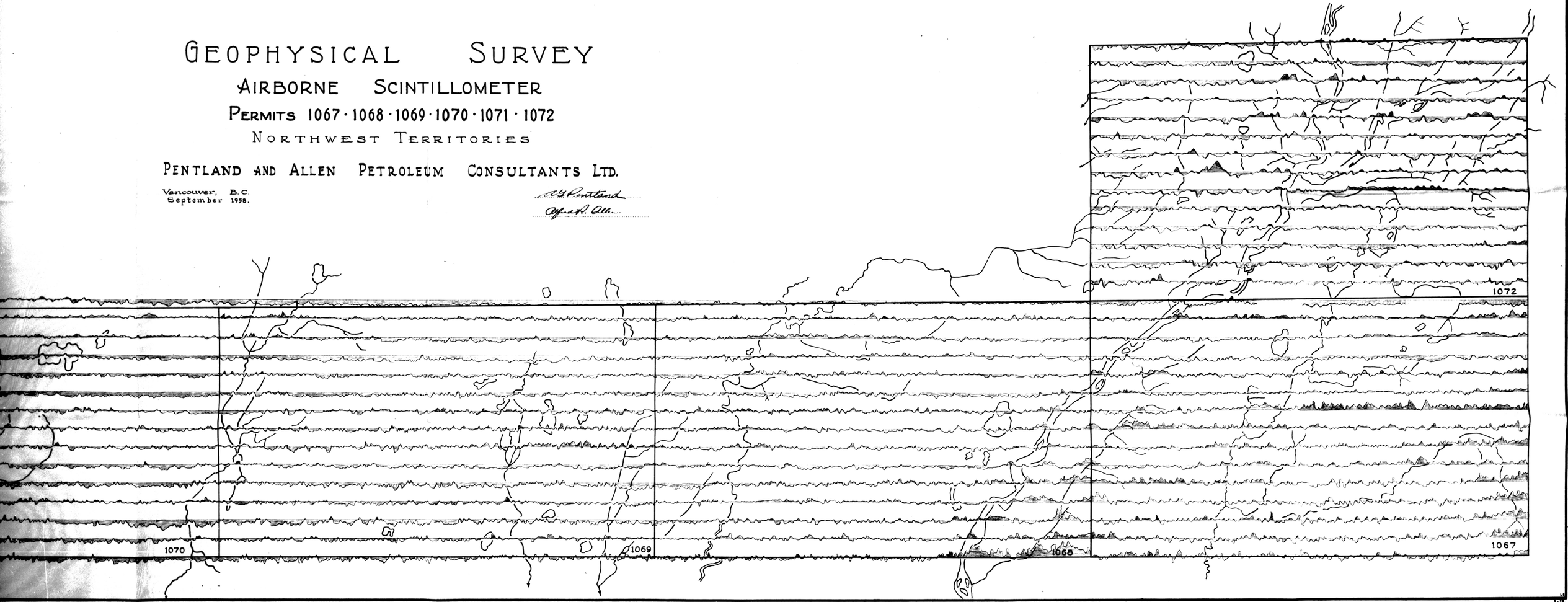

GEOPHYSICAL REPORT

PERMITS

1067, 1068, 1069, 1070, 1071, 1072

NORTHWEST TERRITORIES

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554-10-6-5

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PERMITS 1067, 1068, 1069, 1070, 1071, and 1072

NORTHWEST TERRITORIES

INTRODUCTION

An aerial scintillometer survey was made over Permits 1067, 1068, 1069, 1070, 1071 and 1072 during June and the early part of July, 1958. The method was based upon work that has been carried out by various exploration companies.

Lundberg Explorations Limited surveyed areas in Alberta, British Columbia, Saskatchewan, Quebec, Texas, New Mexico, Oklahoma and various other parts of the United States. Lundberg (1) found that radioactive lows generally are obtained over oil fields and that these lows are commonly surrounded by radioactivity slightly higher than normal. He states that variations in intensity may look rather erratic over broken topography, lakes, swamps, and river valleys, but that the lows above the oil fields may, as a rule, still be observed. He claims that his operations were extended into unknown territory and drill holes were put down on anomalies which looked promising with the result that new oil fields were found.

Other workers, for example Williams and Lorenz (2) do not believe that the measurement of radioactivity is a direct method of finding oil but state that it is a tool that may be used to aid in the interpretation of subsurface geology.

In order to test the method under conditions as nearly like these on the permits as possible, a check was made over the oil field at Norman Wells. It was found that low readings were obtained over the oil pool and that relatively high readings were recorded over parts of the islands and mainland away from the oil pool. As a general rule, readings were low over the Mackenzie River itself.

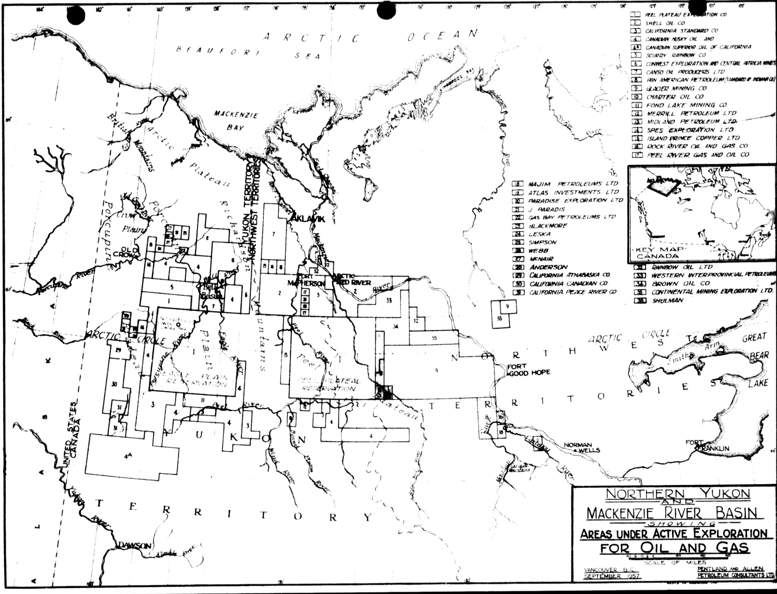
LOCATION

The permits are on the east side and immediately adjacent to the Peel Plateau Reservation. They are on and near the Arctic Red River about 100 miles southeast of the village of Arctic Red River, which is on the Mackenzie River. They are 160 miles northwest of Norman Wells, Northwest Territories. The Arctic Circle crosses Permit 1070.

Permit 1067	66° 10' North	132° 15' West
Permit 1068	66° 20'	132° 15'
Permit 1069	66° 30'	132° 15'
Permit 1070	66° 40'	132° 15'
Permit 1071	66° 30'	132° 15'
Permit 1072	66° 10'	132° 00'

OWNERSHIP

Permits 1067, 1068, 1069, 1070, 1071, and 1072 are



ARCTIC OCEAN
BEAUFORT SEA
MACKENZIE BAY
British Mountains
Arctic Plateau
Porcupine
Old Crow Plain
OLD CROW
Richardson Mountains
YUKON TERRITORY
NORTHWEST TERRITORIES
AKLAVIK
FORT McPHERSON
ARCTIC RED RIVER
Bell Basin
Porcupine River
ARCTIC CIRCLE
EAGLE PLAIN RESERVATION
PEEL PLATEAU RESERVATION
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CANADA
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NORMAN WELLS
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6 CONWEST EXPLORATION AND CENTRAL PATRICIA MINES
7 CANSO OIL PRODUCERS LTD
8 PAN AMERICAN PETROLEUM (STANDARD OF INDIANA CO)
9 GLACIER MINING CO.
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AREAS UNDER ACTIVE EXPLORATION FOR OIL AND GAS
SCALE OF MILES
VANCOUVER B.C.
SEPTEMBER 1957
PENTLAND AND ALLEN
PETROLEUM CONSULTANTS LTD.

owned by Laburnum Enterprises of 404 - 510 West Hastings Street, Vancouver, B. C. The acreage is as follows:

1067	-	51, 966
1068	-	51, 626
1069	-	51, 286
1070	-	50, 946
1071	-	50, 604
1072	-	51, 966
		308, 394

ACCESSIBILITY

Access to the general area is by aircraft throughout the year and by river transportation for freight during the summer months.

Canadian Pacific Airlines operates scheduled flights from Edmonton to Aklavik E 3 using C-46's. The distribution of passengers and air freight to the smaller centres such as Fort McPherson and Fort Good Hope is by Otter Aircraft. Aircraft are available for charter at Aklavik. Freight may be shipped by train during the summer from Edmonton to Waterways, thence by barge down the Athabaska River, through Lake Athabaska, down the Slave River and through Great Slave Lake, down the Mackenzie River, and thence up smaller rivers such as the Arctic Red, Peel, and other main waterways. Heavy equipment may be transported

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Small scattered stands of stunted spruce, poplar, birch and tamarack grow on this muskeg-covered country. In some sheltered areas, usually along the banks of streams, the trees may reach diameters of 12 to 18 inches and heights of 30 to 40 feet.

PHYSIOGRAPHY

The permits are in the area that is generally referred to as the Peel Plateau. This consists of many hundreds of square miles of nearly flat country through which the Peel and other large rivers flow to the Mackenzie River and thence to the Arctic Ocean. Lakes, sloughs, meandering streams and muskeg cover the land surface. The most prominent physical feature near the permit area is the Arctic Red River. This large river flows in a canyon-like valley up to one mile wide 50 to 200 feet below the general level of the area. Tributary creeks enter the river through steeply sloping narrow, deep, V-shaped valleys. Elsewhere throughout the area the creeks are meandering with low banks which expose bedrock in a few places.

The Richardson Mountains lie to the west and the Mackenzie Mountains to the south. To the north and east the monotonous flat plateau extends to the Mackenzie River.

GEOLOGY

The large basin is underlain by Lower Cretaceous flat-lying black shale. Unconformably underlying this is Upper Devonian grey and green sandstone and shale. The north contact between the two formations is located about 15 miles north of the Arctic Circle, and the south contact about 90 miles southerly in the foothills of the Mackenzie Mountains. The generalized geological column for the area is as follows:

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.
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Cambrian	Macdougal group	Limestone; greenish, grey, and black shales; sandstones, gypsum, etc.
Cambrian and/or earlier	Katherine group	Interbedded quartzite and black platy shales.

Upper Devonian and Lower Cretaceous rocks only, outcrop on and near the permits area. Continuous outcrops of thin-bedded dark grey to black friable shales outcrop along the steep high banks of the Arctic Red River and tributary streams. Sandy layers and ironstone concretions are common throughout the black shales. Crystals of gypsum and coatings of sulphur are common on the weathered shale surface. Blocks of shale up to 1,000 feet long and 300 feet thick have sloughed off the nearly vertical banks of the Arctic Red River. One of these is slowly burning near the south end of the permits area. The column of smoke rising from it can be seen for miles. It is not definitely known what is burning in the shale. No coal was observed in the area, and it is doubtful if there is sufficient concentration of carbonaceous material to ignite and burn. It is possible there is sufficient petroliferous material in the shale to cause it to ignite by heat generated when the heavy block of rock sloughed off the side of the valley, and to continue smouldering. The presence of several large burned out areas along the river banks is evidence that this phenomenon is common along the banks of the Arctic Red River. Fossil evidence has established the Lower Cretaceous age of the black shale. Fossils collected by the writers were identified by C. R. Stelck as Lower Cretaceous fish bones and Gastropolites liardensis

Geological mapping along the Arctic Red River shows the contact between Lower Cretaceous and the underlying Imperial

formation of Upper Devonian age about 15 miles west of Permit 1071. The base of the Cretaceous has been mapped on the Ontaratue River about 50 miles to the east. A line joining these two places passes through the southern part of Permit 1071, suggesting that the northern part of the permit is underlain by rocks of Upper Devonian age.

The closest outcrop of Upper Devonian rocks was observed by the writers near the headwaters of Tree Creek a short distance north of Permit 1071. This appears to be Imperial sandstone and shale. Fine-grained brown to grey-green sandstone is here interbedded with black, brown-weathering shale. There are fossil-like, well-defined, elongated, vertical nodules in the sandstone strata. These are devoid of visible interior structure, but have a rough striated and ringed marking on the exterior, and C. R. Stelck has identified them as siphuncle tubes (?). There are also fossils identified by C. R. Stelck as Mya (?). In the shale there are numerous hard, fine-grained concretions up to 18 inches in diameter and 6 inches thick.

Little or no structure is evident throughout the permits area. The shales are nearly flat, there being no measurable dip at any one location and no distinctive markers. No shearing or faulting is evident anywhere in this general locality. Since the Upper Devonian reaches the surface on all sides of the large area of Lower Cretaceous shale it is obvious that the major structure is that of a large basin.

The marine Cretaceous shale is correlated with the Slater

River formation which overlies the Sans Sault, also of Lower Cretaceous age. It is not possible to measure the thickness of these formations on the permits, but evidence from sections that have been measured in other parts of the country indicates that there is at least 2,000 feet of Cretaceous rocks in the southern part of the permits. Thus the average dip throughout the area covered by the permits is southerly at a very low angle.

EQUIPMENT AND METHODS

Equipment consisted of a very sensitive gamma ray detector utilising the scintillation principle, an amplifier, and a recorder which was used to give a continuous record of all readings along each flight line.

Navigation was by means of mosaics on the scale of one inch to one mile and standard maps on the scale of one inch to eight miles. Navigation was greatly simplified because the terrain is very flat and is crossed by one large river and several smaller creeks. Also, there are numerous lakes of sufficient size that they can be recognised at a considerable distance from the aircraft. The fact that the area had been flown on several previous occasions, and that much of it had been covered on foot, helped to simplify navigation. Each time a recognisable feature was crossed a mark was made on the recorder tape and a note made to identify the particular landmark.

All of the flying was done between the hours of seven

in the evening and midnight or very early in the morning on days when there was little or no wind. These hours were picked because the air is generally calm and less turbulent at that time. Thus navigation along a straight line and at a uniform elevation was much more accurate.

Flight lines were flown in a north-south direction and spaced one half mile apart.

On the map, each flight is represented by two lines one of which is straight and the other jagged. The straight line represents the line of flight and the jagged line represents the reading of the scintillometer in counts per second as recorded on the recorder tape. The flight line is used as a co-ordinate of 60 counts per second. If the map is orientated so that the top represents north, the jagged line is to the right of the flight line where the number of counts per second is greater than 60 and to the left of the flight line where the number of counts per second is less than 60.

A second map was constructed by averaging the number of counts per second over on half mile intervals and then drawing lines to represent places of equal counts.

INTERPRETATION OF RESULTS

The area covered by the map may be divided roughly into three parts. The southern part comprising permits 1072, 1067, and the southwest corner of 1068 is characterised by high readings. The central part comprising the greater part of permits 1068, 1069,

and 1070 is characterized by very low readings. The northern part, comprising 1071 and the northeast corner of 1070 is characterized by moderately high readings.

A study of the map reveals part of the reason for these changes. For example, many of the high readings in the southern part of the area were recorded over the banks of the Arctic Red River or the short creeks that cascade into the river from the higher level of the surrounding plains. The river banks are made up of almost continuous outcrops of Cretaceous shale and the creeks with their steep V-shaped valleys also have many exposures of shale. Here there is no overburden to mask the radioactivity. Characteristically, the recorder showed high readings when the aircraft approached one of the banks of the river, then low readings when the aircraft passed over the river itself, and again high readings over the other bank.

The low readings over the central part of the area are due in part to muskeg and the numerous lakes which cover bedrock and cut off a part of the radioactivity that is evident over the river banks.

However, these phenomena do not appear adequate to explain all of the anomalies. For example, there are numerous high readings in the southern part of the area, a few in the south-central part of Permit 1069, and numerous high readings near the northern part of the area that are over parts covered by muskeg and numerous lakes. If the muskeg and lakes completely mask the

high readings in one part of the area it is to be expected that they should completely mask them in all parts, but this is not the case. Therefore there must be other reasons for the observed pattern.

A study of the regional geology suggests that the contact between the Devonian and the Lower Cretaceous rocks may be expected to cross Permit 1071 with a general strike of about 100 or 110 degrees. There are no outcrops on this permit but Devonian rocks were found a short distance to the north and Cretaceous rocks are exposed along the banks of small creeks to the south. A test flight was made along the banks of the Arctic Red River across this contact. The readings were comparatively low and uniform over the Devonian rocks but as the aircraft approached the contact there was a rather sudden jump in the radioactivity as indicated on the recorder and the number of counts per second fluctuated much more than in the first part of the flight. This continued for about seven miles along the river bank until the aircraft was flying over the marine shales of the Cretaceous. Here the readings were comparatively low and uniform.

A similar type of pattern may be observed over the northern part of the area covered by this survey. Readings over Permit 1071 and the northern part of Permit 1070 are relatively high and the amount of fluctuation is great. Readings over the southern part of Permit 1070 and over Permit 1069 are lower and the amount of fluctuation is less. Furthermore, the change from high readings to low readings takes place along a line that is about

parallel to the projected strike of the sediments.

Thus the scintillometer survey provides a check for the assumption made from geological mapping that the contact between Devonian and Lower Cretaceous strata crosses Permit 1071 and that the strike is somewhat south of east.

There are two large areas in which low readings were recorded. One is along the eastern side of Permit 1069 and the other is at the boundary between Permits 1067 and 1072.

The one on the east side of Permit 1069 is on muskeg which tends to mask the radioactivity. However, drainage here is better than in many parts where considerably higher readings were obtained. It is situated near the divide, some of the small streams flow to the east into the Ontaratue River, others flow to the west into the Arctic Red River.

The area of low readings at the boundary between Permits 1067 and 1072 is perhaps more impressive because it is surrounded on three sides by relatively high readings. It is covered by muskeg but has fewer lakes than the areas to the west and east where much higher readings were obtained. Therefore it is not possible to account for the low readings on the basis of masking effect of muskeg alone.

SUMMARY AND CONCLUSIONS

The results of the survey give a good check on the

surface geology. An area of high readings crosses the southwestern part of Permit 1071 and the northeastern part of Permit 1070. There are no outcrops here but, by projection, the Sans Sault formation consisting of interbedded shales, sandstones, and conglomerates is believed to underlie this area. A check flight along the Arctic Red River gives a similar pattern over the Sans Sault formation.

Relatively high readings in the extreme southwest corner of Permit 1067 suggest a change from the marine shales of the Slater River formation to interbedded sandstones and shales of Upper Cretaceous age.

Two areas of very low readings, one on the eastern edge of Permit 1069 and the other along the boundary between Permits 1067 and 1072, are indicated. It does not seem possible to explain these low readings on the basis of the masking effect of the muskeg alone. Therefore they would appear to be the areas of most interest from the point of view of finding oil.

A. G. Pentland

Alfred E. Allen

Vancouver, B. C.
September, 1958

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2

GEOPHYSICAL SURVEY

AIRBORNE SCINTILLOMETER

PERMITS 1067 · 1068 · 1069 · 1070 · 1071 · 1072

NORTHWEST TERRITORIES

TRUE NORTH

LEGEND

Flight Line.

Scintillometer Readings.

Permit Boundary

Counts per Second.

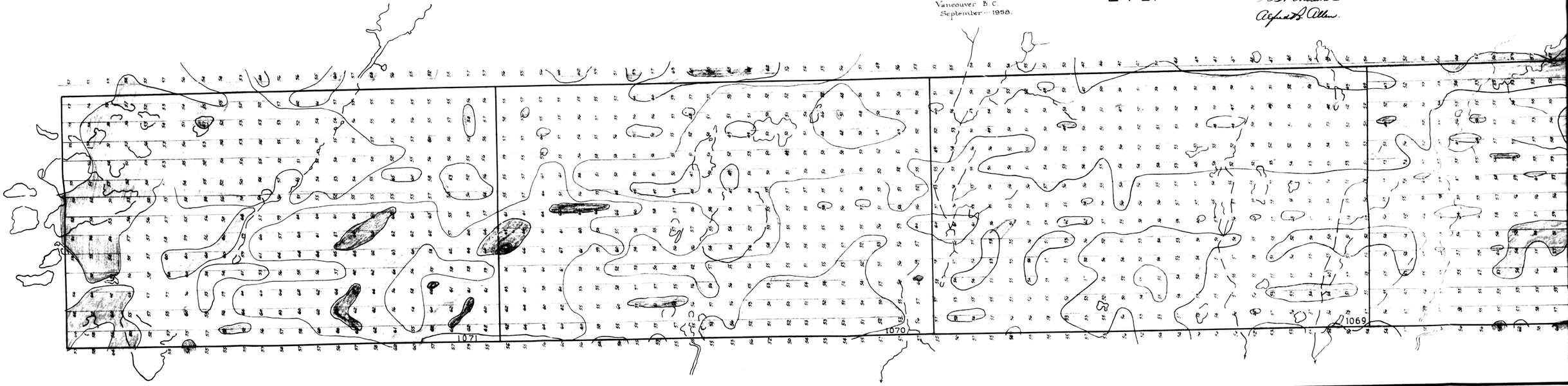
45-49	60-64
50-54	65-69
55-59	70-74

Scale: 1 inch = 1 mile

PENTLAND AND ALLEN
PETROLEUM CONSULTANTS
LTD.

Vancouver B.C.
September 1958.

W.H. Pentland
Alfred B. Allen.



GEOPHYSICAL SURVEY

AIRBORNE SCINTILLOMETER

PERMITS 1067 · 1068 · 1069 · 1070 · 1071 · 1072

NORTHWEST TERRITORIES

Scale: 1 inch = 1 mile

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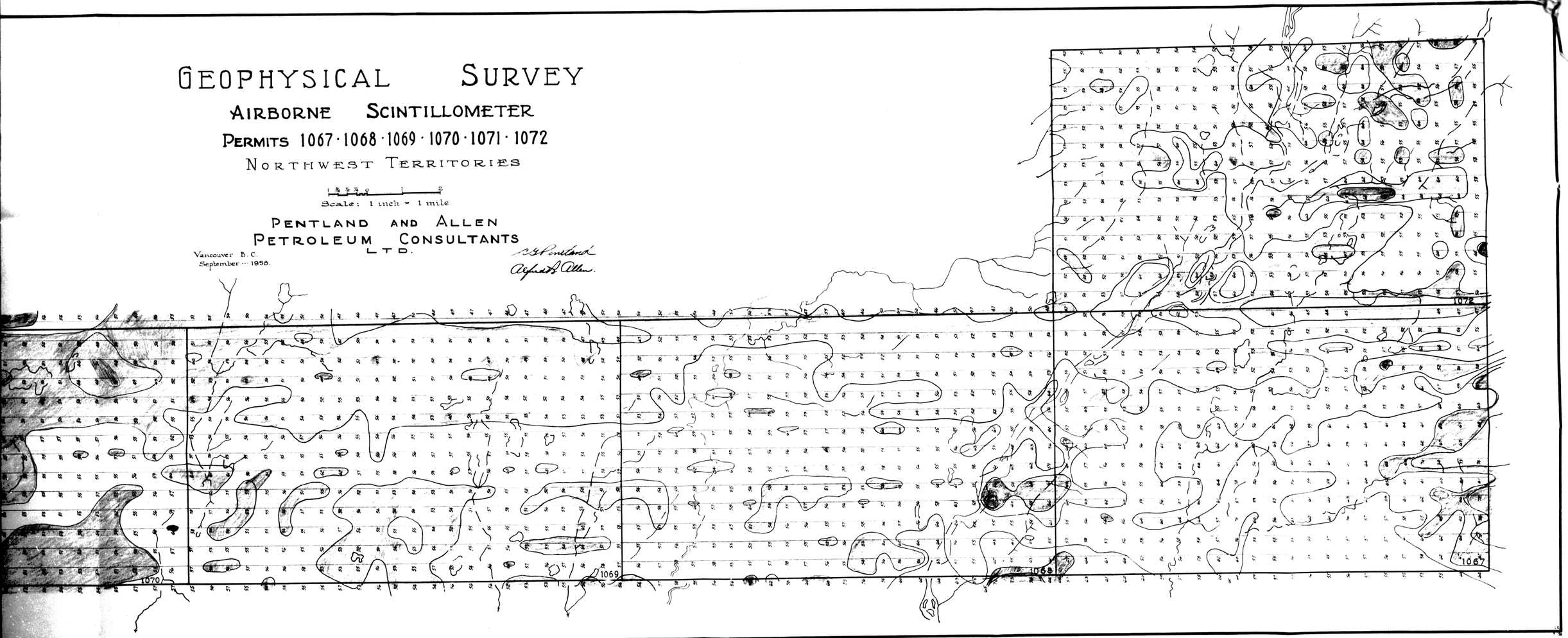


GEOPHYSICAL REPORT

PERMIT 1384

NORTHWEST TERRITORIES

By:

A. C. Pentland

and

Alfred R. Allen

Vancouver, B. C.

December, 19[illegible].

CONTENTS

GEOPHYSICAL REPORT

PERMIT 1384

NORTHWEST TERRITORIES

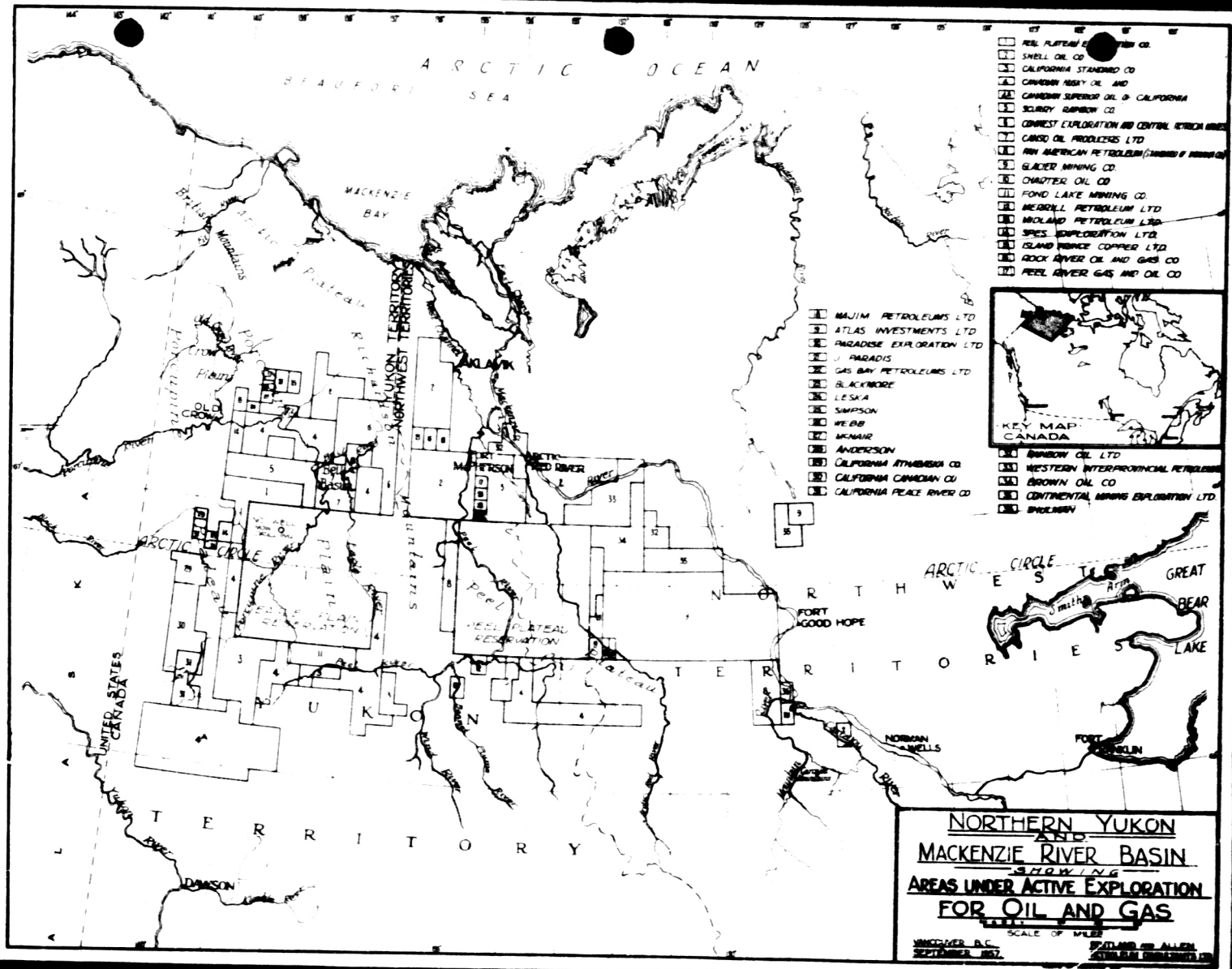
1. Introduction

An aerial scintillometer survey was made over Permit 1384 in July, 1958. The permit is covered with muskeg, a few small lakes, several small streams, and a large area of low swamp land on which there are a series of small sloughs and numerous small meandering creeks. There are few outcrops on or near the permit, but the general geology is evidenced by projection from the outcrops along the Peel River several miles to the west.

Lundberg Explorations Limited surveyed areas in Alberta, British Columbia, Saskatchewan, Quebec, Texas, New Mexico, Oklahoma and various other parts of the United States. Lundberg (1) found that radioactive lows generally are obtained over oil fields and that these lows are commonly surrounded by radioactivity slightly higher than normal. He states that variations in intensity may look rather erratic over broken topography, lakes, swamps, and river valleys, but that the lows above the oil fields may, as a rule, still be observed. He claims that his operations were extended into unknown territory and drill holes were put down on anomalies which looked promising with the result that new oil fields were found.

Other workers, for example Williams and Lerems (2) do not believe that the measurement of radioactivity is a direct method of finding oil but state that it is a tool that may be used to aid in the interpretation of subsurface geology.

In order to test the method under conditions as nearly like those



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

SCALE OF MILES

VANCOUVER B.C. SEPTEMBER 1957.

PORTLAND AND ALLEN PETROLEUM CONSULTANTS LTD.

on the permit as possible, a check was made over the oil field at Norman Wells. It was found that low readings were obtained over the oil pool and that relatively high readings were recorded over parts of the islands and mainland away from the oil pool. As a general rule, readings were low over the Mackenzie River itself.

2. Location and Ownership

Permit 1384 is 28 miles southeast of Fort McPherson and seven miles east of the Peel River. Location of the northeast corner is:

67° - 05' north and 134° - 30' west.

It is owned by Laburnum Enterprises Ltd., of 404-510 West Hastings Street, Vancouver 2, B. C.

3. Accessibility

Access to Fort McPherson is by aircraft throughout the year. During the summer months freight is transported on the Mackenzie and Peel Rivers by barge.

Canadian Pacific Airlines operates scheduled flights from Edmonton to Aklavik B 3 using C-46's. The distribution of passengers and air freight to the smaller centres such as Fort McPherson and Fort Good Hope is by Otter Aircraft. Aircraft are available for charter at Aklavik. Freight may be shipped by train during the summer from Edmonton to Waterways, thence by barge down the Athabaska River, through Lake Athabaska, down the Slave River and through Great Slave Lake, down the Mackenzie River, and thence up smaller rivers such as the Arctic Red, Peel and other main waterways. Heavy equipment may be transported by "cat train" over most of the north country during the winter months. Plans are being made for several main access roads as far as the Arctic Ocean in order to assist in the development of the natural resources of the Yukon and the western part of the Northwest Territories.

4. Climate and Vegetation

Spring break-up is usually in late May or early June. Freeze-up occurs between mid-September and late October. May, June and July are the summer months when there is almost continuous daylight and the weather is pleasantly warm. The sun is not seen during the months of November, December and January and during these winter months the temperature may drop to 60 degrees below zero for short periods of time. With lakes, river, swamps and muskeg frozen, transportation is active by "cat train" over the many winter roads. It is during this winter season that most of the drilling rigs will be moved and ground geophysical survey work done in the search for oil and gas.

Small scattered stands of stunted spruce, poplar, birch and tamarack grow on this muskeg-covered country. In some sheltered areas, usually along the banks of streams, the trees may reach diameters of 12 to 18 inches and heights of 30 to 40 feet.

5. 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.

6. Geology

Outcrops are numerous a few miles west of the permit on the banks of the Peel River. Cretaceous and the underlying Devonian rocks are exposed on the west side of a small lake between the Peel River and Permit 1427. The Upper Devonian Imperial formation is there composed of shale with sandstone interbeds up to one foot thick. The shale is grey to rusty brown and the sandstone light greenish grey with ripple marks. The Cretaceous rocks are massive buff-colored sandstone and fine-grained conglomerate, glauconitic and containing fossil wood and shells. The sandstone and conglomerate dip 5 degrees southwesterly. The attitude of the underlying shale and sandstone is unknown. Projected southeasterly to outcrops along the Arctic Red River, this contact passes through the southwest corner of permit 1427, about six miles north of Permit 1384.

It is evident, therefore, that Permit 1384 is underlain by a somewhat thin section of Cretaceous sandstone and conglomerate lying unconformably on Upper Devonian Imperial interbedded shale and sandstone.

The generalised geological section is as follows:

Table of Formations

Eocene		Imperfectly consolidated sands, clays, and conglomerates with lignite. Contains leaf and plant fragments.
	Erosional Unconformity	
Cretaceous	East Fork	Grey shales
	Little Bear -	Sandstones and shale with coal
	Blater - 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
	Kamperta	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.

7. Equipment and Methods

Equipment consisted of a Cessna 170-B aircraft fitted with a very sensitive gamma ray detector utilising the scintillation principle, an amplifier and a recorder synchronised to give a continuous record of all readings along each flight line.

Navigation was by means of Mosaics on the scale of one inch to one mile and standard maps on the scale of one inch to eight miles. Navigation was greatly simplified by the proximity to the large Peel River valley and the many lakes that can be seen from the aircraft for several miles. Also, the area had been flown several times previously, much of it covered on foot by the writers. When each recognisable feature was

crossed a mark was made on the recording tape to identify that particular landmark.

All flights were made during the late evening to midnight when flying conditions were uniform. Thus navigation along straight north-south lines, at a uniform altitude was accomplished with accuracy.

Flight lines were spaced one half mile apart.

Using readily identifiable topographic features the radioactive intensity graphs were sectioned at half-mile intervals. The average was then taken from each section and recorded in counts per second on a tracing paper overlay in the aerial mosaic. Thus a map was drawn showing only the flight lines and average readings in counts per second for each one half mile. Points of equal radioactivity were joined much the same as for the construction of a topographic map or isopatch. Intervals of five counts per second were used. The areas of "highs" and "lows" are clarified by coloring the map with the lowest readings in red and various intermediate readings in orange, yellow, and white, and the highest readings in blue, green and brown.

8. Interpretation of Results

There is little or no relief in the area and it is covered with muskeg, lakes and streams. Scintillometer readings, averaged for each half mile of flight lines, range from 35 to 70 counts per second.

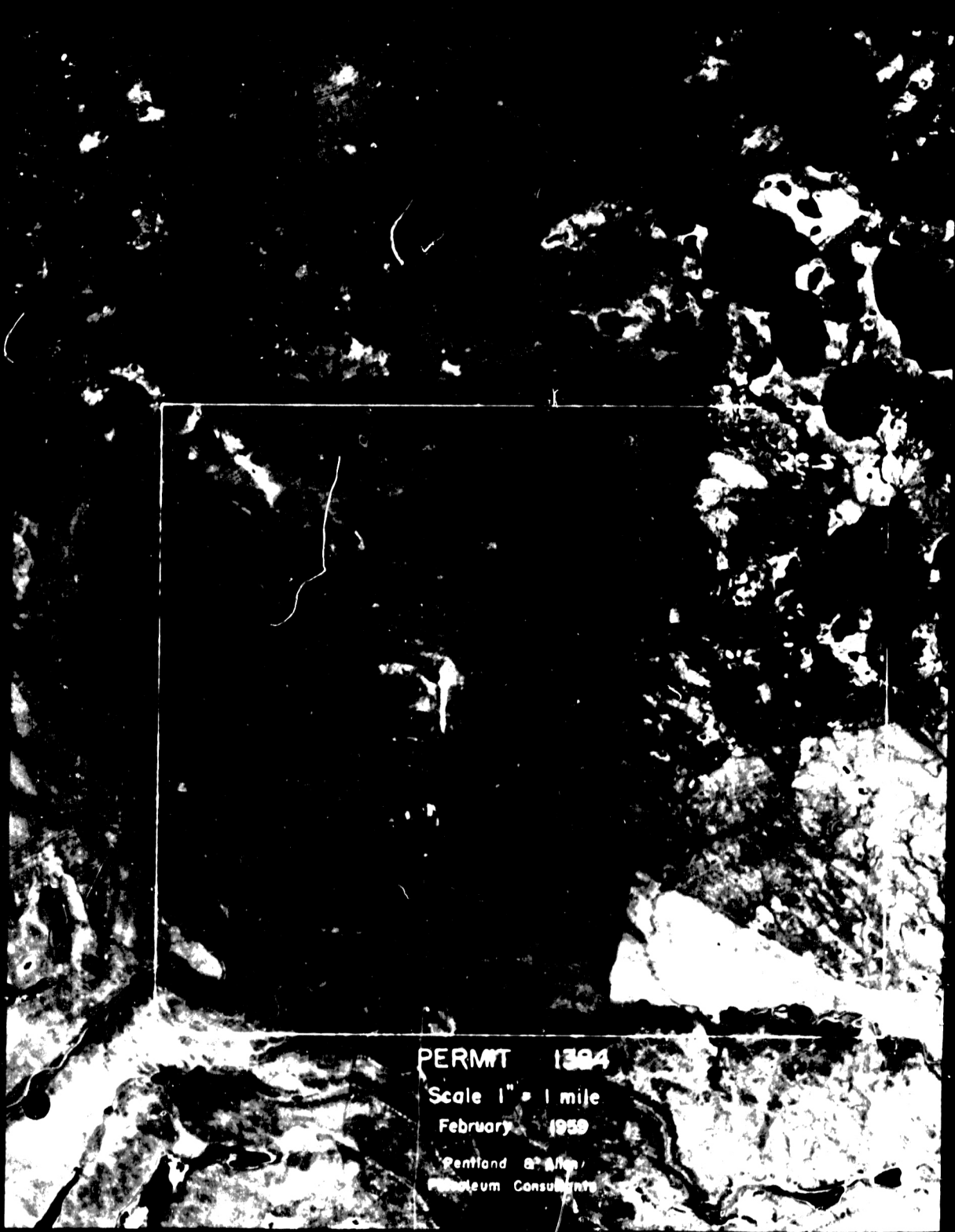
Low readings were recorded over swampy and water-covered areas. High readings were recorded near the northwest and southeast corners of the permit over rim-rocks and areas of light overburden along the edges of stream valleys. Hence a comparison of geophysical results, with surface features on the permit, suggest that the former has been controlled by the latter. It is concluded, therefore, that the aerial scintillometer

survey did not supply any useful information pertaining to the geology of permit 1384.

A. C. Pentland, P.Eng.

Alfred R. Allen, P.Eng.

Vancouver, B. C.
December, 1958.


PERMIT 1394
Scale 1" = 1 mile
February 1959
Pentland & Allen
Petroleum Consultants

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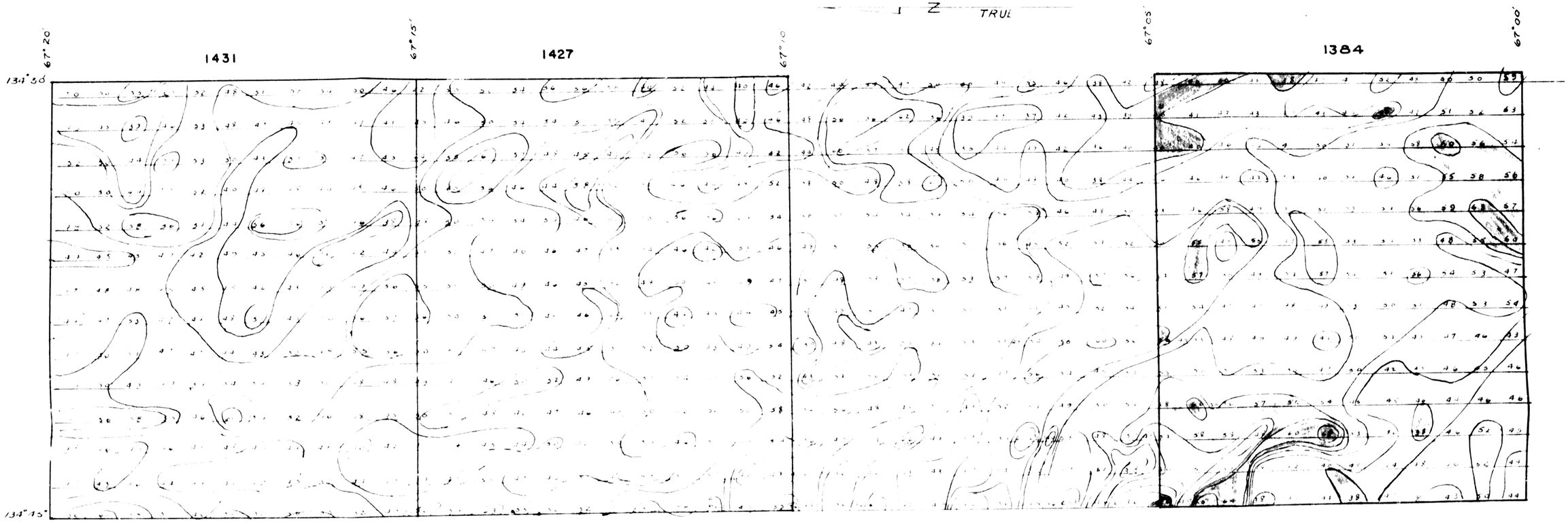

Flight Line

Scintillometer Readings

Permit Boundary

Counts per Second

30	55-60
35-40	60-65
40-45	65-70
45-50	70
50-55	

AIRBORNE SCINTILLOMETER SURVEY

PERMITS 1384, 1427 & 1431

NORTHWEST TERRITORIES

SCALE 1 INCH = 1 MILE

DECEMBER 1958

PENTLAND & ALLEN PETROLEUM CONSULTANTS LTD

A.G. Pentland

Alfred B. Allen