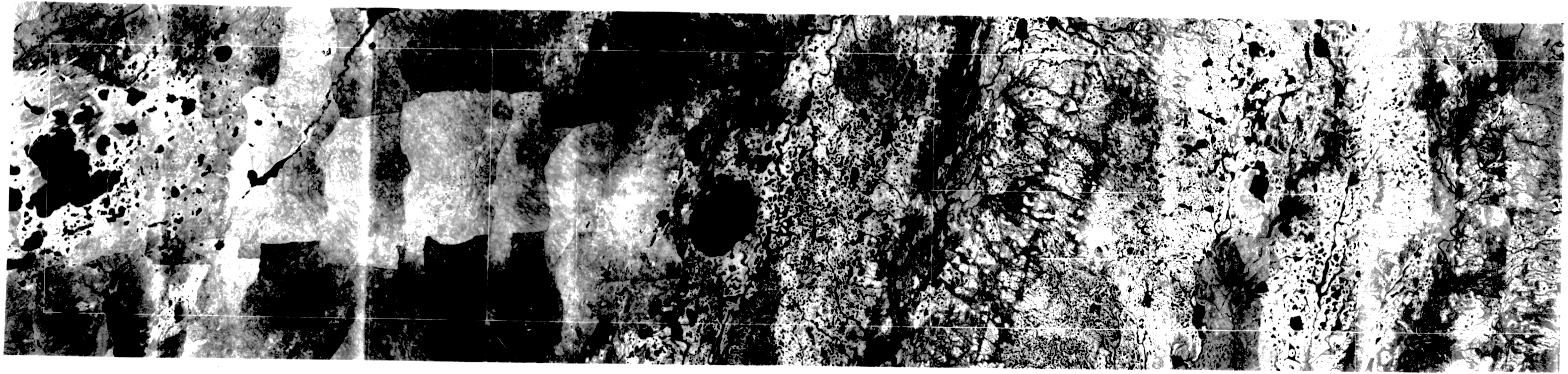

PERMITS
1067, 1068, 1069[redacted], 1070, 1071, 1072
Scale 1" = 1 mile
September 1958
Pentland & Allen
Petroleum Consultants



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GEOPHYSICAL REPORT

PERMITS

1067, 1068, 1069, 1070, 1071, 1072

NORTHWEST TERRITORIES

By:

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and

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Vancouver, B. C.

September, 1958

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GEOPHYSICAL REPORT

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 radio-activity 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.

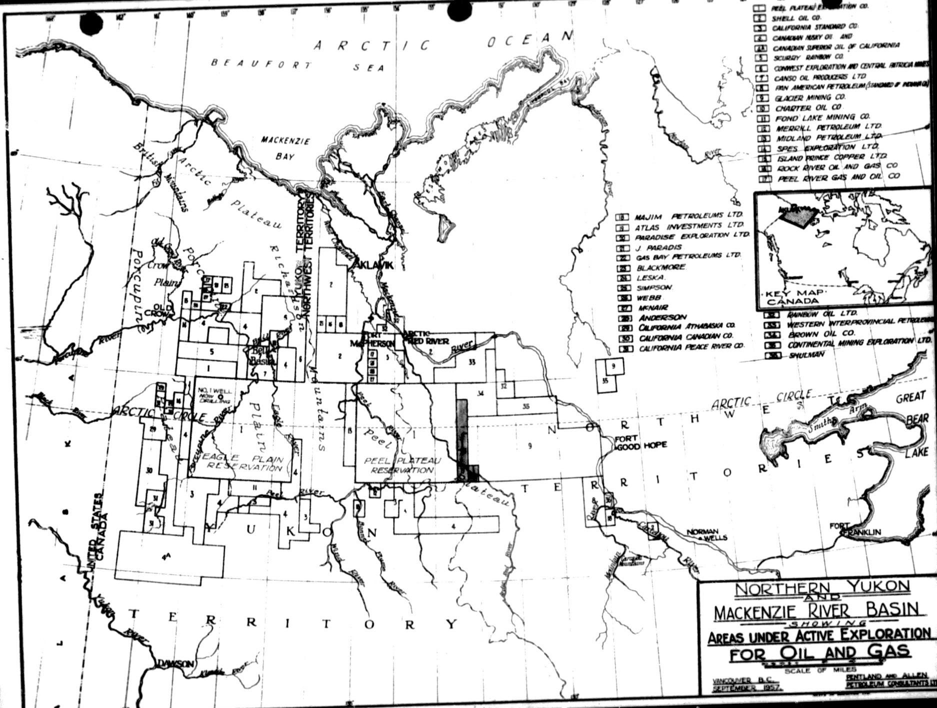
LOCATION

The permits are 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° 50'	132° 15'
Permit 1072	66° 10'	132° 00'

OWNERSHIP

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


ARCTIC OCEAN
BEAUFORT SEA
MACKENZIE BAY
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.
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
18 MAJIM PETROLEUMS LTD.
19 ATLAS INVESTMENTS LTD.
20 PARADISE EXPLORATION LTD.
21 J. PARADIS
22 GAS BAY PETROLEUMS LTD.
23 BLACKMORE.
24 LESKA.
25 SIMPSON.
26 WEBB.
27 McNAIR
28 ANDERSON
29 CALIFORNIA ATHABASKA CO.
30 CALIFORNIA CANADIAN CO.
31 CALIFORNIA PEACE RIVER CO.
32 RAINBOW OIL LTD.
33 WESTERN INTERPROVINCIAL PETROLEUM
34 BROWN OIL CO.
35 CONTINENTAL MINING EXPLORATION LTD.
36 SHULMAN
KEY MAP CANADA
British Arctic Mountains
Arctic Plateau
Porcupine Plateau
Old Crow Plain
Porcupine River
OLD CROW
Richardson Mountains
YUKON TERRITORY
NORTHWEST TERRITORIES
AKLAVIK
FORT McPHERSON
ARCTIC RED RIVER
Bell Basin
NO. 1 WELL NOW DRILLING
Eagle Plain
EAGLE PLAIN RESERVATION
PEEL PLATEAU RESERVATION
Peel Plateau
Peel River
Mackenzie
ARCTIC CIRCLE
FORT GOOD HOPE
NORTHWEST TERRITORIES
GREAT BEAR LAKE
Smith Arm
NORMAN WELLS
FORT FRANKLIN
UNITED STATES
CANADA
YUKON TERRITORY
DAWSON
Yukon River
Klondike River
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

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 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 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.
		Erosional Disconformity
Silurian	Ronning group	Limestone with chert
Ordovician Cambrian	Macdougal group	Argillites and shales 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 Gastroplites liardense.

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 utilizing 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 recognized 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 recognizable 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 characterized 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.

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A. G. Pentland

Alfred R. Allen

Alfred R. Allen

Vancouver, B. C.
September, 1958

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REPORT ON THE GEOLOGY

PERMITS 1069, 1070, 1071

NORTHWEST TERRITORIES

By:

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and

Alfred R. Allen

Vancouver, B. C.

July, 1958

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Report on the Geology

Permits 1069E, 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 Athabaska 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 Peel Plateau Reservation, east of the Arctic Red River, as follows:

1069E	Northeast Corner at	66° - 30': 132°-15'
1070	Northeast Corner at	66° - 40': 132°-15'
1071	Northeast Corner at	66° - 50': 132°-15'

Norman Wells is 180 miles to the southeast.

OWNERSHIP

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

The total area of the permits is 127,793 acres.

ACCESSIBILITY

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 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 property 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 types 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. S. Allen and A. [illegible] 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 [illegible] area 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. McKinnon (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 softer 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 12 miles east of permit 1071. Also, it has been mapped in the upper parts of the Arctic Red River and the 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 Cretaceous 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 ironstone concretions. Typically, it contains many thin bands of bentonite 1/3 to 1 inch thick. The Little Bear formation consists of sandstone, some conglomerate, sandy shales, and coal seams. The East Fork formation directly overlies the sandstone 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 1069E, 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 ironstone 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	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 slaty 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		[illegible]
Cambrian	[illegible] Group	Limestones, greenish, grey, and black shales, sandstones, gypsum, etc.
Precambrian and/or earlier	[illegible] Group	Interbedded quartzite and slate, [illegible]

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 ironstone 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 gray. 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 *Gastroplites liardense*.

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 dya (?) identified by C. R. Stelck (8). The siphuncle tubes (?) are about the size of a man's fore-finger, all vertical, roughly ringed and marked with fine lines on the surface, but without internal structure. The inter-bedded 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 1069E. 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 1069E, 1070, and 1071.

A. G. Pentland

Alfred R. Allen

Vancouver, B. C.
July, 1958

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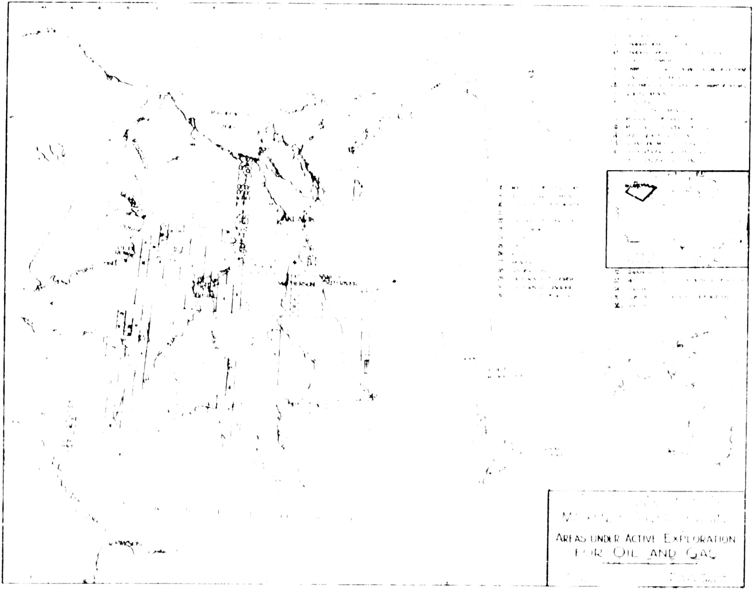
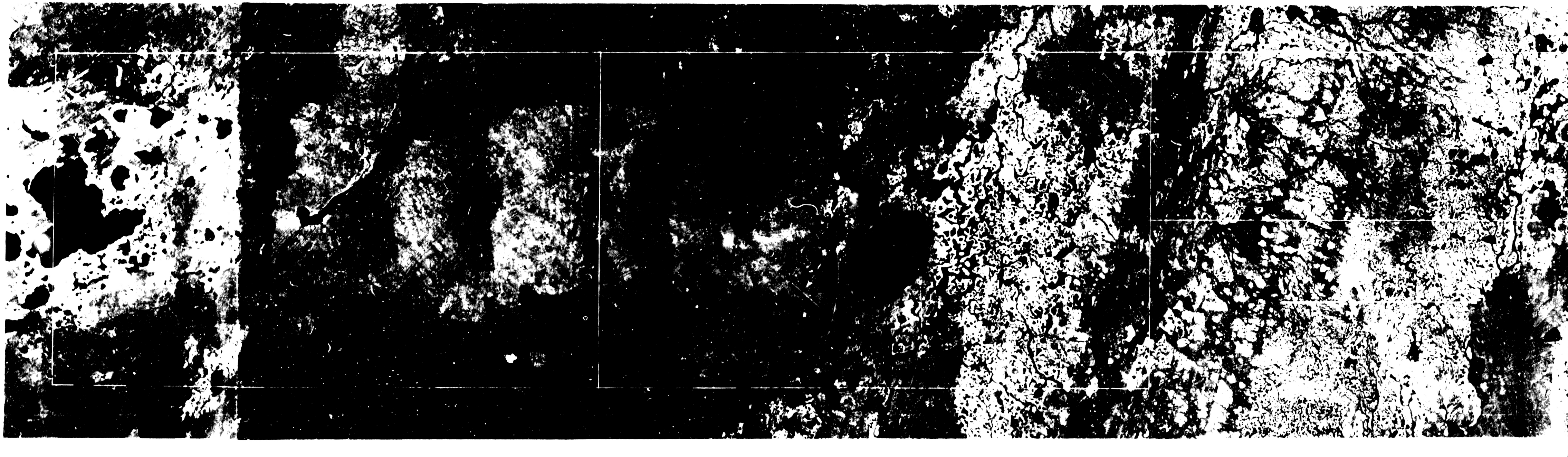
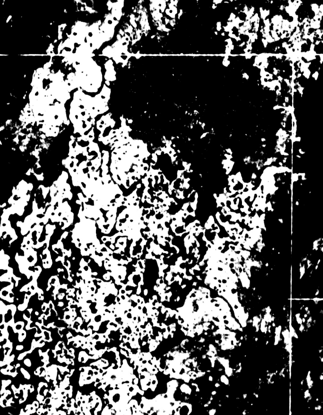
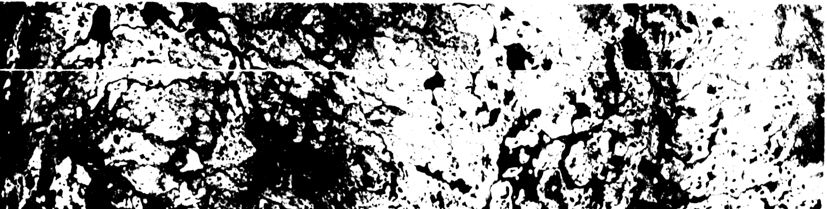
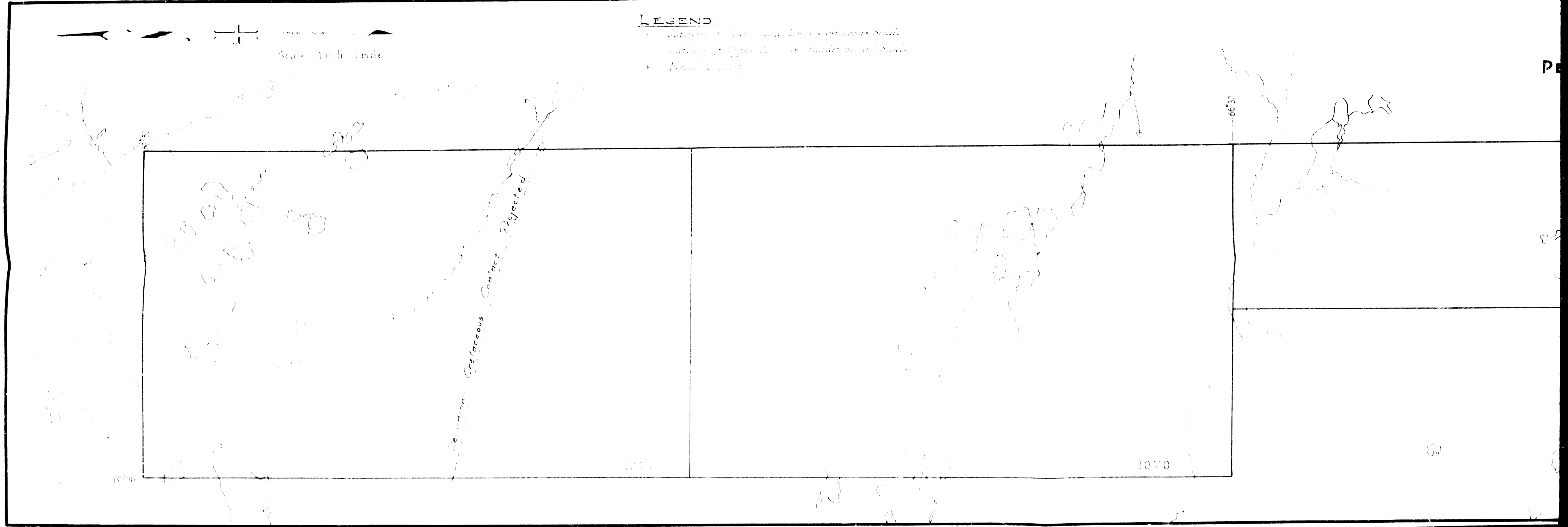
(9) Stewart, J. S.: Geological Survey Paper 45-29.


AREAS UNDER ACTIVE EXPLORATION
FOR OIL AND GAS







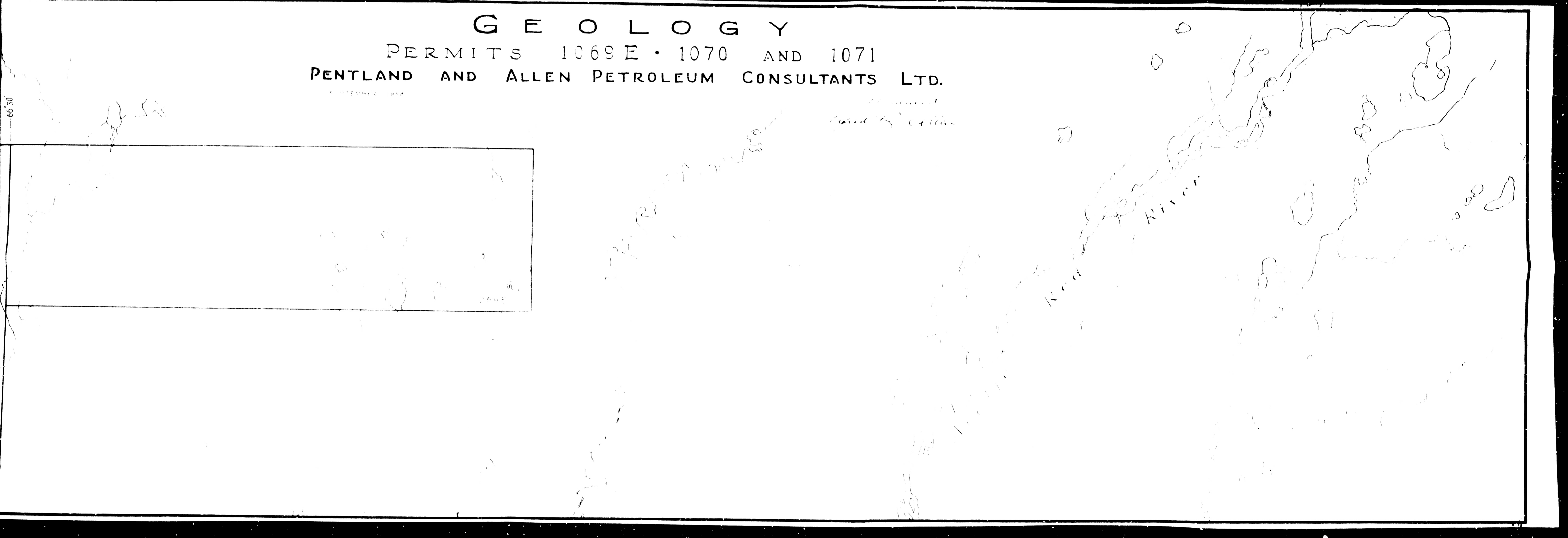


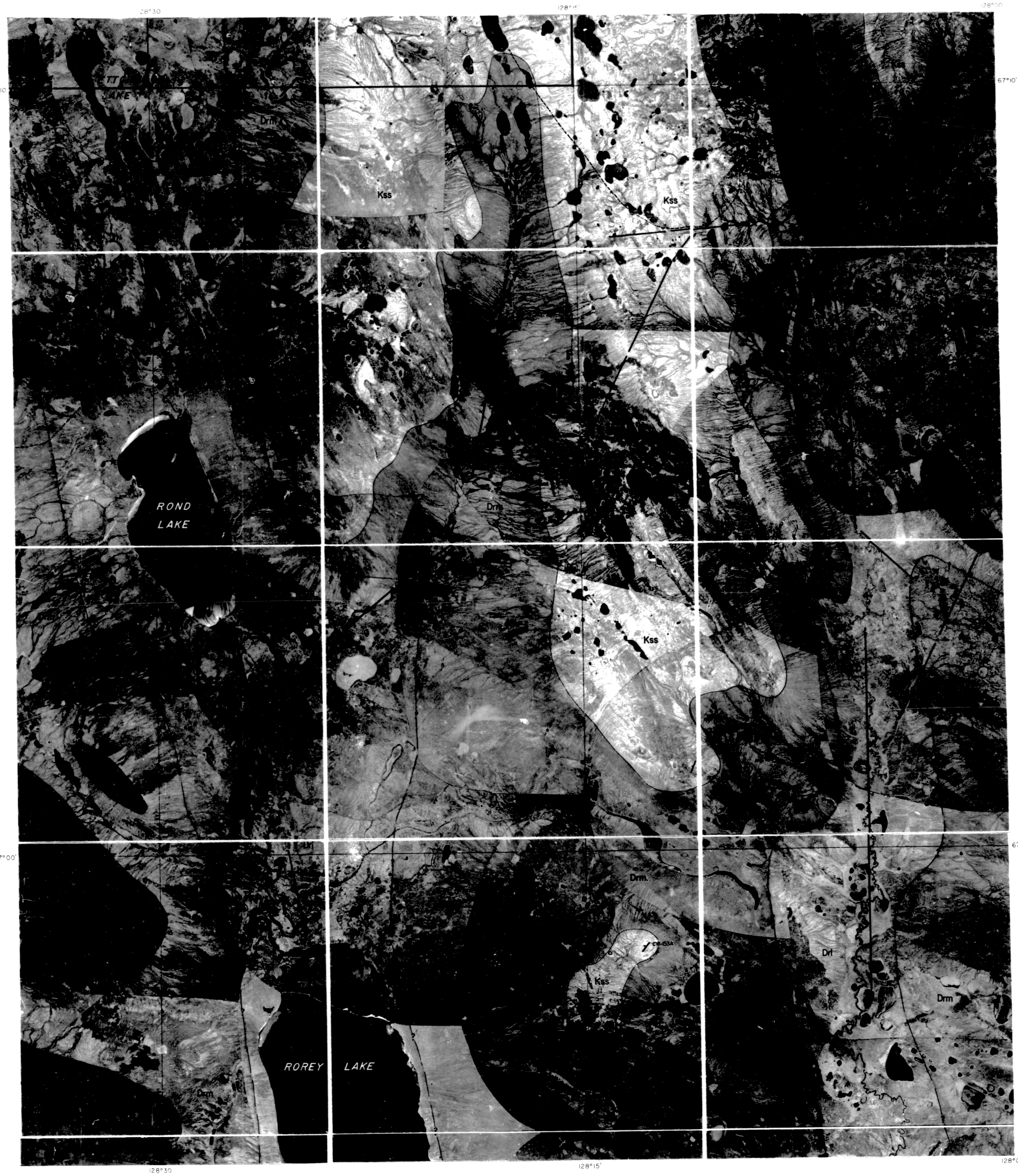
LEGEND
Scale 1 inch = 1 mile
Cretaceous Contact Projected
66°30'
1070

GEOLOGY

PERMITS 1069E · 1070 AND 1071

PENTLAND AND ALLEN PETROLEUM CONSULTANTS LTD.





INDEX MAP

LEGEND

TOPOGRAPHICAL

GEOLOGICAL

MISCELLANEOUS

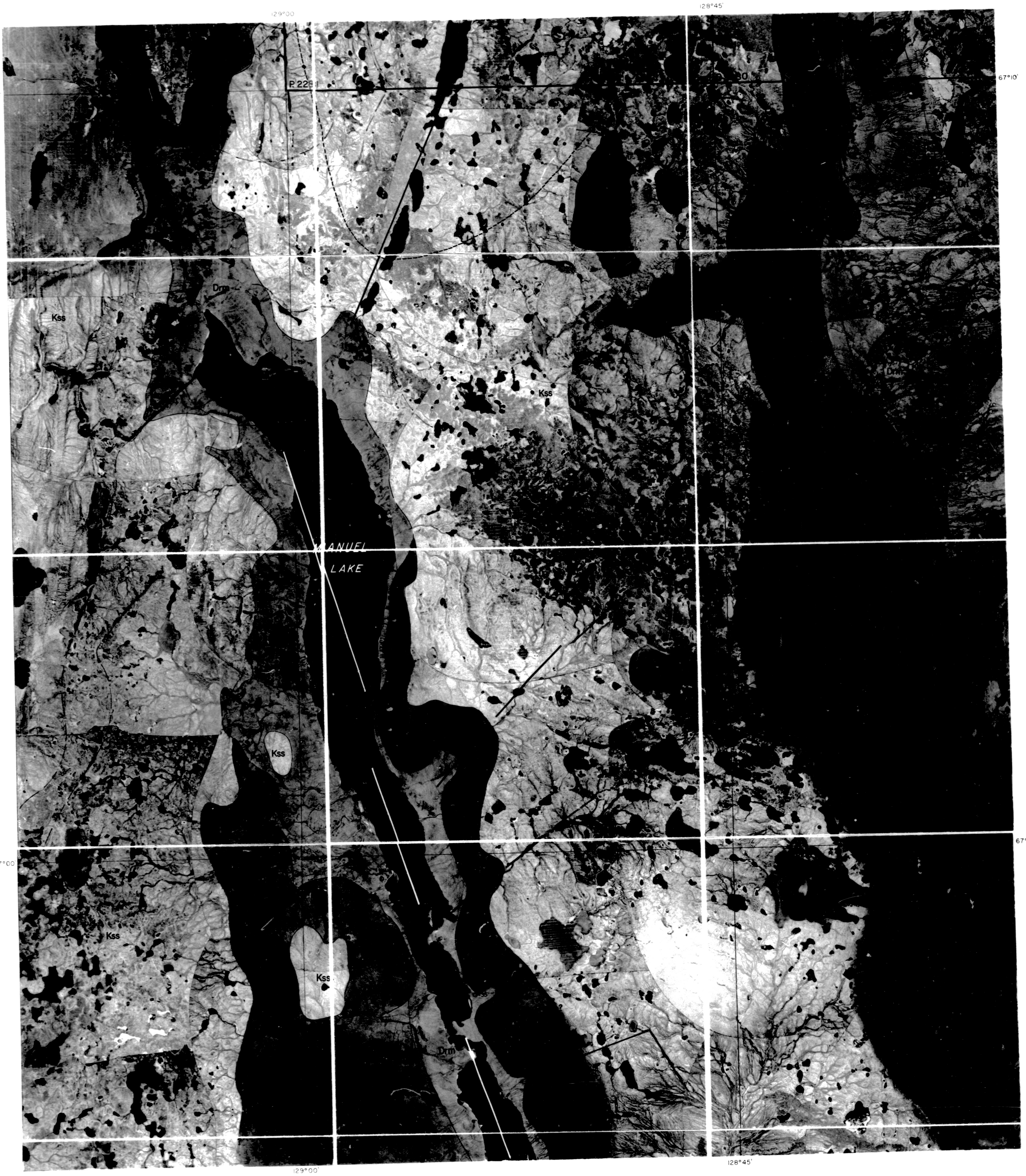
PHOTOGEOLOGICAL

PHOTOGEOLOGICAL MOSAIC

CANOT LAKE AREA

NORTHWEST TERRITORIES

J.H. HIRSHHORN ENTERPRISES



INDEX MAP

LEGEND

TOPOGRAPHICAL

1 Bush
2 Lake
3 Muskeg
4 River

GEOLOGICAL

CRETACEOUS
K — Undifferentiated
Ksh — Shale
Kss — Basal Sandstone

MIDDLE DEVONIAN
Ramparts Formation
Upper Ramparts Member
Drm — Middle Ramparts Member (may include Shale equivalent of Upper Ramparts)
Drl — Lower Ramparts Member

Geological Boundary (observed)
Geological Boundary (conjectural)
Geological Boundary (suggested)
Bedding (inclined, horizontal)
Apparent Direction of Dip
Outcrop Location
Fault (triangle indicates direction of dip)
Anticlinal Axis
Synclinal Axis

MISCELLANEOUS

P&NG Permit Number and Outline
24A — Photograph Point Number and Direction Taken

PHOTOGEOLOGICAL

Bedding Attitude
Indicated Fault Trends
Areas of Indicated High Structural Relief
Glacial Lineation and Direction of Ice Movement
Northern Limits of Pitted Moraine

PHOTOGEOLOGICAL MOSAIC

CANOT LAKE AREA

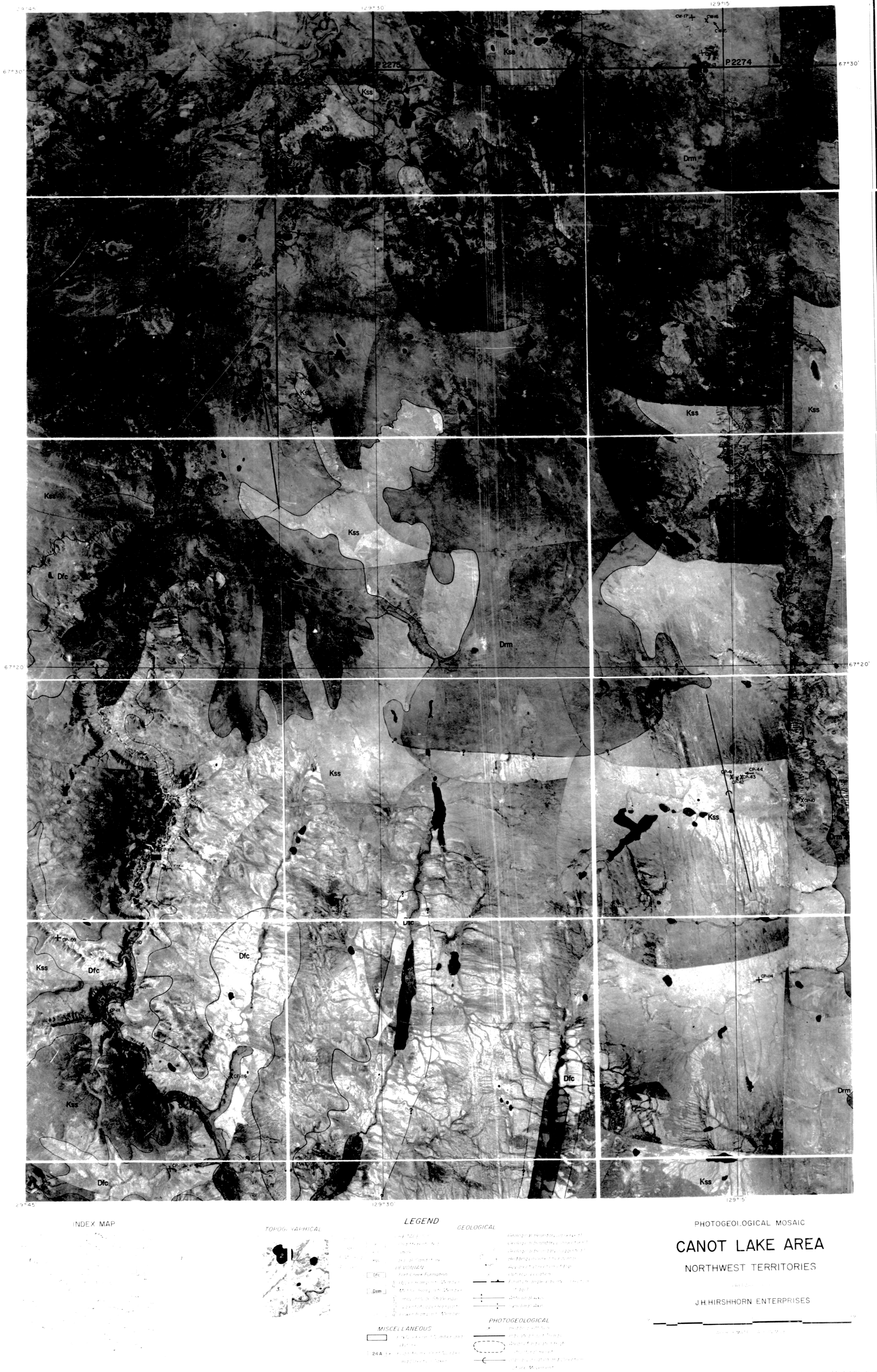
NORTHWEST TERRITORIES

PREPARED FOR

J.H.HIRSHHORN ENTERPRISES

APPROXIMATE SCALE IN MILES

SHEET No 2

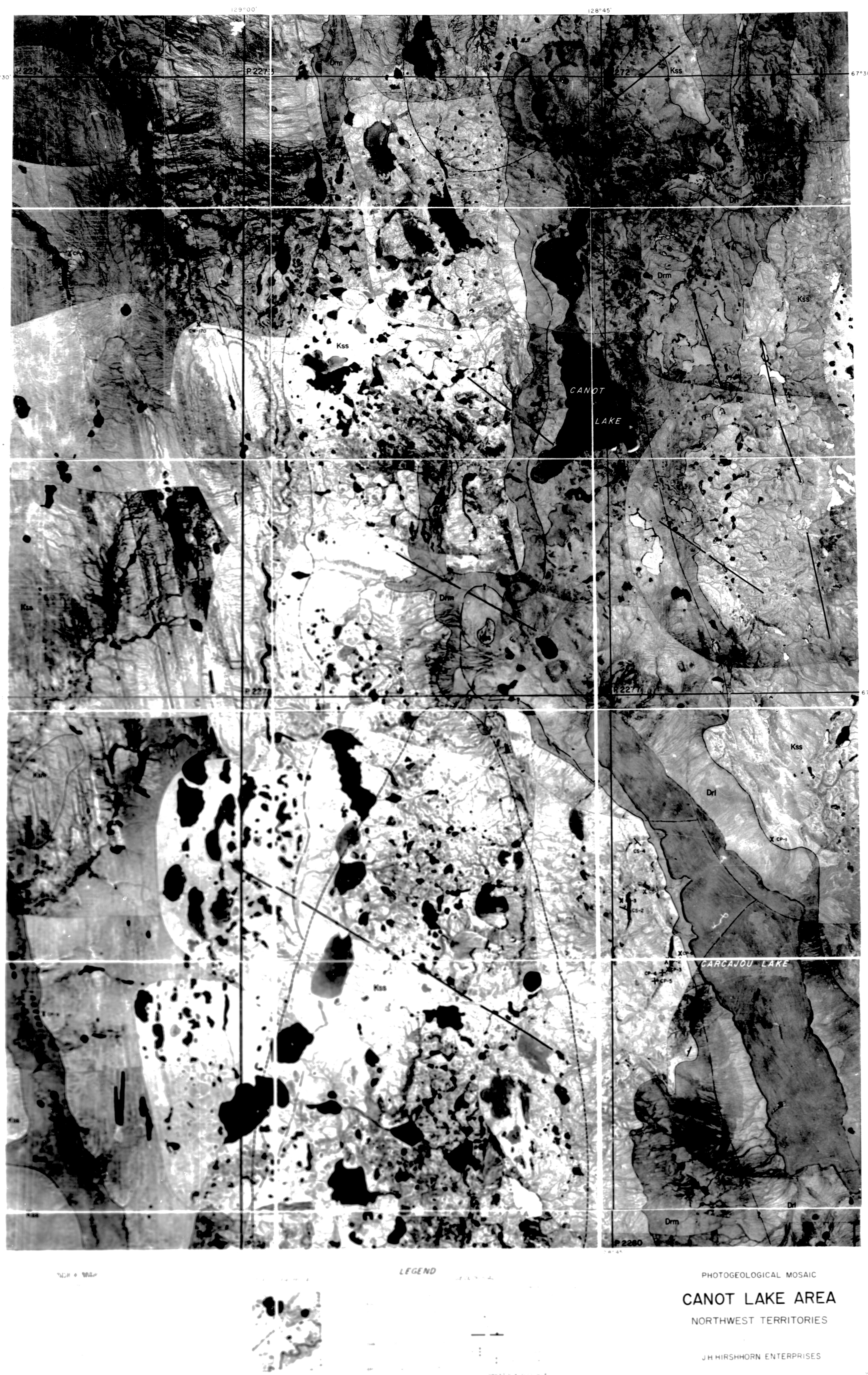


PHOTOGEOLOGICAL MOSAIC

CANOT LAKE AREA

NORTHWEST TERRITORIES

J.H.HIRSHHORN ENTERPRISES

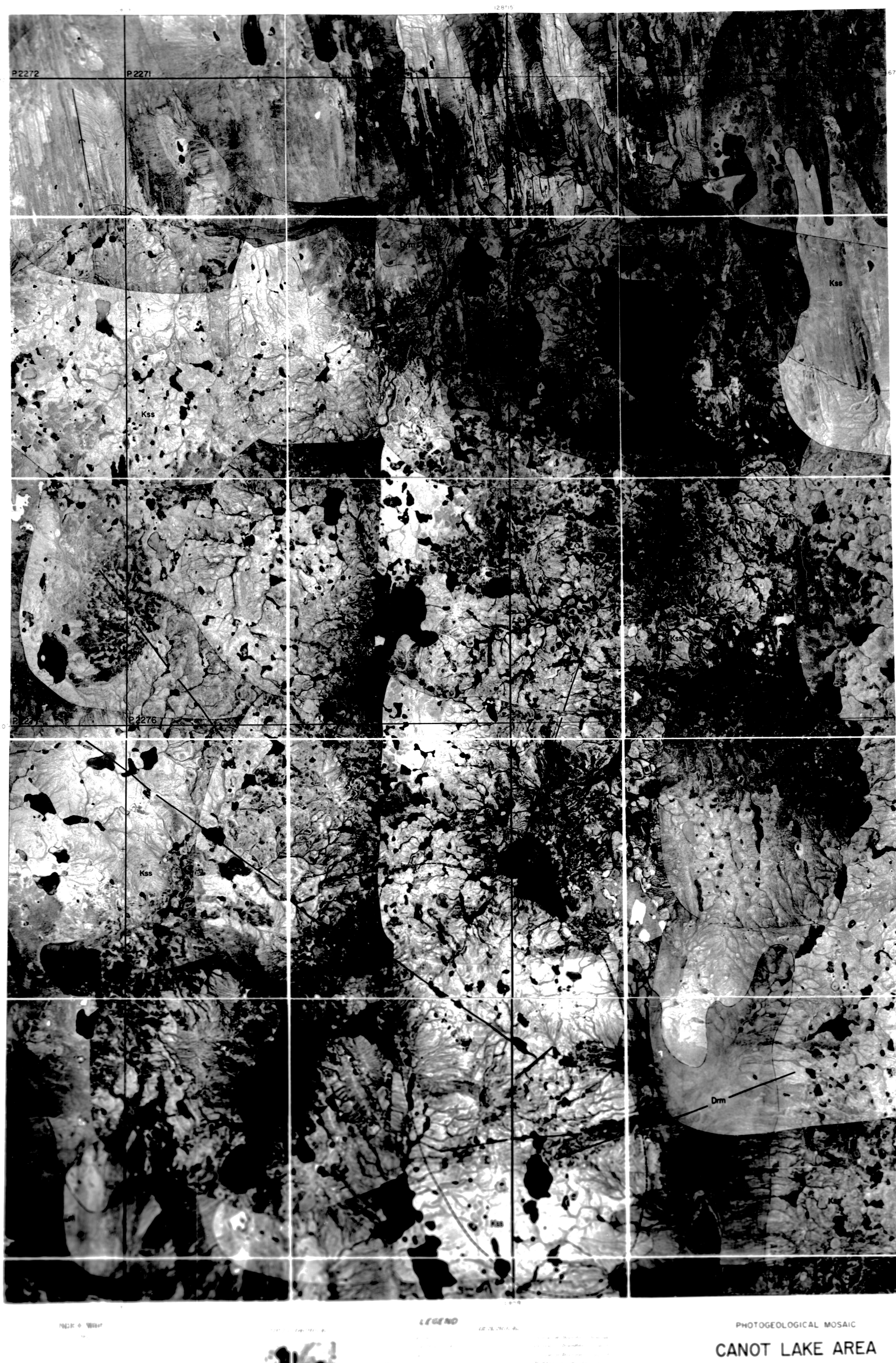


PHOTOGEOLOGICAL MOSAIC

CANOT LAKE AREA

NORTHWEST TERRITORIES

J.H. HIRSHHORN ENTERPRISES



PHOTOGEOLOGICAL MOSAIC

CANOT LAKE AREA

NORTHWEST TERRITORIES

J.H. HIRSHHORN ENTERPRISES

INDEX MAP

TOPOGRAPHICAL

LEGEND

GEOLOGICAL

Drm

Drl

MISCELLANEOUS

24A

PHOTOGEOLOGICAL

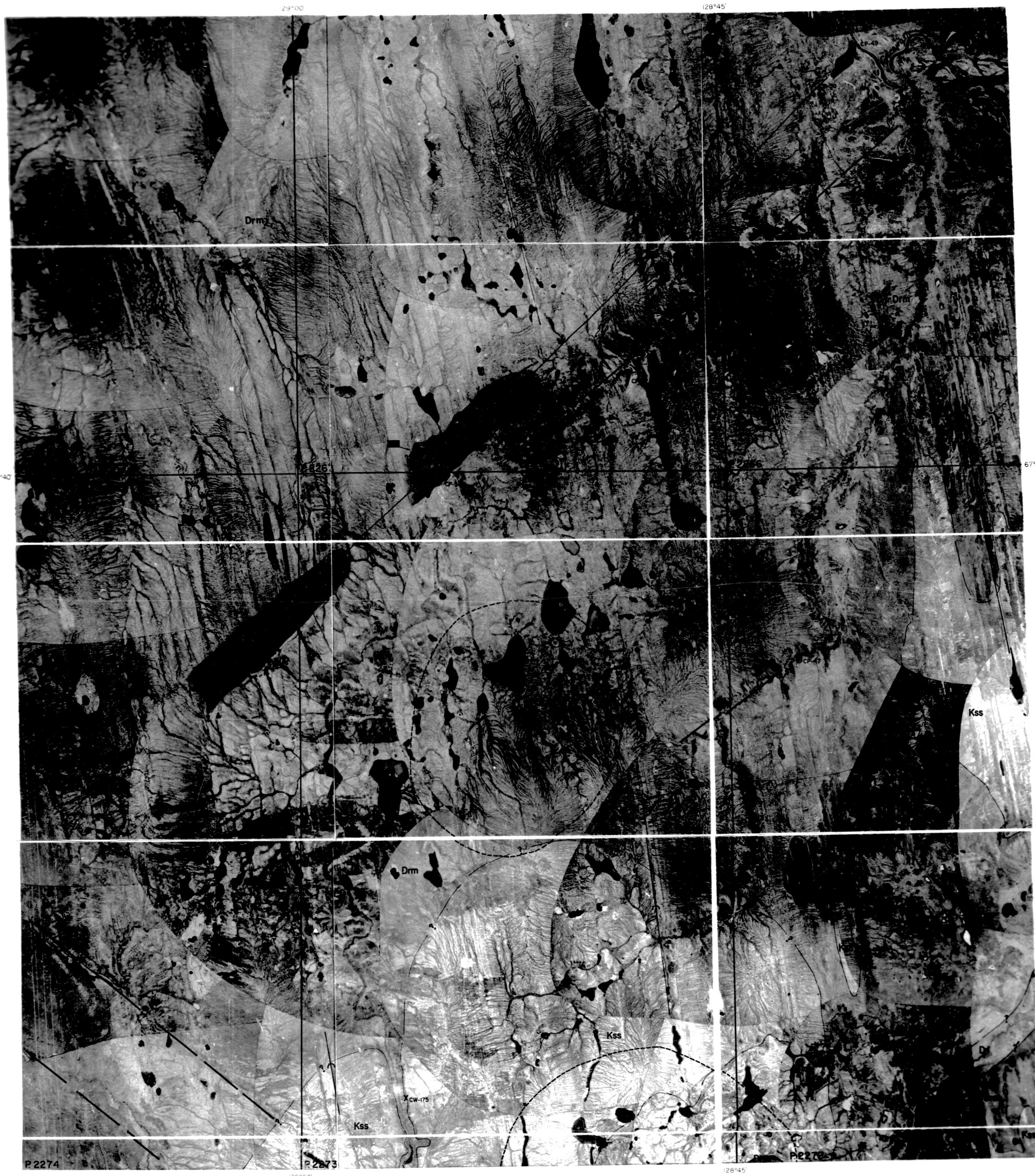
PHOTOGEOLOGICAL MOSAIC

CANOT LAKE AREA

NORTHWEST TERRITORIES

J.H. HIRSHHORN ENTERPRISES

SHEET Nº 6



INDEX MAP

LEGEND

TOPOGRAPHICAL

GEOLOGICAL

Drm

Drl

MISCELLANEOUS

24A

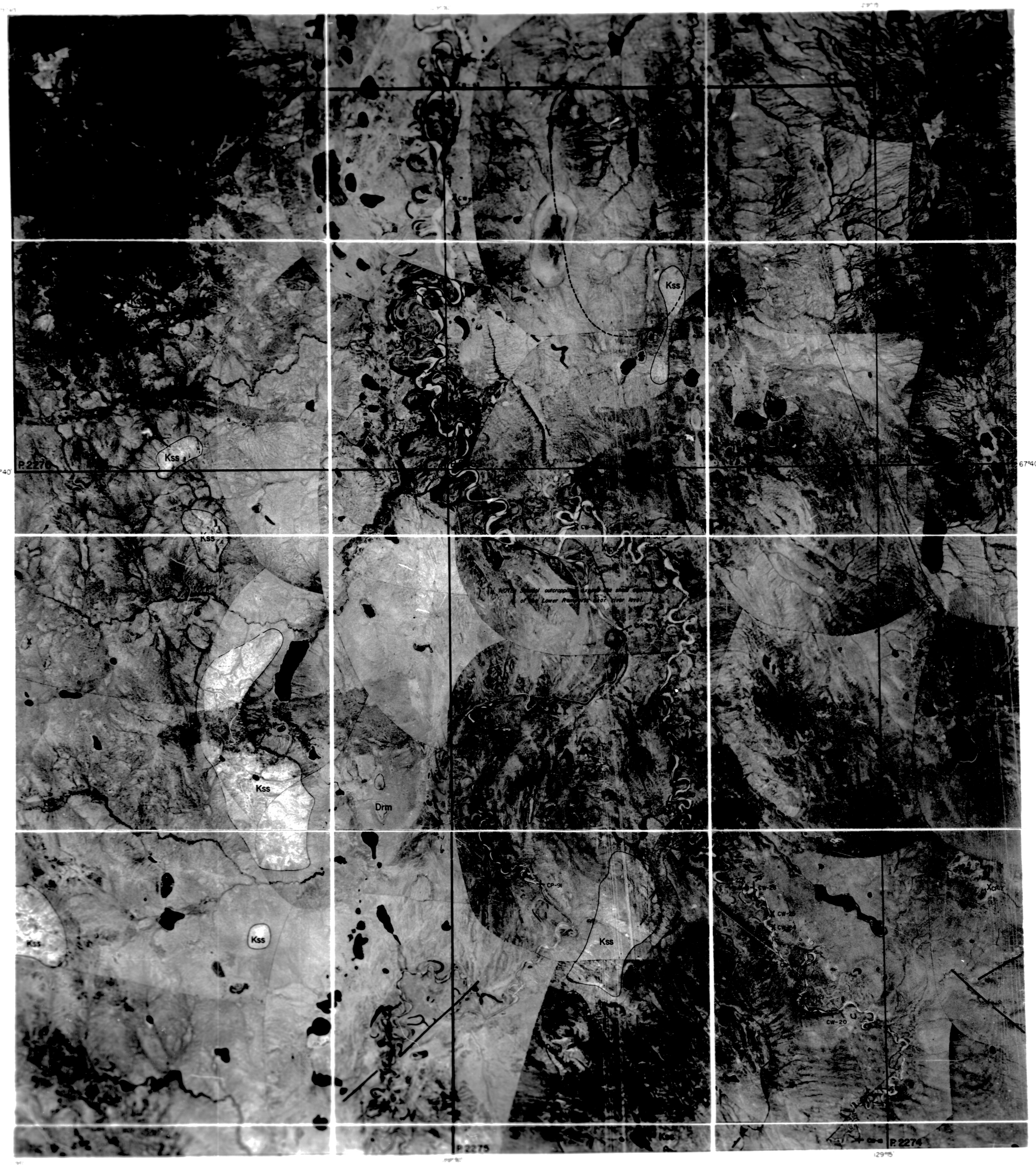
PHOTOGEOLOGICAL

PHOTOGEOLOGICAL MOSAIC

CANOT LAKE AREA

NORTHWEST TERRITORIES

J.H. HIRSHHORN ENTERPRISES



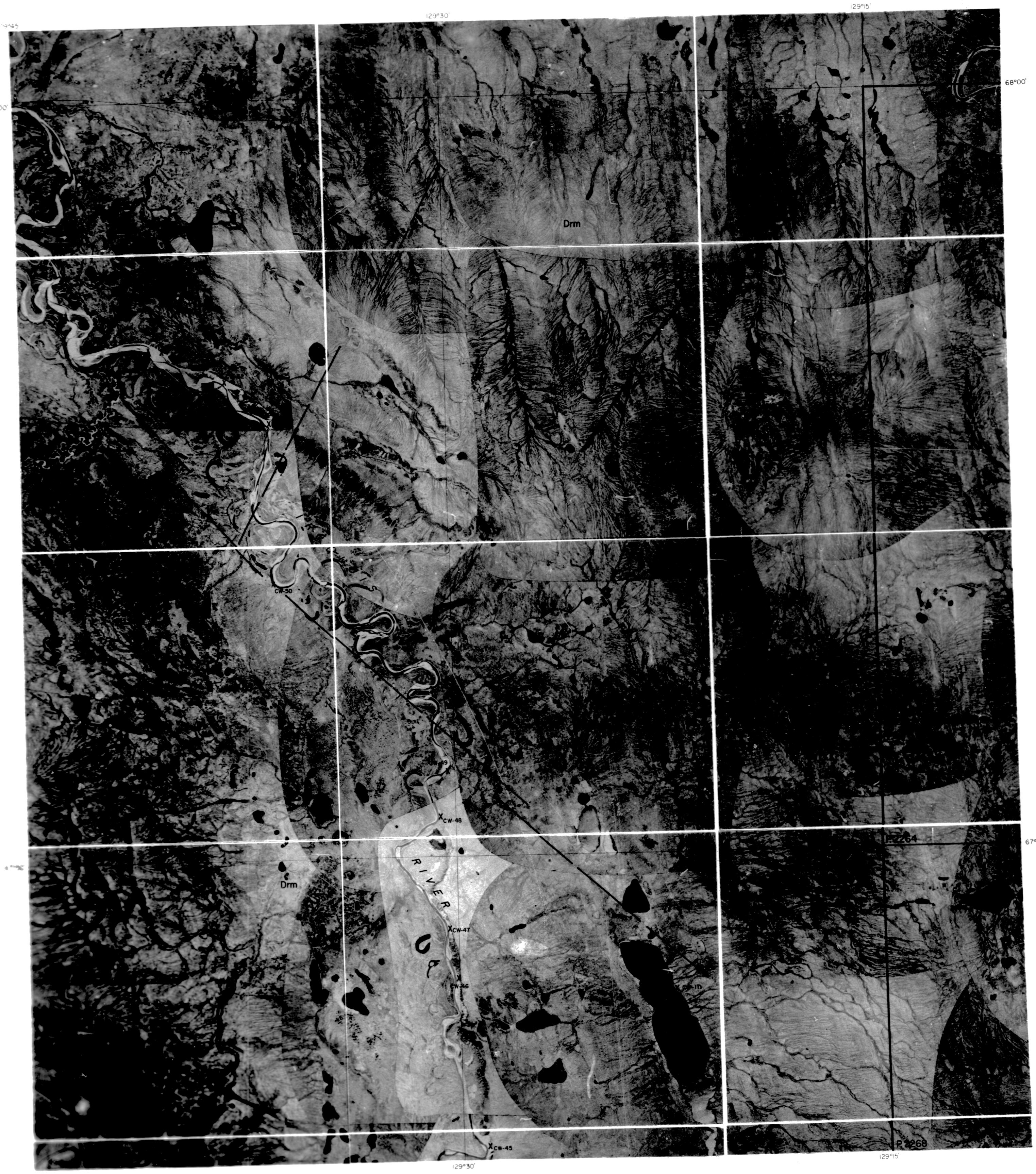
LEGEND

PHOTOGEOLOGICAL MOSAIC

CANOT LAKE AREA

NORTHWEST TERRITORIES

J.H. HIRSHHORN ENTERPRISES



PHOTOGEOLOGICAL MOSAIC

CANOT LAKE AREA

NORTHWEST TERRITORIES

J.H.HIRSHHORN ENTERPRISES

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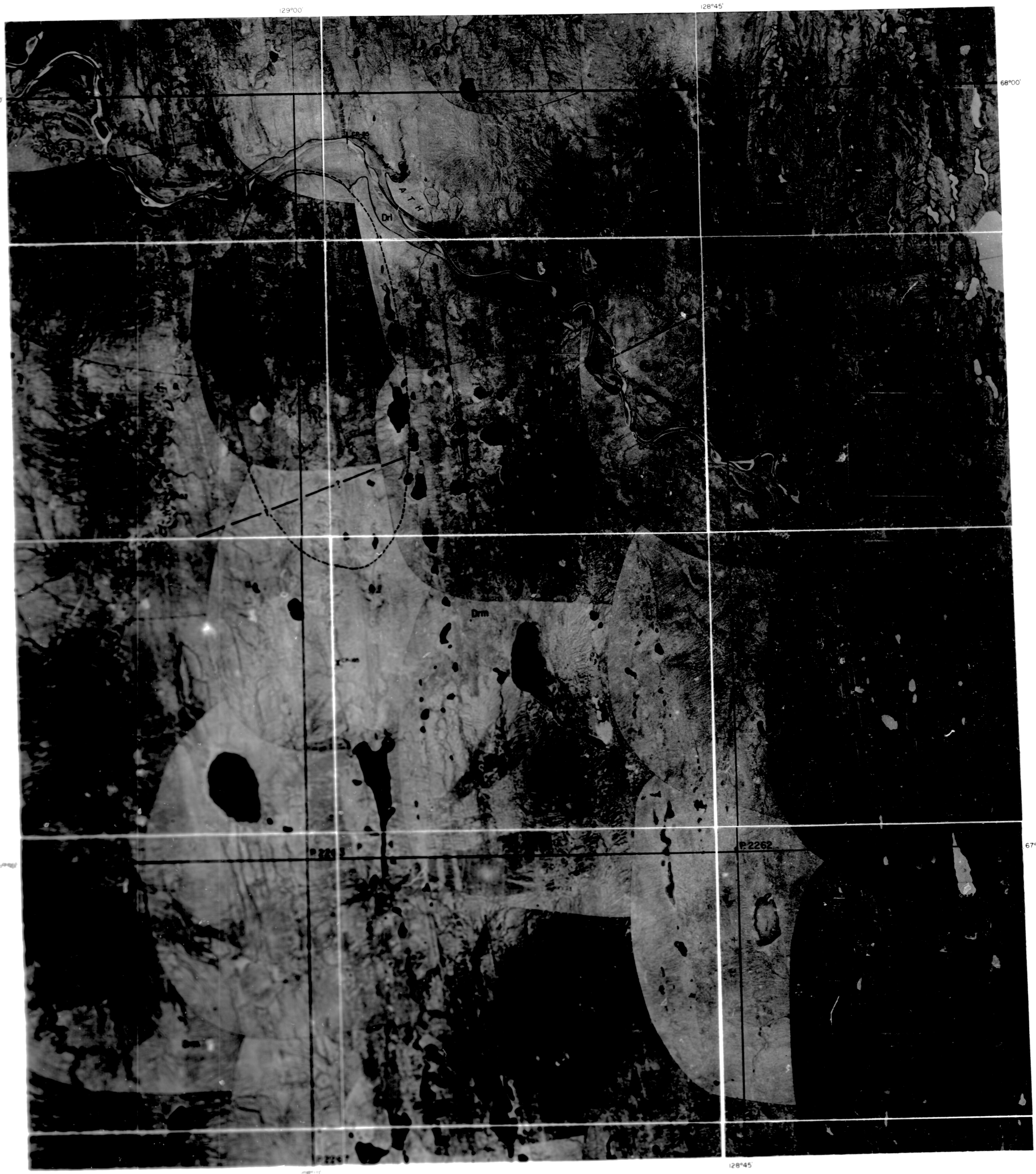
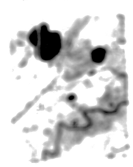


LEGEND

GEOLOGICAL

PHOTOGEOLOGICAL



PHOTOGEOLOGICAL MOSAIC

CANOT LAKE AREA

NORTHWEST TERRITORIES

J.H. HIRSHHORN ENTERPRISES

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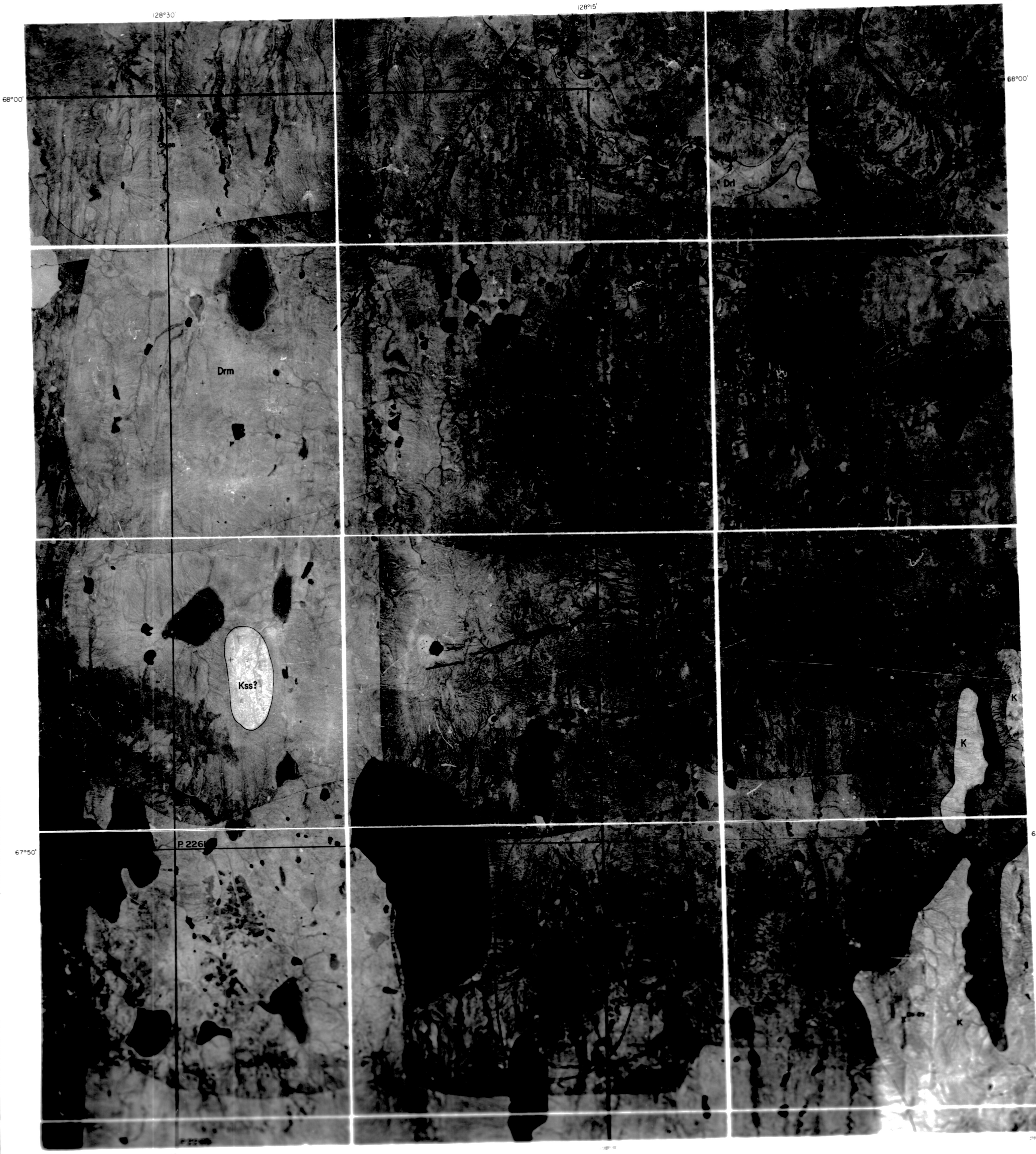


LEGEND

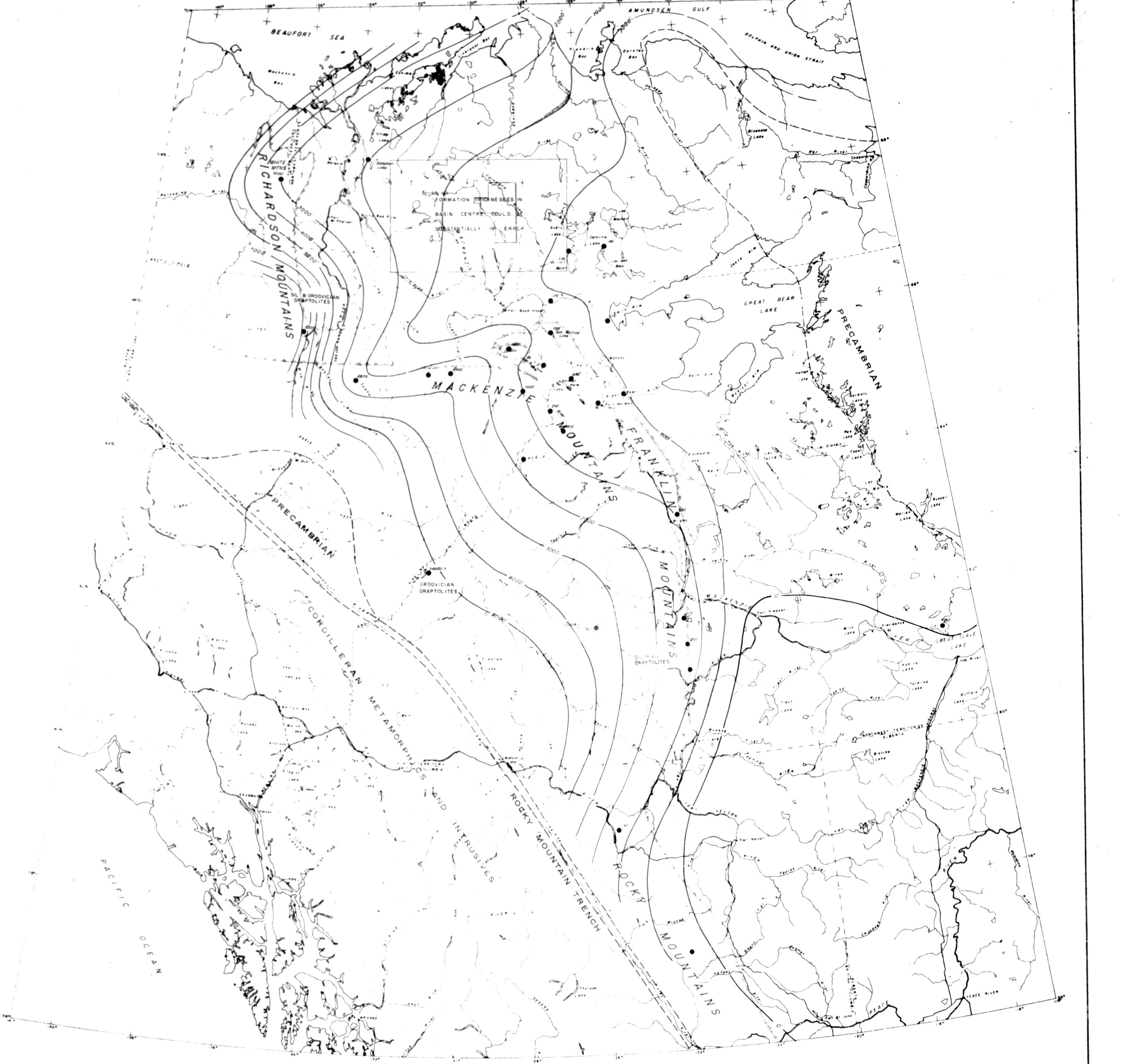
PHOTOGEOLOGICAL MOSAIC

CANOT LAKE AREA

NORTHWEST TERRITORIES

FIGURE - IX

To accompany Geological Report to J. H. Hirshhorn Northwest Oil & Gas Permits, Feb. 1959



ISOPACH AND FACIES MAP

NORTHWESTERN CANADA

Ordovician - Silurian

Eastern Limits of Mountain Belts

● Point or Area of Control

1190' Interval Thickness

Mainly Limestone

Mainly Dolomite

Mainly Black Shales

Precambrian

SCALE 1" = 40 MILES

R. deWit December 1958

Permit Area

542-1-6-2

J.C. SPROULE & ASSOCIATES, CALGARY

FIGURE - IX

REGIONAL GEOLOGICAL MAP

LOWER MACKENZIE BASIN AREA

YUKON & NORTHWEST TERRITORIES

PREPARED FOR

J.H. HIRSHHORN ENTERPRISES

SCALE: 1 INCH = 8 MILES

COMPILED FROM GEOLOGICAL SURVEY OF CANADA MAPS
& FIELDWORK BY J.C. SPROULE & ASSOCIATES

LEGENDS

GEOLOGICAL

- Geological Boundary (Ascertained)
- Geological Boundary (Conjectural)
- Synclinal Axis
- Anticlinal Axis
- Fault
- Bedrock or Near Bedrock (Observed)
- Photogeological Dip
- Bedding (Inclined, Vertical, Horizontal)
- Fault or Joint Zones

GENERAL

- Abandoned Well
- Outline of Mosaics
- Outline of P.& N.G. Permits
- Kodachrome Print No. & Direction Taken
- Measured Stratigraphic Section
- Line of Cross Section

WELL

1 Sans Sault No. 1
2 Whirlpool No. 2
3 Canyon No. 2
4 Canyon No. 1
5 Loon Creek No. 2
6 Loon Creek No. 1
7 Loonex No. 1
8 Mac No. 1
9 Mac No. 2
10 Roy No. 1
11 'C' Location
12 Ft. Norman No. 1
13 Seepage Lake No. 1
14 Raider Island No. 1
15 Morrow Creek No. 1
16 Hoosier Ridge No. 1
17 Hoosier Ridge No. 2
18 Judile No. 1
19 Vermilion Ridge No. 1

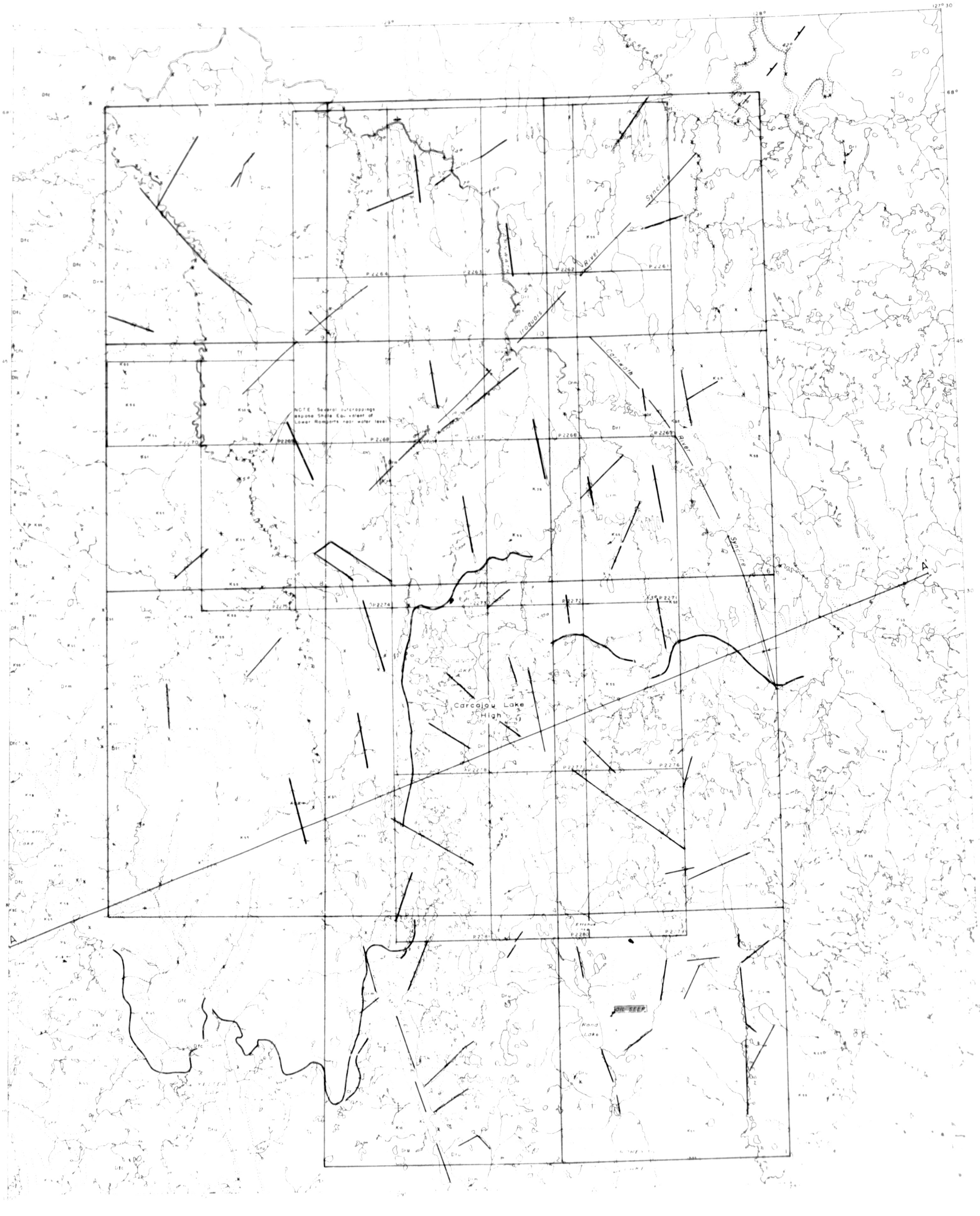
S42-1-6-2

J.C. SPROULE & ASSOCIATES


B E A U F O R T
S E A
KUGMALLIT
BAY

To accompany Geological Report on J.H. Hirschhorn Northwest Oil & Gas Permits, Feb 1959

FIGURE-III



LEGENDS

GEOLOGICAL

CRETACEOUS

K	Undifferentiated
Ksh	Shale
Kss	Basal Sandstone

DEVONIAN

UPPER

Dfc	Fort Creek Fm

MIDDLE

Ramparts Fm

Dru	Upper Ramparts Mbr
Drm	Middle Ramparts Mbr (May include Upper & Lower Member Shale Facies)
Drl	Lower Ramparts Mbr

Geological Contact

Geological Contact (Indefinite)

Geological Contact (Suggested)

Structural Lineation (Joint or Fault which may reflect basement movement)

Thrust Fault (Triangle indicates dip direction)

Synclinal Axis

Anticlinal Axis

Rock Outcrop

Bedding Attitude (Inclined, Horizontal)

Apparent Direction & Degree of Dip

Bedding Attitude (Photogeological)

Glacial Striations & Direction of Ice Movement

Northern Boundary of Pitted Moraine (Photogeological)

GENERAL

P2281 Permit Outline

Mosaic Outlines

Line of Cross Section

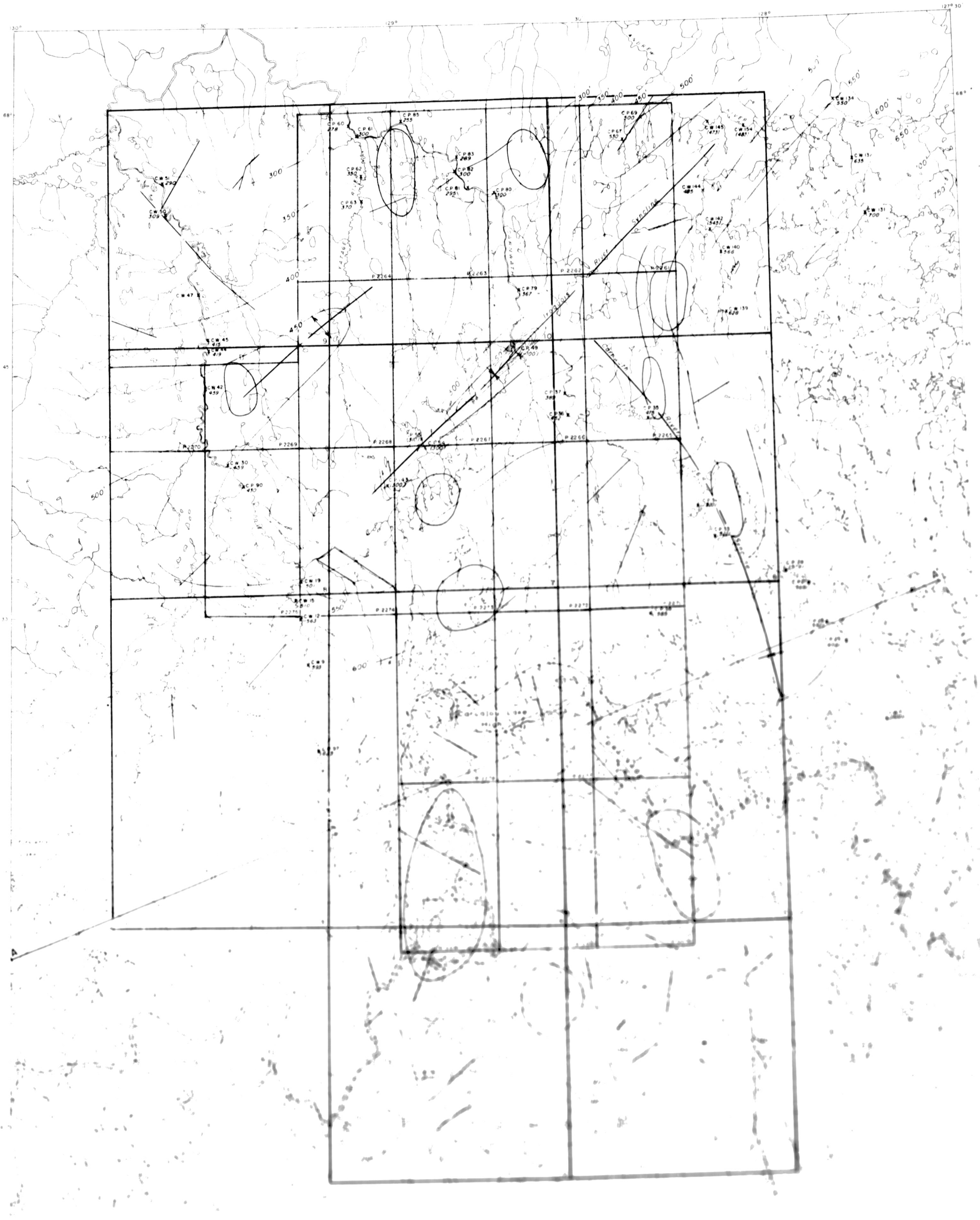
GEOLOGICAL MAP

CANOT LAKE AREA, NWT

542-1-6-2

To accompany Geological Report on J.H. Hirshhorn Northwest Oil & Gas Permits, Feb. 1959.

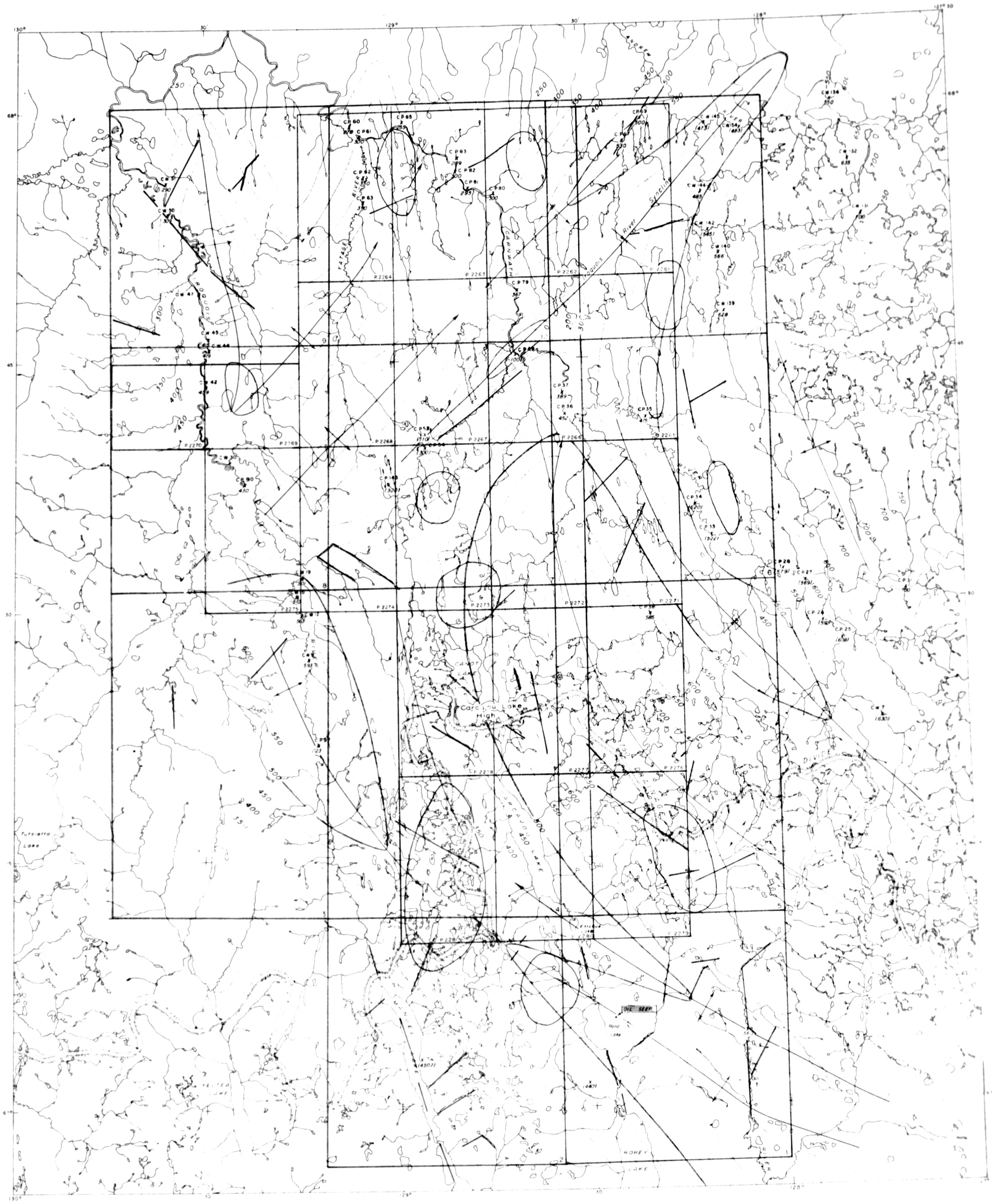
FIGURE IV



STRUCTURE MAP
CANOT LAKE AREA NWT

To accompany Geological Report on J.H. Hirshhorn Northwest Oil & Gas Permits, Feb 1959

FIGURE 4



STRUCTURE MAP

CANOT LAKE AREA, N.W.T.

Top of Lower Member - Ramparts Formation

(Alternate Interpretation)

Contour Interval - 50 ft. Datum - Sea Level

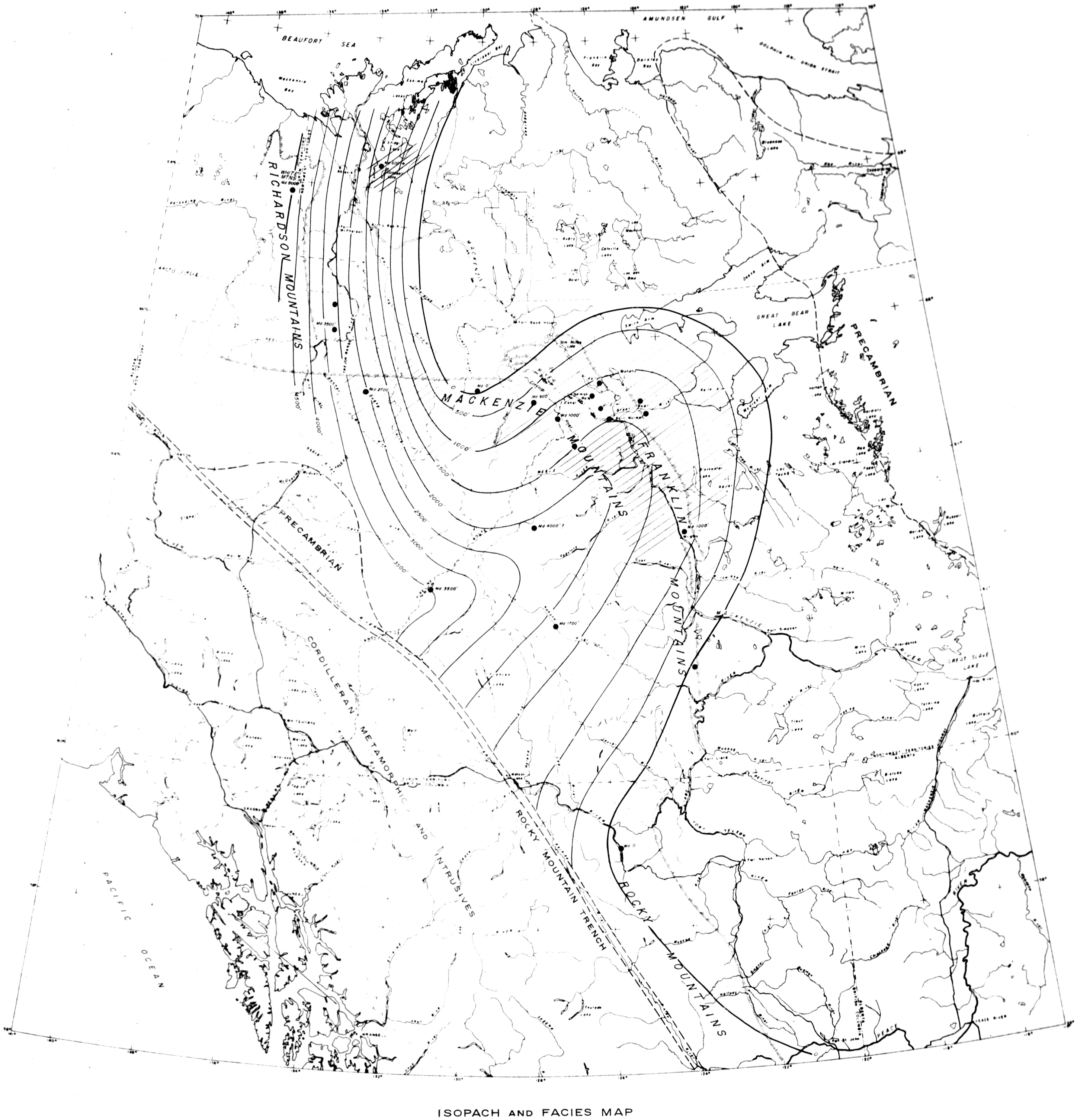
C.W.70 × Outcrop Location
510 Elevation on Top of Lower Ramparts Member - Measured
(510) " " " " " " " - Estimated
—— Structural Lineation (Joint or Fault which may reflect basement movement)
—— Outline of P.&N.G. Permits
Note: Basic Elevation Control from National Topographic Maps
—— Outline of Mosaics
⬭ Area of High Structural Relief

Interpretation by N. Peterson, February 1959

542-1-6-2

FIGURE 4

To accompany Geological Report to J.H. Hirshhorn Northwest Oil & Gas Permits, Feb. 1959



ISOPACH AND FACIES MAP

NORTHWESTERN CANADA

Upper and Middle Cambrian (Macdougal Group)

Prior to Ordovician Sedimentation

SCALE: 1" = 40 MILES

R. deWit December 1958

Eastern Limits of Mountain Belts

Point or Area of Control

Macdougal Group:
- Mainly varicoloured shales
- Mainly carbonates
- Mainly black shales and sandstones
- Evaporites present

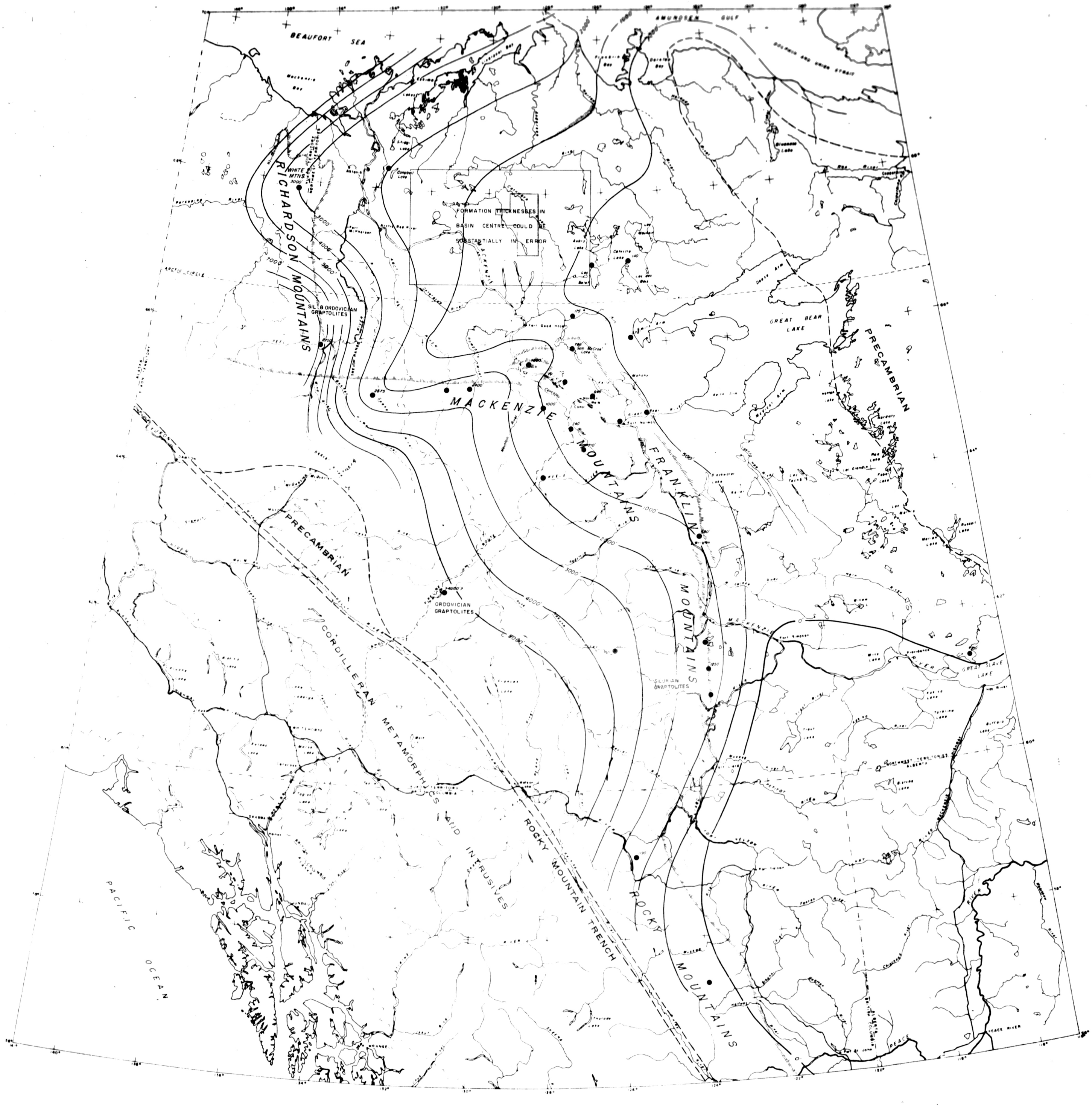
Katherine Group

Precambrian

S42-1-6-2

J.C. Sproule & Associates, Calgary

To accompany Geological Report to J.H. Hirshhorn Northwest Oil & Gas Permits, Feb. 1959



ISOPACH AND FACIES MAP

NORTHWESTERN CANADA

Ordovician - Silurian

Eastern Limits of Mountain Belts
● Point or Area of Control
Interval Thickness

Mainly Limestone
Mainly Dolomite
Mainly Black Shales
Precambrian

40 0 40 80 120 160
SCALE - 1" = 40 MILES

R. deWit December 1958

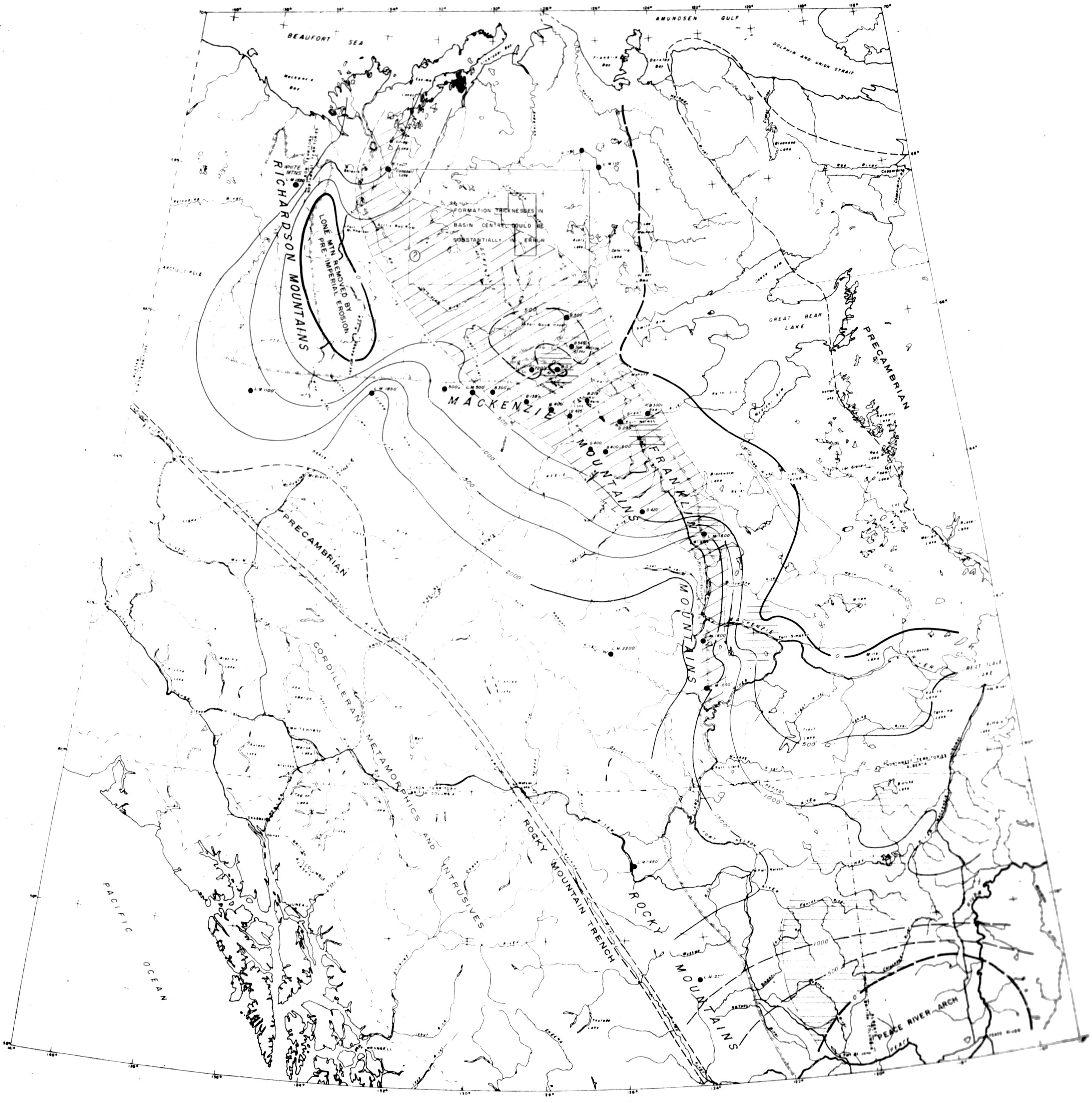
Permit Area

542-1-6-2

J.C. SPROULE & ASSOCIATES, CALGARY

To accompany Geological Report to J.H. Hirshhorn Northwest Oil & Gas Permits, Feb 1959

FIGURE X



ISOPACH AND FACIES MAP

NORTHWESTERN CANADA

Lone Mountain - Bear Rock Interval

SCALE - 1" = 40 MILES

R. deWit - December 1958

Eastern Limits of Mountain Belts

Point or Area of Control

Mainly Limestone

Mainly Dolomite

Evaporites Present

Prominent Brecciation

Precambrian

Permit Area

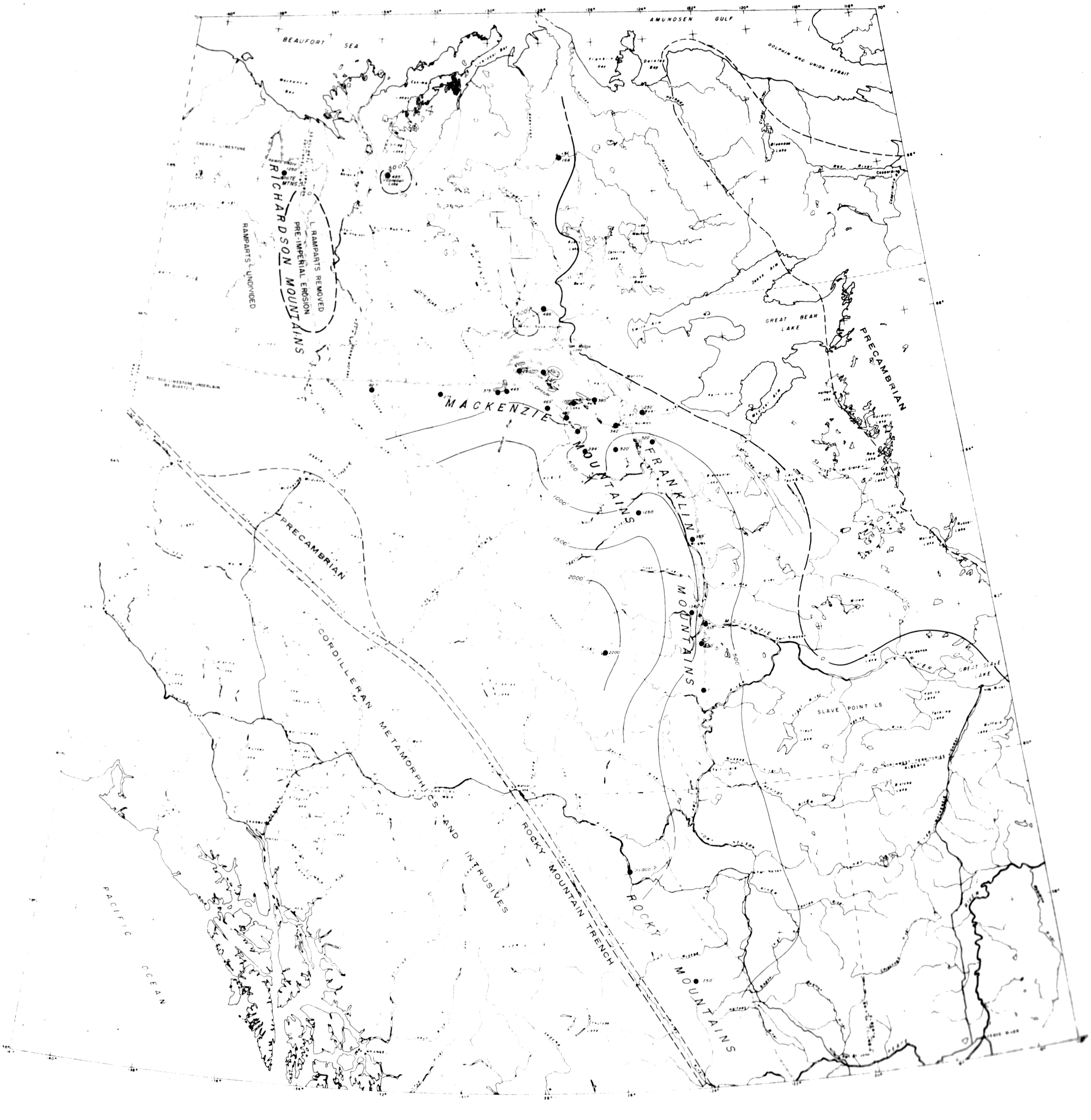
Isopachs are based on the following tentative correlations in the upper Mackenzie Area

MIDDLE DEVONIAN	LOWER RAMPARTS			SLAVE POINT
	LONE MOUNTAIN	BRECCIA		WATT MOUNTAIN
		UNBRECCIATED	MUSKEG	PRESQU'ILE
			KEG RIVER	PINE POINT
		BASAL SANDS		
SILURIAN				
ORDOVICIAN				

542-1-6-2

To accompany Geological Report to J.H. Hirshhorn Northwest Oil & Gas Permits, Feb. 1959

FIGURE-XI



ISOPACH MAP

NORTHWESTERN CANADA

Lower Ramparts Member and
Reefs in Upper Ramparts Member

SCALE 1"=40 MILES

H. deWit December 1958

Eastern Limits of Mountain Belts
Point or Area of Control
Upper Ramparts Reef Limestone
Precambrian
Permit Area