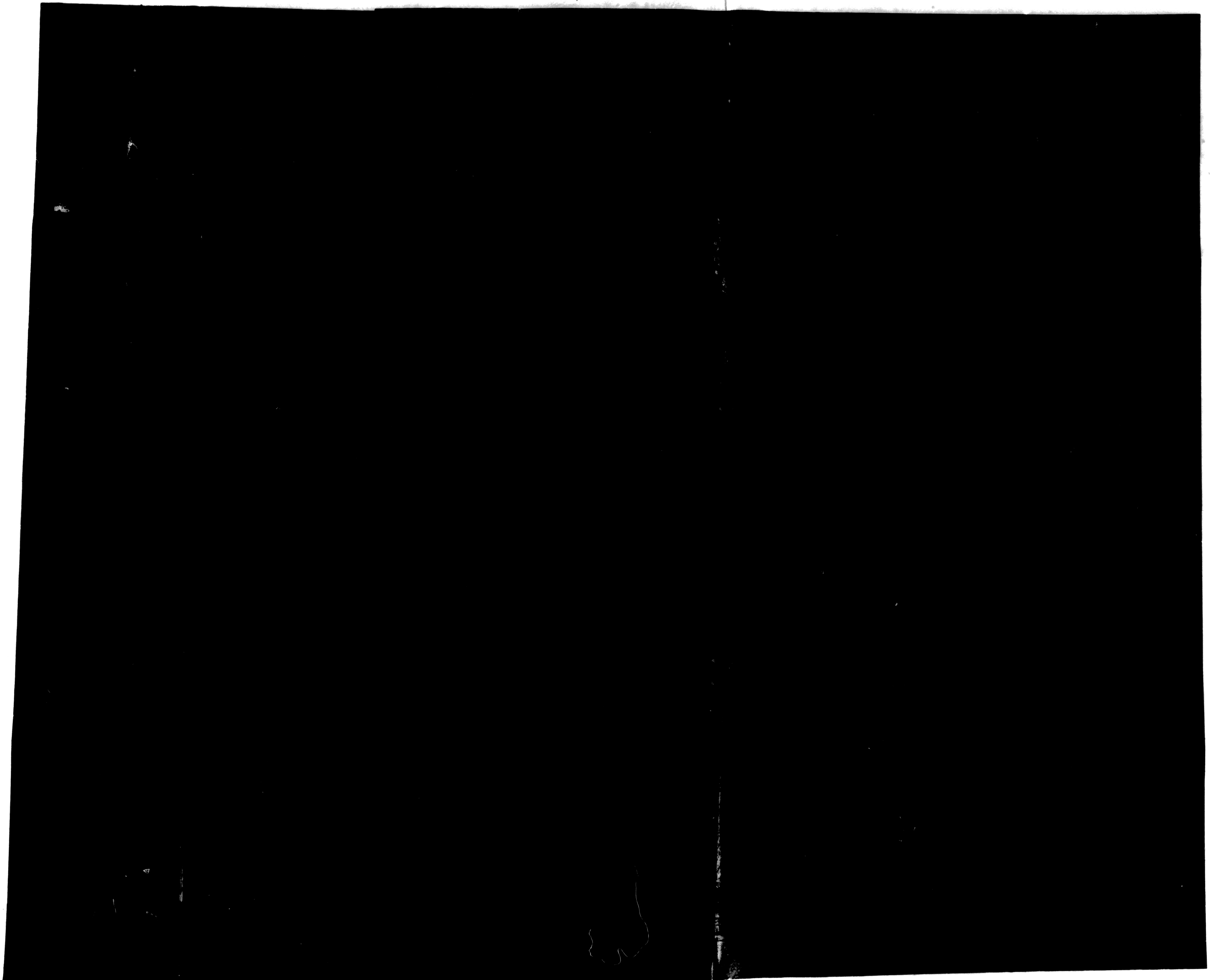
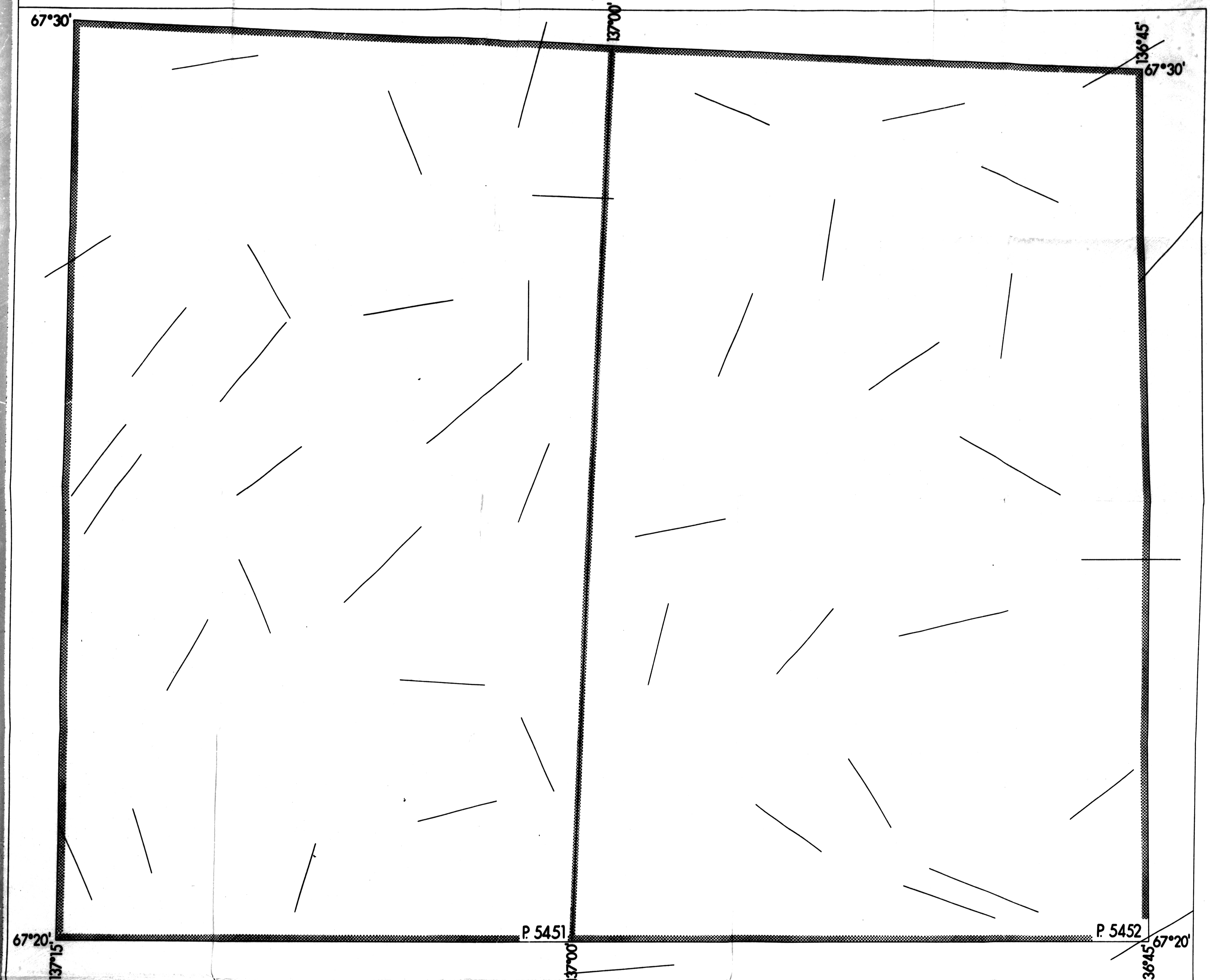


BOSWELL LEASEHOLDS LTD.

P. & N.G. PERMITS 5451 & 5452



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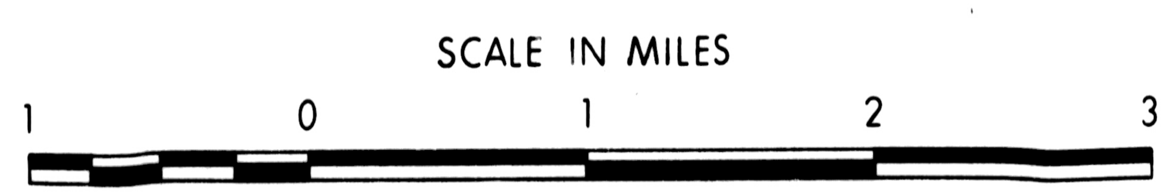
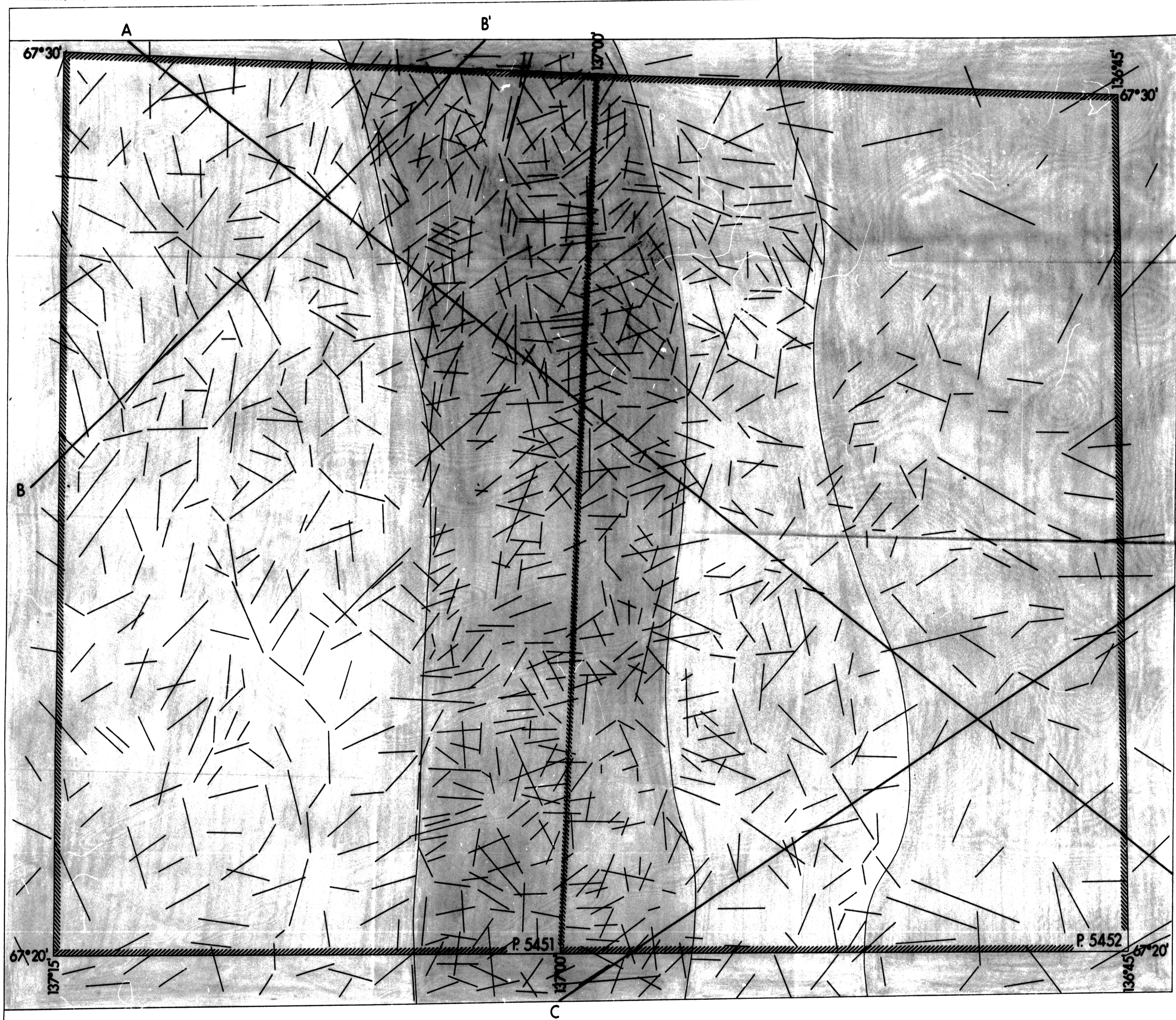
P. & N.G. PERMITS 5451 & 5452

MEGA FRACTURE PATTERN





BOSWELL LEASEHOLDS LTD.

P. & N.G. PERMITS 5451 & 5452

TOTAL FRACTURE PATTERN

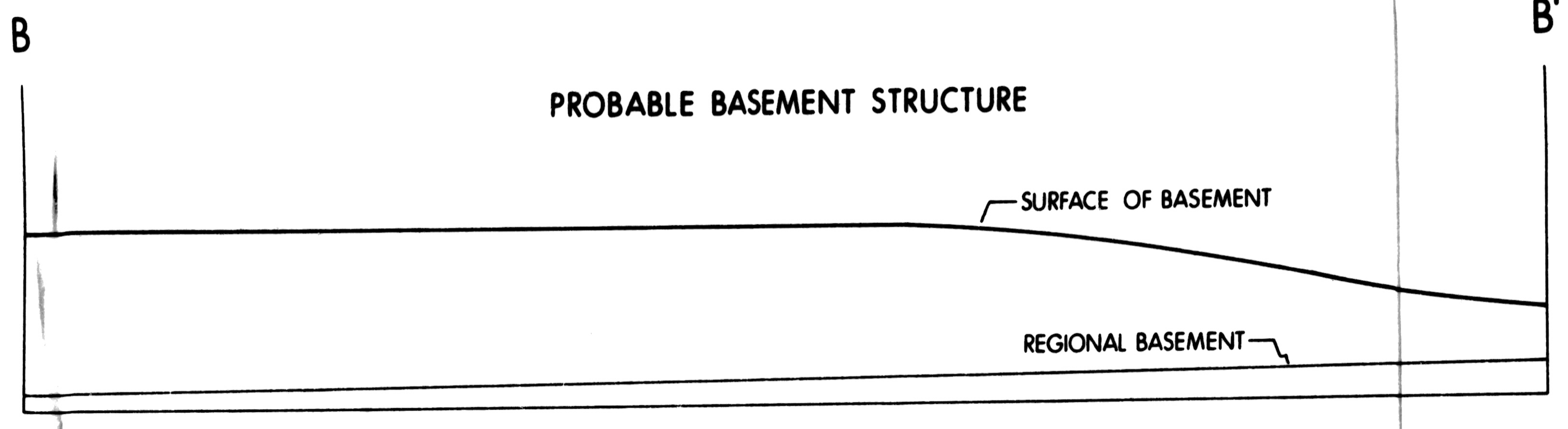
SCALE IN MILES

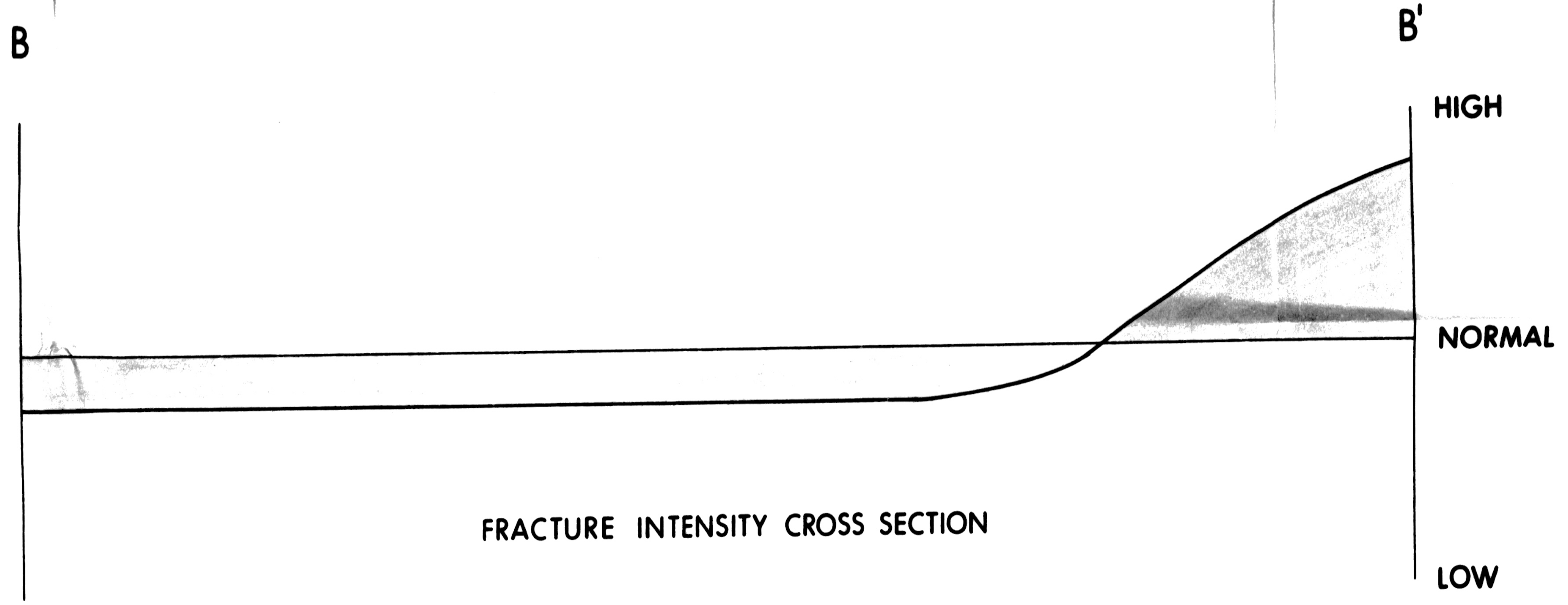
1 0 1 2 3

LOW DENSITY

NORMAL DENSITY

HIGH DENSITY





BOSWELL LEASEHOLDS LTD.

P. & N.G. PERMITS 5451 & 5452

SCALE IN MILES

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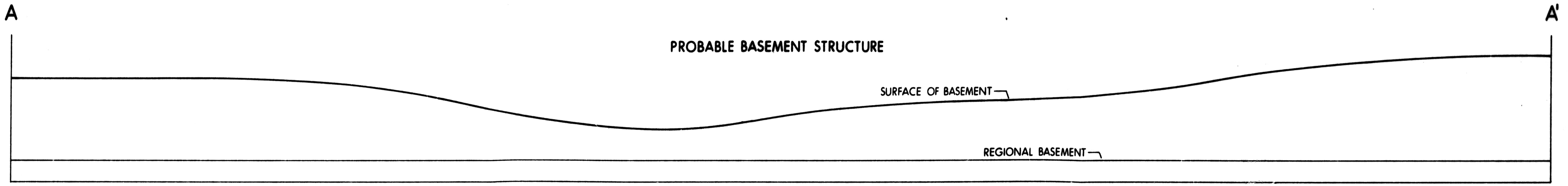

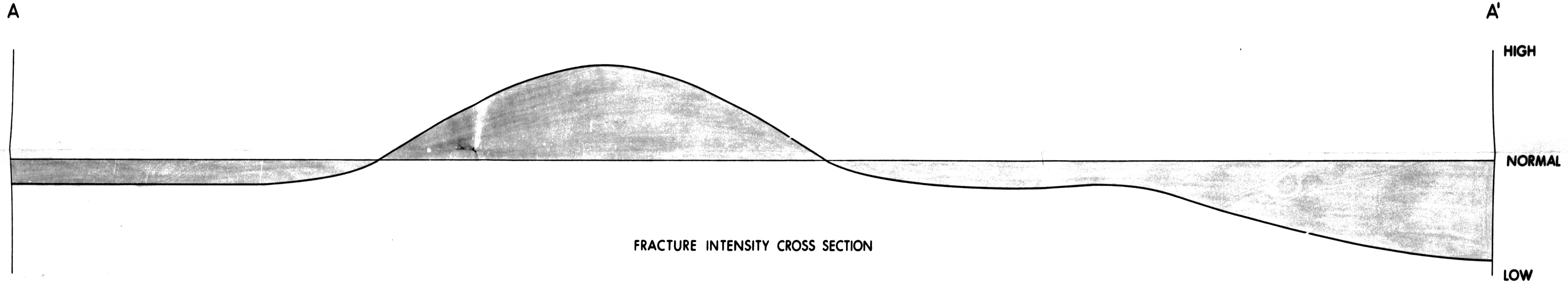

BOSWELL LEASEHOLDS LTD.

P. & N.G. PERMITS 5451 & 5452

SCALE IN MILES

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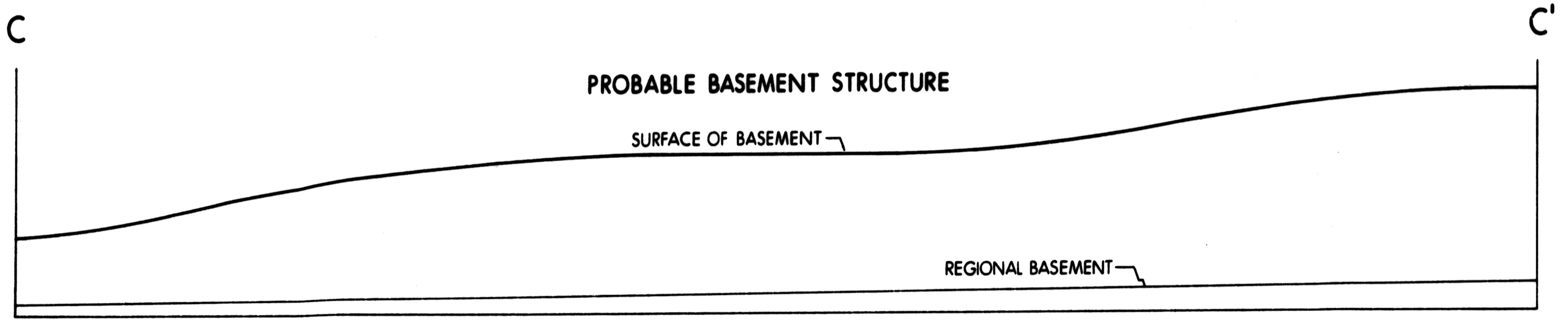

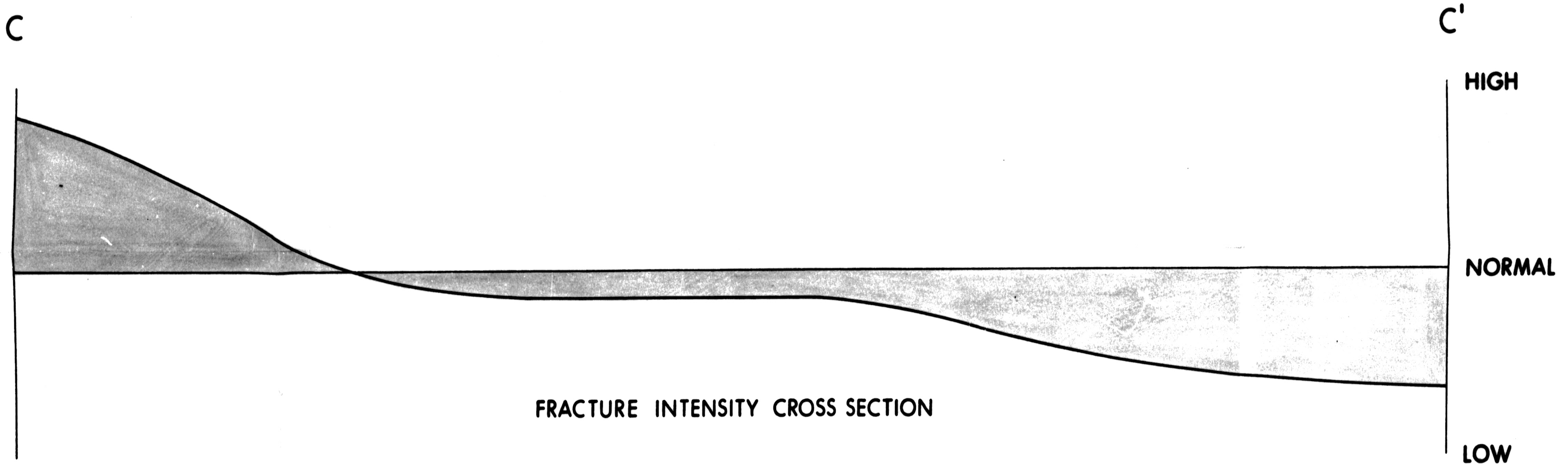

BOSWELL LEASEHOLDS LTD.

P. & N.G. PERMITS 5451 & 5452

SCALE IN MILES

1 0 1 2 3

GENERAL GEOLOGY, GEOMORPHOLOGY

AND

FRACTURE ANALYSIS SURVEY

OF

P.&N.G. PERMITS 5451 and 5452

FOR

BOSWELL LEASEHOLDS LTD.

BY

OVERLAND EXPLORATION SERVICES LTD.

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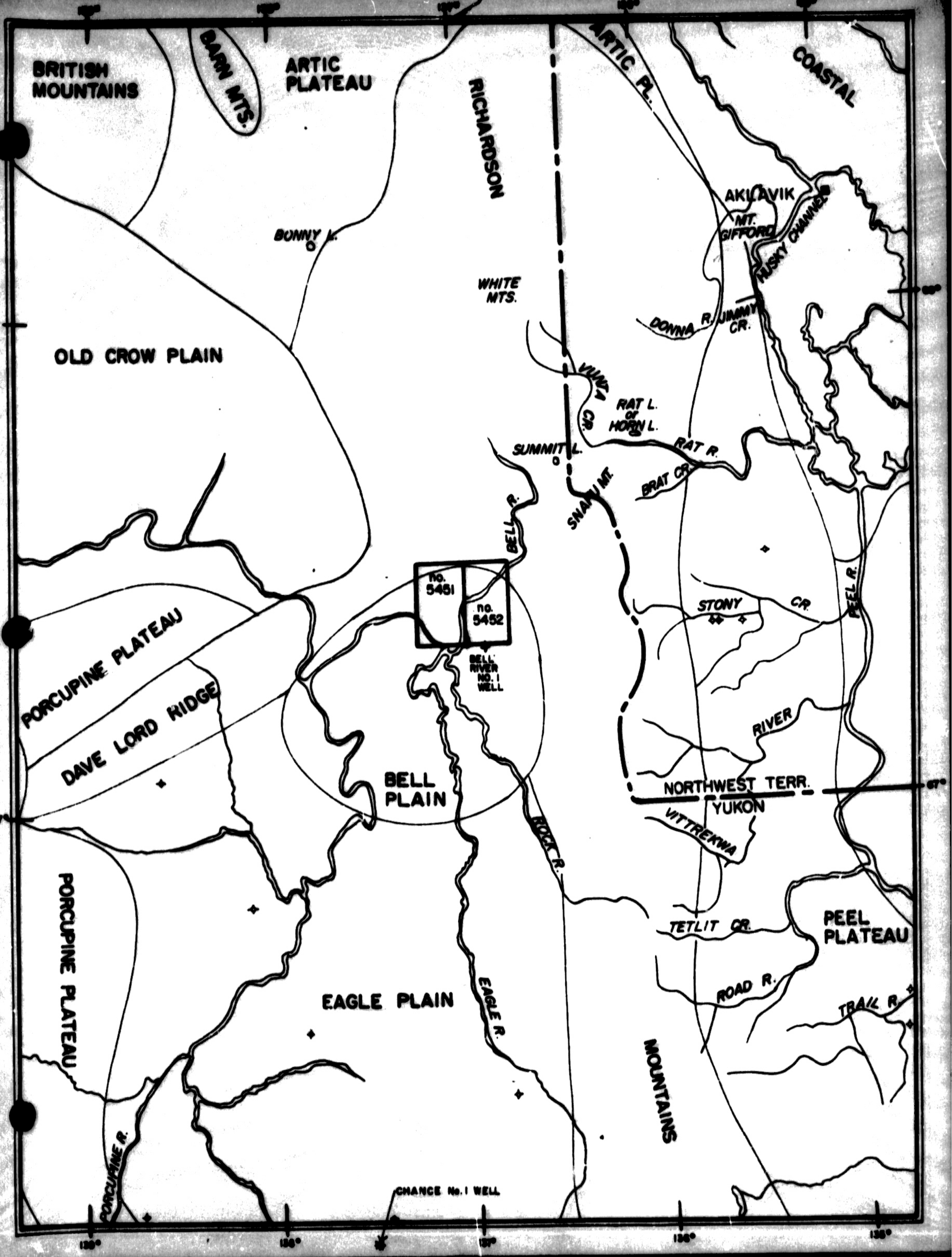
BRITISH MOUNTAINS
BARN MTS.
ARTIC PLATEAU
RICHARDSON
ARTIC PL.
COASTAL
AKLAVIK
MT. GIFFORD
HUSKY CHANNEL
BONNY L.
WHITE MTS.
OLD CROW PLAIN
DONNA R.
JIMMY CR.
VUNTA CR.
RAT L. or HORN L.
RAT R.
SUMMIT L.
BRAT CR.
BELL R.
no. 5451
no. 5452
BELL RIVER NO. 1 WELL
STONY CR.
PEEL R.
PORCUPINE PLATEAU
DAVE LORD RIDGE
BELL PLAIN
RIVER
NORTHWEST TERR.
YUKON
VITTREKWA
ROCK R.
TETLIT CR.
PEEL PLATEAU
ROAD R.
TRAIL R.
EAGLE PLAIN
EAGLE R.
MOUNTAINS
PORCUPINE PLATEAU
PORCUPINE R.
CHANCE No. 1 WELL

INTRODUCTION

Location and Size of Permits

The area herein designated as Permit No. 5451 extends from latitude 67°, 20' to 67°, 30' N., and from longitude 137° to 137°, 15' W. Permit No. 5452 includes the area bounded by latitudes 67°, 20' and 67°, 30' N. and longitudes 136°, 45' and 137° W. Both Permits are situated in the northern Yukon and cover an area of approximately 75 square miles each.

Method and Purpose of Study

A study was made of available published data on roughly the area included within a 200 mile radius of the Permits in order to summarize the geological features of the sedimentary rocks that relate to their evaluation as a potential source of hydrocarbons. Climate, terrain, transportation and Oil and Gas regulations were also studied in order to determine their effect on the development and marketing of hydrocarbons.

Geography and Physiography

Permit No's. 5451 and 5452 are situated in the extreme north-east sector of the Eagle Plain topographical environment. Eagle Plain comprises a rectangular-shaped area approximately 120 miles long north-south and 80 miles wide east-west. The Plain is a rolling country where, with the exception of the occasional local feature, elevations do not exceed 2,000 feet. Precipitation is slight and the region is classified as semi-arid. Mean annual winter temperatures average 25°F. while the mean temperature for July is 50° F. Permafrost on the Eagle Plain ranges in thickness up to 1,500 feet. A maximum of 300 feet of muskeg is present in poorly drained areas. Small lakes in the Bell River flats are primarily the result of poor drainage due to permafrost conditions. Most of the area is covered by Tundra vegetation comprising grasses, sedges, lichens, mosses and dwarf birch and willow. Arctic moss up to 10 feet thick is present on the surface. Trees are locally abundant along the Bell River although the northern one-third of the Permits block is beyond the regional northern limit of trees. All streams on the Permits flow into the Bell River which traverses the Permits in a general northeast to southwest direction and then continues westward for about 15 miles to a point where it empties into the Porcupine River. A somewhat rectilinear stream pattern in the vicinity of the Permits suggests structural control.

Richardson Mountains rise abruptly to elevations in excess of 5,000 feet immediately east and north of the Permits. This mountain system is a northerly trending, folded range about 160 miles long, varying in width from 15 miles south of the Bell River to 50 miles north of it. Stream directions in the mountains are controlled largely by structure. The steep, rocky, well drained slopes of the mountains are without the typical tundra cover. Average daily mean temperature for Aklavik is 16°F. and the average annual precipitation is about 9 inches. No glaciers are present in these mountains and very little snow remains in June.

Although conditions of climate and terrain are severe, indications are that they will not prevent development of the vast petroleum potential.

Access

Prior to the discovery of oil at Norman Wells in 1920 geological investigations were restricted to areas accessible by boat or canoe. Locations drilled to date in the Northwest Territories and Yukon have in the large been those most easily accessible.

A recent multi-well exploration program on Eagle Plain proved the feasibility of year-round seismic and drilling activity on the sub-Arctic plain. Equipment and supplies available in Alberta were moved by truck to Vancouver, by boat to Skagway, by rail to Whitehorse and then by truck to the Eagle Plain where they were stockpiled during the winter months. Roads built after freeze-up in October were of such quality that speeds up to 60 miles per hour could be achieved on the straight stretches. Sections of the road built on Muskeg were unusable after the first of April. Transportation costs per hundred weight per mile ranged from 1/3¢ by road to \$1.95-\$4.06 by boat to \$3.07-\$13.85 by air. The same general access route could be utilized to gain access to the Permits, pending the upgrading of the section of road from Chapman Lake to the Amerada et al test at the south end of Permit No. 5452. An extension of the Alaska Highway from Dawson City to Fort McPherson has been initiated by the Federal Government.

An alternate route to the Permits might be possible via the MacKenzie River to Fort McPherson and then over the McDougall Pass. The MacKenzie Valley and the Western Arctic coast is served by a fleet of 12 diesel tugs. Hay River, the head of river transportation, is connected to Edmonton by rail and highway. The highway continues northward via Fort Providence to Yellowknife. A telephone line runs to Inuvik and connects all intervening points. Inuvik is also linked to Edmonton by 3 weekly PWA DC-6 flights. A road system along the MacKenzie River from Fort Providence to Tuktoyaktuk north of Inuvik has been initiated. Northern highway trucking ranges from 20 to 50 cents per mile. MacKenzie River barges operate for a short 3-1/2 month season and shipping costs about 4¢ per mile per hundred weight. Air freight on fairly short hauls is about $2.00 but larger hauls with larger aircraft may cost as low as 50¢ per mile per hundred weight. Planes, supplies and other services are locally abundant throughout the area.

Aircraft have been used extensively to transport the personnel and supplies essential to exploratory programs. Helicopter transport of equipment for operations other than the drilling of a deep test has been employed on Eagle Plain since 1963 and proved to be highly successful. Under difficult terrain conditions helicopter transport is more economical than conventional modes of operation. Use of this form of transportation has enabled many companies to work practically all year round.

Land Acquisition and Obligations

The various phases of oil and gas operations in the Yukon Territories are administered by the Department of Northern Affairs and Natural Resources, specifically by the Oil and Gas section of the Resources Management Division.

A master grid map which shows all areas under Permit and those lands available for filing is kept at the Resource Management Division in Ottawa. An applicant may request any of the grids that have not been filed on and be given a Permit which allows him to explore for oil and gas. A fee of $250.00 is charged and a deposit that guarantees work commitments will be fulfilled, must be made at the time application is made for a Permit. The deposit is returned when work commitments have been satisfactorily completed. The holder of a Permit is required to spend 5¢ per acre during the 18 month initial evaluation period, with work commitments gradually increasing thereafter up to 50¢ per acre in the final years. Permits may be extended to cover a ten year period. A Permit may be kept in good standing over the ten year period for a total work commitment of $2.90 per acre.

Leases may be acquired in the area for which a Permit is held. The leases may range in size from one section to 50% of the sections contained in the Permit area. Leases are valid for 21 years and are renewable. Rentals are 50¢ per acre for the first year and $1.00 per acre for subsequent years. The portion of the Permit not acquired at the time a lease is taken returns to the Crown. An option to acquire the Crown's portion for the payment of an additional royalty is granted to the Permittee. Royalties on the original leases vary from 5% to 20% for oil and from 5% to 10% for gas, depending on production rates. In the event that the option is not exercised the lands return to the Crown and may subsequently be sold by tender as oil and gas leases in one of three ways:-

(a) Cash bonus

(b) Work bonus; or

(c) Cash bonus, plus a commitment to drill a well to a specified depth.

Federal oil and gas regulations provide for a large grouping of Permits and lower work requirements and oil royalties than Provincial regulations covering the more highly explored areas in southern Canada. Filing activity in the Yukon-Northwest Territories has been heavy over the past few years and most of the choice acreage is presently held under Permit.

Hydrocarbon Shows and Marketing Potential

The Yukon-Northwest Territories has in general been looked upon as a potential oil and gas producing region since the discovery in 1920 of the 419 million barrel field at Norman Wells. Density of drilling is about one wildcat per 800,000 acres.

Tests drilled in the Eagle Plain area have resulted in reports of three gas discoveries and one oil discovery. These finds have not been commercially exploited because of a lack of suitable market outlets within economic reach. However, a continuation of the discovery ratio on Eagle Plain and the general increase in activity in the Yukon-Northwest Territories that is likely to be precipitated by the recent prolific discoveries on the north slope of Alaska may very well result in the establishment of sufficient reserves to justify construction of facilities necessary to move the hydrocarbons to market. The most significant discovery to date on the Eagle Plain was made in 1960 at the Western Minerals Chance No. 1 well. 10 Mmcf/d and 2,000 feet of light gravity oil was tested from the Pennsylvanian at about 4,250 feet.

The area of interest lies within 550 miles of Tidewater at Skagway, where pipeline distances are minimal and in a most competitive position for marine tanker shipments to markets in Japan and California. Construction of such a pipeline would encounter less rugged terrain than that on the route of the Trans Mountain Pipeline from Central Alberta to Vancouver. Oil could be shipped intermittently from the Arctic coast to the Pacific coast via the Beaufort Sea and the Bering Strait, assisted when feasible by ice breakers. Year-round shipments could be made by means of a submarine tanker fleet.

GENERAL GEOLOGY

Permits No's. 5451 and 5452 are, in the broad sense, situated within the northern continuation of the petroliferous sedimentary rocks of Western Canada. The Permits are located specifically in the Cordilleran Region, in the Bell Basin sub-division of the Eagle Plain structural province. The Eagle Plain structural basin is part of a larger intermontain basin which extends northwestward beneath the Arctic Plateau and Arctic Coastal Plain. In excess of 25,000 feet of sediment is estimated to be present in Bell Basin. Structural relief of several thousand feet is present in sediments underlying Eagle Plain.

The nearby Richardson Mountains expose a non-volcanic sequence of sedimentary rocks extending in age from Pre-Cambrian to Late Cretaceous. Structures range from those that are simple to complex folds and faults. Evidence indicates periods of deformation, uplift and erosion occurred in early Upper Devonian, late Pennsylvanian, early Mesozoic, Lower Cretaceous and early Tertiary. Numerous potential stratigraphic traps have been created by the regional unconformities. Facies changes from porous Paleozoic carbonates to shale and from thick Mesozoic sandstones to shale are evident from surface and sub-surface control in the region of the Permits. Source beds are present in the study area.

STRUCTURAL GEOLOGY

The dominant structural feature on Eagle Plain is broad open folds which extend north-south for tens of miles parallel to trends in the Richardson Mountains. More than 300 miles of lineal folds are present. Structural relief between adjacent anticlines and synclines reaches 8,000 feet and affects up to 4,000 feet of closure. The majority of the deformation took place during the late Cretaceous - early Tertiary orogeny although some previous deformation likely occurred at the time of the late Devonian orogeny.

Structural elements of the Richardson Mountains are composed of northerly trending folds with gently plunging axis. Richardson Mountains are block-faulted south of the 67th parallel and become increasingly complex going north. The majority of the deformation is believed to be the result of compressive Laramide forces although Pre-Permian deformation in the central Richardson Mountains likely occurred in Variscan time.

Many of the folds in the Permits block can be recognized on aerial photos and from surface mapping. These features will locate the early stages of exploration for oil and gas.

Northeast trending anticlinal and synclinal structures are present on the surface of Permit No. 5451. The two most easterly synclines and the anticline plunge to the southwest. Direction of plunge on other structural features is not known. Facilities to determine the exact magnitude of structural relief were not available at the time this report was written. Dips are less than 30°. A strong northwest trending anticlinal feature passes through the southwest corner of Permit No. 5452 and into Permit No. 5451. The Amerada et al Bell River No. 1 test located at 67°, 19', 45" N. and 136°, 53', 29" W. was drilled on the aforementioned [illegible]ture. Bell River No. 1 bottomed at 8,009 feet in Cretaceous clastics. Section is repeated in the well as the result of movement along either a high angle reverse fault or a low angle thrust fault. No oil shows were reported and no drill stem tests were run, although some scattered porosity was encountered. The geometry of the Bell River No. 1 structure at depth cannot be determined at this time because of insufficient data. A favourable structural situation may be present near the center of Permit No. 5451 where the northwest trending fold intersects the northeast trending set.

A northwest trending syncline passes through the east boundary of Permit No. 5452. The strong anticlinal feature on which Devonian rocks are exposed to the northeast trends into the Permit. Favourable structure may be present in the northeastern portion of the Permit where it is possible the two features will meet.

STRATIGRAPHY

General

Not counting Middle Cambrian or older rocks, sediments range from 10,000 feet in west-central Eagle Plain to an interpreted 25,000 feet or more in the vicinity of the Permits. Two structural features in particular had a pronounced influence on depositional and erosional patterns; a subsiding trough was located at the site of the present day Richardson Mountains in post-Cambrian, early Paleozoic time and a positive feature, the Eagle Arch, was the site of uplift and erosion from Permian through Middle Jurassic. The axis of this arch trended east-west across the present day Eagle Plain at about 66°, 45' W. longitude. Sedimentary rocks from Cambrian to late Tertiary could be present in the vicinity of the Permits although erosion associated with uplift along the Eagle Arch may have removed any portion or all of the Mississippian to Middle Jurassic section.

Well control in the immediate vicinity of the Permits is non-existent with the exception of a single Cretaceous test at the south end of Permit No. 5452. The stratigraphic sequence which might be expected under the Permits is inferred primarily from geological data published on sections in the Richardson Mountains. Well data from Eagle Plain and information on sections exposed in Mountain ranges to the south, west and northwest of the Plain have been utilized to assist in the interpretation.

There is presently a need for the collection of additional data in the field in order to be able to clean up certain stratigraphic points so that definite regional and local detailed structure maps may be prepared.

Cambrian

Only casual reference has been made to the Cambrian in published literature and no wells have been drilled through basal Cambrian sediments to the Pre-Cambrian.

A section containing Cambrian fossils outcrops along Rat Creek near 136° W. longitude. The strata is comprised of limestone, shale, siltstone and evaporites. Strong brecciation in the beds may be indicative of salt solution. Cambrian non-marine clastic strata is exposed at 65°, 30' N., 137°, 20' W. This latter section is felt to represent a portion of blankets of Cambrian sandstone and siltstone deposited over Pre-Cambrian meta sediments. The most potential trap is the blanket sandstone in association with present day fold and fault systems although shoreline and near shore features such as beach and sand bars of various types are anticipated in the study area. Their pattern of distribution would have been dictated to a large degree by Pre-Cambrian topography. Influx of sediment decreased to the extent that carbonate sedimentation was established at the site of the present day Ogilvie Mountains by the end of Cambrian time. The Cambrian - Ordovician boundary is established on the basis of fossil characteristics since no strong physical break has been observed. Control to date has not established any Cambrian basin trends.

The present day geometry of basement fault patterns will assist in locating areas favourable for the entrapment of hydrocarbons in early Cambrian clastics. It is also desirable to delineate Pre-Cambrian topographic relief as it exists on or separate from any particular fault block. A "post-evaporite" trap (s) similar in mechanics to the one caused by differential salt solution at "Hummingbird" in southern Saskatchewan may exist in overlying beds. Gravity and magnetometer surveys would provide a relatively inexpensive method of acquiring a further insight into the aforementioned structural and lithological environments in the initial stages of exploration on the Permits.

Cambrian strata directly overlying the Pre-Cambrian may harbor another oilfield or fields similar to "Red Earth" in northern Alberta.

Silurian - Ordovician

A north-northeast trending sedimentary trough developed in Ordovician - Silurian time at the site of the present day Richardson Mountains. Some 8,700 feet of graplolitic shales of the lower member of the Road River Formation were deposited in the trough while carbonate banks flourished in the rest of the Northern Yukon. Subsidence in later Ordovician and early Silurian in the area now occupied by the Ogilvie Mountains resulted in deeper water and the upper shaly member of the Road River Formation progressively enroached over the carbonate banks. Shale was still being deposited in the Ogilvies at the end of the Silurian. Early

Silurian shale deposition in the Eagle Plain area was terminated when Paleozoic seas shallowed sufficiently to facilitate the deposition of carbonates. Carbonate sedimentation continued through the Upper Silurian and persisted almost uninterrupted throughout Lower and Middle Devonian time. Where an unconformity is not apparent the top of the Silurian is placed just above the highest beds containing graptolites. A carbonate bank flourished throughout the Ordovician and Silurian at the location of the present day White Mountains. All known Ordovician and Silurian rocks are thought to be marine.

Type section of the Road River Formation is on Tellit Creek, a major tributary of Road River. The formation is divided into two members. The lower member is comprised of thinly to medium bedded dark grey aphanitic to very finely crystalline limestone and argillaceous limestones. Graptolites and inarticulate brachiopods are common fossils while trilobites occur in the occasional thin shell-fragmental limestones. The more recessive upper member consists of dark grey limy shales and thinly bedded argillaceous limestones, greyish-black limy to non-limy shales, thinly bedded black and greyish-black cherts and argillaceous cherts, grey, very finely crystalline limestones and rare dolomites, and limestone breccias and calcarenites. The Ordovician part of the Upper Unit is a mixture of shales, cherts, limestones, breccias and calcarenites while shales predominate in the Silurian part. It is probable that the breccias and calcarenites are turbidity current deposits. Many erosional surfaces are evident and sorting is extremely poor although vertical size grading is usually present. Graptolites are common fossils in the Upper member while inarticulate brachipods, trilobites and corals are rare.

An outcrop of the Road River Formation at Trail River southeast of the type section exhibits a lower contact that is gradational with a thick sequence of shales and siltstones of Cambrian age. Fossil dating places the Cambrian-Ordovician boundary within the lower member of the Road River Formation. The Upper contact of the formation is at an angular unconformity beneath silicious Devonian shales.

Southeast of the Permits at Rock River, the lower unit is about 6,200 feet thick and the upper member about 4,000 feet. The contact between the two formations is diachronous.

Silurian and Ordovician rocks outcrop in the Ogilvie Mountains. A complete section has not been described as yet and dolomitization has masked the original depositional features in the sequences that have been studied. Near Blackstone River at 65o, 41' N., and 137°, 10' W., 2,225 feet of beds was measured beneath the Road River Formation. The thickest development is near Hart and Wind Rivers where 3,000 to 4,000 feet of the unit is exposed. The rocks consist of thickly bedded, finely to coarsely crystalline silicious dolomite although externally similar limestones are present. Vug porosity developed locally in exposures in the Ogilvie range is likely present beneath the Eagle Plain.

The type section of the Vunta Formation is exposed in the

White Mountains along Vunta Creek and at both sides of Fish Creek. A 2,850 foot sequence of pelletoid aphanitic and finely crystalline vuggy limestones is exposed. The upper part of the Vunta is moderately fossiliferous in contrast to the lower pelletoid rocks. Fossil content ranges from late Ordovician to Upper Silurian. The Vunta is overlain by about 2,400 feet of recessive dolomites and limestones which are in turn overlain by Middle Devonian rocks. It appears that the Vunta was deposited in fairly shallow water and was one of the few carbonate banks remaining in existence by late Silurian time.

Limited control suggests it is possible that the front of the Early Ordovician carbonate bank present on the west side of the Richardson Trough will pass through the Permits block. A series of traps similar to the prolific Swan Hills - Virginia Hills trend might be present along the eastern updip margin of the carbonate complex. Such a highly attractive exploration target might, because of the reef to off-reef lithologic change, be seen by the gravity meter.

Devonian

Carbonate deposition dominated throughout the Lower and Middle Devonian. Tectonic uplift in the Richardson Basin during late Middle or early Upper Devonian resulted in the removal of Devonian carbonate section in part of the present day Richardson Mountains. Control is not sufficient to be able to determine the degree to which the Permits area was affected by erosion. Influx of sediment into neighboring areas in Upper Devonian time is evidenced by the presence of a monotonous sequence of sandy shales and siltstones and conglomerates.

An incomplete sequence of 2,345 feet of Devonian clastics is exposed 8 miles north of Rat River at approximately 67°, 28' N. and 136°, 25' W. The strata consists of shale, dark grey to grey-green in part, silty, and sandstone, salt and pepper in part dark grey to greenish to yellowish grey in part, quartzose in part, ferrougenous in part, cherty and conglomeratic with pebbles up to 1/4 inch. The sequence is correlatable with the Upper Devonian Imperial Formation at Norman Wells. It is separated from conglomerates of the overlying Permian by an angular unconformity.

Upper Devonian beds in the Vittrekwa River area include grit, sandstone, shale and pebble conglomerate. The coarse sections contain angular to sub-angular fragments of black chert and siltstone presume to have been derived from Silurian-Ordovician rocks. A conglomerate about 20 feet thick containing cobbles of black chert, quartzite and siltstone is felt to mark the base of the Devonian.

Outcrops north of Summit Lake suggest the Group is probably over 5,000 feet thick and may exceed 7,000 feet in thickness in that area.

An incomplete 3,210 foot section is exposed on "Snafu" Mountain about 4.3 miles southeast of Summit Lake from 67°, 39.7' N. to 67°, 39.5' N. and 136°, 18' W. to 136°, 20' W. It is correlated with the Upper Devonian Imperial Formation of the Norman Wells area. The Devonian beds are overlain unconformably by the conglomeratic Permian sandstones. The interval consists of interbedded sandstone, siltstone and shale. Sandstones are fine to coarsegrained, poorly sorted, slightly calcareous in part, cross-laminated in part, conglomeratic in part.

Sections of Middle Devonian have been measured in the northern Ogilvie Mountains in the vicinity of the Hart and Blackstone Rivers at 65°, 27.5' N., 137°, 00' W., 65°, 25.2' N., 137°, 06' W. and 65°, 42' N., 137°, 26.5' W. The Middle Devonian is divided into an unnamed shale, the Ogilvie Formation and the Michelle Formation, the latter of which rests conformably on black Silurian shale. Vug porosity is well developed locally in the dolomite portion of the carbonates. Both the dolomite and the limestones have a fetid odour in part and 45 feet of oil-stained section was observed at one location.

Relatively shallow seas without a contemporaneous influx of clastics could have been present in the early stages of the orogenic movements which terminated in early Upper Devonian time. It is anticipated that such a condition would cause a migration of the carbonate front eastward into the Richardson Basin. A back-barrier environment with pinnacles, small atolls and other related reef features such as are present in the Rainbow-Zama area of northern Alberta may have existed in the vicinity of the Permits.

The Upper Devonian conglomeratic sandstones observed in the

Mountains to the east and on the Dave Lord Ridge to the west may be present beneath the Permits Block. Conglomeratic deposits associated with ancient shoi lines can be excellent hydrocarbon reservoirs as is evidenced by the Cardium production in the "Cyn-Pem" area.

Mississippian

A 1,500 to 2,000 foot sequence of Mississippian rocks outcrop 10 miles northwest of the Permits in a northeast trending block about 90 miles long and 20 miles wide. The strata is composed of partly fragmental limestone, shale, sandstone, conglomerate and chert. Outcrops are also present over extensive portions of the area included from 68°, 30' to 69° N., and 138° W. to the Yukon - Alaska boundary where the strata consists of thick-bedded blue-grey limestone, cherty limestone, and minor chert beds. The basal contact is at a sharp angular unconformity with Ordovician beds. Unidentifiable brachiopods, corals and bryozoans are preserved near the base of the Mississippian sequence.

A section of questionable Carboniferous age is exposed about 10 miles southeast of Bonny Lake. The strata consists of porous brecciated coarsely crystalline limestone, cherty limestone, chert and dolomite containing crynoid stems. The section is overlain by black argillite, shale, siltstone and chert.

Permo-Carboniferous outcrops in the Ogilvie Mountains have been divided into four units. The basal unit is the Calico Bluff Formation which consists of 1,000 to 2,000 feet of rather bituminous, platy, calcareous shale and shaly limestone, occasionally interbedded with sandstone and conglomerate. An Upper Mississippian age is suggested by brachiopod dating although the upper 100 to 200 feet may be Pennsylvanian in age. Rocks of the Calico Bluff Formation are overlain disconformably by between 300 and 1,000 feet of carbonates of the Lower Limestone Unit. The overlying Middle Recessive unit is comprised of 500 to 1,000 feet of shaly limestone and calcareous shale with sandstone and conglomerate interbeds. The foregoing section is overlain by 500 to 1,000 feet of cherty limestone of the Upper Unit.

A sequence of black petroliferous shales and limestones attaining a maximum thickness of 3,000 feet underlies the southern portion of Eagle Plain. Mississippian rocks were apparently removed from the Eagle Arch area during subsequent periods of erosion.

It is possible that the erosional edge of Mississippian carbonates on the northern side of the Eagle Arch passes through the vicinity of the Permits. Porous Mississippian beds in association with an erosional subcrop edge have given up large quantities of hydrocarbons in central Alberta along the "Sundre - Westward Ho" trend.

Permo-Pennsylvannian

Permo-Pennsylvannian outcrops in the Richardson Mountains vary in composition from carbonates to predominantly clastic rocks. More than 2,800 feet of carbonates are present in the vicinity of the headwaters of the Rat River. The clastic sequence consists of fine grained sandstones, calcareous in part, and shale, sandy, with clay ironstone. Silty and shaly limestones are present in units up to 80 feet thick in the Permian upper part of the section.

Near Rat Lake and north of Vittrekwa River the Permo - Pennsylvanian rests with angular unconformity on older rocks. The base of the section is a 150 foot pebble and cobble conglomerate consisting of subangular to angular fragments of black and grey chert, grey siltstone, and quartzite in a red siltstone matrix. Grey, blocky sandstone and argillaceous siltstone overlie the conglomerate.

The Eagle Arch was emergent during the Permo-Pennsylvanian as is evidenced by the presence of near-shore facies in wells drilled in the southern part of the Eagle Plain. Profound facies changes take place over short distances. Lithologies exhibit a general shaleout and thinning of the section towards a basin axis located at approximately 66° N. The shales are very petroliferous.

The Rat Lake - Vittrekwa River conglomerate may extend westward along the north flank of the Eagle Arch as far as the Permits. Hydrocarbons could be present in structural and/or stratigraphic traps.

<u>Triassic</u>

The Triassic period is part of a transition between major depositional phases in the Paleozoic and the Mesozoic and beds of this age are generally not present in the Eagle Plain area as the result of non-deposition and/or erosion associated with uplift along the Eagle Arch. Marine limestone is exposed at two locations in the Richardson Mountains and non-marine sediments outcrop in a third locality. Seas innundated the area of study from the northwest during late Triassic time. Outcrops and information are insufficient to be able to define depositional basins and Triassic sedimentation patterns.

Only very general comments on the type sections are made here because of their distance from the present area of interest. Triassic sections are exposed in the Richardson Mountains, closer to the Permits.

Type section of the lower Triassic Sadlerochit Formation is exposed on the southside of the Sadlerochit Mountains at about 69°, 35' N., and 145° W. At this location the Sadlerochit is divided into the Echooka Member, which may be Permian in part at least, and the Ivishak Member. The Ivishak Member is comprised of marine, fine grained sandstones and siltstones with shale interbeds.

Type section for the upper Triassic Shubik Formation is on the Canning River on the southwestern side of the Shubik Mountains at 69°, 30' N., 146° W., immediately south of the Sadlerochit Mountains. The lateral graduation of sandstones into carbonates at this location suggests deposition in relatively shallow waters.

A section exposed near the mouth of Brat Creek, a tributary of the Rat River, comprises 50 to 65 feet of dark grey to light grey, in part carbonaceous, shales which contain lenses of impure coal. This section is conformably overlain by Middle Jurassic sandstones and siltstones. The contact with the underlying chert and sandstone pebble conglomerate of the Triassic Brat Creek Formation is sharp and irregular. Tentative dating of the conglomerates has been made on the basis of pollen but there is a possibility that they may be Upper Permian in age. Section is not exposed below the conglomerate. These deposits are interpreted as a local, non-marine shoreline development.

Approximately 90 feet of possible Upper Triassic beds occur in the divide between Rocky and Vittrekwa Rivers. They are conformably overlain by Upper Jurassic sandstones and rest unconformably on the Upper Devonian Imperial Formation. Devonian beds are unconformably overlain by the Jurassic elsewhere in this region. The strata consists of fine grained, calcareous sandstone and light grey limestones. The abundant pelecypods which occur in part as a coquina suggests shell accumulation in shallow agitated marine waters devoid of terrigenous material. Siltstone and sandstone could have been supplied by areas of local relief.

Triassic strata may be present in the Permit area block in scattered, irregular areas sandwiched between two major unconformities.

Jurassic

Subsidence began in late Jurassic in the Richardson basin and Middle and Upper Jurassic seas transgressed from the north. A thin, incompletely developed Jurassic system characterized by shallow water marine to non-marine clastics is present in the Richardson Mountains west and north of the Permits. Shallow water sandstones and siltstones are exposed northeast of the Permits while neritic to non-marine sandstones and siltstones are present in outcrops to the southeast. Outcrops of Jurassic rocks indicate the section in general thickens to the north and to the west and progressively younger rocks underlie it southeast from the northern Richardson Mountains.

The area of typical Lower Jurassic Bug Creek Formation is in the Aklavik Range between the headwaters of Jimmy Creek in the south and Mount Gifford in the north. Exposed sections exhibit 400 to 800 feet of clean to silty, mostly fine grained, quartzose sandstones interbedded with considerable beds of dark grey, more or less sandy siltstone and minor amounts of silty shale and cryptocrystalline limestone. Belemnites are abundant in a section about two-thirds of the way through the formation. Some interbeds of coaly sandstone and a conglomerate are also present near the aforementioned part of the formation. Strata of the Bug Creek is overlain directly by the Upper Jurassic Husky Formation and rest conformably on the Permo-Carboniferous unconformity. Close to 400 feet of Permian rocks were eroded away prior to deposition of the basal sandstones. Bug Creek lithologies are indistinguishable from those of the Devonian and Permo-Carboniferous except with the aid of the fossils.

The Bug Creek Formation in the vicinity of Summit Lake consists of interbedded grey, buff or brown, fine grained quartzose sandstones interbedded with lesser units and beds of dark grey to black, silty shales and sandy siltstone with clay ironstone concretions and bands. The Bug Creek - Permian boundary is paraconformable while contact with the overlying Husky Formation is conformable. A transitional environment between the one to the east and that to the west is suggested by the predominantly marine sequence.

Type section for Upper Jurassic Husky Formation is along Husky Creek where it cuts through the east slope of Aklavik Range at about 68°, 01', 20" N., It comprises a 1,200 to 1,270 foot sequence of dark grey or brownish-grey shale and siltstone interbedded with minor amounts of grey fine grained to very fine grained and silty sandstone, medium to coarse grained, gritty to pebbly sandstone and fine to medium pebble conglomerate. Pockets and layers of coquina limestone occur at random. Contact with the underlying Bug Creek is sharp and uneven. The lack of the accumulation of coarse material in hollows and pockets on the Bug Creek surface suggests an abrupt regional subsidence rather than emergence accompanied by erosion.

An outcrop of Husky approximately 10 miles southwest of Horn Lake consists of dark grey to black shale with thick interbeds of similar siltstone and some bands of concretions of clay iron-stone. Sandstone members up to 200 feet thick are present in the middle part of the formation.

A thick, 3,000 foot section of Husky is developed northwest of Horn Lake in the headwaters of the Bell River.

Type section of the North Branch Formation is in the First Gorge about 6 miles upstream from the confluence of the North Branch with the Vittrekwa River proper. The top 60 to 80 feet at North Branch consists of green to yellowish-green or brownish-grey, coarse to fine grained sandstones. The coarse grained sandstones contain numerous pockets and interbeds of grit. Beneath the sandstone in excess of 500 feet of fine to coarse grained, sometimes gritty sandstone with interbeds of grit and pebbles occur, interbedded with pebble conglomerates. Minor pods of shale, siltstone and clay ironstone are present, mostly near the top of the Formation. The sequence is likely a littoral or beach facies of the upper and middle parts of the Husky Formation deposited at the southern margin of the late Upper Cretaceous Richardson basin. Marine Jurassic rocks are absent south of the Vittrekwa River area.

Near shore facies present at Vittrekwa River may extend far enough westward in association with the Eagle Arch to pass through the vicinity of the Permits block. It is also possible that the thick sandstones observed near Horn Lake are present beneath the Permits.

Cretaceous

Subsidence quickened through the Lower Cretaceous interval and eventually the Eagle Arch was submerged for the first time since Late Permian. Clastic sediments were deposited in Eagle Plain in a wedge that reaches a maximum thickness of 6,500 feet in the northwest corner. Basal Cretaceous strata exposed on the eastern slope of the northern Richardson Mountains is marine while alternating marine and non-marine rocks containing lignite beds occur higher in the section. Early Upper Cretaceous rocks have been preserved in structural lows and outcrop extensively on Eagle Plain. The sequence referred to as the Eagle Plain Formation consists of predominantly non-marine sandstones correlative with the Fort Nelson and Dunvegan Formations of northeastern British Columbia. Dating of the Eagle Plains Formation was established by means of fossil plants. Late Cretaceous rocks are present on the west side of the MacKenzie Delta, and in the northwest Ogilvie Mountains and southern Richardson Mountains.

The Eagle Plain Formation type section is immediately north of the Fishing Branch River about 15 miles above its junction with the Porcupine River and 9 miles due east of Bear Cave Mountain where 2,000 feet of the formation is exposed. Sandstone units 10 to 40 feet thick are separated by 10 to 100 foot covered intervals which are likely underlain by silty shales and argillaceous siltstones with minor, thin interbeds of sandstone. The thick sandstone units are generally fine to medium grained, light brownish grey, have abundant chert grains and some feldspar grains, are crossbedded and contain poor impressions of plant fragments. Eagle Plain strata is underlain gradationally by over 1,200 feet of post-uppermost Lower Cretaceous silty shale with thin siltstone and sandstone interbeds. These beds are in turn separated from underlying beds by an unconformity.

On the east flank of Richardson Mountains between Stony Creek and Lower Donna River the Cretaceous sections have been studied in detail and several pages of notes could be made here on the material that is available. However, for the sake of brevity, while keeping within the framework of the intended purpose of this report, the division, measurement and description of the sequence is summarized as follows:

Early Lower Cretaceous

Lower Shale - siltstone Division

This division is comprised of 180 to 190 feet of quartzitic sandstones in the upper part and light grey, commonly calcareous shales in the lower. The shales are underlain by sandy siltstones, silty sandstones and calcareous sandstones of Jurassic age.

Lower Sandstone Division

The division includes 600 to 650 feet of sandstones, buff to white, medium to coarse grained, gritty to pebbly, with carbonaceous inclusions and interbeds of pebble conglomerates.

Coal-Bearing Division

The lower member consists of about 240 feet of irregularily interbedded, friable to hard, light to dark grey, carbonaceous to coaly sandstones with dark grey to bluish-grey, mostly carbonaceous to coaly siltstones and shales.

Several coal seams are present. The sequence correlates with the non-marine Bullhead Group of the Peace River area.

The Upper Member is comprised of about 280 feet of grey, quartzose, fine to medium grained sandstone, crossbedded and ripple marked, with interbeds of fine grained silty sandstone and sandy shales. This sequence marks the beginning of a widespread mid-Lower Cretaceous transgression.

Mid Lower Cretaceous

Major uplift to the south was accompanied by deep erosion of the lower sandstone and coal-bearing divisions of the Early Lower Cretaceous. The erosional interval was followed by the deposition of 1,500 to 3,000 feet of Mid Lower Cretaceous marine shales, siltstones and sandstone.

Upper Shale - Siltstone Division

This interval consists of 1,500 to 1,750 feet of dark to blackish-grey marine shales and siltstones and a basal conglomerate. The conglomerate rests unconformably on older rocks. Along Vittrekwa Creek the occurance of sandstones and conglomerates in beds up to 200 feet thick suggests proximity to the southern shore line of the mid Lower Cretaceous sea.

Upper Sandstone Division

The thickest section exposed contains about 900 feet of buff, rusty or light green, fine to medium grained, well sorted, quartzose, micaceous sandstone interbedded with units of darker-coloured, fine grained, commonly clayey and shale-like, soft sandstone, sandy siltstone, shale and clay ironstone. On Vittrekwa River pebble conglomerates are present in the lower 300 to 350 feet of the division which rests conformably on pebble conglomerates of Devonian or Mississippian age.

Late Lower Cretaceous

Shale - Siltstone Division

A maximum development of 2,000 feet is present and the section consists of greenish-grey to black hard shales and siltstones with many interbeds of clay ironstone and rows of clay ironstone concretions. A regional unconformity is present at the top of the sequence while the base is marked by a pebbly shale bed.

Upper Cretaceous

Upper Cretaceous Shale Division

This sequence consists of dark to light grey, soft shales with hard, dark grey to black shale concretions containing geodes of carbonate or silicious material. About 1,000 feet maximum section is exposed. A broad transgressive onlap comparable to the mid Lower Cretaceous one is evident.

On Porcupine River near 66°, 30' W. and 138°, 31' N. a sequence overlying the late Lower Cretaceous shale-siltstone division consists of 4,000 feet of thick, medium to coarse grained, salt and pepper, quartzose sandstones.

The nature and distribution of sediments suggests that the region was for the most part emergent during Late Cretaceous and early Tertiary. Structural relationships in the Richardson Mountains indicate that more than one phase of post mid-upper Cretaceous orogenic movements took place.

The sequence described above is suggestive of a lacustrine to fluvial to transitional environment. Deltaic environments are very favourable for the generation of petroleum. Numerous periods of erosion and transgressive onlap resulted in the formation of many stratigraphic traps which may contain hydrocarbons.

FRACTURE ANALYSIS

This section of the report discusses the results of a Detailed Fracture Analysis Survey carried out within, and in the immediate vicinity of, Petroleum and Natural Gas Permits 5451 and 5452. An aerial mosaic (scale 1.65 inches equals approximately 1 mile) made from Dominion Government aerial photographs accompanies this report. These same photographs were examined stereoscopically and the fractures plotted on the individual photographs, then transferred to the mosaic for analysis.

The theory that the earth's crust is abundantly and methodically fractured is the basic premise on which is built the exploration technique known as Fracture Analysis. A Fracture is defined as "... generally abundant, natural lineation discernible on aerial photographs".

Fracturing is largely caused by external stresses on the surface. The most important are:

(a) earth tides

(b) radial acceleration of the earth along its radius vector

(c) a gradual decrease of the earth's rate of rotation

As stated above, the earth is systematically fractured and the fracture system would approach symmetry if the crust were homogeneous. It is considered that irregularities are caused by regional heterogeneous conditions within the earth's crust. Local departures from the norm are caused by structural or stratigraphic anomalies.

The term "photogeophysics" was introduced by Blanchet (1956) and deals with mapping, analysis and interpretation of fracture traces as recorded on aerial photographs. In a more general way "photogeophysics" can be defined as the methodical statistical analysis of linear features seen on aerial photographs and this system is applied by any method recording all observable lineations, or the totality of a certain type of linear feature, and the statistical presentation of the data on contoured intensity maps or dry plotting the fractures directly on the mosaic.

In this report a megafracture is longer than one mile and a microfracture is shorter than one mile.

GENERAL DISCUSSION

Origin of Fractures

Fracturing is largely caused by external stresses on the earth, although internal stresses may play some minor roll. The most important of these external forces are the diurnal earth tides due to the gravitational effects of the sun and moon; the change in radial acceleration of the earth along its radius vector and the gradual decrease in the earth's rate of rotation. The endless rhythemic action of these earth tides is probably the principal cause of the systematic fracture system seen over most of the world, even though the amplitude of these tides is only 9 - 13 inches. The fractures are most likely generated by the process of fatigue as the end result of these stresses which are repeated regularly over millions and millions of years. Metals fatigue in the same manner when subjected to continual vibration.

In general the initiating forces which generate fractures must have continued for a very long time and the process involved are continuous and are probably active at the present time. Furthermore, Mollard (1957) states, "The mechanism required to reflect lineaments to ground surface must be reasonably simple, for simple patterns are produced on diverse topography and in diverse types and depths of surficial deposits that overlie different kinds of relatively flat-lying sedimentary rocks of varying thickness. The mechanism producing the lineament pattern must persist over extensive and widespread belts of the earth's outer shell; that is today, the engendering mechanism must in fact be worldwide".

External forces such as earth tides obviously fit these parameters. Some internal forces may also apply such as the action of deep seated tectonic forces, and the most probable of these is isostatic adjustment. Isostatic rebound following the melting of the glaciers may still be taking place and this will further accentuate fractures present before glaciation.

In general it can be said that fracture patterns are caused by either internal or external forces. If the forces are internal the result would be different orientation of the fracture systems in areas of similar tectonic history but different position. If the forces are external the orientation of the fracture arrangement should have world wide similarity. However, stable areas such as the masses of the continents may develop fracture patterns due to external forces and tectonically active areas may develop their own pattern due to internal forces.

If joints form early in the history of a sediment then systematic joints must be successively younger upwards through the section and the joint pattern is imposed on each new layer of sediments when they have become consolidated enough to fracture. This upward propagation is caused by the fatigue caused by stress, which in turn is caused by diurnal earth tides.

Expression of Fracture

Fractures have been observed in aerial photographs from every climate and on every continent in the world. They are expressed as topographic relief, vegetation differences and soil tonal differences.

Topographic Relief Lineaments

A common type are relief lineaments which can be manifested by a change (usually abrupt) of topographic elevation on either side of a relatively straight line. They may be also expressed as straight valleys or hills or by straight streams where the stream course is controlled by a fracture zone.

Vegetal Lineaments

Vegetal lineaments are the most common in the parkland and muskeg areas of western Canada and many excellent examples of fractures can be seen on almost any aerial photograph of northern Saskatchewan, Alberta or British Columbia. Straight lines of both deciduous and evergreen trees as well as scrub growth are universally visible. However, the most common vegetal lineament seen by this writer is a straight "edge" to a clump of trees or bushes. In many cases these fractures control the size and shape of the clumps of trees as well as the size and shape of cultivated fields. Excellent examples of this latter expression of fractures are present in the western part of the Peace River district.

Soil Tonal Lineaments

These reflect differentiation in soil moisture and general ground water conditions. These are common in the southern parts of Alberta and Saskatchewan, especially near large rivers.

Surface investigations have shown that fractures are associated with bedrock joints; however, in glaciated areas such as Western Canada, the photoanalyst must take care to establish the direction of ice flow over an area before he begins to statistically plot and analyse the fractures. Most areas in Western Canada show an abundance of grooves and flutes caused by the glacier and these must not be mistaken for fracture traces caused by subsurface structural conditions. In parts of the Lloydminster area of eastern Alberta the glacial scars are so deeply impressed on the surface that fracture analysis is at best difficult and often impossible.

Interpretation of Fracture Data

The object of Fracture Analysis (Photogeophysics) is to locate shallow to deep-seated structural and stratigraphic anomalies. The actual count of fractures per unit area is made and values are contoured on a "Fracture Intensity Map". In areas of known reefs the fracture intensity is 2 - 3 times greater on the flanks of the reef than directly above the reef.

In any fracture pattern there are two main systems of fractures; the axial system and the shear system. In both systems the fractures are sub-parallel and in general the two systems are at approximate right angles to each other.

Because of certain inherent limiting factors, Structure Incidence Surveys have a lower order of reliability than Detailed Fracture Analysis Surveys. To some extent at least, surface conditions affect the fracture count. In areas covered by lakes, sloughs and rivers, the fracture count is zero. Cultivated areas generally yield a lower count than adjacent virgin territory. Consequently, a difference or contrast in fracture count (F/l) between two points may be in part due to structure, but, also due in part to different surface conditions. To some extent, this can be compensated for by applying appropriate weightings to the observed counts, but over or under corrections may result.

Nevertheless, in spite of these sources of error, it has been demonstrated in (plains) areas where abundant subsurface control is available, that the incidence of fracturing is considerably above normal in the surrounding area immediately out from the steepest part of the flanks of the structure. This is in contrast with a low or normal incidence over the crestal area, and also to a normal incidence off structure.

FRACTURE ANALYSIS OF PERMITS 5451 and 5452

The fracture pattern as shown on the enclosed mosaic and maps shows a great variation in intensity over various areas of the Permits. The two Permits are located in the northeast part of the Eagle Plain Area, Yukon Territories, and are many miles from the closest settlement.

The sedimentary section is about 20,000 feet (plus) thick and several systems are represented. In addition a thin layer of Tertiary glacial till covers nearly all of the area. Potential reservoir horizons are present within the Cambrian, Silurian - Ordovician, Devonian, Mississippian, Permo-Penn, Triassic, Jurassic and Cretaceous systems.

Fractures as plotted on the mosaic show considerable variation in intensity. There is one area where the fracture intensity is greater than normal and there is one area where the fracture intensity is less than normal. The high intensity area is shown in red and the low intensity area is shown in green. The average length of the fractures is about 4,000 feet and both mega and micro fractures are present.

In any fracture pattern there are two main systems of fractures: the axial system and the shear system. In both systems the fractures are sub-parallel and in general, the two systems are at approximate right angles to each other. Within Petroleum and Natural Gas Permits 5451 and 5452 the statistical mean direction of the axial system is North 40 degrees West and the statistical mean direction of the shear system is North 30 degrees East. A third minor system, here termed the sub-axial system, trends nearly north-south.

No regional fractures of great length can be seen and as these are conceded to originate within the Basement, it is assumed that all fractures plotted on the mosaic originate within the sedimentary section. Furthermore, as the fractures are short for this area it is very likely that they originate in the upper two-thirds of the sedimentary section.

There is one area on the mosaic where the fractures are less intense than the surrounding area. Some fractures are always present within these low areas but they usually have a lower incidence than the surrounding area. These low intensity areas are important and it is quite likely that they are due to some subsurface feature. The type of feature will be discussed in the next section of this report.

STRUCTURE

Petroleum and Natural Gas Permits 5451 and 5452 are located on the Eagle Plain of the Yukon Territories.

Structural features which could be present and which could cause the low incidence anomalies mentioned in this report are discussed.

1. Pre-Cambrian Topography

Basement topography under Permits 5451 and 5452 is thought to be much the same as it is today along the southwest edge of the Shield. Low rounded hills separated by gentle to abrupt valleys are seen on the Shield and these features are undoubtedly present under the subject Permits. The effect of this Basement relief on the overlying sedimentary rocks is often great. The Granite Wash sand is usually present in the topographic "lows" on the Basement but absent on the "highs". The Granite Wash is an excellent potential reservoir.

Further effects of Basement topography on beds higher than the Granite Wash is the gentle folding present over Basement hills. These folds are anticlines in every sense and could form traps for oil or gas.

It is considered unlikely that the fracture pattern outlined in this report is caused by Basement fractures.

2. Devonian Reefs

Devonian reefs strongly affect the fracture pattern and control the occurrence of gas and oil in the overlying beds. Furthermore, it is possible that some reefs are present in the area of Permits 5451 and 5452. Reefs are known in the Norman Wells Area, which is 300 miles to the southeast.

3. Tectonic Folding and Faulting

The presence of tectonic folds is very likely as the Permits are located in a belt of known folding and faulting.

4. Topographic Relief on an Intra-Sedimentary

Unconformity, is a possible source of fracture intensity anomalies, and within the Permit area it is likely that the relief on many unconformities within the sedimentary section is great enough to affect the fracture pattern.

Reference to the Total Fracture Pattern Map which accompanies this report will show that there is one area of "high" fracture intensity, and one area of "low" fracture intensity (green). The general interpretation is that the low fracture intensity areas are underlain by topographic highs on an unconformity within the sedimentary section. With this established, the deduction is that there is a "high" within the section which trends north-south and which is present at the junction of the two Permits.

Intra-sedimentary high features are most interesting from the oil and gas point of view. The general shape of this feature is such that the causative feature must be a hill on an intra-sedimentary unconformity. A fault is unlikely as the causative feature on this high feature is over one and one-half miles in width. If a fault caused the fracture "low" the width of the low would be about one mile or less.

Three hypothetical structure cross-sections accompany this report and reference to them will show how Basement "highs" are inferred to be present beneath areas of low fracture intensity. Two profiles $C\text{-}C^1$ and $B\text{-}B^1$ run at right angles to the strike of the Basement while the third $A\text{-}A^1$ is parallel to strike.

RECOMMENDATIONS

In the initial stages of exploration it is imperative to understand the geometry of fault systems that may be present and to be aware of any gross lithologic changes in the area of interest. It is therefore recommended that a detailed photogeologic study be undertaken with the aim of selecting the appropriate grid pattern for a relatively inexpensive reconnaisance gravity and magnetometer survey. Spot checks of surface structures and lithologies could be made in the field at the same time the aforementioned surveys were being run.

Seismic surveys might be conducted during the second period of the life of the Permit. Near surface structure and lithology could be checked by means of helicopter-mounted drilling rigs in the summer months. Track-mounted rigs would be able to add to, or deepen the existing stratigraphic test holes during the winter months. Exploration activities might culminate in the drilling of relatively deep tests.

Respectfully submitted by:

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