[illegible]

There are two areas on the map where the features are less intense than the surrounding area. Some features are always present within these areas but they always have a lower intensity 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 Permit No.5059 is located on the interior plain of the Northwest Territories about 50 miles from the west of the edge of the Pre-Cambrian Shield. The strike of the sedimentary rocks is about north 30 degrees west and the units dip to the southwest at a few tens of feet per mile.

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

(1) PRE-CAMBRIAN TOPOGRAPHY

Basement topography under Permit No.5059 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 Permit. 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 gentle folding present over Basement hills. These folds are anticlines in every sence and could form traps for oil or gas.

Many small faults have been reported by A.W. Norris (1965) in the Basement and immediately overlying rocks and these features could cause closure within the sedimentary units.

2. DEONVIAN REEFS

Devonian reefs strongly affect the fracture pattern and control the occurrence of gas and oil in the overlying beds. Devonian reefs are present west of this Permit and others could well be present under the subject area.

3. TECTONIC FOLDING & FAULTING

The presence of tectonic folds is very unlikely, but some normal faulting is probably present.

4. TOPOGRAPHY RELIEF ON AN INTRA-SEDIMENTARY UNCONFORMITY

Unconformity, is a possible source of fracture intensity anomalies, but within the Permit area it is unlikely that the relief on any 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 two areas of "low" fracture intensity (green). The general interpretation is that the low fracture intensity areas are underlain by topographic highs on the Basement, With this established, the deduction is that the Basement is high in the central-east and southwest parts of Permit 5059.

These Basement high features are most interesting from the oil and gas point of view. The general shape of the features is such that the causative feature must be a hill on the Basement surface. A fault is unlikely as the causative feature as the high areas are greater than one and one-half miles in width. If a fault caused the fracture "low" the width of the low would be less than one mile.

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 run at right angles to the strike of the Basement while the third is parallel to strike.

Respectfully submitted by:

RAYALTA PETROLEUMS LTD.

William H. Cook

WGC/lp

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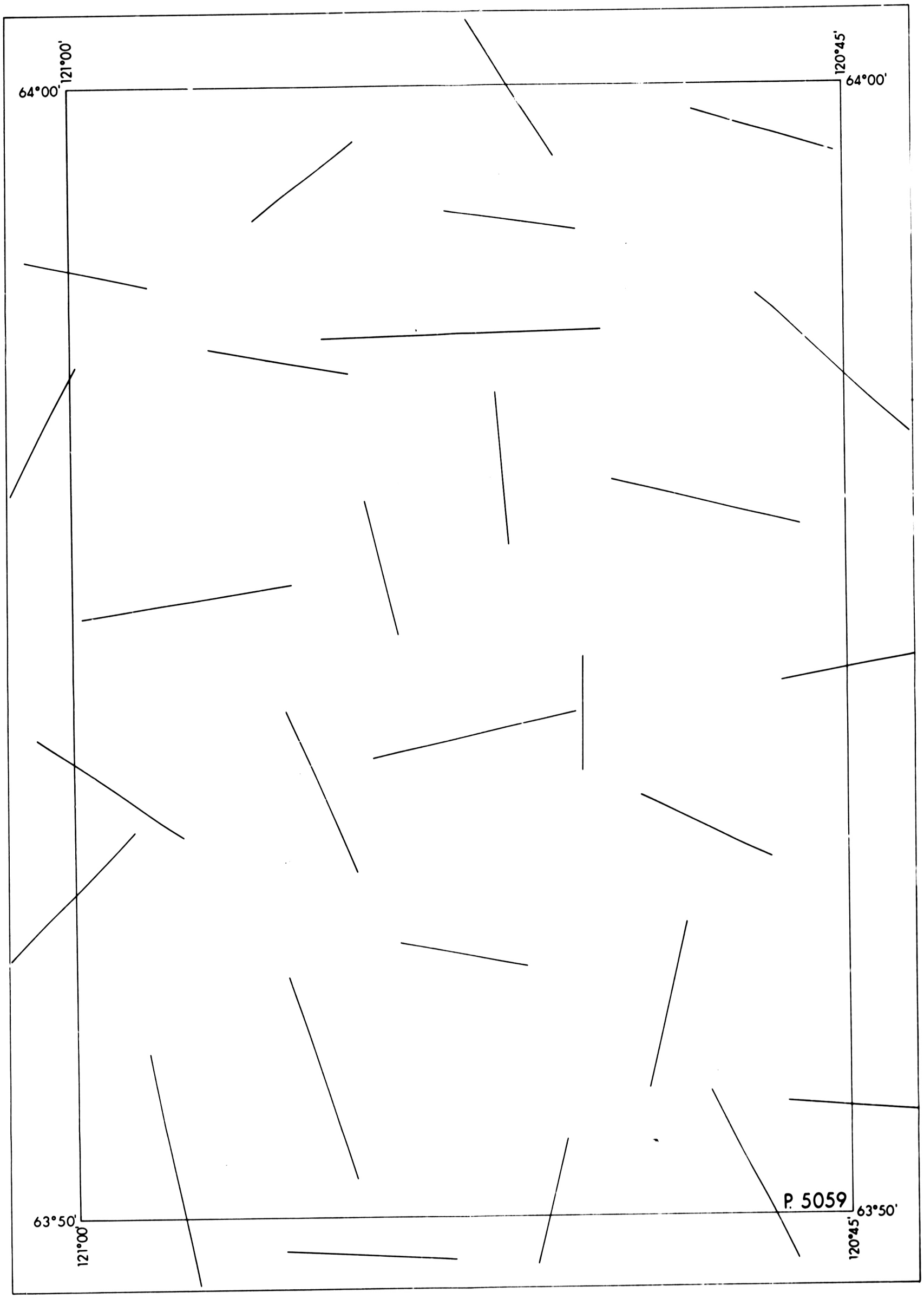

GROSMONT OIL & GAS LTD.

P. & N.G. PERMIT 5059

MEGA FRACTURE PATTERN 662-1-S:12

SCALE IN MILES

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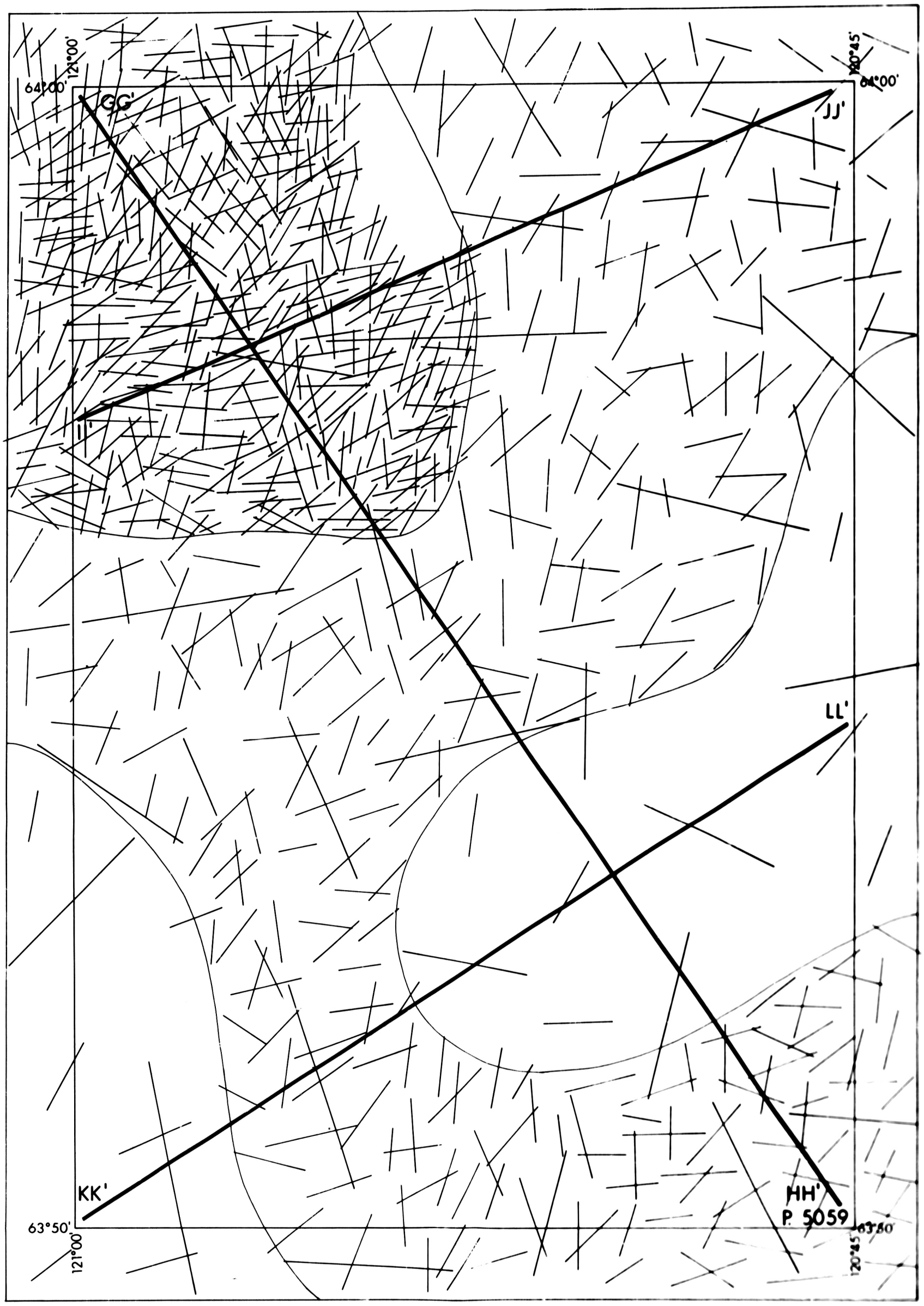


GROSMONT OIL & GAS LTD.

P. & N.G. PERMIT 5059

TOTAL FRACTURE PATTERN

662-1-8-12

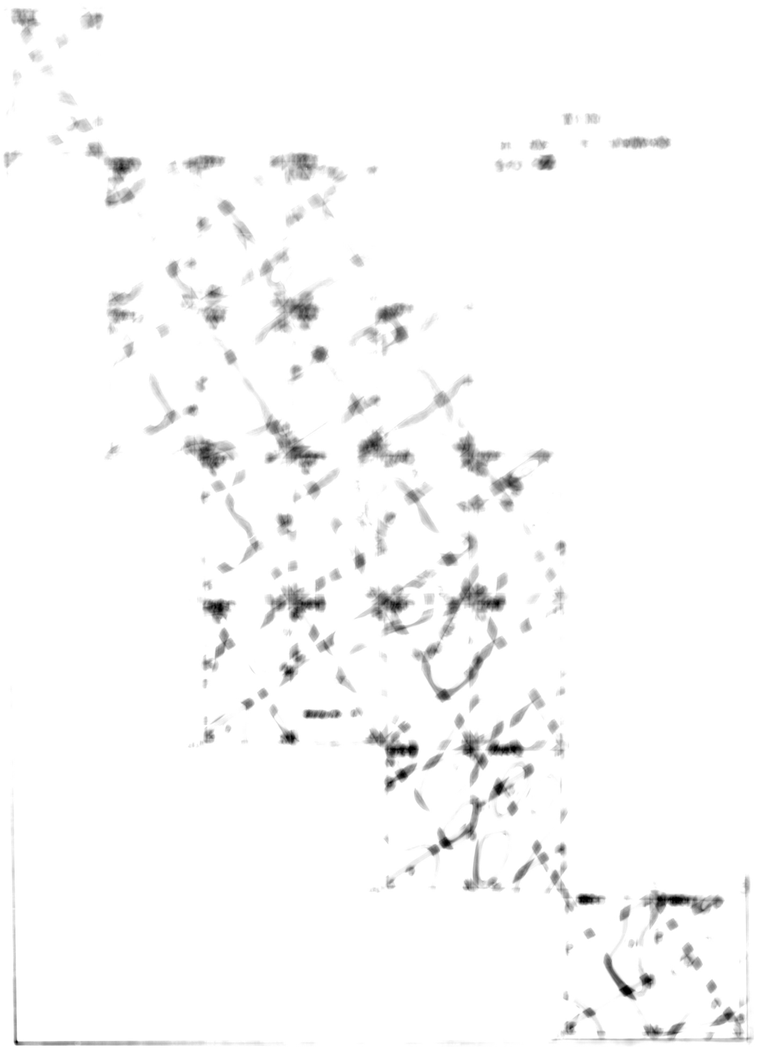
SCALE IN MILES

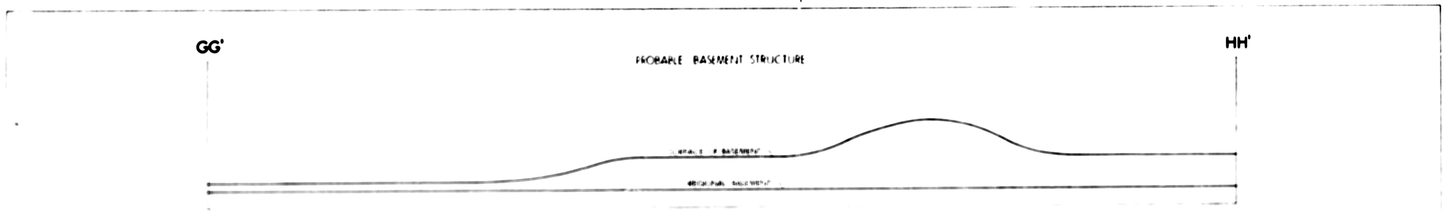
1 0 1 2 3

LOW DENSITY

NORMAL DENSITY

HIGH DENSITY




GG'
HH'
PROBABLE BASEMENT STRUCTURE


GG'
HH'

662-45-12

GENERAL GEOLOGY

&

FRACTURE ANALYSIS SURVEY

of

P. & N. G. PERMIT NO. 3059

for

CROSMONT OIL & GAS LTD.

by

RAYALTA PETROLEUMS LTD.

INTRODUCTION

This report discusses the results of a Fracture Analysis Survey carried out within, and in the immediate vicinity of, Petroleum and Natural Gas Permit No. 5059. This Permit is located in the Northwest Territories and is held under the Canada Oil and Gas Land Regulations and is located between 120° 45' to 122° 00' longitude and 63° 50' to 64° 00' latitude. The Permit is 760 miles north of Edmonton and 240 miles northwest of Yellowknife.

The Yellowknife Highway serves Fort Providence which is 200 miles southeast of the Permit and is the closest road to the area. Access to the Permit itself is by helicopter or on foot during the summer or by vehicle during the months when the ground is frozen. However, there are no roads in the area and considerable road construction would be required to reach any particular area. Some narrow cut lines are present and these afford limited access.

The surface of the Permit is quite flat-lying and total relief does not exceed 100 feet. There is only a poorly developed drainage pattern within this area and a few intermittent streams flow northwest towards the Johnny Hoe River. A layer of very soft muskeg covers this part of the North-west Territories and this muskeg is so soft that it is impassable to all but specialized vehicles.

Vegetation consists of thick stands of thin evergreen trees interspersed with many small open areas. These open areas are covered by muskeg grass and scrub deciduous growth. The evergreen trees show up as a medium gray tone on the mosaic and the open areas are a lighter gray. A few small patches of deciduous trees are present.

There is no topographic form or aerial photo feature present which immediately suggests the presence of any geologic structure.

The results of this survey are illustrated on the Total Fracture Map, the Mega Fracture Map plus the rosette with the fractures superimposed. In addition there are three hypothetical cross sections. All the above can be found in the folder at the back of this report.

STRATIGRAPHY

GENERAL STATEMENT

The stratigraphic discussion presented herewith is based on a study of the area covered by Petroleum and Natural Gas Permit 1033 and Permits 1062 to 1081 inclusive. The outcrops in this area are located along the south shore of the North Arm of Great Bear Lake and extend southeast to about 64° 00' - 62° 00'. No wells have been drilled in this area and surface outcrops are rare and widely scattered. Therefore, it has been necessary to study the regional geology of the whole Mackenzie Plain area and make many projections of data and, admittedly, some of these projections are rather long ranged. However, when combined with such subsurface information as is available an accurate picture of the sedimentary stratigraphy can be presented

The Permits are on the Interior Plains 40 to 60 miles east of the Franklin Mountains, and about 100 miles west of the Pre-Cambrian Shield outcrop area. The Permits lie about 150 miles east-southeast of the Norman Wells Oil Field which provides most of the nearest well control. The area covered by the above referred Permits is underlain by sediments ranging in age from Cambrian to Tertiary. Regional isopachs indicate about 6,000 feet of sediments should be present under the northern Permits and about 4,500 feet under the southern Permits. Structurally, they should be underlain by homoclinal to gently folded beds. However, since the Northern Franklin Mountains are the result of compressional movements, it would seem likely that the area lying in front of the mountains may have been folded into anticlines of appreciable magnitude. The Pre-Cambrian may have undergone early faulting under the Permits since faulting of this age is quite common in this region. The Basement

faults have commonly produced northeast trending lineaments but are generally conceded to have not disturbed the Paleozoic sediments. The Basement faults are generally steeply inclined right-hand faults and as far as is known, the horizontal movement exceeds the vertical movement by a large amount. Some recurrent movement at widely separated times has been noted in the region. Well control east of the acreage concerned is very scarce. Regional isopachs and facies maps along with published geological reports have been used to describe the stratigraphic sequence which might be expected to underlie this area.

CAMBRIAN and/or OLDER

KATHERINE GROUP

The Katherine Group which represents the earliest Paleozoic sediments in this region, is named from a section exposed in the Upper Carcajou River area which lies about 150 miles

west of the acreage under study The section exposed consists of interbedded quartzites and black, platy shales The shales which are black, platy, bituminous as well as green and chocolate coloured, are contained in interbeds within the quartzites The quartzites are generally pink, buff, rusty and white in outcrop The top of the Katherine is placed at the base of a chocolate coloured shale succession while the base was not seen in outcrop leaving the total thickness unknown for this area The Katherine Group has not been penetrated by any drill holes in this region to date, which means the subsurface section is unknown While reservoir beds are not described in outcrop it must be expected that sand bodies such as offshore bars, beach sands and long shore bars will eventually be found in this group of sediments Similar sands are found to be prolific producers in the Red Earth Creek area of northern Alberta The delineation of prospective areas for encountering such sands is dependant

on a knowledge of present Pre-Cambrian structure as well as its topographical expression, when the sands were being deposited A gravity meter and airborne magnetometer survey could be used to good advantage in locating areas for more detailed exploration Source rocks for hydrocarbons should be no problem since the outcrop section previously described would appear to contain an adequate source within its bituminous shales. This section should be considered in any exploratory plans for this area

CAMBRIAN

MACDOUGAL GROUP

The type section of the Macdougal Group is located about 130 miles west of this area in the Dodo Canyon of the Macdougal River. At the type section the Macdougal is divisible into a number of formations which total 997 feet in thickness. The base is placed at the bottom

of a 130 foot thick chocolate brown shale while the top is placed above 50 feet of evenly bedded limestone with shale partings. The lithology is made up of interbedded limestones, sandstones, reddish coloured gypsum, black, petroliferous shales, red and green shales as well as choclate coloured shales. The Imperial River section which was mapped by Laudon lies 30 miles to the northwest of the type section. The section, which is 1,839 feet thick with the base not exposed, consists of alternating sandstones, limestones, gypsum and varicoloured shales. The lower part consists of sandstones with minor shale interbeds which appear to be a shallow water deposit since they are ripple marked and cross-bedded. The section becomes increasingly shaly upwards. The gypsum content is also greater near the top. A 146 foot thick bed of black to dark grey, laminated, algal limestone is located near the top of the section. Calcareous algae up to three feet in diameter are present. At

Norman Wells the Macdougal Group contains a bed of salt 2,000 feet thick which is correlated with the Saline River Formation This salt section is believed to be present to the north, west and south of Norman Wells for the following reasons:

1 The Western margin of the Saline River salt is known in the Norman Wells area and a postulated extension of this margin can be made to the north, west and south of Norman Wells

2 The overlying Ronning carbonates are brecciated at exposures in the northern Richardson Mountains west of Inuvik, suggesting salt solution collapse

3 The type section at Saline River which lies 100 miles south of

creates the possibility of salt structures in the overlying carbonate banks similar to those found to be productive in southeast Saskatchewan and at Rainbow Lake in northwestern Alberta. The algal laminate at Imperial River indicates some organic activity in the Macdougal seas and this coupled with underlying salt features, could give rise to hydrocarbon bearing reservoirs within this sequence. The petroliferous shales within the Macdougal should be adequate source material. The Macdougal has been reached by very few of the wells drilled in this region and no where has it been fully penetrated. Imperial Vermilion Ridge No. 1, drilled 3,177 feet of Macdougal beds without reaching the underlying Katherine Group. To date no reservoirs have been tested in the wells which have drilled to the Macdougal.

ORDOVICIAN-SILURIAN

RONNING FORMATION

Rocks of Ordovician Age have not, as noted by various authors, been definitely identified in this region; however, it seems to be generally accepted that they are present in the Norman Wells region. The contact with the underlying Macdougal is unconformable Stelck mapped 1,500 feet of shales and argillites at outcrops in the Upper Peel River area, which lies some 300 miles to the west of these Permits. About 150 miles west of the Permits, at the Keele and Twitya River confluence, the Ordovician section was mapped by Keele as 4,000 feet of alternating beds of argillite, dolomite and limestone with 1,500 feet of sandstone overlying and separated from them by a 100 foot thick diabase sill He mapped this same sandstone 35 miles to the east as being 4,500 feet thick with only occasional shale partings The sections described in outcrop by Keele

and Steick along with the scattered subsurface control available have been used to establish some regional lithofacies trends for the Ordo-vician.

The Upper [illegible] is [illegible] as an open marine [illegible] sequence of shales and argillites. Flanking this basin are shelf edge carbonates which are [illegible]. These shelf edge carbonates are found along the Mackenzie Mountains and in the [illegible] Plateau. [illegible] of the shelf edge carbonates are the shelf carbonates [illegible] which are generally clean [illegible] carbonates with variable porosity. They are [illegible] over most of the [illegible] and [illegible] the [illegible] discussion.

[illegible]

with variable degrees of porosity.

At the nearest outcrop section of the Ronning, which is found about 50 miles west of the Ronning at Mt. St. Charles on Great Bear River, the Franklin Mountain Formation is about 661 feet in thickness. The section consists of limestones with the basal 200 feet described as cavernous; about midway in the section is 71 feet of cherty limestone. The upper [illegible] feet is a grey, dolomitic limestone. The base of the Franklin Formation here is not exactly clear as various workers have included beds beneath those described in the Ronning Group as well. They consist of gypsum, conglomeratic limestone with black, bituminous shales and highly bituminous limestones, which seems more like Macdougal to the writer. The Mount Kindle consists of 480 feet of carbonates; the basal [illegible] feet is a dolomitic limestone containing corals while overlying it are 80 feet of limestone and chert beds. The upper

180 feet is a hard, grey dolomite that is cherty in the lower part. The section is overlain by the Bear Rock brecciated dolomites. The section at Bear Rock near Fort Norman, which is 30 miles west of Mt. St. Charles, consists of 600 feet of limestone, dolomites and shales with the brecciated sediments of the Bear Rock overlying them and the Macdougal red and green, gypsiferous shales underlying them. The Mount Kindle is apparently not present here. Imperial Loon Creek No. 2, in 65° 07' 20" N., and 126° 12' 51" W., which is about 75 miles west of the Permits, penetrated 1,270 feet of Ronning which is close to the same thickness as mapped at Mt. St. Charles. The Loon Creek well found the Ronning to consist mainly of white to grey, micro-crystalline to granular dolomites with some evaporitic plugging. Scattered poor porosity was present throughout; however, no tests were run. Outcrops of the Ronning are found about 200 miles to the northwest of the Permits along the Hare Indian

River. The section consists of 750 feet of limestones, overlain by the Bear Rock with the base not exposed. The section is not identified as Mount Kindle but regionally it should be present at this location.

Stelck mapped 100 feet of massive, crystalline, porous limestones containing some coralline fauna at Schooner Creek, which is four miles north of Norman Wells. He correlated them with the lower portion of the Mount Kindle Formation. This section can be interpreted as a porous, carbonate bank deposit The Mount Kindle is likely to have a number of these carbonate banks or low transgressive reef fronts in this area, since, as can be seen from the various sections described above, it undergoes both facies changes and thickness changes in this region. Since the Mount Kindle is present on Mt St Charles to the east of the Permits, as well as to the north of them it will doubtlessly be present under

(b) As outlined previously, low reef fronts or carbonate banks may be present and coupled with a seal provided by overlying Bear Rock evaporites could present an extensive trap. Lateral facies changes from porous to semi-evaporitic carbonates also provide a potential trap of considerable areal extent.

(c) Selective solution of the underlying Cambrian Saline River salt may give rise to one or two stage salt solution structures such as are found to be productive of oil in the [illegible] area of southeast Saskatchewan. Partial solution of the salt prior to or during the [illegible] could have served to provide local elevations on the sea bottom where the salt was not removed. These local elevations

would provide the loci for reef and/or carbonate banks to grow on. Traps of the Hummingbird type would involve early local solution of the salt. This may have occurred in late Cambrian or early Ronning time. The depressions created would receive an extra fill of sediments over that being deposited where the salt was not removed. Once sedimentation within the sink caught up, subsequent sediments would be deposited on a normal sea floor. The second stage in the formation of the Hummingbird type trap would involve the removal of the salt surrounding the original sink at some time [illegible] deposition. This would leave the [illegible] overlying the site of the

original salt solution structurally high. The Bear Rock evaporites should provide an effective reservoir seal. Evidence to support one or two stage salt removal in this region is present in the brecciated nature of the sediments composing the Lower Ronning and Bear Rock sediments in known sections.

(d) Gentle to tight anticlinal folds may have been formed by some of the numerous periods of structural activity which have occurred in this region.

MIDDLE DEVONIAN

BEAR ROCK FORMATION

The Bear Rock Formation overlies the Ronning Group and is separated from it by a

[illegible]

Mountains continues southeast along the western side of the MacKenzie Mountains. The basinal shales are flanked by a belt of shelf-edge limestones and dolomites along their eastern side. Porosity is developed within these carbonates. Adjacent to the shelf-edge carbonates and covering much of the Interior Plains and Peel Plateau area are the shelf limestone and dolomite facies. In the Peel Plateau they attain a thickness of some 2,000 feet and consist of micritic, pellet and micitic skeletal limestone with intervals of finely crystalline, porous dolomite in the lower part. The shelf carbonates are in turn replaced by a relatively narrow belt of shelf dolomites. This takes place in the MacKenzie Mountains and extends in a line north through the Fort Good Hope region and south into the Camsell and Nahanni Ranges. The shelf dolomites in turn are replaced by an evaporite facies along their entire length. This facies change begins to the west of Norman Wells. In the Norman

Wells area and also in the area of the Permits under discussion the basal portion of the Bear Rock is commonly evaporitic while the upper portion consists of carbonate breccias. The evaporite facies extends southward into northern Alberta where it is known as the Chinchaga Formation. South of Norman Wells a strong depositional feature called the Camsell Basin occurs. Thickening from 2,000 feet to more than 5,000 feet, accompanied by facies changes from evaporites through shelf carbonates to basinal sediments takes place into this basin. The shelf carbonates are cryptocrystalline to microcrystalline dolomites while the shelf-edge facies is reefal with some of it at least being porous.

The Bear Rock carbonates in the Norman Wells area have been found to be very porous in some wells while in others the porosity has been plugged by anhydrite and gypsum. Considerable bitumin has been en-

[illegible]. The eruption occurred on Mt. [illegible] which is about 10 miles west of the [illegible] [illegible] may be considered as supporting evidence for the theory that the [illegible] of the Clear Creek was caused by the [illegible] of [illegible] [illegible] ash during Clear Creek deposition. The eruption is described by Williams as the last one of [illegible], [illegible] [illegible] [illegible] [illegible] [illegible] by [illegible] [illegible] of [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. The top of the Clear Creek was not eroded. In addition to the [illegible] [illegible] [illegible] the Clear Creek [illegible], the great thickness of sediments [illegible] in Clear Creek could be considered [illegible] of greater [illegible] during the [illegible] [illegible] than were occurring in adjacent [illegible]. The thickness of Clear Creek which is the [illegible] [illegible] is around [illegible] feet. The [illegible] thickness [illegible] [illegible] [illegible] [illegible] to [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

ever, this does not seem very plausible. The rapid facies changes which may be espected within the Bear Rock is evident when the Mt. St. Charles section is compared to an exposure three miles further north. Here the chert beds of the underlying Mount Kindle Formation are overlain by 500 feet of grey gypsum beds that are in turn overlain by limestone beds that are mapped as part of the overlying Hume (Ramparts) Formation. The Mt. St. Charles section has no evaporites. The thickness variation between these two sections is worthy of comparison also.

HUME FORMATION

Considerable confusion has existed in the literature concerning the relationship of the Ramparts or Hume, Hare Indian and Kee Scarp Reef. A paper by H.G. Basset in the Geology of the Arctic Symposium is probably the most important to an understanding of the Middle Devonian geology of this area.

Hume defined the Ramparts Formation as containing all definite Middle Devonian beds in the Norman Wells area as well as in the surrounding area. The base would be placed at the top of the underlying Bear Rock and the top at the contact with the overlying Fort Creek Shales. He divided the Ramparts into three members, a lower limestone member, a middle shale member and an upper limestone member. The lower limestone, which is relatively thin in the Norman Wells area, thickens in a northwest direction. About 60 miles west-northwest of Norman Wells in the Imperial Range on Mountain River the Lower Ramparts is described as 445 feet of limestone, dark grey to black, with irregular black shale partings, very fossiliferous in part (particularly corals) and very petroliferous in part. The Middle Ramparts of this section consists of 700 feet of grey to green shales and limey shales with many thin limestone beds which are commonly conquinoid in the lower

[redacted]

[redacted]

[redacted]

[illegible]

[illegible]

The Hume has been described at various localities as being very petroliferous in part. This situation is also duplicated in the Keg River platform where it is overlain by the

productive Keg River pinnacle reefs in north-western Alberta. The Keg River platform is almost certainly the source of the oil in these prolific reefs, and because of the similarities outlined above any reservoirs developed in the Hume must be considered as prospective

HARE INDIAN

The contact of the Hare Indian with the underlying Hume is generally sharp and probably represents a sudden influx of mud into a clean well aerated sea It appears to represent a mud bank deposit with the source area lying to the northeast, partially filling a large basin The contact of the Hare Indian with the overlying Kee Scarp is somewhat diachronous, since it is generally placed at the point the section changes from predominant shale to predominant limestone. Facies changes thus account for the diachronous nature of the contact as well as having been the cause of some of the confusion which has

and is usually about 100 feet thick at Norman Wells. South of Norman Wells it is again represented by about 500 feet of shale around the confluence of the MacKenzie and Redstone Rivers. Worthy of note is the similarity between the Carcajou River section and the relationship between the Klua Shale and the adjacent reefs in the Clarke Lake area of northeastern British Columbia. Here the Klua Shale which is Middle Devonian, overlies the Keg River Formation in some areas while in others continuous reef growth from Keg River time through Slave Point has allowed no shale deposition.

KEE SCARP

The Kee Scarp as redefined by Bassett is a widely distributed formation. Ostracods have been used to establish the Kee Scarp as equivalent to the combined Sulphur Point Slave Point sequence of northern Alberta. The contact with the underlying Hare Indian shale as [illegible] noted is [illegible]. The Kee

Scarp in the Norman Wells area consists of a lower platform unit which is about 75 feet to 165 feet thick and lithologically is a bedded limestone with abundant fossils. The platform unit is usually devoid of hydrocarbons. Overlying the foundation unit is a biohernal reef which constitutes the reservoir for the Norman Wells Oil Field. The reef is composed of materials such as corallites, bryozoans and stromatoporoids set in a coral sand matrix. The facies varies widely between wells as would be expected in a true reef. The thickness of the Kee Scarp reef above the platform unit varies from zero (0) feet to 350 feet in the Norman Wells area. The greatest overall measured thickness of Kee Scarp in the area is 495 feet. The Kee Scarp is overlain by the Canol Formation, or, in its absence, the Fort Creek shales which Basset redefined as part of the Imperial Formation.

The oil in the Norman Wells Field is trapped in the updip end of a discrete Kee Scarp reef. The thickness of the reef ranges up to a total of 495 feet. Reserves in the reef have been estimated as high as 60,000,000 barrels while the productive area of the field is placed at 2,600 acres.

The platform unit of the Kee Scarp is undoubtedly the correlative of the Upper Famoarts limestone unit mapped by Hume. This fact, as mentioned above, means the Kee Scarp is a widespread unit. Since the Kee Scarp reef grows upwards from the platform unit any well drilled in this area and any acreage held, must be considered as possibly containing discrete Kee Scarp reefs. Maximum reef growth, regionally, has generally been found on the margins of Hare Indian thicks, however, the presence of them does not ensure Kee Scarp reefs. The margins of the two Hare Indian thicks, which were described

CRETACEOUS

SANS SAULT GROUP

The Sans Sault Group is the basal group of Cretaceous sediments which lie directly above the disconformity separating Cretaceous and Devonian sediments. The top of the Group is usually placed at the base of the first bentonite bed in the overlying thick shale sequence. The sequence consists of shales and sandstones of marine origin. The thickness is about 1,411 feet at the Sans Sault section.

SLATER RIVER FORMATION

The Slater River which overlies the Sans Sault Group, consists of thin bedded, [illegible] friable shales with abundant ironstone concretions. There are also some beds of white and yellow alum and sulphur. Sandstone is only occasionally present. There are many beds of bentonite, which in outcrop are [illegible] thick. The Slater River

Formation also contains a fish scale horizon which is thought to indicate an upper Cretaceous Age for the formation. This formation is about 1,000 feet thick at the type section.

LITTLE BEAR FORMATION

The type section of this formation is west of Fort Norman on the Little Bear River. The beds consist of sandstone, some conglomerates, sandy shales and coal seams. The beds are not correlatable between areas due to their lenticular nature. The beds are 780 feet thick at their type section and contain marine, brackish and fresh water fossils.

EAST FORK FORMATION

The East Fork Formation is made up of a series of well stratified, grey, conchoidal and plastic marine shales. There are some thin limy sandstone members and thin coal seams near the base. The thickness of this formation is 850 feet at its type locality on the

East Fork of the Little Bear River.

The thickness of Cretaceous beds present underlying this Permit area is very difficult to ascertain. C.S. Lord noted coal deposits on Etacho Point which lies about 100 miles due north of the Permits on the west side of Great Bear Lake. The coal which is lignite, is contained in about 1-1/2 miles of outcrops. The outcrops usually contain several seams separated by a few feet of clay, sand, or silt. The width of one seam is from 12 feet to 17 1/2 feet and may be about 7,000 feet in length. The age of the coal is not given, but it may be part of the Little Bear Formation.

The unconformity which underlies the Cretaceous in this area has probably removed much of the Devonian Imperial Formation from the area covered by these Permits. Since subsurface and surface control is so sparce in this area, any prediction of the depth of

this erosion is very difficult to make. North of Norman Wells this erosion has in places removed the entire Upper Devonian sequence, leaving the Middle Devonian Formation at subcrop.

TERTIARY

The Tertiary sediments in the Norman Wells area are not subdivided. They consist of conglomerates, gravels, shales, lignites, soft, coarse, carbonaceous sands and soft clays. The Tertiary is exposed south of the Permits under review in the Mt. St. Charles area long the Great Bear River. Plants collected from the exposures along the Great Bear River indicate an Eocene Age. The thickness is approximately 600 feet at these exposures. At exposures on the Little Bear River, 1,600 feet of Tertiary sediments have been mapped. Near the headwaters of the East Fork River beds up to 1,200 feet

have been mapped with coal seams eight feet to ten feet thick. The sections mentioned form part of a basin which dips to the south-west in this area.

It is recommended that further evaluation of the Permits under review consist of gravity meter and/or airborne magnetometer surveys. They should be of great assistance in outlining the distribution of the Saline River salt and any salt structures associated with it. The present structure of the Pre-Cambrian Basement could probably be mapped by this method, also, as well as providing a better idea of the drilling depth to it.

FRACTURE ANALYSIS

This section of the report discusses the results of a Detailed Fracture Analysis Survey carried out on the area under discussion. An aerial mosaic (scale 1.5 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"

[illegible]

[illegible]

[illegible]

SOIL TONAL LINEAMENTS

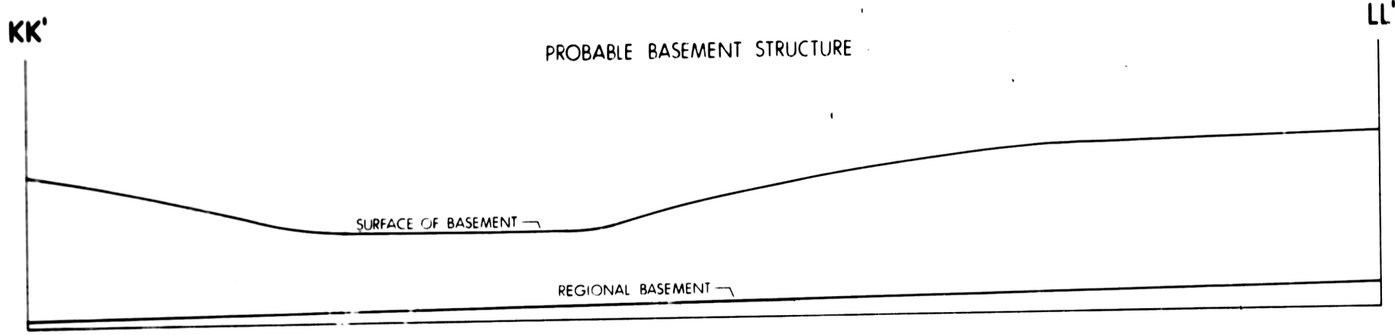
deeply impressed on the surface that fracture analysis is at best difficult and often impossible

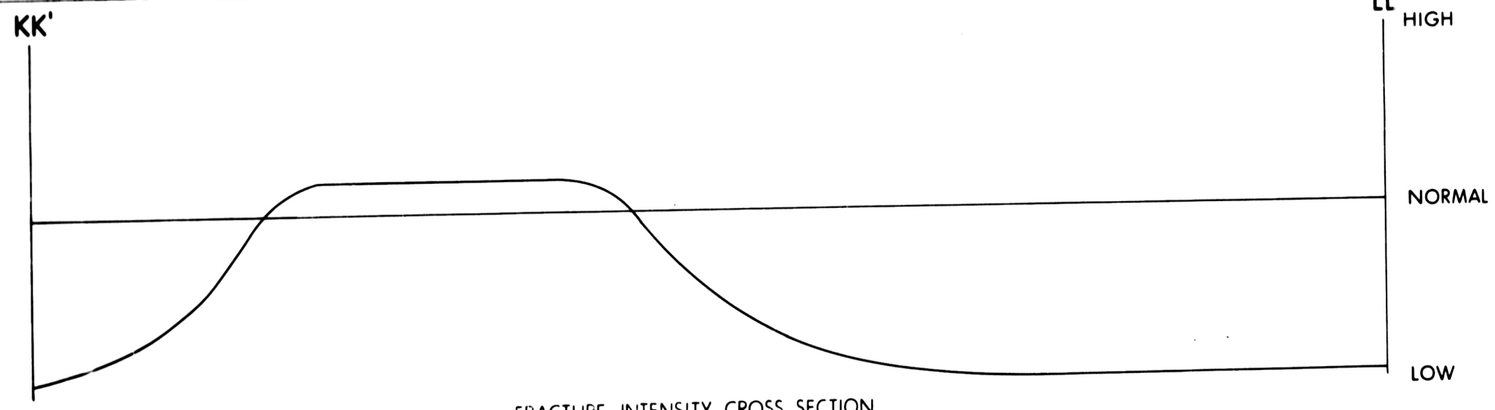
INTERPRETATION OF FRACTURE DATA

[illegible]

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 of contrast in fracture count [F/I] 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 proper factor weightings to the observed counts but even so [illegible]

structure This is in contrast with a low or normal incidence over the crestal area, and also to a normal incidence off structure





FRACTURE INTENSITY CROSS SECTION

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SCALE IN MILES

1 0 1 2 3