662-N-5-21

GENERAL GEOLOGY

&

FRACTURE ANALYSIS SURVEY

of

P.&N.G. PERMIT NO. 5063

for

GROSMONT 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. 5063. This Permit is located in the Northwest Territories and is held under the Canada Oil and Gas Land Regulations and is located between 121° 00' to 121° 15' longitude and 64° 00' to 64° 10' latitude. The Permit is 800 miles northwest of Edmonton and 260 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 150 feet. There is only a poorly developed drainage pattern within this area and a few intermittent streams flow into the Johnny Hoe River which cuts through the Permit. A layer of very soft muskeg covers this part of the Northwest 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 intersperced 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 lus the mosaic 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 1059 and Permits 1062 to 1081 inclusive. The north limit of this area is located along the south shore of the Keith Arm of Great Bear Lake and it trends southeast to about 64° 00' : 121° 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 Northwest Territories 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 acceptable picture of the sedimentary stratigraphy can be presented

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 Katherine 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 choclate 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 Mackenzie 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

the Permits under discussion,
contains salt as evidenced by
the presence of salt springs

b Aeromagnetic coverage
south of Inuvik has disclosed
two features which bear a
marked similarity to known salt
domes in the Arctic Islands

t The gypsum in three
diapiric structures which intrude
Cretaceous beds on the east
margin of the Richardson
Mountains west of Inuvik contains
evidence of early Paleozoic
origin

Since the Caribou River salt is evidently
of Devonian age it should be present under this
area with the eastern edge lying some unknown
distance to the east The solution of this salt

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 Stelck along with the scattered subsurface control available have been used to establish some regional lithofacies trends for the Ordovician.

The Upper Peel River section is mapped as an open marine basinal sequence of shales and argillites. Flanking this basin are shelf-edge carbonates which are reefal in part. These shelf-edge carbonates are found along the MacKenzie Mountains and on the Peel Plateau. Back of the shelf-edge carbonates are the shelf carbonates proper, which are generally clean, finely crystalline carbonates with variable porosity. They are present over most of the interior plains and should underlie the Permits under discussion.

The distribution of Silurian Age strata covers a much wider area than do the beds of Ordovician Age. Lithologically the Silurian rocks are very similar to the underlying

Ordovician beds and for this reason as well as ease of working with them, they have been grouped together as the Ronning Group. The sedimentary pattern for the Silurian is very similar to that established in the underlying Ordovician. In the Norman Wells area the Ronning Group can be divided into two formations, a lower unit named the Franklin Mountain and an upper unit named the Mount Kindle. The Franklin Mountain Formation is generally composed of limestones and dolomites with abundant irregular shaped chert nodules. The Mount Kindle is usually found to consist of a sequence of chert poor limestones and dolomites which tend to thin in a southerly and easterly direction.

The Franklin Mountain Formation should be approximately 800 feet thick in the area covered by these Permits. It should consist of clean, finely crystalline shelf carbonates with abundant chert inclusions and

[illegible]

[illegible]

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.

Sleich 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 Ekwan, as well as to the north of there it will doubtlessly be present under

them. The section may contain carbonate banks or low reefs fringing the eastern shoreline of the Mount Kindle sea Oil staining has been described in the Upper Ronning Group at wells in the Norman Wells area.

The trapping conditions which can be outlined in this area, are quite varied. A few of these potential traps are outlined below:

(a) The marked disconformity which separates the Ronning Group from the overlying Middle Devonian-Bear Rock Formation may have produced erosional features, such as scarps and monodnocks, which would be sealed by the basal evaporites of the Bear Rock. Leaching should enhance the reservoir properties and make this an effective hydrocarbon trap.

(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 Hummingbird area of south-east Saskatchewan. Partial solution of the salt prior to or during Mount Kindle deposition would 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 subsequent to Mount Kindle deposition. This would leave the Mount Kindle reservoirs 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

[redacted]

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-

countered in places. Drill stem test results vary from mud recoveries to water flowing to surface. While the wells drilled by Western Decalta at Rond Lake are about 250 miles to the northwest of the Permits under review the oil shows in these wells is significant in that they establish the presence of hydrocarbons in beds of Bear Rock Age. Decalta et al Rond Lake # 2, located in 67° 5' 27" N., and 128° 25' 42" W., lost circulation near the top of the Bear Rock and sulphur water was bailed from this interval. Decalta et al Rond Lake # 1, located in 67° 04' 51" N., and 128° 28' 18" W., flowed sulphurous water on a test conducted about 900 feet below the top of the Bear Rock. Subsequent to the completion of drilling, a plug was set to 1,046 feet. The hole was bailed to 600 feet with oil cut sulphurous water being recovered. Three weeks later the hole was again bailed with oil cut sulphurous water recovered again. Indicative of the stratigraphic trap possibilities, is the

fact that the Rond Lake # 1 well was located downdip to the # 2 well and recovered oil cut water near the base of the Bear Rock, while # 2 well only recovered sulphurous water from the top of the formation. The Bear Rock could be placed in trap position by any of the various structural conditions outlined in the preceding discussion of the Ronning Group.

The Bear Rock is present in outcrop along the Hare Indian River about 140 miles northwest of the acreage under review. It consists of typical brecciated limestone and gypsum. The brecciated nature of the Bear Rock was previously mentioned as being a probable product of the solution of the Cambrian Saline River salt. A more conventional theory for the origin of the breccia is that it is a product of the sharp disconformity separating the Ronning Group from the overlying Bear Rock Formation. This theory is doubtlessly true for the basal portion of the Bear Rock

[illegible] defined the Ramparts Formation as consisting of 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 Shale. 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 [illegible] in the Norman Wells area, [illegible] in a northwest direction. About 60 miles west northwest of Norman Wells in the [illegible] the Lower [illegible] feet of [illegible] with [illegible] [illegible] [illegible] of the [illegible] shale and [illegible] with [illegible] [illegible] in the lower

part. The Upper Ramparts limestone at this section is 180 feet thick and is mapped as limestone, black to grey-brown, massive, grading to shale at the base. The upper portion consists of limestones, grey to dark grey, massive, with thin black shale partings.

The term Ramparts was discarded by Basset in his paper. The section as re-defined by Basset consists of: The Hume Formation which he equates with the Lower Ramparts of Hume; the Hare Indian, which is considered the correlative of the Middle Ramparts Shale and the Kee Scarp which is correlated with the Upper Ramparts.

The type section of the Hume is located in the MacKenzie Mountains on the east branch of the Hume River where it consists of 400 feet of thinly bedded limestones which are light grey, argillaceous, very fossiliferous and of shallow water origin. The Hume is cor-

related diachronously with the lower portion of the Keg River Formation of northern Alberta. The correlation is based on ostracod zones within the Hume and Lower Keg River Formations. The Hume has been found as far north as the Anderson River. The thickness of the Hume is quite variable as is readily apparent if the type section is compared to the section at Schooner Creek, which is four miles north of Norman Wells. The Hume here is only 8.5 feet thick and consists of limestone, black, shaly to slaty and fossiliferous. The basal foot is a one foot thick conglomerate indicating a disconformable contact with the underlying Bear Rock.

The Hume Formation is generally encountered as a non-porous rock both in outcrop and in subsurface. The Keg River platform of northern Alberta is also normally a non-porous rock; however, it does develop into marginal shoal along the north flank of the

Peace River Arch. This marginal shoal is very porous, granular, reefy dolomite which yields large quantities of water when drill stem tested. The marginal shoal is in turn replaced by back shoal mud flats, which are the lateral equivalent to shoreline sands. The sands have been found productive of oil in some locales. The facies pattern developed along the north flank of the Peace River Arch should have been repeated in this area long the margins of the Pre-Cambrian Shield. The marginal shoal and the shoreline sands may have been removed by one of the many periods of deep erosion that have occurred in this region; however, the acreage covered by these Permits must be considered as very well placed to evaluate these possibilities.

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 northwestern 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 Cranberry River section and the relationship between the Blue Shale and the adjacent reefs in the Clear Lake area of northeastern British Columbia, where the Blue Shale which is Middle Devonian overlies the Keg River Formation in some areas while in others contemporaneous reef growth from Keg River time through Slave Point time allowed no shale deposition.

REEF SCARP

The Cranberry reefs are outlined by Devonian to Middle Carboniferous limestone. Cores from wells have been used to establish the Devonian subsurface of the Cranberry Outlier. From these cores and other geological evidence, the Cranberry reefs are interpreted to be Middle Devonian in age. The Devonian

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 Passet 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 Ramparts 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

under the discussion of that formation, have not yet been found to contain reefs, however, they have not been adequately explored either

UPPER DEVONIAN

CANOL FORMATION

The Canol Formation was defined by Basset to include the black to very dark brown, non-calcareous, bituminous shales which overlie the Kee Scarp, or, in its absence, the Hare Indian Formation. The Canol is overlain by the Imperial Formation. The Canol may be the equivalent of the lower part of the Besa River shale of northeastern British Columbia. The Canol thickness ranges from zero to 101 feet in the Norman Wells area. The thickness varies in relation to the underlying Kee Scarp reef much in the same manner that the Besa thickness is related to Leduc reefs within the Province of Alberta, i.e. the Canol thins over the reefs to nil in places and thickens in the off-reef direction. The Canol Formation should

[illegible]

[illegible]

[illegible]

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 southwest 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

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figure orientation of bear dilbuh and
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In any fracture pattern there are two main systems of fractures: the axial system and the shear system. In both systems the fractures are at approximate right angles to each other. Within Petroleum and Natural Gas Permit No.5063 the statistical mean direction of the axial system is north 35 degrees west and the statistical mean direction of the shear system is north 55 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. As the surface of the Permit is relatively flat-lying no azimuth correction is necessary for this study. It has been demonstrated that the low incidence anomalies on mosaic are considerably larger than the subsurface feature which causes them.

There are two areas on the mosaic where the fractures are less intense than the surrounding area. Some fractures are always present within these areas but they always 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 Permit No. 5063 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 would cause the low incidence anomalies mentioned in this report are discussed in order of probability.

(1) PRE-CAMBRIAN TOPOGRAPHY

Basement topography under Permit No. 5063 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. DEVONIAN 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.

[illegible]

[redacted] These hypothetical structure cross-sections accompany this report and reference to them will show how Gaspereau 'Highs' are inferred to be present beneath areas of low fracture intensity. Two profiles run at right angles to the strike of the Gaspereau while the third is parallel to strike.

[redacted] Respectfully submitted by

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William H. Cook

[redacted]

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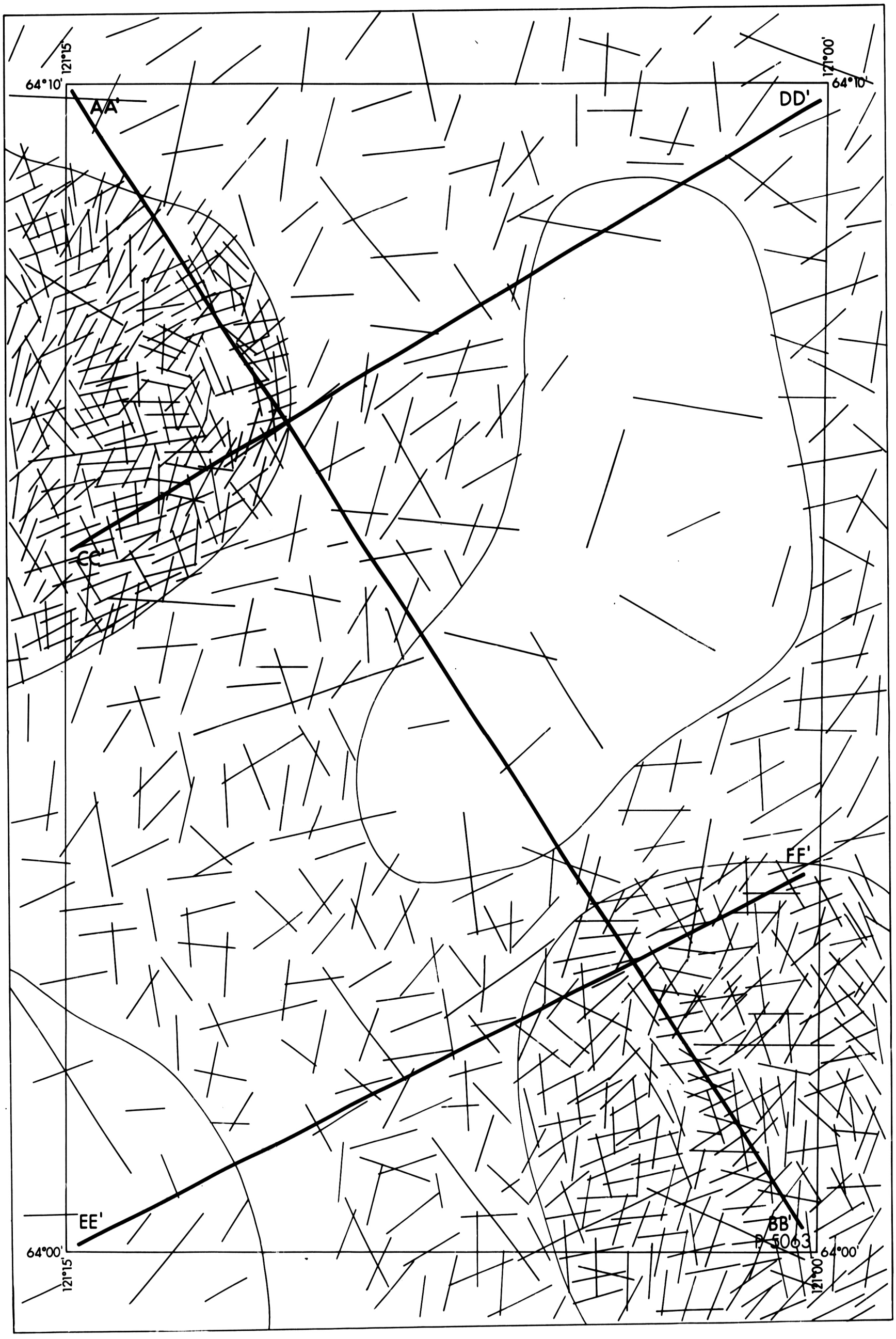
P & NG PERMIT 5063

662-1-5-21

SCALE IN MILES

1 0 1 2 3



GROSMONT OIL & GAS LTD.

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TOTAL FRACTURE PATTERN

662-1-5-21

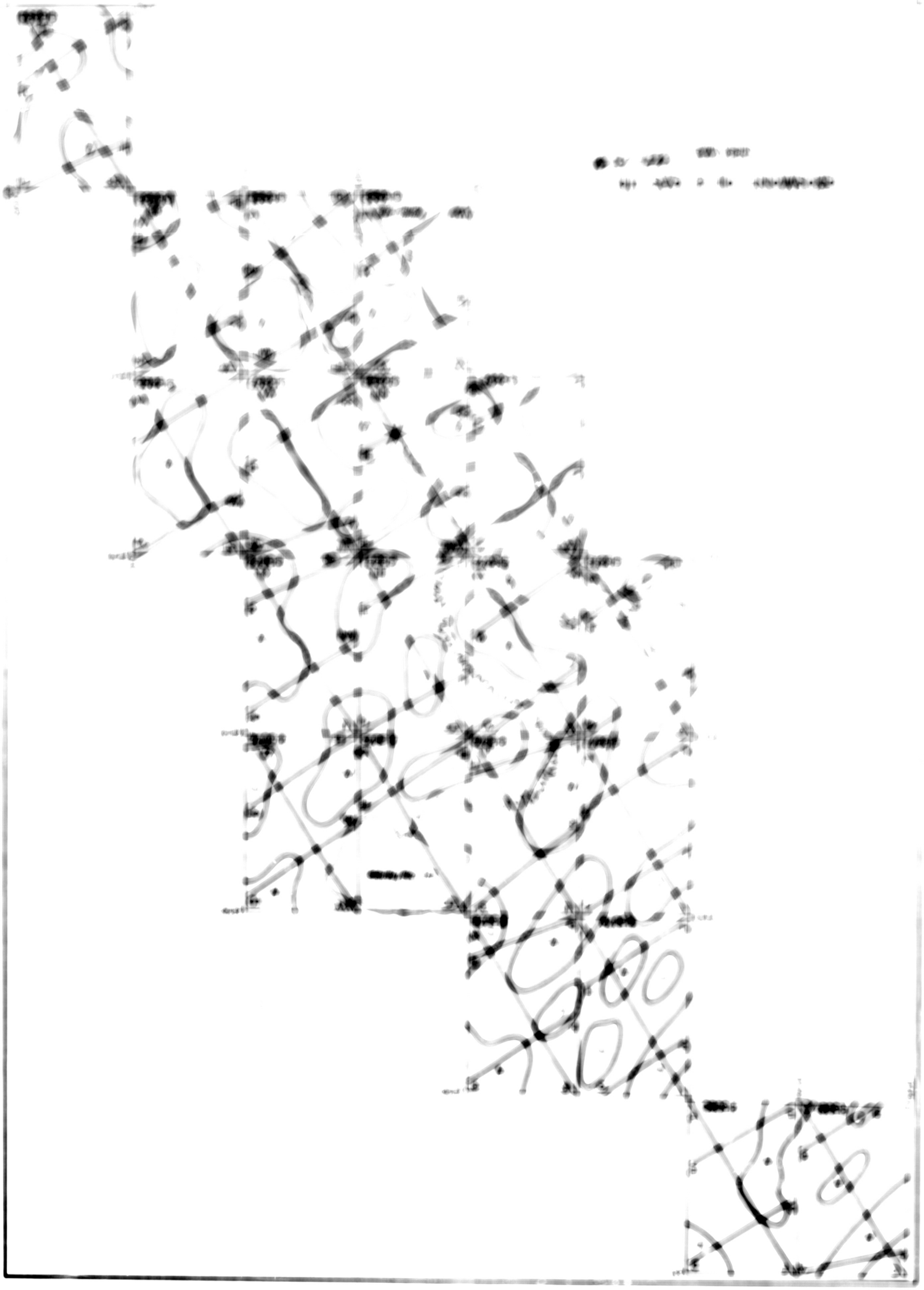
SCALE IN MILES

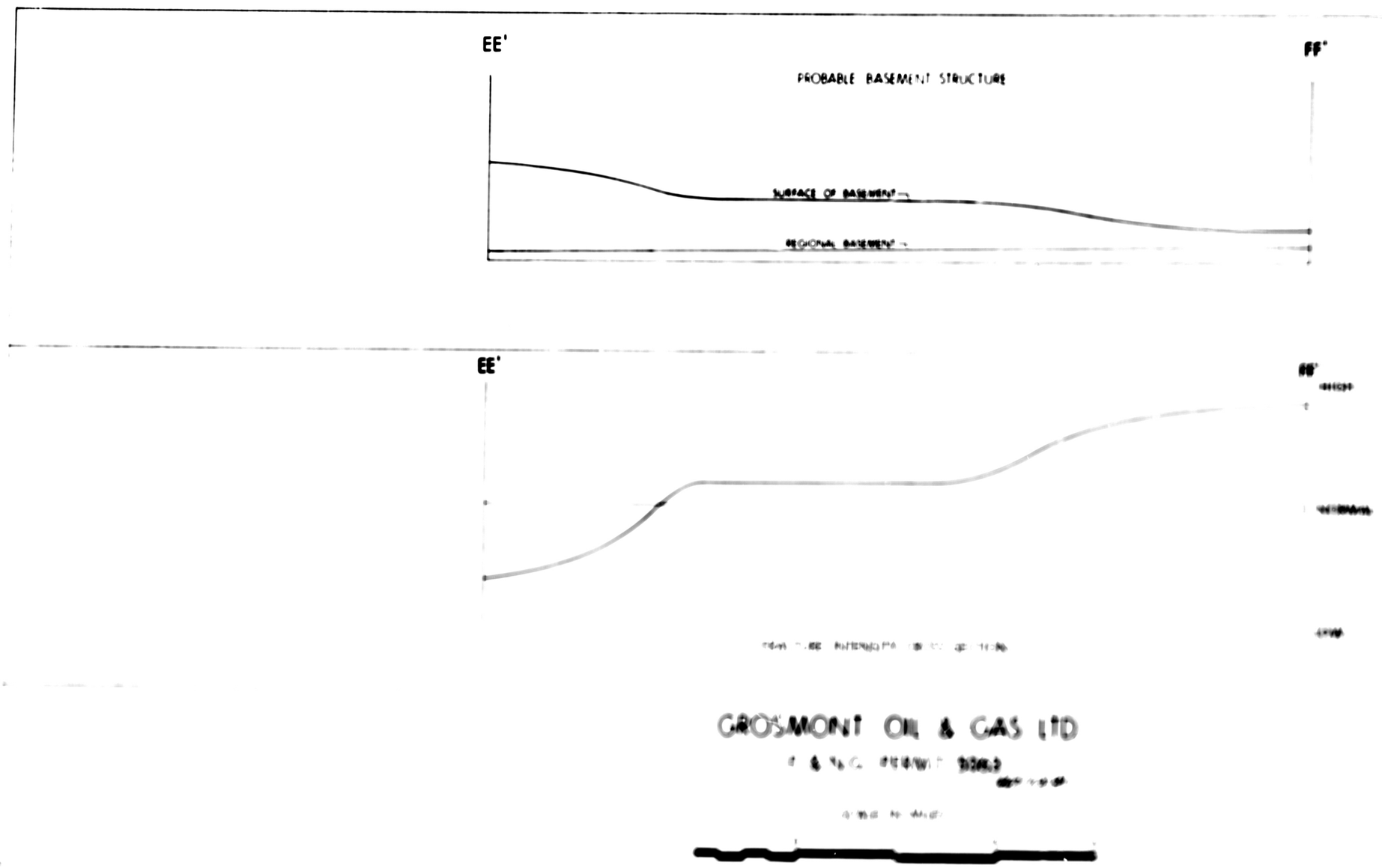
1 0 1 2 3

LOW DENSITY

NORMAL DENSITY

HIGH DENSITY





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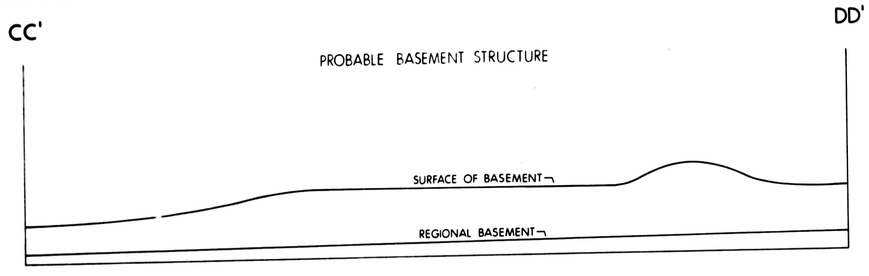

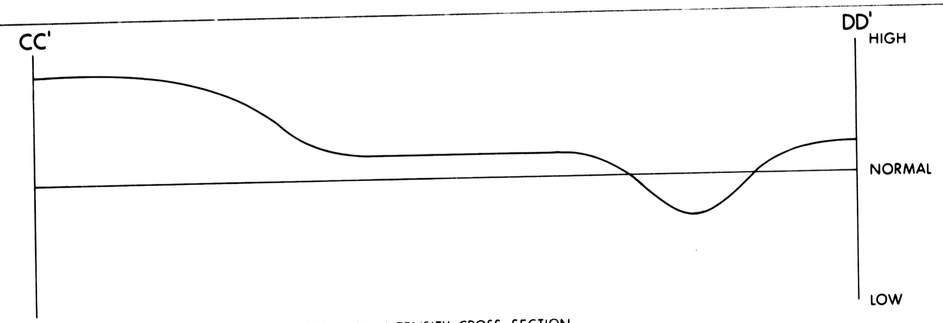

FRACTURE INTENSITY CROSS SECTION

GROSMONT OIL & GAS LTD.

P. & N.G. PERMIT 5063 662-15-21

SCALE IN MILES

1 0 1 2 3