



CARSON HOLDINGS LTD.

P. & N.G. PERMIT 4737

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THIS IS AN UNCONTROLLED MOSAIC AND SHOULD NOT BE TAKEN AS AN

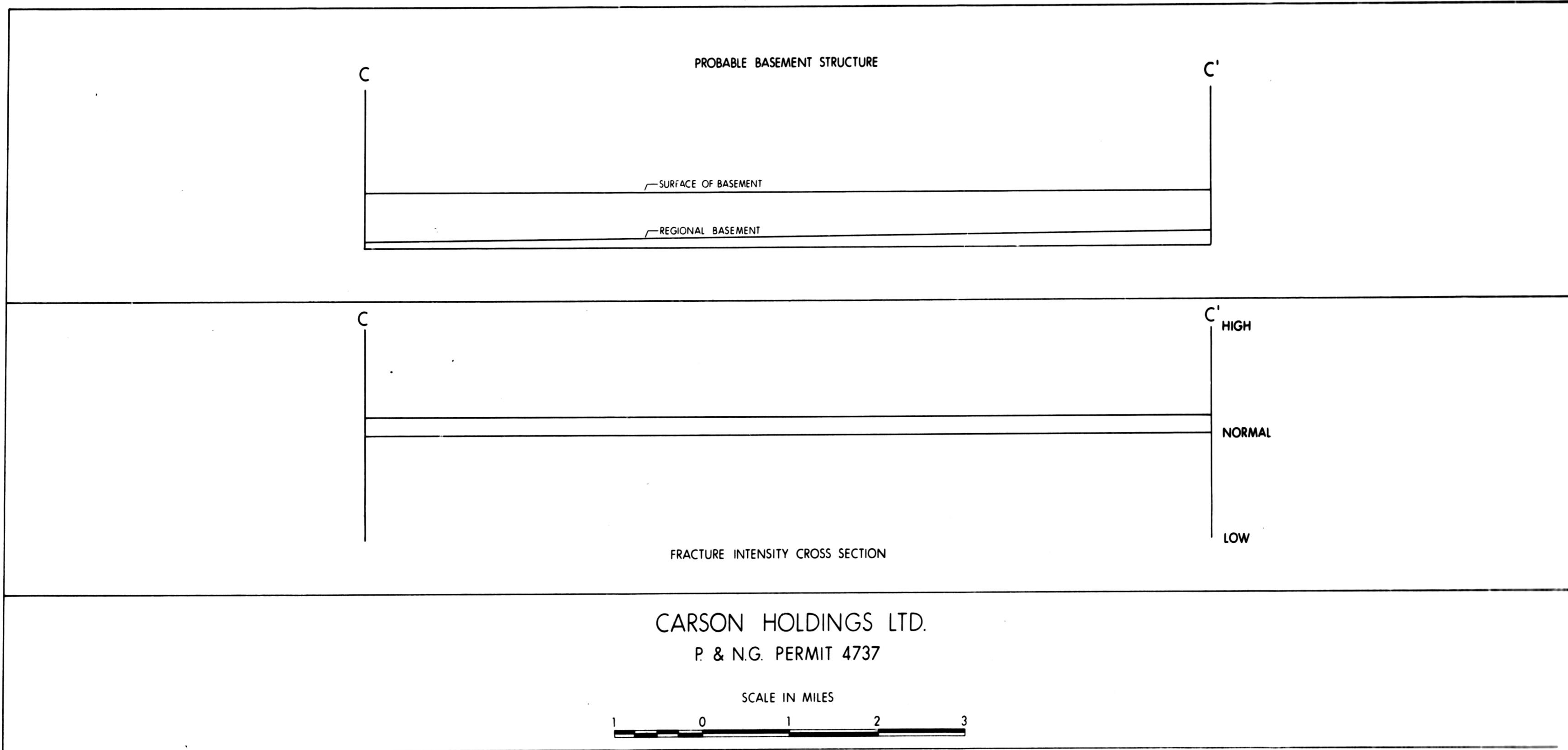


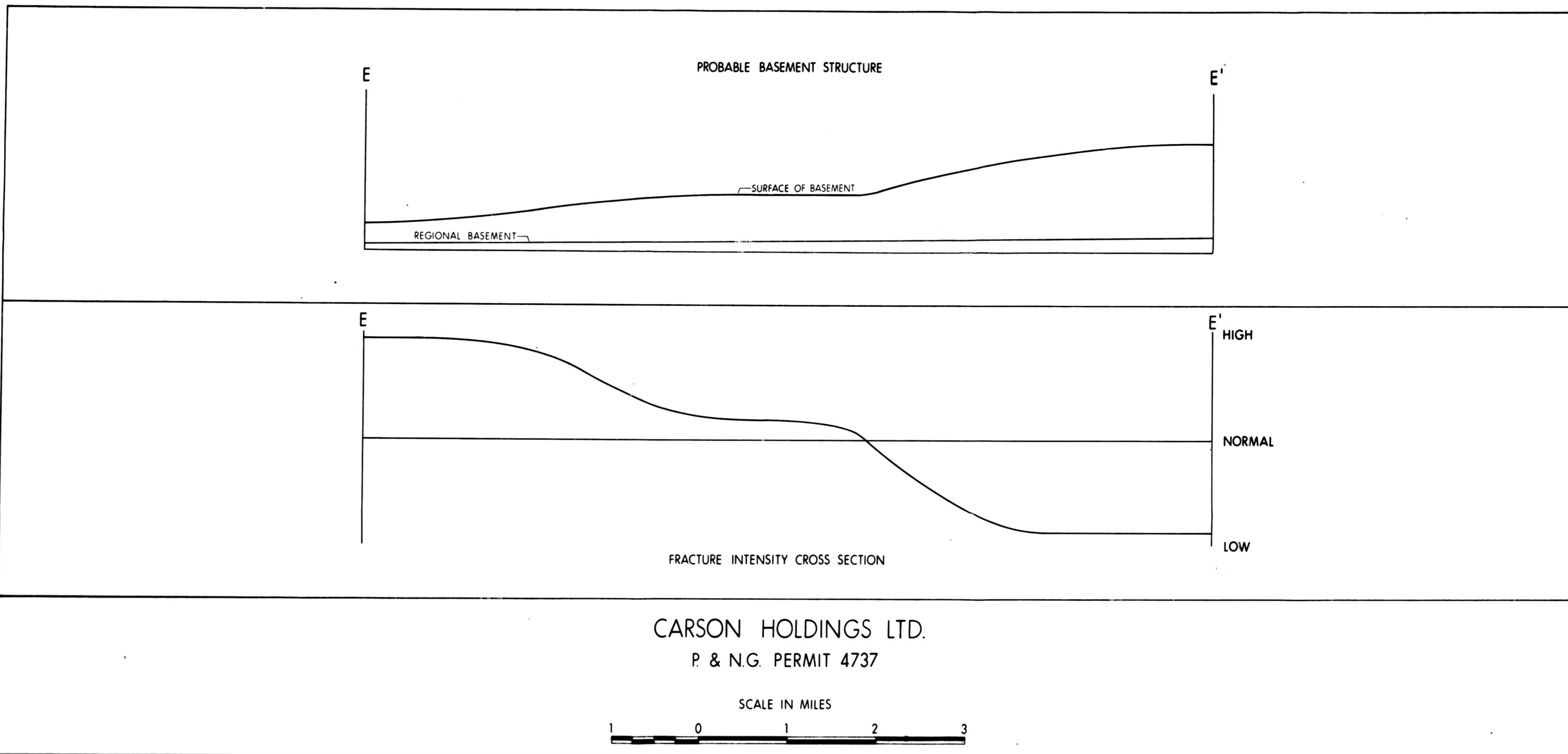
CARSON HOLDINGS LTD  
P & NG PERMIT 4737  
TOTAL FRACTURE PATTERN

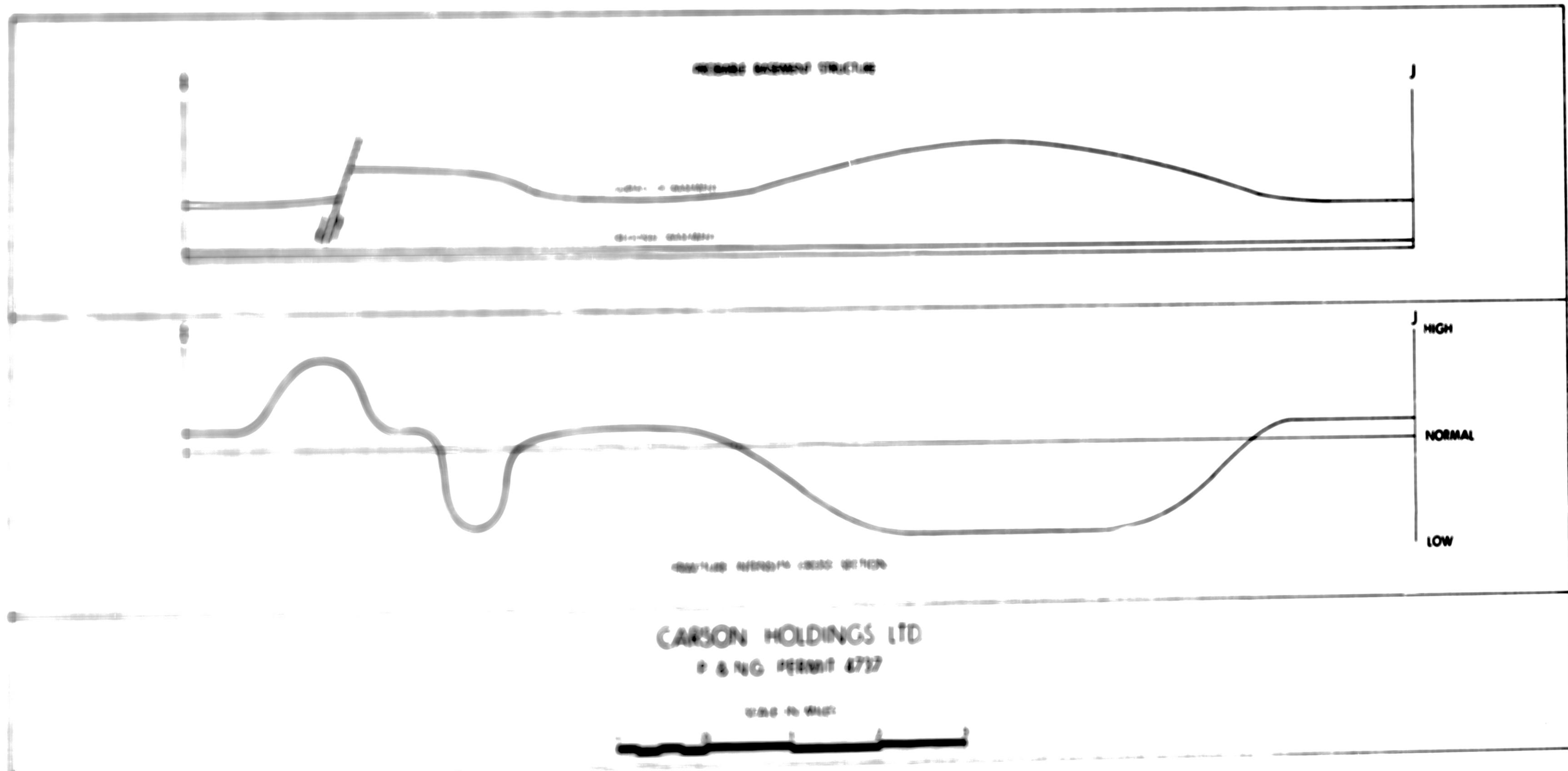
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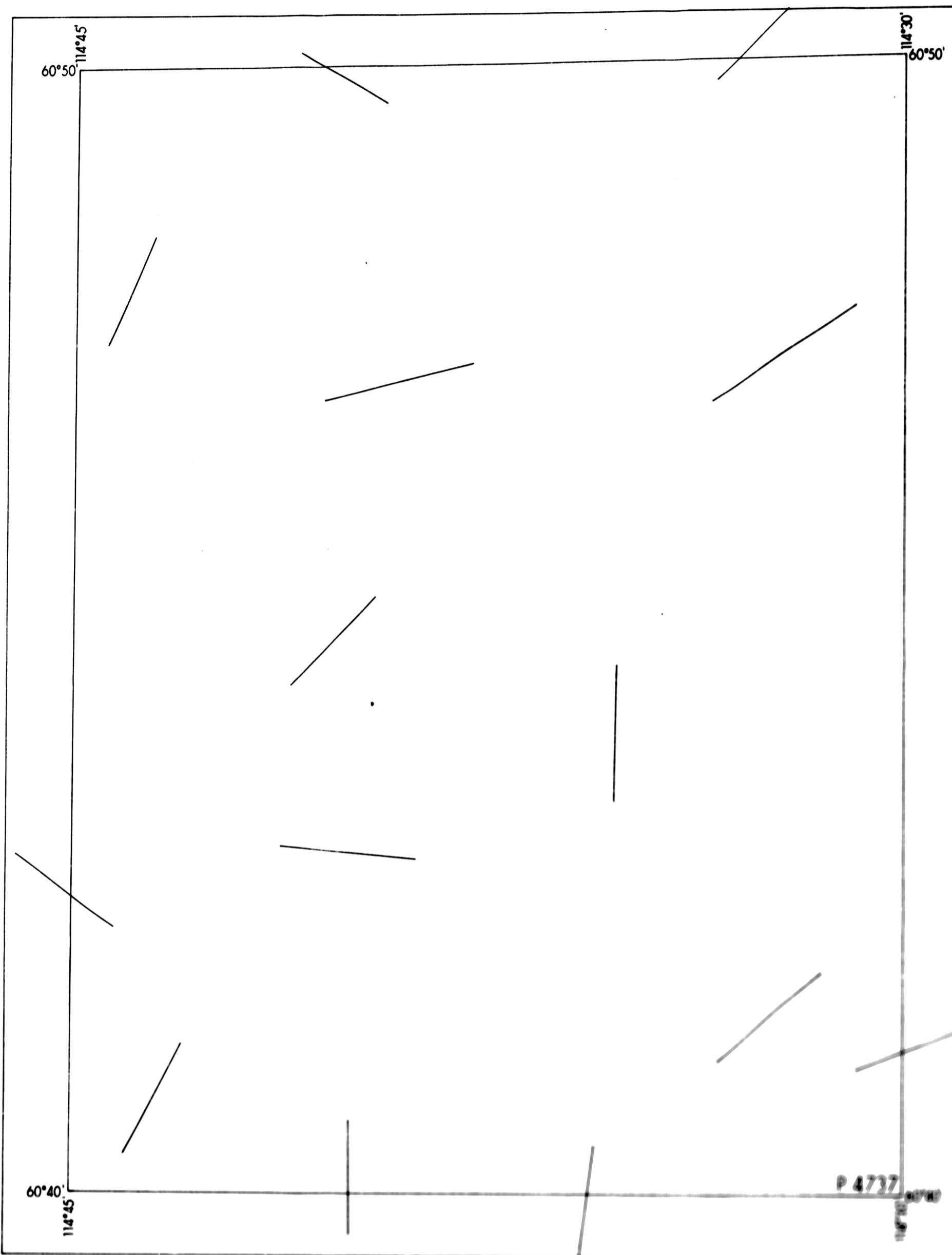


10 MILES  
5 MILES









CARSON HOLDINGS LTD

P & NG PERMIT 4737

MEGA FRACTURE PATTERN

SCALE IN MILES



654-2-48

GENERAL GEOLOGY

b

FRACTURE ANALYSIS SURVEY

of

P. & N. G. PERMIT NO. 4737

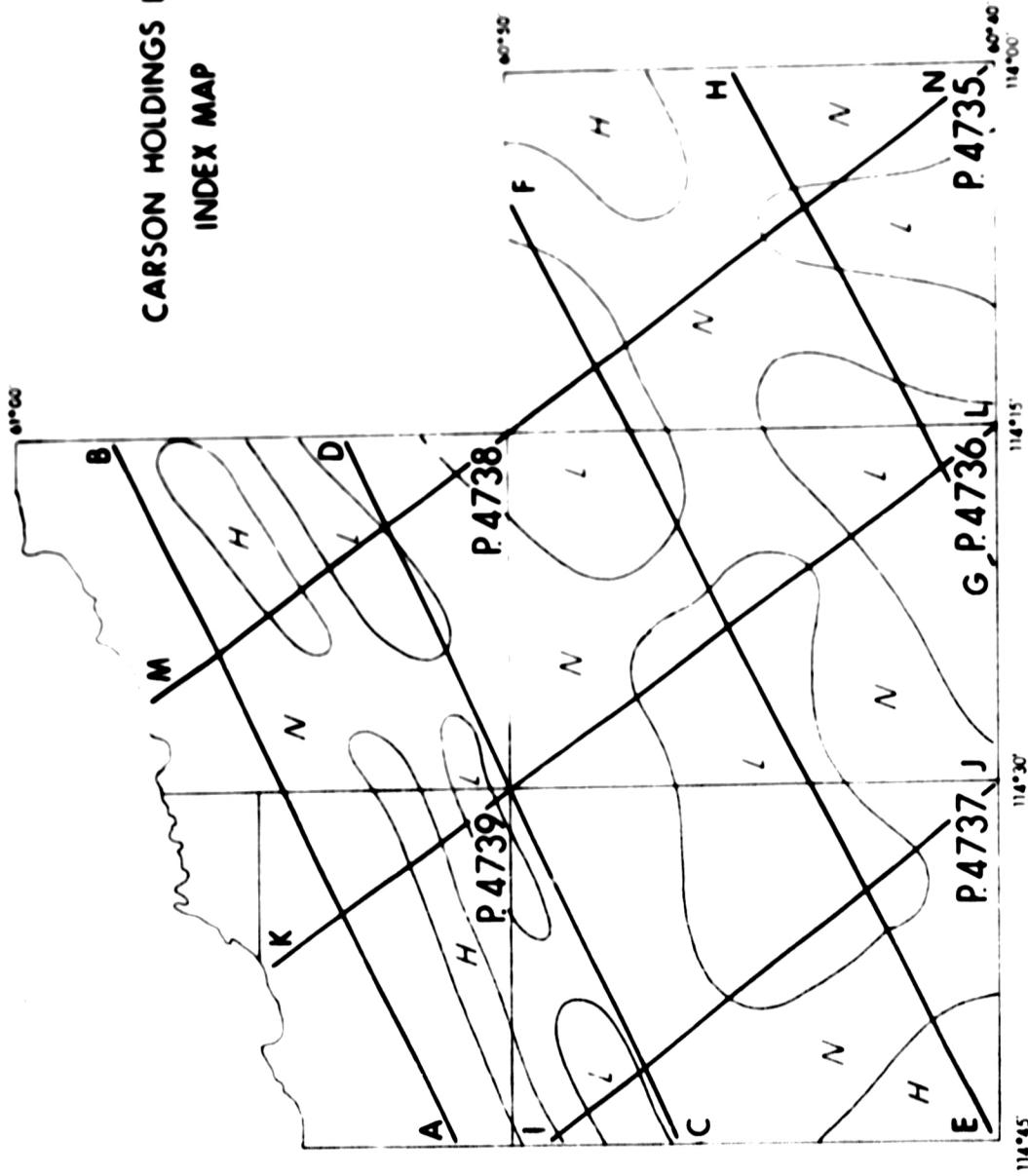
for

CARSON HOLDINGS LTD.

by

RAYALTA PETROLEUMS LTD.

CARSON HOLDINGS LTD.  
INDEX MAP



## 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. 4737. This Permit is located in the Northwest Territories and is held under the Canada Oil and Gas Land Regulations and is located between  $114^{\circ} 30'$  to  $114^{\circ} 45'$  longitude and  $60^{\circ} 40'$  to  $60^{\circ} 50'$  latitude. The Permit is 500 miles north of Edmonton and 100 miles west of Yellowknife.

The Pine Point Highway passes through the Permit as does the Highway to Fort Smith. These are the only roads which service 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 side roads in the area and considerable road construction would be required to reach any particular area.

The surface of the Permit is quite flat-lying and total relief does not exceed 240 feet. There is only a poorly developed drainage pattern within this area and a few intermittent streams flow to the north towards Great Slave Lake. 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 interspersed with many 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 the survey are illustrated on  
the four figures that the Major General will  
give the members with the following observations:  
In addition there are three photographs which illustrate  
the effects not so much in the nature of the roads  
as the terrain.

卷之三

## • **What is a self-organized system?**

## STRATIGRAPHY

### TABLE OF FORMATIONS

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## STRATIGRAPHY

### TABLE OF FORMATIONS

- 3 -

ERA	PERIOD	FORMATION or MEMBER & THICKNESS	LITHOLOGY
P A L E O Z O O	Z - N O D E O	BITUMINOUS SHALE & LIME- STONE MEMBER	Dark to medium brown, thinly bedded limestone, partly petrilliferous and dolomitic; also dark brown, fine grained thinly bedded and nodular limestone, interbedded with black bituminous shale.
	W	0' - 200'	
	Z	?	
P A L E O Z O O	O D E O	LIME- STONE MEMBER	Medium brown fine grained to aphanitic limestone, interbedded limestone and brown- ish gray shale.
	W	0' - 110'	
	Z		
M I D D L E	Q	CHIN- CHAGA	Gypsum limestone dolomite, limestone & dolomite breccia, salt and minor green shale.
	Q	300'	
			Red beds of dolomite,

## STRATIGRAPHY

### TABLE OF FORMATIONS

ERA	PERIOD	FORMATION or MEMBER & THICKNESS	LITHOLOGY
PALeOZOIC	MIDDLE DEVONIAN	MIRAGE POINT 595'	dolomitic silty mud-stone breccia, gypsiferous and sandy dolomite shale, siltstone anhydrite & sand.
		OLD FORT ISLAND 0' - 110'	White friable quartzose sandstone and minor greenish gray siltstone and green shale.

## WILDE DEPOSIT

### SLAVE POINT FORMATION

The formation consists of upper 100' of the  
Slave Point (Gullane) and consists of a thin  
greenish shale interbedded with thin sandstones  
with thin bedded sandstone. Lower 100' consists of  
thinly bedded sandstone with thin bedded greenish shale  
containing Ammonites, Ammonoid Clams, Crinoids  
and Concholepas. There are minor amounts of thin  
yellowish limestone containing concholepas and  
with thin bedded thin greenish shale  
sand and massive greenish sandstone. Although  
though some features are not found the rock has  
poor porosity.

The Slave Point formation is overlain by an  
11 foot bed of gray shale and argillite limestone  
which served as a marker bed for the base of the  
Slave Point formation in the Buffalo River area. This  
11 foot bed is believed to be the remains of the  
Mountain formation to the south (Law 1957) and is

center of the field. The evidence is sufficient to  
warrant charges of an offense in liquid continuity.

The above offense has apparently been committed by the  
subject. However, there is no way to identify him.

### RECENT PUBLIC STATEMENTS

There is no evidence to corroborate the subject's  
statements of his continuing financial dependence upon  
the inheritance of a million dollars and his desire to obtain  
supplementary funds to supplement funds received on regular basis  
from his inheritance.

There is no evidence of a recent financial or other  
transaction which could be an indication of the subject's  
current financial condition or desire to obtain  
supplementary funds.

Although the subject's claim to regular income  
from his inheritance appears to be accurate, there  
is no evidence of any recent financial transaction  
which could be an indication of the subject's  
current financial condition.

Preceptite and below the Amco shale. In another area the Sulphur Point formation appears to interfinger with the upper part of the Pine Point formation.

### PRESQUEILE FORMATION

The Presqueile formation, overlain by the Pine Point formation and Sulphur Point formation, is exposed in certain outcrops close to Pine Point village. This formation is composed of a light colored massive recrystallized variably vuggy massive dolomite. The recrystallized dolomite is a replacement for reefal limestone, the original type of rock of which the reefs were composed.

There is some debate as to the type of reef that forms this formation, although the barrier reef idea is popular.

The dolomite on the surface, appears to wedge eastward from the Pine Point area and disappears into the overlying Sulphur Point in the subsurface.

coarsely recrystallized dolomite underlies a crescent shaped area fringing the south side of Great Slave Lake.

South of Presquile Point, the dolomite is a medium gray to purplish gray, coarsely to medium crystalline, vuggy to cavernous, massive and weathers light gray to brown. The formation is very irregular to the east with thickness varying considerably.

The Presquile formation overlies the Fine Grained Dolomite Member of the Pine Point formation.

#### NYARLING FORMATION

An evaporitic area of gypsum and minor thin bedded, brown fissile, fine grained to aphanitic limestone, with occasional dark brown carboniferous streaks, occupies the southern part of this area.

The name applied to this formation is the Nyarling

formation and it is thought to be the stratigraphic equivalent of the upper portion of the Pine Point formation, the whole of the Presqu'ile and Sulphur Point formation.

Because of the soft erosive nature of this unit, very few outcrops were observed.

#### PINE POINT FORMATION

##### BUFFALO RIVER MEMBER

The Buffalo River Member is the youngest unit of the Point Point formation. Penetration by two drill holes, immediately west of Buffalo River revealed a bluish gray to dark green fissile, limy shale with occasional iron sulphide, approximately 100 feet thick. It was overlain by fine grained porous dolomite and underlain by the Bituminous Shale and Limestone Member of the Pine Point formation.

This formation was also present in Cominco's G-4 well, with 105 feet being present.

### FINE GRAINED DOLOMITE MEMBER

The Fine Grained Dolomite Member of the Pine Point formation is the largest and thickest member of that formation, and may possibly be given formation status in the future.

In Cominco's G-1 well the Fine Grained Dolomite Member comprises the upper 460 feet of the Pine Point formation, which is itself 540 feet thick. In this area, the Fine Grained Dolomite Member is overlain by the Presquile formation and overlies the Limestone Member of the Pine Point formation.

At Cominco's G-4 well, the member is overlain by the Bituminous shale and Limestone member, and overlies the Chinchaga formation. It consists of a sandy vari-colored dolomite and minor limestone, which interfingers with the Buffalo River Shale.

In the G-1 well area where the member is thickest the basal beds consist of a gray, finely crystalline compact, vuggy, fractured dolomite, about 35 feet thick. Overlying the basal dolomite are two beds of green shale and argillaceous dolomite, separated by three feet of dark brown dolomite. Campbell (1950) referred to these as the E-2 (lower) and E-1 (upper) horizons.

The overlying 310 feet between the top of the E-1 horizon and the Presquile formation consists mainly of a light brown, fine grained sandy porous dolomite. Coal-like carbonaceous material is present between 100 feet and 130 feet above the E-1 marker bed.

#### BROWN LIMESTONE MEMBER

This unit is equivalent to the upper part of the Fine Grained Dolomite and is exposed in a series of escarpments between 1 and 1.7 miles southwest of Dawson Landing.

the case where a child is born

Replies received: over 1000 by December 1968  
and is increasing steadily and is expected to be 10,000  
before May 1969.

1940-1941 1941-1942 1942-1943 1943-1944 1944-1945 1945-1946  
1946-1947 1947-1948 1948-1949 1949-1950 1950-1951 1951-1952  
1952-1953 1953-1954 1954-1955 1955-1956 1956-1957 1957-1958  
1958-1959 1959-1960 1960-1961 1961-1962 1962-1963 1963-1964

Also discussed were other types of  
and use of radio monitoring at the plant. Among  
the types of systems in the early discussions were  
a radio monitoring system designed to be  
used in the

as the name of the plant is also used  
in the name of the company. The name of the company  
is being considered as the name of the plant, and the name of the  
plant is the name of the company.

#### MANUFACTURING PLANT

Also discussed were other types of  
and use of radio monitoring at the plant. Among  
the types of systems in the early discussions were  
a radio monitoring system designed to be

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in the name of the company. The name of the company  
is being considered as the name of the plant, and the name of the  
plant is the name of the company.

The upper part consists of grayish brown  
equivalent to the grained limestone, containing irregular  
and elongated shingles. The Limestone Member  
of the Pine Point Formation is considered to be the  
lower part of the formation and is the lithographic  
equivalent of the slightly fine grained dolomite located  
at the base of the fine grained dolomite member in  
Section 10 west.

LOWER MIDDLE DEVONIAN  
and  
ORDOVICIAN

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Underlying the Pine Point formation is the evaporitic Chinchaga formation a regular unit of between 310 feet - 325 feet thick, encountered at 675 feet in Cominco's G-1 well and 709.5 feet in Cominco's G-4 well. This formation is composed mainly of gypsum, argillaceous limestone, anhydrite, and salt, with minor limy dolomite. There is some possibility that this formation may be, in part, Upper Silurian, but, the evidence is inconclusive.

A large unconformity separates the Chinchaga from the underlying Upper Middle Ordovician-Mirage Point Formation. These beds are composed of red and green beds of silty mudstone, quartz siltstone, dolomite, gypsum, anhydrite and dolomite in a matrix of clay and gypsum.

In Cominco's G-1 well, the Mirage Point formation overlies the igneous Pre-Cambrian and in Cominco's G-4 well 20 feet of the Old Fort Island formation, a quartzose, silty sandstone separates the Mirage Point formation from the Pre-Cambrian.

## STRUCTURE

If one interprets the Presquile reef as being a barrier reef migrating northward over the fore-reef deposits of the Pine Point formation, it would restrict the circulation of sea water in the back-reef area to the south, resulting in the deposition of evaporites. Such an evaporite exists as the Nyarling Formation. There is a general dip of 20 feet - 25 feet per mile to the south-west, but the local structure is not well known, due to lack of well control.

The Presquile reef is probably in part, biostromal and biohermal. Dips of 5 degrees - 10 degrees are common, and occasionally much higher. Large gentle folds parallel the reef trend.

The Slave Point Formation seems to have been deposited on the western flank of the undolomitized equivalent of the Presquile Formation, (the Sulphur Point Formation) extending over a broad westward tilting shelf, which may have been restricted in cir-

culation, of sea water, resulting in some chrysotile being deposited. When normal conditions returned (the top of the Precarrie being exposed, or the depth of water sufficiently increased) the waves were laid down.

CR. & NATURAL GAS  
PROSPECTS

The area area has an extremely good possibility of containing a commercial reservoir. The Precoquille formation has the most porosity and very good permeability. The Glens Point Formation has the best porosity, but has the permeability exceeding the Precoquille. However, it has been shown to have significant sandstone (Glens Point River # 3-33). Parts of the Glens Point Formation have high porosity and are to be considered.

Areas of commercial importance could occur. It is possible that one or two fields could be developed simultaneously with each other, or a major anticline could be the area indicated by the Precoquille structure.

## 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".

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 STATEMENT**

## ORIGIN OF FRACTURES

Fracturing is largely caused by contraction or tension on the earth, although important influences may often play a minor role. The major influences of the earth's contraction are the diurnal earth tides due to the gravitational influence of the sun and moon. The changes in position of the center of the earth along the equatorial diameter show a gradual decrease in the earth's rate of rotation. The resulting rhythmic action of these two influences apparently produces periodic changes of the earth's rotation. The length of time over which these changes occur is not known. The changes of these rates are small, so it is difficult to determine the exact result of these influences upon the earth's rotation. Other influences are not so clearly defined. Volcanic eruptions, the action of wind, and the action of water on the earth's surface are all factors which may affect the earth's rotation.



1. *Therapeutic interventions in the treatment of depression*

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• 11 •

11. *Leucosia* (Leucosia) *leucostoma* (Fabricius) (Fig. 11)

“新民主主义时期，民族资产阶级上层地主的性质” 3

Fig. 1. The effect of the addition of  $\text{NaCl}$  on the  $\text{Na}^+$  and  $\text{K}^+$  content of the plasma membrane of *Escherichia coli*.

10. *Phragmites australis* (Cav.) Trin. ex Steud. (Common reed)

For more information on the use of the *bioRxiv* preprint server, see the [bioRxiv](https://www.biorxiv.com) website.

1986-1987: The first year of the new program, with 100 students and 10 faculty.

11 22 33 44 55 66 77 88 99 100

## VEGETAL LINEAMENTS

Vegetal lineaments are the most common in the aridified and semiarid 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 especially 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 lineaments control the size and shape of cultivated fields. Excellent examples of this latter expression of lineaments 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 photanalyst 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/F) between two specimens may be in part due to structure, but this due in part to different surface conditions. To some extent this can be compensated for by applying some weighting coefficients to the observed counts, but this is difficult and probably may result.

Nevertheless, in spite of these difficulties, it has been demonstrated in laboratory and the field that abundant subsurface fracturing is associated with the presence of fracturing, a considerable amount occurring in the overlying area immediately out from the original face of the flanks of the structures. This is in addition to the low or normal no-fracture zone. This is due not only also to a normal no-fracture zone.



normal and there are three areas where the fracture intensity is less than normal. The high intensity areas are shown in red and the low intensity areas are shown in green. The average length of the fractures is about 2,800 feet and both mega and micro fractures are present. It is worthy of special note to mention the glacial problem in this area.

Reference to the mosaic will show that the area is moderately scarred with glacial grooves and cavations and that the direction of ice flow was about north 60 degrees east. Some of these grooves are so deeply impressed on the surface that they control the shape of the lakes and the growth in the area. In any area such as this the photogrammetrist is faced with the difficult problem of eliminating the glacial scars from the topographic surface without creating false anomalies. The angle of cut required to remove a 10 to 12 degree

arc in any area will create fracture anomalies and it requires delicate weighting of the whole pattern to adjust for these effects.

In any fracture pattern there are two main systems of fractures: the axial system and the shear system. In both systems the fracture are at approximate right angles to each other. Within Petroleum and Natural Gas Permit No. 4737 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 a mosaic are considerably larger than the subsurface feature which causes them.

There are three areas on the mosaic where the fractures are less intense than the surrounding area. Some fractures are always present within these 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.

## 2. ~~STRUCTURE~~

Granular and angular glass occurs in the sand  
as lenses in the intertidal areas of the tidal flats.  
This material occurs 30 miles from the village at the  
edge of the Rio Grande River. The origin of the  
sedimentary material is either sand or silt. The  
sand and the silt are the constituents of a few  
kinds of local sand.

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2000 Direct Strike Devastation

There are present just now of the  
Tatars, 10000 and others could well  
be present within the subject area

3) ELECTRIC FOLDING & FAILING

The presence of electric folds is very  
unusual. Such cases normally resulting in  
extreme pressure. The development  
of the electric folds has been previously  
discussed

4) OROGRAPHIC RELIEF ON AN  
EXTRA SEDIMENTARY  
UNCONFORMITY

Orographically to a possible extent  
of the high mountain range. Such  
mountains the pressure areas to a uniformly  
high. The water can only one surface within  
which the sedimentary section is greater  
strength to offset the high pressure

Reference to the Total Fracture Pattern Map which accompanies this report will show that there are two areas of "high" fracture intensity, and three 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 north and east-central parts of Permit No. 4737.

These Basement high features are most interesting from the oil and gas point of view. The general shape of both north features is such that the causative feature must be a fault on the Basement surface. A hill is probably the causative feature for the central-east anomaly as it is over one and one-half miles in

width. If a fault causes a 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 run at right angles to the strike of the Basement while the third is parallel to strike.

Respectfully submitted by:

RAYALTA PETROLEUMS LTD.

*William G. Cook*

WGC/jp

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## REFERENCES

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• Methods of Evaluation  
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