GENERAL GEOLOGY

&

FRACTURE ANALYSIS SURVEY

of

P & N G PERMIT NO 6735

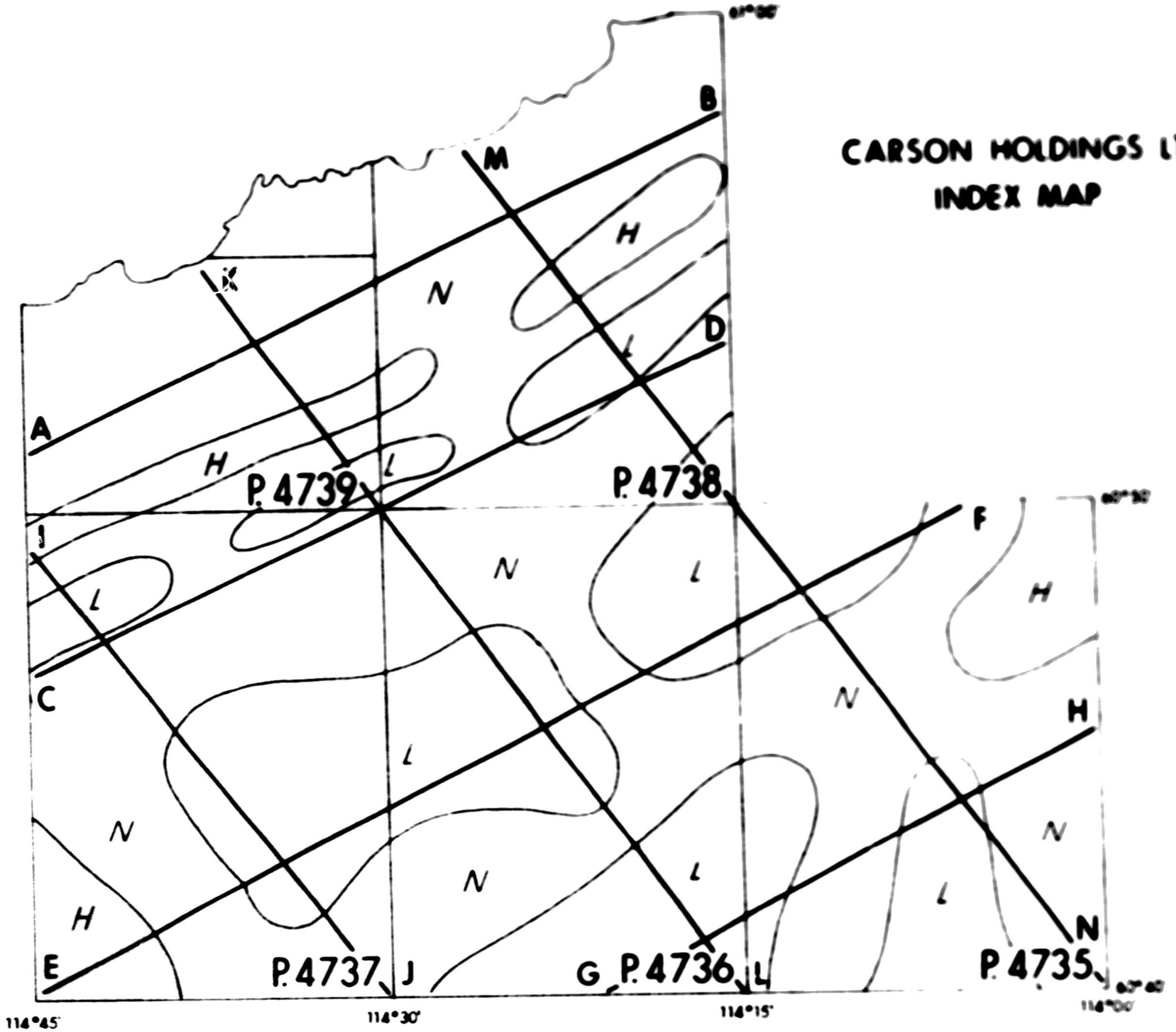
for

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. 4735. This Permit is located in the Northwest Territories and is held under the Canada Oil and Gas Land Fegulations and is located between 114° 00' to 114° 15' longitude and 60° 40' to 60° 50' latitude. The Permit is 500 miles north of Edmonton and 100 miles south of Yellowknife.

The Pine Point Highway is about ten miles northeast of the Permit and this is the only road which passes through 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. A few minor cut lines may be present and these would provide limited access.

The surface of the Permit is quite flat-lying and total relief does not exceed 100 feet. There is a poorly developed drainage pattern within this area and only a few intermittent streams are present. 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 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 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

TABLE OF FORMATIONS

ERA	PERIOD	FORMATION or MEMBER & THICKNESS	LITHOLOGY
PALEOZOIC	MIDDLE DEVONIAN	SLAVE POINT 0' - 300'	Brown-fine grained stromatoporoidal limestone, or dense argillaceous limestone Amco Shale marker present in Buffalo River area.
		?	
		SULPHUR POINT 0' - 170'	Light brown stromatoporoidal limestone minor beds of light brown petroliferous sandy limestone, some dark brown fine grained dolomite.
		PRESQUILE 0' - 260'	Reefoidal, recrystallized vuggy coarse grained massive dolomite, in part petroliferous
		NYARLING 0' - 460'	Evaporitic sequence, mainly gypsum, some limestone.

STRATIGRAPHY

TABLE OF FORMATIONS

2

ERA	PERIOD	FORMATION or MEMBER & THICKNESS		LITHOLOGY
PALEOZOIC	MIDDLE DEVONIAN	PINE POINT	(Fine grained) DOLOMITE MEMBER 0 - 460'	Brown, in part vuggy and petroliferous fine grained granular dolomite. Also sandy and minor coarse grained dolomite.
			(Brown) LIME-STONE MEMBER 150'	Thinly bedded, brown fine grained fossiliferous limestone; brown platey, partly petroliferous limestone medium brown to coarse grained vuggy dolomite.
			BUFFALO RIVER MEMBER 0 - 185'	Green to bluish gray fissile limy shale, some iron sulphide

STRATIGRAPHY

TABLE OF FORMATIONS

ERA	PERIOD	FORMATION or MEMBER & THICKNESS		LITHOLOGY
PALEOZOIC	MIDDLE DEVONIAN	PINE POINT	BITUMINOUS SHALE & LIME-STONE MEMBER 0' - 200'	Dark to medium brown thinly bedded limestone, partly petroliferous and dolomitic; also dark brown, fine grained thinly bedded and nodular limestone, interbedded with black bituminous shale.
PALEOZOIC	MIDDLE DEVONIAN	PINE POINT	?	
PALEOZOIC	MIDDLE DEVONIAN	PINE POINT	LIME-STONE MEMBER 0' - 110'	Medium brown fine grained to aphanitic limestone, interbedded limestone and brownish gray shale.
PALEOZOIC	MIDDLE DEVONIAN	PINE POINT	CHIN-CHAGA 300'	Gypsum limestone dolomite, limestone & dolomite breccia, salt and minor green shale.
PALEOZOIC	MIDDLE DEVONIAN			Red beds of dolomite,

STRATIGRAPHY

TABLE OF FORMATIONS

ERA	PERIOD		FORMATION or MEMBER & THICKNESS	LITHOLOGY
PALEOZOIC	MIDDLE DEVONIAN	UPPER to MIDDLE ORDOVICIAN or OLDER	MIRAGE POINT ± 595'	dolomitic silty mudstone breccia, gypsiferous and sandy dolomite shale, siltstone anhydrite & salt.
			OLD FORT ISLAND 0' - 110'	White friable quartzose sandstone and minor greenish gray siltstone and green shale.

MIDDLE DEVONIAN

SLAVE POINT FORMATION

This formation marks the upper limit of the Middle Devonian (Givetian) and consists of a fine grained fragmental, cryptocrystalline buff limestone with chert nodules near the top. Certain areas are richly fossiliferous, with numerous brachiopods including Amphipora, Atrypa, Cladopora, Stromatopora and Emanuella. There are minor amounts of brown aphanitic limestone containing carboniferous streaks with thinly interbedded fine grained granular limestone and massive quartzose sandy limestone. Although some fractures are oil stained the rock has poor porosity.

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

[illegible]

[illegible]

SULPHUR POINT FORMATION

This formation is [illegible] the [illegible] equivalent of the underlying Presqu'ile formation and it consists of a medium grey, fine grained limestone interbedded with a brownish grey, [illegible] [illegible] limestone, and [illegible] dolomite.

Minor occurrences of a [illegible] medium brown [illegible] limestone and a greenish grey limestone with black carbonaceous [illegible] along bedding [illegible] are found near Sulphur Point.

Although the Sulphur Point formation has certain features in common with the Presqu'ile [illegible] does occupy, at one locality, a position above the [illegible]

[illegible]
[illegible]
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[illegible]

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

South of Presqu'ile 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 Presqu'ile 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 165 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 Presqu'ile 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 3-1 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 Presqu'ile 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 [illegible]

The beds consist of a dark to medium brown, fine grained, thin bedded and laminated, partly petroliferous and argillaceous limestone. There are also occasional beds of brown, medium to coarse grained, vuggy dolomite which is richly fossiliferous.

This member overlies the Bituminous Shale and Limestone Member, and is believed to be the Buffalo River Member.

BITUMINOUS SHALE & LIMESTONE MEMBER

Two main types of lithology are present in the Bituminous Shale and Limestone Member of the Pine Point Formation.

The lower sequence consists of a dark calcareous bituminous shale thinly interbedded with medium to dark brown fine grained to aphanitic partly argillaceous limestone weathering a medium brownish grey. This unit is extremely fossiliferous

Two diamond drill holes have penetrated this unit 5.5 miles southwest of Pine Point. There, the beds are present on the south-southeast flank of a west-southwest trending syncline, plunging in the same direction.

On the shore of Great Slave Lake, west of Isle du Mort, the Bituminous Shale and Limestone Member appears to underlie and intertongue with the shale of the Buffalo River Member.

LIMESTONE MEMBER

The Limestone Member of the Pine Point formation does not outcrop on the lease area but is present in the subsurface, in Cominco's G-1 well.

The lower [illegible] feet of the member is composed of a light brown, fine grained to aphanitic limestone with [illegible] [illegible] and [illegible] [illegible]

The upper part consists of grayish brown aphanitic to fine grained limestone, containing irregular dark bituminous partings. The Limestone Member of the Pine Point Formation is considered to be the basal unit of this formation and is the stratigraphic equivalent of the cherty fine grained dolomite located at the base of the fine grained dolomite member in Cominco G-1 well.

LOWER MIDDLE DEVONIAN
and
ORDOVICIAN

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 Presqu'ile 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 Presqu'ile 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 Presqu'ile Formation, (the Sulphur Point Formation) extending over a broad westward tilting shelf, which may have been restricted in circulation, of sea water, resulting in some anhydrite being deposited. When normal conditions returned (the top of the Presqu'ile being eroded, or the depth of water sufficiently increased) limestone was laid down.

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[illegible]

[illegible] California [illegible] [illegible]

[illegible]

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

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] likely generated by the [illegible] result of these [illegible] over millions and millions of years [illegible] the same manner when subjected to [illegible]

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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 photo-analyst 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/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 appropriate weightings to the observed counts, but over or under corrections may result.

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

[illegible]

[illegible]

[illegible]

The fracture [illegible] [illegible]

[illegible]

[illegible]

[illegible] Lake and is about 15 miles from the [illegible]

[illegible]

The sedimentary section is [illegible] about 2,000 feet [illegible]

[illegible] In addition [illegible]

glacial till [illegible]

[illegible]

[illegible]

Fractures [illegible]

[illegible]

where the fracture intensity is greatest. [illegible] 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 striations 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 of tree growth in the area. In any area such as this the photoanalyst is faced with the difficult problem of eliminating the glacial scars from the fracture pattern without creating false anomalies. The removal of all fractures from a 10-12 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 fractures are sub-parallel and in general, the two systems are at approximate right angles to each other. Within Petroleum and Natural Gas Permit No. 4735 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 coneded 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 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. 4735 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 25 degrees west and the units dip to the southwest at a few tens of feet per mile.

Structural features which would 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. 4735 is thought to be much the same as it is today along the south-west 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 [illegible]. The effect of this Basement relief on the overlying sedimentary rocks is often great. The Granite Wash sand is usually present in the topographic "lows" on the Basement but absent on the "highs". The Granite Wash is an excellent potential reservoir.

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

[illegible]

[illegible] [illegible]

[illegible]

[illegible]

[illegible]
[illegible]
[illegible]

[illegible]

[illegible]

[illegible]

These Basement high features are most interesting from the oil and gas point of view. The general shape of both 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 area is over one and one-half miles in width. If a fault caused the fracture "low" the width of the low would be about one mile or less.

Three hypothetical structure cross-sections accompany this report and reference to them will show how Basement "highs" are inferred to be present beneath areas of low fracture intensity. Two profiles 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. Crook

WGC/jp

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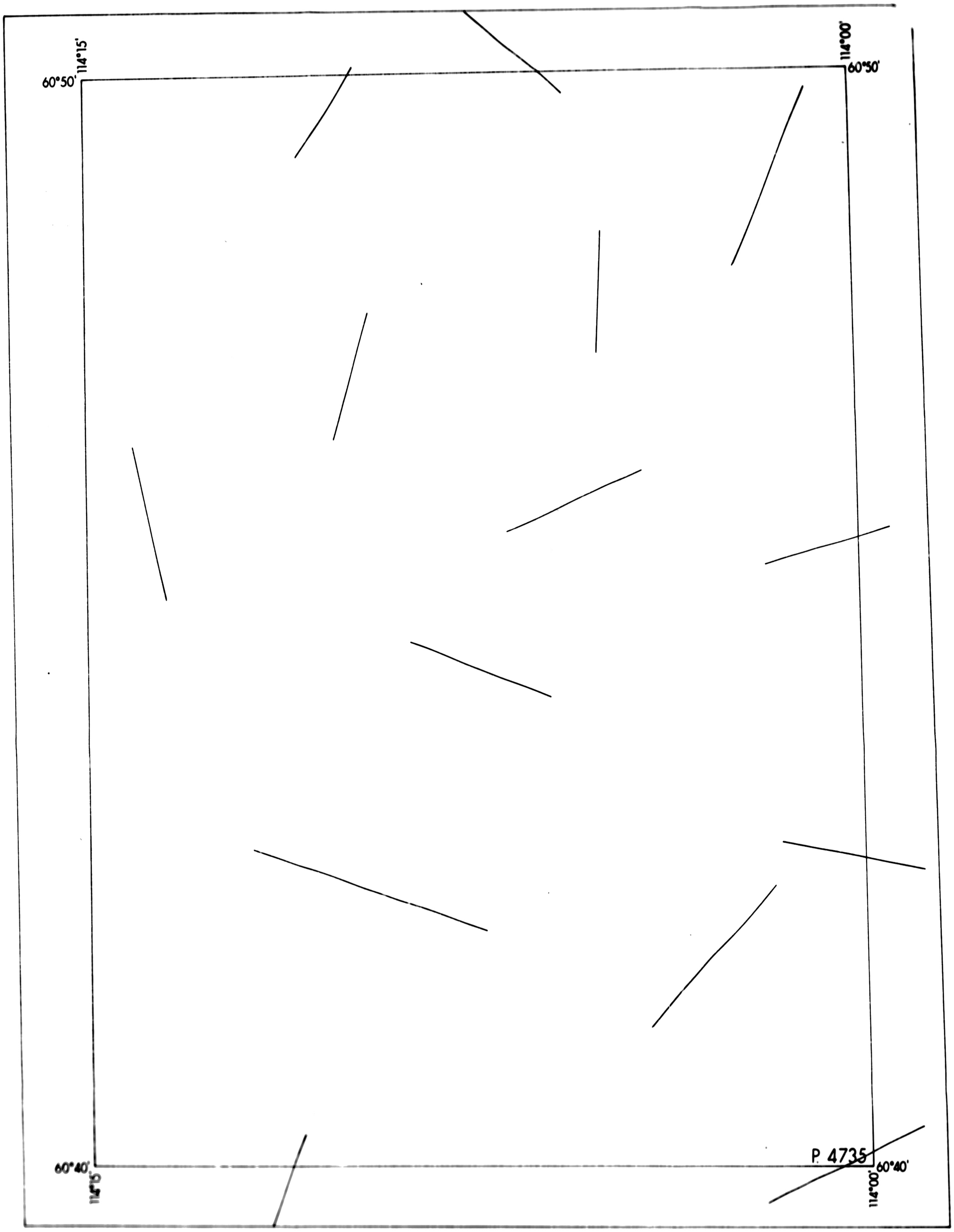
P. & N.G. PERMIT 4735

654-2-4-1

SCALE IN MILES

1 0 1 2 3

THIS IS AN UNCONTROLLED MOSAIC AND SHOULD NOT BE TAKEN AS AN ACCURATE TOPOGRAPHIC MAP



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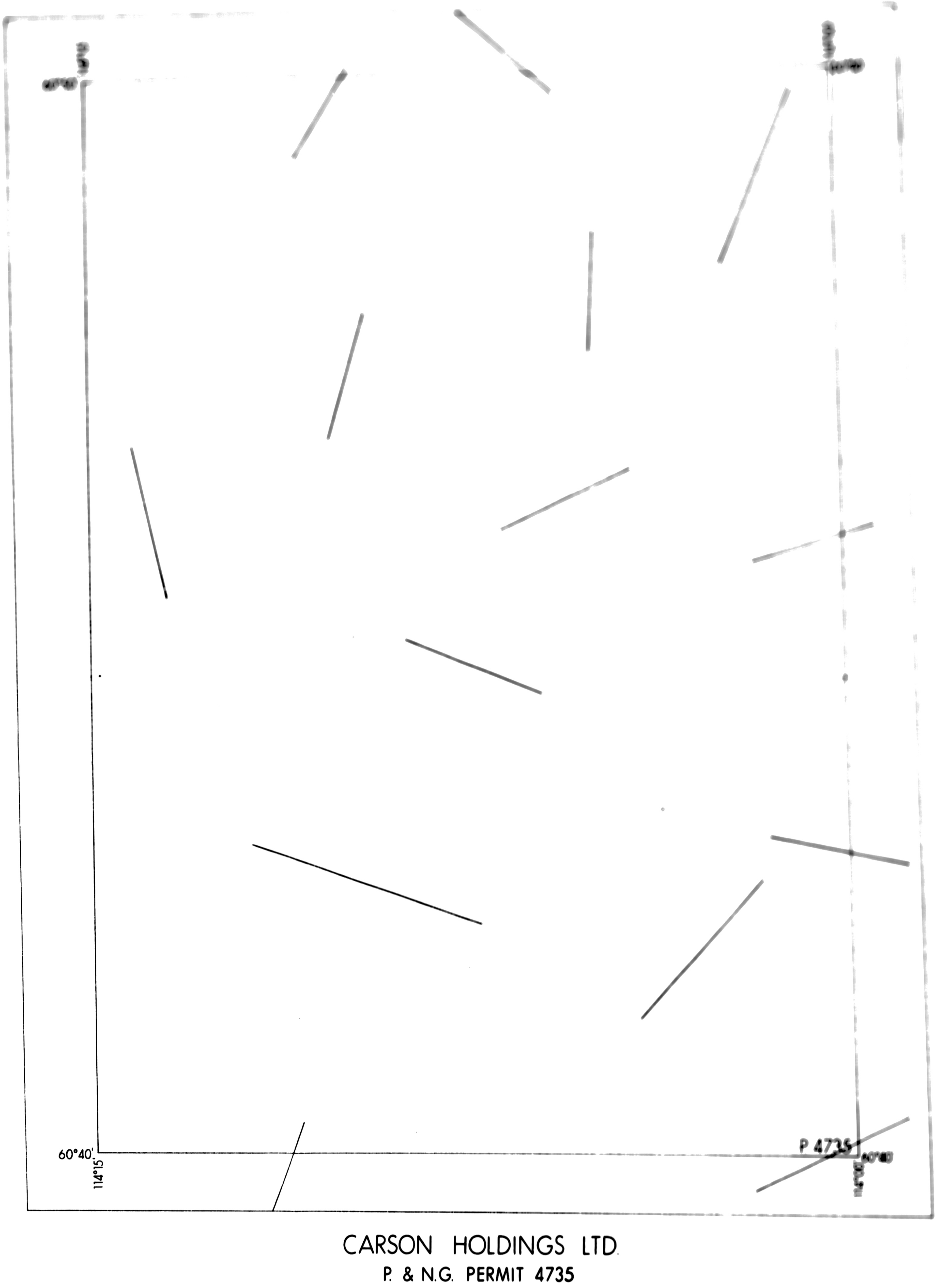
MEGA FRACTURE PATTERN

SCALE IN MILES



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MEGA FRACTURE PATTERN

654-247

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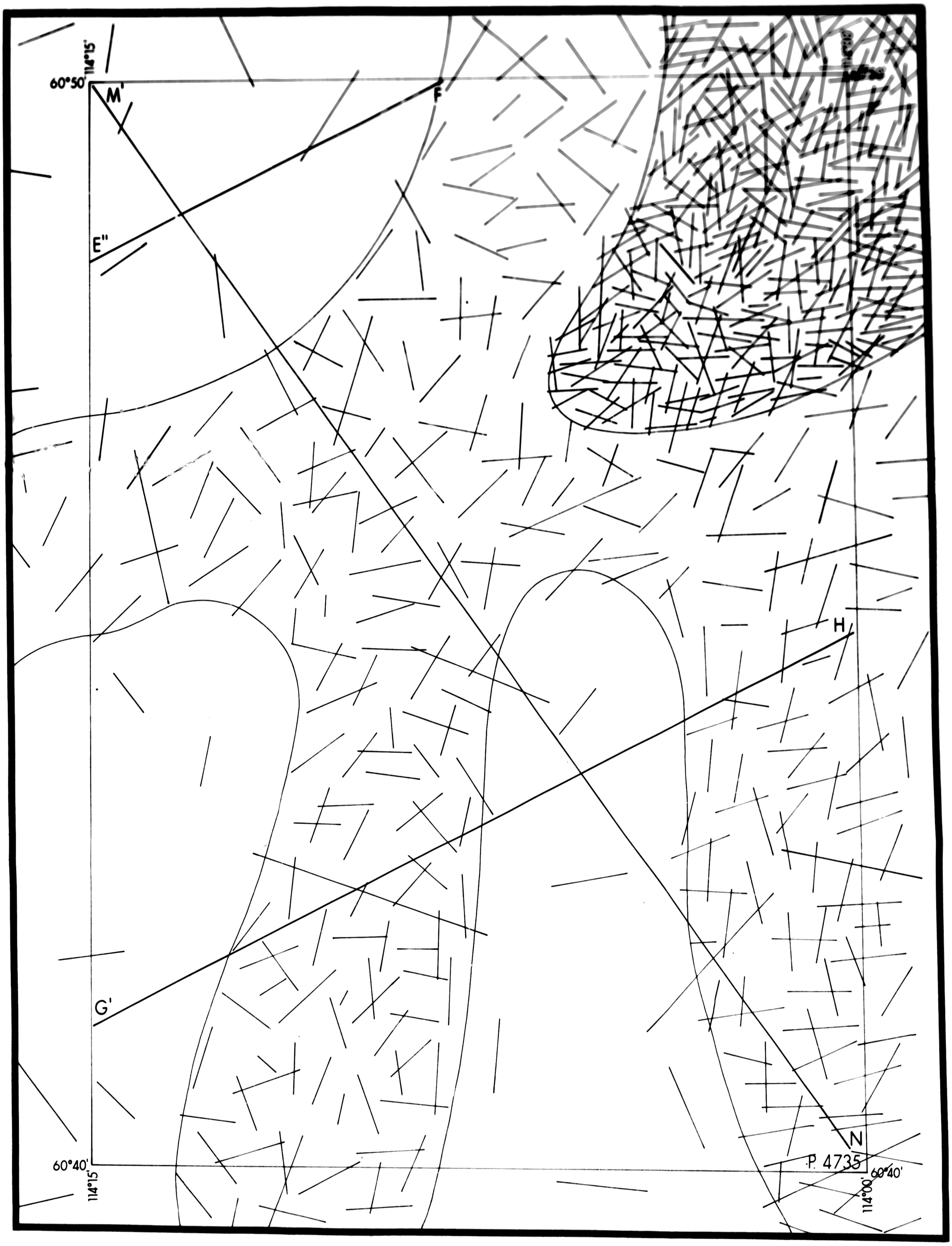

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TOTAL FRACTURE PATTERN

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SCALE IN MILES

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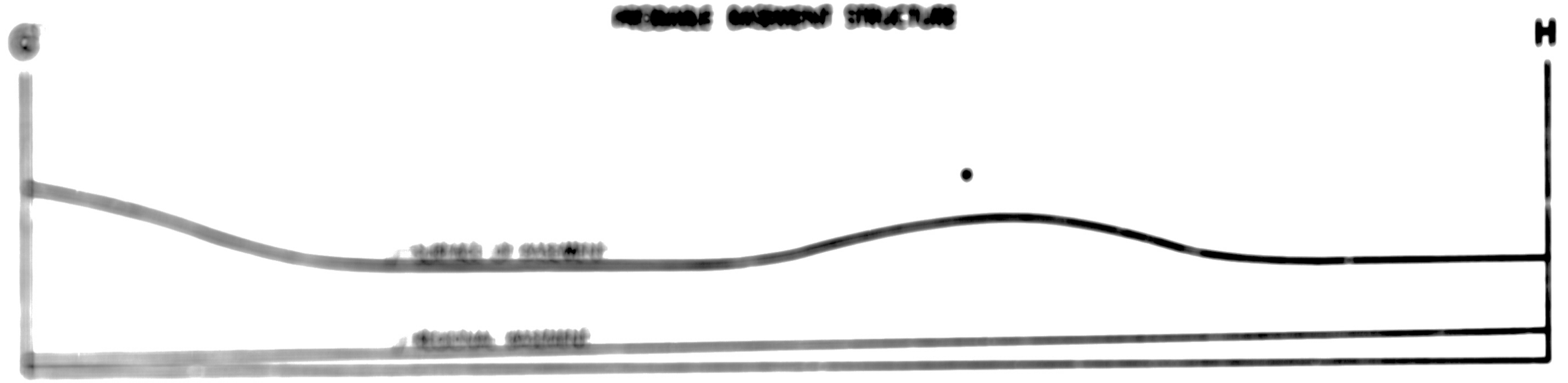
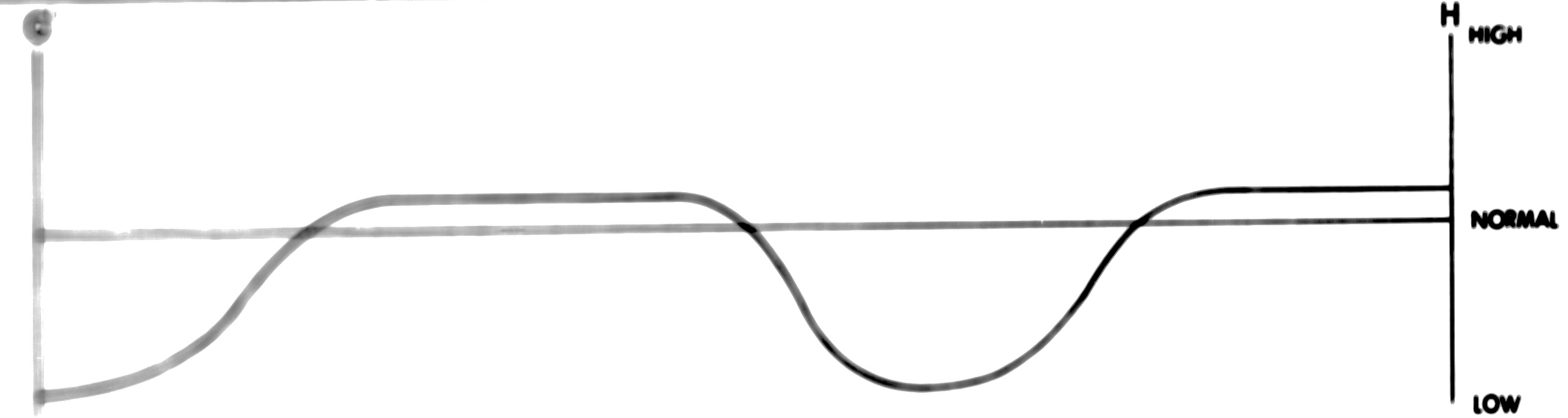
LOW DENSITY

NORMAL DENSITY

HIGH DENSITY





FRACTURE INTENSITY CROSS SECTION

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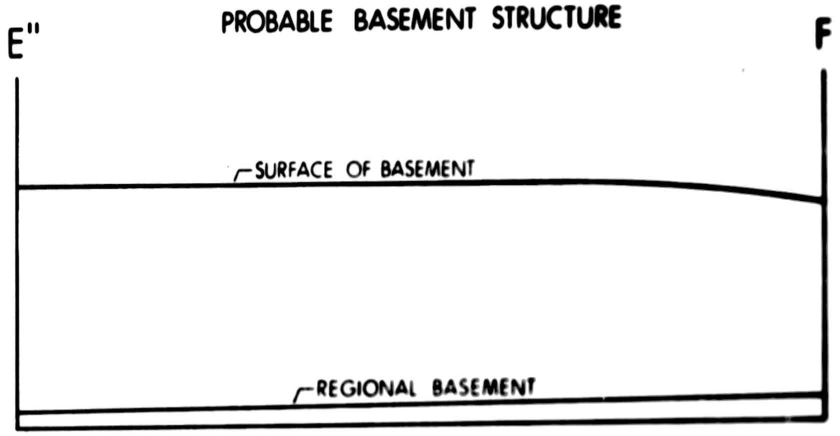
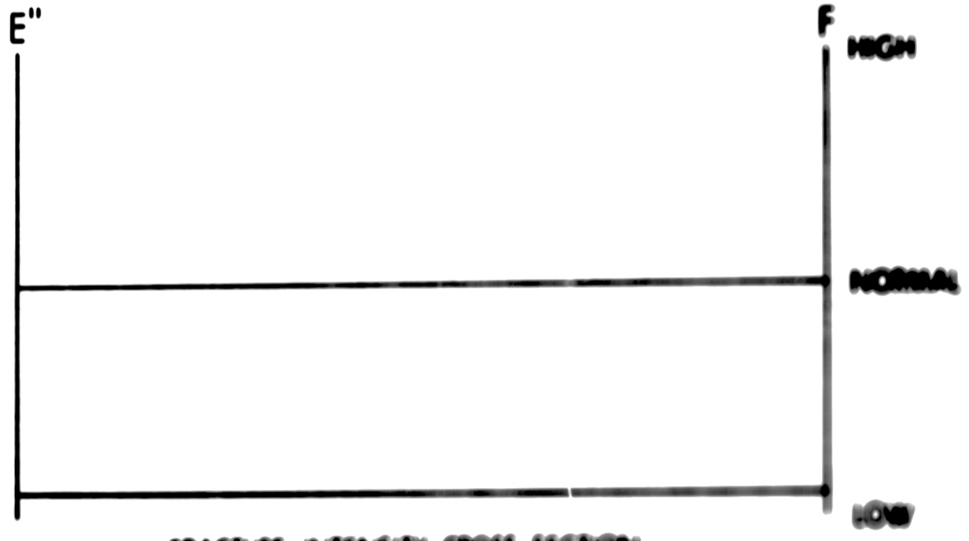
SCALE IN MILES

PROBABLE BASEMENT STRUCTURE





FRACTURE INTENSITY CROSS SECTION

CARSON HOLDINGS LTD

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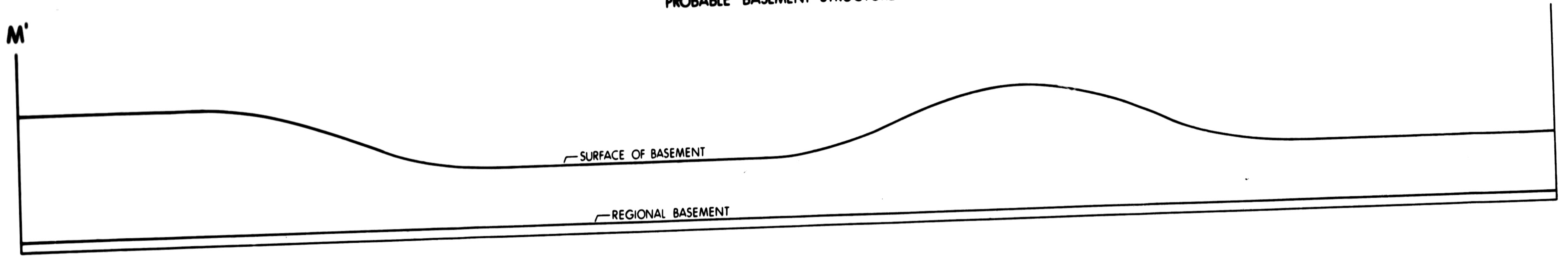
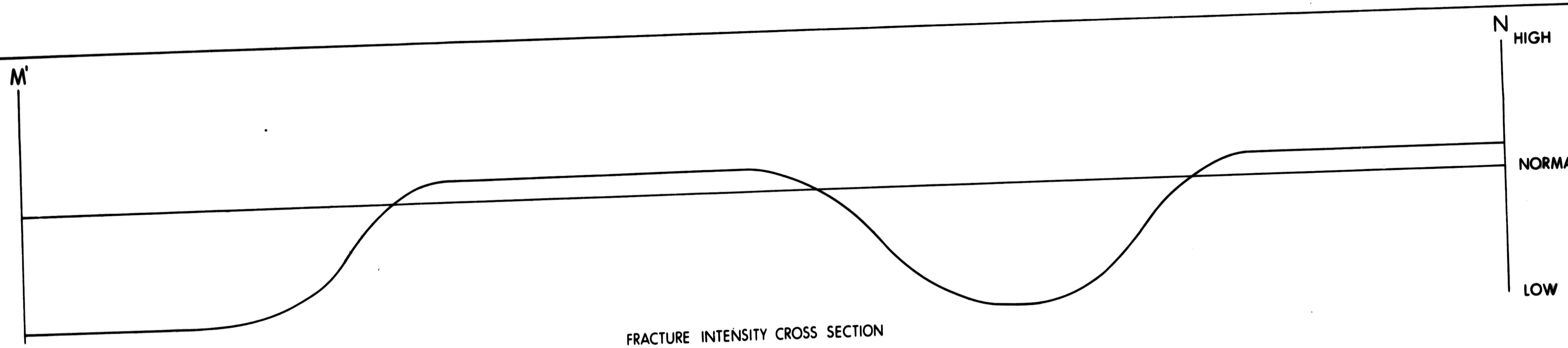
SCALE IN MILES

PROBABLE BASEMENT STRUCTURE





FRACTURE INTENSITY CROSS SECTION

CARSON HOLDINGS LTD. 654-2-4-7

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SCALE IN MILES

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