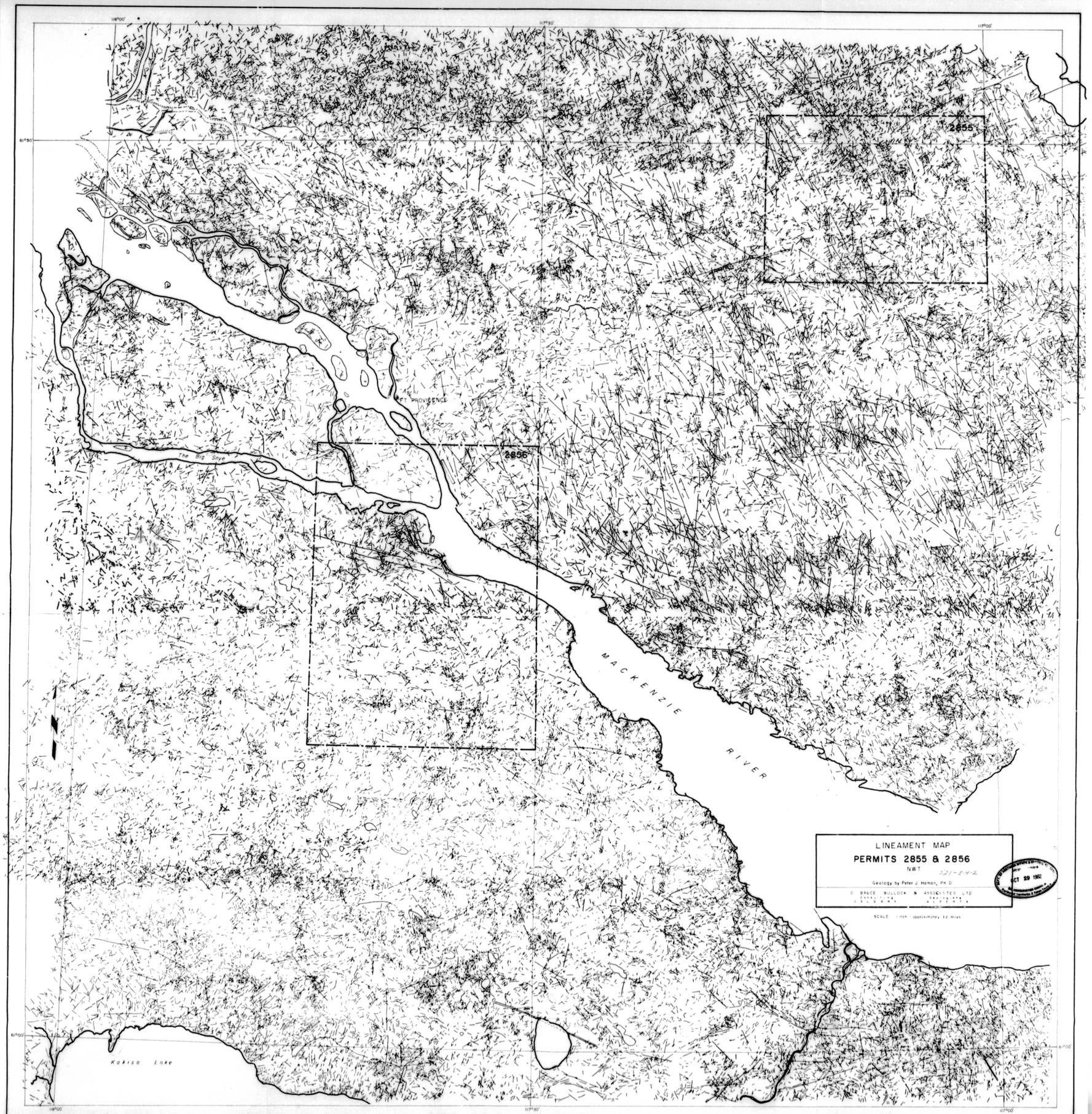
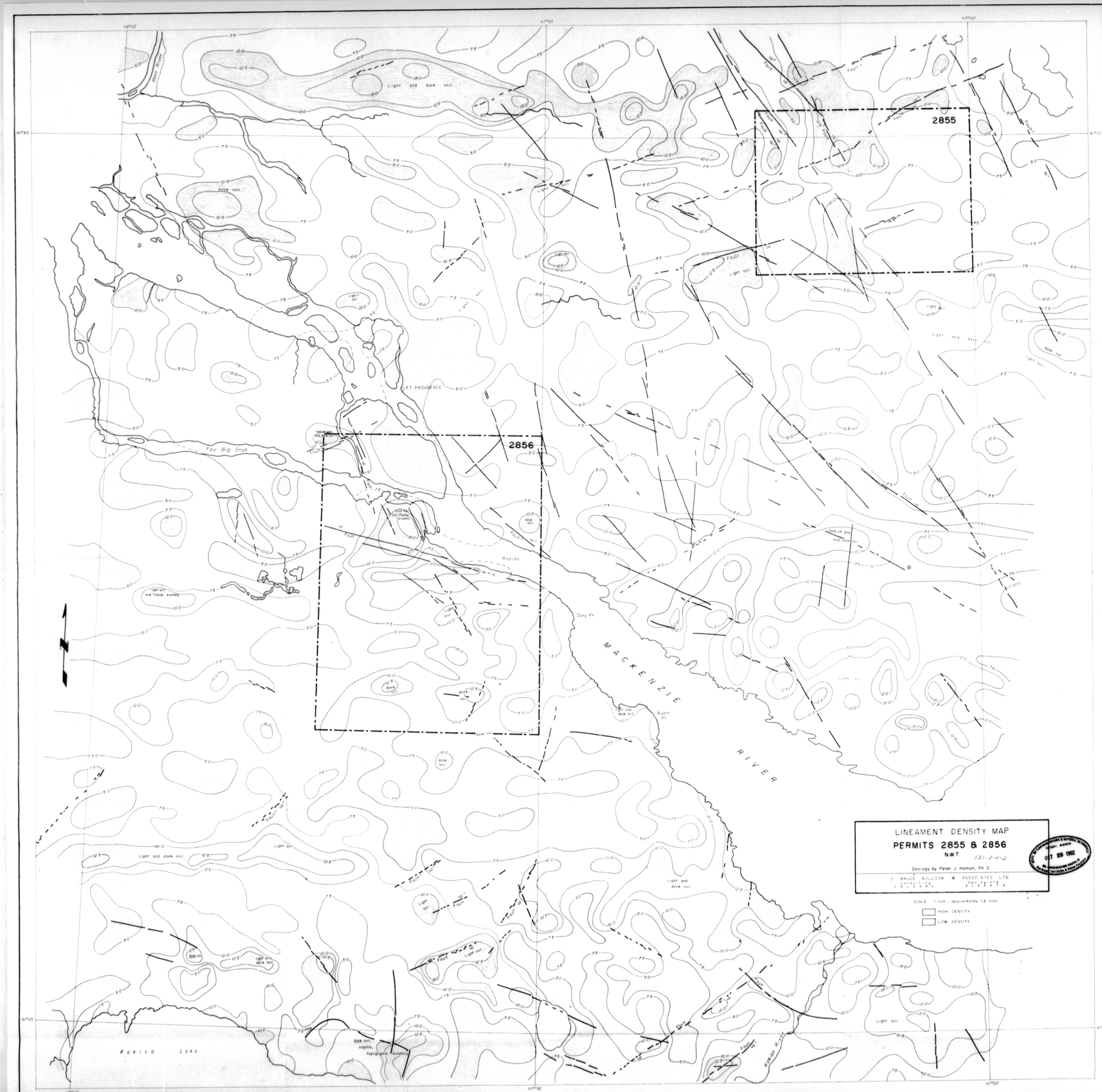

2855
2856
FT PROVIDENCE
The Big Snye
MACKENZIE RIVER
Kakisa Lake
LINEAMENT MAP
PERMITS 2855 & 2856
NWT
521-542
Geology by Peter J. Hamon, Ph.D.
D. BRUCE BULLOCK & ASSOCIATES LTD
SCALE 1 inch = approximately 12 miles
OCT 29 1982


2855
2856
FT PROVIDENCE
The Big Stye
Rapids
Dory Pt
MACKENZIE
RIVER
Burnt Pt
Kakisa Lake
Light and dark soil
dark soil
Light soil
Fault
LINEAMENT DENSITY MAP
PERMITS 2855 & 2856
N.W.T. 52-2-4-2
Geology by Peter J. Homan, Ph.D.
D. BRUCE BULLOCK & ASSOCIATES LTD
SCALE 1 inch = approximately 12 miles
HIGH DENSITY
LOW DENSITY
OCT 29 1982

Oct 1962

LINEAMENT ANALYSIS

PERMITS 2855 and 2856

NORTHWEST TERRITORIES

(for) Richard C. Cowell)

Prepared For

RICHARD C. COWELL

by

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CONTENTS

INTRODUCTION

The area of study is bordered approximately by west longitude 117° 00' and 118° 00' and north longitude 61° 00' and 61° 30' and includes Permits 2855 and 2856.

The purpose of this study is to analyse the density of micro-lineaments on aerial photographs and relate their occurrence to possible structural connotations. The lineaments were observed with the naked eye or with the aid of stereoscopic view. The observed lineaments of each photograph was transferred to a lineament map. A lineament density map was prepared from the lineament map by estimating the total length of lineaments within one square mile. Some significant long lineaments are plotted on the density map and are interpreted as either macro-fractures or as traces of faults.

The lineament map and the lineament density map have some distortion because of a different scale of the

photographs in different flight lines and sometimes also within one flight line. The average scale of both maps is approximately one inch to 1.2 miles. Geographic markers as, for example, lakes, rivers and streams or prominent soil tonal differentiations are marked on the lineament map in order to facilitate local adjustments.

The density pattern of lineaments, the macrofractures and the postulated traces of faults may be useful for a geological interpretation of subsurface anomalies.

Work on this project was carried out during the summer of 1962, prior to July 13, 1962.

EXPRESSION AND NATURE OF LINEAMENTS

Linear features on aerial photographs were observed throughout the area. They are expressed as topographic relief lineaments, vegetal lineaments and soil tonal lineaments. The studied area is generally one of very low relief and topographic lineaments are generally only faintly expressed. There is a great abundance of soil tonal and vegetal lineaments which apparently reflect differentiation in soil moisture and a change of either density of vegetal cover or vegetation type.

ORIGIN OF MICRO-LINEAMENTS

Micro-lineaments were elsewhere defined as individual continuous (or nearly continuous) natural lineations discernible on aerial photographs. They range in length from 0.1 miles to approximately two miles. The great majority of micro-lineaments are believed to be of structural origin. Lineation originating from a prevailing wind direction was not observed. Glacial lineation was observed in some areas but is relatively insignificant. The lineaments shown in this study can therefore be considered to be micro-fractures, i.e., they have to a large extent, structural control.

Micro-fractures are believed to consist of joint concentrations and are essentially vertical.

The density of micro-fractures has been found to increase along anomalies in the subsurface (anomalies in this usage refers to sudden lateral changes of the rock property, as e.g., the change from competent to incompetent material).

The density of micro-fractures was found to increase in areas with increasing competency of rocks of the stratigraphic column beneath the topographic surface. Buried reefs in the subsurface flanked by shales may therefore be expressed on the surface by a higher concentration of micro-fractures.

The thickness of unconsolidated material overlying the bedrock has some effect on the density of the fracture pattern. Exposed flat lying bedrock is usually characterized by an extremely high density of micro-fractures. If the bedrock is marked by unconsolidated material the density of fractures decreases to a certain extent. The thickness of the unconsolidated cover, however, has apparently no or only minor influence upon the density of micro-fractures. Micro-fractures in the bedrock can be propagated upwards through unconsolidated material regardless of its thickness. This explains the abundant occurrence of micro-fractures in various types of surficial material as well as in varying thicknesses of the unconsolidated cover from a few feet to several hundreds of feet.

The surface conditions modify the fracture pattern generally to only a minor extent. Certain types of muskeg, solifluction, dust sedimentation are some agents which locally may obscure the lineament pattern at the surface. In the studied area these agents were found to be insignificant and the lineament pattern is believed to reflect subsurface anomalies to a large extent.

MACRO-FRACTURES

Macro-fractures usually consist of a concentration of micro-fractures along a rectilinear or slightly curvulinear trend. The length of macro-fractures generally exceeds two miles and may be up to several tens of miles. Macro-fractures are major zones of weakness in the earth's crust, and are frequently used for lateral or vertical movements caused by tectonic forces.

It has been found that normal faults frequently display a low density of lineaments on the down thrown block. This may be explained by the greater thickness of incompetent and/or unconsolidated material on the downthrown block. In the studied area this rule of thumb may not be applicable in all cases and the opposite may be the case. The block showing a low density of lineaments may be the upthrown block. This may be explained by Upper Devonian carbonates overlying upper Devonian shales. The carbonates may be eroded off on the upthrown block. The low density of lineaments may be explained by the shaly Devonian section. The upper Devonian

carbonates may be preserved on the downthrown block and the higher lineament density may be explained by the higher competency of the carbonates.

FRACTURE PATTERN WITHIN THE AREA OF STUDY

This analysis was carried out as a thorough investigation of all more or less continuous lineaments. The majority of the lineaments has a length between 0.1 miles and 1.5 miles. It is believed that most of the lineaments have structural control and may therefore be classified as "micro-fractures". Some lineaments exceed the length of two miles and may be classified as "macro-fractures".

The lineament density map shows minima of less than five miles of lineaments within one square mile. The maxima display a density of up to fifteen miles within one square mile. This density is similar to the density observed in the Sturgeon Lake area of Alberta. (Haman, 1961)

The regionally greatest density of lineaments is shown in an east-west trending zone east of Fort Providence. The lineaments are characterized by a considerable increase

of the average length. The great majority of the lineaments trends towards the northeast. (See Lineament Map) It is possible that the prominence of Northwest trending lineaments is governed by glaciation. Lineaments trending in northeasterly direction may be more or less obscured. The discrimination between possible glaciation lineaments and fractures was difficult within this area. Dubious linear features were omitted to a large extent and the true fracture density may be considerably higher than shown on the density map. Changes of lineament density within this area may partly be caused by anomalous surface conditions. Certain types of muskeg or other vegetation obscures the lineament traces and the density pattern has only a limited value for structural interpretation. Two maxima in the northern portion of this area appear to be significant. One maximum is located immediately west of the southwest corner of Permit 2855, the other maximum is shown in the southwest corner of this permit. Both maxima appear to be related to north-northwest and east-northeast trending

faults. The type and pattern of the lineaments within this east-west trending zone resembles lineament patterns observed on the Canadian Shield. It is suggested that this zone is underlain by an uplift involving Precambrian rocks. Middle Devonian strata may possible thin out and Upper Devonian shales may be absent or thin. This interpretation may be supported by Northwest Territories Deep Bay No. 1 well, which is located east of this area. Only three hundred ten feet of Upper Devonian shales are reported to be overlain by eighty feet of drift.

The area interpreted as Precambrian uplift is surrounded by a rim of characteristic low density of lineaments. The average length is still above normal. This low density zone trends east-west through the central portions of Permit 2855 and swings southward immediately east of Fort Providence and through the northeastern portion of Permit 2856 and trends back towards the east approximately four miles north of Dory Point. This rim

of low density of lineaments is interpreted as a subcrop of Upper Devonian shales below the drift. The Northwest Territories No. 1 well near Fort Providence may support this interpretation. One thousand one hundred thirty five feet of Upper Devonian shales are reported to be overlain by one hundred seventy five feet of drift. This well is located within this zone of low density. The postulated Precambrian uplift east of Fort Providence appears to plunge towards the west.

Away from the postulated uplift the rim of low density grades to a zone with high lineament density which is characterized by a generally very short average length of the micro-fractures. This zone trends east-west along the northern border of the map area, through the northern portion of Permit 2855. The high density of short micro-fractures may indicate a relatively high competency of the rock underlying the drift. The Alexandra Formation, or any other competent Upper Devonian or younger formation,

overlying the Upper Devonian shales may be found underneath the drift. Long lineaments trending north-northwest and east-northeast are interpreted as fault traces and may complicate the regional structure. Two subparallel north-northwest trending fault traces at the northwest corner of Permit 2855 border a zone of low lineament density. A low lineament density has elsewhere been found on the downthrown block of a normal fault. If this observation were generally correct, then the block between the fault traces has to be interpreted as a graben. The writer favours the interpretation that the block between the fault traces is a horst. The low lineament density between the fault traces is explained by Upper Devonian shales as the youngest Devonian sediment underneath the drift. The higher lineament density on both sides of the fault block may indicate the Alexandra (or other) competent formation overlying the shales. If this interpretation were correct, then the northwest corner of Permit 2855 is very prospective for a structural entrapment of hydrocarbons.

The configuration of the high lineament density zone possibly related to the Alexandra (or other) competent formation is less distinct in the western portion of the map area. A somewhat higher lineament density is apparent west of Fort Providence and the Alexandra (or other) formation underneath the drift may trend south immediately west of Fort Providence, through the northern portions of Permit 2856 and may then trend east at approximately Dory Point. The northern portion of Permit 2856 shows long lineaments which may be interpreted as faults. This portion of the permit may also be favourable for a structural entrapment of hydrocarbons.

The southeastern corner of the map area is characterized by a regionally high density of short lineaments. It is believed that competent paleozoic rocks are underlying the drift. A more detailed interpretation cannot be given at present because of complications due to some apparent faulting within this area.

Soil tonal differentiations are marked on the lineament density map in areas of high lineament density. A light soil appears to occur frequently in areas underlain by paleozoic carbonates. It is not known whether soil tonal differentiations may be an additional aid for interpretation.

Some areas of high lineament density immediately north of Kakisa Lake are shown as dark soil tonal, vegetal and topographic relief anomalies. If there is any significance to different soil tonals and relief anomalies, then the high lineament density may be caused by an anomaly other than the rock property of the formation underlying the drift. A possible explanation may be either Middle Devonian reef build up or Precambrian uplift.

CONCLUSIONS

Micro-lineament analysis is believed to be a very useful tool for an analysis of the regional as well as for local structure. Macro-fractures may be interpreted as faults and the relative displacement may be deducted from a regional structural and from the lineament density pattern. The lineament density pattern may primarily reflect the subcrop pattern of Devonian formations underneath varying thicknesses of drift. Lateral changes from competent to incompetent rock of Middle or Upper Devonian age cannot be depicted from the lineament pattern without additional information of the regional structure. Any high density of micro-fractures not related to the subcrop pattern of competent paleozoic rocks underneath the drift may possible originate from Devonian reef build up or from Precambrian uplift.

An east-west trending Precambrian uplift is postulated east of Fort Providence. Middle Devonian strata may thin out above the uplift and Upper Devonian may be missing. The time of uplifting is not known. If this area was already a structural high during Middle Devonian time, one may expect a capping reef on top of the uplift, or a lagoonal reef, with the reef build up surrounding the uplift. Permit 2855 is located on the north flank of the postulated Precambrian uplift and is prospective for a structural entrapment of hydrocarbons. Permit 2856 is located on the south flank of the postulated west plunging Precambrian uplift. Structural entrapment of hydrocarbons is possible in the northern portion of this permit.

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