MAR 19660001: FIREBAG RIVER

Received date: Dec 31, 1966

Public release date: Jan 01, 1968

1966 0001

PHOTOGEOLOGICAL AND GEOMORPHOLOGICAL STUDY FIREBAG RIVER AREA, NORTHERN ALBERTA FOR C. C. HUSTON & ASSOCIATES

by

J. C. SPROULE AND ASSOCIATES LTD.

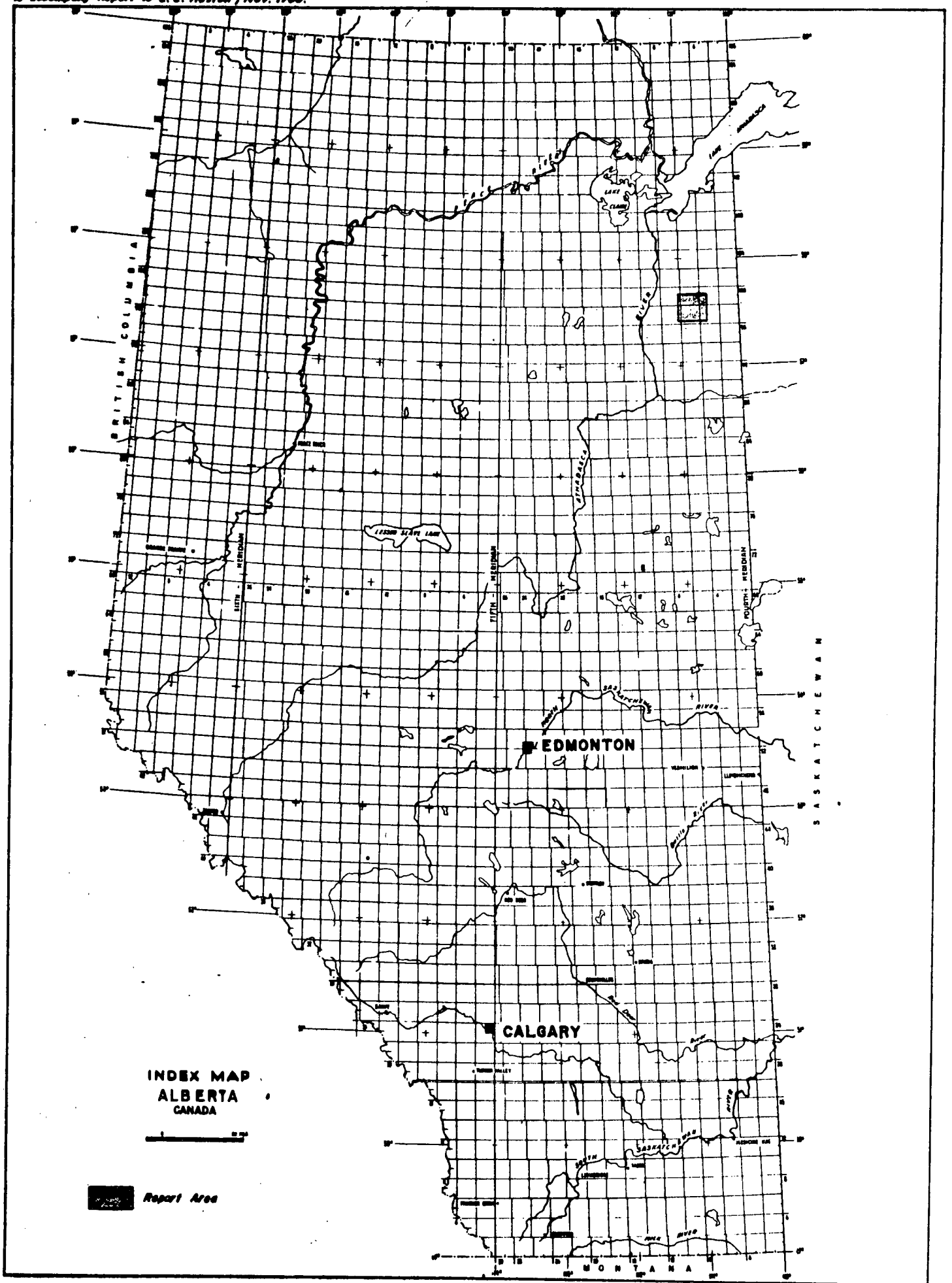
Calgary, Canada
November 1966

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

19660001

To accompany Report to C.C. Huston, Nov. 1966.



J.C. SPROULE AND ASSOCIATES LTD., CALGARY

PHOTOGEOLOGICAL AND GEOMORPHOLOGICAL STUDY

FIREBAG RIVER AREA, NORTHERN ALBERTA

INTRODUCTION

In accordance with the authorization by Mr. C. C. Huston of C. C. Huston & Associates, Toronto, Ontario, we have undertaken a photogeological and geomorphological study of a certain Mineral Permit in the Firebag River area of northern Alberta. The location of the area studied is shown on the index map (Frontispiece). The purpose of the study is to attempt to find geological features that may be of significance in guiding the proposed drilling program. In particular, it was hoped to identify fault and fracture systems, which might be related to the presence of porous reef carbonates which might be excellent host rocks for lead-zinc mineralization. Three illustrations accompany this report. Figure I is an annotated photogeological mosaic. Figure II is a "plain" unannotated mosaic and Figure III is a map showing the principal drainage features in the Permit.

A secondary objective has to do with access and drilling site logistics within the area.

REGIONAL GEOLOGICAL SETTING

The northeast corner of the Permit area adjoins, for all practical purposes, the boundary between the exposed Precambrian rocks of the Canadian Shield and the eastern feather edge of the Western Canadian Sedimentary Basin. The sedimentary beds have a gentle regional dip southwestward but locally reversals of dip are present due to faulting (and associated folding) either of basement origin or connected with salt solution from Paleozoic beds, and to draping over comparatively competent blocks such as reefs or erosional remnants at unconformities.

The stratigraphic section in the Western Canadian Sedimentary Basin consists of a Paleozoic carbonate shale and evaporite sequence, unconformably overlain by Mesozoic sandstones and shales.

Structural variations within the Paleozoic beds are almost invariably reflected through the unconformity into the overlying Mesozoic sediments and, in some cases, especially where the Mesozoic cover is thin, may be expressed at the surface.

GEOLOGY OF THE PERMIT AREA

The formations shown below can be expected to occur within the Permit area.

Table of Formations

Era and Period	Group or Formation	Lithology	Thickness In Permit Area Feet
Quaternary		Soil, glacial, lacustrine and aeolian deposits. Reworked McMurray oil sands.	5-50
Mesozoic Lower Cretaceous	McMurray	Sandstones, in part oil-saturated. Minor clay beds.	50±
	- UNCONFORMITY -		
Paleozoic Devonian	Elk Point Group Methy Fm.	Dolomite, calcareous to sandy dolomite.	200-250
	McLean River Fm.	Shale, in part silty, siltstone.	100-150
Devonian(?)	"Granite Wash"	Arkosic sandstone, conglomeratic sandstone.	0-100?
Precambrian		Crystalline and metamorphosed rocks.	

Stratigraphy

Bedrock exposures within the Permit area are few and those known have been assigned to the McMurray Formation. Information regarding the Precambrian and Paleozoic beds in the subsurface can only, therefore, be obtained by extrapolation. Precambrian rocks outcrop a few miles north of the Permit. Carrigy(1) gives a detailed account of their lithology. On the Clearwater River, some 65 miles southeast of the Permit, Precambrian rocks are overlain by an arkosic unit of variable thickness. Norris(2) has named this unit, widely known as "Granite Wash", the LaRoche Formation. The thickness of this unit varies considerably and appears to be thickest in lows on the eroded Precambrian surface. Basal clastic beds can be expected within the Permit area and may be estimated to have a maximum thickness of 100 feet, and that in erosional lows. Over structurally high features,

(1) Carrigy, M.A., 1959: Geology of the McMurray Formation, Part III, General Geology of the McMurray Area; Res. Counc. Alberta, Geol. Div. Memoir 1.
(2) Norris, A.W., 1963: Devonian Stratigraphy of Northeastern Alberta and Northwestern Saskatchewan; Geol. Surv., Can., Mem. 313.

the unit should be thin or absent. On a wide regional basis, these clastics are probably equivalent to the Winnipeg sandstone in Manitoba and the Athabasca sandstone of northwestern Saskatchewan.

The basal beds of the Devonian Elk Point Group on the Clearwater River consist of shale-siltstone, siltstone and sandy dolomite that grade into a predominantly dolomitic unit, the latter being the well-known Methy Formation. Norris has proposed the name, "Mclean River Formation", for the beds lying between the Granite Wash and the Methy dolomite. Beds of the Mclean River Formation presumably occur in the Permit area. Thickness of the beds may be in the order of 100 to 150 feet.

The Methy Formation consists essentially of dolomites and dolomitic limestones, and is the reefal facies of the 'First Salt' Formation. On a regional basis, the Methy is correlated with the Presqu'ile and Winnipegosis formations. It is not at this stage possible to accurately predict variations in the detailed lithology of the Methy beds within the Permit area, but a few observations on the lithology of the Presqu'ile and Winnipegosis formations may be useful. The Presqu'ile reef developments in the Slave Lake area can be related in a general way with regional faults in the underlying Precambrian rocks. The reefs do not, however, appear to grow on vertical projections of Precambrian fault scarps as has been suggested but are, rather, related to the structurally unstable zones emphasized by the Precambrian faults. The zone of faulting that passes through the Pine Point area continues southwestward into the Rainbow area of northern Alberta, and incidently slight mineralisation has been reported from Rainbow oil-bearing reefs. (Similar mineralization is also known from the Leduc-Rimbey reefs.)

The location of Winnipegosis reefs with regard to Precambrian fault trends is not documented but it is reasonable to suppose that some of the larger reef developments in the subsurface in Saskatchewan and Manitoba are related to tectonically active and unstable zones.

A small outcrop of dolomitic limestone, possibly belonging to the Methy Formation, is present just outside the northern boundaries of the Permit area and, since the regional dip of the beds is southwestwards, is good evidence for assuming beds of that formation to be present throughout the Permit. It is possible, and indeed probable, that variations in the lithology of the Methy Formation, perhaps only slight, will occcur across structurally high and structurally low areas. From the point of view of mineralization, however, it does not seem to be critically important that reefoid developments are present. In the Pine Point area, mineralisation also occurs in the fine-grained, generally non-porous, off-reef facies of the Presqu'ile.

It is possible that in the southwestern portion of the Permit a feather edge of the 'First Salt' Formation may be present. Beds of that formation, if present, will probably be of anhydritic facies. There is no conclusive evidence for the presence or absence of the 'First Salt' Formation in the area.

The contact between the Precambrian and Paleozoic as mapped by us is highly problematical. McMurray oil sands may overlap the Devonian bedrock locally as shown by Carrigy on his map.

Unconformably overlying the Methy, a variable thickness of McMurray sands (sensu lato) can be expected throughout the Permit area. Some of the 'McMurray' exposed on the Firebag River, as at the junction of the Firebag and the Marguerite rivers, is, in the opinion of Dr. J. C. Sproule, who has studied them in the field, 'reworked' McMurray and not genuine oil sand. This being the case, the McMurray (sensu stricto) may locally be absent. This may be especially applicable in the low lying area in the western part of the Permit.

Beds of the Clearwater Formation may be present in the southeastern part of the Permit. Carrigy on his map suggests that they may be. It is possible that Clearwater beds are responsible in part for the rather unusual drainage (Figure III) in the south and southeastern parts of the Permit.

Quaternary deposits obscure the bedrock feature over the entire area, except in a few places where streams have eroded down into the bedrock. Two or three generations of these comparatively recent beds are present. Glacial deposits are the oldest of the drift deposits and together with glacial lacustrine beds form the bulk of the drift. Wind-blown sand from glacial deposits subsequently added to the Quaternary cover. Finally, Recent alluvial and soil deposits were formed locally. The extent and nature of the Quaternary beds is of interest as, like the underlying Mesozoic beds, they, too, vary with the topography of the surface on which they were deposited. Also their lithological nature will have a bearing on the proposed drilling operations. It is suggested that, as far as is practical, test drilling be confined to topographically high and surficially well-drained areas where the drift should be thinnest.

Mention must be made at this point of the drainage in the Permit area. Figure III shows the principal creeks, streams and rivers in the area. The implications of the drainage configuration will be discussed under structure. At the present time, attention is drawn to:

(1) The large, generally north-northeast-southwest trending area lacking surface drainage.

(2) The difference in drainage style between the area just mentioned and that occurring in the southeastern part of the Permit.

(3) The rather pronounced feature north of the Firebag River in Township 97, Range 5, W. 4 M., and outlined on the photogeological mosaic (Figure I).

Structure

Any obvious structures that may be present in the Permit area are obscured by Quaternary beds and, therefore, their presence must be inferred from a detailed study of variations in the present land surface and subtle changes in drainage patterns and 'drift' appearance.

Numerous 'lineations' are present in the Permit area. Their significance, other than those of obvious glacial origin, is to some extent unknown but they must reflect either faults and fractures in bedrock or adjustments in the surficial cover to bedrock features.

The most prominent of these lineations are shown on the photogeological mosaic. Our interpretation of the more conspicuous linear features will be discussed after mentioning once again the variations in drainage patterns. A study of Figures I, II, and III, together with topographic maps, show a distinct difference in the almost rectilinear drainage in the southeastern portion of the Permit with that of the central parts. The southeastern area is topographically high and has retained distinct glacial grooving, whereas land to the west is considerably lower, poorly drained, and has only indistinct traces of ice movement. It is a known fact that topographically high lands throughout the Athabasca area generally reflect highs on the Paleozoic erosional surface, which in turn are basement controlled. On this basis, the entire eastern part of the Permit could also be structurally high. Two separate high areas are shown on the accompanying photomosaic (Figure I). They may or may not be separated by a localized low or a fault zone. It is not unreasonable to suppose that some of the stronger lineations reflect fault zones. Such fault zones, if present however, are not apparent on the published aeromagnetic maps, which show a generally northwest-southeast magnetic trend. The combination of thin sedimentary cover and pronounced variations in the lithology of the Precambrian rocks could mask the fault zones, and, although we have not attempted re-contouring the aeromagnetic data to a northeast-southwest strike, such an approach might accentuate the presence of any faults striking in that direction.

West of this postulated fault zone is an area characterized by underground drainage. This feature is well shown on Figure III. Whether or not this is a structural high, we are not sure, but for various reasons think it may be one on which the topography has become inverted. This is in contrast with the rule we mentioned previously, that structurally high areas are generally reflected as topographic highs in the Athabasca area. Reasons for suggesting the feature is a high, however, are:

(1) A Devonian erosional high is indicated in core holes southwest of the Firebag River in the area shown on Figure III. Control for this high is very limited but the direction of buildup towards our postulated axis of structural high is definite (Figure III).

(2) The overall drainage pattern of that portion of the Firebag River shown on the southwest corner of the photomosaics and map is identical to that occurring across a known structurally high and structurally low area, a few miles downstream. In this other area, the river cuts southwestwards into a low on the Devonian surface and cuts northeastwards into structural highs.

(3) It is possible that the Precambrian rocks just north of the Permit, whose southerly position is anomalous on a regional basis, are also related to a large, structurally high, regional feature trending from the area of Precambrian outcrop down across into the southwest corner of the Permit.

Immediately north of the Firebag River, in the southeast corner of the Permit, a small but pronounced topographically high area, flanked to the north and south by immature drainage, is probably also a structural high. The feature, outlined on the photogeological mosaic, is very apparent even on the "plain" photomosaic (Figure II). The drainage characteristics in this area are analogous in many aspects to those on the banks of the Red Deer River farther south, where it crosses local structural highs.

MINERALIZATION

The only mineralization within or near the Permit we are aware of is that reported by Carrigy in Township 89, Range 1, W. 4 M., where galena has been found in a small cavity in the Methy dolomite. The Permit area, however, appears to be favourably located. Faults in the Precambrian rocks of the Shield can be projected into the Permit and lineations within the Permit itself may be the surface expressions of basement faults. The Methy dolomite, a reefal facies correlative with the mineralized Presqu'ile reef at Pine Point, almost certainly underlies the entire area.

SUMMARY AND RECOMMENDATIONS

The Permit area is covered by Quaternary deposits, except for a few isolated outcrops referred to the Lower Cretaceous McMurray Formation. The local geology of the area must therefore be inferred. Sedimentary beds underlying the Permit probably consist of a basal Paleozoic clastic unit overlain by Devonian shales and siltstones, which grade into a predominantly dolomitic unit. Unconformable on the Devonian beds are sands of the Lower Cretaceous McMurray Formation. Glacial, lacustrine and aeolian beds form the land surface. The maximum thickness of the sedimentary section is thought to be in the order of 500 feet. Several topographic and surface features are interpreted as structural highs. If these highs are basement controlled, they may have influenced Devonian sedimentation and resulted in unusually thick and porous Methy reef developments though in our opinion porous reef developments are not a prerequisite for mineralization.

We recommend that, if logistically feasible, the initial, say five, test holes be drilled widely apart; for example, near the four extremities of the Permit and in the centre. Subsequent drilling could fill in between the earlier holes. Using this approach, it may be possible to identify at an early stage the area or areas of prime interest.

[redacted]

J. H. Stuart Smith, P. Geol.

[redacted]

J. C. Sproule, P. Geol.

1009 Fourth Avenue S.W.,
Calgary, Alberta.
November 11, 1966.
JHSS/JCS/fc

R.6

R.5

R.4 - W.4

T.99

T.98

T.97

Audet Lake

Area of Precambrian Outcrops

Projected Axis of Paleozoic High in Subsurface

Area of Underground Drainage

POSSIBLE AXIS OF STRUCTURAL

Structural High with Inverted Topography ?

Topographically and Probably Structurally High Area

Direction of Build-up of Paleozoic High from Subsurface Information

FIREBAG RIVER

Erosional Characteristics Suggest this Area is Structurally High

Outline of Permit Area

FIREBAG RIVER AREA
NORTHEASTERN ALBERTA

SHOWING

Principal Drainage and Interpretive Structural Features

SCALE 1/2" = 1 MILE

1966 0001 Figure III

R. 6 R. 5 R4 W.4 M

Tp. 100

Tp. 99

Tp. 98

Tp. 97

Marguerite River

MOSTLY PRECAMBRIAN BEDROCK

PRECAMBRIAN OUTCROPS

APPROXIMATE POSITION OF PRECAMBRIAN / PALEOZOIC BOUNDARY

POSSIBLE PRECAMBRIAN OUTCROPS

DOL. LIMESTONE (METH) OUTCROP

OIL SANDS OUTCROP

BEDROCK OBSCURED BY QUATERNARY DEPOSITS

MOSTLY PRECAMBRIAN BEDROCK

OIL SANDS OUTCROP

BEDROCK OBSCURED BY QUATERNARY DEPOSITS

AREA?

STRUCTURALLY HIGH

OIL SANDS OUTCROP

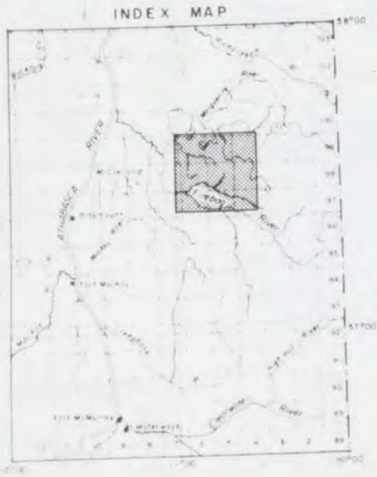
BEDROCK OBSCURED BY QUATERNARY DEPOSITS

AREA?

STRUCTURALLY HIGH

R. 7 R.6 R. 5 R4 W.4 M

INDEX MAP



LEGEND

- Alignment of probable geological significance
- Abandoned river terrace
- Glacial alignment showing direction of ice movement
- Mineral Permit Outline

PHOTOGEOLOGICAL MOSAIC

FIREBAG RIVER AREA

ALBERTA

PREPARED FOR

C.C. HUSTON

M.1 1/2 0 1 2 3 M.

APPROXIMATE SCALE IN MILES

THIS IS AN UNCONTROLLED MAP-MOSAIC AND SHOULD NOT BE MISTAKEN FOR AN ACCURATE GEOGRAPHIC BASE

J.C. SPROULE AND ASSOCIATES LTD. CALGARY, ALBERTA

NOVEMBER 1966

1966000/

Figure I

R. 6 R. 5 R.4 W. 4 M.

Tp 100 Tp 100

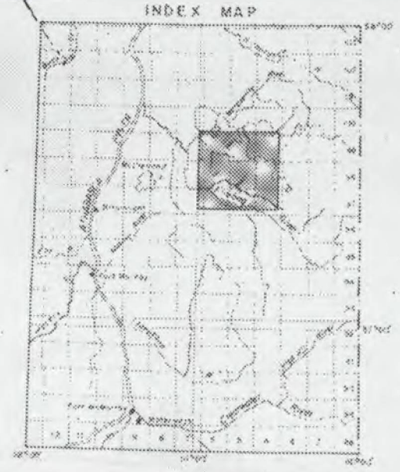
Tp 99 Tp 99

Tp 98 Tp 98

Tp 97 Tp 97

R. 7 R. 6 R. 5 R. 4 W. 4 M.

INDEX MAP



PERMIT TO OPERATE GEOPHYSICAL EQUIPMENT NO. 355
GEOPHYSICAL LICENCE NO. 3129
C-C-HUSTON PROSPECTING PERMIT NO. 126 794

FIREBAG RIVER AREA

ALBERTA

PREPARED FOR

C.C. HUSTON

APPROXIMATE SCALE IN MILES

THIS IS AN UNCONTROLLED MAP-MOSAIC AND SHOULD NOT BE MISTAKEN FOR AN ACCURATE GEOGRAPHIC BASE

NOVEMBER 1966

1966 0001
Figure II