

MAR 19680064: NORTHERN ALBERTA

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1968 0064

ECONOMIC MINERALS
FILE REPORT No.
S-AF-070(1)

PHOTOGEOLOGICAL STUDY
SULPHUR PROSPECTING PERMIT NO. 70
NORTHERN ALBERTA

Prepared For
Joe Phillips Ltd.
July, 1968

J. C. SPROULE AND ASSOCIATES LTD.
OIL AND GAS ENGINEERING AND GEOLOGICAL CONSULTANTS

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PHOTOGEOLOGICAL STUDY
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NORTHERN ALBERTA

INTRODUCTION

This report has been prepared at the request of Mr. David Ewing, acting for Joe Phillips Ltd., hereinafter referred to as the "Company." The request made was for a photogeological analysis of the Company's Sulphur Prospecting Permit No. 70, integrated with other available geological information. A map of north-central Alberta, Figure 1, shows the general geological setting of the Company Permit and its relationship to other sulphur permits in the area. Figure 2 represents the results of this preliminary study on a photogeological mosaic.

The immediate objective of this photogeological study was to identify from the study of aerial photographs those areas that, from our present knowledge, would be the most favourable for the occurrence of sulphur. Such areas could then be examined in the field to determine the presence or absence of sulphur.

Sulphur Prospecting Permit No. 70 totals approximately 39,680 acres.

BEDROCK GEOLOGY AND TOPOGRAPHY

Sulphur Prospecting Permit No. 70 is located on the north side of the Peace River, about 75 miles east-northeast of the town of Fort Vermilion. The area of the permit includes level to gently undulating lands southeast of the Caribou Mountains, with fair to good drainage into the Peace River.

The Company Permit is favourably situated within the area underlain by Devonian limestones, dolomites, shales and evaporites but few outcrops may be expected. The bedrock is generally overlain by a variable thickness of glacial till, glacio-lacustrine and Recent deposits.

The original sulphur discovery was made on Sulphur Prospecting Permit No. 8, approximately 30 miles southwest of the Company Permit and also within the area of Devonian bedrock.

MODE OF OCCURRENCE AND RELATIONSHIP OF SULPHUR TO GENERAL GEOLOGY.

Within the general area of interest in which sulphur prospecting permits have been issued (Figure 1), the principal bedrock formations are of Cretaceous age, but, to the north and northeast, erosion has stripped off the Cretaceous beds exposing older Devonian rocks. The Devonian, as well as overlying Cretaceous rocks, are generally inclined gently westward into the Alberta Syncline so that progressively younger rocks of both Paleozoic and Mesozoic ages are present in that direction.

The bedrock, whether of Devonian or Cretaceous age, is overlain by a variable thickness of glacial and related sediments. The thickness of these overlying sediments is generally at a minimum in those areas where river valleys are deeply incised and greatest in the hilly portions of the area.

The surficial geology of the area is of particular interest to the subject of possible economic occurrences of sulphur because of the probability that any economic deposits in this area are in surficial deposits.

The last glacier to cover the subject area was of Wisconsin age. Dating by the 'carbon 14' method indicates that this advancement over the region occurred over 31,000 years ago. Ice flow features on the Glacial Map of Canada indicate that this glacier came from an area west of Hudson Bay. The thickness of the glacier is estimated to have been approximately 5,000 feet and the average direction of flow in the subject area was to the west-southwest.

The general absence of terminal moraines and other ice marginal features indicates that the retreat of the glacier was mainly by rapid stagnation. Dead-ice moraine forms the surface or underlies lacustrine deposits over much of the regional area.

As the glacier retreated, the lowland to the north was blocked by ice and meltwaters and could not drain freely. Extensive proglacial and superglacial lakes were formed, resulting in the deposition of glacio-lacustrine deposits that vary in thickness from a few inches to fifty feet or more.

It is, at this time, not clear as to what extent the sulphur is developed in surficial deposits and to what extent it may be present within the stratified deposits of the Cretaceous and/or Devonian, but both modes of occurrence may exist. The most likely commercial deposits are, however, probably surficial.

Sulphur occurrences in the general region may be broken into three groups, as follows:

- (1) In muskeg or other poorly drained lacustrine or "dried lacustrine" areas. The most important known apparent example of this type is the Sulphur Prospecting Permit No. 8 discovery occurrence.
- (2) Deposits of elemental sulphur in connection with active springs with or without associated gas. One such known occurrence involved gas, which was, at least in part, combustible.
- (3) Cretaceous shales in the area frequently contain finely disseminated sulphur. Although we know of no reported concentrations of significant size from the Cretaceous, the possibility of such economic occurrences cannot be entirely eliminated.

In many parts of the general area, burnt shales have also been reported. These usually appear to be associated with recent slumps, possibly because the slumping brings the combustible material, which may include sulphur, in contact

with the surface. The origin of the combustion is, at this time, purely conjectural, but lightning produced forest fires are the most likely cause.

We are not prepared at this time to enter into detailed discussions of theories of the origin of the sulphur because of the large number of presently uncertain factors in this new area. Studies in the area are, however, likely to yield substantial information over the coming field season. Meanwhile, theories of origin from Paleozoic connate waters or from bedded Devonian and other gypsum and anhydrite deposits are of principal interest.

The manner of occurrence of sulphur deposits will determine whether they can be mined at the surface by stripping or from deeper strata by the Frasch process.

Solution of many of the questions of origin and occurrence is of prime economic importance and should be given very detailed attention as the present permit areas are evaluated.

Meanwhile, it is of general interest to the overall sulphur problem in this region that continuous flowing sulphur springs have been known in the area for nearly 200 years and that such springs are still known along a broad area along the Mesozoic-Paleozoic surface geological contact that extends from Western Saskatchewan, through the McMurray oil sands area, and across the present region of sulphur permits into the southern part of the Northwest Territories near Pine Point and westward along the Liard River. It is of further possible significance that there appears to be a genetic relationship between these sulphur occurrences and the McMurray oil, which has a four to five percent sulphur content. In addition to this, there is considerable free sulphur associated with the McMurray oil sands, both within and outside of the oil saturated area. As a measure of the amount of sulphur already known to have been deposited, probably

from the same type of connate waters that can be expected to have deposited the sulphur under study, we might refer to the "reserve" of the sulphur in the McMurray oil sands. Most recent estimates indicate that there is over 600 billion barrels of oil-in-place in the McMurray oil sands. This oil contains four to five percent of sulphur weighing approximately eight to ten billion long tons.

The above and other evidence available would indicate that what is needed to produce an economic sulphur deposit in this area is a favourable combination of faults and fractures for sulphate spring exits, sulphur supply in the connate waters and poorly drained lacustrine or other flat basin areas immediately adjacent to the spring exits. All these individual circumstances are known to exist. Under the proper combination of circumstances, there is no definite limit to the amount of sulphur that could be formed. Whether or not, or where, commercial deposits are present remains to be seen.

PHOTO GEOLOGICAL STUDY WITH RECOMMENDATIONS FOR FIELD EVALUATION

Numerous photo alignments are indicated on the accompanying photomosaic and these are assumed to represent bedrock controlled fracturing. The most prominent fractures trend northeast-southwest and are represented by several persistent parallel or en echelon alignments. This trend may have been accentuated by the advancing glaciers which moved essentially in a southwesterly direction. Thus, the actual significance of these alignments will remain in doubt until more details become available. A second well developed system is represented by numerous short, northwest-southeast trending alignments. North-south and east-west fractures have limited distribution and occurrence. Fracture intersections are common in the area and these represent possible means of egress for sulphurous emanations, if active in this area.

Except for the southeastern corner of the area, closed muskegs have widespread distribution. Some are small, but others reach an appreciable size. Many of the muskegs possess a pronounced northeast-southwest elongation that parallels the main fracture trends. Other divergent muskeg elongations also reflect control by adjacent fracturing. This combination of closed muskegs and related intersecting fractures represent favourable conditions for the formation of surficial sulphur deposits. The Permit has a variable potential and three areas are treated separately below.

'Area 1' is well endowed with closed elongate to irregular muskegs and associated fracturing. Thus, this area is considered to be a prime target of the Permit for further study, and the larger muskegs localized along the major northeast-southwest fractures represent the most attractive loci for initial investigation.

'Area 2' is considered of secondary importance because the excessive size of the sole muskeg may prove to be a detriment in that sulphur accumulations may occur in small localized 'basins' that would be difficult to locate. In any event, a field examination in the vicinity of the major northeast-southwest fracture is suggested as an initial step.

'Area 3' is also relatively attractive but is consigned to the lowest priority because the 'basins' are generally small and less abundant and they are not as commonly intimately associated with fractures. Nevertheless, if success is achieved in either 'Area 1' or 'Area 2', then 'Area 3' will definitely have to be investigated.

CONCLUSIONS AND RECOMMENDATIONS

From our overall sulphur studies in the general area, we conclude that the most likely sources of commercial sulphur are surficial deposits.


We also conclude, from our regional studies of the sulphur prospects of the subject area, that surficial deposits of sulphur are likely to occur in muskegs and lakes, or in abandoned lacustrine depressions, with particular reference to such areas that are along or adjacent to fractures and/or faults which may localize sulphate water springs.

We have determined that a number of such features show well on the air photographs and these areas have been outlined on the accompanying photogeological mosaic, Figure 2.

In view of the above, it is recommended that a field check be made of the areas that have been indicated by the photogeological study to be prospective. This field check would be that indicated as the "Preliminary Field Check" in our letter of June 10, 1968.

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H. B. Lyall, P. Geol.


S. R. L. Harding, P. Geol.

1009 Fourth Avenue S.W.,
Calgary 2, Alberta.
July 29, 1968.
HBL/JCS/SRLH/fc

19680064 SULPHUR PROSPECTING PERMIT NO. 70

CANCELLED

JOE PHILLIPS LIMITED,
625 - 4th AVENUE S.W.,
CALGARY, ALBERTA.

DATE OF ISSUE - DECEMBER 18, 1967
AREA - 39,680 ACRES.

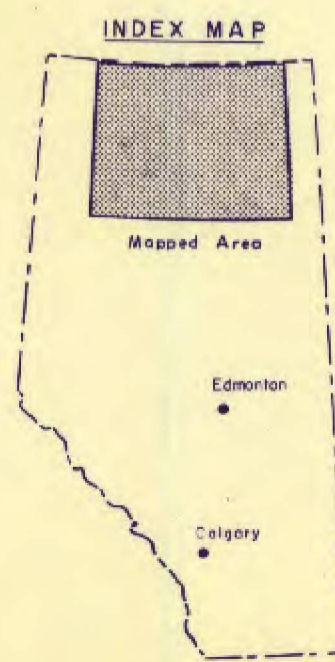
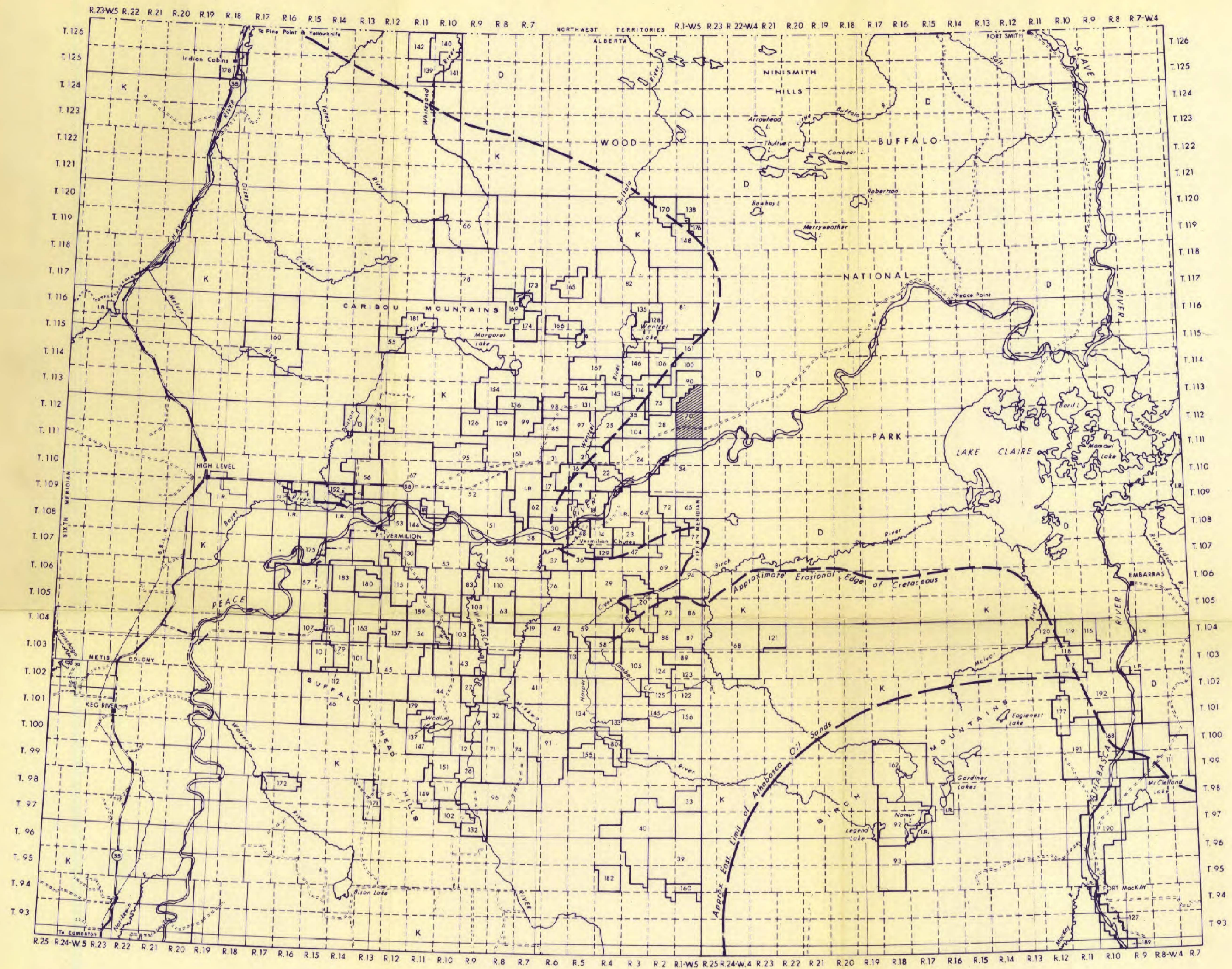
NO LEASES SELECTED

845/19418
TP. 113

TP. 112

R. 2

R. 1 W. 5 M.

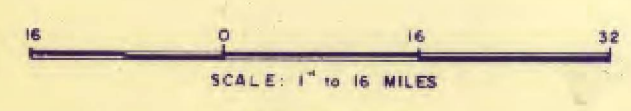


LEGEND

- K Cretaceous Formations
- D Devonian Formations
- 138 Sulphur Prospecting Permits
- Subject Permit
- Highway - Gravelled
- All Weather Road - Gravelled
- Dry Weather Road - Dirt - Truck Trail

NORTH - CENTRAL ALBERTA

SHOWING
SULPHUR PROSPECTING PERMITS



PREPARED FOR
JOE PHILLIPS LTD.

NOTE: Permits as Published to: March 29, 1968 (Data on later permits not yet available)

R.1 W.5 114°00'

**PHOTOGEOLOGICAL MOSAIC
SULPHUR PROSPECTING PERMIT**

No. 70

**FORT VERMILION AREA
ALBERTA**

PREPARED FOR
JOE PHILLIPS LIMITED



APPROXIMATE SCALE IN MILES

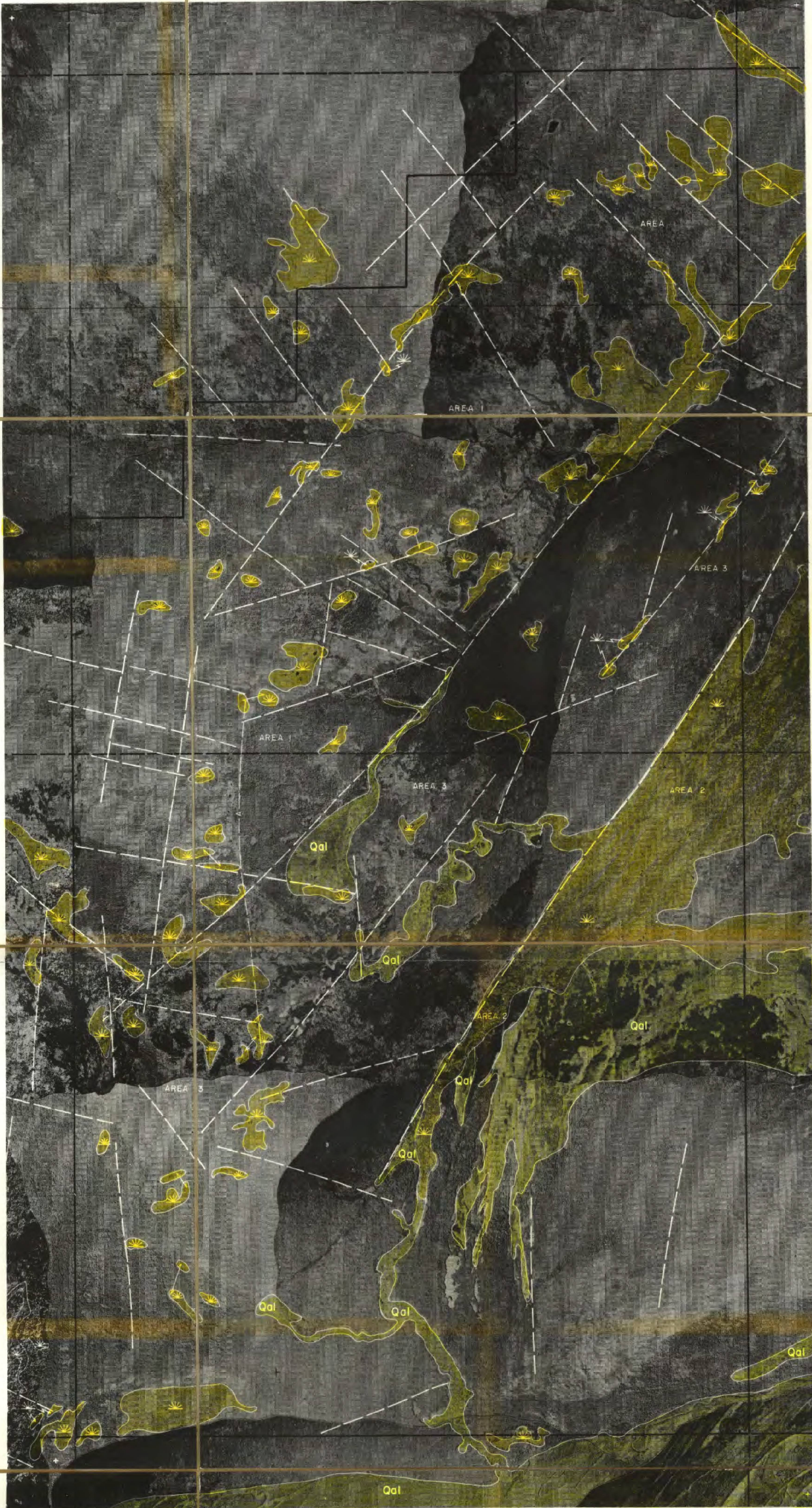
THIS IS A SEMICONTROLLED MAP-MOSAIC AND SHOULD
NOT BE MISTAKEN FOR AN ACCURATE GEOGRAPHIC BASE

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

JULY 1968

58°50'

T. 113



58°45'

T. 112

R.1 W.5 114°00'

LEGEND

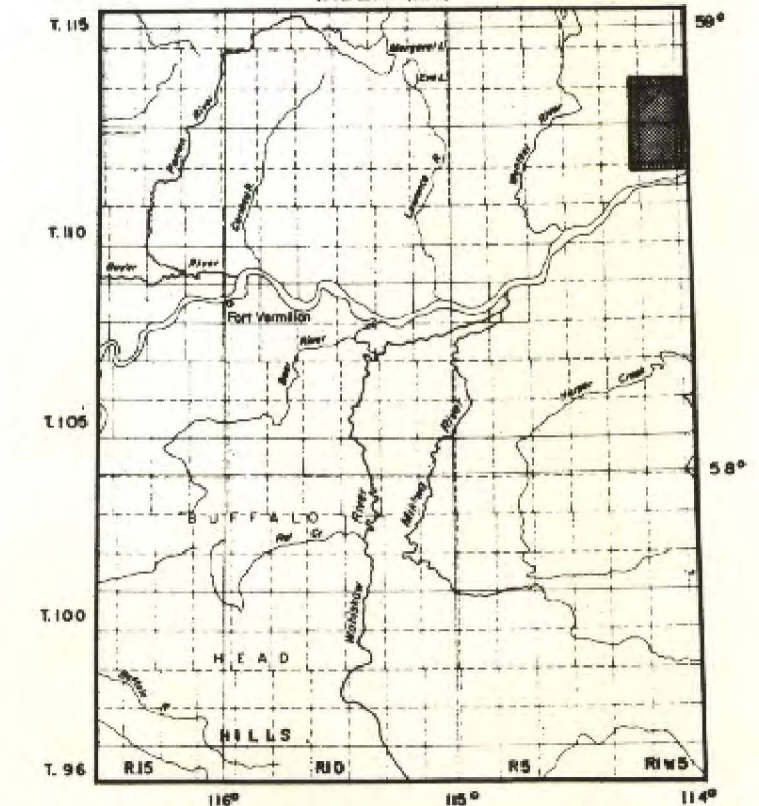
SURFICIAL DEPOSITS

- Qal Alluvium
- Muskeg

PHOTOGEOLOGICAL SYMBOLS

- Alignment interpreted to indicate faulting or fracturing in bedrock
- Alignment of probable geological significance
- AREA 1, 2 etc. Areas of interest discussed in report
- 70 Sulphur prospecting permit outline

INDEX MAP



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