

MAR 19680144: NORTHERN ALBERTA

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ECONOMIC MINERALS
FILE REPORT No.
S-AF-178(1)

PRELIMINARY GEOLOGICAL REPORT AND PHOTOGEOLOGICAL STUDY
SULPHUR PROSPECTING PERMIT NO. 178
NORTHERN ALBERTA

Prepared For
Aztec Oil & Gas Company
May, 1968

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

1009 FOURTH AVENUE S.W.
CALGARY - ALBERTA

TELEPHONE 269-7951

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ILLUSTRATION

Figure 1 - Photogeological Mosaic, Sulphur Prospecting Permit
No. 178, Rat Lake Area Alberta.

In Pocket

PRELIMINARY GEOLOGICAL REPORT AND PHOTOGEOLOGICAL STUDY

SULPHUR PROSPECTING PERMIT NO. 178

NORTHERN ALBERTA

INTRODUCTION

This report has been prepared at the request of Mr. James B. Duff, acting for Aztec Oil & Gas Company, hereinafter referred to as the "Company."

Sulphur shows in various forms have been reported in northern Alberta and the Northwest Territories for many years but, until recently, there has been no active interest in the sulphur potential of the area. The current world shortage of sulphur and increased sulphur prices have stimulated interest in the prospecting for and development of new sources of supply. During recent months, considerable attention has been given to northern Alberta by a number of companies, including several large producers and users of sulphur. At least 178 Sulphur Prospecting Permits, totalling over 7,000,000 acres, have been issued in the general area.

Most of the filing on the sulphur permits took place in late 1967 and early 1968. The winter weather has prevented any detailed field investigations of these permits. It was arranged, however, for three senior geologists of the firm of J.C. Sproule and Associates Ltd. to make brief visits to the area in late October and early November, at which time they confirmed the mode of occurrence of

sulphur on Alberta Sulphur Prospecting Permit No. 8 as well as other recorded occurrences. It is expected that the present summer season will see considerable activity in the area of these permits.

The purpose of this photogeological study is to assist in the selection for study of areas of special interest in order that initial field work may be directed towards these areas.

The photogeological work relating to the subject permit was carried out largely by Mr. V.A. Farley.

DESCRIPTION OF PROPERTY

The Company's acreage, as presented to us, is summarized as follows:

<u>Permit No.</u>	<u>Location</u>	<u>Gross Acreage</u>
178	Township 125, Range 18, W. 5 M.	19,840

Although the information of this property, as given to us by Mr. James B. Duff, has been accepted as correct, we have made no investigation as to legal title or interests held.

LOCATION, ACCESS AND TOPOGRAPHY

Sulphur Prospecting Permit No. 178 is located about 90 miles due north of the town of High Level and six miles south of the southern boundary of the Northwest Territories. High Level lies approximately 375 miles northwest of Edmonton and is served by the Mackenzie Highway and the Great Slave Railway. Both the Mackenzie Highway and the Great Slave Railway continue on to the north from High Level passing through the centre of the subject permit. Accessibility should, therefore, constitute no problem.

The topography of the area is generally quite flat. Surface drainage is restricted and, as a result, approximately 70 percent of the permit area is occupied by muskeg. The Hay River flows in a northerly direction through the eastern part of the permit.

MODE OF OCCURRENCE AND RELATIONSHIP OF SULPHUR TO GENERAL GEOLOGY

Within the general area of interest, 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 geological setting is quite similar to that which exists in the Fort Vermilion area where the sulphur play originated.

Surface outcrops of both Paleozoic and Cretaceous age are widespread but not numerous. No outcropping bedrock is evident from the photos within the permit area. Outcrops may, however, be present. The number of faults and fracture lines indicates that the bedrock is in many places at or near the surface.

The bedrock, whether of Devonian or Cretaceous age, is overlain by a variable thickness of glacial and related sediments. The thickness of the glacial beds varies from zero to several hundred feet. The thickness is generally at a minimum in those areas where river valleys and deeply incised and greatest in the hilly portions of the area.

It is, at this time, not clear as to what extent the sulphur is developed in surficial deposits and to what extent it is present within the stratified deposits of the Cretaceous and/or Devonian, but it is believed that both modes of occurrence may exist. The most likely commercial deposits are 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 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 original cause of the combustion is, at this time, purely conjectural, but lightning causing forest fires is the most likely source.

We are not prepared, at this time, to enter into detailed discussions of theories of origin 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 or 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 area is 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 percent to five percent sulphur content. In addition to this, there is considerable free sulphur associated with the McMurray 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 million barrels of McMurray oil in place in the Oil Sands. This oil contains four percent to five percent sulphur (close to saturated) weighing approximately 8 to 10 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.

PHOTOGEOLOGICAL STUDY - SULPHUR PROSPECTING PERMIT NO. 178

Aerial photographs of the subject permit area were examined stereoscopically for the purpose of selecting general areas of interest that, from our present knowledge, would appear to be the most favourable for the occurrence of sulphur. The areas recommended for field study are those that are most likely to have sulphur occurrences at or near the surface. We are reasonably certain that most occurrences in this area are at the surface and that our method of identification of the most likely areas is practical.

The dominant structural feature of this area is a southwest-trending fracture pattern (Figure 1) which is part of the Pine Point-Hay River-Rainbow, etc. tectonic system. The presence of this major fault zone has been confirmed by well control and aeromagnetics. In the Northwest Territories, the Pine Point lead-zinc deposits occur along this same zone, suggesting that mineral bearing solutions are controlled by the major fault and fracture systems and that ore was deposited in the Middle Devonian Presqu'ile Formation.

Within the area of study (Figure 1), prominent fault zones trend from northeast to southwest through the Company permit and are seemingly responsible for the abrupt change in direction of the Hay River near Rat Lake.

Large, poorly drained areas of muskeg also occur within the permit boundaries. The most prominent of these cover several square miles and occupy the west-central part of the permit. This area is shown on the accompanying mosaic as

Area 1. There are several streams in the area but local portions of Area 1 do not appear to be connected, on the surface at least, with the drainage.

Area 2, in the northwestern part of the permit, is similar to Area 1 with the exception that a thin layer of alluvial material has been deposited over most of the area. Alluvium has been carried down by streams from the adjacent Cameron Hills. Such areas differ from the surrounding muskeg areas in that they are lighter in tone. This general area also has regional drainage and local areas of sedimentation, or areas of possible sulphur deposition away from the streams. Alluvial areas may reduce the sulphur prospects in some areas.

It would be desirable to concentrate initial field studies in the numerous small muskeg areas away from the main drainage channels and in the immediate vicinity of the principal fault trends. The prominent fault and/or fracture systems in both Areas 1 and 2 would appear to indicate high local bedrock structural relief, areas that are generally conducive to the occurrence of fracturing and related occurrences of springs.

In the eastern portion of the permit area, Areas 3, 4 and 5 are located within the ancestral valley of Hay River and are, therefore, probably fairly well drained. Parts of these areas are in muskeg developed in finer alluvial material. The coarse alluvial material is probably from zero to 20 feet in thickness. Sedimentary deposits of sulphur of significant size in this area are not as likely to occur as in areas to the west of the river.

Area 6 is a relatively small muskeg area that is well-drained and, therefore, of little interest.

There are muskeg areas other than those mentioned above and they are either too small or too well-drained to be of prime interest.

SUMMARY AND RECOMMENDATIONS

Aztec Oil & Gas Company holds Sulphur Prospecting Permit No. 178 located in northern Alberta. The permit totals 19,840 acres.

The subject permit is located in a general area where active interest has been shown by a number of companies, including large sulphur producers and users.

The initial discovery of sulphur was made on Sulphur Prospecting Permit No. 8 in the Fort Vermilion area. The occurrence of sulphur on this permit, as well as in other parts of the general area, has been confirmed by geologists of J.C. Sproule and Associates Ltd.

The origin of the sulphur occurrences in this area is not known at this time. On the basis of our general knowledge of the sulphur occurrences in this general area, however, we believe the best prospects are in poorly drained lacustrine and muskeg areas where fracturing occurs and where the Devonian beds are relatively near the surface, either beneath glacial material or a relatively thin mantle of Mesozoic rocks.

From this latter point of view, Sulphur Prospecting Permit No. 178 is particularly favourably located in that it is situated on a major fault zone trend in an area where the Devonian is overlain by an estimated 100 to 150 feet of Cretaceous and Recent sediments. Very strong sulphur springs are known to occur along this trend a short distance to the southwest of the Pine Point silver-lead-zinc mining area.

As a result of our study, it is recommended that a preliminary field study be carried out over the subject permit and that, during the study, particular attention should be paid to the examination and sampling of springs, spring deposits and lake and muskeg bottoms. Any areas yielding free sulphur or sulphur odour should be analyzed. Shallow augering of selected areas will provide valuable information.

It is further suggested that this field study be conducted in two parts, or steps. Step 1 should be a purely preliminary reconnaissance carried out by use of a helicopter and trenching and hand auger tools. During this step, all small muskeg and lake or basin areas observed on photos or from the air should be checked closely and if sufficient evidence of sulphur is found to justify proceeding, the geological party should remain in the field and complete a more comprehensive sampling and hand-auger study. If no encouragement is received during Step 1 of this phase, however, abandonment of the permit and recovery of the deposit might be in order, unless some other member of the Industry should wish to take it over on a farmout basis.

J.C. Sproule and Associates Ltd. will have a geological party in the area on several other similar jobs, beginning toward the end of June and would be pleased to undertake Step 1 of the reconnaissance phase, as well as Step 2 if it is justified from the results of Step 1. This work could be carried out at relatively low cost because of the overall amount of other work to be carried out in the area.

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J.C. Sproule, P. Geol.


V.A. Farley.

1009 - 4th Avenue S.W.,
Calgary 2, Alberta.
May 31, 1968.
JCS:VAF:ldl

SULPHUR PROSPECTING PERMIT No. 178

CANCELLED

AZTEC OIL & GAS COMPANY
1090 ELVEDEN HOUSE,
CALGARY 2, ALBERTA

DATE OF ISSUE - FEBRUARY 26, 1968
AREA - 19,840 ACRES

NO LEASES SELECTED

ALBERTA - NORTH WEST TERRITORIES BOUNDARY

84N/
14+15
NE+NW
TP. 125

TP. 124

R. 18

R. 17 W. 5 M.

R.18 W.5 117°00'

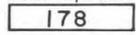
59°55'

T.125

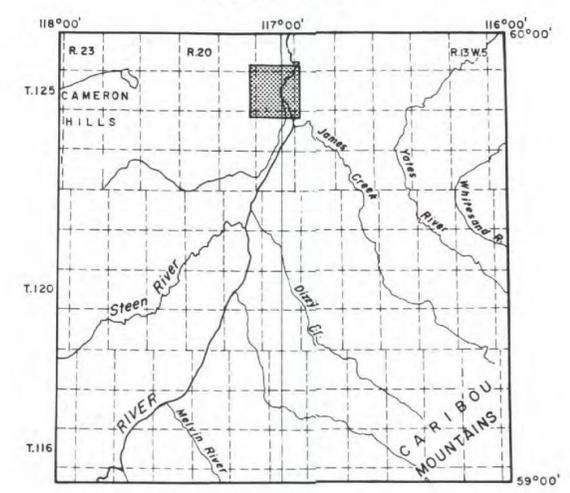
59°50'



LEGEND

-  Alignments interpreted to indicate faulting or bedrock fracturing
-  Muskeg
-  AREA 1, 2 etc. General areas of interest
-  178 Permit Outline

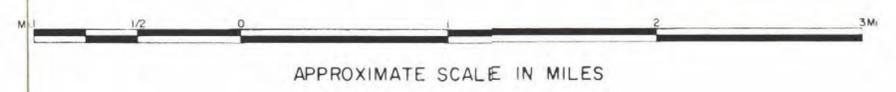
INDEX MAP



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**PHOTOGEOLOGICAL MOSAIC
SULPHUR PROSPECTING PERMIT
No. 178
RAT LAKE AREA
ALBERTA**

PREPARED FOR
AZTEC OIL & GAS CO. LTD.



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

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

MAY 1968