

MAR 19680096: NORTHERN ALBERTA

Received date: Dec 31, 1968

Public release date: Jan 01, 1970

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ECONOMIC MINERALS

FILE REPORT No.

5-AF-106(2)

PHOTOGEOLOGICAL STUDY
SULPHUR PROSPECTING PERMIT NO. 106
NORTHERN ALBERTA

Prepared For
Ortega Minerals Ltd.
December, 1968

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

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BEDROCK GEOLOGY AND TOPOGRAPHY

Sulphur Prospecting Permit No. 106 is located along the north side of the valley of the Peace River on the eastern flank of the Caribou Mountains, some 70 miles northeast of Fort Vermilion. The Cretaceous-Devonian boundary runs in a southwest-northeast direction between the Caribou Mountains and the Peace River, crossing the southeastern segments of Sulphur Prospecting Permit No. 106, so that Devonian rocks immediately underlie the surficial sediments throughout a portion of the Permit area. In this respect, Permit No. 106 is located in a comparable position to the sulphur discovery Permit No. 8 (Figure 1).

The topography in the area of Permit No. 106 presents a sloping, irregular surface with well developed drainage and locally incised streams.

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 '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.

PHOTOGEOLOGICAL STUDY

SULPHUR PROSPECTING PERMIT NO. 106

NORTHERN ALBERTA

INTRODUCTION

This report has been prepared at the request of Mr. J.E. Cleveland, acting for Ortega Minerals Ltd., hereinafter referred to as the "Company." The request made was for a photogeological analysis of the Company's Sulphur Prospecting Permit No. 106, 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. 106 includes approximately 19,840 acres.

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 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 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.

PHOTOGEOLOGICAL STUDY

WITH RECOMMENDATIONS FOR FIELD EVALUATION

Several alluvium-filled depressions, sometimes obscured by a vegetation overgrowth, have been outlined on the accompanying photomosaic. These normally represent areas of flattening within the general surface slope which explains the sporadic distribution and irregular outlines of these muskegs. The area is patterned by numerous alignments that are presumed to represent bedrock faults or joints. One prominent fracture set trends northeast-southwest but the many parallel northwest-southeast trending fractures may indicate that this is also a major structural trend. A subsidiary east-west fracture development also exists in the area as well as other diversely trending alignments.

The Permit lies partly within the Devonian subcrop adjacent to the Cretaceous unconformity. This situation is comparable geologically to that which exists in Sulphur Prospecting Permit No. 8, the sulphur discovery Permit, except that there is less Devonian outcrop occurring on Sulphur Prospecting Permit No. 106. Topographically, however, these two Permits differ in that Permit No. 8 is flat and swampy and Permit No. 106 is sloping with an irregular surface and few small to medium sized muskegs. Since our knowledge of the mode of occurrence of this type of surficial sulphur deposit is becoming more definite as time and investigations proceed, it seems that topographically elevated and well-drained "basins" are no less prospective than lower, flat muskeg terrain. Thus, it is suggested that the "basins" outlined within Permit No. 106 be further investigated without discrimination as to relative rank since all are associated with linear fractures. Because of the small number of muskegs, a field program could be achieved in a relatively short time, particularly if only a few of the larger "basins" were singled out for attention initially.

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, lakes or in abandoned lacustrine depressions, with particular reference to such areas that are along or adjacent to fractures and/or faults responsible for 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. We are further aware that some of the nearby Permits have yielded high sulphur analyses.


In view of the above, it is recommended that a field check of representative muskeg localities within the subject Permit be made. In summer conditions, we would recommend that spot-sampling, trenching and/or auger sampling be undertaken as the occasion demands. Present winter conditions prohibit an effective examination of the Permit by a helicopter-borne geological crew at this time. It would be necessary to move a small drilling unit into the Permit area if the Company is to obtain samples prior to January 16, 1969 expiration date of the Permit.


An alternative to this plan would be to renew only that portion of Sulphur Prospecting Permit No. 106 that includes the depressional features which are recommended for field examination and wait for more favourable field conditions in the spring of 1969. It is our understanding that this can be done for ten cents per acre renewed, for a period of six months. If this program is undertaken, it is recommended that the following acreage be renewed:

- a) Sections 4, 5 and 10, Township 115, Range 2, W. 5 M.
- b) Sections 16, 17, 18, 19, 20, 21, 30 and 31, Township 114,
Range 2, W. 5 M.

The results of the preliminary field work will then inform the Company as to whether or not a full-scale field operation should be undertaken. If the preliminary results do not indicate that further work should be done, it would then be recommended that the Company apply immediately for abandonment and the return of their \$2,500 deposit.

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December 6, 1968.
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