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ECONOMIC MINERALS
FILE REPORT No.

S-AF-144(6)

TERRAIN ANALYSIS

of

SULPHUR PERMIT 144

19680121

Prepared for

MESA-PETROLEUM CO.

Wainco Oil and Chemicals



June, 1968.

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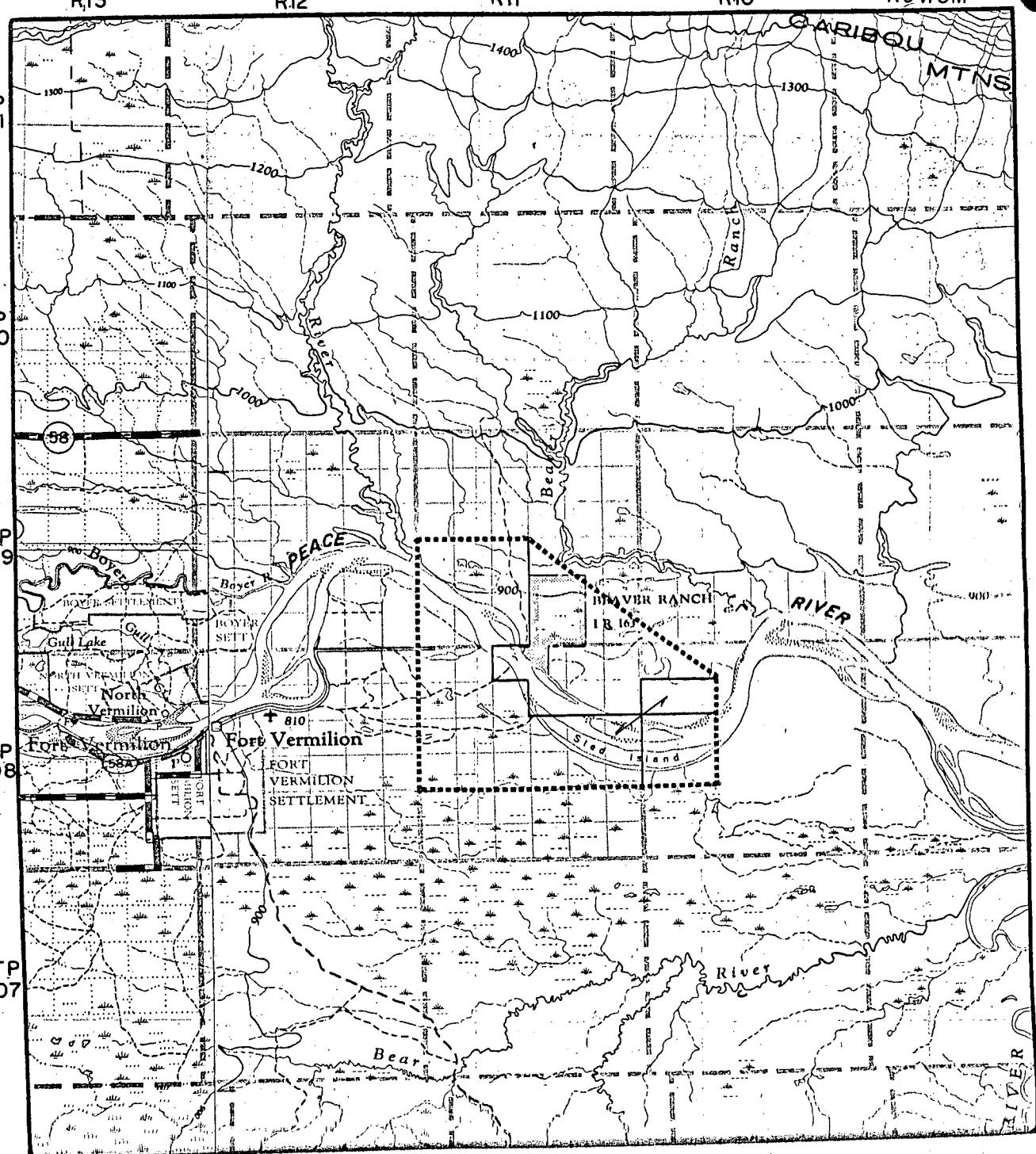


FIGURE 1

INDEX MAP

Hulphur Hill 1:250,000

Project Area

SCALE: 1 INCH = 4.3 MILES

REPRODUCED FROM FEDERAL TOPOGRAPHIC MAP

GEOPHOTO SERVICES LTD.

INTRODUCTION

Geophoto Services, Ltd. has completed a Terrain Analysis of Sulphur Permit 144, in the vicinity of Fort Vermilion, Alberta. A stereoscopic examination of photographs covering Permit 144 was made and a map showing terrain and vegetation distribution was prepared covering the area shown in Figure 1.

The study was made for the specific purpose of delineating criteria which may indicate potential areas of sulphur occurrence. Therefore, certain modifications have been made to the Standard Terrain Analysis to incorporate various criteria, such as non-vegetated areas, and photo lineaments into the final map.

PHOTOGRAPHY AND MAP COMPILATION

Stereoscopic panchromatic air photographs taken by the Federal Government in 1955, were used in this study. These photographs were taken with a camera equipped with a six inch focal length lens at an altitude above terrain of approximately 17,500 feet, resulting in a photograph scale of 1:35,000.

Uncontrolled, stapled mosaics were prepared of Permit 144, at a scale of one inch equals one mile and one inch equals one-half mile. The one inch to one-half mile mosaic covers primarily the area of the sulphur permit. The one inch equals one mile mosaic covers an area extending from T. 107 to T. 110, R. 9 to R. 12, W5M. This larger area mosaic was constructed for future fracture analysis of the Permit 144 area. The mosaics were constructed by carefully matching details of alternate air photographs along east-west flight lines using hydrographic and topographic features for control. Federal Government 1:250,000 scale topographic maps and Alberta Planimetric Maps at a scale of 1:63,360, were used for mosaic control. Accuracy of the individual mosaics is considered satisfactory. However, due to distortions within the individual photographs minor planimetric inaccuracies are unavoidable and measurements on the mosaics should be considered approximations of ground distances.

A permascale base map was prepared by tracing planimetric

and hydrographic details from the 1:31,680 scale mosaic, so that terrain features can be easily correlated with the mosaic.

The final maps were prepared by transferring details from individual aerial photographs to their respective base maps. Trails and routes are current to date of photography, 1955. Ozalid prints of the base maps were hand coloured and these comprise the final maps of this report.

ACCESS

Sulphur Permit 144 is located approximately six miles east of Fort Vermilion, Alberta. The project area is connected to Fort Vermilion by a road on the north side of T. 108, R. 11 and 12, WSM. Several trails extend from Fort Vermilion into the project area. The Peace River traverses Sulphur Permit 144.

PHYSIOGRAPHY AND REGIONAL GEOLOGY

Permit 144 is located on generally flat to rolling topography with many small lakes and muskeg. The flat topography is punctuated by the sharp banks paralleling the course of Peace River. The banks along the Peace River are generally less than 100 feet in height. The area is drained by Peace River and its tributaries. Total relief is less than 100 feet. Sulphur Permit 144 lies within the eastern edge of the Great Plains Physiographic Province and is approximately 175 miles west of the Precambrian Shield. Caribou Mountains are located approximately 25 miles northwest of Permit 144.

A detailed account of the geology of this region is beyond the scope of this paper and the reader is referred to Norris (1963, p. 68), and maps of the Geological Survey of Canada for such an account. However, in brief summary, the Precambrian basement is unconformably overlain by the wedge-edge of Middle and Upper Devonian Carbonates, thin beds of clastics and evaporites. The Devonian rocks are overlain by Cretaceous Loon River Formation. The project area is covered by glacial drift which was deposited by ice moving approximately S85°W to S90°W, as indicated by numerous glacial grooves southwest of the project area. Little is known of the structural configuration of the area, however, dips up to eight degrees in magnitude are found along Peace River where re-

gional dip is approximately 23 feet per mile to the west and southwest (Norris, 1963, p. 74). Sikabonyi and Rodgers (1959) and Haites (1960) have shown an extensive network of faults to the east and west of the project area. The predominant trend of faults is northeast both in the vicinity of the Peace River Uplift and on the Precambrian Shield. Numerous linear stream courses further indicate possible northeast trending faults between Peace River Uplift and the Precambrian Shield. Therefore, major subsurface faulting can probably be expected on trend with the Boundary Lake Fault (Sikabonyi and Rodgers, 1959, p. 197) and faults shown on the north edge of Lake Athabasca by Byers (1962, p. 52), Godfrey (1959, p. 8) and Haites (1960, p. 4).

INTERPRETATION

A Terrain Analysis was made of Sulphur Permit 144 and vicinity. The purpose of this study was to delineate any surface topographic and geologic or vegetative characteristics which may suggest a sulphurous lithology.

Field work in the sulphur exploration region has been too sparse or data gained remains on confidential status, and therefore mode of origin, accumulation, concentration and distribution of sulphur is unknown.

Brief articles in various trade journals have generally postulated two modes of origin of native sulphur in northeast Alberta. In brief summary they can be stated as :

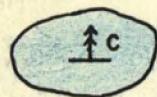
- 1) Production of H_2S during decay of organic matter and change to S by sulphur bacteria.
- 2) condensation of H_2S vapors along faults and oxidation of H_2S to H_2O and S.

Bateman (1950, p. 788) discusses these and other modes of occurrence including the reduction of gypsum to calcium sulphide which with water and CO_2 would form $CaCO_2$ and H_2S ; the H_2S would be oxidized to S. A recent paper by Rozowski (1967, p. 1065) discussed hydrochemical patterns in southeastern Saskatchewan. His study shows

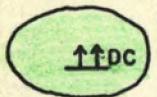
the deposition, by groundwater, of many salts including various sulphates. The example used by Rozowski has many similarities to Permit area 144. The topography is undulating to rolling, elevations range from 2,700 feet on the western part of the Moose Mountain (zone of groundwater accumulation) to a low of 2,100 feet in areas of sloughs. The bedrock strata is overlain by glacial drift from 100 to 350 feet in thickness and the water table follows topography. In Permit 144 area, the topography is similar and rises to an elevation of about 3,000 feet in the Caribou Mountains (Figure 1). An aerial photograph (Rozowski, 1967, p. 1066) of the Moose Mountain area shows many potholes surrounded or partially surrounded by white salt deposits which may contain up to eight percent gypsum. The gypsum could be reduced to CaCO_3 and H_2S ; the H_2S could then be oxidized to native sulphur. Schneider (1968, p. 261) discusses salinity in prairie pothole areas of North Dakota and demonstrates the lack of vegetation and white salt deposits around salt basins.

It appears that many favourable conditions and a variety of possible mechanisms are available with which to form native sulphur in Permit 144. The major faults trending from the Precambrian Shield to the Peace River Uplift may provide a conduit for escaping hydrogen sulphide gasses. The decay of organic matter; the leaching of probably high sulphate containing bedrock and glacial till by groundwater, with subsequent deposition

of sulphate salts as rings around muskeg sloughs, marshes, or lakes, thus providing indicators of concentrated sulphur in this region.



Primarily tall trees, generally fully stocked; trees average over 40 feet in height; moderate to good drainage.



Primarily trees of medium or less height, generally fully stocked; trees average less than 40 feet in height; moderate to fair relief, moderate to fair drainage.



Primarily scattered groves of trees, moderately stocked, with brush, grassland and minor areas of muskeg. Trees average less than 40 feet in height. Moderate to low relief, fair to poor drainage.



Brush and meadows with minor muskeg areas; moderate to low relief, fair to poor drainage. Includes old burn regrowth areas of low trees and dense underbrush.



Muskeg or marsh with minor brush areas and scattered trees; low relief, water table at or near surface.



Undifferentiated vegetation associated with river flats, bottomlands and pediments; cover may range from muskeg to tall trees.



1. Dry clearing, devoid of vegetation, possibly grass covered, surrounded by deciduous trees.
2. Dry clearing, single or clumps of trees in clearing, or pot-hole in center, surrounded by deciduous trees.
3. Dry clearing, devoid of vegetation, possibly grass covered, surrounded by coniferous trees.
4. Dry clearing, single or clumps of trees in clearing, or pot-hole in center, surrounded by coniferous trees.
5. Dry clearings surrounded by mixed vegetation, may or may not contain clumps of trees or pot-holes.

TERRAIN ANALYSIS

Vegetation has been delineated in six categories. Clearings or areas of no or little vegetation were mapped in five categories, relative to surrounding vegetation and to grass or brush cover (Plate 1). It is believed empirically that areas of highly sulphurous soils will not support extensive vegetation, therefore, the clearings may be the logical locations to initiate field work in the search for sulphur. The approximate percentage of land area covered by each vegetation category has been estimated and is shown below. The vegetation categories have been identified on the air photographs by tonal patterns, tree heights, and topography. The symbol indicating vegetation cover is representative of the dominant vegetation in that area. For example: an area shown as primarily tall trees will undoubtedly contain smaller trees and brush, but the dominant trees will be large spruce or pine trees. Similarly, scattered groves of spruce and deciduous trees will be found in areas designated as muskeg.

Vegetation Type							
						Water	
Estimated Percent of Map Covered	10	2.1	10	5	30	5	20

Treeless areas of categories 2 and 5 have been shown in the project area. Category 2 may be more prospective than category 5, as they appear to be more anomalous in location and generally drier. Several class 2 clearings occur north of Peace River in the project area. The class 5 clearing is located on the east side of the lake in the northwest corner of T. 108. This class 5 clearing may represent a dried lake bottom. Several elongate clearings are located north of Peace River in T. 108, R. 10, W5M. These class 2 clearings probably result from dried stream courses and meandering channels associated with the Peace River.

The most prospective clearings found in the area are those class 2 clearings in T. 109, R. 11, W5M. The clearings in this area appear to be oriented westerly or northwesterly, and thus are probably not related to glacial grooving or narrow meander scars. However, they also may be dried lake bottoms. It is recommended that a field check be undertaken of these class 2 clearings. A small trail extends from the Peace River northerly to the largest of these clearings.

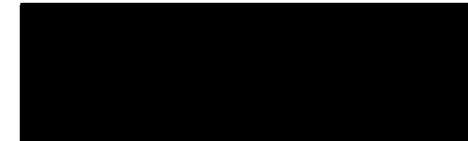
A large number of lineaments have been delineated south of the project area and may be important indicators of subsurface faulting along which sulphur vapors or groundwater could percolate, leaching gypsum beds and subsequently depositing sulphates, sulphides or native sulphur at the surface. One such lineament is shown within the project area near the west-central part of T. 108, R. 11, W5M. It is further recommended that

these linear zones be inspected to ascertain the presence of sulphur in that area.

In conclusion, it is recommended that this study be followed by a field check of the areas indicated on the Terrain Analysis Map by purple color and designated as class 2 or 5 clearings and also of linear zones shown in and adjacent to Sulphur Permit 144. The linear zones south of the project boundary are delineated on the aerial photographs.

Respectfully submitted,

GEOPHOTO SERVICES, LTD.



T. J. French



Paul Fuenning

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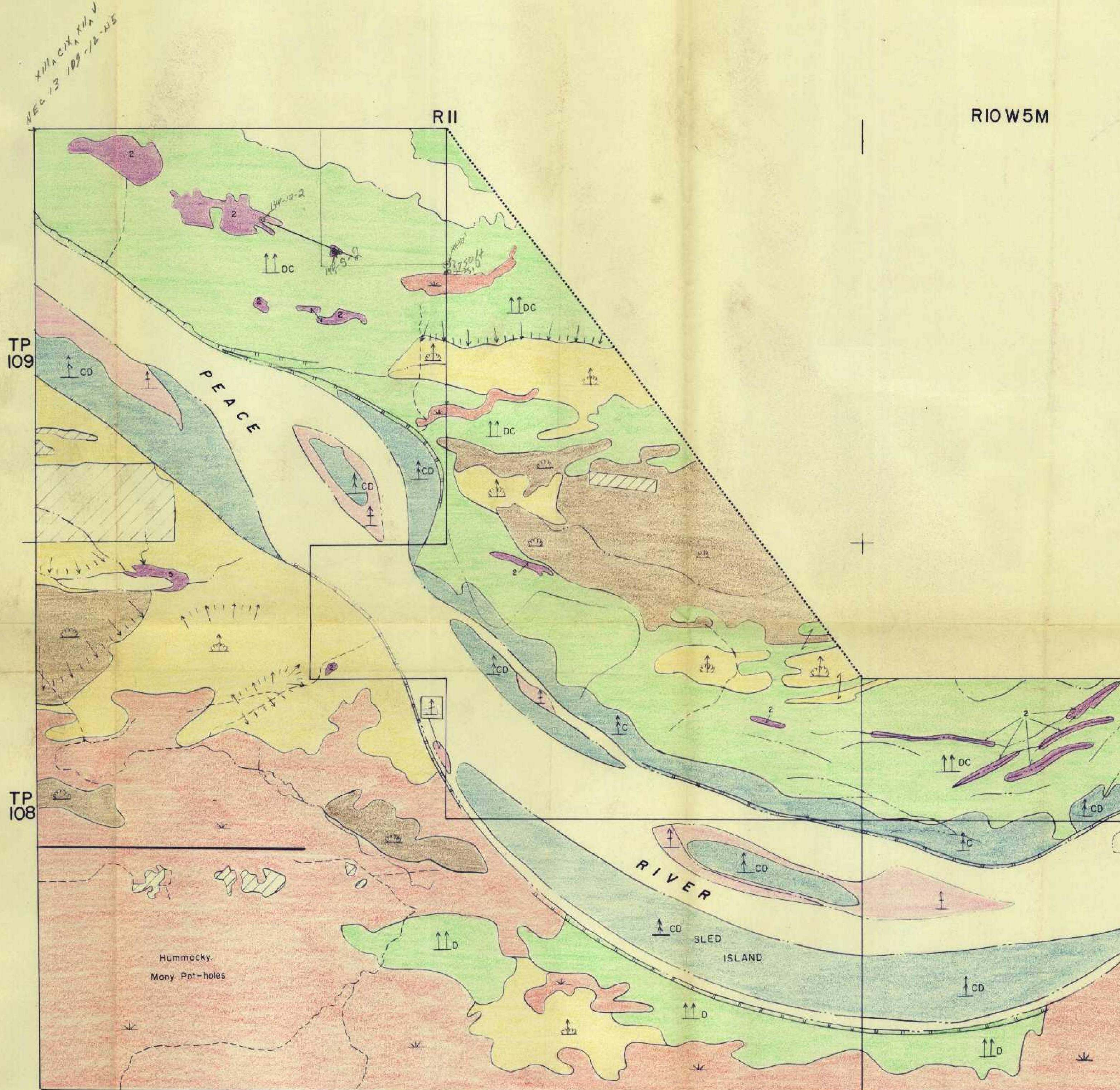
TERRAIN ANALYSIS MAP

OF

SULPHUR PERMIT 144

PREPARED FOR
Wainaco
MESA-PETROLEUM CO.SCALE:
Two inches = one mile or 1:31,680
0 2 MILES

JUNE, 1968.

EXPLANATION

- (+) D Primarily tall trees, generally fully stocked; trees average over 40 feet in height; moderate to good drainage.
- (+) C Primarily trees of medium or less height, generally fully stocked; trees average less than 40 feet in height; moderate to fair relief, moderate to fair drainage.
- (+) DC Primarily scattered groves of trees, moderately stocked, with brush, grassland and minor areas of muskeg. Trees average less than 40 feet in height. Moderate to low relief, fair to poor drainage.
- (+) CD Brush and meadows with minor muskeg areas; moderate to low relief, fair to poor drainage. Includes old burn regrowth areas of low trees and dense underbrush.
- (+) Muskeg or marsh with minor brush areas and scattered trees; low relief, water table at or near surface.
- (+) Undifferentiated vegetation associated with river flats, bottomlands and pediments; cover may range from muskeg to tall trees.

- Moderate escarpment 15-50 feet.
- Prominent escarpment over 50 feet.
- Moderate slope. Arrows indicate direction of slope.
- Steep slope. Arrows indicate direction of slope.

Stream or river

Lake or pond

Road or trail

1. Dry clearing, devoid of vegetation, possibly grass covered, surrounded by deciduous trees.
2. Dry clearing, single or clumps of trees in clearing, or pot-hole in center, surrounded by deciduous trees.
3. Dry clearing, devoid of vegetation, possibly grass covered, surrounded by coniferous trees.
4. Dry clearing, single or clumps of trees in clearing, or pot-hole in center, surrounded by coniferous trees.
5. Dry clearings surrounded by mixed vegetation, may or may not contain clumps of trees or pot-holes.

Photo lineation, generally with topographic relief, may be fault controlled.

Glacial grooves. Direction of glacial movement indicated.

Forest clearing.

Sulphur permit boundary.

Project boundary.

SULPHUR PROSPECTING PERMIT No. 144

WESTERN LAND SERVICES CO. LTD.,
214 - CENTENNIAL BLDG.,
EDMONTON, ALBERTA.

DATE OF ISSUE - FEBRUARY 7, 1968
AREA - 19,576 ACRES.

84 J/S
SW
TP. 109

TP. 108

