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June/1979.

REPORT ON
A REFRACTION SEISMIC SURVEY

OF THE
HUDSON BAY LOWLANDS
MANITOBA, CANADA

FOR
SOGEPET LIMITED

BY
HEILAND EXPLORATION CANADA (1959) LTD.

FROM
SEPTEMBER 1, 1964 to SEPTEMBER 26, 1964

SUBMITTED BY:
JAMES BARRON - SUPERVISOR

INTRODUCTION

In the latter part of April 1964 and in September 1964, three seismic refraction profiles and one reflection profile were shot in the Hudson Bay Lowlands area of Manitoba, Canada. The object of the survey was to determine the thickness of the various geologic formations down to the Precambrian surface, to correlate seismic velocities with lithologic units, and to test the possibility of using reflection methods in this area. An $X^2 - T^2$ profile was also planned in conjunction with this survey, but this objective was not achieved.

LOCATION OF PROFILES

Two refraction profiles were shot near the mouth of the Kaskattama River and one refraction profile was shot at the mouth of the Black Duck River.

A location map has been included with this report which shows the location of the profiles shot, and also indicates the direction of the cross-section which is included in the report.

EQUIPMENT AND PROCEDURE

All seismic data were recorded through a 24 channel S.I.E. P-11 recording instrument. Two cables 1900 feet in length with a geophone interval of 158 feet were used. The effective spread distance was 3792 feet. Geophones with a frequency of 7.5 c. p. s. were used for the refraction profiles. In shooting the reflection profile, geophones with a frequency of 28 c. p. s. were placed 30 feet apart with the nearest detector at a distance of 200 feet from the shot point.

Small transistorized refraction radios were used to provide communications in the field and to supply time break information. Since all work was carried out along the Hudson Bay coast and on river deltas near the coastline, all locations were considered to be at sea-level elevation.

In shooting the refraction profiles, the spread was laid out near the center of a large area which allowed straight line offsets in both directions from the ends of this spread. Charges were then placed in water, or buried with a shovel at the end of the spread, and at various offset distances to obtain the required velocity information.

Charge sizes varied from five pounds to fifty pounds for the refraction shots. Good energy return was obtained with charges of 5/8 pound and 5/16 pound on the reflection shots.

The field recording crew consisted of an Instrument Operator, a Shooter and a Surveyor who also assisted the shooter with the field work. Two men with a power canoe assisted with the overall operation.

Two small amphibious vehicles called Penguin's were used by the crew to traverse the shoreline to lay out the equipment and for transporting the instruments and men. These vehicles were found to be unsatisfactory for this type of work. The main faults with them was the lack of clearance under the units, and their inability to operate in mud.

A casual chartered DeHavilland Otter aircraft was used to move the equipment from the railhead at Ilford, Manitoba to the site of operations and back to Ilford when the work was discontinued.

COMPUTATIONAL PROCEDURE

Time distance plots were made of all refraction data obtained. This information was plotted on standard cross-section paper with a vertical scale of 1cm = .020 seconds, and a horizontal scale of 1cm = 158 feet. Critical time and distance figures were obtained from these plots. As many as five velocities were utilized in calculating the thickness of the velocity beds in the area. A multilayer solution suggested by Dr. C. A. Heiland (Geophysical Exploration, 1940) was used in calculating the thickness of the various velocity layers. The generalized formula used was as follows:

$$2 \frac{h_n}{V_n} \cos i_n = t_{n+1} - \left(\frac{x_n}{V_{n+1}} + 2 \sum_{k=n}^{k=n+1} \frac{h_k}{V_k} \cos \alpha_k \right)$$

DISCUSSION OF RESULTS

The following are the results calculated from the refraction data obtained in the area:

Location No. 1	Hudson Bay Coast Near Mouth Of Black Duck River
<u>Interval</u>	<u>Velocity</u>
0 - 78	7,100 ' / s (drift)
78 - 570	9,150 ' / s
570 - 1068	12,600 ' / s
1068 - 1887	14,500 ' / s
1887 -	21,400 ' / s (Precambrian)

Location No. 5

Hudson Bay Coast North Of Mouth Of
Kaskattama River

Interval

Velocity

0 - 39	7,000 '/s (drift)
39 - 218	9,160 '/s
218 - 651	11,850 '/s
651 -	13,750 '/s
	(Depth to Precambrian not established)

Location No. 11

Kaskattama River Delta Approximately
Two Miles South From Location No. 5

Interval

Velocity

0 - 38	7,000 '/s (drift)
38 - 204	12,300 '/s
204 - 931	14,850 '/s
931 - 2952	17,500 '/s
2952 -	22,600 '/s (Precambrian)

A cross-section has been submitted with this report which shows the generalized correlation of the different velocity data obtained.

The velocities of 9,160 '/s and 9,150 '/s measured for the first interval below the drift layer at Locations Number 5 and 1, suggest a shale type material which may be of Cretaceous age. The higher velocities shown for the underlying layers are similar to those usually found in Paleozoic formations and could be representative of Devonian, Silurian and Ordovician sediments. The velocities in excess of 21,000 '/s are identified as Precambrian.

The contoured map submitted with this report shows the thickness of the sedimentary section in the area covered by the survey. Information supplied by the Ontario Department of Mines has been placed on the map on the Ontario side of the border. Refraction information obtained from the Geological Survey of Canada in the area lying northwest of Cape Tatnam has also been used in contouring this map.

In general, the information obtained shows the sedimentary section to be thickening quite rapidly in a northeast direction with the deepest area being offshore from the Kaskattama River delta.

Three reflection records were shot near the Location No. 11 refraction profile. The information obtained from this shooting appears to be quite reliable. A strong reflection originates on the record at a time of 0.120 seconds and ties very closely to the top of the 14,850 $\frac{1}{s}$ marker indicated on the refraction profile. A good reflection is also indicated at a time of 0.375 seconds which closely ties the Precambrian contact calculated from the refraction profile.

A reflection character change is evident on the seismic record at a time of 0.260 seconds. Calculation indicates this

event originates at a depth of 1885 feet. Judging from the character of the seismic reflection, this could be an indication that a low velocity layer such as a sandstone is present within the thick layer of 17,500 's material, which is probably limestone in nature.

CONCLUSIONS

The seismic survey conducted during April and September has been partially successful insofar as it has been possible to measure the thickness of the sedimentary section at two locations, and also that tests indicate reflection seismograph methods are possible in areas where the sedimentary section exceeds 1000 feet in thickness.

The type of terrain peculiar to this area proved to be the main difficulty encountered in traversing the coastline. Large swamp buggies could be used, but costs for this type of operation would run fairly high since the nearest supplier of this type of equipment is in the southern part of the U. S. A.

A limited helicopter mounted operation is also possible. This type of program will be complicated by the extremely poor weather prevalent in this area most of the year.

The thickest part of the sedimentary section appears to be in the area of the Hudson Bay offshore from the mouth of the Kaskattama River, and any seismic reconnaissance of this part of the acreage held under lease would have to be carried out by the use of a water-borne seismic crew.

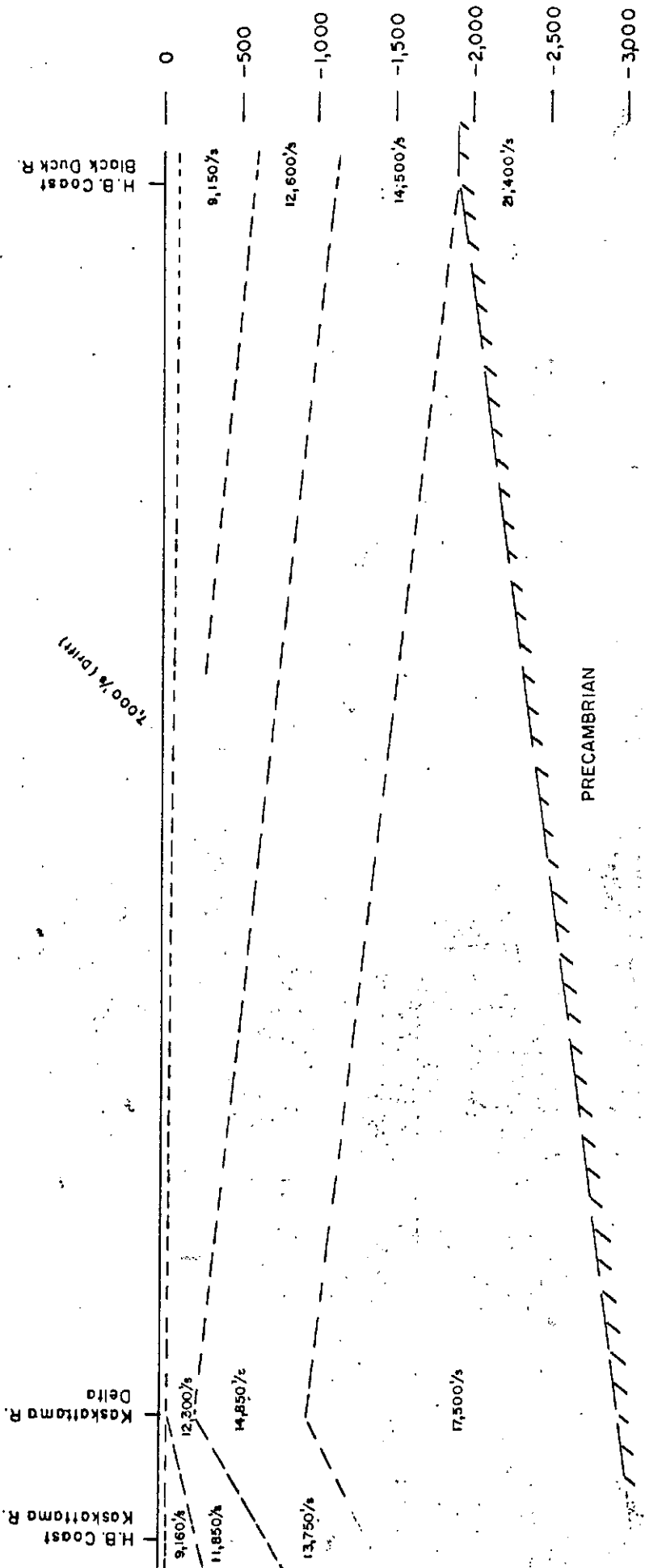
Respectfully submitted,

HEILAND EXPLORATION CANADA (1959) LTD.

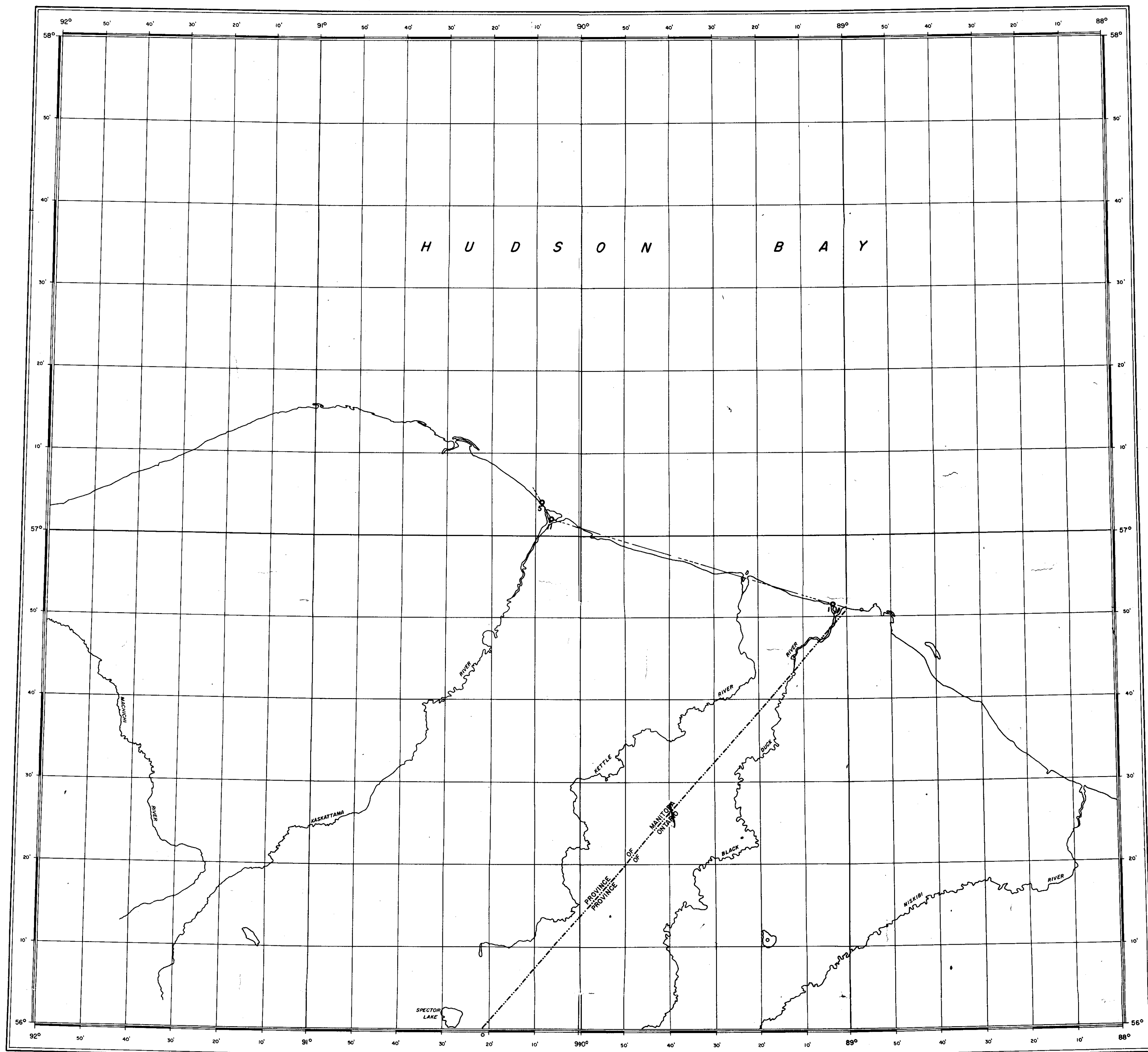


James Barron
Supervisor

5 11



CROSS-SECTION 5-11-1



HUDSON BAY LOWLANDS

CAPE TATNAM AREA
ONTARIO — MANITOBA
CANADA

LOCATION MAP

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Scale: 1" = 8 miles

November 30, 1964