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HUNTING SURVEY CORPORATION LIMITED

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Air Photography Maps Volumes Control Photo Interpretation Geology Geophysics Resources Inventories Route and Site Analyses

December 11th, 1962

Sogepet Limited,
88 University Avenue,
TORONTO 1, Ontario.

Attention Mr W. F. Atkins

Re Interpretation of Aeromagnetic Profiles - Southwest Hudson Bay

Dear Sirs

In accordance with our quotation dated November 13th and your letter of November 22nd , I have carried out a study of approximately 1,186 line miles of magnetic profile surveyed by the Department of Mines and Technical Surveys in Southwest Hudson Bay These profiles are made up of three types of reconnaissance survey

(1) Reconnaissance aeromagnetic profile, G S C No 2, Churchill to Great Whale, approximately 300 line miles, flight elevation 1,000 feet A M S L

(2) High level (4,000 feet to 10,000 feet A M S L), 3-component aeromagnetic profiles by the Dominion Observatory, Lines No 12, 14, 17 and 19, total mileage approximately 816 line miles.

(3) Sea-magnetometer profile, Line No. 21, approximately 70 line miles Line No. 7 was examined but because of a positioning failure, the profile could not be transferred to the map

Preliminary studies and tracing of these profiles were done in Ottawa on November 8th and 9th The scale of the profiles was changed and the data transferred to a map at scale 1 inch to 8 miles in the Toronto

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office and more detailed studies were carried out on the anomalies themselves This letter summarizes the work done, the conclusions and limitations. Two copies of the map are attached and the original is on file at our office if you require it

The Magnetic Data

Geological Survey of Canada Aeromagnetic Profile

This profile, described in "Aeromagnetic Surveys Across Hudson Bay from Churchill to Coral Harbour and Churchill to Great Whale River", Geological Survey of Canada Paper 59-13, 1960, by Margaret E. Bower, constitutes the most reliable source of information available for the present study. The scale of the records was 60 gamma to the inch vertical and approximately 2,154 feet to the inch horizontal. Variations in the total intensity of the earth's magnetic field are readable to an accuracy of 1 to 2 gamma. Positioning, however, is rather poor, being by dead reckoning only. The portion of this profile studied lies between longitudes 86°00'W and 93°00'W. Six determinations of depth to "magnetic basement" were made by Margaret Bower on this portion of the profile An additional seven determinations were made in the present study and the other six were checked and revised slightly

Apart from the positioning inaccuracy which could lead to errors of several miles horizontally, the main limitation of these data is the ambiguity inherent in the interpretation of single-line data Assuming the anomaly to be caused by a tabular body extending to depth (this assumption inherent in nearly all magnetic work and leading in most cases to a maximum depth), it is necessary also to assume that the body extends some distance on either side of the flight line and crosses the flight line in a perpendicular direction These last two assumptions are much more restrictive than the first If the body makes a 45° angle with the flight line, then the assumption of perpendicularity leads to a depth (from the plane of observation) too great by a factor of 1 4 If the body lies to one side of the flight line, the anomaly will look narrower than its true width and will lead to a determination that is too shallow The dip of the body also is indeterminable on single-line data On strongly asymmetric anomalies the assumption of vertical dip generally leads to a depth that is slightly too low We have, then, two factors which lead to maximum depths and two factors which lead to minimum depths. On the whole, the former factors are more prevalent and restrictive and it is considered that the true depths in most cases are less than those obtained by the present study.

Dominion Observatory Profiles

These profiles were carried out with a 3-component, gyro-

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stabilized magnetomer, flown at a constant barometric datum of from 4,000 feet to 10,000 feet A.M.S.L , positioning being done by an automatic sun-tracking instrument at 5-minute intervals Positioning is considered accurate to approximately ±2 miles. The data are available in the form of profiles of vertical and horizontal intensity (measured in the plane of the total magnetic field) and a profile of declination Tracings were made of the vertical and horizontal recordings It was hoped that the horizontal intensity data would assist in the present study but it was found that its use was limited too severely by the poor accuracy and discontinuous nature. The vertical scale of these data is either 230 gamma to the inch vertical and approximately 4 miles to the inch horizontal or 460 gamma to the inch vertical and approximately 4 miles to the inch horizontal The vertical intensity profile has been rectified and transferred to the attached map at a vertical scale of approximately 500 gamma to the inch. The accuracy of the vertical intensity data is approximately ±10 gamma.

The same basic limitations as were described above are also inherent in the Observatory profiles. Since the data are less accurate, there is a further inaccuracy amounting to approximately 10 to 20 percent of the depth, depending upon the size of the anomaly Since the flight elevation is much higher, the depth errors are proportionally greater than in the case of the G S.C profile.

Sea-Magnetometer Profiles

The sea-magnetometer data were recorded by a total magnetic intensity instrument of the proton precession type. This instrument registers 10 gamma changes in the magnetic field and was operated on this survey with a vertical scale of 110 gamma to the inch and a horizontal scale of approximately 4-1/2 inches to the mile Distances along the traverse are shown at 1/10th.-mile intervals and there are fixes (presumably by sun or star shots) every 50 or so miles The horizontal accuracy of positioning is not known The data themselves are accurate to about ±5 gamma. Several large portions of Line 21 are missing, presumably through instrument breakdowns and/or magnetic storms The same is true of Line 7, with the added complication that no distances are recorded along the traverse. In the case of this profile, depths calculated by Dr P. J. Hood of the G.S.C are shown in their approximate positions only. These could be as much as 10 or more miles out.

Depths calculated from the sea-magnetometer data fall between the two previously mentioned in accuracy. Since the instrument is closer to the "magnetic basement", a particular relative accuracy will produce less actual error in depth than in the case of the airborne profiles. Only three depth determinations were obtainable from these data, but they are considered to be of relatively high quality. The same inherent

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ambiguities apply, however, as are described under the heading Geological Survey of Canada Profile, above.

Basement Depths

It was hoped originally that by compiling all of these profiles on a single base, the anomalies could be compared from line to line and some inferences drawn concerning the nature of the basement and the strike of the magnetic bodies Unfortunately, in most cases the anomalies are much too narrow and discrete to show much correlation from line to line In the case of the very broad anomalies near the west ends of Observatory Lines No 14 and 19, a northeast to east-northeast strike could be inferred. This is confirmed by the Geological Survey of Canada maps available in the area north of latitude 58°99'N How this affects the depth determinations can be seen, for example, in relation to the 1,6400 foot A.M.S.L. depth on Observatory Line No 19 If a correction is made for strike, assuming that the profile crosses this broad anomaly at an angle of about 30°, the depth obtained reduces to 5,700 feet It was obviously impossible to make corrections of this sort on this survey, as the interpretation of strike direction is far too indefinite

Elevations of the tops of the magnetic bodies causing the anomalies have been shown on the attached maps in feet relative to mean sea level. They have been obtained through the assumptions mentioned above, by the application of the Half-Slope method of Peters (Geophysics, Vol. XIV, No. 3, July 1949). They have been shown as "probable depths" though, as explained above, they may on the average tend to be on the high side

A quick examination of the results, especially in regions where there is a fairly high density, such as near the intersections of sea-magnetometer Line No. 21, G S C Profile No. 2 and Observatory Line No 12, confirms the inaccuracies referred to above In the region just mentioned, apparent basement depths vary from 2,600 feet to 16,750 feet, the deeper values occurring on the line which strikes north-northeast. Most of this scatter is believed to be the result of strike effect The actual basement depth in that region is most probably close to the smallest value in the group. Similarly, an anomaly occurs on Observatory Line No. 19 at longitude 91°10'W, which almost certainly correlates with one on intersecting G.S.C. Profile No. 2 A depth of 5,800 feet is interpreted for this anomaly, but if a correction is made assuming a northeast strike (suggested by the relative disposition of anomaly peaks), the depth is reduced to approximately 2,800 feet.

In view of these inaccuracies, the preparation of a basement contour map is a somewhat hazardous undertaking. However, because

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of the preliminary nature of this study and the need for some opinion on the basement configuration in the area, an attempt has been made

The basement contours shown on the attached map are drawn largely on the basis of grade A and grade B depth determinations The grade of the determination is shown in parentheses after the depth figure on the map In addition, some allowance has been made for the local scatter of basement depths and for possible strike effects Thus, the depth of 2,350 feet at longitude 92°00'W on Observatory Line No 17 has been ignored in the contouring. It does not fit the values adjacent to it and it occurs in a region where anomalies are believed to strike in a direction not greatly different from the direction of the profile

In conclusion, the basement contours are to be considered highly speculative and the interpreted basement configuration can only be considered a first approximation to the regional structure of the area.

Identification of Basement

It has not been possible to do very much towards the identification of the "magnetic basement" on the basis of the available profiles A comparison of the profiles with the magnetic contours in the three areas of block coverage in the west would be helpful. The character of the profiles does not vary greatly from west to east or from south to north across the area. In other words, there is no reason to suspect that the basement is greatly different under Hudson Bay than it is near Churchill or along the Nelson River. The nature of the high intensity, broad anomalies occurring over the G S.C. survey block north of latitude 58°00'N is not known at the present time A repetition of this type of anomaly is seen on Observatory Line No. 12 at latitude 57°40'N and again, possibly, on Observatory Line No. 17 east of longitude 87°00'W These anomalies may represent flat-lying Proterozoic rocks containing magnetite. On the other hand, they could be explained on the basis of wide intrusive bodies of Archean age. Narrow, dike-like bodies are represented on all of the profiles and appear to have strikes varying from northwest to northeast. Because of the difficulties in positioning the anomalies accurately, the strikes are very indefinite

If a significant thickness of Proterozoic exists, two sets of depth values might be expected. At first glance, this may seem to be the case in this area. However, most of the very deep values can be explained by strike effect alone

A sample of weathered basement rock from diamond drill hole No. 1 near the Pennycutaway River was measured for magnetic susceptibility. Its value was found to be 9×10^{-6} c.g.s. units, implying less than 0.004% by volume of magnetite. In fact, it can be said that the

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weathering in the first 200 feet of this diamond drill hole has removed virtually all of the original magnetite If this is true over the area as a whole, there may be an unspecified amount of weathered basement rock above the "magnetic basement" interpreted from the data.

In conclusion, it can be said that this study has not succeeded in identifying the "magnetic basement" in the area. The basement contours drawn on the attached map represent an unidentified horizon believed only to be of Precambrian age.

Conclusions and Recommendations

1. A study has been made of 1,186 line miles of magnetic profile in the vicinity of the Sogepet Exploration Permit in Southwest Hudson Bay.

2. Determinations of depth to "magnetic basement" have been made in 44 places Each determination has been given a grade letter based on its probably reliability.

3. Basement depth obtained on the basis of single-line data are subject to an over-riding ambiguity which can amount to 100% or more A grade A determination has the same over-riding ambiguity as a grade C determination. In general, the depths interpreted in this study are believed to be slightly greater on the average than the true depths to basement.

4. Contours of elevation of the basement have been interpreted and drawn on the attached map. These contours are obtained by a process of selection and averaging plus a certain amount of intuitive reasoning and guesswork They are believed to indicate in a general way the regional structure of the basement. Because of the scarcity and unreliability of the depth determinations the basement configuration so described is to be considered highly speculative.

5. On the basis of this study it appears that the Sogepet area is located on a broad basement arch, plunging steeply to the northeast The depth to basement on the land portion of the area is interpreted to be less than 1,000 feet. Elsewhere, the depth may reach 3,000 feet or more

6. In view of the rather shallow depths obtained in the land portion of the Sogepet area, it is considered that further aeromagnetic work on the land would be neither diagnostic of structure offshore nor of direct economic interest in itself. Groups of closely space (1/2 to 3/4 mile) lines flown perpendicular to the shoreline would be of value in interpreting the basement configuration in the offshore part of the area. Since

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the predominant basement strike in the area appears to be northeast, these lines should be surveyed in a north-south or northwest-southeast direction.

7. Recommendations for further work cannot be made at this time as it may be decided on geological grounds that stratigraphic information is more important than a more accurate definition of the basement surface.

This report represents a preliminary study of existing aeromagnetic data While the amount of time devoted to this study is considered sufficient for the present purposes, it is emphasized that the limitations of the data and the method of interpretation are quite severe and the conclusions should be treated accordingly.

HUNTING SURVEY CORPORATION LIMITED

Norman R. Paterson,
Chief Geophysicist.

NRP/ko

Exploration Permits #1-35 ©

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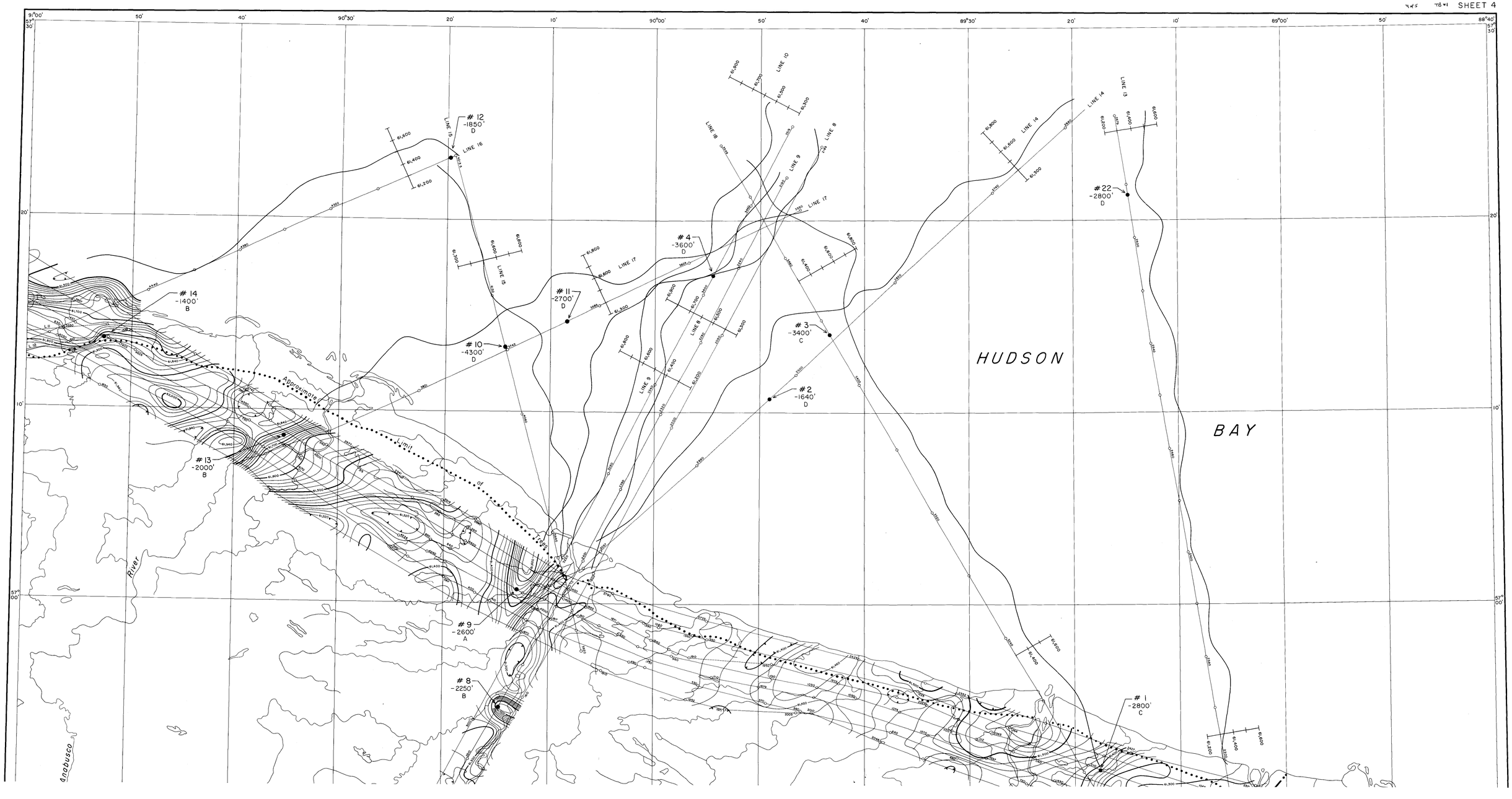
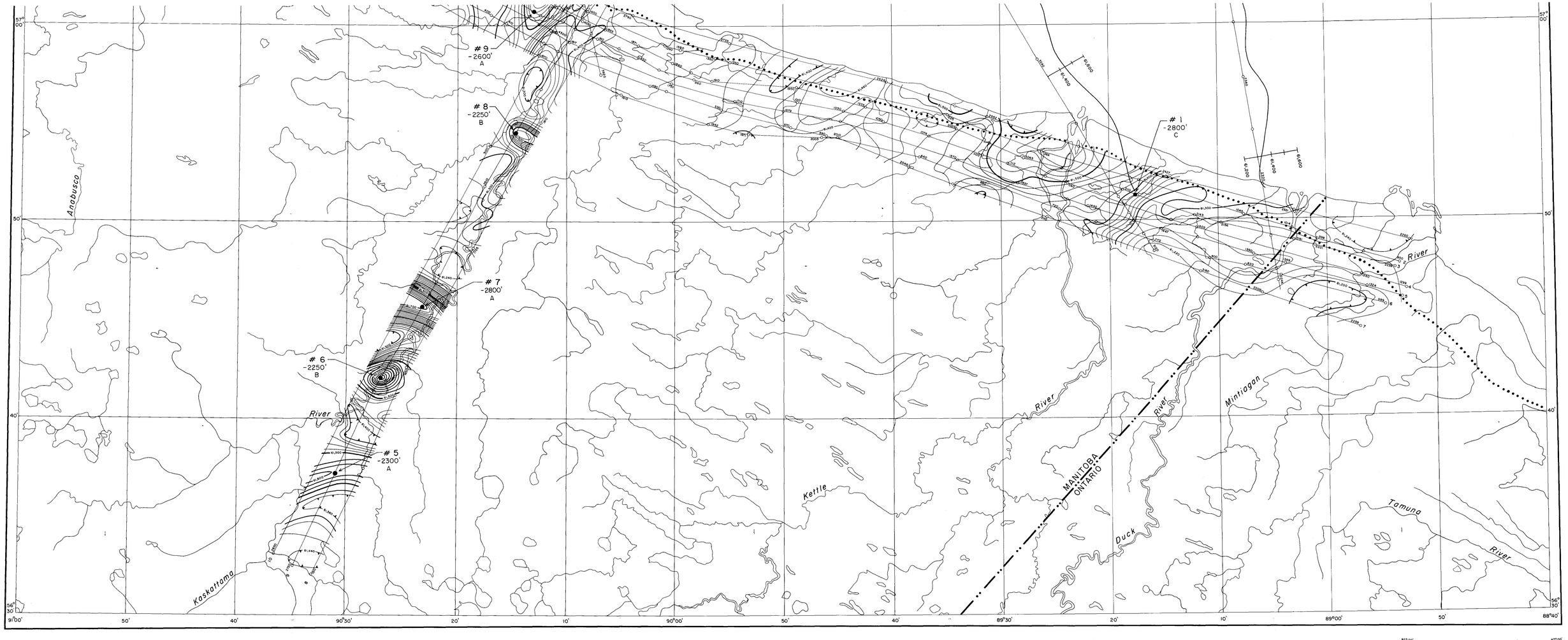




CONTOUR INTERVAL ..... 20 GAMMA
MEAN TERRAIN CLEARANCE ..... 1000 FEET
500 GAMMA CONTOUR .....
100 GAMMA CONTOUR .....
20 GAMMA CONTOUR .....
MAGNETIC LOW .....
FIDUCIAL POINTS 3690
FLIGHT LINES .....

Number and Location of Depth Determination
Followed by Depth in Feet (M.S.L.) and Grade ● # 24 - 1400 A

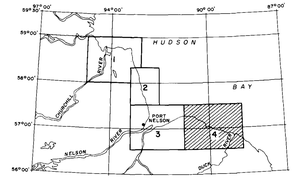
AEROMAGNETIC MAP

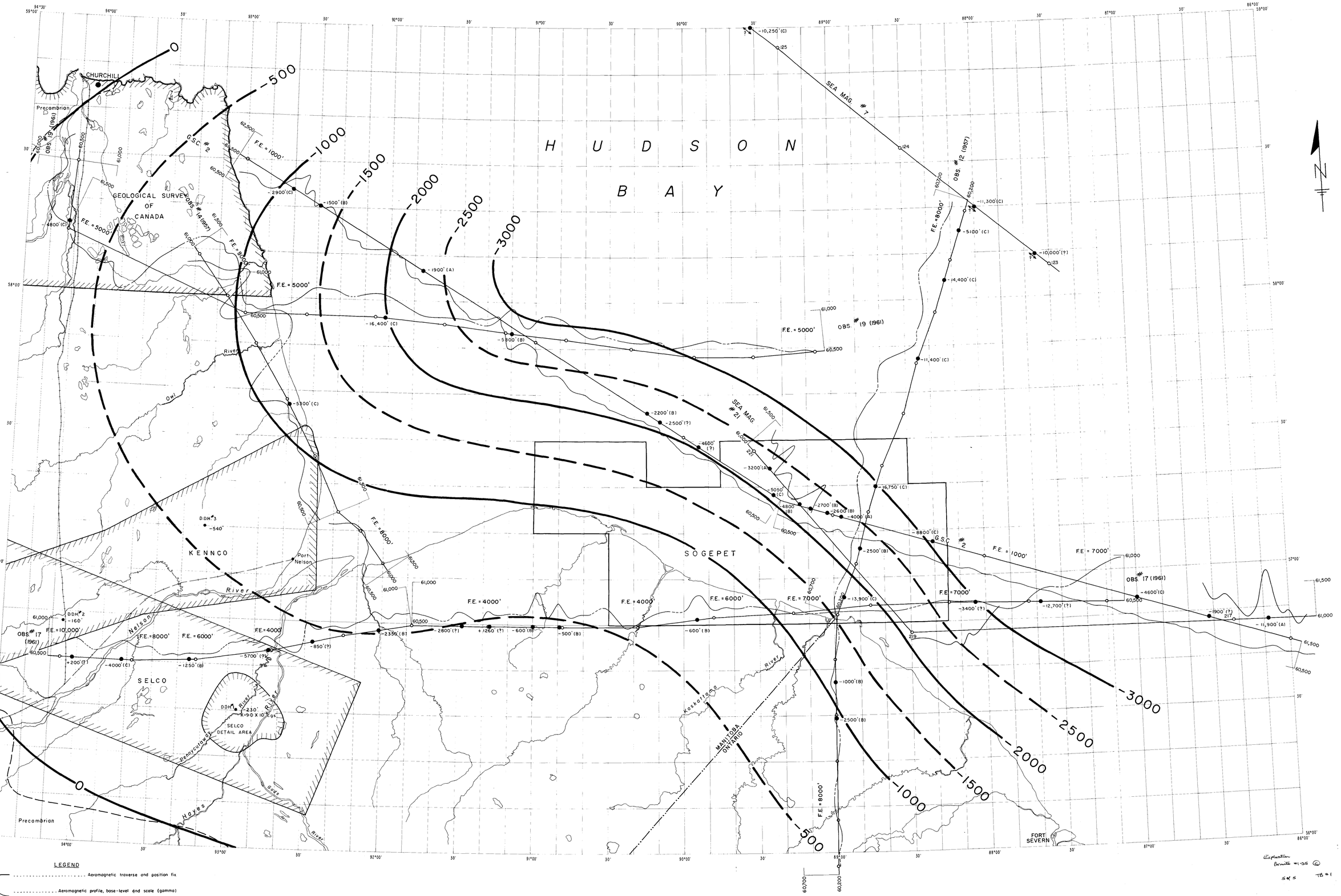
SCALE

2 MILES 0 2 4 6 8 MILES

1 Inch to 2 Miles

Flown and Compiled
for
SOGEPET LIMITED
by
HUNTING SURVEY CORPORATION LIMITED
Toronto, Canada
1963





LEGEND

- Aeromagnetic traverse and position fix
- Aeromagnetic profile, base-level and scale (gamma)
- F.E. = 4000' — Flight elevation = 4000' A.M.S.L.
- -1250' (B) — Probable depth (A.M.S.L.) to "magnetic basement"
- Exact location of determination unknown
- Existing aeromagnetic survey coverage
- D.D.H. #2 -160' — Diamond Drill Hole and depth (A.M.S.L.) to Precambrian
- Paleozoic / Precambrian contact
- -1000 — Generalized contours (A.M.S.L.) of "magnetic basement", interpreted

COMPILATION AND INTERPRETATION OF

AEROMAGNETIC SURVEY TRAVERSES (SOUTHWEST HUDSON BAY)

BY THE DEPARTMENT OF MINES AND TECHNICAL SURVEYS

FOR

SOGEPET LIMITED

SCALE

8 MILES 0 8 16 24 32 MILES

1 inch to 8 miles

Compiled and interpreted by
HUNTING SURVEY CORPORATION LIMITED, TORONTO, CANADA
November – December, 1962

Exploration Permits #135 ©

C

Exploration Permit #1-35 ©

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SHEET 3

93°10' 93°00' 50' 40' 92°30' 20' 10' 92°00' 50' 40' 91°30' 20' 10' 91°00'

57° 30'

20'

10'

57° 00'

50'

40'

HUDSON

BAY

Creek

White

Rupert

Bear

Creek

Sam

Creek

Trees

Approximate

Limit

Woodcock

Black

Bear

Creek

Root

Creek

Port Nelson

BASE LINE

Harts

Creek

York Factory

North

Seal

Creek

Nelson

River

Seal

Creek

Shilling

Creek

Ten

River

French

Creek

Fountain

Creek

Machichi

Mistigokan

Naytow

Creek

Trees

Limit

Approximate

Menahook

River

Fourteen

River

River

#23
-1500'
A

#21
-1700'
B

#20
-2650'
C

#15
-1210'
C

#16
-2120'
C

#17
-2150'
C

#18
-1420'
C

#19
-1800'
A

AEROMAGNETIC MAP

SCALE

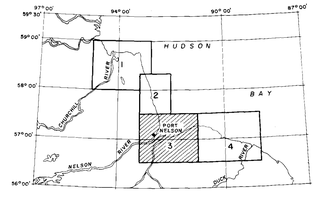
2 MILES 0 2 4 6 8 MILES

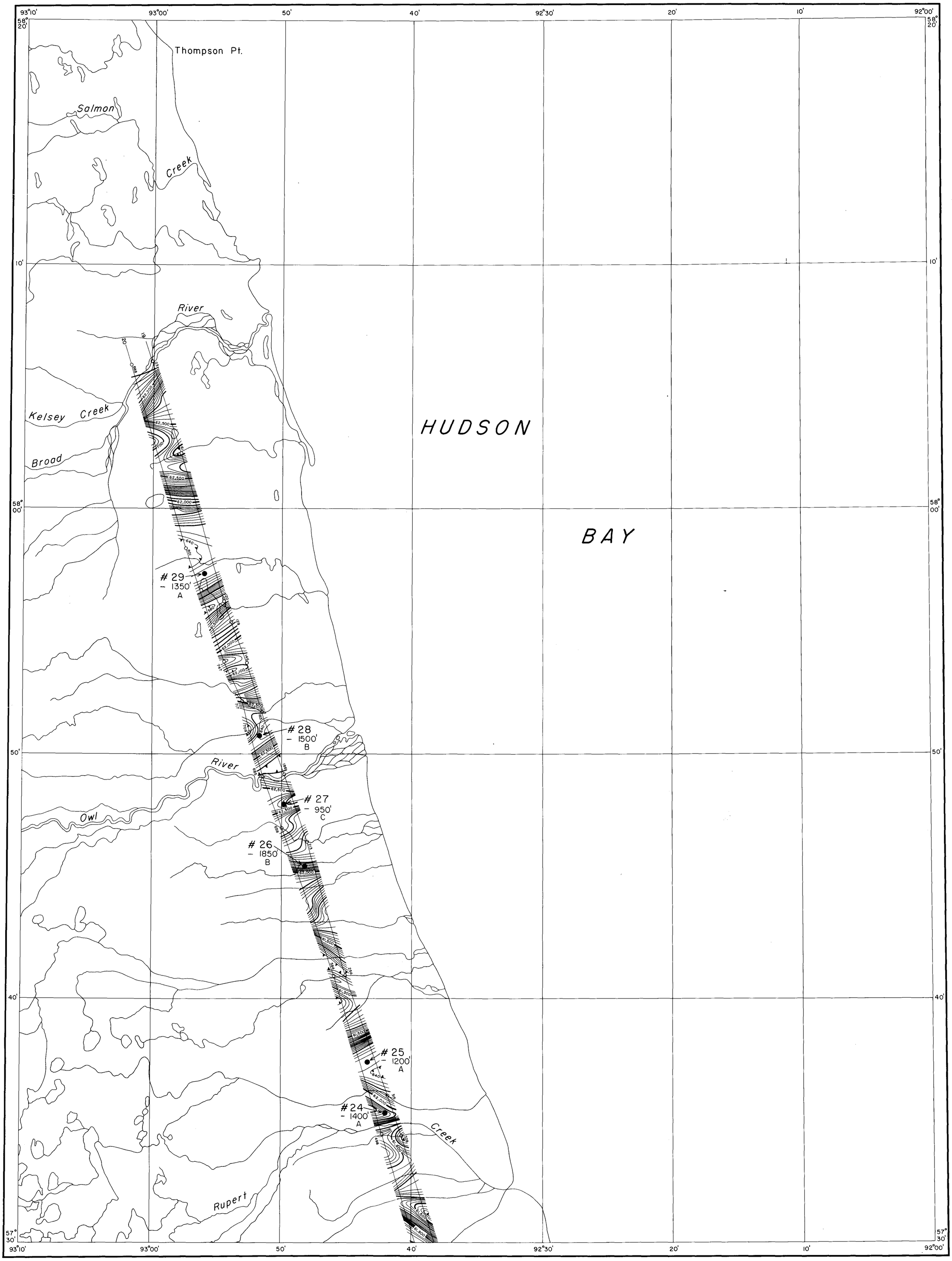
1 Inch to 2 Miles

CONTOUR INTERVAL ..... 20 GAMMA
MEAN TERRAIN CLEARACE ..... 1000 FEET
500 GAMMA CONTOUR .....
100 GAMMA CONTOUR .....
20 GAMMA CONTOUR .....
MAGNETIC LOW .....
FIDUCIAL POINTS 36900
FLIGHT LINES .....

Number and Location of Depth Determination Followed by Depth in Feet (M.S.L.) and Grade ● # 24 - 1400 A

Flown and Compiled
for
SOGEPET LIMITED
by
HUNTING SURVEY CORPORATION LIMITED
Toronto, Canada
1963





CONTOUR INTERVAL ..... 20 GAMMA
MEAN TERRAIN CLEARANCE ..... 1000 FEET
500 GAMMA CONTOUR .....
100 GAMMA CONTOUR .....
20 GAMMA CONTOUR .....
MAGNETIC LOW .....
FIDUCIAL POINTS 690
FLIGHT LINES .....

Number and Location of Depth Determination Followed by Depth in Feet (M.S.L.) and Grade — # 24 ● – 1400' A

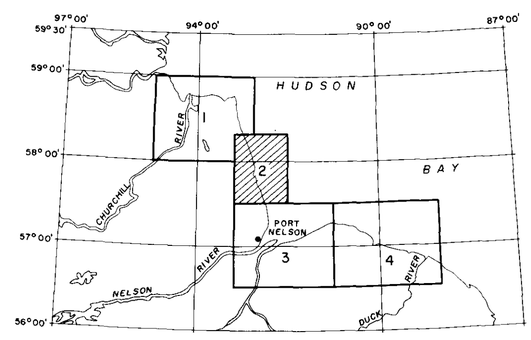
AEROMAGNETIC MAP

SCALE

2 MILES 0 2 4 6 8 MILES

1 Inch to 2 Miles

Flown and Compiled
for
SOGEPET LIMITED
by
HUNTING SURVEY CORPORATION LIMITED
Toronto, Canada
1963



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ZRS TBH

SHEET 1

95°00'
94°00'
93°00'
59°00'
58°30'
58°00'

HUDSON
BAY

#33
-1300
D

#32
1600
B

#30
1800
B

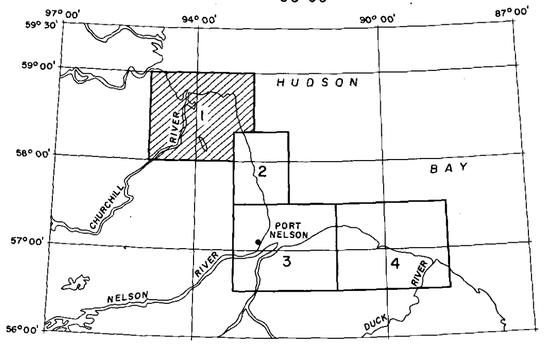
SEAL RIVER AREA, MANITOBA

COMPOSITE MAP

REGIONAL COMPILATION OF AEROMAGNETIC MAPS
ISSUED BY THE GEOLOGICAL SURVEY OF CANADA

Scale : 1 inch to 4 miles

Composite and reproduction by
Hunting Survey Corporation Limited
1450 O'Connor Drive, Toronto, Canada



Exploration
Permits #1-35 ©
1 of 5

TB#1