AEROMAGNETIC INTERPRETATION
YORK FACTORY AREA
HUDSON BAY
MANITOBA

KANATA EXPLORATION COMPANY

GAI-GMX CANADA LIMITED

Calgary Alberta

January 1969

PART I

INTRODUCTORY REPORT
ELEMENTS OF AEROMAGNETIC INTERPRETATION

INTRODUCTORY REPORT

This introductory report is intended to explain the philosophy of aeromagnetic interpretation, the method of using it in practice, and GAI-GMX's conventions for presenting the results. All interpretations have their especial circumstances which are handled in the individual reports with whatever additional maps, sections, or other illustrations that may be necessary.

CONTENTS

ILLUSTRATIONS

ELEMENTS OF AEROMAGNETIC INTERPRETATION

Very broadly, the earth may be considered as a uniformly magnetized sphere. If this were the case, the magnetic field would change uniformly and regularly in passing from one point to another on the earth's surface. Actually, there are local distortions of the field which are caused by magnetic inhomogeneities in the earth's crust.

Any magnetic inhomogeneity will distort the field. An example is shown by Figure 1 in which the shaded area represents a volume of material which is more magnetic than the adjacent material around it. Being more magnetic, the lines of force tend to squeeze together to pass through this volume. This squeezing of the lines is equivalent to an increase in the intensity of the field, and a magnetometer above the area of the magnetic body would show a local increase in magnetic intensity over that body.

Now, let us place the body of Figure 1 in a geological environment as shown in Figure 2. The body may be considered to represent a volume of rock which is more magnetic than the adjacent rock. For the most part, being "more magnetic" means containing a larger volume percentage of magnetite. Magnetite is not the only magnetic mineral but is so much more common and so much more magnetic than any other common rock-forming mineral that, to a very large degree, local variations in magnetic intensity mean local variations in magnetite content of the rocks. Our magnetic body may now be thought of as representing a more magnetic basement rock such as gabbro intruded into a less magnetic rock such as granite. The overlying sediments, in general, contain such a low percentage of magnetite that their magnetic effect can be disregarded, and the analysis can be carried out as if they were not present. This very definite difference in magnetite content between basement rocks and the sediments is of primary importance in the interpretation of magnetic data because it means that, for the most part, the magnetic disturbances begin at a definite geological boundary and that by proper analysis of these disturbances one can determine the depth to that boundary and thereby the depth to the basement and the thickness of sedimentary rocks.

The preceding remarks apply just as much to the formerly common measurements of vertical magnetic intensity made on the ground as to the airborne magnetometer. There is a technical difference in that the ground magnetometer is leveled for each measurement and determines variations in the vertical component of the field. The airborne magnetometer measures variations in the total intensity as its reference direction is the direction in space of the magnetic vector rather than a level which would be very difficult to maintain in an airplane. This makes for minor technical differences in the analysis of results. A much more important difference is the fact that the airborne survey (in addition to the inherent advantage of being airborne and thereby reducing problems of accessibility) has two important advantages, i.e.:

(1) The airborne instrument makes a continuous recording, rather than a point-by-point measurement, which permits a much higher degree of analysis, and

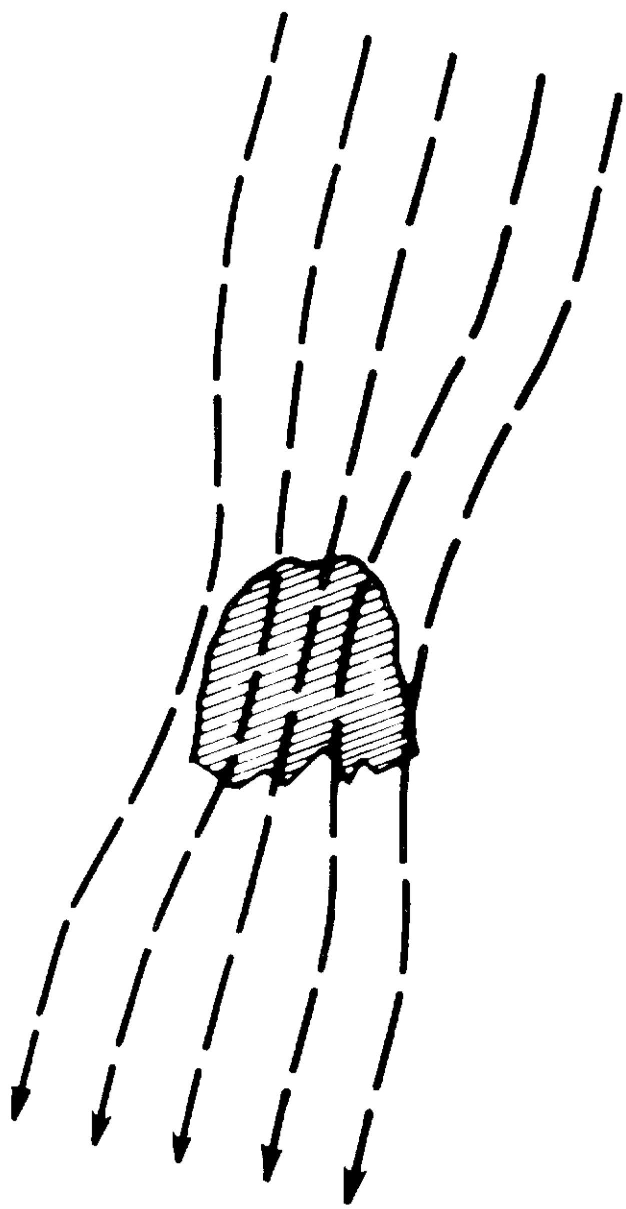
(2) In being at some distance above the surface, the distortions due to local accumulations of magnetic material are so much attenuated that usually their effect is completely negligible.

The quantitative use of magnetic surveys to determine basement depth depends on the nature of the magnetic disturbances produced by magnetized bodies of various geometric form. It turns out that a body such as that of Figure 2 can be represented magnetically by a vertical-sided geometric body and that, for practical purposes, the approximations of this simple representation are such that calculated curves based on geometrical bodies can be used effectively to determine the depth to the geological bodies causing the magnetic anomalies found in nature. The effectiveness of such calculations is investigated in detail in Geological Society of America Memoir 47, published in 1951, which includes an extensive atlas of magnetic patterns for various geometric forms.

The use of an ideal geometric body is illustrated by Figure 3. This shows curves of magnetic intensity along an east-west profile across a north-south block of magnetized material which has a width eight times its depth of burial. The four curves, A, B, C, and D, are calculated for different depths to the base of the block, as indicated on the diagram. Curve A, with an amplitude of 500 gamma, is for the case with the bottom at infinite depth. Curve B is for a depth to the bottom of four units, and Curve C, of one unit. The magnitude of these calculated effects is quite different, but it is found that certain essential form parameters are substantially constant. In particular, if a straight line is drawn tangent to the flank of the curve, as shown on the left side of the figure, it is found that the distance, d, between the points where the curve breaks away from this tangent, i.e., the so-called "slope" measurement, is substantially the same for these three curves and that this distance is linearly related to the depth of burial. Therefore, this essential parameter depends on the depth to the top of the block but practically not at all on the depth to the bottom.

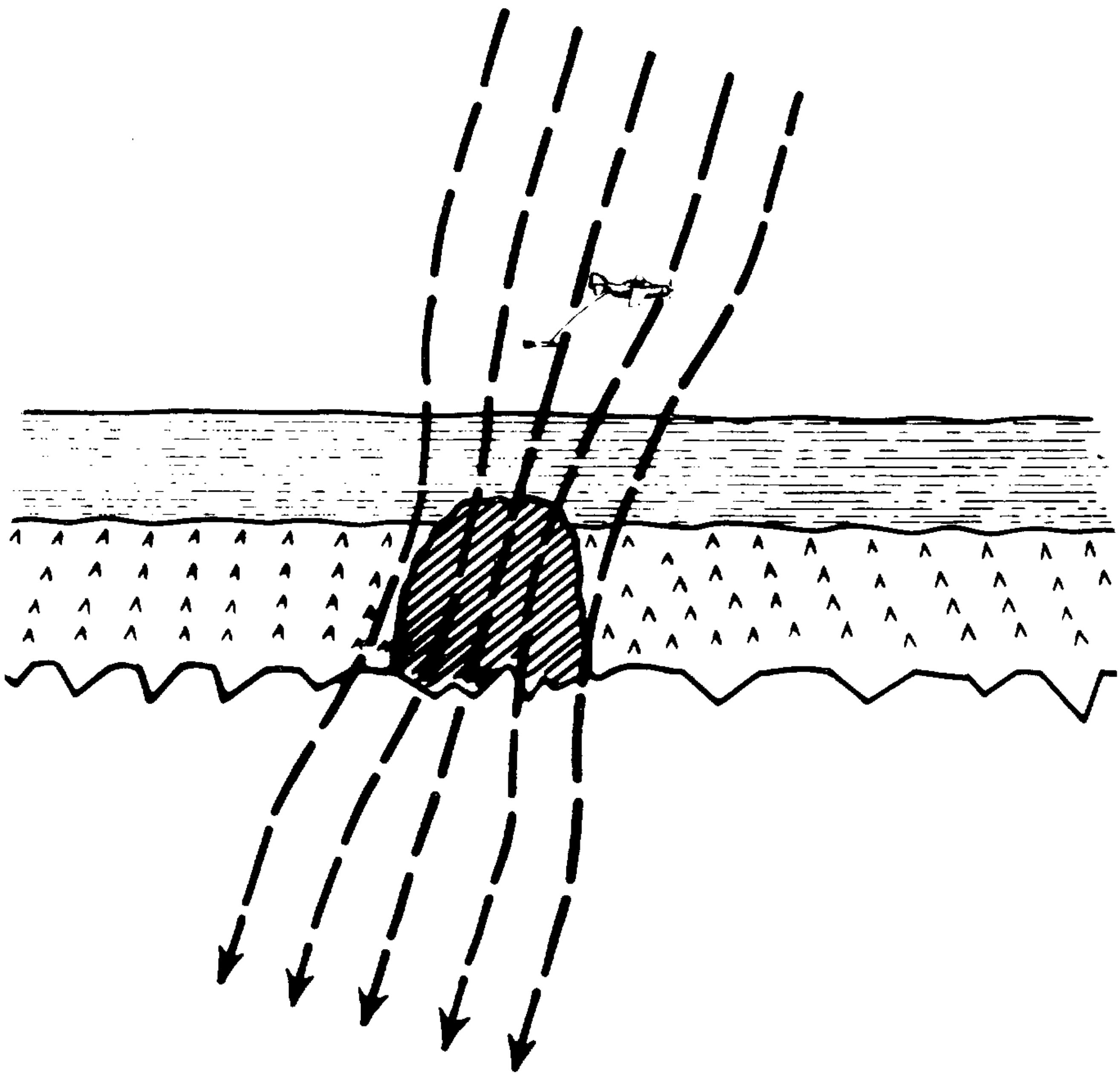
For Curve D, the thickness of the block is reduced to only 0.1 of its depth. In this case, the slope measurement is substantially different (smaller) but is still directly related to the depth of burial.

Of course, the depths define the surface of the "magnetic" basement so that any identification of its age must originate from geologic correlation. Moreover, it is necessary, but certainly not predictable, that this basement is the effective limit in depth in exploration. One can experience a basement of non-magnetic quartzite, for example, acting as the effective basement for exploration but clearly not mappable from



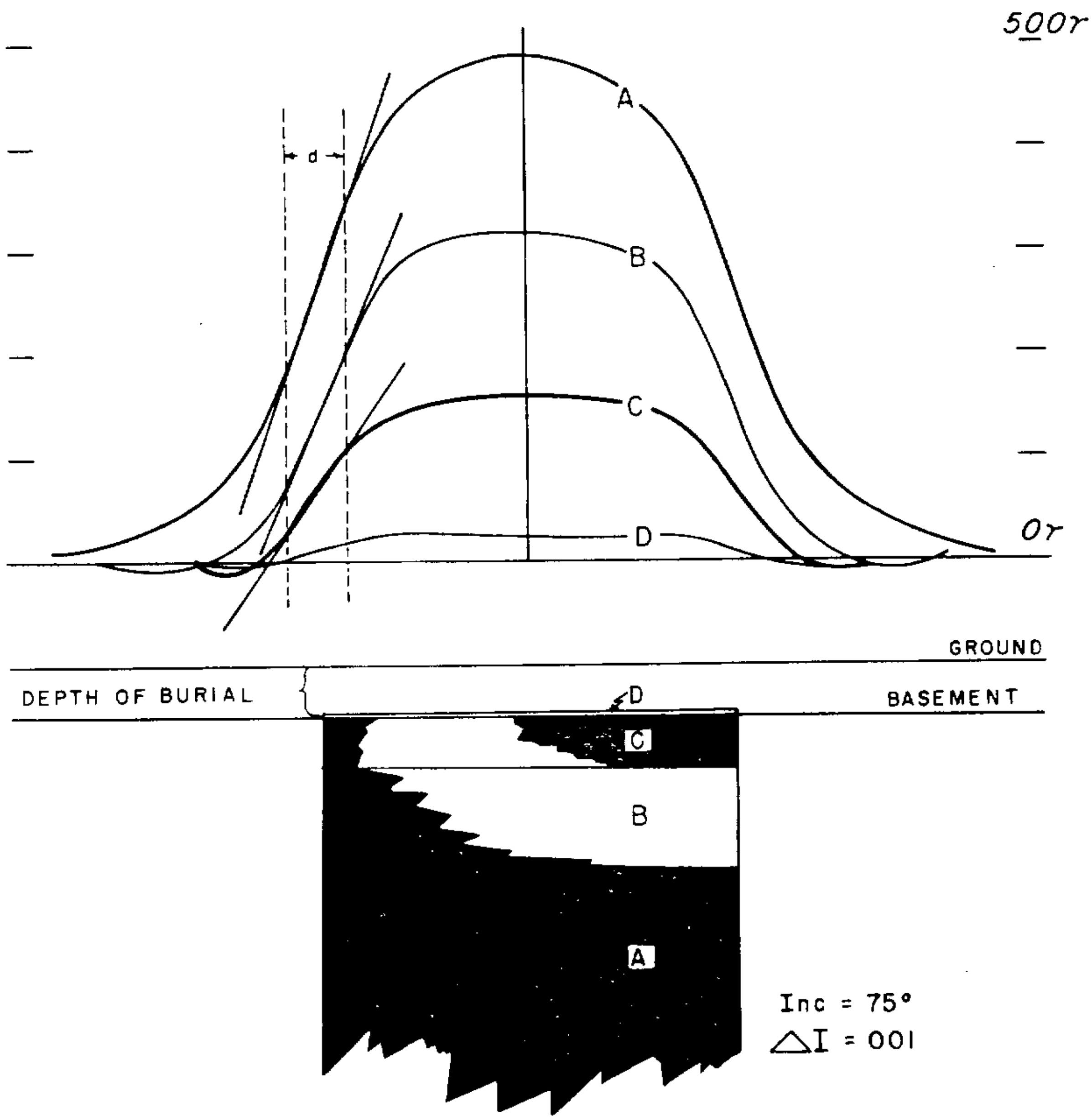
AEROMAGNETIC ANOMALY

FIGURE 1



BASEMENT EFFECT

FIGURE 2



INTRABASEMENT AND SUPRABASEMENT EFFECTS

FIGURE 3

magnetic data. Fortunately, experience shows that this is a most infrequent occurrence. Experience over the entire earth shows that most often the "effective basement" and the "magnetic basement" are one and the same. Moreover, the basement is Precambrian in most areas.

METHOD OF INTERPRETATION

It is found that observed magnetic curves can be accounted for almost completely by a combination of thick blocks giving relatively large magnetic effects corresponding to Curves A, B, or C and thin blocks having relatively low relief magnetic effects corresponding to Curve D. The thin sheets or plates could represent local relief on the basement surface which could be erosional or structural in origin or they could represent thin sheets of magnetic material just below the basement surface rather than relief on that surface.

The analysis of aeromagnetic data is based primarily on the original flight line records. These records are examined and resolved into components which can be attributed to (1) "intrabasement" magnetic contrasts which extend into the basement for depths at least as great as the depth of burial (i.e., thick bodies); (2) "suprabasement" components which are attributed to thin bodies at or near the basement surface and which may or may not represent relief of that surface; and (3) shallow disturbances which have their origin within or near the surface of the sedimentary section, usually from intrusive or extrusive rocks. When these components are resolved, certain elements of the curves are measured as distances on the tapes. These distances are corrected for the azimuth of the flight line with respect to the boundary of the magnetized body as inferred from the observed and derivative maps, then reduced to distances on the ground. From this distance and the proper depth parameter, a depth below flight level is calculated. This depth is reduced to sea level datum by subtracting the flight elevation, and the resulting number is placed on a map at the location corresponding to the center of the element of flight line used for the measurement.

The process of interpretation is very much dependent on recognizing the different components of the aeromagnetic profiles. This recognition may be easy or difficult, depending on the degree and the manner in which the various effects may overlap or interfere with one another. An important criterion for the recognition and resolution of the anomalies is the consistency of depth calculations from the thin and thick bodies because the depth parameters from which these calculations are made are quite different, but, properly used, will lead to the same depth values.

The recognition of the thin plate anomalies and their use for depth estimates greatly extends the amount of depth control which can be obtained from the analysis. These may occur cleanly, by themselves, but often occur in association with intrabasement anomalies, as superpositions on intrabasement anomalies, as adjacent to or as noses from intrabasement anomalies, or they may occur along a geologically reasonable trend not otherwise connected with intrabasement anomalies.

Second Vertical Derivative Calculations

During the course of the interpretation, second vertical derivative calculations are made over the entire area of the magnetic survey and prints of the Second Vertical Derivative Maps are furnished with the Basement Maps (contoured) with each report.

Derivative calculations of various kinds have been used for many years in the analysis of gravity and magnetic surveys. The primary purpose of such calculations is to provide an objective operation which will discriminate local features and suppress broad or regional influences.

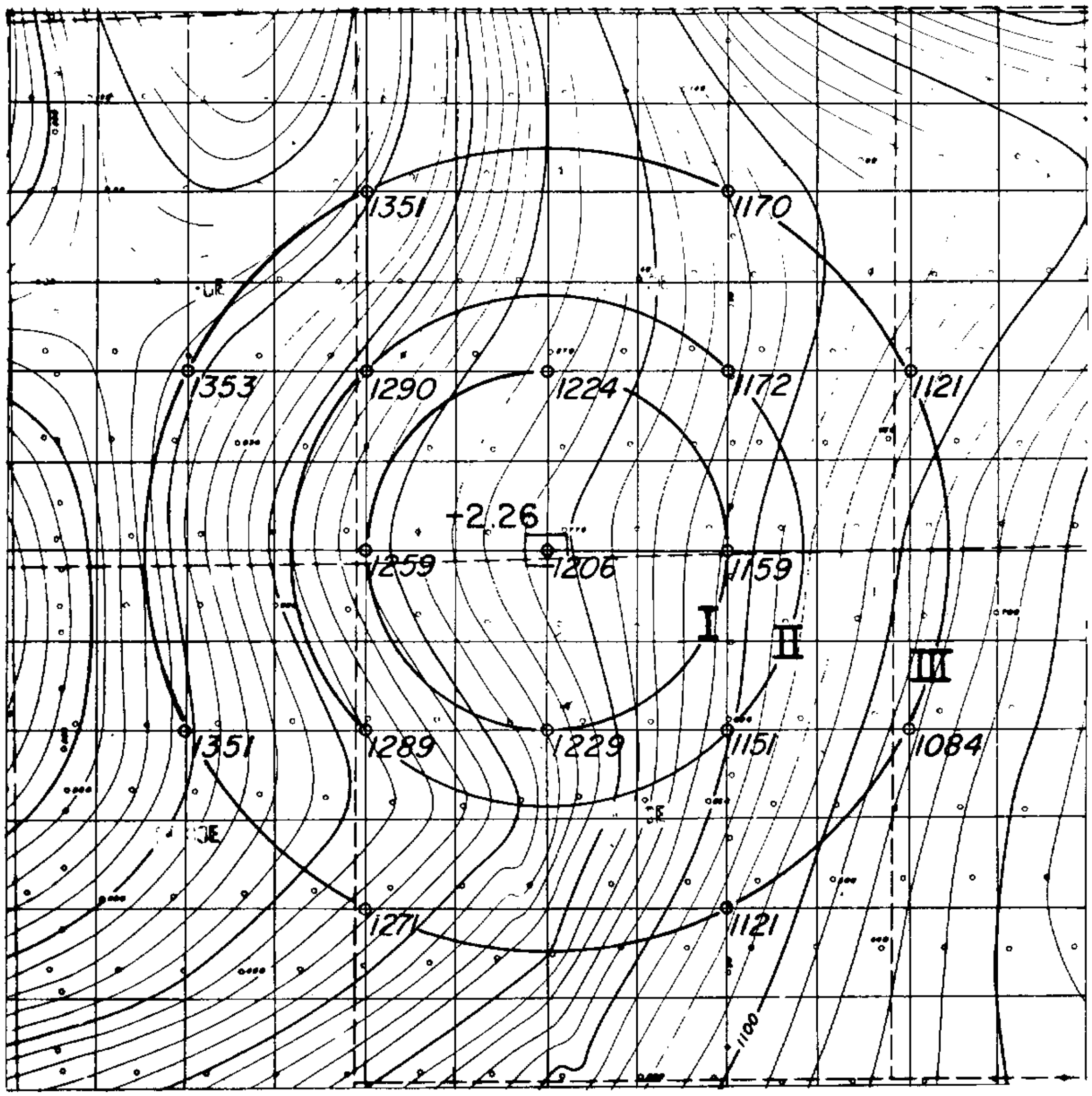
A great variety of derivative calculation systems have been published in the geophysical literature. * All of these systems take into account the data on circles of various radii in a limited area surrounding the point of calculation and operate on these data with numerical coefficients. The sum of the coefficients which multiply the center point and the average of each ring is zero. To make the derivative calculation, a grid of points is laid down over the map and the value of magnetic intensity is written in at each of these points. A template with a pattern of openings corresponding to the choice of the calculation array is laid down over the map and the holes in the template expose the numbers at the center point and in successive circles around the center point. These numbers are averaged, multiplied by the corresponding coefficients, and the resulting products are added to give the calculated derivative value at the center point. The template is then moved one space and the entire operation repeated.

The grid-spacing, number of rings, and correspondingly the coefficients are adapted to each area; but these are described in each report. An example for a single calculation is shown in Figure 4.

If the field were flat over the area of the template, there would be no differences in average values between the various circles and the resulting calculated value would be zero (because the sum of the coefficients is zero). This would be true also if the area within the template has a uniform slope or gradient. On the other hand, if values near the center of the template are, on the average, higher than those toward the edge, the calculation will lead to a positive value. If the central area is lower, the calculation will lead to a negative value.

The derivative calculation is equivalent to a determination of the curvature of a geometric surface which would be represented by the magnetic contours. If, within the

* GEOPHYSICS, Vol. XVI, No. 1, January 1951, pp. 29-50.



EXAMPLE OF A SECOND VERTICAL DERIVATIVE CALCULATION

$$-2.26 = .09136(206) + .00831(224+159+229+259) - .00623(172+151+289+290)$$
$$- .01246(170+121+84+121+271+351+353+351)$$

FIGURE 4

area of the template, this surface is concave upward the calculated value is positive. If the surface is concave downward, the calculated value is negative. The magnitudes of the calculated values are proportional to the sharpness of the curvature.

The derivative calculation leads to an increase in the complexity of the map. For instance, a simple maximum on the magnetic map will have positive curvature over its center and, therefore, positive derivative values there, but it has negative curvature over the flanks leading to negative derivative values there. Thus, a simple maximum on an observed magnetic map has a positive center and flanking negatives on the second derivative map. Therefore, a second derivative map tends to have numerous closed maxima and minima where the observed map may have terraces or noses without closures.

To some extent the pattern of the second derivative map is a crude estimate of depth. Where the disturbances are of shallow origin, the pattern of the derivative map is nearly always more complicated, the maxima and minima are closer together, and their relief is relatively large. Where the basement is deep, the contours are smoother, the distances between maxima and minima tend to be greater, and their relief is much less.

Being a second derivative of the magnetic field, the quantities have the dimensions of a magnetic intensity divided by the square of a length. In scientific units, these are expressed as oersteds divided by centimeters squared. Since the original data are in units of gamma, or 10^{-5} oersted, and the lengths as usually measured on the map are of the order of miles or kilometers, or generally the order of about 10^5 centimeters, the order of magnitude of the second derivative values in terms of oersteds/cm^2 is $10^{-5} / (10^5)^2 = 10^{-15}$ cgs.

The second vertical derivative map is primarily a tool or accessory of the interpretation. The pattern of features which it shows, for the most part, is an expression of areas of relatively high or low magnetization of the basement rocks. Therefore, the highs and lows on this map generally should not be interpreted as indicative of highs or lows on the basement surface. That surface could be very smooth and regular and still have a strong pattern of second derivative features. On the other hand, the emplacement of the magnetic material responsible for the second derivative features often appears to be controlled by structural or tectonic movements and, therefore, it is very common for the pattern of the second derivative map to be parallel with the tectonic trends of an area.

A particular use of the derivative map is as a guide to the size and shape of the blocks of magnetic material which cause disturbances of the map and on the magnetic profiles. The derivative picture helps in choosing the boundaries of these bodies, their azimuth for determination of angle corrections, and their horizontal extent which helps in the selection of depth parameters. The map is useful only in a secondary and rather general way as an indicator of depth to the basement surface.

In areas where substantial relief of the basement surface is indicated by the depth contours, one can expect to see more or less corresponding effects in the second derivative contours. On the other hand, when the possible deformation of the basement is only a small fraction (less than about one-tenth) of its depth below the flight level, the magnetic effects become so small and diffuse that they may only make small effects on the second vertical derivative map from subtle but recognizable variations in the magnetic profiles. Conversely, shallow disturbances, and particularly intrusive or extrusive rocks, nearly always have sharp magnetic effects on both observed and derivative maps.

PRESENTATION OF RESULTS

Reports for the interpretations discuss the results and are ordinarily accompanied by maps of basement contours and second derivative contours. Inasmuch as experience with the current capability of aeromagnetic data gives evidence for determining depths to an order of $\pm$ 5% (Ref.: The evaluation of the Peace River aeromagnetic survey, Steenland, GEOPHYSICS, October, 1963), basement maps have an optimum contour interval of 5% of the depth below the level of the survey. Less sufficient data may result in a larger contour interval, and very good data may make a lesser interval possible. The contour interval ordinarily ranges between 2-1/2% and 10% of the depth of burial. Identification of the basement's age must originate from geologic correlation. However, the company's staff, who ordinarily have substantial accessory information, can contour the results to their satisfaction on the uncontoured map of the basement depths. For example, GMX's contouring does not include patterns of faulting because from the magnetic anomalies, alone, it is not possible to distinguish between a monocline or a fault. Moreover, if it were, it is not possible to discriminate between normal and reverse faults. A company may, however, have reason to know that a feature is actually a fault and may contour the area accordingly.

The derivative maps are contoured at variable intervals depending upon the relationships between the amplitudes of its anomalies and the scales of the maps.

The Magnetic Basement Map

The Calculated Basement Depths as estimated from the magnetic data are given in hundreds of feet from sea level datum. These depths are shown either as numbers on the map with three, two, or one underlines indicating relative grades of good, fair, or poor or as numbers followed by the letter "S." The underlined numbers are calculated from intrabasement anomalies; i.e., those coming from magnetized bodies with vertical dimensions comparable with or substantially greater than the depth of burial. The quality rating is based on the availability and consistency of depth values from different measurable parameters on the records.

Calculations from Plate Anomalies give the values followed by the letter "S." These are calculated on the assumption of plate-like magnetic bodies which may be either closed or one-sided. The outline of the assumed plate is indicated by a thin line on the map. If only one side of the plate is recognizable, the outline degenerates to a single line with the letter "D" on the magnetically low or possibly "downthrown" side as these features could represent faults at the basement surface. The figure written in feet is an indication of the order of magnitude of thickness of the sheet which would be required to give the maximum magnetic amplitude of the anomaly resolved on the magnetic profile. This figure would be the relief of a local feature, if the plate anomaly is caused by erosional or structural relief of the basement surface, but the anomaly may well be caused by magnetic contrasts within but near the top of the basement section without deformation of the basement surface. Therefore, these anomalies should be considered primarily as features which permit the derivation of additional basement depth values for control of the contours. They could represent relief on the basement surface and therefore be important as structural indications but should not be considered as definitely indicative of structure unless they are supported by the basement contours or by other evidence as, for example, seismograph indications.

Shallow Disturbances

There may be a series of usually small, closed, and often quite irregular outlines with the computed thickness in feet. These are colored red. These indicate the outlines of bodies of shallow magnetic material which would account for relatively sharp features observed on the aeromagnetic profiles. Depths to the centers of these features are given, in hundreds of feet, followed by "sh." The magnetic material is often practically at the surface and always relatively high in the sedimentary section.

Basement Depths from Drill-tests

Basement depths from drill-tests are used to the extent that such data are available. These figures are shown on the map either as subsea depths to the mapped basement (for example, -5928) or as estimated depths with the formation from which the estimate is made shown in parentheses ((for example, -5900 (Mch) for an estimate computed from the Mississippian Charles formation)).

Basement Depth Contours

These are GMX's interpretation and reconciliation of the depth estimates from the magnetic calculations and the actual or estimated basement depths from the drilling. Transparencies of the Basement Maps with the depth figures but without contours are furnished.

Recommended Areas

These are based on considerations of the depth estimates, the suprabasement anomalies, the regional structure, the local structure, stratigraphy, the exploration experience in the area, perhaps even leasing possibilities. In other words, the end evaluation is one of the possibility of new production in the area. The areas are ordinarily outlined in brown. They may be graded or otherwise listed in their order of preference.

The Second Vertical Derivative Map

These maps are contoured at suitable intervals from the derivative values ordinarily calculated directly from the observed aeromagnetic maps. The positive areas are shaded red; negative, yellow. Green outlines and traces represent the edges of thin plates considered to be the causative bodies of the suprabasement magnetic anomalies. Sometimes the red outlines of the "possible shallow magnetic material" are included to show the assumed origin of the correlative derivative anomalies.

The Observed Aeromagnetic Map

This contoured map is furnished by the company or airborne contractor and is not submitted with GMX's report. However, each report contains a discussion of the observed aeromagnetic field. As noted above, the observed map is ordinarily used without correction for the derivative's calculation. It is also necessary for the identification of the orientation and size of the causative body of each anomaly.

GRAVITY METER EXPLORATION COMPANY

Nelson C. Steenland

STATEMENT ON MAGNETIC INTERPRETATION

Experience over the last decade of interpreting data convinces GAI-GMX of the authenticity, within the general range of accuracy claimed, of the fundamental assumptions used in its interpretations. However, GAI-GMX is equally aware of the ambiguity of the sources of aeromagnetic anomalies. All available accessory subsurface and geophysical data are incorporated in the analyses. However, additional data, either unknown to GAI-GMX at the time or later developed, principally from drilling, often reveal errors in the original aeromagnetic interpretation.

GAI-GMX hereby offers to revise its interpretations, without charge, wherever valid errors are demonstrated because of its recognition of the capabilities of this method and its interest in having the most possible correct interpretations on record.

GAI-GMX CANADA LIMITED

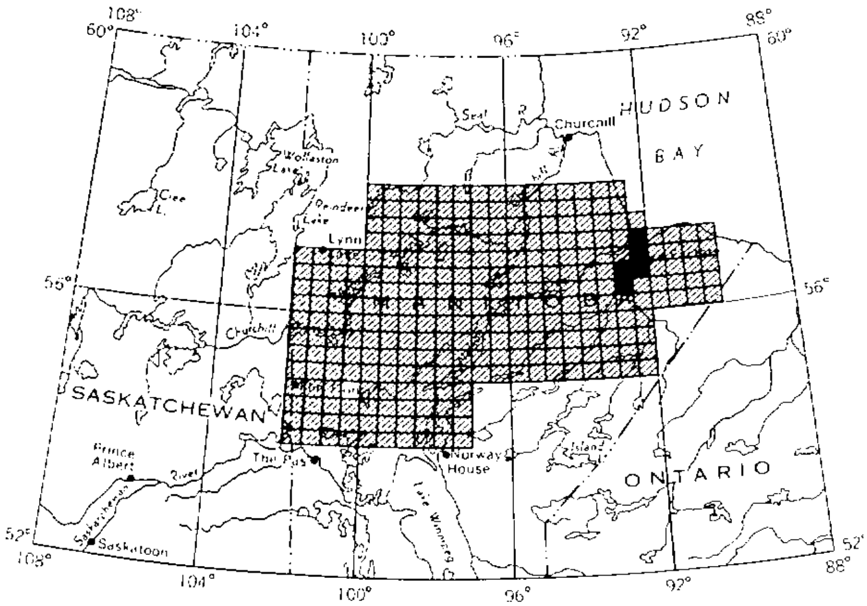
PART II

INTERPRETATION
YORK FACTORY AREA
HUDSON BAY
MANITOBA

SUMMARY

The York Factory area, Manitoba, is located in the northwestern part of the Hudson Bay Lowlands between the coast and the Precambrian shield to the west and south. Aeromagnetic coverage is available from the Geological Survey of Canada, and a portion is the basis for this interpretation.

An analysis of the profile data, in conjunction with the computation of a second vertical derivative of the observed magnetic field, was made to show the depth and configuration of the magnetic basement. Depth estimates to that surface are contoured on the Magnetic Basement Map at a 200 ft interval, and outlines of suprabasement anomalies which indicate areas of possible local relief are also shown.



INDEX MAP

SCALE : 1 IN / 200 MI

GAI - GMX

CONTENTS

FRONTISPIECE

MAPS
(1 in/1 mi)

INTRODUCTION

York Factory is situated near the mouth of the Hayes River which empties into the southwestern edge of Hudson Bay. The survey area, primarily south and west of the townsite, is bounded by latitudes 56°23′ and 57°07′N, longitudes 92°00′ and 93°00′W. Within this coverage the license area centers along 56°45′ between 92°00′ and 92°30′.

Geology

The area, part of the Hudson Bay Lowlands province, is on the northeastern periphery of the Precambrian shield. Surface rocks are flat-lying and consist of Pleistocene and Recent sediments. Updip, Silurian formations are exposed followed by Ordovician outcropping which in turn rest on the Precambrian. South and east Devonian beds are present, but these are not known to underlie the survey area.

Except for the test at 56°30′N, 92°58′W, which bottomed in Precambrian rock at -310 ft, little is known of the sedimentary section in the immediate vicinity. Moreover, the magnetic interpretation indicates that this hole is astride an unusually shallow, uplifted block and that its depth is not representative of the general basement attitude.

For a detailed account of the area's geology reference should be made to Geological Survey of Canada Paper 67-60, Geology of the Hudson Bay Lowlands by B. V. Sanford, A. W. Norris, and H. H. Bostock, 1968, and the Bulletin of Canadian Petroleum Geology, Vol.14, No. 4, Geology of Hudson Bay Basin by S. J. Nelson and R. D. Johnson, 1966.

OBSERVED MAP

The total intensity maps are published by the Geological Survey of Canada at scale 1 in/1 mi. Each sheet, on a planimetry base, covers 15′ of latitude and 30′ of longitude. The magnetic field values are contoured at a 20 gamma interval with dotted 10 gamma contours where detail permits. These values are reduced to an arbitrary base level to which no correction has been made for removal of the Earth's normal field.

Traverses are oriented north-south at half-mile intervals with east-west control lines spaced no farther apart than 20 miles. Flight altitude was established at 1000 ft above mean terrain or 1000-1300 ft over the rather featureless, low topography. The magnetic profile recordings are of good quality with vertical and horizontal scales of 60 gamma per inch and 0.75 mile per inch, respectively.

The flight-line direction and spacing are ideal for magnetic mapping in this region. Traverses are perpendicular to the major magnetic trends and are of sufficient density to adequately detail the smaller anomalies which are generated by basement rock at depths less than one mile below flight altitude. The smooth contour configuration also indicates that each flight path has been accurately located and the data mapped correctly with respect to adjacent traverses.

The observed field is highly anomalous with the amplitude on individual features ranging from 100 to 1000 gamma. There are isolated domal shapes, representative of the shield environment, but many positive anomalies also join to form elongated east-west trends. These are possibly indicative of younger mineralization zones within the basement complex. The most prominent anomaly is a circular feature of 12,000 gamma amplitude situated on such a chain at 56°30'N, 82°58'W. A test which encountered Precambrian rock at -310 ft has been drilled at this location.

SECOND VERTICAL DERIVATIVE MAP

Derivative values are computed from the total magnetic intensity map at one-mile intervals using the ring configuration and formula given in Appendix I. A discussion of the computation method and the application of the derivative map is made in the Introductory Report, Part I.

Areas of positive curvature are defined by the zero contour and shaded red. The most prominent of these are naturally coincident with the major intensity anomalies but serve to add detail to the extent and configuration of the source anomaly. Within weaker intensity zones the derivative outlines are guides for correlating small amplitude suprabasement events from line to line, such as the feature at 56°42'N, 92°00'-07W. Conversely, the derivative may indicate a separation between events which, from similar appearance on nearby profiles, may initially have been interpreted as a contiguous anomaly. An example of this situation occurs between the two plate anomalies at 56°53'N, 92°19'-30'W.

Superimposed on the derivative map are the outlines of all the suprabasement and shallow magnetic material anomalies. In this area the comparative delineation of magnetic events by profile analysis and by derivative computation is rather straightforward.

MAGNETIC BASEMENT MAP

The mapped horizon is everywhere believed to be the Precambrian surface. This is confirmed directly by the one drill test at 56°30'N, 92°58'W and indirectly by the order of depths being representative of the anticipated section thickness. There is no evidence of anomalies arising from younger, massive intrusives which would probably mask the true magnetic basement effect. The only occurrences of extraneous magnetic material are those from local, near-surface bodies of probable erosional origin. These are principally concentrated along 56°35'N from 92°27' to 92°48'W, and their maximum thicknesses are computed to be only 100 ft.

Regionally, the basement dips northeastward into Hudson Bay. Unexpectedly, however, this is not at a uniform gentle rate as might be anticipated from the area's close proximity to the Precambrian shield. Locally there are basinal areas flanked by uplifts associated with the major intensity trends. The largest area containing greater than 2000 ft of section extends from the coast southward to the narrow ridge situated along 56°52'. Next in areal extent is a six-mile wide trough extending westward eighteen miles from 92°30' along 56°35' to the western survey boundary. A single domal feature rising to -1400 ft causes the only major disruption in the -2200 ft contour. The Precambrian depth of -310 ft to the south is also considered to be very localized, due probably to a plug-like basement mass which has also undergone an extensive mineralization change.

The main area of interest, east of 92°30' and generally between 56°35' and 56°50', contains three basinal areas. Most attractive, from the standpoint of maximum section, is the area bounded by 56°35'-45', 92°00'-10'. Three possible structural features within the basin proper are defined at 56°33'N, 92°02'W; 56°42'N, 92°00'-07'W; and 56°43'N, 92°01'W. Westward, a good suprabasement plate is found in the center of the basinal arm at 56°42.5'N, 92°27'W. In the northeastern extension of this basement low, an irregularly shaped plate anomaly is superimposed on a broad intrabasement block at 56°48'N, 92°20'W. The foregoing anomalous events are recommended as being the most probable areas within the respective basins to exhibit a structural attitude. It should also be noted here that the depths shown on these features, suffixed by an "S," have been computed with a factor which yields a maximum figure. Similarly, those depths with underlines, and generally made on the anomalies flanking the basins, are computed with a minimal factor. The choice of coefficient that was made on each slope measurement is felt to have produced a realistic basement map. Locally, however, there is the possibility that the use of the alternate factor would result in depicting even greater relief between basement highs and deeps.

CONCLUSION

The results of the aeromagnetic data analysis, presented as a contour map of the magnetic basement, depicts the depth to this surface and its structural trends. Estimates of slightly greater than -3000 ft are found at the northern boundary of the survey near the mouth of Hayes River. Inland, there are numerous domal and ridge-like basement highs varying from

-1000 to -1500 ft. These form the flanks of several basinal areas containing sediments in excess of 2000 ft. Recommended features within the deeper zones should provide the best sites for stratigraphic as well as structural tests.

GAI-GMX CANADA LIMITED

R. H. Hammons

APPENDIX I

Data Resumé

NAME OF SURVEY	York Factory
AREA	Hudson Bay, Manitoba
CONTRACTOR	Canadian Aero Service Limited for Geological Survey of Canada
FLYING	
INITIATION	June 1963
COMPLETION	November 1963
SURVEY MILEAGE	
LINEAR	2200
SQUARE	1107
COST OF INTERPRETATION	
TOTAL	$2,214.00
PER MILE	$ 1.01
PER SQUARE MILE	$ 2.00
LOCATION SYSTEM	Photographic
FLIGHT DIRECTION	North-South
FLIGHT ALTITUDE	1000 ft mean terrain clearance
TRAVERSE INTERVAL	0.5 by 10-20 mi
MAGNETOMETER	Gulf fluxgate

ORIGINAL RECORDING

	Type	Vertical Scale	Horizontal Scale	Quality
ANALOG	Rectilinear	60 gamma/inch	0.75 mi/in	Good

PRINCIPAL FACTS OF EARTH'S NORMAL FIELD

INCLINATION	83^{o}
DECLINATION	1^{o}W
INTENSITY	61,400 gamma

OBSERVED MAPS

BASE	Planimetry reduced from 1 in/4 mi Topographic Sheets
SCALE	1 in/1 mi
NUMBER OF SHEETS	All or portions of 5 sheets
CONTOUR INTERVAL	10 gamma

SECOND VERTICAL DERIVATIVE MAPS

BASE	Overlay
SCALE	1 in/1 mi
NUMBER OF SHEETS	1
CONTOUR INTERVAL	Minimum 10×10^{-15} cgs, maximum 5000×10^{-15} cgs
GRID SPACING	Two-ring, one mile, computed every mile

FORMULA

$$\frac{\partial^2 T}{\partial Z^2} = 2.316\, T_o - 0.772\, (T_{11} + \ldots T_{14}) + 0.193\, (T_{21} + \ldots T_{24})$$

MAGNETIC BASEMENT MAPS

BASE	Overlay
SCALE	1 in/1 mi
NUMBER OF SHEETS	1
CONTOUR INTERVAL	200 ft

REPORTS

FINAL	29 January 1969

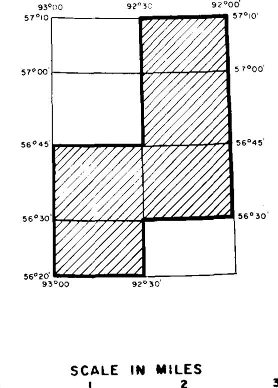
HUDSON BAY
YORK FACTORY
GILLAM ISLAND
THIS MAP IS NOT TO BE REPRODUCED OR DISPLAYED EXCEPT AS PROVIDED FOR UNDER THE TERMS OF THE PURCHASE AGREEMENT
SECOND VERTICAL DERIVATIVE COMPUTED EVERY MILE
2 RING - 1 MILE GRID - HENDERSON & ZIETZ
$\frac{\partial^2 T}{\partial T^2} = 2.316\ T_0 - 0.772\ (T_{11} + \ldots T_{14}) + 0.193\ (T_{21} + \ldots T_{24})$
POSSIBLE LOCAL BASEMENT STRUCTURES
MAGNETIC MATERIAL WITHIN SEDIMENTARY SECTION
SCALE IN MILES

SECOND VERTICAL DERIVATIVE COMPUTED EVERY MILE
2 RING – 1 MILE GRID – HENDERSON & ZIETZ

$$\frac{\partial^2 T}{\partial T^2} = 2.316\,T_0 - 0.772\,(T_{11} + \dots T_{14}) + 0.193\,(T_{21} + \dots T_{24})$$

POSSIBLE LOCAL BASEMENT STRUCTURES

MAGNETIC MATERIAL WITHIN SEDIMENTARY SECTION



SCALE IN MILES

SURVEYED AND COMPILED 1963
BY CANADIAN AERO SERVICE LTD OTTAWA

FLIGHT ALTITUDE : 1000 MTC
TRAVERSE INTERVAL : 1/2 MILE

KANATA EXPLORATION CO

AEROMAGNETIC INTERPRETATION

HUDSON BAY

YORK FACTORY AREA MANITOBA

SECOND VERTICAL DERIVATIVE

GAI/GMX CANADA LIMITED

Contour Interval: 10,50,100,500,1000	Scale: 1 IN = 1 MI	Date: JANUARY 1969
& 5000 x 10^{-15} CGS	Datum:	Map No:


HUDSON BAY
YORK FACTORY
Nelson River
GILLAM ISLAND
THIS MAP IS NOT TO BE REPRODUCED OR DISPLAYED EXCEPT AS PROVIDED FOR UNDER THE TERMS OF THE PURCHASE AGREEMENT
-5928 p€ "TOP" IN FT
MAGNETIC BASEMENT DEPTH ESTIMATES FT/100 SEA LEVEL DATUM
-72 FROM INTRABASEMENT ANOMALY
GOOD FAIR POOR
-72s FROM SUPRABASEMENT ANOMALY
OUTLINES OF PLATE FROM SUPRABASEMENT ANOMALIES WITH MAXIMUM THICKNESS IN FEET ESTIMATED WITH 0.002 cgs MAGNETIZATION CONTRAST
D
MAGNETIC MATERIAL WITHIN SEDIMENTARY SECTION
100' MAXIMUM THICKNESS IN FEET
-7sh DEPTH ESTIMATE IN FT/100
93°00'
92°30'
92°00'
57°10'
57°00'
56°45'
56°30'
56°20'
SCALE IN MILES
1 0 1 2 3

-5928 pЄ "TOP" IN FT

MAGNETIC BASEMENT DEPTH ESTIMATES FT/100 SEA LEVEL DATUM
- 72 FROM INTRABASEMENT ANOMALY — GOOD — FAIR — POOR
- 72s FROM SUPRABASEMENT ANOMALY

OUTLINES OF PLATE FROM SUPRABASEMENT ANOMALIES WITH MAXIMUM THICKNESS IN FEET ESTIMATED WITH 0.002 cgs MAGNETIZATION CONTRAST

MAGNETIC MATERIAL WITHIN SEDIMENTARY SECTION
100' MAXIMUM THICKNESS IN FEET
-7sh DEPTH ESTIMATE IN FT/100

SCALE IN MILES

SURVEYED AND COMPILED 1963
BY CANADIAN AERO SERVICE LTD OTTAWA
FLIGHT ALTITUDE : 1000 MTC
TRAVERSE INTERVAL : 1/2 MILE

KANATA EXPLORATION CO

AEROMAGNETIC INTERPRETATION

HUDSON BAY

YORK FACTORY AREA MANITOBA

MAGNETIC BASEMENT

GAI/GMX CANADA LIMITED

Contour Interval: 200 FEET	Scale: 1 IN = 1 MI	Date: DECEMBER 1968
	Datum:	Map No: