010

LOGISTICS AND PROCESSING REPORT OF THE AIRBORNE VLF ELECTROMAGNETIC AND MAGNETIC SURVEY IN THE KAPUSKASING AREA, ONTARIO FOR HOMESTAKE CONSULTING

BY

GEOTERREX LIMITED

PROJECT NO. 276

DECEMBER 1986

B. SCHACHT

Lual
2.1907

TABLE OF CONTENTS

	PAGE
INTRODUCTION	1
I. SURVEY OPERATIONS	2
I.1 Flight Grid	2
I.2 Flight Altitude	2
I.3 Navigation	2
I.4 Aircraft & Geophysical On-board Equipment	3
I.5 Ground Station Monitor Equipment	4
I.6 Pre-Survey Tests	5
I.7 Field Operations	6
II. DATA PROCESSING	7
II.1 Flight Path Recovery	7
II.2 Editing of Air Data	7
II.3 Total Intensity Contour Map	8
II.4 Calculated Magnetic Vertical Gradient Contour Map	9
II.5 VLF Profile Maps	9
II.6 Final Products	9
APPENDIX A - FOURTH DIFFERENCE EDITING	
APPENDIX B - TRIANGULAR FILTERING	
APPENDIX C - ARCHIVE TAPE DESCRIPTION	

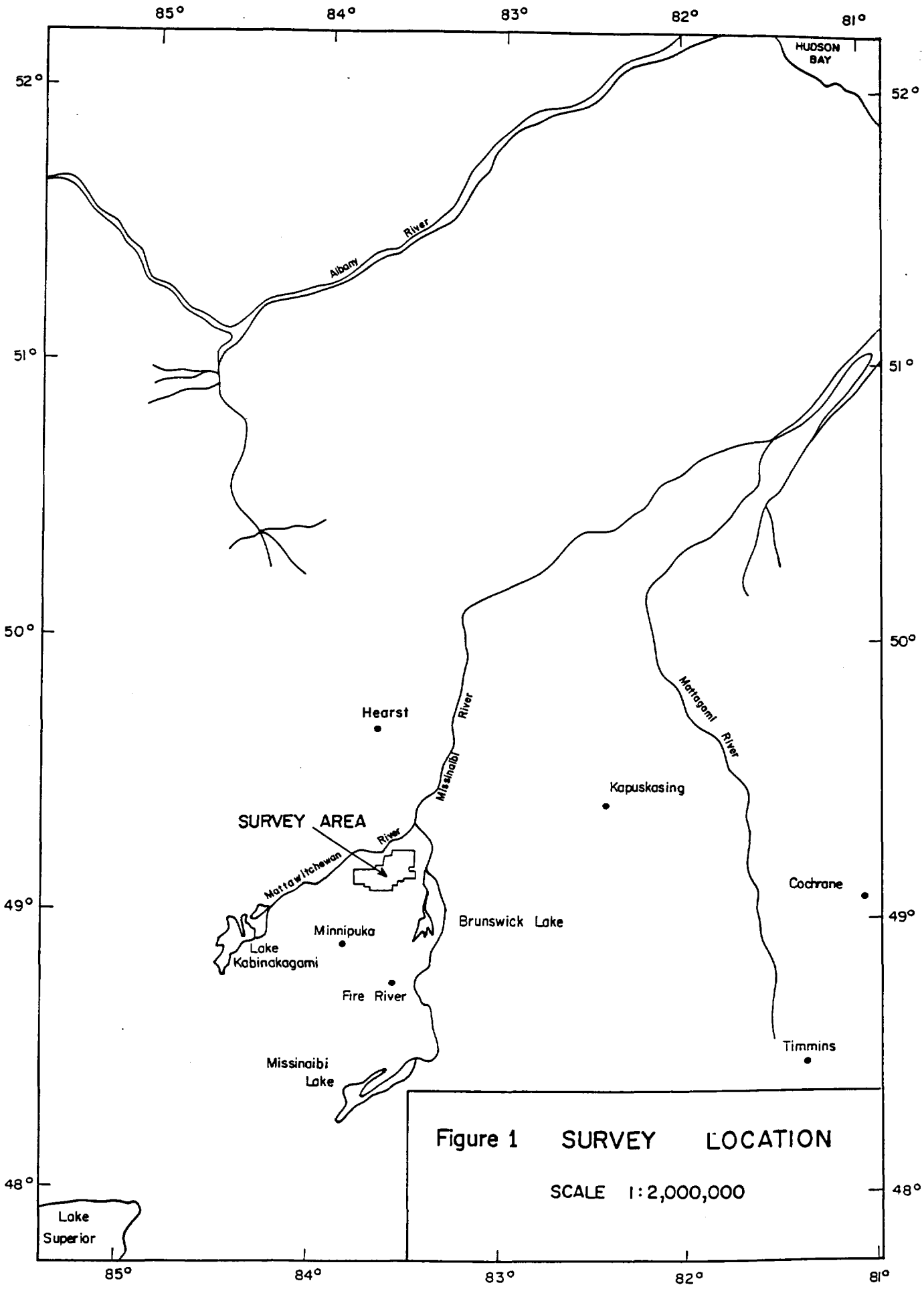


Figure 1 SURVEY LOCATION

SCALE 1:2,000,000

INTRODUCTION

During the period of October 6th to 17th, 1986, a combined airborne magnetic and VLF electromagnetic survey was flown for Homestake Consulting by GEOTERREX LIMITED. In all, 1856 kilometres of survey lines were flown in the Kapuskasing area of Ontario (see figure 1).

The data was compiled and processed in Ottawa by GEOTERREX LIMITED and is presented as a total intensity contour map (IGRF corrected), VLF profile map for each of two frequencies (plus analogs) and calculated magnetic vertial gradient contour map, plus report.

I. SURVEY OPERATIONS

I.1 Flight Grid

The area was covered with flight lines at a 100 m interval, in an East-West direction.

The tie-lines were flown at right angles to the flight lines, at a 1000 m interval.

A total of 1,856 line kilometres of data was flown.

I.2 Flight Altitude

The survey was flown at a height of 80 m above ground whenever possible, with regard to topographic relief and commensurate with the safety of the aircraft. The average value of all radar altimeter readings was actually 79 m; and the average value of any individual line never varied more than ±10 m from the prescribed altitude.

I.3 Navigation

The navigation was visual, assisted by Doppler. Airphoto mosaics at a scale of 1:10,000 were prepared by GEOTERREX LIMITED for navigation and path recovery.

Lines and tie-lines were reflown whenever their spacing exceeded the specifications by more than 50% over a distance of more than 2 km. Points were picked every km or less whenever possible.

I.4 Aircraft & Geophysical On-board Equipment

The survey aircraft used was a Navaho, registration CF-FRY, maintaining a survey speed of 260 km/hr (18 m per 1/4 second sample interval).

The following equipment was on-board the aircraft.

- VLF Electromagnetic system: Totem 2A, measuring total field and quadrature every 1/4 second; using Seattle, Washington at 24.8 kHz and Cutler, Maine at 24.0 kHz with Annapolis, Maryland at 19.0 kHz as alternative.
- Digital Acquisition system: The following information was recorded digitally:
  - 2 VLF EM channels in total field and quadrature
  - Magnetic total field and its fourth difference
  - Radar altitude
  - Barometric altimeter
  - Time and fiducials
  - Doppler velocity along track
  - Doppler velocity across track
  - Doppler heading
- Magnetometer: Cesium vapour magnetometer, mounted in a stinger on the tail of the aircraft, and compensated for aircraft magnetic effects. Its sample rate was 1/4 second. It recorded the earth's total field in units of 0.01 gamma.*
- Altimeters:
  - Radar altimeter: COLLINS
  - Barometric altimeter: Rosemount
- Tracking Camera: 35 mm continuous strip camera.

One gamma is equivalent to the S.I. unit nanotesla (nT).

- Analogue recorder: Displaying the following information with a chart speed of 10.1 cm/min. up to mid-flight 4 and 20 cm/min. thereafter.

- 2 VLF EM channels (Cutler, Maine at 24.0 kHz and Seattle, Wash. 24.8 kHz) in both total field and quadrature at a vertical scale of 20 %/cm.

- The magnetic total field at a vertical scale of 100 and 1000 gammas full scale.

- The radar altitude at a vertical scale of 250 feet/cm.

- The barometric altitude at a vertical scale of 400 feet/cm.

- Fourth difference of the total magnetic field at a vertical scale of 2 nT/cm.

- Fiducials ticked at every 10 samples and labelled at every 100 samples.

- Time labelled every 25 seconds (100 samples).

I.5 Ground Station Monitor Equipment

- A cesium vapour magnetometer measuring the total magnetic field at the same sensitivity (0.01 nT) and sample rate (1/4 sec) as the magnetometer on-board the aircraft.

- A Totem 2A VLF receiver.

- A digital acquisition system, recording time, fids, and the output from the magnetometer, and VLF receiver.

- An analogue recorder, displaying the total magnetic field at 10 and 100 gammas full scale and the fourth difference at 4 gammas full scale plus the total field and

quadrature from both the Cutler and Seattle transmitters at ± 25% full scale. Plotting speed was 3.4 cm/minute.

The base station was set-up at Kapuskasing (see figure 1), the base of operations throughout the entire survey. The magnetometer and VLF receiver were located remote from potential sources of cultural interference.

No magnetic air data was accepted when the magnetic ground station showed departures of 10 gammas or more from a chord 2 minutes in length. In fact, the ground data rarely varied more than 5 gammas from a 5 minute chord; and diurnal variations had no deleterious effect upon the magnetic contours.

I.6 Pre-Survey Tests

a) Figure of merit - The aircraft is put through a series of pitches ($\pm 5^{o}$), yaws ($\pm 5^{o}$), and rolls ($\pm 10^{o}$) in the four cardinal directions, to examine the noise induced in the magnetometer resulting from aircraft manoeuvres. This noise is to the eddy currents generated by the aircraft itself plus the changes in orientation of the sensor with regard to the earth's field. This test shows how well the instrument is compensated. The total noise envelope from the 12 manoeuvres (roll plus pitch plus yaw, times four) was less than 2.5 gammas.

b) Lag tests (magnetic & electromagnetic)

The camera on-board the aircraft records its position, A, relative to the ground at time t_o. In fact, the sensor will arrive over A at time t_1 greater than t_o. Furthermore, because of electronic delays, the reading performed at time t_1 will be recorded on the magnetic tape at time t_2 greater than t_1. The difference $t_2 - t_o$ represents the lag between the actual position of the aircraft and the position of the corresponding reading

on the magnetic tape.

The test is performed by flying the aircraft at survey altitude in opposite directions over a well defined magnetic and electromagnetic anomaly. The difference in the position of the anomalies, recorded in both directions, is equal to twice the "lag". The following lag values were determined:

- Magnetometer = 0.75 second (equal to 3 sample intervals)
- VLF EM = 1.75 seconds (equal to 7 samples)

These "lag" values were taken into account at the processing stage by shifting the digital values correspondingly back in time.

c) Clover leaf test

The aircraft is flown over the same ground point in the four cardinal directions in an area of low magnetic gradient in order to detect any large changes in magnetic level caused by the orientation of the sensor. After applying corrections from the base station, the maximum recorded difference was only 1.6 gammas.

1.7 Field Operations

The following KENTING personnel were present in the field:

Rob Bishop	Pilot
Dave Baldwin	Engineer
Deiter Wensorra	Electronics technician
Dave Graham	Dataman

II. DATA PROCESSING

II.1 Flight Path Recovery

The flight path was recovered by identifying points on the 35 mm tracking film and on the photomosaics, at a scale of 1:10,000. Every effort was made to identify a point at approximately every km on the ground along the flight lines. These points were then digitized on a flat-bed digitizer table, directly from the photomosacis.

After checking for errors by calculating the average speed of the aircraft between picked points, the flight path was automatically plotted at a scale of 1:15,840 and merged with the Doppler flight path. The flight path coordinates were recovered in UTM metres, using the Clarke 1866 Spheroid with a central meridian of 81°W, a false easting of 500,000, a false northing of 0 and a scale factor of 0.9996.

II.2 Editing of Air Data

The recorded total magnetic intensity, the VLf data, the radar and barometric altimeter readings and the time and fiducials were intially verified for continuity and validity by generating a listing of the first and second difference values. This will locate any major busts or gaps in the data.

Following this, obvious errors in the digital records of the raw total intensity and all 4 VLF fields were detected by creating an error listing using the fourth difference of the raw values. Such defects as spikes or missing values were automatically corrected by the program or simply flagged and corrected manually when outside the limits of the program. The total magnetic intensity values were thus corrected down to a threshold of

1.0 nT on the fourth difference values, corresponding approximtely to a noise level on the total intensity data of 0.06 nT.

All VLF data was corrected down to a threshold of 4% on the fourth difference, corresponding approximately to a noise level on the total field, and quadrature, of 1/4 %.

Refer to Appendix A for a description of the fourth difference editing technique.

II.3 Total Intensity Contour Map

The magnetic data used as input to the contours was the total intensity after editing of bad values.

In order to contour the magnetometer data, the values from the lines and tie-lines were levelled together. This was done automatically by comparing the values of the total field at the intersection of each line and tie-line. The differences were analysed and a compensation was calculated at each intersection in order to provide a pattern of smoothly varying adjustments along each line and tie-line. Erratic differences implying an error in the intersection location were carefully checked and corrected.

The values were then sorted and gridded along a 40 m grid; at the map scale of 1:15,840 this is equal to 2.5 mm. The IGRF regional was subtracted and a constant of 10,000 gammas was added. The final gridded values were then automatically contoured using a 5 nT interval.

In order to remove noise created in the gridding of such closely spaced lines and partial lines, a triangular grid filter was applied to remove anomalies of up to 120 metres in wavelength, with a 9 nT threshold. As the minimum possible wavelength from a

geological source, (e.g. a magnetic dipole on surface) at the recording height of 80 m, is 160 m, the filter's effect upon the geological signal is negligible. See Appendix B for a description of this filter.

II.4 Calculated Magnetic Vertical Gradient Contour Map

Using the filtered total field grid as input, a square 13 x 13 point operator was applied to every second grid point, 80 metres apart. Values were interpolated every 40 metres for contouring at 1:15,840 scale with a basic interval of 50 nT/km.

II.5 VLF Profile Maps

Separate maps were prepared for data using the Cutler, Maine, transmitter at 24.0 kHz and the Seattle, Washington, transmitter at 24.8 kHz. Each map displays the total field in black ink and the quadrature in blue, with a heavier pen, over the flight path in red ink. Horizontal scale is 1:15,840 and vertical scale is 30 %/cm.

The data presented is the result of a band pass triangular filter which enhanced wavelengths in the range of 90 to 1050 metres. The low pass (narrow) filter had a threshold of 3% and was aimed at removing high frequency noise. The high pass filter had no threshold and was applied to remove broad, non geological, level shifts.

Lines flown during transmission gaps, which were more frequent from the Seattle station, were omitted from the plot.

II.6 Final Products

All maps: isomagnetic and vertical gradient contours plus VLF profile maps from

both stations, were produced at 1:15,840 scale on a reproducible transparency with flight path, major planimetry, UTM grid, and geographic co-ordinates. Three ozalid copies of each map are included. Because of the high density of data on the VLF profile maps, the planimetry was omitted from them.

A digital archive tape was prepared with both air and ground data, as described in Appendix C.

Should you have any questions at any time in the future, please do not hesitate to contact us.

Respectfully yours,

Brian Schacht

Brian Schacht

APPENDIX A

Short Note

Application of Fourth Differences in Aeromagnetic Surveys, By M.S. Reford.

A standard method of examining any set of data, sampled at regular intervals, is the calculation of numerical difference tables. These can be used, for instance, to detect errors, for interpolation, or for numerical differentiation (Scarborough, 1950). Digital recordings of aeromagnetic data are ideal for such study, and Hood et al (1979) discussed the use of fourth differences in detecting and correcting errors in their high resolution aeromagnetic measurements. The purpose of this note is to review such correction procedures and report on the recording of fourth differences in the aircraft, to provide an immediate monitor of noise.

The tables below show how three different types of error are propagated through difference tables. In each case the column T shows the error, which would be superimposed on the sequence of measurements; the column Δ^1 shows the first differences, obtained by subtracting each value from the following one; similarly Δ^2 shows the second differences, obtained by successive subtractions of the first differences; and so on.

SPIKE					STEP OR LEVEL SHIFT					NOISE				
T	Δ^1	Δ^2	Δ^3	Δ^4	T	Δ^1	Δ^2	Δ^3	Δ^4	T	Δ^1	Δ^2	Δ^3	Δ^4
o		o		S	o		o		L	o		2e		-8e
	o		S			o		L			e		-4e	
o		S		-4S	o		L		-3L	e		-2e		8e
	S		-3S			L		-2L			-e		4e	
S		-2S		6S	L		-L		3L	o		2e		-8e
	-S		3S			o		L			e		-4e	
o		S		-4S	L		o		-L	e		-2e		8e
	o		-S			o		o			-e		4e	
o		o		S	L		o		o	o		2e		-8e

The spike produces a characteristic fourth difference peak, flanked by a pair of lows. In contrast, the level shift forms a fourth difference high-low pair. The noise envelope of e on the original data is amplified to an envelope of 16e on the fourth difference. This amplification is of prime importance for measuring noise or for automatic error correction in aeromagnetic measurements. The original data consists of signal and noise. The noise is often obscured by a regional slope, which is completely removed by taking second differences. However, a sharp anomaly can have appreciable second differences. By going to fourth differences, the signal is almost completely destroyed, and only the noise and bad values remain.

Figure 1 and 2 show sample analog records from a high-resolution aeromagnetic survey, our first one to show both the total intensity and fourth difference traces in the aircraft. The measurements were made at 0.5 second intervals with a cesium-vapor magnetometer in a bird. The effect of turbulent air on the noise envelope is obvious on the fourth difference trace. This trace allows, for the first time, an immediate check of noise in the field, an important feature for quality control of the survey data. The magnetometer operator can decide to terminate a flight because noise has become too large.

The fourth difference values can also be used for automatic correction of simple errors in the data. To recognise the errors, we first set a threshold based on the general noise envelope, wishing to treat only those which exceed this threshold. For instance we have used a threshold of 0.40 gammas on the fourth difference for high-resolution aeromagnetic surveys, where measurements are made in units of 0.01 gammas. This threshold would detect spikes exceeding 0.40/6 or 0.07 gammas in the total intensity measurements, and level shifts exceeding 0.40/3 or 0.13 gammas.

The next step is one of pattern recognition, to try and determine the cause of a particular error. It is easy to examine the fourth difference patterns produced by various errors by a simple process of addition, as shown below:

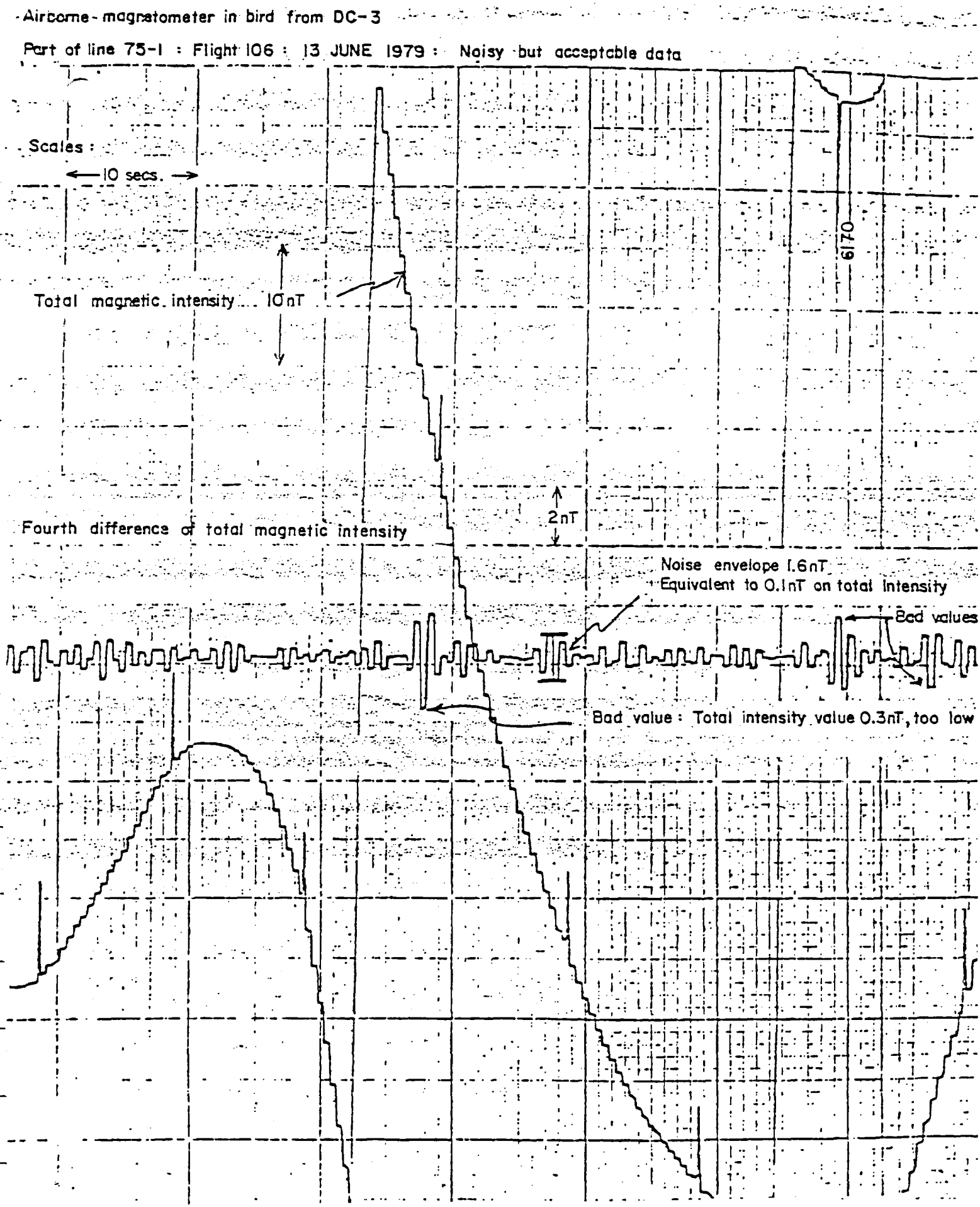

Aircorne - magnetometer in bird from DC-3
Part of line 75-1 : Flight 106 : 13 JUNE 1979 : Noisy but acceptable data
Scales :
10 secs.
6170
Total magnetic intensity ... 10nT
2nT
Fourth difference of total magnetic intensity
Noise envelope 1.6nT
Equivalent to 0.1nT on total intensity
Bad values
Bad value : Total intensity value 0.3nT, too low

Figure 1

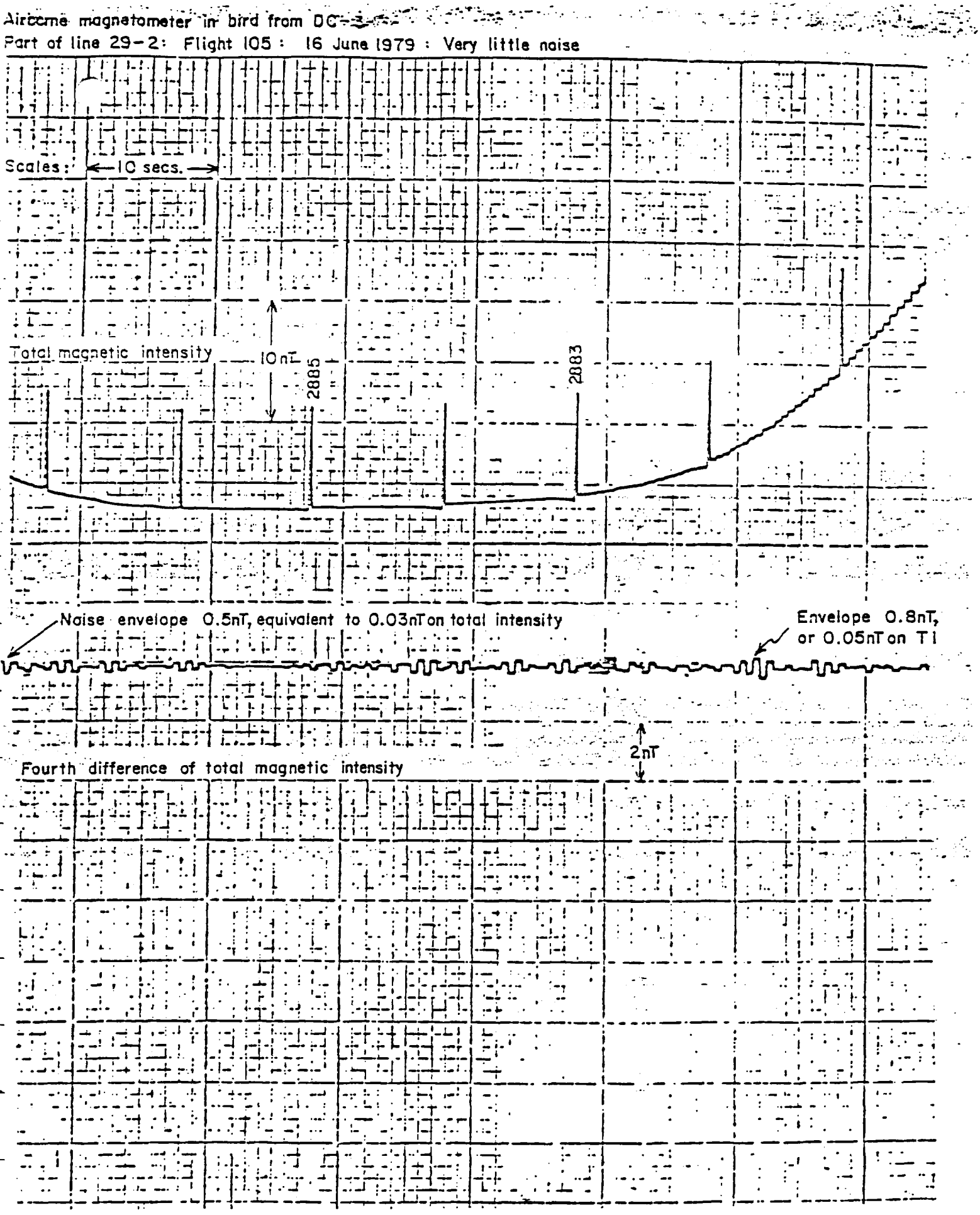
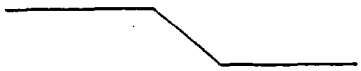

Airborne magnetometer in bird from DC-3
Part of line 29-2: Flight 105 : 16 June 1979 : Very little noise
Scales: ← 10 secs. →
Total magnetic intensity
10nT
2885
2883
Noise envelope 0.5nT, equivalent to 0.03nT on total intensity
Envelope 0.8nT, or 0.05nT on TI
2nT
Fourth difference of total magnetic intensity

Figure 2

	Unit Error	Fourth difference
1.		+1 -4 +6 -4 +1
2.		(+1 -4 +6 -4 +1) + (+1 -4 +6 -4 +1) = +1 -4 +7 -8 +7 -4 +1
3.		(+1 -4 +6 -4 +1) + (-1 +4 -6 +4 -1) = +1 -5 +10 -10 +5 -1
4.		-1 +3 -3 +1

To distinguish between these different cases, we have found it useful to work with the peak fourth difference value, the two adjacent values on either side, and the ratios between them. These ratios are sufficiently different first to distinguish the symmetrical errors (Cases 1 and 2) from the antisymmetrical errors (Cases 3 and 4). It is not always so easy to distinguish between Cases 1 and 2. Note that if Case 2 is treated as if it were Case 1, the effect would be to raise the central value instead of lowering the two false peaks. Fortunately this does not seem to be a frequent type of error. Similarly it can be difficult to distinguish between Cases 3 and 4. This is important, since level shifts do sometimes occur, and if improperly corrected, they will create false pulls in contour maps. However, if a level shift is sufficiently large, it may be recognised on the total intensity trace.

At the present time, we are taking a cautious attitude towards automatic corrections of the data, and correcting only the simple spike, Case 1. Other errors are simply flagged, on an error list, and listed as possible steps if they are antisymmetrical in form. Inspection is needed before other corrections are made.

Figure 3 shows an example of the automatic correction. The four traces show the total intensity and fourth differences, before and after correction. Three noise spikes are obvious on the fourth difference. These are believed to be caused by interference from a radar system on the ground.

Figure 4 is a machine plot of actual data, which includes an error looking like a level shift of about 0.5 gammas on the total magnetic intensity peak. The table below lists the raw total field and fourth difference values, all in units of 0.01 gammas. The large fourth difference values could not be fitted by a level shift, but implied an unequal high-low pair. The corrections noted on the total field easily reduced the fourth differences to small values.

TOTAL FIELD		FOURTH DIFFERENCE		
Raw	Correction	Raw	Correction	Corrected
5509075		20		20
5509103		-7	12	5
5509119		50	-73	-23
5509127	+12	-172	172	0
5509181	-25	197	-198	-1
5509163		-112	112	0
5509152		30	-25	5
5509115		-3		-3
5509049		17		17
5509948		23		23

The purpose of correcting the data is to remove errors, and so reduce the noise envelope, before doing any linear processing, such as smoothing or filtering. Use of fourth differences allows a significant reduction in the basic noise envelope.

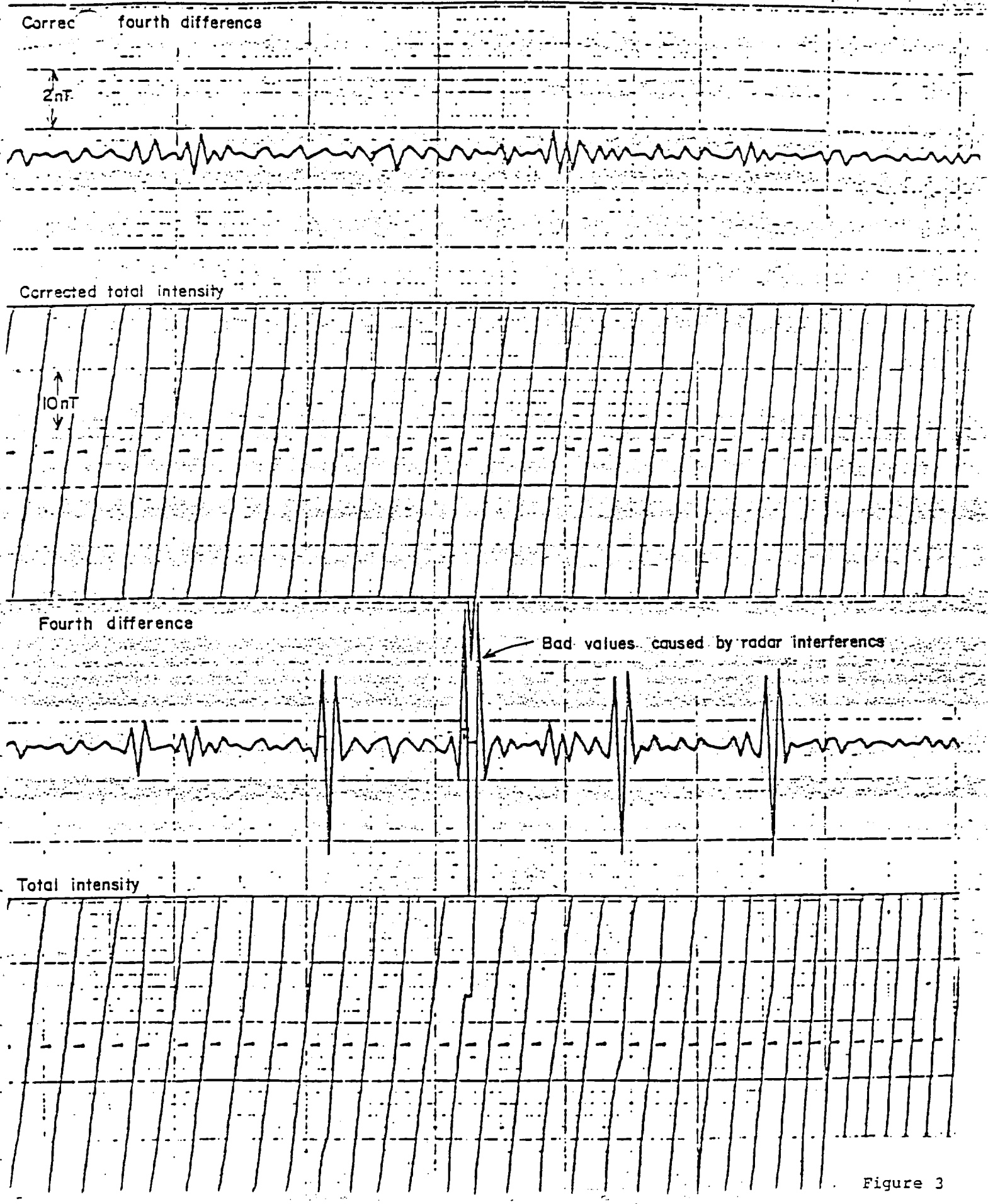

Automatic correction of bad magnetic values
Correc fourth difference
2nT
Corrected total intensity
10nT
Fourth difference
Bad values caused by radar interference
Total intensity

Figure 3

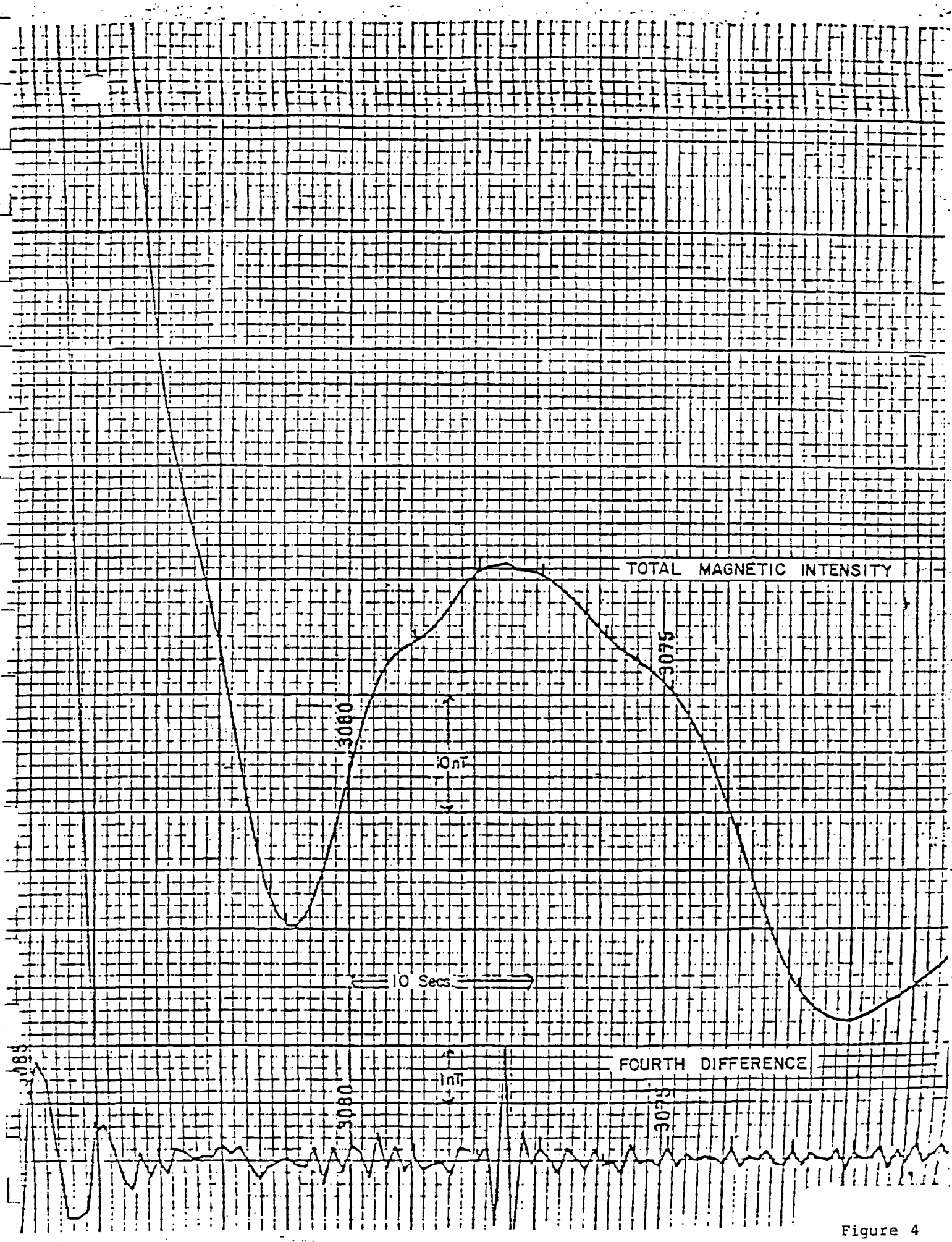

TOTAL MAGNETIC INTENSITY
3080
3075
0nT
10 Secs
FOURTH DIFFERENCE
1nT
3080
3075

Figure 4

REFERENCES

HOOD, P.J., HOLROYD, M.T., AND McGRATH, P.H., 1979, Magnetic methods applied to base metal exploration: in Geophysics and geochemistry in the search for metallic ores, P/J. Hood editor, Geol. Surv. Can. Econ. Geol. Report 31, p.77-104.

SCARBOROUGH, J.B., 1950, Numerical mathematical analysis, 2nd ed. Johns Hopkins Press, Baltimore.

APPENDIX B

TRIANGULAR FILTERS FOR SMOOTHING AEROMAGNETIC PROFILES

Triangular smoothing operators have been found very effective in removing noise from aeromagnetic profiles. By using a cutoff threshold, it is possible to treat profiles containing a mixture of broad and narrow anomalies, without seriously damaging the latter.

Coefficients

The operator coefficients are as follows:

2n-1 points: $1/n^2$ $2/n^2$ .....n/n^2 .....$2/n^2$ $1/n^2$
e.g. 3 points, n=2, 1/4 1/2 1/4
5 points, n=3, 1/9 2/9 3/9 2/9 1/9

The operator removes noise with peak-to-peak wavelength equal to n.

Cutoff Threshold

An amplitude threshold, C, limits the effect of the filter by specifying that none of the original values may be changed by an amount greater than C. In order to avoid introducing discontinuities, this threshold is applied progressivey for changes smaller than C. The threshold is normally set to equal twice the average noise.

Example

Figures 1 to 4 show the results of a test perfromed on low sensitivity aeromagnetic data of good quality. The raw magnetic trace shows,

- a regular noise whose period does not exceed 3 measurement intervals with an amplitude rarely exceeding +/- 1 gamma.

- narrow anomalies created by a surficial or near-surface marker (1 measurement interval equal 50m on the ground). Their widths range between 8 and 24 measurement intervals. Their amplitudes range from 5 to 15 gammas.

- a broad, almost regional anomaly.

As the noise is very regular in amplitude and probably of instrumental origin, a triangular filter was used. Tests were run with n=2, 3 and 4. Initially the amplitude threshold was not used (see Figures 1 and 2).

This test shows that the noise has been removed everywhere for n=4 and that its amplitude rarey exceeds +/- 1 gamma. The "n=4" triangular filter, however, badly damaged the anomaly located at 5668 whose amplitude is reduced by half.

In a second stage, the amplitude threshold was set to 2 gammas and the test rerun. Figures 3 and 4 show that all the noise has been removed and that the sharpness of anomaly 5668 has been kept.

Figure 1

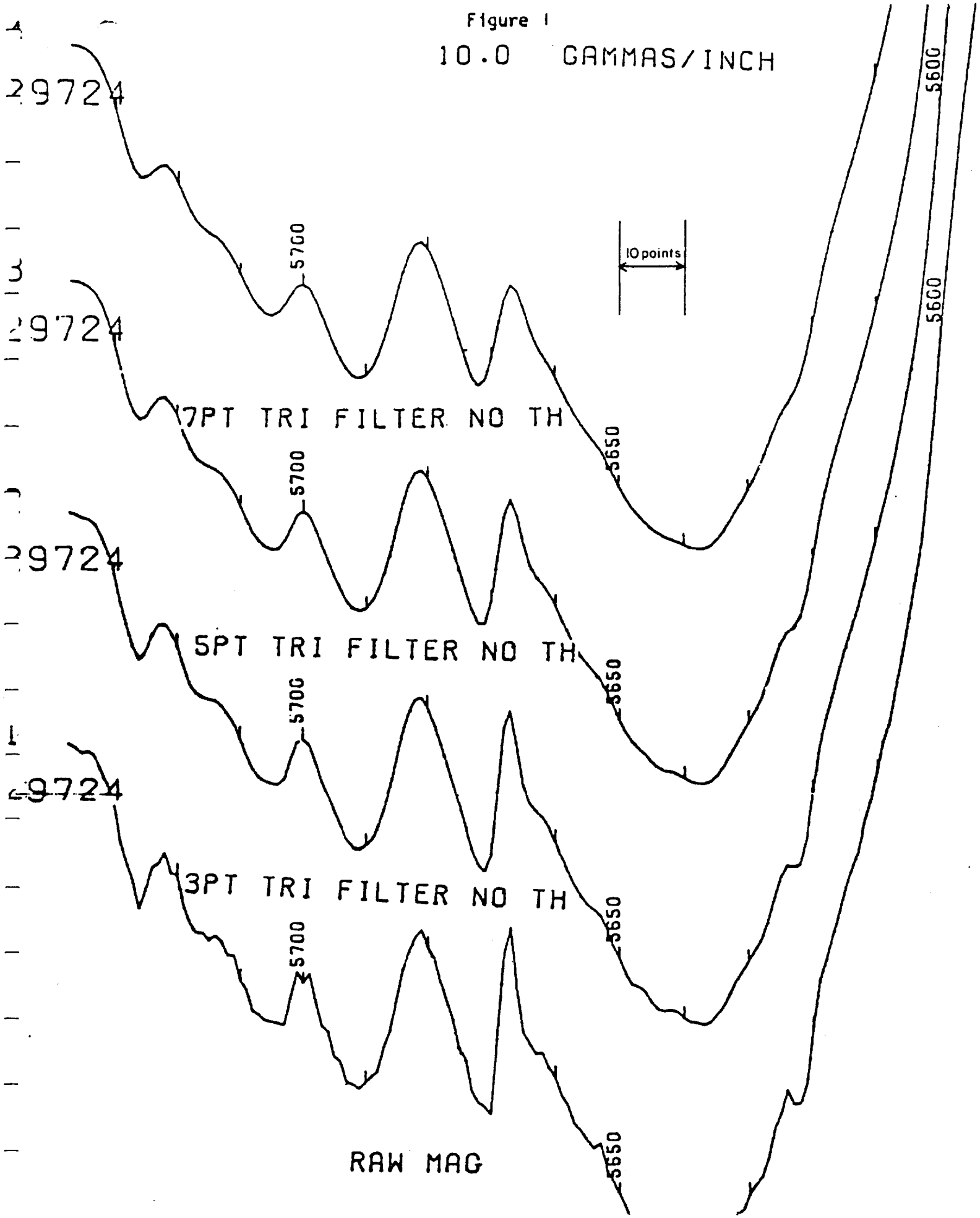

10.0 GAMMAS/INCH
29724
29724
29724
29724
10 points
7PT TRI FILTER NO TH
5PT TRI FILTER NO TH
3PT TRI FILTER NO TH
RAW MAG
5700
5650
5600

Figure 2

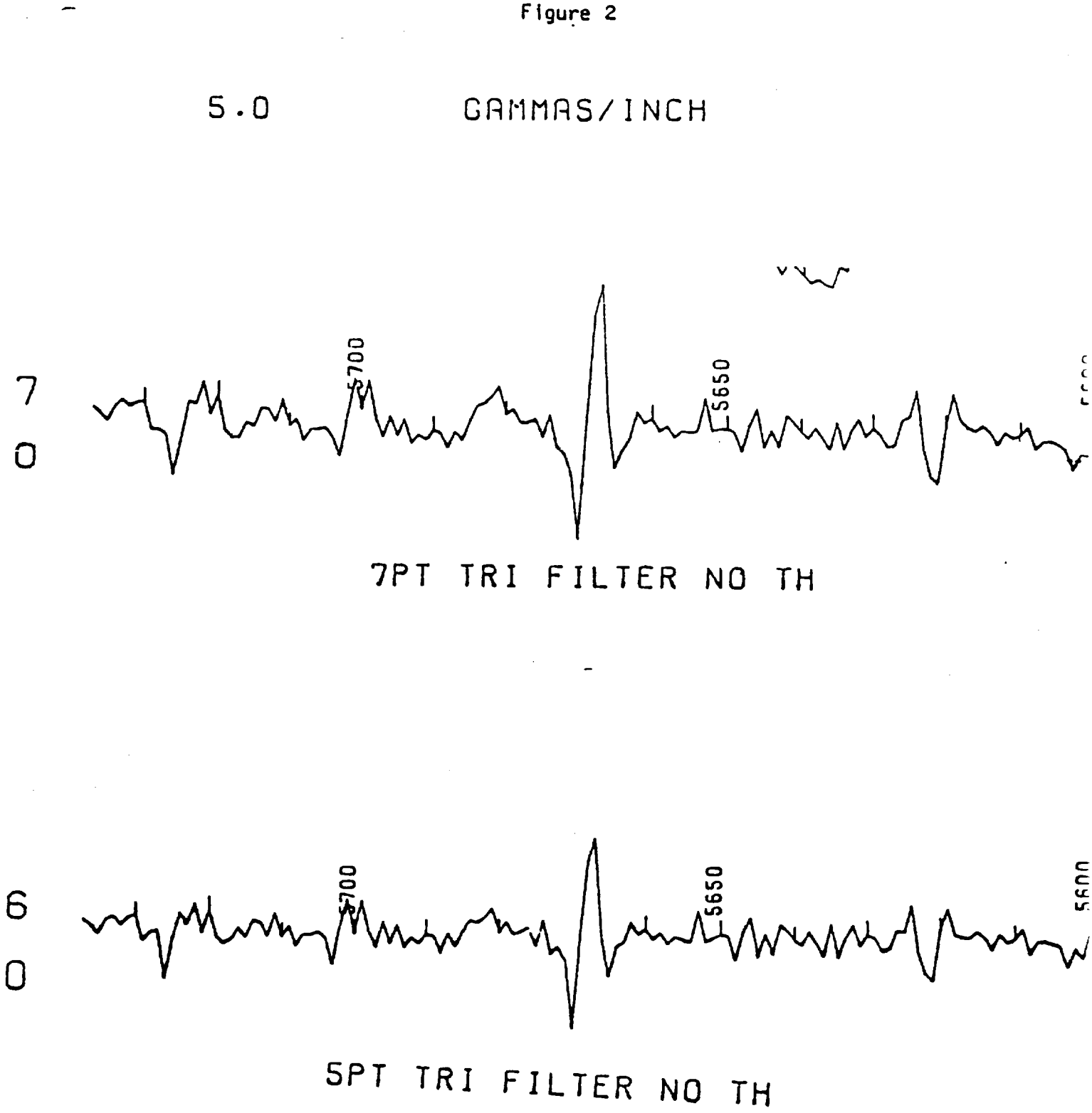

5.0
GAMMAS/INCH
7
0
5700
5650
7PT TRI FILTER NO TH
6
0
5700
5650
5600
5PT TRI FILTER NO TH

Figure 3

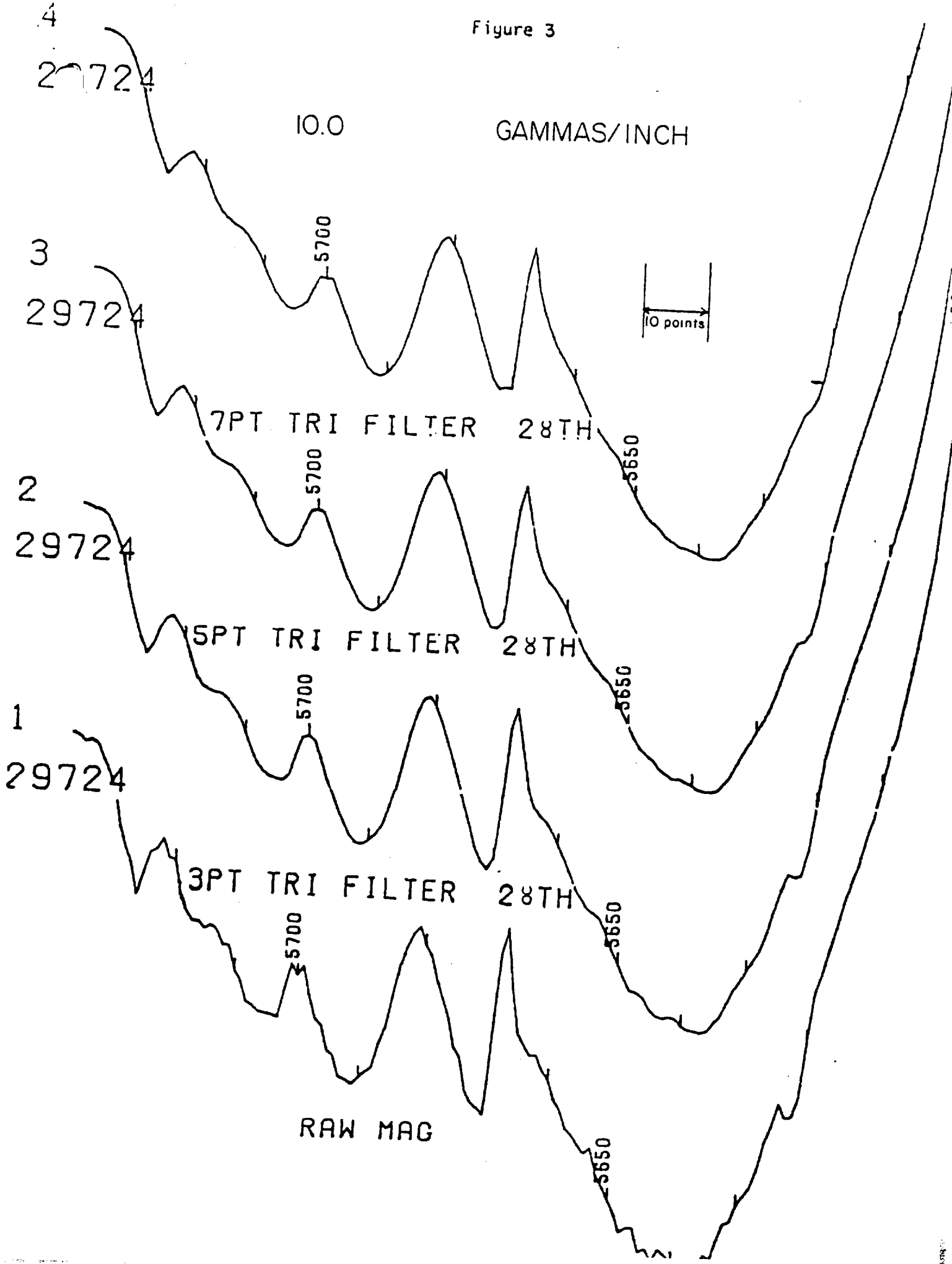
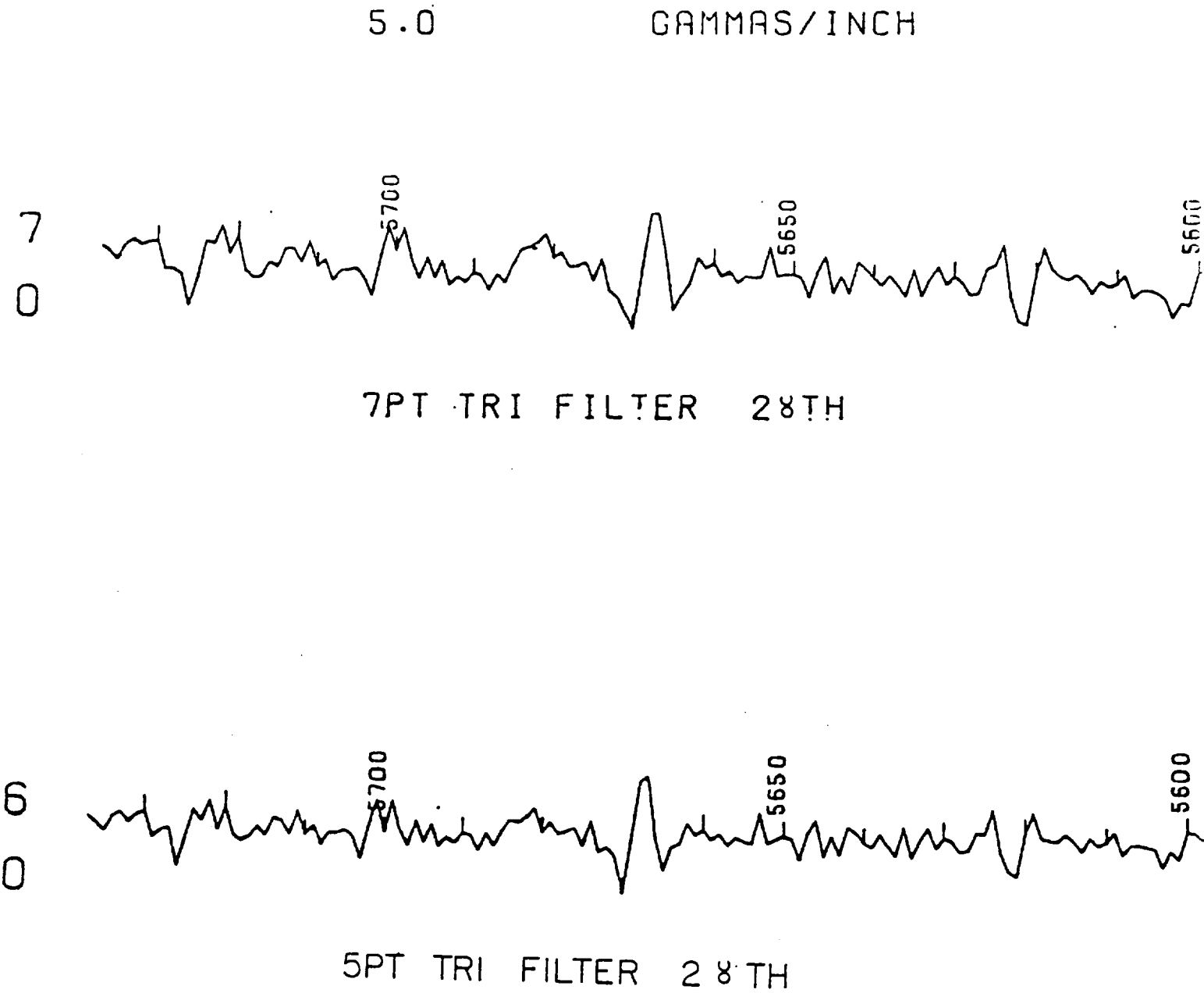

4
29724
10.0 GAMMAS/INCH
5700
3
29724
10 points
7PT TRI FILTER 28TH
5650
5700
2
29724
5PT TRI FILTER 28TH
5650
5700
1
29724
3PT TRI FILTER 28TH
5650
5700
RAW MAG
5650

Figure 4


5.0 GAMMAS/INCH
7
0
5700
5650
5600
7PT TRI FILTER 28TH
6
0
5700
5650
5600
5PT TRI FILTER 28TH

APPENDIX C

DIGITAL ARCHIVE DESCRIPTION

Tape Number	:	R27601
Area	:	Kapuskasing Ontario
Archive Date	:	December 1986
Recording Density	:	9 Track, 1600 BPI
Recording Mode	:	EBCDIC (no labels)
Encoding Format	:	(18 I 8)
Logical Record Length	:	144 Bytes (fixed)
Physical Blocksize	:	9216 Bytes (fixed)

Each physical block consists of 64 logical records of digital archived data. The composition of a single logical record is described below:

Logical Record Contents

Parameter	Characters	Contents
1	1 - 8	Line number x 100 + Part number
2	9 - 16	Fiducial
3	17 - 24	Time (1/4 seconds after midnight)
4	25 - 32	Ground (gammas X 100)
5	32 - 40	Easting (utm metres)
6	41 - 48	Northing (utm metres)
7	49 - 56	Radar Altimeter (-feet)
8	57 - 64	Barometric Altimeter (2ft./units)
9	65 - 72	Edited magnetics (gammas X 100)
10	73 - 80	Final magnetics (gammas X 100)
11	81 - 88	Raw VLF MAINE TF (1/10 %)
12	89 - 96	Raw VLF MAINE QUAD. (1/10 %)
13	97 - 104	Raw VLF WASH. TF (1/10 %)
14	105 - 112	Raw VLF WASH. QUAD. (1/10 %)
15	113 - 120	Final VLF MAINE TF (1/10 %)
16	121 - 128	Final VLF MAINE QUAD. (1/10 %)
17	129 - 136	Final VLF WASH. TF (1/10 %)
18	137 - 144	Final VLF WASH. QUAD. (1/10 %)

Notes:

1. Final magnetics consist of the magnetic value plus the compensation value, minus the I.G.R.F. plus a constant of 1000000.
   The levelled magnetics field will contain null values (-9999999) for portions of line ends which have no control (that is they go beyond the last intersection). Null data is to be ignored by the gridding algorithm.
   All other data fields will contain their regular values.
2. When the data for a line terminates in mid-block, the remainder of the block is zero filled.
3. Archived data terminates with a single end of file.

Projection	:	UTM
Spheroid	:	Clarke 1866
Central Meridian	:	81 degrees West
Scaling Factor	:	0.9996
False Easting	:	500000
False Northing	:	0

020

INTERPRETATION SUPPLEMENT TO THE LOGISTICS AND PROCESSING REPORT OF THE AIRBORNE VLF ELECTROMAGNETIC AND MAGNETIC SURVEY IN THE KAPUSKASING AREA, ONTARIO FOR HOMESTAKE CONSULTING

BY

GEOTERREX LIMITED

PROJECT NO. 276

FEBRUARY 1987

B. SCHACHT

Table of Contents

	Page
1. INTERPRETATION METHODS	1
1.1 General Magnetic Theory	1
1.2 Qualitative Interpretation	2
2. INTERPRETATION DISCUSSION	4
2.1 Magnetics	4
2.2 VLF Electromagnetics	5

1. INTERPRETATION METHODS

1.1 General Magnetic Theory

The earth's magnetic field, which changes from about 60,000 nT in a vertical direction at the poles to about 30,000 nT in a horizontal direction at the equator, induces a secondary magnetic field in rock bodies containing ferromagnetic minerals. It is this property to become magnetized by an external field which is described as the susceptibility of a rock.

Some rocks contain a natural or thermoremanent magnetization which was acquired when the rock was last heated above the Curie point and subsequently cooled. The direction of this remanent magnetization is parallel to the magnetic field which prevailed during the cooling period. These fields, both the induced and remanent, disturb the otherwise smooth magnetic pattern of the earth's field, and it is these perturbations that are of prime interest in aeromagnetic interpretation.

The crystalline rocks of igneous or high grade metamorphic origin, such as granite, basalt, gneiss and schist, usually contain sufficient quantities of ferromagnetic minerals (mainly magnetite) that their influence on the earth's field can be observed even when covered by sedimentary sections thousands of feet thick.

The magnetic pattern over large areas of a single rock type is generally consistent throughout, and whenever the magnetic character changes, it usually imples a change in the rock composition. For example, the contact between a granitic mass and an ultrabasic unit can usually be precisely positioned where the magnetic pattern begins to change from the usual quiet character of a granite to the more distrubed pattern of an

ultrabasic rock body.

The study of magnetic anomalies does, to some degree, depend upon the latitude; in high latitudes, attention is devoted to positive anomalies, while at the equator, negative anomalies are of prime interest. This is due to the inclination of the earth's magnetic field, which is near vertical, 90 degrees, at the pole, horizontal, 0 degrees, at the equator, and about 78 degrees N in this survey area. The sets of curves on Figure 1 show how the theoretical magnetic anomaly depends on the inclination of the earth's magnetic field. The curves are based on a thin sheet-type body uniformly magnetized by induction. The interpretation of these anomalies can be done both qualitatively and quantitatively with certain assumptions.

1.2 Qualitative Interpretation

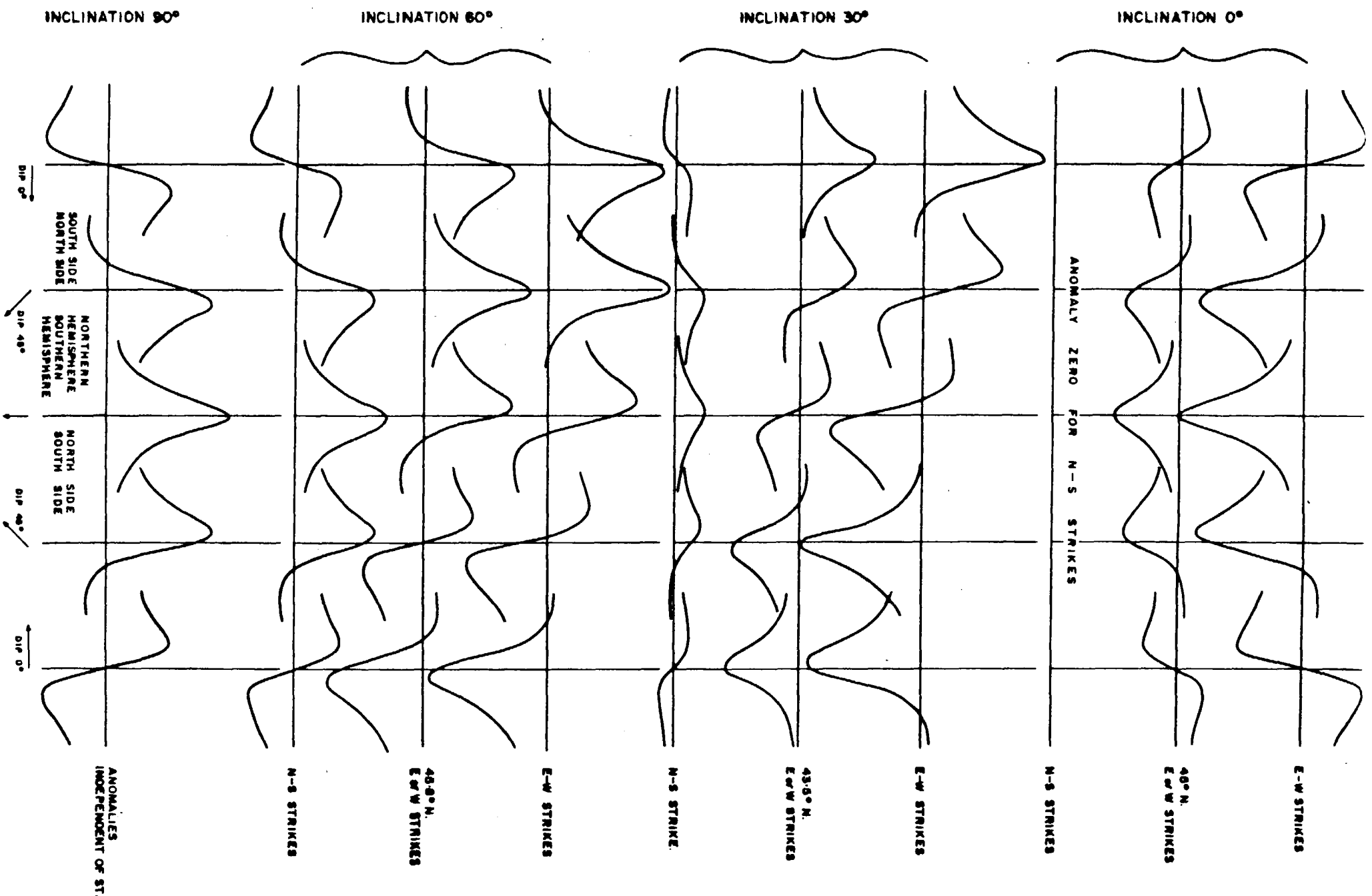
In the qualitative interpretation, magnetic features on the total field and vertical gradient contour maps are studied with regard to shape, size, strike, and density.

Magnetic axes were drawn at the point of maximum curvature of all positive anomalies. Axes were omitted where it was decided that anomalies represented end effect (i.e. flight line doesn't directly overfly magnetic source), or interference of neighbouring sources.

All anomalies which are adequately defined sport a magnetic contact which outlines their probable source. The outlines of lithologic units may be indicated as lithological boundaries or faults. Magnetically, it is difficult to distinguish the two unless a fault has obvious strike slip. Generally we use faults for linear boundaries, particularly when joining isolated areas of magnetic disruptions. Lithological boundaries

FIGURE 1

TOTAL FIELD MAGNETIC ANOMALIES CAUSED BY A THIN SHEET



are used primarily for zones of circular or convoluted outline. They usually follow a continuous magnetic gradient and are thus more objective than the faults.

2. INTERPRETATION DISCUSSION

2.1 Magnetics

The interpretation map was made as self-explanatory as possible and this discussion will simply expand on those features which could not be adequately described with a map alone.

The numbers appearing on the interpretation map were taken from the legend of the Ontario Geological Survey's map of the Precambrian geology of Caithness, and parts of Scholfield, Pelletier and Doherty townships, number P.2961, scale 1:31,680. As outcrop of the same rock units often appeared within areas of high magnetic activity as well as magnetically inactive areas, we have added a plus sign to those lithology numbers lying in the active zones. The increase in magnetite (or pyrrhotite) necessary to change the overall magnetic character of a rock is usually accompanied by other significant mineralogical changes. As the geological outcrop was limited, these numbers should be considered very tentative. Furthermore, some lithologies on this map were magnetically invisible (eg. unit 2, the felsic metavolcanics) and thus, two or more numbers may appear without any magnetic/geologic contact or fault separating them.

All narrow linear anomalies striking north-northwest were mapped as dykes plus some north to northeast anomalies. The magnetic effect of these dykes dominates the total field contour map, making definition of the country rock units rather speculative.

The dykes at D_1 in the northeast corner of sheet 1 are problematic as they blend smoothly into east-west trending units of mafic metavolcanics, which outcrop at this point. However, the continuation of the two "dyke" anomalies southeast across the

survey makes a diabase lithology most likely. The left lateral offset of this dyke pair at D_1 suggests that one of the contacts of the east-west la^+ units is a strike slip fault. D_2 and D_3, near the centres of sheets 1 and 2 respectively are also sites of possible confusion between dyke and l^+ units.

The arcuate l^+ body, B_1 on the east edge of sheet 1, suggests a plunging fold axis. Mapping shows a northern dip on both limbs of this possible fold, suggesting an isoclinal overfold. Another roughly arcuate l^+ body, directly north of this at B_2, could be the synclinal (or anticlinal) counterpart of the structure at B_1. However, the geology infers an intrusive contact at this point which would also explain the arcuate magnetic anomaly.

2.2 VLF Electromagnetics

The map symbol for a good conductor was used when a total VLF field high coincided with a crossover on the quadrature, going from a negative to a positive in the flight direction. All other configurations on total field or quadrature, which correlated across adjacent flight lines, were shown as poor conductors. Data from the two stations agreed almost without exception, although the Maine data was generally better in amplitude and definition.

The greatly predominant trend of the conductors is the north northwest direction of the diabase dykes with a few conductors reflecting the northeast strike of the Archean host rock. Despite this apparent bedrock control of conductors, there are few precise correlations of magnetic and conductive sources: A pair of conductors at C_1, on sheet 2 follows two well defined magnetic highs. Conductor C_2, to the south, runs parallel and just off the edge of a powerful magnetic source. Several of the north northwest trending

conductors coincide with magnetic axes/dykes while others run parallel but between the dykes. This suggests the presence of conductive but non-magnetic dykes or a series of faults parallel to the NNW striking dykes. Alternatively, this could simply mean that these dykes control weathering or the deposition of conductive overburden in this area.

A small group of conductors in the southeast corner of sheet one strikes northwest across the dykes. These conductors may reflect structure within the non-magnetic host rock in this area, or minor glacial features not shown on the topographic map.

Some coincidence of conductors with streams and roads was found and noted on the map; however it was not more than would be expected from mere chance.

A noteable correlation occurs between possible fault F_1, on sheet 2, and a discontinuous chain of conductors. A similarly northwest striking pair of conductors, in the northeast corner of sheet 2, inspired the location of fault F_2 on a rather nebulous magnetic disruption. This conductivity along a fault may be due to mineralization, but it is usually the result of graphite and/or clay.

We trust this interpretation will assist your exploration program and we remain at your service for any questions or comments regarding this survey.

Respectfully Yours,

Brian Schacht

Brian Schacht

GEOCHEMICAL SURVEY – PROCEDURE RECORD

Numbers of claims from which samples taken _____

Total Number of Samples _____
Type of Sample _____ (Nature of Material)
Average Sample Weight _____
Method of Collection _____

Soil Horizon Sampled _____
Horizon Development _____
Sample Depth _____
Terrain _____

Drainage Development _____
Estimated Range of Overburden Thickness _____

SAMPLE PREPARATION
(Includes drying, screening, crushing, ashing)

Mesh size of fraction used for analysis _____

General _____

ANALYTICAL METHODS

Values expressed in: per cent ☐ p. p. m. ☐ p. p. b. ☐

Cu, Pb, Zn, Ni, Co, Ag, Mo, As,-(circle)

Others _____
Field Analysis (_____ tests)
Extraction Method _____
Analytical Method _____
Reagents Used _____
Field Laboratory Analysis
No. (_____ tests)
Extraction Method _____
Analytical Method _____
Reagents Used _____

Commercial Laboratory (_____ tests)
Name of Laboratory _____
Extraction Method _____
Analytical Method _____
Reagents Used _____

General _____

Ontario

Ministry of Natural Resources

File 2.9705

GEOPHYSICAL – GEOLOGICAL – GEOCHEMICAL TECHNICAL DATA STATEMENT

TO BE ATTACHED AS AN APPENDIX TO TECHNICAL REPORT
FACTS SHOWN HERE NEED NOT BE REPEATED IN REPORT
TECHNICAL REPORT MUST CONTAIN INTERPRETATION, CONCLUSIONS ETC.

Type of Survey(s) AIRBORNE VLF & MAGNETIC
Township or Area Pelletier, CAITHNESS, DOHERTY TWP.
Claim Holder(s) LARY SALO, BRUCE MORTSON, HERVÉ ST. LOUIS
RENE LENERT, W. WEISFLUCK, R. CADA, N. BOA, W. CADA
M. RANGER, R. LAMONTE
Survey Company GEOTERREX LIMITED
Author of Report B. SCHACHT
Address of Author 2060 WALKLEY RD. ~~OTTAWA, ONTARIO K1G 3P5~~
Covering Dates of Survey Oct. 6 to 17, 1986 (linecutting to office)
Total Miles of ~~Line Cut~~ Flying 1856 Kms.

SPECIAL PROVISIONS CREDITS REQUESTED

ENTER 40 days (includes line cutting) for first survey.

ENTER 20 days for each additional survey using same grid.

DAYS per claim

Geophysical
–Electromagnetic _____
–Magnetometer _____
–Radiometric _____
–Other _____
Geological _____
Geochemical _____

AIRBORNE CREDITS (Special provision credits do not apply to airborne surveys)

Magnetometer 40 Electromagnetic 40 Radiometric _____ (enter days per claim)

DATE: Jan. 16/87 SIGNATURE: C.E. Page
Author of Report or Agent

Res. Geol. _____ Qualifications _____

Previous Surveys

File No.	Type	Date	Claim Holder

OFFICE USE ONLY

837 (5/79)

MINING CLAIMS TRAVERSED
List numerically

(prefix)	(number)
P	860487
	860577
	860578
	860579
	860580
	860581
	860582
	860583
	860584
	860585
	860586
	860587
	860588
	860589
	860590
	860591
	860592
	860593
	860594
	860595
	860596
	860597

TOTAL CLAIMS 971

If space insufficient, attach list

GEOPHYSICAL TECHNICAL DATA

GROUND SURVEYS – If more than one survey, specify data for each type of survey

Number of Stations _____ Number of Readings _____

Station interval _____ Line spacing _____

Profile scale _____

Contour interval _____

MAGNETIC

Instrument _____

Accuracy – Scale constant _____

Diurnal correction method _____

Base Station check-in interval (hours) _____

Base Station location and value _____

_____

ELECTROMAGNETIC

Instrument _____

Coil configuration _____

Coil separation _____

Accuracy _____

Method: ☐ Fixed transmitter ☐ Shoot back ☐ In line ☐ Parallel line

Frequency _____
(specify V.L.F. station)

Parameters measured _____

GRAVITY

Instrument _____

Scale constant _____

Corrections made _____

_____

Base station value and location _____

_____

Elevation accuracy _____

INDUCED POLARIZATION RESISTIVITY

Instrument _____

Method ☐ Time Domain ☐ Frequency Domain

Parameters – On time _____ Frequency _____

– Off time _____ Range _____

– Delay time _____

– Integration time _____

Power _____

Electrode array _____

Electrode spacing _____

Type of electrode _____

SELF POTENTIAL

Instrument _____ Range _____

Survey Method _____

_____

Corrections made _____

_____

RADIOMETRIC

Instrument _____

Values measured _____

Energy windows (levels) _____

Height of instrument _____ Background Count _____

Size of detector _____

Overburden _____
(type, depth – include outcrop map)

OTHERS (SEISMIC, DRILL WELL LOGGING ETC.)

Type of survey _____

Instrument _____

Accuracy _____

Parameters measured _____

_____

Additional information (for understanding results) _____

_____

_____

AIRBORNE SURVEYS

Type of survey(s) ① VLF ELECTROMAGNETIC, ② MAGNETOMETER

Instrument(s) ① TOTEM 2A ② CESIUM VAPOUR
(specify for each type of survey)

Accuracy ① 5% ② 2/10 gamma
(specify for each type of survey)

Aircraft used NAVAHO - FIXED WING

Sensor altitude 80 meters

Navigation and flight path recovery method VISUAL with Doppler

Airphoto mosaics @ 1:10,000

Aircraft altitude 80 meters Line Spacing 10

Miles flown over total area _____ Over claims only 1856

PELLETIER TWP. (278)

860598
860599
860600
876401
876402
876403
876404
876405
876406
876407
876408
876409
876410
876411
876412
876413
876414
876415
876416
876417
876418
876419
876420
876421
876422
876423
876424
880601
880602
880603
880604
880605
880606
880607
880608
880609
880610
880611
880612
880613
880614
880615
906587
906588
906589
906590
906594
906595
906596
906597

880751
880752
880753
880754
880755
880756
880757
880758
880759
880760
880761
880762
880763
880764
880765
880766
880767
880768
880769
880770
880771
880772
880773
880774
880775
880776
880777
880778
880779
880780
880781
880782
880783
880784
880785
880786
880787
880788
880789
880790
880791
880792
880793
880794
880795
880796
880797
880798

880651
880652
880653
880654
880655
880656
880657
880658
880659
880660
880661
880662
880663
880664
880665
880666
880667
880668
880669
880670
880671
880672
880673
880674
880675
880676
880677
880678
880679
880680
880681
880682
880683
880684
880685
880686
880687
880688
880689
880690
880691
880692
880693

860661
860662
860663
860664
860665
860666
860667
860668
860669
860670
860671
860672
860673
860674
860675
860676
860677
860678
860679
860680
860681
860682
860683
860684
860685
860686
860687
860688
860689
860690
860691
860692
860693
860694
860695
860696
880701
880702
880703
880704
880705
880706
880707
880708
880709
880710
880711
880712
880713
880714
880715
880716

880717
880718
880719
880720
880721
880722
880723
880724
880725
880726
880727
880728
880729
880730
880731
880732
880733
880734
880735
880736
880737
880738
880739
880740
880741
880742
880743
880744
880745
880746

889401
889402
889403
889404
889405
889406
889407
889408
889409
889410
889411
889412
889413
889414
889415
889416
889417
889418
889419
889420
889421
889422
889423
889424
889425
889426
889427
889428
889429
889430
889431
889432
889433

CAITHNESS TWP (257)

899858
899859
899860
899861
899862
899863
899864
899865
899866
899867
899869
899870
899871
899872
899873
899874
899875
899876
899877
899878
899879
899880
899881
899882
899883
899884
899885
899886
899887
899888
899889
899890
899891
899892
899893
899894
899895
899896
899897
899898
899899
899900
899901
899902
899903
906151
906152
906153
906154
906155
906156
906157
906158
906159
906160
906161
906162
906163
906164
906165
906166
906167
906168
906169
906170
906171
906172
906173
906174
906175
906176
906177
906178
906179
906180
900901
900902
900903
900904
900905
900906
900907
900908
900909
900910
900911
900912
900913
900914
900915
900916
900917
900918
900919
900920
900921
900922
900923
900924
900925
900926
900927
900928
900929
900930
900931
900932
900933
900934
900935
900936
900937
900938
900939
900940
900941
900942
900943
900944
900945
900946
900947
900948
901001
901002
901003
901004
901005
901006
901007
901008
901009
901010
901011
901012
901013
901014
901015
901016
901017
901018
901019
901020
901021
901022
901023
901024
901025
901026
901027
901028
901029
901030
901031
901032
901033
901034
901035
901036
901037
901038
901039
901040
901041
901042
901043
901044
901045
901046
901047
901048
905043
905044
905045
905046
905047
905048
905049
905050
905051
905052
905053
905054
905055
905056
905057
905058
905059
905060
905061
905062
905063
905064
905065
905066
905067
905068
905069
905070
905071
905072
905073
905074
905075
905076
905077
905078
905079
905080
905081
905082
905083
905084
905085
905086
905087
905088

DOHERTY TWP. (436)

876801
876802
876803
876804
876805
876806
876807
876808
876809
876810
876811
876812
876813
876814
876815
876816
876817
876818
876819
876820
876821
876822
876823
876824
876825
876826
876827
876828
876829
876830
876831
876832
876833
876834
876835
876836
876837
876838
876839
876840
876841
876842
876843
876844
876845
876846
876847
876848

921501
921502
921503
921504
921505
921506
921507
921508
921509
921510
921511
921512
921513
921514
921515
921516
921517
921518
921519
921520
921521
921522
921523
921524
921525
921526
921527

921528
921529
921530
921531
921532
921533
921534
921535
921536
921537
921538
921539
921540
921541
921542
921543
921544
921545
921546
921547
921548
921549
921550
921551
921552

860601
860602
860603
860604
860605
860606
860607
860608
860609
860610
860611
860612
860613
860614
860615
860616
860617
860618
860619
860620
860621
860622
860623
860624
860625
860626
860627

860628
860629
860630
860631
860632
860633
860634
860635
860636
860637
860638
860639
860640
860641
860642
860643
860644
860645
860646
860647
860648
860649
860650
860651
860652
860653
860654
860655

860656
860657
860658
860659
860660

876701
876702
876703
876704
876705
876706
876707
876708
876709
876710
876711
876712
876713
876714
876715
876716
876717
876718
876719

876720
876721
876722
876723
876724
876725
876726
876727
876728
876729
876730
876731
876732
876733
876734
876735
876736
876737
876738
876739
876740

876741
876742
876743
876744
876745
876746
876747
876748
876749
876750
876751
876752
876753
876754
876755
876756
876757
876758
876759
876760
876761
876762
876763
876764
876765
876766
876767
876768
876769
876770
876771
876772
876773

876774
876775
876776
876777
876778
876779
876780
876781
876782
876783
876784
876785
876786
876787
876788
876789
876790
876791
876792
876793
876794
876795
876796

921401
921402
921403
921404
921405
921406
921407
921408
921409
921410
921411
921412
921413
921414
921415
921416
921417
921418
921419

921420
921421
921422
921423
921424
921425
921426
921427
921428
921429
921430
921431
921432
921433
921434
921435
921436
921437
921438
921439
921440
921441
921442
921443
921444
921445
921446
921447
921448
921449
921450
921451
921452
921453
921454
921455
921456

921457	889434	860543
921458	889435	860544
921459	889436	860545
921460	889437	860546
921461	889438	860547
921462	889439	860548
921463	889440	860549
921464	889441	860550
921465	889442	860551
921466	889443	860552
921467	889444	860553
921468	889445	860554
921469	889446	860555
921470	889447	860556
921471	889448	860557
921472	889449	860558
	889450	860559
921473	889451	860560
921474	889452	860561
921475	889453	860562
921476	889454	860563
921477	889455	860564
921478	889456	860565
921479	889457	860566
921480	889458	860567
921481	889459	860568
921482	889460	860569
921483	889461	860570
921484	889462	860571
921485	889463	860572
921486	889464	860573
921487	889465	860574
921488	889466	860575
921489	889467	860576
921490	889468	
921491	889469	
921492	889470	
921493	889471	
921494	889472	
921495	889473	
921496	889474	
921497	889475	
921498	889476	
	889477	
	889478	
	889479	
	889480	
	889481	

2.9705

Ministry of Natural Resources — Ontario

Report of Work
(Geophysical, Geological, Geochemical and Expenditures)

* 414/8

86-414

Mini

42G03NE0001 2.9705 CAITHNESS

900

Type of Survey(s): AIRBORNE MAGNETIC AND VLF-EM. | PELLETIER TWP.

Claim Holder(s): LARRY SALO,① BRUCE MORTSON②, HERVE ST. LOUIS③

Prospector's Licence No.: M20010①, K19157②, M20851③

Address: 800-111 RICHMOND ST. WEST. TORONTO. M5H-2G4

Survey Company: GEOTERREX LTD.

Date of Survey (from & to): 15 10 86 (Day Mo. Yr.) — 30 11 86 (Day Mo. Yr.)

Total Miles of line Cut: 1600 Line km.

Name and Address of Author (of Geo-Technical report): M.C. CARSON, 2660 WAKILEEY R.D. CITY, ONTARIO K1G-3P5

Credits Requested per Each Claim in Columns at right

Special Provisions		Days per Claim
For first survey: Enter 40 days. (This includes line cutting)	Geophysical	
	- Electromagnetic	
	- Magnetometer	
For each additional survey: using the same grid: Enter 20 days (for each)	- Radiometric	
	- Other	
	Geological	
	Geochemical	

Man Days		Days per Claim
Complete reverse side and enter total(s) here	Geophysical	
	- Electromagnetic	
	- Magnetometer	
	- Radiometric	
	- Other	
	Geological	
	Geochemical	

Airborne Credits		Days per Claim
Note: Special provisions credits do not apply to Airborne Surveys.	Electromagnetic	40
	Magnetometer	40
	Radiometric	

RECORDED DEC 12 1986

Expenditures (excludes power stripping)

Type of Work Performed

Performed on Claim(s)

Calculation of Expenditure Days Credits

Total Expenditures: $ DEC 12 1986 ÷ 15 = Total Days Credits

RECEIVED PORCUPINE MINING DIVISION DEC 12 1986

Instructions: Total Days Credits may be apportioned at the claim holder's choice. Enter number of days credits per claim selected in columns at right.

Date: Dec. 9/86 — Recorded Holder or Agent (Signature): C.E. Page

Mining Claims Traversed (List in numerical sequence)

Mining Claim Prefix	Number	Expend. Days Cr.
P.	860487	
	860577	
	860578	
	860579	
	860580	
	860581	
	860582	
	860583	
	860584	
	860585	
	860586	
	860587	
	860588	
	860589	
	860590	
	860591	
	860592	
	860593	
	860594	
	860595	
	860596	
	860597	
	860598	

Mining Claim Prefix	Number	Expend. Days Cr.
P.	860599	
	860600	
	876401	
	876402	
	876403	
	876404	
	876405	
	876406	
	876407	
	876408	
	876409	
	876410	
	876411	
	876412	
	876413	
	876414	
	876415	
	876416	
	876417	
	876418	
	876419	
	876420	
	876421	

Total number of mining claims covered by this report of work: 163

For Office Use Only

Total Days Cr. Recorded: 13,040 — Date Recorded: Dec. 12/86 — Mining Recorder: [signature]

Date Approved as Recorded: [illegible] — Branch Director: [signature]

Certification Verifying Report of Work

I hereby certify that I have a personal and intimate knowledge of the facts set forth in the Report of Work annexed hereto, having performed the work or witnessed same during and/or after its completion and the annexed report is true.

Name and Postal Address of Person Certifying: CHARLES E. PAGE, 800-111 RICHMOND ST. WEST, TORONTO ONTARIO M5H-2G4

Date Certified: Dec. 9/86 — Certified (Signature): C.E. Page

LARRY SALO M20010 (CONT'D) (72)

P. 876422
876423
876424
880601
880602
880603
880604
880605
880606
880607
880608
880609
880610
880611
880612
880613
880614
880615
906587
906588
906589
906590
906594
906595
906596
906597

BRUCE MORTSON (K19157) (43)

P. 880651
880652
880653
880654
880655
880656
880657
880658
880659
880660
880661
880662
880663
880664
880665
880666
880667
880668
880669
880670
880671
880672
880673
880674
880675
880676
880677
880678

P. 880679
880680
880681
880682
880683
880684
880685
880686
880687
880688
880689
880690
880691
880692
880693

HERVE ST. LOUIS (M21084) (43)

P. 880751
880752
880753
880754
880755
880756
880757
880758
880759
880760
880761
880762
880763
880764
880765
880766
880767
880768
880769
880770
880771
880772
880773
880774
880776
880778

P. 880779
880780
880781
880782
880783
880784
880785
880786
880787
880788
880789
880790
880791
880792
880793
880794
880795
880796
880797
880798

Ontario Ministry of Natural Resources

Report of Work
(Geophysical, Geological, Geochemical and Expenditures)

Mining Act

#418/86

2.9705

Instructions: – Please type or print.
– If number of mining claims traversed exceeds space on this form, attach a list.
Note: – Only days credits calculated in the "Expenditures" section may be entered in the "Expend. Days Cr." columns.
– Do not use shaded areas below.

Type of Survey(s): AIRBORNE MAGNETIC AND VLF-EM

Township or Area: CAIRNESS TWP

Claim Holder(s): ① ROBERT CADA, ② NOLAN BCA, ③ HERVE ST. LOUIS

Prospector's Licence No.: ① M23578 ② 479-57 ③ M21084

Address: 920-111 RICHMOND ST. WEST, TORONTO M5H-2G4

Survey Company: GEOTERREX LTD.

Date of Survey (from & to): 15 Day 10 Mo. 86 Yr. – 30 Day 11 Mo. 86 Yr.

Total Miles of line Cut: 1800 line kms.

Name and Address of Author (of Geo-Technical report): M.C. NIXON 2056 WALKLEY RD., OTTAWA, ONTARIO K1G-3P5

Credits Requested per Each Claim in Columns at right

Special Provisions		Days per Claim
For first survey: Enter 40 days. (This includes line cutting)	Geophysical	
	- Electromagnetic	
	- Magnetometer	
For each additional survey: using the same grid: Enter 20 days (for each)	- Radiometric	
	- Other	
	Geological	
	Geochemical	

Man Days		Days per Claim
Complete reverse side and enter total(s) here	Geophysical	
	- Electromagnetic	
	- Magnetometer	
	- Radiometric	
	- Other	
	Geological	
	Geochemical	

Airborne Credits		Days per Claim
Note: Special provisions credits do not apply to Airborne Surveys.	Electromagnetic	40
	Magnetometer	40
	Radiometric	

RECORDED DEC 12 1986

Expenditures (excludes power stripping)

Type of Work Performed

Performed on Claim(s)

Calculation of Expenditure Days Credits

Total Expenditures $ ÷ 15 = Total Days Credits

RECEIVED MINING LANDS DIVISION DEC 12 1986

Instructions: Total Days Credits may be apportioned at the claim holder's choice. Enter number of days credits per claim selected in columns at right.

Date: Dec 5/86

Recorded Holder or Agent (Signature)

Mining Claims Traversed (List in numerical sequence)

Mining Claim Prefix	Number	Expend. Days Cr.
P.	900959	
	900960	
	900961	
	900962	
	900963	
	900964	
	900965	
	900966	
	900967	
	900968	
	900969	
	900970	
	900971	
	900972	
	900973	
	900974	
	900975	
	900976	
	900977	
	900978	
	900979	
	900980	
	900981	

Mining Claim Prefix	Number	Expend. Days Cr.
P.	900982	
	900983	
	900984	
	900985	
	900986	
	900987	
	900988	
	900989	
	900990	
	900991	
	900992	
	900993	
	900994	
	900995	
	900996	
	900997	
	900998	
	899895	
	899899	
	899900	
	899901	
	899902	
	899863	

Total number of mining claims covered by this report of work: 163

For Office Use Only

Total Days Cr. Recorded: 13,040

Date Recorded: Dec. 12/86

Date Approved as Recorded: Dec 12/86

Mining Recorder: Stanley

Branch Director

Certification Verifying Report of Work

I hereby certify that I have a personal and intimate knowledge of the facts set forth in the Report of Work annexed hereto, having performed the work or witnessed same during and/or after its completion and the annexed report is true.

Name and Postal Address of Person Certifying

Date Certified: Dec 5/86

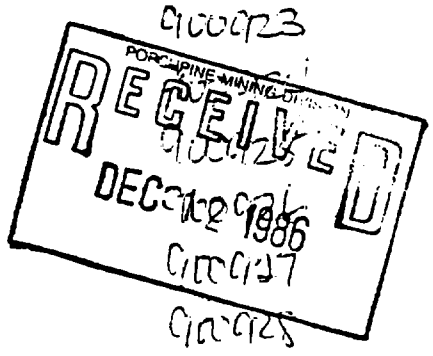
Certified by (Signature)

1382 (81/01)

HERVE ST. LOUIS M21084 (48)

P. 900901
900902
900903
900904
900905
900906
900907
900908
900909
900910
900911
900912
900913
900914
900915
900916
900917
900918
900919
900920
900921
900922
900923
900924
900925
900926
900927
900928

P. 900929
900930
900931
900932
900933
900934
900935
900936
900937
900938
900939
900940
900941
900942
900943
900944
900945
900946
900947
900948



NOLAN BOA (CONT'D) H-8667 (75)

P. 899864
899865
899866
899867
[redacted]
899869
899870
899871
899872
899873
899874
899875
899876
899877
899878
899879
899880
899881
899882
899883
899884
899885
899886
899887
899888
899889
899890
899891

P. 899892
899893
899894
899895
899896
899897
899898
899899
899900
899901
899902
899903
906151
906152
906153
906154
906155
906156
906157
906158
906159
906160
906161
906162
906163
906164
906165
906166

P. 906167
906168
906169
906170
906171
906172
906173
906174
906175
906176
906177
906178
906179
906180

2.9705

Ministry of Natural Resources
Ontario

Report of Work
(Geophysical, Geological, Geochemical and Expenditures)

#417/86

Mining Act

Instructions: – Please type or print.
– If number of mining claims traversed exceeds space on this form, attach a list.
Note: – Only days credits calculated in the "Expenditures" section may be entered in the "Expend. Days Cr." columns.
– Do not use shaded areas below.

Type of Survey(s)	Township or Area
AIRBORNE MAGNETIC AND VLF-EM	DOHERTY TWP.

Claim Holder(s) ① MARK RANGER, ② WILLIAM WEISFLOCK, ③ LARRY SALO
Prospector's Licence No. ④ M23639, ⑤ M23582, M20[illegible]

Address: 800-111 RICHMOND ST WEST, TORONTO, ONT. M5H-2G4

Survey Company: GEOTERREX LTD.

Date of Survey (from & to): 15 Day | 10 Mo. | 86 Yr. | 30 Day | 11 Mo. | 86 Yr.

Total Miles of line Cut: 1800 line kms.

Name and Address of Author (of Geo-Technical report): M.C. CARON, 2060 WALKLEY RD., OTTAWA, ONTARIO K1G-3P5

Credits Requested per Each Claim in Columns at right

Special Provisions		Days per Claim
For first survey: Enter 40 days. (This includes line cutting)	Geophysical - Electromagnetic	
	- Magnetometer	
For each additional survey: using the same grid: Enter 20 days (for each)	- Radiometric	
	- Other	
	Geological	
	Geochemical	

Man Days		Days per Claim
Complete reverse side and enter total(s) here	- Electromagnetic	
	- Magnetometer	
	- Radiometric	
	- Other	
	Geological	
	Geochemical	

Airborne Credits		Days per Claim
Note: Special provisions credits do not apply to Airborne Surveys.	Electromagnetic	40
	Magnetometer	40
	Radiometric	

RECORDED DEC 12 1986

Expenditures (excludes power stripping)

Type of Work Performed

Performed on Claim(s)

Calculation of Expenditure Days Credits

Total Expenditures ÷ 15 = Total Days Credits

RECEIVED DEC 12 1986

Instructions
Total Days Credits may be apportioned at the claim holder's choice. Enter number of days credits per claim selected in columns at right.

Date: DEC 12/86 | Recorded Holder or Agent (Signature)

Mining Claims Traversed (List in numerical sequence)

Mining Claim Prefix	Number	Expend. Days Cr.
P.	921401	
	921402	
	921403	
	921404	
	921405	
	921406	
	921407	
	921408	
	921409	
	921410	
	921411	
	921412	
	921413	
	921414	
	921415	
	921416	
	921417	
	921418	
	921419	
	921420	
	921421	
	921422	
	921423	

Mining Claim Prefix	Number	Expend. Days Cr.
P.	921424	
	921425	
	921426	
	921427	
	921428	
	921429	
	921430	
	921431	
	921432	
	921433	
	921434	
	921435	
	921436	
	921437	
	921438	
	921439	
	921440	
	921441	
	921442	
	921443	
	921444	
	921445	
	921446	

Total number of mining claims covered by this report of work: 180

For Office Use Only

Total Days Cr. Recorded: 14,400

Date Recorded: Dec. 12/86

Date Approved as Recorded:

Mining Recorder: [signature]

Branch Director: [signature]

Certification Verifying Report of Work

I hereby certify that I have a personal and intimate knowledge of the facts set forth in the Report of Work annexed hereto, having performed the work or witnessed same during and/or after its completion and the annexed report is true.

Name and Postal Address of Person Certifying: [illegible]

Date Certified: DEC 8/86 | Certified by (Signature)

WILLIAM WEISFLOCK (45)

P 889434
889435
889436
889437
889438
889439
889440
889441
889442
889443
889444
889445
889446
889447
889448
889449
889450
889451
889452
889453
889454
889455
889456
889457
889458
889459
889460
889461
889462

P. 889463
889464
889465
889466
889467
889468
889469
889470
889471
889472
889473
889474
889475
889476
889477
889478
889479
889480
889481

LARRY SALO (34)

P. 860543
860544
860545
860546
860547
860548
860549
860550
860551
860552
860553
860554
860555
860556
860557
860558
860559
860560
860561
860562
860563
860564
860565
860566
860567
860568
860569
860570
860571

P. 860572
P. 860573
860574
860575
860576

MARK RANGER (CONT'D) (9E)

P. 921447
921448
921449
921450
921451
921452
921453
921454
921455
921456
921457
921458
921459
921460
921461
921462
921463
921464
921465
921466
921467
921468
921469
921470
921471
921472
921473
921474
921475
921476
921477
921478
921479
921480
921481
921482
921483
921484
921485
921486
921487
921488
921489
921490
921491
921492
921493
921494
921495
921496
921497
921498

2.9705

Ministry of Natural Resources — Ontario

Report of Work
(Geophysical, Geological, Geochemical and Expenditures)

419/86

Mining Act

Instructions: – Please type or print.
– If number of mining claims traversed exceeds space on this form, attach a list.
Note: – Only days credits calculated in the "Expenditures" section may be entered in the "Expend. Days Cr." columns.
– Do not use shaded areas below.

Type of Survey(s)	Township or Area
AIRBORNE MAGNETIC AND VLF-EM	CAITHNESS TWP.

Claim Holder(s)	Prospector's Licence No.
WAYNE CADA ①, WILLIAM WEISFLOCK ②	M23579 ① M23562 ②

Address: 800-111 RICHMOND ST. WEST. TORONTO M5H-2G4

Survey Company	Date of Survey (from & to)	Total Miles of line Cut
GEOTERREX LTD.	15 Day / 10 Mo. / 86 Yr. to 30 Day / 11 Mo. / 86 Yr.	1600 line kms

Name and Address of Author (of Geo-Technical report)
N.C. CAGNAN 2000 OAKLEY RD. OTTAWA, ONTARIO K1G-3P5

Credits Requested per Each Claim in Columns at right

Special Provisions		Days per Claim
For first survey: Enter 40 days. (This includes line cutting)	Geophysical - Electromagnetic	
	- Magnetometer	
For each additional survey: using the same grid: Enter 20 days (for each)	- Radiometric	
	- Other	
	Geological	
	Geochemical	

Man Days		Days per Claim
Complete reverse side and enter total(s) here	Geophysical - Electromagnetic	
	- Magnetometer	
	- Radiometric	
	- Other	
	Geological	
	Geochemical	

Airborne Credits		Days per Claim
Note: Special provisions credits do not apply to Airborne Surveys.	Electromagnetic	40
	Magnetometer	40
	Radiometric	

RECORDED DEC 12 1986

Expenditures (excludes power stripping)

Type of Work Performed

Performed on Claim(s)

Calculation of Expenditure Days Credits

Total Expenditures $ ÷ 15 = Total Days Credits

Instructions
Total Days Credits may be apportioned at the claim holder's choice. Enter number of days credits per claim selected in columns at right.

Date: Dec. 8/86 — Recorded Holder or Agent (Signature): C.E. Page

Mining Claims Traversed (List in numerical sequence)

Mining Claim Prefix	Number	Expend. Days Cr.
P.	901001	
	901002	
	901003	
	901004	
	901005	
	901006	
	901007	
	901008	
	901009	
	901010	
	901011	
	901012	
	901013	
	901014	
	901015	
	901016	
	901017	
	901018	
	901019	
	901020	
	901021	
	901022	
	901023	

Mining Claim Prefix	Number	Expend. Days Cr.
P.	901024	
	901025	
	901026	
	901027	
	901028	
	901029	
	901030	
	901031	
	901032	
	901033	
	901034	
	901035	
	901036	
	901037	
	901038	
	901040	
	901041	
	901042	
	901043	
	901044	
	901045	
	901046	
	901047	

Total number of mining claims covered by this report of work: 94

For Office Use Only

Total Days Cr. Recorded	Date Recorded	Mining Recorder
7520	Dec. 12/86	
	Date Approved as Recorded: 4 May/87	Branch Director

Certification Verifying Report of Work

I hereby certify that I have a personal and intimate knowledge of the facts set forth in the Report of Work annexed hereto, having performed the work or witnessed same during and/or after its completion and the annexed report is true.

Name and Postal Address of Person Certifying
CHARLES E. PAGE, 800 - 111 RICHMOND ST WEST
TORONTO ONTARIO M5H-2G4

Date Certified: Dec. 8/86 — Certified by (Signature): C.E. Page

WAYNE CADA (CONTD) M123574 (46)

P. 901C48
P. 901038

WILLIAM WEISFLOCK M123582 (46)

P 905043
905044
905045
905046
905047
905048
905049
905050
905051
905052
905053
905054
905055
905056
905057
905058
905059
905060
905061
905062
905063

P 905066
905068
905069
905070
905071
905072
905073
905074
905075
905076
905077
905078
905079
905080
905081
905082
905083
905084
905085
905086
905087
905088

2.9705

Ministry of Natural Resources
Ontario

Report of Work
(Geophysical, Geological, Geochemical and Expenditures)

416/86

Mining Act

Instructions: – Please type or print.
– If number of mining claims traversed exceeds space on this form, attach a list.
Note: – Only days credits calculated in the "Expenditures" section may be entered in the "Expend. Days Cr." columns.
– Do not use shaded areas below.

Type of Survey(s)	Township or Area
AIRBORNE MAGNETIC AND VLF-EM	DOHERTY TWP

Claim Holder(s): BRUCE MORTSON[1], RAYMOND LAMONTE[2], RENE LEVERT[3]
Prospector's Licence No.: K1915[1] M24235[2] M23[illegible][3]
Address: 800-111 RICHMOND ST. WEST, TORONTO M5H-2G4
Survey Company: GEOTERREX LTD.
Date of Survey (from & to): 15 10 Feb | 30 11 Feb
Total Miles of line Cut: 160 line kms.
Name and Address of Author (of Geo-Technical report): M.C. CARON, 2066 WALKLEY RD, OTTAWA ONTARIO K1G-3P5

Credits Requested per Each Claim in Columns at right

Special Provisions		Days per Claim
For first survey: Enter 40 days. (This includes line cutting)	Geophysical - Electromagnetic	
	- Magnetometer	
For each additional survey: using the same grid: Enter 20 days (for each)	- Radiometric	
	- Other	
	Geological	
	Geochemical	

Man Days		Days per Claim
Complete reverse side and enter total here	Geophysical - Electromagnetic	
	- Magnetometer	
	- Radiometric	
	- Other	
	Geological	
	Geochemical	

Airborne Credits		Days per Claim
Note: Special provisions credits do not apply to Airborne Surveys.	Electromagnetic	40
	Magnetometer	40
	Radiometric	

RECORDED DEC 12 1986

Expenditures (excludes power stripping)

Type of Work Performed

Performed on Claim(s)

Calculation of Expenditure Days Credits

Total Expenditures: S ÷ 15 = Total Days Credits

Instructions: Total Days Credits may be apportioned at the claim holder's choice. Enter number of days credits per claim selected in columns at right.

RECEIVED DEC 12 1986

Date: DEC 9/86 | Recorded Holder or Agent (Signature)

Certification Verifying Report of Work

I hereby certify that I have a personal and intimate knowledge of the facts set forth in the Report of Work annexed hereto, having performed the work or witnessed same during and/or after its completion and the annexed report is true.

Name and Postal Address of Person Certifying
[illegible] TORONTO ONTARIO M5H-2G4

Date Certified: DEC 9/86 | Certified (Signature)

Mining Claims Traversed (List in numerical sequence)

Mining Claim Prefix	Number	Expend. Days Cr.
P	S76801	
	S76802	
	S76803	
	S76804	
	S76805	
	S76806	
	S76807	
	S76808	
	S76809	
	S76810	
	S76811	
	S76812	
	S76813	
	S76814	
	S76815	
	S76816	
	S76817	
	S76818	
	S76819	
	S76820	
	S76821	
	S76822	
	S76823	

Mining Claim Prefix	Number	Expend. Days Cr.
P.	S76824	
	S76825	
	S76826	
	S76827	
	S76828	
	S76829	
	S76830	
	S76831	
	S76832	
	S76833	
	S76834	
	S76835	
	S76836	
	S76839	
	S76840	
	S76841	
	S76842	
	S76843	
	S76844	
	S76845	
	S76846	
	S76847	

Total number of mining claims covered by this report of work: 256

For Office Use Only

Total Days Cr. Recorded: 20,480
Date Recorded: Dec. 12/86
Mining Recorder: [signature]
Date Approved as Recorded:
Branch Director:

BRUCE MCRTSON (CONT'D) K-19157 (48)

P 876837
876838

RAYMOND LAMOUTE M24250 (52)

P 921501
921502
921503
921504
921505
921506
921507
921508
921509
921510
921511
921512
921513
921514
921515
921516
921517
921518
921519
921521
921522
921523
921524

P 921525
921526
921527
921528
921529
921530
921531
921532
921533
921534
921535
921536
921537
921538
921539
921540
921541
921542
921543
921544
921545
921546
921547
921548

P 921549
921550
921551
921552

REN LEVGRT M23662 (15¢)

P 860603
860604
860605
860606
860607
860608
860609
860610
860611
860612
860613
860614
860615
860616
860617
860618
860619
860620
860621
860622
860623
860624
860625
860626
860627
860628
860629
860630
860631

P 860632
860633
860634
860635
860636
860637
860638
860639
860640
860641
860642
860643
860644
860645
860646
860647
860648
860649
860650
860651
860652
860653
860654
860655
860656
860657
860658
860659
860660

P 876701
876702
876703
876704
876705
876706
876707
876708
876709
876710
876711
876712
876713
876714
876715
876716
876717
876718
876719
876720
876721
876722
876723
876724
876725
876726
876727
876728
876729

P. 876730
876731
876732
876733
876734
876735
876736
876737
876738
876739
876740
876741
876742
876743
876744
876745
876746
876747
876748
876749
876750
876751
876752
876753
876754
876755
876756
876757
876758

P. 876759
876760
876761
876762
876763
876764
876765
876766
876767
876768
876769
876770
876771
876772
876773
876774
876775
876776
876777
876778
876779
876780
876781
876782
876783
876784
876785
876786
876787

P. 876788
876789
876790
876791
876792
876793
876794
876795
876796
860601
860602

2.7705

Ontario — Ministry of Natural Resources

Report of Work
(Geophysical, Geological, Geochemical and Expenditures)

Mining Act

415/86

Instructions: – Please type or print.
– If number of mining claims traversed exceeds space on this form, attach a list.
Note: – Only days credits calculated in the "Expenditures" section may be entered in the "Expend. Days Cr." columns.
– Do not use shaded areas below.

Type of Survey(s): AIRBORNE MAGNETIC AND VLF-EM

Township or Area: PELLETIER TWP.

Claim Holder(s): RENE LEVERT (1) WILLIAM WOISFLOCK (2)

Prospector's Licence No.: M.23062 (1) M23582

Address: 800-111 RICHMOND ST. WEST, TORONTO M5H-2G4

Survey Company: GEOTERREX LTD.

Date of Survey (from & to): 15 Day 10 Mo. 86 Yr. 30 Day 11 Mo. 86 Yr.

Total Miles of line Cut: 1800 line kms.

Name and Address of Author (of Geo-Technical report): M.C. CARSON, 2060 WAKLEY RD., OTTAWA, ONTARIO K1G-3P5

Credits Requested per Each Claim in Columns at right

Special Provisions		Days per Claim
For first survey: Enter 40 days. (This includes line cutting)	Geophysical - Electromagnetic	
	- Magnetometer	
For each additional survey: using the same grid: Enter 20 days (for each)	- Radiometric	
	- Other	
	Geological	
	Geochemical	

Man Days		Days per Claim
Complete reverse side and enter total(s) here	Geophysical - Electromagnetic	
	- Magnetometer	
	- Radiometric	
	- Other	
	Geological	
	Geochemical	

RECORDED DEC 12 1986

Airborne Credits		Days per Claim
Note: Special provisions credits do not apply to Airborne Surveys.	Electromagnetic	40
	Magnetometer	40
	Radiometric	

Expenditures (excludes power stripping)

Type of Work Performed

Performed on Claim(s)

Calculation of Expenditure Days Credits

Total Expenditures: S ÷ 15 = Total Days Credits

Instructions: Total Days Credits may be apportioned at the claim holder's choice. Enter number of days credits per claim selected in columns at right.

RECEIVED DEC 12 1986

Date: Dec. 9/86

Recorded Holder or Agent (Signature): C.E. Page

Mining Claims Traversed (List in numerical sequence)

Mining Claim Prefix	Number	Expend. Days Cr.
P.	860661	
	860662	
	860663	
	860664	
	860665	
	860666	
	860667	
	860668	
	860669	
	860670	
	860671	
	860672	
	860673	
	860674	
	860675	
	860676	
	860677	
	860678	
	860679	
	860680	
	860681	
	860682	
	860683	

Mining Claim Prefix	Number	Expend. Days Cr.
P.	860684	
	860685	
	860686	
	860687	
	860688	
	860689	
	860690	
	860691	
	860692	
	860693	
	860694	
	860695	
	860696	
	880701	
	880702	
	880703	
	880704	
	880705	
	880706	
	880707	
	880708	
	880709	
	880710	

Total number of mining claims covered by this report of work: 115

For Office Use Only

Total Days Cr. Recorded: 9200

Date Recorded: Dec. 12/86

Mining Recorder: [signature]

Date Approved as Recorded: [illegible] Director

Certification Verifying Report of Work

I hereby certify that I have a personal and intimate knowledge of the facts set forth in the Report of Work annexed hereto, having performed the work or witnessed same during and/or after its completion and the annexed report is true.

Name and Postal Address of Person Certifying: CHARLES E. PAGE, 800-111 RICHMOND ST WEST, TORONTO, ONTARIO M5H-2G4

Date Certified: Dec. 9/86

Signature: C.E. Page

RENE LEVERT M-23062 (cont'd) (82)

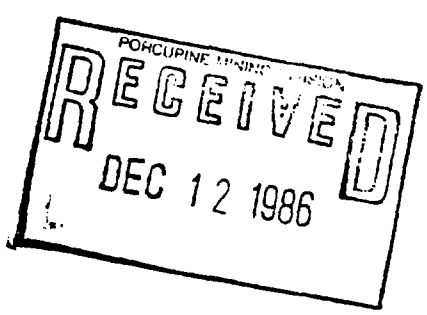
P. 880711
880712
880713
880714
880715
880716
880717
880718
880719
880720
880721
880722
880723
880724
880725
880726
880727
880728
880729
880730
880731
880732
880733
880734
880735
880736
880737
880738

P. 880739
880740
880741
880742
880743
880744
880745
880746

WILLIAM WEISFLOCK (M-23582) (33)

P. 889401
889402
889403
889404
889405
889406
889407
889408
889409
889410
889411
889412
889413
889414
889415
889416
889417

P. 889418
889419
889420
889421
889422
889423
889424
889425
889426
889427
889428
889429
889430
889431
889432
889433

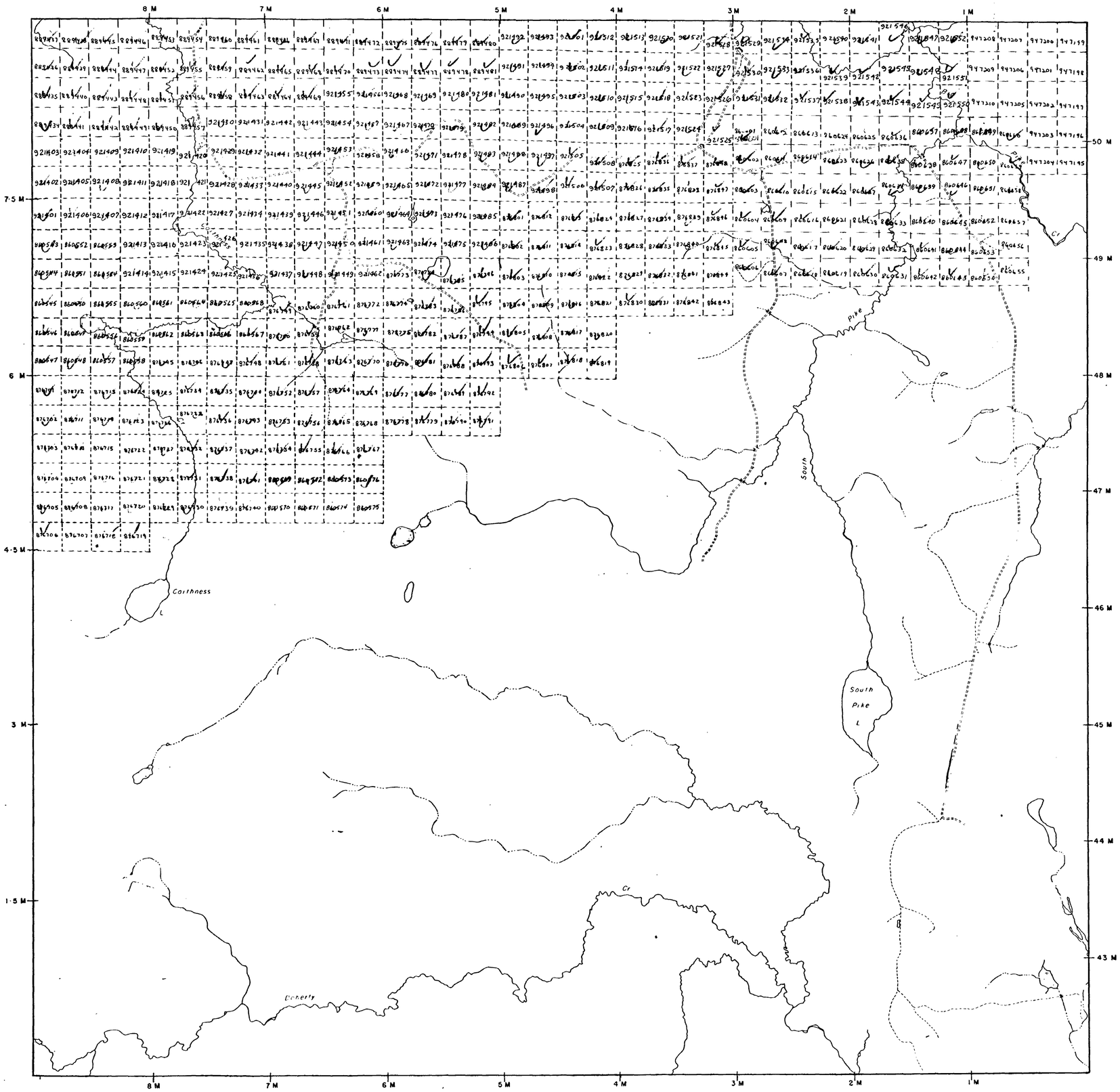


AREAS WITHDRAWN FROM DISPOSITION

M.R.O. – MINING RIGHTS ONLY
S.R.O. – SURFACE RIGHTS ONLY
M. – S. – MINING AND SURFACE RIGHTS

Description	Order No.	Date	Disposition	File

CAITHNESS TWP. G-2295



PELLETIER TWP. G-2343

ABBOTT TWP. G-

BYNG TWP. G-2294

HIGHWAY AND ROUTE No
OTHER ROADS
TRAILS
SURVEYED LINES:
TOWNSHIPS, BASE LINES, ETC
LOTS, MINING CLAIMS, PARCELS, ETC
UNSURVEYED LINES
LOT LINES
PARCEL BOUNDARY
MINING CLAIMS ETC
RAILWAY AND RIGHT OF WAY
UTILITY LINES
NON-PERENNIAL STREAM
FLOODING OR FLOODING RIGHTS
SUBDIVISION OR COMPOSITE PLAN
RESERVATIONS
ORIGINAL SHORELINE
MARSH OR MUSKEG
MINES
TRAVERSE MONUMENT

DISPOSITION OF CROWN LANDS

TYPE OF DOCUMENT	SYMBOL
PATENT, SURFACE & MINING RIGHTS	●
" , SURFACE RIGHTS ONLY	◒
" , MINING RIGHTS ONLY	◓
LEASE, SURFACE & MINING RIGHTS	■
" , SURFACE RIGHTS ONLY	▣
" , MINING RIGHTS ONLY	▤
LICENCE OF OCCUPATION	▼
ORDER-IN-COUNCIL	OC
RESERVATION	⊕
CANCELLED	⊗
SAND & GRAVEL	⊙

NOTE: MINING RIGHTS IN PARCELS PATENTED PRIOR TO MAY 8, 1913, VESTED IN ORIGINAL PATENTEE BY THE PUBLIC LANDS ACT, R.S.O. 1970, CHAP. 380, SEC. 63, SUBSEC. 1

SCALE: 1 INCH = 40 CHAINS

FEET 0 1000 2000 4000 6000 8000
METRES 0 200 1000 (1 KM) 2000 (2 KM)

2·9705

TOWNSHIP

DOHERTY

M.N.R. ADMINISTRATIVE DISTRICT

HEARST

MINING DIVISION

PORCUPINE

LAND TITLES / REGISTRY DIVISION

ALGOMA

Ministry of Natural Resources — Land Management Branch
Ontario

Date MARCH 19, 1984.

Number G-2302

200

REFERENCES

AREAS WITHDRAWN FROM DISPOSITION

M.R.O. – MINING RIGHTS ONLY
S.R.O. – SURFACE RIGHTS ONLY
M.+S. – MINING AND SURFACE RIGHTS

Description	Order No.	Date	Disposition	File

ORKNEY TWP. G-2342

SCHOLFIELD TWP. G-2349

RYKERT TWP. G-

REF. – 60671

PELLETIER TWP.
G-2343

DOHERTY TWP. G-2302

XII XI X IX VIII VII VI V IV III II I

31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

LEGEND

- HIGHWAY AND ROUTE No
- OTHER ROADS
- TRAILS
- SURVEYED LINES:
  - TOWNSHIPS, BASE LINES, ETC
  - LOTS, MINING CLAIMS, PARCELS, ETC
- UNSURVEYED LINES
  - LOT LINES
  - PARCEL BOUNDARY
  - MINING CLAIMS ETC
- RAILWAY AND RIGHT OF WAY
- UTILITY LINES
- NON PERENNIAL STREAM
- FLOODING OR FLOODING RIGHTS
- SUBDIVISION OR COMPOSITE PLAN
- RESERVATIONS
- ORIGINAL SHORELINE
- MARSH OR MUSKEG
- MINES
- TRAVERSE MONUMENT

DISPOSITION OF CROWN LANDS

TYPE OF DOCUMENT	SYMBOL
PATENT, SURFACE & MINING RIGHTS	●
" , SURFACE RIGHTS ONLY	●
" , MINING RIGHTS ONLY	●
LEASE, SURFACE & MINING RIGHTS	■
" , SURFACE RIGHTS ONLY	■
" , MINING RIGHTS ONLY	■
LICENCE OF OCCUPATION	▼
ORDER-IN-COUNCIL	OC
RESERVATION	◔
CANCELLED	◔
SAND & GRAVEL	◔

NOTE MINING RIGHTS IN PARCELS PATENTED PRIOR TO MAY 6, 1913, VESTED IN ORIGINAL PATENTEE BY THE PUBLIC LANDS ACT, R.S.O. 1970, CHAP. 380, SEC. 63, SUBSEC. 1

SCALE: 1 INCH = 40 CHAINS

FEET 0 1000 2000 4000 6000 8000

METRES 0 200 400 1000 2000
(1 KM) (2 KM)

MUNICIPAL MINING DIVISION
RECEIVED
MAY 27 1985

J 4105

TOWNSHIP

CAITHNESS

M.N.R. ADMINISTRATIVE DISTRICT
HEARST
MINING DIVISION
PORCUPINE
LAND TITLES / REGISTRY DIVISION
COCHRANE

Ontario Ministry of Natural Resources — Land Management Branch

Date MARCH, 1984
Rec'd MAY 31/84

Number G-2295

AREAS WITHDRAWN FROM DISPOSITION

M.R.O. – MINING RIGHTS ONLY
S.R.O. – SURFACE RIGHTS ONLY
M.+S. – MINING AND SURFACE RIGHTS

Description	Order No.	Date	Disposition	File

SCHOLFIELD TOWNSHIP

CAITHNESS TOWNSHIP

ROCHE TOWNSHIP

DOHERTY TOWNSHIP

MINNIPUKA TOWNSHIP

Goat River

Pelletier Lake

Goat River

Doherty Lake

Doherty Cr.

HIGHWAY AND RAILWAY
OTHER ROADS
TRAILS
SURVEYED LINES
TOWNSHIPS, BASE LINES, ETC.
LOTS, MINING CLAIMS, PARCELS, ETC.
UNSURVEYED LINES
LOT LINES
PARCEL BOUNDARY
MINING CLAIMS, ETC.
RAILWAY AND RIGHT OF WAY
UTILITY LINES
NON-PERENNIAL STREAM
FLOODING OR FLOODING RIGHTS
SUBDIVISION OR COMPOSITE PLAN
RESERVATIONS
ORIGINAL SHORELINE
MARSH OR MUSKEG
MINES
TRAVERSE MONUMENT

DISPOSITION OF CROWN LANDS

TYPE OF DOCUMENT	SYMBOL
PATENT SURFACE & MINING RIGHTS	●
" SURFACE RIGHTS ONLY	◑
" MINING RIGHTS ONLY	◐
LEASE SURFACE & MINING RIGHTS	■
" SURFACE RIGHTS ONLY	◪
" MINING RIGHTS ONLY	◧
LICENCE OF OCCUPATION	▼
ORDER IN COUNCIL	OC
RESERVATION	R
CANCELLED	C
SAND & GRAVEL	S

NOTE MINING RIGHTS IN PARCELS PATENTED PRIOR TO MAY 4 1913 VESTED IN ORIGINAL PATENTEE BY THE PUBLIC LANDS ACT R.S.O. 1970 CHAP. 380 SEC. 63 SUBSEC. 1

SCALE 1 : 20 000

2.9705

TOWNSHIP

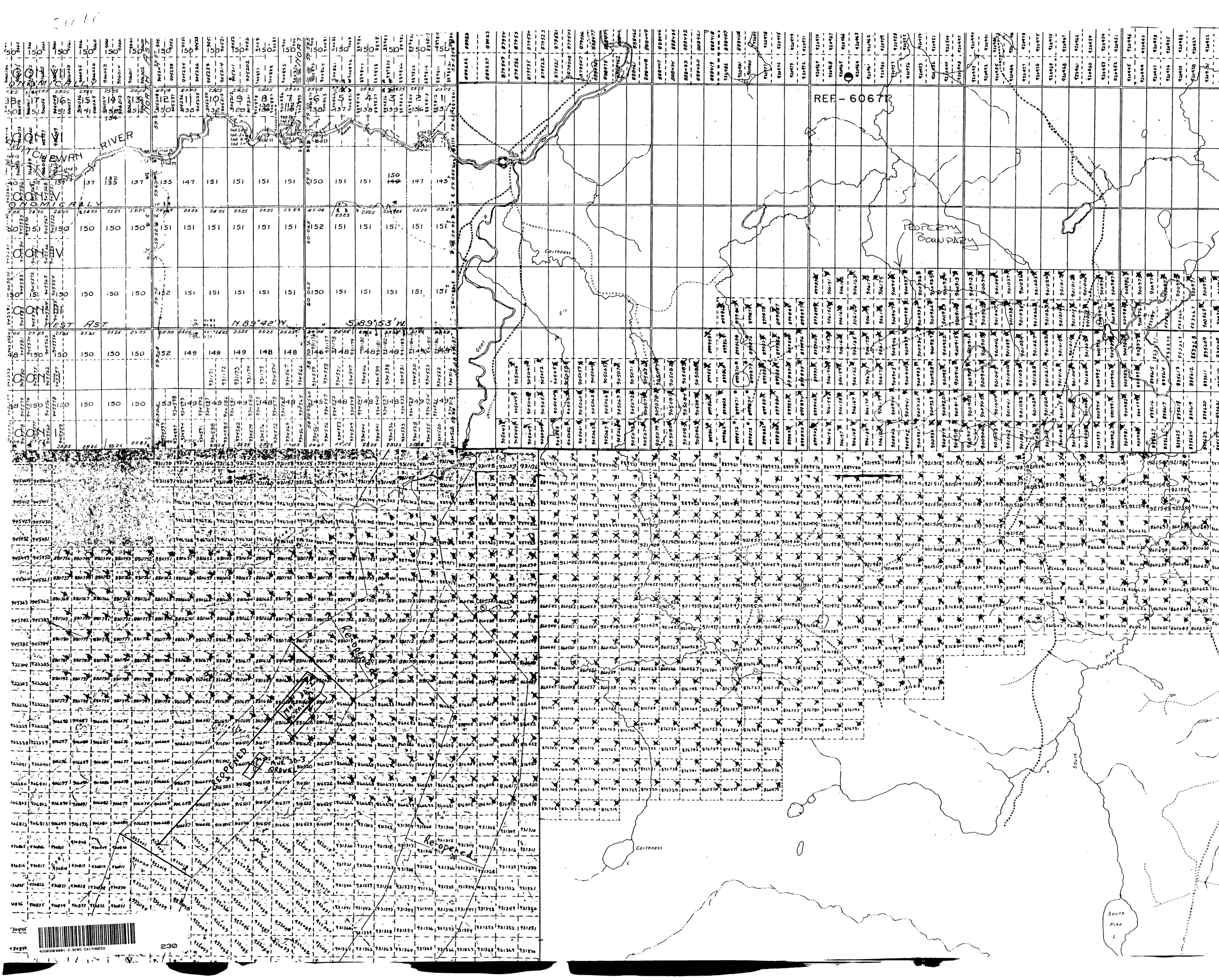
PELLETIER

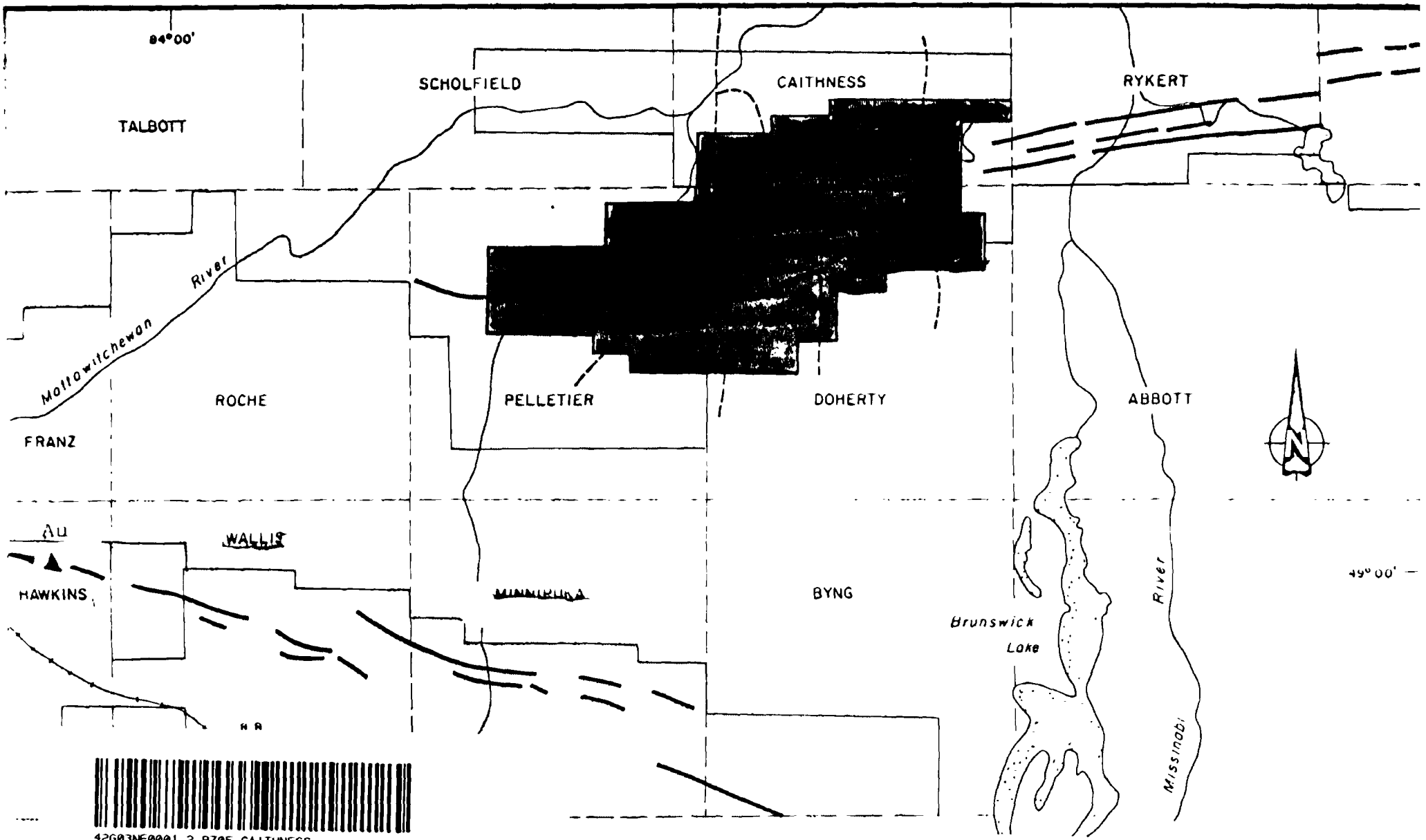
M.N.R. ADMINISTRATIVE DISTRICT
HEARST
MINING DIVISION
PORCUPINE
LAND TITLES / REGISTRY DIVISION
ALGOMA

Ontario
Ministry of Natural Resources
Ministry of Northern Development and Mines

Date SEPTEMBER, 1986
Number G-2343

220





42G03NE0001 2.9705 CAITHNESS

240

Recent staking

Kapuskasing Joint Venture Property

Lumber roads

Airborne Conductive Trend

HSK MINERALS LIMITED

KAPUSKASING JOINT VENTURE

0 2 4 6 8

METERS

OCT 1986

WM 86-187

2.9705 (Map)

299000 300 302 304 306 308 310 312000

5455000 5454 5452 5450 5448 5446 5444 5443000

MAP PROJECTION : UTM
SPHEROID : CLARKE 1866
CENTRAL MERIDIAN : 81 DEGREES
FALSE EASTING : 500000
FALSE NORTHING : 0
SCALE FACTOR : 0.9996

INTERPRETATION LEGEND:

POSITIVE MAGNETIC ANOMALY AXIS

DIABASE DYKE

MAGNETIC/GEOLOGIC CONTACT (PROBABLE, POSSIBLE)

POSSIBLE FAULT, SHOWING RELATIVE MOVEMENT

POSSIBLE LITHOLOGY (NO. REFERS TO O.G.S. MAP #2461, PLUS SIGNIFIES HIGH APPARENT MAGNETIC SUSCEPTIBILITY) 1+

Y.L.F. / E.M. CONDUCTOR AXIS (GOOD CONDUCTOR, POOR CONDUCTOR)

FEATURES REFERRED TO IN THE REPORT: C1

SCALE 1:15840

200 0 200 400 600 800 1000 1200 1400 1600 Metres

1000 0 1000 2000 3000 4000 Feet

N

29705

COMPILED & INTERPRETED BY geoterrex ltd.

FOR HOMESTAKE CONSULTING

AIRBORNE MAGNETIC / VLF-EM SURVEY

KAPUSKASING ONTARIO

INTERPRETATION MAP MAG / VLF

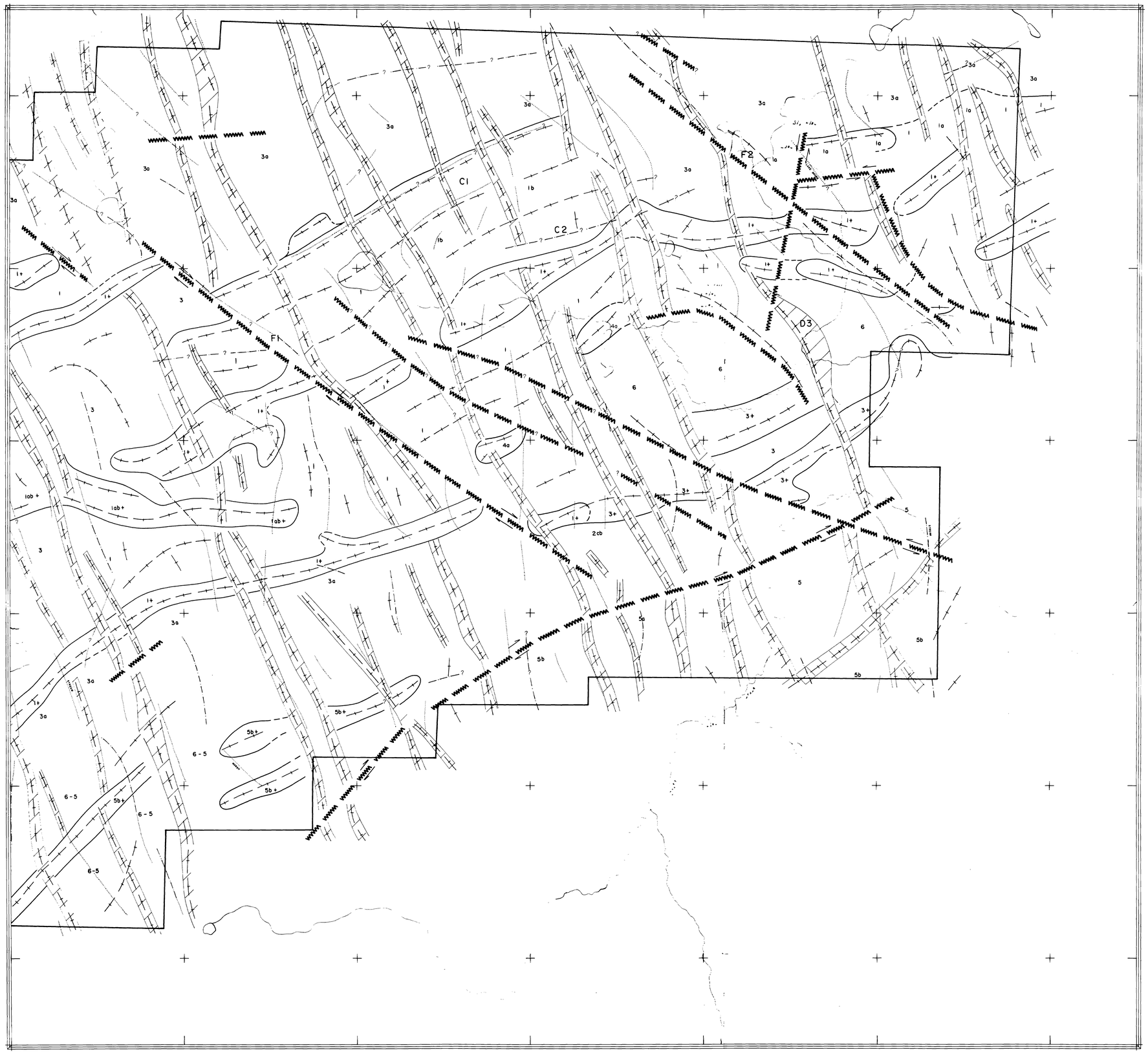
SHEET 1 OF 2 | POSITIONAL CONTROL ..... BASED ON PHOTOMOSAIC | ALTITUDE ± 80 METRES | FLOWN BY KENTING LTD.

SCALE 1:15840 | DATE: OCTOBER 1986 | GEOTERREX PROJECT NO. 278

250

312000 314 316 318 320 322 324 325000

5455000 5454 5452 5450 5448 5446 5444 5443000



MAP PROJECTION : UTM
SPHEROID : CLARKE 1866
CENTRAL MERIDIAN : 81 DEGREES
FALSE EASTING : 500000
FALSE NORTHING : 0
SCALE FACTOR : 0.9996

INTERPRETATION LEGEND:

POSITIVE MAGNETIC ANOMALY AXIS

DIABASE DYKE

MAGNETIC/GEOLOGIC CONTACT (PROBABLE,POSSIBLE)

POSSIBLE FAULT, SHOWING RELATIVE MOVEMENT

POSSIBLE LITHOLOGY (NO. REFERS TO O.G.S. MAP PRIMARY RIVE SIGNIFIES HIGH APPARENT MAGNETIC SUSCEPTIBILITY) 1+

V.L.F. / E.M. CONDUCTOR AXIS (GOOD CONDUCTOR, POOR CONDUCTOR)

FEATURES REFERRED TO IN THE REPORT: C1

SCALE 1:15840

200 0 200 400 600 800 1000 1200 1400 1600 Metres

1000 0 1000 2000 3000 4000 Feet

N 27°05'

COMPILED & INTERPRETED BY geoterrex ltd.

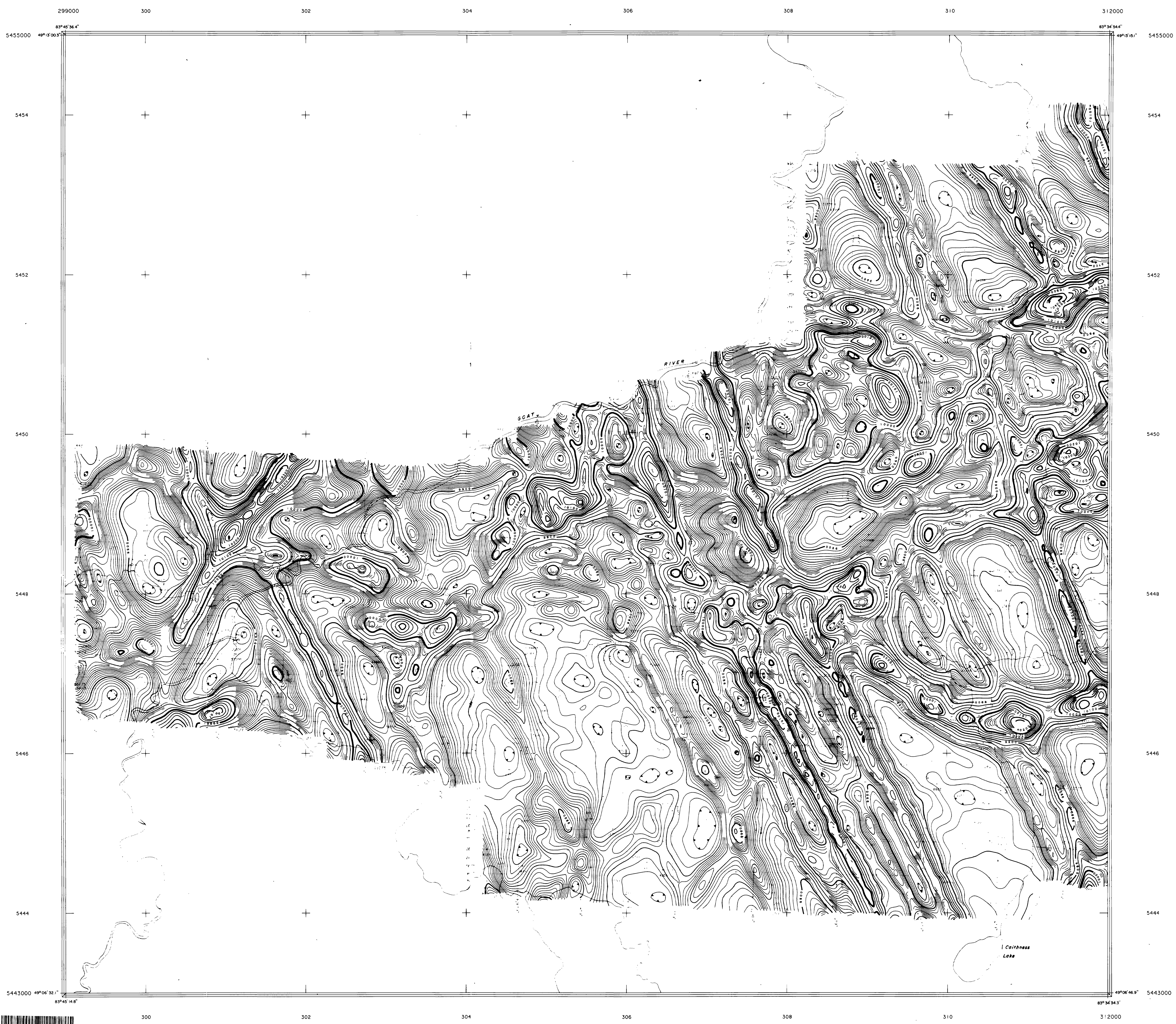
FOR HOMESTAKE CONSULTING

AIRBORNE MAGNETIC / VLF-EM SURVEY

KAPUSKASING ONTARIO

INTERPRETATION MAP MAG / VLF

SHEET 2 OF 2 | SCALE 1: 15840 | POSITIONAL CONTROL ..... BASED ON PHOTOMOSAIC | ALTITUDE = 80 METRES | DATE: OCTOBER 1986 | FLOWN BY KENTING LTD. | GEOTERREX PROJECT NO. 276



LEGEND

500 GAMMAS ....
100 GAMMAS ....
25 GAMMAS ....
5 GAMMAS ....

MAGNETIC LOW ....

CONTOUR INTERVAL 5 GAMMAS

I.G.R.F. CORRECTED, 10,000 nT ADDED

MAP PROJECTION	: UTM
SPHEROID	: CLARKE 1866
CENTRAL MERIDIAN	: 81 DEGREES
FALSE EASTING	: 500000
FALSE NORTHING	: 0
SCALE FACTOR	: 0.9996

SCALE 1:15840

200 0 200 400 600 800 1000 1200 1400 1600 Metres

1000 0 1000 2000 3000 4000 Feet

2.9705

COMPILED BY

geoterrex ltd

FOR

HOMESTAKE CONSULTING

AIRBORNE MAGNETIC / VLF-EM SURVEY

KAPUSKASING

ONTARIO

ISOMAGNETIC CONTOUR MAP

SHEET 1 OF 2	POSITIONAL CONTROL ...... BASED ON	ALTITUDE = 80 METRES	FLOWN BY KENTING LTD.
SCALE 1: 15840	PHOTOMOSAIC	DATE: OCTOBER 1986	GEOTERREX PROJECT NO. 278

270

312000 314 316 318 320 322 324 325000

83°34'54.4" 49°15'15.5" 93°24'12.4" 49°15'29.0"

5455000 5454 5452 5450 5448 5446 5444 5443000

BLACK TRACE = VLF TOTAL FIELD CUTLER MAINE
BLUE TRACE = VLF QUADRATURE CUTLER MAINE

VERTICAL SCALE : 30 PERCENT/CM
FLIGHT PATH DATUM : 0

MAP PROJECTION : UTM
SPHEROID : CLARKE 1866
CENTRAL MERIDIAN : 69 DEGREES
FALSE EASTING : 500000
FALSE NORTHING : 0
SCALE FACTOR : 0.9996

SCALE 1:15840

200 0 200 400 600 800 1000 1200 1400 1600 Metres

1000 0 1000 2000 3000 4000 Feet

2.9705

83°34'34.3" 49°06'46.9" 83°23'53.6" 49°07'00.7"

320

COMPILED BY geoterrex LTD		FOR HOMESTAKE CONSULTING
AIRBORNE MAGNETIC / VLF-EM SURVEY		
KAPUSKASING ONTARIO		VLF PROFILE MAP 24.0 kHz
SHEET 2 OF 2	POSITIONAL CONTROL ..... BASED ON	ALTITUDE = 80 METRES FLOWN BY KENTING LTD.
SCALE 1:15840	PHOTOMOSAIC	DATE: OCTOBER 1986 GEOTERREX PROJECT NO. 276

299000 300 302 304 306 308 310 312000

83°45'36.4" 49°15'00.3" 83°34'54.6" 49°15'15.1"

5455000 5454 5452 5450 5448 5446 5444 5443000

BLACK TRACE = VLF TOTAL FIELD CUTLER MAINE
BLUE TRACE = VLF QUADRATURE CUTLER MAINE

VERTICAL SCALE = 20 PERCENT/CM
FLIGHT PATH DATUM = 0

MAP PROJECTION = UTM
SPHEROID = CLARKE 1866
CENTRAL MERIDIAN = 69 DEGREES
FALSE EASTING = 500000
FALSE NORTHING = 0
SCALE FACTOR = 0.9996

SCALE 1:15840

200 0 200 400 600 800 1000 1200 1400 1600 Metres
1000 0 1000 2000 3000 4000 Feet

N

29705

COMPILED BY
geoterrex LTD.

FOR
HOMESTAKE CONSULTING

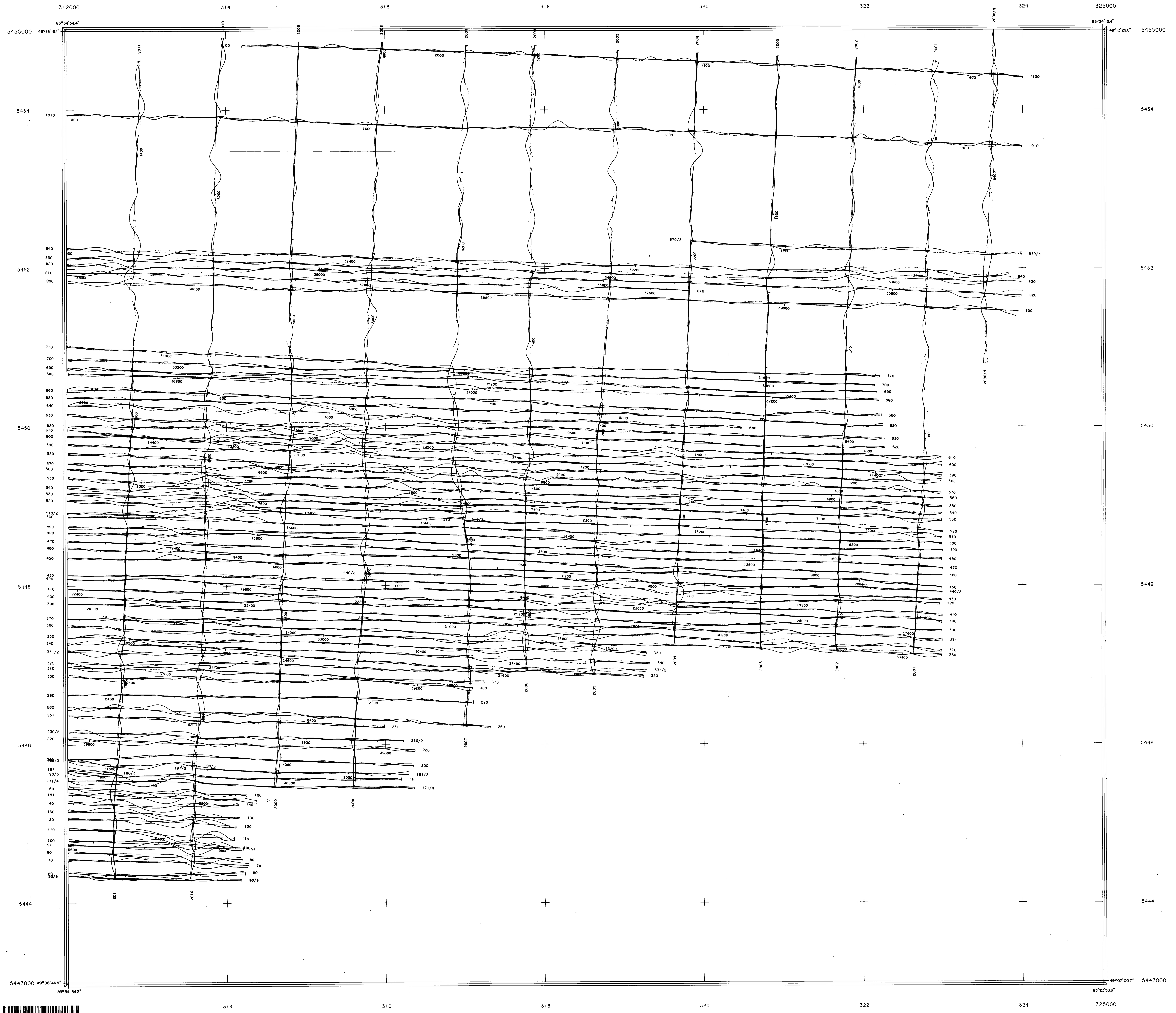
AIRBORNE MAGNETIC / VLF-EM SURVEY

KAPUSKASING
ONTARIO

VLF PROFILE MAP
24.0 kHz

SHEET 1 OF 2 | POSITIONAL CONTROL ..... BASED ON | ALTITUDE = 80 METRES | FLOWN BY KENTING LTD.
SCALE 1: 15840 | PHOTOMOSAIC | DATE: OCTOBER 1986 | GEOTERREX PROJECT NO. 276

310



BLACK TRACE = VLF TOTAL SEATTLE WASH.
BLUE TRACE = VLF QUADRATURE SEATTLE WASH. adjusted to simulate a western (northern) flight direction on all lines (tie lines)

VERTICAL SCALE = 30 PERCENT/CM
FLIGHT PATH DATUM = 0 POSITIVE TO THE NORTH AND WEST

MAP PROJECTION : UTM
SPHEROID : CLARKE 1866
CENTRAL MERIDIAN : 81 DEGREES
FALSE EASTING : 500000
FALSE NORTHING : 0
SCALE FACTOR : 0.9996

COMPILED BY geoterrex ltd

FOR HOMESTAKE CONSULTING

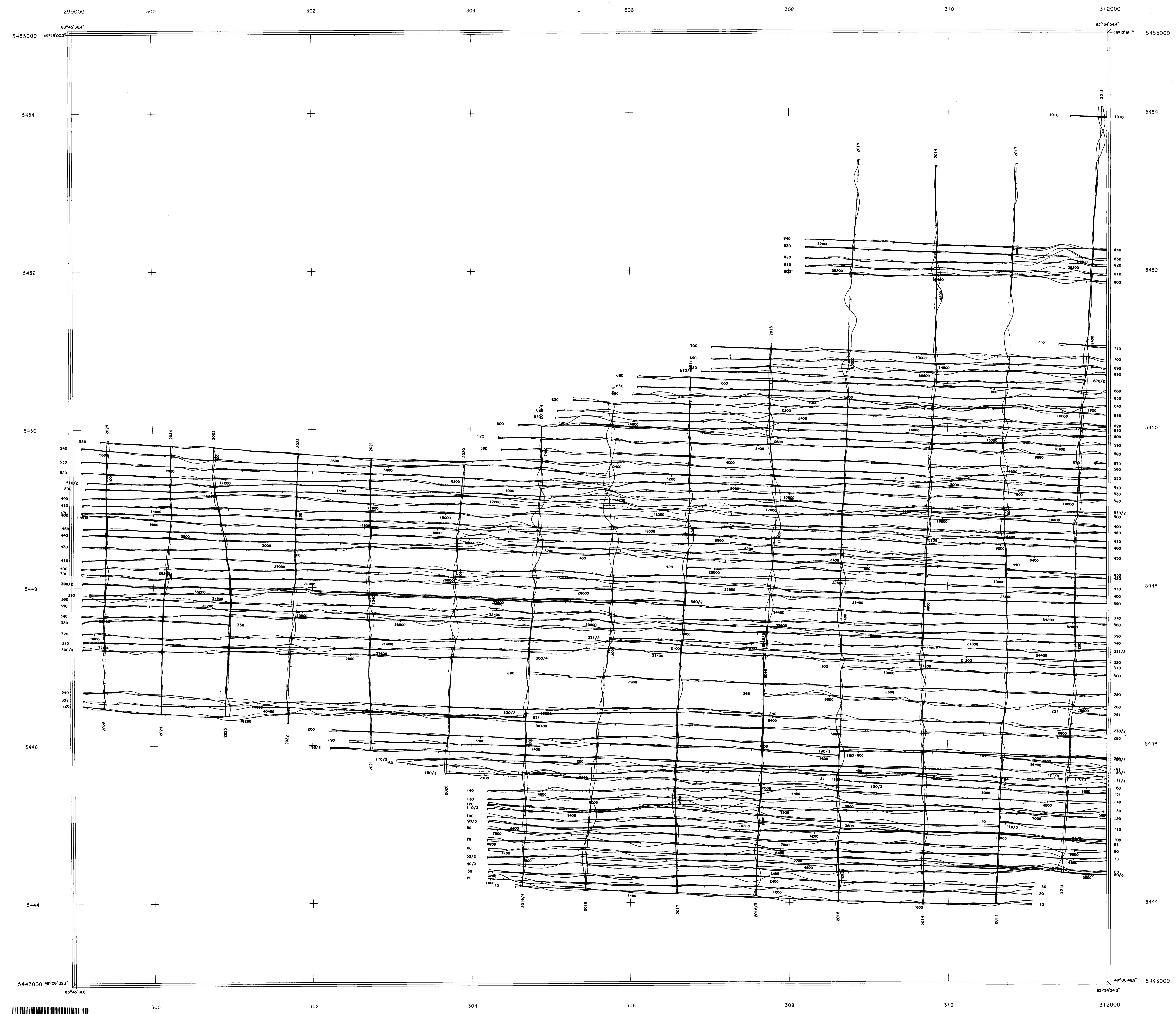
AIRBORNE MAGNETIC / VLF-EM SURVEY

KAPUSKASING
ONTARIO

VLF PROFILE MAP
24.8 kHz

SHEET 2 OF 2	POSITIONAL CONTROL . . . . . . BASED ON PHOTOMOSAIC	ALTITUDE = 80 METRES	FLOWN BY KENTING LTD.
SCALE 1: 15840		DATE: OCTOBER 1986	GEOTERREX PROJECT NO. 276

OM 86-187 2.9705 (dup)



BLACK TRACE = VLF TOTAL SEATTLE WASH.
BLUE TRACE = VLF QUADRATURE SEATTLE WASH. adjusted to simulate a western(northern) flight direction on all lines (tie lines)

VERTICAL SCALE = 30 PERCENT/CM
FLIGHT PATH DATUM = 0

MAP PROJECTION : UTM
SPHEROID : CLARKE 1866
CENTRAL MERIDIAN : 81 DEGREES
FALSE EASTING : 500000
FALSE NORTHING : 0
SCALE FACTOR : 0.9996

SCALE 1:15840

COMPILED BY geoterrex ltd

FOR HOMESTAKE CONSULTING

AIRBORNE MAGNETIC / VLF-EM SURVEY

KAPUSKASING ONTARIO

VLF PROFILE MAP 24.8 kHz

SHEET 1 OF 2	POSITIONAL CONTROL . . . . . . BASED ON PHOTOMOSAIC	ALTITUDE = 80 METRES	FLOWN BY KENTING LTD.
SCALE 1: 15840		DATE: OCTOBER 1986	GEOTERREX PROJECT NO. 276

em86-187

2.9705 (dup)

312000 314 316 318 320 322 324 325000

83°34'54" 49°13'15" 5455000 — 83°24'24" 49°13'29" 5455000

5454 — 5452 — 5450 — 5448 — 5446 — 5444

5443000 49°06'46.9" — 83°34'34.5" — 83°23'53.6" 49°07'00.7" 5443000

312000 314 316 318 320 322 324 325000

LEGEND

500 GAMMAS .....
100 GAMMAS .....
25 GAMMAS .....
5 GAMMAS .....

MAGNETIC LOW .....

CONTOUR INTERVAL 5 GAMMAS

+G.R.F. CORRECTED, 10,000 nT ADDED

MAP PROJECTION	UTM
ELLIPSOID	CLARKE 1866
CENTRAL MERIDIAN	81 DEGREES
FALSE EASTING	500000
FALSE NORTHING	0
SCALE FACTOR	0.9996

SCALE 1:15840

200 0 200 400 600 800 1000 1200 1400 1600 Metres

1000 0 1000 2000 3000 4000 Feet

N

29705

COMPILED BY

geoterrex ltd.

FOR

HOMESTAKE CONSULTING

AIRBORNE MAGNETIC / VLF-EM SURVEY

KAPUSKASING
ONTARIO

ISOMAGNETIC CONTOUR MAP

SHEET 2 OF 2	POSITIONAL CONTROL ..... BASED ON	ALTITUDE + 80 METRES	FLOWN BY KENTING LTD.
SCALE 1:15840	PHOTOMOSAIC	DATE: OCTOBER 1986	GEOTERREX PROJECT NO. 276

280

299000 300 302 304 306 308 310 312000

83°45'36.4" 49°13'00.3" 5455000 — 83°34'54.4" 49°13'15.5" 5455000

5454 5452 5450 5448 5446 5444

GOAT RIVER

Caithness Lake

5443000 49°06'32.1" — 83°45'14.8" — 83°34'34.3" — 49°06'46.9" 5443000

LEGEND

5000 GAMMAS/KM .....
1000 GAMMAS/KM .....
250 GAMMAS/KM .....
50 GAMMAS/KM .....
MAGNETIC LOW .....
CONTOUR INTERVAL 50 GAMMAS

A 13X13 POINT SQUARE OPERATOR WAS APPLIED TO THE DIGITAL FIELD GRID. THE DISTANCE BETWEEN COEFFICIENTS WAS 80 METRES. INTERPOLATED TO 40 METRES FOR CONTOURING.

MAP PROJECTION	UTM
SPHEROID	CLARKE 1866
CENTRAL MERIDIAN	81 DEGREES
FALSE EASTING	500000
FALSE NORTHING	0
SCALE FACTOR	0.9996

SCALE 1:15840

200 0 200 400 600 800 1000 1200 1400 1600 Metres

1000 0 1000 2000 3000 4000 Feet

N

29705

COMPILED BY geoterrex LTD.

FOR HOMESTAKE CONSULTING

AIRBORNE MAGNETIC / VLF-EM SURVEY

KAPUSKASING ONTARIO

CALCULATED VERTICAL GRADIENT CONTOUR MAP

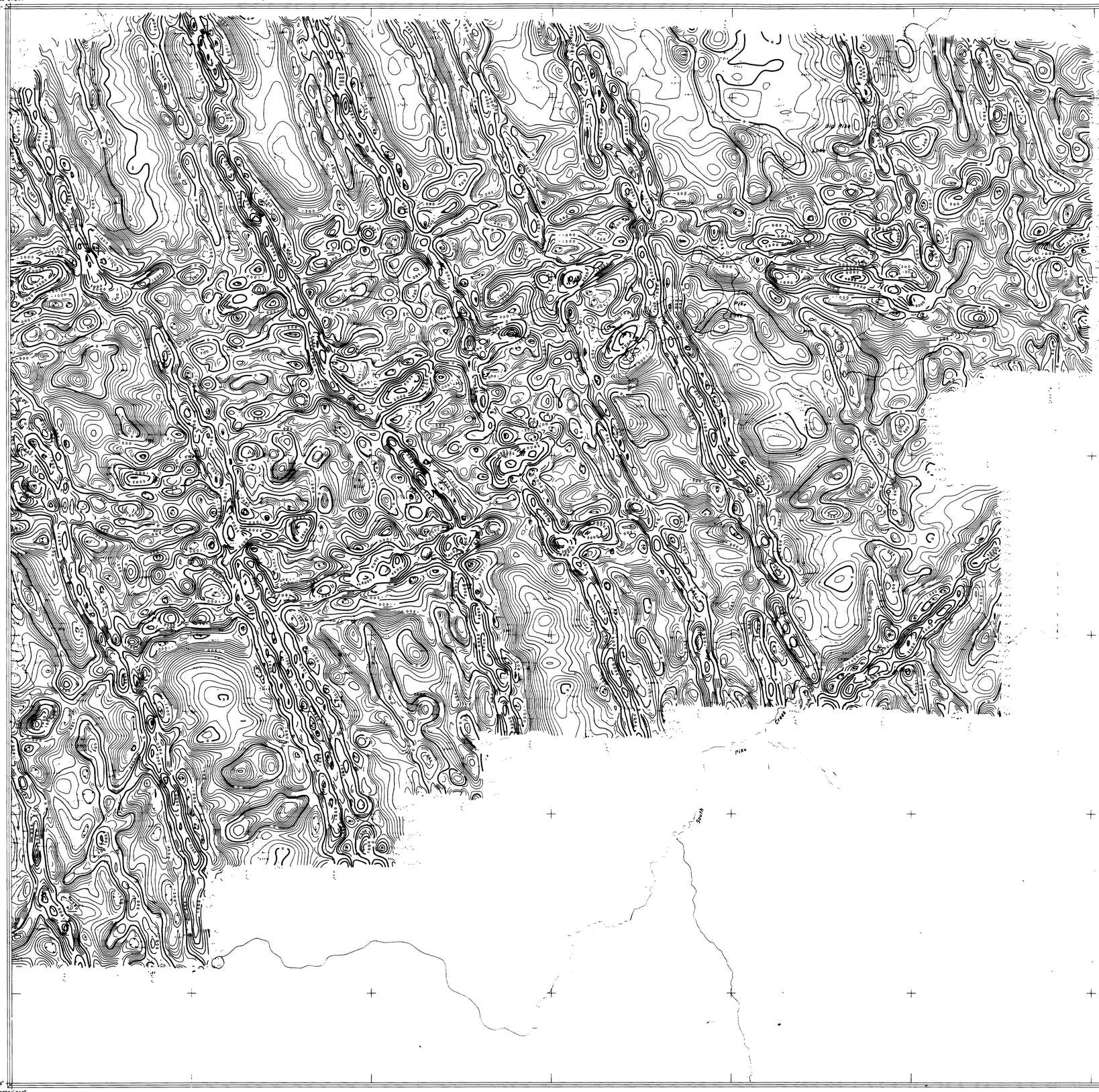
SHEET 1 OF 2	POSITIONAL CONTROL ..... BASED ON	ALTITUDE + 80 METRES	FLOWN BY KENTING LTD.
SCALE 1:15840	PHOTOMOSAIC	DATE: OCTOBER 1986	GEOTERREX PROJECT NO. 276

COL 330

312000 314 316 318 320 322 324 325000

83°34'54.4" 49°3'15.1" 83°24'12.4" 49°3'29.0"

5455000 5454 5452 5450 5448 5446 5444 5443000



83°34'34.3" 49°06'46.9" 83°23'53.6" 49°07'00.7"

3.4 316 318 320 322 324 325000

LEGEND

5000 GAMMAS/KM .....
1000 GAMMAS/KM .....
250 GAMMAS/KM .....
50 GAMMAS/KM .....

MAGNETIC LOW .....

CONTOUR INTERVAL 50 GAMMAS

A 13X13 POINT SQUARE OPERATOR WAS APPLIED TO THE TOTAL FIELD GRID. THE DISTANCE BETWEEN COEFFICIENTS WAS 80 METRES, INTERPOLATED TO 40 METRES FOR CONTOURING.

MAP PROJECTION	: UTM
SPHEROID	: CLARKE 1866
CENTRAL MERIDIAN	: 81 DEGREES
FALSE EASTING	: 500000
FALSE NORTHING	: 0
SCALE FACTOR	: 0.9996

SCALE 1:15840

200 0 200 400 600 800 1000 1200 1400 1600 Metres

1000 0 1000 2000 3000 4000 Feet

N

29705

COMPILED BY geoterrex Ltd.		FOR HOMESTAKE CONSULTING
AIRBORNE MAGNETIC / VLF-EM SURVEY		
KAPUSKASING ONTARIO		CALCULATED VERTICAL GRADIENT CONTOUR MAP
SHEET 2 OF 2	POSITIONAL CONTROL ..... BASED ON	ALTITUDE = 80 METRES
SCALE 1:15840	PHOTOGRAPHIC	DATE: OCTOBER 1986
		FLOWN BY KENTING LTD.
		GEOTERREX PROJECT NO. 276

340