# REPORT ON A COMBINED HELICOPTER-BORNE MAGNETIC, ELECTROMAGNETIC AND VLF-EM SURVEY HURDMAN PROJECT - AREA A SMOOTH ROCK FALLS AREA, ONTARIO

FOR

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July 17, 1991

J9136A

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# LIST OF MAPS

Maps are labelled according to map type. All black line and colour maps are presented at a scale of 1:10,000. The total magnetic field shadow map is presented at a scale of 1:20,000. Survey results are presented in 2 map sheets (1:10,000 scale) and one map sheet (1:20,000 scale).

**BLACK LINE MAPS: (Scale 1:10,000)**

| Map Type | Description |
|---|---|
| 1. | **BASE MAP;** screened photomosaic base plus survey area boundary, claim block boundaries, UTM reference corners, title block and surrounds. |
| 2. | **COMPILATION/INTERPRETATION MAP;** base map plus flight path, EM anomaly symbols and interpretation. |
| 3. | **TOTAL FIELD MAGNETIC CONTOURS;** with base map and flight lines. |
| 4. | **VERTICAL MAGNETIC GRADIENT CONTOURS;** with base map and flight lines. |
| 5. | **VLF-EM TOTAL FIELD CONTOURS;** with base map and flight lines. |

**COLOUR MAPS: (Scale 1:10,000)**

| | |
|---|---|
| 1. | **TOTAL FIELD MAGNETICS;** with superimposed contours, base map, flight lines and EM anomaly symbols. |
| 2. | **VERTICAL GRADIENT MAGNETICS;** with superimposed contours, base map, flight lines and EM anomaly symbols. |
| 3. | **VLF-EM TOTAL FIELD;** with superimposed contours and base map, flight lines, fiducials and EM anomaly symbols. |
| 4A. | **HEM OFFSET PROFILES;** 935 Hz and 33,000 Hz data with base map, flight lines and EM anomaly symbols. |
| 4B. | **HEM OFFSET PROFILES;** 4175 Hz and 4600 Hz data with base map, flight lines and EM anomaly symbols. |

COMPOSITE COLOUR MAP: (Scale 1:10,000)

5. **TOTAL FIELD MAGNETICS;** with superimposed contours, base map, flight lines and EM anomaly symbols (Areas A and B).

DERIVATIVE COLOUR MAP: (Scale 1:20,000)

1-A. **TOTAL FIELD MAGNETICS SHADOW MAP;** at an illumination direction selected after consultation with McKinnon (Areas A and B).

# REPORT ON A
# COMBINED HELICOPTER-BORNE
# MAGNETIC, ELECTROMAGNETIC AND VLF-EM SURVEY
# HURDMAN PROJECT - AREA A
# SMOOTH ROCK FALLS AREA, ONTARIO

## 1. INTRODUCTION

This report describes airborne geophysical surveys carried out on behalf of McKinnon Prospecting (McKinnon), by Aerodat Limited under a contract dated May 23, 1991. Principal geophysical sensors included a five frequency electromagnetic system, a high sensitivity cesium vapour magnetometer and a two frequency VLF-EM system. Ancillary equipment included an electronic navigation system, a colour video tracking camera, a radar altimeter, a power line monitor and a base station magnetometer.

The survey was carried out over an area in Hurdman Township, 25 kilometres north of Smooth Rock Falls. The survey area is some 37 square kilometres over all or parts of three claim groups. The survey area is designated area A to distinguish it from a group of 71 claims which is almost surrounded by survey area A. The group of 71 claims is designated Area B. Both areas were surveyed with one airborne grid. This report describes the results over Area A. Some maps which show survey results over combined Areas A and B are included. The results over Area B are described in a separate report under the Aerodat job number J9136B.

The total coverage over area A was approximately 460 line kilometres. The total coverage over both areas A and B together was some 560 line km. The flight line spacing was 125 m. The Aerodat Job Number is J9136A.

This report describes the survey, the data processing and the data presentation. Electromagnetic anomalies which are thought to be the response to bedrock conductors have been identified and appear on selected map products as EM anomaly symbols with interpreted source characteristics. Where EM results supported it, anomaly centers are joined to form conductor axes. Recommendations concerning areas with favourable geophysical characteristics are made with reference to a compilation/interpretation map.

## 2. SURVEY AREA

The survey area is north of Highway 11 running between Cochrane and Kapuskasing and some 25 km north and slightly west of Smooth Rock Falls, Ontario. Area topography is shown on the 1:50,000 scale NTS maps 42H/5 - Smooth Rock Falls and 42H/12 - Abimatinu River.

Local relief is flat - elevations are 220 ±10 metres. The area is free of major roads, power lines, railroads, etc.

The survey area is shown in the attached index map which includes local topography and latitude - longitude coordinates. Survey areas A and B are shown on this index map. This index map also appears on all map legends.

The flight line direction was north-south. The survey area was covered with a line spacing of 125 m. One magnetic tie line was flown.

In this general area, the earth's magnetic field has a declination of 8° west of north and an inclination of 77°.

## 3. SURVEY PROCEDURES

The survey was flown on May 28 and 29, 1991. Principal personnel are listed in Appendix IV. Fiver (5) survey flights were required to complete the project.

The flight line spacing was 125 m. The aircraft ground speed was maintained at approximately 60 knots (30 metres per second). The nominal EM sensor height was 30 metres, consistent with the safety of the aircraft and crew.

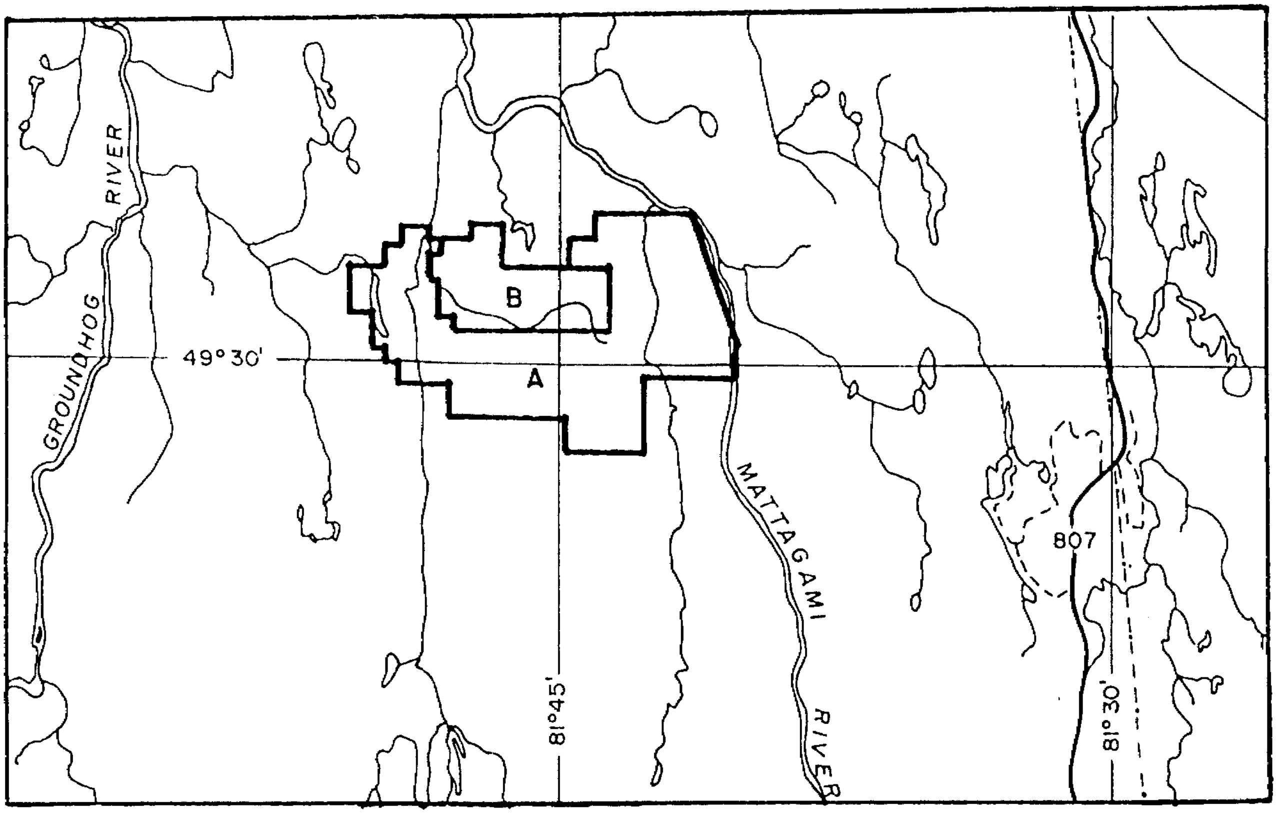
An GPS navigation system was used to guide the pilot over the survey grid and to generate a digital record of position. This is an autonomous system which does not require the installation of ground transponders.

The UTM coordinates of survey area corners were taken from maps provided by McKinnon. These coordinates are used to program the navigation system. A test flight was used to confirm that area coverage would be as required.

Thereafter the traverse lines are flown under the guidance of the navigation system. The navigator/operator marked manual fiducials over prominent topographic features. These were entered on the navigator's map - a 1:10,000 scale topographic map (a 5 times photographic enlargement of local 1:50,000 scale NTS maps). Survey lines which showed excessive deviation were re-flown.

The magnetic tie line was flown using visual navigation in areas of low topographic and magnetic relief. Aircraft position was taken from the navigation system.

Calibration lines are flown at the start, middle (if required) and end of every survey flight. These lines are flown outside of ground effects to record electromagnetic zero levels.




**HELICOPTERBORNE GEOPHYSICAL SURVEY**
**HURDMAN PROJECT - AREA A**

**on behalf of**
**MCKINNON PROSPECTING**

**BY**

**AERODAT LIMITED**
**J9136A**

## 4. DELIVERABLES

The results of the survey are presented in a report plus maps. The report is presented in four copies. White print copies of all black line maps are folded and bound with the report.

The colour and shadow maps are delivered in four copies. The colour and shadow maps are rolled and delivered in map tube(s).

A full list of all map types is given at the beginning of this report. A summary is given here.

| MAP TYPE | DESCRIPTION |
|---|---|
| 1 | Base Map (Black line) |
| 2 | Compilation/Interpretation Map (Black line) |
| 3 | Total Magnetic Field Contours (Black line) |
| 4 | Vertical Magnetic Gradient Contours (Black line) |
| 5 | VLF-EM Total Field Contours (Black line) |
| | |
| 1 | Total Magnetic Field Contours (Colour) |
| 2 | Vertical Magnetic Gradient Contours (Colour |
| 3 | VLF-EM Total Field Contours (Colour) |
| 4A | HEM Offset Profiles - 935 & 33,000 Hz (Colour) |
| 4B | HEM Offset Profiles - 4175 & 4600 Hz (Colour) |
| 5 | Total Magnetic Field - Areas A and B - (Colour) |
| 1A | Total Field Magnetic Shadow Map-Areas A and B-(Colour) |

All black line and colour maps are presented at a scale of 1:10,000. The shadow map is presented at a scale of 1:20,000. All black line maps show a screened photomosaic base, UTM reference corners, the survey area boundary and the outline of three claim blocks which are covered in whole or in part by the survey area. Numbers of corner claims are shown where appropriate. All colour and shadow maps show the survey area boundary and the UTM reference corners. Results are presented in two map sheets.

The processed digital data is organized on 9 track archive tape. Both the profile and the gridded data are saved on tape. A full description of the archive tape(s) is delivered with the tape(s).

All gridded data are also provided on diskettes suitable for displaying on IBM compatible 286 or 386 microcomputers using the Aerodat RTI software package.

All analog records, base station magnetometer records, flight path video tape and original map cronaflexes are delivered with the final presentation.

## 5. AIRCRAFT AND EQUIPMENT

### 5.1 Aircraft

An Aerospatiale ASTAR 350B (C-GJIX), owned and operated by Questral Helicopters, was used for the survey. Installation of the geophysical and ancillary equipment was carried out by Aerodat. The survey aircraft was flown at a mean terrain clearance of 60 metres.

### 5.2 Electromagnetic System

The electromagnetic system was an Aerodat 5-frequency system. Two vertical coaxial coil pairs were operated at 935 Hz and 4,600 Hz and three horizontal coplanar coil pairs at 850, 4,175 and 33,000 Hz. The transmitter-receiver separation was 7 metres. Inphase and quadrature signals were measured simultaneously for the 5 frequencies with a time constant of 0.1 seconds. The HEM bird was towed 30 metres below the helicopter.

### 5.3 VLF-EM System

The VLF-EM System was a Herz Totem 2A. This instrument measures the total field and vertical quadrature components of two selected frequencies. The sensor was towed in a bird 15 metres below the helicopter.

VLF transmitters are designated "Line" and "Ortho". The line station is that which is in a direction from the survey area which is ideally normal to the flight line direction. This is the VLF station most often used because of optimal coupling with near vertical conductors running perpendicular to the flight line direction. The ortho station is ideally 90 degrees in azimuth away from the line station.

The transmitters used were NAA, Cutler, Maine broadcasting at 24.0 kHz and NLK, Jim Creek, Washington broadcasting at 24.8 kHz. From the survey area, Cutler is 20° south of east and Jim Creek is west. Cutler was used as the line station throughout.

### 5.4 Magnetometer

The magnetometer employed a Scintrex H8 cesium, optically pumped magnetometer sensor. The sensitivity of this instrument is 0.001 nanoTeslas at a 0.2 second sampling rate. The sensor was towed in a bird 15 metres below the helicopter.

### 5.5 Ancillary Systems

#### Base Station Magnetometer

An IFG-2 proton precession magnetometer was set up at the base of operations to record diurnal variations of the earth's magnetic field. The clock of the base station was synchronized with that of the airborne system to facilitate later correlation. Recording resolution was 1 nT. The update rate was 4 seconds.

External magnetic field variations are recorded on a 3" wide paper chart and in digital form. The analog record shows the magnetic field trace plotted on a grid. Each division of the grid (0.25") is equivalent to 1 minute (chart speed) or 5 nT (vertical sensitivity). The date, time and current total field magnetic value are printed every 10 minutes.

## Radar Altimeter

A King KRA-10 radar altimeter was used to record terrain clearance. The output from the instrument is a linear function of altitude.

## Tracking Camera

A Panasonic colour video camera was used to record flight path on VHS video tape. The camera was operated in continuous mode. The flight number, 24 hour clock time (to .01 second), and manual fiducial number are encoded on the video tape.

## Electronic Navigation Systems

A Trimble TANS GPS positioning system was used to guide the pilot over a programmed grid. The UTM coordinates were digitally recorded. The output sampling rate is 1 second. Positional coordinates are recorded with a resolution of 0.1 m.

## Analog Recorder

A RMS dot matrix recorder was used to display the data during the survey. Record contents are as follows:

| Label | Contents | Scale |
|---|---|---|
| GEOPHYSICAL SENSOR DATA | | |
| MAGF | Total Field Magnetics, Fine | 2.5 nT/mm |
| MAGC | Total Field Magnetics, Course | 25 nT/mm |
| VLT | VLF-EM, Total Field, Line Station | 2.5 %/mm |
| VLQ | VLF-EM, Vertical Quadrature, Line Station | 2.5 %/mm |
| VOT | VLF-EM, Total Field, Ortho Station | 2.5 %/mm |
| VOQ | VLF-EM, Vertical Quadrature, Ortho Station | 2.5 %/mm |
| CXI1 | 935 Hz, Coaxial, Inphase | 2.5 ppm/mm |
| CXQ1 | 935 Hz, Coaxial, Quadrature | 2.5 ppm/mm |
| CXI2 | 4600 Hz, Coaxial, Inphase | 2.5 ppm/mm |
| CXQ2 | 4600 Hz, Coaxial, Quadrature | 2.5 ppm/mm |
| CPI1 | 850 Hz, Coplanar, Inphase | 10 ppm/mm |
| CPQ1 | 850 Hz, Coplanar, Quadrature | 10 ppm/mm |
| CPI2 | 4175 Hz, Coplanar, Inphase | 10 ppm/mm |

| | | |
|---|---|---|
| CPQ2 | 4175 Hz, Coplanar, Quadrature | 10 ppm/mm |
| CPI3 | 33000 Hz, Coplanar, Inphase | 20 ppm/mm |
| CPQ3 | 33000 Hz, Coplanar, Quadrature | 20 ppm/mm |

ANCILLARY DATA

| | | |
|---|---|---|
| RALT | Radar Altimeter | 10 ft/mm |
| PWRL | 60 Hz Power Line Monitor | - |

The analog zero of the radar altimeter trace is 5 cm from the top of the analog record. A helicopter terrain clearance of 60 m (197 feet) will be seen as an analog trace 3 cm from the top of the analog record.

Chart speed is 2 mm/second. The 24 hour clock time is printed every 20 seconds. The total magnetic field value is printed every 30 seconds. The ranges or preliminary UTM coordinates from the electronic navigation system are printed every minute.

Vertical lines crossing the record are operator activated manual fiducial markers. The start of any survey line is identified by two closely spaced manual fiducials. The end of any survey line is identified by three closely spaced manual fiducials. Manual fiducials are numbered in order. Every tenth manual fiducial is indicated by its number, printed at the bottom of the record.

Calibration sequences are located at the start and end of each flight and at intermediate times where needed.

## Digital Recorder

A DGR-33 data system recorded the digital survey data on magnetic media. Contents and update rates were as follows:

| DATA TYPE | RECORDING INTERVAL | RECORDING RESOLUTION |
|---|---|---|
| Magnetometer | 0.2 s | 0.001 nT |
| VLF-EM (4 Channels) | 0.2 s | 0.03 % |
| HEM (10 Channels) | 0.1 s | 0.03 ppm (coaxial),<br>0.06 ppm (coplanar - 4175 Hz)<br>0.125 ppm (coplanar - 33 kHz) |
| Position (2 Channels) | 0.2 s | 0.1 m |
| Altimeter | 0.2 s | 0.05 m |
| Power Line Monitor | 0.2 s | - |
| Manual Fiducial | | |
| Clock Time | | |

# 6. DATA PROCESSING AND PRESENTATION

## 6.1 Base Map

The base map is a semi-controlled photomosaic prepared by Aerodat using aerial photographs form the Government of Ontario. UTM reference corners, the survey area boundary and the outline of three claim blocks were added. The claim blocks were taken from 1" = 1/2 mile claim maps provided by McKinnon. The claim number of corner claims are shown where appropriate.

## 6.2 Flight Path Map

The flight path is drawn using linear interpolation between x,y positions from the navigation system. These positions are updated every second (or about 3 mm at a scale of 1:10,000). These positions are expressed as UTM eastings (x) and UTM northings (y).

Occasional dropouts occur when electronic navigation is temporarily lost. Interpolation is used to cover short gaps in the flight path. The navigator's flight path and/or the flight path recovered from the video tape may be stitched in to cover larger gaps. Such gaps may often be recognized by the distinctive straight line character of the flight path.

The manual fiducials are shown as a small circle and labelled by fiducial number. The 24 hour clock time is shown as a small square, plotted every 30 seconds. Small tick marks are plotted every 2 seconds. Larger tick marks are plotted every 10 seconds. The line and flight numbers are given at the start and end of each survey line.

The flight line and flight numbers are shown at both ends of each survey line. 104803 indicates for example, line 48 and flight number 3.

The flight path map is merged with the base map by matching UTM coordinates from the base maps and the flight path record. The match is confirmed by checking the position of prominent topographic features as recorded by manual fiducial marks or as seen on the flight path video record.

## 6.3 Electromagnetic Survey Data

The electromagnetic data were recorded digitally at a sample rate of 10 per second with a time constant of 0.1 seconds. A two stage digital filtering process was carried out to reject major sferic events and the reduce system noise.

Local sferic activity can produce sharp, large amplitude events that cannot be removed by conventional filtering procedures. Smoothing or stacking will reduce their amplitude but leave a broader residual response that can be confused with geological phenomena. To avoid this possibility, a computer algorithm searches out and rejects the major sferic events.

The signal to noise ratio was further enhanced by the application of a low pass digital filter. This filter has zero phase shift which prevents any lag or peak displacement from occurring, and it suppresses only variations with a wavelength less than about 0.25 seconds. This low effective time constant gives minimal profile distortion.
Following the filtering process, a base level correction was made using EM zero levels determined during high altitude calibration sequences. The correction applied is a linear function of time that ensures the corrected amplitude of the various inphase and quadrature components is zero when no conductive or permeable source is present.

The filtered and levelled EM data are presented as colour offset profiles - see map types 4A and 4B. Vertical presentation scales are 2 ppm/mm (935 and 4600 Hz), 8 ppm/mm (4175 Hz) and 32 ppm/mm (33,000 Hz). The additional low frequency coplanar data collected by the 5-frequency HEM system has not been presented.

## 6.4 Total Field Magnetics

The aeromagnetic data were corrected for diurnal variations by adjustment with the recorded base station magnetic values. Where needed, the magnetic tie line results were used to further level the magnetic data. No corrections for regional variations were applied. The data was reduced to the pole. The corrected profile data were interpolated on to a regular grid using an Akima spline technique. The grid provided the basis for threading the presented contours. The minimum contour interval is 5 nT. A grid cell size of 25 m was used.

Page size copies of the black line contour maps of the total magnetic field are attached.

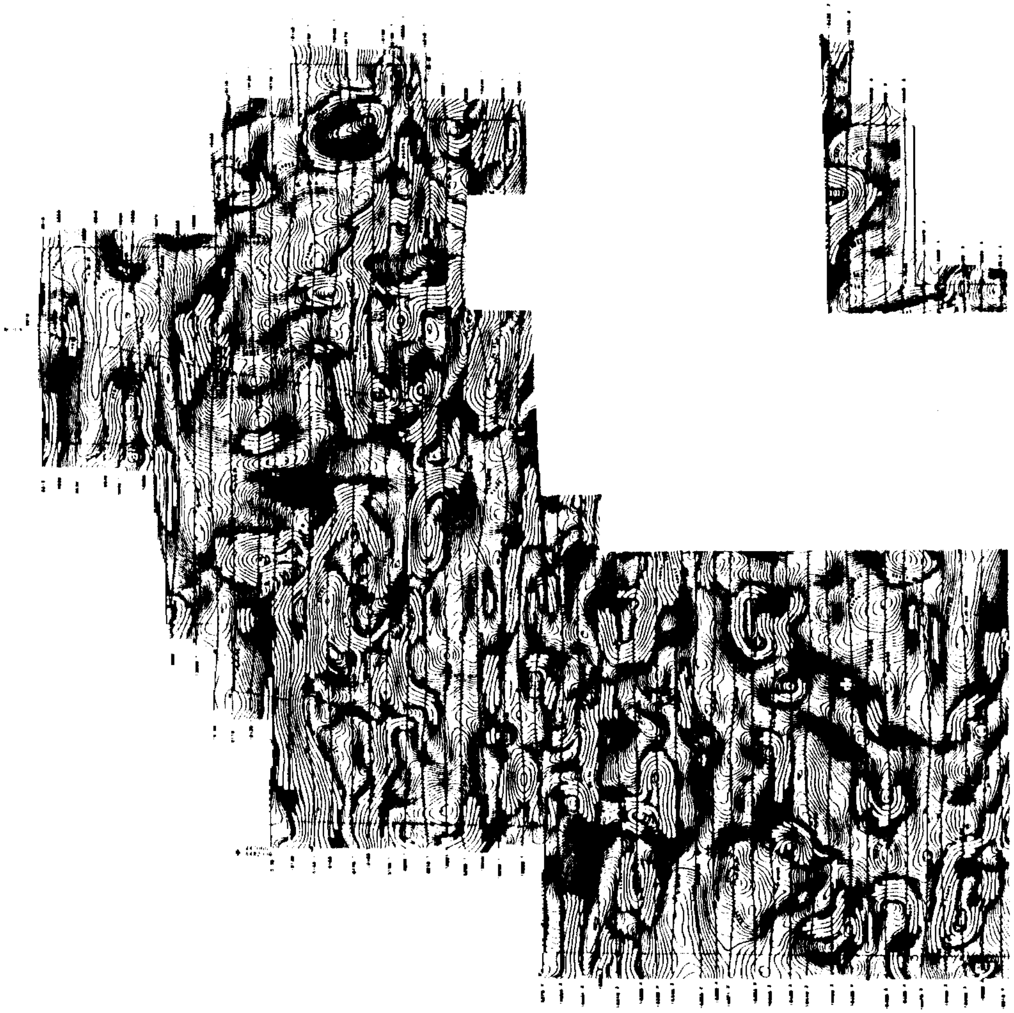
## 6.5 Vertical Magnetic Gradient

The vertical magnetic gradient was calculated from the gridded total field magnetic data. The calculation is based on a 17 x 17 point convolution in the space domain. The results are contoured using a minimum contour interval of 0.2 nT/m. Grid cell sizes are the same as those used in processing the total field data.

## 6.6 VLF-EM

The VLF Total Field data from the Line Station is levelled such that a response of 0% is seen in non-anomalous regions. The corrected profile data are interpolated onto a regular grid using an Akima spline technique. The grid provided the basis for threading the presented contours. The minimum contour interval is 1%. Grid cell size is 25 m.

The resulting contour maps of the VLF total field are of uncertain quality. There appears to have been some difficulty either with the receiver or with an intermittent or unreliable transmitter.



Flight Path

Magnetics

MCKINNON PROSPECTING

TOTAL FIELD MAGNETIC CONTOURS

HURDMAN PROJECT

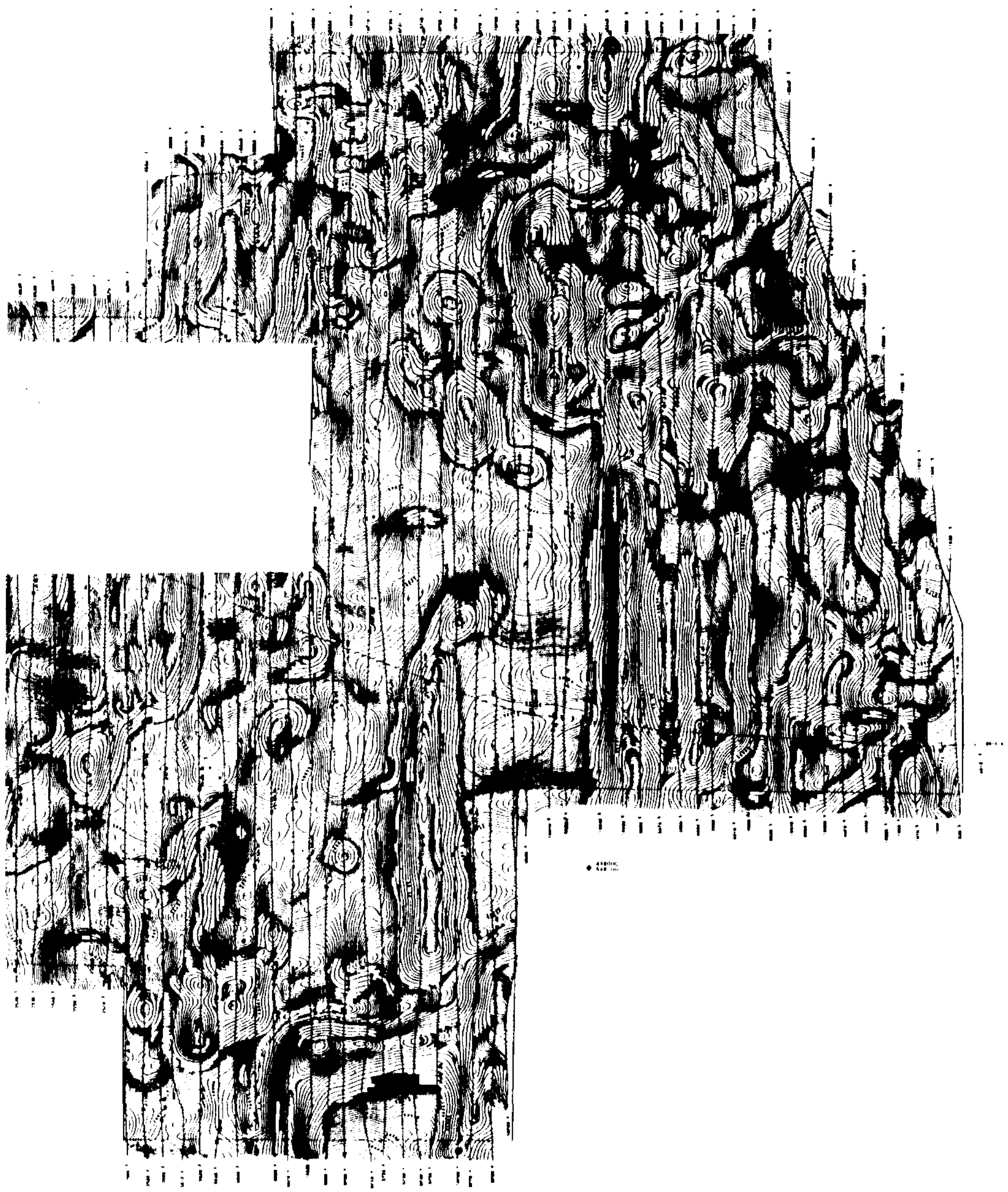
ONTARIO

AERODAT LIMITED

MAY 1991

42 H/5

3



Flight Path

Magnetics

MCKINNON PROSPECTING

TOTAL FIELD MAGNETIC CONTOURS

HURDMAN PROJECT

AERODAT LIMITED

MAY 1991

# 7. INTERPRETATION

## 7.1 Area Geology

Most of the notes on area geology and on the exploration target (see Section 7.2 below) have been taken from a Preliminary Geological Report on the Hurdman Project, for Mattagami Lake Exploration Limited by Paul Nielsen, November, 1979. A copy of this report has been provided by Bruce Durham, consulting geologist, on behalf of McKinnon Prospecting.

* Outcrop exposure is sparse and is primarily concentrated along major creeks and rivers. Much of the area is covered by overburden of glacial, glacial fluvial and lacustrine origin with an average thickness of less than 30 m. The lack of outcrop exposure makes geological interpretation difficult.

* The area is principally underlain by an Archean migmatite - metasedimentary - metavolcanic complex which shows wide variations in compostion and metamorphic structure.

* acid igneous batholiths of granite to granodiorite composition intrude the complex.

* north-south trending Proterozoic diabase dykes intrude all rocks in the area.

The 1:250,000 scale GSC aeromagnetic map (7099G) shows variations in and around the survey area of from 60,000 to 60,200. Peak values are 59,960 and 60,400. Anomaly shapes are elliptical with no preferred orientation or distinctive character. There is no evidence in the survey area of north/south dykes. There is evidence of such dykes to the south. A 10 km wide band of ne/sw trending regional faults appears to pass over the survey area.

## 7.2 Exploration Target

The exploration target is massive metallic sulphide mineralization. Both copper and zinnc sulphides have been discovered on or near the survey area during an exploration history which goes back to the 1960's. The discovery of subeconomic quantities of zinc and copper mineralization in Hurdman Township stimulated a minor rush of claim staking and exploration in the mid-1960's. Mineralization was encountered in several INCO diamond drill holes. Mineralization intercepted consists of slightly disseminated to massive pyrite, pyrrhotite and sphalerite or chalcopyrite associated with metasediments, parogneisses and pegmatites.

These base metal deposits are thought to represent formational sulphide units interbedded with clastic sedimentary rocks. Deposits of this type are typically variable in width extending over long strike lengths. Massive sulphide deposits in the Snow Lake area of Manitoba display similar characteristics, representing distal sulphide deposits, formed in sedimentary environments flanking major volcanic zones.

The area has been one of intermittent exploration activity since the initial discoveries. This has included airborne and ground geophysical surveys and diamond drilling. Some of the prominent EM conductors in or near the area have been extensively tested by Noranda. Only one incidence of graphite has been encountered in the drilling results to date. All other drilled conductors have proved to be massive metallic sulphides.

## 7.3 EM Anomaly Selection and Analysis

### A. Selection

EM anomalies have been picked from analog records and offset profile maps. The selection is based on satisfying any of the following criterion.

* a detectable 935 Hz inphase response.
* a positive 4600 Hz inphase response with coincident 4175 Hz inphase low.
* a positive 4600 Hz inphase response with a coincident proportionately higher 4175 Hz inphase response

These criteria should result in the identification of all possible bedrock conductors. Even horizontal conductors should be identifiable by their edge effects. (see Appendix 1).

These criteria reject EM anomalies due to gradual changes in overburden thickness or resistivity. For such anomalies, the coaxial and coplanar channels (either inphase or quadrature) for the same operating frequency move together and no separation is seen. This information is best viewed in maps of apparent resistivity.

The width of an anomaly from a bedrock conductor will depend principally on depth of burial, dip and orientation with respect to flight line direction. A near vertical conductor running normal to the flight lines will yield a coaxial EM anomaly whose width is about 2.5 times the source-sensor separation (measured from 20% of the anomaly peak). The anomaly from such conductors at surface will therefore be about 80 m. The comparable figures for a conductor under 50 m of overburden is 220 m.

Anomalies are judged to be due to cultural sources if there is a coincident response in the power line monitor as seen on the analog records. Where EM anomalies of a uniform style line up over a major road, railroad or other man made conductor but where there is no response in the power line monitor, such anomalies are also shown as due to cultural sources. No cultural anomalies were identified.

Special care is taken in areas of negative inphase response (due to magnetite). The quadrature channels may be the only indicators of a coincident conductor.

### B. Analysis

The EM anomaly response amplitudes at 935 Hz are used to estimate the conductance and depth of burial of a vertical thin sheet conductor model. These data appear in the anomaly listings in Appendix II.

The inphase anomaly amplitude and the thin sheet conductance range as determined from the 935 Hz response amplitudes are shown with the plotted anomaly symbols. Each anomaly is identified by flight line number and letter.

Cultural anomalies are shown as open squares. Each anomaly is identified by a letter.

Conductive overburden will generally reduce thin sheet conductance estimates because of elevated background levels in the quadrature channels. Depth of burial estimates will in general be too small.

## 7.4 General Comments

### EM

The HEM offset profiles show the long period responses expected from variations in overburden conductivity or thickness. Neither is considered extreme and the detection of bedrock conductors should not be seriously impeded by overburden masking.

A number of strong EM responses are seen. These are characterised for the most part by good 935 and 4600 Hz inphase responses and only slight coincident responses in the 4600 Hz quadrature channel. These are the characteristics of bedrock conductors of moderate to high conductance such as most massive metallic sulphides.

There are in addition EM anomalies which are thought to be caused by weak bedrock conductors. These are usually characterized by complimentary responses in the 4600/4175 Hz coil pairs but a weak response in the 935 Hz inphase channel. The result is a low (1 to 4 mhos) conductance estimate.

Both conductor types - strong and weak as measured by conductance - may be of interest. The difference may be in the relative concentrations of chalcopyrite and sphalerite.

Many of the strongest EM anomalies show coaxial responses which are asymmetric - one side of the anomaly is quite steep, the other side is more gradual. The steep side is often the southern side - the gradual side is the northern side. A conductor at or near surface which dips to the north at less than 45° is expected.

This model of conductor geometry is often supported by the coplanar responses. The 4175 Hz inphase trace often shows an anomaly which is similar in shape and relative amplitude to the 4600 Hz inphase anomaly but with the peak shifted some 50 m to the north.

Where the coaxial and coplanar responses coincide, the conductor is either flat lying or is the flat top of a wide tabular source.

In either case, the EM anomalies seen are not generally those of near vertical thin sheet conductors. This is unusual.

## MAGNETICS

The contoured total field magnetic map is dominated by intermediate amplitude (250 to 500 nT) linear anomalies with a north/south trend. These magnetic anomalies appear to bear little direct relationship to the EM conductors which trend east/west ±45°.

A number of faults have been interpreted from breaks and discontinuities in the vertical gradient contour map. Two directions dominate - nw/se and ne/sw. Faults which may trend n/s go undetected.

The dominant north/south trend in the magnetics suggests a series of dykes which have been overprinted on the original geology which may have been more east/west. These dykes appear to have interrupted east/west structures and may have caused north/south dislocations. The bedrock conductors which show an east/west trend are thought to have been put in place before these dykes.

## 7.5 Compilation Map

The compilation map shows:

- EM conductor axes
- magnetic axes
- faults (inferred from the magnetics)
- favourable target area labels

Page size copies of the compilation maps are attached.

Conductor axes are drawn through EM anomaly centers using similarities in EM anomaly patterns.

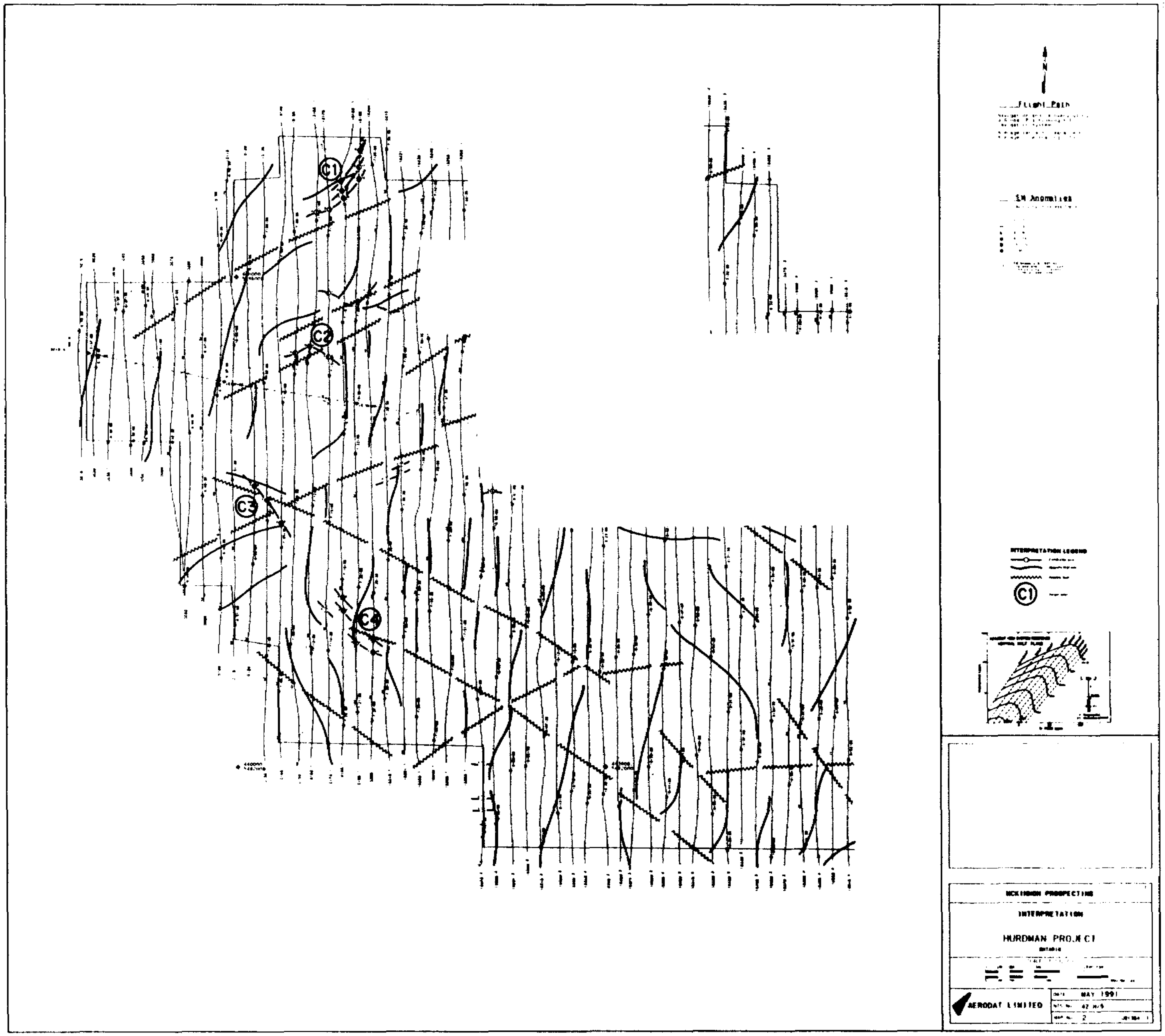
Magnetic axes are drawn through the peak of prominent vertical gradient anomalies. Vertical gradient anomalies which are circular or of short strike length are not well represented by magnetic axes.

Faults are inferred from breaks seen in the black line contour map of vertical gradient data.

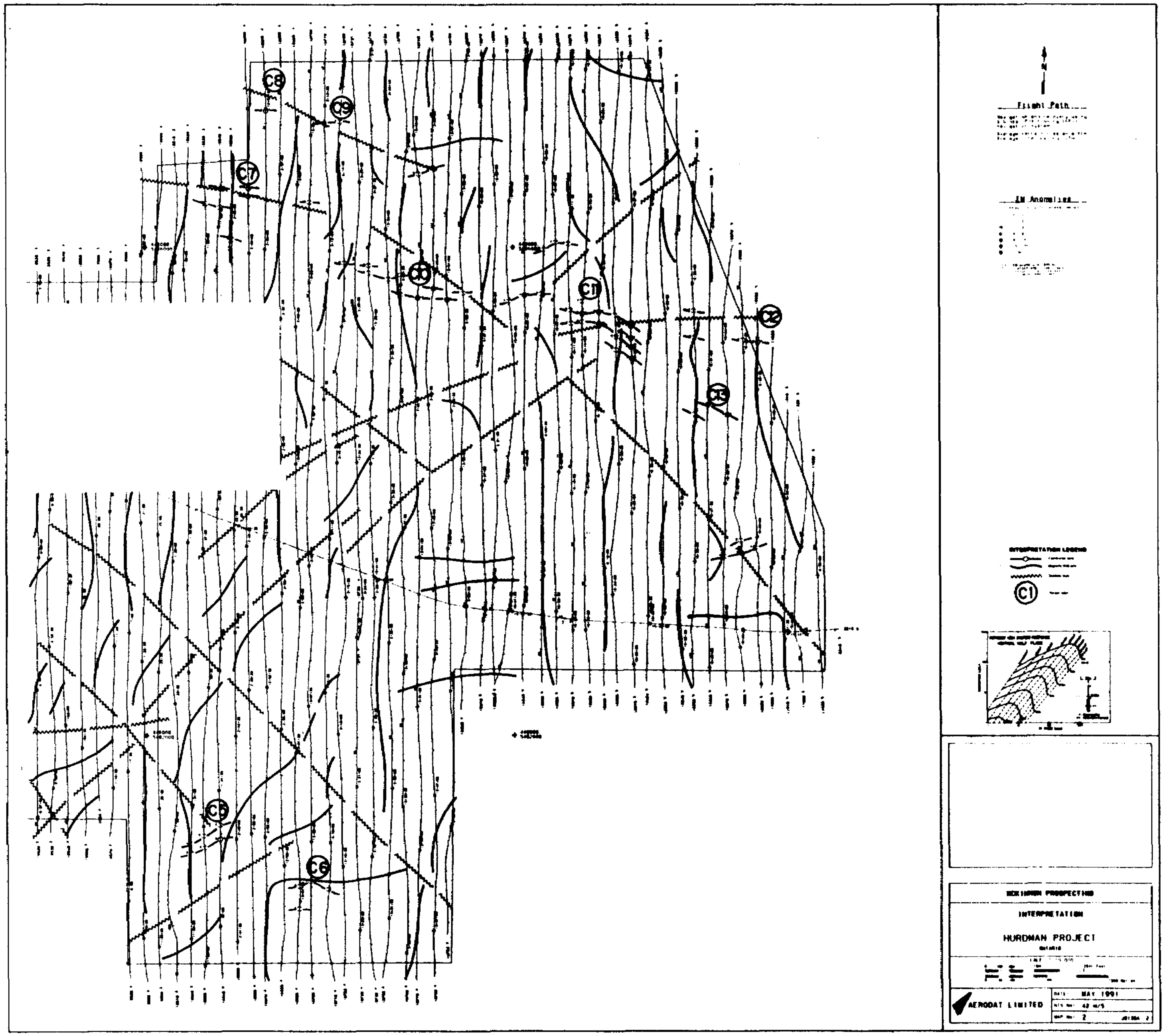
## 7.6 Favourable Areas

Favourable areas are labelled on the compilation maps as C1 to C13. Each area is an EM conductor or group of conductors which has been thought to have a promising response character. This includes a detectable 935 Hz anomaly and/or complimentary responses in the 4600/4175 Hz inphase channels. Weak and isolated EM responses have been passed over.

Favourable area (C1 to C13) are identified below by the position of the best EM anomaly in the conductor(s) or the central EM anomaly where they are of equal promise. This position is given by the survey line number and the 24 hour clock time.



N
Flight Path
EM Anomalies
INTERPRETATION LEGEND
C1
C2
C3
C4
INTERPRETATION
HURDMAN PROJECT
AERODAT LIMITED
MAY 1991
2



C1
C2
C3
C5
C6
C7
C8
C9
Flight Path
EM Anomalies
C1
INTERPRETATION
HURDMAN PROJECT
AERODAT LIMITED
MAY 1991
2

Target area labelling starts in the north west part of the survey area (C1) and increases to the south east (C13).

C1: Line 1018 (17:18:00)

A group of up to three parallel conductors of up to 750 m length. The 935 Hz inphase anomaly at this position is the strongest in the survey area. The peak amplitude is 40 ppm. The coaxial 4600 Hz inphase and coplanar 4175 Hz inphase anomalies are nearly identical in shape. The 4175 Hz anomaly peak is shifted to the north. A near flat lying or wide tabular conductor would explain these responses. If a thin sheet conductor is involved, a shallow dip (less than 45°) to the north is probable.

Conductance estimates are high (8 to 30 mhos). This is the expected result given the high inphase to quadrature peak amplitude ratios.

This group of conductors shows a coincident 300 nT magnetic anomaly although the magnetic anomaly peak is some 200 m north of the position given. The match between the aeromagnetic and the EM data is particularly good on line 1019 where both maps trend north/south.

C2: Line 1016 (17:11:28)

A three line conductor with low EM response amplitudes (less than 4 ppm in 935 Hz inphase) but moderate conductance estimates (2 to 8 mhos). Although EM responses are weak, the shapes and positions are similar to those of C1. A shallow dip to the north is indicated. The anomaly centre represents the leading edge of the conductor.

This conductor has no clear magnetic expression.

A single line EM anomaly to the north (Line 1017 (17:15:47)) is almost as interesting. It is isolated however and there is no detectable 935 Hz inphase anomaly (less than 1 ppm). The conductance estimate (4 to 8 mhos) is unreliable.

C3: Line 1013 (17:01:34)

A three line conductor with a nw/se strike. EM peak response amplitudes are 15 and 20 ppm in the 935 and 4600 Hz inphase channels at the position given. EM response patterns in the coaxial/coplanar channels are similar to those seen with C1 but reversed. A shallow dip to the south-west is indicated.

There is no clear coincident magnetic anomaly with this conductor.

C4: Line 1020 (17:26:43)

This position is midway between two 935 Hz inphase peaks with an along track separation of about 125 m. Peak amplitudes are 13 and 15 ppm. Conductance estimates are 8 to 15 mhos.

At this position the 4175 Hz inphase channel shows a clear peak. This combination of responses strongly support a flat lying or wide tabular bedrock conductor. No evidence of a non-zero dip is seen.

The conductors in this group are shown trending nw/se and in a line with C3.

C5: Line 1064 (11:41:40)

A low amplitude (3 ppm) broad 935 Hz inphase response. There is a coincident and proportionate response in the 4175 Hz inphase channel. The source is thought to be flat (or wide), at a relatively large depth of burial and of moderate to high conductance. Low response amplitudes and the suggested source geometry make the conductance estimate (based on a vertical thin sheet model in a resistive host) unreliable.

This position corresponds to a 200 nT magnetic peak. The relationship between the conductor axis and the local magnetic trends is not clear.

C6: Line 1069 (13:01:04)

This is the strongest EM anomaly in a group of four which are shown to make up two conductor axes. EM response amplitudes are 3 and 20 ppm in the 935 and 4600 Hz inphase channels. The 4600 Hz inphase peak is quite sharp - a near surface conductor with a moderate dip to the south (45° to 75°) is indicated.

The conductor has a coincident 400 to 500 nT magnetic anomaly. The conductor is near the point where a relatively strong magnetic feature which trends e/w turns to straight south.

C7: Line 1064 (11:39:21)

Two EM anomalies on this line form part of a group of conductors. EM peak amplitudes at this location are 6 and 27 ppm in the 935 and 4600 Hz inphase channels. The 4600 Hz peak is sharp - a near surface, this sheet conductor , which runs normal to the flight line direction is expected. An asymmetry in the 4175 Hz inphase channel suggests a moderate dip to the south.

This EM anomaly has a corresponding 50 to 75 nT magnetic anomaly. Magnetic trends are n/s however. This does not fit with a bedrock conductor striking e/w.

C8: Line 1067 (12:54:30)

A one line EM anomaly with 7 and 30 ppm peak amplitudes (935 and 4600 Hz inphase) and coincident magnetic anomaly (100 nT). The thin sheet conductance estimate is not high (1 to 2 mhos).

The EM response is relatively sharp on all coaxial channels. A broader coplanar response to the north suggests a dip to the north.

C9: Line 1071 (13:12:26)

This is a low amplitude (2 ppm) 935 Hz inphase anomaly. The response is relatively broad suggesting a relatively deep source. The profile data shows a strong (750 nT) magnetic anomaly.

At position Line 1070 (13:05:44), 600 m south of C9 is an EM anomaly with good responses in the 4600 Hz channels but little or no response in the low frequency channels. If low conductance targets are of interest, this anomaly should be kept in mind.

C10: Line 1077 (13:42:24)

A string of at least 7 EM anomalies which form a 750 m long bedrock conductor. EM peak amplitudes are 14 and 40 ppm in the 935 and 4600 Hz inphase channels at the position given. There is a small (8 nT) coincident magnetic anomaly.

The EM responses suggest a near surface thin sheet conductor with a moderate northern dip. Conductance estimates are moderate (2 to 4 mhos).

C11: Line 1084 (16:01:38)
Line 1089 (16:19:50)

These are two locations on conductors east of C10. EM peak amplitudes (935 Hz inphase) are 8 and 12 ppm at the positions given.

The first position shows relatively slight coplanar responses - a near vertical thin sheet source is expected. There is no coincident magnetic anomaly - the EM anomaly is in a magnetic low.

The second position shares many characteristics with the EM anomalies of C1 - parallel conductors with shallow northerly dips. The leading edge of the southern most conductor is at the position given. Steep EM gradients on the leading edge suggests a source at or near surface.

The three line conductor to the north west (see Line 1087 (16:11:24)) has reasonable EM responses in the 4600 Hz inphase channel (5 ppm) but no clear anomaly in the 935 Hz inphase channel. The EM profile suggests a near vertical thin sheet conductor. Conductance estimates are low (less than 1 mho). As with the response at line 1070 (13:05:44), this conductor might be investigated if low conductance targets are of interest.

C12: Line 1099 (16:48:39)

A two line conductor on the eastern boundary of the survey area. EM peak amplitudes are 4 and 8 ppm in the 935 and 4600 Hz inphase channels. An equally strong response in the coplanar channels suggests a flat lying or wide tabular source - a model seen with C1, C4 and C5.

C13: Line 1096 (16:41:07)

A string of three EM anomalies near the eastern edge of the survey area. EM peak amplitudes are 7 and 22 ppm in the 935 and 4600 Hz inphase channels. The coplanar channels show the double peak of a near vertical thin sheet conductor. A 5 nT shoulder coincides with the EM anomaly.

## 8. CONCLUSIONS

High resolution helicopterborne geophysical surveys have been completed over an area of a total extent of about 37 square kilometres. The area is in Hurdman Township, some 25 km north of Smooth Rock Falls, Ontario. Total coverage is approximately 460 line kilometres. Results are presented on black line and colour maps at a scale of 1:10,000. Map types include EM anomaly centres, contoured magnetic field, contoured vertical magnetic gradient and contoured VLF-EM Total Field data.

Additional products include colour contours of the total magnetic field at a scale of 1:10,000 and a total field magnetic shadow map at a scale of 1:20,000 - both for area A plus area B. Area B is a small block of 71 claims which is almost surrounded by survey area A.

Preferred geophysical characteristics have been built up from a model geological target. These characteristics have been extracted from various map products and transferred to a compilation/interpretation map. Favourable areas are discussed with reference to this compilation map.

Respectfully submitted,

Ian Johnson, Ph.D., P.Eng.
Consulting Geophysicist
for
**AERODAT LIMITED**
July 17, 1991

J9136A

REGISTERED PROFESSIONAL ENGINEER
I. M. JOHNSON
PROVINCE OF ONTARIO

# APPENDIX I

## GENERAL INTERPRETIVE CONSIDERATIONS

### Electromagnetic

The Aerodat four frequency system utilizes two different transmitter-receiver coil geometries. The traditional coaxial coil configuration is operated at two widely separated frequencies. The horizontal coplanar coil configuration is similarly operated at two different frequencies where at least one pair is approximately aligned with one of the coaxial frequencies.

The electromagnetic response measured by the helicopter system is a function of the "electrical" and "geometrical" properties of the conductor. The "electrical" property of a conductor is determined largely by its electrical conductivity, magnetic susceptibility and its size and shape; the "geometrical" property of the response is largely a function of the conductor's shape and orientation with respect to the measuring transmitter and receiver.

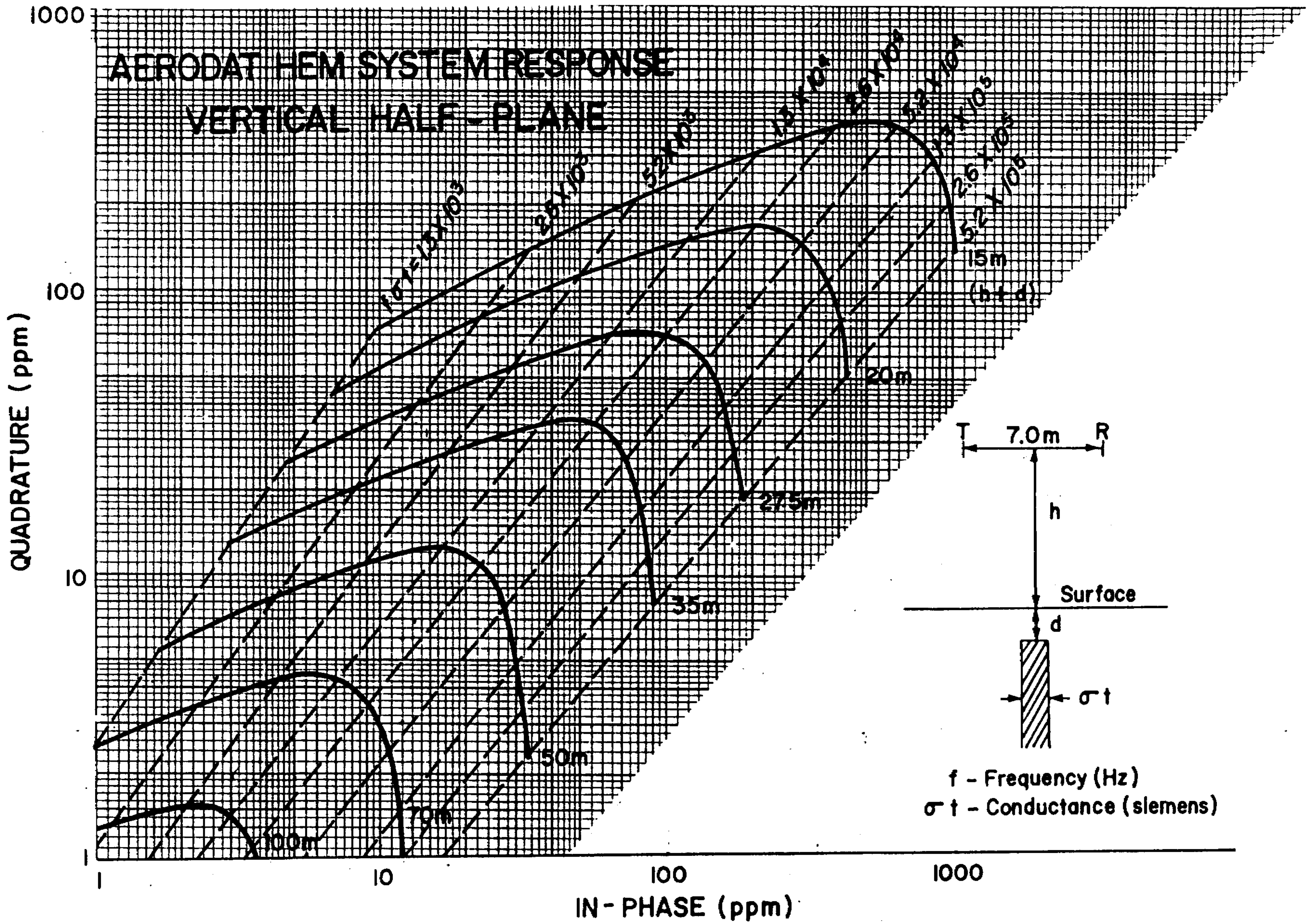
### Electrical Considerations

For a given conductive body the measure of its conductivity or conductance is closely related to the measured phase shift between the received and transmitted electromagnetic field. A small phase shift indicates a relatively high conductance, a large phase shift lower conductance. A small phase shift results in a large inphase to quadrature ratio and a large phase shift a low ratio. This relationship is shown quantitatively for non-magnetic vertical half-plane and half-space models on the accompanying phasor diagrams. Other physical models will show the same trend but different quantitative relationships.

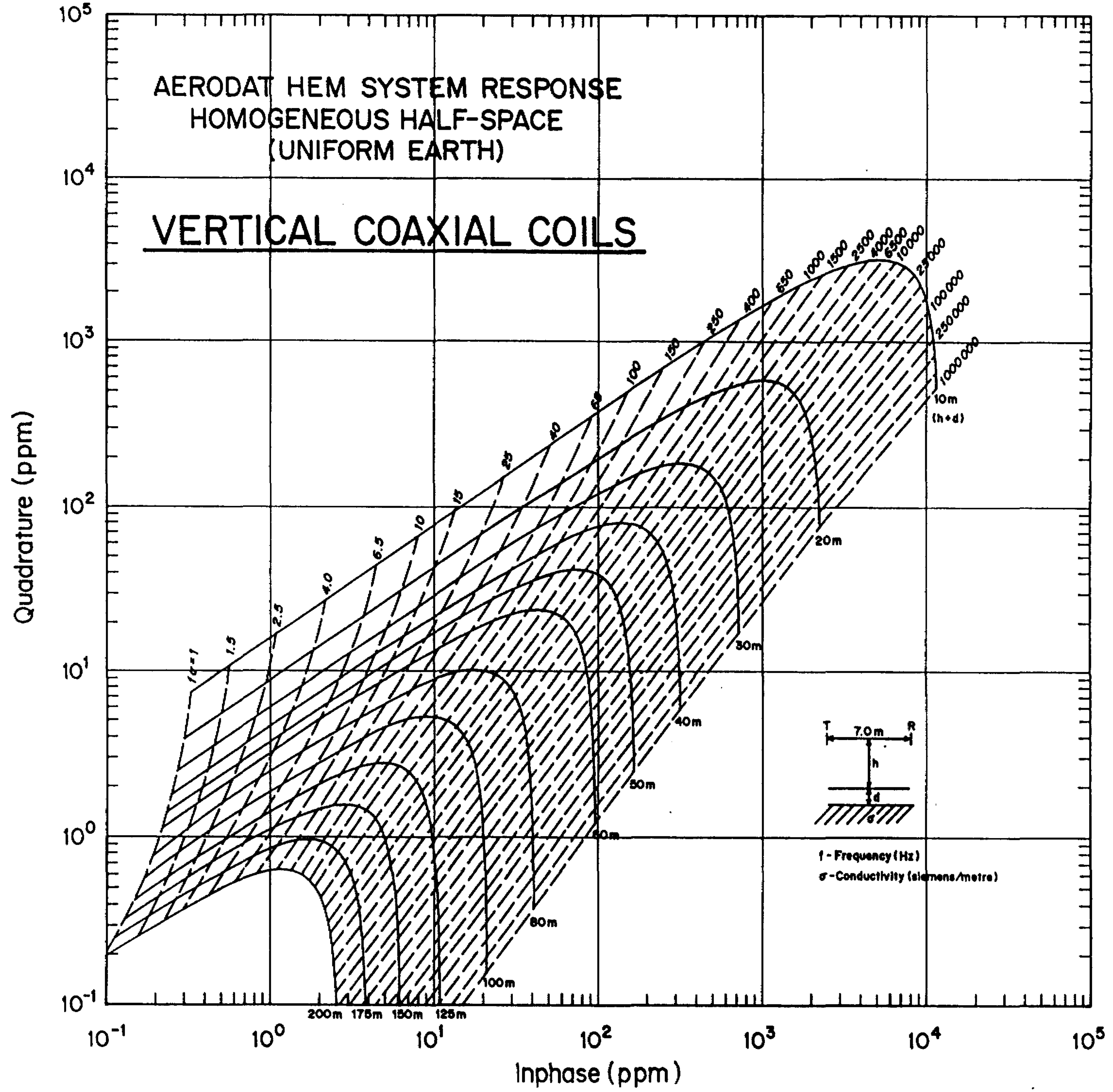
The phasor diagram for the vertical half-plane model, as presented, is for the coaxial coil configuration with the amplitudes in parts per million (ppm) of the primary field as measured at the response peak over the conductor. To assist the interpretation of the survey results the computer is used to identify the apparent conductance and depth of selected anomalies. The results of this calculation are presented in anomaly listings included in the survey report and the conductance and inphase amplitude are presented in symbolized form on the map presentation.

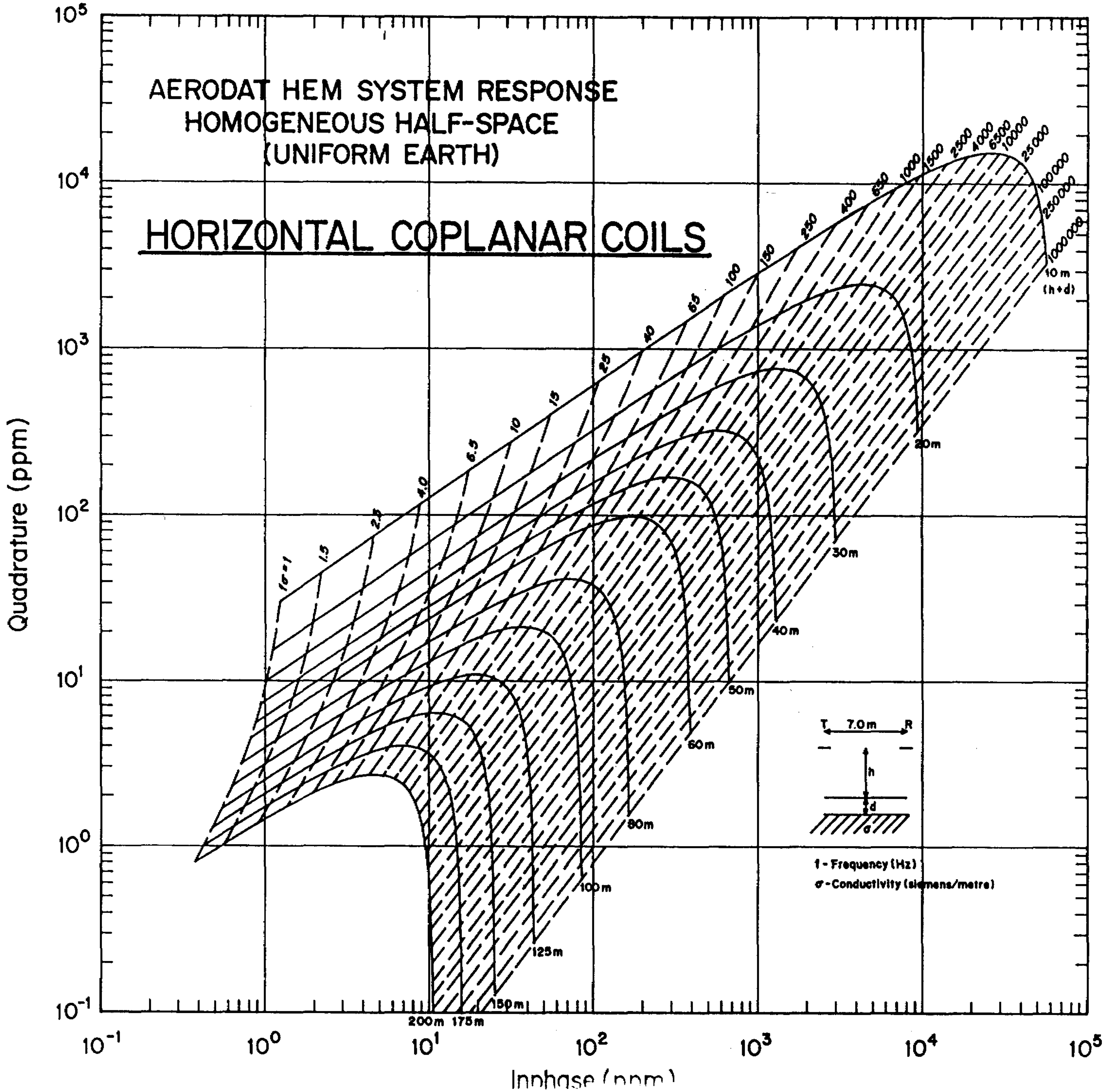
The conductance estimate is most reliable when anomaly amplitudes are large and background resistivities are high. Where the EM anomaly is of low amplitude and background resistivities are low, the conductance estimates are much less reliable. In such situations, the conductance estimate is often quite low regardless of the true nature of the conductor. This is due to the elevated background response levels in the quadrature channel. In an extreme case, the conductance estimate should be discounted and should not prejudice target selection.

The conductance and depth values as presented are correct only as far as the model approximates the real geological situation. The actual geological source may be of limited length, have significant dip, or may be strongly magnetic. Its conductivity and thickness may vary with depth



AERODAT HEM SYSTEM RESPONSE
VERTICAL HALF - PLANE
QUADRATURE (ppm)
IN - PHASE (ppm)
1000
100
10
1
1
10
100
1000
15m
(h+d)
20m
27.5m
35m
50m
70m
100m
T
7.0m
R
h
Surface
d
σ t
f - Frequency (Hz)
σ t - Conductance (siemens)


AERODAT HEM SYSTEM RESPONSE
HOMOGENEOUS HALF-SPACE
(UNIFORM EARTH)
VERTICAL COAXIAL COILS
Quadrature (ppm)
Inphase (ppm)
10m
(h+d)
20m
30m
40m
50m
60m
80m
100m
125m
150m
175m
200m
7.0m
T
R
h
d
f - Frequency (Hz)
σ - Conductivity (siemens/metre)



AERODAT HEM SYSTEM RESPONSE
HOMOGENEOUS HALF-SPACE
(UNIFORM EARTH)
HORIZONTAL COPLANAR COILS
Quadrature (ppm)
Inphase (ppm)
10m (h+d)
20m
30m
40m
50m
60m
80m
100m
125m
150m
175m
200m
T 7.0m R
h
d
σ
f - Frequency (Hz)
σ - Conductivity (siemens/metre)

and/or strike and adjacent bodies and overburden may have modified the response. In general the conductance estimate is less affected by these limitations than is the depth estimate, but both should be considered as relative rather than absolute guides to the anomaly's properties.

Conductance in mhos is the reciprocal of resistance in ohms and in the case of narrow slab-like bodies is the product of electrical conductivity and thickness.

The higher ranges of conductance, greater than 2-4 mhos, indicate that a significant fraction of the electrical conduction is electronic rather than electrolytic in nature. Materials that conduct electronically are limited to certain metallic sulphides and to graphite. High conductance anomalies, roughly 10 mhos or greater, are generally limited to massive sulphides or graphites.

Sulphide minerals, with the exception of such ore minerals as sphalerite, cinnabar and stibnite, are good conductors. Sulphides may occur in a disseminated manner that inhibits electrical conduction through the rock mass. In this case the apparent conductance can seriously underrate the quality of the conductor in geological terms. In a similar sense the relatively non-conducting sulphide minerals noted above may be present in significant concentrations in association with minor conductive sulphides, and the electromagnetic response will only relate to the minor associated mineralization. Indicated conductance is also of little direct significance for the identification of gold mineralization. Although gold is highly conductive, it would not be expected to exist in sufficient quantity to create a recognizable anomaly. Minor accessory sulphide mineralization may however provide a useful indirect indication.

In summary, the estimated conductance of a conductor can provide a relatively positive identification of significant sulphide or graphite mineralization. A moderate to low conductance value does not rule out the possibility of significant economic mineralization.

## Geometrical Considerations

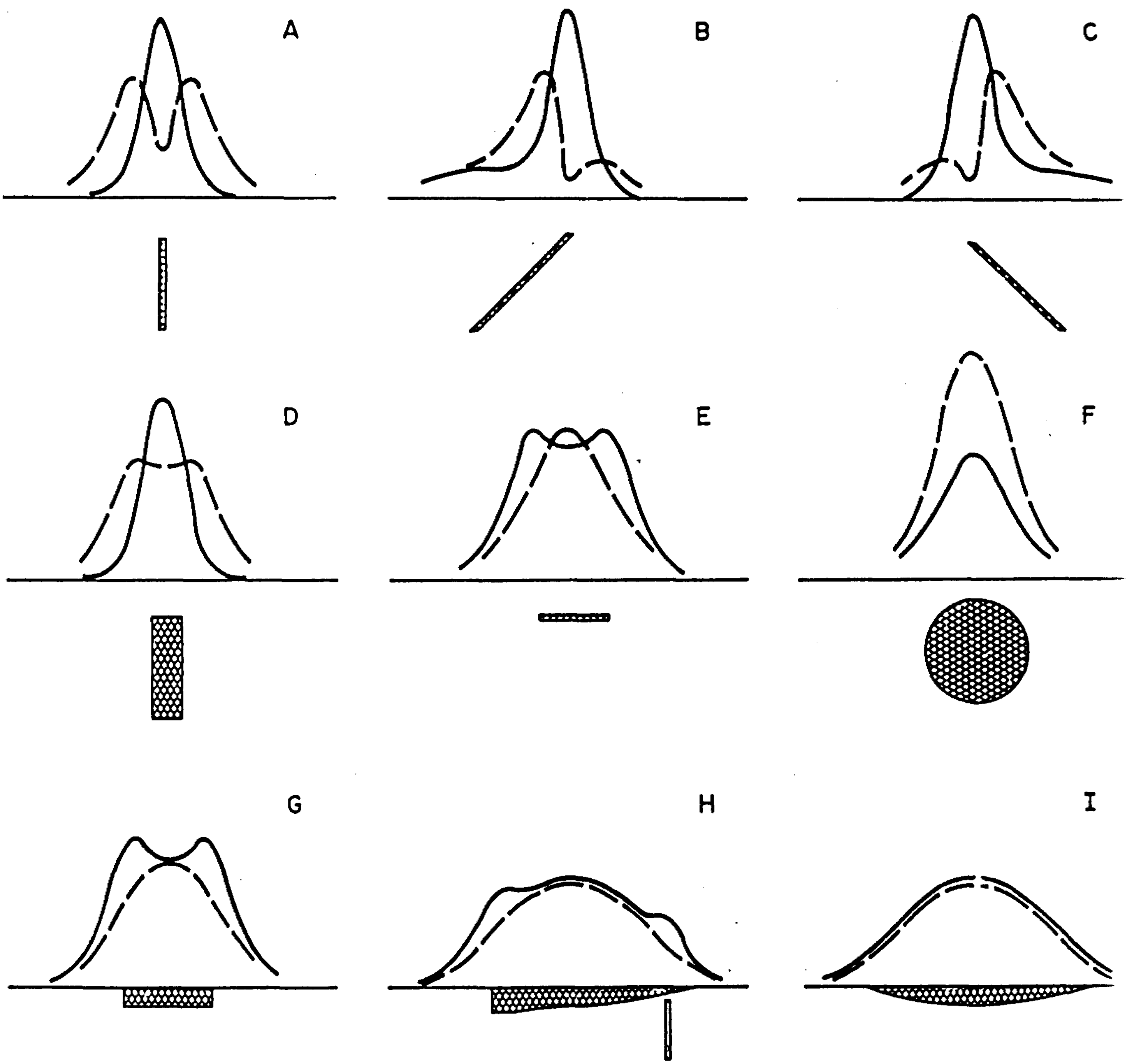
Geometrical information about the geologic conductor can often be interpreted from the profile shape of the anomaly. The change in shape is primarily related to the change in inductive coupling among the transmitter, the target, and the receiver. The accompanying figure shows a selection of HEM response profile shapes from nine idealized targets. Response profiles are labelled A through I. These labels are used in the discussion which follows.

In the case of a thin, steeply dipping, sheet-like conductor, the coaxial coil pair will yield a near symmetric peak over the conductor. On the other hand, the coplanar coil pair will pass through a null couple relationship and yield a minimum over the conductor, flanked by positive side lobes.(Profile A) As the dip of the conductor decrease from vertical, the coaxial anomaly shape changes only slightly, but in the case of the coplanar coil pair the side lobe on the down dip side strengthens relative to that on the up dip side.(Profiles B and C).

As the thickness of the conductor increases, induced current flow across the thickness of the

# HEM RESPONSE PROFILE SHAPE AS AN INDICATOR OF CONDUCTOR GEOMETRY

——— COAXIAL vertical scale 1 ppm/unit
– – – COPLANAR vertical scale 4ppm/unit



conductor becomes relatively significant and complete null coupling with the coplanar coils is no longer possible.(Profile D) As a result, the apparent minimum of the coplanar response over the conductor diminishes with increasing thickness, and in the limiting case of a fully 3 dimensional body or a horizontal layer or half-space, the minimum disappears completely.

A horizontal conducting layer such as a horizontal thin sheet or overburden will produce a response in the coaxial and coplanar coils that is a function of altitude (and conductivity if not uniform). The profile shape will be similar in both coil configurations with an amplitude ratio (coplanar:coaxial) of about 4:1*.(Profiles E and G).

In the case of a spherical conductor, the induced currents are confined to the volume of the sphere, but not relatively restricted to any arbitrary plane as in the case of a sheet-like form. The response of the coplanar coil pair directly over the sphere may be up to 8* times greater than that of the coaxial pair.(Profile F)

In summary, a steeply dipping, sheet-like conductor will display a decrease in the coplanar response coincident with the peak of the coaxial response. The relative strength of this coplanar null is related inversely to the thickness of the conductor. A pronounced null indicates a relatively thin conductor. The dip of such a conductor can be inferred from the relative amplitudes of the side-lobes.

Massive conductors that could be approximated by a conducting sphere will display a simple single peak profile form on both coaxial and coplanar coils, with a ratio between the coplanar to coaxial response amplitudes as high as 8*.

Overburden anomalies often produce broad poorly defined anomaly profiles.(Profile I) In most cases, the response of the coplanar coils closely follows that of the coaxial coils with a relative amplitude ratio of 4*.

Occasionally, if the edge of an overburden zone is sharply defined with some significant depth extent, an edge effect will occur in the coaxial coils. In the case of a horizontal conductive ring or ribbon, the coaxial response will consist of two peaks, one over each edge; whereas the coplanar coil will yield a single peak.(Profile H)

* It should be noted at this point that Aerodat's definition of the measured ppm unit is related to the primary field sensed in the receiving coil without normalization to the maximum coupled (coaxial configuration). If such normalization were applied to the Aerodat units, the amplitude of the coplanar coil pair would be halved.

## Magnetics

The Total Field Magnetic Map shows contours of the total magnetic field, uncorrected for regional variation. Whether an EM anomaly with a magnetic correlation is more likely to be caused by a sulphide deposit than one without depends on the type of mineralization. An apparent coincidence between an EM and a magnetic anomaly may be caused by a conductor which is also magnetic, or by a conductor which lies in close proximity to a magnetic body. The majority of conductors which are also magnetic are sulphides containing pyrrhotite and/or magnetite. Conductive and magnetic bodies in close association can be, and often are, graphite and magnetite. It is often very difficult to distinguish between these cases. If the conductor is also magnetic, it will usually produce an EM anomaly whose general pattern resembles that of the magnetics. Depending on the magnetic permeability of the conducting body, the amplitude of the inphase EM anomaly will be weakened, and if the conductivity is also weak, the inphase EM anomaly may even be reversed in sign.

The interpretation of contoured aeromagnetic data is a subject on its own involving an array of methods and attitudes. The interpretation of source characteristics for example from total field results is often based on some numerical modelling scheme. The vertical gradient data is more legible in some aspects however and useful inferences about source characteristics can often be read off the contoured VG map.

The zero contour lines in contoured VG data are often sited as a good approximation to the outline of the top of the magnetic source. This only applies to wide (relative to depth of burial) near vertical sources at high magnetic latitudes. It will give an incorrect interpretation in most other cases.

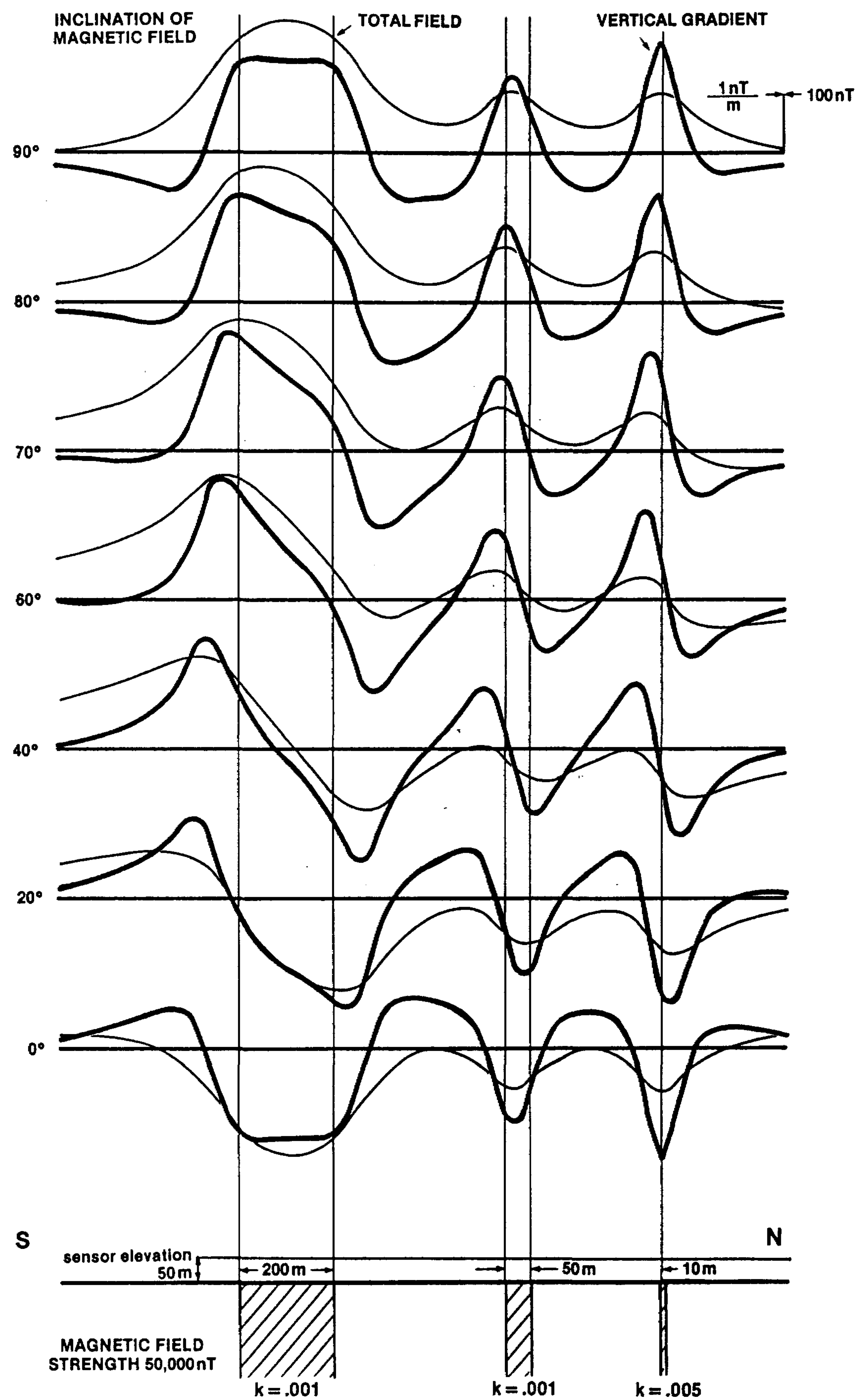
Theoretical profiles of total field and vertical gradient anomalies from tabular sources at a variety of magnetic inclinations are shown in the attached figure. Sources are 10, 50 and 200 m wide. The source-sensor separation is 50 m. The thin line is the total field profile. The thick line is the vertical gradient profile.

The following comments about source geometry apply to contoured vertical gradient data for magnetic inclinations of 70 to 80°.

**Outline**

Where the VG anomaly has a single sharp peak, the source may be a thin near-vertical tabular source. It may be represented as a magnetic axis or as a tabular source of measureable width - the choice is one of geological preference.

Where the VG anomaly has a broad, flat or inclined top, the source may be a thick tabular source. It may be represented as a thick body where the width is taken from the zero contour lines if the body dips to magnetic north. If the source appears to be dipping to the south (i.e. the VG anomaly is asymmetric), the zero contours are less reliable indicators of outline. The southern most zero contour line should be ignored and the outline taken from the northern zero contour line and the extent of the anomaly peak width.


INCLINATION OF MAGNETIC FIELD
TOTAL FIELD
VERTICAL GRADIENT
1 nT / m
100 nT
90°
80°
70°
60°
40°
20°
0°
S
N
sensor elevation 50 m
200 m
50 m
10 m
MAGNETIC FIELD STRENGTH 50,000 nT
k = .001
k = .001
k = .005

**Dip**

A symmetrical vertical gradient response is produced by a body dipping to magnetic north. An asymmetrical response is produced by a body which is vertical or dipping to the south. For southern dips, the southern most zero contour line may be several hundred meters south of the source.

**Depth of Burial**

The source-sensor separation is about equal to half of the distance between the zero contour lines for thin near-vertical sources. The estimated depth of burial for such sources is this separation minus 50 m. If a variety of VG anomaly widths are seen in an area, use the narrowest width seen to estimate local depths.

## VLF Electromagnetics

The VLF-EM method employs the radiation from powerful military radio transmitters as the primary signals. The magnetic field associated with the primary field is locally horizontal and normal to a line pointing at the transmitter.

The Herz Totem uses three coils in the X, Y, Z configuration to measure the total field and vertical quadrature component from two VLF stations. These stations are designated Line and Ortho. The line station is ideally in a direction from the survey area at right angles to the flight line direction. Conductors normal to the flight line direction point at the line station and are therefore optimally coupled to VLF magnetic fields and in the best situation to gather secondary VLF currents. The ortho station is ideally 90 degrees in azimuth from the line station.

The relatively high frequency of VLF (15-25) kHz provides high response factors for bodies of low conductance. Relatively "disconnected" sulphide ores have been found to produce measurable VLF signals. For the same reason, poor conductors such as sheared contacts, breccia zones, narrow faults, alteration zones and porous flow tops normally produce VLF anomalies. The method can therefore be used effectively for geological mapping. The only relative disadvantage of the method lies in its sensitivity to conductive overburden. In conductive ground the depth of exploration is severely limited.

The effect of strike direction is important in the sense of the relation of the conductor axis relative to the energizing electromagnetic field. A conductor aligned along a radius drawn from a transmitting station will be in a maximum coupled orientation and thereby produce a stronger response than a similar conductor at a different strike angle. Theoretically, it would be possible for a conductor, oriented tangentially to the transmitter to produce no signal. The most obvious effect of the strike angle consideration is that conductors favourably oriented with respect to the transmitter location and also near perpendicular to the flight direction are most clearly rendered and usually dominate the map presentation.

The total field anomaly is an indicator of the existence and position of a conductor. The response will be a maximum over the conductor, without any special filtering, and strongly favour the upper edge of the conductor even in the case of a relatively shallow dip.

Conversely a negative total field anomaly is often seen over local resistivity highs. This is because the VLF field produces electrical currents which flow towards (or away from) the transmitter. These currents are gathered into a conductor and are taken from resistive bodies. The VLF system sees the currents gathered into the conductor as a total field high. It sees the relative absence of secondary currents in the resistor as a total field low.

As noted, VLF anomaly trends show a strong bias towards the VLF transmitter. Structure which is normal to this direction may have no associated VLF anomaly but may be seen as a break or interruption in VLF anomalies. If these structures are of particular interest, maps of the ortho station data may be worthwhile.

Conductive overburden will obscure VLF responses from bedrock sources and may produce low amplitude, broad anomalies which reflect variations in the resistivity or thickness of the overburden.

Extreme topographic relief will produce VLF anomalies which may bear no relationship to variations in electrical conductivity. Deep gullies which are too narrow to have been surveyed at a uniform sensor height often show up as VLF total field lows. Sharp ridges show up as total field highs.

The vertical quadrature component over steeply dipping sheet-like conductor will be a cross-over type response with the cross-over closely associated with the upper edge of the conductor.

The response is a cross-over type due to the fact that it is the vertical rather than total field quadrature component that is measured. The response shape is due largely to geometrical rather than conductivity considerations and the distance between the maximum and minimum on either side of the cross-over is related to target depth. For a given target geometry, the larger this distance the greater the depth.

The vertical quadrature component is rarely presented. Experience has shown the total field to be more sensitive to bedrock conductors and less affected by variations in conductive overburden.

AERODAT LIMITED
June, 1991.

# APPENDIX II

# ANOMALY LISTINGS

J9136 - MCKINNON PROSPECTING - AUDEN PROJECT - ANOMALY LIST - BLOCK A

| FLIGHT | LINE | ANOMALY | CATEGORY | AMPLITUDE (PPM) INPHASE | QUAD. | CONDUCTOR CTP MHOS | DEPTH MTRS | BIRD HEIGHT MTRS |
|---|---|---|---|---|---|---|---|---|
| 1 | 10120 | A | 2 | 5.9 | 6.3 | 3.6 | 8 | 53 |
| 1 | 10130 | A | 4 | 14.9 | 9.5 | 10.6 | 5 | 49 |
| 1 | 10140 | A | 2 | 7.6 | 8.5 | 3.8 | 7 | 48 |
| 1 | 10150 | A | 3 | 3.3 | 2.6 | 4.4 | 31 | 53 |
| 1 | 10160 | A | 1 | 3.4 | 5.8 | 1.4 | 4 | 54 |
| 1 | 10160 | B | 2 | 3.5 | 3.4 | 3.3 | 20 | 56 |
| 1 | 10160 | C | 0 | 2.1 | 7.6 | 0.3 | 0 | 43 |
| 1 | 10170 | A | 0 | 2.3 | 10.7 | 0.2 | 0 | 45 |
| 1 | 10170 | B | 3 | 2.9 | 1.6 | 7.0 | 36 | 62 |
| 1 | 10170 | C | 3 | 1.2 | 0.7 | 4.4 | 83 | 48 |
| 1 | 10170 | D | 1 | 6.7 | 12.8 | 1.7 | 2 | 41 |
| 1 | 10180 | A | 4 | 6.9 | 4.0 | 9.1 | 11 | 61 |
| 1 | 10180 | B | 4 | 21.9 | 13.5 | 12.6 | 0 | 60 |
| 1 | 10180 | C | 5 | 39.5 | 16.2 | 26.2 | 0 | 51 |
| 1 | 10180 | D | 2 | 6.0 | 8.7 | 2.3 | 2 | 50 |
| 1 | 10180 | E | 2 | 7.4 | 8.7 | 3.5 | 0 | 55 |
| 1 | 10190 | A | 1 | 3.7 | 5.5 | 1.8 | 15 | 45 |
| 1 | 10190 | B | 0 | 0.2 | 1.7 | 0.0 | 8 | 47 |
| 1 | 10190 | C | 4 | 19.1 | 13.0 | 10.6 | 1 | 47 |
| 1 | 10190 | D | 3 | 17.0 | 14.7 | 7.4 | 1 | 45 |
| 1 | 10190 | E | 2 | 7.0 | 9.6 | 2.7 | 2 | 48 |
| 1 | 10200 | A | 0 | 0.0 | 1.5 | 0.0 | 0 | 54 |
| 1 | 10200 | B | 4 | 14.7 | 9.9 | 9.8 | 0 | 55 |
| 1 | 10200 | C | 4 | 13.1 | 7.4 | 11.9 | 9 | 49 |
| 1 | 10210 | A | 0 | 2.2 | 7.2 | 0.4 | 0 | 55 |
| 1 | 10210 | B | 0 | 1.6 | 3.4 | 0.6 | 21 | 45 |
| 1 | 10221 | A | 0 | 2.4 | 8.8 | 0.3 | 0 | 58 |
| 1 | 10221 | B | 0 | 2.8 | 6.7 | 0.7 | 0 | 55 |
| 2 | 10270 | A | 0 | 0.7 | 4.2 | 0.0 | 0 | 48 |
| 2 | 10270 | B | 0 | 0.7 | 4.5 | 0.0 | 0 | 46 |
| 2 | 10270 | C | 0 | 0.1 | 7.0 | 0.0 | 0 | 49 |
| 2 | 10280 | B | 0 | 4.1 | 10.8 | 0.8 | 0 | 43 |

Estimated depth may be unreliable because the stronger part of the conductor may be deeper or to one side of the flight line, or because of a shallow dip or overburden effects.

J9136 - MCKINNON PROSPECTING - AUDEN PROJECT - ANOMALY LIST - BLOCK A

| FLIGHT | LINE | ANOMALY | CATEGORY | AMPLITUDE (PPM) INPHASE | QUAD. | CONDUCTOR CTP MHOS | DEPTH MTRS | BIRD HEIGHT MTRS |
|---|---|---|---|---|---|---|---|---|
| 3 | 10620 | A | 0 | -0.2 | 5.9 | 0.0 | 0 | 49 |
| 3 | 10620 | B | 0 | -0.2 | 5.8 | 0.0 | 0 | 46 |
| 3 | 10630 | A | 0 | 0.4 | 6.8 | 0.0 | 0 | 45 |
| 3 | 10630 | B | 0 | 0.3 | 6.5 | 0.0 | 0 | 47 |
| 3 | 10630 | C | 0 | 1.4 | 5.0 | 0.2 | 1 | 49 |
| 3 | 10640 | A | 1 | 6.2 | 11.4 | 1.7 | 0 | 46 |
| 3 | 10640 | B | 0 | 2.5 | 9.9 | 0.3 | 0 | 48 |
| 3 | 10640 | C | 0 | 2.1 | 5.9 | 0.5 | 0 | 53 |
| 3 | 10640 | D | 1 | 3.4 | 6.8 | 1.1 | 0 | 53 |
| 4 | 10650 | A | 0 | 4.7 | 11.9 | 0.9 | 0 | 48 |
| 4 | 10660 | A | 1 | 5.9 | 10.2 | 1.8 | 5 | 42 |
| 4 | 10660 | B | 1 | 5.3 | 11.8 | 1.2 | 0 | 42 |
| 4 | 10670 | A | 1 | 6.8 | 15.3 | 1.3 | 0 | 40 |
| 4 | 10690 | A | 0 | 3.9 | 12.1 | 0.6 | 0 | 45 |
| 4 | 10690 | B | 0 | 3.4 | 12.9 | 0.4 | 0 | 44 |
| 4 | 10700 | A | 0 | 2.8 | 11.6 | 0.3 | 0 | 50 |
| 4 | 10700 | B | 0 | 3.1 | 14.1 | 0.3 | 0 | 39 |
| 4 | 10710 | A | 0 | 4.4 | 10.9 | 0.9 | 0 | 47 |
| 4 | 10710 | B | 0 | 1.2 | 7.0 | 0.1 | 0 | 51 |
| 4 | 10710 | C | 0 | 2.9 | 8.0 | 0.6 | 0 | 46 |
| 4 | 10720 | A | 0 | 2.5 | 8.9 | 0.3 | 0 | 44 |
| 4 | 10720 | B | 0 | 2.1 | 7.0 | 0.3 | 0 | 52 |
| 4 | 10740 | A | 0 | 2.6 | 11.8 | 0.2 | 0 | 45 |
| 4 | 10740 | B | 0 | 2.4 | 11.7 | 0.2 | 0 | 48 |
| 4 | 10750 | A | 0 | 3.6 | 18.4 | 0.2 | 0 | 37 |
| 4 | 10760 | A | 0 | 1.9 | 9.3 | 0.1 | 0 | 53 |
| 4 | 10760 | B | 0 | 3.1 | 10.0 | 0.5 | 0 | 52 |
| 4 | 10770 | A | 2 | 13.9 | 19.7 | 3.5 | 0 | 44 |
| 4 | 10770 | B | 0 | 1.8 | 8.2 | 0.2 | 0 | 52 |
| 4 | 10780 | A | 0 | 3.3 | 9.1 | 0.6 | 0 | 52 |

Estimated depth may be unreliable because the stronger part of the conductor may be deeper or to one side of the flight line, or because of a shallow dip or overburden effects.

J9136 - MCKINNON PROSPECTING - AUDEN PROJECT - ANOMALY LIST - BLOCK A

| FLIGHT | LINE | ANOMALY | CATEGORY | AMPLITUDE (PPM) INPHASE | QUAD. | CONDUCTOR CTP MHOS | DEPTH MTRS | BIRD HEIGHT MTRS |
|---|---|---|---|---|---|---|---|---|
| 4 | 10780 | B | 2 | 9.2 | 16.4 | 2.1 | 0 | 48 |
| 4 | 10790 | A | 2 | 8.0 | 13.7 | 2.1 | 0 | 44 |
| 4 | 10800 | A | 0 | 2.3 | 7.2 | 0.4 | 0 | 55 |
| 5 | 10831 | A | 0 | 1.5 | 6.1 | 0.2 | 0 | 48 |
| 5 | 10840 | A | 2 | 8.4 | 9.7 | 3.8 | 2 | 50 |
| 5 | 10850 | A | 0 | 1.8 | 9.7 | 0.1 | 0 | 44 |
| 5 | 10850 | B | 0 | 3.7 | 9.6 | 0.8 | 0 | 43 |
| 5 | 10860 | A | 0 | 1.5 | 12.9 | 0.0 | 0 | 44 |
| 5 | 10870 | A | 0 | 3.0 | 7.6 | 0.7 | 1 | 47 |
| 5 | 10870 | B | 0 | 1.6 | 5.6 | 0.3 | 0 | 48 |
| 5 | 10870 | C | 0 | 2.5 | 11.8 | 0.2 | 0 | 46 |
| 5 | 10880 | A | 0 | 2.8 | 8.6 | 0.5 | 1 | 42 |
| 5 | 10880 | B | 1 | 5.7 | 9.9 | 1.8 | 2 | 46 |
| 5 | 10880 | C | 0 | 3.2 | 9.2 | 0.6 | 0 | 48 |
| 5 | 10890 | A | 2 | 11.6 | 16.1 | 3.3 | 0 | 47 |
| 5 | 10890 | B | 2 | 7.9 | 9.1 | 3.7 | 6 | 47 |
| 5 | 10900 | A | 0 | 2.2 | 7.3 | 0.4 | 0 | 45 |
| 5 | 10900 | B | 0 | 2.4 | 7.3 | 0.4 | 0 | 51 |
| 5 | 10900 | C | 0 | 3.3 | 8.6 | 0.7 | 0 | 48 |
| 5 | 10910 | A | 1 | 6.2 | 10.5 | 1.9 | 1 | 46 |
| 5 | 10910 | B | 2 | 5.9 | 9.6 | 2.0 | 1 | 48 |
| 5 | 10910 | C | 2 | 7.8 | 11.7 | 2.5 | 0 | 48 |
| 5 | 10910 | D | 1 | 5.6 | 9.2 | 1.9 | 3 | 46 |
| 5 | 10950 | A | 0 | 3.0 | 8.4 | 0.6 | 0 | 52 |
| 5 | 10950 | B | 0 | 3.4 | 9.0 | 0.7 | 0 | 48 |
| 5 | 10950 | C | 0 | 3.0 | 10.7 | 0.4 | 0 | 44 |
| 5 | 10960 | A | 2 | 7.0 | 11.1 | 2.2 | 0 | 54 |
| 5 | 10970 | A | 0 | 2.9 | 6.8 | 0.8 | 0 | 55 |
| 5 | 10970 | B | 2 | 5.3 | 6.8 | 2.6 | 1 | 57 |
| 5 | 10980 | A | 0 | 1.9 | 5.5 | 0.4 | 0 | 51 |

Estimated depth may be unreliable because the stronger part of the conductor may be deeper or to one side of the flight line, or because of a shallow dip or overburden effects.

J9136 - MCKINNON PROSPECTING - AUDEN PROJECT - ANOMALY LIST - BLOCK A

| FLIGHT | LINE | ANOMALY | CATEGORY | AMPLITUDE (PPM) INPHASE | AMPLITUDE (PPM) QUAD. | CONDUCTOR CTP MHOS | CONDUCTOR DEPTH MTRS | BIRD HEIGHT MTRS |
|---|---|---|---|---|---|---|---|---|
| 5 | 10980 | B | 0 | 3.5 | 9.3 | 0.7 | 0 | 56 |
| 5 | 10980 | C | 1 | 3.9 | 8.6 | 1.0 | 0 | 48 |
| 5 | 10990 | A | 0 | 2.1 | 6.9 | 0.4 | 0 | 56 |
| 5 | 10990 | B | 1 | 3.8 | 5.6 | 1.8 | 10 | 50 |

Estimated depth may be unreliable because the stronger part of the conductor may be deeper or to one side of the flight line, or because of a shallow dip or overburden effects.

## APPENDIX III

## CERTIFICATE OF QUALIFICATIONS

I, IAN JOHNSON, certify that:

1. I am registered as a Professional Engineer in the Province of Ontario.

2. I reside at 38 Tinti Place in the town of Thornhill, Ontario.

3. I hold a Ph.D. in Geophysics from the University of British Columbia, having graduated in 1972.

4. I have been continuously engaged in both professional and managerial roles in the minerals industry in Canada and abroad for the past fourteen years.

5. The accompanying report was prepared from published or publicly available information and material supplied by McKinnon Prospecting and Aerodat Limited in the form of government reports and proprietary airborne exploration data. I have not personally visited the specific property.

7. I have no interest, direct or indirect, in the property described nor in McKinnon Prospecting.

8. I hereby consent to the use of this report in a Statement of Material Facts of the Company and for the preparation of a prospectus for submission to the appropriate securities commission and/or other regulatory authorities.

Signed,

Ian Johnson, Ph.D., P. Eng.


J9136A
Thornhill, Ontario
July 17, 1991

# APPENDIX IV

## PERSONNEL

### FIELD

| | |
|---|---|
| Flown | May 28 and 29, 1991 |
| Pilot | Roger Morrow |
| Operator | Joe Mercier |

### OFFICE

| | |
|---|---|
| Processing | Anthony Valentini<br>George McDonald |
| Report | Ian Johnson |

# REPORT ON A COMBINED HELICOPTER-BORNE MAGNETIC, ELECTROMAGNETIC AND VLF-EM SURVEY HURDMAN PROJECT - AREA B SMOOTH ROCK FALLS AREA, ONTARIO

FOR

McKINNON PROSPECTING
P.O. BOX 1130
TIMMINS, ONTARIO
P4N 7S6

RECEIVED
JUL 25 1991
MINING LANDS SECTION

BY

AERODAT LIMITED
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July 16, 1991

J9136B

Ian Johnson, Ph.D., P.Eng.
Consulting Geophysicist

## TABLE O






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# LIST OF MAPS

Maps are labelled according to map type. All black line and colour maps are presented at a scale of 1:10,000. Survey results are presented on 1 map sheet.

**BLACK LINE MAPS: (Scale 1:10,000)**

| Map Type | Description |
|---|---|
| 1. | **BASE MAP;** screened photomosaic base plus claim block boundary, UTM reference grid, title block and surrounds. |
| 2. | **COMPILATION/INTERPRETATION MAP;** base map plus flight path, EM anomaly symbols and interpretation. |
| 3. | **TOTAL FIELD MAGNETIC CONTOURS;** with base map and flight lines. |
| 4. | **VERTICAL MAGNETIC GRADIENT CONTOURS;** with base map and flight lines. |
| 5. | **VLF-EM TOTAL FIELD CONTOURS;** with base map and flight lines. |

**COLOUR MAPS: (Scale 1:10,000)**

1. **TOTAL FIELD MAGNETICS;** with superimposed contours, base map, flight lines and EM anomaly symbols.

2. **VERTICAL GRADIENT MAGNETICS;** with superimposed contours, base map, flight lines and EM anomaly symbols.

3. **VLF-EM TOTAL FIELD;** with superimposed contours and base map, flight lines, fiducials and EM anomaly symbols.

4A. **HEM OFFSET PROFILES;** 935 Hz and 33,000 Hz data with base map, flight lines and EM anomaly symbols.

4B. **HEM OFFSET PROFILES;** 4175 Hz and 4600 Hz data with base map, flight lines and EM anomaly symbols.

**REPORT ON A**
**COMBINED HELICOPTER-BORNE**
**MAGNETIC, ELECTROMAGNETIC AND VLF-EM SURVEY**
**HURDMAN PROJECT - AREA B**
**SMOOTH ROCK FALLS AREA, ONTARIO**

## 1. INTRODUCTION

This report describes an airborne geophysical survey carried out on behalf of McKinnon Prospecting (McKinnon), by Aerodat Limited under a contract dated May 23, 1991. Principal geophysical sensors included a five frequency electromagnetic system, a high sensitivity cesium vapour magnetometer and a two frequency VLF-EM system. Ancillary equipment included an electronic navigation system, a colour video tracking camera, a radar altimeter, a power line monitor and a base station magnetometer.

The survey was carried out over an area in Hurdman Township, 25 kilometres north of Smooth Rock Falls. The survey area, designated as area B, covers a block of 71 claims.

The total coverage was approximately 100 line kilometres. The flight line spacing was 125 m. The Aerodat Job Number is J9136B.

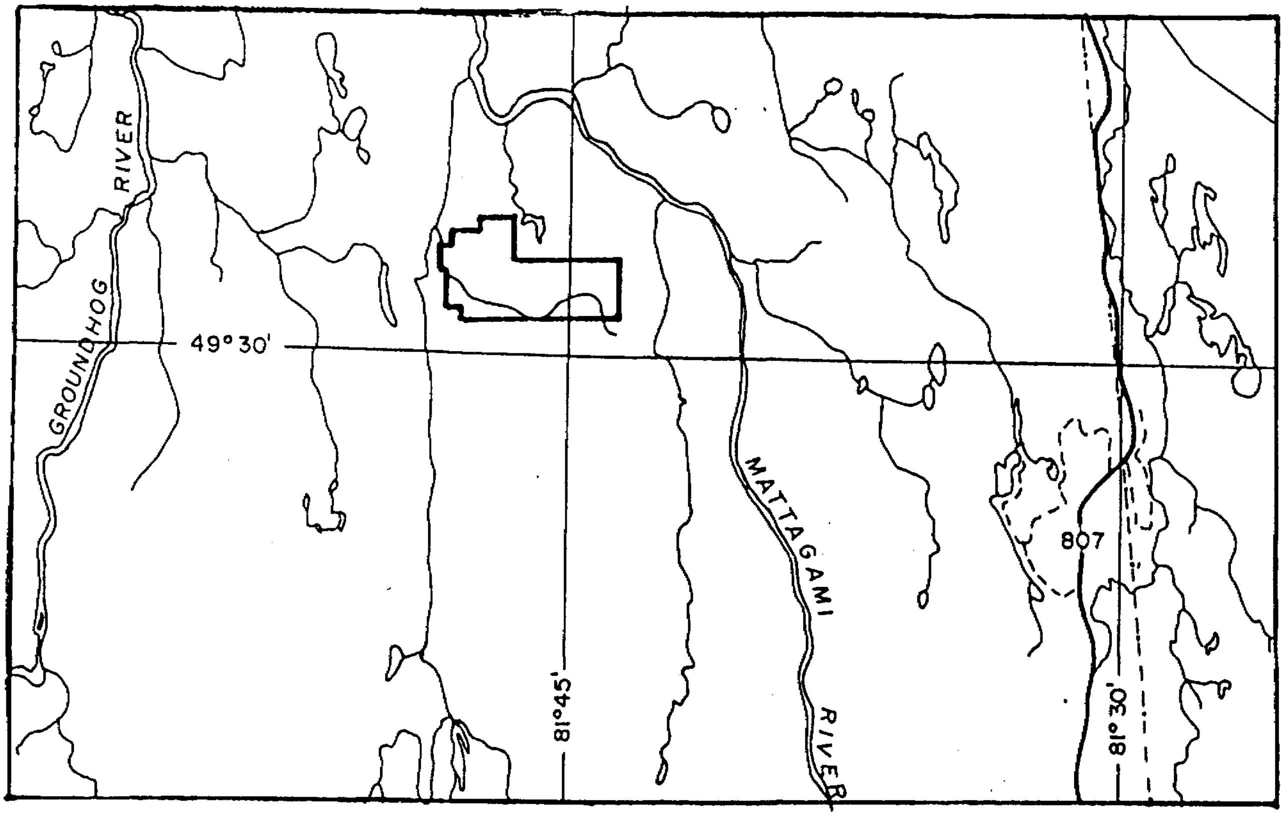
This report describes the survey, the data processing and the data presentation. Electromagnetic anomalies which are thought to be the response to bedrock conductors have been identified and appear on selected map products as EM anomaly symbols with interpreted source characteristics. Where EM results supported it, anomaly centers are joined to form conductor axes. Recommendations concerning areas with favourable geophysical characteristics are made with reference to a compilation/interpretation map.

## 2. SURVEY AREA

The survey area is north of Highway 11 between Cochrane and Kapuskasing and some 25 km north and slightly west of Smooth Rock Falls, Ontario. Area topography is shown on the 1:50,000 scale NTS map 42H/12 - Abimatinu River.

Local relief is flat - elevations are 220 ±10 metres. The area is free of major roads, power lines, railroads, etc.

The survey area is shown in the attached index map which includes local topography and latitude - longitude coordinates. This index map also appears on all map legends.




**HELICOPTERBORNE GEOPHYSICAL SURVEY**
**HURDMAN PROJECT - AREA B**

**on behalf of**
**MCKINNON PROSPECTING**

**BY**

**AERODAT LIMITED**
**J9136B**

The flight line direction was north-south. The survey area was covered with a line spacing of 125 m. One magnetic tie line was flown.

In this general area, the earth's magnetic field has a declination of 8° west of north and an inclination of 77°.

## 3. SURVEY PROCEDURES

The survey was flown on May 28 and 29, 1991. Principal personnel are listed in Appendix IV. Four (4) survey flights were required to complete the project.

The flight line spacing was 125 m. The aircraft ground speed was maintained at approximately 60 knots (30 metres per second). The nominal EM sensor height was 30 metres, consistent with the safety of the aircraft and crew.

An GPS navigation system was used to guide the pilot over the survey grid and to generate a digital record of position. This is an autonomous system which does not require the installation of ground transponders.

The UTM coordinates of survey area corners were taken from maps provided by McKinnon. These coordinates are used to program the navigation system. A test flight was used to confirm that area coverage would be as required.

Thereafter the traverse lines are flown under the guidance of the navigation system. The navigator/operator marked manual fiducials over prominent topographic features. These were entered on the navigator's map - a 1:10,000 scale topographic map (a 5 times photographic enlargement of local 1:50,000 scale NTS maps). Survey lines which showed excessive deviation were re-flown.

The magnetic tie line was flown using visual navigation in areas of low topographic and magnetic relief. Aircraft position was taken from the navigation system.

Calibration lines are flown at the start, middle (if required) and end of every survey flight. These lines are flown outside of ground effects to record electromagnetic zero levels.

## 4. DELIVERABLES

The results of the survey are presented in a report plus maps. The report is presented in four copies. White print copies of all black line maps are folded and bound with the report.

The colour maps are delivered in four copies. The colour maps are rolled and delivered in map tube(s).

A full list of all map types is given at the beginning of this report. A summary is given here.

| MAP TYPE | DESCRIPTION |
|---|---|
| 1 | Base Map (Black line) |
| 2 | Compilation/Interpretation Map (Black line) |
| 3 | Total Magnetic Field Contours (Black line) |
| 4 | Vertical Magnetic Gradient Contours (Black line) |
| 5 | VLF-EM Total Field Contours (Black line) |
| | |
| 1 | Total Magnetic Field Contours (Colour) |
| 2 | Vertical Magnetic Gradient Contours (Colour |
| 3 | VLF-EM Total Field Contours (Colour) |
| 4A | HEM Offset Profiles - 935, & 33,000 Hz (Colour) |
| 4B | HEM Offset Profiles - 4175 & 4600 Hz (Colour) |

All black line and colour maps are presented at a scale of 1:10,000. All black line maps show a screened photomosaic base, UTM reference corners and the claim block boundary. The claim block boundary represents claim boundaries on the periphery of the claim group. Numbers of corner claims are shown where appropriate. All colour maps show the claim block boundary and the UTM reference corners. Results are presented in one map sheet.

The processed digital data is organized on 9 track archive tape. Both the profile and the gridded data are saved on tape. A full description of the archive tape(s) is delivered with the tape(s).

All gridded data are also provided on diskettes suitable for displaying on IBM compatible 286 or 386 microcomputers using the Aerodat RTI software package.

All analog records, base station magnetometer records, flight path video tape and original map cronaflexes are delivered with the final presentation.

## 5. AIRCRAFT AND EQUIPMENT

### 5.1 Aircraft

An Aerospatiale ASTAR 350B helicopter (C-GJIX), owned and operated by Questral Helicopters, was used for the survey. Installation of the geophysical and ancillary equipment was carried out by Aerodat. The survey aircraft was flown at a mean terrain clearance of 60 metres.

## 5.2 Electromagnetic System

The electromagnetic system was an Aerodat 5-frequency system. Two vertical coaxial coil pairs were operated at 935 Hz, 4,600 Hz and three horizontal coplanar coil pairs at 850, 4,175 and 33,000 Hz. The transmitter-receiver separation was 7 metres. Inphase and quadrature signals were measured simultaneously for the 5 frequencies with a time constant of 0.1 seconds. The HEM bird was towed 30 metres below the helicopter.

## 5.3 VLF-EM System

The VLF-EM System was a Herz Totem 2A. This instrument measures the total field and vertical quadrature components of two selected frequencies. The sensor was towed in a bird 15 metres below the helicopter.

VLF transmitters are designated "Line" and "Ortho". The line station is that which is in a direction from the survey area which is ideally normal to the flight line direction. This is the VLF station most often used because of optimal coupling with near vertical conductors running perpendicular to the flight line direction. The ortho station is ideally 90 degrees in azimuth away from the line station.

The transmitters used were NAA, Cutler, Maine broadcasting at 24.0 kHz and NLK, Jim Creek, Washington broadcasting at 24.8 kHz. From the survey area, Cutler is 20° south of east and Jim Creek is west. Cutler was used as the line station throughout.

## 5.4 Magnetometer

The magnetometer employed a Scintrex H8 cesium, optically pumped magnetometer sensor. The sensitivity of this instrument is 0.001 nanoTeslas at a 0.2 second sampling rate. The sensor was towed in a bird 15 metres below the helicopter.

## 5.5 Ancillary Systems

### Base Station Magnetometer

An IFG-2 proton precession magnetometer was set up at the base of operations to record diurnal variations of the earth's magnetic field. The clock of the base station was synchronized with that of the airborne system to facilitate later correlation. Recording resolution was 1 nT. The update rate was 4 seconds.

External magnetic field variations are recorded on a 3" wide paper chart and in digital form. The analog record shows the magnetic field trace plotted on a grid. Each division of the grid (0.25") is equivalent to 1 minute (chart speed) or 5 nT (vertical sensitivity). The date, time and current total field magnetic value are printed every 10 minutes.

### Radar Altimeter

A King KRA-10 radar altimeter was used to record terrain clearance. The output from the instrument is a linear function of altitude.

## Tracking Camera

A Panasonic colour video camera was used to record flight path on VHS video tape. The camera was operated in continuous mode. The flight number, 24 hour clock time (to .01 second), and manual fiducial number are encoded on the video tape.

## Electronic Navigation Systems

A Trimble TANS GPS positioning system was used to guide the pilot over a programmed grid. The UTM coordinates were digitally recorded. The output sampling rate is 1 second. Positional coordinates are recorded with a resolution of 0.1 m.

## Analog Recorder

A RMS dot matrix recorder was used to display the data during the survey. Record contents are as follows:

| Label | Contents | Scale |
|---|---|---|
| GEOPHYSICAL SENSOR DATA | | |
| MAGF | Total Field Magnetics, Fine | 2.5 nT/mm |
| MAGC | Total Field Magnetics, Course | 25 nT/mm |
| VLT | VLF-EM, Total Field, Line Station | 2.5 %/mm |
| VLQ | VLF-EM, Vertical Quadrature, Line Station | 2.5 %/mm |
| VOT | VLF-EM, Total Field, Ortho Station | 2.5 %/mm |
| VOQ | VLF-EM, Vertical Quadrature, Ortho Station | 2.5 %/mm |
| CXI1 | 935 Hz, Coaxial, Inphase | 2.5 ppm/mm |
| CXQ1 | 935 Hz, Coaxial, Quadrature | 2.5 ppm/mm |
| CXI2 | 4600 Hz, Coaxial, Inphase | 2.5 ppm/mm |
| CXQ2 | 4600 Hz, Coaxial, Quadrature | 2.5 ppm/mm |
| CPI1 | 850 Hz, Coplanar, Inphase | 10 ppm/mm |
| CPQ1 | 850 Hz, Coplanar, Quadrature | 10 ppm/mm |
| CPI2 | 4175 Hz, Coplanar, Inphase | 10 ppm/mm |
| CPQ2 | 4175 Hz, Coplanar, Quadrature | 10 ppm/mm |
| CPI3 | 33000 Hz, Coplanar, Inphase | 20 ppm/mm |
| CPQ3 | 33000 Hz, Coplanar, Quadrature | 20 ppm/mm |
| ANCILLARY DATA | | |
| RALT | Radar Altimeter | 10 ft/mm |
| PWRL | 60 Hz Power Line Monitor | - |

The analog zero of the radar altimeter trace is 5 cm from the top of the analog record. A helicopter terrain clearance of 60 m (197 feet) will be seen as an analog trace 3 cm from the top of the analog record.

Chart speed is 2 mm/second. The 24 hour clock time is printed every 20 seconds. The total magnetic field value is printed every 30 seconds. The ranges or preliminary UTM coordinates from the navigation system are printed every minute.

Vertical lines crossing the record are operator activated manual fiducial markers. The start of any survey line is identified by two closely spaced manual fiducials. The end of any survey line is identified by three closely spaced manual fiducials. Manual fiducials are numbered in order. Every tenth manual fiducial is indicated by its number, printed at the bottom of the record.

Calibration sequences are located at the start and end of each flight and at intermediate times where needed.

### Digital Recorder

A DGR-33 data system recorded the digital survey data on magnetic media. Contents and update rates were as follows:

| DATA TYPE | RECORDING INTERVAL | RECORDING RESOLUTION |
|---|---|---|
| Magnetometer | 0.2 s | 0.001 nT |
| VLF-EM (4 Channels) | 0.2 s | 0.03 % |
| HEM (10 Channels) | 0.1 s | 0.03 ppm (coaxial),<br>0.06 ppm (coplanar - 4175 Hz)<br>0.125 ppm (coplanar - 33 kHz) |
| Position (2 Channels) | 0.2 s | 0.1 m |
| Altimeter | 0.2 s | 0.05 m |
| Power Line Monitor | 0.2 s | - |
| Manual Fiducial | | |
| Clock Time | | |

## 6. DATA PROCESSING AND PRESENTATION

### 6.1 Base Map

The base map is a semi-controlled photomosaic prepared by Aerodat using aerial photographs form the Government of Ontario. UTM reference corners and the claim block boundary were added. The claim block boundary was taken from 1" = 1/2 mile claim maps provided by McKinnon. The claim number of corner claims are shown with the survey boundary.

## 6.2 Flight Path Map

The flight path is drawn using linear interpolation between x,y positions from the navigation system. These positions are updated every second (or about 3 mm at a scale of 1:10,000). These positions are expressed as UTM eastings (x) and UTM northings (y).

Occasional dropouts occur when electronic navigation is temporarily lost. Interpolation is used to cover short gaps in the flight path. The navigator's flight path and/or the flight path recovered from the video tape may be stitched in to cover larger gaps. Such gaps may often be recognized by the distinctive straight line character of the flight path.

The manual fiducials are shown as a small circle and labelled by fiducial number. The 24 hour clock time is shown as a small square, plotted every 30 seconds. Small tick marks are plotted every 2 seconds. Larger tick marks are plotted every 10 seconds. The line and flight numbers are given at the start and end of each survey line.

The flight line and flight numbers are shown at both ends of each survey line. 104803 indicates for example, line 48 and flight number 3.

The flight and line numbers do not necessarily start at L as expected. This is because the survey was part of a larger survey block.

The flight path map is merged with the base map by matching UTM coordinates from the base maps and the flight path record. The match is confirmed by checking the position of prominent topographic features as recorded by manual fiducial marks or as seen on the flight path video record.

## 6.3 Electromagnetic Survey Data

The electromagnetic data were recorded digitally at a sample rate of 10 per second with a time constant of 0.1 seconds. A two stage digital filtering process was carried out to reject major sferic events and the reduce system noise.

Local sferic activity can produce sharp, large amplitude events that cannot be removed by conventional filtering procedures. Smoothing or stacking will reduce their amplitude but leave a broader residual response that can be confused with geological phenomena. To avoid this possibility, a computer algorithm searches out and rejects the major sferic events.

The signal to noise ratio was further enhanced by the application of a low pass digital filter. This filter has zero phase shift which prevents any lag or peak displacement from occurring, and it suppresses only variations with a wavelength less than about 0.25 seconds. This low effective time constant gives minimal profile distortion.

Following the filtering process, a base level correction was made using EM zero levels determined during high altitude calibration sequences. The correction applied is a linear function of time that ensures the corrected amplitude of the various inphase and quadrature components is zero when no conductive or permeable source is present.

The filtered and levelled EM data are presented as colour offset profiles - see map types 4A and 4B. Vertical presentation scales are 2 ppm/mm (935 and 4600 Hz), 8 ppm/mm (4175 Hz) and 32 ppm/mm (33,000 Hz). The additional low frequency coplanar data collected by the 5-frequency HEM system has not been presented.

### 6.4 Total Field Magnetics

The aeromagnetic data were corrected for diurnal variations by adjustment with the recorded base station magnetic values. Where needed, the magnetic tie line results were used to further level the magnetic data. No corrections for regional variations were applied. The corrected profile data were interpolated on to a regular grid using an Akima spline technique. The grid provided the basis for threading the presented contours. The minimum contour interval is 5 nT. A grid cell size of 25 m was used.

A page size copy of the black line contour map of the total magnetic field is attached.

### 6.5 Vertical Magnetic Gradient

The vertical magnetic gradient was calculated from the gridded total field magnetic data. The calculation is based on a 17 x 17 point convolution in the space domain. The results are contoured using a minimum contour interval of 0.2 nT/m. Grid cell sizes are the same as those used in processing the total field data.

### 6.6 VLF-EM

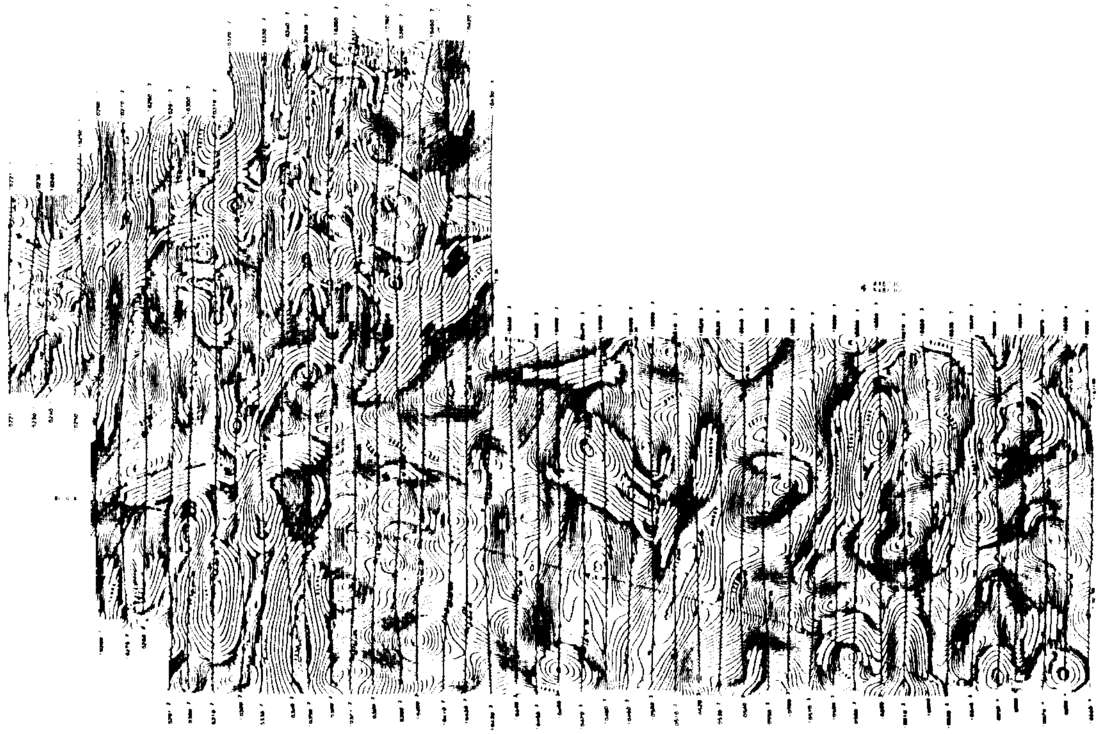
The VLF Total Field data from the Line Station is levelled such that a response of 0% is seen in non-anomalous regions. The corrected profile data are interpolated onto a regular grid using an Akima spline technique. The grid provided the basis for threading the presented contours. The minimum contour interval is 1%. Grid cell size is 25 m.

The resulting contour map of the VLF total field data is of uncertain quality. There appears to have been some difficulty either with the receiver or with an intermittent or unreliable transmitter.

## 7. INTERPRETATION

### 7.1 Area Geology

Most of the notes on area geology and on the exploration target (see Section 7.2 below) have been taken from a Preliminary Geological Report on the Hurdman Project, for Mattagami Lake Exploration Limited by Paul Nielsen, November, 1979. A copy of this



Flight Path

Magnetics

TOTAL FIELD MAGNETIC CONTOURS

HURDMAN PROJECT

ONTARIO

AERODAT LIMITED

MAY 1991

3

report has been provided by Bruce Durham, consulting geologist, on behalf of McKinnon Prospecting.

* Outcrop exposure is sparse and is primarily concentrated along major creeks and rivers. Much of the area is covered by overburden of glacial, glacial fluvial and lacustrine origin with an average thickness of less than 30 m. The lack of outcrop exposure makes geological interpretation difficult.

* The area is principally underlain by an Archean migmatite - metasedimentary - metavolcanic complex which shows wide variations in compostion and metamorphic structure.

* acid igneous batholiths of granite to granodiorite composition intrude the complex.

* north-south trending Proterozoic diabase dykes intrude all rocks in the area.

The 1:250,000 scale GSC aeromagnetic map (7099G) shows variations in and around the survey area of from 60,000 to 60,200. Anomaly shapes are elliptical with no preferred orientation or distinctive character. There is no evidence in the survey area of north/south dykes. There is evidence of such dykes to the south. A 10 km wide band of ne/sw trending regional faults appears to pass over the survey area.

## 7.2 Exploration Target

The exploration target is massive metallic sulphide mineralization. Both copper and zinc sulphides have been discovered on or near the survey area during an exploration history which goes back to the 1960's. The discovery of subeconomic quantities of zinc and copper mineralization in Hurdman Township stimulated a minor rush of claim staking and exploration in the mid-1960's. Mineralization was encountered in several INCO diamond drill holes. Mineralization intercepted consists of slightly disseminated to massive pyrite, pyrrhotite and sphalerite or chalcopyrite associated with metasediments, parogneisses and pegmatites.

These base metal deposits are thought to represent formational sulphide units interbedded with clastic sedimentary rocks. Deposits of this type are typically variable in width extending over long strike lengths. Massive sulphide deposits in the Snow Lake area of Manitoba display similar characteristics, representing distal sulphide deposits, formed in sedimentary environments flanking major volcanic zones.

The area has been one of intermittent exploration activity since the initial discoveries. This has included airborne and ground geophysical surveys and diamond drilling. Some of the prominent EM conductors in or near the area have been extensively tested by Noranda. Only one incidence of graphite has been encountered in the drilling results to date. All other drilled conductors have proved to be massive metallic sulphides.

## 7.3 EM Anomaly Selection and Analysis

### A. Selection

EM anomalies have been picked from analog records and offset profile maps. The selection is based on satisfying any of the following criterion.

* a detectable 935 Hz inphase response.
* a positive 4600 Hz inphase response with coincident 4175 Hz inphase low.
* a positive 4600 Hz inphase response with a coincident proportionately higher 4175 Hz inphase response

These criteria should result in the identification of all possible bedrock conductors. Even horizontal conductors should be identifiable by their edge effects. (see Appendix 1).

These criteria reject EM anomalies due to gradual changes in overburden thickness or resistivity. For such anomalies, the coaxial and coplanar channels (either inphase or quadrature) for the same operating frequency move together and no separation is seen. This information is best viewed in maps of apparent resistivity.

The width of an anomaly from a bedrock conductor will depend principally on depth of burial, dip and orientation with respect to flight line direction. A near vertical conductor running normal to the flight lines will yield a coaxial EM anomaly whose width is about 2.5 times the source-sensor separation (measured from 20% of the anomaly peak). The anomaly from such conductors at surface will therefore be about 80 m. The comparable figures for a conductor under 50 m of overburden is 220 m.

Anomalies are judged to be due to cultural sources if there is a coincident response in the power line monitor as seen on the analog records. Where EM anomalies of a uniform style line up over a major road, railroad or other man made conductor but where there is no response in the power line monitor, such anomalies are also shown as due to cultural sources. No cultural EM anomalies were detected.

Special care is taken in areas of negative inphase response (due to magnetite). The quadrature channels may be the only indicators of a coincident conductor.

### B. Analysis

The EM anomaly response amplitudes at 935 Hz are used to estimate the conductance and depth of burial of a vertical thin sheet conductor model. These data appear in the anomaly listings in Appendix II.

The inphase anomaly amplitude and the thin sheet conductance range as determined from the 935 Hz response amplitudes are shown with the plotted anomaly symbols. Each anomaly is identified by flight line number and letter.

Cultural anomalies would be shown as open squares. Each anomaly is identified by a letter.

Conductive overburden will generally reduce thin sheet conductance estimates because of elevated background levels in the quadrature channels. Depth of burial estimates will in general be too small.

## 7.4 General Comments

### EM

The HEM data shows the long period variations expected from variations in overburden conductivity or thickness. Neither is considered extreme and the detection of bedrock conductors should not be seriously impeded by overburden masking.

A number of strong EM responses are seen. These are characterized for the most part by good 935 and 4600 Hz inphase responses and only slight coincident responses in the 4600 Hz quadrature channel. These are the characteristics of bedrock conductors of moderate to high conductance such as most massive metallic sulphides.

There are in addition EM anomalies which are thought to be caused by weak bedrock conductors. These are usually characterized by complimentary responses in the 4600/4175 Hz coil pairs but a weak response in the 935 Hz inphase channel. The result is a low (1 to 4 mhos) conductance estimate.

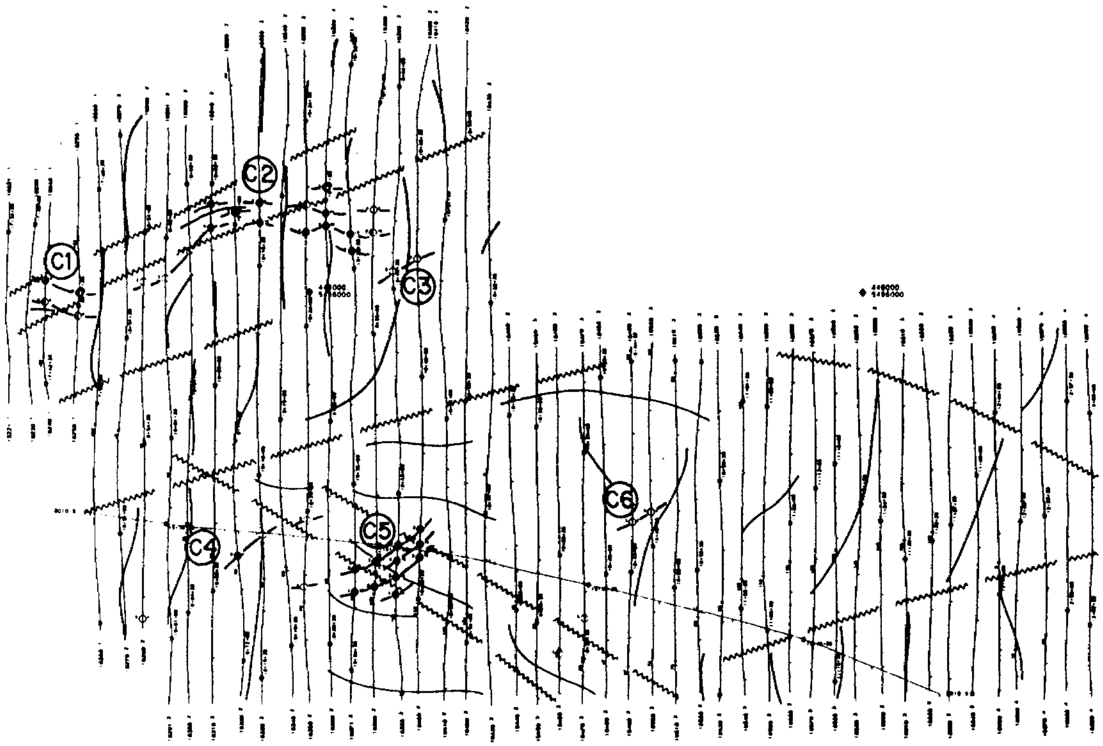
Both conductor types - strong and weak as measured by conductance - may be of interest. The difference may be in the relative concentration of chalcopyrite and sphalerite.

Many of the strongest EM anomalies show coaxial responses which are asymmetric - one side of the anomaly is quite steep, the other side is more gradual. The steep side is often the southern side - the gradual side is the northern side. A conductor at or near surface which dips to the north at less than 45° is expected.

This model of conductor geometry is often supported by the coplanar responses. The 4175 Hz inphase trace often shows an inphase anomaly which is similar in shape and relative amplitude to the 4600 Hz inphase anomaly but with the peak shifted some 50 m or less to the north.

Where the coaxial and coplanar responses coincide, the conductor is either flat lying or is the flat top of a wide tabular source.

In either case, the EM anomalies seen are not generally those of near vertical thin sheet conductors. This is unusual.

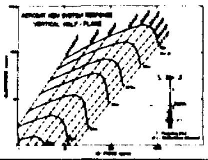



N

Flight Path

EM Anomalies

INTERPRETATION LEGEND



MCKINNON PROSPECTING

INTERPRETATION

HURDMAN PROJECT

ONTARIO

SCALE 1:10,000

AERODAT LIMITED

DATE: MAY 1991

NTS No: 42 H/5

MAP No: 2

## MAGNETICS

The contoured total field magnetic map is dominated by intermediate amplitude (250 to 500 nT) linear anomalies with a north/south trend. These magnetic anomalies appear to bear little direct relationship to the EM conductors which trend east/west ±45°.

A number of faults have been interpreted from breaks and discontinuities in the vertical gradient contour map. Two direction dominate - nw/se and ne/sw. Faults which may trend n/s go undetected.

The dominant north/south trend in the magnetics suggests a series of dikes which have been overprinted on the original geology which may have been more east/west. These dikes appear to have interrupted east/west structures and may have caused north/south dislocations. The massive sulphide targets which show an east/west trend are thought to have been put in place before these dikes.

## 7.5 Compilation Map

The compilation map shows:

- EM conductor axes
- magnetic axes
- faults (inferred from the magnetics)
- favourable target area labels

Page size copy of the compilation map is attached.

Conductor axes are drawn through EM anomaly centers using similarities in EM anomaly patterns.

Magnetic axes are drawn through the peak of prominent vertical gradient anomalies. Vertical gradient anomalies of circular outline or short strike length are poorly represented by such axes.

Faults are inferred from breaks seen in the black line contour map of vertical gradient data.

## 7.6 Favourable Areas

Favourable areas are those conductors which show promise because of a detectable low frequency inphase response and/or complimentary responses in the 4600/4175 Hz inphase traces. EM responses which are weak and isolated have not been selected for highlighting and comment.

Target areas or groups of conductors are labelled on the compilation map as C1 to C6. In the discussion below, target areas are identified by survey line number and 24 hour clock time. This describes the position of the strongest EM response in the group or the central anomaly if all EM anomalies are of equal promise.

C1: Line 1025 (17:47:28)

A group of four EM anomalies which describe two bedrock conductors near the western edge of the survey area. The 935 Hz inphase anomaly is 9 ppm at the position given. The 4175 Hz coaxial inphase trace shows a strong peak (100 ppm) about 50 m north of this position. A shallow dip to the north is indicated. A second peak in the 4600 Hz inphase channel some 150 m north of this position indicates a second possible bedrock conductor.

The combination of coplanar/coaxial response characteristics suggest two parallel conductors with shallow northern dips. The estimated dip is 45° or less. Separation in plan is 100 to 150 m (50 to 75 m real separation for a dip of 30 degrees). Conductance estimates are moderate to high (5 to 10 mhos).

There is no clear magnetic signature to these conductors. Moderate to strong total field anomalies (250 to 400 nT) are coincident or nearby but the relationship is not clear.

C2: Line 1036 (19:27:34)

A large group of conductors which show strong 935 Hz inphase anomalies (28 ppm at the position given). The EM response characteristics on any survey line are similar to those seen for conductor group C1 (see above). Two or three parallel conductors dipping at a low angle to the north are the preferred explanation. The largest EM anomalies are over the leading edge of the southernmost conductor. Response amplitudes decrease to the north. As conductance estimates are relatively constant, conductors to the north (of the two or three parallel conductors) may be at a greater depth of burial. For the same conductor model, response amplitudes will be reduced by a factor of two given a 20% increase in the depth of burial. If the southernmost conductor is at or near surface (as seems likely), the northern conductor need only be under 6 m of cover to reduce response amplitudes by the factors seen.

The second and third conductors are not always seen. The conductors are interrupted by a gap of some 100 m - no EM anomalies were picked on line 1034.

The EM responses on either side of this group of conductors show low background values on some lines. The lowest levels are just south of the leading edge conductor. These high apparent resistivities may be due to relatively thin overburden or resistive bedrock.

The conductor group is associated with a broad total field magnetic high of 59,200 nT with background values of 58,900 nT. North-south trends are superimposed on a broader east-west trending magnetic high. The separation of these two competing effects is difficult. The strongest north-south trending anomaly runs up survey line 1034 - the gap separating the conductors.

A strong magnetic high runs up line 1026 to the west. This separates target groups C1 and C2. Both groups may be part of the same trend but interrupted and displaced by cross-cutting faults with associated dike-like intrusions.

C3: Line 1040 (19:45:44)

Two EM anomalies off the southeastern end of target conductor group 2. These anomalies are classified separately because of low response amplitudes (5 and 10 ppm in the 935 and 4600 Hz inphase channels). The coplanar responses support a shallow dip to the north.

This conductor is probably part of the same trend which encompasses groups C1 and C2.

C4: Line 1032 (19:11:46)

A two line conductor in the south-west corner of the survey area. EM response amplitudes are 6 ppm in the 935 and 4600 Hz inphase channels at this location. The coplanar inphase response to the immediate north is strong. A shallow northern dip is indicated. The low conductance estimate (2 to 4 mhos) should not detract from a clear bedrock conductor.

The magnetic setting is unclear - it sits on the southwest flank of a moderate (250 nT) magnetic anomaly.

C5: Line 1039 (19:42:48)

This is the strongest EM response in the survey area (32 ppm on 935 Hz inphase). The vertical thin sheet conductance estimate at this location is greater than 30 mhos. Although shown as four anomaly centres on this line, the coaxial inphase EM anomalies do not show isolated peaks.

Unlike C2, there is little or no shift between the coaxial and coplanar inphase anomaly peaks. The coaxial and coplanar inphase traces are of a similar shape and position. A flat lying or very wide tabular source is indicated. The neighbouring EM anomalies on line 1038 support multiple parallel conductors with shallow northern dips.

This conductor group has no clear coincident magnetic signature. It lies in an area of low relief and moderate background levels (58,950 to 59,000 nT).

C6: Line 1049 (10:44:08)

A two line conductor in the central part of the area. EM response amplitudes are 5 and 10 ppm in the 935 and 4600 Hz inphase channels at this location. Anomaly shapes are broad. Responses in coplanar inphase channels are of similar shape but shifted to the north. A shallow northern dip is indicated.

Conductance estimates are low - 1 to 2 mhos. As with C4, the EM responses suggest a more optimistic view.

All of the above targets are considered worthy of further investigation. All conductors discussed are considered potential massive sulphides deposits. Ranking might be based on 935 Hz inphase amplitudes and/or conductance estimates.

## 8. CONCLUSIONS

High resolution helicopterborne geophysical surveys have been completed over a block of 71 quarter mile claims in Hurdman Township, some 25 km north of Smooth Rock Falls, Ontario. Total coverage is about 100 line kilometres. Results are presented on black line and colour maps at a scale of 1:10,000. Map types include EM anomaly centres, contoured magnetic field, contoured vertical magnetic gradient and contoured VLF-EM Total Field data.

Preferred geophysical characteristics have been built up from a model geological target. These characteristics have been extracted from various map products and transferred to a compilation/interpretation map. Favourable areas are discussed with reference to this compilation map.

Respectfully submitted,

Ian Johnson, Ph.D., P.Eng.
Consulting Geophysicist
for
**AERODAT LIMITED**
July 16, 1991

J9136B

REGISTERED PROFESSIONAL ENGINEER
I. M. JOHNSON
PROVINCE OF ONTARIO

# APPENDIX I

## GENERAL INTERPRETIVE CONSIDERATIONS

### Electromagnetic

The Aerodat four frequency system utilizes two different transmitter-receiver coil geometries. The traditional coaxial coil configuration is operated at two widely separated frequencies. The horizontal coplanar coil configuration is similarly operated at two different frequencies where at least one pair is approximately aligned with one of the coaxial frequencies.

The electromagnetic response measured by the helicopter system is a function of the "electrical" and "geometrical" properties of the conductor. The "electrical" property of a conductor is determined largely by its electrical conductivity, magnetic susceptibility and its size and shape; the "geometrical" property of the response is largely a function of the conductor's shape and orientation with respect to the measuring transmitter and receiver.

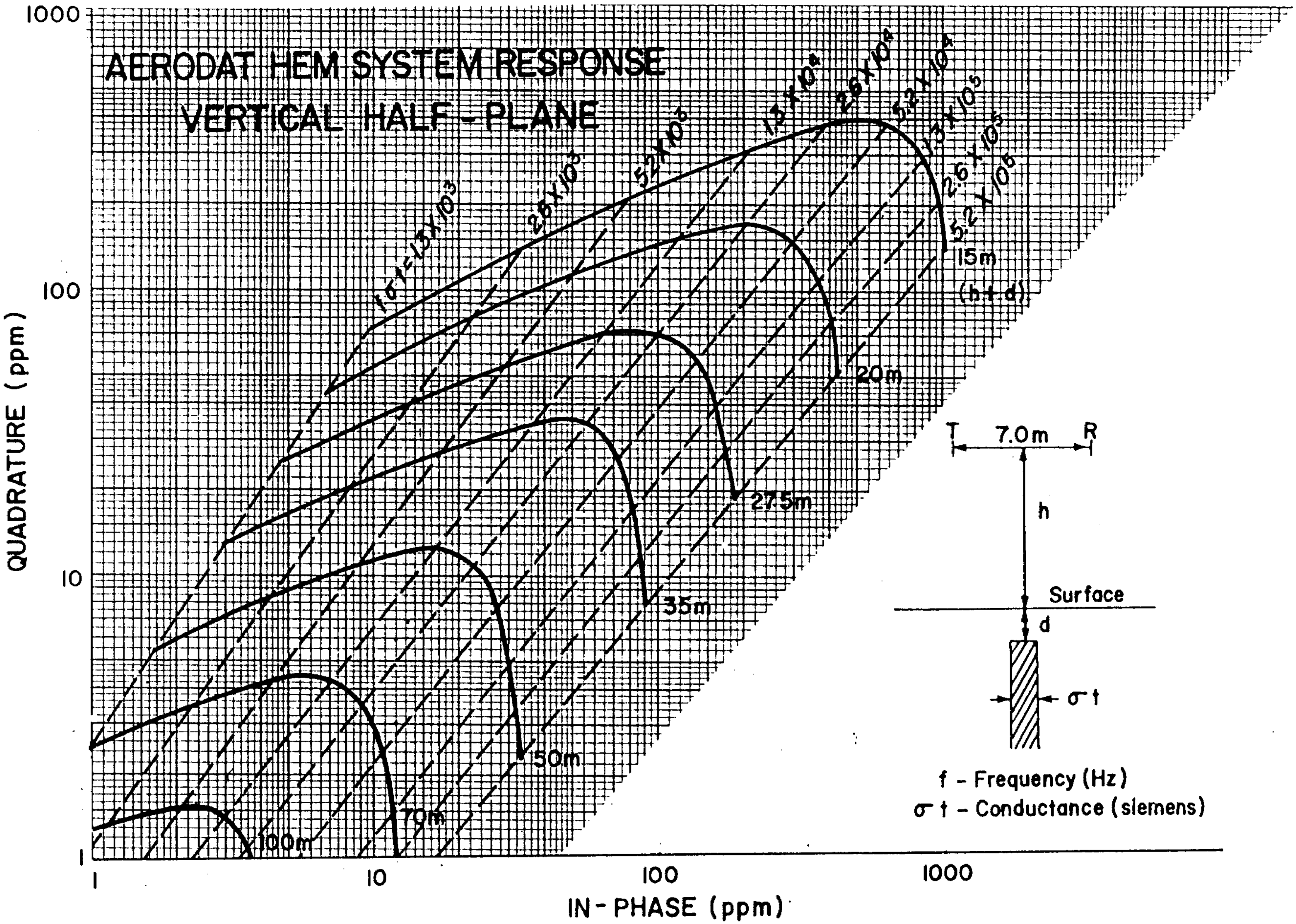
### Electrical Considerations

For a given conductive body the measure of its conductivity or conductance is closely related to the measured phase shift between the received and transmitted electromagnetic field. A small phase shift indicates a relatively high conductance, a large phase shift lower conductance. A small phase shift results in a large inphase to quadrature ratio and a large phase shift a low ratio. This relationship is shown quantitatively for non-magnetic vertical half-plane and half-space models on the accompanying phasor diagrams. Other physical models will show the same trend but different quantitative relationships.

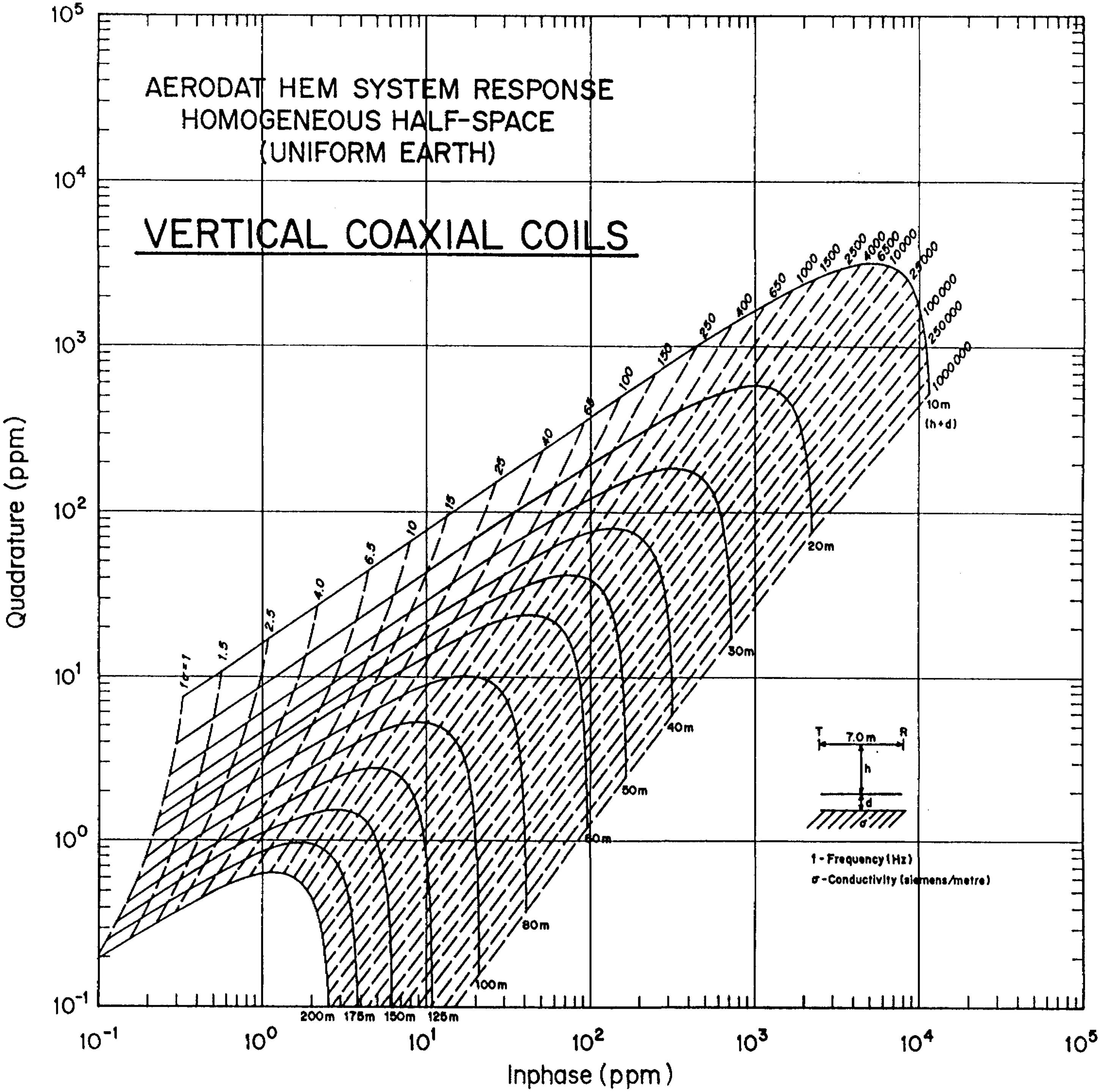
The phasor diagram for the vertical half-plane model, as presented, is for the coaxial coil configuration with the amplitudes in parts per million (ppm) of the primary field as measured at the response peak over the conductor. To assist the interpretation of the survey results the computer is used to identify the apparent conductance and depth of selected anomalies. The results of this calculation are presented in anomaly listings included in the survey report and the conductance and inphase amplitude are presented in symbolized form on the map presentation.

The conductance estimate is most reliable when anomaly amplitudes are large and background resistivities are high. Where the EM anomaly is of low amplitude and background resistivities are low, the conductance estimates are much less reliable. In such situations, the conductance estimate is often quite low regardless of the true nature of the conductor. This is due to the elevated background response levels in the quadrature channel. In an extreme case, the conductance estimate should be discounted and should not prejudice target selection.

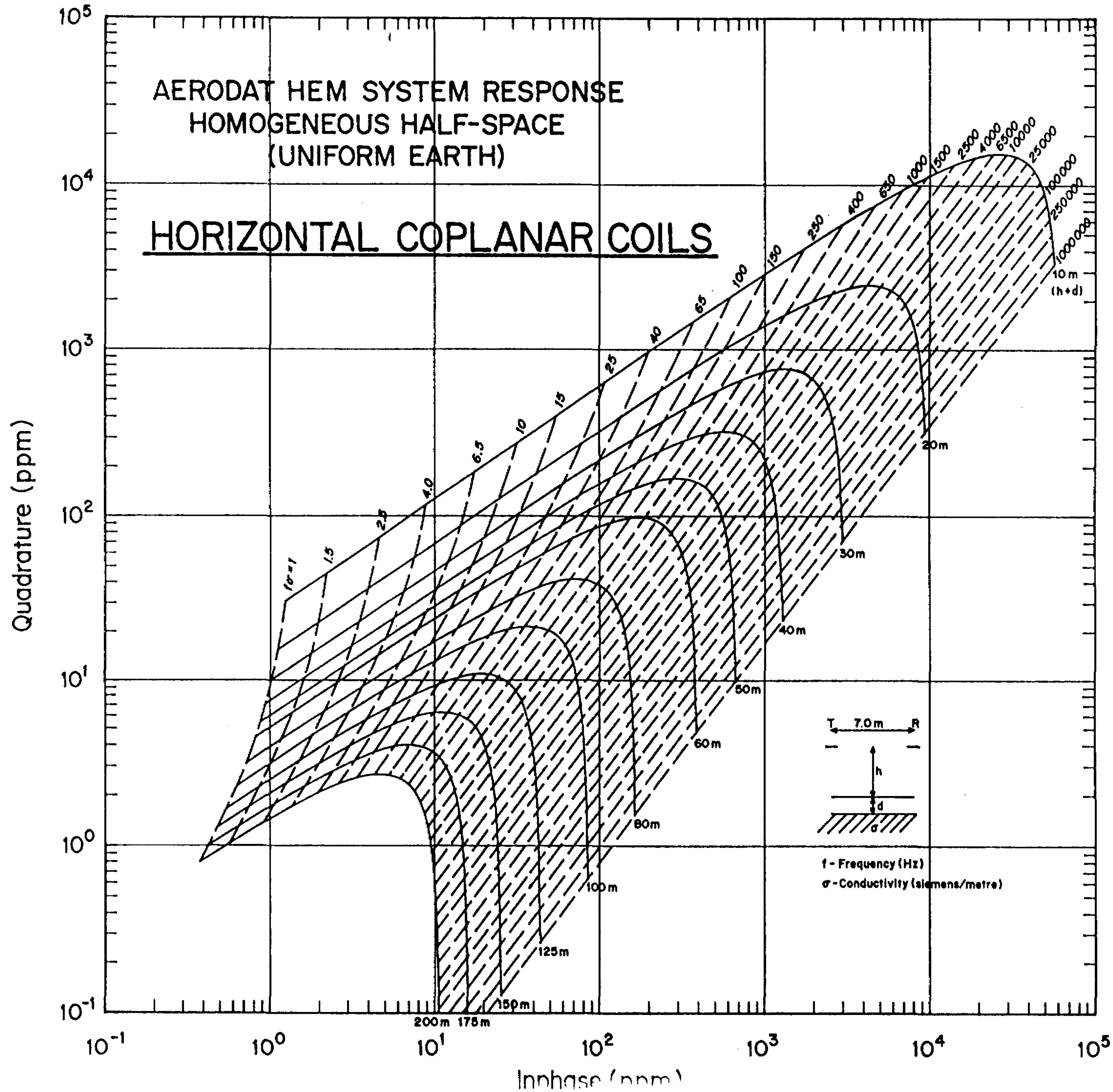
The conductance and depth values as presented are correct only as far as the model approximates the real geological situation. The actual geological source may be of limited length, have significant dip, or may be strongly magnetic. Its conductivity and thickness may vary with depth



AERODAT HEM SYSTEM RESPONSE
VERTICAL HALF-PLANE
1000
100
10
1
QUADRATURE (ppm)
1
10
100
1000
IN-PHASE (ppm)
fσt=1.3X10³
2.6X10³
5.2X10³
1.3X10⁴
2.6X10⁴
5.2X10⁴
1.3X10⁵
2.6X10⁵
5.2X10⁵
15m
(h+d)
20m
27.5m
35m
50m
70m
100m
T
7.0m
R
h
Surface
d
σt
f - Frequency (Hz)
σt - Conductance (siemens)



AERODAT HEM SYSTEM RESPONSE
HOMOGENEOUS HALF-SPACE
(UNIFORM EARTH)
VERTICAL COAXIAL COILS
Quadrature (ppm)
Inphase (ppm)
10m (h+d)
20m
30m
40m
50m
60m
80m
100m
125m
150m
175m
200m
T
7.0m
R
h
d
σ
f - Frequency (Hz)
σ - Conductivity (siemens/metre)



AERODAT HEM SYSTEM RESPONSE
HOMOGENEOUS HALF-SPACE
(UNIFORM EARTH)
HORIZONTAL COPLANAR COILS
Quadrature (ppm)
Inphase (ppm)
f - Frequency (Hz)
σ - Conductivity (siemens/metre)
T 7.0 m R
h
d
10 m (h+d)
20m
30m
40m
50m
60m
80m
100m
125m
150m
200m 175m

and/or strike and adjacent bodies and overburden may have modified the response. In general the conductance estimate is less affected by these limitations than is the depth estimate, but both should be considered as relative rather than absolute guides to the anomaly's properties.

Conductance in mhos is the reciprocal of resistance in ohms and in the case of narrow slab-like bodies is the product of electrical conductivity and thickness.

The higher ranges of conductance, greater than 2-4 mhos, indicate that a significant fraction of the electrical conduction is electronic rather than electrolytic in nature. Materials that conduct electronically are limited to certain metallic sulphides and to graphite. High conductance anomalies, roughly 10 mhos or greater, are generally limited to massive sulphides or graphites.

Sulphide minerals, with the exception of such ore minerals as sphalerite, cinnabar and stibnite, are good conductors. Sulphides may occur in a disseminated manner that inhibits electrical conduction through the rock mass. In this case the apparent conductance can seriously underrate the quality of the conductor in geological terms. In a similar sense the relatively non-conducting sulphide minerals noted above may be present in significant concentrations in association with minor conductive sulphides, and the electromagnetic response will only relate to the minor associated mineralization. Indicated conductance is also of little direct significance for the identification of gold mineralization. Although gold is highly conductive, it would not be expected to exist in sufficient quantity to create a recognizable anomaly. Minor accessory sulphide mineralization may however provide a useful indirect indication.

In summary, the estimated conductance of a conductor can provide a relatively positive identification of significant sulphide or graphite mineralization. A moderate to low conductance value does not rule out the possibility of significant economic mineralization.

## Geometrical Considerations

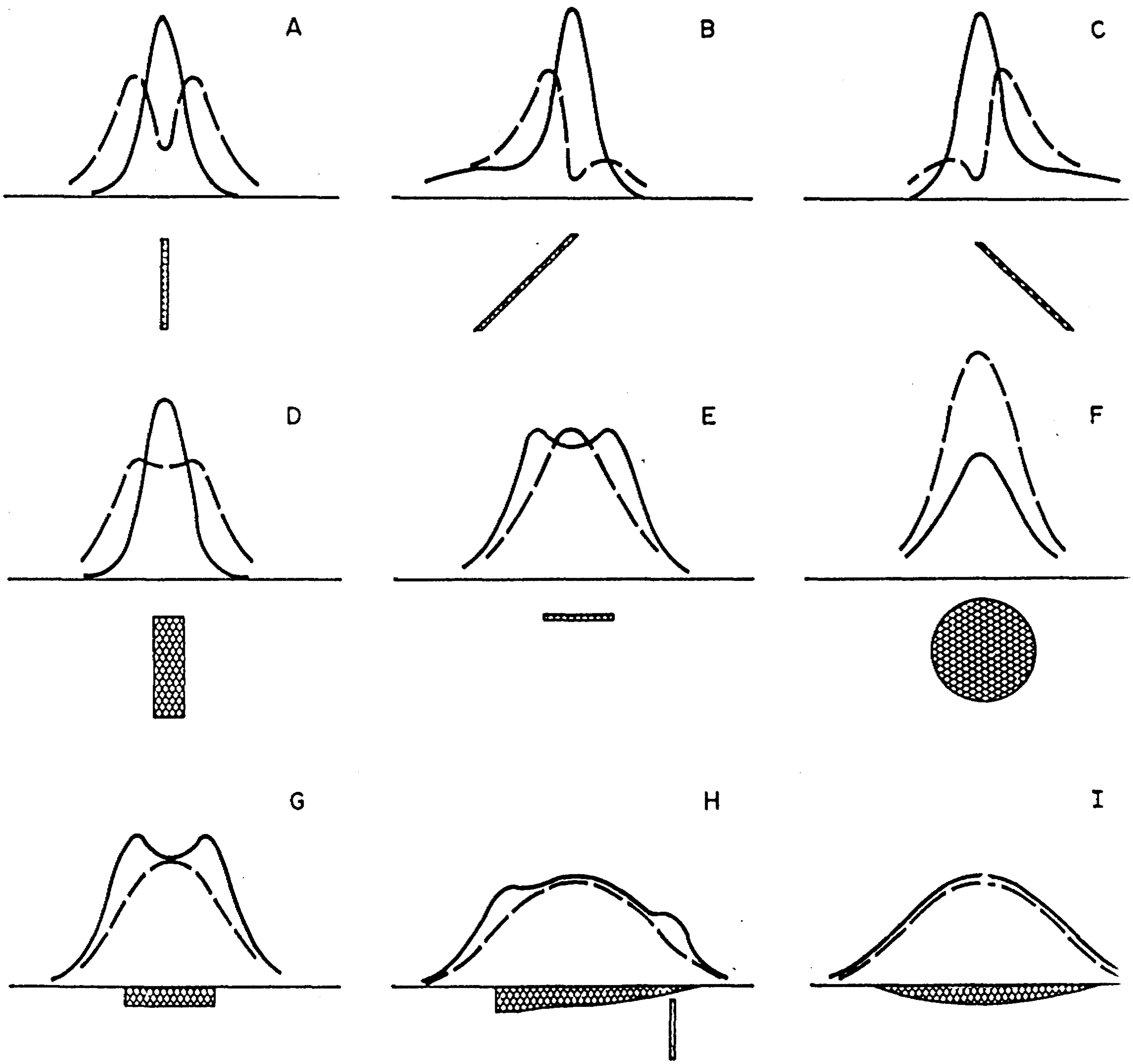
Geometrical information about the geologic conductor can often be interpreted from the profile shape of the anomaly. The change in shape is primarily related to the change in inductive coupling among the transmitter, the target, and the receiver. The accompanying figure shows a selection of HEM response profile shapes from nine idealized targets. Response profiles are labelled A through I. These labels are used in the discussion which follows.

In the case of a thin, steeply dipping, sheet-like conductor, the coaxial coil pair will yield a near symmetric peak over the conductor. On the other hand, the coplanar coil pair will pass through a null couple relationship and yield a minimum over the conductor, flanked by positive side lobes.(Profile A) As the dip of the conductor decrease from vertical, the coaxial anomaly shape changes only slightly, but in the case of the coplanar coil pair the side lobe on the down dip side strengthens relative to that on the up dip side.(Profiles B and C).

As the thickness of the conductor increases, induced current flow across the thickness of the

# HEM RESPONSE PROFILE SHAPE AS AN INDICATOR OF CONDUCTOR GEOMETRY

——— COAXIAL vertical scale 1 ppm/unit
— — — COPLANAR vertical scale 4 ppm/unit



conductor becomes relatively significant and complete null coupling with the coplanar coils is no longer possible.(Profile D) As a result, the apparent minimum of the coplanar response over the conductor diminishes with increasing thickness, and in the limiting case of a fully 3 dimensional body or a horizontal layer or half-space, the minimum disappears completely.

A horizontal conducting layer such as a horizontal thin sheet or overburden will produce a response in the coaxial and coplanar coils that is a function of altitude (and conductivity if not uniform). The profile shape will be similar in both coil configurations with an amplitude ratio (coplanar:coaxial) of about 4:1*.(Profiles E and G).

In the case of a spherical conductor, the induced currents are confined to the volume of the sphere, but not relatively restricted to any arbitrary plane as in the case of a sheet-like form. The response of the coplanar coil pair directly over the sphere may be up to 8* times greater than that of the coaxial pair.(Profile F)

In summary, a steeply dipping, sheet-like conductor will display a decrease in the coplanar response coincident with the peak of the coaxial response. The relative strength of this coplanar null is related inversely to the thickness of the conductor. A pronounced null indicates a relatively thin conductor. The dip of such a conductor can be inferred from the relative amplitudes of the side-lobes.

Massive conductors that could be approximated by a conducting sphere will display a simple single peak profile form on both coaxial and coplanar coils, with a ratio between the coplanar to coaxial response amplitudes as high as 8*.

Overburden anomalies often produce broad poorly defined anomaly profiles.(Profile I) In most cases, the response of the coplanar coils closely follows that of the coaxial coils with a relative amplitude ratio of 4*.

Occasionally, if the edge of an overburden zone is sharply defined with some significant depth extent, an edge effect will occur in the coaxial coils. In the case of a horizontal conductive ring or ribbon, the coaxial response will consist of two peaks, one over each edge; whereas the coplanar coil will yield a single peak.(Profile H)

* It should be noted at this point that Aerodat's definition of the measured ppm unit is related to the primary field sensed in the receiving coil without normalization to the maximum coupled (coaxial configuration). If such normalization were applied to the Aerodat units, the amplitude of the coplanar coil pair would be halved.

## Magnetics

The Total Field Magnetic Map shows contours of the total magnetic field, uncorrected for regional variation. Whether an EM anomaly with a magnetic correlation is more likely to be caused by a sulphide deposit than one without depends on the type of mineralization. An apparent coincidence between an EM and a magnetic anomaly may be caused by a conductor which is also magnetic, or by a conductor which lies in close proximity to a magnetic body. The majority of conductors which are also magnetic are sulphides containing pyrrhotite and/or magnetite. Conductive and magnetic bodies in close association can be, and often are, graphite and magnetite. It is often very difficult to distinguish between these cases. If the conductor is also magnetic, it will usually produce an EM anomaly whose general pattern resembles that of the magnetics. Depending on the magnetic permeability of the conducting body, the amplitude of the inphase EM anomaly will be weakened, and if the conductivity is also weak, the inphase EM anomaly may even be reversed in sign.

The interpretation of contoured aeromagnetic data is a subject on its own involving an array of methods and attitudes. The interpretation of source characteristics for example from total field results is often based on some numerical modelling scheme. The vertical gradient data is more legible in some aspects however and useful inferences about source characteristics can often be read off the contoured VG map.

The zero contour lines in contoured VG data are often sited as a good approximation to the outline of the top of the magnetic source. This only applies to wide (relative to depth of burial) near vertical sources at high magnetic latitudes. It will give an incorrect interpretation in most other cases.

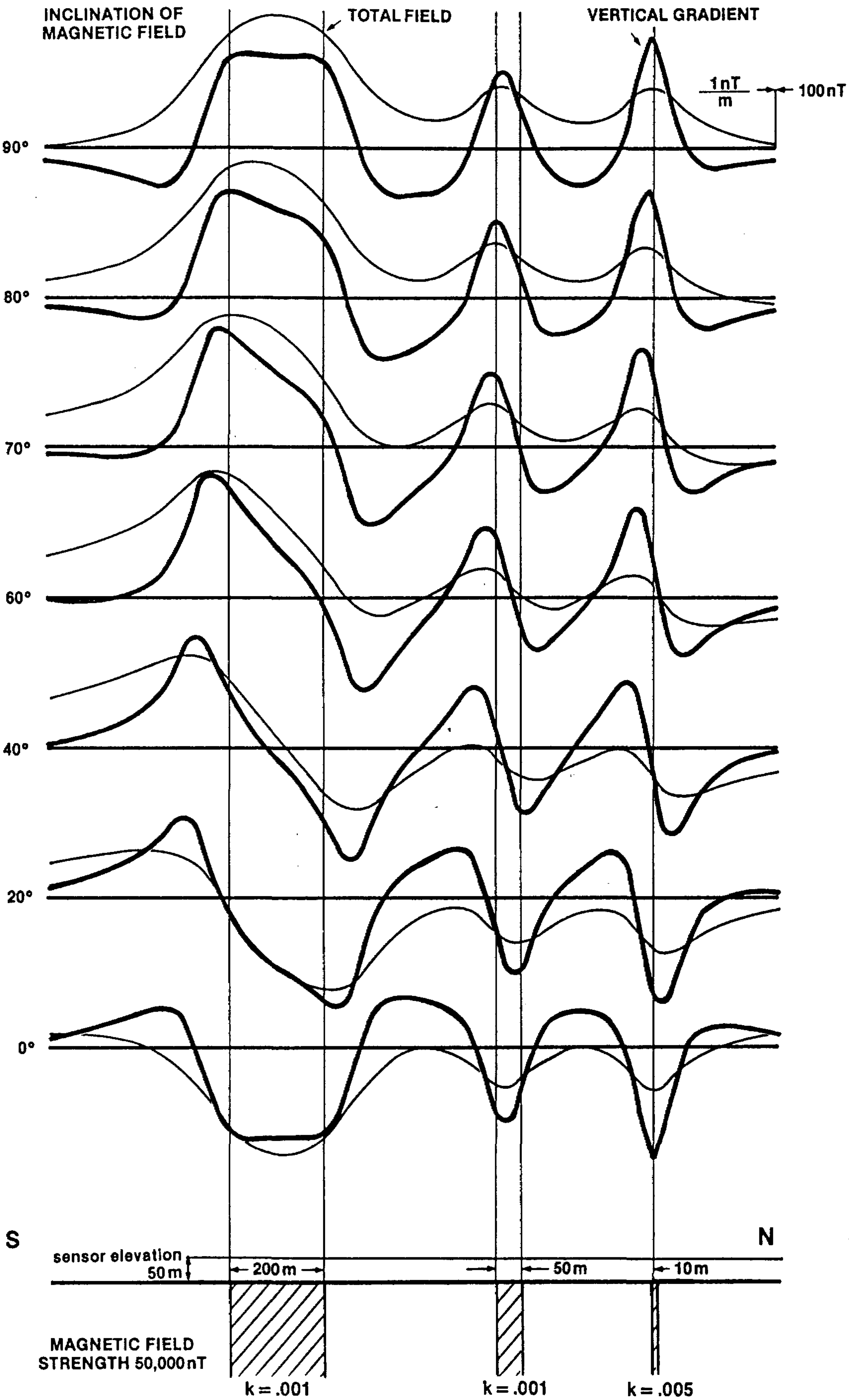
Theoretical profiles of total field and vertical gradient anomalies from tabular sources at a variety of magnetic inclinations are shown in the attached figure. Sources are 10, 50 and 200 m wide. The source-sensor separation is 50 m. The thin line is the total field profile. The thick line is the vertical gradient profile.

The following comments about source geometry apply to contoured vertical gradient data for magnetic inclinations of 70 to 80°.

**Outline**

Where the VG anomaly has a single sharp peak, the source may be a thin near-vertical tabular source. It may be represented as a magnetic axis or as a tabular source of measureable width - the choice is one of geological preference.

Where the VG anomaly has a broad, flat or inclined top, the source may be a thick tabular source. It may be represented as a thick body where the width is taken from the zero contour lines if the body dips to magnetic north. If the source appears to be dipping to the south (i.e. the VG anomaly is asymmetric), the zero contours are less reliable indicators of outline. The southern most zero contour line should be ignored and the outline taken from the northern zero contour line and the extent of the anomaly peak width.



INCLINATION OF MAGNETIC FIELD
TOTAL FIELD
VERTICAL GRADIENT
1nT/m
100nT
90°
80°
70°
60°
40°
20°
0°
S
N
sensor elevation 50m
200m
50m
10m
MAGNETIC FIELD STRENGTH 50,000nT
k = .001
k = .001
k = .005

### Dip

A symmetrical vertical gradient response is produced by a body dipping to magnetic north. An asymmetrical response is produced by a body which is vertical or dipping to the south. For southern dips, the southern most zero contour line may be several hundred meters south of the source.

### Depth of Burial

The source-sensor separation is about equal to half of the distance between the zero contour lines for thin near-vertical sources. The estimated depth of burial for such sources is this separation minus 50 m. If a variety of VG anomaly widths are seen in an area, use the narrowest width seen to estimate local depths.

## VLF Electromagnetics

The VLF-EM method employs the radiation from powerful military radio transmitters as the primary signals. The magnetic field associated with the primary field is locally horizontal and normal to a line pointing at the transmitter.

The Herz Totem uses three coils in the X, Y, Z configuration to measure the total field and vertical quadrature component from two VLF stations. These stations are designated Line and Ortho. The line station is ideally in a direction from the survey area at right angles to the flight line direction. Conductors normal to the flight line direction point at the line station and are therefore optimally coupled to VLF magnetic fields and in the best situation to gather secondary VLF currents. The ortho station is ideally 90 degrees in azimuth from the line station.

The relatively high frequency of VLF (15-25) kHz provides high response factors for bodies of low conductance. Relatively "disconnected" sulphide ores have been found to produce measurable VLF signals. For the same reason, poor conductors such as sheared contacts, breccia zones, narrow faults, alteration zones and porous flow tops normally produce VLF anomalies. The method can therefore be used effectively for geological mapping. The only relative disadvantage of the method lies in its sensitivity to conductive overburden. In conductive ground the depth of exploration is severely limited.

The effect of strike direction is important in the sense of the relation of the conductor axis relative to the energizing electromagnetic field. A conductor aligned along a radius drawn from a transmitting station will be in a maximum coupled orientation and thereby produce a stronger response than a similar conductor at a different strike angle. Theoretically, it would be possible for a conductor, oriented tangentially to the transmitter to produce no signal. The most obvious effect of the strike angle consideration is that conductors favourably oriented with respect to the transmitter location and also near perpendicular to the flight direction are most clearly rendered and usually dominate the map presentation.

The total field anomaly is an indicator of the existence and position of a conductor. The response will be a maximum over the conductor, without any special filtering, and strongly favour the upper edge of the conductor even in the case of a relatively shallow dip.

Conversely a negative total field anomaly is often seen over local resistivity highs. This is because the VLF field produces electrical currents which flow towards (or away from) the transmitter. These currents are gathered into a conductor and are taken from resistive bodies. The VLF system sees the currents gathered into the conductor as a total field high. It sees the relative absence of secondary currents in the resistor as a total field low.

As noted, VLF anomaly trends show a strong bias towards the VLF transmitter. Structure which is normal to this direction may have no associated VLF anomaly but may be seen as a break or interruption in VLF anomalies. If these structures are of particular interest, maps of the ortho station data may be worthwhile.

Conductive overburden will obscure VLF responses from bedrock sources and may produce low amplitude, broad anomalies which reflect variations in the resistivity or thickness of the overburden.

Extreme topographic relief will produce VLF anomalies which may bear no relationship to variations in electrical conductivity. Deep gullies which are too narrow to have been surveyed at a uniform sensor height often show up as VLF total field lows. Sharp ridges show up as total field highs.

The vertical quadrature component over steeply dipping sheet-like conductor will be a cross-over type response with the cross-over closely associated with the upper edge of the conductor.

The response is a cross-over type due to the fact that it is the vertical rather than total field quadrature component that is measured. The response shape is due largely to geometrical rather than conductivity considerations and the distance between the maximum and minimum on either side of the cross-over is related to target depth. For a given target geometry, the larger this distance the greater the depth.

The vertical quadrature component is rarely presented. Experience has shown the total field to be more sensitive to bedrock conductors and less affected by variations in conductive overburden.

AERODAT LIMITED
June, 1991.

# APPENDIX II

# ANOMALY LISTINGS

J9136 - MCKINNON PROSPECTING - AUDEN PROJECT - ANOMALY LIST - BLOCK B

| FLIGHT | LINE | ANOMALY | CATEGORY | AMPLITUDE (PPM) INPHASE | QUAD. | CONDUCTOR CTP MHOS | DEPTH MTRS | BIRD HEIGHT MTRS |
|---|---|---|---|---|---|---|---|---|
| 1 | 10240 | A | 4 | 5.1 | 2.4 | 11.0 | 40 | 43 |
| 1 | 10240 | B | 3 | 8.0 | 6.2 | 6.4 | 15 | 48 |
| 1 | 10250 | A | 3 | 8.6 | 9.3 | 4.2 | 8 | 45 |
| 1 | 10250 | B | 3 | 7.5 | 6.6 | 5.3 | 14 | 47 |
| 2 | 10280 | A | 0 | 0.7 | 3.8 | 0.0 | 0 | 50 |
| 2 | 10291 | A | 0 | 1.8 | 6.1 | 0.3 | 9 | 38 |
| 2 | 10300 | A | 0 | 2.0 | 3.7 | 0.9 | 32 | 35 |
| 2 | 10310 | A | 5 | 8.9 | 3.3 | 18.6 | 27 | 44 |
| 2 | 10310 | B | 4 | 5.2 | 2.5 | 10.7 | 23 | 59 |
| 2 | 10320 | A | 2 | 3.2 | 3.6 | 2.5 | 26 | 48 |
| 2 | 10320 | B | 2 | 5.7 | 8.7 | 2.1 | 0 | 54 |
| 2 | 10330 | A | 0 | 1.9 | 5.0 | 0.5 | 13 | 41 |
| 2 | 10330 | B | 5 | 16.1 | 5.4 | 25.9 | 9 | 49 |
| 2 | 10330 | C | 4 | 8.2 | 4.8 | 9.6 | 23 | 44 |
| 2 | 10350 | A | 0 | 0.5 | 8.1 | 0.0 | 0 | 53 |
| 2 | 10350 | B | 0 | 1.5 | 9.3 | 0.1 | 0 | 40 |
| 2 | 10350 | C | 4 | 9.8 | 6.0 | 9.6 | 17 | 45 |
| 2 | 10350 | D | 3 | 7.8 | 5.5 | 7.3 | 17 | 48 |
| 2 | 10360 | A | 3 | 8.0 | 7.0 | 5.4 | 14 | 46 |
| 2 | 10360 | B | 5 | 21.4 | 8.2 | 23.7 | 4 | 48 |
| 2 | 10360 | C | 5 | 28.7 | 10.0 | 29.4 | 0 | 47 |
| 2 | 10371 | A | 4 | 9.7 | 4.9 | 12.5 | 10 | 55 |
| 2 | 10371 | B | 4 | 9.8 | 6.4 | 8.8 | 11 | 50 |
| 2 | 10371 | C | 5 | 24.1 | 11.6 | 18.1 | 8 | 40 |
| 2 | 10371 | D | 4 | 12.8 | 8.2 | 10.0 | 8 | 48 |
| 2 | 10380 | A | 1 | 5.5 | 10.0 | 1.6 | 0 | 51 |
| 2 | 10380 | B | 3 | 9.5 | 8.3 | 5.8 | 6 | 51 |
| 2 | 10380 | C | 5 | 17.0 | 7.1 | 19.6 | 3 | 53 |
| 2 | 10380 | D | 6 | 25.1 | 7.9 | 32.3 | 0 | 56 |
| 2 | 10390 | A | 6 | 24.3 | 8.0 | 30.1 | 0 | 56 |
| 2 | 10390 | B | 6 | 32.3 | 8.5 | 44.3 | 0 | 47 |
| 2 | 10390 | C | 5 | 17.8 | 6.4 | 24.3 | 3 | 52 |

Estimated depth may be unreliable because the stronger part of the conductor may be deeper or to one side of the flight line, or because of a shallow dip or overburden effects.

J9136 - MCKINNON PROSPECTING - AUDEN PROJECT - ANOMALY LIST - BLOCK B

| FLIGHT | LINE | ANOMALY | CATEGORY | AMPLITUDE (PPM) INPHASE | QUAD. | CONDUCTOR CTP MHOS | DEPTH MTRS | BIRD HEIGHT MTRS |
|---|---|---|---|---|---|---|---|---|
| 2 | 10390 | D | 4 | 8.8 | 5.1 | 10.0 | 18 | 48 |
| 2 | 10390 | E | 0 | 2.4 | 6.3 | 0.6 | 3 | 47 |
| 2 | 10400 | A | 1 | 3.1 | 4.6 | 1.6 | 23 | 42 |
| 2 | 10400 | B | 3 | 7.3 | 5.6 | 6.3 | 25 | 40 |
| 2 | 10400 | C | 4 | 13.8 | 8.9 | 10.1 | 4 | 51 |
| 2 | 10400 | D | 4 | 15.4 | 8.4 | 13.2 | 12 | 42 |
| 3 | 10460 | A | 0 | 1.4 | 8.4 | 0.1 | 0 | 53 |
| 3 | 10470 | A | 0 | 3.2 | 11.3 | 0.4 | 0 | 46 |
| 3 | 10490 | A | 1 | 5.2 | 8.3 | 1.9 | 0 | 53 |
| 3 | 10500 | A | 1 | 3.7 | 7.9 | 1.0 | 0 | 54 |

Estimated depth may be unreliable because the stronger part of the conductor may be deeper or to one side of the flight line, or because of a shallow dip or overburden effects.

## APPENDIX III

## CERTIFICATE OF QUALIFICATIONS

I, IAN JOHNSON, certify that:

1. I am registered as a Professional Engineer in the Province of Ontario.

2. I reside at 38 Tinti Place in the town of Thornhill, Ontario.

3. I hold a Ph.D. in Geophysics from the University of British Columbia, having graduated in 1972.

4. I have been continuously engaged in both professional and managerial roles in the minerals industry in Canada and abroad for the past fourteen years.

5. The accompanying report was prepared from published or publicly available information and material supplied by McKinnon Prospecting and Aerodat Limited in the form of government reports and proprietary airborne exploration data. I have not personally visited the specific property.

7. I have no interest, direct or indirect, in the property described nor in McKinnon Prospecting.

8. I hereby consent to the use of this report in a Statement of Material Facts of the Company and for the preparation of a prospectus for submission to the appropriate securities commission and/or other regulatory authorities.

Signed,

Ian Johnson, Ph.D., P. Eng.

J9136B
Thornhill, Ontario
July 16, 1991

REGISTERED PROFESSIONAL ENGINEER
I. M. JOHNSON
PROVINCE OF ONTARIO

# APPENDIX IV

## PERSONNEL

### FIELD

| | |
|---|---|
| Flown | May 28 and 29, 1991 |
| Pilot | Roger Morrow |
| Operator | Joe Mercier |

### OFFICE

| | |
|---|---|
| Processing | Anthony Valentini<br>George McDonald |
| Report | Ian Johnson |

Ontario

Ministry of Northern Development and Mines

Ministère du Développement du Nord et des Mines

42H12SE8056 2.14249 HURDMAN

900

159 Cedar Street, 4th Floor
Sudbury, Ontario
P3E 6A5

Toll Free: 1-800-465-3880
Telephone: (705) 670-7264
Fax: (705) 670-7262

November 18, 1991

Your File: W. 9160. 00208
Our File: 2. 14249

Mining Recorder
Ministry of Northern Development
and Mines
60 Wilson Avenue
Timmins, Ontario
P4N 2S7

Dear Sir/Madam:

Re: Notice of Intent dated October 16, 1991 for Geophysical (Electromagnetic and Magnetometer) Surveys on mining claims P. 1156133 et al. in the Township of Hurdman.

---

The assessment work credits, as listed with the above-mentioned Notice of Intent have been approved as of the above date.

Please inform the recorded holder of these mining claims and so indicate on your records.

Yours sincerely,

Ron C. Gashinski
Senior Manager, Mining Lands Branch
Mines and Minerals Division

LJ/jl

cc: Mr. Jacques Legault, Timmins, Ontario
Mr. Randall Salo, Timmins, Ontario
Resident Geologist, Timmins, Ontario
Mr. Donald L. McKinnon, Timmins, Ontario
Assessment Files Office, Toronto, Ontario
Aerodat Limited, Mississauga, Ontario

June 30

July 30

Ministry of Northern Development and Mines

Ontario

PREVIOUSLY WRITD. 00204

DOCUMENT No. W9160.00208

# Report of Work

Mining Act

(Geophysical, Geological and Geochemical Surveys)

Instructions
- Please type or print.
- Refer to Section 77, the Mining Act for assessment work requirements and maximum credits allowed per survey type.
- If number of mining claims traversed exceeds space on this form, attach a list.
- Technical Reports and maps in duplicate should be submitted to Mining Lands Section, Mineral Development and Lands Branch.

| Type of Survey(s) | Mining Division | Township or Area |
|---|---|---|
| AIRBORNE MAGNETOMETER VLF EM | PORCUPINE | HURDMAN |

Recorded Holder(s): CLIENT #159090 #191119 #168256
JACQUES LEGAULT (M23645) RANDALL SALO (M21107) DONALD L. MCKINNON (M21873)

Prospector's Licence No.:

Address: BOX 1130 TIMMINS, ONTARIO P4N 7H9

Telephone No.: 705-363-2295

Survey Company: AERODAT LIMITED

2.14248

Name and Address of Author (of Geo-Technical Report): AERODAT LIMITED/ PAUL WESSLER/3883 NASHUA DR. MISSISSAUGA ONT L4V 1R3

Date of Survey (from & to): 29 05 91 – 30 05 91

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) | - Other | |
| | Geological | |
| | Geochemical | |
| **Man Days** | | **Days per Claim** |
| Complete reverse side and enter total(s) here | Geophysical | |
| | - Electromagnetic | |
| | - Magnetometer | |
| | - Other | |
| | Geological | |
| | Geochemical | |
| **Airborne Credits** | | **Days per Claim** |
| Note: Special provisions credits do not apply to Airborne Surveys. | Electromagnetic VLF | 40 |
| | Magnetometer | 40 |
| | Other | |

Total miles flown over claim(s): 506

Date: May 31/91 — Recorded Holder or Agent (Signature): [signature]

Mining Claims Traversed (List in numerical sequence)

| Mining Claim Prefix | Number | Mining Claim Prefix | Number | Mining Claim Prefix | Number |
|---|---|---|---|---|---|
| | PLEASE SEE | ATTACHED LIST | | | |

RECORDED MAY 31 1991 Receipt

Total number of mining claims covered by this report of work: 250

## 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, having performed the work or witnessed same during and/or after its completion and annexed report is true.

Name and Address of Person Certifying: WENDY SIMS KORBA BOX 1130 TIMMINS, ONTARIO P4N 7H9

FAX # 363-3352

Telephone No.: 705-363-2295

Date: May 31/91

Certified By (Signature): [signature]

## For Office Use Only

| Total Days Cr. Recorded | Date Recorded | Mining Recorder |
|---|---|---|
| 20,000 | MAY 31/91 | [signature] Robert Bailey |
| | Date Approved as Recorded | Provincial Manager, Mining Lands |
| | "SEE REVISED WORK STATEMENT" | |

Received Stamp: PORCUPINE MINING DIVISION RECEIVED MAY 31 1991 @ 1:25pm [initials]

Ministry of Northern Development and Mines
Ontario

**Technical Assessment Work Credits**

File: 2.14249

Date: Oct. 16, 1991

Mining Recorder's Report of Work No.: W.9160.00208

Recorded Holder: Jacques Legault, Randall Salo, Donald L. McKinnon

Township or Area: Hurdman Township

| Type of survey and number of Assessment days credit per claim | Mining Claims Assessed |
|---|---|
| **Geophysical** | P.1156133-146 incl. |
| Electromagnetic 40 days | 1156177-196 incl. |
| Magnetometer 40 days | 1176711-721 incl. |
| Radiometric ___ days | 1177665-675 incl. |
| Induced polarization ___ days | 1181571-680 incl. |
| Other ___ days | 1181803-839 incl. |
| Section 77 (19) See "Mining Claims Assessed" column | 1181841-854 incl. |
| Geological ___ days | 1181857-865 incl. |
| Geochemical ___ days | 1181876-877 |
| Man days ☐ Airborne ☒ | 1181882-885 incl. |
| Special provision ☐ Ground ☐ | |
| ☐ Credits have been reduced because of partial coverage of claims. | |
| ☐ Credits have been reduced because of corrections to work dates and figures of applicant. | |

Special credits under section 77 (16) for the following mining claims

No credits have been allowed for the following mining claims

☒ not sufficiently covered by the survey ☐ insufficient technical data filed

P.1176722, 1181840, 1181855, 1181856, 1181866-875 incl.
1181878-881 incl.

The Mining Recorder may reduce the above credits if necessary in order that the total number of approved assessment days recorded on each claim does not exceed the maximum allowed as follows: Geophysical - 80; Geologocal - 40; Geochemical - 40; Section 77(19) - 60.

828 (85/12)

h.[illegible]MAN

P 1156133 SALO. RANDALL
P 1156134 SALO. RANDALL
P 1156135 SALO. RANDALL
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P 1156177 MCKINNON. DONALD L.
P 1156178 MCKINNON. DONALD L.
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P 1156194 MCKINNON. DONALD L.
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P ~~1159196~~ MCKINNON. DONALD L. 1156196
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P 1181620 SALO. RANDALL

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| P 1177672 | MCKINNON, DONALD L. |
| P 1181622 | SALO, RANDALL |
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| P 1181680 | SALO, RANDALL |
| P 1181803 | LEGAULT, JACQUES |
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HURDMAN

P 1181674 SALO, RANDALL
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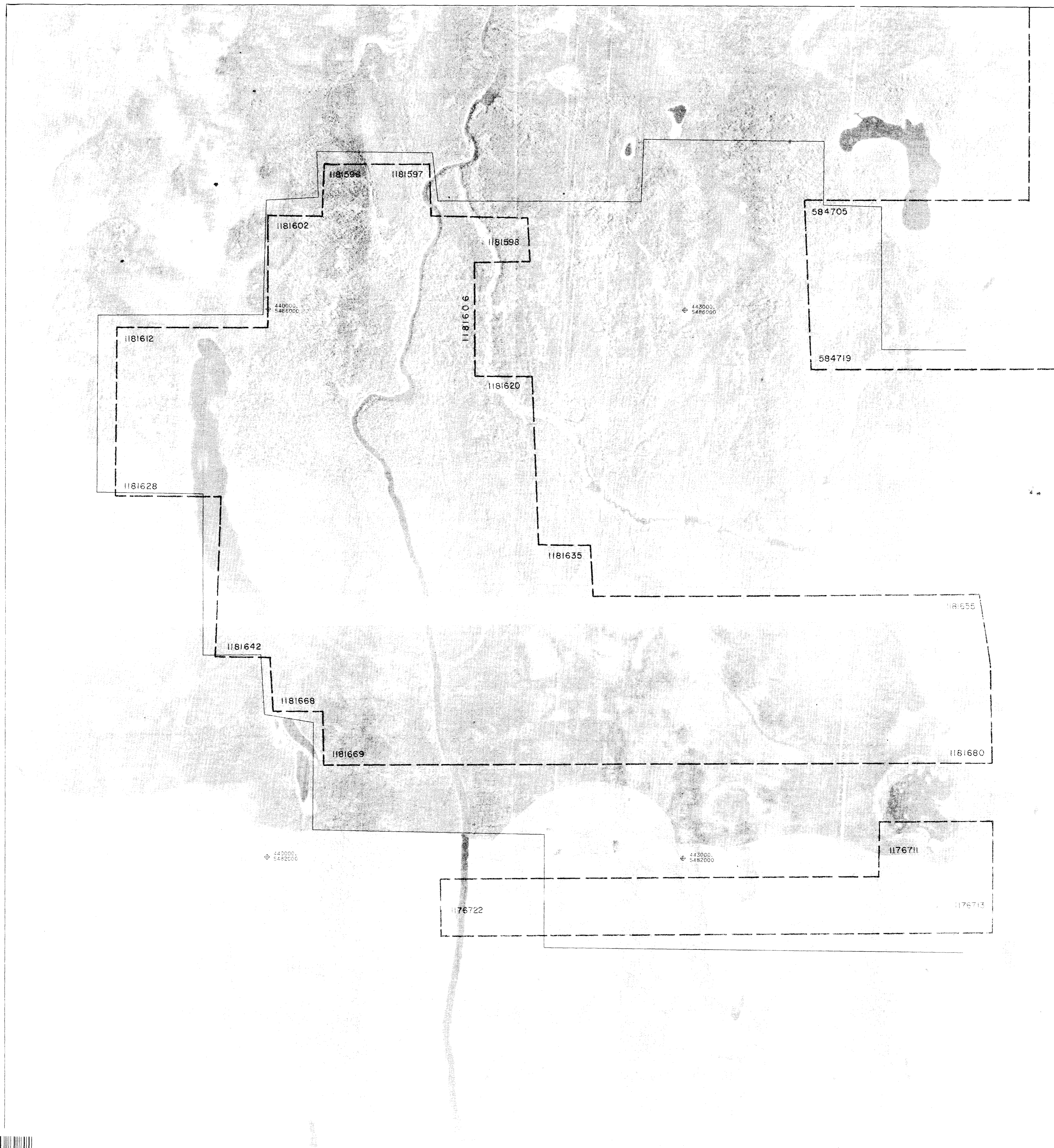


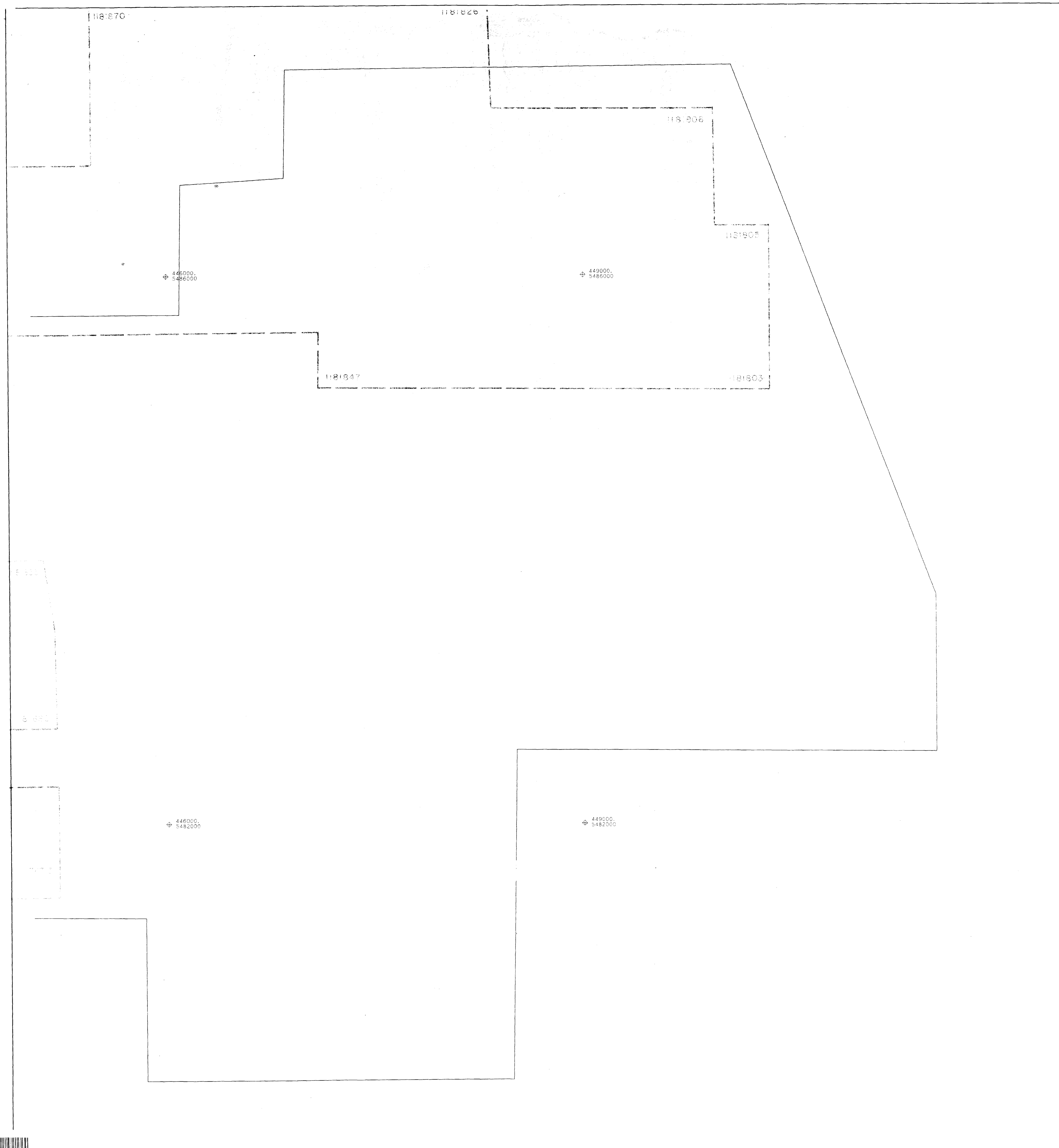

MCKINNON PROSPECTING

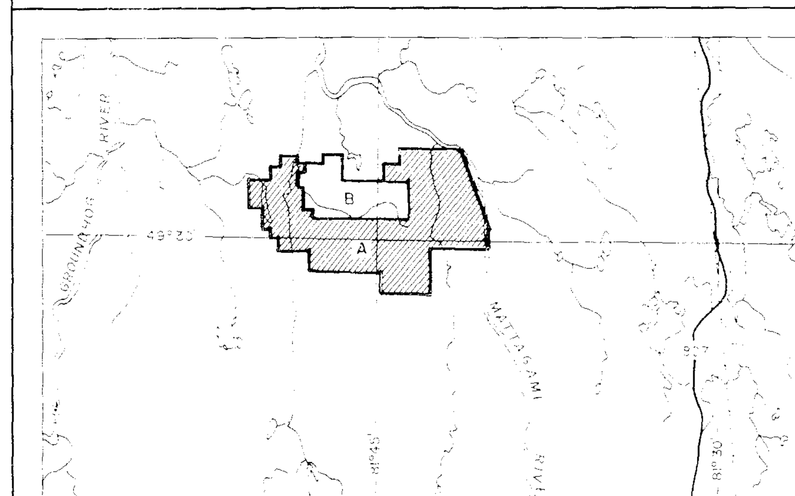
BASE MAP

HURDMAN PROJECT

ONTARIO

AERODAT LIMITED



MCKINNON PROSPECTING

BASE MAP

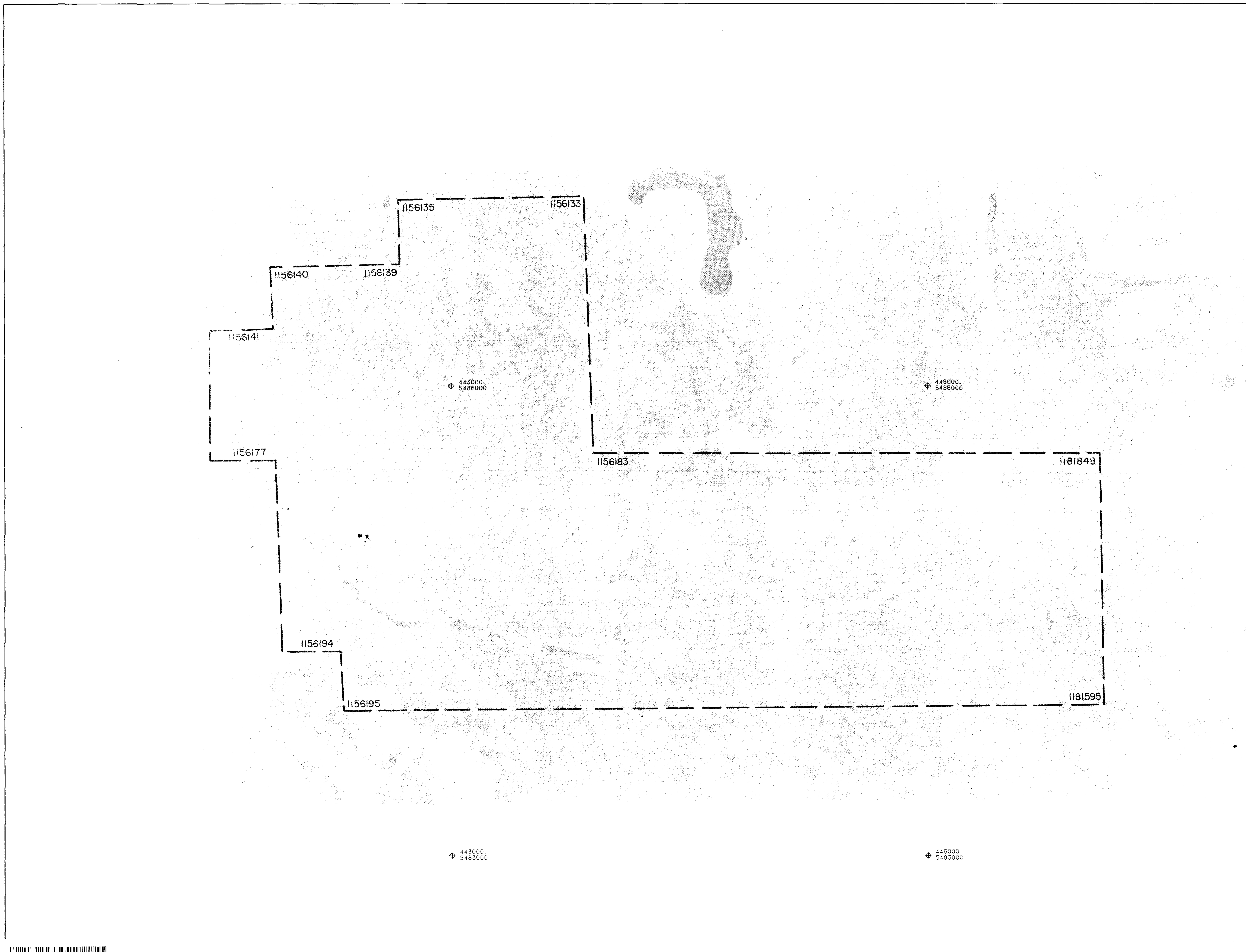
HURDMAN PROJECT

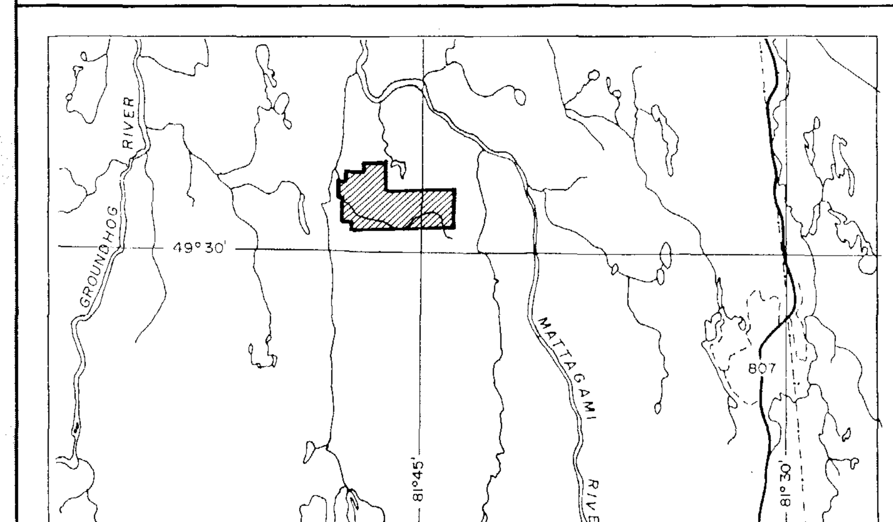
ONTARIO

AERODAT LIMITED

| | |
|---|---|
| DATE | MAY 1991 |
| NTS | 42 H/5 |
| MAP NO. | 1 |
| | J9136A-2 |

210




9

**MCKINNON PROSPECTING**

**BASE MAP**

HURDMAN PROJECT

ONTARIO

SCALE 1:10,000

0 330 660 1320 2640 Feet

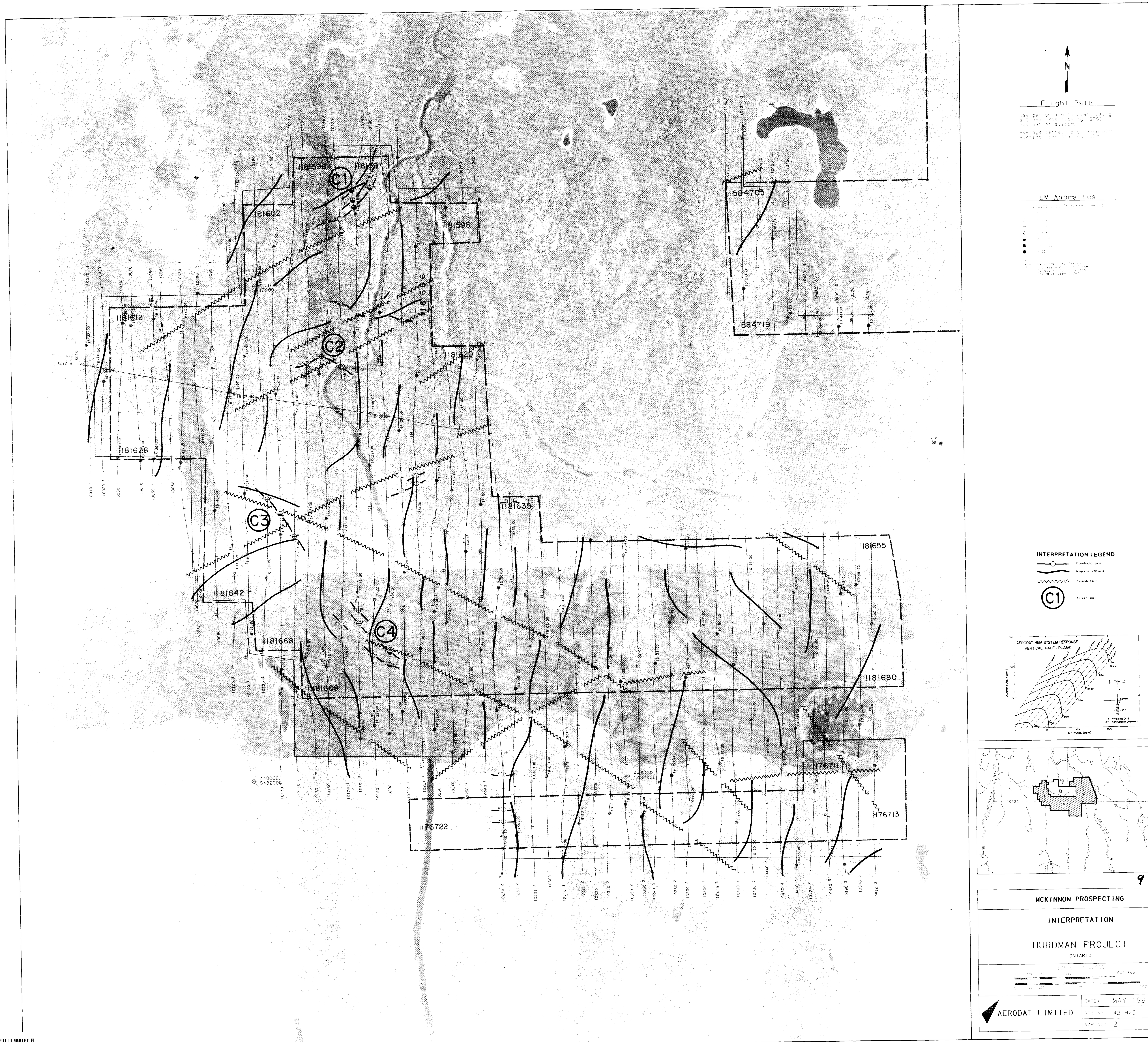
0 100 200 500 1000 Metres

AERODAT LIMITED

| | |
|---|---|
| DATE: | MAY 1991 |
| NTS No: | 42 H/5 |
| MAP No: | 1 |

J91368-1

220




MCKINNON PROSPECTING

INTERPRETATION

HURDMAN PROJECT

ONTARIO

AERODAT LIMITED

DATE: MAY 1991

NTS NO: 42 H/5

MAP NO: 2

J9136A-1

9

230


## Flight Path

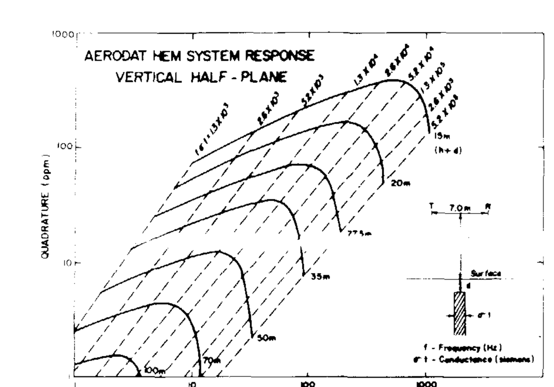
Navigation and recovery using a Global Positioning (GPS) navigation system.

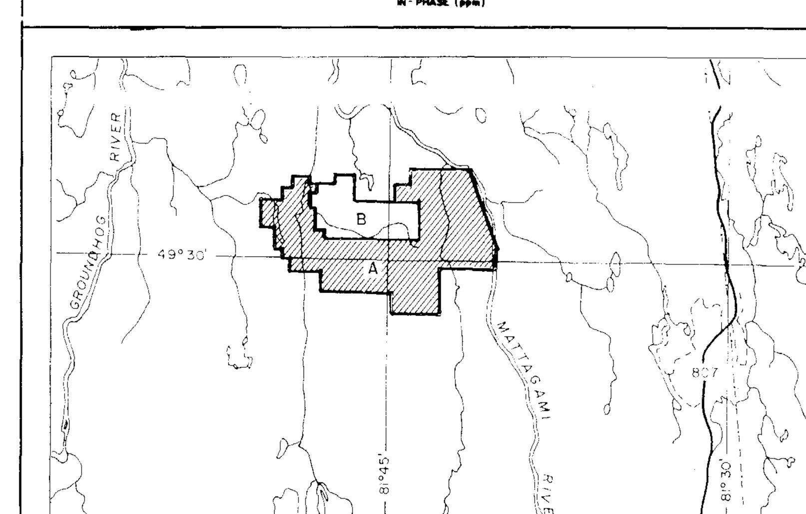
Average terrain clearance 60m
Average line spacing 125m

## EM Anomalies

## INTERPRETATION LEGEND

Conductor axis
Magnetic (VG) axis
Possible fault
C1 Target label




**MCKINNON PROSPECTING**

**INTERPRETATION**

HURDMAN PROJECT

ONTARIO

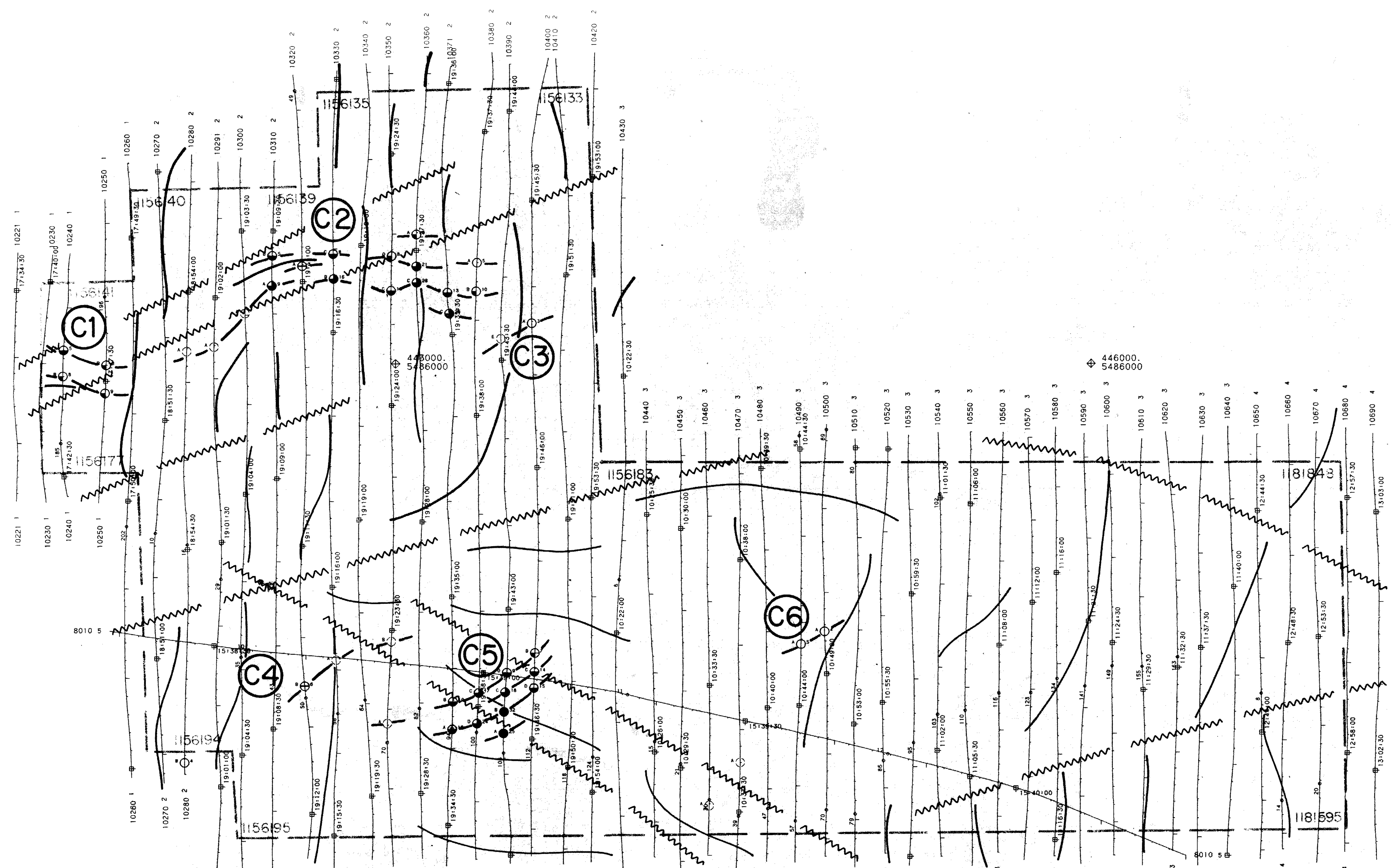
AERODAT LIMITED

DATE: MAY 1991

NTS NO: 42 H/5

MAP NO: 2

J9136A- 2



N

## Flight Path

Navigation and recovery using a Global Positioning (GPS) navigation system.

Average terrain clearance 60m
Average line spacing 125m

## EM Anomalies

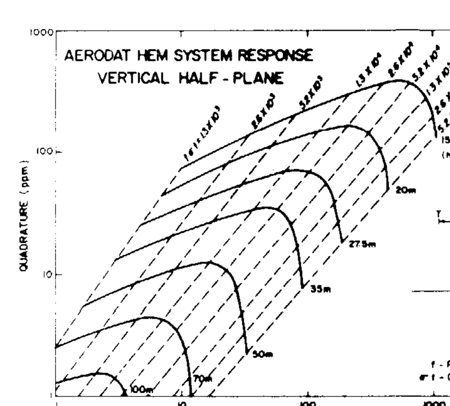
Conductivity Thickness (mhos)

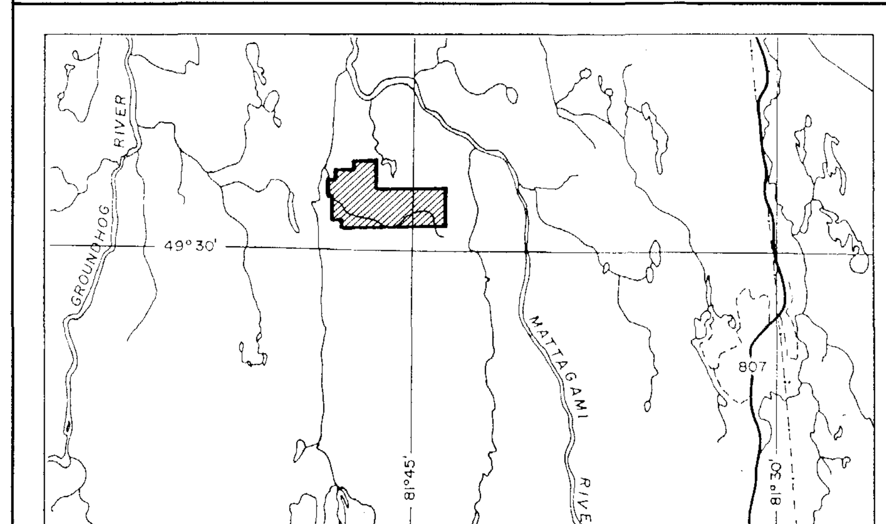
- 0 - 1
- 1 - 2
- 2 - 4
- 4 - 8
- 8 - 15
- 15 - 30
- > 30

EM Anomaly A, 935 Hz inphase amplitude 7 ppm. Conductivity thickness 1-2 mhos (see code).

## INTERPRETATION LEGEND

- Conductor axis
- Magnetic (VG) axis
- Possible fault
- C1 Target label



**MCKINNON PROSPECTING** 9

**INTERPRETATION**

# HURDMAN PROJECT

**ONTARIO**

SCALE 1:10,000

0 330 660 1320 2640 Feet

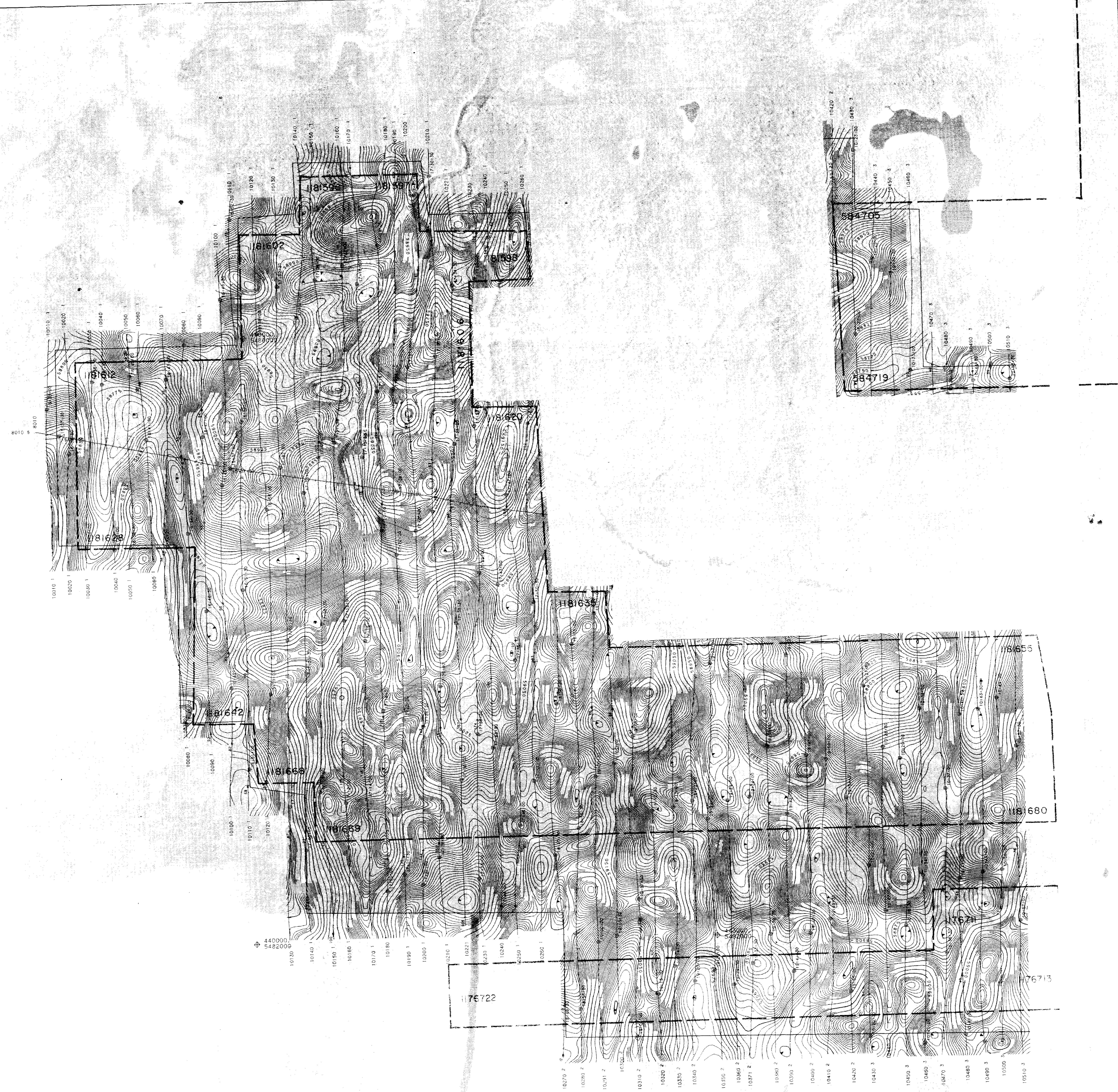
0 100 200 500 1000 Metres

AERODAT LIMITED

| | |
|---|---|
| DATE: | MAY 1991 |
| NTS No: | 42 H/5 |
| MAP No: | 2 |

J9136B- 1

250




N

## Flight Path

Navigation and recovery using a Global Positioning (GPS) navigation system.

Average terrain clearance 60m
Average line spacing 125m

## Magnetics

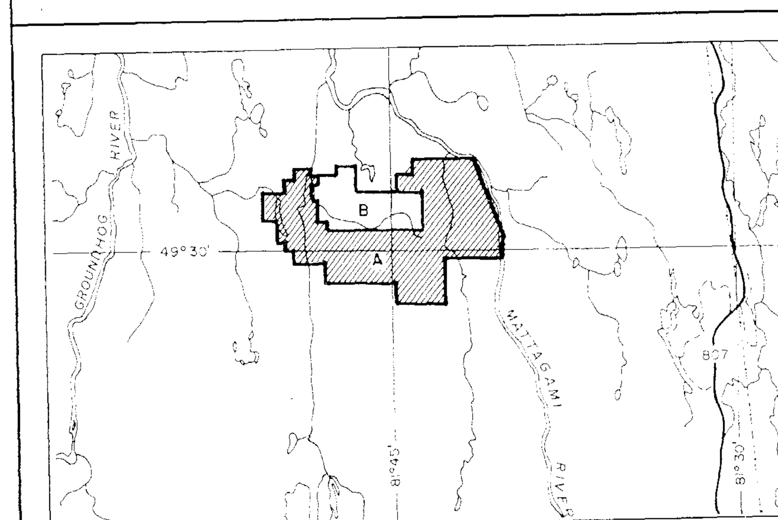
Total Field Magnetic Intensity Contours in nT.

Cesium high sensitivity magnetometer.

Sensor elevation 45m

Map contours are multiples of those listed below

5 nT
25 nT
100 nT
500 nT
2000 nT




9

**MCKINNON PROSPECTING**

**TOTAL FIELD MAGNETIC CONTOURS**

# HURDMAN PROJECT

ONTARIO

SCALE 1:10,000

0 330 660 1320 2640 Feet

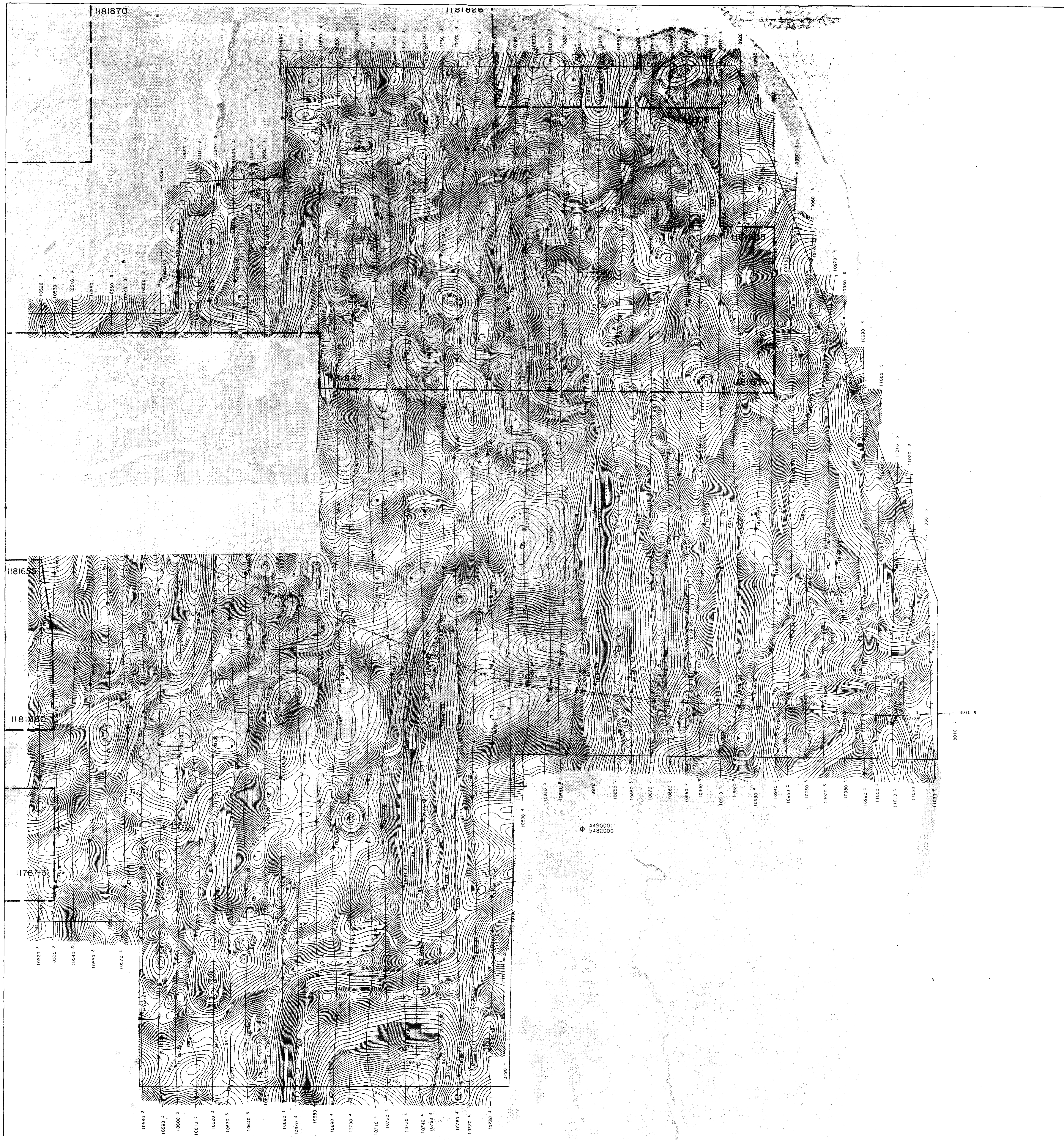
0 100 200 500 1000 Metres

AERODAT LIMITED

DATE: MAY 1991

NTS No: 42 H/5

MAP No: 3 J9136A-1



N

## Flight Path

Navigation and recovery using a Global Positioning (GPS) navigation system.

Average terrain clearance 60m
Average line spacing 125m

## Magnetics

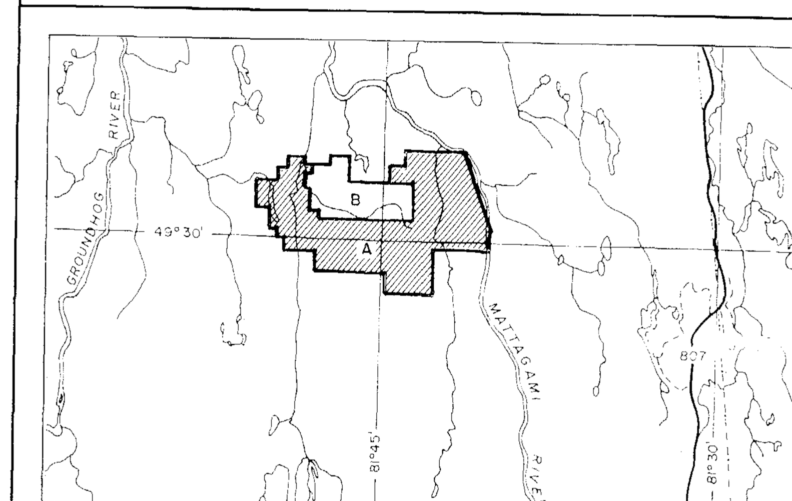
Total Field Magnetic Intensity Contours in nT.

Cesium high sensitivity magnetometer.

Sensor elevation 45m

Map contours are multiples of those listed below

5 nT
25 nT
100 nT
500 nT
2000 nT



9

**MCKINNON PROSPECTING**

**TOTAL FIELD MAGNETIC CONTOURS**

HURDMAN PROJECT

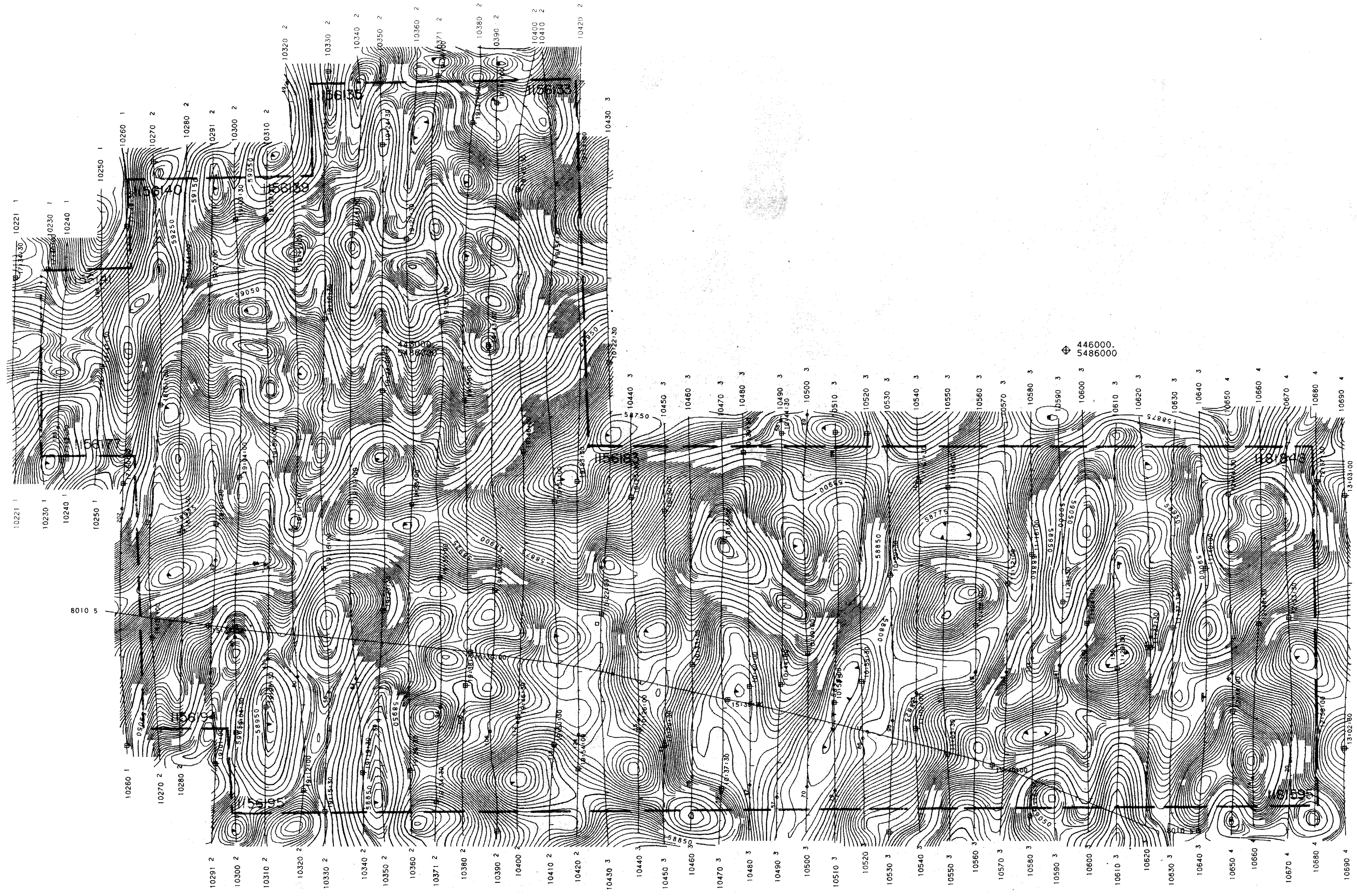
ONTARIO

SCALE 1:10,000

AERODAT LIMITED

DATE: MAY 1991
NTS NO: 42 H/5
MAP NO: 3
J9136A- 2

270



## Flight Path

Navigation and recovery using a Global Positioning (GPS) navigation system.

Average terrain clearance 60m
Average line spacing 125m

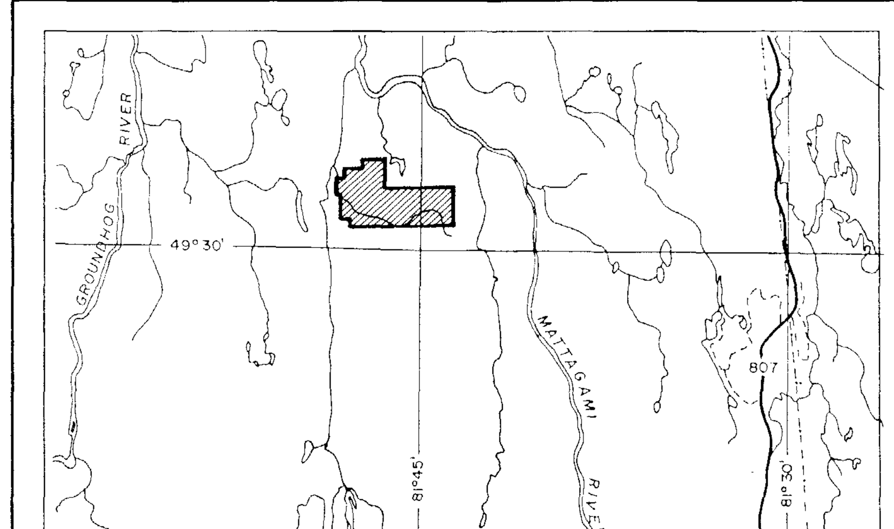
## Magnetics

Total Field Magnetic Intensity Contours in nT.

Cesium high sensitivity magnetometer.

Sensor elevation 45m

Map contours are multiples of those listed below
5 nT
25 nT
100 nT
500 nT
2000 nT



9

**MCKINNON PROSPECTING**

**TOTAL FIELD MAGNETIC CONTOURS**

HURDMAN PROJECT

ONTARIO

SCALE 1:10,000

0 330 660 1320 2640 Feet

0 100 200 500 1000 Metres

AERODAT LIMITED

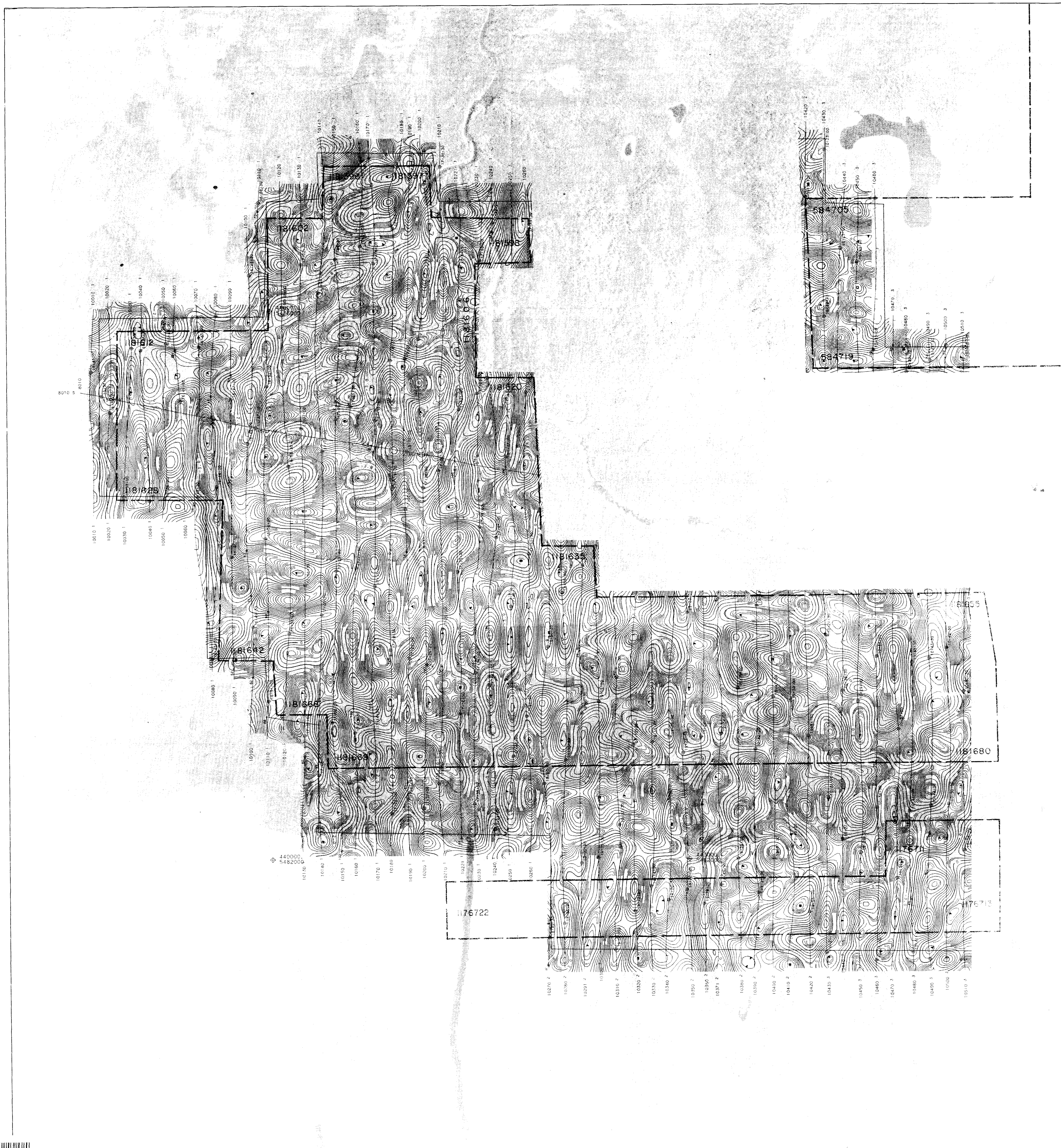
DATE: MAY 1991

NTS No: 42 H/5

MAP No: 3

J9136B-1

280




**MCKINNON PROSPECTING**

CALCULATED VERTICAL MAGNETIC GRADIENT

HURDMAN PROJECT

ONTARIO

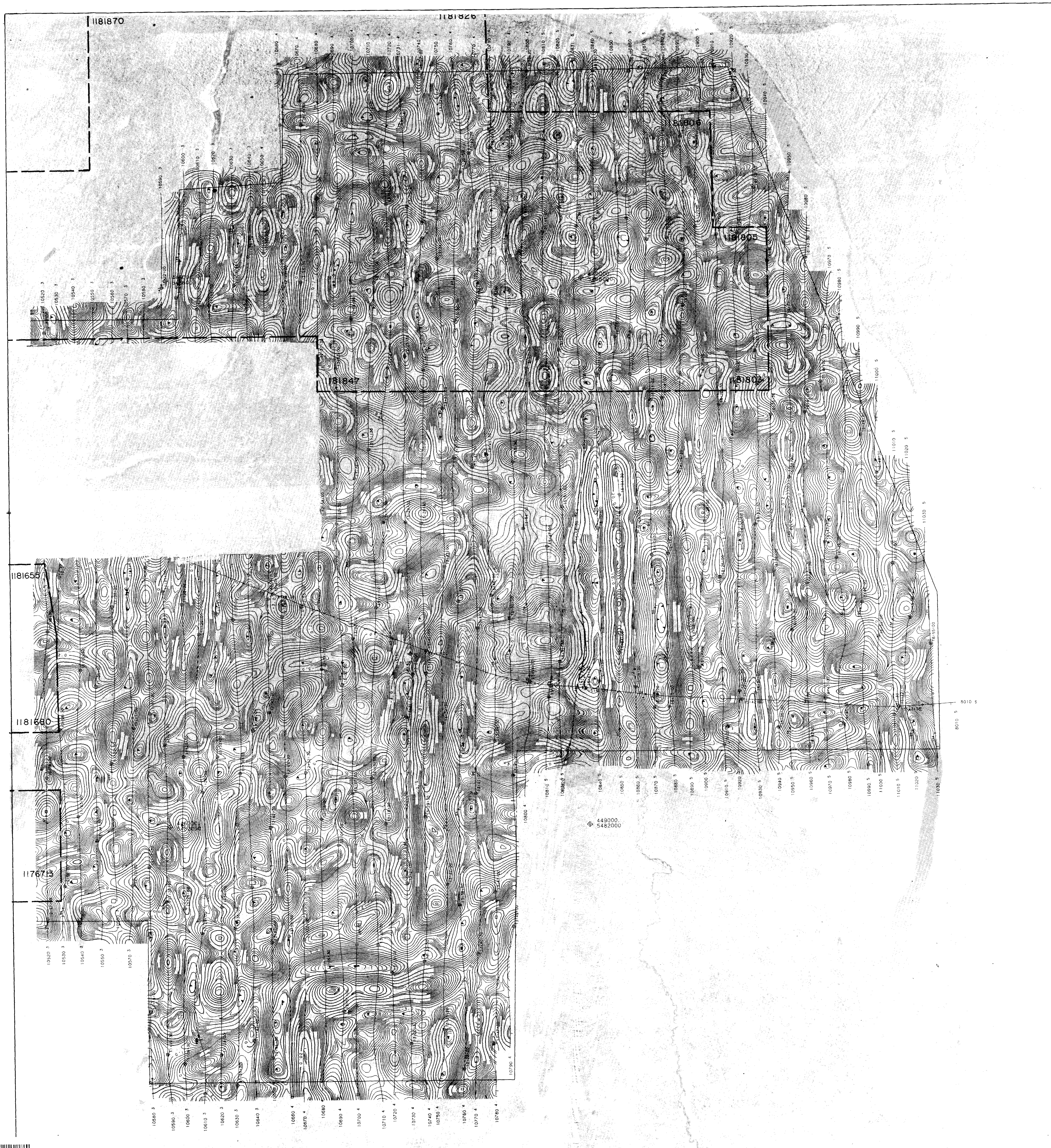
AERODAT LIMITED

MAY 1991

42 H/5

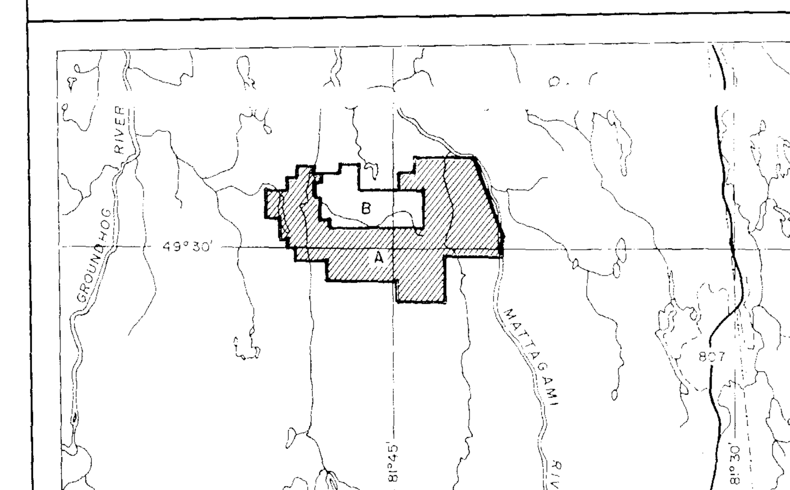
4

290




Flight Path

Vertical Gradient



9

**MCKINNON PROSPECTING**

CALCULATED VERTICAL MAGNETIC GRADIENT

HURDMAN PROJECT

ONTARIO

AERODAT LIMITED

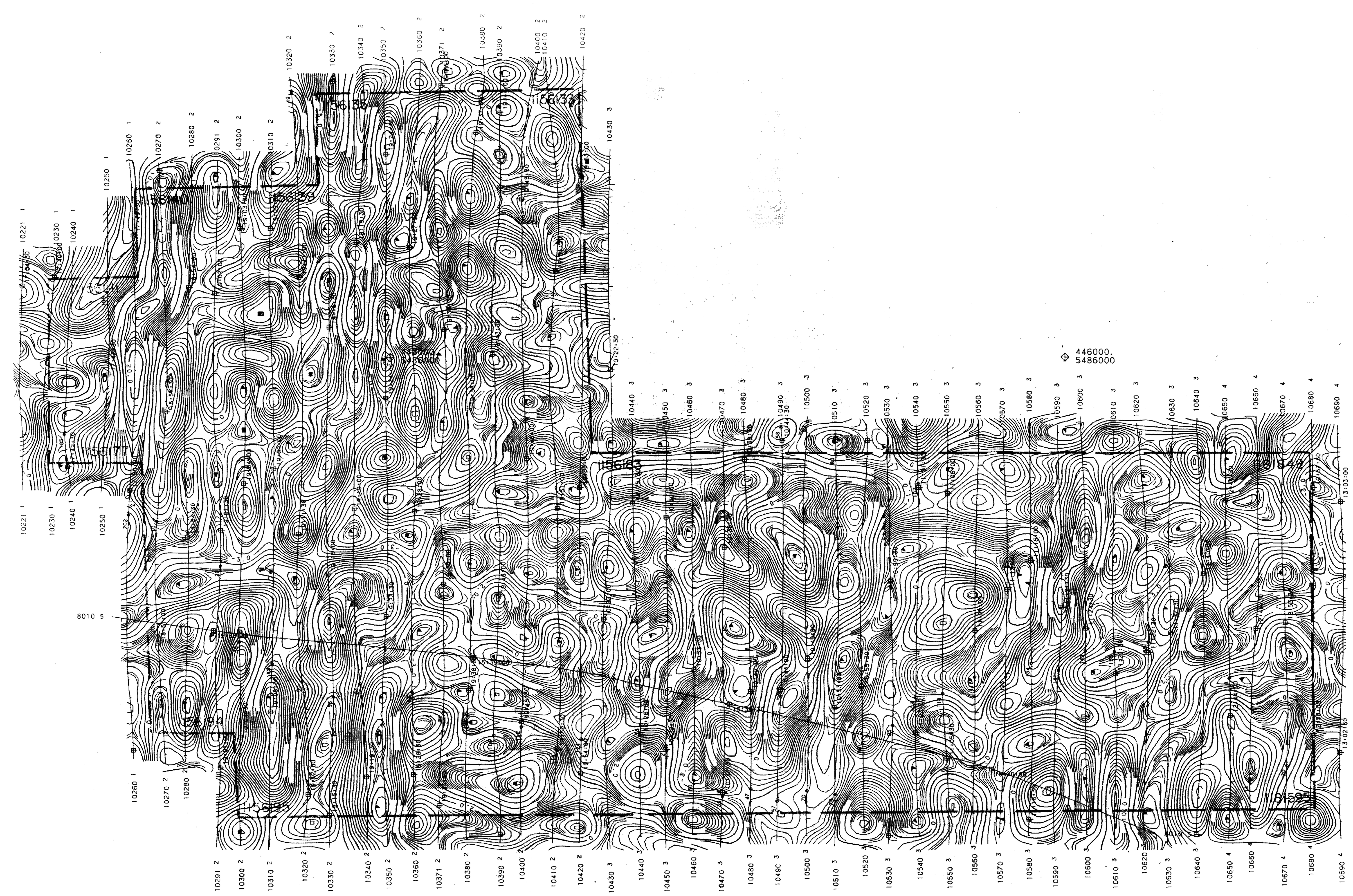
DATE: MAY 1991

NTS NO: 42 H/5

MAP NO: 4

J9136A-2

300




N

## Flight Path

Navigation and recovery using a Global Positioning (GPS) navigation system.

Average terrain clearance 60m
Average line spacing 125m

## Vertical Gradient

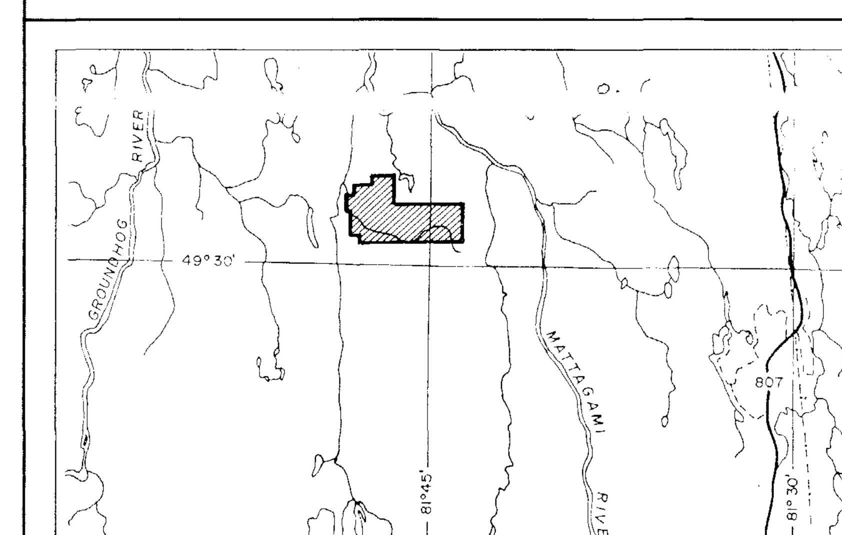
Vertical Magnetic Gradient calculated from the total field magnetic intensity in nT/m.

Cesium high sensitivity magnetometer.

Sensor elevation 45m

Map contours are multiples of those listed below

- .2 nT
- 1.00 nT
- 5.00 nT
- 10.00 nT
- 50.00 nT




9

**MCKINNON PROSPECTING**

**CALCULATED VERTICAL MAGNETIC GRADIENT**

# HURDMAN PROJECT

**ONTARIO**

SCALE 1:10,000

0 330 660 1320 2640 Feet

0 100 200 500 1000 Metres

AERODAT LIMITED

| | |
|---|---|
| DATE: | MAY 1991 |
| NTS No: | 42 H/5 |
| MAP No: | 4 J91369-1 |

310

Flight Path
VLF-EM
584705
584719
1181599
1181597
1181602
1181593
1181612
1181616
1181620
1181628
1181635
1181642
1181655
1181668
1181669
1181680
1176711
1176713
1176722
440000
5482000
MCKINNON PROSPECTING
VLF-EM TOTAL FIELD CONTOURS ( LINE CHANNEL )
HURDMAN PROJECT
ONTARIO
AERODAT LIMITED
MAY 1991
42 H/5
320


## Flight Path

Navigation and recovery using a Global Positioning (GPS) navigation system.

Average terrain clearance 60m
Average line spacing 125m

## VLF-EM

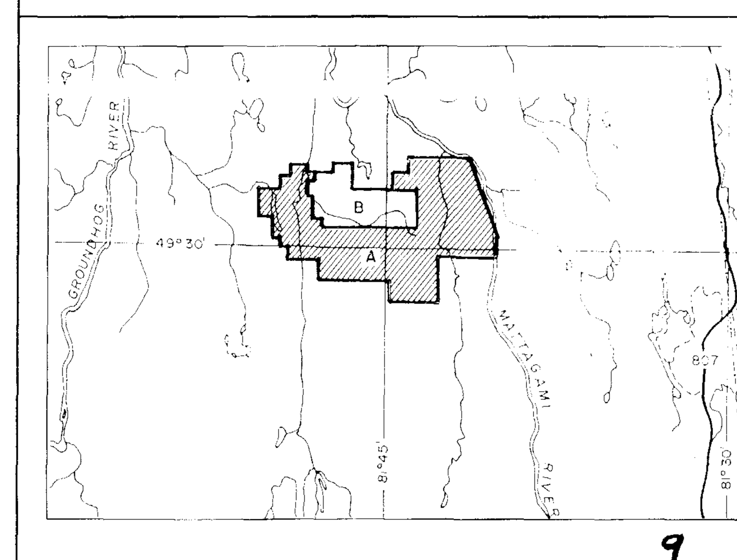
VLF-EM Total Field Intensity in percent.

Station: NAA
Cutler, Maine
24.0 kHz

Sensor elevation 45m

Map contours are multiples of those listed below

1 %
5 %
25 %
100 %




9

**MCKINNON PROSPECTING**

**VLF-EM TOTAL FIELD CONTOURS ( LINE CHANNEL )**

# HURDMAN PROJECT

ONTARIO

SCALE 1:10,000

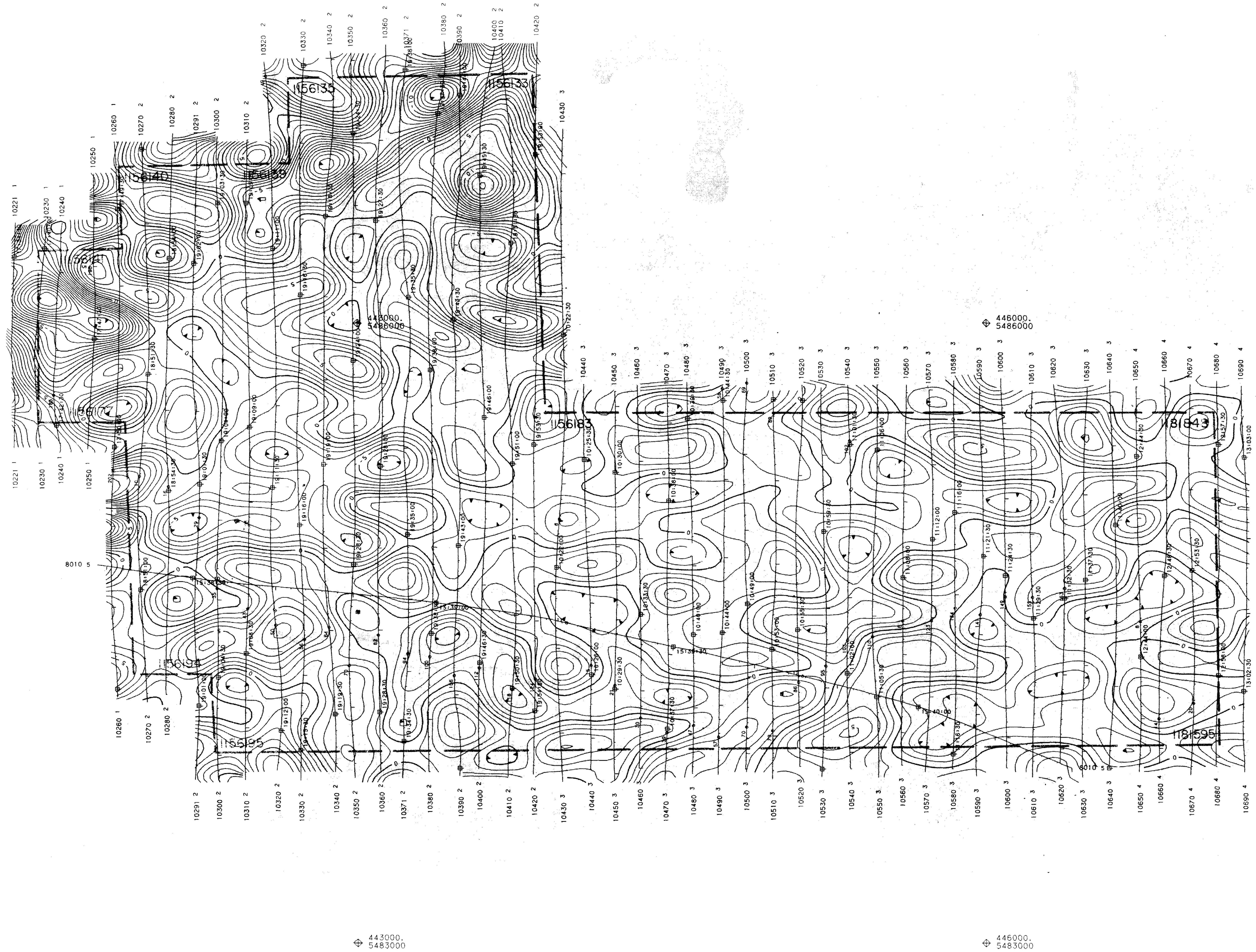
2640 Feet

1000 Metres

AERODAT LIMITED

| | |
|---|---|
| DATE: | MAY 1991 |
| NTS No: | 42 H/5 |
| MAP No: | 5 J9136A- 2 |

330




## Flight Path

Navigation and recovery using a Global Positioning (GPS) navigation system.

Average terrain clearance 60m
Average line spacing 125m

## VLF-EM

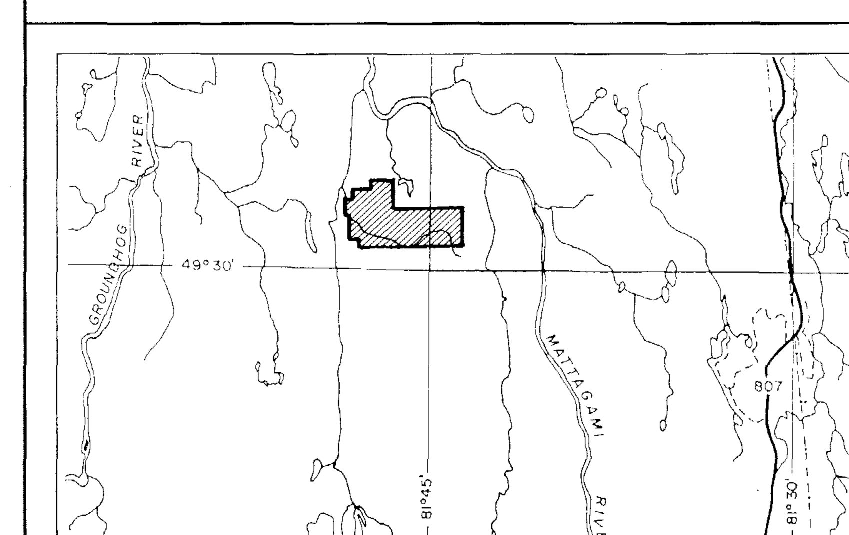
VLF-EM Total Field intensity in percent.

Station: NAA
Cutler, Maine
24.0 kHz

Sensor elevation 45m

Map contours are multiples of those listed below

- 1 %
- 5 %
- 25 %
- 100 %




9

**MCKINNON PROSPECTING**

**VLF-EM TOTAL FIELD CONTOURS ( LINE CHANNEL )**

# HURDMAN PROJECT

ONTARIO

SCALE 1:10,000

0 330 660 1320 2640 Feet

0 100 200 500 1000 Metres

AERODAT LIMITED

DATE: MAY 1991

NTS No: 42 H/5

MAP No: 5 J91368-1

340