MAR 19770018: FORT CHIPEWYAN

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INTERPRETATION REPORT

AIRBORNE ELECTROMAGNETIC (EM30) SURVEY

of

Wilson Lake Area
Highrock Lake Area
Wolvernan Lake Area
Fort Chipewyan Area

for

DENISON MINES LIMITED

by

GEOTERREX LIMITED
(84-148)

MARCH, 1977
OTTAWA, CANADA

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Pages #12-73 are missing from the report.

J. Sazma
26-April-06.

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I. INTRODUCTION

An airborne geophysical programme was carried out by Geoterrex Limited during the period 17 October to 14 November, 1976 for Denison Mines Limited. The survey was flown out of Uranium City, and LaRonge, Saskatchewan. Four separate areas were flown and these are designated as Wilson Lake, Highrock Lake, Wolvernan Lake, and Fort Chipewyan. The exact locations of these areas are shown on the accompanying plan maps.

The survey was conducted with a Beechcraft E18S aircraft with Canadian Registration CF-FLC. It carried the following equipment:

- Hudson Bay EM-30 electromagnetic system,
- Geometrics G-803 high performance proton precession magnetometer,
- Barringer 8 channel analog recorder,
- Moseley 7100 B 2 channel ink recorder,
- 35 mm. Geocam continuous strip camera, and Sperry altimeter.

This equipment is briefly described in Appendix A, where general survey techniques and procedures are also outlined.

Navigation of the survey was by visual means utilizing photo-mosaics. Mean terrain clearance was 250 feet.

Survey specifications, as directed by Denison Mines Ltd., called for flight-lines spaced at approximately 880 feet. The Wilson Lake extension was flown at a line spacing of 880 ft. and 1,760 ft.

The total mileage flown, including tie-lines for control purposes, was 1711.0.

II. PERSONNEL

The following Geoterrex personnel participated in this survey:

A. Field Operation

Pilot	P. Gendron
Navigator	A. Tolley
Aircraft Engineer	R. Innes
Operator	A. Proulx
Data Compiler	J. Taggart
Geophysicist	F. Kiss

B. Office Compilation

Data	P. Tallyhoe
Drafting	B. Schingh
Geophysics	D.M. Wagg
	F. Kiss
	W. Finney

III. DATA PRESENTATION

A. EM Plan Maps

The electromagnetic data is presented on cronaflex transparencies with a photomosaic background. The map scale is 1:20,000 approximately. The EM-30 In-Phase/Out-of-Phase anomalies are portrayed by symbolism and figures which provide the following:

a) ratio of the low frequency In-Phase/ Out-of-Phase, in parts per 10^5.

b) the approximate peak position;

c) terrain clearance of the aircraft, in feet;

d) amplitude of any apparently associated magnetic anomaly, in gammas.

In most instances, ratios are derived from the low frequency channels. When the anomaly appears only on the high frequency, the ratio is bracketed. In cases where the anomaly is obviously surficial, and it appears only on the high frequency out-of-phase, brackets or an open box without numbers are used to identify the response on the map.

All conductive zones of interest, that is, those which may be due to a bedrock source, are outlined, numbered and discussed in Section V of the report.

Outlined zones which are not numbered are interpreted as surficial conductors.

The unnumbered, single line anomalies with small amplitude are generally just briefly discussed in the tabulations which follow the discussion of the conductive zones. Many have suspect character and weak amplitude very close to the noise level. Others are probably real but suggest poor potential in terms of indicating bedrock conductors due to massive sulphides or graphites. It is our opinion, however, that some of these should be investigated to determine conclusively what type of conductor they may represent since we suspect in some cases the source could be very deep.

B. Isomagnetic Contour Maps

The magnetic data is presented in contour form at an approximate scale of 1:20,000. The contour interval is 20 gammas wherever gradient permits. Values shown represent total field values.

C. Original Records

These are presented in book form, one for each area.

D. Tracking Film

The 35 mm tracking film is delivered in 15 rolls, representing 15 production flights. One can refer to the flight logs or to the information which is noted on each of the records in order to relate the film to the geophysical records and maps.

IV. INTERPRETATION - GENERAL

The main objective of the airborne survey and of this interpretation is the direct exploration for strong conductors of the type associated with massive sulphide occurrences or graphites. To arrive at this objective, each and every EM response is carefully examined and grouped into zones which may be identifying specific conductors. These are rated from 1 to 4 depending on how likely the source is thought to be reflecting a massive sulphide response. The Wilson Lake Extension which covers the Key Lake uranium deposit is taken as the type of conductor to be sought after.

We use the term surficial for geological conductors in the overburden and in the weathered layer. It also covers brackish water, salt deposits, clay minerals along fault zones and lake and river bottom deposits. Such sources usually produce very broad quadrature anomalies, and often form irregularly-shaped zones which exhibit very low conductivity.

Most of the surficial response in this survey is very weakly conductive. Anomalies from these are not picked or plotted on the plan maps except where they are narrow enough that they are beginning to look like possible bedrock conductors. Conductive lake bottom sediments seem, in a number of places, to have more conductive narrow sections. These are picked out as low priority prospects especially where we believe the basement is at considerable depth below the Athabasca Sandstone, since in such cases bedrock responses are expected to be very small also.

The term <u>bedrock</u> refers to the geological conductors located in the bedrock, such as massive sulphides, graphitic materials, massive magnetite and some serpentinized ultrabasic rocks. Manganese oxide may also give a weak electromagnetic response.

The criteria which indicate a bedrock source can be briefly outlined as follows:

- the apparent conductivity, as determined by the ratio of the In-phase/Out-phase,

- the shape, width and amplitude of the response,

- the associated magnetics,

- the position with respect to the regional strike and to the direction of structure.

Factors which indicate how favourable that bedrock zone is include the strike length, the position and isolation relative to other conductors in the locale, and the geological environment. All of these factors are considered in our rating system.

Rating System

To assist in the planning of the followup programme, all selected zones have been rated as either first, second, third or fourth priority selections. The rating is based on those geophysical parameters such as intensity, conductivity, magnetic association, relative isolation and strike length.

The Priority 1 group includes zones recommended for followup on a high priority basis. These indicate probable bedrock sources with good potential for sulphide mineralization. As a guide we have used the parameters of the Key Lake deposit as the standard for Priority - 1 prospects. Conductors rated Priority 2 have possible fair potential and would be checked in any relatively complete followup programme. The apparent conductivity of zones in Priority - 2 is less than that of the Priority - 1 group. Priority - 3 zones have even lesser conductivity and are those zones which often follow geologic strike but have broad anomalies more like surficial sources. The final group, Priority - 4, comprises doubtful anomalies which have amplitudes close to the noise level. These would not normally merit further consideration unless local geology was favorable.

The Key Lake deposit does not appear to have a direct association with a specific magnetic horzion. However, it follows a magnetic gradient which probably indicates the contact between two rock units. Hence, where EM conductive zones have a similar magnetic setting we have tended to upgrade them because of this fact. In general, a magnetic association or lack of it does not influence our rating of the zone.

V. INTERPRETATION OF SELECTED CONDUCTORS

All conductors which have a reasonable chance of reflecting a bedrock source are discussed in this section. Ratings are also assigned, indicating our opinion of the zone's overall potential as a prospect of the type noted over the Key Lake deposit.

Zone numbers, line numbers, fiducial numbers and anomaly ratios are included to facilitate reference to the original records and plan maps. The letter W preceding the zone number identifies the Wilson Lake Area, H - Highrock Lake, WV - Wolvernan Lake, FC - Fort Chipewyan.

As for those anomalies appearing in the lists or tabulations after the selected zones, they are regarded as least important. They are usually one line responses of small amplitude which do not suggest good potential for massive sulphides. Some may have a bedrock relationship but others are too suspect to rate highly. Individual circumstances may dictate a more thorough followup, but in our opinion, they belong in the lowest category of any followup programme. They will be included after the discussion of the conductive zones of each sheet.

Government

Disclaimer

This page was inserted by the Coal and Minerals Development Branch, to provide a reference that pages 12 to 73 listed in the table of contents are not contained in the assessment report on file.

FORT CHIPEWYAN

Zone FC-1 **Priority - 3**

Line 27S Fid. 156.55 30/15
through
Line 30N Fid. 209.70 40/15
Tie-Line 3E Fid. 097.27 20/10

A very weak conductor is resolved in this location with a strike length of approximately ½ to 1 mile. The eastern end is very poorly defined due to some surface conductivity and instrument noise resulting from bird motion. However a tie line flown over this location confirms the presence of a weak conductor at depth.

A good correlation between the zone's strike and the magnetic contour trend implies that this anomalous zone may be related to bedrock. A ground check is suggested at line 28N anomaly A.

Because of the moderate to low conductivity implied by the anomalies only a low priority rating is assigned to the zone. However, if the source is deep then the weak amplitudes may not necessarily signify a poor conductor.

Zone FC-1 Priority - 4

Line 34N	Fid. 264.41	55/35
Line 35S	Fid. 273.67	35/20
Line 36N	Fid. 293.12	40/10

The broadness of the anomalies almost certainly indicates a surficial source. The zone locates in low ground around some lakes, or actually in the lake. Hence lake bottom sediments are the most likely source.

The coincident steep Z-axis gradients also add some suspicion of "bird motion" noise on the in-phase channels which is raising the apparent conductivity.

Low priority is assigned to the zone.

Zone FC-1 Priority - 4

Line 35S Fid. 271.32 35/30
Line 36N Fid. 294.58 30/35
Tie-Line 3E Fid. 098.90 40/20

The high frequency data tends to imply a surficial source but there is some shape to the anomalies in the low frequency channels which suggests the possibility of a deep bedrock conductor. Reasonable correlation between the flight-line and tie-line anomalies supports the idea of a geologic conductor.

The apparent conductivity is not good. The lack of a well defined "bedrock shape" to all of the responses is also discouraging. Hence this is a low priority follow-up prospect.

AREA FORT CHIPEWYAN SHEET 1

line	fid.	ratio	conductivity	comments
10N				
A	100.90	50/-	high?	Apparent high conductivity, but "bird motion" noise plus surficial response is the suspected cause of the anomaly. Surficial sediments abundant in the area.
11S				
A	117.11	40/-	high?	Poor correlation between channels. Suspect anomaly.
13S				
A	133.81	40/20	medium	"Bird motion" noise, very probable. Anomaly not observed on adjacent line 14 which is virtually coincident.
16N				
A	014.07	40/25	medium	Probable surficial.
B	015.40	50/10	high?	Probable surficial, combined with "bird motion".
18N				
A	015.45	40/20	medium	Surficial type anomaly.
20N				
A	065.09	20/40	?	Broad on the LF/IP. Looks surficial. Plots in a lake.
21S				
A	073.06	50/-	high?	Locates off the edge of the survey. Could be "bird motion" noise as result of aircraft manoeuvres at the start of the line.
23S				
A	110.07	40/25	med/low	Poor shape. HF data looks surficial. LF/IP is unreliable.
A-1	108.22	40/10	high?	Suspect anomaly because LF/IP response looks stronger than the HF response. No Z-axis signal change. Needs a check.

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AREA FORT CHIPEWYAN SHEET 1

23S con'd

line	fid.	ratio	conductivity	comments
B	106.95	60/-	high?	On the edge of a broad conductor. No OP response. Hence very good conductor or "bird motion". Coincident Z-axis signal change makes the anomaly suspect. No support on the adjacent lines.
23S C	105.33	60/-	high?	No OP on Line 23 response, but anomaly shape is surficial. Anomaly on Line 24 has good shape but is a weak conductor. Coincident Z-axis variations also raise suspicions of noise on the IP channels.
24N B	119.52	55/20	med/low	
25S A	133.34	40/-	high?	Suspect shape. In-phase anomaly only. Strong Z-axis signal change - probable "bird motion".
29S A	198.57	40/30	high	Good shape on the LF/IP but no support on the other channels. Either deep bedrock or "noise". Location at the end of the line and change in altimeter level suggests aircraft manoeuvres.
C	184.35	40/20	medium	Definite anomaly, supported by the OP channels. Locates in a lake. Probable surficial but same lake not conductive on adjacent lines.
30N A	202.21	55/20	high?	Poor shape. Broadness suggests a surficial source which agrees with location over a lake.
31S A	215.19	40/20	high	Good shape on the LF/IP. Coincides with Z-axis gradient; hence it is somewhat suspicious. Locates close to Zone FC-1. Needs a ground check.

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AREA FORT CHIPEWYAN SHEET 1

line	fid.	ratio	conductivity	comments
34N				
A	258.28	45/35	low/med	Broad, poor shape, but on all channels. Definitely geologic conductor but probably lake bottom deposits.
35S				
A	279.23	50/20	medium	Broad anomaly on all channels. Probable lake bottom sediments.
A-1	281.85	40/-	high?	IP anomaly, hence high conductivity or "cable shortening". Coincident gradient on Z-axis signal and altimeter shift. No support on the adjacent lines.
36N				
A-1	286.54	40/-	high?	No OP response. Hence high apparent conductivity. Anomaly shape is suspiciously like a "cable shortening effect" but Z-axis signal not fluctuating excessively.
37S				
A	308.55	20/40	low	Broad responses increasing in amplitude on the high frequency channels. Probable surficial.
38N				
A	315.16	35/35	low	
39S				
A	334.20	45/20	high?	Broad, poor shape. Mainly IP anomaly, hence could be a good conductor. Shape and location on a lake suggest a surficial
B	324.86	40/20	medium	Broad, not attractive shape. Suspect surficial with some "bird motion" noise.
41S				
A	364.82	50/10	medium	Fairly broad anomalies in region of lake sediments. Suspect surficial sources but the strong IP/OP ratios are puzzling. The low position of the Z-axis profile suggests the "bird is flying low" which could introduce some IP response.
B	363.96	90/-	high?	

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AREA FORT CHIPEWYAN SHEET 1

line	fid.	ratio	conductivity	comments
41S con'd				
C	358.60	40/-	high?	Coincident steep changes in Z-axis signa suggests a cable shortening anomaly. Amplitude close to the noise level.
47S				
A	100.61	40/20	medium	Reasonable shape on the LF/IP but poor shape and correlation on the other channels.
51S				
A	156.53	50/-	high?	IP anomaly. Has the shape of "bird motic but terrain seems flat and Z-axis does not indicate an excessive compensation. No support on the adjacent lines.
54N				
A	192.64	60/5	high?	Broad IP response. LF/IP has sinsusoid shape correlating with a "Z-axis anomaly' Suspect cable shortening noise.
56N				
A	023.57	60/15	high?	Good IP/OP ratio but broad shape suggests surficial source. Poor correlation with anomaly A on Line 57.
57S'				
A	049.05	40/15	medium	Flat topped shape looks suspicious, but correlation on all channels. Probable small geologic conductor. On the edge of a lake;could be sediments.
58N				
A	069.77	50/45	low	Broad shape and large OP response suggest a surficial source.
60S				
A	105.00	40/20	medium	Broad IP response or possible double conductor. In a region of surficial conductivity. Low priority.

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AREA FORT CHIPEWYAN SHEET 1

line	fid.	ratio	conductivity	comments
60S cont'd				
B	100.01	20/80	low	Broad anomaly, increasing on all channels. Probable surficial.
Tie-Line 2E				
A	072.79	55/15	medium	In a region of conductive surficials these anomalies could be local variations in thickness of the sediments. Similar type anomalies on the flight-lines in this region. Not typically bedrock.
B	073.27	40/5	medium	

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AREA FORT CHIPEWYAN SHEET 2

line	fid.	ratio	conductivity	comments
61N				
A	121.14	50/-	?	Suspect anomaly. Poor shape and Z-axis signal is off scale.
62N A	164.41	40/15	med/low	Group of anomalies which define a surficial conductor. Locate on a river.
63S A	171.77		med/low	
B				
64N A	196.16	25/25	med/low	
B	196.38	25/40	med/low	
70S				
B	284.78	45/20	medium	Broad anomaly. Distinct altimeter variation. Suspect "bird motion" plus surficial conductor.
77N				
A	352.83	25/20	low	Poor conductor, probable surficial.
78S				
A	358.90	40/-	low	Flat topped anomaly in LF/IP. Not narrow on the OP channel. Suspect surficial. Locates in river bed.
79N				
A	372.37	35/35	low	Suspect surficial soûrce because of the location. LF/IP is narrow; possible bedrock conductor as well.
83N				
A	332.15	20/25	low	Probable surficial. Locates in river bed.
85N				
B	427.05	30/20	?	Suspect shape. Could be "bird motion".
85N				
A	425.90	30/-	?	Suspect anomalies which look like "bird motion" noise. Correlation across two lines is encouragement. Poor correlation between channels within each anomaly.
86N				
A	317.05	40/15	?	

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AREA FORT CHIPEWYAN SHEET 2

line	fid.	ratio	conductivity	comments
87N				
A	308.09	45/35	low	Suspect surficial sources. Both anomalies
B	308.54	35/35	low	locate in drainage area.
89N				
A	282.47	25/20	low	Poor conductivity. Not attractive shape. Suspect surficial.
92S				
A	239.61	30/20	low	Weak conductor. Appear to correlate over
93N				two lines but anomalies appear to be
A	232.58	10/20	low	small sections of surficial conductor.

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AREA FORT CHIPEWYAN SHEET 3

line	fid.	ratio	conductivity	comments
70S A	286.86	50/-	?	The LF/IP anomaly appears similar to "bird motion"noise anomalies. Coinciden large Z-axis signal change. Hence suspect anomaly.
78S A	363.60	60/15	high	Narrow conductor locates near the east end of a lake but surficial conductors not evident. Could be a deep bedrock conductor. Not supported on adjacent lines. Probable bedrock.
82S A	402.10	45/30	med/low	Reasonable shape draws attention. Locat in a lake hence suspect sediments as the source.
102N A	117.95	30/15	low	Some surficial around, hence this could be a more conductive section. Otherwise a deep bedrock source is possible. Broa shape is unattractive.

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VII. CONCLUSIONS AND RECOMMENDATIONS

1. Table 1 summarizes all the conductors in the four survey blocks into priority ratings, one to four. The Priority-1 group includes the known Key Lake uranium deposit and any conductors which have similar characteristics.

2. All of the conductors zoned as Priority-1 and Priority-2 are recommended for ground followup. These are chosen primarily on the conductivity characteristics of the interpreted sources.

3. The Wilson Lake and Highrock Lake areas contain all of the good conductors, and those most highly recommended for followup fall in these two blocks.

4. The zones rated as Priority-3 and Priority-4 are not recommended for followup on the basis of the airborne geophysics only. Additional support, either geological and/or geochemical would be needed in order to justify followup of these conductors.

5. The bulk of the conductors which are given lower priority ratings consist of zones of weak amplitude anomalies (near the noise level of the system), or anomalies which do not show very consistent information on both frequencies. In most cases the suspected source is either surficial conductivity or noise due to excessive "bird swing" or "cable shortening". Since we know in the case of the Fort Chipewyan Area and the

northern part of the Wilson Lake Area that the conductors may be underlying considerable thickness of sandstone it is recommended that some of these weak zones should be evaluated to determine if the source is in the underlying basement. Surficial conductors, such as clays in lake bottom sediments, are the most likely alternative sources.

Respectfully Submitted

[redacted]

F. Kiss

[redacted]

W. Finney, P. Eng.

[redacted]

D. Wagg, P. Eng.

Geophysicists.

APPENDIX A

Following is a description of equipment and procedures used during this airborne geophysical survey.

A. EQUIPMENT

1) Aircraft:

The aircraft is a Beechcraft E-18-S with a normal survey speed of 135 miles per hour, and a mean terrain clearance of 250 feet. The Canadian registration is CFFL-C.

2) Electromagnetometer: - Hudson Bay EM-30 System

The electromagnetic unit was developed by Hudson Bay Mining and Smelting Co. Ltd. It measures In-Phase and Out-of-Phase components of the secondary field. The transmitter is rigidly mounted on the nose of the aircraft with the receiver bird cradle mounted on a swivel boom on the tail. In flight the boom swivels down to support the tow cable at a critical point, the tow cable assuming a straight line from transmitter to bird with a spacing of 225 feet.

Transmitting frequencies of 380 Hz and 1225 Hz are used, at 1000 watts and 330 watts respectively. The transit and receive coils are coaxial and vertical (x-axis in line of flight). Error signals generated by small coils with z-axis and y-axis are treated and used to correct as required, the "normal" signal of both frequencies. The combination of stable receiving coil (relative to the transmitter) and the compensating circuits results in a very low noise level relative to the spacing.

Since the In-Phase and Out-of-Phase components of both frequencies are recorded, a Conductivity-Thickness-Product can be easily calculated. Discrimination against conductive overburden is also excellent and easily diagnostic.

3) Magnetometer:

The magnetometer used is a Geometrics Model G-803 Proton Resonance type incorporating a High Performance option. Recording times are variable, from three times per second to one per 2 seconds, with respective sensitivities of 2 gammas to 0.5 gamma. In normal use readings are obtained once per half second with sensitivity of 2 gammas.

The sensing head is a toroidal coil immersed in a special hydrocarbon fluid and mounted beneath the port wing.

The magnetometer is a digital readout unit and output is used to drive a paper recorder. In addition, analogue outputs are fed to the eight-channel recorder for direct comparison with the electromagnetic results. The analog recorders are a Barringer 8 channel with heat sensitive paper and a Moseley 7100B 2 channel ink recorder.

Full scale deflection is 200 and 2000 gammas. Automatic stepping of the full scale analogue deflection is incorporated. Recordings made on the paper tape are the values of the total field intensity.

4) Altimeter:

The altimeter is a Sperry unit, the output of which is recorded on the eight-channel recorder. The recording is linear and normally covers from 100 to 500 feet.

5) Camera:

The camera used for path recovery is a Geocam continuous strip 35 millimeter type. It can accommodate 400 ft. lengths of film, good for some 250 line miles of survey. It is fitted with a special wide angle lens for low level work.

Fiducial numbers and markers are impressed on the film and controlled by the intervalometer.

6) Intervalometer:

This is a Geonics solid state unit which derives triggering from the magnetometer. In usual operation one fiducial is recorded every 10 seconds. A long pulse is produced one for every ten normal fiducials.

These fiducials marks are impressed on the path recovery film, the eight-channel recorder, and the Hewlett Packard, Moseley Model 7100-B recorder in order to identify and locate geophysical records with ground positions.

7) Eight-Channel Recorder:

This recorder is a Barringer 8 channel chart recorder. Records are made on heat sensitive paper of 16 inch width. Each channel has a width of 1.6 inches. Individual signal processors are included for each channel, selected according to requirements for each channel to be recorded.

Normal chart speed is 5.0 inches per minute giving a horizontal scale of approximately 1000 feet per inch.

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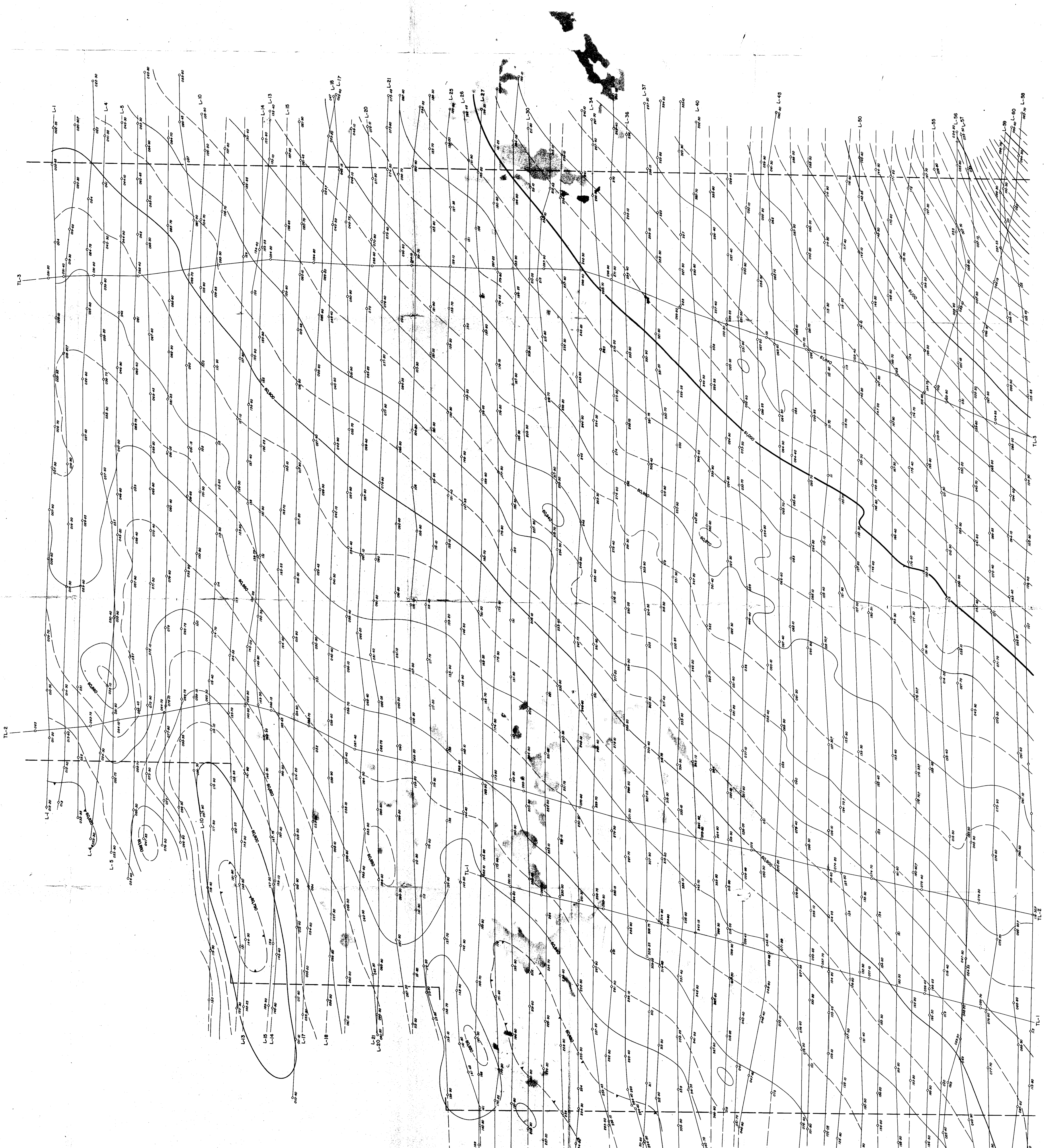

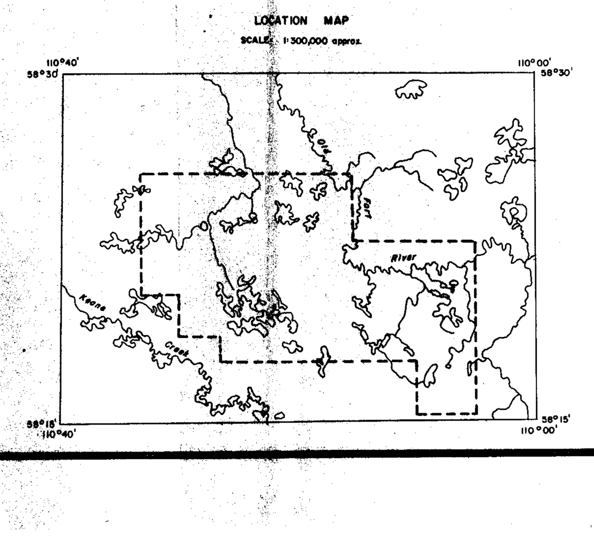

MAGNETIC LEGEND

500 GAMMAS
100 GAMMAS
20 GAMMAS
10 GAMMAS

MAGNETIC LOW
CONTOUR INTERVAL . . . . . . 10 GAMMAS

SHEET INDEX

2
3

SURVEYED & COMPILED BY
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FOR
DENISON MINES LIMITED

AIRBORNE GEOPHYSICAL SURVEY

FORT CHIPEWYAN AREA
ALBERTA

ISOMAGNETIC CONTOUR MAP

19770018

SHEET [illegible]	HORIZONTAL CONTROL . . . . . . BASED ON	CONTOUR INTERVAL 10 GAMMAS	FLIGHT ALTITUDE . . . 400' M.T.C.
SCALE : 1":20,000	PHOTOMOSAICS	FLOWN IN OCT NOV, 1976	GEOTERREX PROJECT No. 84-148

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