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SUBJECT TO CORRECTION

REPORT ON AN
AIRBORNE GEOPHYSICAL SURVEY
BAIRD AND HEYSON TOWNSHIPS, ONTARIO
ON BEHALF OF
MADSEN RED LAKE GOLD MINES LIMITED

by

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TORONTO, Ontario

June 1971

SUMMARY

A combined airborne electromagnetic and magnetic survey was executed over eight contiguous claim groups located in Baird and Heyson Townships, near the town of Red Lake, Ontario, on behalf of Madsen Red Lake Gold Mines Limited. A total of 185 miles of line was flown.

The survey resulted in the location of 1 conducting zone and 29 isolated anomalies.

Two anomalies can be caused by vertical metallic conductors, e.g. sulphides, and have been recommended for geological and geophysical ground follow-up.

Two of the anomalies located show geo-electrical parameters typical of massive sulphide deposits and have been recommended for geological and geophysical ground follow-up.

REPORT ON AN AIRBORNE GEOPHYSICAL SURVEY
BAIRD AND HEYSON TOWNSHIPS, ONTARIO
ON BEHALF OF
MADSEN RED LAKE GOLD MINES LIMITED

INTRODUCTION

During the period May 4th to 5th, 1971, an airborne geophysical survey was undertaken by Seigel Associates Limited over eight contiguous claim groups located in Baird and Heyson Townships, near the Town of Red Lake, Ontario on behalf of Madsen Red Lake Gold Mines Limited. (see Figure 1 on a scale of 1:250,000). A total of 185 line miles was flown over an area 7 miles long covering 8 groups of claims (see Figure 2 on a scale of 1" = 3520').

The airborne survey included electromagnetic and magnetic measurements. Geophysical equipment used for these measurements was respectively a Scintrex Rio-Mullard type in-phase and out-of-phase electromagnetic system operating at 320 cps and a Scintrex MAP-2 nuclear precession magnetometer.

Appendix A attached gives full details of the airborne geophysical equipment and ancillary equipment employed as well as the treatment of data resulting from these surveys. The basic transport vehicle employed during the survey was a DeHavilland Otter aircraft (CF-IUZ) owned by Scintrex Limited, Toronto.

In-flight navigation and flight path recovery were based on a mosaic with a scale of 1" = 1320'. The survey line spacing was one-eighth

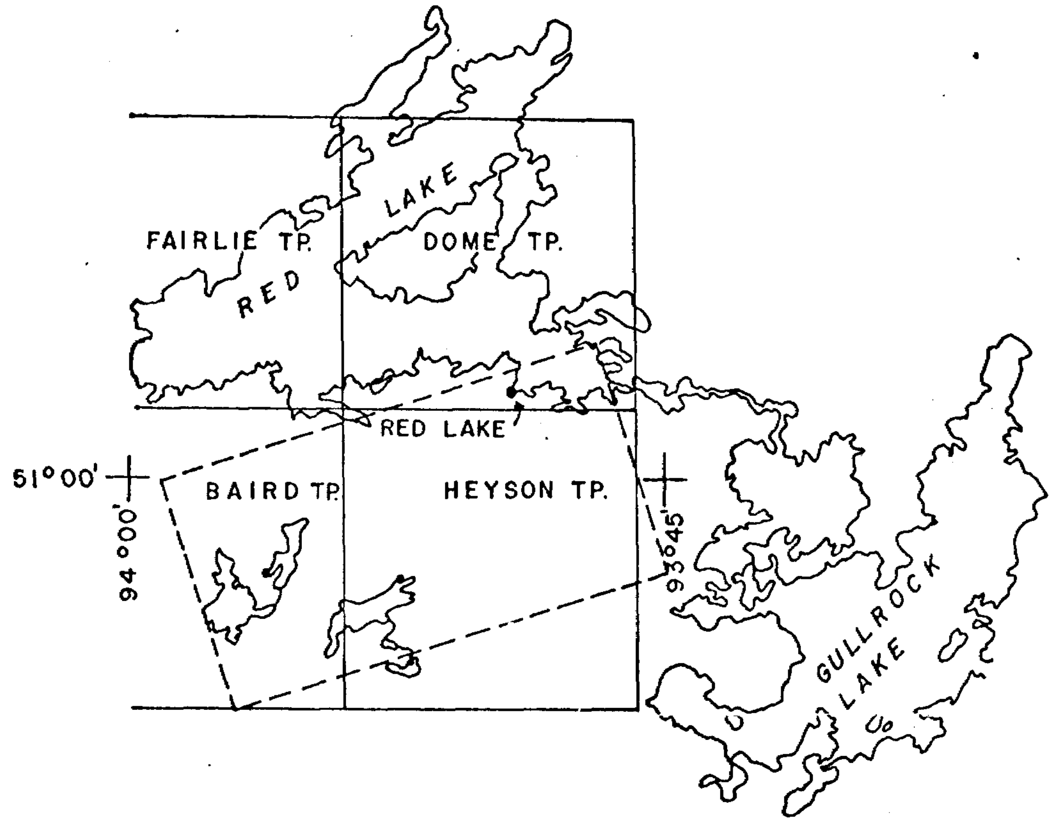

FIGURE I

LOCATION MAP

MADSEN RED LAKE GOLD MINES LIMITED

RED LAKE AREA, ONTARIO

AIRBORNE GEOPHYSICAL SURVEY

SCALE : 1:250,000

71-9376

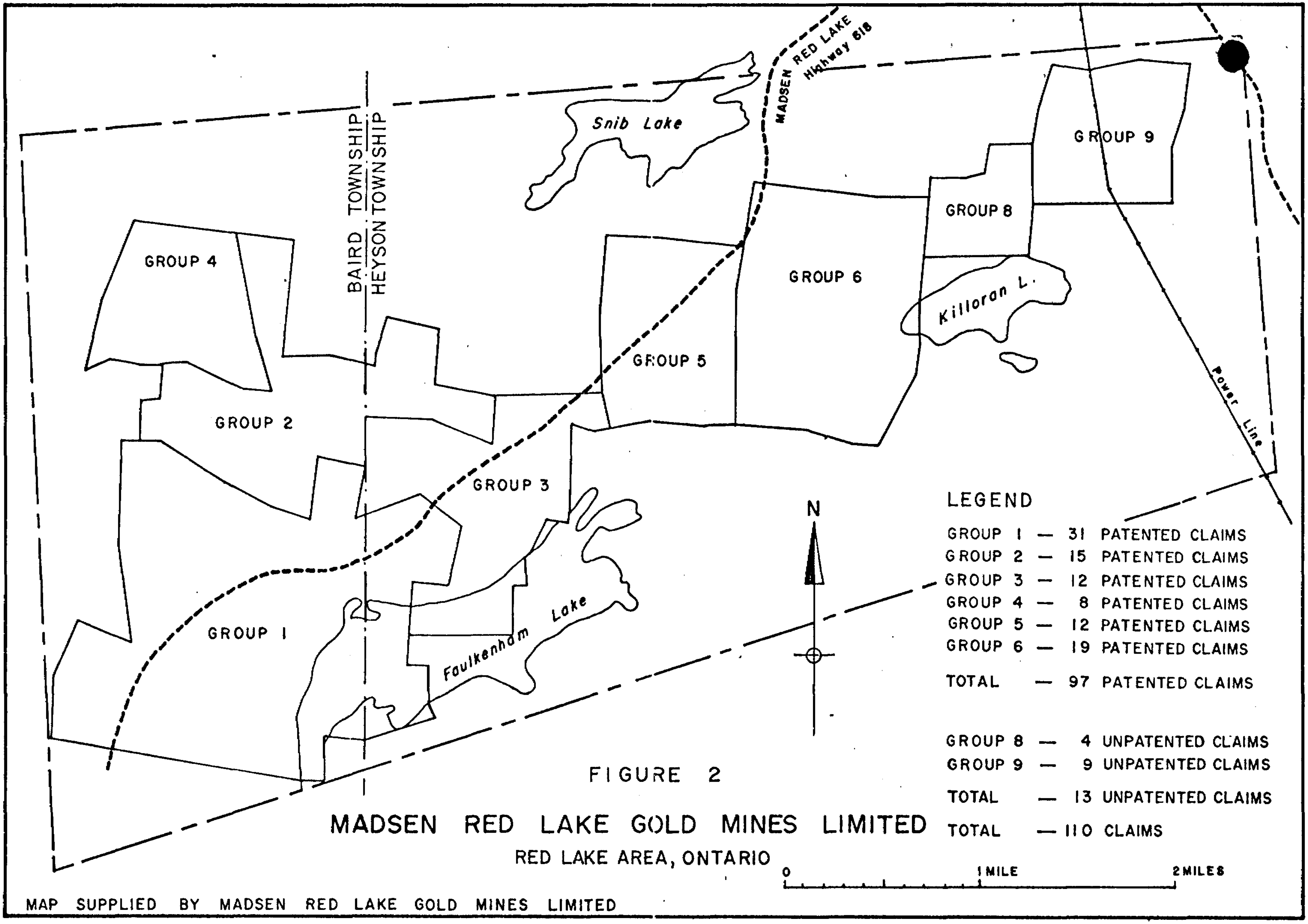

FIGURE 2

MADSEN RED LAKE GOLD MINES LIMITED

RED LAKE AREA, ONTARIO

MAP SUPPLIED BY MADSEN RED LAKE GOLD MINES LIMITED mile, the line direction being approximately northwest-southeast.

The survey was flown at an average airspeed of 90 miles per hour and at an average altitude of 170 ft.

The purpose of the electromagnetic survey was to map the distribution of subsurface conducting systems within the survey area. The simultaneous magnetometer survey was used primarily to obtain (where applicable) correlation of magnetic activity with conducting systems.

PRESENTATION OF DATA

The results of the geophysical survey are presented on Plate 1 on the scale of 1'' = 1320', the electromagnetic results being shown together with the flight lines, fiducial points, etc.

The peak location of the anomalies is shown on Plate 1 by a circle in the appropriate location. In the case of broad conductors or closely spaced multiple conducting zones, there may be more than one peak. In this event all major peaks are shown. The conductor half width, indicated on the plan by an open bar, is the distance between the points of half the maximum conductor disturbance on the geophysical traces.

The in-phase and out of-phase amplitudes are scaled from the original traces and are noted in parts per million opposite the peak location. A conductor peak with apparent direct magnetic correlation is indicated by a double concentric circle.

The original geophysical traces are on the following scales:

Edin Recorder: (from top to bottom of chart)

1st and 2nd channel	not used
3rd channel	magnetometer - 25 gammas/mm
4th channel	electronic noise indication
5th channel	altimeter - Logarithmic
6th channel	electromagnetometer - 80 ppm/mm (out of phase)
7th channel	electromagnetometer - 30 ppm/mm (in phase)
8th channel	accelerometer
9th channel	fiducial marker

Anadex Recorder

The total magnetic field values were recorded in digital form on a paper print-out together with the fiducial numbers.

DISCUSSION OF RESULTS

The following interpretation is based on the geophysical data only.

The airborne survey resulted in the location of one conductor system and twenty-nine single line anomalies. The conductor amplitudes exhibit a spectrum of responses, with the majority of the intersections being graded in the second and third categories.

One of the most important criteria in the evaluation of the electromagnetic anomalies is the in-phase/out-of-phase ratio. In general highly conducting bodies such as massive sulphides or graphite and sea water have high ratios; poorly conducting geological features (e.g. shear zones) and most overburden, will have lower ratios. In areas where there is a clear differentiation in conductivity between targets of economic interest and other possible conductors the ratio is a diagnostic feature. In some areas there is an overlap of conductivity ranges and then the ratio cannot be too rigidly relied upon. Another important criteria is the magnetic coincidence. A conducting body which shows a magnetic correlation is more likely to be a sulphide body than one that is non-magnetic. There are, however, many important base metal deposits which are quite non-magnetic. Still another important criteria is the strike length. Most producing base metal mines have ore bodies of only a relatively short strike (median of 1000 ft.) which give only a single or double line anomaly during the course of any reconnaissance airborne survey. For this reason single line anomalies cannot be overlooked, but neither must long conducting zones be neglected as some ore bodies are known to occur along extensive conductive marker horizons (e.g. Thompson area).

Anomalies located during the survey area can be classified under four categories.

1) Anomalies caused by horizontal conductors such as lake bottom sediments, swamps, etc. A typical example of this type of anomaly is zone 1. intersection A37 (magnetics associated are fortuitous), anomaly A27, A33, B43, etc.

2) Anomalies of a man-made origin (e.g. power lines, railway tracks, etc.) Typical examples of this kind of anomaly are electromagnetic

distortions on lines 13 and 14 over the mine site.

3) Anomalies caused by steeply dipping tabular conductors. These can be caused by metallic conductors such as sulphides, graphite, etc. There are two anomalies in the survey area which are clearly due to vertically dipping conductors. They are anomalies A and B on line 13.

Anomaly A13 reveals strong in-phase and out-of-phase response, a good ratio (>2) and direct magnetic correlation. This anomaly is very likely caused by sulphides and is recommended for further investigation.

Anomaly B13 shows only weak response and no magnetic correlation. Despite this the anomaly is of interest because it is clearly caused by a vertical source.

CONCLUSIONS AND RECOMMENDATIONS

During the survey over claim groups in Baird and Heyson Townships one conducting zone and twenty-nine isolated anomalies were revealed.

Investigation of the electromagnetic anomalies should be limited to the anomalies A and B on line 13, because they show promising geophysical parameters. (Second priority targets are intersections 15B, 62A and $65A_1$.) For examination of these two anomalies (A and B) two small grids should be set up for ground follow-up; these small grids should comprise a baseline, approximately 2000 ft. long, and 6 lines perpendicular to the baseline at 400 ft. spacing, having a length of 1000 ft. on either side. The survey should consist of geological mapping, magnetic and electromagnetic measurements. The writer's are of the opinion that the Turam electromagnetic method would be suitable for quantitative and qualitative evaluation of the targets.

Respectfully submitted,

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Geophysicist.

Jan Klein, M. Sc., P. Eng.,
Geophysicist.

TABLE 1 - AIRBORNE ELECTROMAGNETIC ANOMALIES

Zone No.	Strike	Location	Amplitude	Category	IP/OP Ratio	Magnetic Correlation	Remarks
		A62	100/50	2	2.0	100	possible noise
		$A_1$65	90/30	3	3.0	170	possible noise
		$A_2$65	80/60	3	1.3		possible noise

TABLE 1 - AIRBORNE ELECTROMAGNETIC ANOMALIES

Zone No.	Strike	Location	Amplitude	Category	IP/OP Ratio	Magnetic Correlation	Remarks
1	E-W	A42	120/70	2	1.7	1000	broad, horizontal layer
		A43	120/100	2	1.2		broad, horizontal layer
Isolated Anomalies		A7	70/40	2	1.7	100	weak response
		A13	630/270	1	2.3	200	strong response, excellent anomaly
		B13	100/100	2	1.0		weak response
		A14	70/30	3	2.3		possible noise
		A15	70/40	3	1.7		possible noise
		B15	60/30	2	2.0		possible noise
		A18	90/50	3	1.8		weak response
		A26	100/60	3	1.7		possible noise
		A27	70/40	3	1.7	150	possible noise
		A29	90/40	3	2.2	150	possible noise
		A32	130/90	2	1.4		weak response
		B32	120/90	2	1.3		weak response
		A33	90/60	2	1.5		possible noise
		B33	120/40	2	3.0		possible noise
		A37	150/120	2	1.2		broad, horizontal layer
		A41	160/100	2	1.6	150	possible noise
		B43	160/100	2	1.6		broad, horizontal layer
		A44	150/90	2	1.7		possible noise
		B44	120/90	3	1.3		possible noise
		C44	120/70	2	1.6		possible noise
		$A_1$49	60/60	3	1.0		possible noise
		$A_2$49	70/50	3	1.4		possible noise
		A50	130/120	2	1.1		weak response
		A53	120/90	2	1.3		weak response
		A55	110/70	2	1.6		possible noise
		A60	70/50	3	1.4		possible noise

-continued-

APPENDIX A

SURVEY EQUIPMENT AND PROCEDURES

Electromagnetic System - Scintrex-Rio Mullard

The aircraft used in the present survey is a De Havilland Otter DHC-3 with Canadian registration CF-IUZ. This aircraft is a single engine, slow speed high performance type with a gross weight of 8000 lbs. It may be equipped with wheels, skis or floats as required.

The aircrew consists of pilot, navigator and equipment operator. The aircraft is flown along the proposed lines at an altitude of 150-200 feet using mosaics for navigation.

The operator records in the flight log, the line numbers, direction of flight, duration of flight and starting and finishing fiducial numbers.

The Rio-Mullard Electromagnetic System measures in-phase and out-of-phase components of the secondary field at a frequency of 320 Hz.

A transmitter generates a closely controlled sine wave of 320 Hz which is amplified and fed to a transmitting coil mounted on the starboard wing-tip. This coil is iron cored, has vertical windings and is mounted with its axis in the direction of flight. The circulating coil power is 7500 volt-amperes.

A receiving coil is mounted on the port wing, coplanar with, and 62 feet from the transmitting coil. The voltage developed in the receiver coil due to the transmitted field is 100 millivolts. In the absence of external conductors, this voltage is cancelled by a reference voltage derived directly from the transmitter voltage.

When the aircraft comes within the range of a conductor, the normal (or primary) field is changed by a secondary field and the resultant voltage at the receiver coil is amplified and passed on to the EM receiver in the aircraft. This signal is filtered and split into one component in-phase and one component out-of-phase with reference to the transmitter voltage. The signals are then passed through phase-sensitive detectors where their amplitudes may be read on meters, or recorded on a chart. A system of calibration is included so that the amplitude of responses (anomalies) may be determined in "parts per million" of the primary receiver coil voltage prior to cancellation. The noise level of the system due to movement of the metal aircraft within the EM field is normally 50 parts per million less. Significant conductors depending on distance and size will produce anomalies of more than 50 parts per million.

Calibration marks are shown on the recorder chart and are generally of the order of 1 cm for 300 parts per million.

The reference or "zero" level for each EM trace is an arbitrary one and is obtained empirically from the regional level of each trace. These levels may drift very slowly during a flight because of temperature changes. These drifts are very gradual and are readily distinguishable from much quicker, local changes due to conductors of a geologic origin. Similarly, severe turbulence effects sometimes introduce low-order, primarily in-phase disturbances which are of such short period that they may also readily be distinguished from the effects of geologic conductors.

Man-made disturbances are often to be seen, including power lines, pipe lines, metal fences, railways, etc. The former are generally recognizable as such because they usually show through as cyclic noise of irregular shape and phase relationship. Non-energized, grounded power lines (e.g. 3 phase systems) may also give rise to proper conductor indications, however. Such indications, as well as those from pipe lines and metal fences, etc. are usually of short duration and can be distinguished from proper geologic sources except for very narrow, near-surface lenses. In some instances ground investigation may be necessary in order to resolve the ambiguity of possible source. Whereas the airborne geophysical crew attempts to note visible man-made conductors of the above types, the ground moves by so rapidly at the low flight elevation employed that 100% recognition of such sources cannot be expected from the air.

The normal terrain clearance of the aircraft is 150-250 ft. depending on the surface topography and tree cover, etc. The established useful depth of detection of the system for moderate-to-large conducting bodies is about 400 ft. sub-aircraft under conditions of low extraneous geolgoic noise, i.e. where the general level of conductivity of the overburden and rock types of the area is low. The useful depth of detection of the system is therefore, between 150 ft. and 250 ft. beneath the ground surface under these conditions.

Interpretation of Results: The EM records are interpreted to determine the presence of conducting bodies and to obtain some information relating to their character. The intervalometer time marks (see below) are synchronized with the positioning camera film strip (also see below) and thereby permit the relating of the conductors with appropriate ground locations. The altimeter data (see below) indicate, for each conductor, what the terrain clearance was at the time of detection.

A plan is prepared, either using a subdued photo-mosaic ("greyflex") or an overlay from a mosaic or topographic plan as base. The flight path of each survey line is obtained by means of "tie points", which are features on the mosaic or topographic plan which are also recognizable on the positioning camera film. The flight path is interpolated between these tie points.

Any anomalies noted are listed in the report, indicating their position, amplitudes, magnetic correlation, if any, relative anomaly rating, and comments which may be of significance.

The anomalies are then plotted on a base map in coded form, according to a legend shown on the base map. Anomaly groups which reflect probable ground conductors are circled and numbered. These are described and discussed in the report in the context of their geophysical and where possible, geological significance.

For each conductor the following quantities are measured and recorded:

A. Half width. This is the distance between the points of half the maximum conductor disturbance. For a very thin, steeply dipping body or pipe line, etc., the half width will be about 1.6 times its depth below the aircraft. If the bird is at a mean conductor clearance of 150 feet the half width would be about 250 feet. Larger half widths reflect either more deeply buried or more likely,thicker conductors.

B. Peak Location. The in-phase conductor peak location is shown on the plan by a circle in the appropriate location. In the case of broad conductors or closely spaced multiple conductor zones there may be more than one peak, in which event all major peaks are shown. If a conductor is of short half width there may be no room for a half width bar and only the peak circle will be shown. A conductor which is likely man-made will be indicated by an X rather than by a circle.

C. In-Phase and Out-of-Phase Amplitudes. These amplitudes are scaled from the EM traces and noted in parts per million. On the flight plan, opposite each peak location (circle) will be given the peak in-phase and out-of-phase amplitudes (see below).

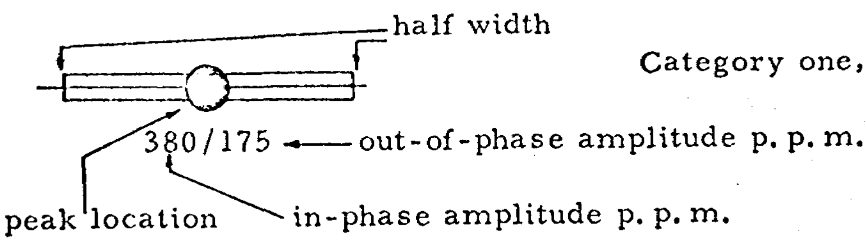
D. Conductor Coding. Conductor intersections are graded in electrical categories 1, 2, and 3, based on the in-phase amplitude but taking into account the terrain clearance. For tabular bodies such as sheet-like ore deposits, strata bound conductors and overburden, their response drops off almost in accordance with the inverse cube power of the elevation. Assuming an average 50 feet of overburden, a category 1 conductor has a peak in-phase response equivalent to 200 ppm or over at 150 feet aircraft-terrain clearance. A category 2 conductor has a peak in-phase response under similar conditions of between 75 ppm and 200 ppm. A category 3 conductor has an equivalent peak in-phase response of less than 75 ppm.

The respective peak circles are shaded to reflect their electrical category, with category 1 fully shaded, category 2 half shaded and category 3 unshaded.

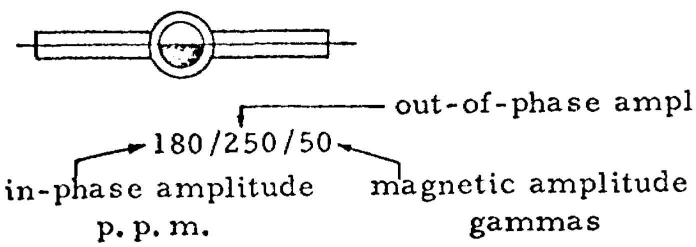
The ratio of peak in-phase over peak out-of-phase amplitudes is indicative of a conductivity-size factor for the conductor. Generally, high conducting bodies such as massive sulphides or graphite and sea-water, etc., have ratios of 1 or over. Moderate conductivity-size bodies will have ratios between .5 and 1. Poor conductivity bodies (e.g. most overburden and some sulphide and graphitic zones) will have ratios of less than .5. In areas where there is a clear differentiation in conductivity between the targets of potential economic interest and other possible conductors, the ratio is a diagnostic feature. In some areas, however, there is an overlap of conductivity ranges and then the ratio cannot be too rigidly relied upon.

Where magnetic data is available, preferably from a coincident recording magnetometer, any correlating magnetic activity will be noted for the pertinent conductor peak. A conductor peak with apparently direct magnetic correlation will be indicated by a double concentric circle. Although a conducting body which is appreciably magnetic is more likely to be a sulphide body than one which is non-magnetic, there are many very important base metal ore bodies which are quite non-magnetic.

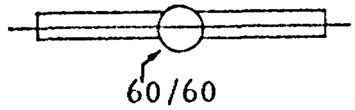
Examples of conductor coding are given below.



Category one, no magnetic correlation.



Category two, magnetic correlation.



Category three, no magnetic correlation.

X — Probably man-made conductor.

<u>Altimeter:</u> The altitude of the aircraft is monitored to an accuracy of ± 10 feet using a Bonzer Model TRN-70 radio altimeter at 1600 MHz. The altimeter results are recorded permanently on one channel of the eight channel recorder.

<u>Camera:</u> The path recovery camera is an Automax 35 mm unit with a special wide angle lens. Its operation is controlled by an intervalometer whereby one frame is triggered for each fiducial number. The camera is thus synchronized with the Edin and Moseley recorders.

<u>Intervalometer:</u> The intervalometer is a Scintrex Model IV-1 Solid State unit with variable time interval from 0.5 to 2 seconds. It operates the marker pens on the two recorders, the frame camera, and a rotary counter. The repetition rate is set so that the camera frames produce only slight overlap. This is approximately once per second.

<u>Recorders:</u> The Edin recorder is an eight-channel ink recorder type 8001. The galvanometer sensitivities are 12 volts full scale into 1350 ohms. The scale on each channel is four centimetres in width and the normal recording speed is 2 millimetres per second. The horizontal scale on the chart is thus roughly 4" per mile of traverse.

The Moseley recorder is a single channel ink recorder type 680. This recorder is used to register the magnetic information.

<u>Reduction of Data:</u> Upon completion of a flight, the film is developed and the actual path of the aircraft is plotted on a base map. This is accomplished by comparing film points with the base map planimetry. For any given point, the appropriate fiducial number is placed on the base map (or photo laydown). The actual flight path is produced by joining the fiducial points.

Where field results are desired, anomalies are chosen and are assigned appropriate fiducial numbers. The anomalies are then transferred to their correct position on the base map.

Flight lines and fiducial numbers are finally presented on a greyflex which is made using the photo mosaic as a base.

In the case of EM or radiometric results the anomalies are plotted on the greyflex as boxes with symbols representing anomaly grade or amplitude (as noted on the legend accompanying each map). Anomaly "systems" are then outlined at which stage a geophysical interpretation can be made.

MAP-2 Proton-Precession Magnetometer

The MAP-2 is a lightweight, one gamma airborne proton-precession magnetometer with a range of 20,000 to 100,000 gammas and an automatic five digit visual display. This new instrument has several significant advantages over other instruments of this type besides its compact size and light weight.

One of its most interesting features is that, unlike other airborne magnetometers which have to be switched manually from one narrow (usually 4000-6000 gammas) range to another, the MAP-2 tracks automatically over its full 80,000 gamma range.

This advantage is particularly significant in surveys flown at low terrain clearances in areas of high magnetic relief, conditions which are common in mineral prospecting.

The instrument is of compact modular design ($\frac{1}{2}$ standard rack size) and has both digital and analogue outputs. The analogue outputs are either 100 or 1000 gammas full scale, with automatic stepping. During each step, an indication of the new stepping level is recorded, providing a permanent reference identifying each step.

The measuring sequence can either be sequentially triggered internally through its own programmer or initiated by a suitable command pulse.

In addition while on internal triggering the instrument provides an external output command pulse enabling other instrumentation to be synchronized with the magnetometer.

The MAP-2 has an unusually wide temperature range, +50°C to -30°C, to permit operation in conditions varying from tropical to arctic without any loss of accuracy.

Specifications:

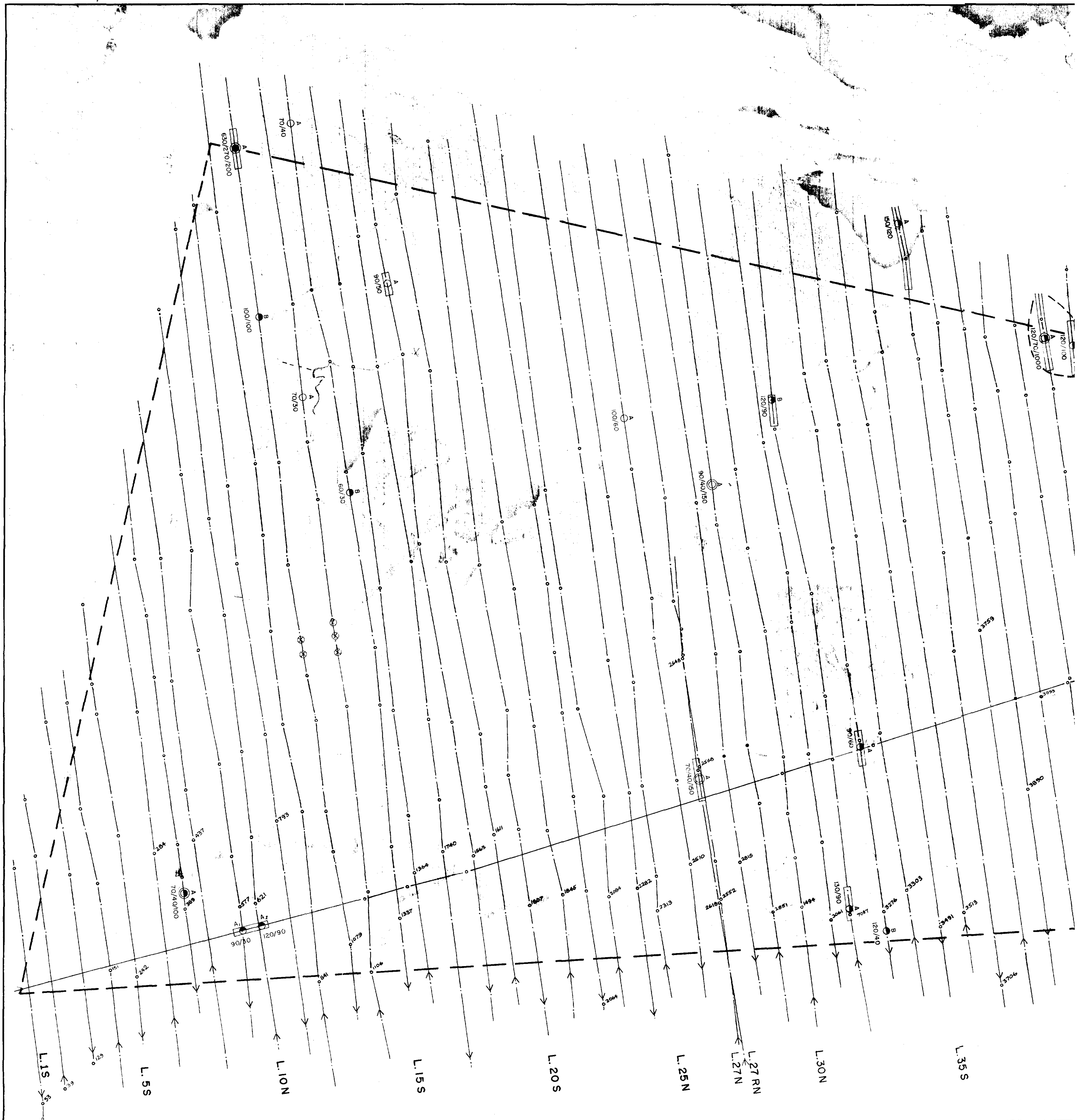
Range:	20 - 100,000 gammas (world-wide) continuous range (automatic tracking).
Sensitivity:	$\pm$ 1 gamma (fully automatic)
Accuracy:	$\pm$ 1 gamma
Sampling Rate:	Automatic standard 1 second, with provision for external triggering from other equipment with minimum 1 second intervals.

Readout-Visual:	Digital Display by 5 incandescent, 7 bar display lights.
Digital Data Output:	BDC 1-2-4-8 DTL, TTL Compatible
Analog Data Output:	5 V full scale for 1000 gammas, 100 gammas, 1 gamma resolution
External Trigger:	Requirement: +4V to 0 transition (as slave)
Trigger Output:	+4V to 0 transition at start of cycle (as master)
Power Requirements:	24-30V DC, 3.2A max.
Temperature Range:	-30 to +50 degrees C

Dimensions and Weights:

Console:
$8\frac{1}{2}''$ x $5\frac{1}{4}''$ x 13'' (half rack)
$21\frac{1}{2}$ cm x $13\frac{1}{2}$ cm x 33 cm
12 lbs. (5.4 kg)

Tow Bird:
7'' x 23'' (18 cm x 58 cm)
20 lbs. (9 kg)



ELECTROMAGNETIC ANOMALY PLAN

LEGEND

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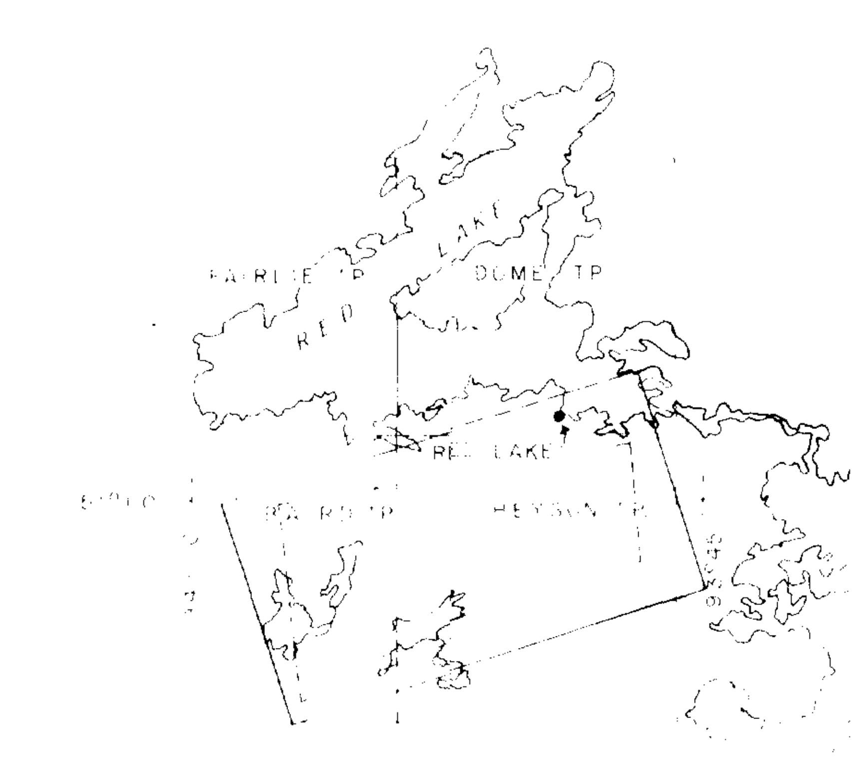

LOCATION MAP

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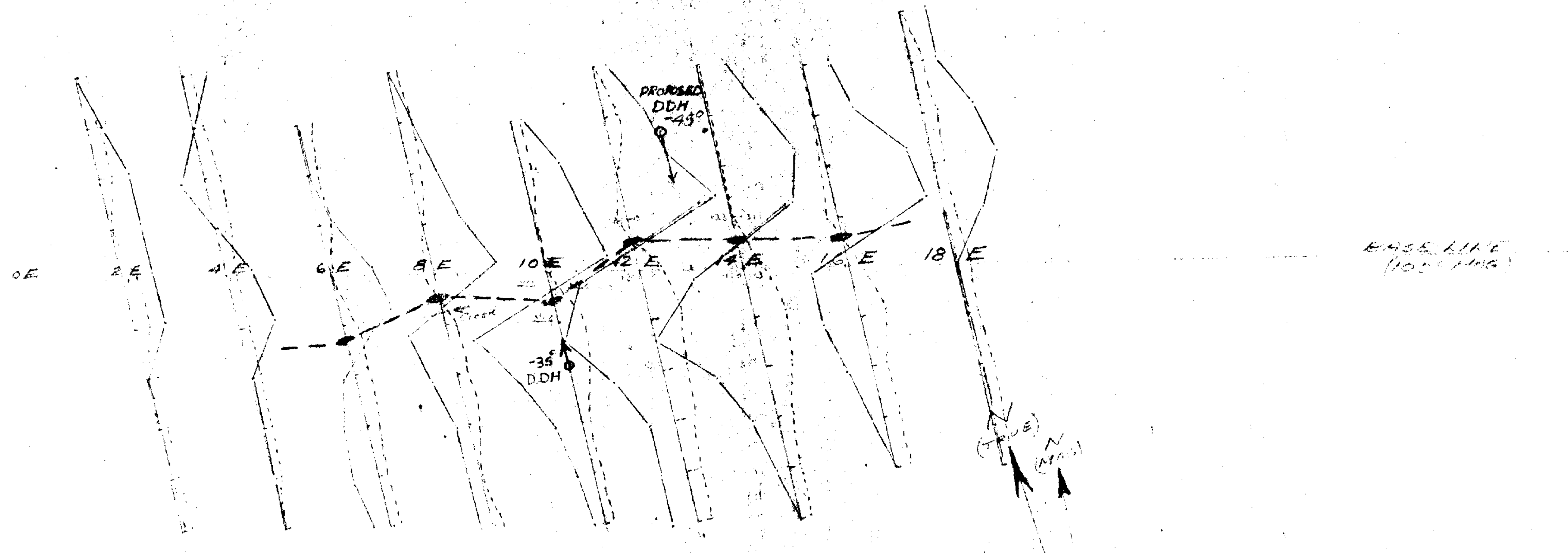
52 K 13, N 4



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MADSEN RED LAKE GOLD MINES

E.M 16 SURVEY

ANOMALY LINE 15B

SCALE: 1" = 200'   JUNE 1971

Readings plotted on scale of 40%:1"
Positive to left, negative to right

Inphase - Solid line
Quadrature - Dotted line
Station - Cutler, Maine