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Yukon Territory

REPORT ON A COMBINED TURAIR ELECTROMAGNETIC AND MAGNETIC SURVEY KEN #1 CLAIM GROUP BLOCK MACMILLAN PASS AREA YUKON/NWT BOUNDARY ON BEHALF OF CANADA TUNGSTEN MINING CORPORATION

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MAR 20 1975
MINING
INSPECTORS OFFICE
WHITEHORSE, Y.T.

This report has been examined by the Geological Evaluation Unit and is recommended to the Commissioner to be considered as representation work in the amount of $ 6000.00

Resident Geologist or
~~Resident Mining Engineer~~

Considered as representation work under Section 53 (4) Yukon Quartz Mining Act.

Commissioner of Yukon Territory

SUMMARY

A combined Turair and magnetic survey executed during August, 1974 has resulted in the detection of a swarm of prominent conductive lineations which are confined almost exclusively to the lower palaeozoic formations. Seven zones exhibiting coincident magnetic correlation have been recommended for ground follow-up work by turam, magnetometer and possibly mercury soil and/or soil gas analysis.

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INTRODUCTION

During the period August 14 - August 25, 1974, a semi-airborne Turair electromagnetic survey and a simultaneous magnetic survey were carried out by Scintrex Surveys Limited on the Ken #1 claim group block in the MacMillan Pass area, Yukon/NWT boundary on behalf of Canada Tungsten Mining Corporation.

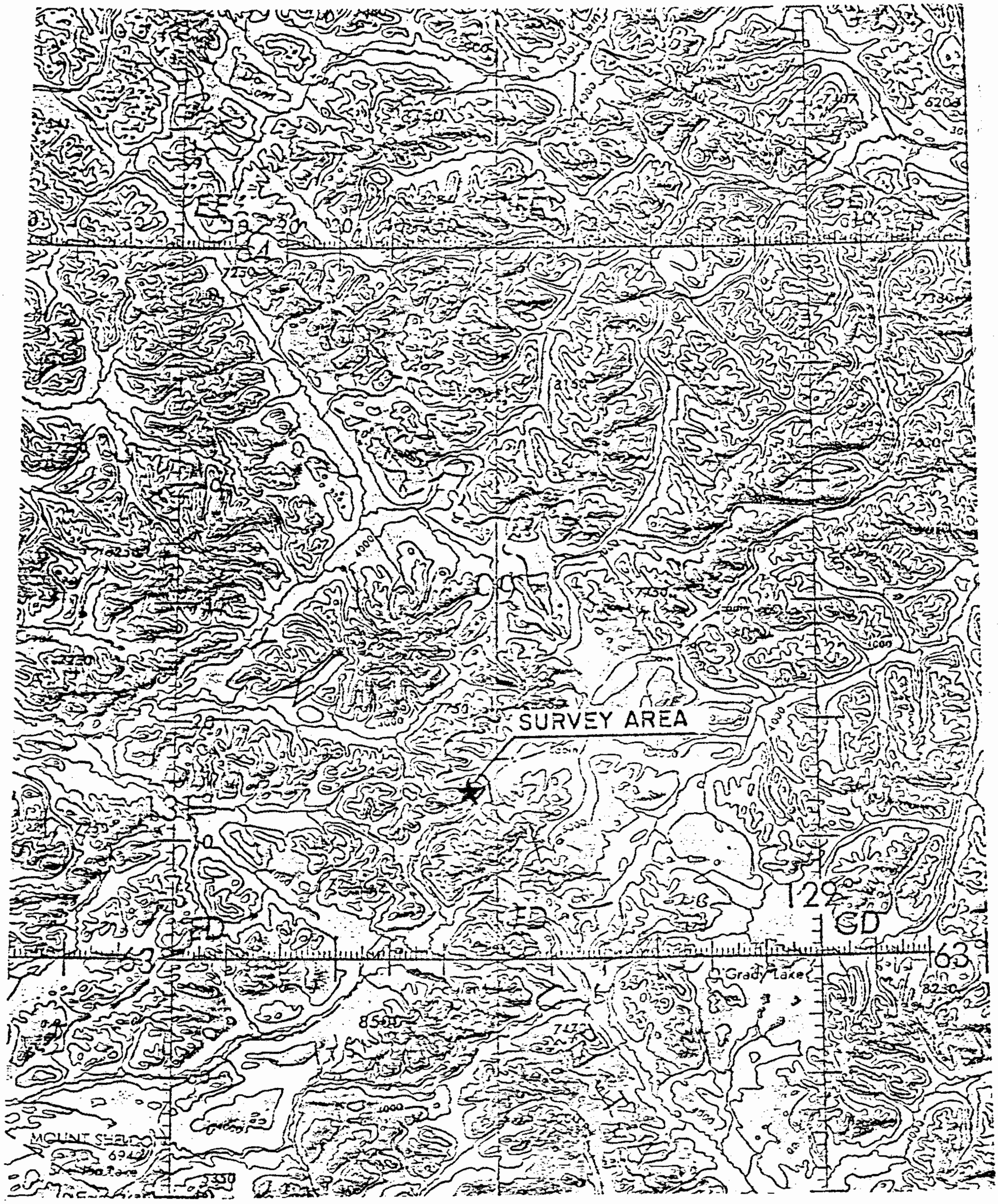
A total of 50 line miles of survey were completed from the leading edge of one loop (#K1).

The necessary survey equipment was mobilized to the survey area on August 14, 1974, but adverse weather conditions prevented the start of the survey until August 24, 1974. Survey operations were conducted from the Tungsten town site and radio contact was maintained with a prospecting team camped at the survey site. The survey area is shown on Figure 1 on a scale of 1:1,000,000.

The project geophysicist was Mr. P. R. Bailey, M.Sc., D.I.C., with overall supervision provided by Mr. J. Klein, M.Sc., P.Eng.

The survey aircraft was a Bell-206-B jet helicopter under charter from Frontier Helicopters, into which the following geophysical equipment was installed: a Scintrex TAR II Turair electromagnetic console and a Scintrex MAP-2 nuclear precession magnetometer. Ancillary equipment included an MFE-3M5B recorder, an MFE-3ME recorder, a Vinten Mk III 16 mm tracking camera with a 5.7 mm wide angle lens, a Bonzer TRN-70 radar altimeter and a Scintrex EIA-6 intervalometer. Detailed specifications of this equipment is given in Appendix C attached to this report.

The purpose of the survey was to map the distribution of subsurface conducting zones while simultaneously recording magnetic information associated with these zones.



LOCATION MAP

CANADA TUNGSTEN MINING CORPORATION LTD.

KEN 1 MACMILLAN PASS, YUKON TERR.

AIRBORNE GEOPHYSICAL SURVEY

Scale : 1:500,000

74-T1003

FIGURE 1

GEOLOGY AND PREVIOUS GEOPHYSICAL WORK

A geological map of the area was prepared by Mr. R. Robertson, B.Sc. during the 1974 summer field season. It is not known whether geophysical methods have been previously used to prospect the survey area.

DATA PRESENTATION

The measured survey parameters were recorded on heat sensitive chart paper. The scales and locations of the original geophysical traces are as follows:

MFE-3M5B Recorder using CP237 Chart Paper (from top to bottom)

Position	Parameter	Scale
Channel 1	Turair Field Strength Ratio	1 cm = 1%
Interchannel	Field Strength Attenuation Range Indicator	
Channel 2	Turair Phase Difference	1 cm = 0.5°
Interchannel	Fiducials	Approximately 1 every 1.2 sec.
		1 cm = 10 gammas steps every 100 gammas

MFE-3M3 Recorder using CP-3 Chart Paper (from top to bottom)

Channel 2	Altimeter	None-linear - as calibrated for each flight
Channel 3	Turair Field Strength	Full Scale - 3.5 cm x 1 Attenuation 8-80 Milligammas f.s. x 10 Attenuation 80-800 Milligammas f.s. x 100 Attenuation 800-8000 Milligammas f.s. x 500 Attenuation 8000-40,000 Milligammas f.s.
Bottom edge	Fiducials	Approximately 1 every 1.2 seconds

All chart traces show flight and line numbers as well as the relevant labeling and scales. A 400 Hz energization frequency and a 1 second time constant were used on the survey.

DISCUSSION OF RESULTS

The Turair survey results are shown on plate 1. In order to help resolve the interline correlation of the extremely complex electromagnetic distortion pattern observed over the southern half of the area, a contour map of the aeromagnetics was prepared. This is shown on Plate 2.

The magnetic relief over the grid is approximately 460 gammas - a contour interval of 20 gammas is employed. The southern half of the area exhibits a complicated magnetic pattern and several apparent structural lineations can be interpreted. "Apparent" must be emphasized here as variations of the sensor height over the rugged topography have likely distorted the picture somewhat. Similarly, inaccuracies in the recovered flight path due to the generally poor quality of the photomosaics may also result in correlation inaccuracies.

Along the southern half of the area the distortion patterns of both the magnetics and the electromagnetics generally show prominent short wavelength responses. These are in sharp contrast to the gentle geophysical relief observed in the northern half of the area. The contact between the two distortion patterns correlates with a mapped unconformity separating Cretaceous granites and Proterozoic phyllites and argillites to the north from Lower Palaeozoic formations to the south.

Seven zones, labeled A, B, C, D, E, F and G on plate 1, lying within Palaeozoic formations, have been critically chosen on account of their coincident magnetic correlation. Several other prominent anomalies are also shown though their significance has been downgraded somewhat because of their lack of direct anomalous magnetic expression. At the present time, however, it is not known to the author if the Mount Allan tungsten deposit has an associated magnetic signature, in which case, this downgrading may not be justified.

All seven zones are situated close to or to the south side of a quartzite marker-horizon. The Amax deposit also appears to be to the south of this particular bed.

The magnetic pattern within the Palaeozoics tends to indicate a fold structure whose axis runs approximately E-W between zones G and F, through the center of Zone E and between Zones B and C. To the east of zones B and C the magnetic pattern is truncated by a SSW striking linear magnetic low - presumably a finger of the Mount Allan granite at relatively shallow depth. This may indicate a lack of geological continuity of the Amax deposit to the west.

Zone A in the southeast corner of the survey area is open to the east and may well represent a westward extension of the Mount Allan deposit. This zone is consequently considered to be of priority interest.

Zone B appears to be separated from Zone A by the inferred Mount Allan granite finger noted above. This may imply that Zone B should also be considered a priority target. If the fold structure theory noted above is correct this, in turn, would imply that zones C, D, F and G be assigned the same high priority interest.

Zone E, located along the axis of the inferred fold structure, is coincident with a small outcrop of tremolite rock (unit I) which has been mapped as an anticlinal structure plunging to the west. The possible economic significance of this rock type as a host for tungsten mineralization is not known to the author. Zone E is surrounded by a magnetic-low ring-structure which, in turn, is surrounded by an elliptical (major axis E-W) magnetic high. These two crude magnetic units external to Zone E probably represent a facies change within the black argillites and slates of unit H. Deep overburden cover in the valley floor prevented detailed mapping in this area.

It is postulated that geophysical Zones B, C, D, G and F are all located within the same sub-unit of geological unit H.

Detailed turam (north-south lines with energizing loops to the north in all cases) and ground magnetometer coverage is recommended over all of the anomalous zones with the possible exception of Zone E. In thecase of Zone A, the eastern-most survey line should run N-S along the eastern edge of the claim block. It would, of course, be extremely useful to correlate such work with any geophysical responses observed over the Amax deposit.

Judging by the highly complex nature of the Turair results a multitude of conductors is likely to be encountered on each ground follow-up grid. In order to help assess individual conductors it is suggested that detailed (50' stations interval) mercury soil gas and/or soil sample analysis be carried out using a field portable mercury spectrometer (eg., Scintrex HGG-3). One of the advantages of this technique over conventional geochemistry is that anomalies generally occur immediately above their sources. A recent paper (re: "Mercury in Granitoids" by Garrett, Journal of Geochemical Exploration 3 1974) has indicated that mercury may be a useful tracer element for scheelite mineralization in the Selwyn Mountain belt. Mercury assays of mineralized samples from this environment would readily determine if mercury "sniffing" would be a viable technique here.

CONCLUSIONS AND RECOMMENDATIONS

The present survey has resulted in the detection of a swarm of prominent conductive lineations, confined almost exclusively to the lower Palaeozoic formations. Seven zones exhibiting coincident magnetic correlation have been recommended for ground follow-up work by turam, magnetometer and mercury soil and/or soil gas analysis.

Respectfully submitted,

SCINTREX SURVEYS LIMITED

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REGISTERED PROFESSIONAL ENGINEER
M. J. LEWIS
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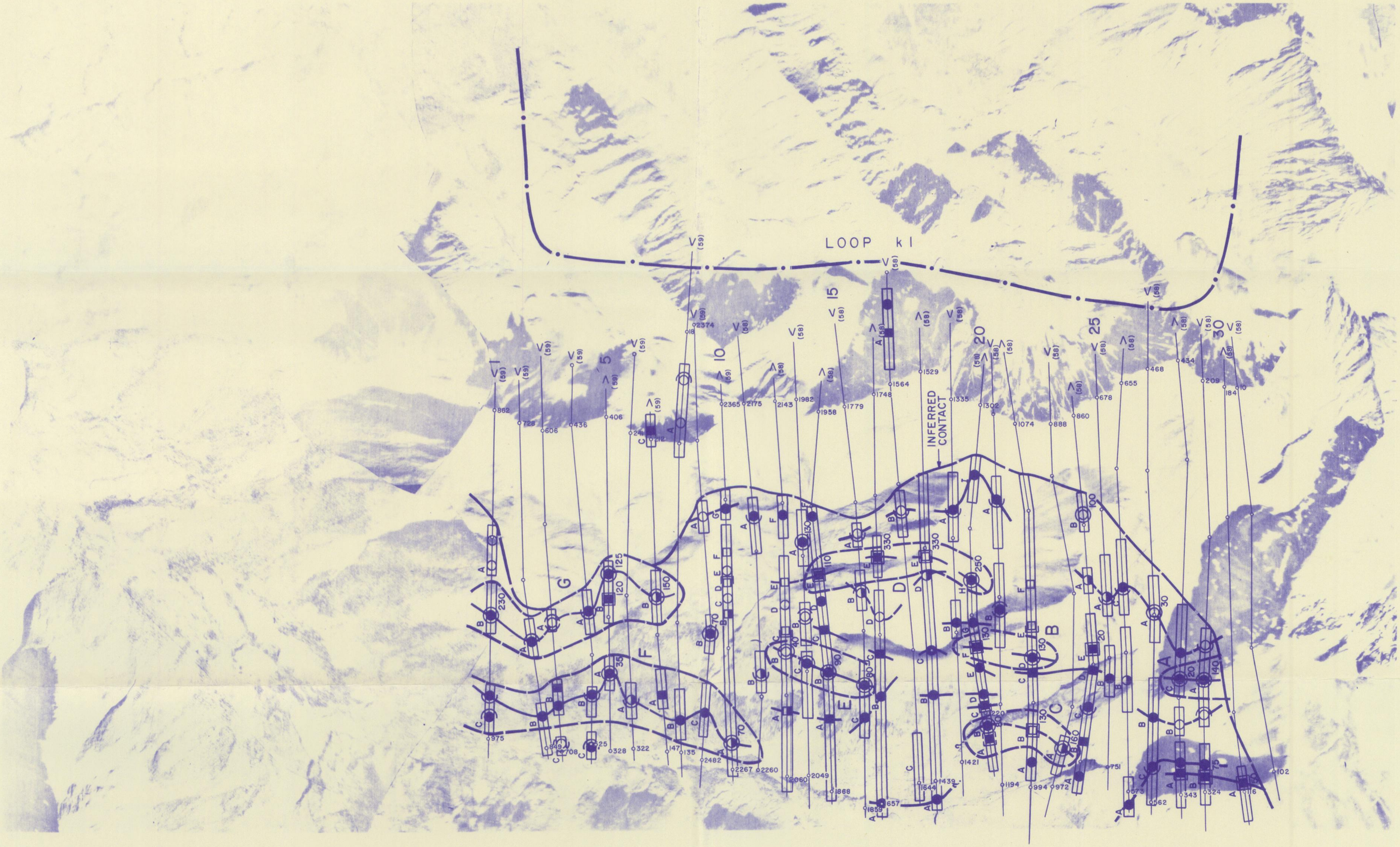

LEGEND

FLIGHT LINE, NUMBER AND DIRECTION	20
CONTROL POINT	2498
MEAN FLIGHT LINE SPACING	440 FEET
MEAN FLIGHT ALTITUDE	250 FEET
1st CATEGORY ANOMALY	
2nd CATEGORY ANOMALY	
3rd CATEGORY ANOMALY	
ANOMALY WITH MAGNETIC COINCIDENCE	A 25 X 50
A - Intersection label; 25 - Conductivity-width value in mhos	
X - Depth indication in feet; 50 - Magnetic value in gammas	
REVERSE ANOMALY	
MAGNETIC HIGH OFF-SET TO RIGHT	
CONDUCTOR EXTENT AND PEAK LOCATION	
MAN MADE CONDUCTOR	
CONDUCTOR AXIS	
CONDUCTOR ZONE	
LOOP BOUNDARY	

PLATE I

CANADA TUNGSTEN MINING CORPORATION LTD.

KEN 1 MACMILLAN PASS, YUKON TERR.

AIRBORNE GEOPHYSICAL SURVEY

SCINTREX TURAIR II and MAP-2 MAGNETOMETER

SCALE : 1320 feet to 1 inch

1000 0 1000 2000 3000 4000 5000 FEET

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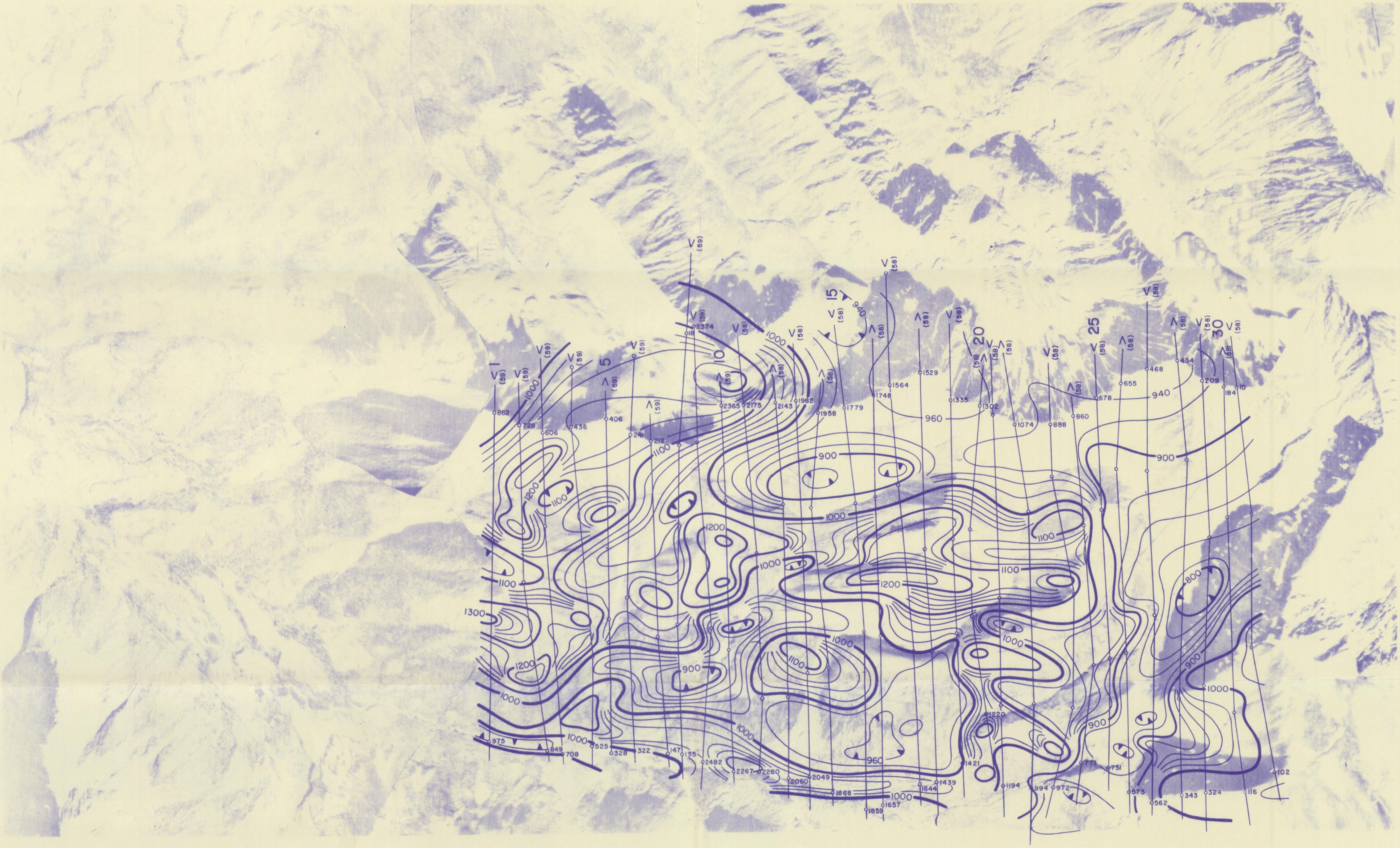
by
SCINTREX SURVEYS LTD.

74-T1003-01



LEGEND

FLIGHT LINE, NUMBER AND DIRECTION	20
CONTROL POINT	2498
MEAN FLIGHT LINE SPACING	440 FEET
MEAN FLIGHT ALTITUDE	250 FEET
CONTOUR INTERVAL	20 GAMMAS
500 GAMMA CONTOUR	
100 GAMMA CONTOUR	
20 GAMMA CONTOUR	
MAGNETIC LOW	
BASE VALUE	58,000 GAMMAS

PLATE 2

CANADA TUNGSTEN MINING CORPORATION LTD.

KEN 1 MACMILLAN PASS, YUKON TERR.

AIRBORNE GEOPHYSICAL SURVEY

SCINTREX TURAIR II and MAP-2 MAGNETOMETER

SCALE 1320 feet to 1 inch

1000 FEET 0 1000 2000 3000 4000 5000 FEET

Flown and Compiled 1974
by
SCINTREX SURVEYS LTD.

74-T1003-02

APPENDIX

TURAIR

METHOD, INSTRUMENTATION, PROCEDURES AND INTERPRETATION

Airborne Electromagnetic System - Scintrex TAR-2

Method

In the application of ground electromagnetic prospecting methods, it has long been recognized that, other things being equal, much greater exploration depths can be attained with systems employing a fixed source than with systems where both source and receiver are moved in unison. For example, a large conducting body which would already be undetectable at a depth of 60 m by any surface moving source (horizontal loop) system, could be detectable by a fixed-source method to a depth of as much as 200 m.

Most present-day airborne electromagnetic systems are of the moving source type, and although such systems have tangible advantages over the ground versions, it appears difficult to increase their useful penetration substantially beyond their present range. Under very favourable conditions the better moving source AEM systems may reach exploration depths of as much as 100 m or in exceptional cases 125 m below the ground surface. This is sufficient for many search problems but in some areas the geologic and topographic conditions necessitate a much deeper penetration to conduct meaningful mineral surveys.

The foregoing considerations have led to the development of the Turair method for the purpose of deep electromagnetic exploration. The system, which can be described as a fixed source, semi-airborne, gradient measuring device, employs a large transmitting loop on the ground as a primary source. The horizontal gradients of amplitude and phase of the vertical or horizontal magnetic field are measured from the air, along traverse lines across the source and perpendicular to the regional geological strike.

The Turair method, because of its semi-airborne character, is particularly suitable for the detailed, deep investigation of structures having geologically favourable characteristics, or a magnetic expression suggesting favourable geology. Because of its potential depth of exploration, it can be successfully employed in areas of deep sedimentary cover, deep weathering, or tall tree cover (tropical area), or in areas where shallower exploration has established the presence of ore deposits and a deeper search is desired. It is, because of its fixed source configuration, less affected by near-surface conduction and can be applied with a very low exciting frequency (e.g. 400 Hz, 200 Hz or less). Finally as a helicopter-borne system it can operate in mountainous topography. Terrain clearance has far less effect on the exploration depth of the Turair system than it has in moving source methods and it can penetrate deep talus cover and valley fillings.

Instrumentation

The Scintrex Turair system has been designed primarily for helicopter operation. The receiver can also be mounted in light fixed-wing aircraft in cases where it is feasible to lay out the source loops by ground vehicle.

The system embodies a fixed transmitter on the ground and a receiver carried in the helicopter. The size and shape of the transmitting loop is guided by geological conditions and the character of the survey. A typical transmitting loop would be a 2 x 4 km rectangle. For the airborne placement of the source loops a special dispensing device is used which can feed out more than 20 km of wire continuously. The present system utilizes a 400 Hz or 200 Hz primary field, excited by means of a motor driven generator which supplies current to the transmitting loop. The system, if desirable, can bemodified to operate at other frequencies.

The receiver system comprises 2 horizontal coplanar and/or 2 vertical coaxial air-cored coils, rigidly mounted 2.2 m apart in a "bird", which is towed approximately 30 m below the helicopter by means of a cable which also carries the electrical signals from the receiver. The horizontal coplanar coil system which measures vertical components, is preferably used. In areas where conducting overburden, etc. might tilt the primary electromagnetic field from a main vertical to predominantly horizontal direction, the vertical coaxial coil system may be used to measure the horizontal components.

The quantities measured are the ratio of the field strength and the phase difference of the alternating magnetic field at the two coils. The sensitivities of the system are 0.1% strength ratio and 0.1° phase difference respectively.

Both parameters are recorded in analogue form on a multi-channel recorder. A digital output can be provided. The intervalometer provides time marks, which are recorded simultaneous with the geophysical data, and which are synchronized with the tracking camera exposures. The altimeter monitors the (helicopter) terrain clearance.

Procedures

Economic ore deposits may have strike lengths less than 200 m. If we want to search for such targets, line spacing should not be much greater and average survey line spacing of 200 m (or one-eight mile) may be considered optimum. In fact larger line spacings do not represent significant savings, because of the reduction of measurable profile from each individual loop layout. Loop dimensions may vary from 1 x 2 km to 4 x 6 km and even the largest loops can usually be dispensed by helicopter in one uninterrupted flight.

The normal terrain clearance of the bird is 30 to 60 m, depending on topography and tree cover, with the helicopter flying 30 m higher. The magnetometer sensor is usually carried closer to the helicopter.

At the start and at one or more points during each flight the scale sensitivities and zero levels of the different channels are checked and if necessary recalibrated.

Amplitude ratio and phase difference are recorded in such a way that when flying 'towards' the nearest loop side a "normal" anomaly shows a field strength ratio increase (i. e. upward deflection). Flying 'away' from the nearest loop side these signs are reversed. Amplitudes reversed from the normal direction may result from certain geometric relations between source and conductor.

Close to the loop sides, within about 100 m, the gradient of the primary field is too steep to distinguish with certainty anomalies due to secondary fields. From a statistical viewpoint the chances of missing a significant conductor are very small, as these "blind" zones constitute less than 3% of the area surveyed from each loop.

Upon the completion of a flight, the film is developed and the actual flight of the aircraft is reconstructed by comparing recognizable features indicated by tie points on the flight path film with the base map. The flight path is then interpolated between the tie points.

The recovered flight lines and relevant fiducial markings are presented on a subdued photomosaic (greyflex) or an overlay from a mosaic or topographic map. The tie points are marked on the flight lines as well as relevant fiducial numbers. Significant electromagnetic anomalies are plotted on their correct position on the base map, and magnetic anomaly peaks are indicated when they are relevant to the electromagnetic results.

Interpretation

The electromagnetic records are interpreted to determine the presence of subsurface conductors. Where field distortion occurs the location and the depth of the main current flow can be derived from the curve shapes. The current "axis" is well defined when the current is concentrated, for instance in thin, steeply dipping conductors. In wide or multiple banded conductors, or in horizontal conductors such as overburden, the current is usually more dispersed and the anomalies yield less positive information.

(a) Peak Location

When the vertical component is measured the current axis is located straight below the maximum field strength ratio deflection or the maximum phase deflection and this 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. A conductor which is likely man-made is indicated by an X rather than by a circle. When the horizontal field is measured the current axis is located straight below the inflection point of the anomaly.

(b) Depth and Conductor Width

The "half width", i.e. the distance between the points of half the maximum vertical response amplitude is, for simple line current sources, approximately equal to the depth of the source under the detector. When the horizontal component is measured the peak to peak separation is for tabular bodies approximately equal to the depth of the source under the detector. Flay-lying conductors (e.g. overburden) characteristically give rise to larger half widths often combined with rather irregular curve shapes. Here the half width may reflect the conductor width rather than the depth and the latter can usually not be determined with certainty. In such cases the separation between the edges is indicated on the plan by an open bar symbol along the flight line. Well defined peaks within this zone are marked. The subsurface depth of the current axis is marked on the lower left of the peak location circle. (It should be noted that this figure gives the maximum depth of the current axis. The conductor can be appreciably shallower, but not deeper.)

(c) Anomaly Classification

To facilitate the evaluation of the geophysical data shown on the plan the electromagnetic anomalies are classified in three groups according to Table 1 (attached).

Generally, category 1 anomalies, which represent well defined conductors of good conductivity, would consititute first order exploration targets; category 2 anomalies, due to well defined conductors of lower conductivity, are second priority targets; and category 3, which covers all weaker and poorly defined anomalies, are targets which, on the basis of the geophysical data alone, are of questionable merit. Of course these priorities are based on the geophysical character only and subject to subsequent modification in the light of other information relevant to the geology of the area and the type of mineralization.

(d) Conductivity x Thickness (σt) Product

The field strength ratios and phase differences provide a measure of the conductivity of the conducting bodies, i.e. good conductors are characterized by field strength distortion combined with relatively little phase shifting, whereas poor conductors affect the phase rather than the strength of the resultant field. Thus the quotient Q of the field strength ratio amplitude and phase difference amplitude can, in first approximation, be used for conductivity discrimination.

For a more accurate grading the conductivity x thickness product (σt value), of individual conductors, can be derived from the field strength ratio and phase difference amplitudes, taking into consideration the exciting frequency and the strike length of conductor, by means of appropriate diagrams. When the anomaly is well defined and the amplitudes can be determined with adequate accuracy the σt value is marked on the upper-right side of the peak location circle. When a highly conducting cover is present the σt value of underlying conductors may be distorted as the result of mutual induction and cannot be reliably determined.

Highly conducting bodies such as massive sulphides or graphite, generally have high σt values. Moderate conductors will have σt values between 10 and 100 mhos. Poorly conducting bodies (e.g. most overburden and some sulphide and graphitic zones) will have σt values of less than 10 mhos. In areas where there is a clear differentiation in conductivity between the targets of potential economic interest and other possible conductors, the σt values may form the main basis for discrimination. When the conductivity ranges of economic and non-economic overlap, the σt value cannot, of course, be rigidly relied upon.

A vector diagram for the evaluation of conductivity x thickness products, prepared from data obtained by model studies, is shown in Figure 1 (R. A. Bosschart: "Analytical Interpretation of Fixed Source Electromagnetic Prospecting Data.") The diagram applies to tabular steeply dipping "thin" conductors.

To obtain the conductivity-thickness product for a conductor intersection the amplitude-ratio and phase difference are plotted on abscissa and ordinate respectively and a line is drawn through the resultant point and the origin. Where this line intersects the curve corresponding to the interpreted strike length of the conductor, one interpolates between the values of conductivity x thickness which are shown, in mhos, on the upper bounding curve.

(e) Current Pattern

To obtain the projection of the current pattern, the anomalies may be connected between lines, using geological strike, depth, σt values and other characteristics of the curves as criteria.

(f) Magnetic Correlation

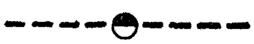
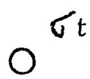
The relation between the electromagnetic anomalies and the magnetic intensity is indicated only when the latter is simultaneously recorded, and when close and significant correlation is evident, i.e. when both anomalies arise from sources at a comparable depth and are coincident or only slightly off-set.

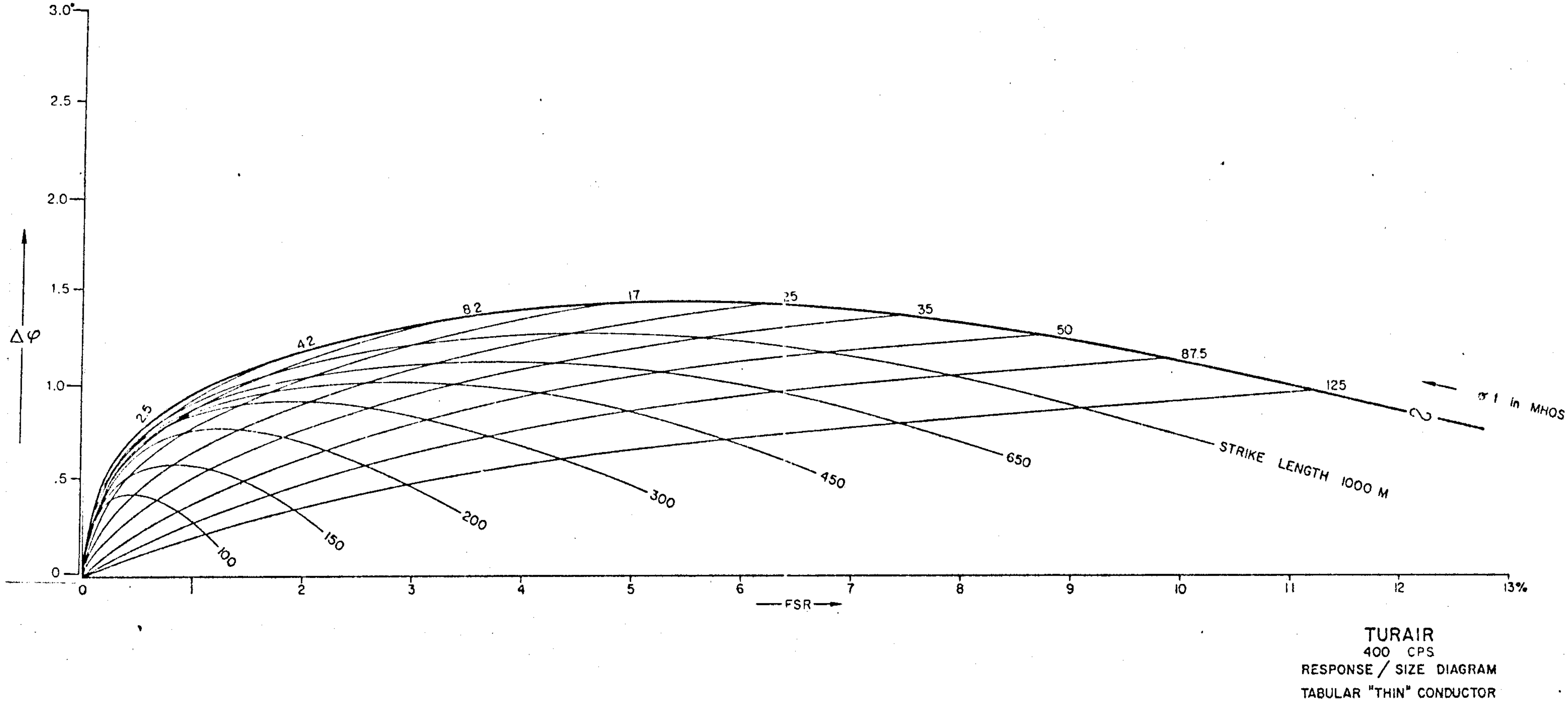
Direct correlation is indicated by a double concentric circle. When the anomalies are off-set half a concentric circle is shown on the side of the magnetic high.

(g) Spurious Anomalies

Man-made conductors, including power lines, pipe lines, telephone lines, metal fences, railways, etc. may cause spurious anomalies. They tend to display typical characteristics and can usually be readily identified.

TABLE 1

Coding	Category	Signal/ Noise	Q	Remarks
	1	>2	>1	Anomaly well defined, good conductivity.
	2	>2	<1	Anomaly well defined, low to medium conductivity.
	3	<2		Anomaly poorly defined, weak. Quantitative determination not possible.
	Conductivity (σ) x thickness (t) of target conductor.			Marked only if Q can be determined with some certainty and no appreciable overburden distortion is present.
	Subsurface depth (α) to current concentration.			Marked on if α can be determined with sufficient certainty. α is maximum depth, current axis 10-15 m below upper edge of body.
□	Reversed current flow.			
	Magnetic Correlation			
	Direct Coincidence			
	Magnetic high off-set to right.			
	Magnetic high off-set to left.			
⊗	Spurious Anomalies			Mainly man-made conductors.


3.0°
2.5
2.0
1.5
1.0
.5
0
Δφ
0
1
2
3
4
5
6
7
8
9
10
11
12
13%
FSR
2.5
4.2
8.2
17
25
35
50
87.5
125
∞
σ t in MHOS
100
150
200
300
450
650
STRIKE LENGTH 1000 M
TURAIR
400 CPS
RESPONSE / SIZE DIAGRAM
TABULAR "THIN" CONDUCTOR