104B/1W

REPORT ON A TURAIR ELECTROMAGNETIC AND AIRBORNE MAGNETIC SURVEY LEDUC MOUNTAIN AREA, BRITISH COLUMBIA ON BEHALF OF GRANDUC OPERATING COMPANY

3739

by

Jan Klein, M.Sc., P.Eng.
February 29, 1972

LOCATION:

About 25 miles north-northwest of
Stewart, British Columbia
Skeena Mining Division
56° 130° SE

DATES:

July 18 to July 19 and July 24 to July 25, 1971

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SUMMARY

A Turair electromagnetic and airborne magnetic survey was carried out over a block in the Leduc area of British Columbia.

The known Granduc mineralization together with the Granduc Fault immediately to the west of the orebodies revealed itself in a complex distortion pattern. The conductivity-thickness of this banded zone is estimated to be approximately 10 mhos. A long, linear magnetic high coincides with the eastern part of the conductor, reflecting a concentration of magnetite in the known mineralization. To the west of this zone occurs another parallel magnetic high which is associated with the long trail of the phase responses and might reflect minor sulphides connected with a magnetite band in the sediments.

The electromagnetic distortions obtained over the ice field to the north of the main conductor zone are most likely related to the Granduc Fault zone. No appreciable magnetic coincidence occurs with the latter distortions, and it is therefore assumed that this conduction is related to the shear zone rather than to sulphide mineralization.

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TURAIR ELECTROMAGNETIC AND
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LEDUC MOUNTAIN AREA
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GRANDUC OPERATING COMPANY

INTRODUCTION

On July 18, 19, 24 and 25, 1971, a Turair electromagnetic and airborne magnetic survey was executed on behalf of Granduc Operating Company in the Leduc Mountain area, near Stewart, British Columbia, covering approximately four square miles. The airborne surveys included electromagnetic and magnetic measurements. The former employed a Scintrex TAR-1 Turair electromagnetic unit measuring the amplitude (%) and phase (°) of a stationary 400 c.p.s. electromagnetic field; and the latter employed a Scintrex MAP-2 nuclear resonance, total intensity magnetometer with a basic sensitivity of ± 1 gamma.

Appendix 'C' attached gives full details of the airborne geophysical equipment and the ancillary equipment employed, as well as the survey techniques and the treatment of the data resulting from this survey. A Bell 206A – Jet Ranger helicopter, on charter from Okanagan Helicopters, was employed as the basic transport vehicle both to lay the Turair "loop" and to execute the survey.

The flight lines were flown at a nominal line interval of 1/8 mile. Flight navigation and flight path recovery have been based upon an enlarged aerial photo of the area on the scale of 1 inch = 1000 feet.

The magnetometer sensor and the Turair 'bird' were flown separately; the former 50 feet and the latter 100 feet below the helicopter. The Turair "loop" was deployed by helicopter on the glaciers surrounding Leduc Mountain.

The total magnetic field in the area measures approximately 58,000 gammas. The inclination of the total magnetic field is approximately 74 degrees and the declination is 23 degrees east of geographical north.

The purpose of the electromagnetic survey was to locate sulphide mineralization of the type occuring in the area (which generally form bodies of medium to good electric conductivity); e.g. Granduc A, B, C and F ore-bodies. These conductors may be expected to be covered with up to hundreds of feet of glacier-ice.

The simultaneous magnetometer survey was used primarily to determine correlation, if any, between the magnetic field and conductor systems.

PRESENTATION OF DATA

The results of the geophysical surveys are presented on Plates 2 and 3, on the scale of 1 inch = 500 feet. Flight lines and some topographic features are shown on the plates. Plate 2 shows the Turair electromagnetic results. The conductors are coded as shown in appendix 'C'. Plate 3 shows the magnetic contours, drawn at an interval of 100 gammas or less according to magnetic relief.

The original geophysical data were recorded on two dual trace

Moseley 7100B recorders. The electromagnetic amplitude ratio and phase difference are on one chart and magnetometer and altimeter records on the second chart. Fiducial marks representing a navigational photograph per mark were recorded on each chart to enable correlation of all the data and to locate geophysical features on the ground. The original traces were recorded on the following scales:

Turair	1 inch = 1.0% - amplitude ratio 1 inch = 0.3° - phase difference
Magnetometer	1 inch = 100 gammas
Altimeter	As shown on the calibration included with the original data

Detailed information on a small area near the Granduc mine site is presented in figures 1 – 4 on a scale of 1"≈1000'.

Flight path recovery was executed with great care in this area in order to remove the effect of the significantly varying groundspeed of the helicopter.

Figure 1 shows the flight lines with fiducials of lines 3-11 inclusive in the vicinity of the Granduc mine site.

Figure 2 shows a geological sketch taken from C.I.M.M. special volume #8, 1966, pp. 306.

Figure 3 shows the magnetic contour plan of this area which due to the refined flight path recovery differs slightly from the contours in this area shown on figure 3.

Figure 4 shows the electromagnetic results over these lines, and figures 5 and 6 are copies of sections of the (repositioned) original traces of lines 6W and 8W.

GEOLOGY

The survey area overlies a portion of the Coast Mountain System and lies approximately one mile east of a large mass of Coast Range granodiorite. The rocks of the survey area are of Jurassic through Lower Cretaceous age and consist of volcanic and sedimentary rocks (see figure 2). The higher elevation areas in the southern and eastern portion of the survey area are underlain primarily by basic volcanic rocks (porphyritic andesites and amphibolites, etc.), while the lower elevation areas to the west and north are primarily metasediments (greywackes, argillites, limestones, schists, etc.). Basic intrusive bodies of the Coast series have intruded the sedimentary rocks.

Several bodies of copper mineralization (Granduc A, B, C and F orebodies) are known and are located in the southwest portion of the survey area. These NNE striking bodies consist of steeply westerly dipping zones of chalcopyrite, pyrrhotite, pyrite and magnetite. Approximately 32 million tons of ore grading 1.93 percent copper is estimated.

This mineralization lies on the eastern side of the Granduc Fault Zone and its emplacement is probably controlled by this zone. This fault zone has been mapped across the width of the survey area. For further details see "Relation of Ore to Fold Patterns at Granduc, British Columbia", by G.W.H. Norman and J. McCue, C.I.M.M. special volume 8, 1966, pp. 305-314.

DISCUSSION OF RESULTS

The present Turair electromagnetic survey resulted in the location of one banded and extensive anomalous zone coinciding with the known mineralization and the Granduc Fault.

As it turned out, one side of the energising loop was located relatively close to the southern edge of the known mineralization, and as a result the primary field at this point was too strong to detect the secondary fields of the southern extremities of the A and B ore bodies.

Spacing between lines 4, 5 and 6 was almost 1000 feet and the A and C bodies were not traversed.

On lines 6W, 7W, and 8W, a cross-over type phase distortion with a peak-peak amplitude of up to $.3^{\circ}$ and a single peaked ratio distortion which peaks at the cross-over point of the phase curve correlates with the up to 500 feet wide zone embracing both the Granduc Fault (argillite filling in the west) and the strings of orebodies to the east (figures 5 and 6 are representative samples of responses obtained over this area).

We have found this complex anomaly pattern, consisting of a positive and negative phase peak and a positive ratio peak between the two phase peaks, to be characteristic of a zone consisting of several parallel bands of conductors, possibly having different conductivity-width values. As a rule, the outside edges of the zone occur slightly beyond the peak phase deflection. Model experiments confirming this type of response have recently been completed.

Complicated distortion patterns as obtained during the present survey do not allow accurate determination of the σt values of the contributing bands. However, it is estimated that the conductivity-width of the present zone ranges from 10 to 20 mhos. For similar reasons conductor axis depths cannot be established with certainty either, but from the steepness of parts of the phase slope of line 6W we might assume that the conductors come close to the ground surface.

The shape and strength of the responses constituting the zone which is marked A on plate 2 probably reflects the Granduc Fault as it continues underneath the snow and ice of Granduc Mountain. Clear tie-in points are lacking in this area and positioning is of necessity inaccurate.

The detailed magnetic results as shown in contour form on figure 3 reveal a magnetic high coinciding with the orebodies. The peak occurs between orebodies A and B and again between C and F, and most likely represents the magnetite present within the deposits. A second magnetic high paralleling the first one is located between the Granduc and Western faults, indicating a magnetite-rich band within the sediments. It is of some interest that the long trailing end of the phase distortions coincides with this magnetic high, which may suggest weak sulphide mineralization in this zone. The main magnetic high weakens to the north and disappears north of the F orebody. A new linear high, however, is located on line 11W along strike and directly west of the Granduc Fault. Plate 3 shows an extension further to the north on line 13W near fiducial 610. No anomalous electromagnetic distortion pattern has been observed near this location.

CONCLUSIONS AND RECOMMENDATIONS

A Turair electromagnetic and airborne magnetic survey was carried out over a block in the Leduc area of British Columbia.

The known Granduc mineralization together with the Granduc Fault immediately to the west of the orebodies revealed itself in a complex distortion pattern. A cross-over type phase response, together with a single peak ratio distortion, the latter peaking at the cross-over point of the phase anomaly, coincides with the 500 feet wide multiple conductor zone. The conductivity-thickness of this banded zone is estimated to be approximately 10 mhos, indicating that the ore body has a relatively low conductivity. A long, linear magnetic high coincides with the eastern part of the conductor, reflecting a concentration of magnetite in the known mineralization.

To the west of this zone, and located between the Granduc and Western fault, there occurs another parallel magnetic high which is associated with the long trail of the phase responses and might reflect minor sulphides connected with a magnetite band in the sediments. The electromagnetic distortions obtained over the ice field to the north of the main conductor zone are most likely related to the Granduc Fault zone, even though the positioning of the anomalies might not be overly accurate. No appreciable magnetic coincidence occurs with the latter distortions, and it is therefore assumed that this conduction is related to the shear zone rather than to sulphide mineralization.

No other electromagnetic distortions of interest were revealed during the present surveys.

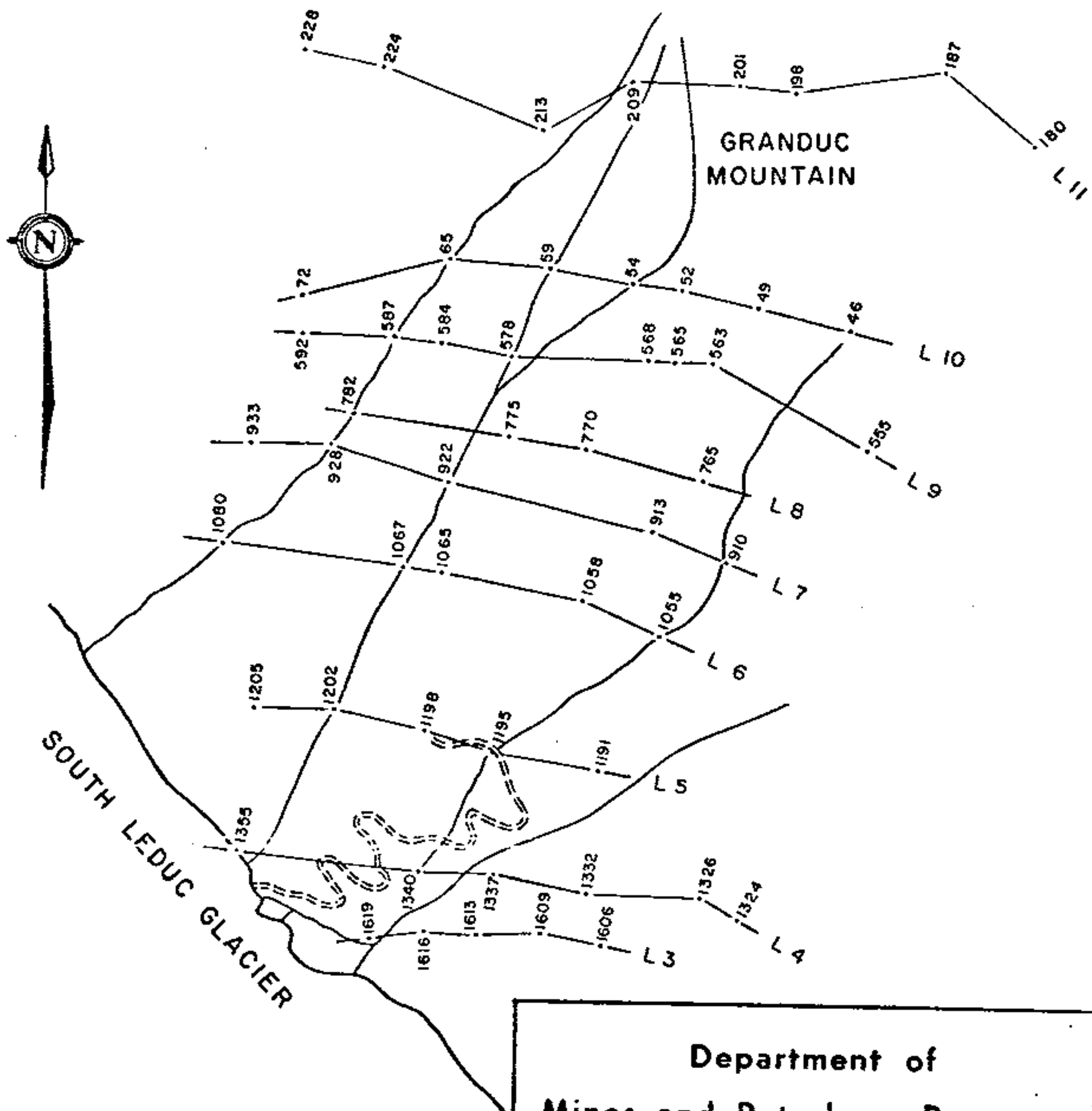
Respectfully submitted,

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

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
JAN KLEIN

SEIGEL ASSOCIATES LIMITED

Expiry Date: April 5, 1973



Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3739 MAP #1

FIGURE I

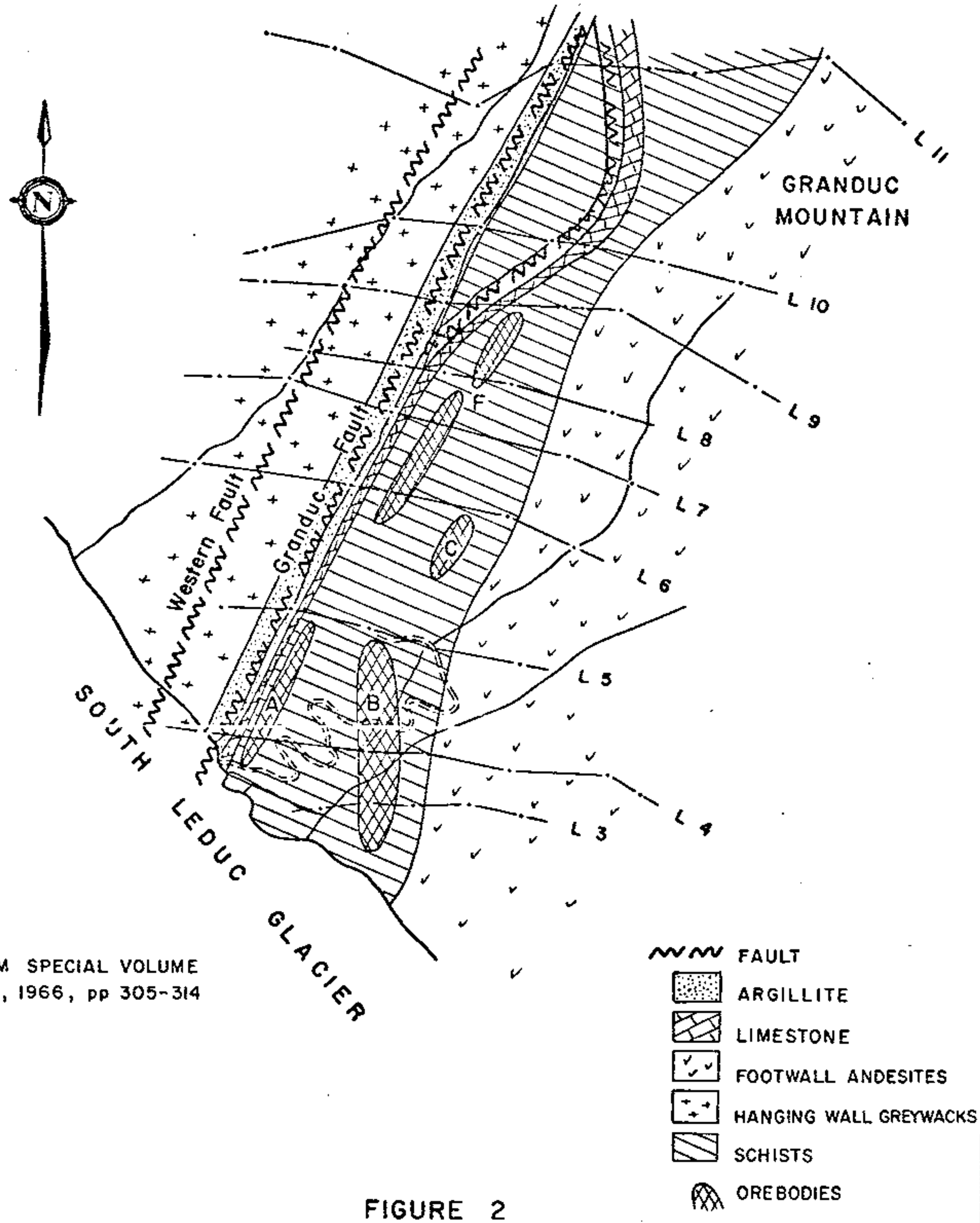
TURAIR ELECTROMAGNETIC SURVEY

FLIGHT LINES WITH FIDUCIALS

GRANDUC OPERATING COMPANY

LEDUC MOUNTAIN, B.C.

SCALE: 1" ≃ 1000'



SOURCE:

CIMM SPECIAL VOLUME
No. 8, 1966, pp 305-314

FIGURE 2

TURAIR ELECTROMAGNETIC SURVEY

GEOLOGICAL SKETCH

GRANDUC OPERATING COMPANY

LEDUC MOUNTAIN, B.C.

SCALE: 1" = 1000'

[illegible] Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3739 MAP #2

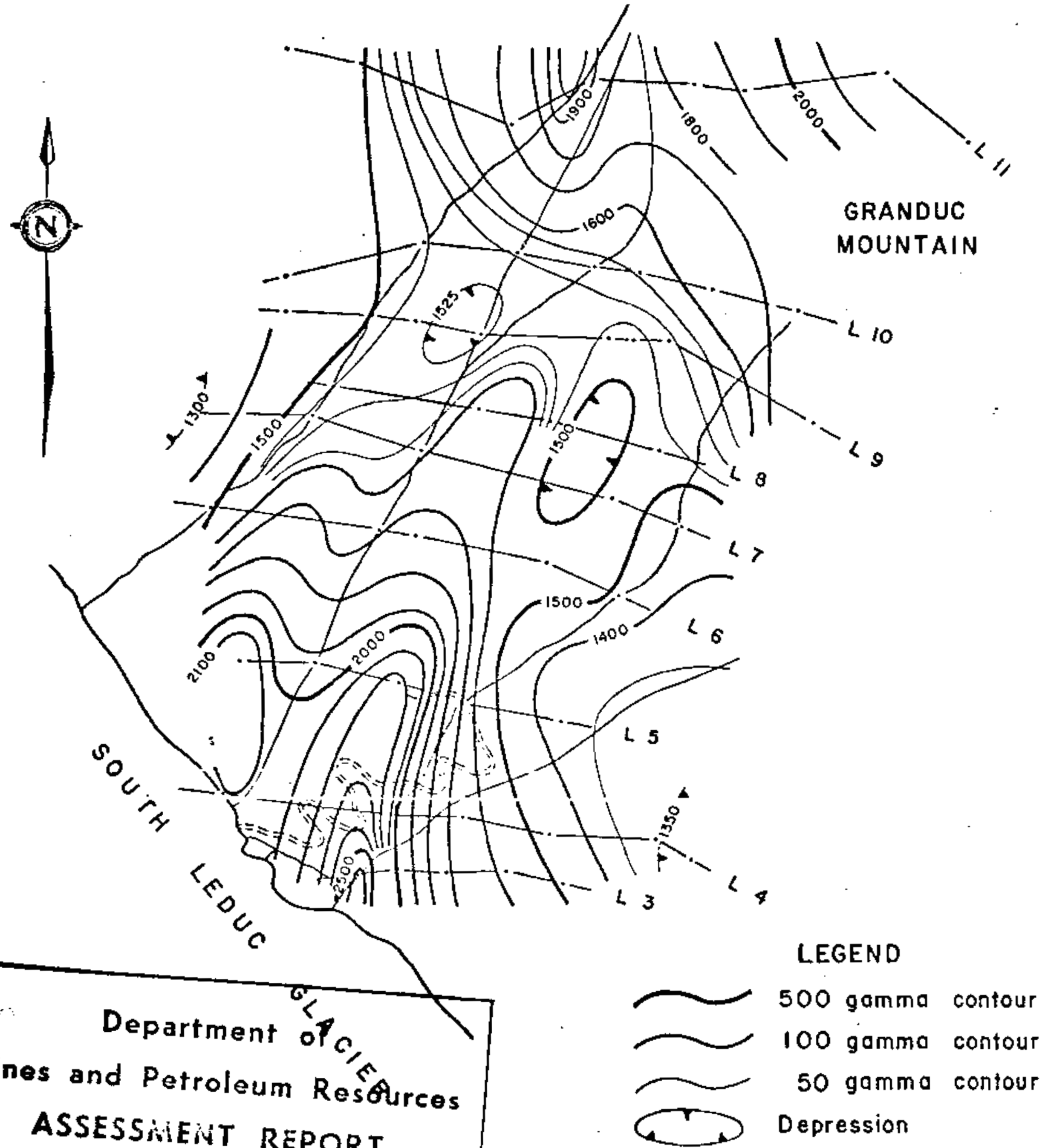


FIGURE 3

TURAIR ELECTROMAGNETIC SURVEY

MAGNETIC CONTOUR PLAN

GRANDUC OPERATING COMPANY

LEDUC MOUNTAIN, B.C.

SCALE: 1" ≈ 1000'

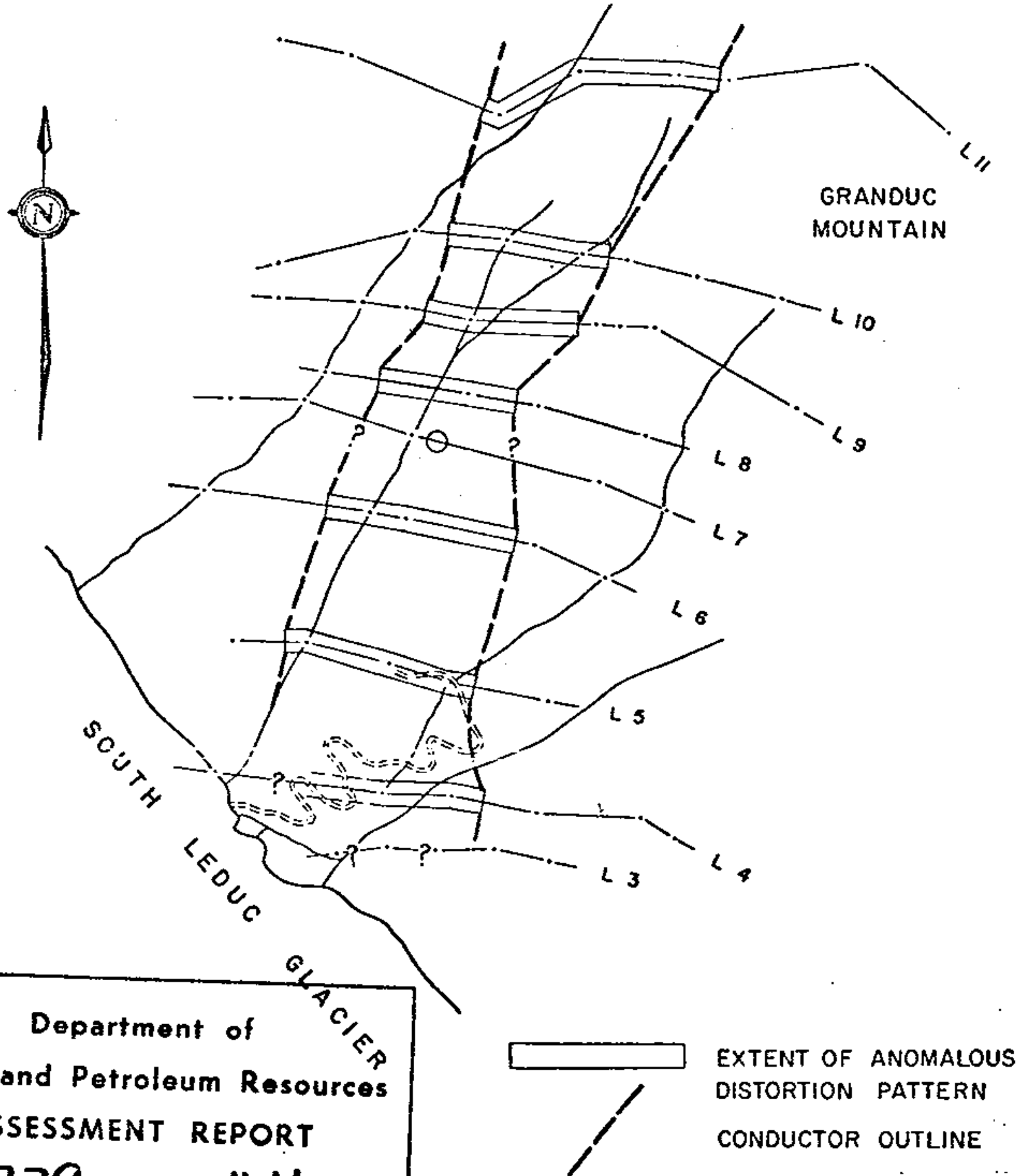


FIGURE 4

TURAIR ELECTROMAGNETIC SURVEY

ELECTROMAGNETIC RESULTS

GRANDUC OPERATING COMPANY

LEDUC MOUNTAIN, B.C.

SCALE: 1" = 1000'

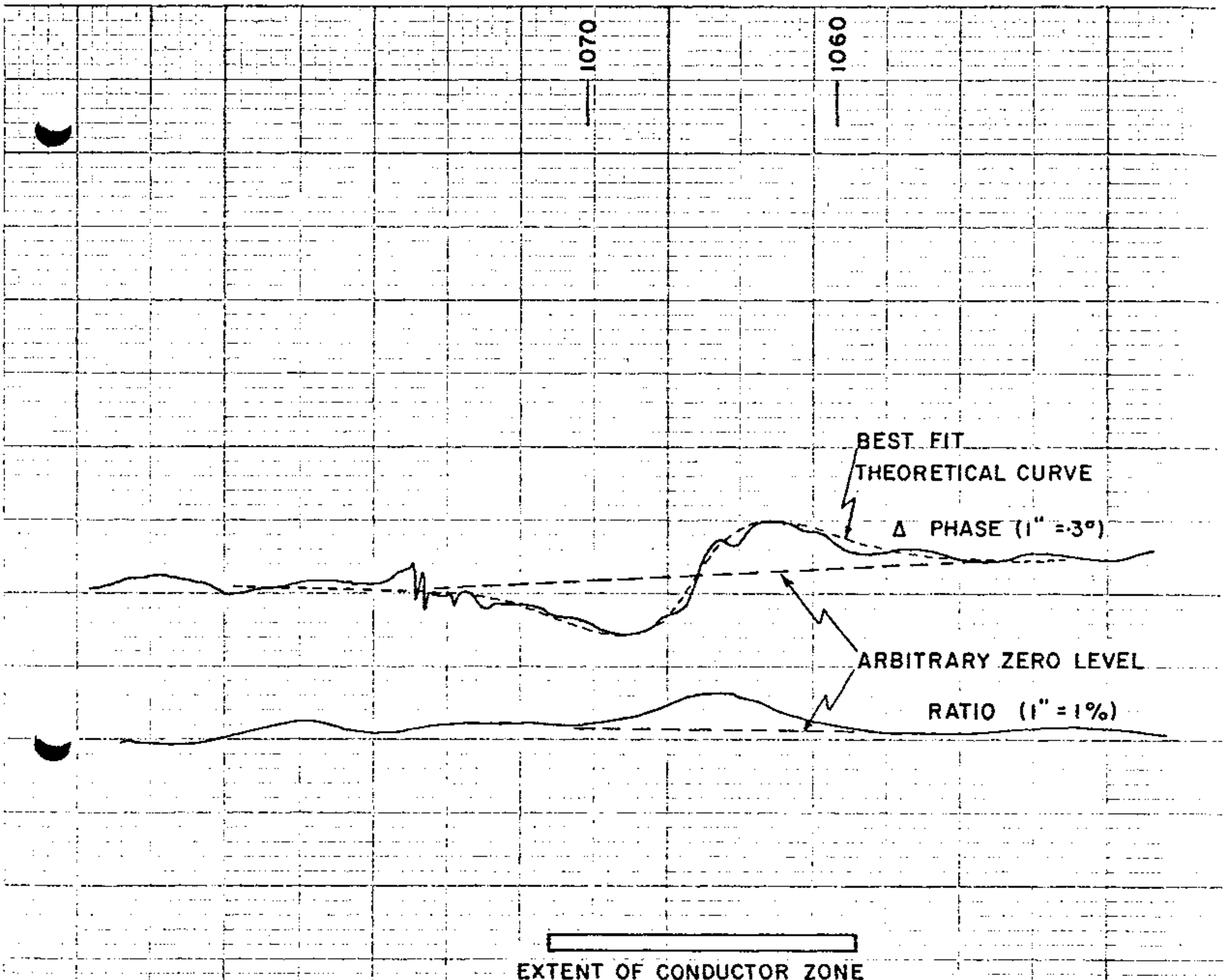


FIGURE 5

TURAIR ELECTROMAGNETIC SURVEY

LINE 6 W (REPOSITIONED)

GRANDUC OPERATING COMPANY

LEDUC MOUNTAIN, B.C.

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Mines and Petroleum Resources

ASSESSMENT REPORT

NO. 3739 MAP #5

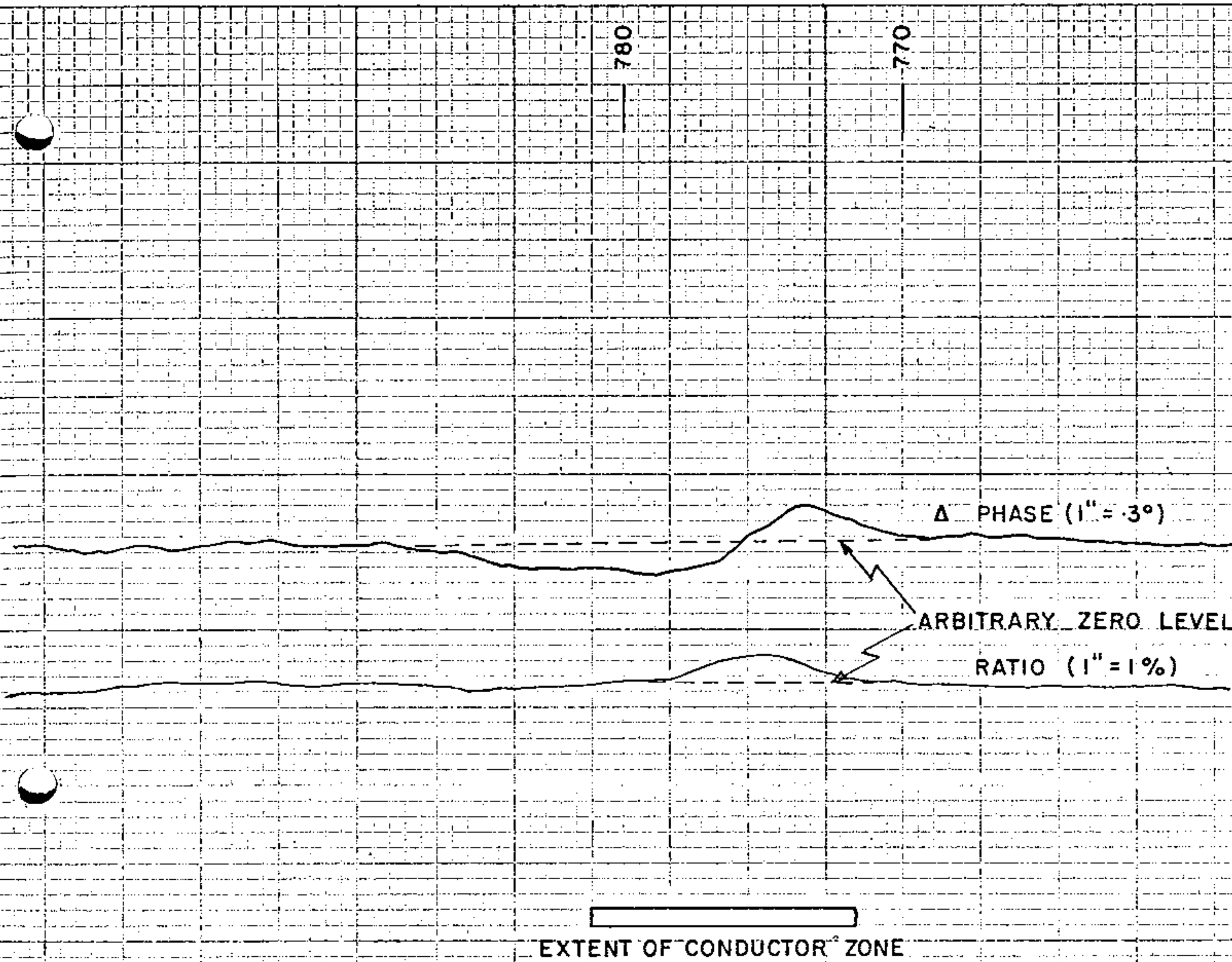


FIGURE 6

TURAIR ELECTROMAGNETIC SURVEY

LINE 8W (REPOSITIONED)

GRANDUC OPERATING COMPANY

LEDUC MOUNTAIN, B.C.

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3739 MAP #6

APPENDIX C

SURVEY EQUIPMENT AND PROCEDURES

TURAIR

Semi-Airborne Electromagnetic System-Scintrex TAR-1

In the application of 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 been 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. 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.

Economic ore deposits may have strike lengths less than 200 m. If we want to search for such targets, particularly at greater depths, line spacing should not be much greater and for the average survey line spacing of 200 m (or one-eighth mile) should be considered optimum. In fact, larger line spacings do not represent significant savings, because of the reduction of measurable profile from one loop layout. The largest primary loop that can efficiently be laid out (by helicopter) is 3 x 5 km. Under average conditions some 400-500 line km of profile at 200 m intervals can be surveyed from this source, the total operation covering approximately one day's field work.

EQUIPMENT

The Scintrex Turair is a fixed source, semi-airborne electromagnetic system designed for helicopter operation.

The system embodies a fixed transmitter on the ground and a receiver carried in the helicopter. The size of the transmitting loop is guided by geological conditions and the character of the survey. A typical loop size would be e.g. a square, 3 miles on each side--other shapes and sized can be used. The loop can be laid out from a truck or by helicopter. For airborne placement a special dispensing device is used which can feed out continuously, several miles of wire. The present system utilizes a 400 Hz primary field, excited by means of a 15 kW motor driven generator which supplies a current of 4-10 amperes into the transmitting loop. The system can operate at any other desired frequency depending on the geological conditions in the survey area.

The receiver system comprises 2 horizontal coplanar or 2 vertical coaxial air-cored coils, rigidly mounted

4.5 m apart in a "bird". This bird is towed approximately 30 m below the helicopter by means of a cable which also carries the electrical signals from the bird. The horizontal coplanar coil system is the one preferably used. In areas where conducting overburden, etc. might tilt the primary electromagnetic field from a mainly vertical to a more horizontally directed one, the vertical to a more horizontally directed one, the vertical coaxial coil system may have to be used. The present Turair receiving system is designed to detect signals stronger than 1 μV in the coils (phase lock principle). The system has a noise level of less than 3 μV. In this way, from a 3 Km x 3 Km loop, energized by 4 amperes, an area of about 55 square Km can be covered in a region underlain by e.g. 100 m or more of overburden or deep weathering of moderate conductivity.

The quantities measured with this dual coil (gradient) measuring electromagnetic system include the ratio of the field strength and the phase differences of the alternating magnetic field at the two coils. The changes in amplitude ratio and phase difference are expressed in percent and degrees respectively. The sensitivities of the system are 0.1 percent and 0.1 degrees respectively.

Both parameters are recorded in analogue form on a dual channel recorder. Digital output can be employed as well. The recorder scale sensitivities can be set to meet all kinds of survey conditions. (e.g. Deep-seated targets give generally lower responses than near surface ones. Therefore, in geological conditions where 100 m or more of sediments are present, higher scale sensitivities are utilized than in areas where strong responses are expected.)

Flying towards or away from the loop the strength of the field detected at the coils changes gradually but considerably. For this reason, a switch connected to the signal detector amplifier is manually activated to keep the amplified output of the preamplifiers within the signal strength limitations necessary for the equipment operation. These switching markers are shown on the recorder charts as short duration "spikes" with appropriate notation and are easy to interpret as such.

At one or more points during each flight, the scale sensitivities and zero levels are checked by means of calibration and zeroing signals respectively. The reference or zero level for each Turair electromagnetic trace is an arbitrary one, and is obtained empirically from the regional level of each section of a trace between the switching markers. These levels may drift slowly during a flight because of temperature changes. The drifts are very gradual and are readily distinguishable from local changes due to conductors of a geologic origin.

Since the gradients of the signals recorded close (i.e. within about 175 m) to the loop sides are too strong, it is not possible to distinguish field changes due to conductors of geologic origin lying in these "blind zone" regions. From a statistical point of view the chances of missing a significant conductor in these "blind zone" regions are very small, since these regions constitute only about 8% of the area surveyed from each loop.

The amplitude ratio and phase difference are recorded in such a way that flying "towards" the loop using the horizontal coplanar coil system, a normal anomaly shows a positive sign (i.e. upward deflection) for the former and a negative sign (i.e. downward deflection) for the latter parameter. While flying "away" from a loop these signs are reversed. Reversed anomalies can also be the result of particular geometric situation, e.g. when the source is located on the hanging wall side of a flatly dipping conductor (Bosschart, 1964, p.22 and figure 9). Man-made disturbances including power lines, pipe lines, metal fences, railways, etc. may cause spurious anomalies. The former are recognizable as such when they appear as cyclic noise of irregular shape and phase relationship. Non-energized, grounded power lines (e.g. 3 phase systems) sometimes give rise to anomalies that are more difficult to identify. Such indications as well as those from pipe lines and metal fences, etc. are however, of short duration and can be distinguished from most geologic sources except for very narrow, near-surface conductors. In some instances, ground investigation may be necessary in order to resolve the ambiguity of possible sources. Although the airborne geophysical crew attempts to note visible man-made conductors of the above type, the ground moves so rapidly at the low flight elevation employed that 100% recognition of such sources cannot always be expected from the air.

The normal terrain clearance of the bird is 30-60 m depending on the surface topography, tree cover, etc. with the helicopter 30 m above. The established useful depth of detection of the system for moderate-to-large conducting bodies, i.e. 300 m or more in plan length, is at least 175 m sub-bird under conditions of low extraneous geologic 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, at least 125-150 m beneath the ground surface under these conditions.

PRESENTATION OF RESULTS

The electromagnetic records are interpreted to determine the presence of conducting bodies and to obtain some information relating to their character. The intervalometer time marks are synchronized with the positioning camera film strip and thereby permit the relating of the conductors with appropriate ground locations. The terrain clearance is obtained from the altimeter data, presented in the form of sidepen markers whose separation is nearly proportional to the helicopter terrain clearance.

A plan is prepared, either using a subdued photomosaic ("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, identified on the positioning camera film. The flight path is interpolated between these tie points.

INTERPRETATION

Where field distortion occurs the curves indicate the location and the depth of the main current flow. The "current axis" is well defined when the current is concentrated, for instance, in thin, steeply dipping conductors. In wide, 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

The peak location of the amplitude ratio (using the horizontal coplanar coil system or the cross-over in case the vertical coaxial coil system is used) 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.

As a rule the current axis is located right below the maximum field strength ratio deflection or the maximum phase anomaly, for the horizontal coplanar receiving coil system (Vertical Field). For the vertical coaxial coil system (Horizontal Field), the current axis is located right below the inflection point of the anomaly. Its depth under the traverse is indicated by the shape of the anomaly.

(b) Depth and Conductor Width

The "half width", i.e. the distance between the points of half the maximum response amplitude is for simple line current sources, using the horizontal coplanar coils, approximately equal to the depth of the source under the detector. In case the vertical coaxial system is used the peak to peak separation is for tabular bodies equal to 1.15 times the depth of the source under the detector. Flat-lying conductors (e.g. overburden) characteristically give rise to very large half widths, 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. In cases where the conductivity zone is interpreted to have appreciable width, 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 should be marked, and if possible interpreted as individual anomalies. The subsurface depth of the current axis (subtract detector altitude) is marked on the lower left of the peak location circle.

(c) Conductor Grading

Field strength ratio and phase difference anomaly amplitudes are dependent on the overall geometry as well as on target size and σt value. Their primary significance is in the degree of certainty they lend to detectability and quantitative interpretation. For the purpose of amplitude grading three categories are used: Category 1, fully shaded; Category 2, half shaded; and Category 3, unshaded.

(d) Conductivity-Thickness Factor

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.

For an accurate grading the conductivity-thickness factor (σt value) of individual conductors can be derived from the calculated in-phase and out-of-phase components, taking into consideration the exciting frequency and the strike length of conductor, by means of the diagram described below. The σt value is then marked on the upper-right side of the peak location circle.

Large, highly conducting bodies such as massive sulphides or graphite and seawater, etc., 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.

Diagram for the Evaluation of Conductivity-Thickness (σt) Factors

This diagram has been prepared from data obtained in model studies (R. A. Bosschart: "Analytical Interpretation of Fixed Source Electromagnetic Prospecting Data.") and is valid for Tabular steeply dipping 'Thin' Conductors.

To obtain the conductivity-thickness factor for a conductor system 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 anomaly system one interpolates between the values of conductivity-thickness, in mhos, shown on the upper bounding curve.

Example:	Amplitude Ratio	0.7%
	Phase difference	0.2°
	Interpreted strike length of system	1000 metres
	Conductivity-thickness value (σt)	35 mhos

(e) Current Pattern

To obtain the projection of the current pattern, the anomalies are connected between lines, using depth σt values and other characteristics of the curves as criteria. The strike of the formation, if known, is also taken into consideration.

(f) Magnetic Correlation

Where magnetic data are available, preferably from a coincident magnetometer recording, any correlating magnetic expression is noted for the pertinent conductor peak. A conductor peak with direct magnetic correlation is indicated by a double concentric circle.

Location of a conductor on the flank of a magnetic anomaly is indicated by means of one half of a concentric circle on the side of the magnetic high.

The significance of direct or flank correlation depends on the search problem. In the former case the magnetic and conductive properties may be coincident or belong to two narrow adjoining zones. In the latter case the conductor may be located at the contact of a wider magnetic formation. In case of direct coincidence, the magnetic value is marked on the lower right side of the peak location circle.

REDUCTION OF DATA

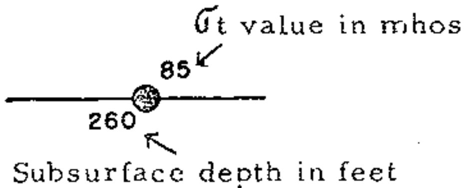
Upon completion of a flight, the film is developed and the actual path of the aircraft is plotted on a base map. This is accomplished by comparing film points with the base map planimetry. For any given point, the appropriate fiducial number is placed on the base map (or photo laydown). The actual flight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

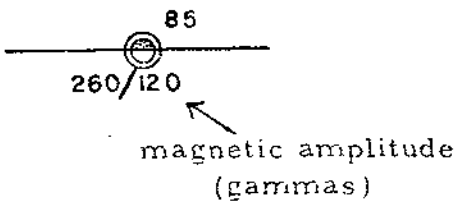
Flight lines and fiducial numbers are finally presented on a greyflex which is made using the photo mosaic as a base.

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

* (Bosschart, 1964, p. 22 and figure 9) Analytical Interpretation of Fixed Source Electromagnetic Prospecting Data.



Category one, no magnetic correlation



Category two, magnetic correlation

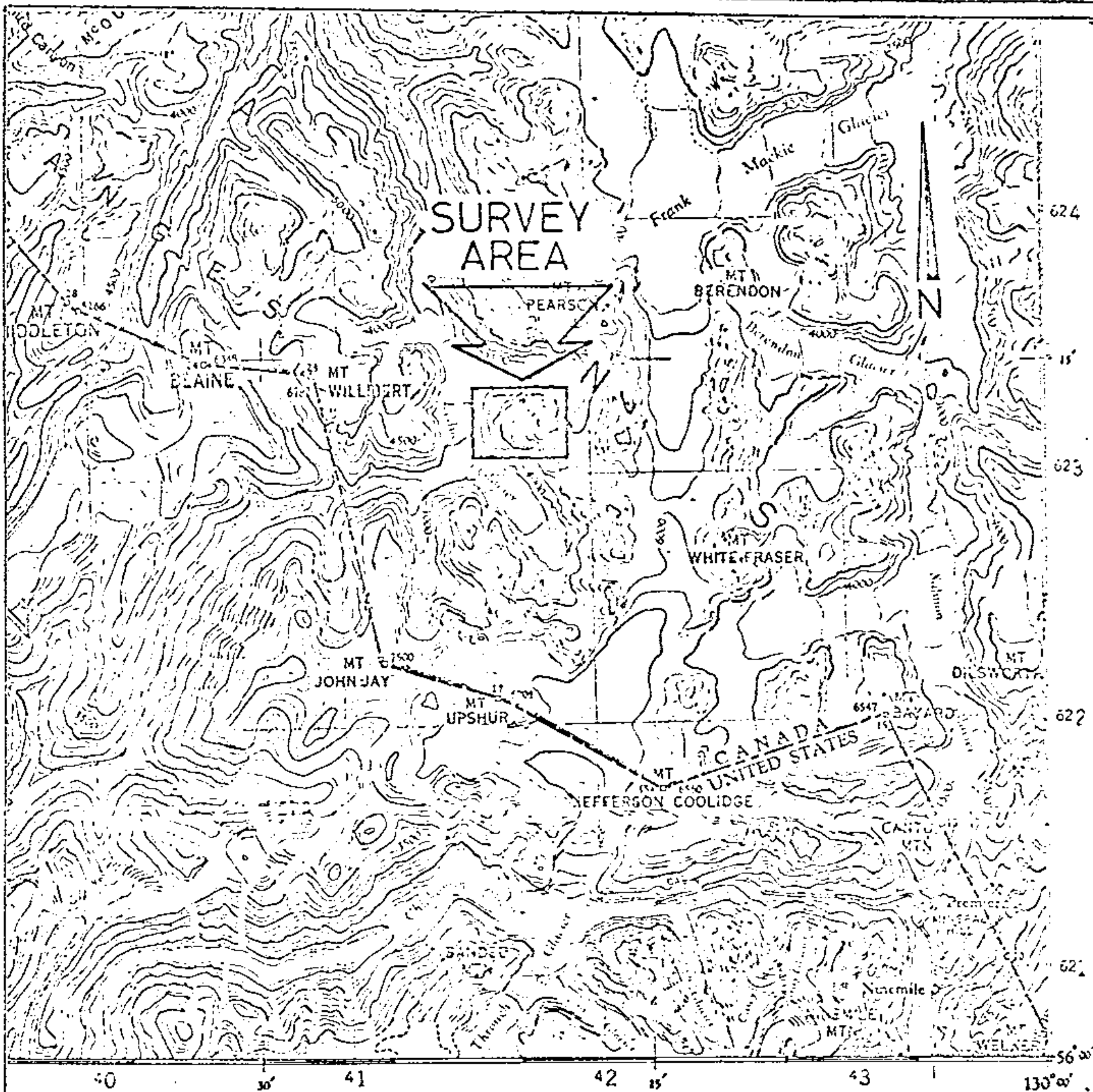
Category three, no magnetic correlation, anomaly too weak or insufficiently defined for quantitative determinations.

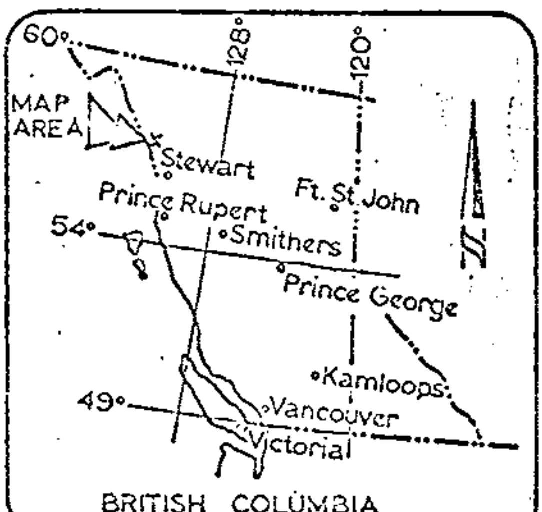
Wide conductive zone, banded (three marked)

Category three, reversed current flow, magnetic correlation

Probably man-made conductor.

EXAMPLES OF CONDUCTOR CODING





GRANDUC OPERATING COMPANY

LOCATION MAP
LEDUC GLACIER AREA, STEWARD B.C.

SCALE
1 : 250,000

4 miles 0 4 miles

Survey by
SEIGEL ASSOCIATES LIMITED
AUGUST 1971

PLATE 1

Department of

Mines and Petroleum Resources

ASSESSMENT REPORT

NO. 3739 MAP #7

DOMINION OF CANADA:

PROVINCE OF BRITISH COLUMBIA. } **In the Matter of** a Turair electromagnetic and airborne magnetic survey, Leduc Mountain area, British Columbia on behalf of Granduc Operating Company

TO WIT:

I, Jan Klein, M.Sc., P.Eng., for Seigel Associates Limited

of 222 Snidercroft Road, Concord, Ontario

in the Province of British Columbia, do solemnly declare that a Helicopter-borne Turair electromagnetic survey has been executed about 25 miles north-northwest of Stewart, British Columbia, Skeena Mining Division, 56° North Latitude - 130° West Longitude; between July 18 to July 19 and July 24 to July 25, 1971.

The following expenses were incurred:

(1)	Wages: C. Mohagen 10 days at $35.00/day	-$350.00	
	R. Paradis 10 days at $32.30/day	-$323.00	$673.00
(2)	Transportation and shipping to the job		$604.42
(3)	Food and living expenses		$181.05
(4)	Helicopter: 20 hours at $195.00 = $3900.00		
	extra fuel charges = $ 275.80		$4175.80
			$5634.27

And I make this solemn declaration conscientiously believing it to be true, and knowing that it is of the same force and effect as if made under oath and by virtue of the "Canada Evidence Act."

Declared before me at the City of Vancouver, in the Province of British Columbia, this 31st day of May, 1972, A.D.

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — JAN KLEIN

Expiry Date: April 5, 1973

A Commissioner for taking Affidavits within British Columbia or A Notary Public in and for the Province of British Columbia.

Declared before me at the ...., in the Province of British Columbia, this VANCOUVER, B.C. day of JUN 5 1972, A.D.

Sub-Mining Recorder

A Commissioner for taking Affidavits within British Columbia or A Notary Public in and for the Province of British Columbia.

In the Matter of

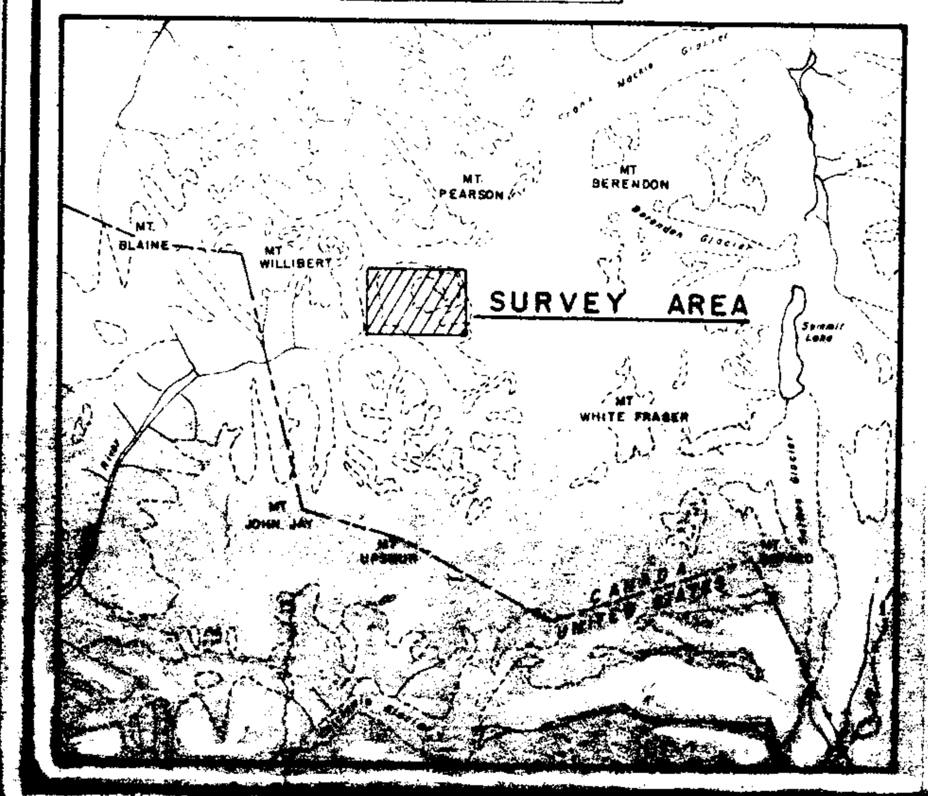
Statutory Declaration

(CANADA EVIDENCE ACT)

L-20
L-21
TL-1
L-22 W
TL-2
AIRSTRIP
L-19 W
L-18 W
L-17 W
L-16 W
L-15 W
L-14 W
L-13 W
L-12 W
L-11 W
L-9 W
L-8 W
L-7 W
L-10W
G L A C I E R
PORTAL CAMP
SNOW
SNOW
SNOW
SNOW
ZONE A

LOCATION MAP

SCALE 1 inch = 4 MILES



LEGEND

L 4W —321— FLIGHT LINE NUMBER, DIRECTION AND NUMBERED CONTROL POINT

RIVER

APPROXIMATE LOOP POSITION

CONDUCTIVE ZONE INSUFFIENTLY DEFINED FOR QUANTITIVE DETERMINATIONS

OUTLINE CONDUCTIVE ZONE

TO ACCOMPANY A GEOPHYSICAL REPORT BY J. KLEIN, FEB. 29, 1972

PLATE 2

GRANDUC OPERATING COMPANY

LEDUC MOUNTAIN AREA, BRITISH COLUMBIA

AIRBORNE GEOPHYSICAL SURVEY

FLIGHT LINES AND ELECTROMAGNETIC CONDUCTOR LOCATION

APPROX. SCALE 1 inch = 500 feet

0 1000 2000 feet

SURVEY BY SEIGEL ASSOCIATES LIMITED

FLOWN AND COMPILED JULY-AUGUST 1971

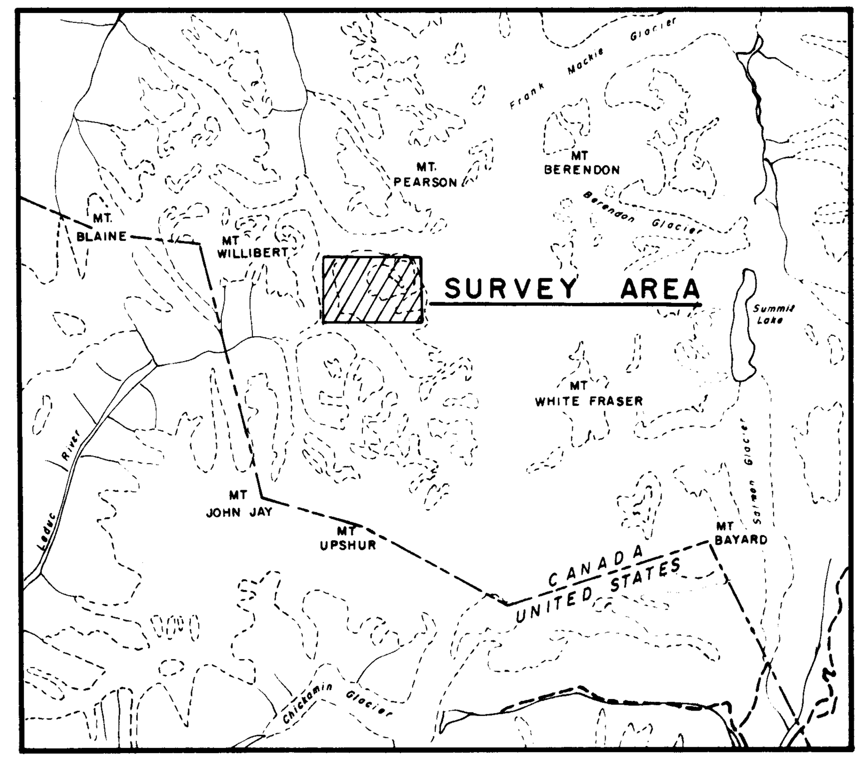
3739 M8

L-20
L-21
L-22
TL-1
TL-2
L-19
L-18
L-17
L-16
L-15
L-14
L-13
L-12
L-11
L-9
L-8
L-7
AIRSTRIP
G L A C I E R
SNOW
SNOW
SNOW
SNOW
PORTAL CAMP

LOCATION MAP

SCALE: 1 inch = 4 MILES

4 0 4 miles



LEGEND

L-2 —o— 1833	FLIGHT LINE, FLIGHT LINE NUMBER AND NUMBERED FIDUCIAL POINTS
	500 GAMMA ISOMAGNETIC CONTOUR INTERVAL
	100 GAMMA ISOMAGNETIC CONTOUR INTERVAL
	20 GAMMA ISOMAGNETIC CONTOUR INTERVAL
	MAGNETIC LOW

AIRCRAFT TERRAIN CLEARANCE 400'

FLIGHT LINE SPACING 1/4 MILE

BASE INTENSITY ARBITRARY

DRAINAGE

TO ACCOMPANY A GEOPHYSICAL REPORT BY JAN KLEIN, DATED 29. FEBRUARY 1972

3739 M-9

Department of Mines and Petroleum Resources ASSESSMENT REPORT NO. 3739 MAP #9

PLATE 3

GRANDUC OPERATING COMPANY

LEDUC MOUNTAIN AREA, BRITISH COLUMBIA

AIRBORNE GEOPHYSICAL SURVEY

MAGNETOMETER CONTOUR PLAN

APPROX. SCALE 1 inch = 500 feet

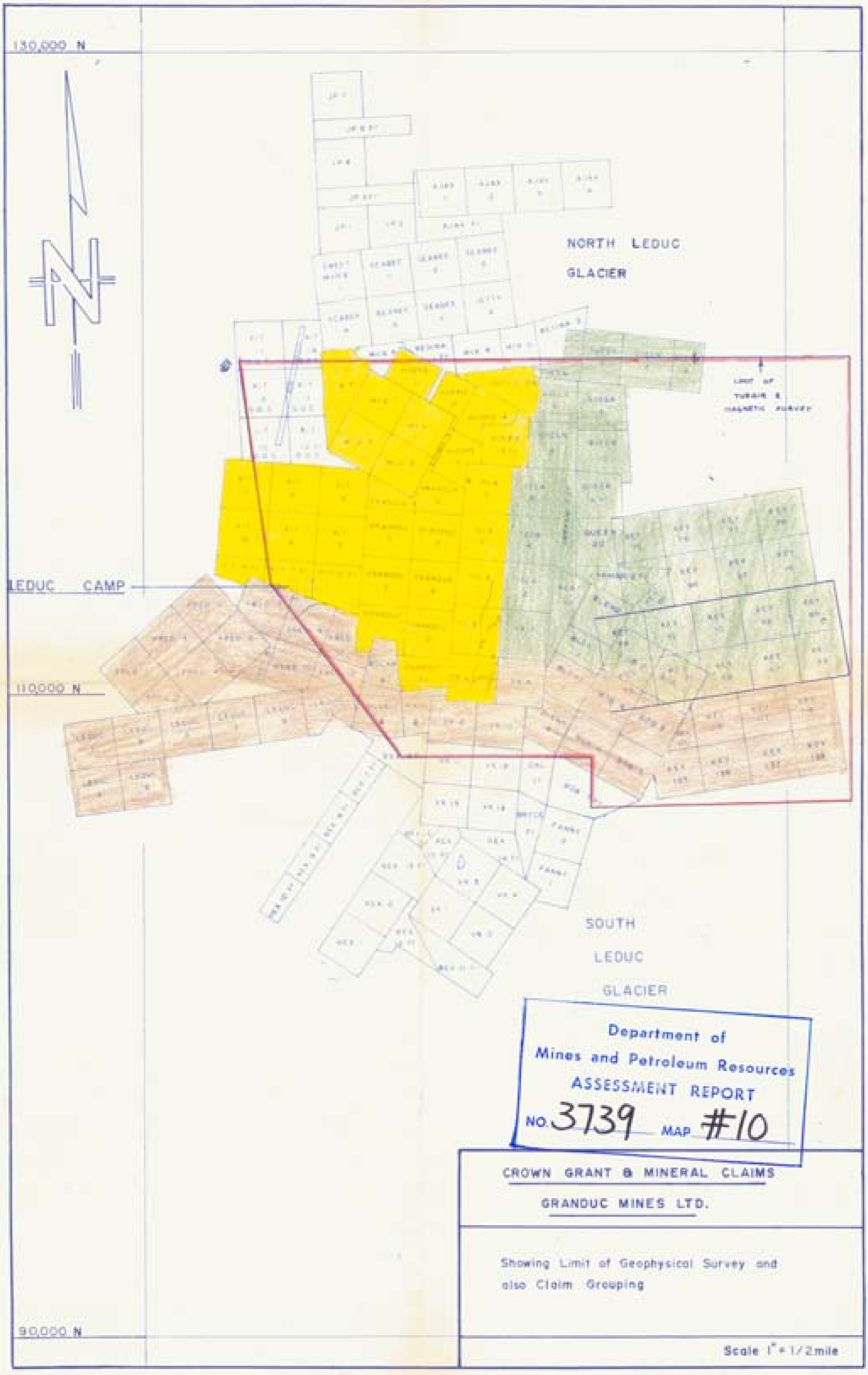
0 1000 2000 feet

SURVEY BY SEIGEL ASSOCIATES LIMITED

FLOWN AND COMPILED JULY-AUGUST 1971

SHEET 1 OF

Expiry Date: April 5, 1973



Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3739 MAP #10

CROWN GRANT & MINERAL CLAIMS

GRANDUC MINES LTD.

Showing Limit of Geophysical Survey and also Claim Grouping

Scale 1" = 1/2 mile