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Province of British Columbia | Ministry of Energy, Mines and Petroleum Resources

ASSESSMENT REPORT
TITLE PAGE AND SUMMARY

TYPE OF REPORT/SURVEY(S): Airborne, Geophysical
TOTAL COST: $1,920.03

AUTHOR(S): D. JOHNSON
SIGNATURE(S): David Johnson

DATE STATEMENT OF EXPLORATION AND DEVELOPMENT FILED: September 1984
YEAR OF WORK: 1984

PROPERTY NAME(S): KENA

COMMODITIES PRESENT: Au, Cu

B.C. MINERAL INVENTORY NUMBER(S), IF KNOWN: 82FSW237

MINING DIVISION: NELSON
NTS: 82-F/6

LATITUDE: 49°25'
LONGITUDE: 117°16'

NAMES and NUMBERS of all mineral tenures in good standing (when work was done) that form the property [Examples: TAX 1-4, FIRE 2 (12 units); PHOENIX (Lot 1706); Mineral Lease M 123; Mining or Certified Mining Lease ML 12 (claims involved)]:

KENA 18, KENA 20, 21, 22, 23, 24, 25 (7 Claims)
Record Nos. 15645, 15647, 15648, 15649, 15650, 15651, 15652,

OWNER(S)
(1) O. Janout
(2)

GEOLOGICAL BRANCH ASSESSMENT REPORT

MAILING ADDRESS
310 - 1509 Martin St.
White Rock, B.C. V4B 3W8

13,348

OPERATOR(S) (that is, Company paying for the work)
(1) Lacana Mining Corporation
(2)

MAILING ADDRESS
312 - 409 Granville St.
Vancouver, B.C. V6C 1T2

PART 2 OF 2

SUMMARY GEOLOGY (lithology, age, structure, alteration, mineralization, size, and attitude):
Gold Mineralization occurs in stratabound pyritic siliceous, yellow weathering zones in Rossland volcanics.

REFERENCES TO PREVIOUS WORK

(over)

TYPE OF WORK IN THIS REPORT	EXTENT OF WORK (IN METRIC UNITS)	ON WHICH CLAIMS	COST APPORTIONED
GEOLOGICAL (scale, area)			
Ground			
Photo			
GEOPHYSICAL (line-kilometres)			
Ground			
Magnetic			
Electromagnetic			
Induced Polarization			
Radiometric			
Seismic			
Other			
Airborne	15.61	KENA 18, 20, 21, 22, 23, 24, 25	
GEOCHEMICAL (number of samples analysed for ....)			
Soil			
Silt			
Rock			
Other			
DRILLING (total metres; number of holes, size)			
Core			
Non-core			
RELATED TECHNICAL			
Sampling/assaying			
Petrographic			
Mineralogic			
Metallurgic			
PROSPECTING (scale, area)			
PREPARATORY/PHYSICAL			
Legal surveys (scale, area)			
Topographic (scale, area)			
Photogrammetric (scale, area)			
Line/grid (kilometres)			
Road, local access (kilometres)			
Trench (metres)			
Underground (metres)			
		TOTAL COST	

FOR MINISTRY USE ONLY	NAME OF PAC ACCOUNT	DEBIT	CREDIT	REMARKS:
Value work done (from report)				
Value of work approved				
Value claimed (from statement)				
Value credited to PAC account				
Value debited to PAC account				
Accepted .... Date	Rept. No.			Information Class

REPORT NO. 217

DIGHEM^{III} SURVEY

OF THE

NELSON AREA, BRITISH COLUMBIA

FOR

LACANA MINING CORP.

BY

DIGHEM SURVEYS & PROCESSING INC.

MISSISSAUGA, ONTARIO
DECEMBER, 1984

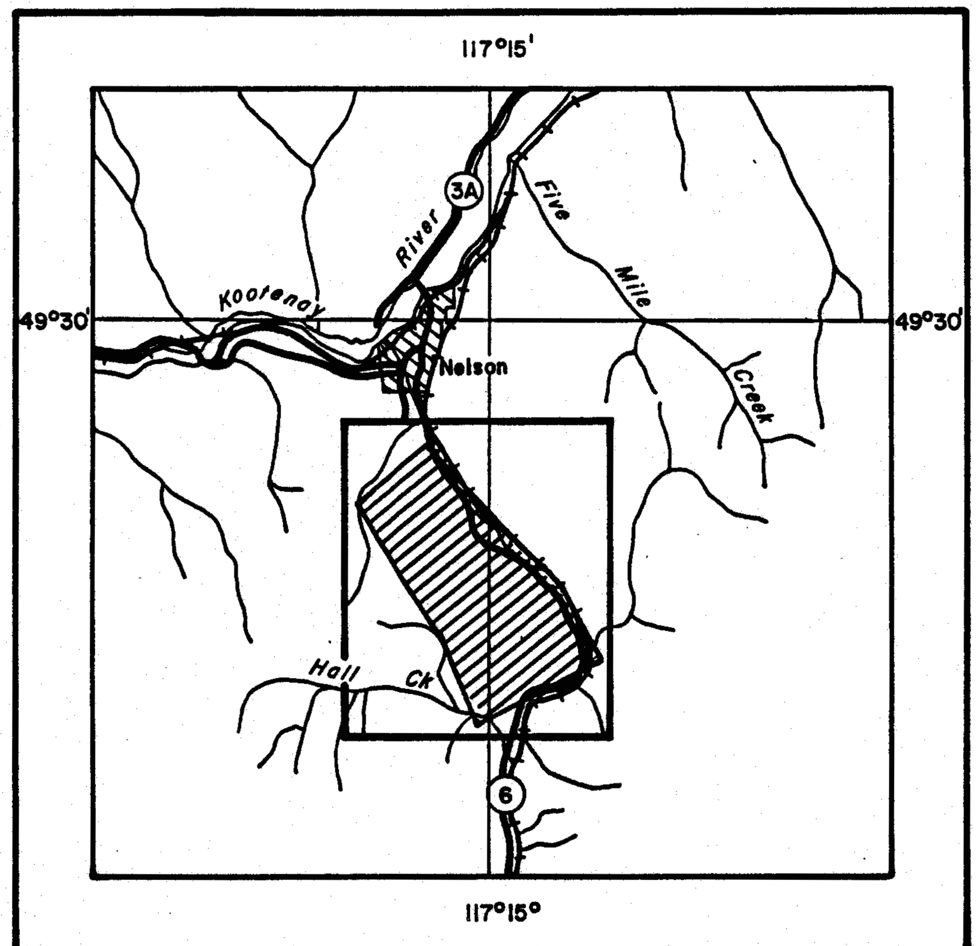
Z. DVORAK
GEOPHYSICIST

SUMMARY AND RECOMMENDATIONS

A total of 268 km of survey was flown with the DIGHEM^{III} system in September and October 1984, on behalf of Lacana Mining Corp., over a property near Nelson, British Columbia.

The survey outlined several discrete and broad bedrock conductors associated with areas of low resistivity. The resistivity, VLF-EM, and magnetic data also provided valuable structural information. Most of the EM and resistivity anomalies appear to warrant further investigation using appropriate surface exploration techniques. Areas of interest may be assigned priorities for follow-up work on the basis of supporting geological, geochemical, and other geophysical information. Any interpreted bedrock conductors, which occur close to cultural sources, should be confirmed as bedrock conductors prior to drilling.

LOCATION MAP



SCALE 1:250,000

FIGURE 1

THE SURVEY AREA

CONTENTS

AJ ZD-234

INTRODUCTION

A DIGHEM^{III} electromagnetic/resistivity/magnetic/VLF survey totalling 268 line-km was flown with 100 m and 200 m line-spacing for Lacana Mining Corp., from September 29 to October 5, 1984, in the Nelson area of British Columbia (Figure 1).

The Lama CG-DEM turbine helicopter flew at an average airspeed of 81 km/h with an EM bird height of approximately 46 m. Ancillary equipment consisted of a Sonotek PMH 5010 magnetometer with its bird at an average height of 61 m, a Sperry radio altimeter, a Geocam sequence camera, an RMS GR33 digital graphics recorder, a Sonotek SDS 1200 digital data acquisition system, a DigiData 1640 9-track 800-bpi magnetic tape recorder, and a Herz Industries Totem-2A VLF-electromagnetometer with its sensor towed at an average height of 69 m. The VLF-EM receivers were tuned to NLK Seattle, Washington, operating at 24.8 kHz, and to NSS Annapolis, Maryland, operating at 21.4 kHz. The analog equipment recorded four channels of EM data at approximately 900 Hz, two channels of EM data at approximately 7200 Hz, two ambient EM noise channels (for the coaxial and coplanar receivers), two channels of magnetics (coarse and fine count), a channel of radio altitude and four channels of VLF-EM (total field and quadrature of the vertical component for two stations). The digital equipment recorded the above parameters, with the EM data to a sensitivity of 0.20 ppm at 900 Hz and 0.40 ppm at 7200 Hz, the magnetic field to one nT (i.e., one gamma), and the VLF-EM field to 0.10 percent.

Appendix A provides details on the data channels, their respective sensitivities, and the flight path recovery procedure. Noise levels of less than 2 ppm are generally maintained for wind speeds up to 35 km/h. Higher winds may cause the system to be grounded because excessive bird swinging produces difficulties in flying the helicopter. The swinging results from the 5 m^2 of area which is presented by the bird to broadside gusts.

EM anomalies shown on the electromagnetic anomaly map are based on a near-vertical, half plane model. This model best reflects "discrete" bedrock conductors. Wide bedrock conductors or flat-lying conductive units, whether from surficial or bedrock sources, may give rise to very broad anomalous responses on the EM profiles. These may not appear on the electromagnetic anomaly map if they have a regional character rather than a locally anomalous character. These broad conductors, which more closely approximate a half space model, will be maximum coupled to the horizontal (coplanar) coil-pair and are clearly evident on the resistivity map. The resistivity map, therefore, may be more valuable than the electromagnetic anomaly map, in areas where broad or flat-lying conductors are considered to be of importance.

Anomalies which occur beyond the first and last fiducials of a line, (i.e., outside the survey area) should be viewed with caution. Although the flight line extensions appear on the maps as straight dashed lines projected from the last two fiducials, they may not reflect the true flight path, which actually consists of a fairly tight loop between consecutive flight lines. The location of anomalies which are situated beyond the end fiducials may, therefore, be uncertain, although an accurate location may be determined by comparing the 35 mm flight path film with the photomosaic base. (The anomaly fiducial will correspond to the flight path frame with the same number.) Furthermore, some of the weaker anomalies could be due to aerodynamic noise, i.e., bird bending, created by abnormal stresses to which the bird is subjected during the climb and turn of the aircraft between lines. Such aerodynamic noise is usually manifested by an anomaly on the coaxial inphase channel only, although severe stresses can affect the coplanar inphase channels as well.

Areas, in which EM responses are evident only on the quadrature components, indicate zones of poor conductivity. Where these responses are coincident with strong magnetic anomalies, it is possible that the inphase component amplitudes have been suppressed by the effects of magnetite. Most of these poorly-conductive magnetic features give rise to resistivity anomalies which are only slightly below background. These weak features are evident on the resistivity map but may not be shown on the electromagnetic anomaly map. If it is expected that poorly-conductive sulphides may be associated with magnetite-rich units, some of these weakly anomalous features may be of interest.

INTRODUCTION

Location and Access

The claims lie approximately 8 km due south of Nelson, B.C., on the N.E. facing slope of Toad Mountain. Terrain is generally steep, with some flat benches. Elevations range from 950 m to 1,800 m.

Access from Nelson is afforded by rough logging roads which connect to Hwy 6 immediately north of the Burlington Northern Railway crossing. Several rough drill-access roads constructed on the claims in 1981 by previous operators remain passable.

Claims

Work described in this report has been applied for assessment credit on the following claims:

Claim	No of Units	Record No.
KENA 18	1	15645
" 20	1	15647
" 21	1	15648
" 22	1	15649
" 23	1	15650
" 24	1	15651
" 25	1	15652

SECTION I: SURVEY RESULTS

The survey covered a grid of northeast-southwest oriented flight lines with 268 km of flying, the results of which are shown on a single map sheet for each parameter. Table I-1 summarizes the EM responses on the sheet with respect to conductance grade and interpretation.

The geologic environment in the survey area is highly resistive. Typical resistivity values range from approximately 5,000 ohm-m to in excess of 8,000 ohm-m. Lower resistivity values occur in three narrow zones striking in a northwest-southeast direction. Two of these zones are confined to the northeast and southwest survey boundaries, the third zone runs through the middle of the area. While the outer two zones, which display resistivites as low as 5 ohm-m, are due to narrow, confined bedrock conductors, the central zone, with resistivities in excess of 500 ohm-m, is due to a broad conductive unit buried at some depth.

The magnetic field in the survey area is active, except for the east corner where only minor magnetic activity occurs. Northwesterly striking trends, similar to the resistivity trends, are apparent on the magnetic map. They are particularly well portrayed by the enhanced magnetic map

TABLE I-1

EM ANOMALY STATISTICS OF THE NELSON AREA, B.C.

CONDUCTOR GRADE	CONDUCTANCE RANGE	NUMBER OF RESPONSES
4	20-49 MHOS	5
3	10-19 MHOS	20
2	5- 9 MHOS	33
1	< 5 MHOS	55
X	INDETERMINATE	46
TOTAL		159

CONDUCTOR MODEL	MOST LIKELY SOURCE	NUMBER OF RESPONSES
D	DISCRETE BEDROCK	41
P	DISCRETE BEDROCK	2
B	DISCRETE BEDROCK	32
G	ROCK OR COVER	34
H	ROCK OR COVER	3
S	COVER	14
L	CULTURE	23
(BLANK)		10
TOTAL		159

(SEE EM MAP LEGEND FOR EXPLANATIONS)

which also shows the presence of numerous cross-trends of close to east-west strike. In addition, several north-southerly striking features may exist. In some instances, they are manifested as the terminations of other trends. For example, an imaginary line running through fiducial 1497, line 15 and fiducial 1820, line 31 is believed to indicate such cross-trend.

The VLF-EM contour map shows moderate activity in the southeast part of the area, and low-to-moderate activity in its northwest portion. A narrow, elongated anomaly of a northwest strike running through the central part of the area (approximately from line 15 to line 56), correlates well with an enhanced magnetic anomaly. Both of these features occur along the northeast margin of a poorly defined resistivity zone mentioned earlier. In general, the VLF-EM anomalies correlate with the enhanced magnetic trends, being coincident (in most instances) or confined to the flanks of these anomalies (e.g., the poorly defined VLF-EM trend between fiducial 1441, line 77 and fiducial 1659, line 80). The high activity zone northeast of a line going through fiducial 996, line 66 and fiducial 1880, line 83 is believed to be caused by topography.

CONDUCTORS IN THE SURVEY AREA

The electromagnetic anomaly map shows the anomaly locations with the interpreted conductor type, dip, conductance and depth being indicated by symbols. Direct magnetic correlation is also shown if it exists. The strike direction and length of the conductors are indicated when anomalies can be correlated from line to line. When studying the map sheets for follow-up planning, consult the anomaly listings appended to this report to ensure that none of the conductors are overlooked.

Anomalies 19C-40C, 43xA-45xA

A sporadically magnetic bedrock conductor, possibly discontinuous on line 41, is indicated by these grade 1 to 4 anomalies and x-type responses. The interruption on line 41 may be factual but it is speculated that it is merely a consequence of the decrease of the EM signals due to higher than usual flying height. Similar interruptions occur on lines 26 and 30.

Anomalies 40xA, 46xA, 49A, 51A

These grade 1 anomalies and x-type responses reflect broad conductive features at depth. They occur in the central part of the area and are confined to the southwest flanks of the magnetic and VLF-EM trends. The anomalies are associated with poorly distinguished zones of lower resistivity which define the extent of these conductive features. Other similar zones occur west of: fiducial 932, line 53, fiducial 1000, line 54, fiducial 1566, line 59, near fiducial 1735, line 61, and west of fiducial 842, line 65.

Anomaly 19A-30A

These grade 1 to 4 anomalies reflect a thin bedrock conductor which dips to the southwest. The conductor has produced a well defined low resistivty zone which occurs just outside an extensive magnetic zone the boundaries of which are apparent from the enhanced magnetic contours. There are indications that conductor 19A-30A terminates in the north at an east-westerly fault. Its northern tip may swing east toward the x-type response 31xA.

Anomaly 32A-49xA

A thin, non-magnetic bedrock conductor of southwest dip is indicated by these grade 1 to 3 anomalies. The conductor appears to constitute a continuation of 19A-30A. The two conductors are clearly discontinuous between lines 30 and 32 as a result of faulting(?). A well defined low resistivity low which has been produced by 32A-49xA occurs on the southwest flanks of weaker magnetic anomalies. In the northwest, the conductor appears to abut against a west-northwesterly fault(?) extending from fiducial 513, line 50 toward fiducial 818, line 22.

The conductive zone associated with conductors 19A-30A and 32A-49xA continues further northwest where it may reflect a broad conductive unit buried at some depth. Of particular interest may be an inextensive zone near fiducial 960, line 53 and fiducial 972, line 54, and the region between 59xA and 71xA.

SECTION II: BACKGROUND INFORMATION

ELECTROMAGNETICS

DIGHEM electromagnetic responses fall into two general classes, discrete and broad. The discrete class consists of sharp, well-defined anomalies from discrete conductors such as sulfide lenses and steeply dipping sheets of graphite and sulfides. The broad class consists of wide anomalies from conductors having a large horizontal surface such as flatly dipping graphite or sulfide sheets, saline water-saturated sedimentary formations, conductive overburden and rock, and geothermal zones. A vertical conductive slab with a width of 200 m would straddle these two classes.

The vertical sheet (half plane) is the most common model used for the analysis of discrete conductors. All anomalies plotted on the electromagnetic map are analyzed according to this model. The following section entitled **Discrete Conductor Analysis** describes this model in detail, including the effect of using it on anomalies caused by broad conductors such as conductive overburden.

The conductive earth (half space) model is suitable for broad conductors. Resistivity contour maps result from the use of this model. A later section entitled **Resistivity Mapping** describes the method further, including the effect of using it on anomalies caused by discrete conductors such as sulfide bodies.

Geometric interpretation

The geophysical interpreter attempts to determine the geometric shape and dip of the conductor. Figure II-1 shows typical DIGHEM anomaly shapes which are used to guide the geometric interpretation.

Discrete conductor analysis

The EM anomalies appearing on the electromagnetic map are analyzed by computer to give the conductance (i.e., conductivity-thickness product) in mhos of a vertical sheet model. This is done regardless of the interpreted geometric shape of the conductor. This is not an unreasonable procedure, because the computed conductance increases as the electrical quality of the conductor increases, regardless of its true shape. DIGHEM anomalies are divided into six grades of conductance, as shown in Table II-1. The conductance in mhos is the reciprocal of resistance in ohms.

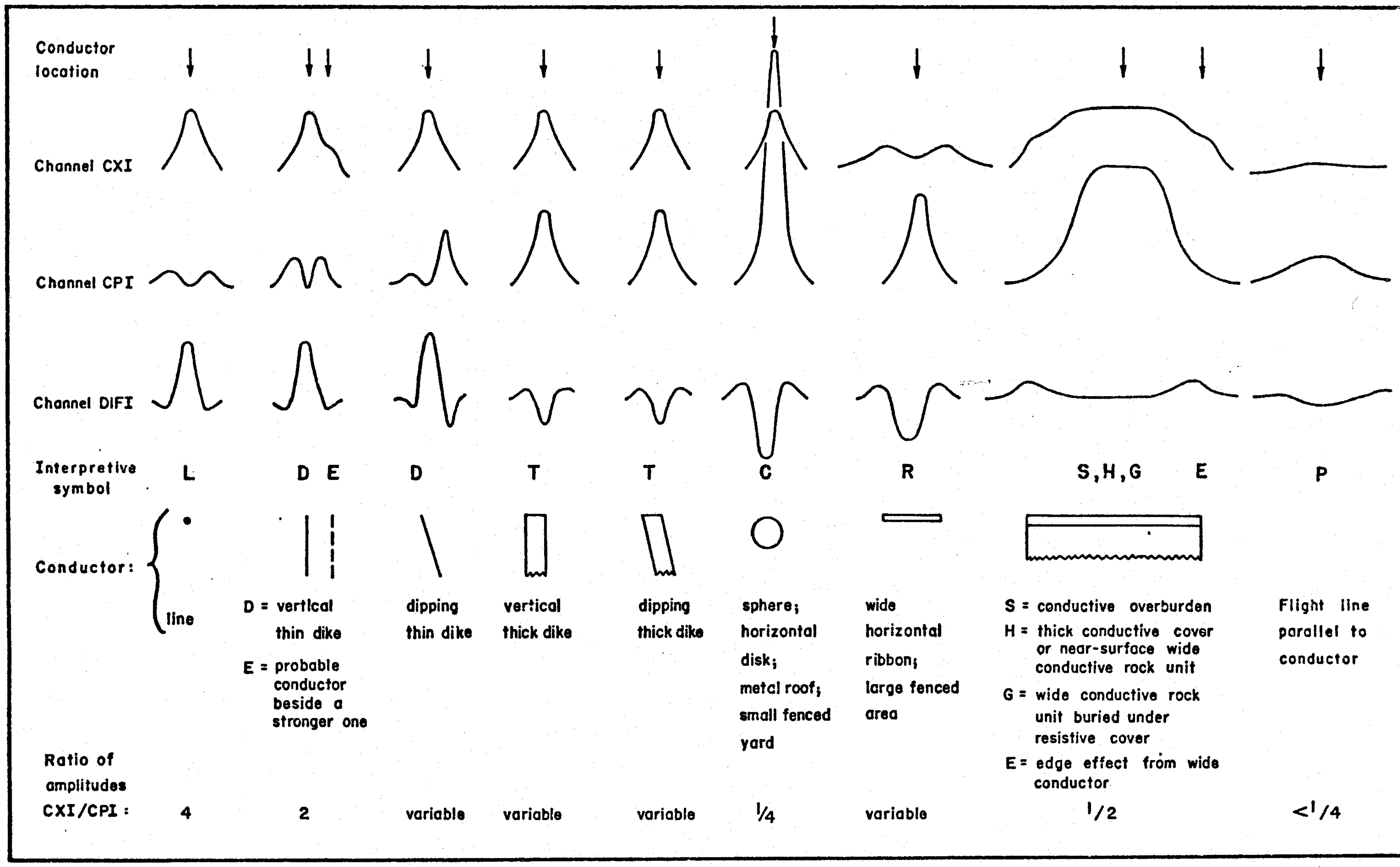


Figure II -1 Typical DIGHEM anomaly shapes

Table II-1. EM Anomaly Grades

Anomaly Grade	Mho Range
6	> 99
5	50 - 99
4	20 - 49
3	10 - 19
2	5 - 9
1	< 5

The conductance value is a geological parameter because it is a characteristic of the conductor alone. It generally is independent of frequency, and of flying height or depth of burial apart from the averaging over a greater portion of the conductor as height increases.[1] Small anomalies from deeply buried strong conductors are not confused with small anomalies from shallow weak conductors because the former will have larger conductance values.

Conductive overburden generally produces broad EM responses which are not plotted on the EM maps. However, patchy conductive overburden in otherwise resistive areas

[1] This statement is an approximation. DIGHEM, with its short coil separation, tends to yield larger and more accurate conductance values than airborne systems having a larger coil separation.

can yield discrete anomalies with a conductance grade (cf. Table II-1) of 1, or even of 2 for conducting clays which have resistivities as low as 50 ohm-m. In areas where ground resistivities can be below 10 ohm-m, anomalies caused by weathering variations and similar causes can have any conductance grade. The anomaly shapes from the multiple coils often allow such conductors to be recognized, and these are indicated by the letters S, H, G and sometimes E on the map (see EM legend).

For bedrock conductors, the higher anomaly grades indicate increasingly higher conductances. Examples: DIGHEM's New Insco copper discovery (Noranda, Canada) yielded a grade 4 anomaly, as did the neighbouring copper-zinc Magusi River ore body; Mattabi (copper-zinc, Sturgeon Lake, Canada) and Whistle (nickel, Sudbury, Canada) gave grade 5; and DIGHEM's Montcalm nickel-copper discovery (Timmins, Canada) yielded a grade 6 anomaly. Graphite and sulfides can span all grades but, in any particular survey area, field work may show that the different grades indicate different types of conductors.

Strong conductors (i.e., grades 5 and 6) are characteristic of massive sulfides or graphite. Moderate conductors (grades 3 and 4) typically reflect sulfides of a less massive character or graphite, while weak bedrock conductors (grades 1 and 2) can signify poorly connected graphite or heavily disseminated sulfides. Grade 1 conductors may not respond to ground EM equipment using frequencies less than 2000 Hz.

The presence of sphalerite or gangue can result in ore deposits having weak to moderate conductances. As an example, the three million ton lead-zinc deposit of Restigouche Mining Corporation near Bathurst, Canada, yielded a well defined grade 1 conductor. The 10 percent by volume of sphalerite occurs as a coating around the fine grained massive pyrite, thereby inhibiting electrical conduction.

Faults, fractures and shear zones may produce anomalies which typically have low conductances (e.g., grades 1 and 2). Conductive rock formations can yield anomalies of any conductance grade. The conductive materials in such rock formations can be salt water, weathered products such as clays, original depositional clays, and carbonaceous material.

On the electromagnetic map, a letter identifier and an interpretive symbol are plotted beside the EM grade symbol. The horizontal rows of dots, under the interpretive symbol, indicate the anomaly amplitude on the flight record. The vertical column of dots, under the anomaly letter, gives the estimated depth. In areas where anomalies are crowded, the letter identifiers, interpretive symbols and dots may be obliterated. The EM grade symbols, however, will always be discernible, and the obliterated information can be obtained from the anomaly listing appended to this report.

The purpose of indicating the anomaly amplitude by dots is to provide an estimate of the reliability of the conductance calculation. Thus, a conductance value obtained from a large ppm anomaly (3 or 4 dots) will tend to be accurate whereas one obtained from a small ppm anomaly (no dots) could be quite inaccurate. The absence of amplitude dots indicates that the anomaly from the coaxial coil-pair is 5 ppm or less on both the inphase and quadrature channels. Such small anomalies could reflect a weak conductor at the surface or a stronger conductor at depth. The conductance grade and depth estimate illustrates which of these possibilities fits the recorded data best.

Flight line deviations occasionally yield cases where two anomalies, having similar conductance values but dramatically different depth estimates, occur close together on the same conductor. Such examples illustrate the reliability of the conductance measurement while showing that the depth estimate can be unreliable. There are a number of factors which can produce an error in the depth estimate, including the averaging of topographic variations by the altimeter, overlying conductive overburden, and the location and attitude of the conductor relative to the flight line. Conductor location and attitude can provide an erroneous depth estimate because the stronger part of the conductor may be deeper or to one side of the flight line, or because it has a shallow dip. A heavy tree cover can also produce errors in depth estimates. This is because the depth estimate is computed as the distance of bird from conductor, minus the altimeter reading. The altimeter can lock onto the top of a dense forest canopy. This situation yields an erroneously large depth estimate but does not affect the conductance estimate.

Dip symbols are used to indicate the direction of dip of conductors. These symbols are used only when the anomaly shapes are unambiguous, which usually requires a fairly resistive environment.

A further interpretation is presented on the EM map by means of the line-to-line correlation of anomalies, which is based on a comparison of anomaly shapes on adjacent lines. This provides conductor axes which may define the geological structure over portions of the survey area. The absence of conductor axes in an area implies that anomalies could not be correlated from line to line with reasonable confidence.

DIGHEM electromagnetic maps are designed to provide a correct impression of conductor quality by means of the conductance grade symbols. The symbols can stand alone with geology when planning a follow-up program. The actual conductance values are printed in the attached anomaly list for those who wish quantitative data. The anomaly ppm and depth are indicated by inconspicuous dots which should not distract from the conductor patterns, while being helpful to those who wish this information. The map provides an interpretation of conductors in terms of length, strike and dip, geometric shape, conductance, depth, and thickness (see below). The accuracy is comparable to an interpretation from a high quality ground EM survey having the same line spacing.

The attached EM anomaly list provides a tabulation of anomalies in ppm, conductance, and depth for the vertical sheet model. The EM anomaly list also shows the conductance and depth for a thin horizontal sheet (whole plane) model, but only the vertical sheet parameters appear on the EM map. The horizontal sheet model is suitable for a flatly dipping thin bedrock conductor such as a sulfide sheet having a thickness less than 10 m. The list also shows the resistivity and depth for a conductive earth (half space) model, which is suitable for thicker slabs such as thick conductive overburden. In the EM anomaly list, a depth value of zero for the conductive earth model, in an area of thick cover, warns that the anomaly may be caused by conductive overburden.

Since discrete bodies normally are the targets of EM surveys, local base (or zero) levels are used to compute local anomaly amplitudes. This contrasts with the use of true zero levels which are used to compute true EM amplitudes. Local anomaly amplitudes are shown in the EM anomaly list and these are used to compute the vertical sheet parameters of conductance and depth. Not shown in the EM anomaly list are the true amplitudes which are used to compute the horizontal sheet and conductive earth parameters.

X-type electromagnetic responses

DIGHEM maps contain x-type EM responses in addition to EM anomalies. An x-type response is below the noise threshold of 3 ppm, and reflects one of the following: a weak conductor near the surface, a strong conductor at depth (e.g., 100 to 120 m below surface) or to one side of the flight line, or aerodynamic noise. Those responses that have the appearance of valid bedrock anomalies on the flight profiles are indicated by appropriate interpretive symbols (see EM map legend). The others probably do not warrant further investigation unless their locations are of considerable geological interest.

The thickness parameter

DIGHEM can provide an indication of the thickness of a steeply dipping conductor. The amplitude of the coplanar anomaly (e.g., CPI channel on the digital profile) increases relative to the coaxial anomaly (e.g., CXI) as the apparent thickness increases, i.e., the thickness in the horizontal plane. (The thickness is equal to the conductor width if the conductor dips at 90 degrees and strikes at right angles to the flight line.) This report refers to a conductor as thin when the thickness is likely to be less than 3 m, and thick when in excess of 10 m. Thick conductors are indicated on the EM map by crescents. For base metal exploration in steeply dipping geology, thick conductors can be high priority targets because many massive sulfide ore bodies are thick, whereas non-economic bedrock conductors are often thin. The system cannot sense the thickness when the strike of the conductor is subparallel to the flight line, when the conductor has a shallow dip, when the anomaly amplitudes are small, or when the resistivity of the environment is below 100 ohm-m.

Resistivity mapping

Areas of widespread conductivity are commonly encountered during surveys. In such areas, anomalies can be generated by decreases of only 5 m in survey altitude as well as by increases in conductivity. The typical flight record in conductive areas is characterized by inphase and quadrature channels which are continuously active. Local EM peaks reflect either increases in conductivity of the earth or decreases in survey altitude. For such conductive areas, apparent resistivity profiles and contour maps are necessary for the correct interpretation of the airborne data. The advantage of the resistivity parameter is that anomalies caused by altitude changes are virtually eliminated, so the resistivity data reflect only those anomalies caused by conductivity changes. The resistivity analysis also helps the interpreter to differentiate between conductive trends in the bedrock and those patterns typical of conductive overburden. For example, discrete conductors will generally appear as narrow lows on the contour map and broad conductors (e.g., overburden) will appear as wide lows.

The resistivity profile (see table in Appendix A) and the resistivity contour map present the apparent resistivity using the so-called pseudo-layer (or buried) half space model defined in Fraser (1978)[2]. This model consists of a resistive layer overlying a conductive half space. The depth channel (see Appendix A) gives the apparent depth below surface of the conductive material. The apparent depth is simply the apparent thickness of the overlying resistive layer. The apparent depth (or thickness) parameter will be positive when the upper layer is more resistive than the underlying material, in which case the apparent depth may be quite close to the true depth.

The apparent depth will be negative when the upper layer is more conductive than the underlying material, and will be zero when a homogeneous half space exists. The apparent depth parameter must be interpreted cautiously because it will contain any errors which may exist in the measured altitude of the EM bird (e.g., as caused by a dense tree cover). The inputs to the resistivity algorithm are the inphase and quadrature components of the coplanar coil-pair. The outputs are the apparent resistivity of the

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2 Resistivity mapping with an airborne multicoil electromagnetic system: Geophysics, v. 43, p. 144-172.

conductive half space (the source) and the sensor-source distance. The flying height is not an input variable, and the output resistivity and sensor-source distance are independent of the flying height. The apparent depth, discussed above, is simply the sensor-source distance minus the measured altitude or flying height. Consequently, errors in the measured altitude will affect the apparent depth parameter but not the apparent resistivity parameter.

The apparent depth parameter is a useful indicator of simple layering in areas lacking a heavy tree cover. The DIGHEM system has been flown for purposes of permafrost mapping, where positive apparent depths were used as a measure of permafrost thickness. However, little quantitative use has been made of negative apparent depths because the absolute value of the negative depth is not a measure of the thickness of the conductive upper layer and, therefore, is not meaningful physically. Qualitatively, a negative apparent depth estimate usually shows that the EM anomaly is caused by conductive overburden. Consequently, the apparent depth channel can be of significant help in distinguishing between overburden and bedrock conductors.

The resistivity map often yields more useful information on conductivity distributions than the EM map. In comparing the EM and resistivity maps, keep in mind the following:

(a) The resistivity map portrays the absolute value of the earth's resistivity. (Resistivity = 1/conductivity.)

(b) The EM map portrays anomalies in the earth's resistivity. An anomaly by definition is a change from the norm and so the EM map displays anomalies, (i) over narrow, conductive bodies and (ii) over the boundary zone between two wide formations of differing conductivity.

The resistivity map might be likened to a total field map and the EM map to a horizontal gradient in the direction of flight[3]. Because gradient maps are usually more sensitive than total field maps, the EM map therefore is to be preferred in resistive areas. However, in conductive areas, the absolute character of the resistivity map usually causes it to be more useful than the EM map.

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[3] The gradient analogy is only valid with regard to the identification of anomalous locations.

Interpretation in conductive environments

Environments having background resistivities below 30 ohm-m cause all airborne EM systems to yield very large responses from the conductive ground. This usually prohibits the recognition of discrete bedrock conductors. The processing of DIGHEM data, however, produces six channels which contribute significantly to the recognition of bedrock conductors. These are the inphase and quadrature difference channels (DIFI and DIFQ), and the resistivity and depth channels (RES and DP) for each coplanar frequency; see table in Appendix A.

The EM difference channels (DIFI and DIFQ) eliminate up to 99% of the response of conductive ground, leaving responses from bedrock conductors, cultural features (e.g., telephone lines, fences, etc.) and edge effects. An edge effect arises when the conductivity of the ground suddenly changes, and this is a source of geologic noise. While edge effects yield anomalies on the EM difference channels, they do not produce resistivity anomalies. Consequently, the resistivity channel aids in eliminating anomalies due to edge effects. On the other hand, resistivity anomalies will coincide with the most highly conductive sections of conductive ground, and this is another source of geologic noise. The recognition of a bedrock conductor in a conductive environment therefore is based on the anomalous responses of the two difference channels (DIFI and DIFQ) and the two resistivity channels (RES). The most favourable situation is where anomalies coincide on all four channels.

The DP channels, which give the apparent depth to the conductive material, also help to determine whether a conductive response arises from surficial material or from a conductive zone in the bedrock. When these channels ride above the zero level on the digital profiles (i.e., depth is negative), it implies that the EM and resistivity profiles are responding primarily to a conductive upper layer, i.e., conductive overburden. If both DP channels are below the zero level, it indicates that a resistive upper layer exists, and this usually implies the existence of a bedrock conductor. If the low frequency DP channel is below the zero level and the high frequency DP is above, this suggests that a bedrock conductor occurs beneath conductive cover.

The conductance channel CDT identifies discrete conductors which have been selected by computer for appraisal by the geophysicist. Some of these automatically selected anomalies on channel CDT are discarded by the geophysicist. The automatic selection algorithm is intentionally oversensitive to assure that no meaningful responses are missed. The interpreter then classifies the anomalies according to their source and eliminates those that are not substantiated by the data, such as those arising from geologic or aerodynamic noise.

Reduction of geologic noise

Geologic noise refers to unwanted geophysical responses. For purposes of airborne EM surveying, geologic noise refers to EM responses caused by conductive overburden and magnetic permeability. It was mentioned above that the EM difference channels (i.e., channel DIFI for inphase and DIFQ for quadrature) tend to eliminate the response of conductive overburden. This marked a unique development in airborne EM technology, as DIGHEM is the only EM system which yields channels having an exceptionally high degree of immunity to conductive overburden.

Magnetite produces a form of geological noise on the inphase channels of all EM systems. Rocks containing less than 1% magnetite can yield negative inphase anomalies caused by magnetic permeability. When magnetite is widely distributed throughout a survey area, the inphase EM channels may continuously rise and fall reflecting variations in the magnetite percentage, flying height, and overburden thickness. This can lead to difficulties in recognizing deeply buried bedrock conductors, particularly if conductive overburden also exists. However, the response of broadly distributed magnetite generally vanishes on the inphase difference channel DIFI. This feature can be a significant aid in the recognition of conductors which occur in rocks containing accessory magnetite.

EM magnetite mapping

The information content of DIGHEM data consists of a combination of conductive eddy current response and magnetic permeability response. The secondary field resulting from conductive eddy current flow is frequency-dependent and consists of both inphase and quadrature components, which are positive in sign. On the other hand, the secondary field resulting from magnetic permeability is independent of frequency and consists of only an inphase component which is negative in sign. When magnetic permeability manifests itself by decreasing the measured amount of positive inphase, its presence may be difficult to recognize. However, when it manifests itself by yielding a negative inphase anomaly (e.g., in the absence of eddy current flow), its presence is assured. In this latter case, the negative component can be used to estimate the percent magnetite content.

A magnetite mapping technique was developed for the coplanar coil-pair of DIGHEM. The technique yields channel "FEO" (see Appendix A) which displays apparent weight percent magnetite according to a homogeneous half space model.[4] The method can be complementary to magnetometer mapping in certain cases. Compared to magnetometry, it is far less sensitive but is more able to resolve closely spaced magnetite zones, as well as providing an estimate of the amount of magnetite in the rock. The method is sensitive to 1/4% magnetite by weight when the EM sensor is at a height of 30 m above a magnetitic half space. It can individually resolve steeply dipping narrow magnetite-rich bands which are separated by 60 m. Unlike magnetometry, the EM magnetite method is unaffected by remanent magnetism or magnetic latitude.

The EM magnetite mapping technique provides estimates of magnetite content which are usually correct within a

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[4] Refer to Fraser, 1981, Magnetite mapping with a multi-coil airborne electromagnetic system: Geophysics, v. 46, p. 1579-1594.

factor of 2 when the magnetite is fairly uniformly distributed. EM magnetite maps can be generated when magnetic permeability is evident as indicated by anomalies in the magnetite channel FEO.

Like magnetometry, the EM magnetite method maps only bedrock features, provided that the overburden is characterized by a general lack of magnetite. This contrasts with resistivity mapping which portrays the combined effect of bedrock and overburden.

Recognition of culture

Cultural responses include all EM anomalies caused by man-made metallic objects. Such anomalies may be caused by inductive coupling or current gathering. The concern of the interpreter is to recognize when an EM response is due to culture. Points of consideration used by the interpreter, when coaxial and coplanar coil-pairs are operated at a common frequency, are as follows:

1. Channels CXS and CPS (see Appendix A) measure 50 and 60 Hz radiation. An anomaly on these channels shows that the conductor is radiating cultural power. Such an indication is normally a guarantee that the conduc-

tor is cultural. However, care must be taken to ensure that the conductor is not a geologic body which strikes across a power line, carrying leakage currents.

2. A flight which crosses a "line" (e.g., fence, telephone line, etc.) yields a center-peaked coaxial anomaly and an m-shaped coplanar anomaly.[5] When the flight crosses the cultural line at a high angle of intersection, the amplitude ratio of coaxial/coplanar (e.g., CXI/CPI) is 4. Such an EM anomaly can only be caused by a line. The geologic body which yields anomalies most closely resembling a line is the vertically dipping thin dike. Such a body, however, yields an amplitude ratio of 2 rather than 4. Consequently, an m-shaped coplanar anomaly with a CXI/CPI amplitude ratio of 4 is virtually a guarantee that the source is a cultural line.

3. A flight which crosses a sphere or horizontal disk yields center-peaked coaxial and coplanar anomalies with a CXI/CPI amplitude ratio (i.e., coaxial/coplanar) of 1/4. In the absence of geologic bodies of this geometry, the most likely conductor is a metal roof or

---

5 See Figure II-1 presented earlier.

small fenced yard.[6] Anomalies of this type are virtually certain to be cultural if they occur in an area of culture.

4. A flight which crosses a horizontal rectangular body or wide ribbon yields an m-shaped coaxial anomaly and a center-peaked coplanar anomaly. In the absence of geologic bodies of this geometry, the most likely conductor is a large fenced area.[6] Anomalies of this type are virtually certain to be cultural if they occur in an area of culture.

5. EM anomalies which coincide with culture, as seen on the camera film, are usually caused by culture. However, care is taken with such coincidences because a geologic conductor could occur beneath a fence, for example. In this example, the fence would be expected to yield an m-shaped coplanar anomaly as in case #2 above. If, instead, a center-peaked coplanar anomaly occurred, there would be concern that a thick geologic conductor coincided with the cultural line.

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6 It is a characteristic of EM that geometrically identical anomalies are obtained from: (1) a planar conductor, and (2) a wire which forms a loop having dimensions identical to the perimeter of the equivalent planar conductor.

6. The above description of anomaly shapes is valid when the culture is not conductively coupled to the environment. In this case, the anomalies arise from inductive coupling to the EM transmitter. However, when the environment is quite conductive (e.g., less than 100 ohm-m at 900 Hz), the cultural conductor may be conductively coupled to the environment. In this latter case, the anomaly shapes tend to be governed by current gathering. Current gathering can completely distort the anomaly shapes, thereby complicating the identification of cultural anomalies. In such circumstances, the interpreter can only rely on the radiation channels CXS and CPS, and on the camera film.

TOTAL FIELD MAGNETICS

The existence of a magnetic correlation with an EM anomaly is indicated directly on the EM map. An EM anomaly with magnetic correlation has a greater likelihood of being produced by sulfides than one that is non-magnetic. However, sulfide ore bodies may be non-magnetic (e.g., the Kidd Creek deposit near Timmins, Canada) as well as magnetic (e.g., the Mattabi deposit near Sturgeon Lake, Canada).

The magnetometer data are digitally recorded in the aircraft to an accuracy of one nT (i.e., one gamma). The digital tape is processed by computer to yield a total field magnetic contour map. When warranted, the magnetic data also may be treated mathematically to enhance the magnetic response of the near-surface geology, and an enhanced magnetic contour map is then produced. The response of the enhancement operator in the frequency domain is illustrated in Figure II-2. This figure shows that the passband components of the airborne data are amplified 20 times by the enhancement operator. This means, for example, that a 100 nT anomaly on the enhanced map reflects a 5 nT anomaly for the passband components of the airborne data.

The enhanced map, which bears a resemblance to a downward continuation map, is produced by the digital bandpass filtering of the total field data. The enhancement is equivalent to continuing the field downward to a level (above the source) which is 1/20th of the actual sensor-source distance.

Because the enhanced magnetic map bears a resemblance to a ground magnetic map, it simplifies the recognition of trends in the rock strata and the interpretation of

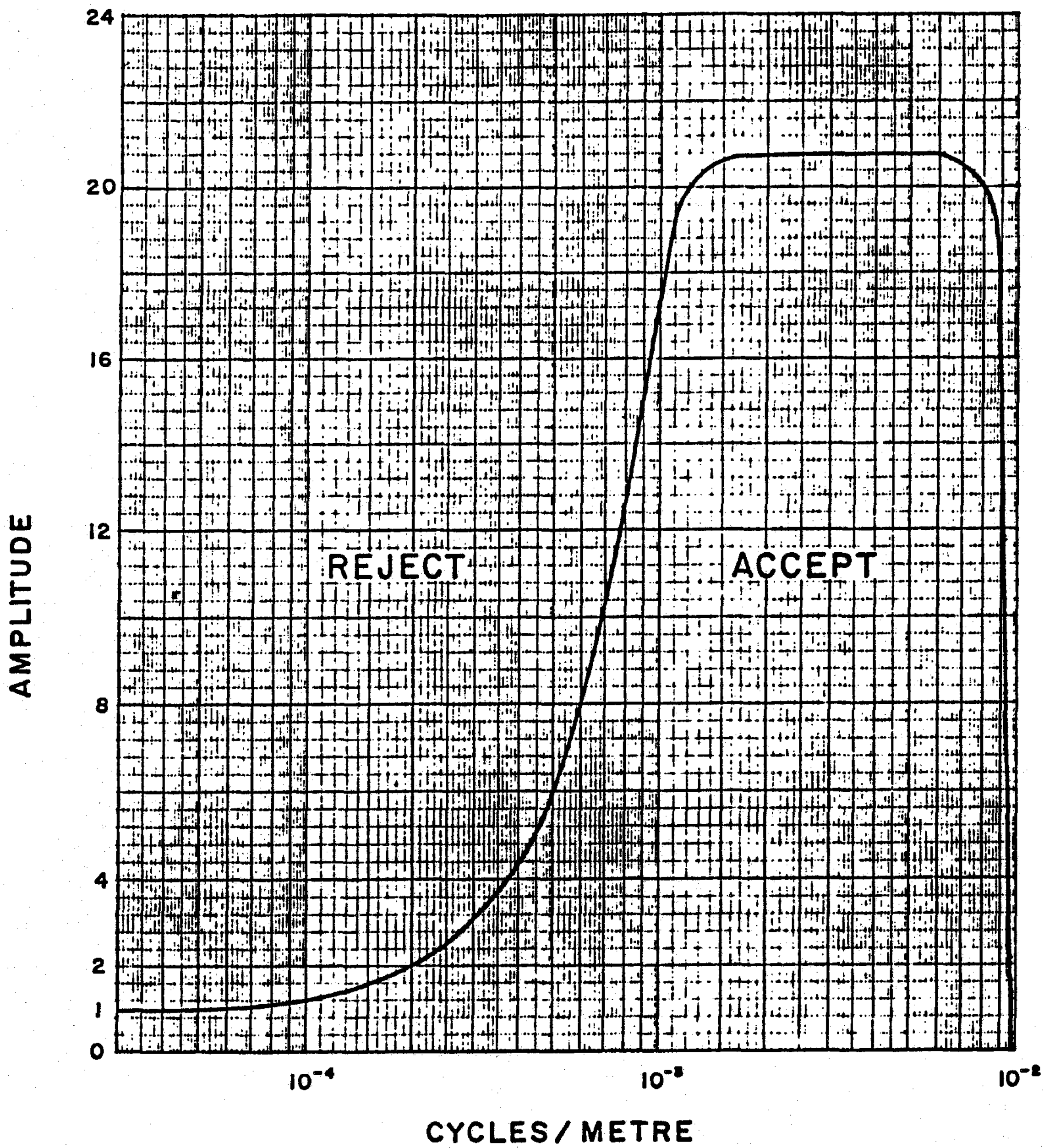


Figure II-2 Frequency response of magnetic enhancement operator.

geological structure. It defines the near-surface local geology while de-emphasizing deep-seated regional features. It primarily has application when the magnetic rock units are steeply dipping and the earth's field dips in excess of 60 degrees.

VLF-EM

VLF-EM anomalies are not EM anomalies in the conventional sense. EM anomalies primarily reflect eddy currents flowing in conductors which have been energized inductively by the primary field. In contrast, VLF-EM anomalies primarily reflect current gathering, which is a non-inductive phenomenon. The primary field sets up currents which flow weakly in rock and overburden, and these tend to collect in low resistivity zones. Such zones may be due to massive sulfides, shears, river valleys and even unconformities.

The Herz Industries Ltd Totem VLF-electromagnetometer measures the total field and vertical quadrature components. Both these components are digitally recorded in the aircraft with a sensitivity of 0.1 percent. The total field yields peaks over VLF-EM current concentrations

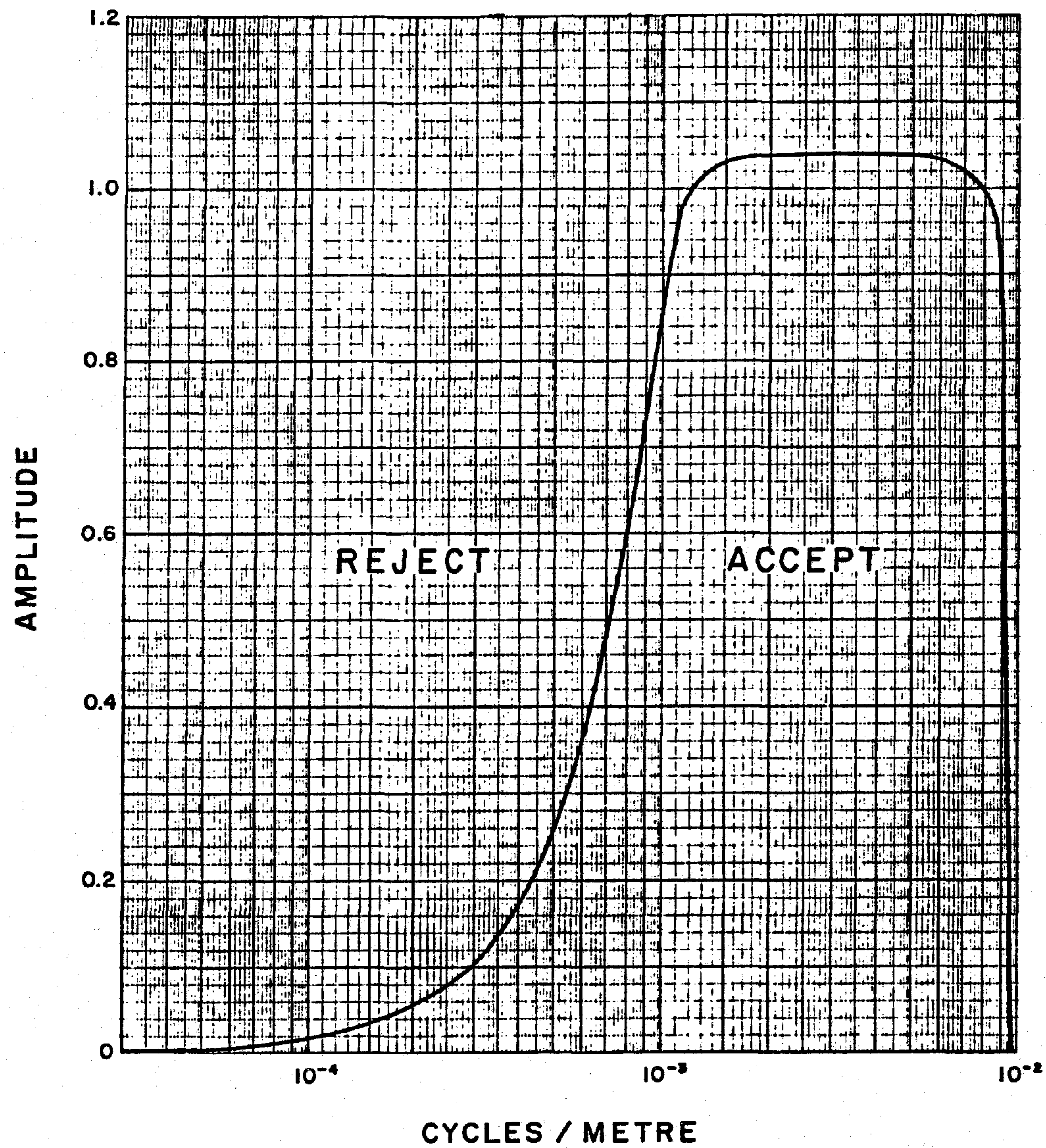


Figure II-3 Frequency response of VLF-EM operator.

whereas the quadrature component tends to yield crossovers. Both appear as traces on the profile records. The total field data also are filtered digitally and displayed on a contour map, to facilitate the recognition of trends in the rock strata and the interpretation of geologic structure.

The response of the VLF-EM total field filter operator in the frequency domain (Figure II-3) is basically similar to that used to produce the enhanced magnetic map (Figure II-2). The two filters are identical along the abscissa but different along the ordinant. The VLF-EM filter removes long wavelengths such as those which reflect regional and wave transmission variations. The filter sharpens short wavelength responses such as those which reflect local geological variations. The filtered total field VLF-EM contour map is produced with a contour interval of one percent.

MAPS ACCOMPANYING THIS REPORT

Five map sheets accompany this report:

Electromagnetic Anomalies	1 map sheet
Resistivity	1 map sheet
Total Field Magnetics	1 map sheet
Enhanced Magnetics	1 map sheet
Filtered Total VLF-EM Field	1 map sheet

Respectfully submitted,
DIGHEM SURVEYS & PROCESSING INC.

Z. Dvorak

Z. Dvorak
Geophysicist

AJ ZD-234

APPENDIX A

THE FLIGHT RECORD AND PATH RECOVERY

Both analog and digital flight records were produced. The analog profiles were recorded on chart paper in the aircraft during the survey. The digital profiles were generated later by computer and plotted on electrostatic chart paper at a scale of 1:10,000. The digital profiles are listed in Table A-1 and the analog profiles in Table A-2.

In Table A-1, the log resistivity scale of 0.03 decade/mm means that the resistivity changes by an order of magnitude in 33 mm. The resistivities at 0, 33, 67, 100 and 133 mm up from the bottom of the digital flight record are respectively 1, 10, 100, 1,000 and 10,000 ohm-m.

Correlation of geophysical data to ground position is accomplished through the use of a fiducial system, which is an incremental counter updating every two seconds. Each fiducial number is registered on the analog record, the digital recording system, and as an individually numbered camera frame. Recognizable topographic or cultural features are then used to plot fiducials on the base maps to locate the track of the aircraft.

The fiducial locations on both the flight records and flight path maps were examined by a computer for unusual helicopter speed changes. Such speed changes may denote an error in flight path recovery. The resulting flight path locations therefore reflect a more stringent checking than is normally provided by manual flight path recovery techniques.

Table A-1. The Digital Profiles

Channel Name	(Freq)	Observed parameters		Scale units/mm
MAG		magnetics		10 nT
ALT		bird height		3 m
CXI	(900 Hz)	vertical coaxial coil-pair inphase		1 ppm
CXQ	(900 Hz)	vertical coaxial coil-pair quadrature		1 ppm
CXS	(900 Hz)	ambient noise monitor (coaxial receiver)		1 ppm
CPI	(900 Hz)	horizontal coplanar coil-pair inphase		1 ppm
CPQ	(900 Hz)	horizontal coplanar coil-pair quadrature		1 ppm
CPS	(900 Hz)	ambient noise monitor (coplanar receiver)		1 ppm
CPI	(7200 Hz)	horizontal coplanar coil-pair inphase		1 ppm
CPQ	(7200 Hz)	horizontal coplanar coil-pair quadrature		1 ppm
VLFT		VLF-EM total field		1 %
VLFQ		VLF-EM vertical quadrature		1 %
		Computed Parameters		
DIFI	(900 Hz)	difference function inphase	from CXI and CPI	1 ppm
DIFQ	(900 Hz)	difference function quadrature	from CXQ and CPQ	1 ppm
CDT		conductance		1 grade
RES	(900 Hz)	log resistivity		.03 decade
RES	(7200 Hz)	log resistivity		.03 decade
DP	(900 Hz)	apparent depth		3 m
DP	(7200 Hz)	apparent depth		3 m
FEO%	(900 Hz)	apparent weight percent magnetite		0.25%

Table A-2. The Analog Profiles

Channel Number	Parameter	Sensitivity per mm	Designation on computer profile
01	coaxial inphase (900 Hz)	2.5 ppm	CXI (900 Hz)
02	coaxial quad (900 Hz)	2.5 ppm	CXQ (900 Hz)
03	coplanar inphase (900 Hz)	2.5 ppm	CPI (900 Hz)
04	coplanar quad (900 Hz)	2.5 ppm	CPQ (900 Hz)
05	coplanar inphase (7200 Hz)	5.0 ppm	CPI (7200 Hz)
06	coplanar quad (7200 Hz)	5.0 ppm	CPQ (7200 Hz)
07	coaxial monitor (900 Hz)	2.5 ppm	CXS (900 Hz)
08	coplanar monitor (900 Hz)	2.5 ppm	CPS (900 Hz)
09	altimeter	3 m	ALT
00,10	magnetics, coarse	10 nT	MAG
11	magnetics, fine	2 nT	
12	VLF-total: Seattle	2%	VLFT
13	VLF-quad: Seattle	2%	VLFQ
14	VLF-total: Annapolis	2%	VT2
15	VLF-quad: Annapolis	2%	VQ2
16			

A P P E N D I X   B

EM ANOMALY LIST

ANOMALY/ FID/INTERP	COAXIAL 900 HZ REAL PPM	COAXIAL 900 HZ QUAD PPM	COPLANAR 900 HZ REAL PPM	COPLANAR 900 HZ QUAD PPM	COPLANAR 7200 HZ REAL PPM	COPLANAR 7200 HZ QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH* M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
LINE 23	(FLIGHT 3)											
B 981 S	2	3	3	4	19	28	1	0	1	32	326	4
LINE 25	(FLIGHT 3)											
A 1217 B	3	3	4	7	17	14	5	0	1	62	147	15
LINE 26	(FLIGHT 3)											
A 1231 D	0	3	4	5	16	15	3	0	1	83	158	31
LINE 27	(FLIGHT 3)											
A 1474 B	2	3	8	7	22	9	6	0	2	83	44	47
B 1447 S	0	0	0	0	0	4	1	0	1	47	6185	0
LINE 28	(FLIGHT 3)											
A 1486 D	5	1	7	2	8	7	33	0	8	81	3	66
LINE 29	(FLIGHT 3)											
A 1690 D	4	1	5	3	10	3	20	0	2	110	47	68
LINE 30	(FLIGHT 3)											
A 1720 D	5	4	7	6	21	10	9	3	1	103	131	52
B 1805 D	4	3	4	3	5	8	12	23	1	130	200	70
LINE 31	(FLIGHT 3)											
A 1820 B	6	4	6	7	18	8	9	0	2	96	47	58
LINE 32	(FLIGHT 3)											
A 1926 B	7	5	13	8	24	11	16	0	4	76	12	51

* ESTIMATED DEPTH MAY BE UNRELIABLE BECAUSE THE STRONGER PART OF THE CONDUCTOR MAY BE DEEPER OR TO ONE SIDE OF THE FLIGHT LINE, OR BECAUSE OF A SHALLOW DIP OR OVERBURDEN EFFECTS.

217-SH.1 NELSON

ANOMALY/ FID/INTERP	COAXIAL 900 HZ REAL PPM	COAXIAL 900 HZ QUAD PPM	COPLANAR 900 HZ REAL PPM	COPLANAR 900 HZ QUAD PPM	COPLANAR 7200 HZ REAL PPM	COPLANAR 7200 HZ QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH* M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
LINE 32	(FLIGHT	3)										
B 1960 S	0	0	0	1	0	4	1	0	1	45	6123	0
C 2001 B	2	4	4	4	12	8	2	0	1	41	145	15
LINE 33	(FLIGHT	4)										
A 384 D	9	5	17	12	36	15	16	0	2	60	49	26
C 423 S	0	0	0	0	0	3	1	0	1	39	6050	0
D 469 B	3	2	3	7	8	3	7	0	2	91	60	47
LINE 34	(FLIGHT	4)										
B 687 D	11	8	18	18	45	25	12	1	3	79	19	53
D 578 B	4	6	10	11	35	18	6	4	1	86	107	42
LINE 35	(FLIGHT	4)										
A 736 D	12	8	19	15	48	23	15	1	3	71	18	46
B 811 B	2	2	4	4	11	5	5	0	1	62	128	13
C 824 G?	1	2	1	3	7	5	2	26	1	109	220	77
LINE 36	(FLIGHT	4)										
A 937 D	6	4	12	13	31	15	10	0	1	76	65	38
B 843 D	7	5	10	9	27	6	11	2	1	83	83	41
LINE 37	(FLIGHT	4)										
A 971 D	18	12	28	25	66	28	16	1	1	62	91	25
B 1043 D	6	2	6	4	13	2	22	0	2	101	31	66
LINE 38	(FLIGHT	4)										
A 1175 D	10	7	19	20	49	17	12	0	1	69	64	33
B 1084 B	5	4	5	6	20	9	8	10	1	104	75	61
LINE 39	(FLIGHT	4)										
C 1275 B	4	4	6	5	15	5	8	2	2	100	57	60
LINE 40	(FLIGHT	4)										
C 1310 B	2	1	1	2	7	6	1	0	1	55	225	25
D 1306 L	1	4	0	1	2	3	1	0	1	163	795	12

* ESTIMATED DEPTH MAY BE UNRELIABLE BECAUSE THE STRONGER PART OF THE CONDUCTOR MAY BE DEEPER OR TO ONE SIDE OF THE FLIGHT LINE, OR BECAUSE OF A SHALLOW DIP OR OVERBURDEN EFFECTS.

217-SH.1 NELSON

	COAXIAL 900 HZ		COPLANAR 900 HZ		COPLANAR 7200 HZ		VERTICAL DIKE		HORIZONTAL SHEET		CONDUCTIVE EARTH	
ANOMALY/ FID/INTERP	REAL PPM	QUAD PPM	REAL PPM	QUAD PPM	REAL PPM	QUAD PPM	COND MHOS	DEPTH* M	COND MHOS	DEPTH M	RESIS OHM-M	DEPTH M
LINE 42 (FLIGHT 4)												
B 1588 B?	1	2	0	3	6	6	1	4	1	93	489	53
C 1584 L	5	4	0	2	3	3	7	16	1	171	1035	0
LINE 44 (FLIGHT 4)												
C 1819 G	1	3	1	4	11	6	2	0	1	67	223	36
LINE 46 (FLIGHT 4)												
B 2044 H?	1	5	1	4	10	12	1	0	1	36	338	4

* ESTIMATED DEPTH MAY BE UNRELIABLE BECAUSE THE STRONGER PART OF THE CONDUCTOR MAY BE DEEPER OR TO ONE SIDE OF THE FLIGHT LINE, OR BECAUSE OF A SHALLOW DIP OR OVERBURDEN EFFECTS.

AUTHORS:

S. DVORAK - has a PhD. degree in geophysics and has been employed by DIGHEM since 1978.

D. FRASER - is a well known exploration geophysist and an Ontario registered P.Eng.

D. JOHNSON - edited and modified the report to conform to B.C. assessment report format.

STATEMENT OF COSTS

KENA 18, 20-25 CLAIMS

DIGHEM INVOICE #84-217

Invoice Total	$30,853.00
Number of Line Kilometres	251
Cost per Line Kilometre	$ 123.00
No. of Line Kilometres per Claim	2.23 km
Cost per Claim	$ 274.29
Total Cost per Claim Group	$1,920.03

NOTE: Survey Flight Lines oriented nearly perpendicular to location line of 2 post claims.

Dighem Limited

P.O. BOX 178, SUITE 7010, 1 FIRST CANADIAN PLACE
TORONTO, ONTARIO, CANADA M5X 1C7
TEL.: (416) 862-7568 TELEX: GEOPHYSICS TOR 06-219566

AUSTRALIA
P.O. BOX 1626
HORNSBY - NORTHGATE
N.S.W. 2077
TEL: (02) 848-8432
TELEX: SECCO AA25468

VANCOUVER TEL. (604) 261-2205
DENVER TEL. (303) 322-3203

NOW: DIGHEM SURVEYS & PROCESSING INC.
228 Matheson Blvd. E.
Mississauga, Ontario L4Z 1X1
Tel: (416)890-0313

Job #217-3

Invoice #84-217
October 12, 1984

Lacana Mining Corp.
409 Grenville St.
Suite 312
Vancouver, B.C. V6C 1T2

IN ACCOUNT WITH
DIGHEM SURVEYS & PROCESSING INC.

To:

Dighem flying of Agreement dated September 18, 1984

Ferry and mobilization charges	$ 5,000.00
Survey charges, 251 line-kilometres at $103.00/line-kilometre	25,853.00
Total	30,853.00
Less progress invoices pursuant to paragraph 10(a) and 10(b)	17,300.00
Net this invoice	$13,553.00

DIGHEM SURVEYS & PROCESSING INC.

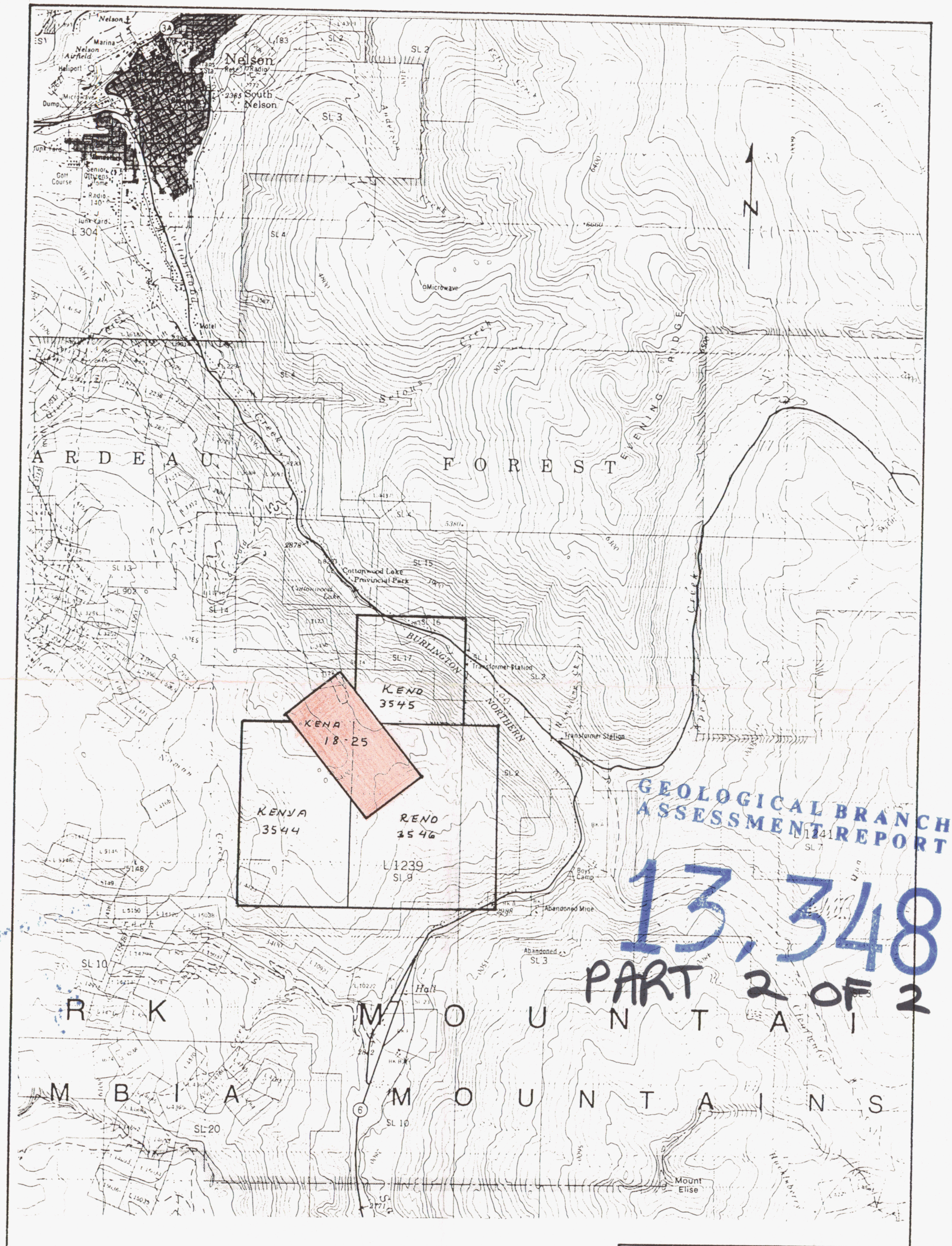
S. Kilty

S. Kilty
Geophysicist

TERMS: Payment due upon receipt. An interest charge of 1.5% per month will be applied after 30 days.

Job No. 217

N SK-250(let1)



To accompany "DIGHEM III" report
on Kena 18, 20-25 and Keno, Reno
and Kenya Mineral Claims, Nelson M.D.

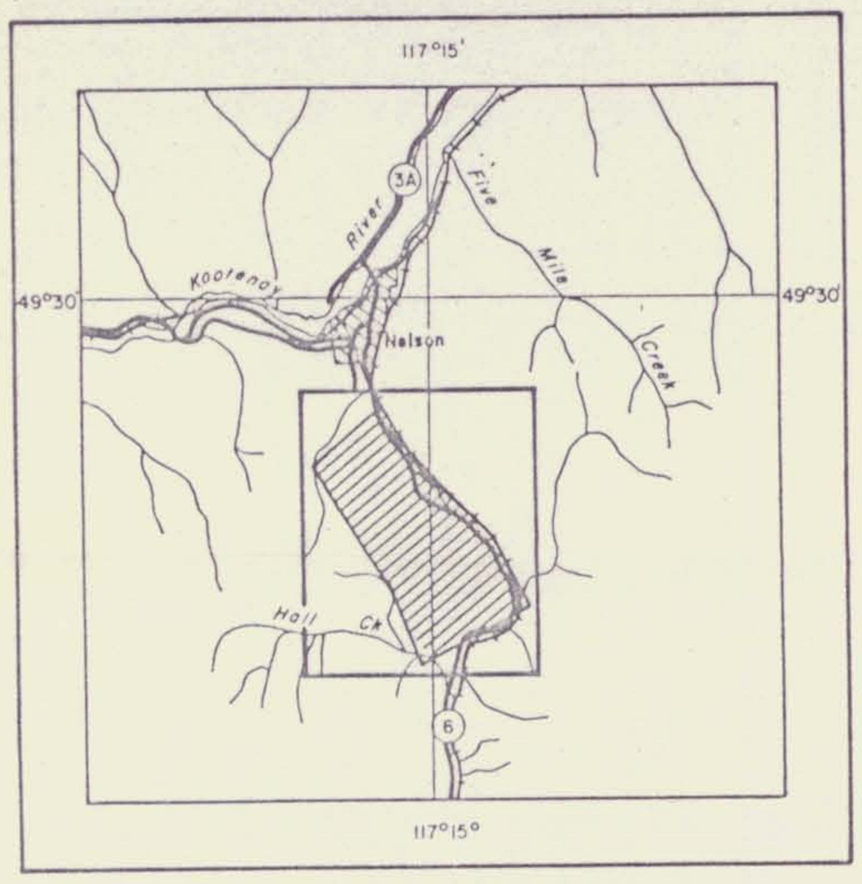
Kilometres (scale bar: 1 0 1 2)

LACANA MINING CORPORATION

NELSON PROJECT
CLAIMS
AND
LOCATION

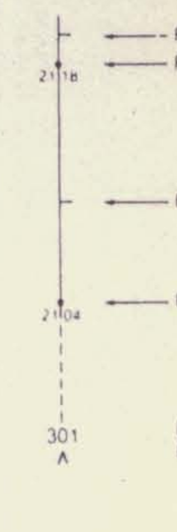
PREPARED BY	SCALE	DATE	N.T.S.	FIGURE
D J	50,000	FEB 85	82 F 6	1

LOCATION MAP



SCALE 1:250,000

Flight Line

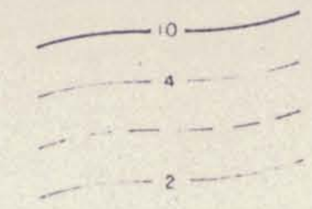


Fiducial 2120 (Not recovered from film)
Fiducial 2118 (Recovered from film)
Fiducial 2110 (Not recovered from film)
Fiducial 2104 (Recovered from film)
Line number and Flight direction

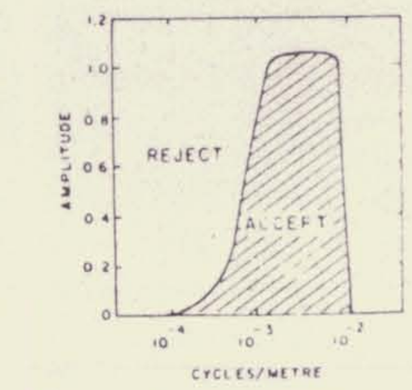
REGISTERED PROFESSIONAL ENGINEER
D. C. FRASER
PROVINCE OF ONTARIO

LEGEND

Contours in percent



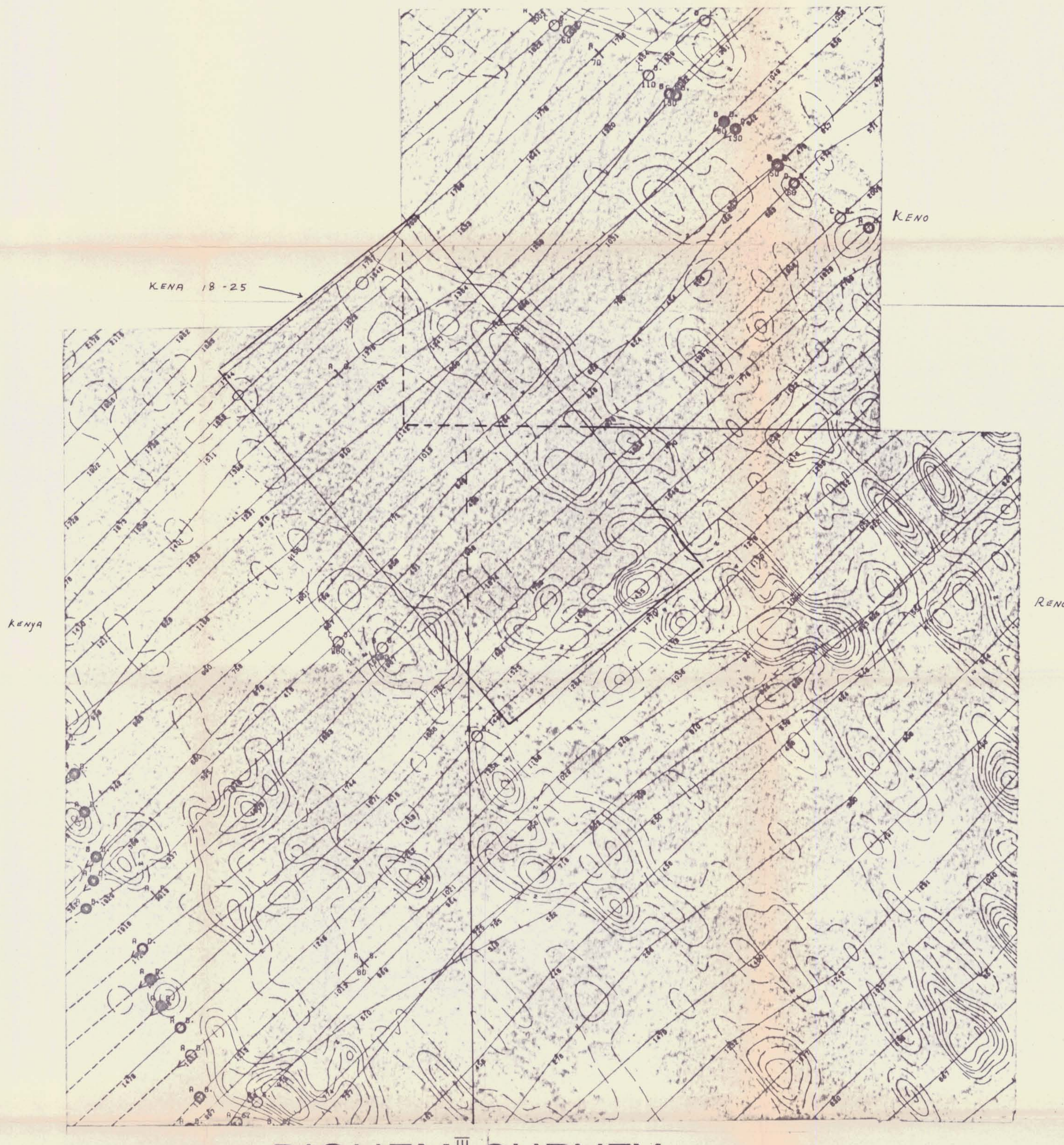
The numbers face in the direction of increasing value.



Frequency response of VLF-EM filter

Tx: NLK SEATTLE Wa.
f = 24.8 kHz

JOB	DATE	DRAWN BY	CHECKED BY
217	DEC / 84	RD	



DIGHEM^III SURVEY

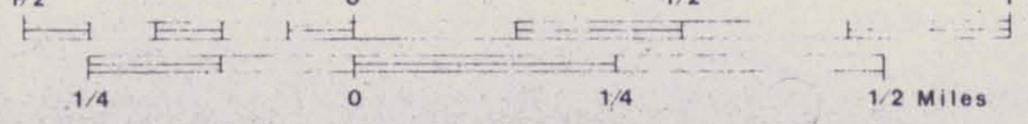
NELSON, B.C.

FILTERED TOTAL VLF-EM FIELD

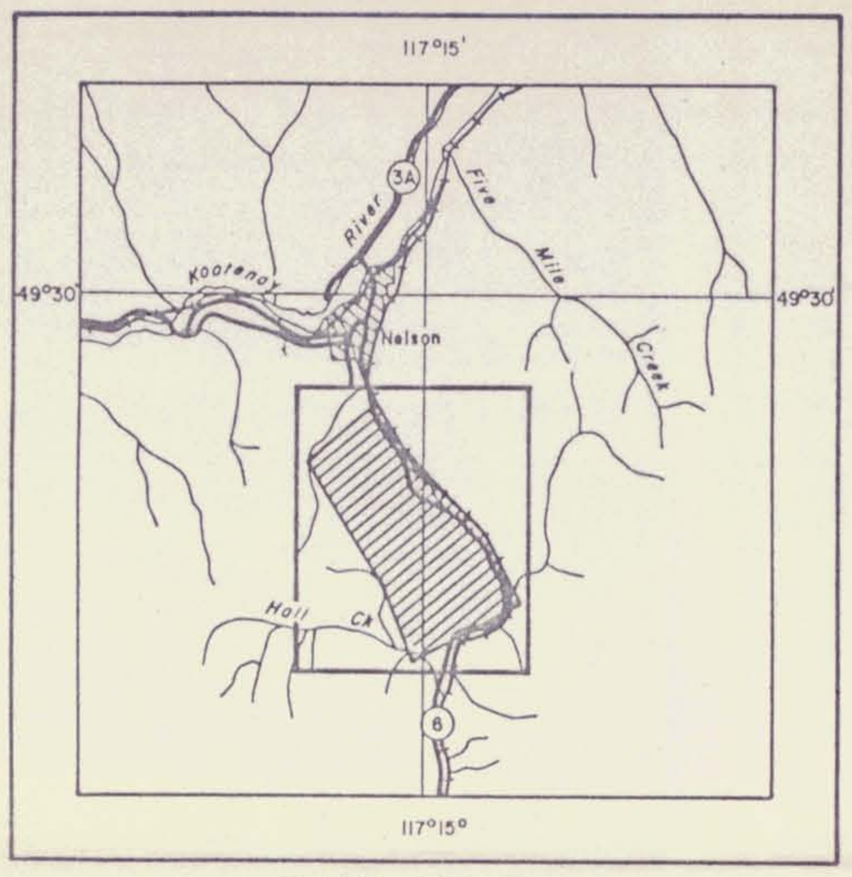
FOR

LACANA MINING CORP.

Scale 1:10,000

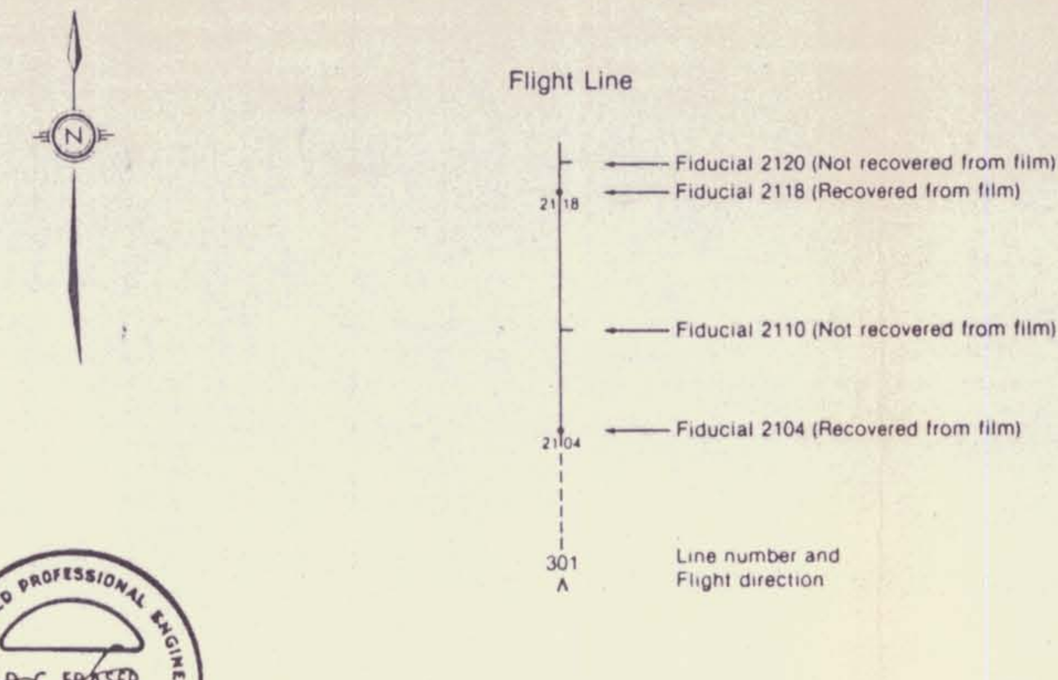


LOCATION MAP



SCALE 1:250,000

Flight Line



REGISTERED PROFESSIONAL ENGINEER
D. C. FRASER
PROVINCE OF ONTARIO

ANOMALY GRADE	EM GRADE SYMBOL	CONDUCTANCE RANGE (MHOS)
6	●	> 99
5	✸	50 – 99
4	●	20 – 49
3	◉	10 – 19
2	O	5 – 9
1	○	< 5
–	X	Indeterminate

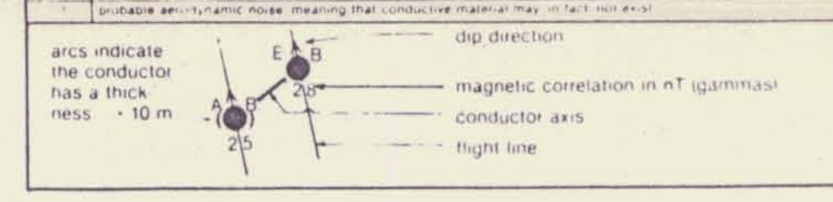
DIGHEM anomalies are divided into six grades of conductivity – thickness product. This product in mhos is the reciprocal of resistance in ohms. The mho is a measure of conductance and is a geologic parameter.

identifier name; interpretive symbol; Depth is greater than 15 m, 30 m, 45 m, 60 m; Inphase and Quadrature of Coaxial Coil is greater than 5 ppm, 10 ppm, 15 ppm, 20 ppm

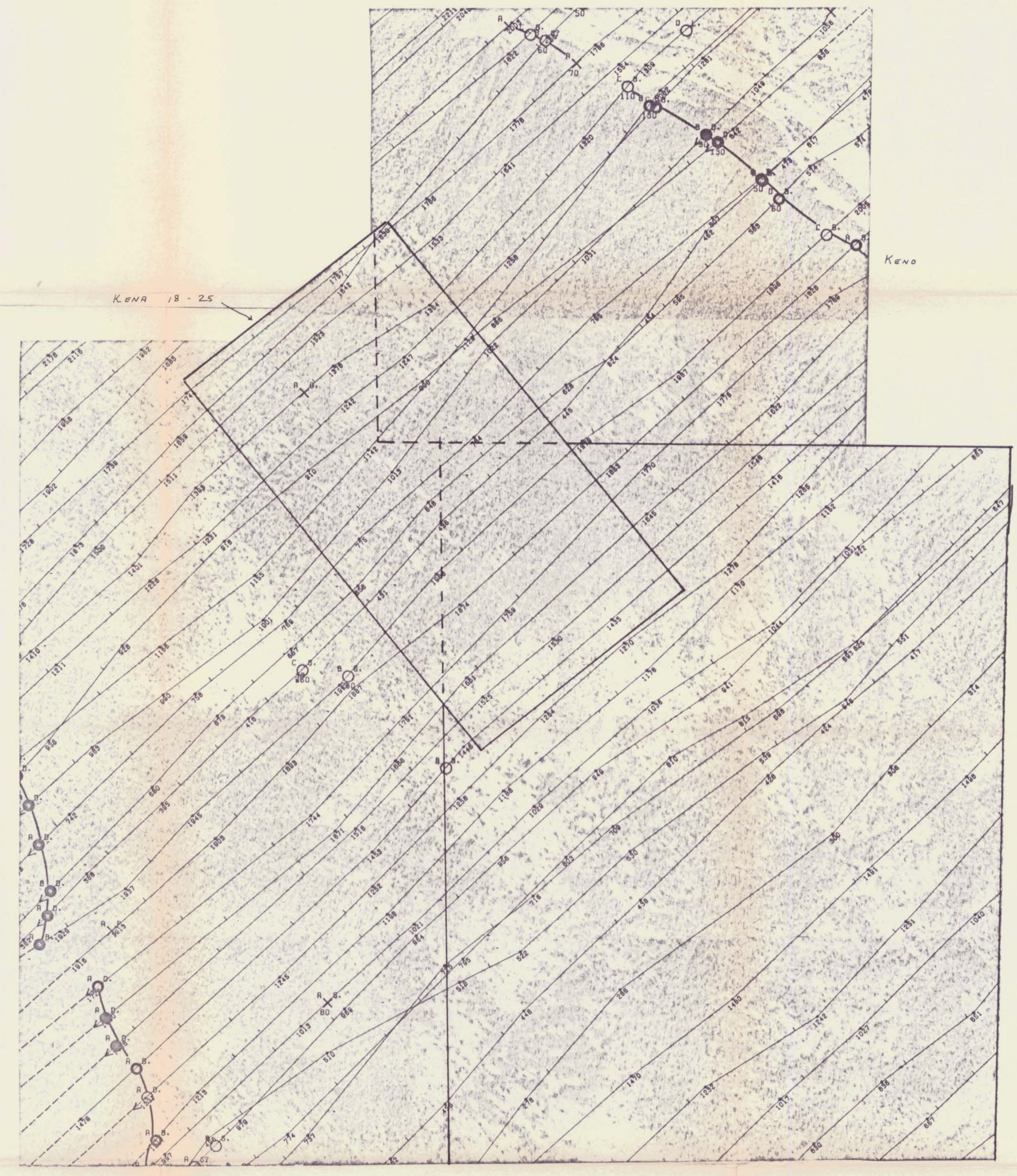
Refer to list of anomalies in survey report for the actual ppm values for all coils and for the conductance and depth of conductors.

The interpretation is shown by the interpretive symbol (see legend below). The left letter is the anomaly identifier. The horizontal rows of dots indicate anomaly amplitude on the flight record, and the vertical column gives the estimated depth. This depth may be unreliable because the stronger part of the conductor may be deeper or to one side of the flight line, or because of a shallow dip or conductive overburden effects.

SYMBOL	GEOPHYSICAL MODEL	BEDROCK CONDUCTOR	or	NON BEDROCK CONDUCTOR	MOST LIKELY
D.	steeply dipping thin dike	steeply dipping planar conductor	or	metal culture which contacts conductive ground	discrete bedrock conductor
T.	thick dike	thick conductor with thickness greater than 10 m	or		
B.	indeterminate	bedrock conductor	or		
P.	conductor to one side of flight line	flight line passed off the end or side of conductor	or	flight line passed off the end or side of culture	
E.	indeterminate	discrete conductor close to a much stronger conductor	or	edge of large conductive zone	
H.	half space (close to surface)	conductive rock unit	or	deep conductive weathering or thick conductive cover	conductive rock or cover
G.	buried half space	conductive rock unit buried under non conductive cover or under a dense forest canopy	or	deep conductive weathering or thick conductive cover buried under a dense forest canopy	
S.	horizontal sheet	weak bedrock conductor masked by conductive cover	or	thin conductive cover or occasionally culture which contacts conductive cover	conductive cover
R.	horizontal ribbon	flatly dipping narrow conductor (not computer picked)	or	narrow surface conductor e.g. stream sediments or large fenced area	culture
C.	sphere horizontal disk	steeply plunging compact conductor	or	metal roof or fenced yard	
L.	line	bedrock conductor masked by culture	or	fence pipeline power line	
a?	"a" is one of the above symbols. "a?" means that the correct identification of the geophysical model is only a reasonable possibility rather than being a reasonable probability				
'	probable aerodynamic noise, meaning that conductive material may in fact not exist				



JOB	DATE	DRAWN BY	CHECKED BY
217	DEC / 84		



DIGHEM^{III} SURVEY

NELSON, B.C.

ELECTROMAGNETIC ANOMALIES

FOR

LACANA MINING CORP.

GEOLOGICAL BRANCH
ASSESSMENT REPORT

PART 2 OF 2

13,348

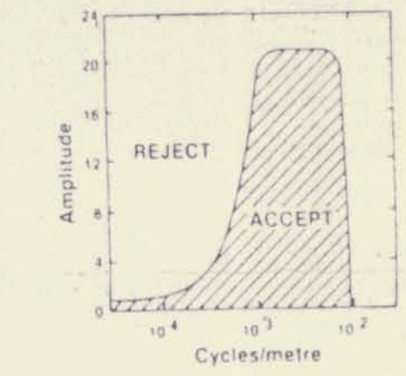
Scale 1:10,000

1/2 0 1/2 1 Kilometres

1/4 0 1/4 1/2 Miles

ISOMAGNETIC LINES
(enhanced field)

5000	5 000 nT
1000	1 000 nT
200	200 nT
	100 nT
	magnetic depression



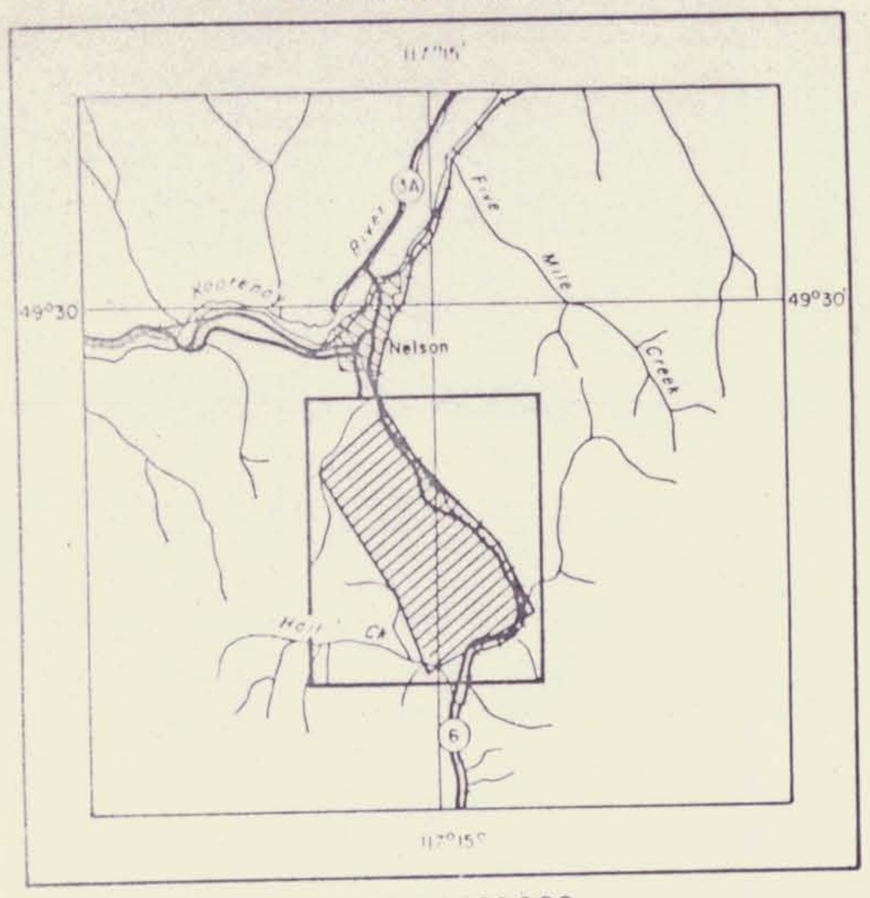
Frequency response of
magnetic operator

Flight Line

- Fiducial 2120 (Not recovered from film)
- Fiducial 2118 (Recovered from film)
- Fiducial 2110 (Not recovered from film)
- Fiducial 2104 (Recovered from film)

301 Line number and Flight direction

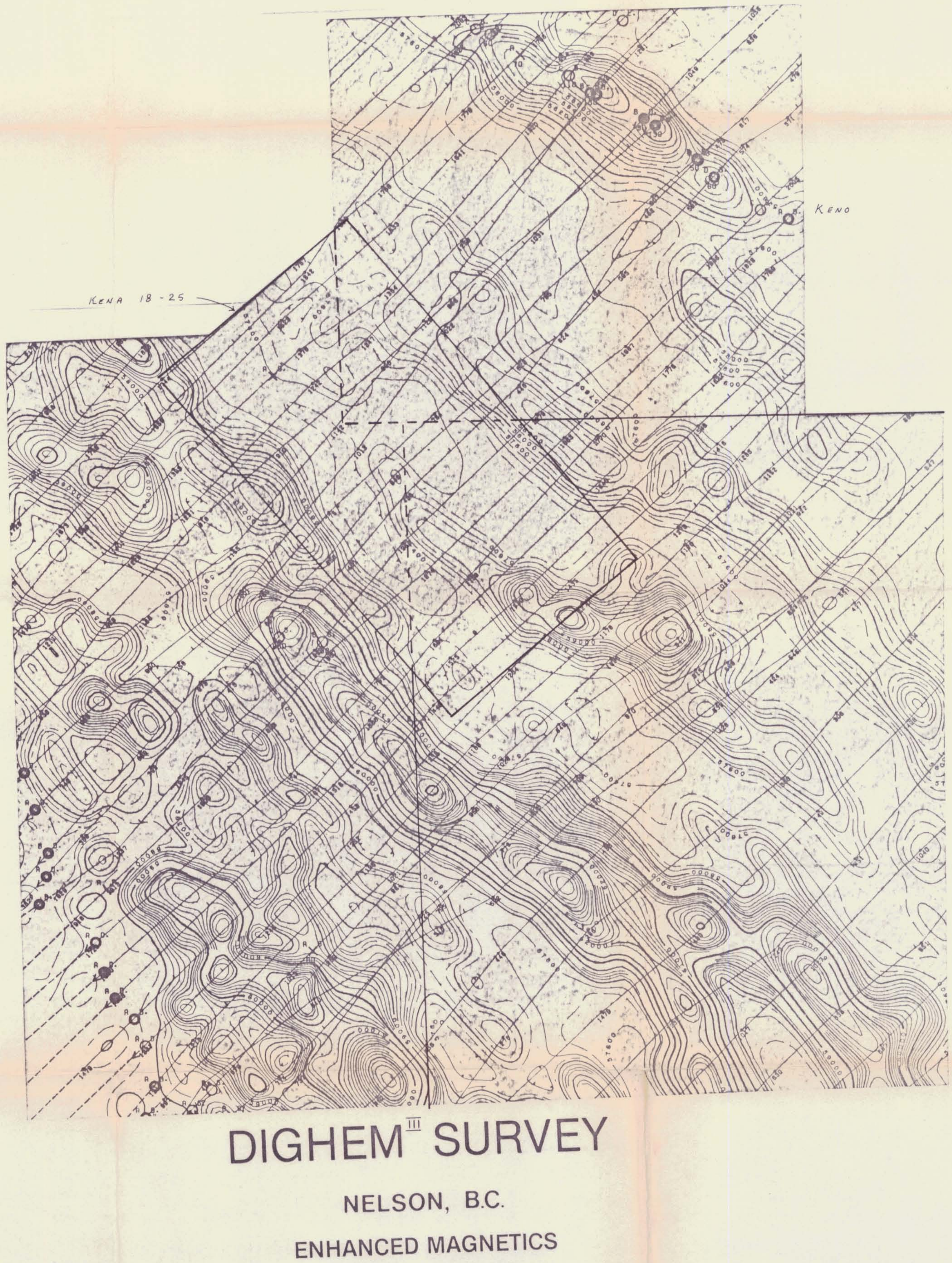
LOCATION MAP



SCALE 1:250,000

REGISTERED PROFESSIONAL ENGINEER
D. C. FRASER
PROVINCE OF ONTARIO

JOB	DATE	DRAWN BY	CHECKED BY
217	DEC. / 84	B.P.	



DIGHEM^III SURVEY

NELSON, B.C.

ENHANCED MAGNETICS

FOR

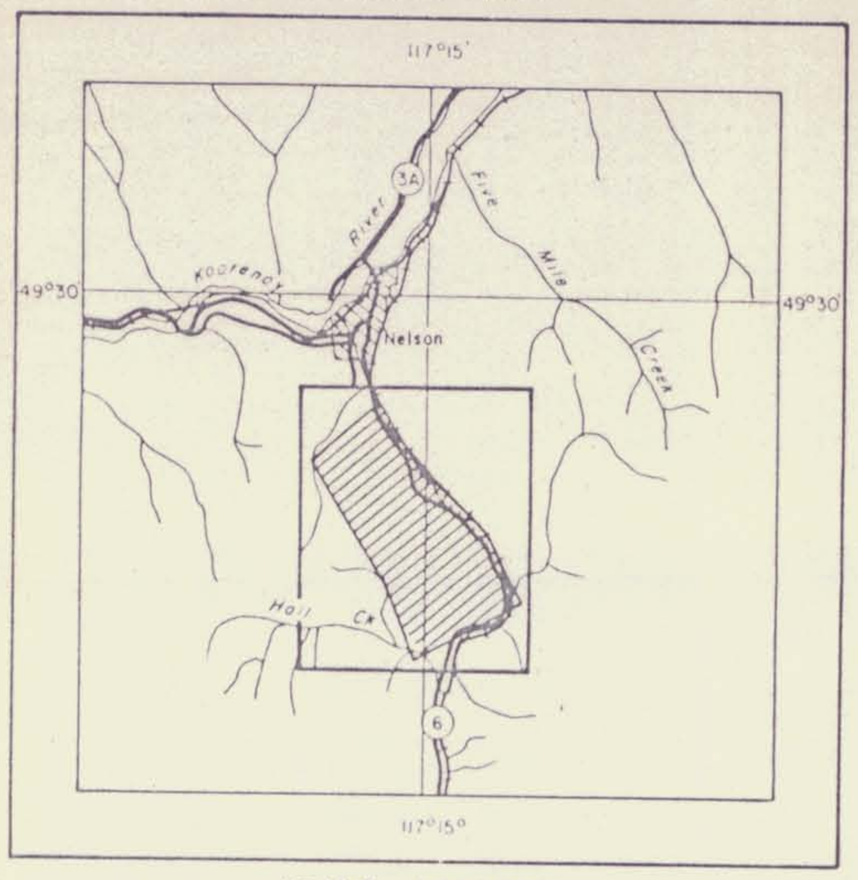
LACANA MINING CORP.

Scale 1:10,000

1/2 0 1/2 1 Kilometres

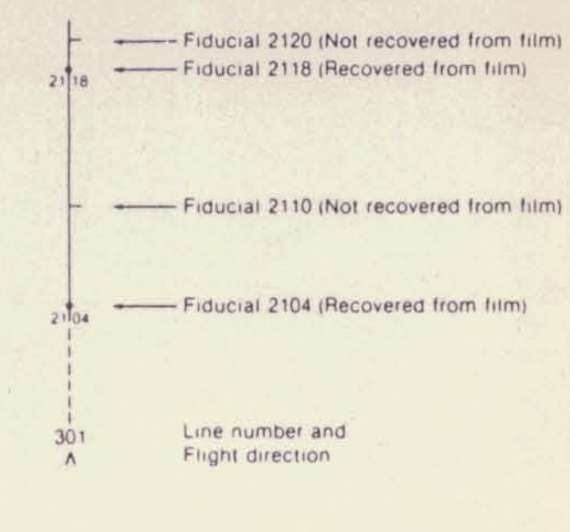
1/4 0 1/4 1/2 Miles

LOCATION MAP



SCALE 1:250,000

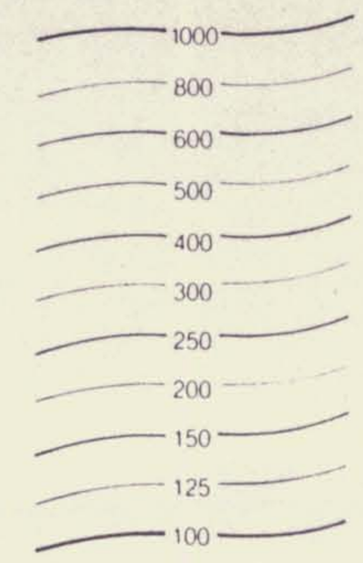
Flight Line



REGISTERED PROFESSIONAL ENGINEER
D. C. FRASER
PROVINCE OF ONTARIO

LEGEND

Contours in ohm – m
at ten intervals per decade



Note

The numbers face in the
direction of increasing value

JOB	DATE	DRAWN BY	CHECKED BY
217	DEC. / 84	B.P.	[illegible]

DIGHEM[III] SURVEY

NELSON, B.C.

RESISTIVITY

FOR

LACANA MINING CORP.

GEOLOGICAL BRANCH
ASSESSMENT REPORT

PART 2 OF 2

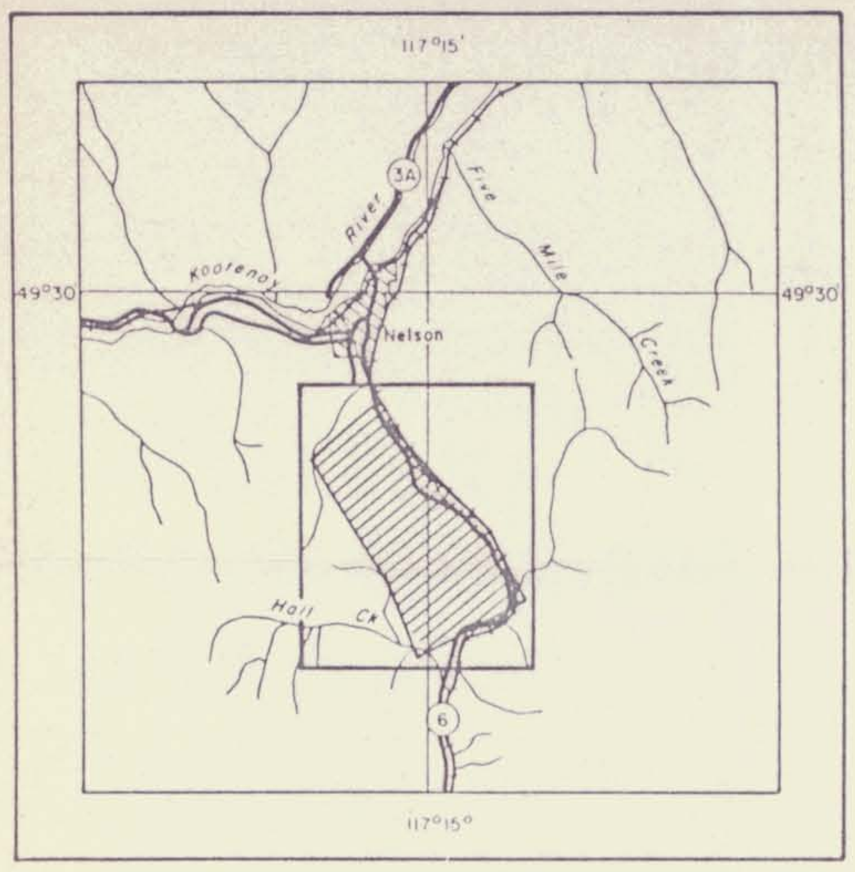
13,348

Scale 1:10,000

1/2 0 1/2 1 Kilometres

1/4 0 1/4 1/2 Miles

LOCATION MAP



SCALE 1:250,000

Flight Line

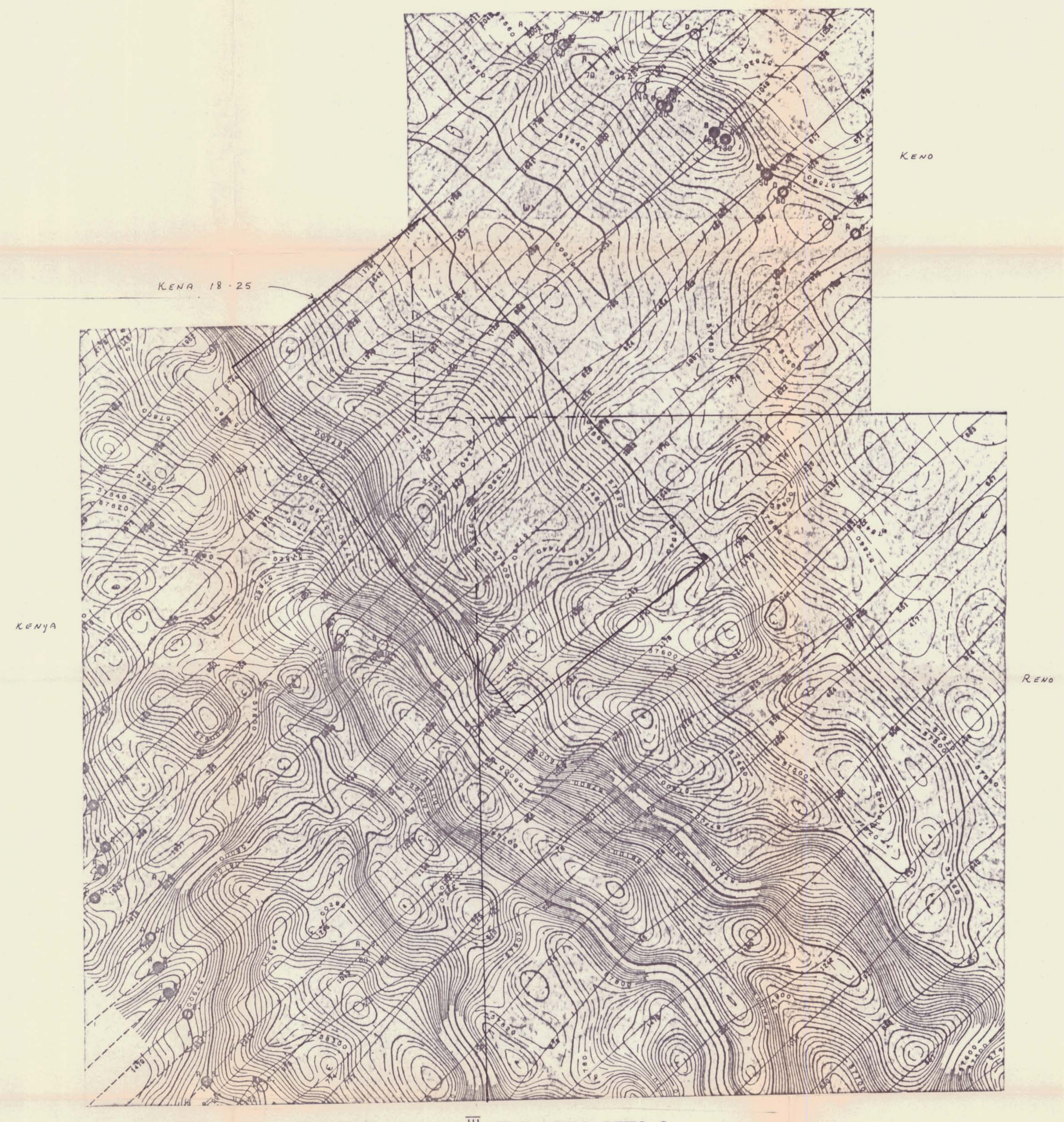
- Fiducial 2120 (Not recovered from film)
- Fiducial 2118 (Recovered from film)
- Fiducial 2110 (Not recovered from film)
- Fiducial 2104 (Recovered from film)
- 301 — Line number and Flight direction

ISOMAGNETIC LINES
(total field)

500	500 nT
100	100 nT
20	20 nT
	10 nT
	magnetic depression

Magnetic Inclination within the survey area 72°

REGISTERED PROFESSIONAL ENGINEER
D. C. FRASER
PROVINCE OF ONTARIO



DIGHEM III SURVEY

NELSON, B.C.

TOTAL FIELD MAGNETICS

FOR

LACANA MINING CORP.

Scale 1:10,000

1/2 0 1/2 1 Kilometres

1/4 0 1/4 1/2 Miles