Duplicate

Office of the Supervising Mining Recorder
AUG 14 1981
WHITEHORSE
Yukon Territory

LOGISTICS REPORT
ON
DIGHEM^{II} SURVEY
OF
FIL CLAIM BLOCK, MINTO AREA, YUKON TERRITORY

FOR

UNITED KENO HILL MINES LIMITED

BY

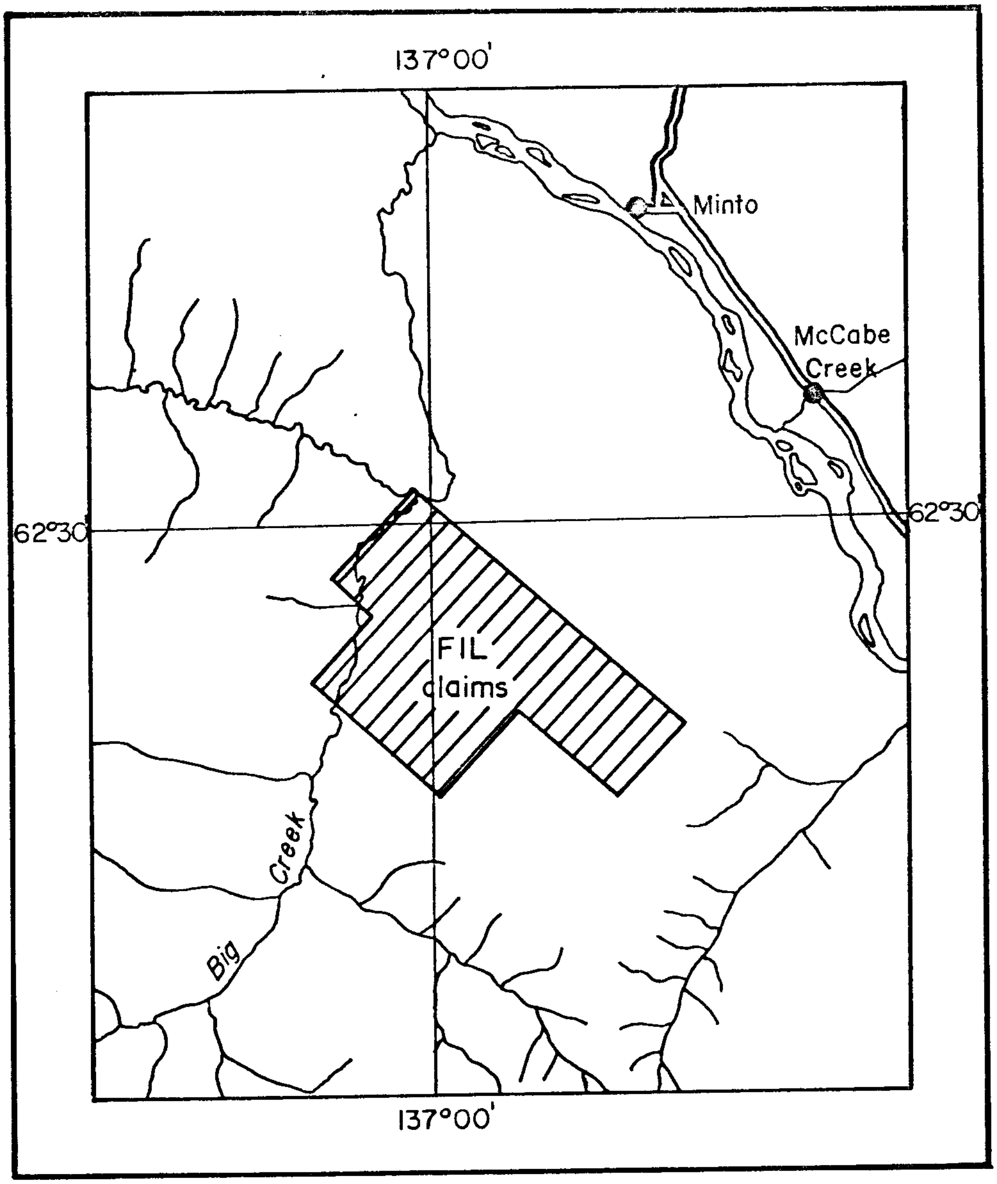
DIGHEM LIMITED

Toronto, Ontario
June 11, 1981

Z. Dvorak
Geophysicist

090850

LOCATION MAP



SCALE 1:250,000

Figure 1. - Survey area.

INTRODUCTION

A DIGHEM^{II} survey of 946 line-kilometres was flown with a 200 m line-spacing for the United Keno Hill Mines Limited, from May 27 to June 6, 1981 in the Minto area, Yukon Territory (Figure 1).

The Lama C-GDEM jet helicopter flew with an average airspeed of 115 km/h and EM bird height of 36 m. Ancillary equipment consisted of a Sonotek PMII-5010 magnetometer with its bird at an average height of 51 m, a Sperry radio altimeter, Geocam sequence camera, Barringer 8-channel hot pen analog recorder, and a Sonotek SDS 1200 digital data acquisition system with a Digi Data DPS 1100 9-track 800-bpi magnetic tape recorder. The analog equipment recorded four channels of EM data at approximately 900 Hz, two ambient EM noise channels (for the coaxial and coplanar receivers), and one channel each of magnetics and radio altitude. The digital equipment recorded the EM data with a sensitivity of 0.25 ppm/bit and the magnetic field to one gamma/bit.

SURVEY PROCEDURES

During the course of the survey the following data were recorded:

(a) DIGHEM^{II} electromagnetic results represented by four EM channels and two environmental monitor EM channels.

(b) One channel of the terrain clearance provided by the radar altimeter.

(c) One channel of the total magnetic field provided by the magnetometer.

(d) A photographic record of the terrain passing below the aircraft obtained from the 35 mm camera.

(e) Time marks impressed synchronously on the film, analog and digital records to facilitate accurate positioning on the final maps.

Data listed under items a, b and c were recorded both in the analog and digital forms.

PROCESSING AND PRESENTATION OF DATA

EM data recorded by the DIGHEM^{II} system during the survey were processed and interpreted by a computer on the basis of the following models:

(a) Vertical thin sheet conductor yielding conductance and depth.

(b) Horizontal sheet yielding conductance and depth.

(c) Conductive earth yielding apparent resistivity and depth.

The total magnetic field data were levelled and a contoured magnetic map was produced.

The magnetic data was also treated mathematically to enhance the magnetic response of the near-surface geology, and to de-emphasize deep-seated regional features.

The data collected during the survey are presented as follows:

(a) Computer-generated profiles of each line containing four channels of EM data, two EM difference channels, one channel of conductance, one channel each of resistivity and depth, one channel of magnetics, one channel of EM bird altitude, and two environmental EM monitor channels.

(b) The master photomosaic with electromagnetic information shown thereon.

(c) A transparent print of the photomosaic with contoured total magnetic field information shown thereon.

(d) A transparent print of the photomosaic with contoured enhanced magnetic field information shown thereon.

(e) A transparent print of the photomosaic with contoured resistivity information shown thereon.

(f) Two white paper prints of each map listed in (b), (c), (d) and (e) above.

(g) Two copies of a brief interpretative report.

SURVEY CHARGES

The services provided by DIGHEM include:

(a) Preparation of mosaics and other data prior to flying.

(b) The flying iteself and all supervision.

(c) Brief interpretation of the results of the survey.

(d) The preparation and delivery of the survey report and survey maps.

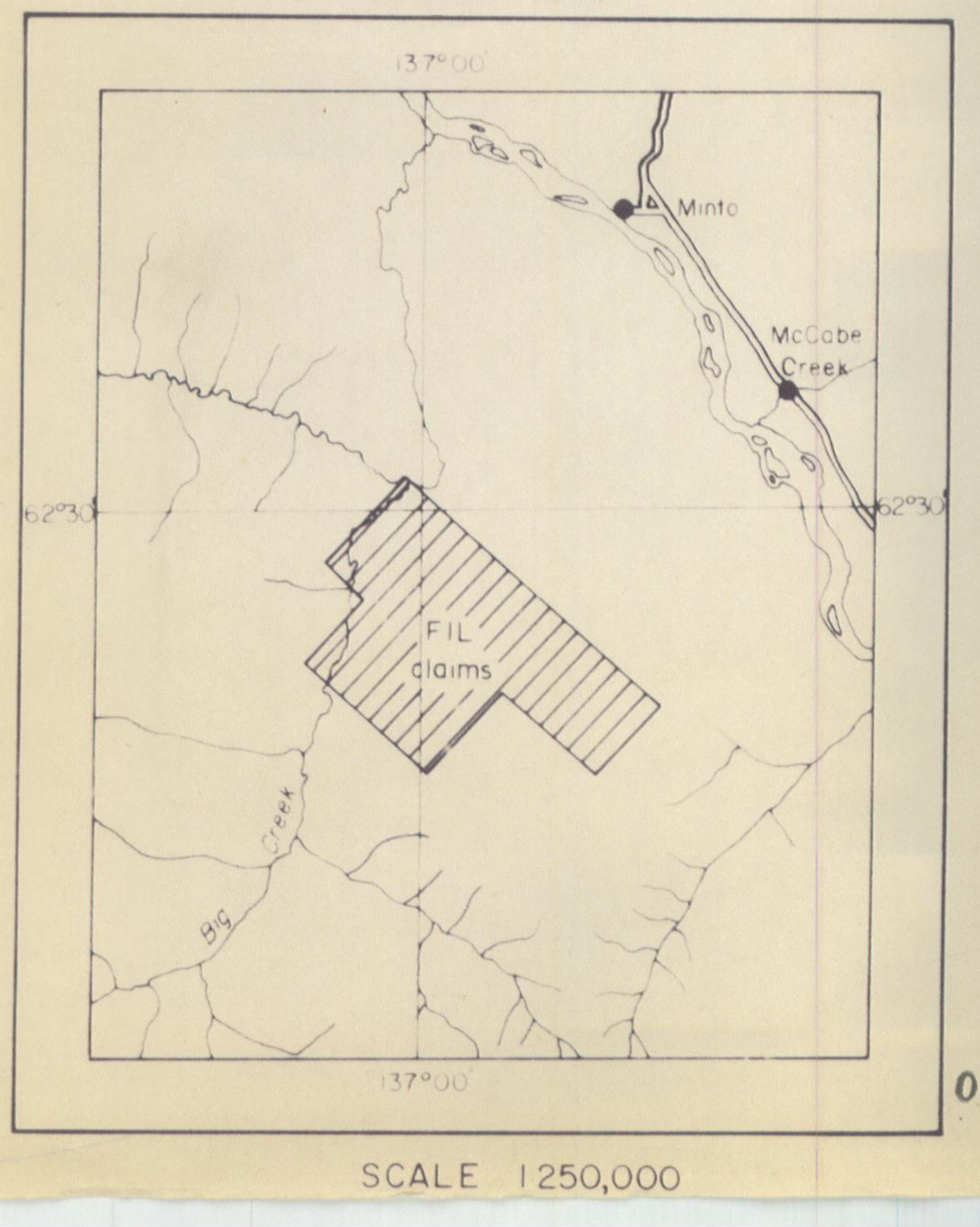
Charges for the above sevices are as follows:

(a)	Ferry and mobilization charges	$ 4,600.00
(b)	Survey charges, 946 line-km @ $52.80/line-km	49,948.80
(c)	Total of (a) and (b)	$54,548.80

Respectfully submitted,
DIGHEM LIMITED

Z. Dvorak
Geophysicist

E ZD-24



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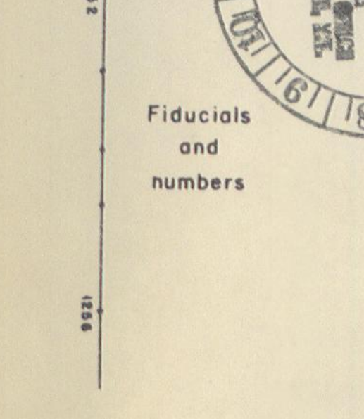
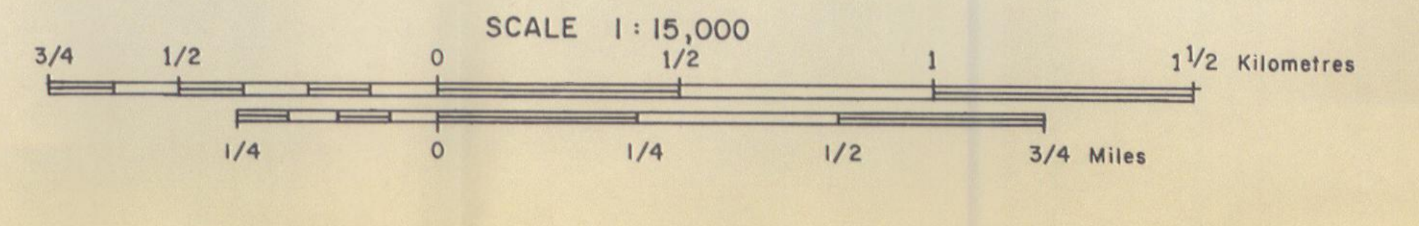


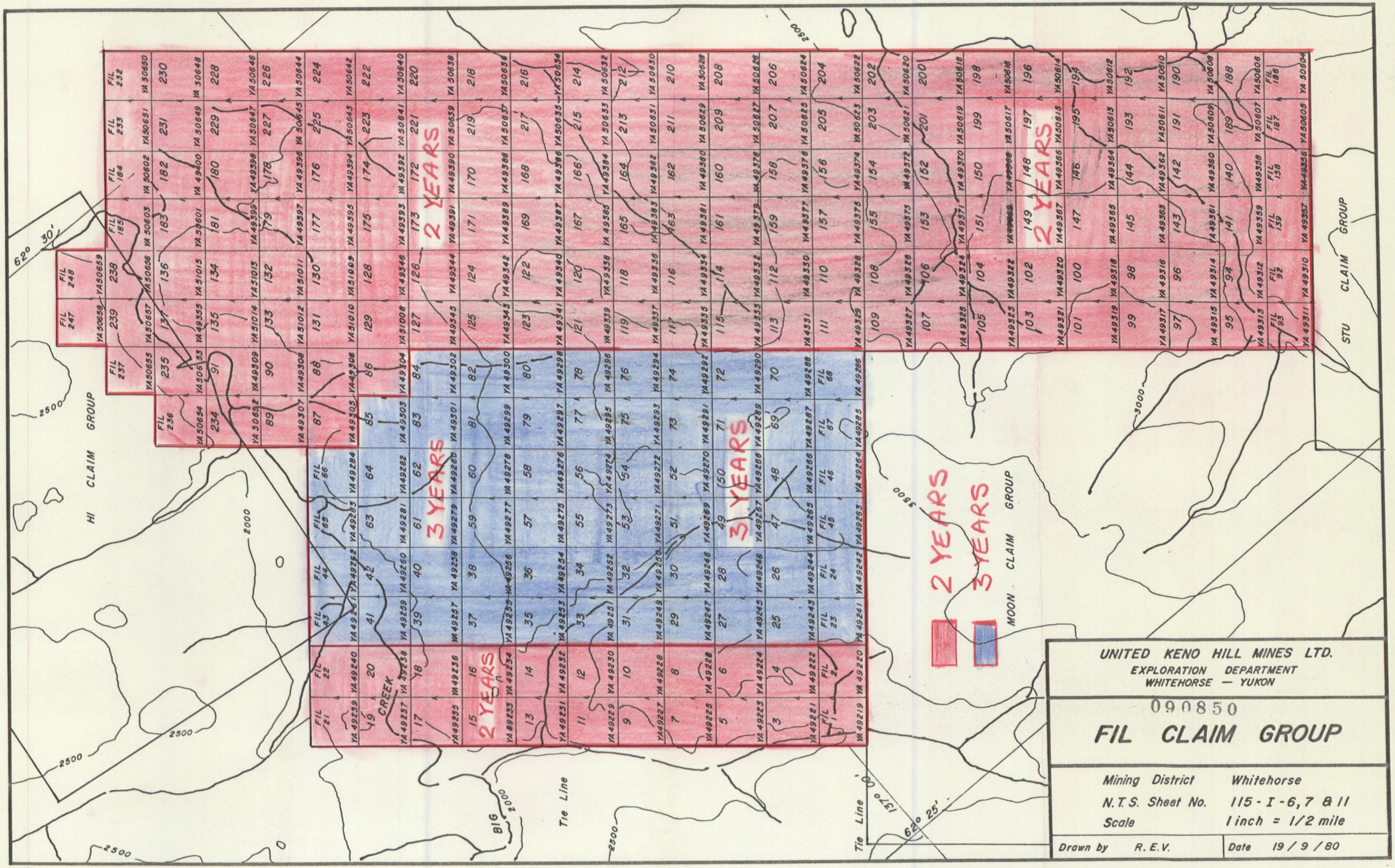
DIGHEM^{II} SURVEY

FOR

UNITED KENO HILL MINES LTD.



D. C. FRASER



UNITED KENO HILL MINES LTD.
EXPLORATION DEPARTMENT
WHITEHORSE — YUKON

090850

FIL CLAIM GROUP

Mining District	Whitehorse
N.T.S. Sheet No.	115 - I - 6, 7 & 11
Scale	1 inch = 1/2 mile
Drawn by R. E. V.	Date 19 / 9 / 80

BCIL - 3043 - U.K.H.M.

DIGHEM^{II} SURVEY

OF

CARMACKS AREA, YUKON

FOR

UNITED KENO HILL MINES LIMITED

BY

DIGHEM LIMITED

RECEIVED
31 JUL 1981
MINING
RECORDERS OFFICE
WHITEHORSE, Y.T.

090850

D.C. FRASER
PRESIDENT

TORONTO, ONTARIO
JULY 17, 1981

1981

DIGHEM^{II} SURVEY

of

THE FIL 1 to 239 and 247 & 248 CLAIM GROUP

for

UNITED KENO HILL MINES LIMITED

by

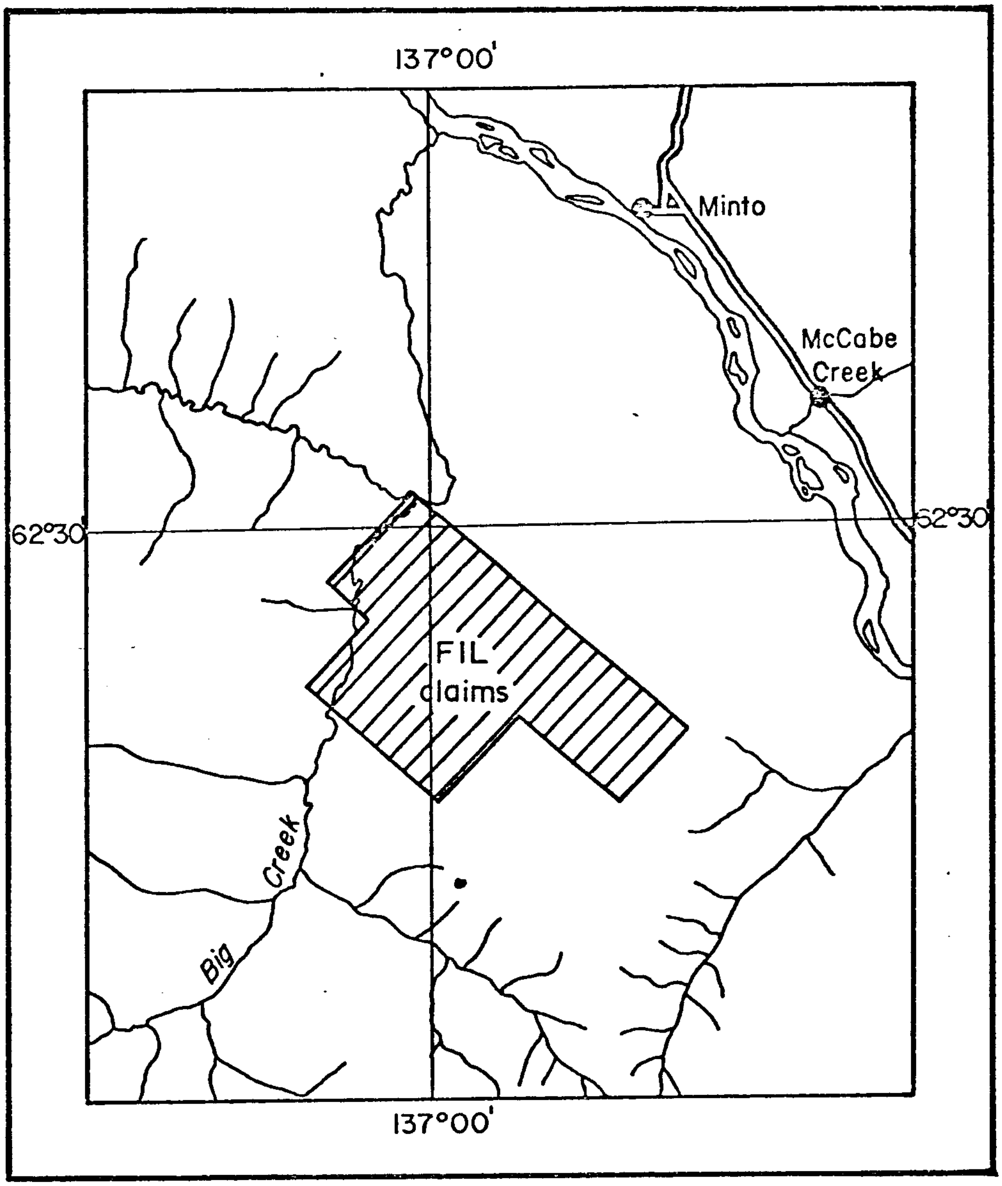
D. C. Fraser,
President,
Dighem Limited

N.T.S. Sheet: 115I 6 & 7
Latitude: 62° 27″ N
Longitude: 137! 00′ W
Dates: May 26 - June 6th, 1981

Dated: Toronto, Ontario
July 17th, 1981

CONTENTS

LOCATION MAP



SCALE 1:250,000

FIGURE 1 THE SURVEY AREA

FIGURE 3

FIL CLAIM GROUP

STAKING SHEETS 115I 6 & 7

BIG CREEK AREA

CLAIMS	GRANT NO.	EXPIRY
FIL 1 to 8	YA49219-YA49226	June 18, 1981
FIL 9 to 16	YA49227-YA49234	"
FIL 17 to 24	YA49235-YA49242	"
FIL 25 to 32	YA49243-YA49250	"
FIL 33 to 40	YA49251-YA49258	"
FIL 41 to 48	YA49259-YA49266	"
FIL 49 to 56	YA49267-YA49274	"
FIL 57 to 64	YA49275-YA49282	"
FIL 65 to 72	YA49283-YA49290	"
FIL 73 to 80	YA49291-YA49298	"
FIL 81 to 88	YA49299-YA49306	"
FIL 89 to 96	YA49307-YA49314	"
FIL 97 to 104	YA49315-YA49322	"
FIL 105 to 112	YA49323-YA49330	"
FIL 113 - 120	YA49331-YA49338	"
FIL 121 - 128	YA49339-YA49346	"
FIL 129 - 136	YA51008-YA51015	July 24, 1981
FIL 137 - 144	YA49355-YA49362	June 18, 1981
FIL 145 - 152	YA49363-YA49370	"
FIL 153 - 160	YA49371-YA49378	"
FIL 161 - 168	YA49379-YA49386	"
FIL 169 - 176	YA49387-YA49394	"
FIL 177 - 182	YA49395-YA49400	"
FIL 183 - 184	YA50601-YA50602	"
FIL 185 - 192	YA50603-YA50610	"
FIL 193 - 200	YA50611-YA50618	"
FIL 201 - 208	YA50619-YA50626	"
FIL 209 - 216	YA50627-YA50634	"
FIL 217 - 224	YA50635-YA50642	"
FIL 225 - 232	YA50643-YA50650	"
FIL 233 - 239	YA50651-YA50657	"
FIL 247 - 248	YA50658-YA50659	"

INTRODUCTION

A DIGHEM^{II} survey was flown with a 200 m line-spacing for United Keno Hill Mines Limited, from May 26, 1981 to June 18, 1981, in the Carmacks area, Yukon (Figure 1).

The Lama C-GDEM turbine helicopter flew with an average airspeed of 106 km/h and EM bird height of 33 m. Ancillary equipment consisted of a Sonotek PMH-5010 magnetometer with its bird at an average height of 48 m, a Sperry radio altimeter, Geocam sequence camera, Barringer 8-channel hot pen analog recorder, and a Sonotek SDS 1200 digital data acquisition system with a DigiData D1130 9-track 800-bpi magnetic tape recorder. The analog equipment recorded four channels of EM data at approximately 900 Hz, two ambient EM noise channels (for the coaxial and coplanar receivers), and one channel each of magnetics and radio altitude. The digital equipment recorded the EM data with a sensitivity of 0.20 ppm/bit and the magnetic field to one gamma/bit.

The Appendix provides details on the data channels, their respective noise levels, and the data reduction procedure. The quoted noise levels are generally valid 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. The DIGHEM system nevertheless can be flown under wind conditions that seriously degrade other AEM systems.

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 100 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 interpreted 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.

Discrete conductor analysis

The EM anomalies appearing on the electromagnetic map are interpreted by computer to give the conductance (i.e., conductivity-thickness product) in mhos of a vertical sheet model. DIGHEM anomalies are divided into six grades of conductance, as shown in Table I. The conductance in mhos is the reciprocal of resistance in ohms.

Table I. EM Anomaly Grades

Anomaly Grade	Mho Range
6	greater than 99
5	50 - 99
4	20 - 49
3	10 - 19
2	5 - 9
1	less than 5

The mho 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 mho values.

Conductive overburden generally produces broad EM responses which are not plotted on the EM maps. However, patchy conductive overburden in otherwise resistive areas can yield discrete-like anomalies with a conductance grade (cf. Table I) 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 as low as 1 ohm-m, anomalies caused by weathering variations and similar causes can have conductance grades as high as 4. The anomaly shapes from the multiple coils often allow such surface conductors to be recognized, and these are indicated by the letter S on the map. The remaining anomalies in such areas could be

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

bedrock conductors. The higher grades indicate increasingly higher conductances. Examples: DIGHEM's New Insco copper discovery (Noranda, Quebec, Canada) yielded a grade 4 anomaly, as did the neighbouring copper-zinc Magusi River ore body; Mattabi (copper-zinc, Sturgeon Lake, Ontario, Canada) and Whistle (nickel, Sudbury, Ontario, Canada) gave grade 5; and DIGHEM's Montcalm nickel-copper discovery (Timmins, Ontario, 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, New Brunswick, 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., grade 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, the actual mho value and a letter are plotted beside the EM grade symbol. The letter is the anomaly identifier. The horizontal rows of dots, beside each anomaly symbol, indicate the anomaly amplitude on the flight record. The vertical column of dots gives the estimated depth. In areas where anomalies are crowded, the identifiers, dots and mho values 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 be accurate whereas one obtained from a small ppm anomaly (no dots) could be 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 mho value and depth estimate will illustrate which of these possibilities fits the recorded data best.

Flight line deviations occasionally yield cases where two anomalies, having similar mho 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 on 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 mho values are plotted 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 direction, conductance, depth, thickness (see below), and dip. The accuracy is comparable to an interpretation from a ground EM survey having the same line spacing.

An EM anomaly list attached to each survey report provides a tabulation of anomalies in ppm, and in mhos and estimated depth for the vertical sheet model. The EM anomaly list also shows the conductance in mhos and the 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 15 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^{II} maps contain x-type EM responses in addition to EM anomalies. An x-type response is below the noise threshold of 2 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 a flight line, or aerodynamic noise. Those responses that have the appearance of valid bedrock anomalies on the flight profiles are mentioned in the report. The others should not be followed up unless their locations are of considerable geological interest.

The thickness parameter

DIGHEM^{II} can provide an indication of the thickness of a steeply dipping conductor. The ratio of the anomaly amplitude of channel 24/channel 22 generally increases as the apparent thickness increases, i.e., the thickness in the horizontal plane. This 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 3m, and thick when in excess of 10 m. In base metal exploration applications, thick conductors can be high priority targets because most massive sulfide ore bodies are thick, whereas non-economic bedrock conductors are usually thin. An estimate of thickness cannot be obtained 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 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 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. This helps the interpreter to differentiate between conductive trends in the bedrock and those patterns typical of conductive overburden. Discrete conductors will generally appear as narrow lows on the contour map and broad conductors will appear as wide lows.

Channel 40 (see Appendix) 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. Channel 41 gives the apparent depth below surface of the conductive material.

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

The apparent depth therefore 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 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^{II} system has been flown for the purpose 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 41 can be of significant help in distinguishing between overburden and bedrock conductors.

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 bedrock conductors. The processing of DIGHEM^{II} data, however, produces four channels which contribute significantly to the recognition of bedrock conductors. These are the inphase and quadrature difference channels (number 33 and 34), and the resistivity and depth channels (40 and 41). The EM difference channels 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 highly conductive environment therefore is based on the anomalous responses of the two difference channels (33 and 34) and the resistivity channel (40). The most favourable situation is where anomalies coincide on all three channels.

Channel 41, which is the apparent depth to the conductive material, also helps determine whether a conductive response arises from surficial material or from a conductive zone in the bedrock. When this channel rides above the zero level on the orange profile paper (i.e., it is negative), it implies that the EM and resistivity profiles are responding primarily to a conductive upper layer, i.e., conductive overburden. If channel 41 is below the zero level, it indicates that a resistive upper layer exists, and this usually implies the existence of a bedrock conductor.

Channels 35 and 36 are the anomaly recognition functions. They are used to trigger the conductance channel 37 which identifies discrete conductors. In highly conducting environments, channel 36 may not be generated because it is subject to some corruption by highly conductive earth signals. Some of the automatically selected anomalies (channel 37) are discarded by the human interpreter. 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 rising from geologic or aerodynamic noise.

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.

(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.

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

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[3] The gradient analogy is only valid with regard to the identification of anomalous locations. The calculation of conductance is based on EM amplitudes relative to a local base level, rather than to an absolute zero level as for the resistivity calculation.

and magnetic polarization. It was mentioned above that the EM difference channels (i.e., channel 33 for inphase and 34 for quadrature) tend to eliminate the response of conductive overburden. This marked a unique development in airborne EM technology, as DIGHEM^{II} 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 polarization. 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 33. This feature can be a significant aid in the recognition of conductors which occur in rocks containing accessory magnetite.

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, Ontario, Canada) as well as magnetic (e.g., the Mattabi deposit near Sturgeon Lake, Ontario).

The magnetometer data are digitally recorded in the aircraft to an accuracy of one gamma. The digital tape is processed by computer to yield a standard total field magnetic map which is usually contoured at 25 gamma intervals. The magnetic data also are treated mathematically to enhance the magnetic response of the near-surface geology, and an enhanced magnetic map is produced with a 100 gamma contour interval. The response of the enhancement operator in the frequency domain is shown in Figure 2. The 100 gamma contour interval is equivalent to a 5 gamma interval for the passband components of the airborne data. This is because these components are amplified 20 times by the operator of Figure 2.

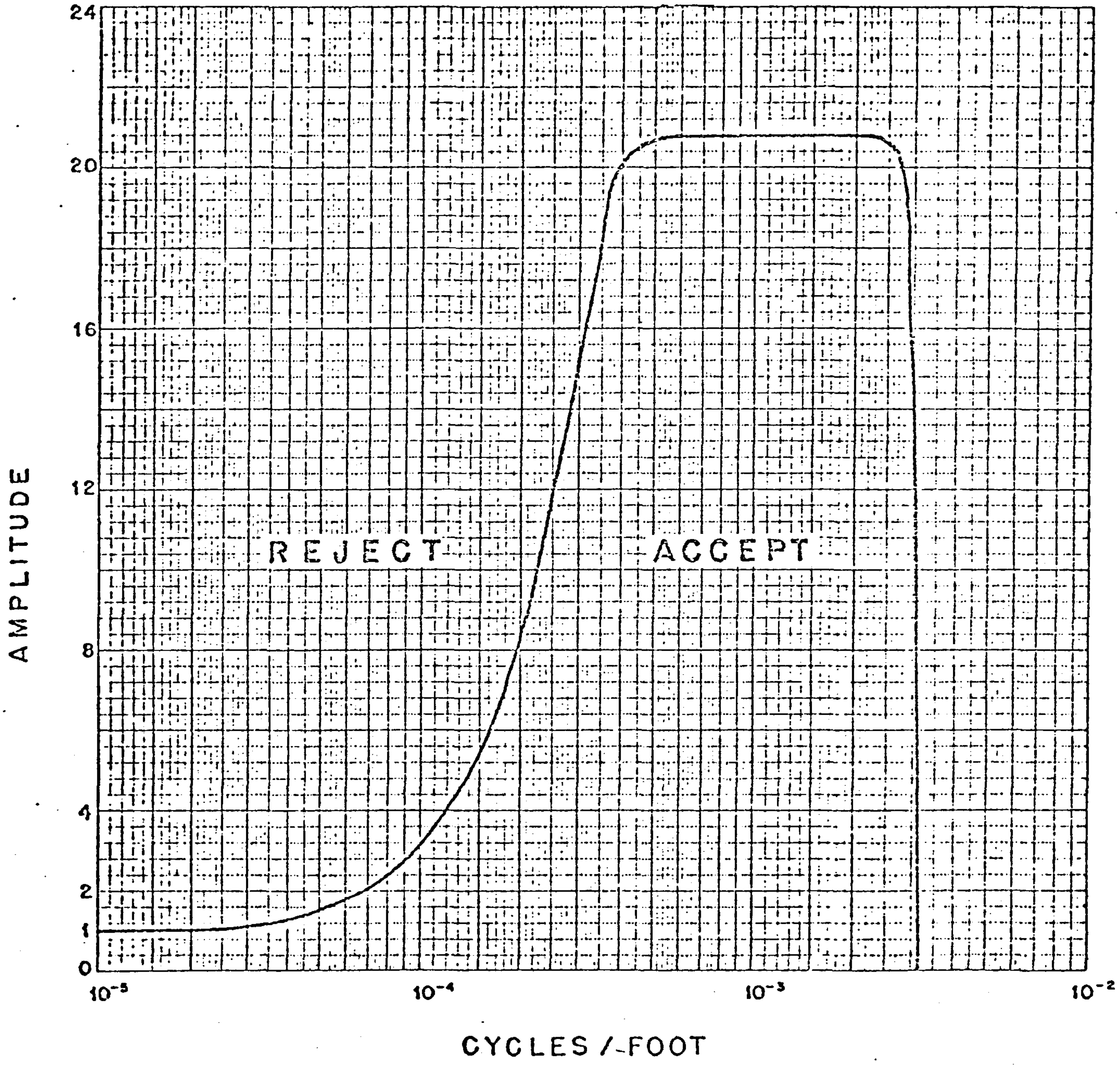

Figure 2 Frequency response of magnetic operator

The enhanced map, which bears a resemblance to a downward continuation map, is produced by digital bandpass filtering 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 geological structure. The contour interval of 100 gammas is suitable for defining the near-surface local geology while de-emphasizing deep-seated regional features.

CONDUCTORS IN THE SURVEY AREA

The electromagnetic maps show the locations of conductors and their interpreted conductance (i.e., conductivity - thickness product) and depth. Their strike direction and length are also shown when anomalies can be correlated from line-to-line. When studying the maps for follow-up planning, consult the anomaly listings appended to this report to ensure that none of the conductors are overlooked.

The survey data between lines 325 and 385 inclusive are presented on one map sheet which covers the assessment area. The amount flown on these lines totals 450 line-km.

The EM map indicates which anomalies are believed to be caused by surficial sources. Generally, such anomalies are not commented on below as the discussions are directed to identifying bedrock features.

A moderately large resistivity low encompasses the grade 1 EM anomaly 329A and the associated x-type responses on the west end of lines 330 and 331. Well defined EM anomalies were not generated by this resistivity low. The low runs off the survey area. It may strike parallel to the flight lines and it has a substantial across-line horizontal width. It reflects broadly distributed conductive material well below the daylight surface.

A resistivity low runs through 341xA. The total field magnetic map also shows that trends exist parallel to the flight line at this point.

Anomaly 325B is part of a long, weakly conductive zone which strikes NW, running off the survey area. It extends SE to 329xC as can be seen on the EM map. This conductive horizon appears to continue SE, striking through 347C, 365xC, etc. as is indicated by the resistivity contour patterns. The geologic situation appears to consist of a weakly conductive formation (which is best shown by the resistivity contours) containing local masses of higher conductivity. Of the latter, the most definitive targets are 325B, 327E, 337xG, 347C and 349B.

A long conductive zone runs through 378xF to 384xD. It continues in a southeast direction off the map area. The zone may be related to the long conductive zone described immediately above.

Note the resistivity low at the east side of the map from lines 333 to 342. This is mentioned because it might be overlooked inasmuch as the resistivity contours are not closed off to the east. The bedrock conductor 339A-342E is caused by this conductive zone.

A number of non-magnetic, single-line or short grade 1 EM anomalies exist, e.g., 325A, 342A, 348B, 348E, 350A, 351A, 353A, etc. The more attractive of such anomalies are those which yield local resistivity lows, e.g. 348B, 350A, 353A. Note also 359xF-362xE and 363xC-365xC. These are bedrock conductors which have well defined resistivity lows. The latter is very slightly magnetic.

A large number of EM anomalies occurs on the west side of the map between lines 360 and 385. Many of these may reflect surficial sources as indicated by the attached interpretation symbols S and S? (see map legend). Others probably indicate bedrock conductors, e.g., 371A-372A, 378A, and the others which are not downgraded by S or S?

Respectfully submitted,
DIGHEM LIMITED

D Fraser

D. C. Fraser
President

Three map sheets accompany this report:

Electromagnetics	1 map sheet
Resistivity	1 map sheet
Magnetics	1 map sheet

C DCF-49

APPENDIX A

THE FLIGHT RECORD AND PATH RECOVERY

Both analog and digital flight records are produced. The analog profiles are recorded on green chart paper in the aircraft during the survey. The digital profiles are generated later by computer and plotted on orange chart paper at a scale identical to the geophysical maps. The digital profiles, which may be displayed, are as follows:

Channel Number	Label	Parameter	Scale units/mm	Noise
20	MAG	magnetometer	10 gamma	2 gamma
21	ALT	bird height	10 feet	5 feet
22	CXI	coaxial coil-pair inphase	1 ppm	1-2 ppm
23	CXQ	coaxial coil-pair quadrature	1 ppm	1-2 ppm
24	CPI	coplanar coil-pair inphase	1 ppm	1-2 ppm
25	CPQ	coplanar coil-pair quadrature	1 ppm	1-2 ppm
26	VLFT	VLF-EM total field	1 %	1-2 %
27	VLFQ	VLF-EM vertical quadrature	1 %	1-2 %
28	CXS	ambient noise monitor (coaxial coil)	1 ppm	1 ppm
29	CPS	ambient noise monitor (coplanar coil)	1 ppm	1 ppm
33	DIFI	difference function inphase	1 ppm	1-2 ppm
34	DIFQ	difference function quadrature	1 ppm	1-2 ppm
35	REC1	first anomaly recognition function	1 ppm	1-2 ppm
36	REC2	second anomaly recognition function	1 ppm	1-2 ppm
37	SIGT	conductance	1 mho	
40	RES	log resistivity at main frequency	.03 decade	
41	DP	apparent depth at main frequency	3 m	
45	RES2	log resistivity at secondary frequency	.03 decade	
46	DP2	apparent depth at secondary frequency	3 m	

Note: Channels 42 to 44 are experimental.

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 and 100 mm up from the bottom of the chart are respectively 1, 10, 100 and 1000 ohm-m.

The fiducial marks on the flight records represent points on the ground which were recognized by the aircraft navigator. Continuous photographic coverage allowed accurate photo-path recovery locations for the fiducials, which were then plotted on the geophysical maps to provide 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 changes may denote an error in flight path recovery. The resulting flight path locations therefore reflect a more stringent checking than is provided by standard flight path recovery techniques.

The following brief description of DIGHEM^{II} illustrates the information content of the various profiles*.

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*For a detailed description, see D.C. Fraser, Geophysics, v.44, p.1367-1394.

Single-frequency surveying

The DIGHEM^{II} system has two transmitter coils which are mounted at right angles to each other. Both coils transmit at approximately the same frequency. (This frequency is given in the Introduction.) Thus, the system provides two completely independent surveys at one pass. In addition, the digital flight chart profiles (generated by computer) include an inphase channel and a quadrature channel which essentially are free of the response of conductive overburden. Also, the EM channels may indicate whether the conductor is thin (e.g., less than 3 m), or has a substantial width (e.g., greater than 10 m). Further, the EM channels include channels of resistivity, apparent depth and conductance. A minimum of 11 EM channels are provided. The DIGHEM^{II} system therefore gives information in one pass which cannot be obtained by any other airborne or ground EM technique.

Figure A1 shows a DIGHEM^{II} flight profile over the massive pyrrhotite ore body in Montcalm Township, Ontario. It will serve to identify the majority of the available channels.

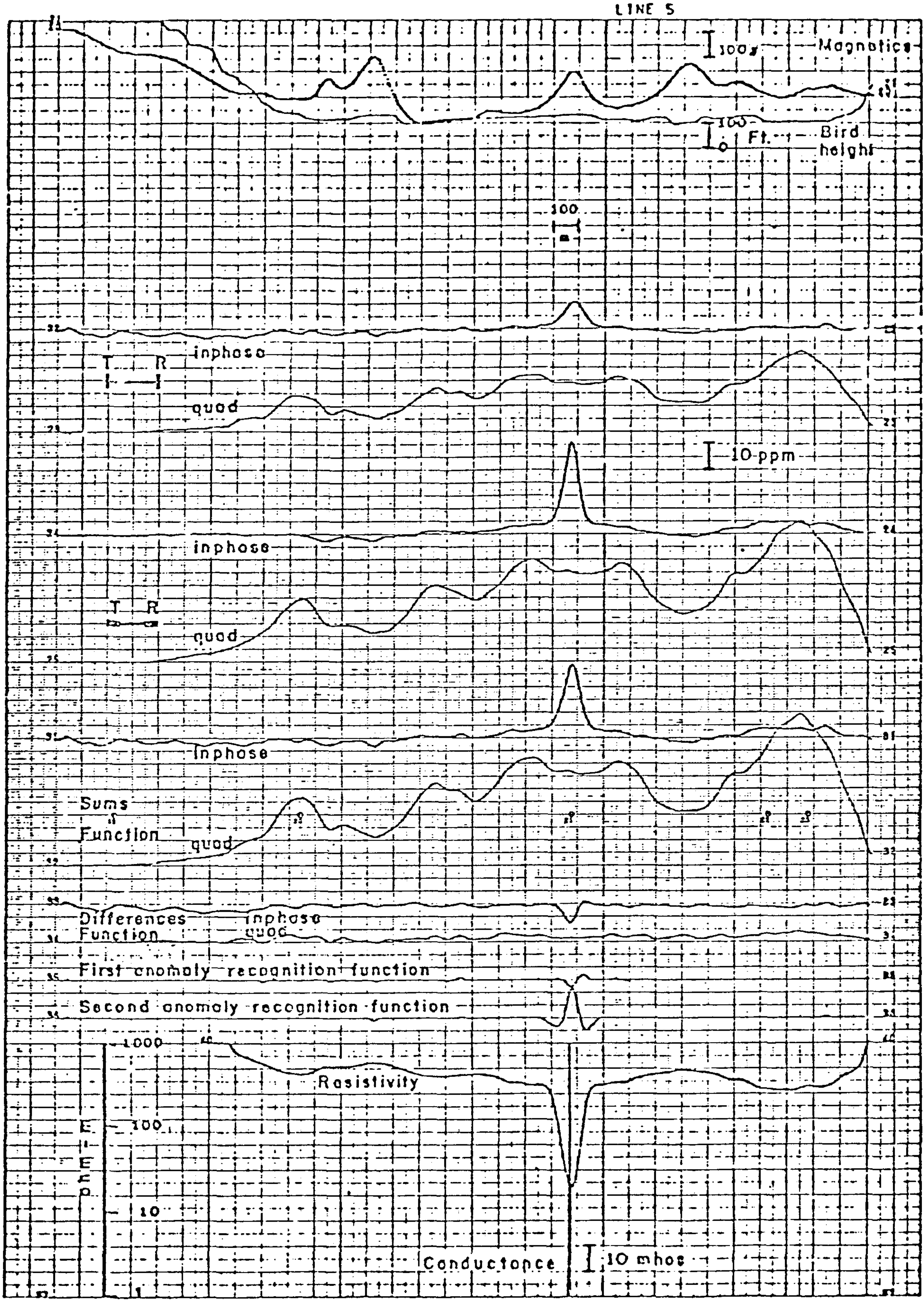

Fig. A1. Flight over Montcalm deposit, with line parallel to strike

The two upper channels (numbered 20 and 21) are respectively the magnetics and the radio altitude. Channels 22 and 23 are respectively the inphase and quadrature of the coaxial coil-pair, which is termed the standard coil-pair. This coil-pair is equivalent to the standard coil-pair of all inphase-quadrature airborne EM systems. Channels 24 and 25 are the inphase and quadrature of the additional coplanar coil-pair which is termed the whaletail coil-pair.

Channels 31 and 32 are inphase and quadrature sum functions of the standard and whaletail channels; they provide a condensed view of the four basic channels 22 to 25. The sum channels normally are not plotted.

Channels 33 and 34 are inphase and quadrature difference functions of the standard and whaletail channels. The difference channels are almost free from the response of conductive overburden. Channel 37 is the conductance. The conductance channel essentially is an automatic anomaly picker calibrated in conductance units of mhos; it is triggered by the anomaly recognition functions shown as channels 35 and 36.

Channel 40 is the resistivity, which is derived from the whaletail channels 24 and 25. The resistivity channel 40 yields data which can be contoured, and so the DIGHEM^{II} system yields a resistivity contour map in addition to an electromagnetic map, a magnetic contour map, and an enhanced magnetic contour map. The enhanced magnetic contour map is similar to the filtered magnetic map discussed by Fraser.*

Figure A2 presents the DIGHEM^{II} results for a line flown perpendicularly to the Montcalm ore body. Channel 20 shows the 175 gamma magnetic anomaly caused by the massive pyrrhotite deposit. For the EM channels, the following points are of interest:

1. On channels 22-25 and 31-34, the ore body essentially yields only an inphase response. The quadrature response is almost completely caused by conductive overburden (which also gives a small inphase response). The hachures show the EM response from the overburden. The overburden response vanishes on the

---

*Cdn. Inst. Mng., Bull., April 1974.

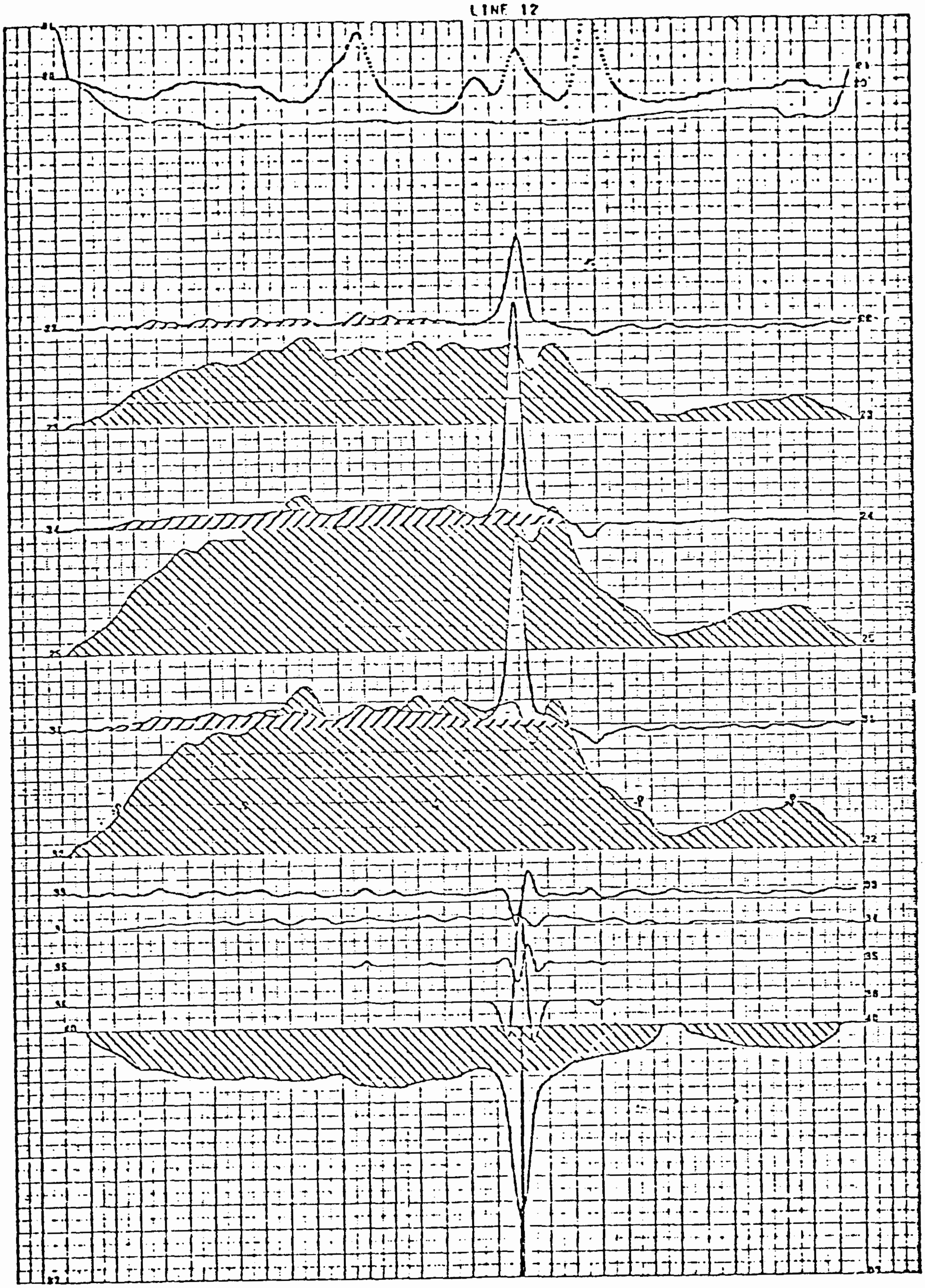

Fig. A2. Flight over Montcalm deposit, with line perpendicular to strike.

difference EM channels, as can be seen by comparing the quadrature channels 25 and 34. This is an important point to note because DIGHEM^{II} is the only EM system which provides an inphase channel and a quadrature channel which are essentially free of conductive overburden response.

2. The whaletail anomaly of channel 24 has a single peak. This shows that the conductor has a substantial width. If the width had been under 3 m, the conductor would have produced a weak m-shaped anomaly on channel 24.

3. The ore body yields a resistivity of 5 ohm-m in a background of about 200 ohm-m (cf. channel 40). A dipole-dipole ground resistivity survey with an a-spacing of 50 m showed a similar background, but the ore body gave a low of only 53 ohm-m because of the averaging effect inherent in the ground technique.

4. The ore body has a conductance of 330 mhos according to its EM response on this particular flight line. The conductance channel 37 saturates at 100 mhos, and so the deposit is indicated by a 100-mho spike.

Figure A1 illustrates the DIGHEM^{II} results for a line flown subparallel to the ore body. The ore body anomaly is small on the standard coil-pair (channel 22) but shows up strongly on the whaletail coil-pair (channel 24).

Dual-frequency surveying

For surveys flown primarily for resistivity mapping, as opposed to EM surveying, the two transmitter coils may be energized at two well-separated frequencies (e.g., 900 and 3600 Hz). Apparent resistivity and apparent depth maps can be made independently for each frequency. The interpretation procedure involves comparing the apparent resistivities and apparent depths at the two frequencies.

The use of two different coil-pair orientations (i.e., standard and whaletail) for dual-frequency resistivity mapping is an unorthodox procedure. However, as long as the current flow patterns are primarily horizontal, the different coil orientations do not influence the results, according to superposed dipole theory. Wire fences and other cultural features will produce local deviations, because they usually respond preferentially to one or the other of the coil-pairs.

The difference channels 33 and 34 are not produced because the divergent frequencies of the two coil-pairs renders them meaningless. In addition, channels 35 to 37 also are not produced.

APPENDIX B

EM ANOMALY LIST

147 S41 UNITED KENO , CARMACKS JUN-198

LINE & ANOMALY	COAXIAL COIL REAL PPM	COAXIAL COIL QUAD PPM	COPLANAR COIL REAL PPM	COPLANAR COIL QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH* FEET	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH FEET	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH FEET
325A	0	3	0	10	1	0	1	120	1035	0
325B	7	9	7	19	4	37	1	165	81	52
326A	2	5	3	15	1	0	1	92	410	0
327B	6	6	5	13	5	94	1	204	108	81
328A	3	5	5	7	4	89	1	170	250	21
329A	1	9	3	20	1	0	1	120	191	0
334B	1	0	0	0	6	471	1	686	1035	0
339A	3	7	6	14	3	54	1	211	75	93
340A	0	5	0	4	1	0	1	247	1035	0
340C	6	11	13	26	4	15	1	155	78	43
341A	0	14	0	33	1	14	1	46	661	0
342A	3	3	4	5	4	97	1	153	175	19
342D	3	4	2	5	3	83	1	157	168	27
342E	5	3	6	4	10	100	1	197	95	51
343A	0	6	0	15	1	0	1	103	969	0
343B	4	2	5	5	8	134	1	159	197	21
343C	0	4	0	7	1	5	1	94	999	0

* 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.

	COAXIAL COIL		COPLANAR COIL		VERTICAL DIKE		HORIZONTAL SHEET		CONDUCTIVE EARTH	
LINE & ANOMALY	REAL PPM	QUAD PPM	REAL PPM	QUAD PPM	COND MHOS	DEPTH* FEET	COND MHOS	DEPTH FEET	RESIS OHM-M	DEPTH FEET
344A	3	1	1	0	16	252	1	106	632	0
345A	0	4	0	3	1	5	1	107	978	0
346B	2	6	2	12	1	4	1	30	785	0
346C	0	5	0	7	1	9	1	79	836	0
347B	0	6	0	10	1	1	1	90	920	0
347C	5	0	6	2	74	150	1	179	177	33
348A	0	7	0	12	1	0	1	131	1035	0
348B	2	5	5	9	3	20	1	108	265	0
348C	0	11	0	24	1	11	1	25	530	0
348E	1	1	1	0	4	233	1	123	1035	0
348G	0	6	0	7	2	72	1	62	721	0
348H	0	2	0	3	1	15	1	95	880	0
349A	0	2	0	0	1	0	1	212	1035	0
349B	5	4	7	9	7	67	1	151	170	15
350A	7	23	8	36	2	0	1	35	233	0
350B	0	2	0	1	1	0	1	170	1035	0
351A	3	3	3	6	5	77	1	61	409	0
352A	0	2	0	1	1	47	1	134	1035	0
353A	2	4	3	7	2	21	1	153	284	0
353C	0	2	2	1	2	145	1	162	565	0

* 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.

147 SHE UNITED KENO , CARMACKS JUN-193

	COAXIAL COIL		COPLANAR COIL		VERTICAL DIKE		HORIZONTAL SHEET		CONDUCTIVE EARTH	
LINE & ANOMALY	REAL PPM	QUAD PPM	REAL PPM	QUAD PPM	COND MHOS	DEPTH* FEET	COND MHOS	DEPTH FEET	RESIS OHM-M	DEPTH FEET
354A	1	5	2	2	2	105	1	29	630	0
354B	1	6	3	10	1	5	1	105	521	0
355A	1	6	0	3	1	0	1	60	1020	0
356A	4	22	4	33	1	0	1	21	389	0
356B	4	15	3	20	1	0	1	15	511	0
356C	3	6	5	14	3	21	1	118	174	0
357A	1	6	0	11	1	0	1	136	1035	0
357B	1	10	6	27	1	0	1	32	210	0
357C	1	3	0	0	3	180	1	33	481	0
358C	4	7	7	13	4	8	1	129	156	0
359A	5	7	5	14	4	44	1	170	161	37
360A	1	1	2	7	2	116	1	7	521	0
360B	4	4	5	9	4	46	1	149	161	14
365A	0	13	0	13	1	0	1	12	603	0
366A	3	3	3	17	2	0	1	0	648	0
366B	1	2	0	1	2	206	1	7	586	0
366C	0	2	2	0	3	223	1	16	728	0

* 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.

	COAXIAL COIL		COPLANAR COIL		VERTICAL DIKE		HORIZONTAL SHEET		CONDUCTIVE EARTH	
LINE & ANOMALY	REAL PPM	QUAD PPM	REAL PPM	QUAD PPM	COND MHOS	DEPTH* FEET	COND MHOS	DEPTH FEET	RESIS OHM-M	DEPTH FEET
369A	2	7	4	11	2	19	1	73	393	0
370A	2	2	2	0	4	122	1	93	742	0
370B	1	8	0	8	1	0	1	72	989	0
371A	3	3	7	3	10	92	1	115	178	0
371B	6	22	12	33	3	0	1	56	160	0
371C	0	9	0	3	2	49	1	55	693	0
372A	4	0	4	0	13	125	1	90	185	0
372B	6	32	14	57	2	0	1	47	135	0
372C	2	5	0	0	2	100	1	78	1020	0
373B	0	3	0	0	2	174	1	97	1035	0
374B	2	16	7	27	2	0	1	57	228	0
375A	5	10	6	18	3	5	1	84	262	0
376A	4	5	4	7	4	13	1	160	118	18
376B	3	13	4	22	1	0	1	94	163	0
376C	2	2	3	7	4	85	1	88	366	0
377A	3	9	3	4	3	34	1	79	113	0
377B	9	22	9	37	3	0	1	48	159	0
377C	5	16	3	19	2	5	1	5	439	0
377D	2	6	4	12	2	14	1	82	144	0
377E	2	1	0	0	2	139	1	139	325	0
377F	1	2	3	4	3	127	1	80	416	0
378A	4	0	6	0	25	155	1	130	142	6

* 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.

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147 SHZ UNITED KENO , CARMACKS   JUN-198



            COAXIAL       COPLANAR    .  VERTICAL     .  HORIZONTAL      CONDUCTIVE
              COIL          COIL      .    DIKE       .    SHEET            EARTH
                                      .               .
LINE S    REAL   QUAD   REAL   QUAD   . COND  DEPTH*. COND  DEPTH     RESIS   DEPTH
ANOMALY   PPM    PPM    PPM    PPM    . MHOS   FEET . MHOS   FEET     OHM-M    FEET
                                      .               .
                                      .               .
 378B       3      4      0      4    .   3      65 .    1     67       178       0
 378C       2      8      6     18    .   2       0 .    1     99       124       0
                                      .               .
                                      .               .
 379A       5     10      8     14    .   4      41 .    1     73       206       0
 379B       5     12      7     17    .   3      23 .    1     31       193       0
 379C       6     17      7     21    .   3      17 .    1     29       207       0
 379E       3      2      5      4    .  11     167 .    1     80       147       0
 379F       2      6      0      5    .   1       0 .    1    134       742       0
                                      .               .
                                      .               .
 380A       4      0      7     11    .   9     127 .    1    102        60       9
 380B       3     10      5     14    .   2       0 .    1     65        80       0
                                      .               .
                                      .               .
 381B       1      4      1      2    .   2      31 .    1    153       553       0
                                      .               .
                                      .               .
 382A       6     13      6     13    .   3       0 .    1    102        97       0
 382B       7     21     10     35    .   3       0 .    1     65        93       0
 382C       4     17      6     21    .   2       0 .    1     46       138       0
                                      .               .
                                      .               .
 383A       5      3      7     16    .   4       0 .    1     91       103       0
 383B       2     13      3     24    .   1       0 .    1     38       122       0
 383C       3      1      2      0    .  13     146 .    1    151       417       0
 383D       2      3      2      4    .   3      94 .    1    146       468       0
                                      .               .
                                      .               .
 384C       8     10     15     73    .   3       0 .    1    103        71      12
 384D       4      4      5      8    .   5      35 .    1    158        92      27
                                      .               .
                                      .               .
 385A       2      7      1     13    .   2       2 .    1     79       146       0
                                      .               .
 385C       2     16      6     35    .   1       0 .    1     71       123       0
 385E       2     12      3     21    .   1       0 .    1     45       516       0
                                      .               .                .
   .
   .* 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.    .
```

APPENDIX C

CERTIFICATE

I, Douglas C. Fraser, of the City of Mississauga, Ontario, Canada do hereby certify that:

1. I am a geophysicist residing at 3191 Cedartree Cres., Mississauga, Ontario.
2. I am a graduate of the University of New Brunswick with a B.A. Sc. degree (1957) and a M.A. Sc. degree (1960) in Geology, and of the University of California with a Ph.D. degree (1966) in Geophysics.
3. I have been practising my profession since January 1966.

REGISTERED PROFESSIONAL ENGINEER
D. C. FRASER
PROVINCE OF ONTARIO

D.C. Fraser

APPENDIX C

DOUGLAS C. FRASER

Douglas C. Fraser obtained a Bachelor's and Master's degree in geology at the University of New Brunswick and, in 1966, a Ph.D. degree in geophysics at the University of California at Berkeley. He has published papers on copper geochemistry, electromagnetics, VLF-EM, induced polarization, ground and airborne resistivity, digital filtering and correlation techniques, and on the design of new interpretation methods. He has been responsible for the design and development of the DIGHEM airborne electromagnetic system.

Dr. Fraser has been employed in geological mapping and geophysical exploration in both the mining and petroleum industries, and in geochemical prospecting for base metals. He is president of Dighem Limited and Fraser Consultants Inc., and is a member of the Association of Professional Engineers of Ontario, the Society of Exploration Geophysicists, the European Association of Exploration Geophysicists, the Canadian Institute of Mining, and is a member and past-president of the Canadian Exploration Geophysical Society.

D. C. FRASER

APPENDIX D

Dighem Limited

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AUSTRALIA
133-135 ALEXANDER STREET
P.O. BOX 57
CROWS NEST, N.S.W. 2065
TEL.: (02) 439-5488
TELEX: SECCO AA25468

October 21, 1981

TO WHOM IT MAY CONCERN

Dighem Limited did undertake and complete an airborne electromagnetic/resistivity/magnetic survey of 3,696 line-km for United Keno Hill Mines in the Carmacks area, Yukon. The field work was carried out in May and June of 1981.

The following is the list of Dighem's personnel who worked on this job at various stages.

I. CONTRACT NEGOTIATIONS

Name	Position-Function	Home Address	Home Telephone Number
D.C. Fraser	President	3191 Cedartree Cres. Mississauga L4Y 3G3	(416) 625-1092
M.M. Steiner	Vice-President	15 Quincy Cres. Willowdale M2J 1C5	(416) 491-2300
Z. Dvorak	Chief Geophysicist	146 Three Valleys Rd. Don Mills M3A 3B9	(416) 444-3276

II FIELD WORK

Name	Position-Function	Home Address	Home Telephone Number
W.R. Blight	Operation Supervisor	62 Henley Cres. Unit 18 Rexdale M9W 2X3	(416) 745-8346
R. Morrow	Pilot	R.R. #1, Bath Ontario	(613) 352-3692
G. Charbonneau	Pilot	R.R. #1, Pembroke Ontario	(613) 587-4749
B. Carruthers	Navigator-operator	R.R. #2, Stayner Ontario	(705) 428-2923 (416) 783-1619
R. Eichmanis	Navigator-operator	2355 Lakeshore Blvd W. #508, Toronto M8V 1B9	(416) 255-1723
S. Arstad	Navigator-operator	R.R. #2 Parry Sound P2A 2W9	(705) 732-2060

III COMPUTER PREPARATION & ANALYSIS OF DATA

P.W. Strandberg	Geophysicist-Computer Manager	84 Pugsley Ave. Richmond Hill L4G 1Z9	(416)883-5810
E. Swanborough	Data Processing Supervisor	6225 Judique Rd., #24 Mississauga L5N 2G4	(416)821-2632
J. Parsonage	Data Compilation Technician	75 Edgar Ave. Thornhill L4J 1S8	(416)881-1879
W. Novak	Data Processor	1423 Mississauga Valley Rd. #823, Mississauga L5A 3R8	(416)275-5764

IV INTERPRETATION OF DATA

D.C. Fraser	President	As shown above	
Z. Dvorak	Chief Geophysicist	As shown above	
S. Vergos	Geophysicist	281 Humberside Ave. Toronto M6P 1K9	(416)766-0132
T. Urquhart	Geophysicist	134 Divadale Dr. Toronto M4G 2P4	(416)425-3639

V DRAFTING

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P. McLoughlin	Draftsman	235 Brookbanks Dr. Don Mills M3A 2T7	(416)449-6392
R. Purcell	Draftsman	108 Henderson Dr. Aurora	(1) 727-1503
E. Janiec	Draftsman	110 St. Clair Ave. W. Toronto M4V 1N4	(416)924-6386

VI REPORT TYPING

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D. Jeffreys	Engineering Secretary	2170 Sherobee Rd. #1405 Mississauga	(416)270-5108

The above was prepared by S. Vergos upon request of United Keno Hill Mines.

DIGHEM LIMITED

S. Vergos
Geophysicist

K SV-27

APPENDIX E

LOGISTICS REPORT
ON
DIGHEM^{II} SURVEY
OF
FIL CLAIM BLOCK, MINTO AREA,
YUKON TERRITORY

FOR

UNITED KENO HILL MINES LIMITED

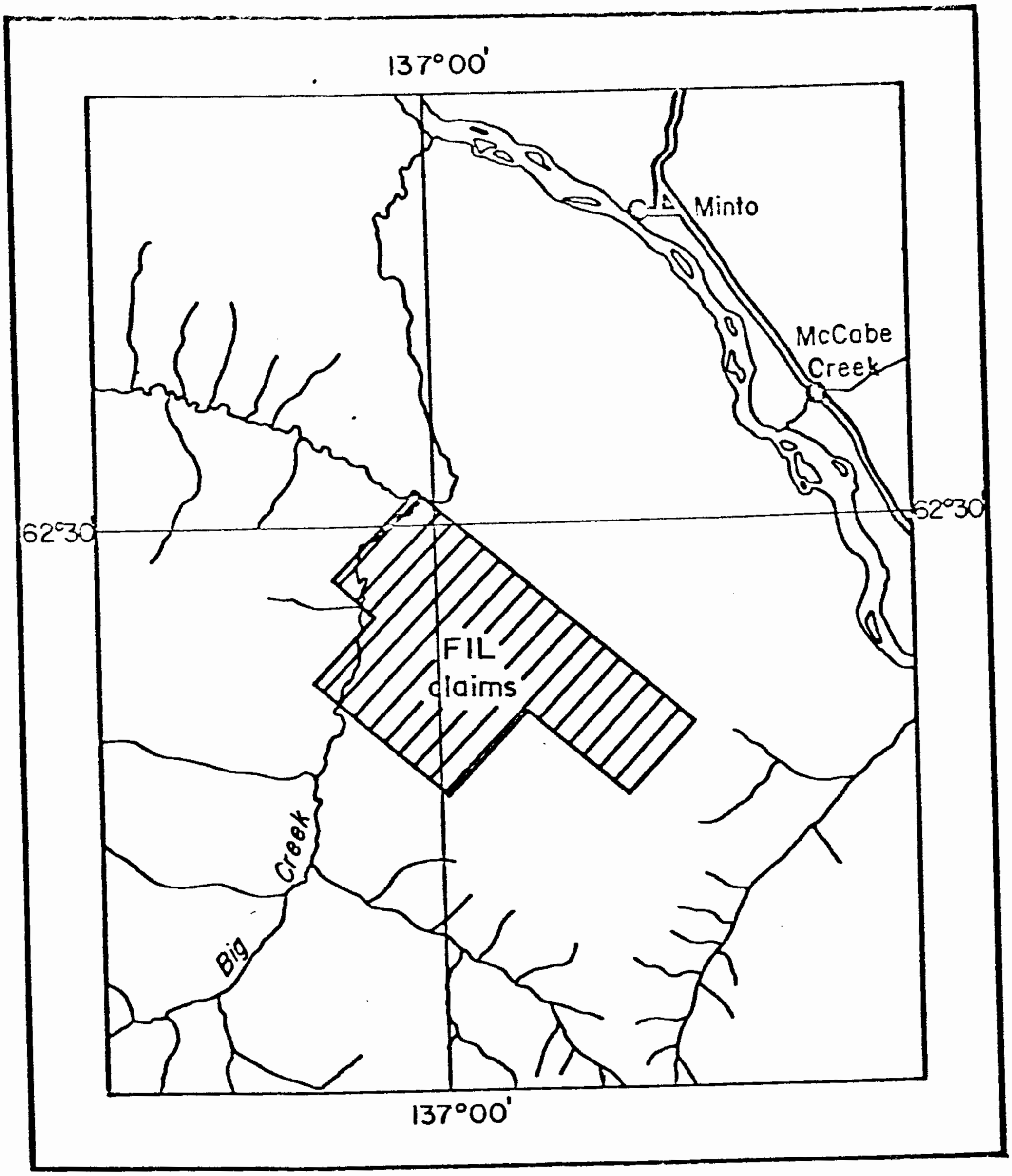
BY

DIGHEM LIMITED

Toronto, Ontario
June 11, 1981

Z. Dvorak
Geophysicist

LOCATION MAP



SCALE 1:250,000

Figure 1. - Survey area.

INTRODUCTION

A DIGHEM^{II} survey of 946 line-kilometres was flown with a 200 m line-spacing for the United Keno Hill Mines Limited, from May 27 to June 6, 1981 in the Minto area, Yukon Territory (Figure 1).

The Lama C-GDEM jet helicopter flew with an average airspeed of 115 km/h and EM bird height of 36 m. Ancillary equipment consisted of a Sonotek PMII-5010 magnetometer with its bird at an average height of 51 m, a Sperry radio altimeter, Geocam sequence camera, Barringer 8-channel hot pen analog recorder, and a Sonotek SDS 1200 digital data acquisition system with a Digi Data DPS 1100 9-track 800-bpi magnetic tape recorder. The analog equipment recorded four channels of EM data at approximately 900 Hz, two ambient EM noise channels (for the coaxial and coplanar receivers), and one channel each of magnetics and radio altitude. The digital equipment recorded the EM data with a sensitivity of 0.25 ppm/bit and the magnetic field to one gamma/bit.

SURVEY PROCEDURES

During the course of the survey the following data were recorded:

(a) DIGHEM^{II} electromagnetic results represented by four EM channels and two environmental monitor EM channels.

(b) One channel of the terrain clearance provided by the radar altimeter.

(c) One channel of the total magnetic field provided by the magnetometer.

(d) A photographic record of the terrain passing below the aircraft obtained from the 35 mm camera.

(e) Time marks impressed synchronously on the film, analog and digital records to facilitate accurate positioning on the final maps.

Data listed under items a, b and c were recorded both in the analog and digital forms.

PROCESSING AND PRESENTATION OF DATA

EM data recorded by the DIGHEM^{II} system during the survey were processed and interpreted by a computer on the basis of the following models:

(a) Vertical thin sheet conductor yielding conductance and depth.

(b) Horizontal sheet yielding conductance and depth.

(c) Conductive earth yielding apparent resistivity and depth.

The total magnetic field data were levelled and a contoured magnetic map was produced.

The magnetic data was also treated mathematically to enhance the magnetic response of the near-surface geology, and to de-emphasize deep-seated regional features.

The data collected during the survey are presented as follows:

(a) Computer-generated profiles of each line containing four channels of EM data, two EM difference channels, one channel of conductance, one channel each of resistivity and depth, one channel of magnetics, one channel of EM bird altitude, and two environmental EM monitor channels.

(b) The master photomosaic with electromagnetic information shown thereon.

(c) A transparent print of the photomosaic with contoured total magnetic field information shown thereon.

(d) A transparent print of the photomosaic with contoured enhanced magnetic field information shown thereon.

(e) A transparent print of the photomosaic with contoured resistivity information shown thereon.

(f) Two white paper prints of each map listed in (b), (c), (d) and (e) above.

(g) Two copies of a brief interpretative report.

SURVEY CHARGES

The services provided by DIGHEM include:

(a) Preparation of mosaics and other data prior to flying.

(b) The flying iteself and all supervision.

(c) Brief interpretation of the results of the survey.

(d) The preparation and delivery of the survey report and survey maps.

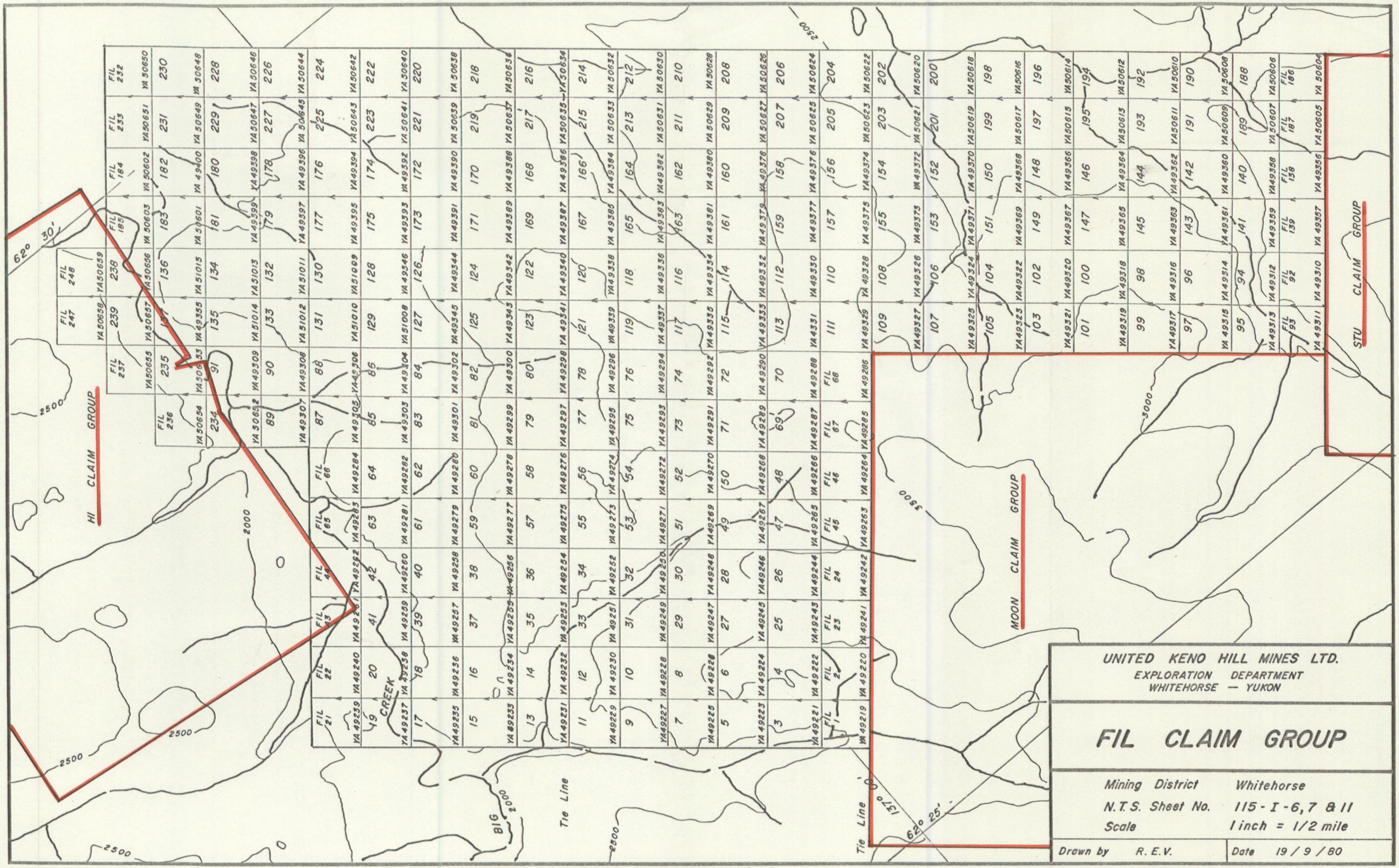
Charges for the above sevices are as follows:

(a)	Ferry and mobilization charges	$ 4,600.00
(b)	Survey charges, 946 line-km @ $52.80/line-km	49,948.80
(c)	Total of (a) and (b)	$54,548.80

Respectfully submitted,
DIGHEM LIMITED

Z. Dvorak
Geophysicist

E ZD-24



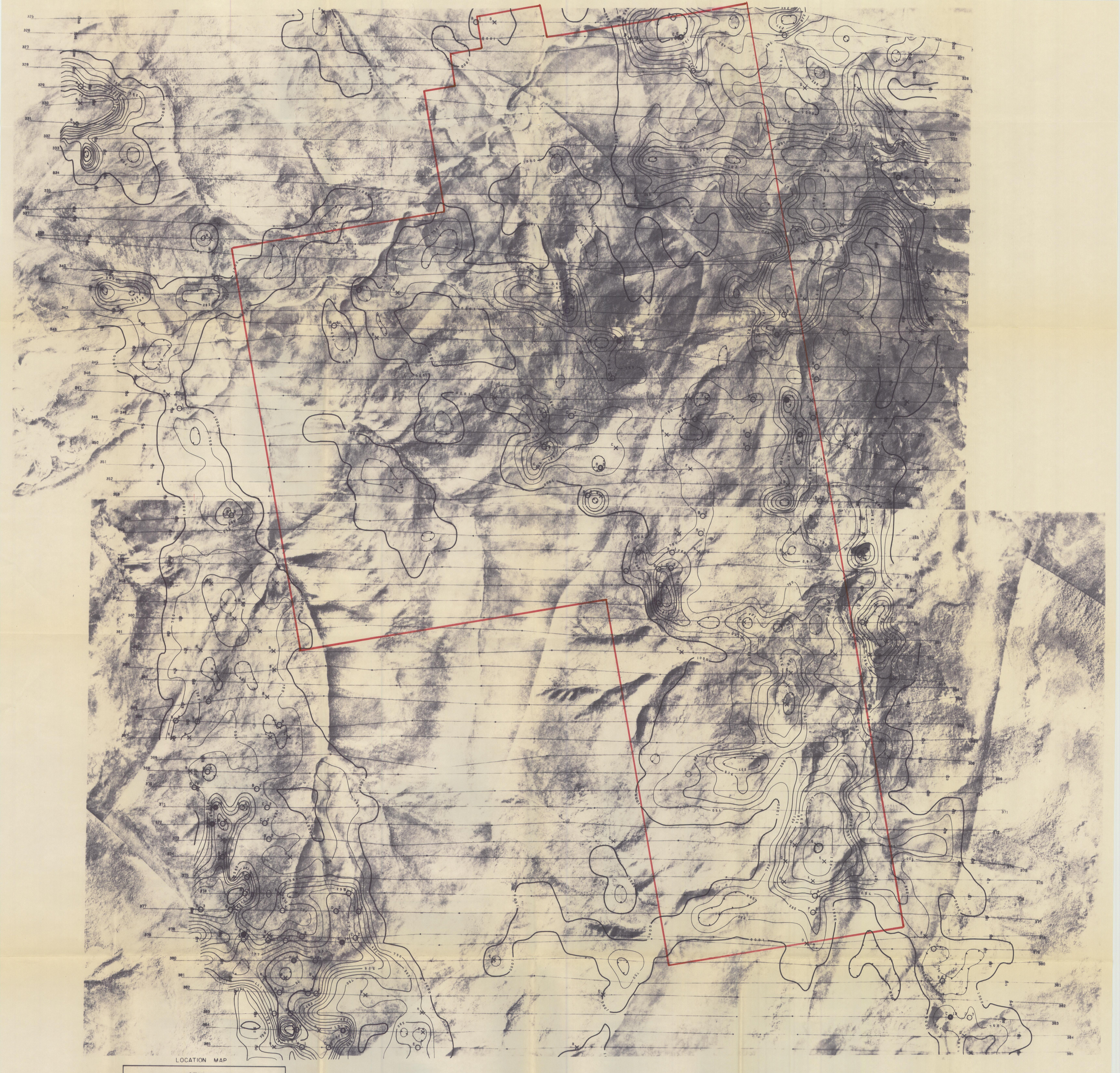
UNITED KENO HILL MINES LTD.
EXPLORATION DEPARTMENT
WHITEHORSE — YUKON

FIL CLAIM GROUP

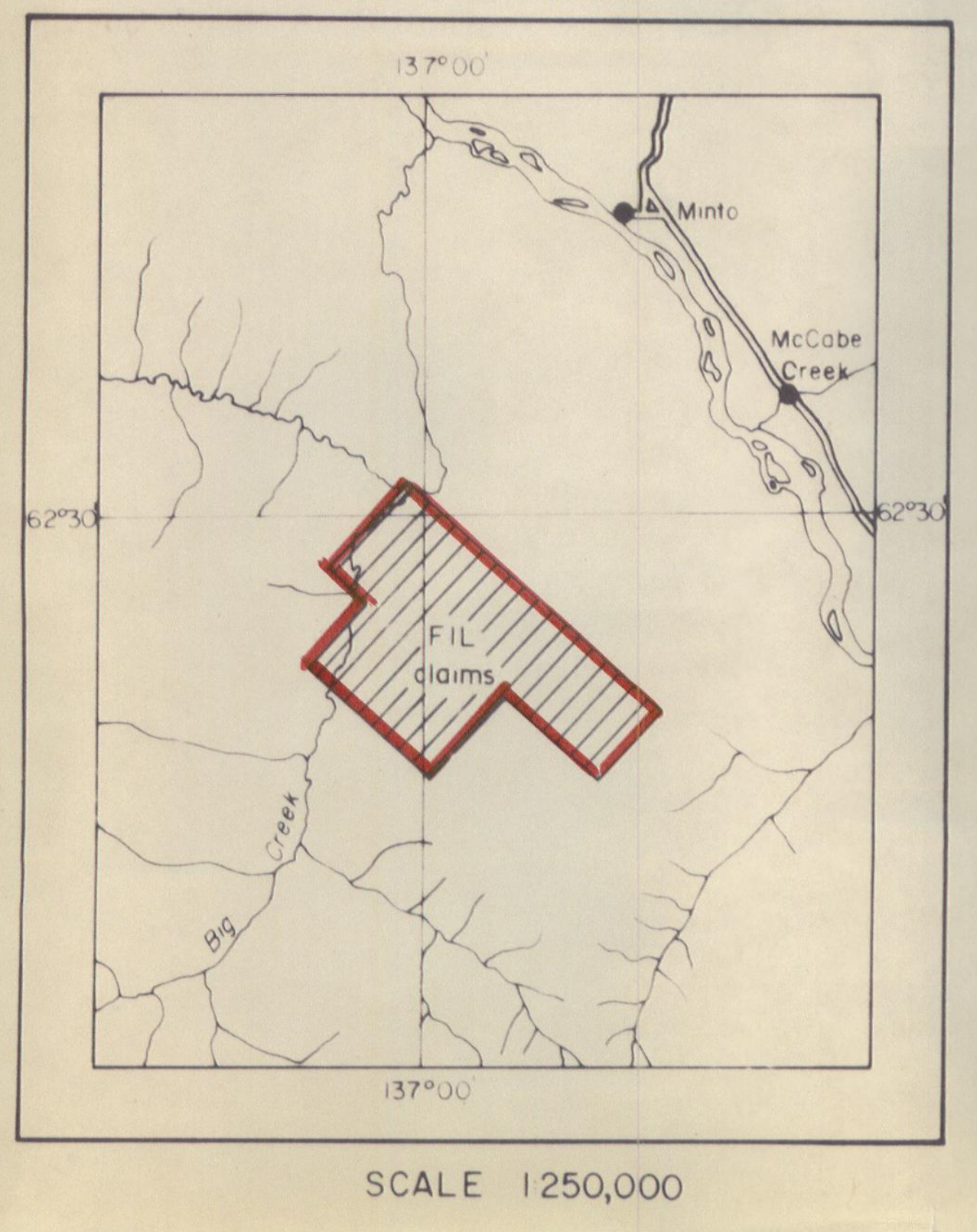
Mining District	Whitehorse
N.T.S. Sheet No.	115 - I - 6, 7 & 11
Scale	1 inch = 1/2 mile
Drawn by R. E. V.	Date 19 / 9 / 80

BCIL - 3043 - U.K.H.M.

FIGURE 2



LOCATION MAP



SCALE 1:250,000

DIGHEM^{II} SURVEY

090850

CARMACKS AREA, YUKON

RESISTIVITY

FOR

UNITED KENO HILL MINES LTD.

090850

REGISTERED PROFESSIONAL ENGINEER
D. C. FRASER
PROVINCE OF ONTARIO

SCALE 1 : 15,000

3/4 1/2 0 1/2 1 1 1/2 Kilometres

1/4 0 1/4 1/2 3/4 Miles

Flight line

1258

Fiducials and numbers

1256

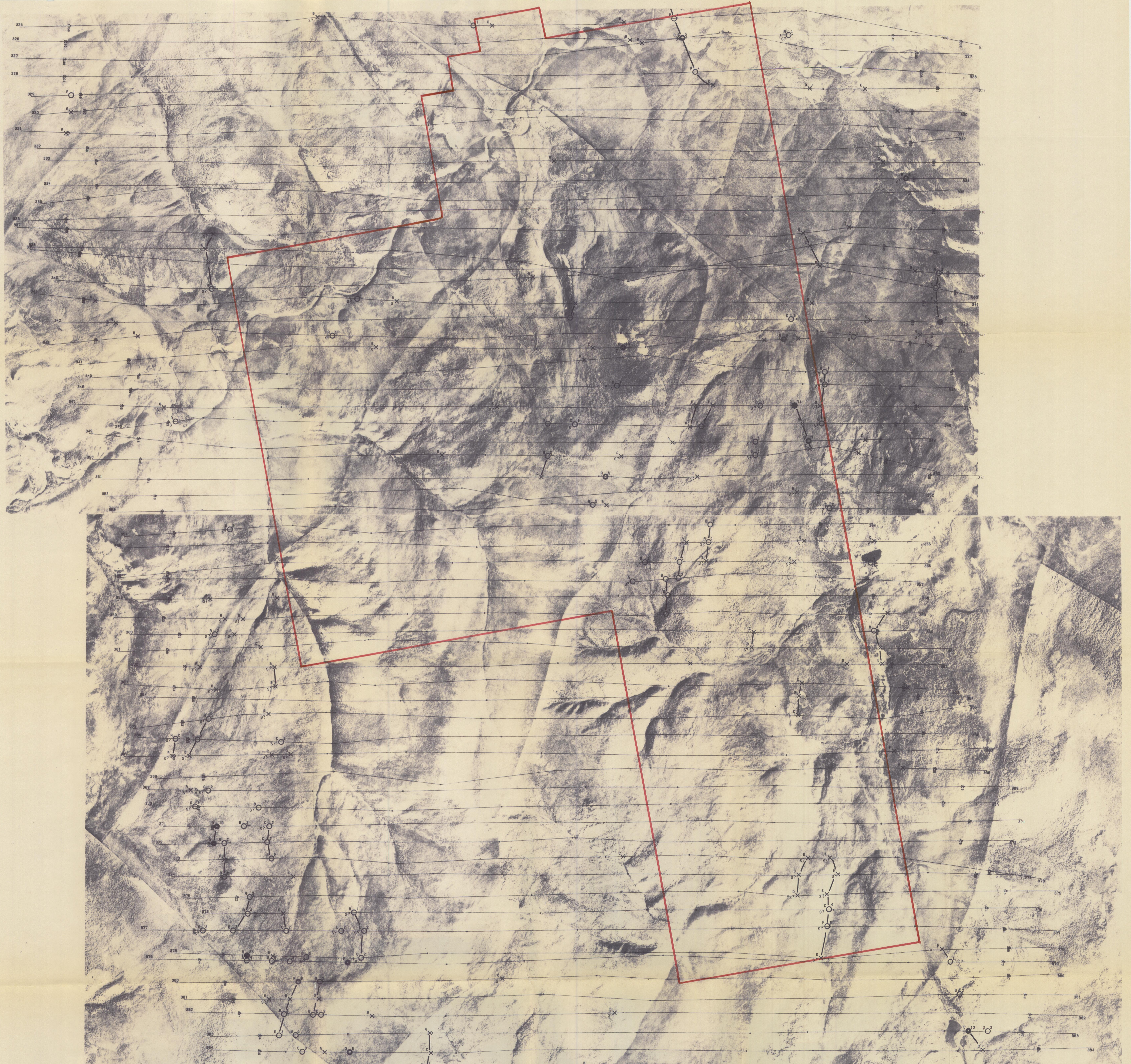
LEGEND

Contours in ohm-m
at eight intervals per decade

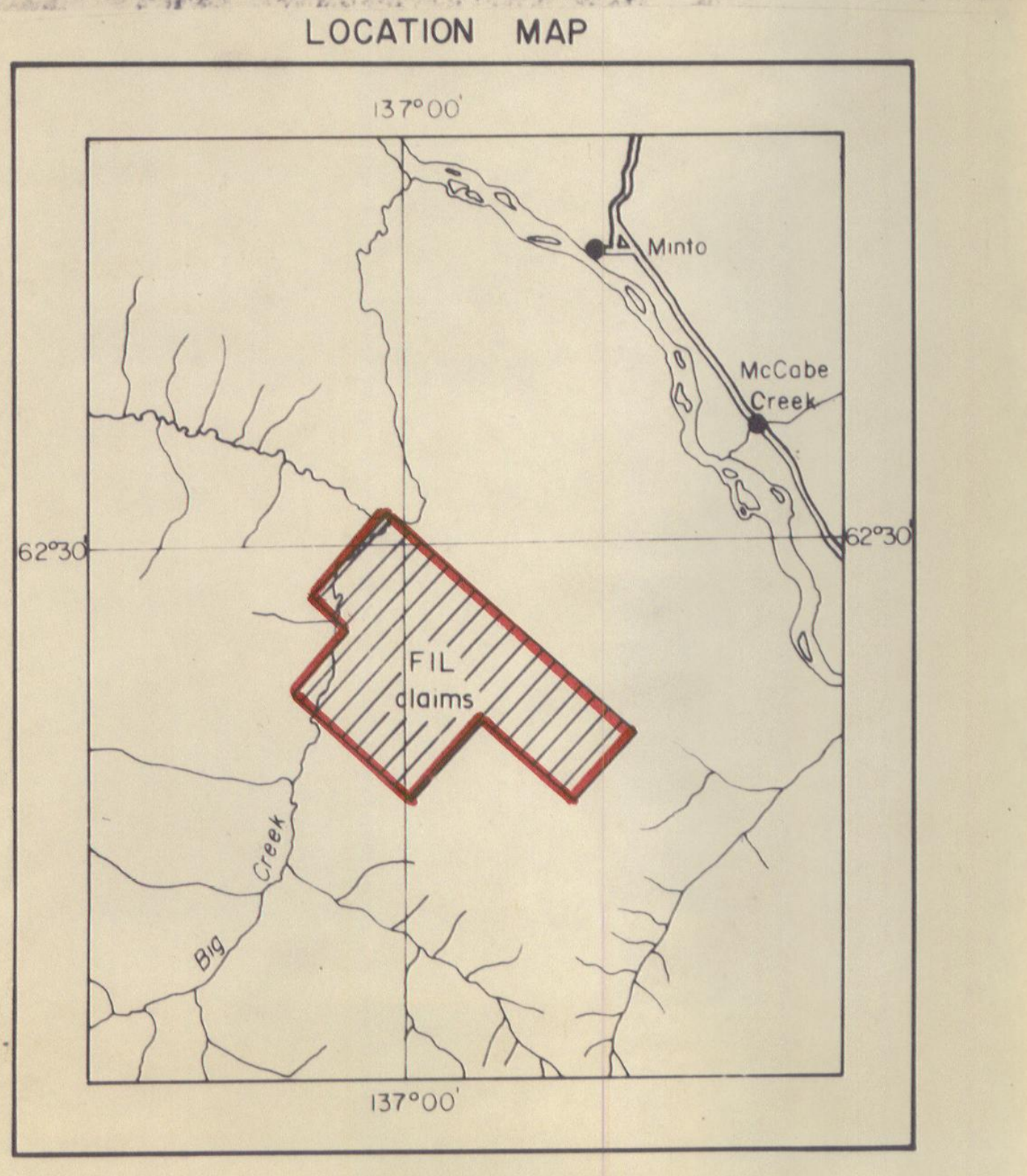
100
75
56
42
31
23
17
13
10

Note

The numbers face in the direction of increasing value.



LOCATION MAP



SCALE 1:250,000

090850

DIGHEM^{II} SURVEY

CARMACKS AREA, YUKON

ELECTROMAGNETICS

FOR

090850

UNITED KENO HILL MINES LTD.

SCALE 1 : 15,000

3/4 1/2 0 1/2 1 1 1/2 Kilometres

1/4 0 1/4 1/2 3/4 Miles

D. C. FRASER

REGISTERED PROFESSIONAL ENGINEER PROVINCE OF ONTARIO

Flight line

1252

Fiducials and numbers

1256

ANOMALY GRADE	EM GRADE SYMBOL	MHO RANGE
6	●	≥ 100
5	✹	50 — 99
4	●	20 — 49
3	◉	10 — 19
2	○	5 — 9
1	○	≤ 4
	×	Possible conductor

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. Most swamps yield Grade 1 anomalies but highly conducting clays can give Grade 2 anomalies. The multi - coil anomaly shapes often allow surface conductors to be recognized, and these are indicated by the letter S on this map. The remaining Grade 1 and 2 anomalies could be weak bedrock conductors. The higher grades indicate increasingly higher conductances. Examples: The ore bodies of the Magusi River camp yield Grade 4 anomalies, while Mattabi and Whistle give Grade 5. Graphite and sulphides can span all grades but, in this survey area, field work may show that the different grades indicate different types of conductors.

identifier → c 38 ← mho value

Depth is greater than
. 50 feet
: 100 feet
⋮ 150 feet
⁞ 200 feet

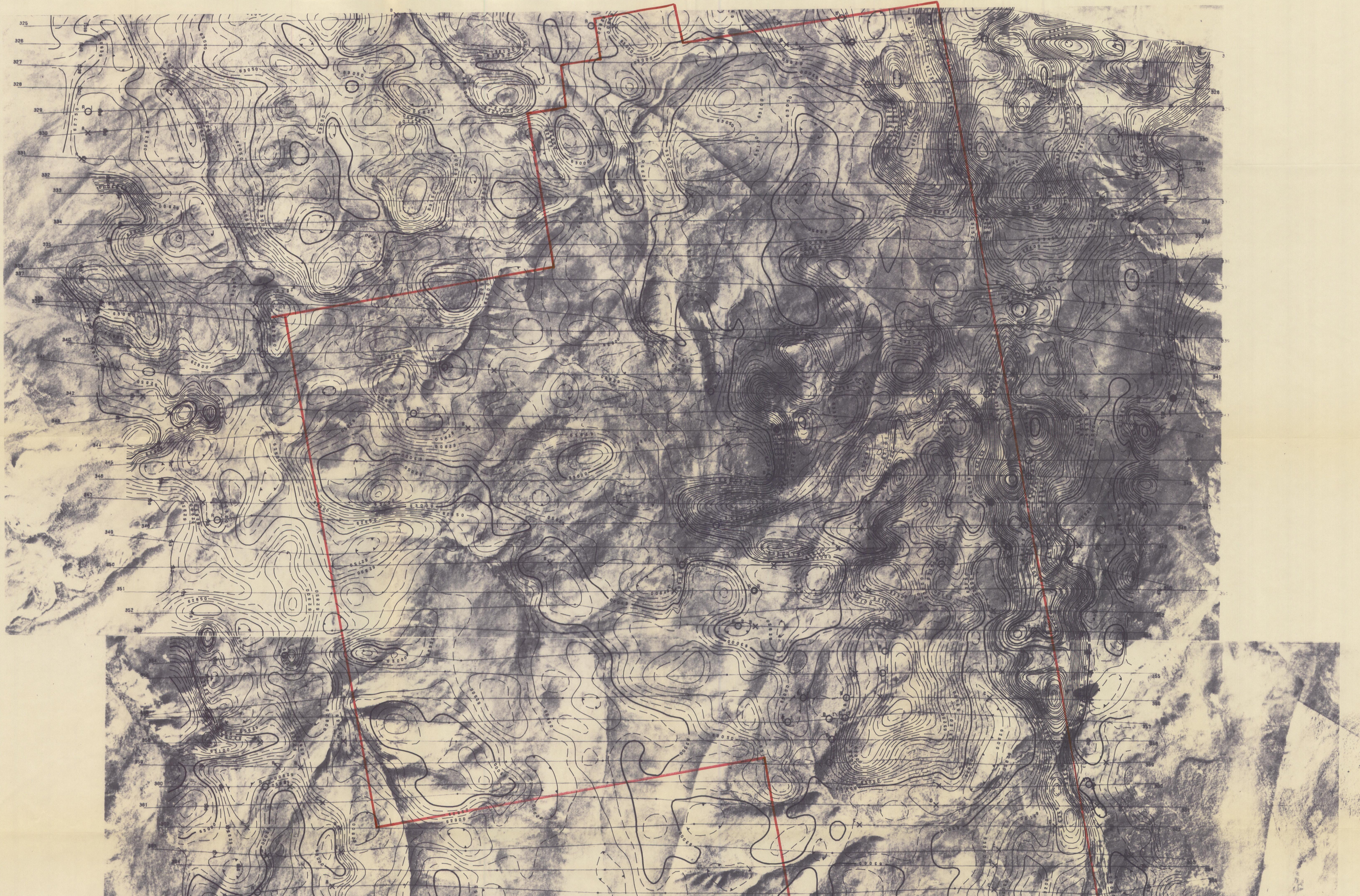
Inphase and Quadrature of Standard Coil is greater than
. 5 ppm
.. 10 ppm
... 15 ppm
.... 20 ppm

Refer to list of anomalies in survey report for the actual ppm values for all coils, and for conductor depths.

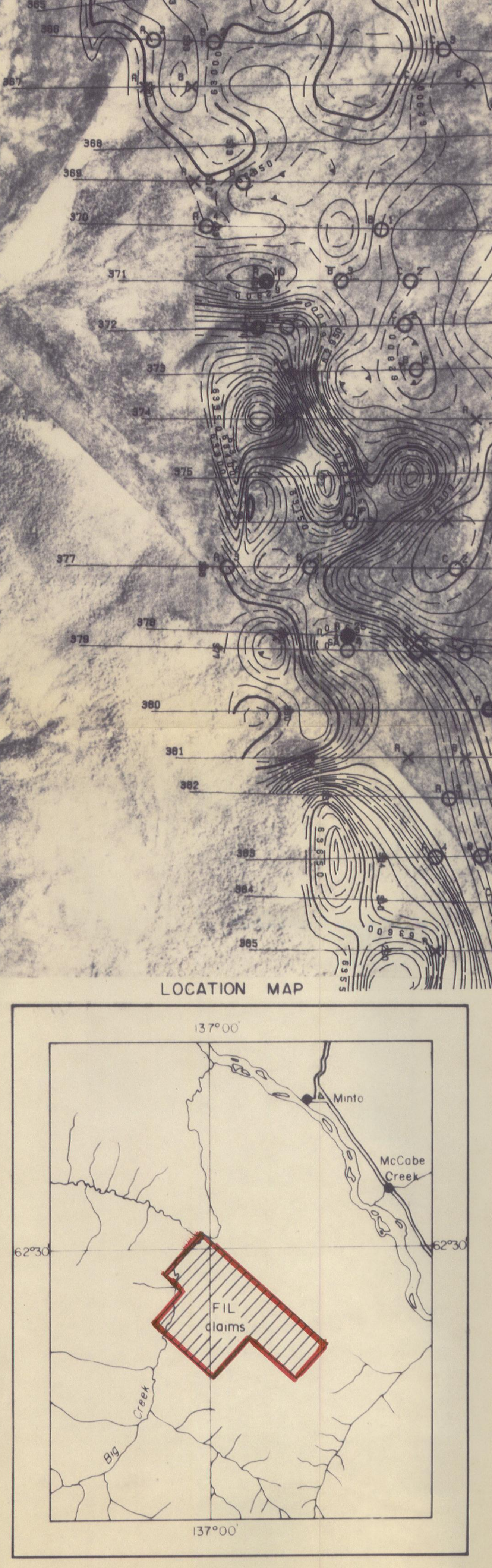
The actual mho value is plotted beside the EM grade symbol. The letter is the anomaly identifier. The horizontal rows of dots indicate anomaly amplitude on the flight record, and the vertical column gives the estimated depth. This depth may be unreliable because the stronger part of the conductor may be deeper or to one side of the flight line, or because of a shallow dip or conductive overburden effects.

╱	Conductor axis
S	Probable surface response
S?	Possible surface response
L	Probable line (power, telephone, pipe, or fence)
L?	Possible line
?	Questionable anomaly
⊂⊃	Apparent thickness > 10 m
>	Dip
100γ	Direct magnetic correlation of 100 gammas

DIGHEM 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 followup program. The actual mho values are plotted 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 all conductors in terms of length, strike direction, conductance and depth. The accuracy is comparable to an interpretation from a ground EM survey having the same line spacing.



LOCATION MAP



SCALE 1:250,000

090850

DIGHEM^{II} SURVEY

CARMACKS AREA, YUKON
MAGNETICS
FOR
UNITED KENO HILL MINES LTD.

D. C. FRASER

SCALE 1 : 15,000

3/4 1/2 0 1/2 1 1½ Kilometres

1/4 0 1/4 1/2 3/4 Miles

Flight line

1258

Fiducials and numbers

1256

ISOMAGNETIC LINES

(total field)

1000 .... 1000 gammas

200 .... 200 gammas

.... 50 gammas

.... 25 gammas

.... magnetic depression

Magnetic Inclination within the survey area: 77°

090850