82-#934-11020

GEOLOGICAL BRANCH ASSESSMENT REPORT

11,020

PART 5 OF 8

1982 GEOLOGICAL, GEOCHEMICAL, GEOPHYSICAL & DRILLING REPORT

on Way 1-33, Bull 1-6, Climax 1-11, Post 1-10 & Macc Claims

Liard Mining Division, B.C., NTS: 104-O-16 E & W
Latitude 59°56'N; Longitude 130°15'W

Date Submitted: January, 1983

VOLUME IV AIRBORNE GEOPHYSICS; by Dighem Limited

B.C. Midway Property 1982 Assessment Report

THIS REPORT CONSISTS OF THE FOLLOWING VOLUMES:

VOLUME I - Text (also includes Tables, Figures and Appendices)

VOLUME II - Plates (plates 1 to 22 inclusive)

VOLUME III-A - Diamond Drilling
- Logging Format
- Diamond Drill Core Logs with Assay & Analysis Record Sheets for ~~DDH MW 81- 1 to MW-81-6~~ DDH MW 82- 7 to MW 82-15

VOLUME III-B - Diamond Drilling (continued)
- Diamond Drill Core Logs with Assay & Analysis Record Sheets for DDH MW 82-16 to MW 82-20
  DDH B 82-1
  DDH EB 82-1 to EB 82-4

VOLUME IV - Airborne Geophysics; by Dighem Limited, Toronto
- Rpt. No. 158/1: Dighem II Survey on Way Claim Block
- Rpt. No. 168/2 Dighem II Survey on Post Claim Block

VOLUME V-A - Ground EM; by Glen E. White Geophysical Consulting & Services Ltd.
- Geophysical Report on a Horizontal Loop Pulse Electromagnetometer Survey

VOLUME V-B - Ground EM; by Glen E. White Geophysical Consulting & Services Ltd.
- Geophysical Report on a Pulse Electromagnetometer Survey

VOLUME VI - Gravity; by Ager, Berretta & Ellis Inc.
- Geophysical Report Gravity Survey

1 9 8 2

GEOLOGICAL, GEOCHEMICAL, GEOPHYSICAL & DRILLING REPORT

ON THE

WAY 1-33, BULL 1-6, CLIMAX 1-11, POST 1-10 & MACC

MINERAL CLAIMS

LIARD MINING DIVISION, BRITISH COLUMBIA
N.T.S. 104-O-16 E and W
Latitude 59°56'N; Longitude 130°15'W

OWNER: REGIONAL RESOURCES LTD.

under option to

AMAX of Canada Limited

OPERATOR: REGIONAL RESOURCES LTD.

CONSULTANT: CORDILLERAN ENGINEERING

By

Cordilleran Engineering
1418-355 Burrard Street
Vancouver, B.C. V6C 2G8

DATE SUBMITTED: January, 1983

FIELD PERIOD: June 1 - Oct. 6, 1982

VOLUME IV

TABLE OF CONTENTS

REPORT NO. 158/1

DIGHEM^{II} SURVEY

OF

WAY CLAIM BLOCK, TOOTSEE RIVER AREA
BRITISH COLUMBIA

FOR

CORDILLERAN ENGINEERING

BY

DIGHEM LIMITED

TORONTO, ONTARIO
JULY 23, 1982

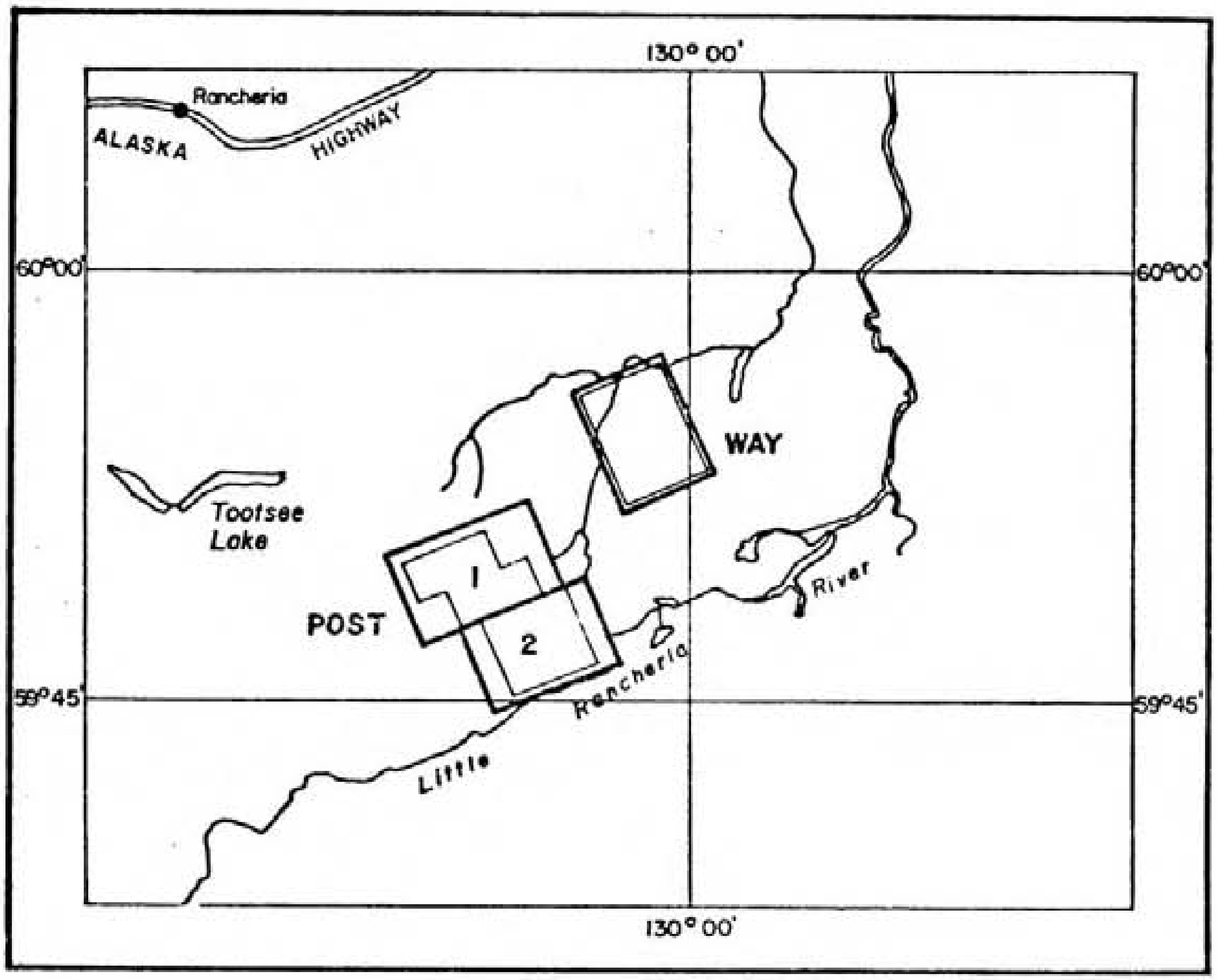
Z. DVORAK
VICE-PRESIDENT

SUMMARY

A DIGHEM^{II} airborne electromagnetic/resistivity/ magnetic survey of 235 line-km was flown in May, 1982, for Cordilleran Engineering over the Way claim block in the Tootsee River area, British Columbia.

The geologic environment in the survey area was moderately-to-highly conductive. The EM and resistivity anomalies detected occurred predominantly due to conductive bedrock features. Only a minor proportion of the responses were due to conductive overburden. Several features of possible exploration interest were located. They are satellitic to the major conductive trends of long strike length along the eastern boundary of the survey area as well as being enclosed within the more resistive southwest part of the survey block. All these features appear to warrant ground exploration work.

LOCATION MAP



Scale 1:500,000

Figure 1 The Survey Area

CONTENTS

INTRODUCTION

A DIGHEM^{II} survey of 235 line-km was flown with a 300 m line-spacing for the Cordilleran Engineering, from May 13 to May 18, 1982 over the Way claim block in the Tootsee River area, British Columbia (Figure 1).

The C-GDEM turbine helicopter flew with an average airspeed of 125 km/h and EM bird height of 36 m. Ancillary equipment consisted of a Geometrics 803 magnetometer with its bird at an average height of 51 m, a Sperry radio altimeter, Geocam sequence camera, RMS GR-33 digital graphics recorder, and a Sonotek SDS 1200 digital data acquisition system with a DigiData 1640 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.

Appendix A provides details on the data channels, their respective scales, and the data reduction 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. 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	≥ 100
5	50 - 99
4	20 - 49
3	10 - 19
2	5 - 9
1	< 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 below 1 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 surface conductors to be recognized, and these are indicated by the letter S on the map. The remaining anomalies in such areas could be bedrock

---

[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.

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., 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, 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 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 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 high quality 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 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 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 along the flight line. 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 3 m, 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.

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

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 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 six channels which contribute significantly to the recognition of bedrock conductors. These are the inphase and quadrature difference channels (#33 and 34), the resistivity and depth channels (#40 and 41), the conductivity contrast channel (#42), and the product of the conductivity contrast and depth contrast channels (#44).

The EM difference channels (33 and 34) 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 electrostatic chart 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.

The conductivity contrast channel (#42) highlights local resistivity lows. This channel, and the depth contrast (#43), both yield positive anomalies from conductors at depth. Channel 44 is the multiple 42*43 and it is highly sensitive to conductors at depth. The interpretation of channels 42 and 44 has to be done carefully, however, because they may also respond in a similar fashion to a local thickening in the conductive cover as, for example, over a buried river channel. Channels 42 and 43 are derived from channels 40 and 41 using digital filter techniques.

Channels 35, 36 and 42 are the anomaly recognition functions. They are used to trigger the conductance channel 37 which identifies discrete conductors. In highly conducting environments, channel 36 is deactivated because it is subject to 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 arising from gèologic 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

---

[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.

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 and magnetic permeability. 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 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 33. 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^{II} 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^{II}. The technique yields channel 50 which displays apparent weight percent magnetite according to a homogeneous half space model. 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.

The EM magnetite mapping technique provides estimates of magnetite content which are usually correct within a 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 channel 50.

The EM magnetite algorithm is basically quite simple because a linear relationship exists between volume percent magnetite and the negative inphase response in ppm. This linear relationship is true for a fixed survey altitude when demagnetization effects are disregarded and when a fixed susceptibility-volume percent relationship is assumed. The technique in practice involves, first, correcting the actual EM response for variations in flying altitude and, second, calibrating the negative inphase ppms in terms of volume percent magnetite.

EM magnetite mapping provides another method of airborne geologic mapping. It thus joins resistivity mapping, magnetometer mapping, spectrometry, photogeology, etc., as a possible means by which geologic information can be obtained from airborne techniques. It is not nearly as useful in the general sense as the other airborne mapping techniques, but can be of value in cases where the magnetite content gives an indication of lithology.

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.

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.

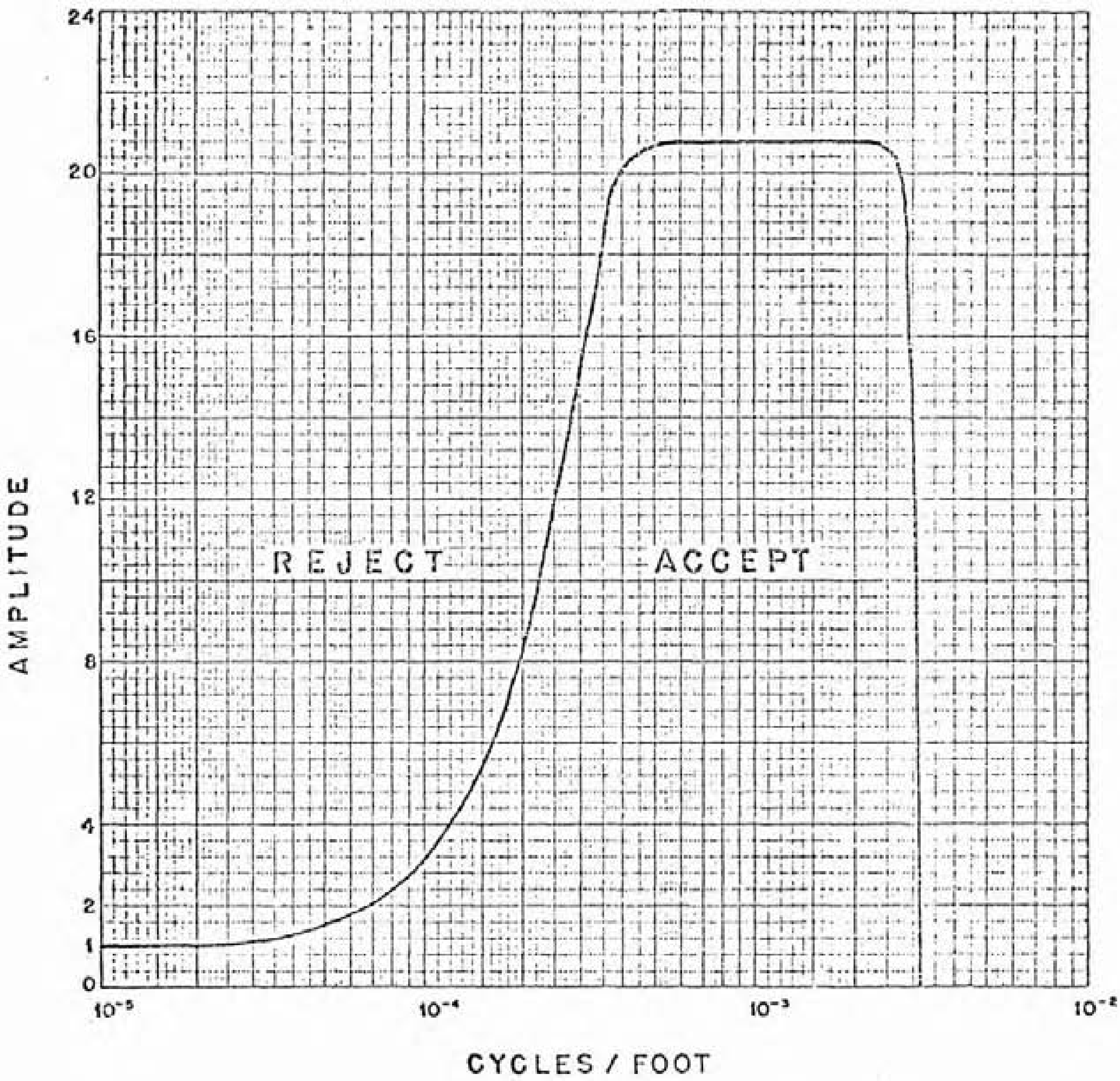


Figure 2 Frequency response of magnetic operator

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), depth and, occasionally, dip. 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 geologic environment in the survey area was moderately-to-highly conductive. A broad semi-oval resistive zone containing a conductive centre occurs in the southwest part of the sheet. In the east, it is bordered by a 1.5 to 3 km wide conductive zone which appears to consist of two separate highly conductive belts which, at places, display resistivities as low as 1-3 ohm-m. The geology of the area is not well known. Fragmental geologic information from the northern part of the sheet and from the area of a river paralleling the eastern half of line 2240 suggests that the two conductive zones in the eastern part of the survey block may reflect carbonaceous shales. A number of well defined bedrock conductors, of generally southwest dip, are associated with these conductive zones. Many of these have a considerable strike length which suggests that they may be formational conductors with little exploration potential. Because of the abundance of conductive material in this part of the survey area, the resistivity patterns portray the conductivity distributions better than the EM map.

In general, the line-to-line correlation of EM anomalies, which is based on a comparison of anomaly profiles and resistivity patterns, is quite reliable. It becomes difficult, however, when the resistivity lows become broad, and when the locally conductive highs are missing. The best example of such a situation is the conductive zone confined to anomalies 2080C, 2090D, and 2100C. This is a very attractive target which should be investigated on the ground.

Other targets of possible interest, which were similarly identified on the basis of the resistivity patterns, are 2131D-2141E and 2151C-2200E. They appear to be satellitic to the long linear conductive trends and should be considered in the follow-up program.

One of the most intriguing features is anomaly 2070D-2090A. The EM responses suggest that these grade 2 anomalies belong all to the same conductor. This interpretation is supported by the resistivity patterns. It is, however, noted that the conductor cuts across magnetic trends suggesting that two separate conductors may exist.

The conductive core of the resistive zone in the southwest part of the area reflects conductive material and depth. Its lateral extent is best indicated by the resistivity patterns. Only a few EM anomalies are associated with this zone, e.g., 2160B, 2160C, and 2180xA. This lack of EM anomalies occurs because the resistivity patterns are broad and the EM anomalies cannot be reliably identified.

Other conductive zones which appear to reflect conductive material at depth occur along the outer boundary of the main resistive zone, e.g., south of 2130A; in the vicinity of fiducial 2640 on line 2100; along conductor 2310D-2151xB with a possible extension to line 2170, 280 m west of 2170A; and further SSE to 2300xA.

The northwest corner of the survey area shows the presence of conductive rocks. It is separated from the rest of the area by a highly resistive zone. The magnetic maps suggest that a fault or a geologic contact extends in a NS-to-NNE direction through the area. Both the EM and the resistivity data are very active and, on occasion, difficult to correlate properly on a line-to-line basis. The limited geologic information available for the area suggests that conductor 2010C-2030E, and possibly other conductors, indicate carbonaceous shales. Neither resistivity, nor magnetics or enhanced magnetics, offer much help in sorting out individual EM responses. Only two observations are made which may help in the exploration program. First, the northwesterly striking conductors 2010A-2030A and 2020A-2021A and the associated low resistivity zone may connect with 2040A, 2040B and swings north towards 2030B in a fold-like fashion. Second, the enhanced magnetic anomaly, which extends from line 2050 (about 230 m east of 2050B) to line 2030 (about 170 m east of 2030G) may be indicative of a fault extending further northwest towards the river. Note the high resistivity zone on lines 2010 to 2030 on strike with this anomaly. Note also that a possible fault was mapped at the river outside the survey boundary, roughly on strike with the enhanced magnetic anomaly and the high resistivity zone.

Respectfully submitted,
DIGHEM LIMITED

Z. Dvorak

Z. Dvorak
Vice-President

Four map sheets accompany this report.

Electromagnetics	1 map sheet
Resistivity	1 map sheet
Magnetics	1 map sheet
Enhanced magnetics	1 map sheet

K ZD-76

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 electrostatic chart paper at 1:15,000 or at map scale, whichever is larger. The digital profiles, which may be displayed, are as follows:

Channel Number	Parameter	Scale units/mm
20	magnetics	10 gamma
21	bird height	3 m
22	vertical coaxial coil-pair inphase (freq #1)	1 ppm
23	vertical coaxial coil-pair quadrature (freq #1)	1 ppm
24	horizontal coplanar coil-pair inphase (freq #2)	1 ppm
25	horizontal coplanar coil-pair quadrature (freq #2)	1 ppm
26	VLF-EM total field	1 %
27	VLF-EM vertical quadrature	1 %
28	ambient noise monitor (coaxial receiver)	1 ppm
29	ambient noise monitor (coplanar receiver)	1 ppm
33	difference function inphase from channels 22 and 24	1 ppm
34	difference function quadrature from channels 23 and 25	1 ppm
35	first anomaly recognition function	1 ppm
36	second anomaly recognition function	1 ppm
37	conductance	1 mho
40	log resistivity (at freq #2)	.03 decade
41	apparent depth or thickness (at freq #2)	3 m
42	conductivity contrast (at freq #2)	arbitrary
43	depth contrast (at freq #2)	arbitrary
44	product 42*43 (at freq #2)	arbitrary
45	log resistivity (at freq #1)	.03 decade
46	apparent depth or thickness (at freq #1)	3 m
47	conductivity contrast (at freq #1)	arbitrary
48	depth contrast (at freq #1)	arbitrary
49	product 47*48 (at freq #1)	arbitrary
50	apparent weight percent magnetite	0.25%

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 recovered from camera film. 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*.

---

*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 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 14 EM channels are provided. The DIGHEM^{II} system 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 a conductive ore body in Australia. It will serve to identify the majority of the available channels.

Channels 20 and 21 are respectively the magnetics and the EM bird height. Channels 22 and 23 are the inphase and quadrature of the coaxial coil-pair. This coil-pair is

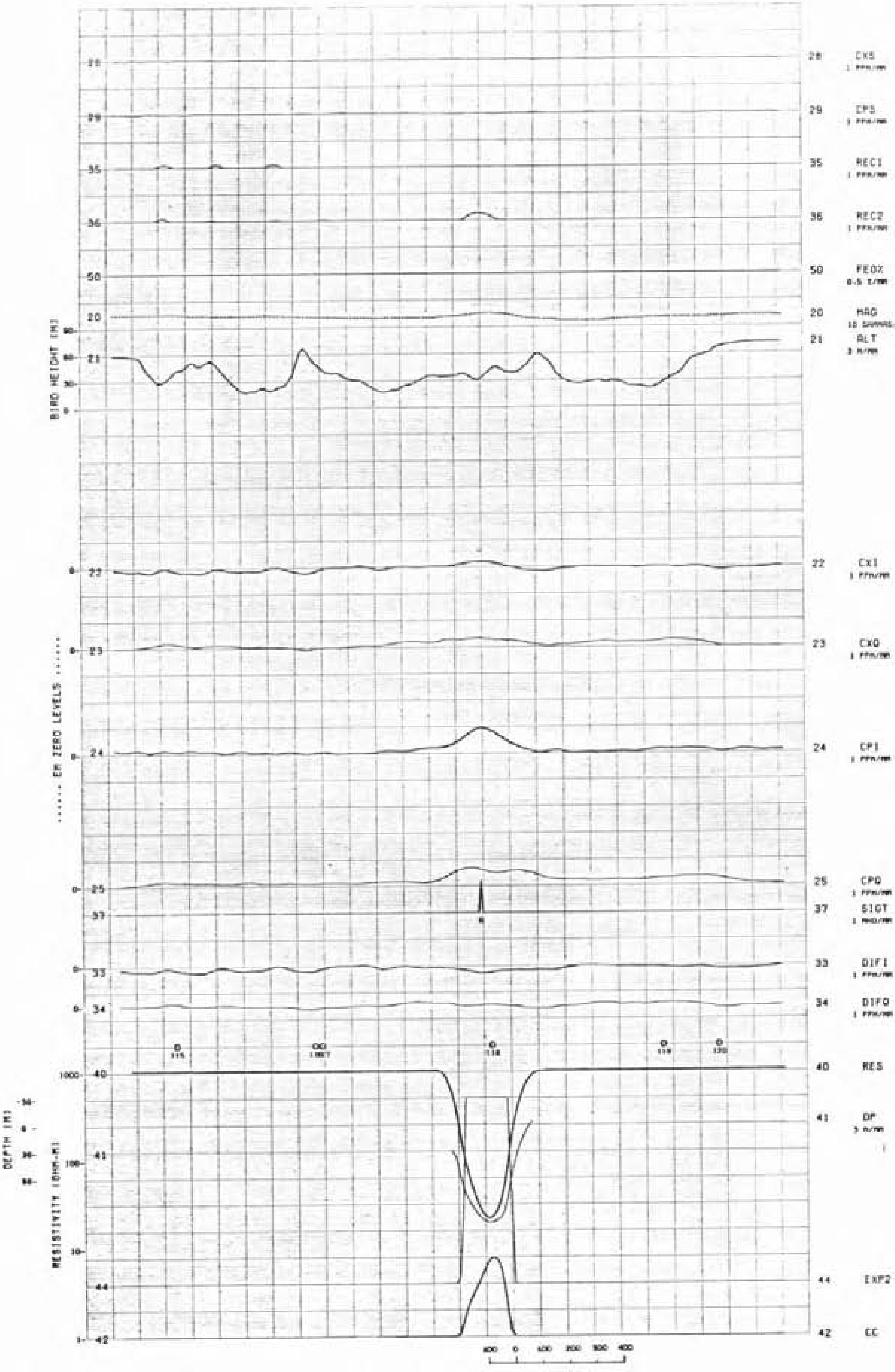


Fig. A1 DIGHEM^{II} digital profile.

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.

Channels 33 and 34 are inphase and quadrature difference functions of the coaxial and coplanar channels. The difference channels tend to be 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, 36, and 42.

Channel 40 is the resistivity, which is derived from the coplanar 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.*

---

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

Channel 41 is the depth channel. A depth estimate which is negative will occur when conductive overburden exists. A negative depth estimate implies that the conductive material occurs above the daylight surface. This false estimate shows that the EM system has responded to the conductive surface material and had also sensed the underlying resistive rock. In Fig. A1, the positive depth estimate of about 100 m is close to the true depth for this bedrock conductor.

Channel 42 is the conductivity contrast which highlights resistivity lows. Channel 43 is the depth contrast, which usually is not plotted. Both channels 42 and 43 tend to yield positive responses over bedrock conductors at depth. Channel 44 is the multiple of channels 42*43. Consequently, channel 44 tends to yield large positive responses over bedrock conductors at depth. The interpretation of channels 42 and 44 has to be done with care, however, because they may also respond in a similar fashion to a local thickening in conductive cover, e.g., over a buried river channel.

Channel 50 provides an estimate of the percent by weight of magnetite. This computation is made whenever the coplanar inphase channel 24 is negative. The negative response shows that magnetic permeability exists.

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 maps can be made independently for each frequency. The interpretation procedure involves comparing the apparent resistivity and apparent depth parameters at the two frequencies.

The use of two different coil-pair orientations (i.e., coaxial and coplanar) 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. 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, and the anomaly recognition channel 35, are not produced for dual frequence surveys. This is because the divergent frequencies of the two coil-pairs render them meaningless.

APPENDIX B

EM Anomaly List

	COAXIAL COIL		COPLANAR COIL		VERTICAL DIKE		HORIZONTAL SHEET		CONDUCTIVE EARTH	
LINE & ANOMALY	REAL PPM	QUAD PPM	REAL PPM	QUAD PPM	COND MHOS	DEPTH* M	COND MHOS	DEPTH M	RESIS OHM-M	DEPTH M
2010A	22	9	27	11	35	12	2	50	52	17
2010B	3	1	5	4	16	58	2	74	30	45
2010C	78	41	132	78	39	5	8	45	2	33
2010D	56	39	127	110	23	0	10	26	1	16
2010E	11	2	23	16	27	23	15	24	1	15
2010F	111	45	191	101	55	0	16	22	1	14
2010G	5	7	22	13	11	9	9	51	2	37
2010H	13	15	25	43	7	0	4	29	11	12
2010I	29	27	41	57	11	1	2	33	29	9
2010J	36	29	67	56	18	0	4	37	8	21
2020A	16	17	39	40	11	0	4	33	8	15
2020B	3	4	0	3	6	35	1	41	116	7
2020C	4	4	11	9	10	24	2	73	38	40
2020D	42	16	98	46	45	0	19	45	1	36
2020E	33	10	76	30	54	2	16	29	1	20
2020F	38	10	49	27	48	0	15	29	1	19
2020G	11	2	26	6	76	19	8	79	3	62
2020H	56	11	122	35	112	1	14	34	1	24
2020I	17	17	42	37	13	2	4	41	11	23
2021A	10	24	45	59	7	0	4	35	10	16
2021B	20	28	44	59	9	0	2	25	28	0
2021C	7	9	21	22	8	10	2	54	35	24
2021D	56	12	129	20	178	0	21	44	1	35
2021E	9	1	13	1	49	27	9	68	2	52
2021F	45	15	94	39	56	0	11	35	1	24
2021G	6	1	14	5	48	37	5	86	7	66
2021H	19	8	41	13	41	10	6	60	5	43
2030A	61	82	104	148	12	0	3	26	12	9
2030B	16	16	32	33	11	7	3	41	20	18
2030C	8	10	6	35	3	2	2	38	37	11
2030D	36	39	81	81	14	2	2	36	37	11
2030E	36	30	81	81	17	0	4	36	11	18
2030F	1	0	27	7	59	46	4	85	9	64
2030G	2	0	27	7	66	43	3	97	18	70
2030H	18	31	37	70	6	0	3	36	19	14
2030I	13	2	18	10	39	38	4	81	9	60

* 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.

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* M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
2030J	11	11	16	21	8	1	4	43	9	25
2030K	44	23	98	46	39	0	10	30	1	19
2030M	33	15	57	31	34	0	6	36	5	20
2030N	16	25	18	50	5	0	5	34	7	18
2030O	41	31	91	67	22	0	4	33	12	15
2040A	96	43	203	96	54	0	11	22	1	13
2040B	68	42	126	96	28	0	6	23	4	10
2040C	16	12	51	44	15	0	5	39	6	23
2040D	15	14	34	34	11	0	4	35	10	17
2040E	8	8	25	25	10	4	3	33	13	14
2040F	31	14	100	32	54	3	4	36	8	20
2040G	39	13	99	46	49	0	6	26	4	12
2040H	10	13	24	31	7	7	4	50	9	32
2040I	3	7	12	18	4	0	6	29	5	13
2040J	25	10	50	19	44	0	7	35	3	21
2050A	5	11	9	12	4	17	2	60	35	30
2050B	15	18	12	11	9	22	2	63	54	30
2050C	11	23	31	66	5	0	2	23	46	0
2050D	32	24	56	57	16	11	4	37	11	19
2050E	154	100	235	212	32	0	6	24	4	12
2050F	14	13	37	33	13	2	4	40	9	23
2050G	38	37	101	90	17	0	6	28	4	14
2060A	8	13	14	22	5	7	1	36	70	6
2060B	4	12	10	28	3	0	1	25	95	0
2060C	5	6	4	10	4	20	1	57	87	20
2060D	7	17	22	34	5	0	4	28	10	11
2060E	42	16	89	45	42	0	7	31	3	18
2060F	11	13	41	35	12	4	6	32	5	18
2060G	27	14	74	34	36	0	7	26	3	13
2060H	3	6	0	0	3	19	1	70	201	20
2070A	5	17	9	16	3	6	1	34	56	7
2070B	4	11	8	23	3	7	1	31	63	4
2070C	2	13	1	22	1	0	1	21	125	0
2070D	8	8	11	9	9	25	1	44	125	9

* 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* M	COND MHOS	DEPTH M	RESIS OHM-M	DEPTH M
2070E	12	20	14	36	5	8	1	36	72	8
2070F	0	10	0	19	1	0	2	32	48	7
2070G	13	2	219	22	308	11	3	25	16	7
2070H	164	182	231	333	18	0	4	17	7	4
2070I	58	67	107	138	14	0	5	21	7	7
2070J	25	9	54	31	33	12	3	44	17	22
2070K	16	27	24	44	6	0	1	24	63	0
2080A	14	16	26	36	8	8	2	50	29	23
2080B	27	37	66	75	11	0	3	29	13	9
2080C	1	0	4	0	269	75	8	94	3	75
2080D	29	25	71	54	19	0	5	28	6	12
2081A	12	17	31	44	7	10	2	39	37	13
2081B	44	25	66	58	23	5	3	35	14	16
2081C	36	28	91	91	17	0	4	28	11	11
2081D	26	15	43	43	17	0	4	31	12	13
2081E	19	26	33	48	8	0	4	36	12	17
2081F	8	3	22	16	17	7	5	50	6	32
2090A	12	21	24	48	5	7	2	35	45	10
2090B	2	10	1	14	1	0	1	30	166	0
2090C	61	76	102	175	11	0	2	22	29	2
2090D	23	7	31	10	55	24	7	52	4	38
2090E	48	50	50	74	12	0	4	25	11	8
2090F	50	48	51	107	11	0	2	16	21	0
2090G	2	6	0	5	3	36	1	39	199	4
2100A	9	15	26	36	6	2	2	39	36	12
2100B	44	38	87	88	17	0	3	25	17	5
2100C	53	27	136	45	54	0	11	23	1	13
2100D	28	40	38	60	8	0	6	26	4	13
2100E	17	36	35	103	5	0	3	20	17	0
2100F	5	11	1	18	2	0	1	22	313	0
2110A	4	2	2	3	10	3	1	64	287	2
2110B	6	27	11	43	2	0	1	32	103	3

* 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.

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* M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
2110C	10	12	13	28	5	12	1	39	75	10
2110D	0	11	0	10	1	0	1	43	77	11
2110E	0	7	0	15	1	0	2	37	34	11
2110F	52	39	107	75	25	1	5	38	5	23
2110G	31	15	78	45	32	3	6	30	5	16
2110H	39	42	70	109	11	0	3	22	17	3
2110I	2	16	0	21	1	0	1	3	679	0
2120C	16	13	25	26	12	11	2	43	52	13
2120D	55	48	121	93	22	0	5	24	6	9
2120E	39	56	68	113	9	0	3	22	18	2
2120F	6	15	1	19	2	0	1	15	282	0
2130A	4	7	6	15	3	3	1	45	171	3
2130B	8	38	8	59	2	0	1	15	230	0
2130C	14	9	19	22	12	19	2	46	48	17
2130D	5	15	13	32	3	0	1	36	64	7
2130E	8	18	26	55	5	6	2	37	38	12
2130F	40	49	98	89	17	0	4	32	9	16
2130G	69	62	160	138	22	0	5	24	6	10
2131A	14	18	26	44	7	0	2	27	37	0
2131B	4	9	4	16	3	0	1	44	89	9
2131C	10	8	22	17	13	0	2	46	30	17
2131D	34	16	86	35	42	0	6	31	4	17
2140A	7	14	10	24	4	6	1	36	121	3
2140B	10	9	14	18	8	9	2	46	47	15
2140C	17	15	29	27	13	0	3	42	19	19
2140D	61	29	125	84	34	0	8	24	2	12
2141A	18	31	30	60	6	0	2	29	44	3
2141B	2	3	6	9	4	35	1	71	62	35
2141C	4	12	52	45	9	4	2	47	31	19
2141D	29	26	63	47	17	0	4	38	10	21
2141E	9	5	12	6	21	35	4	48	9	30
2141F	45	47	68	82	13	0	4	28	10	11

* 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* M	COND MHOS	DEPTH M	RESIS OHM-M	DEPTH M
2141G	23	38	65	83	9	0	4	24	11	6
2150A	3	21	5	41	1	0	1	25	136	0
2150B	3	6	4	9	3	25	1	48	217	6
2150C	24	30	47	59	10	0	2	28	23	5
2150D	7	11	6	12	4	16	1	46	77	14
2150E	39	22	89	51	31	0	5	31	8	15
2150F	22	29	57	25	17	6	4	35	10	18
2151A	5	9	11	18	4	9	2	58	51	24
2151B	5	1	10	2	67	0	5	68	8	44
2151C	16	10	37	23	21	9	5	53	5	36
2151D	14	17	22	41	7	4	3	45	13	26
2151E	10	18	13	40	4	0	2	34	31	8
2160A	5	1	2	1	80	63	1	92	113	44
2160B	5	5	4	11	4	19	1	55	96	17
2160C	5	10	8	20	4	8	1	45	81	12
2160D	15	18	18	30	7	0	2	37	48	7
2160E	8	2	7	5	25	9	2	57	45	21
2160F	39	6	78	44	55	0	8	35	3	23
2160G	27	18	48	36	20	2	6	41	4	26
2170A	2	7	1	5	1	9	1	37	454	0
2170B	11	28	9	40	3	2	1	37	81	9
2170C	12	26	142	102	17	2	3	40	14	20
2170D	84	61	192	136	30	0	7	28	3	16
2170E	16	7	21	13	24	19	4	34	9	17
2170F	40	37	72	89	14	0	3	17	15	0
2170G	16	18	22	38	8	1	1	41	74	8
2180A	6	1	0	0	59	57	1	50	378	0
2180B	5	8	10	18	4	14	1	52	73	18
2180C	6	13	12	24	4	2	2	49	51	17
2180D	20	8	47	27	31	0	3	42	19	18
2180E	24	7	28	13	42	13	6	37	4	22
2180F	22	20	38	54	11	0	3	29	16	9

* 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* M	COND MHOS	DEPTH M	RESIS OHM-M	DEPTH M
2190A	10	2	13	14	20	34	1	44	82	13
2190B	18	54	15	99	3	0	1	19	62	0
2190C	9	17	60	63	10	12	2	39	28	16
2190D	48	31	72	75	20	3	2	28	36	5
2190E	126	68	198	140	39	0	8	23	2	12
2190F	35	15	61	57	23	0	6	28	4	14
2190G	13	19	7	19	5	0	1	38	147	0
2200B	18	25	34	51	8	0	2	26	36	1
2200C	6	13	0	6	4	8	1	40	61	8
2200D	36	21	94	50	32	0	7	29	3	16
2200E	24	27	54	57	12	0	4	24	9	7
2200F	33	35	65	74	13	0	4	28	8	13
2210A	2	11	1	13	1	0	1	36	981	0
2210B	2	12	1	12	1	0	1	13	823	0
2210C	29	35	47	72	10	0	2	33	24	10
2210D	28	48	78	121	9	0	3	29	15	10
2210E	12	20	18	36	5	6	2	48	23	24
2210F	76	67	175	137	24	0	6	19	4	6
2220A	4	14	4	25	2	0	1	27	138	0
2220B	31	32	56	63	13	0	2	27	24	3
2220C	13	9	27	19	16	6	3	35	22	10
2220D	24	23	46	59	11	0	2	19	38	0
2220E	5	5	13	15	8	24	2	60	39	29
2230A	7	18	4	15	3	4	1	21	401	0
2230B	38	64	56	95	8	0	2	33	38	9
2230C	43	55	56	95	10	0	1	24	77	0
2230D	11	17	17	8	9	20	1	47	55	17
2230E	8	6	18	17	11	30	2	43	48	15
2230F	29	23	47	54	14	12	2	42	39	16
2230G	4	5	7	12	4	24	1	51	114	15
2240A	5	10	4	16	3	4	1	27	258	0
2240B	7	12	8	13	5	8	1	53	86	16

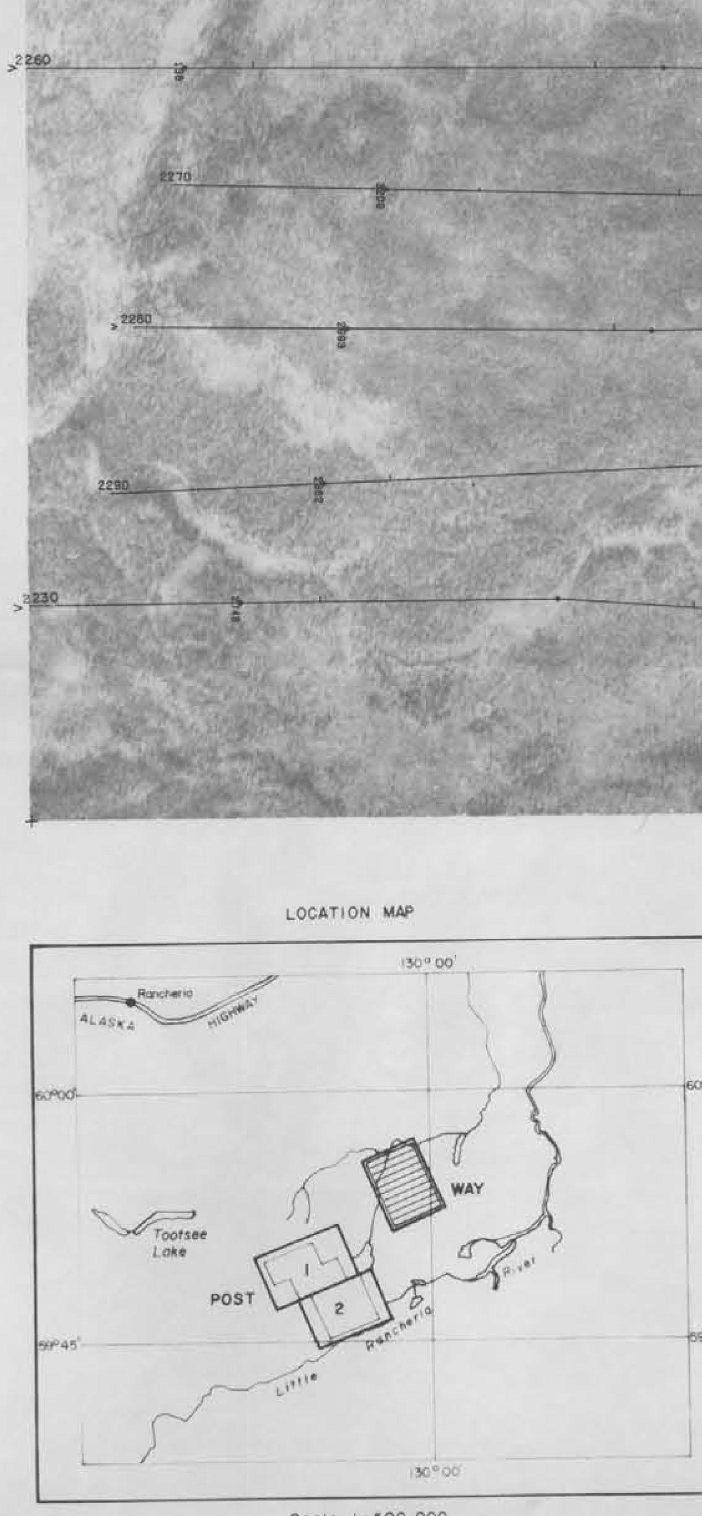
* ESTIMATED DEPTH MAY BE UNRELIABLE BECAUSE THE STRONGER PART OF THE CONDUCTOR MAY BE DEEPER OR TO ONE SIDE OF THE FLIGHT LINE, OR BECAUSE OF A SHALLOW DIP OR OVERBURDEN EFFECTS.

	COAXIAL COIL		COPLANAR COIL		VERTICAL DIKE		HORIZONTAL SHEET		CONDUCTIVE EARTH	
LINE & ANOMALY	REAL PPM	QUAD PPM	REAL PPM	QUAD PPM	COND MHOS	DEPTH* M	COND MHOS	DEPTH M	RESIS OHM-M	DEPTH M
2240C	7	4	15	8	19	29	2	64	45	31
2240D	6	4	15	8	17	17	2	43	51	10
2240E	2	6	1	16	1	0	1	43	89	9
2240F	55	32	136	90	31	0	9	37	2	25
2250A	3	15	0	27	1	0	1	29	215	0
2250B	27	21	45	46	15	2	2	43	35	16
2250C	46	40	103	104	18	1	2	37	25	14
2250D	2	12	6	21	2	0	1	45	302	2
2260A	27	22	46	46	15	0	3	32	15	10
2260B	19	11	32	29	17	7	2	61	36	30
2270A	21	33	26	57	6	2	2	38	46	11
2270B	6	11	30	22	9	17	2	50	33	23
2270C	35	13	79	43	38	0	6	39	4	24
2270D	19	26	44	66	8	4	3	54	20	31
2280A	24	23	33	45	11	0	2	42	36	14
2280B	5	15	32	29	7	0	2	52	28	24
2280C	17	17	48	40	14	0	3	36	13	16
2280D	18	19	42	51	10	0	3	44	21	20
2290A	5	20	4	17	2	1	1	32	293	0
2290B	47	38	62	78	15	0	3	30	20	8
2290C	55	39	110	78	25	0	6	34	5	19
2290D	15	10	21	25	12	12	2	61	42	29
2300A	7	6	4	11	6	5	1	52	63	15
2300B	7	24	40	33	7	4	2	36	31	11
2300C	32	10	81	25	64	7	7	44	3	30

* 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.

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* M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
2310A	9	3	23	6	49	0	6	51	5	31
2310B	2	17	10	50	1	0	1	25	91	0
2310C	6	7	14	16	7	20	2	46	51	16
2310D	4	21	10	41	2	0	1	23	137	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.



DIGHEM II SURVEY

WAY CLAIM BLOCK , TOOTSEE RIVER AREA, B.C.

GEOLOGICAL BRANCH
ASSESSMENT REPORT

ELECTROMAGNETICS

FOR

CORDILLERAN ENGINEERING

11,020

PART
5 of 8

SCALE 1:10,000

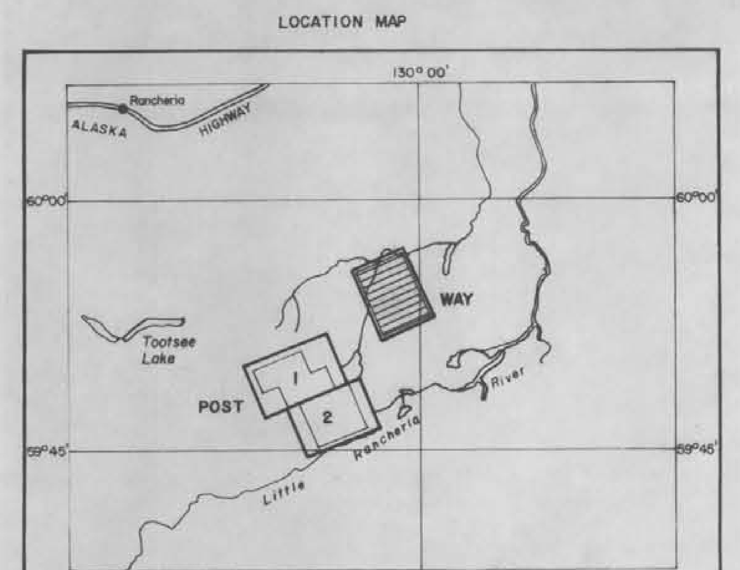
Flight Line

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

D.C. FRASER
REGISTERED PROFESSIONAL ENGINEER
PROVINCE OF ONTARIO

JOB · 158 | DATE: JULY, 1982 | DRAWN BY: | CHECKED BY:

LOCATION MAP



Scale 1:500,000

DIGHEM^II SURVEY

WAY CLAIM BLOCK, TOOTSEE RIVER AREA, B.C.

GEOLOGICAL BRANCH
ASSESSMENT REPORT

RESISTIVITY

11,020

FOR

PART 5 OF 8

CORDILLERAN ENGINEERING

SCALE 1:10,000

1/2 — 0 — 1/2 — 1 Kilometres

1/4 — 0 — 1/4 — 1/2 Miles

Flight Line

- Fiducial 2120 (Not recovered from film)
- Fiducial 2118 (Recovered from film)
- Fiducial 2110 (Not recovered from film)
- Fiducial 2104 (Recovered from film)
- Fiducial 2100 (Not recovered from film)
- 301 Line number and Flight direction

LEGEND

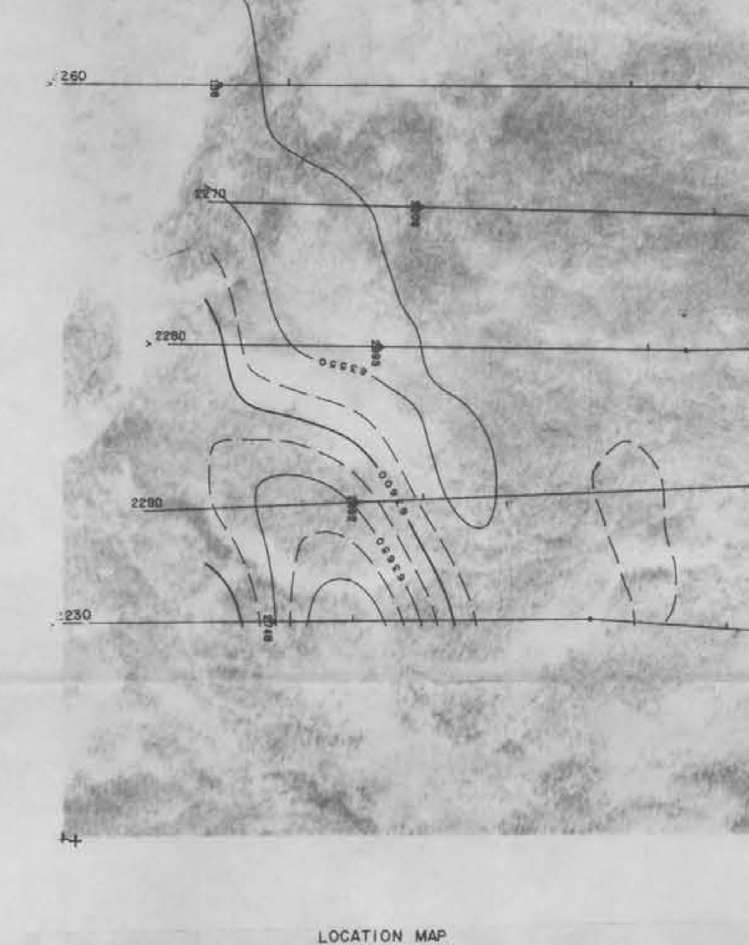
Contours in ohm-m at eight intervals per decade

100, 75, 56, 42, 31, 23, 17, 13, 10

Note

The numbers face in the direction of increasing value.

JOB: 158	DATE: JULY, 1982	DRAWN BY: BD	CHECKED BY: Z.D



DIGHEM^II SURVEY

WAY CLAIM BLOCK , TOOTSEE RIVER AREA, B.C.

GEOLOGICAL BRANCH
ASSESSMENT REPORT

MAGNETICS

11,020

FOR

PART 5 of 8

CORDILLERAN ENGINEERING

SCALE 1:10,000

Flight Line

- Fiducial 2120 (Not recovered from film)
- Fiducial 2118 (Recovered from film)
- Fiducial 2110 (Not recovered from film)
- Fiducial 2104 (Recovered from film)
- Fiducial 2100 (Not recovered from film)
- 301 Line number and Flight direction

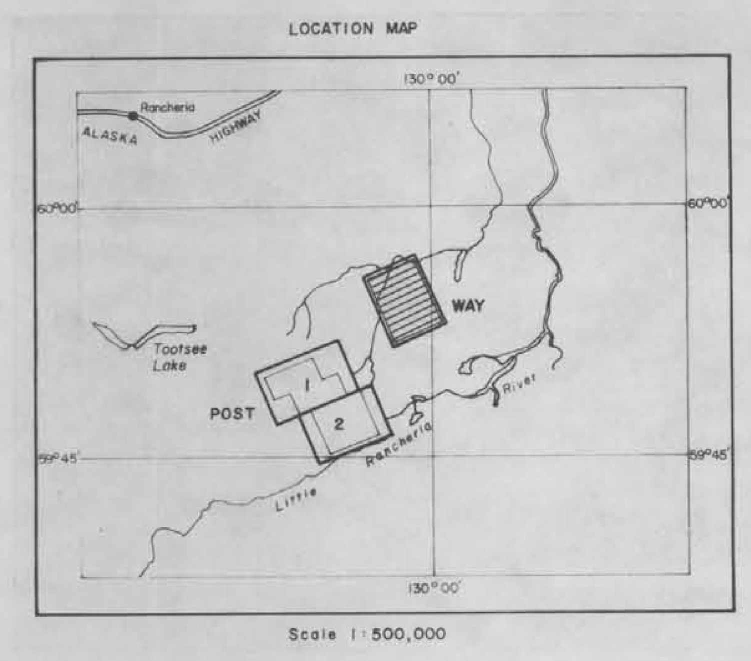
ISOMAGNETIC LINES

(total field)

- 1000 .... 1000 gammas
- 200 .... 200 gammas
- 50 .... 50 gammas
- .... 25 gammas
- .... magnetic depression

Magnetic Inclination within the survey area: 77°

JOB 158	DATE JULY, 1982	DRAWN BY DO	CHECKED BY R.D.



DIGHEM II SURVEY

WAY CLAIM BLOCK . TOOTSEE RIVER AREA, B.C.

ENHANCED MAGNETICS

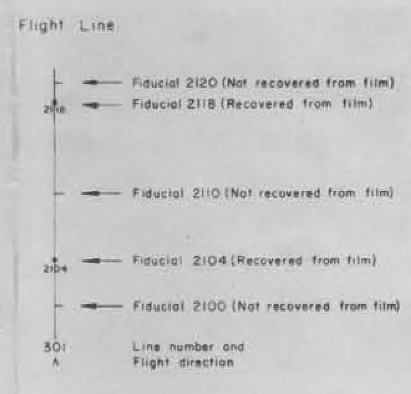
FOR

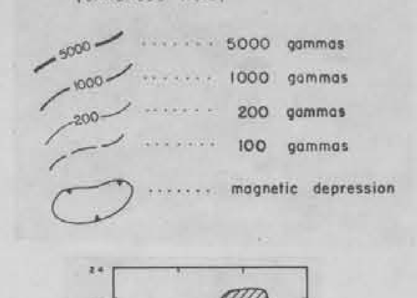
CORDILLERAN ENGINEERING

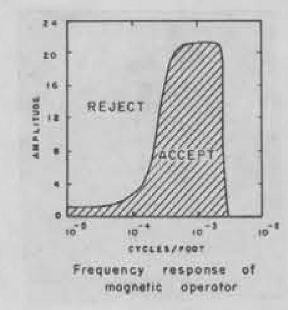
SCALE 1:10,000

1/2 0 1/2 1 Kilometres

1/4 0 1/4 1/2 Miles







Frequency response of magnetic operator

JOB : 158	DATE : JULY, 1982	DRAWN BY:	CHECKED BY:

REPORT NO. 168/2

DIGHEM^{II} SURVEY

OF

POST CLAIM BLOCK, TOOTSEE RIVER AREA
BRITISH COLUMBIA

FOR

CORDILLERAN ENGINEERING

BY

DIGHEM LIMITED

TORONTO, ONTARIO
AUGUST 4, 1982

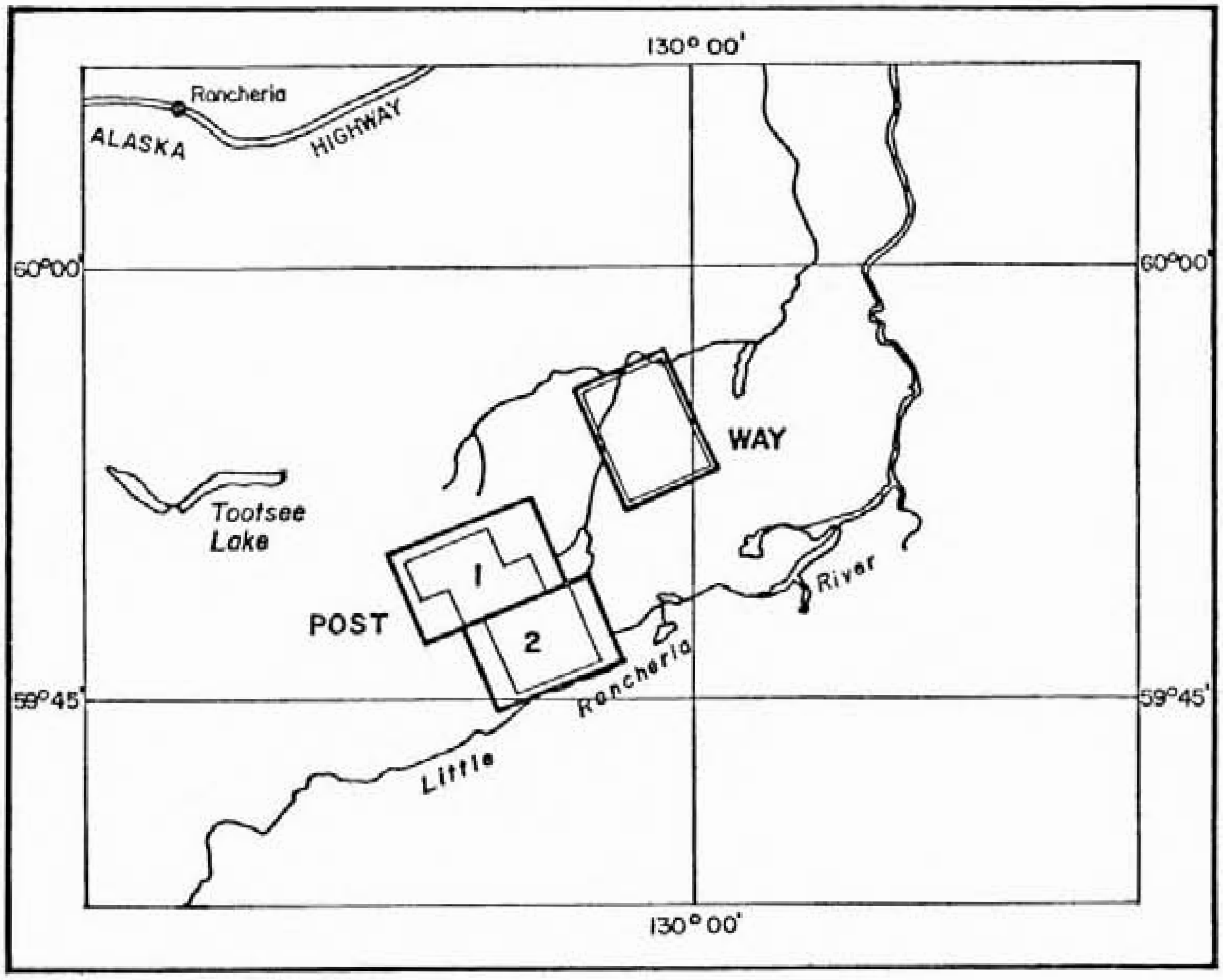
Z. DVORAK
VICE-PRESIDENT

SUMMARY

A DIGHEM^{II} airborne electromagnetic/resistivity/ magnetic survey of 282 line-km was flown in May, 1982, for Cordilleran Engineering over the Post claim block in the Tootsee River area, British Columbia.

The geologic environment in the survey area varied from highly conductive to quite resistive. The geophysical data appeared to show a high degree of mutual correlation. It also appeared to correlate well with known geology of the survey area. Several extensive zones were located which contained a number of well defined EM anomalies reflecting bedrock conductors. Many of the EM and resistivity features seem to be quite attractive and appear to warrant ground follow-up work.

LOCATION MAP



Scale 1:500,000

Figure 1 The Survey Area

CONTENTS

INTRODUCTION

A DIGHEM^{II} survey of 282 line-km was flown with a 300 m line-spacing for Cordilleran Engineering, on May 13 and May 19, 1982, over the Post claim block in the Tootsee River area, British Columbia (Figure 1).

The Lama C-GDEM turbine helicopter flew with an average airspeed of 118 km/h and EM bird height of 37 m. Ancillary equipment consisted of a Geometrics 803 magnetometer with its bird at an average height of 52 m, a Sperry radio altimeter, Geocam sequence camera, RMS GR-33 digital graphics recorder, and a Sonotek SDS 1200 digital data acquisition system with a DigiData 1640 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.

Appendix A provides details on the data channels, their respective sensitivities, and the data reduction 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. 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	$\geq$ 100
5	50 - 99
4	20 - 49
3	10 - 19
2	5 - 9
1	< 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 below 1 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 surface conductors to be recognized, and these are indicated by the letter S on the map. The remaining anomalies in such areas could be bedrock

---

[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.

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., 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, 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 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 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 high quality 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 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 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 along the flight line. 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 3 m, 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.

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

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 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 six channels which contribute significantly to the recognition of bedrock conductors. These are the inphase and quadrature difference channels (#33 and 34), the resistivity and depth channels (#40 and 41), the conductivity contrast channel (#42), and the product of the conductivity contrast and depth contrast channels (#44).

The EM difference channels (33 and 34) 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 electrostatic chart 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.

The conductivity contrast channel (#42) highlights local resistivity lows. This channel, and the depth contrast (#43), both yield positive anomalies from conductors at depth. Channel 44 is the multiple 42*43 and it is highly sensitive to conductors at depth. The interpretation of channels 42 and 44 has to be done carefully, however, because they may also respond in a similar fashion to a local thickening in the conductive cover as, for example, over a buried river channel. Channels 42 and 43 are derived from channels 40 and 41 using digital filter techniques.

Channels 35, 36 and 42 are the anomaly recognition functions. They are used to trigger the conductance channel 37 which identifies discrete conductors. In highly conducting environments, channel 36 is deactivated because it is subject to 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 arising 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

[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.

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 and magnetic permeability. 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 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 33. 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^{II} 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^{II}. The technique yields channel 50 which displays apparent weight percent magnetite according to a homogeneous half space model. 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.

The EM magnetite mapping technique provides estimates of magnetite content which are usually correct within a 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 channel 50.

The EM magnetite algorithm is basically quite simple because a linear relationship exists between volume percent magnetite and the negative inphase response in ppm. This linear relationship is true for a fixed survey altitude when demagnetization effects are disregarded and when a fixed susceptibility-volume percent relationship is assumed. The technique in practice involves, first, correcting the actual EM response for variations in flying altitude and, second, calibrating the negative inphase ppms in terms of volume percent magnetite.

EM magnetite mapping provides another method of airborne geologic mapping. It thus joins resistivity mapping, magnetometer mapping, spectrometry, photogeology, etc., as a possible means by which geologic information can be obtained from airborne techniques. It is not nearly as useful in the general sense as the other airborne mapping techniques, but can be of value in cases where the magnetite content gives an indication of lithology.

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.

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.

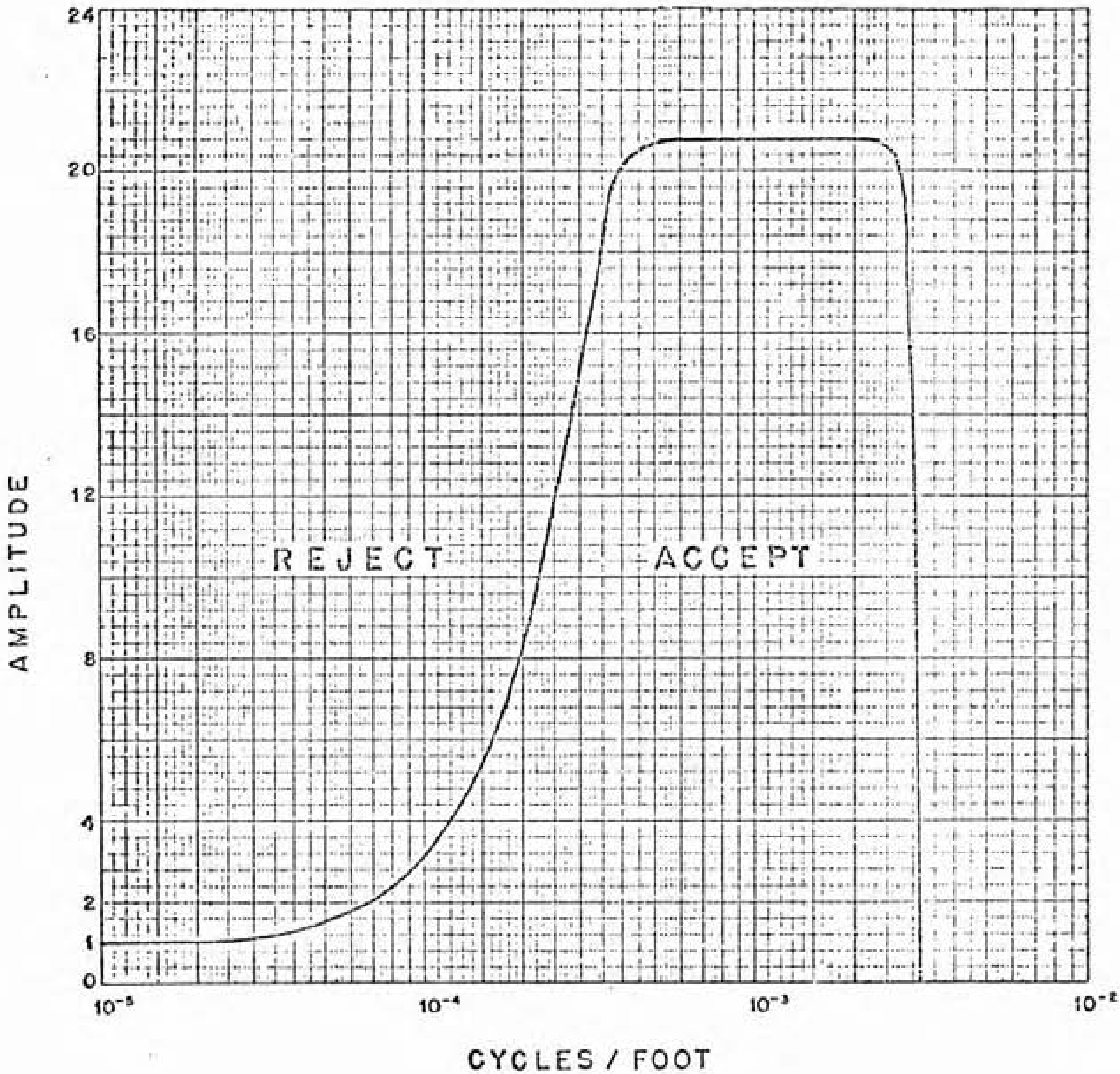


Figure 2 Frequency response of magnetic operator

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), depth and, occasionally, dip. 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 area is geophysically very active. Electromagnetics, resistivity, and total and enhanced magnetics all display great variety of responses ranging from zero to very strong. In general, very good correlation exists between various geophysical parameters.

The resistivity map suggests that the survey area can be divided into several blocks which may reflect different geologic units. The northwest part of the area contains an extensive highly conductive zone, major portions of which are characterized by resistivities lower than 10 ohm-m. It is of interest to note that this zone is magnetically quiet. The enhanced magnetic map, however, indicates the presence of two anomalies. One occurs on line 1010, just west of 1010B and correlates with a small resistive zone. The other magnetic feature extends from 1060H to line 1070, about 100 m west of 1070J. Closer examination of the enhanced magnetic map shows that this last anomaly may be a part of a poorly defined linear trend extending north towards the survey boundary.

The northwest zone terminates abruptly in the south. All the geophysical parameters show a marked change from high activity to near zero responses (e.g., EM and resistivity) or vice versa (e.g., magnetics), presumably being indicative of a geologic contact with resistive volcanics (?) to the south. The available geologic information appears to agree well with the geophysical data. The high resistivity zone in the west corner of the zone extending from the area east of fiducial 437, line 1010, to the area west of fiducial 891, line 1040, may be indicative of resistive dolomites and limestones. An assumed contact with more conductive argillite and sandstone conglomerate further east may occur along a trend running east of conductor 1010C-1110A. The resistivity map shows a poorly defined linear feature extending from fiducial 547, line 1020, towards fiducial 1158, line 1090, which cuts through the most conductive part of this zone. Note that there are very weak indications of a similar trend on the enhanced magnetic map.

A number of well defined EM anomalies occur in this northwest conductive zone. They mostly reflect long bedrock conductors and/or conductive trends. Usually, conductors of short-to-intermediate strike length are the most attractive from the exploration point of view; for example, 1051C-1050C, 1050B-1070C, etc., could be of interest. It should be noted, however, that in a highly conductive environment like this, the line-to-line correlation of individual EM anomalies may not be fully satisfactory. It is for this reason that the use of the resistivity map should be stressed, because the resistivity contour patterns provide a better presentation of the conductivity distribution than the EM anomaly map.

The central volcanic(?) belt is characterized by high resistivities and active magnetics. A northwesterly trend cutting through the eastern part of this zone is best portrayed by the enhanced magnetic map. Local interruptions to this trend, which may have structural significance, occur on lines 1070, and 1120-1130; a crosscutting north-south trend occurs on lines 1210-1270. A well defined low resistivity zone parallels the magnetic trend. This zone has been caused by a well defined bedrock conductor of an easterly dip, 1100E-1130xB, which may extend beyond the survey boundary in a northwesterly direction. The conductive trend appears to continue in a discontinuous manner further southeast cutting through, presumably, greenstones on lines 1200, and 1220 to 1300. The EM anomalies associated with this zone (1200H and 1220H-1300xB) indicate bedrock conductor, or conductors, of an easterly dip. All these, including 1100E-1130xB, should be investigated on the ground.

The central and southeastern parts of the survey area contain a sequence of conductive zones displaying some characteristics similar to those of the northwestern zone; the highly conductive portions of these zones are, in general, magnetically inactive. It is, however, noticed that the highly resistive area covering the west ends of lines 1240 to 1370 also displays low magnetic activity. It is surmised that conductive zones in the central and southern parts of the area reflect an upper conductive (sedimentary?) layer. If true, the thickness of this upper layer may vary from about 25 m to close to 60 m, as indicated by the apparent depth channel 41 of the respective line profiles. The enhanced magnetic map indicates that the well defined trend of a northwest direction paralleling conductor 1170G-1230B may extend south of line 1210 towards line 1270, taking a southeasterly swing at this line. Possible continuation of this feature occurs at the west ends of lines 1340 to 1370.

The most conductive portions of the central zone, which are characterized by resistivities lower than 10 ohm-m, are confined to two areas at the west ends of lines 1140 to 1180, and 1200 to 1230, respectively. They may reflect the same geology. A great number of EM anomalies, occurring in than part of the survey area, reflect bedrock conductors of variable strike length. The most attractive anomalies appear to be confined to the highly conductive parts of the zone (resistivities of the order of 10 ohm-m or less), e.g., 1130xA-1160A, 1160B-1180A, 1170E, 1170H, 1170G-1201C, 1190A-1210A, 1201B-1220A, 1230A, 1310A-1320A, 1310B-1330A, 1310C-1330xB, 1310D-1340A, or to have short strike length, e.g., 1170F, 1290C-1300E, 1290D-1291E.

The character of the geophysical responses changes in the southeastern corner of the area. The most distinguishing characteristic is the increased magnetic activity. It is worth noting that this higher magnetic activity occurs throughout the area, regardless of the electric character of the environment, i.e., indiscriminately over conductive as well as resistive zones. It should also be noted that the general strike of the EM and resistivity features changes from west-to-northwest, which is characteristic for most of the area, to near north-to-northeast, almost paralleling the flight line direction, e.g., the conductive zone at the east end of lines 1290 and 1300. A number of EM anomalies reflecting bedrock conductors were located, which should be investigated on the ground. It is noted that practically all of these anomalies lack proper line-to-line correlation because of their attitude with respect to the flight line direction. At the same time, the resistivity parameter should be used as the guiding information because it is derived from the coplanar coil-pair data which is independent of the flight direction. In the ground follow-up program, consideration should be given to these conductive features.

Respectfully submitted,
DIGHEM LIMITED

Z. Dvorak
Vice-President

Eight map sheets accompany this report:

Electromagnetics	2 map sheets
Resistivity	2 map sheets
Magnetics	2 map sheets
Enhanced magnetics	2 map sheets

K ZD-80 /ef

A P P E N D I X   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 electrostatic chart paper at 1:15,000 or at map scale, whichever is larger. The digital profiles, which may be displayed, are as follows:

Channel Number	Parameter	Scale units/mm
20	magnetics	10 gamma
21	bird height	3 m
22	vertical coaxial coil-pair inphase (freq #1)	1 ppm
23	vertical coaxial coil-pair quadrature (freq #1)	1 ppm
24	horizontal coplanar coil-pair inphase (freq #2)	1 ppm
25	horizontal coplanar coil-pair quadrature (freq #2)	1 ppm
26	VLF-EM total field	1 %
27	VLF-EM vertical quadrature	1 %
28	ambient noise monitor (coaxial receiver)	1 ppm
29	ambient noise monitor (coplanar receiver)	1 ppm
33	difference function inphase from channels 22 and 24	1 ppm
34	difference function quadrature from channels 23 and 25	1 ppm
35	first anomaly recognition function	1 ppm
36	second anomaly recognition function	1 ppm
37	conductance	1 mho
40	log resistivity (at freq #2)	.03 decade
41	apparent depth or thickness (at freq #2)	3 m
42	conductivity contrast (at freq #2)	arbitrary
43	depth contrast (at freq #2)	arbitrary
44	product 42*43 (at freq #2)	arbitrary
45	log resistivity (at freq #1)	.03 decade
46	apparent depth or thickness (at freq #1)	3 m
47	conductivity contrast (at freq #1)	arbitrary
48	depth contrast (at freq #1)	arbitrary
49	product 47*48 (at freq #1)	arbitrary
50	apparent weight percent magnetite	0.25%

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 recovered from camera film. 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*.

---

*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 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 14 EM channels are provided. The DIGHEM^{II} system 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 a conductive ore body in Australia. It will serve to identify the majority of the available channels.

Channels 20 and 21 are respectively the magnetics and the EM bird height. Channels 22 and 23 are the inphase and quadrature of the coaxial coil-pair. This coil-pair is

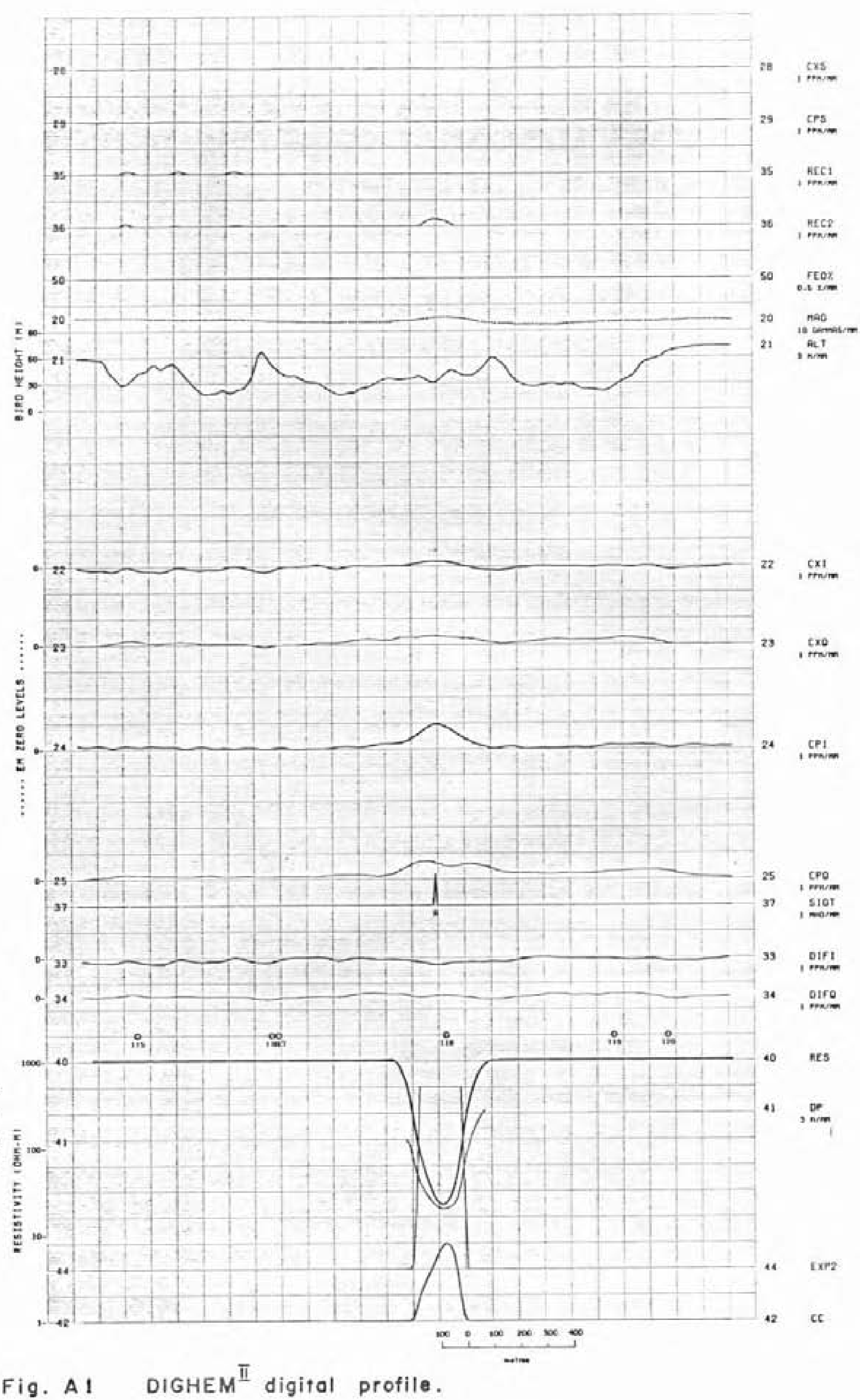


Fig. A1 DIGHEM$^{\text{II}}$ digital profile.

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.

Channels 33 and 34 are inphase and quadrature difference functions of the coaxial and coplanar channels. The difference channels tend to be 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, 36, and 42.

Channel 40 is the resistivity, which is derived from the coplanar 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.*

---

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

Channel 41 is the depth channel. A depth estimate which is negative will occur when conductive overburden exists. A negative depth estimate implies that the conductive material occurs above the daylight surface. This false estimate shows that the EM system has responded to the conductive surface material and had also sensed the underlying resistive rock. In Fig. A1, the positive depth estimate of about 100 m is close to the true depth for this bedrock conductor.

Channel 42 is the conductivity contrast which highlights resistivity lows. Channel 43 is the depth contrast, which usually is not plotted. Both channels 42 and 43 tend to yield positive responses over bedrock conductors at depth. Channel 44 is the multiple of channels 42*43. Consequently, channel 44 tends to yield large positive responses over bedrock conductors at depth. The interpretation of channels 42 and 44 has to be done with care, however, because they may also respond in a similar fashion to a local thickening in conductive cover, e.g., over a buried river channel.

Channel 50 provides an estimate of the percent by weight of magnetite. This computation is made whenever the coplanar inphase channel 24 is negative. The negative response shows that magnetic permeability exists.

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 maps can be made independently for each frequency. The interpretation procedure involves comparing the apparent resistivity and apparent depth parameters at the two frequencies.

The use of two different coil-pair orientations (i.e., coaxial and coplanar) 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. 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, and the anomaly recognition channel 35, are not produced for dual frequence surveys. This is because the divergent frequencies of the two coil-pairs render them meaningless.

APPENDIX B

EM ANOMALY LIST

158 SH1 POST

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* M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
1010A	56	28	73	62	28	0	4	34	10	16
1010B	5	1	6	1	109	0	4	79	14	50
1010C	3	0	7	0	200	47	7	114	4	93
1010D	6	30	14	51	2	3	1	33	153	3
1010E	4	30	14	51	2	2	2	78	31	49
1010F	12	8	26	17	17	12	3	32	18	10
1010G	14	23	12	47	4	0	2	26	39	2
1010H	27	29	54	61	12	0	3	25	13	7
1010I	0	11	0	15	1	0	1	39	83	8
1010J	7	5	3	11	6	16	1	45	105	8
1020A	5	1	7	4	20	31	4	60	10	38
1020B	47	8	93	17	165	0	15	41	1	30
1020C	6	3	12	8	17	0	4	57	10	33
1020D	8	11	20	34	6	0	2	35	40	5
1020E	3	0	2	0	41	29	3	47	25	18
1020F	22	12	49	31	24	0	5	31	7	15
1030A	3	2	11	4	16	0	19	39	1	30
1030B	9	0	15	2	49	0	28	35	1	28
1030C	3	3	16	10	12	41	9	101	3	84
1030D	21	5	27	9	59	6	9	63	2	47
1030E	6	7	10	19	5	21	2	50	31	23
1030F	4	7	14	17	5	22	3	49	17	27
1030G	2	0	12	7	22	54	4	53	12	35
1030H	8	11	18	21	7	12	2	38	22	15
1030I	39	58	61	115	8	0	2	18	29	0
1030J	81	62	139	127	23	0	3	25	13	7
1040A	16	4	29	7	71	0	14	38	1	25
1040B	1	2	1	4	2	27	13	137	2	123
1040C	47	22	75	46	33	0	8	37	2	24
1040D	1	0	5	10	4	19	5	49	6	30
1040E	10	0	27	0	49	22	7	47	3	33
1040F	26	35	35	63	8	0	3	25	20	3
1040G	18	17	15	26	8	11	2	44	35	17
1040H	3	1	0	0	31	67	1	52	78	13

* 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.

158 SH1 POST

	COAXIAL COIL		COPLANAR COIL		VERTICAL DIKE		HORIZONTAL SHEET		CONDUCTIVE EARTH	
LINE & ANOMALY	REAL PPM	QUAD PPM	REAL PPM	QUAD PPM	COND MHOS	DEPTH* M	COND MHOS	DEPTH M	RESIS OHM-M	DEPTH M
1050A	254	115	216	296	37	0	5	17	5	4
1050B	3	3	2	4	5	50	5	102	7	82
1050C	149	66	176	121	47	0	9	21	2	11
1050D	0	46	33	87	2	0	10	30	1	20
1050E	155	70	145	143	38	0	7	22	3	11
1050F	41	23	65	66	20	2	5	25	5	12
1050G	53	23	61	57	28	4	6	26	5	13
1050H	54	60	113	137	14	0	4	20	10	3
1050I	15	22	24	34	7	10	2	43	29	18
1051A	21	7	43	13	54	0	19	44	1	35
1051B	1	7	0	9	1	0	1	84	122	38
1051C	11	1	16	12	33	30	5	75	8	55
1051D	89	34	165	61	69	0	12	29	1	19
1051E	6	5	3	3	8	27	5	35	7	18
1051F	76	26	167	65	68	0	11	21	1	11
1051G	17	32	30	70	5	0	2	27	24	6
1051H	0	1	7	7	4	36	2	33	28	8
1051I	20	22	40	51	10	8	3	39	20	16
1051J	2	10	0	14	1	0	1	41	90	7
1060A	62	20	121	45	67	0	12	35	1	25
1060B	96	24	168	61	94	0	17	20	1	11
1060C	57	24	92	34	53	0	9	23	2	12
1060D	65	5	142	28	277	0	13	23	1	14
1060E	28	24	67	61	16	0	6	26	5	13
1060F	30	22	34	50	13	0	5	27	6	13
1060G	0	15	0	26	1	0	2	34	30	9
1060H	6	0	2	0	49	68	2	63	25	36
1060I	10	7	16	6	18	7	2	48	34	17
1061A	108	41	193	103	56	0	12	24	1	15
1061B	63	13	108	32	107	0	14	35	1	25
1061C	44	11	100	12	162	0	11	41	1	29
1061D	12	10	9	29	6	0	8	24	3	12
1061E	48	1	103	10	49	0	14	24	1	14
1061F	20	4	30	23	32	7	6	27	5	12
1061G	38	23	60	35	27	0	7	25	4	12
1061H	45	46	89	101	15	0	3	18	12	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.

158 SH1 POST

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* M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
1061I	9	8	19	17	11	13	2	41	23	16
1070A	6	5	21	15	12	33	6	81	5	65
1070B	72	41	126	83	33	7	6	30	4	18
1070C	37	14	11	26	22	21	5	28	5	16
1070D	6	37	27	82	3	0	5	29	7	15
1070E	28	45	30	77	6	3	6	29	5	17
1070F	22	10	42	44	18	16	8	32	2	20
1070G	45	5	75	31	97	11	11	29	1	20
1070H	6	4	6	30	4	9	5	33	6	18
1070I	21	22	23	34	10	14	5	46	6	31
1070J	25	24	29	51	9	11	2	42	21	20
1070K	16	22	25	46	7	0	2	33	27	9
1070M	1	6	0	0	2	21	1	62	69	25
1070N	6	6	12	12	9	5	2	42	37	11
1080A	10	6	28	16	19	26	8	67	2	53
1080B	21	1	56	6	49	22	21	55	1	47
1080C	11	8	30	13	21	24	7	55	3	41
1080D	92	35	225	89	70	0	15	20	1	11
1080E	60	47	76	100	16	0	3	33	20	11
1080F	33	23	61	66	17	0	3	24	14	5
1080G	16	0	34	21	49	20	3	38	14	18
1090A	14	0	23	0	2000	41	5	89	6	71
1090B	15	0	41	4	49	31	15	71	1	60
1090D	4	1	16	6	37	53	3	67	19	44
1090E	29	21	66	43	22	14	5	48	8	32
1090F	96	89	214	179	24	0	6	30	5	18
1090G	21	17	38	42	13	11	2	26	28	4
1090H	16	25	37	50	8	8	2	29	20	9
1100A	3	0	9	2	49	66	8	101	3	83
1100B	13	2	30	8	78	27	7	83	4	66
1100C	13	8	24	16	16	19	3	70	24	43
1100D	12	10	29	26	13	14	2	46	31	19
1100E	5	6	11	14	6	16	1	43	244	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.

158 SH1 POST

	COAXIAL COIL		COPLANAR COIL		VERTICAL DIKE		HORIZONTAL SHEET		CONDUCTIVE EARTH	
LINE & ANOMALY	REAL PPM	QUAD PPM	REAL PPM	QUAD PPM	COND MHOS	DEPTH* M	COND MHOS	DEPTH M	RESIS OHM-M	DEPTH M
1110A	2	0	7	1	79	72	2	118	48	81
1110B	4	4	8	7	8	45	1	62	154	23
1110C	3	0	6	0	184	72	1	50	211	9
1110D	9	13	17	31	6	10	1	33	176	0
1120A	6	5	11	13	7	15	1	57	104	17
1140A	13	3	29	8	69	26	6	75	4	59
1150A	59	49	118	99	21	0	6	30	4	17
1150B	2	0	5	0	37	85	1	39	186	2
1150C	5	3	13	8	15	46	1	50	109	16
1160A	8	7	30	21	14	1	9	32	2	20
1160B	36	14	63	32	39	7	6	37	5	23
1160C	0	6	0	0	4	31	1	0	557	0
1160D	5	24	7	41	2	0	1	7	274	0
1160E	2	6	4	24	1	0	1	4	341	0
1160F	2	6	7	12	3	12	1	50	76	15
1160G	6	5	4	7	7	37	1	31	206	0
1170A	68	46	104	92	24	0	6	23	4	9
1170B	9	16	10	21	4	1	4	38	8	21
1170C	3	8	11	23	3	11	1	35	53	8
1170D	0	10	4	35	1	0	1	20	60	0
1170E	54	33	138	88	30	0	6	30	4	17
1170F	5	3	17	1	55	52	3	62	19	38
1170G	6	0	19	3	147	48	3	74	16	52
1170H	5	0	21	0	200	53	2	84	29	55
1170I	9	3	20	10	30	38	2	66	53	33
1170J	4	4	10	15	5	32	1	51	85	19
1180A	0	10	21	23	4	10	5	44	5	29
1180B	21	8	42	22	32	12	8	32	2	20
1180C	10	13	36	45	8	8	6	34	4	21
1180D	0	17	2	37	1	0	3	42	14	22
1180E	4	11	6	20	3	4	2	52	48	21
1180F	12	0	21	5	150	33	5	89	7	70

* 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* M	COND MHOS	DEPTH M	RESIS OHM-M	DEPTH M
1180G	13	15	20	31	8	10	2	57	32	29
1180H	10	6	11	16	10	20	2	52	26	26
1190A	2	0	7	0	245	66	2	101	33	70
1190C	6	8	11	26	4	14	2	42	46	14
1190D	6	10	11	26	4	13	2	39	44	12
1190E	14	4	25	17	24	27	4	71	12	50
1190F	28	28	58	63	13	0	4	35	12	17
1190G	12	16	13	33	5	5	1	32	54	5
1190H	21	35	34	64	7	0	2	28	22	7
1190J	3	11	1	19	1	0	1	18	802	0
1200A	35	29	68	61	17	6	5	37	7	23
1200B	8	16	12	37	4	0	2	37	26	12
1200C	4	0	8	4	29	47	3	71	25	44
1200E	15	15	28	28	11	5	3	49	14	29
1200F	7	11	16	23	6	6	2	39	39	10
1200G	17	16	34	38	11	0	3	31	20	8
1200H	13	18	28	47	7	0	1	28	66	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.

POST TIE LINE

	COAXIAL COIL		COPLANAR COIL		VERTICAL DIKE		HORIZONTAL SHEET		CONDUCTIVE EARTH	
LINE & ANOMALY	REAL PPM	QUAD PPM	REAL PPM	QUAD PPM	COND MHOS	DEPTH* M	COND MHOS	DEPTH M	RESIS OHM-M	DEPTH M
1380B	2	0	7	0	49	55	6	78	5	60

* 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* M	COND MHOS	DEPTH M	RESIS OHM-M	DEPTH M
1201A	17	11	31	6	32	15	5	44	7	27
1201B	15	6	22	9	36	29	4	45	10	28
1201C	7	1	4	4	24	46	2	69	39	37
1201D	22	17	37	37	14	9	2	47	25	22
1201E	2	0	8	22	3	19	2	41	43	12
1201F	48	56	77	108	12	0	3	29	14	10
1210A	55	53	80	70	18	7	6	33	5	21
1210B	50	28	86	37	37	13	5	34	5	21
1210C	0	2	0	0	6	51	2	38	26	15
1210D	6	5	6	9	7	36	2	69	42	37
1210E	16	17	32	37	10	13	2	50	23	25
1210F	8	10	5	28	3	7	1	32	68	4
1210G	35	33	52	63	13	0	3	29	15	9
1210H	2	26	3	44	1	0	1	32	66	6
1210J	4	12	4	21	2	2	1	13	658	0
1211A	31	25	55	51	16	0	5	35	7	18
1211B	2	1	0	2	7	61	2	91	45	55
1211C	19	19	30	38	10	7	2	50	31	22
1211D	13	9	25	21	14	0	3	36	19	13
1211E	2	12	8	22	2	0	1	33	54	3
1220A	10	7	18	14	13	2	5	48	6	29
1220B	4	3	6	6	8	32	2	86	33	55
1220C	6	2	7	7	17	39	2	68	43	35
1220D	8	7	17	22	8	12	2	39	35	11
1220E	20	19	39	41	12	0	3	28	15	7
1220F	1	8	6	21	1	0	2	33	29	8
1220G	0	0	3	9	2	23	2	39	39	10
1220H	15	15	32	37	10	0	2	35	33	7
1230A	27	8	60	19	65	13	9	47	2	35
1230B	0	0	4	0	49	120	3	68	19	45
1230C	33	27	62	49	18	9	4	44	9	28
1230D	7	21	5	21	2	0	1	34	81	5
1230F	39	53	74	115	10	0	3	22	14	5
1230G	0	0	0	12	3	35	2	29	29	7

* 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.

158 SH2 POST

	COAXIAL COIL		COPLANAR COIL		VERTICAL DIKE		HORIZONTAL SHEET		CONDUCTIVE EARTH	
LINE & ANOMALY	REAL PPM	QUAD PPM	REAL PPM	QUAD PPM	COND MHOS	DEPTH* M	COND MHOS	DEPTH M	RESIS OHM-M	DEPTH M
1230H	13	5	31	17	28	24	3	80	14	57
1240A	1	0	6	0	83	82	3	95	24	66
1240B	8	2	14	3	49	41	4	71	12	49
1240C	24	27	35	52	10	0	3	32	16	11
1240D	8	15	9	30	3	0	2	39	35	12
1240E	16	37	26	62	5	0	2	29	33	7
1240F	20	12	43	33	19	0	3	39	16	17
1250A	24	13	43	32	21	15	3	55	16	33
1250B	55	43	110	97	21	0	4	28	8	13
1250C	15	30	6	50	3	0	2	30	34	5
1250D	9	29	7	49	2	0	1	32	83	4
1250F	30	21	51	44	19	0	2	37	24	11
1260A	10	13	10	15	6	15	2	71	55	35
1260B	11	10	21	18	12	0	2	34	43	0
1270A	16	19	24	39	8	0	1	38	70	6
1270B	16	16	24	39	8	0	2	46	27	19
1270C	5	4	10	11	9	19	2	54	40	22
1270E	10	13	22	32	7	0	1	38	85	3
1271A	6	7	9	13	6	12	2	73	46	38
1271B	6	24	19	69	3	1	1	31	94	4
1271C	14	28	32	56	6	5	2	39	27	15
1280A	6	11	13	21	5	0	2	57	36	25
1280B	7	10	14	20	6	3	2	54	44	21
1280D	45	36	79	74	18	1	3	41	14	21
1281A	3	6	6	6	4	0	2	36	30	7
1290A	10	38	12	80	2	0	3	32	18	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.

	COAXIAL COIL		COPLANAR COIL		VERTICAL DIKE		HORIZONTAL SHEET		CONDUCTIVE EARTH	
LINE & ANOMALY	REAL PPM	QUAD PPM	REAL PPM	QUAD PPM	COND MHOS	DEPTH* M	COND MHOS	DEPTH M	RESIS OHM-M	DEPTH M
1290B	56	60	105	128	15	0	4	27	9	11
1290C	10	10	33	17	17	14	3	63	15	41
1290D	13	10	33	17	20	6	4	54	10	34
1290E	11	15	21	34	6	4	2	44	30	17
1290F	8	9	16	18	7	13	2	51	25	25
1290G	23	24	67	62	14	0	2	30	29	6
1290H	6	4	14	13	10	28	2	65	26	38
1291A	3	2	7	2	16	59	1	113	178	58
1291B	8	19	15	37	4	4	2	53	34	25
1291C	7	14	4	23	3	0	2	52	43	21
1291D	10	8	26	17	14	14	2	61	30	32
1291E	10	8	26	14	18	8	3	57	15	35
1291F	7	9	19	30	6	1	2	43	30	16
1300A	2	3	15	11	9	18	2	89	53	50
1300C	10	16	16	33	5	2	3	52	23	26
1300D	4	6	7	16	3	10	2	51	27	24
1300E	31	23	46	43	17	2	3	35	19	13
1300F	7	13	8	21	4	12	2	53	40	24
1300G	5	2	0	3	9	58	1	60	72	24
1300H	9	10	11	15	7	11	2	38	41	9
1310A	42	18	110	50	45	0	11	35	1	24
1310B	33	19	69	37	29	0	7	37	3	23
1310C	21	3	34	8	116	17	6	48	5	32
1310D	23	3	32	12	93	19	5	53	6	36
1320A	6	0	11	5	47	33	4	78	11	55
1320B	10	0	17	0	49	40	8	70	3	55
1320C	23	9	23	14	29	17	6	52	5	36
1330A	13	4	25	8	42	28	5	68	6	50
1330B	5	3	8	9	9	34	3	70	18	47
1330C	2	2	6	1	16	65	5	77	6	58

* 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.

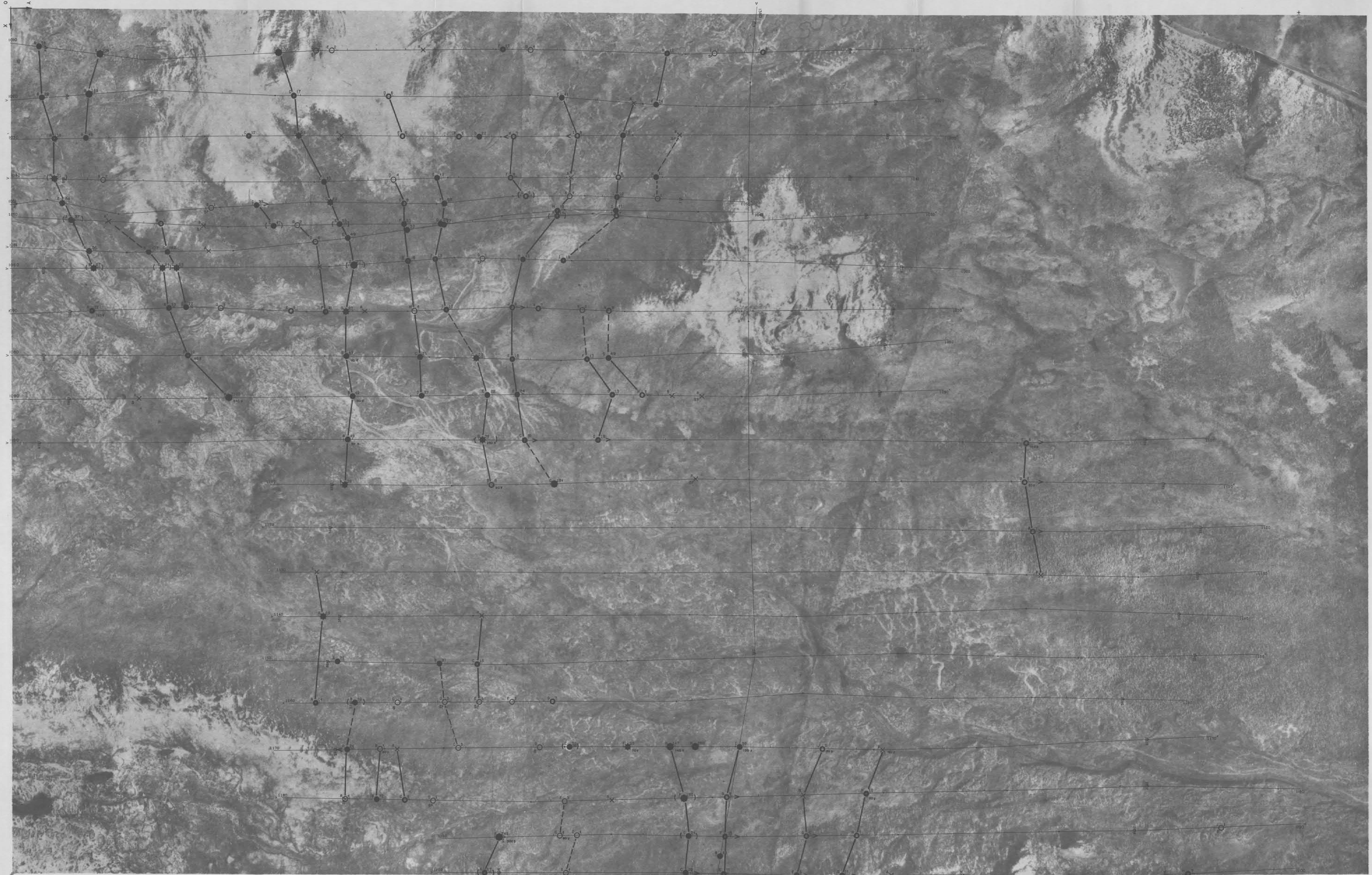
158 SH2 POST

	COAXIAL COIL		COPLANAR COIL		VERTICAL DIKE		HORIZONTAL SHEET		CONDUCTIVE EARTH	
LINE & ANOMALY	REAL PPM	QUAD PPM	REAL PPM	QUAD PPM	COND MHOS	DEPTH* M	COND MHOS	DEPTH M	RESIS OHM-M	DEPTH M
1340A	3	0	4	0	200	69	3	91	18	64
1350A	4	2	5	5	11	57	2	90	32	60
1350B	2	5	5	12	3	15	1	49	133	11
1360A	3	9	9	22	3	7	2	49	47	19
1370A	3	1	7	5	13	39	3	86	19	59
1370B	14	17	29	35	9	4	2	47	30	20

* 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* M	COND MHOS	DEPTH M	RESIS OHM-M	DEPTH M
1380A	3	0	6	4	19	52	3	82	14	58
1380B	1	4	8	7	4	18	3	67	19	42
1380C	11	11	12	16	8	8	2	51	42	20
1380D	3	4	6	7	5	24	2	86	41	52

* 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.



DIGHEM[II] SURVEY

RPT 168/2

POST CLAIM BLOCK , TOOTSEE RIVER AREA, B.C.

ELECTROMAGNETICS

FOR

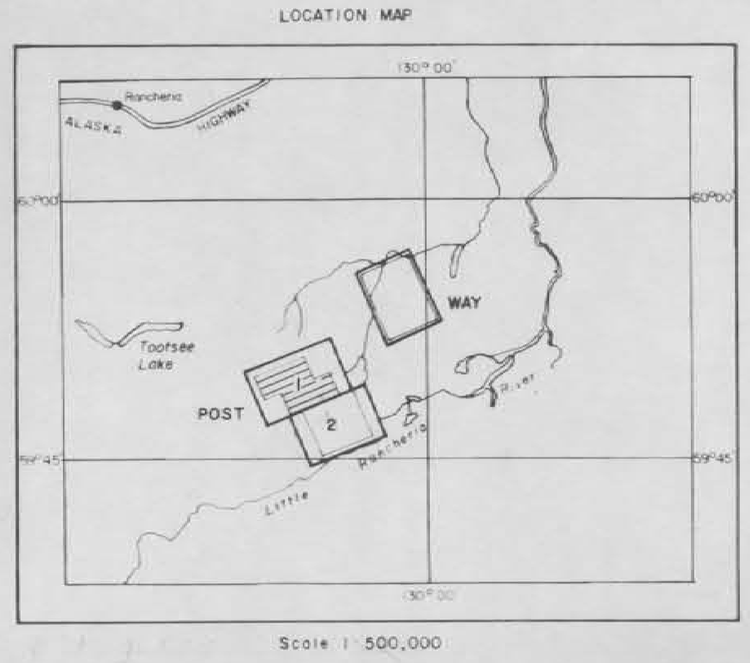
CORDILLERAN ENGINEERING

SCALE 1:10,000

1/2 0 1/2 1 Kilometres

1/4 0 1/4 1/2 Miles

SHEET 1



GEOLOGICAL BRANCH
ASSESSMENT REPORT

11,020

PART 5 OF 8

Flight Line

- Fiducial 2120 (Not recovered from film)
- 2118 Fiducial 2118 (Recovered from film)
- Fiducial 2110 (Not recovered from film)
- 2104 Fiducial 2104 (Recovered from film)
- Fiducial 2100 (Not recovered from film)
- 301 Line number and Flight direction

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 (Quebec, Canada) yield grade 4 anomalies, while Mattabi and Whistle (Ontario, Canada) 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 39 ← mho value

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 conductor depths.

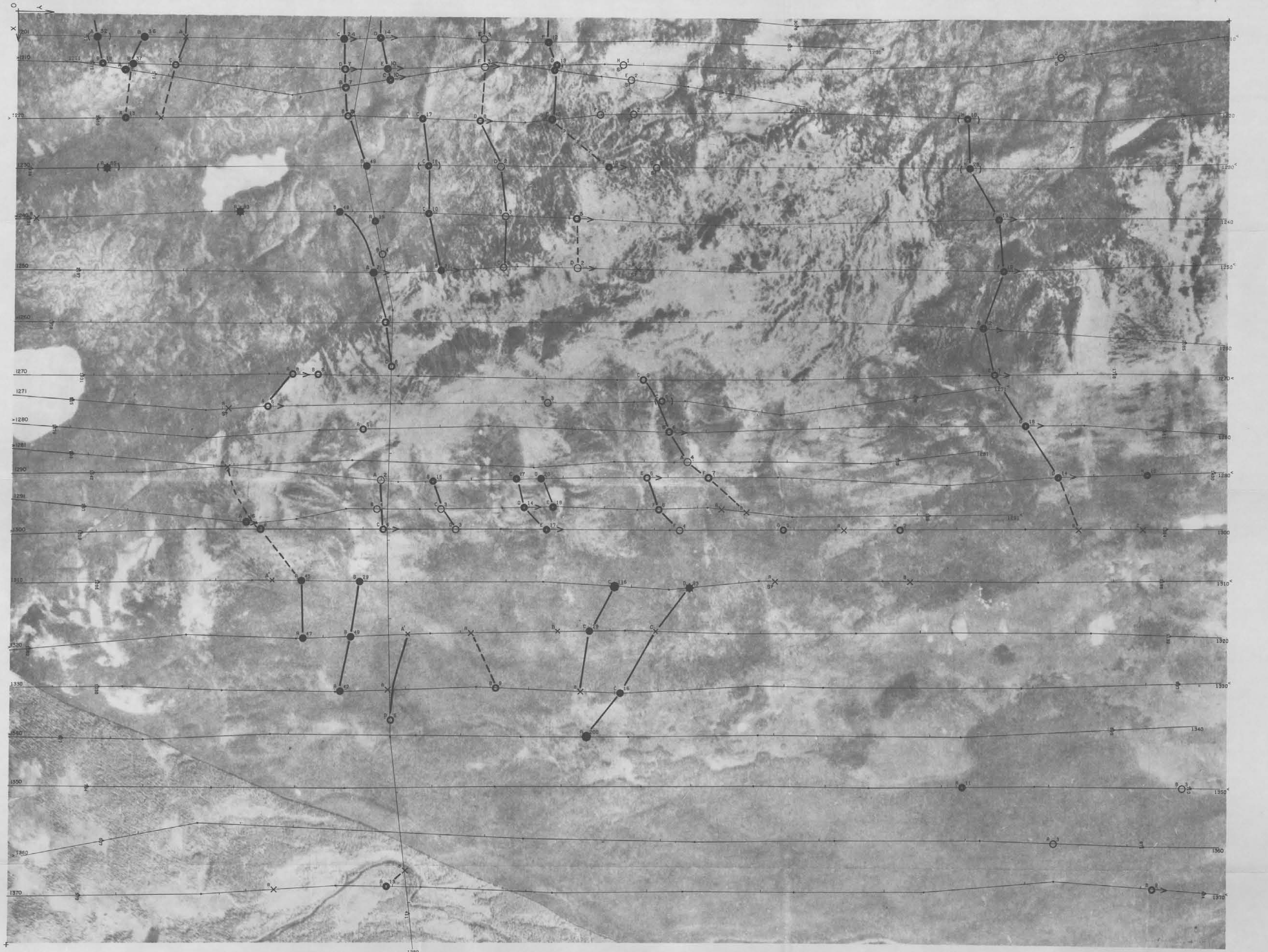
The actual mho value is plotted beside the EM grade symbol. The letter is the anomaly identifier. The horizontal rows of dots indicate anomaly amplitude on the flight record, and the vertical column gives the estimated depth. This depth may be unreliable because the stronger part of the conductor may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

- Conductor axis
- S — Surface response (usually conductive overburden, but includes conductive response from broad expanse of weathered and unweathered rocks, and from culture which gathers current from conductive ground).
- S? — Possible surface response
- L — Culture (usually a line such as a fence, power or telephone line, but also includes buildings, etc.)
- L? — Possible culture
- ? — Questionable anomaly
- O — Apparent thickness > 10m
- V — Dip direction
- 100 Σ — Direct magnetic correlation of 100 gammas

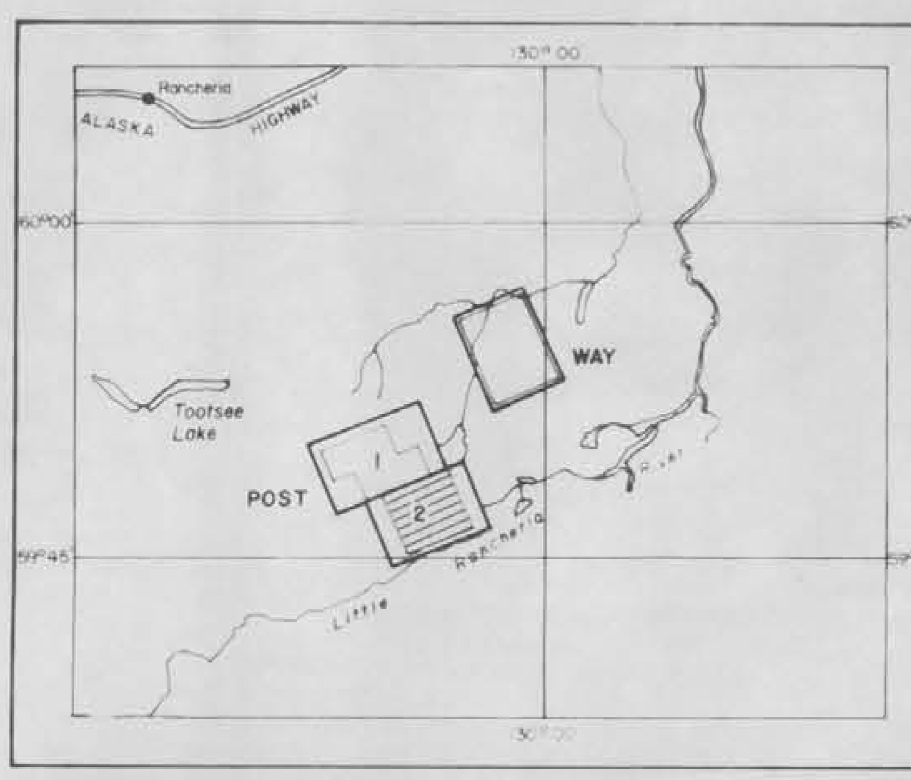
DIGHEM maps are designed to provide a correct impression of conductor quality by means of the conductance grade symbols. The symbols can stand alone with geology when planning a followup program. The actual mho values are plotted for those who wish quantitative data. The anomaly ppm and depth are indicated 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.

JOB	DATE	DRAWN BY	CHECKED BY
158	AUGUST, 82		

REGISTERED PROFESSIONAL ENGINEER
D. C. FRASER
PROVINCE OF ONTARIO



LOCATION MAP



Scale 1 : 500,000

DIGHEM^II SURVEY

Rpt. 1/4b

POST CLAIM BLOCK , TOOTSEE RIVER AREA, B.C.

ELECTROMAGNETICS

FOR

CORDILLERAN ENGINEERING

SCALE 1 : 10,000

1/2 0 1/2 1 Kilometres

1/4 0 1/4 1/2 Miles

SHEET 2

Flight Line

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

GEOLOGICAL BRANCH
ASSESSMENT REPORT

11,020

PART 5 OF 8

ANOMALY GRADE	EM GRADE SYMBOL	MHO RANGE
6	●	≥ 100
5	●	50 — 99
4	●	20 — 49
3	◉	10 — 19
2	O	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 (Quebec, Canada) yield grade 4 anomalies, while Mattabi and Whistle (Ontario, Canada) 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 28 ← mho value

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

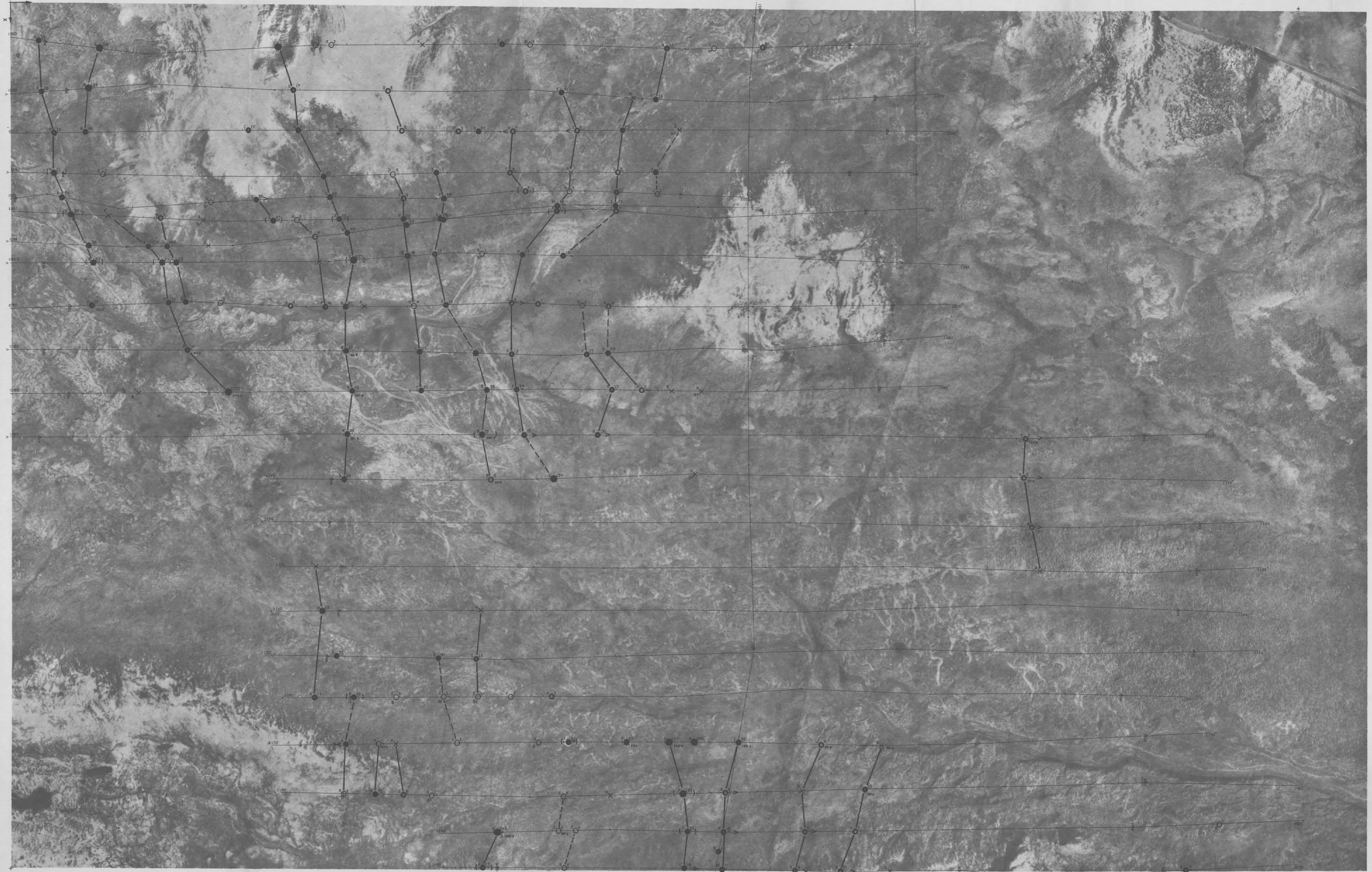
Refer to list of anomalies in survey report for the actual ppm values for all dots, and for conductor depths.

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 — Surface response (usually conductive overburden, but includes conductive response from broad expanses of weathered and unweathered rocks, and from culture which gathers current from conductive ground).
- S? — Possible surface response
- L — Culture (usually a line such as a fence, power or telephone line, but also includes buildings, etc.)
- L? — Possible culture
- ? — Questionable anomaly
- O — Apparent thickness ≥ 10m
- > — Dip direction
- 100$ — 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.

JOB	DATE	DRAWN BY	CHECKED BY
158	JULY, 82	DD	Z.B.



DIGHEM^II SURVEY

RPT. 169/2

POST CLAIM BLOCK , TOOTSEE RIVER AREA, B.C.

ELECTROMAGNETICS

FOR

CORDILLERAN ENGINEERING

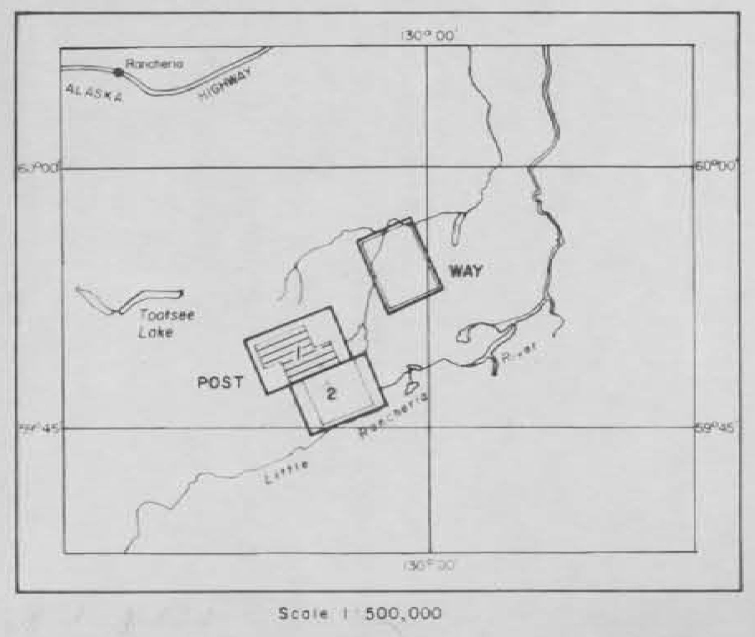
SCALE 1:10,000

1/2 0 1/2 1 Kilometres

1/4 0 1/4 1/2 Miles

SHEET 1

LOCATION MAP



Scale 1:500,000

GEOLOGICAL BRANCH
ASSESSMENT REPORT

11,020

PART 5 OF 8

Flight Line

Fiducial 2120 (Not recovered from film)

2118 Fiducial 2118 (Recovered from film)

Fiducial 2110 (Not recovered from film)

2104 Fiducial 2104 (Recovered from film)

Fiducial 2100 (Not recovered from film)

301 A Line number and Flight direction

ANOMALY GRADE	EM GRADE SYMBOL	MHO RANGE
6	●	≥ 100
5	●	50 – 99
4	●	20 – 49
3	●	10 – 19
2	O	5 – 9
1	○	≤ 4
	X	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 (Quebec, Canada) yield grade 4 anomalies, while Mattabi and Whistle (Ontario, Canada) 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 28 ← mho value

Depth is greater than 15m 30m 45m 60m

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

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 Surface response (usually conductive overburden, but includes conductive response from broad expanse of weathered and unweathered rocks, and from culture which gathers current from conductive ground)

S? Possible surface response

L Culture (usually a line such as a fence, power or telephone line, but also includes buildings, etc.)

L? Possible culture

? Questionable anomaly

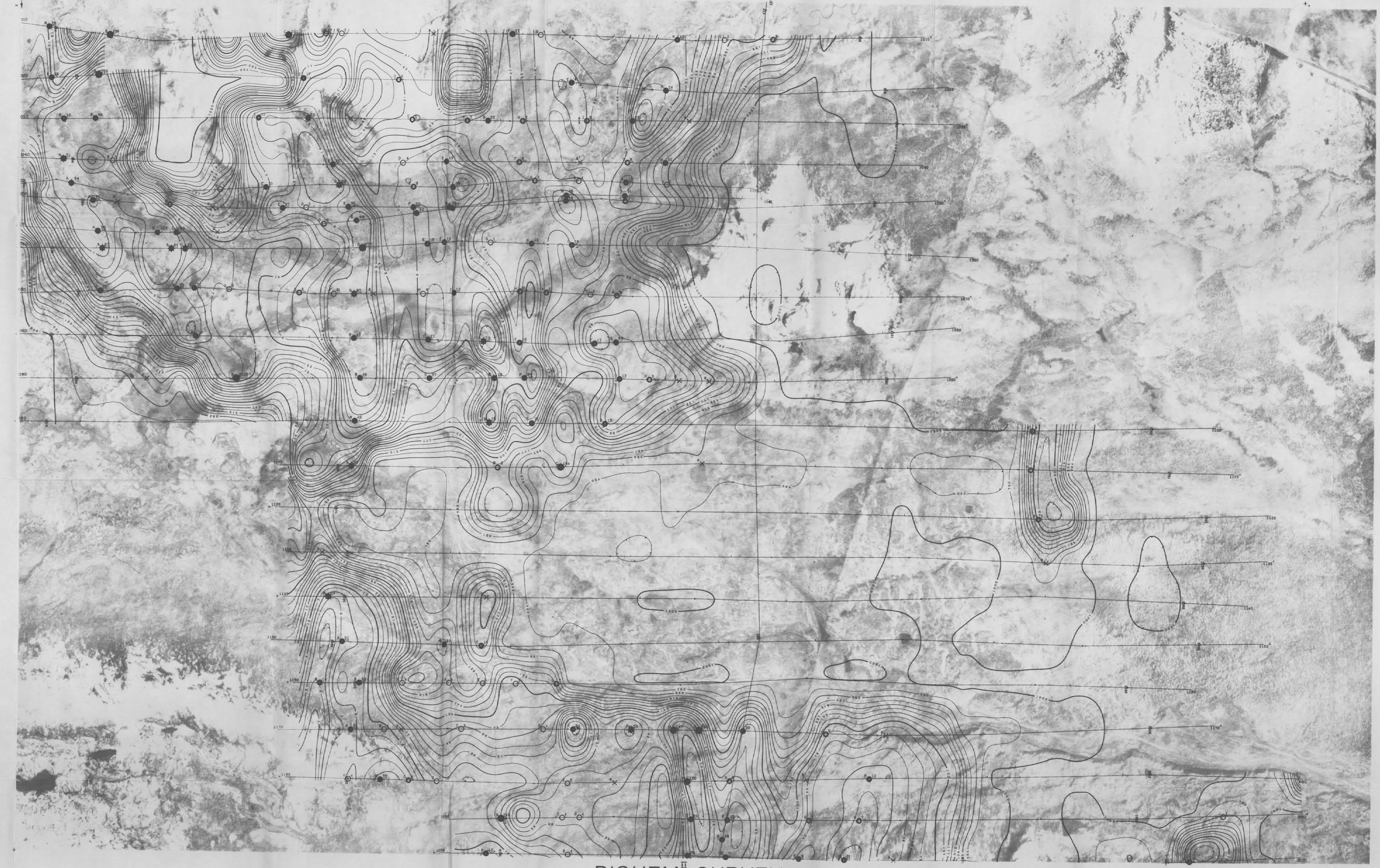
Apparent thickness > 10m

Dip direction

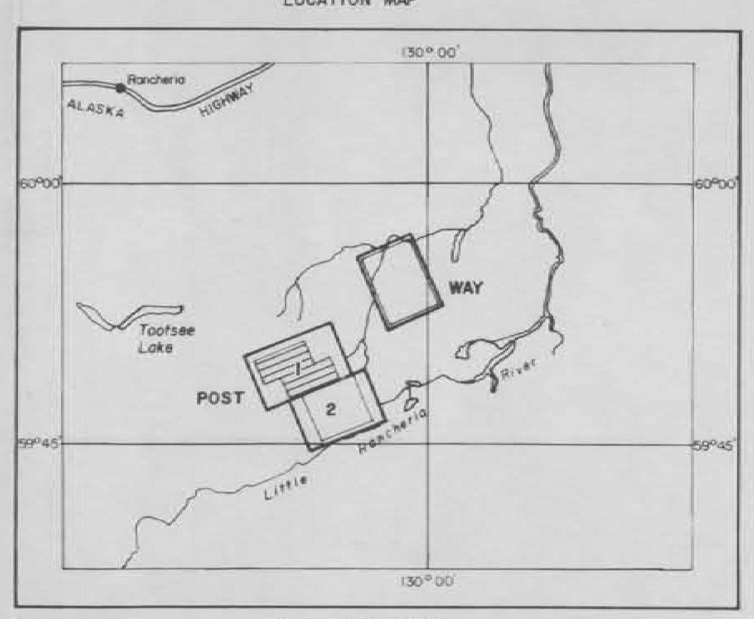
100 Direct magnetic correlation of 100 gammas

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.

JOB	DATE	DRAWN BY	CHECKED BY
158	AUGUST, 82		



LOCATION MAP



Scale 1:500,000

DIGHEM[II] SURVEY

RPT. 164/6

POST CLAIM BLOCK , TOOTSEE RIVER AREA, B.C.

RESISTIVITY

FOR

CORDILLERAN ENGINEERING

SCALE 1:10,000

1/2 0 1/2 1 Kilometres

1/4 0 1/4 1/2 Miles

SHEET 1

GEOLOGICAL BRANCH
ASSESSMENT REPORT

11,020

PART 5 OF 8

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

LEGEND

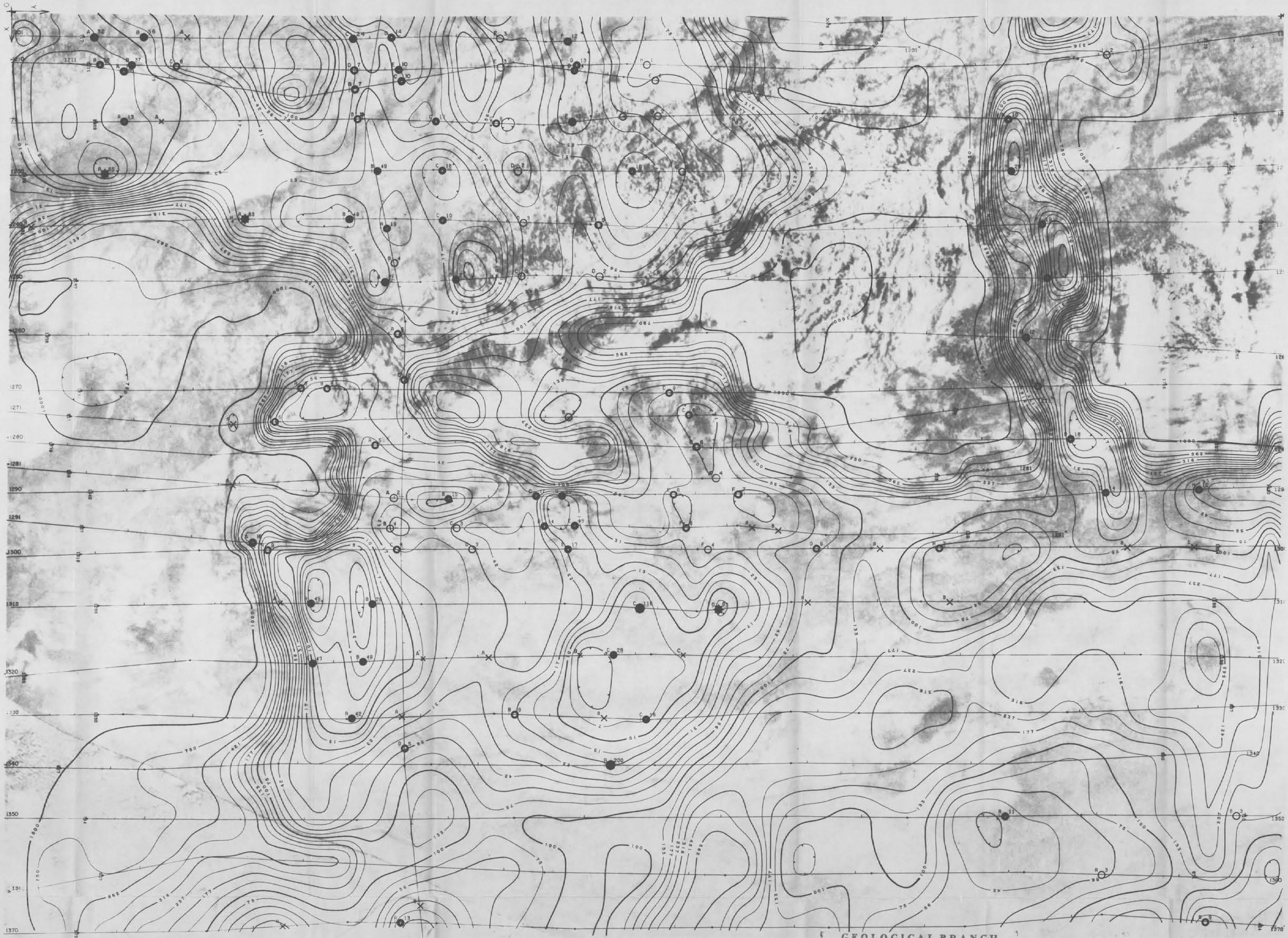
Contours in ohm – m
at eight intervals per decade

100
75
56
42
31
23
17
13
10

Note

The numbers face in the direction of increasing value.

JOB	DATE	DRAWN BY	CHECKED BY
158	AUGUST, 82	P.P.	Z.O.



GEOLOGICAL BRANCH
ASSESSMENT REPORT

11,020

PART 5 OF 8

DIGHEM[II] SURVEY

RPT. 164/2

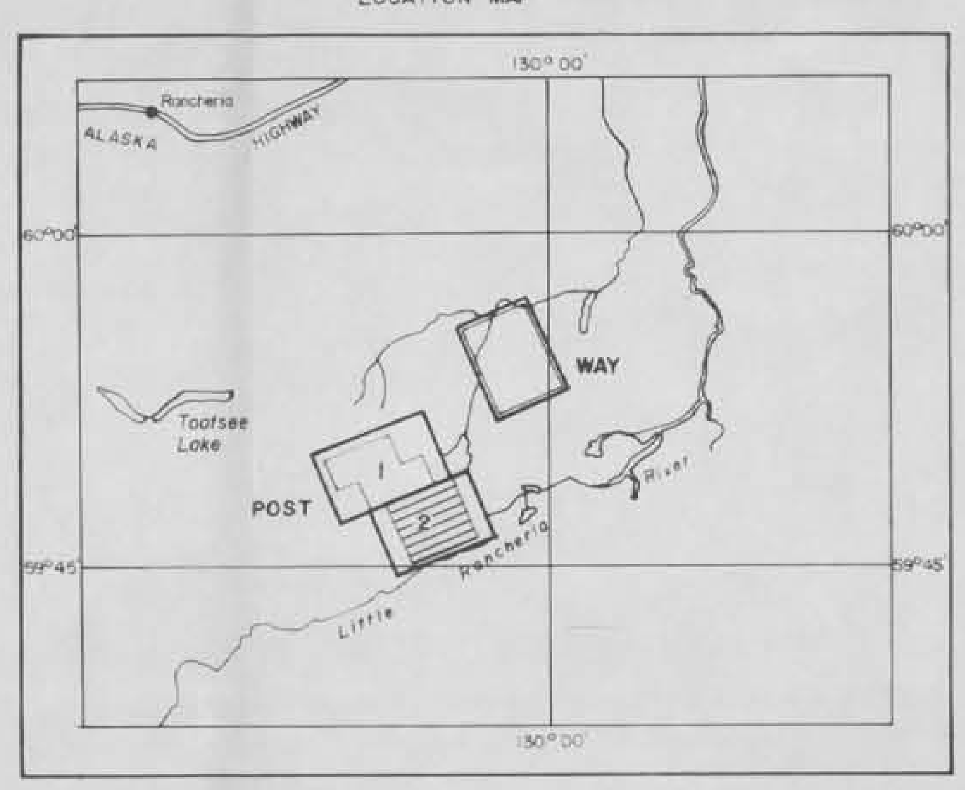
POST CLAIM BLOCK , TOOTSEE RIVER AREA, B.C.

RESISTIVITY

FOR

CORDILLERAN ENGINEERING

LOCATION MAP



Scale 1: 500,000

REGISTERED PROFESSIONAL ENGINEER
D. C. FRASER
PROVINCE OF ONTARIO

SCALE 1:10,000

1/2 Kilometres

1/2 Miles

SHEET 2

Flight Line

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

LEGEND

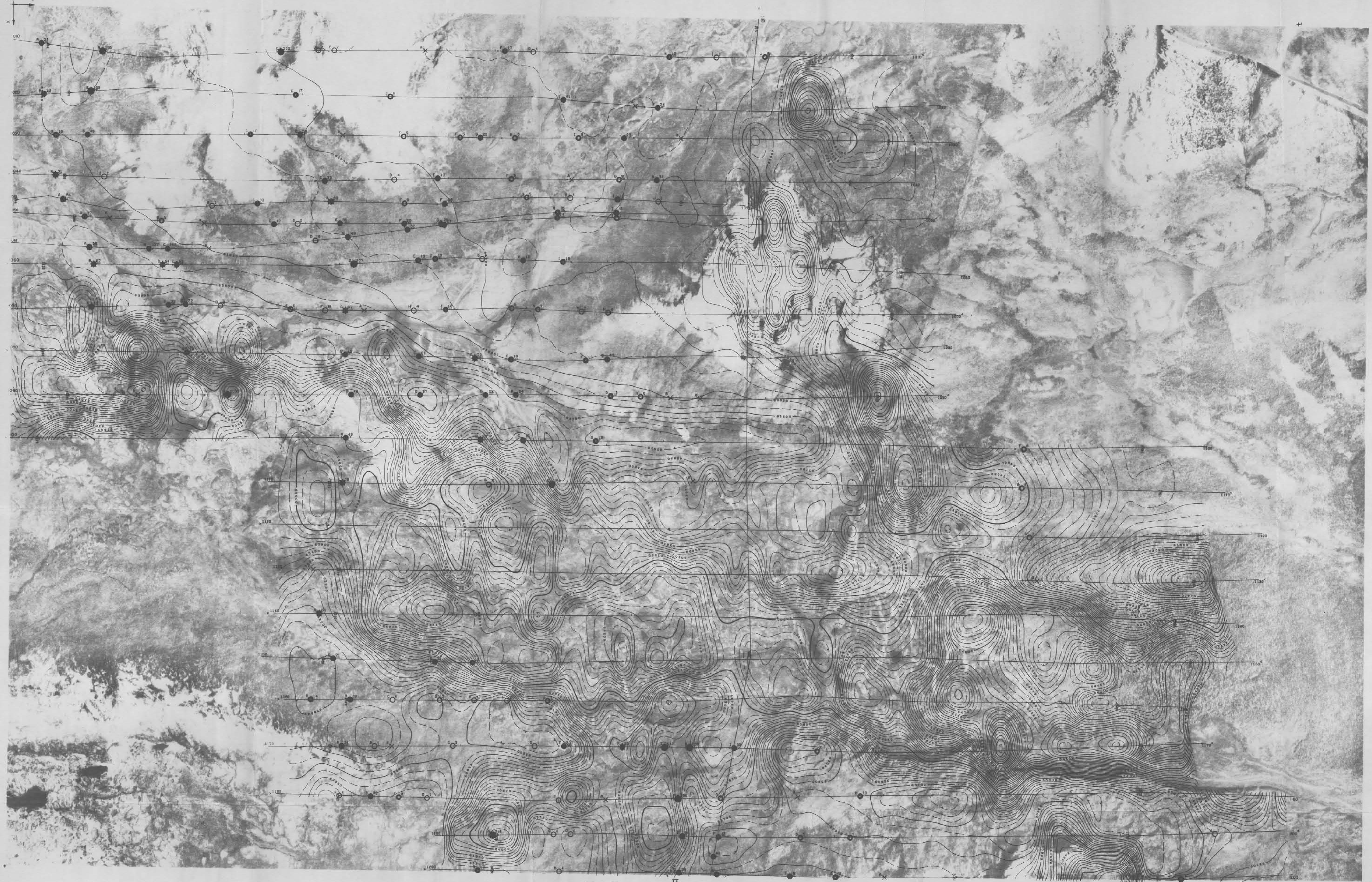
Contours in ohm – m
at eight intervals per decade

100
75
56
42
31
23
17
13
10

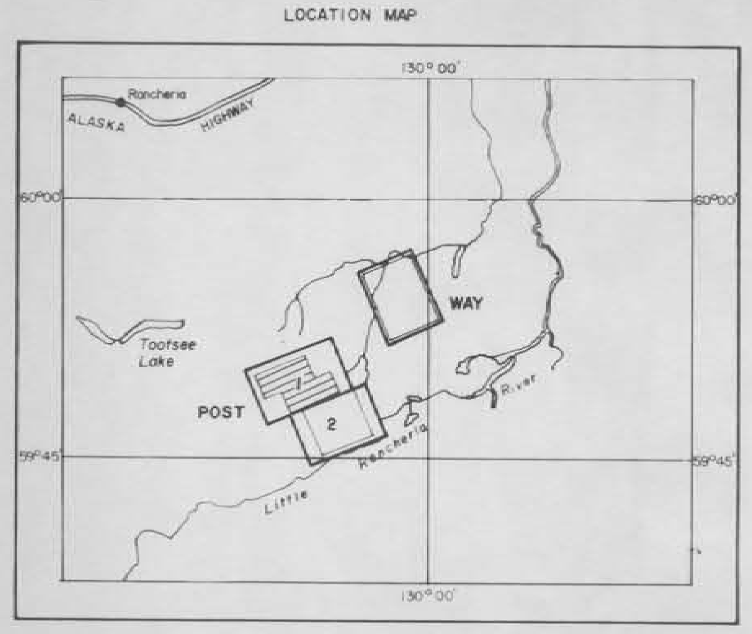
Note

The numbers face in the direction of increasing value.

JOB	DATE	DRAWN BY	CHECKED BY
158	JULY, 82	RD	Z.D.



LOCATION MAP



Scale 1:500,000

DIGHEM[II] SURVEY

Rpt. 168/2

POST CLAIM BLOCK, TOOTSEE RIVER AREA, B.C.

MAGNETICS

FOR

CORDILLERAN ENGINEERING

SCALE 1:10,000

1/2 0 1/2 1 Kilometres

1/4 0 1/4 1/2 Miles

SHEET 1

REGISTERED PROFESSIONAL ENGINEER
D. C. FRASER
PROVINCE OF ONTARIO

GEOLOGICAL BRANCH
ASSESSMENT REPORT

11,020

PART 5 OF 8

Flight Line

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

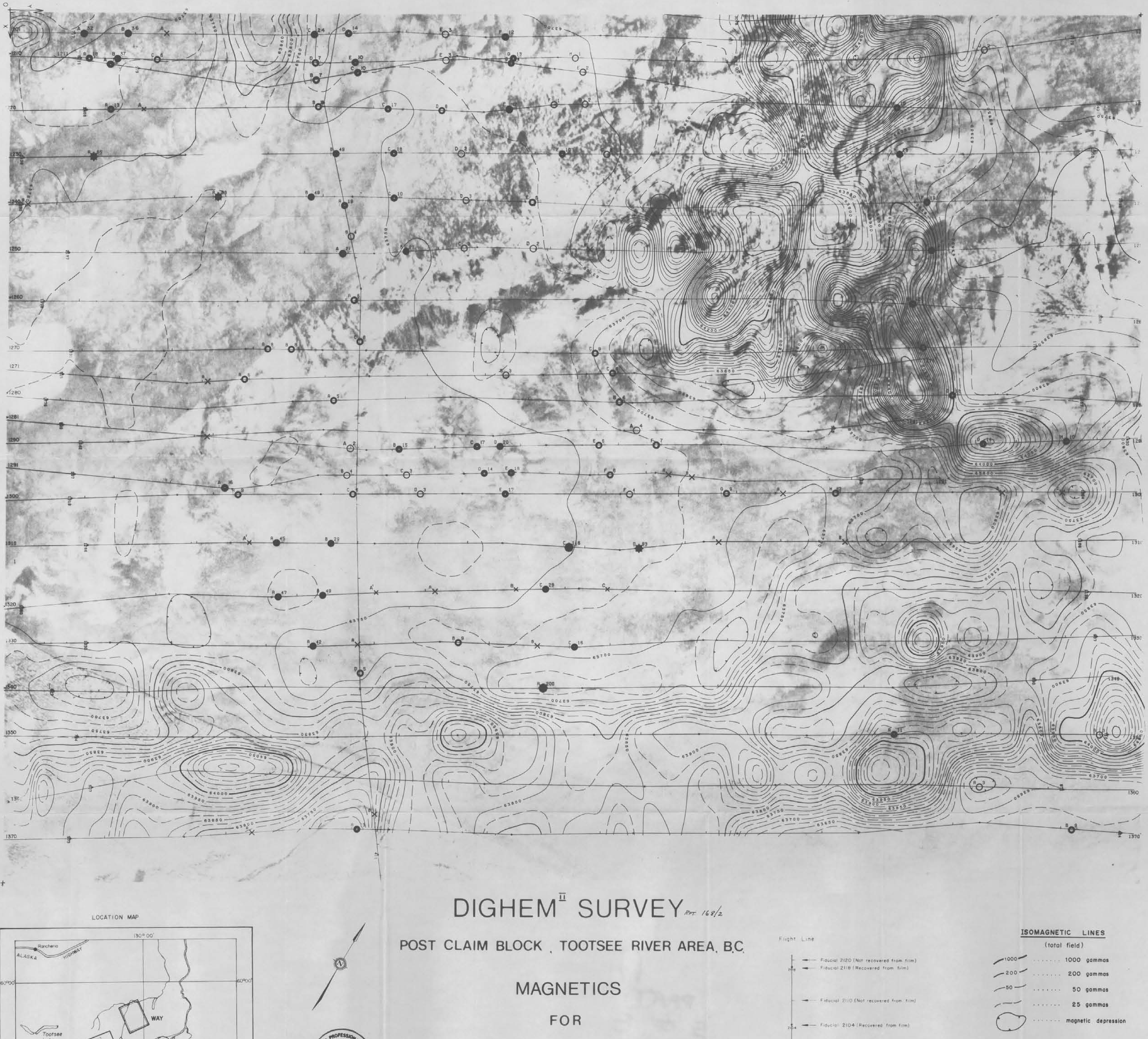
ISOMAGNETIC LINES

(total field)

- 1000 .... 1000 gammas
- 200 .... 200 gammas
- 50 .... 50 gammas
- .... 25 gammas
- .... magnetic depression

Magnetic Inclination within the survey area: 30°

JOB	DATE	DRAWN BY	CHECKED BY
158	AUGUST, 82	BB	Z.D.



DIGHEM^II SURVEY RPT. 168/2

POST CLAIM BLOCK, TOOTSEE RIVER AREA, B.C.

MAGNETICS

FOR

CORDILLERAN ENGINEERING

REGISTERED PROFESSIONAL ENGINEER D.C. FRASER PROVINCE OF ONTARIO

SCALE 1:10,000

1/2 0 1/2 1 Kilometres
1/4 0 1/4 1/2 Miles

SHEET 2

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

ISOMAGNETIC LINES

(total field)

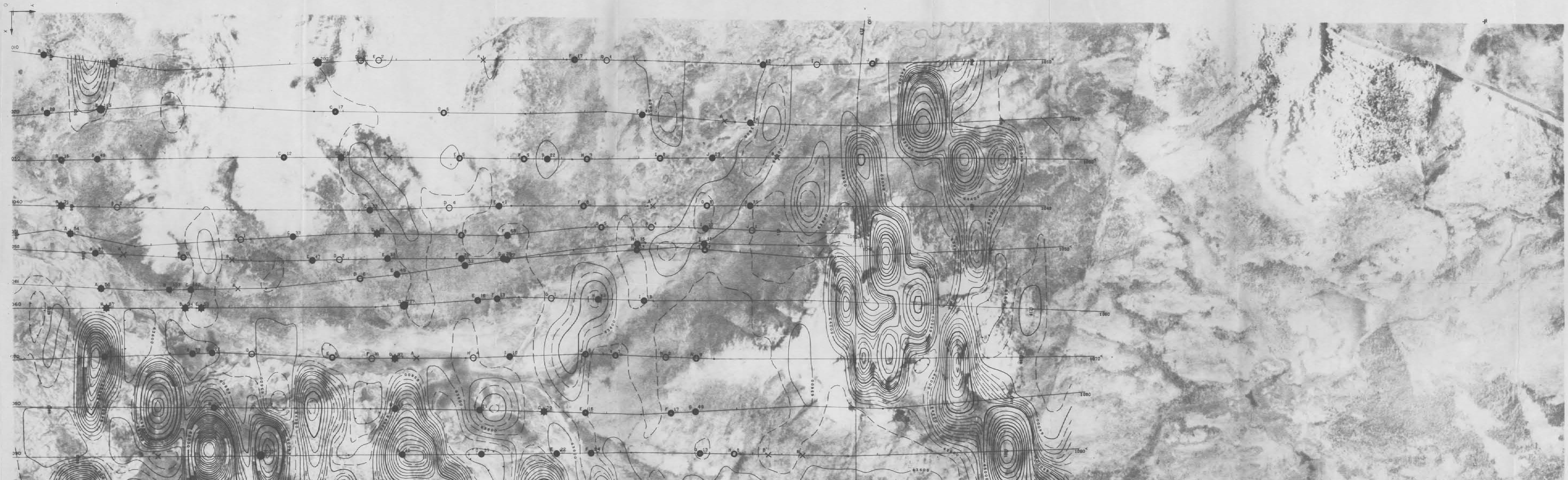
1000	1000 gammas
200	200 gammas
50	50 gammas
	25 gammas
	magnetic depression

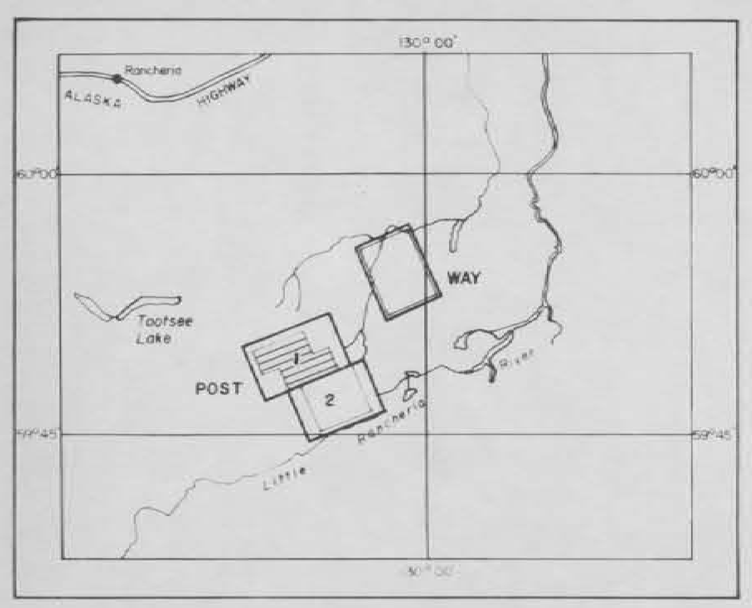
Magnetic Inclination within the survey area: 30°

GEOLOGICAL BRANCH ASSESSMENT REPORT

11,020
PART 5 OF 8

JOB	DATE	DRAWN BY	CHECKED BY
158	JULY, 82	DD.	Z.Z.





DIGHEM[II] SURVEY

RPT 168/2

POST CLAIM BLOCK , TOOTSEE RIVER AREA, B.C.

ENHANCED MAGNETICS

FOR

CORDILLERAN ENGINEERING

SCALE 1:10,000

SHEET 1

GEOLOGICAL BRANCH
ASSESSMENT REPORT

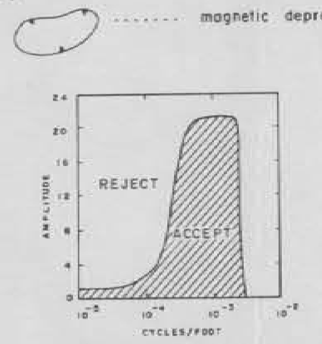
11,020

PART 5 OF 8

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

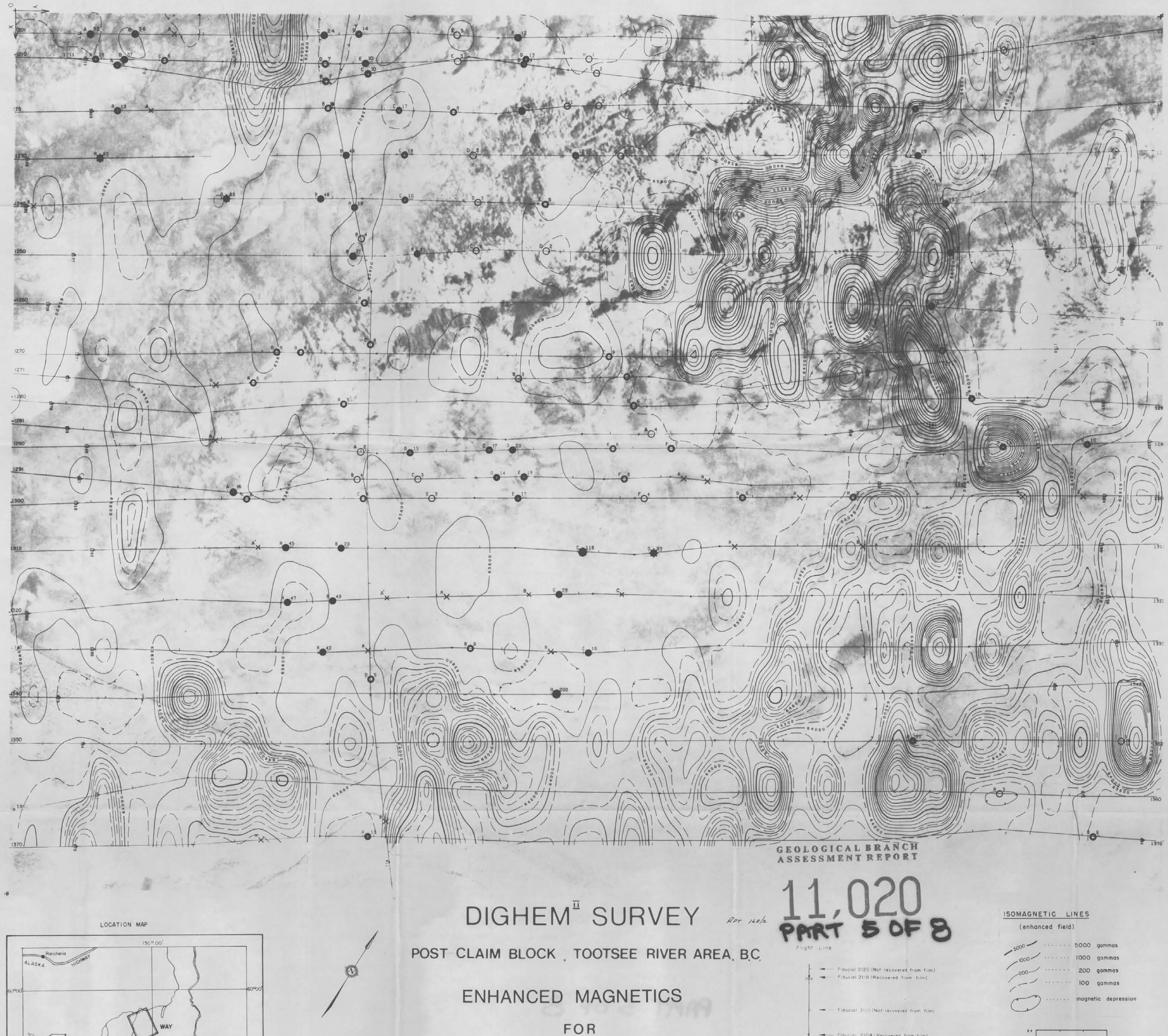
ISOMAGNETIC LINES
(enhanced field)

5000 gammas
1000 gammas
200 gammas
100 gammas
magnetic depression

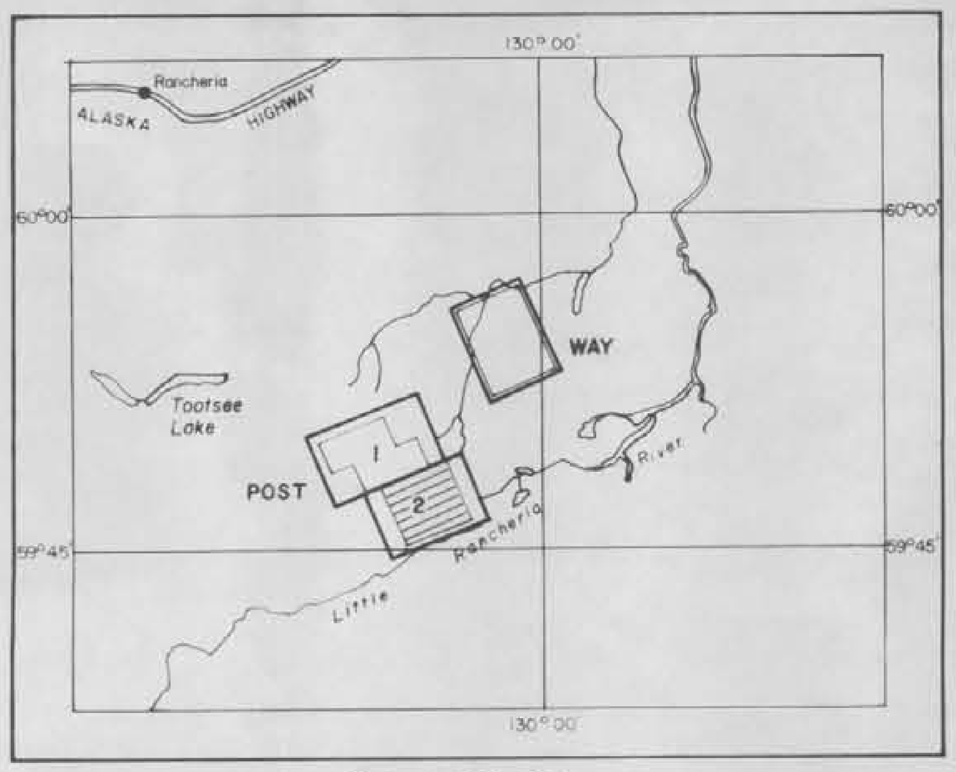


Frequency response of magnetic operator

JOF	DATE	DRAWN BY	CHECKED BY
158	AUGUST 82	RD	Z.Z.



LOCATION MAP



Scale 1:500,000

DIGHEM II SURVEY

POST CLAIM BLOCK, TOOTSEE RIVER AREA, B.C.

ENHANCED MAGNETICS

FOR

CORDILLERAN ENGINEERING

SCALE 1:10,000

1/2 0 1/2 1 Kilometres

1/4 0 1/4 1/2 Miles

REGISTERED PROFESSIONAL ENGINEER
D. C. FRASER
PROVINCE OF ONTARIO

SHEET 2

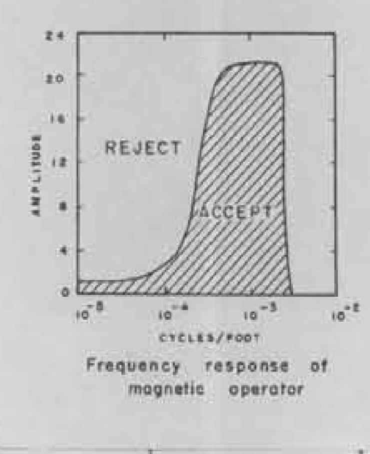
Flight Line

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

501 A — Line number and Flight direction

ISOMAGNETIC LINES
(enhanced field)

- 5000 gammas
- 1000 gammas
- 200 gammas
- 100 gammas
- magnetic depression



Frequency response of magnetic operator

JOB	DATE	DRAWN BY	CHECKED BY
158	JULY, 82		