LOG NO: 0115

FILE NO:

REPORT ON A
COMBINED HELICOPTER BORNE
MAGNETIC, ELECTROMAGNETIC AND VLF-EM
SURVEY
UNUK RIVER AREA
NORTHERN BRITISH COLUMBIA

FOR
SWIFT MINERALS LTD.
BY
AERODAT LIMITED
October 20, 1989

J8973

Kevin Killin
Geophysicist

TABLE OF CONTENTS

LIST of MAPS
(Scale 1:10,000)

Basic Maps : (As described under Appendix "B" of Contract)

1. TOPOGRAPHIC BASE MAP;
Showing registration crosses corresponding to NTS coordinates on survey maps, on stable Cronaflex film.

2. FLIGHT LINES;
Photocombination of flight lines, anomalies and fiducials with base map.

3. AIRBORNE ELECTROMAGNETIC SURVEY INTERPRETATION MAP;
showing conductor axes and anomaly peaks along with conductivity thickness values; on a Cronaflex base; Interpretation Report.

4. TOTAL FIELD MAGNETIC CONTOURS;
showing magnetic values contoured at 2 nanoTesla intervals; on a Cronaflex base map.

5. CALCULATED VERTICAL MAGNETIC GRADIENT CONTOURS;
showing vertical gradient values contoured at 0.05 nanoTesla per metre intervals showing flight lines and fiducials; on a Cronaflex base map.

6. APPARENT RESISTIVITIES CALCULATED FROM 4175 Hz COPLANAR COILS;
contoured data at logarithmic intervals (in ohm.m.), on a base map.

7. VLF-EM TOTAL FIELD CONTOURS;
of the VLF Total field from the Cutler, Maine transmitter; as a Cronaflex base map.

C.R. Harris, P.Eng.,
2709 Wembley Drive
North Vancouver, B.C.
V7J 3B7

January 10, 1990

T. E. Kalnins,
Geological Survey Branch,
Rm. 121 - 525 Superior Street,
Victoria, B.C. V8V 1X4

Re: DUP GROUP Assessment

COST STATEMENT

The attached statements cover the costs of airborne geophysical surveys over 4 claims, the DUP 4, 6 & 7 and the FRED 15

Since the DUP 7 and FRED 15 are not included in the DUP Group for which assessment work is claimed, the cost shown on the invoices has been pro-rated accordingly:

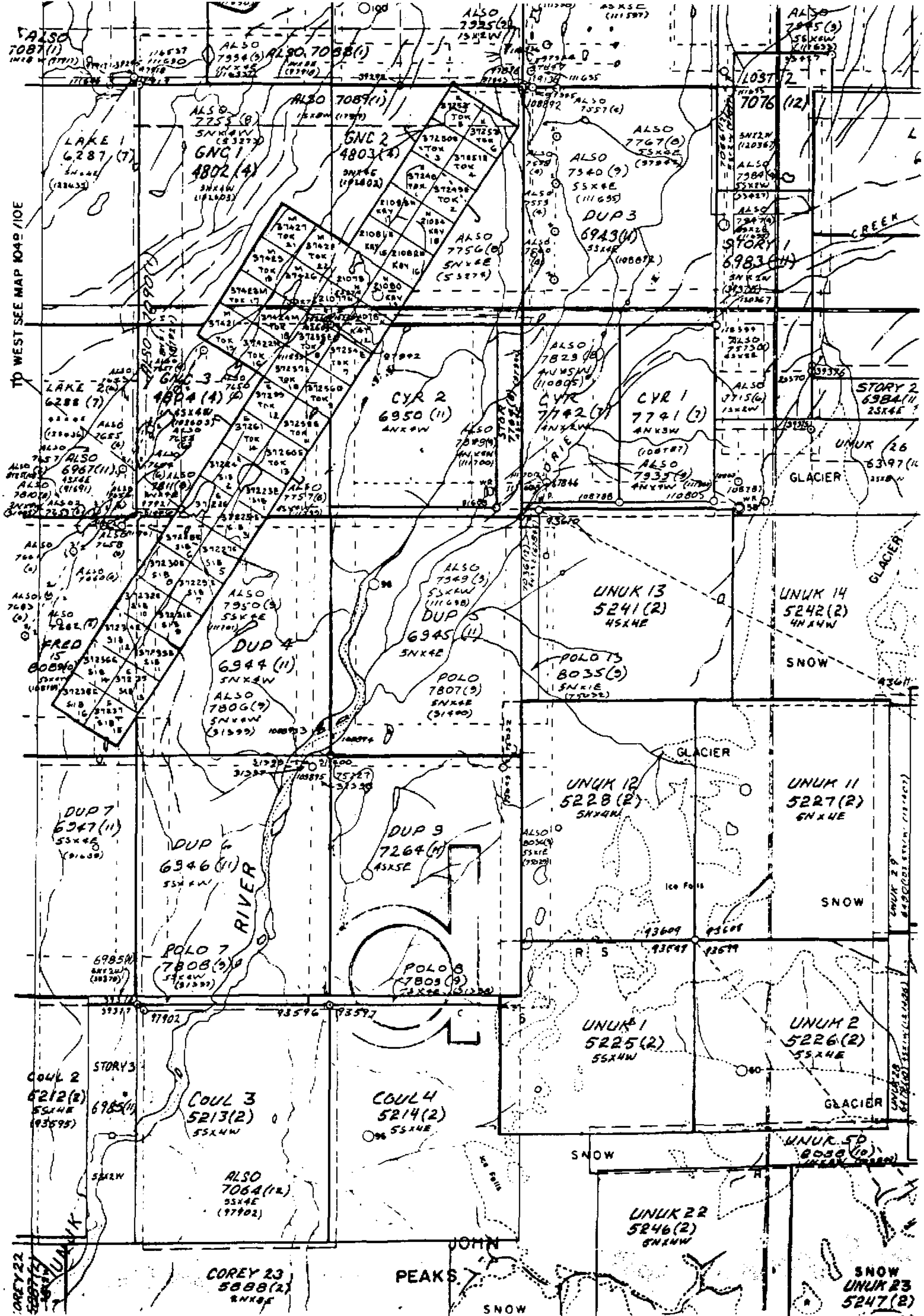
TOTAL Cost of Survey .... $ 29,000.00

50% of above = ... $ 14,500.00

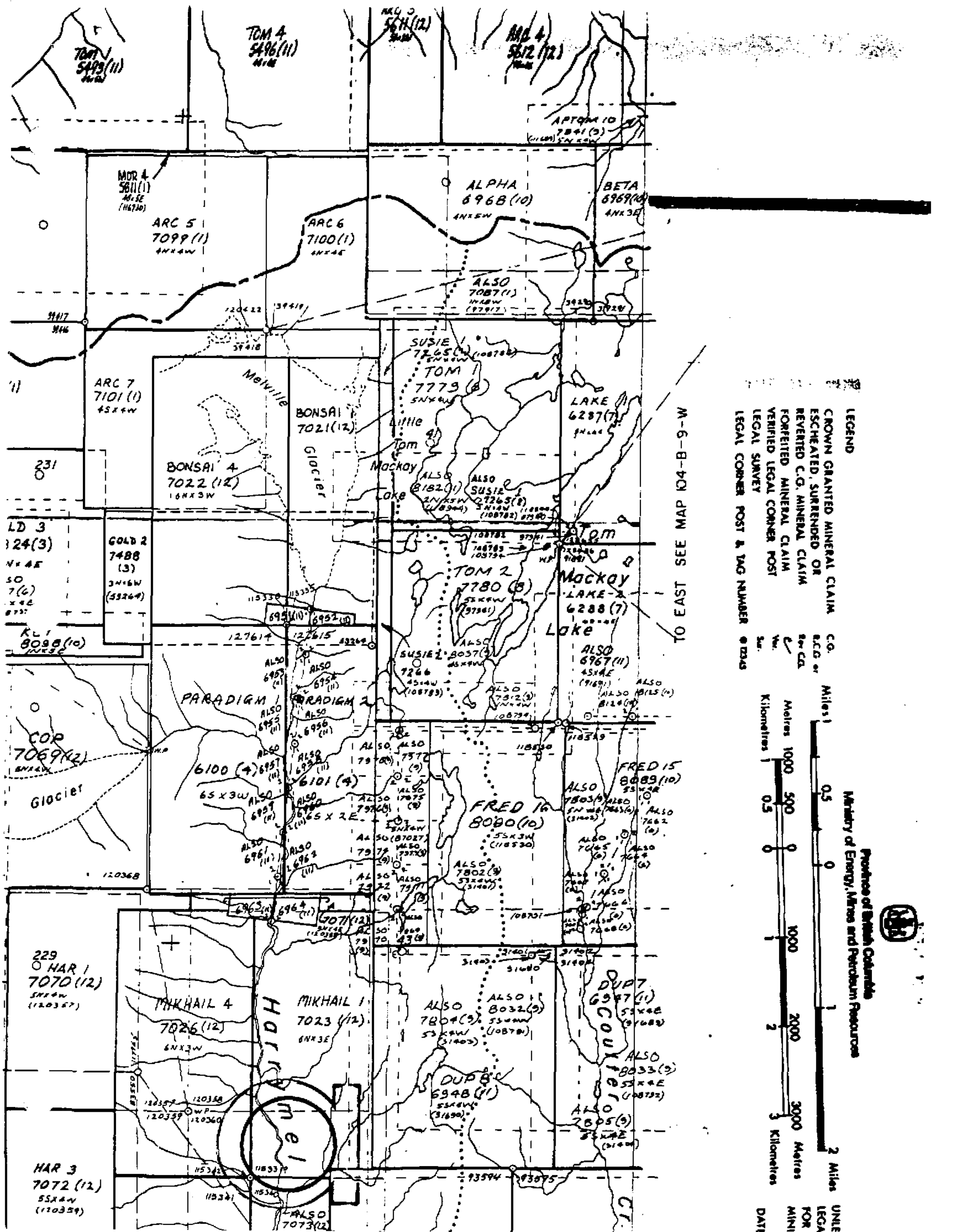
$ 14,500.00 is therefore applicable to assessment on the DUP Group which is more than adequate to cover the amount claimed.

....

C. R. Harris, P.Eng.



TO WEST SEE MAP 104B/10E
ALSO 7087(1)
ALSO 7088(1)
ALSO 7089(1)
LAKE 1 6287 (7)
GNC 1 4802 (4)
GNC 2 4803 (4)
GNC 3 4804 (4)
ALSO 7755 (8)
ALSO 7767(8)
ALSO 7340 (9)
DUP 3 6943(11)
ALSO 7756 (8)
LOST 2 7076 (12)
STORY 1 6983 (11)
CREEK
LAKE 2 6288 (7)
ALSO 6967(11)
CYR 2 6950 (11)
CYR 7742 (7)
CYR 1 7741 (7)
ALSO 7823 (8)
ALSO 7933 (9)
ALSO 7715(6)
STORY 2 6984(11)
UNUK 26 6397
GLACIER
ALSO 7757(8)
ALSO 7549 (9)
DUP 6945 (11)
UNUK 13 5241 (2)
UNUK 14 5242(2)
SNOW
FRED 15 8089(10)
DUP 4 6944 (11)
ALSO 7950 (9)
ALSO 7806 (9)
POLO 13 8035(9)
POLO 7807(9)
UNUK 12 5228 (2)
UNUK 11 5227(2)
DUP 7 6947 (11)
DUP 6 6946 (11)
DUP 9 7264 (11)
RIVER
Ice Falls
POLO 7 7808 (9)
POLO 8 7809 (9)
UNUK 1 5225 (2)
UNUK 2 5226 (2)
COUL 2 6212(2)
STORY 3 6985(11)
COUL 3 5213(2)
COUL 4 5214(2)
ALSO 7064(12)
UNUK 50 8056 (10)
UNUK 22 5246(2)
UNUK
JOHN PEAKS
COREY 23 5888(2)
COREY 22
SNOW
UNUK 23 5247(2)


TOM 4
5496(11)
TOM 1
5493(11)
ARC 4
5612(12)
APTOM 10
7841(5)
MOR 4
5611(1)
ALPHA
6968(10)
4NX5W
BETA
6969(10)
4NX3E
ARC 5
7099(1)
4NX4W
ARC 6
7100(1)
4NX4E
ALSO
7087(1)
SUSIE 1
7265(8)
TOM 1
7779(8)
5NX4W
ARC 7
7101(1)
4SX4W
Melville
BONSAI 1
7021(12)
Little
Tom
Mackay
Lake
LAKE
6287(7)
BONSAI 4
7022(12)
16NX3W
Glacier
GOLD 2
7488
(3)
3N×6W
(53264)
TOM 2
7780(8)
Tom
Mackay
Lake
LAKE 2
6288(7)
SUSIE 2
7266
ALSO
6967(11)
PARADIGM
PARADIGM 2
COP
7069(12)
Glacier
6100 (4)
6101 (4)
FRED 16
8090(10)
FRED 15
8089(10)
HAR 1
7070(12)
MIKHAIL 4
7026(12)
6NX3W
MIKHAIL 1
7023(12)
6NX3E
Harrymel
DUP 8
6948(11)
DUP 7
6947(11)
Coulter
ALSO
8032(5)
ALSO
7804(5)
ALSO
8033(5)
ALSO
7805(5)
HAR 3
7072(12)
55X4W
ALSO
7073(12)
TO EAST SEE MAP 104-B-9-W
LEGEND
CROWN GRANTED MINERAL CLAIM C.G.
ESCHEATED, SURRENDED OR REVERTED C.G. MINERAL CLAIM E.C.G. or Rev.C.G.
FORFEITED MINERAL CLAIM
VERIFIED LEGAL CORNER POST Ver.
LEGAL SURVEY Sur.
LEGAL CORNER POST & TAG NUMBER
Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources
Miles 1 0.5 0 1 2 Miles
Metres 1000 500 0 1000 2000 3000 Metres
Kilometres 1 0.5 0 1 2 3 Kilometres

1. INTRODUCTION

This report describes an airborne geophysical survey carried out on behalf of Swift Minerals Ltd., by Aerodat Limited. The survey equipment included a four frequency electromagnetic system, a high sensitivity cesium vapour magnetometer, a 2 frequency VLF-EM system, a radar positioning system and a video tracking camera. Electromagnetic, magnetic, and altimeter data were recorded in analog and digital forms. Positioning data were recorded digitally as well as being encoded on VHS video tape and being marked on the flight path map by the operator.

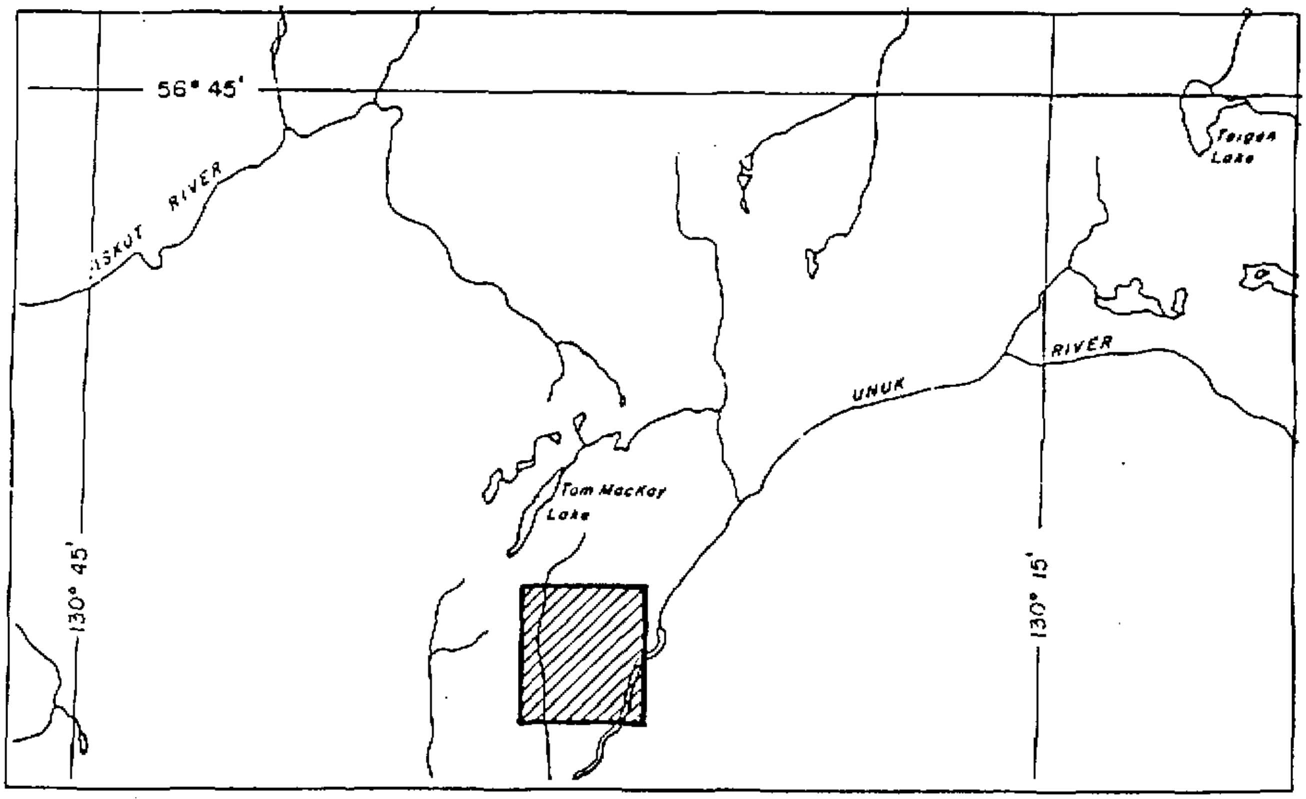
The survey area, comprising one block in the Unuk River area in northern British Columbia, was flown in the period of September 13 to September 17, 1989. The area was covered in 8 flights flown in an east-west orientation at a line spacing of 100 m. The data quality and coverage were considered to be well within contract specifications.

The purpose of this survey was to acquire data over and around ground that is of interest to Swift Minerals Ltd. A total of 200 kilometres of data were compiled in map form and are presented with this report according to specifications laid out by Swift Minerals Ltd.

2. SURVEY AREA LOCATION

The survey area depicted below is centred at approximately 56° 35 minutes north latitude, and 130° 30 minutes west longitude. It is approximately 80 kilometres northwest of Stewart, British Columbia, and 35 kilometres east of Bronson Creek (NTS Reference Map number 104B). The area can be accessed by helicopter from Bronson Creek airstrip, Stewart, or Bell II on the Cassiar Stewart highway.

Terrain in the area is rugged with elevations varying from roughly 1000' a.s.l. to 4000' a.s.l.



3. AIRCRAFT AND EQUIPMENT

3.1 Aircraft

An Aerospatiale SA 315B Lama helicopter, (C-GOLV), piloted by J. Kamphaus, owned and operated by Peace Helicopters Limited, was used for the survey. The Aerodat equipment operator and navigator was Peter Moore. Installation of the geophysical and ancillary equipment was carried out by Aerodat. The survey helicopter was flown at a mean terrain clearance of 60 metres, while the EM sensors have a ground clearance of 30 metres.

3.2 Equipment

3.2.1 Electromagnetic System

The electromagnetic system was an Aerodat 4 frequency system. Two vertical coaxial coil pairs are operated at 935 Hz and 4600 Hz and two horizontal coplanar coil pairs at 4175 Hz and 32 kHz. The transmitter-receiver separation was 7 metres. Inphase and quadrature signals were measured simultaneously for the 4 frequencies with a time constant of 0.1 seconds. The electromagnetic bird was towed 30 metres below the helicopter.

3.2.2 VLF-EM System

The VLF-EM System was a Herz Totem 2 A. This instrument measures the total field and quadrature component of the selected frequency. The sensor was towed in a bird 12 metres below the helicopter. The transmitting station used was NAA, Cutler, Maine broadcasting at 24.0 kHz. This station is maximum coupled with N-S striking conductors and provides usable results for strikes +/- 30 degrees.

3.2.3 Magnetometer

The magnetometer employed a Scintrex Model VIW 2321 H8 cesium, optically pumped magnetometer sensor. The sensitivity of this instrument was 0.1 nanoTeslas at a 0.2 second sampling rate. The sensor was towed in a bird 12 metres below the helicopter.

3.2.4 Magnetic Base Station

An IFG (GEM 8) proton precession magnetometer was operated at the base of operations to record diurnal variations of the earth's magnetic field. The clock of the base station was synchronized with that of the airborne system to facilitate later correlation.

3.2.5 Radar Altimeter

A King KRA 10 radar altimeter was used to record terrain clearance. The output from the instrument is a linear function of altitude for maximum accuracy.

3.2.6 Tracking Camera

A Panasonic video flight path recording system was used to record the flight path on standard VHS format video tapes. The system was operated in continuous mode and the flight number, real time and manual fiducials were registered on the picture frame for cross-reference to the analog and digital data.

3.2.7 Analog Recorder

An RMS dot-Matrix recorder was used to display the data during the survey. In addition to manual and time fiducials, the following data was recorded:

Channel	Input	Scale
CXI1	Low Frequency Inphase Coaxial	25 ppm/cm
CXQ1	Low Frequency Quadrature Coaxial	25
CXI2	High Frequency Inphase Coaxial	25
CXQ2	High Frequency Quadrature Coaxial	25
CPI1	Mid Frequency Inphase Coplanar	100ppm/cm
CPQ1	Mid Frequency Quadrature Coplanar	100
CPI2	High Frequency Inphase Coplanar	200
CPQ2	High Frequency Quadrature Coplanar	200
VLT	VLF-EM Total Field, Line NAA	25 %/cm
VLQ	VLF-EM Quadrature, Line NAA	25 %/cm
VOT	VLF-EM Total Field,Ortho NLK	25 %/cm

Channel	Input	Scale
VOQ	VLF-EM Quadrature, Ortho NLK	25 %/cm
RALT	Radar Altimeter, (150 m. at top of chart)	100ft/cm
MAGF	Magnetometer, fine	25nT/cm
MAGC	Magnetometer, coarse	250nT/cm

3.2.8 Digital Recorder

A DGR 33:16 data system recorded the survey on magnetic tape. Information recorded was as follows:

Equipment	Recording Interval
EM System	0.1 seconds
VLF-EM	0.2 seconds
Magnetometer	0.2 seconds
Altimeter	0.2 seconds
Power Line Monitor	0.2 seconds

4. DATA PRESENTATION

4.1 Base Map

A topographic base map at a scale of 1:10,000 was prepared by Aerodat from existing 1:50,000 scale topographic maps. The data is presented on an unscreened Cronaflex base. Registration points corresponding to the Universal Transmercator Grid are shown to ensure accurate registration to the base topography.

4.2 Flight Path Map

The flight path for the survey area was received using data supplied by the Motorola Mini-Ranger radar navigation system. Transponders at fixed locations were interrogated several times per second, and the helicopter position calculated by triangulation.

Where the navigational information was absent, flight path recovery was done utilizing the VHS video tapes recorded while in flight.

The flight lines have time and camera fiducials, flight number and line number for cross reference with the analog and digital data. Anomaly peaks picked from the 4600 Hz coaxial coils are shown with conductivity thickness ranges and inphase amplitudes.

4.3 Airborne Electromagnetic Interpretation Map

The electromagnetic data was recorded digitally at a sample rate of 10 per second and a time constant of 0.1 seconds. A two stage filtering process was carried out to reject major sferic events and to reduce the system noise.

Local sferic activity can produce sharp, large amplitude events that cannot by removed by conventional filtering procedures. Smoothing and stacking will reduce their amplitude, but leave broader residual responses that can be confused with geological phenomena. To avoid this possibility, a computer algorithm searches out and rejects major sferic events.

The signal to noise ratio was further enhanced by the application of a low pass digital filter. It has a zero phase shift which prevents any lag or peak displacement from occurring, and it suppresses only the variations with a wavelength less than about 0.25 seconds. This low effective time constant permits maximum profile shape resolution.

Following the filtering process, a base level correction was made. This correction is a linear function of time that ensures the corrected amplitude of the various inphase and quadrature components is zero when no conductive or permeable source is presented. This filtered and levelled data was used in the electromagnetic interpretation. An interpretation map showing flight lines, conductor axes anomaly peak locations and interpreted structure. These data are presented on a cronaflex copy of the base map.

4.4 Total Field Magnetic Contours

The aeromagnetic data have been corrected for diurnal variation by adjustment with the digitally recorded base station data. There have been no correction for regional variation applied. The corrected profile data have been interpolated onto a grid at a 25 m true scale interval using an Akima spline technique. These data were then contoured at a 2 nanoTesla interval and presented on a Cronaflex copy of the base map.

4.5 Calculated Vertical Magnetic Gradient Contours

The vertical magnetic gradient was calculated from the gridded total field magnetic data. These data were then contoured at .05 nanoTesla per metre interval and presented on a Cronaflex copy of the base map.

4.6 Apparent Resistivity Contours

The electromagnetic data was processed to yield a map of the apparent resistivity of the ground. The calculations are based on a half space model, i.e. assuming a geological unit with a thickness greater than 200 m. The computer generates a resistivity that would be constant with the bird height and recorded amplitudes for the 4175 Hz coplanar coils. The apparent resistivities calculated for this model were then interpolated onto a grid at a 25 m true scale interval using an Akima spline technique and are presented on a Cronaflex copy of the topographic base map.

4.7 VLF-EM Total Field Contours

The VLF-EM signals from NAA (Cutler, Maine) broadcasting at 24.0 kHz were recorded and presented in contour form on the Cronaflex base map. The orthogonal signals were recorded digitally and may be processed and presented at a later date.

5. INTERPRETATION

5.1 Geology

Regional Geological information (Ministry of Energy, Mines & Petroleum Resources Open File Map 1989-10) was provided to Aerodat by Swift Minerals Ltd. There are a limited number of geological stations within the survey block, and hence the geology can only be used as a general guide.

The Unuk River area is underlain by Stikine rock assemblages. These Upper Triassic to Lower Jurassic volcanics and sediments are weakly met amorphosed. The are dominantly Lower greenschist, but locally can grade to lower amphibolite. These are overlain by Middle Jurassic basin sediments.

Major north trending faults are believed to be related to late turassic - early cretaceous orogenisis.

There are four main rock types documented within the survey block. The eastern edge of the block is cut by the Unuk River valley. Here, and in other valleys within the area, alluvium deposits of varying thickness occur.

Felsic volcanics of the Mt. Dillman formation occur in two bands along the eastern and western edges of the area. There are documented disseminated sulphide occurrences within these felsic units. These are separated by a central pyroclastic, epiclastic sequence of andesites and basalts.

The western portion of the survey block is underlain dominantly by rhythmically bedded siltstones, indicative of a basin sedimentation environment.

There are two documented north trending faults through the property. The eastern fault trends through the Unuk River valley, the western fault trends north through the Coulter Creek valley.

5.2 Magnetics

Data obtained from the cesium vapour high sensitivity magnetometer provided virtually a continuous reading when recorded at .2 second intervals. The system is practically noise free, and the sensitivity of 0.1 nT allows for the mapping of very small inflections in the magnetic field. The maps resulting from these data are comparable in quality to ground data.

The magnetic field in the area varies from about 57360 nT in the southwest corner of the block, to 57590 nT in the centre. The map is characterized by a complicated narrow magnetic band trending through the centre of the area surrounded by a gentle sloping trend surrounding this central body.

The magnetics seem to have outlined the known geology. The areas with magnetic fields above 57500 nT generally map the inferred volcanics. The areas below map the felsics and sediments.

The central magnetic trend is clearly broken and warped. A number of faults have been inferred by this data, and seems to roughly correspond with the area topography. These faults trend in a NW-NNW direction, one trending NE. This is in contrast to the known faults which trend north. The Coulter Creek and Unuk River faults are also mapped, although their magnetic signature is weak. This is due to the gentle gradient decreasing from the central portion of the map to both the east and west. The Unuk River fault has been extended with the help of the vertical magnetic gradient data, and now appears as a continuous fault crossing the Unuk River valley.

The faulting appears to be of two generations. The NW faulting appears to be the oldest, the larger north trending faults that cut these appear younger. The faulting may be due to more than these two generations as the structure in the area appears quite complex.

A magnetic anomaly at 7:15:55 on line 10100 appears within the mapped felsics. This is between a known and inferred fault. This may be indicative of a continuation of the high intensity central unit further along strike. It may also be the expression of a separate stratigraphic unit trending NS beneath the documented felsics. An examination of the vertical gradient data shows this trend terminating at line 10170. The along strike continuation may be seen as either line 10120 @ 12:01:45. This second trend may be part of the felsic unit with disseminated sulphides documented on the regional geology map.

5.3 Calculated Vertical Magnetic Gradient

The calculated vertical magnetic gradient map has the effect of enhancing the high frequency component of the total field magnetics. This is essentially similar to remaining the regional effects and enhancing the local magnetic trends. The gives a fairly accurate rendition of the underlying magnetic bodies.

Comparison of the gradient map with geological data will help to produce a better understanding of the geological structure in the area.

5.4 Apparent Resistivity

The apparent resistivity map was calculated from the 4175 Hz coplanar coils. The values vary from 30 ohm-metres adjacent to the Coulter Creek Valley, to high resistivities of greater than 7943 ohm-metres through a large portion of the survey block.

There are two pronounced resistivity lows trending NS through the survey area. The eastern trend maps the topographic low associated with the Unuk River Valley and alluvium. This trend has a sharp termination to the west, where the inferred alluvium terminates. It should be noted that although the apparent resistivity low correlates roughly with the Unuk River, there is an underlying fault zone which may be enhancing the conductivity.

The second pronounced resistivity trend parallels the Coulter Creek Valley. There is a weak correlation with the valley bottom sediments, although most of the zone appears to map some conductive lithology(s) east of the Creek. The known sulphide occurrence appears to have an expression of the map, and is on trend with resistivity zone B. It should also be noted that this zone roughly follows the magnetic trend noted earlier from the gradient map.

Resistivity zone A occurs in the north-central portion of the map. It parallels a valley and may be due to alluvium or tulks accumulation. This zone parallels an interpreted fault, and may be an expression of conductive material at depth within this zone of weakness.

Further south (zone B), centred on line 10260 and spanning several lines, are two resistivity lows which span the felsic/volcanic rock contact; and are along strike with a known sulphide occurrence.

Resistivity low (zone C) noted on the interpretation map is noteworthy. It has no significant topographic correlation and occurs along strike with an interpreted fault further north. This may indicate an extension of the structure along strike as far as the Unuk River fault.

The observation that a number of the resistivity trends are closely related with interpreted structure may prove useful in further exploration.

5.5 VLF-EM Total Field Contours

The signal from NAA Cutler, Maine are presented. There is a low amplitude variation over the area which outlines mainly N-S trending conductors. There seems to be little correlation with the magnetic resistivity data.

This map may be a reflection of the changes in surficial conductance as opposed to major structural features.

5.6 Electromagnetics

The electromagnetic data were first checked by examination of the analog data in conjunction with the presented profiles. Record quality was good, with little noise evident on the analog traces. Sferic and system noise was removed from the traces with the application of a smoothing filter. Geologic noise in terms of surficial conductors, is evident on the high frequency traces, as well as the lower frequency quadrature traces. This has not presented any interpretation problems.

Electromagnetic anomalies were picked off of the plotted profiles using the vertical sheet conductor model as a guide. These picked conductors were compared with selections made by a computerized selection program that was adjusted for ambient and system noise. The conductor axes were then plotted based on similarity of electromagnetic response. These interpreted conductors were then evaluated based on correlation with other geophysical data, as well as lithology when applicable.

Most conductors within the block are poorly defined on the 935 Hz channels, however, they are clearly defined on the mid frequency coaxial and coplanar channels as then, vertical sheet type conductors. Most conductors also fall near the Unuk River and adjacent to the Coulter Creek valley, within the previously mentioned resistivity lows. The writer has broken the conductors into ten groups based upon strike, similarity of response, and magnetic correlation.

No attempt has been made to prioritize conductors, or conductive zones, and numbers are provided only for the purpose of reference between the report and interpretation map.

Conductor Group I occurs in the northwestern corner of the survey block. Two individual conductors trend adjacent to a documented fault, and within a zone mapped as sediments. These are steeply dipping conductors of moderate conductance. These conductors trend along a unit defined in the vertical gradient map.

Group II trends NNW along the northern end of the Coulter Creek valley. These anomalies have weak to moderate conductance and trend along topographic lows. These conductors may be due in part to alluvial or talus deposits, though their inphase responses both the 4600 Hz an 4175 Hz coils indicate a steeply dipping conductor.

The Group III conductors in the west central portion of the block correlate well with the documented Coulter Creek fault. The conductors have high conductances, indicating a bedrock source. The conductors indicate a vertical source, which correlates well with the known fault zone. These could be due to weak mineralization and fluid content in the fault zone. The alluvium in the valley bottom may also contribute to the electromagnetic responses.

Group IV correlate well with mapped disseminated pyrite occurrence within felsics. These conductors have a high conductance, with good responses on the 935 Hz coils. These conductors are also near vertical.

Group V has a noted similarity with Group IV. These conductors correspond well to an inferred fault zone and a magnetic anomaly. When correlated with the magnetic data, the writer believes these conductors may be contained within the same stratigraphic unit as Group IV, and are separated by some as yet undefined structure.

Groups VI, VII and IX represent individual conductors with low to moderate conductances. These conductors correlate with known and inferred faults. These may be due to fluids or weak mineralization within the fault zone.

Groups VIII and X reflect the combined effects of conductive sediments and possible bedrock conductors. The Unuk River conductors approximate the valley, but also parallel the documented fault. Some anomalies are of the "edge" type where the sediments come into contact with the more resistive bedrock to the east and west.

The apparent correlation between the conductor axes and proposed fault zones gives support to the inferred structure from the contoured magnetic data.

5.7 Conclusions & Recommendations

The survey block seems to have a much more complex geology than is documented to date. The Total Field Magnetics and Calculated Vertical Magnetic Gradient data infer structures and trends not evident on the compiled geology map of the area. The documented folding/faulting in the area leads the writer to believe there are more subtle structures to be mapped at a later date.

The block is highly resistive, making detection of bedrock conductors easy. Conductive zones appear to parallel documented and inferred faults. These fall in topographic lows, where alluvium and talus mask the real source of the anomalies.

Discontinuities in both the magnetic and calculated vertical gradient data are believed to be structural, i.e. shears, and faults. These are important for future exploration as gold mineralization appears to be structurally controlled in this area.

Geological mapping ground follow up of conductors and inferred faults is recommended. This will lead to a better understanding of the geology and source of the electromagnetic responses.

Correlation of the results of this survey with any detail geological data compiled on a common base will allow the client to prioritize targets based on mutual correlation of all data sets.

Respectfully submitted,

Kevin Killin,
Geophysicist
AERODAT LIMITED
October 20, 1989

J8973

APPENDIX I

GENERAL INTERPRETIVE CONSIDERATIONS

Electromagnetic

The Aerodat four frequency system utilizes two different transmitter-receiver coil geometries. The traditional coaxial coil configuration is operated at two widely separated frequencies and the horizontal coplanar coil pair is operated at a frequency approximately aligned with one of the coaxial frequencies.

The electromagnetic response measured by the helicopter system is a function of the "electrical" and "geometrical" properties of the conductor. The "electrical" property of a conductor is determined largely by its electrical conductivity, magnetic susceptibility and its size and shape; the "geometrical" property of the response is largely a function of the conductor's shape and orientation with respect to the measuring transmitter and receiver.

Electrical Considerations

For a given conductive body the measure of its conductivity or conductance is closely related to the measured phase shift between the received and transmitted electromagnetic field. A small phase shift indicates a relatively high conductance, a large phase shift lower conductance. A small phase shift results in a large inphase to quadrature ratio and a large phase shift a low ratio. This relationship is shown quantitatively for a non-magnetic vertical half-plane model on the accompanying phasor diagram. Other physical models will show the same trend but different quantitative relationships.

The phasor diagram for the vertical half-plane model, as presented, is for the coaxial coil configuration with the amplitudes in parts per million (ppm) of the primary field as measured at the response peak over the conductor. To assist the interpretation of the survey results the computer is used to identify the apparent conductance and depth at selected anomalies. The results of this calculation are presented in table form in Appendix II and the conductance and inphase amplitude are presented in symbolized form on the map presentation.

The conductance and depth values as presented are correct only as far as the model approximates the real geological situation. The actual geological source may be of limited length, have significant dip, may be strongly magnetic, its conductivity and thickness may vary with depth and/or strike and adjacent bodies and overburden may have modified the response. In general the conductance estimate is less affected by these limitations than is the depth estimate, but both should be considered as relative rather than absolute guides to the anomaly's properties.

Conductance in mhos is the reciprocal of resistance in ohms and in the case of narrow slab-like bodies is the product of electrical conductivity and thickness.

Most overburden will have an indicated conductance of less than 2 mhos; however, more conductive clays may have an apparent conductance of say 2 to 4 mhos. Also in the low conductance range will be electrolytic conductors in faults and shears.

The higher ranges of conductance, greater than 4 mhos, indicate that a significant fraction of the electrical conduction is electronic rather than electrolytic in nature. Materials that conduct electronically are limited to certain metallic sulphides and to graphite. High conductance anomalies, roughly 10 mhos or greater, are generally limited to sulphide or graphite bearing rocks.

Sulphide minerals, with the exception of such ore minerals as sphalerite, cinnabar and stibnite, are good conductors; sulphides may occur in a disseminated manner that inhibits electrical conduction through the rock mass. In this case the apparent conductance can seriously underrate the quality of the conductor in geological terms. In a similar sense the relatively non-conducting sulphide minerals noted above may be present in significant consideration in association with minor conductive sulphides, and the electromagnetic response only relate to the minor associated mineralization. Indicated conductance is also of little direct significance for the identification of gold mineralization. Although gold is highly conductive, it would not be expected to exist in sufficient quantity to create a recognizable anomaly, but minor accessory sulphide mineralization could provide a useful indirect indication.

In summary, the estimated conductance of a conductor can provide a relatively positive identification of significant sulphide or graphite mineralization; however, a moderate to low conductance value does not rule out the possibility of significant economic mineralization.

Geometrical Considerations

Geometrical information about the geologic conductor can often be interpreted from the profile shape of the anomaly. The change in shape is primarily related to the change in inductive coupling among the transmitter, the target, and the receiver.

In the case of a thin, steeply dipping, sheet-like conductor, the coaxial coil pair will yield a near symmetric peak over the conductor. On the other hand, the coplanar coil pair will pass through a null couple relationship and yield a minimum over the conductor, flanked by positive side lobes. As the dip of the conductor decreased from vertical, the coaxial anomaly shape changes only slightly, but in the case of the coplanar coil pair the side lobe on the down dip side strengthens relative to that on the up dip side.

As the thickness of the conductor increases, induced current flow across the thickness of the conductor becomes relatively significant and complete null coupling with the coplanar coils is no longer possible. As a result, the apparent minimum of the coplanar response over the conductor diminishes with increasing thickness, and in the limiting case of a fully 3 dimensional body or a horizontal layer or half-space, the minimum disappears completely.

A horizontal conducting layer such as overburden will produce a response in the coaxial and coplanar coils that is a function of altitude (and conductivity if not uniform). The profile shape will be similar in both coil configurations with an amplitude ratio (coplanar:coaxial) of about 4:1*.

In the case of a spherical conductor, the induced currents are confined to the volume of the sphere, but not relatively restricted to any arbitrary plane as in the case of a sheet-like form. The response of the coplanar coil pair directly over the sphere may be up to 8* times greater than that of the coaxial pair.

In summary, a steeply dipping, sheet-like conductor will display a decrease in the coplanar response coincident with the peak of the coaxial response. The relative strength of this coplanar null is related inversely to the thickness of the conductor; a pronounced null indicates a relatively thin conductor. The dip of such a conductor can be inferred from the relative amplitudes of the side-lobes.

Massive conductors that could be approximated by a conducting sphere will display a simple single peak profile form on both coaxial and coplanar coils, with a ratio between the coplanar to coaxial response amplitudes as high as 8*.

Overburden anomalies often produce broad poorly defined anomaly profiles. In most cases, the response of the coplanar coils closely follows that of the coaxial coils with a relative amplitude ration of 4*.

Occasionally, if the edge of an overburden zone is sharply defined with some significant depth extent, an edge effect will occur in the coaxial coils. In the case of a horizontal conductive ring or ribbon, the coaxial response will consist of two peaks, one over each edge; whereas the coplanar coil will yield a single peak.

* It should be noted at this point that Aerodat's definition of the measured ppm unit is related to the primary field sensed in the receiving coil without normalization to the maximum coupled (coaxial configuration). If such normalization were applied to the Aerodat units, the amplitude of the coplanar coil pair would be halved.

Magnetics

The Total Field Magnetic Map shows contours of the total magnetic field, uncorrected for regional variation. Whether an EM anomaly with a magnetic correlation is more likely to be caused by a sulphide deposit than one without depends on the type of mineralization. An apparent coincidence between an EM and a magnetic anomaly may be caused by a conductor which is also magnetic, or by a conductor which lies in close proximity to a magnetic body. The majority of conductors which are also magnetic are sulphides containing pyrrhotite and/or magnetite. Conductive and magnetic bodies in close association can be, and often are, graphite and magnetite. It is often very difficult to distinguish between these cases. If the conductor is also magnetic, it will usually produce an EM anomaly whose general pattern resembles that of the magnetics. Depending on the magnetic permeability of the conducting body, the amplitude of the inphase EM anomaly will be weakened, and if the conductivity is also weak, the inphase EM anomaly may even be reversed in sign.

VLF Electromagnetics

The VLF-EM method employs the radiation from powerful military radio transmitters as the primary signals. The magnetic field associated with the primary field is elliptically polarized in the vicinity of electrical conductors. The Herz Totem uses three coils in the X, Y, Z configuration to measure the total field and vertical quadrature component of the polarization ellipse.

The relatively high frequency of VLF (15-25) kHz provides high response factors for bodies of low conductance. Relatively "disconnected" sulphide ores have been found to produce measurable VLF signals. For the same reason, poor conductors such as sheared contacts, breccia zones, narrow faults, alteration zones and porous flow tops normally produce VLF anomalies. The method can therefore be used effectively for geological mapping. The only relative disadvantage of the method lies in its sensitivity to conductive overburden. In conductive ground to depth of exploration is severely limited.

The effect of strike direction is important in the sense of the relation of the conductor axis relative to the energizing electromagnetic field. A conductor aligned along a radius drawn from a transmitting station will be in a maximum coupled orientation and thereby produce a stronger response than a similar conductor at a different strike angle. Theoretically, it would be possible for a conductor, oriented tangentially to the transmitter to produce no signal. The most obvious effect of the strike angle consideration is that conductors favourably oriented with respect to the transmitter location and also near perpendicular to the flight direction are most clearly rendered and usually dominate the map presentation.

The total field response is an indicator of the existence and position of a conductivity anomaly. The response will be a maximum over the conductor, without any special filtering, and strongly favour the upper edge of the conductor even in the case of a relatively shallow dip.

The vertical quadrature component over steeply dipping sheet-like conductor will be a cross-over type response with the cross-over closely associated with the upper edge of the conductor.

The response is a cross-over type due to the fact that it is the vertical rather than total field quadrature component that is measured. The response shape is due largely to geometrical rather than conductivity considerations and the distance between the maximum and minimum on either side of the cross-over is related to target depth. For a given target geometry, the larger this distance the greater the depth.

The amplitude of the quadrature response, as opposed to shape is function of target conductance and depth as well as the conductivity of the overburden and host rock. As the primary field travels down to the conductor through conductive material it is both attenuated and phase shifted in a negative sense. The secondary field produced by this altered field at the target also has an associated phase shift. This phase shift is positive and is larger for relatively poor conductors. This secondary field is attenuated and phase shifted in a negative sense during return travel to the surface. The net effect of these 3 phase shifts determine the phase of the secondary field sensed at the receiver.

A relatively poor conductor in resistive ground will yield a net positive phase shift. A relatively good conductor in more conductive ground will yield a net negative phase shift. A combination is possible whereby the net phase shift is zero and the response is purely in-phase with no quadrature component.

A net positive phase shift combined with the geometrical cross-over shape will lead to a positive quadrature response on the side of approach and a negative on the side of departure. A net negative phase shift would produce the reverse. A further sign reversal occurs with a 180 degree change in instrument orientation as occurs on reciprocal line headings. During digital processing of the quadrature data for map presentation this is corrected for by normalizing the sign to one of the flight line headings.

APPENDIX II

ANOMALY LIST

J8973 UNUK RIVER AREA, British Columbia - EM ANOMALIES

FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS
8	10490	A	0	2.6	5.3	0.1	0	323
8	10490	B	1	5.8	7.0	0.6	0	332
8	10490	C	0	7.2	19.1	0.2	0	207
8	10490	D	0	5.8	20.8	0.1	0	199
8	10490	E	0	7.1	22.0	0.1	0	189
8	10480	A	0	5.1	11.3	0.2	0	272
8	10480	B	0	6.3	12.1	0.3	0	276
8	10480	C	1	4.0	5.0	0.5	0	359
8	10480	D	1	4.7	6.0	0.5	0	333
8	10480	E	0	2.7	7.1	0.1	0	275
8	10480	F	0	2.4	7.2	0.1	0	247
8	10470	A	0	2.9	3.9	0.3	0	261
8	10470	B	0	4.0	5.8	0.4	0	331
8	10460	A	1	7.1	9.7	0.5	0	197
8	10460	B	1	7.9	8.6	0.8	0	313
8	10460	C	1	9.2	10.9	0.7	0	239
8	10460	D	5	5.0	0.4	26.4	0	505
8	10460	E	3	6.2	3.2	2.1	0	359
8	10460	F	4	3.3	0.7	5.9	0	296
8	10460	G	0	4.2	6.4	0.3	0	235
8	10450	A	5	2.5	0.3	12.2	0	475
8	10450	B	2	4.5	3.5	1.0	0	395
8	10450	C	1	6.3	5.6	0.9	0	232
8	10450	D	2	6.6	5.5	1.1	0	282
8	10450	E	1	5.6	6.3	0.6	0	245
8	10440	A	0	5.1	10.9	0.2	0	268
8	10440	B	0	7.5	14.5	0.3	0	256
7	10430	A	0	5.7	9.8	0.3	0	272
7	10430	B	0	5.0	8.1	0.3	0	337
7	10420	A	0	9.1	19.0	0.3	0	264
7	10420	B	0	8.5	18.6	0.3	0	213
7	10420	C	0	6.4	12.7	0.3	0	305
7	10420	D	0	7.4	19.3	0.2	0	254
7	10410	A	0	5.5	13.9	0.2	0	245
7	10410	B	0	8.0	13.5	0.4	0	260
7	10410	C	0	11.1	19.2	0.4	0	264

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.

J8973 UNUK RIVER AREA, British Columbia - EM ANOMALIES

FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	AMPLITUDE (PPM) QUAD.	CONDUCTOR CTP MHOS	CONDUCTOR DEPTH MTRS	BIRD HEIGHT MTRS
7	10400	A	2	6.1	5.3	1.0	0	349
7	10400	B	0	7.3	12.2	0.4	0	263
7	10400	C	0	6.3	10.5	0.4	0	342
7	10390	A	0	6.6	15.3	0.2	0	215
7	10390	B	1	8.3	10.6	0.6	0	336
7	10380	A	0	8.5	18.6	0.3	0	247
7	10380	B	1	8.8	10.4	0.7	0	368
7	10370	A	0	5.3	11.3	0.2	0	278
7	10361	A	1	8.1	8.3	0.8	0	363
7	10361	B	2	13.4	14.7	1.0	0	313
6	10360	A	1	6.3	5.9	0.9	0	351
6	10360	B	1	17.5	22.4	0.9	0	272
6	10360	C	2	4.1	2.8	1.2	0	352
6	10350	A	1	7.7	8.9	0.7	0	405
6	10350	B	1	14.7	21.8	0.6	0	219
6	10350	C	2	17.8	20.0	1.0	0	299
6	10350	D	1	21.7	28.2	0.9	0	235
6	10350	E	1	12.1	13.1	0.9	0	304
6	10350	F	2	10.2	9.6	1.1	0	320
6	10340	A	0	3.4	4.2	0.4	0	423
6	10340	B	1	7.0	7.3	0.8	0	322
6	10340	C	2	15.2	16.5	1.0	0	249
6	10340	D	2	11.4	11.1	1.1	0	310
6	10340	E	2	7.9	5.6	1.4	0	354
6	10340	F	2	5.1	3.1	1.5	0	201
6	10330	A	1	8.0	8.2	0.8	0	362
6	10330	B	2	19.1	20.9	1.1	0	235
6	10330	C	2	13.5	12.6	1.2	0	292
6	10330	D	2	8.5	6.6	1.3	0	256
6	10320	A	1	5.1	5.5	0.6	0	347
6	10320	B	2	7.3	6.6	1.0	0	306
6	10320	C	2	10.6	9.9	1.1	0	294
6	10320	D	2	14.2	11.9	1.4	0	303
6	10320	E	2	15.7	13.6	1.4	0	251
6	10320	F	3	18.8	12.2	2.2	0	318

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.

J8973 UNUK RIVER AREA, British Columbia - EM ANOMALIES

FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS
6	10320	G	2	7.5	6.5	1.1	0	234
6	10310	A	1	7.3	7.5	0.8	0	372
6	10310	B	2	13.7	15.1	1.0	0	274
6	10310	C	2	16.0	14.1	1.4	0	238
6	10310	D	3	28.2	21.5	2.1	0	246
6	10310	E	0	2.6	4.6	0.2	0	147
6	10310	F	0	3.2	4.8	0.3	0	264
5	10300	A	0	2.6	5.3	0.1	0	294
5	10300	B	1	4.7	4.0	0.9	0	345
5	10300	C	1	10.3	12.5	0.7	0	238
5	10300	D	2	6.5	5.5	1.0	0	357
5	10300	E	2	8.9	5.7	1.7	0	333
5	10300	F	2	10.6	7.4	1.6	0	330
5	10300	G	3	29.2	15.4	3.4	0	279
5	10300	H	1	10.7	17.3	0.5	0	210
5	10300	J	0	3.8	8.1	0.2	0	193
5	10300	K	1	4.4	4.5	0.6	0	315
5	10290	A	3	5.1	2.3	2.3	0	453
5	10290	B	2	5.3	3.5	1.4	0	450
5	10290	C	2	4.3	2.4	1.6	0	409
5	10290	D	2	9.7	7.2	1.5	0	377
5	10290	E	0	5.4	7.6	0.4	0	263
5	10290	F	1	9.1	12.7	0.6	0	235
5	10290	G	1	5.8	5.6	0.8	0	391
5	10290	H	1	3.1	2.7	0.7	0	420
5	10290	J	0	4.0	8.5	0.2	0	272
5	10280	A	1	10.8	15.2	0.6	0	227
5	10280	B	2	21.4	17.6	1.7	0	218
5	10280	C	2	11.1	7.6	1.7	0	355
5	10280	D	2	7.3	5.5	1.3	0	304
5	10280	E	2	4.3	3.2	1.0	0	303
5	10270	A	3	6.2	3.1	2.2	0	358
5	10270	B	3	9.7	3.6	3.8	0	426
5	10270	C	4	8.8	2.4	5.7	0	351
5	10270	D	3	12.5	5.8	3.1	0	222
5	10270	E	3	11.0	6.7	2.0	0	205
5	10270	F	3	19.3	13.3	2.1	0	235
5	10270	G	1	14.7	19.6	0.7	0	223
5	10270	H	1	11.3	13.9	0.8	0	290
5	10270	J	1	11.6	14.0	0.8	0	245

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.

J8973 UNUK RIVER AREA, British Columbia - EM ANOMALIES

FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS
5	10270	K	1	9.3	11.6	0.7	0	297
5	10260	A	1	7.0	7.7	0.7	0	245
5	10260	B	1	9.3	10.4	0.8	0	241
5	10260	C	3	14.7	9.0	2.2	0	344
5	10260	D	2	4.8	2.7	1.6	0	324
5	10260	E	3	8.0	3.6	2.7	0	296
5	10250	A	0	3.8	5.5	0.3	0	339
5	10250	B	2	6.4	3.5	1.9	0	295
5	10250	C	3	4.1	1.7	2.4	0	409
5	10250	D	2	6.9	5.4	1.2	0	335
5	10250	E	2	15.9	12.9	1.5	0	282
5	10250	F	1	4.9	4.2	0.9	0	314
5	10240	A	2	3.7	2.2	1.4	0	360
5	10240	B	2	15.6	12.5	1.6	0	207
5	10240	C	2	7.8	5.0	1.6	0	362
5	10240	D	2	12.0	8.4	1.7	0	329
5	10240	E	4	24.2	9.9	4.5	0	304
5	10240	F	3	8.9	3.6	3.3	0	363
5	10240	G	4	16.1	6.4	4.1	0	409
5	10240	H	4	13.1	4.5	4.7	0	374
5	10230	A	4	9.6	2.9	5.1	0	382
5	10230	B	3	15.6	7.2	3.3	0	237
5	10230	C	4	13.9	4.6	5.1	0	265
5	10230	D	3	9.3	4.8	2.4	0	317
5	10230	E	1	4.7	4.5	0.7	0	236
5	10230	F	2	8.4	6.7	1.2	0	284
5	10230	G	2	6.3	5.0	1.1	0	271
5	10230	H	3	11.2	5.3	2.9	0	412
5	10230	J	2	24.3	19.3	1.9	0	262
5	10230	K	2	11.2	11.0	1.0	0	255
4	10220	A	2	13.0	12.6	1.1	0	255
4	10220	B	3	16.1	10.6	2.1	0	319
4	10220	C	3	14.4	9.0	2.1	0	284
4	10220	D	3	11.7	5.2	3.2	0	251
4	10220	E	3	11.7	5.1	3.3	0	314
4	10220	F	2	6.4	3.7	1.8	0	398
4	10210	A	5	7.2	0.8	18.6	0	487
4	10210	B	4	18.4	7.7	4.0	0	218
4	10210	C	4	15.7	6.0	4.3	0	265

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.

J8973 UNUK RIVER AREA, British Columbia - EM ANOMALIES

FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS
4	10210	D	3	5.1	2.5	2.1	0	374
4	10210	E	2	6.1	3.8	1.6	0	439
4	10200	A	1	6.0	5.4	0.9	0	287
4	10200	B	2	6.7	4.5	1.5	0	300
4	10200	C	3	11.8	7.2	2.1	0	387
4	10200	D	3	18.4	11.8	2.3	0	250
4	10200	E	2	14.2	9.8	1.9	0	274
4	10200	F	2	5.9	4.5	1.1	0	380
4	10200	G	4	6.5	1.4	7.2	0	394
4	10190	A	4	16.4	6.7	4.0	0	297
4	10190	B	2	4.1	2.4	1.5	0	328
4	10190	C	3	14.6	7.9	2.6	0	375
4	10180	A	1	7.4	9.5	0.6	0	235
4	10180	B	2	9.0	8.4	1.0	0	280
4	10180	C	3	20.8	14.9	2.0	0	245
4	10180	D	3	30.1	22.7	2.2	0	219
4	10180	E	2	13.6	10.2	1.6	0	265
4	10180	F	3	25.2	13.9	3.1	0	282
4	10180	G	4	18.0	7.1	4.3	0	360
4	10180	H	4	17.9	7.0	4.4	0	374
4	10180	J	2	10.2	7.8	1.4	0	217
3	10170	A	5	14.3	2.1	15.5	0	298
3	10170	B	5	16.0	3.8	8.3	0	220
3	10170	C	4	7.4	1.7	6.9	0	278
3	10170	D	1	1.5	0.9	0.9	0	245
3	10170	E	3	11.3	5.7	2.6	0	246
3	10160	A	3	13.7	7.1	2.7	0	257
3	10160	B	3	22.3	10.3	3.8	0	266
3	10160	C	4	22.7	9.7	4.2	0	259
3	10160	D	5	8.5	0.8	24.6	0	400
3	10160	E	4	10.7	3.1	5.6	0	391
3	10160	F	4	5.9	1.7	4.6	0	303
3	10150	A	4	4.7	1.1	5.8	0	243
3	10150	B	1	2.4	2.5	0.5	0	199
3	10150	C	3	8.4	4.7	2.1	0	343
3	10150	D	3	13.2	6.0	3.2	0	334
3	10140	A	2	6.1	4.2	1.4	0	209
3	10140	B	2	12.6	11.6	1.2	0	187

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.

J8973 UNUK RIVER AREA, British Columbia - EM ANOMALIES

FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS
3	10140	C	3	12.4	6.2	2.8	0	317
3	10140	D	3	6.0	2.5	2.8	0	200
3	10140	E	3	6.2	2.1	3.8	0	289
3	10140	F	4	6.7	2.2	4.0	0	308
3	10130	A	3	7.1	3.8	2.1	0	258
3	10130	B	3	8.9	4.8	2.2	0	281
3	10130	C	5	10.5	1.8	11.4	0	329
3	10130	D	2	5.0	2.6	1.9	0	212
3	10130	E	1	4.0	3.6	0.8	0	179
3	10130	F	0	2.4	3.0	0.3	0	186
3	10130	G	1	6.0	5.4	0.9	0	242
3	10120	A	3	5.2	2.3	2.4	0	285
3	10110	A	3	3.4	1.3	2.5	0	306
3	10110	B	3	11.7	5.2	3.2	0	387
3	10110	C	4	26.8	7.7	7.5	0	237
3	10110	D	4	7.7	2.3	4.8	0	260
3	10110	E	4	11.1	2.7	7.2	0	337
3	10110	F	4	9.2	2.6	5.5	0	351
3	10110	G	4	9.0	2.6	5.3	0	316
3	10110	H	0	2.9	5.4	0.2	0	316
3	10110	J	0	5.9	8.6	0.4	0	208
3	10100	A	2	7.7	5.8	1.3	0	369
3	10100	B	2	9.8	9.5	1.0	0	320
3	10100	C	2	11.0	7.5	1.7	0	417
3	10100	D	4	7.2	2.1	4.9	0	391
3	10100	E	4	6.2	1.5	6.0	0	272
3	10100	F	2	12.3	10.7	1.3	0	148
3	10100	G	2	13.7	11.9	1.3	0	208
3	10100	H	1	8.8	10.4	0.7	0	159
3	10100	J	3	9.4	3.5	3.8	0	237
3	10100	K	5	11.2	2.3	9.1	0	343
3	10100	M	5	15.7	3.2	10.2	0	257
3	10100	N	5	9.5	1.9	9.0	0	330
3	10100	O	3	6.1	2.7	2.6	0	217
3	10090	A	4	18.5	5.7	6.1	0	261
3	10090	B	4	19.0	6.4	5.5	0	271
3	10090	C	4	9.4	3.2	4.3	0	285
3	10090	D	3	5.5	1.9	3.5	0	282
3	10090	E	2	4.3	2.3	1.7	0	271
3	10090	F	2	8.4	5.8	1.5	0	202

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.

J8973 UNUK RIVER AREA, British Columbia - EM ANOMALIES

FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS
3	10090	G	0	1.5	2.2	0.2	0	274
2	10080	A	4	7.2	2.4	4.0	0	283
2	10080	B	3	6.1	2.1	3.6	0	269
2	10080	C	4	7.3	2.4	4.1	0	281
2	10080	D	4	10.1	2.4	7.2	0	251
2	10080	E	2	6.3	3.6	1.8	0	275
2	10080	F	5	5.8	1.1	8.3	0	431
2	10070	A	3	12.5	5.2	3.6	0	337
2	10070	B	0	1.8	3.5	0.1	0	198
2	10070	C	3	6.4	3.1	2.3	0	253
2	10070	D	2	6.7	3.9	1.8	0	347
2	10070	E	0	3.7	5.6	0.3	0	222
2	10060	A	4	5.1	1.4	4.7	0	377
2	10060	B	3	10.9	4.7	3.2	0	210
2	10060	C	3	8.1	3.4	3.0	0	233
2	10060	D	4	7.6	2.4	4.4	0	355
2	10060	E	2	6.9	5.5	1.1	0	316
2	10060	F	5	9.9	0.9	26.9	0	277
2	10060	G	3	8.6	3.6	3.1	0	263
2	10060	H	4	11.2	3.0	6.3	0	306
2	10050	A	4	9.9	2.3	7.4	0	317
2	10050	B	5	10.7	1.7	12.8	0	337
2	10050	C	0	3.8	5.2	0.4	0	291
2	10050	D	3	9.5	5.2	2.2	0	211
2	10050	E	2	8.8	6.5	1.4	0	209
2	10050	F	2	5.8	3.6	1.5	0	252
2	10050	G	2	4.5	3.4	1.0	0	340
2	10041	A	3	7.9	4.1	2.2	0	226
2	10031	A	3	20.5	11.1	2.9	0	294
2	10031	B	3	16.0	8.4	2.8	0	341
2	10031	C	3	5.0	2.4	2.1	0	435
2	10031	D	2	6.5	4.0	1.6	0	291
2	10021	A	2	7.6	5.5	1.4	0	192
2	10021	B	2	3.7	2.8	1.0	0	276
2	10021	C	3	8.8	4.0	2.8	0	313
2	10021	D	3	9.4	3.9	3.3	0	377
2	10021	E	3	11.8	5.4	3.1	0	329
2	10021	F	4	23.0	8.6	5.0	0	300

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.

J8973 UNUK RIVER AREA, British Columbia - EM ANOMALIES

FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS
2	10011	A	6	4.7	0.3	35.5	0	486
2	10011	B	6	4.2	-0.1	133.5	0	536
2	10011	C	2	8.7	6.3	1.4	0	220
2	10011	D	2	8.8	5.2	1.9	0	258
5	10290	A	3	6.1	2.8	2.4	0	362
5	10290	B	4	7.3	1.9	5.7	0	464
6	10310	A	4	4.5	1.1	5.3	0	464

Estimated depth may be unreliable because the stronger part of the conductor may be deeper or to one side of the flight line, or because of a shallow dip or overburden effects.

APPENDIX III

CERTIFICATE OF QUALIFICATIONS

I, KEVIN J. KILLIN, certify that: -

1. I hold a B. Sc. (Hons.) in Geological Geophysics from the University of Western Ontario. I also attended University of Toronto as a full-time student during which time I obtained credits in geology.

2. I reside at 255 Grey Squirrel Place in the city of Waterloo, Ontario.

3. I have been engaged in a professional role in the oil and minerals industry in Canada for the past four years.

4. I have been a member of the Prospectors & Developers Association since 1984.

5. The accompanying report was prepared from information supplied by Swift Minerals Ltd. and from a review of the proprietary airborne geophysical survey flown by Aerodat Limited for Swift Minerals Ltd. I have not personally visited the property.

6. I have no interest, direct or indirect, in the property described nor do I hold securities in Swift Minerals Ltd.

Signed,

Kevin J. Killin
Geophysicist

Mississauga, Ontario
October 20, 1989

APPENDIX IV

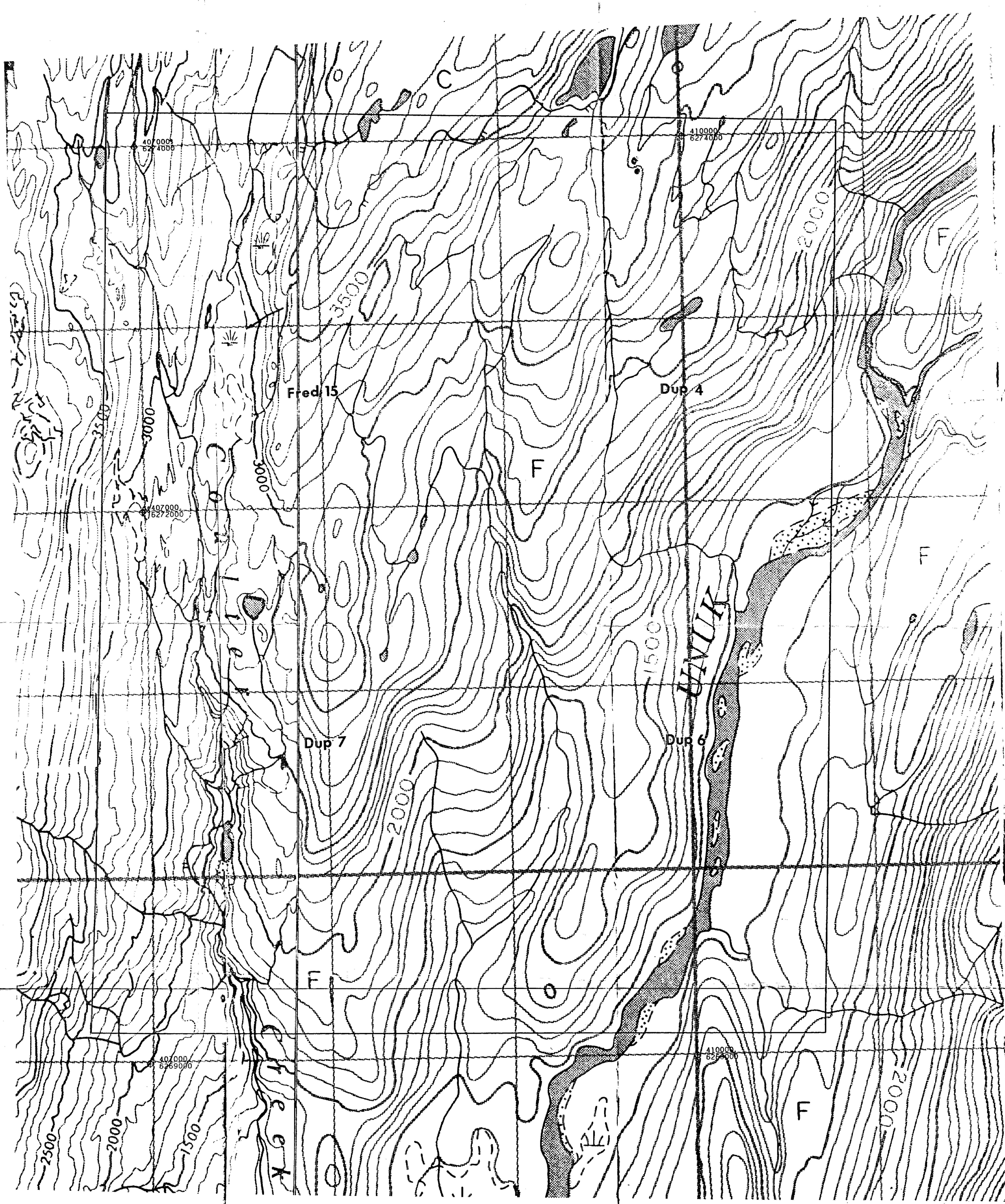
PERSONNEL

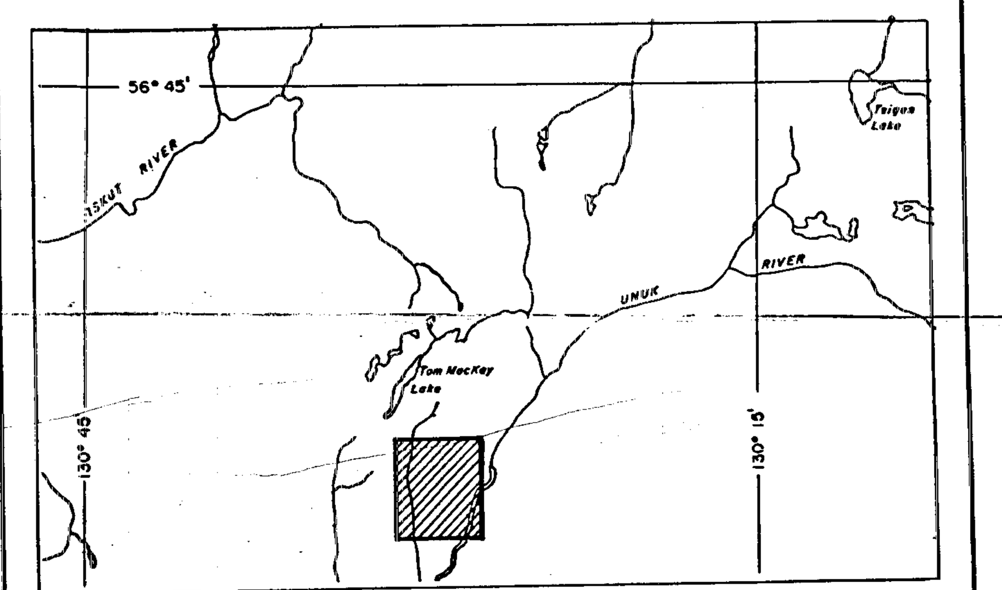
FIELD

Flown	September, 1989
Pilot	J. Kamphaus
Operator	P. Moore

OFFICE

Processing	A.E. Valentini George McDonald
Report	K. Killin





SWIFT MINERALS LTD.

BASE MAP

UNUK RIVER AREA

NORTHERN BRITISH COLUMBIA

SCALE 1:10,000

0 330 660 1320 2640 Feet

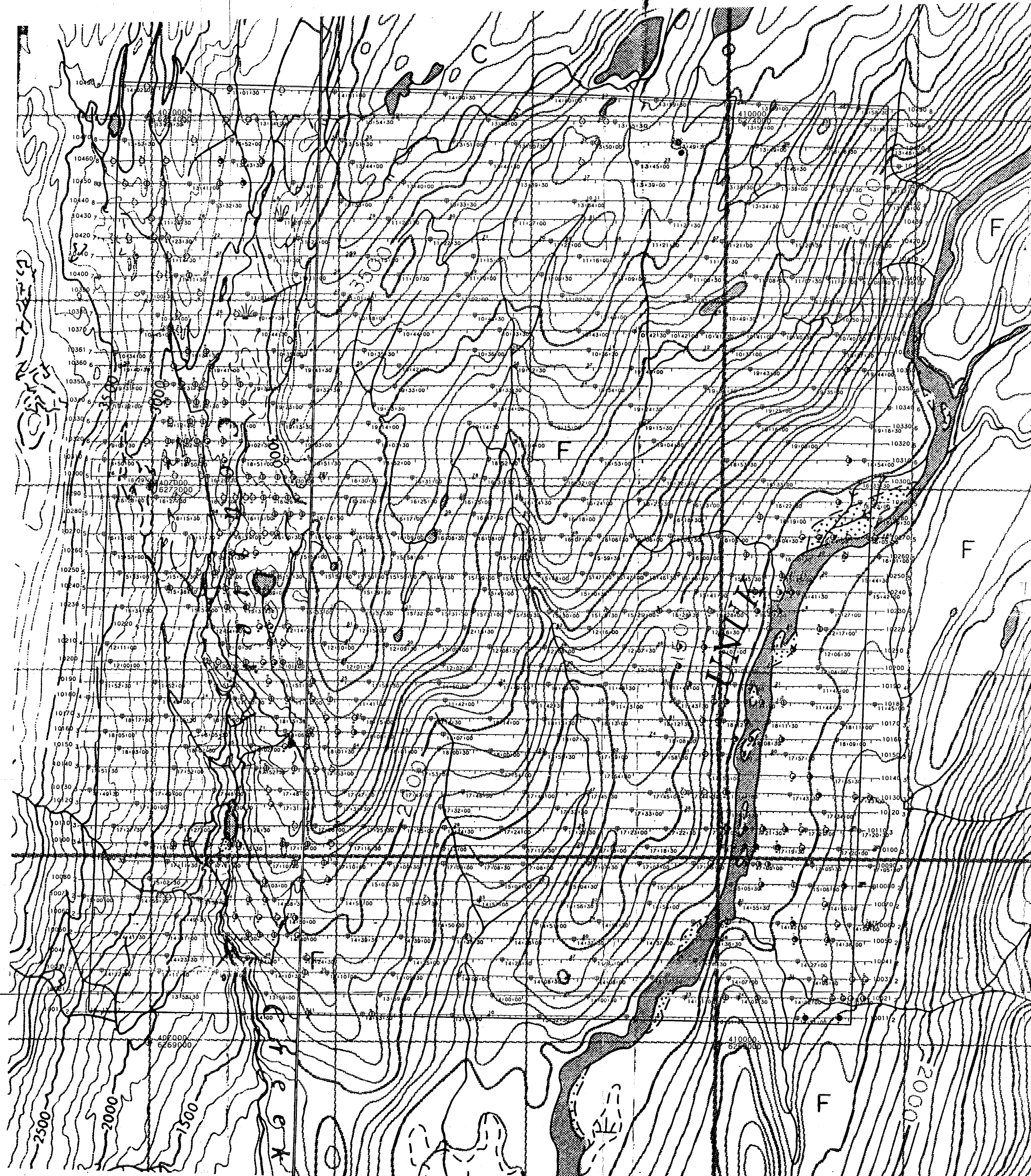
0 100 200 500 1000 Metres

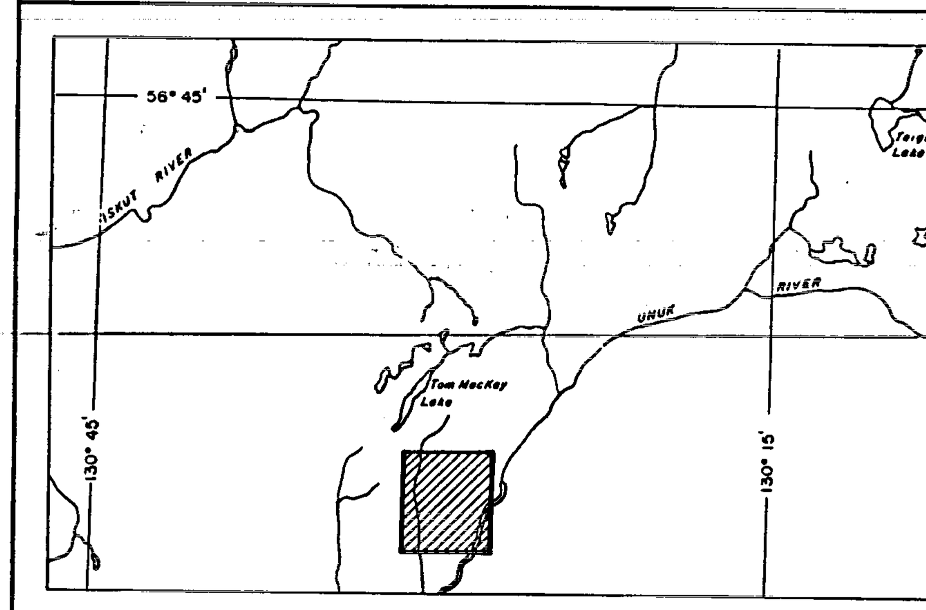
AERODAT LIMITED

DATE: SEPT 1989

NTS No: 104 B/9,10

MAP No: 1 J8973





EM Anomalies

Conductivity Thickness (mhos)

- 0 - 1
- 1 - 2
- 2 - 4
- 4 - 8
- 8 - 15
- 15 - 30
- > 30

EM Anomaly A, 4600 Hz inphase amplitude 7 ppm. Conductivity thickness 1-2 mhos (see code).

Flight Path

Navigation and recovery using Motorola Mini-Ranger (MRS III) radar navigation system.

Average terrain clearance 60m
Average line spacing 100m

SWIFT MINERALS LTD.

FLIGHT PATH

UNUK RIVER AREA

NORTHERN BRITISH COLUMBIA

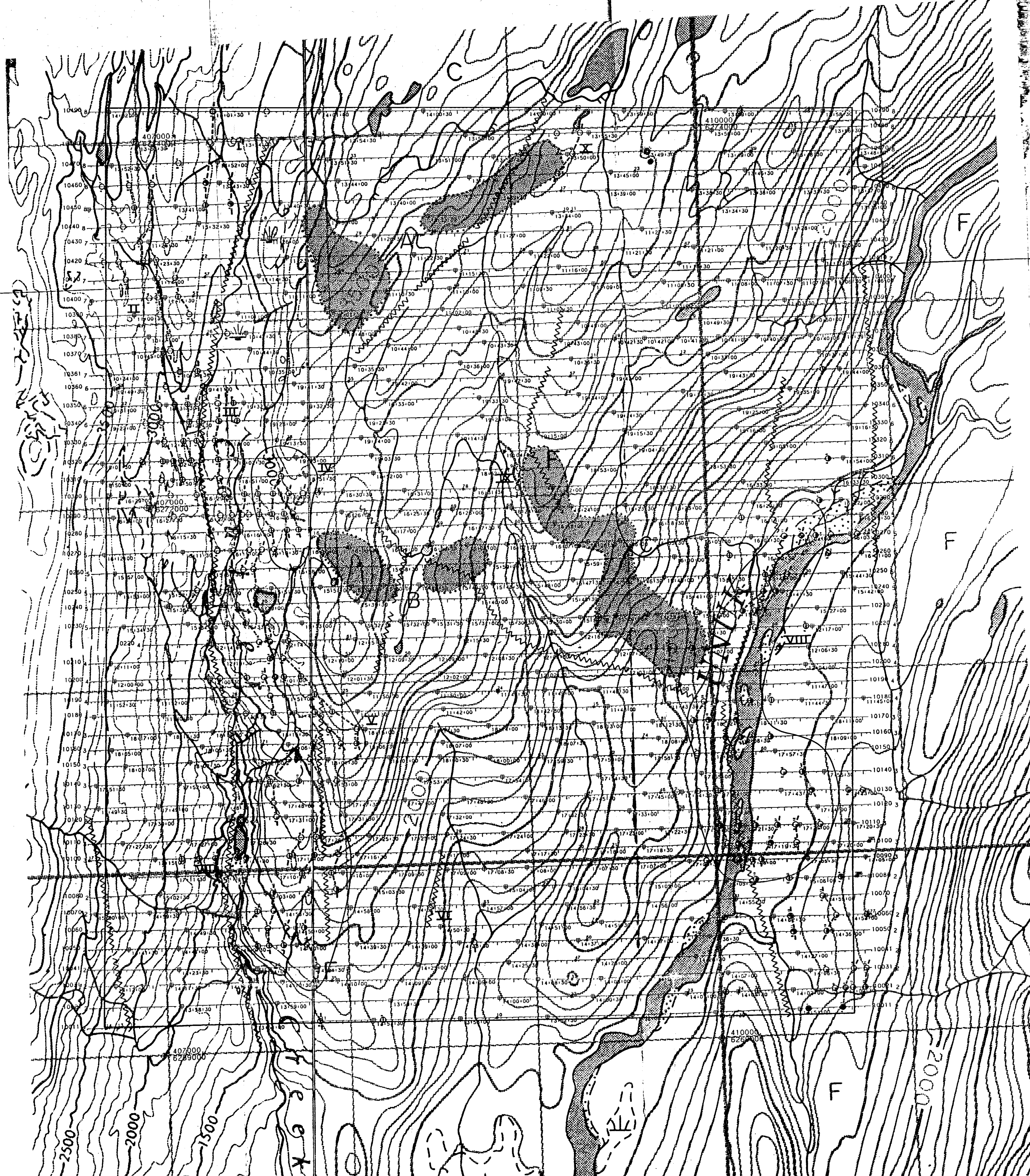
SCALE 1:10,000

0 330 660 1320 2640 Feet

0 100 200 500 1000 Metres

AERODAT LIMITED

DATE: SEPT 1989
NTS No: 104 B/9,10
MAP No: 2 J8973



INTERPRETATION LEGEND

- EM Conductors
- Interpreted Fault
- Resistivity Low

EM Anomalies

Conductivity Thickness (mhos)

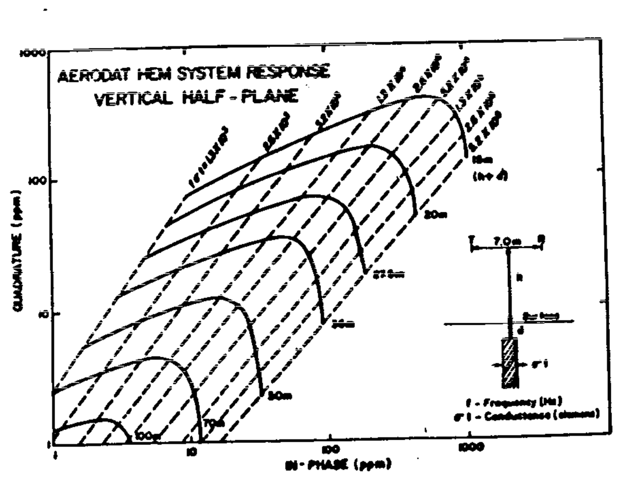
- 0 - 1
- 1 - 2
- 2 - 4
- 4 - 8
- 8 - 15
- 15 - 30
- > 30

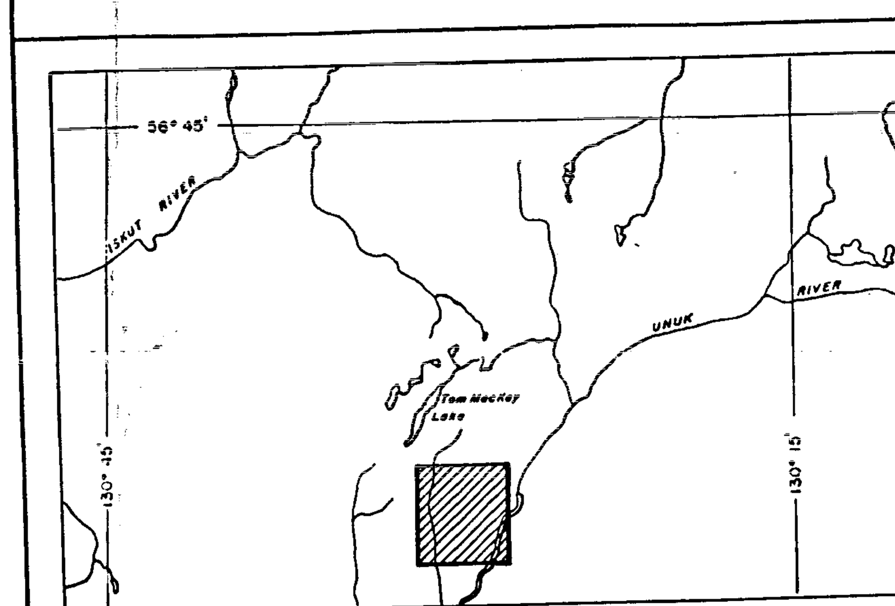
EM Anomaly A, 4600 Hz inphase amplitude 7 ppm. Conductivity thickness 1-2 mhos (see code).

Flight Path

Navigation and recovery using Motorola Mini-Ranger (MRS III) radar navigation system.

Average terrain clearance 60m
Average line spacing 100m





SWIFT MINERALS LTD.

INTERPRETATION

UNUK RIVER AREA

NORTHERN BRITISH COLUMBIA

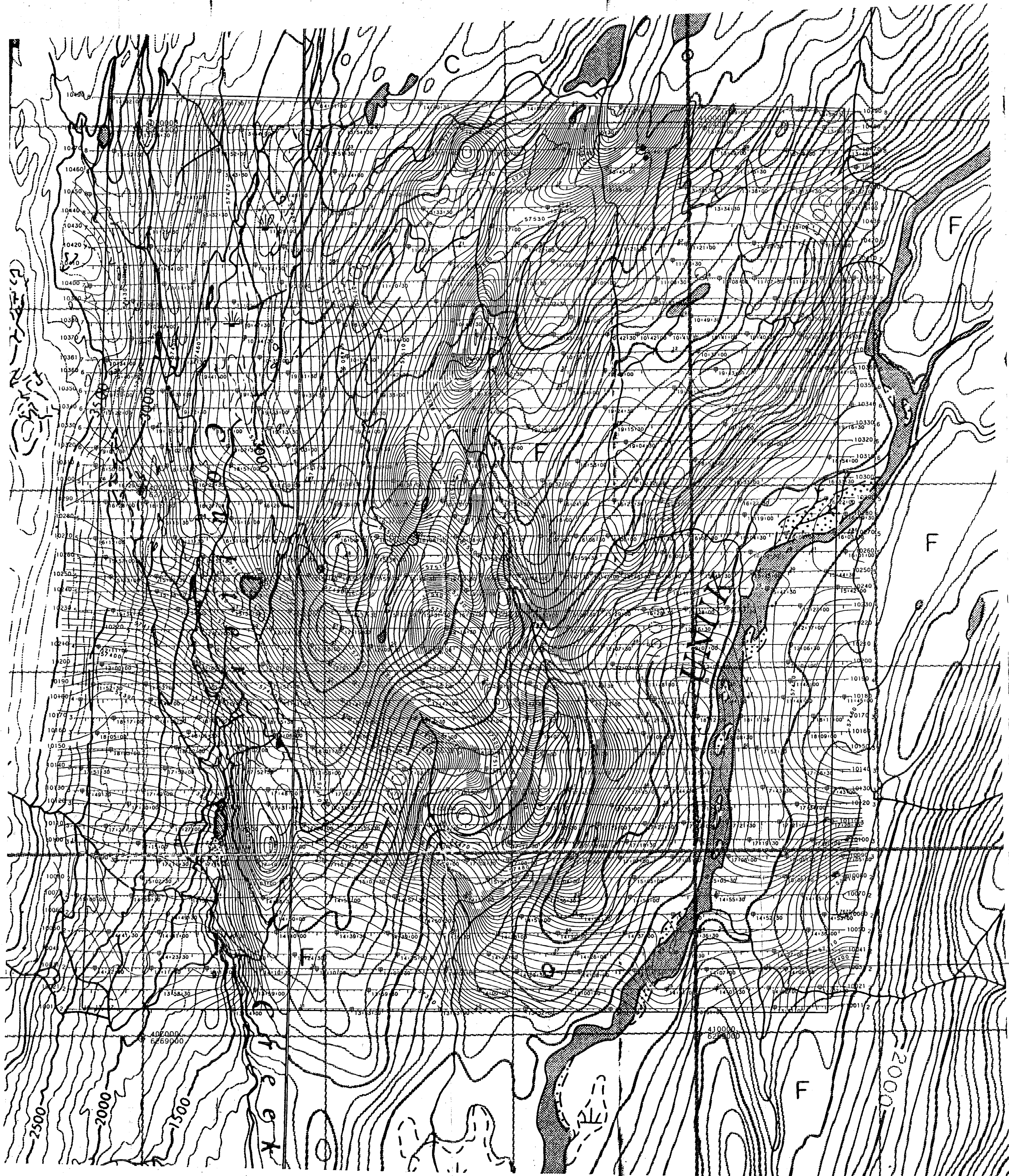
SCALE 1:10,000

0 330 660 1320 2640 Feet

0 100 200 500 1000 Metres

AERODAT LIMITED

DATE:	SEPT 1989
NTS No:	104 B/9, 10
MAP No:	3



Magnetics

Total Field Magnetic Intensity Contours in nT.

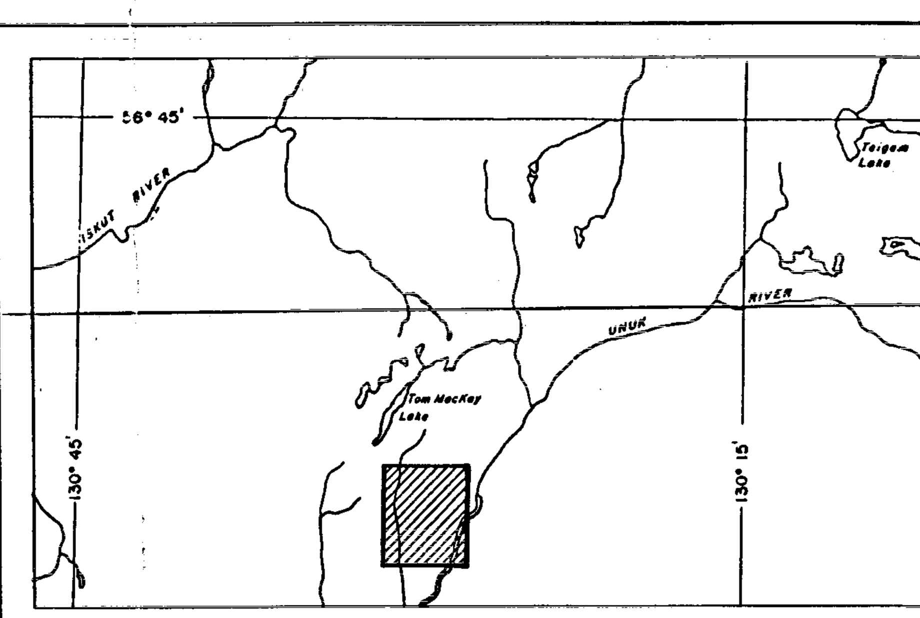
Cesium high sensitivity magnetometer.

Sensor elevation 45m

Flight Path

Navigation and recovery using Motorola Mini-Ranger (MRS III) radar navigation system.

Average terrain clearance 60m
Average line spacing 100m



SWIFT MINERALS LTD.

TOTAL FIELD MAGNETIC CONTOURS

UNUK RIVER AREA

NORTHERN BRITISH COLUMBIA

SCALE 1:10,000

0 330 660 1320 2640 Feet

0 100 200 500 1000 Metres

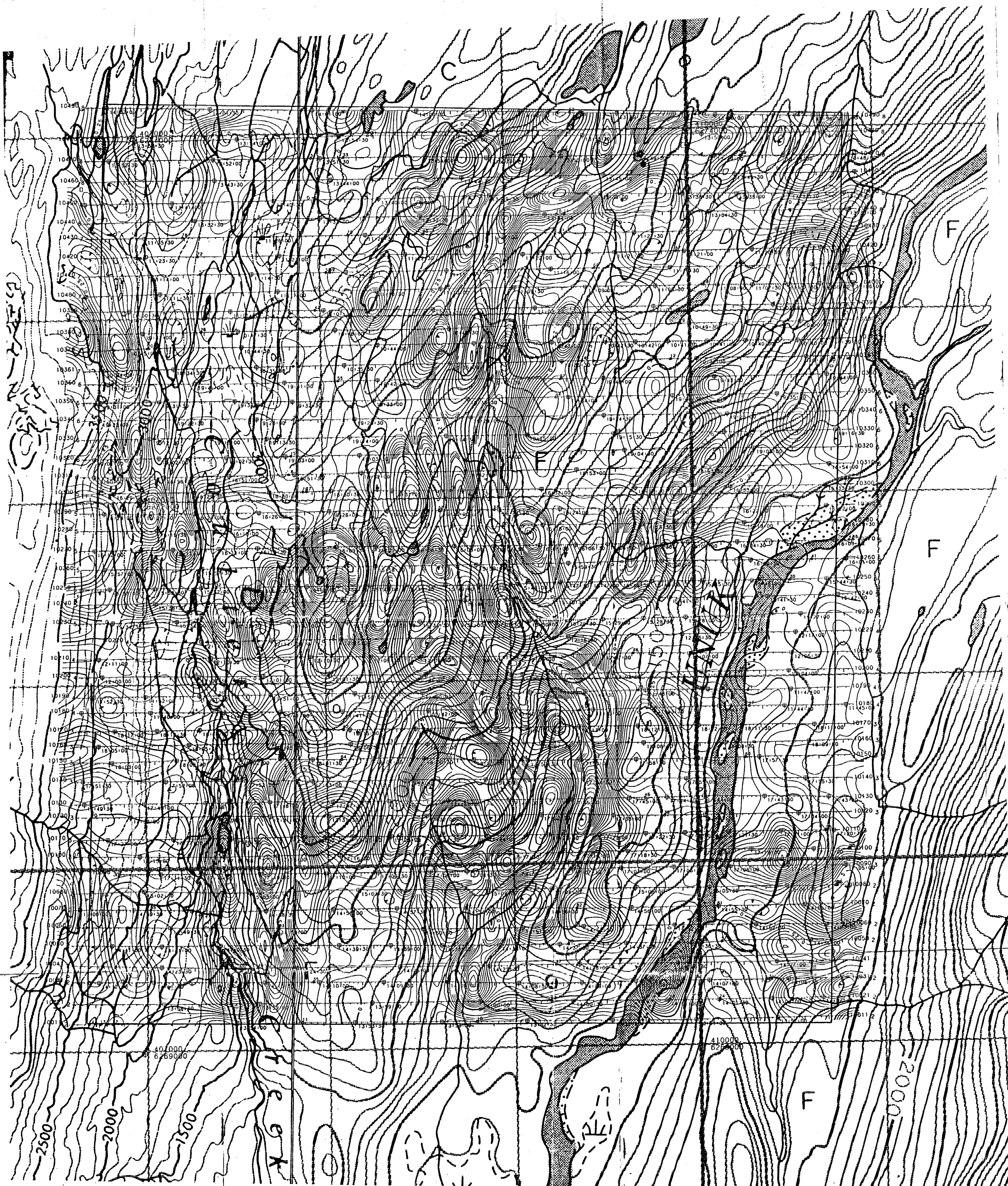
AERODAT LIMITED

DATE: SEPT 1989

NTS No: 104 B/9,10

MAP No: 4

J8973



N

Vertical Gradient

Vertical Magnetic Gradient calculated from the total field magnetic intensity in nT/m.

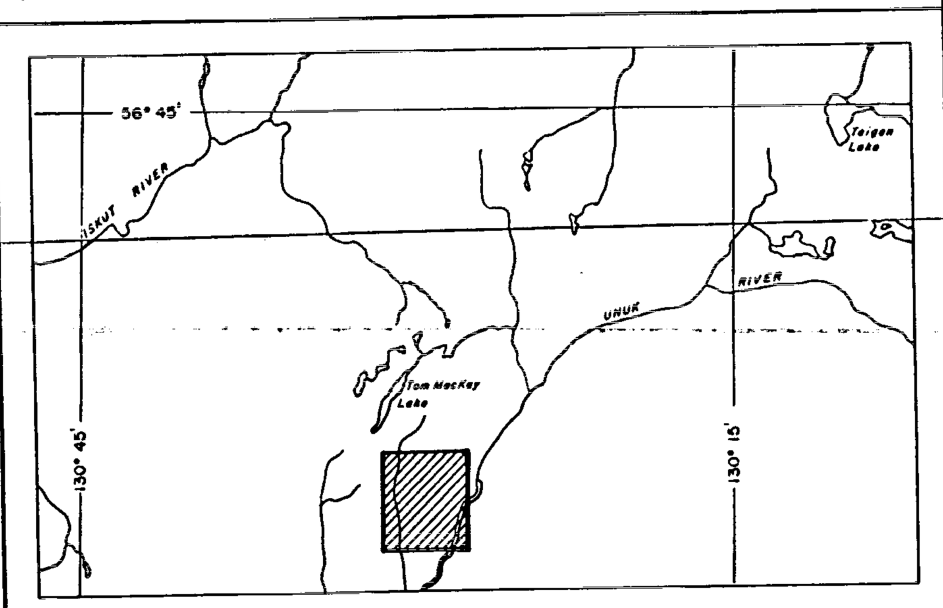
Cesium high sensitivity magnetometer.

Sensor elevation 45m

Flight Path

Navigation and recovery using Motorola Mini-Ranger (MRS III) radar navigation system.

Average terrain clearance 60m
Average line spacing 100m



SWIFT MINERALS LTD.

CALCULATED VERTICAL MAGNETIC GRADIENT

UNUK RIVER AREA

NORTHERN BRITISH COLUMBIA

SCALE 1:10,000

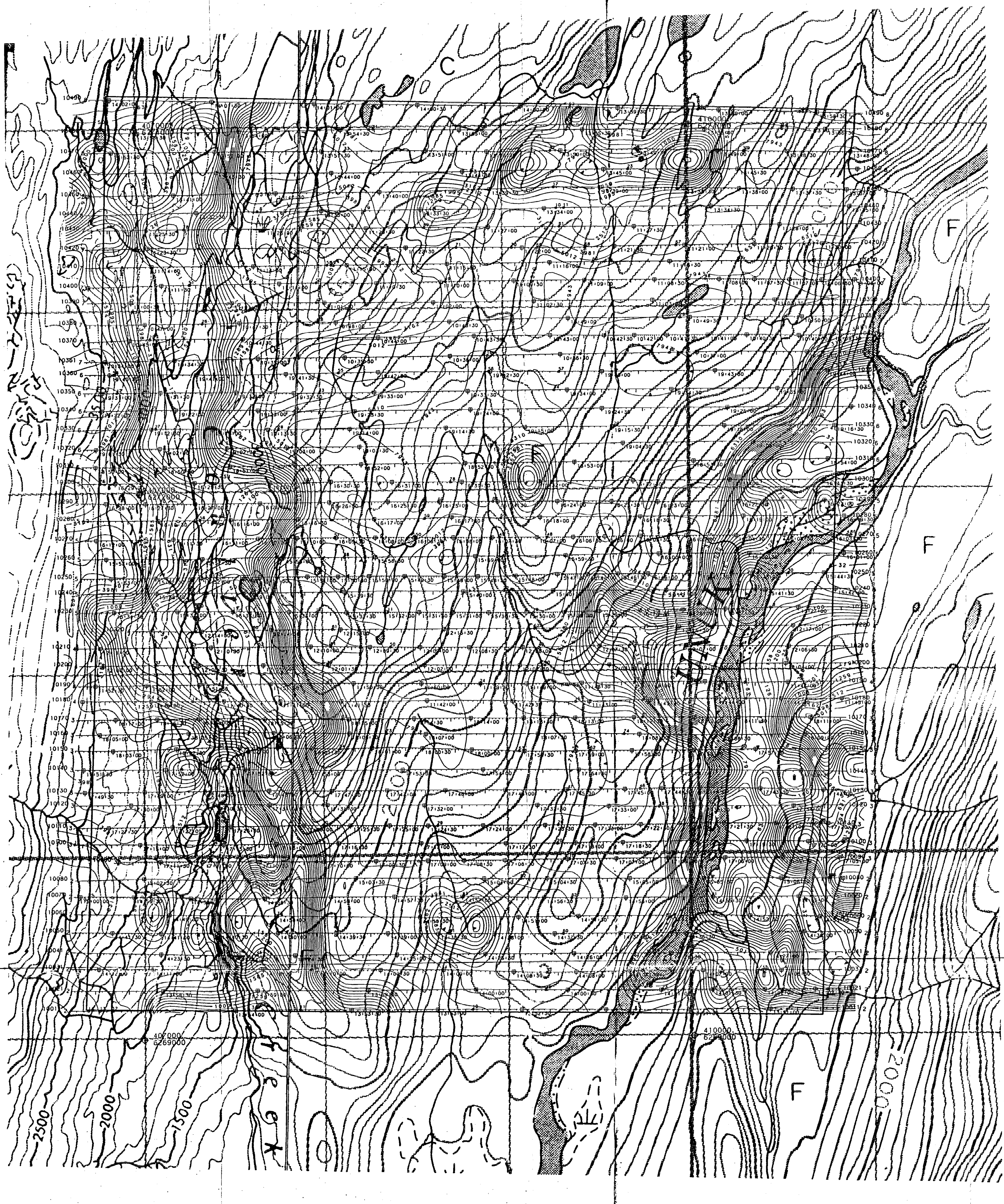
0 330 660 1320 2640 Feet

0 100 200 500 1000 Metres

AERODAT LIMITED

DATE:	SEPT 1989
NTS No:	104 B/9
MAP No:	5

J8973



Apparent Resistivity

Calculated from 4175 Hz coplanar EM response assuming a 200 m conductive layer.

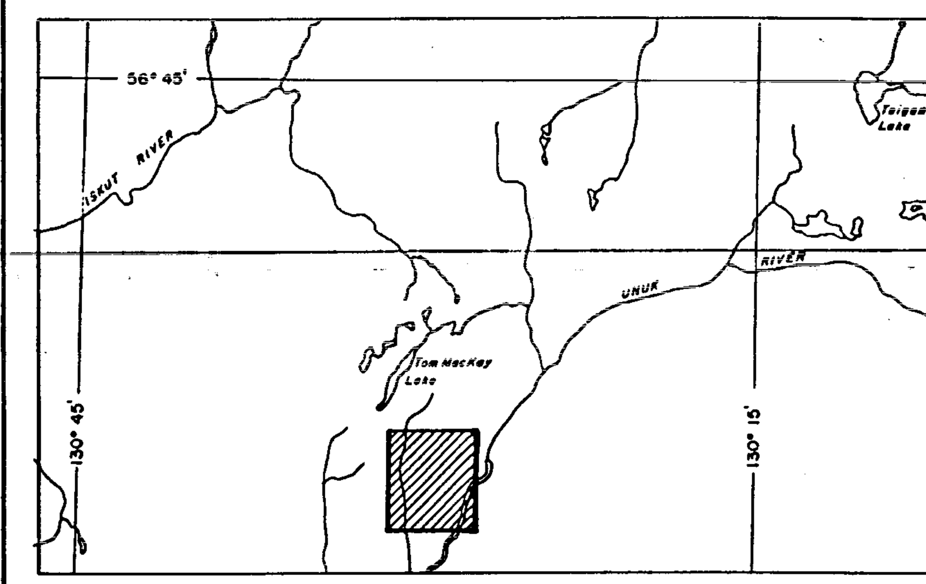
Contouring in ohm-m at logarithmic intervals.

Sensor elevation 30m

Flight Path

Navigation and recovery using Motorola Mini-Ranger (MRS III) radar navigation system.

Average terrain clearance 60m
Average line spacing 100m



SWIFT MINERALS LTD.

APPARENT RESISTIVITY CONTOURS

UNUK RIVER AREA

NORTHERN BRITISH COLUMBIA

SCALE 1:10,000

0 330 660 1320 2640 Feet

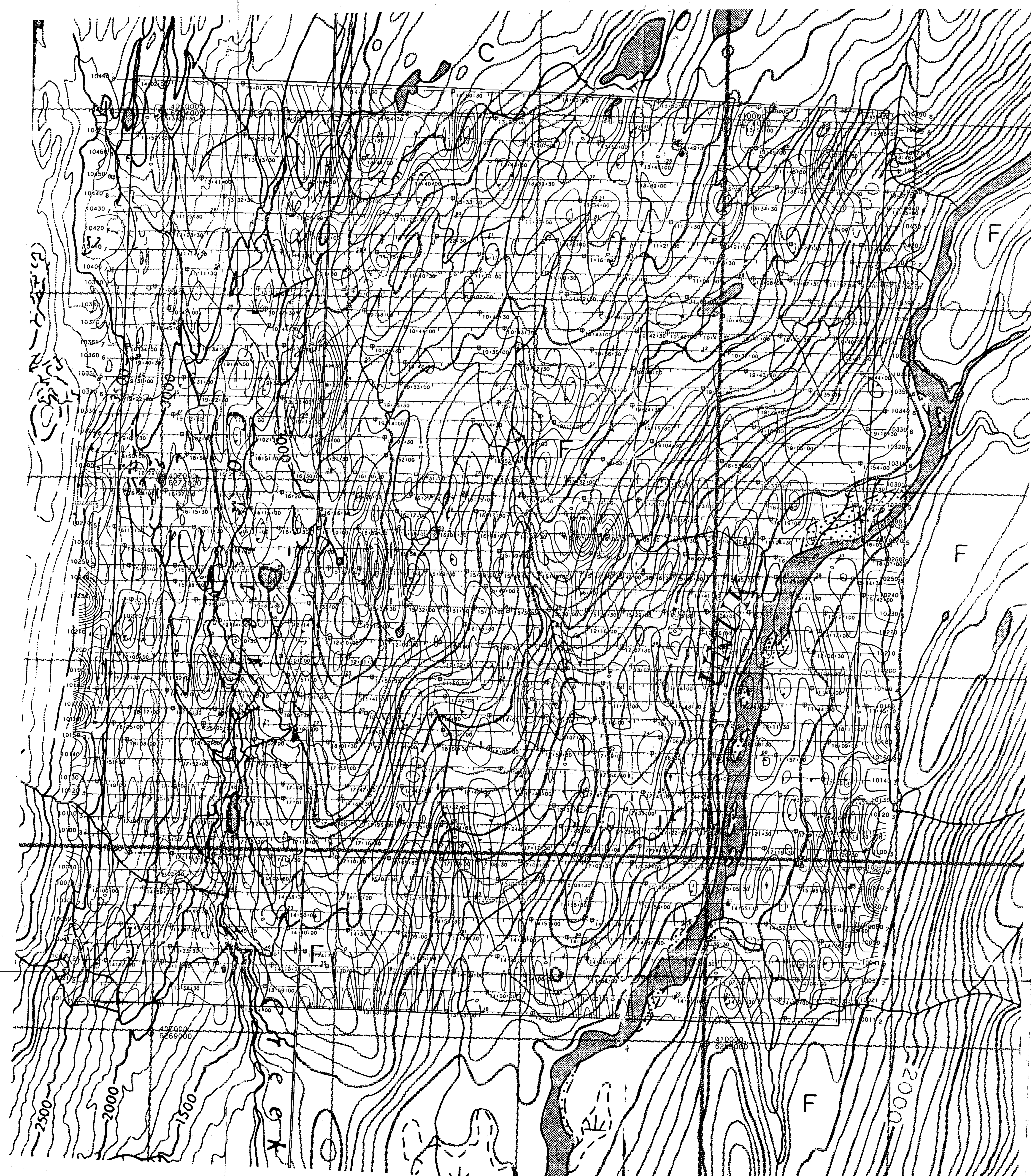
0 100 200 500 1000 Metres

AERODAT LIMITED

DATE: SEPT 1989

NTS No: 104 B/9,10

MAP No: 6



VLF-EM

VLF-EM Total Field Intensity in percent.

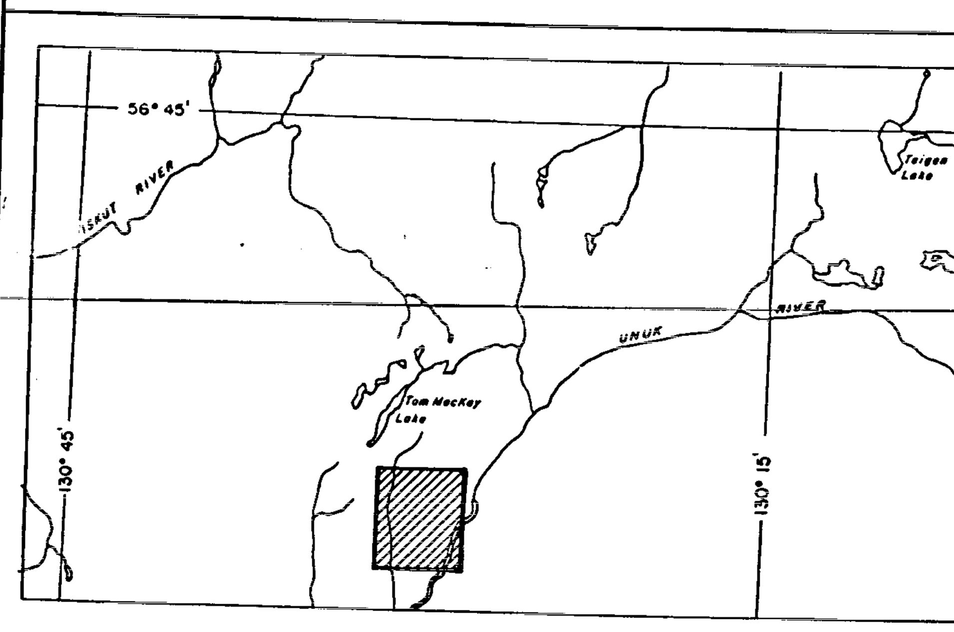
Station: NAA
Cutler, Maine
24.0 kHz

Sensor elevation 45m

Flight Path

Navigation and recovery using Motorola Mini-Ranger (MRS III) radar navigation system.

Average terrain clearance 60m
Average line spacing 100m



SWIFT MINERALS LTD.

VLF-EM TOTAL FIELD CONTOURS

UNUK RIVER AREA

NORTHERN BRITISH COLUMBIA

7

SCALE 1:10,000

0 330 660 1320 2640 Feet

0 100 200 500 1000 Metres

AERODAT LIMITED

DATE: SEPT 1989

NTS No: 104 B/9,15