87-138-15963

REPORT ON 2/85

COMBINED HELICOPTER BORNE

### MAGNETIC, ELECTROMAGNETIC AND VLF

### SURVEY

SQUAW CREEK PROPERTY

### NORTHERN BRITISH COLUMBIA

### CLAIMS SURVEYED

UNITS

16

<u>CLAIM</u> Muncaster Snow Cave Avalanche II Nancy I Julie I

RECORD

 20
 29 March

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 29 March

ANNIVERSARY

29 March

Attin M.D. 114P/14E 59°59.4' 137°04.3'

for

Operator: ARBOR RESOURCES LTD. Owner: Colin Little

FILMED

by

AERODAT LIMITED

February 15, 1987 GEOLOGICAL BRANCH ASSESSMENT REPORT

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G. Podolsky P. Eng.

British Columbia Energy, Mines and Petroleum Resources	ASSESSMENT REPORT TITLE PAGE AND SUMMARY
TYPE OF REPORT/SURVEY(S)	TOTAL COST
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AUTHOR(S)G, Podolsky.	IGNATURE (S) Affinite Colorans, for
DATE STATEMENT OF EXPLORATION AND DEVELOPMENT FI	LED . Feb. 20, 1987 YEAR OF WORK 1987
PROPERTY NAME(S)	
SQUAW CREEKPLACER, SHE	EP
COMMODITIES PRESENT	
B.C. MINERAL INVENTORY NUMBER(S), IF KNOWN	147-4, 21
MINING DIVISION	NTS . 114P/14E
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MUNCASTER (16 UNITS), SNOW CAVE (20	units, AVALANCH . Z. (20. units),
NANCY 1. (70 units), JULIE 1. (70	units)
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### LIST of MAPS

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### (Scale 1:10,000)

MAPS:	
I	PHOTOMOSAIC BASE MAP; prepared from an uncontrolled photo laydown, showing registration crosses corresponding to NTS co-ordinates on survey maps.
II	FLIGHT LINE MAP; showing all flight lines and fiducials.
III	ELECTROMAGNETIC ANOMALY MAP; showing all EM conductors interpreted from the analog and profile data.
IV	AIRBORNE ELECTROMAGNETIC SURVEY INTERPRETATION MAP; showing conductor axes and anomaly peaks along with inphase amplitudes and conductivity thickness ranges for the 4600 Hz coaxial coil system.
V	TOTAL FIELD MAGNETIC CONTOURS; showing magnetic values contoured at 5 nanoTesla intervals.
VI	VERTICAL MAGNETIC GRADIENT CONTOURS; showing computed vertical magnetic gradient values contoured at 1 nanoTes1a per metre.
VII	APPARENT RESISTIVITY CONTOURS; showing contoured resistivity values, flight lines, fiducials and anomaly peaks
VIII	VLF-EM TOTAL FIELD CONTOURS; showing relative contours of the VLF Total Field response.

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### INTRODUCTION

This report describes an airborne geophysical survey carried out on behalf of Arbor Resources Ltd. by Aerodat Limited. Equipment operated included a four frequency electromagnetic system, a high sensitivity cesium vapour magnetometer, a two frequency VLF-EM system, a video tracking camera and an altimeter. Electromagnetic, magnetic and altimeter data were recorded both in digital and analog form. Positioning data were recorded on a standard VHS video tape as well as being marked on the flight path mosaic by the operator while in flight.

The survey area, comprising a block of ground along Squaw Creek in the Tatshenshini River valley of northern British Columbia and situated about 13 kilometres west of the Hayes Road just south of the B.C.-Yukon boundary, was flown on January 14, 1987. Two flights were required to complete the survey with flight lines oriented at an approximate Azimuth of 030 degrees and flown at a nominal spacing of 100 metres. Coverage and data quality were considered to be within the specifications described in the contract with due consideration of survey parameters and limitations of technology and equipment.

The purpose of the survey was to record airborne geophysical data over and around ground that is of interest to Arbor Resources Ltd.

A total of 100 kilometres of the recorded data were compiled in map form and are presented as part of this report according to specifications outlined by Arbor Resources Ltd.

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### SURVEY AREA LOCATION

The survey area is depicted on the index map shown below. It is centred at Latitude 59 degrees 59.5 minutes north, Longitude 137 degrees 05 minutes west, approximately 13 kilometres west of the Hayes Road in the Tatshenshini River valley of northern British Columbia (NTS Reference Map No. 114 P/14). The area is accessed by trail off the Hayes Road or by helicopter from any convenient base of operations.



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### AIRCRAFT AND EQUIPMENT

### 3.1 Aircraft

A Bell 206-L helicopter, (C-GLGF), owned and operated by Lakeland Helicopters Limited, was used for the survey. Installation of the geophysical and ancillary equipment was carried out by Aerodat. The survey aircraft was flown at a mean terrain clearance of 75 metres.

### 3.2 Equipment

### 3.2.1 Electromagnetic System

The electromagnetic system was an Aerodat 4-frequency system. Two vertical coaxial coil pairs were operated at 935 Hz and 4600 Hz and two horizontal coplanar coil pairs at 4175 Hz and 30 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 transmitter.

### 3.2.2 VLF-EM System

The VLF-EM System was a Herz Totem 2A. This instrument measures the total field and quadrature components of two selected transmitters, preferably oriented at right angles to one another. The sensor was towed in a bird 12 metres below the helicopter. The transmitting stations monitored were NAA Cutler, Maine, broadcasting at 24.0 kHz for the "Line" station and NLK Jim Creek, Washington, broadcasting at 24.8 kHz for the "Ortho" station.

### 3.2.3 Magnetometer

The magnetometer was a Scintrex Model V104 high sensitivity unit employing a Scintrex Model VIW - 2321 H8 cesium, optically pumped magnetometer sensor. The sensi-

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tivity 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

A Geometrics G862 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 camera was used to record flight path on a standard VHS video tape. The camera was operated in the normal (continuous) mode with times and fiducial numbers encoded on the tape 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 were recorded:

Channel	Input	Scale
00	Low Frequency Inphase	2.5 ppm/mm
01	Low Frequency Quadrature	2.5 ppm/mm
02	High Frequency Inphase	2.5 ppm/mm
03	High Frequency Quadrature	2.5 ppm/mm
04	Mid Frequency Inphase	10 ppm/mm
05	Mid Frequency Quadrature	10 ppm/mm
	Section 3: Aircr	aft and Equipment

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06	VH Frequency Inphase	20	ppm/mm
07	VH Frequency Quadrature	20	ppm/mm
08	Power Line Monitor		
09	VLF-EM Total Field, Line	2.5	≹∕mm
10	VLF-EM Quadrature, Line	2.5	≹∕mm
11	VLF-EM Total Field, Ortho	2.5	¢/mm
12	VLF-EM Quadrature, Ortho	2.5	≹∕mm
13	Altimeter (150 m at top of chart)	3 m/	/mm
14	Magnetometer, fine	l r	nT/mm
15	Magnetometer, coarse	10 r	nT/mm

### 3.2.8 Digital Recorder

A DAS - 8 data system recorded the survey on magnetic tape. Information recorded was as follows:

Equipment	Recording Interval
EM system	0.1 seconds
VLF-EM	0.5 seconds
Magnetometer	0.25 seconds
Altimeter	0.5 seconds
Power Line Monitor	0.5 seconds

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### DATA PRESENTATION

### 4.1 Base Map

A photomosaic base at a scale of 1:10,000 was prepared from an uncontrolled photo lay down, on a screened mylar base, with registration marks corresponding to NTS co-ordinates as taken from a suitable topographic map.

### 4.2 Flight Path Map

The flight path was derived from a combination of the navigators manual "picks" that were marked on the photomosaic flight line map and points picked from the record of the flight path taken by the video tracking camera. In rugged or mountainous terrain where line-of-sight electronic navigation and flight path recovery systems are not practical, this method is the only means available to establish flight path. Depending on the quality of the air photos and the photomosaic, the degree and density to which points can be recovered, the rugged nature of the terrain and the quality of the navigation, this method may show errors of greater than 30 metres in the location of anomalies on the topographic map with respect to their true position on the ground. The flight path is presented on a mylar overlay of the base map, with camera time marks and navigator's manual fiducials for cross reference to both the analog and digital data.

### 4.3 Electromagnetic Anomaly Maps

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

Local sferic activity can produce sharp, large amplitude events that cannot be removed by conventional filtering pro-

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cedures. Smoothing or stacking will reduce their amplitude but leave a broader residual response that can be confused with geological phenomena. To avoid this possibility, a computer algorithm searches out and rejects the major sferic events.

The signal to noise ratio was further enhanced by the application of a low pass digital filter. It has zero phase shift which prevents any lag or peak displacement from occurring, and it suppresses only 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. The correction applied 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 present. The filtered and levelled data were used in the interpretation of the electromagnetics.

The anomalous responses of the 4600, 945 Hz coaxial and 4175 Hz coplanar coil configurations were plotted on a mylar overlay of the photomosaic base map.

### 4.4 Airborne Electromagnetic Survey Interpretation Map

An interpretation map was prepared showing peak locations of anomalies and conductivity thickness ranges along with the Inphase amplitudes (computed from the 4600 Hz coaxial response) and conductor axes. The data are presented on a mylar copy of the photomosaic base map.

### 4.5 Total Field Magnetic Contours

The aeromagnetic data were corrected for diurnal variations by adjustment with the digitally recorded base station magnetic J8650.SC Section 4: Data Presentation

values. No correction for regional variation was applied. The corrected profile data were interpolated onto a regular grid at a 25 metre true scale interval using a cubic spline technique. The grid provided the basis for threading the presented contours at a 5 nanoTesla interval.

The contoured aeromagnetic data have been presented on a mylar copy of the photomosaic base map.

### 4.6 Vertical Magnetic Gradient Contours

The vertical magnetic gradient was calculated from the gridded total field magnetic data. Contoured at a 1 nT/m interval, the gradient data were presented on a mylar copy of the photomosaic base map.

### 4.7 Apparent Resistvity Contours

The electromagnetic information was processed to yield a map of the apparent resistivity of the ground.

The approach taken in computing apparent resistivity was to assume a model of a 200 metre thick conductive layer (i.e., effectively a half space) over a resistive bedrock. The computer then generated, from nomograms for this model, the resistivity that would be consistent with the bird elevation and recorded amplitude for the coaxial frequency pair used. The apparent resistivity profile data were interpolated onto a regular grid at a 25 metres true scale interval using a cubic spline technique.

The contoured apparent resistivity data were presented on a mylar copy of the photomosaic base map with the flight path and electromagnetic anomaly information.

Section 4: Data Presentation

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### 4.8 VLF - EM Total Field Contours

The VLF-EM signals from NAA, Cutler, Maine and NLK, Jim Creek, Washington, broadcasting at 24.0 and 24.8 kHz respectively, were compiled in contour map form and presented on mylar copies of the photomosaic base map.

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### INTERPRETATION

### GEOLOGY

No geologic data were supplied to Aerodat by Arbor Resources Ltd. and no other published data was available to the writer. Also, types of targets sought have not been discussed or identified by Arbor Resources or their consultant, Mark Management Ltd., although it is generally assumed that the primary interest is in gold mineralization that is known to occur within the general region.

### MAGNETICS

The magnetic data from the high sensitivity cesium magnetometer provided virtually a continuous magnetic reading when recording at two-tenth second intervals. The system is also noise free for all practical purposes.

The sensitivity of 0.1 nT allows for the mapping of very small inflections in the magnetic field, resulting in a contour map that is comparable in quality to ground data. Both the fine and coarse magnetic traces were recorded on the magnetic charts.

The magnetic grain appears to trend in a northwesterly direction almost along the long axis of the survey area. A large, elongate anomaly, approximately one-half kilometre wide and extending off the north east corner of the survey shows an anomalous amplitude of approximately 650 nanoTeslas (nT) above the average background value of 57,400 nT. Other anomalous values rarely exceed 200 nT. A series of smaller anomalies occur along the south west boundary of the survey. These show a northerly swing in the area of Line 1240 and may continue, in a north westerly direction, through the north central portion of the block.

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For reasons involving principally the short line lengths and the difficulties of producing an accurate flight path map in the topographic conditions pertaining to this survey, a reliable structural interpretation is virtually impossible. On a best estimate bases, a near north-south fault in the vicinity of Line 1170 and an east northeasterly fault centred on Line 1350 together with a parallel structure centred on Line 1420, were interpreted from the data. Other similar structures may be interpreted but the evidence for these is less clear.

The anomaly in the north east corner is thought to be due to a mafic intrusive whereas the other, lesser trends appear to be stratabound. Geologic guidelines would be helpful in developing an interpretation of the magnetic data.

### ELECTROMAGNETICS

The electromagnetic data was first checked by a line-by-line examination of the analog records. Record quality was very good to excellent with relatively minor noise levels on the very high frequency (30 kHz) coplanar trace. This was readily removed from the traces by an appropriate smoothing filter. Instrument noise was well within specifications. Geologic noise, in the form of surficial conductors, is present on the higher frequency responses and to a minor extent, on the low frequency quadrature response.

Anomalies were picked off the analog traces of the low and high frequency coaxial responses and then validated on the coplanar profile data. These selections were then checked with a proprietary computerized selection program which can be adjusted for ambient and instrumental noise. The data were then edited and re-plotted on a copy of the of the profile map. This procedure ensured that every anomalous response spotted on the analog data was plotted on the final map and allowed for the rejection - or inclusion if warranted - of obvious surficial conductors.

Each conductor or group of conductors was evaluated on the bases of magnetic (and lithologic, where applicable) correlations apparent on the analog data and man made or surficial features not obvious on the analog charts.

### RESULTS

The electromagnetic profile data show a number of relatively strong, presumably bedrock conductors throughout the area. They appear to correlate with magnetic low trends or the flanks (i.e., contacts) of magnetic highs. For purposes of this interpretation, several of the individual conductive bands have been grouped into conductive areas (e.g., Conductive Area II), a decision necessitated by poor J8650.SC Section 5: Interpretation

to questionable line to line correlations, possibly due to problems with establishing accurate flight path.

Strong surficial conductors, indicated where EM response was recorded on all channels, exist within the surveyed area and an attempt to differentiate these from bedrock zones. The 30 kHz coplanar response should provide a good picture, both in terms of areal extent and magnitude, of the overburden resistivities.

### CONDUCTOR I - (Lines 1050, 1060):

This two line anomaly, possibly masked by surface conductivity to the west, coincides with a small, 20 nT magnetic anomaly. It appears to consist of two thin, moderate conductance bands with a probable north east dip.

### CONDUCTIVE AREA II - (Lines 1010 to 1200):

Conductive Area II represents a series of moderate conductance bands that lie along regions of magnetic lows or, in some cases, flanks of magnetic trends. The individual bands tend to occur within wide belts of lower conductance that pinch and swell along their length (e.g., contrast the response along Line 1110 to that on Lines 1100 and 1120). These abrupt discontinuities may be due to structure but are more likely a function of the topography, stratigraphy and erosion. A small magnetic body, possibly an intrusive, centred on Line 1250, may have broken the continuity between Conductive Area II and Conductor VI, the latter a large amplitude zone of moderate conductance similar to II.

### CONDUCTIVE ZONES III, IV and V - (Lines 1270 to 1480):

These conductive zones appear to encircle the large magnetic body in the north east corner of the survey. Conductances are low to moderate despite the high EM J8650.SC Section 5: Interpretation responses. Multi banding is indicated.

### CONDUCTOR VII - (Lines 1120 to 1181):

This may represent an edge effect off a surficial conductor or a moderately conductive flat dipping sheet. It is designated as a possible bedrock conductor. This anomaly is somewhat characteristic of much of what has been classed as surficial conductance within the area of this survey.

### VLF - EM TOTAL FIELD

The VLF data show a general east-west VLF low trend running diagonally across the surveyed area. In other respects, there is little or no correlation with either the magnetic or electromagnetic maps. Certainly, no structure is apparent from the data presented. In general, the writer is skeptical about the possibilities of interpreting airborne VLF results in mountainous terrain as much of the response will frequently follow the topography.

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### CONCLUSIONS

The survey appears to have mapped a series of stratabound, generally non-magnetic conductive trends along the Squaw Creek valley. Despite the fairly large EM responses, particularly on the higher frequency channels, moderate conductance, near surface zones are indicated. The weight of the data suggests to the interpreter that the zones are flat lying strata comprising bands of graphitic material along the base and sides of the valley. Geologic guidelines and mineralization criteria would be of great help.

Although comment has been made on the problems involved with errors in flight path. the writer is satisfied that the existing map represents the best efforts of the contractor, considering the survey parameters, area, and available technology, to produce an accurate map.

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### RECOMMENDATIONS

Compilation of any detailed geology with the airborne data is a requisite step in evaluating the area for potential mineralization. Ground geophysical coverage should be directed at pin pointing the airborne conductors. If short spaced horizontal loop profiles are impractical, one might consider I.P. or resistivity methods. VLF may pick up the stronger horizons but would also be very sensitive to the strong surficial conductors as may be seen from the 30 kHz response.

PROFESSIONAL REGISTER B CHGINEER George Podols for G. PODGESKY ERODAT LIMITED ROLINCE OF ONTANIO February 15, 1987

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### APPENDIX I

### GENERAL INTERPRETIVE CONSIDERATIONS

### Electromagnetic

The Aerodat three 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 nonmagnetic 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

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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 nonconducting 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

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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.

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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.

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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 ratio 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.

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### 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.

- 8 -

### 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 measureable 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 the 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

- 9 -

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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

- 10 -

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

- 11 -

is possible whereby the net phase shift is zero and the response is purely in-phase with no quadrature component.

- 12 -

A net positive phase shift combined with the geometrical crossover 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

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Anomaly List

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FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUD INPHASE	E (PPM) QUAD.	CONI CTP MHOS	DUCTOR DEPTH MTRS	BIRD HEIGHT MTRS
1 1 1 1 1 1 1	1010 1010 1010 1010 1010 1010 1010	A B C D E F G H	4 5 2 3 1 1	39.5 46.0 31.3 25.6 29.7 44.6 61.1 60.1	11.8 8.2 4.9 19.2 10.4 15.4 72.0 63.5	8.0 16.7 17.8 2.0 6.0 6.9 1.5 1.8		47 52 53 49 62 53 45 48
1 1 1 1 1	1020 1020 1020 1020 1020 1020	A B C D F	3 3 2 4 5 5	36.6 30.4 29.2 29.1 36.4 46.8	11.3 10.8 22.1 7.6 5.2 8.4	7.5 5.9 2.1 8.8 21.0 16.6		60 61 51 58 60 61
1 1 1 1 1 1	1030 1030 1030 1030 1030 1030 1030 1030	A B C D E F G H J	3 4 4 3 3 3 4 3	77.7 92.4 69.3 61.4 26.3 36.2 32.2 36.0 23.3	28.5 32.2 22.5 18.4 8.7 17.3 12.7 8.5 10.0	7.5 8.4 9.1 6.2 4.2 5.2 10.7 4.2		50 50 49 48 51 46 60 61 61
1 1 1 1	$1040 \\ 1040 \\ 1040 \\ 1040 \\ 1040 \\ 1040 $	A B C D E	3 2 3 3 3	26.2 35.5 66.1 60.7 82.1	11.1 19.0 29.9 26.6 29.6	4.4 3.6 5.4 5.5 7.8	0 0 0 0	65 54 55 62 59
1 1 1 1 1 1 1 1	1050 1050 1050 1050 1050 1050 1050 1050	A B C D E F G H J K M N	2 3 3 3 3 1 0 0 2 2 1	17.8 56.4 84.3 63.0 60.2 53.8 22.5 18.6 21.7 42.6 29.2 40.7	11.8 24.2 36.7 27.6 24.2 23.0 17.8 36.1 48.6 26.5 20.9 47.6	2.1 5.5 6.1 5.6 6.2 5.5 1.8 0.5 0.4 3.1 2.3 1.3		56 46 52 55 56 57 38 36 54 57 46

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						CONI	BIRD	
FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUD INPHASE	QUAD.	CTP MHOS	DEPTH MTRS	HEIGHT MTRS
						• • • •		
1	1060	A	1	25.8	26.2	1.4	0	48
1	1060	B	3	16.5	5.8	4.9	0	79
1	1060	D	2	27.2	14.2	3.4	0	63
1	1060	Ē	3	57.6	24.9	5.5	õ	64
1	1060	F	1	20.0	21.3	1.2	0	57
1	1070	А	3	73.5	36.6	5.0	0	51
1	1070	B	3	64.4	30.5	5.1	0	52
⊥ 1	1070		4	44.3	28.7 21 7	3.0	U 0	51
ī	1070	E	3	112.9	54.0	5.9	i i i	45
1	1070	F	3	42.6	16.0	6.1	0	72
1	1070	G	0	12.0	24.7	0.4	0	48
1	1080	А	0	20.2	37.0	0.5	0	52
1	1080	B	2	60.6 52.0	34.8	3.9	0	54
1	1080	D	2	52.9 95.6	30.3 47.3	2.7	0	
1	1080	Ē	2	76.6	58.1	2.9	ŏ	58
1	1080	F	3	214.9	127.4	5.5	0	37
1	1090	A	2	31.5	18.5	3.1	0	67
1	1090	B	1	31.0	29.6	1.6	0	62
⊥ 1	1090		3	29.2	33.2	4.4	0	50 72
1	1090	E	ĩ	38.2	36.2	1.7	õ	47
1	1090	F	2	78.3	65.2	2.6	0	39
1	1100	A	0	11.6	15.6	0.7	0	74
1	1100	В	0	16.4	22.7	0.7	0	55
1	1100		1 2	21.0 28.2	18.0	$\frac{1.6}{2.1}$	0 .	· 61 55
1	1100	E	<u> </u>	149.9	103.1	4.1	ŏ	41
1	1100	F	3	153.2	84.5	5.4	0	43
1	$1100 \\ 1100$	G ਸ	3	133.0	83.6 79 3	4.4	N 0	44
-	1100	**	-	54.5	10.0	* • *	v	50
1 1	$\begin{array}{c} 1110\\ 1110 \end{array}$	A B	3 2	29.0 30.1	12.6 17.5	4.4 3.0	0 0	74 65
1	1120	A	• 2	77.5	62.0	2.7	0	56
1	1120	В	2	103.6	81.6	3.1	0	41
1	1120	С	1	98.6	117.0	1.8	0	39

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

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					E (PPM)	COND CTP	UCTOR DEPTH	BIRD
FLIGHT	LINE	ANOMALY	CATEGORY	INPHASE	QUAD.	MHOS	MTRS	MTRS
1 1 1	1120 1120 1120	D E F	4 3 3	196.6 182.4 156.4	83.6 98.3 96.0	8.1 5.9 4.8	0 0 0	45 43 42
1 1 1	1130 1130 1130	A B C	2 0 2	27.7 19.6 30.1	16.4 35.7 14.5	2.9 0.5 3.9	0 0 0	57 57 75
1 1 1 1	1140 1140 1140 1140 1140	A B C D E	3 2 2 0 0	69.1 85.9 60.8 19.0 7.6	33.7 59.7 56.0 45.3 11.4	5.0 3.4 2.1 0.4 0.5		49 53 47 38 61
1 1	1150 1150	A B	2 3	54.3 32.1	30.0 15.5	3.9 4.0	0 0	57 69
1 1	1160 1160	A B	2 2	31.9 35.1	18.7 29.6	3.1 2.0	0 0	62 39
1	1170	A	1	14.9	14.9	1.1	0	76
1 1 1 1	1181 1181 1181 1181	A B C D	2 2 2 0	41.5 27.8 28.4 8.7	33.7 21.0 20.2 22.3	2.2 2.1 2.3 0.2	0 0 0	66 61 47 50
1 1 1 1	1190 1190 1190 1190 1190	A B C D E	0 0 1 1	6.5 1.5 7.1 98.1 74.4	23.9 23.1 9.5 112.9 90.0	0.1 0.0 0.5 1.9 1.6	0 0 0 0	46 43 88 36 43
1	1200	A	. 0	9.7	30.1	0.2	0	36
1 1	1220 1220	A B	0 1	21.8 24.1	49.1 28.5	0.4 1.1	··· 0 0	46 64
1 1 1 1	1232 1232 1232 1232	A B C D	1 0 0 0	29.5 9.7 9.3 14.1	33.7 34.4 31.6 47.3	1.2 0.1 0.1 0.2	0 0 0	62 42 43 44
1 1	1240 1240	A B	1 1	32.3 35.8	29.5 33.9	1.7 1.7	0 0	59 58

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						CONDUCTOR		BIRD
FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUD INPHASE	OE (PPM) QUAD.	CTP MHOS	DEPTH MTRS	HEIGHT MTRS
1	1270	A	2	39.5	32.5	2.1	0	64
1	1270 1270	B C	2	25.7 11.1	18.1	2.2	0	56 55
	1000	-					•	
1 1	1280 1280	A B	2	24.5 39.4	17.4	2.2	0	71 61
1	1280	c	$\frac{1}{2}$	32.3	22.9	2.4	õ	66
1	1280	DF	0	27.4	38.8	0.9	0	62
<u> </u>	1200	<u>1</u>	Ŭ	27.0	41.T	0.0	0	02
1	1290	A	0	9.5	13.1	0.6	0	69
1	1290	Ċ	2	51.4	31.5	3.4	0	44
1	1290	D	2	62.3	46.5	2.8	0	52
2	1300	А	2	43.3	33.8	2.3	0	57
2	1300	B	2	50.9	30.9	3.4	0	52
2	1300	D	2	19.3 23.7	13.9 32.6	2.0	0	94 51
2	1300	E	1	24.7	27.1	1.2	õ	54
2	1310	A	0	14.6	28.2	0.4	0	44
2	1310	В	0	16.4	25.2	0.6	Ö	58
2	1310 1310	C D	0	8.4 15.7	15.6 14.6	0.4	0	48
2	1310	E	ō	14.0	17.1	0.8	ŏ	63
2	1310	F	2	20.7	12.5	2.6	0	74
2	1310	H	1	48.3	44.4 52.8	1.6	0	36 37
2	1320	A	2	22 0	17 0	<b>2</b> A	0	60
2	1320	B	2	30.5	16.9	3.4	0	90
2	1320	С	1	31.2	42.4	1.0	Ő	44
2	1320	D	. 4	54.3	48.4	2.1	0	48
2	1330	A	0	58.0	118.4	0.7	0	40
2	1330	B C	± 2	48.0 43.7	64.6 39.1	1.2 2.0	0	47 57
2	1330	D	1	24.8	28.0	1.2	Õ.	61
2	1330 1330	E	2	50.8	35.1	2.9	0	50
2	1330	Ğ	1	40.4	36.0	1.9	0	44
2	1340	А	1	36.5	38.5	1.5	0	45
							-	

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						CONDUCTOR		BIRD	
<b>57 T GUM</b>				AMPLITU	DE (PPM)	CTP	DEPTH	HEIGHT	
FLIGHT	LINE	ANOMALY	CATEGORY	INPHASE	QUAD.	MHOS	MTRS	MTRS	
2	1340	в	3	36.8	18.2	4.0	0	69	
2	1340	С	1	61.0	70.1	1.6	0	42	
2	1340	D	2	49.1	39.7	2.3	0	51	
2	1340	E	2	21.4	15.3	2.1	0	77	
2	1340	G	1 0	24.U 19.7	44.7	1.3	0	46	
$\overline{2}$	1340	H	Ő	50.4	89.0	0.8	0	4⊥ २७	
							v	• •	
2	1350	A	1	79.4	91.8	1.7	0	47	
2	1350	В	2	40.2	30.8	2.3	0	55	
2	1350		2	34.9	24.9	2.4	0	58	
2	1350	E	3	26.2	11.1	<b>4 4</b>		. D⊥ 70	
		-	-	2012			v	70	
2	1360	A	0	35.1	55.0	0.9	0	42	
2	1360	B	1	42.7	42.6	1.7	0	56	
2	1360	C م	2	33.6	24.1	2.4	0	55	
2	1360	E	2	56 0	50.1 87 2	2.5	0	49	
-		-	-	50.0	07.2	1.0	U	34	
2	1370	A	1	25.2	20.7	1.8	0	57	
2	1370	B	1	31.8	28.1	1.8	0	61	
2	1370	C	1	45.0	53.3	1.4	0	49	
2	T210	D	2	04.4	45.6	3.0	0	56	
2	1380	A	2	47.0	28.9	3.3	0	56	
2	1380	В	1	35.1	35.4	1.5	0	51	
2	1380	C	1	22.6	25.7	1.1	0	43	
2	1380	D F	0	1.2	71.0	0.0	0	33	
2	1380	<u>고</u> ㅋ	1	134 2	223.2	0.8	0	33	
-		•	-	134.2	T)4.0	1,00	U	с 	
2	1390	A	0	17.6	69.6	0.2	0	29	
2	1390	В	2	57.3	49.5	2.2	0	55	
2	1400	A	0	22.3	31.6	0.8	· 0	51	
2	1400	В	2	94.5	91.6	2.3	Õ	38	
2	1 4 1 0		2				-		
2	1410	A B	2	133.5	147.2	2.2	0	43	
4	171V	-	*	±3.1	±4.4	⊥•4	U	02	
2	1420	A	1	17.2	18.3	1.1	0	61	
2	1 4 7 7		•		~~ ~		•	• •	
2	1430 1430	A B	U 2	41.1	90.2	0.6	0	36	
<b>4</b> 0	7400	<u>,</u>	44	TO • T	2.1	4.J	U	04	

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						CONI	DUCTOR	BIRD
				AMPLITUD	E (PPM)	CTP	DEPTH	HEIGHT
FLIGHT	LINE	ANOMALY	CATEGORY	INPHASE	QUAD.	MHOS	MTRS	MTRS
			• • • • • • • •					
2	1430	С	1	17.4	15.4	1.4	0	60
2	1430	D	1	24.8	29.0	1.1	0	52
2	1430	E	0	60.1	135.3	0.6	Ō	37
2	1430	F	0	42.5	80.3	C.7	Õ	41
2	1430	G	0	19.1	41.0	0.4	Ő	45
2	1450	А	1	17.7	13.2	1.8	0	62
2	1460	A	1	16.8	14.7	1.4	0	70
2 2	1470 1470	A B	2 1	20.2 16.0	14.2 15.8	2.1	0	66 69
2	1480	A	1	29.3	28.9	1.5	0	64

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### APPENDIX III

### CERTIFICATE OF QUALIFICATIONS

- I, GEORGE PODOLSKY, certify that: -
- 1. I am registered as a Professional Engineer in the Province of Ontario and work as a Professional Geophysicist.
- 2. I reside at 172 Dunwoody Drive in the town of Oakville, Ontario.
- 3. I hold a B. Sc. in Engineering Physics from Queen's University, having graduated in 1954.
- 4. I have been continuously engaged in both professional and managerial roles in the minerals industry in Canada and abroad for the past thirty two years.
- 5. I have been an active member of the Society of Exploration Geophysicists since 1960 and hold memberships on other professional societies involved in the minerals extraction and exploration industry.
- 6. The accompanying report was prepared from information published by government agencies, materials supplied by Arbor Resources Ltd. and from a review of the proprietary airborne geophysical survey flown by Aerodat Limited for Arbor Resources Ltd. Although I have worked in the general area on several occasions, I have not personally visited the property.
- 7. I have no interest, direct or indirect, in the property described nor do I hold securities in Arbor Resources Inc.
- 8. I hereby consent to the use of this report in a Statement of Material Facts of the Company and for the preparation of a prospectus for submission to the British Columbia Securities Commission and/or other regulatory authorities.

Signed 000**1.**SKY George Podolsky, P./Eng. GEOPOD ASSOCIATES INC. A CEOFONTAR

Oakville, Ontario

February 15, 1987

### COST STATEMENT GEOPHYSICAL SURVEY SQUAW CREEK PROPERTY 14 JANUARY 87

### AERODAT LIMITED

MOB/DEMOB	\$2,000.00	
100 LKM @ \$75.00	7,500.00	\$ 9,500.00

### MARK MANAGEMENT LTD.

Planning &	Supervision,	Report	1,700.00
TOTAL COST			\$11,200.00





# GEOLOGICAL BRANCH ASSESSMENT REPORT

# 15,963

ARBOR RESOURCES INC.

# FLIGHT PATH

# TATSHENSHINI RIVER

BRITISH COLUMBIA

0	770	660	SCALE	1/10,000	l/2 mile	-
0	100	200	1320	500	i Kilometre	
	. <i>.</i>			DATE	January 1987	
)C	DAT	LIM	ITED	N.T.S. No:	114 P	
				MAP No:	2	
					J 865	0



# 15,963

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ARBOR RESOURCES INC.

ELECTROMAGNETIC SURVEY

# TATSHENSHINI RIVER

BRITISH COLUMBIA

0	330	S C .	ALE 1320	1/10,000	l∕2 mile ——
0	100	200		00	l Kilometre
				DATE	January 1987
DE	)AT I		D	N.T.S. No:	II4 P
		•		MAP No:	3
					10050

J8650



# INTERPRETATION LEGEND



EM Anomaly A, in-phase amplitude 7 ppm. Conductivity thickness range 2 (see code) Interpreted bedrock conductor axis Possible bedrock conductor axis

Conductive Zone

MOTOROLA MINI-RANGER MRS III 30 metres Mean flight line spacing 100 metres



GEOLOGICAL BRANCH ASSESSMENT REPORT

15,963

# ARBOR RESOURCES INC.

## **ELECTROMAGNETIC SURVEY** INTERPRETATION

# TATSHENSHINI RIVER

BRITISH COLUMBIA

	MAP No:	4	
DDAT LIMITED	N.T.S. No:	114 P	
	DATE:	January 1987	
0 100 200	500	l Kilometre	
SCALE 0 <u>330 660 1320</u>	1/10,000	1/2 mile	•

J 8650



### TOTAL FIELD MAGNETIC CONTOURS

MEAN MAGNETOMETER SENSOR ELEVATION: CONTOUR INTERVAL:

48 metres 5 gammas

50	gammas	فتستنب
25	gammas	
5	gammas	

# GEOLOGICAL BRANCH ASSESSMENT REPORT

15,963

# ARBOR RESOURCES INC.

TOTAL FIELD MAGNETIC CONTOURS

.

# TATSHENSHINI RIVER

BRITISH COLUMBIA

SCALE 0 <u>330 660 13</u> 20	1/10,000	l/2 mile ⊒⊐
0 100 200	500	l Kilometre
	DATE:	January 1987
DAT LIMITED	N.T.S. No:	II4 P
	MAP No:	5
		J 8650



### VERTICAL MAGNETIC GRADIENT

(CALCULATED FROM TOTAL MAGNETIC FIELD) CONTOUR INTERVAL:

25 gammas / metre ...... 5 gammas / metre ...... 1 gammas / metre .....

# GEOLOGICAL BRANCH ASSESSMENT REPORT

![](_page_47_Picture_5.jpeg)

# ARBOR RESOURCES INC.

# COMPUTED VERTICAL MAGNETIC GRADIENT CONTOURS

# TATSHENSHINI RIVER BRITISH COLUMBIA

SCALE 0 <u>330 660 1320</u>	1/10,000	1/2 mile	
0 100 200	500	l Kilon	netre
	DATE:	January I	987
ODAT LIMITED	N.T.S. No:	114 P	
	MAP No:	6	
			J 8650

![](_page_48_Figure_0.jpeg)

### APPARENT RESISTIVITY CONTOURS

Calculated assuming 200 m conductive layer (using 4600 Hz coaxial data)

 10 <sup>N0</sup> OHM-M	N = 1:2.3.	9	
 10 <sup>N M</sup> OHM-M	 M = 1.2.3	9	

# GEOLOGICAL BRANCH ASSESSMENT REPORT

15,963

ARBOR RESOURCES INC.

# APPARENT RESISTIVITY CONTOURS

# TATSHENSHINI RIVER

BRITISH COLUMBIA

SCALE O <u>330 660 1320</u>	1/10,000	I/2 mile	
0 100 200	500	l Kilometre	
	DATE	January 1987	
ODAT LIMITED	N.T.S. No	II4 P	
	MAP No:	7	
			J 8650

![](_page_49_Figure_0.jpeg)

### VLF-EM TOTAL FIELD CONTOURS

VLF STATION: NAA (Cutler, Maine) 24.0 kHz. MEAN VLF-EM SENSOR ELEVATION: 48 metres

CONTOUR INTERVAL

25	%	
5	%	
1	%	
	-	

# GEOLOGICAL BRANCH ASSESSMENT REPORT

15,963

ARBOR RESOURCES INC. VLF-EM TOTAL FIELD CONTOURS TATSHENSHINI RIVER BRITISH COLUMBIA SCALE 1/10,000 l/2 mile Kilometre January 1987 DATE ▼ AERODAT LIMITED 114 P N.T.S. No: MAP No: 8 J8650