MARLIN DEVELOPMENTS LTD.
GEOPHYSICAL REPORT ON AN
AIRBORNE MAGNETIC AND VLF-EM SURVEYS
GIL CLAIMS
SKEENA MINING DIVISION
NTS: 104A/5W & 12W
LATITUDE: 56° 30'N LONGITUDE: 129° 50'W
AUTHOR: Jeffrey C. Murton, B.Sc., P.Geoph.
DATE OF WORK: FEB 26 & 27, MAR 7, 1990
DATE OF REPORT: MAY 23, 1990

GEOLOGICAL BRANCH
ASSESSMENT REPORT

20,074

-Part 2 of 2-

WESTERN GEOPHYSICAL AERO DATA LTD.

TABLE OF CONTENTS **PAGE**

ILLUSTRATIONS

INTRODUCTION:

On February 26, 27, and March 7, 1990 an airborne reconnaissance magnetic and VLF-EM survey was conducted over the **Gil claims** by Western Geophysical Aero Data Ltd. for **Marlin Developments Ltd.**.

The intention of this survey is to direct further exploration to favorable target areas and to assist in the geological mapping of the property. Approximately 474.7 line kilometers of airborne magnetic and VLF-EM data has been collected, processed, and displayed in order to evaluate this property.

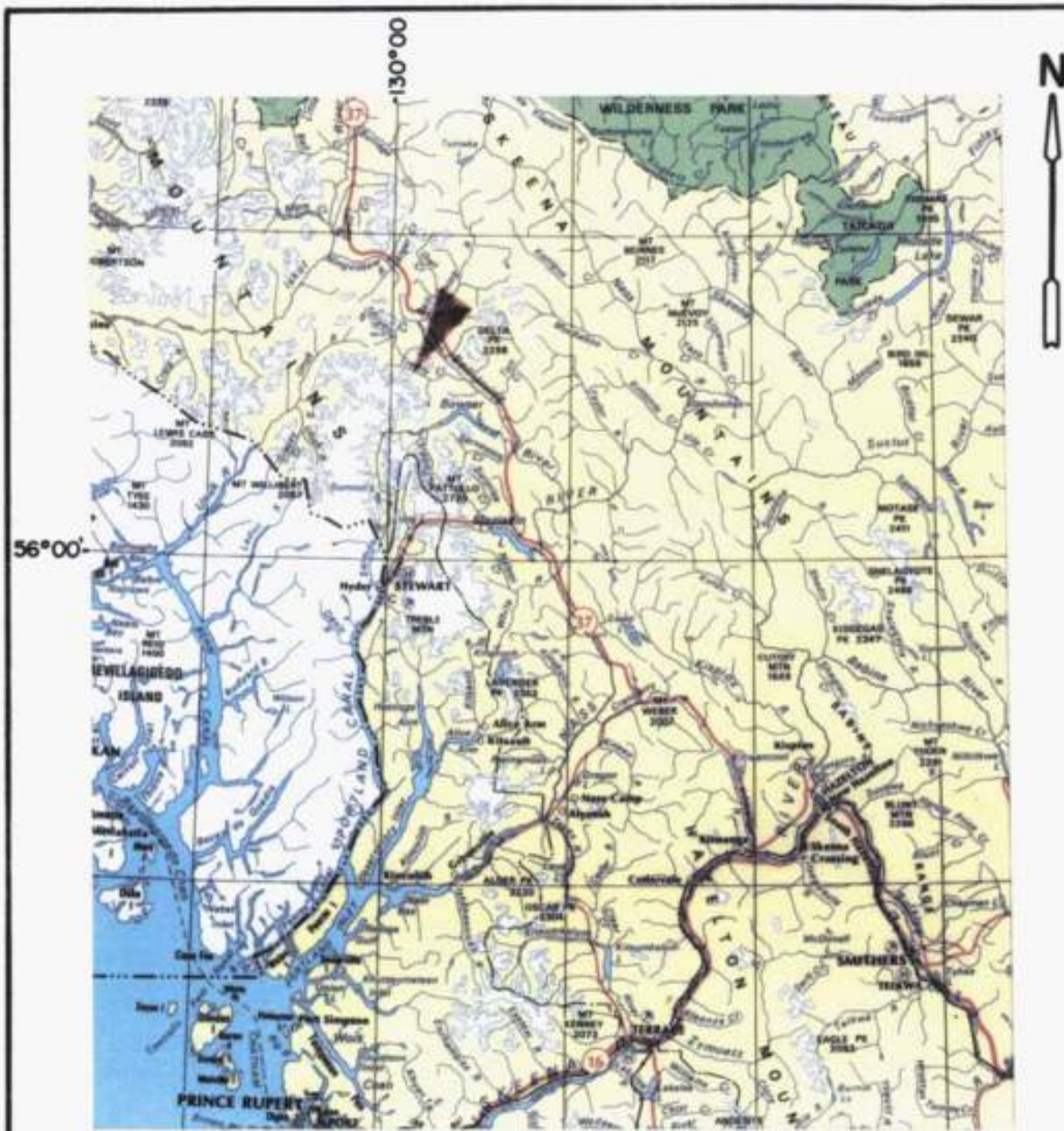
LOCATION AND ACCESS

The **Gil claims** are located 56 kilometres north and 3 kilometres east of Stewart, B.C. (Figure 1). The property lies between Treaty Creek, to the north, Bowser River, to the south, and west of Todedada Creek (Figure 2).

There is year-round highway access to Stewart. Property access was gained by a thirty minute helicopter charter ride to the area east of Charles Glacier.

AIRBORNE MAGNETIC AND VLF-EM SURVEY:

This geophysical survey simultaneously monitors and records the output signals from a Barringer Research proton precession magnetometer and a Herz dual-frequency VLF-EM receiver. The sensors are installed in an aerodynamically stable "bird" which is towed thirty metres below a helicopter. Fixed to the helicopter skid is a shock and gimbal-mounted, downward-facing video camera. A video signal is recorded and later reviewed and correlated with a recent air photograph in order determine the precise locations of the flight paths. The elevation of the helicopter above the ground is recorded by a radar altimeter and



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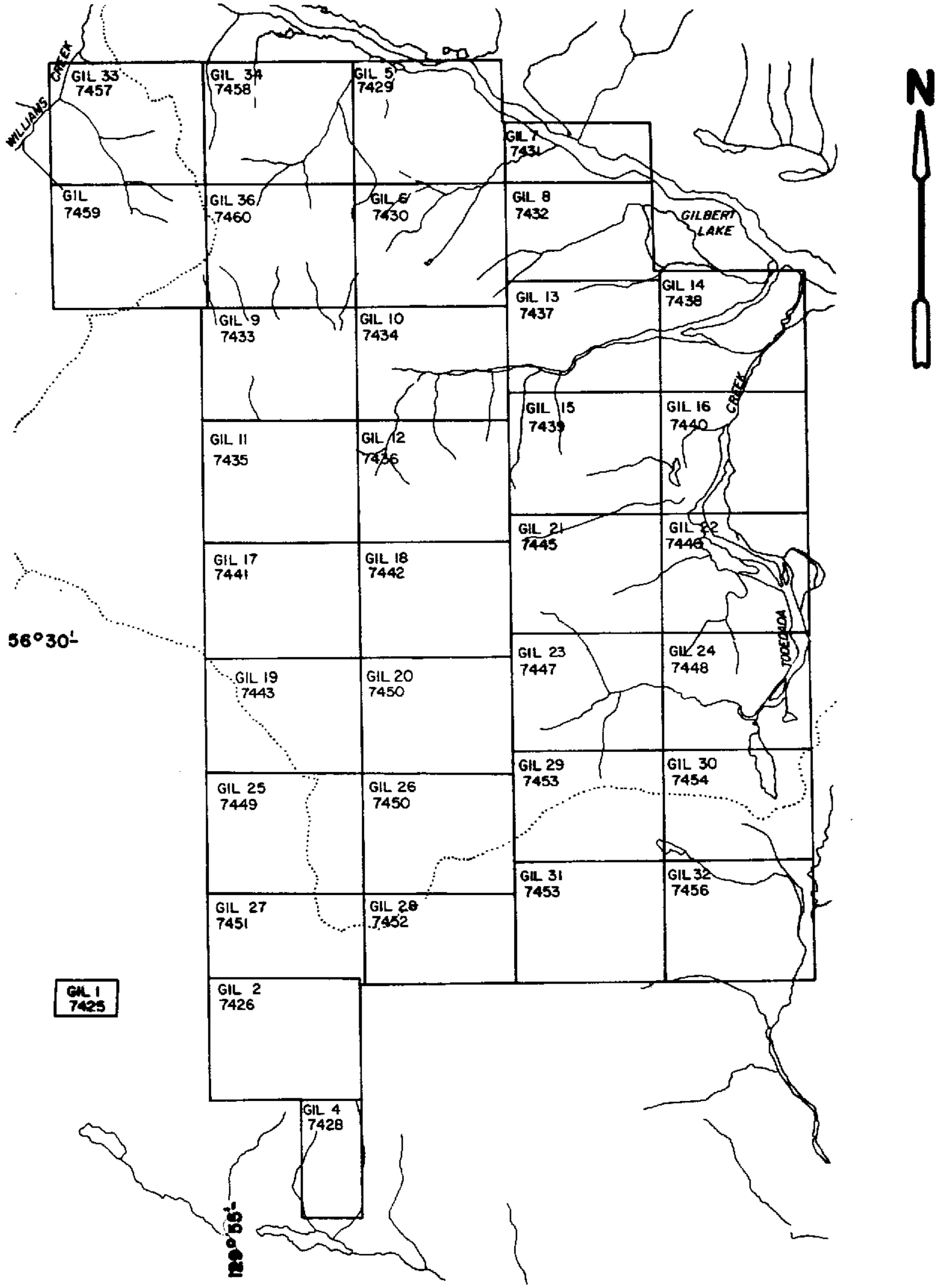
GIL CLAIMS

LOCATION MAP

N.T.S. 104B/8E & 104A/5W

SCALE = 1:2 000 000

FIG. 1



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GIL CLAIMS

CLAIMS MAP

SCALE = 1:100 000 N.T.S. 104A/5W & 12W FIG. 2

monitored by the pilot and navigator in order to maintain a constant ground clearance.

A computer records readings of the magnitude of the earth's magnetic field and of the fields induced by two powerful VLF-EM transmitters (located in Annapolis, Maryland and Seattle, Washington). This data, the time and date it was observed, radar altimeter values, and survey fiducial points are all superimposed on the video image and recorded on both video cassettes and 3.5 inch computer diskettes.

Data quality is assured by the survey operator monitoring a real-time display of direct and unfiltered recordings of all the geophysical output signals while a navigator directs the helicopter pilot from an air photograph.

Magnetic (Figures 4 & 5) data is useful for mapping the position and extent of regional and local geological structures which have varying concentrations of magnetically susceptible minerals. Many lithological changes correlate with a change in magnetic signature.

VLF-EM data is useful for mapping conductive zones. These zones usually consist of argillaceous graphitic horizons, conductive clays, water-saturated fault and shear zones, or conductive mineralized bodies. The VLF-EM data is presented as contoured total field data overlain by quadrature (out-of-phase component) profiles. Conductors are located at inflection points or a change in sign (cross-over) of the quadrature component over a local total field VLF-EM high.

In a typical VLF-EM survey, satisfactory conductor coupling and imaging occurs only within 45° of the primary field selected (in the direction of the transmitter). For maximum coupling, and in turn, imaging, a transmitter should be selected in the same direction as geologic strike.

DATA PROCESSING:

The video image, with superimposed line and fiducial identification, recording times, and the recorded data, is correlated with both the navigator's and operator's field notes and topographic features observed from an air photograph. The "recovered" flight paths are digitized to obtain relative x and y positions which are then combined with the data. Subsequently, all geophysical data is filtered to remove spurious noise bursts and chatter, and then plotted as flight path profiles and contour maps for each of the sensors.

Both the total field magnetometer signal and the total field and quadrature components of VLF-EM signal are sensitive to topographic changes and bird oscillations. Short wavelength (less than 200 meters) oscillations, are attenuated by filtering the VLF-EM data with a digital low-pass filter. Long wavelength effects (anomalies greater than 2000 metres), attributed to broad topographic features, are also removed from both the VLF-EM channels by high-pass filtering.

DISCUSSION OF RESULTS:

The Gil claims were surveyed on February 26, 27, and March 7, 1990. Over 474.7 line kilometers of airborne magnetic and VLF-EM survey data have been recorded and evaluated for this property. Survey lines were flown approximately east-west on a Hughes 500D helicopter with an average spacing of 300 metres. The geophysical survey data were recorded on average three times per second for an effective sample interval of 15 metres. The sensors were towed below the helicopter with an average terrain clearance of 30 metres where possible.

The abrupt topographic changes due to the erosional effects of creeks on the property contribute up to an additional 190 metres of ground-to-sensor separation in places. In any airborne geophysical survey an increase in the ground-to-sensor distance by five metres is noteworthy and by ten metres is significant. The effect of separation increases of this magnitude upon the magnetic and VLF-EM responses is a marked reduction in measured intensity. Increased sensor-ground separation attenuates the geophysical response and results in the appearance of a mappable magnetic or VLF-EM low. In many geological settings the location of creeks and rivers correspond to the surface expression of fault and shear zones, or lithological contacts and are likely areas to observe significant VLF-EM conductors. In part, the VLF-EM response, and to a less extent the magnetometer response, may have been "over-printed" or attenuated in these areas by increased separation effects thus masking conductors that might be observed on a ground survey.

VLF-EM conductors corresponding to Seattle and Annapolis transmitters have been interpreted and numbered on the Geophysical Interpretation Map (Figures 10). The intensity of the conductors imaged by the Seattle, Washington transmitter (Figures 6 & 7) are greater than those induced by the Annapolis, Maryland transmitter (Figure 8 & 9). The Seattle VLF-EM total field contours (Figure 7) have a contour interval of 2.0 per cent whereas the Annaplois data is contoured at an interval of 1.0 per cent. The better Seattle response is more likely the result of a shorter transmission distance rather than improved geological coupling.

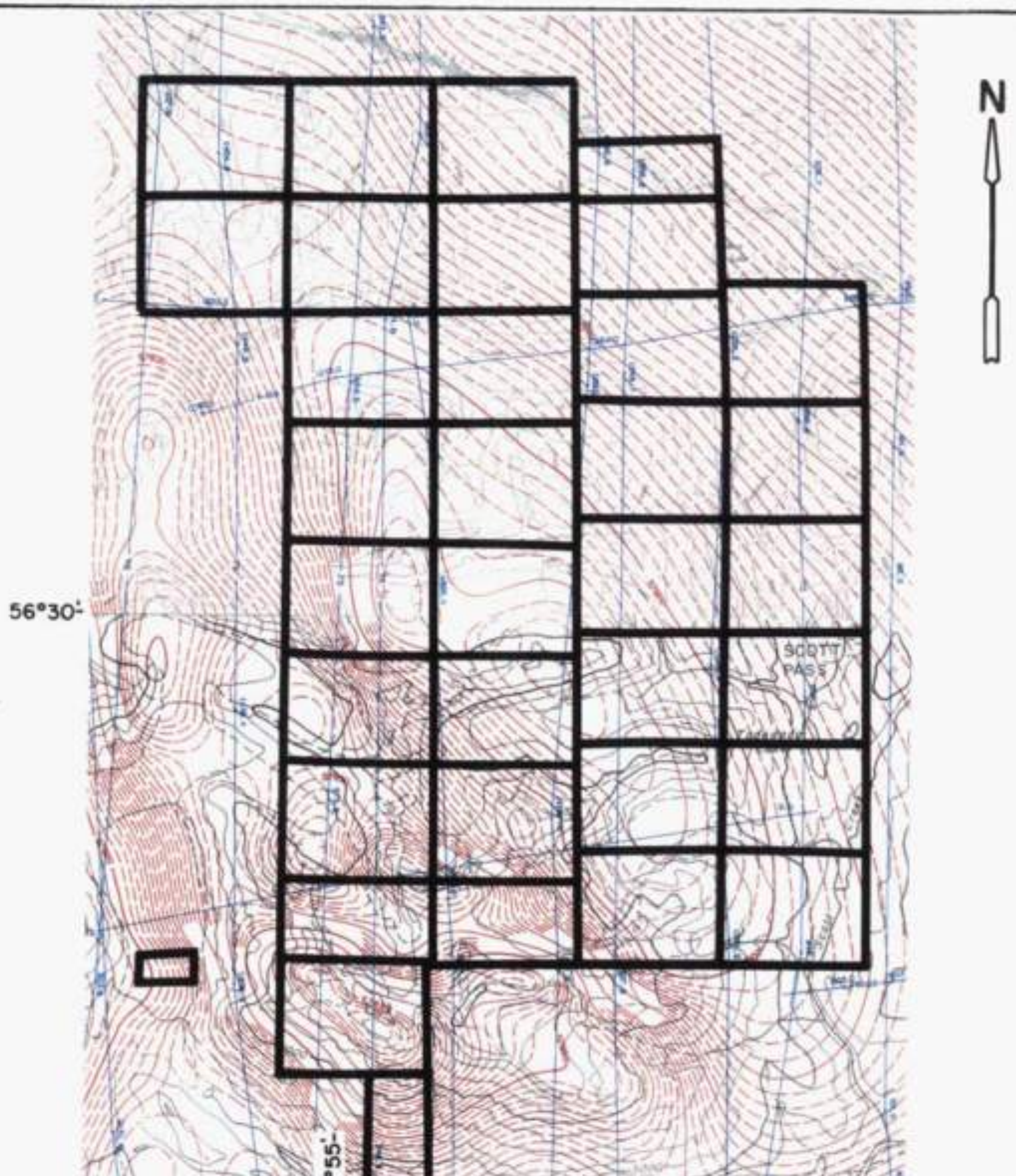
Good conductors exhibit strong in-phase crossovers, the quadrature usually lags by up to 90 degrees or mirrors the in-phase response, and the total field is a local high. Conversely, for poor conductors, the quadrature response nearly mimics the in-phase and there are no strong in-phase crossovers and, in some cases, no associated total field anomalies. Poor conductors may be associated with conductive overburden, weathered bedrock, and conductive effects in swampy areas. In airborne surveys the in-phase component is not recorded therefore conductors must be interpreted with only to total field and quadrature responses.

The profiled and contoured magnetic data (Figures 4 & 5) nearly mimics the published GSC magnetic data (Figure 3). From a central magnetic low (located around Todedada Glacier) there is a week magnetic gradient increasing to the north east where the contour lines trend NW-SE. The NE corner of the survey area, encompassing **Gil 5-8, 13 and 14 claims**, has an apparently featureless magnetic expression.

Two areas have been interpreted from the collected magnetic data as having potential geological contacts. In the SW corner of the survey, covering **Gil 2, 4, and 27 claims**, two contacts have been interpreted as possible boundaries with an igneous intrusion. The area within these interpreted contacts correspond to a local magnetic high. The northern contact, trending NW, spans Lines 40-48 and corresponds to a ridge line and may be a topographic "over-print". The southern interpreted contact, on **Gil 4**, spans Lines 52 and 53 correlates with an increase in surficial cover and vegetation on the airphoto.

A second area corresponding to a significant magnetic gradient has been interpreted as potential geologic contact within the volcanic and marine sedimentary rocks. This contact trends SE from Line 29 to 37 and turns perpendicular at conductor S15 to trend SW to Line 44.

The VLF-EM response on the survey area was as expected in an area of extreme topographic relief. Many strong conductors are primary due to topographic effects - corresponding to ridge lines. For example, along the east claim boundary of **Gil 17, 19, 25 and 27**, on Lines 28 to 40, conductors S27, A41 and A42 correspond to a NNW trending ridge line. Typically VLF-EM lows correspond to areas of deep glacial cover. Conductors associated



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GIL CLAIMS

AEROMAGNETIC MAP

N.T.S. 104A/5W & 12W

SCALE = 1:100 000

FIG.3

with glacier ice are aligned in areas following crevasses. The Author has interpreted these as topographic effects due to probable reduced ice thickness in these areas.

Conductors which intersect topographic features obliquely are numerous on the **Gil claims**. These "cross-cutting" conductors may be due to fault structures, mineralized zones, or lithological differences on the property. There are a number of conductors on the relative low lands on the east side of the property were topographic effects are less than the effects on the west side where high altitude, topographic extremes are encountered. East side conductors S1, S2-A1, S3, S4-A2, S9-A6, S5, S6, S7, S8-A8, A9, A11, A12, and west side conductors A28 and S19, between Lines 14 and 17, A16 and the northern half of S15, all appear to have minimal topographic "over-printing" and warrent further investigation. Additional west side conductors which warrent further study are those on the steep, southward facing slope immediately north of Todedada Glacier between Lines 22 and 25. The only oblique-to-topography conductor on the survey north of Gilbert Glacier are conductors A35 and S37 located on **Gil 36.**

CONCLUSIONS AND RECOMMENDATIONS

The **Gil** are located an area where the dominant lithology is a Middle Jurassic pyroclastic - epiclastic sequence which corresponds to the Betty Creek Formation (Grove, 1986). There is little magnetic relief except on the southwest quadrant of the survey area where elevated magnetic levels where recorded. Three geologic contacts, parallel to magnetic contours, have been interpreted in this area of magnetic relief. The southern two northwest trending contacts have been interpreted as corresponding to a small, more mafic intrusive body. To the northeast, the third potential contact may correspond to pyroclastic flow boundary or a contact between pyroclastic material to the southwest and more epiclastic material to the northeast. All three contacts may not be a result of a lithologic changes but due to changes in erosion cover and topographic relief.

Elsewhere, the magnetic response shows little influence of topographical features. This magnetic response may be due to sediments of a more marine than volcanic origin. Usually volcanic rocks have a higher mafic mineral content than marine sediments resulting in an elevated magnetic response.

Overall, the VLF-EM conductors recorded on the survey are correspond to topographical highs. VLF-EM lows typically correlate to glaciated areas. Significantly there are a number of conductors which trend at oblique angles to topographic features. The topographic, or structural, or lithological characteristics of these "cross-cutting" conductors should be evaluated.

The position and presence of the faults, geological contacts, and/or mineralization should be verified with the interpreted oblique-to-topography conductors on the **Gil claims**. A more complete picture of the local geology is necessary to interpret the geophysical data both lithologically and structurally. It is recommended that a follow-up search of all sources for additional geological information and past work on these and adjacent claims be undertaken. Subsequent to this search effort a program of geological mapping should be first undertaken on the areas where "cross-cutting" conductors are associated with good rock exposure. Following mapping of the west side conductors of interest, the east side conductors which occur in areas of significant overburden cover should be evaluated.

Following the study of available literature, past work, and the local mapping effort, the airborne data should be re-interpreted with the compiled geological information. A follow-up program of ground geophysical surveying should be completed over those airborne geophysical anomalies which correlate with mapped areas of mineralogical and geological interest.

Respectfully submitted,

Jeffrey C. Murton, B.Sc., P.Geoph.(APEGGA)

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STATEMENT OF QUALIFICATIONS

NAME:	MURTON, Jeff C.
PROFESSION:	Geophysicist
EDUCATION:	B.Sc - Geophysics Major University of British Columbia
PROFESSIONAL ASSOCIATIONS:	Society of Exploration Geophysicists Association of Professional Engineers, Geologists, and Geophysicists of Alberta
EXPERIENCE:	1984-88 - Geophysicist, Interactive Graphics with Western Geophysical Company of Canada Ltd. in Calgary, Alberta. 1988 - Geophysicist with White Geophysical Inc.

INSTRUMENT SPECIFICATIONS

BARRINGER AIRBORNE MAGNETOMETER

Model:	M 1041
Type:	Proton Precession
Range:	20,000 to 100,000 gammas
Accuracy:	+ 1 gamma at 24 V d.c.
Sensitivity:	1 gamma throughout range
Cycle Rates:	Manual: Pushbutton single cycle
	External: Actuated by a contact closure (short) longer than 10 microseconds
	Continuous: 1.114 seconds with external pins shorted
	Internal: 1 second to 3 minutes in 1 second steps
Outputs:	Analogue: 2 channels, 0 to 99 gammas or 0 to 990 gammas at 1 m.a. or 100 mV full scale deflection
	Digital: Parallel output 5 figure 1248 BCD, TTL compatible
	Visual: 5 digit numeric display directly in gammas
Size:	Instrument set in console
	19" x 3.5" x 10"
Weight:	10.6 lbs.
Power Requirements:	28 ± 5 volts dc, @ 1.5 amps - polarizing 4 amps
Detector:	Noise cancelling torroidal coil installed in air foil

INSTRUMENT SPECIFICATIONS

HERZ TOTEM - 2A VLF-EM SYSTEM

Primary Source:	Magnetic field component radiated from VLF radio transmitters (one or two simultaneously)
Parameters Measured:	Total field, vertical quadrature, horizontal quadrature and gradient
Frequency Range:	15 kHz to 25 kHz; front panel selectable for each channel in 100 Hz steps
Sensitivity Range:	130 µV m to 100 mV at 20 kHz, 3 dB down at 14 kHz and 24 kHz
VLF Signal Bandpass:	-3 dB at +/- 80 Hz; < 4% variation at ±50 Hz
Adjacent Channel Rejection:	300 to 800 Hz = 20 to 32 dB; 800 to 1500 Hz = 32 to 40 dB; > 1500 Hz > 40 dB (for < 2% noise envelope)
Out of Band Rejection:	10 kHz to 2.5 Hz = 5 x 10^{-4} Am to 5 x 10^{-1} Am < 2.5 kHz rising at 12 dB octave 30 kHz to 60 kHz = 5 x 10^{-4} Am to 8 x 10^{-3} Am > 60 kHz rising at 6 dB octave (for no overload condition)
Output Span:	±100% = ±1.0 V
Output Filter:	Time constant 1 sec. for 0% to 50% or 10% to 90% noise bandwidth 0.3 Hz (second order LP)
Internal Noise:	1.3 µV m rms (ambient noise will exceed this)
Sferics Filter:	Reduces noise contribution of impulse filter
Electric Field Rejection:	<0.5% error for 20 m tow cable
Controls:	Power switch, frequency selector switches (Line and Ortho), meter switch (Total Quad), and sferics filter switch
Displays:	Meters (Line and Ortho), sferics light, overhead light

HERZ TOTEM - 2A VLF-EM SYSTEM - PAGE 2

Inputs:	Power: 23 to 32 V DC; fused 0.5 Amps
	Signal: Sensor upper; sensor lower
Outputs	Total, quad, gradient, multiplexed (line and ortho)
	Audio monitor, stereo line and ortho
Dimensions and Weight:	Console: 480 mm wide x 45 mm high x 340 mm deep, 3.8 kg
	Sensor and Preamplifier Assembly: 150 mm diameter x 460 mm long, 1.5 kg

INSTRUMENT SPECIFICATIONS

DATA ACQUIISITION UNIT

Model:	HP-3852A
Mainframe Supports:	Eight function module slots
	Data acquisition operating system
	System timer
	Measurement pacer
	Full alphanumeric keyboard, command and result displays
Number of Channels:	20 channel relay multiplexer HP44708A/H
Voltmeter:	5½ to 3½ digit intergrating voltmeter HP44701A measures:

DC voltage

resistance

AC voltage

Range ±30V, ±0.008%, +300uV

Intergration Time 16.7 msec

Number of converted digits 6½

Reading rate (readings/ sec)	57
Min-Noise rejection (dB) Normal Mode Rejection at 60 Hz ±0.09%	60
DC Common Mode Rejection with 1 KΩ in low lead	120
Effective Common Mode Rejection at 60 Hz ±0.09% with 1 KΩ in low lead	150

Communication:	HPIB interface with Compaq
Power Requirements:	110/220 Volts AC at 60/50 Hz
Dimensions:	45.7 cm x 25.4 cm x 61.0 cm
Weight:	9.5 kg.

INSTRUMENT SPECIFICATIONS

CONTROLLER AND RECORDING SYSTEM - SPECIFICATIONS

Type:	Compaq Portable II
	An 80286 microprocessor
	640 Kbytes of RAM
	2 three and a half inch 720 Kbyte drives one 20-Megabyte fixed disk drive
	Monochrome, dual-mode, 9-inch internal monitor
	Asynchronous communications interface
	Parallel interface
	Composite-video monitor interface
	RGB monitor interface
	RF modulator interface
	Two expansion slots
	Real-time clock
	An 80287 coprocessor
	A HPIB Interface Card
Data Storage:	3 1/2 inch diskettes in ASCII
	Roland 1012 printer for printed output
	Beta I video cassettes
Power Requirements:	115 Volt AC at 60 Hz
Weight:	11 kg
Dimensions:	45 cm x 25 cm x 30 cm

INSTRUMENT SPECIFICATIONS

FLIGHT PATH RECOVERY SYSTEM

T.V. Camera:	Model: RCA TC2055 Vidicon
	Power Supply: 12 volt DC
	Lens: Variable, selected on basis of expected terrain clearance
	Mounting: Gimbal and shock mounted in housing, mounted on helicopter skid
Video Recorder:	Model: Sony SLO-340
	Power Supply: 12 volt DC / 120 volt AC (60Hz)
	Tape: Betamax ½" video cassette - optional length
	Dimensions: 30 cm X 13 cm X 35 cm
	Weight: 8.8 Kg
	Audio Input: Microphone in - 60 db low impedance microphone
	Video Input: 1.0 volt P-P, 75 unbalanced, sync negative from camera
Altimeter:	Model: King KRA-10A Radar Altimeter
	Power Supply: 0-25 volt (1 volt/1000 feet) DC signal to analogue meter, 0-10 v (4mv/ft) analogue signal to data acquisition unit
	Mounting: Fixed to T.V. camera housing, attached to helicopter skid

COST BREAKDOWN:

DESCRIPTION	TOTAL
Gil claims survey totals	
Mobilization and demobilization, 2 men, Brent Robertson and Gerald MacKenzie....................	$ 1 400.00
Airborne geophysical surveying (Feb 26,27 & Mar 7 1990) (474.7 km @ $61.81/km)	$29 340.00
Data processing and report charges	$18 125.00
Subtotal	**$48,865.00**