Report #11046

PROJECT REPORT OF THE AIRBORNE GEOPHYSICAL SURVEY

COLORADO RESOURCES LTD.

MAC PASS CLAIM GROUP
BEN CLAIM

EASTERN YUKON

DIGHEM SURVEY

NTS: 105O/1, 2, 3, 6, 7; 105P/4

Fugro Airborne Surveys Corp.
Mississauga, Ontario
November 30th, 2011

SUMMARY

This report describes the logistics, data acquisition, processing and presentation of results of a DIGHEM airborne geophysical survey carried out for Colorado Resources Ltd. over the Mac Pass Claim Group and the Ben Claim areas located in the eastern Yukon. The survey was flown from July 11th to August 4th, 2011. Total coverage of the survey blocks amounted to 3064.0 line-km.

The purpose of this airborne survey was to map the magnetic and conductive properties of the survey areas, and use these properties to detect possible zones of mineralization. This was accomplished by using a DIGHEM multi-coil, multi-frequency electromagnetic system, supplemented by a high sensitivity cesium magnetometer. A GPS electronic navigation system ensured accurate positioning of the geophysical data with respect to the base maps.

The survey data were processed and compiled in the Fugro Airborne Surveys Toronto office. Map products and digital data were provided in accordance with the scales and formats specified in the Survey Agreement.

The total field magnetic and apparent resistivity data sets have successfully mapped the magnetic and conductive characteristics of the lithologies in the survey areas.

Discrete EM anomalies have been interpreted from the electromagnetic data. They have been interpreted to fall within one of two general categories. The first type consists of discrete, well-defined anomalies, which are usually attributed to conductive sulphides or graphite. The second class of anomalies comprises moderately broad responses, which exhibit the characteristics of a half space. Some of these anomalies may reflect conductive rock units or zones of deep weathering.

The survey properties contain many anomalous features, some of which may be considered as exploration targets. Several anomalous zones appear to warrant further investigation using appropriate surface exploration techniques. Areas of interest may be assigned priorities on the basis of supporting geophysical, geochemical and/or geological information. After initial investigations have been carried out, it may be necessary to re-evaluate the remaining anomalies based on information acquired from the follow-up program.

It is recommended that the survey results be reviewed in detail, in conjunction with all available geophysical, geological and geochemical information. Image processing of existing geophysical data should be considered, in order to extract the maximum amount of information from the survey results.

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1. INTRODUCTION

A DIGHEM electromagnetic/resistivity/magnetic survey was flown for Colorado Resources Ltd. The survey was flown from July 11th to August 4th, 2011 over the Mac Pass Claim Group and the Ben Claim areas, located in the eastern Yukon. The survey areas are located on NTS map sheets 105 O/1, 2, 3, 6, 7 and 105 P/4 (Figure 2-1).

Survey coverage consisted of approximately 3064.0 line-km including 283.8 line-km of tie lines. Flight lines were flown with a line separation of 200 metres for both areas. Tie lines were flown perpendicular to the flight direction, with a line spacing of 2000 metres, also for both areas. The flight direction and breakdown of kilometres flown per block are given below in table 1-1.

Table 1-1 Survey Coverage

Block	Flight line direction	Tie line direction	Traverse Line (km)	Tie Line (km)	Total
Mac Pass Claim Group	30°/210°	120°/300°	2695.6	272.4	2968.0
Ben Claim	27°/207°	117°/297°	84.6	11.4	96.0
TOTAL			2780.2	283.8	3064.0

The survey employed the DIGHEM electromagnetic system. Ancillary equipment consisted of a high sensitivity cesium magnetometer, radar and laser altimeters, video camera, digital data recorder, and an electronic navigation system. The instrumentation was installed in an AS-350-B2 turbine helicopter (Registration C-GJIX) that was provided by Questral Helicopters Ltd. The helicopter flew with a nominal EM sensor height of approximately 35 metres.

Figure 1-1: Fugro Airborne Surveys DIGHEM EM Bird

2. SURVEY OPERATIONS

The survey areas are located on NTS map sheets 105 O/1, 2, 3, 6, 7 and 105 P/4 (Figure 2-1).

Table 2-1 lists the corner coordinates of the survey area in NAD83, UTM Zone 9N, central meridian 129°W.

Table 2-1 The Area Corners

Block	Corners	X-UTM (E)	Y-UTM (N)
11046-1	1	387150	7022700
Mac Pass	2	388150	7024432
Claim Group	3	388914	7023991
	4	389193	7024337
	5	390193	7026069
	6	391186	7025496
	7	391650	7026300
	8	391928	7026300
	9	392509	7027022
	10	392847	7026750
	11	403350	7026750
	12	403350	7026300
	13	406050	7026300
	14	406050	7025850
	15	407850	7025850
	16	407850	7025400
	17	410550	7025400
	18	410550	7024950
	19	414150	7024950
	20	414150	7016400
	21	415050	7016400
	22	415050	7015950
	23	415950	7015950
	24	415950	7015500
	25	416850	7015500
	26	416850	7015050
	27	418650	7015050
	28	418650	7014600
	29	419550	7014600
	30	419550	7013700
	31	417699	7013700

Block	Corners	X-UTM (E)	Y-UTM (N)
	32	415950	7010671
	33	415950	7009650
	34	416850	7009650
	35	416850	7008750
	36	422583	7008751
	37	423189	7009800
	38	423652	7009790
	39	423639	7009333
	40	423303	7008750
	41	424050	7008750
	42	424050	7007850
	43	426750	7007850
	44	426750	7007400
	45	427650	7007400
	46	427650	7006950
	47	430800	7006950
	48	430800	7004700
	49	432600	7004700
	50	432600	7004250
	51	434400	7004250
	52	434400	7003800
	53	433950	7003021
	54	433950	7001100
	55	434400	7001100
	56	434400	6999300
	57	438000	6999300
	58	438000	6997950
	59	438900	6997950
	60	438900	6997050
	61	439800	6997050
	62	439800	6993000
	63	430800	6993000
	64	430800	7000200
	65	429900	7000200
	66	429900	7001100
	67	429000	7001100
	68	429000	7001550
	69	428100	7001550
	70	428100	7002450

Block	Corners	X-UTM (E)	Y-UTM (N)
	71	427200	7002450
	72	427200	7002900
	73	426300	7002900
	74	426300	7003350
	75	425400	7003350
	76	425400	7003800
	77	424500	7003800
	78	424500	7004250
	79	423150	7004250
	80	423150	7005150
	81	415050	7005150
	82	415050	7010100
	83	411450	7010100
	84	411450	7010550
	85	405150	7010550
	86	405150	7011000
	87	399750	7011000
	88	399750	7011900
	89	397950	7011900
	90	397950	7014150
	91	392550	7014150
	92	392550	7017300
	93	391650	7017300
	94	391650	7018200
	95	390750	7018200
	96	390750	7018650
	97	389850	7018650
	98	389850	7019550
	99	388950	7019550
	100	388950	7020000
	101	388050	7020000
	102	388050	7020450
	103	387150	7020450
11046-2	1	447936	7000006
Ben Claim	2	451144	6998372
	3	449101	6994362
	4	445893	6995996

The survey specifications are given below in table 2-2.

Table 2-2 Survey Specifications

Parameter	Specifications
Sample interval (EM and magnetics)	10 Hz, 3.3 m @ 120 km/h
Aircraft mean terrain clearance	60 m
EM sensor mean terrain clearance	35 m
Mag sensor mean terrain clearance	35 m
Navigation (guidance)	±5 m, Real-time GPS
Post-survey flight path	±1 m, Differential GPS

The base of operations for the survey was established in Macmillan Pass for the duration of the survey flying.

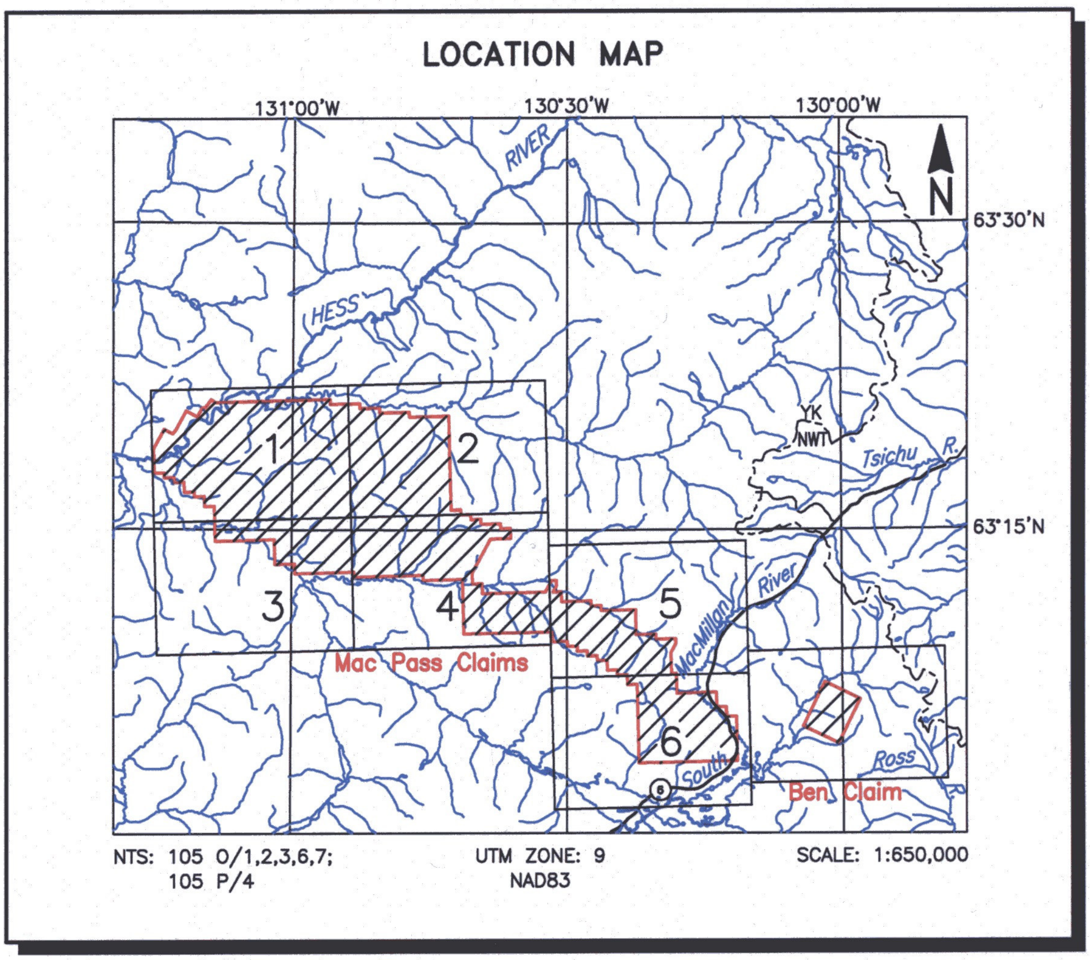


Figure 2-1
Location Map and Sheet Layout
Mac Pass Claim Group and Ben Claim Areas
Eastern Yukon
Job # 11046

3. SURVEY EQUIPMENT

This section provides a brief description of the geophysical instruments used to acquire the survey data and the calibration procedures employed. The geophysical equipment was installed in an AS-350-B2 turbine helicopter. This aircraft provided a safe and efficient platform for surveys of this type.

Electromagnetic System

Model: DIGHEM

Type: Towed bird, symmetric dipole configuration operated at a nominal survey altitude of 35 metres. Coil separation is 8 metres for 900 Hz, 1000 Hz, 5500 Hz and 7200 Hz, and 6.3 metres for the 56,000 Hz coil-pair.

Coil orientations, frequencies and dipole moments

Atm^2	orientation	nominal	actual
211	coaxial /	1000 Hz	1117 Hz
211	coplanar /	900 Hz	832 Hz
67	coaxial /	5500 Hz	5909 Hz
56	coplanar /	7200 Hz	7490 Hz
15	coplanar /	56 000 Hz	56 270 Hz

Channels recorded:
5 in-phase channels
5 quadrature channels
2 monitor channels

Sensitivity:
0.12 ppm at 1000 Hz Cx
0.12 ppm at 900 Hz Cp
0.24 ppm at 5500 Hz Cx
0.24 ppm at 7200 Hz Cp
0.44 ppm at 56 000 Hz Cp

Sample rate: 10 per second, equivalent to 1 sample every 3.3 m, at a survey speed of 120 km/h.

The electromagnetic system utilizes a multi-coil coaxial/coplanar technique to energize conductors in different directions. The coaxial coils are vertical with their axes in the flight direction. The coplanar coils are horizontal. The secondary fields are sensed simultaneously by means of receiver coils that are maximum coupled to their respective transmitter coils. The system yields an in-phase and a quadrature channel from each transmitter-receiver coil-pair.

In-Flight EM System Calibration

Calibration of the system during the survey uses the Fugro AutoCal automatic, internal calibration process. At the beginning and end of each flight, and at intervals during the flight, the system is flown up to high altitude to remove it from any "ground effect" (response from the earth). Any remaining signal from the receiver coils (base level) is measured as the zero level, and is removed from the data collected until the time of the next calibration. Following the zero level setting, internal calibration coils, for which the response phase and amplitude have been determined at the factory, are automatically triggered – one for each frequency. The on-time of the coils is sufficient to determine an accurate response through any ambient noise. The receiver response to each calibration coil "event" is compared to the expected response (from the factory calibration) for both phase angle and amplitude, and any phase and gain corrections are automatically applied to bring the data to the correct value.

In addition, the outputs of the transmitter coils are continuously monitored during the survey, and the gains are adjusted to correct for any change in transmitter output.

Because the internal calibration coils are calibrated at the factory (on a resistive half-space) ground calibrations using external calibration coils on-site are not necessary for system calibration. A check calibration may be carried out on-site to ensure all systems are working correctly. All system calibrations will be carried out in the air, at sufficient altitude that there will be no measurable response from the ground.

The internal calibration coils are rigidly positioned and mounted in the system relative to the transmitter and receiver coils. In addition, when the internal calibration coils are calibrated at the factory, a rigid jig is employed to ensure accurate response from the external coils.

Using real time Fast Fourier Transforms and the calibration procedures outlined above, the data are processed in real time, from measured total field at a high sampling rate, to in-phase and quadrature values at 10 samples per second.

Airborne Magnetometer

Model:	Fugro D1344 processor with Scintrex CS3 sensor
Type:	Optically pumped cesium vapour
Sensitivity:	0.01 nT
Sample rate:	10 per second

The magnetometer sensor is housed in the EM bird, 25 m below the helicopter.

Magnetic Base Station

Model:	CF1 base station with timing provided by integrated GPS	
Sensor type:	Scintrex CS2	
Counter specifications:	Accuracy:	±0.25 nT
	Resolution:	0.01 nT
	Sample rate	1 Hz
GPS specifications:	Model:	Marconi Allstar
	Type:	Code and carrier tracking of L1 band, 12-channel, C/A code at 1575.42 MHz
	Sensitivity:	-90 dBm, 1.0 second update
	Accuracy:	Manufacturer's stated accuracy for differential corrected GPS is 2 metres

Environmental
Monitor specifications: Temperature:

- Accuracy: ±1.5°C max
- Resolution: 0.0305°C
- Sample rate: 1 Hz
- Range: -40°C to +75°C

Barometric pressure:

- Model: Motorola MPXA4115A
- Accuracy: ±3.0° kPa max (-20°C to 105°C temp. ranges)
- Resolution: 0.013 kPa
- Sample rate: 1 Hz
- Range: 55 kPa to 108 kPa

Backup

Model:	GEM Systems GSM-19
Type:	Digital recording proton precession
Sensitivity:	0.10 nT
Sample rate:	3 second intervals

A digital recorder is operated in conjunction with the base station magnetometer to record the diurnal variations of the earth's magnetic field. The clock of the base station is synchronized with that of the airborne system, using GPS time, to permit subsequent removal of diurnal drift. The CF1 was the primary magnetic base station. The location of the primary base station is given below in table 3-1.

Table 3-1 Magnetic Base Station Location

Status	Location Name	WGS84 Latitude	WGS84 Longitude	Date Set Up
Primary	Mac Pass	N63 05 58.99974	W130 12 46.51958	13-Jul-11

Navigation (Global Positioning System)

Airborne Receiver

Model:	Novatel OEM4/V
Type:	Code and carrier tracking of L1-C/A code at 1575.42 MHz and L2-P code at 1227.0 MHz. 24-channel
Sample rate:	0.5 second update
Accuracy:	Better than 1 metre in differential mode
Antenna:	mounted on the tail of the aircraft

Primary Base Station for Post-Survey Differential Correction

Model:	Novatel OEM4/V
Type:	Code and carrier tracking of L1-C/A code at 1575.42 MHz and L2-P code at 1227.0 MHz, 24-channel
Sample rate:	0.5 second update
Accuracy:	Manufacturer's stated accuracy for differential corrected GPS is better than 1 metre

Secondary GPS Base Station

Model:	Marconi Allstar OEM, CMT-1200, part of CF1 base station
Type:	Code and carrier tracking of L1 band, 12-channel, C/A code at 1575.42 MHz
Sensitivity:	-90 dBm, 1.0 second update
Accuracy:	Manufacturer's stated accuracy for differential corrected GPS is 2 metres

The Novatel OEM4 is a line of sight, satellite navigation system that utilizes time-coded signals from at least four of forty-eight available satellites. Both Russian GLONASS and American NAVSTAR satellite constellations are used to calculate the position and to provide real time guidance to the helicopter. A Novatel OEM4 GPS unit was also used as the primary base station. A Marconi Allstar GPS unit, part of the CF-1, was used as the secondary base station. The mobile and base station raw XYZ data were recorded, thereby permitting post-survey differential corrections for theoretical accuracies of better than 1 metre. Each base station receiver is able to calculate its own latitude and longitude. The locations of the base stations are given below in table 3-2.

Table 3-2 GPS Base Station Locations

Status	Location Name	WGS84 Latitude	WGS84 Longitude	Orthometric Height (m)	Date Set Up
Primary	Mac Pass	63 05 59.22527	130 12 46.44419	1138.510	13-Jul-11
Secondary	Mac Pass	63 05 58.99974	130 12 46.51958	1134.655	13-Jul-11

The GPS records data relative to the WGS84 ellipsoid, which is the basis of the revised North American Datum (NAD83). Conversion software is used to transform the WGS84 coordinates to the UTM system displayed on the maps.

Radar Altimeter

Manufacturer: Honeywell/Sperry
Model: RT300/AT220
Type: Short pulse modulation, 4.3 GHz
Sensitivity: 0.3 m
Sample rate: 2 per second

The radar altimeter measures the vertical distance between the helicopter and the ground.

Laser Altimeter

Manufacturer: Optech
Model: ADMGPA100
Type: Fixed pulse repetition rate of 2 kHz
Sensitivity: ±5 cm from 10ºC to 30ºC
±10 cm from -20ºC to +50ºC

Sample rate: 2 per second

The laser altimeter is housed in the EM bird, and measures the distance from the EM bird to ground, except in areas of dense tree cover.

Barometric Pressure and Temperature Sensors

Model: DIGHEM D1300
Type: Motorola MPX4115AP analog pressure sensor
AD592AN high-impedance remote temperature sensors
Sensitivity: Pressure: 150 mV/kPa
Temperature: 100 mV/°C or 10 mV/°C (selectable)

Sample rate: 10 per second

The D1300 circuit is used in conjunction with one barometric sensor and up to three temperature sensors. Two sensors (baro and temp) are installed in the EM console in the aircraft, to monitor pressure (1KPA) and internal operating temperatures (2TDC).

Digital Data Acquisition System

Manufacturer:	Fugro
Model:	HELIDAS
Recorder:	Compact Flash Card

The stored data are downloaded to the field workstation PC at the survey base, for verification, backup and preparation of in-field products.

Video Flight Path Recording System

Type:	Panasonic WVCD/32 Colour camera
Recorder:	Axis 241S video server and tablet computer

Fiducial numbers are recorded continuously and are displayed on the margin of each image. This procedure ensures accurate correlation of data with respect to visible features on the ground.

4. QUALITY CONTROL AND IN-FIELD PROCESSING

Digital data for each flight were transferred to the field workstation, in order to verify data quality and completeness. A database was created and updated using Geosoft Oasis Montaj and proprietary Fugro Atlas software. This allowed the field personnel to calculate, display and verify both the positional (flight path) and geophysical data on a screen or printer. The initial database was examined as a preliminary assessment of the data acquired for each flight.

In-field processing of Fugro survey data consists of differential corrections to the airborne GPS data, verification of EM calibrations, drift correction of the raw airborne EM data, spike rejection and filtering of all geophysical and ancillary data, verification of the digital flight path recordings, calculation of preliminary resistivity data, diurnal correction, and preliminary levelling of magnetic data.

All data, including base station records, were checked on a daily basis to ensure compliance with the survey contract specifications. Reflights were required if any of the following specifications were not met.

Navigation

A specialized GPS system provided in-flight navigation control. The system determined the absolute position of the helicopter by monitoring the range information of twelve channels (satellites). Novatel's OEM4/V receiver was used for this application. The OEM4/V receiver is WAAS-enabled (Wide Area Augmentation System) providing better real-time positioning.

A Novatel OEM4 GPS base station was used that recorded pseudo-range, carrier phase, ephemeris, and timing information for up to 12 NAVSTAR GPS satellites at a one second interval. Recording was via flash disk.

Flight Path

The flight lines did not deviate from the intended flight path by more than 25% of the planned flight path over a distance of more than 1 kilometre. Flight specifications were based on GPS positional data recorded at the helicopter.

Clearance

Survey elevations did not deviate by more than +/- 20% over a distance of 2 kilometres from the contracted elevation.

Survey elevation is defined as the measurement of the helicopter radar altimeter to the tallest obstacle in the helicopter path. An obstacle is any structure or object which will impede the path of the helicopter to the ground and is not limited to and includes tree canopy, towers and power lines.

Survey Elevations may vary based on the pilot's judgment of safe flying conditions around man-made structures or in rugged terrain.

Flying Speed

Nominal aircraft indicated airspeed was between 55 to 80 knots, the nominal aircraft ground speed was approximately 3 to 5 metres per sample at 10 Hz sampling.

Airborne High Sensitivity Magnetometer

The non-normalized 4th difference will not exceed 1.6 nT over a continuous distance of 1 kilometre excluding areas where this specification is exceeded due to natural anomalies.

Magnetic Base Station

The ground magnetometers are generally placed within 50 kilometres of the centre of the survey area and in regions of low magnetic gradient. They were sited away from moving steel objects, vehicles or power transmission lines.

For acceptance of the magnetic data, non-linear variations in the magnetic diurnal should not exceed 10 nT per minute.

Electromagnetic Data

Reflights will result when peak to peak noise envelopes of the EM channels exceeds the specified tolerance continuously over a horizontal distance of 2,000 metres under normal survey conditions. The approximate tolerances by frequency and coil orientation are given below in table 4-1.

Table 4-1 The EM System Noise Specifications

Nominal Frequency (Hz)	Coil Orientation	Peak-to-Peak Noise Envelope (ppm)
1000	coaxial	5
900	coplanar	10
5500	coaxial	10
7200	coplanar	20
56,000	coplanar	40

Spherics

If the frequency of spherics events affected the quality of the electromagnetic data as it was being processed by the acquisition system in real time, survey flying was suspended. Flying was not performed when spherics became sufficiently intense and frequent that digital data processing techniques could not recover useful data.

The Dighem EM system includes two spheric/powerline channels for noise monitoring. Most spheric activity is susceptible to reduction by post-survey filtering to less than 2.0 ppm.

Spheric pulses may occur having strong peaks but narrow widths. The EM data are considered acceptable when their occurrence is less than 10 spheric events exceeding the stated noise specification for a given frequency per 100 samples continuously over a distance of 2,000 meters.

5. DATA PROCESSING

Appendix C depicts the data processing flow for the electromagnetic and magnetic datasets.

Flight Path Recovery

The raw range data from at least four satellites are simultaneously recorded by both the base and mobile GPS units. The geographic positions of both units, relative to the model ellipsoid, are calculated from this information. Differential corrections, which are obtained from the base station, are applied to the mobile unit data to provide a post-flight track of the aircraft, accurate to within 1 metre. Speed checks of the flight path are also carried out to determine if there are any spikes or gaps in the data.

The corrected WGS84 latitude/longitude coordinates are transformed to the UTM coordinate system used on the final maps. Images or plots are then created to provide a visual check of the flight path.

Electromagnetic Data

EM data are processed at the recorded sample rate of 10 samples/second. Spheric rejection median and Hanning filters are then applied to reduce noise to acceptable levels.

The EM data are examined to allow the interpreter to select the most appropriate EM anomaly picking controls for a given survey area. The EM picking parameters depend on several factors but are primarily based on the dynamic range of the resistivities within the survey area, and the types and expected geophysical responses of the targets being sought.

Anomalous electromagnetic responses are selected and analysed by computer to provide preliminary electromagnetic anomaly picks. The automatic selection algorithm is intentionally oversensitive to assure that no meaningful responses are missed. Using the preliminary picks in conjunction with the profile data, the interpreter then classifies the anomalies according to their source and eliminates those that are not substantiated by the data. The final interpreted EM anomalies include bedrock, surficial and cultural conductors and are defined based on typical HEM anomaly shapes, which are defined in Appendix B, figure B-1. The types of conductors interpreted from the EM data are given below in table 5-1.

Table 5-1 EM Anomaly Interpretation

Interpretation Symbol	Conductor Model
D	Narrow bedrock conductor (“vertical or dipping thin dyke”)
B	Bedrock conductor
S	Conductive cover (“horizontal thin sheet”)
H	Broad conductive rock unit, deep conductive weathering, thick conductive cover (“half space”)
E	Edge of broad conductor (“edge of a half space”)
“?”	Indicates some degree of uncertainty as to which is the most appropriate EM source model, but does not question the validity of the EM anomaly

The anomalies shown on the electromagnetic anomaly map are based on a near-vertical, half plane model. This model best reflects "discrete" bedrock conductors. Wide bedrock conductors or flat-lying conductive units, whether from surficial or bedrock sources, may give rise to very broad anomalous responses on the EM profiles. These may not appear on the electromagnetic anomaly map if they have a regional character rather than a locally anomalous character.

These broad conductors, which more closely approximate a half-space model, will be maximum coupled to the horizontal (coplanar) coil-pair and should be more evident on the resistivity parameter. Resistivity maps, therefore, may be more valuable than the electromagnetic anomaly maps, in areas where broad or flat-lying conductors are considered to be of importance.

Excellent resolution and discrimination of conductors was accomplished by using a fast sampling rate of 0.1 sec and by employing a “common” frequency (5500/7200 Hz) on two orthogonal coil-pairs (coaxial and coplanar). The resulting difference channel parameters often permit differentiation of bedrock and surficial conductors, even though they may exhibit similar conductance values. For any Fugro multi-component helicopter frequency domain EM system (HFEM), the difference channel is a calculated product to assist interpretation of discrete conductor targets. There is one each for the in-phase and quadrature components of the EM channels, called DIFI and DIFQ.

The difference channel is a parameter used to quantify the difference between the coaxial and coplanar response, to help distinguish which conductivity changes are caused by flat-lying conductors (like swamps) or changes in the layered earth (with a 1:4 ratio between CX and CP), and which anomalies are caused by discrete conductive bodies (ideally with a 1:1 CX to CP ratio). The difference between the CP and CX for both in-phase and quadrature EM data is calculated everywhere, weighted to adjust the response for the geometric difference as well as differences in coil separation. For a flat-lying or halfspace (thick, flat-lying) conductor, the difference channel (DIFI or DIFQ) will be near zero, as it will over background areas (a layered earth). For a discrete conductor like a vertical thin dike, the difference channel will have a positive value. In practice the value will be somewhat variable, dependent on the shape and thickness of the conductor and the conductivity of the host rock. Because it is a difference, not a ratio, the amplitude of the difference channel over a discrete conductor will depend on the strength of the anomaly, but it will remain near zero for the flat-lying targets.

Anomalies that occur near the ends of the survey lines (i.e., outside the survey area) should be viewed with caution. Some of the weaker anomalies could be due to aerodynamic noise, i.e., bird bending, which is created by abnormal stresses to which the bird is subjected during the climb and turn of the aircraft between lines. Such aerodynamic noise is usually manifested by an anomaly on the coaxial in-phase channel only, although severe stresses can affect the coplanar in-phase channels as well.

The EM anomalies resulting from this survey appear to fall within one of two general categories. The first type consists of discrete, well-defined anomalies that yield marked inflections on the difference channels. These anomalies are usually attributed to conductive sulphides or graphite and are generally given a "B" (bedrock), "D" (vertical or dipping thin dyke) or "T" (vertical or dipping thick dyke) interpretive symbol, all denoting a bedrock source. EM anomalies that do not display the classic anomaly shape of the “thin dyke” model, but are considered to reflect sources at depth are generally given a “B” interpretation. The “T” anomaly is a very specific anomaly type, and is generally not used unless the specific criteria defined in figure B-1 of appendix B are met. No “T” anomalies were identified within this survey area.

The second class of anomalies comprises moderately broad responses that exhibit the characteristics of a half-space and do not yield well-defined inflections on the difference channels. Anomalies in this category are usually given an "S" or "H" interpretive symbol. The lack of a difference channel response usually implies a broad or flat-lying conductive source such as overburden. Some of these anomalies could reflect conductive rock units, zones of deep weathering, or the weathered tops of kimberlite pipes, all of which can yield “non-discrete” signatures.

The effects of conductive overburden are evident over portions of the survey area. Although the difference channels (DIFI and DIFQ) are extremely valuable in detecting bedrock conductors that are partially masked by conductive overburden, sharp undulations in the bedrock/overburden interface can yield anomalies in the difference channels which may be interpreted as possible bedrock conductors. Such anomalies usually fall into the "S?" or "B?" classification but may also be given an "E" interpretive symbol, denoting a resistivity contrast at the edge of a conductive unit.

The "?" symbol does not question the validity of an anomaly, but instead indicates some degree of uncertainty as to which is the most appropriate EM source model. This ambiguity results from the combination of effects from two or more conductive sources, such as overburden and bedrock, gradational changes, or moderately shallow dips. The presence of a conductive upper layer has a tendency to mask or alter the characteristics of bedrock conductors, making interpretation difficult. This problem is further exacerbated in the presence of magnetite.

In areas where EM responses are evident primarily on the quadrature components, zones of poor conductivity are indicated. Where these responses are coincident with magnetic anomalies, it is possible that the in-phase component amplitudes have been suppressed by the effects of magnetite. Poorly-conductive magnetic features can give rise to resistivity anomalies that are only slightly below or slightly above background. If it is expected that poorly-conductive economic mineralization could be associated with magnetite-rich units, most of these weakly anomalous features will be of interest. In areas where magnetite causes the in-phase components to become negative, the apparent conductance and depth of EM anomalies will be unreliable. Magnetite effects usually give rise to overstated (higher) resistivity values and understated (shallow) depth calculations.

It is impractical to assess the relative merits of EM anomalies on the basis of conductance. It is recommended that an attempt be made to compile a suite of geophysical "signatures" over any known areas of interest. Anomaly characteristics are clearly defined in the profile data of the EM channels.

Apparent Resistivity

The apparent resistivities in ohm-m are generated from the in-phase and quadrature EM components for all of the coplanar frequencies, using a pseudo-layer half-space model. The inputs to the resistivity algorithm are the in-phase and quadrature amplitudes of the secondary field. The algorithm calculates the apparent resistivity in ohm-m, and the apparent height of the bird above the conductive source. Any difference between the apparent height and the true height, as measured by the radar altimeter, is called the pseudo-layer and reflects the difference between the real geology and a homogeneous halfspace. This difference is often attributed to the presence of a highly resistive upper layer. Any errors in the altimeter reading, caused by heavy tree cover, are included in the pseudo-layer and do not affect the resistivity calculation. The apparent depth estimates, however, will reflect the altimeter errors. Apparent resistivities calculated in this manner may differ from those calculated using other models.

In areas where the effects of magnetic permeability or dielectric permittivity have suppressed the in-phase responses, the calculated resistivities will be erroneously high. Various algorithms and inversion techniques can be used to partially correct for the effects of permeability and permittivity. No corrections for permeability and permittivity were made to the data for this survey.

The apparent resistivity parameters portray all of the information for a given frequency over the entire survey area. This full coverage contrasts with the electromagnetic anomalies, which provide information only over interpreted conductors. The large dynamic range afforded by the multiple frequencies makes the apparent resistivity parameter an excellent mapping tool.

The preliminary apparent resistivity images are carefully inspected to identify any lines or line segments that might require base level adjustments. Subtle changes between in-flight calibrations of the system can result in line-to-line differences that are more recognizable in resistive (low signal amplitude) areas. If required, manual level adjustments are carried out to eliminate or minimize resistivity differences that can be attributed, in part, to changes in operating temperatures. These levelling adjustments are usually very subtle, and do not result in the degradation of discrete anomalies.

After the manual levelling process is complete, revised resistivity grids are created. The resulting grids can be subjected to a microlevelling technique in order to smooth the data for contouring. The coplanar resistivity parameter has a broad 'footprint' that requires very little filtering.

Apparent resistivity maps, which display the conductive properties of the survey area, were produced from the 900 Hz, 7200 Hz and 56 000 Hz coplanar data. Maximum resistivity values are calculated for each frequency. These cutoffs eliminate the erratic higher resistivities that would result from unstable ratios of very small EM amplitudes.

Residual Magnetic Field

A Fugro CF-1 cesium vapour magnetometer was operated at the survey base 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 permit subsequent removal of diurnal drift.

A fourth difference editing routine was applied to the magnetic data to remove any spikes.

The aeromagnetic data were corrected for measured system lag, and then adjusted for regional variations (or IGRF gradient, 2010, updated to the date of data acquisition and adjusted for altimeter variations). The data were then corrected for diurnal variations by subtraction of the digitally recorded base station magnetic data. The results were then levelled using tie and traverse line intercepts. Manual adjustments were applied to any lines that required levelling, as indicated by shadowed images of the gridded magnetic data. The manually levelled data were then subjected to a microlevelling filter. The gridded data show the magnetic properties of the rock units underlying the survey areas.

If a specific magnetic intensity can be assigned to the rock type that is believed to host the target mineralization, it may be possible to select areas of higher priority on the basis of the total field magnetic data. This is based on the assumption that the magnetite content of the host rocks will give rise to a limited range of contour values that will permit differentiation of various lithological units. Structural complexities are evident on the images as variations in magnetic intensity, irregular patterns, and as offsets or changes in strike direction.

The magnetic results, in conjunction with the other geophysical parameters, have provided valuable information that can be used to effectively map the geology and structure in the survey areas.

Calculated Vertical Magnetic Gradient (First Vertical Derivative)

The diurnally-corrected, IGRF-corrected magnetic data were subjected to a processing algorithm that enhances the response of magnetic bodies in the upper 500 metres and attenuates the response of deeper bodies. The resulting vertical gradient grid provides better definition and resolution of near-surface magnetic units. It also identifies weak magnetic features that may not be quite as evident in the total field data. Regional magnetic variations and changes in lithology, however, may be better defined on the total magnetic field parameter.

Digital Elevation

The laser altimeter values (ALTLAS_BIRD – EM bird to ground clearance) are subtracted from the differentially corrected and de-spiked GPS-Z values to produce profiles of the height above the ellipsoid along the survey lines. These values are gridded to produce contour maps showing approximate elevations within the survey area. The calculated digital terrain data are then tie-line levelled and adjusted to mean sea level. Any remaining subtle line-to-line discrepancies are manually removed. After the manual corrections are applied, the digital terrain data are filtered with a microlevelling algorithm.

The accuracy of the elevation calculation is directly dependent on the accuracy of the two input parameters, ALTLAS_BIRD and GPS-Z. The ALTLAS_BIRD value may be erroneous in areas of heavy tree cover, where the altimeter reflects the distance to the tree canopy rather than the ground. The GPS-Z value is primarily dependent on the number of available satellites. Although post-processing of GPS data will yield X and Y accuracies in the order of 1-2 metres, the accuracy of the Z value is usually much less, sometimes in the ±10 metre range. Further inaccuracies may be introduced during the interpolation and gridding process.

Because of the inherent inaccuracies of this method, no guarantee is made or implied that the information displayed is a true representation of the height above sea level. Although this product may be of some use as a general reference, <u>THIS PRODUCT MUST NOT BE USED FOR NAVIGATION PURPOSES.</u>

Contour, Colour and Shadow Map Displays

The magnetic and resistivity data are interpolated onto a regular grid using a modified Akima spline technique. The resulting grid is suitable for image processing and generation of contour maps. The grid cell size is 20% of the line interval.

Colour maps are produced by interpolating the grid down to the pixel size. The parameter is then incremented with respect to specific amplitude ranges to provide colour "contour" maps.

6. PRODUCTS

This section lists the final maps and products that have been provided under the terms of the survey agreement. Other products can be prepared from the existing dataset, if requested. These include magnetic enhancements or derivatives, percent magnetite, resistivities corrected for magnetic permeability and/or dielectric permittivity, digital terrain, resistivity-depth sections, inversions, and overburden thickness. Most parameters can be displayed as contours, profiles, or in colour.

Base Maps

Base maps of the survey areas were produced by scanning published topographic maps to a bitmap (.bmp) format. This process provides a relatively accurate, distortion-free base that facilitates correlation of the navigation data to the map coordinate system. The topographic files were combined with geophysical data for plotting some of the final maps. All maps were created using the following parameters:

<u>Projection Description</u>:

Datum:	NAD83
Ellipsoid:	GRS80
Projection:	UTM (Zone: 9N)
Central Meridian:	129°W
False Northing:	0
False Easting:	500000
Scale Factor:	0.9996
WGS84 to Local Conversion:	Molodensky
Datum Shifts:	DX: 0 DY: 0 DZ: 0

Maps depicting the survey results have been provided at a scale of 1:20 000 as listed in Table 6-1. Each Parameter is plotted on 6 map sheets for the Mac Pass Claim Group area, and a single map sheet for the Ben Claim area. The final digital archives are provided on DVD. Both line data and grid archives are provided in Geosoft format.

Table 6-1 Survey Products

Final Map Product	No. of Colour Map Sets
EM Anomalies with interpretation	2
Residual Magnetic Intensity	2
Calculated Vertical Magnetic Gradient	2
Apparent Resistivity 900 Hz	2
Apparent Resistivity 7200 Hz	2
Apparent Resistivity 56 000 Hz	2

Additional Products

Digital Archive (see Archive Description)	1 DVD
Survey Report	PDF format on archive DVD, 2 paper copies
Flight Path Video	all flights in .BIN/.BDX format on DVD with viewer
Final colour maps	all products, in Geosoft map format

7. SURVEY RESULTS

Tables 7-1 and 7-2 summarize the discrete EM anomaly responses interpreted from the survey data with respect to conductance grade and interpretation for the survey areas. The anomalies are listed in .PDF format and archived in XYZ format on the final archive DVD.

Interpretation maps at a scale of 1:20 000, which include the EM anomalies, accompany this report. Prominent magnetic and conductive zones have been outlined in red or blue, respectively. Linear features that have been interpreted from either the magnetic or resistivity data, and which may reflect possible structural breaks within the survey area, are shown with a dashed green line.

Mac Pass Claim Group

The western portion of the Mac Pass Claim Group survey area is dominated by a highly conductive zone, R1. It seems to reflect a broad conductive unit, which is made up of multiple, closely spaced, thin conductive trends. The conductivity associated with R1 seems to reflect sources at depth, as the low frequency resistivities are generally lower than those calculated from the high frequency. The changes in the calculated resistivities one frequency to another, gives an approximation of the subsurface. Conductivity depth sections, such as differential resistivity sections as shown below, may be useful in defining the characteristics of complex conductive units such as R1. Two cross sections of R1, based on the differential resistivity calculation are shown below for lines 10130 and 10500. Differences in depth to conductor, and change in conductivity with depth are readily apparent.

Line 10500 displays resistivities that are much closer in value over the three coplanar frequencies, suggesting that all frequencies are seeing the same highly conductive, thick conductive unit. Line 10130, displays much higher resistivities on the high frequency, suggesting the source of the conductivity has a deeper source, identified on the low, 900 Hz frequency.

TABLE 7-1 EM ANOMALY STATISTICS
Mac Pass Claim Group
Eastern Yukon
Job # 11046-1

CONDUCTOR GRADE	CONDUCTANCE RANGE SIEMENS (MHOS)	NUMBER OF RESPONSES
7	>100	124
6	50 - 100	164
5	20 - 50	441
4	10 - 20	683
3	5 - 10	1057
2	1 - 5	6529
1	<1	2246
*	INDETERMINATE	257
TOTAL		11501

CONDUCTOR MODEL	MOST LIKELY SOURCE	NUMBER OF RESPONSES
D	DISCRETE BEDROCK CONDUCTOR (THIN DYKE MODEL)	1392
B	BEDROCK CONDUCTOR	6460
S	CONDUCTIVE COVER	3524
E	EDGE OF WIDE CONDUCTOR	10
H	ROCK UNIT OR THICK COVER	115
TOTAL		11501

TABLE 7-2 EM ANOMALY STATISTICS
Ben Claim
Eastern Yukon
Job # 11046-2

CONDUCTOR GRADE	CONDUCTANCE RANGE SIEMENS (MHOS)	NUMBER OF RESPONSES
7	>100	10
6	50 - 100	16
5	20 - 50	35
4	10 - 20	42
3	5 - 10	55
2	1 - 5	166
1	<1	129
*	INDETERMINATE	12
TOTAL		465

CONDUCTOR MODEL	MOST LIKELY SOURCE	NUMBER OF RESPONSES
D	DISCRETE BEDROCK CONDUCTOR (THIN DYKE MODEL)	41
B	BEDROCK CONDUCTOR	390
S	CONDUCTIVE COVER	34
TOTAL		465

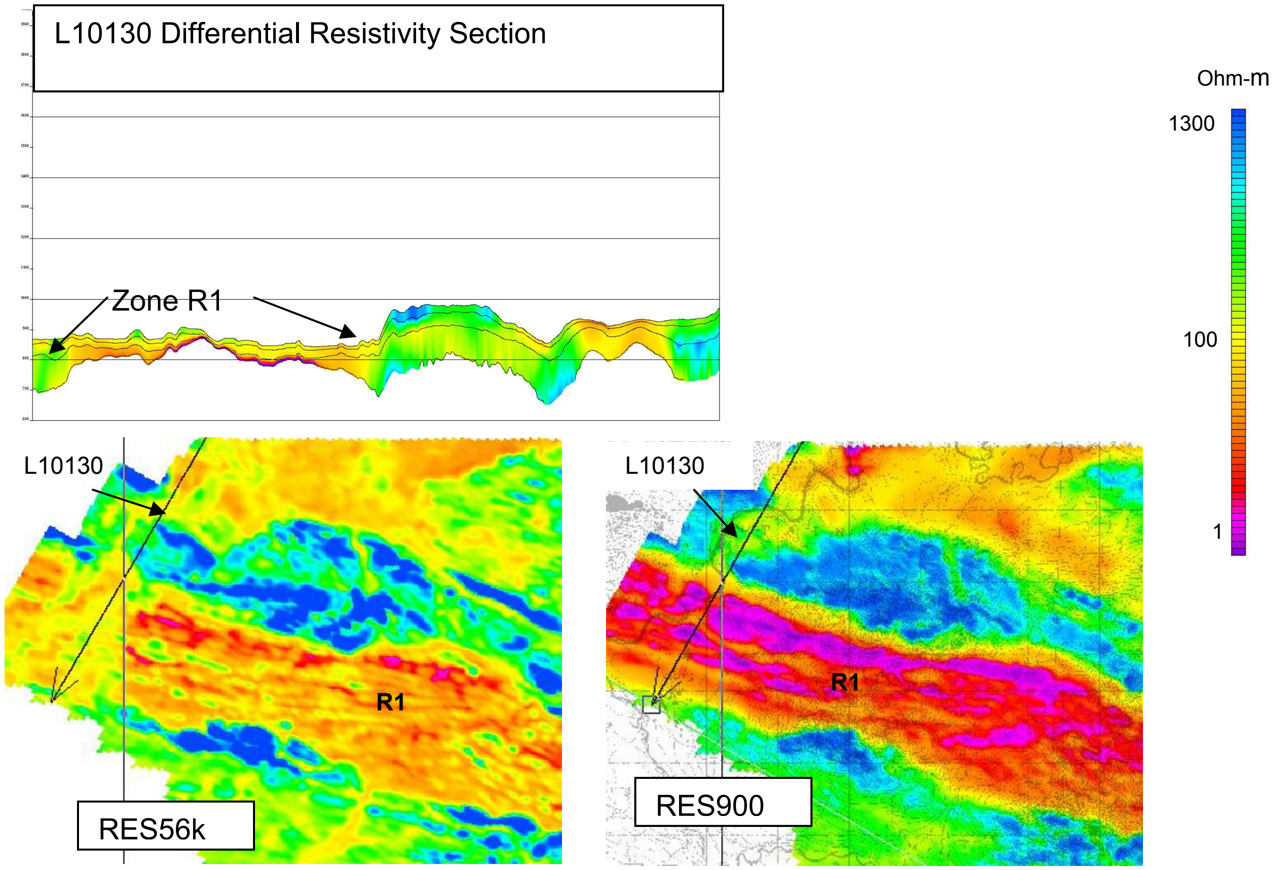


Figure 7-1 Line 10130

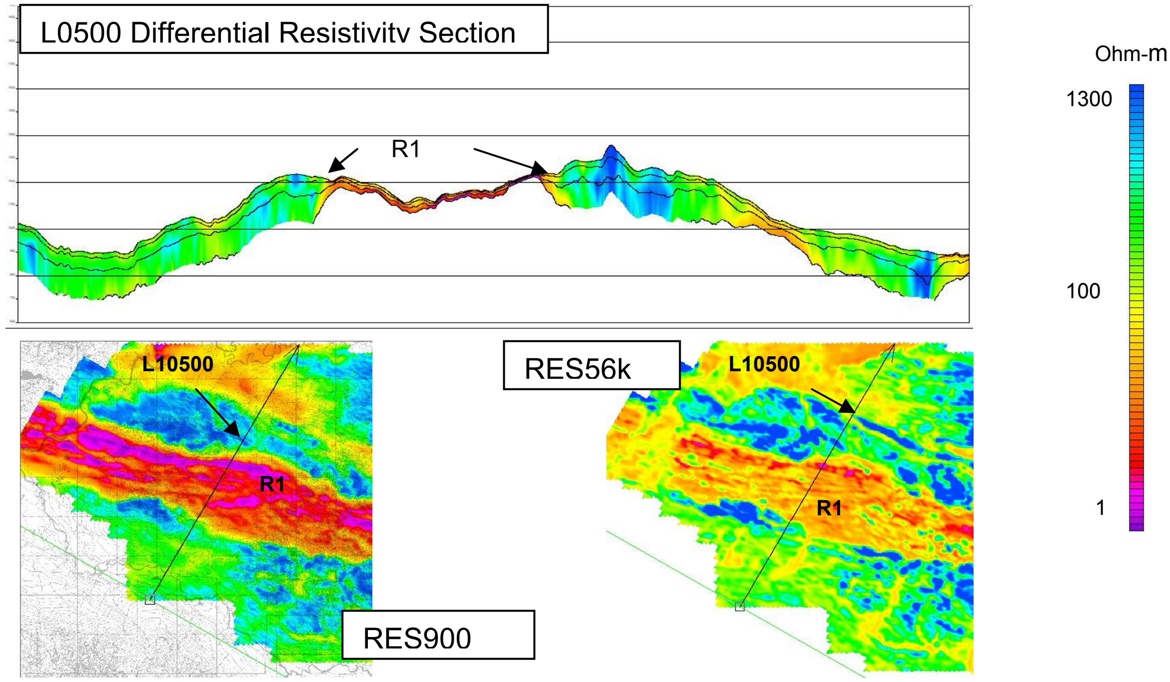


Figure 7-2 Line 10500

R1 displays some correlation with the magnetic data, as many of the possible breaks identified on the magnetic parameters are also on the resistivity parameters. Several moderately magnetic units, M1, M2 and M3, are situated near the edges of conductive zone R1 on sheet 1. All are situated in areas of complexity in the magnetic data, as many prominent breaks are evident in the vicinity of all three magnetic zones. M1 is situated at the northern limit of R1. It is interesting as it seems to be part of an oval shaped magnetic feature defined on the calculated first vertical magnetic derivative map, the outline of which is shown below in Figure 7-3.

M5, which is situated on sheet 2, differs from M1, M2 and M3 as it is situated within R1 rather than near the edge of the zone. It is coincident with a resistive zone within R1 which is associated with a topographic high.

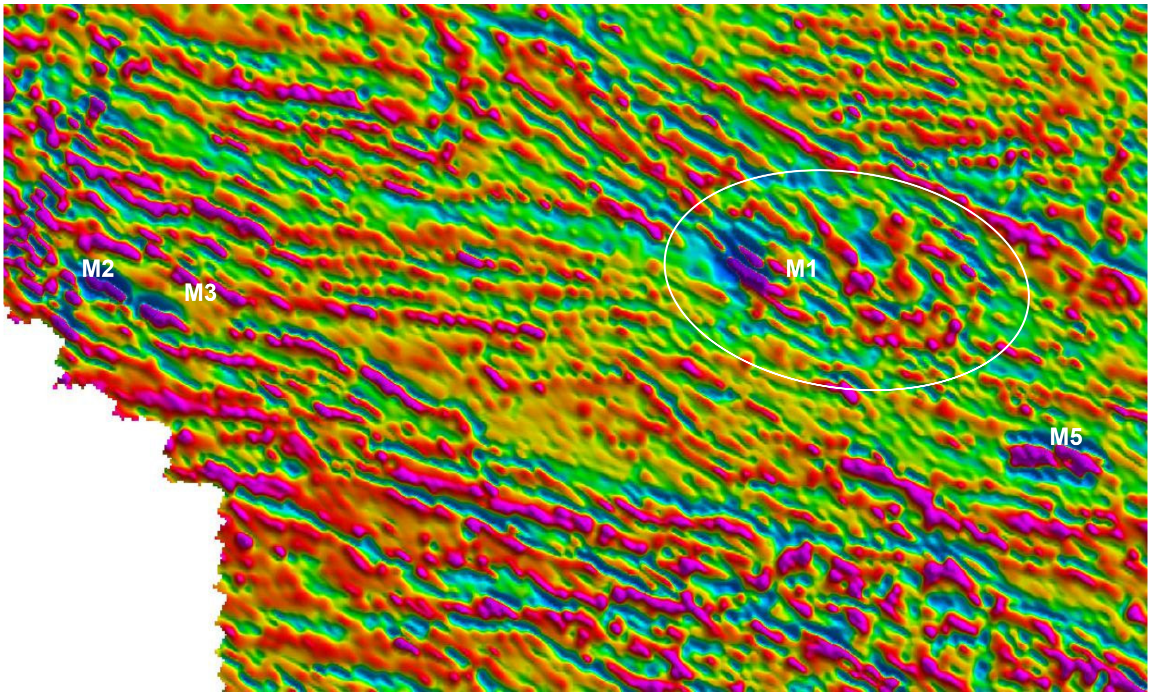


Figure 7-3 Shadowed Calculated First Vertical Derivative

Several less extensive conductive zones R2 and R3 are also situated on sheet 1, and reflect conductive sources at depth. Neither displays any direct correlation with the magnetic data, as they are situated within the relatively non-magnetic northwest area of the survey block. R4, which is situated to the north of R1, situated over sheets 1 and 2, also reflects possible bedrock conductivity. Its southern limit is coincident with a prominent northwest/southeast trending break in the magnetic data.

M4 is a complex magnetic zone situated near the northern edge of sheet 2. The magnetic features within this zone are generally associated with topographic highs. Many possible structural features, inferred from the magnetic data, intersect this zone. The strongest magnetic feature within M4 is situated at the northern edge of the zone, immediately to the west of a prominent north-northwest/south-southeast trending magnetic break. Conductive zone R5 is situated along this break, and may reflect weakly conductive features at depth.

The character of the magnetic data changes drastically between the northern and southern regions of the survey block. The northern region generally consists of low gradient magnetic features, with a dynamic range of less than 100 nT. The southern portion of the survey block displays much higher magnetic gradients and contains magnetic features, M6 through M21, which display increased magnetic intensities. One of the strongest magnetic features is M6, situated at the southeastern limit of sheet 4. M6 appears to be separated from smaller zones M7 through M10 by a prominent structural feature, which extends northwest/southeast along its eastern edge. M6 displays some association with R7, a conductive ring-like zone, which reflects possible bedrock conductivity.

Much of the southern region of the survey block is dominated by conductive zone R8. It displays similar characteristics to R1, as it seems to reflect multiple, closely spaced conductive sources, but conductivities within this zone are much lower than those in R1 on all frequencies. Calculated resistivities of less than one ohm-metre are evident throughout much of the zone on the 900 Hz resistivity parameter.

Extensive conductive zones such as R1 and R8 often reflect formational conductors that may be of minor interest as direct exploration targets. However, attention may be focused on areas where these zones appear to be faulted or folded or where anomaly characteristics differ along strike. Such structural breaks are considered to be of particular interest as they may have influenced mineral deposition within the survey area.

Ben Claim

Three conductive zones, R1 through R3, are evident within this small block situated to the east of sheet 6 of the Mac Pass Group Claims area. R1 is the most extensive zone, and reflects multiple closely spaced conductive sources. The 900 Hz parameter displays the lowest resistivities, suggesting the source of the conductivity is at depth. Several moderately magnetic features, M1 through M4, are associated with the central region of R1, although the strongest conductivities within R1 are located around the edge of the zone and are generally non-magnetic. Magnetic zones M1 through M4 appear to be intersected by or separated from each other by several possible structural features.

Conductive zone R3 reflects multiple possible bedrock sources situated in the southern corner of the survey area. This east/west trending feature is situated along an inferred structural feature that intersects magnetic zone M6.

8. CONCLUSIONS AND RECOMMENDATIONS

This report provides a very brief description of the survey results and describes the equipment, data processing procedures and logistics of the survey.

The survey has been successful in mapping the magnetic and conductive properties of the survey areas. The survey was also successful in locating anomalous zones that may warrant additional work. The various maps included with this report display the magnetic and conductive properties of the survey areas. It is recommended that a complete assessment and detailed evaluation of the survey results be carried out, in conjunction with all available geophysical, geological and geochemical information.

The interpreted bedrock conductors and anomalous targets defined by the survey should be subjected to further investigation, using appropriate surface exploration techniques. Anomalies that are currently considered to be of moderately low priority may require upgrading if follow-up results are favourable.

It is also recommended that image processing of existing geophysical data be considered, in order to extract the maximum amount of information from the survey results. Current software and imaging techniques often provide valuable information on structure and lithology, which may not be clearly evident on the contour and colour maps. These techniques can yield images that define subtle, but significant, structural details.

Respectfully submitted,

FUGRO AIRBORNE SURVEYS CORP.

APPENDIX A
LIST OF PERSONNEL

The following personnel were involved in the acquisition, processing, interpretation and presentation of data, relating to a DIGHEM airborne geophysical survey carried out for Colorado Resources Ltd. over the Mac Pass Claim Group and the Ben Claim areas, Eastern Yukon.

Graham Konieczny	Manager, Data Processing and Interpretation
Terry Lacey	Geophysical Operator
Amanda Heydorn	Geophysical Data Processor - Field
Sara Underhay	Geophysical Data Processor - Field
Richardo White	Geophysical Data Processor
Guy Lajoie	Pilot (Questral Helicopters Ltd.)
Mark Lapointe	Pilot
Ruth Pritchard	Interpretation
Lyn Vanderstarren	Drafting Supervisor

The survey consisted of approximately 3064.0 line-km flown from July 11th to August 4th, 2011.

All personnel were employees of Fugro Airborne Surveys, except where indicated.

APPENDIX B

BACKGROUND INFORMATION

APPENDIX B
BACKGROUND INFORMATION

Electromagnetics

Fugro electromagnetic responses fall into two general classes, discrete and broad. The discrete class consists of sharp, well-defined anomalies from discrete conductors such as sulphide lenses and steeply dipping sheets of graphite and sulphides. The broad class consists of wide anomalies from conductors having a large horizontal surface such as flatly dipping graphite or sulphide sheets, saline water-saturated sedimentary formations, conductive overburden and rock, kimberlite pipes and geothermal zones. A vertical conductive slab with a width of 200 m would straddle these two classes.

The vertical sheet (half plane) is the most common model used for the analysis of discrete conductors. All anomalies plotted on the geophysical maps are analyzed according to this model. The following section entitled **Discrete Conductor Analysis** describes this model in detail, including the effect of using it on anomalies caused by broad conductors such as conductive overburden.

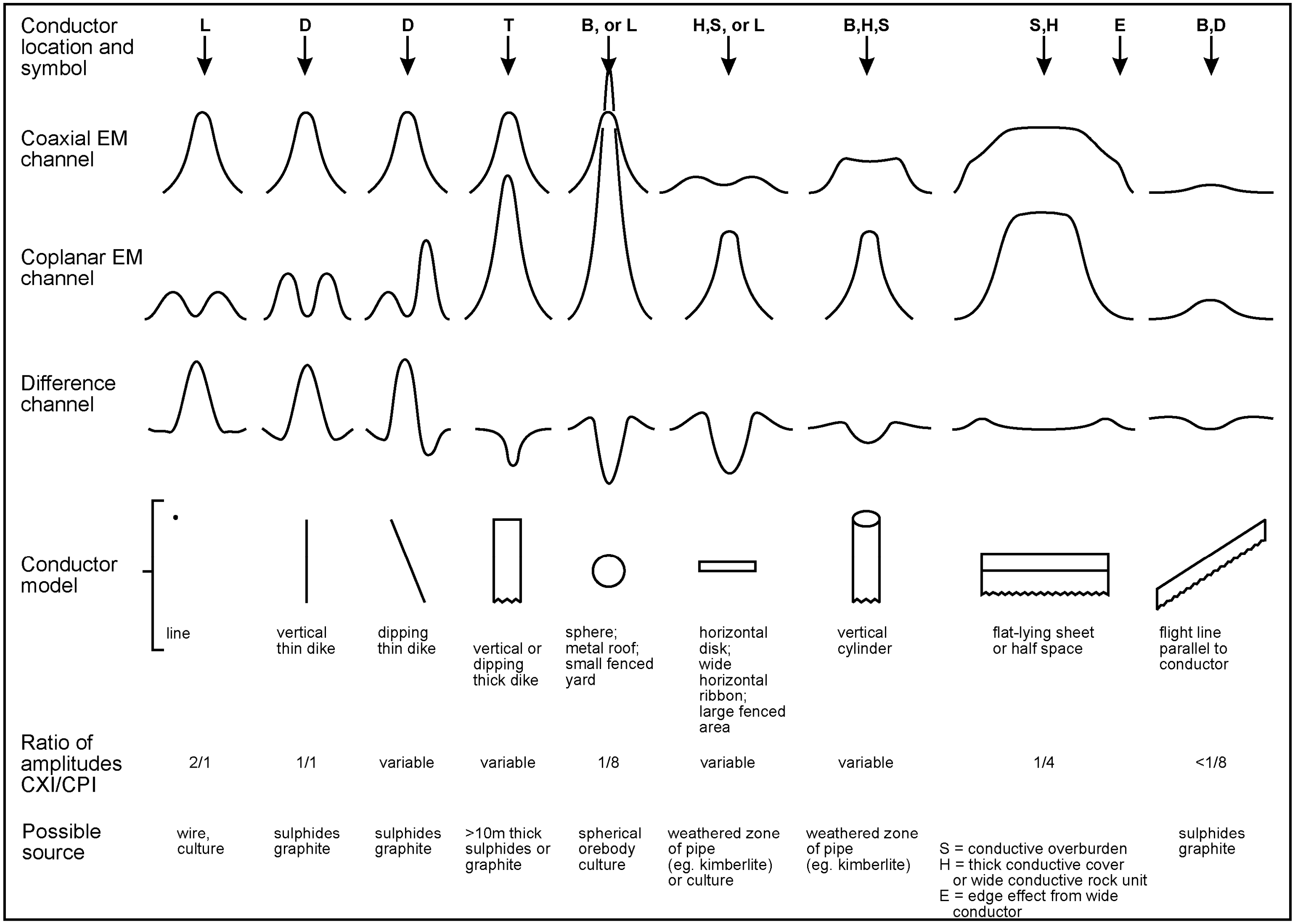
The conductive earth (half-space) model is suitable for broad conductors. Resistivity contour maps result from the use of this model. A later section entitled **Resistivity Mapping** describes the method further, including the effect of using it on anomalies caused by discrete conductors such as sulphide bodies.

Geometric Interpretation

The geophysical interpreter attempts to determine the geometric shape and dip of the conductor. Figure B-1 shows typical HEM anomaly shapes which are used to guide the geometric interpretation.

Discrete Conductor Analysis

The EM anomalies appearing on the electromagnetic map are analyzed by computer to give the conductance (i.e., conductivity-thickness product) in siemens (mhos) of a vertical sheet model. This is done regardless of the interpreted geometric shape of the conductor. This is not an unreasonable procedure, because the computed conductance increases as the electrical quality of the conductor increases, regardless of its true shape. DIGHEM anomalies are divided into seven grades of conductance, as shown in Table B-1. The conductance in siemens (mhos) is the reciprocal of resistance in ohms.



Typical HEM anomaly shapes

Figure B-1

The conductance value is a geological parameter because it is a characteristic of the conductor alone. It generally is independent of frequency, flying height or depth of burial, apart from the averaging over a greater portion of the conductor as height increases. Small anomalies from deeply buried strong conductors are not confused with small anomalies from shallow weak conductors because the former will have larger conductance values.

Table B-1. EM Anomaly Grades

Anomaly Grade	Siemens
7	> 100
6	50 - 100
5	20 - 50
4	10 - 20
3	5 - 10
2	1 - 5
1	< 1

Conductive overburden generally produces broad EM responses which may not be shown as anomalies on the geophysical maps. However, patchy conductive overburden in otherwise resistive areas can yield discrete anomalies with a conductance grade (cf. Table B-1) of 1, 2 or even 3 for conducting clays which have resistivities as low as 50 ohm-m. In areas where ground resistivities are below 10 ohm-m, anomalies caused by weathering variations and similar causes can have any conductance grade. The anomaly shapes from the multiple coils often allow such conductors to be recognized, and these are indicated by the letters S, H, and sometimes E on the geophysical maps (see EM legend on maps).

For bedrock conductors, the higher anomaly grades indicate increasingly higher conductances. Examples: the New Insco copper discovery (Noranda, Canada) yielded a grade 5 anomaly, as did the neighbouring copper-zinc Magusi River ore body; Mattabi (copper-zinc, Sturgeon Lake, Canada) and Whistle (nickel, Sudbury, Canada) gave grade 6; and the Montcalm nickel-copper discovery (Timmins, Canada) yielded a grade 7 anomaly. Graphite and sulphides can span all grades but, in any particular survey area, field work may show that the different grades indicate different types of conductors.

Strong conductors (i.e., grades 6 and 7) are characteristic of massive sulphides or graphite. Moderate conductors (grades 4 and 5) typically reflect graphite or sulphides of a less massive character, while weak bedrock conductors (grades 1 to 3) can signify poorly connected graphite or heavily disseminated sulphides. Grades 1 and 2 conductors may not respond to ground EM equipment using frequencies less than 2000 Hz.

The presence of sphalerite or gangue can result in ore deposits having weak to moderate conductances. As an example, the three million ton lead-zinc deposit of Restigouche Mining Corporation near Bathurst, Canada, yielded a well-defined grade 2 conductor. The 10 percent by volume of sphalerite occurs as a coating around the fine grained massive pyrite, thereby inhibiting electrical conduction. Faults, fractures and shear zones may produce anomalies that typically have low conductances (e.g., grades 1 to 3). Conductive rock formations can yield anomalies of any conductance grade. The conductive materials in such rock formations can be salt water, weathered products such as clays, original depositional clays, and carbonaceous material.

For each interpreted electromagnetic anomaly on the geophysical maps, a letter identifier and an interpretive symbol are plotted beside the EM grade symbol. The conductance grade and depth estimate illustrates which of these possibilities fits the recorded data best.

The conductance measurement is considered more reliable than the depth estimate. There are a number of factors that can produce an error in the depth estimate, including the averaging of topographic variations by the altimeter, overlying conductive overburden, and the location and attitude of the conductor relative to the flight line. Conductor location and attitude can provide an erroneous depth estimate because the stronger part of the conductor may be deeper or to one side of the flight line, or because it has a shallow dip. A heavy tree cover can also produce errors in depth estimates. This is because the depth estimate is computed as the distance of bird from conductor, minus the altimeter reading. The altimeter can lock onto the top of a dense forest canopy. This situation yields an erroneously large depth estimate but does not affect the conductance estimate.

Dip symbols are used to indicate the direction of dip of conductors. These symbols are used only when the anomaly shapes are unambiguous, which usually requires a fairly resistive environment.

A further interpretation is presented on the EM map by means of the line-to-line correlation of bedrock anomalies, which is based on a comparison of anomaly shapes on adjacent lines. This provides conductor axes that may define the geological structure over portions of the survey area. The absence of conductor axes in an area implies that anomalies could not be correlated from line to line with reasonable confidence.

The electromagnetic anomalies are designed to provide a correct impression of conductor quality by means of the conductance grade symbols. The symbols can stand alone with geology when planning a follow-up program. The actual conductance values are available in the EM anomaly archive for those who wish quantitative data. The map provides an interpretation of conductors in terms of length, strike and dip, geometric shape, conductance, depth, and thickness. The accuracy is comparable to an interpretation from a high quality ground EM survey having the same line spacing.

The EM anomaly archive provides a tabulation of anomalies in ppm, conductance, and depth for the vertical dyke model for bedrock anomalies (i.e. B D and T anomaly types), and for a horizontal sheet model for broad anomalies (i.e. S, H and E). No conductance or depth estimates are shown for weak anomalous responses that are not of sufficient amplitude to yield reliable calculations.

Since discrete bodies normally are the targets of EM surveys, local base (or zero) levels are used to compute local anomaly amplitudes. This contrasts with the use of true zero levels which are used to compute true EM amplitudes. Local anomaly amplitudes are shown in the EM anomaly list and these are used to compute the parameters of conductance and depth.

Questionable Anomalies

The EM maps may contain anomalous responses that are displayed as asterisks (*). These responses denote weak anomalies of indeterminate conductance, which may reflect one of the following: a weak conductor near the surface, a strong conductor at depth (e.g., 100 to 120 m below surface) or to one side of the flight line, or aerodynamic noise. Those responses that have the appearance of valid bedrock anomalies on the flight profiles are indicated by appropriate interpretive symbols (see EM legend on maps). The others probably do not warrant further investigation unless their locations are of considerable geological interest.

The Thickness Parameter

A comparison of coaxial and coplanar shapes can provide an indication of the thickness of a steeply dipping conductor. The amplitude of the coplanar anomaly (e.g., CPI channel) increases relative to the coaxial anomaly (e.g., CXI) as the apparent thickness increases, i.e., the thickness in the horizontal plane. (The thickness is equal to the conductor width if the conductor dips at 90 degrees and strikes at right angles to the flight line.) This report refers to a conductor as thin when the thickness is likely to be less than 3 m, and thick when in excess of 10 m. Thick conductors are indicated on the EM map by parentheses "( )". For base metal exploration in steeply dipping geology, thick conductors can be high priority targets because many massive sulphide ore bodies are thick. The system cannot sense the thickness when the strike of the conductor is subparallel to the flight line, when the conductor has a shallow dip, when the anomaly amplitudes are small, or when the resistivity of the environment is below 100 ohm-m.

Resistivity Mapping

Resistivity mapping is useful in areas where broad or flat lying conductive units are of interest. One example of this is the clay alteration which is associated with Carlin-type deposits in the south west United States. The resistivity parameter was able to identify the clay alteration zone over the Cove deposit. The alteration zone appeared as a strong resistivity low on the 900 Hz resistivity parameter. The 7,200 Hz and 56,000 Hz resistivities showed more detail in the covering sediments, and delineated a range front fault. This is typical in many areas of the south west United States, where conductive near surface sediments, which may sometimes be alkalic, attenuate the higher frequencies.

Resistivity mapping has proven successful for locating diatremes in diamond exploration. Weathering products from relatively soft kimberlite pipes produce a resistivity contrast with the unaltered host rock. In many cases weathered kimberlite pipes were associated with thick conductive layers that contrasted with overlying or adjacent relatively thin layers of lake bottom sediments or overburden.

Areas of widespread conductivity are commonly encountered during surveys. These conductive zones may reflect alteration zones, shallow-dipping sulphide or graphite-rich units, saline ground water, or conductive overburden. In such areas, EM amplitude changes can be generated by decreases of only 5 m in survey altitude, as well as by increases in conductivity. The typical flight record in conductive areas is characterized by in-phase and quadrature channels that are continuously active. Local EM peaks reflect either increases in conductivity of the earth or decreases in survey altitude. For such conductive areas, apparent resistivity profiles and contour maps are necessary for the correct interpretation of the airborne data. The advantage of the resistivity parameter is that anomalies caused by altitude changes are virtually eliminated, so the resistivity data reflect only those anomalies caused by conductivity changes. The resistivity analysis also helps the interpreter to differentiate between conductive bedrock and conductive overburden. For example, discrete conductors will generally appear as narrow lows on the contour map and broad conductors (e.g., overburden) will appear as wide lows.

The apparent resistivity is calculated using the pseudo-layer (or buried) half-space model defined by Fraser (1978)[1]. This model consists of a resistive layer overlying a conductive half-space. The depth channels give the apparent depth below surface of the conductive material. The apparent depth is simply the apparent thickness of the overlying resistive layer. The apparent depth (or thickness) parameter will be positive when the upper layer is more resistive than the underlying material, in which case the apparent depth may be quite close to the true depth.

The apparent depth will be negative when the upper layer is more conductive than the underlying material, and will be zero when a homogeneous half-space exists. The apparent depth parameter must be interpreted cautiously because it will contain any errors that might exist in the measured altitude of the EM bird (e.g., as caused by a dense tree cover). The inputs to the resistivity algorithm are the in-phase and quadrature components of the coplanar coil-pair. The outputs are the apparent resistivity of the conductive half-space (the source) and the sensor-source distance. The flying height is not an input variable, and the output resistivity and sensor-source distance are independent of the flying height when the conductivity of the measured material is sufficient to yield significant in-phase as well as quadrature responses. The apparent depth, discussed above, is simply the sensor-source distance minus the measured altitude or flying height. Consequently, errors in the measured altitude will affect the apparent depth parameter but not the apparent resistivity parameter.

The apparent depth parameter is a useful indicator of simple layering in areas lacking a heavy tree cover. Depth information has been used for permafrost mapping, where positive apparent depths were used as a measure of permafrost thickness. However, little quantitative use has been made of negative apparent depths because the absolute value of

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

the negative depth is not a measure of the thickness of the conductive upper layer and, therefore, is not meaningful physically. Qualitatively, a negative apparent depth estimate usually shows that the EM anomaly is caused by conductive overburden. Consequently, the apparent depth channel can be of significant help in distinguishing between overburden and bedrock conductors.

Interpretation in Conductive Environments

Environments having low background resistivities (e.g., below 30 ohm-m for a 900 Hz system) yield very large responses from the conductive ground. This usually prohibits the recognition of discrete bedrock conductors. However, Fugro data processing techniques produce three parameters that contribute significantly to the recognition of bedrock conductors in conductive environments. These are the in-phase and quadrature difference channels (DIFI and DIFQ, which are available only on systems with “common” frequencies on orthogonal coil pairs), and the resistivity and depth channels (RES and DEP) for each coplanar frequency.

The EM difference channels (DIFI and DIFQ) eliminate most of the responses from conductive ground, leaving responses from bedrock conductors, cultural features (e.g., telephone lines, fences, etc.) and edge effects. Edge effects often occur near the perimeter of broad conductive zones. This can be a source of geologic noise. While edge effects yield anomalies on the EM difference channels, they do not produce resistivity anomalies. Consequently, the resistivity channel aids in eliminating anomalies due to edge effects. On the other hand, resistivity anomalies will coincide with the most highly conductive sections of conductive ground, and this is another source of geologic noise. The recognition of a bedrock conductor in a conductive environment therefore is based on the anomalous responses of the two difference channels (DIFI and DIFQ) and the resistivity channels (RES). The most favourable situation is where anomalies coincide on all channels.

The DEP channels, which give the apparent depth to the conductive material, also help to determine whether a conductive response arises from surficial material or from a conductive zone in the bedrock. When these channels ride above the zero level on the depth profiles (i.e., depth is negative), it implies that the EM and resistivity profiles are responding primarily to a conductive upper layer, i.e., conductive overburden. If the DEP channels are below the zero level, it indicates that a resistive upper layer exists, and this usually implies the existence of a bedrock conductor. If the low frequency DEP channel is below the zero level and the high frequency DEP is above, this suggests that a bedrock conductor occurs beneath conductive cover.

Reduction of Geologic Noise

Geologic noise refers to unwanted geophysical responses. For purposes of airborne EM surveying, geologic noise refers to EM responses caused by conductive overburden and magnetic permeability. It was mentioned previously that the EM difference channels (i.e., channel DIFI for in-phase and DIFQ for quadrature) tend to eliminate the response of conductive overburden.

Magnetite produces a form of geological noise on the in-phase channels. Rocks containing less than 1% magnetite can yield negative in-phase anomalies caused by magnetic permeability. When magnetite is widely distributed throughout a survey area, the in-phase EM channels may continuously rise and fall, reflecting variations in the magnetite percentage, flying height, and overburden thickness. This can lead to difficulties in recognizing deeply buried bedrock conductors, particularly if conductive overburden also exists. However, the response of broadly distributed magnetite generally vanishes on the in-phase difference channel DIFI. This feature can be a significant aid in the recognition of conductors that occur in rocks containing accessory magnetite.

EM Magnetite Mapping

The information content of HEM data consists of a combination of conductive eddy current responses and magnetic permeability responses. The secondary field resulting from conductive eddy current flow is frequency-dependent and consists of both in-phase and quadrature components, which are positive in sign. On the other hand, the secondary field resulting from magnetic permeability is independent of frequency and consists of only an in-phase component which is negative in sign. When magnetic permeability manifests itself by decreasing the measured amount of positive in-phase, its presence may be difficult to recognize. However, when it manifests itself by yielding a negative in-phase anomaly (e.g., in the absence of eddy current flow), its presence is assured. In this latter case, the negative component can be used to estimate the percent magnetite content.

A magnetite mapping technique, based on the low frequency coplanar data, can be complementary to magnetometer mapping in certain cases. Compared to magnetometry, it is far less sensitive but is more able to resolve closely spaced magnetite zones, as well as providing an estimate of the amount of magnetite in the rock. The method is sensitive to 1/4% magnetite by weight when the EM sensor is at a height of 30 m above a magnetitic half-space. It can individually resolve steep dipping narrow magnetite-rich bands which are separated by 60 m. Unlike magnetometry, the EM magnetite method is unaffected by remanent magnetism or magnetic latitude.

The EM magnetite mapping technique provides estimates of magnetite content which are usually correct within a factor of 2 when the magnetite is fairly uniformly distributed. EM magnetite maps can be generated when magnetic permeability is evident as negative in-phase responses on the data profiles.

Like magnetometry, the EM magnetite method maps only bedrock features, provided that the overburden is characterized by a general lack of magnetite. This contrasts with resistivity mapping which portrays the combined effect of bedrock and overburden.

The Susceptibility Effect

When the host rock is conductive, the positive conductivity response will usually dominate the secondary field, and the susceptibility effect[2] will appear as a reduction in the in-phase, rather than as a negative value. The in-phase response will be lower than would be predicted by a model using zero susceptibility. At higher frequencies the in-phase conductivity response also gets larger, so a negative magnetite effect observed on the low frequency might not be observable on the higher frequencies, over the same body. The susceptibility effect is most obvious over discrete magnetite-rich zones, but also occurs over uniform geology such as a homogeneous half-space.

High magnetic susceptibility will affect the calculated apparent resistivity, if only conductivity is considered. Standard apparent resistivity algorithms use a homogeneous half-space model, with zero susceptibility. For these algorithms, the reduced in-phase response will, in most cases, make the apparent resistivity higher than it should be. It is important to note that there is nothing wrong with the data, nor is there anything wrong with the processing algorithms. The apparent difference results from the fact that the simple geological model used in processing does not match the complex geology.

Measuring and Correcting the Magnetite Effect

Theoretically, it is possible to calculate (forward model) the combined effect of electrical conductivity and magnetic susceptibility on an EM response in all environments. The difficulty lies, however, in separating out the susceptibility effect from other geological effects when deriving resistivity and susceptibility from EM data.

Over a homogeneous half-space, there is a precise relationship between in-phase, quadrature, and altitude. These are often resolved as phase angle, amplitude, and altitude. Within a reasonable range, any two of these three parameters can be used to calculate the half space resistivity. If the rock has a positive magnetic susceptibility, the in-phase component will be reduced and this departure can be recognized by comparison to the other parameters.

The algorithm used to calculate apparent susceptibility and apparent resistivity from HEM data, uses a homogeneous half-space geological model. Non half-space geology, such as horizontal layers or dipping sources, can also distort the perfect half-space relationship of the three data parameters. While it may be possible to use more complex models to calculate both rock parameters, this procedure becomes very complex and time-consuming. For basic HEM data processing, it is most practical to stick to the simplest geological model.

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[2] Magnetic susceptibility and permeability are two measures of the same physical property. Permeability is generally given as relative permeability, μ_r, which is the permeability of the substance divided by the permeability of free space ($4 \pi \times 10^{-7}$). Magnetic susceptibility k is related to permeability by $k=\mu^r-1$. Susceptibility is a unitless measurement, and is usually reported in units of 10^{-6}. The typical range of susceptibilities is –1 for quartz, 130 for pyrite, and up to 5×10^5 for magnetite, in 10^{-6} units (Telford et al, 1986).

Magnetite reversals (reversed in-phase anomalies) have been used for many years to calculate an "FeO" or magnetite response from HEM data (Fraser, 1981). However, this technique could only be applied to data where the in-phase was observed to be negative, which happens when susceptibility is high and conductivity is low.

Applying Susceptibility Corrections

Resistivity calculations done with susceptibility correction may change the apparent resistivity. High-susceptibility conductors, that were previously masked by the susceptibility effect in standard resistivity algorithms, may become evident. In this case the susceptibility corrected apparent resistivity is a better measure of the actual resistivity of the earth. However, other geological variations, such as a deep resistive layer, can also reduce the in-phase by the same amount. In this case, susceptibility correction would not be the best method. Different geological models can apply in different areas of the same data set. The effects of susceptibility, and other effects that can create a similar response, must be considered when selecting the resistivity algorithm.

Susceptibility from EM vs. Magnetic Field Data

The response of the EM system to magnetite may not match that from a magnetometer survey. First, HEM-derived susceptibility is a rock property measurement, like resistivity. Magnetic data show the total magnetic field, a measure of the potential field, not the rock property. Secondly, the shape of an anomaly depends on the shape and direction of the source magnetic field. The electromagnetic field of HEM is much different in shape from the earth's magnetic field. Total field magnetic anomalies are different at different magnetic latitudes; HEM susceptibility anomalies have the same shape regardless of their location on the earth.

In far northern latitudes, where the magnetic field is nearly vertical, the total magnetic field measurement over a thin vertical dike is very similar in shape to the anomaly from the HEM-derived susceptibility (a sharp peak over the body). The same vertical dike at the magnetic equator would yield a negative magnetic anomaly, but the HEM susceptibility anomaly would show a positive susceptibility peak.

Effects of Permeability and Dielectric Permittivity

Resistivity algorithms that assume free-space magnetic permeability and dielectric permittivity do not yield reliable values in highly magnetic or highly resistive areas. Both magnetic polarization and displacement currents cause a decrease in the in-phase component, often resulting in negative values that yield erroneously high apparent resistivities. The effects of magnetite occur at all frequencies, but are most evident at the lowest frequency. Conversely, the negative effects of dielectric permittivity are most evident at the higher frequencies, in resistive areas.

The table below shows the effects of varying permittivity over a resistive (10,000 ohm-m) half space, at frequencies of 56,000 Hz (DIGHEM^V) and 102,000 Hz (RESOLVE).

Apparent Resistivity Calculations
Effects of Permittivity on In-phase/Quadrature/Resistivity

Freq (Hz)	Coil	Sep (m)	Thres (ppm)	Alt (m)	In Phase	Quad Phase	App Res	App Depth (m)	Permittivity
56,000	CP	6.3	0.1	30	7.3	35.3	10118	-1.0	1 Air
56,000	CP	6.3	0.1	30	3.6	36.6	19838	-13.2	5 Quartz
56,000	CP	6.3	0.1	30	-1.1	38.3	81832	-25.7	10 Epidote
56,000	CP	6.3	0.1	30	-10.4	42.3	76620	-25.8	20 Granite
56,000	CP	6.3	0.1	30	-19.7	46.9	71550	-26.0	30 Diabase
56,000	CP	6.3	0.1	30	-28.7	52.0	66787	-26.1	40 Gabbro
102,000	CP	7.86	0.1	30	32.5	117.2	9409	-0.3	1 Air
102,000	CP	7.86	0.1	30	11.7	127.2	25956	-16.8	5 Quartz
102,000	CP	7.86	0.1	30	-14.0	141.6	97064	-26.5	10 Epidote
102,000	CP	7.86	0.1	30	-62.9	176.0	83995	-26.8	20 Granite
102,000	CP	7.86	0.1	30	-107.5	215.8	73320	-27.0	30 Diabase
102,000	CP	7.86	0.1	30	-147.1	259.2	64875	-27.2	40 Gabbro

Methods have been developed (Huang and Fraser, 2000, 2001) to correct apparent resistivities for the effects of permittivity and permeability. The corrected resistivities yield more credible values than if the effects of permittivity and permeability are disregarded.

Recognition of Culture

Cultural responses include all EM anomalies caused by man-made metallic objects. Such anomalies may be caused by inductive coupling or current gathering. The concern of the interpreter is to recognize when an EM response is due to culture. Points of consideration used by the interpreter, when coaxial and coplanar coil-pairs are operated at a common frequency, are as follows:

1. Channels CXPL and CPPL monitor 60 Hz radiation. An anomaly on these channels shows that the conductor is radiating power. Such an indication is normally a guarantee that the conductor is cultural. However, care must be taken to ensure that the conductor is not a geologic body that strikes across a power line, carrying leakage currents.

2. A flight that crosses a "line" (e.g., fence, telephone line, etc.) yields a centre-peaked coaxial anomaly and an m-shaped coplanar anomaly.[3] When the flight crosses the

[3] See Figure B-1 presented earlier.

cultural line at a high angle of intersection, the amplitude ratio of coaxial/coplanar response is 2. Such an EM anomaly can only be caused by a line. The geologic body that yields anomalies most closely resembling a line is the vertically dipping thin dike. Such a body, however, yields an amplitude ratio of 1 rather than 2. Consequently, an m-shaped coplanar anomaly with a CXI/CPI amplitude ratio of 2 is virtually a guarantee that the source is a cultural line.

3. A flight that crosses a sphere or horizontal disk yields centre-peaked coaxial and coplanar anomalies with a CXI/CPI amplitude ratio (i.e., coaxial/coplanar) of 1/8. In the absence of geologic bodies of this geometry, the most likely conductor is a metal roof or small fenced yard.[4] Anomalies of this type are virtually certain to be cultural if they occur in an area of culture.

4. A flight that crosses a horizontal rectangular body or wide ribbon yields an m-shaped coaxial anomaly and a centre-peaked coplanar anomaly. In the absence of geologic bodies of this geometry, the most likely conductor is a large fenced area.[5] Anomalies of this type are virtually certain to be cultural if they occur in an area of culture.

5. EM anomalies that coincide with culture, as seen on the camera film or video display, are usually caused by culture. However, care is taken with such coincidences because a geologic conductor could occur beneath a fence, for example. In this example, the fence would be expected to yield an m-shaped coplanar anomaly as in case #2 above. If, instead, a centre-peaked coplanar anomaly occurred, there would be concern that a thick geologic conductor coincided with the cultural line.

6. The above description of anomaly shapes is valid when the culture is not conductively coupled to the environment. In this case, the anomalies arise from inductive coupling to the EM transmitter. However, when the environment is quite conductive (e.g., less than 100 ohm-m at 900 Hz), the cultural conductor may be conductively coupled to the environment. In this latter case, the anomaly shapes tend to be governed by current gathering. Current gathering can completely distort the anomaly shapes, thereby complicating the identification of cultural anomalies. In such circumstances, the interpreter can only rely on the radiation channels and on the camera film or video records.

Magnetic Responses

The measured total magnetic field provides information on the magnetic properties of the earth materials in the survey area. The information can be used to locate magnetic bodies of direct interest for exploration, and for structural and lithological mapping.

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[4] It is a characteristic of EM that geometrically similar anomalies are obtained from: (1) a planar conductor, and (2) a wire which forms a loop having dimensions identical to the perimeter of the equivalent planar conductor.

The total magnetic field response reflects the abundance of magnetic material in the source. Magnetite is the most common magnetic mineral. Other minerals such as ilmenite, pyrrhotite, franklinite, chromite, hematite, arsenopyrite, limonite and pyrite are also magnetic, but to a lesser extent than magnetite on average.

In some geological environments, an EM anomaly with magnetic correlation has a greater likelihood of being produced by sulphides than one which is non-magnetic. However, sulphide ore bodies may be non-magnetic (e.g., the Kidd Creek deposit near Timmins, Canada) as well as magnetic (e.g., the Mattabi deposit near Sturgeon Lake, Canada).

Iron ore deposits will be anomalously magnetic in comparison to surrounding rock due to the concentration of iron minerals such as magnetite, ilmenite and hematite.

Changes in magnetic susceptibility often allow rock units to be differentiated based on the total field magnetic response. Geophysical classifications may differ from geological classifications if various magnetite levels exist within one general geological classification. Geometric considerations of the source such as shape, dip and depth, inclination of the earth's field and remanent magnetization will complicate such an analysis.

In general, mafic lithologies contain more magnetite and are therefore more magnetic than many sediments which tend to be weakly magnetic. Metamorphism and alteration can also increase or decrease the magnetization of a rock unit.
Textural differences on a total field magnetic contour, colour or shadow map due to the frequency of activity of the magnetic parameter resulting from inhomogeneities in the distribution of magnetite within the rock, may define certain lithologies. For example, near surface volcanics may display highly complex contour patterns with little line-to-line correlation.

Rock units may be differentiated based on the plan shapes of their total field magnetic responses. Mafic intrusive plugs can appear as isolated "bulls-eye" anomalies. Granitic intrusives appear as sub-circular zones, and may have contrasting rings due to contact metamorphism. Generally, granitic terrain will lack a pronounced strike direction, although granite gneiss may display strike.

Linear north-south units are theoretically not well-defined on total field magnetic maps in equatorial regions due to the low inclination of the earth's magnetic field. However, most stratigraphic units will have variations in composition along strike that will cause the units to appear as a series of alternating magnetic highs and lows.

Faults and shear zones may be characterized by alteration that causes destruction of magnetite (e.g., weathering) that produces a contrast with surrounding rock. Structural breaks may be filled by magnetite-rich, fracture filling material as is the case with diabase dikes, or by non-magnetic felsic material.

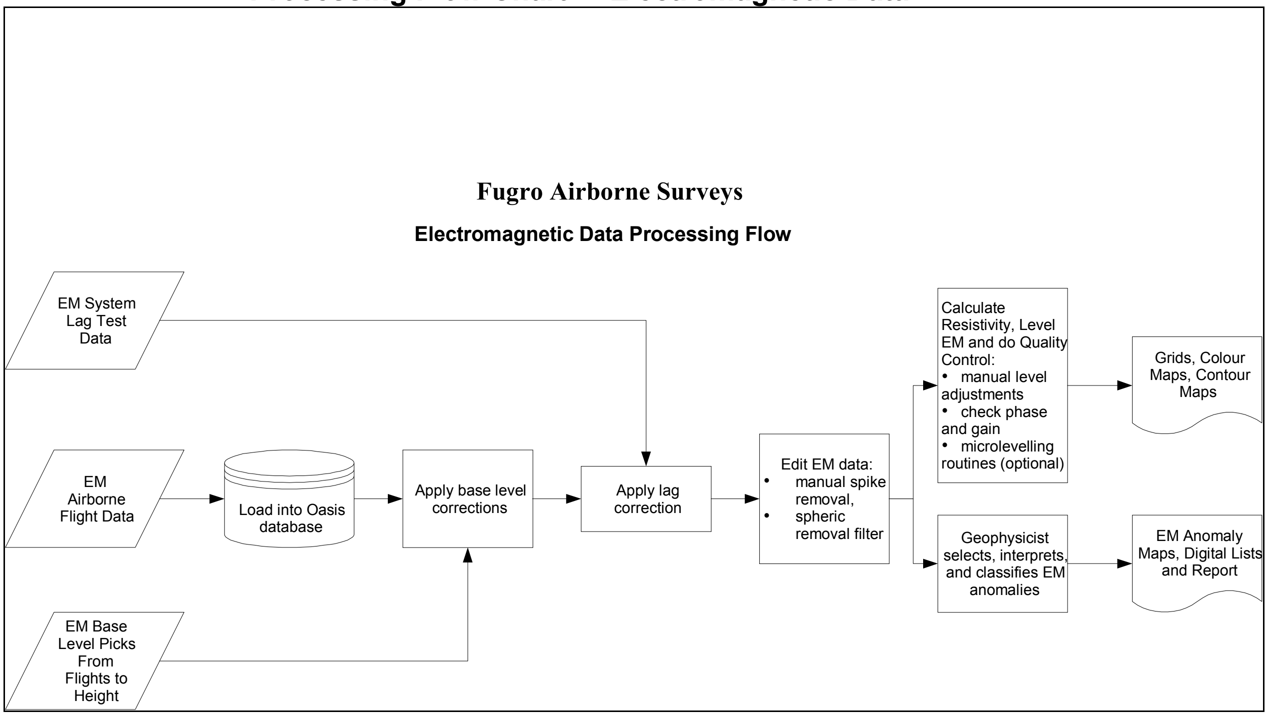
Faulting can also be identified by patterns in the magnetic total field contours or colours. Faults and dikes tend to appear as lineaments and often have strike lengths of several kilometres. Offsets in narrow, magnetic, stratigraphic trends also delineate structure. Sharp contrasts in magnetic lithologies may arise due to large displacements along strike-slip or dip-slip faults.

APPENDIX C

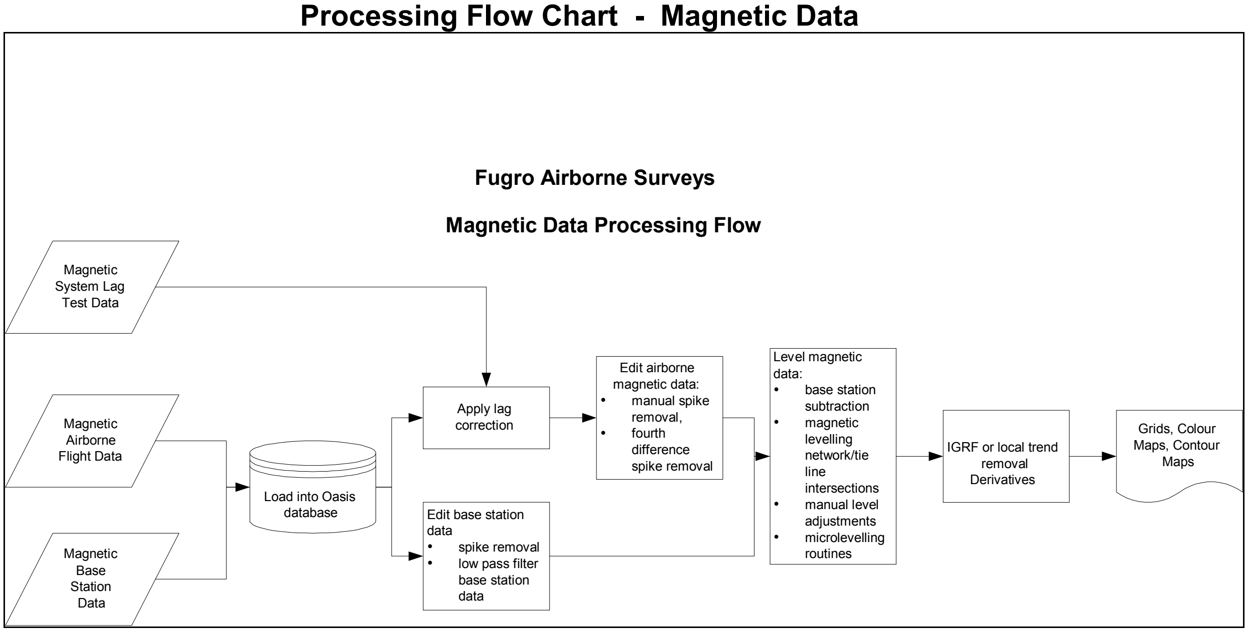
DATA PROCESSING

APPENDIX C

Processing Flow Chart - Electromagnetic Data



Processing Flow Chart - Magnetic Data



APPENDIX D

GLOSSARY

APPENDIX D
GLOSSARY OF AIRBORNE GEOPHYSICAL TERMS

Note: The definitions given in this glossary refer to the common terminology as used in airborne geophysics.

altitude attenuation: the absorption of gamma rays by the atmosphere between the earth and the detector. The number of gamma rays detected by a system decreases as the altitude increases.

apparent- : the ***physical parameters*** of the earth measured by a geophysical system are normally expressed as apparent, as in "apparent ***resistivity*"**. This means that the measurement is limited by assumptions made about the geology in calculating the response measured by the geophysical system. Apparent resistivity calculated with ***HEM***, for example, generally assumes that the earth is a ***homogeneous half-space*** – not layered.

amplitude: The strength of the total electromagnetic field. In ***frequency domain*** it is most often the sum of the squares of ***in-phase*** and ***quadrature*** components. In multi-component electromagnetic surveys it is generally the sum of the squares of all three directional components.

analytic signal: The total amplitude of all the directions of magnetic ***gradient***. Calculated as the sum of the squares.

anisotropy: Having different ***physical parameters*** in different directions. This can be caused by layering or fabric in the geology. Note that a unit can be anisotropic, but still **homogeneous**.

anomaly: A localized change in the geophysical data characteristic of a discrete source, such as a conductive or magnetic body. Something locally different from the **background**.

B-field: In time-domain **electromagnetic** surveys, the magnetic field component of the (electromagnetic) **field**. This can be measured directly, although more commonly it is calculated by integrating the time rate of change of the magnetic field **dB/dt**, as measured with a receiver coil.

background: The "normal" response in the geophysical data – that response observed over most of the survey area. **Anomalies** are usually measured relative to the background. In airborne gamma-ray spectrometric surveys the term defines the **cosmic**, radon, and aircraft responses in the absence of a signal from the ground.

base-level: The measured values in a geophysical system in the absence of any outside signal. All geophysical data are measured relative to the system base level.

base frequency: The frequency of the pulse repetition for a ***time-domain electromagnetic*** system. Measured between subsequent positive pulses.

bird: A common name for the pod towed beneath or behind an aircraft, carrying the geophysical sensor array.

calibration coil: A wire coil of known size and dipole moment, which is used to generate a field of known ***amplitude*** and ***phase*** in the receiver, for system calibration. Calibration coils can be external, or internal to the system. Internal coils may be called Q-coils.

coaxial coils: **[CX]** Coaxial coils are in the vertical plane, with their axes horizontal and collinear in the flight direction. These are most sensitive to vertical conductive objects in the ground, such as thin, steeply dipping conductors perpendicular to the flight direction. Coaxial coils generally give the sharpest anomalies over localized conductors. (See also ***coplanar coils***)

coil: A multi-turn wire loop used to transmit or detect electromagnetic fields. Time varying ***electromagnetic*** fields through a coil induce a voltage proportional to the strength of the field and the rate of change over time.

compensation: Correction of airborne geophysical data for the changing effect of the aircraft. This process is generally used to correct data in ***fixed-wing time-domain electromagnetic*** surveys (where the transmitter is on the aircraft and the receiver is moving), and magnetic surveys (where the sensor is on the aircraft, turning in the earth's magnetic field.

component: In ***frequency domain electromagnetic*** surveys this is one of the two **phase** measurements – ***in-phase or quadrature***. In "multi-component" electromagnetic surveys it is also used to define the measurement in one geometric direction (vertical, horizontal in-line and horizontal transverse – the Z, X and Y components).

Compton scattering: gamma ray photons will bounce off the nuclei of atoms they pass through (earth and atmosphere), reducing their energy and then being detected by ***radiometric*** sensors at lower energy levels. See also ***stripping***.

conductance: See ***conductivity thickness***

conductivity: [σ] The facility with which the earth or a geological formation conducts electricity. Conductivity is usually measured in milli-Siemens per metre (mS/m). It is the reciprocal of ***resistivity***.

conductivity-depth imaging: see ***conductivity-depth transform***.

conductivity-depth transform: A process for converting electromagnetic measurements to an approximation of the conductivity distribution vertically in the earth, assuming a ***layered earth***. (Macnae and Lamontagne, 1987; Wolfgram and Karlik, 1995)

conductivity thickness: [**σt**] The product of the ***conductivity***, and thickness of a large, tabular body. (It is also called the "conductivity-thickness product") In electromagnetic geophysics, the response of a thin plate-like conductor is proportional to the conductivity multiplied by thickness. For example a 10 metre thickness of 20 Siemens/m mineralization will be equivalent to 5 metres of 40 S/m; both have 200 S conductivity thickness. Sometimes referred to as conductance.

conductor: Used to describe anything in the ground more conductive than the surrounding geology. Conductors are most often clays or graphite, or hopefully some type of mineralization, but may also be man-made objects, such as fences or pipelines.

coplanar coils: **[CP]** The coplanar coils lie in the horizontal plane with their axes vertical, and parallel. These coils are most sensitive to massive conductive bodies, horizontal layers, and the ***halfspace***.

cosmic ray: High energy sub-atomic particles from outer space that collide with the earth's atmosphere to produce a shower of gamma rays (and other particles) at high energies.

counts (per second): The number of ***gamma-rays*** detected by a gamma-ray ***spectrometer***. The rate depends on the geology, but also on the size and sensitivity of the detector.

culture: A term commonly used to denote any man-made object that creates a geophysical anomaly. Includes, but not limited to, power lines, pipelines, fences, and buildings.

current gathering: The tendency of electrical currents in the ground to channel into a conductive formation. This is particularly noticeable at higher frequencies or early time channels when the formation is long and parallel to the direction of current flow. This tends to enhance anomalies relative to inductive currents (see also ***induction***). Also known as current channelling.

current channelling: See current gathering.

daughter products: The radioactive natural sources of gamma-rays decay from the original element (commonly potassium, uranium, and thorium) to one or more lower-energy elements. Some of these lower energy elements are also radioactive and decay further. ***Gamma-ray spectrometry*** surveys may measure the gamma rays given off by the original element or by the decay of the daughter products.

dB/dt: As the ***secondary electromagnetic field*** changes with time, the magnetic field [**B**] component induces a voltage in the receiving ***coil***, which is proportional to the rate of change of the magnetic field over time.

decay: In ***time-domain electromagnetic*** theory, the weakening over time of the ***eddy currents*** in the ground, and hence the ***secondary field*** after the ***primary field*** electromagnetic pulse is turned off. In ***gamma-ray spectrometry***, the radioactive breakdown of an element, generally potassium, uranium, thorium, or one of their ***daughter*** products.

decay series: In ***gamma-ray spectrometry***, a series of progressively lower energy ***daughter products*** produced by the radioactive breakdown of uranium or thorium.

decay constant: see time constant.

depth of exploration: The maximum depth at which the geophysical system can detect the target. The depth of exploration depends very strongly on the type and size of the target, the contrast of the target with the surrounding geology, the homogeneity of the surrounding geology, and the type of geophysical system. One measure of the maximum depth of exploration for an electromagnetic system is the depth at which it can detect the strongest conductive target – generally a highly conductive horizontal layer.

differential resistivity: A process of transforming ***apparent resistivity*** to an approximation of layer resistivity at each depth. The method uses multi-frequency HEM data and approximates the effect of shallow layer ***conductance*** determined from higher frequencies to estimate the deeper conductivities (Huang and Fraser, 1996)

dipole moment: [NIA] For a transmitter, the product of the area of a ***coil***, the number of turns of wire, and the current flowing in the coil. At a distance significantly larger than the size of the coil, the magnetic field from a coil will be the same if the dipole moment product is the same. For a receiver coil, this is the product of the area and the number of turns. The sensitivity to a magnetic field (assuming the source is far away) will be the same if the dipole moment is the same.

diurnal: The daily variation in a natural field, normally used to describe the natural fluctuations (over hours and days) of the earth's magnetic field.

dielectric permittivity: **[ε]** The capacity of a material to store electrical charge, this is most often measured as the relative permittivity [ε_r], or ratio of the material dielectric to that of free space. The effect of high permittivity may be seen in HEM data at high frequencies over highly resistive geology as a reduced or negative ***in-phase***, and higher ***quadrature*** data.

drift: Long-time variations in the base-level or calibration of an instrument.

eddy currents: The electrical currents induced in the ground, or other conductors, by a time-varying ***electromagnetic field*** (usually the ***primary field***). Eddy currents are also induced in the aircraft's metal frame and skin; a source of ***noise*** in EM surveys.

electromagnetic: **[EM]** Comprised of a time-varying electrical and magnetic field. Radio waves are common electromagnetic fields. In geophysics, an electromagnetic system is one which transmits a time-varying ***primary field*** to induce ***eddy currents*** in the ground, and then measures the ***secondary field*** emitted by those eddy currents.

energy window: A broad spectrum of ***gamma-ray*** energies measured by a spectrometric survey. The energy of each gamma-ray is measured and divided up into numerous discrete energy levels, called windows.

equivalent (thorium or uranium): The amount of radioelement calculated to be present, based on the gamma-rays measured from a **daughter** element. This assumes that the ***decay series*** is in equilibrium – progressing normally.

fiducial, or fid: Timing mark on a survey record. Originally these were timing marks on a profile or film; now the term is generally used to describe 1-second interval timing records in digital data, and on maps or profiles.

fixed-wing: Aircraft with wings, as opposed to "rotary wing" helicopters.

footprint: This is a measure of the area of sensitivity under the aircraft of an airborne geophysical system. The footprint of an ***electromagnetic*** system is dependent on the altitude of the system, the orientation of the transmitter and receiver and the separation between the receiver and transmitter, and the conductivity of the ground. The footprint of a ***gamma-ray spectrometer*** depends mostly on the altitude. For all geophysical systems, the footprint also depends on the strength of the contrasting ***anomaly***.

frequency domain: An ***electromagnetic*** system which transmits a ***primary field*** that oscillates smoothly over time (sinusoidal), inducing a similarly varying electrical current in the ground. These systems generally measure the changes in the ***amplitude*** and ***phase*** of the ***secondary field*** from the ground at different frequencies by measuring the **in-phase** and **quadrature** phase components. See also ***time-domain***.

full-stream data: Data collected and recorded continuously at the highest possible sampling rate. Normal data are stacked (see ***stacking***) over some time interval before recording.

gamma-ray: A very high-energy photon, emitted from the nucleus of an atom as it undergoes a change in energy levels.

gamma-ray spectrometry: Measurement of the number and energy of natural (and sometimes man-made) gamma-rays across a range of photon energies.

gradient: In magnetic surveys, the gradient is the change of the magnetic field over a distance, either vertically or horizontally in either of two directions. Gradient data is often measured, or calculated from the total magnetic field data because it changes more quickly over distance than the ***total magnetic field***, and so may provide a more precise measure of the location of a source. See also ***analytic signal***.

ground effect: The response from the earth. A common calibration procedure in many geophysical surveys is to fly to altitude high enough to be beyond any measurable response from the ground, and there establish ***base levels*** or ***backgrounds***.

half-space: A mathematical model used to describe the earth – as infinite in width, length, and depth below the surface. The most common halfspace models are ***homogeneous*** and ***layered earth***.

heading error: A slight change in the magnetic field measured when flying in opposite directions.

HEM: Helicopter ElectroMagnetic, This designation is most commonly used to helicopter-borne, ***frequency-domain*** electromagnetic systems. At present, the transmitter and receivers are normally mounted in a ***bird*** carried on a sling line beneath the helicopter.

herringbone pattern: a pattern created in geophysical data by an asymmetric system, where the **anomaly** may be extended to either side of the source, in the direction of flight. Appears like fish bones, or like the teeth of a comb, extending either side of centre, each tooth an alternate flight line.

homogeneous: This is a geological unit that has the same ***physical parameters*** throughout its volume. This unit will create the same response to an HEM system anywhere, and the HEM system will measure the same apparent ***resistivity*** anywhere. The response may change with system direction (see ***anisotropy***).

in-phase: the component of the measured ***secondary field*** that has the same phase as the transmitter and the ***primary field***. The in-phase component is stronger than the ***quadrature*** phase over relatively higher ***conductivity***.

induction: Any time-varying electromagnetic field will induce (cause) electrical currents to flow in any object with non-zero ***conductivity***. (see ***eddy currents***)

infinite: In geophysical terms, an “infinite’ dimension is one much greater than the ***footprint*** of the system, so that the system does not detect changes at the edges of the object.

International Geomagnetic Reference Field: **[IGRF]** An approximation of the smooth magnetic field of the earth, in the absence of variations due to local geology. Once the IGRF is subtracted from the measured magnetic total field data, any remaining variations are assumed to be due to local geology. The IGRF also predicts the slow changes of the field up to five years in the future.

inversion, or **inverse modeling**: A process of converting geophysical data to an earth model, which compares theoretical models of the response of the earth to the data measured, and refines the model until the response closely fits the measured data (Huang and Palacky, 1991)

layered earth: A common geophysical model which assumes that the earth is horizontally layered – the ***physical parameters*** are constant to ***infinite*** distance horizontally, but change vertically.

magnetic permeability: **[μ]** This is defined as the ratio of magnetic induction to the inducing magnetic field. The relative magnetic permeability [μ_r] is often quoted, which is the ratio of the rock permeability to the permeability of free space. In geology and geophysics, the ***magnetic susceptibility*** is more commonly used to describe rocks.

magnetic susceptibility: **[k]** A measure of the degree to which a body is magnetized. In SI units this is related to relative ***magnetic permeability*** by $k=\mu_r-1$, and is a dimensionless unit. For most geological material, susceptibility is influenced primarily by the percentage of magnetite. It is most often quoted in units of 10^{-6}. In HEM data this is most often apparent as a negative ***in-phase*** component over high susceptibility, high ***resistivity*** geology such as diabase dikes.

noise: That part of a geophysical measurement that the user does not want. Typically this includes electronic interference from the system, the atmosphere (***sferics***), and man-made sources. This can be a subjective judgment, as it may include the response from geology other than the target of interest. Commonly the term is used to refer to high frequency (short period) interference. See also ***drift***.

Occam's inversion: an ***inversion*** process that matches the measured ***electromagnetic*** data to a theoretical model of many, thin layers with constant thickness and varying resistivity (Constable et al, 1987).

off-time: In a ***time-domain electromagnetic*** survey, the time after the end of the ***primary field pulse***, and before the start of the next pulse.

on-time: In a ***time-domain electromagnetic*** survey, the time during the ***primary field pulse***.

phase: The angular difference in time between a measured sinusoidal electromagnetic field and a reference – normally the primary field. The phase is calculated from $\tan^{-1}$(***in-phase / quadrature***).

physical parameters: These are the characteristics of a geological unit. For electromagnetic surveys, the important parameters for electromagnetic surveys are ***conductivity***, ***magnetic permeability*** (or ***susceptibility***) and ***dielectric permittivity***; for magnetic surveys the parameter is magnetic susceptibility, and for gamma ray spectrometric surveys it is the concentration of the major radioactive elements: potassium, uranium, and thorium.

permittivity: see ***dielectric permittivity***.

permeability: see ***magnetic permeability***.

primary field: the EM field emitted by a transmitter. This field induces ***eddy currents*** in (energizes) the conductors in the ground, which then create their own ***secondary* fields**.

pulse: In time-domain EM surveys, the short period of intense ***primary*** field transmission. Most measurements (the ***off-time***) are measured after the pulse.

quadrature: that component of the measured ***secondary field*** that is phase-shifted 90° from the ***primary field***. The quadrature component tends to be stronger than the ***in-phase*** over relatively weaker ***conductivity***.

Q-coils: see ***calibration coil***.

radiometric: Commonly used to refer to ***gamma ray*** spectrometry.

radon: A radioactive daughter product of uranium and thorium, radon is a gas which can leak into the atmosphere, adding to the non-geological background of a gamma-ray spectrometric survey.

resistivity: **[ρ]** The strength with which the earth or a geological formation resists the flow of electricity, typically the flow induced by the ***primary field*** of the electromagnetic transmitter. Normally expressed in ohm-metres, it is the reciprocal of ***conductivity***.

resistivity-depth transforms: similar to ***conductivity depth transforms***, but the calculated ***conductivity*** has been converted to ***resistivity***.

resistivity section: an approximate vertical section of the resistivity of the layers in the earth. The resistivities can be derived from the ***apparent resistivity***, the ***differential resistivities***, ***resistivity-depth transforms***, or ***inversions***.

secondary field: The field created by conductors in the ground, as a result of electrical currents induced by the ***primary field*** from the ***electromagnetic*** transmitter. Airborne ***electromagnetic*** systems are designed to create, and measure a secondary field.

Sengpiel section: a ***resistivity section*** derived using the ***apparent resistivity*** and an approximation of the depth of maximum sensitivity for each frequency.

sferic: Lightning, or the ***electromagnetic*** signal from lightning, it is an abbreviation of "atmospheric discharge". These appear to magnetic and electromagnetic sensors as sharp "spikes" in the data. Under some conditions lightning storms can be detected from hundreds of kilometres away. (see ***noise***)

signal: That component of a measurement that the user wants to see – the response from the targets, from the earth, etc. (See also ***noise***)

skin depth: A measure of the depth of penetration of an electromagnetic field into a material. It is defined as the depth at which the primary field decreases to 1/e of the field at the surface. It is calculated by approximately 503 x √(resistivity/frequency). Note that depth of penetration is greater at higher ***resistivity*** and/or lower ***frequency.***

spectrometry: Measurement across a range of energies, where ***amplitude*** and energy are defined for each measurement. In gamma-ray spectrometry, the number of gamma rays are measured for each energy ***window***, to define the ***spectrum***.

spectrum: In ***gamma ray spectrometry***, the continuous range of energy over which gamma rays are measured. In ***time-domain electromagnetic*** surveys, the spectrum is the energy of the **pulse** distributed across an equivalent, continuous range of frequencies.

spheric: see ***sferic***.

stacking: Summing repeat measurements over time to enhance the repeating ***signal***, and minimize the random ***noise***.

stripping: Estimation and correction for the gamma ray photons of higher and lower energy that are observed in a particular ***energy window***. See also ***Compton scattering***.

susceptibility: See ***magnetic susceptibility***.

tau: [τ] Often used as a name for the ***time constant***.

TDEM: ***time domain electromagnetic***.

thin sheet: A standard model for electromagnetic geophysical theory. It is usually defined as thin, flat-lying, and ***infinite*** in both horizontal directions. (see also ***vertical plate***)

tie-line: A survey line flown across most of the ***traverse lines***, generally perpendicular to them, to assist in measuring ***drift*** and ***diurnal*** variation. In the short time required to fly a tie-line it is assumed that the drift and/or diurnal will be minimal, or at least changing at a constant rate.

time constant: The time required for an ***electromagnetic*** field to decay to a value of 1/e of the original value. In ***time-domain*** electromagnetic data, the time constant is proportional to the size and ***conductance*** of a tabular conductive body. Also called the decay constant.

Time channel: In ***time-domain electromagnetic*** surveys the decaying ***secondary field*** is measured over a period of time, and the divided up into a series of consecutive discrete measurements over that time.

time-domain: ***Electromagnetic*** system which transmits a pulsed, or stepped ***electromagnetic*** field. These systems induce an electrical current (***eddy current***) in the ground that persists after the ***primary field*** is turned off, and measure the change over time of the ***secondary field*** created as the currents ***decay***. See also ***frequency-domain***.

total energy envelope: The sum of the squares of the three ***components*** of the ***time-domain electromagnetic secondary field***. Equivalent to the ***amplitude*** of the secondary field.

transient: Time-varying. Usually used to describe a very short period pulse of ***electromagnetic*** field.

traverse line: A normal geophysical survey line. Normally parallel traverse lines are flown across the property in spacing of 50 m to 500 m, and generally perpendicular to the target geology.

vertical plate: A standard model for electromagnetic geophysical theory. It is usually defined as thin, and ***infinite*** in horizontal dimension and depth extent. (see also ***thin shee***t)

waveform: The shape of the ***electromagnetic pulse*** from a ***time-domain*** electromagnetic transmitter.

window: A discrete portion of a ***gamma-ray spectrum*** or ***time-domain electromagnetic decay***. The continuous energy spectrum or ***full-stream*** data are grouped into windows to reduce the number of samples, and reduce ***noise***.

Version 1.1, March 10, 2003
Greg Hodges,
Chief Geophysicist
Fugro Airborne Surveys, Toronto

Common Symbols and Acronyms

k	Magnetic susceptibility
ε	Dielectric permittivity
μ, μ_r	Magnetic permeability, apparent permeability
ρ, ρ_a	Resistivity, apparent resistivity
σ,σ_a	Conductivity, apparent conductivity
σt	Conductivity thickness
τ	Tau, or time constant
Ω.m	Ohm-metres, units of resistivity
AGS	Airborne gamma ray spectrometry.
CDT	Conductivity-depth transform, conductivity-depth imaging (Macnae and Lamontagne, 1987; Wolfgram and Karlik, 1995)
CPI, CPQ	Coplanar in-phase, quadrature
CPS	Counts per second
CTP	Conductivity thickness product
CXI, CXQ	Coaxial, in-phase, quadrature
fT	femtoteslas, normal unit for measurement of B-Field
EM	Electromagnetic
keV	kilo electron volts – a measure of gamma-ray energy
MeV	mega electron volts – a measure of gamma-ray energy 1MeV = 1000keV
NIA	dipole moment: turns x current x Area
nT	nano-Tesla, a measure of the strength of a magnetic field
ppm	parts per million – a measure of secondary field or noise relative to the primary.
pT/s	picoTeslas per second: Units of decay of secondary field, dB/dt
S	Siemens – a unit of conductance
x:	the horizontal component of an EM field parallel to the direction of flight.
y:	the horizontal component of an EM field perpendicular to the direction of flight.
z:	the vertical component of an EM field.

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Macnae, J. and Lamontagne, Y., 1987, Imaging quasi-layered conductive structures by simple processing of transient electromagnetic data: Geophysics, v52, 4, 545-554.

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APPENDIX E

ARCHIVE DESCRIPTION

- Appendix E.1 -

Fugro Archive Summary

Reference: CDVD00878
# of DVD's: 1
Archive Date: December 01, 2011

This archive contains FINAL data and grids of an airborne DighemV electromagnetic and magnetic geophysical survey over the MacPass and Ben Claims, Yukon, conducted by FUGRO AIRBORNE SURVEYS CORP. on behalf of Colorado Resources Ltd., flown from July 11 to August 3, 2011.

Job # 11046

******* Disc 1 of 1 *******

\GRIDS Grids in Geosoft format (with associated GI files)

Ben_CVG.GRD	- Calculated Vertical Magnetic Gradient nT/m
Ben_MAG.GRD	- Residual Magnetic Intensity nT
Ben_RES900.GRD	- Apparent Resistivity 900 Hz ohm•m
Ben_RES7200.GRD	- Apparent Resistivity 7200 Hz ohm•m
Ben_RES56K.GRD	- Apparent Resistivity 56k Hz ohm•m
MacPass_CVG.GRD	- Calculated Vertical Magnetic Gradient nT/m
MacPass_MAG.GRD	- Residual Magnetic Intensity nT
MacPass_RES900.GRD	- Apparent Resistivity 900 Hz ohm•m
MacPass_RES7200.GRD	- Apparent Resistivity 7200 Hz ohm•m
MacPass_RES56K.GRD	- Apparent Resistivity 56k Hz ohm•m

\LINEDATA

Ben.GDB	- Data archive in Geosoft GDB format
Ben.XYZ	- Data archive in Geosoft ASCII format
AEM_Ben.XYZ	- Anomaly archive in ASCII format
MacPass.GDB	- Data archive in Geosoft GDB format
MacPass.XYZ	- Data archive in Geosoft ASCII format
AEM_Pass.XYZ	- Anomaly archive in ASCII format

\MAPS\GEOSOFT Final colour maps in Geosoft format (* represents sheet 1, 2, 3, 4, or 6)

Ben_AEM.MAP	- Electromagnetic Anomalies sheet
Ben_CVG.MAP	- Calculated Vertical Magnetic Gradient nT/m sheet
Ben_MAG.MAP	- Residual Magnetic Intensity nT sheet
Ben_RES900.MAP	- Apparent Resistivity 900 Hz ohm•m sheet
Ben_RES7200.MAP	- Apparent Resistivity 7200 Hz ohm•m sheet
Ben_RES56K.MAP	- Apparent Resistivity 56 KHz ohm•m sheet
MacPass_AEM-*.MAP	- Electromagnetic Anomalies sheet

MacPass_CVG-*.MAP	- Calculated Vertical Magnetic Gradient nT/m sheet
MacPass_MAG-*.MAP	- Residual Magnetic Intensity nT sheet
MacPass_RES900-*.MAP	- Apparent Resistivity 900 Hz ohm•m sheet
MacPass_RES7200-*.MAP	- Apparent Resistivity 7200 Hz ohm•m sheet
MacPass_RES56K-*.MAP	- Apparent Resistivity 56 KHz ohm•m sheet

\MAPS\PDF Final colour maps in PDF format (* represents sheet 1, 2, 3, 4, or 6)

Ben_AEM.MAP	- Electromagnetic Anomalies sheet
Ben_CVG.MAP	- Calculated Vertical Magnetic Gradient nT/m sheet
Ben_MAG.MAP	- Residual Magnetic Intensity nT sheet
Ben_RES900.MAP	- Apparent Resistivity 900 Hz ohm•m sheet
Ben_RES7200.MAP	- Apparent Resistivity 7200 Hz ohm•m sheet
Ben_RES56K.MAP	- Apparent Resistivity 56 KHz ohm•m sheet

MacPass_AEM-*.MAP	- Electromagnetic Anomalies sheet
MacPass_CVG-*.MAP	- Calculated Vertical Magnetic Gradient nT/m sheet
MacPass_MAG-*.MAP	- Residual Magnetic Intensity nT sheet
MacPass_RES900-*.MAP	- Apparent Resistivity 900 Hz ohm•m sheet
MacPass_RES7200-*.MAP	- Apparent Resistivity 7200 Hz ohm•m sheet
MacPass_RES56K-*.MAP	- Apparent Resistivity 56 KHz ohm•m sheet

\REPORT

R11046.PDF	- Interpretation Report
Anomalies_11046a_MacPass.PDF	- Anomaly Table, Mac Pass Claim Group area
Anomalies_11046b_Ben.PDF	- Anomaly Table, Ben Claims Area

\VECTORS Final vectors files in DXF format (* represents sheet 1, 2, 3, 4, or 6)

FP_Ben.DXF	- Flightpath
AEM_Ben.DXF	- Anomaly Picks
Interp_Ben.DXF	- Interpretation

FP_MacPass-*.DXF	- Flighpath
AEM_MacPass-*.DXF	- Anomaly Picks
Interp_MacPass-*.DXF	- Interpretation

****

GEOSOFT GDB and XYZ ARCHIVE SUMMARY

#	CHANNEL NAME	TIME	UNITS	DESCRIPTION
1	x	0.1	m	easting NAD 83 (UTM Zone 9)
2	y	0.1	m	northing NAD 83 (UTM Zone 9)
3	fid	0.1		fiducial increment
4	longitude	0.1	degrees	longitude WGS 84
5	latitude	0.1	degrees	latitude WGS 84
6	flight	0.1		flight number

7	date	0.1		flight date (yyyy/mm/dd)
8	altrad_bird	0.1	m	calculated bird height above surface from radar altimeter
9	altlas_bird	0.1	m	measured bird height above surface from laser altimeter
10	gpsz	0.1	m	bird height above spheroid
11	dtm	0.1	m	digital terrain model (above WGS 84 datum)
12	diurnal_filt	1.0	nT	measured diurnal ground magnetic intensity
13	diurnal_cor	0.1	nT	diurnal correction - base removed
14	mag_raw	0.1	nT	total magnetic field - spike rejected
15	mag_lag	0.1	nT	total magnetic field - corrected for lag
16	mag_diu	0.1	nT	total magnetic field - diurnal variation removed
17	igrf	0.1	nT	international geomagnetic reference field
18	mag_rmi	0.1	nT	residual magnetic intensity - final
19	cpi900_filt	0.1	ppm	coplanar inphase 900 Hz - unlevelled
20	cpq900_filt	0.1	ppm	coplanar quadrature 900 Hz - unlevelled
21	cxi1000_filt	0.1	ppm	coaxial inphase 1000 Hz - unlevelled
22	cxq1000_filt	0.1	ppm	coaxial quadrature 1000 Hz - unlevelled
23	cxi5500_filt	0.1	ppm	coaxial inphase 5500 Hz - unlevelled
24	cxq5500_filt	0.1	ppm	coaxial quadrature 5500 Hz -unlevelled
25	cpi7200_filt	0.1	ppm	coplanar inphase 7200 Hz - unlevelled
26	cpq7200_filt	0.1	ppm	coplanar quadrature 7200 Hz -unlevelled
27	cpi56k_filt	0.1	ppm	coplanar inphase 56 kHz - unlevelled
28	cpq56k_filt	0.1	ppm	coplanar quadrature 56 kHz - unlevelled
29	cpi900	0.1	ppm	coplanar inphase 900 Hz
30	cpq900	0.1	ppm	coplanar quadrature 900 Hz
31	cxi1000	0.1	ppm	coaxial inphase 1000 Hz
32	cxq1000	0.1	ppm	coaxial quadrature 1000 Hz
33	cxi5500	0.1	ppm	coaxial inphase 5500 Hz
34	cxq5500	0.1	ppm	coaxial quadrature 5500 Hz
35	cpi7200	0.1	ppm	coplanar inphase 7200 Hz
36	cpq7200	0.1	ppm	coplanar quadrature 7200 Hz
37	cpi56k	0.1	ppm	coplanar inphase 56 kHz
38	cpq56k	0.1	ppm	coplanar quadrature 56 kHz
39	res900	0.1	ohm·m	apparent resistivity - 900 Hz
40	res7200	0.1	ohm·m	apparent resistivity - 7200 Hz
41	res56k	0.1	ohm·m	apparent resistivity - 56 kHz
42	dep900	0.1	m	apparent depth - 900 Hz
43	dep7200	0.1	m	apparent depth - 7200 Hz
44	dep56k	0.1	m	apparent depth - 56 kHz
45	difi	0.1		difference channel based on cxi5500/cpi7200
46	difq	0.1		difference channel based on cxq5500/cpq7200
47	cppl	0.1		coplanar powerline monitor
48	cxsp	0.1		coaxial spherics monitor
49	cpsp	0.1		coplanar spherics monitor

FUGRO ANOMALY SUMMARY

#	CHANNEL NAME	TIME	UNITS	DESCRIPTION

- Appendix E.4 -

1	Easting	0.10	m	easting NAD83 (Zone 9N)
2	Northing	0.10	m	northing NAD83 (Zone 9N)
3	FID	1.00		Synchronization Counter
4	FLT	0.10		Flight
5	MHOS	0.10	siemens	Conductance (see report for model used)
6	DEPTH	0.10	m	Depth (see report for model used)
7	MAG	0.10	nT	Mag Correlation, local amplitude
8	CXI1	0.10	ppm	Inphase Coaxial 5500 Hz, local amplitude
9	CXQ1	0.10	ppm	Quadrature Coaxial 5500 Hz, local amplitude
10	CPI1	0.10	ppm	Inphase Coplanar 7200 Hz, absolute amplitude
11	CPQ1	0.10	ppm	Quadrature Coplanar 7200 Hz, absolute amplitude
12	CPI2	0.10	ppm	Inphase Coplanar 56000 Hz, absolute amplitude
13	CPQ2	0.10	ppm	Quadrature Coplanar 56000 Hz, absolute amplitude
14	LET	0.10		Anomaly Identifier
15	SYM	0.10		Anomaly Interpretation Symbol
16	GRD	0.10		Anomaly Grade

The coordinate system for all grids and the data archive is projected as follows

Datum	NAD83
Spheroid	GRS80
Central meridian	129 West (Zone 9N)
False easting	500000
False northing	0
Scale factor	0.9996
Northern parallel	N/A
Base parallel	N/A
WGS84 to local conversion method	Molodensky
Delta X shift	0
Delta Y shift	0
Delta Z shift	0

If you have any problems with this archive please contact

Fugro Airborne Surveys Corp.
2505 Meadowvale Boulevard
Mississauga, Ontario
Canada L5N 5S2
Phone   +1 905 812 0212
Fax   +1 905 812 1504
Website www.fugroairborne.com