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PART 1 of 2
RPT 1 & 2

REPORT ON
COMBINED HELICOPTER-BORNE
MAGNETIC AND VLF SURVEY
FORT ST. JAMES
BRITISH COLUMBIA

FOR
GOLDEN RULE RESOURCES
BY
AERODAT LIMITED
December 10, 1990

Ed Hamilton

J9058

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(Scale 1:10,000)

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     Showing VLF total field response from the line transmitter with flight lines, fiducials, and base map.

1. INTRODUCTION

This report describes an airborne geophysical survey carried out on behalf of Golden Rule Resources. Equipment operated during the survey included a high sensitivity cesium vapour magnetometer, a two frequency VLF-EM system, a video tracking camera, radar altimeter, and an electronic positioning system. Magnetic and altimeter data were recorded both in digital and analog forms. Positioning data was stored in digital form, encoded on VHS format video tape and recorded at regular intervals in local UTM coordinates, as well as being marked on the flight path mosaic by the operator while in flight.

The survey area is located approximately 175 kilometres north-northwest of Fort St. James, British Columbia. Data from twenty eight (28) flights were used to compile the survey results. The flight lines were oriented at an angle of 90 degrees, with a nominal line spacing of 100 metres (according to Appendix "A" of the contract). Geophysical information is provided in the form of maps at 1:10,000. Coverage and data quality were considered to be well within the specifications described in the service contract.

The purpose of the survey was to record airborne geophysical data over ground that is of interest to Golden Rule Resources.

The survey encompasses approximately 2630 line kilometres of the recorded data that were compiled in a map form at a scale of 1:10,000. The maps are presented as part of this report according to specifications laid out by Golden Rule Resources.

2. SURVEY AREA LOCATION

The survey area is depicted on the following index map.

Block 1 is centred at approximate geographic latitude 55 degrees 5 minutes North, longitude 125 degrees 15 minutes West.
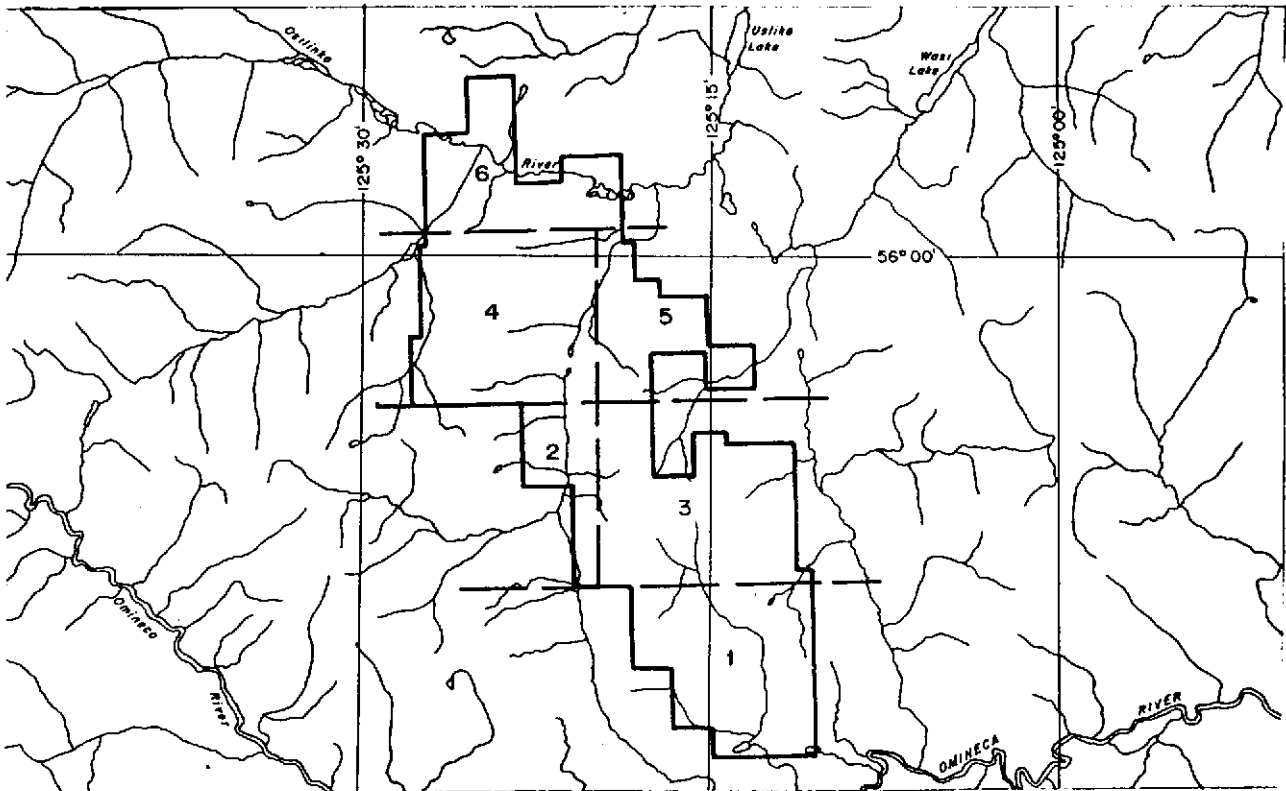
3. AIRCRAFT AND EQUIPMENT

3.1   Aircraft

An Aerospatiale A-Star 350 B helicopter, (C-GYHT), piloted by George Hawkins, owned

and operated by Peace Helicopters Limited, was used for the survey.   Kevin McCart of

Aerodat acted as navigator and equipment operator.   Installation of the geophysical and

ancillary equipment was carried out by Aerodat.   The survey equipment was flown at a

mean terrain clearance of 60 metres.

3.2   Equipment

3.2.1   VLF-EM System

The VLF-EM System was a Herz Totem 2 A. This instrument measures the total

field and quadrature component of the selected frequency. The sensor was towed

in a bird 30 metres below the helicopter.

3.2.2   Magnetometer System

The magnetometer employed a Scintrex Model VIW 2321 H8 cesium, optically

pumped magnetometer sensor. The sensitivity of this instrument was 0.1

nanoTeslas. The sensor was towed in a bird 30 metres below the helicopter.

3.2.3 Magnetic Base Station

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

3.2.4 Altimeter System

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

3.2.5 Tracking Camera

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

3.2.6 Analog Recorder

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

Channel	Input	Scale
VLT	VLF-EM Total Field, Line	25 %/cm
VLQ	VLF-EM Quadrature, Line	25 %/cm
VOT	VLF-EM Total Field, Ortho	25 %/cm
VOQ	VLF-EM Quadrature, Ortho	25 %/cm
RALT	Radar Altimeter	100 ft./cm
MAGF	Magnetometer, fine	25 nT/cm
MAGC	Magnetometer, coarse	250 nT/cm

3.2.7 Digital Recorder

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

Equipment	Recording Interval
VLF-EM	0.20 seconds
Magnetometer	0.20 seconds
Altimeter	0.20 seconds
Nav System	0.20 seconds

3.2.8 Radar Positioning System

A Mini-Ranger MRS-III radar navigation system was used for both navigation and flight path recovery. Transponders sited at fixed locations were interrogated

several times per second and the ranges from these points to the helicopter were measured to a high degree of accuracy. A navigational computer triangulated the position of the helicopter and provided the pilot with navigation information. The range/range data was recorded on magnetic tape for subsequent flight path determination.

4. DATA PRESENTATION

4.1   Base Map

An orthophotomosaic base map at a scale of 1:10,000 was supplied by Golden Rule Resources.

4.2   Flight Path Map

The flight path was derived from the Mini-Ranger radar positioning system. The distance from the helicopter to two established reference locations was measured several times per second and the position of the helicopter was calculated by triangulation. It is estimated that the flight path is generally accurate to about 10 metres with respect to the topographic detail on the base map.

The flight lines have the time and the navigator's manual fiducials for cross reference to both analog and digital data.

4.3   Magnetics

4.3.1   Total Field Magnetic Contours Map

The magnetic data from the high sensitivity cesium magnetometer provided virtually a continuous magnetic reading when recording at 0.2 second intervals. The system is also noise free for all practical purposes.

A sensitivity of 0.1 nanoTesla (nT) allows for the mapping of very small inflections in the magnetic field, resulting in a contour map that is equal to or exceeds ground data in quality and accuracy.

The aeromagnetic data was corrected for diurnal variations by adjustment with the digitally recorded base station magnetic values. No correction for regional variation was applied. The corrected data was interpolated onto a regular grid at a 25 metre true scale interval using an Akima spline technique. This grid provided the basis for threading the presented contours at a 2 nT interval.

The contoured aeromagnetic data has been presented on a Cronaflex copy of the base map with flight lines.

4.3.2   Vertical Gradient Contour Map

The vertical magnetic gradient was calculated from the total field magnetic data. Contoured at a 0.2 Nt/m interval, the data was presented on a cronaflex copy of the base map with flight lines.

4.4   VLF-EM Total Field Contours

The VLF data was interpolated onto a regular grid at a 25 metre true scale interval using an Akima spline technique. This grid provided the basis for threading the contours at a 2% interval.

The VLF-EM signal from the line transmitting station was compiled as contours in map form on cronaflex copies of the base map with flight lines.

The VLF stations used for the survey area were NAA, Cutler Maine, U.S.A., broadcasting at 24.0 kHz, NSS, Annapolis, Md., U.S.A., broadcasting at 21.4 kHz, and NPM, Lualualei, Hawaii, broadcasting at 23.4 kHz.

NAA was used as the line transmitting station for flights 1-3 and flight 8. NSS was used as the line transmitting station for flights 4-28.

NPM, was used for flights 1-8 and NAA was used for flights 9-28 as the orthogonal station.

Respectfully submitted,

December 10, 1990   Ed Hamilton

APPENDIX I

PERSONNEL

FIELD

Flown   August/September, 1990

Pilot   George Hawkins

Operator   Kevin McCart

OFFICE

Processing   E. Hamilton
                G. McDonald

Report   E. Hamilton

APPENDIX II

GENERAL INTERPRETIVE CONSIDERATIONS

Magnetics

A digital base station magnetometer was used to detect fluctuations in the magnetic field during flight times. The airborne magnetic data was levelled by removing these diurnal changes. The Total Field Magnetic map shows the levelled magnetic contours, uncorrected for regional variation.

The Calculated Vertical Gradient map shows contours of the magnetic gradient as calculated from the total field magnetic data. The zero contour shows changes in the magnetic lithologies and will coincide closely with geologic contacts assuming a steeply dipping interface. Thus this data may be used as a pseudo-geologic map.

VLF Electromagnetics

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

The relatively high frequency of VLF (15-25) kHz provides high response factors for bodies of low conductance. Relatively "disconnected" sulphide ores have been found to produce

measurable VLF signals. For the same reason, poor conductors such as sheared

contacts, breccia zones, narrow faults, alteration zones and porous flow tops normally

produce VLF anomalies. The method can therefore be used effectively for geological mapping.

The only relative disadvantage of the method lies in its sensitivity to conductive overburden. In

conductive ground to depth of exploration is severely limited.

The effect of strike direction is important in the sense of the relation of the conductor axis

relative to the energizing electromagnetic field. A conductor aligned along a radius drawn from

a transmitting station will be in a maximum coupled orientation and thereby produce a stronger

response than a similar conductor at a different strike angle. Theoretically, it would be possible

for a conductor, oriented tangentially to the transmitter to produce no signal. The most obvious

effect of the strike angle consideration is that conductors

favourably oriented with respect to the transmitter location and also near perpendicular to the

flight direction are most clearly rendered and usually dominate the map presentation.

The total field response is an indicator of the existence and position of a conductivity anomaly.

The response will be a maximum over the conductor, without any special filtering, and strongly

favour the upper edge of the conductor even in the case of a relatively shallow dip.

The vertical quadrature component over steeply dipping sheet-like conductor will be a cross-over

type response with the cross-over closely associated with the upper edge of the conductor.

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

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

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

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