

## ASSESSMENT REPORT TITLE PAGE AND SUMMARY

#### TITLE OF REPORT: Geophysical Report Eagle Property

#### **TOTAL COST:**\$15,927

AUTHOR(S): P. E. Fox PhD P.Eng

SIGNATURE(S):

NOTICE OF WORK PERMIT NUMBER(S)/DATE(S): STATEMENT OF WORK EVENT NUMBER(S)/DATE(S):

5553864, May 6, 2015

YEAR OF WORK: 2015 PROPERTY NAME: Eagle CLAIM NAME(S) (on which work was done): 603472, 508613

COMMODITIES SOUGHT: Copper Molybdenum silver gold

MINERAL INVENTORY MINFILE NUMBER(S), IF KNOWN: 93N91,92,139

 MINING DIVISION: Omenica

 NTS / BCGS: 93N2

 LATITUDE: \_\_54\_\_\_\_\_° \_\_12\_\_\_\_\_' \_\_\_\_\_"

 LONGITUDE: \_\_124\_\_\_\_\_° \_\_52' \_\_\_\_\_" (at centre of work)

 UTM Zone:
 10

 EASTING:
 531307

OWNER(S): Rich rock Resources

MAILING ADDRESS:

910-475 West Georgia St, Vancouver, BC

OPERATOR(S) [who paid for the work]: Rich Rock resources

MAILING ADDRESS: 910-475 West Georgia St Vancouver BC

REPORT KEYWORDS (lithology, age, stratigraphy, structure, alteration, mineralization, size and attitude. **Do not use abbreviations or codes**) Upper Triassic Quesnellia Molybdenum Copper gold propylitic alteration

REFERENCES TO PREVIOUS ASSESSMENT WORK AND ASSESSMENT REPORT NUMBERS: Worth and Bidwell, aris report 29671; Fox (2010), Geohysical report aris 31689; Fox (2012) Geophysical report aris 33354.

TYPE OF WORK IN THIS REPORT	EXTENT OF WORK (in metric units)	ON WHICH CLAIMS	PROJECT COSTS APPORTIONED (incl. support)
GEOLOGICAL (scale, area)			
Ground, mapping			
Photo interpretation			
GEOPHYSICAL (line-kilometres)			
Ground			
Magnetic	17.5 km	603472 508613,	15,927
Electromagnetic			
Induced Polarization			
Radiometric			
Seismic			
Other			
Airborne			
GEOCHEMICAL (number of samples	analysed for)		
Soil			
Silt			
Rock			
Other			
DRILLING (total metres, number of he	oles, size, storage location)		
Core			
Non-core			
RELATED TECHNICAL			
Sampling / Assaying			
Petrographic			
Mineralographic			
Metallurgic			
PROSPECTING (scale/area)			
PREPATORY / PHYSICAL			
Line/grid (km)			
Topo/Photogrammetric (scale	, area)		
Legal Surveys (scale, area)			
Road, local access (km)/trail			
Trench (number/metres)			
Underground development (m	etres)		
Other			
		TOTAL COST	\$ 15,9 27

ASSESSMENT REPORT

# **GEOPHYSICAL REPORT**

on the

# EAGLE PROPERTY

Eagle 3-8 Claims

**Omineca Mining Division** 

NTS93N02

Latitude 54°12, Longitude 124°52

UTM 313017E, 6009569N (10)

RICH ROCK RESOURCES INC

910-475 West Georgia St Vancouver, BC

By

P. E. Fox, PhD., P.Eng

May 10, 2015

EVENT # 5553864

SUMMARY1
INTRODUCTION2
LOCATION AND ACCESS2
CLAIMS2
HISTORY2
REGIONAL GEOLOGY5
GEOLOGY5
MINERALIZATION7
WORK PROGRAM9
INTERPRETATION10
CONCLUSIONS AND RECOMMENDATIONS10
EXPENDITURES12
STATEMENT OF QUALIFICATIONS13
APPENDIX I15

# TABLE OF CONTENTS

# LIST OF TABLES

TABLE 1: CLAIM STATUS	5
TABLE 2: EXPENDITURES	12

## LIST OF FIGURES

FIGURE 1: LOCATION MAP	4
FIGURE 2: CLAIM MAP	6
FIGURE 3: REGIONAL GELOGY	8
FIGURE 4: GEOLOGY AND TMI MAP	11

## APPENDECES

#### SUMMARY

The Eagle property is underlain by diorite and granodiorite of the Upper Triassic to Lower Jurassic Hogem Batholith and sediments of the Takla Group. The property has been the object of numerous geophysical surveys, soil geochemical surveys and two phases of diamond drilling. Three areas of copper mineralization have been identified along a northwest-trending zone within the Hogem Batholith, known as the Vector, Mid and Nighthawk Zones. Mineralization here consists of chalcopyrite, pyrite, malachite and minor azurite along fractures and shear zones. The nearby Gibson gold-silver prospect lies in hornfelsed Takla sediments near the Hogem contact 400m southwest of the Nighthawk zone.

This report details a ground magnetic magnetic survey completed on April 7<sup>th</sup> and 8<sup>th</sup>, 2015. The work comprised 17.5 km of surveying by Meridian Mapping Ltd.. Expenditures are \$15,927. The purpose of the program was to identify the trace of Hogem batholith contact in this part of the property, an area largely devoid of outcrop.

### INTRODUCTION

The Eagle property has received considerable exploration work since its discovery in 1966. Work by Noranda Exploration in 1989-1991. Birch Mountain Resources in 1996 identified several porphyry targets and the Gibson gold-silver-base metal target in the southwest part of the property

Work this year comprised 17.5 km of magnetic ground survey completed on April 7<sup>th</sup>/ 8<sup>th</sup>, 2015 by Meridian Mapping Ltd. Results are detailed herein. Expenditures were \$15, 927. Work was paid for by Rich Rock Resources Inc.

## LOCATION AND ACCESS

.The property is located (Figure 1) on map sheet 93N02 at co-ordinates 54<sup>0</sup> 12' N and 124<sup>o</sup> 52'W in the Omineca Mining Division. Access to the property is by road from Fort St James to the west end of Tchlento Lake, a distance of 100 kms. The property is reached by a BCFS road east for 15km to the west boundary of the property and another four km to the Vector zone area.

#### CLAIMS

The property consists of eight claims comprising 4,543 hectares as set out in Table 1. A claim map is given in Figure 2. The work program was completed between April 7<sup>th</sup> and 8<sup>th</sup>, 2015. Expiry dates shown assume the work presented herein is accepted for assessment work purposes. Work was recorded under event no.5553864 and filed on May 6, 2015

## HISTORY

West Coast Mining and Exploration Company completed an I.P. survey over the Nighthawk (Eagle) copper showings in 1966. A second I.P. survey was carried

out in 1967 to cover an expanded grid surrounding the Nighthawk showings. Noranda Exploration optioned the property in 1971 and conducted EM, magnetometer, I.P. and geochemical surveys. Some 915m of diamond drilling were completed in 1971 and 1974. A.D. Halleran staked the property in July 1988. Subsequently Noranda optioned the prospect and conducted an exploration program in 1989, including 57 km of line cutting, 35 km of magnetometer and 13 km of I.P. surveying. Noranda also collected 1362 soil samples.

In 1990, Noranda continued exploration with detailed geological, geochemical and I.P. surveys.. The 1990 geochemical survey outlined the Gibson zone to the west of the Hogem Batholith. A small hand trench here led to the discovery of the Gibson zone zinc-lead gold-silver mineralization. The showing was then followed up by geochemical, geological and I.P. surveys. In 1991, Noranda conducted diamond drilling to test several coincident magnetic, induced polarization and geochemical anomalies. The program consisted of 1483.3m of diamond drilling in 17 holes, of which 9 holes (657.3m) were drilled to test the Gibson showing.

Birch Mountain Resources Ltd. optioned the property in 1996 and completed geological mapping, soil geochemical sampling and Max-Min and magnetometer surveys over most of the claim area. This grid was extended to the Gibson zone where 8.2 km of lines were cut. A ground magnetometer survey and a horizontal loop (Max-Min) survey were conducted along these grids in1996. In early September, 1838.6m of diamond drilling were completed on the nearby Vector and Nighthawk zones. Geoinfomatics Exploration optioned the property in 2007 and compiled much of the prior data from Aris reports for the Nighthawk and other copper occurrences on the property. Rich Rock Resources completed airborne magnetic surveys in 2010 and 2012.



Tenure No	Name	Expiry date	Area (Ha)
508613		Nov 25, 2015	1569.8
508615		Nov 25, 2015	1366
603472	EAGLE 3	Nov 25, 2015	332.4
603473	EAGLE 4	Nov 25, 2015	443.4
603547	EAGLE 5	Nov 25, 2015	55.4
603852	EAGLE 6	Nov 25, 2015	258.7
796002	EAGLE 7	Nov 25, 2015	388
796022	EAGLE 8	Nov 25, 2015	129.4

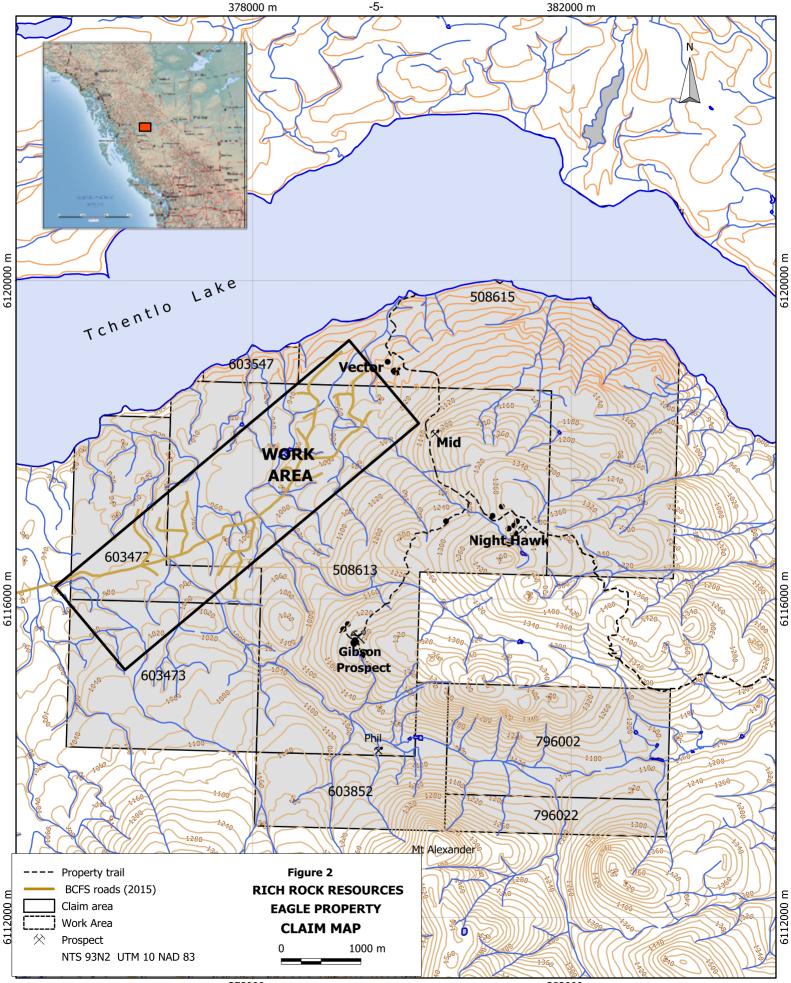
Table 1. Claim Data

## **REGIONAL GEOLOGY**

The Eagle property is located within a northwesterly trending belt of largely volcanic strata comprising Upper Triassic to Lower Jurassic Takla Group volcanics and sediments that have been intruded by a series of felsic to ultramafic stocks and batholiths of alkalic affinity (Figure 3). These intrusions, which are associated with a number of copper-gold deposits, generally lie in a northwest belt from Inzana Lake in the south to Chuchi Lake (and beyond). The Takla Group rocks form part of a large Upper Triassic volcanic arc (the Quesnellia Terrane) lying offshore of the North American continental plate. Rocks at the Eagle property include greywacke, shale, and argillite of the Inzana Lake Formation cut by the regionally extensive Hogem batholith. A regional geological map is given in Figure 3. Numerous copper-gold prospects occur throughout the district.

## GEOLOGY

The Eagle property is underlain predominantly by rocks of the Hogem Batholith and hornfelsed siltstone of the Takla Group (Inzana Lake Formation, Figure 4).



378000 m

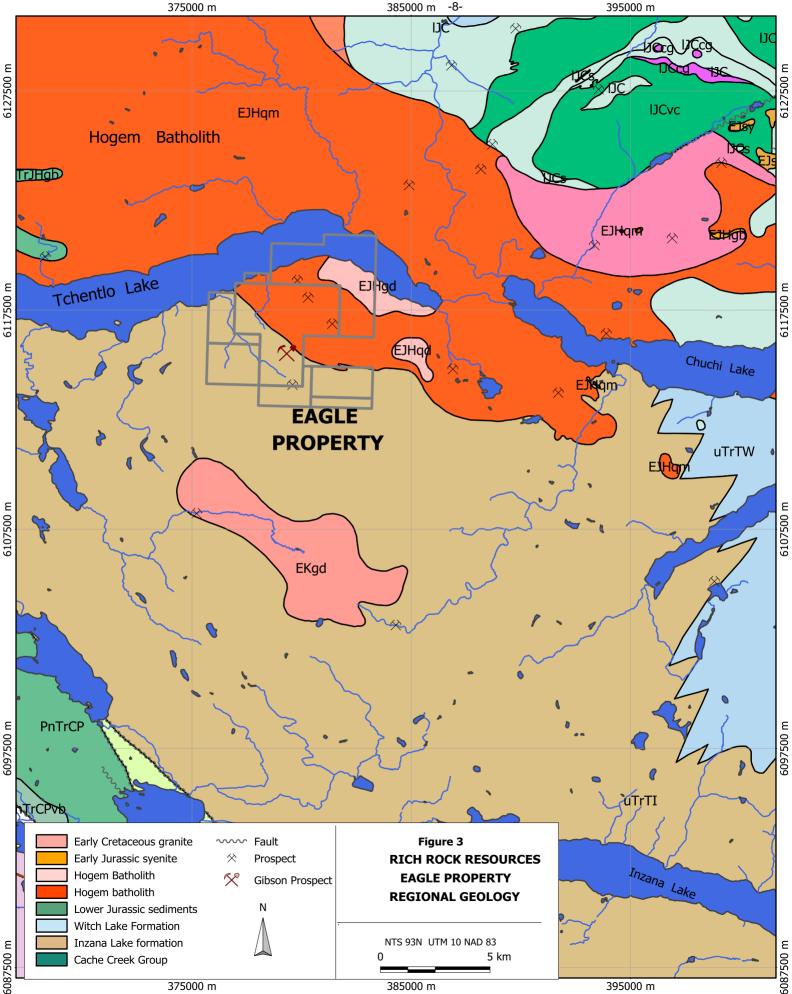
382000 m

The dominant intrusive phase of the Hogem is a medium-grey, equigranular, medium-grained diorite consisting of 80% plagioclase, 10% hornblende, 5% augite, magnetite and 5% biotite, with minor or trace chlorite, epidote and actinolite. A less common phase is a light- to medium-grey, coarse- to medium-grained monzonite, consisting of 60% plagioclase, 20% K-feldspar, 10% hornblende, 5-10% augite, magnetite and 5% biotite, with minor chlorite, apatite, tourmaline and epidote. North of the Nighthawk zone, an irregularly-shaped body of dark grey, coarse-grained gabbro contains plagioclase, pyroxene, magnetite and biotite, with minor hornblende, chlorite, epidote, and actinolite.

The contact between the Hogem Batholith and the Takla rocks is present in the northeast part of the Gibson Zone where the volcanic rocks are hornfelsed and generally contain 2-5% disseminated pyrite and trace amounts of chalcopyrite. The Hogem diorite near the contact is usually altered and contains minor or trace pyrite, chalcopyrite and malachite. Away from the contact, the volcanic rocks are generally light purple to medium-grey fine-grained and hornfelsed. In some areas, remnant bedding may indicate that the rocks may have been volcanic tuffs.

#### MINERALIZATION

A number of mineralized zones have been found on the Eagle property to date referred to as the Gibson Zone, the Nighthawk Zone, the Vector Zone and the Mid Zone (Stewart 1990). The latter three comprise the Main zone, which has received most of the exploration work and drilling to date. The Nighthawk showing consists of disseminated pockets and stockwork veinlets of chalcopyrite and pyrite in chlorite and epidote altered diorite. The Mid Zone is located in an area of very strong propylitic alteration. The showing is a shear zone approximately 2 m wide that contains 10% pyrite and chalcopyrite in a chloritic alteration zone. The Vector Zone in the north part of the property can be traced in outcrop for up to 350 metres along a small creek. This zone contains strong to



intense propylitic alteration through most of the strike length. The zones of propylitic alteration invariably contain 2-3% pyrite and 2-5% chalcopyrite in fracture filling veinlets 1 mm to 8 cm thick surrounded by albite-chlorite-magnetite alteration with pervasive, finely disseminated sulfides.

The Gibson zone is largely known from drilling work conducted by Noranda in 1991. Nine holes were drilled on the Gibson zone to test the size and continuity of the Gibson showing. All of the holes drilled intersected significant clay-sericitequartz altered and pyrite-galena-sphalerite mineralized volcanics in an extensive northwest-trending composite zone some 400 metres long and 4.5 metres thick.

#### WORK PROGRAM

The magnetometer survey comprised a total of 17.5 kilometers surveyed over two field days. The magnetic survey was conducted by two operators using two GPS equipped GSM Ver 7.0 19W Overhauser magnetometers manufactured by GEM Systems of Richmond Hill, Ontario (see Appendix I for detailed instrument specifications). This instrument measures variations in the total intensity of the earth's magnetic field to an absolute accuracy of +/- 0.1 nT. They were used in "walking mode" and set to record a reading every 2 seconds. A third GSM 19 magnetometer was employed as a stationary base to measure the diurnal variations. Data was recorded at a 3 second interval at the base. Base data was used to apply diurnal correction to the rover data. A 200 meter length of overlap line was walked each morning by both units. Data from this overlap line was used to level the data between the two instruments as well as between survey days. For Locations, the GSM 19W magnetometers are equipped with Novatel SuperStar II DGPS boards. The GPS attaches 3-dimensional coordinates, differentially corrected in real-time using the WAAS service, to each magnetometer reading. Full survey specifications are given in Appendix I along with appropriate map products. These include total magnetic intensity, B&W

contour plots of TMI and survey track plot. Preliminary processing of the field data included: Diurnal correction of the rover data using data from the stationary base. Leveling of data from the rover unit across multiple survey days using data from the overlap line.

Cleaning GPS 'spikes' and extrapolating positions to fill GPS gaps.

Trimming of unnecessary data.

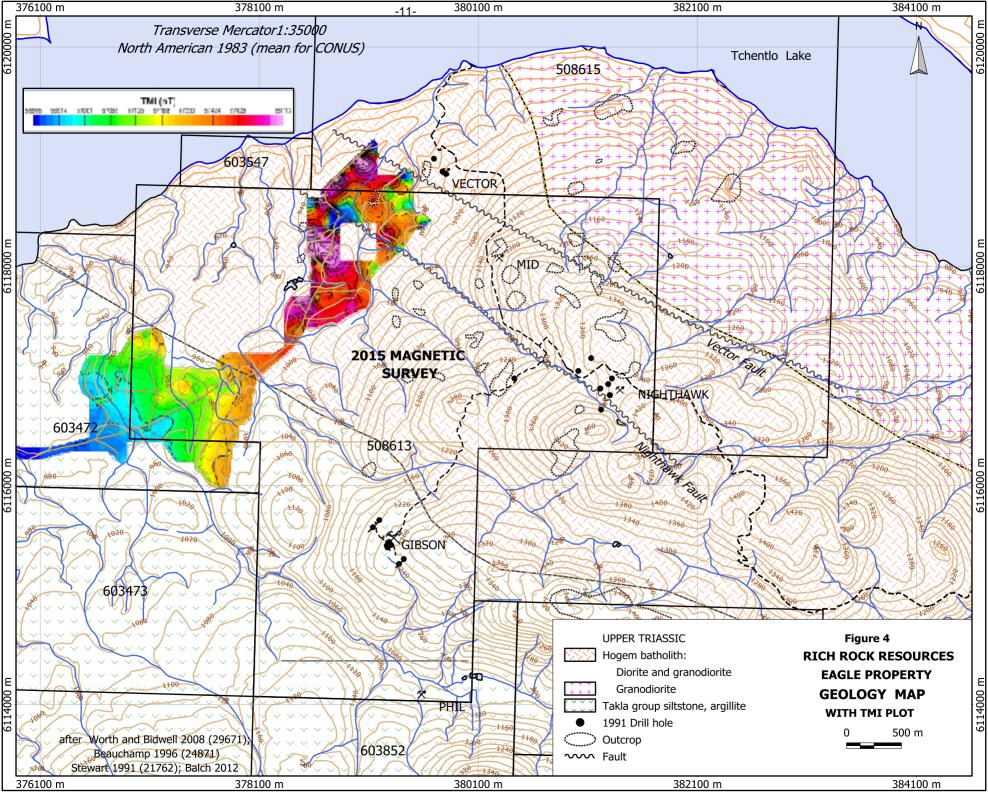
Preliminary QA/QC of both magnetic and positional data to ensure quality and completeness of field data prior to the field crew leaving the project.

#### INTERPRETATION

A compilation map of property geology and the TMI data resulting from the current work program (Appendix I) is given in Figure 4. The Hogem contact determined from regional mapping and the current survey indicates that the contact trends northwest through the 508613 claim as shown. In addition the intense TMI anomalies at the east end of the survey coincide with magnetic patterns associated with porphyry copper mineralizaton at the Vector zone (Fox 2010, 2012).

#### **CONCLUSIONS AND RECOMMENDATIONS**

Confirmed the Hogem bathiith contact with the enclosing Takla Group sediments and extended the magnetic pattern of the Vector porphyry zone to the west. Futher work costing some \$300,000 for phase I was recommended by Price et al (2010) in his 43101 report.



## EXPENDITURES

Expenditures for the work presented herein are listed in Table 2.

## Table 3. Expenditures

ITEMS	Cost
Labour	
Consulting: PE Fox PhD P.Eng 3 days @ \$900	2,700
Ground geophysical survey:	
Meridian mapping Ltd	
Contract invoice amount	9,127
Supplies	200
Report preparation P Fox PhD P.Eng	3,900
Total Expenditures	\$15,927

Prepared by

Peter E. Fox PhD. P.Eng. May 10, 2015

## STATEMENT OF QUALIFICATIONS

I, Peter E. Fox of Richmond, British Columbia do hereby certify that I:

- am a graduate of Queens University in Kingston, Ontario with a Bachelor of Science and Master of Science degrees in Geological Sciences in 1959 and 1962, and a graduate of Carleton University, Ottawa, Ontario with a degree of Doctor of Philosophy in 1966.
- am a member of the Association of Professional Engineers and Geoscientists of British Columbia #8133.
- have practiced my profession since 1966.
- am a consulting geologist and Vice President Exploration for Eagle Peak Resources
- I am the author of this report entitled "Geophysical Report on the Eagle Property"

Dated at Richmond, British Columbia this 10<sup>th</sup> Day of May, 2015

Respectfully submitted,

Peter E. Fox PhD P.Eng May 10, 2015



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Veerman, H., 1968. Geophysical – Geochemical report on the Vector Group claims. Aris report 1599.

Worth, A. and Bidwell, G., 2008. Nighthawk property. Aris report #29671.

## **APPENDIX I**

# REPORT

# **GROUND MAGNETIC SURVEY**

# **MERIDIAN MAPPING LTD**

9400 Bel Air Dr Coldstream BC, V1B 1C3

APRIL 2015



# LOGISTICS REPORT

On

## GROUND MAGNETIC SURVEY

EAGLE PROPERTY OMINECA MINING DIVISION, BC 55° 11' 11" N Lat, 124° 54' 42' W Long NAD 83 UTM Zone 10 378000E, 6117000N NTS Mapsheet(s): 093N/02 BCGS Mapsheet(s): 093N.016 & 26

APRIL 7<sup>th</sup> to 8<sup>th</sup> 2015

For

RICH ROCK RESOURCES INC. Suite 910 475 West Georgia Street Vancouver, British Columbia V6B 4M9

By

Meridian Mapping Ltd.

Coldstream, British Columbia

**APRIL 2015** 

#### INTRODUCTION:

Between April 7<sup>th</sup> and 8<sup>th</sup> 2015, Meridian Mapping Ltd. completed a ground magnetometer survey over a portion of the Eagle Property near Tchentlo Lake, British Columbia for Rich Rock Resources Inc. This was a survey of recently developed Forest Service Roads and block access roads which access the property from the West.

#### PROPERTY LOCATION & ACCESS:

The Eagle Property is located 93 kilometers northwest of the town of Fort St James in North-Central British Columbia. The center of the survey area is located 8 kilometers west of the eastern end of Tchentlo Lake in the Omineca Mining Division.

Access was gained by travelling north from Fort St. James on the Highway 27 for a distance of about 6.5 kilometers from the center of town, then travelling northwest approximately 41 kilometers on the Tachie Road. Turn northwest on the Leo Creek Forest Service Road and continue straight past a major junction at the 38.5Km board continuing on the Leo Creek FSR to the 68.5Km board. Turn north onto the Driftwood FSR and follow for a distance of 2.8 kilometers. Turn east on the Driftwood Airline FSR crossing into the Eagle Property about 300 meters East of the 15Km board. Recently constructed Forest Service Road and block roads provide access to this portion of the property with additional block roads scheduled to be constructed in the near future.

#### SURVEY SPECIFICATIONS:

#### Survey Area:

The 2015 survey covered the newly constructed Driftwood Airline FSR from the property boundary east to its terminus and recently constructed roads that access blocks north, south and east from that.

A total of 17.5 Km of ground magnetometer surveying were completed for the survey.

#### Magnetic Survey:

The magnetic survey was conducted by an operators using a GPS equipped GSM Ver 7.0 19W Overhauser walking magnetometers manufactured by GEM Systems of Richmond Hill, Ontario. This instrument measures variations in the total intensity of the earth's magnetic field to an absolute accuracy of +/- 0.1 nT. Instruments were used in 'walking mode' and set to record a reading every 2 seconds. A GSM 19 magnetometer was employed as a stationary base to measure the diurnal variations in the earth's magnetic field. Data was recorded at a 3 second interval at the base. This base data was used to apply diurnal correction to the rover data. A 200 meter length of overlap line was walked each morning by the rover unit. Data from this overlap line was used to level the data between survey days. The location of the base receiver and the start and end points of the overlap line ware marked with stakes to allow the inclusion and levelling of future ground survey data.

#### Positional Control:

The GSM 19W magnetometers are equipped with Novatel SuperStar II DGPS boards. The GPS attaches 3dimensional coordinates, differentially corrected in real-time using the WAAS service, to each magnetometer reading. Accuracies of +/- 1.5m can be achieved in ideal conditions, however ~5m is more typical under tree canopy.

#### DATA PROCESSING:

#### <u>Preliminary Processing:</u>

Preliminary processing of the field data included:

- Diurnal correction of the rover data using data from the stationary base.
- Leveling of data from the rover unit across multiple survey days using data from the overlap line.
- Cleaning GPS 'spikes' and extrapolating positions to fill GPS gaps.

- Trimming of unnecessary data.
- Preliminary QA/QC of both magnetic and positional data to ensure quality and completeness of field data prior to the field crew leaving the project.

### Final Processing:

Final processing of the total field magnetometer data was performed in Geosoft Oasis Montaj, and followed conventional processing techniques. Processing steps were as follows:

- Diurnally corrected total magnetic profile data was despiked either manually, or by a 3pt non-linear filter, as required. This step removes one-station spikes that are caused by instrument dropouts or sensor "knocks".
- A total magnetic intensity (TMI) grid was generated by gridding the final filtered data using the minimum curvature algorithm, with a grid cell size of 10 m and a blanking distance of 320 m.

Geotiff maps of TMI colour grid, TMI B&W contours, and line path maps were exported.

#### DATA DELIVERABLES:

Deliverable data includes:

- 1. Total Magnetic Intensity
- 2. B&W Contour Plot of TMI.
- 3. Survey Track Plot

Respectfully Submitted, Meridian Mapping Ltd.

Juft Outp

Dugald Dunlop B.Sc. (Geology)

APPENDIX I – EQUIPMENT SPECIFICATIONS

# **Terraplus**



# **GSM-19 v7.0** Overhauser Magnetometer / Gradiometer / VLF

The unique Overhauser unit blends physics, data quality, operational efficiency, system design and options into an instrumentation package that ... exceeds proton precession and matches costlier optically pumped cesium capabilities.

And the latest v7.0 technology upgrades provide even more value, including:

- Data export in standard XYZ (i.e. line-oriented) format for easy use in standard commercial software programs
- **Programmable export format** for full control over output
- **GPS elevation values** provide input for geophysical modeling
- <1.5m standard GPS for highresolution surveying
- <1.0 OmniStar GPS
- <0.7m for Newly introduced CDGPS
- Multi-sensor capability for advanced surveys to resolve target geometry
- **Picket marketing / annotation** for capturing related surveying information on the go.

And all of these technologies come complete with the most attractive prices and warranty in the business!

## Introduction

The GSM-19 v7.0 Overhauser instrument is the total field magnetometer / gradiometer of choice in today's earth science environment representing a unique blend of physics, data quality, operational efficiency, system design and options that clearly differentiate it from other quantum magnetometers.

With data quality exceeding standard proton precession and comparable to costlier optically pumped cesium units, the GSM-19 is a standard (or emerging standard) in many fields, including:

- \* Mineral exploration (ground and airborne base station)
- \* Environmental and engineering
- \* Pipeline mapping
- \* Unexploded Ordenance Detencion
- \* Archeology
- \* Magnetic observatory measurements
- \* Volcanology and earthquake prediction

## **Taking Advantage of the Overhauser Effect**

Tel: 905-764-5505 Fax: 905-764-8093 Email: sales@terraplus.ca Website: www.terraplus.ca

**Terraplus Inc**. 52 West Beaver Cr. Rd. #12, Richmond Hill, ON. Canada L4B 1L9

Overhauser effect magnetometers are essentially proton precession devices except that they produce an order-of magnitude greater sensitivity. These "supercharged" quantum magnetometers also deliver high absolute accuracy, rapid cycling (up to 5 readings / second), and exceptionally low power consumption.

The Overhauser effect occurs when a special liquid (with unpaired electrons) is combined with hydrogen atoms and then exposed to secondary polarization from a radio frequency (RF) magnetic field.

The unpaired electrons transfer their stronger polarization to hydrogen atoms, thereby generating a strong precession signal-- that is ideal for very high-sensitivity total field measurement.

In comparison with proton precession methods, RF signal generation also keeps power consumption to an absolute minimum and reduces noise (i.e. generating RF frequencies are well out of the bandwidth of the precession signal).

In addition, polarization and signal measurement can occur simultaneously which enables faster, sequential measurements. This, in turn, facilitates advanced statistical averaging over the sampling period and/or increased cycling rates (i.e. sampling speeds).

## Maximizing Your Data Quality with the GSM-19

Data quality is a function of five key parameters that have been taken into consideration carefully in the design of the GSM-19. These include sensitivity, resolution, absolute accuracy, sampling rates and gradient tolerance.

Sensitivity is a measure of the signalto noise ratio of the measuring device and reflects both the underlying physics and electronic design. The physics of the Overhauser effect improves sensitivity by an order of magnitude over conventional proton precession devices. Electronic enhancements, such as high-precision precession frequency counters enhance sensitivity by 25% over previous versions.

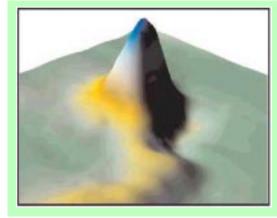
The result is high quality data with sensitivities of 0.022 nT / vHz. This sensitivity is also the same order-of magnitude as costier optically pumped cesium systems.

Resolution is a measure of the smallest number that can be displayed on the instrument (or transmitted via the download process). The GSM-19 has unmatched resolution (0.01mT)

This level of resolution translates into welldefined, characteristic anomalies; improved visual display; and enhanced numerical data for processing and modeling.

Absolute accuracy reflects the closeness to the "real value" of the magnetic field -- represented by repeatability of readings either at stations or between different sensors. With an absolute accuracy of +/- 0.1 nT, the GSM-19 delivers repeatable station-to-station results that are reflected in high quality total field results.

Similarly, the system is ideal for gradient installations (readings between different sensors do not differ by more than +/- 0.1 nT) -- maintaining the same high standard of repeatability.



The GSM-19 gradiometer data are consistently low in noise and representative of the geologic environment under investigation.

Sampling rates are defined as the fastest speed at which the system can acquire data. This is a particularly important parameter because high sampling rates ensure accurate spatial resolution of anomalies and increase survey efficiency.

The GSM-19 Overhauser system is configured for two "measurement modes" or maximum sampling rates --"Standard" (3 seconds / reading), and "Walking" (0.2 seconds / reading) These sampling rates make the GSM-19 a truly versatile system for all ground applications (including vehicle-borne applications).

Gradient tolerance represents

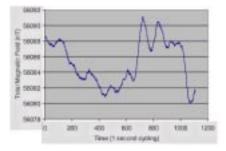
the ability to obtain reliable measurements in the presence of extreme magnetic field variations. GSM-19 gradient tolerance is maintained through internal signal counting algorithms, sensor design and Overhauser physics. For example, the Overhauser effect produces high amplitude, long-duration signals that facilitate measurement in high gradients.

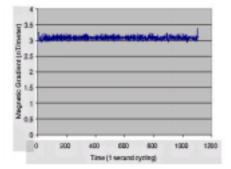
The system's tolerance (10,000 nT / meter) makes it ideal for many challenging environments -- such as highly magnetic rocks in mineral exploration applications, or near cultural objects in environmental, UXO or archeological applications.

> Tel: 905-764-5505 Fax: 905-764-8093

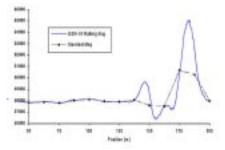
# MAGNETOMETERS

Data from Kalahari Desert kimberlites. **Courtesy of MPH** Consulting (project managers), IGS c. c. (geophysical contractor) and Aegis Instruments (Pty) Ltd., Botswana.





Total Field and Stationary Vertical Gradient showing the gradient largely unaffected by diurnal variation. Absolute accuracy is also shown to be very high (0.2 nT/meter).



Much like an airborne acquisition system, the GSM-19 "Walking" magnetometer option delivers very highly-sampled, high sensitivity results that enable very accurate target location and / or earth science decision-making.

Email: sales@terraplus.ca Website: www.terraplus.ca

Terraplus Inc. 52 West Beaver Cr. Rd. #12, Richmond Hill, ON. Canada L4B 1L9

## Increasing Your Operational Efficiency

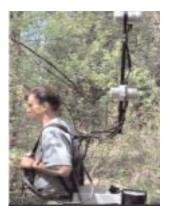
Many organizations have standardized their magnetic geophysical acquisition on the GSM-19 based on high performance and operator preference. This preference reflects performance enhancements such as memory capacity; portability characteristics; GPS and navigation; and dumping and processing.

**Memory capacity** controls the efficient daily acquisition of data, acquisition of positioning results from GPS, and the ability to acquire high resolution results (particularly in GSM-19's "Walking" mode).

V7.0 upgrades have established the GSM-19 as the commercial standard for memory with over 1,465,623 readings (based on a basic configuration of 32 Mbytes of memory and a survey with time, coordinate, and field values).

**Portability characteristics** (ruggedness, light weight and power consumption) are essential for operator productivity in both normal and extreme field conditions.

GSM-19 Overhauser magnetometer is established globally as a robust scientific instrument capable of withstanding temperature, humidity and terrain extremes. It also has the reputation as the lightest and lowest power system available -- reflecting Overhauser effect and RF polarization advantages.



In comparison with proton precession and optically pumped cesium systems, the GSM-19 system is the choice of operators as an easy-to-use and robust system.

#### **GPS and navigation options** are

increasingly critical considerations for earth science professionals.

GPS technologies are revolutionizing data acquisition -- enhancing productivity, increasing spatial resolution, and providing a new level of data quality for informed decision-making.

The GSM-19 is now available with realtime GPS and DGPS options in different survey resolutions. For more details, see the GPS and DGPS section.

The GSM-19 can also be used in a GPS Navigation option with real-time coordinate transformation to UTM, local X-Y coordinate rotations, automatic end of line flag, guidance to the next line, and survey "lane" guidance with cross-track display and audio indicator.

Other enhancements include way point pre-programming of up to 1000 points. Professionals can now define a complete survey before leaving for the field on their PC and download points to the magnetometer via RS-232 connection.

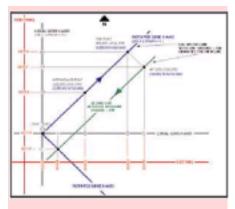
The operator then simply performs the survey using the way points as their survey guide. This capability decreases survey errors, improves efficiency, and ensures more rapid survey completion.

**Dumping and processing** effectiveness is also a critical consideration today. Historically, up to 60% of an operator's "free" time can be spent on low-return tasks, such as data dumping.

Data dumping times are now significantly reduced through GEM's implementation of high-speed, digital data links (up to 115 kBaud).

# MAGNETOMETERS

This functionality is faciliated through a new RISC processor as well as the new GSM-19 data acquisition / display software. This software serves as a bi-directional RS-232 terminal. It also has integrated processing functionality to streamline key processing steps, including diurnal data reduction. This software is provided free to all GSM-19 customers and regular updates are available.

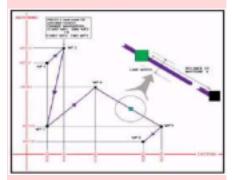


#### **Navigation and Lane Guidance**

The figure above shows the Automatic Grid (UTM, Local Grid, and Rotated Grid). With the Rotated Grid, you can apply an arbitrary origin of your own definition. Then, the coordinates are always in reference to axes parallel to the grid. In short, your grid determines the map, and not the NS direction.

The Local Grid is a scaled down, local version of the UTM system, and is based on your own defined origin. It allows you to use smaller numbers or ones that are most relevant to your survey.

The figure below shows how programmable-waypoints can be used to plan surveys on a point-by-point basis. Initially, you define waypoints and enter them via PC or the keyboard. In the field, the unit guides you to each point.



While walking between waypoints, lane guidance keeps you within a lane of predefined width using arrows (<  $\circ or - >$ ) to indicate left or right. Within the lane, the display uses horizontal bars (--) to show your relative position in the lane. The display also shows the distance (in meters) to the next waypoint.

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# Adding Value through Options

When evaluating the GSM-19 as a solution for your geophysical application, we recommend considering the complete range of options described below. These options can be added at time of original purchase or later to expand capabilities as your needs change or grow.

Our approach with options is to provide you with an expandable set of building blocks:

- \* Gradiometer
- \* Walking- Fast Magnetometer /
- Gradiometer
- VLF (3 channel)
- GPS (built-in and external)

## **GSM-19G Gradiometer Option**

The GSM-19 gradiometer is a versatile, entry level system that can be upgraded to a full-featured "Walking" unit (model GSM-19WG) in future.

The GSM-19G configuration comprises two sensors and a "Standard" console that reads data to a maximum of 1 reading every three seconds.



An important GSM-19 design feature is that its gradiometer sensors measure the two magnetic fields concurrently to avoid any temporal variations that could distort gradiometer readings. Other features, such as single-button data recording, are included for operator ease-of-use.

## GSM-19W / WG "Walking" Magnetometer / Gradiometer Option

The GSM-19 was the first magnetometer to incorporate the innovative "Walking" option which enables the acquisition of nearly continuous data on survey lines. Since its introduction, the GSM-19W / GSM-19WG have become one of the most popular magnetic instruments in the world.

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Similar to an airborne survey in principle, the system records data at discrete time intervals (up to 5 readings per second) as the instrument is carried along the line.

At each survey picket (fiducial), the operator touches a designated key. The system automatically assigns a picket coordinate to the reading and linearly interpolates the coordinates of all intervening readings (following survey completion during post-processing).

A main benefit is that the high sample density improves definition of geologic structures and other targets (UXO, archeological relics, drums, etc.).

It also increases survey efficiency because the operator can record data almost continuously. Another productivity feature is the instantaneous recording of data at pickets. This is a basic difference between the "Walking" version and the GSM-19 / GSM-19G (the "Standard" mode version which requires 3 seconds to obtain a reading each time the measurement key is pressed).

# GSM-19 "Hands-Free" Backpack Option

The "Walking" Magnetometer and Gradiometer can be configured with an optional backpack-supported sensor. The backpack is uniquely constructed permitting measurement of total field or gradient with both hands free.

This option provides greater versatility and flexibility, which is particularly valuable for high-productivity surveys or in rough terrain.

## MAGNETOMETERS

## **GSM-19GV "VLF" Option**

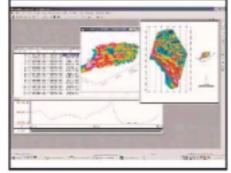
With its omnidirectional VLF option, up to 3 stations of VLF data can be acquired without orienting. Moreover, the operator is able to record both magnetic and VLF data with a single stroke on the keypad.

## **3rd Party Software - A One-Stop Solution for Your Potential Field Needs**

As part of its complete solution approach, Terraplus offers a selection of proven software packages. These packages let you take data from the field and quality control stage right through to final map preparation and modeling.

#### Choose from the following packages:

- Contouring and 3D
- Surface Mapping
- Geophysical Data
- Processing & Analysis
- \* Semi-Automated Magnetic Modeling \* Visualization and
  - Modeling / Inversion



Geophysical Data Processing and Analysis from Geosoft Inc.



GSM-19 with internal GPS board. Small receiver attaches above sensor

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Website:	www.terraplus.ca

Tel: 905-764-5505 Fax: 905-764-8093

# MAGNETOMETERS

## Version 7 -- New Milestones in Magnetometer Technology

The recent release of v7.0 of the GSM-19 system provides many examples of the ways in which we continue to advance magnetics technologies for our customers.

## Enhanced data quality:

- \* 25% improvement in sensitivity (new frequency counting algorithm)
- new intelligent spike-free algo rithms (in comparison with other manufacturers, the GSM-19 does not apply smoothing or filtering to achieve high data quality)

# Improved operational efficiency:

- \* Enhanced positioning (GPS engine with optional integrated / external GPS and real-time navigationl)
- \* 16 times increase in memory to 32 Mbytes
- \* 1000 times improvement in processing and display speed (RISC microprocessor with 32-bit data bus) 2 times faster digital data link (115 kBaud through RS-232)

## Innovative technologies:

- Battery conservation and survey flexibility (base station scheduling option with 3 modes - daily, flexible and immediate start)
- \* Survey pre-planning (up to 1000 programmable waypoints that can be entered directly or downloaded from PC for greater efficiency)
- \* Efficient GPS synchronization of field and base units to Universal Time (UTC)
- \* Cost saving with firmware up grades that deliver new capabilities via Internet

## More About the Overhauser System

In a **standard Proton magnetometer**, current is passed through a coil wound around a sensor containing a hydrogenrich fluid. The auxiliary field created by the coil (>100 Gauss) polarizes the protons in the liquid to a higher thermal equilibrium.

When the current, and hence the field, is terminated, polarized protons precess in the Earth's field and decay exponentially until they return to steady state. This process generates precession signals that can be measured as described below.

**Overhauser magnetometers** use a more efficient method that combines electronproton coupling and an electron-rich liquid (containing unbound electrons in a solvent containing a free radical). An RF magnetic field -- that corresponds to a specific energy level transition -- stimulates the unbound electrons.

Instead of releasing this energy as emitted radiation, the unbound electrons transfer it to the protons in the solvent. The resulting polarization is much larger, leading to stronger precession signals.

Both Overhauser and proton precession, measure the scalar value of the magnetic field based on the proportionality of precession frequency and magnetic flux density (which is linear and known to a high degree of accuracy). Measurement quality is also calculated using signal amplitude and its decay characteristics. Values are averaged over the sampling period and recorded.

With minor modifications (i.e. addition of a small auxiliary magnetic flux density while polarizing), it can also be adapted for high sensitivity readings in low magnetic fields. (ex. for equatorial work)

# **GPS - Positioning You for Effective Decision Making**



The use of Global Positioning Satellite (GPS) technology is increasing in earth science disciplines due to the ability to make better decisions in locating and following up on anomalies, and in improving survey cost effectiveness and time management.

Examples of applications include: Surveying in remote locations with no grid system (for example, in the high Arctic for diamond exploration)

- \* High resolution exploration mapping
- High productivity ferrous ordnance (UXO) detection
- \* Ground portable magnetic and gradient surveying for environmental and engineering applications
- Base station monitoring for observing diurnal magnetic activity and disturbances with integrated GPS time

The GSM-19 addresses customer requests for GPS and high-resolution Differential GPS (DGPS) through both the industry's only built-in GPS (as well as external GPS).

Built-in GPS offers many advantages such as minimizing weight and removing bulky components that can be damaged through normal surveying. The following table summarizes GPS options.

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#### **GPS Options:**

or s optionst			
Description	Range	Services	
		Time	
GPS Option A		Reception	
		only	
GPS Option B	<1.5m	DGPS*	
GPS Option C	<1.0m	Ag 114 DGPS*,	
		OmniStar	
	<0.7m		
GPS Option D	<1.2m	CDGPS, DGPS *,	
	<1.0M	OmniStar.	
	Output		
Time, Lat / Long	g, UTM, Ele	vation and	
number of Satel	lites		
*DGPS with SB	AS (WASS/	EGNOS/MSAS)	

### **Key System Components**

Key components that differentiate the GSM-19 from other systems on the market include the sensor and data acquisition console. Specifications for components are provided on the right side of this page.

### Sensor Technology

Overhauser sensors represent a proprietary innovation that combines advances in electronics design and quantum magnetometer chemistry.

Electronically, the detection assembly includes dual pick-up coils connected in series opposition to suppress far-source electrical interference, such as atmospheric noise. Chemically, the sensor head houses a proprietary hydrogen-rich liquid solvent with free electrons (free radicals) added to increase the signal intensity under RF polarization.

From a physical perspective, the sensor is a small size, light-weight assembly that houses the Overhauser detection system and fluid. A rugged plastic housing protects the internal components during operation and transport.

All sensor components are designed from carefully screened non-magnetic materials to assist in maximization of signal-to-noise. Heading errors are also minimized by ensuring that there are no magnetic inclusions or other defects that could result in variable readings for different orientations of the sensor. Optional omni-directional sensors are available for operating in regions where the magnetic field is near-horizontal (i.e. equatorial regions). These sensors maximize signal strength regardless of field direction.

## Data Acquisition Console Technology

Console technology comprises an external keypad / display interface with internal firmware for frequency counting, system control and data storage / retrieval. For operator convenience, the display provides both monochrome text as well as real-time profile data with an easy to use interactive menu for performing all survey functions.

The firmware provides the convenience of upgrades over the Internet via its software. The benefit is that instrumentation can be enhanced with the latest technology without returning the system to us -- resulting in both timely implementation of updates and reduced shipping / servicing costs.

## MAGNETOMETERS

#### Performance

Sensitivity:	0.022 nT / vHz@1Hz
Resolution:	0.01 nT
Absolute Accuracy	r: +/- 0.1 nT
Dynamic Range:	15,000
	to 120,000 nT
Gradient Tolerance	e: > 10,000 nT/m
Sampling Rate:	60+, 3, 2, 1,
	0.5, 0.2 sec
Operating Temp:	-40C to +55C

## **Operating Modes**

#### Manual:

Coordinates, time, date and reading stored automatically at minimum 3 second interval.

#### **Base Station:**

Time, date and reading stored at 3 to 60 second intervals.

#### **Remote Control:**

Optional remote control using RS-232 interface.

#### Input / Output:

RS-232 or analog (optional) output using 6-pin weatherproof connector

Mobile:	
Base Station:	
Gradiometer:	
Walking Magnetometer:	

#### **Dimensions**

Console: Sensor:

#### Weights

Console:2.1 kgSensor and Staff Assembly:1.0 kg

#### **Standard Components**

GSM-19 console, GEMLinkW software, batteries, harness, charger, sensor with cable, RS-232/USB cable, staff, instruction manual and shipping case.

1,465,623

5,373,951

1,240,142

2,686,975

223 x 69 x 240 mm

175 x 75mm diameter cylinder

#### **Optional VLF**

Frequency Range:	Up to 3 stations between 15 to 30.0 kHz
Parameters:	Vertical in-phase and out-of phase
	components as % of total field. 2 components
	of the horizontal field amplitude and total field

strenght in pT

**Resolution:** 

0.1% of total field

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