

Report of VLF-EM,  
and Total Field Magnetic Surveys

On the

Ogden Grid

Ogden Township, Ontario

Mining Claim No. 4276213

Porcupine Mining Division

For

L.B.L. Richgold Mines Inc.

November 15, 2014  
Timmins, Ontario

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## **1.0 Introduction**

The Ogden grid is located on the Ogden property which is owned by L.B.L. Richgold Mines Inc., located in southeast Ogden Township, Porcupine Mining Division. The Ogden grid in Ogden Township covers portions of or all of mining claim number 4276213. On October 22, 2014; a geophysical survey program consisting of VLF-EM, and total field magnetic surveys was conducted over a portion of this claim. Yvan Veronneau of Timmins completed the magnetic and VLF-EM surveys. The geophysical surveys were performed in order to evaluate and map the presence of disseminated to massive sulphides with respect to their location, width, and concentrations.

## **2.0 Location And Access**

The Ogden property is located approximately 8 kilometers south of the City of Timmins, Ontario; in southeastern Ogden Township. Access to the grid area is via Pine St. south from Timmins for approximately 8 kilometers. From this point a number of bush roads and trails can be accessed by four wheel drive vehicles, ATV, or snowmobiles for 1 kilometers in a southerly direction to the northern area of the grid (see figures 1 and 2).

## **3.0 Summary of 2014 Geophysical Program**

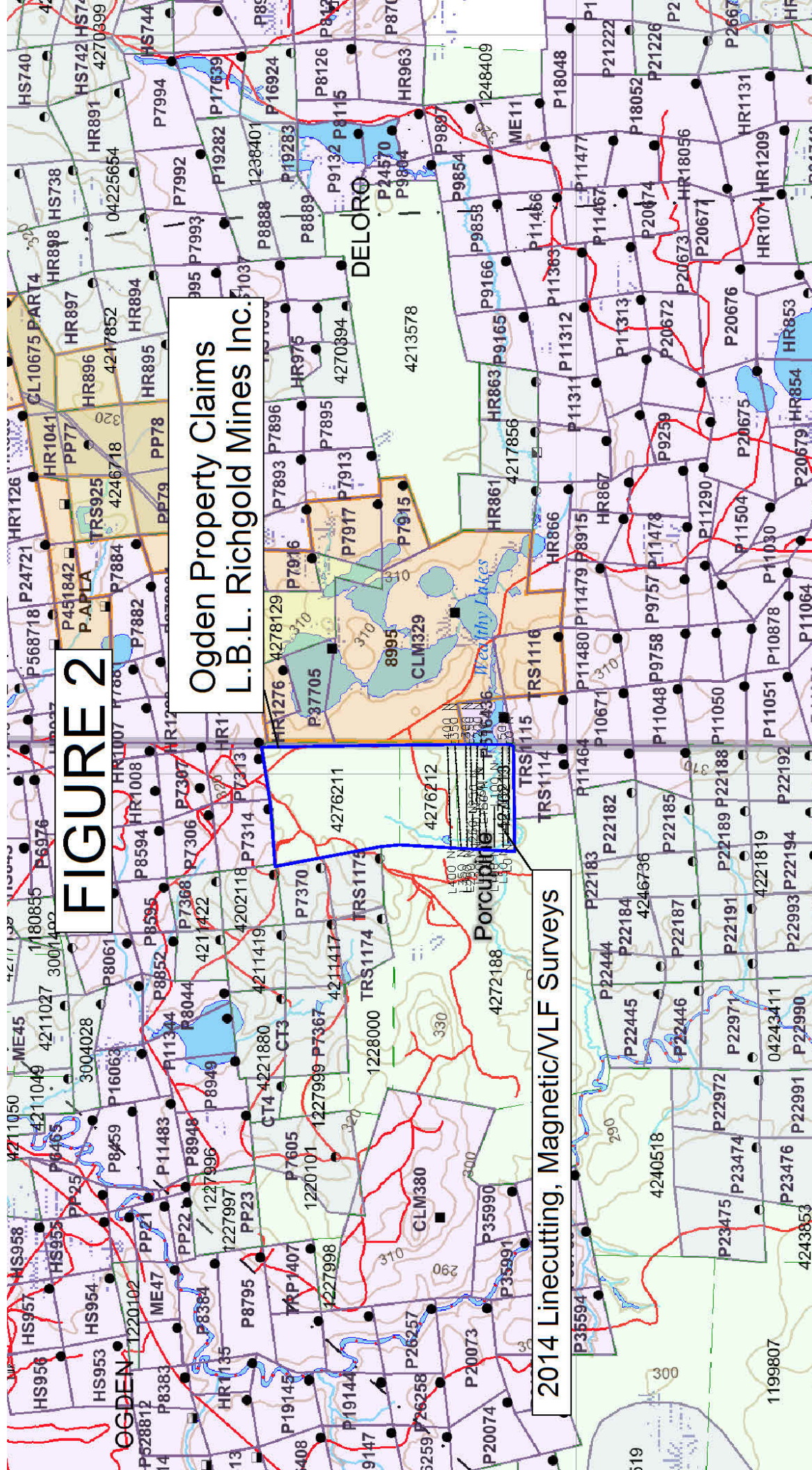
The geophysical grid totaled 5.24 kilometers, which consisted of a 0.40 kilometer long baseline striking at approximately 0 degrees. The lines were established every 50 meters along this baseline and surveyed to a lengths of between of 200 and 700 meters. The base line, grid lines, and all geophysical measurement locations were established via a cut grid. Line cutting totaled 7.4 km., however only 5.24 km. were available to be surveyed due to subsequent flooding of parts of the grid area. The grid lines were measured every 50 meters with measurements recorded at 12.5-meter intervals along all lines.

The geophysical program consisted of total field magnetic surveying, and VLF-EM electromagnetic surveying. The total magnetic field survey and VLF-EM survey,



Figure 1





using a GEM GSM-19 magnetometer/VLF system, totaled 5.24 kilometers with readings collected every 12.5 meters along all lines. The VLF-EM survey was conducted utilizing the transmitting station located in Cutler, Maine; which transmits at a frequency of 24.0 kHz. A total of 5.24 kilometers of VLF data was collected at 12.5-meter station intervals.

The geophysical data has been presented on plan maps at a scale of 1:2500, showing the profiles and postings of the VLF-EM survey, and contours and postings of the magnetic data (see maps in pocket).

A description of the survey method and equipment used can be found in Appendix A.

#### **4.0 Discussion of Results**

The magnetic survey on the Ogden grid indicates a relatively active magnetic background disrupted by several anomalous magnetic anomalies with magnetic values ranging between 55806.22 and 66217.07 nT. The background magnetic field strength is 57726 nT. The isomagnetic contour pattern suggests an underlying lithology striking in an generally north-westerly (azimuth 120 degrees) direction through the grid area. All of the anomalies are easily identified and are labeled on the plan maps. The overall magnetic pattern is disrupted by several strong anomalous magnetic highs striking at approximately 70 degrees azimuth. These magnetic anomalies have been identified and labeled as M1 through M4 and are located in the southwest and northeast portions of the grid area and are easily seen on the magnetic contour map. These magnetic anomalies may represent mafic diabase dikes, common to this geologic setting or possibly mafic or ultramafic lithology.

The magnetic data has been presented on plan maps at a scale of 1:2500, showing the contours and postings, as well as the interpretations (see maps in pocket).

The VLF-EM survey over the Ogden grid was successful in mapping several electromagnetic conductive trends. Three conductive trends were interpreted and identified as V1 to V3, and are shown on the VLF profile and magnetic contour maps. The most significant conductive trends were mapped as V1 and V2. These conductive

trends may be reflecting faults or structures containing mineralization which may be significant to the present exploration program. VLF anomaly V2 is adjacent to and parallel to magnetic anomaly M4. All of the VLF-EM anomalies strike in a direction parallel to the dominant strike direction indicated by the magnetic survey, of approximately 120 degrees azimuth.

The VLF-EM geophysical data has been presented on plan maps at a scale of 1:2500, showing the profiles and postings of the VLF-EM survey as well as the interpreted VLF-EM conductor axis locations.

## **5.0 Conclusions and Recommendations**

The VLF-EM, and magnetic surveys completed over the Ogden grid were successful in mapping several areas of VLF-EM conductors and magnetic anomalies. The most significant anomalies appear to be the VLF-EM anomalies V1 and V2. These anomalies may reflect steeply dipping, weakly to moderately mineralized bedrock conductive horizons.

It is recommended that a program of induced polarization surveying would greatly aid in better defining any possible mineralized zones indicated by the magnetic and VLF survey results. The VLF-EM surveys may be reflecting relatively shallow, disseminated or semi-massive accumulations of sulphide minerals. The IP surveys would greatly enhance the understanding these zones as they are often prospective for gold and base metal deposits. A limited program of either dipole-dipole or pole-dipole IP surveying with an 'a' spacing of 25 meters and reading levels of  $n=1$  to 6 is recommended in order to further evaluate the Ogden property.

All of the responses should be investigated further in order to determine the priority of follow-up needed. The anomalies should be further screened utilizing any other different types of geophysical surveys that may have been undertaken on the Ogden grid. This would aid greatly in further refining the interpretation of the I.P. survey. Any existing geological, diamond drilling or geochemical information that may exist in

the mining recorder assessment files should be investigated and compiled prior to further exploration of the Ogden property in order to accurately assess the area of the current geophysical surveys and to determine the most effective follow-up exploration method for this property.

Respectively Submitted,

A handwritten signature in dark ink, appearing to read "Matthew Johnston". The signature is written in a cursive, flowing style with some loops and flourishes.

Matthew Johnston



## Statement of Qualifications

This is to certify that: MATTHEW JOHNSTON


I am a resident of Timmins; province of Ontario since June 1, 1995.

I am self-employed as a Consulting Geophysicist, based in Timmins, Ontario.

I have received a B.Sc. in geophysics from the University of Saskatchewan; Saskatoon, Saskatchewan in 1986.

I have been employed as a professional geophysicist in mining exploration, environmental and other consulting geophysical techniques since 1986.

Signed in Timmins, Ontario, this November 15, 2014

A handwritten signature in purple ink, reading "Matthew Johnston". The signature is stylized with a large, looped 'M' and a cursive 'Johnston'.

## **Appendix A**



## GSM-19 v7.0

### Overhauser Magnetometer / Gradiometer / VLF

#### 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 Ordnance Detection**
- \* **Archeology**
- \* **Magnetic observatory measurements**
- \* **Volcanology and earthquake prediction**

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).

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 high-resolution surveying
- **<1.0 OmniStar GPS**
- **<0.7m for Newly introduced CDGPS**
- **Multi-sensor capability** for advanced surveys to resolve target geometry
- **Picket marking / 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!**

#### Taking Advantage of the Overhauser Effect

## 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 signal-to 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.

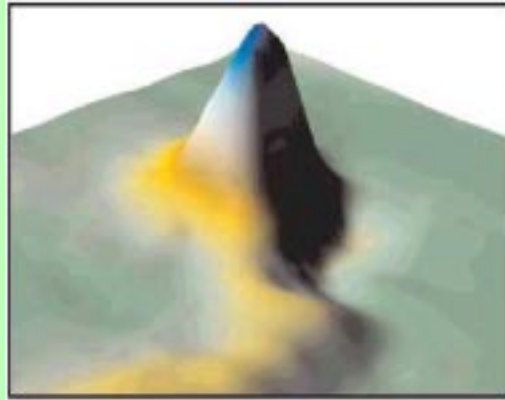
The result is high quality data with sensitivities of 0.022 nT / vHz. This sensitivity is also the same order-of magnitude as costlier optically pumped cesium systems.

**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 well-defined, 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.



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

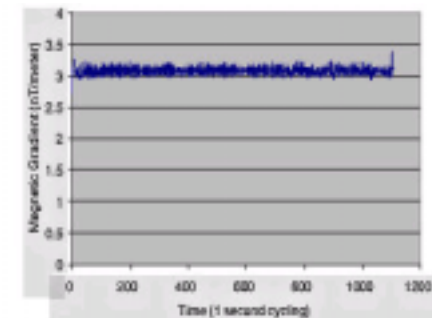
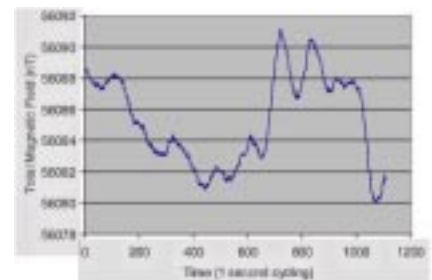
The GSM-19 gradiometer data are consistently low in noise and representative of the geologic environment under investigation.

**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.

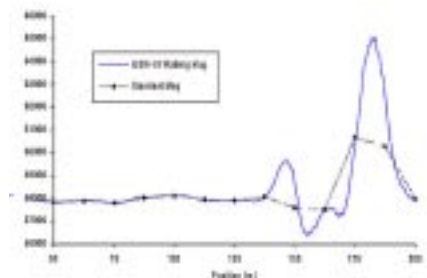
The GSM-19 Overhauser system is configured for two "measurement modes" or maximum sampling rates -- "Standard" (3 seconds / reading), and "Walking" (0.2 seconds / reading). These sampling rates make the GSM-19 a truly versatile system for all ground applications (including vehicle-borne applications).

**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.



**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.

## 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 real-time 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.

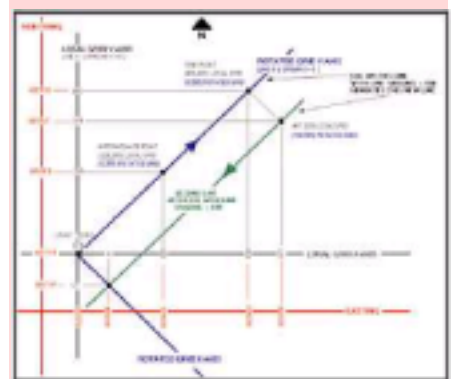
Other enhancements include way point pre-programming of up to 1000 points. Professionals can now define a complete survey before leaving for the field on their PC and download points to the magnetometer via RS-232 connection.

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).

This functionality is facilitated 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.

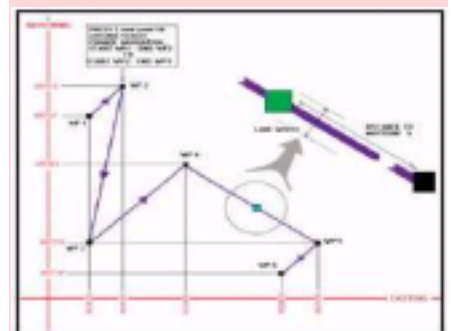


### Navigation and Lane Guidance

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 (< - 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.



## 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.

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.

## GSM-19GV "VLF" Option

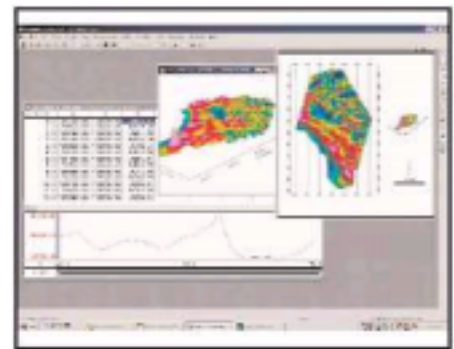
With its omnidirectional VLF option, up to 3 stations of VLF data can be acquired without orienting. Moreover, the operator is able to record both magnetic and VLF data with a single stroke on the keypad.

## 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

**Terraplus Inc.**

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

Tel: 905-764-5505

Fax: 905-764-8093

Email:

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Website:

www.terraplus.ca

## 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 algorithms (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 navigation!)
- \* 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 upgrades 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 hydrogen-rich 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 electron-proton 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.

## GPS Options:

Description	Range	Services
GPS Option A		Time Reception only
GPS Option B	<1.5m	DGPS*
GPS Option C	<1.0m	Ag 114 DGPS*, OmniStar
GPS Option D	<0.7m <1.2m <1.0M	CDGPS, DGPS *, OmniStar.
<b>Output</b>		
Time, Lat / Long, UTM, Elevation and number of Satellites		
*DGPS with SBAS (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.

## Performance

Sensitivity: 0.022 nT / vHz@1Hz  
 Resolution: 0.01 nT  
 Absolute Accuracy: +/- 0.1 nT  
 Dynamic Range: 15,000 to 120,000 nT  
 Gradient Tolerance: > 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

## Storage - 32Mbytes (# of Readings)

Mobile: 1,465,623  
 Base Station: 5,373,951  
 Gradiometer: 1,240,142  
 Walking Magnetometer: 2,686,975

## Dimensions

Console: 223 x 69 x 240 mm  
 Sensor: 175 x 75mm diameter cylinder

## Weights

Console: 2.1 kg  
 Sensor and Staff Assembly: 1.0 kg

## Standard Components

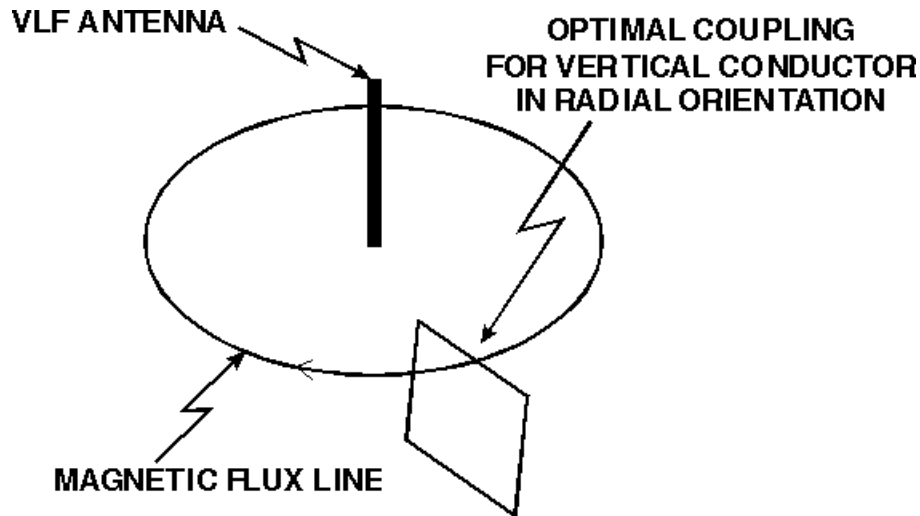
GSM-19 console, GEMLinkW software, batteries, harness, charger, sensor with cable, RS-232/USB cable, staff, instruction manual and shipping case.

## 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 strength in pT  
 Resolution: 0.1% of total field

## The VLF Method

- The very low frequency (VLF) method is a reconnaissance electromagnetic technique used mainly in mineral exploration
- The method makes use of powerful VLF transmitters (3-30 kHz) that are used for military communications
- The U.S. Navy operates 11 transmitters that serve as standard VLF sources for geophysical work



- The VLF method is essentially a tilt-angle technique. In the absence of any conductive body, the secondary field is zero, and the resultant (primary) magnetic field is thus horizontal. If a conductor is present, the associated secondary field will cause the resultant to be tilted.
- Flux linkage analysis can be used to show that vertically above the conductor, the tilt angle passes through zero (see Reynolds, 1997, p. 656).
- VLF signal strength diminishes rapidly with depth (i.e., the skin depth is small). Consequently, VLF methods are primarily used to detect near-surface features, and not for depth-sounding.
- Data acquisition:
  - The most common field technique (VLF-EM) uses a hand-held antenna. In older systems, an audio signal is nulled to determine the tilt angle. In newer systems, data acquisition is entirely digital (push one button, the electronics do the rest). The measured parameters are tilt angle (in degrees) and quadrature component (in %).
- Another field technique, known as VLF-R, uses an electrical dipole. Measured parameters are apparent resistivity (Ohm-m) and quadrature component (%).

# Survey Theory - Total Field Magnetism

## Magnetic Survey

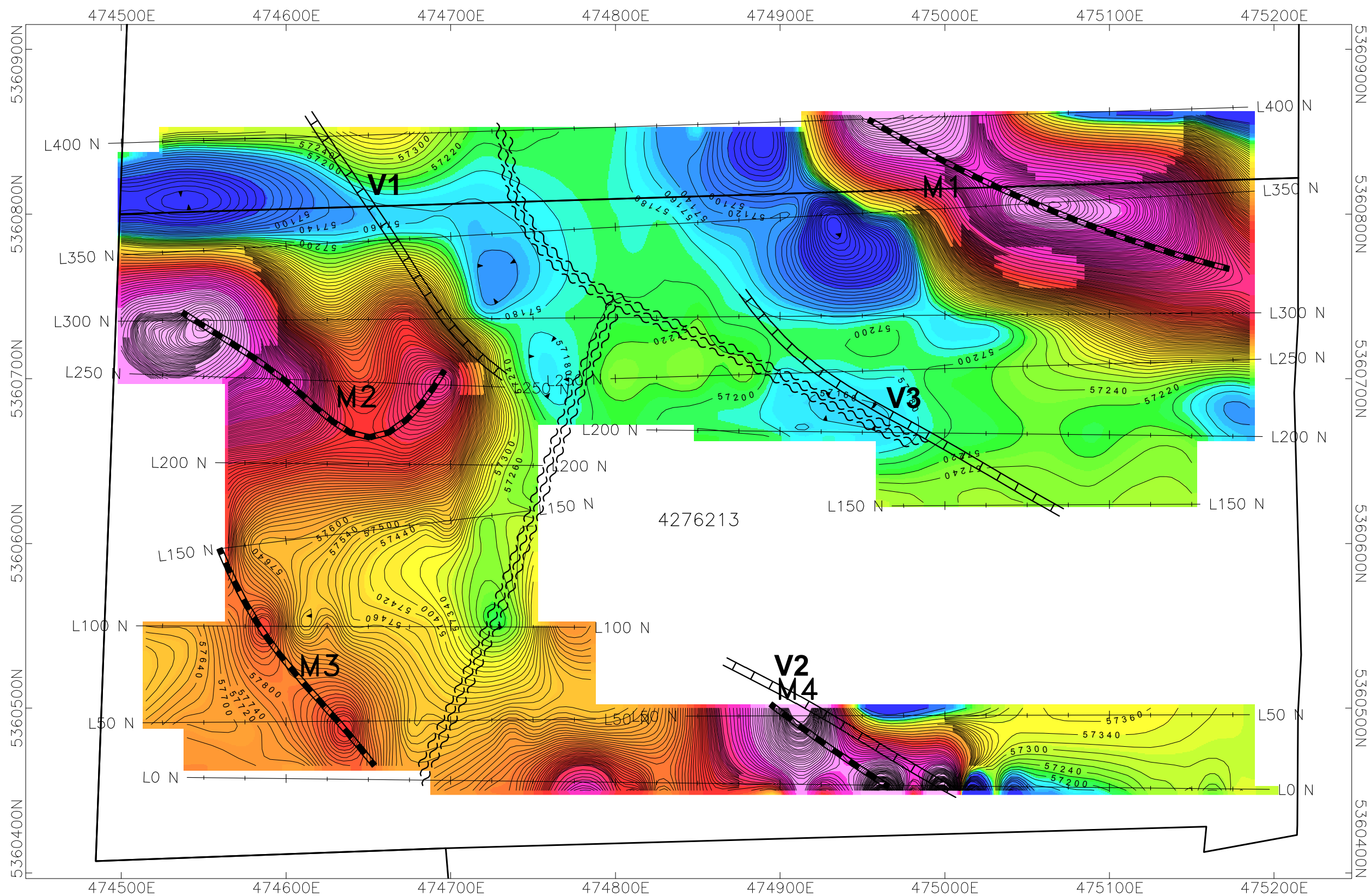
### Theory:

The magnetic method is based on measuring alteration in the shape and magnitude of the earth's naturally occurring magnetic field caused by changes in the magnetization of the rocks in the earth. These changes in magnetization are due mainly to the presence of the magnetic minerals, of which the most common is magnetite, and to a lesser extent ilmenite, pyrrhotite, and some less common minerals. Magnetic anomalies in the earth's field are caused by changes in two types of magnetization: (1) Induced, caused by the magnetic field being altered and enhanced by increases in the magnetic susceptibility of the rocks, which is a function of the concentration of the magnetic minerals. (2) Remanent magnetism is independent of the earth's magnetic field, and is the permanent magnetization of the magnetic particles (magnetite, etc.) in the rocks. This is created when these particles orient themselves parallel to the ambient field when cooling. This magnetization may not be in the same direction as the present earth's field, due to changes in the orientation of the rock or the field. The **unit** of measurement (variations in intensity) is commonly known as the Gamma which is equivalent to the nanotesla (nT).

### Method:

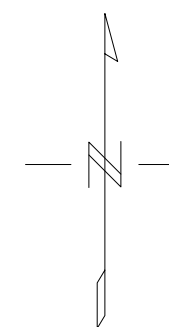
The magnetometer, a GEM Systems **GSM-19** with an Overhauser sensor measures the **Total Magnetic Field** (TFM) perpendicular to the earth's field (horizontal position in the polar region). The unit has no moving parts, produces an absolute and relatively high resolution measurement of the field and displays the measurement on a digital lighted display and is recorded (to memory). Initially, the tuning of the instrument should agree with the nominal value of the magnetic field for each particular area. The Overhauser procession magnetometer collected the data with a **0.2 nanoTesla accuracy**. The operator read each and every line at a 12.5 **m** intervals with the sensor attached to the top of four (56cm), aluminum tubing sections. The readings were corrected for changes in the earth's magnetic field (diurnal drift) with a similar GSM-19 magnetometer, acting as a stationary base station which automatically read and stored the readings at every 15 seconds. The data from both units was then downloaded to PC and base corrected values were computed.





## Legend

- Interpreted VLF-EM Conductor Location/Trend
- Interpreted Magnetic Anomaly Location/Trend
- Interpreted Location of Magnetic Lineament/Fault



Scale 1:2500  
50 0 50 100 150  
metres  
NAD83 / UTM zone 17N

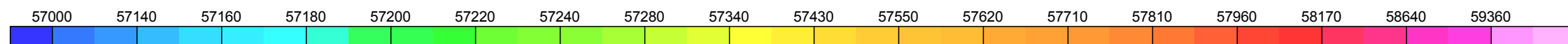
L.B.L. RICHGOLD MINES INC.

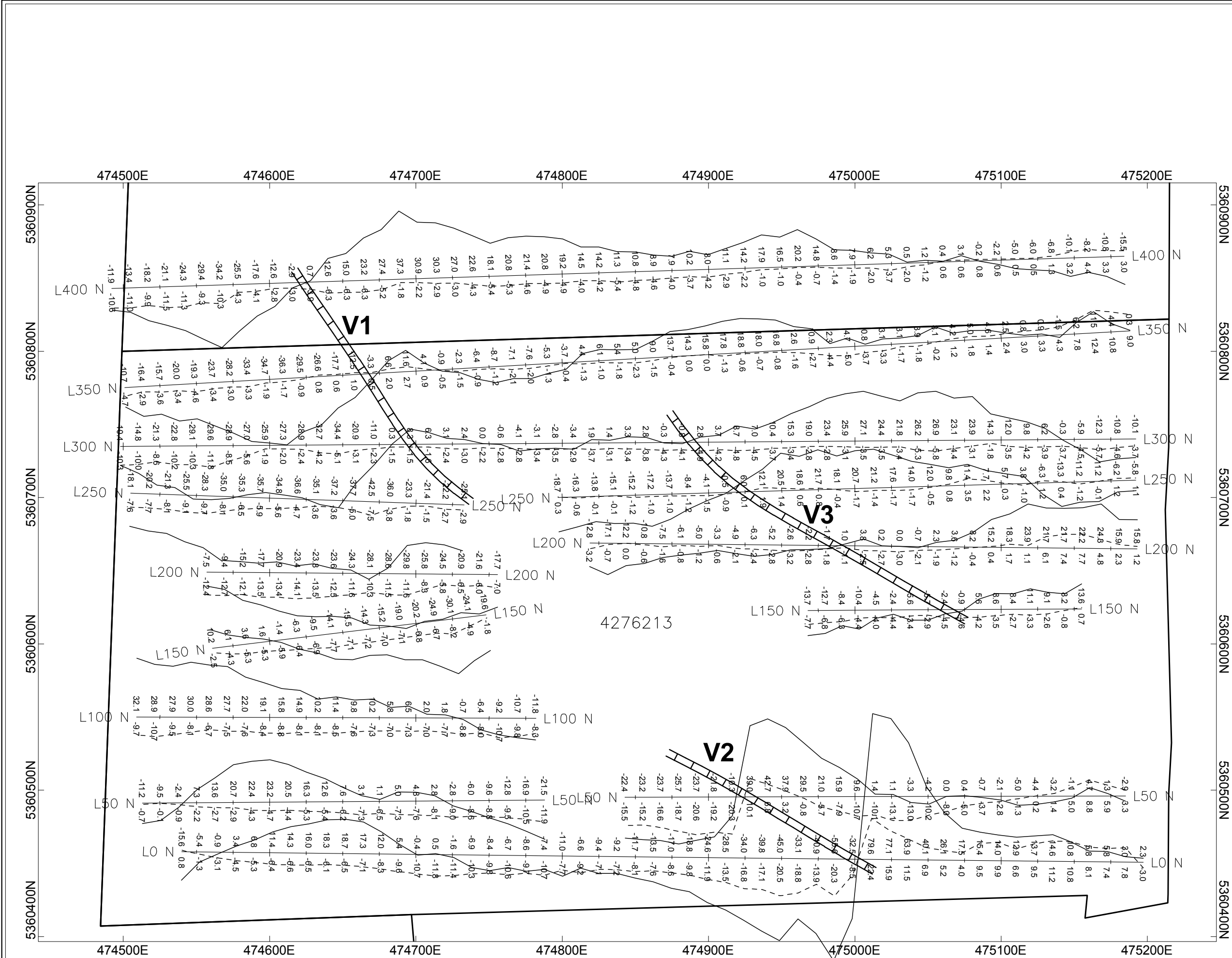
OGDEN TWP. PROJECT  
TOTAL FIELD MAGNETIC SURVEY – CONTOURS  
OCTOBER – 2014

OGDEN TWP. PORCUPINE MINING DIVISION  
CLAIM NO. 4276213  
CONTOUR INTERVAL = 20, 100 nT  
INSTRUMENT: GEM SYSTEMS GSM-19 MAGNETOMETER/VLF

SURVEYED BY: YVAN VERRONEAU

Total Field Magnetics  
nT




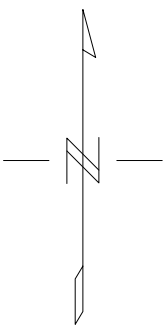


VLF PROFILES  
1 cm. = 20 %  
- PROFILE +  
---- IP POSTING Q ----

NAA CUTLER, ME. 24.0 kHz.  
INSTRUMENT : GEM SYSTEM GSM-19 MAGNETOMETER/VLF

### Legend

 Interpreted VLF-EM Conductor Location/Trend



Scale 1:2500  
(meters)  
NAD83 / UTM zone 17N

LINE KILOMETERS SURVEYED: 5.24

L.B.L. RICHGOLD MINES INC.
OGDEN TWP. PROJECT VLF-EM 24.0 kHz. PROFILES OCTOBER 22 - 2014
OGDEN TWP. PORCUPINE MINING DIVISION CLAIM NO. 4276213 VLF-EM OMNI DIRECTIONAL RECEIVER INSTRUMENT: GEM SYSTEMS GSM-19 MAGNETOMTER/VLF
SURVEYED BY: YVAN VERRONEAU

