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Ontario

Report on
Linecutting, Spectral IP/Resistivity, Magnetics, VLF-EM Surveys, & Historic Data Review

at the

Toanga Project

Morrisette Township Property
Kirkland Lake Area, NE Ontario

2015 & 2016

ClearView Geophysics Inc.

Report On
Linecutting, Spectral IP/Resistivity, Magnetics, VLF-EM Surveys, & Historic Data Review
at the
Toanga Project
Morrisette Township Property
Kirkland Lake Area, NE Ontario

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Plate: **L2N**

- Spectral IP/resistivity pseudosections/inversion models/spectral; Magnetics profile; VLF-EM inphase and quadrature profiles; Interpreted Anomalies

References:

- Geology of Bernhardt and Morrisette Townships By R.J. Rupert and H.L. Lovell, 1970.
- Report on ground geophysical investigations for Strike Minerals: IP Surveys, Gerard Lambert, 1995.
- Medici Resources Ltd., Geological Map, Airport Reserve Project, F.J. Sharpley, 1989.
- ClearView Geophysics Inc., ref.Q0716 and Q0716_addendum, 2012.

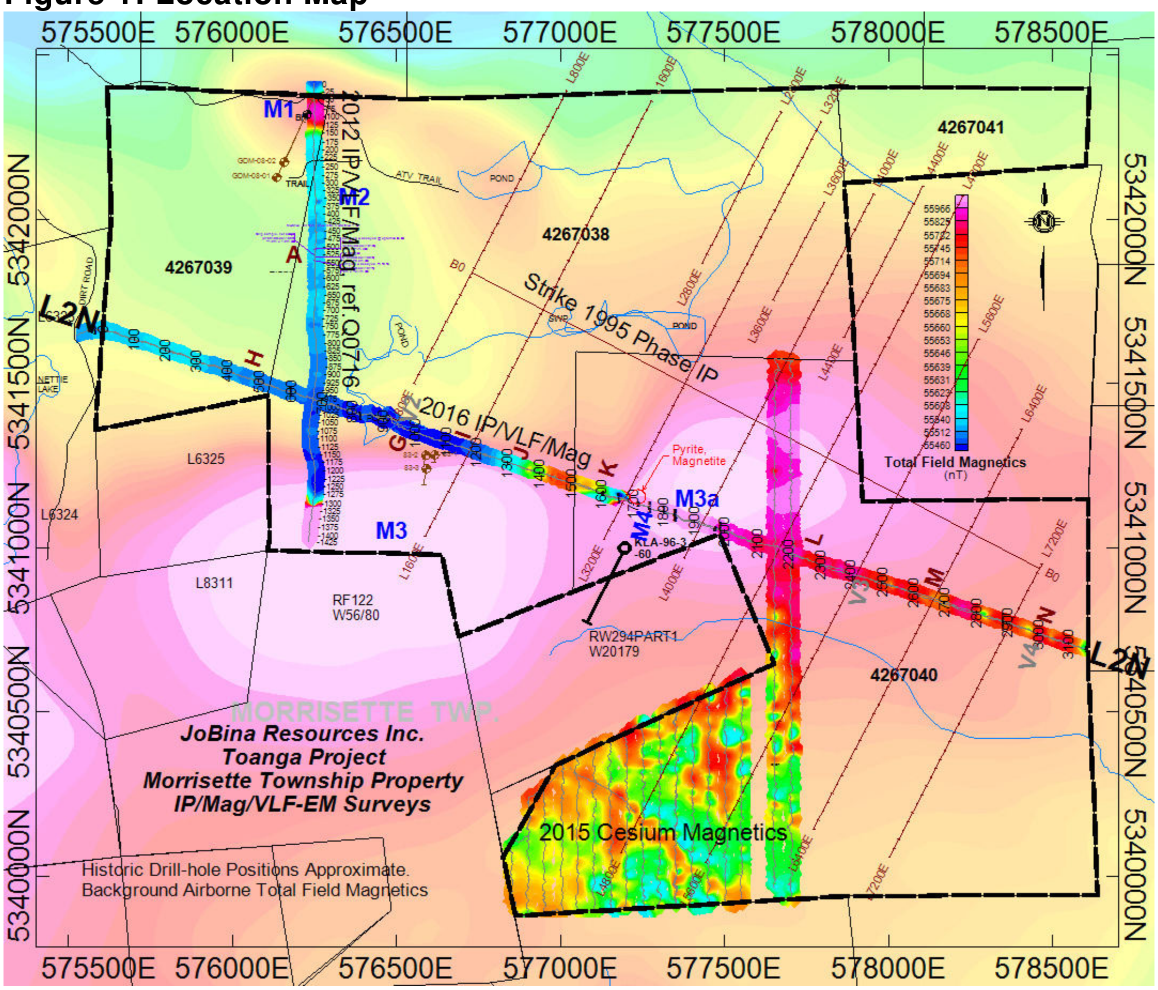
1. Introduction

ClearView Geophysics Inc. carried out Line cutting, Spectral IP/Resistivity, Magnetics, VLF-EM Surveys, and historic data review for JoBina Resources Inc. on its Toanga Project, Morrisette Township Property located near Kirkland Lake, Ontario. The field work was completed in 2015 and 2016 in order to locate and prioritize anomalies that could result from economic mineralization.

2. Location & Access

The base of operations for the crew was at a camp located on Lake Sesekinika. Daily access to the survey area was by 4W-drive truck and snowmobile along dirt roads and trails from the Kirkland Lake airport road.

Figure 1: Location Map



3. PERSONNEL

Joe Mihelcic; Geophysicist/Party Chief:

Joe cut the 2016 Line 2N survey line, operated the IPR12 receiver, EnviC and GSM19W rover and base magnetometers and EM16 receiver. He was responsible for the surveys' data quality and processed/plotted the data on a daily basis. He compiled, reviewed & interpreted relevant historic assessment reports, and prepared this report.

Sabina Mihelcic, Alex Rumball, Adam Mihelcic, George Vent; Field Operators and Assistants:

Sabina assisted with the 2015 cesium magnetometer surveys. Alex assisted with the IP survey. Adam operated the IP transmitter and assisted with the IP survey. George operated the IP transmitter.

4. SURVEY SPECIFICATIONS & EQUIPMENT

The following tables summarize the survey specifications and equipment:

Table 1: Production Report

]

Date	Method	Distance (m)	Temperatur e	Comments
2015:				
Feb.24	Mobilization			Brampton to KL
Feb.25	Magnetics	3350	-20C	Joe, Sabina
Feb.26	Magnetics	4100	-18C	Joe
Feb.27	Demobilization			KL to Brampton
…	…	…	…	…
April 16	Mobilization			Brampton to KL
Apr.17	Magnetics	5450	-5C	Joe
Apr.18	Demobilization			KL to Brampton
2016:				
Jul.23	Mobilization			Brampton to KL
Jul.24	Linecutting	0-	25C, sunny	Joe
Jul.25	Linecutting		28C, sunny	Joe, Alex couple hours
Jul.26	Linecutting		30C, sunny	Joe, Alex couple hours
Jul.27	Linecutting		29C, sunny	Joe
Jul.28	Linecutting		30C, sunny	Joe
Jul.29	…	…	…	**…**
Jul.30	Magnetics	6520	32C, sunny	Joe, surveyed in both directions (3260m x 2)
Jul.31	IP/resistivity			Joe prep gear

Aug.1	IP/resistivity		-29C, sunny	Joe layout wire, rods and porous pots on grid, notify adjacent property owner working in area.
Aug.2	IP/resistivity	1100	-32C, sunny	Joe/Alex/Adam/George
Aug.3	…	…	…	…
Aug.4	IP/Resistivity	1100	-30C, sunny	Joe/Alex/Adam/George
Aug.5	…	…	…	…
Aug.6	IP/Resistivity	1000	-23C, sunny	Joe/Alex/Adam/George, pull gear out of bush, pack
Aug.7	VLF	6300	-24C, sunny	Joe, Cutler Maine NAA 24.0 kHz and La Moure North Dakota NML4 25.2 kHz
…	…	…	…	…
Aug.10	Demobilization			Brampton to KL

Table 2: Coverage

Refer to Appendix A for Instrument Specifications.

Linecutting/Chaining	3 250 m
Spectral IP/Resistivity	3 200 m
Total Field Magnetics	19 420 m
VLF-EM (Cutler)	6 300 m

Table 3: Instrumentation and Configurations

Refer to Appendix A and DVD for Instrument Specifications.

Surface IP	Dipole-dipole, n=1-8, "a"=100 metres; stations at 100 metre intervals.
IP Rx/Tx	Scintrex IPR12, time domain / Walcer 10 kW
Magnetics	Total Field: Base: GEM Systems Base, version 7 Overhauser; 1x per second, Rover: Scintrex EnviC Cesium Magnetometer; 10x per second.
VLF-EM	Geonics EM16, Cutler Maine NAA Tx 24.0 kHz, La Moure North Dakota NML4 25.2 kHz

5. SURVEY METHODOLOGY

5.1 LINECUTTING

The survey line 2N was established with a Garmin 62stc hand-held GPS. The line was machete and chain-saw cut and marked with wooden pickets at 100-metre intervals. The first picket is 0E and the last is 3100N which is located approximately 50 metres west of the claim line.

5.2 SURFACE DIPOLE-DIPOLE IP SURVEY

The surface dipole-dipole IP survey consisted of injecting an electric current into the ground for two seconds. The transmitter current was then turned off for two seconds, during which time an IP receiver recorded the decaying voltage at pre-defined intervals.

Both current electrodes were located on the survey line, always south of the potential electrodes, and at the same spacing as the receiver electrodes. There were nine receiver electrodes placed at equal intervals down the survey line. The potential electrode located nearest the transmitter current electrode is called "P1". The furthest electrode down the line is called "P9". Electrode pairs are called dipoles. Eight dipoles were read for every position except at the south end of survey line segments where dipoles were dropped.

Voltage drops are measured for each dipole. The transmitter operator measured the contact resistance and electric current passing through the current electrodes during the readings. These current measurements were relayed to the receiver operator and entered into the IPR12 instrument for subsequent apparent resistivity calculations. As the dipoles increased in distance from the transmitter current electrode, they obtained decay information from deeper features. Therefore, the results are displayed as "pseudosections" (Plate, Appendix C).

The transmitter operator also wrote down field notes relayed by the line workers. These notes are related to topography and obstacles encountered along the survey line (e.g., cliffs, lakes) that could be relevant to data interpretation. Field notes are plotted on the top panel of the Plate (Appendix C).

5.3 TOTAL FIELD MAGNETICS SURVEY

The total field magnetics survey was carried out using a back-pack mounted cesium magnetometer and GPS sensor. The magnetometer sensor was located at a height of approximately 2-metres above ground surface. The GPS sensor was located just above the operator's head. Rover readings were acquired at 10x per second towards the east and repeated towards the west. GPS timing and positioning was with the base and rover internal GPS's. Picket locations were recorded in the rover unit as the survey progressed. The base station magnetics data were real-time UTC stamped. It was located approximately 25 metres west of L2N/stn.0E.

5.4 VLF-EM SURVEY

The VLF-EM survey was carried out using the hand-held EM16 receiver with the Cutler Maine and La Moure transmitters. The direction of the instrument was perpendicular to the transmitter; south-southwest for both transmitters. Readings were acquired at 12.5-metre intervals referenced to the 100-metre pickets by constant pace. Both VLF stations were read because La Moure, the better oriented, was read traveling up the line to the east and Cutler, the stronger amplitude, was read traveling down the line to the west. Both datasets were used for quality control.

6. DATA PROCESSING AND PRESENTATION

6.1 SURFACE DIPOLE-DIPOLE IP SURVEY

The IP data are presented as pseudosections for L2N (refer to Plate, Appendix C). Pseudosection panels are presented for the Mx chargeability (690 ms – 1050 ms decay slice), apparent resistivity, Spectral *M-IP*, Spectral *Tau* and Spectral *c*. The selected chargeability slice of 690 ms to 1050 ms is the industry standard slice used by the *Scintrex* IPR11 receiver. This was done so that experience gained during the past few decades could be applied more readily to the present data.

The IP and resistivity data were also inversion modeled using UBC's 2D inversion software. This software consists of a program library for forward modeling and inversion of DC resistivity and induced polarization data over 2D structures. It was developed under the consortium research project *Joint/Cooperative Inversion of Geophysical and Geological Data*, UBC-Geophysical Inversion Facility, Department of Earth and Ocean Sciences, University of British Columbia, Vancouver, British Columbia.

Results from the 2D inversions are presented for the Mx chargeability and apparent resistivity in the lowest two panels presented in the Plate in Appendix C.

6.2 SPECTRAL IP:

Spectral data for ***Tau, M-IP*** and ***'c'*** were calculated and presented for the surface IP data. They are calculated from a modified version of *Scintrex' Spectrum* software. This software matches the IP data to a suite of master curves. Readings with poor matches are screened and not plotted.

Detailed information about Spectral IP can be found in the following technical paper: *Geophysics, Vol. 49, No. 11, (November 1984), P. 1993-2003 "Spectral induced polarization parameters as determined through time-domain measurements"*. A brief description of Spectral IP follows:

The spectral parameters calculated from the IPR12 data provide an increased dimension to IP interpretation. The time constant *Tau* and exponent *c* are measurable physical properties which describe the shape of the decay curve. *Tau* can be used to discriminate between fine and coarse-grained polarizable mineralization. For a 2-second pulse, it ranges between 0.01 s for fine-grained sulphides, to 100 s for coarse-grained sulphides. *Tau* is important in gold exploration as gold is often associated with fine-grained sulphide mineralization. In rare cases, gold can be associated with coarse-grained mineralization, and therefore medium to long *Tau.*

Spectral *Tau* is a useful signature parameter for helping to correlate anomalies that likely originate from the same geologic source. For example, anomalies with different *Tau* values likely belong to separate zones.

Exponent *c* is diagnostic of the uniformity of the grain size of the target. It ranges from 0.1 for non-uniform grain size to 0.8 for uniform grain size and 1.0 for inductive coupling effects. Low *c* means that there is less certainty to the calculated *M-IP* and *Tau* values because there are likely multiple chargeable sources contributing to the response. The Cole-Cole models are based on theoretical decay curves for a uniform source.

The *M-IP* is the relative residual voltage that would be seen immediately after the shut-off of the transmitted pulse. It is expressed as mV/V and its amplitude relates to the quantity of the polarizable mineralization.

M-IP parameter is very useful because theoretically it is not affected by ground resistivity. Normally, low resistivity tends to suppress the measured (apparent) chargeability decreasing its amplitude. A problem in areas of very high resistivity is that the apparent chargeability moves sympathetically with high resistivities. Therefore, when a high chargeability anomaly correlates with a resistivity high, it is impossible to know when the anomaly is solely caused by sulphides unless the *M-IP* parameter is used.

The *M-IP* parameter allows for the selection of chargeability anomalies associated with resistivities that have a high probability to be associated with sulphides. In gold exploration this is very important because highly silicified areas are usually associated with gold mineralization. However, sulphide zones are the most favourable gold exploration targets within the zone of silicification.

The procedure for determining the spectral parameters plotted on the pseudosections is the result of Cole-Cole model curve matching. Matches that have a poor RMS standard deviation fit are not plotted. Poor fits to the model curves can result from inductive coupling, which is usually seen in the early decay slices, lack of significantly chargeable response, or noisy readings.

6.3 MAGNETICS AND VLF-EM:

The magnetics and VLF-EM data are presented as profiles in the top panel of the Plate presented in Appendix C. The diurnally corrected magnetics data are presented as the solid thick blue profile. The VLF-EM data are presented as solid black and red lines for the inphase and quadrature components respectively.

The base and rover magnetics data were downloaded to a computer and input as databases using *Geosoft Oasis* software. Magnetic diurnal corrections were done with

Geosoft's Table-lookups. This application linked the files according to GPS acquired UTC time. Base station readings were taken at 1-second intervals. Straight-line interpolation was applied to the base station readings to match the coinciding field magnetometer readings. Postings of the magnetics data are not presented on the plates because readings are too dense to display at the presented map scale.

The VLF-EM data were recorded in a field book. The Cutler NAA results are posted with the profiles. Both Cutler and La Moure results are tabulated in Appendix B. The data were transferred to a *Geosoft* database for subsequent plotting.

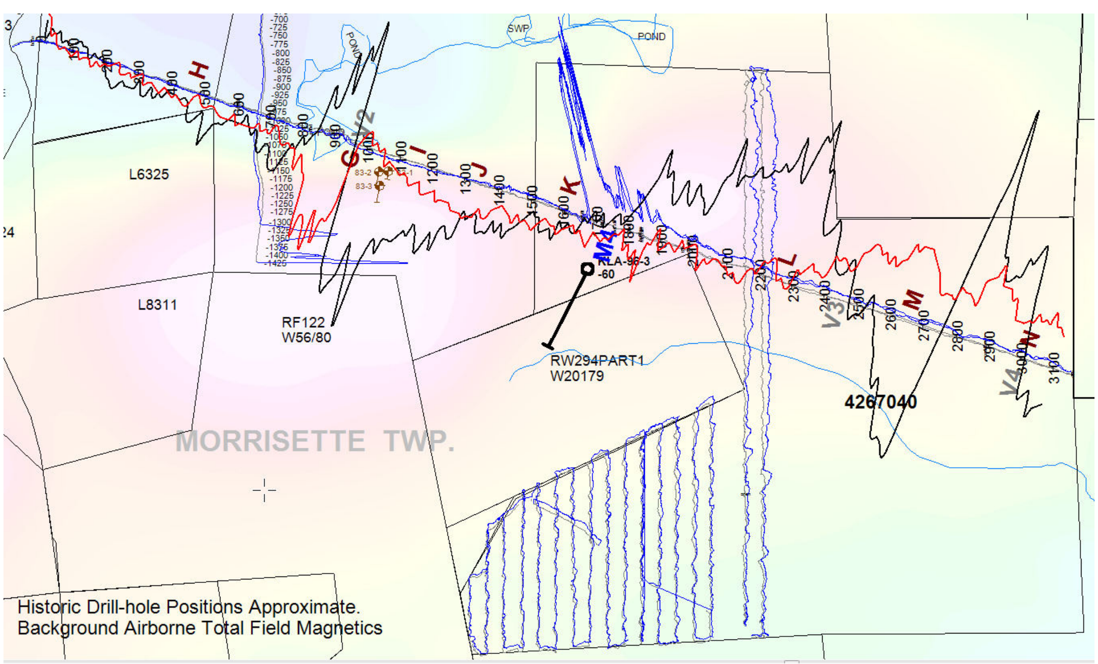
7. PROBLEMS & LOGISTICAL ISSUES

With the exception of very cold conditions for the 2015 magnetometer surveys and very hot conditions for the 2016 work, there were no problems or logistical issues that impeded the survey production or data quality.

8. DISCUSSION OF RESULTS

Several chargeability anomalies were interpreted. They are identified with lettering that continues from those identified in ClearView reference Q0716 "Report on Linecutting, Spectral IP/Resistivity, Magnetics, VLF-EM Surveys, Sampling & Historic Data Review at the Toanga Project Morrisette Township Property Kirkland Lake Area, NE Ontario, Fall 2012". The anomalies are identified on the Plate (Appendix C) and in the following plan map Figure 2. A brief discussion of the anomalies follows.

Figure 2: Mag/Cutler VLF profiles and Anomaly Locations



G, V2:

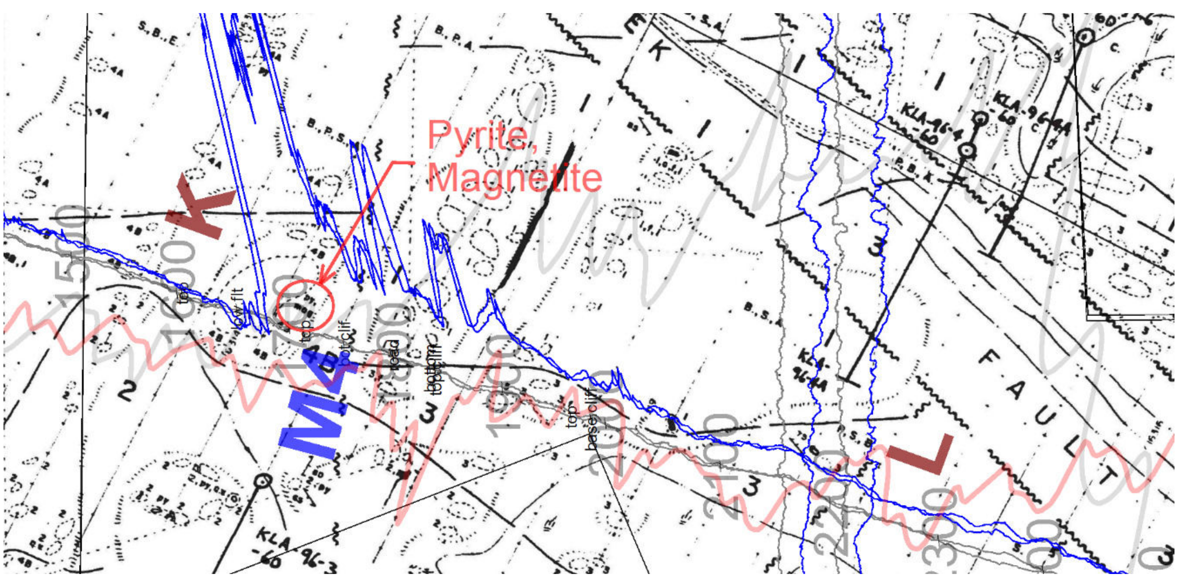
Anomaly **G** is a moderately strong chargeability anomaly that coincides with a well-defined VLF anomaly **V2** with inphase and quadrature cross-over located at station 970mE. The UBC 2d inversion model indicates a steeply west dipping source at a depth of 100 metres. The corresponding very high apparent resistivity, high spectral 'c' and short spectral 'Tau' indicates the potential for fine-grained sulphides located within a broad zone of potentially silicified rock. Whether the source of the VLF anomaly **V2** is a sub-zone of conductive mineralization within **G** is uncertain.

M4:

This strong well defined magnetics high anomaly is characterized by a high gradient magnetics high at station 1685E which likely indicates a fault or geologic contact. The zone remains highly variable across high ground and outcrop with decreasing amplitude towards the east until approximately station 1915E. Maps prepared by Medici in 1989 indicate magnetite and pyrite were mapped at this location as indicated in Figure 3.

There is no significant corresponding VLF anomaly at this location. The chargeability and apparent resistivity pseudosections indicate overall higher chargeability and apparent resistivity values to the west of **M4** compared to overall lower values to the east of **M4.** This reinforces the interpretation that **M4** is at a fault or geologic contact. Low ground located at 1660E, approximately 25 metres west of the start of **M4** could result from such a fault or shear zone. This potential fault was noted on "Map 2193, Bernhardt and Morrisette Townships" included in Geological Report 84, 1970, prepared by Rupert and Lovell.

Figure 3: Magnetite mapped on outcrop at M4, Medici 1989



The apparent resistivity data indicate low apparent resistivity for most of the areas west of **M4** to a depth of approximately 85 metres. This could result from more weathered meta-arkose/conglomerate which is indicated by Rupert and Lovell in the area. However, it could also indicate a different rock type that could be more favourable as a host to economic mineralization. Anomalies **G** (previously discussed) through **K** are located west of **M4.**

H:

Anomaly **H** is 2d inversion modeled as a weak chargeability anomaly that is strongest at approximately 200 metres deep. The apparent resistivity data indicate lower near surface apparent resistivity but very high apparent resistivity at depth beginning at approximately 100 metres deep. Spectral values are short indicating the potential for fine-grained sulphides. There is no readily discernable corresponding magnetic or VLF response.

I, J, and K:

These weak chargeability anomalies located west of **M4** are similarly strongest below 100 metres deep. Corresponding apparent resistivity values are high to surface for all three anomalies. The magnetics data indicate minor variations at an outcrop located at the top of a hill 1420E which is halfway between **J** and **K.** These anomalies could result from minor amounts of fine-grained sulphides.

L, M, N, V3 and V5:

These very weak chargeability and VLF anomalies are located under primarily cedar swamp east of **M4.** The chargeability anomalies are inversion modeled as discrete poorly defined features. Whether they result from fine-grained sulphides or variations in bedrock is uncertain.

Strike Minerals 1995 IP Survey:

A 25-metre dipole-dipole phase IP survey was completed by Gerard Lambert Geosciences in 1995. The n=3 chargeability and apparent resistivity data were digitized from hard copy plots and are presented in Figure 4 and Figure 5.

These results are significant because they generally show low chargeability response at rocks types indicated by Rupert and Lovell as quartz-feldspar porphyry and felsic to intermediate metavolcanics. The strongest anomalies are located north of **G/V2** and in and around **M4.** Although no significant chargeability response was seen by the present "a"=100m survey at **M4**, this could result from the different survey orientation and much larger "a"-spacing for the present survey.

A comparison between the chargeability colour contour map in Figure 4 versus the apparent resistivity map in Figure 5 shows that the chargeability and apparent resistivity are inversely related. Whether this is an artifact of the survey being carried out in the frequency domain and/or a natural response from higher chargeability within more resistive rock types is uncertain.

Figure 4: Phase IP, n=3, 1995 Survey for Strike Minerals

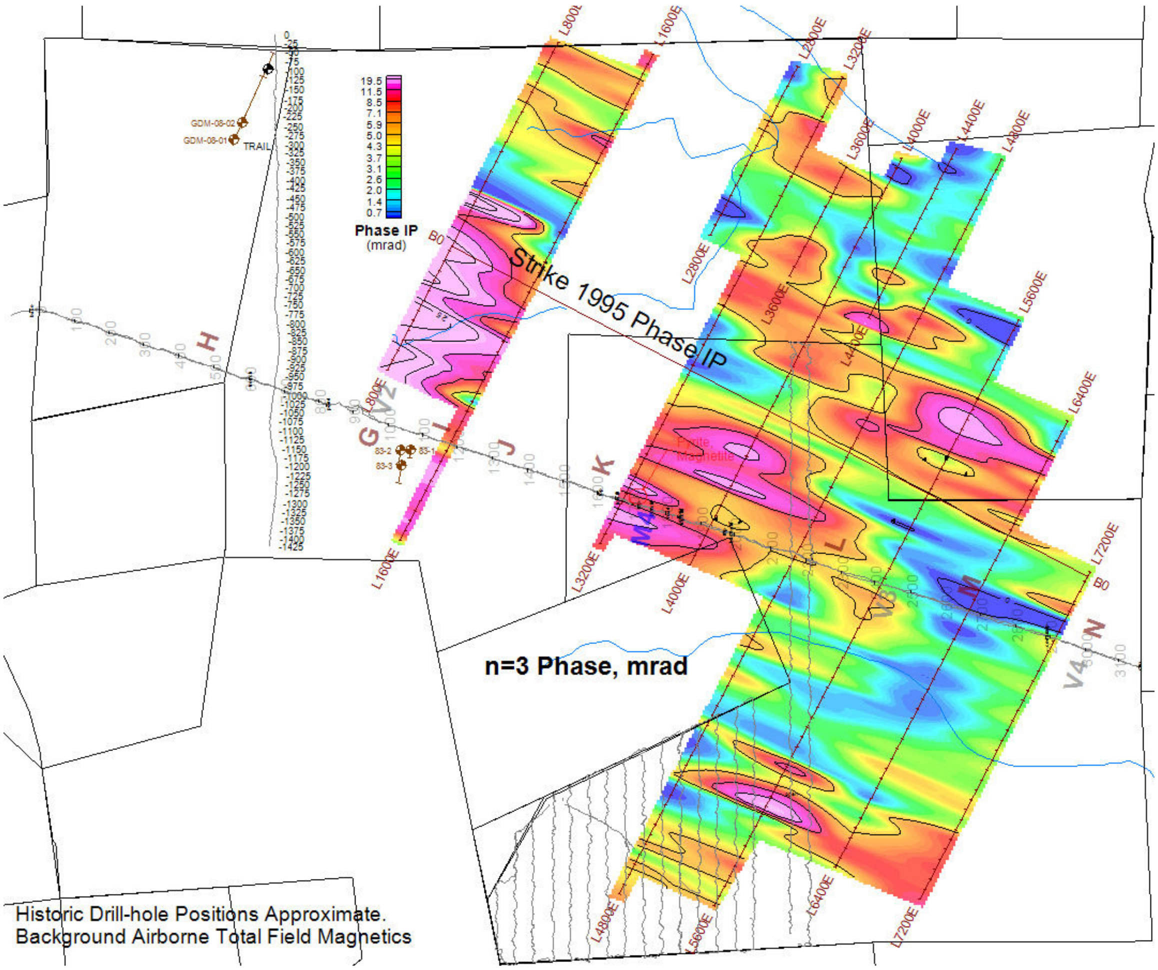
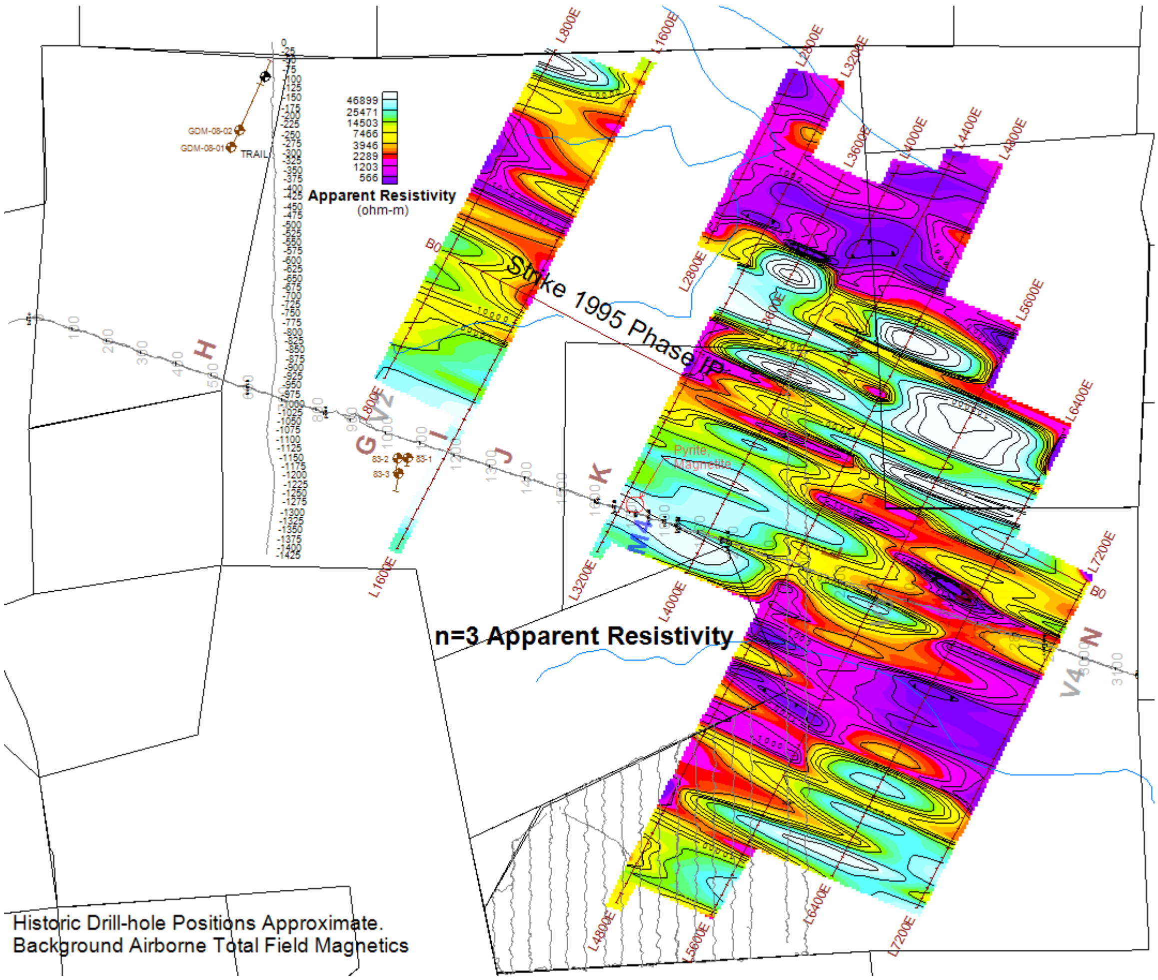


Figure 5: Apparent Resistivity, n=3, 1995 Survey for Strike Minerals



9. RECOMMENDATIONS AND CONCLUSIONS

Anomaly **G/V2** should be drill tested for economic mineralization at L2N, station 970mE, to a depth of at least 125 metres. The anomaly is located under a swamp as indicated in the following photo, Figure 6. Additional ~east-west spectral IP/resistivity lines centred at anomaly **G/V2** are warranted to the north and south if favourable results are achieved by drilling, particularly since the 1995 phase IP survey detected a relatively broad and strong anomaly to the north (refer to Figure 4).

Figure 6: Anomaly G/V2 from ~stn.925E facing towards east along line.

A lower priority anomaly for follow-up is chargeability anomaly **H.** This anomaly should be tested to determine if a different potentially economically mineralized rock type is located under the less favourable meta-arkose/conglomerate units (refer to ClearView report Q0716).

The 50-metre cesium north-south oriented magnetometer coverage completed in the south portion of the property should be continued throughout the property to help identify geologic trends particularly for deeper sources. The present limited coverage did not identify significant features that could be used to develop a geophysical signature of the rock types and showings indicated by Rupert and Lovell.

If there are any questions about the surveys or this report, please do not hesitate to contact the undersigned.

Sincerely,

ClearView Geophysics Inc.
Per:

Joe Mihelcic, P.Eng., M.B.A.
Geophysicist/President

10. STATEMENT OF QUALIFICATIONS, JOE MIHELCIC

I, Joe Mihelcic, Hereby certify that:

1) I am a geophysicist with business office at 12 Twisted Oak Street, Brampton, Ontario L6R 1T1.

2) I am the owner of ClearView Geophysics Inc., a company performing geophysical services.

3) I with my wife Sabina Mihelcic are the owner's of JoBina Resources Inc., a company exploring for economic mineralization.

4) I am a graduate of Queen's University in Applied Science, Geological Engineering (B.Sc. 1988) and of Ivey Business School (M.B.A. 1995).

5) I am a member of the Professional Engineers of Ontario (PEO).

6) I am a member of the Northwest Territories Association of Professional Engineers and Geoscientists (NAPEG).

7) I have practiced my profession for 28 years.

Signed Joe Mihelcic ________________________

Joe Mihelcic, P.Eng., M.B.A.
Brampton, Ontario
August 14, 2016

APPENDIX A – Instrument Specifications

SCINTREX

IPR-12 Time Domain Induced Polarization/Resistivity Receiver

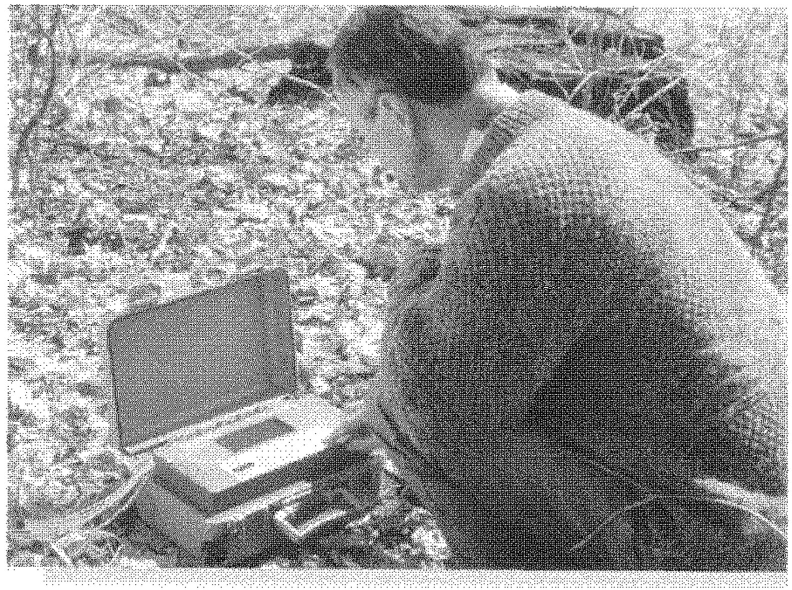
Brief Description

The IPR-12 Time Domain IP/Resistivity Receiver is principally used in exploration for precious and base metal mineral deposits. In addition, it is used in geoelectrical surveying for groundwater or geothermal resources, often to great depths. For these latter targets, the induced polarization measurements may be as useful as the high accuracy resistivity results since it often happens that geological materials have IP contrasts when resistivity differences are absent.

Due to its integrated, lightweight, microprocessor based design and its large, 16 line display screen, the IPR-12 is a remarkably powerful, yet easy to use instrument. A wide variety of alphanumeric and graphical information can be viewed by the operator during and after the taking of readings. Signals from up to eight potential dipoles can be measured simultaneously and recorded in solid-state memory along with automatically calculated parameters. Later, data can be output to a printer or a PC (direct or via modem) for processing into profiles and maps.

The IPR-12 is compatible with Scintrex IPC, TSQ and VERSA Transmitters, or others which output square waves with equal on and off periods and polarity changes each half cycle. The IPR-12 measures the primary voltage (Vp), self potential (SP) and time domain induced polarization(Mi) characteristics of the received waveform. Resistivity, statistical and Cole-Cole parameters are calculated and recorded in memory with the measured data, time and location.

Scintrex has been active in induced polarization research, development, manufacturing, consulting and surveying for over thirty years. We offer a full range of instrumentation, accessories and training.



The IPR-12 Receiver measures eight dipoles simultaneously then records measured and calculated parameters in memory.

BENEFITS

Speed Up Surveys

The IPR-12 saves you time and money in carrying out field surveys. Its capacity to measure up to eight dipoles simultaneously is far more efficient than older receivers measuring a single dipole. This advantage is particularly valuable in drillhole logging where electrode movement time is minimal.

The built-in, solid-state memory records all information associated with a reading, dispensing with the need for any hand written notes. PC compatibility means rapid electronic transfer of data from the receiver to a computer for rapid data processing.

Taking a reading is simple and fast. Only a few keystrokes are needed since the IPR-12 features automatic circuit resistance checks, SP buckout and gain setting.

High Quality Data

One of the most important features of the IPR-12 in permitting high quality data to be acquired, is the large display screen which allows the operator easy real time access to graphic and alphanumeric displays of instrument status and measured data. The IPR-12 ensures that the operator obtains accurate data from field work.

The number and relative widths of the IP decay curve windows have been carefully chosen to yield the transient information required for proper interpretation of spectral IP data. Timings are selectable to permit a very wide range of responses to be measured.

The IPR-12 stacks the information for each cycle and calculates a running average for Vp, SP and each transient window. This enhancement is equivalent to a noise decrease of $\sqrt{N}$ or a transmitter power increase of N where N is the number of values averaged. Since values are measured each few seconds, it does not take long for this signal enhancement technique to have great effect.

The automatic SP program bucks out and corrects completely for linear SP drift. Data are also kept noise free by: radio-frequency (RF) filters, low pass filters and statistical spheric noise spike rejection.

To prevent mistriggering, the IPR-12 does not accept trigger-line signals at inappropriate times.

The IPR-12 is fully portable and easy to use.

FEATURES

Eight Dipoles Simultaneously
The analog input section of the IPR-12 contains eight identical differential inputs to accept signals from up to eight individual potential dipoles. Any dipole can be disabled. The amplified analog signals are converted to digital form by a high resolution A/D converter and recorded with other pertinent information identifying each group of dipoles.

Large Backlit Display
The 16 line by 40 character backlit SuperTwist Liquid Crystal Display (LCD) enhances the operator's understanding of the status and the accuracy of the measured data. Any one of thirteen different display screens are used for entering information, monitoring the progress of a reading and checking data before and after recording. An LCD heater is provided for low temperature operation.

Programmable Windows
The user has the option to use the default window width's in the IPR-12 or you may set up custom slice width's to suit your application.

Keyboard
Seventeen large keys control the instrument and permit entry of alphanumeric information.

Solid State Memory
All instrument parameters as well as; entered notes, measured and calculated quantities are stored in the large capacity, fail-safe memory.

Memory Recall
Any observation recorded in memory can be recalled, by simple keypad entry, for inspection on the display.

PC Compatibility
The IPR-12 uses an RS-232C, 7 or 8 bit ASCII high baud rate interface, compatible with most lap-tops or PC's. This permits data to be dumped on a line by line basis or all at once from the receiver's memory for archiving or processing.

Spectral Quality IP
Depending on receive time, 10 to 14 windows are measured simultaneously for each dipole. Selectable total receive times are 1, 2, 4, 8, 16 and 32 seconds. After the current is shut off, there is a delay of t milliseconds. Then, the width of each window in the seven following pairs of windows is, respectively: t, 2t, 4t, 8t, 14t, 23t and 36t. This format provides a high density of information at early times where the decay of the curve is steepest.

Variable Chargeability Summing
By keyboard selection, you can choose an additional, summed transient window. This value, Mx, is recorded in memory along with the value for each of the measured transient windows. Summing can be done for the purpose of obtaining a parameter close to that measured with earlier receivers. The width of the Mx window ranges upwards from 10 milliseconds in 10 millisecond steps.

Signal Enhancement
Primary voltage, self potential and individual transient windows are continuously averaged and the display is updated every cycle so the operator is fully aware of signal improvement.

Calculates Cole-Cole Parameters
The IPR-12 calculates the Cole-Cole parameters; true chargeability (M) and time constant (Tau) for a fixed C of 0.25. These parameters, which are recorded in memory may be used to assist interpretation by distinguishing between different chargeable sources, based mainly on textural differences. This feature is not available if programmable windows are selected.

Noise Rejection

F E A T U R E S

Individual samples contaminated by noise can be automatically rejected.

Statistical Parameters
The IPR-12 calculates statistical error parameters for Mx. The RMS error of the deviation between the measured data and best fit of the Cole-Cole calculation is also derived.

Selectable Reading Termination
By keyboard selection the receiver can be set up to terminate readings by either a manual key press or when a preset number of cycles have been measured.

Normalizes for Time and Vp
The value recorded for each M window is in millivolt/volt, that is to say that normalization is automatically done for the width of each window and for the primary voltage, Vp is also normalized for time of integration.

Automatic Resistivity Calculations
The IPR-12 calculates the geometrical (K) factors for standard arrays shown in the Info display based on electrode positions given in the Locations display. This feature is particularly helpful for arrays like the Gradient of Schlumberger in which the K-Factors change for every station. Then, using measured primary voltages with operator entered current values, the receiver calculates and records apparent resistivity values.

Automatic Vp Self Ranging
There is no manual adjustment for different primary voltages since the IPR-12 automatically adjusts the gain of its signal conditioning amplifiers for any Vp signal in the range of 50 microvolts to 14 volts full scale.

Automatic SP Correction
Self potential buckout is entirely automatic, both initially and throughout the measurement.

Synchronization
In normal operation, the IPR-12 synchronizes itself on the received waveform, and triggering is disabled until to within about 60 milliseconds before a signal transition. This reduces to a negligible level the possibility of false triggering.

Electrode Resistance Check
A built-in AC ohmmeter avoids electrode polarization, while checking the ground resistance of electrodes and the continuity of field cables. The circuit resistance values are displayed and are automatically recorded in memory.

Self-Check Program
Each time the instrument is turned on, a verification of the program memory is automatically performed.

Out of Limit Checks
Messages appear on the display if any of the following errors occur: out of calibration or failed memory test, incorrect signal amplitude or excessive noise, signal input with respect to the reference electrode in excess of the permitted range, synchronization failure, previous station's data not filed and data memory full.

Analog Meter
When signals on up to eight dipoles are presented simultaneously on the digital display, one analog meter, easily switchable from dipole to dipole, has been provided for monitoring particularly noisy conditions.

Internal Test Generator
An internal signal generator is used to test the instrument periodically, to ensure that it is functioning properly.

Overload Detection
All analog signal levels are monitored to prevent measurements on individual dipoles for which limits are exceeded and appropriate messages are displayed. The affected samples are not added to the previous average.

Noise Filters
Radio frequency and 10Hz, 6 pole low pass filters enhance signal quality. The low cut off frequency and steep roll-off of the latter filters provide better powerline noise rejection than notch filters.

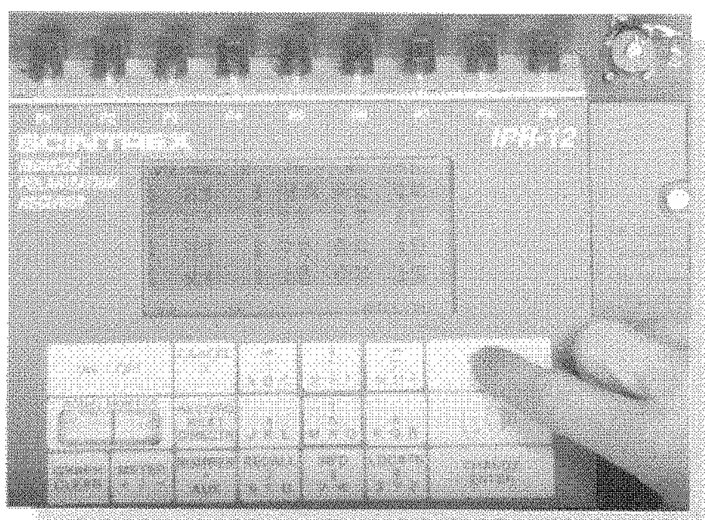
Noise Monitor
This monitor allows the display of noise and/or the received signal for any selected dipole in a similar manner to that of a digital oscilloscope.

Input Protection
If signals in excess of 14V and up to 60V are accidentally applied at the input, zener diode protection ensures that no damage will occur. For higher voltages fuse protection is used.

Binding Posts
To avoid inter-electrode leakage which may occur in humid conditions with small, multipin connectors, the IPR-12 has been designed with widely spaced binding posts.

Mueller Cable
The "Mueller IP/Resistivity Snake" is a potential cable set that has been designed by a geophysical field operator with many years of practical experience in conducting surveys in all types of terrain. Designed to be easily and quickly moved along the survey line to increase your survey efficiency results in significant cost savings made possible by the "Snake".

Software
A complete range of data processing, plotting and interpretation software is available to meet all requirements.



The IPR-12 features a new, improved large highly visible Liquid Crystal Display.

SPECIFICATIONS

Inputs
1 to 8 dipoles are measured simultaneously.

Input Impedance
16 Megohms

SP Bucking
± 10 volt range. Automatic linear correction operating on a cycle by cycle basis.

Input Voltage (Vp) Range
50 µvolt to 14 volt

Chargeability (M) Range
0 to 300 millivolt/volt

Tau Range
60 microseconds to 2000 seconds

Reading Resolution of Vp, SP and M
Vp, 10 microvolt; SP, 1 millivolt; M, 0.01 millivolt/volt

Absolute Accuracy of Vp, SP and M
Better than 1%

Common Mode Rejection
At input more than 100db

Vp Integration Time
10% to 80% of the current on time.

IP Transient Program
Total measuring time keyboard selectable at 1, 2, 4, 8, 16 or 32 seconds. Normally 14 windows except that the first four are not measured on the 1 second timing, the first three are not measured on the 2 second timing and the first is not measured on the 4 second timing. An additional transient slice of minimum 10 ms width, and 10ms steps, with delay of at least 40 ms is keyboard selectable. Programmable windows also available.

Transmitter Timing
Equal on and off times with polarity change each half cycle. On/off times of 1, 2, 4, 8, 16 or 32 seconds. Timing accuracy of ±100 ppm or better is required.

External Circuit Test
All dipoles are measured individually in sequence, using a 10 Hz square wave. The range is 0 to 2 Mohm with 0.1 kohm resolution. Circuit resistances are displayed and recorded.

Synchronization
Self synchronization on the signal received at a keyboard selectable dipole. Limited to avoid mistriggering.

Filtering
RF filter, 10 Hz 6 pole low pass filter, statistical noise spike removal.

Internal Test Generator
1200 mV of SP; 807 mV of Vp and 30.28 mV/V of M.

Analog Meter
For monitoring input signals; switchable to any dipole via keyboard.

Keyboard
17 key keypad with direct one key access to the most frequently used functions.

Display
16 lines by 40 characters, 128 x 240 dots, Backlit SuperTwist Liquid Crystal Display. Displays instrument status and data during and after reading. Alphanumeric and graphic displays.

Display Heater
Available for below -15°C operation.

Memory Capacity
Stores approximately 400 dipoles of information when 8 dipoles are measured simultaneously.

Real Time Clock
Data is recorded with year, month, day, hour, minute and second.

Digital Data Output
Formatted serial data output for printer and PC etc. Data output in 7 or 8 bit ASCII, one start, one stop bit, no parity format. Baud rate is keyboard selectable for standard rates between 300 baud and 57.6 kBaud. Selectable carriage return delay to accommodate slow peripherals. Hand-shaking is done by X-on/X-off.

Standard Rechargeable Batteries
Eight rechargeable Ni-Cad D cells. Supplied with a charger, suitable for 110/230V, 50 to 60 Hz, 10W. More than 20 hours service at +25°C, more than 8 hours at -30°C.

Ancillary Rechargeable Batteries
An additional eight rechargeable Ni-Cad D cells may be installed in the console along with the Standard Rechargeable Batteries. Used to power the Display Heater or as backup power. Supplied with a second charger. More than 6 hours service at -30°C.

Use of Non-Rechargeable Batteries
Can be powered by D size Alkaline batteries, but rechargeable batteries are recommended for lower cost over time.

Operating Temperature Range
-30°C to +50°C

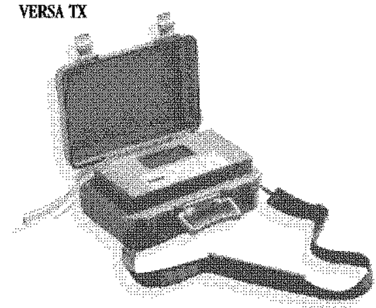
Storage Temperature Range
-30°C to +50°C

Dimensions
Console: 355 x 270 x 165 mm
Charger: 120 x 95 x 55 mm

Weights
Console: 5.8 kg   Batteries: 1.3 kg
Charger: 1.1 kg

Transmitters Available

IPC-9 200 W	TSQ-2E 750 W
TSQ-3 3 kW	TSQ-4 10 kW
VERSA TX	



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Earth Science Instrumentation

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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 Ordenance Detencion**
* **Archeology**
* **Magnetic observatory measurements**
* **Volcanology and earthquake prediction**

Taking Advantage of a "Quirk" of Physics

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 up-grades 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
- **Enhanced GPS positioning** resolution
- **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!

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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.

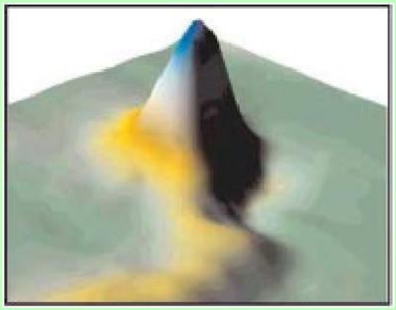
The result is high quality data with sensitivities of 0.015 nT / √Hz or better. This sensitivity is also the same order-of magnitude as costlier optically pumped cesium systems. .

Resolution is a measure of the smallest number that can be displayed on the instrument (or transmitted via the download process). The Overhauser magnetometer displays 7 digits which includes 5 digits, decimal point and two decimal digits.

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.

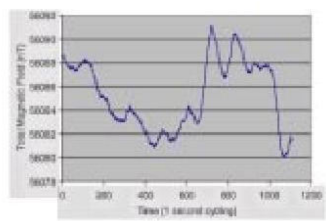
The GSM-19 gradiometer data are consistently low in noise and representative of the geologic environment under investigation.

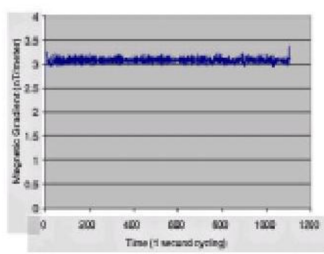
Sampling rates are defined as the fastest speed at which the system can acquire data. This is a particularly important parameter because high sampling rates ensure accurate spatial resolution of anomalies and increase survey efficiency.

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).

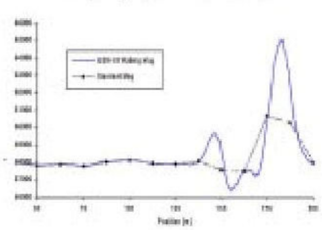
Gradient tolerance represents the ability to obtain reliable measurements in the presence of extreme magnetic field variations. GSM-19 gradient tolerance is maintained through internal signal counting algorithms, sensor design and Overhauser physics. For example, the Overhauser effect produces high amplitude,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

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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 838,860 readings (based on a basic configuration of 16 Mbytes of memory and a survey with time, coordinate, and field values).

An optional increment up to 32 Mbytes doubles the memory -- making the GSM-19 an ideal system for acquisition of data with integrated GPS readings (when required).

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.

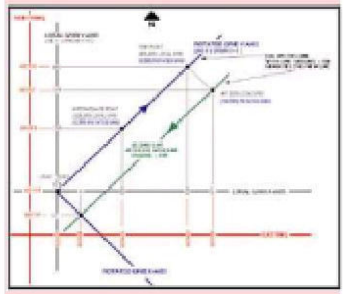
Other enhancements include way point pre-programming of up to 1000 points. Professionals can now define a complete survey before leaving for the field on their PC and download points to the magnetometer via RS-232 connection.

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 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.

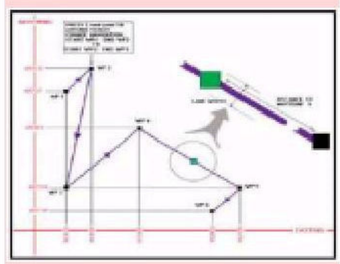


Navigation and Lane Guidance

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 (<- 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

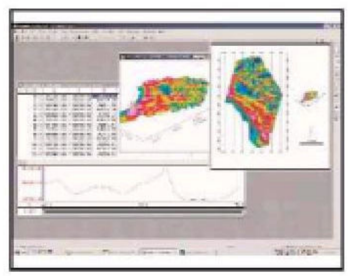
With its omnidirectional VLF option, up to 3 stations of VLF data can be acquired without orienting. Moreover, the operator is able to record both magnetic and VLF data with a single stroke on the keypad.

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

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 (optional). 16 Mbytes standard

* 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 fields less than 20,000 nT (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.

Description	Range	Services	Output	Nav Option
Standalone	5m	GPS	Time, Lat / Long, UTM	Y
Corrected automatically by GPS without radio modem	3m	WAAS / EGNOS, OmniSTAR	Time, Lat / Long, UTM	Y
Corrected automatically by GPS without radio modem	1m	WAAS / EGNOS, OmniSTAR	Time, Lat / Long, UTM	Y
Corrected automatically by GPS with radio modem	0.1m	RTCM, RTK	Time, Lat / Long, UTM	Y

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:	< 0.015 nT / vHz@1Hz
Resolution:	0.01 nT
Absolute Accuracy:	+/- 0.1 nT
Dynamic Range:	10,000 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 - 16Mbytes (# of Readings)

Mobile:	838,860
Base Station:	2,796,202
Gradiometer:	699,050
Walking Magnetometer:	1,677,721

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 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-ofphase components as % of total field. 2 relative components of the horizontal field.
Resolution:	0.1% of toal field

MAGNETIC METHODS

SCINTREX
A DIVISION OF LRS

NEW

ENVI CS MAGNETOMETER

ENVI CS™ MAGNETOMETER SPECIFICATIONS

The Scintrex ENVI CS Cesium Vapour magnetometer is the next advancement in magnetometers using the latest hardware available. It takes the well proven predecessor the ENVI MAG and modernizes it with today's technology. The ENVI CS is a continuous reading magnetometer with high sensitivity, now more affordable, compared with lower sensitivity continuous magnetometers. This system can be easily switched over to use a Proton Sensor making it a versatile tool.

Magnetometry is commonly used for mineral exploration, geological mapping, archaeological investigations and environmental and geotechnical applications.

Sensor:	Self-oscillating split-beam Cesium Vapor (non radioactive Cs133) automatic hemisphere switching. Single sensor is standard. Optional second sensor (gradiometer). Standard systems are field upgradeable.
Data capacity:	Up to 8 million readings
Operating Zones:	10-85 Degrees
Data output:	Active Sync (RS-232C), USB, USB Flash Drive and SD Card
GPS Accuracy:	2.4m (CEP) and 6m (2DRMS) SBAS, Logged at 0.5Hz
Resolution:	0.01 nT(γ) for all sample rates
Sensitivity:	<0.003 nT (γ) √Hz RMS
Sample Rate:	User selectable 1, 2, 5, 10 samples per second
Gradient Tolerance:	1,000 nT (γ) per inch (40,000 nT(γ)/m)
Display:	LCD touchscreen and colour display with adjustable LED backlighting
User Interface:	Full keypad and 6 function dedicated keys
Heading Error:	<± 1 nT (γ)
Real Time Clock:	Accurate synchronization to GPS via NMEA String
Standard Software:	Scintrex Map Registration and Setup. QCTool quality control and display tool
Console:	230mm x 185mm x 60mm (9.0" x 7.3" x 2.3") Weight: 1.3 kg (2.9 lb)
Sensor:	Diameter: 63 mm (2.5"), Length: 160 mm (6.3") Weight: 1.5 kg (2.3 lbs)
Sensor Electronics:	Dimension: 230 x 56 x 38mm (9" x 2.2" x 1.5") Weight: 600g (1.3 lb)
Backpack:	9 kg (20 lb) including batteries
Power:	External Power: 21 – 28 VDC Battery Charger: Standard 120/240V AC
Environmental:	Operating temperature: -20°C (-4°F) to +50°C (122°F) Storage temperature: -30° C (-22°F) to +70°C (158°F)

OPTIONS

Processing Software - Additional Cs Sensor - Conversion Kit for Proton Magnetometer

An ISO 9001:2008 registered company

All specifications are subject to change without notice

Part Number 792711 Preliminary

CANADA
Scintrex
222 Snidercroft Road
Concord, Ontario L4K 2K1
Telephone: +1 905 669 2280
Fax: +1 905 669 6403
e-mail: scintrex@scintrexltd.com
Website: www.scintrex.com

USA
Micro-g LaCoste
1401 Horizon Avenue
Lafayette, CO 80026
Telephone: +1 303 828 3499
Fax: +1 303 828 3288
e-mail: info@microglacoste.com
Website: www.microglacoste.com

Walcer Model TX 9000

Power Input
125V line to neutral
400 Hz / 3 phase
Powered by MG-12

Output
100 - 3200V in 10 steps
0.05 - 20 Amps
Tested to 9.25 kVA

Switching
1 sec., 2 sec., 4 sec., 8 sec.

Metering
LED for line voltage
and output current

Size
63cm. x 54cm. x 25cm.

Weight
44 kg.

Physical & Performance:

Physical dimensions	2.4" x 6.3" x 1.4" (6.1 x 16.0 x 3.6 cm)
Display size, WxH	1.43" x 2.15" (3.6 x 5.5 cm); 2.6" diag (6.6 cm)
Display resolution, WxH	160 x 240 pixels
Display type	transflective, 65-K color TFT
Weight	9.3 oz (262.1 g) with batteries
Battery	2 AA NiMH batteries (included)
Battery life	16 hours (2 AA batteries)
Water rating	IPX7
Floats	No
High-sensitivity receiver	Yes
Interface	high-speed USB and NMEA 0183 compatible

Maps & Memory:

Basemap	Yes
Preloaded maps	yes (topographic)
Ability to add maps	Yes
Built-in memory	3.5GB total space; 500MB available for use
Accepts data cards	microSD™ card (not included)
Waypoints/favorites/locations	2000
Routes	200
Track log	10,000 points, 200 saved tracks

Features & Benefits:

Automatic routing (turn by turn routing on roads)	Yes (with optional mapping for detailed roads)
Electronic compass	Yes (tilt-compensated 3-axis)

Touchscreen	No
Barometric altimeter	Yes
Camera	yes (5 megapixel with autofocus; automatic geo-tagging)
Geocaching-friendly	Yes (Paperless)
Custom maps compatible	Yes
Photo navigation (navigate to geotagged photos)	Yes
Hunt/fish calendar	Yes
Sun and moon information	Yes
Area calculation	Yes
Custom POIs (ability to add additional points of interest)	Yes
Unit-to-unit transfer (shares data wirelessly with similar units)	Yes
Picture viewer	Yes
Garmin Connect™ compatible (online community where you analyze, categorize and share data)	Yes

APPENDIX B – VLF data

La Moure North Dakota NML4 25.2 kHz; station, inphase, quadrature							
0	-3	0		1562.5	-9	0	
12.5	-5	-4		1575	-11	-1	
25	-2	-4		1587.5	-8	4	
37.5	-2	-2		1600	-8	3	
50	-2	-7		1612.5	-6	-2	root_o/c_flat
62.5	-4	-5		1625	-7	2	going_down_slope
75	-3	-7		1637.5	-7	2	
87.5	-5	-7		1650	-5	4	base_slope_Eside
100	-3	-7		1662.5	-5	0	
112.5	-2	-6		1675	-2	0	upslope
125	-3	-8		1687.5	-2	-1	o/c
137.5	-2	-7		1700	-3	4	near_top_slope
150	-1	-8		1712.5	-1	2	top_o/c_slope
162.5	-2	-4		1725	-2	0	base_cliff(pic)
175	-2	-6		1737.5	-2	2	going_down_hill_o/c
187.5	-5	-4		1750	-3	3	
200	-3	-6		1762.5	0	2	
212.5	-5	-5		1775	1	3	
225	-8	-4		1787.5	2	1	low_gnd_at_drill_rd
237.5	-7	-4		1800	4	4	low_gnd_at_drill_rd
250	-7	-6		1812.5	5	3	
262.5	-7	-3		1825	8	0	
275	-5	-4		1837.5	5	4	o/c_top
287.5	-6	-5		1850	7	5	flat_gnd_plat
300	-6	-6		1862.5	10	4	
312.5	-6	-2		1875	11	4	going_down_gradually
325	-7	-3		1887.5	5	5	
337.5	-7	-4		1900	5	6	
350	-6	-6		1912.5	9	4	top_o/c_flat
362.5	-6	-4		1925	10	4	
375	-4	-5		1937.5	9	4	top_o/c_flat
387.5	-6	-6		1950	12	5	
400	-2	-4		1962.5	11	3	slope_down_toS
412.5	-4	-8		1975	15	6	o/c_slope_down
425	-5	-5		1987.5	18	3	hill_o/c_toN, bigGap
437.5	-4	-4		2000	9	6	flat_onwards
450	-2	-5		2012.5	13	7	
462.5	-2	-3		2025	24	4	
475	-5	-5		2037.5	23	6	
487.5	-8	-1		2050	25	0	
500	-8	-6		2062.5	27	0	

512.5	-4	-5		2075	27	-2	
525	-4	-4		2087.5	32	-1	
537.5	-7	-4		2100	33	0	
550	-5	-1		2112.5	36	3	start_flat_area
562.5	-1	-6		2125	33	-2	
575	-3	-8		2137.5	35	0	
587.5	-4	-7		2150	36	1	
600	-2	-6		2162.5	35	-1	
612.5	-3	-6		2175	34	3	
625	-2	-6		2187.5	33	4	
637.5	-3	-5		2200	31	8	
650	-4	-5		2212.5	28	8	
662.5	-2	-7		2225	25	10	
675	-3	-4		2237.5	30	9	
687.5	-4	-5		2250	31	5	
700	-4	-4		2262.5	40	4	
712.5	-6	-6		2275	40	5	
725	-8	-4		2287.5	37	4	
737.5	-10	-4	bottom_hill	2300	28	8	
750	-11	0	wet	2312.5	19	7	
762.5	-10	-3	end_wet	2325	7	12	
775	-6	-4		2337.5	10	9	
787.5	-4	-6		2350	12	9	
800	0	-9		2362.5	12	6	
812.5	1	-8		2375	12	7	
825	0	-6	edge_pond	2387.5	7	10	
837.5	0	-11		2400	0	10	
850	1	-11		2412.5	1	14	
862.5	5	-17		2425	-4	14	
875	7	-18		2437.5	2	15	
887.5	14	-21		2450	8	6	
900	16	-20	edge_o/c	2462.5	4	12	
912.5	17	-22	on_log	2475	-3	15	
925	15	-19	wet_bog	2487.5	-6	20	
937.5	13	-18	shrubs	2500	2	20	
950	24	-20	shrubs	2512.5	14	17	
962.5	16	-11		2525	25	14	
975	-20	-1		2537.5	25	11	
987.5	-32	5		2550	8	15	
1000	-40	5		2562.5	-3	16	
1012.5	-40	6	along_swp_treeline	2575	-15	13	
1025	-36	6		2587.5	-17	13	

1037.5	-31	4		2600	-20	15	
1050	-33	6	diag_small_creek	2612.5	-33	21	
1062.5	-42	6	edge_swp	2625	-25	22	
1075	-31	4	high_gnd	2637.5	-21	22	
1087.5	-26	3	low_gnd_10mN	2650	-31	22	
1100	-24	0	flat_to_N	2662.5	-31	29	
1112.5	-23	2	near_top_hill	2675	-25	26	
1125	-21	2	top_plateau	2687.5	-23	26	
1137.5	-22	1		2700	-27	28	
1150	-21	-3		2712.5	-19	25	
1162.5	-15	-1		2725	-10	22	start_cedar_swp
1175	-16	0		2737.5	-4	23	
1187.5	-15	-3		2750	4	20	
1200	-13	-4		2762.5	13	20	
1212.5	-14	-1		2775	23	20	
1225	-19	0		2787.5	30	17	
1237.5	-14	-3		2800	44	10	
1250	-13	-2		2812.5	50	8	
1262.5	-12	0		2825	42	10	
1275	-11	-5		2837.5	31	13	
1287.5	-9	-3		2850	24	13	
1300	-10	-3		2862.5	17	15	
1312.5	-7	-3		2875	13	14	
1325	-6	-4		2887.5	12	15	road_n/s
1337.5	-4	-3		2900	10	15	
1350	-2	-6		2912.5	8	12	
1362.5	0	-6	flat_low_area	2925	10	10	
1375	-5	-4		2937.5	8	8	
1387.5	-11	0		2950	13	4	
1400	-13	2	uproot	2962.5	14	6	
1412.5	-11	-1	start_up_hill	2975	13	7	
1425	-12	-1	o/c	2987.5	4	6	
1437.5	-12	-2	top_hill	3000	-4	8	
1450	-9	2		3012.5	-15	10	
1462.5	-9	0		3025	-21	9	
1475	-8	0		3037.5	-18	10	
1487.5	-8	-1		3050	-13	10	
1500	-7	-3		3062.5	-23	10	
1512.5	-5	0		3075	-19	10	
1525	-7	1		3087.5	-13	9	
1537.5	-7	0		3100	-19	10	
1550	-9	0		3112.5	-6	8	

				3125	9	5	
				3137.5	13	1	
				3150	18	6	clm_line

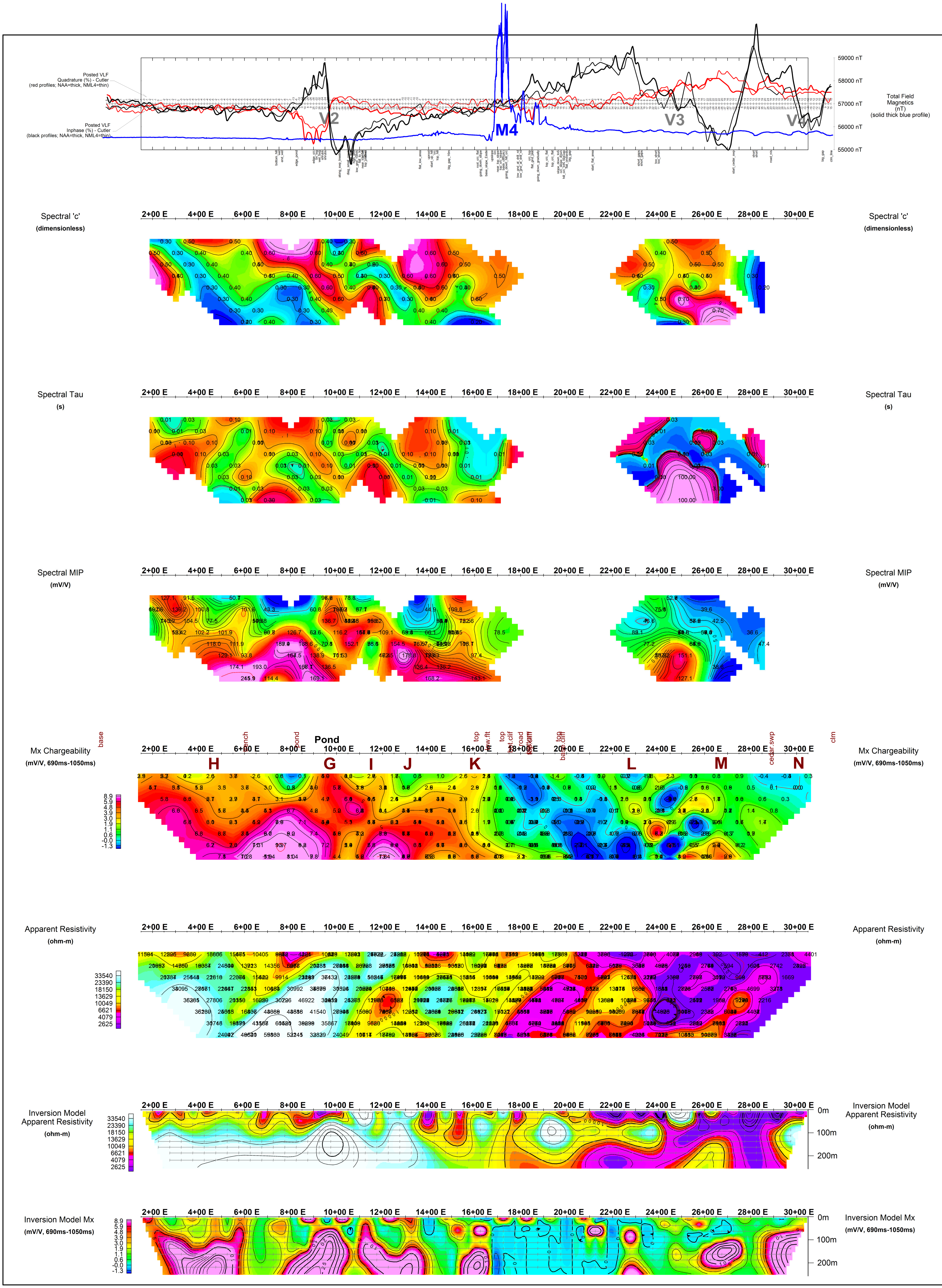
Cutler Maine NAA 24.0 kHz; station, inphase, quadrature							
3150	15	10	clm_line	1575	-6	-5	
3137.5	14	10		1562.5	-7	-4	
3125	9	10		1550	-8	-4	
3112.5	0	11		1537.5	-4	-6	
3100	-11	10		1525	-4	-8	
3087.5	-12	12		1512.5	-3	-7	
3075	-13	12		1500	-5	-6	
3062.5	-16	16		1487.5	-7	-7	
3050	-8	12		1475	-9	-5	
3037.5	-10	13		1462.5	-10	-8	
3025	-12	12		1450	-13	-6	
3012.5	-2	14		1437.5	-9	-5	
3000	7	11		1425	-12	-4	
2987.5	18	11		1412.5	-9	-5	
2975	33	10		1400	-13	-6	
2962.5	31	10		1387.5	-13	-9	
2950	27	10		1375	-14	-9	
2937.5	28	16		1362.5	-9	-7	
2925	22	15		1350	-9	-10	
2912.5	22	18		1337.5	-11	-10	
2900	20	18		1325	-9	-11	
2887.5	20	18		1312.5	-17	-10	
2875	26	24		1300	-18	-10	
2862.5	27	20		1287.5	-15	-10	
2850	35	19		1275	-16	-8	
2837.5	44	18		1262.5	-23	-8	
2825	70	10		1250	-18	-8	
2812.5	48	12		1237.5	-22	-9	
2800	40	13		1225	-25	-6	
2787.5	29	13		1212.5	-20	-7	
2775	18	14		1200	-17	-8	
2762.5	6	10		1187.5	-21	-8	
2750	-5	11		1175	-20	-5	
2737.5	-16	11		1162.5	-22	-6	
2725	-22	10		1150	-24	-7	

2712.5	-37	12		1137.5	-24	-5	
2700	-40	16		1125	-24	-4	
2687.5	-37	18		1112.5	-29	-5	
2675	-35	20		1100	-25	-4	
2662.5	-36	22		1087.5	-28	-3	
2650	-34	22		1075	-35	-2	
2637.5	-26	22		1062.5	-53	-4	moss_low
2625	-19	20		1050	-38	1	
2612.5	-22	22		1037.5	-28	0	
2600	-18	17		1025	-38	2	
2587.5	-12	16		1012.5	-41	1	
2575	-9	14		1000	-44	5	
2562.5	-3	16.5		987.5	-40	3	
2550	-1	14		975	-31	0	
2537.5	4	17		962.5	5	-18	
2525	0	16		950	35	-24	
2512.5	-3	18		937.5	24	-24	
2500	-3	18		925	28	-32	
2487.5	-5	16		912.5	13	-22	
2475	0	15		900	25	-35	
2462.5	10	10		887.5	9	-26	
2450	12	9		875	8	-25	
2437.5	8	11		862.5	14	-32	
2425	7	12		850	0	-14	
2412.5	8	11		837.5	-2	-12	
2400	11	12		825	-5	-8	
2387.5	20	6		812.5	-3	-13	
2375	22	5		800	-7	-7	
2362.5	19	6		787.5	-6	-7	
2350	17	6		775	-10	-6	
2337.5	18	8		762.5	-14	-7	
2325	24	6		750	-15	-6	
2312.5	35	4		737.5	-14	-3	
2300	35	5		725	-9	-2	
2287.5	50	-1		712.5	-8	-5	
2275	43	-1		700	-11	-4	
2262.5	44	1		687.5	-10	-5	
2250	38	0		675	-5	-3	
2237.5	30	5		662.5	-7	-5	
2225	31	6		650	-5	-5	
2212.5	42	4		637.5	-2	-5	
2200	34	4		625	-5	-5	

2187.5	31	0		612.5	-5	-6	
2175	33	1		600	-5	-3	
2162.5	30	0		587.5	-5	-5	
2150	30	-4		575	-7	-5	
2137.5	28	-4		562.5	-7	-5	
2125	27	-2		550	-8	-4	
2112.5	30	-3		537.5	-11	-3	
2100	27	-1		525	-15	-3	
2087.5	26	-1		512.5	-5	-4	
2075	26	0		500	-7	-3	
2062.5	22	0		487.5	-9	-1	
2050	36	-2		475	-9	-2	
2037.5	25	-1		462.5	-4	-5	
2025	22	-5		450	-3	-5	
2012.5	14	1		437.5	-4	-4	
2000	11	2		425	-3	-3	
1987.5	15	1		412.5	-3	-4	
1975	16	0		400	-3	-3	
1962.5	19	2		387.5	-5	-2	
1950	12	-2		375	-4	-4	
1937.5	14	-1		362.5	-6	-3	
1925	19	0		350	-3	-2	
1912.5	13	-2		337.5	-6	-2	
1900	11	-3		325	-6	-3	
1887.5	15	3		312.5	-2	0	
1875	20	-2		300	-5	-1	
1862.5	18	-2		287.5	-5	-2	
1850	26	-14		275	-5	-1	
1837.5	17	-5		262.5	-4	-2	
1825	13	-8		250	-6	-2	
1812.5	9	-4		237.5	-7	1	
1800	6	-6		225	-5	0	
1787.5	3	0		212.5	-4	-1	
1775	1	-2		200	-1	-1	
1762.5	4	-2		187.5	1	-2	
1750	3	-4		175	0	-1	
1737.5	1	-4		162.5	1	-3	
1725	-1	-5		150	-1	-1	
1712.5	3	-4		137.5	2	-1	
1700	0	-3		125	2	-2	
1687.5	3	-8		112.5	3	0	
1675	-1	-6		100	2	-2	

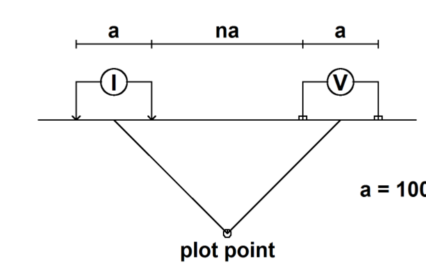
1662.5	0	-4		87.5	1	-1	
1650	-5	-5		75	2	0	
1637.5	-5	-3		62.5	1	-1	
1625	-3	-4		50	4	0	
1612.5	-5	-5		37.5	3	3	
1600	-3	-7		25	4	2	
1587.5	-9	-5		12.5	1	7	
				0	7	8	

APPENDIX C – Plate



2 N

Dipole-Dipole Array



a = 100.0 M

Anomalies:

A IP Chargeability

M1 Magnetics

V1 VLF-EM

Scale 1:10000

100 0 100 200 300 400 500 600 (meters)

JOBINA RESOURCES INC.

SPECTRAL IP/RES SURVEY
SPECTRAL IP/RES SURVEY
TOANGA PROJECT
MORRISETTE TWP PROPERTY

2 N
16/08/04
Rx (2 sec): Scintrex IPR12, Tx (2 sec): Walcer 10kW

ClearView Geophysics Inc. ref. U0721