REPORT ON AN

AIRBORNE MAGNETIC & VLF-EM SURVEY

HEYSON TOWNSHIP

KENORA - RED LAKE
MINING DIVISION

ONTARIO

2.13134

for

MR. LARRY HERBERT

RECEIVED

FEB 26 1990

MINING LANDS SECTION

TERRAQUEST LTD.
Toronto, Canada

January 25, 1989
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1.0 INTRODUCTION

This report describes the specifications and results of an airborne geophysical survey carried out for Mr. Larry Herbert of Box 1059 Red Lake, Ontario, P0V 2M0 by Terraguest Ltd., 240 Adelaide Street West, Toronto, Canada. The field work was carried out from December 12 to 13, 1989 and the data processing, interpretation and reporting from December 14, 1989 to January 25, 1990.

The purpose of a survey of this type is two-fold. First to prospect directly for anomalously conductive and magnetic areas in the earth's crust which may be caused by, or at least related to, mineral deposits. A second is to use the magnetic and conductivity patterns derived from the survey results to assist in mapping geology, and to indicate the presence of faults, shear zones, folding, alteration zones and other structures potentially favourable to the presence of gold and base-metal concentration. To achieve this purpose the survey area was systematically traversed by an aircraft carrying geophysical instruments along parallel flight lines spaced at even intervals, 100 metres above the terrain surface, and aligned so as to intersect the regional geology in a way to provide the optimum contour patterns of geophysical data.

2.0 THE PROPERTY

The property is located in Heyson township, in the Kenora - Red Lake Mining Division of Ontario about 300 metres south of the town of Red Lake. The claims lie in the northeast corner of the township and are readily accessible by several gravel roads and by highway #105 which passes through the property.

The latitude and longitude are 51 degrees 02 minutes, and 93 degrees 57 minutes respectively, and the N.T.S. reference is 52N/4.

The claim numbers are shown in figure 2 and listed below:

KRL 869699-869708 (10)
     869971-869793 (3)
     967218-967223 (6)....total 19 claims

3.0 GEOLOGY

Map References

1. Map 2125: Heyson Township. scale 1:12,000 ODM 1967

The claim group lies in the southern portion of the Red Lake
FIGURE 2. SURVEY AREA

(exact claim locations not certified)

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Archean greenstone belt. Most of the lithologies are intermediate to felsic metavolcanics, primarily latites, plus associated basalts and gabbro. The latites are folded around the basalts in an east-northeast trending, tight syncline which plunges to the southwest. The gabbros are intruded semiconformably in both types of metavolcanics, and may include coarser grained parts of the basalt flows.

No faults or shear zones are shown on either of the geological maps.

4.0 SURVEY SPECIFICATIONS

4.1 Aircraft and Instruments

The survey was carried out using a Cessna 206 aircraft, registration C-GGLS, which carries a magnetometer and a VLF electromagnetic detector.

The magnetometer sensor is a high sensitivity, optically pumped cesium vapour magnetometer mounted in an extension boom attached to the tail of the aircraft. Its specifications are as follows:

- **Working range:** 20,000-100,000 gammas
- **Sensitivity:** 0.005 gammas
- **Sampling rate:** 0.2 seconds
- **Model:** BIW 2321H8
- **Manufacturer:** Scintrex, Concord Ontario.

The magnetometer processor is a PMAG 3000 and the data acquisition system is a PDAS 1000, both manufactured by Picodas Group Inc.

The signal to noise ratio of the magnetic response is improved by a compensation technique provided by Picodas Group Inc. The sources of noise are permanent, induced and eddy current effects of the airframe, and the heading effects. The system uses three orthogonal fluxgate magnetometers to measure the aircraft attitude with respect to the earth's magnetic field vector. A mathematical model is used to solve this interference effect.

The VLF-EM sensor is mounted in the port wingtip. It uses three orthogonal detector coils to measure (a) the total field strength of the time-varying EM field and (b) the phase between the vertical coil and both the "along line" coil (LINE) and the "cross-line" coil (ORTHO). The LINE coil is tuned to a transmitter station that is ideally positioned at right angles to the flight lines, while the ORTHO coil transmitter should be in line with the flight lines. Its specifications are:

- **Accuracy:** 1%
- **Reading Interval:** 0.2 second
Model: TOTEM 2A
Manufacturer: Herz Industries, Toronto, Canada

Other instruments are:

* King KRA-10A radar altimeter
* PDAS-1000 data processor with 40 mByte cassette tape and 3 1/2" disk recorder manufactured by Picodas Group Inc.
* Trimble TRANS GPS satellite and Loran-C navigation
* Video tape flight path confirmation, 1/10th second fiducial intervals and electronic attitude compensation

4.2 Lines and Data

Total survey area...........76 kilometres
Claim group coverage.......40 kilometres
Line direction.............135 degrees azimuth
Line interval...............100 metres
Tie line interval..........2 kilometres
Terrain clearance.........100 metres
Average ground speed......193 kilometres/hour
Data point interval:
  Magnetic..............11 metres
  VLF-EM..............11 metres
Channel 1 (LINE).........NAA Cutler, 24.0 kHz
Channel 2 (ORTHO)........NSS Annapolis, 21.4 kHz

4.3 Tolerances

Line spacing: Any gaps wider than twice the line spacing and longer than 10 times the line spacing were filled in by a new line.

Terrain clearance: Portions of line which were flown above 125 metres for more than one kilometre were reflown if safety considerations were acceptable.

Diurnal magnetic variation: Less than ten gammas deviation from a smooth background over a period of two minutes or less as seen on the base station analogue record.

Manoeuvre noise: nil

4.4 Navigation and Recovery

The satellite navigation system was used during periods of satellite visibility to ferry to the survey site and to survey along each line using either NTS or UTM coordinates. The real time accuracy is variable depending on the number and condition of the satellites, however it is less than twenty five metres and typically in the ten to fifteen metre range. Post processing accuracy can be in the range of plus or minus three metres. The
FIGURE 3. SAMPLE OF ANALOG DATA
satellite window of visibility occurred during lines 13 to 24.

For assisting the navigation of the aircraft and the recovery of the flight path, semi-controlled mosaics of aerial photographs were made from existing air photos. Each photograph forming the mosaic was adjusted to conform to the NTS map system before the mosaic was assembled. These mosaics are also used as a base for the data and interpretation maps and thereby allow detailed ground locations for follow-up investigations and further mapping.

In addition, flight path recovery was also carried out in the field using a video tape viewer to observe the flight path as recorded by the Geocam video camera system. The flight path recovery was completed daily to enable reflights to be selected where needed for the following day and to provide correlation between the satellite navigation/recovery data and the photomosaic base maps.

5.0 DATA PROCESSING

The magnetic data was levelled in the standard manner by tying survey lines to the tie lines. The IGRF has not been removed. The total field was contoured by computer using a program provided by Dataplotting Services Inc. To do this the final levelled data set is gridded at a grid cell spacing of 1/10th of an inch at map scale.

The vertical magnetic gradient is computed from the gridded and contoured total field data using a method of transforming the data set into the frequency domain, applying a transfer function to calculate the gradient, and then transforming back into the spatial domain. The method is described by a number of authors including Grant, 1972 and Spector, 1968. The computer program for this purpose is provided by Paterson, Grant and Watson Ltd. of Toronto.

The VLF data was treated automatically so as to normalize the non conductive background areas to 100 (total field strength) and zero (quadrature). The algorithms to do this were developed by Terraquest and will be provided to anyone interested by application to the company.

All of these data processing calculations and map contouring were carried out by Dataplotting Services Inc. of Toronto.


Grant, F.S., 1972: Review of Data Processing and Interpretation Methods in Gravity and Magnetics; Geophysics Vol 37-4

6.0 INTERPRETATION

6.1 General Approach

To satisfy the purpose of the survey as stated in the introduction, the interpretation procedure was carried out on both the magnetic and VLF-EM data. On a local scale "geological" units were interpreted from the magnetic gradient contour patterns based on their characteristic patterns and intensities, or "signatures". The contacts are typically located along the steepest section of the gradient; therefore the vertical magnetic gradient format was used primarily to delineate stratigraphy. The total magnetic field format was used to determine the relative magnetic intensity of the interpreted unit. Where possible these units were related to existing geology (known outcrops) to provide a geological identity to the units.

Magnetic anomalies that are caused by iron deposits of ore quality are usually obvious owing to their high amplitude, often in tens of thousands of gammas. Mafic to felsic metavolcanics are usually characterized by respectively strong to weak magnetic intensities. Clastic metasediments generally possess very low magnetic susceptibilities and therefore correlate with very low magnetic responses, and in some cases, the observed responses are overwhelmed by the magnetic field from the surrounding lithologies.

Alteration zones can show up as anomalously quiet areas, often adjacent to strong, circular anomalies that represent intrusives, or along an otherwise magnetically active horizon. In some cases contact metamorphic aureoles are characterized by magnetic anomalies.

On a regional scale the total magnetic field contour patterns were used in the same way to delineate bodies of larger dimensions.

Faults and shear zones were interpreted mainly from lateral displacements of otherwise linear magnetic anomalies but also from long narrow "lows". The direction of regional faulting and the topographic lineaments in the general area were taken into account when selecting the dominant fault orientations. Folding is usually seen as curved regional patterns.

VLF-EM anomalies are evaluated according to a) the relative intensities of the total field strength, b) correlation of the total field strength with magnetic, geologic and topographic features, and c) the intensity and nature of the quadrature or phase response.

Areas showing a smooth VLF-EM response somewhat above background (ie. 110 or so) are likely caused by overburden which is thick enough and conductive enough to saturate at these frequencies. In
this case no response from bedrock is seen.

The VLF-EM conductor axes have been identified and evaluated according to the Terraquest classification system (Figure 4). This system correlates the nature and orientation of the conductor axes with stratigraphic, structural and topographic features to obtain an association from which one or more possible origins may be selected. Alternate associations are indicated in parentheses.

The phase response has been categorized according to whether the slope of the profile is normal, reverse, or has no phase at all. The significance of the differing phase responses is not completely understood although in general reverse phase indicates either overburden as the source or a conductor with considerable depth extent, or both. Normal phase response is theoretically caused by surface conductors with limited depth extent. In some cases, a change in the orientation of the conductor appears to affect the sense of the phase response.

6.2 Interpretation

The magnetic and VLF-EM data are shown in contoured format on maps at a scale of 1:10,000 in the back pocket. An interpretation map is also provided. The following notes are intended to supplement these maps.

The interpreted lineaments show a wide variety of orientations although many cluster about 005 and 095 degrees azimuth. A third set, located primarily in the centre of the survey area, trends at 155 degrees azimuth.

The total magnetic field is relatively strong for the area covered with a range of approximately 1,550 gammas. The magnetic pattern is consistent with the general trend of the lithologies. The vertical magnetic gradient shows improved resolution of the strong anomalies and enhances the subtle magnetic responses.

The strongest responses lie to the north and correlate with outcrops of gabbro (Unit 3). The vertical magnetic gradient has been used to shift the contacts slightly within the framework of the known geology. Elsewhere, small outcrops separated from the main gabbroic bodies often do not coincide with strong responses. This is probably due to their low volume and not necessarily a change in magnetic content.

The outcrops of mafic metavolcanic composition correlate with an anomaly with a relief of approximately 200 gammas. This trend is shown as Unit 1 on the interpretation map and is probably caused by the higher concentrations of magnetic minerals commonly found within mafic lithologies. The responses are similar to those over the gabbro and therefore intrusive horizons may be expected
### Figure 4: Terraquest Classification of VLF-EM Conductor Axes

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>CORRELATION</th>
<th>ASSOCIATION: Possible Origins</th>
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<tbody>
<tr>
<td>a, A</td>
<td>Coincident with magnetic stratigraphy</td>
<td>Bedrock magnetic horizons: stratabound mineralogic origin or shear zone</td>
</tr>
<tr>
<td>b, B</td>
<td>Parallel to magnetic stratigraphy</td>
<td>Bedrock non-magnetic horizons: stratabound mineralogic origin or shear zone</td>
</tr>
<tr>
<td>c, C</td>
<td>No correlation with magnetic stratigraphy</td>
<td>Association not known: possible small scale stratabound mineralogic origin, fault or shear zone, overburden</td>
</tr>
<tr>
<td>d, D</td>
<td>Coincident with magnetic dyke</td>
<td>Dyke or possible fault: mineralogic or electrolytic</td>
</tr>
<tr>
<td>f, F</td>
<td>Coincident with topographic lineament or parallel to fault system</td>
<td>Fault zone: mineralogic or electrolytic</td>
</tr>
<tr>
<td>ob, OB</td>
<td>Contours of total field response conform to topographic depression</td>
<td>Most likely overburden: clayey sediments, swampy mud</td>
</tr>
<tr>
<td>cul, CUL</td>
<td>Coincident with cultural sources</td>
<td>Electrical, pipe or railway lines</td>
</tr>
</tbody>
</table>

### Notes
1. Upper case symbols denote a relatively strong total field strength
2. Underlined symbols denote a relatively strong quadrature response
3. Mineralogic origins include sulphides, graphite, and in fault zones, gouge
4. Electrolytic origins imply conductivity related to porosity or high moisture content
locally. This is consistent with the mapped gabbro to the southwest beyond the survey area.

Most of the remaining magnetic responses are probably derived from the intermediate to felsic metavolcanics (Unit 2). Magnetically active horizons within this lithological group (Unit 2m) with a relief of up to 100 gammas, may be related to increased concentrations of magnetic minerals such as magnetite or pyrrhotite, or to more mafic compositions. The stronger anomalies appear to be associated with a combination of different metavolcanic rocks and minor gabbro.

Several fault or shear zones have been interpreted from a combination of the lineament and magnetic data. These structures can be grouped according to orientation at 095, 115 and 145 degrees azimuth.

The VLF-EM survey has identified numerous conductive zones. Those that correlate with the edges of lakes and swampy areas are probably associated with conductive overburden suggesting that surficial conductivity is restricted to topographic depressions. Some exceptions to this may occur to the south where the broad contour patterns may reflect overburden type sources. A few of the conductor axes are associated with power transmission lines.

Those conductor axes that crosscut magnetic stratigraphy are interpreted to be caused by structural origins, either faults or shear zones. This type of conductivity may be related to a) minerals such as graphite, sulphides or gouge along the structure, or b) an ionic effect created by water or porosity either within the structure or along the upper weathered and leached edge. These should be considered for epithermal type mineralization.

Conductor axes that are parallel to or coincide with magnetic stratigraphy are probably derived from bedrock stratabound sources. These include graphite, disseminated to massive sulphides, and porous rock types such as porous flow tops. They should be investigated in detail on the ground using EM or IP methods.
7.0 SUMMARY

An airborne combined magnetic and VLF-EM survey has been carried out at 100 metre line intervals with data reading stations at 11 metres along the flight lines. All data is produced on maps at a scale of 1:10,000.

The magnetic data has been used to modify and update the existing geology and has shown a number of new contacts and faults. The intermediate to felsic metavolcanics contain magnetically active horizons that can be used to delineate stratigraphy.

A number of VLF-EM conductor axes were found of which some are associated with structural sources, culture and overburden. A few are believed to have potential sulphide origins and have been recommended for additional investigation.

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Charles Q. Barrie, M.Sc.
Geologist

Qual 2.8305
**Report of Work**

(Mining, Geophysical, Geological and Geochemical Surveys)

<table>
<thead>
<tr>
<th>Type of Survey(s)</th>
<th>Mining Division</th>
<th>Township or Area</th>
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<tr>
<td>AIRBORNE MAG + EM</td>
<td>RED LAKE</td>
<td>HEYSON Twp</td>
</tr>
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**Recorded Holder(s):**

LARRY HERBERT

**Address:**

BOX 996 RED LAKE, ONT P0V 2M0

**Survey Company:**

TERRAQUEST LTD

**Name and Address of Author of Geo-Technical Report:**

CHARLES BARBIE 230 ADENALDE ST W, TORONTO, ONT M5H 1W7

**Date of Survey:**

12 27 63 12 39

**Credits Requested per Each/Claim in Columns at right:**

<table>
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<th>Special Provisions</th>
<th>Days per Claim</th>
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<tr>
<td>Electromagnetic</td>
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<tr>
<td>Magnetometer</td>
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<tr>
<td>Other</td>
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<tr>
<td>Geological</td>
<td></td>
</tr>
<tr>
<td>Geochemical</td>
<td></td>
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</tbody>
</table>

**Special Provisions**

*For first survey:*

Enter 40 days. (This includes line cutting)

*For each additional survey: using the same grid:*

Enter 20 days (for each)

**Man Days**

Complete reverse side and enter total(s) here

**Airborne Credits**

Note: Special provisions credits do not apply to Airborne Surveys.

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<tbody>
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<td>Electromagnetic</td>
</tr>
<tr>
<td>Magnetometer</td>
</tr>
</tbody>
</table>

**Total Miles Flown Over Claim(s):**

51 km

**Certification Verifying Report of Work**

I hereby certify that I have a personal and intimate knowledge of the facts set forth in this Report of Work, having performed the work or witnessed same during and/or after its completion and annexed report is true.

Name and Address of Person Certifying:

MARTINS BOBINSKI

Box 996 RED LAKE, ONT P0V 2M0

**Total Number of Mining Claims Covered by This Report of Work:**

19

**For Office Use Only**

Total Days Cr. Recorded: 1520

Date Recorded: Dec 28/89

Mining Recorder: J. D. Robins

Date Approved as Recorded: 6 June 90

Provincial Manager: J. D. Robins

ONTARIO GEOLOGICAL SURVEY ASSESSMENT FILES

JUN 7, 1990

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