HELICOPTER BORNE TEM SURVEY
FOR
ASSESSMENT WORK CREDIT

Mining Claims Involved

TB 1196090
1242501-504 incl.
3012082-092 incl.
3012351-352 incl.
3012364

PROPERTY NAME: AURUM PROJECT
LOCATION: O'SULLIVAN LAKE AREA
G PLAN#: G-0362 & G-0319
NTS LOCATION: 42L6NE & 42L7NW

Date: January 6, 2005
Superior Canadian Resources Inc.
Flight Lines
Aeroquest Survey
Claims
Aurum Project, O'Sullivan Lake, Ontario

By: D.A. Beauchamp, P.Geo

Date: 2004 07 15
Revised: 2005 01 06
REPORT ON A HELICOPTER-BORNE MAGNETIC AND ELECTROMAGNETIC SURVEY
"featuring the AeroQuest AeroTEM® System"

Sim Lake and Aurum Projects
Lake Nipigon Area, Ontario

for

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May, 2004
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MAPS

The results of the survey are presented in a series of black line and colour maps at a scale of 1:10,000. Map products are as follows:

- Plate 1. Flight path with EM anomaly centres.
- Plate 2. Total Magnetic Intensity (TMI) colour grid w/line contours and EM anomaly centres.
- Plate 3. Z1 On-time, Z5 On-time, and Z0 (or Z5) Off-time EM profiles and anomaly centres.
- Plate 4. Z0 Off-time or Z1 On-time EM colour grid w/line contours and anomaly centres.

All the maps show the flight path, skeletal topography, and EM anomalies represented by computed on-time conductance classified symbols. An anomaly identifier label, the on-time conductance in siemens, the off-time conductance in siemens, and the number of off-time channels of response, are posted alongside the anomaly symbol. Colour contour maps show colour fill plus superimposed line contours.

DIGITAL DATA on CD-ROM

The results of the survey are archived on a single CD-ROM as Geosoft GDB (binary) databases as well as Geosoft maps and magnetic grids. A readme.txt file may be found on the CD which describes the contents in more detail.

For the reader's convenience, a copy of Geosoft's Oasis Montaj Ver 6.0 Free Interface is included on the CD. To install the interface, unzip the two files and follow the instructions in the PDF format (Adobe Reader) guide.

The CD also contains a digital version of this report in PDF (Adobe Acrobat) format including the technical paper by Balch, et al, which is re-printed in the appendix of this report. Adobe Acrobat Reader Ver 5.0 has been included on the CD.
1. INTRODUCTION

This report describes a helicopter-borne geophysical survey carried out on behalf of Canadian Superior Resources Inc. on the Sim Lake and Aurum projects situated in the Lake Nipigon area of Northern Ontario. The objective of the Sim Lake survey was to detail prospective areas indicated by an earlier AeroTEM survey, executed in December, 2002.

Principal geophysical sensors included AeroQuest's exclusive AeroTEM\textsuperscript{©} time domain helicopter electromagnetic system and a high sensitivity cesium vapour magnetometer. Ancillary equipment included a GPS navigation system with GPS base station, radar altimeter, video recorder, and a base station magnetometer. Raw streaming EM data, consisting of 126 channels of $Z$ and $X$ component sampled at 300 times per second during both on-current and off-current times, was recorded. A second RMS "analogue" acquisition system recorded 6 $Z$-component and one $X$-component channels of semi-processed EM data at 7.5 times per second, in addition to recording GPS position, magnetic field, and terrain clearance.

Appendix 1 lists the UTM corner co-ordinates for the survey areas. The total line kilometres (unwindowed) flown was 149.5 km at Sim Lake and 146.2 km at Aurum. The survey flying described in this report took place on May 29, 2004.

EM conductors were auto-picked from the ZO Off-time profile and graded according to the on-time conductance. This report describes the survey, the data processing and presentation.

2. SURVEY AREA

The Sim Lake claims are located approximately 300 kilometres north-northeast of Thunder Bay, Ontario, 170 kilometres northwest of Geraldton, and 100 kilometres northeast of Armstrong (Figure 1). The claim group is centred at latitude 51°05' and longitude 88°06', within NTS map sheet 52/P1.

The Aurum claims are located approximately 280 kilometres northeast of Thunder Bay, Ontario, 80 kilometres north of Geraldton, and 140 kilometres east of Armstrong. The claim group is centred at latitude 50°26' and longitude 87°04', within NTS map sheet 42L/6.

Both the Sim Lake and Aurum claims are recorded within the Thunder Bay Mining Division. The regional and local settings of the survey area are shown in figures 1-2.
During the execution of the survey, the survey crew was accommodated at the Golden Nugget Hotel in Geraldton. Survey specification details may be found in the next section of the report.

3. SURVEY SPECIFICATIONS AND PROCEDURES

The survey specifications are summarised in the following table:

<table>
<thead>
<tr>
<th>Area Name</th>
<th>Line Spacing (m)</th>
<th>Unwindowed Total Survey (km)</th>
<th>Windowed Total Survey (km)</th>
<th>Dates Flown (2004)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sim Lake</td>
<td>50</td>
<td>149.5</td>
<td>132.0</td>
<td>May 29</td>
</tr>
<tr>
<td>Aurum</td>
<td>50/100</td>
<td>146.2</td>
<td>130.7</td>
<td>May 29</td>
</tr>
</tbody>
</table>
The unwindowed kilometres flown were calculated by adding up the survey and control (tie) line lengths as defined in the database. The windowed kilometres represent the ideal navigation flight path. Sim Lake was flown at UTM grid N135°E direction. Aurum East Block was flown at N26°E direction and Aurum West Block was flown at N146°E direction. The magnetic control or tie lines were flown perpendicular to the survey lines.

Nominal EM bird terrain clearance was ~30m (100 ft). The magnetometer sensor was mounted in a smaller bird connected to the tow rope 21 metres above the EM bird and 17 metres below the helicopter. Nominal survey speed was 75 km/hr. Scan rates for data acquisition was 0.1 second for the magnetometer, electromagnetics and altimeter and 0.2 second for the GPS determined position. This translates to a geophysical reading about every 2-3 metres along flight track.
Fig 2. Sim Lake Survey
Navigation was assisted by a GPS receiver and the RMS data acquisition system which reports GPS co-ordinates as NAD27 latitude/longitude and directs the pilot over a pre-programmed survey grid. The x-y-z position of the aircraft, as reported by the GPS, is recorded at 0.2 second intervals.

Unlike frequency domain electromagnetic systems, the AeroTEM® system has negligible drift due to thermal expansion. The system static offset is removed by high altitude zero calibration lines and employing local levelling lines.

The operator was responsible for ensuring the instrument was properly warmed up prior to departure and that the instruments operated properly throughout the flight. He also maintained a detailed flight log during the survey noting the times of the flight as well as any unusual geophysical or topographic features.

On return of the aircrew to the base camp, the RMS acquisition system survey data on FlashCard was downloaded to the data processing work station. The MDAS recorded data, on removable hard-drive, was also downloaded to the processing station and archived onto DVD. In-field processing included flight preparation, transfer of the RMS acquired data to Geosoft GDB database format and production of preliminary EM, magnetic contour, and flight path maps. Survey lines which showed excessive deviation from the intended flight path were re-flown.

4. AIRCRAFT AND EQUIPMENT

4.1 Aircraft

A Eurocopter (Aerospatiale) AS350B2 "A-Star" helicopter - registration C-FAVI was used as survey platform. The helicopters was owned and operated by Abitibi Helicopters Ltd., LaSarre, P.Q. Installation of the geophysical and ancillary equipment was carried out by AeroQuest Limited at the Gateway Helicopters Base in North Bay, Ont. then ferried to the survey area. The survey aircraft was flown at a nominal terrain clearance of 220 ft (70 m).

4.2 Magnetometer

The AeroQuest airborne survey system employed the Geometrics G-823A cesium vapour magnetometer sensor installed in a two metre towed bird airfoil attached to the main tow line, 17 metres below the helicopter. The sensitivity of the magnetometer is 0.001 nanoTesla at a 0.1 second sampling rate. The nominal ground clearance of the magnetometer bird was 51 metres (170 ft.). The magnetics data is recorded at 10Hz by the RMS DGR-33.
4.3 Electromagnetic System

The electromagnetic system employed was an AeroQuest AeroTEM® Time Domain towed bird system. A triangular transmitter on-time pulse of 1.150 millisecond is employed, at a base frequency of 150 Hz. During every tx on-off cycle (300 per second), 126 contiguous channels of raw x and z component (as well as a transmitter current monitor, itx) of the received waveform are measured. Each channel width is 26.455 microsec starting at the beginning of the Tx pulse on. This 126 channel data is referred to as the raw streaming data.

The AeroTEM system has two separate EM data recording streams, the conventional RMS DGR-33 and the MDAS system.

RMS DGR-33 Acquisition System

In addition to the magnetics, altimeter and position data, six time channels of on-board real time processed off-time EM decay in the Z direction and one in the X direction are recorded by the RMS DGR-33 acquisition system at 7.5 samples per second. These channels are derived by a real-time binning, stacking and filtering procedure on the raw streaming data. The RMS data (Z1 to Z6, X1) is also sent to the analogue chart recorder and is often referred to as the analogue data.

The channel window timing of the RMS DGR-33 6 channel system is described in the table below.

<table>
<thead>
<tr>
<th>RMS Channel</th>
<th>Start time (microsec)</th>
<th>End time (microsec)</th>
<th>Width (microsec)</th>
<th>Streaming Channels</th>
<th>Noise tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z1, X1</td>
<td>1269.8</td>
<td>1322.8</td>
<td>52.9</td>
<td>48-50</td>
<td>20 ppb</td>
</tr>
<tr>
<td>Z2</td>
<td>1322.8</td>
<td>1455.0</td>
<td>132.2</td>
<td>50-54</td>
<td>20 ppb</td>
</tr>
<tr>
<td>Z3</td>
<td>1428.6</td>
<td>1587.3</td>
<td>158.7</td>
<td>54-59</td>
<td>15 ppb</td>
</tr>
<tr>
<td>Z4</td>
<td>1587.3</td>
<td>1746.0</td>
<td>158.7</td>
<td>60-65</td>
<td>15 ppb</td>
</tr>
<tr>
<td>Z5</td>
<td>1746.0</td>
<td>2063.5</td>
<td>317.5</td>
<td>66-77</td>
<td>10 ppb</td>
</tr>
<tr>
<td>Z6</td>
<td>2063.5</td>
<td>2698.4</td>
<td>634.9</td>
<td>78-101</td>
<td>10 ppb</td>
</tr>
</tbody>
</table>

Fig.4 Instrument Rack
MDAS Acquisition System

The 126 channels of raw streaming are recorded by the MDAS acquisition system onto a removable hard drive. The streaming data may undergo post-survey processing to yield 32 stacked and binned on-time and off-time channels at a 10 Hz sample rate. The timing of those reduced streaming channels is described in the following table.

<table>
<thead>
<tr>
<th>Processed Channel</th>
<th>Measured Channel(s)</th>
<th>Start (microsec)</th>
<th>Stop (microsec)</th>
<th>Mid (microsec)</th>
<th>Width (microsec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ON</td>
<td>24</td>
<td>634.9</td>
<td>661.4</td>
<td>648.1</td>
<td>26.5</td>
</tr>
<tr>
<td>2 ON</td>
<td>25</td>
<td>661.4</td>
<td>687.8</td>
<td>674.6</td>
<td>26.5</td>
</tr>
<tr>
<td>3 ON</td>
<td>26</td>
<td>687.8</td>
<td>714.3</td>
<td>701.1</td>
<td>26.5</td>
</tr>
<tr>
<td>4 ON</td>
<td>27</td>
<td>714.3</td>
<td>740.7</td>
<td>727.5</td>
<td>26.5</td>
</tr>
<tr>
<td>5 ON</td>
<td>28</td>
<td>740.7</td>
<td>767.2</td>
<td>754.0</td>
<td>26.5</td>
</tr>
<tr>
<td>6 ON</td>
<td>29</td>
<td>767.2</td>
<td>793.7</td>
<td>780.4</td>
<td>26.5</td>
</tr>
<tr>
<td>7 ON</td>
<td>30</td>
<td>793.7</td>
<td>820.1</td>
<td>806.9</td>
<td>26.5</td>
</tr>
<tr>
<td>8 ON</td>
<td>31</td>
<td>820.1</td>
<td>846.6</td>
<td>833.3</td>
<td>26.5</td>
</tr>
<tr>
<td>9 ON</td>
<td>32</td>
<td>846.6</td>
<td>873.0</td>
<td>859.8</td>
<td>26.5</td>
</tr>
<tr>
<td>10 ON</td>
<td>33</td>
<td>873.0</td>
<td>899.5</td>
<td>886.2</td>
<td>26.5</td>
</tr>
<tr>
<td>11 ON</td>
<td>34</td>
<td>899.5</td>
<td>925.9</td>
<td>912.7</td>
<td>26.5</td>
</tr>
<tr>
<td>12 ON</td>
<td>35</td>
<td>925.9</td>
<td>952.4</td>
<td>939.2</td>
<td>26.5</td>
</tr>
<tr>
<td>13 ON</td>
<td>36</td>
<td>952.4</td>
<td>978.8</td>
<td>965.6</td>
<td>26.5</td>
</tr>
<tr>
<td>14 ON</td>
<td>37</td>
<td>978.8</td>
<td>1005.3</td>
<td>992.1</td>
<td>26.5</td>
</tr>
<tr>
<td>15 ON</td>
<td>38</td>
<td>1005.3</td>
<td>1031.7</td>
<td>1018.5</td>
<td>26.5</td>
</tr>
<tr>
<td>16 ON</td>
<td>39</td>
<td>1031.7</td>
<td>1058.2</td>
<td>1045.0</td>
<td>26.5</td>
</tr>
<tr>
<td>0 OFF</td>
<td>44</td>
<td>1164.0</td>
<td>1190.5</td>
<td>1177.2</td>
<td>26.5</td>
</tr>
<tr>
<td>1 OFF</td>
<td>45</td>
<td>1190.5</td>
<td>1216.9</td>
<td>1203.7</td>
<td>26.5</td>
</tr>
<tr>
<td>2 OFF</td>
<td>46</td>
<td>1216.9</td>
<td>1243.4</td>
<td>1230.2</td>
<td>26.5</td>
</tr>
<tr>
<td>3 OFF</td>
<td>47</td>
<td>1243.4</td>
<td>1269.8</td>
<td>1256.6</td>
<td>26.5</td>
</tr>
<tr>
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<td>1269.8</td>
<td>1296.3</td>
<td>1283.1</td>
<td>26.5</td>
</tr>
<tr>
<td>5 OFF</td>
<td>49</td>
<td>1296.3</td>
<td>1322.8</td>
<td>1309.5</td>
<td>26.5</td>
</tr>
<tr>
<td>6 OFF</td>
<td>50</td>
<td>1322.8</td>
<td>1349.2</td>
<td>1336.0</td>
<td>26.5</td>
</tr>
<tr>
<td>7 OFF</td>
<td>51</td>
<td>1349.2</td>
<td>1375.7</td>
<td>1362.4</td>
<td>26.5</td>
</tr>
<tr>
<td>8 OFF</td>
<td>52</td>
<td>1375.7</td>
<td>1402.1</td>
<td>1388.9</td>
<td>26.5</td>
</tr>
<tr>
<td>9 OFF</td>
<td>53</td>
<td>1402.1</td>
<td>1428.6</td>
<td>1415.3</td>
<td>26.5</td>
</tr>
<tr>
<td>10 OFF</td>
<td>54</td>
<td>1428.6</td>
<td>1455.0</td>
<td>1441.8</td>
<td>26.5</td>
</tr>
<tr>
<td>11 OFF</td>
<td>55</td>
<td>1455.0</td>
<td>1481.5</td>
<td>1468.3</td>
<td>26.5</td>
</tr>
<tr>
<td>12 OFF</td>
<td>56</td>
<td>1481.5</td>
<td>1507.9</td>
<td>1494.7</td>
<td>26.5</td>
</tr>
<tr>
<td>13 OFF</td>
<td>57-60</td>
<td>1507.9</td>
<td>1640.2</td>
<td>1574.1</td>
<td>132.3</td>
</tr>
<tr>
<td>14 OFF</td>
<td>61-68</td>
<td>1613.8</td>
<td>1825.4</td>
<td>1719.6</td>
<td>211.6</td>
</tr>
<tr>
<td>15 OFF</td>
<td>69-84</td>
<td>1825.4</td>
<td>2248.7</td>
<td>2037.0</td>
<td>423.3</td>
</tr>
<tr>
<td>16 OFF</td>
<td>85-116</td>
<td>2248.7</td>
<td>3095.2</td>
<td>2672.0</td>
<td>846.6</td>
</tr>
</tbody>
</table>
4.4 Ancillary Systems

Magnetometer and GPS Base Station

An integrated GPS and magnetometer base station was set up to monitor the static position GPS errors to permit differential post-processing and to record the diurnal variations of the earth's magnetic field. Each sensor, GPS and magnetic, receiver/signal processor was attached to a dedicated laptop computer for purposes of instrument control and/or data display and recording. The laptops were, in turn, linked together to provide a common recording time reference using the GPS clock.

The base magnetometer was a Scintrex CS-2 cesium precession magnetometer coupled with a Picodas MEP-710 frequency counter/decoupler. Data logging and magnetometer control was provided by the Picodas basemag.exe software. The logging was configured to measure at 1.0 second intervals. Digital recording resolution was 0.1 nT. The sensor was placed on a tripod away from potential noise sources at the White Wolf Resort at 49.780885°N and 86.9565640°W, one kilometre south of the Geraldton airport. A continuously updated profile plot of the base station values was available for viewing on the base station display.

The GPS base station employed a Leica Mx9212 12 channel GPS receiver with external antenna mounted near the magnetometer sensor. Although the GPS receiver was controlled by the Picodas cdu510.exe software, logging was not engaged as the aircraft employed a real-time differential GPS receiver. The base GPS was used only for the GPS clock for synchronisation purposes.

The current AeroTEM® Transmitter Dipole moment is 38.8 kNIA. The AeroTEM® bird was towed 38 metres (125 ft) below the helicopter. More technical details of the system may be found in the technical paper in the Appendix.
Radar Altimeter

A Terra TRA 3500/TRI-30 radar altimeter was used to record terrain clearance. The antenna was mounted on the outside of the helicopter beneath the cockpit. The recorded data represented the height of the antenna, i.e. helicopter, above the ground. The Terra altimeter has an altitude accuracy of +/- 1.5 metres.

Video Tracking and Recording System

A high resolution colour VHS/8mm video camera was used to record the helicopter ground flight path along the survey lines. The video is digitally annotated with GPS position and time and can be used to verify ground positioning information and cultural causes of anomalous geophysical data.

GPS Navigation System

The navigation system consisted of an Ag-Nav Inc. AG-NAV2 GPS navigation system comprising a PC based acquisition system, navigation software, a deviation indicator in front of the aircraft pilot to direct the flight, a full screen display with controls in front of the operator, a Trimble AgGPS132 WAAS enabled GPS receiver mounted on the instrument rack and a Trimble antenna mounted on the magnetometer bird.

WAAS (Wide Area Augmentation System) consists of approximately 25 ground reference stations positioned across the United States that monitor GPS satellite data. Two master stations, located on either coast, collect data from the reference stations and create a GPS correction message. This correction accounts for GPS satellite orbit and clock drift plus signal delays caused by the atmosphere and ionosphere. The corrected differential message is then broadcast through one of two geostationary satellites, or satellites with a fixed position over the equator. The corrected position has a published accuracy of under 3 metres. A recent static ground test of the Trimble WAAS GPS yielded a standard deviation in x and y of under 0.6 metres and for z under 1.5 metres over a two hour period.

Survey co-ordinates are set-up prior to survey and the information is fed into the airborne navigation system. The co-ordinate system employed in the survey design was NAD83 UTM. The real-time differentially corrected GPS positional data was recorded by the RMS DGR-33 in NAD83 latitude and longitude at 0.2 second intervals directly in the analogue geophysical data file. The datum of the recorded latitude/longitude depended on the datum defined in the navigation file used to guide the survey aircraft.
Digital Acquisition System

The RMS Instruments DGR33A data acquisition system was used to collect and record the analogue data stream, i.e. the geophysical and positional data, including processed 6 channel EM, magnetic, radar altimeter, GPS position, and time. The data was recorded on 100Mb capacity Zip disks. The RMS output was also directed to a thermal chart recorder.

The AeroTEM received waveform sampled during on and off-time at 126 channels per decay, 300 times per second, was logged in parallel by the proprietary MDAS data acquisition system. The channel sampling commences at start of the Tx cycle and the width of each channel is 26.445 microseconds. The streaming data was recorded on a removable hard-drive and was later backed-up onto DVD-ROM on the field-processing computer.

5. PERSONNEL

The following AeroQuest personnel were involved in the project

Field -
Party Chief and Operator: Bert Simon    Data Processor: Tim Dohey/Neil Fiset

Office -
Data Processing and Report: Neil Fiset/Matt Holden/Steve Balch

The survey pilot, Kevin Jackson, was employed directly by the helicopter operator - Abitibi Helicopters Ltd.

6. DELIVERABLES

The report includes a set of four geophysical maps plotted at 1:10,000 scale. The map types are as follows:

- Plate 1. Flight path with EM anomaly centres.
- Plate 2. Total Magnetic Intensity (TMI) colour grid w/line contours and EM anomaly centres.
- Plate 3. Z1 On-time, Z5 On-time, and Z0 (or Z5) Off-time EM profiles and anomaly centres.
- Plate 4. Z0 Off-time or Z1 On-time EM colour grid w/line contours and anomaly centres.

The basic map coordinate/projection system used is NAD83 Universal Transverse Mercator Zone 16. For reference, the latitude and longitude are also noted on the maps.
All the maps show flight path trace with time reference fiducials marked at a 10 second interval, skeletal topography, and conductor picks represented by an anomaly symbol classified according to calculated on-time conductance. The anomaly symbol is accompanied by postings denoting the calculated on-time and off-time conductance as well as an anomaly identifier label and the number of off-time channels of response. The anomaly symbol legend may be found in the margin of the maps. Colour contour maps show colour fill plus superimposed line contours.

The geophysical profile data is archived digitally in a Geosoft GDB binary format database. The binary database contains both the processed streaming data and the RMS data. A description of the various channels found in this database may be found in the appendices of this report.

An archive CD complements the hard copy report and maps. It contains the digital database as well as the geophysical maps and grids in Geosoft format.

7. DATA PROCESSING AND PRESENTATION

All in-field and post-field data processing was carried out using Geosoft Montaj as well as AeroQuest proprietary data processing software. Plotting was on a 36 inch wide HP650C ink-jet plotter.

7.1 Base Map

The geophysical maps accompanying this report are based on positioning in the datum of NAD83. The survey geodetic GPS positions have been map projected using the Universal Transverse Mercator projection in Zone 16.

A summary of the map datum and projection specifications are as follows:
Ellipse: WGS84
Ellipse major axis: 6378137.0m  eccentricity: 0.081819191
Datum: North American 1983
Datum Shifts (x,y,z) : 0, 0, 0 metres
Map Projection: Universal Transverse Mercator Zone 16 (Central Meridian 87°W)
Central Scale Factor: 0.9996
False Easting, Northing: 500,000m, 0m

The skeletal topographic map underlay was provided by Canadian Superior.
7.2 Flight Path & Terrain Clearance

The position of the survey helicopter was directed by use of the Global Positioning System (GPS). Positions were updated five times per second (5Hz) and expressed as NAD83 latitude and longitude calculated from the raw pseudorange derived from the C/A code signal.

The instantaneous GPS flight path, after conversion to the local datum UTM co-ordinates, is drawn using linear interpolation between the x/y positions. The time reference fiducials are drawn on the map at appropriate intervals and are used to reference the digital data files to the plan map.

The raw Digital Terrain Model (DTM) was derived by simply taking the satellite position altitude and subtracting the radar altimeter. The calculated values are relative and are not tied into to surveyed geodetic heights.

7.3 Electromagnetic Data

The raw streaming data, sampled at a rate of 38,400 Hz (126 channels, 300 times per second) was reprocessed using a proprietary software algorithm developed by Mr. Steve Balch. Processing began with a segmenting and synchronisation procedure that isolates the relevant portion of the flight and pre-processes the time series to ensure data synchronisation is maintained. The pre-processed segment was then partially stacked and tested for high noise events, including sferics, which are skipped during the main stacking procedure. The coefficients for the waveform deconvolution process were also determined.

During the main processing algorithm, data were stacked for 40 full-cycles or 0.2 seconds. Deconvolution of the system waveform, primary field removal during the on-time, and system transient removal during the off-time were performed ahead of the stacking. The data were then binned into the 16 On-time and 17 Off-time channels and their base levels corrected. The resulting profiles were then filtered using a filter with 11 coefficients. An overburden stripped response was generated by subtracting the off-time response from the on-time response for the X1 to X16 and Z1 to Z16 channels. New RMS emulation channel windows, Z1New to Z6New and X1New, were calculated based on the RMS windows.

Apparent EM anomalies have been auto-picked from positive peak excursions in the off-time Z0 channel profile. No attempt was made to determine whether multiple anomaly peaks were due to dipping or wide conductors and all peaks have been selected without discrimination. The AeroTEM conductor picks are based on two criteria, 1) a minimum ZOff0 threshold of 2.5 nT/sec and 2) a peak in ZOff0 channel as defined by two leading values that are increasing, and two trailing values that are decreasing. At each conductor pick, estimates of the on-time and off-time conductance have been generated based on a threshold of 5.0 nT/s on and 2.5 nT/s off. The number of off-time channels of response (from channels ZOff0-ZOff15) above the threshold is also noted.
In addition, a conductance (COND) value has been calculated for those data points along line where the on-time response amplitude is sufficient to yield an acceptable estimate. The value is calculated from the off-time response, unless there are 16 off-time channels with nT/s > 2.0 in the response. Then it jumps to the on-time because of the higher conductance.

The final processing step was to merge the processed EM data back into a Geosoft GDB file with the GPS position, altimeter, levelled magnetics, etc. data. The EM fiducial is used to synchronise the two datasets. The processed channels are labelled in the "streaming" database as ZOn1 to ZOn16, ZOff1 to ZOff16, XO1 to XO16, and XO1f to XO1f. The overburden stripped channels are labelled Z1Obr to Z16Obr and X1Obr to X16Obr. The original RMS data (channels Z1RMS to Z6RMS, and X1RMS) has been converted from ppm to nT/sec and is included in the streaming database. In the streaming database the processed AeroTEM EM channels are expressed as nT/sec. To convert to parts per billion (ppb), multiply by 6.29049.

In the streaming database, each conductor pick has been given an identification letter label and has also been classified according to a set of seven ranges of calculated on-time conductance values. The anomalies were then plotted on the plan maps with one of seven symbols reflecting that classification level. Adjacent to the map symbol is posted the identifier label as well as the calculated on-time and off-time conductance values in siemens, and the number of off-time channels of response above 2.5nT/sec. The maximum possible number of off-time channels is 16 given the last channel of the 17 measured is not included.

With regard to the six channel off-time data recorded by the RMS DGR-33 and archived in the "RMS" database, after a lag correction then a two stage digital filtering process was used to remove any residual short wavelength noise. Sharp large amplitude events were removed with a 0.4 sec non-linear filter. The signal to noise ratio was further improved by the application of a low pass linear digital filter. This filter has zero phase shift which prevents any lag or peak displacement from occurring, and it suppresses only variations with a wavelength less than about 1.0 seconds or 30 metres. This filter is referred to as a 1.0 sec linear filter. In the RMS archive database, the raw channels are denoted with the suffix "raw", e.g. z1raw, x1raw, etc. The filtered channels are indicated by the "f" suffix, e.g. z1f, x1f, etc.

During the high elevation checks, an internal 5 second wide calibration pulse in all EM channels was generated in order to ensure that the gain of the system remained constant and within specifications.
7.4 Magnetic Data

Prior to any levelling the magnetic data was subjected to a lag correction of -0.3 seconds and a spike removal filter. The filtered aeromagnetic data were then corrected for diurnal variations using the magnetic base station and the intersections of the tie lines. No corrections for the regional reference field (IGRF) were applied. The corrected profile data were interpolated on to a grid using a random grid technique with a grid cell size of 25 metres. The final levelled grid provided the basis for threading the presented contours which have a minimum contour interval of 5 nT.

Respectfully submitted,

Neil Fiset, B.Sc.,
AeroQuest Limited
August 15, 2004
### APPENDIX 1  Description of Database Fields

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>Zone 16 UTM Easting in metres (NAD83)</td>
</tr>
<tr>
<td>y</td>
<td>Zone 16 UTM Northing in metres (NAD83)</td>
</tr>
<tr>
<td>lat</td>
<td>Latitude in decimal degrees (NAD83)</td>
</tr>
<tr>
<td>long</td>
<td>Longitude in decimal degrees (NAD83)</td>
</tr>
<tr>
<td>fiducial</td>
<td>Time reference fiducial in seconds</td>
</tr>
<tr>
<td>manfid</td>
<td>Manual Fiducial</td>
</tr>
<tr>
<td>chartfid</td>
<td>Chart Recorder Fiducial</td>
</tr>
<tr>
<td>emfid</td>
<td>Fiducial counter for streaming data synchronisation</td>
</tr>
<tr>
<td>utctime</td>
<td>UTC Time in seconds of the day</td>
</tr>
<tr>
<td>rtctime</td>
<td>Local (System) time in HH:MM:SS</td>
</tr>
<tr>
<td>f1tno</td>
<td>Flight number</td>
</tr>
<tr>
<td>date</td>
<td>Date in YY/MM/DD format</td>
</tr>
<tr>
<td>galtf</td>
<td>GPS Altitude in metres</td>
</tr>
<tr>
<td>ralt</td>
<td>Radar Altimeter in metres</td>
</tr>
<tr>
<td>bheight</td>
<td>Terrain clearance of EM bird in feet</td>
</tr>
<tr>
<td>dtm</td>
<td>Raw Digital Terrain Model in metres</td>
</tr>
<tr>
<td>basemag</td>
<td>Base Station magnetic field in nT</td>
</tr>
<tr>
<td>rawmag</td>
<td>Raw total magnetic intensity in nT</td>
</tr>
<tr>
<td>mag</td>
<td>Diurnally corrected Total Magnetic Intensity in nT</td>
</tr>
<tr>
<td>magtie</td>
<td>Tie line levelled Total Magnetic Intensity in nT</td>
</tr>
<tr>
<td>x1f</td>
<td>Smoothed RMS Off-Time EM-X component of channel 1 in ppb</td>
</tr>
<tr>
<td>z1f-z6f</td>
<td>Smoothed RMS Off-Time EM-Z component of channels 1 to 6 in ppb</td>
</tr>
<tr>
<td>ZOn1-ZOn16</td>
<td>Processed Streaming On-Time Z component Channels 1-16 in nT/sec</td>
</tr>
<tr>
<td>ZOff0-ZOff16</td>
<td>Processed Streaming Off-Time Z component Channels 0-16 in nT/sec</td>
</tr>
<tr>
<td>XOn1-XOn16</td>
<td>Processed Streaming On-Time X component Channels 1-16 in nT/sec</td>
</tr>
<tr>
<td>XOff0-XOff16</td>
<td>Processed Streaming Off-Time X component Channels 0-16 in nT/sec</td>
</tr>
<tr>
<td>Z1Ob1r-ZObr16</td>
<td>Overburden stripped Z component response Channels 1-16 in nT/sec</td>
</tr>
<tr>
<td>X1Ob1r-XObr16</td>
<td>Overburden stripped X component response Channels 1-16 in nT/sec</td>
</tr>
<tr>
<td>ZOff17-ZOff22</td>
<td>Special weighted combination channels in nT/sec (see note below)</td>
</tr>
<tr>
<td>anum</td>
<td>Index number of conductor pick</td>
</tr>
<tr>
<td>anomlabelw</td>
<td>Letter label of conductor pick</td>
</tr>
<tr>
<td>nchanw</td>
<td>No of off-time (or on-time) channels with response over 2.5nT/sec</td>
</tr>
<tr>
<td>on_conw</td>
<td>On-time conductance in siemens</td>
</tr>
<tr>
<td>off_conw</td>
<td>Off-time conductance in siemens</td>
</tr>
<tr>
<td>Aclassw</td>
<td>Classification from 1-7 based on conductance of pick</td>
</tr>
<tr>
<td>cond</td>
<td>Interpreted conductance in siemens</td>
</tr>
</tbody>
</table>
Weighted channels:

ZOff17: 0.25*ch44 + 0.50*ch45 + 0.25*ch46
ZOff18 : (ch46+ch47)/2
ZOff19 : (ch48+ch49+ch50+ch51)/4
ZOff20 : (ch52..ch59)/8
ZOff21 : (ch60..ch75)/16
ZOff22: (ch76..ch107)/32

In the databases the Survey lines, Tie Lines, and High Altitude/Internal Q coil lines are prefixed with an "L" or "Line", "T" or "Tie", and "S" or "Test", respectively.
APPENDIX 2 - Technical Paper

Mineral Exploration with the AeroTEM System
S.J. Balch, W.P. Boyko, G. Black, and R.N. Pedersen, AeroQuest Limited, Presented at the SEG Intl' Exposition and 72nd Annual Meeting, Salt Lake City, Utah, October 6-11, 2002
Mineral Exploration with the AeroTEM System

Summary
AeroTEM is a concentric-loop time-domain EM system designed for mineral exploration and geologic mapping. The high dipole moment of the transmitter in combination with the unique superimposed dipole coil geometry allows the system to achieve a depth of exploration similar to fixed-wing systems, but with the resolution and target response symmetry that is typical of conventional helicopter-towed EM systems. AeroTEM has flown over 20,000 line-km since its introduction in 1999. Ground follow-up geophysical surveys and drilling programs have confirmed the depth of exploration to be in excess of 200 m with high spatial resolution of target conductors confirmed. The compact, rigid system geometry should provide for a true on-time measurement of secondary fields from highly conductive sources often associated with Ni-Cu-PGE mineralization, thereby gaining a considerable advantage over all towed-receiver fixed-wing airborne EM systems, which are known to be blind to such targets (Hanneson, 1998).

Introduction
Airborne EM systems, as they have evolved since the 1940's generally fall into one of two categories, namely, (1) the loosely coupled towed-bird systems on fixed-wing aircraft, and (2) the rigid transmitter-receiver configuration towed by helicopters (e.g., Fountain, 1998). The fixed-wing systems operate in the time domain and are characterized by a wideband high-moment transmitter to maximize depth penetration, especially in a resistive environment. The rigid helicopter systems operate in the frequency domain and are characterized by multiple narrow-band low-moment transmitters and closely spaced receivers to maximize spatial resolution and provide moderate depth penetration. Thus one system seeks to maximize signal while the other strives to minimize noise, both attempting to increase the signal-to-noise-ratio...this being the only determining factor of an EM system's level of performance.

The AeroTEM system is a wide-band time-domain EM design that draws on the rigid design of the frequency-domain systems and the high-moment transmitter design of the fixed-wing platforms. The system attempts to both maximize signal and minimize noise by incorporating the two major advantages of airborne EM systems - transmitter power and rigid coil geometry. As Duckworth (1993) so succinctly states, the optimum coupling to a target by a transmitter-receiver coil pair is achieved by only two possible coil configurations. The first optimum coupling is achieved when the coil separation is 0.6 times the distance to the target. The second optimum coupling is achieved when the coils are coincident. Because target depth cannot be known a priori, the coincident coil geometry is obviously preferred.

Method
The system (Figure 1) consists of a 3-axis receiver coil mounted centrally within a large 5-m diameter transmitter loop. The transmitter waveform is a triangular current pulse of 1.15 ms duration at a base frequency of 150 Hz with a peak current of 260 A for a total transmitter moment of 40,000 Am². The mutually orthogonal receiver coils are mounted with the X-axis along the flight line, transverse, and Z vertical. System waveforms and typical conductor responses are shown in Figure 2.

The system is towed 40 m below the helicopter at a nominal terrain clearance of 30 m. The present transmitter produces a peak primary field of 300 nT vertically below the transmitter at ground level. Because the transmitter and receiver are located close to the ground, AeroTEM produces a stronger target response in the upper 50 m of the earth compared to a fixed-wing aircraft with a peak dipole moment of 500,000 Am² and a peak primary field of 55 nT at ground surface.

The strength of the primary field from an EM transmitter decreases rapidly with distance from the transmitter location. High moment transmitters on fixed-wing aircraft, such as GEOTEM, tend to have better depth penetration because the strength of the primary field...even at 300 m
The AeroTEM System

is sufficiently high to energize a conductor and produce a measurable secondary field. Large loop ground EM systems have even greater depth penetration, owing to the lower rate at which the primary field falls off with distance from the transmitter for distances on the order of the loop dimensions. The strength of the primary field from the AeroTEM transmitter is compared with that of some common systems in Figure 3.

Although the fixed-wing and ground EM systems gain an advantage in primary field at depth, this energy is diffused over a larger volume, thus reducing their effectiveness in energizing smaller conductors. For large loop ground EM systems, this is especially a problem where large regional conductors can mask the more subtle responses of smaller isolated targets.

Example One: Spatial Resolution

The vertical (Z-axis) component produces responses that are independent of the flight line direction. The close proximity of the transmitter and receiver coils produces very sharp anomaly edges. These two factors combine to produce images of the Z component channels that have high spatial resolution.

In the following example, the amplitude of the earliest off-time channel for the Z component receiver coil is shown in Figure 4. The survey was conducted for Nuinseco Resources in the Lac Rocher area of Quebec during an exploration program for Ni-Cu-PGE deposits.

One discrete anomaly detected from the Lac Rocher survey, and represented by the black outline in Figure 4, is shown in profile format in Figure 5. The approximate lateral extent of the conductor response is 50 m on the earliest time channel (width at half-maximum). The narrow response of this isolated conductor compares favorably with the spatial resolution achieved with conventional HEM systems.
The AeroTEM System

An expanded view of the airborne response is shown in Figure 7. The Crone early-time response is shown in Figure 8. The conductor was located within an area of favorable geology. Modeling of the Crone response suggested a sub-horizontal conductor dipping at 25° below the horizontal and located approximately 100 m below surface. The AeroTEM response also suggested a flat-lying conductor because of the symmetric Z component response.

Example Two: Airborne-Ground Comparison

Aurogin Resources, in joint venture with Heron Mines, flew an 800 line-km AeroTEM survey over the Belledune Property in New Brunswick in the search for Cu-Zn-Pb deposits. Several AeroTEM airborne EM conductors were identified from that survey over two separate areas.

A ground follow-up program of Crone Pulse EM was conducted over one selected target in Area Two. The AeroTEM early-time Z component response is shown in Figure 6. The anomaly subjected to the ground follow-up program is outlined in black (Figure 6).

Figure 5: The high spatial resolution of AeroTEM is demonstrated by the EM response of an isolated conductor. The width of the response is less than 50 m on the earliest time channel (peak amplitude at half-maximum).

Figure 6: Early-time Z component AeroTEM response over the Belledune Survey Area Two. A detailed ground follow-up survey was centered over the response outlined in black.

Figure 7: AeroTEM earliest time-channel Z component response, Belledune Property, New Brunswick. The survey was flown with a line spacing of 100 m.

Figure 8: Crone Pulse EM vertical component amplitude of time channel 10, from the Belledune Property, New Brunswick. The survey was performed in-loop with a 100 m line spacing.
The AeroTEM System

Two boreholes were drilled to then evaluate the EM responses and both intersected up to 15 sulphide containing significant Au-Ag-Cu within a volcanic rhyolite. Downhole Pulse EM surveys confirmed the intersection of a conductor approximately 170 m downhole, coincident with the intersected mineralization, and corresponding to a vertical depth of 145 m. The peak response in the earliest AeroTEM time channel was 90 ppb, or roughly 200 times above the system noise level. The peak response in the Crone survey was 110 nTIs, about 200 times above the system noise level. This is an example of a drilling program that could have proceeded directly from the airborne survey without the added expense of ground geophysics.

Example Three: Airborne Airborne Comparison

Nuinsco Resources conducted GEOTEM and AeroTEM surveys over the Lac Rocher property covering both the known mineralized area and a larger area of unexplored claims. In one area of the survey both GEOTEM (Figure 9) and AeroTEM (Figure 10) recorded responses that were coincident with a large magnetic anomaly.

Both systems clearly show a distinct, multi-channel anomaly. Nuinsco drilled the conductor in 1999 and intersected 2.2 m of massive sulphide at a depth of 200 m below surface. The AeroTEM peak response was 3 ppb or 10 times the system noise level, while the GEOTEM peak response was 400 ppm or 40 times system noise level. While noise levels are dependent upon the level of filtering, the higher apparent signal-to-noise-ratio of the GEOTEM response can be attributed to its higher moment transmitter and the depth of the conductor.

Conclusions

AeroTEM shows a high spatial resolution, due to its unique coil configuration. The system produces responses that compare well with existing ground and airborne systems. The present depth of exploration is estimated to be up to 250 m with a typical noise level of +/-0.5 ppb.

Improvements to the system will come in the form of larger transmitter moments, decreased noise levels and the development of true on-time measurements through full waveform recording. There are numerous advantages of using helicopter-towed time-domain systems with a depth penetration approaching that of the fixed-wing platforms. The success of these systems will no doubt be dictated by the perceived needs of the mineral exploration industry for such techniques.

References


Acknowledgments

AeroQuest wishes to thank Nuinsco Resources and Aurorin Resources for permission to publish the survey data from their respective properties.
AEROTEM Helicopter Electromagnetic System

System Characteristics
Transmitter: Triangular Pulse Shape Base Frequency 30 or 150 Hz.
Tx On Time - 5,750 (30Hz) or 1,150 (150Hz) microsec.
Tx Off Time - 10,915 (30Hz) or 2,183 (150Hz) microsec.
Loop Diameter - 5 m.
Peak Current - 250 A.
Peak Moment - 38,800 NIA.
Typical Z Axis Noise at Survey Speed = 8 ppb peak.
Sling Weight: 270 Kg.
Length of Tow Cable: 40 m.
Bird Survey Height: 30 m or less nominal.

Receiver
Three Axis Receiver Coils (x, y, z) positioned at centre of transmitter loop.
Selectable Time Delay to start of first channel 21.3, 42.7, or 64.0 msec.

Analogue Display & Acquisition
Six Channels per Axis.
Analogue (RMS) Channel Widths: 52.9, 132.3, 158.7, 158.7, 317.5, 634.9 microsec.
Recording & Display Rate = 10 readings per second.
MDAS Digital recording at 126 sample per decay curve at a maximum of 300 curves per second (26.455 microsec channel width).

System Considerations
Comparing a fixed wing time domain transmitter with a typical moment of 500,000 NIA flying at an altitude of 120 m with a Helicopter TDEM at 30 m, notwithstanding, the substantial moment loss in the airframe of the fixed wing, the same penetration by the lower flying helicopter system would only require a sixty-fourth of the moment. Clearly the AeroTEM system with nearly 40,000 NIA has more than sufficient moment.

The airframe of the fixed wing presents a response to the towed bird, which must be compensated for dynamically. This problem is non-existent for AeroTEM since transmitter and receiver positions are fixed. The AeroTEM system is completely portable, and can be assembled at the survey site within half a day.
ARTEMIS On Time Conductance Symbols

>50 S
35-50 S
20-35 S
10-20 S
5-10 S
1-5 S
<1 S

Anomalies picked off ZO Off Time profile w/2.5 nTIs threshold
Anomaly Letter A 12 Off Time Channels of Response (1-16)

SURVEY SPECIFICATIONS:
Survey flown: May 28, 2004
Traverse Time spacing: 50 / 100 metres
Traverse line direction: N26°E & N146°E
Nominal EM bird height: 30 metres
Aircraft: Aerospatiale AStar 350B2 (C-FAVI)

INSTRUMENTATION:
Data acquisition: MDAS2 & RMS DGR~33
Magnetics: Geometrics G-823-Ace SIum va pour Installation Towed bird: 21 m above EM
Resolution: 0.01 nanoTesla
Electromagnetics: AEROTEM Magic 2
Configuration Towed bird: 29.0° N
NAVIGATION:
Navigation: Global Positioning System (DGPS)
Navigation equipment: Trimble AgGPS 132
Radar Altimeter: Terra TRA3000fTRI-30

DATA PROCESSING:
Magnetic: Base station and tie line levelling applied
EM smoothing:
Non-linear 4 point
Low pass 5 point boxcar
POSITIONING:
Ellipsoid: NAD83
Major Axis: 6378137.000
Eccentricity: 0.081819191
Projection: Universal Transverse Mercator
Central Meridian: 77° W (Zone 16)
Central Scale Factor: 0.9996
False Easting/ Northing: 500,000m
Scale: 1:105,000

Superior Canadian Resources Inc.
Arum Project, O’Sullivan Lake Area, Ontario

FLIGHT PATH
Arum West and East Blocks
NTS-42U5-E
Survey flown: May 23, 2004

Traverse line spacing: 500 to 1000 metres

Nominal EM bird height: 30 metres

Aircraft: Aerospatiale AStar 350B (C-FAVJ)

INSTRUMENTATION:

Data acquisition: MDAS2 & RMS DGR-33

Magnetometer: Geometrics G-823A cesium

Installation: over bird 21 m above EM bird

Resolution: 0.001 nanoTesla

Electromagnetics: AEROTEM Mk-II System

NAVIGATION:

Global Positioning System (DGPS)

Navigation equipment: Trimble AgGPS 132

Radar Altimeter Terra TRA3000

DATA PROCESSING:

Magnetics: Base station and tie line levelling applied

EM smoothing: Non-linear 4th order

Low Pass 5th order boxcar

POSITIONING:

Ellipsoid NAD83

Major Axis 6378137.000

Eccentricity 0.081819191

Projection: Universal Transverse Mercator

Central Meridian: B7°W (Zone 16)

Central Scale Factor: 0.9996

False Easting/Northing: 500,000 m/0 m

Contour interval: 5, 25 & 100 nT/sec scale 1:10,000 meters

Superior Canadian Resources Inc.

Aurum Project, O'Sullivan Lake Area, Ontario

AEROTEM Z1 Off-Time

Arum West and East Blocks

By: Superior Canadian Resources Inc.

Milton, Ont., CANADA L9T 3Z3

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May 2004