DIPOLE – DIPOLE

COMPLEX RESISTIVITY AND IP SURVEY

Round Top Project

Galena, Alaska

LOGISTICS REPORT

for

Western Alaska Copper and Gold Co.

ZONGE JOB# 10143

ISSUE DATE: DECEMBER, 2010

ZONGE ENGINEERING AND RESEARCH ORGANIZATION, INC.

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Geophysical Results through Continuous Innovation
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EXECUTIVE SUMMARY

At the request of Kit Marrs of Western Alaska Copper and Gold Co., Zonge Engineering and Research Organization (Zonge) conducted a dipole-dipole Complex Resistivity Induced Polarization (CR-IP) geophysical investigation on the Round Top Project during the period of August 8 to 16, 2010. The project area is located near Galena, Alaska. CR-IP data were acquired along 2 lines for a total coverage of 5.4 line-km at 29 stations. The 2010 CR-IP survey was a follow up to previous geophysical work performed in 1981. A pole-dipole survey was conducted in 1981, and was reprocessed in 2010 by Zonge (Zonge job # DAT1010, included on CD). The 2010 survey was designed to image features at greater depth than the previous survey, with the objective of defining base depths of anomalous features such as sulfides encountered in Drill Hole RT-7, and to determine zones of enhanced chargeability that may lead to new target picks of Cu-Ag mineralization.

Zonge crew chief Mark Reed supervised the field operation for this survey under Zonge job number 10143. Principle Geophysicist Scott Urquhart was responsible for survey oversight and direction from the Zonge Engineering office, and Geophysicist Nicole Pendrigh was in charge of data processing. This report covers data acquisition, instrumentation, processing, and interpretation.
PROJECT LOGISTICS

Dipole-dipole CR-IP data were acquired along 2 lines (Lines 1400E and 7000N) using a dipole-dipole electrode array with a dipole length (a-spacing) of 200 meters. Total survey line coverage was 5.4 line-km and included 29 stations. Measurements were made at n-spacings of 1 through 8 with data acquired in standard 7-spread arrays (for more information, an Introduction to the IP method pdf file is included on the Archive Disk).

Survey specifics including the project production schedule and survey line specifics are included in Tables 1 and 2, respectively.

Table 1. Daily Production Summary.

<table>
<thead>
<tr>
<th>Date</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/8/2010</td>
<td>Mobe from Tucson, Az to Fairbanks, Ak</td>
</tr>
<tr>
<td>8/9/2010</td>
<td>Obtain Gear and Supplies</td>
</tr>
<tr>
<td>8/10/2010</td>
<td>Mobe to camp, set up TX</td>
</tr>
<tr>
<td>8/11/2010</td>
<td>Weather delay, started Line 1400E</td>
</tr>
<tr>
<td>8/12/2010</td>
<td>Weather delay, continued on Line 1400E</td>
</tr>
<tr>
<td>8/13/2010</td>
<td>Finished Line 1400E, started Line 7000N</td>
</tr>
<tr>
<td>8/14/2010</td>
<td>Finished Line 7000N</td>
</tr>
<tr>
<td>8/15/2010</td>
<td>Demobe to Anchorage, Ak</td>
</tr>
<tr>
<td>8/16/2010</td>
<td>Demobe from Anchorage, Ak to Tucson, Az</td>
</tr>
</tbody>
</table>

Table 2. Survey Line Coordinates.

<table>
<thead>
<tr>
<th>Line</th>
<th>Start Easting</th>
<th>Northing</th>
<th>End Easting</th>
<th>Northing</th>
<th>Azimuth</th>
<th>A-space</th>
<th># of Station s</th>
<th>Length (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1400E</td>
<td>571411</td>
<td>7115199</td>
<td>571408</td>
<td>7117996</td>
<td>N00E</td>
<td>200</td>
<td>15</td>
<td>2800</td>
</tr>
<tr>
<td>7000N</td>
<td>569499</td>
<td>7116999</td>
<td>572101</td>
<td>7116995</td>
<td>N90E</td>
<td>200</td>
<td>14</td>
<td>2600</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>29</td>
<td>5400</td>
</tr>
</tbody>
</table>

Line locations, station coordinates, and elevations were determined by the client and provided at the start of the survey. Line 1400E was acquired N-S over the same line coverage as the survey from 1981, and Line 7000N was acquired W-E as a baseline control for this survey as well as the older data. The survey layout is shown in Figure 1, below, and is also included in the back pocket of this report. All maps and coordinates are provided in UTM Zone 4 meters, datum NAD83.
Figure 1. Line Location Map (datum NAD83, UTM Zone 4 meters.)


The Round Top Prospect is a porphyry system divided into eastern and western “lobes” of felsic intrusives. L1400N traverses the Eastern lobe from south to north, while L7000N transects the western lobe, from west to east, then extends through the adjoining mica schist,
and complex structural geology between the two lobes, to the northern extent of the eastern lobe (Figure 2).

Figure 2. Geology and geochemistry of Round Top system

Red lines indicate 2010 CR-IP survey, black lines indicate 1981 CR-IP survey. Geology and geochemistry were compiled by K Marrs, and digital copies were provided by Alaska Earth Sciences (aesalaska.net)
**Instrumentation**

Non-reference dipole-dipole CR-IP data were acquired with a six channel Zonge GDP-32\textsuperscript{ii} multi-purpose receiver. The GDP-32\textsuperscript{ii} instrument is a backpack-portable, 16 bit, microprocessor-controlled receiver. The six-channel case is the smallest and most portable of the GDP-32\textsuperscript{ii} series receivers. The electric-field signals were measured using non-polarizing ceramic porous-pot electrodes connected to the receiver with insulated 14-gauge wire.

The signal source used for the CR-IP measurements was a portable Zonge GGT-10 (10 KW) transmitter. The GGT-series transmitter is a constant-current transmitter capable of operating with output voltages approaching 1000 volts. Transmitter power was provided by the Zonge ZMG-7.5 motor-generator. The transmitter was controlled by an XMT-32 transmitter controller.

CR-IP data collection requires time and frequency synchronization between the GDP-32\textsuperscript{ii} and GGT transmitter: this synchronization process establishes a common time base between the transmitted and received electrical signals. This requires matching the duty cycle and frequency (defined at the repetition rate for CR-IP measurements) as well as synchronizing clock times. Synchronization (time) between the crystal oscillators in the GDP and XMT is controlled by two steps: (1) matching quartz clock frequencies sets the time-domain repetition rate for the GDP and XMT, and (2) synchronizing quartz crystal clock times establishes a common time base between the GDP and XMT.

**Safety and Environmental Issues**

No health, safety incidents, or accidents occurred during the course of this survey. In terms of environmental impact and damage resulting from operations of the survey crew, survey operations imposed a minimal impact to the environment.
**DATA PROCESSING**

Routine CR-IP data processing consisted of the following steps:

1. The raw instrument dumps were reviewed to evaluate the data quality.
2. Data noted as spurious were flagged and removed from further processing.
3. Raw data files (.raw) were then processed via the CRAVGW 1.12i program where the individual measurements were averaged and output in a column-based ASCII file (.avg) having single averaged values for Phase and Apparent Resistivity at each measurement point.
4. The .AVG files were used as input into TS2DIP v4.60e, for two-dimensional smooth-model inversions of the IP (EM corrected Phase) and Resistivity data. Pseudosections for Apparent Resistivity and EM corrected Phase are provided for all Lines.

**Data Quality**

**Culture**

Culture related electromagnetic noise can significantly influence electrical (IP) geophysical data quality. Typical cultural-related noise sources include radiofrequency (RF) and electrical powerline transmissions, cathodic protection on pipelines, metal fences, buried pipes, etc. No cultural related noise sources were present in and around the survey area, and normal EM coupling is evident when comparing the raw low frequency phase data to the 3-Pt decoupled results.

Low signal in some areas (especially the southern end of L1400N) resulting from inductive coupling contributed to poor quality. In other areas, data collected for this project exhibit good repeatability with low standard errors.
DATA PRESENTATION

Inversion depth models for the Round Top project are included in the back pockets of this report and on the enclosed CD. Inversion model resistivities are shown in ohm-meters, with “warm” colors (orange, red) indicating low resistivity and “cool” colors (green, blue) indicating high resistivity. Smooth-model inversion of the IP data (from CR-IP survey) are shown in milliradians (mrad) units, with “warm” colors (orange, red) indicating high IP values, and “cool” colors (green, blue) indicating low, background IP values. The color scales used for resistivity and IP are consistent for all model lines presented in this report. Station numbers are posted across the top of the plots and elevation is shown on the vertical axis.

**Smooth-Model Inversions**

The dipole-dipole IP and resistivity cross-sections provided are 2-D smooth-model inversion results generated from the program TS2DIP developed by Zonge Engineering (MacInnes and Zonge, 1996). These IP values are analyzed for EM coupling, and corrected if necessary.

Smooth-model inversion is a robust method for converting resistivity and IP measurements to smoothly varying model cross-sections. It is important to note that the smooth-model inversion models show gradational changes in resistivity and IP, rather than abrupt differences, irrespective of the actual geologic structure. Smooth-model inversions and observed and calculated apparent data vs n-level pseudosections are attached in Appendix A.

**Line 1400E**

A shallow resistivity high lies between stations 6000 and 6900 on Line 1400E (Figure 3). This unit is approximately 100-150m thick. On its southern edge, centered at station 5800, is a resistivity low that extends to depth and the contact between these two features dips shallowly to the north. This appears to be a gradational contact and may be correlated to the southern edge of the mica schist. At 6000, the IP values at the surface decrease rapidly, indicating the southern edge of the porphyry contact (Figure 4). The resistivity high to the south of these contacts is geologically unknown, but there is evidence of copper and silver found on southern end of the Eastern Lobe. High surface IP values may also be an indication of the presence of
these minerals; the IP highs that are observed on the southern end of the line at stations 5550 and 5750 appear to be up-dip southern extensions of a large high IP anomaly between 6000 and 6600.

Another relative resistivity low occurs at depth from stations 6700 to 7100. The top of this feature is at an approximate depth of 150-200m. Above this feature, surface resistivity values are low to moderate. This zone lies just north of drill hole RT-7, while RT-3 is collared at 6950 and transects this zone at a southerly angle (RT-7 and approximate location of RT-3 are indicated on the figures for Line 1400E).

Figure 3. Line 1400E CR-IP 2D smooth-modeled inversion resistivity section.

The IP model results from Line 1400E show a very large and strong IP anomaly centered at approximately stations 6300-6400; this high IP zone is greater than 300 m thick, its top is 100m from the surface on the south side, and it reaches to surface on the north side at approximately 6500. At 6600, there is an abrupt steeply dipping contact with low IP values to the north. Drill hole RT-7 is located in the relative IP Low. As IP values increase to the north of this feature, Drill hole RT-3 transects a moderate IP response which increases in value at the surface between the drill holes, and in the northern portion of the line. The surface/near-surface high IP zones from 7200 to 7450 and 7600 to the end of the line, have shallow bases (200m and 50 m depth, respectively).
Figure 4. Line 1400E CR-IP 2D smooth-modeled inversion IP section.

At RT-7 we see a small area of higher IP values at the surface, then low values from 50 m to approx 250 m. According to the Round Top Cross Section D-D’ East Lobe (Round Top Project Property Prospectus, Marrs, K., 2010 – not included with this report), the IP signatures coincide with a quartz latite fragmental overlying a quartz stock work as seen in the drill hole. The moderate IP anomaly just north of RT-7 (at 6800), is vertical, then dips under the latite at approx 225 m depth. According to the section D-D’, at 7000, we see a quartz mica schist (moderate IP) which overlies a quartz monzonite porphyry. A high IP response shows up at the surface between 7000 and 7400. By comparing the geology map to the IP model section, the high IP values in the feature south of RT-7 is consistent with quartz monzonite porphyry.

The resistivity high on north end, from stations 7100 to 7500 is beyond the scope of the compiled geology and geochemistry interpretation, but it may be the deep-seated source for the porphyry system. However, this interpretation would require further geological and geophysical investigation. Between 7000 and 7100, the contact between moderate and high resistivity values may indicate the northern edge of the Mica Schist as mapped.
The resistivity model for Line 7000N correlates with geologic and structural features observed in local and regional geology interpretations. For example, the shallow resistivity highs observed from approximately stations 0-800 are indicative of a quartz latite fragmental, with a broad underlying quartz chlorite mica schist (stations 0-1300) with moderate resistivity values.

A shallow resistivity low dips under a surface high at approximately station -100 to 0. This feature is comparable to the southern end of L1400, suggesting a similar contact of the quartz chlorite mica schist and quartz latite. A low resistivity anomaly approximately 150 m deep, with a thickness of 150-200m occurs from stations 300 to 700, then ends abruptly with a near vertical contact with a moderate to high resistivity feature. An expansive low resistivity feature occurs at depth throughout almost the entire section, with the lowest values below the above mentioned anomaly (station 400). This underlying material extends to 1200, where values decrease in an up-dip trend to the east, terminating at 1400. This is most likely a structure related to the NW-SE structural trends noted on the north side of the prospect area.

According to the geology and geochemistry map, between 1500 and 1600, the quartz chlorite mica schist terminates. At the eastern end of Line 7000N, the moderate resistivity values are of unknown geology. However, this fits on trend with the deep source on Line 1400E, although values are not as low as on Line 1400E.
According to the Round Top Cross Section D-D’, and the above discussion, where Line 1400E intersects Line 7000N quartz mica schist occurs from the surface to approx 100m depth. Below this is a quartz monzonite porphyry with unknown depth. The L7000 IP section (Figure 6) indicates that at this intersection, the first 100m have lower IP values, then the moderate IP values occur for another 150m or so, before values drop back to background. These values may indicate that, at this location, the quartz monzonite porphyry has a thickness of 150-200m. However, this moderate IP feature continues from station 800 to 1400, but from 300 to 700 it occurs slightly deeper in the section and is also thicker. This offset suggests a fault at approximately station 750, which coincides with the abrupt change seen on the resistivity section.

Figure 6. Line 7000N CR-IP 2D smooth-modeled inversion IP section.
DELIVERABLE PRODUCTS

PLATES:

Location Map (NAD 83, UTM Zone 7, meters)

Lines 1400E, 7000N modeled depth sections:
   Smooth-model imaged resistivity vs. depth
   Smooth-model imaged IP vs. depth

Lines 1400E, 7000N pseudosections:
   CR-IP resistivity and 3pt-DC phase vs. frequency

ARCHIVE DISK:

One DVD Archive Disk is included with this report:

Digital CR-IP data (processed) files are listed line-by-line. Folders are provided for:

1. Report with associated figures and plates
2. IP and Resistivity CR-IP model data
3. Auxiliary material including an Introduction to CR-IP Method and Equipment Specifications
Respectfully Submitted,

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REFERENCES


Marrs, K., 2010, Round Top Project Property Prospectus, Western Alaska.
APPENDIX A: CR-IP INVERSION MODEL, OBSERVED AND CALCULATED APPARENT DATA PSEUDOSECTIONS

Since the dipole-dipole array is not a vertical sounding method, a buried IP responder or change in resistivity can affect measurements that are not directly over the responder, making the interpretation of location, size, and depth very difficult. Smooth-model inversion (MacInnes and Zonge, 1996) is a robust method for converting resistivity and IP measurements to smoothly varying model cross-sections. Background models for resistivity and IP are calculated from moving-average calculations of observed apparent resistivity and IP. Resistivity and IP values in the two-dimensional model section are then iteratively modified until calculated data values match observed data as closely as possible, subject to constraints on model smoothness and the difference between background and inverted model values. Constraints control the character of 2D inversion models. Separate constraint parameters are included for vertical smoothness, horizontal smoothness and for differences from an arbitrary background model. Constraint weighting can also be varied to suit known geologic conditions.

In the following figures, the top panel shows the model inversion results plotted with respect to the terrain along the line. The center panel shows the resistivity or IP pseudosection calculated from the model shown on the top panel. The bottom panel shows the observed resistivity or IP field data (pseudosection). The match between observed and calculated pseudosections relates to the accuracy of the inversion model results.

The white contours shown on the plots correspond to the percent sensitivity of the inversion model parameters to the observed data. Low sensitivity values point to regions where model parameters are less well-resolved. In general, a 1% sensitivity contour corresponds roughly to an optimistic estimate of the maximum depth of investigation (DOI), while the 3 or 4% sensitivity contours are a more conservative estimate of the DOI.
Figure A-1. Line 1400E dipole-dipole CR-IP 2D Smooth-modeled Inversion resistivity section with observed and calculated apparent resistivity pseudosections.
Figure A-2. Line 1400E dipole-dipole CR-IP 2D Smooth-modeled Inversion IP section with observed and calculated 3-Pt IP phase sections.
Figure A-3. Line 7000N dipole-dipole CR-IP 2D Smooth-modeled Inversion resistivity section with observed and calculated apparent resistivity pseudosections.
Figure A-4. Line 7000N dipole-dipole CR-IP 2D Smooth-modeled Inversion IP section with observed and calculated 3-Pt IP phase sections.