Logistics Report
Ground Time Domain Survey, December 2011
Alberta Geological Survey

Introduction

A series of small time domain electromagnetic survey (TEM) were planned at different positions beneath the Aeroquest AeroTEM airborne TEM survey carried out in the spring of 2011. Initially 6 sites were chosen, however one site was eliminated due to its proximity to the TransCanada highway. The 5 remaining sites were in the grounds surrounding sand/gravel pits.

Frontier Geosciences of Vancouver was asked to perform the survey work. Surveying began on the morning of November 29 and ended in the afternoon of December 4. Survey design and data quality control was carried out by Petros Eikon of Brampton. Petros Eikon will also complete the interpretation and comparison to the airborne models and data.

Equipment

Frontier brought to survey areas, a ProTEM receiver, an EM57 transmitter, an EM47 transmitter and two antennae coils for reception of the fields. Neither of the two antennae utilizes magnetic material to augment the signal. The larger of the coils has an effective area of 100 square metres and the smaller, 31.4 square meters. The transmitting antenna is a simple wire placed along the ground.

All of this equipment is manufactured by Geonics Ltd of Mississauga. The principle equipment to be used was the ProTEM receiver, the EM57 transmitter operating at a basefrequency of 30Hz and the 100 sq. m. coil. This choice was to ensure as deep a penetration as possible. The choice of the other equipment was both as a verification of the principle data and possibly a better shallow discrimination.

Survey Design

The intended survey design was to utilize a 400m x 400m transmitting loop at each site with approximately 20 receiver stations at the site. The readings were to be taken along a principle profile of about 2km in length either NS or EW through the loop. The second line was about 1.5 km. The density of stations was highest along only one direction from the loop centre with the other measurements taken as checks.

For all TEM equipment, there must be synchronization between the transmitter and receiver units in order to assure proper measurement of the data. The Geonics equipment manages this synchronization in two possible means, the first via a reference cable that connects the transmitter directly to the receiver and the second via clocks that are required to be synchronized extremely accurately. The reference cable link is awkward and also limited to relatively short distances between transmitter and receiver. Thus, as a check 2 calibration sites were designed to check the reference cable readings (REF) with the crystal clock readings (XTAL).

Each data point was to be read for approximately 2 minutes providing approximately 3600 repeats (stacks) to increase signal to noise and each station reading was repeated to check signal to noise.

Surveying Problems and Adjustments

Two problems arose with the survey design. The first was caused by problems synchronizing the receiver and transmitter in the XTAL mode. There were several reasons for this problem. First, the design of the equipment forced an automatic synchronization which was not accurate and there is no monitor in the equipment to observe drift in the clock synchronization. Second, the transmitter was not equipped with a battery to allow warming prior to arriving in the field and powering the transmitter from the motor generator which was exacerbated by weather conditions. Finally, the operator was not familiar with slow synchronization problems as the equipment had been recently equipped with new crystals which were slower to synchronize than the previous crystals. Secondly, the lack of close accommodations meant relatively long travel times to the site which combined with the short daylight hours limited the time for surveying in any given day. The repercussions were that in the first days, the crystal data was of limited use.

As a result, the survey design was modified. First, the loop size was decreased to 200m by 200m to reduce the setup time for the transmitter loop. Secondly, the number of data stations was reduced in order to ensure more accuracy in those sites which were collected. Finally, a modified system of more reference cable data sites was initiated to provide more usable data in this mode but also to allow more warming time for the crystals. Finally, after the first day, all surveying was limited to the EM57 transmitter operating at 30Hz with the 100 sq. m. coil.

Survey Data Summary

In the data archive, three (3) files are supplied for each day. A transmitter loop file in ASCII .txt format giving accurate GPS locations of the loop. The second file is the GPS locations of the coil data collection points (in ASCII .txt format) with labels as per the data file. The final file is the Geonics data file with data and labels. This is rather a cumbersome format but familiar to most geophysicists experienced with TEM data. The survey was carried out in standard NAD83 coordinates and not in the specialized NAD83 Alberta projection.

<u>November 29 – Site 6</u>

The calibration stations near the corner of the loop were read in both REF and XTAL mode. However, the XTAL mode data was badly out of synchronization was not of any use. The REF data was good. These stations were read with the EM57 and the 100 sq.m. coil.

XTAL data was then read on 10 stations on an EW line and 2 stations on a NS line. The data is slightly out of synchronization of limited use.

Data was then read at a 75Hz basefrequency with the EM47 transmitter and the 31sq.m. coil. Two stations were read on an EW line. The data is of somewhat more use both not perfectly synchronized. Finally, two stations were read with the EM47 and the 31 sq.m. coil on an EW line. At this point, the usefulness of this data is uncertain. More details will be provided in the final interpretation report.

It was not possible to return to this site to improve the data quality as the site was locked by the landowner leasing the property and it was not possible to get the site re-opened to continue.

November 30 – Site 3

This site was carried out with a 400x300m transmitter loop. Crystal and reference mode data were read at two calibration points near one corner of the loop and then a further 4 points were read in reference mode along an approximate EW line through the loop. Two points were collected in the inside of the loop and 2 points to the west of the loop. Finally, 7 points were read in XTAL mode starting at 500m to the west of the centre of the loop and then every 100m until a point 300m east of the centre of the loop.

The REF data is all excellent. However, the XTAL data at the 2 calibration points are clearly not useful and further the 7 XTAL datapoints along the EW are of questionable use. It is not as yet determined if this XTAL data if of no use.

December 1 – Site 2

At this stage, it was decided to be very conservative in an attempt to collect no wasted data for the day. Thus, it was decided to work with a smaller 200x200m loop and also to measure only REF data.

Thus, six datapoints were read and at each point the data reading was repeated. Three points were read on a NS line, one point at the centre , another 200m north of the centre and another 200m south of the centre. Three readings were then carried out on an EW line, one at the centre, another 200m west of the centre and another 200m east of the centre of the loop.

In this way, 2 repeats were collected at each station to ensure repeatability. Further, an additional 2 repeats were obtained at the centre but with a relatively long delay time between the second set. This was to check instrument drift throughout the survey. Finally, if the ground beneath the survey was relatively homogeneous in a lateral sense then the 4 readings outside the loop would be essentially the same. As it is not possible to collect sufficient data in one day to do a three-dimensional interpretation, it is necessary to check if the resistivity structure is relatively one dimensional in order to assure ourselves of an accurate model.

The data repeats were all excellent with little signs of noise. The repeats at the centre showed little drift and the outside station repeats in the 4 directions indicated a 1D solution was appropriate. Further details will be provided in the interpretation report.

As there was time at the end of the survey, more data was collected at Site 2 on the last day.

December 2 – Site 5

Again a 200x200m loop was used to allow more survey time. On this day, the operator began to get control over the synchronization issue and good REF and XTAL data was collected. First, REF data was collected as on December 1 with 3 stations on 2 lines, one EW and one NS. Two repeats were done at all stations and as on December 1, the centre point was repeated a total of 4 times. An additional station was done to the east of the loop but the data proved not useful.

During the process of collecting the REF data, the transmitter and receiver synchronization were repeatedly checked until the operator was assured they were fully in sync. Thus, 8 points were read in XTAL mode each with 2 repeats. The readings started at the centre then moved to 200m south of the centre and they every 50m until reaching 500m south of the loop.

Thus, other than the somewhat smaller loop, the original objectives for the site were met.

December 3 – Site 4

A 200m x 200m transmitting loop was used. First a survey was performed in reference mode (REF) as on the previous 2 days completing 5 points – 4 repeats at the centre and 2 repeats in each direction, 200m outside the loop. However, on this day , two additional stations were read with 2 repeats each. One station, 300m west of the centre of the loop and another 400m west of the centre of the loop.

Once the REF survey was finished, the RX and TX were well synchronized and a further XTAL survey carried out on an EW line. 6 points were read each with 2 repeats at 500, 400, 300, 200m west of the centre of the loop, one point at the centre and a further point 300m east of the centre of the loop. The position at 200m west had to be re-read as the first pair of readings seemed to have a problem. This was verified on closer examination.

However, the remainder of the data is all of good quality and provides adequate information for a good interpretation to a reasonable depth.

December 4 – Site 2

As Site 6 could not be accessed and adequate data had been acquired at the other sites, it was decided to return to Site 2 on the last day and attempt to collect more data further outside the loop in order to provide a deeper interpretation. Again, a 200x200m loop was utilized.

First, REF data was collected. The first station was at the centre of the loop in order to verify a repeat of data from December 1. Then data was collected 200, 300 and 400m north of the centre of the loop. XTAL data was then collected at 9 stations on a 1km line NS through the loop. The stations were at the centre of the loop and then 200, 300, 400 and 500m north and south of the centre of the loop.

The data is of very good quality and will likely give us our deepest interpretation. The one unfortunate matter was that the operators did not repeat the GPS of the loop and previous stations relying on their previous data. This will place a little error on the positioning of the survey but modeling indicates that this will not make a serious impression on the final interpretation.

Data Archive

The data archive is provided in a zip file – *archive.zip.* When unpacking, ensure that the choice is made to maintain directory names. In this way, 6 subdirectories will be made , one for each survey data and in each subdirectory will be found the data for that day along with the loop and station coordinates. Again, the coordinate information is in standard NAD83 and not in the Alberta projection.

Submitted Respectively
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