Quantec Geoscience Pty. Ltd.

Data Acquisition Report

Wellington Range TEM Project
for
Cameco Australia Pty. Ltd.

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Summary:

Quantec Geoscience was contracted by Cameco Australia Pty Ltd to undertake TEM surveys at their Wellington Range prospect between 10 July and 24 July 2007. The purpose of the survey was to establish whether there was an electromagnetic response from shallowly dipping (40°) graphitic schist intersected by drilling below 170 m of conductive cover.

A moving loop (in-loop and slingram) survey was conducted as a first pass in order to establish the survey parameters for a subsequent step loop survey.

1. Survey Location:

The survey was conducted in the Wellington Range area of Arnhem Land NT (Figure 1), approximately 100km NNE of Jabiru. The crew was based at Cameco’s King River camp, an approximate one hour drive from the survey area.

2. Survey Access:

The survey area was accessed by 4WD vehicles along dirt roads of good to average condition. The majority of the grid was quite heavily vegetated, particularly with long grass, which tended to conceal obstacles such as logs and stumps. Sections of the survey area had been burnt off by the client prior to surveying. This tended to increase the production rate and minimise the possibility of vehicle damage as it cleared the area of long grass.

Figure 1 Wellington Range NT.

3. Techniques:

The techniques employed were moving loop TEM (in-loop and slingram) and step loop TEM. The former was conducted as a trial survey in order to determine the parameters required for the step loop survey.

As the moving loop survey was a trial prior to the main step-loop survey, and the target was situated under conductive cover, Quantec Geoscience read slingram readings in order to investigate the x component response east of the loop.

The plotting point for a slingram reading is half way between the transmitter centre and the receiver position, which, in this case, corresponds to the eastern north-south axial wire position. The primary field at this position is horizontal and therefore does not couple well with the conductive overburden. Although the target was shallowly dipping, at 40°, the desired result was to better define the target by minimising the extent to which the overburden was coupled.

An additional benefit of slingram readings is that they minimise negative late time responses (current reversals) caused by I.P. effects which can conceal any late time conductors. I.P. effects were not, however, encountered on this survey.

The in-loop reading was situated at the transmitter centre while the slingram reading was situated 200m east of the transmitter loop centre.

Step loop readings were obtained 500m from either side of the transmitter centre at 50m intervals. Readings then progressed through the loop excluding the eastern and western wire positions as these readings are generally noisy. The loop was then moved west 200m and the process repeated.

4. Equipment:

4.1. Receiver.

The receiver used was a SMARTem V which is a PC based 8 channel acquisition system which enables rapid acquisition, analysis and display of TEM data. Five channels of data may be collected simultaneously while maintaining a high sample rate of 20000Hz.

The SMARTem’s graphical display aids in data quality control by displaying along-line profiles in log and linear formats as well as allowing comparison between the last reading and average readings at each station for all windows or a user-specified subset. SMART processing aids in the rejection of powerline, sferic, VLF and telluric interference.

4.2. Sensors.

The sensors used were a fluxgate magnetometer, a three component RVR and a single component RVR. The magnetometer reads B field data or the time integral of impulse response (step response) to a square wave signal while the RVR measures dB/dt or the approximation of impulse response to the same signal.

As the SMARTem V enables simultaneous acquisition of multiple channels of data, acquisition of B field data is achieved with minimal extra time spent in setting up the magnetometer (approximately one minute per reading). This expenditure is insignificant when viewed in the light of the benefits of B field sensors:

- superior performance in the presence of interference such as that caused by sferics
- the ability to attenuate rapid decays from weaker or unconfined conductors in preference to decays which are slow
- anomalies from targets under conductive cover appear significantly earlier in the decay and therefore above the noise threshold
- superior sensitivity at low frequencies.

In terms of the Wellington Range survey the collection of B field data was desirable given the following:

- close proximity to the equator
    - more likelihood of sferics
- detecting a target which is more conductive than the conductive cover
    - fast decay of cover attenuated in preference to the slower decay of target
    - anomaly from target under conductive cover appears earlier in time
- having to see through the conductive cover
    - low frequency required.

4.3. Transmitter.

The transmitter used was a Zonge ZT-30 which operates with an input voltage of 120V DC. The input voltage was supplied by 9 12V batteries connected in series.

The ZT-30 supplies a maximum of 30 Amps to the loop in the form of a 50% duty cycle square wave. A double turn loop is desirable in some instances (eg 200m or 100m loop) in order to minimise the drain on the batteries and maintain 120V input. For larger loops, connecting the wire in parallel reduces the resistance and maintains a high current, although the batteries require replacement throughout the day.

5. Survey Parameters:

5.1 Frequency.

The frequency chosen for the moving loop and step loop survey was 0.5Hz. The windowing scheme used for both surveys was SMARTem Standard. Using this windowing scheme, there are a total of 39 windows of data recorded with a window centre for the 39th window of 371.22 ms.

Initial tests indicated that the RVR was decaying out to window 33 or 101.395ms. The operator chose a frequency of 0.5Hz resulting in approximately 6 extra windows of data which, in his view, would have been adequate to detect any late time conductors over the area of interest.

5.2 Moving Loop.

The moving loop survey was conducted using a twin turn 200m loop. A reading was taken in the centre of the loop. The receiver was then moved to a location 200m east of the transmitter centre where a slingram reading was taken. The loop was then moved east by 50m and the process was repeated.

The in-loop station was recorded as the centre of the transmitter loop whereas the slingram reading was recorded as half way between the transmitter centre and the receiver location (ie centre + 100mE).

The sensors used for the moving loop survey (in-loop and slingram) and the components read are listed in Table 1.

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Sensor Type	Measured Property	Component Measured	Convention
3C RVR	dB/dt	Z	Positive up
		X	Positive east
Fluxgate Magnetometer	B field	Z	Positive up
		X	Positive east

Table 1. Moving Loop Sensors.

5.3 Step Loop.

The step loop survey was conducted using a 400m x 200m loop. The azimuth of the long axis was 0º. The loop consisted of 2 x 200m thick wires and 8 x 200m thin wires. The thick wire was placed on the short axis and was moved along the line by towing it with the aid of a quad bike. The thin wire was connected in parallel with a soft join at the centre (front and back of loop). This configuration maximised the current supplied by the transmitter at approximately 30 Amps.

The loop was configured in such a way as to allow the transmitter truck access to the centre of the front or back edge as well as access to any of the four corners. This configuration minimised vehicle damage by allowing multiple access points as well as minimising the potential for wire breaks as the 400m front and back edge were towed in 200m lengths by a quad bike and joined at the middle.

Step loop readings were conducted a distance of 500m east and west of the centre of the transmitter loop. Readings were taken at 50m intervals, however, readings were not taken at the loop edge. A total of 19 readings were therefore obtained for a single loop location.

The loop was then moved west by 200m and the receiver was read through the loop as described.

The sensors used for the step loop survey and the components read are listed in Table 2.
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Sensor Type	Measured Property	Component Measured	Convention
1C RVR	dB/dt	Z	Positive up
Fluxgate Magnetometer	B field	Z	Positive up
		X	Positive east
		Y	Positive north

Table 2. Step Loop Sensors.

6. Survey Extents:

6.1 Moving Loop (In-Loop).

The survey extents for the in-loop readings (AGD66 Zone 53) are given in Table 3.

Minimum Extent	Northing	Easting	Maximum Extent	Northing	Easting
Loop Centre	8711900mN	282300mE	**Loop Centre**	8711900mN	283800mE
Reading Location	8711900mN	282300mE	**Reading Location**	8711900mN	283800mE

Table 3. Survey extents for in-loop readings.

6.2 Moving Loop (Slingram).

The survey extents for the slingram readings (AGD66 Zone 53) are given in Table 4.

Minimum Extent	**Northing**	**Easting**	**Maximum Extent**	**Northing**	**Easting**
Loop Centre	8711900mN	282300mE	**Loop Centre**	8711900mN	283800mE
Reading Location	8711900mN	282500mE	**Reading Location**	8711900mN	284000mE

Table 4. Survey extents for slingram readings.

6.3 Step Loop.

The survey extents for the step loop readings (AGD66 Zone 53) are given in Table 5.

Minimum Extent	**Northing**	**Easting**	**Maximum Extent**	**Northing**	**Easting**
Loop Centre	8711900mN	282400mE	**Loop Centre**	8711900mN	283800mE
Reading Location	8711900mN	281900mE	**Reading Location**	8711900mN	284300mE

Table 5. Survey extents for step loop readings.

7. File Conventions:

7.1 Moving Loop (In-Loop).

The file names and station designation for the in-loop readings are given in Table 6.

Minimum Extent	**Northing**	**Easting**	**Maximum Extent**	**Northing**	**Easting**
Reading Location	8711900mN	282300mE	**Reading Location**	8711900mN	283800mE
Label (File, Station)	8711900i.DAT	2300	**Label (File, Station)**	8711900i.DAT	3800

Table 6. File name and station designation with survey extents for in-loop survey.

7.2 Moving Loop (Slingram).

The file names and station designation (*which is half way between transmitter centre and reading location) for the slingram readings are given in Table 7.

Minimum Extent	**Northing**	**Easting**	**Maximum Extent**	**Northing**	**Easting**
Reading Location	8711900mN	282500mE	**Reading Location**	8711900mN	284000mE
Label (File, Station)	8711900s.DAT	2400*	**Label (File, Station)**	8711900s.DAT	3900*

Table 7. File name and station designation with survey extents for slingram survey.

7.3 Step Loop.

Each loop of the step loop survey was read as a separate line (file) designated by the centre easting coordinate of the loop. Each station was recorded as its easting along the line as was the case for the in-loop readings.

The file names and station designation for the step loop readings are given in Table 8.

Minimum Extent	**Northing**	**Easting**	**Maximum Extent**	**Northing**	**Easting**
Loop Centre	8711900mN	282400mE	**Loop Centre**	8711900mN	283800mE
Reading Location	8711900mN	281900mE	**Reading Location**	8711900mN	284300mE
Label (File, Station)	282400.DAT	1900	**Label (File, Station)**	283800.DAT	4300

Table 8. File name and station designation with survey extents for step loop survey.

8. Data Processing:

Raw data was inspected by the operator each evening and any decays which were either significantly different from the average at the same station were removed from the final data set. The resultant file was designated as edited with the addition of an "E" in the file name.

The data was then split into an RVR file and a fluxgate file eg 282400FG.DAT and 282400RVR.DAT. The fluxgate data was multiplied by 0.35 to convert the measured units of μV/A to pT/A. The data was finally merged (gains merged and readings averaged) to produce a single decay at each station. This file was designated as merged with the addition of an "M" in the file name.

The resultant files for the in-loop and slingram survey are listed in Table 9.

File Name	Sensor	Sensor Location
8711900iFGM	Fluxgate	In-Loop
8711900iRVRM	RVR	In-Loop
8711900sFGM	Fluxgate	Slingram
8711900sRVRM	RVR	Slingram

Table 9. In-loop and slingram data files.

The resultant files for the step loop survey are listed in Table 10.

File Name	Sensor	Loop Location
283800FGM	Fluxgate	8711900mN, 283800mE
283800RVRM	RVR	8711900mN, 283800mE
283600FGM	Fluxgate	8711900mN, 283600mE
283600RVRM	RVR	8711900mN, 283600mE
…	…	…
…	…	…
282400FGM	Fluxgate	8711900mN, 282400mE
282400RVRM	RVR	8711900mN, 282400mE

Table 10. Step Loop data files.

9. Recommendations:

In order to maximise production rates and minimise vehicle damage it would be desirable to burn off the entire survey area prior to surveying (provided permission is granted of course). Areas which are not burnt off require the operator to clear a suitable pad for the sensors. A sturdy hoe comes in handy for this purpose. In the presence of long grass care must be taken in maneuvering the transmitter vehicle and quad bike as there are numerous hidden stumps. In order to transport the receiver and sensors, a cart or barrow with a large diameter wheel is desirable to assist in negotiating stumps, logs and other vegetation.

9.1 Moving Loop.

Production rates could be improved by clearing the centre (reading) line as well as a line 100m north or south of the reading line to allow ease of access for the transmitter vehicle. This is based on a 200m x 200m loop configuration.

9.2 Step Loop.

The step loop survey would require only the centre reading line cleared as loop moves are infrequent. It is therefore possible and efficient for the quad bike to move the entire loop and for the transmitter vehicle to be located at the middle of the long wire moving along the cleared centre line.

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