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Geophysical Survey Logistics Report

TITAN-24 MT and DC/IP Surveys over Ketza River Project, ~70km south of Ross River, Yukon Territories. For Ketza River Holdings Ltd., Vancouver, BC, Canada

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CA00681T
August, 2009

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1. INTRODUCTION

- **Quantec Project No:** CA00681T
- **Project Name:** Ketza River Project
- **Client:** Ketza River Holdings Ltd.
- **Client Address:** 540 – 688 West Hastings Street
  Vancouver, BC
  Canada
  V6B 1P1
- **Client Representative:** Graham C. Dickson
  Tel: (604) 688-9427
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  E-mail: graham@ygcr.ca
- **Grid Name:** Ketza Grid
- **Survey Type**: Tensor Magnetotelluric (MT)
  DC Resistivity and Induced Polarization (DCIP).
- **Survey Period:** Thirteen days (from August 9, 2009 to August 21, 2009)
- **Objectives:**

  To map and detect potential manto mineralization to depth within the Ketza Project for drill targeting, delineation and ground condemnation. To evaluate Titan 24 as an exploration tool for providing deep vectoring tools for manto occurrences within the Ketza region.

  The DC/IP component of the survey should provide an excellent means of delineating target mineralization within the top 500 to 750 meters pending geologic and cultural environment. MT resistivity provides additional resistivity information from surface to depths beyond one kilometer. The MT resistivity is useful for mapping geological contacts with resistivity contrasts and deep conductors that may potentially represent alteration or mineralization.

  The Titan 24 **D**istributed **A**cquisition **S**ystem (**DAS**) employs a combination of multiplicity of sensors, 24-bit digital sampling, and advanced signal processing (Sheard N., 1998). It provides three independent datasets capable of measuring subsurface resistivities (structure, alteration & lithology) and chargeability (mineralization) to depth.

- **Report Type:**

  Survey logistics, describing the survey parameters and methodology, as well as presenting the survey results in digital/plot forms.

2. GENERAL SURVEY DETAILS

2.1 LOCATION

- **General Location:** Approx. 70km south of Ross River, Yukon Territories (Figure 1)
- **Province:** Yukon Territories
- **Nearest Settlements:** Ross River, Yukon
- **Datum & Projection:** NAD 27, Zone 08V
- **Lat / Long (L0N, 0E):** approx.: 61°32'05.99 / 132°17'13.39
- **UTM position[1] (L0N, 0E):** approx.: 6825180N, 644234E

Figure 1: Ketza River Project General Location Map[2]

[1] *UTM coordinates (NAD 27, Zone08V) supplied by Quantec Geoscience Ltd.*
[2] *Ketza River Project General Location Map supplied by Ketza River Holdings Ltd.*

2.2 Access

- **Base of Operations:** Ketza River Holdings Ltd. Camp, Yukon Territories
- **Mode of Access to Grid:** Trucks & ATVs
- **Mode of Access to Lines:** Trucks, ATV & by foot

2.3 Survey Area

- **Established by:** Ketza River Holdings Ltd.
- **Coordinate Reference System:** Survey Grid referenced to UTM Coordinates, (Figure 2 and Table 1)
- **Station Interval:** ~100m
- **Grid Azimuth:** ~49° (True North)
- **Declination:** ~23°E
- **Method of Chaining:** Metric, pickets GPS surveyed

Line	Array Coord. Start	Array Coord. End	UTM Coord. Start		UTM Coord. End	
			Easting	Northing	Easting	Northing
L0N	0E	2400E	644234	6825180	646051	6826769
L400N	0E	2400E	644014	6825515	645824	6827025
L600N	0E	2400E	643836	6825652	645632	6827242

Table 1: Ketza River Project Survey Lines (UTM Referenced NAD 27, Zone 08V)

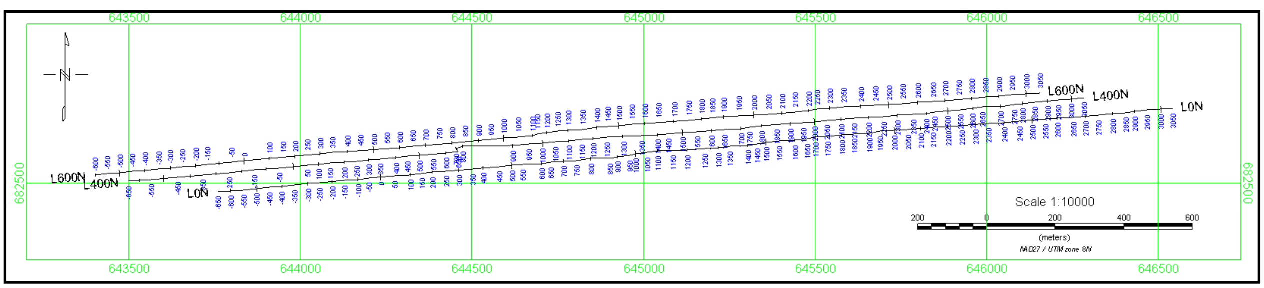

Figure 2: Ketza Grid Line Location Map

3. SURVEY WORK UNDERTAKEN

3.1 Generalities

- **Survey Days (read time):** 6 days
- **Mob/Demob:** 2 days
- **Line Setup/Pickup/ Picketing:** 5 days
- **Parallel Sensor Test:** 1 day (same for line setup)
- **Weather/Down Days:** 0 days
- **Number of Lines Surveyed:** 3 lines
- **Survey Coverage:** DCIP survey: 7.2 km (11.1 km with current extensions) (Table 2); MT survey: 7.2 km (Table 3)

3.2 Personnel

- **Project Manager:** Kevin Blackshaw, Kevin Killin
- **Responsible Geophysicist:** Evelio Martinez
- **Data Processing (in field):** Emily Data, Keeme Mokubung
- **Crew Chief:** Jeff Violette
- **IP Operator:** Dave Clinton, Jeff Violette
- **MT Operators:** Mark Morrison, Jeremie Chaput
- **Remote Operators:** Shawna Miller
- **Field Technicians:** Donnie McLaren, Eric Hotvedt, Jesse Rondeau, Rodney Reneaud, Steve Bates, Leon Simpson, Chris Marchildon, Rylee Lamonthe, Badden Leuszler

3.3 Survey Specifications

3.3.1 DCIP Surveys

- **Survey Array:** Dipole-Pole-Dipole Array (combined PDR & PDL[3], Figure 3)
- **Receiver Configuration**: 24 Ex = Continuous In-line voltages (Figure 4); 13 Ey = Alternating (2-station) cross-line voltages[4]
- **Array Length:** ~2400 meters (3600m with current extensions)

[3] PDR-pole-dipole right, PDL-pole-dipole left
[4] Note: Cross-Line Ey voltages obtained for future reference purposes – not presented in cross-sectional plots.

- **Number of Arrays/line:** 1
- **Dipole spacing:** ~100 meters
- **Sampling Interval:** Ex = 100 meters
  Ey = 200 meters
- **Rx-Tx Separation:** N-spacing (Rxn-Txn) = 0.5 to 23.5 (no extensions); 0.5 to 36.5 (with current extensions)
  Current electrodes at midpoints between potential electrodes (Figure 4).
- **Infinite Pole Location:** UTM: 648158E, 6834234N (NAD27, Z08V);
  Grid Coordinates: 8901E, 4259N
- **Spectral Domain:** Tx = Frequency-domain square-wave current
  Rx = Full waveform time-series acquisition
  Data processing/output in frequency-domain

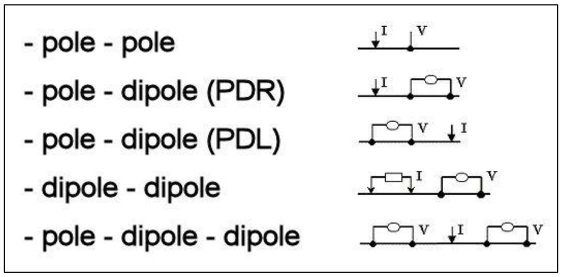

Figure 3: Common DC/IP Survey Layouts

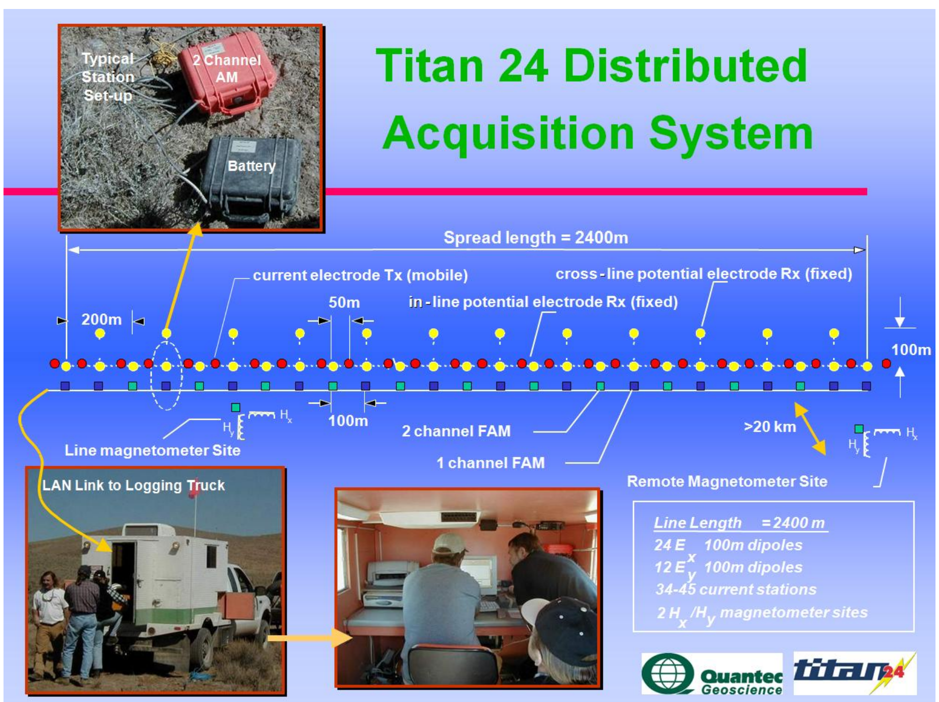

Figure 4: Titan-24 Tensor MT and DC/IP Schematic Survey Layout

3.3.2 MT Surveys

- **Technique:** Tensor MT soundings, remote-referenced
- **Base Configuration:** 24 Ex = Continuous In-line E-fields
  13 Ey = Alternating (2-stations) cross-line E-fields
  1 pair LF coils
  1 pair HF coils
- **Remote Configuration** 1 Ex = in line E-fields
  1 Ey = cross-line E fields
  1 pair LF coils
  1 pair HF coils
- **Array Length:** ~2400 meters
- **Number of Arrays/line:** 1
- **Dipole Spacing:** ~100 meters
- **Sampling Interval:** Ex = 100 meters
  Ey = 200 meters
- **Ex/Ey Sampling Ratio:** 2:1
- **E/H Sampling Ratio:** Ex = 24:1
  Ey = 13:1
- **Remote-reference Measurements:** 1 Hx/Hy set (1 Ey/Ex set for verification/monitoring)
- **Remote Reference Position:** 649118E; 6840658N (NAD 27, Zone 08V)
- **Frequency bandwidth:** 0.01 to 10000 Hz.
- **Data Acquisition:** Full-waveform time-series acquisition
  Data processing/output in frequency-domain.

3.4 SURVEY COVERAGE

3.4.1 DCIP Survey

LINE	SET UP	Min P1	Max P2	Min Tx	Max Tx	Coverage (km)	Coverage (km) with Tx extension
L0N	1	0E	2400N	650W	3050E	2.4	3.7
L400N	1	0E	2400N	650W	3050E	2.4	3.7
L600N	1	0E	2400N	650W	3050E	2.4	3.7
					TOTAL	**7.2**	**11.1**

Table 2: Ketza Grid – DC/IP survey coverage

3.4.2 MT Survey

LINE	SETUP	Min EXTENT (m)	Max EXTENT (m)	Coverage (km)
L0N	1	0E	2400E	2.4
L400N	1	0E	2400E	2.4
L600N	1	0E	2400E	2.4
			TOTAL	**7.2**

Table 3: Ketza Grid - MT Survey Coverage

3.5 INSTRUMENTATION

- **Receiver System:** Quantec Distributed Array Acquisition System comprising:
  - 61channels max. per system (55ch operationally with internal A/D conversion (24bit @120db / dual speed @120-48kHz), and buffer memory (6Mb).
    22 x 2-channel Acquisition Modules (AMs)
    17 x 1-channel Acquisition Modules (Ams)
    AM data transmission using LAN cabling
  - 2 Central Recording Units (CRU), at base & remote (MT surveys) reference sites (140Gb data storage)
  - 2 GPS synchronization clocks (10nsec precision /12.3MHz clock-speed), at base & remote (MT surveys) CPU's
  - 2 PC-based Central Processing Units (base & remote)
- **Transmitter (DCIP Surveys):** GDD (5.0 kW) with frequency/waveform control, using TRM, and Current Monitor (CM)
- **Power Supply (DCIP Surveys):** Westinghouse Alternator (30 KVA @ 400 Hz / 220V / 3 phases) with Kolher Command 25 engine (25 HP / 2cyl) and GDD TRM voltage regulator
- **Receiver Electrodes**: Ground contacts using stainless steel rods
- **Transmit electrodes** 4 to 10 x 1.2cm diameter 1 meter long stainless steel rods
- **Receiver Coils (MT Surveys):** 4 Phoenix magnetometers "P50 model" (0.0001Hz to 1kHz); 2 at base & 2 at remote
  4 EMI magnetometers "BF-6 model" (1Hz to 25kHz); 2 at base & 2 at remote

3.6 PARAMETERS

3.6.1 DCIP Survey

- **Transmitter Waveform:** 30/256 Hz square waves at 100% duty cycle (~4sec Pos./Neg.)
- **Transmitter Output Current:** min 0.4 amperes to max 5.2 Amperes
- **Receiver Sampling Speed:** 240 samples/second (24 bit A/D @ 120 db dynamic range)
- **Tx-Rx Synchronization:** using current monitor (10 μsec time-accuracy)
- **Time-Series Stacking:** 20 & 40 cycles (full-waveform)
- **Read Time:** approx 3.0 minutes per event (20 cycles)
  approx 6.0 minutes per event (40 cycles)
- **Post-Processing:** using QGL QuickLay™ v.2.30.14
  1) Time-series stacking
  2) Robust statistics
  3) Current waveform deconvolution
  4) Digital filtering (60Hz + harmonics)
  5) Spectral model decay-curve fitting (Figure 5)
- **Time-Domain Decay Window:** T_O to T_F= 0.80 to 1.93 seconds[5]

[5] *T_0-integration start time, T_F- integration end time.*

- **Final Data Output:** 1) Normalized voltage (mVolts/Ampere)
  2) Voltage error (mV/A)
  3) Phase (milliradians)
  4) Phase error (milliradians)
  5) Apparent Resistivity (Ωhm-meters).
- **Spectral Chargeability Model[6]:** Halverson-Wait (Figure 5)

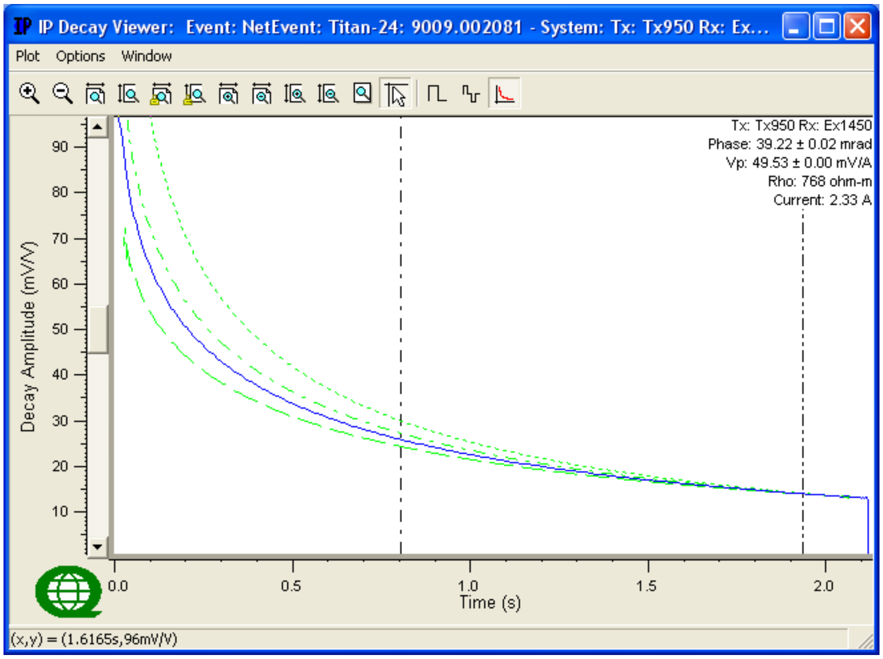

Figure 5: Example of Spectral Chargeability Model and Calculated Halverson-Wait Decays[7]

3.6.2 MT Survey

- **Frequency Bandwidth:** Operating: 0.01 to 48000 Hz
  Effective: 0.1 to 20000 Hz
- **Time-series Sampling:** High Range: 48000 samples/sec
  Mid-Range: 9600 samples/sec
  Low Range: 120 samples/sec.
- **Remote-Base Synchronization**: GPS clocks (10μsec time-accuracy)
- **Time-Series Stacking:** High Range: 1,534,999 samples
  Mid-Range: 20^{20} (1,048,576) samples
  Low Range: 2^{19} (524,288) samples
- **Sample/Record Time:** High Range: min. 5 events @ ~30 seconds per event
  Mid Range: min. 2 events @ 2.5 minutes per event
  Low Range: 3 events @ 80 minutes for a full event
  (total recording and retrieving time approx. 7.5 hrs)
- **Post-Processing:** using QGL QuickLay™ v.2.30.14

[6] *The Halverson-Wait model chargeability (Halverson et al., 1981) is similar to and improves upon the frequency-domain Cole-Cole model (Pelton et el., 1978) described in the time-domain by Johnson (1984).*

[7] *HW model parameters calculated in frequency domain, with hatched green lines corresponding to theoretical HW decay with spectral r-factors of 0.1, 1.0 (default) & 10, k-factor of 0.2 (default).*

1) Coherent noise rejection using remote-reference
2) Proprietary digital filtering (scrubbing)
3) Coherency sorting
4) Impedance estimate stacking

- **Final Data Output:** 1) Auto and cross-power spectral estimates
2) Unrotated (XY & YX) Tensor impedances + errors (apparent resistivities and E/H phase – Figure 6).

- **Final Data Processing:** Edited and un-edited phase & resistivity sounding curves (0.1-10000 Hz @ 8 pts/decade) using Geotools™.

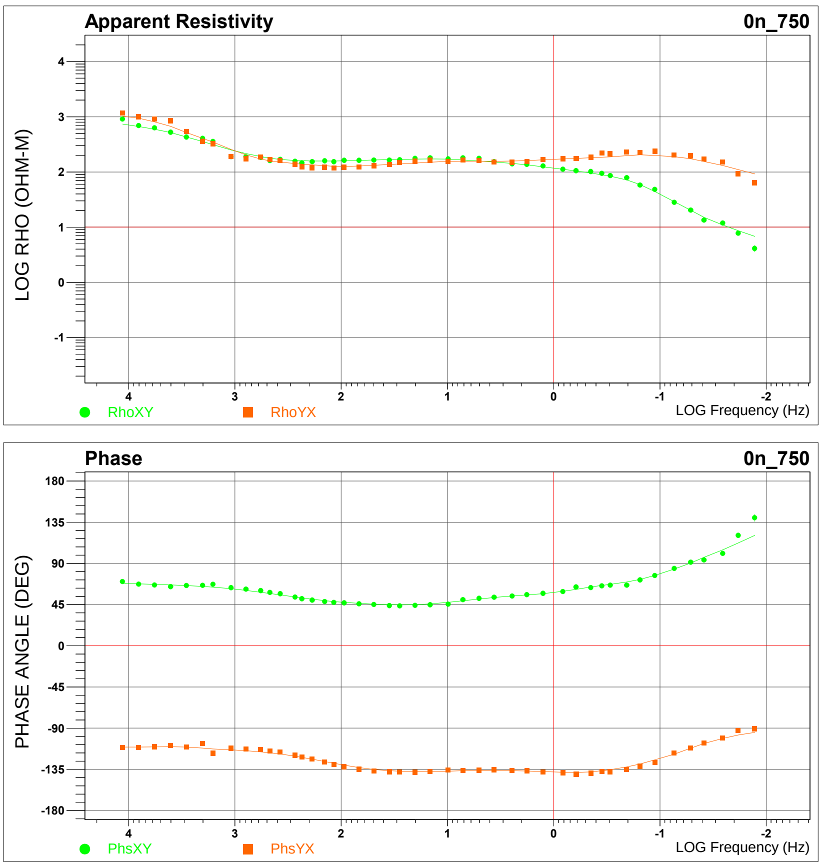

Figure 6: Example of Apparent Resistivity and Phase (XY and YX) Sounding Curves

3.7 Data Accuracy and Repeatability

3.7.1 DCIP Survey

ERROR TYPE	PHASE ERRORS	VOLTAGE ERRORS
1. **Measured Data** error (from csv files) using Halverson-Wait model calculation.	86% of points have less than 10% error	93% of points have less than 1% error

Table 4: Minimum Errors for DCIP Measurements

3.7.2 MT Survey

- **Parallel Sensor Test:** Test for BF-6 (High to Mid Frequency Range)
  Figure 7 and Appendix F
  Test for BF-4 (Low Frequency Range)
  Figure 8 and Appendix F
- **Data Error:** Apparent Resistivity = <1/20TH decade average.
  Phase = <3 degrees average.
- **Inversion Error:** 1/20TH decade, minimum acceptable.

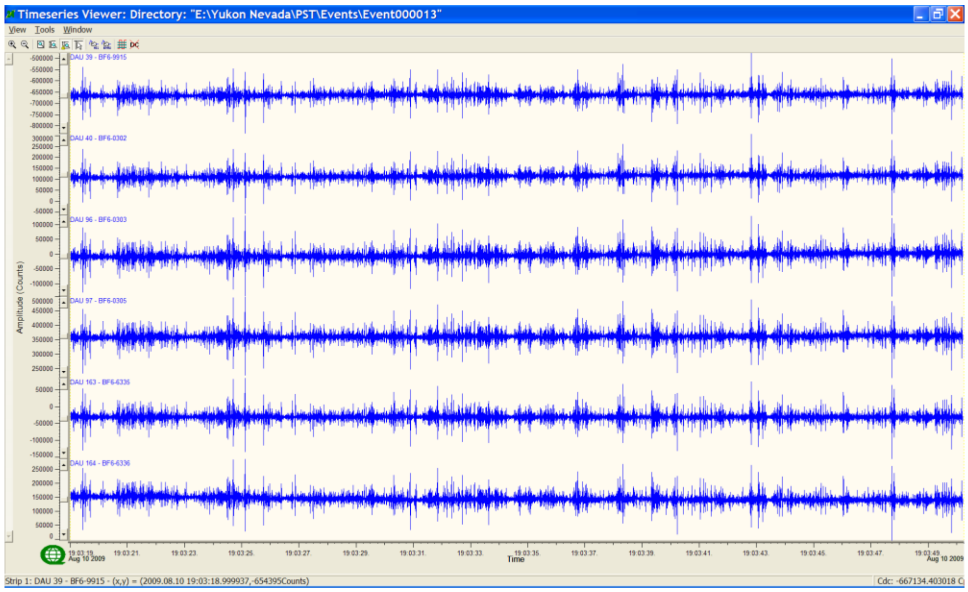

Figure 7: Example of Time Series from Parallel Sensor Test (BF-6 coils)

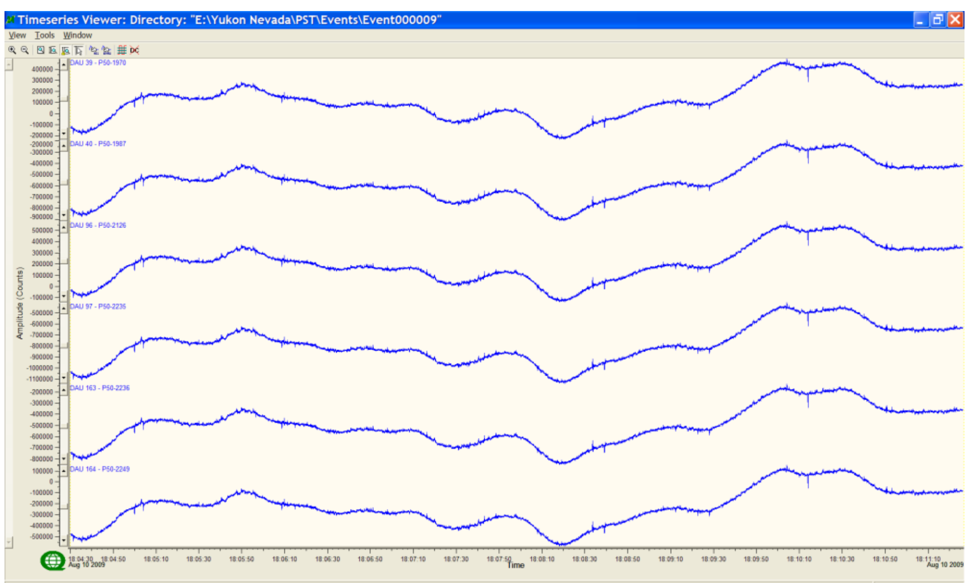

Figure 8: Example of Time Series from Parallel Sensor Test (P50 coils)

3.8 DATA PRESENTATION

3.8.1 DCIP Survey

- **Pseudosection Plots:** In-line[8] DC/IP Resistivity and Chargeability Pseudo-sections, posted, contoured (equal area zoning) and plotted in ground units using Quantec's QuickLay viewer (Appendix C).
- **Digital:** Raw Data: Raw Event Log File Folders (eg. Eventxxxx.dat). Also contains AU.txt and Event.log files, which contain information on the location and time of the event in QuickLay propriety digital format (output to Matlab format upon request).

  Processed Data: DCIP ASCII DATA, in *.CSV (comma delimited) file format, from QuickLay, containing final processed voltage and phase data (Ex)

Line 1:	Column headings
Column 1:	Event name/number (e.g., Event100020)
Column 2:	Transmitter site ID (e.g., Tx150)
Column 3:	Receiver site ID (e.g., Rx150)
Column 4-11:	C1-C2/P1-P2 positions in X and Y meters)
Column 12:	Current (Amperes)
Column 13:	Current error (Amperes)
Column 14:	Normalized voltage (Volts/Ampere)
Column 15:	Voltage error (Volts/Ampere)
Column 16:	Phase (milliradians)
Column 17:	Phase error (milliradians)
Column 18:	Apparent resistivity (Ohm-meters)[9].

3.8.2 MT Survey

- **Sounding Curves:** MT Apparent Resistivity and Phase (XY and YX) (Appendix D) in log frequency format, using Geotools™ viewer.
- **Pseudosection Plots:** MT Apparent Resistivity and Phase Pseudosections (XY, and YX), posted, contoured (equal area zoning) and plotted, in grid units using Geotools™ viewer (Appendix E).
- **Digital:** Raw data: Base and Remote Raw Event Log File Folders (i.e. Base - Eventxxxxx.dat; Remote Eventxxxxxx.dat). Also contains AU.txt and Event.log files, which contain information on the location and time of the event in QuickLay propriety digital format.
  Processed data: MT DATA, in .EDI (electronic data interchange) file, created in Geotools™ containing tensor-sounding data (XY & YX)[10], for individual stations (sites) and profiles (site-sets), in a format conforming to SEG standard for the storage MT data.

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[8] *Cross-line (YX) values not shown for presentation purposes.*

[9] *Apparent resistivities calculated in 2d space using 4-electrode general array configuration (as per XY electrode positioning in columns 4-11 of csv file) – not based on pole-dipole calculations (K. Nurse, QGL, pers. comm., 07-2004).*

[10] *XY denotes in-line electrical (E) field and orthogonal magnetic (H) field (Ex/Hy). YX denotes in-line H field and orthogonal E-field (Ey/Hx).*

4. REFERENCES

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4. Sheard, N. (1998). MIMDAS: A new direction in geophysics. Proceedings of the ASEG 13th International Conference, Hobart, Tasmania

RESPECTFULLY SUBMITTED
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