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2-56652

Logistics Report on a BH UTEM 4 Survey
in
Sudbury, Ontario area
for
Canadian Continental Exploration Corp.

Property	Boreholes
Afton Township Property	AT-14-01

LAMONTAGNE GEOPHYSICS LTD.
GÉOPHYSIQUE LTÉE.

April 2015
Geoff Heminsley, P.Geo.
Christina Demerling, M.Sc.

Table of Contents

INTRODUCTION

A BH UTEM 4 survey was conducted by Lamontagne Geophysics Ltd. personnel on behalf of Canadian Continental Exploration Corporation November 16th, 2014. One hole was surveyed on the Afton Township Property, in the northeast corner of the Sudbury Basin (see Figure 1), with a total of 2,185 m of borehole surveying. The purpose of this survey was to locate and define any conductors present in the vicinity of the borehole.

This report documents all survey logistics. Results, presented as BH UTEM 4 profiles and vector plots, are attached as appendices.

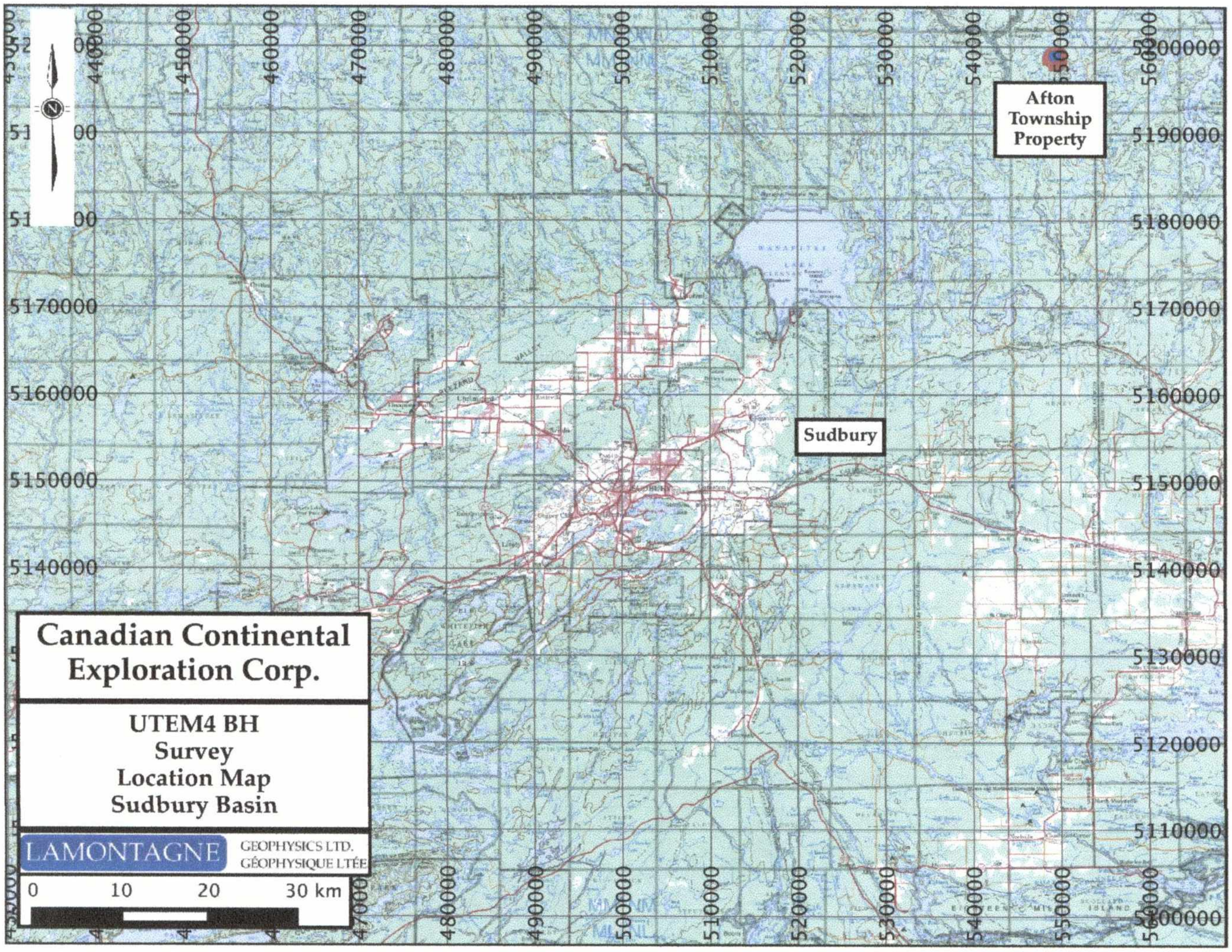


Figure 1: UTEM 4 BH survey locations in the Sudbury area for Canadian Continental Exploration Corp. in November 2014.

SURVEY DESIGN

Afton Township Property (see Figure 2)

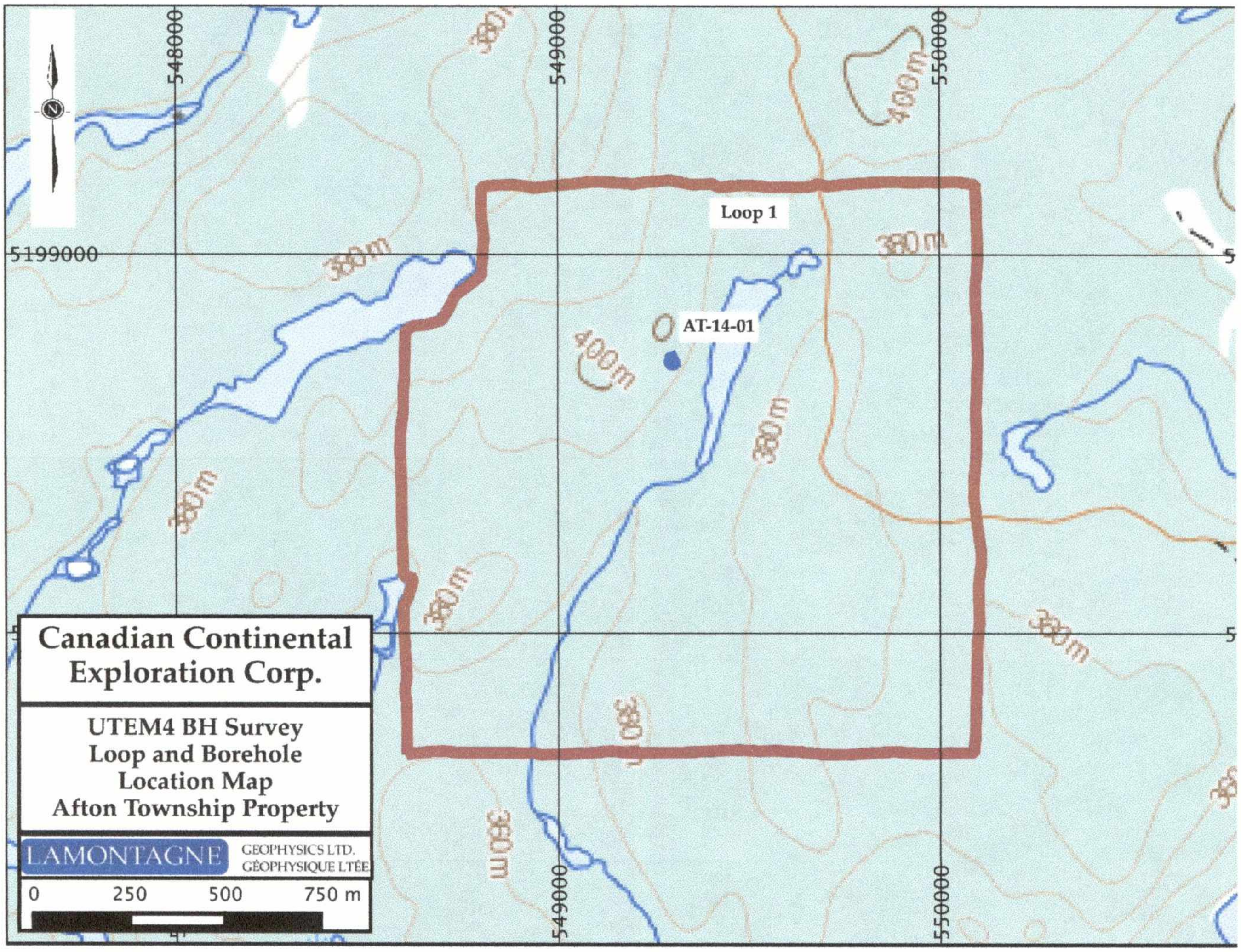


Figure 2: Loop and borehole location map for the Afton Township Property.

Loop 1 (a slightly irregular shape) measured approximately 1500m by 1500m. Borehole AT-14-01 was surveyed using Loop 1 at a frequency of 30.974Hz.

For the above BH UTEM 4 coverage, measurements of the axial (Hw) and the two transverse (Hs and Hn) components of the electromagnetic field were taken at each station. Also, at each station, three component magnetometer, three component accelerometer and temperature data were collected. The nominal station spacing was forty metres (40m) for the top portion of the hole. The spacing was decreased to ten or twenty metres for the bottom portion of the hole and further to five metres if it was thought necessary to better define an anomalous zone. At every station, thirteen channel data were collected with a minimum stack of 512 half cycles recorded at every station. Repeat readings were taken regularly to ensure the repeatability of the data.

For additional information on aspects of BH UTEM 4 survey design and the Data Presentation and reduction schemes used during this survey, see Appendix D.

FIELD WORK

The Lamontagne Geophysics crew commenced operations in the Sudbury Basin on November 14th and continued until November 18th, 2014. The crew consisted of G. Lafortune and T. Gallant. Operations were mobilized out of the Lamontagne Sudbury Office in Chelmsford, Ontario but operated out of the Manitou Lodge in Afton Township.

The survey equipment consisted of one UTEM 4 transmitter, one UTEM 4 receiver, two BH UTEM 4 probes, one borehole winch system, fiber optic cables and all accessories and support equipment. A field computer (iMac) was used for all reduction and plotting of the survey data while on site. This data was delivered to Canadian Continental Exploration Corp. on a timely basis.

A description of the daily field work is provided in the Production Log that follows in Appendix A. All production is summarized in Table 1. Site-specific details of all data acquisition activities are provided below. Geometric control for all transmitter loops was achieved with a hand-held GPS system.

Afton Township Property

Borehole AT-14-01 was dummied to a depth of 2202m and surveyed to a depth of 2185m.

Table 1: Survey Summary

Project Area	Borehole Name	Survey Depth (m)	Dummy Depth (m)	Loop Number	Frequency
Afton Township	AT-14-01	2185	2202	1	30.974

Appendix A: Production Log

BH UTEM 4 Survey

Sudbury area, Ontario, Canada

for

Canadian Continental Exploration Corp.

Production Log (1412)

Canadian Continental Exploration Corp.

Sudbury, ON

Date	Rate	Production	Comments
Nov 14	0.5 Mob 0.5 L-2	-	The crew departed Sudbury and arrived at ManitouLodge in Afton Township. The crew was shown where Hole AT-14-01 was located on the grid. Dummied Hole AT-14-01 (2202m). Approximately 1 kilometre of wire was laid on Loop 1 Crew: G. Lafortune and T. Gallant.
Nov 15	L-2	-	Finished laying Loop 1. Crew: G. Lafortune and T. Gallant.
Nov 16	P-2	2185m	Read: Hole AT-14-01 Loop 1 2185m 30.974Hz at Afton Township. Crew: G. Lafortune and T. Gallant.
Nov 17	L-2	-	Packed up all of the survey equipment at the hole collar and brought it back to the lodge. Picked up Loop 1. Crew: G. Lafortune and T. Gallant.
Nov 18	Demob	-	Crew departed camp and returned to Sudbury. Crew: G. Lafortune and T. Gallant.

LEGEND

Code	Meaning
P-x	Medium Production (UTEM 4 Tx) - # of personnel >1400m, <2100m depth
L-x	Looping (UTEM 4 Tx) - # of personnel
S-x	Stand By (UTEM 4 Tx) - # of personnel
D-x	Down - # of personnel

Appendix B: BH UTEM 4 Plot Profiles

BH UTEM 4 Survey

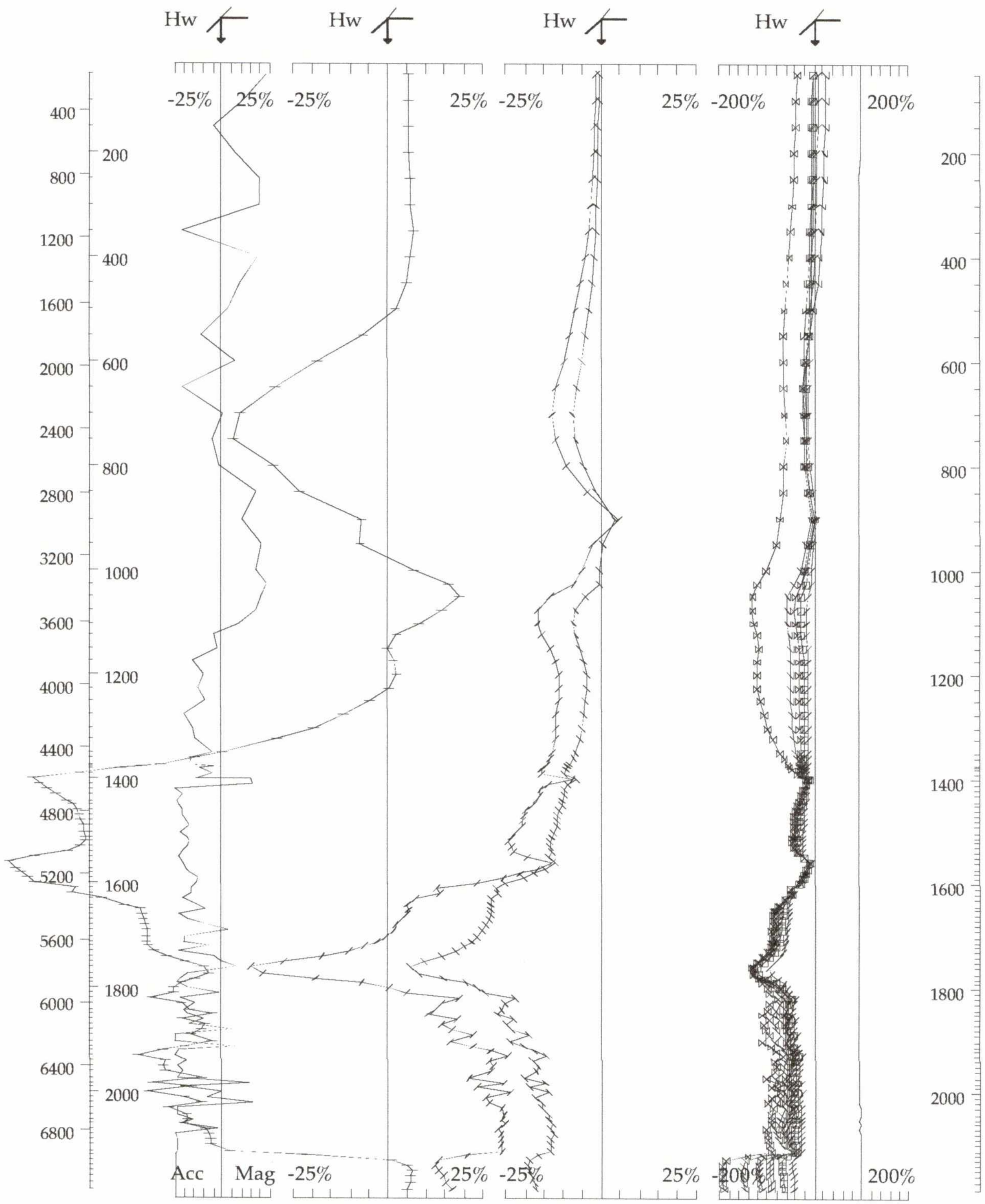
Sudbury area, Ontario, Canada

for

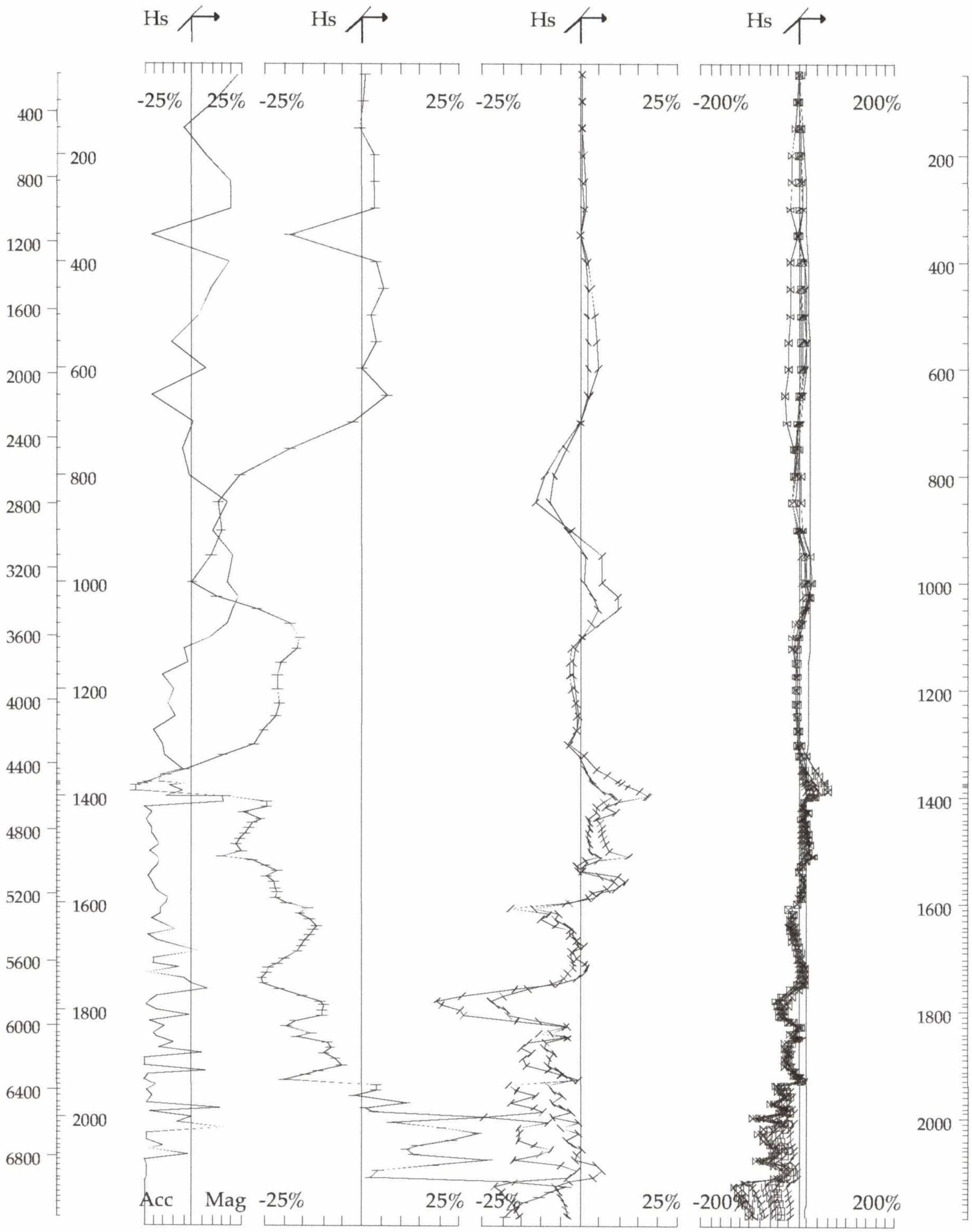
Canadian Continental Exploration Corp.

BH UTEM 4 Plot Profiles—Afton Township

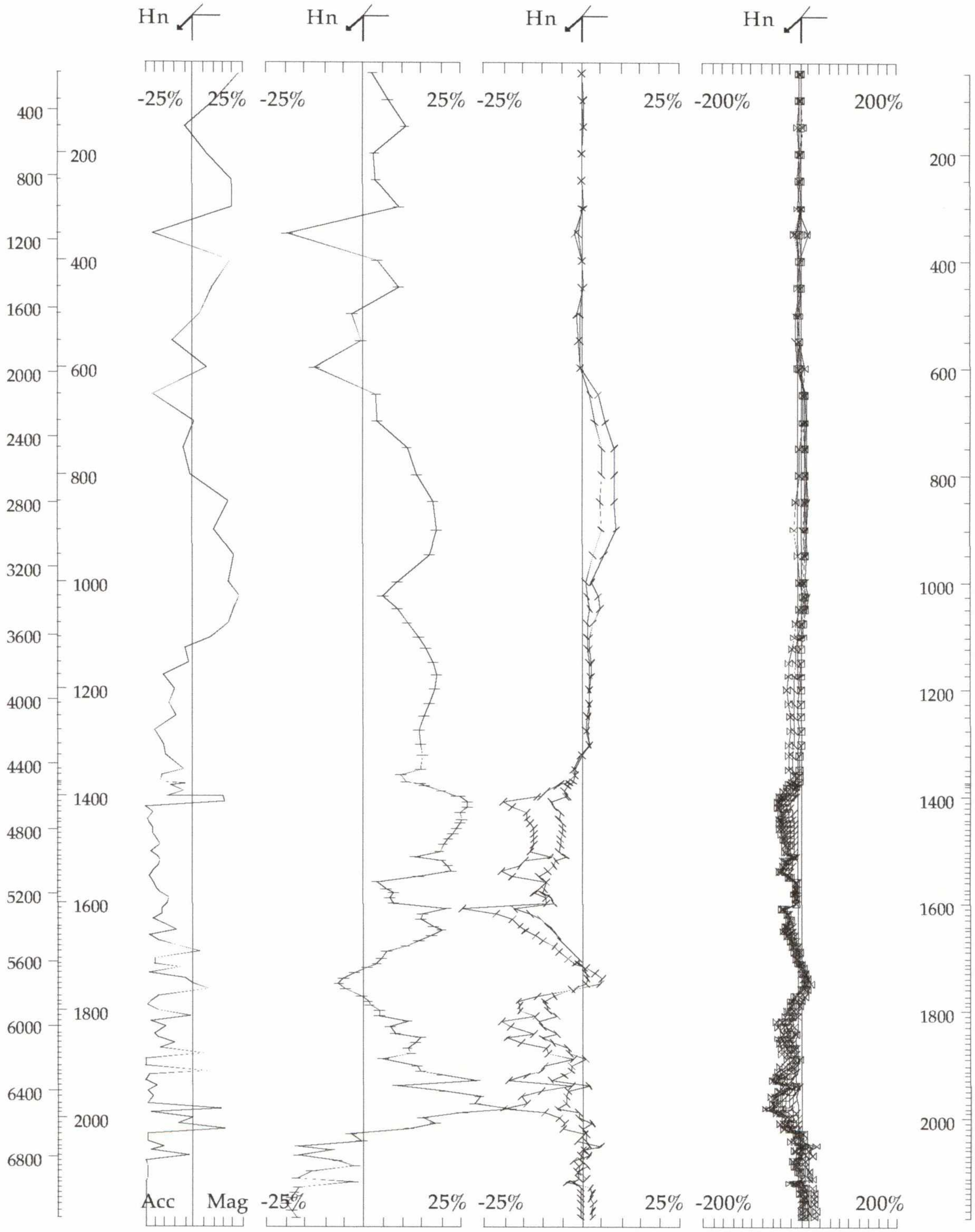
Project Area	Borehole	Loop Number	Frequency (Hz)
Afton Township	AT-14-01	1	30.974



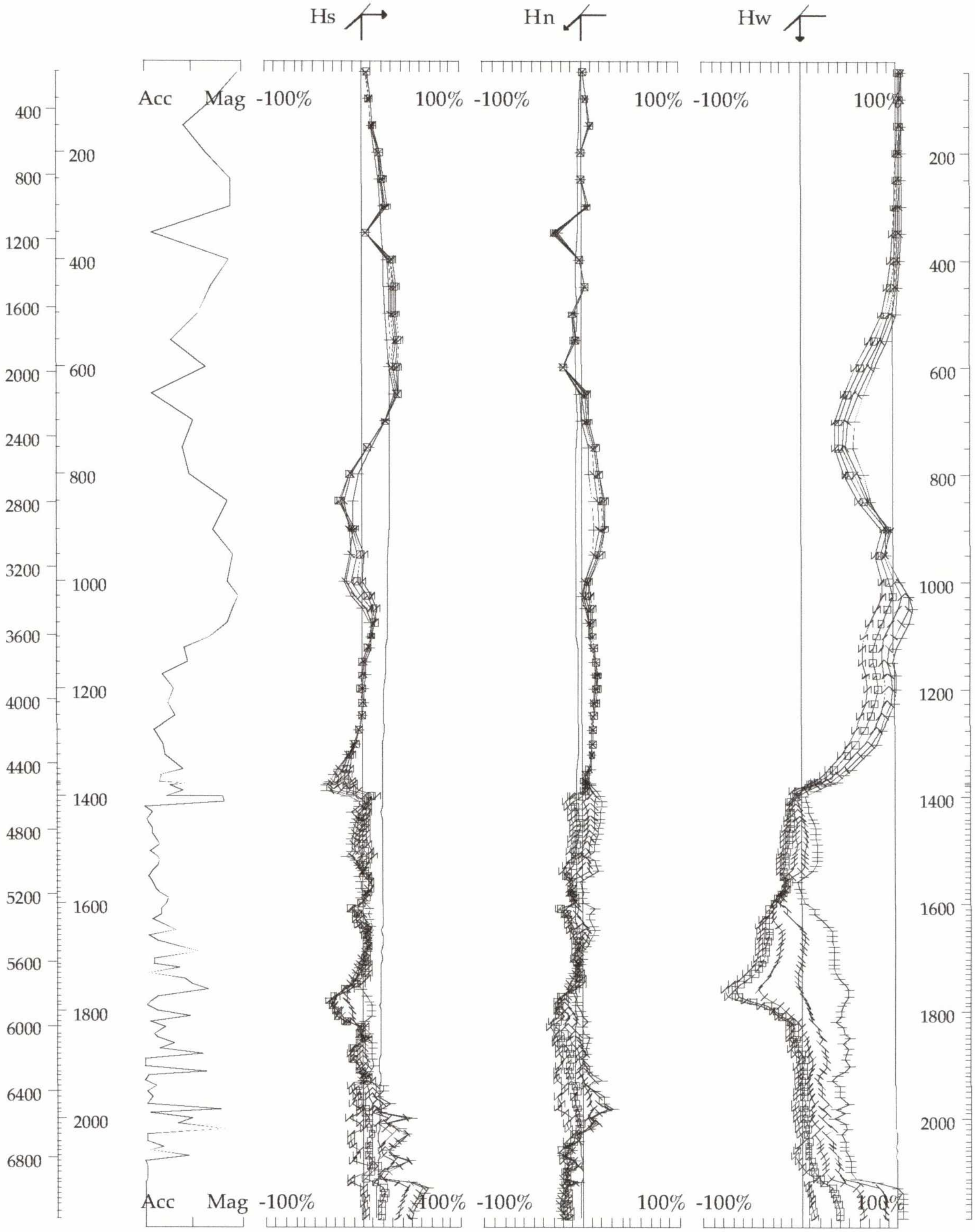
Hole: AT-14-01	Secondary, (Chn-Ch1)/ | Hp |	BHUTEM-4 Survey at: Afton Township Property
Lp: 1; Job: 1412	Cont norm @ Δz:0m	For: Canadian Continental Exploration Corp.
Cpt: Hw	Base freq: 30.974 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE
S 360°; N 90°	Gain factor: -1	Surv: 16/11/14 Red : 18/11/14 Plot: 14/4/15



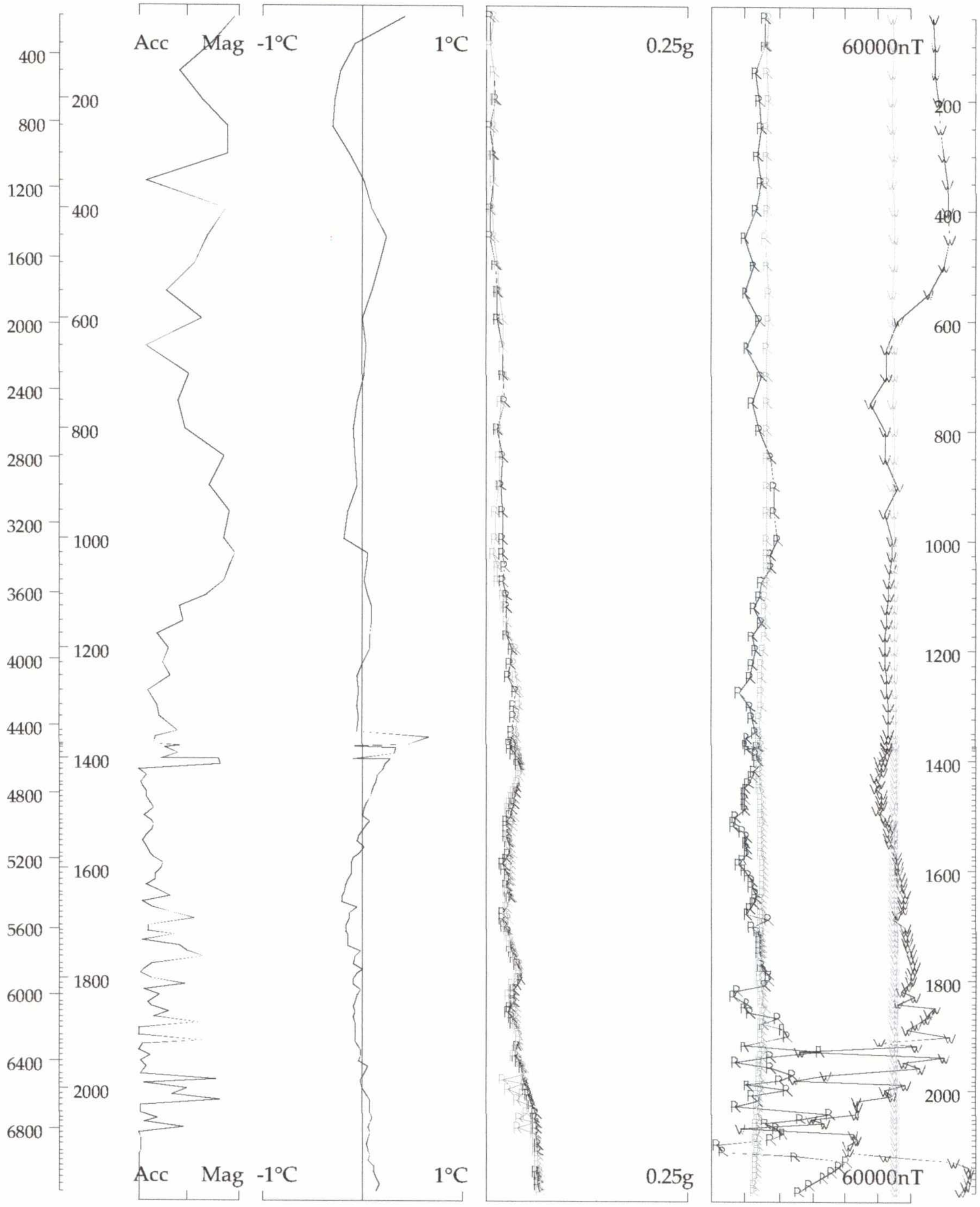
Hole: AT-14-01 Lp: 1; Job: 1412 Cpt: Hs S 360°; N 90°	Secondary, (Chn-Ch1)/ |Hp| Cont norm @ Δz:0m Base freq: 30.974 Hz Gain factor: -1	BHUTEM-4 Survey at: Afton Township Property For: Canadian Continental Exploration Corp. LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Surv: 16/11/14 Red : 18/11/14 Plot: 14/4/15



Hole: AT-14-01 Lp: 1; Job: 1412 Cpt: Hn S 360°; N 90°	Secondary, (Chn-Ch1)/ |Hp| Cont norm @ Δz:0m Base freq: 30.974 Hz Gain factor: -1	BHUTEM-4 Survey at: Afton Township Property For: Canadian Continental Exploration Corp. LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Surv: 16/11/14 Red : 18/11/14 Plot: 14/4/15



Hole: AT-14-01 Lp: 1; Job: 1412 Cpt: Hs,Hn,Hw S 360°; N 90°	Total, Chn/ |Hp| Cont norm @ Δz:0m Base freq: 30.974 Hz Gain factor: -1	BHUTEM-4 Survey at: Afton Township Property For: Canadian Continental Exploration Corp. LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Surv: 16/11/14 Red : 18/11/14 Plot: 14/4/15



Hole: AT-14-01 Lp: 1; Job: 1412 Cpt: S 360°; N 90°	Secondary, (Chn-Ch1)/ |Hp| Cont norm @ Δz:0m Base freq: 30.974 Hz Gain factor: -1	BHUTEM-4 Survey at: Afton Township Property For: Canadian Continental Exploration Corp. LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Surv: 16/11/14 Red : 18/11/14 Plot: 14/4/15

Appendix C: BH UTEM 4 Vector Plots

BH UTEM 4 Survey

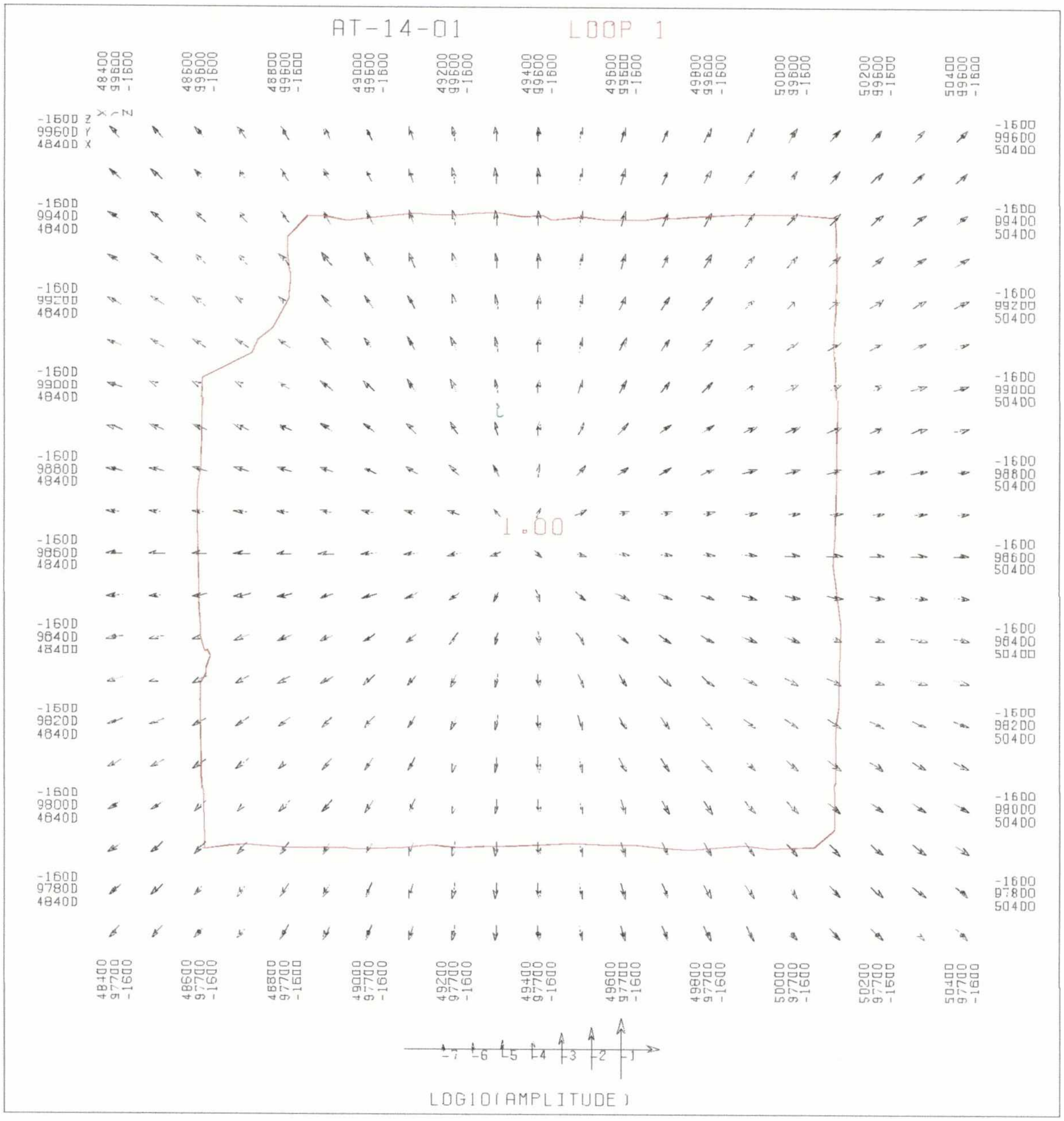
Sudbury area, Ontario, Canada

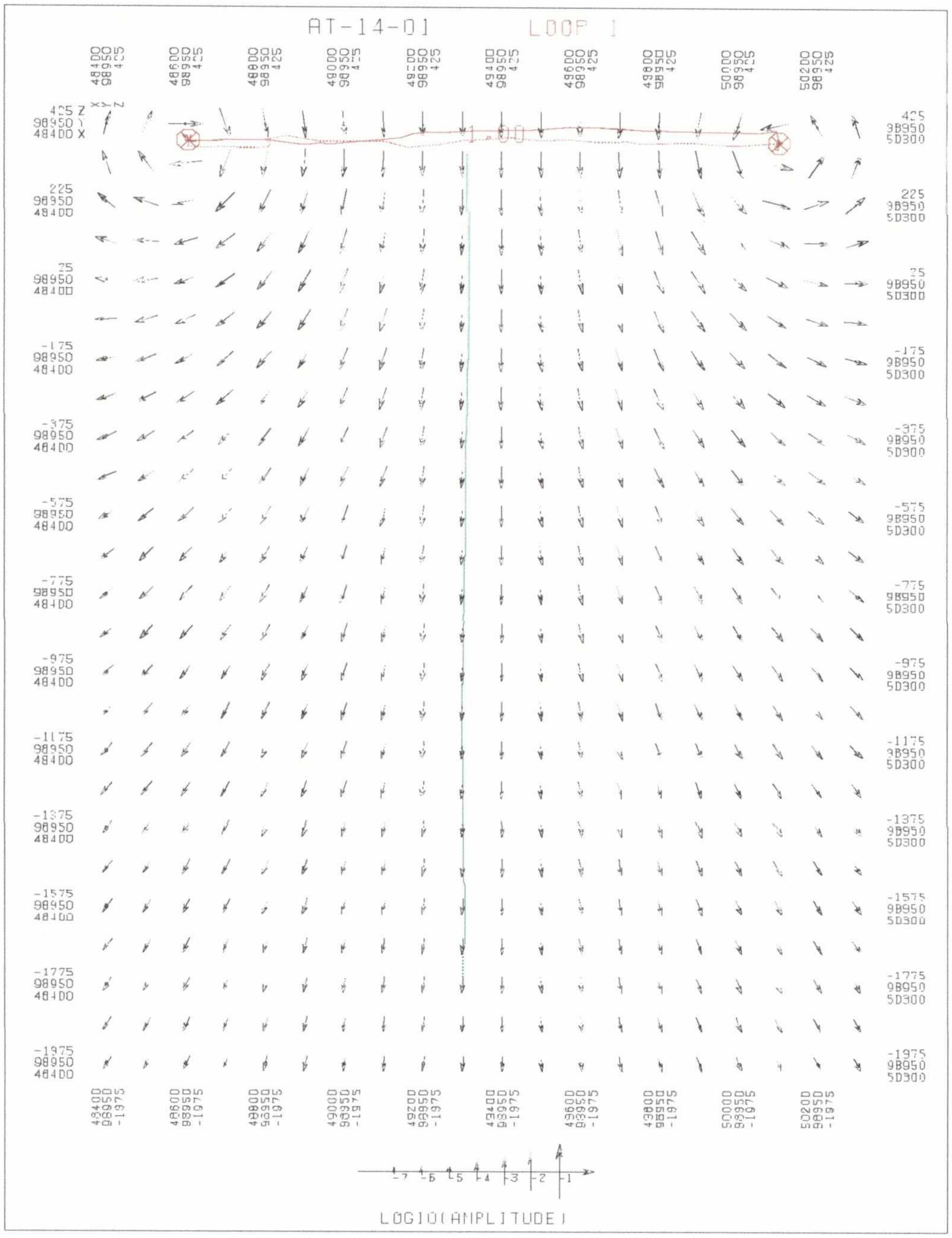
for

Canadian Continental Exploration Corp.

BH UTEM 4 Vector Plots—Afton Township

Loop	Borehole	View
1	AT-14-01	Plan
1	AT-14-01	Section


AT-14-01
LOOP 1
1.00
LOG10(AMPLITUDE)


AT-14-01
LOOP 1
LOG10(AMPLITUDE)

Appendix D: The BHUTEM 4 SYSTEM

Data Reduction and Plotting Conventions

Data Presentation

BH UTEM 4 Survey

Sudbury area, Ontario, Canada

for

Canadian Continental Exploration Corp.

INTRODUCTION

The BHUTEM 4 downhole system is a three-axis downhole transient EM system which incorporates a low-noise coincident three-axis coil design, fully digital down the hole encoding and a fibre-optic probe-to-surface data link. The system allows three components of the transient magnetic field to be simultaneously averaged and stored. Probe orientation within the hole is monitored by integrated 3-axis magnetometer and 3-axis accelerometer devices. Temperature measurements taken to correct the accelerometer package can also be used to detect the thermal signature of ore bodies.

Waveform and Sampling

The UTEM transmitter passes a low-frequency (~1 Hz to 90 Hz) current of a precisely regulated waveform through the transmitter loop. The frequency may be set to any value within the operating range of the transmitter, but is usually set at 31 Hz so as to minimize power line effects (60 Hz noise). Lower base frequencies are used to survey highly conductive bodies with time constants much larger than the 16ms half-cycle.

Since the receiver coil responds to the time derivative of this magnetic field, it is said that the system really "sees" the step response of the ground. In practice, the transmitted waveform is tailored to optimize signal to noise and deconvolution techniques are employed within the system to produce an equivalent to this conceptual "step response" at the receiver. UTEM is the only time domain system which measures the step response of the ground. All other T.D.E.M. systems, to date, transmit a modified step current so that they "see" the (im)pulse response of the ground at the receiver.

While the channel time gates are programmable, a standard set of 13 time gates which fully sample the waveform are usually used as shown in Figure 2. The time gates are described with respect to a system of units where the length of the half-cycle is 1062 units. Ten of the thirteen channels are plotted and used for standard interpretation. Figure 1 shows the plotting symbols used for these channels. The latest of these is designated as channel 1 and it occupies almost the entire second half of the half-cycle, from 512 -1024 units. Channels 2-10 are arranged in a binary progression, each occupying one half of the time interval remaining from the beginning of the half cycle. Thus channel 2 is from 256 to 512 units, channel 3 is from 128 to 256units, etc. Channels 11 and 12 are only one unit wide (15 microseconds @ 31 Hz) and they occupy opposite sides of the waveform transition. They are used primarily for the purposes of monitoring phase drift between the transmitter and receiver clocks. Channel 13 occupies the 37 unit wide interval from the end of channel 1, 1024 units, to 1061 units. While this is later than channel 1, this channel is much narrower and hence less precise. It is used in quality control and in some processing techniques but is not usually displayed.

Probe Orientation

Because the probe is rotating freely in the hole the raw transverse components must be "rotated" to point in a consistent direction along the hole. The rotation process is a mathematical one which is performed after the data are collected but which requires a knowledge of the actual orientation of the probe in the hole at each station. The determination of the probe orientation is achieved using two independent tools; a three-axis magnetometer and a 3-axis accelerometer. Data from these devices are collected before each EM stack. In ideal situations, such as an inclined hole directed well away from magnetic north and away from large magnetic anomalies, either tool is capable of precise orientation of the probe. In a near vertical hole, the accelerometer becomes incapable of determining the probe orientation, while in a hole directed along the earth's magnetic field, the same is true for the magnetometer. The data reduction software uses the best combination of the estimates derived by these two devices.

Coordinate Systems

The three observed components of the transient magnetic field are designated as Hu, Hv and Hw with: Hw being the axial component pointing down the hole and Hu and Hv oriented in a right-handed system with respect to Hw. The coordinate systems used to orient these transverse three-axis data are based on the concept of a drill section. The drill section is a vertical plane perpendicular to the geological strike and is in general the plane in which inclined holes would be drilled. It is specified by the drill section azimuth which is the azimuth of the positive coordinate direction within the plane. For a north-south section plane, for instance, the drill section azimuth would be zero (due north) while for an east west section plane, it would be 090 (east). Usually a section azimuth is adopted for an entire survey area, even if the actual azimuths of individual holes are slightly different. Once the section is determined by the section azimuth, the out of section direction is 90 degrees clockwise from the section azimuth as seen in plan.

UTEM 4 data are presented in one of two coordinate systems. The coordinate system used to express the data is identified by the notation used for the components.

UTEM System Mean Delay Times
10 Channel Mode @ 31 hz.(approx.)
(base freq: 30.974 hertz)

Channel #	Delay time(ms)	Plot Symbol
1	12.11	|
2	6.053	\
3	3.027	/
4	1.513	□
5	0.757	Σ
6	0.378	∡
7	0.189	7
8	0.095	X
9	0.047	Δ
10	0.024	◇

Figure 1

Hole based coordinate system

This is the most commonly used system. In this system the components are designated as Hs, Hn and Hw. Hw is the axial component and as such is independent of the orientation of the probe in the hole. The Hn component lies on the plane perpendicular to the section plane. Hs lies as close as possible to the designated drill section plane while being perpendicular to the other two components. Note that Hs and the designated drill section plane are coincident only if the local hole azimuth is exactly the same as the designated section azimuth.

The hole based coordinate system is useful for several reasons. It is easiest to interpret the

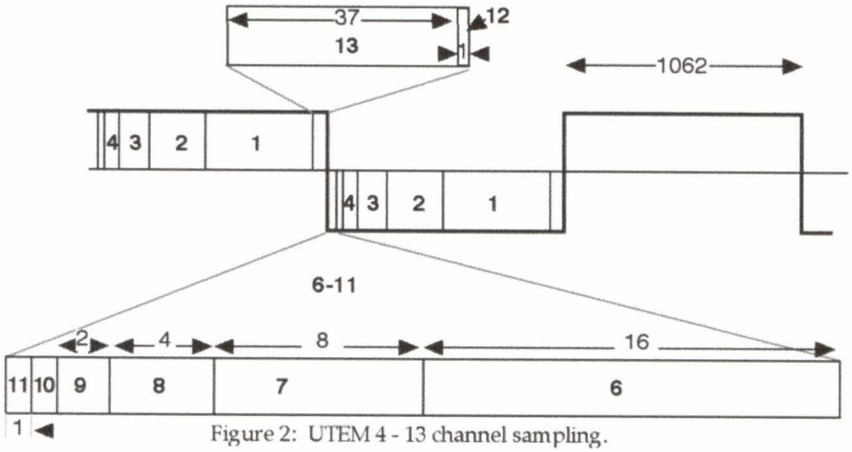


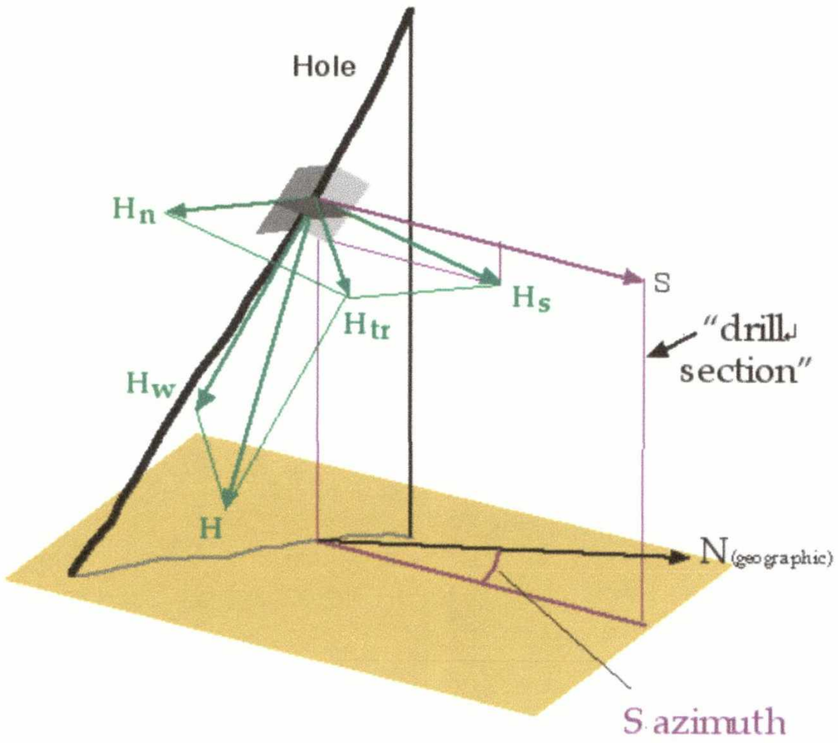
Figure 2: UTEM 4 - 13 channel sampling.

orientation of a conductive body relative to the trajectory of the hole, rather than in absolute terms. In this respect a hole-relative coordinate system is much easier to use. A second important reason is that the axial component has a substantially higher signal/noise than the transverse components. In the hole based system, the axial component is plotted as is and is not required to be combined with the transverse components.

Cartesian coordinate system

This is not a standard presentation. It may, however, be useful from time-to-time to present the data in the Cartesian system. In this system the HS component is in the section direction, the HN component is in the out of section direction, and the HZ direction is down. Note that in the Cartesian system, except in a vertical hole, every component is a linear combination of the three raw observed components.

BH UTEM ORIENTED COMPONENTS H_W, H_S, H_n



S(ection) azimuth: +ve clockwise from geographical north

Note: STANDARD VIEW on a plotted Profile is:
S to right of page
N towards observer
W axial down

Figure 3

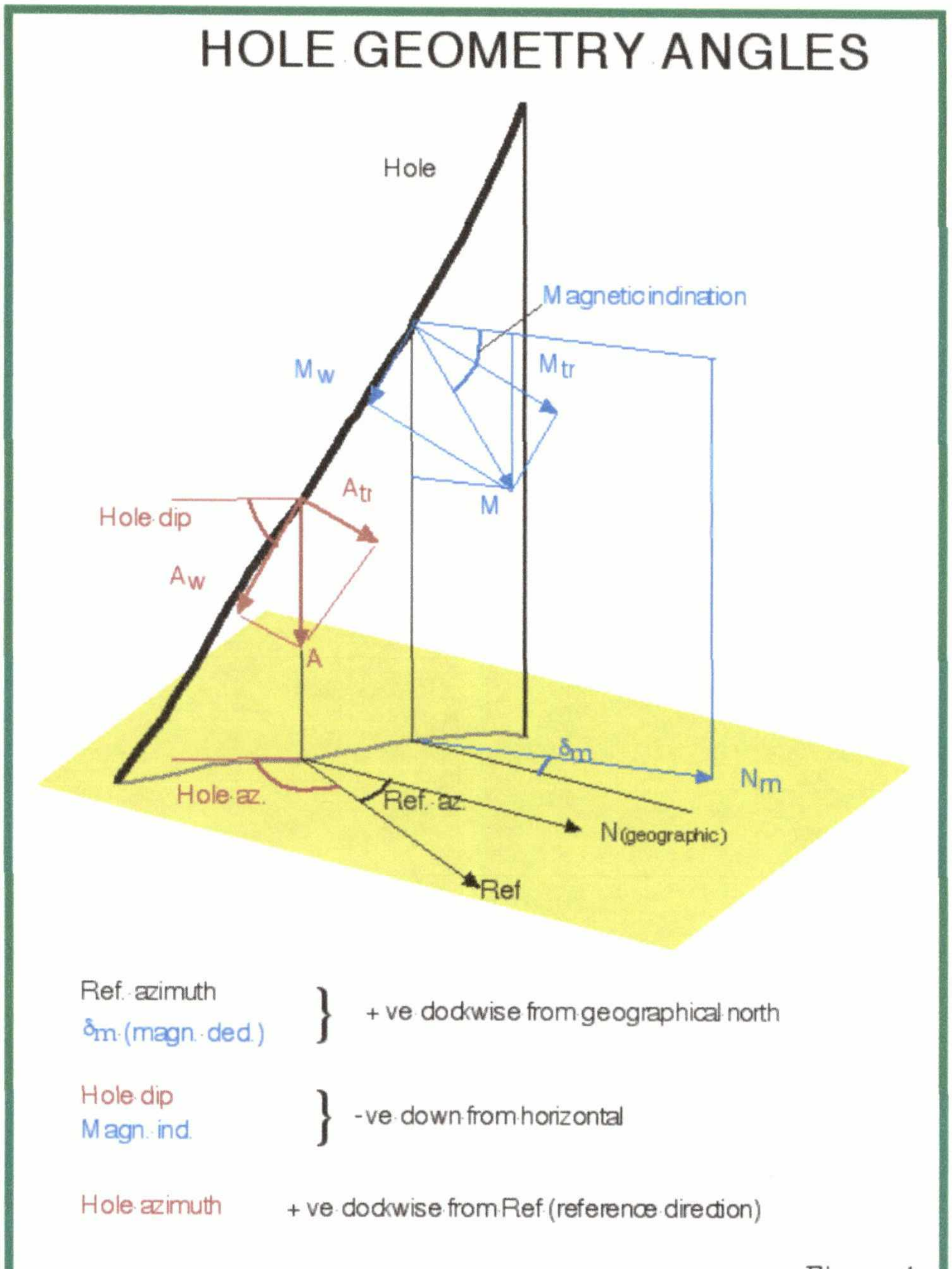


Figure 4

Figures 3 and 4 show the main features of the geometry conventions and terminology used. In Figure 3 the transient field vector is designated as H, which is resolved into the axial, Hw, and the transverse, Htr, components. The transverse Htr is resolved into the Hs and Hn components where: Hn lies in the plane perpendicular to the designated drill section clockwise from Hs as seen in plan and Hs is perpendicular to both Hn and Hw Note that the drill hole itself does not lie in the designated drill section. Because of this the Hs component will not be exactly in the designated drill section in this example. The designated drill section itself is specified by the section azimuth, measured clockwise from geographic north.

Figure 4 shows the relationship of the hole geometry to the magnetic and gravitational fields used for orienting the probe. The magnetometer and accelerometer are both resolved into axial (Aw,Mw) and transverse (Atr,Mtr) components. For each device, it is the resolution of the computed transverse field direction with the two observed transverse signals which determines the probe orientation. The precision of orientation is greatest when the transverse field is a large component of the total.

Orientation Device Selection

The factors which limit the precision of the magnetometer and accelerometer devices as orientation tools are:

Magnetometer	Accelerometer
magnetic anomalies	gravitational anomalies (insignificant)
errors in magnetic declination and inclination	orientation of gravitation field is known precisely
errors in surveyed azimuth and dip of hole	errors in surveyed azimuth and dip of hole
no significant temperature dependence	temperature calibration of accelerometer incorrect
magnetic tensor calibration	accelerometer tensor calibration

While these factors cannot be tracked individually on a routine basis, the total transverse magnetic and gravitational fields are independent of the rotation of the probe in the hole and they can be compared to their predicted values. The discrepancy between these is a measure of the "error" of the device as far as its use as an orientation tool and it forms a basis for the *orientation tradeoff parameter, a.* This is a parameter which varies from +1.0 for pure magnetometer, to -1.0 for pure accelerometer. In between, a linear weighted average between the probe orientations as determined by the mag and accelerometer is used.

Data Reduction

The kind of reduction applied to the raw data is indicated on each plot in the second field of the title block. The observed UTEM data represents a sum of the signal directly from the transmitter loop (Primary field) and the field resulting from eddy currents induced in conductive bodies and/or a conductive host rock (Secondary field). In the case of a *Total Field* plot the observed data are simply expressed as a percentage of a normalizing field which is either the primary field magnitude at a fixed point in space (Point Normalization) or the primary field magnitude at each station (Continuous Normalization). The *Secondary Field* is of most interest from an interpretive point of view. As such an estimate of the primary field must be determined and subtracted from the data. There are two ways in which this is done:

1. **Primary Field Reduction**: The computed primary field is subtracted from all channels. This is designated by the formula (Chn-Hpc)/(|Hp|) in the title block of the plot.
2. **Channel 1 Reduction**: The computed primary field is subtracted from Channel 1. For all earlier channels, channel 1 is subtracted as an estimate of the primary field. This is designated by the formula (Chn-Ch1)/(|Hp|) in the title block of the plot.

As in the Total field case, the |Hp| primary field magnitude in the denominator is either evaluated at a fixed point in space (Point Normalization) or at each station (Continuous Normalization).

Standard BHUTEM 4 Plot Suite

The UTEM 4 3-axis data are usually presented as a set of five profile plots for each hole and loop surveyed. The data are plotted as a function of the distance down the hole. The depth axes are always labelled in metres but are also labelled in feet on imperial grids. Each axis which displays EM data indicates the component according to the conventions discussed above (Hs, Hn, Hw). As well, the component is indicated graphically by the direction of the arrow in the small coordinate axis system plotted at the end of each axis. To understand this system, consider that the plot is oriented with the axis down, that the section plane is the plane of the paper and that the section direction is to the right. The out of section component is then out of the page. The value of the geographic section azimuth is indicated in the second field of the title block of each of the plots along with the type of reduction and normalization. All plots include as well a profile on the lowest axis which shows the orientation tradeoff parameter used to derive the probe orientation. The plot set is comprised of:

- 3 plots of channel 1 reduced secondary field: one each for components Hs, Hn and Hw. These plots have the early, intermediate and latest time channels plotted on separate axes. The computed primary field in the direction of the component is also plotted as a solid curve on the upper axis with the early time channels.
- 1 total field plot: with all channels of each of the three components on a different axis. Each axis includes as well a plot of the primary field as a solid curve. In most cases the following of the primary field curve of each of the components by its respective channel 1 indicates that the basic geometry of the hole relative to the loop is correct. This may not be true, however in very conductive environments where a large response persists in channel 1.
- 1 plot comprised of magnetometer data on the top axis, accelerometer data on the middle axis and temperature data on the lower axis. For the mag and accelerometer plots, three curves are presented. In black, the observed axial (symbol W) and total transverse (symbol R) are plotted, while in grey, the expected total transverse is plotted. Discrepancies between the expected and the observed total transverse mag and accelerometer components can point to a number of problems including: incorrect hole

dip, incorrect hole azimuth, poor mag/acc device calibration, magnetic anomalies and incorrect magnetic declination and/or inclination.

The raw temperature profile taken down the hole is dominated by the geothermal gradient of about 18°C per kilometre of depth. Superimposed on this are small amplitude anomalies which may be beneficial in locating thermally conductive dipping ore bodies. The curve that is plotted is the residual temperature after the removal of a best fitting polynomial. The order of the polynomial used in indicated in the axis label of the plot. For example, "Temp-P(2)", indicates that a second order polynomial has been subtracted.

Appendix E: Note on sources of anomalous Ch1

BH UTEM 4 Survey

Sudbury area, Ontario, Canada

for

Canadian Continental Exploration Corp.

Note on sources of anomalous Ch1

This section outlines the possible sources of anomalous channel 1 which is not correlated to the Ch2-10 data plotted on the upper axes of a *channel 1 normalized* plot.

1) Mislocation of the transmitter loop and/or survey stations

Mislocating the transmitter loop and/or the survey stations results in an error in the calculated primary field at the station and appears as an anomalous Ch1 value not correlated to *channel 1 normalized* Ch2-10. The effect is amplified near the loop front. This can be seen in the profiles - the error in Ch1 generally increases approaching the loop. As a rule a 1% error in measurement of the distance from the loop will result in, for outside the loop surveys, an error in Ch1 of:

- 1% near the loop front (long-wire field varies as 1/r)
- 3% at a distance from the loop front (dipolar field varies as 1/r3)
- 2% at intermediate distances (intermediate field varies as ~1/r2)

Errors in elevation result in smaller errors but as they often affect the chainage they accumulate along the line.

The in-loop survey configuration generally diminishes geometric error since the field gradients are very low. At the centre of the loop the gradient in the vertical field is essentially zero so it is difficult to introduce geometric anomalies near the loop centre. Near the loop sides and at the closest approach of the lines to the wire mislocation of the loop and the station becomes more critical. Typically loop sides are designed to be >200m from any survey stations.

2) Magnetostatic UTEM responses

Magnetostatic UTEM responses arise over rocks which generate magnetic anomalies. Such magnetic materials will amplify the total (primary + secondary) field of the UTEM transmitter which is sensed by the receiver coil. The secondary field is generated by subtracting a computed primary which does not include magnetic effects. This can give rise to strong and abrupt channel 1 anomalies when the source of the magnetics is at surface. This is the case in a number of places on these grids. UTEM magnetostatic anomalies differ from DC magnetic anomalies in the following three major ways:

1. In the case of DC magnetics the field is dipping N and is very uniform over the scale of the survey area while the UTEM field inside the loop is vertical and it is stronger near the loop edges.

2. Most aeromagnetics are collected as total field while with UTEM we measure a given (in this case generally z,x) component.
3. DC magnetic instruments observe the total magnetization of the causative body which is due to its susceptibility as well as any remnant magnetization. An AC method such as UTEM will not respond to the remnant portion of the magnetization.

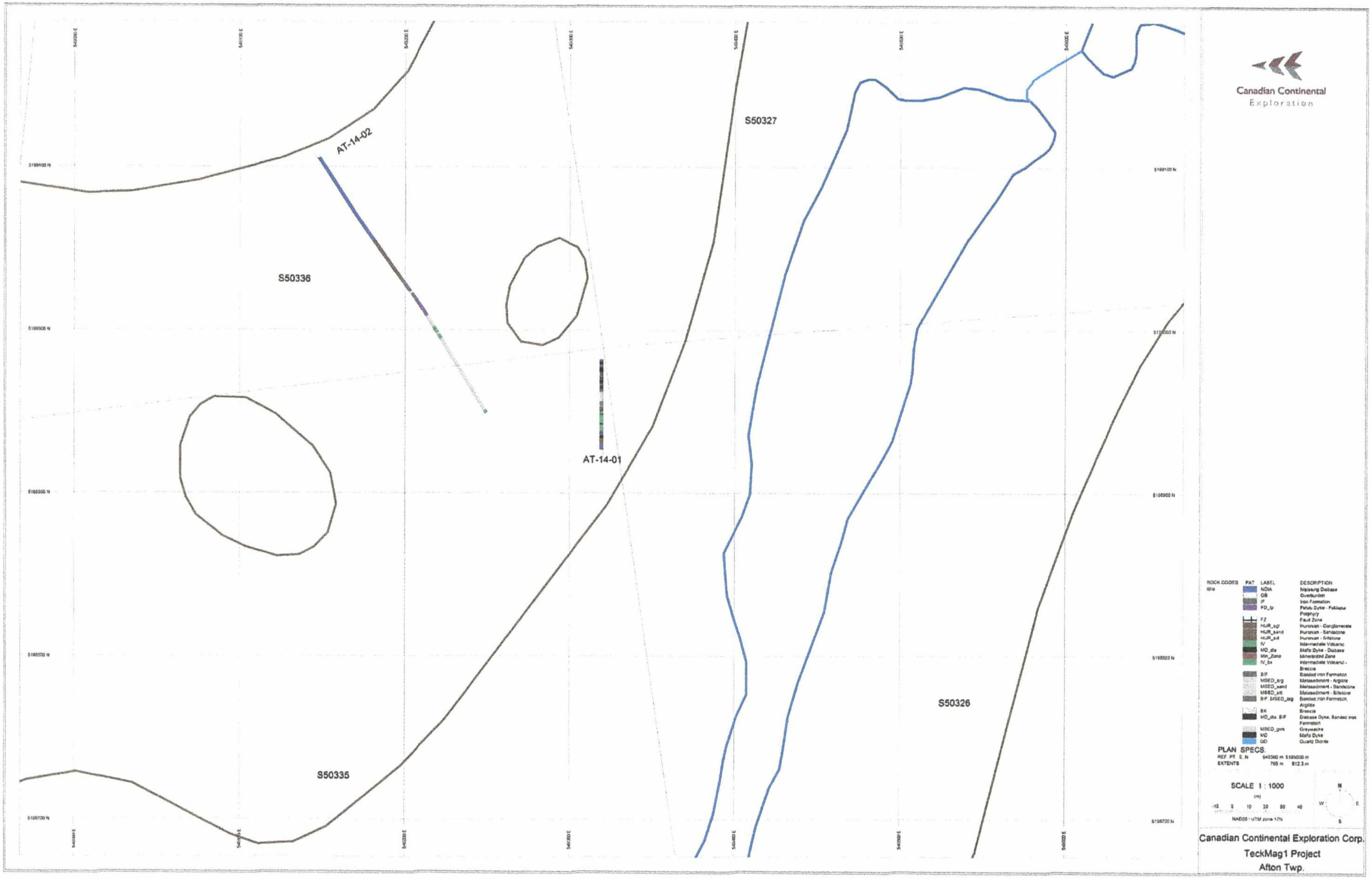
The larger amplitude of the UTEM Ch1 response is explained by the fact that the UTEM primary field is often more favourably coupled (magnetostatically speaking) to magnetic mineralization as compared to the earths field. Another factor could be the presence of a reverse remnant component to the magnetization.

Note that positive (*negative*) magnetic anomalies will cause:

- positive (*negative*) Ch1 anomalies in data collected outside the loop
- negative (*positive*) Ch1 anomalies in data collected inside the loop

3) **Extremely good conductors**

An extremely good conductor will be characterized by a time constant much longer than the half-period (@ 30Hz >>16ms). This will give rise to an anomalous Ch1 which is not correlated to the Ch2-10 data plotted on the upper axes of a *channel 1 normalized* plot.


AT-14-02
AT-14-01
S50327
S50336
S50326
S50335
Canadian Continental
Exploration
ROCK CODES
PAT
LABEL
DESCRIPTION
NDIA
Nipissing Diabase
OB
Overburden
IF
Iron Formation
FZ
Fault Zone
IV
Intermediate Volcanic
MD_dia
Mafic Dyke - Diabase
Min_Zone
Mineralized Zone
IV_bx
Intermediate Volcanic - Breccia
BIF
Banded Iron Formation
BX
Breccia
MSED_gwk
Greywacke
MD
Mafic Dyke
QD
Quartz Diorite
PLAN SPECS.
REF. PT. E, N
EXTENTS
SCALE 1 : 1000
(m)
-10 0 10 20 30 40
NAD83 / UTM zone 17N
N
W
E
S
Canadian Continental Exploration Corp.
TeckMag1 Project
Afton Twp.