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Tittel
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Med CD

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Råstoffgruppe	Råstofftype	
Malm/metall	Cu Ni	

Sammendrag, innholdsfortegnelse eller innholdsbeskrivelse

APPENDIX F
2006 SUMMER DRILLING & BOREHOLE GEOPHYSICS, ERTELIEN PROJECT

LAMONTAGNE GEOPHYSICS LTD.
GEOPHYSIQUE LTEE.

-Logistics Report-
2006 UTEM Survey
Ertelien Project - summer
Norway
for
A/S Sulfidmalm

LAMONTAGNE GEOPHYSICS LTD
GEOPHYSIQUE LTEE

September, 2006

Rob Langridge, M.Sc.

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INTRODUCTION

During the period of July 9th 2006 through July 22nd 2006 a UTEM/BHUTEM-3 survey was carried out by Lamontagne Geophysics Limited personnel for A/S Sulfidmalm in the Ertelien Project area, Norway (Figure 1). This survey continues on from a UTEM 3 survey done in the winter of 2006 (Loops 1, 1B, 2,, 3, 5, 6, 7, and 8)). The location of the various grids on the property are shown in Figures 2 and 3. Areas of interest were identified from the results of an airborne survey and previous work. The survey was carried out to locate/detail conductors in the immediate grid areas with the intention of outlining targets for future work.

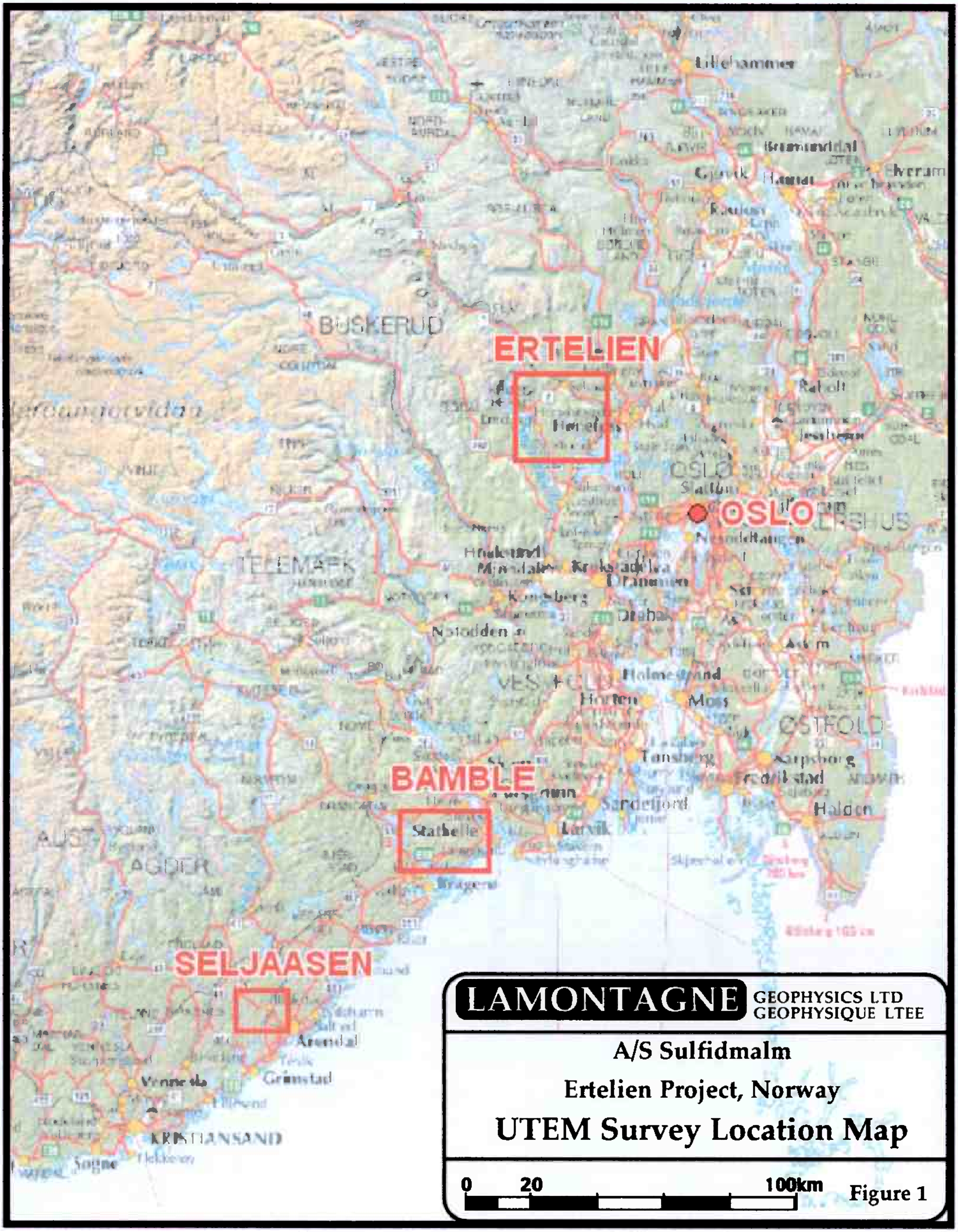
A total of 16.375km of surface UTEM data was collected using 3 transmitter loops (Loops 4, 9 and 9B). All lines were surveyed measuring the vertical component, Hz. A station spacing of 25m or 50m and a line spacing of 50m, 100m or 200m was employed.

In addition to the surface UTEM a total of 6 holes were surveyed with BHUTEM-3. All holes were drilled in 2006 and each hole was surveyed from both Loop 9 and Loop 9B for a total of 12 profiles.

For all loops - both surface UTEM and BHUTEM-3 - the receiver operated in 10-channel mode at a transmitter frequency of 3.251Hz.

This report documents the UTEM/BHUTEM survey in terms of logistics, survey parameters and field personnel. Appendix A contains the data presented in profile form. Other appendices contain:

- List of Personnel/Production Log (Appendix B)
- an outline of the UTEM System (Appendix C)
- Note on sources of anomalous Ch1 (Appendix D)
- Note on 4Hz UTEM Data (Appendix E)
- Discussion of noise issue (Appendix F)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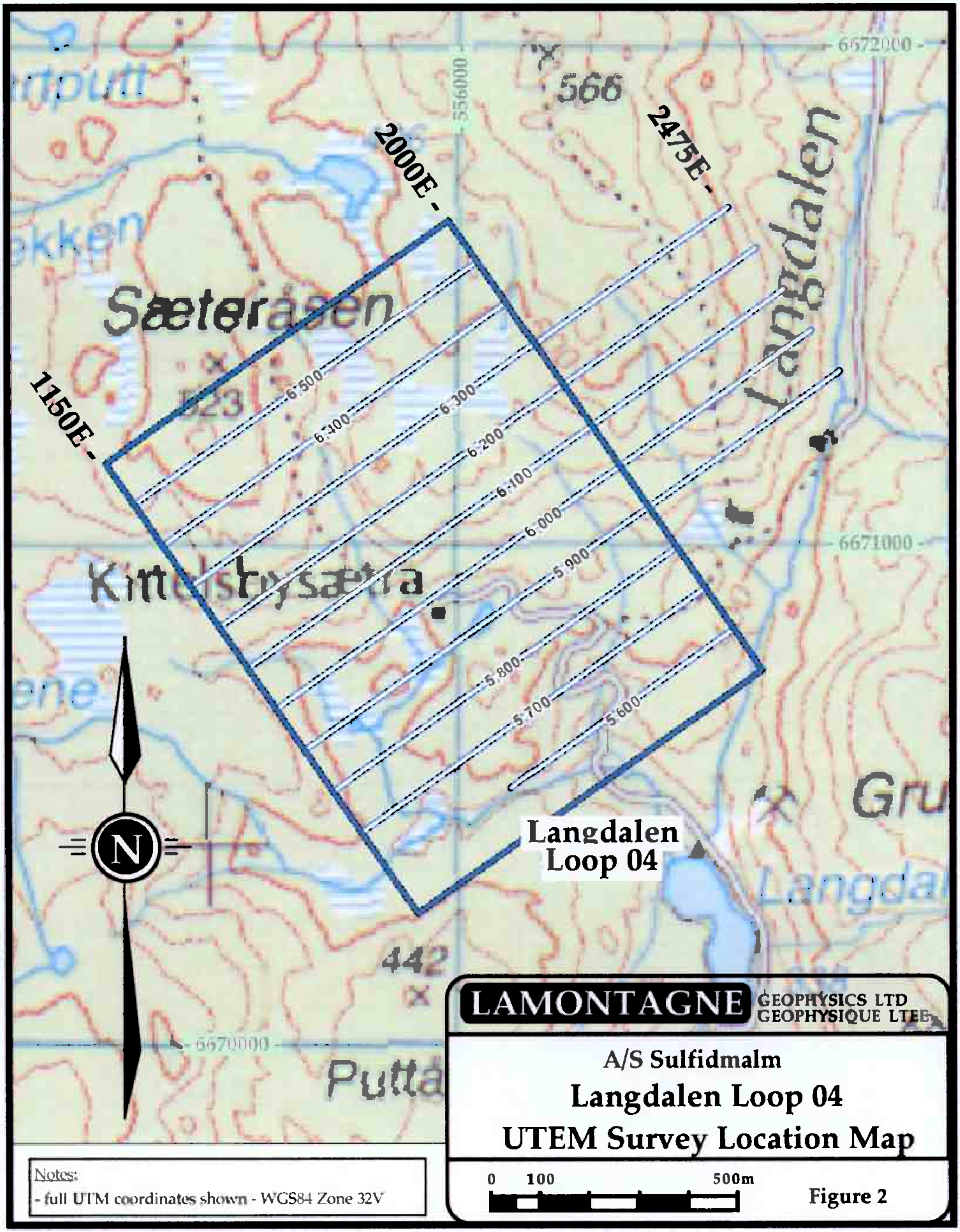
SELJAASEN
OSLO
BUSKERUD
TELEMARK
Lillehammer
Hønefoss
Drammen
Kongsberg
Notodden
Holmestrand
Horten
Moss
Tønsberg
Sandefjord
Larvik
Stathelle
Fredrikstad
Sarpsborg
Halden
Arendal
Grimstad
KRISTIANSAND
ØSTFOLD
LAMONTAGNE
GEOPHYSICS LTD
GEOPHYSIQUE LTEE
A/S Sulfidmalm
Ertelien Project, Norway
UTEM Survey Location Map
0
20
100km
Figure 1



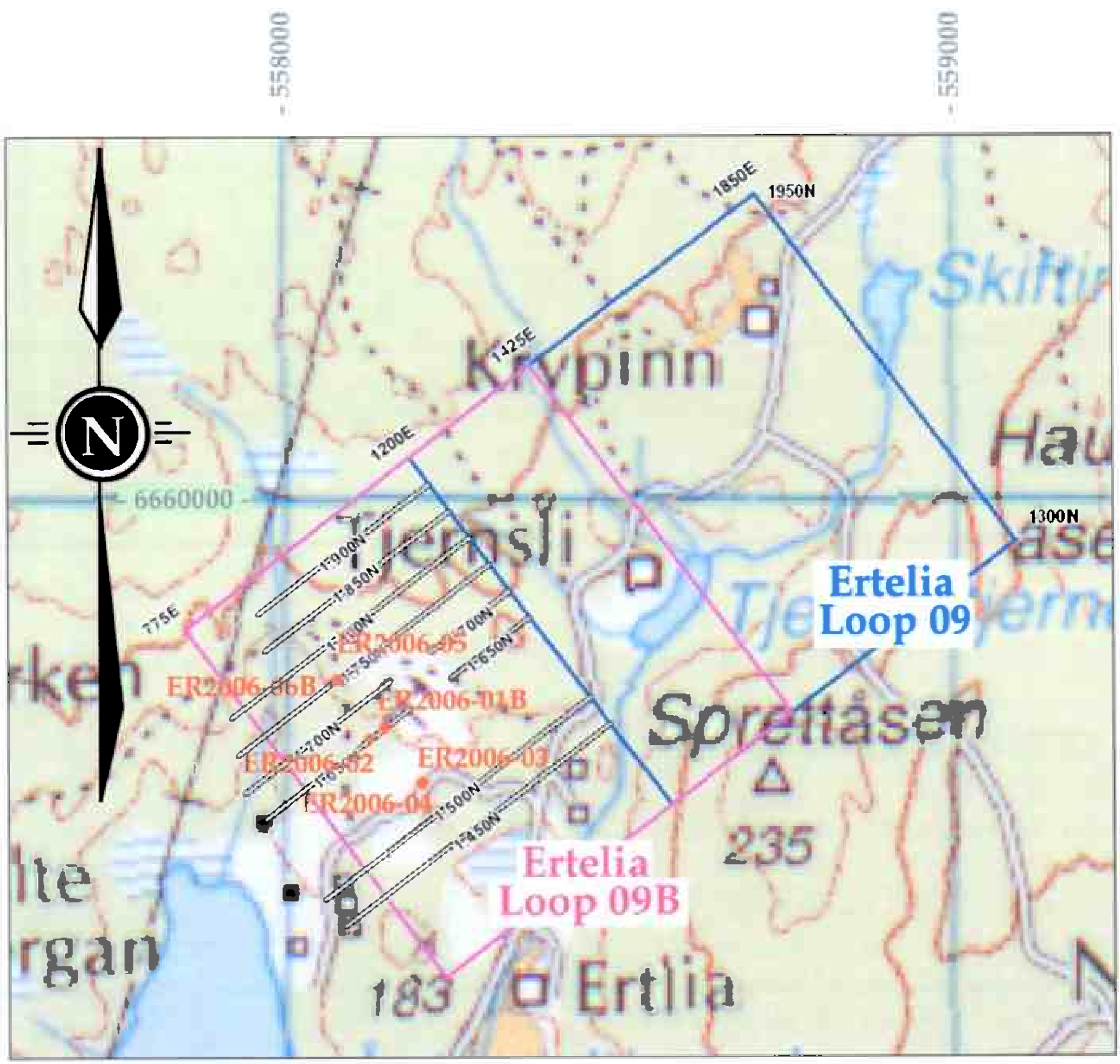
A/S Sulfidmalm

Langdalen Loop 04

UTEM Survey Location Map

Figure 2

Notes:
- full UTM coordinates shown - WGS84 Zone 32V



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A/S Sulfidmalm
Ertelia Loops 09/09B
UTEM Survey Location Map

0 100 500m

Figure 3

Notes:
- full UTM coordinates shown - WGS84 Zone 32V

SURVEY DESIGN

This UTEM survey is part of a nickel exploration program in the Ertelien Project area. Historically, mining of Ni-bearing massive sulfide deposits has been carried out in the area. The UTEM survey was planned and carried out to outline and allow better definition of known conductors, to detect/outline new conductors and to detect/outline deeper features and depth continuations of known features.

The grid and loop layout was designed by A/S Sulfidmalm/Falconbridge Ltd. personnel to allow efficient coverage of the project area. Loop size and locations were selected to provide good coupling with the expected targets, to enhance the signal to noise, and to allow efficient coverage of the grid area. The base frequency was lowered from the international standard ~26Hz to 3.251Hz to eliminate the response of many "moderate" conductors - these responses will have decayed away by Ch1 time. Any remaining Ch1 responses are then considered to be representative of conductors of an appreciably higher conductivity.

The survey parameters employed:

- both in-loop and outside-the-loop coverage with 2 receivers
- 1.70mm diameter (~2mm^2 ~14-gauge) copper wire - DAMID PE GR 2
- variable transmitter loop size - to fit the area to be covered and the relief
- line spacing of 200m, 100m or 50m intervals as required
- station interval of 25m or 50m with detailing at 12.5m as required.
- Hz (vertical component measurements)
- BHUTEM-3 coverage of boreholes @15/10/5m - 4/2/1m in zones of interest
- 10-channel data at a frequency of 3.251Hz
- minimum 256 stacking (512 half-cycles) increased where noise levels dictate

In nickel exploration non-decaying Channel 1 (Ch1) conductors are indicative of highly conductive mineralization. Any non-decaying anomalous Ch1 features are therefore of interest. Non-decaying channel UTEM anomalies can reflect:

i) the presence of conductive mineralization
ii) the presence of a magnetic anomaly
iii) poor geometric control - either station location or loop location

These are outlined in more detail in Appendix D. From an interpretation standpoint magnetic anomalies and geometric control should be considered and evaluated as a mandatory part of any interpretation. From a field standpoint precise geometric control should be part of any UTEM survey where the target is non-decaying. Poor geometric control has the potential to both mask and invent Ch1 conductors.

For this survey GPS data was collected by the client and made available for use in reducing the UTEM data. GPS data was collected for all survey points and at intervals around all transmitter loops. GPS data collection for UTEM reduction should be most detailed along loop fronts - the most important portion of the loop from a UTEM reduction perspective. The goal along the loop front - and for in-loop surveying the loop sides/back - is to recover the topographic shape of the loop as well as the loop/line intersection points. Note the elevations at a small number of stations were erroneous by ~30m. These have been corrected.

SURVEY LOGISTICS

A Lamontagne Geophysics crew mobilized from Canada on June 11th and arrived in Oslo on June 12th. The crew consisted of Rob Langridge (crew chief) , John Frost (operator), Kevin Arsenault (looper/operator) and Patrick Foley (looper). The crew worked on other projects in Norway and arrived at the field house near Tyristrand on July 8th and began work on the Ertelien Project on the following morning - July 9th. The first day loops 09 and 09B were laid out and the transmitter site was prepared on a common side to facilitate switching between loops during BHUTEM surveying. The BHUTEM gear arrived and surveying began the following morning - July 10th.

Three transmitter loops were used during the surface UTEM survey for a total surface survey coverage of 16.375km. Figures 2 and 3 show the loop locations and grid layouts. Access to the Ertelien Project area was by pick-up truck and then on foot. The grid/loop positions had been established by GPS and were demarcated by flagging. The flagging was removed by the UTEM crew as the stations were surveyed unless otherwise indicated.

Loop numbering began at Loop 09 - following along with the loop numbering in the 2006 UTEM surveys. Note that Loop 04 at Langdalen retains the number assigned to it during planning for the previous survey. Loop 09B was planned to be used solely for BHUTEM work - hence the 09B(orehole). In the course of the survey surface work was carried out using Loop 9B. The BHUTEM surveying consisted of coverage from both Loop 09 and 09B of the following holes:

Ertelia	ER2006-01B
	ER2006-02
	ER2006-03
	ER2006-04
	ER2006-05
	ER2006-06B

Electrical connection to the generator was made through an LGL isolation-transformer and a Variac which was rewired to conform with the sockets (standard 2-pin/side-clip ground european) on the generator. The generator was left in the field during the nights. For a number of nights the transmitter was connected to a battery, switched to remote, packed up and left in the field. Other nights it was brought back to the field house. This worked well for the duration of the survey.

In general, surface surveying for all loops went well although at times - due to noise levels - slowly . Noise levels proved to be high and in places, along certain geologic structures and proximal to powerlines, extremely high. Higher noise levels in the vertical component are typical of very resistive areas. Locally, noisy areas indicate some channeling of telluric currents along features in the very-resistive country rock. The noise levels encountered in the project area are discussed further in Appendix F.

The progress of the drilling at Ertelia required that the remaining work be completed more slowly - to avoid a crew standby awaiting completion of drilling. As a result the third (spare) receiver was shipped home on July 10th. And after a few busy days of loop laying and surveying two crew members - Kevin Arsenault and Patrick Foley - were demobilized back to Canada on July 12th.

BHUTEM surveying was completed on July 19th and packing commenced. The BHUTEM equipment was shipped out on July 21st. Surface surveying was completed the same day and packing/wire transfer continued. The following day - July 22nd - the LGL crew picked-up the remaining wire from Loops 09/09B at Ertelia, completed packing the UTEM gear and transferring the wire back onto the factory spools in preparation for demobilization. The equipment was transported to Gardemoen Airport the same day - July 22nd. The remaining crew demobilized from Oslo the following day. Details of the daily production and personnel are included in the Production Log (Appendix B) along with a summary of production.

The survey equipment consisted of two UTEM 3 receivers and one UTEM 3 transmitter as well as all necessary accessories, support equipment and backup equipment. Data was reduced on a field computer (Macintosh) and UTEM profiles and digital data were made available/emailed to the client's personnel on a daily basis. The weather during the survey was good - quite hot and dry for Norway.

In terms of surveying we found that constantly scanning for flagging on uncut lines - in the middle distance - resulted in a number of stick-in-the-eye incidents. Safety glasses were obtained and the problem was lessened considerably. It is highly recommended that in this type of surveying - working in brush in summer on uncut lines - glasses be worn. Note that this may require the use of prescription safety glasses by some crew members.

Ticks also proved to be a concern and a considerable effort was made to "groom" after/during a days work and to use insect repellent. It should be noted that one crew member tested positive for Lyme disease after the work and received treatment. If further work is planned in this area the possibility of a vaccine being available should be investigated. Post-field testing for exposure to Lyme disease is also recommended.

SURVEY RESULTS

The results of the survey are summarized and presented as UTEM profiles in Appendix A. The survey Grids and Loop Locations are presented in Figures 2 and 3. Overall the data quality is good - though in places it is noisy. Evidence of conductors and/or conductive features are evident in the profiles, particularly the profiles near the old mine workings. Although every effort was taken to shelter the receiver coil, minor wind noise may be evident in some profiles. Note the elevations at a small number of stations were erroneous by ~30m. These have been corrected.

Surface profiles are listed by Grid and Loop number and presented as 3-axis profiles in the following order:

Hz	**continuous norm**	***Ch1 reduced***	**(blue separator)**
Hz	**point normalized**	***Ch1 reduced***	**(pink separator)**

BHUTEM3 profiles follow in order of Hole number. The following plots are presented for a borehole:

3-axis plot
total field plot
plan vectorplot
grideast-west section vectorplot

A description of the standard plotting formats used and of the UTEM System is presented in Appendix C.

<u>Outline of surface profile types</u>

Hz continuous norm ***Ch1 reduced*** **(blue separator)**

Continuous normalization is useful for detection of the presence of anomalies at any position on a profile. The anomaly shape is distorted by the normalization to the local field. As the field gets very big near the wire the continuously normalized Ch1 tends towards zero.

top axis - Ch5-10
middle axis - Ch2-5
bottom axis - Ch1
bottom axis - topography - no vertical exaggeration

Hz point normalized ***Ch1 reduced*** **(pink separator)**

normalization point:	Loop 04	all lines	~centre of the loop
	Loop 09	all lines	~250m out from loop-front centre
	Loop 09B	all lines	~centre of the loop

Point normalized data is useful for interpretation purposes. Anomaly shape is preserved as is the amplitude if the normalization point is local to the anomaly.

The data collected entirely outside of the loop (Loop 09) have been point normalized to the field at a point ~250m out from the centre of the loop front. Note that this field value is intermediate and it was chosen because the survey was performed both inside-the-loop and outside-the-loop. Normalizing to an intermediate point allows the interpretation of responses along the entire line. The amplitude of responses close to (**further from**) the loop front will be blown up (**muted**).

All the data collected in-loop (Loops 04 and 09B), have been normalized to a point at the centre of the loop. This field value is the smallest field value inside the loop and is a standard field value used for plotting, when surveying from inside the loop.

The disadvantage of point normalization is that small errors in location near the wire and in current tend to appear as large errors in Ch1. If the loop/station locations and the current are accurately known then point normalized Ch1 (in the absence of a local conductor) will tend to be continuous approaching the wire - unlike the continuously normalized Ch1 which, as described above, will dip to zero.

top axis - Ch5-10
middle axis - Ch2-5
bottom axis - Ch1
bottom axis - topography - no vertical exaggeration

<u>Outline of BHUTEM-3 plot types</u>

3-axis plot - **secondary field**
total field plot - **total field**

Both continuously normalized secondary and total field plots are presented for each borehole surveyed. Note that for reference the primary field is plotted on all BHUTEM profiles. The axes on the **3-axis plot** contain:

top axis - Ch5-10
middle axis - Ch2-5
bottom axis - Ch1 + primary field

The axis on the **total field plot** contains:

axis - Ch1-10 + primary field

plan and grideast-west section vectorplots

Plan and grideast-west section vectorplots are included for each borehole surveyed. Vectorplots are useful in both planning loop locations and in evaluating profiles - particularly in areas of high relief. Vectorplots show the primary field local to the borehole - allowing the coupling to be evaluated.

Discussion of the Grids

The profiles presented in Appendix A have been reduced with a grid produced from the GPS data collected by the client. The overall results are quite good (Appendix A). Some of the character in Ch1 profiles is due to remaining errors in loop/line location - this is particularly true near the loop wire where errors in station/loop location/elevation have a larger effect (Appendix D). Aside from survey accuracy and day-to-day variation sources of error in location include "adjustments" of the loop to topography and wind. Note the elevations at a small number of stations were erroneous by ~30m. These have been corrected.

The GPS data for this survey was provided by a new source (Scandicraft) and was only provided in full UTM coordinates. For previous surveys both full UTM coordinates and local grid coordinates were provided. Note that this means that the full UTM coordinates provided with this UTEM data set should be used in preference to the local grid coordinates which have been calculated by the author of this report. For reference the transformation from UTM to local grid coordinates used by the author follow.

<u>For the Ertelia Grid (Loops 9 and 9B)</u>

a) translation:
UTM WGS84 Zone 32V (UTMeasting, UTMnorthing) (558401.49mE, 6657794.75 mN)
becomes
Local Ertelia Grid (gridEast, gridNorth) (0,0)

b) rotation: Local Ertelia Grid gridNorth is @ azimuth 323.

<u>For the Langdalen Grid (Loop 4)</u>

a) translation:
UTM WGS84 Zone 32V (UTMeasting, UTMnorthing) (558129mE, 6665102mN)
becomes
Local Langdalen Grid (gridEast, gridNorth) (0,0)

b) rotation: Local Langdalen Grid gridNorth is @ azimuth 325.

Discussion of the Results

The Ertelien Project area is very resistive, and the noise levels proved to be high and in places, along certain geologic structures, extremely high. Higher noise levels in the vertical component are typical of very resistive areas. Local noisy areas can indicate some channeling of telluric currents along features in the very-resistive country rock. Further discussion of the noise levels encountered in the project area is presented in Appendix F.

The off-loop data from Loop 09 at the Ertelia Grid is noisy-to-very-noisy once the distance to the loop front exceeds 100-300m. The in-loop configuration (Loop 09B) provides better quality data at considerably reduced stacking levels. The in-loop configuration has been the choice for most of the grids surveyed on this project. Note that in-loop surveying is less sensitive to small, steeply-dipping conductors

CONCLUSIONS AND RECOMMENDATIONS

The results of the survey are summarized and presented as UTEM profiles in Appendix A. The final Grid and Loop Locations are presented in Figures 2 and 3. Overall the data quality is good - though in places it is noisy. The area surveyed is very resistive and cultural noise was present on many of the grids. This contributed to the elevated noise levels seen in the profiles, and is discussed further in Appendix F.

The profiles presented in Appendix A have been reduced with the grids corrected as well as possible using available information. The location of all survey points and loop locations were collected using a GPS system. The accuracy of the GPS system was quite high, however small errors may remain in loop locations and station/coil locations. The GPS data for this survey was provided by a new source (Scandicraft) and was only provided in full UTM coordinates. Note that this means that the full UTM coordinates provided with this UTEM data set should be used in preference to the local grid coordinates which have been calculated by the author of this report. For reference the transformation from UTM to grid coordinates used by the author are listed above.

Two considerations when planning future summer field work in the area:

- It is highly recommended that in this type of surveying - working in brush in summer on uncut lines - glasses be worn. Note that this may require the use of prescription safety glasses by some crew members.
- Ticks also proved to be a concern and crews should be informed to be watchful and to use insect repellent. It should be noted that one crew member tested positive for Lyme disease after the work and received treatment. If further work is planned in this area the possibility of a vaccine being available should be investigated. Post-field testing for exposure to Lyme disease is recommended.

Otherwise, in terms of logistics, the survey ran quite smoothly. The Falconbridge Ltd. employees were extremely helpful and their hard work is greatly appreciated.

Appendix A

0616 UTEM Profiles
0616 BHUTEM Profiles

UTEM 3 Survey

Ertelien
Norway

for

A/S Sulfidmalm

Presentation

The results of the survey are summarized and presented as UTEM profiles in Appendix A. The survey Grids and Loop Locations are presented in Figures 2 and 3. Overall the data quality is good - though in places it is noisy. Evidence of conductors and/or conductive features are evident in the profiles, particularly the profiles near the old mine workings. Although every effort was taken to shelter the receiver coil, minor wind noise may be evident in some profiles. Note the elevations at a small number of stations were erroneous by ~30m. These have been corrected. A description of the standard plotting formats used and of the UTEM System is presented in Appendix C.

The profiles are listed by Loop number and presented as 3-axis profiles in the order:

Hz continuous norm *Ch1 reduced* **(blue separator)**
Hz point normalized *Ch1 reduced* **(pink separator)**

BHUTEM3 profiles follow in order of Hole number. The following plots are presented for a borehole:

3-axis plot
total field plot
plan vectorplot
grideast-west section vectorplot

Outline of surface profile types

Hz continuous norm *Ch1 reduced* **(blue separator)**

Continuous normalization is useful for detection of the presence anomalies at any position on a profile. The anomaly shape is distorted by the normalization to the local field. As the field gets very big near the wire the continuously normalized Ch1 tends towards zero.

top axis - Ch5-10
middle axis - Ch2-5
bottom axis - Ch1
bottom axis - topography - no vertical exaggeration

Hz point normalized *Ch1 reduced* **(pink separator)**

normalization point: Loops 4 and 09B — the centre of the loop
normalization point: Loop 09 — ~250m out from the loop-front centre

Point normalized data is useful for interpretation of responses. Anomaly shape is preserved as is the amplitude if the normalization point is local to the anomaly.

The data collected entirely outside of the loop (Loop 09) have been point point normalized to a the field at a point ~250m out from the centre of the loop front. Note that this field value is intermediate and it was chosen because the survey was reformed both inside-the-loop and off-loop. Normalizing to an intermediate point allows the interpretation of responses along the entire line. The amplitude of responses close to (**further from**) the loop front will be blown up (**muted**).

All the data collected in-loop (Loops 04 and 09B), have been normalized to a point at the centre of the loop. This field value is the smallest field value inside the loop and is a standard field value used for plotting, when surveying from inside the loop.

The disadvantage of point normalization is that small errors in location near the wire and in current tend to appear as large errors in Ch1. If the loop/station locations and the current are accurately known then point normalized Ch1 (in the absence of a local conductor) will tend to be continuous approaching the wire - unlike the continuously normalized Ch1 which, as described above, will dip to zero.

top axis - Ch5-10
middle axis - Ch2-5
bottom axis - Ch1
bottom axis - topography - no vertical exaggeration

Outline of BHUTEM-3 plot types

3-axis plot - secondary field
total field plot - total field

Both continuously normalized secondary and total field plots are presented for each borehole surveyed. Note that for reference the primary field is plotted on all BHUTEM profiles. The axes on the **3-axis plot** contain:

top axis - Ch5-10
middle axis - Ch2-5
bottom axis - Ch1 + primary field

The axis on the **total field plot** contains:

axis - Ch1-10 + primary field

plan and grideast-west section vectorplots

Plan and grideast-west section vectorplots are included for each borehole surveyed. Vectorplots are useful in both planning loop locations and in evaluating profiles - particularly in areas of high relief. Vectorplots show the primary field local to the borehole - allowing the coupling to be evaluated.

Notes on Survey and Presentation/plotting details

- An effort has been to keep the scales consistent. The horizontal scale is 1cm:100m. For BHUTEM plots it is 1cm:20m.

List of Data Collected and Plotted

Ertelien - summer - 2006

Surface coverage - @ 3.251 Hertz

	Line	coverage	
Loop 04	Line 5600N	1400E - 2000E	600m
	Line 5700N	1150E - 2000E	850m
	Line 5800N	1150E - 2000E	850m
	Line 5900N	1150E - 1575E	425m
		1650E - 2475E	825m
	Line 6000N	1150E - 2475E	1325m
	Line 6100N	1150E - 2475E	1325m
	Line 6200N	1150E - 2475E	1325m
	Line 6300N	1150E - 2475E	1325m
	Line 6400N	1150E - 2000E	850m
	Line 6500N	1150E - 2000E	850m
	Langdalen	Loop 04 Total	**10550m**
	Langdalen - summer 2006	**Total**	**10.550km**
Loop 09	Line 1450N	700E - 1200E	500m
	Line 1500N	775E - 1200E	425m
	Line 1650N	700E - 1200E	500m
	Line 1700N	700E - 1200E	500m
	Line 1750N	725E - 1200E	475m
	Line 1800N	800E - 1200E	400m
	Line 1850N	875E - 1200E	325m
	Line 1900N	950E - 1200E	250m
	Ertelia	Loop 09 Total	**3375m**
Loop 09B	Line 1650N	700E - 1175E	475m
	Line 1700N	700E - 1175E	475m
	Line 1750N	725E - 1175E	450m
	Line 1800N	850E - 1200E	350m
	Line 1850N	900E - 1200E	300m
	Line 1900N	800E - 1200E	400m
	Ertelia	Loop 09B Total	**2450m**
	Ertelia - summer 2006	**Total**	**5.825km**
		Total all Grids	**16.375km**

List of Borehole Data Collected and Plotted

Area	Borehole Name	Survey Depth	Dummy Depth	Loop Number	Frequency
Listed by hole number:					
Ertelia	ER2006-01B	124m	125m	Loop 09	3.251Hz
		124m		Loop 09B	3.251Hz
Ertelia	ER2006-02	206m	208m	Loop 09	3.251Hz
		206m		Loop 09B	3.251Hz
Ertelia	ER2006-03	220m	221m	Loop 09	3.251Hz
		220m		Loop 09B	3.251Hz
Ertelia	ER2006-04	220m	221m	Loop 09	3.251Hz
		220m		Loop 09B	3.251Hz
Ertelia	ER2006-05	236m	239m	Loop 09	3.251Hz
		236m		Loop 09B	3.251Hz
Ertelia	ER2006-06B	336m	342m	Loop 09	3.251Hz
		336m		Loop 09B	3.251Hz

0616

Surface UTEM Profiles

Langdalen Loop 04
Ertelia Loops 09/09B

Langdalen

Loop 04

Hz

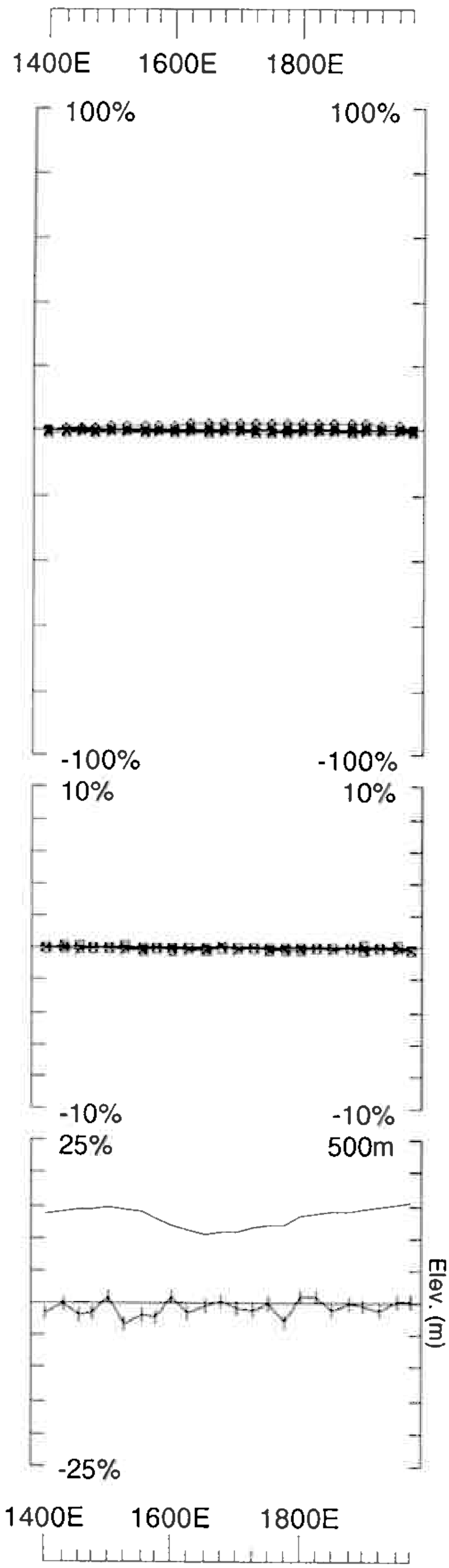
@3.251 Hz frequency

continuous norm

Ch1 reduced

Loop 04	Line 5600N	1400E - 2000E	600m
	Line 5700N	1150E - 2000E	850m
	Line 5800N	1150E - 2000E	850m
	Line 5900N	1150E - 1575E	425m
		1650E - 2475E	825m
	Line 6000N	1150E - 2475E	1325m
	Line 6100N	1150E - 2475E	1325m
	Line 6200N	1150E - 2475E	1325m
	Line 6300N	1150E - 2475E	1325m
	Line 6400N	1150E - 2000E	850m
	Line 6500N	1150E - 2000E	850m
	Langdalen	Loop 04 Total	10550m

Loop 04 - continuous norm



Loop: 04
Line: 5600N
Compt: Hz

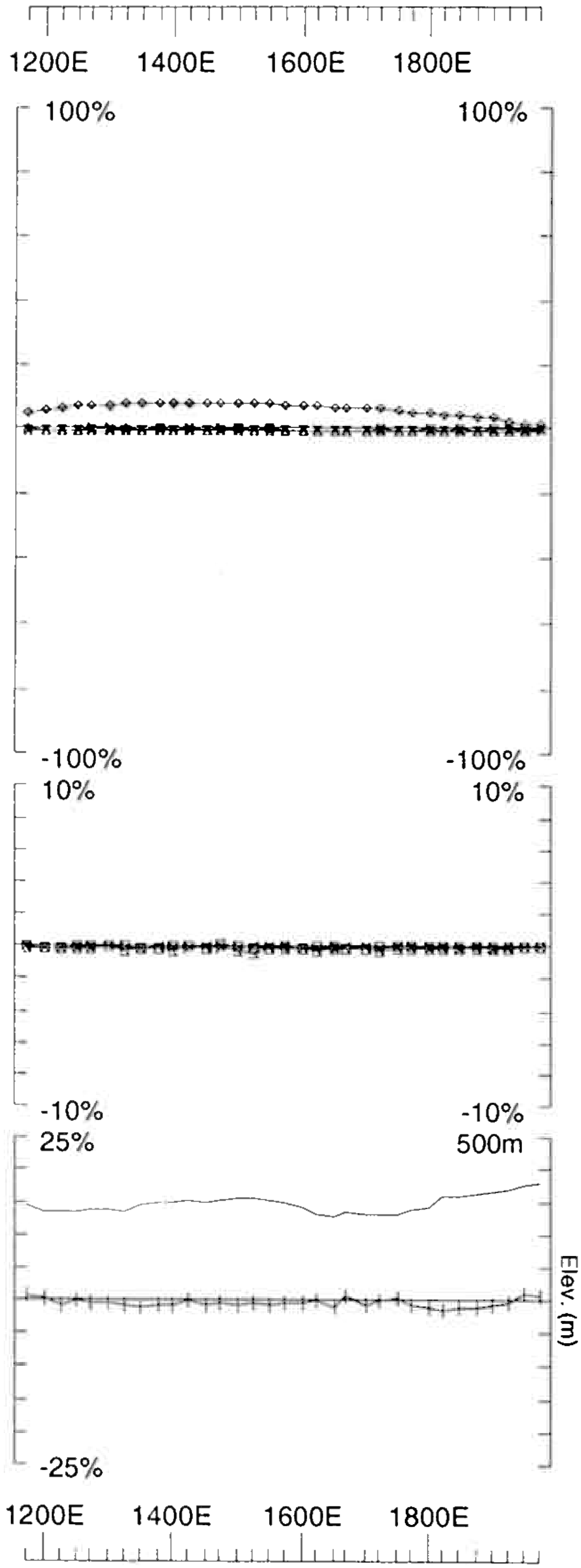
Secondary, (Chn - Ch1)/IHpl
Contin. Norm at depth of 0 m
Base Freq. 3.251 Hz

UTEM Survey at: Langdalen Grid
For: A/S Sulfidmalm

LAMONTAGNE GEOPHYSICS LTD
GEOPHYSIQUE LTEE

Job 0616

Surveyed : 16/7/6
Reduced : 6/9/6
Plotted : 6/9/6



UTEM Survey at: Langdalen Grid

For: A/S Sulfidmalm

LAMONTAGNE GEOPHYSICS LTD
GEOPHYSIQUE LTEE

Job 0616

Surveyed : 16/7/6
Reduced : 6/9/6
Plotted : 6/9/6

Secondary, (Chn - Ch1)/IHpI

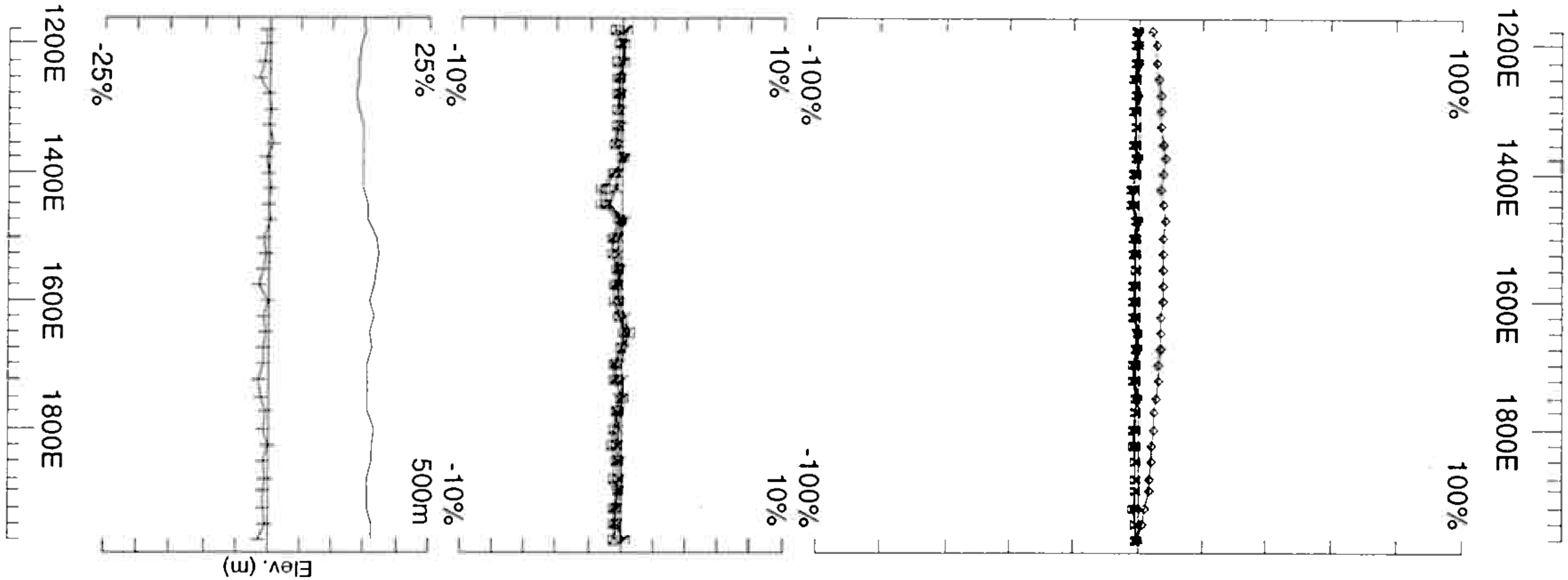
Contin. Norm at depth of 0 m

Base Freq. 3.251 Hz

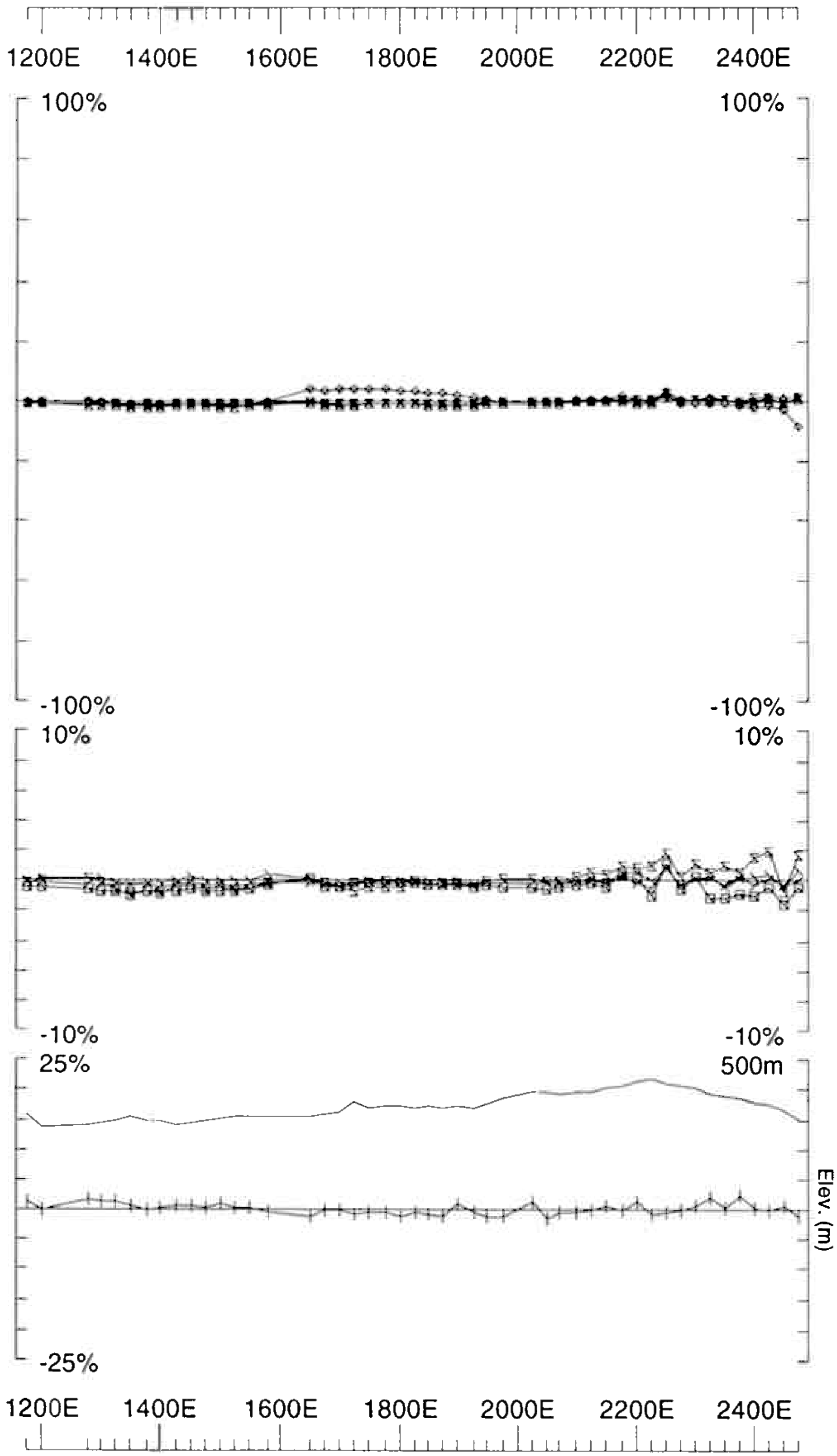
Loop: 04

Line: 5700N

Compt: Hz



Loop: 04 Line: 5800N Compt: Hz	Secondary, (Chn - Ch1)/lHpl Contin. Norm at depth of 0 m Base Freq. 3.251 Hz	UTEM Survey at: Langdalen Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 16/7/6 Reduced : 6/9/6 Plotted : 6/9/6



UTEM Survey at: Langdalen Grid
For: A/S Sulfidmalm

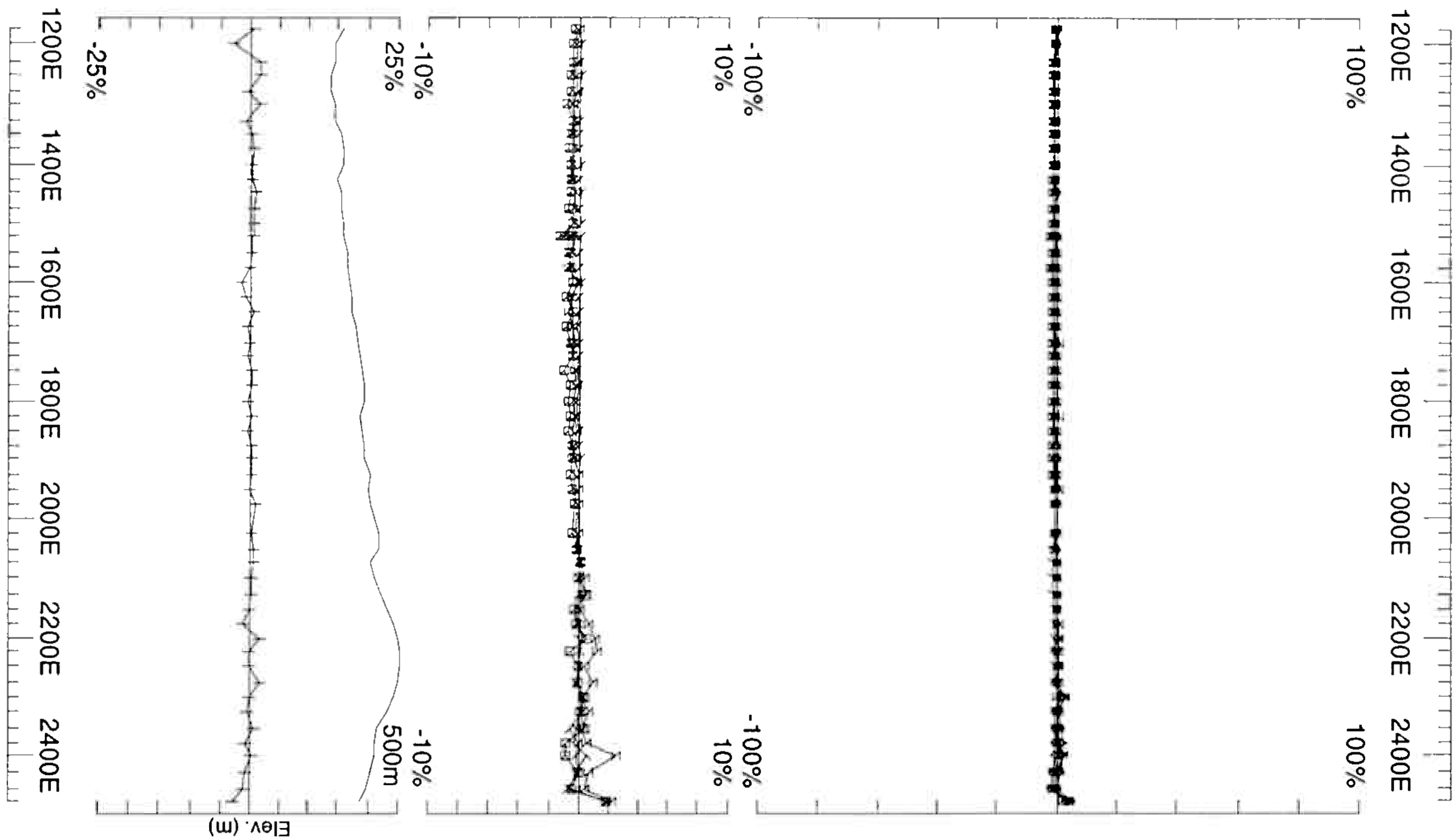
LAMONTAGNE GEOPHYSICS LTD
GEOPHYSIQUE LTEE

Job 0616

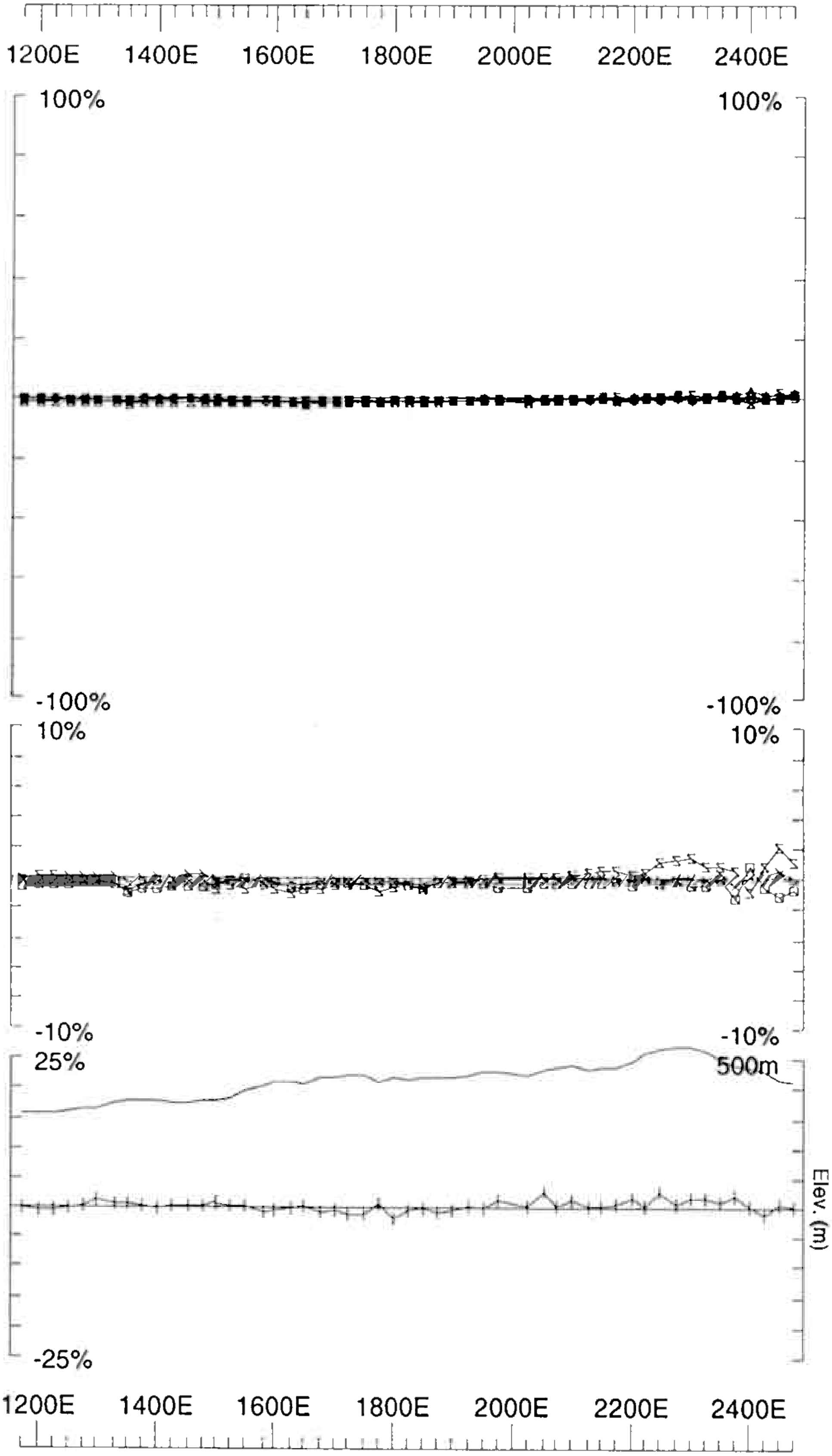
Plotted : 6/9/6

Loop: 04
Line: 5900N
Compt: Hz

Secondary, (Chn - Ch1)/IHpl
Contin. Norm at depth of 0 m
Base Freq. 3.251 Hz



Loop: 04 Line: 6000N Compt: Hz	Secondary, (Chn - Ch1)/IHpI Contin. Norm at depth of 0 m Base Freq. 3.251 Hz	UTEM Survey at: Langdalen Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Plotted: 6/5/6



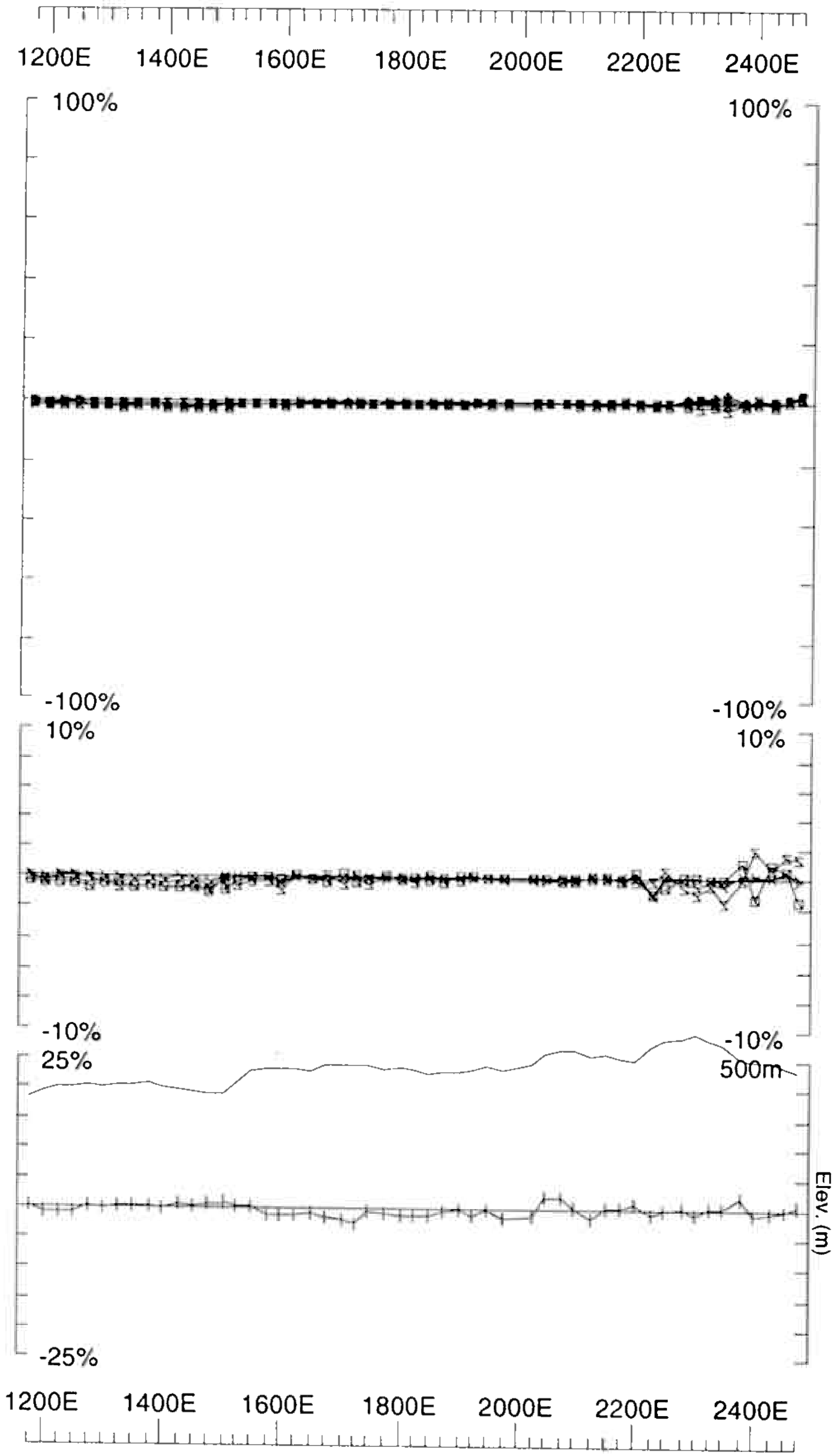
UTEM Survey at: Langdalen Grid
For: A/S Sulfidmalm

LAMONTAGNE GEOPHYSICS LTD
GEOPHYSIQUE LTEE

Job 0616
Plotted : 6/9/6

Loop: 04
Line: 6100N
Compt: Hz

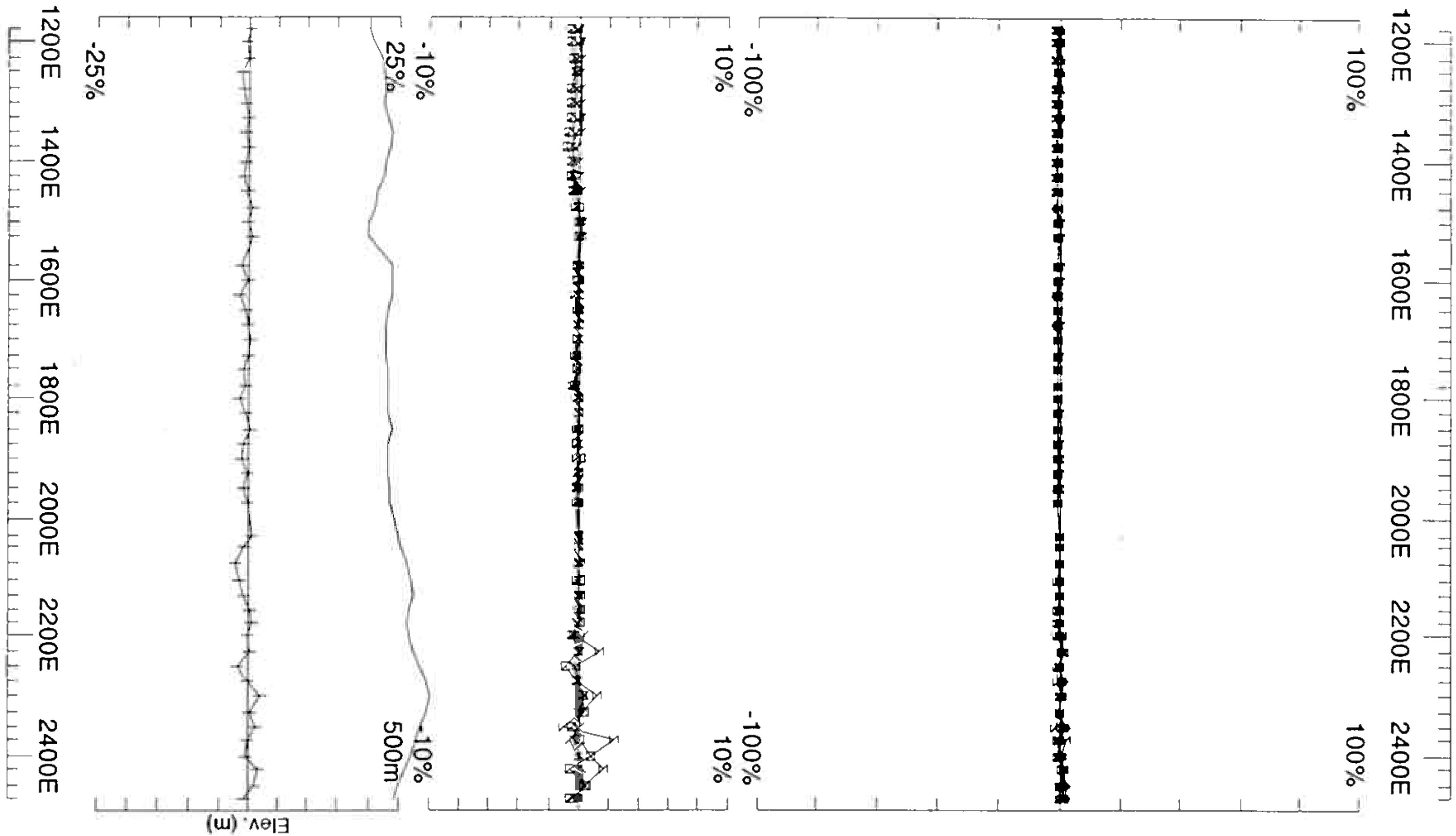
Secondary, (Chn - Ch1)/IHpl
Contin. Norm at depth of 0 m
Base Freq. 3.251 Hz



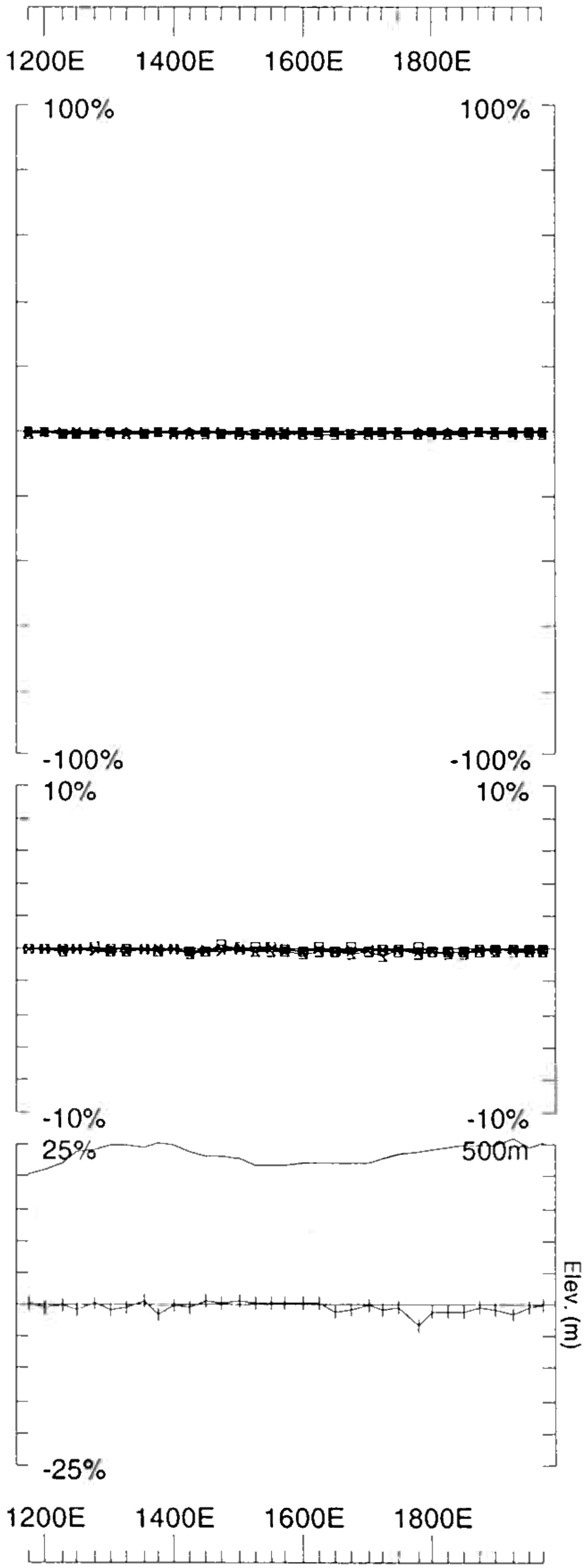
UTEM Survey at: Langdalen Grid
For: A/S Sulfidmalm
LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE
Job 0616
Plotted : 6/9/6

Secondary, (Chn - Ch1)/lHpl
Contin. Norm at depth of 0 m
Base Freq. 3.251 Hz

Loop: 04
Line: 6200N
Compt: Hz



Loop: 04 Line: 6300N Compt: Hz	Secondary, (Chn - Ch1)/lHpl Contin. Norm at depth of 0 m Base Freq. 3.251 Hz	UTEM Survey at: Langdalen Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Plotted : 6/9/6



Loop: 04
Line: 6400N
Compt: Hz

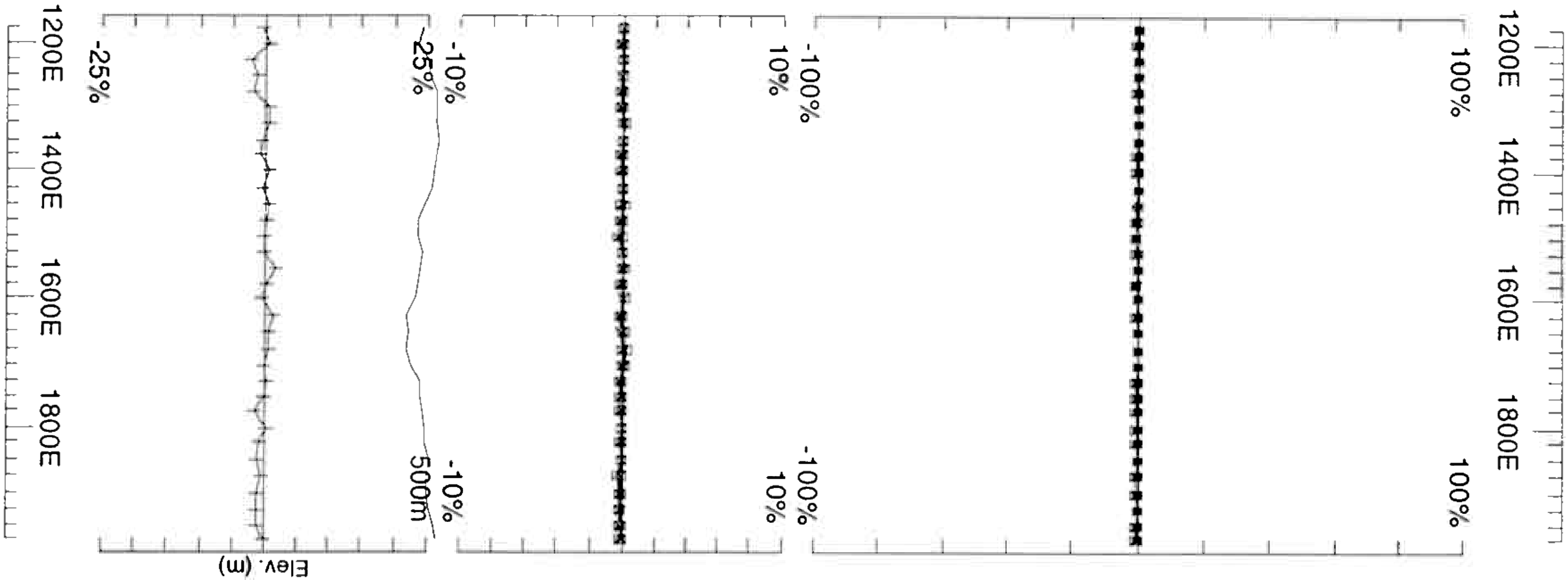
Secondary, (Chn - Ch1)/IHpl
Contin. Norm at depth of 0 m
Base Freq. 3.251 Hz

UTEM Survey at: Langdalen Grid
For: A/S Sulfidmalm

LAMONTAGNE GEOPHYSICS LTD
GEOPHYSIQUE LTEE

Job
0616

Surveyed : 18/7/6
Reduced : 6/9/6
Plotted : 6/9/6



Loop: 04	Secondary, (Chn - Ch1)/IHpl	UTEM Survey at: Langdalen Grid
Line: 6500N	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Hz	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 18/7/6 Reduced : 6/9/6 Plotted : 6/9/6

Ertelia

Loop 09

Hz

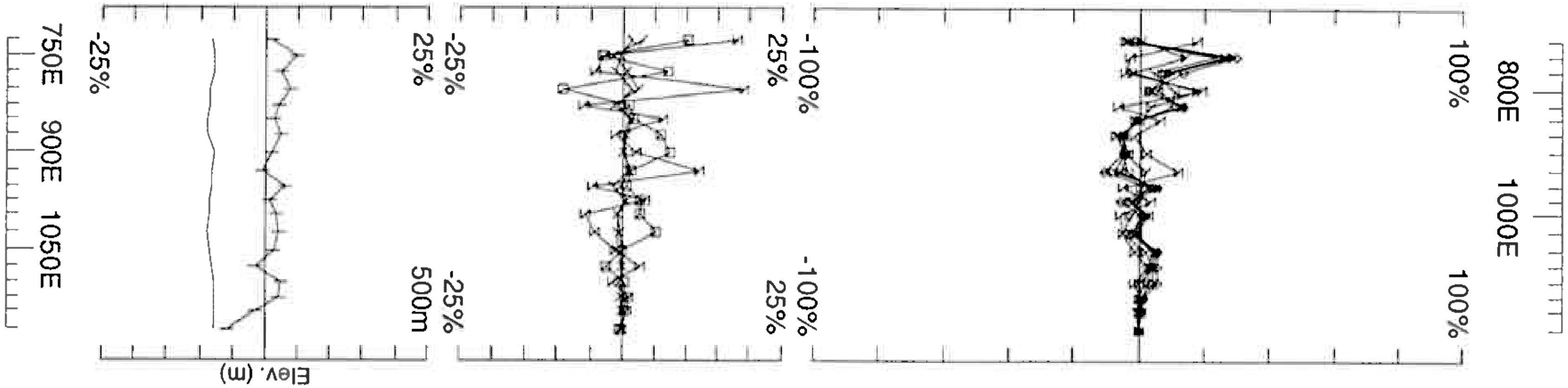
@3.251 Hz frequency

continuous norm

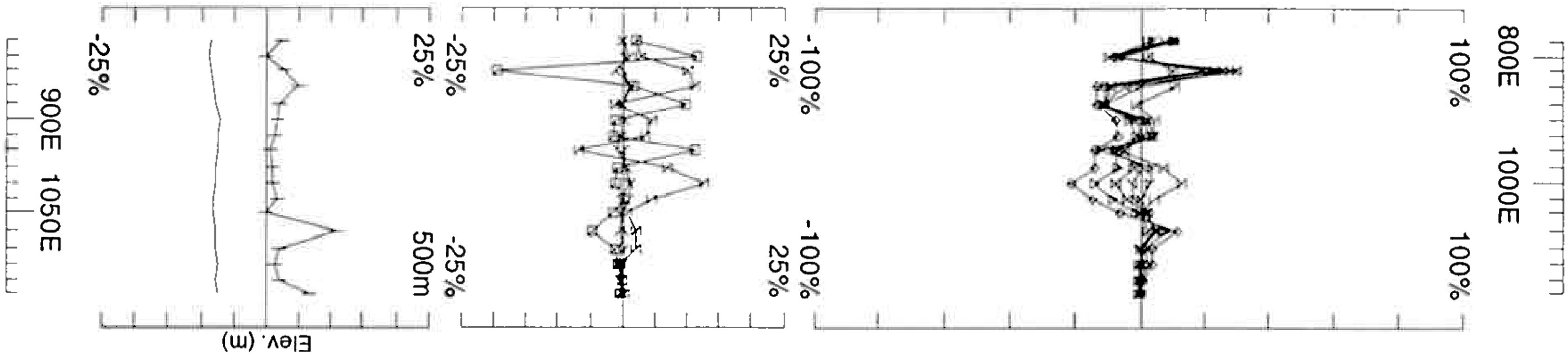
Ch1 reduced

Loop 09	Line 1450N	700E - 1200E	500m
	Line 1500N	775E - 1200E	425m
	Line 1650N	700E - 1200E	500m
	Line 1700N	700E - 1200E	500m
	Line 1750N	725E - 1200E	475m
	Line 1800N	800E - 1200E	400m
	Line 1850N	875E - 1200E	325m
	Line 1900N	950E - 1200E	250m
	Ertelia	Loop 09 Total	3375m

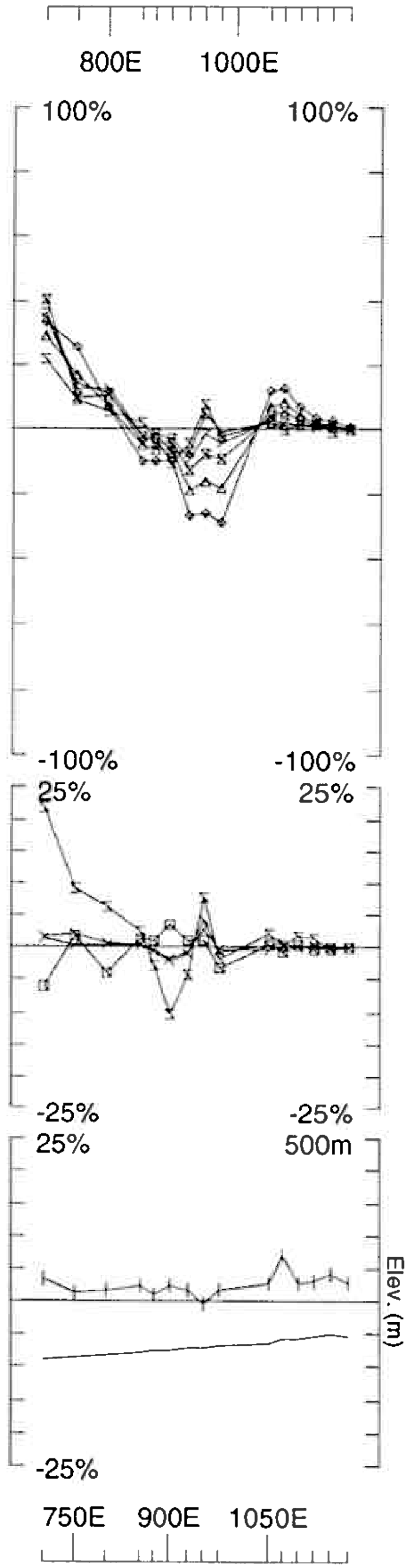
Loop 09 - continuous norm



Loop: 09	Secondary, (Chn - Ch1)/IHpI	UTEM Survey at: Ertelia Grid
Line: 1450N	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Hz	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 10/7/6 Reduced : 10/7/6 Plotted : 6/9/6



Loop: 09 Line: 1500N Compt: Hz	Secondary, (Chn - Ch1)/IHpI Contin. Norm at depth of 0 m Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed: 12/5/7 Reduced: 10/7/6 Plotted: 6/9/6



UTEM Survey at: Ertelia Grid

For: A/S Sulfidmalm

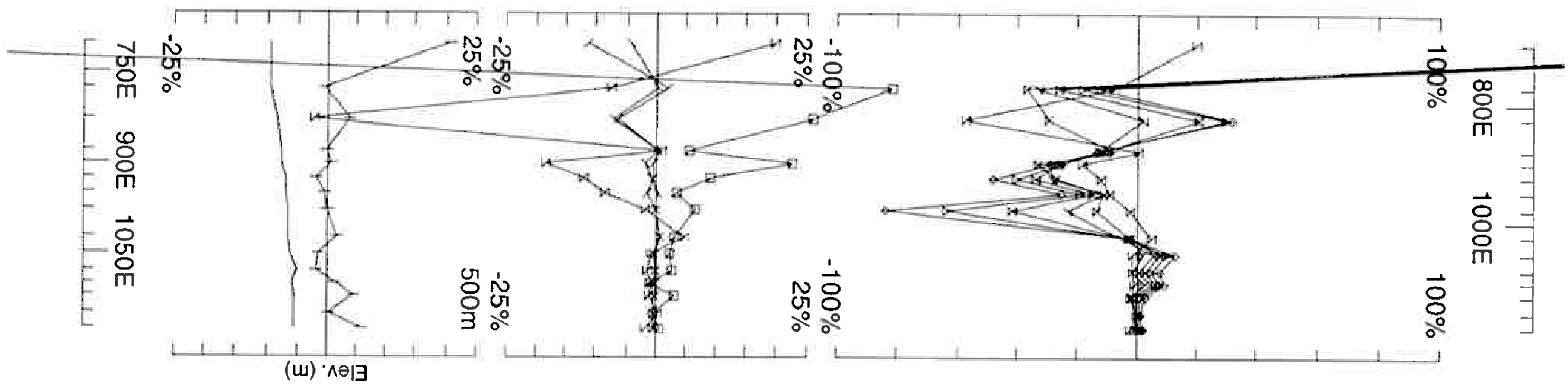
LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE

Job 0616

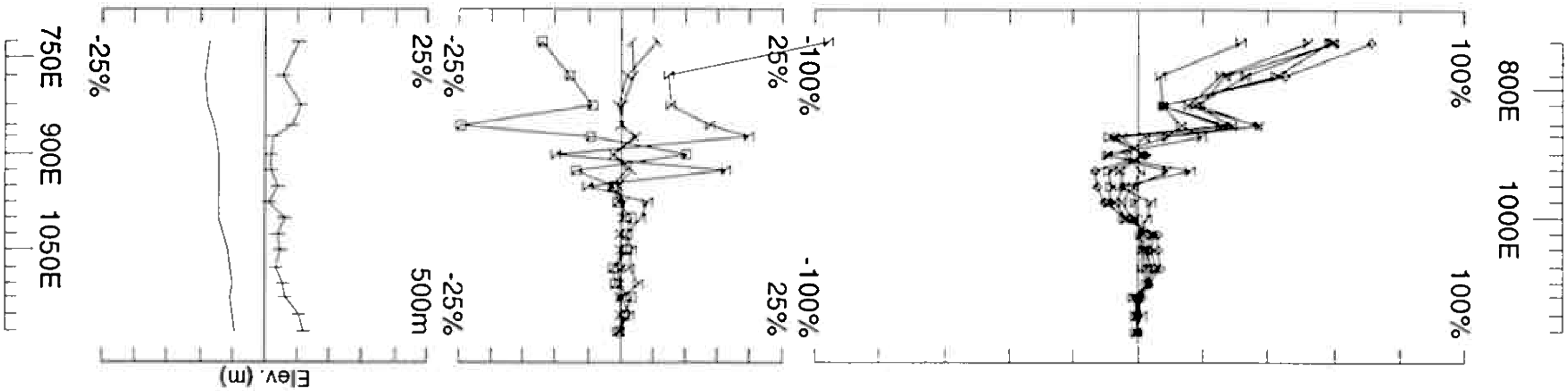
Surveyed : 11/7/6
Reduced : 11/7/6
Plotted : 6/9/6

Loop: 09
Line: 1650N
Compt: Hz

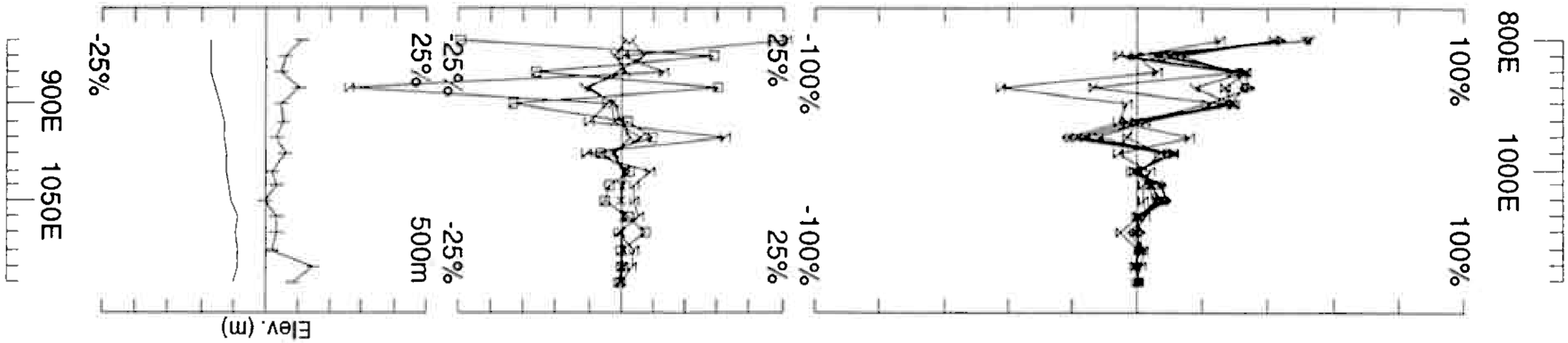
Secondary, (Chn - Ch1)/IHpI
Contin. Norm at depth of 0 m
Base Freq. 3.251 Hz



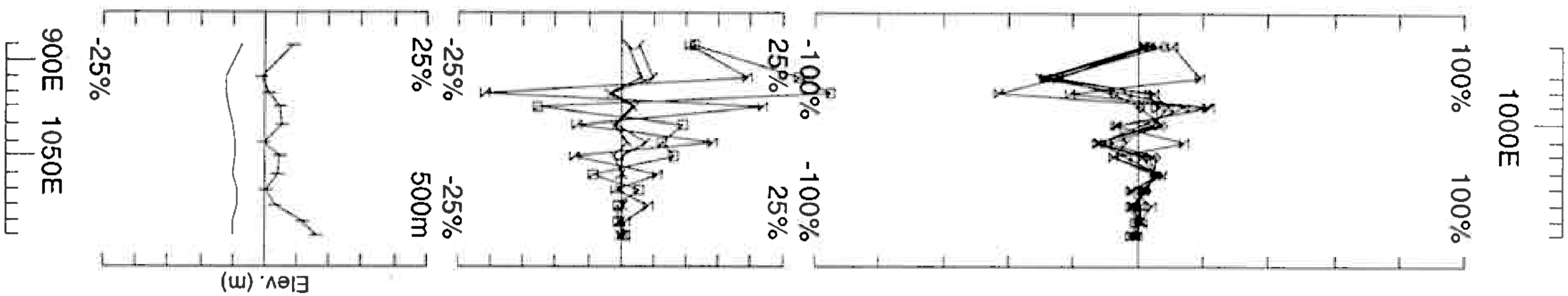
Loop: 09 Line: 1700N Compt: Hz	Secondary, (Chn - Ch1)/IHpI Contin. Norm at depth of 0 m Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD / GEOPHYSIQUE LTEE Job 0616 Plotted : 6/9/6



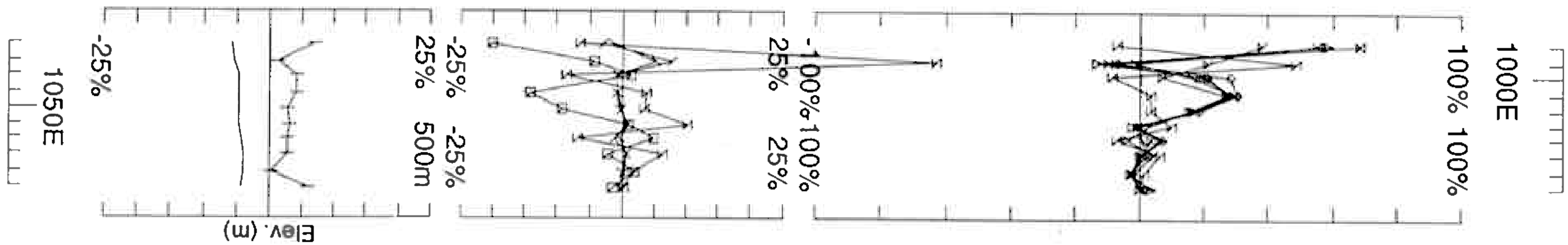
Loop: 09	Secondary, (Chn - Ch1)/IHpl	UTEM Survey at: Ertelia Grid
Line: 1750N	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Hz	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Plotted : 6/9/6



Loop: 09 Line: 1800N Compt: Hz	Secondary, (Chn - Ch1)/lHpl Contin. Norm at depth of 0 m Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Plotted : 6/9/6



Loop: 09	Secondary, (Chn - Ch1)/lHpl	UTEM Survey at: Ertelia Grid
Line: 1850N	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Hz	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 20/7/6 Reduced : 20/7/6 Plotted : 6/9/6



Loop: 09	Secondary, (Chn - Ch1)/lHpl	UTEM Survey at: Ertelia Grid
Line: 1900N	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Hz	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed: 20/7/6 Reduced: 20/7/6 Plotted: 6/9/6

Ertelia

Loop 09B

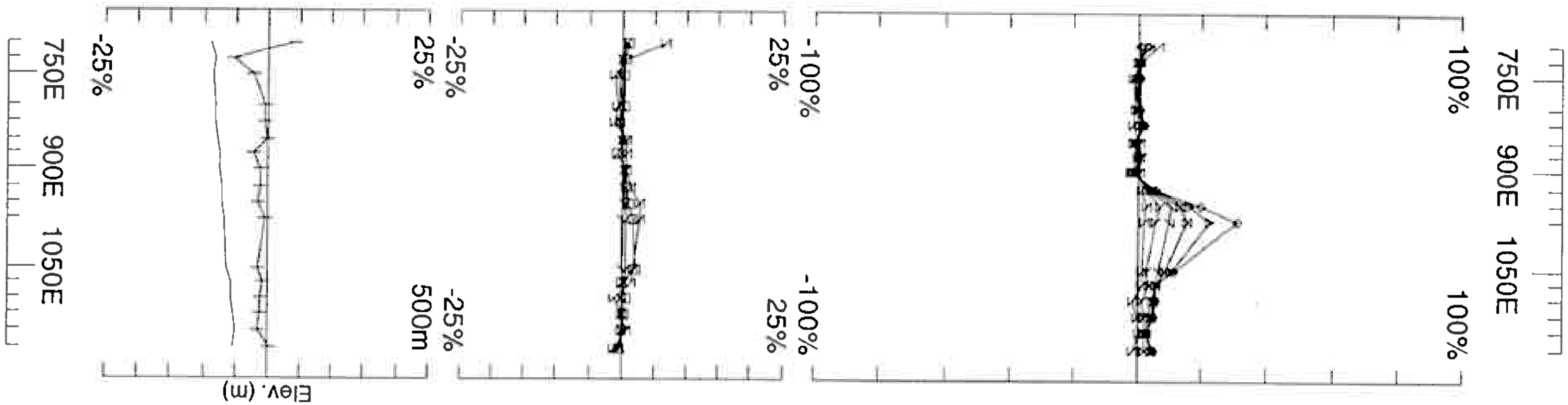
Hz
@3.251 Hz frequency

continuous norm

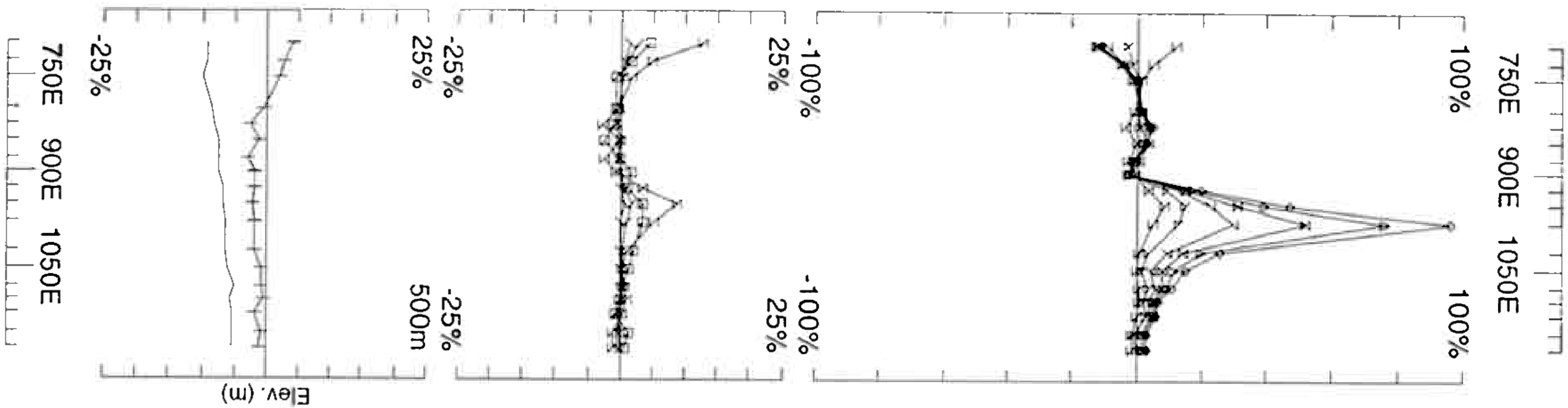
Ch1 reduced

Loop 09B	Line 1650N	700E - 1175E	475m
	Line 1700N	700E - 1175E	475m
	Line 1750N	725E - 1175E	450m
	Line 1800N	850E - 1200E	350m
	Line 1850N	900E - 1200E	300m
	Line 1900N	800E - 1200E	400m
	Ertelia	Loop 09B Total	2450m

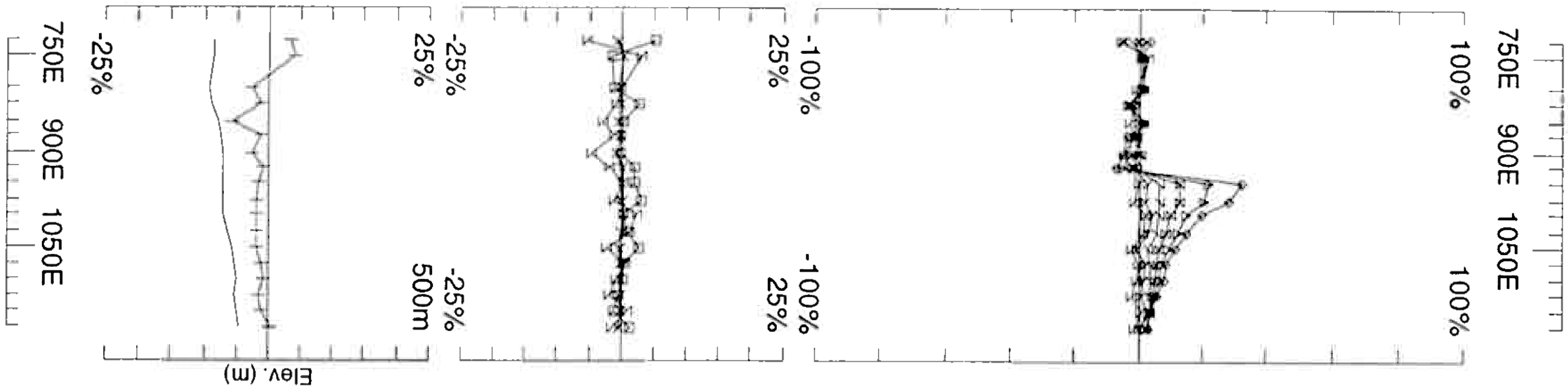
Loop 09B - continuous norm



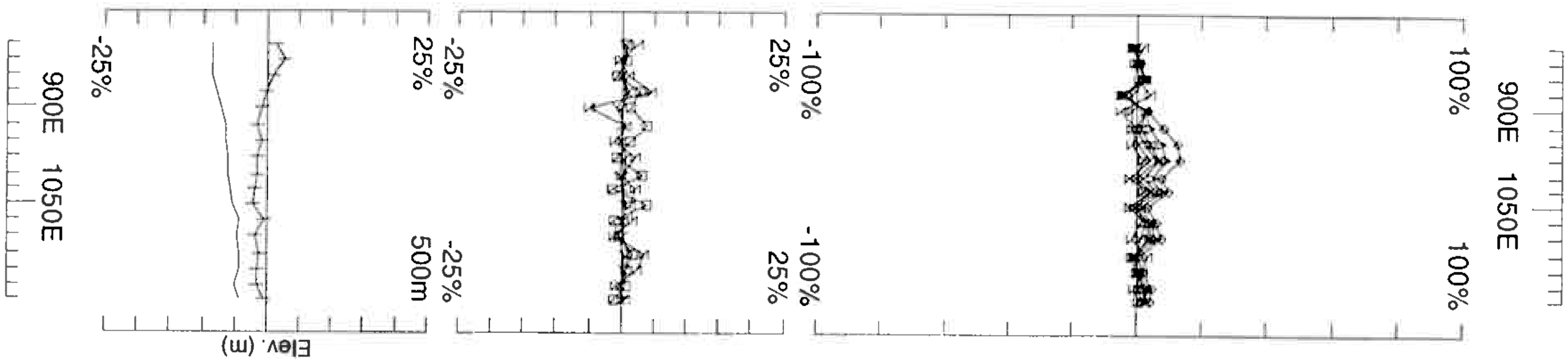
Loop: 09B	Secondary, (Chn - Ch1)/IHpl	UTEM Survey at: Ertelia Grid
Line: 1650N	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Hz	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 21/7/6 Reduced : 22/7/6 Plotted : 6/9/6



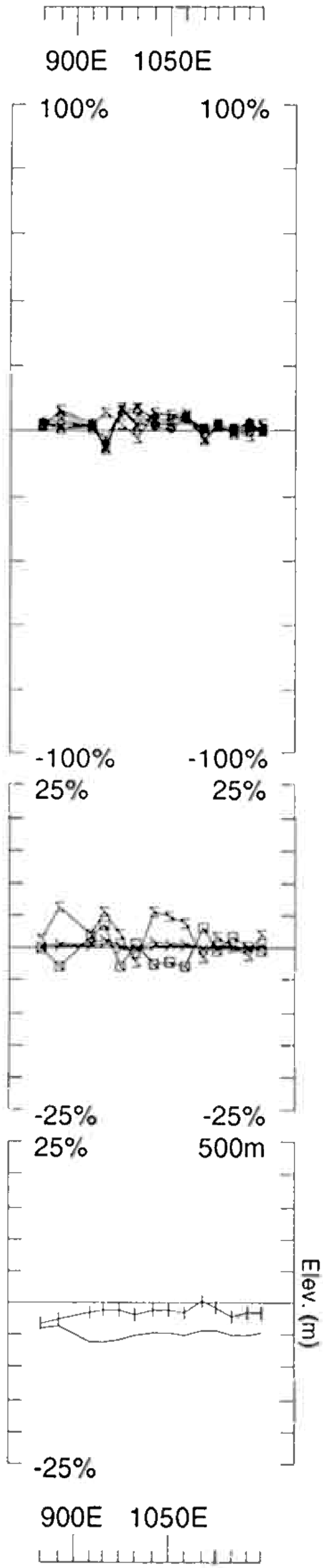
Loop: 09B	Secondary, (Chn - Ch1)/IHpl	UTEM Survey at: Ertelia Grid
Line: 1700N	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Hz	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed: 21/7/6 Reduced: 22/7/6 Plotted: 6/9/6



Loop: 09B Line: 1750N Compt: Hz	Secondary, (Chn - Ch1)/IHpl Contin. Norm at depth of 0 m Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 21/7/6 Reduced : 22/7/6 Plotted : 6/9/6



Loop: 09B Line: 1800N Compt: Hz	Secondary, (Chn - Ch1)/IHpI Contin. Norm at depth of 0 m Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 21/7/6 Reduced : 22/7/6 Plotted : 6/9/6



UTEM Survey at: Ertelia Grid
For: A/S Sulfidmalm

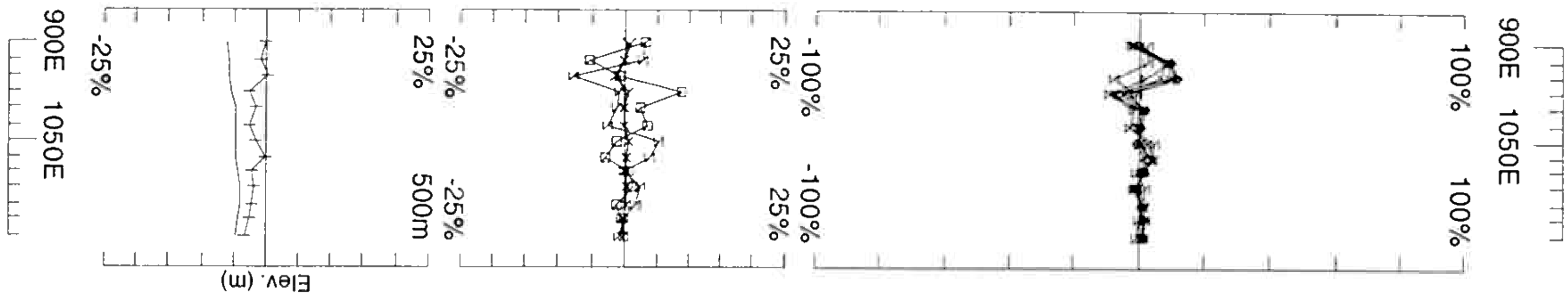
LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE

Job 0616

Surveyed : 21/7/6
Reduced : 22/7/6
Plotted : 6/9/6

Loop: 09B
Line: 1850N
Compt: Hz

Secondary, (Chn - Ch1)/lHpl
Contin. Norm at depth of 0 m
Base Freq. 3.251 Hz



Loop: 09B Line: 1900N Compt: Hz	Secondary, (Chn - Ch1)/IHpI Contin. Norm at depth of 0 m Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD / GEOPHYSIQUE LTEE — Job 0616 — Surveyed: 21/7/6, Reduced: 22/7/6, Plotted: 6/9/6

Langdalen

Loop 04

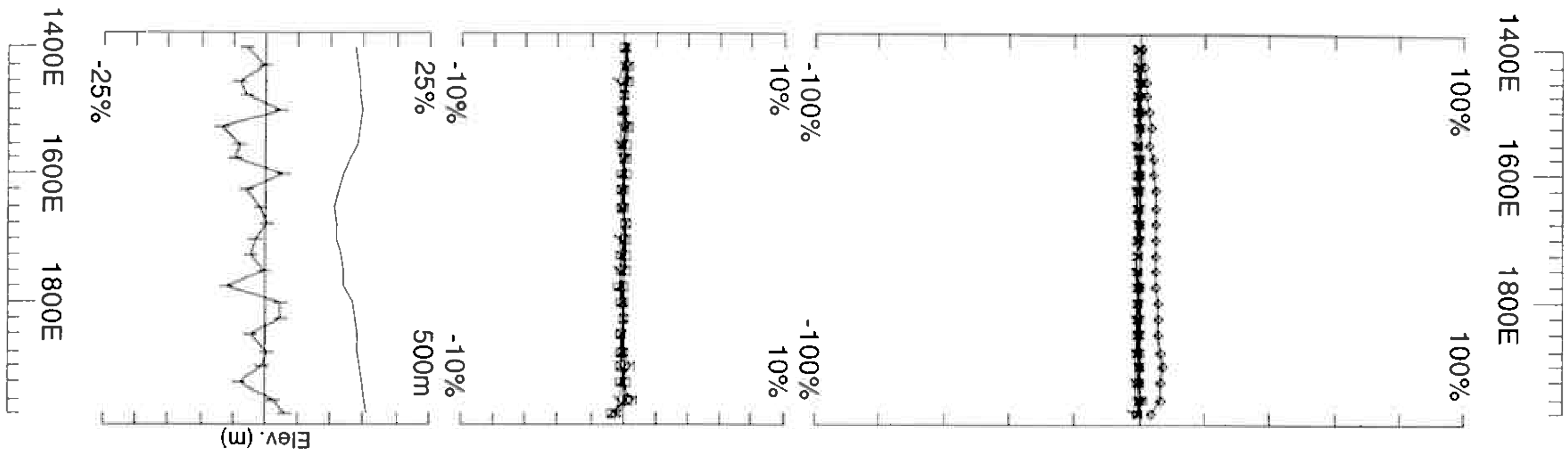
Hz
@3.251 Hz frequency

point norm
@
(x,y,z) = (8800E,5550N, 920 m.a.s.l.)

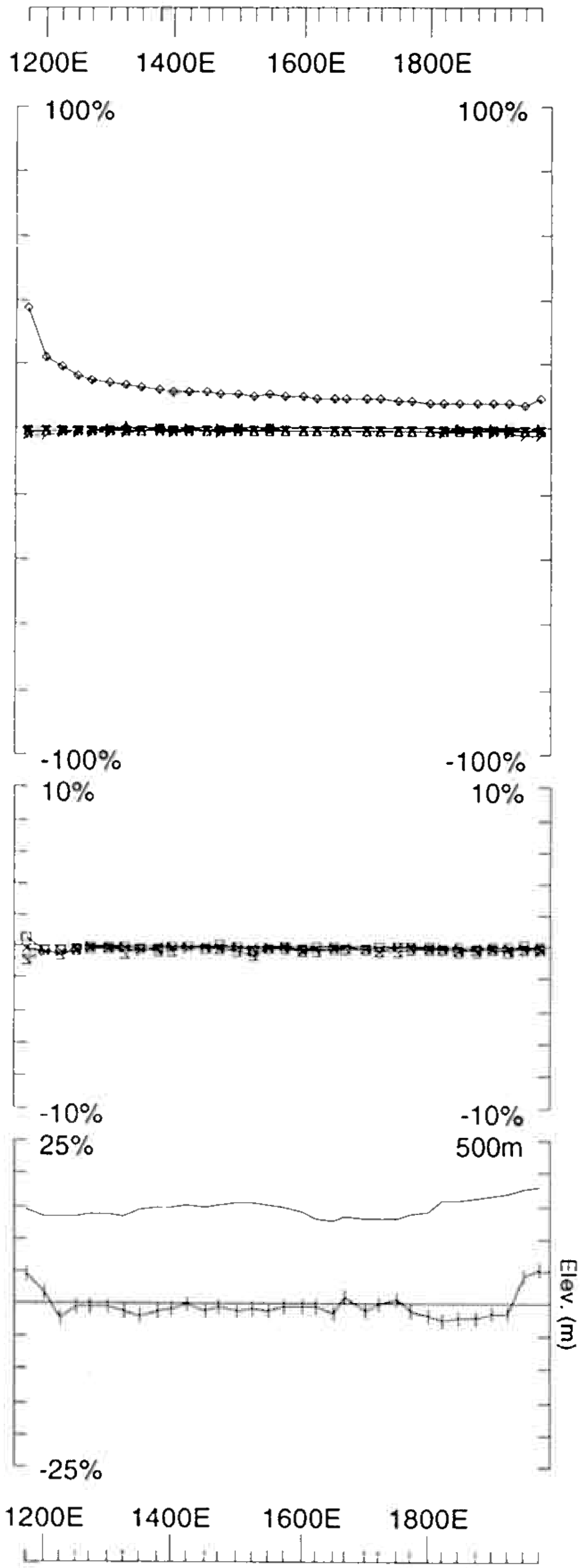
Ch1 reduced

Loop 04	Line 5600N	1400E - 2000E	600m
	Line 5700N	1150E - 2000E	850m
	Line 5800N	1150E - 2000E	850m
	Line 5900N	1150E - 1575E	425m
		1650E - 2475E	825m
	Line 6000N	1150E - 2475E	1325m
	Line 6100N	1150E - 2475E	1325m
	Line 6200N	1150E - 2475E	1325m
	Line 6300N	1150E - 2475E	1325m
	Line 6400N	1150E - 2000E	850m
	Line 6500N	1150E - 2000E	850m
	Langdalen	Loop 04 Total	**10550m**

Loop 04 - point norm



Loop: 04 Line: 5600N Compt: Hz	Secondary, (Chn - Ch1)/IHpl Point Norm.at x,y,z (5950,950,450) Base Freq. 3.251 Hz	UTEM Survey at: Langdalen Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 16/7/6 Reduced : 6/9/6 Plotted : 6/9/6



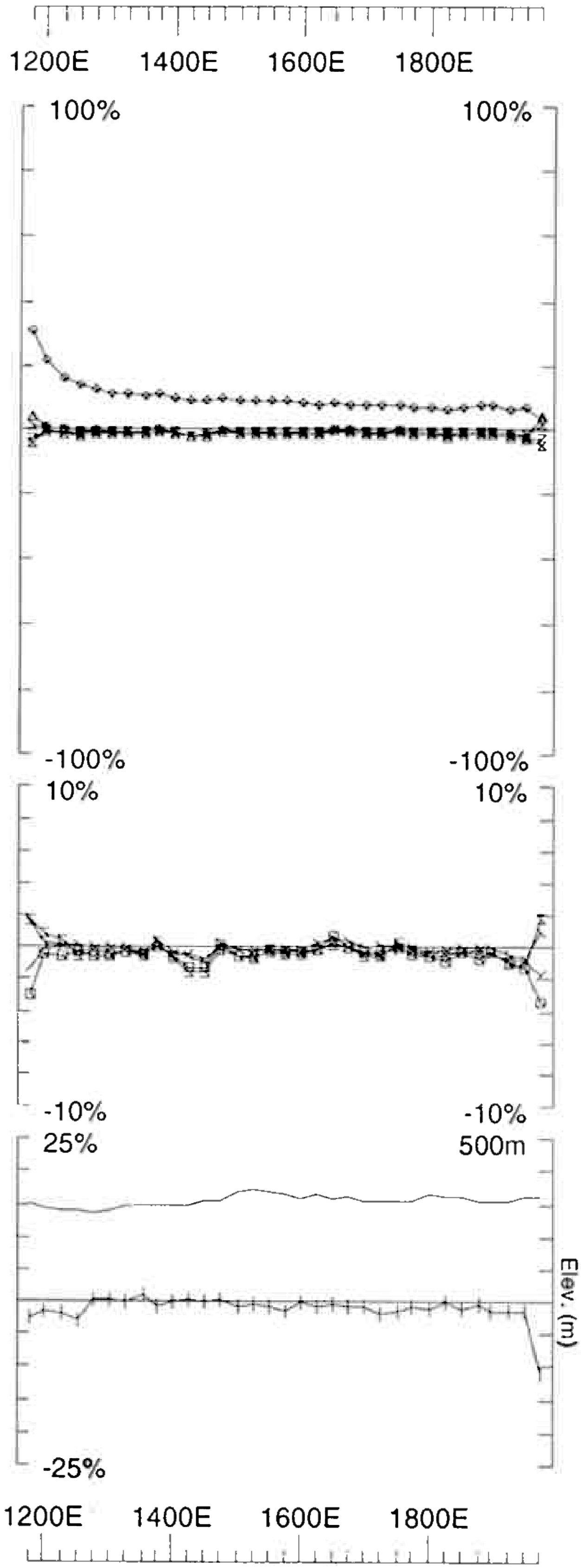
Loop: 04 Line: 5700N Compt: Hz	Secondary, (Chn - Ch1)/lHpl Point Norm.at x,y,z (5950,950,450) Base Freq. 3.251 Hz

UTEM Survey at: Langdalen Grid
For: A/S Sulfidmalm

LAMONTAGNE GEOPHYSICS LTD / GEOPHYSIQUE LTEE

Job 0616

Surveyed: 16/7/6
Reduced: 6/9/6
Plotted: 6/9/6



UTEM Survey at: Langdalen Grid
For: A/S Sulfidmalm

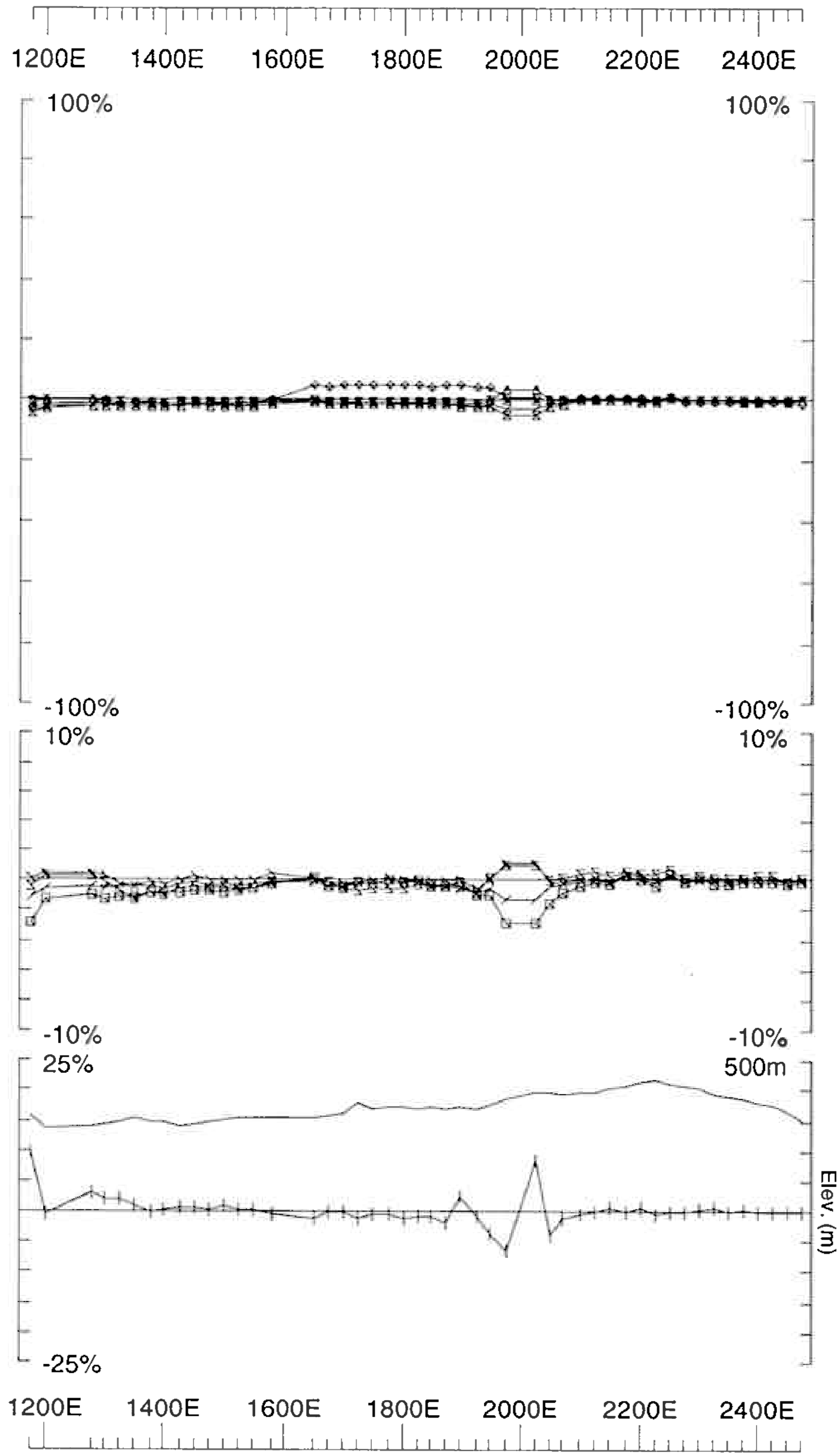
LAMONTAGNE GEOPHYSICS LTD
GEOPHYSIQUE LTEE

Job 0616

Surveyed : 16/7/6
Reduced : 6/9/6
Plotted : 6/9/6

Secondary, (Chn - Ch1)/|Hp|
Point Norm. at x,y,z
(5950,950,450)
Base Freq. 3.251 Hz

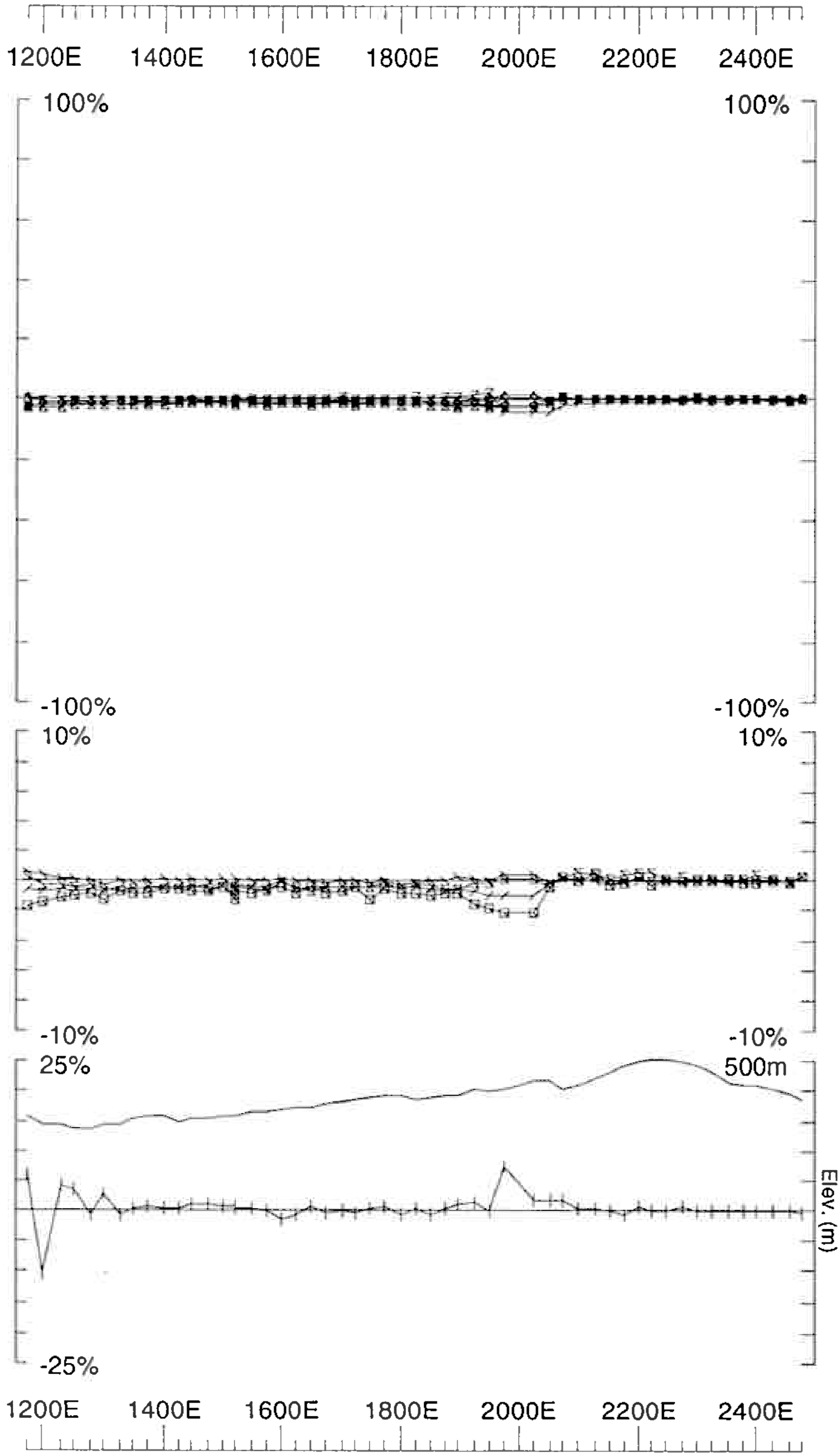
Loop: 04
Line: 5800N
Compt: Hz



UTEM Survey at: Langdalen Grid
For: A/S Sulfidmalm
LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE
Job 0616
Plotted: 6/9/6

Secondary, (Chn - Ch1)/|Hp|
Point Norm.at x,y,z
(5950,950,450)
Base Freq. 3.251 Hz

Loop: 04
Line: 5900N
Compt: Hz



UTEM Survey at: Langdalen Grid
For: A/S Sulfidmalm

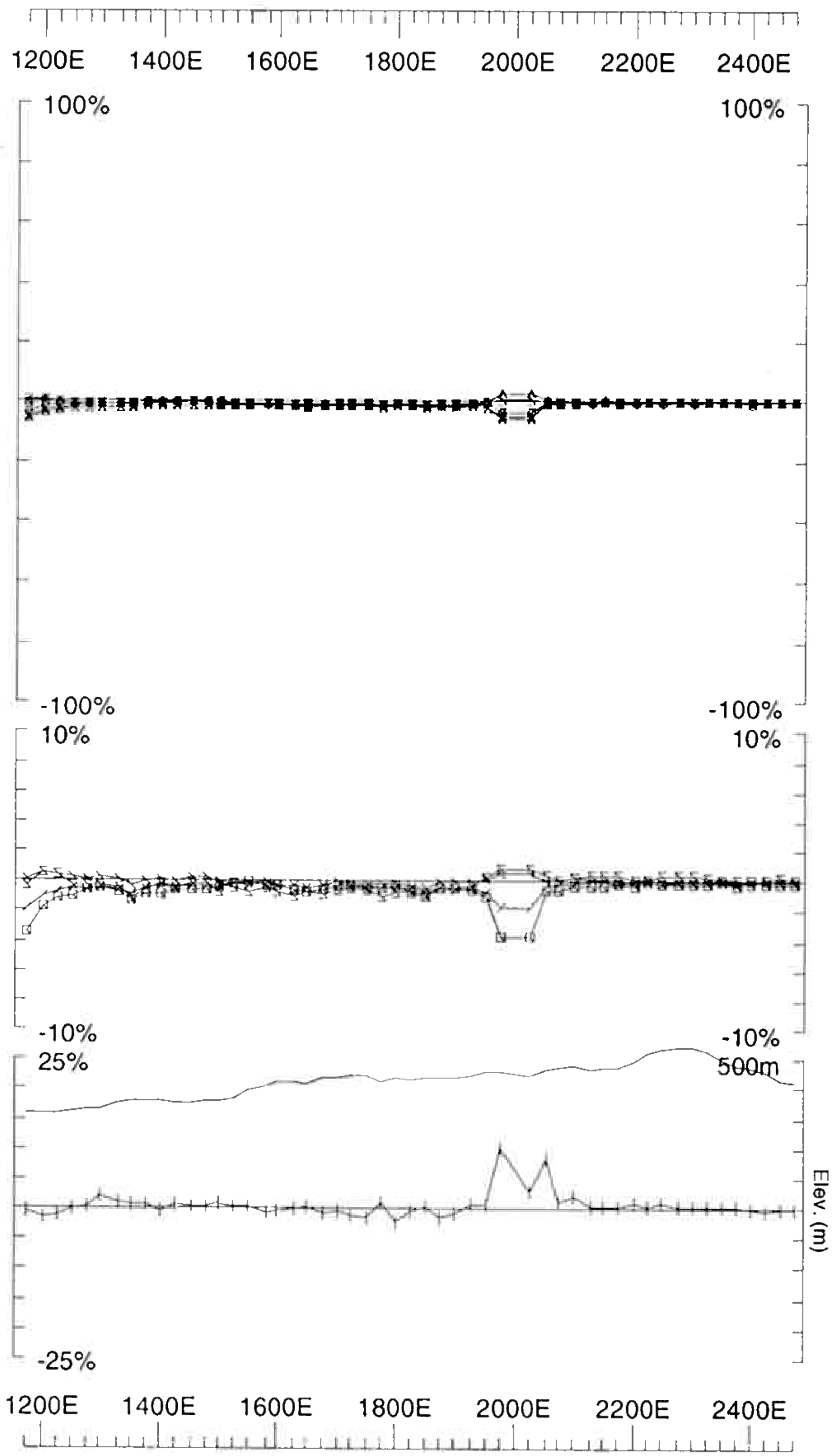
LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE

Job 0616

Plotted : 6/9/6

Secondary, (Chn - Ch1)/IHpI
Point Norm.at x,y,z
(5950,950,450)
Base Freq. 3.251 Hz

Loop: 04
Line: 6000N
Compt: Hz



Loop: 04
Line: 6100N
Compt: Hz

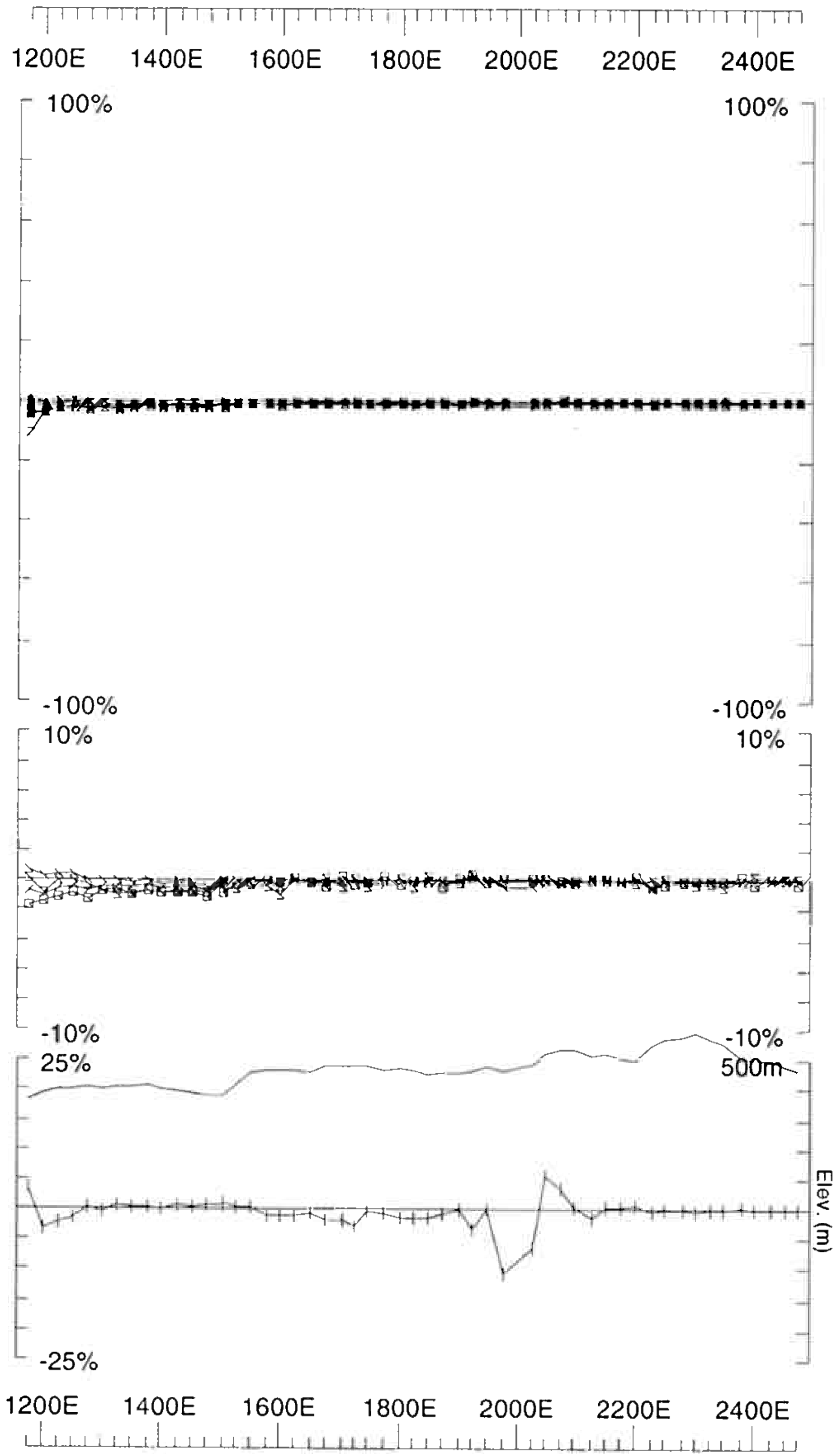
Secondary, (Chn - Ch1)/IHpI
Point Norm.at x,y,z
(5950,950,450)
Base Freq. 3.251 Hz

UTEM Survey at: Langdalen Grid
For: A/S Sulfidmalm

LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE

Job 0616

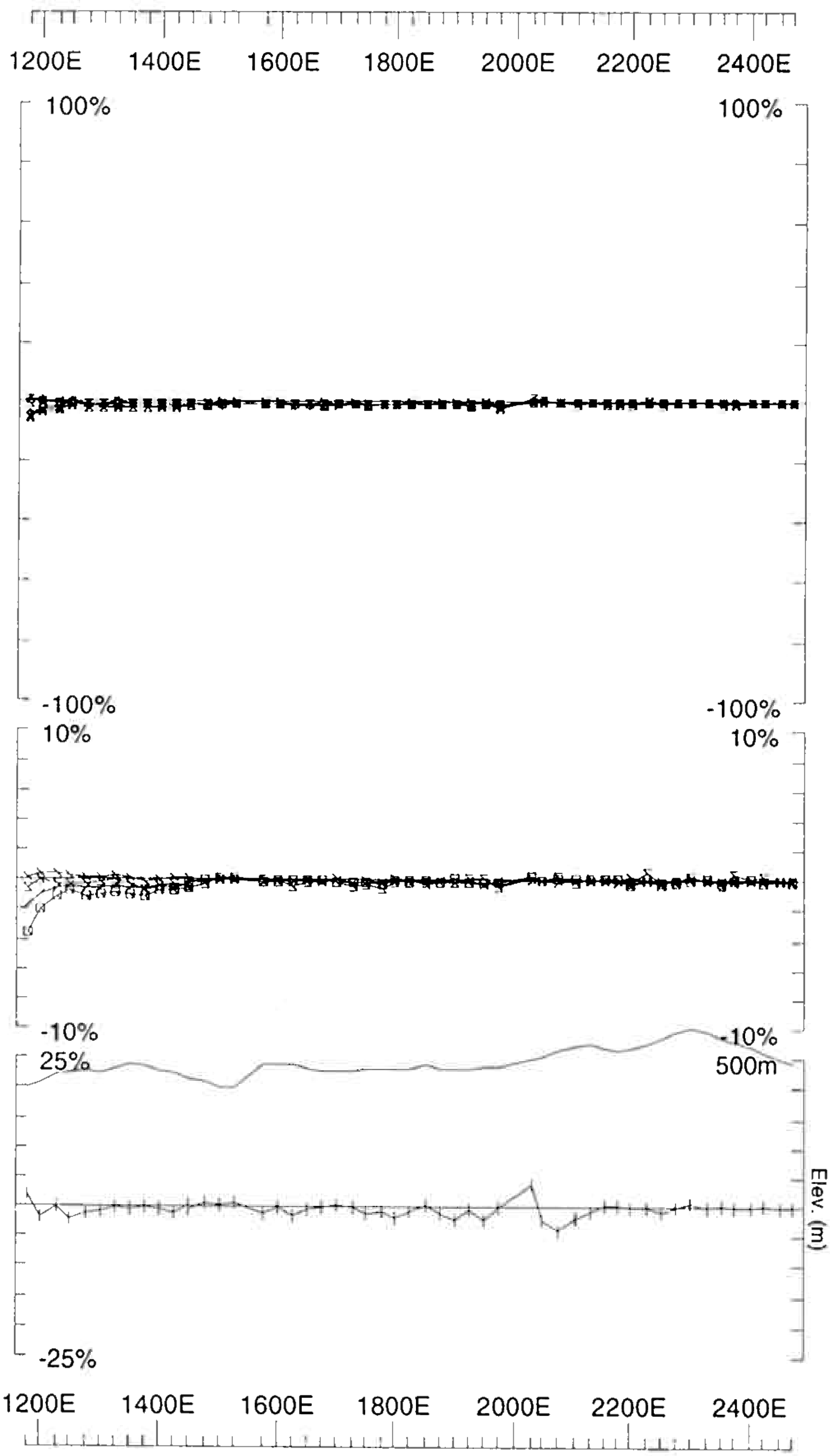
Plotted: 6/9/6



UTEM Survey at: Langdalen Grid
For: A/S Sulfidmalm
LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE
Job 0616
Plotted: 6/9/6

Secondary, (Chn - Ch1)/|Hp|
Point Norm.at x,y,z
(5950,950,450)
Base Freq. 3.251 Hz

Loop: 04
Line: 6200N
Compt: Hz

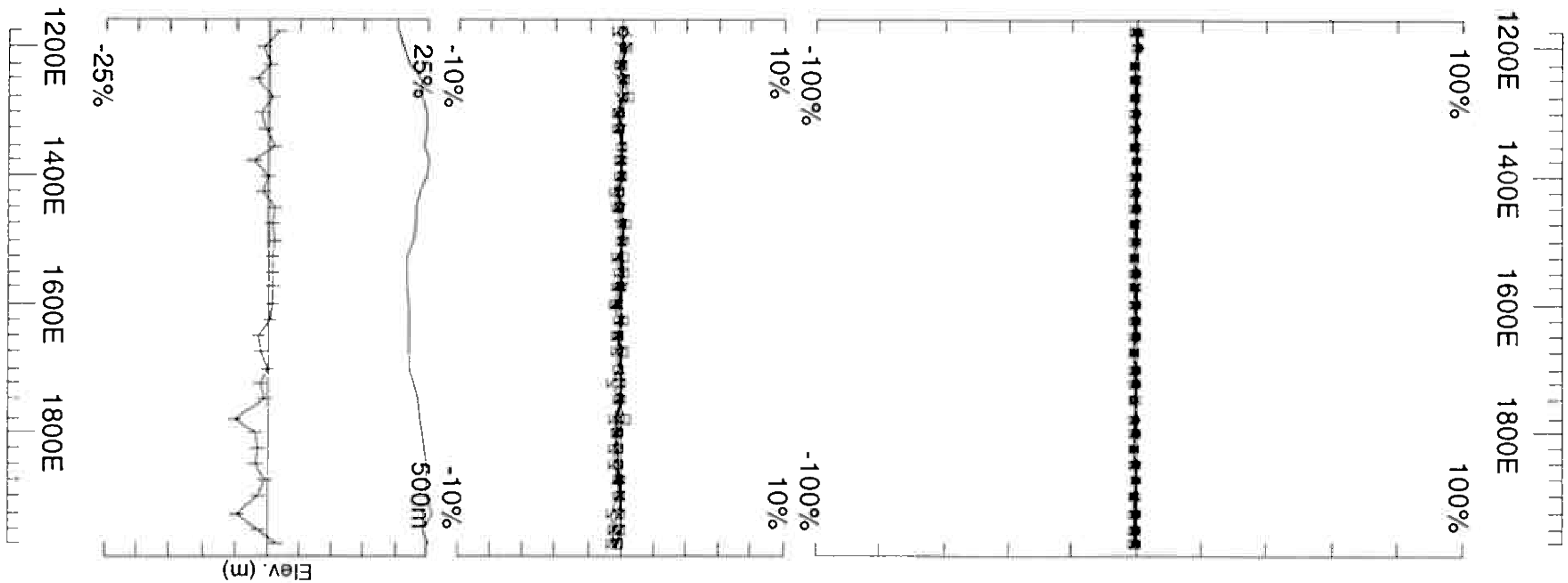


Loop: 04
Line: 6300N
Compt: Hz

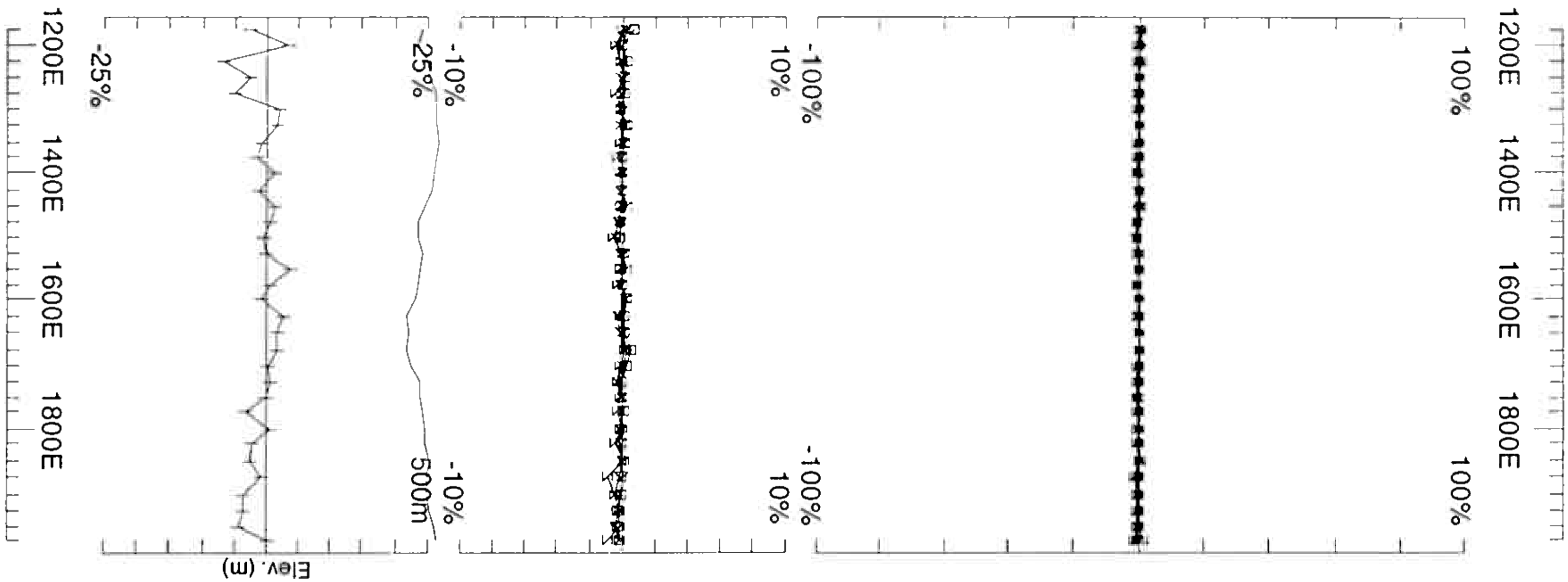
Secondary, (Chn - Ch1)/IHpl
Point Norm.at x,y,z
(5950,950,450)
Base Freq. 3.251 Hz

UTEM Survey at: Langdalen Grid
For: A/S Sulfidmalm

LAMONTAGNE GEOPHYSICS LTD
GEOPHYSIQUE LTEE
Job 0616
Plotted : 6/9/6



Loop: 04 Line: 6400N Compt: Hz	Secondary, (Chn - Ch1)/IHpI Point Norm.at x,y,z (5950,950,450) Base Freq. 3.251 Hz	UTEM Survey at: Langdalen Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 18/7/6 Reduced : 6/9/6 Plotted : 6/9/6



Loop: 04 Line: 6500N Compt: Hz	Secondary, (Chn - Ch1)/IHpl Point Norm.at x,y,z (5950,950,450) Base Freq. 3.251 Hz	UTEM Survey at: Langdalen Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 18/7/6 Reduced : 6/9/6 Plotted : 6/9/6

Ertelia

Loop 09

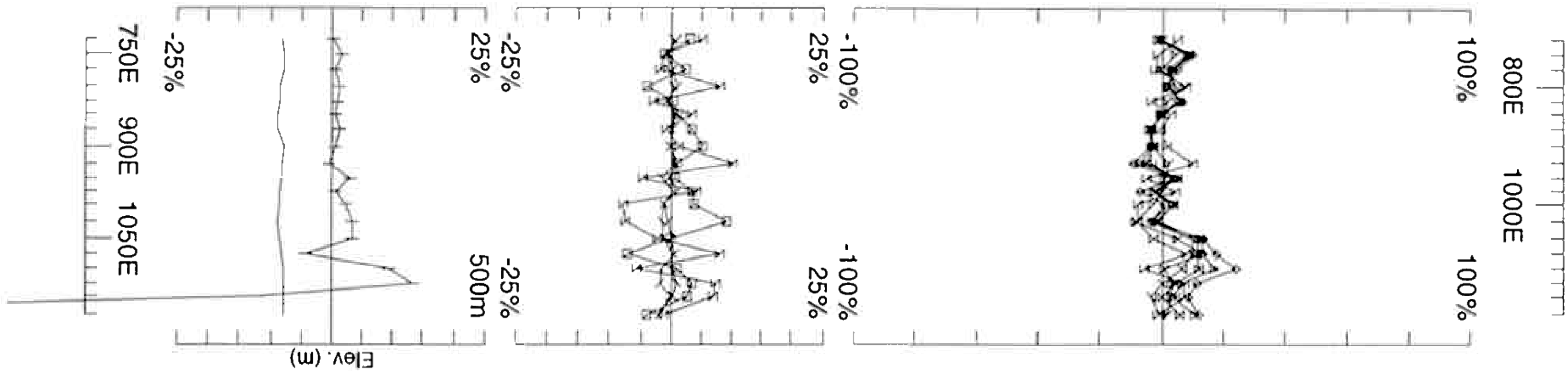
Hz
@3.251 Hz frequency

point norm
@
(x,y,z) = (558650, 6660000, 200 m.a.s.l.)

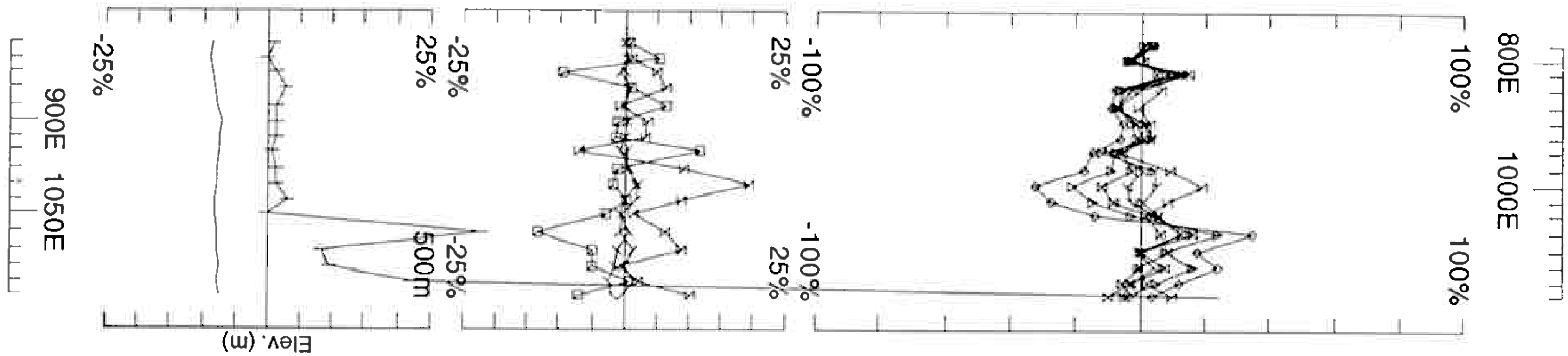
Ch1 reduced

Loop 09	Line 1450N	700E - 1200E	500m
	Line 1500N	775E - 1200E	425m
	Line 1650N	700E - 1200E	500m
	Line 1700N	700E - 1200E	500m
	Line 1750N	725E - 1200E	475m
	Line 1800N	800E - 1200E	400m
	Line 1850N	875E - 1200E	325m
	Line 1900N	950E - 1200E	250m
	Ertelia	Loop 09 Total	**3375m**

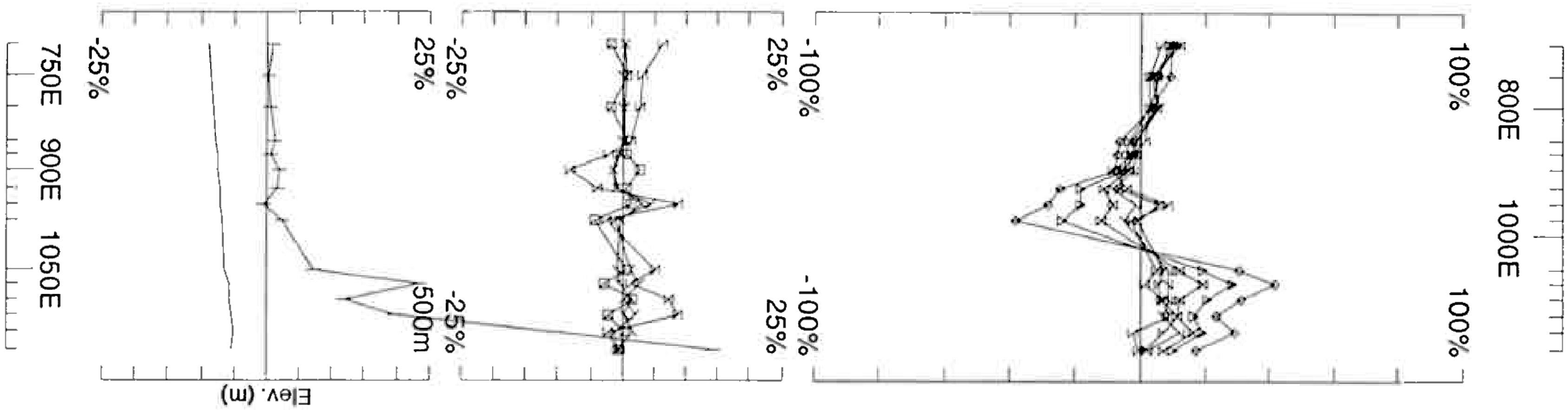
Loop 09 - point norm



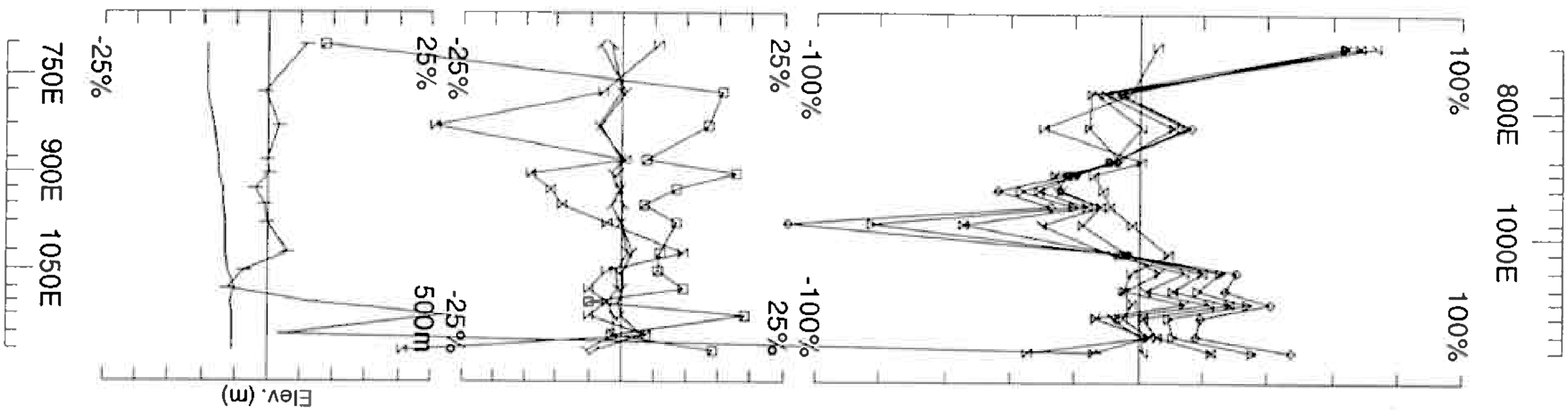
Loop: 09 Line: 1450N Compt: Hz	Secondary, (Chn - Ch1)/IHpl Point Norm.at x,y,z (8175,9650,200) Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE · Job 0616 · Surveyed : 10/7/6 Reduced : 10/7/6 Plotted : 6/9/6



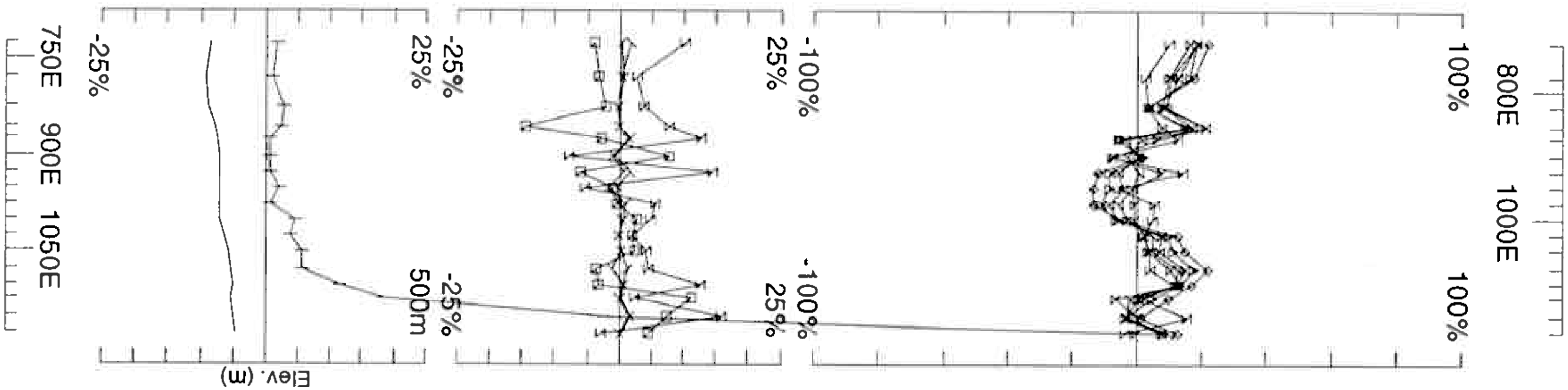
Loop: 09 Line: 1500N Compt: Hz	Secondary, (Chn - Ch1)/IHpl Point Norm.at x,y,z (8175,9650,200) Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 12/5/7 Reduced : 10/7/6 Plotted : 6/9/6



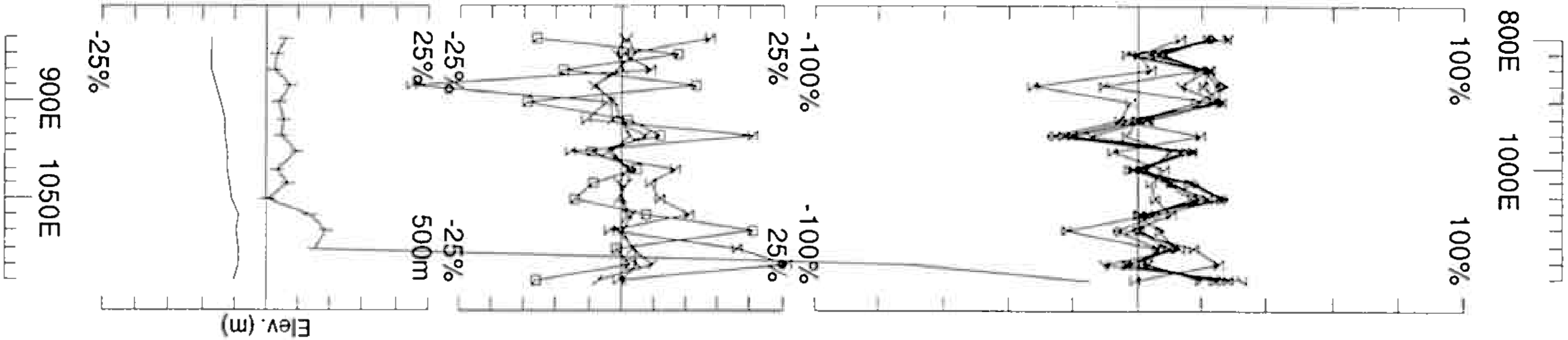
Loop: 09 Line: 1650N Compt: Hz	Secondary, (Chn - Ch1)/lHpl Point Norm.at x,y,z (8175,9650,200) Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 11/7/6 Reduced : 11/7/6 Plotted : 6/9/6



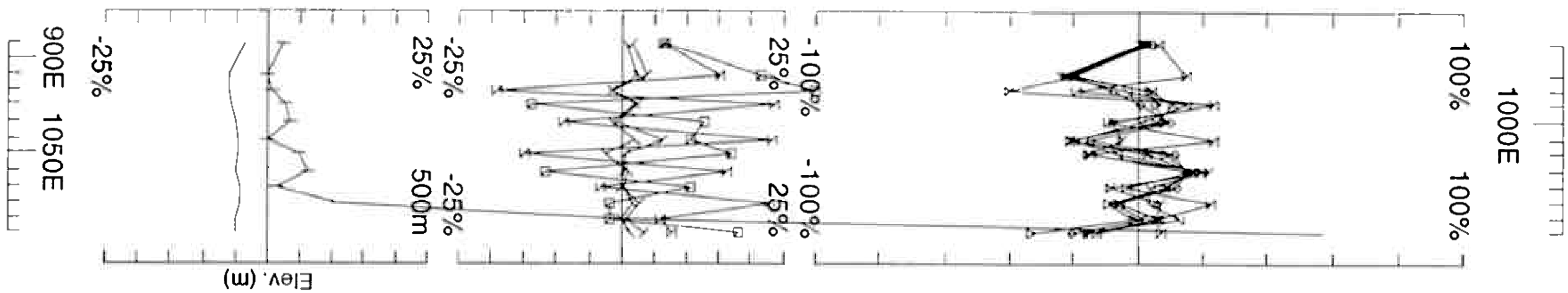
Loop: 09 Line: 1700N Compt: Hz	Secondary, (Chn - Ch1)/IHpI Point Norm.at x,y,z (8175,9650,200) Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Plotted : 6/9/6



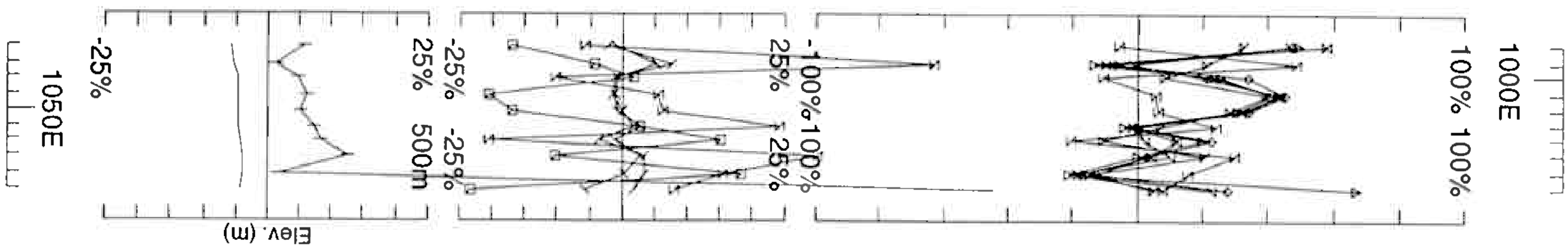
Loop: 09 Line: 1750N Compt: Hz	Secondary, (Chn - Ch1)/IHpl Point Norm.at x,y,z (8175,9650,200) Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Plotted : 6/9/6



Loop: 09 Line: 1800N Compt: Hz	Secondary, (Chn - Ch1)/lHpl Point Norm.at x,y,z (8150,9625,200) Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Plotted : 6/9/6



Loop: 09 Line: 1850N Compt: Hz	Secondary, (Chn - Ch1)/lHpl Point Norm.at x,y,z (8175,9650,200) Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 20/7/6 Reduced : 20/7/6 Plotted : 6/9/6



Loop: 09 Line: 1900N Compt: Hz	Secondary, (Chn - Ch1)/IHpI Point Norm.at x,y,z (8175,9650,200) Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 20/7/6 Reduced : 20/7/6 Plotted : 6/9/6

Ertelia

Loop 09B

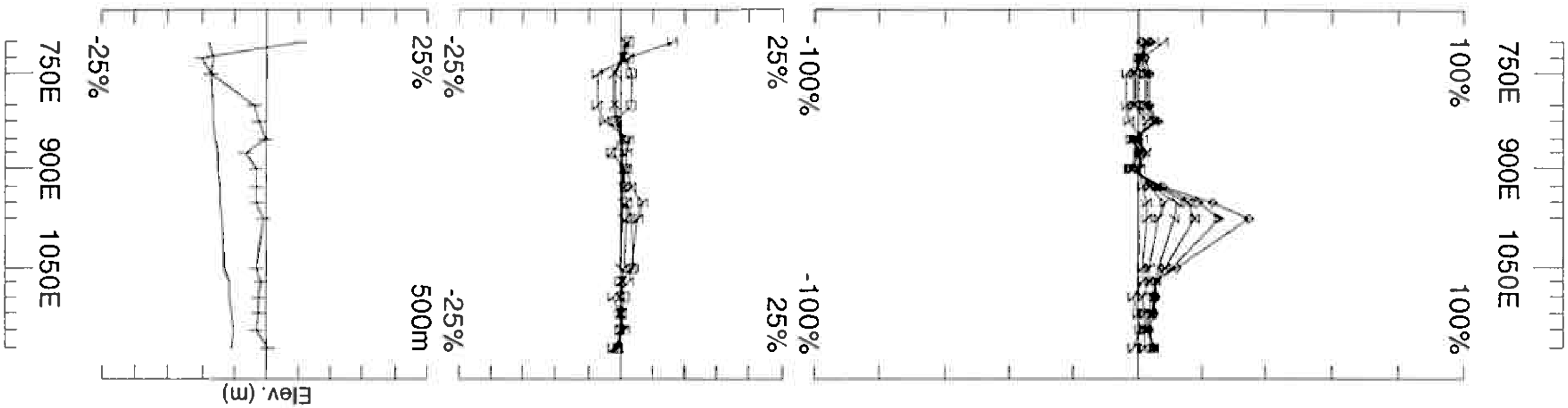
Hz
@3.251 Hz frequency

point norm
@
(x,y,z) = (558300, 6659750, 200 m.a.s.l.)

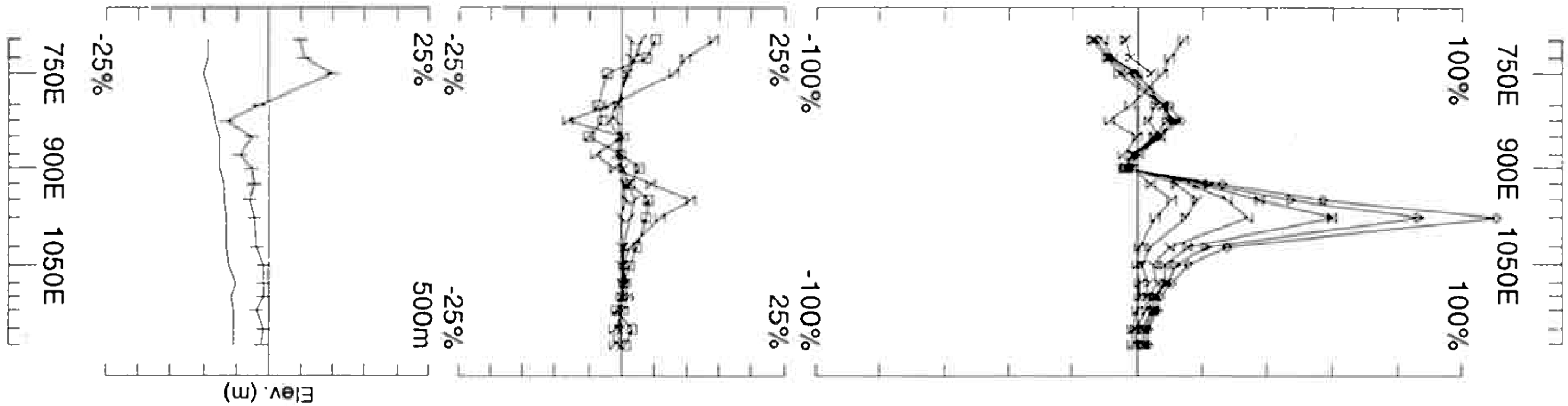
Ch1 reduced

Loop 09B	Line 1650N	700E - 1175E	475m
	Line 1700N	700E - 1175E	475m
	Line 1750N	725E - 1175E	450m
	Line 1800N	850E - 1200E	350m
	Line 1850N	900E - 1200E	300m
	Line 1900N	800E - 1200E	400m
	Ertelia	Loop 09B Total	**2450m**

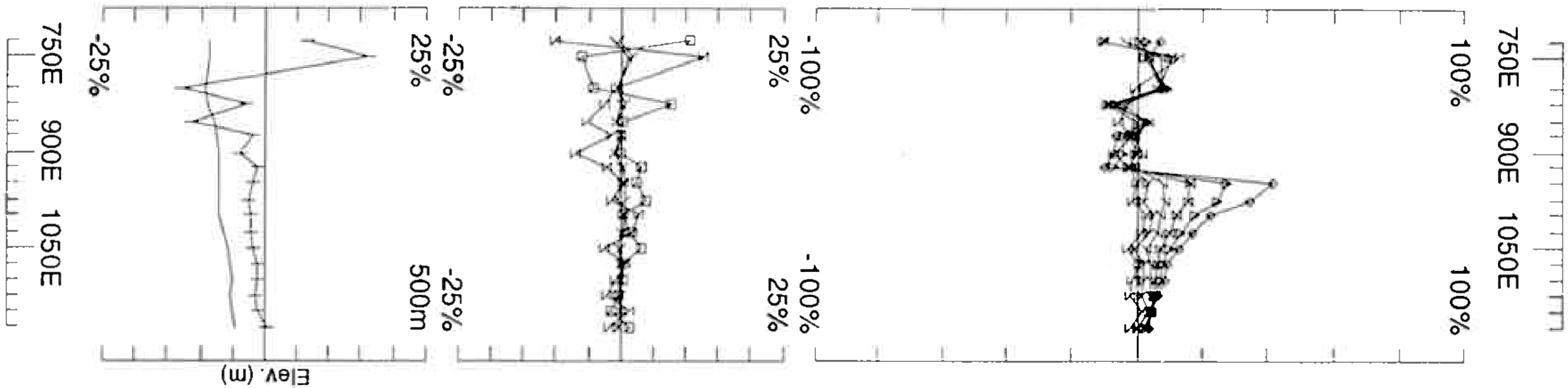
Loop 09B - point norm



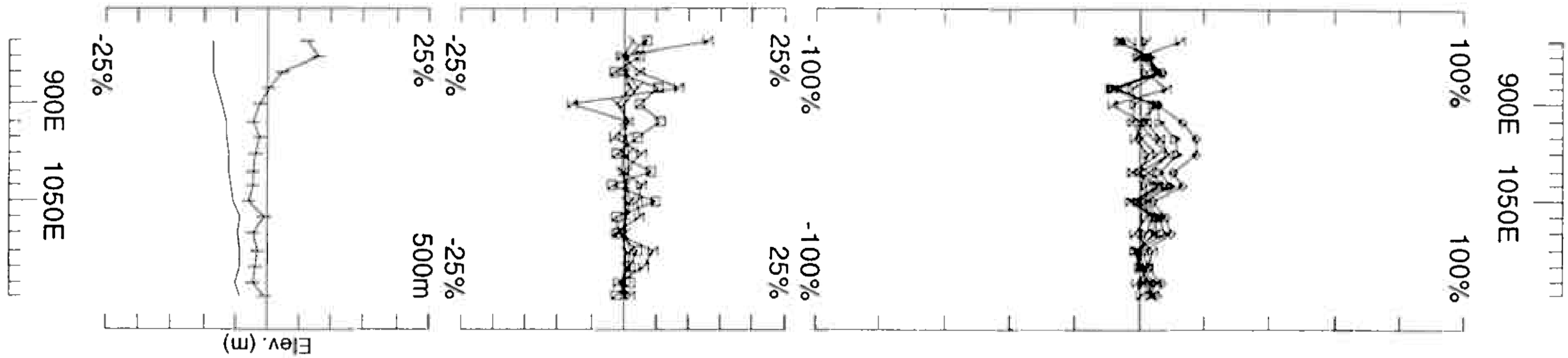
Loop: 09B Line: 1650N Compt: Hz	Secondary, (Chn - Ch1)/IHpl Point Norm.at x,y,z (8300,9750,200) Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 21/7/6 Reduced : 22/7/6 Plotted : 6/9/6



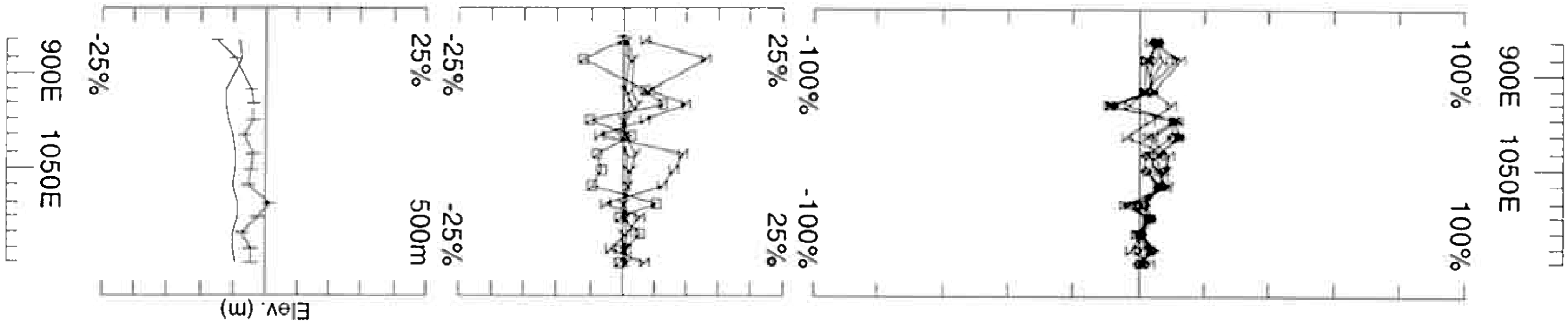
Loop: 09B Line: 1700N Compt: Hz	Secondary, (Chn - Ch1)/IHpI Point Norm.at x,y,z (8300,9750,200) Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE	Job 0616	Surveyed : 21/7/6 Reduced : 22/7/6 Plotted : 6/9/6



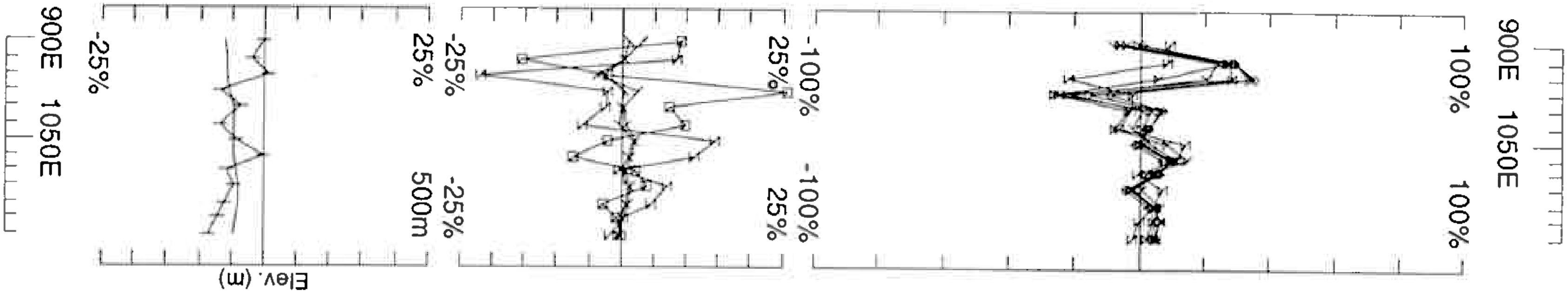
Loop: 09B Line: 1750N Compt: Hz	Secondary, (Chn - Ch1)/IHpl Point Norm.at x,y,z (8300,9750,200) Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 21/7/6 Reduced : 22/7/6 Plotted : 6/9/6



Loop: 09B Line: 1800N Compt: Hz	Secondary, (Chn - Ch1)/IHpI Point Norm.at x,y,z (8300,9750,200) Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 21/7/6 Reduced : 22/7/6 Plotted : 6/9/6



Loop: 09B Line: 1850N Compt: Hz	Secondary, (Chn - Ch1)/IHpI Point Norm.at x,y,z (8300,9750,200) Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed: 21/7/6 Reduced: 22/7/6 Plotted: 6/9/6



Loop: 09B Line: 1900N Compt: Hz	Secondary, (Chn - Ch1)/IHpI Point Norm.at x,y,z (8300,9750,200) Base Freq. 3.251 Hz	UTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 21/7/6 Reduced : 22/7/6 Plotted : 6/9/6

0616

BHUTEM 3 Profiles with vectorplots

BHUTEM 3 Profiles

Area	Borehole Name	Survey Depth	Dummy Depth	Loop Number	Frequency
Listed by hole number:					
Ertelia	ER2006-01B	124m	125m	Loop 09	3.251Hz
		124m		Loop 09B	3.251Hz
Ertelia	ER2006-02	206m	208m	Loop 09	3.251Hz
		206m		Loop 09B	3.251Hz
Ertelia	ER2006-03	220m	221m	Loop 09	3.251Hz
		220m		Loop 09B	3.251Hz
Ertelia	ER2006-04	220m	221m	Loop 09	3.251Hz
		220m		Loop 09B	3.251Hz
Ertelia	ER2006-05	236m	239m	Loop 09	3.251Hz
		236m		Loop 09B	3.251Hz
Ertelia	ER2006-06B	336m	342m	Loop 09	3.251Hz
		336m		Loop 09B	3.251Hz

Ertelia

Loop 09 - BH UTEM-3

@3.251 Hz frequency

Ch1 reduced

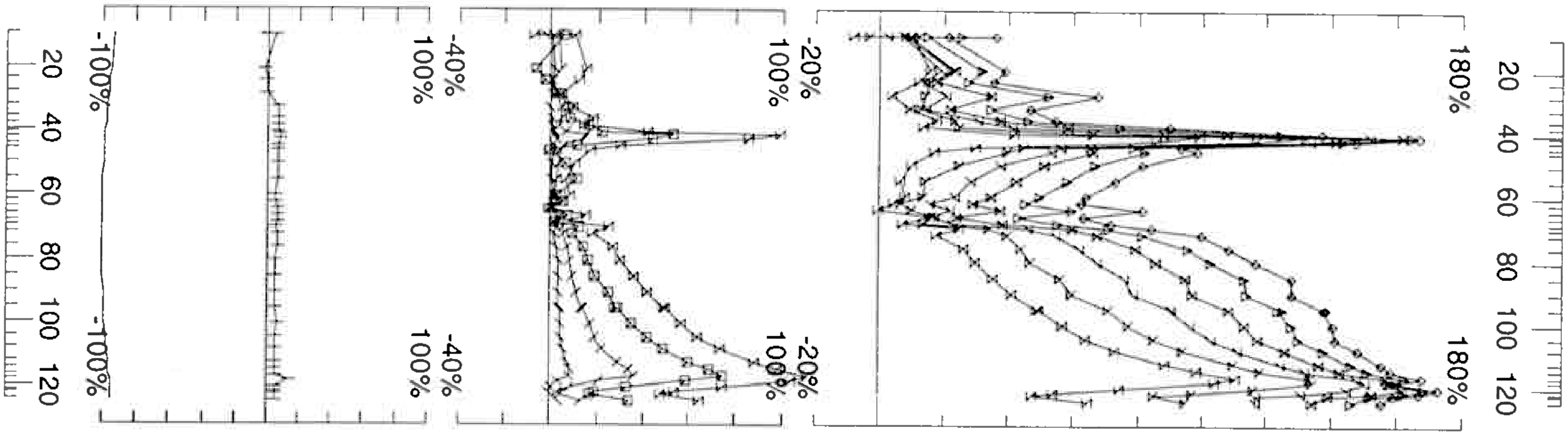
Ertelia	ER2006-01B	124m	208m	Loop 09	3.251Hz
	ER2006-02	206m	208m	Loop 09	3.251Hz
	ER2006-03	220m	221m	Loop 09	3.251Hz
	ER2006-04	220m	221m	Loop 09	3.251Hz
	ER2006-05	236m	239m	Loop 09	3.251Hz
	ER2006-06B	336m	342m	Loop 09	3.251Hz

ER2006-01B
ER2006-02
ER2006-03
ER2006-04
ER2006-05
ER2006-06B

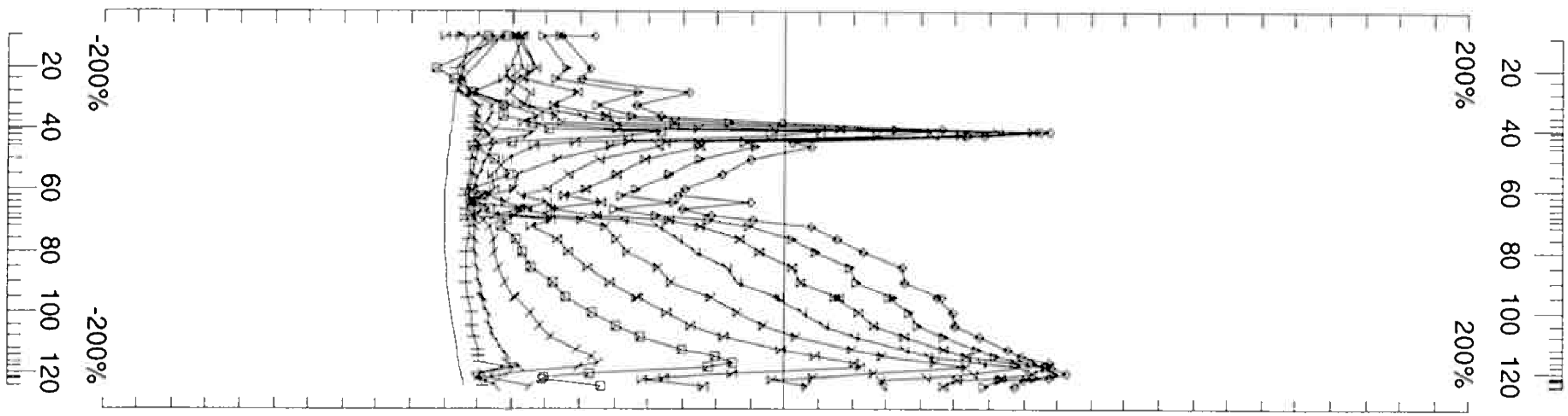
3-axis plot
total field plot

plan vectorplot - all holes
grideast-west section vectorplot - holes 01B/02
grideast-west section vectorplot - holes 03/04
grideast-west section vectorplot - holes 05/06B

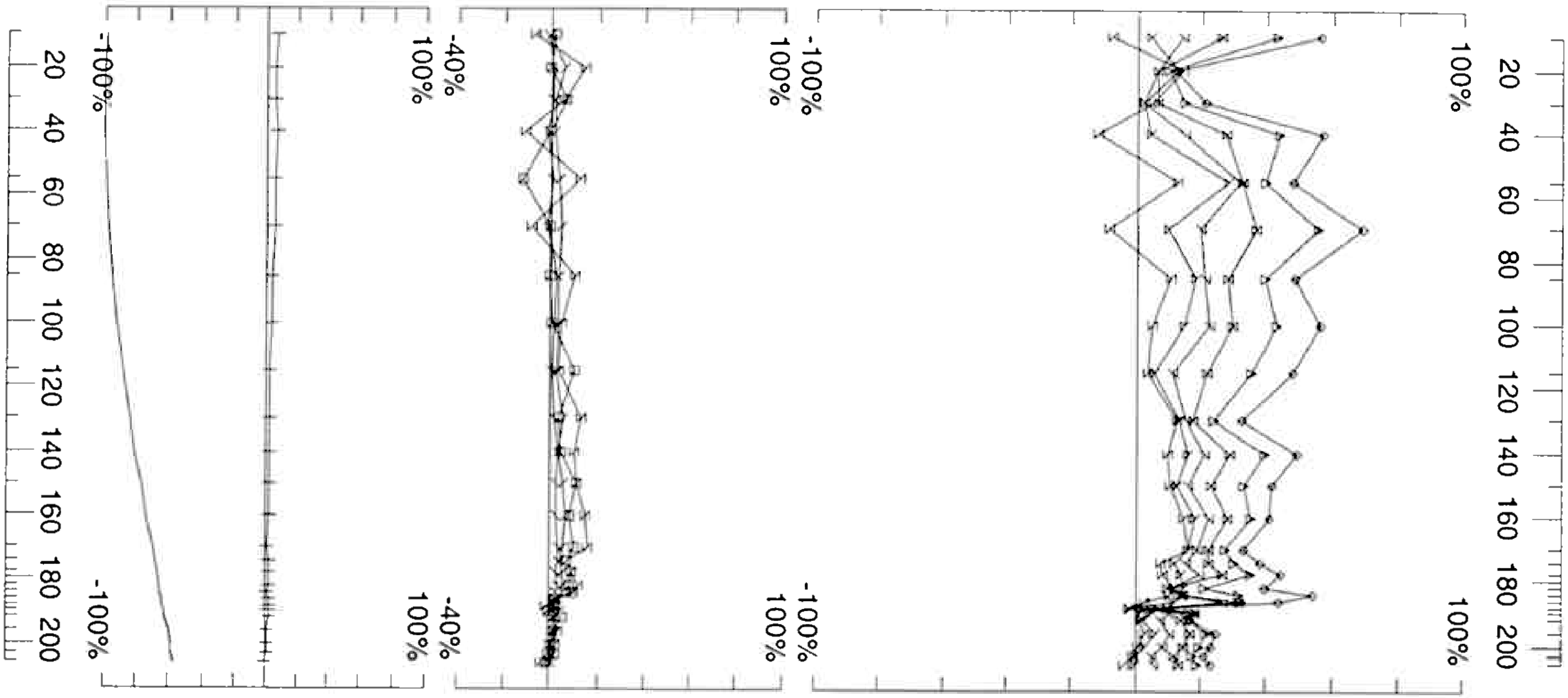
ER2006-01B/02/03/04/05/06B



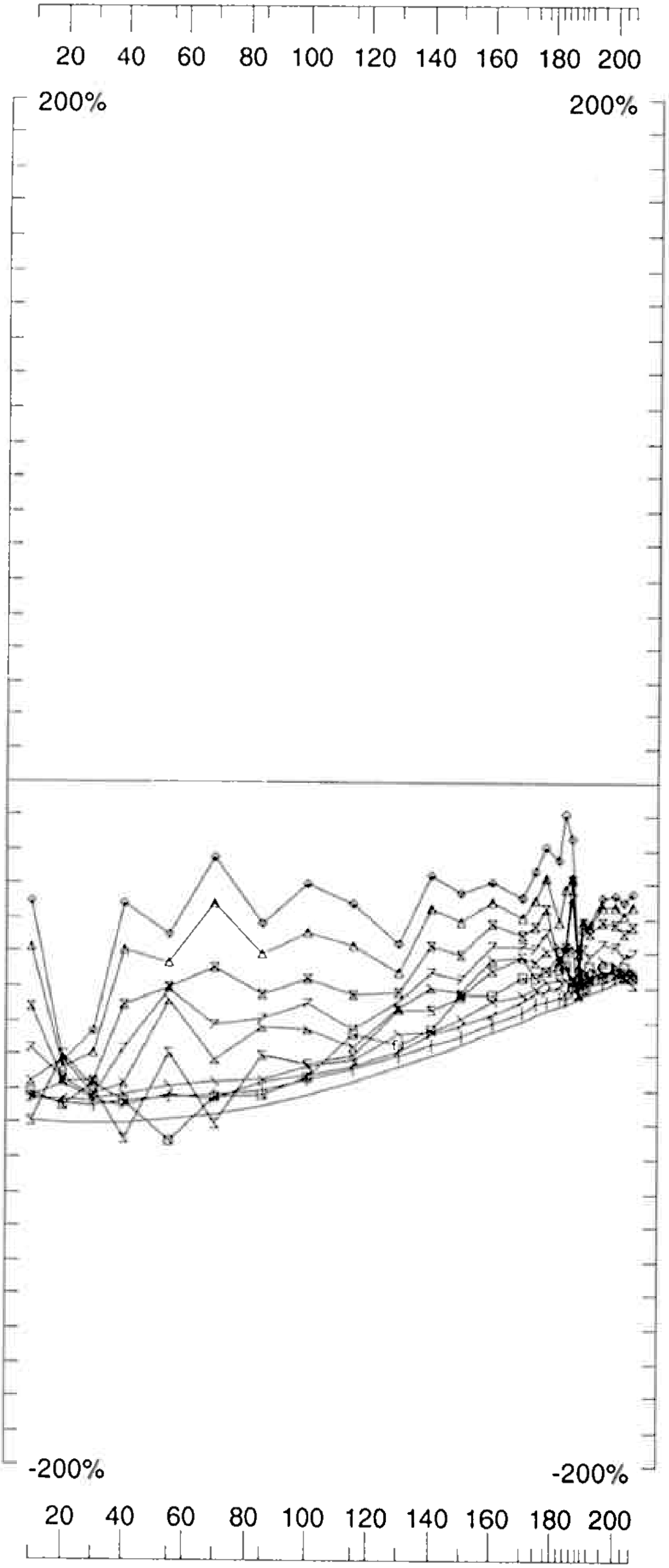
Loop: 09	Secondary, (Chn - Ch1)/IHpl	BHUTEM Survey at: Ertelia Grid
Hole: ER-2006-01B	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Axial	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE — Job 0616 — Surveyed : 13/7/6 Reduced : 14/7/6 Plotted : 6/9/6



Loop: 09	Total, Chn/IHpl	BHUTEM Survey at: Ertelia Grid
Hole: ER-2006-01B	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Axial	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 13/7/6 Reduced : 14/7/6 Plotted : 6/9/6



Loop: 09	Secondary, (Chn - Ch1)/IHpI	BHUTEM Survey at: Ertelia Grid
Hole: ER-2006-02	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Axial	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed: 13/7/6 Reduced: 14/7/6 Plotted: 6/9/6



BHUTEM Survey at: Ertelia Grid
For: A/S Sulfidmalm

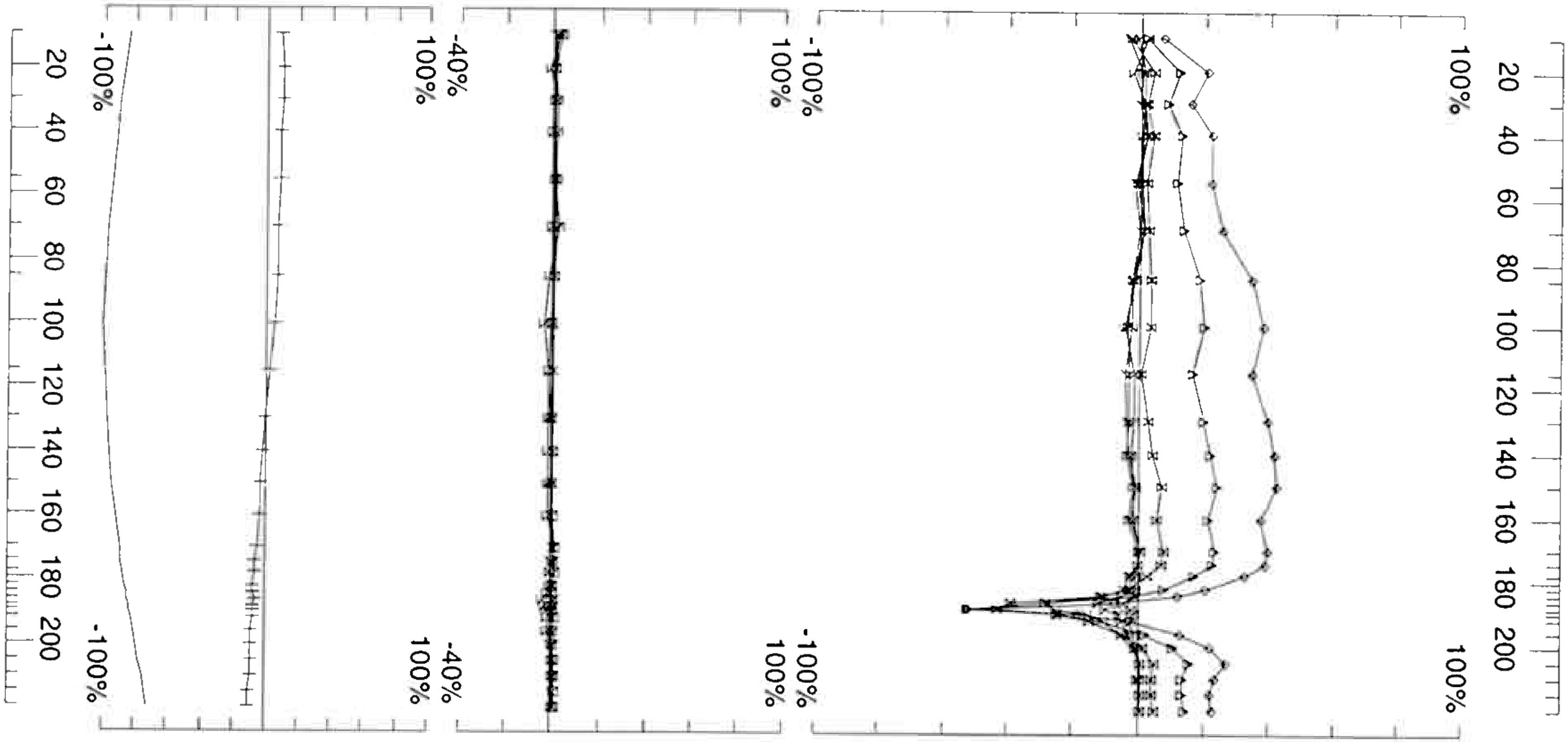
LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE

Job 0616

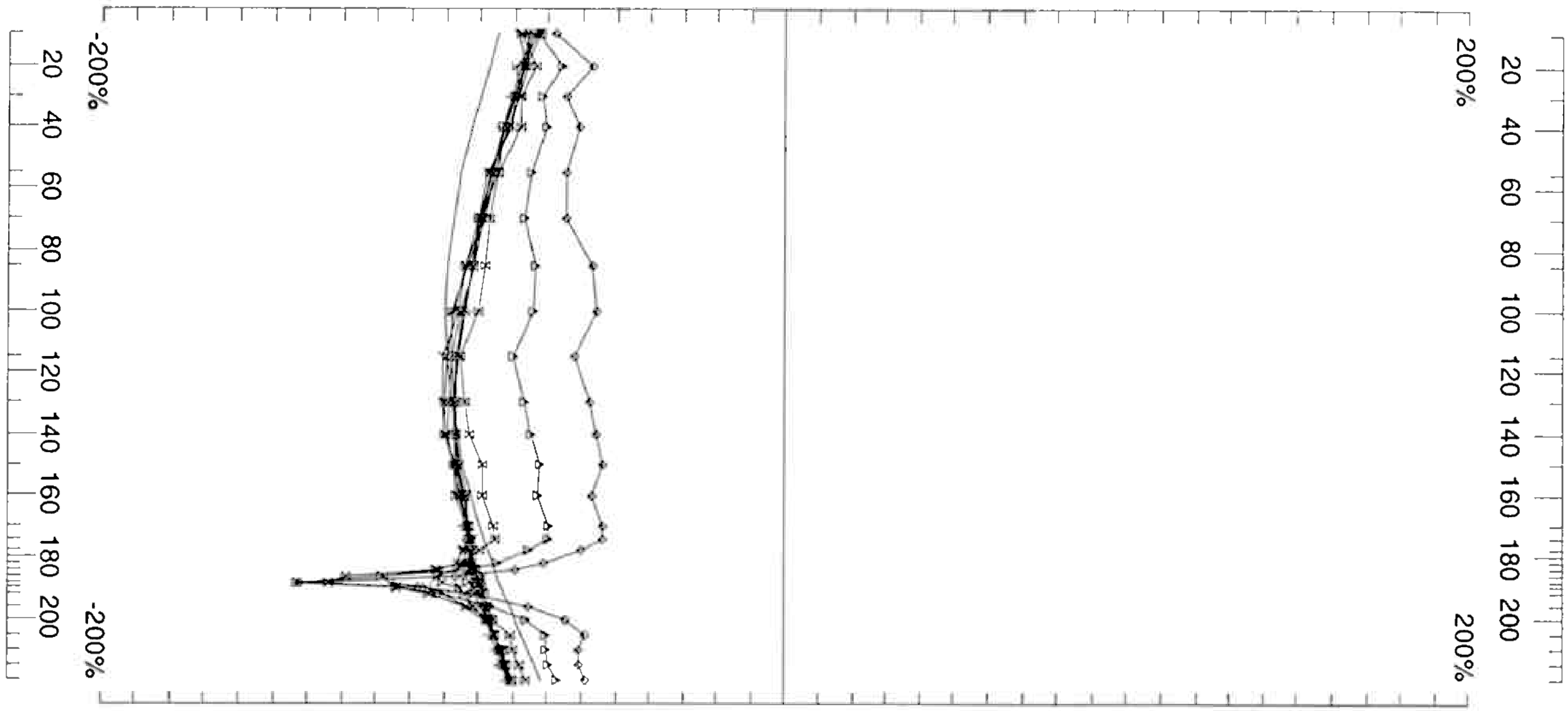
Surveyed: 13/7/6
Reduced: 14/7/6
Plotted: 6/9/6

Loop: 09
Hole: ER-2006-02
Compt: Axial

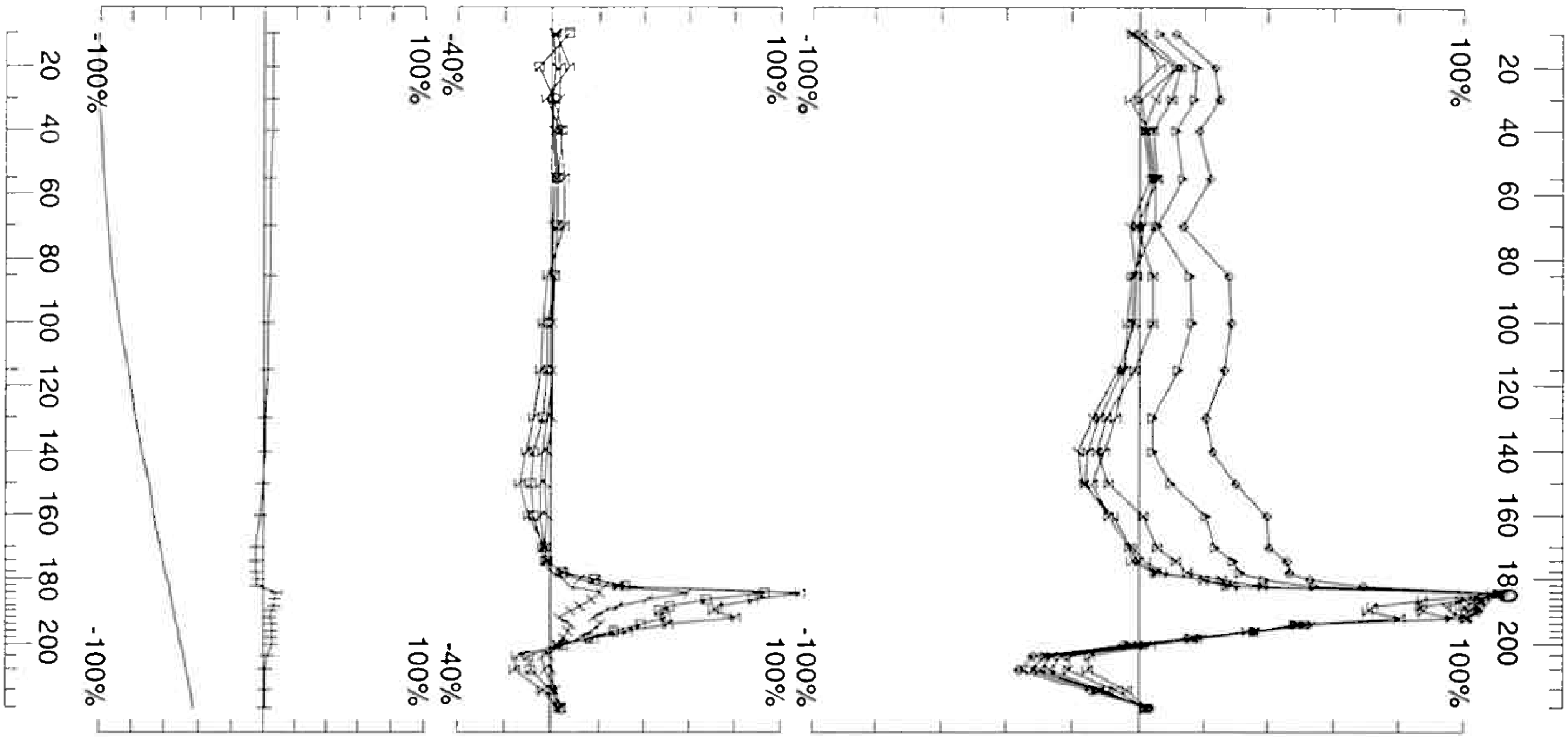
Total, Chn/IHpl
Contin. Norm at depth of 0 m
Base Freq. 3.251 Hz



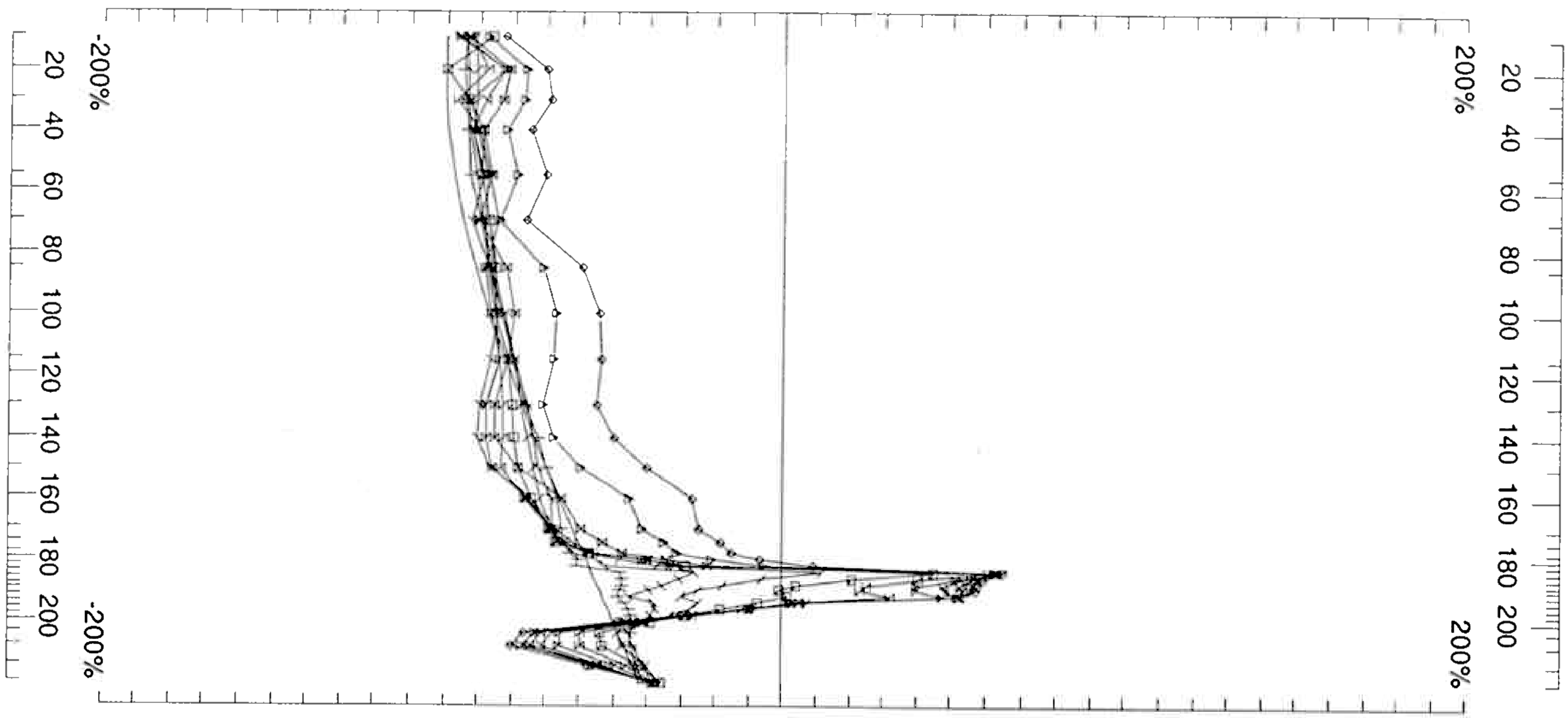
Loop: 09	Secondary, (Chn - Ch1)/IHpl	BHUTEM Survey at: Ertelia Grid
Hole: ER-2006-03	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Axial	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 11/7/6 Reduced : 13/7/6 Plotted : 6/9/6



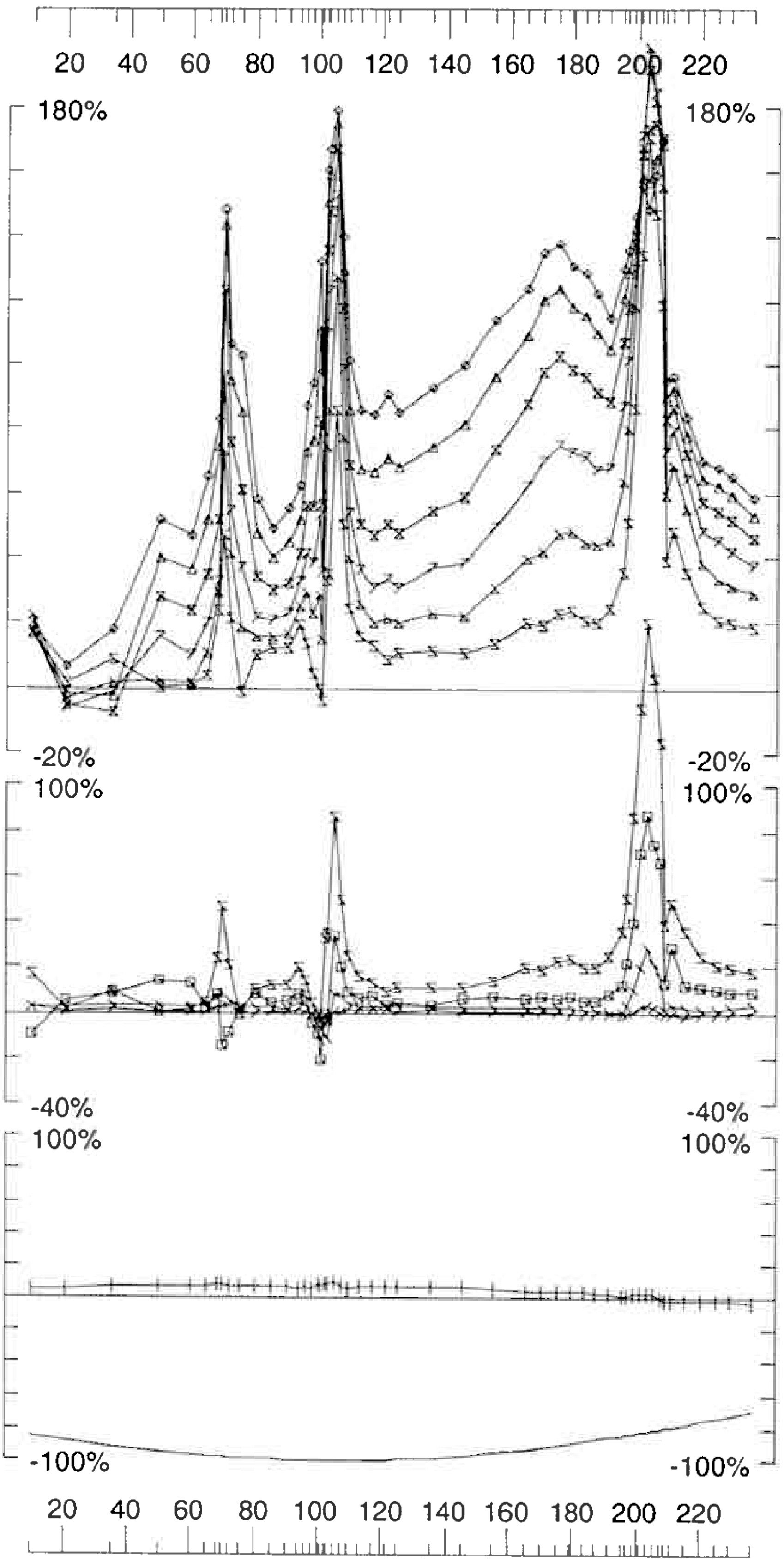
Loop: 09	Total, Chn/IHpl	BHUTEM Survey at: Ertelia Grid
Hole: ER-2006-03	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Axial	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 11/7/6 Reduced : 13/7/6 Plotted : 6/9/6



Loop: 09	Secondary, (Chn - Ch1)/IHpl	BHUTEM Survey at: Ertelia Grid
Hole: ER-2006-04	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Axial	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 11/7/6 Reduced : 11/7/6 Plotted : 6/9/6



Loop: 09	Total, Chn/lHpl	BHUTEM Survey at: Ertelia Grid
Hole: ER-2006-04	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Axial	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed: 11/7/6 Reduced: 11/7/6 Plotted: 6/9/6



BHUTEM Survey at: Ertelia Grid
For: A/S Sulfidmalm

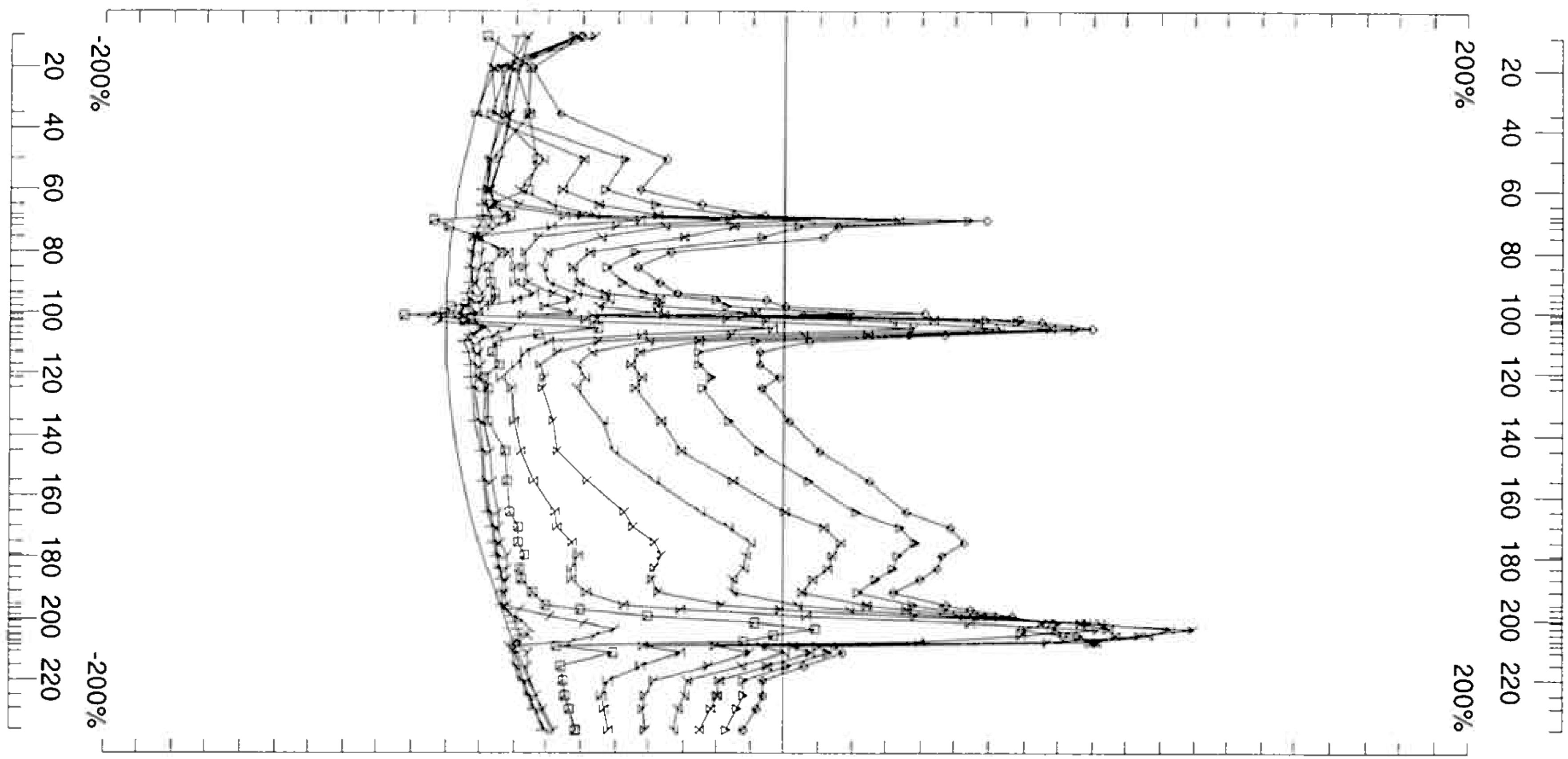
LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE

Job 0616

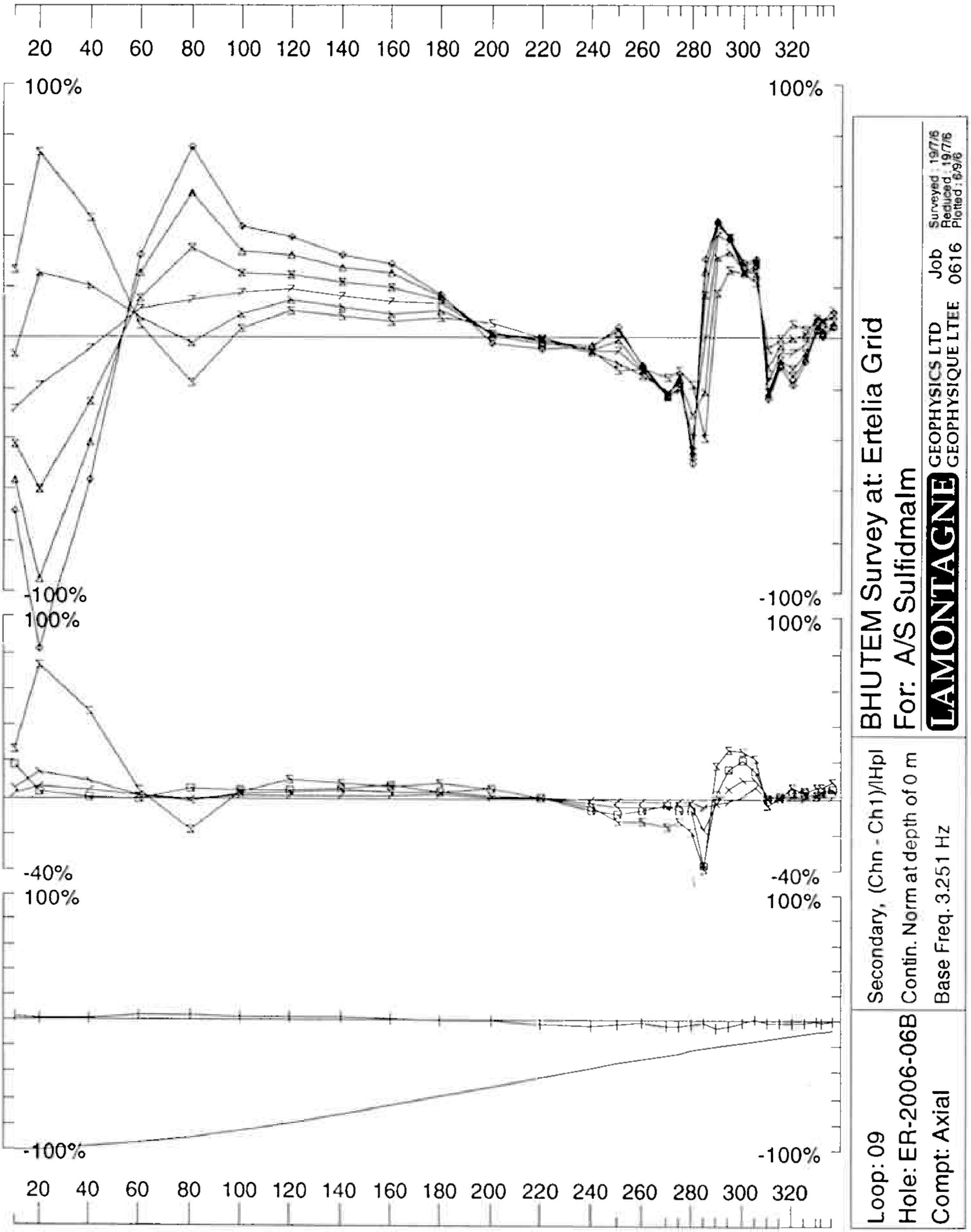
Surveyed : 14/7/6
Reduced : 19/7/6
Plotted : 6/9/6

Secondary, (Chn - Ch1)/IHpl
Contin. Norm at depth of 0 m
Base Freq. 3.251 Hz

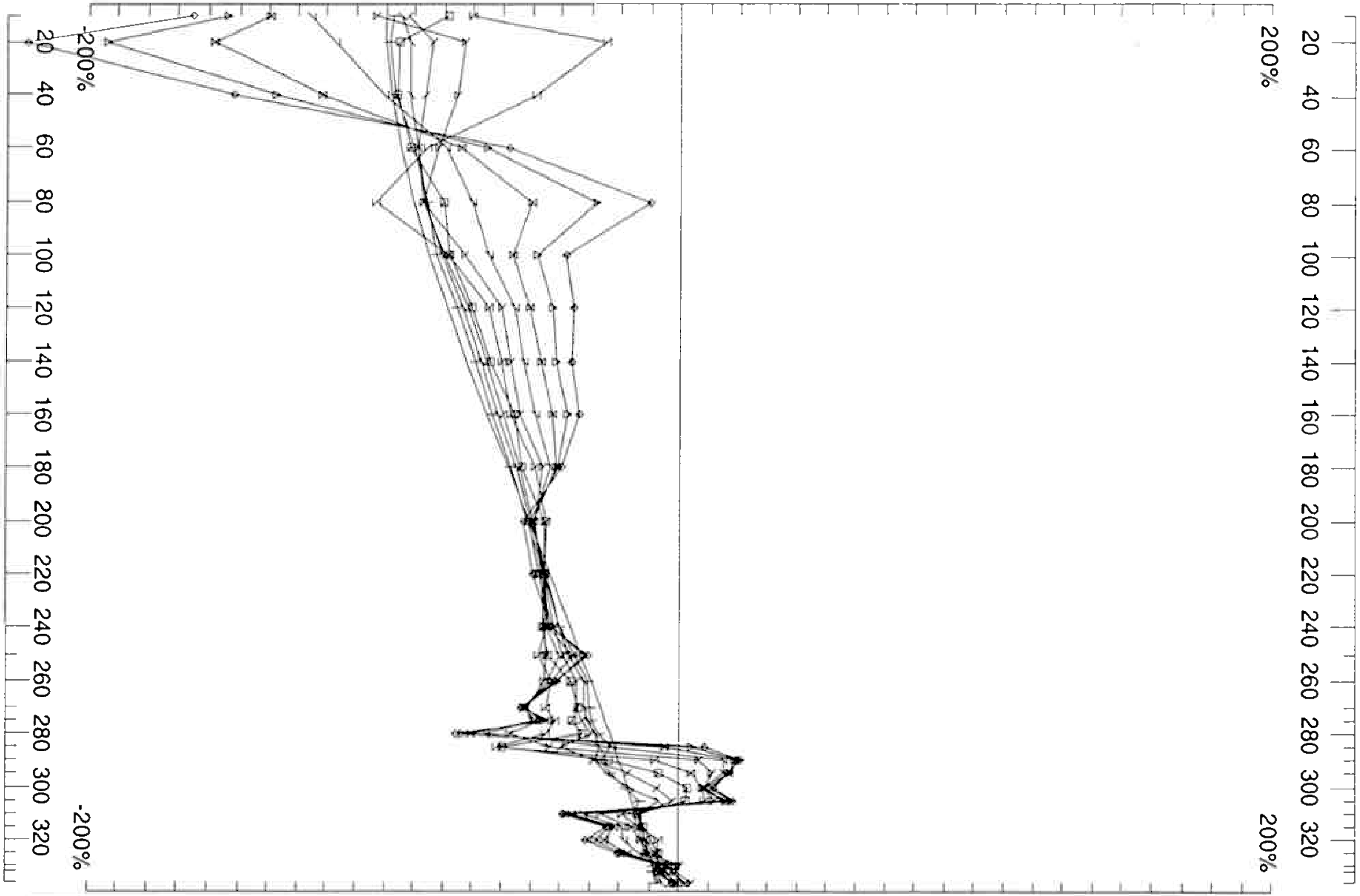
Loop: 09
Hole: ER-2006-05
Compt: Axial



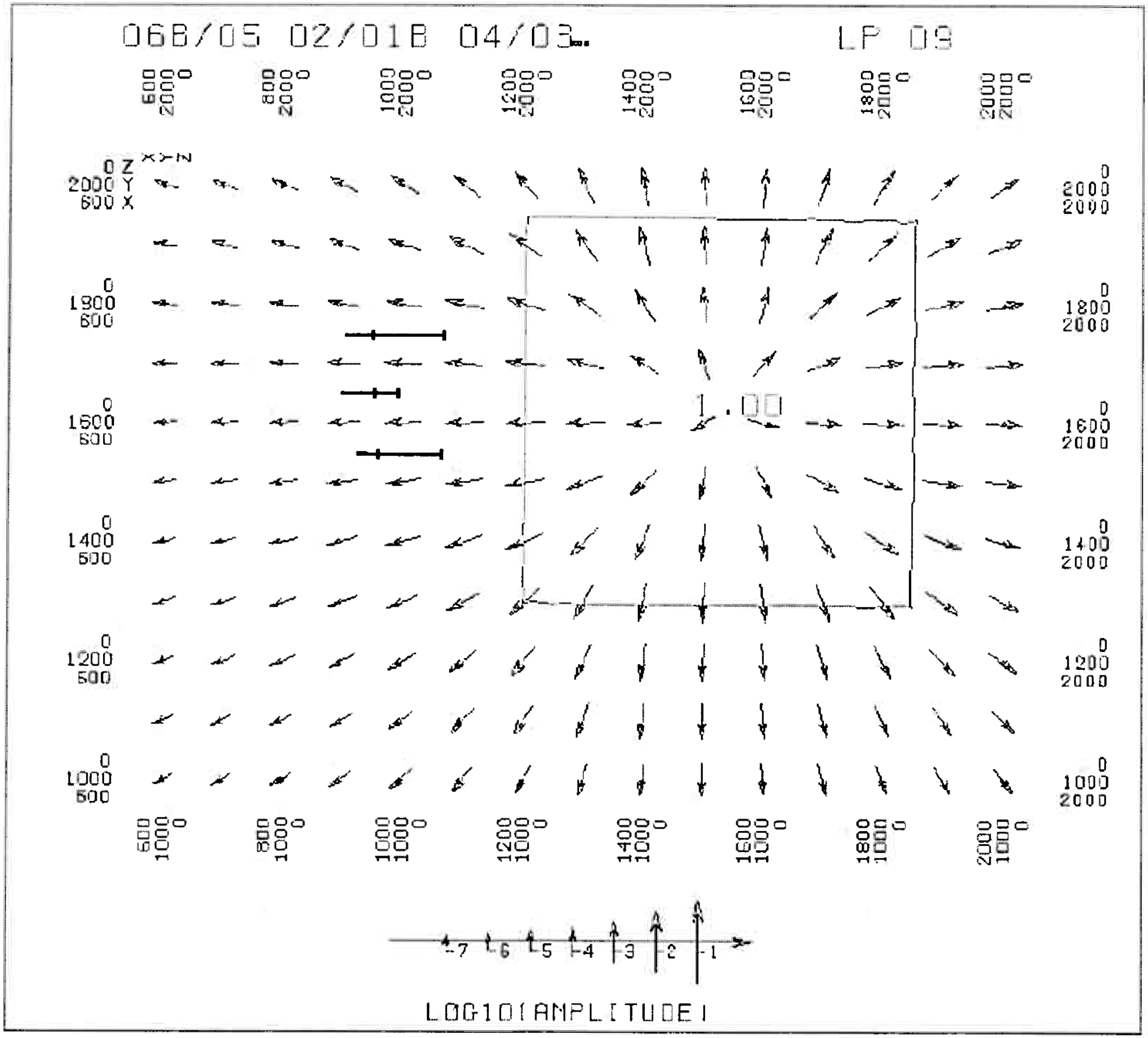
Loop: 09	Total, Chn/lHpl	BHUTEM Survey at: Ertelia Grid
Hole: ER-2006-05	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Axial	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 14/7/6 Reduced : 19/7/6 Plotted : 6/9/6

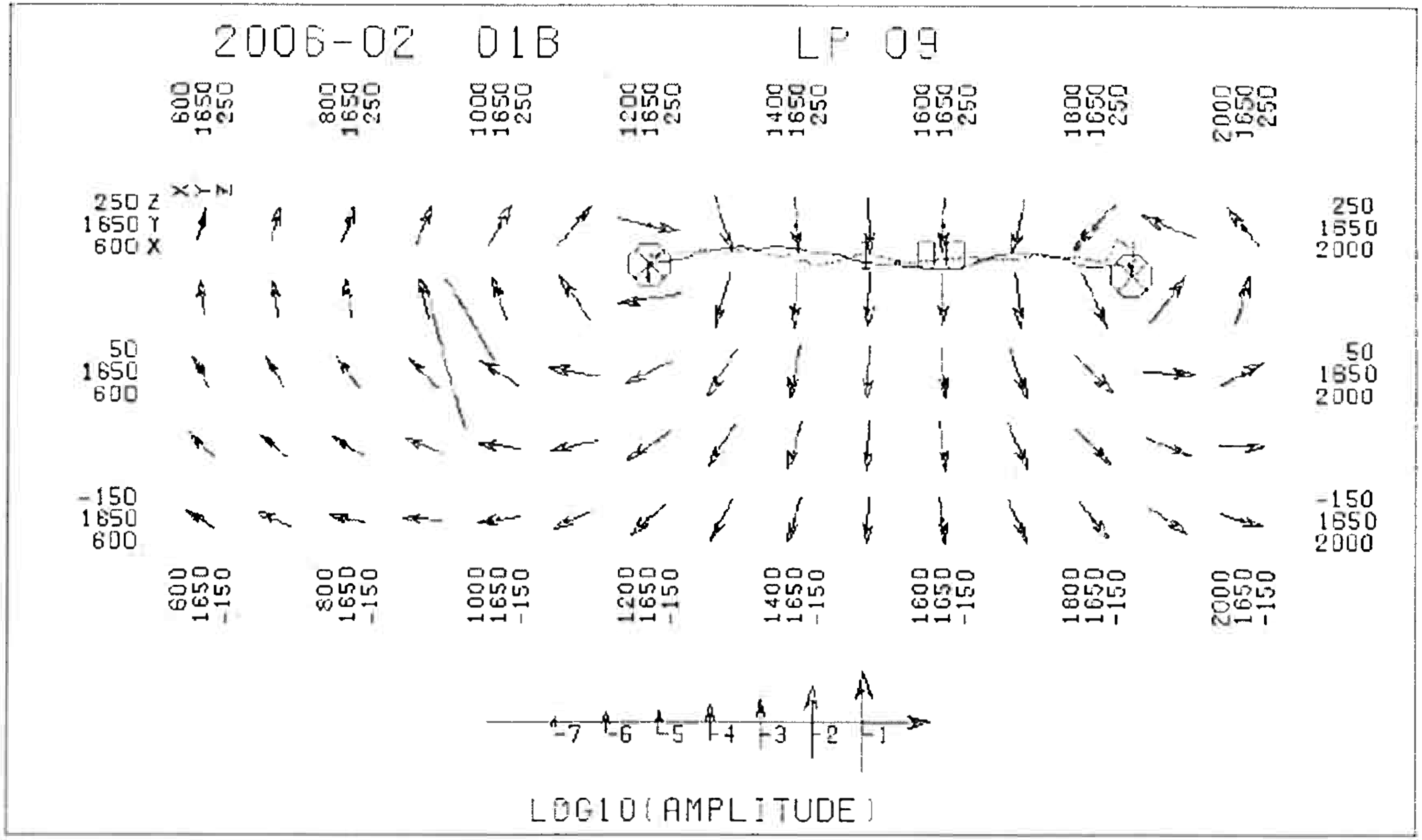


20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320
100%
-100%
100%
-40%
100%
-100%
BHUTEM Survey at: Ertelia Grid
For: A/S Sulfidmalm
LAMONTAGNE
GEOPHYSICS LTD
GEOPHYSIQUE LTEE
Job 0616
Surveyed : 19/7/6
Reduced : 19/7/6
Plotted : 6/9/6
Secondary, (Chn - Ch1)/IHpl
Contin. Norm at depth of 0 m
Base Freq. 3.251 Hz
Loop: 09
Hole: ER-2006-06B
Compt: Axial

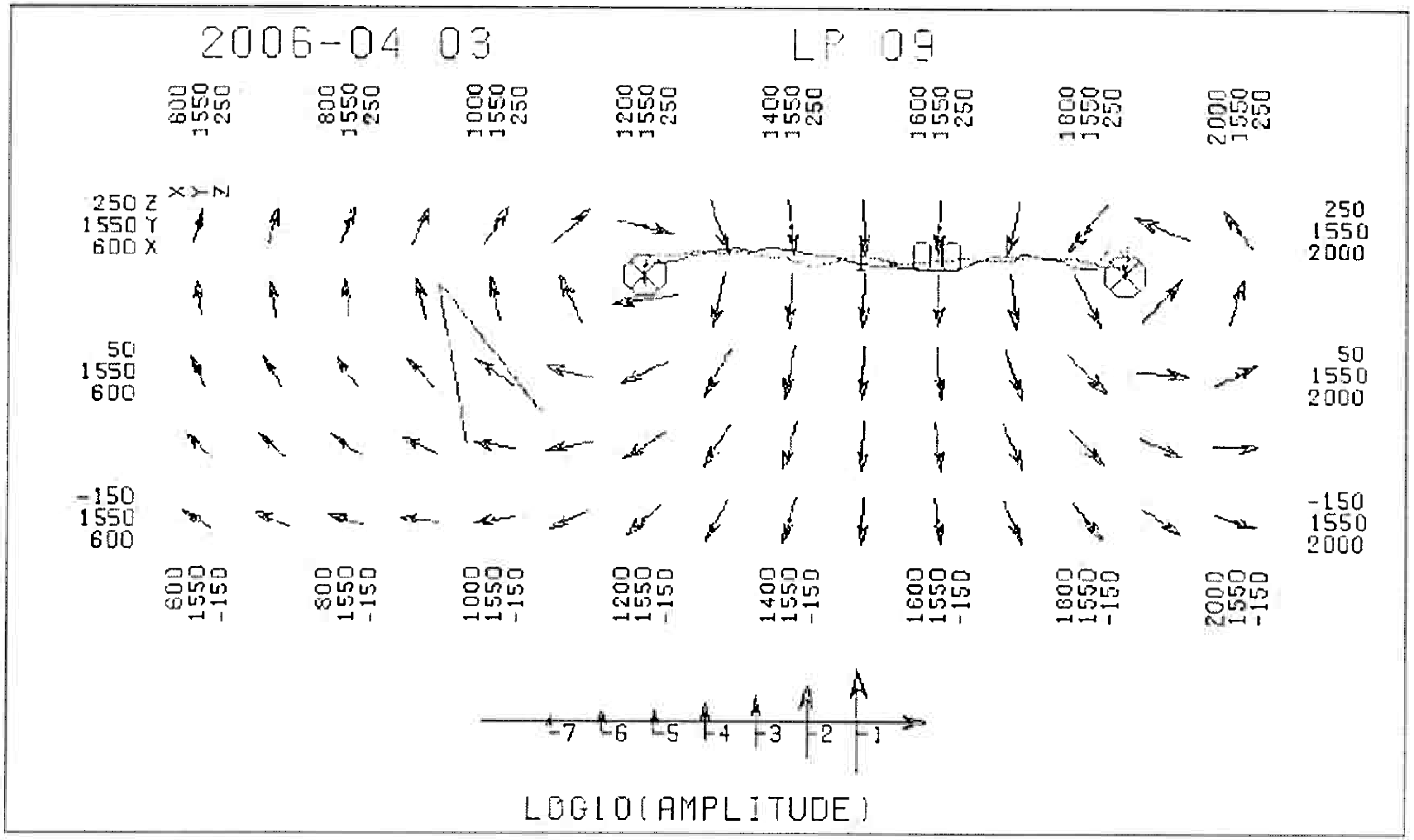


Loop: 09	Total, Chn/lHpl	BHUTEM Survey at: Ertelia Grid
Hole: ER-2006-06B	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Axial	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 19/7/6 Reduced : 19/7/6 Plotted : 6/9/6

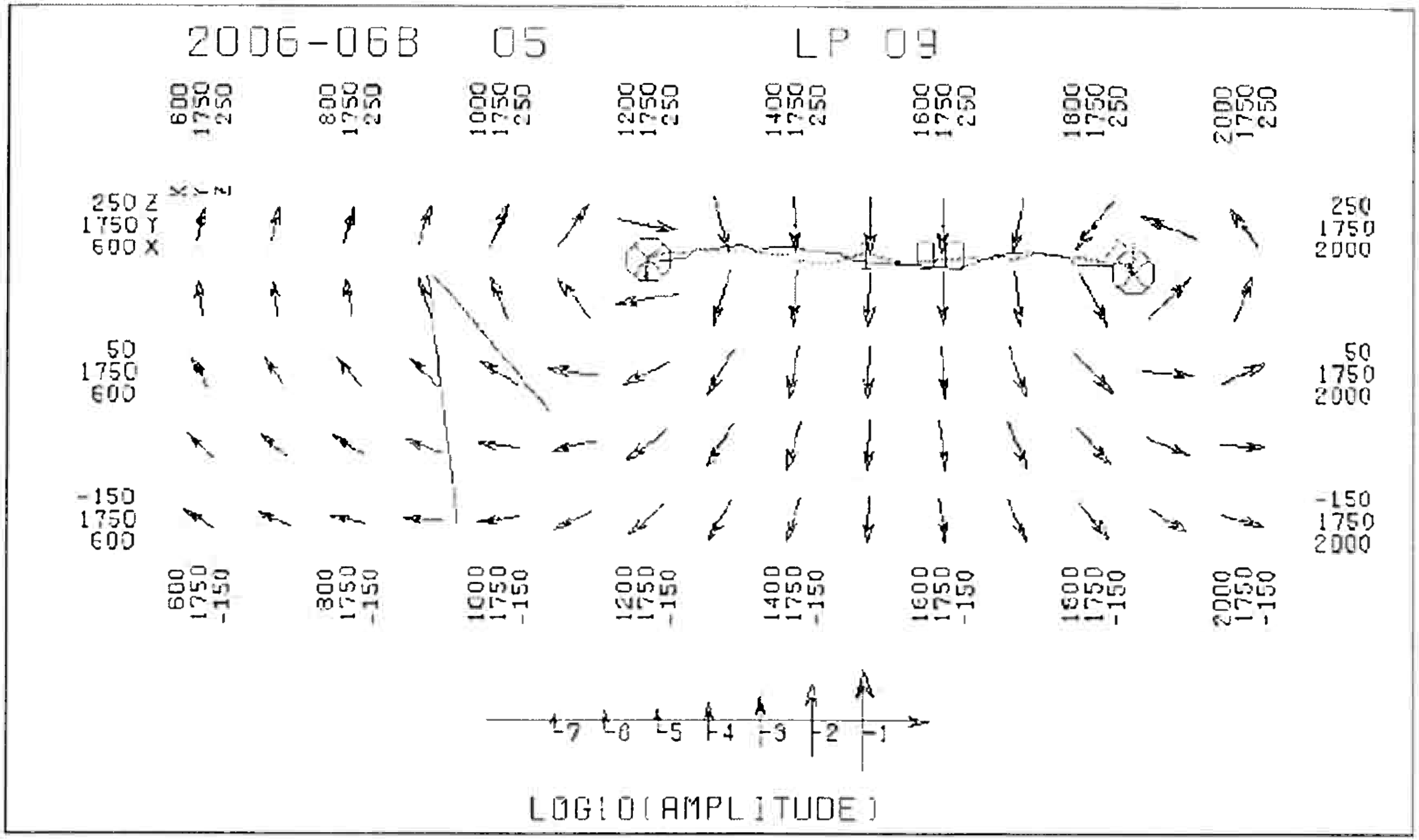

06B/05 02/01B 04/03
LP 09
0 Z
2000 Y
600 X
1.00
LOG10(AMPLITUDE)
-7 -6 -5 -4 -3 -2 -1



2006-02 01B
LP 09
600 1650 250
800 1650 250
1000 1650 250
1200 1650 250
1400 1650 250
1600 1650 250
1800 1650 250
2000 1650 250
X Y Z
250 Z
1650 Y
600 X
50 1650 600
-150 1650 600
250 1650 2000
50 1650 2000
-150 1650 2000
600 1650 -150
800 1650 -150
1000 1650 -150
1200 1650 -150
1400 1650 -150
1600 1650 -150
1800 1650 -150
2000 1650 -150
-7 -6 -5 -4 -3 -2 -1
LOG10(AMPLITUDE)



2006-04 03
LP 09
LOG10(AMPLITUDE)



2006-06B 05
LP 09
250 Z
1750 Y
600 X
50
1750
600
-150
1750
600
250
1750
2000
50
1750
2000
-150
1750
2000
-7 -6 -5 -4 -3 -2 -1
LOG10(AMPLITUDE)

Ertelia

Loop 09B - BH UTEM-3

@3.251 Hz frequency

Ch1 reduced

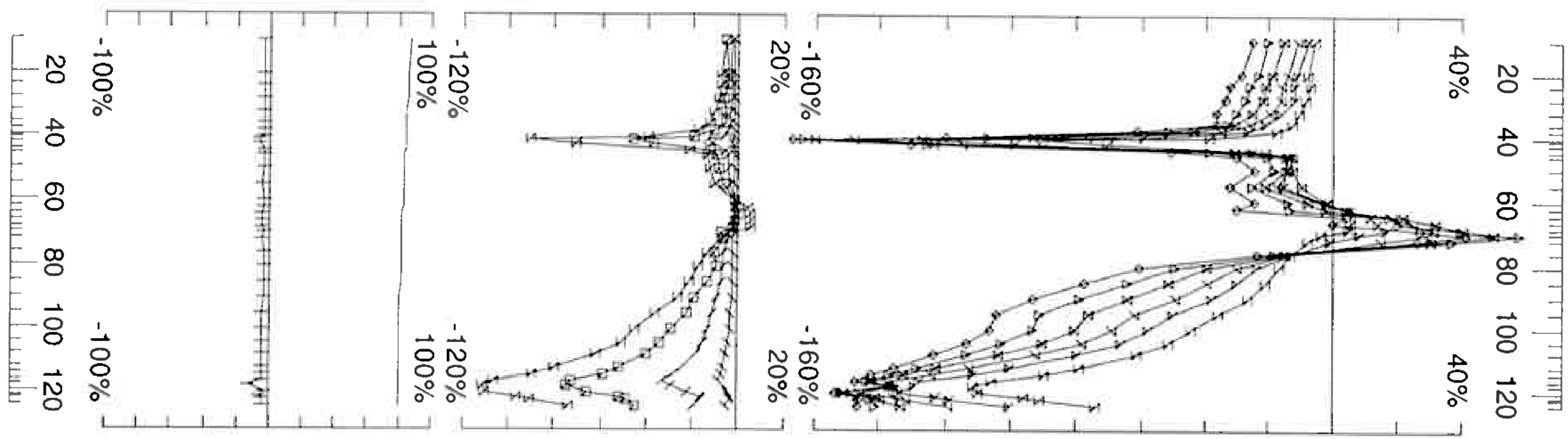
Ertelia	ER2006-01B	124m	208m	Loop 09B	3.251Hz
	ER2006-02	206m	208m	Loop 09 B	3.251Hz
	ER2006-03	220m	221m	Loop 09B	3.251Hz
	ER2006-04	220m	221m	Loop 09B	3.251Hz
	ER2006-05	236m	239m	Loop 09B	3.251Hz
	ER2006-06B	336m	342m	Loop 09B	3.251Hz

ER2006-01B
ER2006-02
ER2006-03
ER2006-04
ER2006-05
ER2006-06B

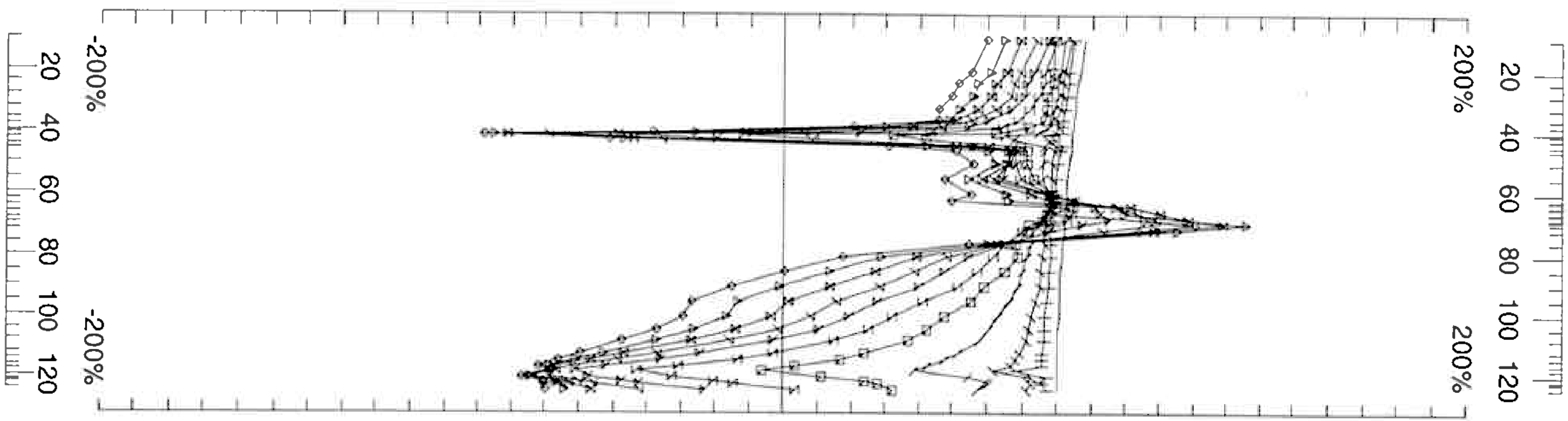
3-axis plot
total field plot

plan vectorplot - all holes
grideast-west section vectorplot - holes 01B/02
grideast-west section vectorplot - holes 03/04
grideast-west section vectorplot - holes 05/06B

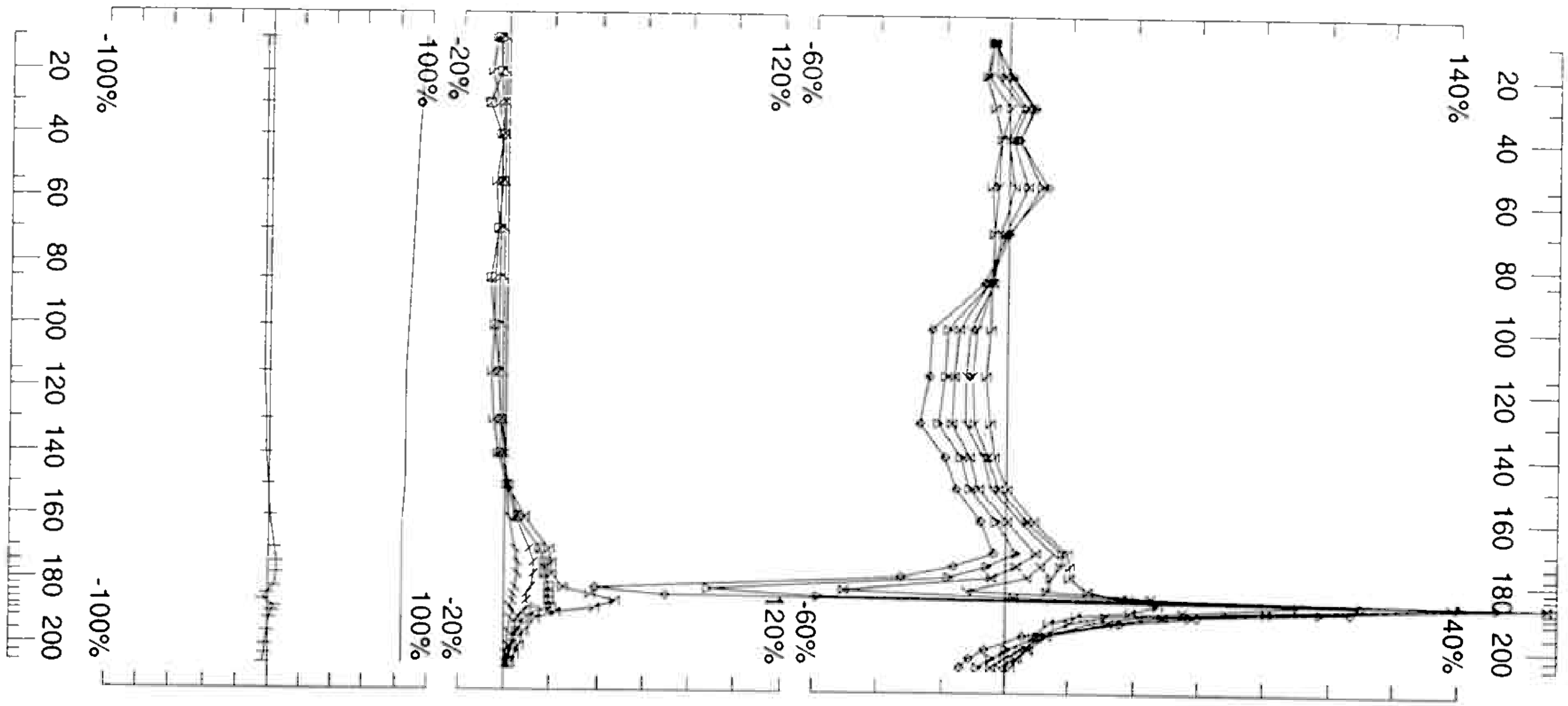
ER2006-01B/02/03/04/05/06B



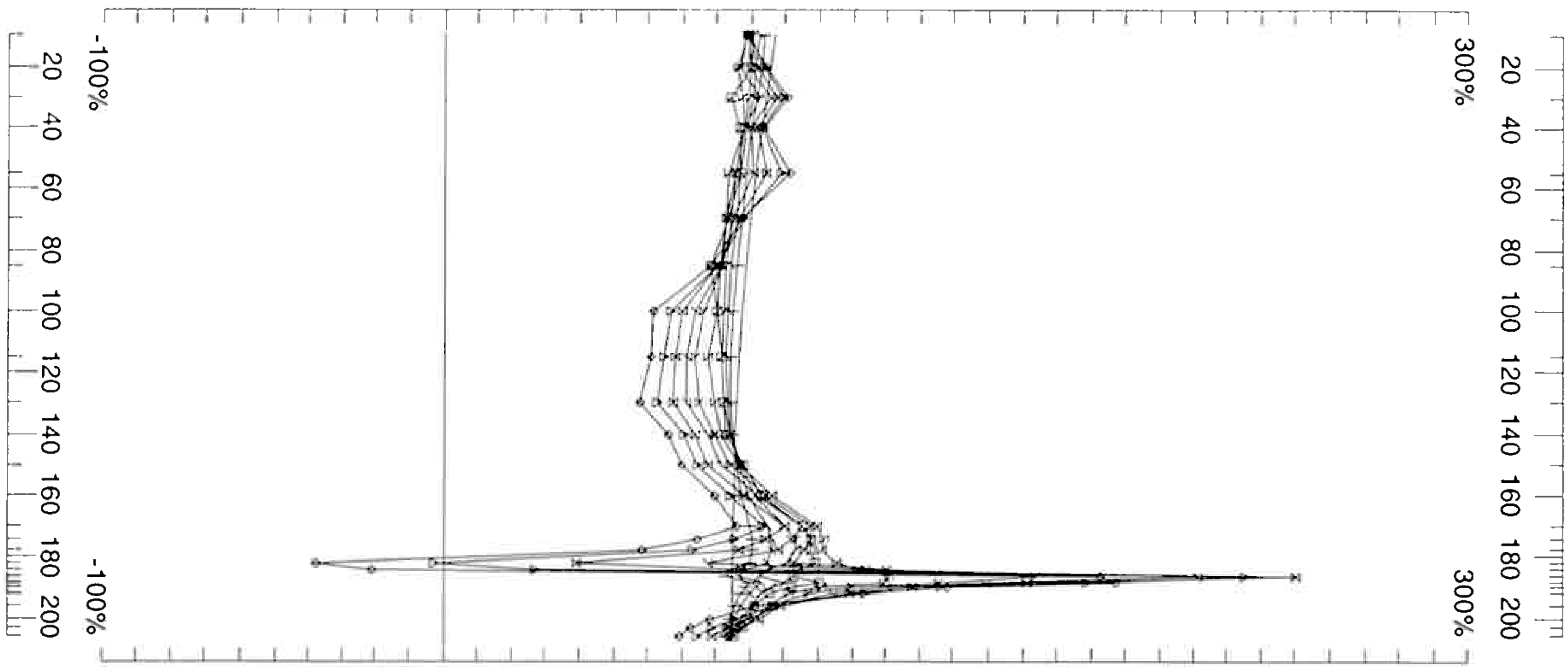
Loop: 09B	Secondary, (Chn - Ch1)/IHpl	BHUTEM Survey at: Ertelia Grid
Hole: ER-2006-01B	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Axial	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 14/7/6 Reduced : 14/7/6 Plotted : 6/9/6



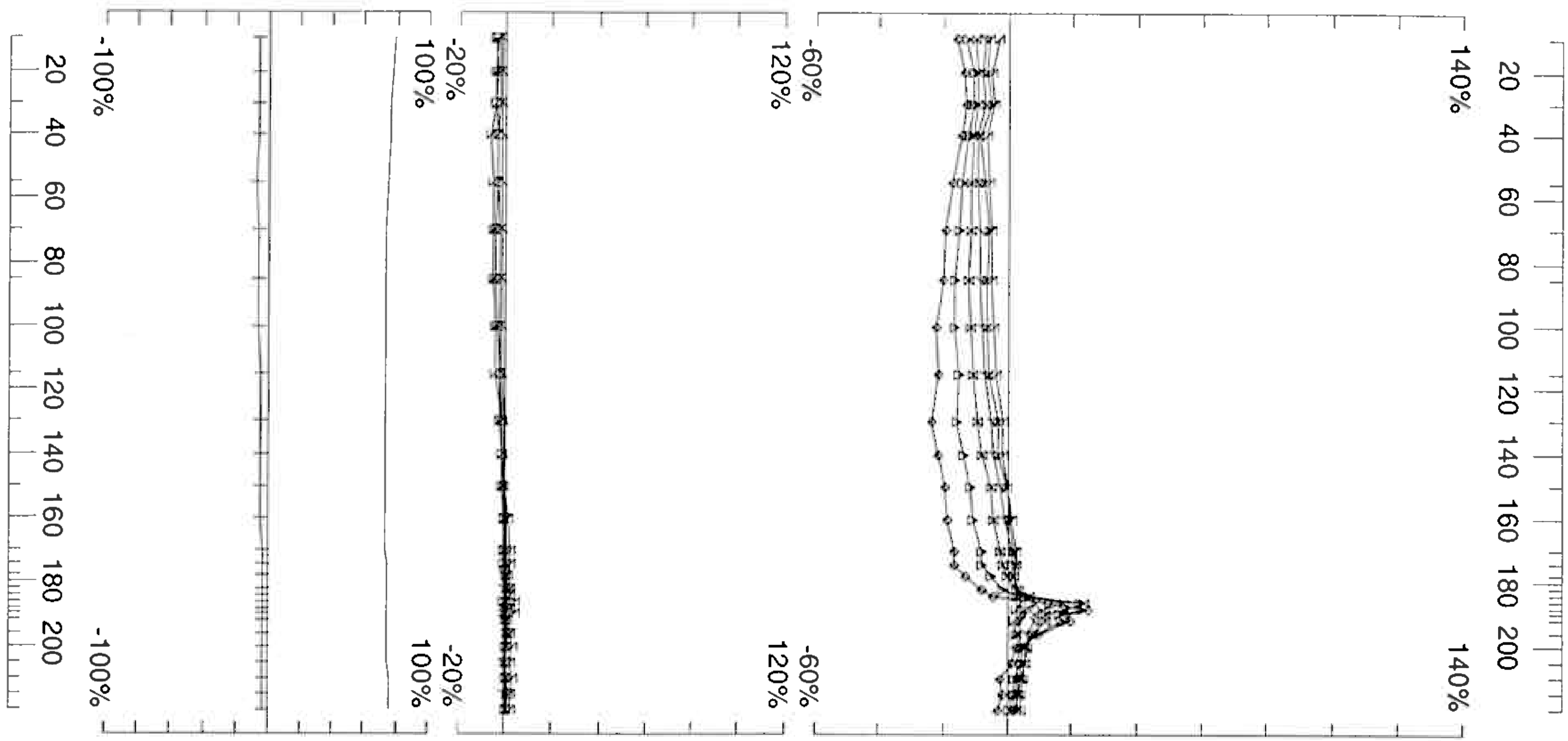
Loop: 09B	Total, Chn/lHpl	BHUTEM Survey at: Ertelia Grid
Hole: ER-2006-01B	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Axial	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 14/7/6 Reduced : 14/7/6 Plotted : 6/9/6



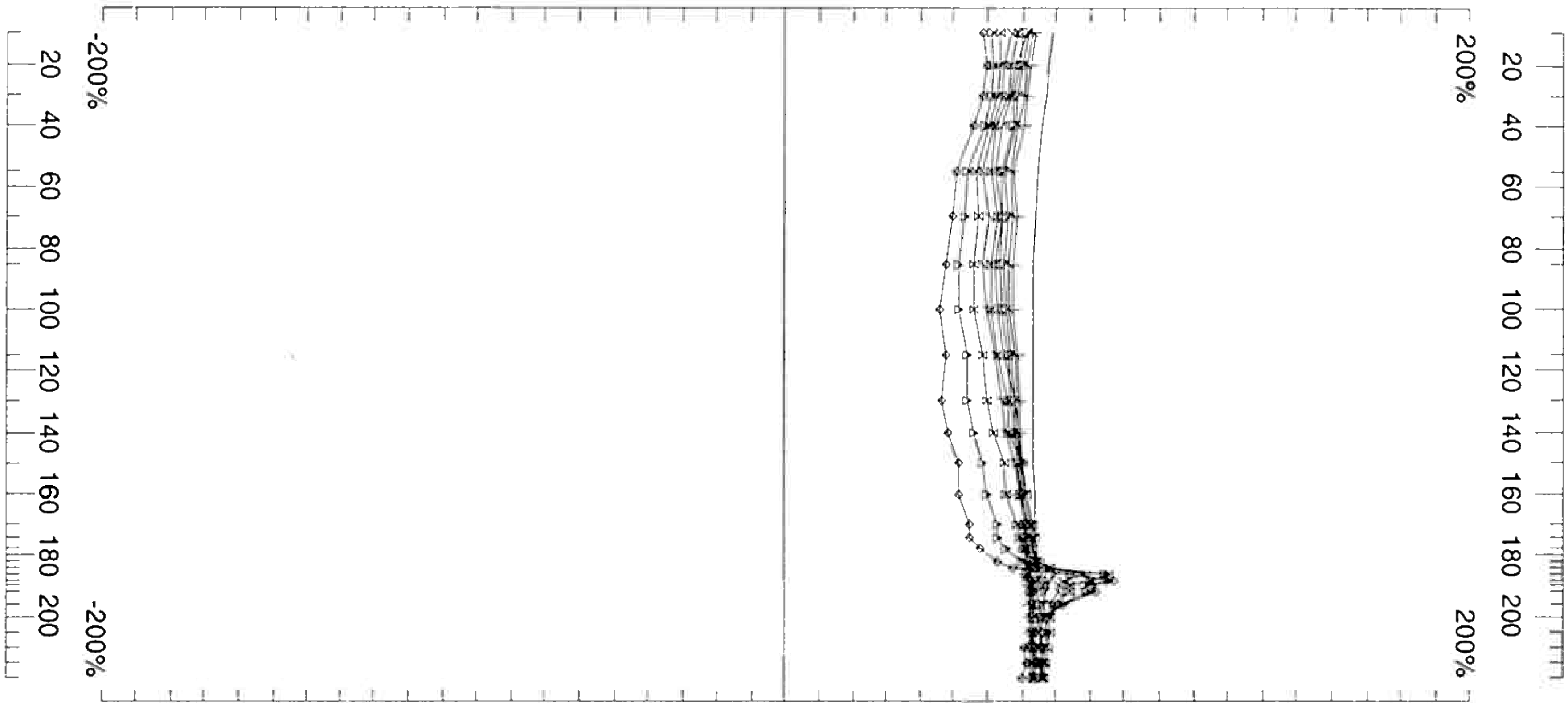
Loop: 09B Hole: ER-2006-02 Compt: Axial	Secondary, (Chn - Ch1)/lHpl Contin. Norm at depth of 0 m Base Freq. 3.251 Hz	BHUTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed: 13/7/6 Reduced: 14/7/6 Plotted: 6/9/6



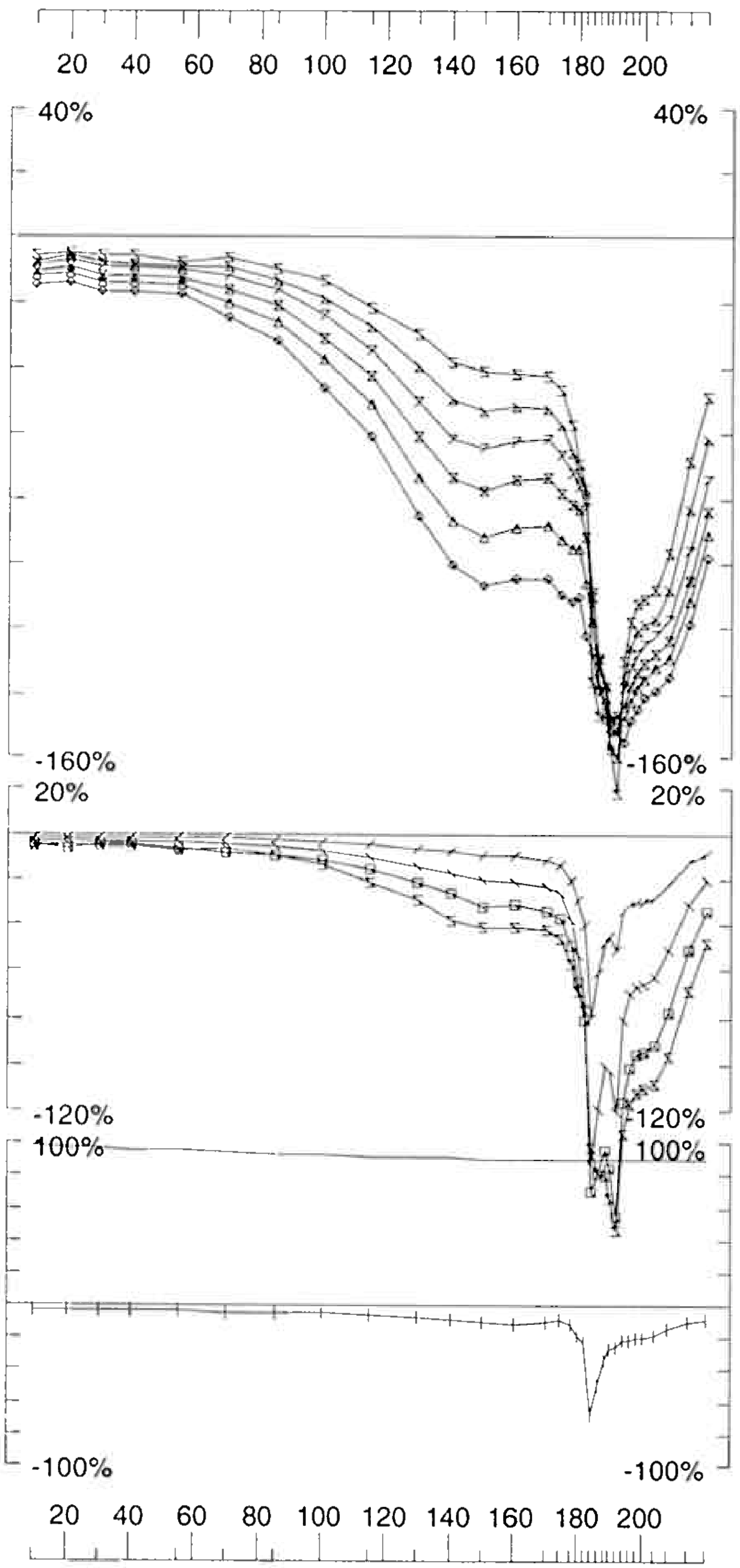
Loop: 09B	Total, Chn/IHpl	BHUTEM Survey at: Ertelia Grid
Hole: ER-2006-02	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Axial	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 13/7/6 Reduced : 14/7/6 Plotted : 6/9/6



Loop: 09B Hole: ER-2006-03 Compt: Axial	Secondary, (Chn - Ch1)/IHpl Contin. Norm at depth of 0 m Base Freq. 3.251 Hz	BHUTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed: 12/7/6 Reduced: 13/7/6 Plotted: 6/9/6



Loop: 09B Hole: ER-2006-03 Compt: Axial	Total, Chn/IHpl Contin. Norm at depth of 0 m Base Freq. 3.251 Hz	BHUTEM Survey at: Ertelia Grid For: A/S Sulfidmalm LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed : 12/7/6 Reduced : 13/7/6 Plotted : 6/9/6



BHUTEM Survey at: Ertelia Grid
For: A/S Sulfidmalm

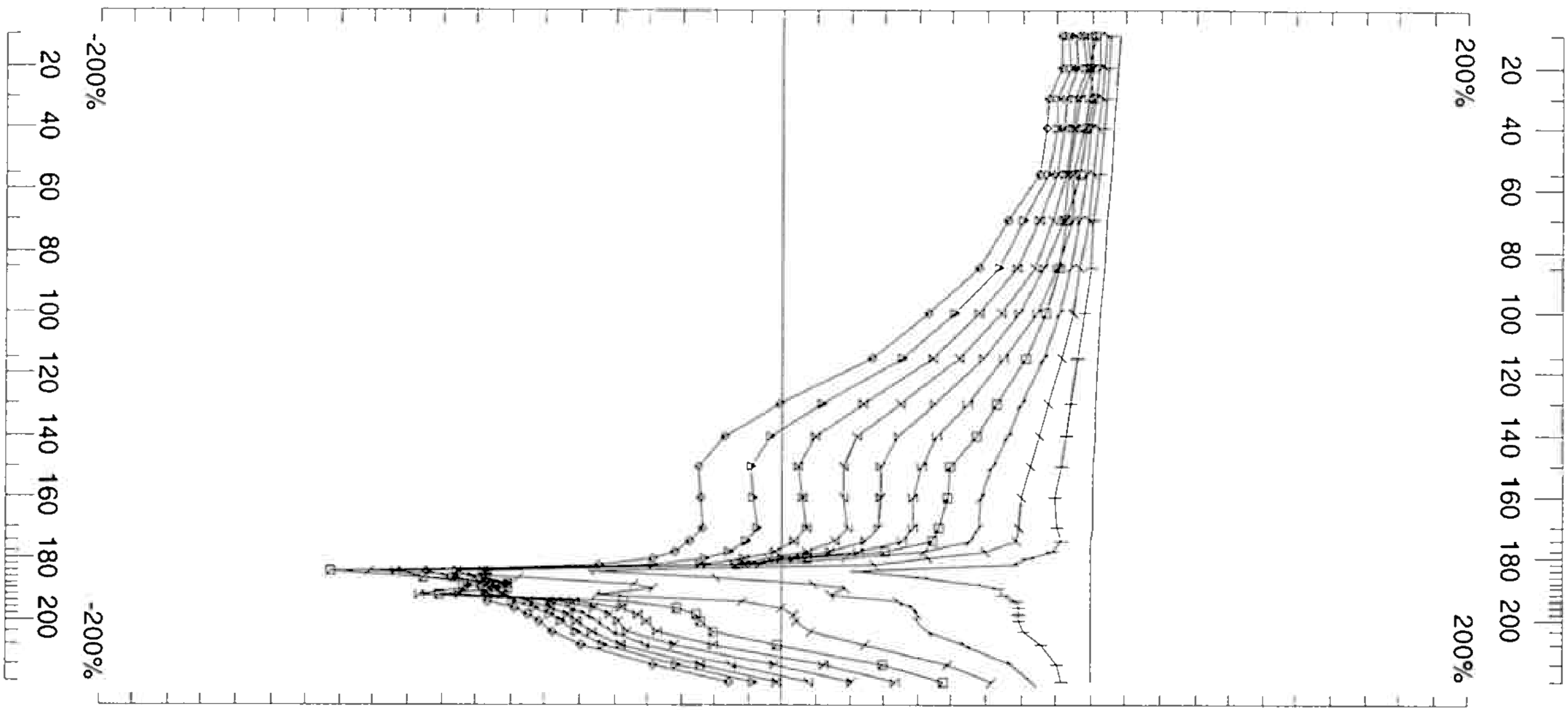
LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE

Job 0616

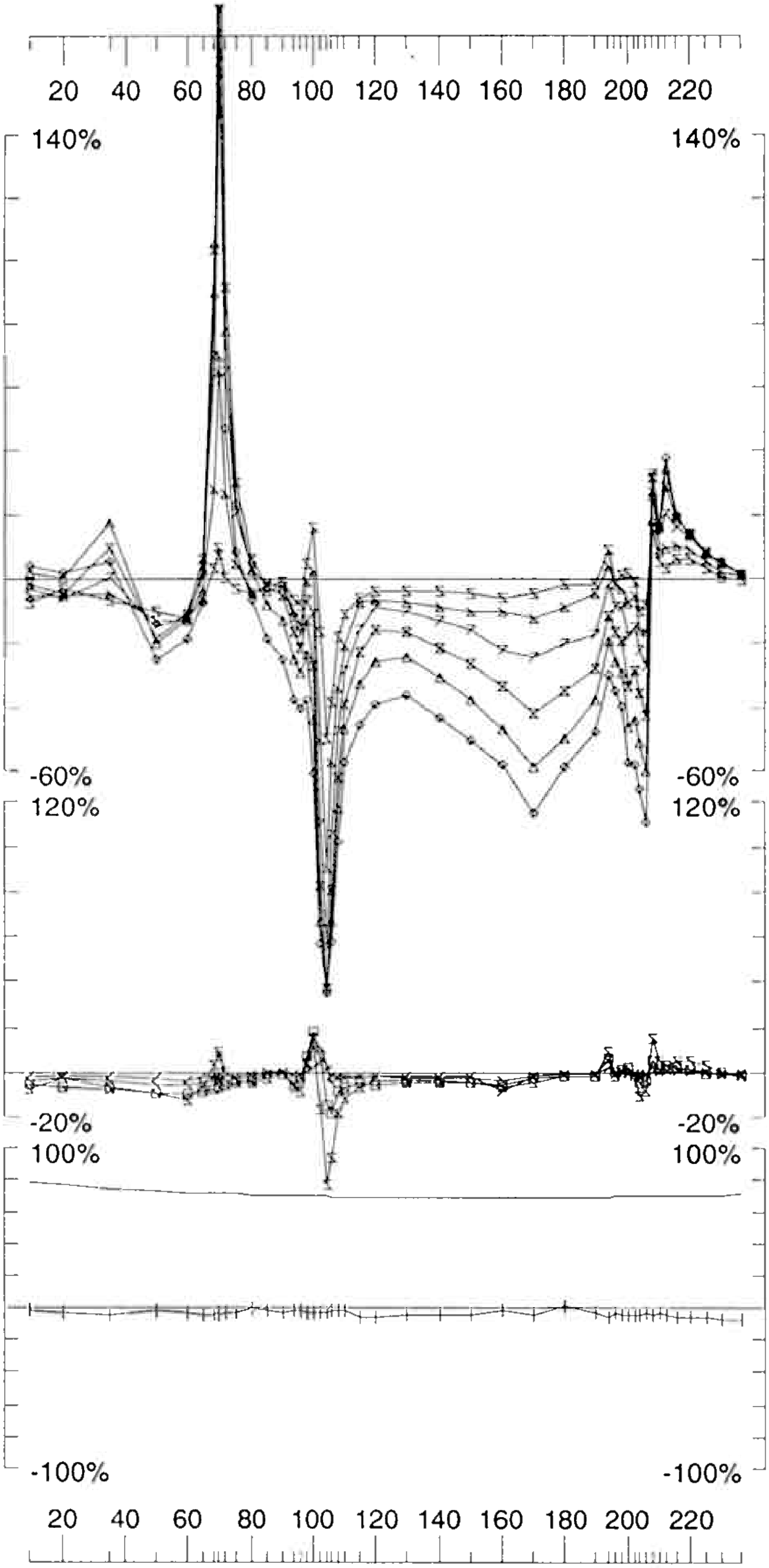
Surveyed: 12/7/6
Reduced: 13/7/6
Plotted: 6/9/6

Secondary, (Chn - Ch1)/IHpl
Contin. Norm at depth of 0 m
Base Freq. 3.251 Hz

Loop: 09B
Hole: ER-2006-04
Compt: Axial



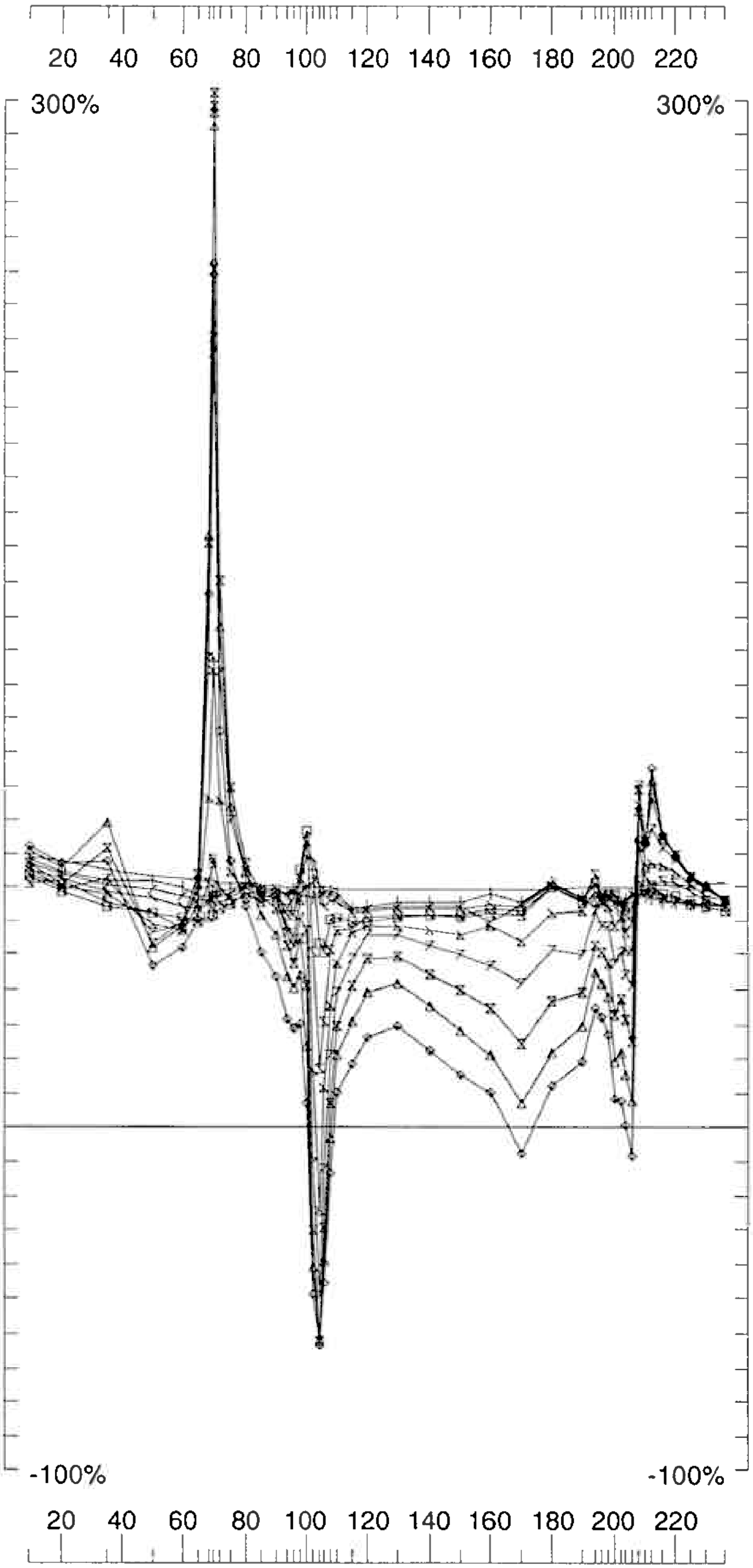
Loop: 09B	Total, Chn/IHp!	BHUTEM Survey at: Ertelia Grid
Hole: ER-2006-04	Contin. Norm at depth of 0 m	For: A/S Sulfidmalm
Compt: Axial	Base Freq. 3.251 Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE Job 0616 Surveyed: 12/7/6 Reduced: 13/7/6 Plotted: 6/9/6



BHUTEM Survey at: Ertelia Grid
For: A/S Sulfidmalm
LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE
Job 0616
Surveyed: 14/7/6
Reduced: 14/7/6
Plotted: 6/9/6

Secondary, (Chn - Ch1)/IHpl
Contin. Norm at depth of 0 m
Base Freq. 3.251 Hz

Loop: 09B
Hole: ER-2006-05
Compt: Axial



BHUTEM Survey at: Ertelia Grid
For: A/S Sulfidmalm

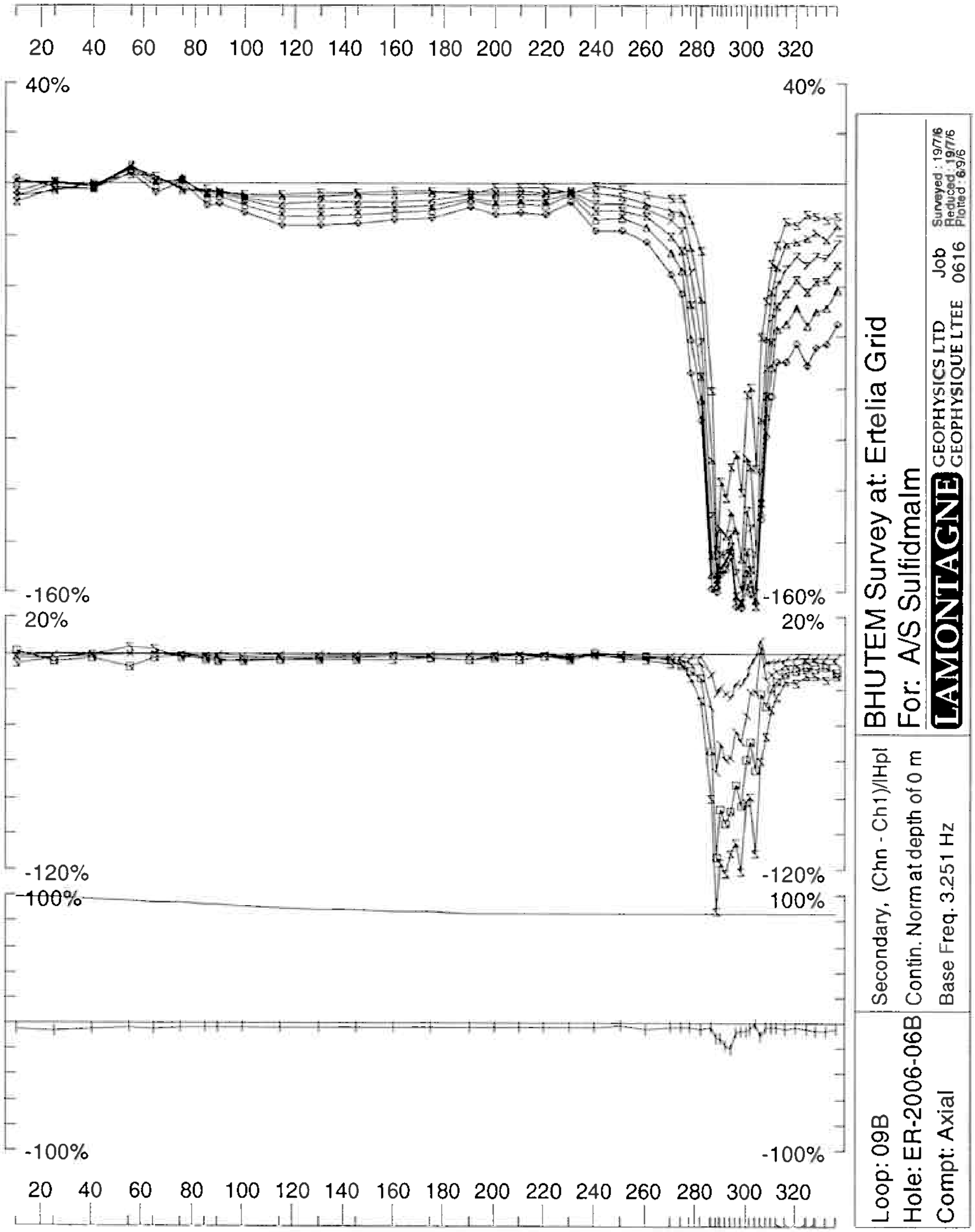
LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE

Job 0616

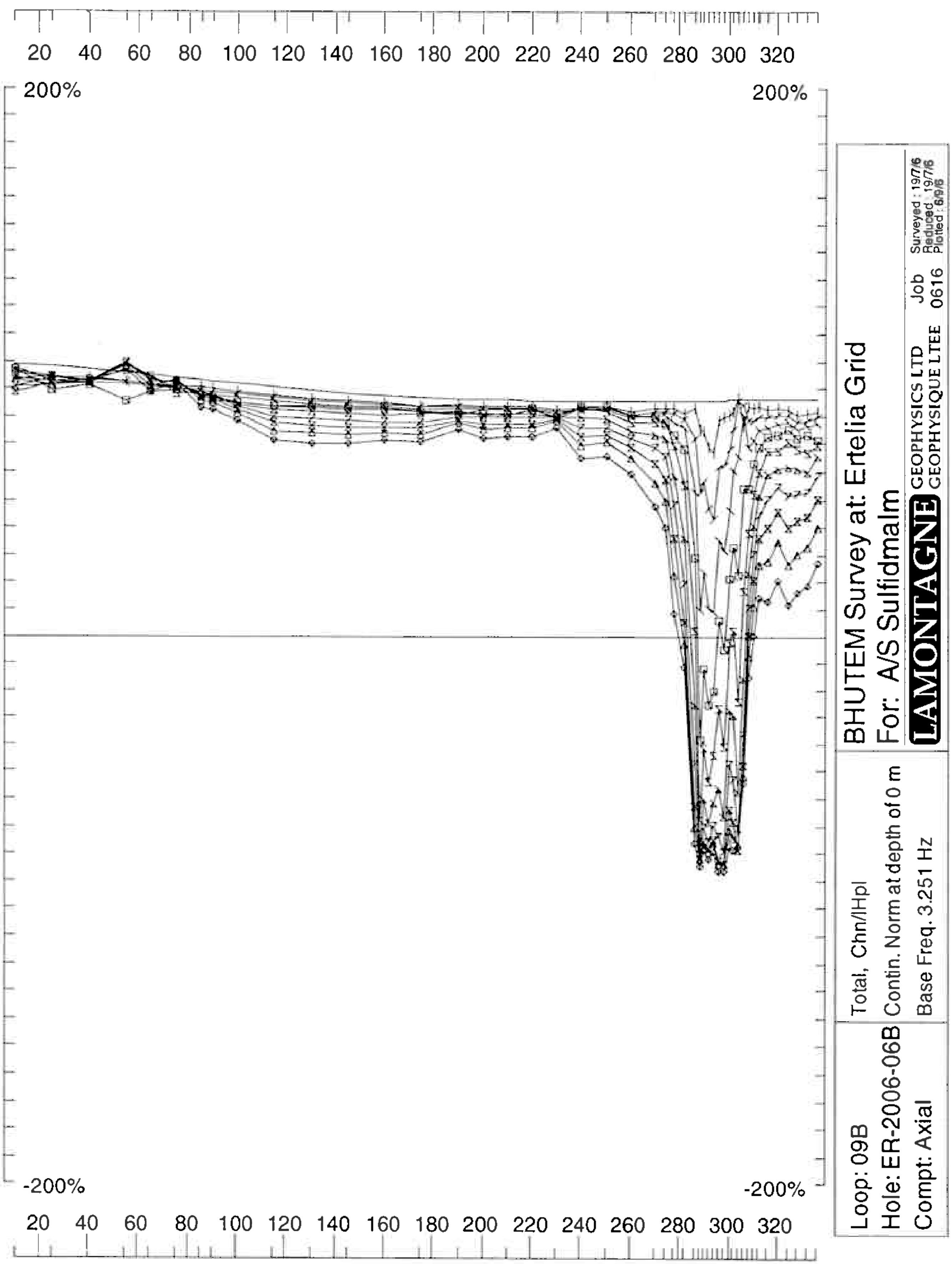
Surveyed: 14/7/6
Reduced: 14/7/6
Plotted: 6/9/6

Loop: 09B
Hole: ER-2006-05
Compt: Axial

Total, Chn/IHpl
Contin. Norm at depth of 0 m
Base Freq. 3.251 Hz

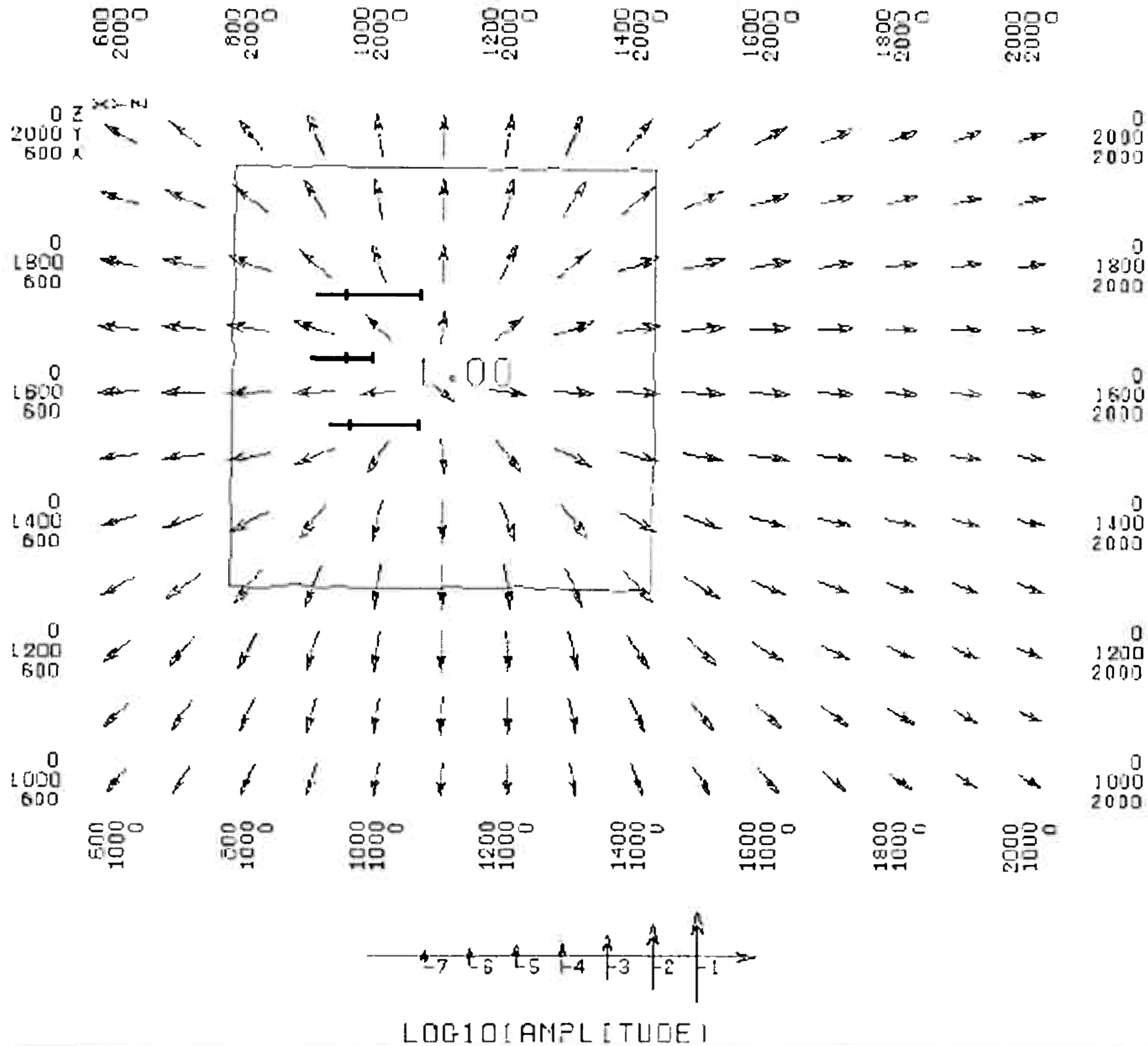


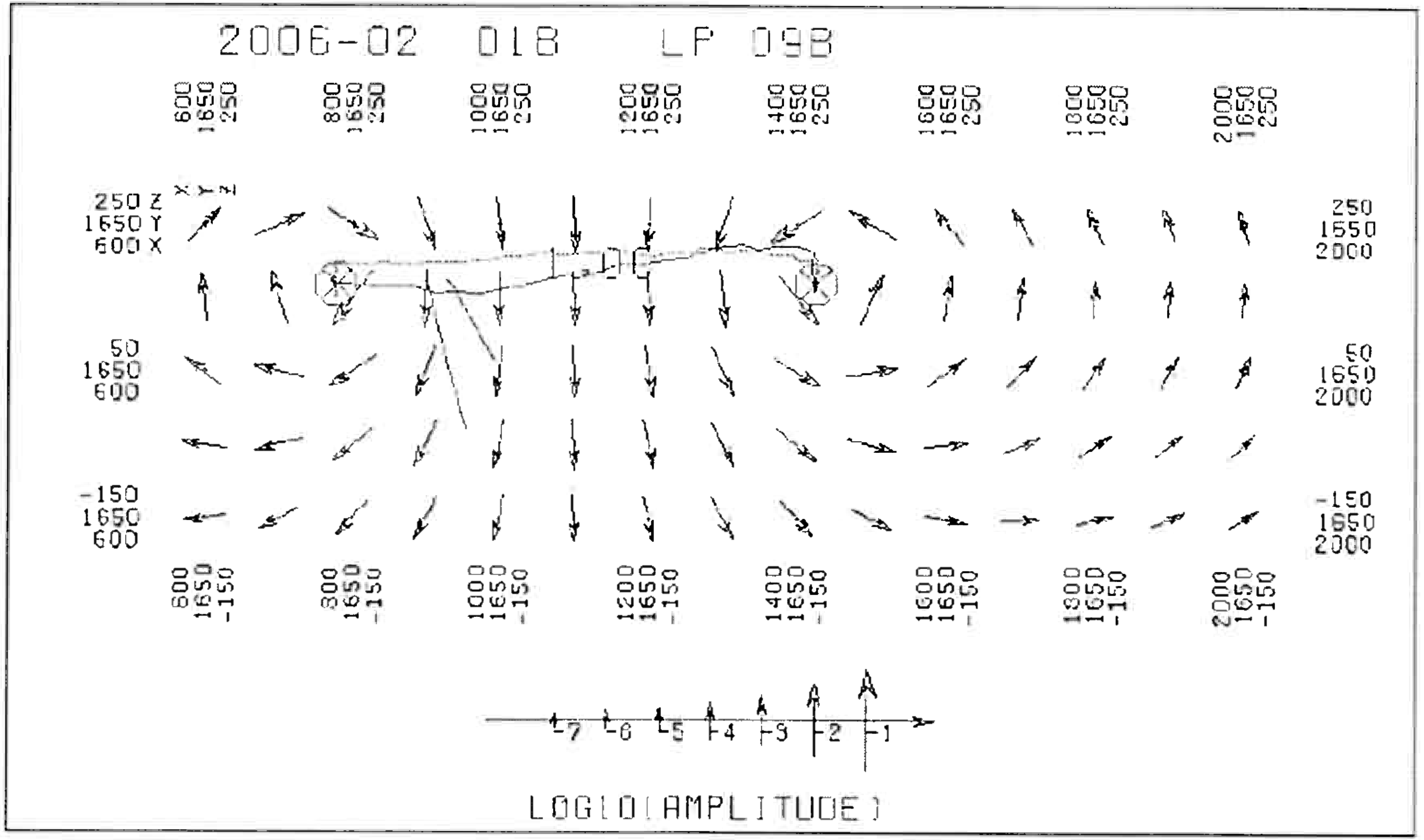
20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320
40%
-160%
20%
-120%
100%
-100%
BHUTEM Survey at: Ertelia Grid
For: A/S Sulfidmalm
LAMONTAGNE
GEOPHYSICS LTD
GEOPHYSIQUE LTEE
Job 0616
Surveyed : 19/7/6
Reduced : 19/7/6
Plotted : 6/9/6
Secondary, (Chn - Ch1)/IHpI
Contin. Norm at depth of 0 m
Base Freq. 3.251 Hz
Loop: 09B
Hole: ER-2006-06B
Compt: Axial



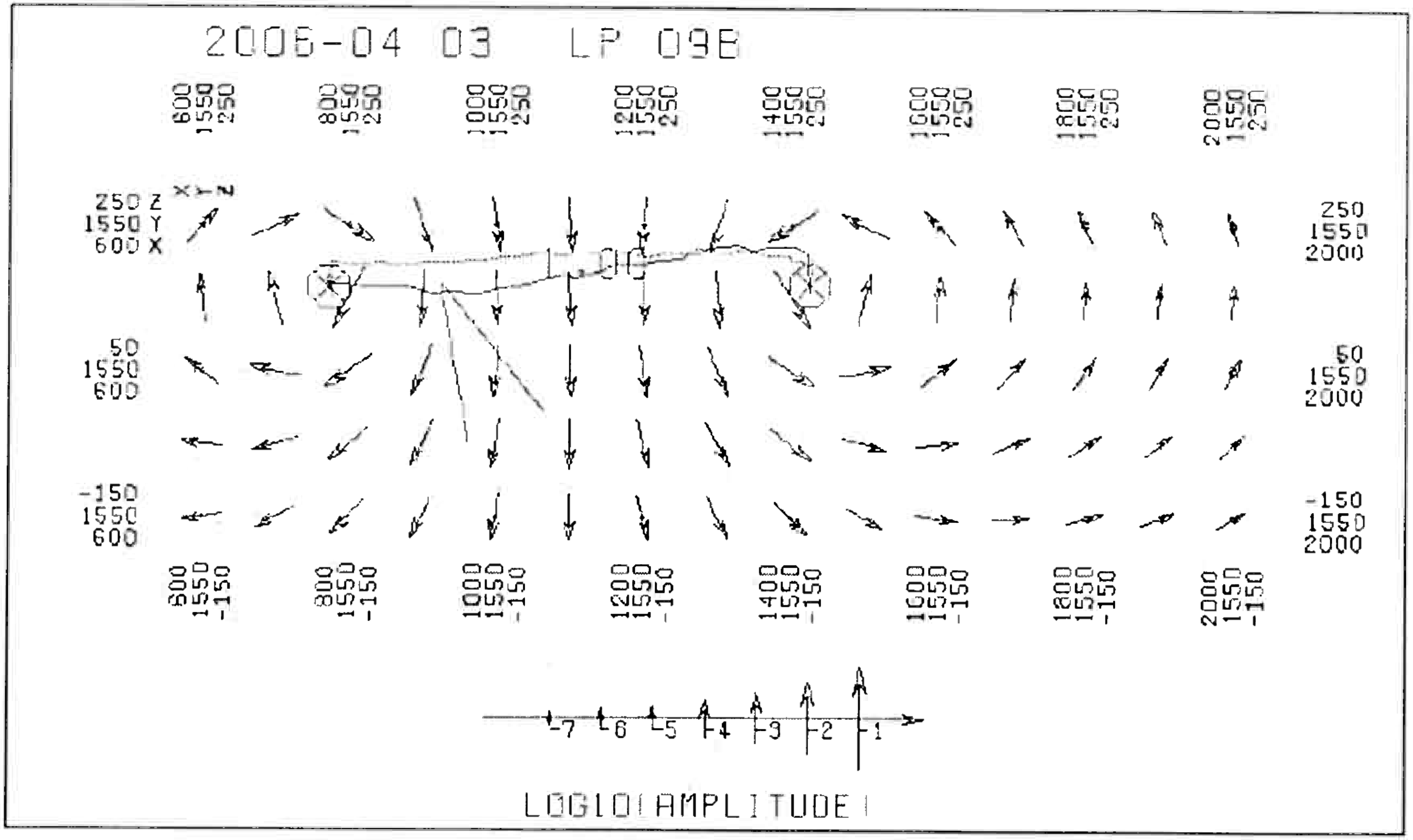
20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320
200%
-200%
BHUTEM Survey at: Ertelia Grid
For: A/S Sulfidmalm
LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE
Job 0616
Surveyed : 19/7/6
Reduced : 19/7/6
Plotted : 6/9/6
Total, Chn/lHpl
Contin. Norm at depth of 0 m
Base Freq. 3.251 Hz
Loop: 09B
Hole: ER-2006-06B
Compt: Axial

06B/05 02/01B 04/03LP09B

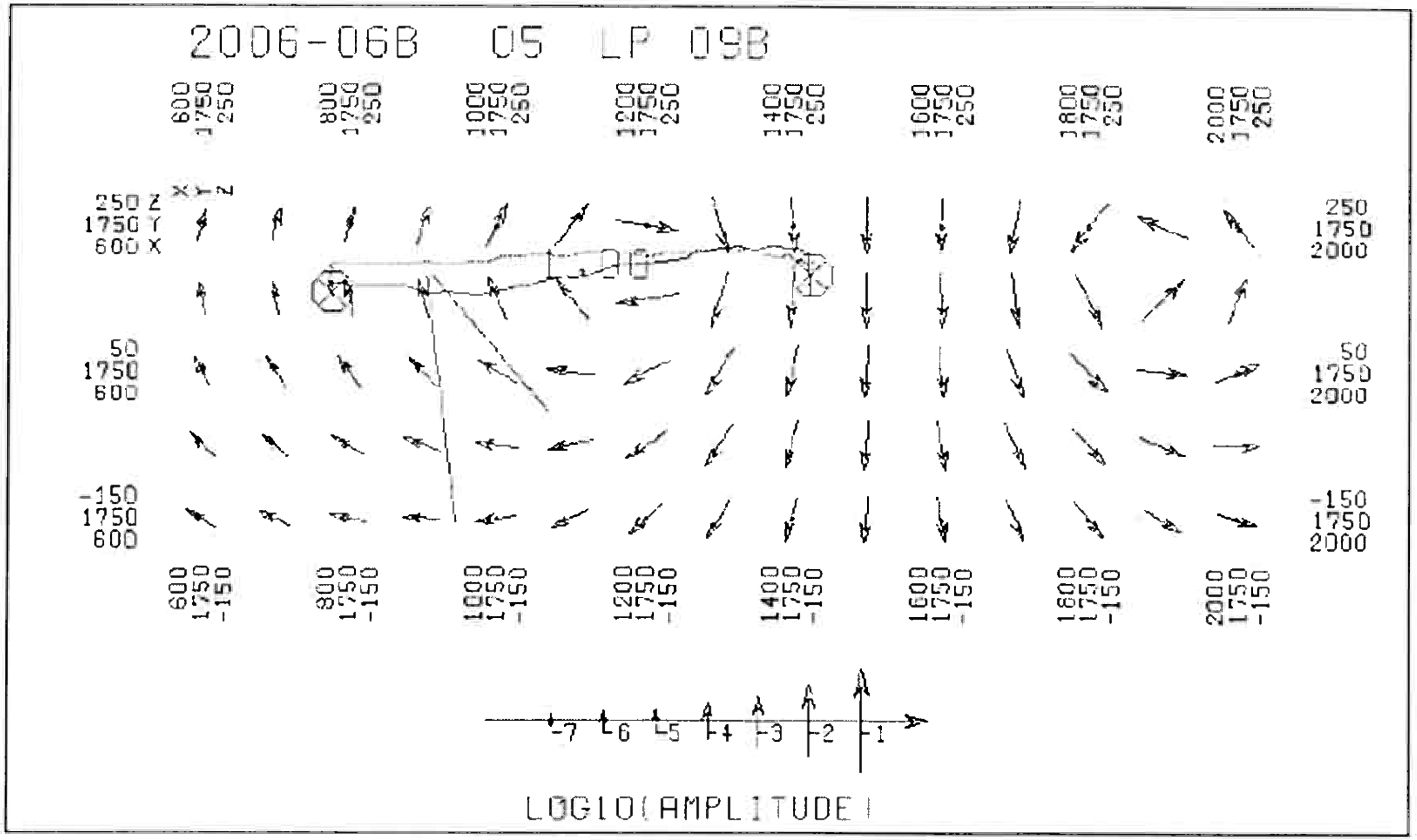




2006-02 01B LP 09B
600 1650 250
800 1650 250
1000 1650 250
1200 1650 250
1400 1650 250
1600 1650 250
1800 1650 250
2000 1650 250
X Y Z
250 Z
1650 Y
600 X
250 1650 2000
50 1650 600
50 1650 2000
-150 1650 600
-150 1650 2000
600 1650 -150
800 1650 -150
1000 1650 -150
1200 1650 -150
1400 1650 -150
1600 1650 -150
1800 1650 -150
2000 1650 -150
-7 -6 -5 -4 -3 -2 -1
LOG10(AMPLITUDE)



2006-04 03 LP 09B
600 1550 250
800 1550 250
1000 1550 250
1200 1550 250
1400 1550 250
1600 1550 250
1800 1550 250
2000 1550 250
X Y Z
250 Z
1550 Y
600 X
50
1550
600
-150
1550
600
250
1550
2000
50
1550
2000
-150
1550
2000
600 1550 -150
800 1550 -150
1000 1550 -150
1200 1550 -150
1400 1550 -150
1600 1550 -150
1800 1550 -150
2000 1550 -150
-7
-6
-5
-4
-3
-2
-1
LOG10(AMPLITUDE)



2006-06B 05 LP 09B
LOG10(AMPLITUDE)

Appendix B

0616 Production Diary

UTEM 3 Surface Survey

Ertelien Grid
Norway

for

A/S Sulfidmalm

Production Log (0616)
UTEM Survey - Ertelien
Norway
A/S Sulfidmalm

Date	Rate	Production	Comments
up to June 04		-	Discussions, signing of the contract, assembly of crew and equipment.
June 05	Mob	(equip)	Equipment packed up and labelled. Picked up from Kingston. Shipping address is: Wilhelmsen Agencies AS P. Box 14 NO 2061 Gardermoen Norway
June 11	Mob	-	The LGL crew -Rob Langridge, John Frost, Kevin Arsenault and Pat Foley - travel from Canada->Frankfurt(FRA)->Oslo (OSL).
June 12 - July 07		-	Crew working on other grids in Norway.
July 04	Mob (BH equip)		Borehole equipment packed up and labeled. Picked up from Kingston. Crew working on other grids in Norway. Crew:R.Langridge,J.Frost,K.Arsenault,P.Foley
July 05	Mob (BH equip)		Borehole equipment in transit. Crew working on other grids in Norway.
July 06	Mob (BH equip)		Borehole equipment in transit. Crew working on other grids in Norway.
July 07	Mob (BH equip)		Borehole equipment in transit. Crew working on other grids in Norway.
July 08	Mob (BH equip)		Borehole equipment in transit. Crew moves to Tyristrand. Stop at airport to clarify tickets.
July 09	**P(2)-4** Mob (BH equip)		Out to the Ertelia Grid to lay out Loops 09 and 09B. Pack gear into transmitter site. Crew back in camp ~14:30 Crew:R.Langridge,J.Frost,K.Arsenault,P.Foley Total to date: 0.000km

Date	Rate	Production	Comments
July 10	P(2)-4 Mob (BH equip)	1425m	Out to the Ertelia Grid. Read three lines in noisy conditions with some minor transmitter problems. Crew back in camp ~18:00. Note: Rx 04 shipped back to Canada at the request of Falconbridge. BH gear collected from airport and unpacked.

Loop 09

Line 1450N	**700E**	-	**1200E**	**Hz**	**Rx05**
Line 1500E	**775E**	-	**1200E**	**Hz**	**Rx05**
Line 1700E	**700E**	-	**1200E**	**Hz**	**Rx5/6**

Crew:R.Langridge,J.Frost,K.Arsenault,P.Foley Total to date: 1.425km

Date	Rate	Production	Comments
July 11	**P(1)-2**	550m	Out to the Ertelia Grid. Repair a loop break and set up the surface crew - they read without incident.
	PB(1)-2	BH 440m	Set up and dummy BH-ER-2006-04 (221m) and BH-ER-2006-03 (221m). Read both holes to 220m from Loop 9. Crew back in camp ~17:30. Note: after supper Kevin Arsenault and Pat Foley travel to the Norlandia Hotel and stay overnight prior to flying home. Rx 04 (spare) in transit.

Loop 09

Line 1650E	**700E**	-	**1200E**	**Hz**	**Rx05**
Line 1750E	**725E**	-	**775E**	**Hz**	**Rx05**

Crew:R.Langridge,J.Frost,K.Arsenault,P.Foley Total to date: 1.975km

Date	Rate	Production	Comments
July 12	**PB(1)-2**	BH 440m	Set up to read BH-ER-2006-04 and BH-ER-2006-03. Loop 9B was repaired and we read both holes to 220m from Loop 9B with the assistance of Nadia Asgeirsdottir. Crew back in camp ~17:00. Note: Kevin Arsenault and Pat Foley travel to the Canada and arrive safely. Rx 04 in transit.

Crew:**R.Langridge,J.Frost**,K.Arsenault,P.Foley Total to date: 1.975km

Date	Rate	Production	Comments
July 13	**PB(1)-2**	BH 625m	Set up and read BH-ER-2006-02 (206m) from Loop 9B with the assistance of Nadia Asgeirsdottir while Loop 9 is repaired. Switch to Loop 9 and read ER-2006-02 up. Dummy ER-2006-01B to 125m - it broke through into old workings just below this. Read ER-2006-01B to 95m from Loop 9. At this point we encountered a problem that turned out to be a low battery in the probe. Crew back in camp ~17:15. Note: Rx 04 in transit.

Crew:R.Langridge,J.Frost Total to date:

Date	Rate	Production	Comments
			1.975km

Date	Rate	Production	Comments
July 14	PB(1)-2	BH 491m	Set up on BH ER-2006-01B and complete the hole 95-124m from Loop 9, switch to Loop 9B and read the hole up. Josh Ulla arrives to help us for the rest of the day. Move to ER-2006-05. The hole is blocked @~4m depth. We hit it with the dummy and the drillers lend us a hand with a pair of rods. The debris is dislodged and we start to dummy - stopping a number of times hit the debris. We dummy to 239m and then re-dummy to the same depth. Read ER-2006-05 to 236m from Loop 9B and then start to read up from Loop 9. At 236m the probe is stopped. we haul on the cable and it pulls free. We continue to read and finish the hole Crew back in camp ~17:15. Note: Rx 04 arrives in Kingston.

Crew:R.Langridge,J.Frost — Total to date: 1.975km

Date	Rate	Production	Comments
July 15	P(1)-2 BES		Out to Ertelia to collect the transmitter and coils. Out again to Langdalen to lay in Loop 10. Crew back in camp ~15:00.

Crew:R.Langridge,J.Frost — Total to date: 1.975km

Date	Rate	Production	Comments
July 16	P(2)-2 BES	3125m	Out to the Langdalen Grid with with the assistance of Nadia Asgeirsdottir and Maria Loe Halvorsen. Repair the loop and start surveying @11:00. Survey without incident. Crew back in camp ~17:30.

Loop 04

Line 5600N	**1400E**	**-**	**2000E**	**Hz**	**Rx05**
Line 5700N	**1150E**	**-**	**2000E**	**Hz**	**Rx05**
Line 5800N	**1150E**	**-**	**2000E**	**Hz**	**Rx06**
Line 5900N	**1650E**	**-**	**2475E**	**Hz**	**Rx06**

Crew:R.Langridge,J.Frost — Total to date: 5.100km

Date	Rate	Production	Comments
July 17	P(2)-2 BES	3925m	Out to the Langdalen Grid with with the assistance of Finn Hansen and Josh Ulla. Repair the loop and start surveying @10:30. Survey without incident. Crew back in camp ~17:30.

Loop 04

Line 6000N	**1525E**	**-**	**2475E**	**Hz**	**Rx06**
Line 6100N	**1500E**	**-**	**2475E**	**Hz**	**Rx06**
Line 6200N	**1500E**	**-**	**2475E**	**Hz**	**Rx05**
Line 6300N	**1450E**	**-**	**2475E**	**Hz**	**Rx05**

Crew:R.Langridge,J.Frost — Total to date:

Date	Rate	Production	Comments
			9.025km

Date	Rate	Production	Comments
July 18	P(2)-2 **BES**	3500m	Out to the Langdalen Grid with with the assistance of Finn Hansen and Josh Ulla. Survey without incident. Crew back in camp ~15:30.

Loop 04

Line 5900N	**1150E**	**-**	**1575E**	**Hz**	**Rx06**
Line 6000N	**1150E**	**-**	**1525E**	**Hz**	**Rx06**
Line 6100N	**1150E**	**-**	**1500E**	**Hz**	**Rx06**
Line 6200N	**1150E**	**-**	**1500E**	**Hz**	**Rx06**
Line 6300N	**1150E**	**-**	**1450E**	**Hz**	**Rx06**
Line 6400N	**1150E**	**-**	**2000E**	**Hz**	**Rx05**
Line 6500N	**1150E**	**-**	**2000E**	**Hz**	**Rx05**

Crew:R.Langridge,J.Frost Total to date: 12.525km

Date	Rate	Production	Comments
July 19	**PB(1)-2**	BH 672m	Set up and dummy BH-ER-2006-06 (342m) before the drill is pulled off site. Out to the Langdalen Grid with with the assistance of Josh Ulla and pick up Loop 04. Return to Ertelia Grid and set up and read BH-ER-2006-06 (336m) from loop 09B while Loop 09 is repaired (3 breaks). Then read BH-ER-2006-06 (336m) up with Loop 9. Crew back in camp ~19:15.

Crew:R.Langridge,J.Frost Total to date: 12.525km

Date	Rate	Production	Comments
July 20	P(2)-2 **BES**	1400m	Out to the Ertelia Grid with with the assistance of Josh Ulla. Survey without incident. Crew back in camp ~17:30.

Loop 09

Line 1750N	**775E**	**-**	**1200E**	**Hz**	**Rx05**
Line 1800N	**800E**	**-**	**1200E**	**Hz**	**Rx05**
Line 1850N	**875E**	**-**	**1200E**	**Hz**	**Rx06**
Line 1900N	**950E**	**-**	**1200E**	**Hz**	**Rx06**

Crew:R.Langridge,J.Frost Total to date: 13.925km

Date	Rate	Production	Comments
July 21	P(2)-2 **BES**	2450m	Packed borehole gear and it was transported to Gardemoen by the client. Out to the Ertelia Grid with with the assistance of Josh Ulla. Survey without incident. Pick up some wire. Crew back in camp ~17:30.

Loop 09B

Line 1650N	**700E**	**-**	**1175E**	**Hz**	**Rx05**
Line 1700N	**700E**	**-**	**1175E**	**Hz**	**Rx05**
Line 1750N	**725E**	**-**	**1175E**	**Hz**	**Rx05**
Line 1800N	**850E**	**-**	**1200E**	**Hz**	**Rx06**

Date	Rate	Production	Comments					
			Line 1850N	**900E**	**-**	**1200E**	**Hz**	**Rx06**
			Line 1900N	**800E**	**-**	**1200E**	**Hz**	**Rx06**

Crew:R.Langridge,J.Frost Total to date: 16.375km

Date	Rate	Production	Comments
July 22	**L(2)-2** Demob (BH equipment)		Out to the Ertelia Grid with with the assistance of Josh Ulla to pick up the remaining wire. Transfer wire and pack surface gear. Transport to Gardemoen. Help in the shuffle of field trucks for maintenance. Rob Langridge to Gardemoen.
	Crew:R.Langridge,J.Frost		Total to date: 16.375km
July 23	**Demob** (all equipment) Crew:R.Langridge,J.Frost		Crew makes the journey back to Canada. Equipment (borehole and surface) in transit.
July 24 ->July 27	**Demob** (all equipment)	-	Equipment (borehole and surface) in transit.
July 28	**Demob** (surface equipment)		Equipment (borehole) arrives in Kingston. Equipment (surface) in transit.
July 29 ->August 07	**Demob** (surface equipment)	-	Equipment (surface) in transit.
August 08	**Demob**		Equipment (surface) arrives in Kingston.

LEGEND

P(n)-x	Surface Production (# of receivers) - # of personnel
PB(n)-x	BHUTEM3 Production (# of receivers) - # of personnel
L(n)-x	Looping (# of receivers) - # of personnel
S(n)-x	Standby (# of receivers) - # of personnel
D(n)-x	Down (# of receivers) - # of personnel
DB(n)-x	Down BHUTEM3 (# of receivers) - # of personnel
SES	Surface Equipment Standby
BES	Borehole Equipment Standby

Appendix C

The UTEM SYSTEM

The UTEM System

UTEM Data Reduction and Plotting Conventions

Data Presentation

The UTEM SYSTEM

UTEM uses a large, fixed, horizontal transmitter loop as its source. Loops range in size from 300m x 300m up to as large as 4km x 4km. Smaller loops are generally used over conductive terrain or for shallow sounding work. The larger loops are only used over resistive terrain. The UTEM receiver is typically syncronized with the transmitter at the beginning of a survey day and operates remotely after that point. The clocks employed - one in each of the receiver and transmitter - are sufficiently accurate to maintain synchronisation.

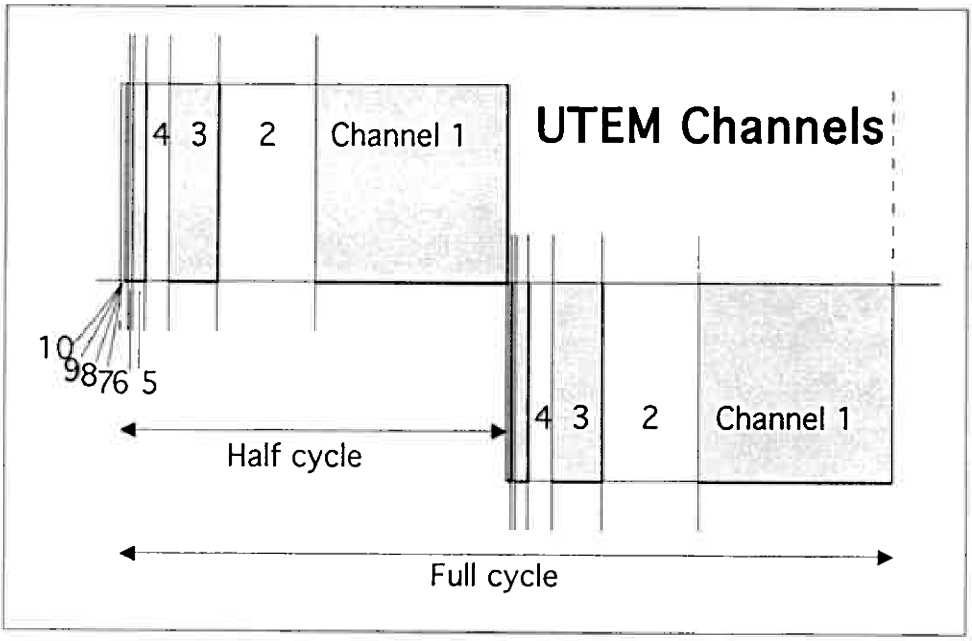
Measurements are routinely taken to a distance of 1.5 to twice the loop dimensions, depending on the local noise levels, and can be continued further. Lines are typically surveyed out from the edge of the loop but may also be read across the loop wire and through the centre of the loop, a configuration used mainly to detect horizontal conductors. BHUTEM - the borehole version of UTEM -surveys have been carried out to depths up to 3000+ metres.

System Waveform

The UTEM transmitter passes a low-frequency (4 Hz to 90 Hz) current of a precisely regulated triangular waveform through the transmitter loop. The frequency can be set to any value within the operating range of the transmitter, however, it is usually set at 31 Hz to minimise power line (60 Hz in North America) effects. Since a receiver coil responds to the time derivative of the magnetic field, the UTEM system really "sees" the step response of the ground. 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 and "see" the (im)pulse response of the ground at the receiver. In practice, the transmitted UTEM waveform is tailored to optimize signal-to-noise. Deconvolution techniques are employed within the system to produce an equivalent to the conceptual "step response" at the receiver.

System Sampling

The UTEM receiver measures the time variation of the magnetic field in the direction of the receiver coil at 10 delay times (channels). UTEM channels are spaced in a binary, geometric progression across each half-cycle of the received waveform. Channel 10 is the earliest channel and it is $1/2^{10}$ of the half-cycle wide. Channel 1, the latest channel, is $1/2^{1}$ of the half-cycle wide (see Figure below). The measurements obtained for each of 10 channels are accumulated over many half-cycles. Each final channel value, as stored, is the average of the measurements for that time channel. The number of half-cycles averaged generally ranges between 2048 (1024 full-cycles - 1K in UTEM jargon) to 32768 (16K) depending on the level of ambient noise and the signal strength.



System Configurations

For surface work the receiver coil is mounted on a portable tripod and oriented. During a surface UTEM survey the vertical component of the magnetic field (Hz) of the transmitter loop is always measured. Horizontal in-line (Hx) and cross-line (Hy) components are also measured if more detailed information is required. The UTEM System is also capable of measuring the two horizontal components of the electric field, Ex and Ey. A dipole sensor comprised of two electrodes is used to measure the electric field components. This is generally used for outlining resistive features to which the magnetic field is not very sensitive.

BHUTEM surveys employ a receiver coil that is smaller in diameter than the surface coil. The borehole receiver coil forms part of a down-hole receiver package used to measure the axial (along-borehole) component of the magnetic field of the transmitter loop. Due to the distance between coil and receiver in borehole surveys the signal must be transmitted up to the receiver. In BHUTEM the signal is transmitted to surface digitally using a kevlar-reinforced fibre-optic cable as a data link. Using a fibre-optic link avoids signal degradation problems and allows surveying of boreholes to 3000+m. The cable is also very light - the specific gravity is nearly 1.0 - making the cable handling hardware quite portable.

The EM Induction Process

Any time-varying transmitted ("primary") field induces current flow in conductive regions of the ground below and around the transmitter loop (i.e. in the earth or "half-space"). This current flow produces a measurable EM field, the secondary field, which has an inherent "inertia" that resists the change in primary field direction. This "inertial" effect is called self-inductance; it limits the rate at which current can change and is only dependent on the shape and size of a conductive path.

It takes a certain amount of time for the transmitted current flow to be redirected (reversed) and reestablished to full amplitude after the rate-of-change of the primary field reverses direction. This measurable reversal time is characteristic for a given conductor. In general, for a good conductor this time is greater than that of a poor conductor. This is because in a good conductor the terminal current level is greater, whereas its rate of change is limited by the inductance of the current path. The time-varying current causes an Emf in the sensor proportional to the time derivative of the current. This Emf decays with time - it vanishes when the reversal is complete - and the characteristic time of the Emf decay as measured by the sensor is referred to as the **decay time** of the conductor.

The large-scale current which is induced in the half-space by the primary field produces the half-space response as seen in typical UTEM profiles. This background response is influenced by the finite conductivity of the surrounding rock. Other currents may be induced in locally more conductive zones (conductors) that have longer decay times than the half-space response. The responses of these conductors are superimposed upon the background response. The result is that the UTEM receiver detects:

- the primary field waveform, a square-wave
- the half-space (background) response of the surrounding rock
- a slight-to-large response due to any conductors present.

The result is that in the presence of conductors the primary field waveform is substantially (and anomalously) distorted.

UTEM DATA REDUCTION and PLOTTING CONVENTIONS

The UTEM data as it appears in the data files is in total field, continuously normalized form. In this form, the magnetic field data collected by the receiver is expressed as a % of the calculated primary magnetic field vector magnitude at the station. These are total field values - the UTEM system measures during the "on-time" and as such samples both the primary and secondary fields.

For plotting purposes, the reduced magnetic field data (as it appears in the data file) are transformed to other formats as required. The following is provided as a description of the various plotting formats used for the display of UTEM data. A plotting format is defined by the choice of the *normalization* and *field type* parameters selected for display.

NORMALIZATION

UTEM results are always expressed as a % of a normalizing field at some point in space.

In **continuously normalized** form the normalizing factor (the denominator) is the magnitude of the computed local primary field vector. As the primary exciting field magnitude diminishes with increasing distance from the transmitter loop the response is continuously amplified as a function of offset from the loop. Although this type of normalization considerably distorts the response shape, it permits anomalies to be easily identified at a wide range of distances from the loop.

Note: An optional form of continuous normalization permits the interpreter to normalize the response to the magnitude of the primary field vector at a fixed depth below each station. This is useful for surface profiles which come very close to the loop. Without this adjustment option, the normalizing field is so strong near the loop that the secondary effects become too small in the presence of such a large primary component. In such circumstances interpretation is difficult, however; by "normalizing at some depth" the size of the normalizing field, near the loop in particular, is reduced and the resulting profile can be more effectively interpreted to a very close distance from the transmitter wire. The usual choice for the depth is the estimated target depth is used.

In **point normalized form** the normalizing factor is the magnitude of the computed primary field vector at a single point in space. When data is presented in this form, the point of normalization is displayed in the title block of the plot. Point normalized profiles show the non-distorted shape of the field profiles. Unfortunately, the very large range in magnitude of anomalies both near and far from the loop means that small anomalies, particularly those far from the loop, may be overlooked on this type of plot in favor of presenting larger amplitude anomalies.

Note: Selecting the correct plot scales is critical to the recognition of conductors over the entire length of a point normalized profile. Point normalized data is often used for interpretation where an analysis of the shape of a specific anomaly is required. Point normalized profiles are therefore plotted selectively as required during interpretation. An exception to this procedure occurs where surface data has been collected entirely inside a transmitter loop. The primary field does not vary greatly inside the loop, therefore, the benefits of continuous normalization are not required in the display of such results. In these cases data is often point normalized to a fixed point near the loop centre.

FIELD TYPE

The type of field may be either the **Total field** or the **Secondary field.** In general, it is the secondary field that is most useful for the recognition and interpretation of discrete conductors.

UTEM Results as Secondary Fields

Because the UTEM system measures during the transmitter on-time the determination of the secondary field requires that an estimate of the primary signal be subtracted from the observations. Two estimates of the primary signal are available:

1) UTEM Channel 1

One estimate of the primary signal is the value of the latest time channel observed by the UTEM System, channel 1. When Channel 1 is subtracted from the UTEM data the resulting data display is termed *Channel 1 Reduced*. This reduction formula is used in situations where it can be assumed that all responses from any target bodies have decayed away by the latest time channel sampled. The Channel 1 value is then a reasonable estimate of the primary signal present during Channels 2....10.

In practice the *Channel 1 Reduced* form is most useful when the secondary response is very small at the latest delay time. In these cases channel 1 is indeed a good estimate of the primary field and using it avoids problems due to geometric errors or transmitter loop current/system sensitivity errors.

2) Calculated primary field

An alternate estimate of the primary field is obtained by computing the primary field from the known locations of the transmitter loop and the receiver stations. When the computed primary field is subtracted from the UTEM data the resulting data display is termed ***Primary Field Reduced***.

The calculated primary field will be in error if the geometry is in error - mislocation of the survey stations or the loop vertices - or if the transmitter loop current/system sensitivity is in error. Mislocation errors from loop/station geometry may give rise to very large secondary field errors depending on the accuracy of the loop and station location method used. Transmitter loop current/system sensitivity error is rarely greater than 2%. ***Primary Field Reduced*** is plotted in situations where a large Channel 1 response is observed. In this case the assumption that the Channel 1 value is a reasonable estimate of the primary field effect is not valid.

Note: When UTEM data is plotted in the ***Channel 1 Reduced*** form the secondary field data for Channel 1 itself are always presented in ***Primary Field Reduced*** form and are plotted on a separate axis. This plotting format serves to show any long time-constant responses, magnetostatic anomalies and/or geometric errors present in the data.

Mathematical Formulations

In the following expressions:

Rn_j is the result plotted for the n^{th} UTEM channel,

$R1_j$ is the result plotted for the latest-time UTEM channel, channel 1,

Chn_j is the raw component sensor value for the n^{th} channel at station j,

$Ch1_j$ is the raw component sensor value for channel 1 at station j,

$H^P{}_j$ is the computed primary field component in the sensor direction

$|H^P|$ is the magnitude of the computed primary field at:
- a fixed station for the entire line (point normalized data)
- the local station of observation (continuously normalized data)
- a fixed depth below the station (continuously normalized at a depth).

Channel 1 Reduced Secondary Fields : Here, the latest time channel, Channel 1 is used as an "estimate" of the primary signal and channels 2-10 are expressed as:

$$Rn_j = (Chn_j - Ch1_j) / |H^P| \quad x\ 100\%$$

Channel 1 itself is reduced by subtracting a calculation of the primary field observed in the direction of the coil, H^P as follows:

$$R1_j = (Ch1_j - H^P{}_j) / |H^P| \quad x\ 100\%$$

Primary Field Reduced Secondary Fields : In this form all channels are reduced according to the equation used for channel 1 above:

$$Rn_j = (Chn_j - H^P{}_j) / |H^P| \quad x\ 100\%$$

This type of reduction is most often used in cases where very good geometric control is available (leading to low error in the calculated primary field, $H^P{}_j$) and where very slowly decaying responses result in significant secondary field effects remaining in channel 1 observations.

UTEM Results as a Total Field

In certain cases results are presented as a % of the **Total Field**. This display is particularly useful, in borehole surveys where the probe may actually pass through a very good conductor. In these cases the shielding effect of the conductor will cause the observed (total) field to become very small below the intersection point. This nullification due to shielding effects on the total field is much easier to see on a separate *Total Field* plot. In cases where the amplitude of the anomalies relative to the primary field is small, suggesting the presence of poorly conductive bodies, the *Total Field* plot is less useful.

The data contained in the UTEM reduced data files is in *Total Field*, continuously normalized form if:

$$Rn_j = Chn_j / |H^P| \quad x\ 100\%$$

DATA PRESENTATION

All UTEM survey results are presented as profiles in an Appendix of this report. For BHUTEM surveys the requisite Vectorplots, presented as plan and section views showing the direction and magnitude of the calculated primary field vectors for each transmitter loop, are presented in a separate Appendix.

The symbols used to identify the channels on all plots as well as the mean delay time for each channel is shown in the table below.

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	I
2	6.053	\
3	3.027	/
4	1.513	□
5	0.757	⧖
6	0.378	∡
7	0.189	7
8	0.095	X
9	0.047	Δ
10	0.024	◇

Notes on Standard plotting formats:

10 channel data in *Channel 1 Reduced* form - The data are usually displayed on three separate axes. This permits scale expansion, allowing for accurate determination of signal decay rates. The standard configuration is:

Bottom axis - Channel 1 (latest time) is plotted alone in *Primary Field Reduced* form using the same scale as the center axis.

Center axis - The intermediate to late time channels, ch5 to ch2 are plotted on the center axis using a suitable scale.

Top axis - The early time channels, ch10 to ch6 and a repeat of ch5 for comparison are plotted on the top axis at a reduced scale. The earliest channels, ch8 to ch10, may not be plotted to avoid clutter.

10 channel data in *Primary Field Reduced* form: The data are displayed using a

single axis plot format. Secondary effects are plotted using a Y axis on each data plot with peak to peak values up to 200%.

BHUTEM data plotted as total field profiles: Data are expressed directly as a percentage of the ***Total Field*** value. The Y axis on each single axis data plot shows peak values of up to 100%. These departures are always relative to the measured total field value at the observation station.

BHUTEM data plotted as secondary field profiles: Check the title block of the plot to determine if the data is in ***Channel 1 Reduced*** form or in ***Primary Field Reduced*** form.

Note that on all BHUTEM plots the ratio between the axial component of the primary field of the loop and the magnitude of the total primary field strength (dc) is plotted as a profile without symbols. In UTEM jargon this is referred to as the "primary field" and it is plotted for use as a polarity reference tool.

Appendix D

Note on sources of anomalous Ch1

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 $1/r^3$)
- 2% at intermediate distances (intermediate field varies as $\sim 1/r^2$)

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 magnetic anomalies will cause:

- positive Ch1 anomalies in data collected outside the loop
- negative 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.

Appendix E

Note on 4 Hz UTEM data: The effect of the presence of a 60-cycle powerline.

Note
While this Appendix uses data collected in the presence of a 60Hz powerline the issue dealt with applies equally to UTEM data collected in the presence of a 50Hz powerline.

Note: The standard presentation in Appendix A has Ch2-5 plotted on the middle axis. An alternative presentation - with Ch2 and Ch3 on the middle axis - is sometimes chosen when a powerline cuts through the surveyed area. This Appendix is a brief discussion of why the alternative presentation is chosen.

Note on 4 Hz UTEM data:The effect of the presence of a 60-cycle powerline.

This appendix outlines and discusses the effect of the presence of a 60-cycle powerline on ~4Hz (3.872Hz) UTEM data. This line is from a series of loops with a powerline cutting across the survey area. The UTEM data is affected by the presence of the powerline.

example data:

Figure E1(a) is the example data as presented in Appendix A - an alternative presentation with Ch2 and Ch3 on the middle axis. The standard presentation is shown in Figure E1(b) - with Ch2-5 plotted on the middle axis. The alternative presentation was chosen for a series of loops (including this loop) with a powerline cutting through the surveyed area. Figure E1(c) shows why - Ch4 and Ch5 show a pattern where when one is up the other is down and vice versa. The amplitude of the pattern decreases with distance away from the powerline. It was felt that this pattern obscured the information in Ch2 and 3 and the alternative presentation was chosen.

explanation:

Figure E2a) shows the UTEM waveform at ~4Hz with a 60Hz waveform superimposed on it. Roughly 16 cycles of the 60-cycle waveform fit into the full UTEM waveform. On a channel-by-channel basis:

~4 cycles fit into Ch1
~2 cycles fit into Ch2
~1 cycle fits into Ch3.

The multiple cycles tend to cancel out. Earlier channels are narrower - only part of a cycle wide. In particular Ch4 is ~half a cycle wide and Ch5 falls in the opposite halfcycle. The result is the pattern shown in Figure 1(c): Ch4 and Ch5 tending to diverge from one another - more strongly near the powerline.

other presentations:

Figures E3(a) and (b) show the example data in two other presentations where several channels are combined to give fewer, cleaner channels:

Figure E3(a): In this presentation Ch4 and 5 are combined to give a combined Ch"4" that is ~1.5 times as wide as the original Ch4. The Ch"4" is cleaner than the original. The original Ch5-10 are shown on the upper axis.

Figure E3(b): In this presentation Ch4-10 are combined to give a combined Ch"4" that is 2x as wide as the original Ch4 (equal in width to the original Ch3). The Ch"4" is as clean as the original Ch3. Note that Ch10 is added in twice to make the 2x factor exact. The original Ch5-10 are shown on the upper axis.

Discussion:

Several elements of UTEM survey design and procedure will have an affect on the number of useful channels in the final data set. These would include:

- careful positioning of the transmitter loops relative to the powerline(s)
- increasing the transmitter current (and the signal-to-noise ratio)
- care in the selection of gains during surveying. Near a source of coherent noise (eg powerline) the signal gain should be selected to minimize data rejections.

Consideration should also be given to increasing the station spacing in the vicinity of the powerline. This allows additional stacking to be done (at fewer stations) without much of an increase in surveying time.

Several other ways to increase the number of channels free of the powerline affects are:

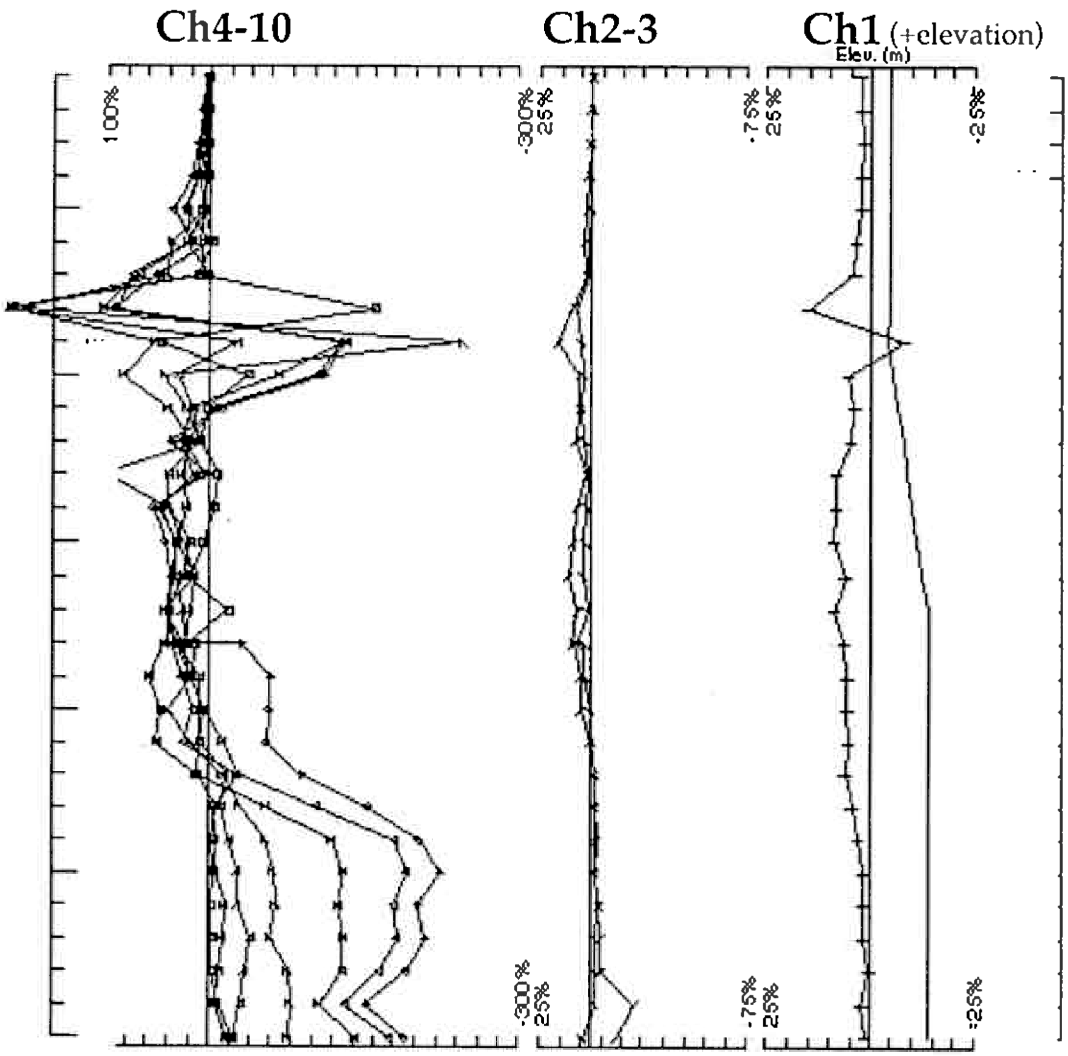
- lowering the frequency: each factor of two lower in frequency would add a channel relatively free of the affects of the powerline. The cost would be increased stacking time at each station.

- taking multiple readings: each reading starts at a different (random) point on the 60-cycle waveform. The sum of several readings will tend to better average out any affect.

- alternative channel sampling: Figure E2b) shows the standard UTEM 3 Boxcar channel sampling. An alternative - tapered channel sampling - is available (and often used) with UTEM 4. In this case if tapered sampling had been available it would likely have been used. The result would have been:

  - a slightly noisier Ch3
  - a considerably improved Ch4
  - an improved Ch5

  The choice of which sampling to use on a UTEM 4 survey depends on the frequency of the survey, the proximity and the frequency of any local powerline and the type of decay seen.



Loop	Secondary, (Chn-Ch1/Hpl	
Line	Contin. Norm at a depth of 0m	
Compt: Hz	Base Freq. 3.872Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE

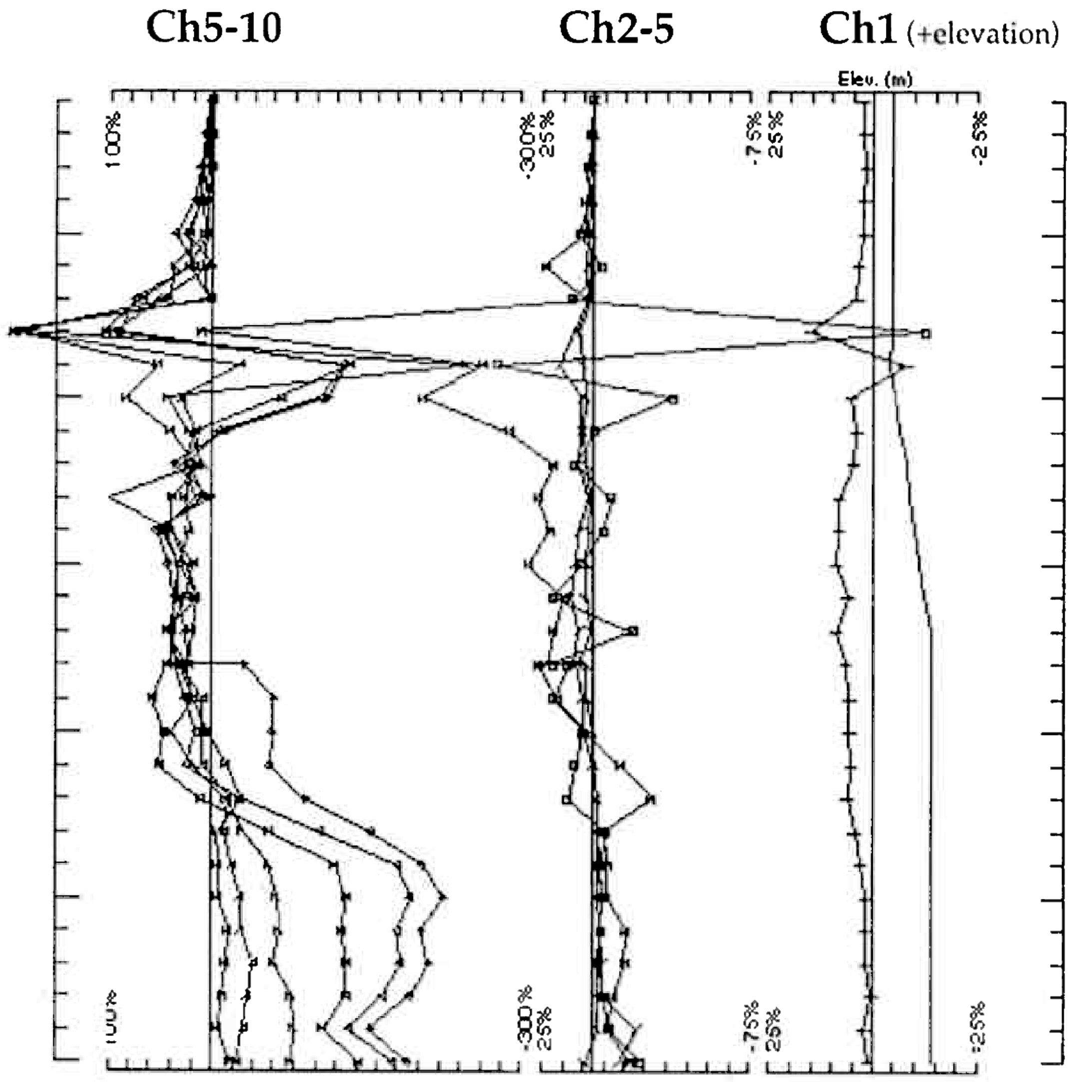
LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE

Appendix E

Figure E1(a)

Original 4Hz data: alternative format

Figure E1a



Loop	Secondary, (Chn-Ch1/Hpl	
Line	Contin. Norm at a depth of 0m	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE
Compt: Hz	Base Freq. 3.872Hz	

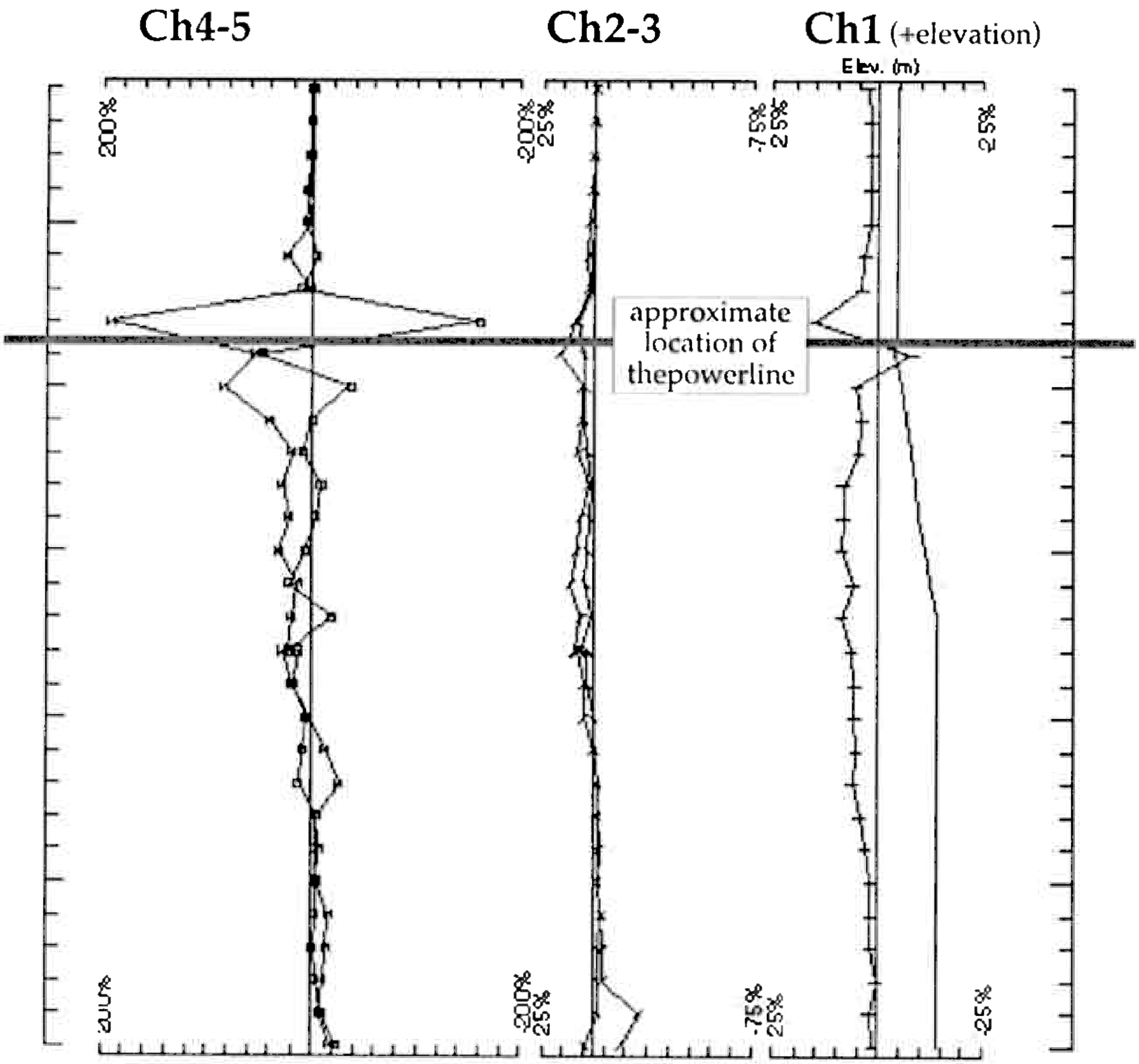
LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE

Appendix E

Figure E1(b)

Original 4Hz data: standard format

Figure E1b



Loop	Secondary. (Chn-Ch1/Hpl
Line	Contin. Norm at a depth of 0m
Compt: Hz	Base Freq. 3.872Hz

LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE

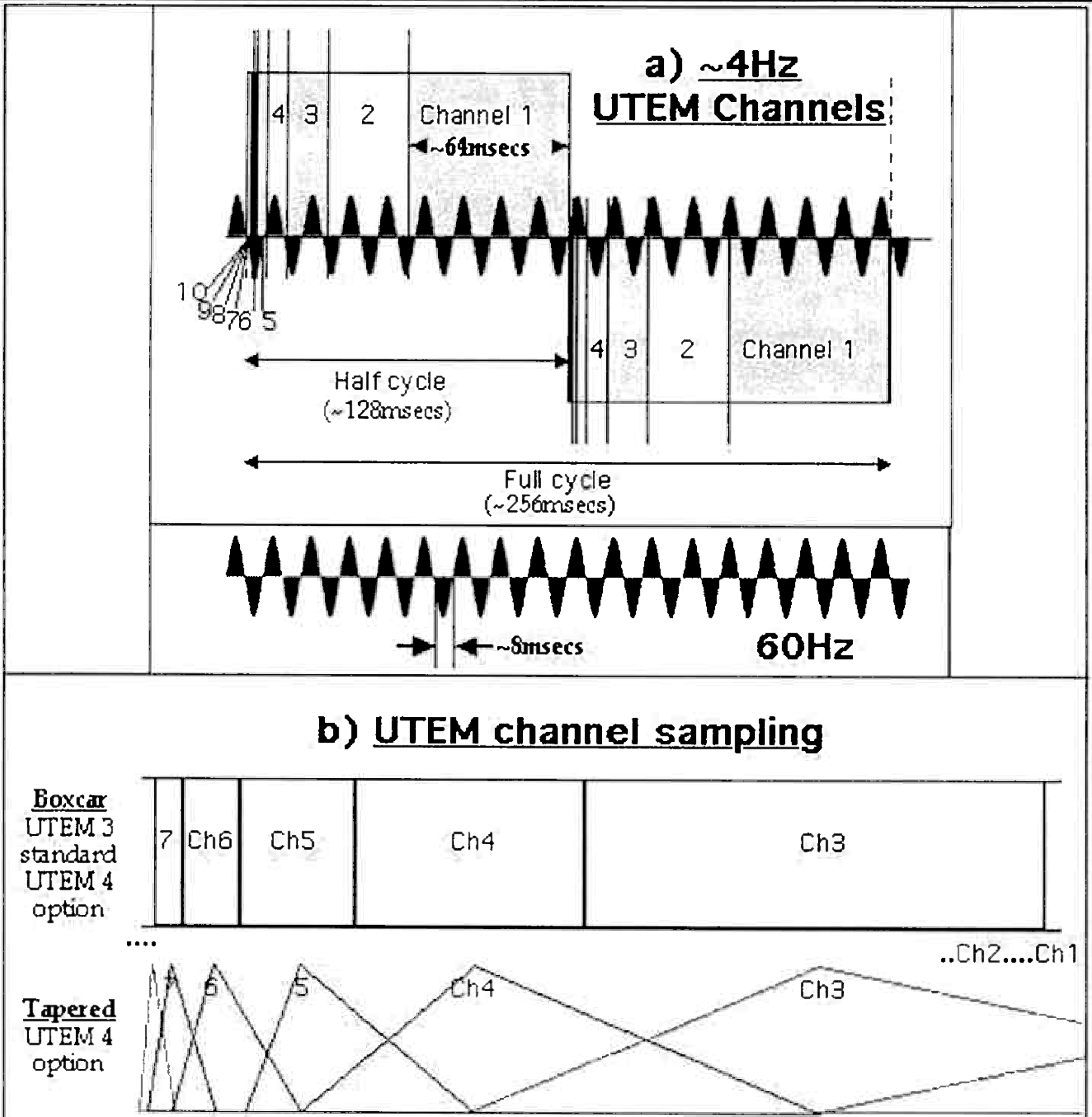
LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE

Appendix E

Figure E1(c)

Original 4Hz data: Ch4/5 detail

Figure E1c



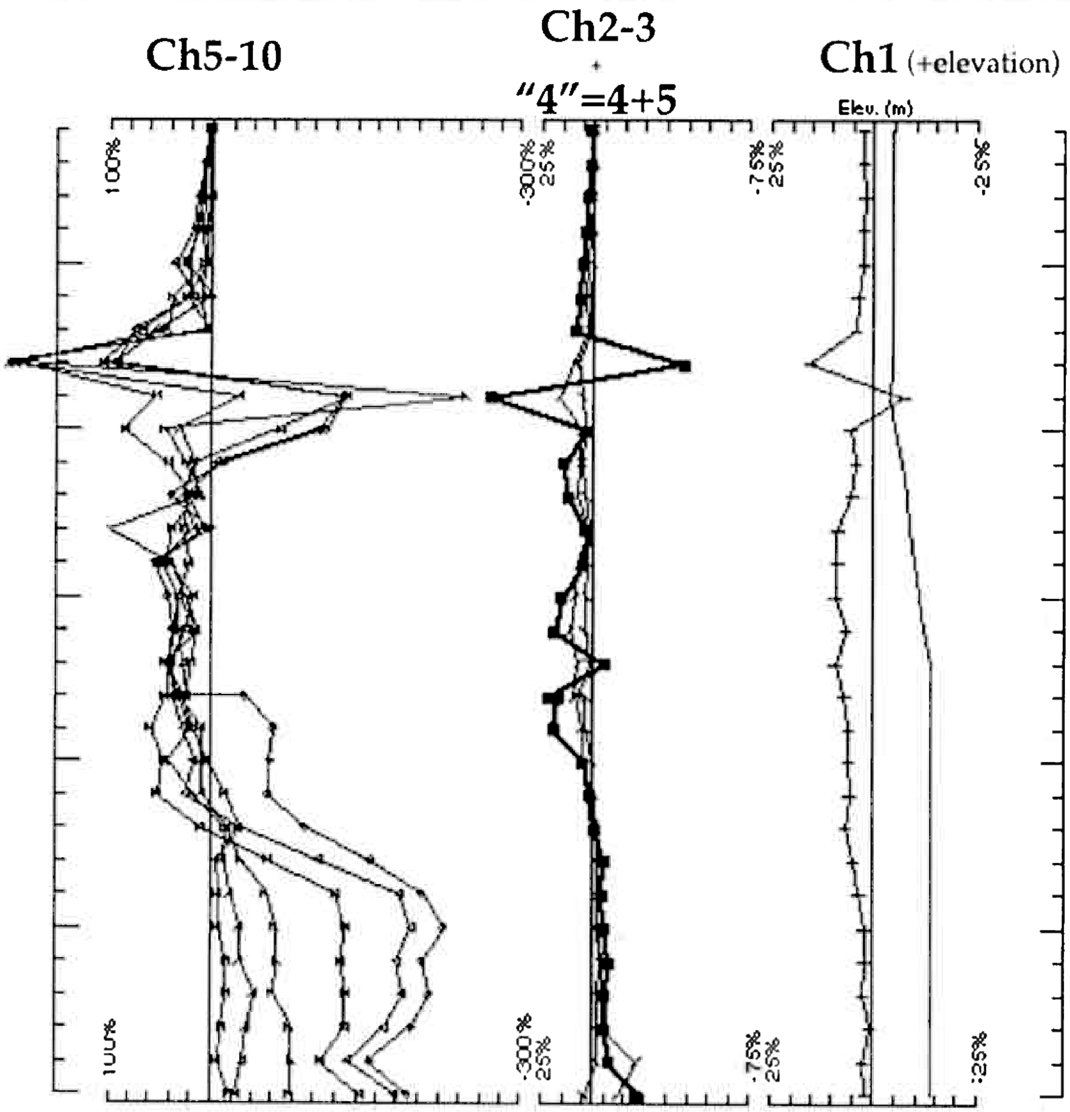
LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE

Appendix E

Figure E2

a) ~4Hz UTEM Channels with 60Hz signal
b) UTEM Channel sampling options

Figure E2



Loop:	Secondary, (Chn-Ch1/Hpl
Line	Contin. Norm at a depth of 0m
Compt: Hz	Base Freq. 3.872Hz

LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE

"modified" Ch4
=
2/3(Ch4+1/2Ch5)

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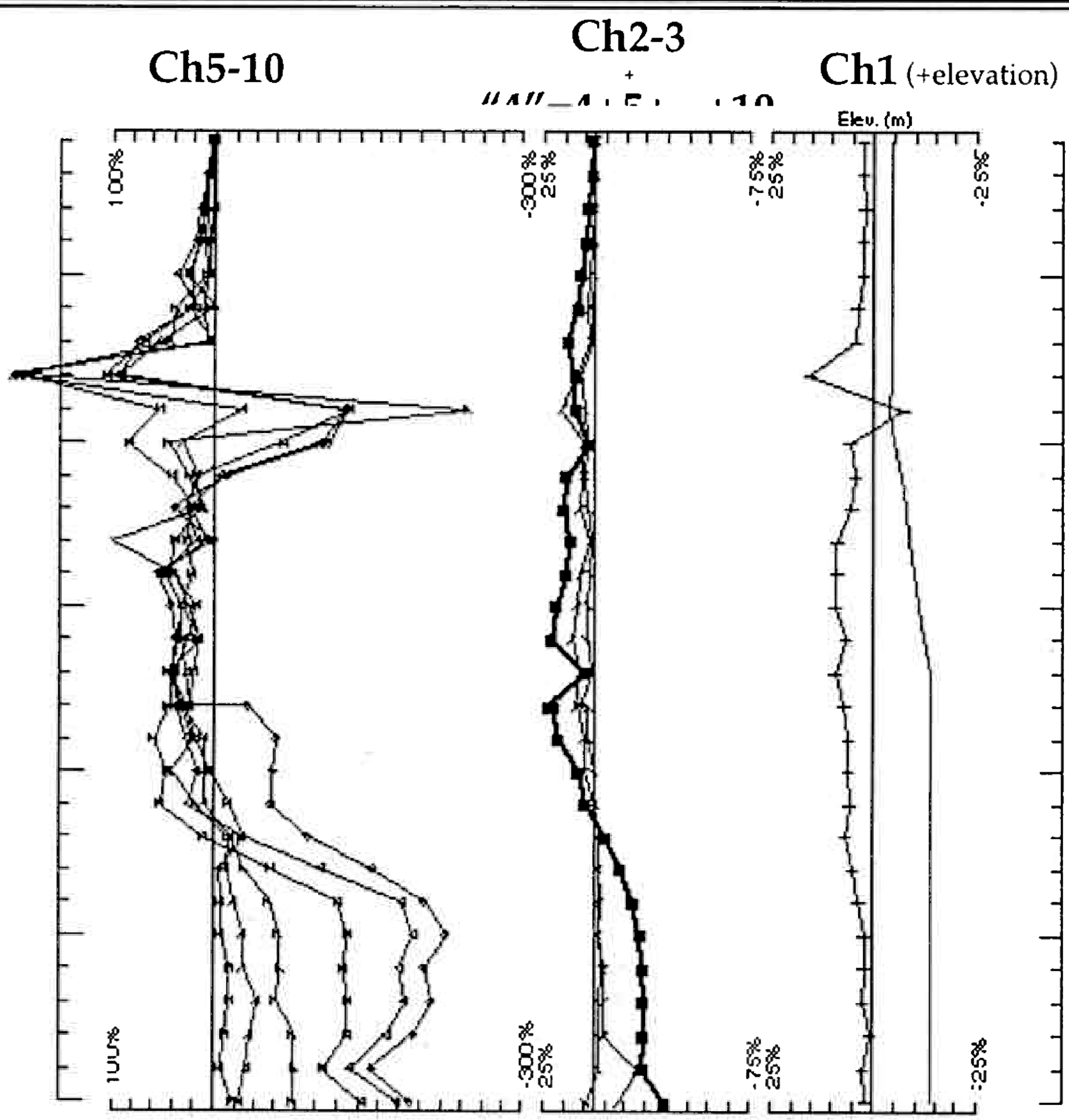
Appendix E

Figure E3(a)

Modified 4Hz data: Ch4/5 combined

Figure E3a



Loop:	Secondary, (Chn-Ch1/Hpl	
Line	Contin. Norm at a depth of 0m	
Compt: Hz	Base Freq. 3.872Hz	LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE

"modified" Ch4
=
1/2Ch4+1/4Ch5+1/8Ch6+1/16Ch7)+
1/32Ch8+1/64Ch9+1/128Ch10+
1/128Ch10
Note: extra 1/128Ch10 to ~complete "modified" Ch4

LAMONTAGNE GEOPHYSICS LTD GEOPHYSIQUE LTEE

Appendix E

Figure E3(b)

Modified 4Hz data: Ch4-10 combined

Figure E3b

Appendix F

Discussion of Noise Issue
in
Very Resistive Terrains

Discussion of noise issue in very resistive terrains

From the standpoint of data collection during a UTEM survey there are a number of different sources of "noise" - natural, cultural, coil motion, instrumental and geological. For the purpose of this discussion the following distinction is made:

- "true" noise - results in poor repeatability and is due to:
  - a noise field composed of: power line fields, sferic fields due to thunderstorm activity worldwide, other natural EM sources (micropulsations, etc), or
  - coil motion due to the effect of wind either: moving the the coil directly, causing movement in the ground near trees or undulating the ice surface of a large frozen lake.

  In the case of poor repeatability increased stacking time will improve things.
- geological noise - in resistive areas profiles show scatter but features are repeatable. The scatter in the data is due to short-wavelength geological responses which are spatially undersampled. In this case increased stacking time will not improve things. Repeat readings that are in agreement, however, serve to confirm that the scatter represents geological noise.

  Note that if the features are of interest a finer station spacing may resolve them.

So repeated readings should tell whether noisy-looking data is due to poor repeatability or short-wavelength geological responses.

UTEM surveys carried out at the Ertelien Project area in early 2006 and on projects in northern Norway in late 2005 were carried out over very resistive terrain and ran into very noisy conditions. The following is a discussion of the noise issue as it affects these surveys and the strategies/changes that have been employed/made to combat it.

Overall the high noise issue as it affects UTEM surveys carried out over very resistive terrain - including the 2006 Ertelien Project UTEM survey and the 2005 northern Norway surveys - can be resolved into three factors:

- surveying in/over very resistive terrain
- the nature of the target(?) conductor(s) in very resistive terrain
- the combination of the response of a powerline and the noise associated with a powerline

A look at each of these factors follows. Note that there is some overlap between the three factors.

<u>Surveying in/over very resistive terrain</u>

When conductive overburden or a typically conductive country rock is present very little of the natural sferic field penetrates to the geological conductors. The noise field at the earth's surface is ~horizontally-polarized. In terms of how this affects a typical UTEM survey it means that:

- when measuring Hz - the vertical component and the component most often measured - noise levels are typically lower and stacking times are chosen to allow accurate measurement of the smaller secondary field in the presence of the (typically) stronger primary field.
- when measuring Hx/Hy - horizontal components - noise levels are typically higher

and stacking times are chosen to allow accurate measurement of the small secondary field in the presence of higher noise levels. In relatively flat terrain the horizontal component of the primary field is typically weak.

Over very resistive terrain the noise field becomes somewhat less horizontally-polarized. A significant component of the noise field penetrates to the geological conductors. The result is a tilted noise field - more noise is in the vertical component.

In addition over very resistive terrain there is an increase in geological noise due to induced current channeling in discrete faults and overburden channels. The vertical noise field in particular is amplified by current channeling anomalies.

Result: stacking times for Hz measurements must be increased to allow accurate measurement of the secondary field in the presence of higher noise levels. Increased stacking time will not affect scatter in the data that represents geological noise. Repeat readings will serve to confirm if the scatter represents geological noise.

<u>The nature of the target(?) conductor(s) in very resistive terrain</u>

The presence of a good, consistent conductive feature will make UTEM data look very clean - secondary currents flow in a "well organized" fashion and give a good response. A larger response forces the use of a coarser plotting scale - visually "suppressing" noise even further.

In very resistive areas there is little or no background response present. If there are no local features of appreciable size present to give rise to a response then virtually all you see on a profile is a combination of "true" noise and geological noise. In this instance plotting scales are often blown up in an attempt to reveal whether subtle responses are present - and noise is visually "amplified".

Weakly-conductive features - especially those that are broken up and vary in character/orientation along strike - produce geological noise on a profile. In very resistive terrain even very weakly-conductive features will channel current. The overall result can be line-to-line variable, "scattered" responses that give the profiles the appearance of an increase in noise in general. These weakly-conductive variable features also affect the noise field. The vertical noise field in particular is amplified by current channeling anomalies in very resistive terrain.

Very long geological conductors tilt the natural (for our purposes noise) field in their vicinity giving rise to cross-over tilt angle anomalies - more noise in the vertical component. Since the natural fields are very large scale and the conductors very long the response of very long geological conductors is much greater in proportion than what the UTEM data would lead us to believe.

The net affect on an off-loop UTEM survey appears in one of two fashions:

- locally high noise levels at one or more stations near the "geologically-noisy" feature.

  Result: stacking times for Hz measurements must be increased at the noisy stations to allow accurate measurement of the secondary field but stacking times can be reduced again once the noisy section is passed. If there is an indication that the noise is geological then repeat readings should be taken.

- high noise levels that start abruptly at the "geologically noisy" feature and persist beyond it.

  Result: stacking times for Hz measurements must be increased abruptly at the "geologically noisy" feature and increased stacking must be continued at all stations beyond (further from the loop). If there is an indication that the noise is geological then repeat readings should be taken.

Note that in the field it may take a while for an operator to determine the correct procedure to follow. Abruptly increasing the stacking time and doing repeat readings can add significantly to the survey time. For reference at 3.251Hz approximate reading times are as follows for single readings and to cover 100m (4 stations):

	single	100m @25m
512 stack	~2min 50secs	~11min 20secs
x2 = 1K stack	~5min 40secs	~22min 30secs
x2 = 2K stack	~11min 10secs	~44min 50secs
x2 = 4K stack	~22min 20secs	~89min 25secs
x2 = 8K stack	~44min 40secs	~178min 40secs

As an example increasing from a 512 stack to a 1K stack and doing a repeat reading will take the stacking time from ~2min 50secs (~11min 20secs/100m) to ~~11min 20secs (~44min 50secs/100m). Note also that to the operator in the field abruptly noisy data looks very much like an instrument problem. In checking for instrumental problems some additional delay will occur.

<u>The combination of the response of a powerline and the powerline noise</u>

A typical UTEM survey is affected by the presence of a powerline in two ways:

- There will be a response due to the powerline. The response will be coincident with the powerline and can serve to mask other conductive features. The nature of a powerline response varies depending on the powerline's: characteristics, location with-respect-to the transmitter loop and geological setting. Note that in resistive terrain all power line return currents are concentrated in long geological conductors rather than being dispersed throughout the conductive earth.
  The option of "stripping" the powerline response exists - this can reveal the presence of any masked conductive features. Data used in "stripping" the response is typically collected on a more detailed traverse across the powerline.

Result: surveying time will be increased somewhat because of the increased stacking required to collect data accurate enough to allow "stripping" to reveal any masked features. In some cases a few additional stations will be surveyed.

- There will be EM noise present due to any operating powerline. Noise levels increase as the powerline is approached. Power line noise normally is strongest on the vertical component near a power line and becomes more horizontal at a distance because of induction in the earth. This rotation towards the horizontal occurs much farther away from the power line in resistive terrain than in a conductive area. In very resistive terrain powerline noise in the vertical component will persist to a considerably distance.
  For some powerlines the noise levels will be high enough to force the data to be collected at a lowered signal gain. For many larger powerlines noise levels very close to the powerline are high enough that data cannot be collected at all.

Result: surveying time will be increased because of the increased stacking required to overcome the higher noise levels. Some coverage in the immediate vicinity of the powerline may be missed due to very high noise levels.

Strategies/changes that have been employed/made to combat the noise issue

In order to overcome the noise a number of strategies/changes have been employed/made:

- stacking increased
  improves data quality when dealing with "true" noise but @3.251Hz readings can become quite long
- readings repeated where there are indications that the noise is geological
  repeat readings that are in agreement serve to confirm that scatter in the data represents geological noise.
- increased station spacing at some chosen distance from the loop front
  a trade off between improved data quality and station sampling when readings @3.251Hz become quite long - see above.
- higher pre-whitening levels used where possible
  improves noise rejection but the UTEM 3 transmitter is required to run close to the rise-time limit - transmitter operation can be finicky at this level, especially if there are powerlines in the vicinity.
- the use of heavier gauge wire
  larger wire = allows higher current = improves signal-to-noise ratio
  Improved signal-to-noise ratio means that less stacking is required for the same level of data quality.
- where possible a switch to in-loop surveying
  in-loop = considerably stronger applied field = improved signal-to-noise ratio Note: in-loop surveying is less sensitive to small, steeply-dipping conductors.