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Oskarshamn site investigation

RAMAC, BIPS and deviation logging in boreholes KLX16A and HLX42

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Malå Geoscience AB/RAYCON

March 2007

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Keywords: BIPS, RAMAC, Radar, TV, Deviation logging, Flexit.

Abstract

This report includes the data gained in geophysical logging operations performed within the site investigation at Oskarshamn. The logging operations presented here includes borehole radar (RAMAC), BIPS and deviation logging in the core drilled borehole KLX16A and in the percussion drilled borehole HLX42. All measurements were conducted by Malå Geoscience AB/RAYCON during January 2007.

The objective of the radar surveys is to achieve information on the rock mass around the borehole. Borehole radar is used to investigate the nature and the structure of the rock mass enclosing the boreholes.

The objective of the BIPS logging is to achieve information of the borehole including occurrence of rock types as well as determination of fracture distribution and orientation.

The objective of the deviation measurement is to achieve information on borehole coordinates as well as dip and azimuth along the borehole length.

This report describes the equipment used as well as the measurement procedures and data gained. For the BIPS survey, the result is presented as images. Radar data is presented in radargrams and the identified reflectors are listed. The deviation measurement is presented as a list of data.

The borehole radar data quality from KLX16A and HLX42 was poor to good. In parts with lower quality, this is most probably due to more conductive conditions. This conductive environment of course reduces the possibility to distinguish and interpret possible structures in the rock mass which otherwise could give a reflection. However, the borehole radar measurements resulted in 132 identified radar reflectors in KLX16A and of these 19 were orientated (strike/dip). In HLX42 17 structures were identified.

Very good BIPS image quality in HLX42 due to perfect water quality. In KLX16A the image quality is lower. Mud covering the lower most part of the borehole wall limits the visibility, better quality in the bottom of the borehole.

Sammanfattning

Denna rapport omfattar geofysiska loggningar inom platsundersökningsprogrammet för Oskarshamn. Mätningarna som presenteras här omfattar borrhålsradarmätningar (RAMAC), och BIPS-loggningar i kärnborrhålet KLX16A och i hammarborrhålet HLX42. I alla borrhål genomfördes även avvikelsemätningar, s k krökningsmätningar. Alla mätningar är utförda av Malå Geoscience AB/RAYCON under januari 2007.

Syftet med radarmätningarna är att samla information om bergmassan runt borrhålet. Borrhålsradar används till att karakterisera bergets egenskaper och strukturer i bergmassan närmast borrhålet.

Syftet med BIPS-loggningen är att skaffa information om borrhålet inkluderande förekommande bergarter och bestämning av sprickors fördelning och deras orientering.

Syftet med krökningsmätningarna är att mäta lutning och riktning och därmed få fram koordinater för punkter längs med borrhålet.

Rapporten beskriver utrustningen som använts liksom mätprocedurer och en beskrivning och tolkning av data som erhållits. För BIPS-loggningen presenteras data som plottar längs med borrhålet. Radardata presenteras i radargram och en lista över tolkade radarreflektorer ges. Krökningsmätningen presenteras som en lista med lägesdata.

Borrhålsradardata från KLX16A och HLX42 var dålig till bra. I delar med sämre djuppenetration är detta troligen till stor del beroende på en konduktiv miljö. En konduktiv miljö minskar möjligheterna att identifiera strukturer från borrhålsradardata. Dock har 132 radarreflektorer identifierats i KLX16A och av dessa har 19 orienterats (med strykning/stupning). I HLX42 identifierades 17 strukturer.

Mycket bra kvalitet på BIPS bilderna i HLX42 främst beroende på mycket bra vattenkvalitet. Det är något sämre bildkvalitet i KLX16A, suspendat täcker den nedre delen av borrhålsväggen i den övre delen av borrhålet.

Contents

1 Introduction

This report presents the data gained in geophysical logging operations, which is one of the activities performed within the site investigation at Oskarshamn. The logging operations presented here includes borehole radar (RAMAC) and BIPS in the core drilled borehole KLX16A and in the percussion drilled borehole HLX42. In both boreholes deviation measurements were also carried out.

The work was carried out in accordance with activity plan AP PS 400-07-004. In Table 1-1 the controlling documents for performing this activity are listed. Both the activity plan and method descriptions are SKB's internal controlling documents.

This report includes measurements from 0 to 425 m in KLX16A. The borehole was core drilled with a diameter of 76 mm. The measurements in HLX42 was made from 0 to 148 m. The borehole was percussion drilled with a diameter of 139 mm.

All measurements were conducted by Malå Geoscience AB/RAYCON during January 2007. The investigation site and location of the boreholes is shown in Figure 1-1.

The used investigation techniques comprised:

- Borehole radar measurements (Malå Geoscience AB:s RAMAC system) with dipole and directional radar antennas.
- Borehole TV logging with the so-called BIP-system (Borehole Image Processing System), which is a high resolution, side viewing, colour borehole TV system.
- Borehole deviation equipment (Flexit SmartTool from Flexit AB), measuring azimuth, inclination (dip), tool face (gravity and magnetic) and magnetic dip.

The delivered raw and processed data have been inserted in the database of SKB (SICADA) and data are traceable by the activity plan number.

Table 1-1. Controlling documents for the performance of the activity (SKB's internal controlling documents).

Activity plan	**Number**	**Version**
Borrhålsradar, BIPS och Flexit-mätning i KLX16A och HLX42	AP PS 400-07-004	1.0
Method descriptions	**Number**	**Version**
Metodbeskrivning för TV-loggning med BIPS	SKB MD 222.006	1.0
Metodbeskrivning för borrhålsradar	SKB MD 252.020	3.0
Metodbeskrivning för krökningsmätning av hammar- och kärnborrhål	SKB MD 224.001	1.0

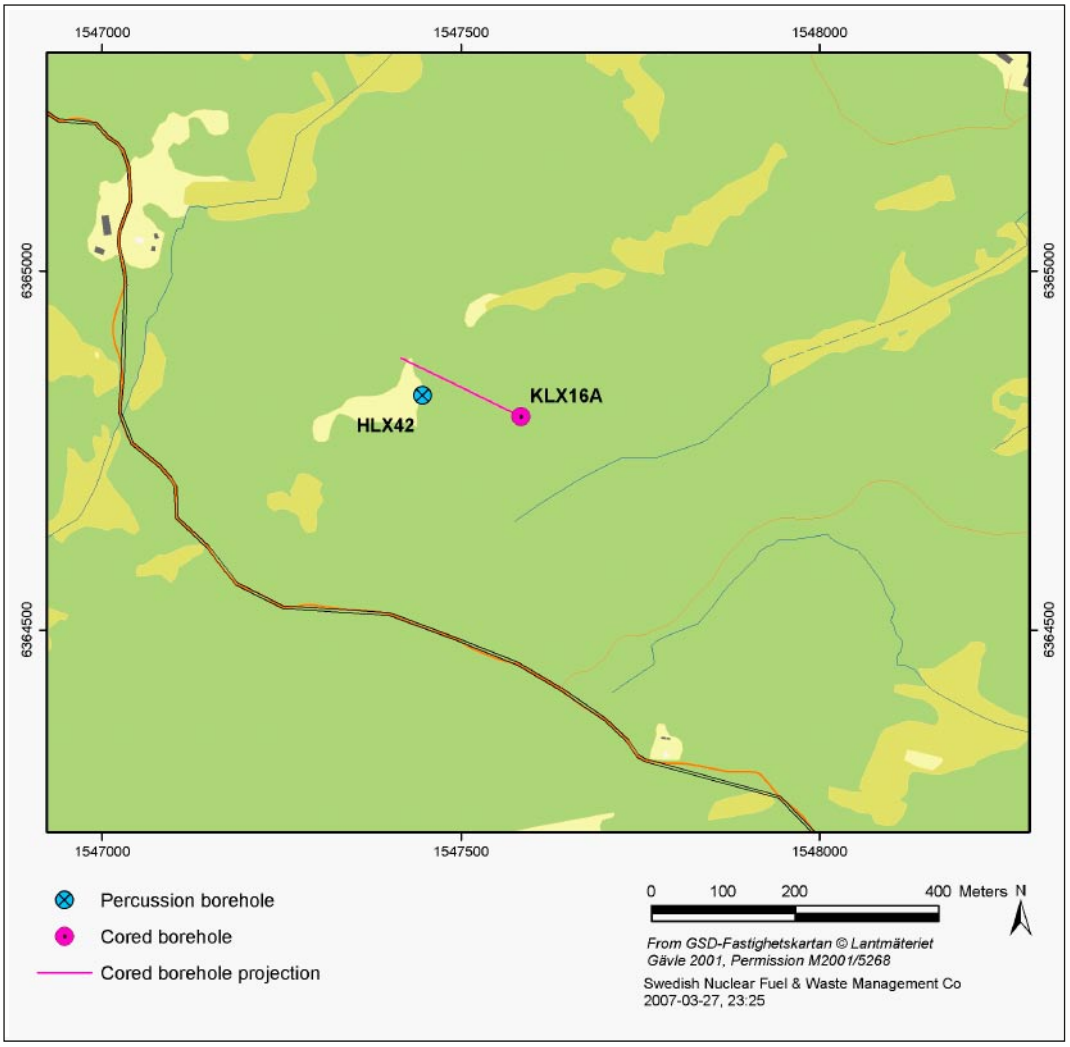


Figure 1-1. *Map of the location of the boreholes KLX16A and HLX42 in the Laxemar subarea, Oskarshamn.*

2 Objective and scope

The objective of the radar and BIPS surveys is to achieve information on the borehole conditions (borehole wall) as well as on the rock mass around the borehole. Borehole radar is engaged to investigate the nature and the structure of the rock mass enclosing the boreholes, and borehole TV for geological surveying of the borehole including determination of rock types as well as fracture distribution and orientation.

The objective of deviation logging is to achieve information of the borehole coordinates as well as dip and azimuth along the entire borehole length.

This report describes the equipment used for the radar, BIPS and deviation surveys as well as the measurement procedures and data gained. For the BIPS survey, the result is presented as images. Radar data is presented in radargrams and the identified reflectors are listed. The deviation measurements are presented as lists of data (coordinates etc).

3 Equipment

3.1 Radar measurements RAMAC

The RAMAC GPR system owned by SKB is a fully digital GPR system where emphasis has been laid on fast survey speed and easy field operation. The system operates dipole and directional antennas (see Figure 3-1). A system description is given in the SKB internal controlling document MD 252.021.

The borehole radar system consists of a transmitter and a receiver antenna. During operation an electromagnetic pulse, within the frequency range of 20 MHz up to 250 MHz, is emitted into the bedrock. Once a feature, e.g. a water-filled fracture, with sufficiently different electrical properties is encountered, the pulse is reflected back to the receiver and recorded.

3.2 TV-Camera, BIPS

The BIPS 1500 system used is owned by SKB and described in SKB internal controlling document MD 222.005. The BIPS method for borehole logging produces a digital scan of the borehole wall. In principle, a standard CCD video camera is installed in the probe in front of a conical mirror (see Figure 3-2). An acrylic window covers the mirror part and the borehole image is reflected through the window and displayed on the cone, from where it is recorded. During the measuring operation, pixel circles are grabbed with a resolution of 360 pixels/circle.

The system orientates the BIPS images according to two alternative methods, either using a compass (vertical boreholes) or with a gravity sensor (inclined boreholes).

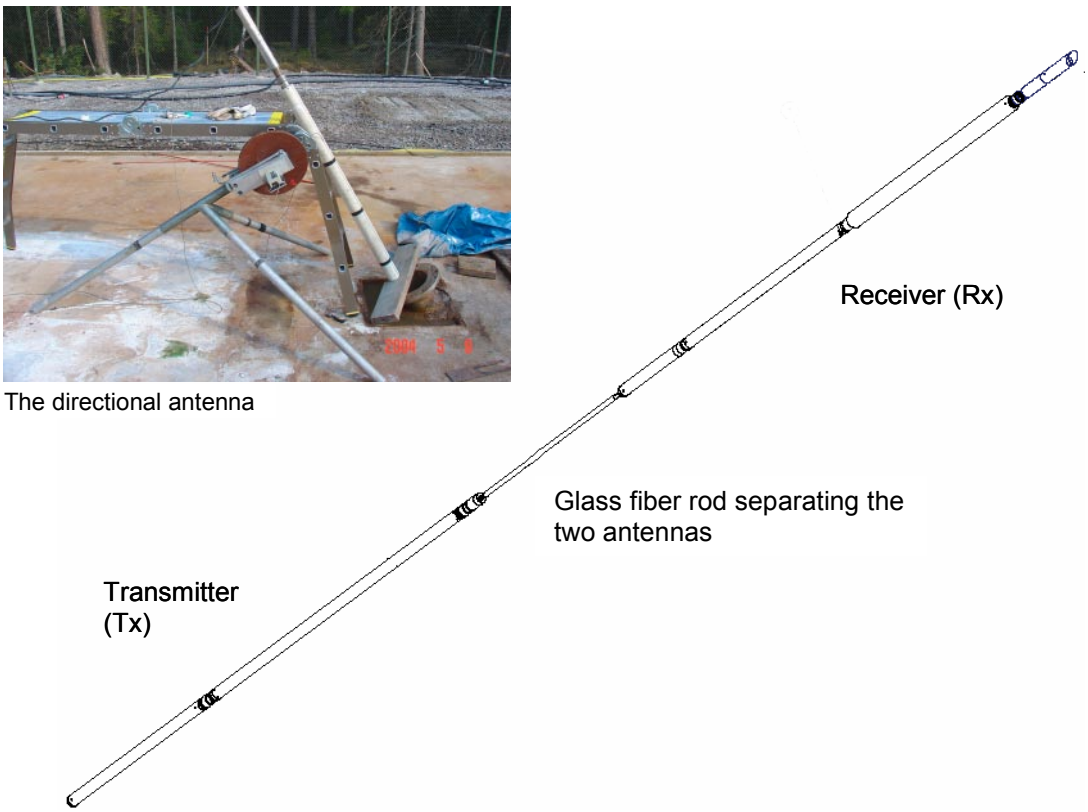


Figure 3-1. *Example of a borehole radar antenna.*

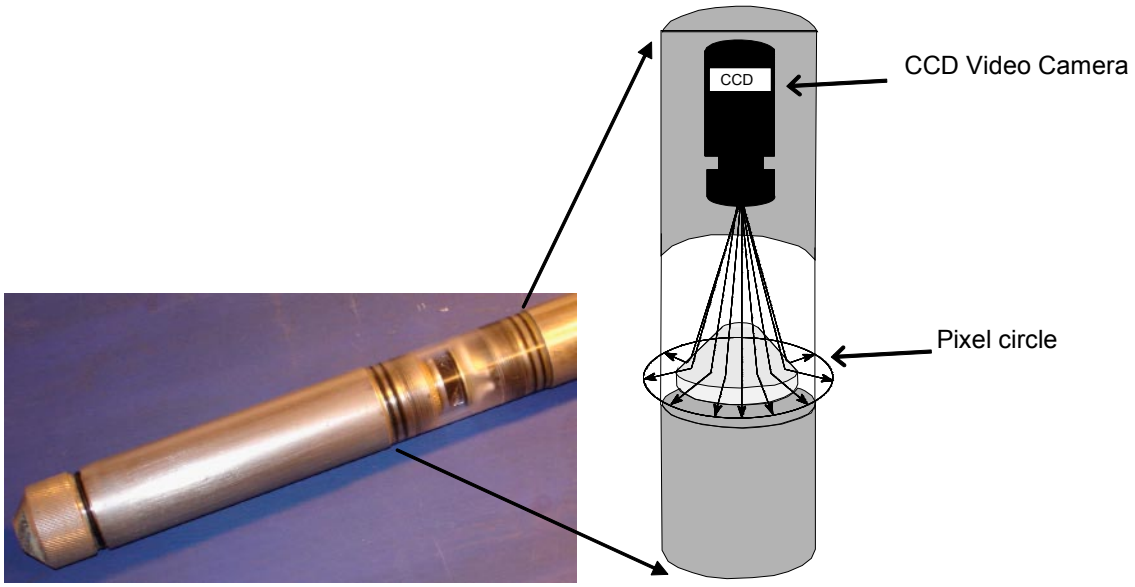


Figure 3-2. *The BIP-system. Illustration of the conical mirror scanning.*

3.3 Deviation measurements, Flexit SmartTool

The deviation measurements were carried out with the Flexit SmartTool Deviation equipment, Figure 3-3. The system is based on station readings.

The system consist of a borehole probe (SensIT) including 3-component magnetometers and accelerometers, measuring a number of different parameters. Table 3-1 describe the delivered parameters. Inside the probe the radio link is also built in were all data is downloaded after the end of the survey. The probe are controlled during the measurement either by an external PC and the software package called MeasureIT or a data pad StoreIT. For processing and reporting data the PC software MeasureIT and DisplayIT are used.

In the Flexit SmartTool system there is a magnetic integrity check to detect magnetic disturbance in the survey measurements. Magnetic disturbance results in incorrect/inaccurate azimuth values. The operator can select the average values for this parameters in the MeasureIT software and run a magnetic integrity check and if necessary change or delete azimuth values. If the azimuth value is changed the new added value by the operator is interpolated from the nearby station readings.

For more information and technical specification visit www.flexit.se.

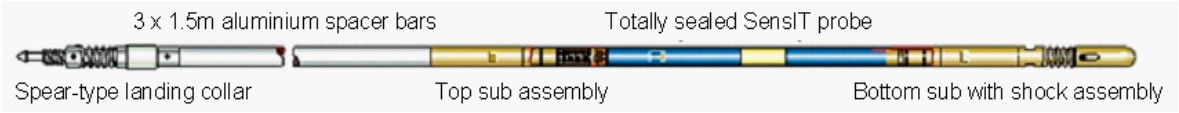


Figure 3-3. *The FlexIT SmartTool-system. Illustration of the set-up in the borehole.*

Table 3-1. Flexit SmartTool result tables.

Dip:	Inclination of the borehole at the position for reading.
Azimuth:	Direction of the borehole at the position for reading.
Easting Northing and Elevation:	Co-ordinate of the borehole at the position for reading.
Mag. Field:	Strength of earth's magnetic field.
Mag. Dip:	Inclination of earth's magnetic field.
Grav. Field:	Indicates if the probe was moved during recording at that station.
Status:	Indicates if the azimuth value at the reading station was disturbed or changed by the operator. If the azimuth value has been edited or the magnetic integrity check have indicated a magnetic disturbance at the reading station a symbol with more than two "hands" is visible in the status field. 
Updown:	Shows the distance the actual reading station is above or below the planned straight line for the borehole given the starting direction.
Left/Right:	Shows the distance the actual reading station is left or right the planned straight line for the borehole given the starting direction.
Short Fall:	Shows the amount the actual point falls short of the planned survey point.

4 Execution

4.1 General

4.1.1 RAMAC Radar

The measurements in KLX16A and HLX42 were carried out with dipole radar antennas, with frequencies of 250, 100 and 20 MHz. In KLX16A measurements were also carried out with a directional antenna, with a central frequency of 60 MHz.

During logging the dipole antennas (transmitter and receiver) were lowered continuously into the borehole and data were recorded on a field PC along the measured interval. The measurement with the directional antenna was made step wise, with a short pause for each measurement occasion. The antennas (transmitter and receiver, both for dipole and directional) were kept at a fixed separation by glass fiber rods according to Tables 4-1 and 4-2. See also Figures 3-1 and 4-1.

All measurements were performed in accordance with the instructions and guidelines from SKB (internal document MD 252.020). All cleaning of the antennas and cable was performed according to the internal document SKB MD 600.004 before the logging operation.

The functionality of the directional antenna was tested before measurements in KLX16A. This was performed by measurements in the air, where the receiver antenna and the transmitter antenna are placed apart. While transmitting and measuring the receiver antenna is turned around and by that giving the direction from the receiver antenna to the transmitter antenna. The difference in direction is measured by compass and the result difference achieved from the directional antenna was approximately 8 degrees. This can be considered to be satisfying due to the disturbed environment, with metallic objects etc at the test site.

For more information on system settings used in the investigation of KLX16A and HLX42 see Tables 4-1 and 4-2 below.

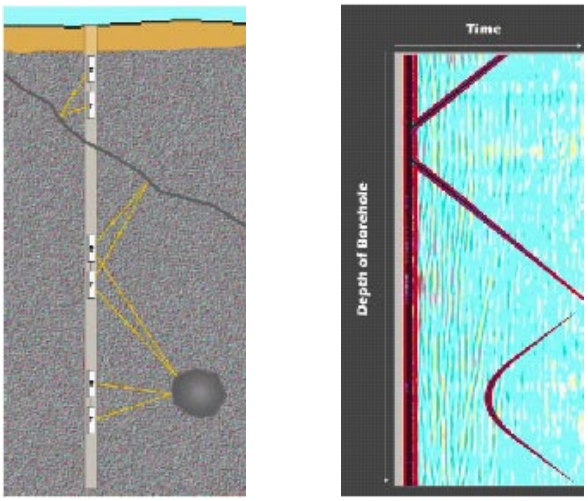


Figure 4-1. *The principle of radar borehole reflection survey and an example of result.*

Table 4-1. Radar logging information from KLX16A.

Site:	**Oskarshamn**	**Logging company:**	**MALÅ GeoScience/RAYCON**		
BH:	**KLX16A**	**Equipment:**	**SKB RAMAC**		
Type:	**Directional/Dipole**	**Manufacturer:**	**MALÅ GeoScience**		
Operator:	**CG**	**Antenna**			
		Directional	**250 MHz**	**100 MHz**	**20 MHz**
Logging date:		2007-01-31	2007-01-31	2007-01-31	2007-01-31
Reference:		T.O.C.	T.O.C.	T.O.C.	T.O.C.
Sampling frequency (MHz):		615	2,424	891	239
Number of samples:		512	619	518	518
Number of stacks:		32	Auto	Auto	Auto
Signal position:		410.5	–0.36	–0.36	–1.42
Logging from (m):		15.4	1.5	2.6	6.25
Logging to (m):		418.4	427.2	425.6	421.45
Trace interval (m):		0.5	0.1	0.2	0.25
Antenna separation (m):		5.73	2.4	3.9	10.05

Table 4-2. Radar logging information from HLX42.

Site:	**Oskarshamn**	**Logging company:**	**MALÅ GeoScience AB/RAYCON**	
BH:	**HLX42**	**Equipment:**	**SKB RAMAC**	
Type:	**Dipole**	**Manufacturer:**	**MALÅ GeoScience**	
Operator:	**CG**	**Antenna**		
		250 MHz	**100 MHz**	**20 MHz**
Logging date:		2007-01-30	2007-01-30	2007-01-30
Reference:		T.O.C.	T.O.C.	T.O.C.
Sampling frequency (MHz):		2,424	891	239
Number of samples:		619	518	518
Number of stacks:		Auto	Auto	Auto
Signal position:		–0.36	–0.36	–1.42
Logging from (m):		1.5	2.6	6.25
Logging to (m):		149.9	148.5	144.95
Trace interval (m):		0.1	0.2	0.25
Antenna separation (m):		2.4	3.9	10.05

4.1.2 BIPS

All measurements were performed in accordance with the instructions and guidelines from SKB (internal document MD 222.006). All cleaning of the probe and cable was performed according to the internal document SKB MD 600.004 before the logging operation.

During the measurement, a pixel circle with a resolution of 360 pixels/circle was used and the digital circles were stored at every 1 mm on a MO-disc in the surface unit. The maximum speed during data collection was 1.5 m/minute.

A gravity sensor based on an air bulb in an alcohol liquid was used to measure the orientation of the images in the boreholes KLX16A and HLX42.

In order to control the quality of the system, calibration measurements were performed in a test pipe before logging and after logging. Figure 4-2 shows the results of the test logging performed before and after the logging campaign in January 2007. The results showed no difference regarding the colours and focus of the images. Results of the test loggings were included in the delivery of the raw data.

The BIPS logging information is found in the header for every single borehole presented in Appendices 3 and 4 in this report.

4.1.3 Deviation measuremnts

The deviation measurements were carried out according to the instructions and guidelines from SKB (internal document MD 224.001). All cleaning of the probe and cable was performed according to the internal document SKB MD 600.004 before the logging operation.

During the logging a measurement was performed for each 3 metre. The logging was carried out in two directions, both from the surface measuring to the bottom of the borehole and a second run measuring from the bottom of the borehole up to the surface. For the operation in the core drilled boreholes the RAMAC/BIPS winch installed in the container was used together with the standard length measuring devices. For an accurate depth control the length recording was adjusted regularly for every 50 metre by the actual marks on the logging cable. Maximum depth error for the measuring wheel is 0.5%.

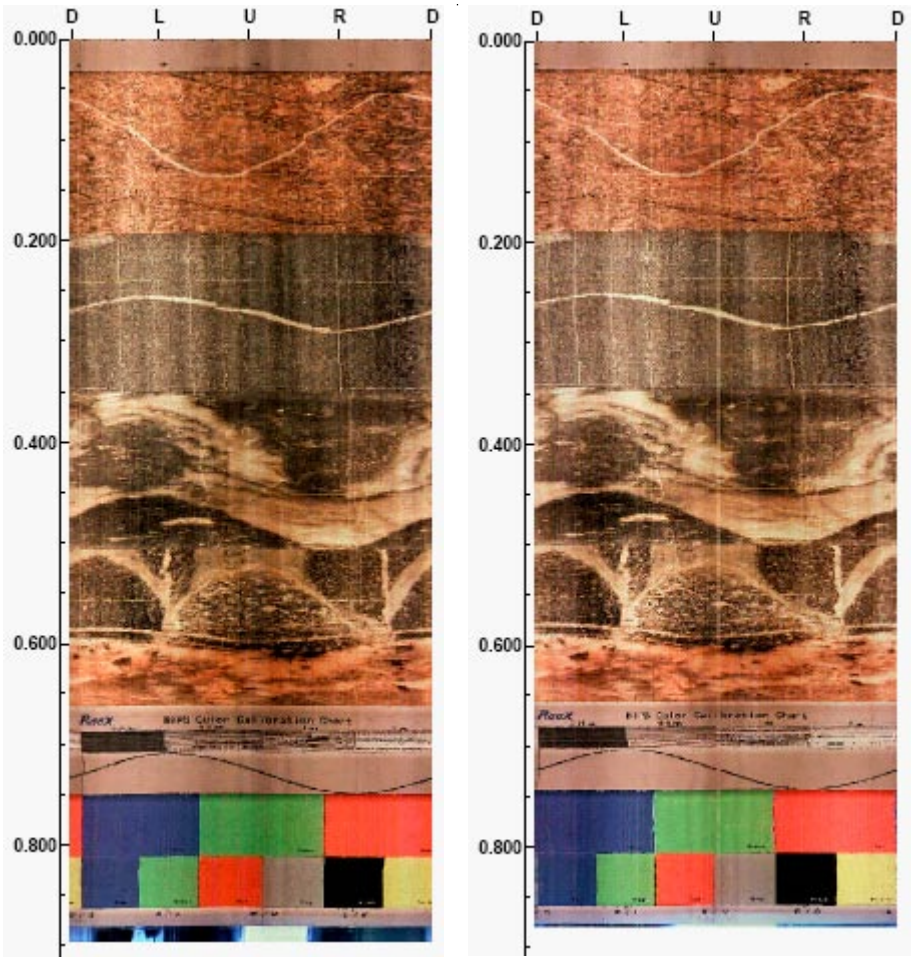


Figure 4-2. *Results from logging in the test pipe before and after the logging campaign in January, 2007.*

4.1.4 Length measurements

During logging the depth recording for the RAMAC systems is taken care of by a measuring wheel mounted on the cable winch. The logging is measured from TOC (Top of Casing). The length is adjusted to the bottom of casing when visible in the BIPS image.

During the BIPS logging in core drilled boreholes, where the reference marks in the borehole wall is visible on the image, the position where the depth mark is visible is marked with scotch tape on the logging cable. During BIPS logging the measured length was adjusted to true length according to depth mark visible in the BIPS image. The adjusted true length is marked with red in the image plot together with the non-adjusted measured length. The non-adjusted length is marked with black as seen in Appendices 3 and 4. The tape marks on the logging cable are then used for controlling the RAMAC measurement.

The experience we have from earlier measurements with dipole antennas in the core drilled boreholes in Forsmark and Oskarshamn for the radar logging is that the depth divergence is less than 100 cm in the deepest parts of a 1,000 metre deep borehole.

The depth divergence is taken into account in the resulting tables in Chapter 5.

4.2 Analyses and Interpretatoin

4.2.1 Radar

The result from radar measurements is most often presented in the form of a radargram where the position of the probes is shown along one axis and the radar wave propagation and reflection is shown along the other axis. The amplitude of the received signal is shown in the radargram with a grey scale where black colour corresponds to large positive signals and white colour to large negative signals. Grey colour corresponds to no reflected signals.

The presented data in this report is adjusted for the measurement point of the antennas. The measurement point is defined to be the central point between the transmitter and the receiver antenna.

The two basic patterns to interpret in borehole measurements are point and plane reflectors. In the reflection mode, borehole radar essentially gives a high-resolution image of the rock mass, showing the geometry of plane structures which may or may not, intersect the borehole (contact between layers, thin marker beds, fractures) or showing the presence of local features around the borehole (cavities, lenses etc).

The distance to a reflecting object or plane is determined by measuring the difference in arrival time between the direct and the reflected pulse. The basic assumption is that the speed of propagation is the same everywhere.

There are several ways to determine the radar wave propagation velocity. Each of them has its advantages and its disadvantages. For this logging campaign the velocity determination earlier performed between KLX07A and KLX07B by keeping the transmitter fixed in one borehole while moving the receiver downwards in a nearby borehole was used. The velocity measurement was performed with the 20 MHz antennas in boreholes KLX07A and KLX07B /1/.

The result is plotted in Figure 4-3 and the calculation shows a velocity varying between 110 and 117 m/micro seconds. The lower velocities most probably represent a fracture zone in the depth interval 40 to 60 m.

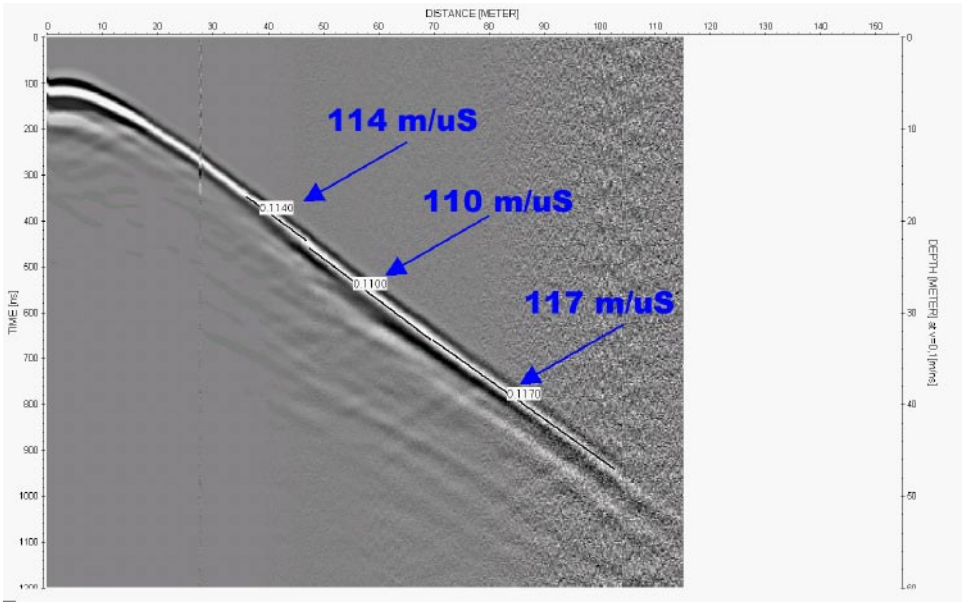


Figure 4-3. *Results from velocity measurements /1/.*

The visualization of data is made with ReflexWin, a Windows based processing software for filtering and analysis of borehole radar data. The processing steps are shown in Tables 4-3 and 4-4. It should be observed that the processing steps in Tables 4-3 and 4-4 below refer to Appendices 1 and 2 in this report. The filters applied affect the whole borehole length and are not always suitable in all parts, depending on the geological conditions and conductivity of the borehole fluid. During interpretation further processing can be done, most often in form of bandpass filtering. This filtering can be applied just in parts of the borehole, where needed.

For the interpretation of the intersection angle between the borehole axis and the planes visible on the radargrams the RadinterSKB software has been used. The interpreted intersection points and intersection angles of the detected structures are presented in the Tables 5-3 and 5-4 and are also visible on the radargrams in Appendices 1 and 2.

Table 4-3. Processing steps for borehole radar data from KLX16A.

Site:	**Oskarshamn**	**Logging company:**	**MALÅ GeoScience/RAYCON**	
BH:	**KLX16A**	**Equipment:**	**SKB RAMAC**	
Type:	**Directional/Dipole**	**Manufacturer:**	**MALÅ GeoScience**	
Interpret:	**JG**	**Antenna**		
	Directional	**250 MHz**	**100 MHz**	**20 MHz**
Processing:	Move start time (–45 samples)	Move start time (–8.6)	Move start time (–26.7)	Move start time (–81.7)
	DC shift (41–510)	DC shift (190–230)	DC shift (470–530)	DC shift (1,800–2,000)
	Time gain (start 84 lin 100 exp 5)	Gain (start 12 lin 2.5 exp 0.9)	Gain (start 33 lin 1.4 exp 0.6)	Gain (start 100 lin 3 exp 0.2)
	(FIR)			

Table 4-4. Processing steps for borehole radar data from HLX42.

Site:	**Oskarshamn**	**Logging company:**	**MALÅ GeoScience AB/RAYCON**	
BH:	**HLX42**	**Equipment:**	**SKB RAMAC**	
Type:	**Dipole**	**Manufacturer:**	**MALÅ GeoScience AB**	
Interpret:	**JG**	**Antenna**		
		250 MHz	**100 MHz**	**20 MHz**
Processing:		Move start time (–10.9)	Move start time (–29.5)	Move start time (–80.6)
		DC removal (190–230)	DC removal (470–530)	DC removal (1,800–2,000)
		Gain (start 17 lin 0.3 exp 0.1)	Gain (start 50 lin 1.3 exp 0.5)	Gain (start 80 lin 1.7 exp 0.2)

4.2.2 BIPS

The visualization of data is made with BDPP, a Windows based processing software for filtering, presentation and analysis of BIPS data. As no fracture mapping of the BIPS image is performed, the raw data was delivered on a CD-ROM together with printable pictures in *.pdf format before the field crew left the investigation site.

The printed results were delivered with measured length, together with adjusted length according to the length marks visible in the BIPS image. For printing of the BIPS images the printing software BIPP from RaaX was used.

4.2.3 Deviation measurements

The resulting data from the deviation measurements were corrected relatively to the magnetic North, 2.73 degrees east of RT90 North for the presentation in Appendices 5 and 6. For delivery to SICADA the azimuth was delivered relatively to magnetic North.

4.3 Nonconformities

No nonconformities occurred during the logging campaign in January, 2007.

5 Results

The results from the BIPS measurements for KLX16A and HLX42 were delivered as raw data (*.bip-files) on CD-ROM disks and MO-disks to SKB together with printable BIPS pictures in *.pdf format before the field crew left the investigation site. The information of the measurements was registered in SICADA, and the digital data and VHS tapes stored by SKB.

The RAMAC radar data was delivered as raw data (file format *.rd3 (dipole antennas) or *.rd5 (directional antenna)) for KLX16A and HLX42 with corresponding information files (file format *.rad) whereas the data processing steps and results are presented in this report. Relevant information, including the interpretation presented in this report, was inserted into the SKB database SICADA.

The results from the deviation measurement were delivered to SKB in form of raw Flexit files and Excel-files, and also presented in Appendices 5 and 6 in this report. Each reading station depth are referred from T.O.C. in the appendices.

The delivered raw and processed data have been inserted in the database of SKB (SICADA) and data are traceable by the activity plan number.

5.1 RAMAC logging

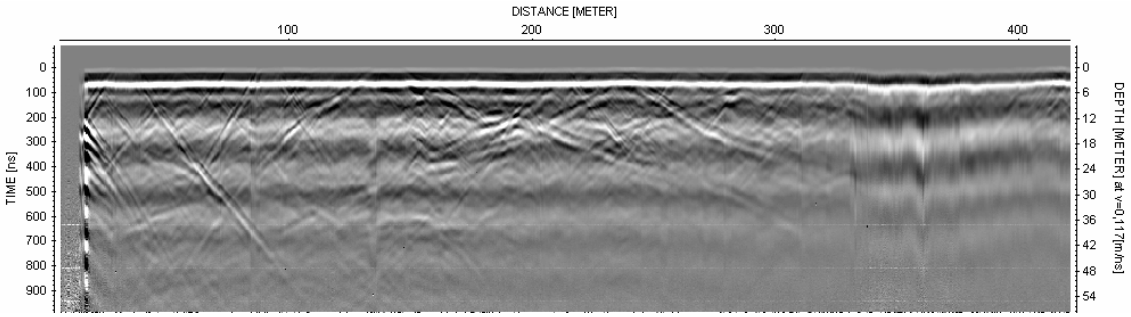
The results of the interpretation of the radar measurements are presented in Tables 5-1 to 5-7. Radar data is also visualized in Appendices 1 and 2. It should be remembered that the images in Appendices 1 and 2 are only a composite picture of all events 360 degrees around the borehole, and do not reflect the orientation of the structures.

Only the larger clearly visible structures are interpreted in RadinterSKB. An overview of the boreholes are given in Figure 5-1 below. A number of minor structures also exist but not interpreted as indicated in the Appendices. Often a number of structures can be noticed, but most probably lying so close to each other that it is impossible to distinguish one from the other Larger structures parallel to the borehole, if present, are also indicated in the Appendices. It should also be pointed out that reflections interpreted will always get an intersection point with the borehole, but being located further away. They may in some cases not reach the borehole.

The data quality from KLX16A (as seen in Appendix 1) is good, but in parts of lower quality due to more conductive conditions, see data from below 330 m. In HLX42 the data quality is very low, due to conductive conditions. A conductive environment makes the radar wave to attenuate, which decreases the penetration. This conductive environment of course also reduces the possibility to distinguish and interpret possibly structures in the rock which otherwise could give a reflection. In parts with an increased conductivity and thereby a decreased depth penetration most often only the edges of structures can be distinguished, giving an intersection angle of 90 degrees. This is especially seen for the 250 MHz data from HLX42, see Figure 5-2.

The effect of a conductive environment is also seen in the directional antenna for KLX16A, which makes it more difficult to interpret the direction to the identified structures.

As also seen in Appendices 1 and 2 the resolution and penetration of radar waves depend on the antenna frequency used. Low antenna frequency gives less resolution but higher penetration depth compared to a higher frequency. If structures can be identified with all three antenna frequencies, it can probably be explained by that the structure is quite significant.



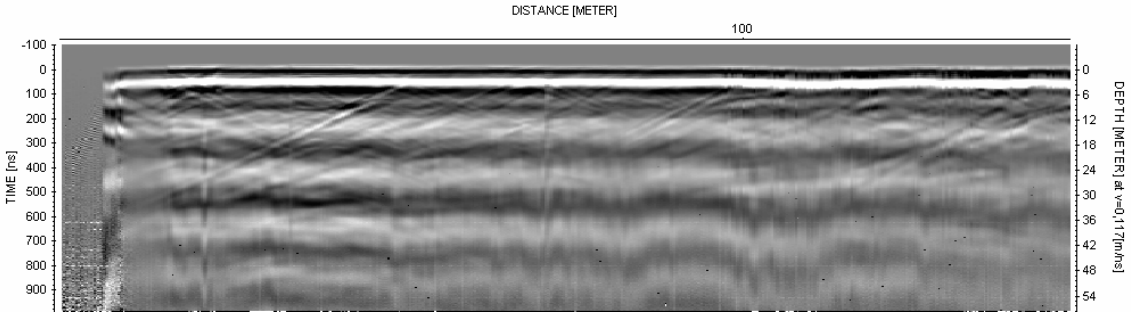


Figure 5-1. *An overview (20 MHz data) of the radar data for the boreholes KLX16A and HLX42. Observe that the length (x-scale) differs between the different boreholes.*

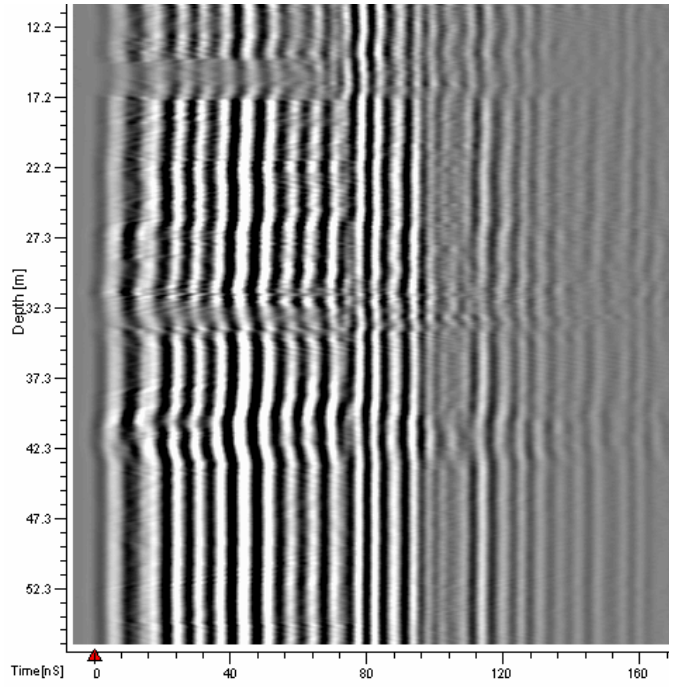


Figure 5-2. *Example of data from HLX42 (250 MHz data). The effect of a probably high conductivity is seen as structures with an intersection angle of 90 degrees.*

In Tables 5-1 and 5-2 below the distribution of identified structures along the borehole are listed for KLX16A and HLX42.

Tables 5-3 and 5-4 summarises the interpretation of radar data from KLX16A and HLX42. The direction to the reflector (object) is also given for the borehole KLX16A. As seen some radar reflectors in Table 5-3 are marked with ±, which indicates an uncertainty in the interpretation of direction. The direction can in these cases be ±180 degrees. The direction to the reflector (object) is defined in Figure 5-3. As the borehole inclination is less than 85° the direction to object is calculated using gravity roll. The direction to object and the intersection angle are recalculated to strike and dip, also given in Table 5-3. The plane strike is the angle between line of the plane's cross-section with the surface and the Magnetic North direction. It counts clockwise and can be between 0 and 359 degrees. A strike of 0 degrees implies a dip to the east while a strike of 180 degrees implies a dip to the west. The plane dip is the angle between the plane and the surface. It can vary between 0 and 90 degrees.

Observe that a structure can have several different angles, if the structure is undulating, and thereby also different intersection depths is given. This is seen for instance for structure 50 in Table 5-3 and Appendix 1. To this structure, most likely, also structure 50x belongs.

Table 5-1. Identified structures as a function of depth in KLX16A.

Depth (m)	No. of structures
–50	17
50–100	21
100–150	19
150–200	10
200–250	15
250–300	15
300–350	17
350–400	9
400–450	9

Table 5-2. Identified structures as a function of depth in HLX42.

Depth (m)	No. of structures
–20	1
20–40	3
40–60	1
60–80	2
80–100	3
100–120	1
120–140	4
140–160	1
160–	1

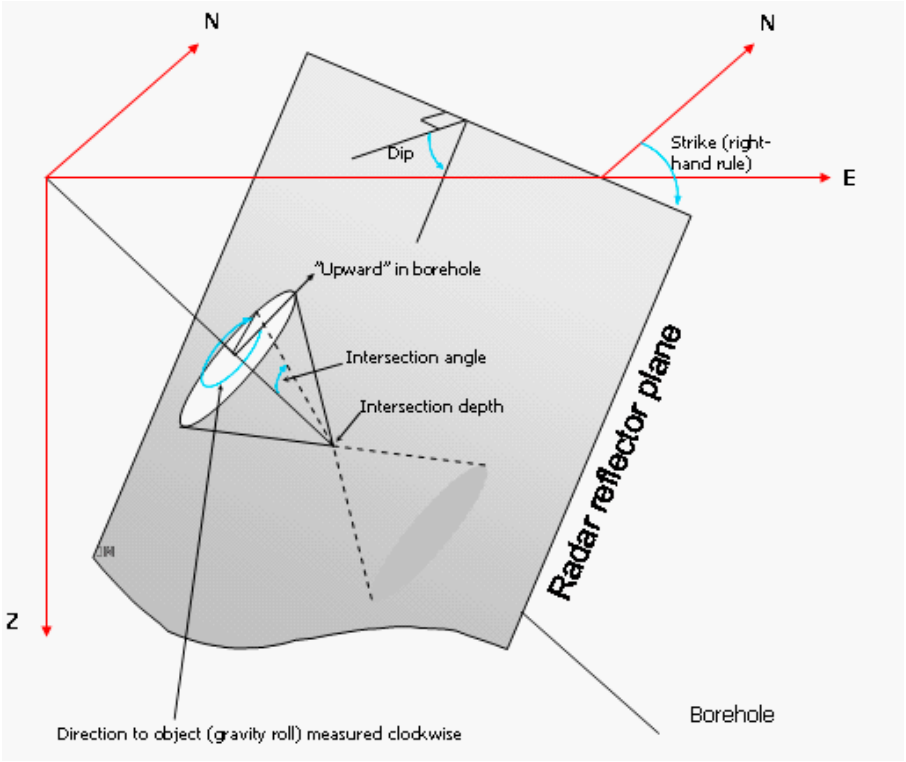


Figure 5-3. *Definition of intersection angle, direction to object using gravity roll, dip and strike using the right hand rule as presented in Table 5-3.*

Table 5-3. Interpretation of radar reflectors from the dipole antennas 250, 100 and 20 MHz, and the directional antenna 60 MHz in borehole KLX16A.

RADINTER MODEL INFORMATION (Directional antenna)							
Site: name:		**Oskarshamn**					
Borehole		**KLX16A**					
Nominal velocity (m/µs):		**117.0**					
Name	**Intersection depth**	**Intersection angle**	**RadInter direction to object (gravity roll)**	**Dip 1**	**Strike 1**	**Dip 2**	**Strike 2**
2	11.6	73					
116	12.9	55					
1	13.0	77					
12	14.0	22					
3	17.0	79					
4	20.3	72					
5	20.9	58					
6	26.3	48					
11	27.2	24					
8x	27.6	46					
7	31.0	55					
8	33.3	58					
9	34.2	58	249	28	324		
10	42.4	72					
15	43.9	17					
13	45.3	67					

RADINTER MODEL INFORMATION
(Directional antenna)

Site: name:	**Oskarshamn**
Borehole	**KLX16A**
Nominal velocity (m/µs):	**117.0**

Name	Intersection depth	Intersection angle	RadInter direction to object (gravity roll)	Dip 1	Strike 1	Dip 2	Strike 2
50x	45.4	6					
14	52.3	54					
16	57.1	70					
17	58.6	52					
18	58.7	67					
102	60.2	56					
119	64.4	46	60 ±	59	70	36	294
19	67.0	66					
20	68.1	64					
117	75.9	72					
43	76.8	9					
21	77.9	69					
22	79.0	63					
120	79.8	60	231 ±	24	304	49	56
30	84.2	46					
42x	86.8	17					
23	90.7	63					
24	92.7	62					
25	93.0	66	255 ±	27	338	36	62
26	94.4	36					
27	96.2	61					
103	98.7	70					
28	101.9	81					
42	104.5	24					
104	109.0	63					
31	110.0	50					
29	113.8	27					
32	114.0	48	318 ±	59	356	26	129
33	118.0	42	144 ±	28	144	66	359
44	124.3	27					
34	127.8	69					
35	130.5	58					
36	132.7	44					
37xx	133.8	33					
50	134.4	14	72	85	94		
37	138.3	34					
39	140.7	68					
37xxx	141.5	28					
38	143.3	34					
37x	143.5	23	96	64	109		
37xxxx	148.2	30					
40	157.7	23					
41	170.0	37	33 ±	73	52	33	257
48	179.4	73					

RADINTER MODEL INFORMATION
(Directional antenna)

Site: name:	**Oskarshamn**
Borehole	**KLX16A**
Nominal velocity (m/µs):	**117.0**

Name	Intersection depth	Intersection angle	RadInter direction to object (gravity roll)	Dip 1	Strike 1	Dip 2	Strike 2
45	180.3	61					
53	182.1	14					
47	183.3	65	279	39	340		
46	184.2	58					
56xxx	191.5	13					
109	195.4	51					
49	197.2	53					
55	202.4	52					
121	205.7	14	81 ±	81	101	74	293
52	207.3	75					
51	209.9	56	333 ±	59	8	18	143
70	215.1	6					
57	225.3	52					
56x	226.4	24					
54	227.5	15					
56xx	227.8	22					
56	230.1	20	51 ±	85	72	55	268
113	232.1	12					
60	232.4	64					
59	237.2	56					
105	246.0	66					
61	247.4	64					
84	253.2	9					
62	258.4	45					
58	260.8	16	45	89	248		
64	263.6	72					
63	264.6	58	276	41	335		
66	266.6	81					
65	268.4	56					
77	271.5	26					
67	274.5	71					
68	275.5	67					
107	276.6	27					
69	276.8	72					
71	285.5	59					
71x	289.6	33					
72	297.2	45	300	59	342		
74	300.7	60					
73	301.7	29					
75	304.3	53					
118	310.4	45					
76	312.8	46					
80	313.6	59					
78	315.7	45					

RADINTER MODEL INFORMATION
(Directional antenna)

Site: name:	**Oskarshamn**
Borehole	**KLX16A**
Nominal velocity (m/µs):	**117.0**

Name	Intersection depth	Intersection angle	RadInter direction to object (gravity roll)	Dip 1	Strike 1	Dip 2	Strike 2
82	316.4	32					
106x	316.7	14					
79	317.1	64					
81	317.9	59					
83	325.0	47					
85	331.9	56					
86	338.9	63					
106	339.1	7	213	62	243		
87	340.0	78					
88	344.7	68	18 ±	49	35	8	309
89	353.7	72					
91	370.8	63	243 ±	27	319	44	61
90	371.9	76					
92	380.2	61					
93	382.0	61					
100x	389.5	11					
110	390.1	46					
95	396.1	41					
94	397.8	18					
108	407.4	66					
96	408.5	74					
100	409.0	35					
97	412.8	58					
111	415.5	37					
99	421.3	67					
98	423.3	73					
101	424.7	41					
115	439.7	47					

Table 5-4. Interpretation of radar reflectors from the dipole antennas 250, 100 and 20 MHz, in borehole HLX42.

RADINTER MODEL INFORMATION (20, 100 and 250 MHz Dipole Antennas)			
Site:		**Oskarshamn**	
Borehole name:		**Borehole name:**	
Nominal velocity (m/µs):		**117.0**	
Reflector type	**Name**	**Intersection depth**	**Intersection angle**
PLANE	1	14.5	70
PLANE	2	30.7	48
PLANE	3	33.7	55
PLANE	5	38.9	47
PLANE	4	40.8	44
PLANE	6	61.4	66
PLANE	7	76.0	61
PLANE	8	80.0	50
PLANE	9	86.0	58
PLANE	17	92.1	62
PLANE	10	109.5	57
PLANE	11	122.9	53
PLANE	12	125.4	52
PLANE	13	129.5	58
PLANE	14	133.6	38
PLANE	16	150.6	67
PLANE	15	167.8	36

In Appendices 1 and 2, the amplitude of the first arrival is plotted against the depth, for the 250 MHz dipole antennas. The amplitude variation along the borehole indicates changes of the electrical conductivity of the volume of rock surrounding the borehole. A decrease in this amplitude may indicate fracture zones, clay or rock volumes with increases in water content, i.e. increases in electric conductivity. The decrease in amplitude is shown in Tables 5-5 and 5-6.

Table 5-5. Borehole length intervals in KLX16A with decreased amplitude for the 250 MHz antenna.

Length (m)	Length (m)
35	335–370
90–95	400–405
135–140	405–415
250–285	425
315–320	

Table 5-6. Borehole length intervals in HLX42 with decreased amplitude for the 250 MHz antenna.

Length (m)	Length (m)
15	105–115
35	130–135
70–95	140–145

Finally, the structures considered as the most important (clear in the radargram, identified with several antenna frequencies, stretching out far from the borehole wall etc) are listed in Table 5-7 below.

Observe that it can be very difficult to classify different structures in an objective manner, along a borehole. This is due to the fact that the water quality (the conductivity) amongst others varies along the borehole length and by that reason affects the results of the radar logging, by for instance attenuating the radar waves differently. Also the intersection angle of the identified structures affects the amplitude on the resulting radargram. A small intersection angle will most often give an increased amplitude compared to a larger intersection angle, and by that a more clear structure.

5.2 BIPS logging

The BIPS pictures from KLX16A and HLX42 are presented in Appendices 3 and 4.

In order to control the quality of the system, calibration measurements were performed in a test pipe before and after the logging. The resulting images displayed with no difference regarding the colours and focus of the images. Results of the test loggings were included in the delivery of the raw data.

To get the best possible depth accuracy, the BIPS images are adjusted to the reference mark on the cable for the logging.

The error in the depth recording depends mainly on the tension of the cable and error of the depth readings from the measuring wheel. The adjusted depth is showed in red colour and the recording depth have black colour in the printouts.

The BIPS image quality in HLX42 was of very good quality. In general the image quality is better in percussion drilled boreholes compared with core drilled.

The image quality in KLX16A is acceptable. Mud covering the lower most part and a quit high content of the induced miss-coloring of the borehole walls induced during the drilling phase limits the visibility.

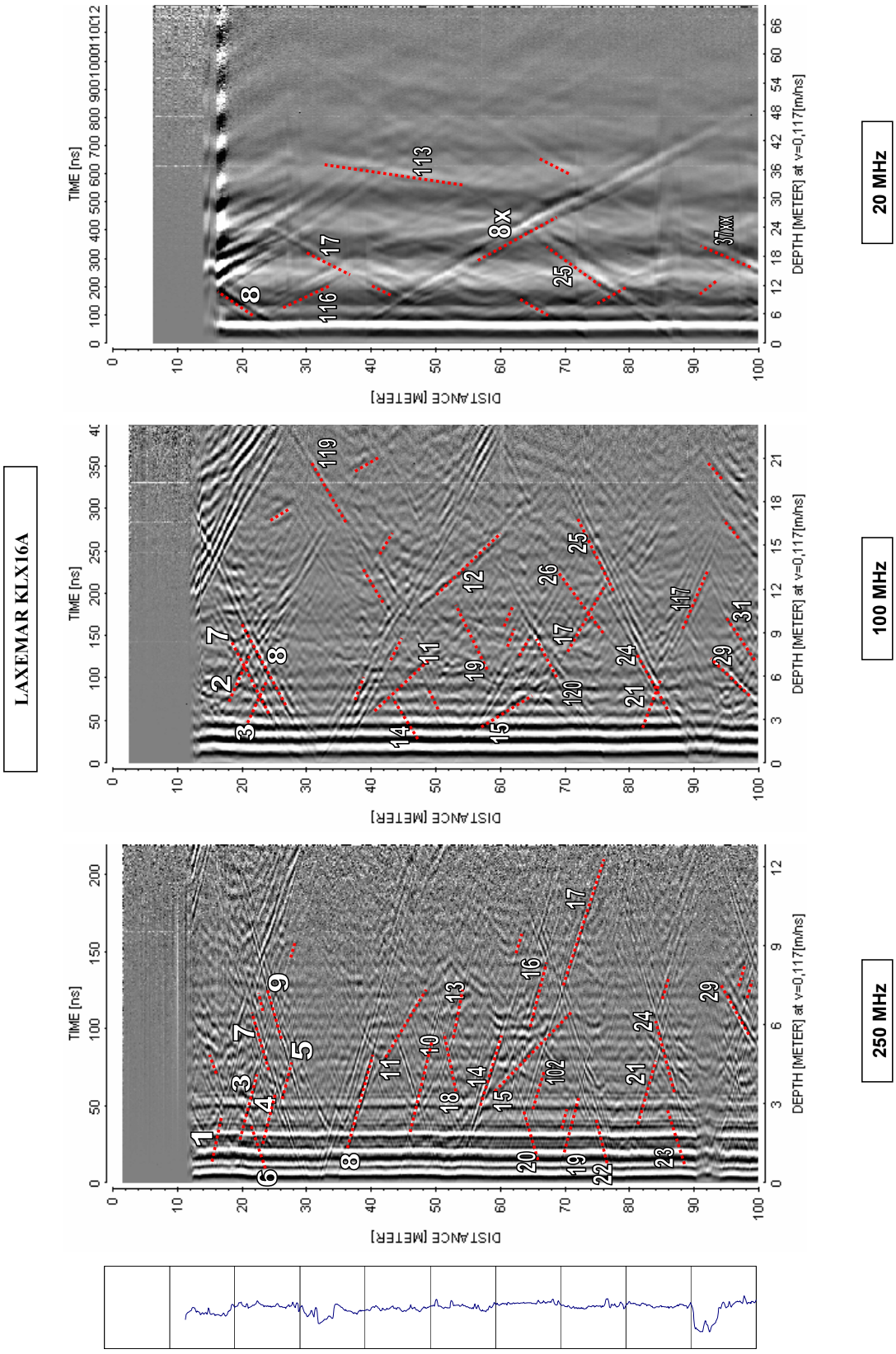
Table 5-7. Some important structures in KLX16A and HLX42.

Borehole	KLX16A	HLX42
Structures	8, 17, 25, 37, 37x, 37xx, 37xxx, 37xxxx, 41, 42, 42x, 50, 50x, 56, 56x, 56xx, 58, 106, 106x, 112 and 121	6, 8, 9, 10, 16 and 17

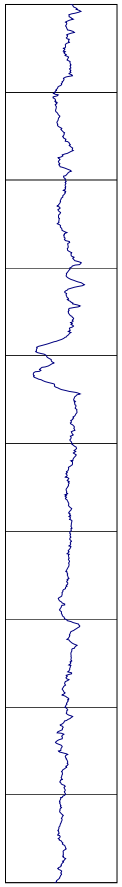
References

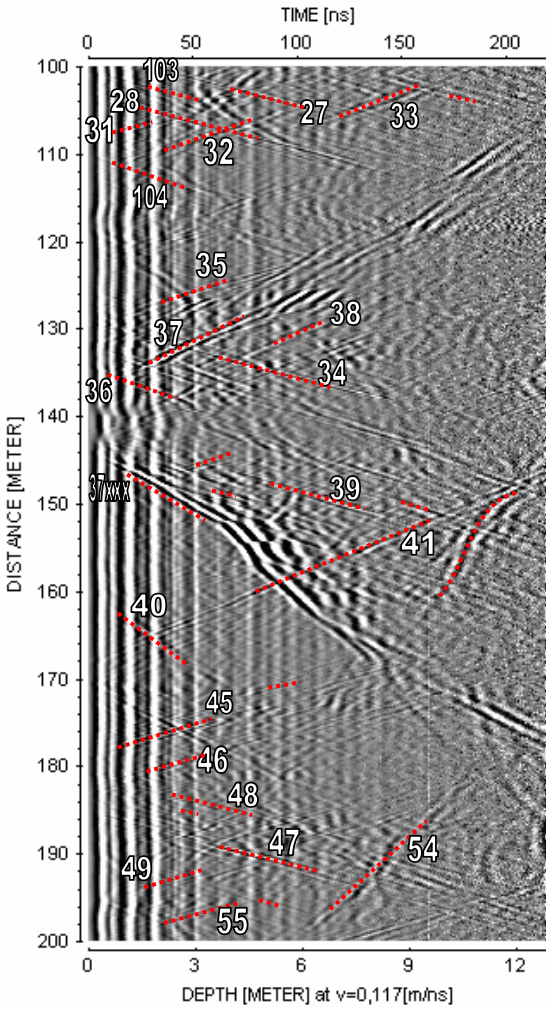
/1/ **Gustafsson J, Gustafsson C, 2005.** Oskarshamn site investigation. RAMAC and BIPS logging in boreholes KLX07A, KLX07B, HLX34 and HLX35 and deviation logging in boreholes KLX07B, HLX34 and HLX35. SKB P-05-231, Svensk Kärnbränslehantering AB.

Radar logging in KLX16A, 0 to 425 m, dipole antennas 250, 100 and 20 MHz

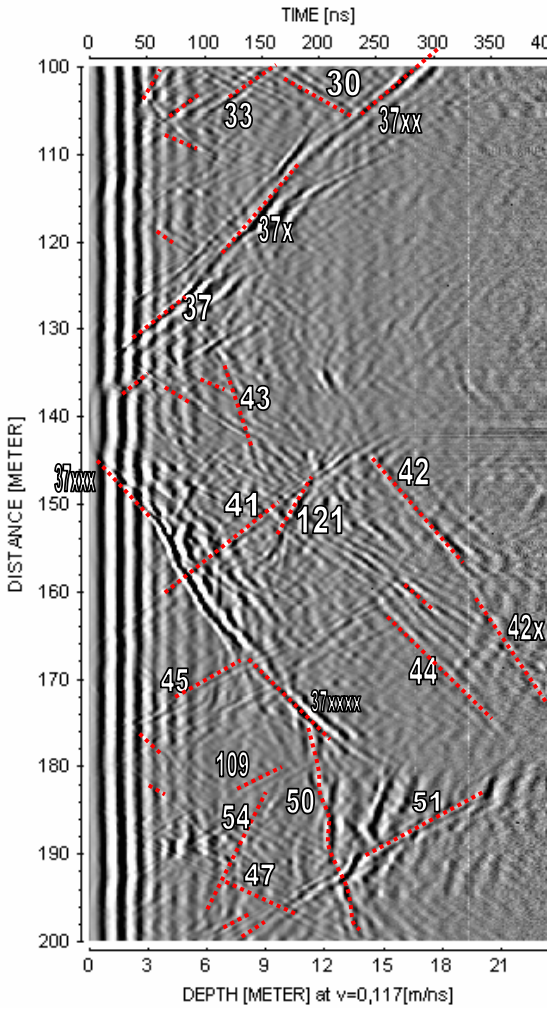


LAXEMAR KLX16A

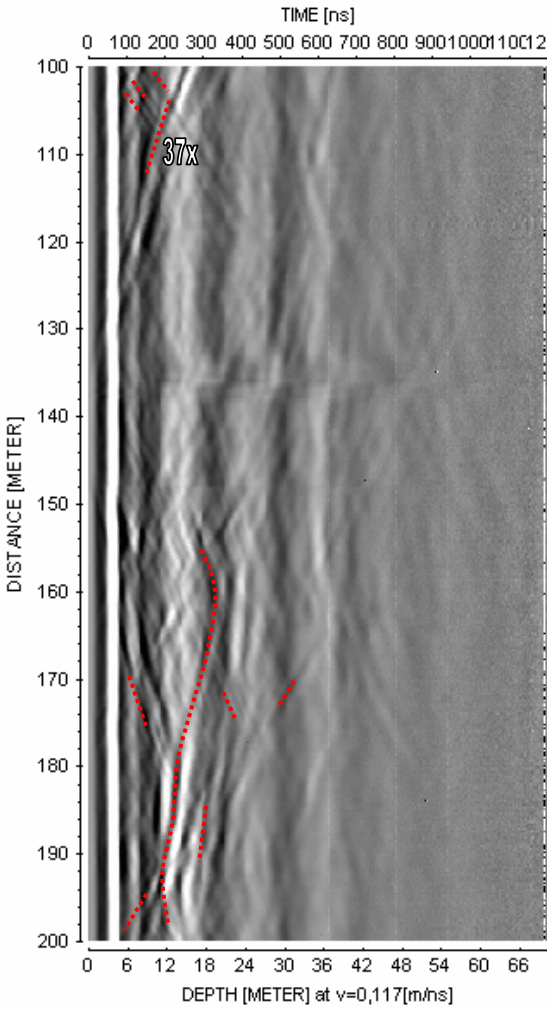




250 MHz

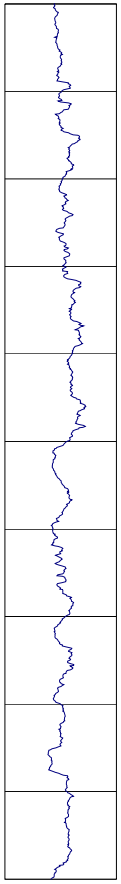


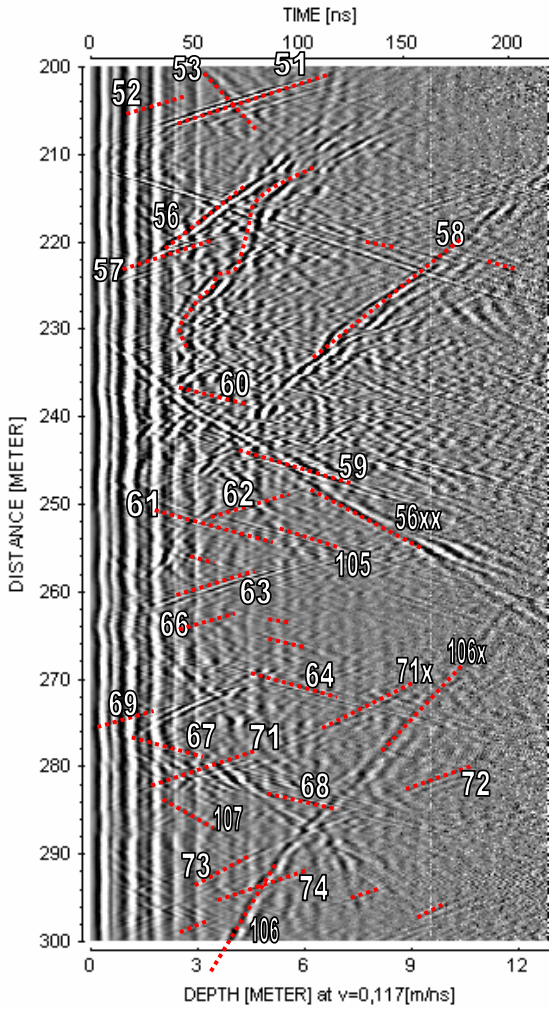
100 MHz



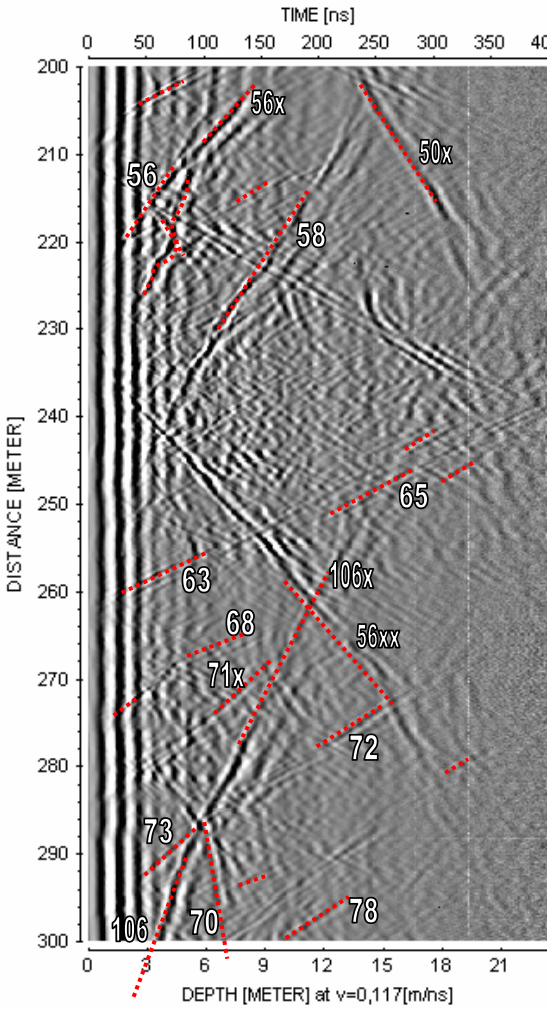
20 MHz

LAXEMAR KLX16A

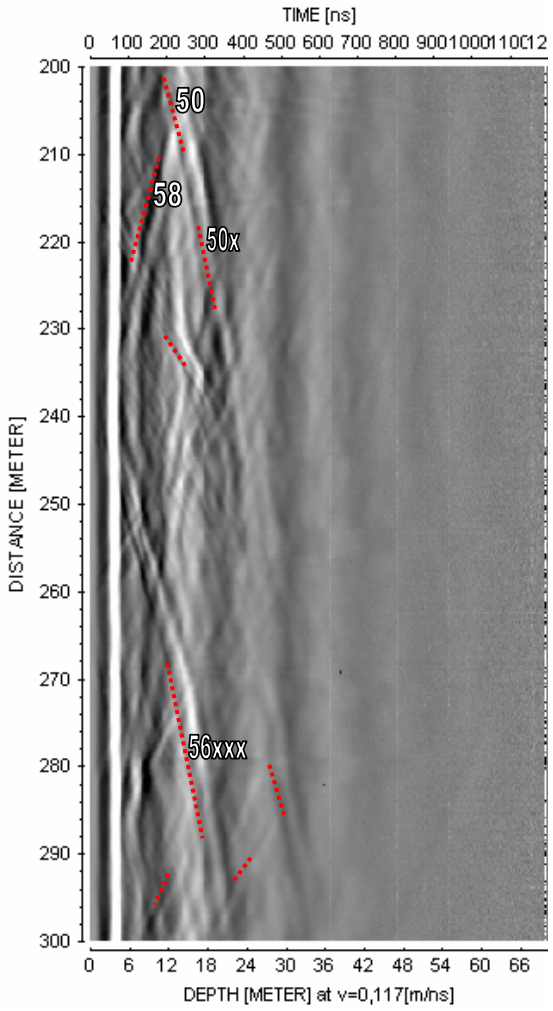




250 MHz

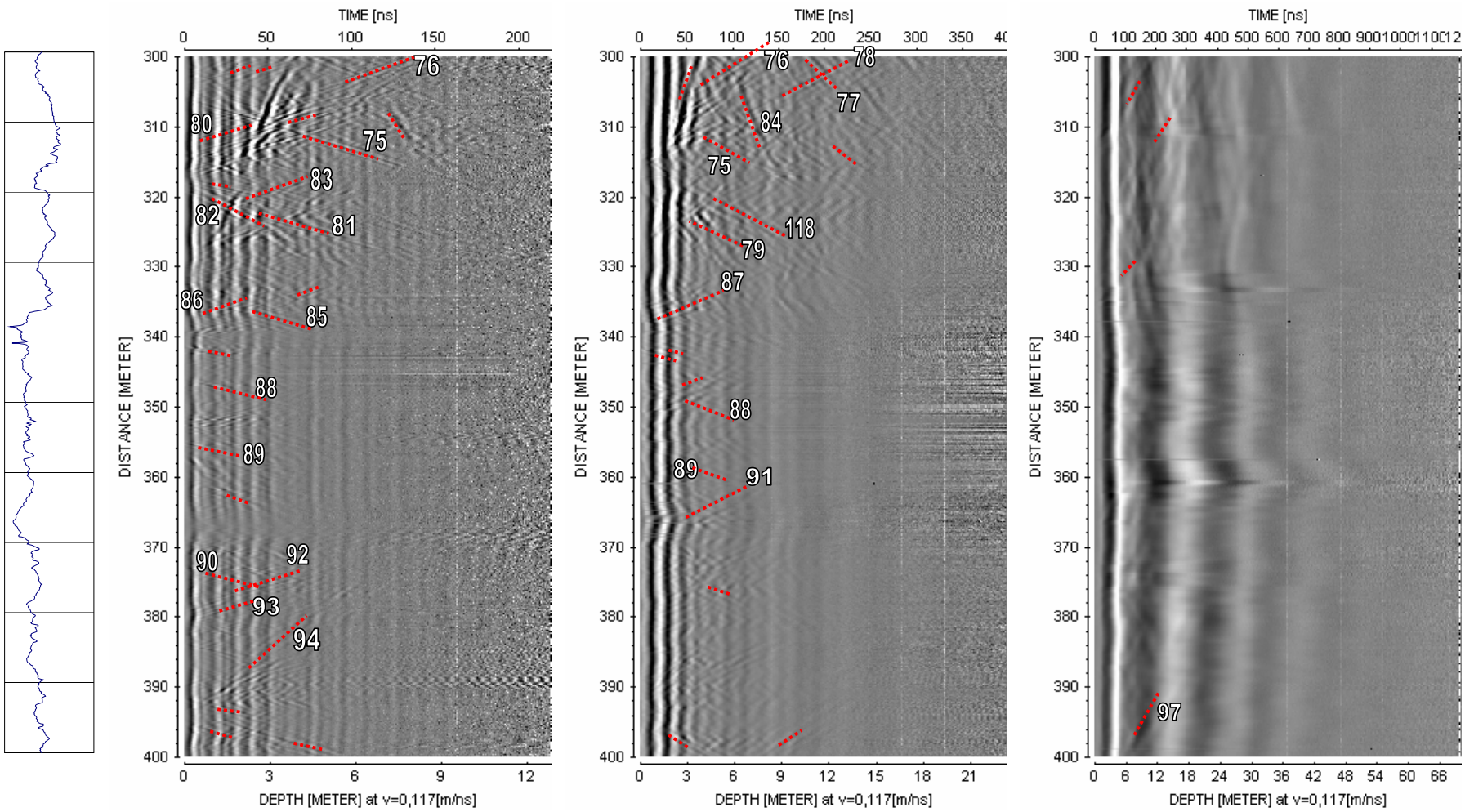


100 MHz



20 MHz

LAXEMAR KLX16A

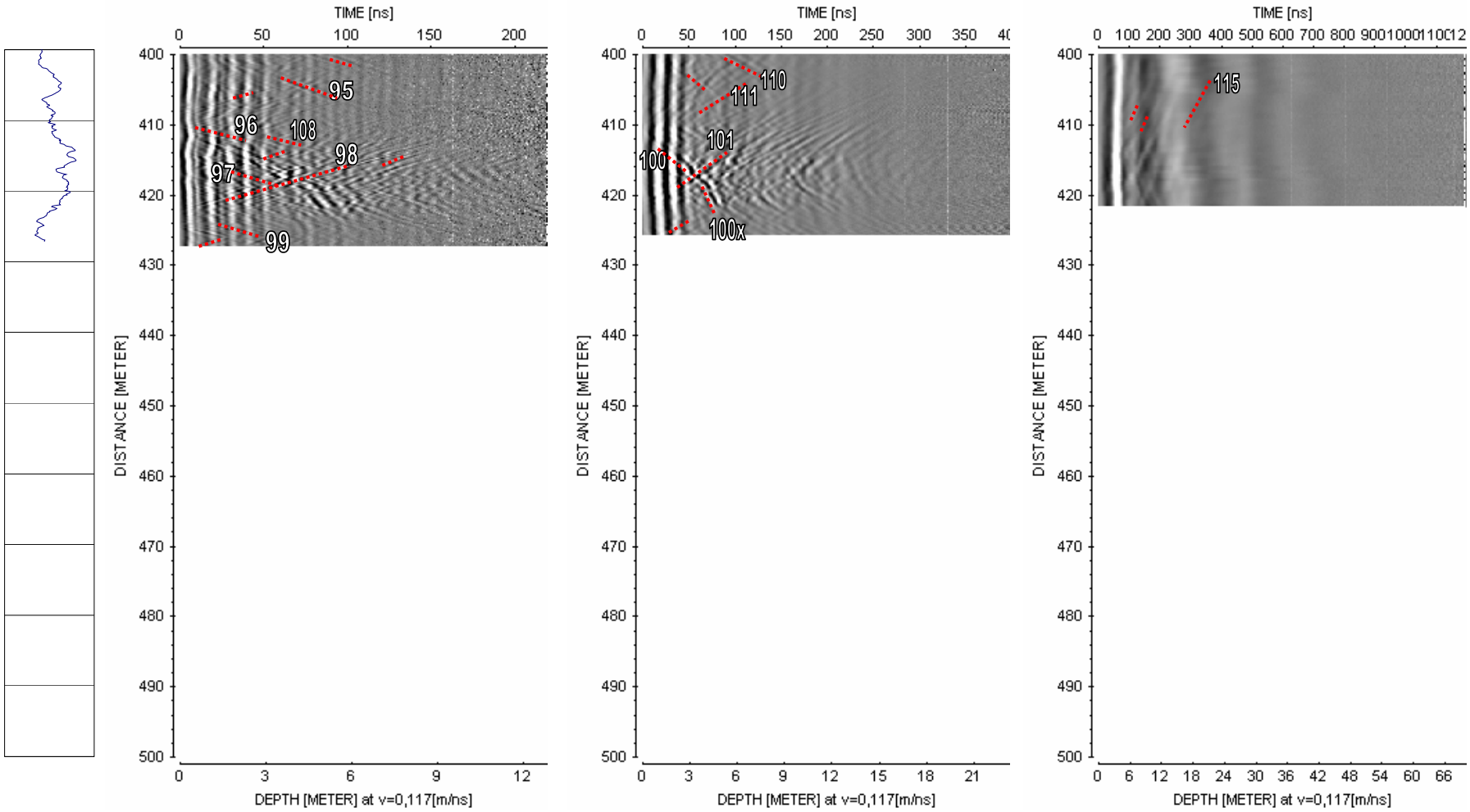


250 MHz

100 MHz

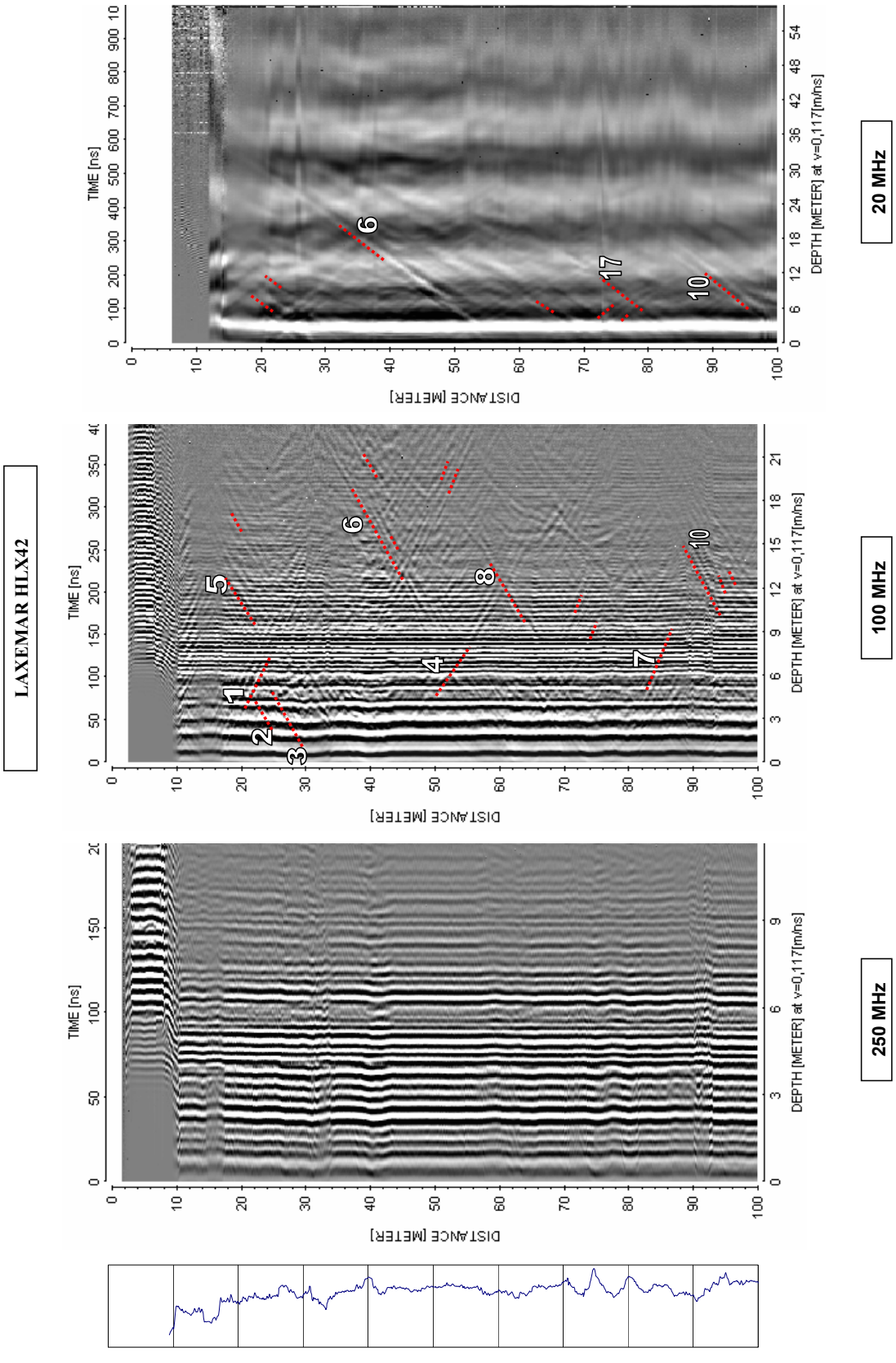
20 MHz

LAXEMAR KLX16A

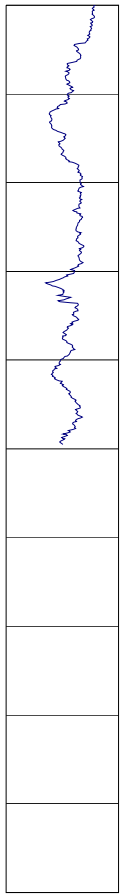


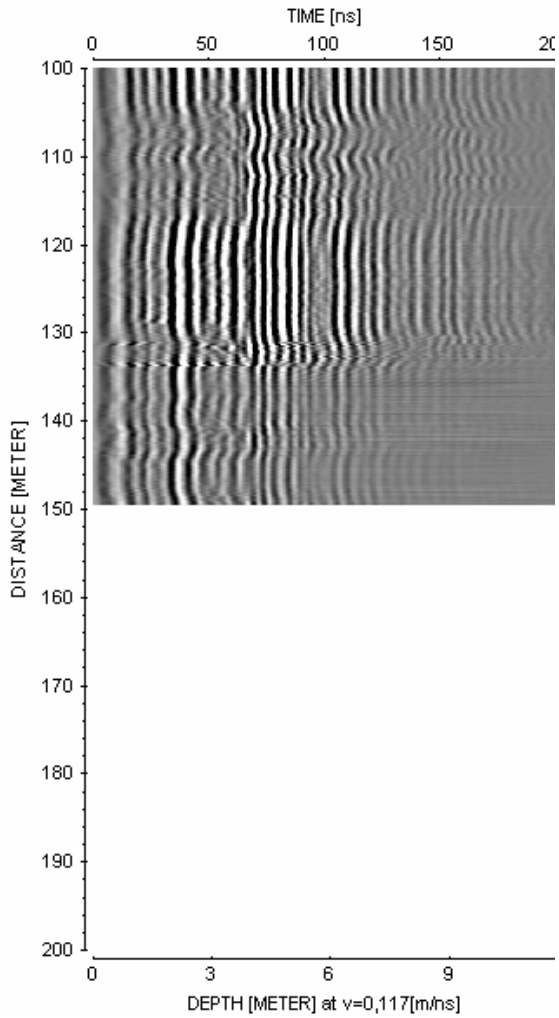
250 MHz | **100 MHz** | **20 MHz**

Radar logging in HLX42, 0 to 148 m, dipole antennas 250, 100 and 20 MHz

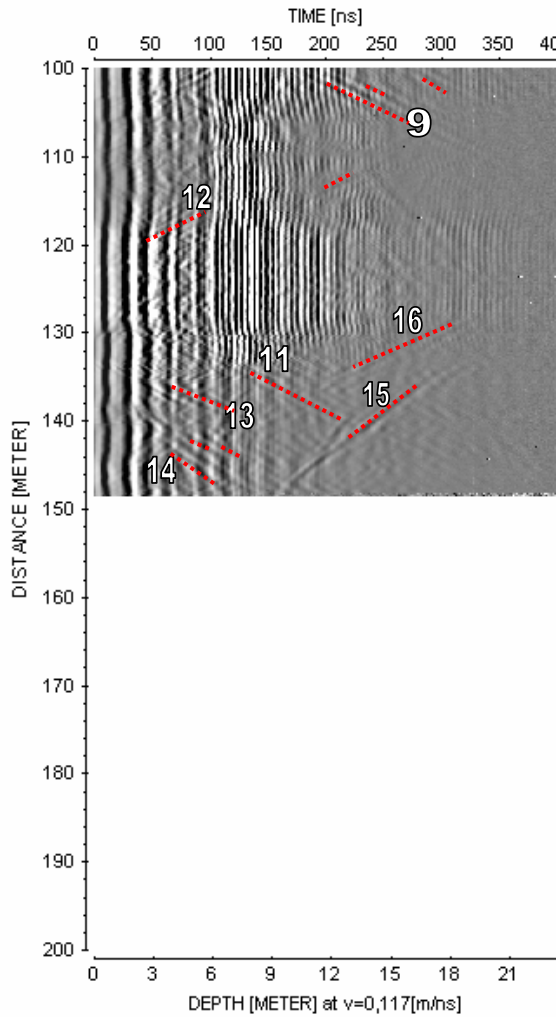


LAXEMAR HLX42

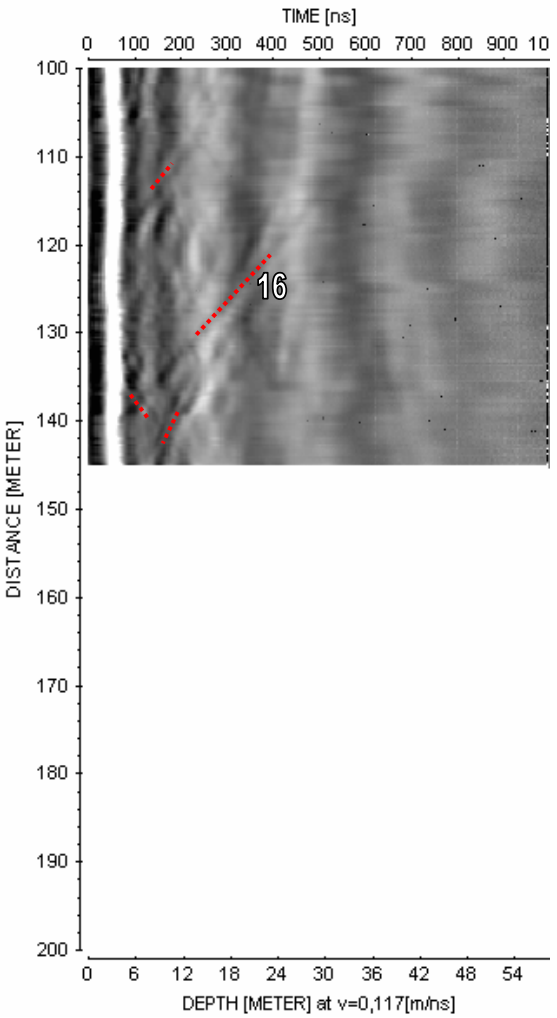




250 MHz



100 MHz



20 MHz

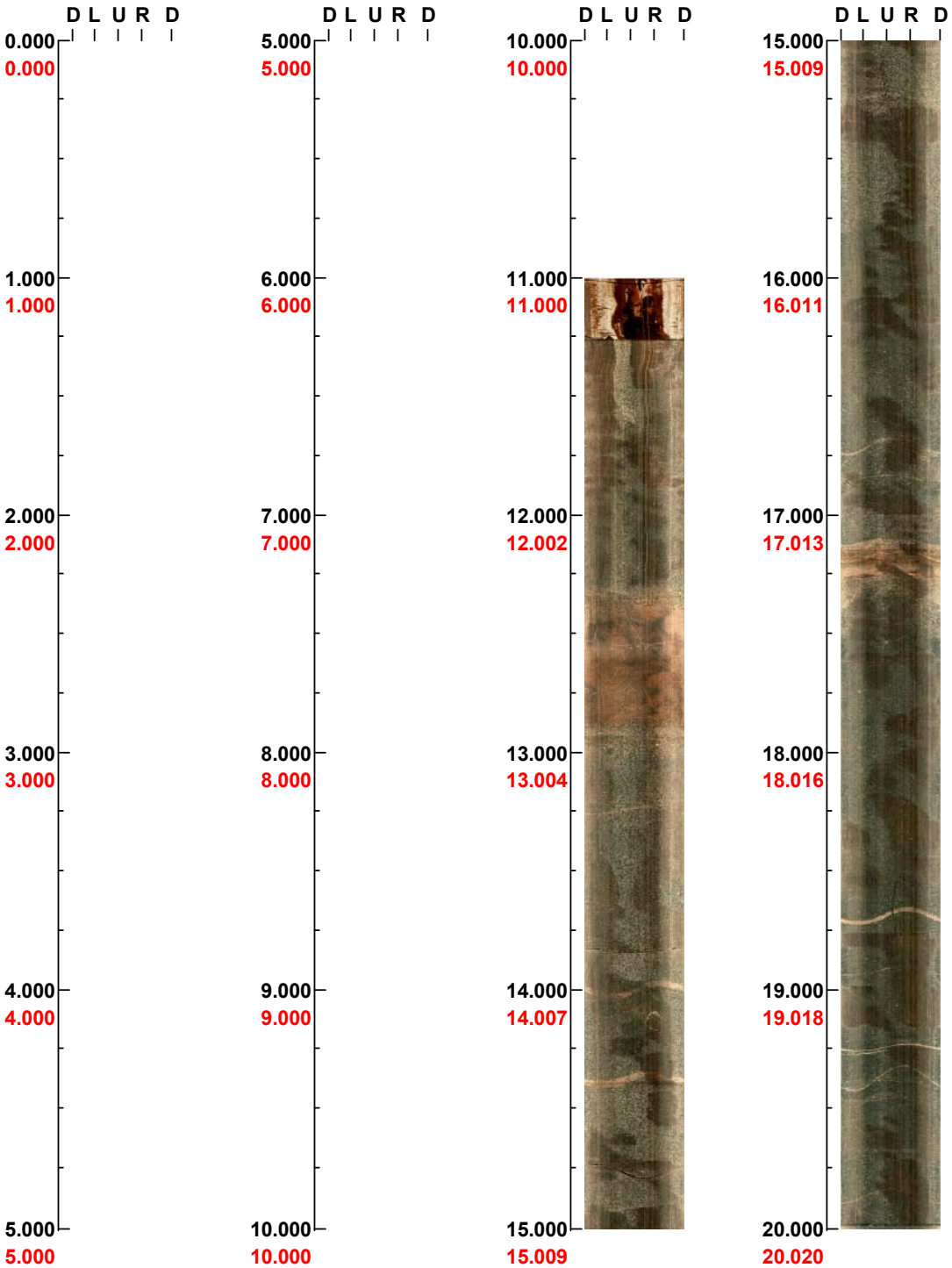
BIPS logging in KLX16A, 11 to 427 m

Project name: Laxemar

Image file	**: c:\work\r5597k~1\bips\klx16a.bip**
BDT file	**: c:\work\r5597k~1\bips\klx16a.bdt**
Locality	**: LAXEMAR**
Bore hole number	**: KLX16A**
Date	**: 07/01/30**
Time	**: 17:14:00**
Depth range	**: 11.000 - 427.377 m**
Azimuth	**: 0**
Inclination	**: -90**
Diameter	**: 76.0 mm**
Magnetic declination	**: 0.0**
Span	**: 4**
Scan interval	**: 0.25**
Scan direction	**: To bottom**
Scale	**: 1/25**
Aspect ratio	**: 175 %**
Pages	**: 22**
Color	**: +0 +0 +0**

Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 0** **Inclination: -90**

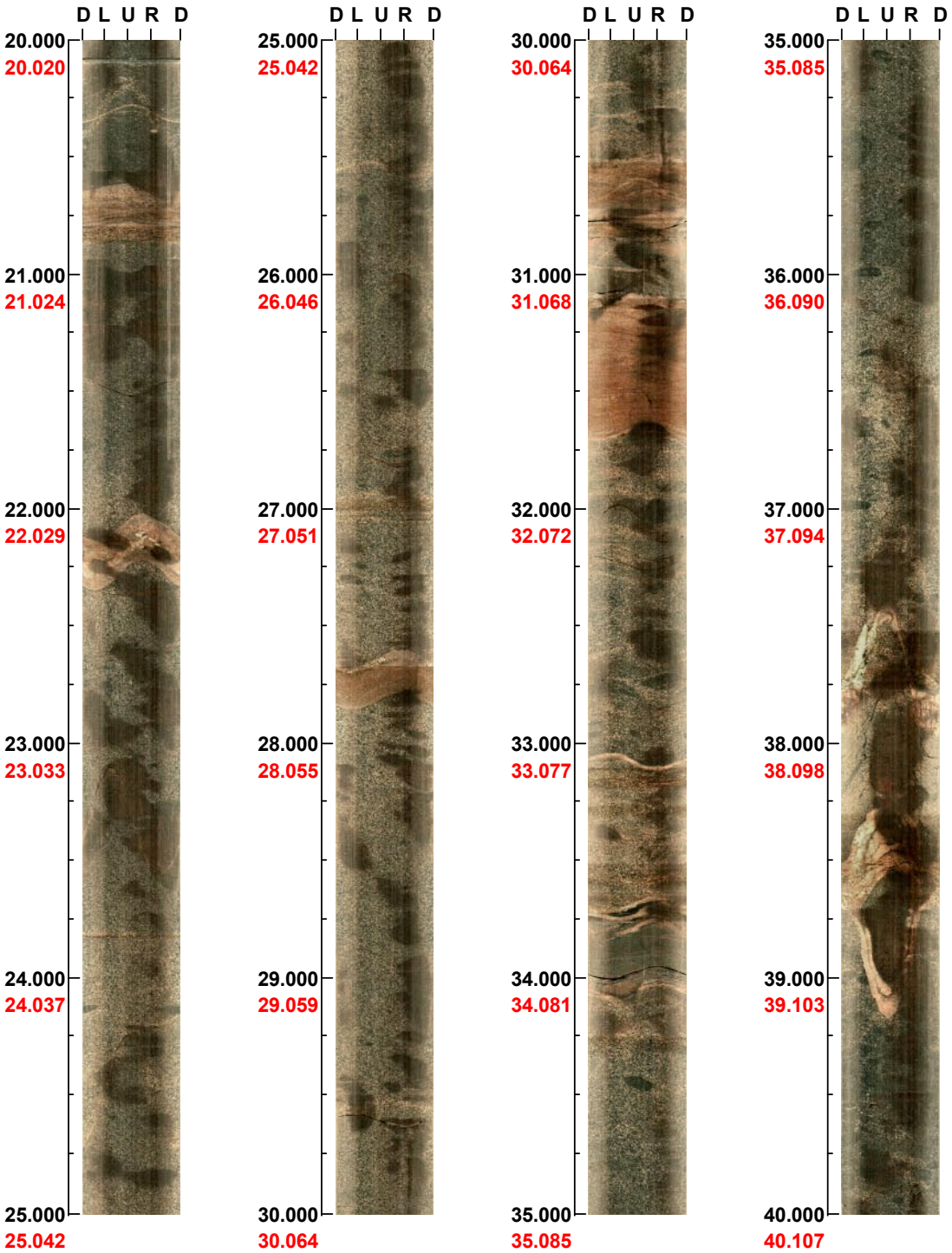
Depth range: 0.000 - 20.000 m



(1 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

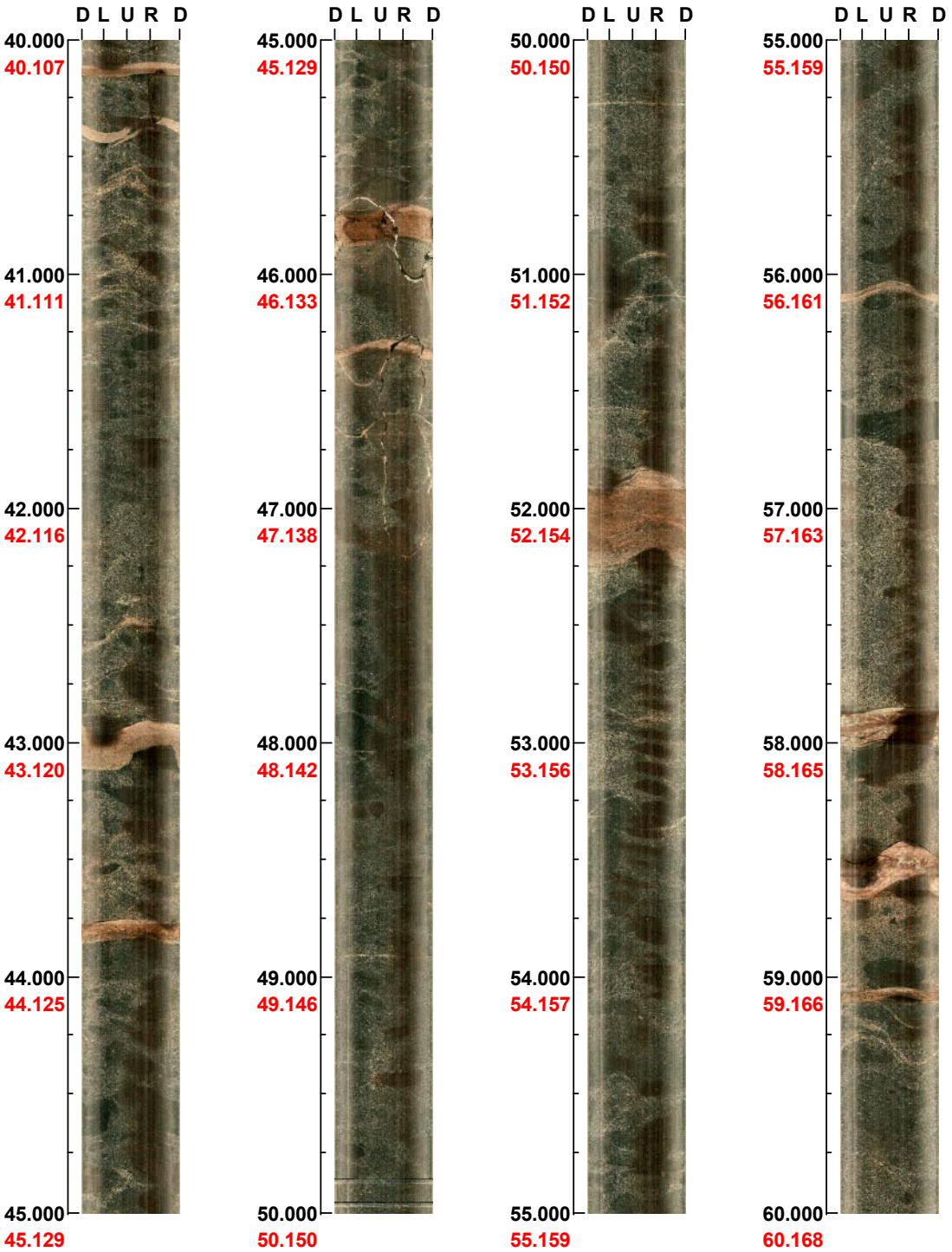
Depth range: 20.000 - 40.000 m



(2 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

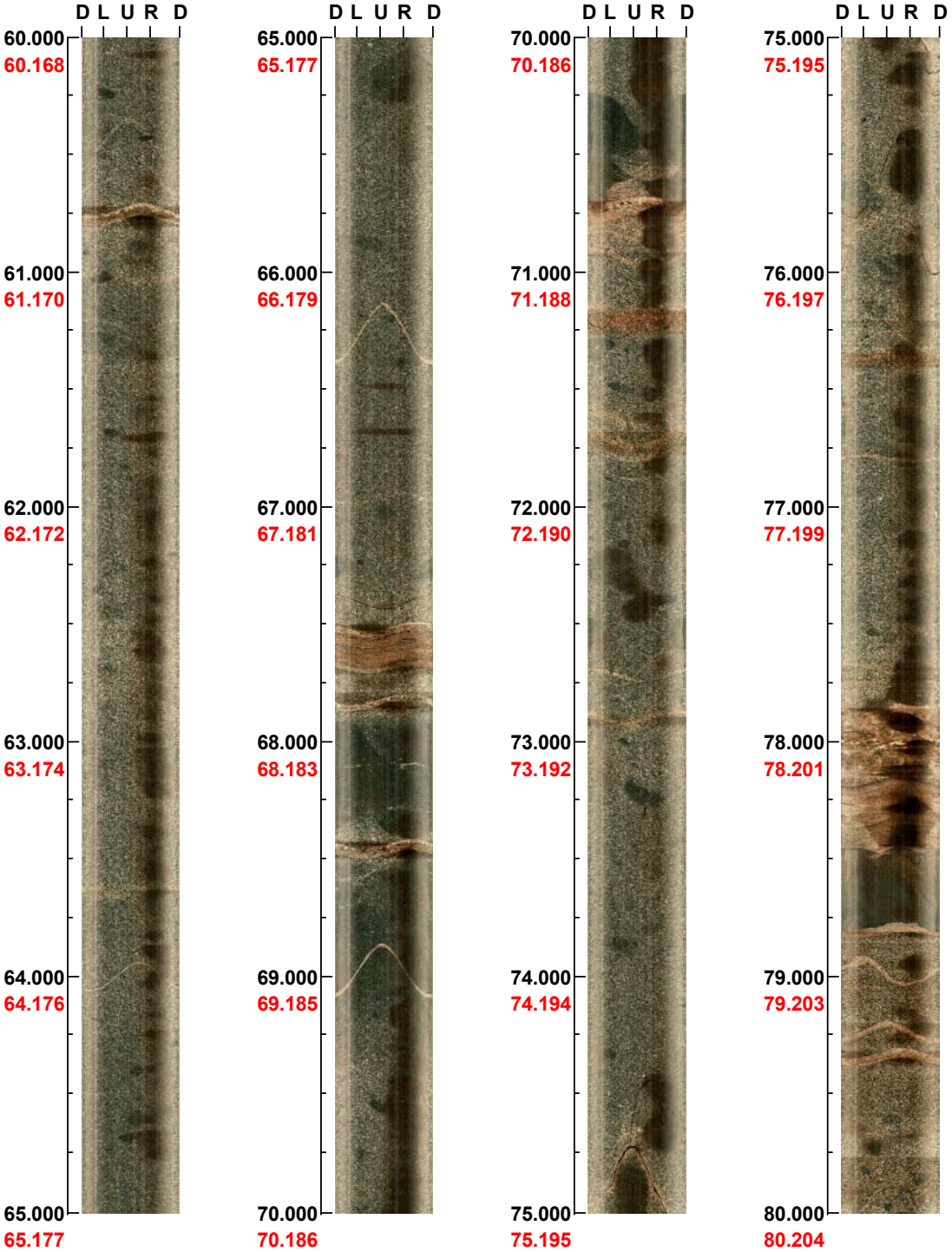
Depth range: 40.000 - 60.000 m



(3 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

Depth range: 60.000 - 80.000 m



(4 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

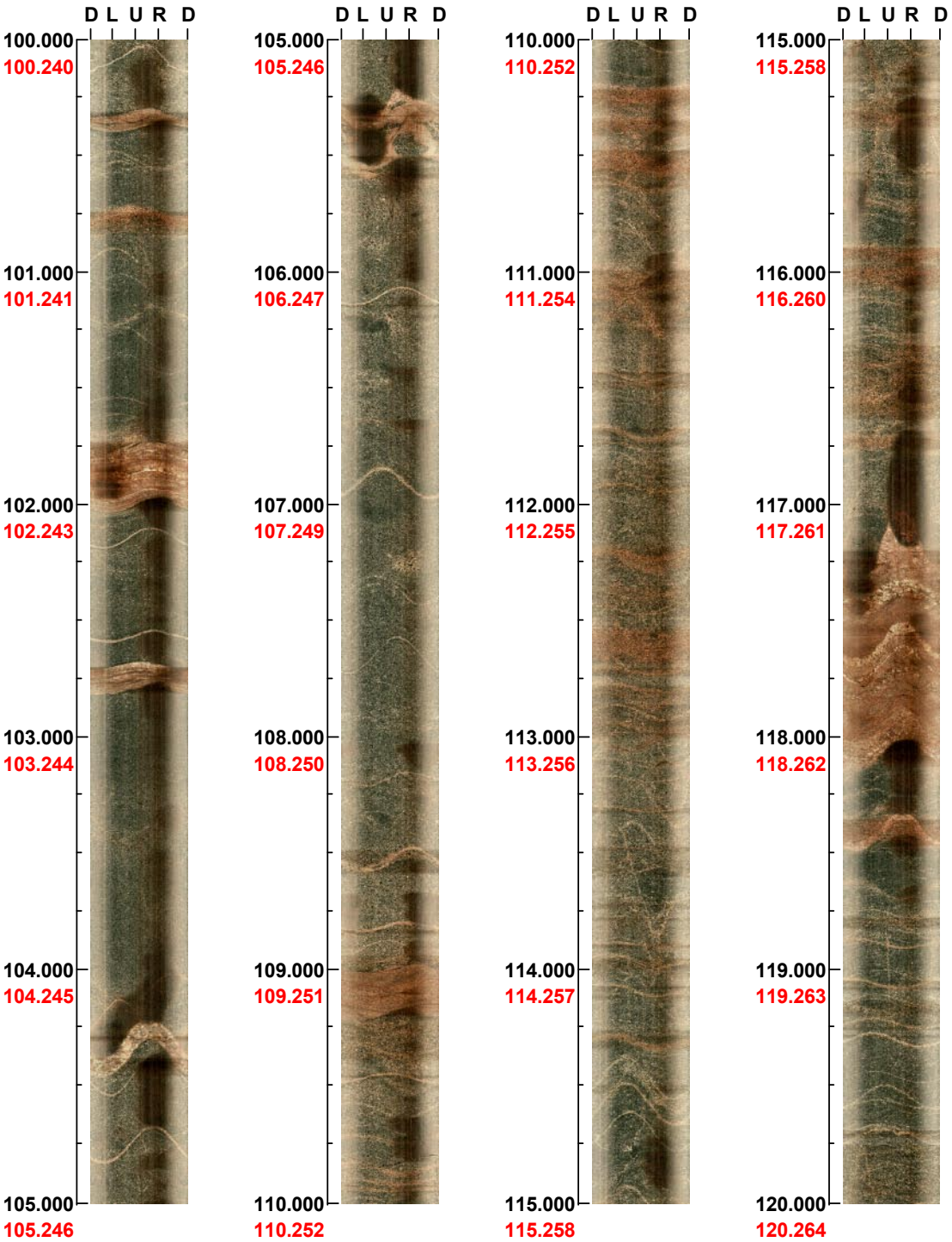
Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

Depth range: 80.000 - 100.000 m

(5 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

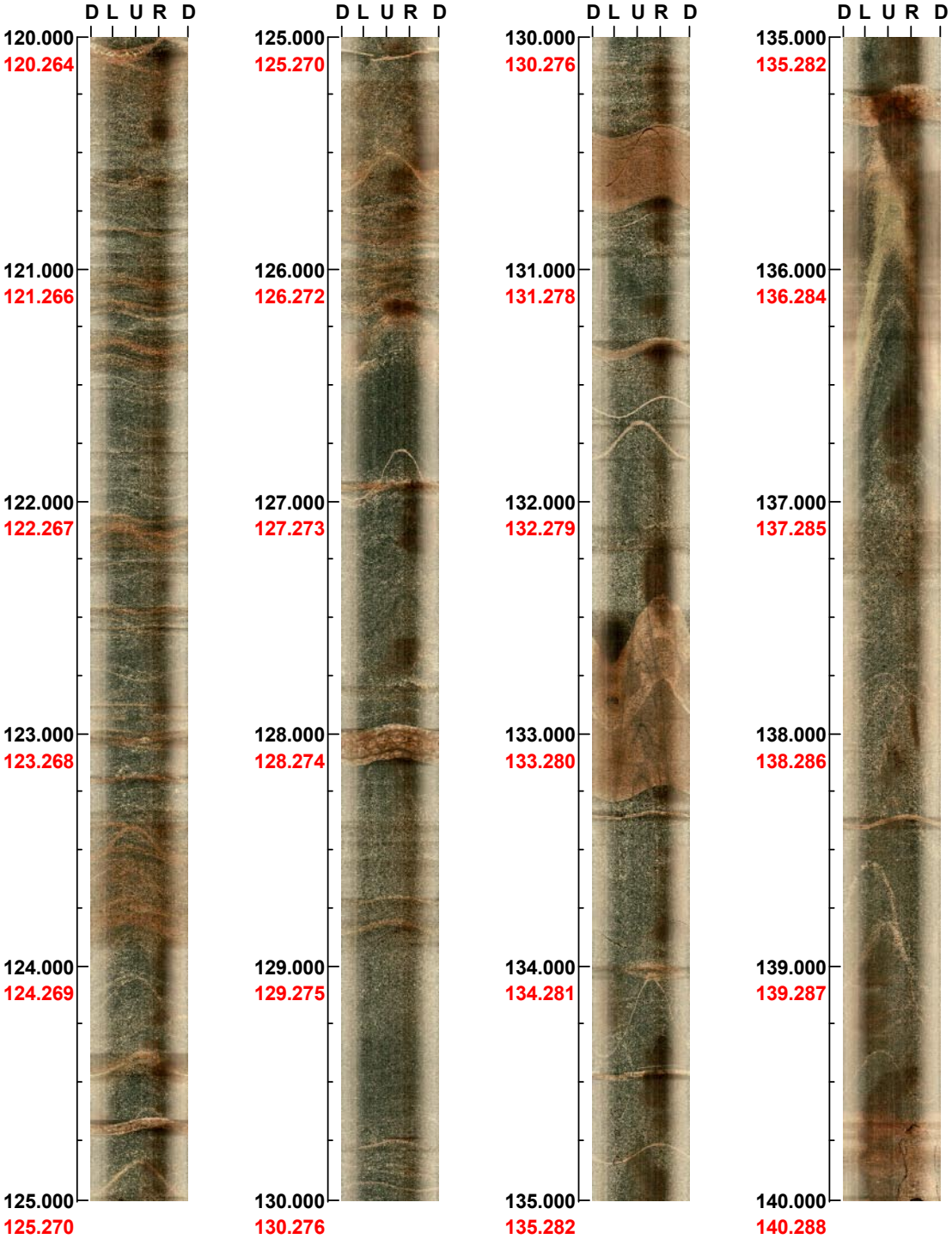
Depth range: 100.000 - 120.000 m



(6 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

Depth range: 120.000 - 140.000 m



(7 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

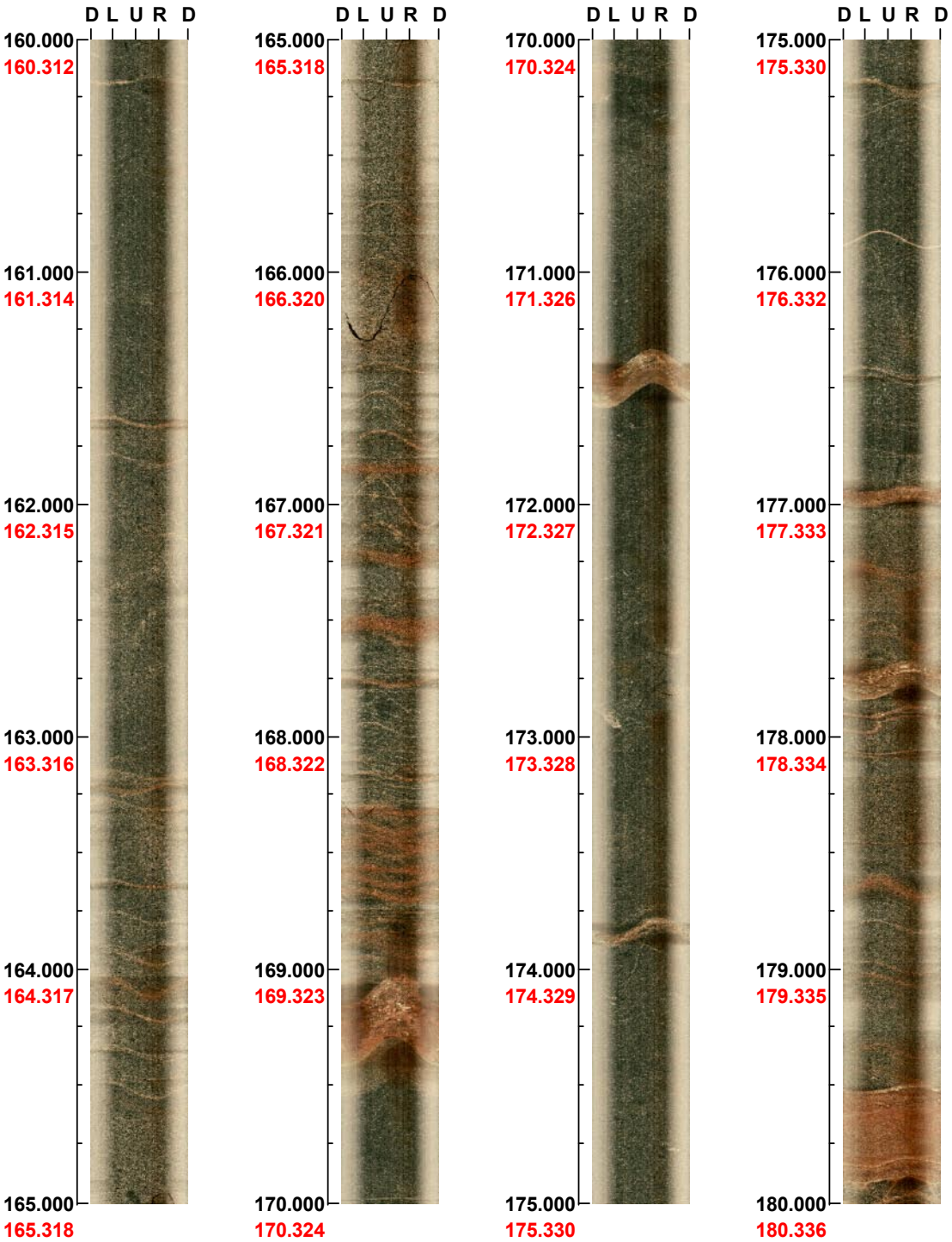
Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

Depth range: 140.000 - 160.000 m

(8 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

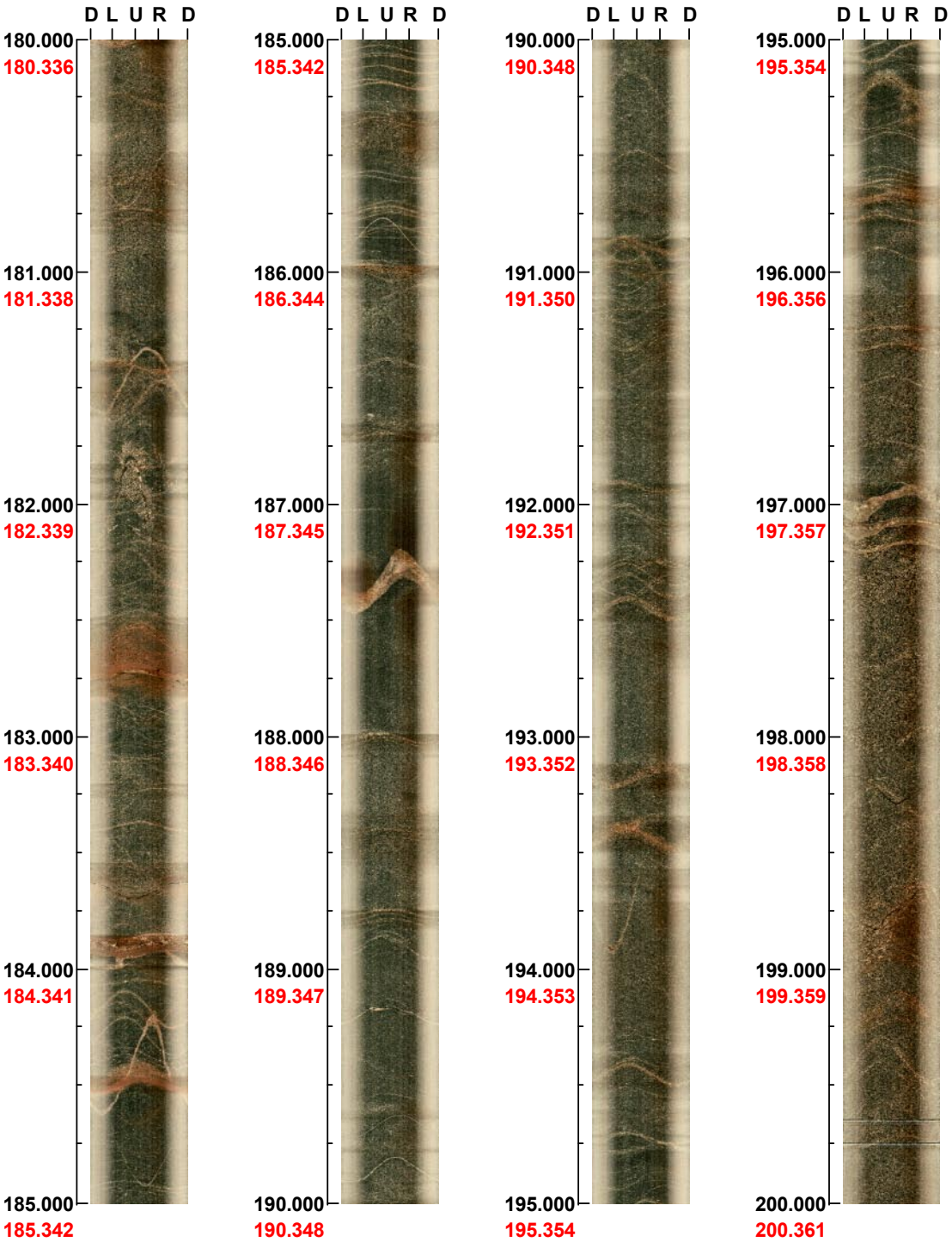
Depth range: 160.000 - 180.000 m



(9 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

Depth range: 180.000 - 200.000 m



(10 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

Depth range: 200.000 - 220.000 m

(11 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

Depth range: 220.000 - 240.000 m

(12 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

Depth range: 240.000 - 260.000 m

(13 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

Depth range: 260.000 - 280.000 m

(14 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

Depth range: 280.000 - 300.000 m

(15 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

Depth range: 300.000 - 320.000 m

(16 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

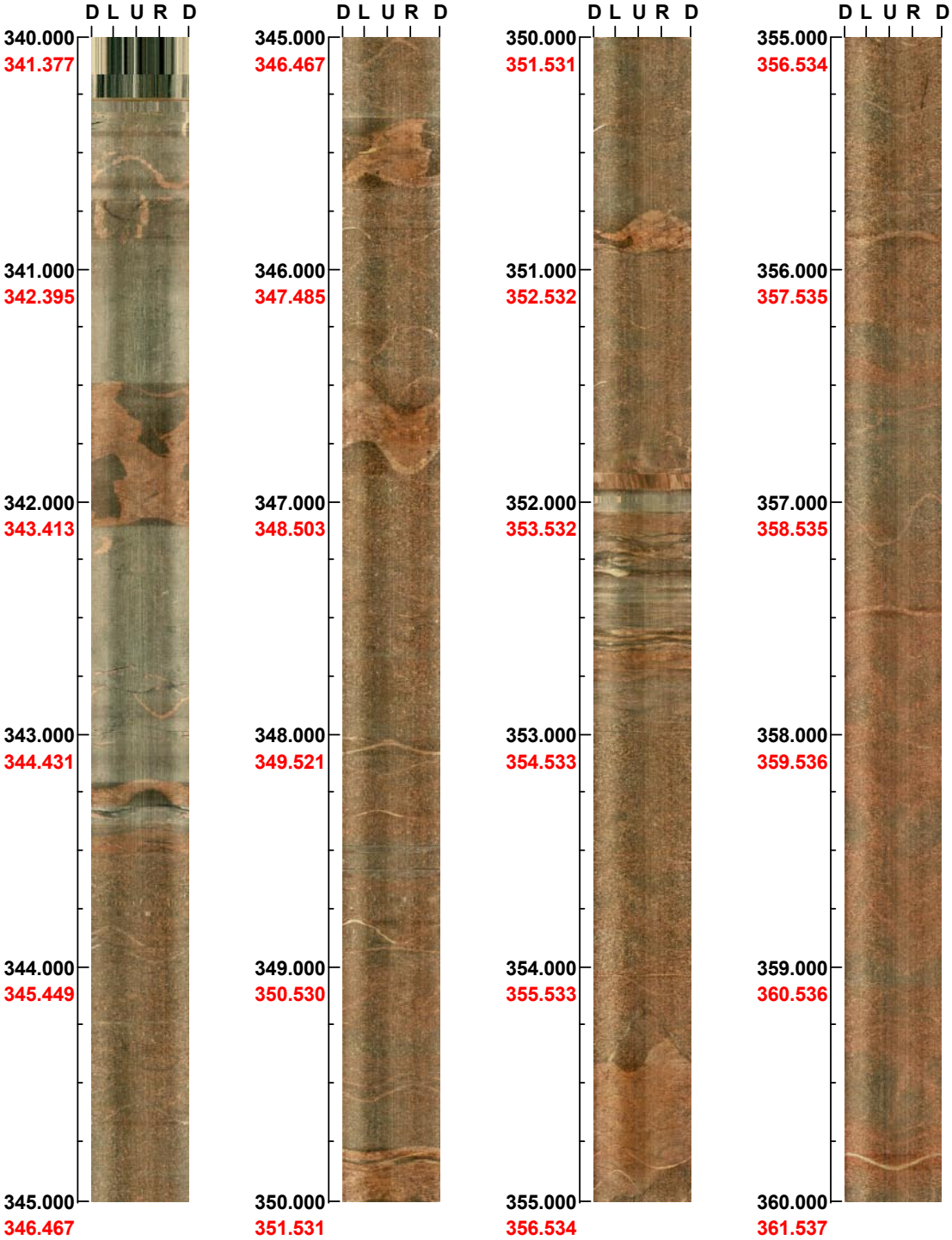
Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

Depth range: 320.000 - 340.000 m

(17 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

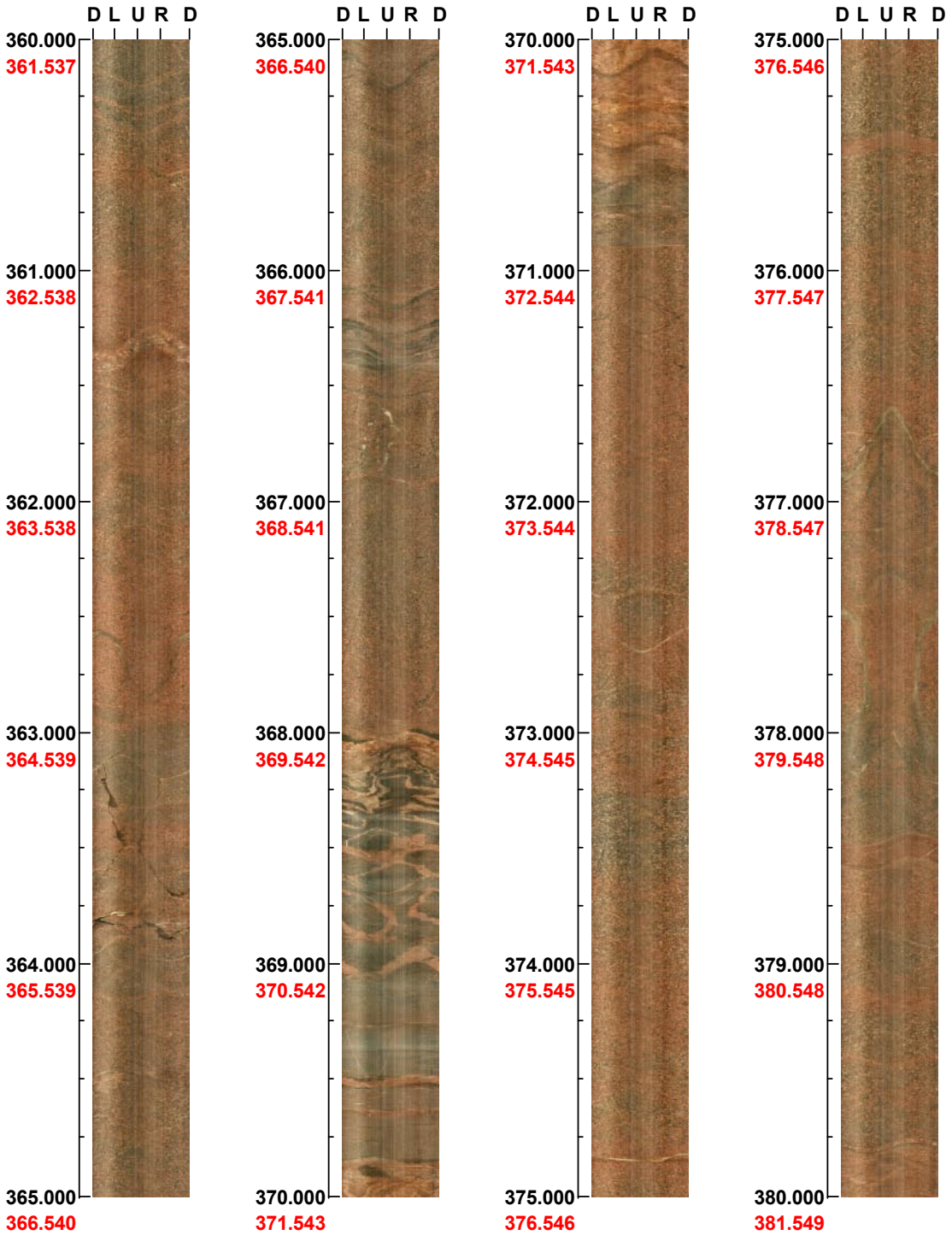
Depth range: 340.000 - 360.000 m



(18 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

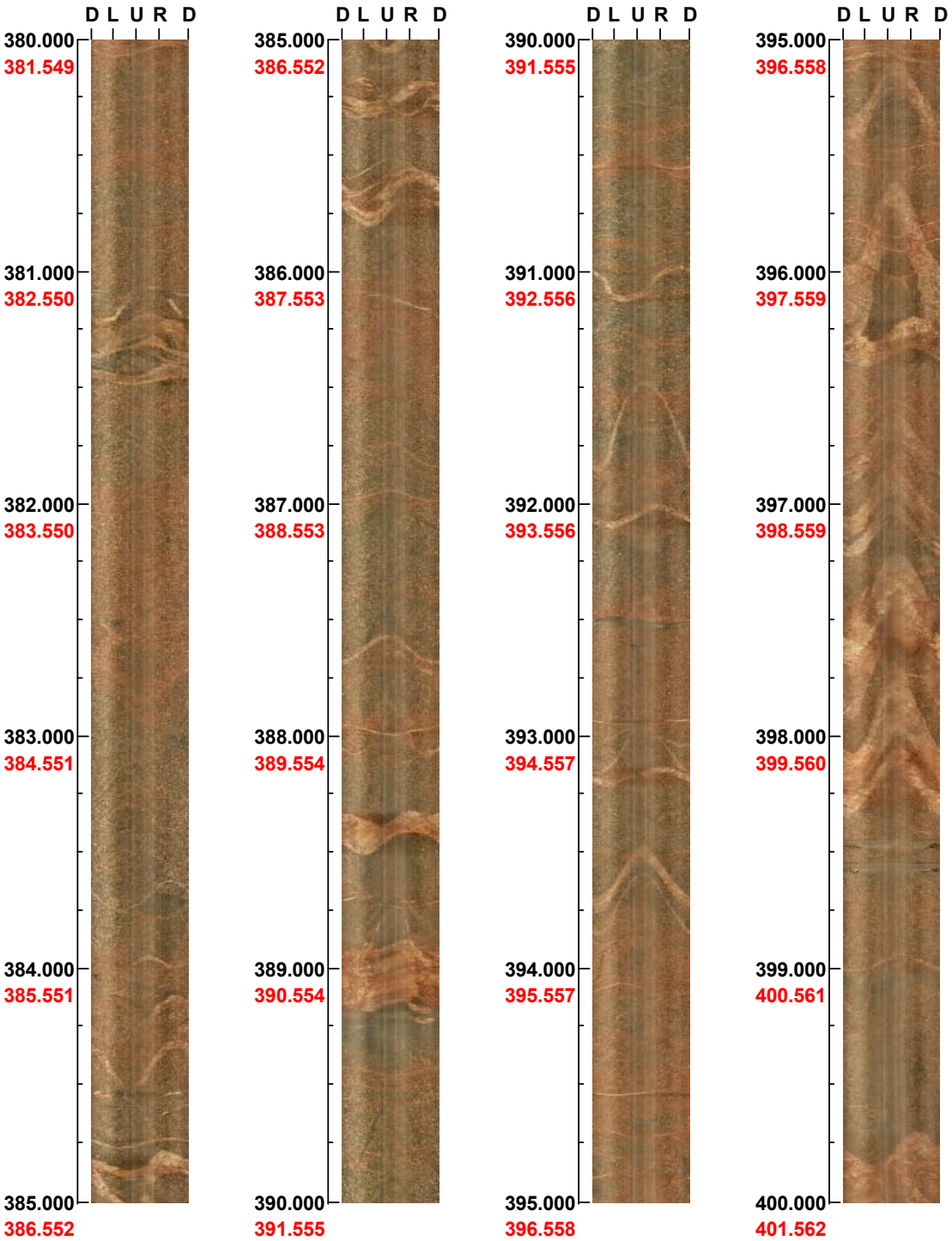
Depth range: 360.000 - 380.000 m



(19 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

Depth range: 380.000 - 400.000 m



(20 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

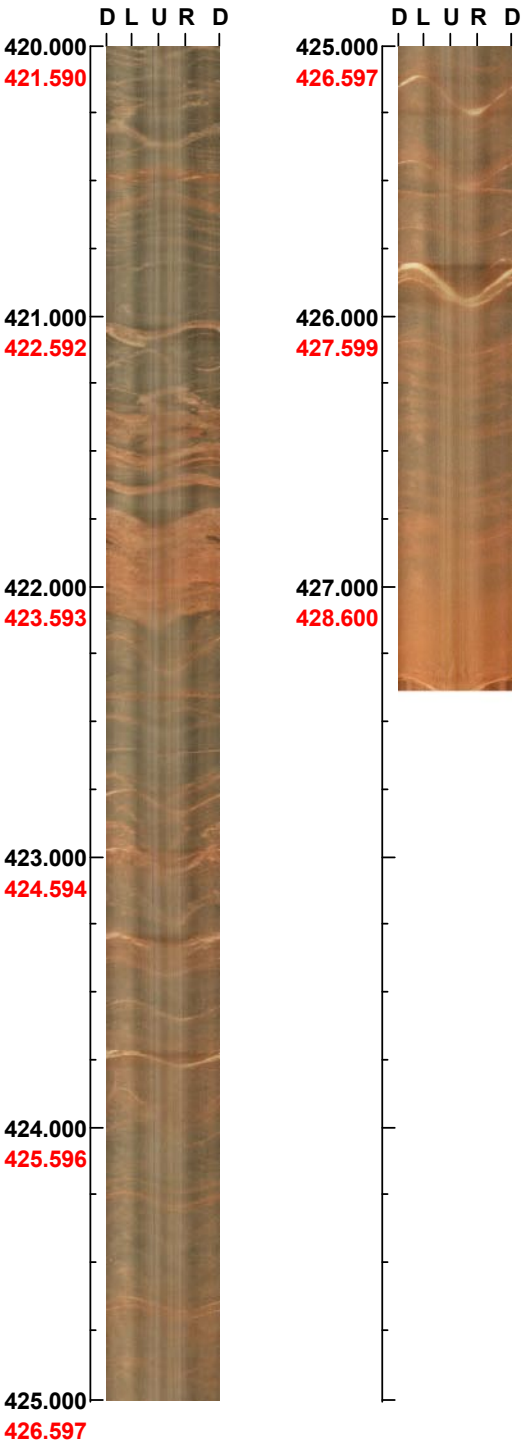
Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

Depth range: 400.000 - 420.000 m

(21 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar
Bore hole No.: KLX16A **Azimuth: 295** **Inclination: -65**

Depth range: 420.000 - 427.377 m



(22 / 22) **Scale: 1/25** **Aspect ratio: 175 %**

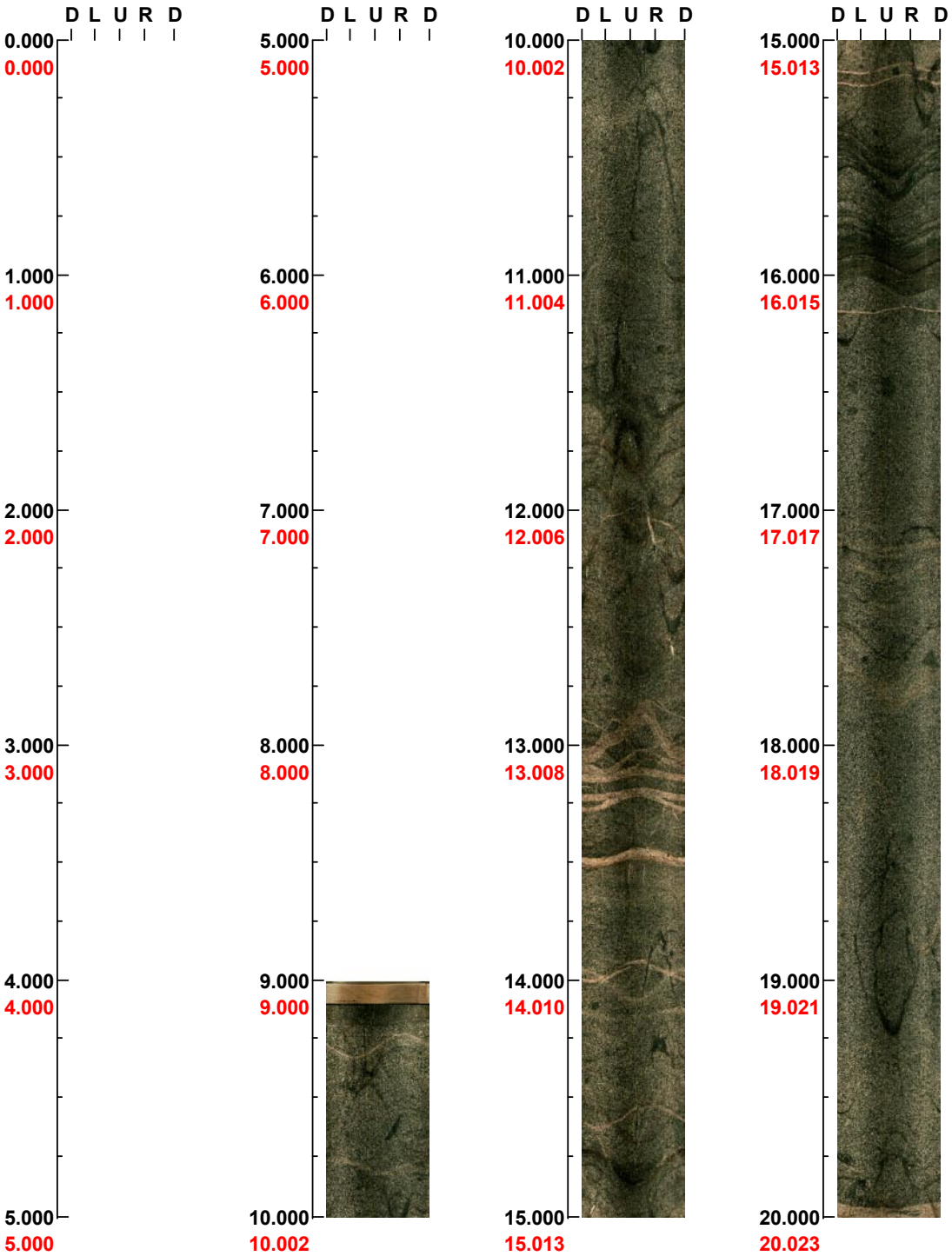
BIPS logging in HLX42, 0 to 150 m

Project name: Laxemar

Image file	: c:\work\r5597k~1\bips\hlx42.bip
BDT file	: c:\work\r5597k~1\bips\hlx42.bdt
Locality	: LAXEMAR
Bore hole number	: HLX42
Date	: 07/01/30
Time	: 10:22:00
Depth range	: 9.000 - 152.022 m
Azimuth	: 322
Inclination	: -52
Diameter	: 140.0 mm
Magnetic declination	: 0.0
Span	: 4
Scan interval	: 0.25
Scan direction	: To bottom
Scale	: 1/25
Aspect ratio	: 100 %
Pages	: 8
Color	:  +0 +0 +0

Project name: Laxemar
Bore hole No.: HLX42 **Azimuth: 322** **Inclination: -52**

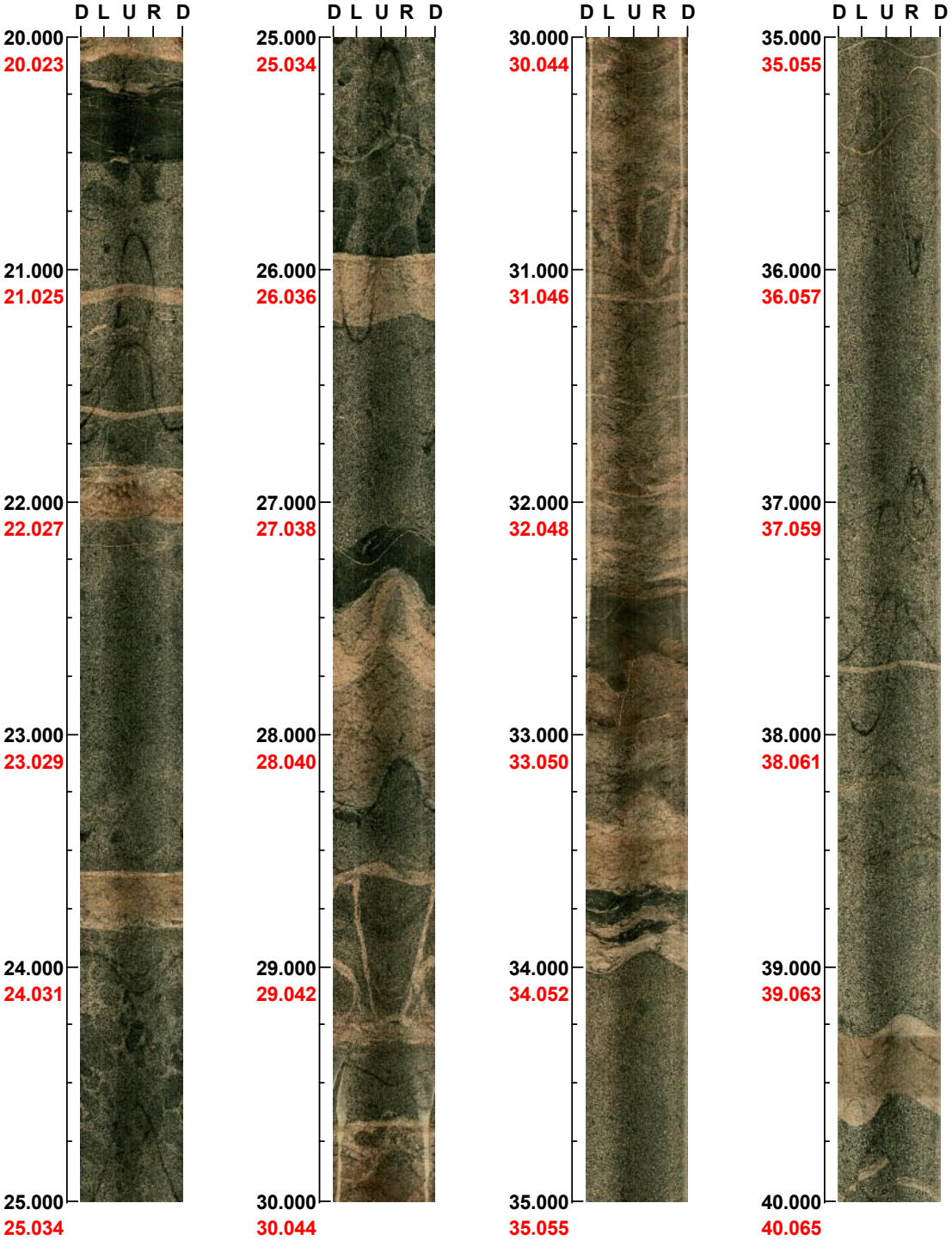
Depth range: 0.000 - 20.000 m



(1 / 8) **Scale: 1/25** **Aspect ratio: 100 %**

Project name: Laxemar
Bore hole No.: HLX42 **Azimuth: 322** **Inclination: -52**

Depth range: 20.000 - 40.000 m



(2 / 8) **Scale: 1/25** **Aspect ratio: 100 %**

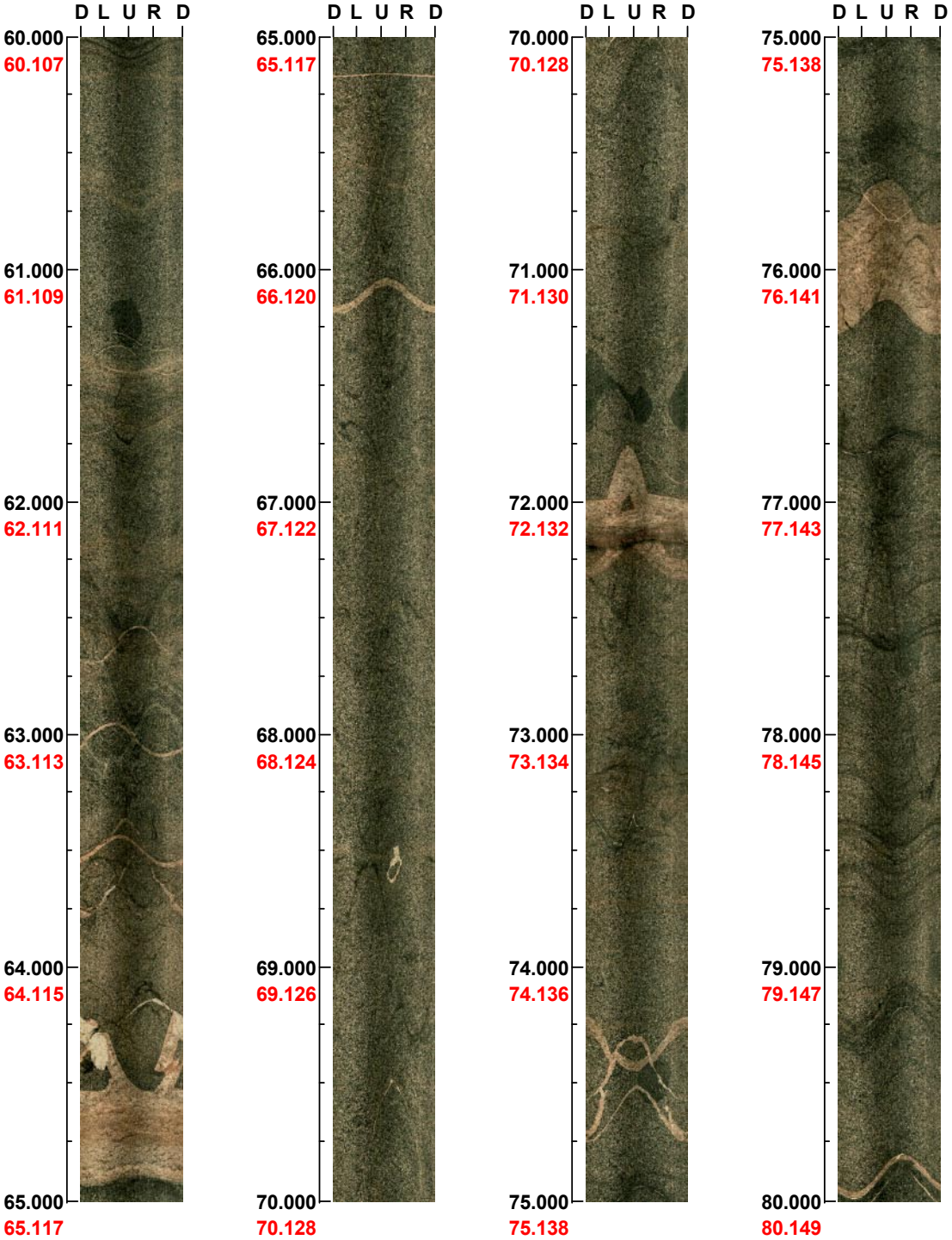
Project name: Laxemar
Bore hole No.: HLX42 **Azimuth: 322** **Inclination: -52**

Depth range: 40.000 - 60.000 m

(3 / 8) **Scale: 1/25** **Aspect ratio: 100 %**

Project name: Laxemar
Bore hole No.: HLX42 **Azimuth: 322** **Inclination: -52**

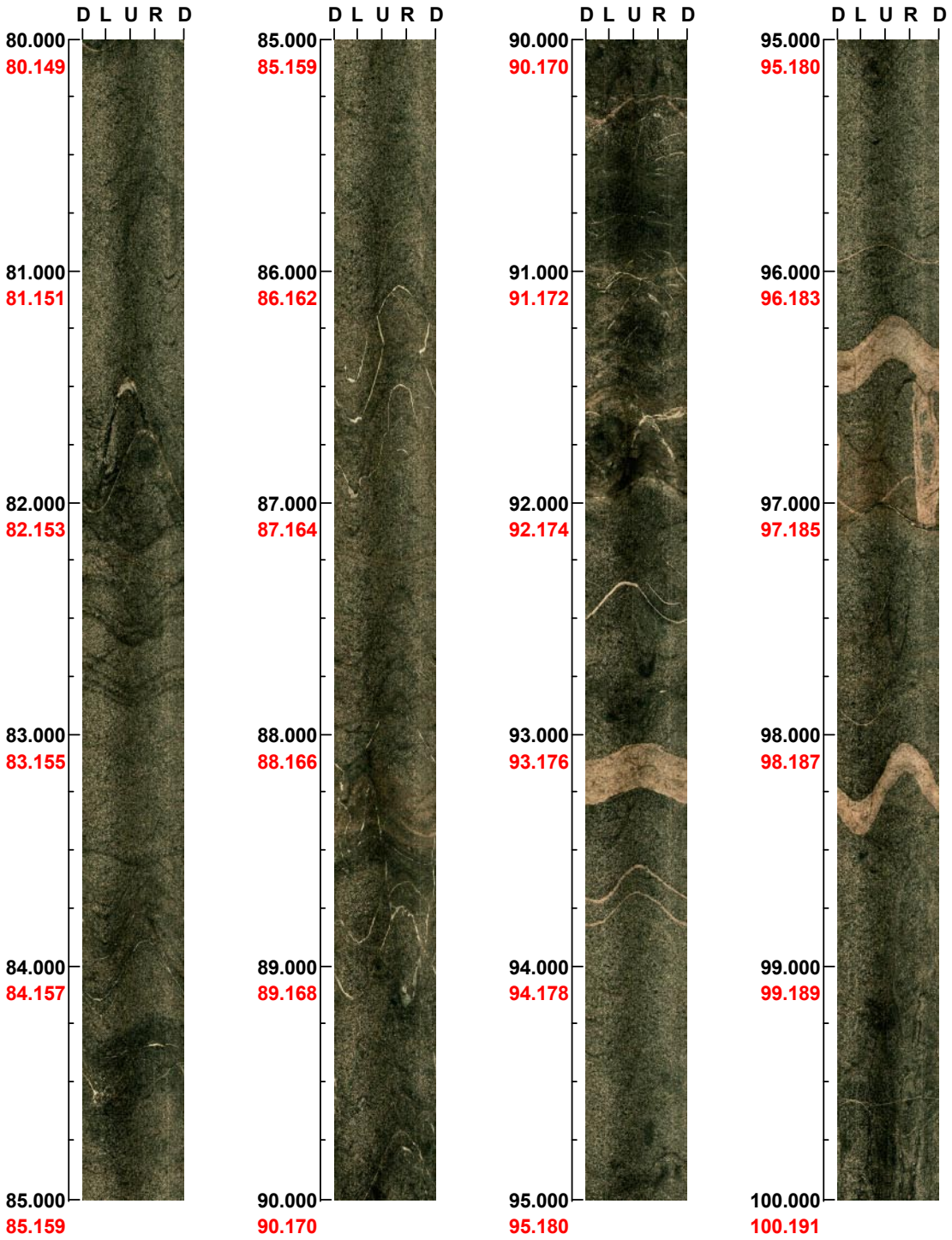
Depth range: 60.000 - 80.000 m



(4 / 8) **Scale: 1/25** **Aspect ratio: 100 %**

Project name: Laxemar
Bore hole No.: HLX42 **Azimuth: 322** **Inclination: -52**

Depth range: 80.000 - 100.000 m



(5 / 8) **Scale: 1/25** **Aspect ratio: 100 %**

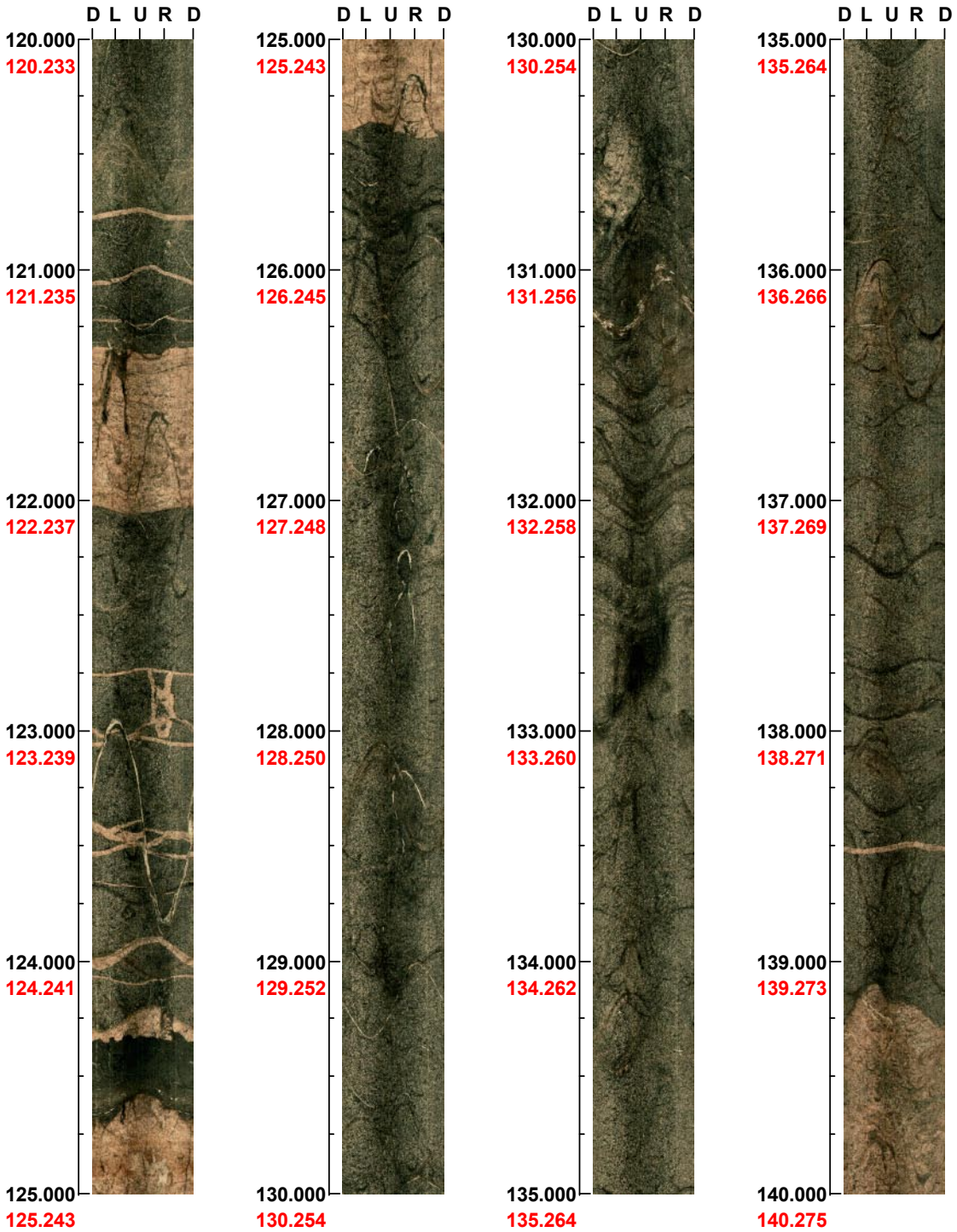
Project name: Laxemar
Bore hole No.: HLX42 **Azimuth: 322** **Inclination: -52**

Depth range: 100.000 - 120.000 m

(6 / 8) **Scale: 1/25** **Aspect ratio: 100 %**

Project name: Laxemar
Bore hole No.: HLX42 **Azimuth: 322** **Inclination: -52**

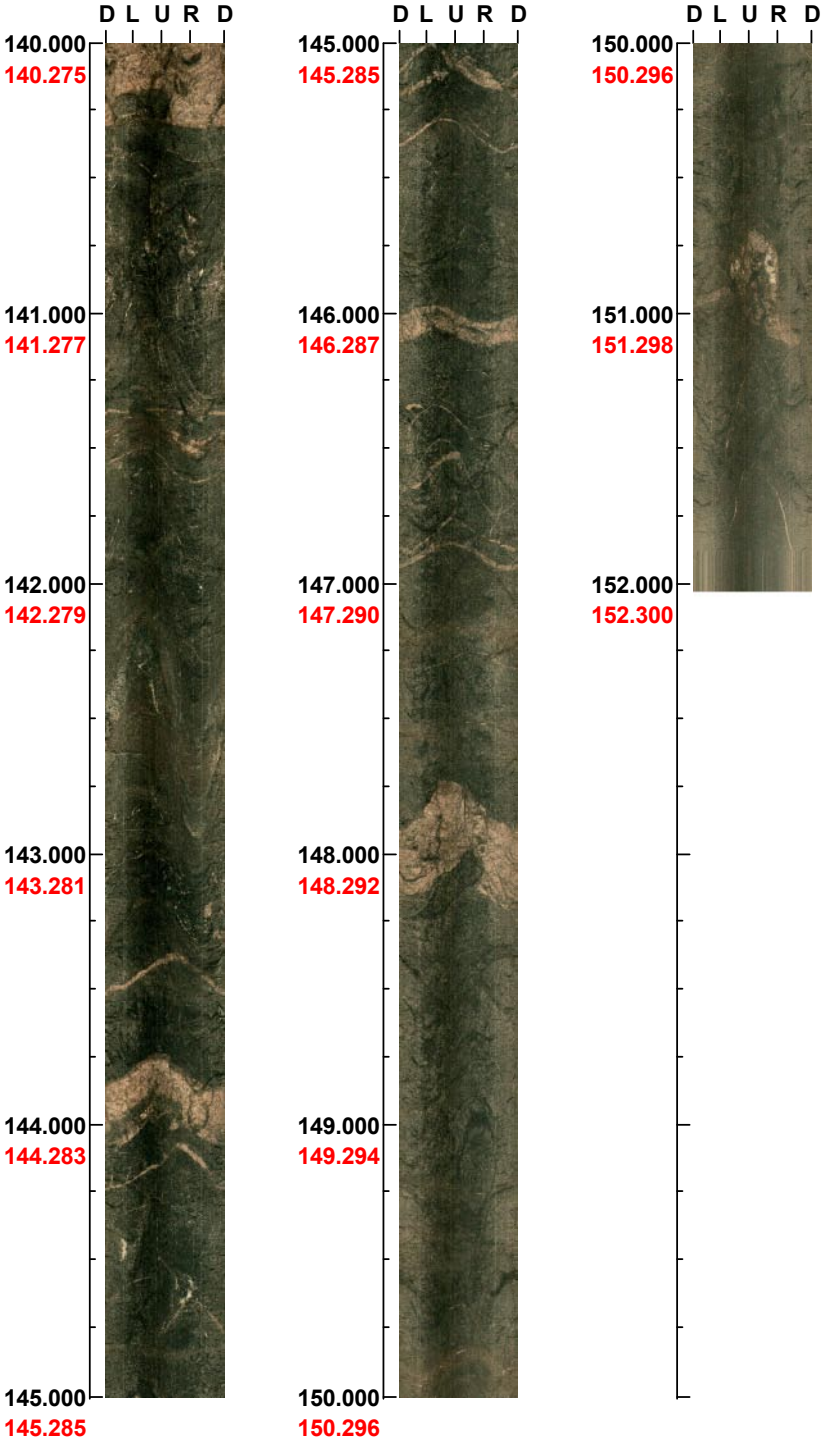
Depth range: 120.000 - 140.000 m



(7 / 8) **Scale: 1/25** **Aspect ratio: 100 %**

Project name: Laxemar
Bore hole No.: HLX42 **Azimuth: 322** **Inclination: -52**

Depth range: 140.000 - 152.022 m



(8 / 8) **Scale: 1/25** **Aspect ratio: 100 %**

Deviation logging in KLX16A, 0 to 426 m

New MeasureIT files

Survey name:	**KLX16A**
Survey date:	31/01/2007 11:03:00
Project:	PLU
Location:	Laxemar

Country:	Sweden
Survey company:	MALÅ GeoScience / RAYCON
Surveyed by:	Christer Gustafsson
Survey type:	STANDARD
Operating conditions:	
General comments:	
Client name:	SKB
Client ID number:	APPS 400-07-004
Client reference:	Leif Stenberg
Drill company:	
Drill rig:	
Drill diameter:	76
Survey direction:	INTO hole
Survey run on:	Wireline
Magnetic Var.:	2.73 degrees East of North

Conventions	
Linear units:	Metres
Angular units:	Degrees
Temperature units:	Centigrade
Co-ordinate system:	0 North
Elevation positive	Up
Dip origin:	0 Horizontal
Dip positive:	Up

Magnetic Integrity Check (MagIC)	Mid value	± limit	
Field strength:	49700	1000	nano Tesla
Magnetic dip:	71	1.5	Degrees

SURVEY	Actual start	End of survey	Difference
Station:	0.0	426.0	426.0
East:	1547584.06	1547421.03	-163.03
North:	6364797.69	6364882.97	85.28
Elevation:	18.85	-365.35	-384.20
Dip:	-65.04	-63.74	1.30
Azimuth:	294.37	296.83	2.46

OFFSETS at end
Offsets relative to: ACTUAL START
4.43 metres upwards
10.41 metres right
0.17 metres shortfall

Printed on: 2007-03-28 19:25:46

Survey name : KLX16A

Survey date : 31/01/2007 11:03:00

Printed on 2007-03-28 19:26:05

Station	Dip	Azimuth	Easting	Northing	Elevation	Mag.Field	Mag.Dip	Grav.Field	Status	UpDown	LeftRight	Shortfall
Metres	Degrees	Degrees	Metres	Metres	Metres	nT	Degrees	G	*	Metres	Metres	Metres
0.0	-65.04	294.37	1547584.06	6364797.69	18.85	44275	69.18	0.999509	✍✍✍	0.00	0.00	0.00
3.0	-65.26	296.23	1547582.92	6364798.23	16.13	48244	69.51	1.000633	✍	-0.01	0.02	0.00
6.0	-65.09	296.92	1547581.79	6364798.79	13.40	48373	70.61	0.999870	✍	-0.01	0.07	0.00
9.0	-65.00	296.97	1547580.67	6364799.37	10.68	47403	71.25	0.999655	✍	-0.02	0.13	0.00
12.0	-65.01	297.41	1547579.54	6364799.94	7.97	48526	71.41	0.999706	✍	-0.01	0.19	0.00
15.0	-65.04	297.08	1547578.41	6364800.52	5.25	47978	71.57	0.999810	✍	-0.01	0.25	0.00
18.0	-65.04	296.73	1547577.28	6364801.10	2.53	48555	72.26	0.999613	✍✍	-0.02	0.31	0.00
21.0	-65.03	296.25	1547576.15	6364801.66	-0.19	49171	71.80	0.999502	✍	-0.02	0.35	0.00
24.0	-65.02	295.92	1547575.01	6364802.22	-2.91	49260	71.95	1.000026	✍	-0.02	0.39	0.00
27.0	-64.97	297.36	1547573.88	6364802.79	-5.63	49199	71.39	0.999784	✍	-0.01	0.44	0.00
30.0	-64.94	297.90	1547572.75	6364803.38	-8.35	49693	70.97	0.999859	✍	-0.01	0.51	0.00
33.0	-64.93	296.19	1547571.62	6364803.95	-11.07	49707	71.16	0.999523	✍	-0.01	0.57	-0.01
36.0	-64.93	295.20	1547570.48	6364804.51	-13.78	48997	71.74	0.999766	✍	0.00	0.60	-0.01
39.0	-64.95	296.52	1547569.33	6364805.06	-16.50	49428	71.08	0.999958	✍	0.00	0.64	-0.01
42.0	-64.97	297.75	1547568.20	6364805.64	-19.22	49302	71.09	0.999936	✍	0.01	0.70	-0.01
45.0	-64.98	297.74	1547567.08	6364806.23	-21.94	49491	71.19	0.999595	✍	0.01	0.77	-0.01
48.0	-64.98	297.32	1547565.95	6364806.82	-24.66	48670	71.38	0.999930	✍	0.01	0.84	-0.01
51.0	-64.98	297.84	1547564.83	6364807.40	-27.38	49621	70.88	0.999629	✍	0.01	0.91	-0.01
54.0	-64.99	298.47	1547563.71	6364808.00	-30.09	48806	71.23	0.999905	✍	0.01	1.00	-0.01
57.0	-64.95	298.77	1547562.60	6364808.61	-32.81	49807	71.03	0.999832	✍	0.01	1.09	-0.01
60.0	-64.92	297.86	1547561.48	6364809.21	-35.53	49312	71.23	1.000176	✍	0.02	1.18	-0.01
63.0	-64.91	297.67	1547560.35	6364809.81	-38.25	49304	71.28	0.999844	✍	0.02	1.25	-0.01
66.0	-64.87	297.31	1547559.22	6364810.39	-40.96	49635	71.34	0.999610	✍	0.03	1.32	-0.01
69.0	-64.91	297.55	1547558.09	6364810.98	-43.68	49358	71.30	0.999987	✍	0.03	1.39	-0.02
72.0	-64.92	297.83	1547556.97	6364811.57	-46.40	49240	71.25	0.999831	✍	0.04	1.46	-0.02
75.0	-64.91	297.80	1547555.84	6364812.16	-49.11	49269	71.18	0.999893	✍	0.04	1.54	-0.02
78.0	-64.88	298.07	1547554.72	6364812.76	-51.83	49705	70.90	0.999705	✍	0.05	1.62	-0.02
81.0	-64.88	297.55	1547553.59	6364813.35	-54.55	49263	71.31	0.999705	✍	0.05	1.70	-0.02
84.0	-64.85	298.36	1547552.47	6364813.95	-57.26	49043	71.27	0.999758	✍	0.06	1.78	-0.02
87.0	-64.83	297.76	1547551.34	6364814.55	-59.98	49076	70.81	0.999733	✍	0.07	1.86	-0.02
90.0	-64.85	298.20	1547550.21	6364815.15	-62.69	50324	71.11	0.999821	✍	0.08	1.94	-0.02
93.0	-64.79	297.16	1547549.08	6364815.74	-65.41	50037	71.07	0.999862	✍	0.09	2.01	-0.02
96.0	-64.77	297.65	1547547.95	6364816.33	-68.12	49892	71.05	0.999543	✍	0.10	2.08	-0.02
99.0	-64.74	298.09	1547546.82	6364816.93	-70.84	50044	70.85	1.000292	✍	0.11	2.16	-0.03

Survey name : KLX16A
Survey date : 31/01/2007 11:03:00

Printed on 2007-03-28 19:26:05

Station Metres	Dip Degrees	Azimuth Degrees	Easting Metres	Northing Metres	Elevation Metres	Mag.Field nT	Mag.Dip Degrees	Grav.Field G	Status *	UpDown Metres	LeftRight Metres	Shortfall Metres
102.0	-64.75	298.30	1547545.69	6364817.53	-73.55	49127	71.16	0.999792	✍	0.13	2.24	-0.03
105.0	-64.74	298.04	1547544.56	6364818.14	-76.26	49446	71.05	0.999824	✍	0.14	2.33	-0.03
108.0	-64.73	297.96	1547543.43	6364818.74	-78.97	49981	70.85	0.999694	✍	0.15	2.41	-0.03
111.0	-64.71	298.39	1547542.30	6364819.35	-81.69	49184	71.14	0.999835	✍	0.17	2.49	-0.03
114.0	-64.71	297.91	1547541.17	6364819.95	-84.40	49330	71.05	0.999711	✍	0.18	2.58	-0.03
117.0	-64.73	298.71	1547540.04	6364820.56	-87.11	49226	70.95	0.999695	✍	0.20	2.67	-0.03
120.0	-64.70	298.94	1547538.92	6364821.17	-89.83	48867	71.09	0.999772	✍	0.21	2.77	-0.03
123.0	-64.70	298.60	1547537.80	6364821.79	-92.54	49456	71.01	0.999728	✍	0.23	2.87	-0.04
126.0	-64.68	297.64	1547536.67	6364822.40	-95.25	49372	71.14	0.999712	✍	0.24	2.95	-0.04
129.0	-64.66	297.49	1547535.53	6364822.99	-97.96	49802	70.65	0.999832	✍	0.26	3.02	-0.04
132.0	-64.66	296.72	1547534.39	6364823.58	-100.67	49639	71.05	0.999578	✍	0.28	3.08	-0.04
135.0	-64.70	296.56	1547533.24	6364824.15	-103.38	49245	71.23	1.000068	✍	0.30	3.13	-0.04
138.0	-64.65	296.65	1547532.09	6364824.73	-106.10	49426	71.00	0.999666	✍	0.32	3.18	-0.04
141.0	-64.65	297.93	1547530.95	6364825.31	-108.81	49634	70.95	0.999812	✍	0.33	3.25	-0.04
144.0	-64.67	297.85	1547529.81	6364825.92	-111.52	49444	71.14	0.999699	✍	0.35	3.33	-0.04
147.0	-64.66	297.07	1547528.68	6364826.51	-114.23	49103	71.14	0.999798	✍	0.37	3.40	-0.04
150.0	-64.66	298.03	1547527.54	6364827.10	-116.94	49373	71.18	0.999887	✍	0.39	3.47	-0.04
153.0	-64.64	296.66	1547526.40	6364827.69	-119.65	49352	71.13	1.000284	✍	0.41	3.53	-0.04
156.0	-64.59	297.07	1547525.25	6364828.27	-122.36	49415	70.99	1.000047	✍	0.43	3.59	-0.05
159.0	-64.61	299.08	1547524.11	6364828.88	-125.07	48930	71.26	0.999938	✍	0.45	3.67	-0.05
162.0	-64.61	298.57	1547522.99	6364829.50	-127.78	48973	71.15	1.000222	✍	0.47	3.77	-0.05
165.0	-64.60	297.81	1547521.85	6364830.11	-130.49	49365	71.23	0.999945	✍	0.49	3.86	-0.05
168.0	-64.57	298.90	1547520.72	6364830.72	-133.20	49347	70.95	1.000086	✍	0.51	3.95	-0.05
171.0	-64.55	298.67	1547519.59	6364831.34	-135.91	48988	71.37	0.999756	✍	0.53	4.05	-0.05
174.0	-64.53	299.66	1547518.46	6364831.97	-138.62	49218	71.44	1.000064	✍	0.55	4.16	-0.05
177.0	-64.53	298.46	1547517.34	6364832.59	-141.33	49738	71.24	0.999990	✍	0.58	4.26	-0.06
180.0	-64.54	298.14	1547516.20	6364833.20	-144.04	49832	71.23	0.999359	✍	0.60	4.35	-0.06
183.0	-64.49	299.13	1547515.07	6364833.82	-146.75	49853	71.32	1.000158	✍	0.63	4.45	-0.06
186.0	-64.46	298.86	1547513.94	6364834.45	-149.45	48587	71.19	1.000250	✍	0.65	4.55	-0.06
189.0	-64.44	298.79	1547512.80	6364835.07	-152.16	48509	71.04	0.999948	✍	0.68	4.65	-0.06
192.0	-64.43	298.82	1547511.67	6364835.70	-154.87	48691	70.73	0.999996	✍	0.71	4.75	-0.06
195.0	-64.42	299.41	1547510.54	6364836.33	-157.57	48932	71.26	0.999502	✍	0.74	4.86	-0.07
198.0	-64.40	297.62	1547509.40	6364836.95	-160.28	49252	70.94	0.999989	✍	0.77	4.95	-0.07
201.0	-64.38	297.73	1547508.25	6364837.55	-162.98	49140	71.14	1.000330	✍	0.80	5.03	-0.07

Survey name : KLX16A

Survey date : 31/01/2007 11:03:00

Printed on 2007-03-28 19:26:05

Station	Dip	Azimuth	Easting	Northing	Elevation	Mag.Field	Mag.Dip	Grav.Field	Status	UpDown	LeftRight	Shortfall
Metres	Degrees	Degrees	Metres	Metres	Metres	nT	Degrees	G	*	Metres	Metres	Metres
204.0	-64.35	297.73	1547507.10	6364838.15	-165.69	48614	71.16	1.000068	✍✍	0.83	5.10	-0.07
207.0	-64.31	299.28	1547505.96	6364838.77	-168.39	49740	71.06	1.000342	✍	0.87	5.20	-0.07
210.0	-64.31	298.82	1547504.82	6364839.40	-171.09	49665	71.08	0.999852	✍	0.90	5.30	-0.07
213.0	-64.29	298.54	1547503.68	6364840.03	-173.80	49630	71.07	0.999937	✍	0.94	5.40	-0.08
216.0	-64.27	298.17	1547502.54	6364840.65	-176.50	49625	71.04	1.000182	✍	0.97	5.49	-0.08
219.0	-64.25	297.91	1547501.39	6364841.26	-179.20	49739	71.01	1.000294	✍	1.01	5.57	-0.08
222.0	-64.23	298.10	1547500.23	6364841.87	-181.90	49736	70.99	0.999700	✍	1.05	5.66	-0.08
225.0	-64.42	297.89	1547499.09	6364842.48	-184.61	49725	71.08	1.000102	✍	1.09	5.74	-0.08
228.0	-64.48	297.86	1547497.94	6364843.09	-187.32	49712	71.09	1.000740	✍	1.12	5.82	-0.08
231.0	-64.42	297.91	1547496.80	6364843.69	-190.02	49725	71.08	1.000289	✍	1.15	5.90	-0.08
234.0	-64.38	297.88	1547495.65	6364844.30	-192.73	49752	71.09	0.999812	✍	1.18	5.98	-0.09
237.0	-64.39	297.89	1547494.51	6364844.90	-195.43	49740	71.09	1.000179	✍	1.21	6.06	-0.09
240.0	-64.36	298.00	1547493.36	6364845.51	-198.14	49707	71.09	1.000519	✍	1.24	6.14	-0.09
243.0	-64.40	297.85	1547492.21	6364846.12	-200.84	49701	71.11	1.000132	✍	1.28	6.22	-0.09
246.0	-64.36	297.79	1547491.07	6364846.73	-203.55	49689	71.12	0.999981	✍	1.31	6.30	-0.09
249.0	-64.55	297.68	1547489.92	6364847.33	-206.25	49652	71.13	1.000226	✍	1.34	6.37	-0.09
252.0	-64.40	297.77	1547488.78	6364847.93	-208.96	49595	71.12	1.000122	✍	1.37	6.45	-0.09
255.0	-64.40	297.66	1547487.63	6364848.53	-211.67	49601	71.12	1.000420	✍	1.40	6.52	-0.09
258.0	-64.37	297.55	1547486.48	6364849.13	-214.37	49617	71.16	0.999986	✍	1.43	6.60	-0.10
261.0	-64.38	297.48	1547485.33	6364849.73	-217.08	49681	71.12	1.000038	✍	1.46	6.67	-0.10
264.0	-64.37	297.48	1547484.18	6364850.33	-219.78	49626	71.11	1.000155	✍	1.50	6.74	-0.10
267.0	-64.42	297.26	1547483.03	6364850.93	-222.49	49599	71.11	1.000416	✍	1.53	6.81	-0.10
270.0	-64.37	297.54	1547481.88	6364851.52	-225.19	49558	71.05	1.000433	✍	1.56	6.87	-0.10
273.0	-64.35	297.55	1547480.73	6364852.12	-227.90	49604	71.04	1.000163	✍	1.60	6.95	-0.10
276.0	-64.37	297.54	1547479.57	6364852.72	-230.60	49530	71.08	0.999839	✍	1.63	7.02	-0.10
279.0	-64.37	297.72	1547478.42	6364853.33	-233.31	49846	71.09	1.000280	✍	1.66	7.09	-0.10
282.0	-64.38	297.26	1547477.27	6364853.93	-236.01	49566	71.14	1.000125	✍	1.70	7.16	-0.10
285.0	-64.36	297.19	1547476.12	6364854.52	-238.72	49525	71.04	1.000399	✍	1.73	7.23	-0.10
288.0	-64.31	296.99	1547474.96	6364855.11	-241.42	49757	71.03	1.000691	✍	1.77	7.29	-0.11
291.0	-64.28	296.79	1547473.80	6364855.70	-244.12	49754	70.95	0.999973	✍	1.80	7.35	-0.11
294.0	-64.22	296.03	1547472.63	6364856.28	-246.82	49801	71.13	1.000295	✍	1.84	7.39	-0.11
297.0	-64.17	296.22	1547471.46	6364856.85	-249.53	49759	71.08	1.000230	✍	1.89	7.43	-0.11
300.0	-64.21	295.73	1547470.29	6364857.43	-252.23	49600	71.15	0.999965	✍	1.93	7.47	-0.11
303.0	-64.17	296.93	1547469.12	6364858.01	-254.93	49597	71.09	0.999877	✍	1.98	7.51	-0.11

Survey name : KLX16A

Survey date : 31/01/2007 11:03:00

Printed on 2007-03-28 19:26:05

Station	Dip	Azimuth	Easting	Northing	Elevation	Mag.Field	Mag.Dip	Grav.Field	Status	UpDown	LeftRight	Shortfall
Metres	Degrees	Degrees	Metres	Metres	Metres	nT	Degrees	G	*	Metres	Metres	Metres
306.0	-64.16	297.15	1547467.95	6364858.60	-257.63	49653	71.12	1.000105	✍	2.02	7.57	-0.11
309.0	-64.13	297.19	1547466.79	6364859.20	-260.33	49682	70.93	1.000146	✍	2.07	7.64	-0.11
312.0	-64.09	297.19	1547465.62	6364859.80	-263.03	49803	70.96	1.000071	✍	2.12	7.70	-0.11
315.0	-64.07	296.89	1547464.46	6364860.39	-265.72	49897	70.98	1.000164	✍	2.16	7.76	-0.11
318.0	-64.05	299.37	1547463.30	6364861.01	-268.42	49077	71.26	0.999948	✍	2.21	7.85	-0.11
321.0	-64.01	297.46	1547462.14	6364861.64	-271.12	49707	71.16	0.999956	✍	2.26	7.94	-0.12
324.0	-63.97	297.05	1547460.97	6364862.24	-273.81	49854	71.07	1.000205	✍	2.32	8.01	-0.12
327.0	-63.94	297.18	1547459.80	6364862.84	-276.51	49872	71.06	1.000294	✍	2.37	8.07	-0.12
330.0	-63.89	297.20	1547458.63	6364863.44	-279.20	49894	71.04	1.000416	✍	2.43	8.14	-0.12
333.0	-63.84	297.42	1547457.45	6364864.05	-281.90	49872	71.02	1.000261	✍	2.49	8.20	-0.12
336.0	-63.82	297.47	1547456.28	6364864.66	-284.59	49903	71.02	0.999952	✍	2.55	8.28	-0.12
339.0	-63.76	297.66	1547455.10	6364865.27	-287.28	49919	71.00	1.000345	✍	2.62	8.35	-0.12
342.0	-63.78	297.77	1547453.93	6364865.89	-289.97	49889	70.99	0.999953	✍	2.68	8.43	-0.13
345.0	-63.77	297.57	1547452.76	6364866.50	-292.66	49817	71.03	0.999878	✍	2.75	8.50	-0.13
348.0	-63.81	297.58	1547451.58	6364867.12	-295.36	49678	71.02	1.000645	✍	2.81	8.58	-0.13
351.0	-63.80	297.69	1547450.41	6364867.73	-298.05	49859	70.98	1.000437	✍	2.87	8.65	-0.13
354.0	-63.78	297.34	1547449.23	6364868.34	-300.74	49803	71.02	1.000172	✍	2.94	8.72	-0.13
357.0	-63.82	298.01	1547448.06	6364868.96	-303.43	49598	71.13	1.000414	✍	3.00	8.80	-0.13
360.0	-63.78	298.40	1547446.89	6364869.58	-306.12	48756	71.11	1.000107	✍	3.06	8.89	-0.14
363.0	-63.76	298.21	1547445.73	6364870.21	-308.81	49420	71.10	1.000602	✍	3.13	8.98	-0.14
366.0	-63.74	297.80	1547444.55	6364870.84	-311.50	49566	71.17	1.000449	✍	3.19	9.06	-0.14
369.0	-63.77	297.97	1547443.38	6364871.46	-314.19	49783	70.82	1.000484	✍	3.26	9.15	-0.14
372.0	-63.81	296.75	1547442.20	6364872.07	-316.89	49221	71.22	1.000089	✍	3.32	9.22	-0.14
375.0	-63.80	298.14	1547441.03	6364872.68	-319.58	49360	70.86	1.000647	✍	3.38	9.29	-0.14
378.0	-63.80	297.50	1547439.86	6364873.29	-322.27	49704	71.08	1.000679	✍	3.45	9.37	-0.15
381.0	-63.84	297.75	1547438.69	6364873.91	-324.96	49653	70.98	1.000296	✍	3.51	9.44	-0.15
384.0	-63.81	297.45	1547437.51	6364874.52	-327.65	49575	71.05	1.000369	✍	3.57	9.52	-0.15
387.0	-63.85	297.25	1547436.34	6364875.13	-330.35	49441	71.04	1.000441	✍	3.63	9.58	-0.15
390.0	-63.81	296.75	1547435.16	6364875.73	-333.04	49324	71.30	1.000031	✍	3.69	9.65	-0.15
393.0	-63.84	297.79	1547433.98	6364876.34	-335.73	49133	71.03	1.000305	✍	3.76	9.71	-0.15
396.0	-63.86	296.38	1547432.81	6364876.94	-338.43	49527	71.05	1.000522	✍	3.82	9.77	-0.15
399.0	-63.90	296.72	1547431.62	6364877.53	-341.12	49635	70.80	1.000139	✍	3.88	9.83	-0.16
402.0	-63.89	297.37	1547430.45	6364878.13	-343.81	49534	71.13	1.000258	✍	3.94	9.89	-0.16
405.0	-63.87	296.73	1547429.27	6364878.73	-346.51	49246	71.21	1.000260	✍	4.00	9.95	-0.16

Survey name : KLX16A

Survey date : 31/01/2007 11:03:00

Printed on 2007-03-28 19:26:05

Station	Dip	Azimuth	Easting	Northing	Elevation	Mag.Field	Mag.Dip	Grav.Field	Status	UpDown	LeftRight	Shortfall
Metres	Degrees	Degrees	Metres	Metres	Metres	nT	Degrees	G	*	Metres	Metres	Metres
408.0	-63.87	297.42	1547428.10	6364879.33	-349.20	49792	71.16	1.000154	✍	4.06	10.01	-0.16
411.0	-63.84	296.89	1547426.92	6364879.93	-351.89	49982	70.81	1.000235	✍	4.12	10.07	-0.16
414.0	-63.87	296.79	1547425.74	6364880.53	-354.59	49991	71.17	1.000391	✍	4.18	10.13	-0.16
417.0	-63.79	297.41	1547424.56	6364881.13	-357.28	50182	70.89	1.000213	✍	4.24	10.19	-0.16
420.0	-63.78	297.61	1547423.39	6364881.74	-359.97	49699	70.93	1.000310	✍	4.30	10.27	-0.16
423.0	-63.77	297.70	1547422.21	6364882.36	-362.66	50144	70.90	1.000920	✍	4.37	10.34	-0.17
426.0	-63.74	296.83	1547421.03	6364882.97	-365.35	49621	70.63	1.000381	✍	4.43	10.41	-0.17

Deviation logging in HLX42, 9 to 152 m

New MeasureIT files

Survey name:	**HLX42**
Survey date:	30/01/2007 16:04:46
Project:	PLU
Location:	Laxemar

Country:	Sweden
Survey company:	MALÅ GeoScience / RAYCON
Surveyed by:	Christer Gustafsson
Survey type:	STANDARD
Operating conditions:	
General comments:	
Client name:	SKB
Client ID number:	APPS 400-07-004
Client reference:	Leif Stenberg
Drill company:	
Drill rig:	
Drill diameter:	76
Survey direction:	INTO hole
Survey run on:	Wireline
Magnetic Var.:	2.73 degrees East of North

Conventions	
Linear units:	Metres
Angular units:	Degrees
Temperature units:	Centigrade
Co-ordinate system:	0 North
Elevation positive	Up
Dip origin:	0 Horizontal
Dip positive:	Up

Magnetic Integrity Check (MagIC)	Mid value	± limit	
Field strength:	49700	1000	nano Tesla
Magnetic dip:	71	1.5	Degrees

SURVEY	Actual start	End of survey	Difference
Station:	0.0	150.0	150.0
East:	1547446.73	1547396.25	-50.48
North:	6364827.04	6364891.48	64.44
Elevation:	12.88	-112.79	-125.67
Dip:	-58.52	-54.87	3.65
Azimuth:	321.51	320.79	-0.72

OFFSETS at end

Offsets relative to:
ACTUAL START

4.18 metres upwards
0.59 metres right
0.08 metres shortfall

Printed on: 2007-03-28 19:24:56

Survey name : HLX42

Survey date : 30/01/2007 16:04:46

Printed on 2007-03-28 19:25:33

Station	Dip	Azimuth	Easting	Northing	Elevation	Mag.Field	Mag.Dip	Grav.Field	Status	UpDown	LeftRight	Shortfall
Metres	Degrees	Degrees	Metres	Metres	Metres	nT	Degrees	G	*	Metres	Metres	Metres
0.0	-58.52	321.51	1547446.73	6364827.04	12.88	49945	72.99	0.997748	✍✍	0.00	0.00	0.00
3.0	-58.56	321.23	1547445.75	6364828.26	10.32	50027	71.23	1.002292	✍	0.00	0.00	0.00
6.0	-58.01	320.98	1547444.76	6364829.49	7.77	50329	70.95	1.002087	✍	0.01	-0.01	0.00
9.0	-57.58	321.36	1547443.76	6364830.74	5.23	50074	70.90	1.001511	✍	0.05	-0.02	0.00
12.0	-57.52	322.17	1547442.76	6364832.00	2.70	50104	71.11	0.998776	✍	0.10	-0.02	0.00
15.0	-57.63	321.69	1547441.77	6364833.27	0.17	49981	71.49	0.999013	✍	0.15	-0.01	0.00
18.0	-57.52	321.49	1547440.77	6364834.53	-2.37	49686	71.05	0.999390	✍	0.20	0.00	0.00
21.0	-57.51	322.25	1547439.78	6364835.79	-4.90	49607	71.29	0.999443	✍	0.25	0.01	0.00
24.0	-57.53	321.69	1547438.78	6364837.06	-7.43	49739	70.98	0.998848	✍	0.30	0.02	0.00
27.0	-57.50	322.12	1547437.79	6364838.33	-9.96	49831	71.01	0.999498	✍	0.36	0.03	0.00
30.0	-57.31	322.44	1547436.80	6364839.61	-12.48	50002	71.08	0.999349	✍	0.41	0.05	0.00
33.0	-57.39	322.50	1547435.82	6364840.89	-15.01	49992	71.07	0.999442	✍	0.47	0.08	0.00
36.0	-57.48	322.21	1547434.83	6364842.17	-17.54	49648	71.29	0.999028	✍	0.53	0.10	-0.01
39.0	-57.48	321.79	1547433.84	6364843.44	-20.07	49703	71.16	0.999262	✍	0.59	0.12	-0.01
42.0	-57.73	322.21	1547432.85	6364844.71	-22.60	49535	71.65	1.000324	✍	0.63	0.13	-0.01
45.0	-57.68	322.19	1547431.86	6364845.98	-25.14	49728	71.28	0.998700	✍	0.68	0.15	-0.01
48.0	-57.68	321.82	1547430.88	6364847.24	-27.67	49670	71.42	0.997833	✍	0.72	0.16	-0.01
51.0	-57.73	321.77	1547429.89	6364848.50	-30.21	49675	71.73	0.997657	✍	0.76	0.17	-0.01
54.0	-57.74	322.22	1547428.90	6364849.76	-32.75	49712	71.20	0.998455	✍	0.80	0.19	-0.01
57.0	-57.67	322.32	1547427.92	6364851.03	-35.28	49754	71.11	0.998719	✍	0.85	0.21	-0.01
60.0	-57.77	322.14	1547426.94	6364852.30	-37.82	49732	71.25	0.997687	✍	0.89	0.23	-0.01
63.0	-57.68	322.62	1547425.96	6364853.57	-40.35	49745	71.17	0.997670	✍	0.93	0.25	-0.01
66.0	-57.59	322.67	1547424.99	6364854.84	-42.89	49676	71.21	0.997157	✍	0.98	0.28	-0.01
69.0	-57.43	322.64	1547424.01	6364856.12	-45.42	49697	71.19	0.997819	✍	1.03	0.32	-0.01
72.0	-57.37	322.58	1547423.03	6364857.41	-47.95	49688	71.18	0.997864	✍	1.09	0.35	-0.01
75.0	-57.32	322.73	1547422.04	6364858.69	-50.47	49643	71.09	0.998701	✍	1.15	0.38	-0.01
78.0	-57.18	322.73	1547421.06	6364859.99	-52.99	49669	71.03	0.998682	✍	1.21	0.41	-0.01
81.0	-57.17	322.61	1547420.08	6364861.28	-55.52	49687	71.08	0.998080	✍	1.28	0.45	-0.01
84.0	-57.12	322.90	1547419.09	6364862.57	-58.04	49688	71.09	0.998041	✍	1.36	0.48	-0.01
87.0	-57.13	322.41	1547418.10	6364863.87	-60.55	49704	71.03	0.998375	✍	1.43	0.51	-0.02
90.0	-57.06	322.48	1547417.11	6364865.16	-63.07	49717	71.00	0.998767	✍	1.50	0.54	-0.02
93.0	-57.08	322.19	1547416.11	6364866.45	-65.59	49718	71.00	0.998776	✍	1.58	0.56	-0.02
96.0	-57.05	322.00	1547415.11	6364867.74	-68.11	49706	70.99	0.998786	✍	1.65	0.58	-0.02
99.0	-56.93	322.23	1547414.11	6364869.03	-70.63	49708	70.97	0.999589	✍	1.73	0.60	-0.02

Survey name : HLX42

Survey date : 30/01/2007 16:04:46

Printed on 2007-03-28 19:25:33

Station Metres	Dip Degrees	Azimuth Degrees	Easting Metres	Northing Metres	Elevation Metres	Mag.Field nT	Mag.Dip Degrees	Grav.Field G	Status *	UpDown Metres	LeftRight Metres	Shortfall Metres
102.0	-56.64	322.26	1547413.10	6364870.33	-73.13	49690	70.92	0.999751	✍	1.83	0.62	-0.02
105.0	-56.43	322.00	1547412.08	6364871.63	-75.64	49711	70.95	1.000172	✍	1.93	0.64	-0.02
108.0	-56.37	321.71	1547411.06	6364872.94	-78.14	49716	70.96	0.999684	✍	2.04	0.65	-0.02
111.0	-56.46	321.98	1547410.03	6364874.25	-80.64	49703	70.94	1.000163	✍	2.15	0.66	-0.03
114.0	-56.35	322.01	1547409.01	6364875.55	-83.13	49701	70.94	0.999458	✍	2.26	0.67	-0.03
117.0	-56.26	321.71	1547407.98	6364876.86	-85.63	49689	70.90	0.999946	✍	2.38	0.68	-0.03
120.0	-56.11	321.59	1547406.95	6364878.17	-88.12	49695	70.89	1.001163	✍	2.50	0.69	-0.03
123.0	-55.76	321.41	1547405.90	6364879.49	-90.61	49701	70.88	1.000994	✍	2.63	0.68	-0.04
126.0	-55.54	321.41	1547404.85	6364880.81	-93.08	49697	70.88	1.000553	✍	2.78	0.68	-0.04
129.0	-55.47	321.41	1547403.79	6364882.14	-95.56	49712	70.88	0.999574	✍	2.94	0.68	-0.04
132.0	-55.25	321.32	1547402.72	6364883.47	-98.03	49692	70.93	0.999371	✍	3.11	0.67	-0.05
135.0	-55.27	321.10	1547401.65	6364884.80	-100.49	49677	70.92	0.999868	✍	3.28	0.67	-0.05
138.0	-55.14	321.39	1547400.58	6364886.14	-102.95	49716	70.91	0.999604	✍	3.45	0.66	-0.06
141.0	-55.11	321.03	1547399.50	6364887.47	-105.42	49672	70.94	0.999750	✍	3.63	0.65	-0.06
144.0	-55.04	320.84	1547398.42	6364888.81	-107.88	49653	70.92	0.999984	✍	3.81	0.63	-0.07
147.0	-55.01	320.89	1547397.34	6364890.14	-110.33	49674	70.89	1.001025	✍	3.99	0.61	-0.08
150.0	-54.87	320.79	1547396.25	6364891.48	-112.79	49660	70.88	1.000826	✍	4.18	0.59	-0.08