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Oskarshamn site investigation

RAMAC, BIPS and deviation logging in boreholes KLX19A, KLX28A and KLX29A

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January 2007

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

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 logging and deviation logging in the core drilled boreholes KLX19A, KLX28A and KLX29A. All measurements were conducted by Malå Geoscience AB/RAYCON during October and November 2006.

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 KLX19A, KLX28A and KLX29A was relatively satisfying, but in parts of lower quality 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 168 identified radar reflectors in KLX19A and of these 36 were orientated (strike/dip). The corresponding figures for KLX28A is 20 and 3 and for KLX29A 24 and 3. In KLX19A a very large structure can be identified along the whole borehole length.

The images from the BIPS survey in KLX19A was not of the best quality. Mud covering the lower part of the borehole wall limits the visibility along the borehole. In KLX28A and KLX29A the condition in the boreholes is very good except for the last 20 metres were mud limits the visibility.

Sammanfattning

Denna rapport omfattar geofysiska loggningar inom platsundersökningsprogrammet för Oskarshamn. Mätningarna som presenteras här omfattar borrhålsradarmätningar (RAMAC), BIPS-loggningar och avvikelsemätningar, s k krökningsmätningar i kärnborrhålen KLX19A, KLX28A och KLX29A. Alla mätningar är utförda av Malå Geoscience AB/RAYCON under oktober och november 2006.

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 få fram koordinater samt lutning och riktning 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 KLX19A, KLX28A och KLX29A var relativt tillfredställande, men i vissa delar var djuppenetrationen sämre troligen till stor del beroende på en konduktiv miljö. En konduktiv miljö minskar möjligheterna att identifiera strukturer från borrhålsradardata. Dock har 168 radarreflektorer identifierats i KLX19A och av dessa har 36 orienterats (med strykning/stupning). Motsvarande siffror för KLX28A är 20 och 3 och för KLX29A 24 och 3. I KLX19A kan en tydlig reflektor följas längs med hela borrhålet.

BIPS mätningarna i KLX19A är inte av bästa kvalitet, borrkax täcker borrhålsväggens nedre kant längs hela borrhålet och försämrar väsentligt kvalitén på bilderna. Betydligt bättre bildkvalitet blev det i KLX28A och KLX29A där det endast är de sista 20 metrarna i respektive borrhål som har en något försämrad kvalitet.

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), BIPS and deviation measurements in the core drilled boreholes KLX19A, KLX28A and KLX29A.

The work was carried out in accordance with activity plan AP PS 400-06-117. In Table 1-1 controlling documents for performing this activity are listed. Both activity plan and method descriptions are SKB's internal controlling documents.

This report includes measurements from 100 to 794 m in KLX19A, from 0 to 76 in KLX28A and from 0 to 56 m in KLX29A.

The borehole KLX19A are percussion drilled with a diameter of 255 mm down to 98.5 m, from there the borehole is core drilled with a diameter of 76 mm. The boreholes KLX28A and KLX29A are core drilled with a diameter of 76 mm.

All measurements were conducted by Malå Geoscience AB/RAYCON during October and November 2006. 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 internal controlling documents).

Activity plan	Number	Version
Borrhålsradar, BIPS och Flexit-mätning i KLX19A, KLX28A och KLX29A	AP PS 400-06-117	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	2.0
Metodbeskrivning för krökningsmätning av hammar- och kärnborrhål	SKB MD 224.001	1.0

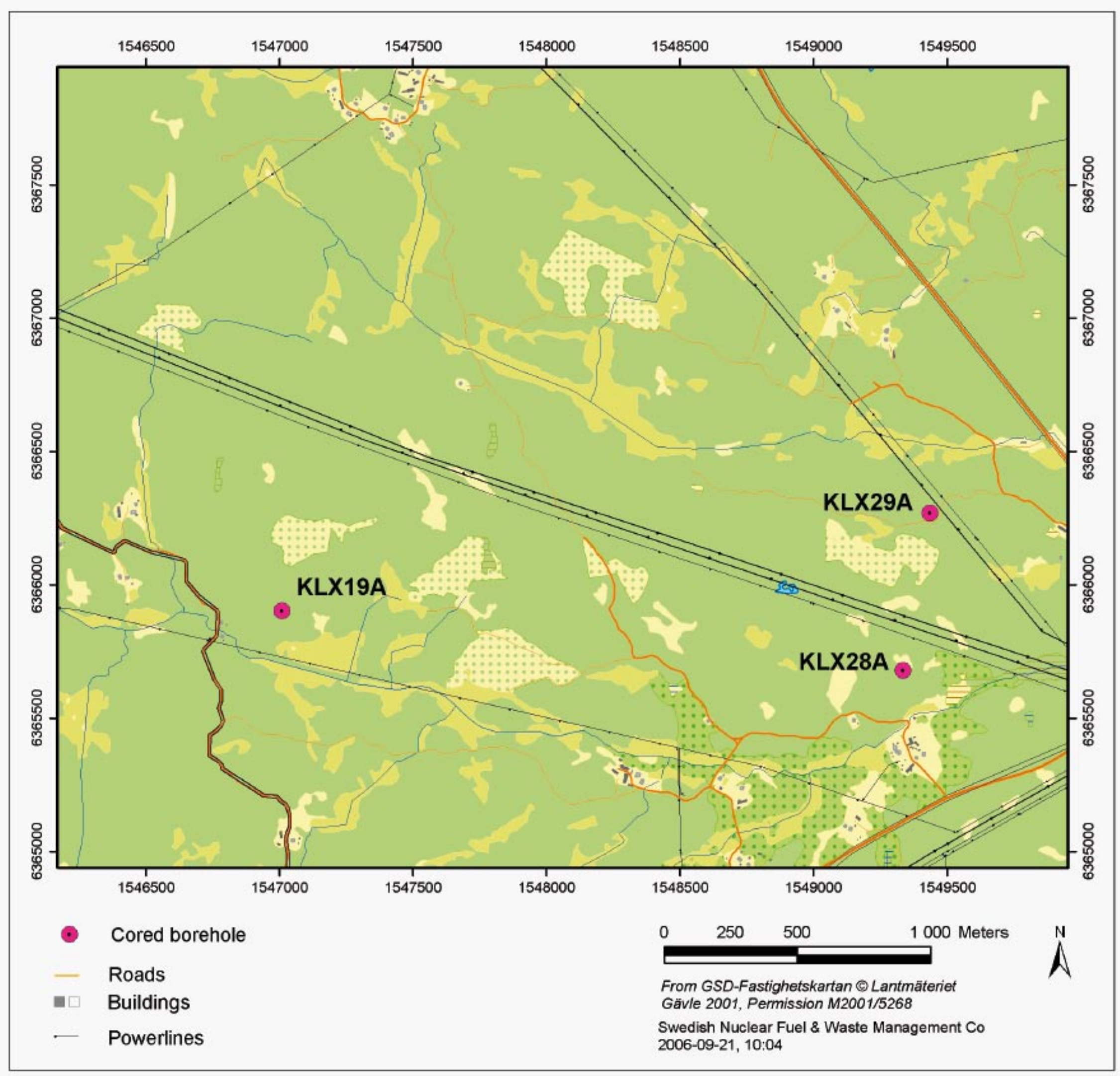


Figure 1-1. *Map of the location of the boreholes KLX19A, KLX28A and KLX29A, in the Laxemar subarea, Oskarshamn.*

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.

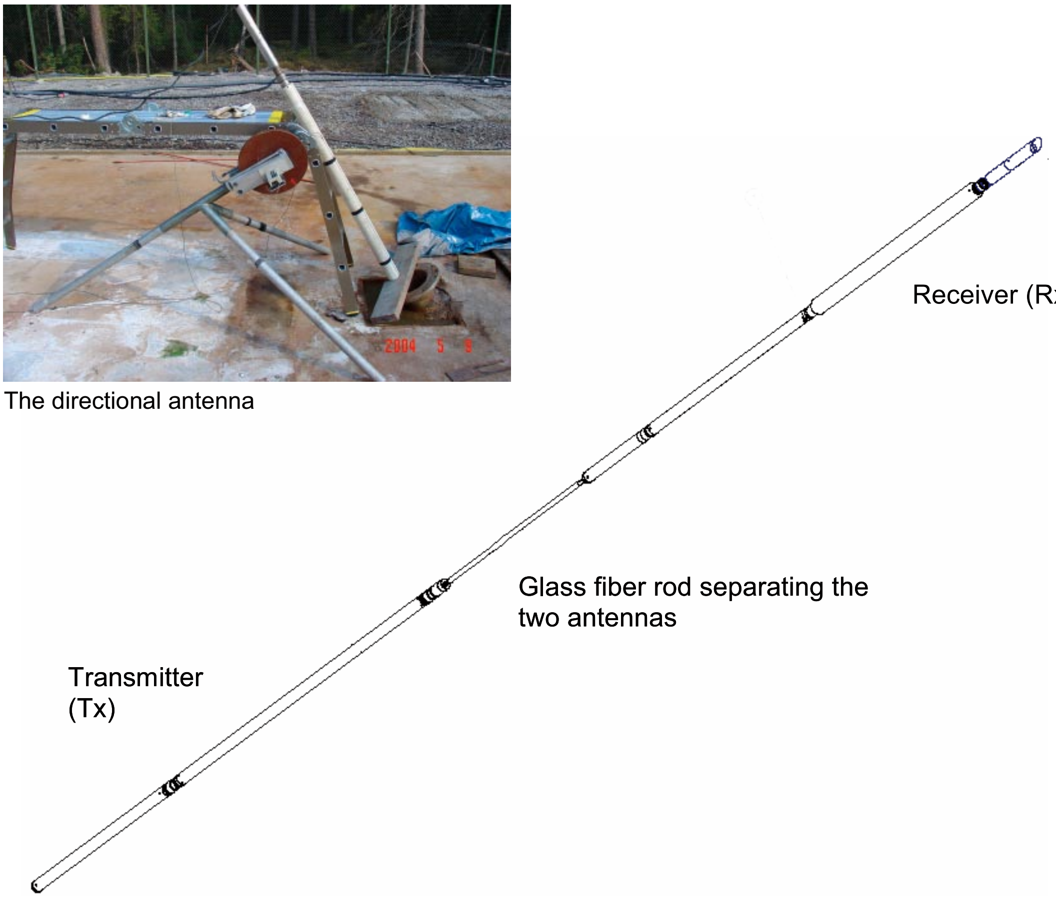


__Figure 3-1.__ Example of a borehole radar antenna.

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).

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.

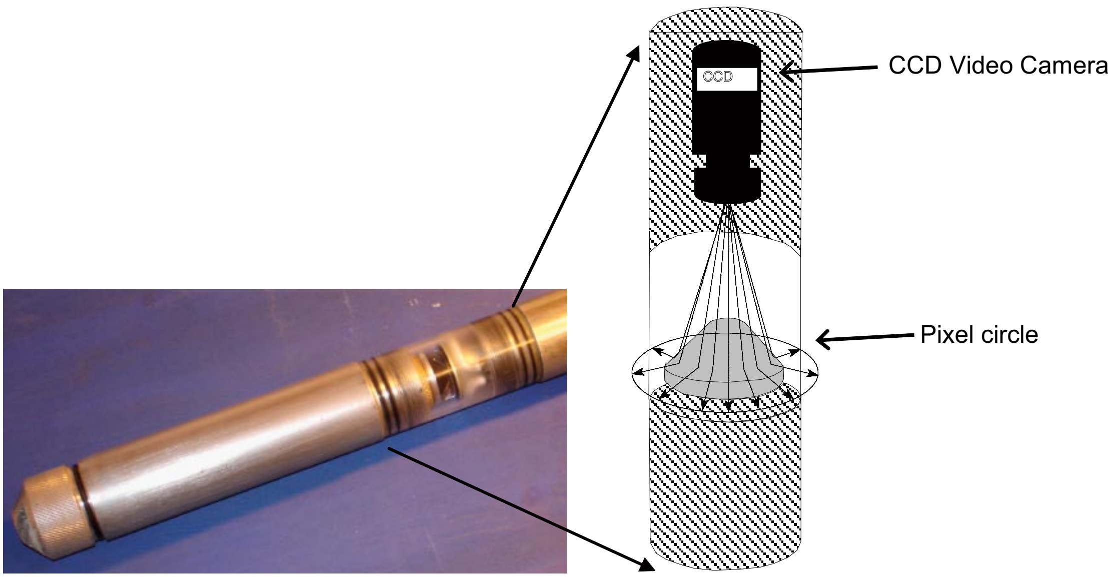


Figure 3-2. *The BIP-system. Illustration of the conical mirror scanning.*

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:	Coordinate 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

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

4 Execution

4.1 General

4.1.1 RAMAC Radar

The measurements in KLX19A, KLX28A and KLX29A were carried out with dipole radar antennas, with frequencies of 250, 100 and 20 MHz. Measurements were also carried out using the 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 is made step wise, with a short pause for each measurement occasion. The antennas (transmitter and receiver, both for dipole and directional) are kept at a fixed separation by glass fibre rods according to Tables 4-1 to 4-3. See also Figure 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 KLX19A and KLX28A. 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 about 9 degrees. This can be considered to be good due to the disturbed environment, with metallic objects etc at the test site.

For more information on system settings used in the investigation of KLX19A, KLX28A and KLX29A, see Tables 4-1 to 4-3 below.

Table 4-1. Radar logging information from KLX19A.

Site:	**Oskarshamn**	**Logging company:**	**RAYCON**		
BH:	**KLX19A**	**Equipment:**	**SKB RAMAC**		
Type:	**Directional / Dipole**	**Manufacturer:**	**MALÅ GeoScience**		
Operator:	**CG**	**Antenna**			
		Directional	**250 MHz**	**100 MHz**	**20 MHz**
Logging date:		06-10-11	06-10-10	06-10-10	06-10-10
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	–0.34	–0.35	1.42
Logging from (m):		103.4	101.5	102.6	106.25
Logging to (m):		793.4	795.1	796.5	791.65
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 KLX28A.

Site: **Oskarshamn**	**Logging company:**	**RAYCON**		
BH: **KLX28A**	**Equipment:**	**SKB RAMAC**		
Type: **Directional / Dipole**	**Manufacturer:**	**MALÅ GeoScience**		
Operator: **CG**	**Antenna**			
	Directional	**250 MHz**	**100 MHz**	**20 MHz**
Logging date:	06-11-08	06-11-08	06-11-08	06-11-08
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	–0.34	–0.35	1.42
Logging from (m):	3.4	1.5	2.6	6.25
Logging to (m):	73.4	77.6	77.2	72.85
Trace interval (m):	0.5	0.1	0.2	0.25
Antenna separation (m):	5.73	2.4	3.9	10.05

Table 4-3. Radar logging information from KLX29A.

Site: **Oskarshamn**	**Logging company:**	**RAYCON**		
BH: **KLX29A**	**Equipment:**	**SKB RAMAC**		
Type: **Directional / Dipole**	**Manufacturer:**	**MALÅ GeoScience**		
Operator: **CG**	**Antenna**			
	Directional	**250 MHz**	**100 MHz**	**20 MHz**
Logging date:	06-11-07	06-11-07	06-11-07	06-11-07
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	–0.34	–0.35	1.42
Logging from (m):	3.4	1.5	2.6	6.25
Logging to (m):	53.4	57.7	56.9	52.95
Trace interval (m):	0.5	0.1	0.2	0.25
Antenna separation (m):	5.73	2.4	3.9	10.05

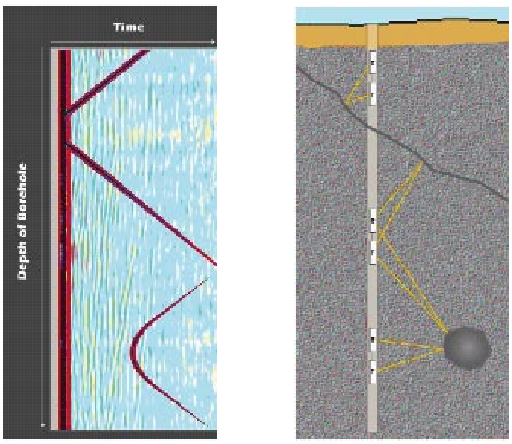


***Figure 4-1.** The principle of radar borehole reflection survey and an example of result.*

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 was used to measure the orientation of the images in the boreholes KLX19A, KLX28A and KLX29A.

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 and 4-3 shows the results of the test logging performed before and after the logging campaigns in October and November. 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 4 to 6 in this report.

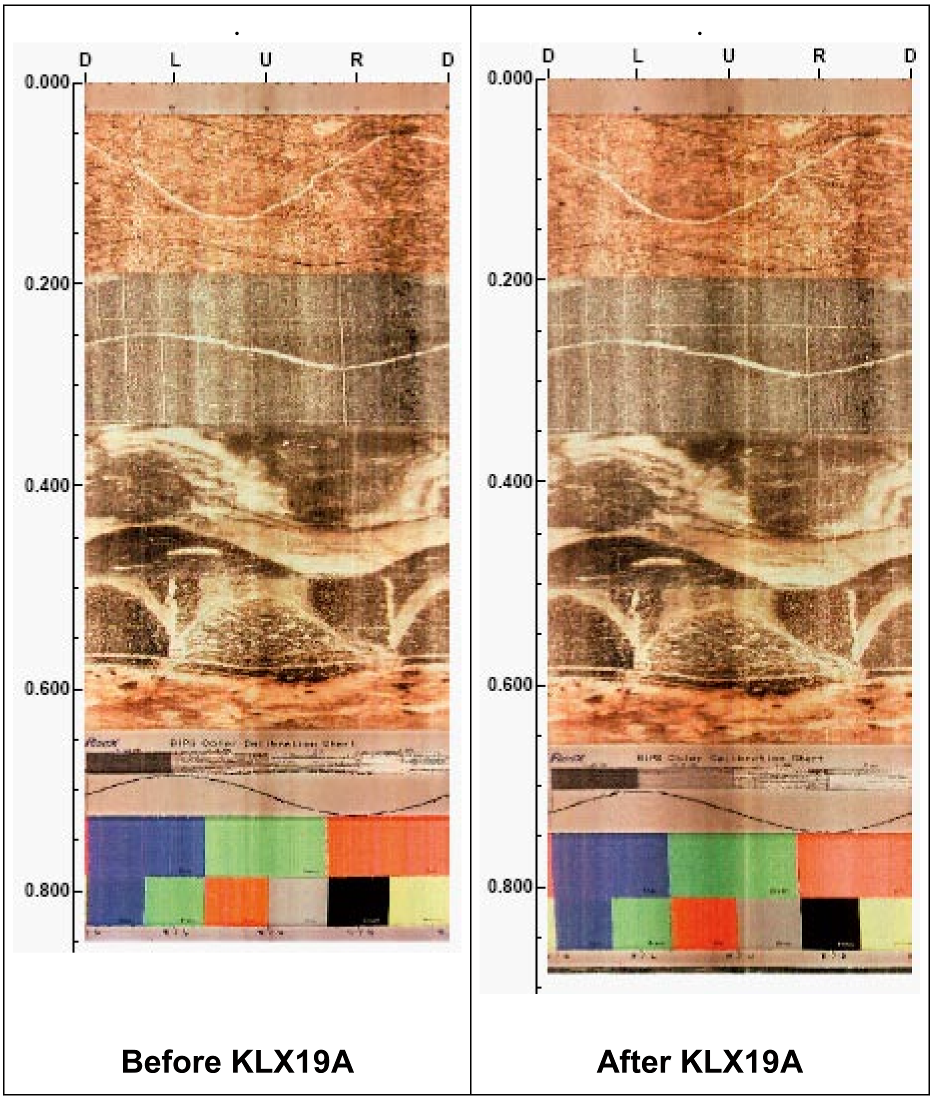


__Figure 4-2.__ Results from logging in the test pipe before and after the logging campaign in October, 2006.

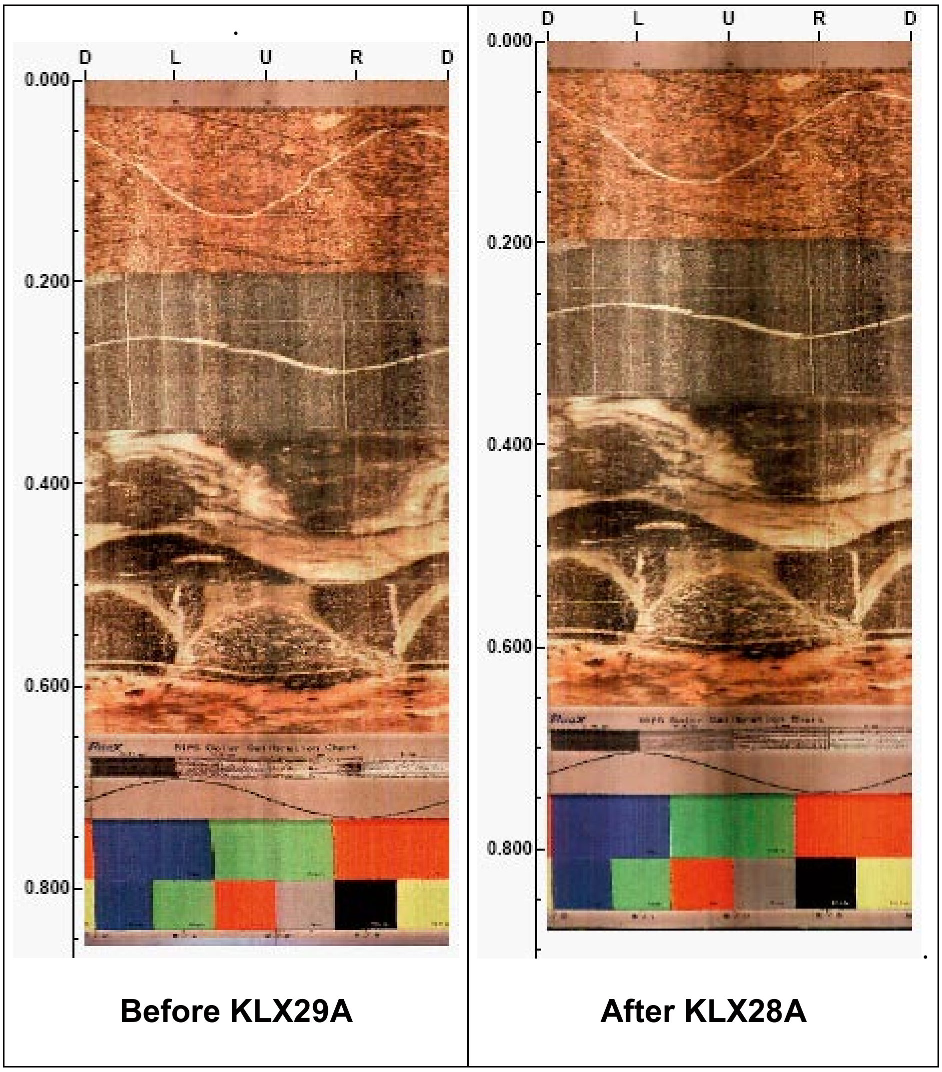


Figure 4-3. Results from logging in the test pipe before and after the logging campaign in November, 2006.

4.1.3 Deviation measurements

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 were performed for each 3 m. 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 borehole 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.

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 4 to 6. 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 Interpretation

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 propagation of 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 the 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 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 was performed between KLX07A and KLX07B by keeping the transmitter fixed in one borehole while moving the receiver downwards in a nearby borehole. The velocity measurement was performed with the 20 MHz antennas in boreholes KLX07A and KLX07B /1/.

The result is plotted in Figure 4-4 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.

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 4-4 to 4-6. It should be observed that the processing steps in Tables 4-4 to 4-6 below refer to Appendix 1 to 3 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.

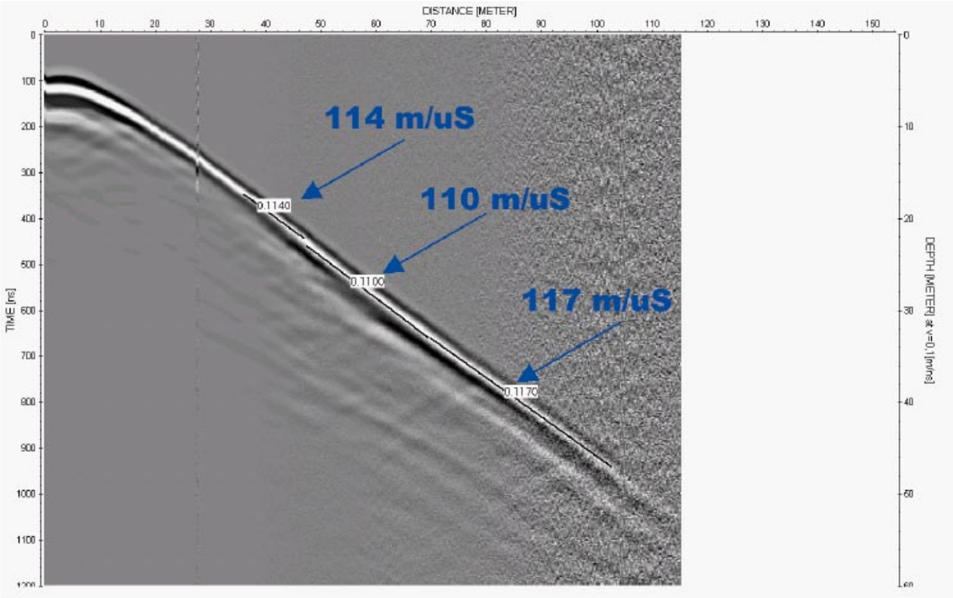


Figure 4-4. *Results from velocity measurements /1/.*

Table 4-4. Processing steps for borehole radar data from KLX19A.

Site:	**Oskarshamn**	**Logging company:**	**RAYCON**		
BH:	**KLX19A**	**Equipment:**	**SKB RAMAC**		
Type:	**Directional/Dipole**	**Manufacturer:**	**MALÅ GeoScience**		
Interpret:	**JG**	**Antenna**			
		Directional	**250 MHz**	**100 MHz**	**20 MHz**
Processing:		Move start time (42 samples) DC shift (390–510) Time gain (start 72 lin 100 exp 5) (FIR)	Move start time (–13.4) DC shift (190–230) Gain (start 24 lin 2 exp 0.3)	Move start time (–35.6) DC shift (470–530) Gain (start 35 lin 2.5 exp 0.4)	Move start time (–89) DC shift (1,800–2,000) Gain (start 100 lin 3.6 exp 0.1)

Table 4-5. Processing steps for borehole radar data from KLX28A.

Site:	**Oskarshamn**	**Logging company:**	**RAYCON**		
BH:	**KLX28A**	**Equipment:**	**SKB RAMAC**		
Type:	**Directional/Dipole**	**Manufacturer:**	**MALÅ GeoScience**		
Interpret:	**JG**	**Antenna**			
		Directional	**250 MHz**	**100 MHz**	**20 MHz**
Processing:		Move start time (43 samples) DC shift (390–510) Time gain (start 68 lin 100 exp 5) (FIR)	Move start time (–19.6) DC shift (190–230) Gain (start 15 lin 2.9 exp 0.5)	Move start time (–38.8) DC shift (470–530) Gain (start 38 lin 3 exp 0. 4)	Move start time (–88) DC shift (1,800–2,000) Gain (start 100 lin 2.9 exp 0.1)

Table 4-6. Processing steps for borehole radar data from KLX29A.

Site:	**Oskarshamn**	**Logging company:**	**RAYCON**		
BH:	**KLX29A**	**Equipment:**	**SKB RAMAC**		
Type:	**Directional/Dipole**	**Manufacturer:**	**MALÅ GeoScience**		
Interpret:	**JG**	**Antenna**			
		Directional	**250 MHz**	**100 MHz**	**20 MHz**
Processing:		Move start time (43 samples)	Move start time (–15.2)	Move start time (–34.5)	Move start time (–92.5)
		DC shift (390–510)	DC shift (190–230)	DC shift (470–530)	DC shift (1,800–2,000)
		Time gain (start 76 lin 100 exp 5)	Gain (start 15 lin 1.7 exp 1)	Gain (start 42 lin 2.5 exp 0.5)	Gain (start 140 lin 10 exp 0.04)
		(FIR)			Bandpass (10–200)

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 5-4 to 5-6 and are also visible on the radargrams in Appendices 1 to 3.

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 meausrements

The resulting data from the deviation measurements were corrected relatively to the magnetic North, 2.33 degrees east of RT90 North for the presentation in Appendices 7 to 9. For delivery to SICADA the azimuth was delivered relatively to magnetic North.

4.3 Nonconformities

No nonconformities occurred during the logging campaigns in October and November, 2006.

5 Results

The results from the BIPS measurements for KLX19A, KLX28A and KLX29A 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 or *.rd5) for KLX19A, KLX28A and KLX29A 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 7 and 8 in this report. Each reading station depth are referred from TOC 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 5-6 and in Table 5-10. Radardata is also visualized in Appendices 1 to 3. It should be remembered that the images in Appendices 1 to 3 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. Overviews of the four different boreholes are given in Figure 5-1 below. Especially in KLX19A very clear and large structures can be observed. A number of minor structures also exist, indicated in Appendices 1 to 3. 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 Appendices 1 to 3. 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.

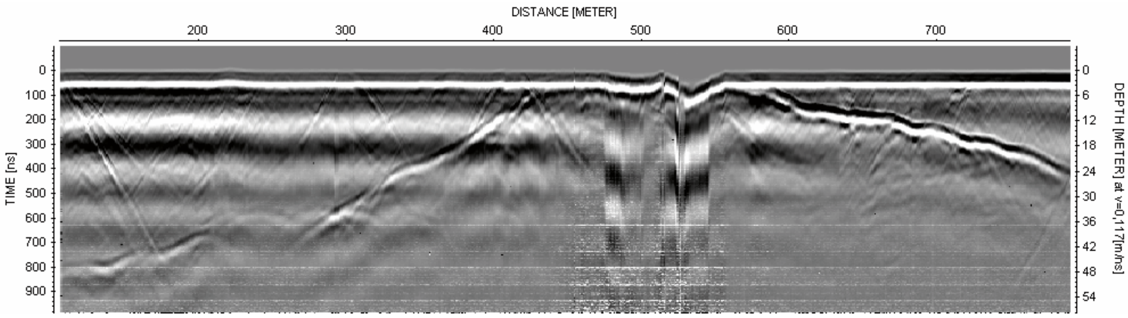
In Figure 5-1 and Appendix 1 in data from KLX19A a very large structure can be identified along the whole borehole length. In the resulting table, Table 5-4, this structure is named with ID 58, 141 and 89, but it is most probably only one large geological formation.

The data quality from KLX19A, KLX28A and KLX29A, (as seen in Appendices 1 to 3) is satisfying to good. In parts the data quality is lower due to more 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.

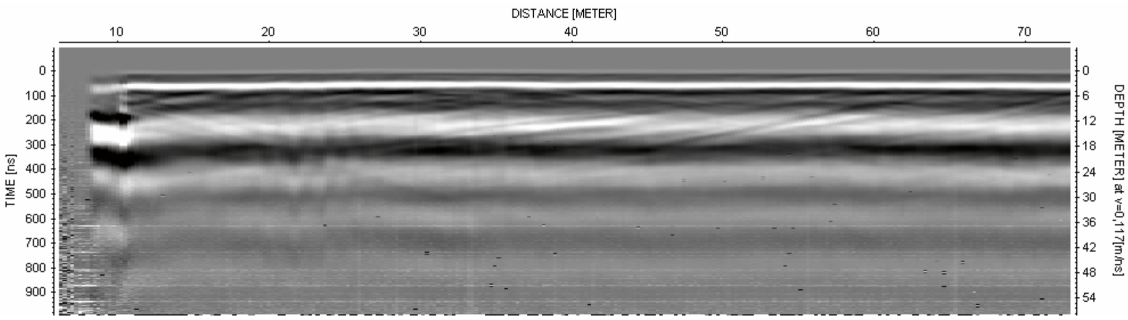
This effect is also seen in the directional antenna, which makes it more difficult to interpret the direction to the identified structures.

As also seen in Appendices 1 to 3 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.

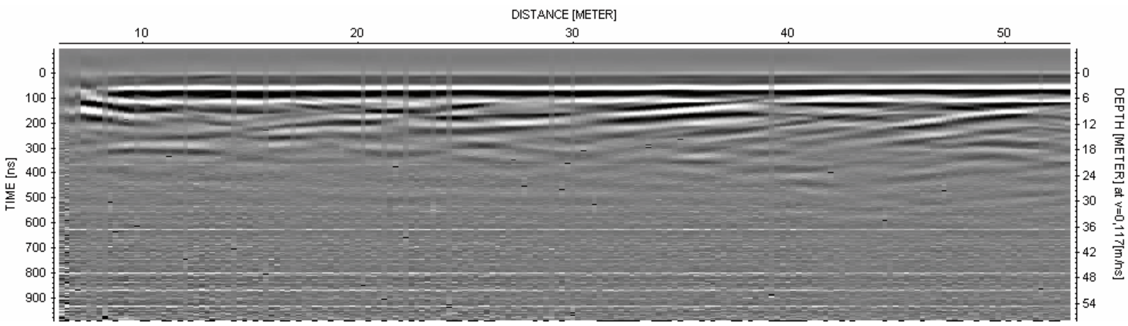
In Table 5-1 to 5-3 below the distribution of identified structures along the borehole are listed for KLX19A, KLX28A and KLX29A.



KLX19A



KLX28A



KLX29A

Figure 5-1. *An overview (20 MHz data) of the radar data for the three different boreholes; KLX19A, KLX28A and KLX29A. Observe that the length (x-scale) differs between the different boreholes.*

Table 5-1. Identified structures as a function of depth in KLX19A.

Depth (m)	No. of structures
–100	7
100–150	10
150–200	18
200–250	8
250–300	16
300–350	7
350–400	14
400–450	22
450–500	8
500–550	9
550–600	10
600–650	9
650–700	9
700–750	10
750–800	8
800–	3

Table 5-2. Identified structures as a function of depth in KLX28A.

Depth (m)	No. of structures
–10	2
10–20	2
20–30	3
30–40	3
40–50	2
50–60	1
60–70	1
70–80	3
80–	3

Table 5-3. Identified structures as a function of depth in KLX29A.

Depth (m)	No. of structures
–10	2
10–20	6
20–30	3
30–40	3
40–50	3
50–	7

Tables 5-4 to 5-6 summarises the interpretation of radar data from KLX19A, KLX28A and KLX29A. As seen some radar reflectors in Tables 5-4 to 5-6 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 (the plane) is defined in Figure 5-2. 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 5-4. 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 structure 4 in Table 5-4 and Appendix 1. To this structure, most likely, also structure 4x and 4xx belongs.

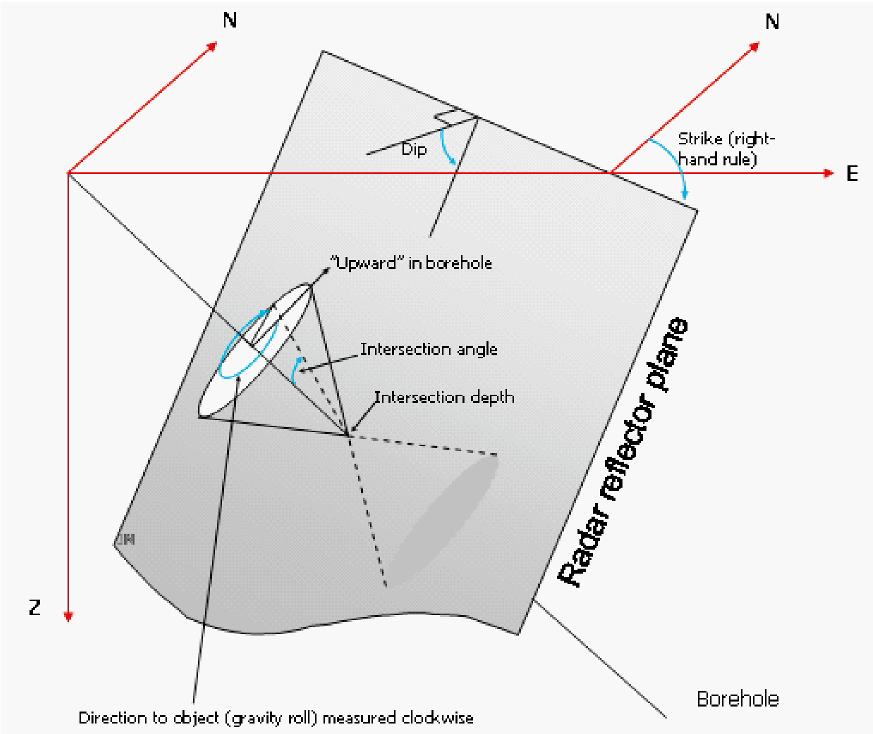


Figure 5-2. Definition of intersection angle, direction to object using gravity roll, dip and strike using the right hand rule as presented in Table 5-4.

Table 5-4. Interpretation of radar reflectors from the dipole antennas 250, 100 and 20 MHz, and the directional antenna 60 MHz in borehole KLX19A.

RADINTER MODEL INFORMATION
(Directional antenna)

Site:	**Oskarshamn**
Borehole name:	**KLX19A**
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
134x	–111.8	4					
143	85.0	6	3 ±	63	110	53	111
4	89.5	17					
128	89.7	45					
4xx	92.6	22	189	36	121		
5	99.1	41	195	21	141		
1	99.8	53					
4x	103.1	29					
22	103.1	17	183 ±	41	111	75	110
2	104.8	57					
8	106.7	56					
134	111.7	14					
9	113.1	49					
3	114.1	28	204 ±	33	148	90	128
127	114.5	8					
6	116.4	39					
12	142.0	35					
19	151.4	13					
10	152.5	12					
20	152.9	33					
11	152.9	21					
25	153.2	9	0 ±	67	107	49	107
23	155.0	36					
14	160.3	29					
15	166.1	34					
14x	166.2	25	198 ±	35	136	85	123
16	167.9	32					
18	170.8	62					
17	171.9	53	3 ±	67	289	6	126
25x	172.2	15					
129	175.1	32					
13	186.7	9					
21	188.1	37					
27	192.8	45					
24	198.7	64					
30	202.3	58					
26	202.4	34	162	28	73		
28	208.2	30					
29	211.9	44					
31	228.9	59					
144	234.3	46					

RADINTER MODEL INFORMATION
(Directional antenna)

Site:	**Oskarshamn**
Borehole name:	**KLX19A**
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
32	239.2	66					
145	245.4	50					
33x	251.1	23					
34	252.2	41					
33	252.9	23					
35	254.1	74					
149	259.6	25	201 ±	37	140	85	126
36	260.8	64					
37	264.4	41					
7	267.6	4	141	62	62		
142	273.9	26					
38	275.3	43					
39	277.3	23					
130	293.5	24					
41	293.9	58	60 ±	51	318	30	227
135	294.8	59					
42	297.7	67					
40	299.3	49	345 ±	71	277	11	50
40x	301.9	37					
40xx	306.3	36					
132	326.6	13					
43	331.0	48					
136	339.0	52					
131	340.7	47					
44	343.4	61	15 ±	60	295	9	233
50	351.2	33					
45	353.6	57					
49	356.4	52					
46	359.3	28					
48	359.8	25					
89xx	366.1	3	120 ±	71	35	77	38
51	370.1	46					
47	372.7	17					
52	374.1	37					
55	374.5	60					
137	381.6	55					
148	382.2	17					
54	385.9	49					
53	387.0	28					
58xx	400.2	25					
60	402.8	62					
57	403.4	51	318 ±	65	259	25	15
56	405.9	11					
62	406.7	60					

RADINTER MODEL INFORMATION (Directional antenna)							
Site:	**Oskarshamn**						
Borehole name:	**KLX19A**						
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**
59	413.1	33	297	75	235		
61	413.4	50					
63	416.0	40					
97x	417.2	4					
64	417.9	41					
65	428.7	40					
66	429.4	51					
67	431.3	39					
68	432.5	38					
75	433.3	41					
71	435.4	37					
76	437.6	41					
72	440.0	29					
74	442.2	33					
70	443.0	25					
58xxx	444.4	14					
73	445.0	20					
79	456.3	14	303	85	49		
58xxxx	457.2	13	141 ±	53	57	78	68
78	457.9	42					
77	461.8	53					
58	470.7	13	129 ±	59	44	82	57
80	475.7	57					
81	480.4	50					
141x	494.5	8	120 ±	67	39	82	47
82	501.5	51					
89xxx	507.1	5	120 ±	70	37	79	42
83	508.5	30					
84	508.5	50					
87	516.9	18	120	58	28		
85	523.3	55					
86	525.3	49					
89	543.9	10	120	65	31		
58x	548.8	7					
88	551.9	59					
89x	557.7	13					
138	562.9	44					
90	571.2	39					
92	572.1	50	24	72	297		
91	576.0	47					
95	583.1	26					
96	588.5	49					
94	592.7	47					

RADINTER MODEL INFORMATION
(Directional antenna)

Site:	**Oskarshamn**
Borehole name:	**KLX19A**
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
93	596.8	23	174	32	91		
89xxxx	600.2	8					
97	609.6	25					
98	611.9	42					
99	614.3	47					
100	626.7	37					
101	627.2	45					
102	628.9	66					
103	648.0	24					
107	649.0	50					
139	654.1	29					
133	663.0	28					
104	654.6	45	150 ±	20	28	73	263
105	670.0	49					
109	677.0	55					
110	682.2	63					
111	684.3	64					
108	690.9	24					
114	695.0	57					
118	701.8	51	84 ±	49	333	44	229
112	702.5	32					
113	703.3	71					
115	706.2	31					
140	716.0	58					
106	718.7	12	243	65	178		
117	729.9	35	330	83	260		
117xx	726.0	29					
116	730.6	24					
117x	733.4	29					
124	750.4	48	288	59	237		
121	751.7	34					
120	754.8	23					
122	766.0	81	228 ±	28	270	41	296
119	767.3	9	294	86	39		
123	778.0	82	222 ±	27	269	41	294
141	794.4	4					
126	797.2	39					
125	806.7	55	30	61	301		
146	835.1	44					
147	1,075.0	4	186	53	111		

Table 5-5. Interpretation of radar reflectors from the dipole antennas 250, 100 and 20 MHz, in borehole KLX28A.

RADINTER MODEL INFORMATION (Directional antenna)							
Site:		**Oskarshamn**					
Borehole name:		**KLX28A**					
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	2.2	60					
1	5.6	67					
3	12.7	55					
4	15.5	69					
11x	24.3	15	357 ±	76	96	44	95
7	27.3	43					
5	28.2	47					
6	30.5	47					
8	31.8	45					
11	39.4	32					
9	45.7	74					
10	47.8	49					
17	58.7	59					
12	60.2	73					
19	76.9	28					
13	77.0	43					
16	77.1	46	285 ±	61	225	45	352
14	82.2	32					
18	83.9	52					
15	95.5	26	132 ±	47	33		

Table 5-6. Interpretation of radar reflectors from the dipole antennas 250, 100 and 20 MHz, in borehole KLX29A.

RADINTER MODEL INFORMATION
(Directional antenna)

Site:Oskarshamn

Borehole name:KLX29A

Nominal velocity (m/μs):117.0

Name	Intersection depth	Inter-section angle	RadInter direction to object (gravity roll)	Dip 1	Strike 1	Dip 2	Strike 2
4	6.3	62					
1	8.4	52					
2	12.0	65					
2x	12.4	72					
3	13.2	83					
5	17.2	50					
6	18.1	43					
7	19.3	48	195 ±	17	277	74	71
8	21.8	76					
18	23.9	54					
19	23.9	37					
10	35.4	60					
9	36.7	60					
16	39.3	53					
11	41.2	45					
20	42.0	54					
14	44.9	61					
15	52.1	59					
12x	53.9	21					
12	56.2	21	315 ±	90	19	50	180
17	57.5	53					
21	62.1	48					
13x	63.7	24					
13	67.7	19	153	44	202		

In Appendices 1 to 3, 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 5-7 to 5-9.

Table 5-7. Borehole length intervals in KLX19A with decreased amplitude for the 250 MHz antenna.

Length (m)	Length (m)
105	435–440
215	480–510
300	520–555
375–380	765
415	

Table 5-8. Borehole length intervals in KLX28A with decreased amplitude for the 250 MHz antenna.

Length (m)	Length (m)
10–20	50
45	

Table 5-9. Borehole length intervals in KLX29A with decreased amplitude for the 250 MHz antenna.

Length (m)	Length (m)
0–10	25
15	

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 5-10 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 angle will most often give a increased amplitude than a larger angle, and by that a more clear structure.

Table 5-10. Some important structures in KLX19A, KLX28A and KLX29A.

Borehole	KLX19A	KLX28A	KLX29A
Structures	4, 4x, 4xx, 5, 17, 21, 25, 25x, 40, 40x, 40xx, 52, 58, 58x, 58xx, 58xxx, 58xxxx, 59, 79, 87, 89, 89x, 89xx, 89xxx, 89xxxx, 105, 106, 117, 117x, 117xx, 119, 122, 123, 125, 141, 141x, 143 and 146	5, 6, 11, 11x, 16 and 19	2, 2x, 4, 10, 12, 12x, 13, 13x, 17 and 21

5.2 BIPS logging

The BIPS pictures from KLX19A, KLX28A and KLX29A are presented in Appendices 4 to 6.

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 in KLX19A and KLX28A are adjusted to the reference mark produced during the drilling operation. For KLX29A the marks on the logging cable at 50 metre were used for adjustment of the depth.

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 images from the BIPS survey in KLX19A was not of the best quality. Mud covering the lower part of the borehole wall limits the visibility. The mud gradually increases along the borehole. From 400 metres down to the bottom is it impossible to get any good images from the lower part of the borehole wall. Still the images is interpretable and will give a satisfying quality for the core logging.

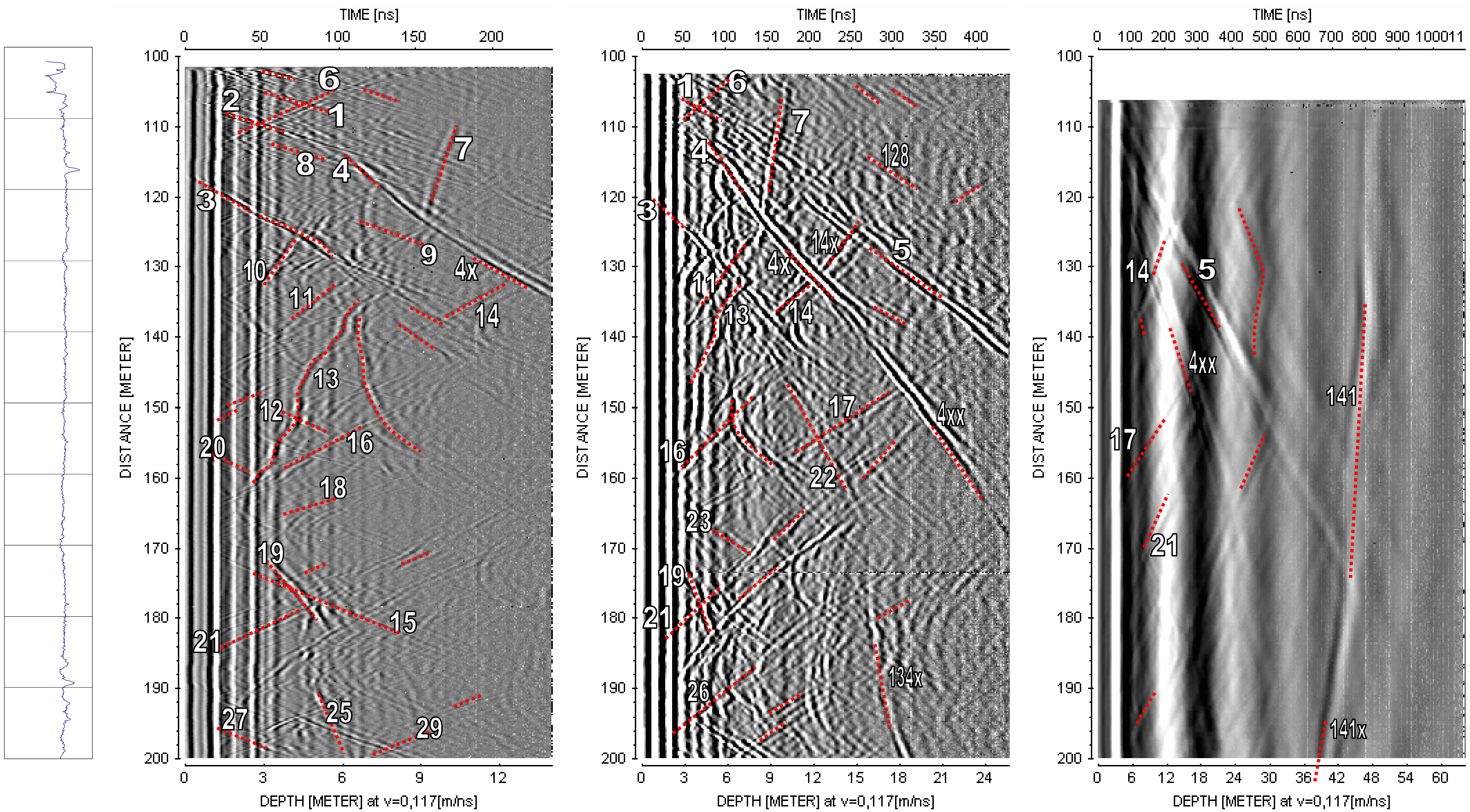
In KLX28A and KLX29A the images is of very good quality except for the last 20 metres where presence of mud lowers the image quality.

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 KLX19A, 100 to 794 m, dipole antennas 250, 100 and 20 MHz

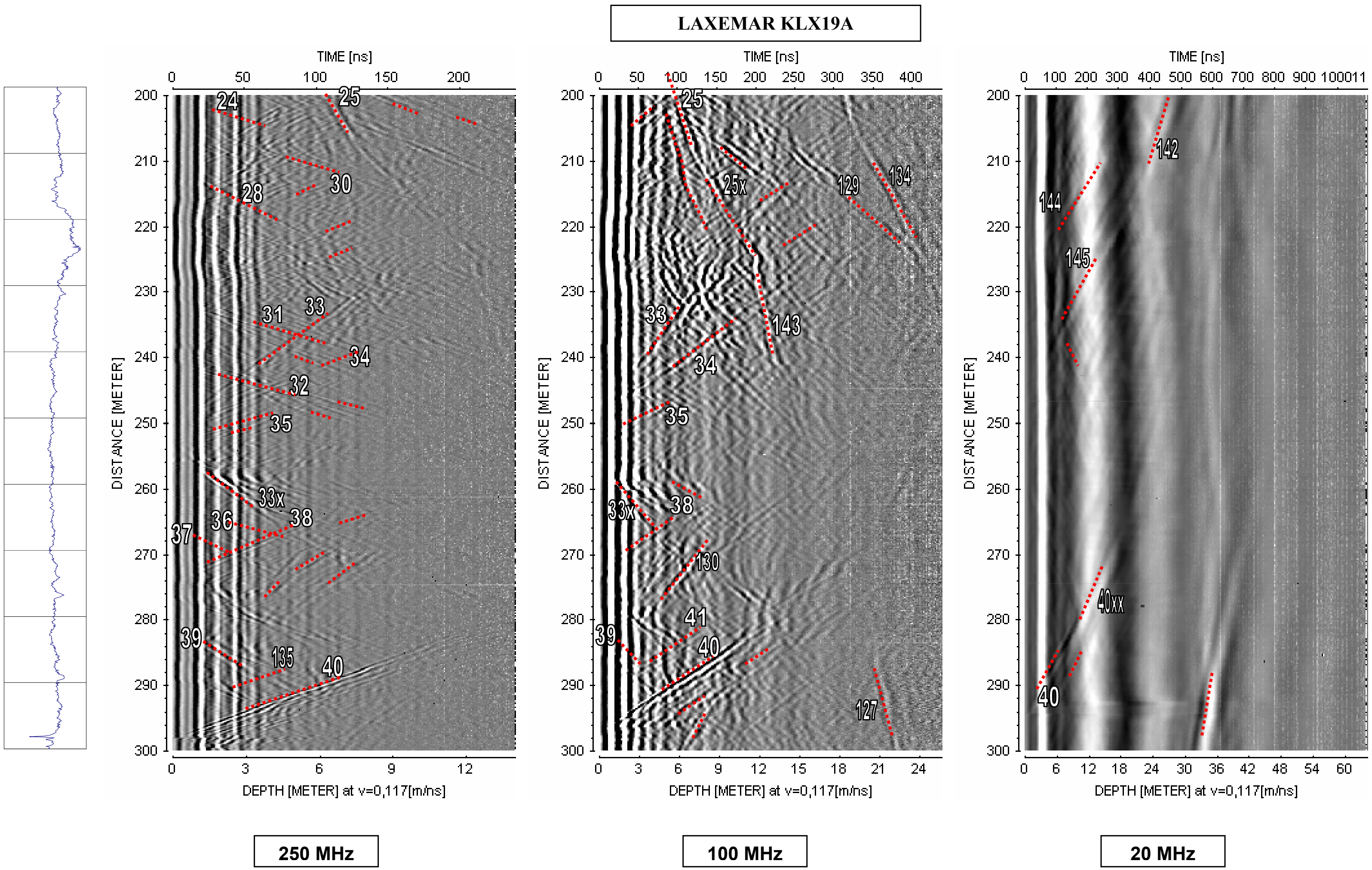
LAXEMAR KLX19A



250 MHz

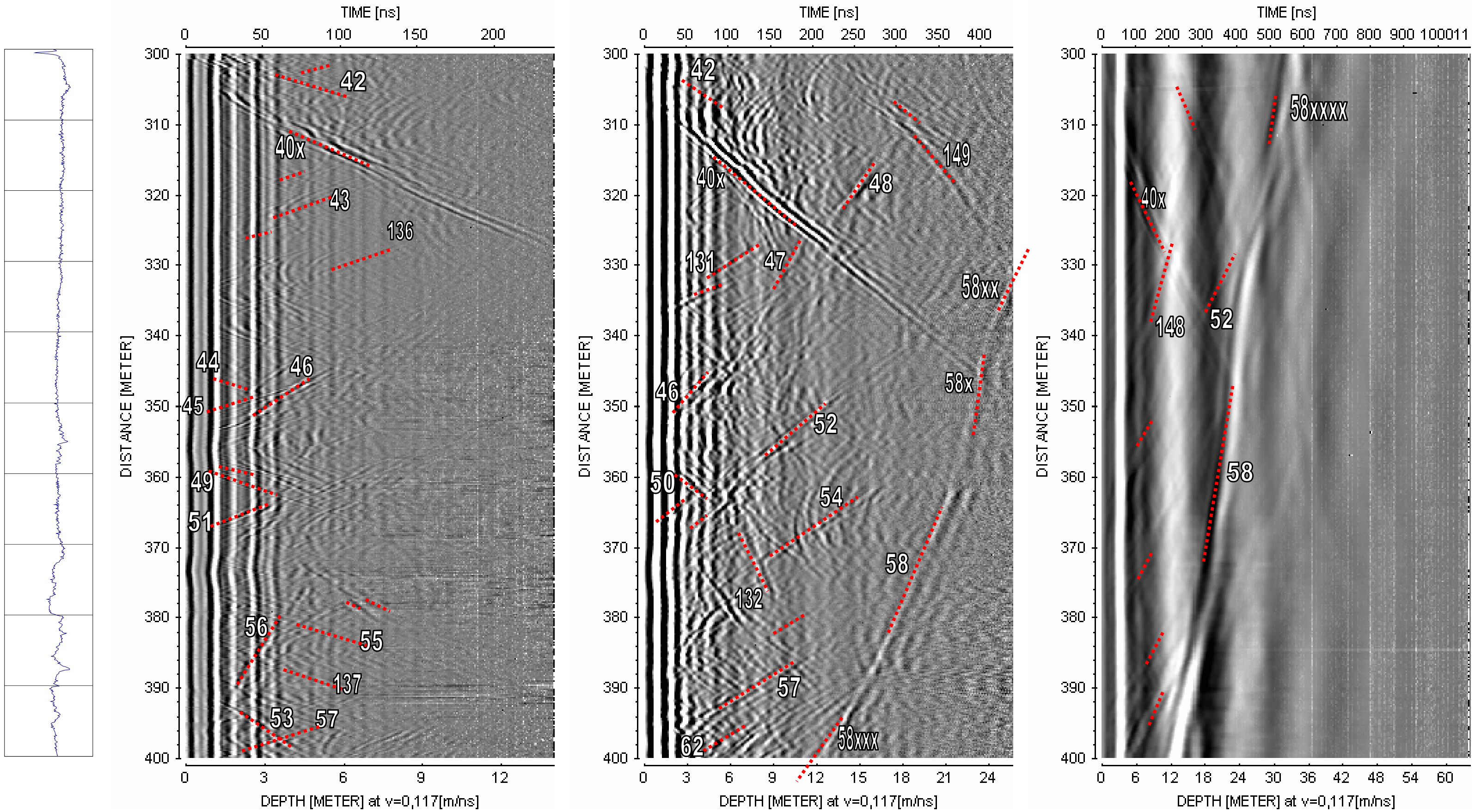
100 MHz

20 MHz



LAXEMAR KLX19A
TIME [ns]
DISTANCE [METER]
DEPTH [METER] at v=0,117[m/ns]
250 MHz
100 MHz
20 MHz

LAXEMAR KLX19A

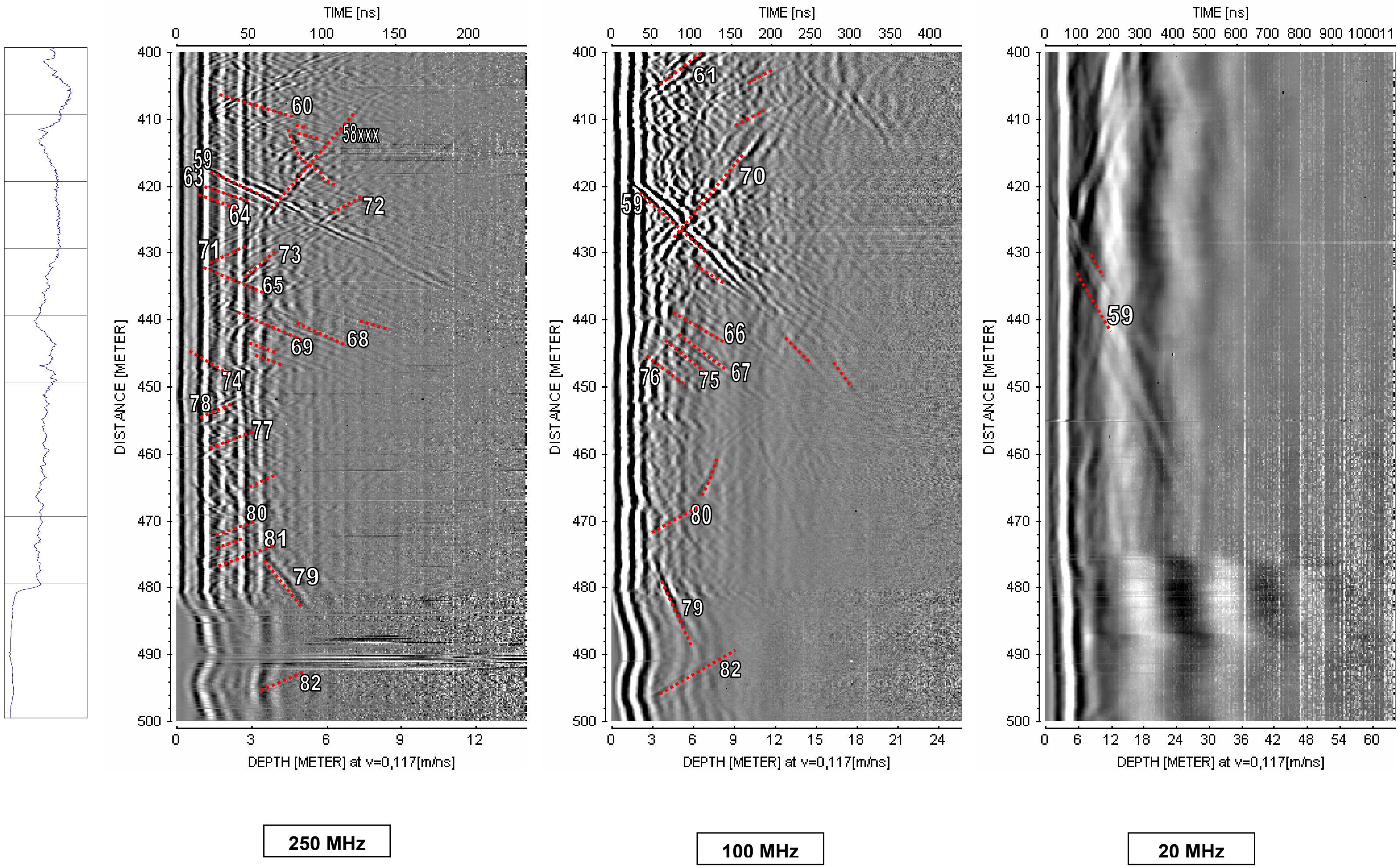


250 MHz

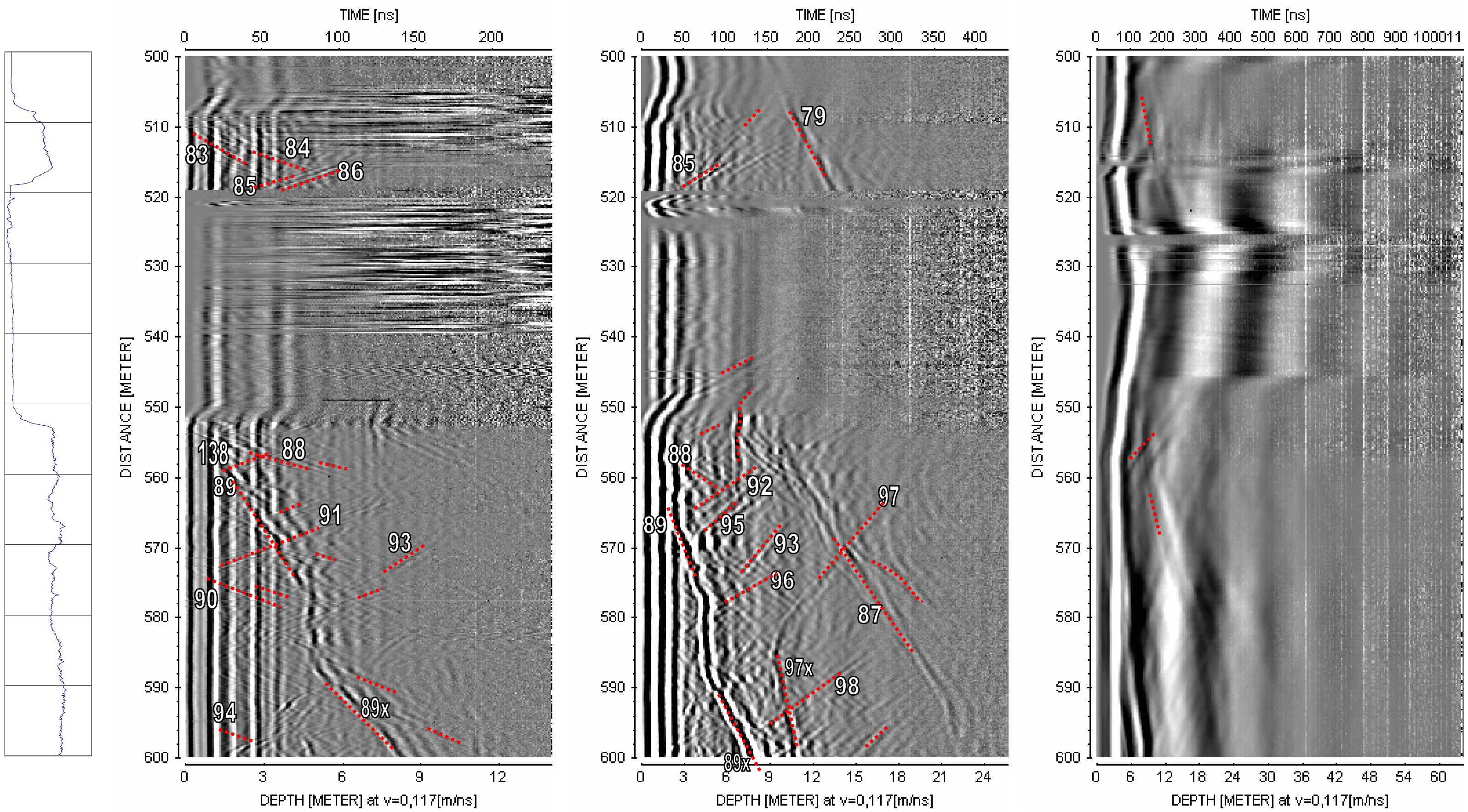
100 MHz

20 MHz

LAXEMAR KLX19A

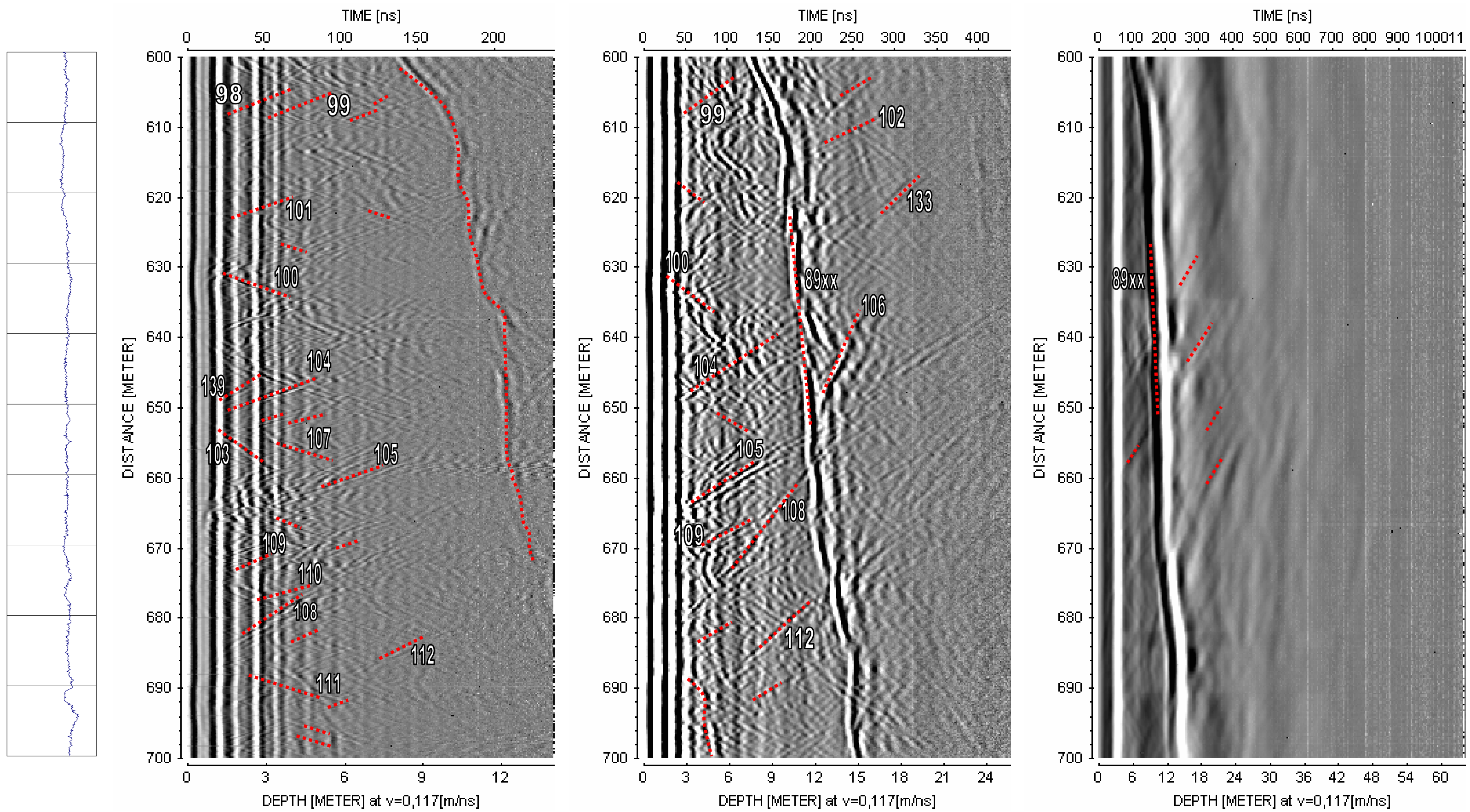


LAXEMAR KLX19A



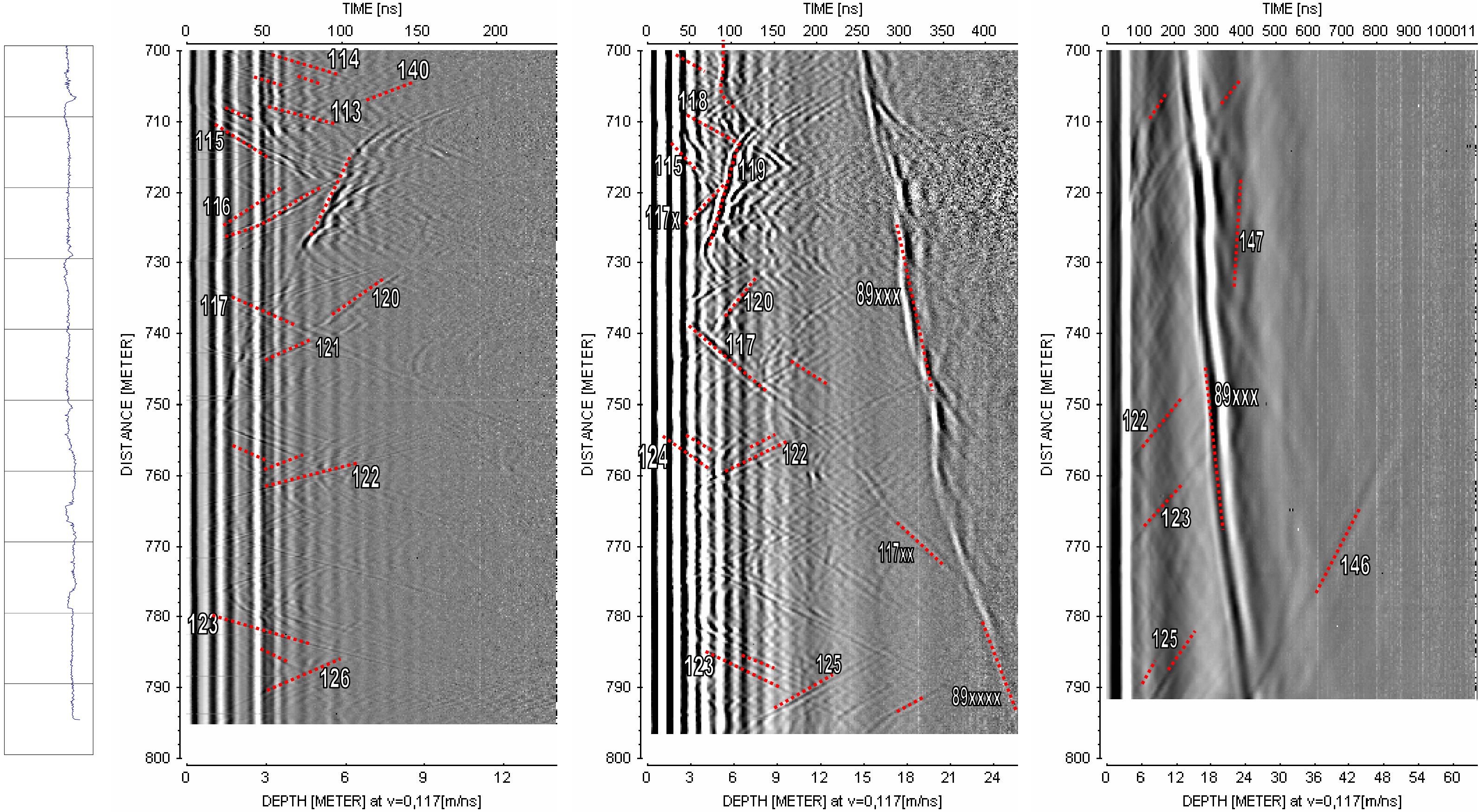
250 MHz **100 MHz** **20 MHz**

LAXEMAR KLX19A



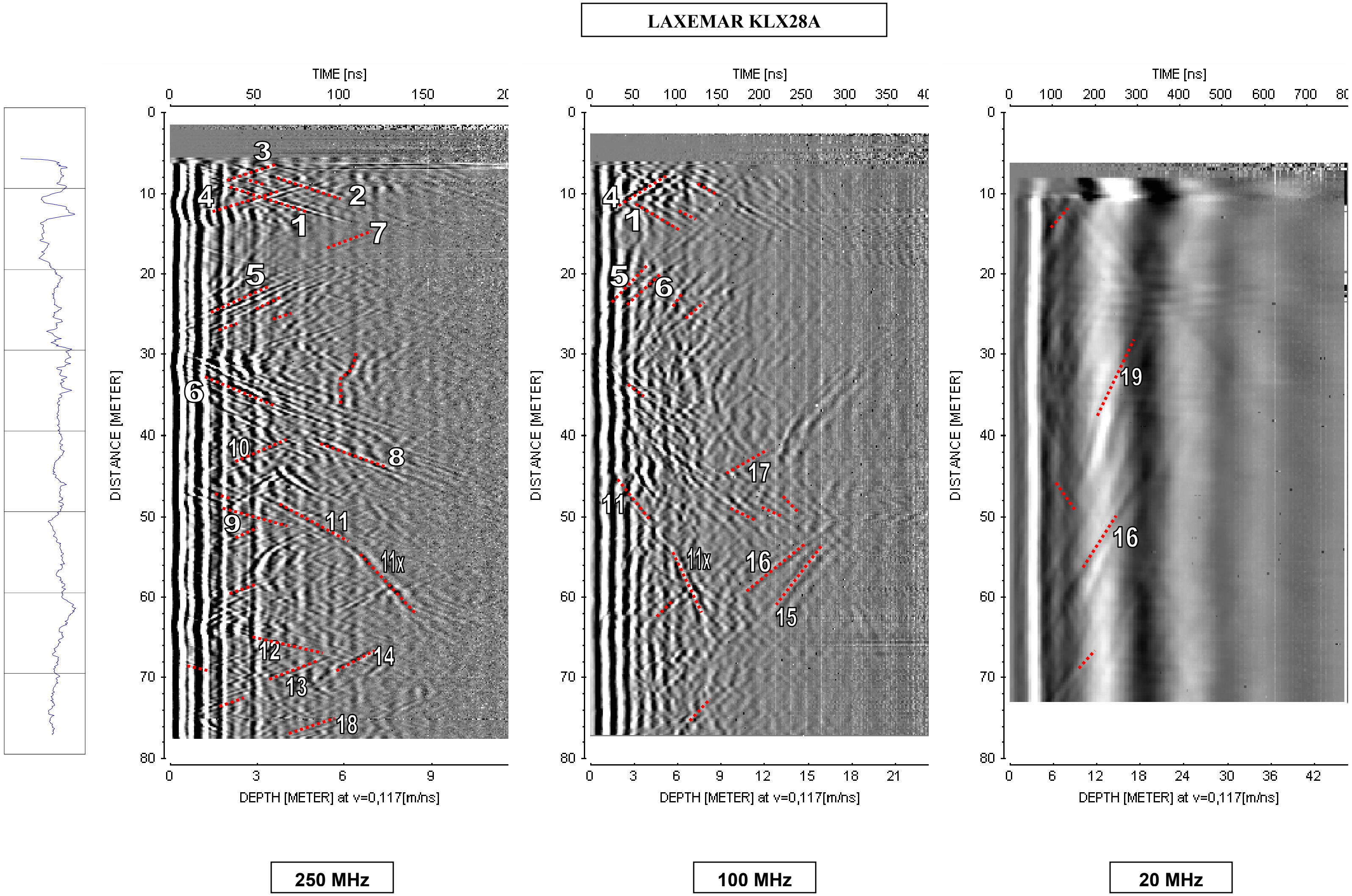
250 MHz **100 MHz** **20 MHz**

LAXEMAR KLX19A

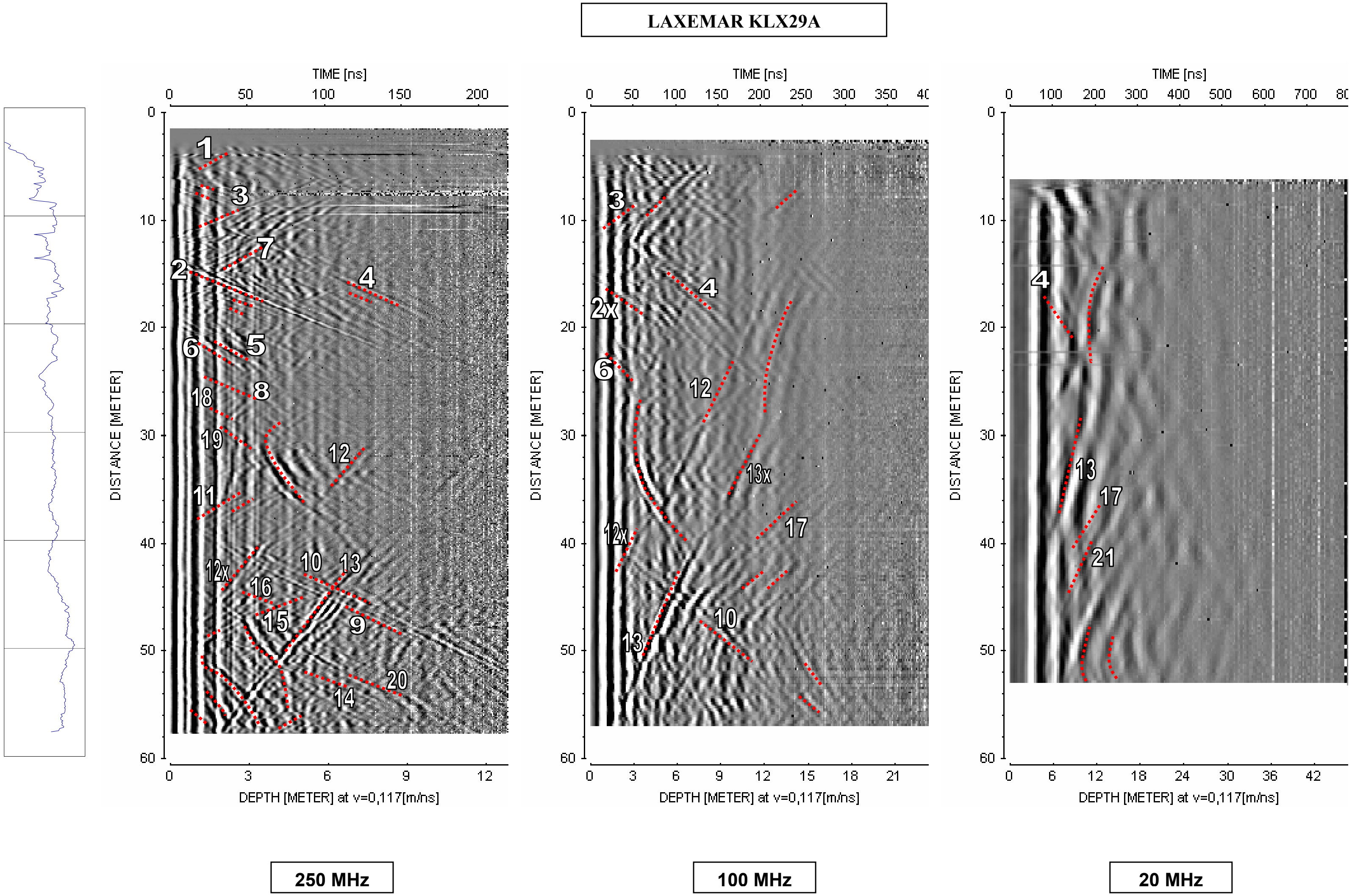


250 MHz **100 MHz** **20 MHz**

Radar logging in KLX28A 0 to 76 m, dipole antennas 250, 100 and 20 MHz



Radar logging in KLX29A, 0 to 56 m, dipole antennas 250, 100 and 20 MHz



BIPS logging in KLX19A, 100 to 795 m

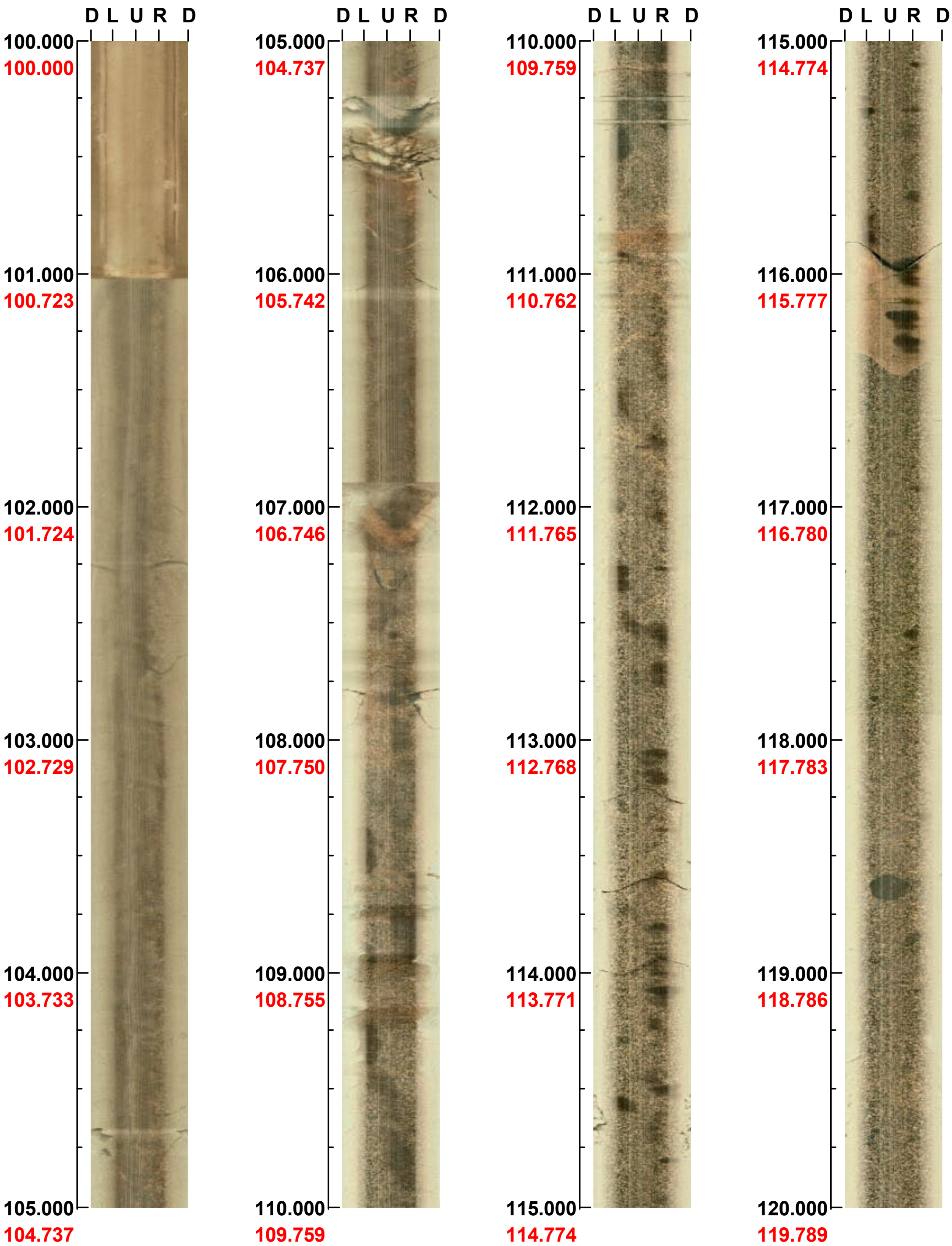
Project name: Laxemar

Image file	: c:\temp\klx19a_1.bip
BDT file	: c:\temp\klx19a_1.bdt
Locality	: LAXEMAR
Bore hole number	: KLX19A
Date	: 06/10/09
Time	: 16:05:00
Depth range	: 100.000 - 794.994 m
Azimuth	: 197
Inclination	: -58
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	: 29
Color	: +0 +0 +0

Project name: Laxemar

Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

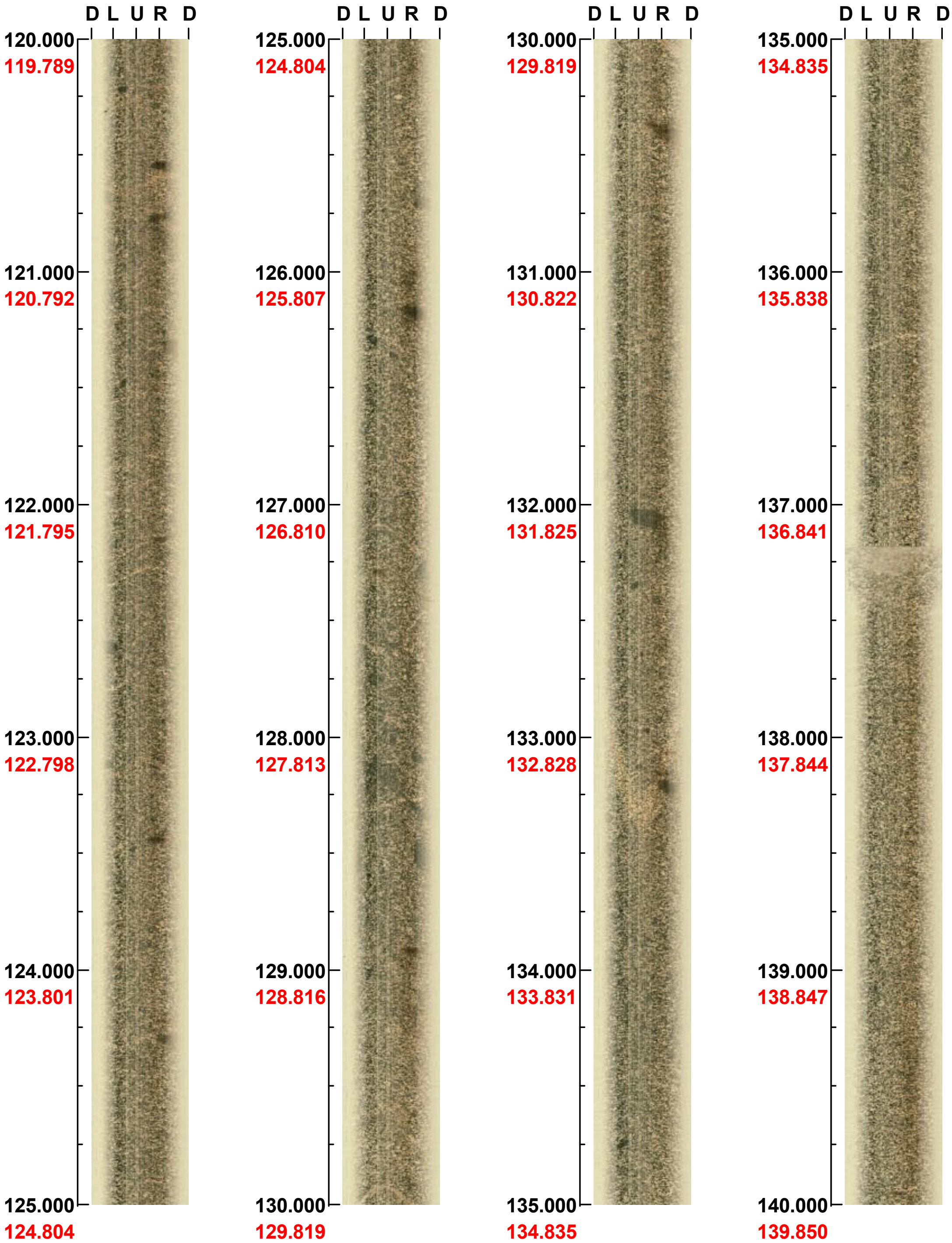
Depth range: 100.000 - 120.000 m



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

Project name: Laxemar
Bore hole No.: KLX19A Azimuth: 197 Inclination: -58

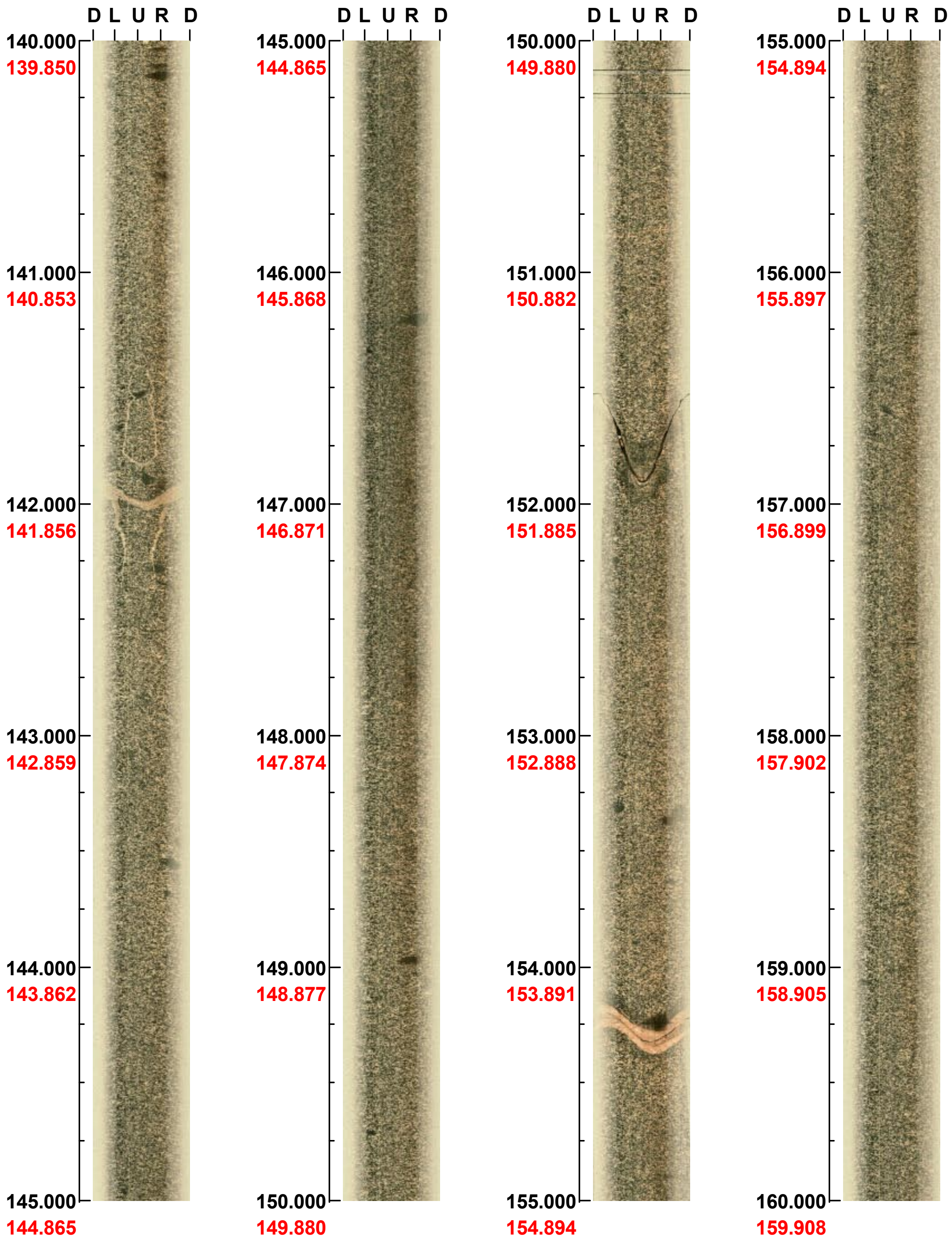
Depth range: 120.000 - 140.000 m



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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

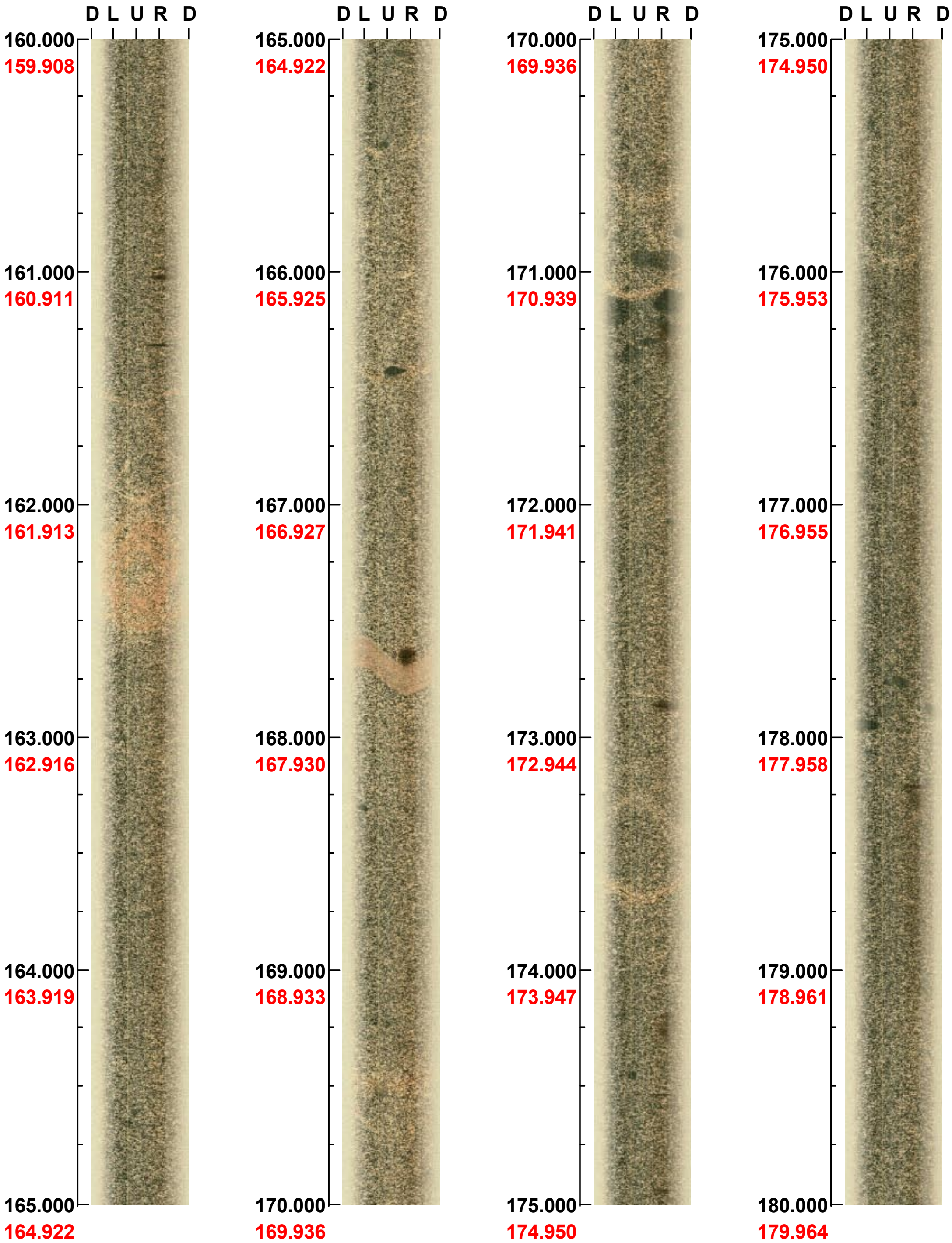
Depth range: 140.000 - 160.000 m



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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

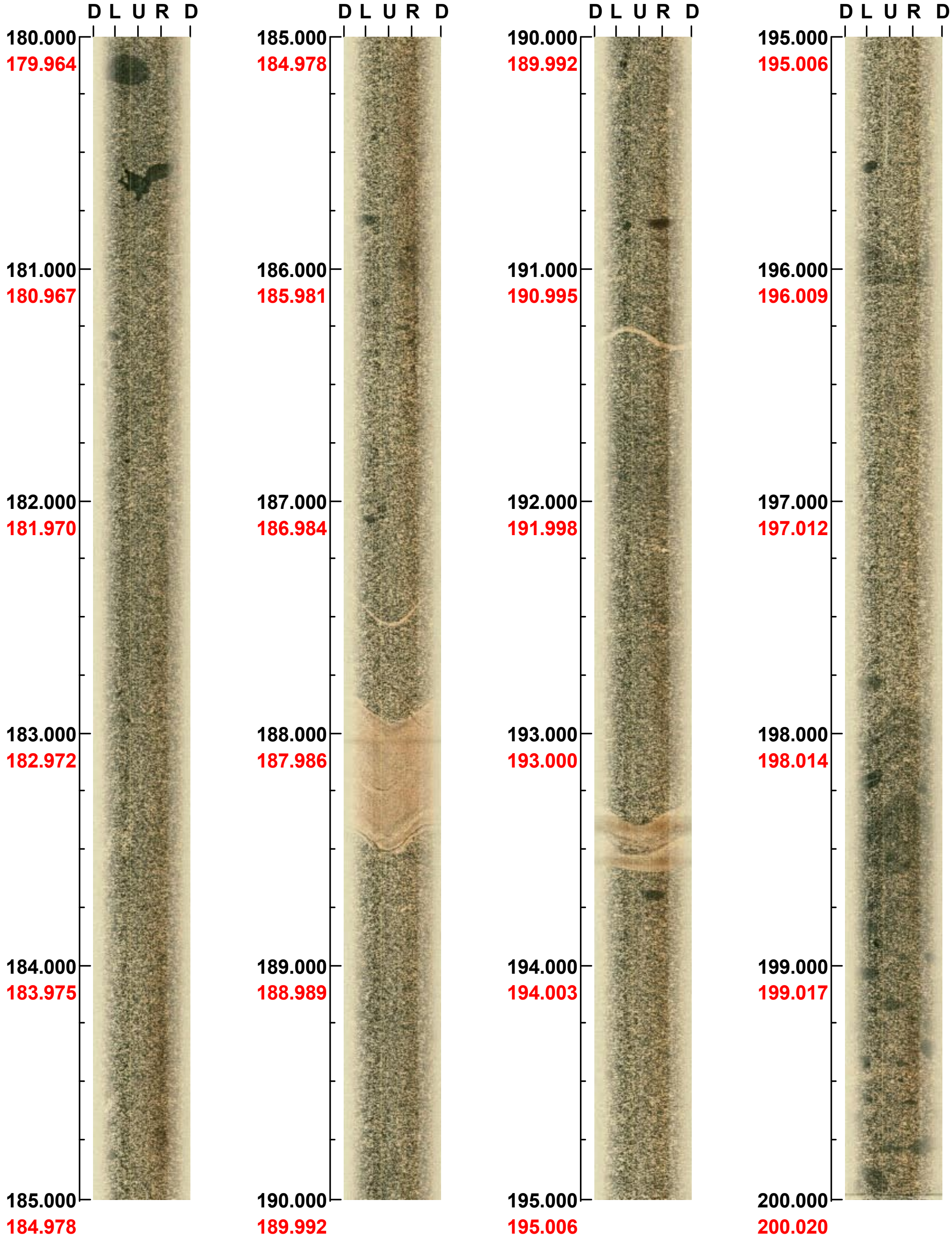
Depth range: 160.000 - 180.000 m



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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

Depth range: 180.000 - 200.000 m



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

Project name: Laxemar

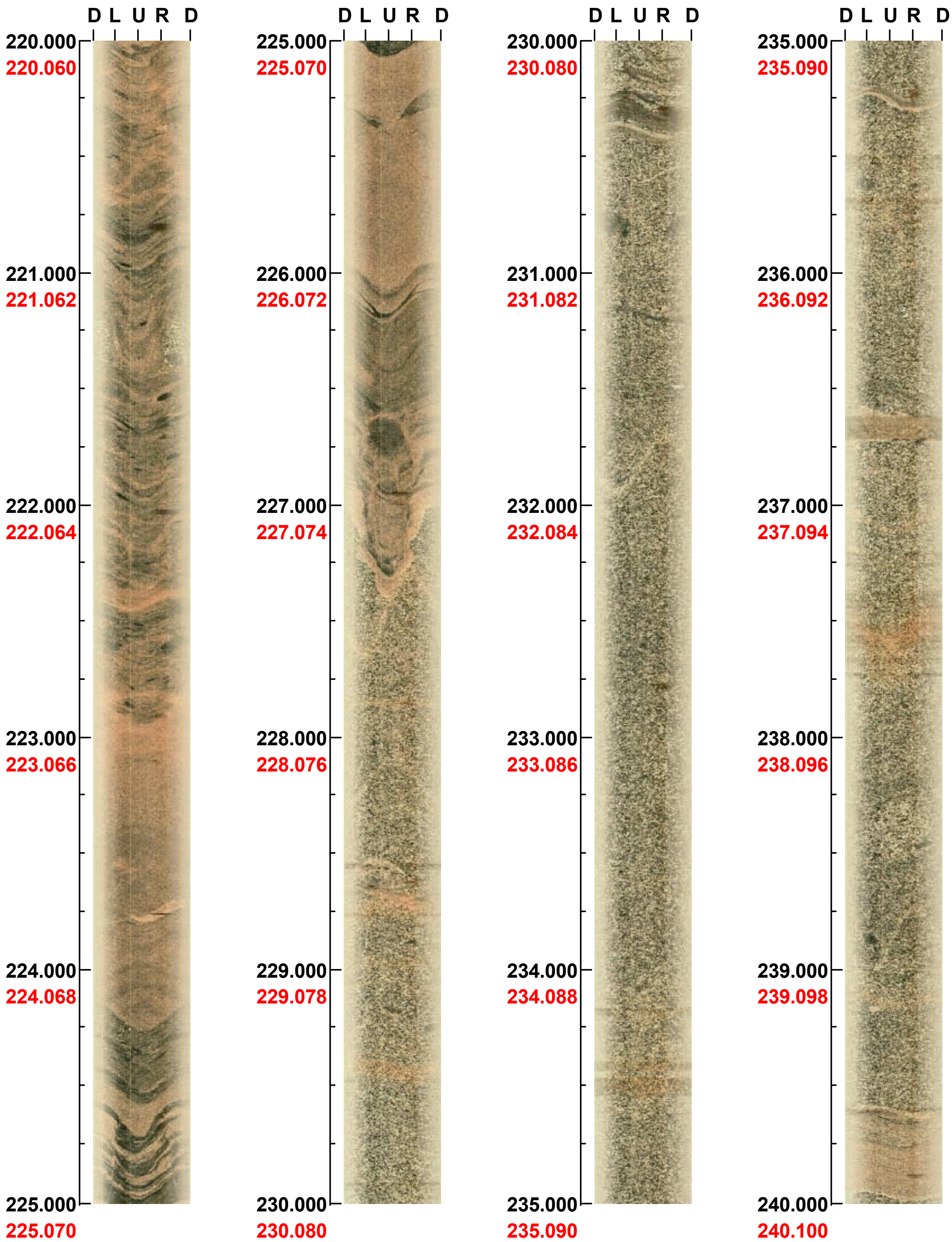
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

Depth range: 200.000 - 220.000 m

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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

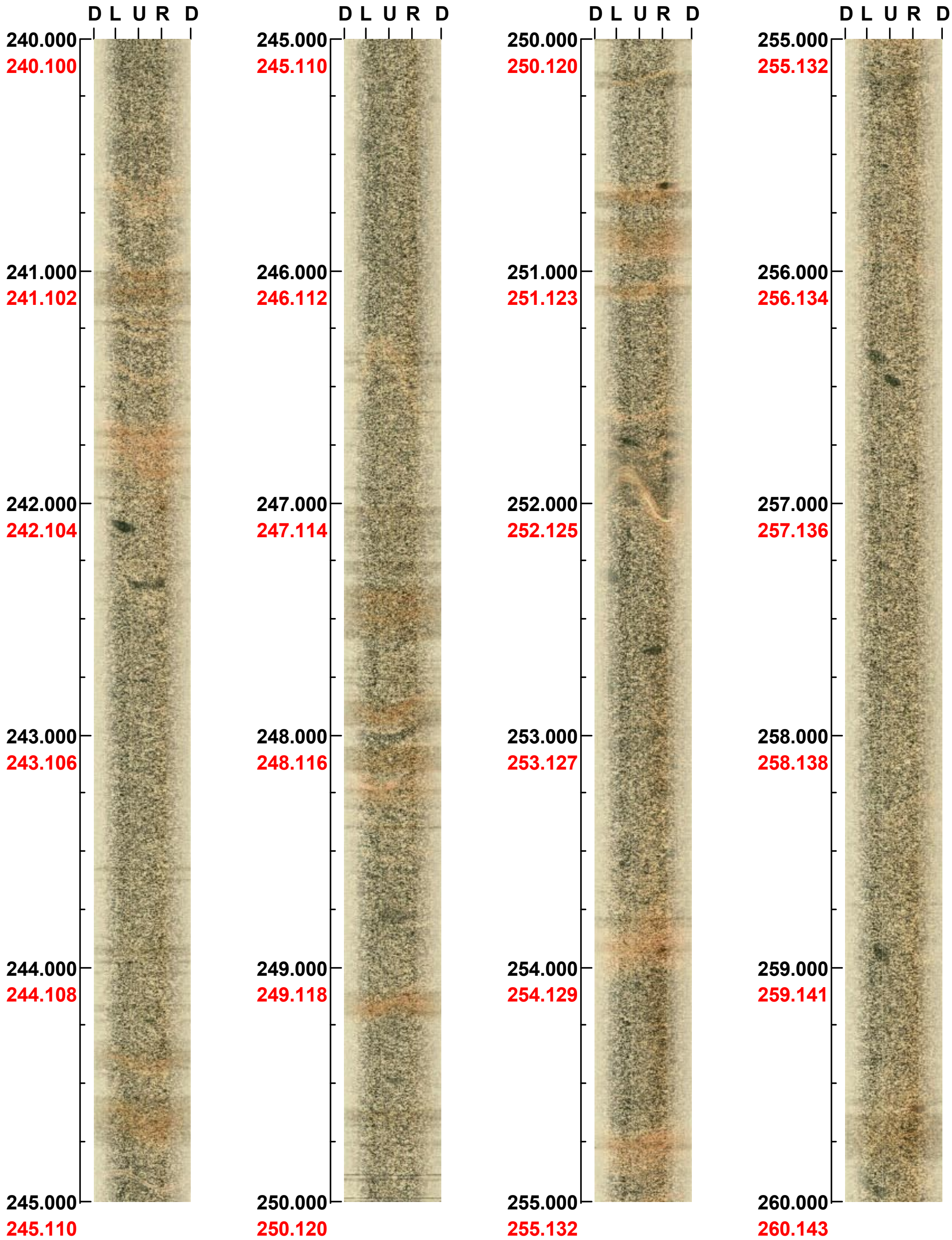
Depth range: 220.000 - 240.000 m



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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

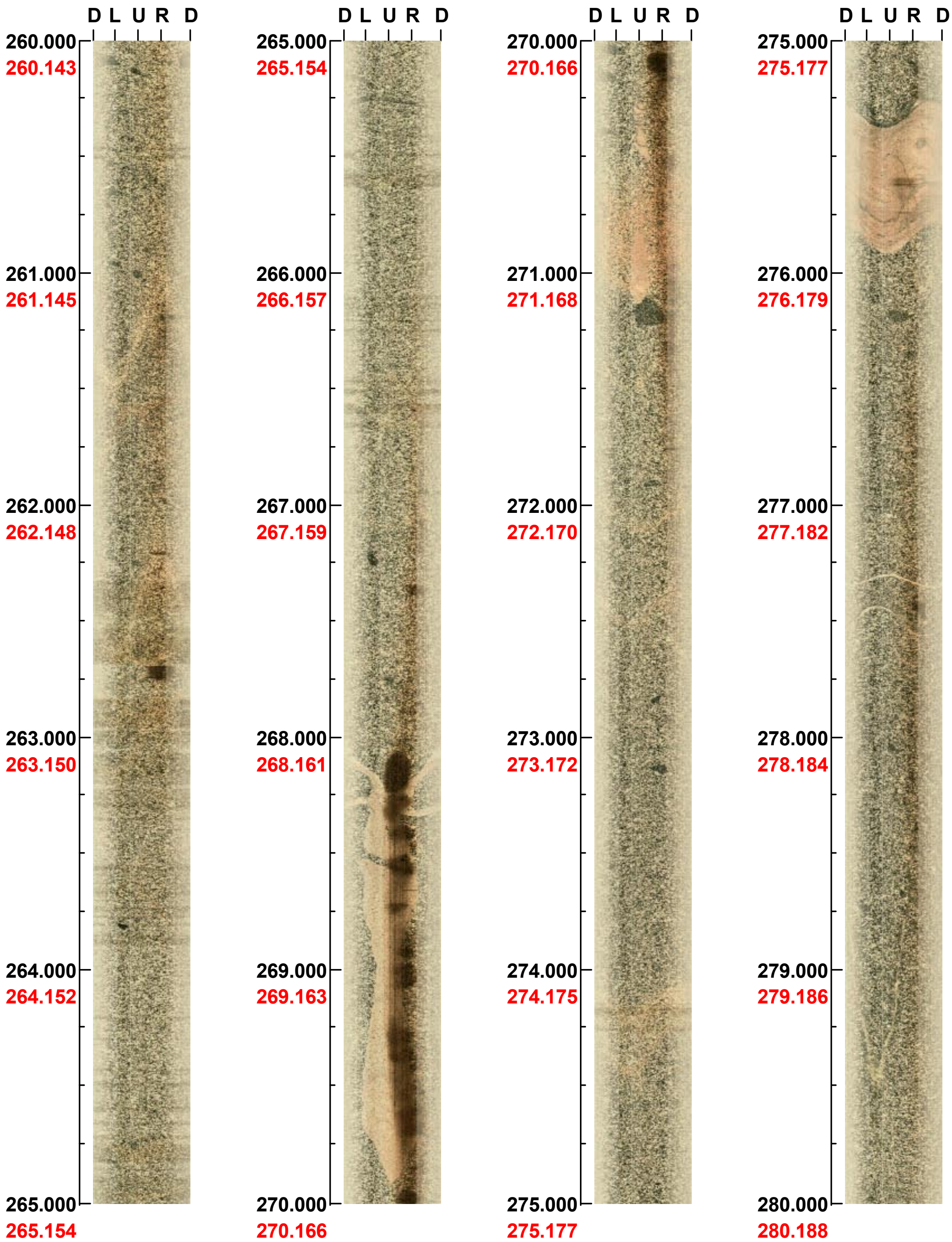
Depth range: 240.000 - 260.000 m



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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

Depth range: 260.000 - 280.000 m

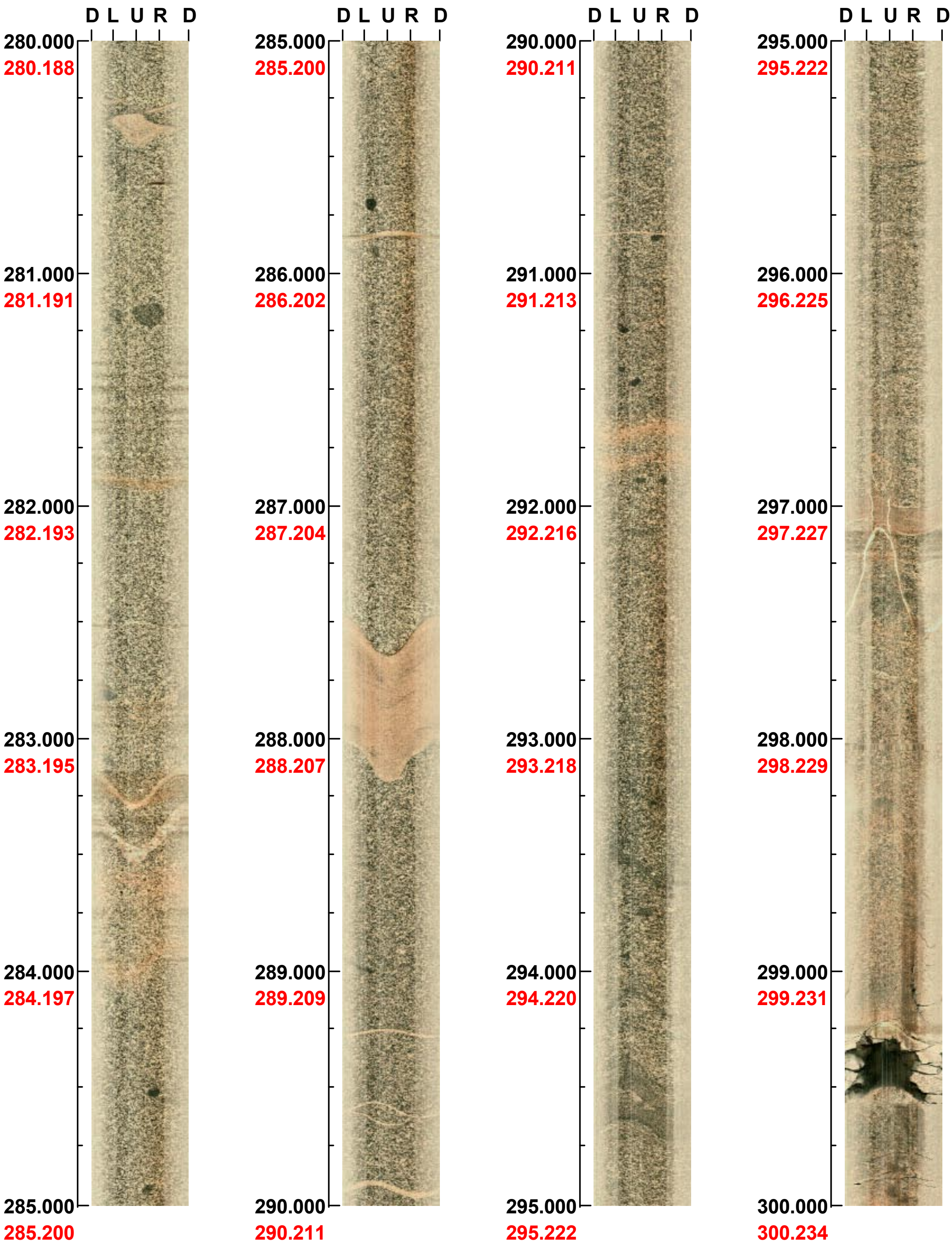


(9 / 29) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar

Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

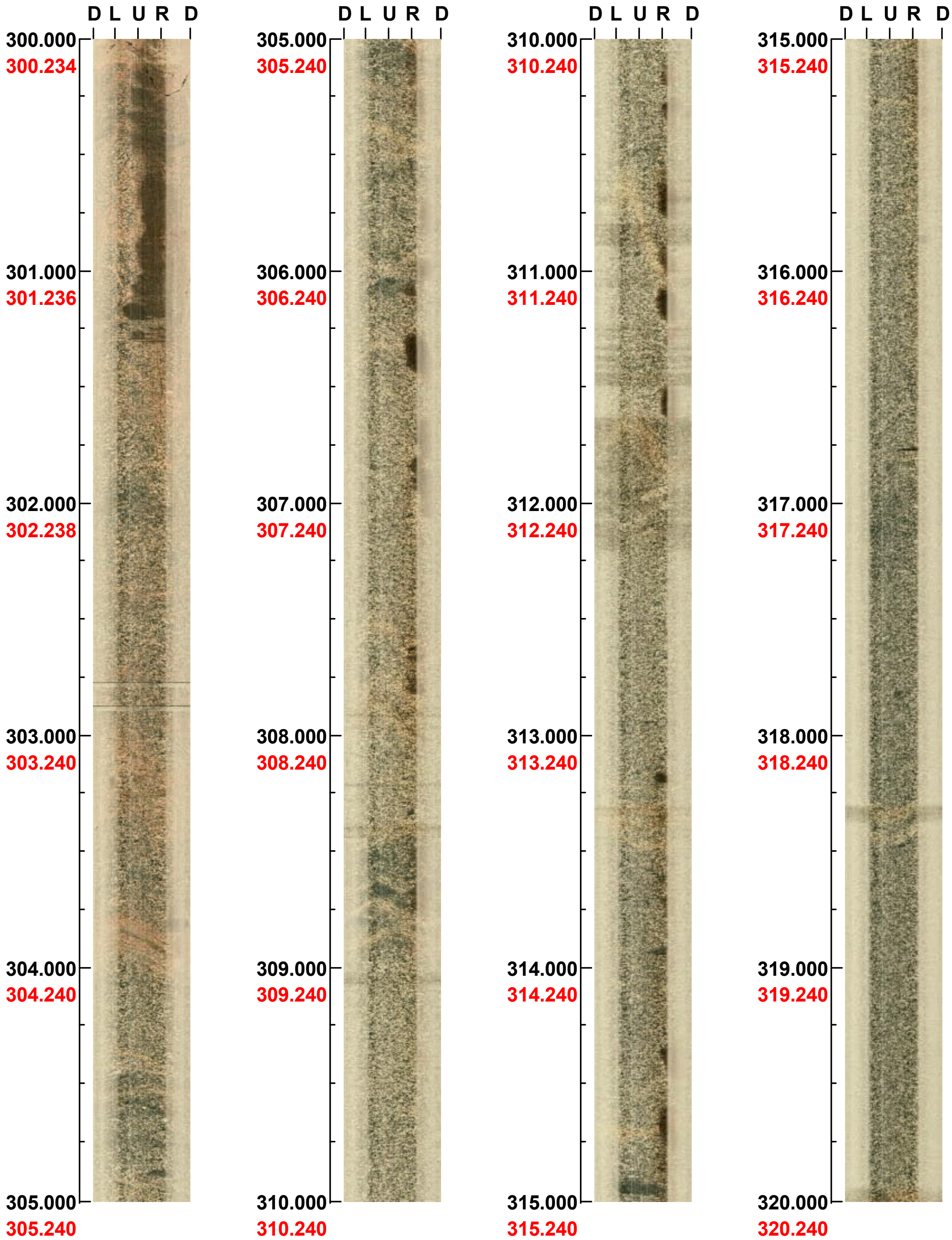
Depth range: 280.000 - 300.000 m



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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

Depth range: 300.000 - 320.000 m



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

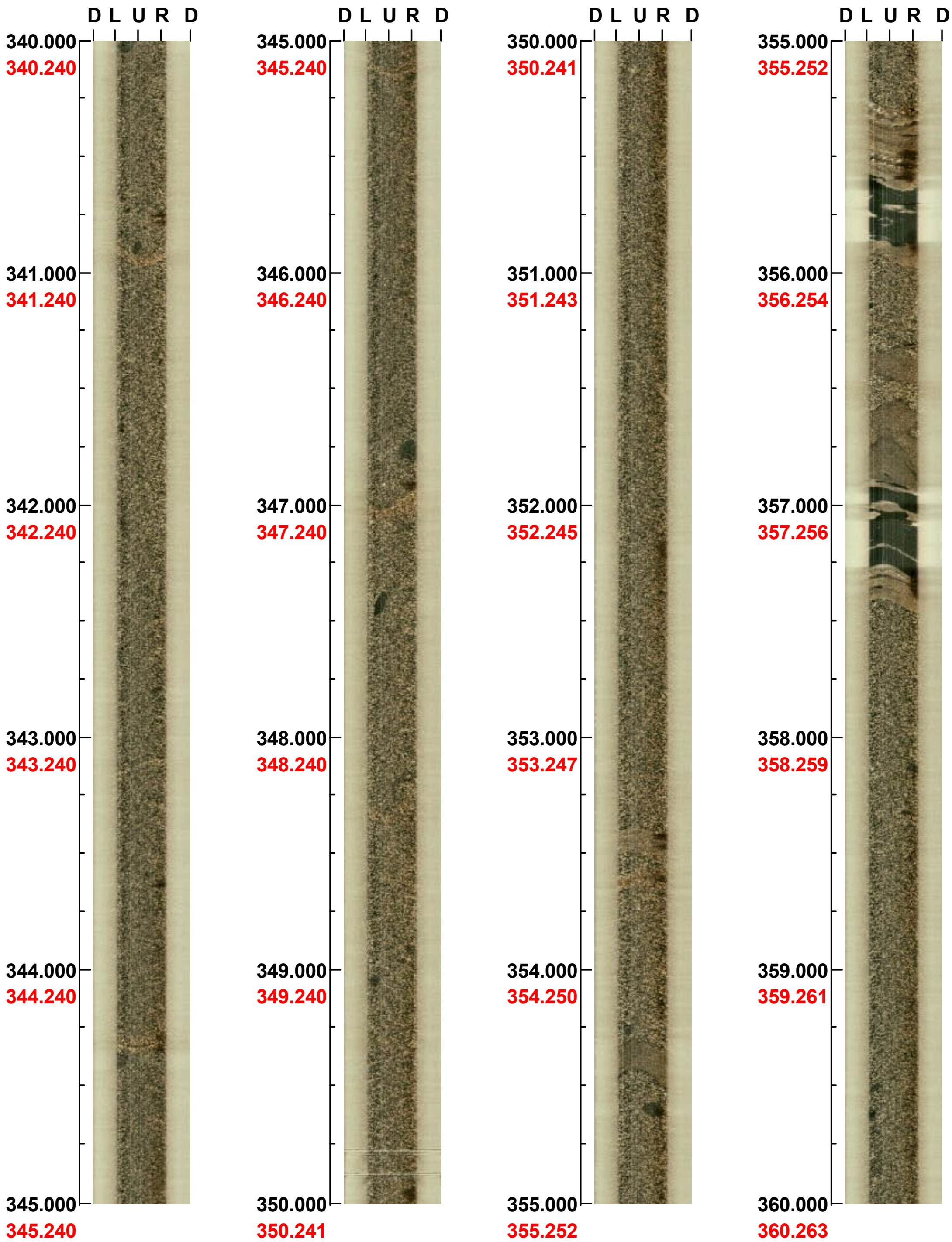
Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

Depth range: 320.000 - 340.000 m

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

Project name: Laxemar
Bore hole No.: KLX19A　　　　Azimuth: 197　　Inclination: -58

Depth range: 340.000 - 360.000 m

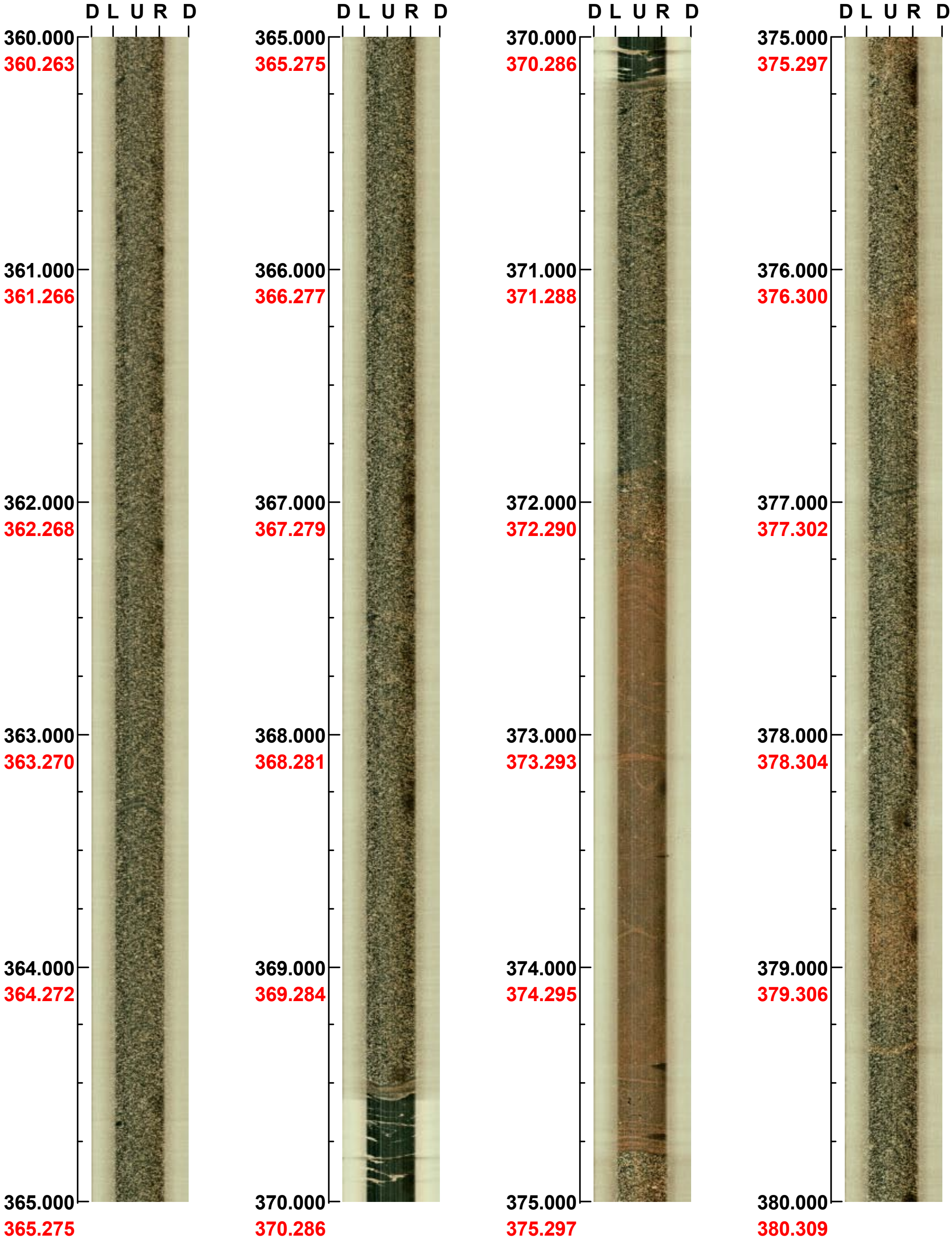


(13 / 29)　Scale: 1/25　Aspect ratio: 175 %

Project name: Laxemar

Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

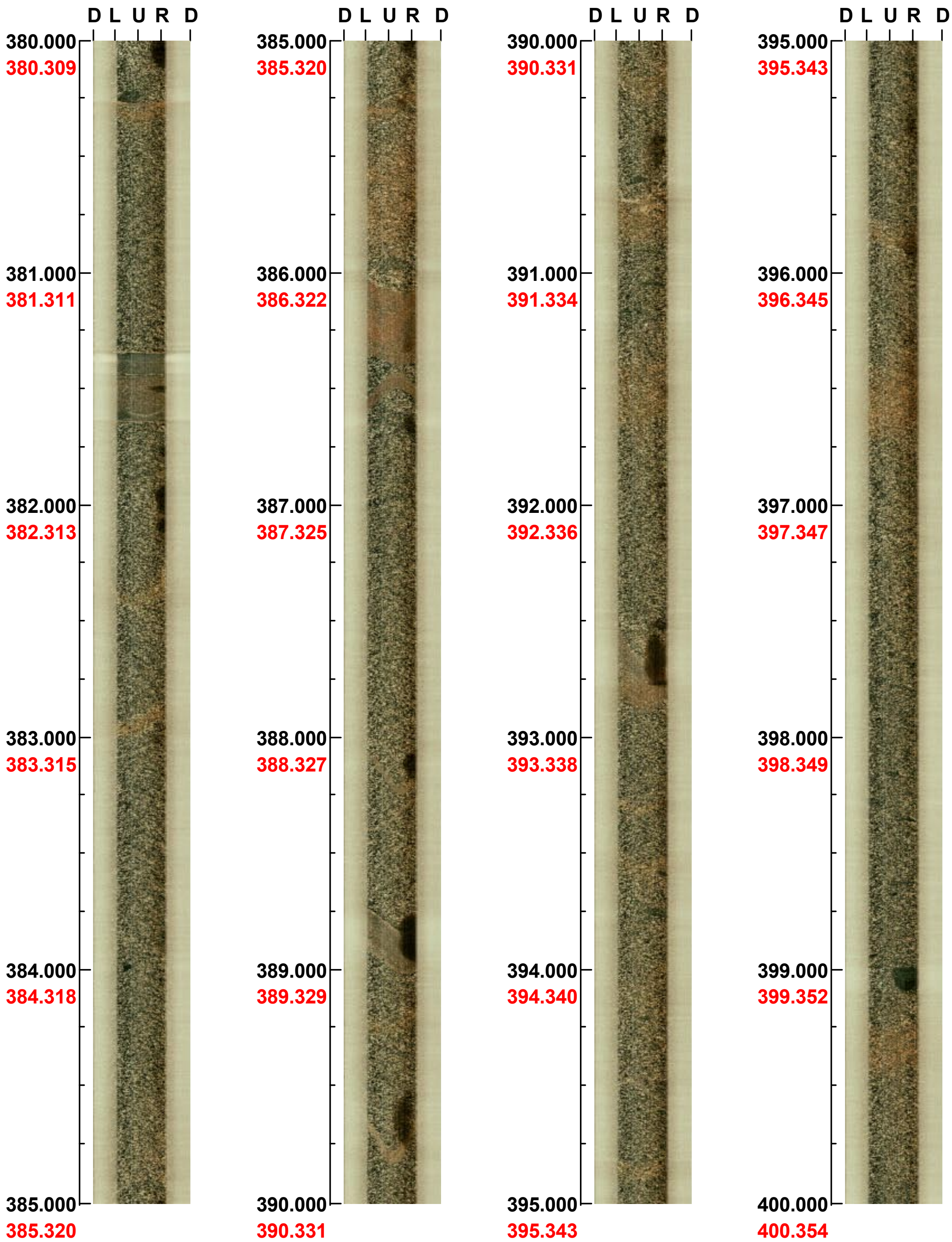
Depth range: 360.000 - 380.000 m



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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

Depth range: 380.000 - 400.000 m



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

Project name: Laxemar
Bore hole No.: KLX19A

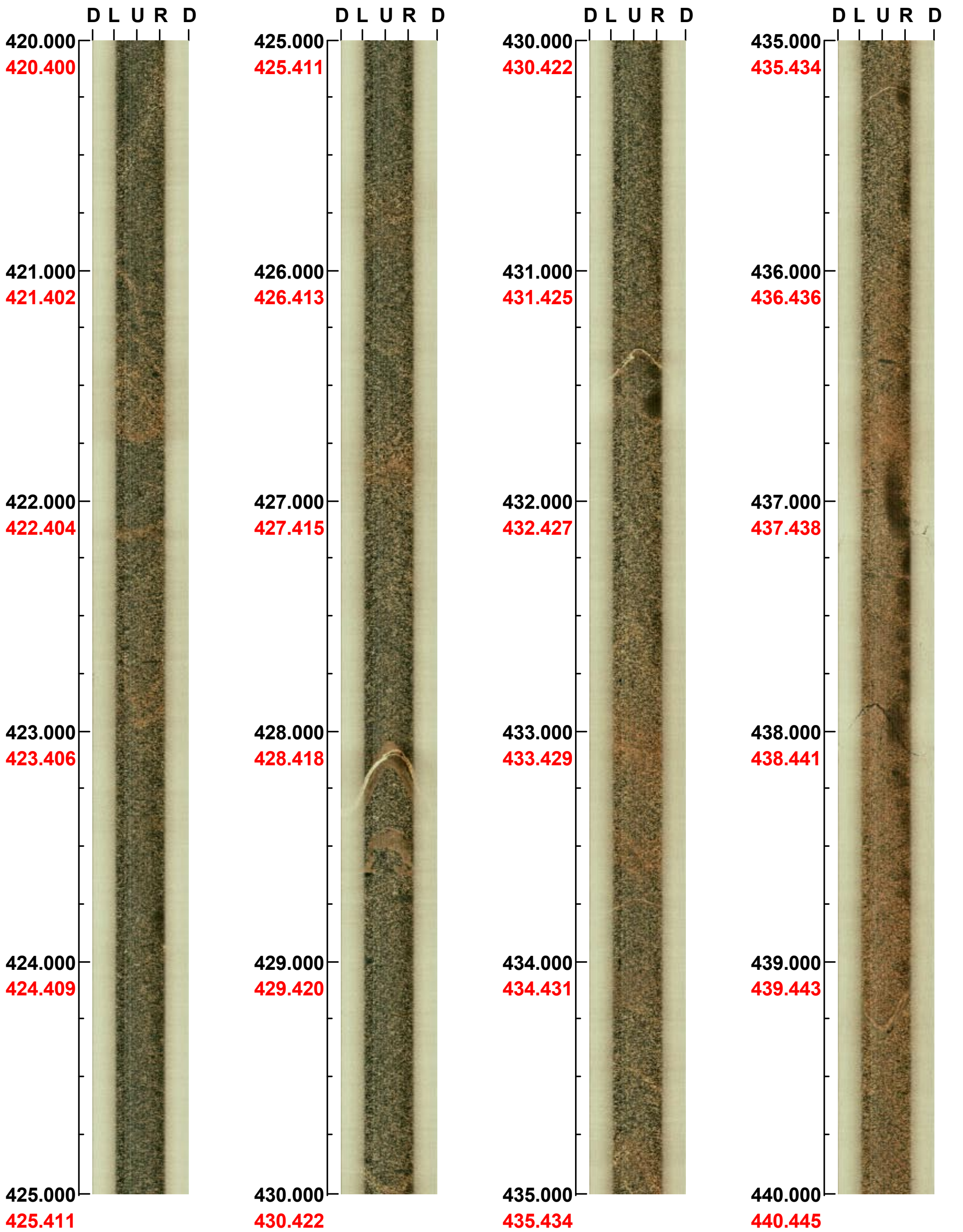
Azimuth: 197 Inclination: -58

Depth range: 400.000 - 420.000 m

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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

Depth range: 420.000 - 440.000 m



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

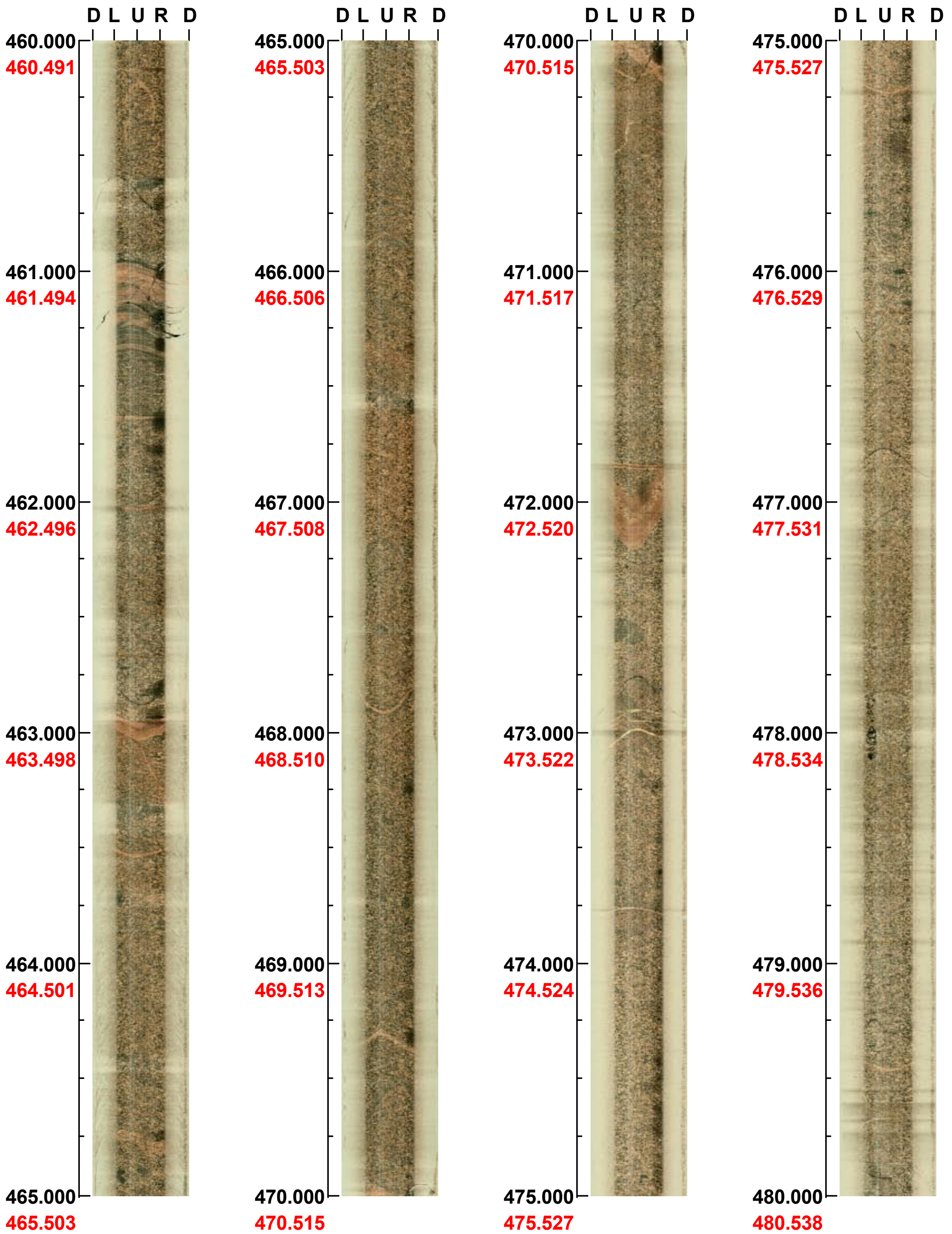
Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

Depth range: 440.000 - 460.000 m

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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

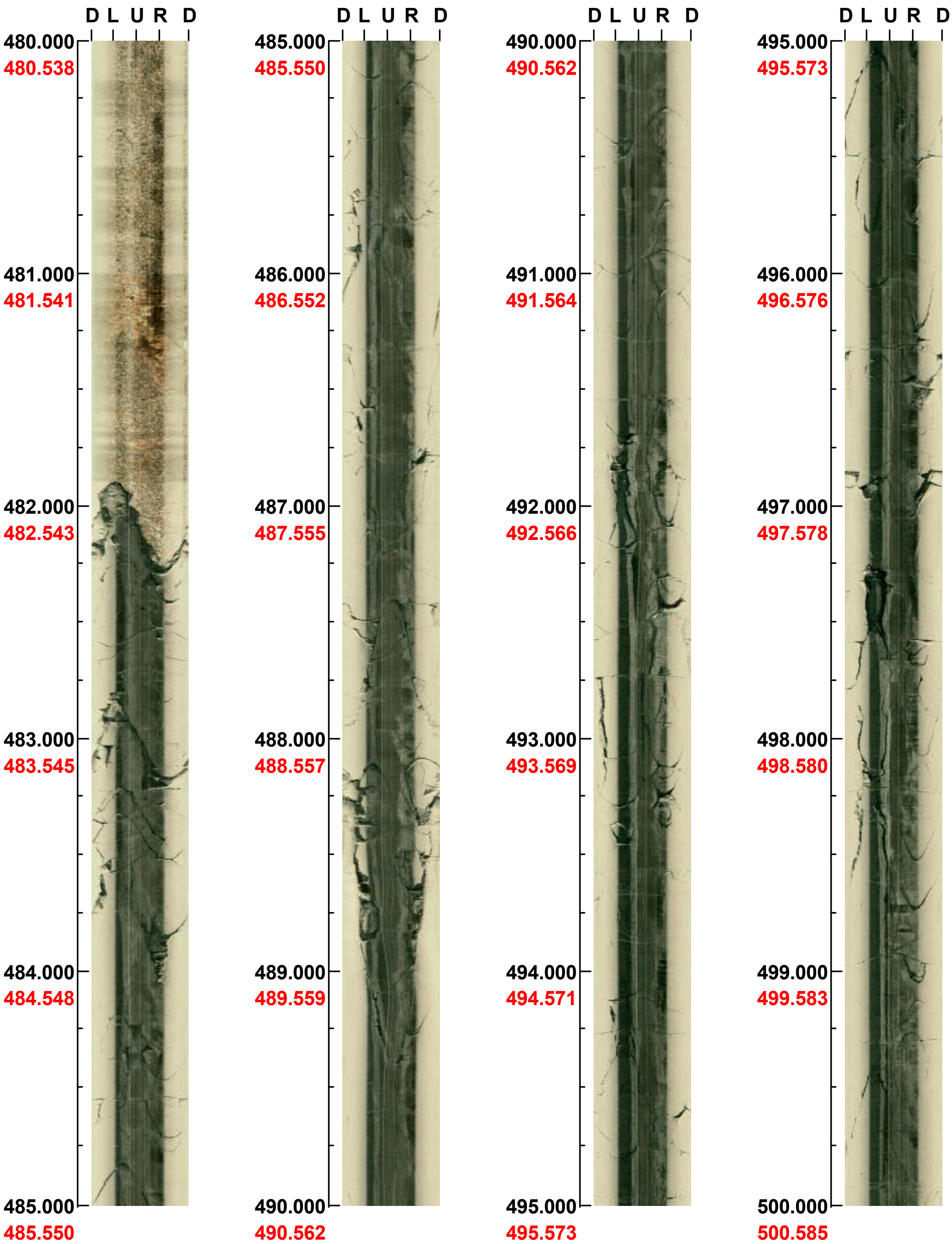
Depth range: 460.000 - 480.000 m



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

Project name: Laxemar
Bore hole No.: KLX19A | Azimuth: 197 | Inclination: -58

Depth range: 480.000 - 500.000 m

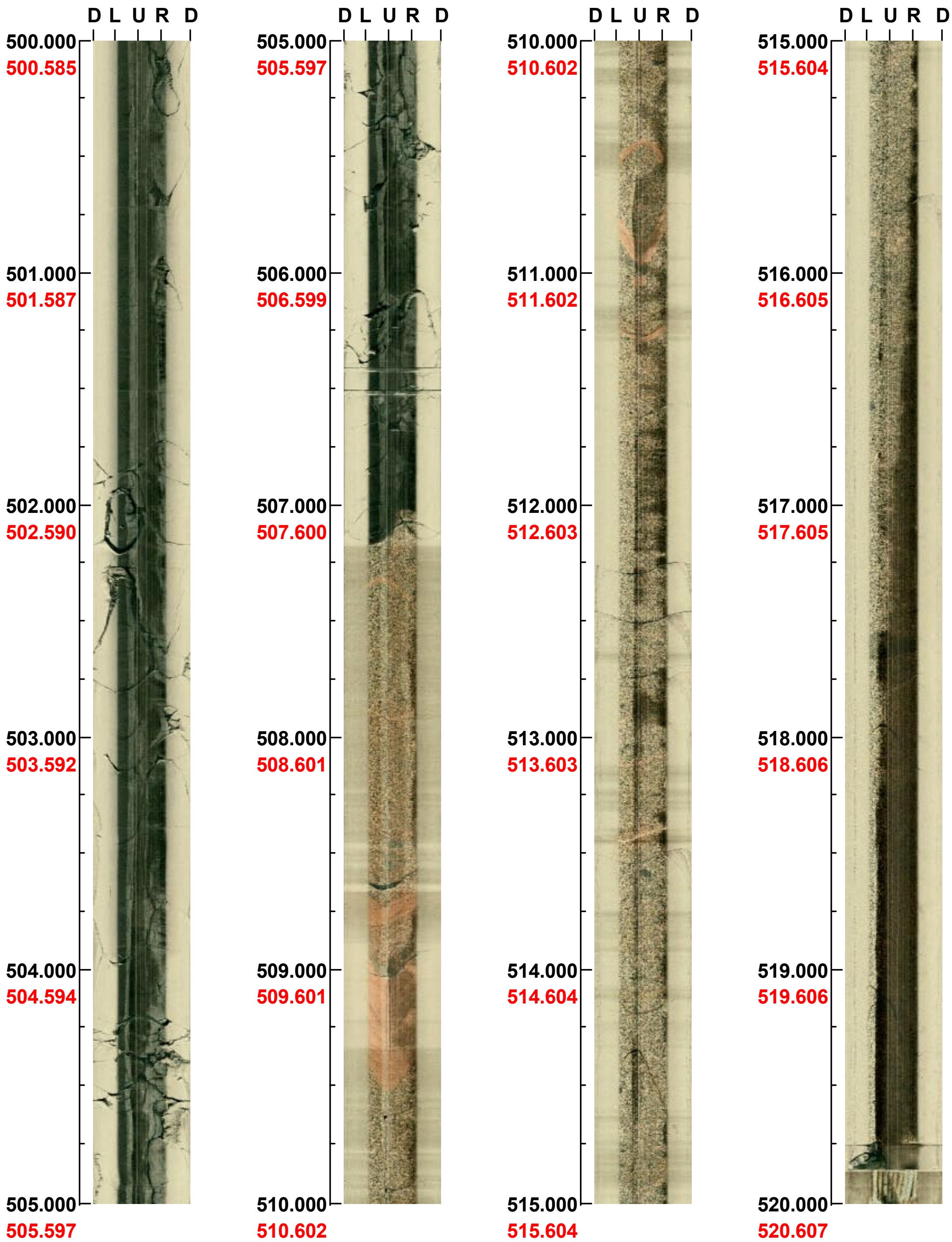


(20 / 29) Scale: 1/25 Aspect ratio: 175 %

Project name: Laxemar

Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

Depth range: 500.000 - 520.000 m

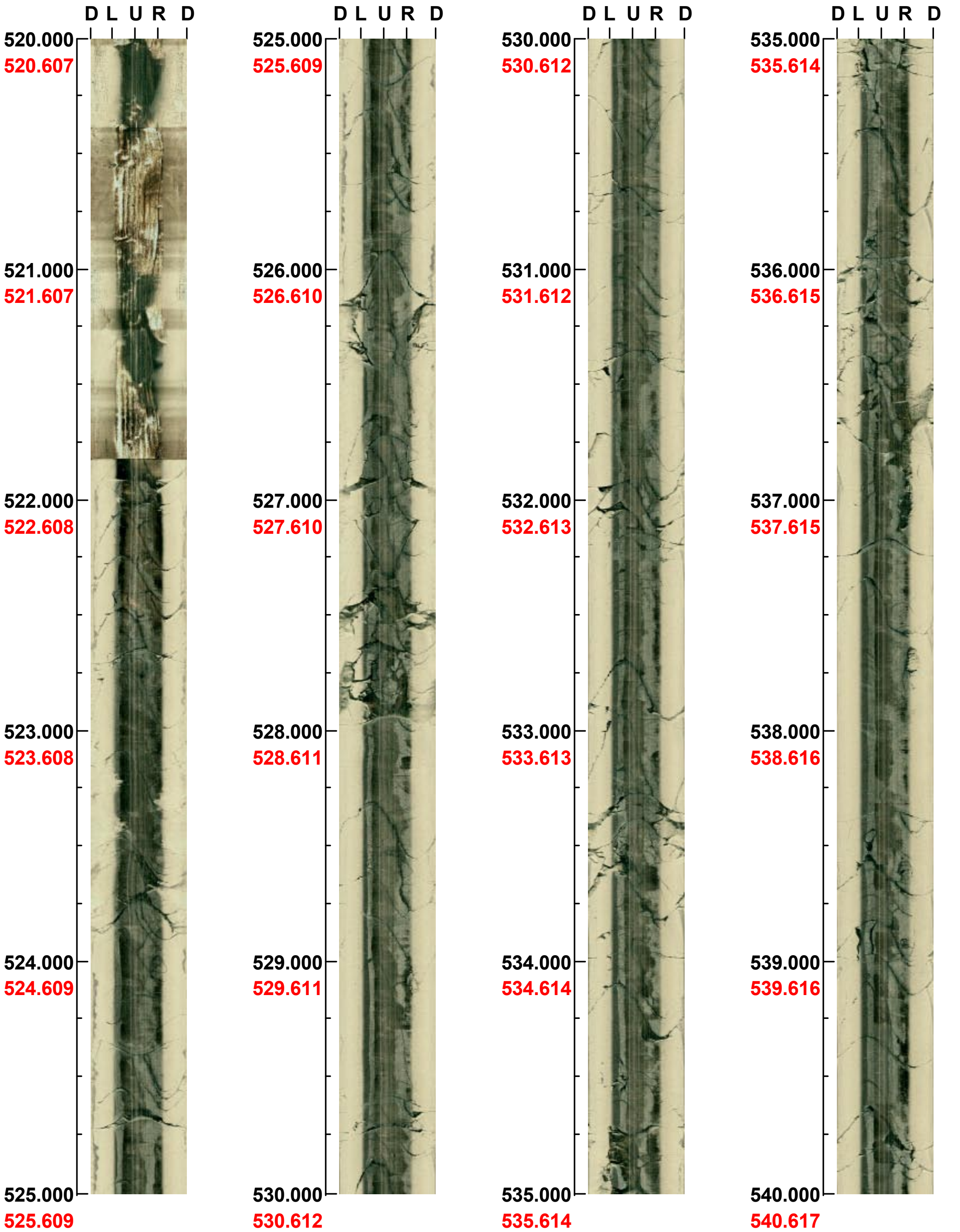


(21 / 29) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar

Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

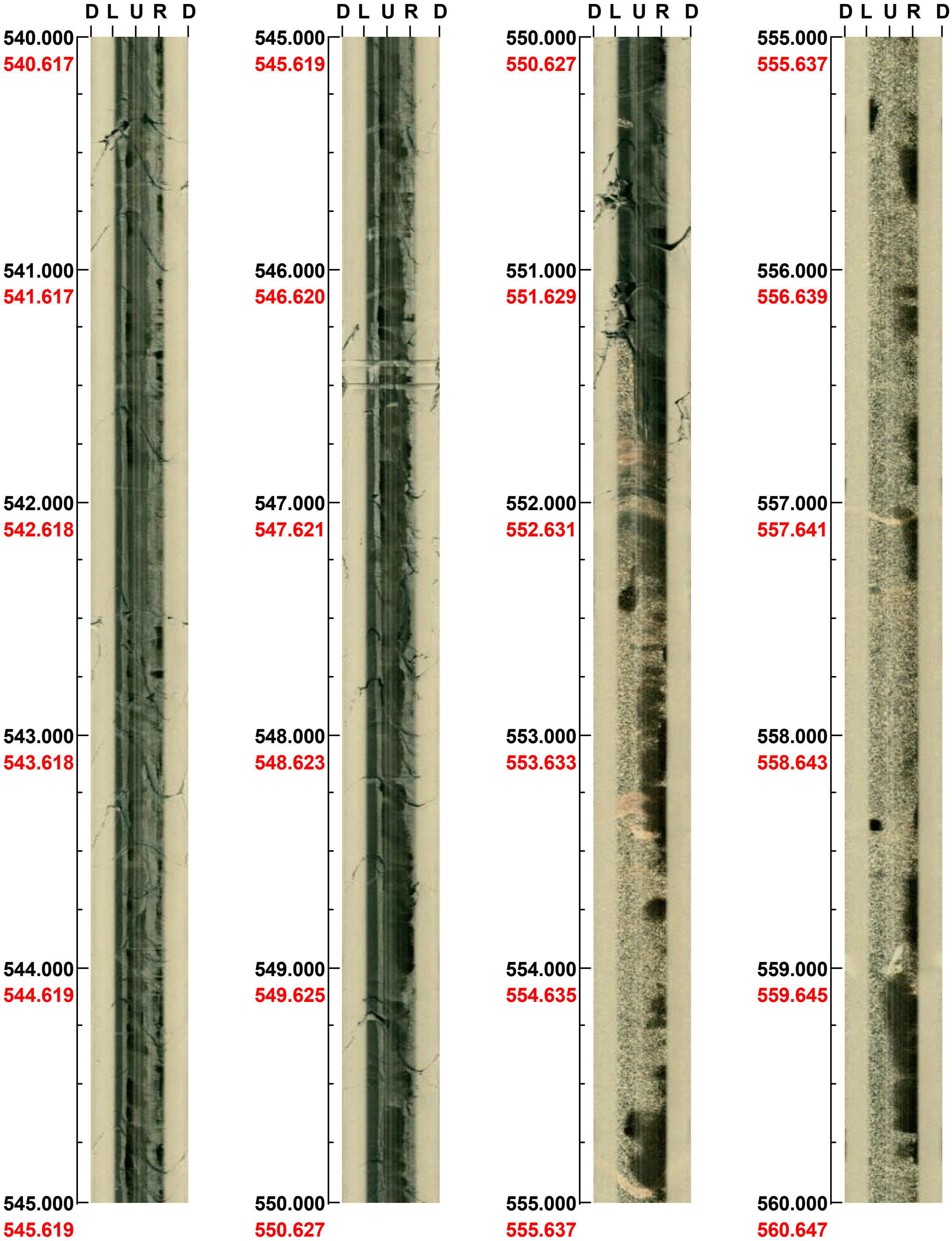
Depth range: 520.000 - 540.000 m



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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

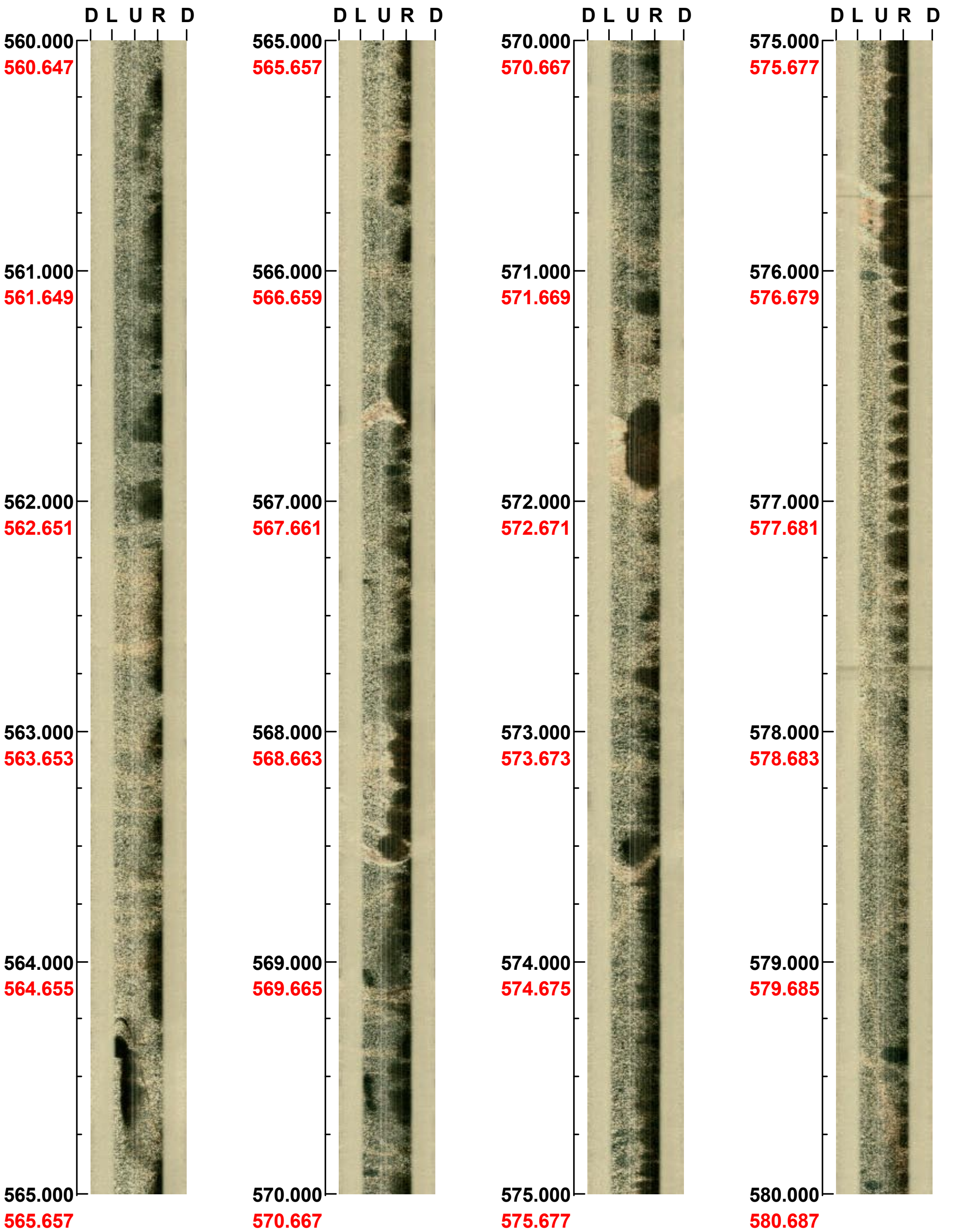
Depth range: 540.000 - 560.000 m



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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

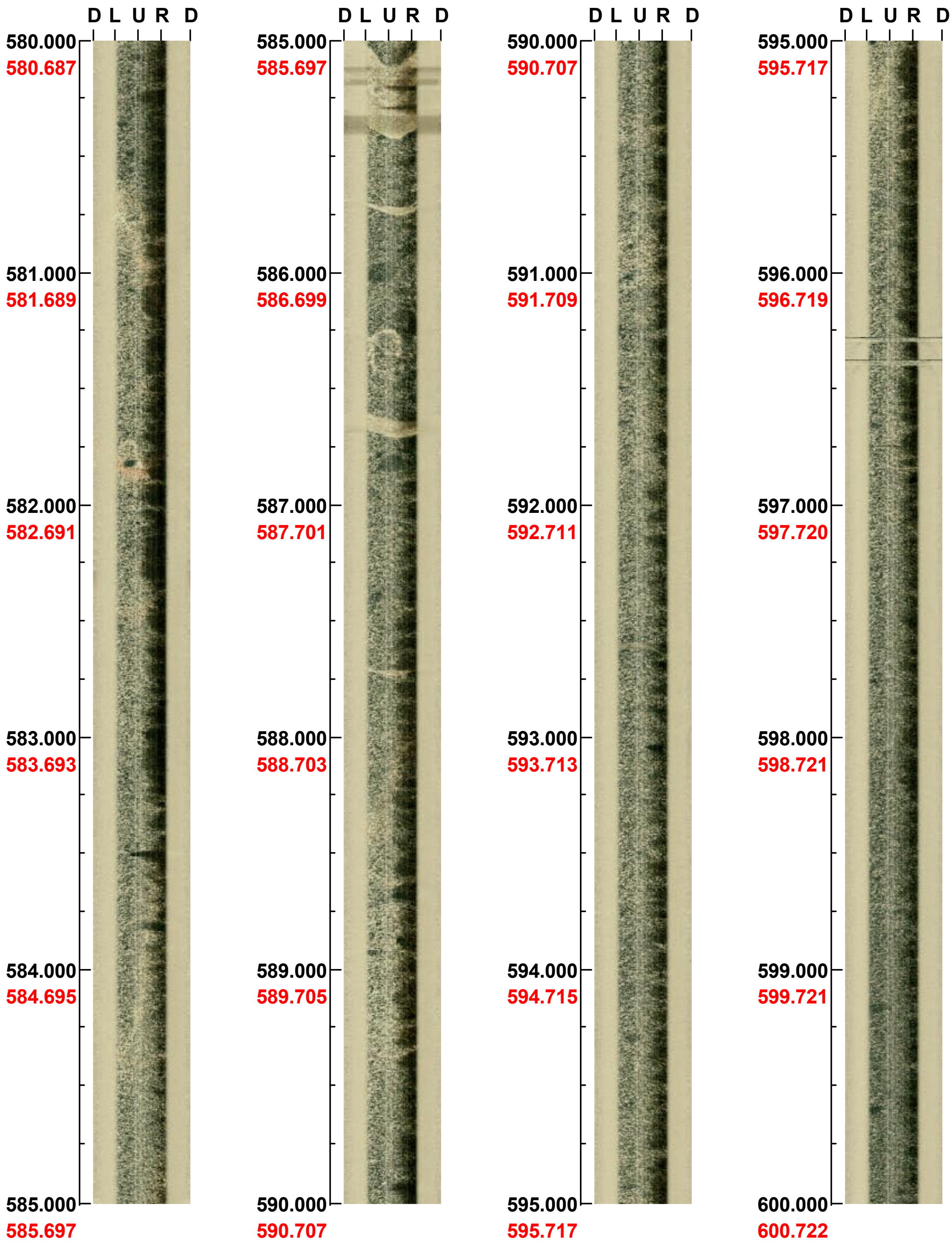
Depth range: 560.000 - 580.000 m



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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

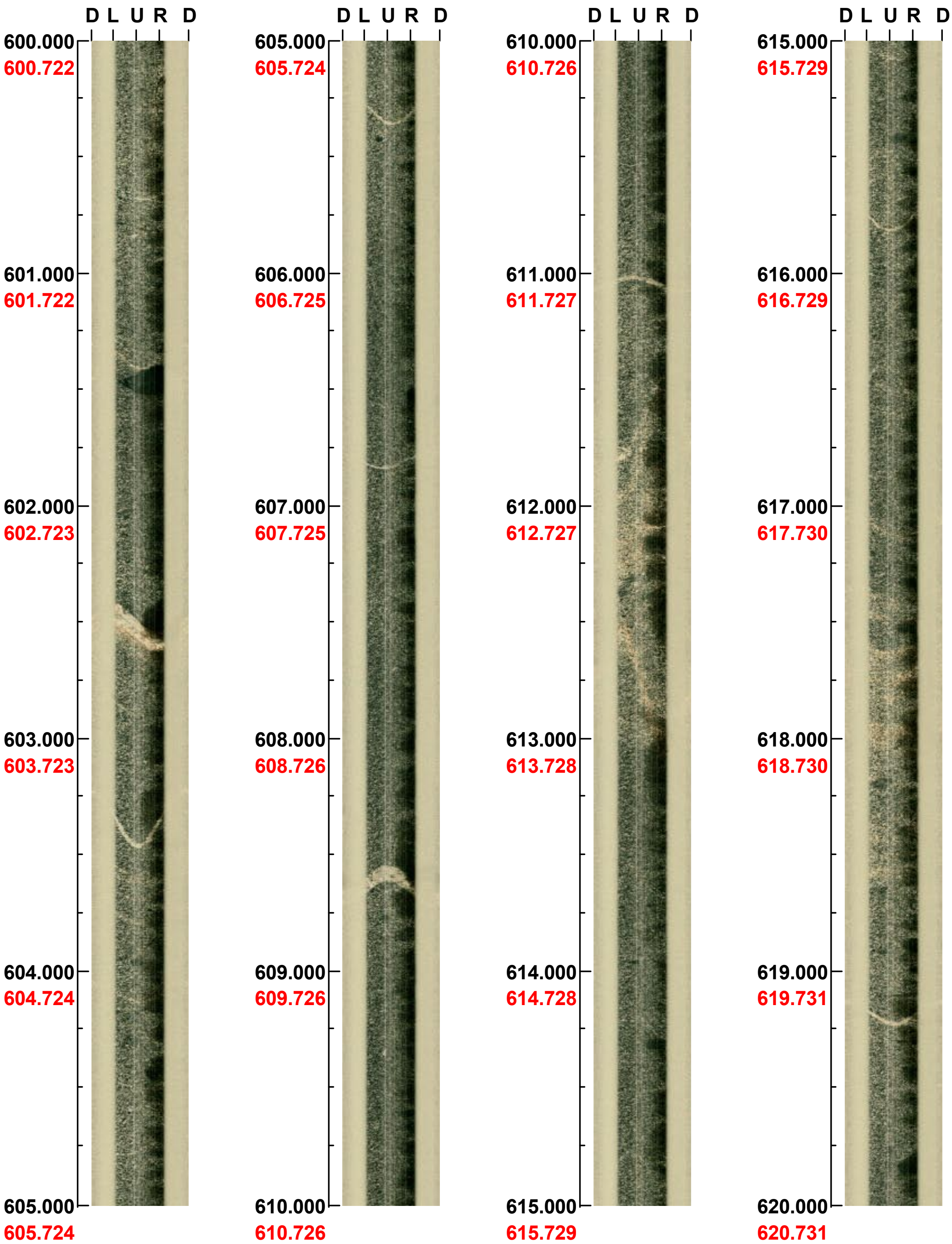
Depth range: 580.000 - 600.000 m



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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

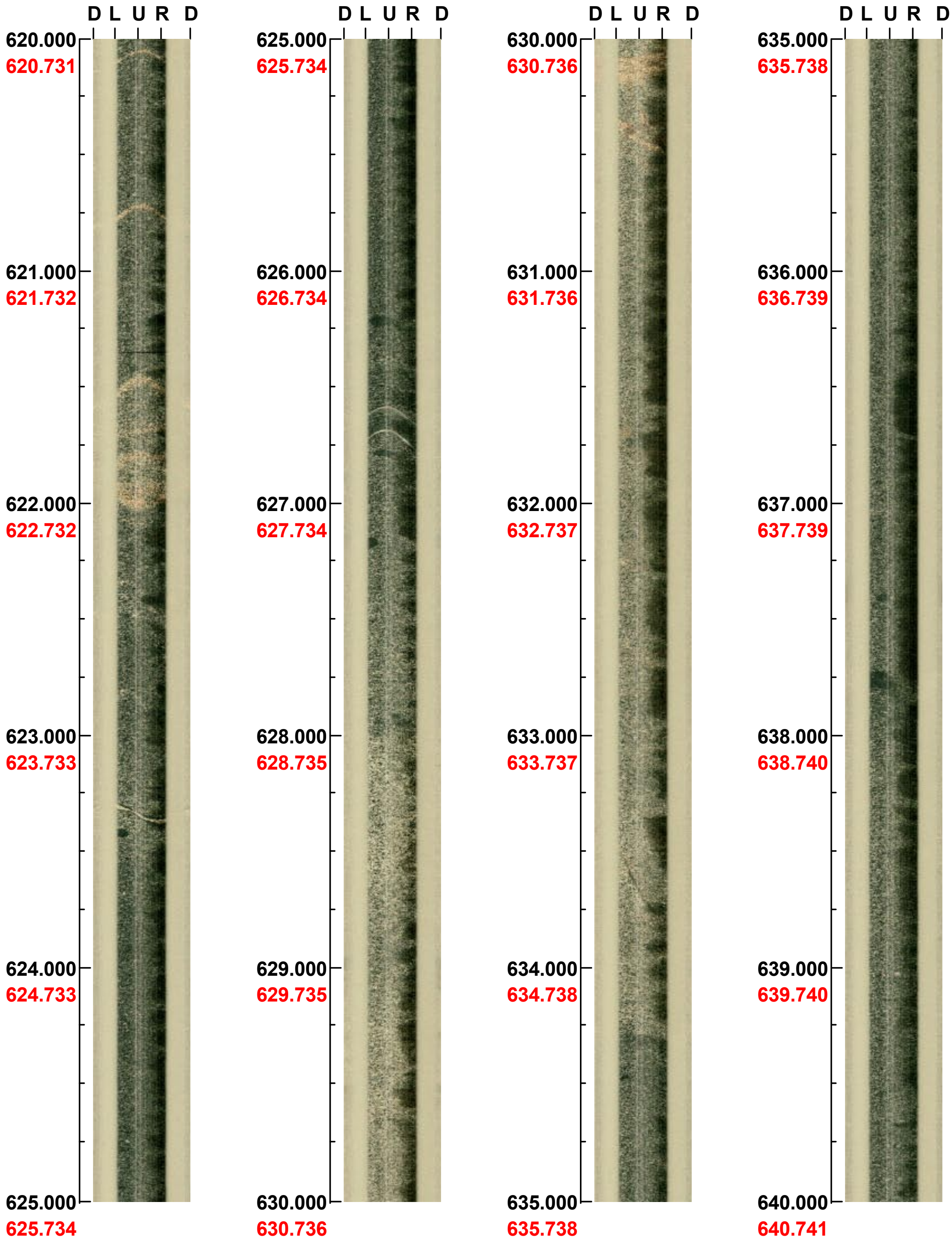
Depth range: 600.000 - 620.000 m



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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

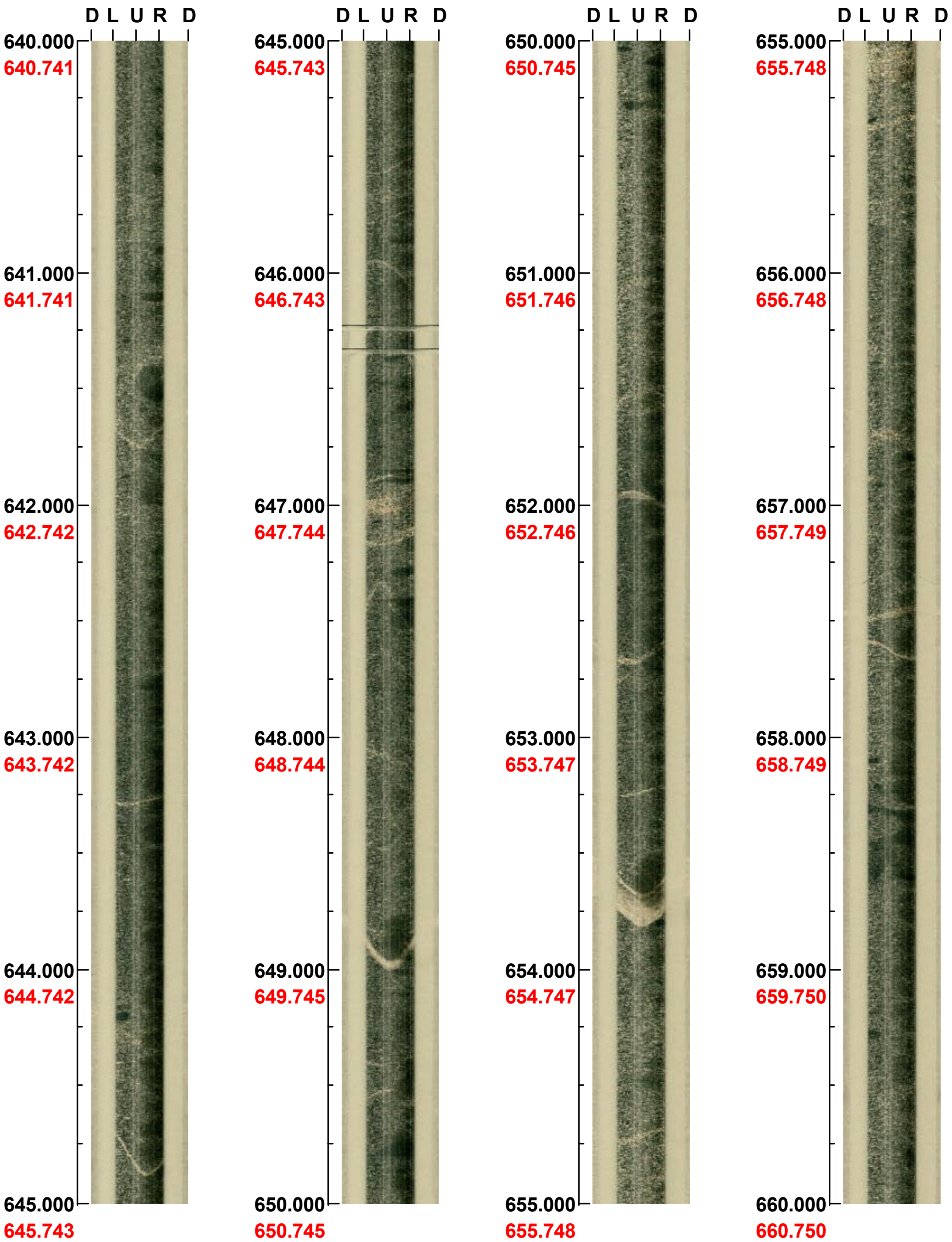
Depth range: 620.000 - 640.000 m



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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

Depth range: 640.000 - 660.000 m



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

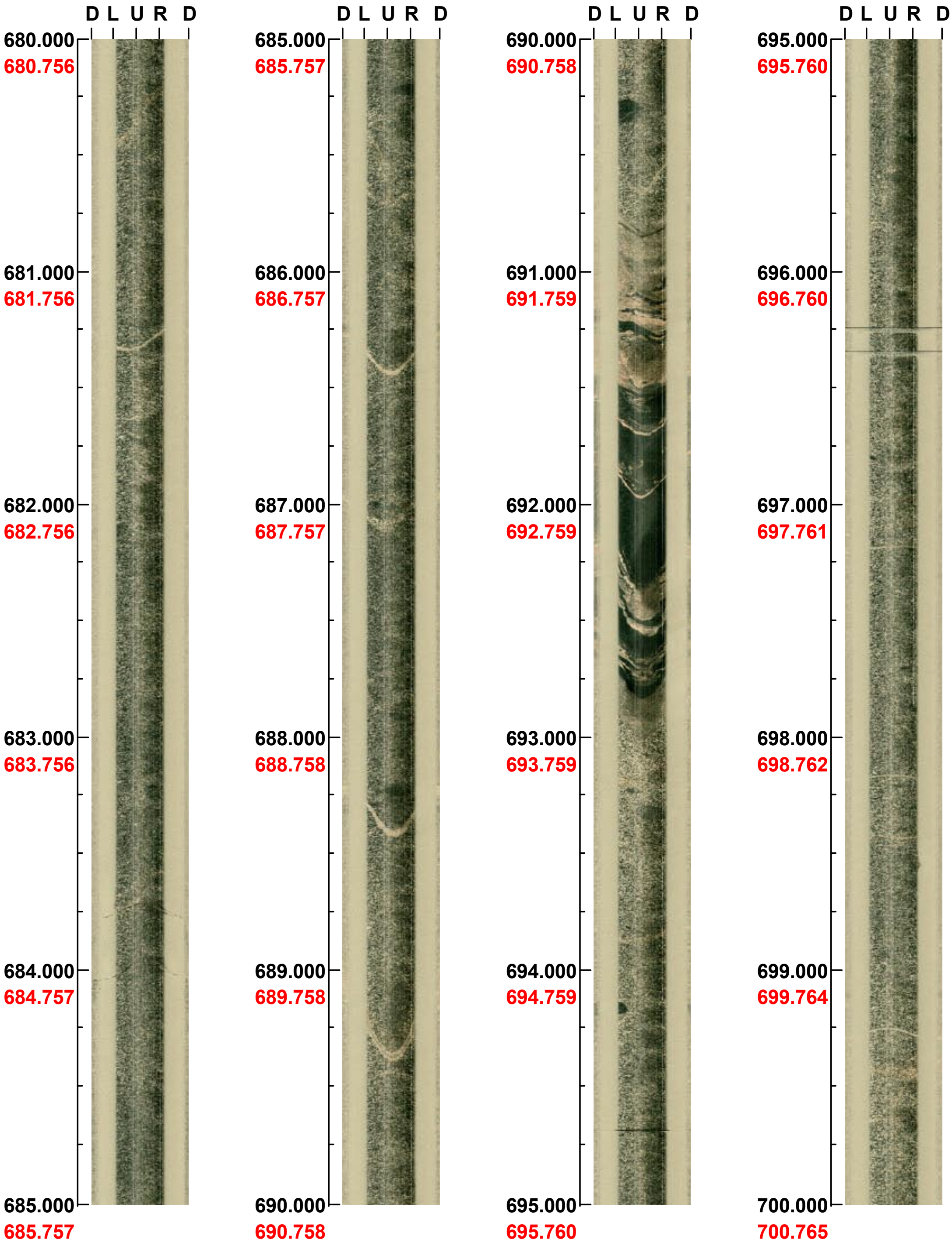
Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

Depth range: 660.000 - 680.000 m

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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

Depth range: 680.000 - 700.000 m

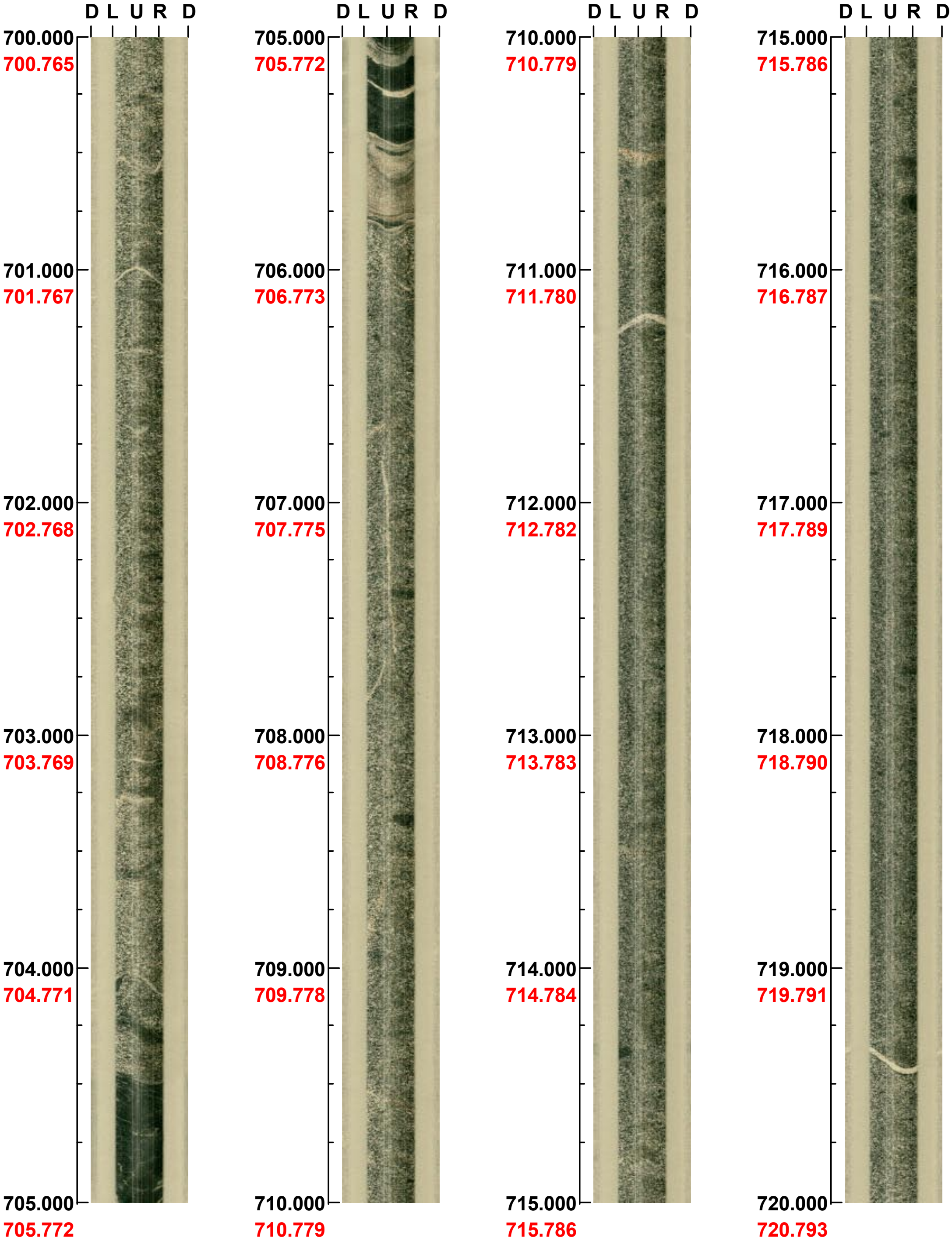


(2 / 7) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar
Bore hole No.: KLX19A

Azimuth: 197 Inclination: -58

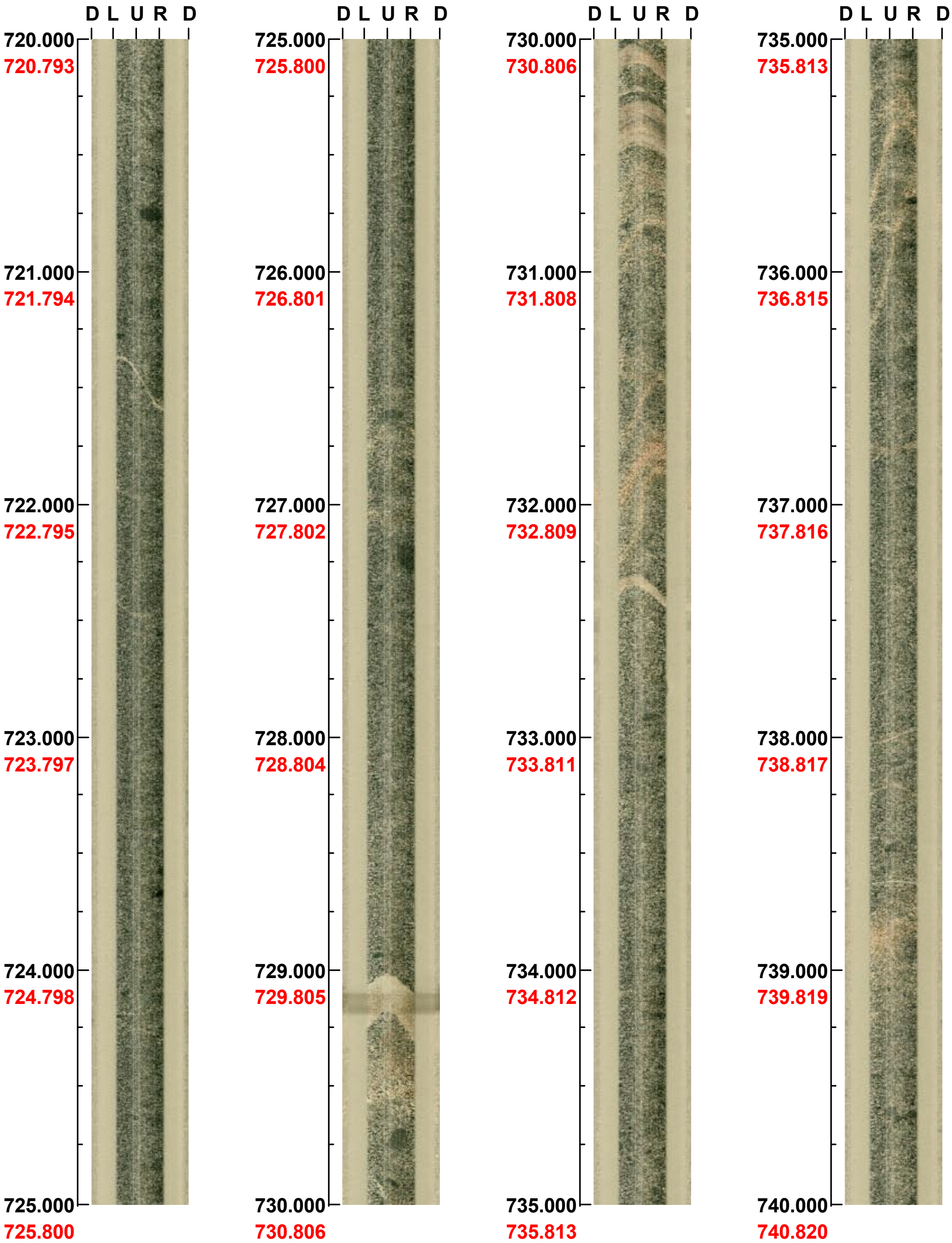
Depth range: 700.000 - 720.000 m



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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

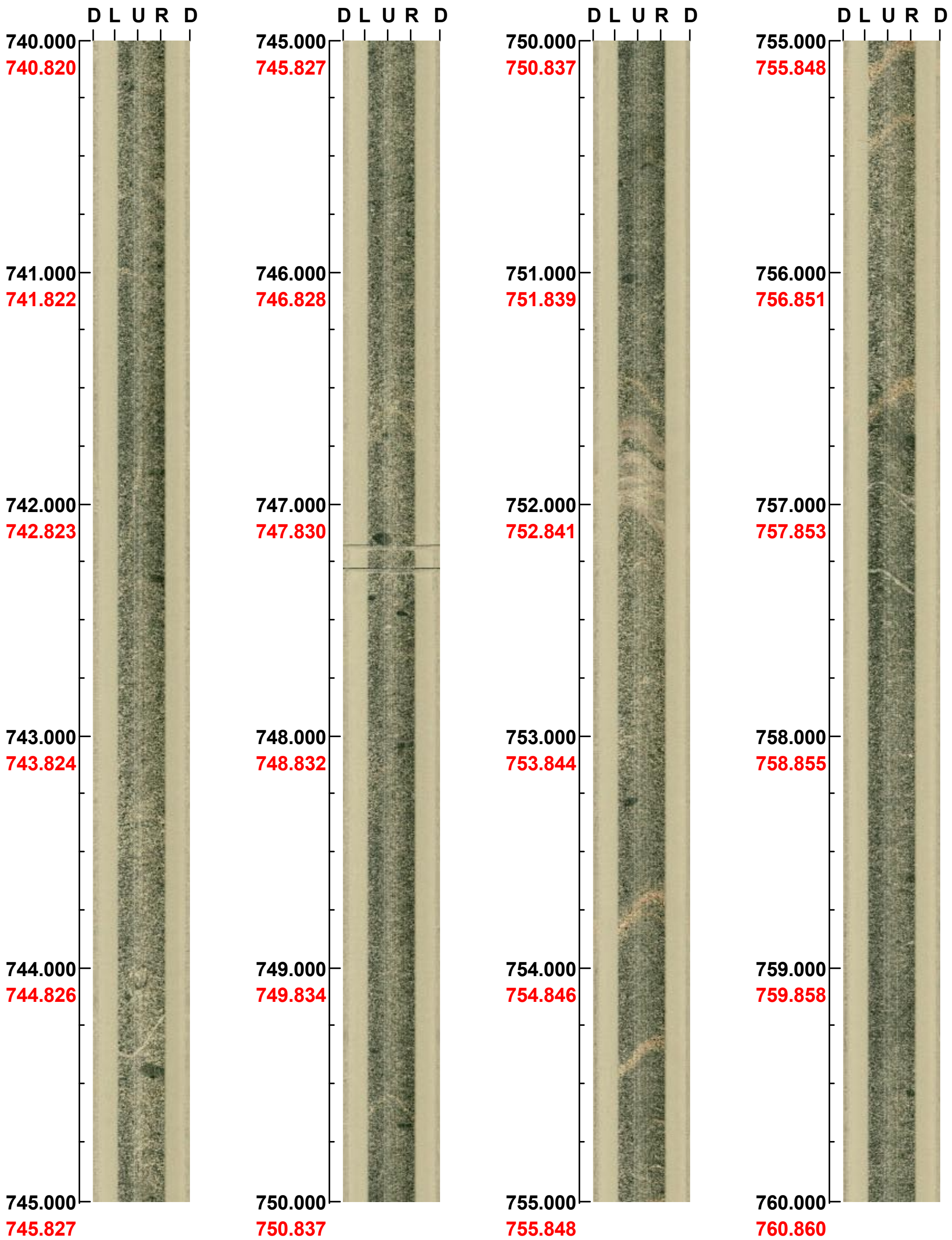
Depth range: 720.000 - 740.000 m



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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

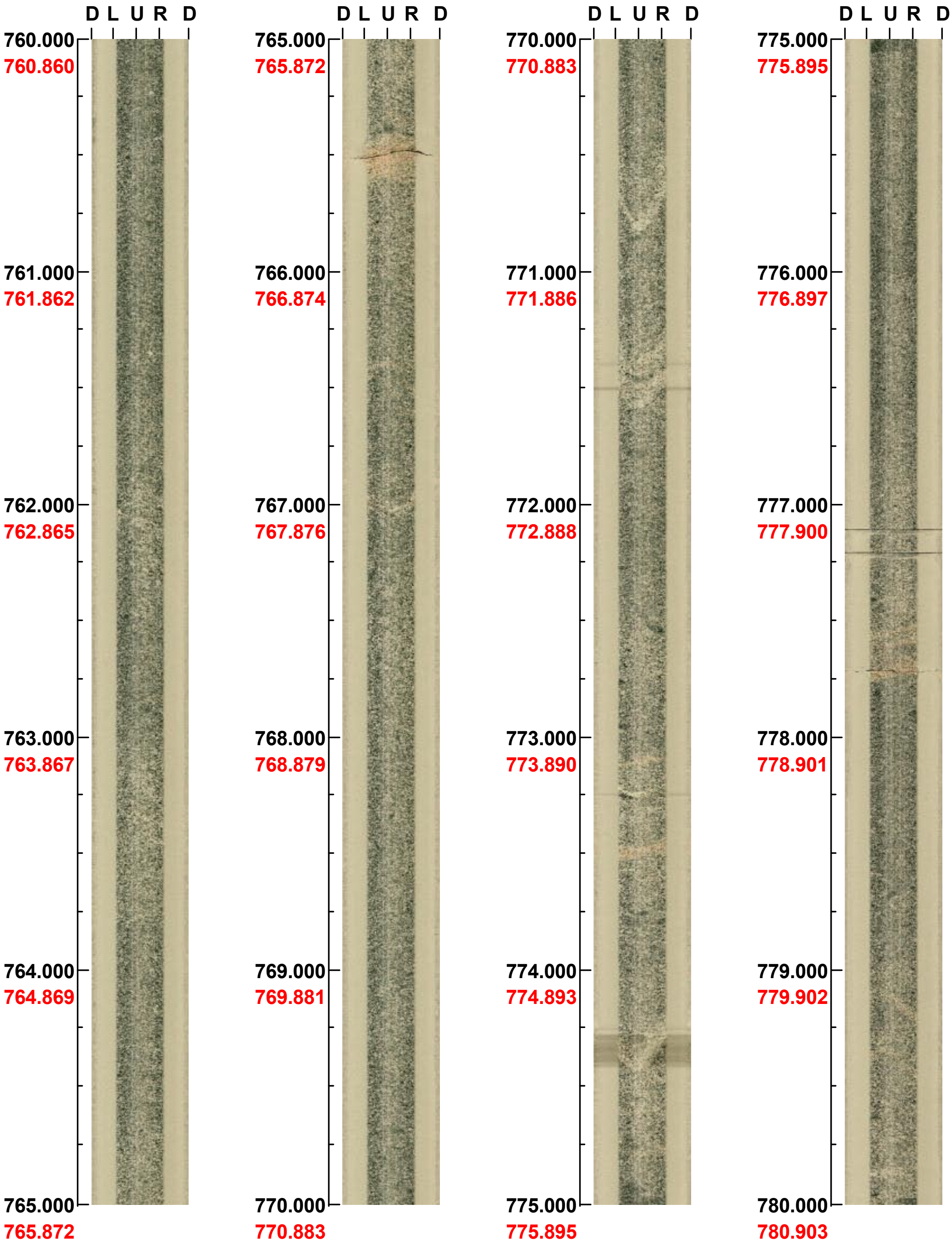
Depth range: 740.000 - 760.000 m



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

Project name: Laxemar
Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

Depth range: 760.000 - 780.000 m

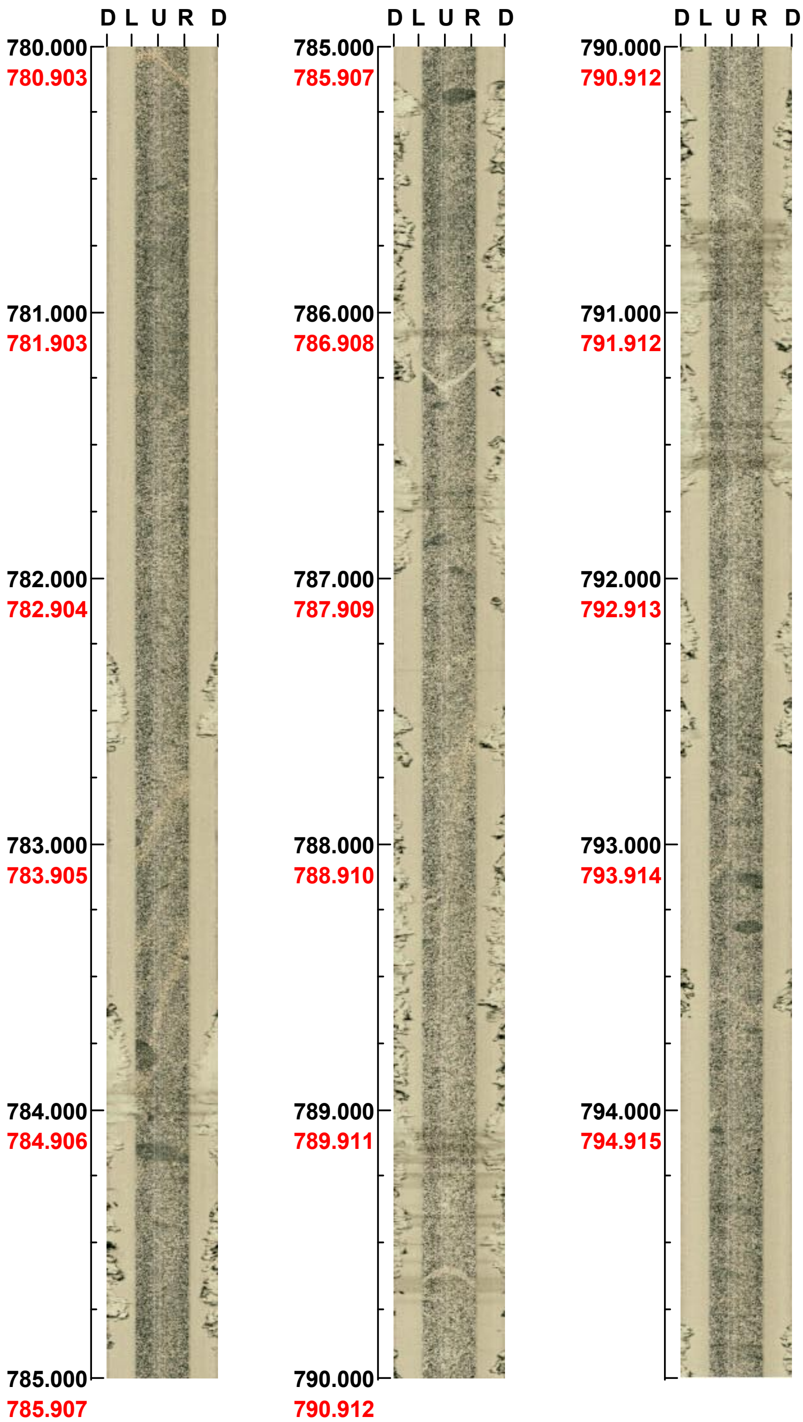


(6 / 7) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar

Bore hole No.: KLX19A **Azimuth: 197** **Inclination: -58**

Depth range: 780.000 - 794.994 m



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

BIPS logging in KLX28A, 4 to 80 m

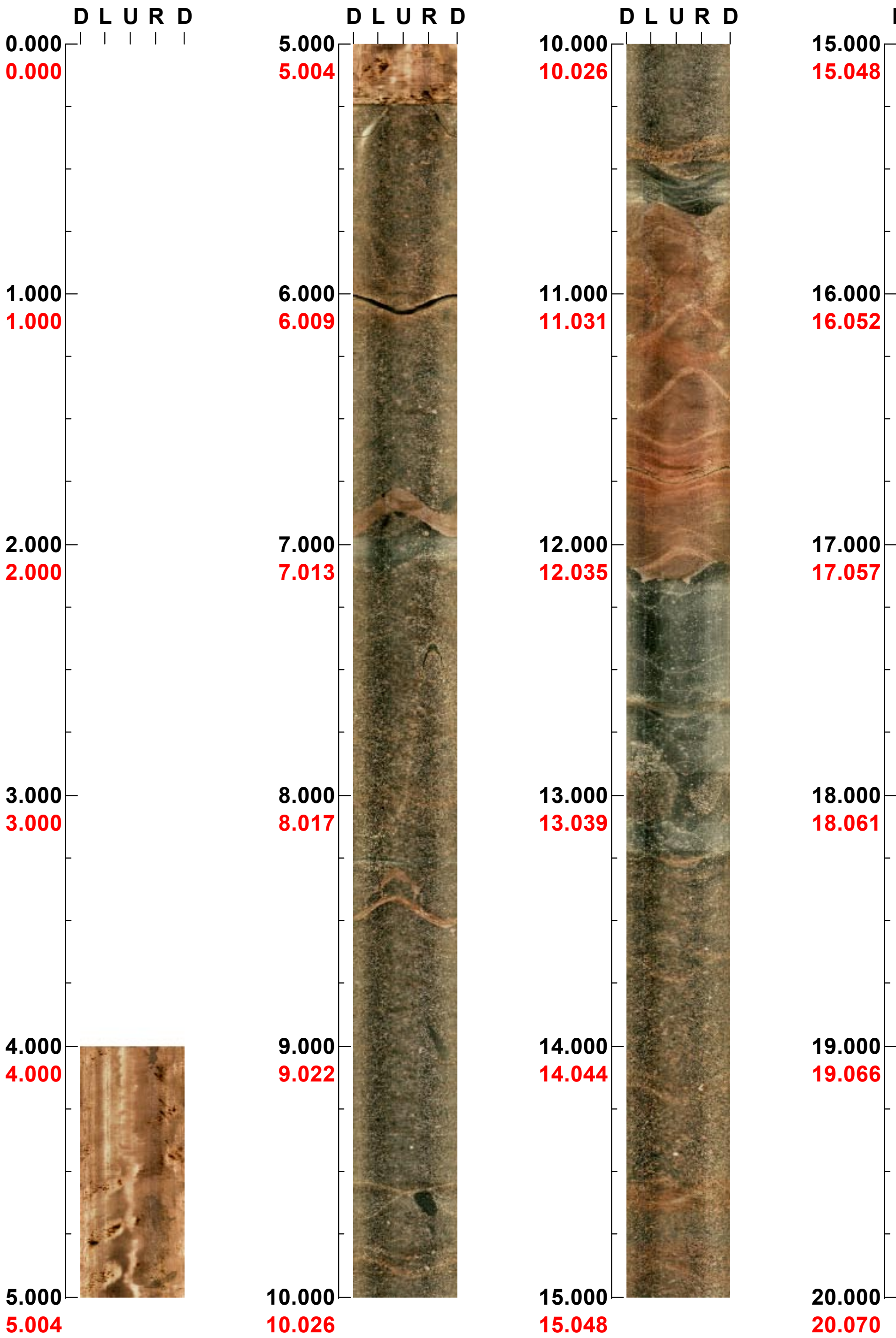
Project name: Laxemar

Image file	: c:\work\r5578k~1\bips\061107~1\klx28a.bip
BDT file	: c:\work\r5578k~1\bips\061107~1\klx28a.bdt
Locality	: LAXEMAR
Bore hole number	: KLX28A
Date	: 06/11/08
Time	: 08:15:00
Depth range	: 4.000 - 79.725 m
Azimuth	: 185
Inclination	: -60
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	: 4
Color	: +0 +0 +0

Project name: Laxemar

Bore hole No.: KLX28A **Azimuth: 185** **Inclination: -60**

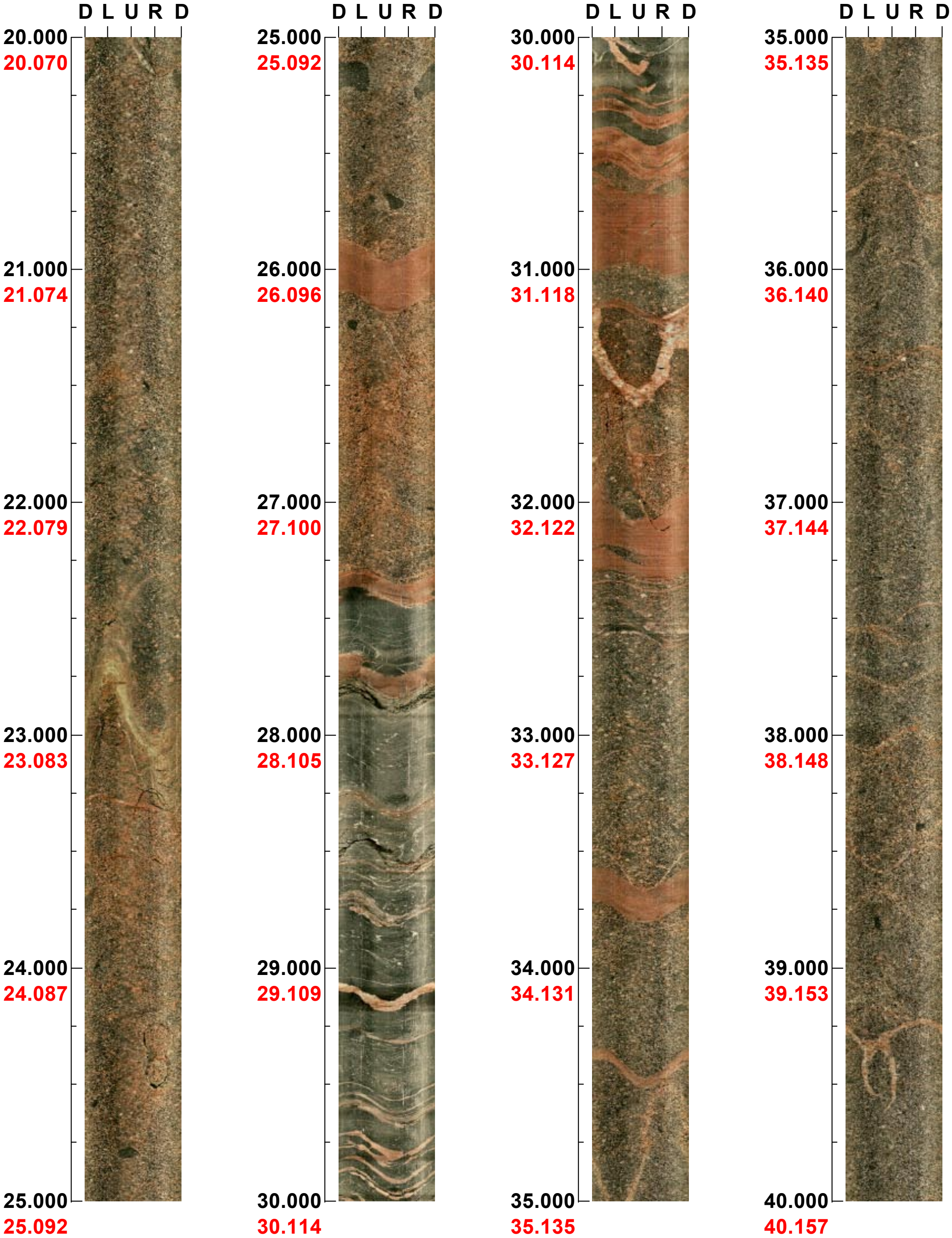
Depth range: 0.000 - 20.000 m



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

Project name: Laxemar
Bore hole No.: KLX28A **Azimuth: 185** **Inclination: -60**

Depth range: 20.000 - 40.000 m

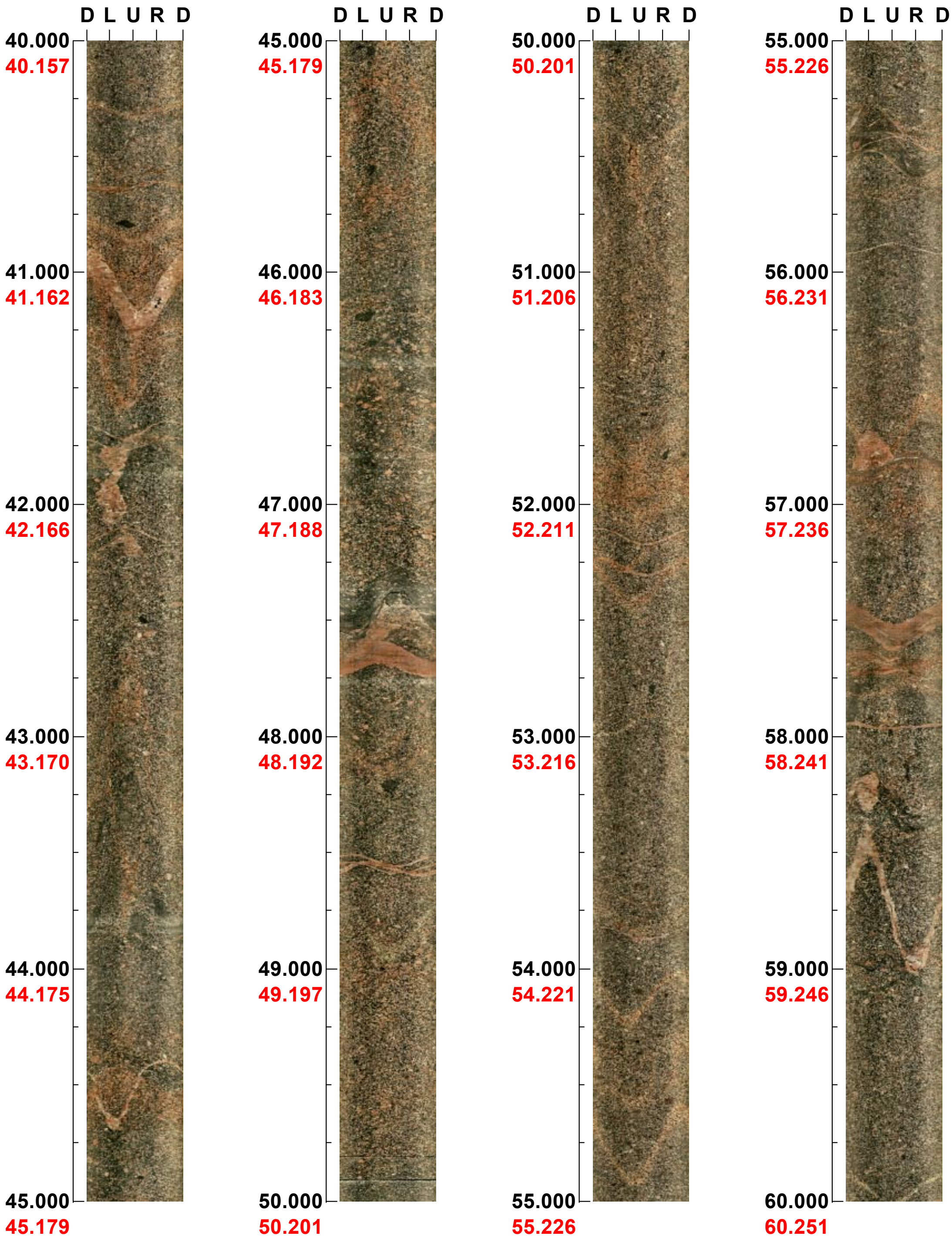


(2 / 4) **Scale: 1/25** **Aspect ratio: 175 %**

Project name: Laxemar

Bore hole No.: KLX28A **Azimuth: 185** **Inclination: -60**

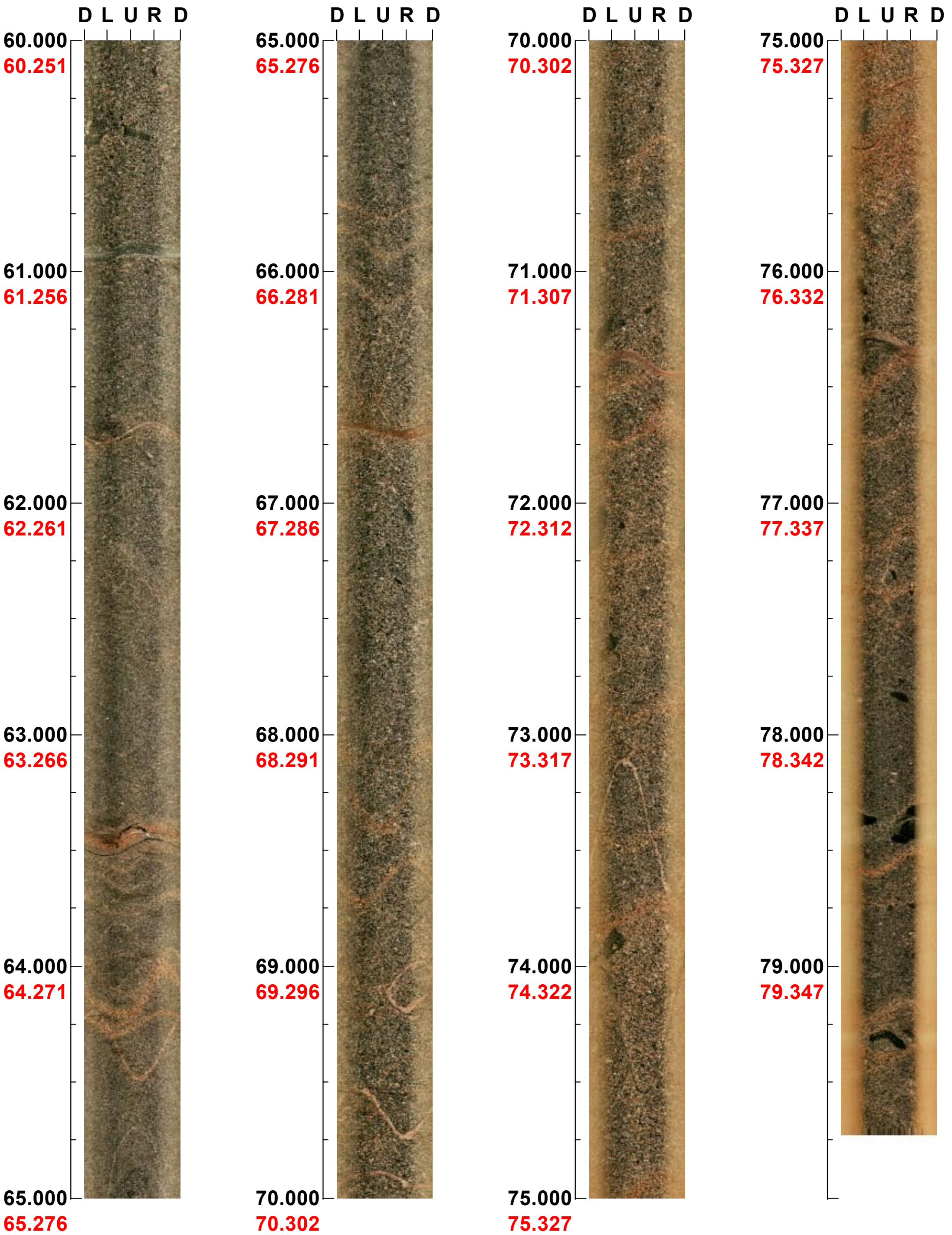
Depth range: 40.000 - 60.000 m



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

Project name: Laxemar
Bore hole No.: KLX28A **Azimuth: 185** **Inclination: -60**

Depth range: 60.000 - 79.725 m



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

BIPS logging in KLX29A, 4 to 59 m

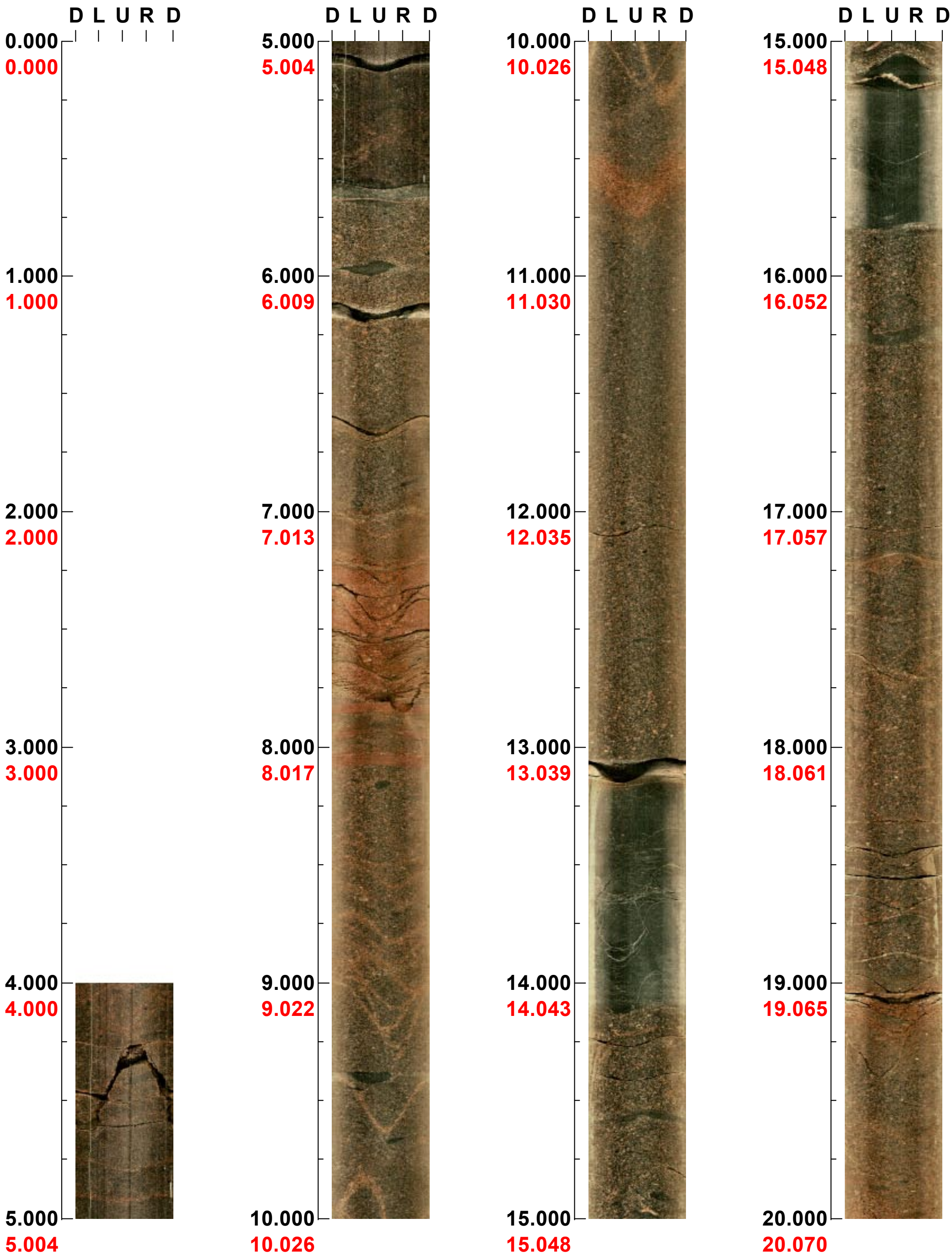
Project name: Laxemar

Image file	: c:\work\r5578k~1\bips\061107~1\klx29a.bip
BDT file	: c:\work\r5578k~1\bips\061107~1\klx29a.bdt
Locality	: LAXEMAR
Bore hole number	: KLX29A
Date	: 06/11/07
Time	: 09:29:00
Depth range	: 4.000 - 58.961 m
Azimuth	: 320
Inclination	: -60
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	: 3
Color	: +0 +0 +0

Project name: Laxemar

Bore hole No.: KLX29A **Azimuth: 320** **Inclination: -60**

Depth range: 0.000 - 20.000 m



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

Project name: Laxemar
Bore hole No.: KLX29A **Azimuth: 320** **Inclination: -60**

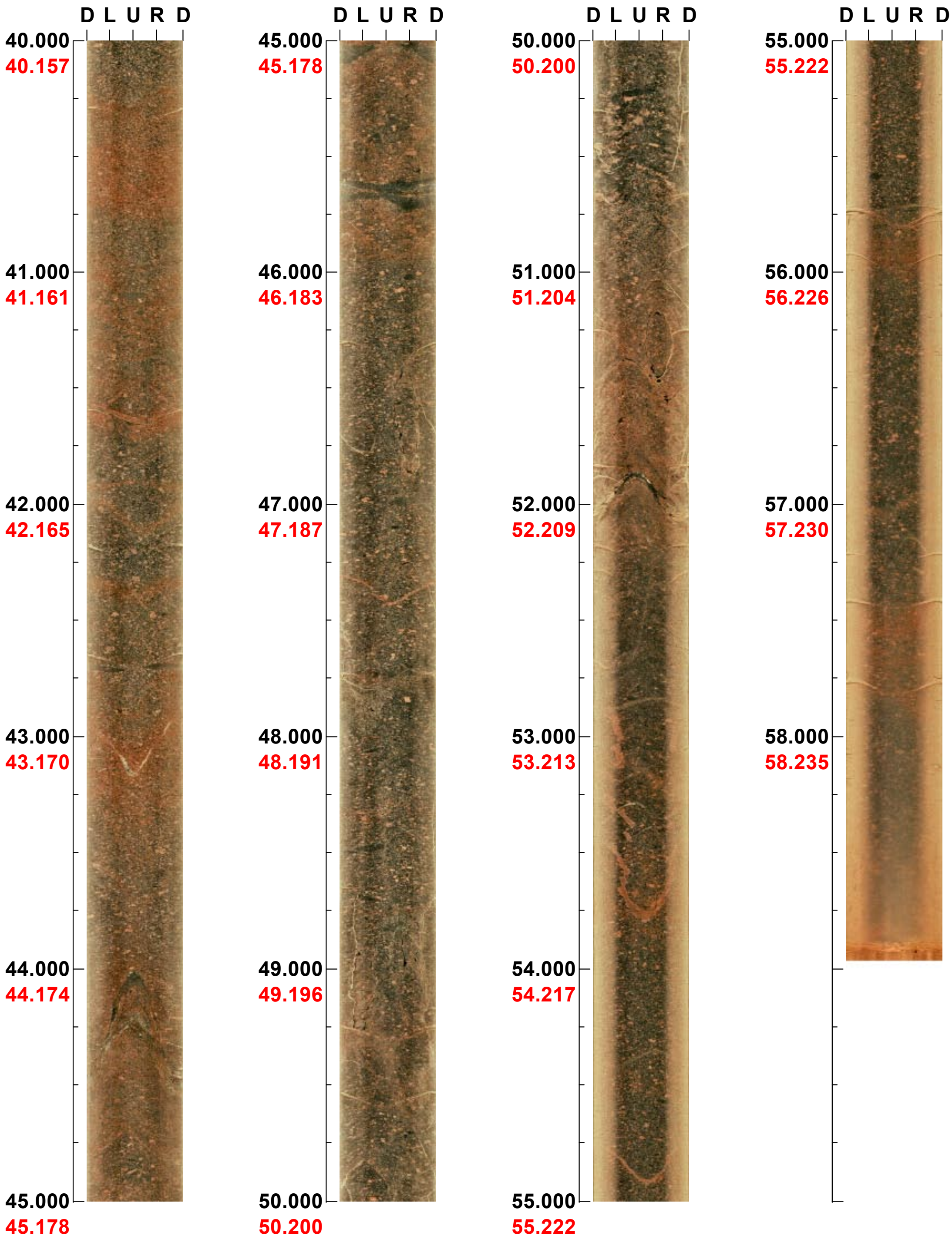
Depth range: 20.000 - 40.000 m

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

Project name: Laxemar

Bore hole No.: KLX29A **Azimuth: 320** **Inclination: -60**

Depth range: 40.000 - 58.961 m



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

Deviation logging in KLX19A, 0 to 792 m

New MeasureIT files

Survey name:	**KLX19A**
Survey date:	10/10/2007 21:39:16
Project:	PLU
Location:	Laxemar
Country:	Sweden
Survey company:	Mala GeoScience AB / RAYCON
Surveyed by:	Christer Gustafsson
Survey type:	STANDARD
Operating conditions:	
General comments:	
Client name:	SKB
Client ID number:	APPS 400-06-117
Client reference:	Leif Stenberg

Drill company:			
Drill rig:			
Drill diameter:	76	Survey run on:	Wireline
Survey direction:	INTO hole	Magnetic Var.:	2,6 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:	49900	2000	nano Tesla
Magnetic dip:	69.8	2	Degrees

SURVEY	Actual start	End of survey	Difference
Station:	0,0	792,0	792,0
East:	1547004,62	1546887,33	-117,29
North:	6365901,42	6365484,09	-417,33
Elevation:	16,87	-645,87	-662,74
Dip:	-57,63	-56,03	1,60
Azimuth:	197,13	193,62	-3,51

OFFSETS at end

Offsets relative to:
ACTUAL START

11,24 metres upwards
10,84 metres left
0,23 metres shortfall

Printed on: 2007-01-25 06:44:44

Page 1 of 9

Survey name : KLX19A

Survey date : 10/10/2007 21:39:16

Printed on 2007-01-25 06:45:41

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	-57,63	197,13	1547004,62	6365901,42	16,87	87120	62,95	0,999157	✍✍✍	0,00	0,00	0,00
3,0	-57,55	198,00	1547004,13	6365899,89	14,34	7562	55,56	0,998189	✍✍✍	0,00	0,01	0,00
6,0	-57,24	198,60	1547003,63	6365898,35	11,81	48252	68,34	1,000017	✍	0,01	0,05	0,00
9,0	-57,33	199,11	1547003,10	6365896,82	9,28	49282	70,88	1,000242	✍	0,03	0,09	0,00
12,0	-57,29	198,85	1547002,58	6365895,28	6,76	49707	71,26	0,999792	✍	0,05	0,15	0,00
15,0	-57,13	199,25	1547002,05	6365893,75	4,24	49898	71,54	0,999833	✍	0,07	0,20	0,00
18,0	-57,21	198,10	1547001,52	6365892,21	1,72	49853	71,26	0,999380	✍	0,09	0,24	0,00
21,0	-57,23	197,03	1547001,03	6365890,66	-0,81	50201	71,32	0,999692	✍	0,11	0,26	0,00
24,0	-57,46	197,56	1547000,55	6365889,11	-3,33	50061	70,96	0,999746	✍	0,13	0,26	0,00
27,0	-57,59	197,22	1547000,07	6365887,58	-5,86	49969	70,66	0,999612	✍	0,13	0,27	0,00
30,0	-57,54	197,65	1546999,59	6365886,04	-8,39	49649	71,25	0,999292	✍	0,14	0,28	0,00
33,0	-57,62	197,47	1546999,10	6365884,51	-10,93	49881	71,16	0,999084	✍	0,14	0,29	0,00
36,0	-57,77	197,30	1546998,62	6365882,98	-13,46	50024	70,85	0,999150	✍	0,14	0,30	0,00
39,0	-57,75	196,60	1546998,16	6365881,45	-16,00	50209	70,79	0,999651	✍	0,13	0,29	0,00
42,0	-57,73	197,20	1546997,69	6365879,91	-18,54	49796	70,41	0,999418	✍	0,13	0,29	0,00
45,0	-57,80	197,77	1546997,21	6365878,39	-21,07	49354	71,79	0,999077	✍	0,12	0,30	0,00
48,0	-57,68	198,15	1546996,72	6365876,87	-23,61	48886	71,88	0,998958	✍	0,11	0,32	0,00
51,0	-57,71	195,51	1546996,25	6365875,33	-26,15	50952	71,24	0,999148	✍	0,11	0,31	0,00
54,0	-57,85	196,35	1546995,82	6365873,79	-28,68	50588	70,26	0,999006	✍	0,10	0,28	0,00
57,0	-57,87	196,00	1546995,37	6365872,26	-31,22	49110	71,83	0,999191	✍✍	0,09	0,25	0,00
60,0	-57,70	196,60	1546994,92	6365870,72	-33,76	50090	70,41	0,999346	✍	0,08	0,23	0,00
63,0	-57,78	195,60	1546994,48	6365869,19	-36,30	49346	71,24	0,999223	✍	0,08	0,20	0,00
66,0	-57,77	195,60	1546994,05	6365867,65	-38,84	49829	71,63	0,999233	✍	0,07	0,16	0,00
69,0	-57,65	198,76	1546993,57	6365866,11	-41,37	51048	69,68	0,998941	✍	0,06	0,16	0,00
72,0	-57,77	198,00	1546993,07	6365864,59	-43,91	52393	67,46	0,999349	✍✍✍	0,06	0,19	0,00
75,0	-58,00	197,71	1546992,58	6365863,08	-46,45	47924	74,53	0,998998	✍	0,05	0,21	0,00
78,0	-57,79	196,60	1546992,11	6365861,55	-48,99	49904	73,07	0,999215	✍✍	0,03	0,21	0,00
81,0	-57,78	196,60	1546991,65	6365860,02	-51,53	47891	70,90	0,999320	✍✍	0,02	0,20	0,00
84,0	-57,78	195,60	1546991,21	6365858,48	-54,07	52134	69,22	0,999190	✍✍	0,02	0,17	0,00
87,0	-58,00	195,60	1546990,78	6365856,95	-56,61	50833	69,15	0,999353	✍	0,00	0,13	0,00
90,0	-57,68	195,60	1546990,35	6365855,41	-59,15	50769	69,75	0,999656	✍	-0,01	0,08	0,00
93,0	-58,02	196,60	1546989,91	6365853,88	-61,69	49273	70,43	0,999003	✍	-0,02	0,06	-0,01
96,0	-58,43	196,60	1546989,46	6365852,36	-64,24	49550	70,79	1,000768	✍	-0,05	0,04	-0,01
99,0	-57,81	196,66	1546989,00	6365850,84	-66,79	50935	72,07	0,999169	✍	-0,08	0,03	-0,01

Survey name : KLX19A

Survey date : 10/10/2007 21:39:16

Printed on 2007-01-25 06:45:41

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
102,0	-57,82	195,98	1546988,55	6365849,31	-69,33	49918	70,64	0,997443	✍	-0,09	0,00	-0,01
105,0	-57,78	196,28	1546988,11	6365847,77	-71,86	49875	70,97	1,001077	✍	-0,10	-0,02	-0,01
108,0	-57,75	196,42	1546987,66	6365846,24	-74,40	49828	70,85	1,000860	✍	-0,10	-0,05	-0,01
111,0	-57,73	196,07	1546987,21	6365844,70	-76,94	49849	71,01	1,001023	✍	-0,11	-0,07	-0,01
114,0	-57,69	195,60	1546986,77	6365843,16	-79,47	50770	71,55	1,000680	✍	-0,11	-0,11	-0,01
117,0	-57,68	196,31	1546986,33	6365841,62	-82,01	49875	71,06	1,000972	✍	-0,12	-0,14	-0,01
120,0	-57,66	196,08	1546985,89	6365840,08	-84,54	49811	70,94	1,000879	✍	-0,12	-0,17	-0,01
123,0	-57,63	195,96	1546985,44	6365838,53	-87,08	49870	70,96	1,000951	✍	-0,12	-0,20	-0,01
126,0	-57,61	196,38	1546985,00	6365836,99	-89,61	49849	70,88	1,000845	✍	-0,12	-0,22	-0,01
129,0	-57,59	196,40	1546984,54	6365835,45	-92,15	49883	70,92	1,000903	✍	-0,12	-0,24	-0,01
132,0	-57,58	196,07	1546984,09	6365833,90	-94,68	49931	70,94	1,000628	✍	-0,11	-0,27	-0,01
135,0	-57,54	195,94	1546983,65	6365832,36	-97,21	49832	70,80	1,000966	✍	-0,11	-0,30	-0,01
138,0	-57,50	195,91	1546983,21	6365830,81	-99,74	49820	71,03	1,001377	✍	-0,10	-0,34	-0,01
141,0	-57,47	196,17	1546982,76	6365829,26	-102,27	49824	70,98	1,001369	✍	-0,10	-0,37	-0,01
144,0	-57,41	196,16	1546982,31	6365827,71	-104,80	49808	70,91	1,000862	✍	-0,09	-0,39	-0,01
147,0	-57,41	196,03	1546981,86	6365826,15	-107,33	49910	70,92	1,000758	✍	-0,08	-0,42	-0,01
150,0	-57,39	195,12	1546981,43	6365824,60	-109,85	50730	70,60	1,000590	✍	-0,06	-0,47	-0,01
153,0	-57,36	196,24	1546980,99	6365823,04	-112,38	49941	70,69	1,001063	✍	-0,05	-0,51	-0,01
156,0	-57,37	196,29	1546980,54	6365821,49	-114,91	49928	70,84	1,001217	✍	-0,04	-0,53	-0,01
159,0	-57,33	196,25	1546980,09	6365819,93	-117,43	49920	70,88	1,000927	✍	-0,02	-0,56	-0,01
162,0	-57,33	196,25	1546979,63	6365818,38	-119,96	49925	70,87	1,000984	✍	-0,01	-0,58	-0,01
165,0	-57,30	196,21	1546979,18	6365816,82	-122,48	49953	70,90	1,000659	✍	0,01	-0,61	-0,01
168,0	-57,27	196,37	1546978,73	6365815,27	-125,01	49964	70,92	1,001154	✍	0,03	-0,63	-0,01
171,0	-57,25	195,85	1546978,27	6365813,71	-127,53	49849	70,89	1,000989	✍	0,05	-0,66	-0,01
174,0	-57,24	196,41	1546977,82	6365812,15	-130,05	49900	70,86	1,000595	✍	0,07	-0,69	-0,01
177,0	-57,20	196,23	1546977,37	6365810,59	-132,58	49787	70,86	1,001125	✍	0,09	-0,71	-0,01
180,0	-57,16	196,35	1546976,91	6365809,03	-135,10	49883	70,93	1,001066	✍	0,11	-0,73	-0,01
183,0	-57,11	196,42	1546976,45	6365807,47	-137,62	49905	70,99	1,000546	✍	0,14	-0,75	-0,01
186,0	-57,13	196,14	1546976,00	6365805,90	-140,14	50187	70,99	1,001112	✍	0,17	-0,78	-0,01
189,0	-57,12	196,47	1546975,54	6365804,34	-142,66	49877	70,94	1,001033	✍	0,19	-0,80	-0,01
192,0	-57,10	196,15	1546975,08	6365802,78	-145,17	49870	71,12	1,001241	✍	0,22	-0,83	-0,01
195,0	-57,10	196,28	1546974,63	6365801,21	-147,69	49812	70,98	1,001208	✍	0,25	-0,85	-0,01
198,0	-57,11	196,39	1546974,17	6365799,65	-150,21	49876	70,99	1,001214	✍	0,27	-0,87	-0,01
201,0	-57,07	196,36	1546973,71	6365798,09	-152,73	49849	71,10	1,000806	✍	0,30	-0,90	-0,01

FLEXIT: SmartTool drillhole survey result table.

Survey name : KLX19A

Survey date : 10/10/2007 21:39:16

Printed on 2007-01-25 06:45:41

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	-57,07	196,77	1546973,24	6365796,52	-155,25	49928	70,96	1,000728	✍	0,33	-0,91	-0,01
207,0	-57,08	196,34	1546972,78	6365794,96	-157,77	49904	70,89	1,001128	✍	0,36	-0,93	-0,01
210,0	-57,06	196,25	1546972,32	6365793,39	-160,29	49962	70,95	1,000980	✍	0,39	-0,95	-0,01
213,0	-57,05	196,48	1546971,86	6365791,83	-162,80	49712	71,05	1,000766	✍	0,42	-0,97	-0,01
216,0	-57,06	196,26	1546971,40	6365790,26	-165,32	50660	71,21	1,000667	✍	0,45	-1,00	-0,01
219,0	-57,07	196,50	1546970,94	6365788,70	-167,84	50440	71,04	1,001002	✍	0,48	-1,02	-0,01
222,0	-57,07	196,35	1546970,48	6365787,13	-170,36	50326	70,97	1,001223	✍	0,51	-1,04	-0,01
225,0	-57,10	196,56	1546970,02	6365785,57	-172,88	50474	70,83	1,000806	✍	0,54	-1,06	-0,01
228,0	-57,09	196,75	1546969,55	6365784,01	-175,39	49828	70,82	1,001058	✍	0,57	-1,07	-0,01
231,0	-57,05	196,37	1546969,09	6365782,45	-177,91	49895	70,79	1,001314	✍	0,60	-1,09	-0,01
234,0	-57,07	196,33	1546968,63	6365780,88	-180,43	49947	70,76	1,000917	✍	0,63	-1,11	-0,01
237,0	-57,03	195,83	1546968,18	6365779,31	-182,95	49978	70,91	1,001300	✍	0,66	-1,14	-0,01
240,0	-57,02	196,22	1546967,72	6365777,74	-185,46	49965	70,80	1,000847	✍	0,69	-1,17	-0,01
243,0	-56,97	195,86	1546967,27	6365776,17	-187,98	49883	70,83	1,000982	✍	0,72	-1,20	-0,01
246,0	-56,94	196,50	1546966,82	6365774,60	-190,49	49889	70,98	1,001282	✍	0,76	-1,23	-0,02
249,0	-56,92	196,36	1546966,35	6365773,03	-193,01	49991	71,00	1,000827	✍	0,79	-1,25	-0,02
252,0	-56,92	196,20	1546965,90	6365771,46	-195,52	49999	71,00	1,000842	✍	0,83	-1,27	-0,02
255,0	-56,92	196,44	1546965,44	6365769,89	-198,04	49982	70,87	1,000881	✍	0,87	-1,30	-0,02
258,0	-56,92	196,20	1546964,98	6365768,32	-200,55	49949	70,92	1,001057	✍	0,90	-1,32	-0,02
261,0	-56,89	195,62	1546964,53	6365766,74	-203,06	49755	70,91	1,001157	✍	0,94	-1,35	-0,02
264,0	-56,86	195,77	1546964,08	6365765,16	-205,58	50026	70,98	1,001162	✍	0,98	-1,39	-0,02
267,0	-56,92	195,72	1546963,64	6365763,59	-208,09	50123	70,86	1,001401	✍	1,02	-1,43	-0,02
270,0	-57,00	196,20	1546963,19	6365762,01	-210,60	49971	70,92	1,001079	✍	1,05	-1,47	-0,02
273,0	-57,00	196,40	1546962,73	6365760,45	-213,12	50011	71,13	1,001014	✍	1,09	-1,49	-0,02
276,0	-57,01	196,69	1546962,26	6365758,88	-215,63	49827	70,91	1,001044	✍	1,12	-1,51	-0,02
279,0	-56,97	196,59	1546961,80	6365757,31	-218,15	50009	71,09	1,001140	✍	1,15	-1,52	-0,02
282,0	-56,99	196,53	1546961,33	6365755,75	-220,67	49942	70,98	1,001335	✍	1,19	-1,54	-0,02
285,0	-56,97	195,84	1546960,87	6365754,18	-223,18	49850	70,86	1,001029	✍	1,22	-1,56	-0,02
288,0	-56,97	196,14	1546960,42	6365752,60	-225,70	49819	70,74	1,000878	✍	1,26	-1,60	-0,02
291,0	-56,97	196,54	1546959,96	6365751,04	-228,21	49582	70,97	1,000931	✍	1,29	-1,62	-0,02
294,0	-56,97	196,22	1546959,50	6365749,47	-230,73	49689	71,01	1,001171	✍	1,33	-1,64	-0,02
297,0	-56,96	196,38	1546959,04	6365747,90	-233,24	49536	71,35	1,001078	✍	1,36	-1,66	-0,02
300,0	-56,97	196,19	1546958,59	6365746,33	-235,76	49452	71,30	1,000865	✍	1,40	-1,69	-0,02
303,0	-56,90	196,31	1546958,13	6365744,76	-238,27	49489	71,49	1,001077	✍	1,43	-1,71	-0,02

FLEXIT: SmartTool drillhole survey result table.

Survey name : KLX19A

Survey date : 10/10/2007 21:39:16

Printed on 2007-01-25 06:45:41

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	-56,90	195,59	1546957,68	6365743,18	-240,78	49508	71,08	1,001102	✍	1,47	-1,75	-0,02
309,0	-56,91	195,96	1546957,23	6365741,60	-243,30	49756	71,01	1,000789	✍	1,51	-1,79	-0,02
312,0	-56,92	196,00	1546956,78	6365740,03	-245,81	49786	70,83	1,001148	✍	1,55	-1,82	-0,02
315,0	-56,89	196,23	1546956,33	6365738,46	-248,32	49870	70,79	1,000841	✍	1,58	-1,85	-0,02
318,0	-56,87	196,18	1546955,87	6365736,88	-250,84	49822	70,84	1,001150	✍	1,62	-1,88	-0,02
321,0	-56,92	196,24	1546955,41	6365735,31	-253,35	49734	70,85	1,000993	✍	1,66	-1,90	-0,02
324,0	-56,97	196,24	1546954,95	6365733,74	-255,86	49681	70,94	1,001080	✍	1,70	-1,93	-0,02
327,0	-56,95	195,94	1546954,50	6365732,17	-258,38	49706	70,83	1,000758	✍	1,73	-1,96	-0,02
330,0	-56,93	195,74	1546954,05	6365730,59	-260,89	49693	71,01	1,001210	✍	1,77	-1,99	-0,02
333,0	-55,99	196,75	1546953,59	6365729,00	-263,39	49702	71,87	0,976731	✍✍	1,83	-2,02	-0,03
336,0	-56,92	196,02	1546953,12	6365727,41	-265,89	49804	70,86	1,000874	✍	1,89	-2,04	-0,03
339,0	-56,91	196,02	1546952,67	6365725,84	-268,41	49746	70,79	1,000953	✍	1,93	-2,07	-0,03
342,0	-56,91	196,34	1546952,21	6365724,26	-270,92	49745	70,82	1,001083	✍	1,97	-2,10	-0,03
345,0	-56,90	196,73	1546951,75	6365722,69	-273,44	49716	71,06	1,000887	✍	2,00	-2,12	-0,03
348,0	-56,91	195,84	1546951,29	6365721,12	-275,95	49629	70,98	1,000622	✍	2,04	-2,14	-0,03
351,0	-56,90	196,10	1546950,84	6365719,55	-278,46	49627	71,04	1,000764	✍	2,08	-2,17	-0,03
354,0	-56,90	196,43	1546950,38	6365717,97	-280,97	49841	71,11	1,000980	✍	2,12	-2,20	-0,03
357,0	-56,91	196,35	1546949,92	6365716,40	-283,49	49677	70,85	1,001001	✍	2,16	-2,22	-0,03
360,0	-56,88	196,34	1546949,46	6365714,83	-286,00	49448	70,91	1,000850	✍	2,19	-2,24	-0,03
363,0	-56,87	196,42	1546948,99	6365713,26	-288,51	49526	70,82	1,001159	✍	2,23	-2,26	-0,03
366,0	-56,87	196,47	1546948,53	6365711,68	-291,03	49582	70,76	1,001026	✍	2,27	-2,28	-0,03
369,0	-56,86	196,86	1546948,06	6365710,11	-293,54	49894	70,59	1,001285	✍	2,31	-2,30	-0,03
372,0	-56,85	196,36	1546947,59	6365708,54	-296,05	49316	71,27	1,001229	✍	2,35	-2,31	-0,03
375,0	-56,84	196,22	1546947,13	6365706,97	-298,56	49452	70,81	1,000799	✍	2,40	-2,34	-0,03
378,0	-56,80	195,93	1546946,67	6365705,39	-301,07	49670	70,82	1,001081	✍	2,44	-2,37	-0,03
381,0	-56,80	196,56	1546946,22	6365703,81	-303,58	49759	70,90	1,000728	✍	2,48	-2,39	-0,03
384,0	-56,77	195,73	1546945,76	6365702,23	-306,09	49732	70,72	1,000798	✍	2,53	-2,42	-0,03
387,0	-56,74	195,84	1546945,31	6365700,65	-308,60	49904	70,98	1,000655	✍	2,57	-2,46	-0,03
390,0	-56,74	195,59	1546944,87	6365699,07	-311,11	49890	70,84	1,000694	✍	2,62	-2,50	-0,03
393,0	-56,75	195,80	1546944,42	6365697,48	-313,62	49950	70,94	1,000709	✍	2,66	-2,54	-0,03
396,0	-56,74	196,02	1546943,97	6365695,90	-316,13	49873	70,97	1,001118	✍	2,71	-2,57	-0,03
399,0	-56,74	195,84	1546943,52	6365694,32	-318,64	49865	70,76	1,000975	✍	2,76	-2,61	-0,04
402,0	-56,72	195,60	1546943,07	6365692,73	-321,14	49809	71,03	1,001017	✍	2,80	-2,65	-0,04
405,0	-56,71	196,25	1546942,62	6365691,15	-323,65	49521	70,85	1,000935	✍	2,85	-2,68	-0,04

Survey name : KLX19A
Survey date : 10/10/2007 21:39:16
Printed on 2007-01-25 06:45:42

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	-56,68	195,66	1546942,17	6365689,57	-326,16	49489	70,62	1,000976	✍	2,90	-2,72	-0,04
411,0	-56,66	195,47	1546941,72	6365687,98	-328,67	49388	70,45	1,001294	✍	2,95	-2,76	-0,04
414,0	-56,61	195,32	1546941,29	6365686,39	-331,17	49453	70,63	1,000729	✍	3,00	-2,81	-0,04
417,0	-56,62	195,50	1546940,85	6365684,80	-333,68	49675	70,83	1,001039	✍	3,05	-2,86	-0,04
420,0	-56,61	195,69	1546940,40	6365683,21	-336,18	49627	70,72	1,000942	✍	3,11	-2,91	-0,04
423,0	-56,61	195,90	1546939,95	6365681,62	-338,69	49625	70,67	1,000990	✍	3,16	-2,94	-0,04
426,0	-56,59	195,94	1546939,50	6365680,03	-341,19	49684	70,62	1,000879	✍	3,21	-2,98	-0,04
429,0	-56,59	196,07	1546939,05	6365678,44	-343,69	49592	70,68	1,000810	✍	3,27	-3,01	-0,04
432,0	-56,57	196,15	1546938,59	6365676,85	-346,20	49590	70,50	1,001215	✍	3,32	-3,04	-0,04
435,0	-56,61	196,84	1546938,12	6365675,27	-348,70	49648	70,58	1,001077	✍	3,38	-3,06	-0,04
438,0	-56,60	196,70	1546937,64	6365673,69	-351,21	49799	70,67	1,000850	✍	3,43	-3,07	-0,04
441,0	-56,59	196,60	1546937,17	6365672,11	-353,71	49481	70,66	1,000858	✍	3,49	-3,08	-0,04
444,0	-56,60	196,77	1546936,69	6365670,52	-356,22	49551	70,55	1,001235	✍	3,54	-3,10	-0,05
447,0	-56,59	196,56	1546936,22	6365668,94	-358,72	49465	70,64	1,000950	✍	3,60	-3,11	-0,05
450,0	-56,57	196,53	1546935,75	6365667,36	-361,22	49472	70,67	1,000894	✍	3,65	-3,13	-0,05
453,0	-56,55	196,36	1546935,28	6365665,77	-363,73	49479	70,72	1,000848	✍	3,71	-3,15	-0,05
456,0	-56,51	196,39	1546934,82	6365664,18	-366,23	49524	70,98	1,000987	✍	3,76	-3,17	-0,05
459,0	-56,50	196,65	1546934,35	6365662,60	-368,73	49289	70,92	1,000963	✍	3,82	-3,19	-0,05
462,0	-56,52	195,99	1546933,88	6365661,01	-371,23	49533	70,83	1,001082	✍	3,88	-3,21	-0,05
465,0	-56,52	196,55	1546933,42	6365659,42	-373,74	49694	70,88	1,000943	✍	3,94	-3,23	-0,05
468,0	-56,54	196,19	1546932,95	6365657,83	-376,24	49430	70,79	1,000861	✍	4,00	-3,26	-0,05
471,0	-56,56	195,75	1546932,50	6365656,24	-378,74	49566	70,78	1,000977	✍	4,05	-3,29	-0,05
474,0	-56,57	196,08	1546932,04	6365654,65	-381,24	49482	70,82	1,000754	✍	4,11	-3,33	-0,05
477,0	-56,56	195,84	1546931,59	6365653,06	-383,75	49515	70,82	1,000869	✍	4,17	-3,36	-0,05
480,0	-56,55	195,55	1546931,14	6365651,47	-386,25	49570	70,86	1,000833	✍	4,22	-3,40	-0,05
483,0	-56,54	195,93	1546930,69	6365649,88	-388,75	49560	70,76	1,001142	✍	4,28	-3,44	-0,05
486,0	-56,55	195,85	1546930,24	6365648,29	-391,26	49523	70,78	1,001091	✍	4,34	-3,48	-0,05
489,0	-56,59	195,73	1546929,79	6365646,70	-393,76	49497	70,96	1,000887	✍	4,39	-3,51	-0,06
492,0	-56,61	195,38	1546929,35	6365645,11	-396,27	49502	70,82	1,000970	✍	4,44	-3,56	-0,06
495,0	-56,62	195,90	1546928,90	6365643,52	-398,77	49704	70,67	0,999198	✍	4,50	-3,60	-0,06
498,0	-56,60	195,88	1546928,45	6365641,93	-401,28	49650	70,67	0,999486	✍	4,55	-3,64	-0,06
501,0	-56,56	195,99	1546928,00	6365640,34	-403,78	49500	70,69	0,999449	✍	4,61	-3,67	-0,06
504,0	-56,57	195,57	1546927,55	6365638,75	-406,28	49591	70,63	0,999323	✍	4,66	-3,71	-0,06
507,0	-56,54	196,75	1546927,09	6365637,16	-408,79	50140	70,80	0,999237	✍	4,72	-3,74	-0,06

Survey name : KLX19A

Survey date : 10/10/2007 21:39:16

Printed on 2007-01-25 06:45:42

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
510,0	-56,55	196,36	1546926,61	6365635,58	-411,29	49559	70,64	0,999501	✍	4,77	-3,76	-0,06
513,0	-56,54	196,18	1546926,15	6365633,99	-413,79	49438	70,57	0,999348	✍	4,83	-3,78	-0,06
516,0	-56,53	196,00	1546925,69	6365632,40	-416,29	49526	70,70	0,999068	✍	4,89	-3,81	-0,06
519,0	-56,61	194,89	1546925,25	6365630,81	-418,80	49107	71,29	0,999425	✍	4,94	-3,86	-0,06
522,0	-56,54	196,12	1546924,81	6365629,22	-421,30	49388	71,02	0,999214	✍	5,00	-3,91	-0,06
525,0	-56,50	195,85	1546924,36	6365627,62	-423,80	49359	70,80	0,998165	✍	5,05	-3,94	-0,06
528,0	-56,49	195,69	1546923,91	6365626,03	-426,31	49414	70,93	0,998714	✍	5,11	-3,98	-0,07
531,0	-56,50	195,45	1546923,46	6365624,44	-428,81	49309	70,92	0,997955	✍	5,17	-4,02	-0,07
534,0	-56,48	195,22	1546923,02	6365622,84	-431,31	49298	70,82	0,998287	✍	5,23	-4,08	-0,07
537,0	-56,44	195,29	1546922,59	6365621,24	-433,81	49272	70,85	0,998557	✍	5,29	-4,13	-0,07
540,0	-56,42	195,34	1546922,15	6365619,64	-436,31	49328	70,83	0,998175	✍	5,36	-4,18	-0,07
543,0	-56,40	195,29	1546921,71	6365618,04	-438,81	49360	70,88	0,998352	✍	5,42	-4,24	-0,07
546,0	-56,40	195,46	1546921,27	6365616,44	-441,31	49378	70,88	0,998287	✍	5,48	-4,29	-0,07
549,0	-56,42	195,34	1546920,83	6365614,84	-443,81	49476	70,96	0,998452	✍	5,55	-4,34	-0,07
552,0	-56,38	195,70	1546920,38	6365613,24	-446,30	49207	71,06	0,998370	✍	5,61	-4,38	-0,07
555,0	-56,40	196,16	1546919,93	6365611,64	-448,80	49610	70,98	0,998603	✍	5,68	-4,42	-0,07
558,0	-56,36	195,18	1546919,48	6365610,04	-451,30	49218	71,18	0,998360	✍	5,74	-4,46	-0,08
561,0	-56,36	195,75	1546919,04	6365608,44	-453,80	49559	70,53	0,998416	✍	5,81	-4,51	-0,08
564,0	-56,35	196,29	1546918,58	6365606,84	-456,30	49889	70,52	0,998376	✍	5,87	-4,54	-0,08
567,0	-56,40	196,13	1546918,11	6365605,25	-458,79	49691	70,49	0,998223	✍	5,94	-4,57	-0,08
570,0	-56,40	194,15	1546917,68	6365603,64	-461,29	49932	71,07	0,998302	✍	6,00	-4,63	-0,08
573,0	-56,37	195,49	1546917,26	6365602,04	-463,79	49961	70,62	0,998523	✍	6,07	-4,69	-0,08
576,0	-56,37	195,30	1546916,82	6365600,44	-466,29	49654	70,72	0,998504	✍	6,13	-4,74	-0,08
579,0	-56,38	195,24	1546916,38	6365598,83	-468,79	49707	70,62	0,998231	✍	6,20	-4,80	-0,08
582,0	-56,35	194,92	1546915,95	6365597,23	-471,29	49777	70,69	0,997992	✍	6,26	-4,86	-0,08
585,0	-56,36	195,11	1546915,51	6365595,62	-473,78	49754	70,39	0,998427	✍	6,33	-4,92	-0,09
588,0	-56,34	195,02	1546915,08	6365594,02	-476,28	49631	70,65	0,998340	✍	6,39	-4,98	-0,09
591,0	-56,32	195,00	1546914,65	6365592,41	-478,78	49608	70,73	0,998058	✍	6,46	-5,04	-0,09
594,0	-56,31	194,62	1546914,23	6365590,80	-481,27	49673	70,83	0,998299	✍	6,53	-5,11	-0,09
597,0	-56,29	194,60	1546913,81	6365589,19	-483,77	49696	70,75	0,998107	✍	6,60	-5,18	-0,09
600,0	-56,30	194,36	1546913,39	6365587,58	-486,26	49720	70,63	0,998069	✍	6,67	-5,26	-0,09
603,0	-56,28	194,19	1546912,98	6365585,97	-488,76	49841	70,73	0,998140	✍	6,74	-5,34	-0,10
606,0	-56,27	194,56	1546912,57	6365584,35	-491,26	49921	70,46	0,998260	✍	6,81	-5,42	-0,10
609,0	-56,28	194,43	1546912,15	6365582,74	-493,75	49642	70,53	0,998117	✍	6,87	-5,50	-0,10

Survey name : KLX19A

Survey date : 10/10/2007 21:39:16

Printed on 2007-01-25 06:45:42

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
612,0	-56,26	194,29	1546911,74	6365581,13	-496,25	49715	70,71	0,998193	✍	6,94	-5,58	-0,10
615,0	-56,29	194,36	1546911,32	6365579,51	-498,74	49785	70,63	0,997963	✍	7,01	-5,66	-0,10
618,0	-56,28	194,17	1546910,91	6365577,90	-501,24	49728	70,67	0,998237	✍	7,08	-5,74	-0,11
621,0	-56,28	194,20	1546910,51	6365576,28	-503,73	49651	70,59	0,998350	✍	7,15	-5,83	-0,11
624,0	-56,26	194,17	1546910,10	6365574,67	-506,23	49590	70,47	0,998399	✍	7,22	-5,91	-0,11
627,0	-56,27	195,24	1546909,67	6365573,06	-508,72	49732	70,81	0,998385	✍	7,29	-5,98	-0,11
630,0	-56,27	195,24	1546909,24	6365571,45	-511,22	49505	70,68	0,998635	✍	7,36	-6,04	-0,11
633,0	-56,26	194,85	1546908,80	6365569,84	-513,71	49837	70,68	0,998149	✍	7,43	-6,10	-0,11
636,0	-56,24	194,60	1546908,38	6365568,23	-516,21	49854	70,50	0,998310	✍	7,50	-6,17	-0,12
639,0	-56,22	194,40	1546907,96	6365566,62	-518,70	49826	70,67	0,998620	✍	7,58	-6,24	-0,12
642,0	-56,25	194,11	1546907,55	6365565,00	-521,19	49733	70,63	0,998095	✍	7,65	-6,33	-0,12
645,0	-56,23	194,25	1546907,14	6365563,38	-523,69	49542	70,52	0,998507	✍	7,72	-6,41	-0,12
648,0	-56,25	194,62	1546906,73	6365561,77	-526,18	49704	70,67	0,998134	✍	7,79	-6,49	-0,12
651,0	-56,24	194,73	1546906,31	6365560,16	-528,68	49757	70,73	0,998403	✍	7,86	-6,56	-0,12
654,0	-56,24	196,36	1546905,86	6365558,55	-531,17	50519	71,15	0,998126	✍	7,93	-6,61	-0,13
657,0	-56,23	194,04	1546905,42	6365556,94	-533,66	49606	70,63	0,998568	✍	8,01	-6,67	-0,13
660,0	-56,24	194,13	1546905,02	6365555,32	-536,16	49932	70,56	0,998320	✍	8,08	-6,75	-0,13
663,0	-56,26	194,09	1546904,61	6365553,71	-538,65	49780	70,63	0,998766	✍	8,15	-6,84	-0,13
666,0	-56,26	194,21	1546904,20	6365552,09	-541,15	49757	70,68	0,998237	✍	8,22	-6,93	-0,13
669,0	-56,27	194,86	1546903,78	6365550,48	-543,64	49666	70,58	0,998436	✍	8,29	-7,00	-0,14
672,0	-56,28	194,51	1546903,36	6365548,87	-546,14	49673	70,52	0,998215	✍	8,36	-7,08	-0,14
675,0	-56,29	194,18	1546902,95	6365547,26	-548,63	49932	71,00	0,998345	✍	8,43	-7,16	-0,14
678,0	-56,31	194,21	1546902,54	6365545,64	-551,13	49721	70,70	0,998323	✍	8,49	-7,24	-0,14
681,0	-56,32	194,37	1546902,13	6365544,03	-553,62	49706	70,52	0,998495	✍	8,56	-7,32	-0,14
684,0	-56,31	193,99	1546901,72	6365542,42	-556,12	49859	70,70	0,998412	✍	8,63	-7,41	-0,14
687,0	-56,32	193,57	1546901,33	6365540,80	-558,62	49815	70,60	0,998138	✍	8,70	-7,51	-0,15
690,0	-56,31	193,65	1546900,94	6365539,18	-561,11	50751	70,32	0,998318	✍	8,76	-7,61	-0,15
693,0	-56,30	194,30	1546900,53	6365537,57	-563,61	49894	70,57	0,998574	✍	8,83	-7,70	-0,15
696,0	-56,31	193,97	1546900,13	6365535,95	-566,11	49959	70,64	0,998349	✍	8,90	-7,79	-0,15
699,0	-56,31	194,44	1546899,72	6365534,34	-568,60	49834	70,61	0,998477	✍	8,96	-7,87	-0,16
702,0	-56,30	193,50	1546899,32	6365532,73	-571,10	50153	70,60	0,998424	✍	9,03	-7,96	-0,16
705,0	-56,29	193,98	1546898,92	6365531,11	-573,59	49724	70,68	0,998539	✍	9,10	-8,06	-0,16
708,0	-56,28	193,74	1546898,52	6365529,49	-576,09	49421	70,62	0,998280	✍	9,17	-8,16	-0,16
711,0	-56,29	194,36	1546898,12	6365527,88	-578,58	49585	70,73	0,998667	✍	9,24	-8,25	-0,16

FLEXIT: SmartTool drillhole survey result table.

Survey name : KLX19A

Survey date : 10/10/2007 21:39:16

Printed on 2007-01-25 06:45:42

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
714,0	-56,30	193,70	1546897,72	6365526,26	-581,08	49900	70,56	0,998319	✍	9,30	-8,34	-0,17
717,0	-56,29	193,88	1546897,32	6365524,64	-583,58	49645	70,63	0,998137	✍	9,37	-8,43	-0,17
720,0	-56,30	193,88	1546896,92	6365523,03	-586,07	49778	70,67	0,997931	✍	9,44	-8,53	-0,17
723,0	-56,26	194,25	1546896,51	6365521,41	-588,57	49795	70,69	0,998424	✍	9,51	-8,62	-0,17
726,0	-56,24	193,98	1546896,11	6365519,80	-591,06	49758	70,74	0,998548	✍	9,58	-8,71	-0,18
729,0	-56,27	194,14	1546895,70	6365518,18	-593,56	49751	70,65	0,998453	✍	9,65	-8,79	-0,18
732,0	-56,25	193,96	1546895,30	6365516,56	-596,05	49757	70,68	0,998341	✍	9,72	-8,88	-0,18
735,0	-56,24	194,09	1546894,89	6365514,95	-598,54	49847	70,61	0,998254	✍	9,79	-8,97	-0,18
738,0	-56,22	193,71	1546894,49	6365513,33	-601,04	49807	70,69	0,998186	✍	9,86	-9,07	-0,18
741,0	-56,21	193,86	1546894,10	6365511,71	-603,53	49829	70,80	0,998641	✍	9,93	-9,17	-0,19
744,0	-56,20	193,68	1546893,70	6365510,09	-606,03	49711	70,68	0,998054	✍	10,00	-9,26	-0,19
747,0	-56,18	193,96	1546893,30	6365508,47	-608,52	49752	70,76	0,998280	✍	10,08	-9,36	-0,19
750,0	-56,20	194,02	1546892,90	6365506,85	-611,01	49712	70,62	0,998290	✍	10,15	-9,45	-0,19
753,0	-56,17	193,63	1546892,50	6365505,23	-613,50	49761	70,55	0,998259	✍	10,22	-9,55	-0,20
756,0	-56,15	194,07	1546892,10	6365503,60	-615,99	49832	70,69	0,998110	✍	10,30	-9,64	-0,20
759,0	-56,14	193,99	1546891,69	6365501,98	-618,49	49896	70,67	0,998411	✍	10,37	-9,73	-0,20
762,0	-56,11	193,73	1546891,29	6365500,36	-620,98	49956	70,83	0,998283	✍	10,45	-9,83	-0,20
765,0	-56,10	193,83	1546890,89	6365498,73	-623,47	49907	70,89	0,998476	✍	10,53	-9,93	-0,21
768,0	-56,09	193,49	1546890,50	6365497,11	-625,96	49867	70,96	0,998259	✍	10,61	-10,03	-0,21
771,0	-56,09	193,55	1546890,11	6365495,48	-628,45	49965	70,99	0,998372	✍	10,68	-10,13	-0,21
774,0	-56,09	193,57	1546889,72	6365493,85	-630,94	49887	70,74	0,998199	✍	10,76	-10,24	-0,21
777,0	-56,07	193,79	1546889,32	6365492,23	-633,43	49878	70,89	0,997993	✍	10,84	-10,34	-0,22
780,0	-56,06	193,89	1546888,92	6365490,60	-635,91	49974	70,89	0,998211	✍	10,92	-10,43	-0,22
783,0	-56,06	193,65	1546888,52	6365488,97	-638,40	49914	70,78	0,998021	✍	11,00	-10,53	-0,22
786,0	-56,02	193,63	1546888,12	6365487,35	-640,89	49891	70,89	0,998161	✍	11,08	-10,63	-0,23
789,0	-56,05	193,63	1546887,73	6365485,72	-643,38	49866	70,76	0,998470	✍	11,16	-10,74	-0,23
792,0	-56,03	193,62	1546887,33	6365484,09	-645,87	49912	70,71	0,998450	✍	11,24	-10,84	-0,23

Deviation logging in KLX28A, 0 to 78 m

New MeasureIT files

Survey name:	**KLX28A**
Survey date:	08/11/2007 13:37:35
Project:	PLU
Location:	Laxemar
Country:	Sweden
Survey company:	Mala GeoScience AB / RAYCON
Surveyed by:	Christer Gustafsson
Survey type:	STANDARD
Operating conditions:	
General comments:	
Client name:	SKB
Client ID number:	APPS 400-06-117
Client reference:	Leif Stenberg
Drill company:	
Drill rig:	
Drill diameter:	76
Survey direction:	INTO hole
Survey run on:	Wireline
Magnetic Var.:	2,6 degrees East of North

FLEXIT

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:	49900	2000	nano Tesla
Magnetic dip:	69.8	2	Degrees

SURVEY	Actual start	End of survey	Difference
Station:	0,0	78,0	78,0
East:	1549333,71	1549327,60	-6,11
North:	6364682,22	6364642,77	-39,45
Elevation:	10,05	-56,95	-67,00
Dip:	-60,10	-58,14	1,96
Azimuth:	189,70	186,60	-3,10

OFFSETS at end
Offsets relative to:
ACTUAL START
1,21 metres upwards
0,62 metres left
0,02 metres shortfall

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Page 1 of 2

FLEXIT: SmartTool drillhole survey result table.

Survey name : KLX28A

Survey date : 08/11/2007 13:37:35

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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
0,0	-60,10	189,70	1549333,71	6364682,22	10,05	49662	72,03	1,004601	✍✍	0,00	0,00	0,00
3,0	-60,06	189,60	1549333,46	6364680,74	7,45	48722	72,95	1,001596	✍✍	0,00	0,00	0,00
6,0	-60,03	189,40	1549333,21	6364679,27	4,85	48975	71,84	1,002230	✍✍	0,00	-0,01	0,00
9,0	-60,02	189,30	1549332,97	6364677,79	2,25	49946	70,71	1,001383	✍	0,01	-0,02	0,00
12,0	-59,93	189,10	1549332,73	6364676,31	-0,35	48614	71,82	1,000714	✍✍	0,01	-0,03	0,00
15,0	-59,87	189,03	1549332,49	6364674,82	-2,94	49359	71,67	1,000451	✍	0,03	-0,05	0,00
18,0	-59,74	190,45	1549332,24	6364673,33	-5,53	49174	71,43	1,000714	✍	0,04	-0,04	0,00
21,0	-59,69	191,07	1549331,95	6364671,85	-8,12	49360	71,27	1,000463	✍	0,06	-0,02	0,00
24,0	-59,62	188,26	1549331,70	6364670,35	-10,71	48991	71,45	1,000813	✍	0,08	-0,02	0,00
27,0	-59,58	188,63	1549331,48	6364668,85	-13,30	50484	71,28	1,000709	✍	0,11	-0,05	0,00
30,0	-59,47	189,24	1549331,24	6364667,35	-15,89	49790	71,24	1,000605	✍	0,14	-0,07	0,00
33,0	-59,44	187,60	1549331,02	6364665,84	-18,47	46834	73,49	1,000567	✍✍✍	0,17	-0,10	0,00
36,0	-59,38	186,42	1549330,83	6364664,33	-21,05	48603	71,71	1,000229	✍	0,21	-0,18	0,00
39,0	-59,28	189,49	1549330,62	6364662,81	-23,63	49105	71,46	1,000598	✍	0,25	-0,22	0,00
42,0	-59,14	189,00	1549330,37	6364661,30	-26,21	48765	71,09	1,000399	✍	0,29	-0,24	0,00
45,0	-59,09	190,09	1549330,12	6364659,78	-28,79	49260	71,07	1,000414	✍	0,35	-0,24	0,00
48,0	-58,98	190,32	1549329,84	6364658,26	-31,36	49846	70,89	1,000704	✍	0,40	-0,23	0,00
51,0	-58,94	188,53	1549329,59	6364656,73	-33,93	49019	71,17	1,000467	✍	0,46	-0,23	-0,01
54,0	-58,86	187,68	1549329,37	6364655,20	-36,50	49380	71,59	1,000257	✍	0,52	-0,28	-0,01
57,0	-58,74	189,29	1549329,14	6364653,66	-39,06	49493	71,23	1,000327	✍	0,59	-0,31	-0,01
60,0	-58,60	188,29	1549328,90	6364652,12	-41,63	48870	71,48	1,000625	✍	0,67	-0,33	-0,01
63,0	-58,49	190,21	1549328,65	6364650,57	-44,18	49522	70,91	1,000264	✍	0,75	-0,35	-0,01
66,0	-58,41	186,54	1549328,42	6364649,02	-46,74	49235	71,35	1,000280	✍	0,83	-0,38	-0,01
69,0	-58,38	188,54	1549328,22	6364647,46	-49,30	49082	71,30	1,000322	✍	0,92	-0,44	-0,01
72,0	-58,30	188,49	1549327,98	6364645,91	-51,85	48873	71,33	1,000335	✍	1,01	-0,47	-0,01
75,0	-58,23	186,47	1549327,78	6364644,34	-54,40	48811	71,62	1,000605	✍	1,11	-0,54	-0,02
78,0	-58,14	186,60	1549327,60	6364642,77	-56,95	50224	70,75	1,000361	✍	1,21	-0,62	-0,02

Deviation logging in KLX29A, 0 to 57 m

New MeasureIT files

Survey name:	**KLX29A**
Survey date:	07/11/2007 15:23:18
Project:	PLU
Location:	Laxemar
Country:	Sweden
Survey company:	Mala GeoScience AB / RAYCON
Surveyed by:	Christer Gustafsson
Survey type:	STANDARD
Operating conditions:	
General comments:	
Client name:	SKB
Client ID number:	APPS 400-06-117
Client reference:	Leif Stenberg
Drill company:	
Drill rig:	
Drill diameter:	76
Survey direction:	INTO hole
Survey run on:	Wireline
Magnetic Var.:	2,6 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:	49900	2000	nano Tesla
Magnetic dip:	69.8	2	Degrees

SURVEY	Actual start	End of survey	Difference
Station:	0,0	57,0	57,0
East:	1549443,99	1549427,26	-16,73
North:	6366264,54	6366287,35	22,81
Elevation:	13,63	-35,85	-49,48
Dip:	-60,99	-59,32	1,67
Azimuth:	322,60	323,77	1,17

OFFSETS at end
Offsets relative to:
ACTUAL START
0,73 metres upwards
0,56 metres right
0,01 metres shortfall

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Page 1 of 2

FLEXIT: SmartTool drillhole survey result table.

Survey name : KLX29A

Survey date : 07/11/2007 15:23:18

Printed on 2007-01-25 11:35:22

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
0,0	-60,99	322,60	1549443,99	6366264,54	13,63	49297	71,34	0,997665	✍	0,00	0,00	0,00
3,0	-60,92	322,60	1549443,11	6366265,70	11,01	48024	70,55	0,998942	✍	0,00	0,00	0,00
6,0	-60,81	321,21	1549442,20	6366266,85	8,39	50789	71,58	0,999581	✍	0,01	-0,02	0,00
9,0	-60,71	321,30	1549441,29	6366267,99	5,77	48039	69,88	0,999623	✍	0,02	-0,05	0,00
12,0	-60,66	321,49	1549440,37	6366269,14	3,15	50215	71,04	0,999573	✍	0,04	-0,08	0,00
15,0	-60,60	322,20	1549439,46	6366270,29	0,54	50374	71,44	0,999319	✍	0,05	-0,10	0,00
18,0	-60,50	323,49	1549438,57	6366271,47	-2,07	49229	71,22	0,999570	✍	0,08	-0,10	0,00
21,0	-60,51	322,83	1549437,69	6366272,65	-4,68	49712	71,37	0,999946	✍	0,10	-0,08	0,00
24,0	-60,44	324,72	1549436,81	6366273,84	-7,30	49387	71,08	0,999862	✍	0,13	-0,05	0,00
27,0	-60,33	324,38	1549435,95	6366275,05	-9,90	49627	71,08	0,999762	✍	0,16	0,00	0,00
30,0	-60,29	324,98	1549435,09	6366276,26	-12,51	48962	70,95	0,999511	✍	0,20	0,05	0,00
33,0	-60,20	324,43	1549434,23	6366277,48	-15,11	49988	71,03	0,999565	✍	0,23	0,11	0,00
36,0	-60,07	324,45	1549433,36	6366278,69	-17,72	49863	70,96	0,999684	✍	0,28	0,16	0,00
39,0	-59,98	324,48	1549432,49	6366279,91	-20,31	49609	70,93	0,999755	✍	0,33	0,20	0,00
42,0	-59,89	324,45	1549431,62	6366281,14	-22,91	49394	70,95	1,000004	✍	0,38	0,25	-0,01
45,0	-59,76	325,55	1549430,75	6366282,37	-25,50	49391	70,91	0,999627	✍	0,44	0,32	-0,01
48,0	-59,69	325,97	1549429,90	6366283,62	-28,10	48944	71,10	0,999569	✍	0,50	0,40	-0,01
51,0	-59,57	324,85	1549429,04	6366284,87	-30,68	49579	71,02	0,999666	✍	0,57	0,47	-0,01
54,0	-59,47	324,25	1549428,16	6366286,11	-33,27	49660	71,02	1,000108	✍	0,65	0,53	-0,01
57,0	-59,32	323,77	1549427,26	6366287,35	-35,85	49738	71,05	1,000586	✍	0,73	0,56	-0,01