P-10-36

Äspö Hard Rock Laboratory

BIPS logging in borehole KC0045F

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August 2010

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ISSN 1651-4416
SKB P-10-36

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Keywords: BIPS, TV

Abstract

This report includes the data gained in geophysical logging operations performed within the investigation at Äspö HRL. The logging operations presented here includes BIPS logging in the core drilled borehole KC0045F. All measurements were conducted during two logging campaigns by Malå Geoscience AB during March and April 2010.

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.

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.

The first logging on March 23th resulted in bad images due to mud covering parts of the borehole walls. After an extensive cleaning operation of the borehole a second logging was performed on April 17th and resulted in a improved image quality down to a depth of 150 metres.

Sammanfattning

Denna rapport omfattar geofysiska loggningar inom undersökningsprogrammet för Äspölaboratoriet. Mätningarna som presenteras här omfattar BIPS-loggning i kärnborrhålet KC0045F. Två mätningar är utförda av Malå Geoscience AB under mars och april 2010.

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

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.

Den första mätningen, vilken genomfördes den 23 mars, resulterade i mycket dåliga bilder. Efter en omfattande rengöring av borrhålet genomfördes en ny mätning den 17 april som resulterade i acceptabel bildkvalitet ner till ca 150 meter.

Contents

1 Introduction

This report presents the data gained in geophysical logging operations, which is one of the activities performed within the investigation at Äspö HRL. The logging operations presented here includes BIPS in the core drilled borehole KC0045F.

The work was carried out in accordance with activity plan AP TD F49-10-008. In Table 1-1 the controlling documents for performing this activity are listed. Both the activity plan and method descriptions are SKB's internal controlling documents.

This report includes measurements from 4 to 225 m in KC0045F. The measurement presented in this report is the second run conducted by Malå Geoscience AB on 17th April 2010.

The used investigation techniques comprised:

- Borehole TV logging with the so-called BIP-system (Borehole Image Processing System), which is a high resolution, side viewing, colour borehole TV system.

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

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

Activity plan	**Number**	**Version**
BIPS i KC0045F	AP TD F49-10-008	1.0
Method descriptions	**Number**	**Version**
Metodbeskrivning för TV-loggning med BIPS	SKB MD 222.006	2.0

2 Objective and scope

The objective of the BIPS surveys is to achieve information on the borehole conditions (borehole wall). Borehole TV is engaged for geological surveying of the borehole including determination of rock types as well as fracture distribution and orientation.

This report describes the equipment used for the BIPS surveys as well as the measurement procedures and data gained. For the BIPS survey, the result is presented as images.

3 Equipment

3.1 TV-Camera, BIPS

The BIPS 1500 system used is owned by SKB and described in SKB internal controlling document MD 222.006. 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 3-1). An acrylic window covers the mirror part and the borehole image is reflected through the window and displayed on the cone, from where it is recorded. During the measuring operation, pixel circles are grabbed with a resolution of 360 pixels/circle.

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

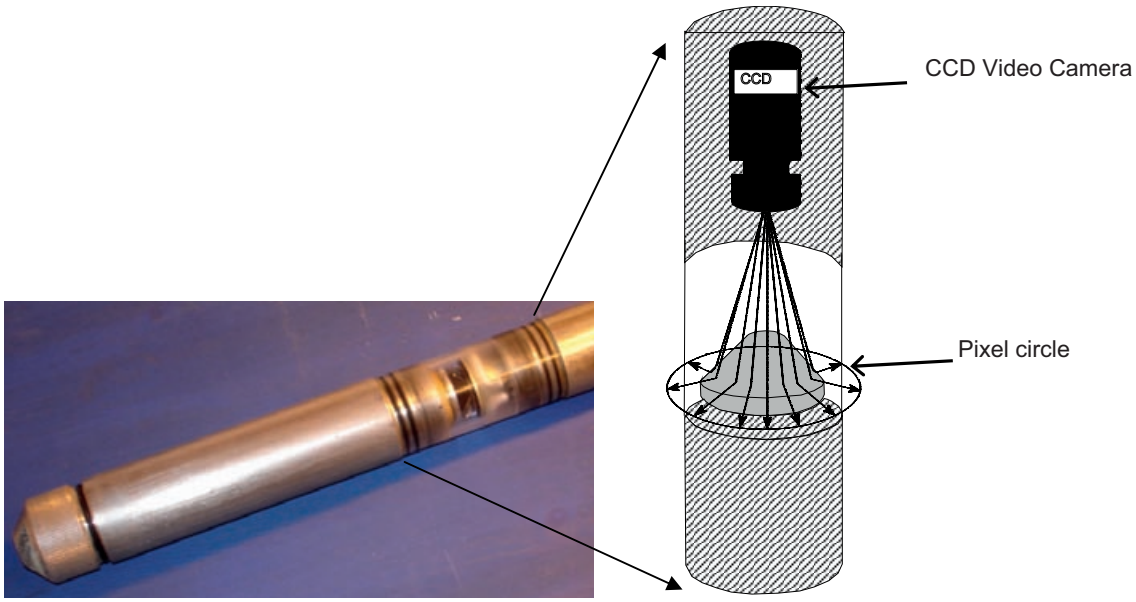


Figure 3-1. *The BIP-system. Illustration of the conical mirror scanning.*

4 Execution

4.1 General

4.1.1 BIPS

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

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

A gravity sensor based on an air bulb in an alcohol liquid was used to measure the orientation of the images in the borehole KC0045F.

In order to control the quality of the system, calibration measurements were performed in a test pipe before logging and after logging. Figure 4-1 shows the results of the test logging performed before and after the logging campaign on 17th April 2010. 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 presented in Appendices 1 and 2 in this report.

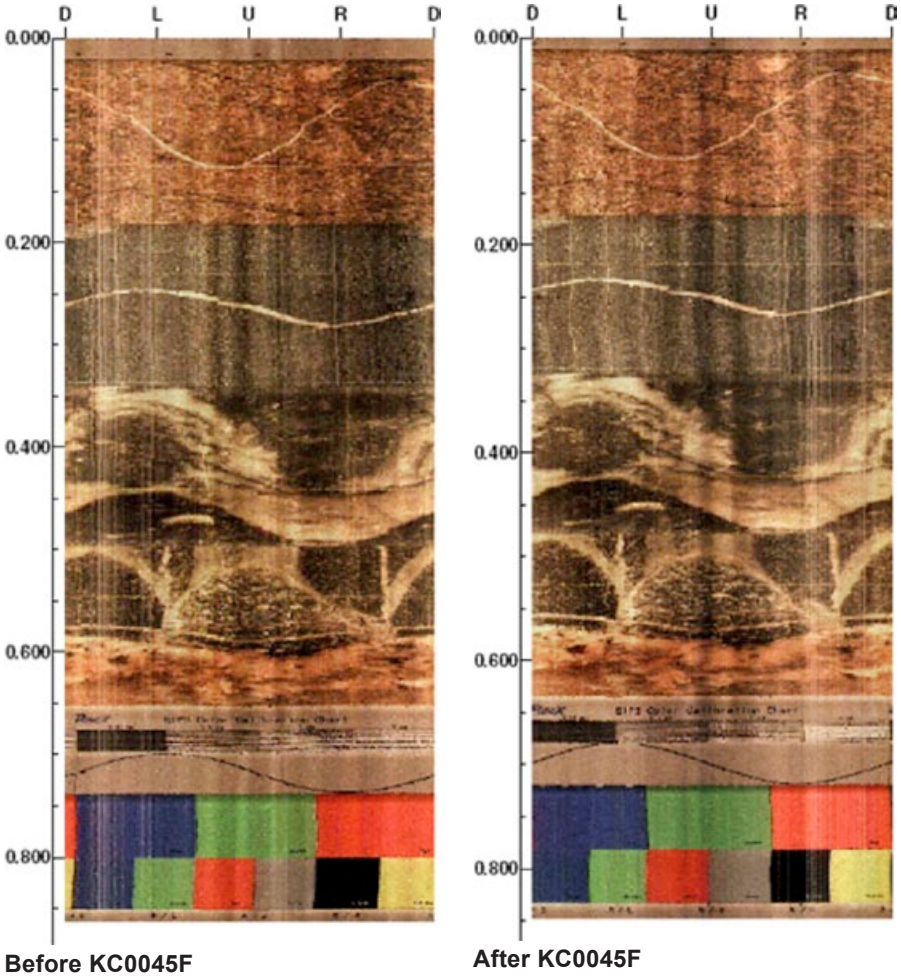


Figure 4-1. *Results from logging in the test pipe before and after the logging campaign in April 2010.*

4.1.2 Length measurements

KC0045F has no depth marks on the borehole wall as normal. Therefore no depth adjustments has been performed on the data and there is only the recorded depth that is presented in the Appendices 1 and 2.

4.2 Analyses and Interpretation

4.2.1 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.

The printed results were delivered with measured length. For printing of the BIPS images the printing software BIPP from RaaX was used.

4.3 Nonconformities

The logging was stopped at 225 metres because of no visibility of the borehole walls.

5 Results

The results from the BIPS measurements for KC0045F were delivered as raw data (*.bip-files) on CD-ROM, DVD 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 stored by SKB.

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 BIPS logging

The BIPS pictures are presented in Appendices 1 and 2.

Due to the low dip angle for the borehole a push rig was used to enter in the BIPS probe into the borehole. The borehole has no reference marks along the borehole, therefore no adjustment for the length recording is performed on the presented result in this report.

In order to control the quality of the system, calibration measurements were performed in a test pipe before the logging and after. The resulting images displayed no differences regarding the colour and focus of the images. The results of the test loggings were included in the delivery of the field data and are also presented in Figure 4-1 in this report.

The repeat section in this case is performed from 4 to 9.5 metres in the borehole in order to check the tool face accuracy on the performed measurement. On the both images a few visible features from the two runs, have been compared. The result presented in Table 5-1 shows that the accuracy of the orientation of the images is within the expected accuracy of the BIPS system. The repeat section is presented in Appendix 2.

Values for the inclination and azimuth of the boreholes, presented in this report, are only preliminary.

The BIPS images show acceptable quality for the logged borehole down to a depth of 153 metres. Deeper down, mud starts to covers the lowermost part of the borehole and at 225 metres the borehole wall is not visible. The images are also partly affected with a distorted signal caused by a malfunction in the winch center. This distortion is visible as a more green background colour on the images.

Table 5-1. Differences in tool face orientation between the delivered logging and repeat section for borehole KC0045F.

KC0045F (metre)	Delivered Tool face orientation	Repeat section Tool face orientation	Difference between the two runs
4.5	187.7	188.9	–1.2
4.9	124.8	127.1	–2.3
5.5	261.4	263.8	–2.4
5.7	218.6	220.2	–1.6
6.8	240.0	242.4	–2.4
7.6	320.8	319.9	0.9
8.4	251.9	251.9	0

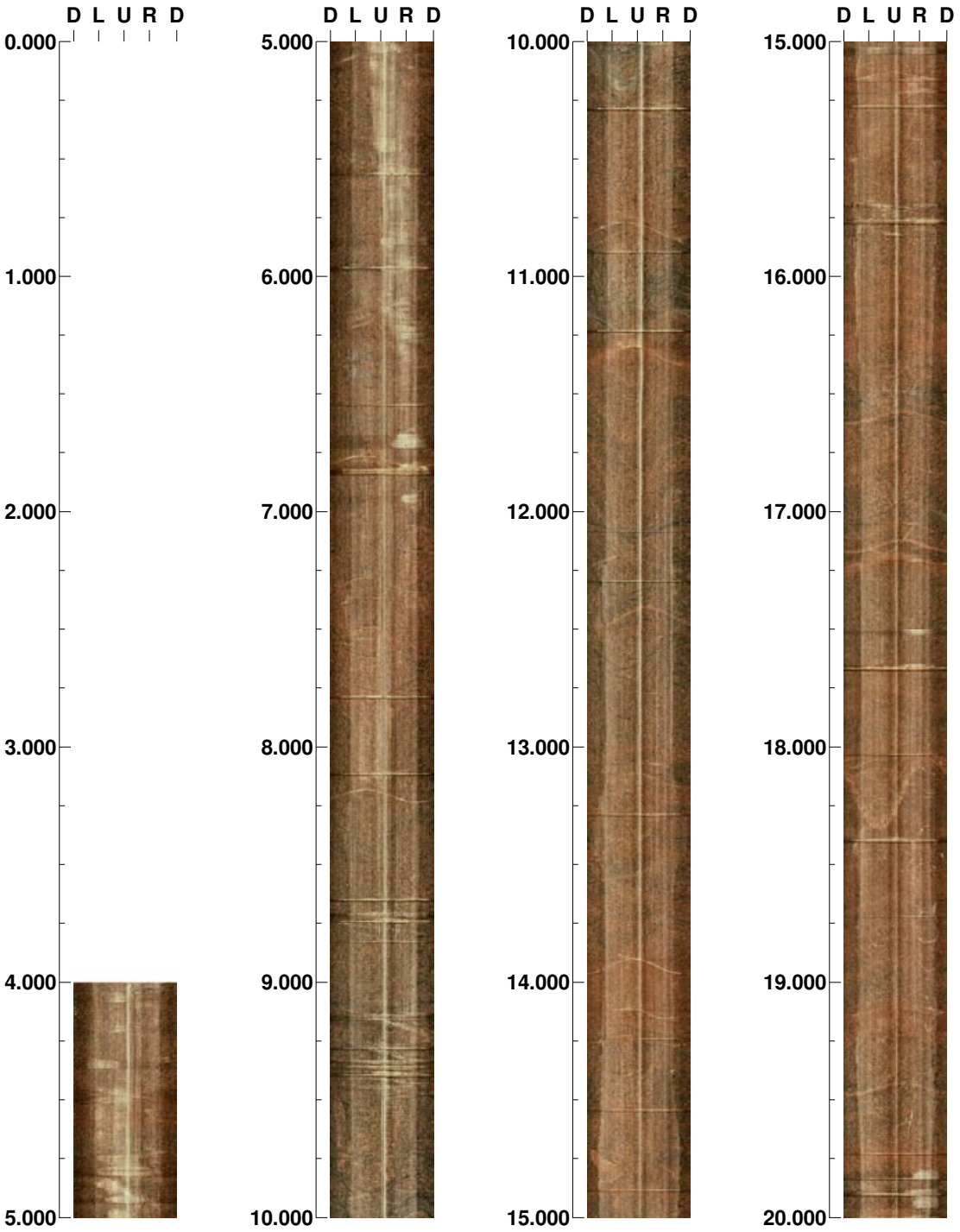
BIPS logging in KC0045F, 4 to 225 m

Project name: Äspö

Image file	**: d:\work\r5865s~1\aptdf4~1\bipsda~2\kc0045f.bip**
BDT file	**:**
Locality	**: ASPO HRL**
Bore hole number	**: KC0045F**
Date	**: 10/04/17**
Time	**: 16:47:00**
Depth range	**: 4.000 - 224.915 m**
Azimuth	**: 85**
Inclination	**: -22.8**
Diameter	**: 56.0 mm**
Magnetic declination	**: 0.0**
Span	**: 4**
Scan interval	**: 0.25**
Scan direction	**: To bottom**
Scale	**: 1/25**
Aspect ratio	**: 250 %**
Pages	**: 12**
Color	**:**  **+0 +0 +0**

Project name: Äspö
Bore hole No.: KC0045F **Azimuth: 85** **Inclination: -22.8**

Depth range: 0.000 - 20.000 m



(1 / 12) **Scale: 1/25** **Aspect ratio: 250 %**

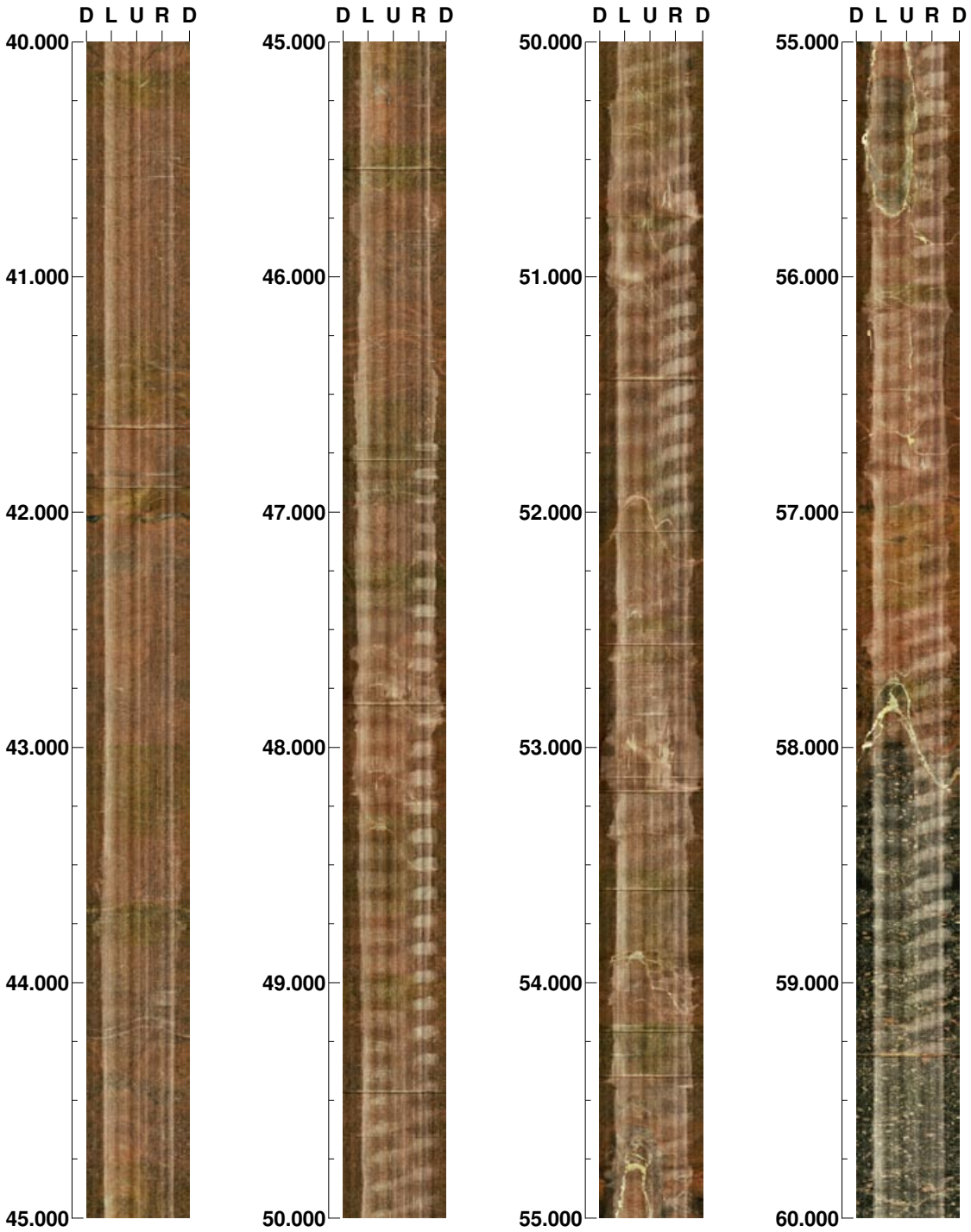
Project name: Äspö
Bore hole No.: KC0045F **Azimuth: 85** **Inclination: -22.8**

Depth range: 20.000 - 40.000 m

(2 / 12) **Scale: 1/25** **Aspect ratio: 250 %**

Project name: Äspö
Bore hole No.: KC0045F **Azimuth: 85** **Inclination: -22.8**

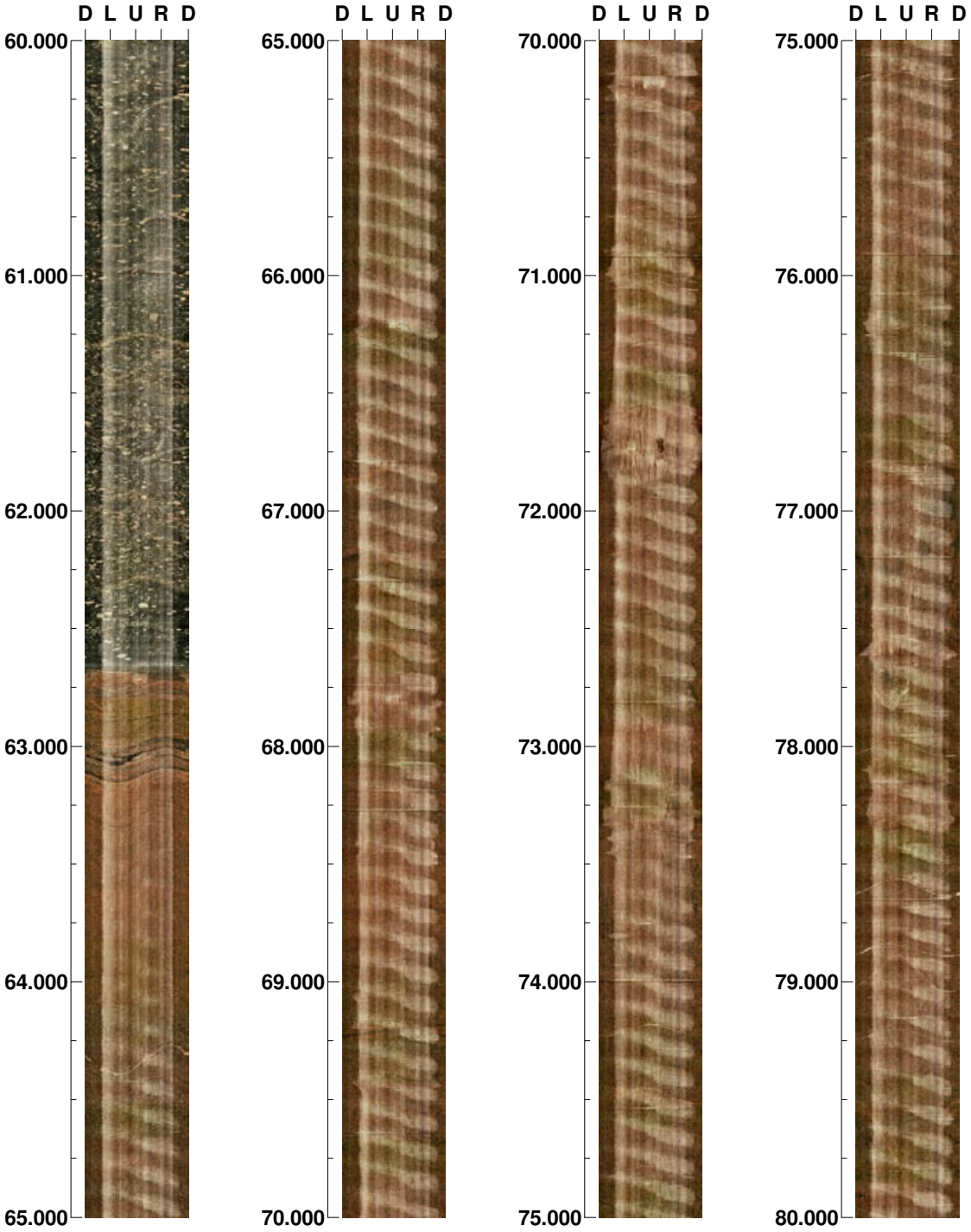
Depth range: 40.000 - 60.000 m



(3 / 12) **Scale: 1/25** **Aspect ratio: 250 %**

Project name: Äspö
Bore hole No.: KC0045F **Azimuth: 85** **Inclination: -22.8**

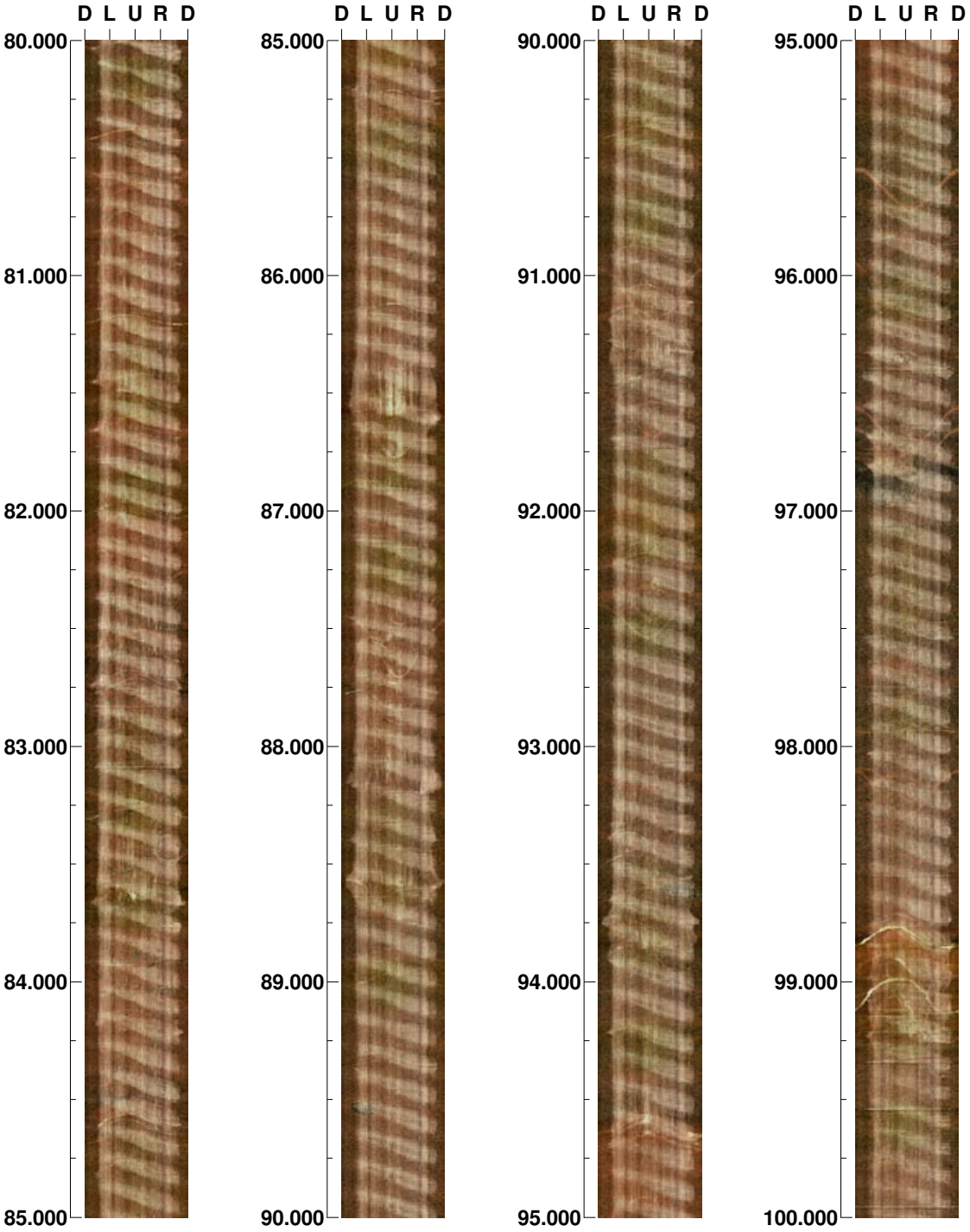
Depth range: 60.000 - 80.000 m



(4 / 12) **Scale: 1/25** **Aspect ratio: 250 %**

Project name: Äspö
Bore hole No.: KC0045F **Azimuth: 85** **Inclination: -22.8**

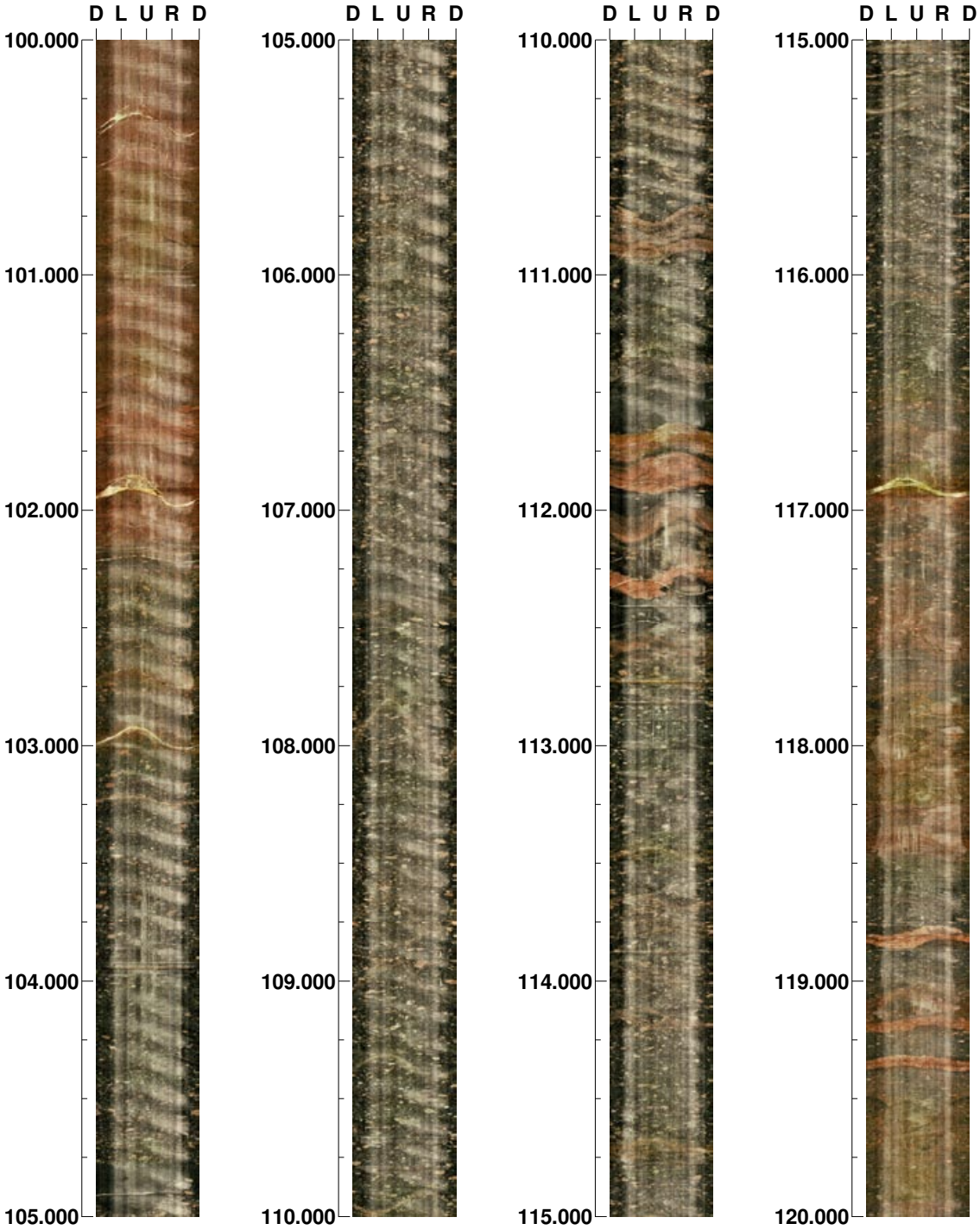
Depth range: 80.000 - 100.000 m



(5 / 12) **Scale: 1/25** **Aspect ratio: 250 %**

Project name: Äspö
Bore hole No.: KC0045F **Azimuth: 85** **Inclination: -22.8**

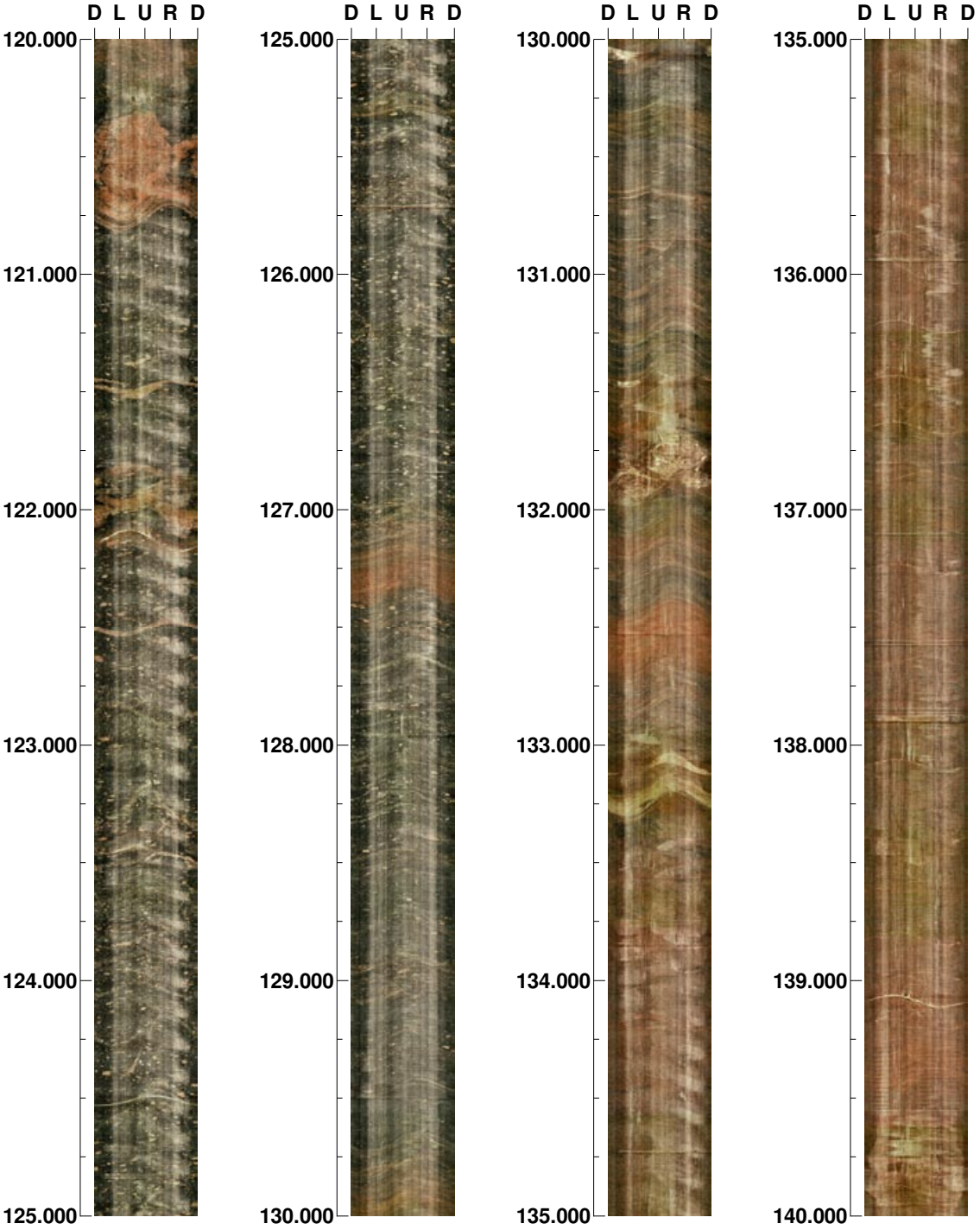
Depth range: 100.000 - 120.000 m



(6 / 12) **Scale: 1/25** **Aspect ratio: 250 %**

Project name: Äspö
Bore hole No.: KC0045F **Azimuth: 85** **Inclination: -22.8**

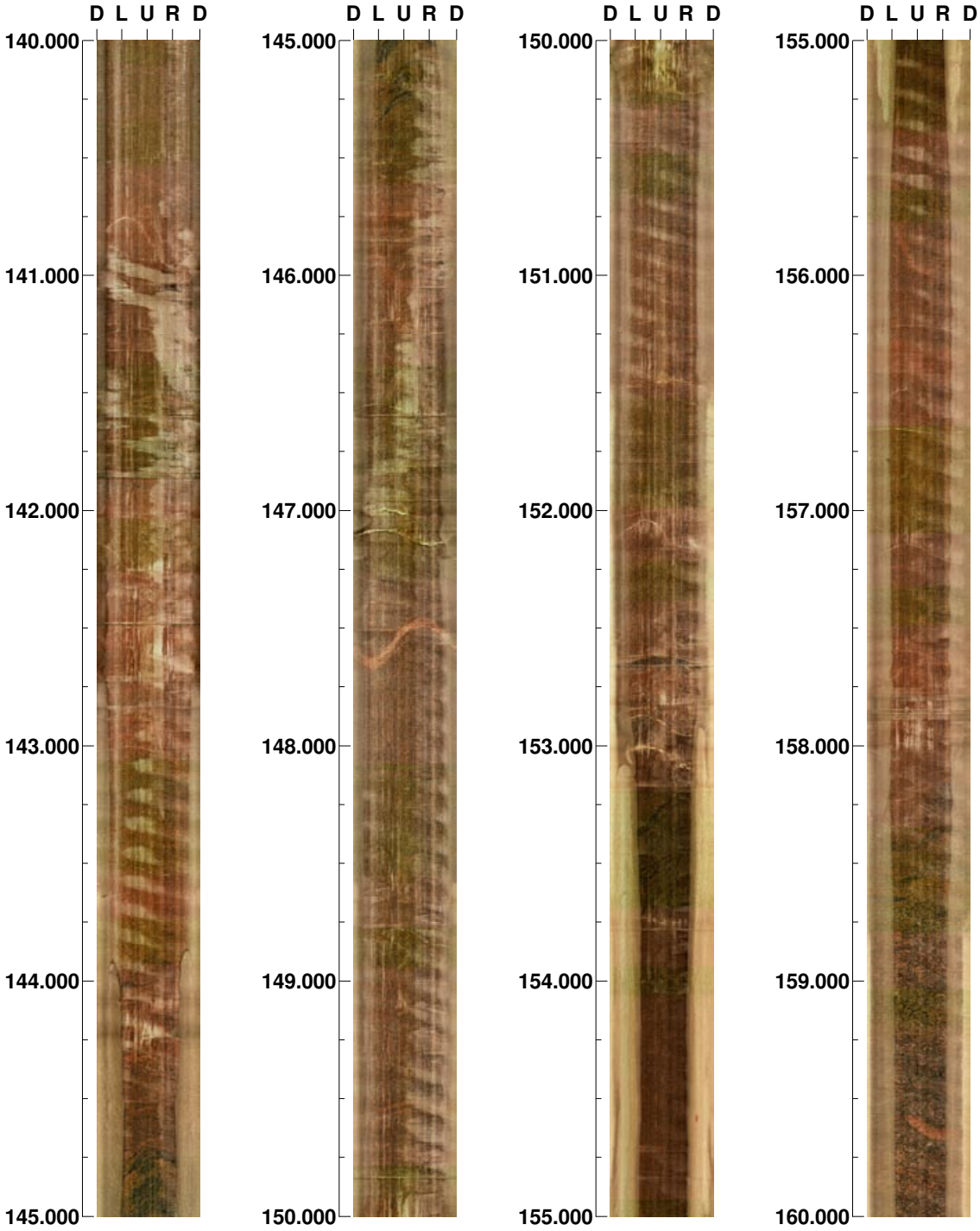
Depth range: 120.000 - 140.000 m



(7 / 12) **Scale: 1/25** **Aspect ratio: 250 %**

Project name: Äspö
Bore hole No.: KC0045F **Azimuth: 85** **Inclination: -22.8**

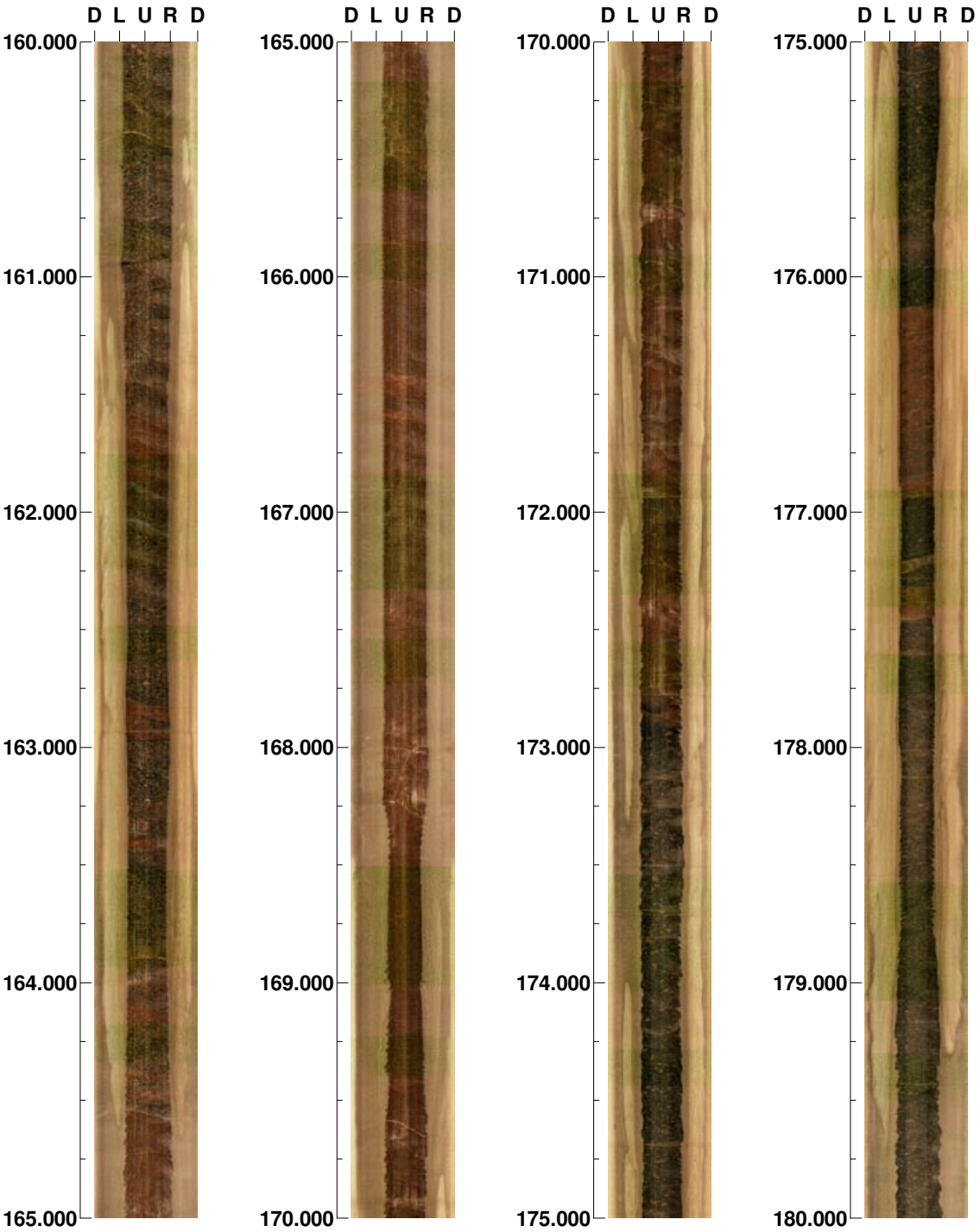
Depth range: 140.000 - 160.000 m



(8 / 12) **Scale: 1/25** **Aspect ratio: 250 %**

Project name: Äspö
Bore hole No.: KC0045F **Azimuth: 85** **Inclination: -22.8**

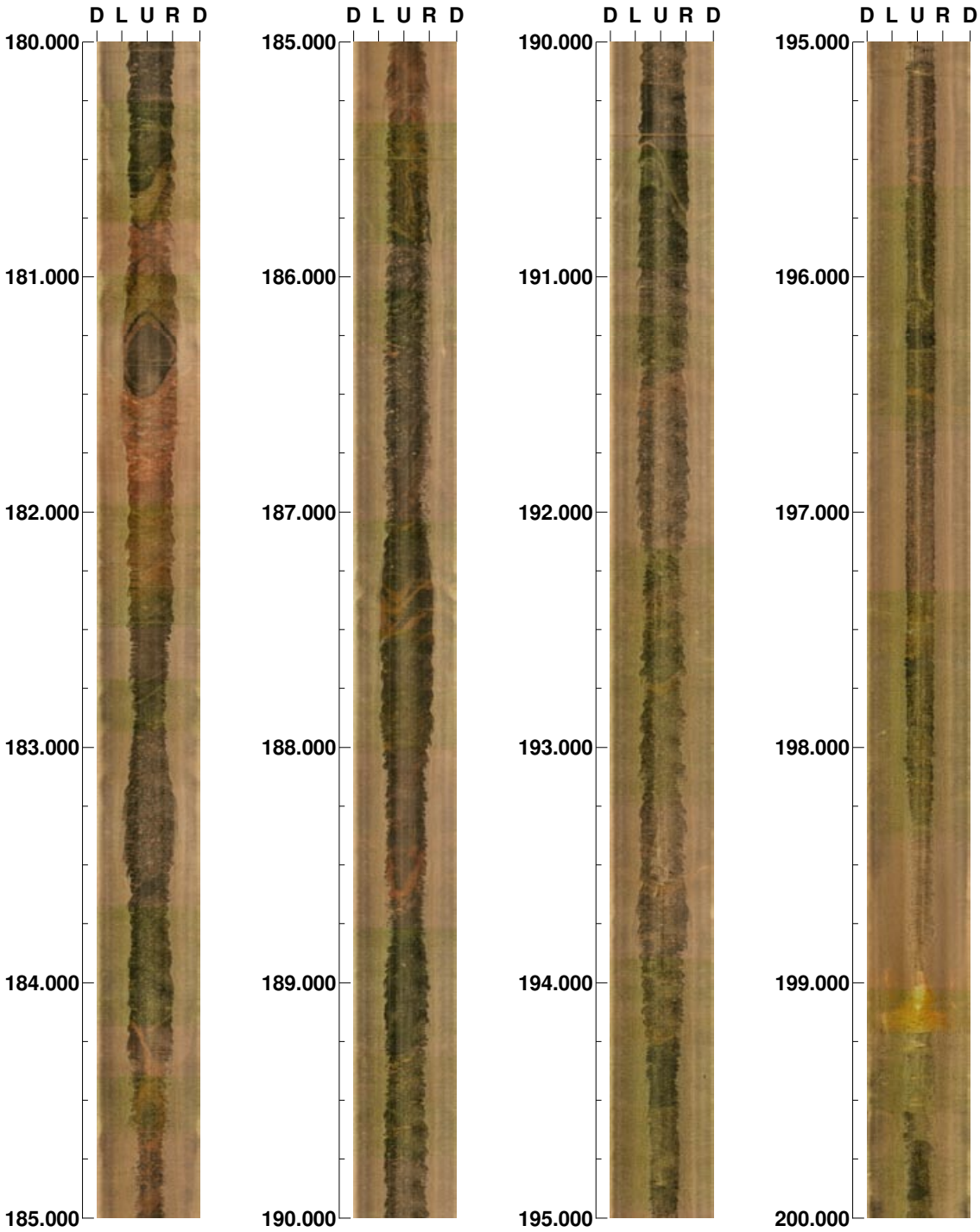
Depth range: 160.000 - 180.000 m



(9 / 12) **Scale: 1/25** **Aspect ratio: 250 %**

Project name: Äspö
Bore hole No.: KC0045F **Azimuth: 85** **Inclination: -22.8**

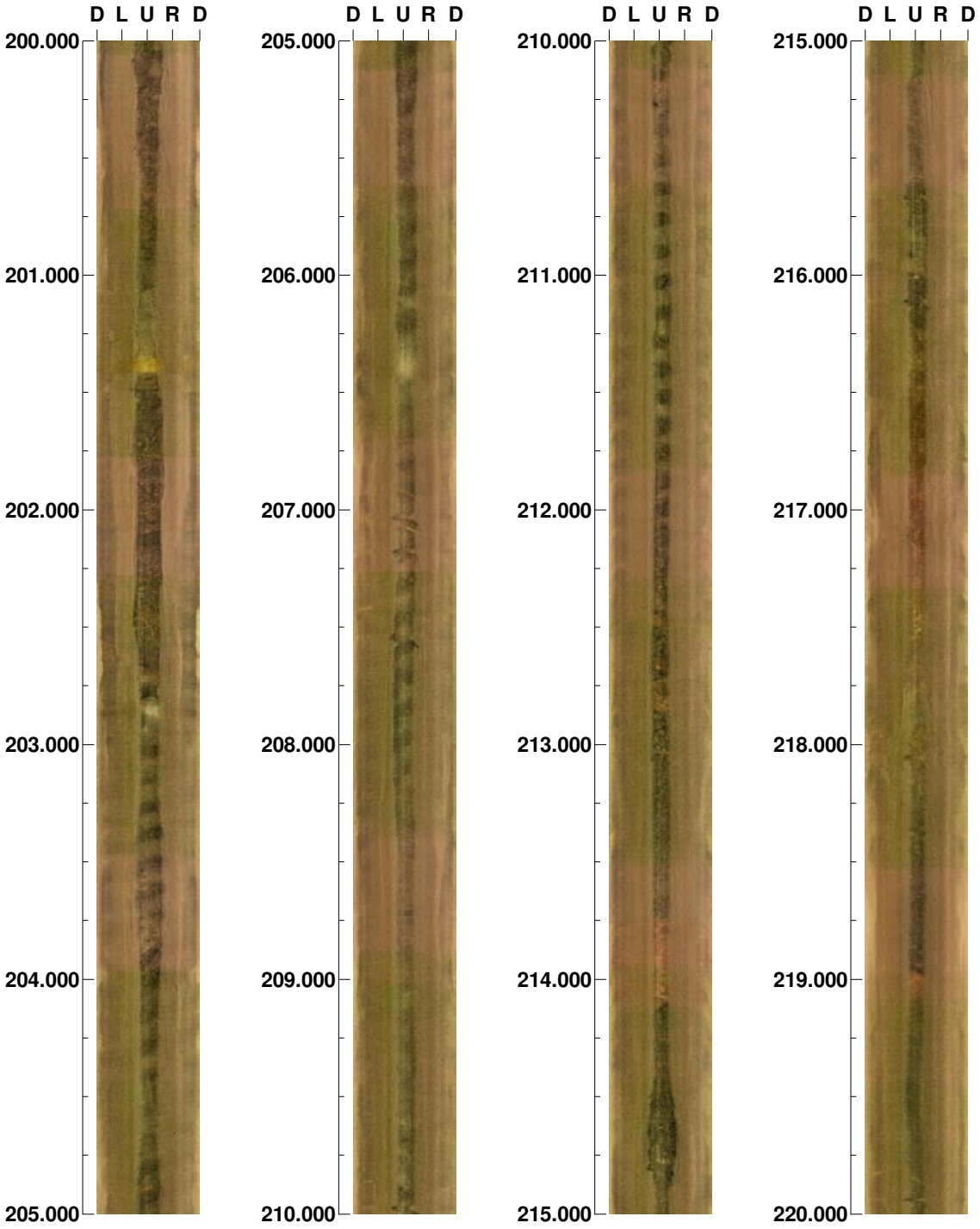
Depth range: 180.000 - 200.000 m



(10 / 12) **Scale: 1/25** **Aspect ratio: 250 %**

Project name: Äspö
Bore hole No.: KC0045F **Azimuth: 85** **Inclination: -22.8**

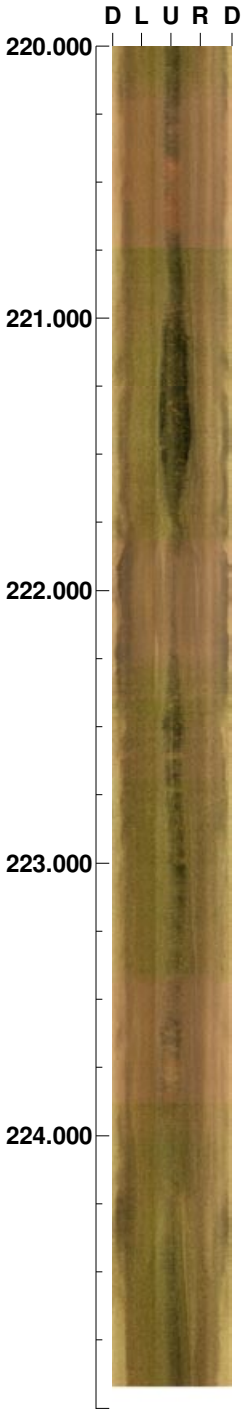
Depth range: 200.000 - 220.000 m



(11 / 12) **Scale: 1/25** **Aspect ratio: 250 %**

Project name: Äspö
Bore hole No.: KC0045F **Azimuth: 85** **Inclination: -22.8**

Depth range: 220.000 - 224.915 m



(12 / 12) **Scale: 1/25** **Aspect ratio: 250 %**

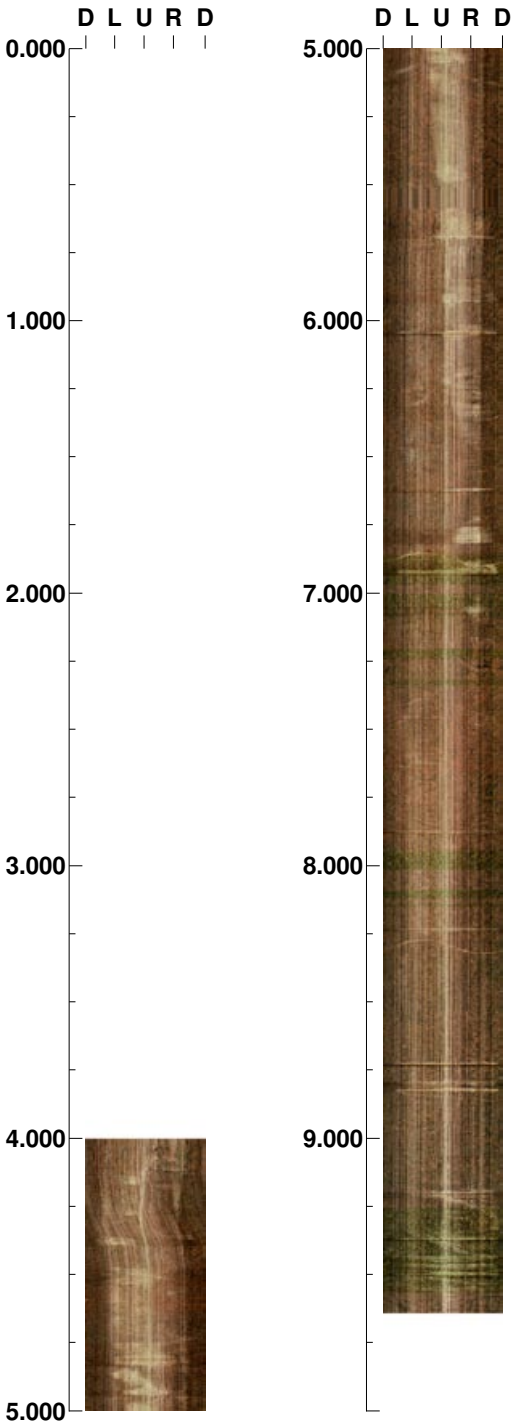
Repeat section, 4 to 9.5 m

Project name: Äspö

Image file	**: d:\work\r5865s~1\aptdf4~1\bipsda~2\001.bip**
BDT file	**:**
Locality	**: ASPH HRL**
Bore hole number	**: KC0045F**
Date	**: 10/04/17**
Time	**: 15:48:00**
Depth range	**: 4.000 - 9.639 m**
Azimuth	**: 85**
Inclination	**: -22.8**
Diameter	**: 56.0 mm**
Magnetic declination	**: 0.0**
Span	**: 4**
Scan interval	**: 0.25**
Scan direction	**: To bottom**
Scale	**: 1/25**
Aspect ratio	**: 250 %**
Pages	**: 1**
Color	**:**  **+0 +0 +0**

Project name: Äspö
Bore hole No.: KC0045F **Azimuth: 85** **Inclination: -22.8**

Depth range: 0.000 - 9.639 m



(1 / 1) **Scale: 1/25** **Aspect ratio: 250 %**