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# **Äspö Hard Rock Laboratory**

## **BIPS logging in borehole KAS09**

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January 2010

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## BIPS logging in borehole KAS09

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*Keywords:* BIPS, TV

This report concerns a study which was conducted for SKB. The conclusions and viewpoints presented in the report are those of the author(s) and do not necessarily coincide with those of the client.



# Abstract

This report includes the data gained in BIPS logging performed at the Äspö Hard Rock Laboratory. The logging operation presented here includes BIPS logging in the core drilled borehole KAS09. The objective for the BIPS logging was to observe the condition of KAS09 in order to restore the borehole in the hydrogeological monitoring programme. All measurements were conducted by Malå Geoscience AB on October 9<sup>th</sup> 2009.

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 basic conditions of the BIPS logging for geological mapping and orientation of structures are satisfying for borehole KAS09, although induced affects from the drilling on the borehole walls limit the visibility.



# Sammanfattning

Denna rapport omfattar BIPS-loggning som genomförts vid Äspölaboratoriet. Mätningen som presenteras här omfattar BIPS-loggning i kärnborrhålet KAS09. Syftet med BIPS loggningen var att undersöka förhållandena i KAS09 inför återställning av borrhålet i det hydrogeologiska monitorings programmet. Mätningen utfördes av Malå Geoscience AB den 9 oktober 2009.

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.

BIPS-bilderna visar att förutsättningarna för geologisk kartering och sprickorientering är goda för KAS09, även om det finns svärtningar på borrhålsväggen som försämrar kvalitén på bilderna.





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# 1 Introduction

This report presents the data gained in BIPS logging operation performed at the Äspö Hard Rock Laboratory. The logging operation presented here includes BIPS logging in the core drilled borehole KAS09. The objective for the BIPS logging was to observe the condition of KAS09 in order to restore the borehole in the hydrogeological monitoring programme.

The work was carried out in accordance with activity plan AP TD F49-09-042. 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.

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

<b>Activity plan</b>	<b>Number</b>	<b>Version</b>
BIPS i KAS09	AP TD F49-09-042	1.0
<b>Method descriptions</b>	<b>Number</b>	<b>Version</b>
Metodbeskrivning för TV- loggning med BIPS	SKB MD 222.006	2.0

This report includes measurements from 100 to 408 m in KAS09. The borehole was core drilled with a diameter of 56 mm from 100 m depth.

The measurements were conducted by Malå Geoscience AB on October 9<sup>th</sup> 2009. The location of the borehole is shown in Figure 1-1.

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.



**Figure 1-1.** Map of the location of the borehole KAS09.

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

## **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 survey as well as the measurement procedures and data gained. For the BIPS survey, the result is presented as images.

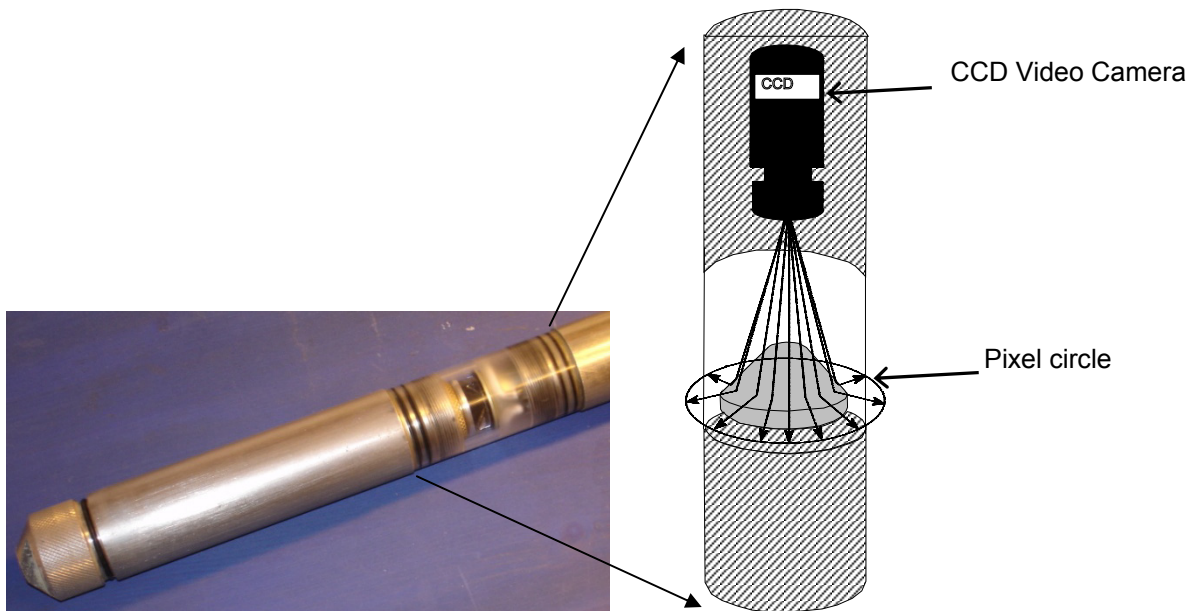


### 3 Equipment

#### 3.1 TV-Camera, BIPS

The BIPS 1500 system used is owned by SKB and described in SKB internal controlling document MD 222.005. 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 3-1). 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**

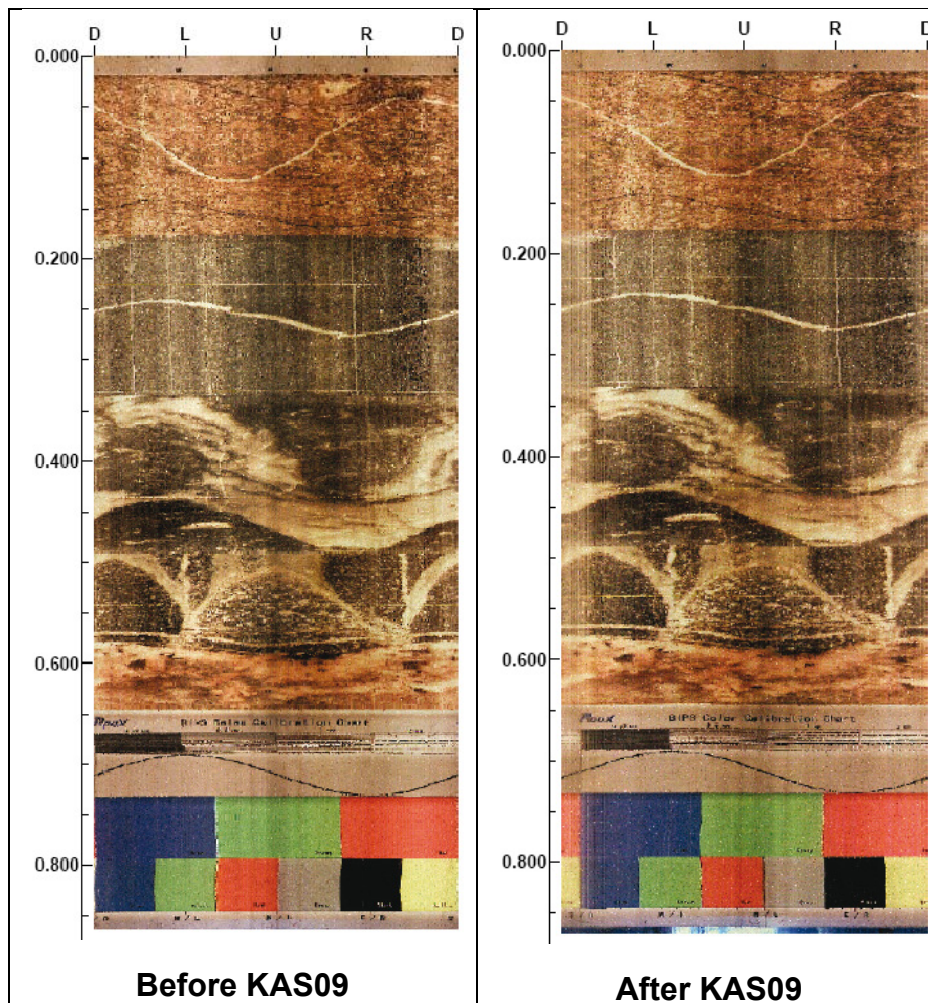
All measurements were performed in accordance with the instructions and guidelines from SKB (internal document MD 222.006). All cleaning of the probe and cable was performed according to the internal document SKB MD 600.004 before the logging operation.

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 KAS09.

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 October 9<sup>th</sup> 2009. 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 Appendix 1 in this report.



*Figure 4-1. Results from logging in the test pipe before and after the logging campaign on October 9<sup>th</sup> 2009.*

#### **4.1.2 Length measurements**

KAS09 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 before the field crew left Äspö Hard Rock Laboratory.

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**

No nonconformities occurred during the logging campaign in KAS09.

## 5 Results

The results from the BIPS measurements for KAS09 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 Äspö Hard Rock Laboratory. The information of the measurements was registered in Sicada, and the digital data and VHS tapes 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 Appendix 1.

To get the best possible length accuracy, the BIPS images are adjusted to the reference marks on the logging cable. In order to control the quality of the system, calibration measurements were performed in a test pipe before and after logging in the campaign. The resulting images displayed no differences regarding the colours 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.

A repeat section (100 to 110 m borehole length) have been performed in the borehole in order to check the accuracy of the interpretation of the direction to an object. The main aim for the repeat section is to get a record of the tool face orientation. In KAS09 the tool face was calculated using the gravity sensor and these orientation results indicates a good performance of the orientation sensor. The repeat section is presented in Appendix 2. A few features, visible in both images 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.

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

The BIPS images show generally acceptable quality for all logged boreholes. However, there always exists mud that covers the lowermost part of the boreholes, especially at the very bottom.

**Table 5-1. Differences in tool face orientation between the delivered logging and repeat section for borehole KAS09.**

<b>KAS09 (meter)</b>	<b>Delivered Tool face orientation</b>	<b>Repeat section Tool face orientation</b>	<b>Difference between the two runs</b>
103.4	316.2	318.9	-2.7
104.3	234.6	233.9	0.7
106.3	51.4	53.8	-2.4
106.8	272.3	269.4	2.9
107.4	283.4	280.2	3.2
109.0	336.2	334.9	1.3

# Appendices

**Appendix 1.** BIPS logging in KAS09, 100 to 408 m.

**Appendix 2.** Repeat section, 100 to 110 m.




**Appendix 1.** BIPS logging in KAS09, 100 to 408 m.





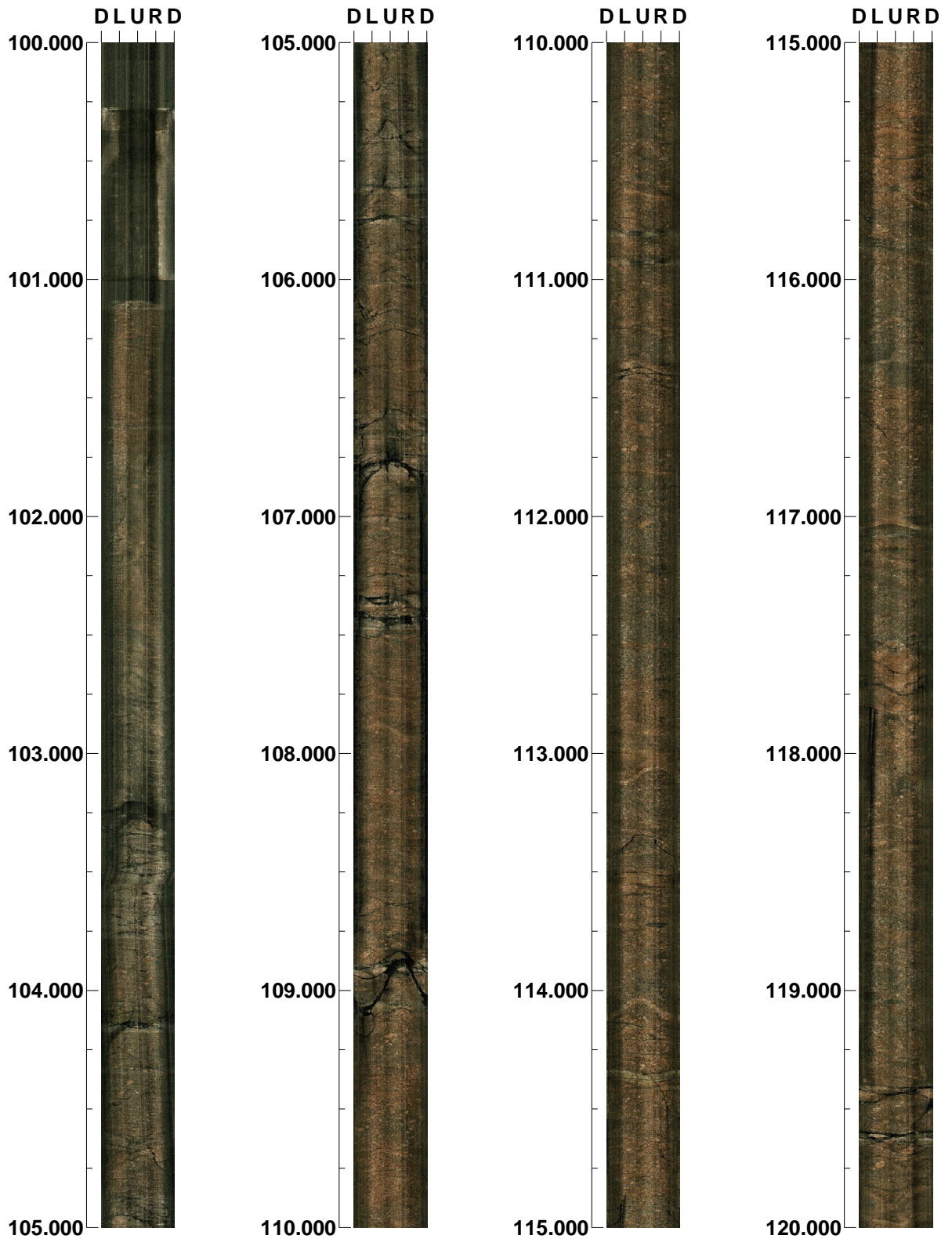
**Project name: ÄSPÖ HRL**

**Image file** : d:\work\r5846s~1\lev\bipsda~1\kas09.bip  
**BDT file** : d:\work\r5846s~1\lev\bipsda~1\kas09.bdt  
**Locality** : ASPO HRL  
**Bore hole number** : KAS09  
**Date** : 09/10/09  
**Time** : 09:02:00  
**Depth range** : 100.000 - 407.940 m  
**Azimuth** : 181  
**Inclination** : -60  
**Diameter** : 56.0 mm  
**Magnetic declination** : 0.0  
**Span** : 4  
**Scan interval** : 0.25  
**Scan direction** : To bottom  
**Scale** : 1/25  
**Aspect ratio** : 175 %  
**Pages** : 16  
**Color** :   
                  +0           +0           +0

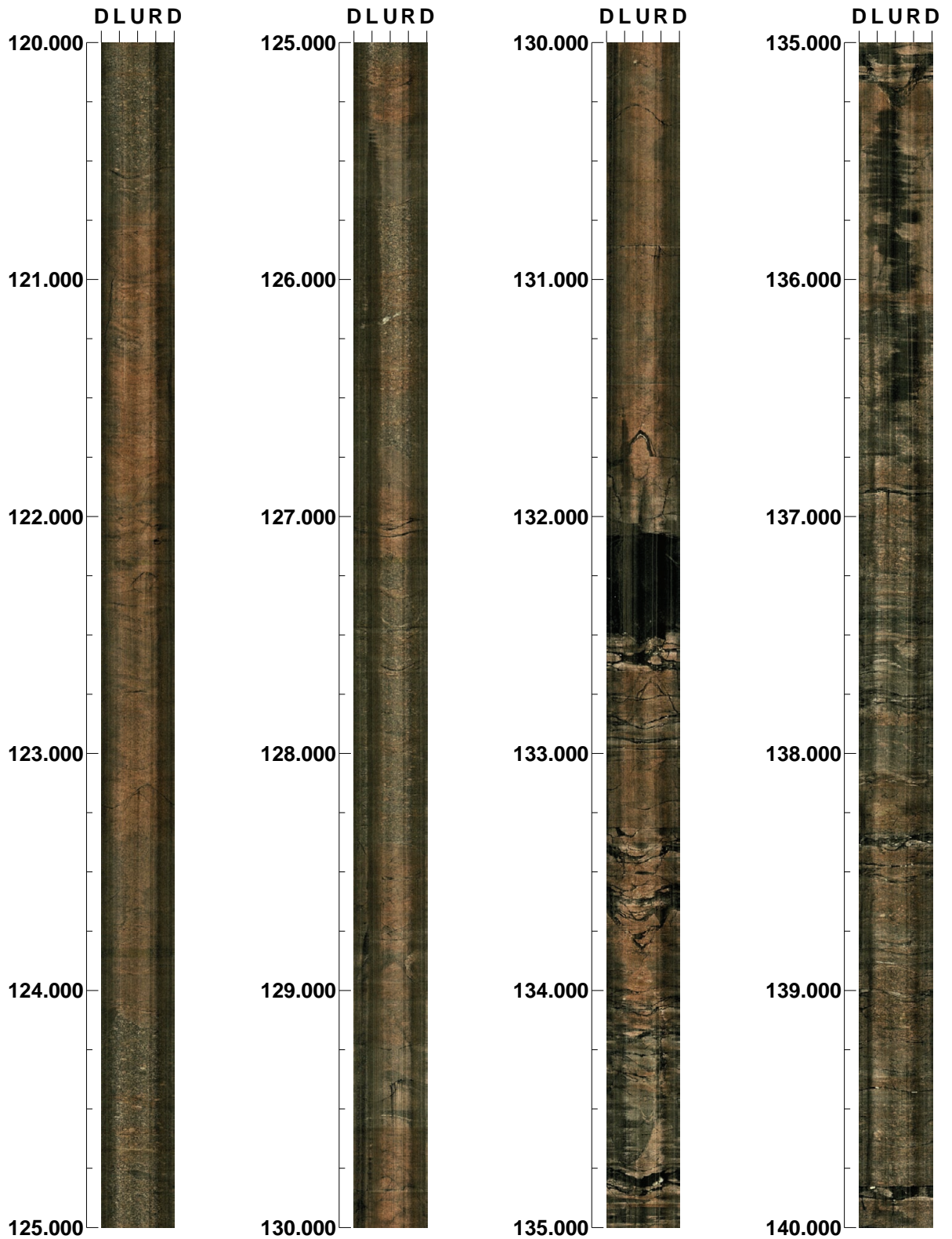
Project name: ÄSPÖ HRL  
Bore hole No.: KAS09

Azimuth: 181      Inclination: -60

Depth range: 100.000 - 120.000 m



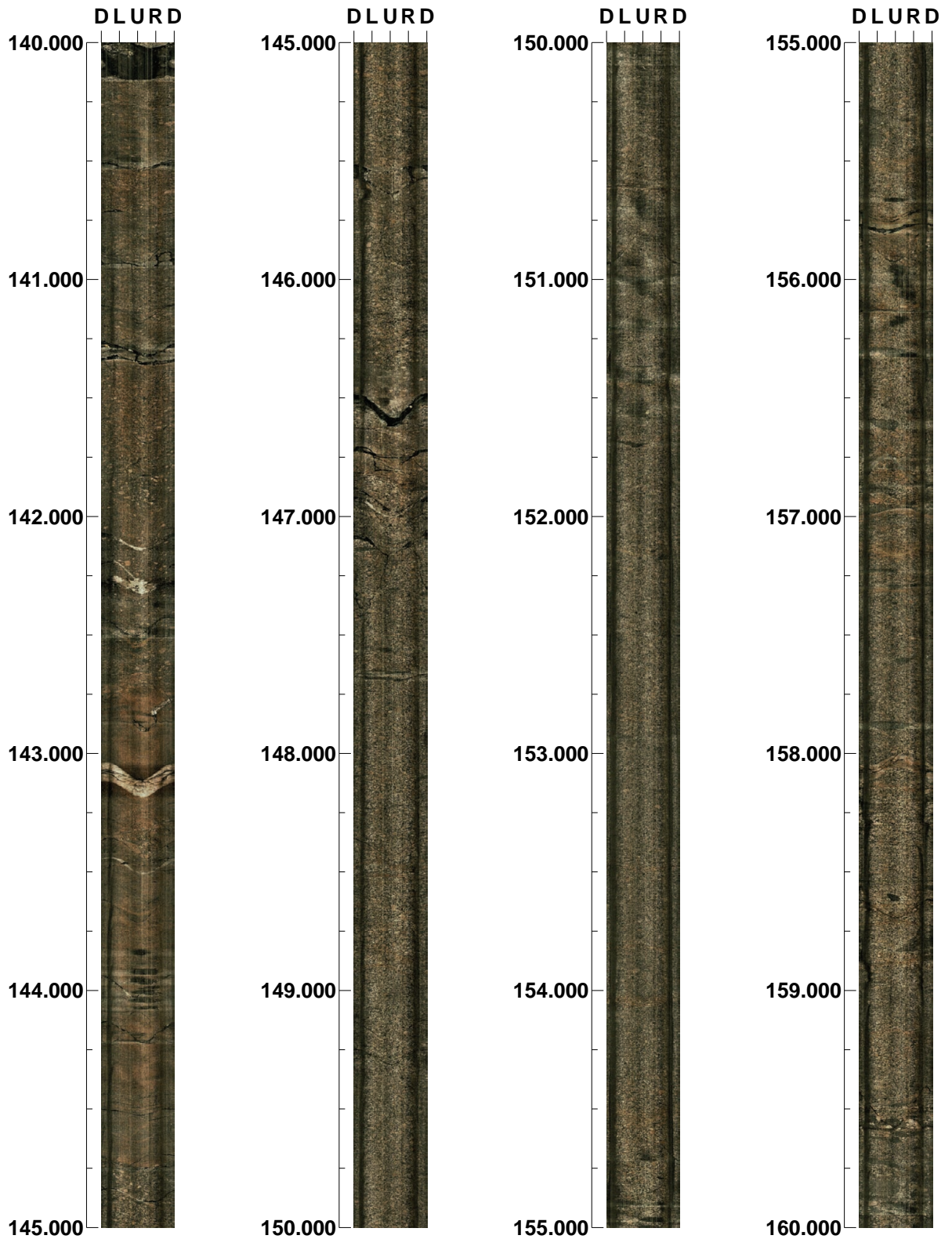
Depth range: 120.000 - 140.000 m



Project name: ÄSPÖ HRL  
Bore hole No.: KAS09

Azimuth: 181      Inclination: -60

Depth range: 140.000 - 160.000 m

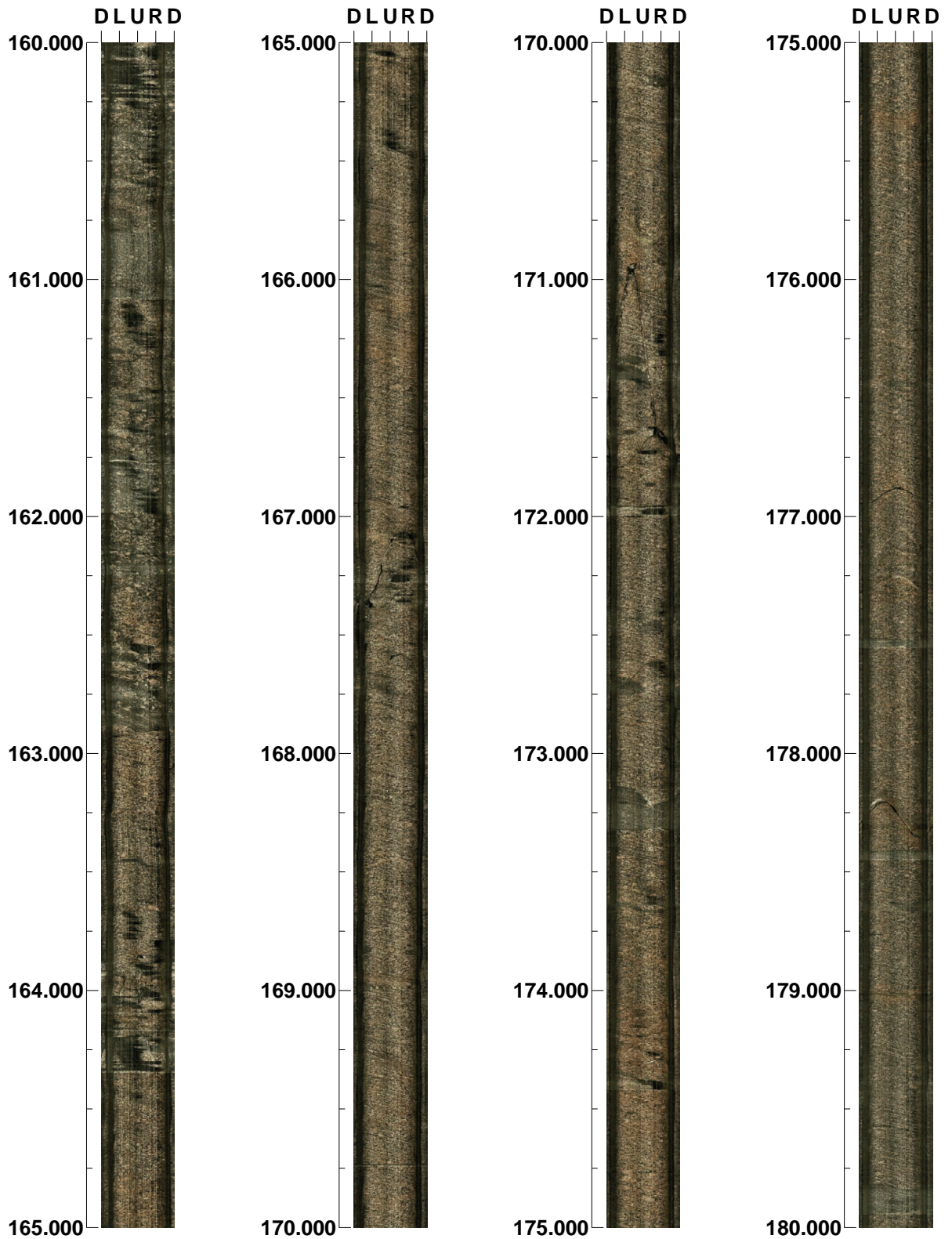




Project name: ÄSPÖ HRL  
Bore hole No.: KAS09

Azimuth: 181      Inclination: -60

Depth range: 160.000 - 180.000 m



Project name: ÄSPÖ HRL  
Bore hole No.: KAS09

Azimuth: 181      Inclination: -60

Depth range: 180.000 - 200.000 m



Project name: ÄSPÖ HRL  
Bore hole No.: KAS09

Azimuth: 181      Inclination: -60

Depth range: 200.000 - 220.000 m

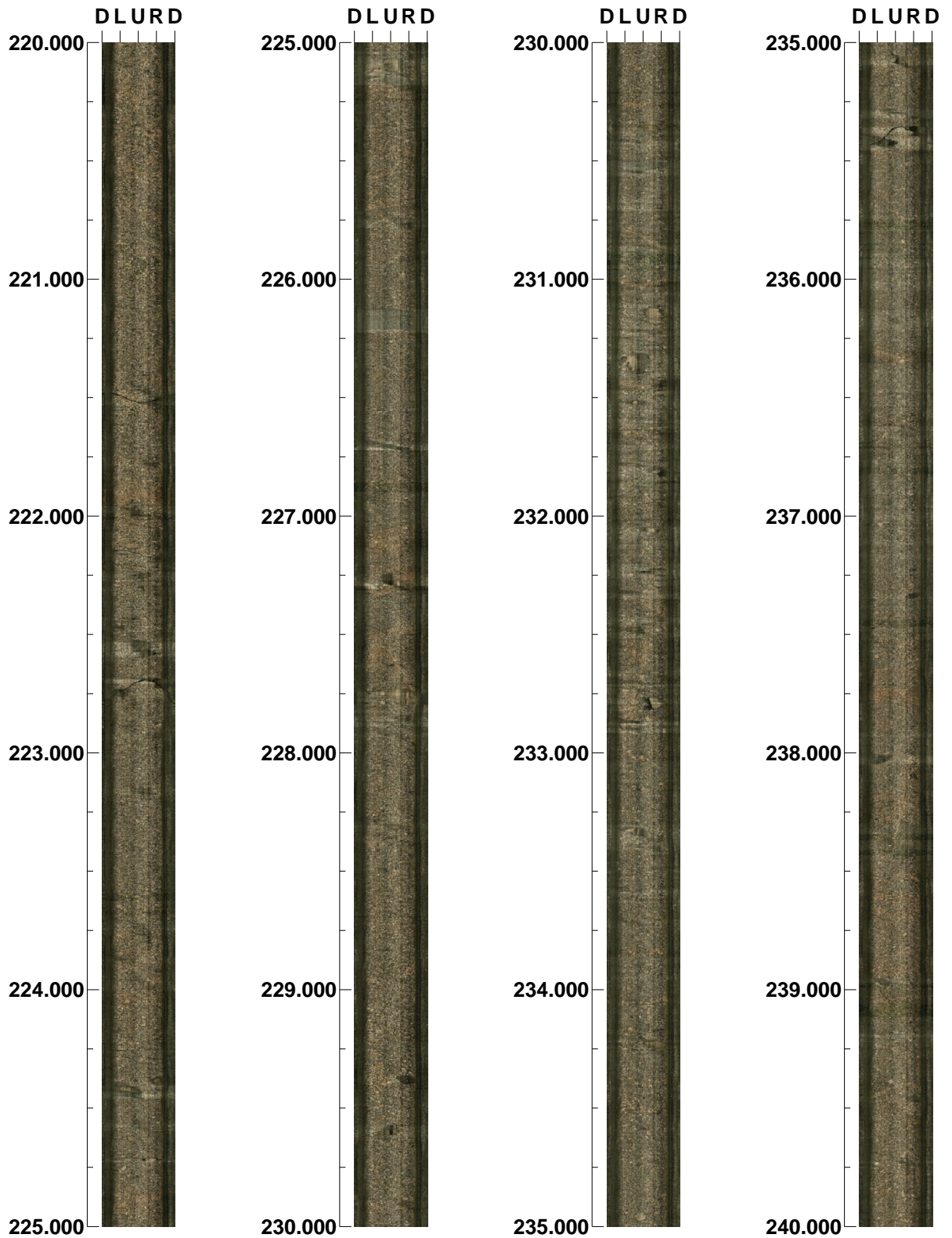




Project name: ÄSPÖ HRL  
Bore hole No.: KAS09

Azimuth: 181      Inclination: -60

Depth range: 220.000 - 240.000 m





Project name: ÄSPÖ HRL  
Bore hole No.: KAS09

Azimuth: 181      Inclination: -60

Depth range: 240.000 - 260.000 m



Depth range: 260.000 - 280.000 m



Depth range: 280.000 - 300.000 m

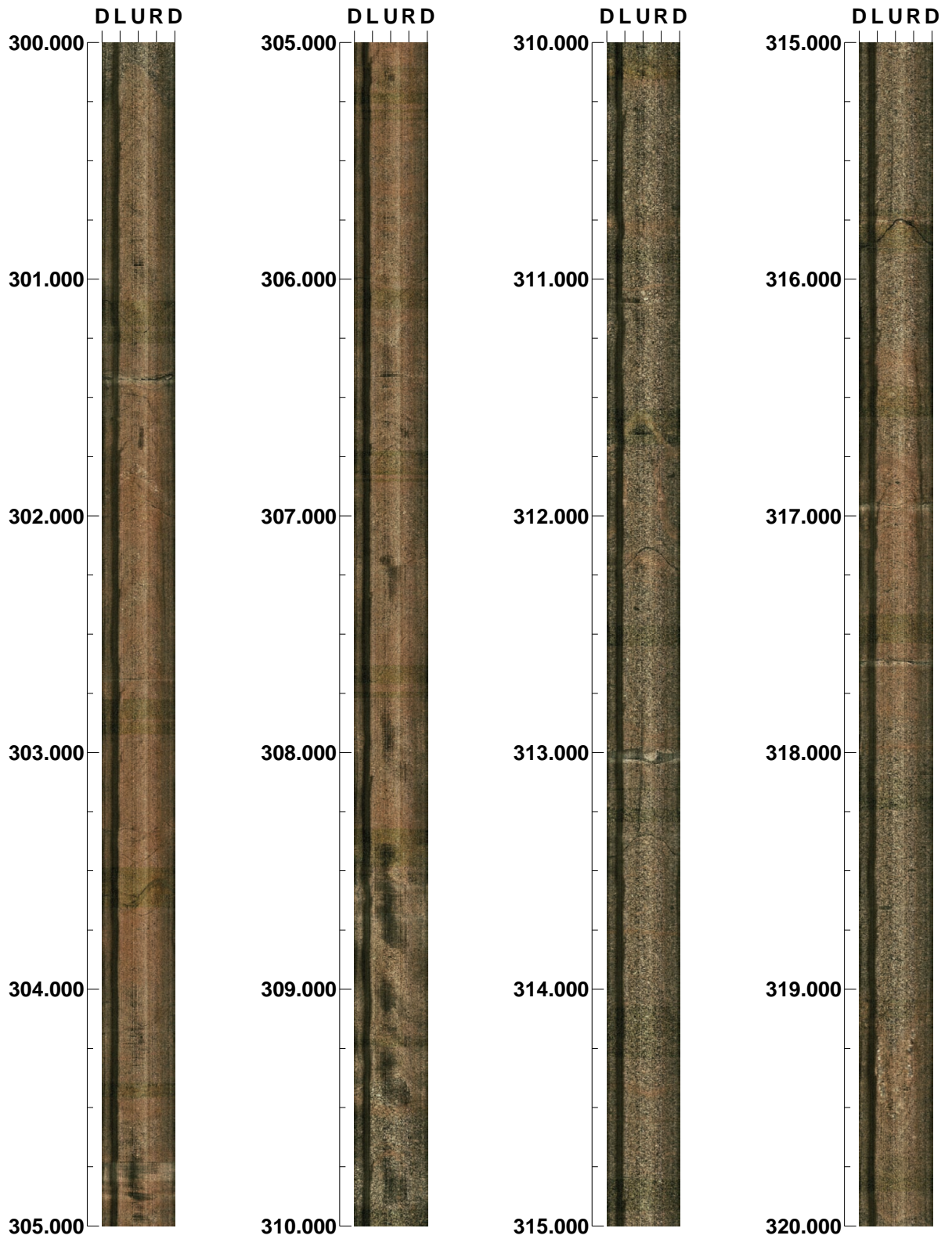




Project name: ÄSPÖ HRL  
Bore hole No.: KAS09

Azimuth: 181      Inclination: -60

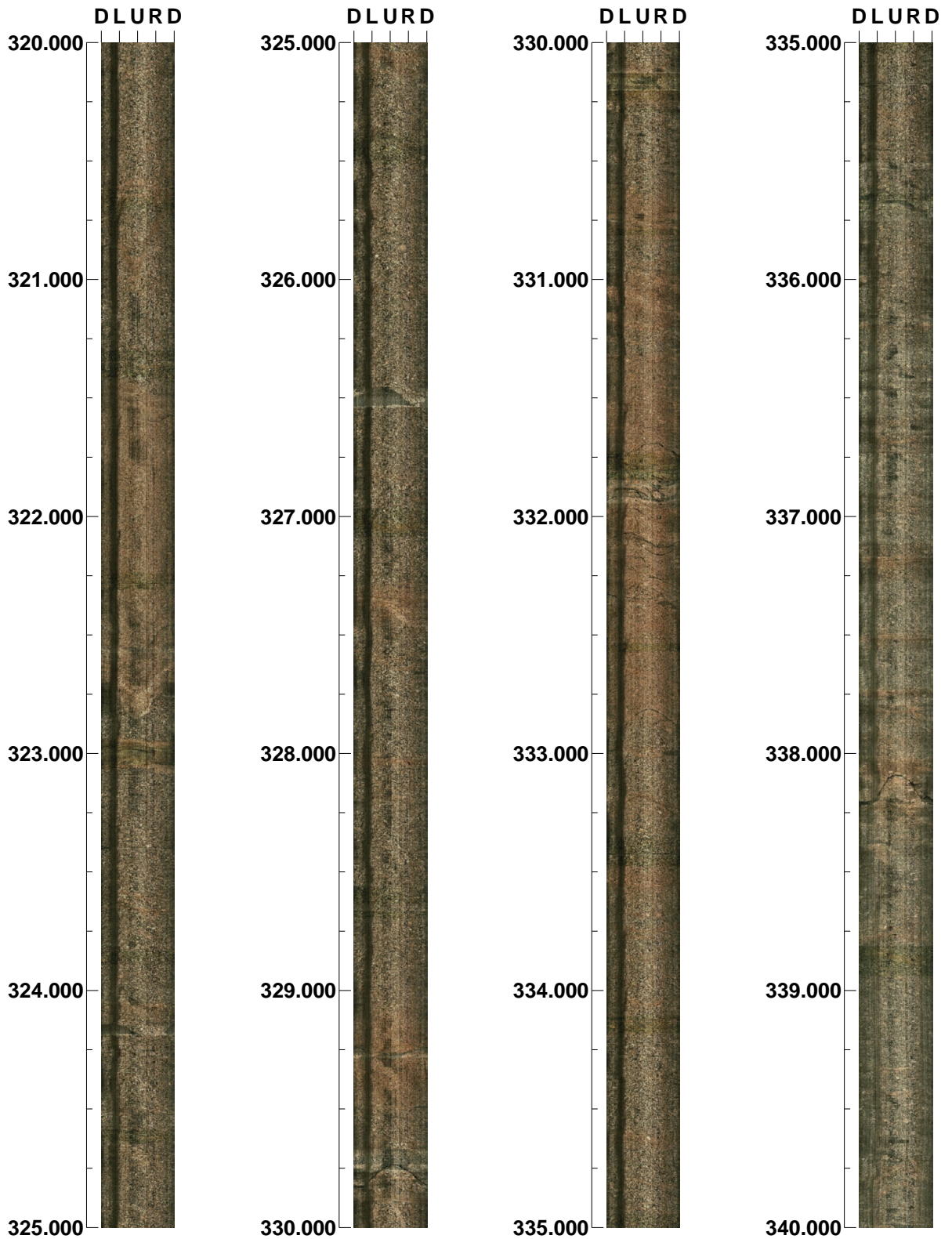
Depth range: 300.000 - 320.000 m



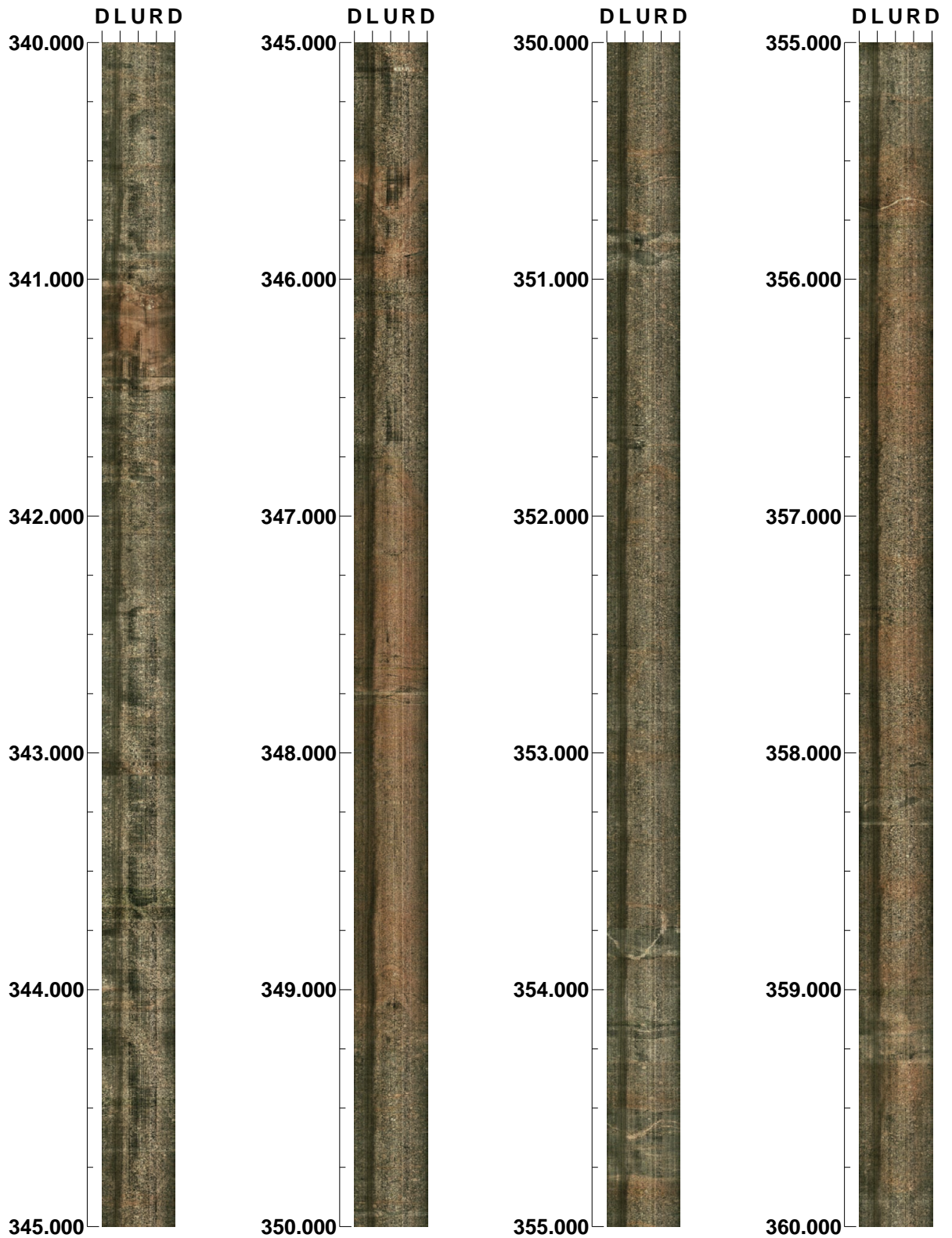
Project name: ÄSPÖ HRL  
Bore hole No.: KAS09

Azimuth: 181      Inclination: -60

Depth range: 320.000 - 340.000 m



Depth range: 340.000 - 360.000 m

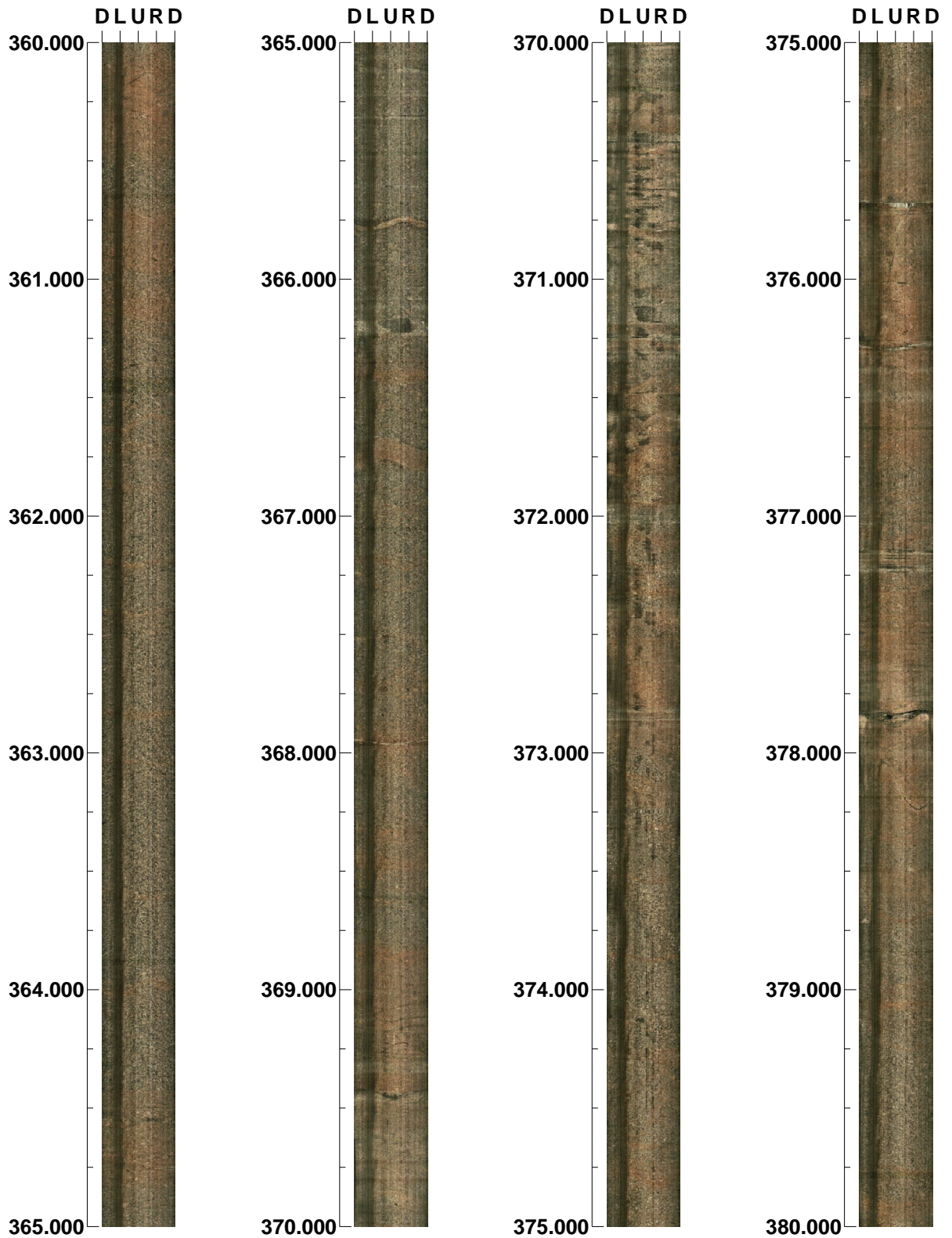




Project name: ÄSPÖ HRL  
Bore hole No.: KAS09

Azimuth: 181      Inclination: -60

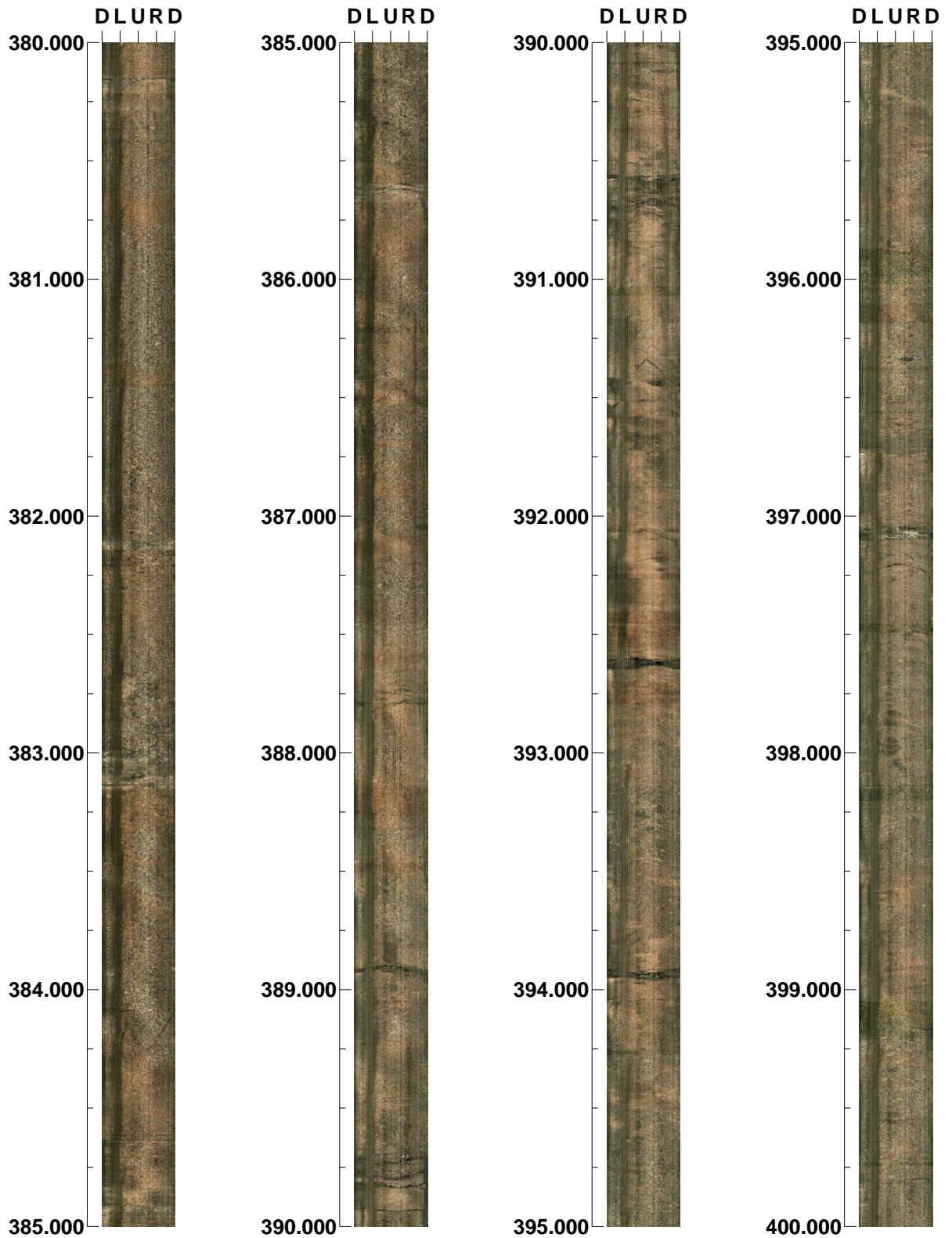
Depth range: 360.000 - 380.000 m



Project name: ÄSPÖ HRL  
Bore hole No.: KAS09

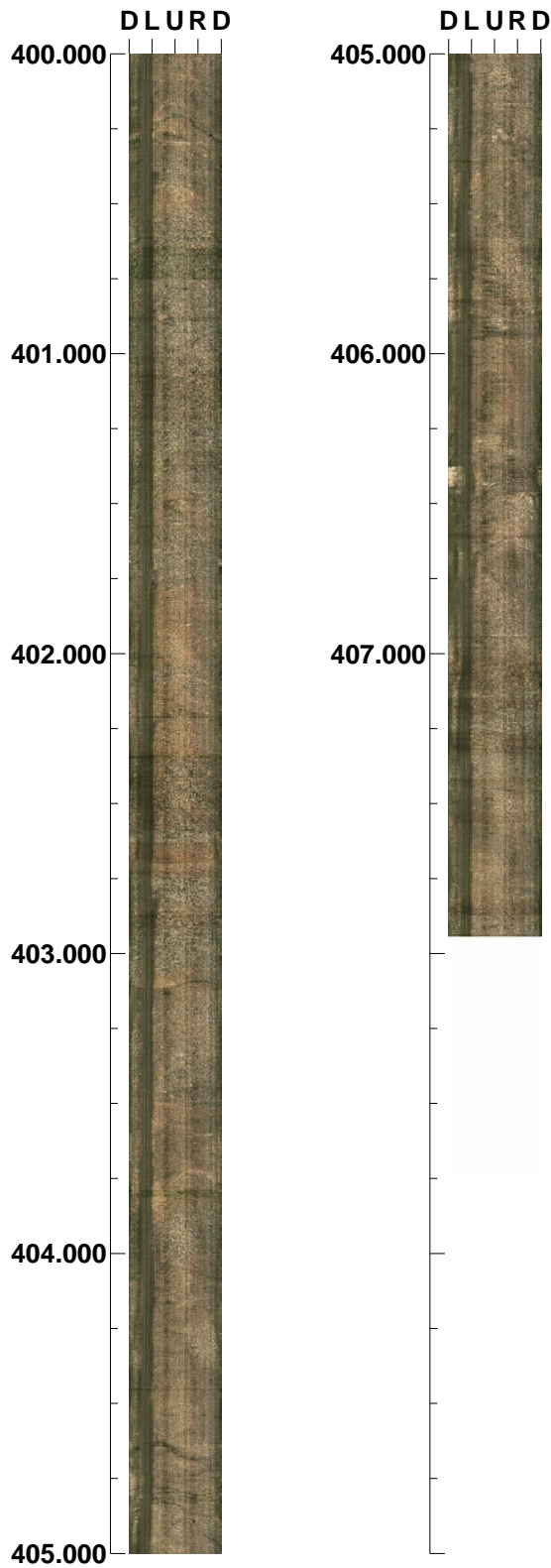
Azimuth: 181      Inclination: -60

Depth range: 380.000 - 400.000 m





Depth range: 400.000 - 407.940 m





**Appendix 2.** Repeat section, 100 to 110 m.



**Project name: ÄSPÖ HRL**

**Image file : d:\work\r5846s~1\lev\bipsda~1\kas09r~1.bip**

**BDT file : d:\work\r5846s~1\lev\bipsda~1\kas09r~1.bdt**

**Locality : ASPO HRL**

**Bore hole number : KAS09**

**Date : 09/10/09**

**Time : 13:01:00**

**Depth range : 100.000 - 110.019 m**

**Azimuth : 181**

**Inclination : -60**

**Diameter : 56.0 mm**

**Magnetic declination : 0.0**

**Span : 4**




**Scan interval : 0.25**

**Scan direction : To bottom**

**Scale : 1/25**

**Aspect ratio : 175 %**

**Pages : 1**

**Color :   **  
**+0 +0 +0**

Depth range: 100.000 - 110.000 m

