

Arbeitsbericht NAB 22-03

**TBO Rheinau-1-1:
Data Report**

**Dossier II
Core Photography**

June 2023

**National Cooperative
for the Disposal of
Radioactive Waste**

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**TBO Rheinau-1-1:
Data Report
Dossier II
Core Photography**

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²Nagra

Keywords:

RHE1-1, Zürich Nordost, TBO, deep drilling campaign,
drill cores, cuttings, photos, composites, CoreScan³

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Nagra Arbeitsberichte NAB ("Working Reports") present the results of work in progress that have not necessarily been subject to a comprehensive review. They are intended to provide rapid dissemination of current information.

This NAB aims at reporting drilling results at an early stage. Additional borehole-specific data will be published elsewhere.

In the event of inconsistencies between dossiers of this NAB, the dossier addressing the specific topic takes priority. In the event of discrepancies between Nagra reports, the chronologically later report is generally considered to be correct. Data sets and interpretations laid out in this NAB may be revised in subsequent reports. The reasoning leading to these revisions will be detailed there.

This Dossier was prepared by:

D. Kaehr (photography post-processing and core photograph composite design and compilation)

M. Gysi (project management, conceptualisation, QC and writing)

Editorial work: Geomecon and M. Unger

The Dossier has greatly benefitted from technical discussions with, and reviews by, external and internal experts. Their input and work are very much appreciated!

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Note: The appendix is only included in the digital version of this report and can be found under the paper clip symbol.

1 Introduction

1.1 Context

To provide input for site selection and the safety case for deep geological repositories for radioactive waste, Nagra has drilled a series of deep boreholes ("Tiefbohrungen", TBO) in Northern Switzerland. The aim of the drilling campaign is to characterise the deep underground of the three remaining siting regions located at the edge of the Northern Alpine Molasse Basin (Fig. 1-1).

In this report, we present the results from the Rheinau-1-1 borehole located in the siting region Zürich Nordost (Fig. 1-2). In the following, the main exploration objectives of this specific borehole are further outlined.

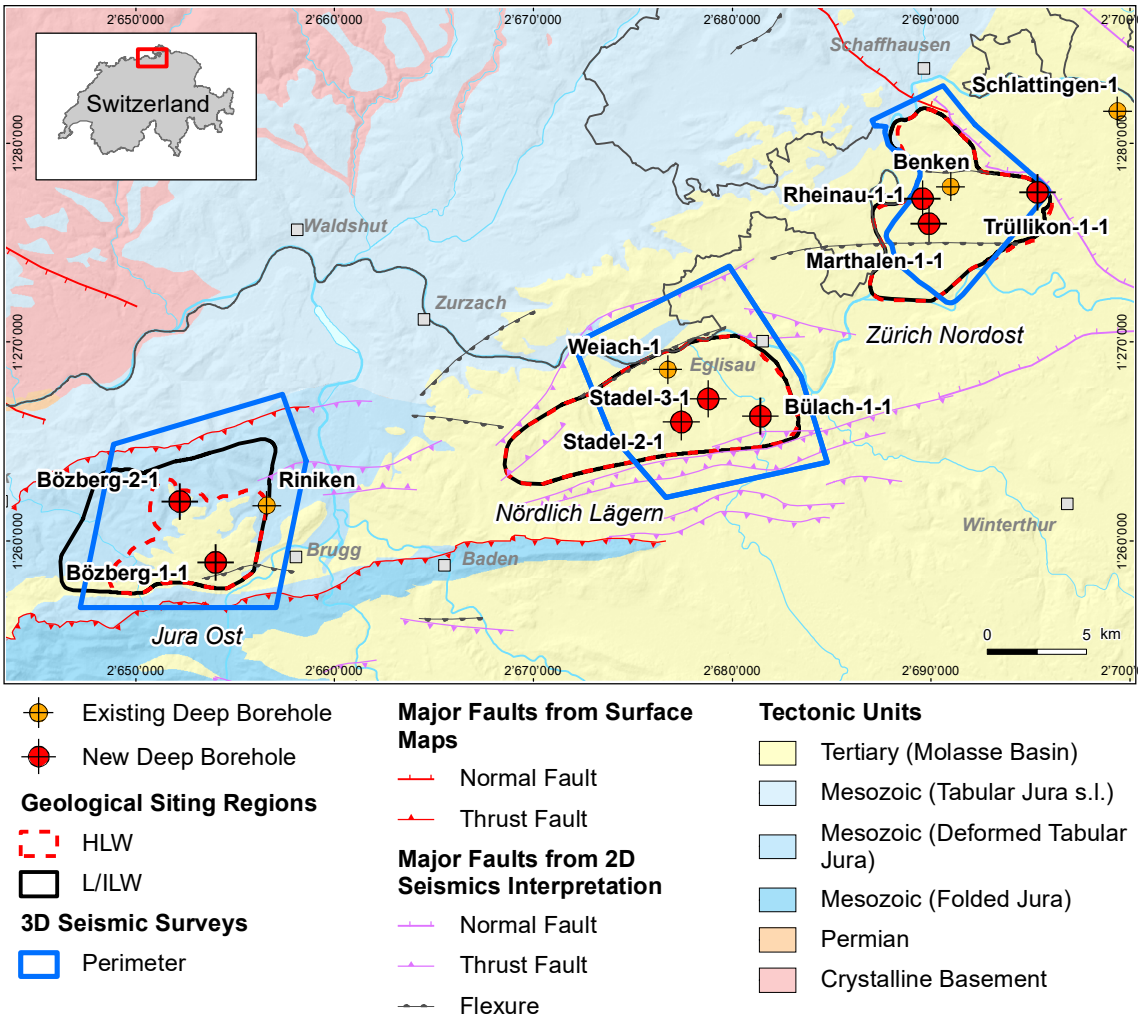


Fig. 1-1: Tectonic overview map with the three siting regions under investigation

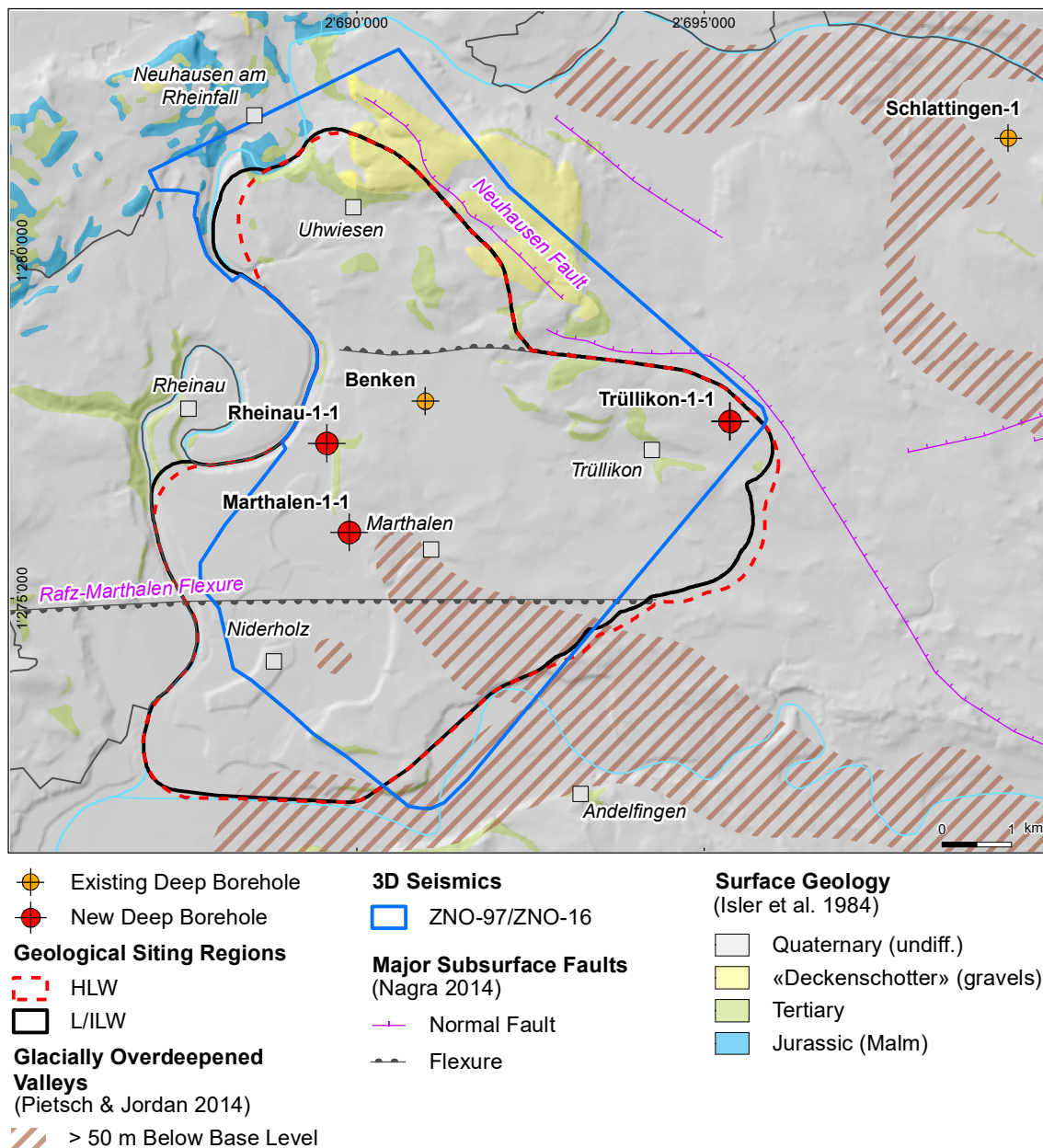


Fig. 1-2: Overview map of the investigation area in the Zürich Nordost siting region with the location of the RHE1-1 borehole in relation to the Benken, TRU1-1 and MAR1-1 boreholes

Exploration objective of the Rheinau-1-1 borehole

In the context of Nagra's TBO project, the Rheinau-1-1 (RHE1-1) borehole is the only deviated borehole. It was planned as a case study with the primary objective of characterising the structural geology of the Opalinus Clay in the area of a steeply dipping fault. Furthermore, dedicated hydrological packer testing and investigations of natural tracers in porewater were conducted to investigate the self-sealing capacity of the Opalinus Clay. More specifically, a stepped constant head injection test was performed in addition to the standard hydraulic packer test to investigate the evolution of transmissivity as a function of effective stress in a fractured interval (cf. Dossier VII, Hydraulic Packer Testing for details).

To enable hydraulic testing in the Opalinus Clay with its relatively low strength and high swelling capacity, the maximum borehole deviation (with respect to vertical) was limited to approximately 35° (borehole plunge of 55°). Hence, for the absolute deviation, a trade-off had to be made between maximising the lateral coverage for fracture frequency statistics (large deviation desired) and robust in-situ testing (small deviation desired).

Given the above-outlined scientific goals and related technical requirements, the Rheinau Fault, located immediately east of the Rheinau-1 drill site, was selected for this case study. It is an NNE-SSW trending, steeply dipping fault showing only very minor indications of vertical offsets in seismic amplitude sections. Nevertheless, it was already identified in seismic attribute horizon slices during initial interpretation of Nagra's 3D seismic campaign in the Zürich Nordost siting region (Birkhäuser et al. 2001) and later confirmed during the analysis of follow-up seismic processing products (e.g. Nagra 2019). Fig. 1-3 shows that this fault has a clear seismic attribute expression along the boundaries of the formations below the Opalinus Clay and also along some of the more brittle units above (see horizon slices of the Top Bänkerjoch and Top Villigen Formations shown in Fig. 1-3). However, within the Opalinus Clay, no clear seismic expression is observed. Fig. 1-4 shows the 3D-seismic interpretation considered for trajectory planning of the RHE1-1 borehole together with the discussed and executed borehole trajectories.

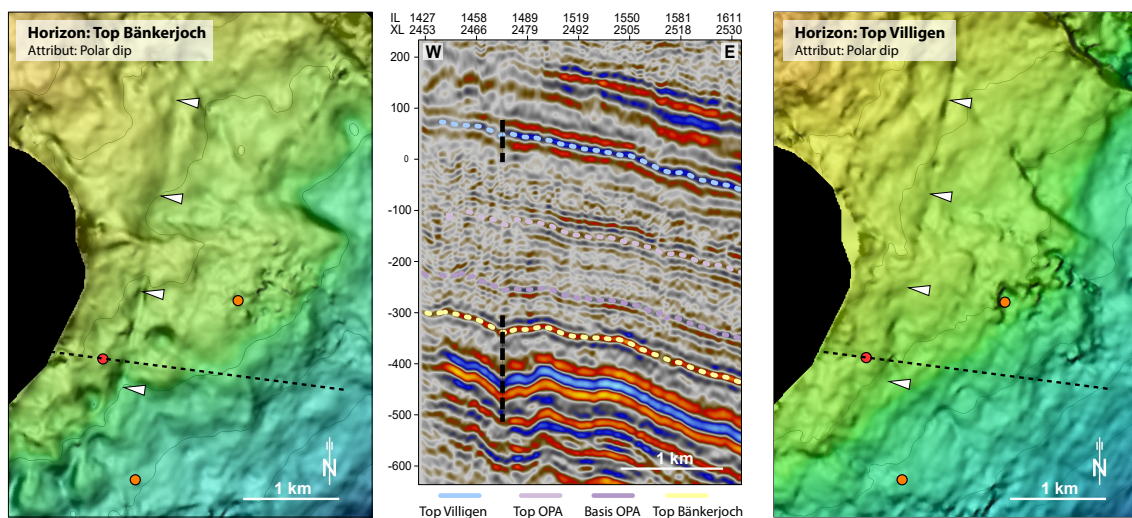


Fig. 1-3: Seismic amplitude cross-section and seismic attribute maps showing the Rheinau Fault

Left and right panels: Seismic attribute maps (polar dip) of a depth-migrated seismic cube (PSDM-A) overlain with depth values (yellowish and blueish colors indicate shallower and larger depths, respectively). The dashed black line indicates the position of the seismic section shown in the central panel. Red and orange dots show the position of the RHE1-1 borehole and neighbouring boreholes, respectively. White triangles mark the lineament representing the Rheinau Fault.

Central panel: Corresponding seismic amplitude section crossing the Rheinau Fault. The vertical axis indicates depth above sea level, and the horizontal axis shows the inline and crossline positions. The approximate trace of the Rheinau Fault above and below the Opalinus Clay is indicated by dashed black lines.

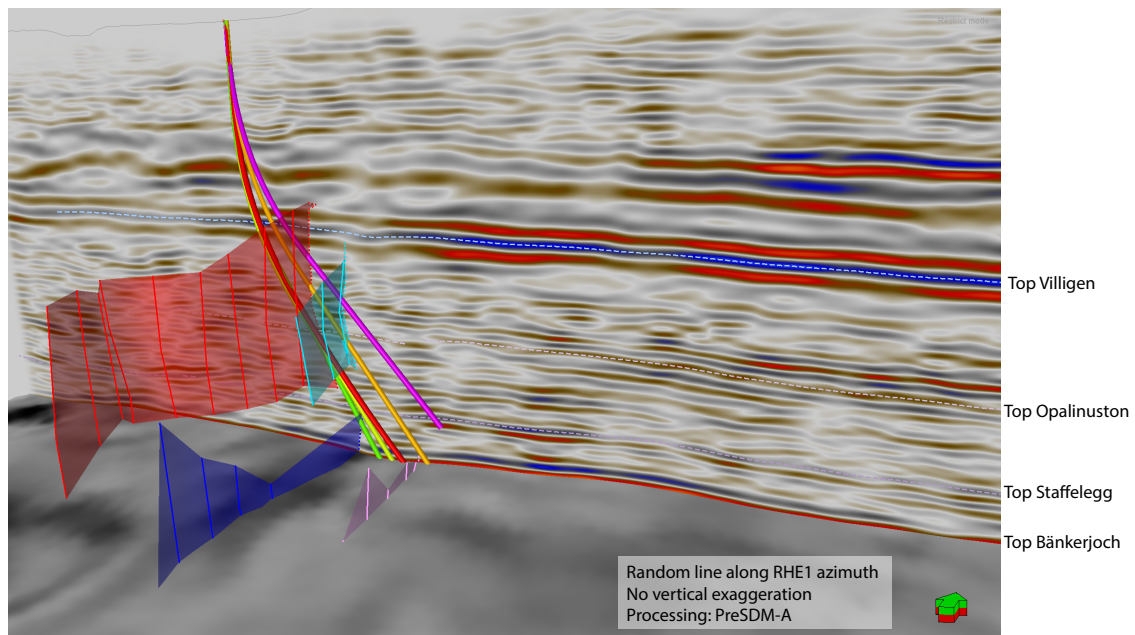


Fig. 1-4: Detailed seismic fault interpretation available for trajectory planning and discussed/executed well trajectories

Cross-section shows seismic amplitude (seismic processing: pre-stack depth migration PDSM-A). The north direction is indicated by a green-and-red arrow. The vertical distance between the Top Opalinus Clay and Top Staffelegg is ~120 m and shows no vertical exaggeration. The horizon slice shows polar dip attribute. Semitransparent subvertical surfaces indicate interpreted faults. The final planned and the drilled trajectories are shown in light green and red, respectively. Other discussed trajectories are shown in yellow, orange and red.

Fig. 1-5 shows a conceptual structural model for the Rheinau Fault incorporating both 3D-seismic interpretations and observations from other exploration boreholes as well as from outcrop studies. This conceptual model shows a pronounced mechanical stratigraphy of Northern Switzerland's Mesozoic sedimentary sequence with more focused deformation in the competent units, and distributed deformation in the incompetent units (Roche et al. 2020). Prior to drilling, three hypotheses were formulated on what the RHE1-1 borehole is likely to encounter in the Opalinus Clay. These hypotheses ranged from 1) absence of a distinct fault zone, likely due to a strong degree of strain partitioning within the rheologically weak Opalinus Clay, 2) one or several prominent fault zones, for example revealing cataclastic fault rock or scaly clay as it has been described to occur along larger faults within the Opalinus Clay (Jäggi et al. 2017) and 3) the former, but including the occurrence of secondary mineralisations.

As this report represents a data documentation, it deliberately avoids engaging in a synthesis of the observations and test results. Nevertheless, the following results can already be highlighted:

- The drilled trajectory was within close limits compared to the planned well path (see Dossier I for a detailed comparison).
- The borehole did not yield any evidence of a larger-scale fault zone within the Opalinus Clay. However, a number of fault planes have been encountered (cf. Dossier V).
- In-situ hydraulic packer tests across these features (cf. Dossier VII) yielded hydraulic conductivities similar to undisturbed Opalinus Clay.

- The stepped constant head test demonstrated that a significant enhancement of the flow rate can only be achieved in existing fractures if the fluid pressure is raised considerably and the magnitude of elevated fluid pressure can be maintained (cf. Dossier VII).
- Excursions in the profiles of natural tracers can indicate past fluid flow. No such irregularities are seen for the RHE1-1 borehole in the Opalinus Clay (cf. Dossier VIII). The stable isotope porewater profiles show characteristics similar to the neighbouring vertical boreholes MAR1-1 and Benken.

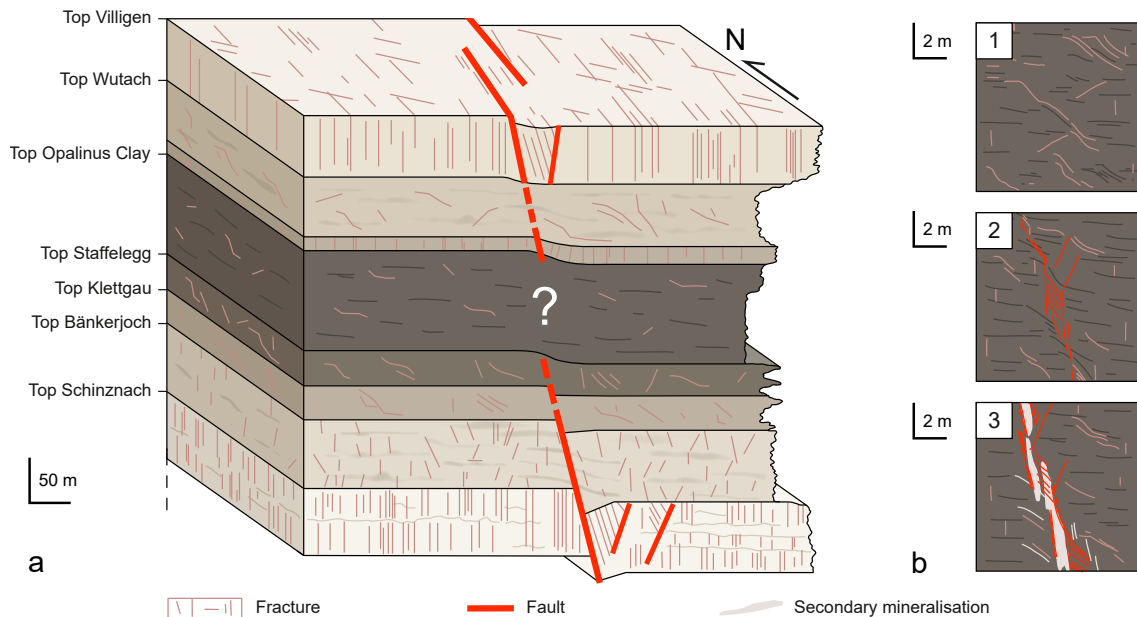


Fig. 1-5: Conceptual structural model of the Rheinau Fault

(a) Conceptual block model. The pronounced mechanical stratigraphy of the Mesozoic sequence in the area is stressed via a schematic weathering profile. The RHE1-1 borehole aimed at characterising the deformation style in the Opalinus Clay constituting a mechanically weak layer in between rheologically stiffer units (e.g. under- and overlying Schinznach/Bänkerjoch and Villigen/Wutach Formations). According to outcrop records and previous borehole results, these units show a significantly higher frequency of fault planes compared to the Opalinus Clay. In 3D seismics, the Rheinau Fault is also only clearly recognisable at the horizons related to stiffer formations.

(b) Hypothetic deformation characteristics of the Opalinus Clay to be encountered in the RHE1 1 borehole: 1) No exceptional deformation features besides small-scale fault planes as previously observed in vertical boreholes outside of seismically recognised faults. 2) One or several localised zones associated with cataclastic fault rock (e.g. scaly clay) as described for larger fault zones elsewhere (e.g. Jäggi et al. 2017). 3) The above, but also including secondary mineralisation (not to scale on picture).

1.2 Location and specifications of the borehole

The Rheinau-1-1 (RHE1-1) exploratory borehole is the eight borehole drilled within the framework of the TBO project. The drill site is located in the western part of the Zürich Nordost siting region (Fig. 1-2). The deviated borehole reached a final depth of 827.99 m MD = 745.33 m TVD (true vertical depth)¹. The borehole specifications are provided in Tab. 1-1.

Tab. 1-1: General information about the RHE1-1 borehole

Siting region	Zürich Nordost
Municipality	Rheinau (Canton Zürich / ZH), Switzerland
Drill site	Rheinau-1 (RHE1)
Borehole	Rheinau-1-1 (RHE1-1)
Coordinates	LV95: 2'689'563.92 / 1'277'235.06
Elevation	Ground level = top of rig cellar: 387.23 m above sea level (asl)
Borehole depth	827.99 m measured depth (MD) = 745.33 m true vertical depth (TVD) below ground level (bgl)
Borehole deviation at total depth (TD)	Inclination from vertical: 38.93° Azimuth from North: 76.25°
Drilling period	19th July – 10th October 2021 (spud date to end of rig release)
Drilling company	PR Marriott Drilling Ltd
Drilling rig	Rig-16 Drillmec HH102
Drilling fluid	Water-based mud with various amounts of different components such as ² : 0 – 497 m: Polymers 497 – 828 m: Potassium silicate & polymers

The lithostratigraphic profile and the casing scheme are shown in Fig. 1-6. The comparison of the core versus log depth³ of the main lithostratigraphic boundaries in the RHE1-1 borehole is shown in Tab. 1-2.

¹ Measured depth (MD) refers to the position along the borehole trajectory, starting at ground level, which for this borehole is the top of the rig cellar. For a perfectly vertical borehole, MD below ground level (bgl) and true vertical depth (TVD) are the same. In all Dossiers depth refers to MD unless stated otherwise.

² For detailed information see Dossier I.

³ Core depth refers to the depth marked on the drill cores. Log depth results from the depth observed during geophysical wireline logging. Note that the petrophysical logs have not been shifted to core depth, hence log depth differs from core depth.

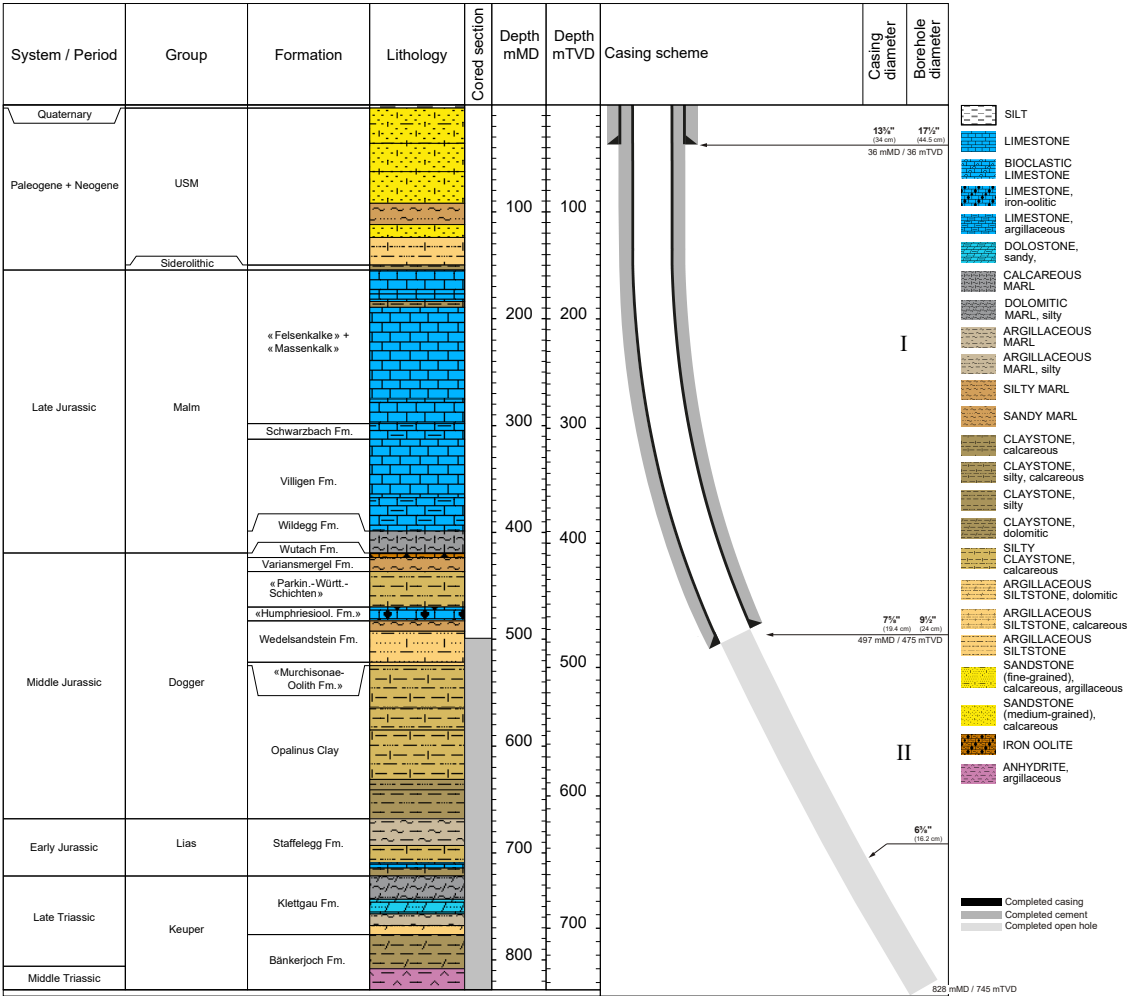


Fig. 1-6: Lithostratigraphic profile and casing scheme for the RHE1-1 borehole⁴

⁴ For detailed information see Dossier I and III.

Tab. 1-2: Core and log depth for the main lithostratigraphic boundaries in the RHE1-1 bore-hole⁵

System / Period	Group	Formation	Core top depth in m (MD)	Log top depth in m (TVD)	Core top depth in m (MD)	Log top depth in m (TVD)
Quaternary			3	—	3	—
Paleogene + Neogene	USM		149.90	—	149.88	—
	Siderolithic		154.40	—	154.37	—
Jurassic	Malm	«Felsenkalk» + «Massenkalk»	298.10	—	295.71	—
		Schwarzbach Formation	312.70	—	309.70	—
		Villigen Formation	398.80	—	389.75	—
		Wildegge Formation	419.20	—	408.04	—
	Dogger	Wutach Formation	423.40	—	411.78	—
		Variansmergel Formation	436.60	—	423.47	—
		«Parkinsoni-Württembergica-Sch.»	469.80	—	452.23	—
		«Humphriesioolith Formation»	482.80	—	463.20	—
		Wedelsandstein Formation	521.43	521.21	495.83	495.64
		«Murchisonae-Oolith Formation»	524.61	524.33	498.51	498.27
		Opalinus Clay	668.07	668.19	617.65	617.75
		Staffelegg Formation	721.46	721.50	660.95	660.98
		Klettgau Formation	776.42	776.79	704.82	705.11
		Bänkerjoch Formation	827.99	828.24	745.33	745.52
			final depth			

⁵ For details regarding lithostratigraphic boundaries see Dossier III and IV; for details about depth shifts (core gonio-metry) see Dossier V.

1.3 Documentation structure for the RHE1-1 borehole

NAB 22-03 documents the majority of the investigations carried out in the RHE1-1 borehole, including laboratory investigations on core material. The NAB comprises a series of stand-alone dossiers addressing individual topics and a final dossier with a summary composite plot (Tab. 1-3).

This documentation aims at early publication of the data collected in the RHE1-1 borehole. It includes most of the data available approximately one year after completion of the borehole. Some analyses are still ongoing and results will be published in separate reports.

The current borehole report will provide an important basis for the integration of datasets from different boreholes. The integration and interpretation of the results in the wider geological context will be documented later in separate geoscientific reports.

Tab. 1-3: List of dossiers included in NAB 22-03

Black marks the dossier at hand.

Dossier	Title	Authors
I	TBO Rheinau-1-1: Drilling	M. Ammen & P.-J. Palten
II	TBO Rheinau-1-1: Core Photography	D. Kaehr & M. Gysi
III	TBO Rheinau-1-1: Lithostratigraphy	M. Schwarz, P. Schürch, P. Jordan, H. Naef, R. Felber, T. Ibele & F. Casanova
IV	TBO Rheinau-1-1: Microfacies, Bio- and Chemostratigraphic Analysis	S. Wohlwend, H.R. Bläsi, S. Feist-Burkhardt, B. Hostettler, U. Menkveld-Gfeller, V. Dietze & G. Deplazes
V	TBO Rheinau-1-1: Structural Geology	A. Ebert, S. Cioldi, E. Hägerstedt, L. Gregorczyk & F. Casanova
VI	TBO Rheinau-1-1: Wireline Logging and Micro-hydraulic Fracturing	J. Gonus, E. Bailey, J. Desroches & R. Garrard
VII	TBO Rheinau-1-1: Hydraulic Packer Testing	R. Schwarz, M. Willmann, P. Schulte, H. Fisch, S. Reinhardt, L. Schlickenrieder, M. Voß & A. Pechstein
VIII	TBO Rheinau-1-1: Rock Properties and Natural Tracer Profiles	J. Iannotta, F. Eichinger, L. Aschwanden & D. Traber
IX		
X	TBO Rheinau-1-1: Petrophysical Log Analysis	S. Marnat & J.K. Becker
	TBO Rheinau-1-1: Summary Plot	Nagra

1.4 Scope and objectives of this dossier

The dossier at hand (Dossier II) documents core photography. The objectives are the following:

- summary of core handling and core photography of this drilling campaign
- visual documentation of the cuttings samples and cores of RHE1-1 from 2 m to 827.99 m MD core depth

2 Executed working procedures

2.1 On-site core handling

The cores were drilled with a 6 m long inner core barrel containing an inner plastic tube. To avoid core jamming and to obtain a better core quality the length of a core run was 3 m, only. After cutting the core, the drilling crew pulled the inner core barrel up with a winch (wireline coring) and placed it on the pipe rack (Fig. 2-1). The core catcher was detached and the inner plastic tube was removed and laid down on trestles. The section containing the core was separated from the empty plastic tube by cutting the tube to a length of approximately 3.5 m. The core was then carried to the core processing area (Fig. 2-2) and pushed out of the tube using an appropriate rod. If the core was jammed inside the tube, the plastic liner was cut laterally using an electric cutting machine.



Fig. 2-1: The inner core barrel is placed on the pipe rack

Showcase picture of rig 16 (Marriott); workflow comparable at the Daldrup rig
(picture credits: © Maya & Daniele)



Fig. 2-2: The 3 m core in the plastic liner is carried to the core processing area

Showcase picture of rig 16 (Marriott); workflow comparable at the Daldrup rig (picture credits: © Maya & Daniele)

Once laid out, the core was washed with water to remove the drilling fluid (Figs. 2-3 and 2-4). Afterwards, the top of the newly cut core was aligned with the bottom of the previous core section. If the two core pieces did not fit properly, they were marked with a red cross and a new set of orientation lines was started. If a fit was established, the orientation lines were correctly copied onto the newly cored section. These orientation lines consist of two parallel lines drawn along the core axis with additional arrows indicating the downhole direction. The line on the right-hand side when looking towards the core top is red (Figs. 2-5 and 2-6). The colour of the line on the left-hand side can be white, yellow or black depending on the colour of the cored rock. The core depth was marked on the core with a line perpendicular to the core axis and corresponding depth labels at 0.5 m intervals.

To facilitate proper core handling, transportation and further analyses, the core sections were cut into pieces approximately one metre long using a diamond-impregnated rock saw before being stored in one metre core boxes.



Fig. 2-3: A core covered in drilling fluid on the core processing table

Picture credits: © Maya & Daniele



Fig. 2-4: A core is washed with water on the core processing table to remove the drilling fluid

Picture credits: © Maya & Daniele



Fig. 2-5: A core is marked with orientation lines

Picture credits: © Maya & Daniele



Fig. 2-6: Cleaned, measured and marked core

2.2 Core photography

All core pieces were photographed (planar pictures) using a modified version of the DMT CoreScan³ system (Fig. 2-7) specifically designed to take high-resolution core photographs (10 px/mm). If the core geometry and condition allowed it, 360° photographs of the core surface were also taken (not documented in this dossier). For both planar and 360° photographs, the core was placed on two rubber rollers and a digital line scan camera recorded the picture via an inclined mirror in the top section of the CoreScan³ system. During 360° photography, the core was rotated around its longitudinal axis and the picture was taken at the upper section of the core. In addition, all 360° photographs were digitally rotated to set the red orientation line to 0°. Both planar and 360° photographs were saved on the CoreScan³ computer, which automatically synchronised the data with the Nagra network-attached storage (NAS) located at the core storage facility in Würenlingen.

2.2.1 Specifications

Camera:

- manufacturer: avaluar GmbH
- camera model: CCD-Colour camera CSc3b1.26
- resolution y: 6'400 (10 px/mm)
- resolution x: 10'680 (10 px/mm)
- spectral response: 400 nm to 700 nm
- sharpening: 0
- gamma: 1.4
- lens maker: Schneider Kreuznach
- lens model: APO COMPONON f4.0/60mm
- aperture: f/8
- focal length: 35 mm
- exposure time: program very dark (custom calibrated for Nagra's LED panels)

LED panels:

- 4x Aladdin BI-FLEX 4 (200 W Bi-Colour Panel): two at the back and two at the front of the CoreScan³ system, protected in aluminium boxes with a diffusor plate as front cover
- 2x Aladdin BI-FLEX 2 (70 W Bi-Colour Panel): one on the left-hand side and one on the right-hand side of the CoreScan³ system, protected in an aluminium box with a diffusor plate as front cover
- all six panels are calibrated to 5'000 K with a Sekonic C-800 SpectroMaster

Reference cards:

- X-Rite ColorChecker White Balance: used for camera calibration (shading)
- X-Rite ColorChecker Classic Mini colour chart: colour reference on every core photo
- BST14 greyscale chart: greyscale reference on every core photo
- Datacolor SpyderCHECKR 48 colour chart: colour reference chart for reference photographs

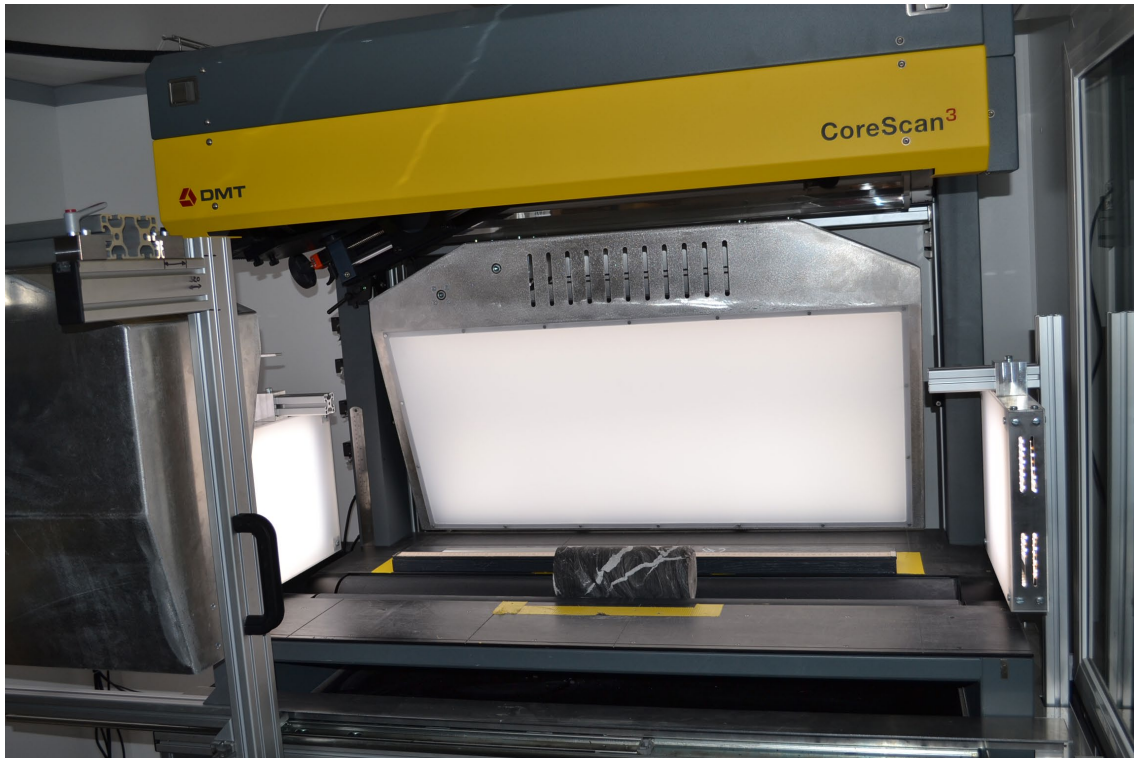


Fig. 2-7: Modified DMT CoreScan³ system at the drill site

2.2.2 Colour drift monitoring

During coring operations, a reference photograph of the Datacolor SpyderCHECKR 48 colour chart was taken with the CoreScan³ system at least twice per 24 h (Fig. 2-8). These reference photographs enabled to monitor the proper functioning of the CoreScan³ system during operations. Issues regarding colour correctness and contrast could be detected early and necessary adjustments to the CoreScan³ system or environment conditions (especially room temperature) could be made. The reference photographs could further be used to create an ICC profile (International Color Consortium): a data set characterising the colour input / output for the most accurate colour matching.

Each core photograph taken included a metre scale, a BST14 greyscale chart and an X-Rite ColorChecker Classic Mini colour chart (Fig. 2-9). The metre scale is essential to have a depth indicator on the core photograph, whereas the colour and greyscale charts allow manual colour management during post-processing of the core photograph if required.

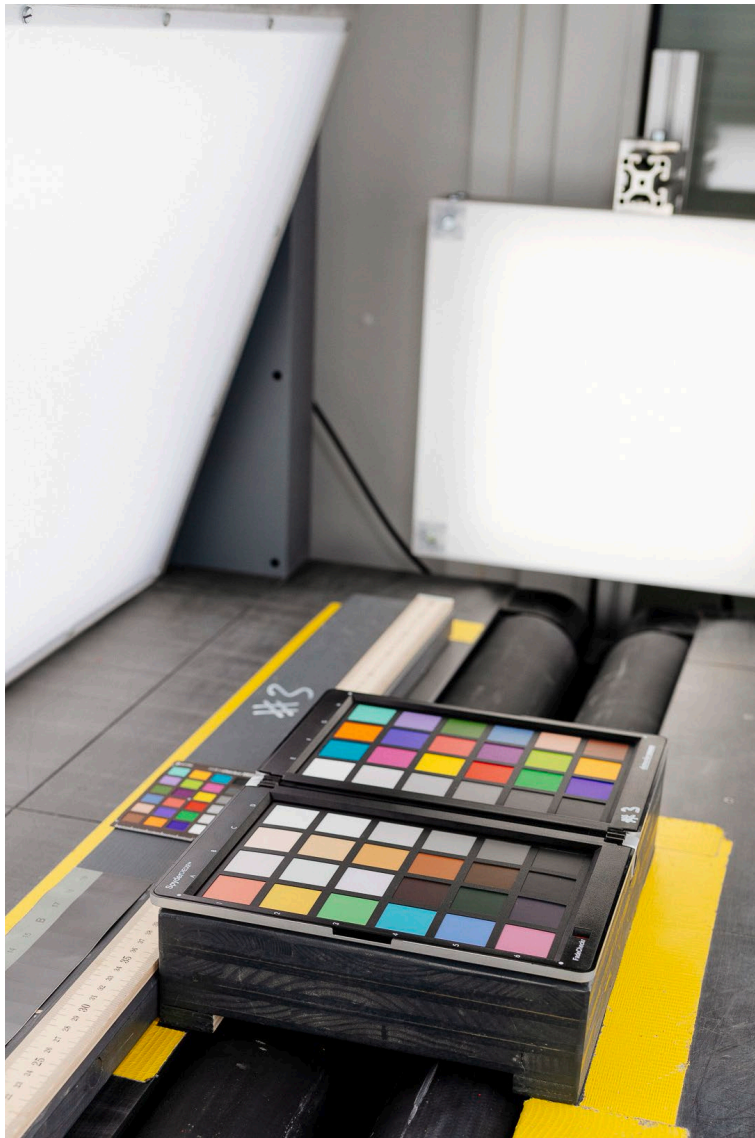


Fig. 2-8: Reference photograph setup of the CoreScan³ system with a Datacolor Spyder-CHECKR 48 colour chart, a metre scale, a BST14 greyscale chart and an X-Rite ColorChecker Classic Mini colour chart

Picture credits: © Maya & Daniele



Fig. 2-9: CoreScan³ system setup during core photography with a metre scale, a BST14 grey-scale chart and an X-Rite ColorChecker Classic Mini colour chart

Picture credits: © Maya & Daniele

2.3 Post-processing of core photographs

All core photographs taken on the drill site were post-processed by a professional photographer. The colour management of the post-processing workflow provided colour-matched, high-resolution core photograph reproductions with enhanced quality and fidelity. The following post-processing steps were applied to a batch of core photographs with comparable camera settings and environmental conditions:

1. noise reduction of the reference photographs of the Datacolor SpyderCHECKR 48 colour chart, shot with the CoreScan³ system
2. ICC profiling of the noise-reduced reference photographs, shot with the CoreScan³ system
3. evaluation of the ICC profiles and selection of the best ICC profile for the post-processing of the core photographs
4. ICC profile application to the core photographs in batch mode
5. correction of contrast and brightness of the core photographs in batch mode
6. conversion of the photographs to eciRGB_v2 standard colour space in batch mode
7. noise reduction and pre-sharpening of every single core photograph
8. correction of colour, exposure and contrast of the core photographs in batch mode

9. comparison between the best ICC profile of the Datacolor SpyderCHECKR 48 colour chart reference photograph, shot with the CoreScan³ system and the ICC profile of the Datacolor SpyderCHECKR 48 colour chart reference photograph, shot with a Canon 5DmkIV camera
10. visual adjustment of the best ICC profile of the Datacolor SpyderCHECKR 48 colour chart reference photograph, shot with the CoreScan³ system to the ICC profile of the Datacolor SpyderCHECKR 48 colour reference photograph, shot with a Canon 5DmkIV camera
11. application of the colour adjustment defined in the previous step to the core photographs in batch mode
12. if required, manual colour neutralisation of every single core photograph based on the BST14 greyscale chart and the X-Rite ColorChecker Classic Mini colour chart
13. cropping of the core photographs to the core outlines
14. export of the core photographs as .jpg and .tiff in pre-defined resolutions and corresponding sharpening parameters

2.4 Signatures

The following signature was used in the composite displays of the complete cores:

- white hachures: missing core due to formation integrity test (FIT) pilot hole or drilling-related technical issues (Fig. 2-10)

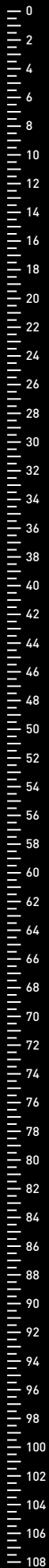


Fig. 2-10: White hachures signature used for missing core due to FIT pilot hole or drilling related technical issues in the composite displays

3 Rheinau-1-1 core- and cuttings composites

2.00m

20.00m



2.00m



20.00m



4.00m



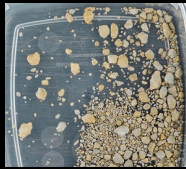
22.00m



6.00m



24.00m



8.00m



26.00m



10.00m



28.00m



12.00m



30.00m



14.00m



32.00m



16.00m



34.00m



18.00m



34.50m

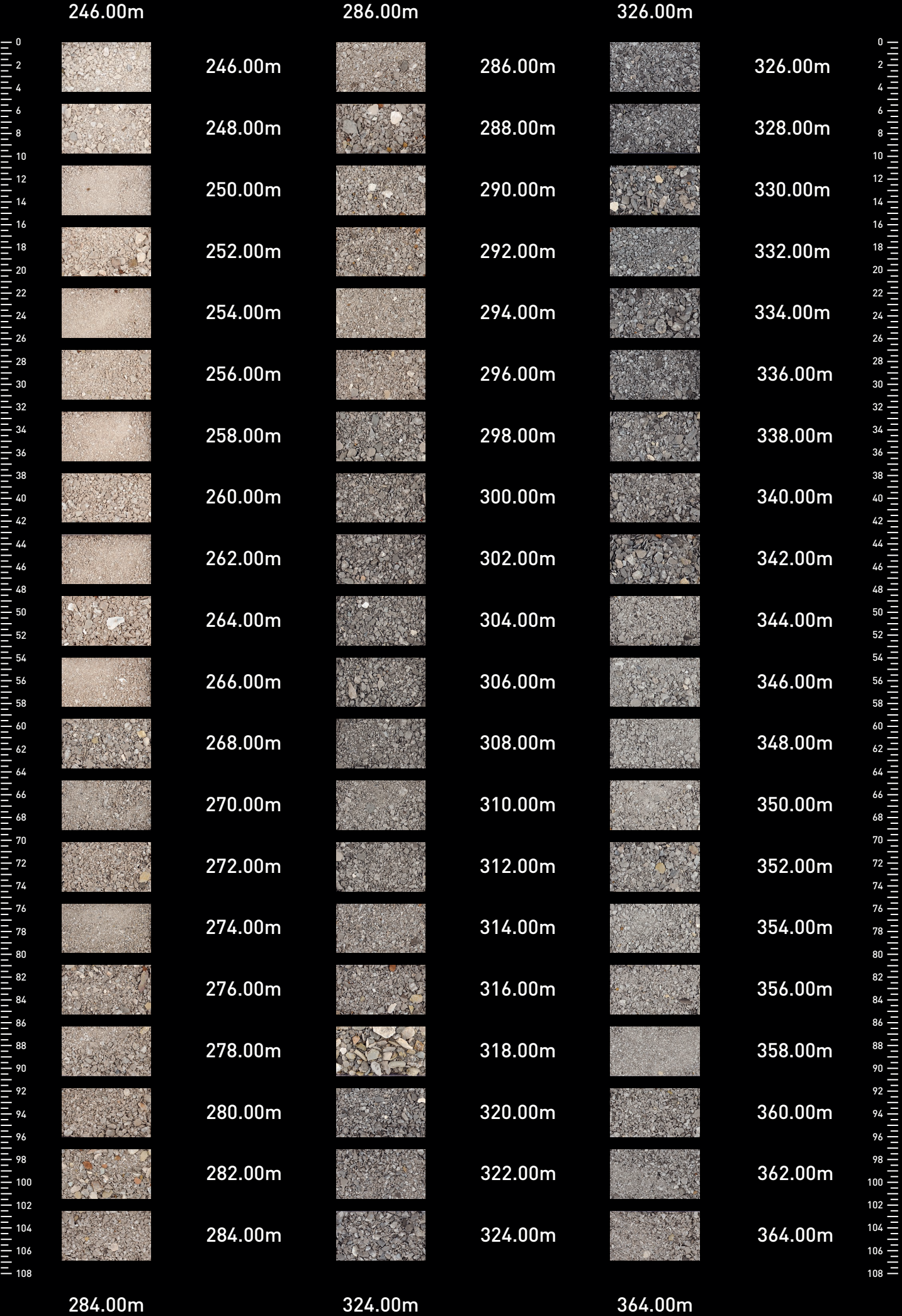
18.00m

34.50m













499.10m

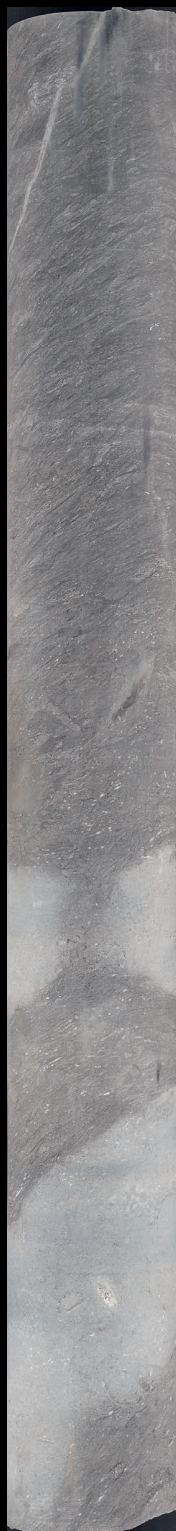
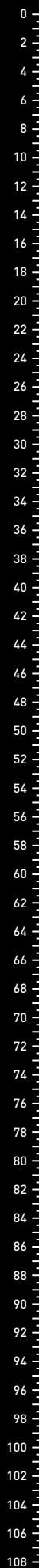
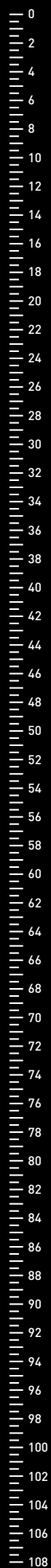
500.09m

500.91m

501.85m

502.66m

503.45m



500.09m

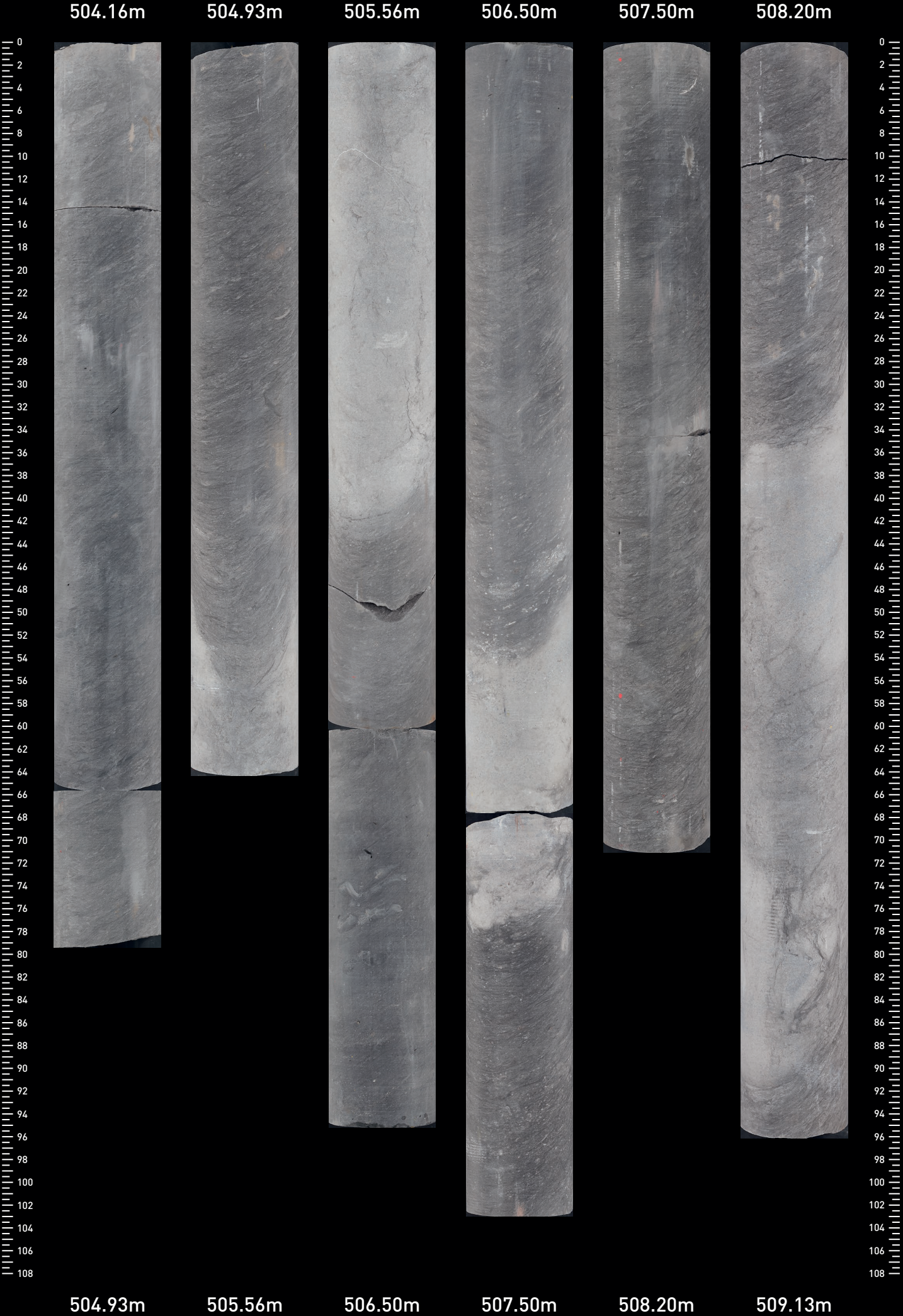
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504.16m



509.13m

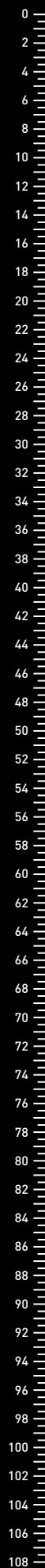
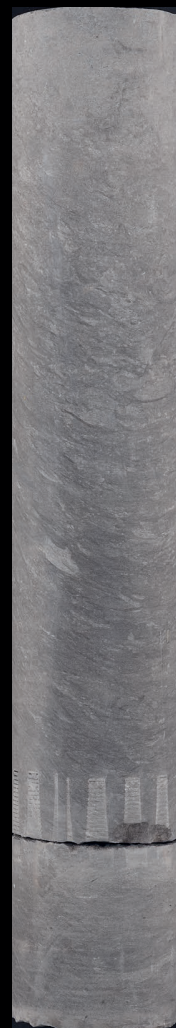
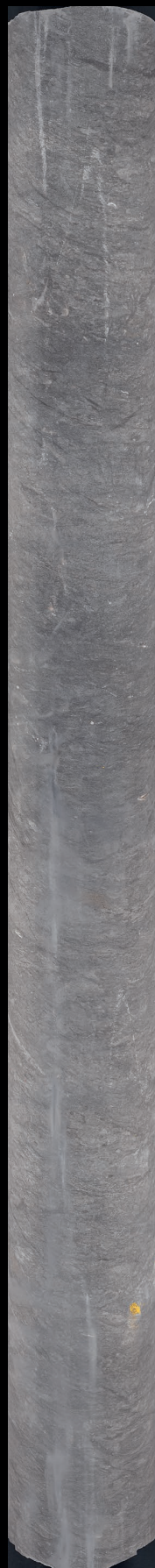
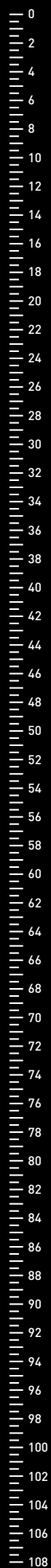
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511.00m

511.95m

512.65m

513.20m



510.05m

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514.20m

515.14m

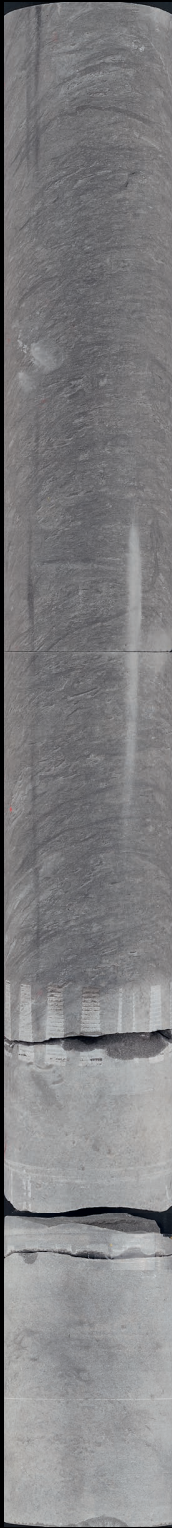
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517.66m

518.50m

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515.14m

516.01m

516.91m

517.66m

518.50m

519.30m

519.30m

519.65m

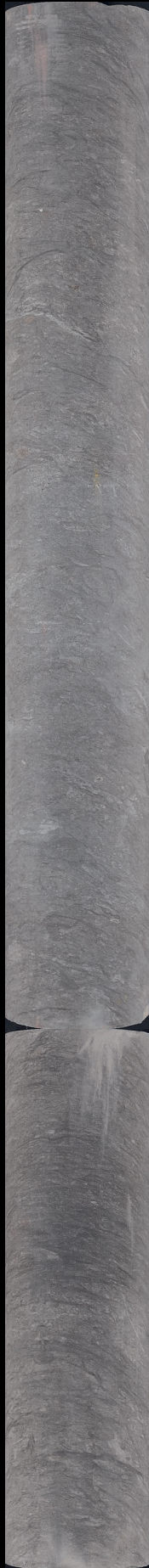
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522.16m

523.11m

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519.65m

520.34m

521.35m

522.16m

523.11m

523.55m

523.55m

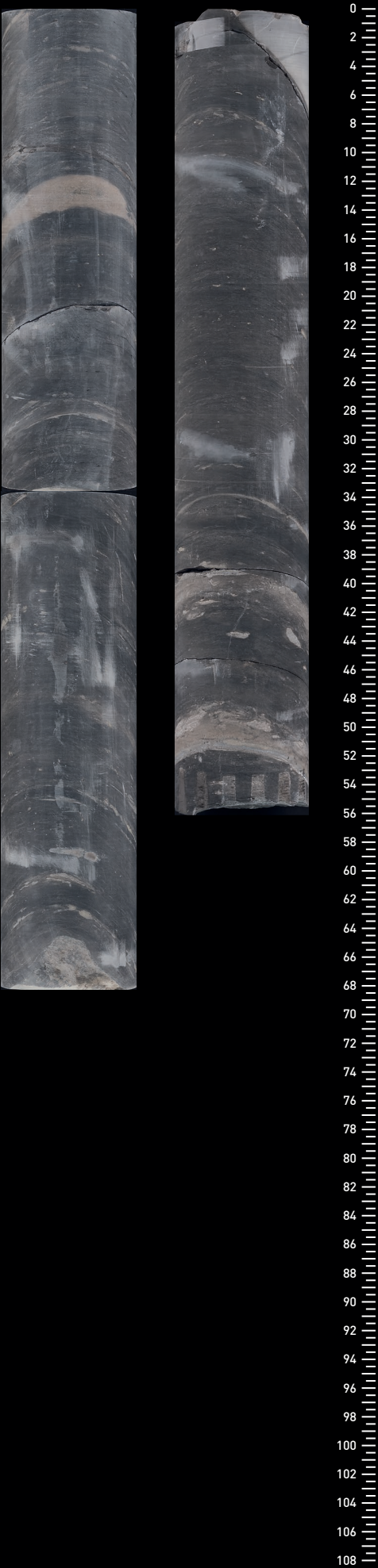
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525.07m

525.59m

526.57m

527.25m



524.25m

525.07m

525.59m

526.57m

527.25m

527.80m

527.80m

528.39m

529.18m

529.53m

530.24m

530.98m



528.39m

529.18m

529.53m

530.24m

530.98m

531.86m



536.80m

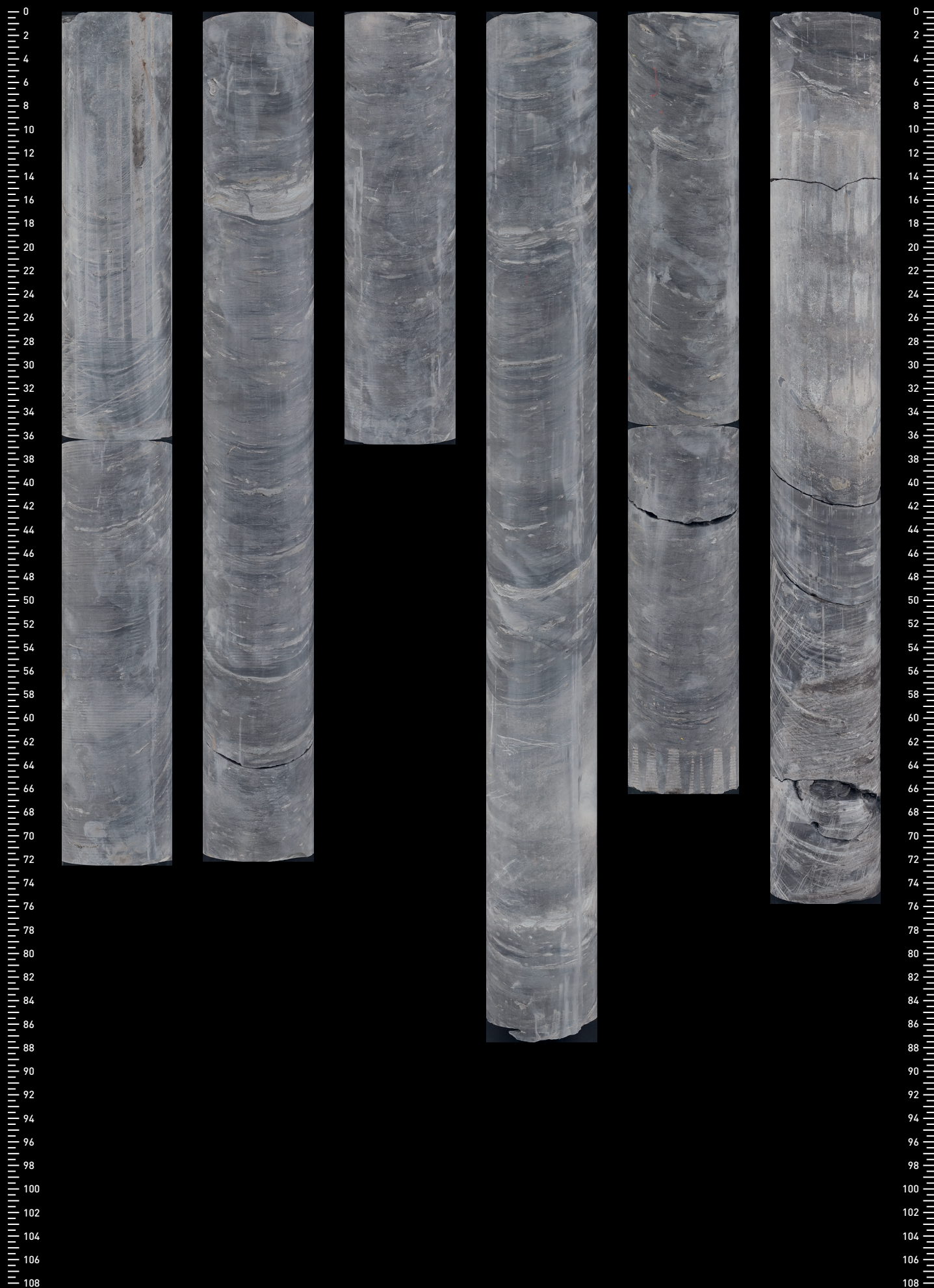
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538.58m

539.43m

540.07m



537.51m

538.23m

538.58m

539.43m

540.07m

540.81m



545.22m

546.03m

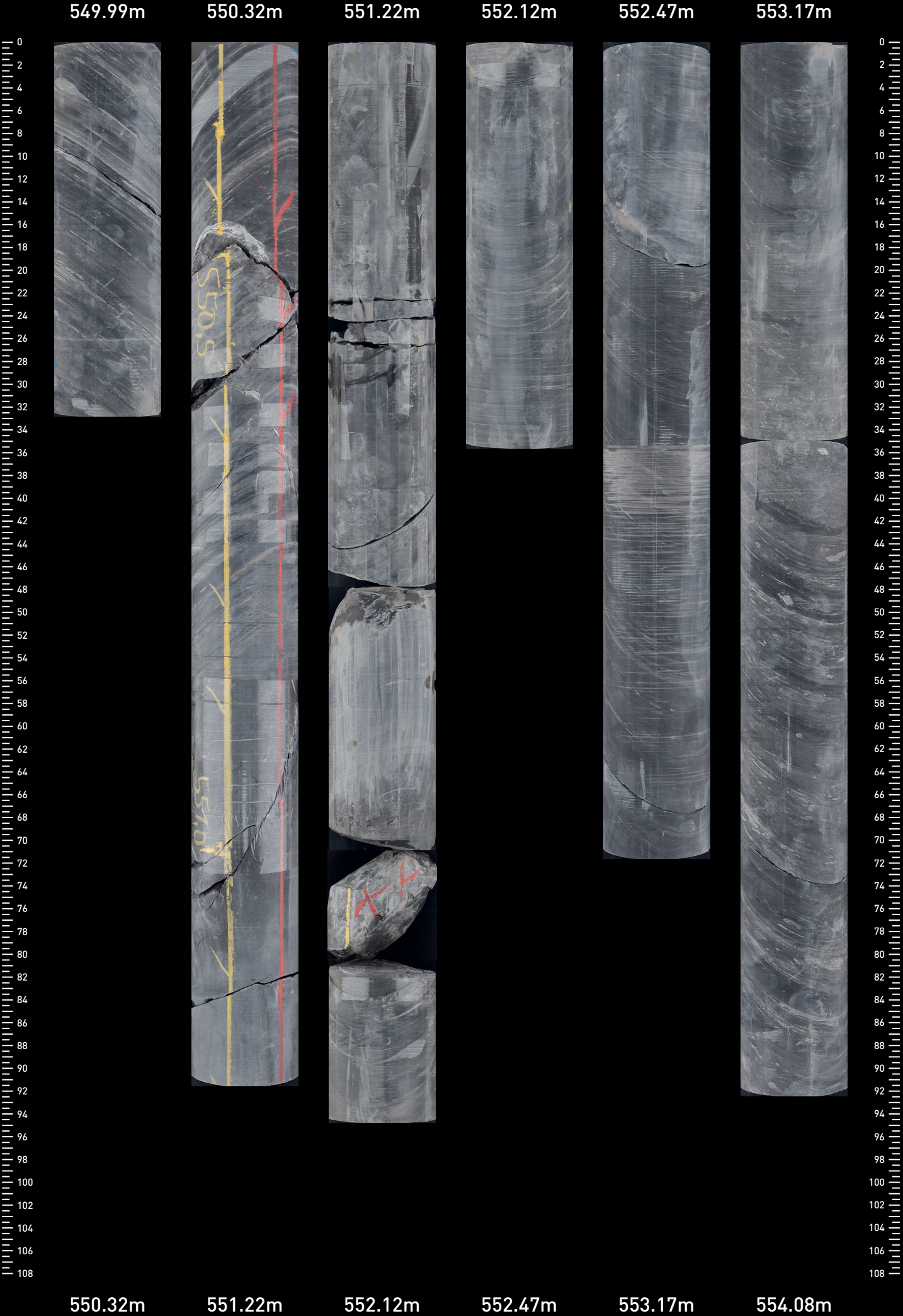
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548.33m

549.04m





554.08m

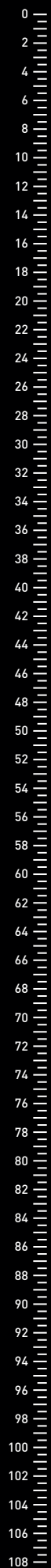
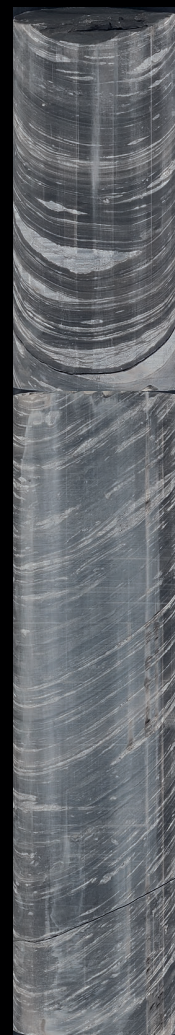
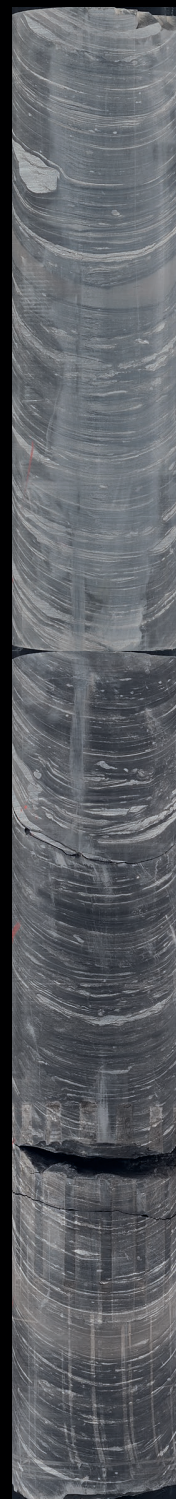
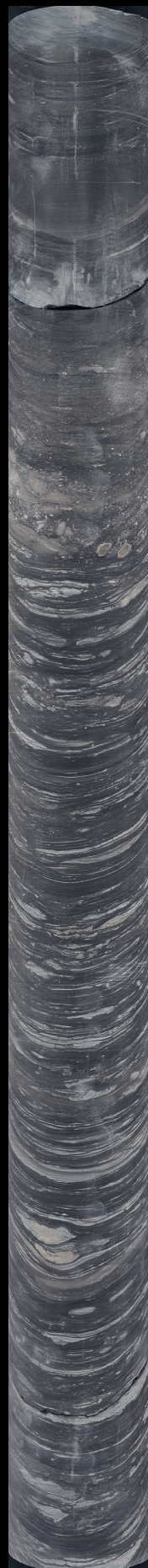
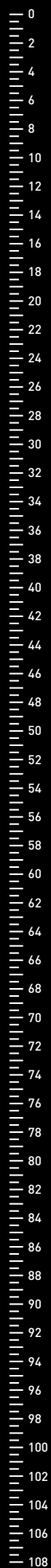
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555.85m

556.20m

557.20m

557.99m



554.88m

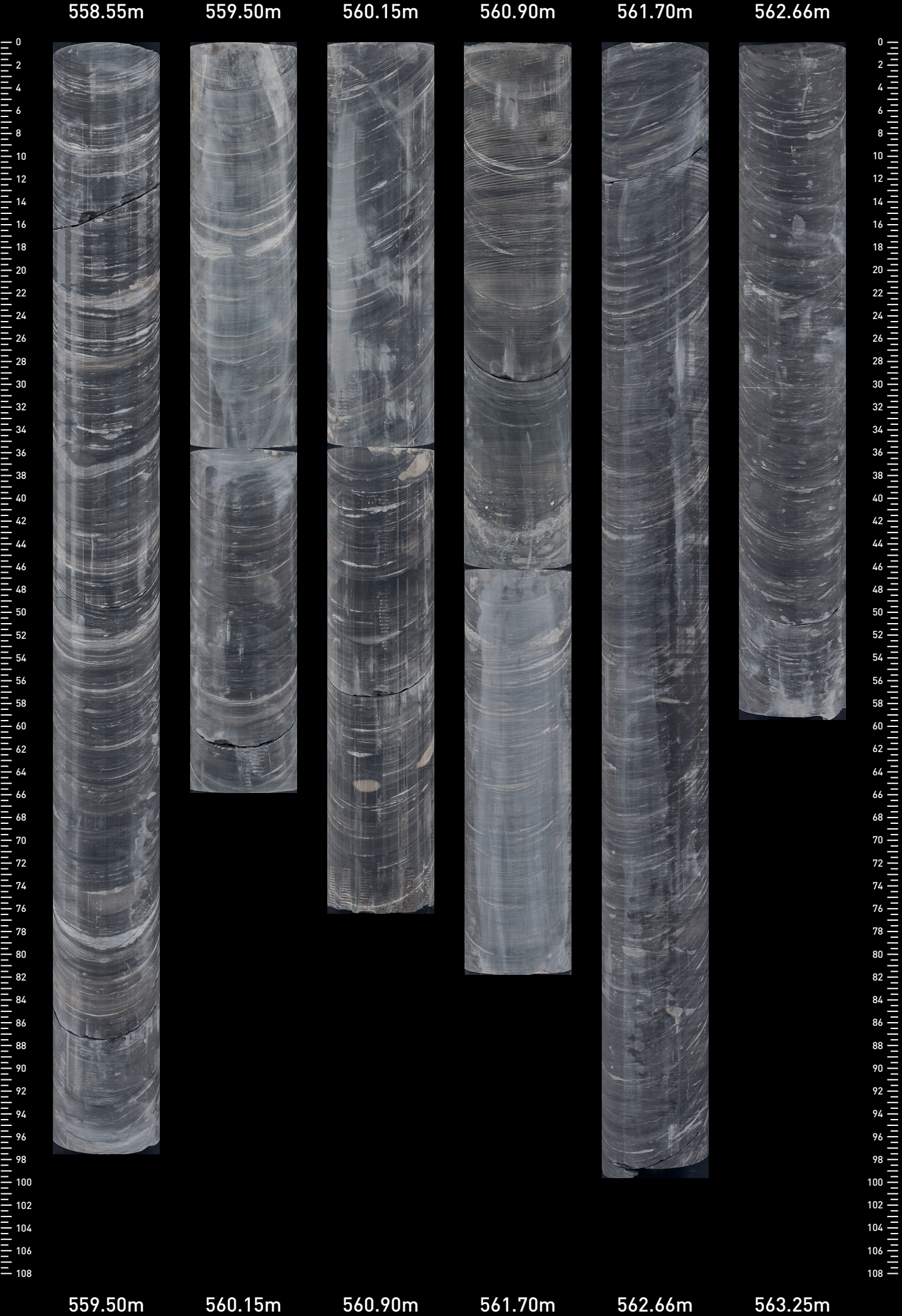
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557.20m

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558.55m



563.25m

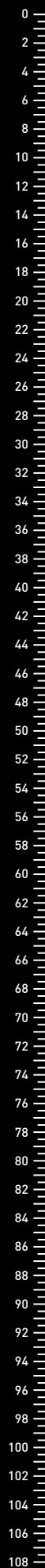
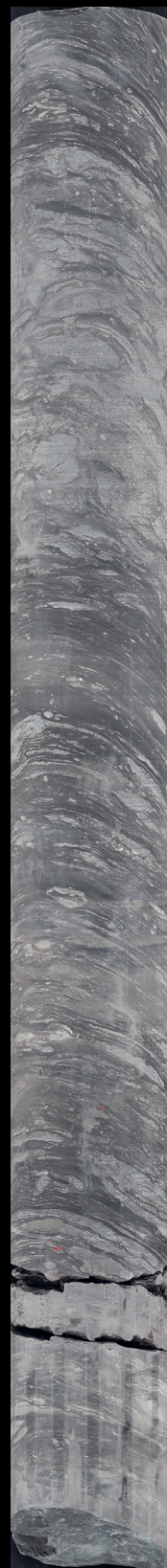
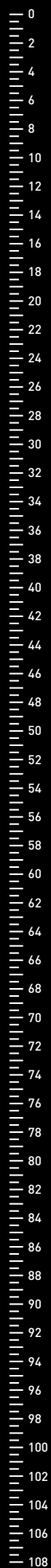
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565.70m

566.05m

566.93m



564.02m

564.85m

565.70m

566.05m

566.93m

567.40m

567.40m

568.16m

569.04m

569.90m

570.77m

571.41m



568.16m

569.04m

569.90m

570.77m

571.41m

572.26m

572.26m

573.02m

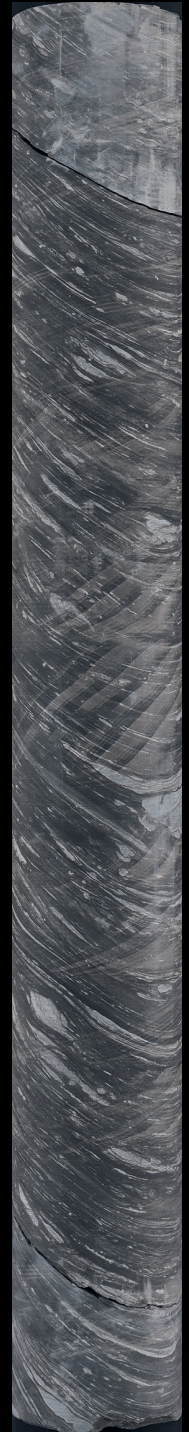
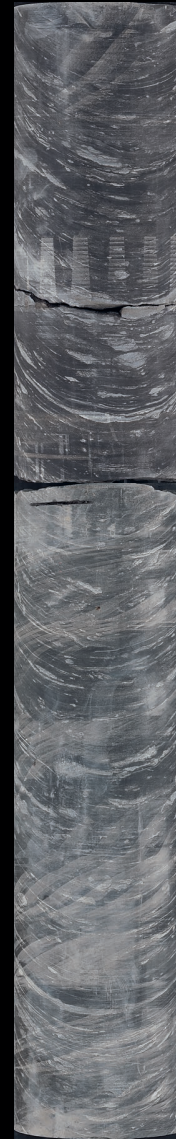
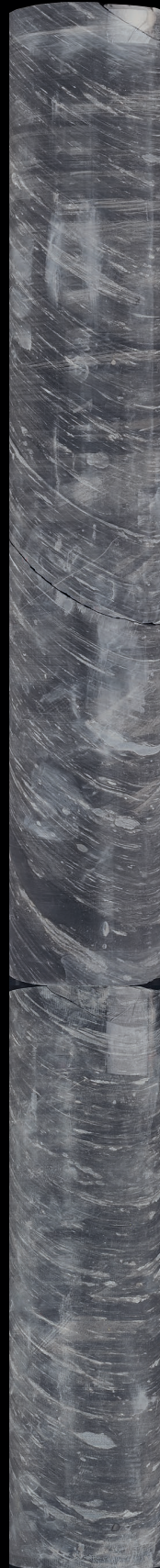
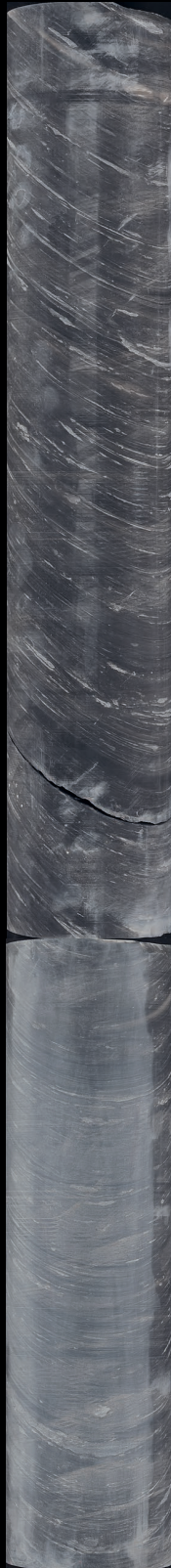
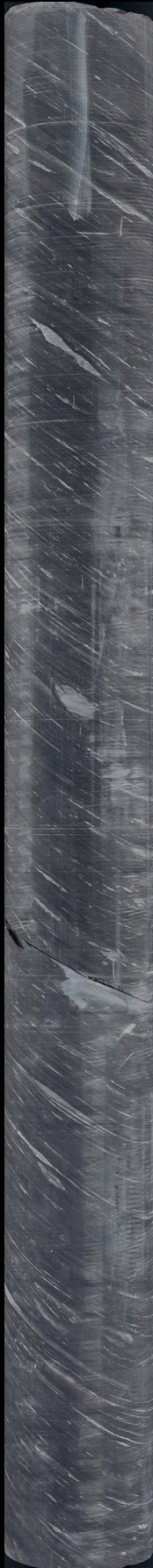
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574.85m

575.78m

576.38m

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573.02m

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574.85m

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577.15m



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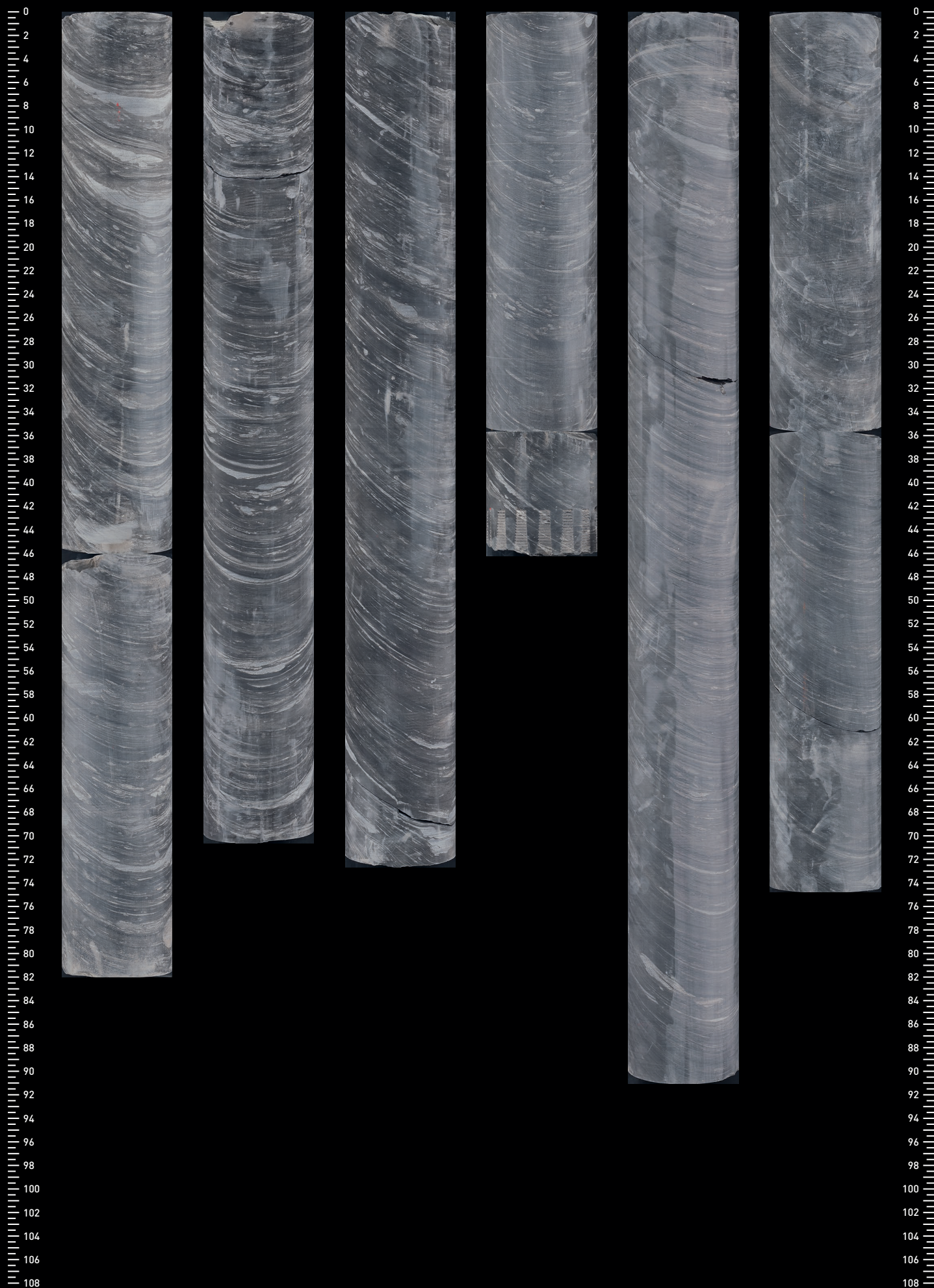
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584.50m

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585.84m



583.10m

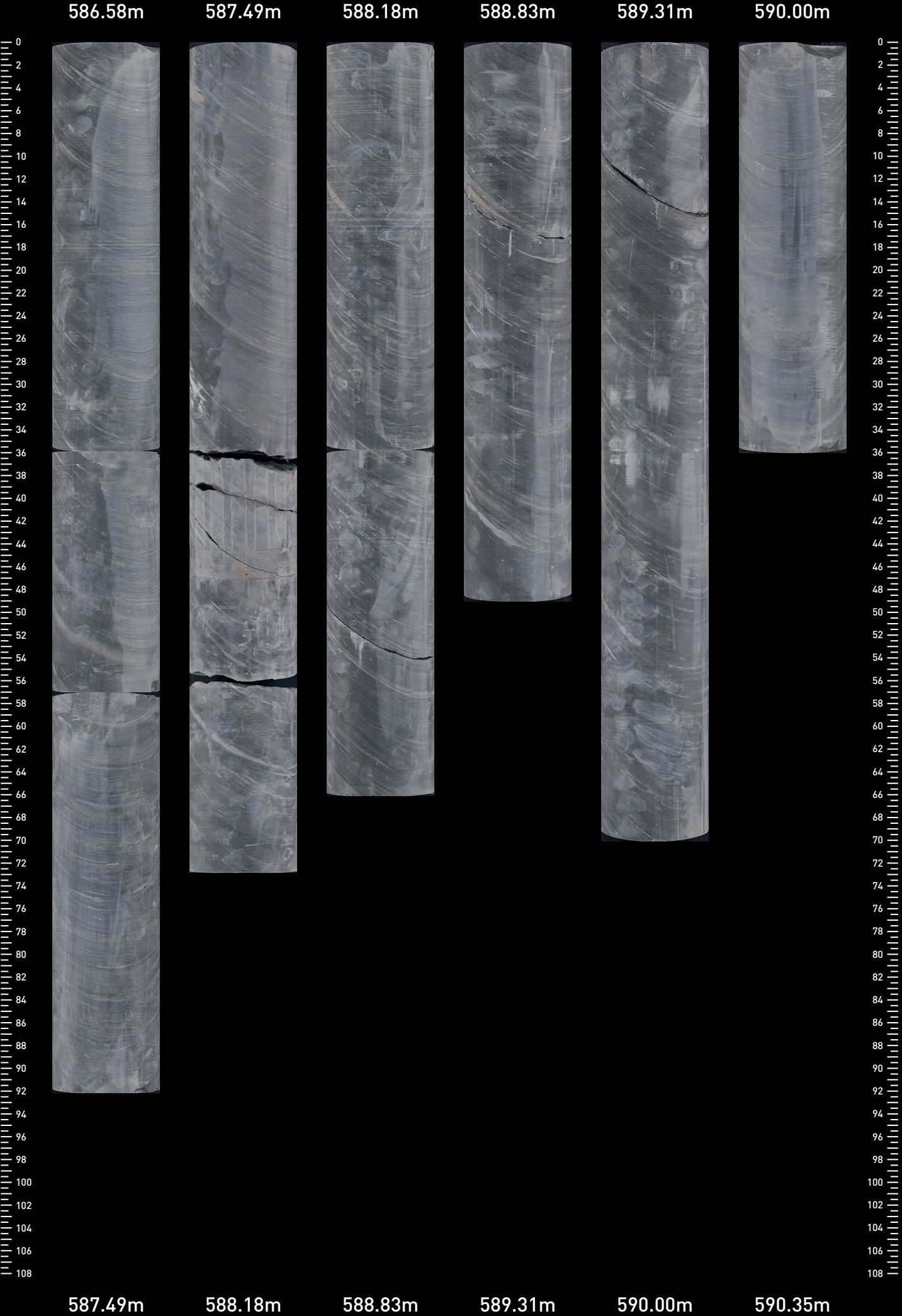
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586.58m



590.35m

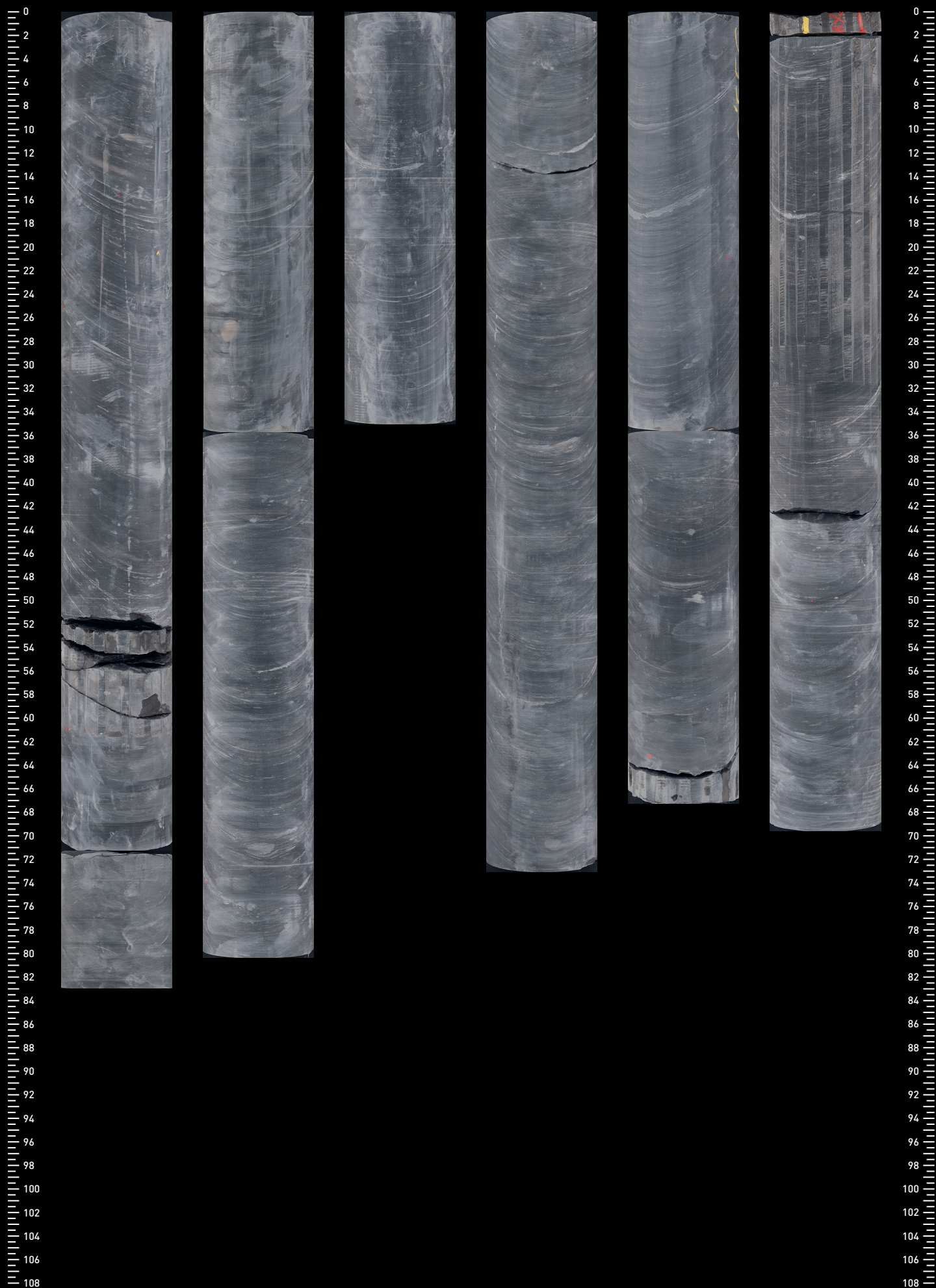
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592.29m

593.00m

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591.16m

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594.34m

594.34m

594.69m

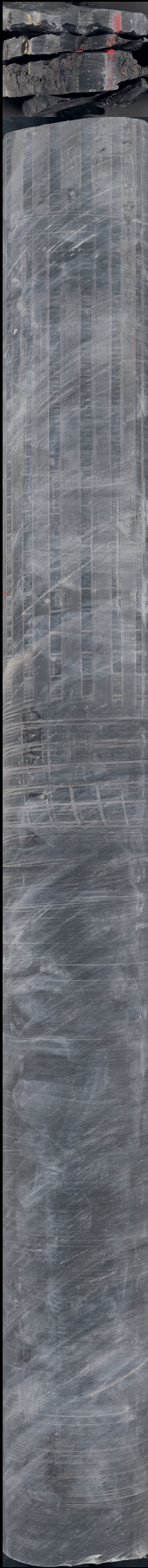
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594.69m

595.59m

596.54m

597.50m

598.40m

599.35m

599.35m

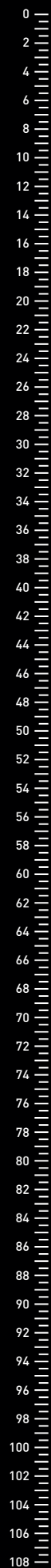
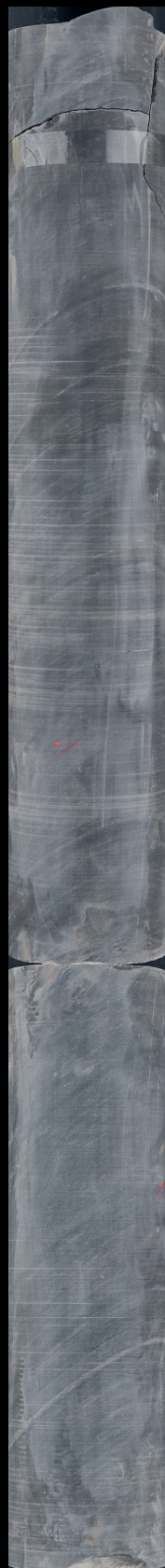
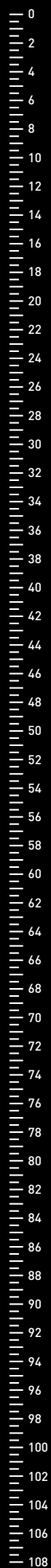
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600.85m

601.75m

602.65m

603.64m



600.08m

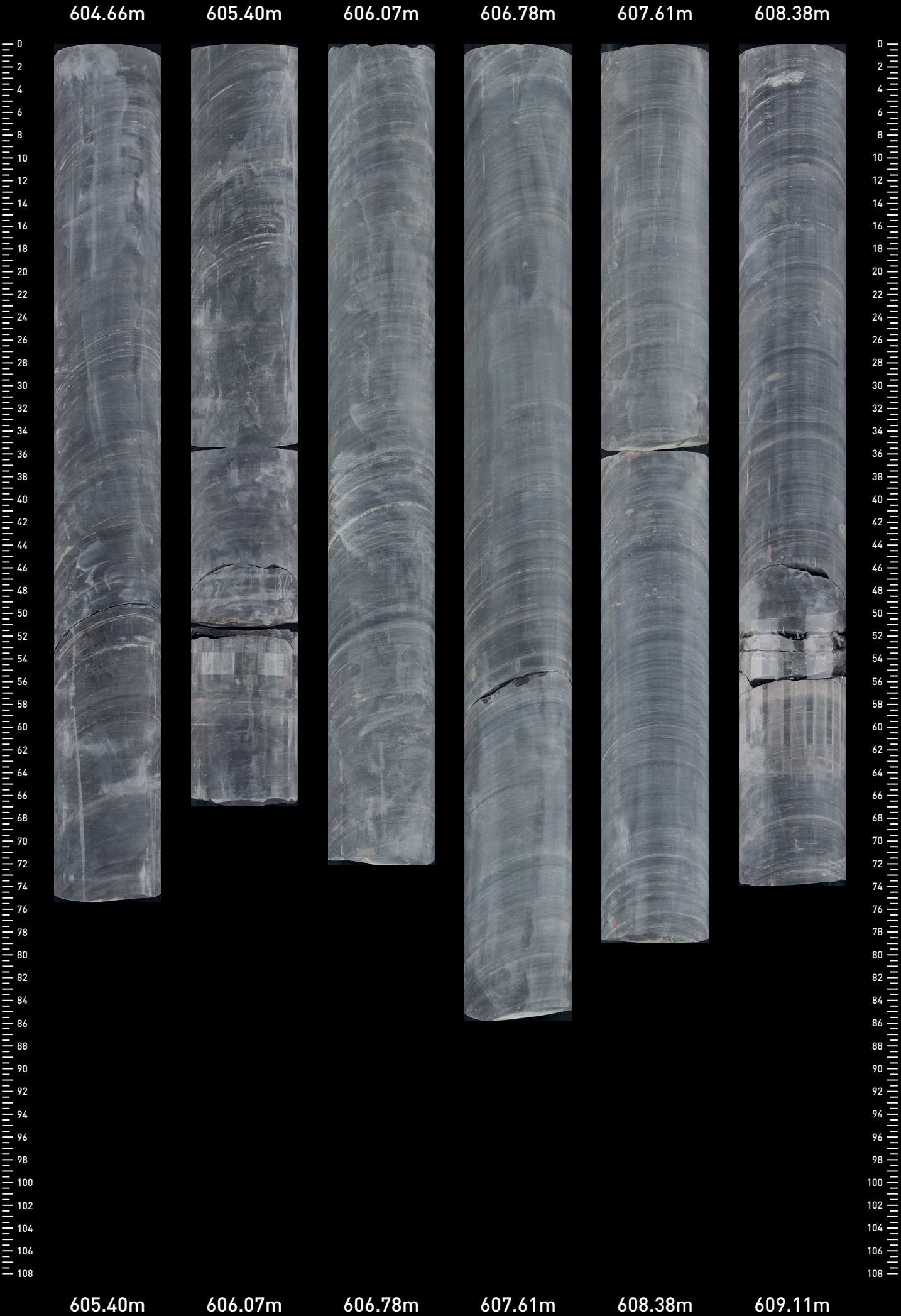
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609.11m

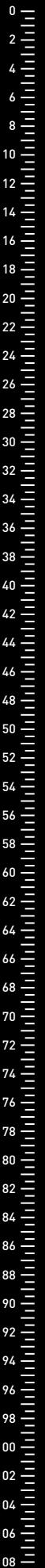
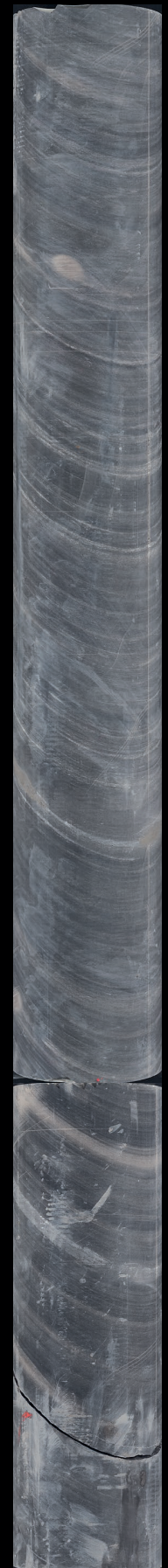
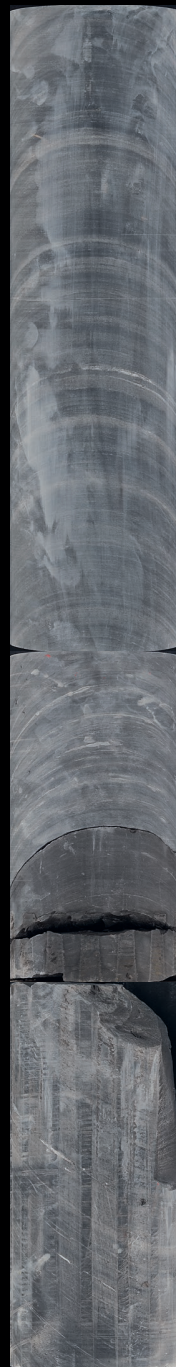
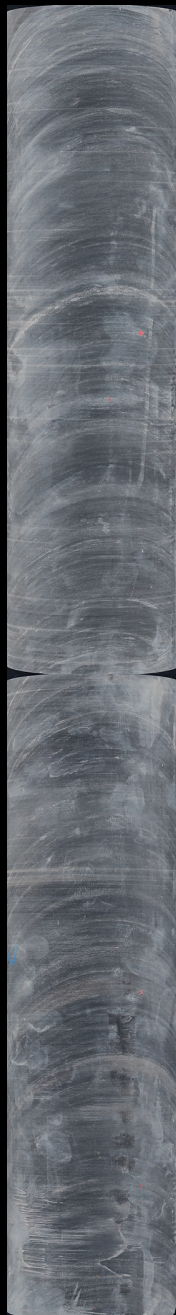
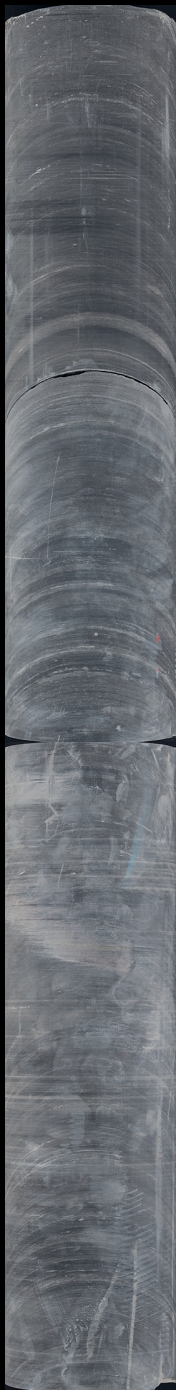
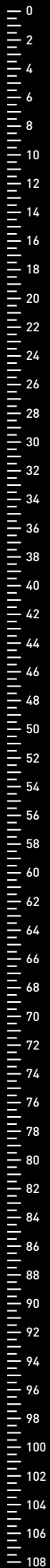
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610.56m

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612.38m



609.85m

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612.38m

613.35m



618.03m

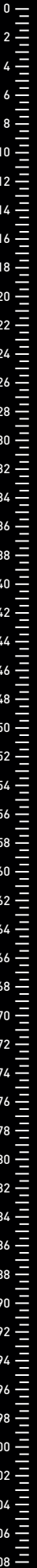
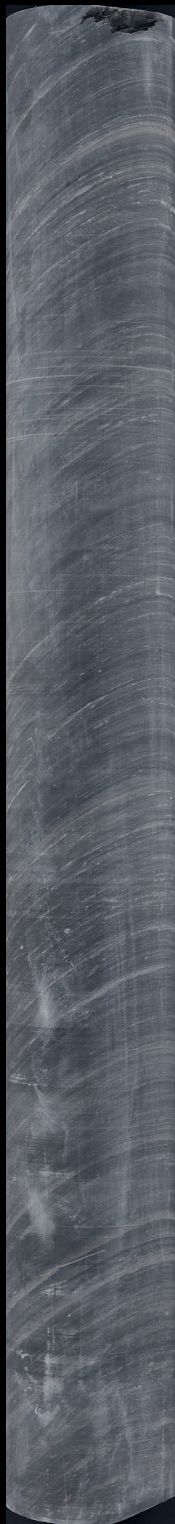
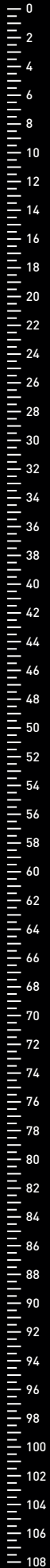
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619.64m

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621.02m

622.00m



618.70m

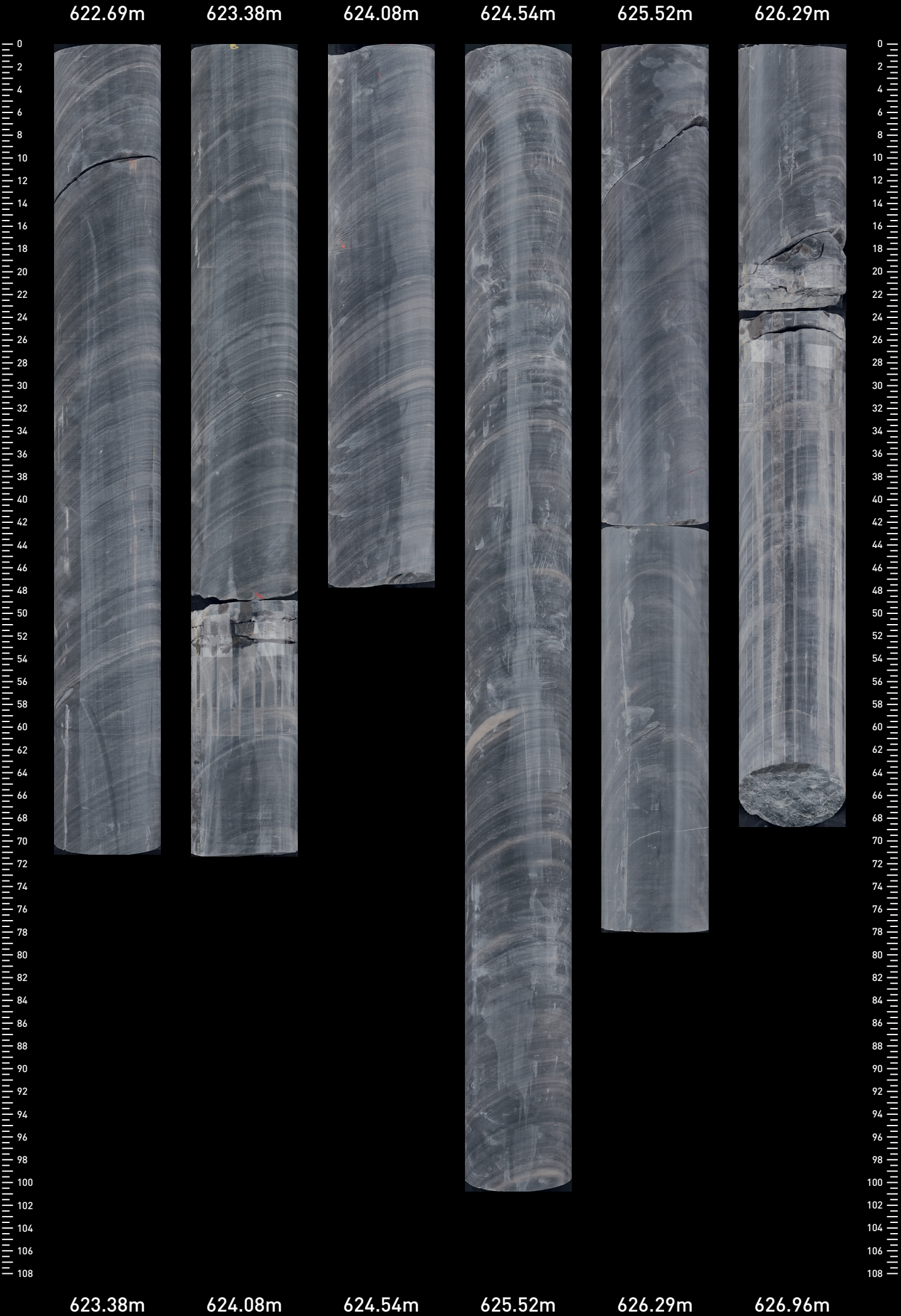
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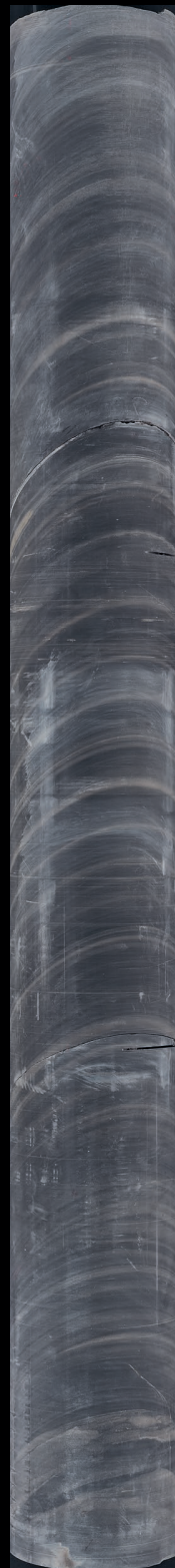
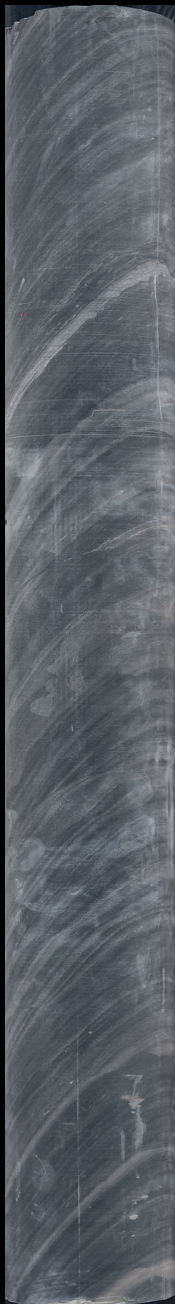
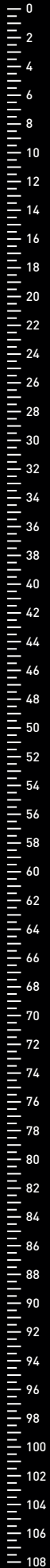
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627.80m

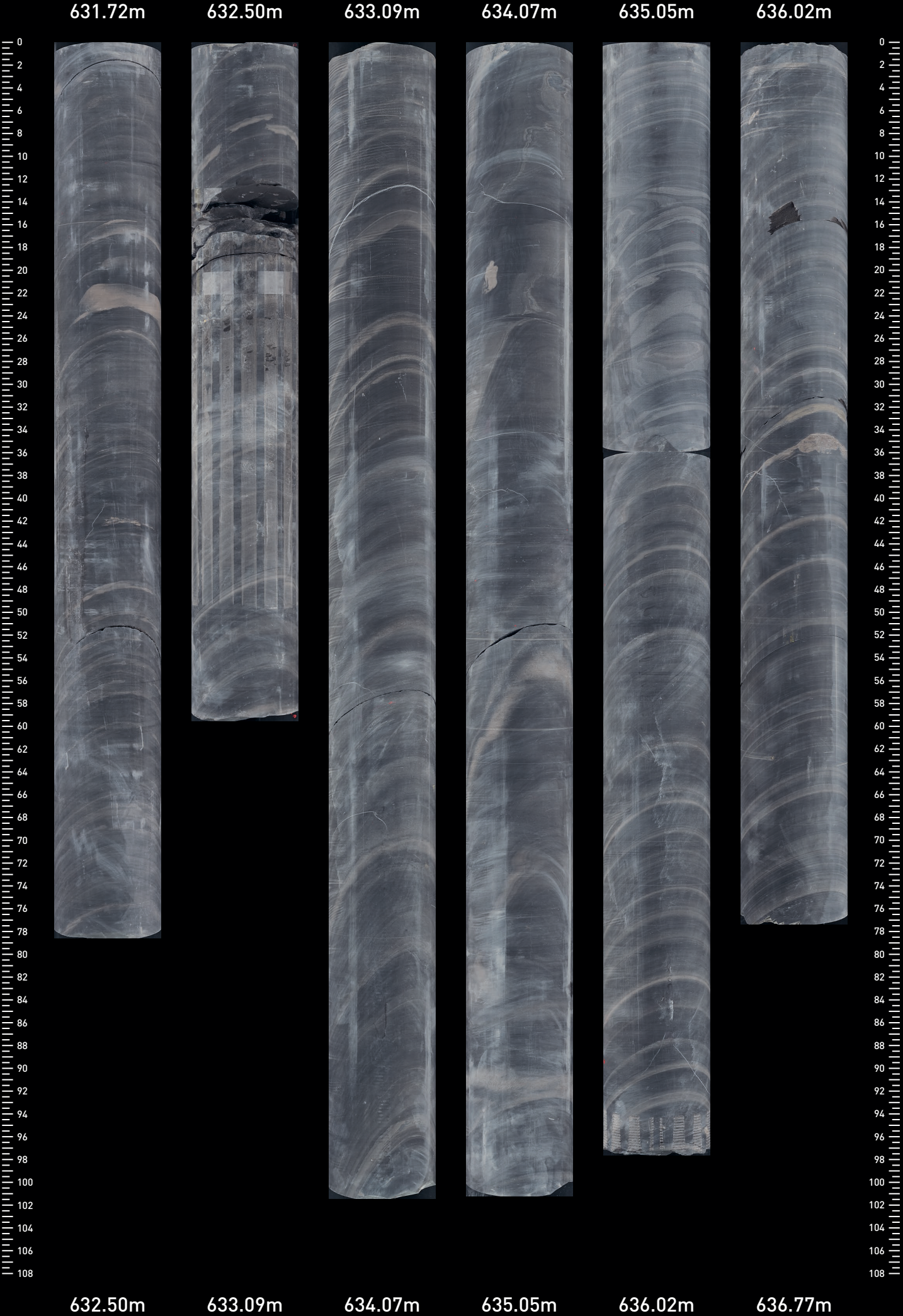
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630.11m

630.95m

631.72m



636.77m

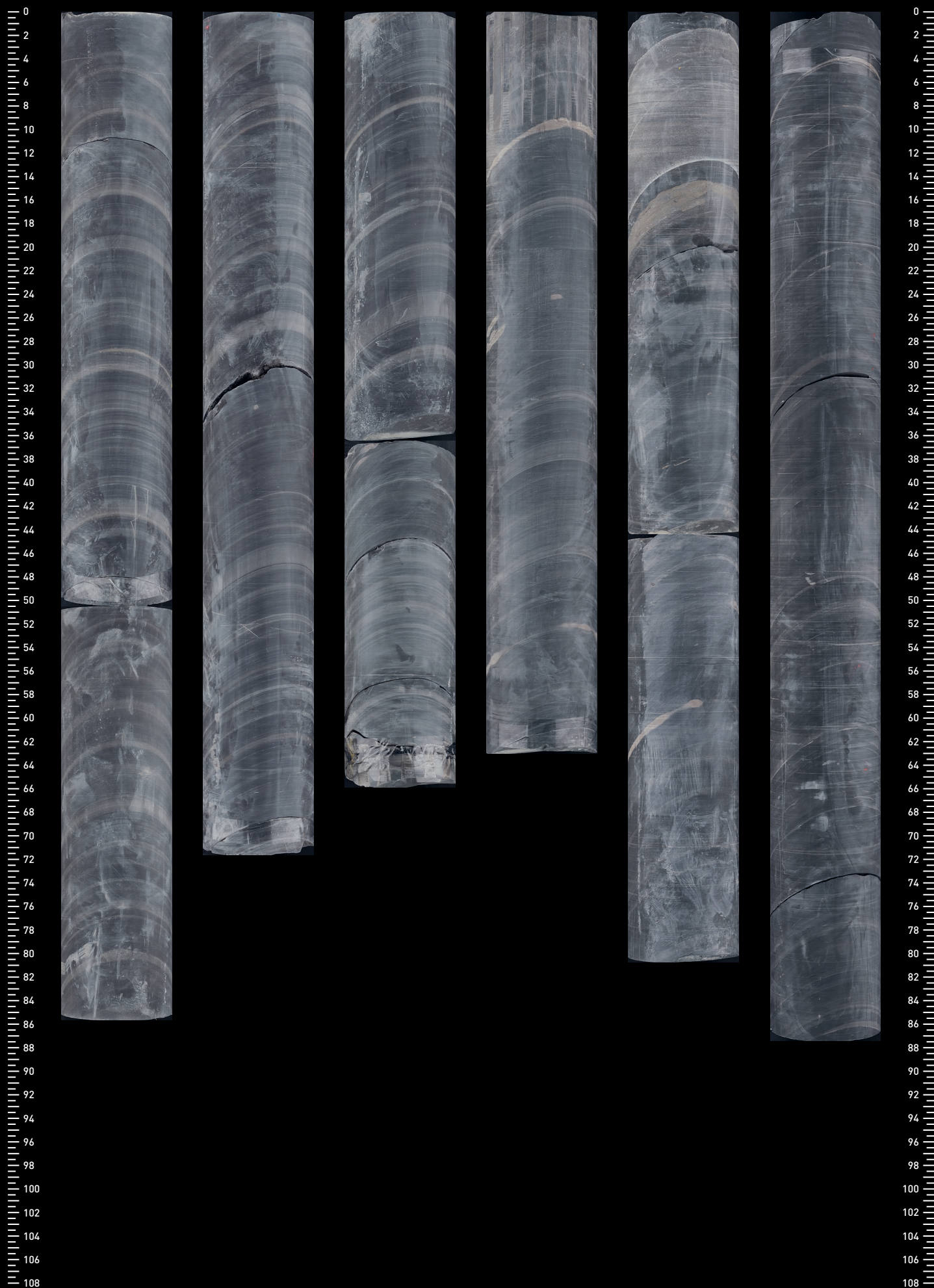
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638.31m

638.93m

639.55m

640.33m



637.61m

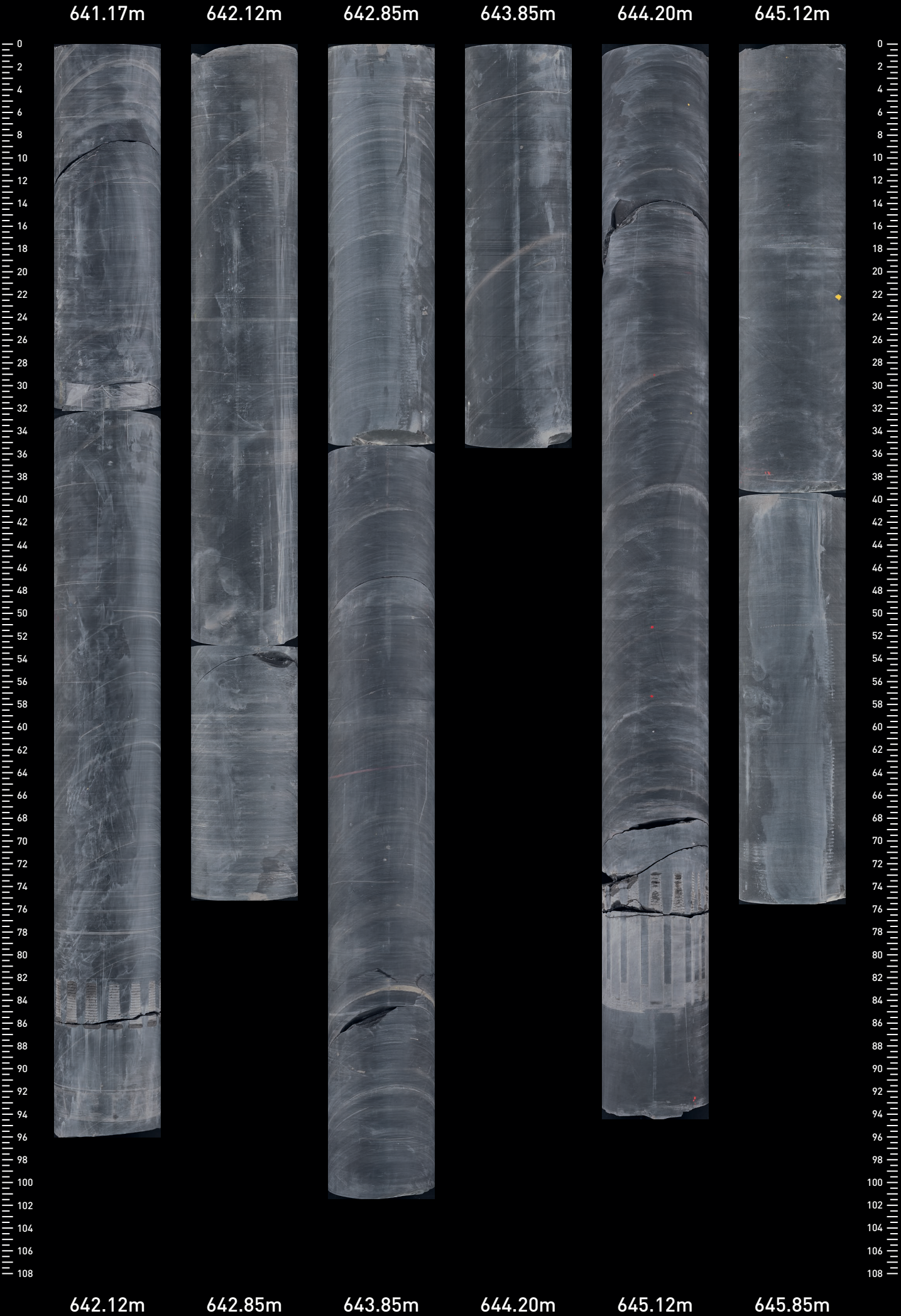
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645.85m

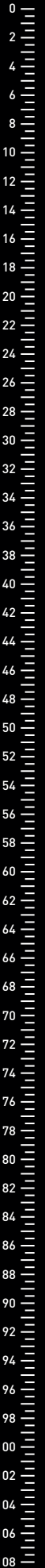
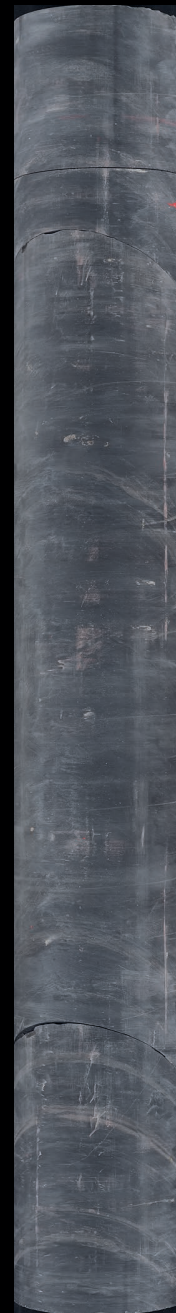
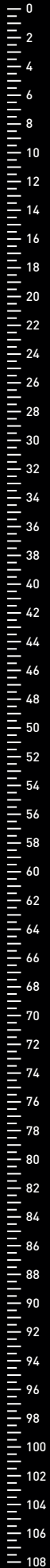
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646.75m

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649.85m

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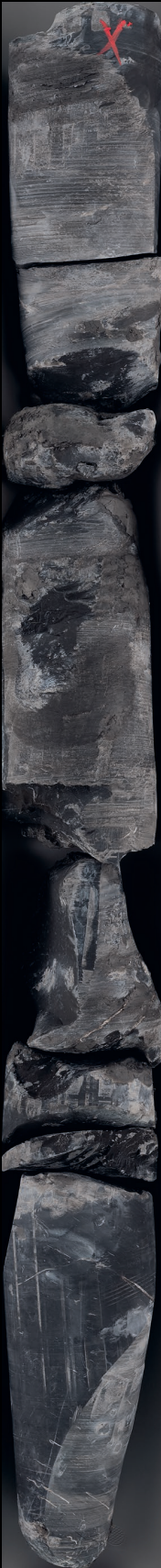
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650.60m

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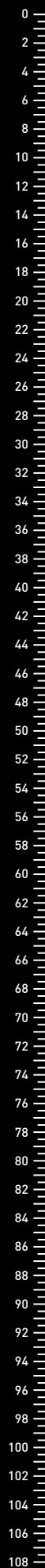
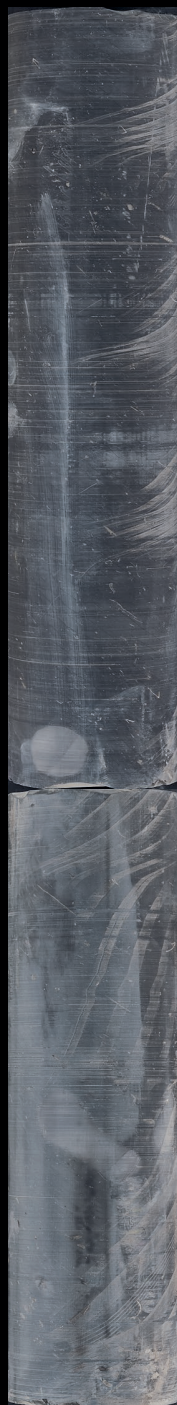
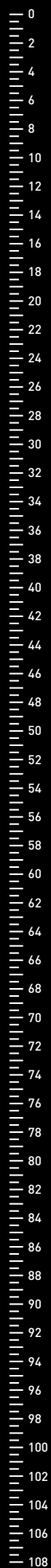
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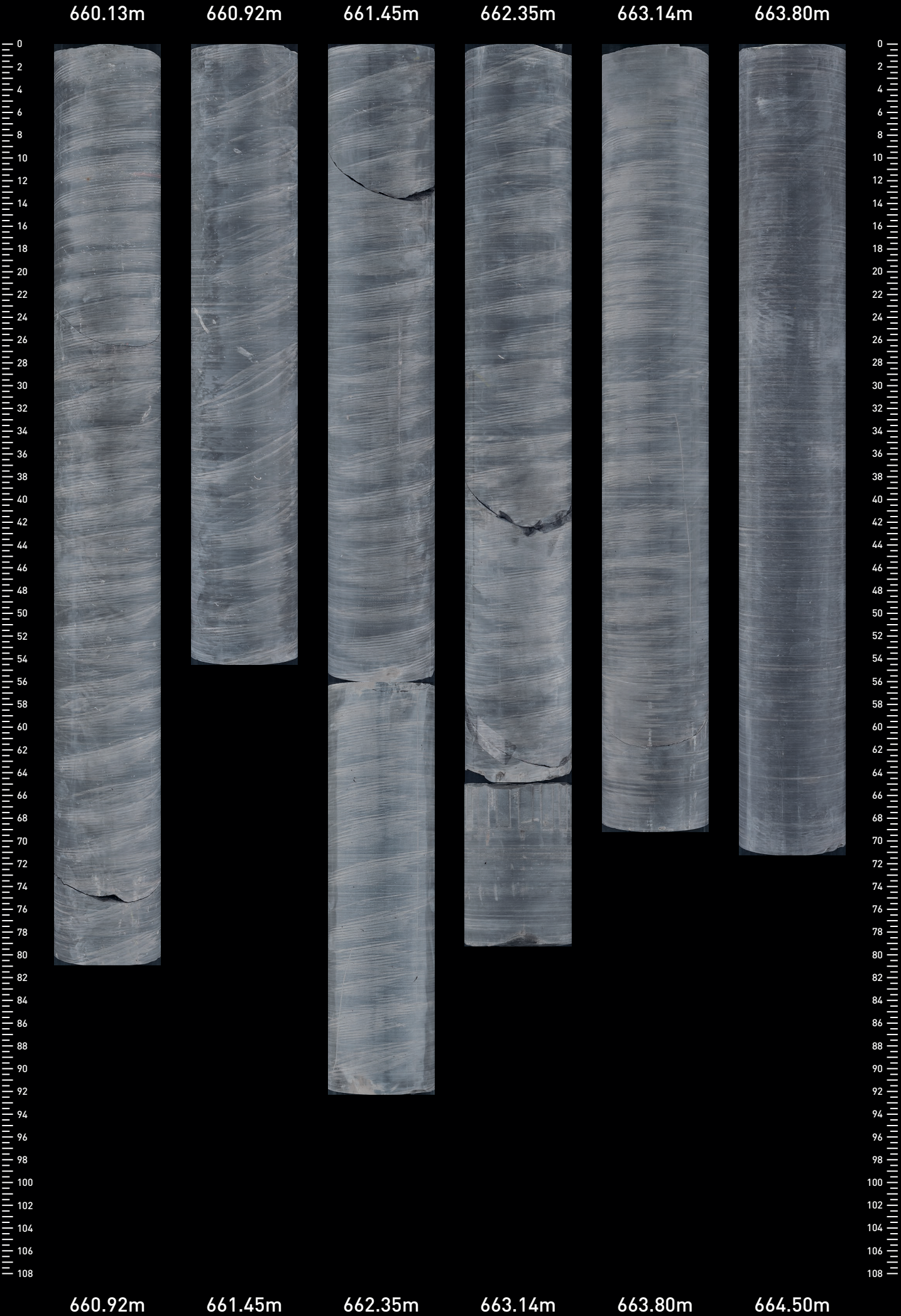
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664.50m

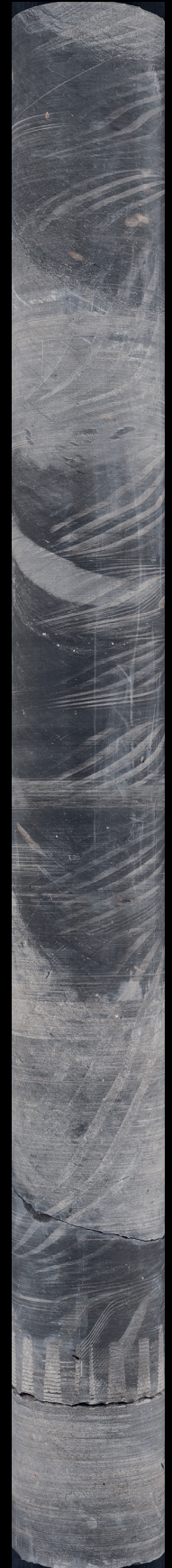
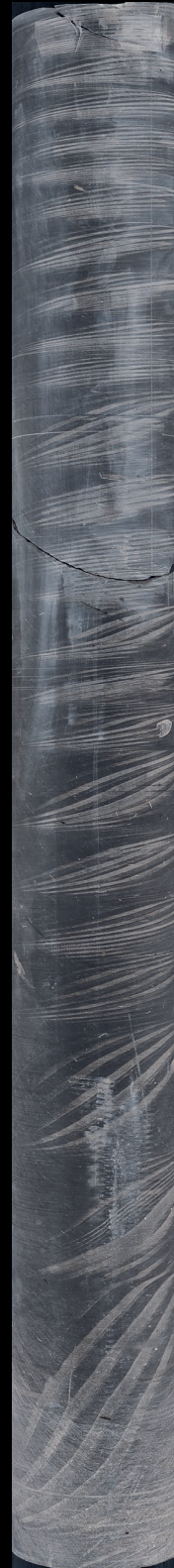
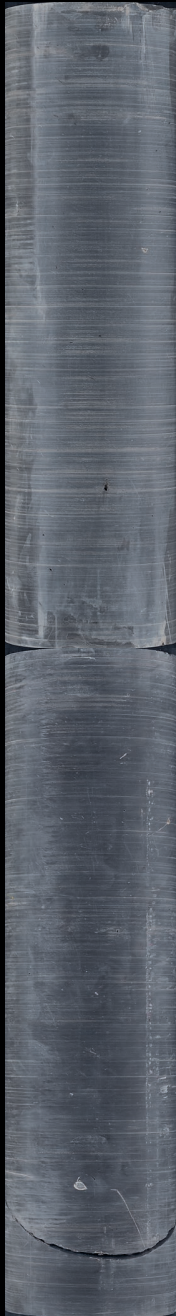
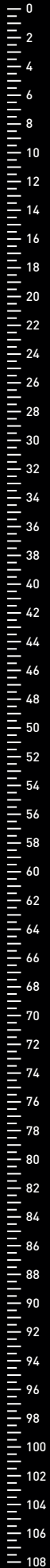
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668.20m



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669.14m

669.14m

670.05m

670.81m

671.54m

672.46m

673.11m

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674.02m

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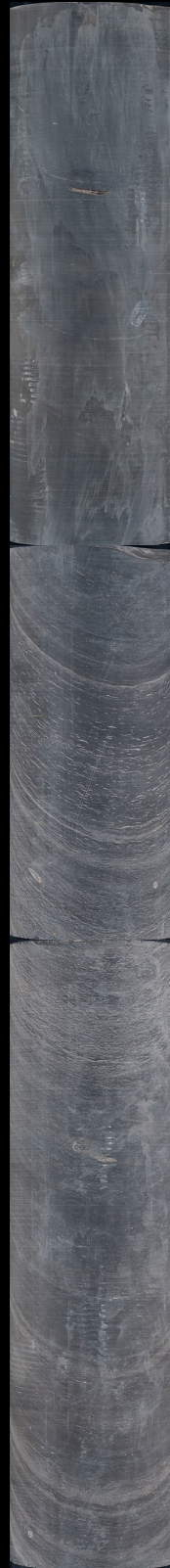
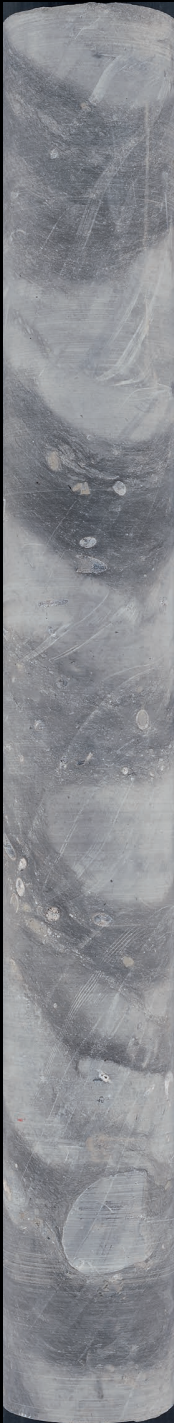
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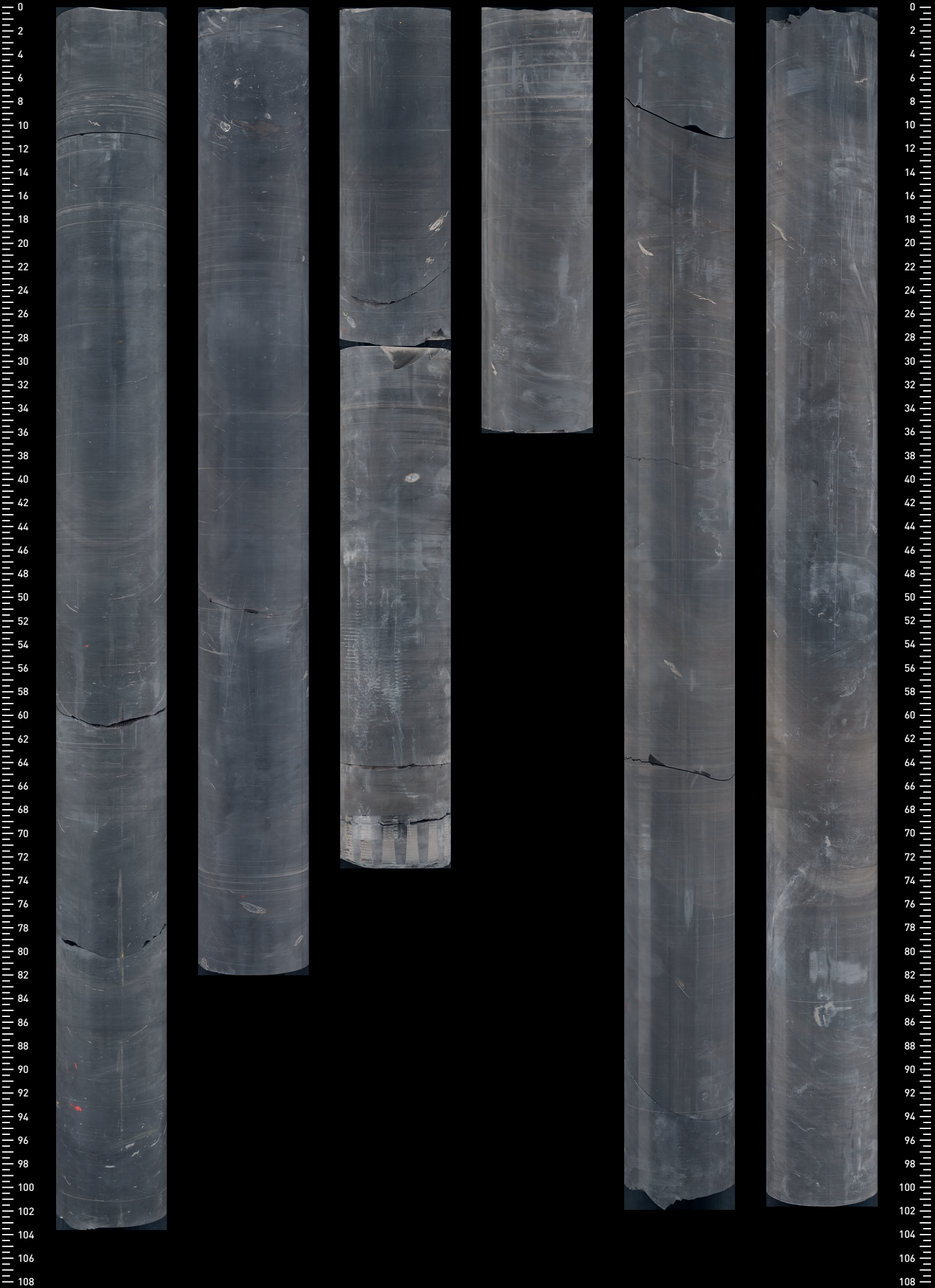
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679.58m

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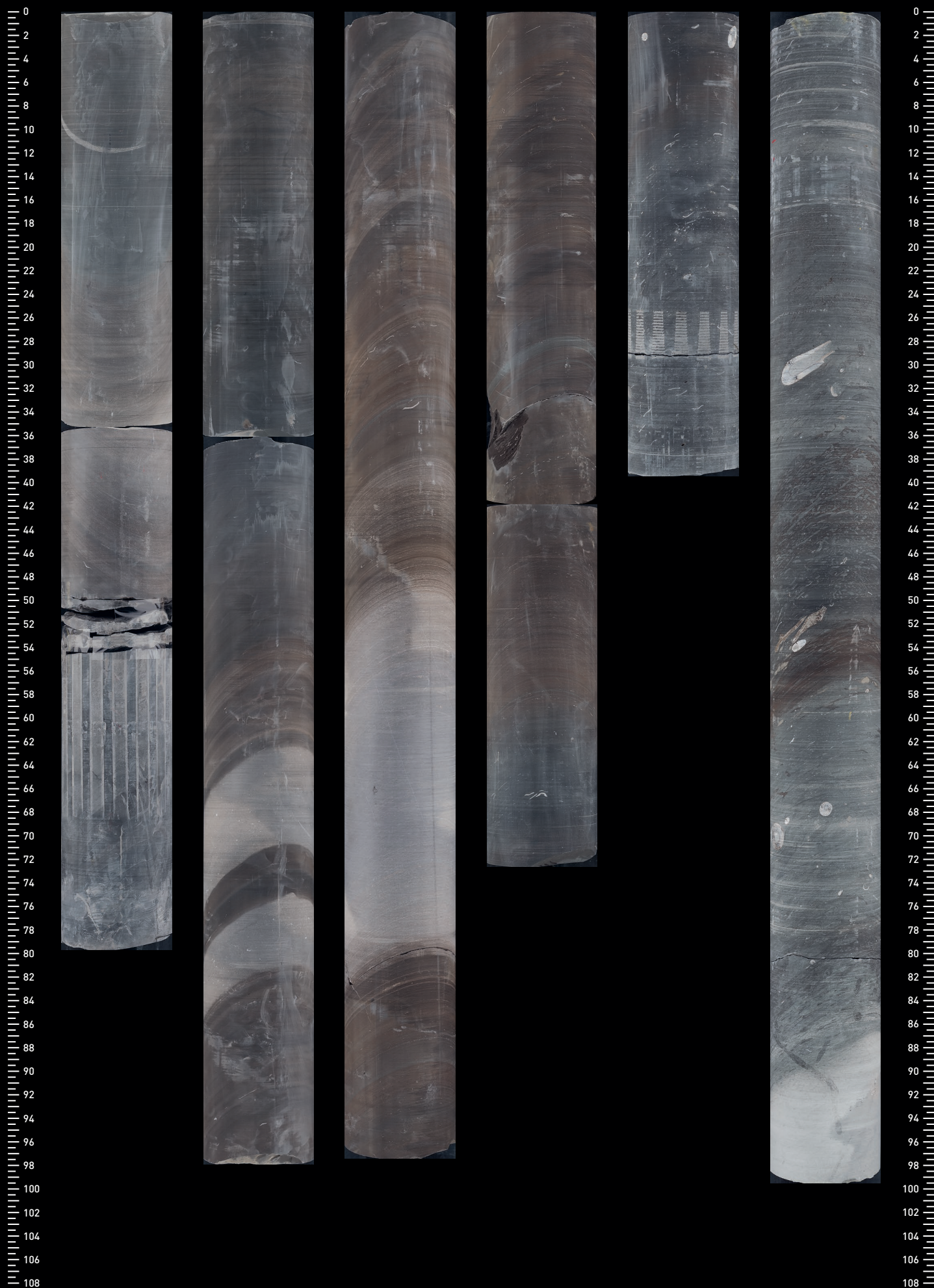
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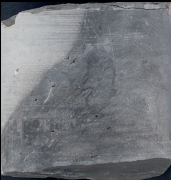
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689.13m

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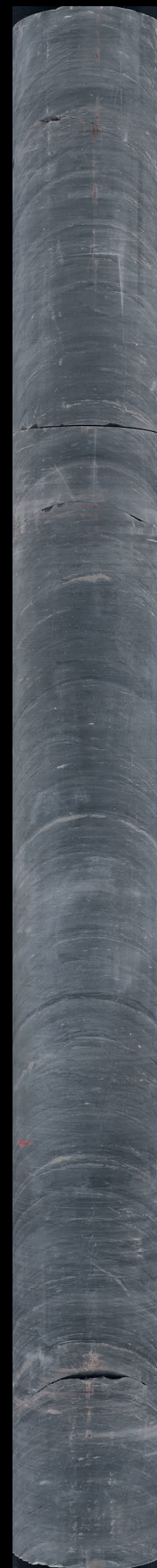
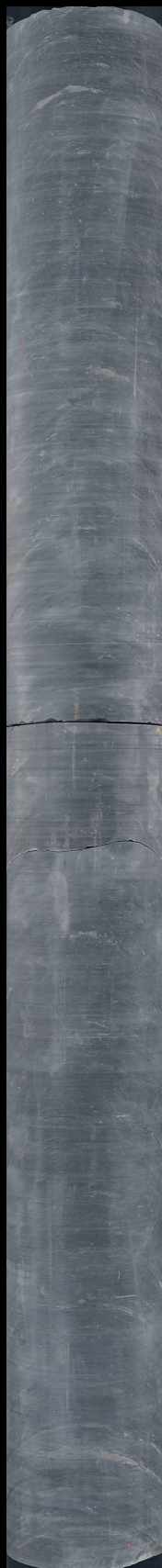
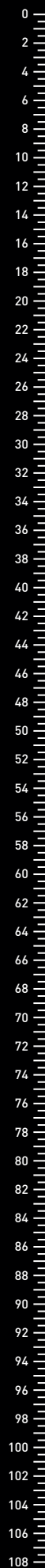
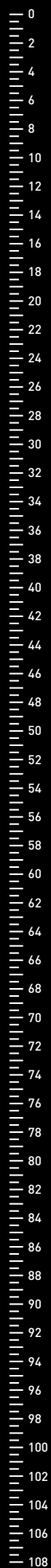
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696.80m



693.58m

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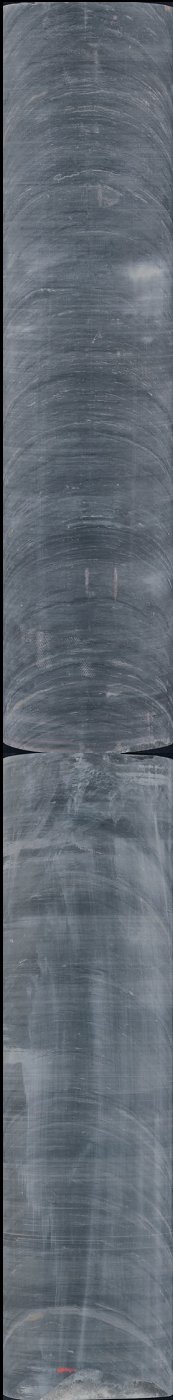
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698.50m

699.26m

700.06m

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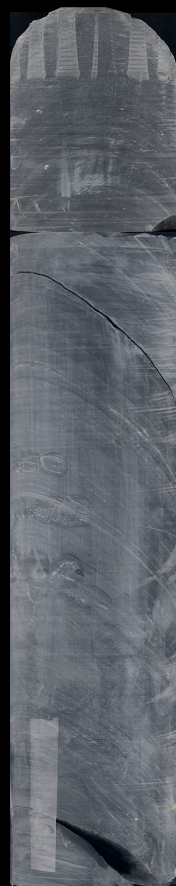
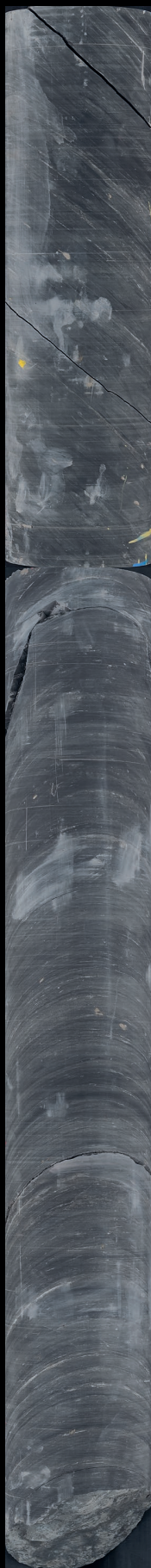
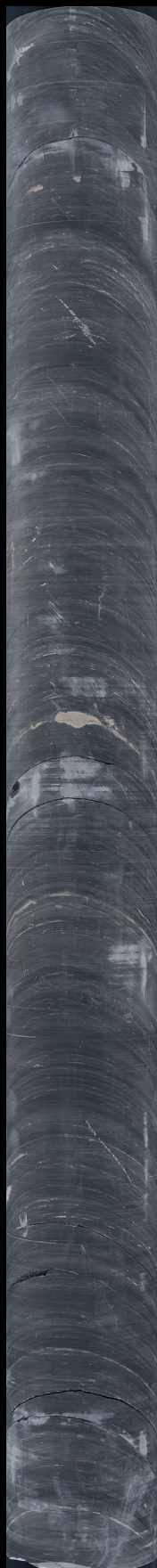
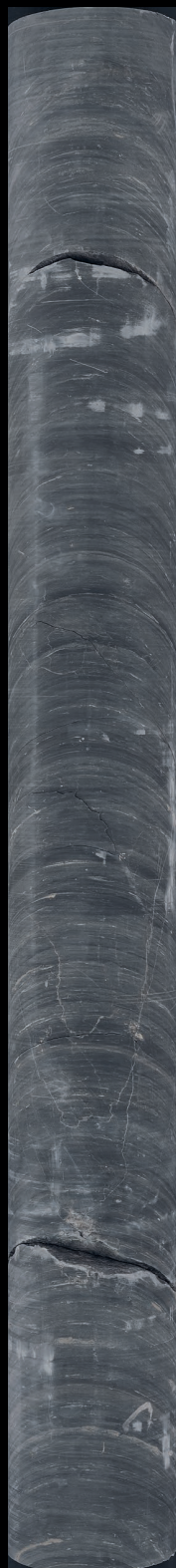
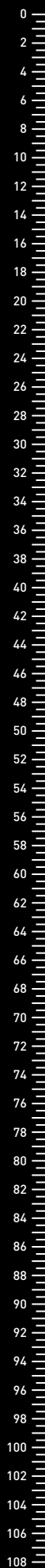
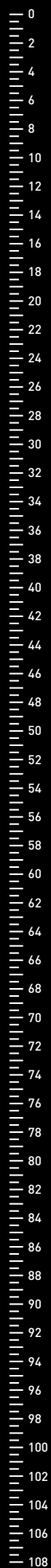
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704.17m

705.17m

705.56m

706.32m



703.23m

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707.00m



711.85m

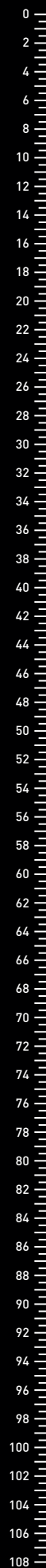
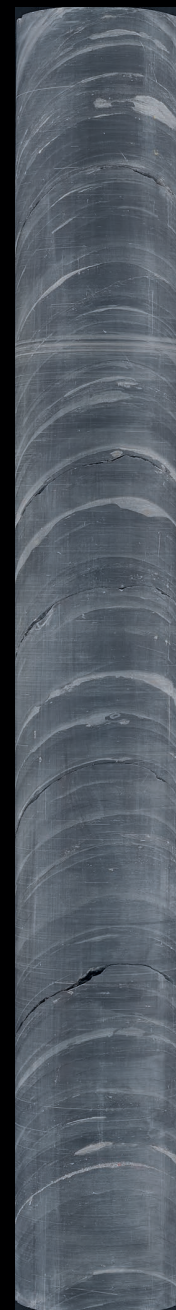
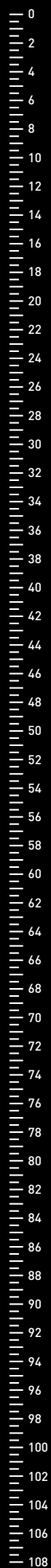
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714.15m

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716.62m

717.19m

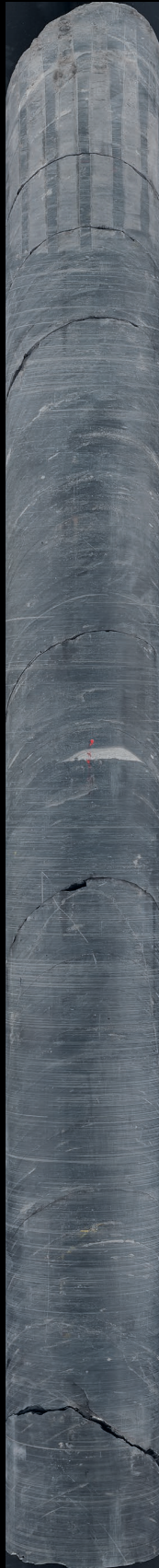
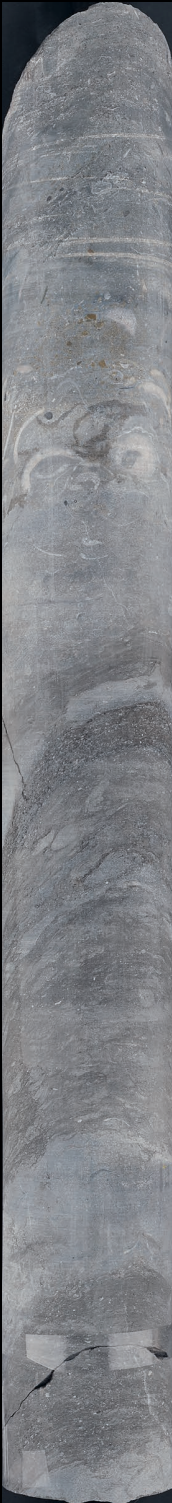
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717.19m

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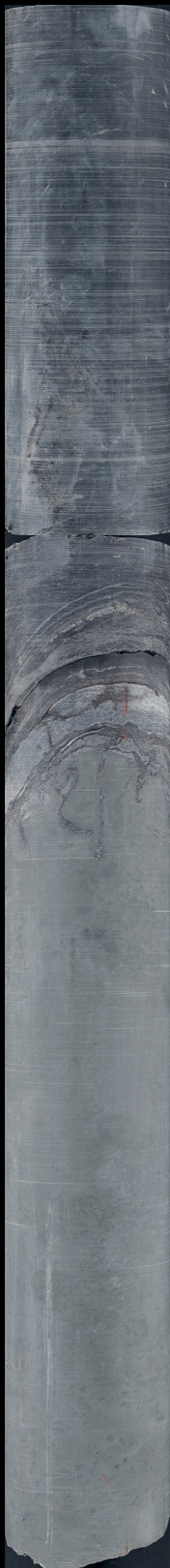
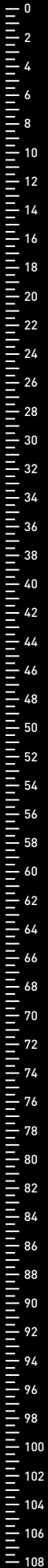
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726.14m

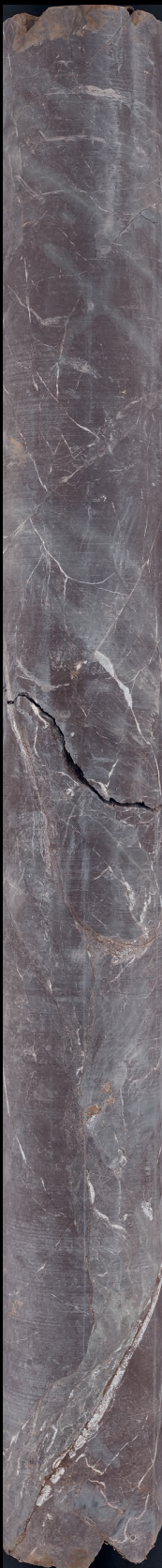
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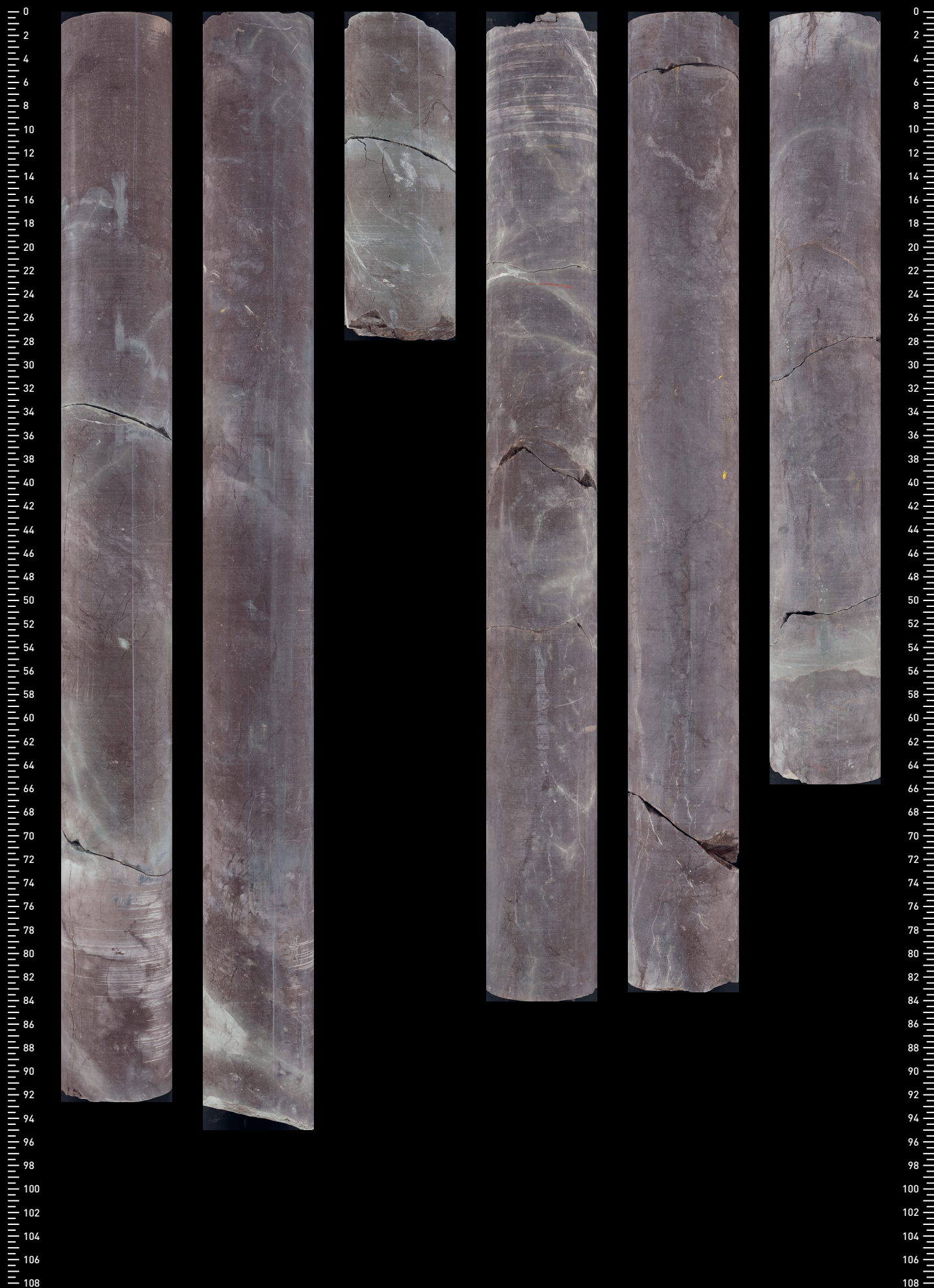
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735.19m

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739.12m

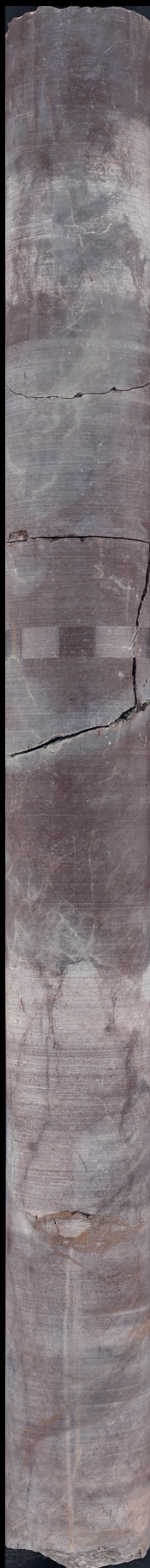
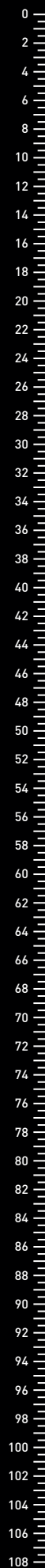
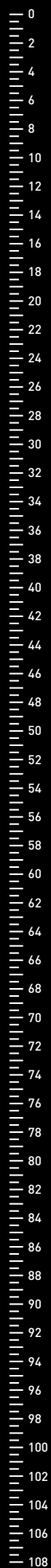
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742.95m



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743.71m

743.71m

744.14m

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746.03m

746.85m

747.24m

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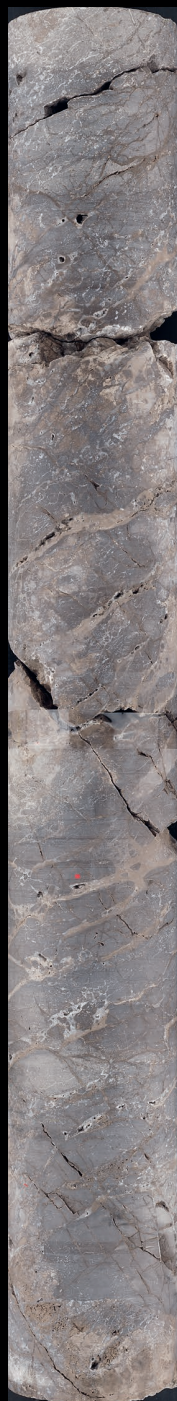
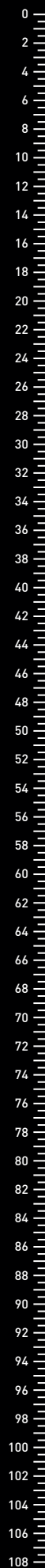
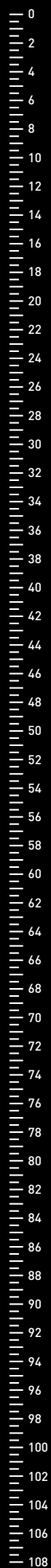
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748.68m

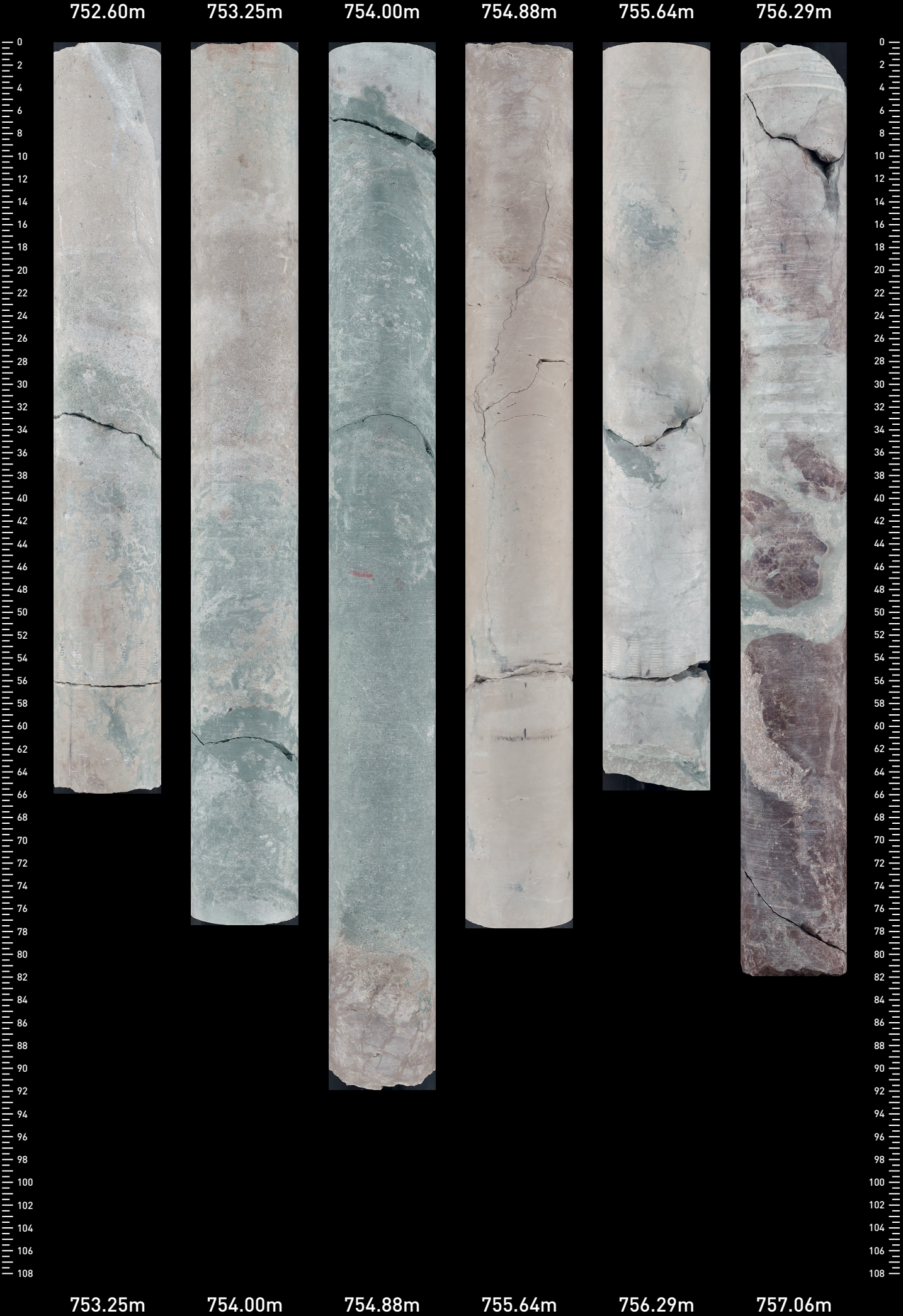
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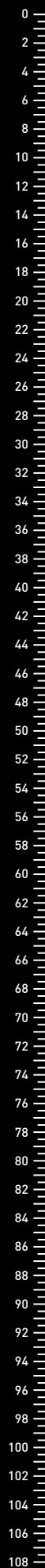
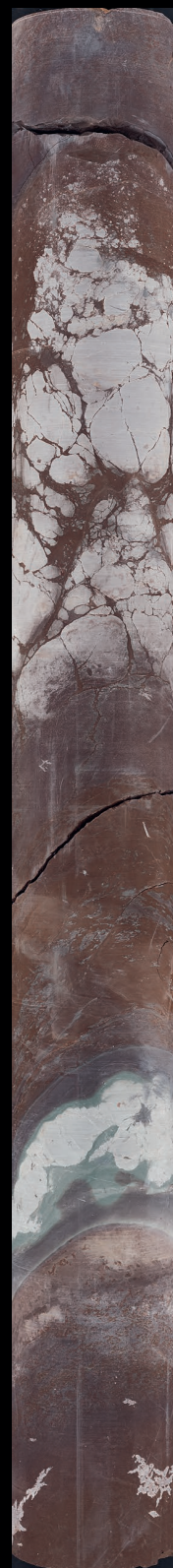
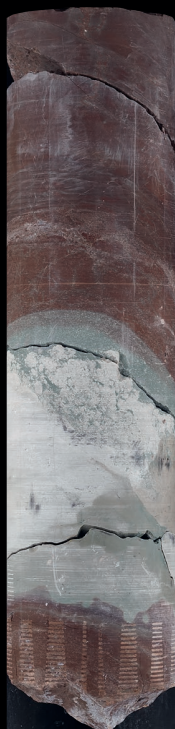
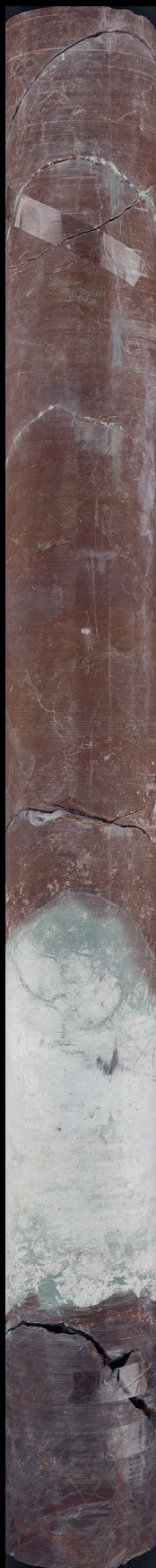
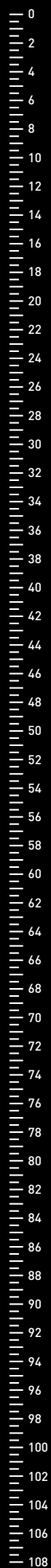
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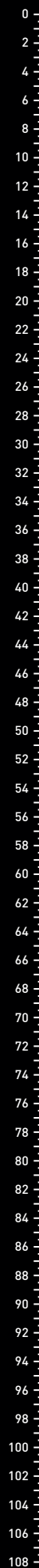
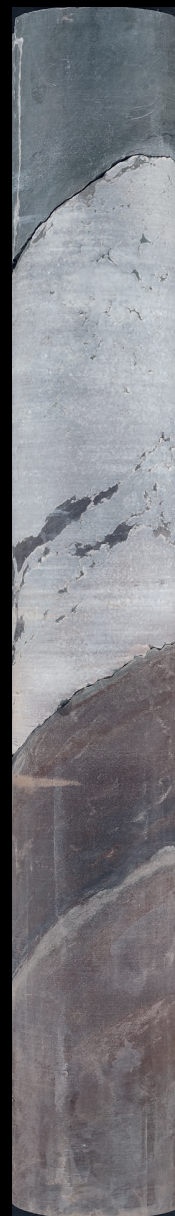
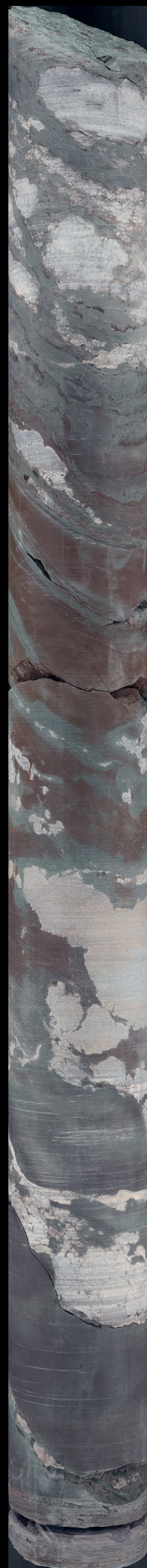
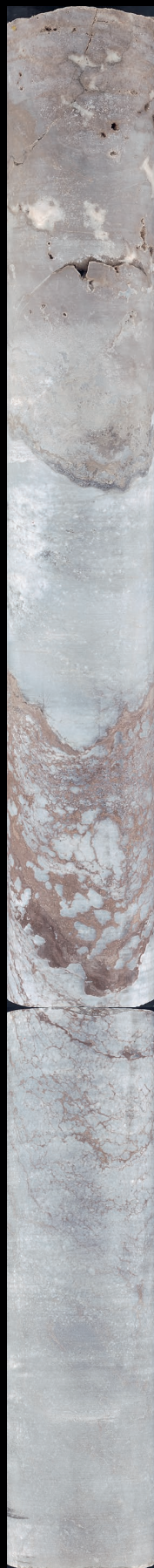
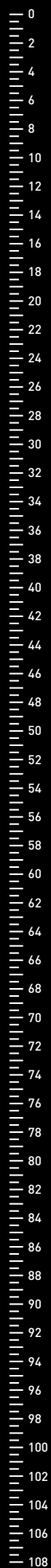
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775.00m

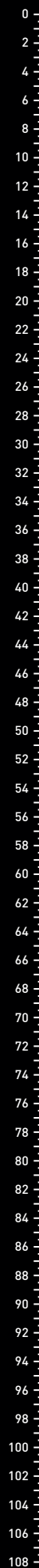
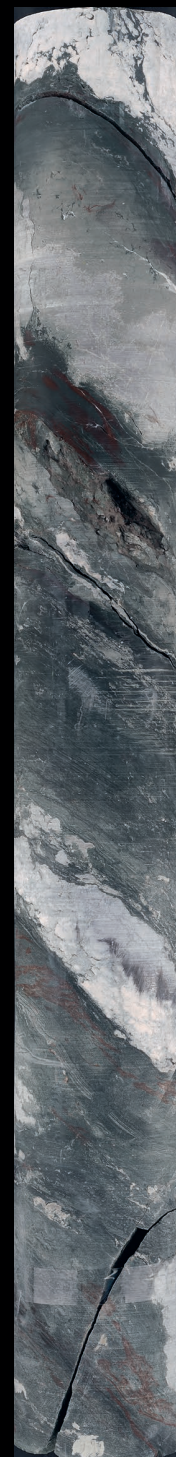
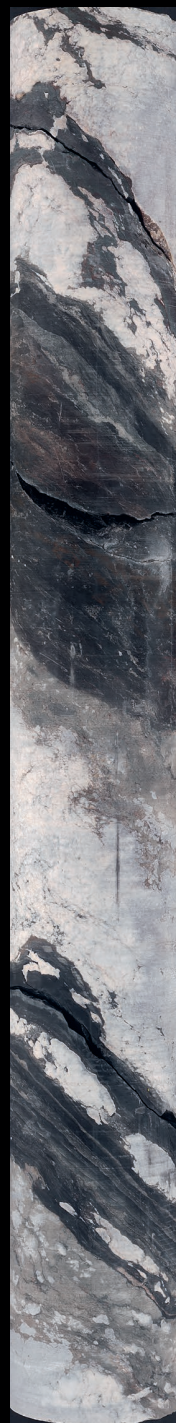
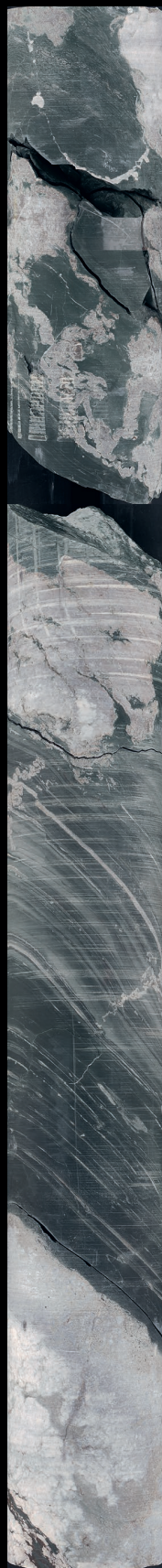
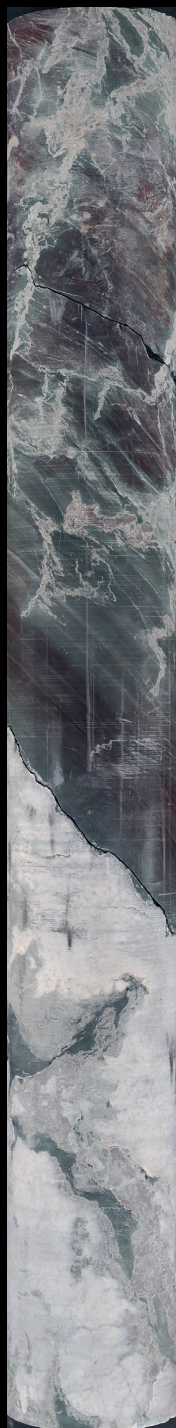
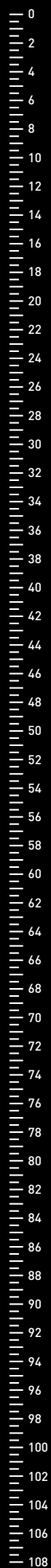
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777.61m

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775.95m

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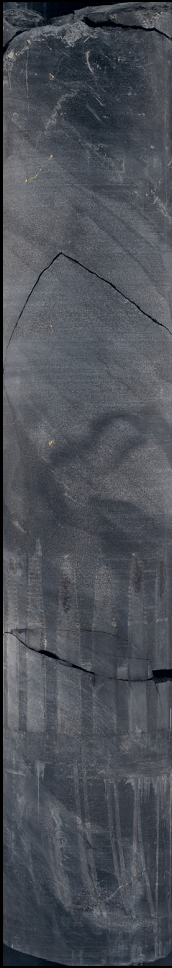
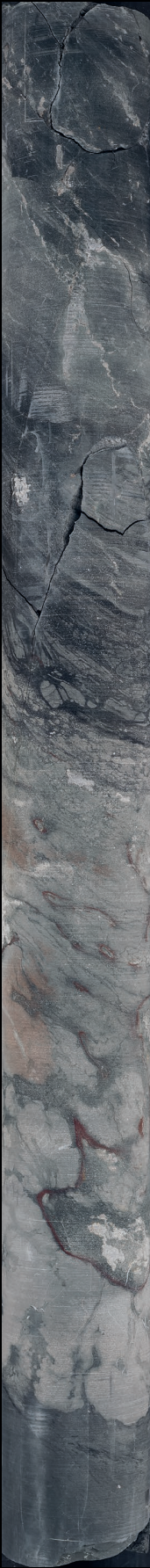
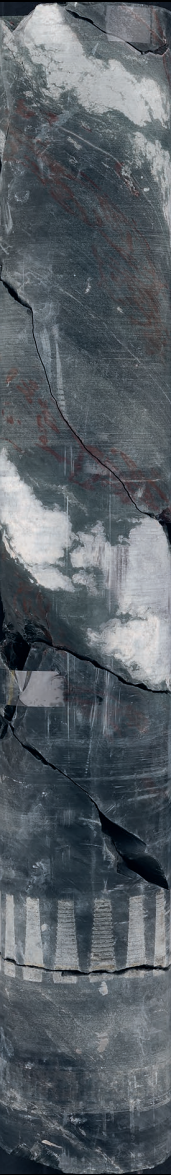
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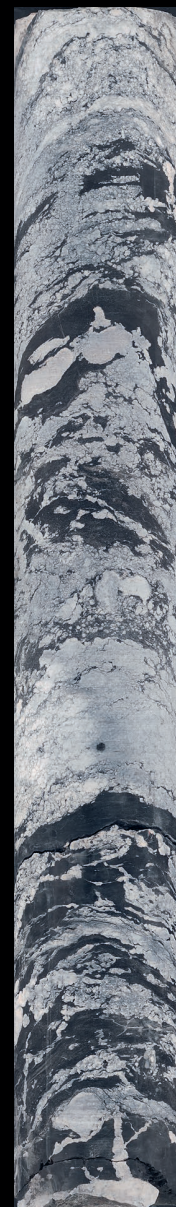
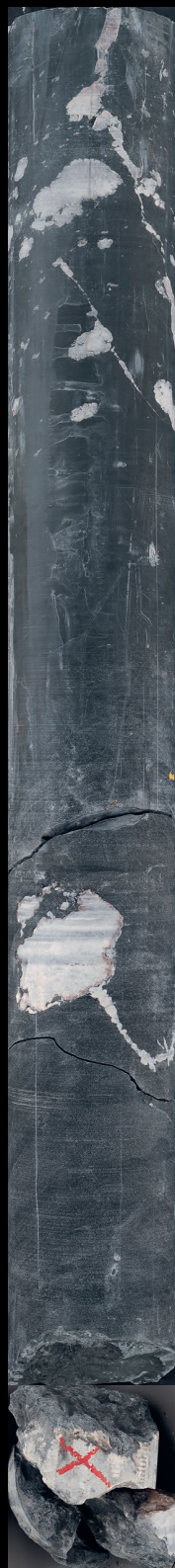
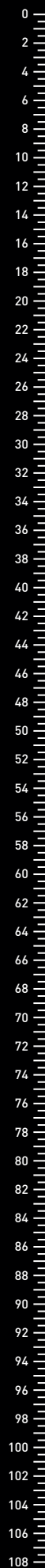
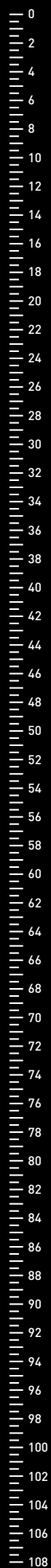
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785.84m

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787.50m



784.24m

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788.14m

788.98m

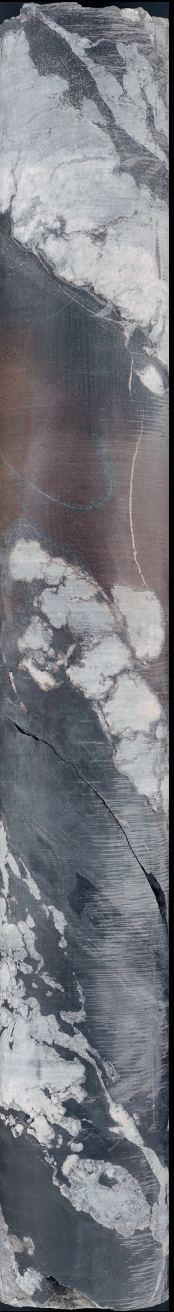
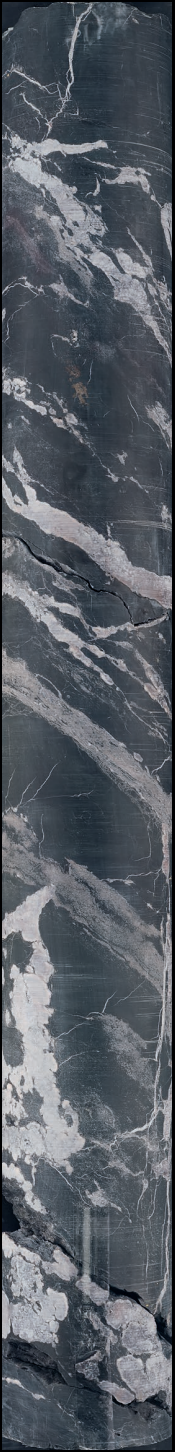
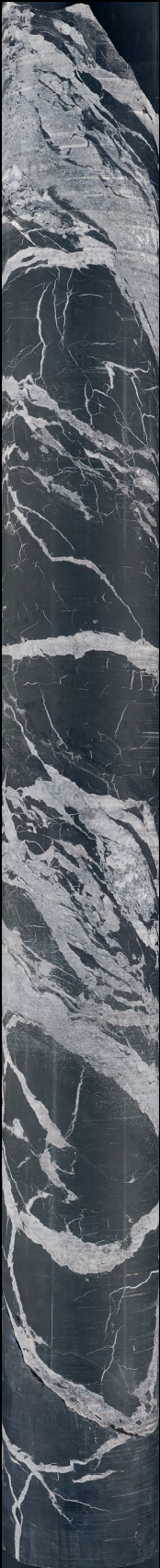
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791.33m

792.12m

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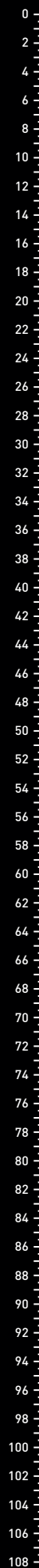
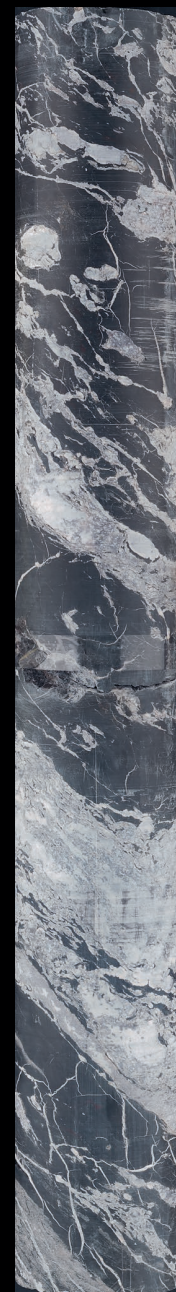
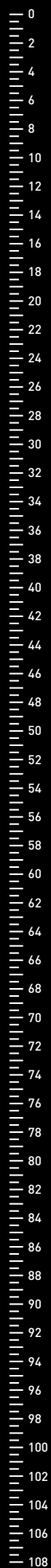
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795.01m

795.91m

796.67m



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797.36m

797.36m

798.02m

798.86m

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800.30m

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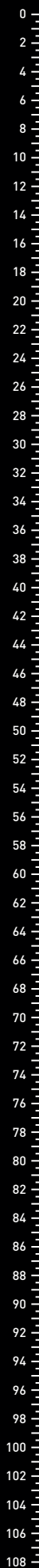
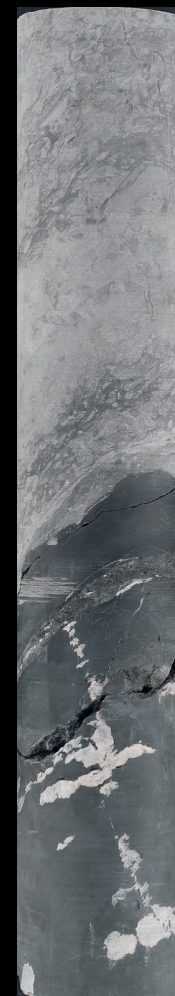
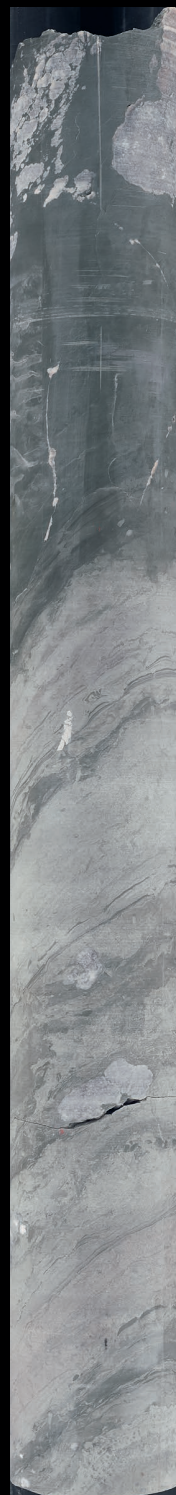
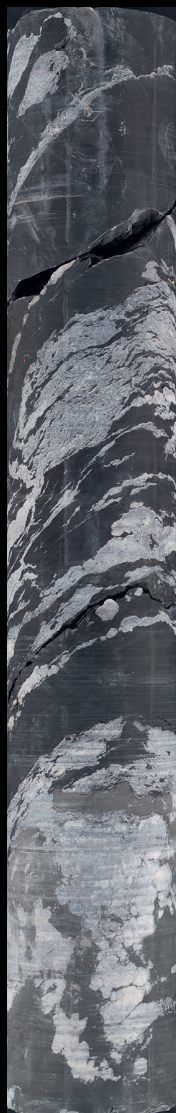
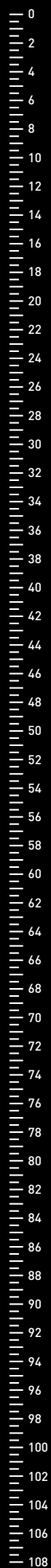
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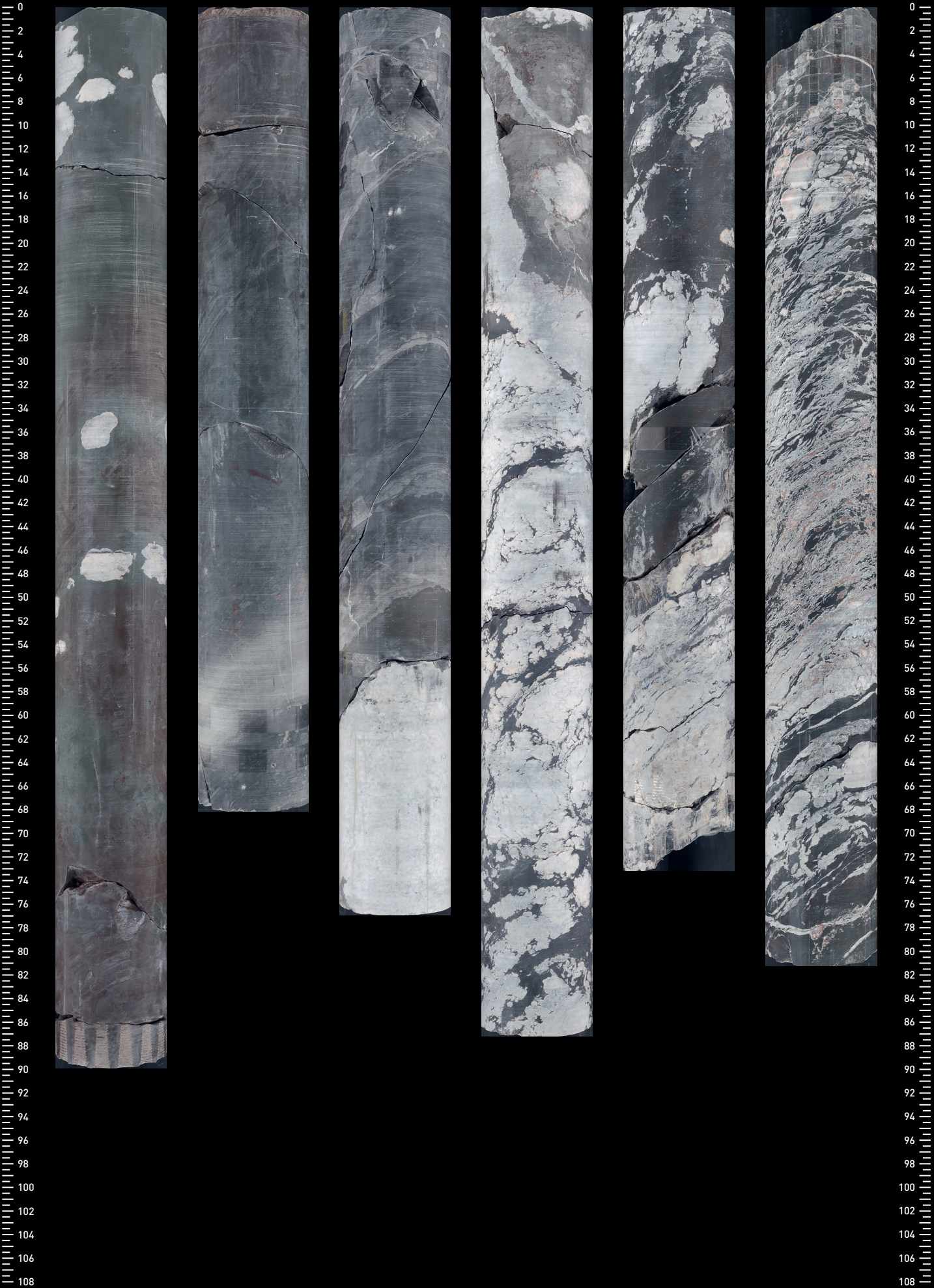
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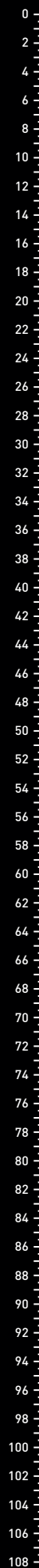
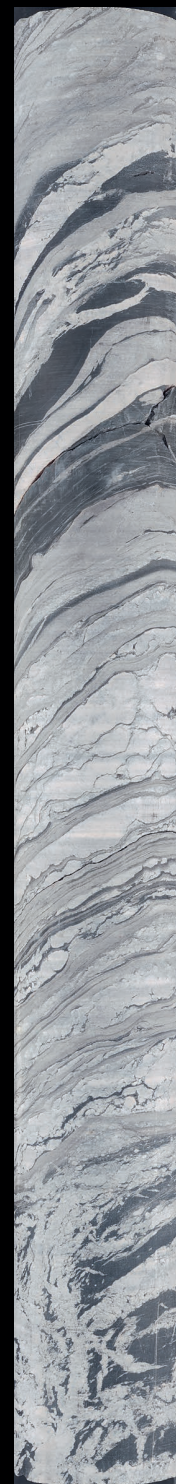
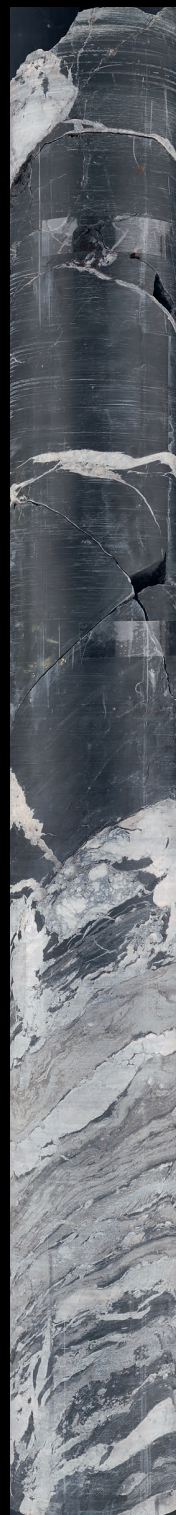
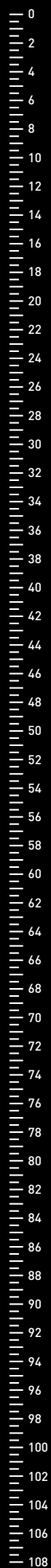
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815.48m

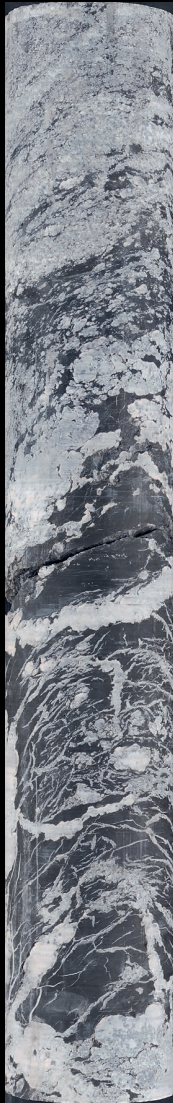
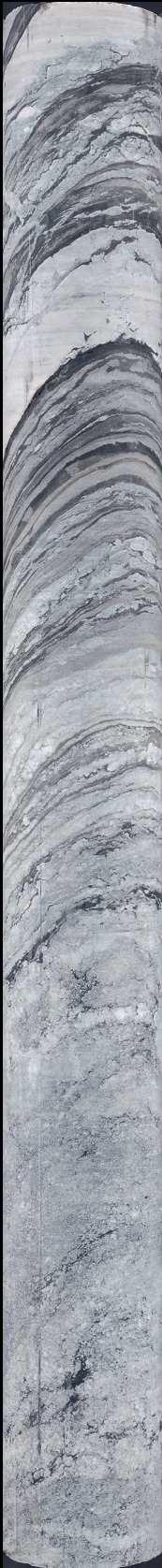
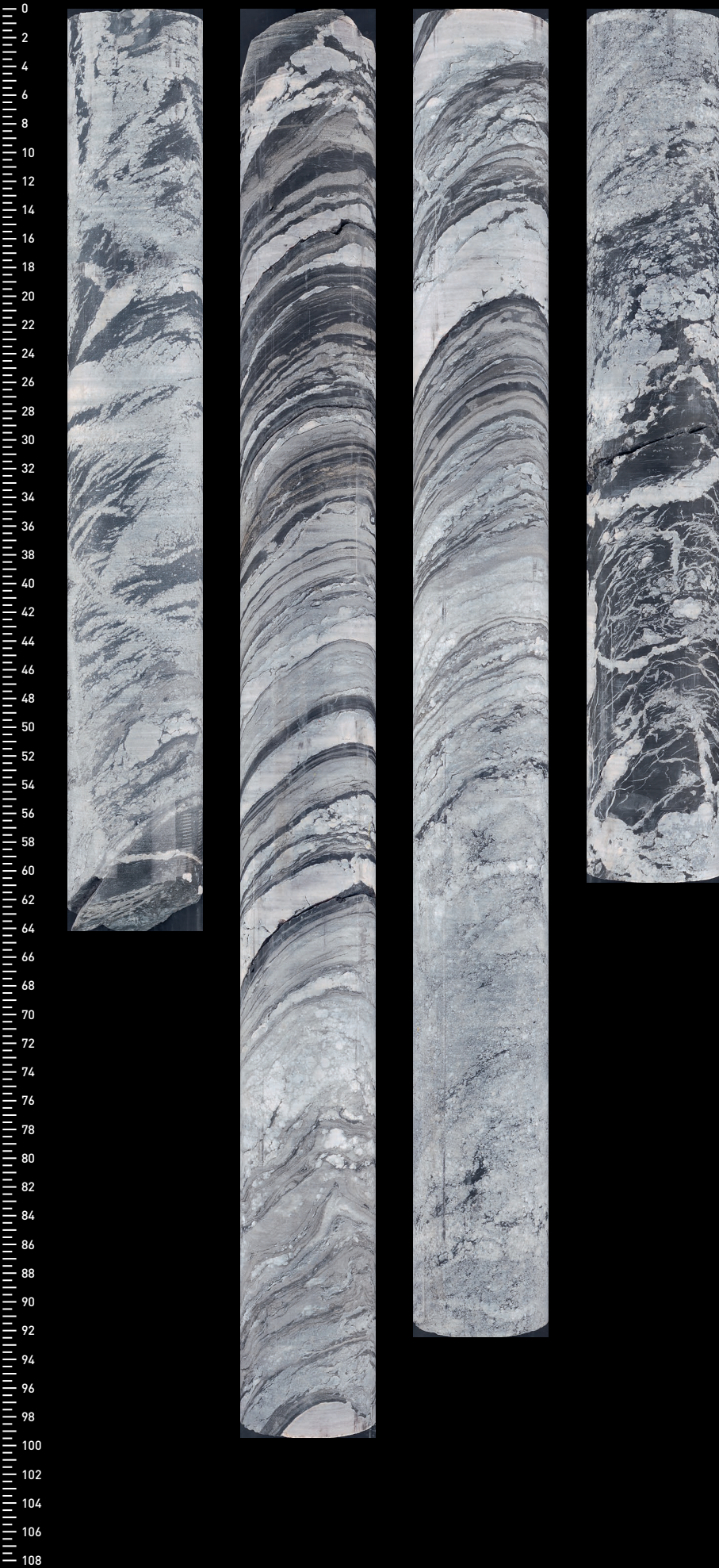
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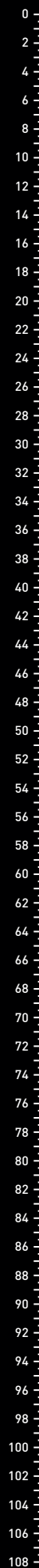
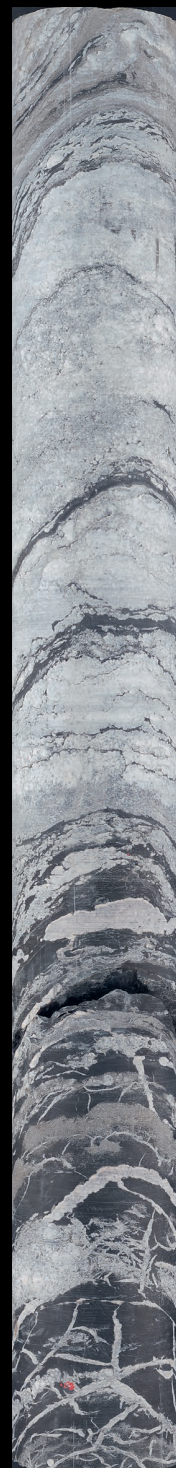
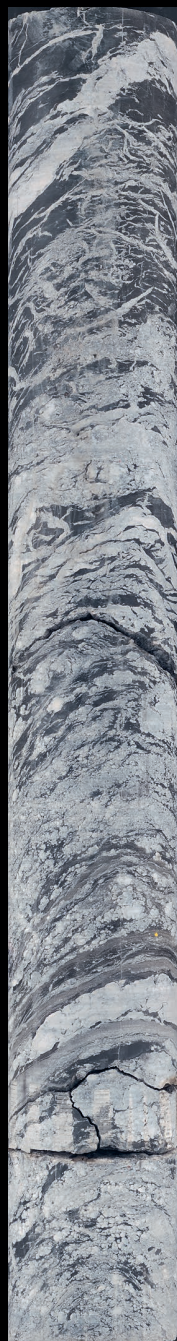
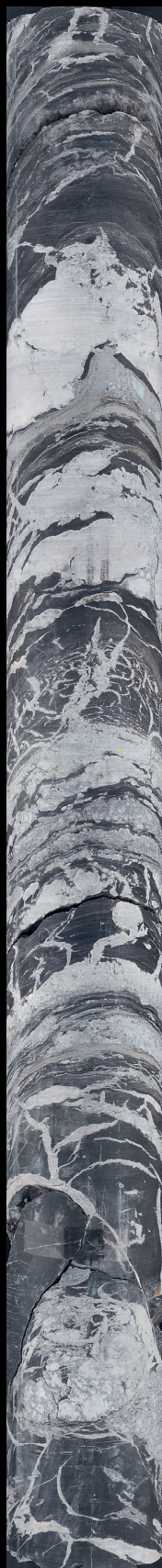
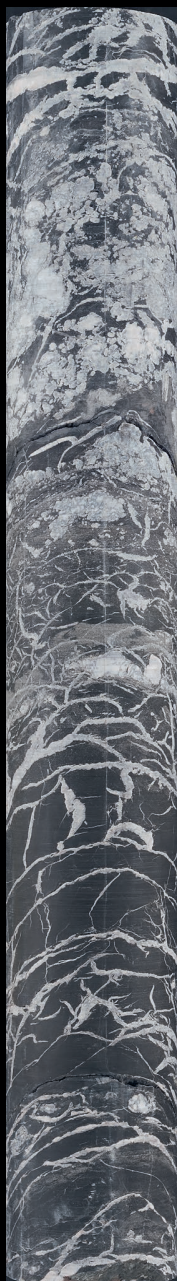
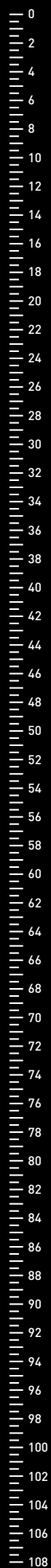
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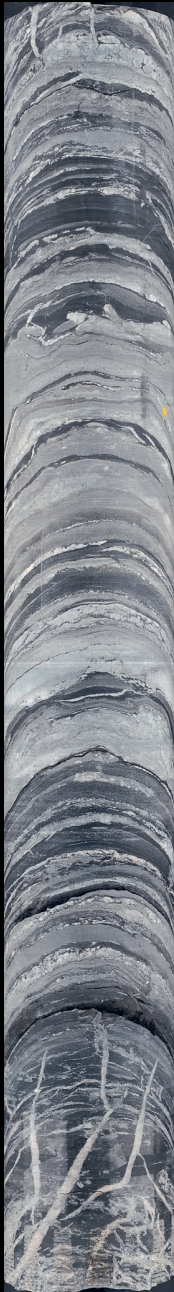
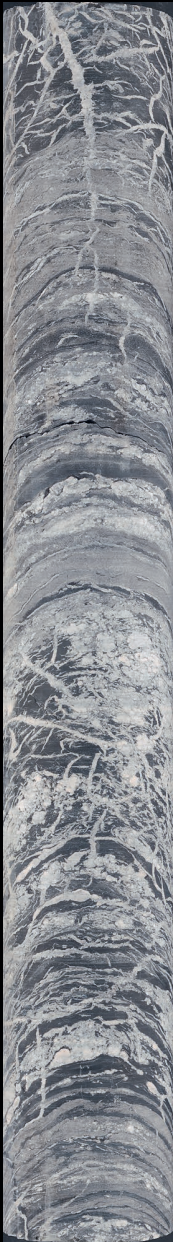
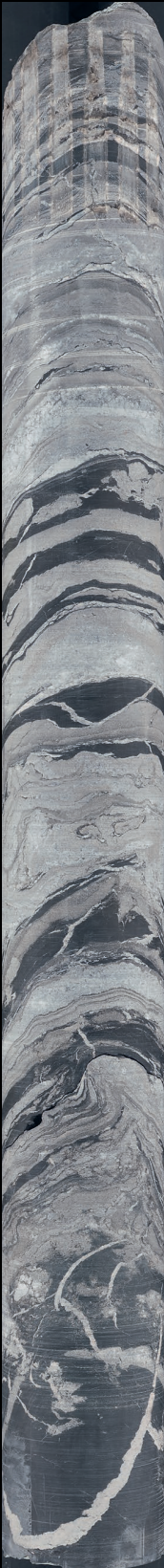
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824.93m

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827.29m

827.99m

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