HEINCKE-Berichte

Marine-Geological Practical Training at Sea
Master Course LV-345

Cruise No. HE683

May 6 - May 13, 2026

Bremerhaven (Germany) – Bremerhaven (Germany)

UHH MARGEO

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2026

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1 Cruise Summary

(Ivo Neumann)

1.1 Summary in English

The research cruise HE683 took place from 6 to 13 May 2026 aboard RV HEINCKE, operating between Bremerhaven and the central North Sea south of Norway. As part of the marine-geological field course, Master's students received practical training in hydrographic, sedimentological and hydroacoustic methods, with a focus on independent handling of sampling equipment and understanding key physical and geological processes in the study area. A total of 20 stations and several hydroacoustic transects were conducted. The standardized sampling sequence included SECCHI disk and APSTEIN net, CTD rosette, Bottom Water Sampler, VAN VEEN grab and MULTICORER. Water depths ranged from 52 to 71 m, and visibility from 6 to 17 m. CTD profiles showed pronounced thermal stratification with a thermocline at 20–30 m and a chlorophyll- and oxygen-rich intermediate layer. Elevated near-bottom suspended matter occurred particularly at the northern stations. The sediments consisted mainly of fine to medium sands with oxidized surface layers, reduced organic-rich subsurface layers and clear bioturbation. Hydroacoustic data revealed a flat seafloor morphology and three seismic units indicating Holocene sedimentation over glacially shaped structures. The scientific program was complemented by safety briefings, knot-tying practice and evening seminars. Due to a storm, the vessel diverted into the German Bight, preventing the completion of the final planned stations. All samples and datasets were subsequently transferred to the University of Hamburg for further analysis.

1.2 Zusammenfassung

Die Forschungsfahrt HE683 fand vom 6. bis 13. Mai 2026 an Bord der FS HEINCKE statt und führte von Bremerhaven in das Arbeitsgebiet der zentralen Nordsee südlich Norwegens. Im Rahmen des Marin-Geologischen Praktikums erhielten Master-Studierende eine praktische Einführung in hydrographische, sedimentologische und hydroakustische Methoden. Ziel war das eigenständige Arbeiten mit gängigen Beprobungsgeräten sowie das Verständnis der physikalischen und geologischen Prozesse im Untersuchungsgebiet. Es wurden 20 Stationen sowie zusätzliche Hydroakustik-Transekte bearbeitet. Die standardisierte Probenahme umfasste den Einsatz von SECCHI-Scheibe und APSTEIN-Netz, CTD-Rosette, Bodenwasserschöpfer, VAN-VEEN-Greifer und MULTICORER. Die Wassertiefen lagen zwischen 52 und 71 m, die Sichttiefen zwischen 6 und 17 m. Die CTD-Profile zeigten eine ausgeprägte thermische Schichtung mit einer Thermokline in 20–30 m Tiefe sowie ein chlorophyllreiches, sauerstoffreiches Zwischenwasser. Bodennah traten erhöhte Schwebstoffgehalte auf, insbesondere an den nördlichen Stationen. Die Sedimente bestanden überwiegend aus Fein- bis Mittelsanden mit oxidierten Oberflächenlagen, reduzierten organikreichen tieferen Schichten und deutlicher Bioturbation. Hydroakustische Messungen dokumentierten eine flache Meeresbodenmorphologie und drei seismische Einheiten, die holozäne Sedimentation über glazial geprägten Strukturen anzeigen. Begleitend fanden Sicherheitseinweisungen, Knotenkurse und thematische Abendseminare statt. Ein Sturmtief erforderte einen Ausweichkurs in die Deutsche Bucht, wodurch die letzten geplanten Stationen entfielen. Alle Proben und Datensätze wurden anschließend zur weiteren Analyse an die Universität Hamburg übergeben.

2 Participants

2.1 Principal Investigators

Name	Institution
Lahajnar, Niko, Dr.	UHH, IfGeol
Lüdmann, Thomas, Dr.	UHH, IfGeol
Schulz, Gesa, Dr.	Hereon

2.2 Scientific Party

Name	Discipline	Institution
Lahajnar, Niko, Dr.	Chief Scientist, Biogeochemistry	UHH, IfGeol
Lüdmann, Thomas, Dr.	Hydroacoustics, Sequence Stratigraphy	UHH, IfGeol
Schulz, Gesa, Dr.	Research assistant, Biogeochemistry	Hereon
Celik, Serra	Student (M.Sc.)	UHH, IfGeol
Cetin, Ramazan	Student (M.Sc.)	UHH, IfGeol
Hopfauf, Adrian	Student (M.Sc.)	UHH, IfGeol
Kampmann, Jan	Student (M.Sc.)	UHH, IfGeol
Neumann, Ivo	Student (M.Sc.)	UHH, IfGeol
Purwin, Florian	Student (M.Sc.)	UHH, IfGeol
Shafer, Claire	Student (M.Sc.)	UHH, IfGeol
Spano, Lara	Student (M.Sc.)	UHH, IfGeol
Tepfer, Ben	Student (B. Sc.)	UHH, IfGeol

Fig. 2.1 Participants of the cruise

2.3 Participating Institutions

UHH, IfGeol	Institute for Geology, University of Hamburg
Hereon	Helmholtz-Zentrum Hereon

3 Research Program

3.1 Description of the Work Area

(Ivo Neumann)

The study area of research cruise HE683 is located in the central North Sea south of Norway, within the Norwegian Exclusive Economic Zone (EEZ). All sampling stations fall between 56°00.00'N–57°00.00'N and 003°00.00'E–004°00.00'E (Fig. 3.1). In this region, the seafloor is predominantly covered by Pleistocene to Holocene sediments, consisting mainly of fine- to medium-grained sands.

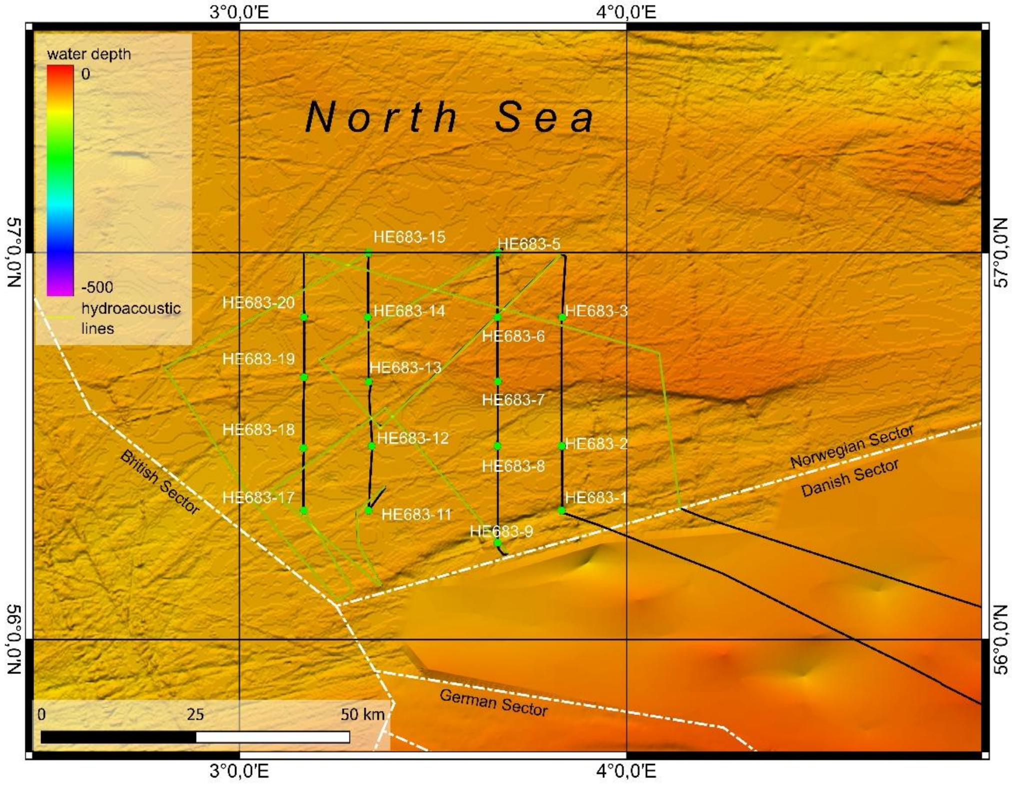

Fig. 3.1 Map of the working area of the HE683 cruise. Sampling stations are marked in green, the daytime route in black lines and the hydroacoustic survey in green lines

The North Sea is an epicontinental shelf sea of roughly 570,000 km² situated at the northwestern margin of the European plate (Schwarzer et al., 2019). It is bordered by the British Isles to the west, Scandinavia to the northeast, and the European mainland to the south and east. The basin has an average depth of ~94 m, with maximum depths >700 m in the Norwegian Trench (Skagerrak) and shallow areas <20 m at the Dogger Bank. The English Channel connects the North Sea to the Atlantic Ocean, while the Skagerrak links it to the Baltic Sea. To the north, the basin opens into the Norwegian Sea and the northern Atlantic.

The North Sea is commonly subdivided into southern, central and northern sectors, which reflect differences in geological and tectonic evolution. The crystalline basement at 8-10 km depth consists of Precambrian terranes (Laurentia, Baltica, Avalonia) that were deformed during the Caledonian Orogeny from the Upper Cambrian to the Lower Devonian (490-390 Ma). After peak orogenesis, the Caledonides underwent gravitational collapse and extensive erosion from the

Middle Devonian onward, resulting in the accumulation of thick Old Red Sandstone sequences (Patruno et al., 2022).

The Variscan Orogeny followed in the Late Devonian to Early Permian (380–290 Ma), producing renewed mountain building across the European plate. During the Carboniferous, the southern North Sea region was located near the equator and experienced tropical flooding, leading to carbonate deposition. In contrast, the northern region developed deltaic swamp environments in which major coal deposits formed (Schwarzer et al., 2019). The Permian marks the end of Variscan uplift and the onset of regional collapse, erosion, and crustal subsidence accompanied by volcanism and extension that continued into the Triassic. During this period, the northern and southern Permian basins developed, and Rotliegend sediments accumulated within these depocentres (Patruno et al., 2022). A major transgression in the Late Permian led to the deposition of thick Zechstein evaporites.

Salt mobilization began in the Late Triassic, initiating widespread salt tectonics. The main rifting phase in the North Sea occurred in the Middle Jurassic, driven by the rise of a mantle plume beneath the central basin and the formation of a thermal dome (Patruno et al., 2022). This phase produced the characteristic Jurassic horst–graben architecture, including the Central and Viking Grabens. Following collapse of the thermal dome and marine transgression, thick clay sequences accumulated in the grabens and were later sealed by Cretaceous sediments, forming major hydrocarbon reservoirs (Schwarzer et al., 2019).

In the early Cenozoic, the basin underwent thermal subsidence due to lithospheric cooling and experienced far-field compression related to the Alpine Orogeny (Clausen et al., 2012; Patruno et al., 2022). At the same time, seafloor spreading in the North Atlantic imposed a complex stress regime on the region. By the Eocene, the North Sea had largely reached its present basin geometry. Throughout the Paleogene and Miocene, alternating regressive–transgressive cycles resulted in the deposition of carbonate and siliciclastic successions (Clausen et al., 2012; Schwarzer et al., 2019).

From the Paleogene onward, global cooling culminated in the Pleistocene glacial–interglacial cycles, which shaped the basin through glacial, marine, and fluvial sedimentation (Patruno et al., 2022). During the Last Glacial Maximum (Weichselian), the North Sea was subaerially exposed, forming the Doggerland land bridge between Scandinavia, the British Isles, and continental Europe (Schwarzer et al., 2019). With the onset of the Holocene, rising sea levels flooded Doggerland around 8 ka, establishing the modern coastline and enabling the development of the Wadden Sea. Postglacial isostatic rebound continues to affect the northern North Sea today.

3.2 Aims of the Cruise

(Jan Kampmann)

The main goal of the HE683 research cruise was to give master's students the opportunity to get hands-on experience in marine sampling methods and to enable them to apply previously gained theoretical knowledge into practice. The focus of this educational expedition lay on marine geology, biogeochemistry, while working independently in a challenging environment. This was achieved through the collection and examination of plankton, water, and sediment samples, as well as through hydroacoustic measurements. The students were split into three groups of two and one group of three people. Every group was responsible for a certain device for the day and learned how to safely operate them, communicate with the bridge and the winch correctly, how to prepare the samples for further analysis, as well as how to properly document the results. With every station the students were given more responsibility to the point where they were fully responsible for the station and its success. In the evenings, seminars were held where the students presented different topics related to the North Sea, further deepening their knowledge. In addition, they learned the most important knots as well as nautical terminology. During the night, hydroacoustic measurements were conducted and each group took an overnight shift to monitor the proper data recording. Additionally, the students gained valuable firsthand experience of the work on a research vessel and its challenges and grew together as a team.

3.3 Agenda of the Cruise

(Jan Kampmann)

The research Cruise HE683 started with nine Master students from the Universität Hamburg in Bremerhaven on Wednesday morning May 6, 2026. After the HEINCKE left the harbor, the 2nd Officer held a safety briefing, where he explained the general rules on board, as well as what to do in case of an emergency and how to use the safety equipment properly. For the practical work on board, the students were split into four teams, three teams of two and one of three students. Each team was responsible for one of the principal sampling systems CTD (Conductivity, Temperature, Depth), BWS (Bottom Water Sampler), or MUC (MULTICORER) or for daily station coordination. The station coordinators deployed the SECCHI disk, the APSTEIN net, and the van-Veen-Grab (vVG), while also maintaining communication with the bridge. To minimize the risk of sample contamination, all station followed a strict workflow. Every station began with the SECCHI disk being lowered manually to determine the visibility. Right after, the APSTEIN net, with a 25 µm mesh size, was lowered to a depth of around 5m, to catch plankton which was later examined microscopically and the species identified.

The CTD was the first instrument operated via the ship's winch. Its deployment required continuous communication between the scientific team, the winch operator, and the bridge. During the lowering, physical parameters were recorded throughout the water column. Based on the resulting profiles, sampling depths were selected after the downcast. In most cases, the first four NISKIN bottles were closed several meters above the seabed - at a minimum distance of 2 m, but generally between 4 and 6 m, depending on the sea conditions. Four additional bottles were closed at the depth of the fluorescence maximum, while the remaining four were sampled near the surface. The collected water was subsequently filtered, with filtration volumes ranging from 6 to 10 liters depending on filter loading. After filtration, the samples were refrigerated for later analyses, yielding a total of 51 filter samples.

Following the CTD operations, the bottom water sampler (BWS) was deployed. The instrument was lowered carefully to depths between 62 and 70.9 m and held stationary for at least 6 minutes. Afterwards, the triggering mechanism was activated, simultaneously closing three horizontally mounted NISKIN bottles positioned 28.5, 58.0, and 110.5 cm above the seabed. At the stations 6 and 7 the trigger mechanism malfunctioned. Water recovered from the bottles was processed using the same filtration procedure as for the CTD samples. Typically, 5 liters were filtered, in total, 55 filters were used, refrigerated, and stored for subsequent laboratory analyses.

The VAN VEEN GRAB was then employed to obtain a preliminary assessment of seabed sediment characteristics and to determine sediment permeability. Upon reaching the seafloor, the grab closed automatically under its own weight and recovered sediment samples. For permeability measurements, an undisturbed subsample was extracted from the closed grab using a cylindrical corer. The remaining sediment was emptied onto a wooden board, where students described grain size, color, and bycatch components.

To investigate sediment stratification and color variations in greater detail, a MULTICORER (MUC) was used. The system consists of eight PLEXIGLAS tubes that penetrate the seabed under their own weight, allowing the recovery of largely undisturbed sediment cores. During retrieval, the tubes closed automatically, ideally recovering eight intact cores. Once on deck, three representative cores were selected and described according to their general sedimentological characteristics. However, obtaining suitable cores was not always successful.

The use of the MUC depended on sediment conditions, as coarse-grained sediments could damage the coring tubes. Therefore, the suitability of each station for multicoring was assessed based on the sediment recovered by the van-Veen-Grab. When at least three high-quality cores were available, one core was photographed and described using, for example, the MUNSELL color chart. From another core, the uppermost 2 cm, including a small amount of overlying bottom water, were sampled for micropaleontological investigations. A second core was sectioned into 1 cm intervals down to a depth of 5 cm for biogeochemical analyses. The third core served as a reserve sample in case either of the primary cores was compromised. Completion of the MUC sampling marked the end of station operations.

Scientific seminars were held each evening, covering a range of topics related to the North Sea. In addition, students practiced maritime terminology and Seamans’ knots techniques. During these meetings, the operational plan for the following day was discussed, including assignments for instrument operation, night-watch duties, and scientific presentations. One team was assigned to the night shift, during which seismic and hydroacoustic surveys were monitored. These measurements were generally conducted between 7:00 pm and 07:00 am ship time.

The final evening seminar included an assessment of the maritime terminology acquired during the cruise. Students were required to demonstrate both their knowledge of nautical terms and their ability to tie and apply the most important knots used aboard maritime vessels.

The 'Principles of Responsible Research', established by the DFG Senate Commission for Oceanography and the German Marine Research Consortium (KDM), and the 'Code of Conduct for Responsible Marine Research in the Deep and High Seas of the OSPAR Maritime Area', published by the Commission for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), were applied and implemented for cruise HE683. The DFG “Mitigation measures for the operation of seismic and hydroacoustic sources with pulsed sound emissions” were applied. All works were conducted within the EEZ of Norway upon prior permission being granted by the Norwegian authorities.

4 Narrative of the Cruise

(Florian Purwin)

On **Tuesday, May 5th, 2026**,
at 11:30 UTC, the scientific team consisting of the chief scientist, the instructing scientists, and the nine students arrived in Bremerhaven, Germany, and boarded RV HEINCKE. The group moved into their assigned cabins and met at 12:15 UTC for an introductory briefing in the dry lab. At 12:45 UTC, the equipment for filtering water samples, measuring permeability, and microscopy was unloaded from the crates in the hangar and set up in the wet lab, secured to prevent slipping. At 14:00 UTC, the second officer conducted a safety briefing, which included a presentation on safety and house rules aboard RV HEINCKE, followed by a tour of the ship to view all relevant areas. At 15:15 UTC, the first group dinner was held in the officers' mess before spending the first night on RV HEINCKE in Bremerhaven.

On **Wednesday, May 6th, 2026**,
the first breakfast was served at 05:15 UTC. At 05:55 UTC, RV HEINCKE departed from the pier, heading for the work area in the Norwegian sector. At 06:45 UTC, a drill alarm was conducted. The scientific party retrieved their respective life jackets and met with the second officer on the muster deck for a demonstration of the proper use of the life jackets and immersion suits. At 07:15 UTC, the chief scientist gave an introduction to the research area, as well as the general daily and station structure. After lunch at 09:15 UTC, the scientific equipment was prepared for the test sampling station at 11:30 UTC. At 12:00 UTC, RV HEINCKE reached the test sampling station off Helgoland. The scientific equipment, including the CTD rosette, bottom water sampler and MULTICORER was tested to ensure proper functioning. At 12:40 UTC, the station work was completed and the voyage toward the research area continued. At 14:15, the chief scientist gave an introduction to nautical terminology in the dry lab to ensure smooth communication with the ship's crew. Dinner was served punctually at 15:15 UTC, followed by an introduction to knot tying by the chief scientist at 17:30 UTC. With winds from the northwest at Beaufort 5, RV HEINCKE moved against the waves and made slower progress than planned.

Thursday, May 7th, 2026
Due to the northwest wind, progress was still slower than planned, which is why at 05:15 UTC, RV HEINCKE is still en route to the study area. At 09:00 UTC, RV HEINCKE reached the first station (HE683_1) in the study area, and the standardized sampling sequence was carried out. The sampling sequence consists of five steps, which were carried out one after another in a fixed order: (1) SECCHI disk and APSTEIN-net, (2) CTD, (3) BWS, (4) vVG, and (5) MUC. On this day, stations HE683_2 and HE683_3 were also processed at 12:45 UTC and 16:00 UTC, followed by station HE683_4, which began at 16:07 UTC and recorded a Multibeam EM712 profile, led by the hydroacoustic scientist. At 18:30 UTC, two presentations were held: one by Ivo Neumann on "*Sampling Methods: Water and Sediment*" and one by Florian Purwin on "*The North Sea: Eutrophication and Environmental Problems.*" At 21:00 UTC the hydroacoustic scientist, Thomas Lüdmann, gave Ivo Neumann, Lara Spano, and Florian Purwin an introduction to the operation of the multibeam (MBES) and the sub-bottom profiler system (SES, INNOMAR), after which the three students took over the first night shift until 05:00 UTC.

Friday, May 8th, 2026

The day began with partly cloudy to sunny skies and wind force 4 Bft. After breakfast at 05:15 UTC, station setup began at 05:45 UTC and work at station HE683_5 started at 06:00 UTC. As on the previous day, the “clean ship” policy was followed and the sampling sequence was carried out. Between 06:00 UTC and 16:30 UTC, the five stations HE683_5 through HE683_9 were processed. At 18:00 UTC, additional knots were taught in the dry lab and the presentations “*North Sea: Sediments and Sediment Transport*” by Adrian Hopfauf and “*Offshore Wind Farms in the North Sea*” by Claire Shafer were held. Ben Tepfer and Adrian Hopfauf took over the night shift at station HE683_10 at 20:30 UTC.

Saturday, May 9th, 2026

With several oil platforms in sight, the day began cloudy, but fairly calmly, with winds at Beaufort 1. Work at Station HE683_11 began at 05:55 UTC. Before lunch at 09:15 UTC, Station HE683_12 was also processed using the fixed sampling sequence. Over the course of the day, the wind picked up to Beaufort 6, yet three additional stations (HE683_13–HE683_15) were successfully processed by 14:55 UTC. During the evening seminar at 18:00 UTC, additional knots were taught, and the presentations “*North Sea: Phytoplankton and Zooplankton*” by Lara Spano and “*North Sea: Hydrography*” by Serra Celik were given. Serra Celik and Claire Shafer took over the night shift, monitoring station HE683_16.

Sunday, May 10th, 2026

On Sunday morning, the sun was shining and the North Sea was somewhat choppy with a Beaufort 6 wind. Work at Station HE683_17 began at 05:55 UTC and proceeded without incident. At Station HE683_18, the bottom water sampler and the MULTICORER were deployed twice, as they had not triggered in the initial try. Since the MULTICORER did not trigger on the second attempt either, it was tested on deck during the transit to Station HE683_19, where it functioned perfectly. Upon arrival at Station HE683_19 station work began at 11:05 UTC with the MUC, as it was still attached to the winch. Since the “clean ship” policy was not met due to the use of the MULTICORER, the ship was moved one cable length after the MULTICORER was deployed. At the new position, the remaining equipment in the sampling sequence was processed. At 13:10 UTC, the chief scientist and the supporting scientist withdrew and station HE683_20 was fully managed and processed by the students without incident. At 14:00 UTC the voyage continued. Due to a forecast storm in the work area with estimated wind speeds of up to 40 knots, RV HEINCKE navigated into the eye of the storm toward the German Bight, as milder weather conditions were forecast there. During the seminar at 18:00 UTC, participants were briefed on the current weather conditions and how to handle them, in addition to other topics. Following that, Jan Kampmann gave a presentation titled: “*The North Sea: Oil and Natural Gas: Deposits and Extraction*.” Jan Kampmann and Ramazan Cetin took over the night shift at station HE683_21, which ended at 01:20 UTC.

Monday, May 11th, 2026

Due to the storm in the work area, the course was set for the German Bight on Monday, May 11, 2026, under cloudy skies and Beaufort 5 winds. As the weather conditions made station work impossible, the time was used to digitize the station data and make entries in the guestbook. In addition, there was an engine room tour led by the chief at 13:30 UTC. During the evening seminar at 18:00 UTC, the plan for the next day's schedule was explained and the chief scientist gave a presentation on the geological history of the North Sea. At 20:00 UTC, the night shift was taken over by Ivo Neumann, Lara Spano, Serra Celik, and Florian Purwin, during which the HE683_22 station between Sylt and Heligoland was navigated.

Tuesday, May 12th, 2026

Due to excessive rolling of the ship, it was decided at 06:00 UTC that station work was not possible and the ship set course back to Bremerhaven. The time during the crossing was used to dismantle the wet lab and clean it in preparation for handover. At 11:30 UTC RV HEINCKE entered the Bremerhaven lock and moored at the dock at 12:45 UTC. In the evening at 18:00 UTC the students were tested on nautical terminology and knots.

Wednesday, May 13th, 2026

On the final day aboard RV HEINCKE, the cabins and the dry lab were cleaned at 06:00 UTC and subsequently inspected by the chief mate. At 08:00 UTC the cargo was unloaded and four members of the scientific party left Bremerhaven for Hamburg. The rest of the crew departed at 10:00 UTC after the cargo cleared customs and arrived in Hamburg around 12:00 UTC.

5 Preliminary Results

5.1 Water Sampling

5.1.1 SECCHI Disk

(Claire Shafer)

A SECCHI disk is a circular metal plate commonly used in oceanography and limnology to estimate water transparency. Its diameter typically ranges between 20 and 50 cm; the disk used during the expedition had a diameter of approximately 30 cm. The upper surface is divided into four equal segments with alternating black and white colouration, improving visibility under varying light conditions.

A rope is attached to the centre of the disk via a metal loop. This rope is marked at regular intervals of one meter, allowing for depth estimation during deployment. A weight fixed to the underside ensures that the disk remains vertically stable and sinks steadily through the water column without tilting (Fig. 5.1).

Fig. 5.1 SECCHI Disk used during HE683.

To determine the visibility depth, the SECCHI disk is lowered slowly into the water until it is no longer visible. The depth is then read from the rope markings. If the disappearance of the disk occurs between two markings, the distance is estimated accordingly. This measured depth provides an approximation of water clarity and can be used to infer the extent of the euphotic zone, i.e., the upper layer of the water column where sufficient light is available for photosynthesis (e.g., Marra et al., 2014).

It should be noted that this method provides only an approximate value. Several environmental factors can influence the measurement, including surface reflections, wave conditions, currents causing lateral movement of the disk, and overall weather and light conditions. Any such influences should be considered when interpreting the results and, if relevant, documented during sampling.

At all 20 stations of the expedition, the visible water depth was determined using the SECCHI disk (Fig. 5.2). The deepest visible water depths were measured at stations 11, 12 and 13 with 17 m each. The total water depths at these stations were 70.6 m, 66.4 m and 62.5 m, respectively. In contrast, the shallowest visible depth was recorded at station 15 with only 6 m at a water depth of 63.7 m. Other comparatively low visibility depths were measured at station 20 with 7 m, although the total water depth at this station was still around 62 m.

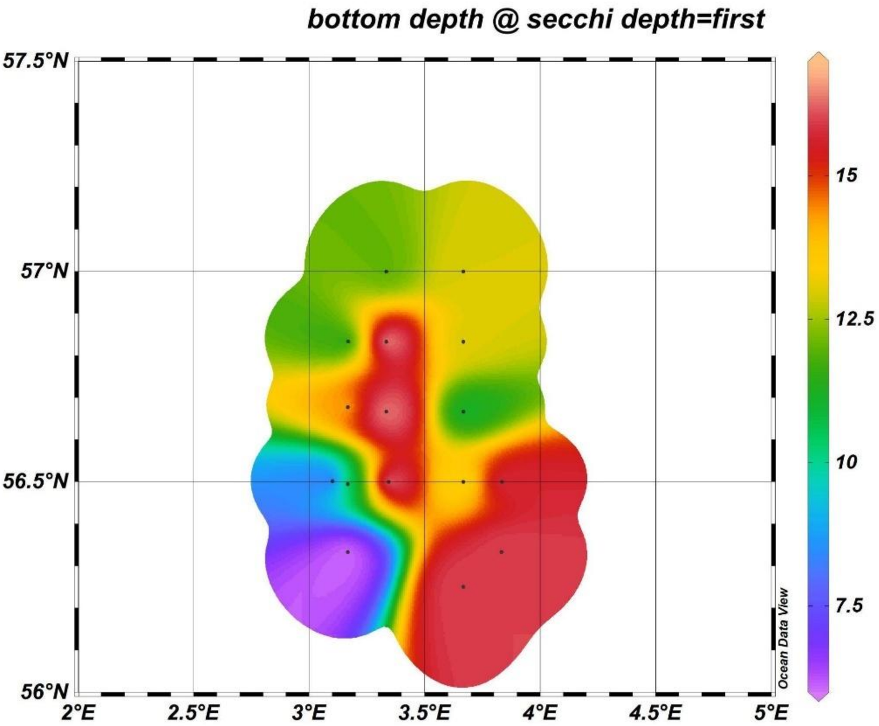

Fig. 5.2 Depth of visibility (SECCHI Depth).

The ratio between visible depth and total water depth (Fig. 5.3) indicates no direct correlation (R= 0.1033) between these two parameters. Most stations had similar total water depths between approximately 52 and 70.6 m, whereas the visibility depth varied considerably between 6 and 17 m. The highest visibility depths were mainly measured at southern stations, while lower visibility depths occurred more frequently in the northern stations of the transect.

A slight tendency of decreasing visibility depth from south to north can be recognized, although local variations are evident. Environmental conditions during the measurements may have influenced the results, such as variations in solar radiation during the different stations, which could have affected the visibility of the SECCHI disk. Furthermore, drifting of the SECCHI disk caused by varying current velocities may also have influenced the measurements, as well as wave conditions.

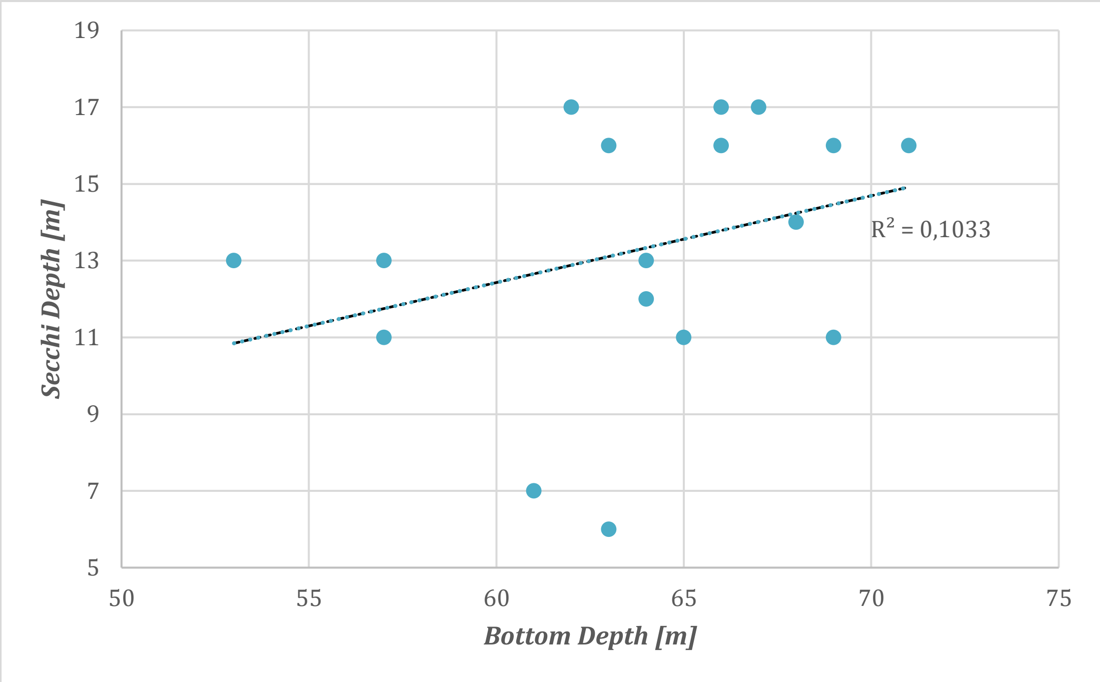

Fig. 5.3 Bottom depth vs. Secchi depth, with linear regression (R=0.1033). Based on the available data, there does not appear to be any correlation.

5.1.2 Plankton Sampling (APSTEIN-net)

(Claire Shafer)

During the cruise, several methods were applied to investigate the plankton biocenosis, including water sampling with CTD and BWS systems. However, the most direct method for assessing plankton composition and abundance was the use of an APSTEIN plankton net (Fig. 5.4)

The APSTEIN net is a cone-shaped net with a length of approximately 50 cm and an opening diameter of 30 cm. It is constructed with a fine mesh size of 25 µm, allowing the collection of both small phytoplankton and larger zooplankton organisms. The net tapers into a collecting cylinder at its lower end, which can be opened via a valve to retrieve the sample. It is attached to a rope with meter markings.

Sampling was generally conducted after SECCHI disk measurements, allowing an estimation of the euphotic zone and thus an informed selection of sampling depth. In most cases, the net was lowered to depths around 5 m to ensure comparability between stations. Environmental conditions such as currents and wave action occasionally caused the net to drift beneath the vessel, which limited the achievable sampling depth and required adjustments during deployment.

After retrieval, the sample was transferred into a beaker by opening the valve at the end of the net. To minimize sample loss, the net was rinsed with seawater. In the onboard wet laboratory, subsamples were placed in Petri dishes and examined under a stereomicroscope (e.g., ZEISS STEMI 508) to obtain an overview of plankton diversity and relative abundance (Fig. 5.5)

Species identification was carried out using standard identification literature (e.g., Kraberg et al., 2010; Larink and Westheide, 2011). Due to ship motion and the mobility of many organisms, precise identification was not always possible and some taxa could only be classified to genus or higher taxonomic levels.

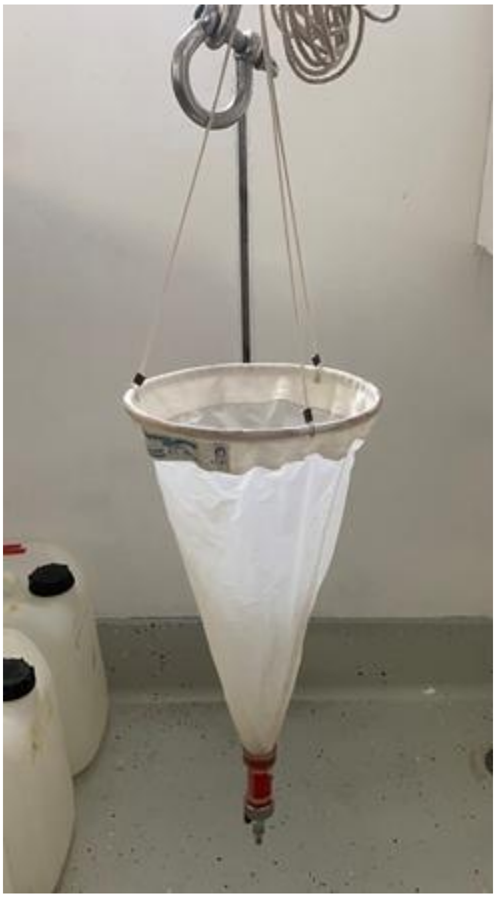

Fig. 5.4 The APSTEIN-Net used during the HE683 expedition.

Across almost all stations, phytoplankton was dominated by *Calocalanus sp.* (Copepoda) and other copepod taxa were frequently observed. Additionally, diatomea genera such as *Coscinodiscus sp.* were occurring regularly.

Meroplanktonic organisms were also widely present. Echinoderm larvae, especially *Spatangus sp.* (red-pigmented pluteus larvae), were very common and occurred at nearly all stations, often in high abundance. *Late pluteus* larvae were also frequently recorded, indicating an active benthic–pelagic coupling in the studied area.

The siphonophore *Lensia subtilis* was observed at station 6, representing gelatinous zooplankton within the samples. In addition, the copepod *Monstrilla helgolandica* was recorded at station 17, although only in low abundance.

Overall, diatoms and copepods dominated the plankton community, while meroplanktonic larvae (especially echinoderm pluteus larvae) formed a consistent and often abundant fraction of the samples. Spatial variability between stations was evident, with some stations showing higher phytoplankton diversity and others being strongly dominated by a few taxa. This variability likely reflects changes in local hydrographic conditions, nutrient availability and water mass structure.

Fig. 5.5 ZEISS STEMI 508 stereomicroscope used during the HE683 expedition.

5.1.3 CTD-Rosette

(Ramazan Cetin and Gesa Schulz)

The CTD-rosette system is an oceanographic instrument designed for the simultaneous measurement of conductivity, temperature and depth throughout the water column. The system consists of an upper and a lower section enclosed within a cylindrical protective frame. The upper section contains the CTD probe and the rosette assembly equipped with twelve 5 l NISKIN bottles used for discrete water sampling at defined depths. The lower section houses the primary sensors for temperature, conductivity and pressure measurements. Additional sensors and auxiliary instruments can be mounted on both sections to record further environmental parameters, including salinity, dissolved oxygen concentration, chlorophyll-a fluorescence and optical transmission.

The CTD system is connected via a conducting cable to an onboard electronic deck unit and computer system, enabling real-time acquisition, visualization and storage of all measured parameters throughout deployment. Each NISKIN bottle is equipped with top and bottom lids connected by a tensioned lanyard mechanism held open by individual release hooks located at the upper centre of the rosette assembly. During deployment, bottle closure can be closed remotely through the software, allowing discrete water samples to be collected at specific depths (Fig. 5.6). During the cruise, a total of 17 CTD stations were conducted.

Prior to each deployment, the CTD-rosette system underwent manual preparation and inspection. All NISKIN bottles were conditioned by opening both end caps and securing them using the tensioned lanyard mechanism. Air vent valves were closed, petcocks were shut and protective sensor caps were removed. A thorough visual inspection of the frame, connectors and sensor array was performed to confirm operational readiness. Flushing devices remained attached to the sensors until immediately prior to deployment to prevent contamination and drying out.

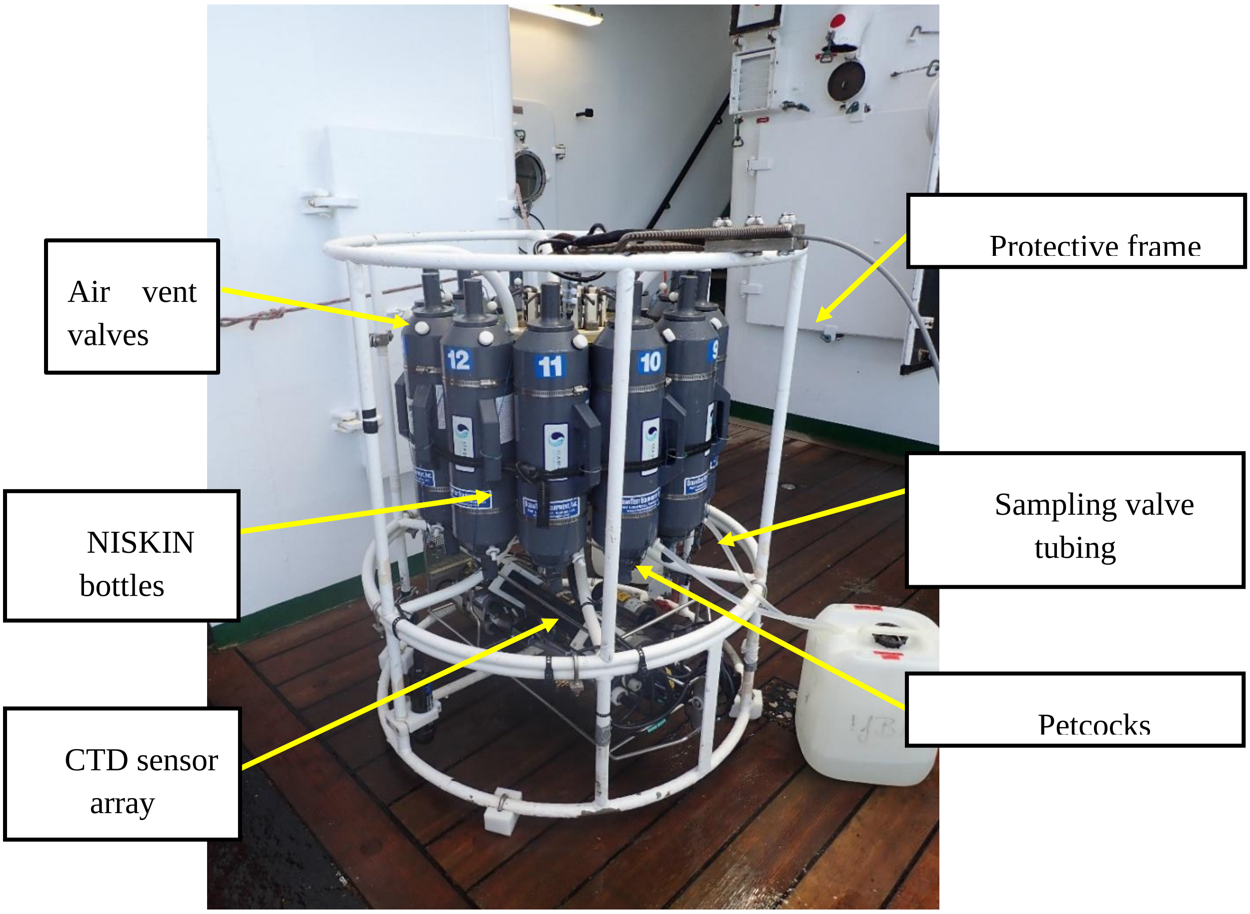

Fig. 5.6 Schematic overview of the CTD-rosette system and its main operational components, including the CTD sensors, NISKIN bottle assembly, and protective frame structure.

Just before lowering the system into the water, the deck unit was activated. Due to the high-voltage nature of the instrument, direct contact while energized was strictly avoided. Upon reaching approximately 5 m depth, the CTD descent was temporarily paused to allow full pressurization and stabilization of the sensor pumps. Once the CTD instrument was activated, data acquisition commenced automatically. After stable conditions had been achieved, the instrument was briefly lifted toward the surface in order to reduce the influence of initial transient signals on the recorded dataset. The CTD was then lowered at a constant rate to approximately 5 m above the seabed, guided by real-time readings from the echo sounder and altimeter.

At near-bottom depth, the first set of four NISKIN bottles was triggered to obtain bottom water samples. During the upward cast, a second set of four bottles was closed at depths corresponding to the chlorophyll maximum, identified in real time from the fluorescence profile recorded during the downcast. The final set of four bottles was fired just below the sea surface. Accordingly, water samples representing three distinct depth intervals were collected at each daytime station.

After completion of the vertical profiling and sampling sequence, data acquisition was stopped and the deck unit switched off prior to recovery of the instrument. Once secured on deck using lashing straps, all sensors and mechanical components were thoroughly rinsed with Milli-Q water using dedicated flushing equipment. The flushing system, consisting of silicone tubing connected to syringe reservoirs, remained installed between deployments to preserve sensor cleanliness and integrity. Additional cleaning was carried out on hooks and valve systems to remove residual salt and particulate material by flushing with freshwater.

Water sampling began immediately after retrieval of the CTD system. Bottom water collected from NISKIN bottles 1–4 was transferred via silicone tubing into a dedicated storage canister. Water from the chlorophyll maximum layer (bottles 5–8) and from near-surface layers (bottles 9–12) was collected separately using the same procedure. To minimize contamination, all tubing and containers were rinsed twice with the respective sample water prior to filling. Immediately after collection, all water samples from the different depth horizons were processed using a multi-unit vacuum filtration system (Fig. 5.7).

The setup consisted of five parallel filtration units, each comprising a funnel, a filter holder, and a clamping system securing pre-combusted glass fibre filters (WHATMAN GF/F; pore size: 0.7 µm; diameter: 47 mm). Prior to deployment, all filters were combusted at 450 °C and individually weighed, with initial masses ranging from 122.24 to 135.39 mg.

Fig. 5.7 The multi-unit vacuum filtration system used for suspended particulate matter sampling, including the filtration units, membrane pump, collection tank, and WOULFF bottle water trap.

For each station and depth layer, filtration was carried out using two filters in parallel. Water samples were dispensed into the filtration funnels using dedicated 2 l polyethylene bottles. A membrane pump generated vacuum pressure, drawing the filtrate into a shared 26 l collection tank that was periodically emptied to prevent overflow. To protect the pump system from accidental water ingress, a WOULFF bottle acting as a water trap was installed between the collection tank and the pump.

Mean filtered volumes were 8.82 ± 1.29 l for bottom water, 8.09 ± 2.10 l for surface water, and 7.71 ± 2.17 l for samples from the estimated chlorophyll maximum. Final volumes varied depending on particulate load and filtration efficiency. After filtration, the particle-loaded filters were carefully retrieved using sterile tweezers, placed into labelled storage containers and stored under refrigerated conditions until the end of the expedition and subsequent laboratory analysis.

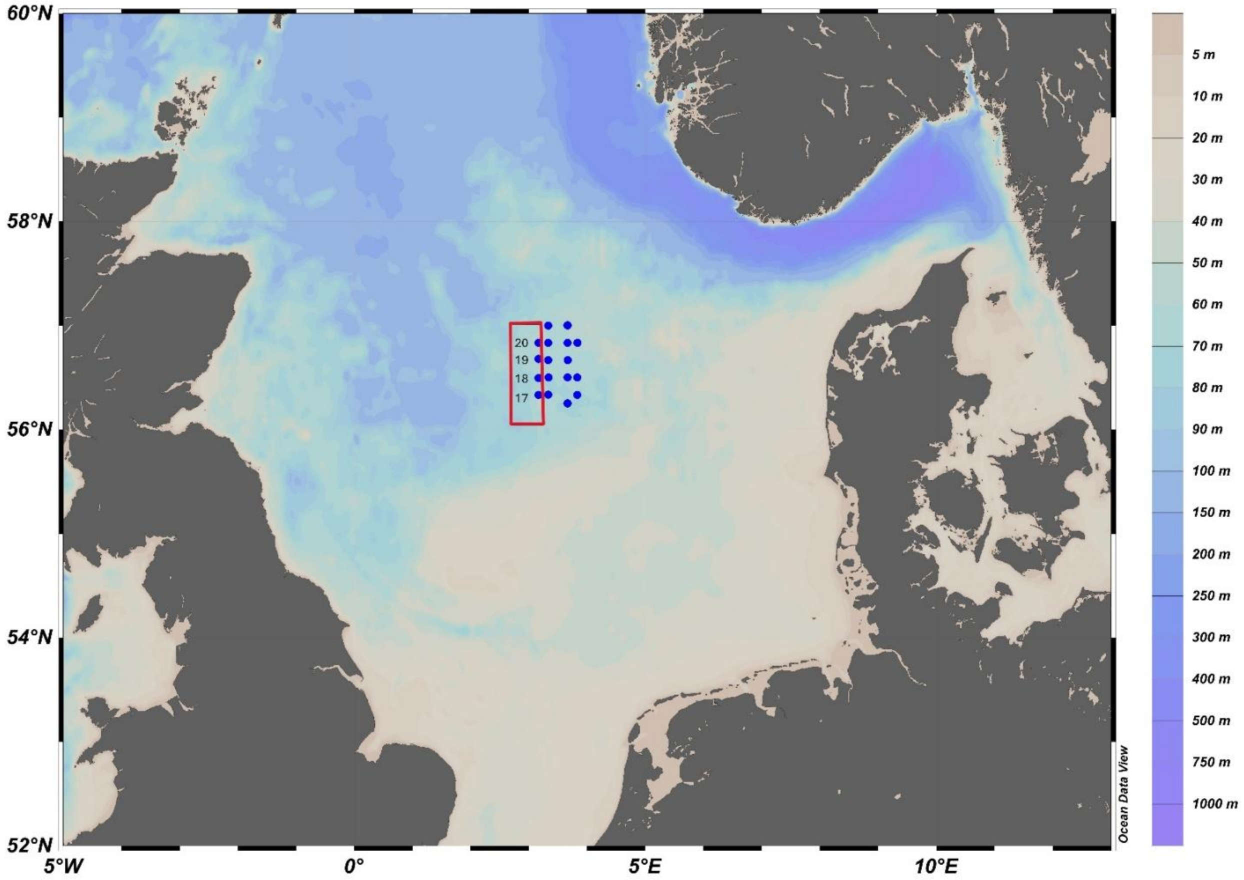

Fig. 5.8 Map of the study area showing all 17 sampling daylight stations occupied during cruise HE683, including station numbers and corresponding water depths. The selected north–south transect used for hydrographic analysis is highlighted in red.

For an initial spatial overview of the hydrographic conditions, a north–south transect including stations 17, 18, 19, and 20 was generated (Fig. 5.8). This transect was characterized based on four key parameters: temperature, salinity, dissolved oxygen concentration, and fluorometric measurements (Fig. 5.9).

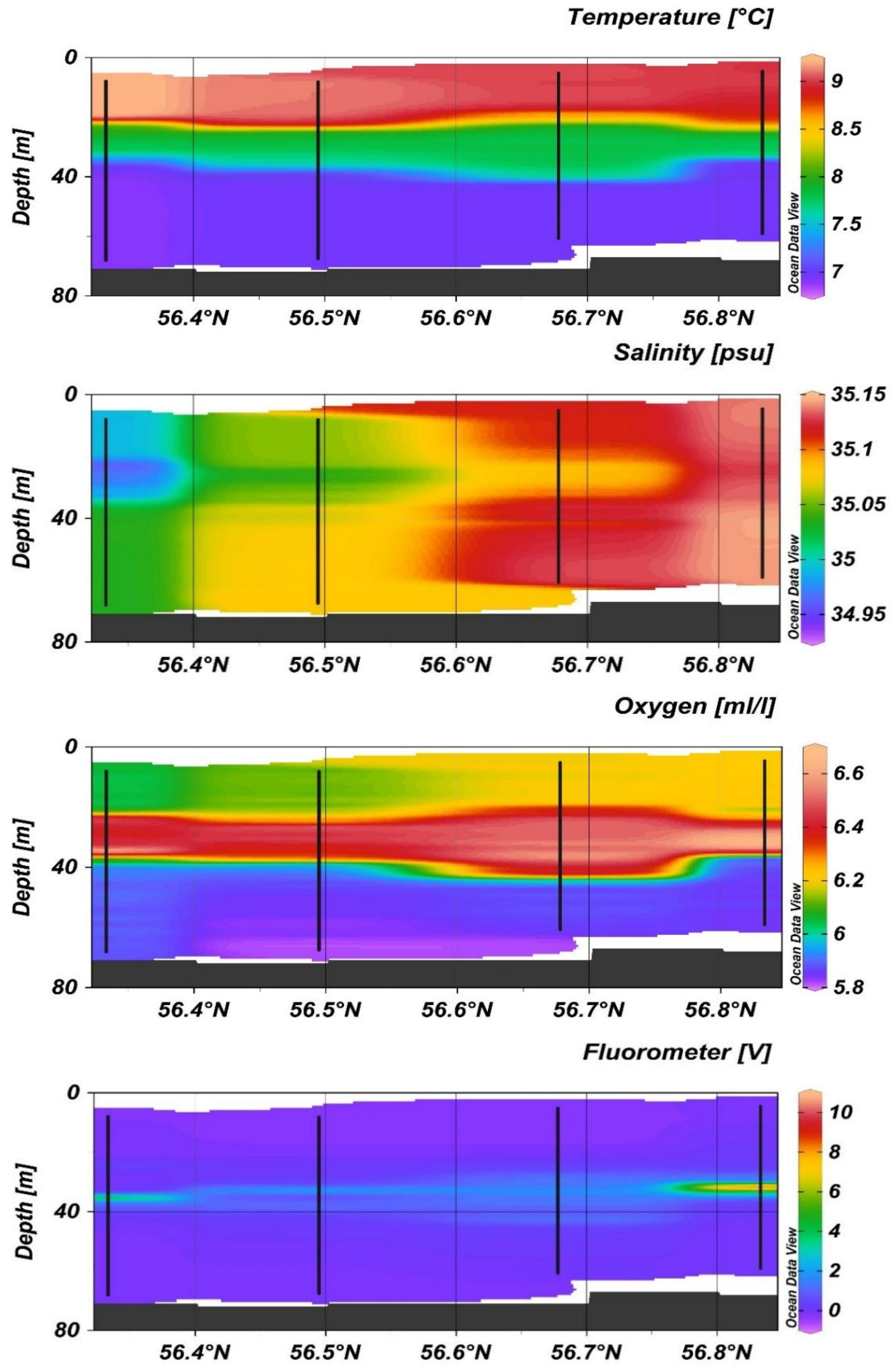

Fig. 5.9 Vertical profiles along the north–south transect showing the distribution of temperature (°C), salinity, dissolved oxygen concentration (ml l^{-1}), and fluorescence (mg m^3). Vertical black lines indicate the positions of the individual sampling stations.

The vertical distribution of hydrographic parameters along the north–south transect is summarized in Fig. 5.9. Water temperatures ranged from approximately 7 °C to 10 °C and exhibited a clear vertical stratification. Highest temperatures were observed in the near-surface layer (approximately 9–10 °C), gradually decreasing with depth to values close to 7 °C. A distinct thermocline was present between approximately 20 and 30 m water depth, indicating pronounced water column stratification during the sampling period.

Salinity displayed a relatively weak but consistent spatial gradient along the transect (Fig. 5.9). Slightly elevated salinity values were generally observed toward the northern stations, with overall variability remaining limited (approximately 34.95–35.15 PSU). In addition, a depth-dependent structure was evident at several stations, indicating increasing salinity with depth within the stratified water column.

Dissolved oxygen concentrations showed a more variable vertical structure compared to temperature and salinity. Surface waters were characterized by moderate oxygen levels (approximately 6.0–6.3 ml l^{-1}). Concentrations increased within the intermediate water column between approximately 20 and 35 m depth, reaching values above 6.6 ml l^{-1}, before decreasing sharply below approximately 35–40 m depth. This pattern indicates a vertically structured oxygen distribution, potentially linked to water mass layering and biological activity. Comparable hydrographic conditions have previously been reported for parts of the North Sea. For example, Große et al. (2016) concluded from model simulations that regions between 54-57° N and 4.5-7° E exhibit an elevated potential for oxygen deficiencies (<6 mg O_2 l^{-1}).

A relationship between elevated dissolved oxygen concentrations and increased biological productivity was also reflected in the fluorescence measurements. Fluorometer signals were generally homogeneous across most of the transect, with only localized maxima observed. Enhanced fluorescence signals occurred primarily at stations 17 and 20 at intermediate depths (~32–35 m), indicating a pronounced chlorophyll maximum layer. This depth interval corresponded closely to the zone of elevated oxygen concentrations, suggesting enhanced primary production and associated oxygen generation within the subsurface water column. The increased biological activity was further supported by the subsequent filtration workflow, where the lowest mean filtration volume (7.71 l) was required for samples from this depth interval, consistent with elevated particle concentrations relative to surface and bottom waters.

To further resolve station-specific differences, detailed vertical CTD profiles from stations 17 and 20 are presented in Fig. 5.10. These profiles provide a higher-resolution comparison of hydrographic conditions and highlight subtle spatial variability not fully resolved by the transect overview.

Both stations exhibit a comparable overall stratification structure; however, differences in the vertical positioning of key hydrographic features are evident. At station 20, the onset of thermal stratification is slightly deeper compared to station 17, while near-surface temperatures at station 17 are marginally higher. Salinity is generally elevated at station 20 throughout the water column. A near-surface salinity decrease occurs more abruptly at station 20 (starting at ~10 m depth), whereas at station 17 the initial reduction is observed closer to ~20 m depth. Below approximately

22–26 m, both stations show a secondary increase in salinity, indicating a comparable deeper water mass influence.

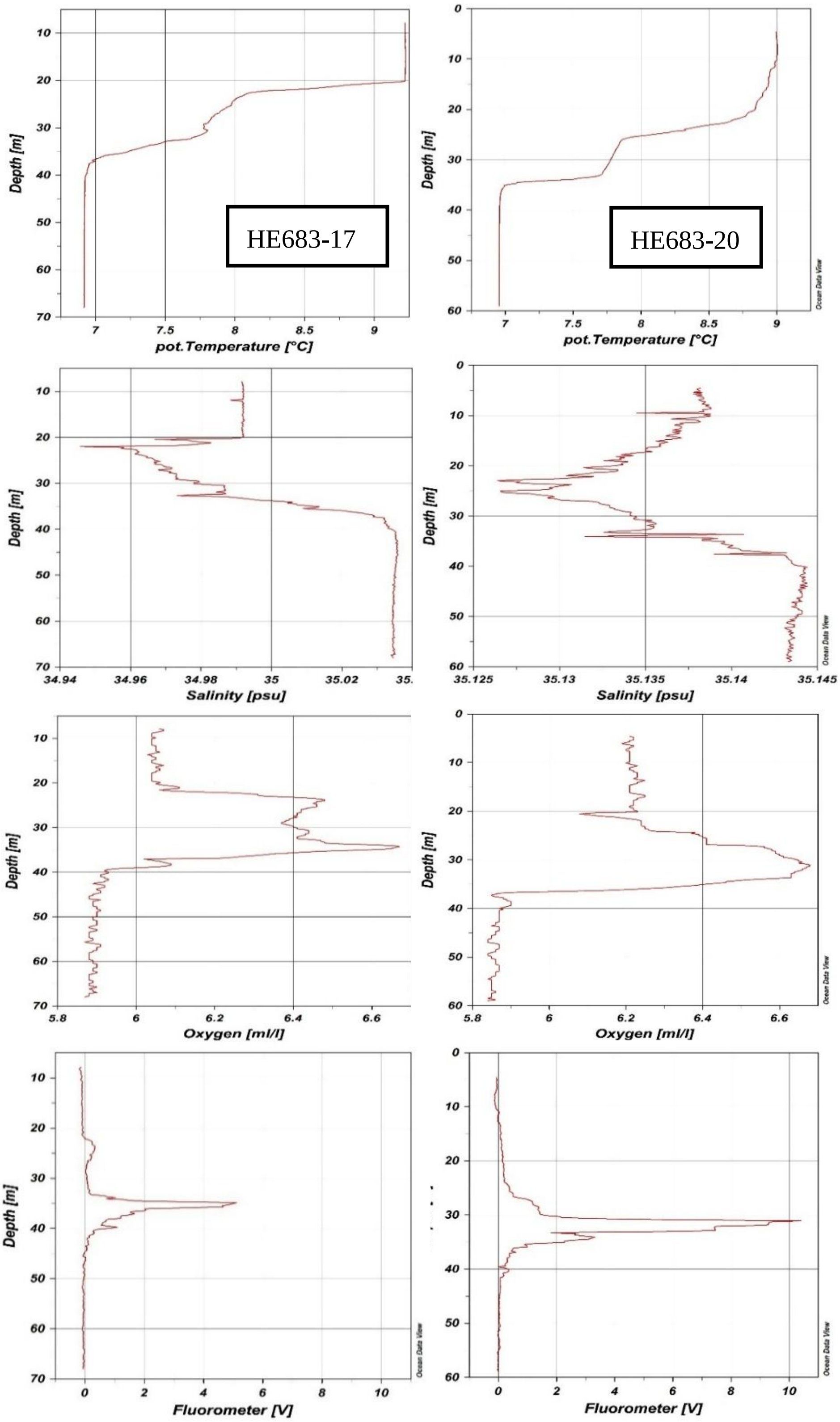

Fig. 5.10 Vertical CTD profiles recorded at stations HE683-17 and HE683-20, illustrating the water column distribution of temperature (°C), salinity, dissolved oxygen concentration (ml l^{-1}), and fluorescence (mg m^3).

Dissolved oxygen profiles are consistent between both stations and reflect the vertical structure described in the transect analysis, with increasing concentrations between approximately 20 and 35 m depth followed by a pronounced decline below ~35 m. This confirms a coherent oxygen distribution pattern across the study area despite local variability.

Fluorescence profiles show the most pronounced inter-station differences. The depth of the chlorophyll maximum is located at approximately 35 m at station 17 and at around 32 m at station 20. Outside this depth range, fluorescence signals are broadly comparable, suggesting similar background conditions in the upper and deeper water masses.

5.1.4 Bottom Water Sampler (BWS)

(Adrian Hopfauf)

The Bottom Water Sampler (BWS) is used to collect water samples directly above the seafloor, which is impossible with the CTD. It serves to extract the suspended particles and planktonic organisms in the bottom water for further analysis in the laboratory.

The BWS device used on this cruise was built by the company K.U.M in Kiel, Germany. It can accommodate up to five NISKIN bottles, which can be placed between 10 and 155 cm above the seafloor. Each of these bottles has a volume of 5 l. On this cruise, only 3 bottles were used, positioned at 28 cm, 59.5 cm and 103.5 cm above the seafloor. The bottles are attached to a rotatable metal rod in the centre, which can rotate to an angle up to 120°. Before each deployment, the bottles have to be opened and the bottle caps have to be connected to a trigger mechanism attached to the middle column. To ensure that the BWS aligns itself with the current, streaming fins are attached to the central rod and to the outer frame. The legs of the frame are equipped with weight, ensuring that the device is stable on the ground (Fig. 5.11).

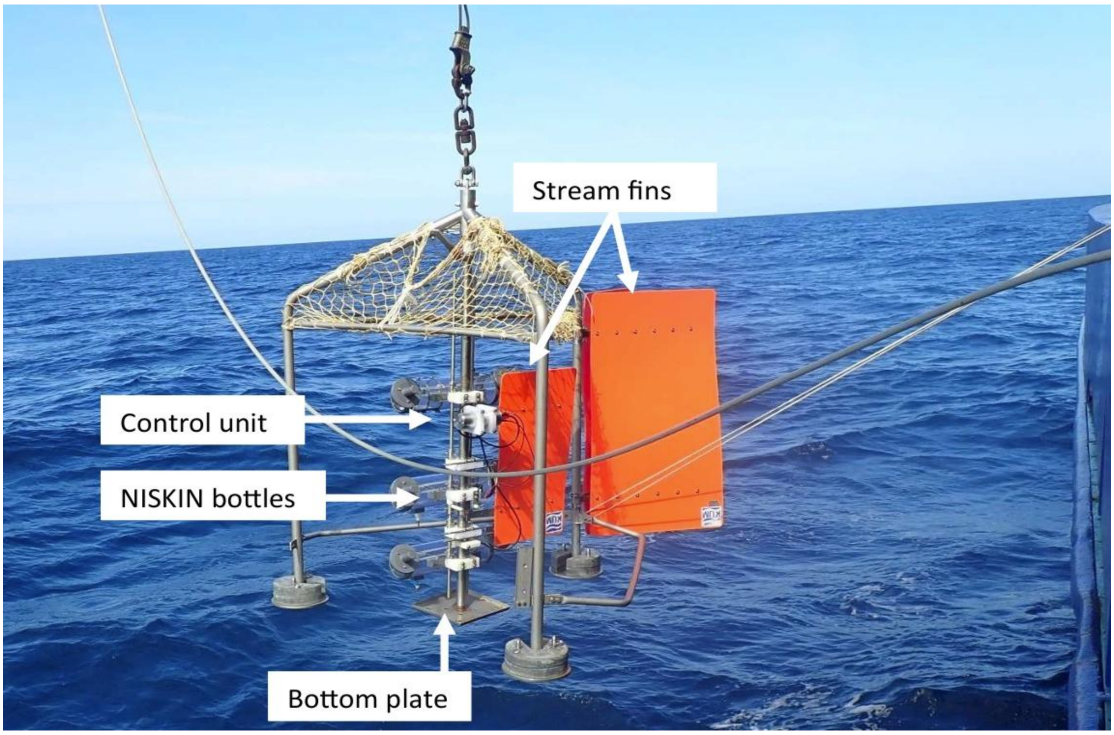

Fig. 5.11 BWS used during cruise HE683.

The closing of the bottles is controlled by an electric control unit. For this purpose, a wire loop, which is partially insulated and connected to the control unit, is attached to a mechanical locking system. This mechanical locking system can be triggered by a pre-programmed command initiated through the electric control unit. The wire and the control unit have to be set up before each deployment. When the device is placed on the seafloor, a metal plate attached to the central rod is pushed upwards. This activates a timer, which triggers the autonomous closing mechanism. The length to which the timer is set depends on the local conditions. In strong currents, the BWS can lift off after the initial landing, causing the plate that activates the timer to lose contact with the ground and starting the timer anew. Therefore, in stronger currents, the timer has to be shorter to prevent this from happening. After the timer has elapsed, the electric control unit then applies an electric voltage to the cable which is connected to the wire. One part of the wire is not insolated, allowing for a current to run through and encounter a very high electrical resistance. This heats the wire to an extremely high temperature, causing it to melt and release the triggers for closing the bottle.

Due to the moderately strong currents encountered during the cruise, the timer was set to three minutes. Additionally, the device was kept at ground position for six minutes to ensure proper closing of the NISKIN bottles. During the grounding time, the guide pully guiding the rope was closely monitored. If excessive tightening of the rope was observed, the time on ground was extended. The BWS sampling was largely successful, except at stations HE683_6 and HE683_7, where the bottles did not close and at station HE683_18, where the bottles closed on the second attempt.

When the BWS was lifted back on deck, the NISKIN bottles were emptied into plastic bottles. The samples were filtered through a glass fiber filter (0.7µm). The process is analogous to the handling of the CTD samples (see 5.1.3). The filters were pre-weighed before the cruise and the volume of filtered water was recorded. The amount of filtered water varied between 4 and 6 l per sample. The filters were stored in a refrigerator after filtration and then further analyzed at the Institute of Geology at the Universität Hamburg. The goal was to examine the suspended particles and planktonic organisms in the bottom water. The filters were dried and weighed. Using the weights obtained before filtration and after drying, as well as the filtered water, the suspended matter in mg l^{1-} can be calculated according to the formula:

$$suspended\ matter\ \left[\frac{mg}{l}\right] = \frac{m_{dried\ sample} - m_{empty\ sample}}{filtered\ water\ [l]}$$

The data shows high inter-station and depth dependent fluctuation (Fig. 5.12). At a bottle height of 28 cm the suspended matter varies between 1 and 30 mg l^{-1}, however the majority of the data points lie between 1 and 7 mg l^{-1}, resulting in an average value of 7.33 ± 9.34 mg l^{-1}. At 59.5 cm above the seafloor the suspension varies between 0.7 and 8 mg l^{-1} with an average of 3.18 ± 2.64 mg l^{-1}. The samples from the height of 103.5 cm vary between 0.9 and 6 mg l^{-1} and exhibit an average of 3.30 ± 2.46 mg l^{-1}. Consequently, the maximum concentrations of suspended matter can be observed in the lowest bottle, whereas the bottles at 59.5 and 103.5 cm are comparable.

Very conspicuous are stations 18, 19, and 20 with very high amounts of suspended matter in the lowest bottle. This can be a result of sediment resuspension caused by the sampling process.

This could explain why the suspended matter is significantly higher closest to the ground or it can be because of local physical processes such as hydrodynamic conditions, including mixing and sedimentation (Ridderinkhof et al., 1990), which explains why this phenomenon does not occur in isolation, but rather in conjunction. An alternative explanation could be a local plankton bloom, but to further explain this spike more data and analyses would be necessary.

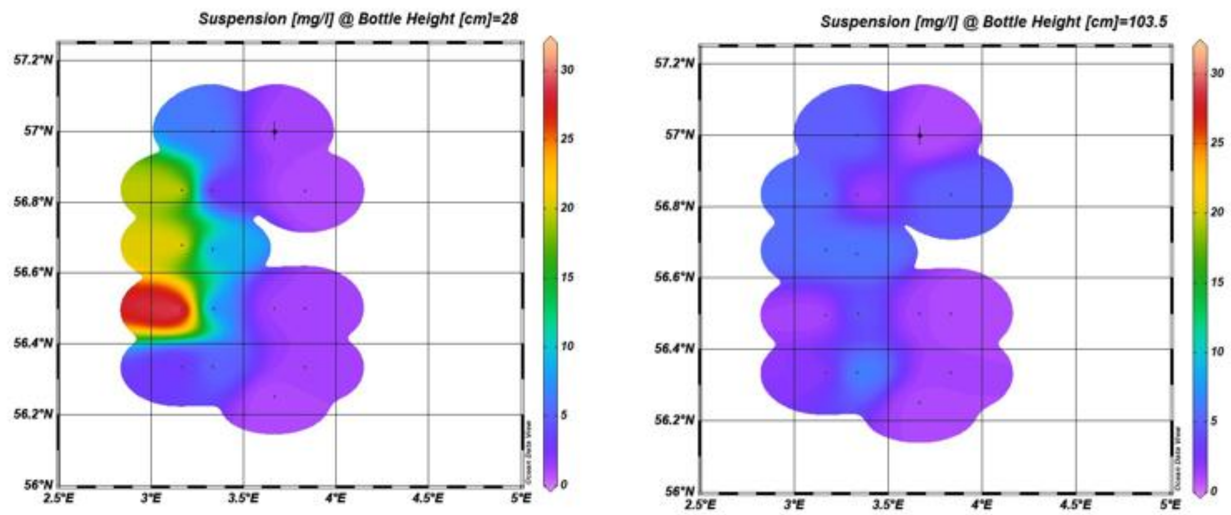

Fig. 5.12 Suspended matter in mg l^{-1} at 28 cm and 103.5 cm above ground.

5.1.5 Thermosalinograph (TSG)

(Adrian Hopfauf)

The Thermosalinograph (TSG) is an instrument (SEABIRD SB-21) installed on RV HEINCKE with an externally mounted temperature sensor (SB-38), located at the hull of the ship. This instrument continuously measures the temperature and conductivity of the surface water up to a depth of four meters. For this, seawater was constantly sucked into the ship`s hull at a rate of 30 l min^{-1}. The temperature is directly measured with the external temperature sensor. The measurements of the internal sensor are used to calculate salinity, as conductivity is temperature dependent. From the measured temperature and conductivity, the salinity and sound velocity can be calculated. The salinity is dimensionless (sometimes given in PSU) and the temperature in °C. Measurements were taken continuously throughout the duration of the cruise. This helps to create an overview of the working area beyond the limited resolution of the station-work.

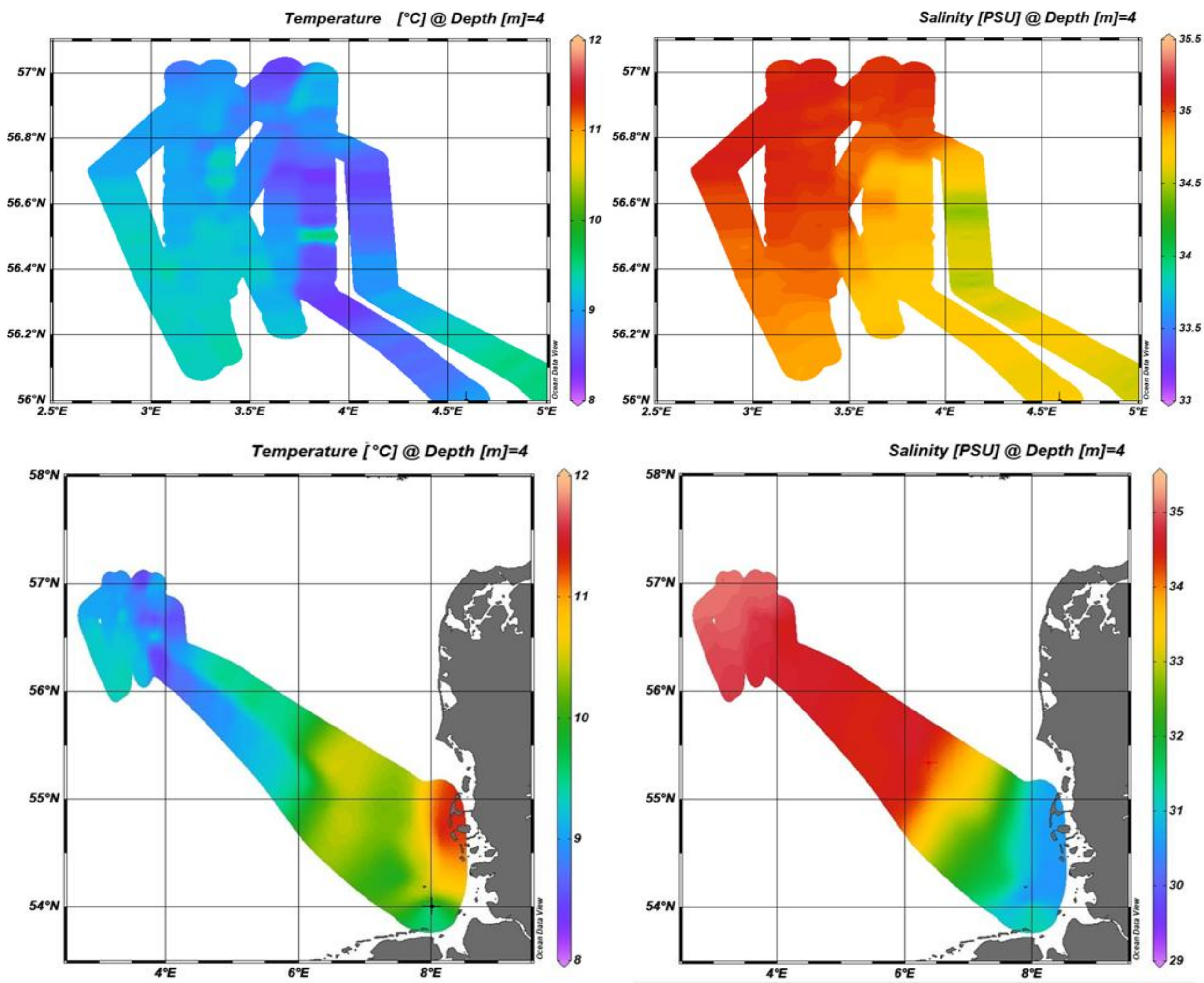

Fig. 5.13 Thermosalinograph data: Water temperature (left) and Salinity (right) at the target working area (top) and overall cruise path (bottom).

The measured temperature and salinity over the 8521 data points of the TSG are shown in Fig. 5.13. A distinct gradient is evident, characterized by a decrease in temperature from the south-east towards the north-west and with increasing distance from the coast, while the salinity increases. The temperature varies between 8.7 and 11.9 °C and the salinity between 30 and 35 PSU. The thermal decline is a result of the increasing water depth and the influx of warmer river water along the coastline. Because shallow coastal waters warm up more rapidly than deeper offshore water columns, deeper areas inherently exhibit lower temperatures (Klein et al., 2016). The shoreward drop in salinity is caused by freshwater influx from rivers. As the river influence fades offshore, the growing dominance of highly saline Atlantic water masses elevates the salinity to its maximum of 35 PSU in the open sea (Otto et al., 1990).

5.2 Sediment Sampling

(Lara Spano)

Sediment sampling is an important part of the investigation of seafloor conditions, as it provides information on grain size, sediment composition, organic content and the general depositional environment. Two different devices were used for this purpose: a VAN VEEN grab (vVG) to collect surface sediment and a MULTICORER (MUC) to obtain undisturbed sediment cores. Sediment sampling was conducted at the end of each station to avoid disturbing the water column measurements. This ensures that the physical and chemical properties of the water column are recorded under natural conditions. A total of 17 stations was sampled within the Norwegian EEZ. Both devices were deployed at all stations; however, at Station 1 and 18 the MUC failed to trigger on the first attempt, while the second deployment was successful.

Fig. 5.14 VAN-VEEN Grab (vVG) used during HE683.

5.2.1 Surface Sediment Sampling (VAN-VEEN-Grab, vVG)

The VAN VEEN grab (vVG) was deployed at all stations to obtain material from the surface sediment layer. Although this method disturbs the sediment during closure, it provides an initial assessment of the texture and properties of the seafloor. The instrument consists of two opposing jaws mounted on a spring-loaded frame that closes upon contact with the seafloor (Fig. 5.14).

In contrast to the MUC, the vVG is robust enough to operate across a wide range of sediment types. It is also used to determine whether the sediment conditions are suitable for MUC deployments, as coarse or gravel-rich sediment could interfere with core recovery or damage the device. The vVG is lowered from deck und guided straight to the seabed. Upon reaching the bottom, it settles under its own weight and sinks into the sediment before the closing mechanism is triggered. When the device is lifted, the tension on the frame causes the jaws to close, securing the sediment inside.

After recovery, a subsample was taken from the least disturbed portion of the vVG for permeability measurements, collected directly from the sediment inside the closed grab before it was emptied (Fig. 5.15). After pressing the glass-cylinder into the sediment, the upper opening is sealed with a plug, creating a vacuum that stabilises the material inside, to obtain an undisturbed sample. The container is then withdrawn from the grab, and the lower end is closed with a second plug to secure the sample for further analysis.

The remaining sediment was spread out on deck for macroscopic examination. The description included the grain size, smell, colour, visible layering and the presence of shell fragments or benthic organisms. Sediment colour was determined using the Munsell Colour Chart, allowing a consistent and standardised description of subtle colour variations, including oxidised layers, darker reduced horizons or interbedded organic-rich lenses. These observations provide a first impression of the depositional environment and help assess whether the sediment composition is suitable for subsequent MUC operations.

The sediment collected with the vVG consisted of fine to medium sand, with only minor variations between stations. Although the method disturbs the sediment; evidence of bedding was still visible. The samples contained shell fragments and, in some stations, intact shells and echinoderms, such as sea urchins and starfish. A strong sulphurous smell was noted at stations 7, 8 and 11, possibly indicating reduced conditions. The upper layer of the sediment was typically lighter in colour and consists of medium to fine sand, whereas the lower layer was dominated by darker fine sand with streaks of black components with a higher organic content.

Fig. 5.15 Sampling for permeability from the top sediment layer captured by the vVG.

To measure sediment permeability, the lower plug of the cylindrical glass container is replaced with a perforated plug fitted with a short outlet tube. Before inserting the sample, the perforation is covered with a piece of moistened filter paper that allows water to pass through while preventing sediment from entering the tube. The sediment cores, which ranged between 7 and 13.4 cm in length, are then positioned upright in the holder. A column of seawater of approximately equal height is added on top of the sediment to establish a defined hydraulic head.

Once the setup is prepared, the container is placed in a vertical position and the valve at the end of the tube is opened to initiate drainage. A stopwatch is started simultaneously. Throughout the measurement, the sediment remains fully submerged to maintain its natural water content. The water level is observed for at least 30 minutes and the change in column height over time is recorded. The rate at which the water column decreases, reflects how quickly water can move through the sediment, providing a direct measurement of its permeability. Figure 5.16 shows the distribution of the permeability in the study area.

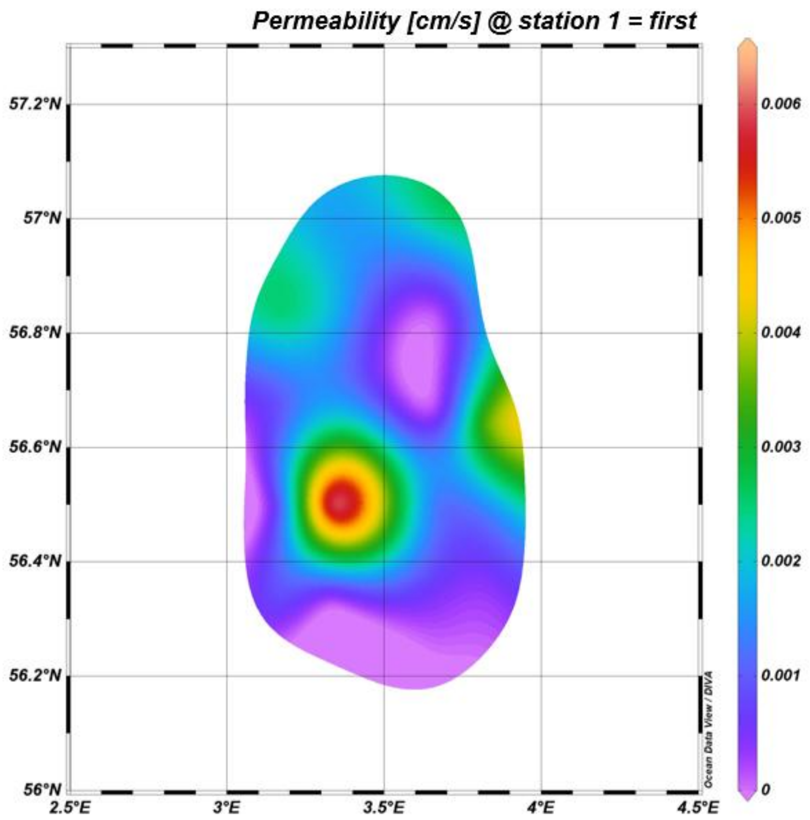

Fig. 5.16 Map of the permeability in the study area of HE683.

5.2.2 MULTICORER (MUC)

The MULTICORER (MUC) was deployed to recover undisturbed sediment cores from the seafloor. In contrast to the VAN VEEN grab, this instrument preserves the structure of the sediment. It consists of eight polycarbonate tubes arranged around a central frame. Each tube is 62 cm long with a diameter of 10 cm, allowing the recovery of sediment cores of up to 60 cm. The upper and lower ends of the tubes are equipped with mechanically operated lids that seal during retrieval. The frame rests on six feet to secure contact with the seafloor. Prior to deployment, a protective net is placed over the frame to prevent cables from becoming entangled with the tubes (Fig. 5.17).

To prepare the instrument for operation, the MUC is attached to the winch and lifted into working position. Two securing rods are removed from the rail above the tubes, allowing the inner core carrier to move freely once the device reaches the seabed. The tube lids are fixed in the open position so that water can pass through the tubes during descent, preventing pressure build-up and ensuring a smooth approach to the seafloor.

After preparation, the MUC is lowered with 0.5 m s^{-1} into the water and held about five meters above the seafloor to allow the device to settle and stop swinging. Then it is lowered at a controlled rate of 0.3 m s^{-1} until the foot frame makes contact with the bottom. This triggers the release mechanism. Once activated, the central rail and the additional weights push the core tubes downward into the sediment. After a settling period of one minute, the instrument is retrieved slowly. During retrieval the upper lids close first, creating a vacuum that stabilises the sediment inside the tubes. As the tubes are lifted out of the sediment, the lower lids swing into place and seal the cores from below. Once the MUC reaches the surface, the securing rods are reinserted to lock the inner frame before touching the deck.

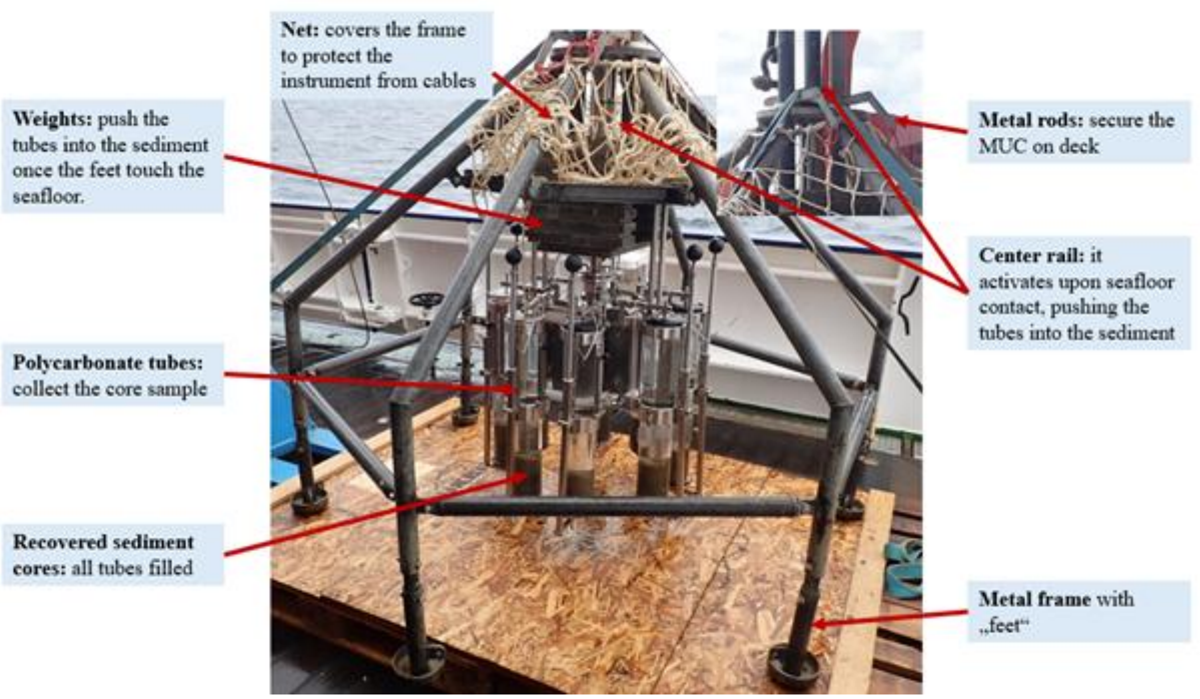

Fig. 5.17 MUC with annotated descriptions of the component parts.

After recovery, the cores were removed from the frame and sealed with plugs. This step is important because the closing system does not always fully seal, particularly in soft, fine-grained sediments, where overlying water or sediment can leak from the bottom of the tube and disturb the internal structure or wash all the sediment out. Once the plugs were in place, the cores were stabilised and secured for further processing.

Two cores were then selected for detailed analysis. One core was photographed and described visually, focusing on colour gradients, oxidation layers, the presence of reduction spots, shell fragments, organic-rich horizons, benthic organisms and any signs of bioturbation. These characteristics provide information on depositional processes. A second core was sampled for biogeochemical analysis, where the upper 5 cm were subsampled in 1 cm intervals. In addition, a separate core is used to collect water from the sediment-water interface and the upper 2 cm were subsampled specifically for micropaleontological investigations.

The MUC was successfully utilized at all stations. At stations 1 and 18, the triggering mechanism did not activate during the first attempt, but both deployments were repeated immediately and the instrument triggered the second attempt. At station 18, only a single core was recovered during the second deployment. As a result, the instrument was inspected thoroughly on deck to ensure proper functioning before continuing with the sampling programme.

At station 19, the MUC was deployed first to verify its performance after inspection. To avoid disturbing the water column at the planned sampling location through resuspended sediment from the seafloor, the deployment was carried out approximately one-tenth of a nautical mile away from the original station position, at 56° 40.54' N, 003° 10.00' E. This precaution ensured that the actual station site remained unaffected by any material stirred up.

The recovered core lengths ranged from 4 to 19 cm. Overall; the cores are remarkably similar across the stations. The sediment consists of fine to medium sand, with only minor variations in grain size. All cores displayed at least two distinct layers: a lighter upper layer and a darker lower layer, the latter indicating redox-related colour changes. The upper layer frequently showed signs of bioturbation, including burrows, mottled structures, worms and bivalves. Beneath this, the sediment contained abundant shell fragments, locally organic-rich material, and in some cases a more cohesive, slightly muddy horizon, suggesting increased binding and reduced oxygenation compared to the surface layer.

5.3 Underway Hydroacoustics

(Serra Celik and Thomas Lüdmann)

The hydroacoustic survey was conducted throughout the duration of the cruise. Three hull-mounted acoustic systems were used: the KONGSBERG EM712 multibeam echosounder (MBES), the INNOMAR SES2000 parametric sub-bottom profiler (pSES/SBP) and the TELEDYNE RDI Workhorse Mariner 150 kHz Acoustic Doppler Current Profiler (ADCP). MBES and pSES/SBP data was acquired within the working area along the tracks shown in Fig. 5.18 (green lines).

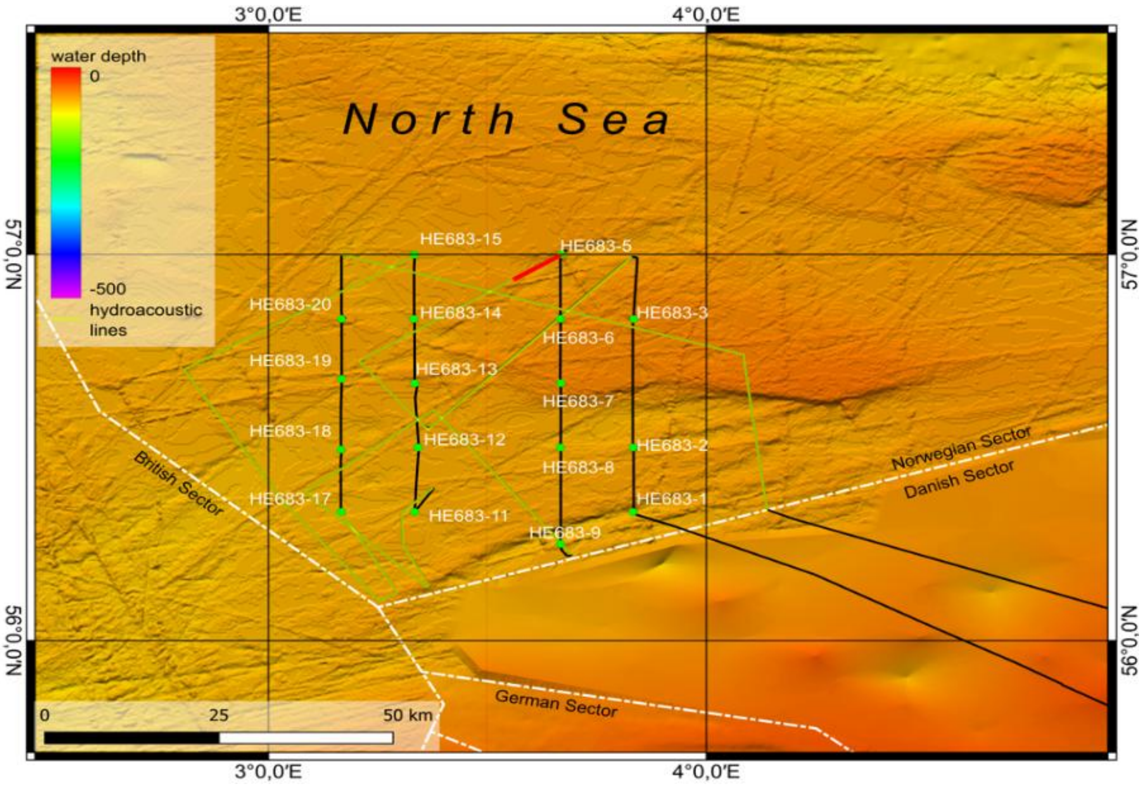

Fig. 5.18 Overview map showing the hydroacoustic survey lines, sampling stations (green dots), and an example profile line (red line) along station 5 in the North Sea study area

To minimize interference with concurrent sampling activities, hydroacoustic surveys were carried out at night. The ADCP was used continuously throughout the entire cruise. The ADCP was setup up for 4 m bins, blanking distance of 6 m and bottom tracking on.

The multibeam echosounder (MBES) is a hull-mounted acoustic system used for bathymetric surveys. The system forms fan-shaped transmit and receive beams using multiple transducers, allowing detailed mapping of seafloor morphology over a wide swath beneath the vessel. A swath angle of 120-140 degrees was applied, resulting in a survey swath width of approximately 58 m. The system was operated in single-swath, shallow-water ping mode with high-density, equidistant beam spacing. The amplitude of the reflected acoustic signal gives information on the acoustic properties of the seabed, from which sedimentary properties can be derived. In addition, a VALEPORT MIDAS Sound Velocity Profiler (SVP) was utilized during CTD casts attached the CTD frame to collect sound-velocity profiles in the water column.

The MBES bathymetric data was processed using the QPS Qimera Software, while the backscatter data was processed using the QPS FMGT/Fledermaus Geocoder Toolbox.

The INNOMAR SES2000 sub-bottom profiler uses parametric acoustic technology and is suitable for operation in water depths from less than 1 m to approximately 500 m. During the cruise, the system was operated at a frequency of 6 kHz in water depths of around 64 m.

The MBES data show seafloor bathymetry with water depths of approximately 60-70 m. The example swath displays a generally shallow relief with subtle roughness and localized small-scale bathymetric irregularities.

Fig. 5.19 shows the backscatter intensity of the same example survey swath. Backscatter intensity varies according to seabed character: high intensity indicates that a larger proportion of the acoustic signal is reflected, which is commonly associated with denser or coarser material such as

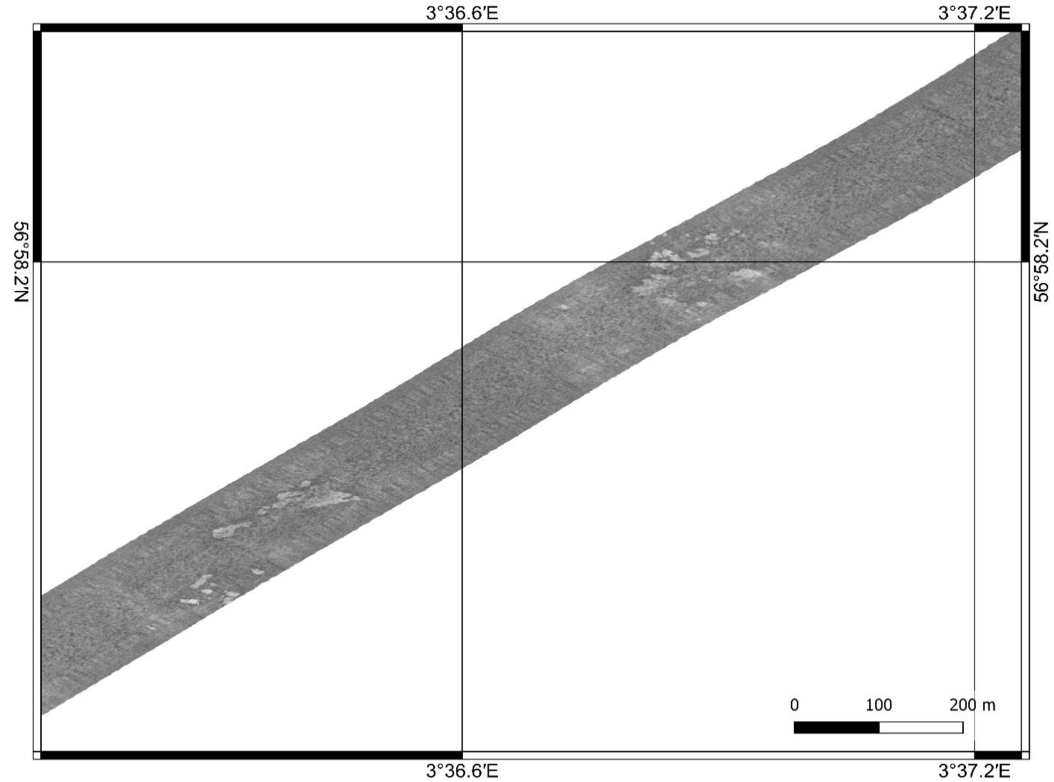

Fig. 5.19 Backscatter intensity profile along the example MBES swath shown in Fig. 5.18. The darker the shading, the higher the intensity.

sand, gravel or rock. Low intensity generally indicates finer or lower-density material such as mud or silt. In this profile, brighter patchy areas may indicate localized rougher or coarser seabed material, while the surrounding lower-intensity areas likely represent more homogeneous or finer sediment.

Fig. 5.20 shows the bathymetry of the example profile shown in Fig. 5.18 (red line). The seafloor depth along the profile is mostly uniform at a depth of around 67 m. Patches of slightly deeper seafloor appear to correspond to those observed in the backscatter plot (lighter patches, Fig. 5.19).

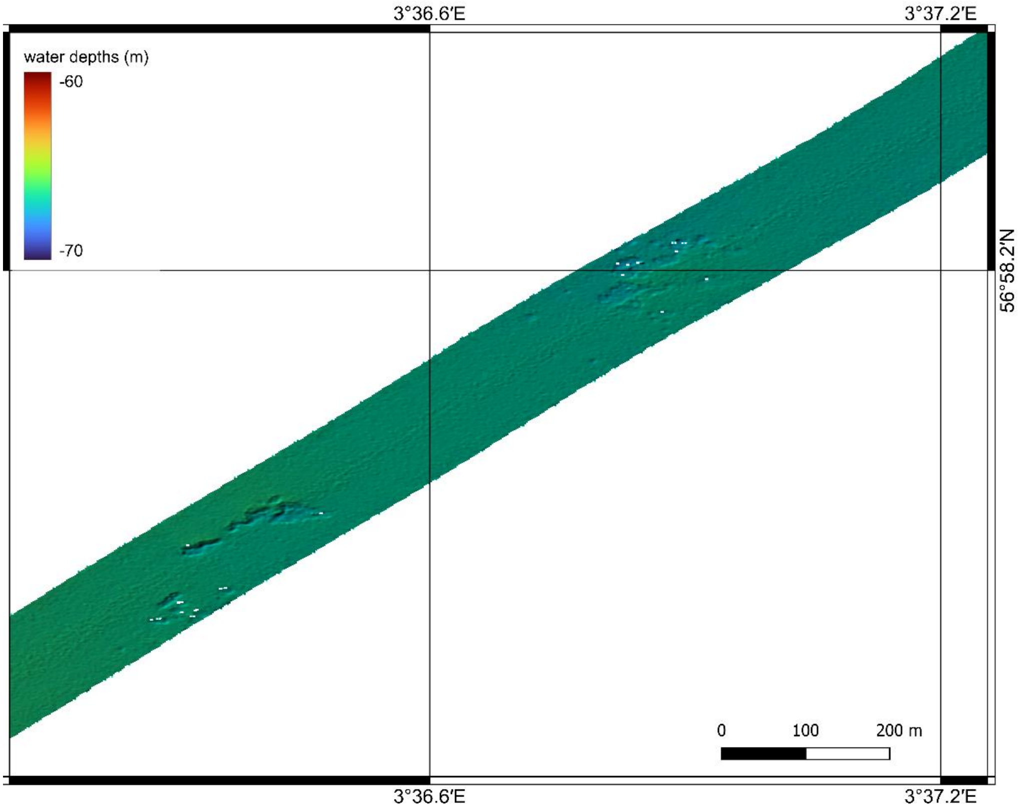

Fig. 5.20 MBES bathymetry along the example survey path shown in Fig. 5.18.

The velocity direction - NAV plot (**Fig. 5.21**a) illustrates the temporal and vertical distribution of flow direction measured by the ADCP along the track indicated in Figure 5.17 (red line). The x-axis represents ensemble number and measurement time, covering an observation period of approximately 26 minutes. The y-axis shows range from the instrument, extending to roughly 60 m. Each coloured cell represents the mean flow direction calculated for an individual range cell of 4 m. The plot indicates a generally stable flow direction through most of the measurement period, with only localized deviations in some bins. Based on the dominant green-to-yellow colours, the flow direction is mainly within the southward to south-westward sector, although the exact directional range should be read from the colour scale. The velocity magnitude - NAV plot (**Fig. 5.21**bThe ADCP profile indicates an average current speed of approximately 0.2-0.3 m s^{-1}. The dominant flow direction appears to be southward to south-westward, with modest vertical variation between range cells) shows the corresponding variation in current-speed magnitude. Most values fall within the moderate range shown by cyan-to-green colours, with localized higher values in some shallower to mid-range bins and lower velocities in parts of the upper and deeper profile. Overall, the ADCP data indicate relatively stable current conditions with small vertical and temporal variations rather than abrupt changes across the whole profile.

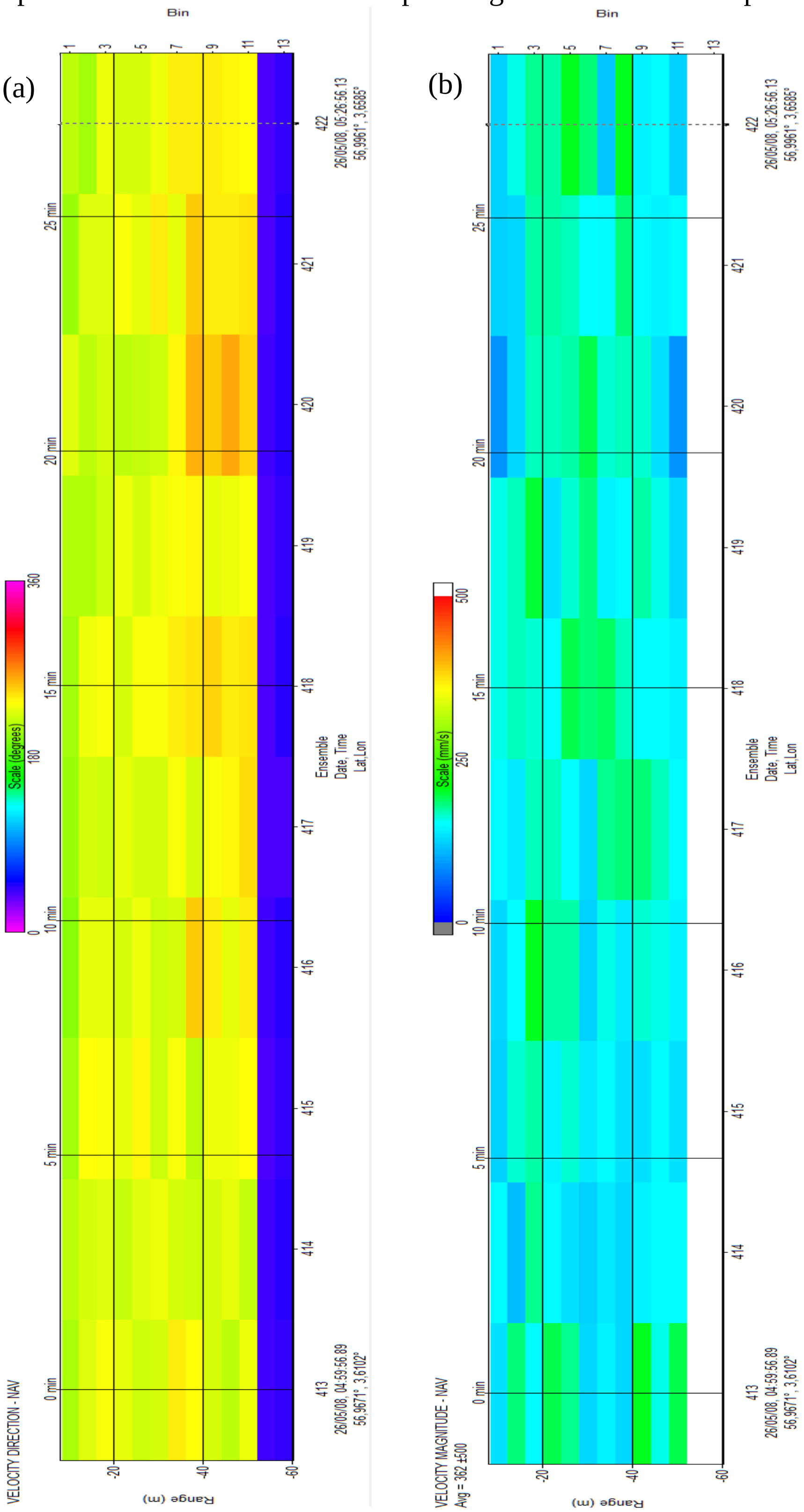

Fig. 5.21 (a) Velocity Direction - NAV plot showing the temporal (x-axis) and vertical distribution (y-axis, ranging from 0 (purple) to 360 (pink) degrees) of current direction measured by the ADCP. (b) Velocity Magnitude - NAV plot showing the temporal (x-axis) and vertical distribution (y-axis, ranging from 0 (blue) to 500 (red) mm s^{-1}) of current-speed magnitude measured by the ADCP.

The ADCP profile indicates an average current speed of approximately 0.2-0.3 m s^{-1}. The dominant flow direction appears to be southward to south-westward, with modest vertical variation between range cellsThe pSES/SBP profile (Fig. 5.22) is located in the northern part of the study area within the Norwegian Economic Zone (red line in Fig. 5.17). Here, the seabed smooth and represented by a continuous high-amplitude reflector, highlighted in red colour. It lies in approximately 67.5 m water depth, if a sound velocity of 1500 m s^{-1} is assumed. Only minor topographic variations are visible, indicating a largely flat, young seafloor that may have been smoothed by glacial erosion.

Below the seabed reflector, reflection patterns vary laterally. In the central part of the profile, especially between approximately 15,200 m and 17,600 m, the data show stronger backscatter, more pronounced internal structure and locally discontinuous or chaotic reflections. These patterns suggest heterogeneous sediment bodies or erosional structures, possibly related to glacial or glaciofluvial deposition and reworking. However, acoustic artefacts such as diffraction, scattering or signal attenuation cannot be ruled out, so the interpretation should remain cautious. The Laminar Unit (LU) occurs immediately below the seabed and is characterized by relatively continuous, sub-horizontal reflections of low to medium amplitude. It could be interpreted as homogenous marine fine sand deposited under relatively calm open-marine conditions after the last glacial period. The Discontinuous High-Amplitude Unit (DHAU) occurs below the LU and fills channel-like depressions. It is characterized by discontinuous, laterally variable, medium- to high-amplitude reflections. This unit may represent coarser sands and gravels associated with higher reflection energy induced by strong impedance contrasts. The Transparent Unit (TU) comprises the acoustic basement with weak or almost absent internal reflections. Possible explanations include the penetration limit of the 6 kHz pSES signal, acoustic masking caused by gas, or a lithologically homogeneous sediment body such as massive glacial till.

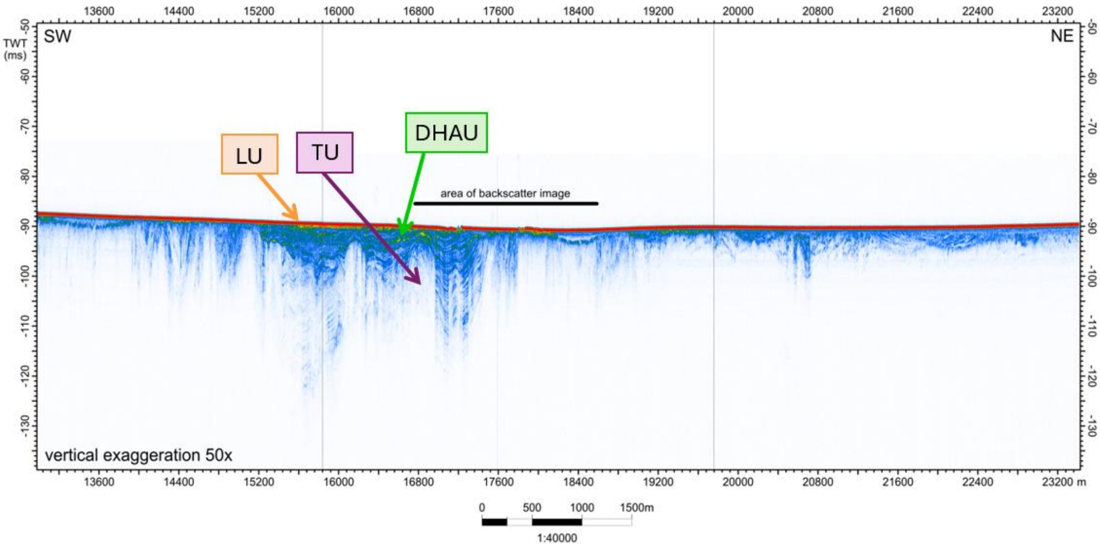

Fig. 5.22 Example pSES/SBP profile from the North Sea. The Laminar Unit (LU) is marked in orange, the Discontinuous High-Amplitude Unit (DHAU) in green, and the Transparent Unit (TU) in purple.

6 Station List HE683

Abbreviations:

DWD: Weather Station
TSG: Thermosalinograph
ADCP: Acoustic Doppler Current Profiler 600 kHz
Secchi: SECCHI -Disk
Plankton Net: Plankton-Net 25 µm (APSTEIN)
CTD: CTD-Rosette
BWS: Bottom Water Sampler
vV-GRAB: VAN VEEN Grab
MUC: MULTICORER
Multibeam: Multibeam EM712

Table 6.1 Station list HE683

Station No.	Latitude	Longitude	Date	Time [UTC]	Water Depth [m]	Device	Action
HE683_0	53° 31.918' N	008° 34.682' E	06.05.2026	06:10:01	4	DWD	station start
HE683_0	53° 54.319' N	008° 01.935' E	06.05.2026	09:30:44	13	TSG	station start
HE683_0	56° 17.407' N	003° 56.522' E	07.05.2026	08:24:29	69	ADCP 600 kHz	station start
HE683_0	56° 17.486' N	003° 56.327' E	07.05.2026	08:25:20	68	SES2000	station start
HE683_1-1	56° 19.990' N	003° 49.945' E	07.05.2026	09:55:18	70	Secchi	station start
HE683_1-1	56° 19.988' N	003° 49.946' E	07.05.2026	09:57:59	71	Secchi	in the water
HE683_1-1	56° 19.988' N	003° 49.952' E	07.05.2026	10:01:25	71	Secchi	on deck
HE683_1-2	56° 19.988' N	003° 49.945' E	07.05.2026	10:08:23	71	Plankton Net	in the water
HE683_1-2	56° 19.987' N	003° 49.945' E	07.05.2026	10:09:09	70	Plankton Net	on deck
HE683_1-3	56° 19.992' N	003° 49.955' E	07.05.2026	10:13:36	70	CTD	in the water
HE683_1-3	56° 19.986' N	003° 49.947' E	07.05.2026	10:18:27	70	CTD	max depth/on ground
HE683_1-3	56° 19.986' N	003° 49.936' E	07.05.2026	10:25:01	71	CTD	on deck
HE683_1-4	56° 19.993' N	003° 49.942' E	07.05.2026	10:30:32	72	BWS	in the water
HE683_1-4	56° 19.999' N	003° 49.961' E	07.05.2026	10:46:46	70	BWS	on deck
HE683_1-5	56° 20.019' N	003° 49.973' E	07.05.2026	10:53:29	70	vV-Grab	max depth/on ground
HE683_1-6	56° 20.041' N	003° 49.956' E	07.05.2026	11:07:54	70	MUC	max depth/on ground
HE683_1-6	56° 20.061' N	003° 49.967' E	07.05.2026	11:27:17	70	MUC	max depth/on ground
HE683_1-6	56° 20.071' N	003° 49.958' E	07.05.2026	11:35:41	71	MUC	station end
HE683_2-1	56° 29.970' N	003° 49.999' E	07.05.2026	12:45:10	63	Secchi	station start
HE683_2-1	56° 30.009' N	003° 49.994' E	07.05.2026	12:49:37	63	Secchi	in the water
HE683_2-1	56° 30.011' N	003° 50.006' E	07.05.2026	12:51:55	64	Secchi	on deck
HE683_2-2	56° 30.012' N	003° 50.012' E	07.05.2026	12:54:50	63	Plankton Net	in the water
HE683_2-2	56° 30.010' N	003° 50.009' E	07.05.2026	12:56:25	63	Plankton Net	on deck
HE683_2-3	56° 30.009' N	003° 50.001' E	07.05.2026	12:59:46	63	CTD	in the water
HE683_2-3	56° 30.013' N	003° 49.988' E	07.05.2026	13:05:35	63	CTD	max depth/on ground
HE683_2-3	56° 30.009' N	003° 49.959' E	07.05.2026	13:10:42	64	CTD	on deck
HE683_2-4	56° 30.015' N	003° 49.945' E	07.05.2026	13:15:52	64	BWS	in the water
HE683_2-4	56° 30.029' N	003° 49.931' E	07.05.2026	13:30:51	63	BWS	on deck
HE683_2-5	56° 30.032' N	003° 49.926' E	07.05.2026	13:36:14	63	vV-Grab	max depth/on ground
HE683_2-6	56° 30.026' N	003° 49.917' E	07.05.2026	13:48:49	64	MUC	max depth/on ground

Station No.	Latitude	Longitude	Date	Time [UTC]	Water Depth [m]	Device	Action
HE683_2-6	56° 30.026' N	003° 49.911' E	07.05.2026	13:56:01	63	MUC	station end
HE683_3-1	56° 50.009' N	003° 50.039' E	07.05.2026	16:00:20	57	Secchi	station start
HE683_3-1	56° 49.999' N	003° 50.035' E	07.05.2026	16:02:29	57	Secchi	in the water
HE683_3-1	56° 49.993' N	003° 50.031' E	07.05.2026	16:04:02	56	Secchi	on deck
HE683_3-2	56° 49.982' N	003° 50.026' E	07.05.2026	16:05:56	56	Plankton Net	in the water
HE683_3-2	56° 49.977' N	003° 50.024' E	07.05.2026	16:06:51	57	Plankton Net	on deck
HE683_3-3	56° 49.969' N	003° 50.045' E	07.05.2026	16:15:59	57	CTD	max depth/on ground
HE683_3-3	56° 49.976' N	003° 50.044' E	07.05.2026	16:21:38	57	CTD	on deck
HE683_3-4	56° 49.975' N	003° 50.039' E	07.05.2026	16:24:25	57	BWS	in the water
HE683_3-4	56° 49.980' N	003° 50.018' E	07.05.2026	16:37:51	56	BWS	on deck
HE683_3-5	56° 49.982' N	003° 50.015' E	07.05.2026	16:41:38	57	vV-Grab	max depth/on ground
HE683_3-6	56° 49.985' N	003° 50.022' E	07.05.2026	16:51:44	57	MUC	max depth/on ground
HE683_3-6	56° 49.989' N	003° 50.019' E	07.05.2026	16:57:46	56	MUC	station end
HE683_4-1	56° 49.987' N	003° 50.020' E	07.05.2026	17:06:36	58	Multibeam	station start
HE683_4-1	56° 49.987' N	003° 50.020' E	07.05.2026	17:06:43	57	Multibeam	profile start
HE683_4-1	57° 00.367' N	003° 40.521' E	08.05.2026	05:36:14	63	Multibeam	profile end
HE683_4-1	57° 00.577' N	003° 40.644' E	08.05.2026	05:40:59	63	Multibeam	station end
HE683_5-1	57° 00.015' N	003° 40.046' E	08.05.2026	06:00:03	63	Secchi	station start
HE683_5-1	57° 00.012' N	003° 40.046' E	08.05.2026	06:01:21	64	Secchi	in the water
HE683_5-1	57° 00.005' N	003° 40.043' E	08.05.2026	06:03:07	64	Secchi	on deck
HE683_5-2	57° 00.009' N	003° 40.035' E	08.05.2026	06:05:04	64	Plankton Net	in the water
HE683_5-2	57° 00.003' N	003° 40.028' E	08.05.2026	06:07:12	64	Plankton Net	on deck
HE683_5-3	56° 59.994' N	003° 40.029' E	08.05.2026	06:15:02	64	CTD	max depth/on ground
HE683_5-3	56° 59.989' N	003° 40.025' E	08.05.2026	06:22:22	64	CTD	on deck
HE683_5-4	56° 59.993' N	003° 40.025' E	08.05.2026	06:27:45	64	BWS	in the water
HE683_5-4	56° 59.974' N	003° 40.025' E	08.05.2026	06:41:57	64	BWS	on deck
HE683_5-5	56° 59.992' N	003° 40.058' E	08.05.2026	06:46:41	64	vV-Grab	max depth/on ground
HE683_5-6	56° 59.988' N	003° 40.035' E	08.05.2026	06:56:49	63	MUC	max depth/on ground
HE683_5-6	56° 59.913' N	003° 40.019' E	08.05.2026	07:05:01	64	MUC	station end
HE683_6-1	56° 50.019' N	003° 39.993' E	08.05.2026	08:15:43	58	Secchi	station start
HE683_6-1	56° 50.003' N	003° 39.987' E	08.05.2026	08:17:30	57	Secchi	in the water
HE683_6-1	56° 50.005' N	003° 39.993' E	08.05.2026	08:19:20	57	Secchi	on deck
HE683_6-2	56° 50.000' N	003° 40.001' E	08.05.2026	08:20:28	57	Plankton Net	in the water
HE683_6-2	56° 49.996' N	003° 40.010' E	08.05.2026	08:21:56	57	Plankton Net	on deck
HE683_6-3	56° 49.995' N	003° 40.013' E	08.05.2026	08:32:31	58	CTD	max depth/on ground
HE683_6-3	56° 49.994' N	003° 39.990' E	08.05.2026	08:38:20	58	CTD	on deck
HE683_6-4	56° 49.987' N	003° 39.998' E	08.05.2026	08:40:55	57	BWS	in the water
HE683_6-4	56° 49.983' N	003° 40.013' E	08.05.2026	08:56:47	57	BWS	on deck
HE683_6-5	56° 49.990' N	003° 40.004' E	08.05.2026	09:00:37	57	vV-Grab	max depth/on ground
HE683_6-6	56° 49.983' N	003° 40.028' E	08.05.2026	09:10:31	57	MUC	max depth/on ground
HE683_6-6	56° 49.976' N	003° 40.028' E	08.05.2026	09:15:41	58	MUC	station end
HE683_7-1	56° 40.040' N	003° 40.019' E	08.05.2026	10:30:27	53	Secchi	station start
HE683_7-1	56° 40.014' N	003° 40.017' E	08.05.2026	10:32:45	53	Secchi	in the water
HE683_7-1	56° 40.015' N	003° 40.020' E	08.05.2026	10:34:27	53	Secchi	on deck
HE683_7-2	56° 40.016' N	003° 40.030' E	08.05.2026	10:35:50	53	Plankton Net	in the water
HE683_7-2	56° 40.015' N	003° 40.051' E	08.05.2026	10:37:37	54	Plankton Net	on deck

Station No.	Latitude	Longitude	Date	Time [UTC]	Water Depth [m]	Device	Action
HE683_7-3	56° 40.013' N	003° 40.073' E	08.05.2026	10:46:11	53	CTD	max depth/on ground
HE683_7-3	56° 40.006' N	003° 40.063' E	08.05.2026	10:51:33	53	CTD	on deck
HE683_7-4	56° 40.007' N	003° 40.057' E	08.05.2026	10:55:06	53	BWS	in the water
HE683_7-4	56° 39.999' N	003° 40.052' E	08.05.2026	11:07:27	53	BWS	on deck
HE683_7-5	56° 39.997' N	003° 40.036' E	08.05.2026	11:11:44	53	vV-Grab	max depth/on ground
HE683_7-6	56° 40.001' N	003° 40.051' E	08.05.2026	11:19:46	53	MUC	max depth/on ground
HE683_7-6	56° 39.996' N	003° 40.032' E	08.05.2026	11:25:20	53	MUC	station end
HE683_8-1	56° 30.001' N	003° 39.958' E	08.05.2026	12:35:03	66	Secchi	station start
HE683_8-1	56° 30.001' N	003° 39.958' E	08.05.2026	12:35:09	66	Secchi	in the water
HE683_8-1	56° 29.997' N	003° 39.968' E	08.05.2026	12:36:43	65	Secchi	on deck
HE683_8-2	56° 29.998' N	003° 39.980' E	08.05.2026	12:38:51	65	Plankton Net	in the water
HE683_8-2	56° 29.999' N	003° 39.980' E	08.05.2026	12:39:45	66	Plankton Net	on deck
HE683_8-3	56° 29.998' N	003° 40.003' E	08.05.2026	12:48:24	65	CTD	max depth/on ground
HE683_8-3	56° 29.997' N	003° 39.992' E	08.05.2026	12:55:06	65	CTD	on deck
HE683_8-4	56° 29.992' N	003° 40.001' E	08.05.2026	12:57:02	66	BWS	in the water
HE683_8-4	56° 29.990' N	003° 39.994' E	08.05.2026	13:11:11	65	BWS	on deck
HE683_8-5	56° 29.988' N	003° 40.002' E	08.05.2026	13:14:52	66	vV-Grab	max depth/on ground
HE683_8-6	56° 29.986' N	003° 40.023' E	08.05.2026	13:23:56	65	MUC	max depth/on ground
HE683_8-6	56° 29.987' N	003° 40.024' E	08.05.2026	13:29:14	66	MUC	station end
HE683_9-1	56° 15.018' N	003° 39.978' E	08.05.2026	15:27:25	69	Secchi	station start
HE683_9-1	56° 15.018' N	003° 39.979' E	08.05.2026	15:28:43	69	Secchi	in the water
HE683_9-1	56° 15.019' N	003° 39.987' E	08.05.2026	15:30:08	69	Secchi	on deck
HE683_9-2	56° 15.020' N	003° 39.989' E	08.05.2026	15:30:28	69	Plankton Net	in the water
HE683_9-2	56° 15.022' N	003° 39.995' E	08.05.2026	15:31:20	69	Plankton Net	on deck
HE683_9-3	56° 15.020' N	003° 40.008' E	08.05.2026	15:38:43	69	CTD	max depth/on ground
HE683_9-3	56° 15.016' N	003° 40.012' E	08.05.2026	15:44:57	69	CTD	on deck
HE683_9-4	56° 15.021' N	003° 40.028' E	08.05.2026	15:49:58	69	BWS	in the water
HE683_9-4	56° 15.017' N	003° 40.022' E	08.05.2026	16:03:35	69	BWS	on deck
HE683_9-5	56° 15.017' N	003° 40.022' E	08.05.2026	16:07:41	69	vV-Grab	max depth/on ground
HE683_9-6	56° 15.015' N	003° 40.023' E	08.05.2026	16:16:46	69	MUC	max depth/on ground
HE683_9-6	56° 15.014' N	003° 40.019' E	08.05.2026	16:21:32	69	MUC	station end
HE683_10-1	56° 13.483' N	003° 41.433' E	08.05.2026	16:44:49	66	Multibeam	station start
HE683_10-1	56° 13.505' N	003° 41.415' E	08.05.2026	16:45:05	66	Multibeam	profile start
HE683_10-1	56° 23.548' N	003° 22.341' E	09.05.2026	05:13:52	66	Multibeam	profile end
HE683_10-1	56° 23.570' N	003° 22.368' E	09.05.2026	05:14:10	66	Multibeam	station end
HE683_11-1	56° 19.992' N	003° 19.993' E	09.05.2026	05:55:36	67	Secchi	station start
HE683_11-1	56° 19.994' N	003° 19.991' E	09.05.2026	05:56:40	67	Secchi	in the water
HE683_11-1	56° 19.999' N	003° 19.987' E	09.05.2026	05:59:28	67	Secchi	on deck
HE683_11-2	56° 19.999' N	003° 19.987' E	09.05.2026	05:59:51	67	Plankton Net	in the water
HE683_11-2	56° 20.001' N	003° 19.990' E	09.05.2026	06:01:16	67	Plankton Net	on deck
HE683_11-3	56° 20.007' N	003° 20.012' E	09.05.2026	06:10:04	67	CTD	max depth/on ground
HE683_11-3	56° 19.999' N	003° 20.021' E	09.05.2026	06:16:39	67	CTD	on deck
HE683_11-4	56° 19.990' N	003° 20.004' E	09.05.2026	06:20:55	67	BWS	in the water
HE683_11-4	56° 19.995' N	003° 19.990' E	09.05.2026	06:34:31	67	BWS	on deck
HE683_11-5	56° 19.985' N	003° 19.999' E	09.05.2026	06:38:47	67	vV-Grab	max depth/on ground
HE683_11-6	56° 19.960' N	003° 20.003' E	09.05.2026	06:49:47	67	MUC	max depth/on ground

Station No.	Latitude	Longitude	Date	Time [UTC]	Water Depth [m]	Device	Action
HE683_11-6	56° 19.964' N	003° 20.000' E	09.05.2026	06:55:46	67	MUC	station end
HE683_12-1	56° 29.983' N	003° 20.471' E	09.05.2026	08:00:18	66	Secchi	station start
HE683_12-1	56° 30.031' N	003° 20.531' E	09.05.2026	08:03:35	66	Secchi	in the water
HE683_12-1	56° 30.026' N	003° 20.536' E	09.05.2026	08:05:09	66	Secchi	on deck
HE683_12-2	56° 30.026' N	003° 20.536' E	09.05.2026	08:05:28	66	Plankton Net	in the water
HE683_12-2	56° 30.024' N	003° 20.535' E	09.05.2026	08:06:36	66	Plankton Net	on deck
HE683_12-3	56° 30.012' N	003° 20.514' E	09.05.2026	08:13:38	67	CTD	max depth/on ground
HE683_12-3	56° 30.009' N	003° 20.505' E	09.05.2026	08:19:49	66	CTD	on deck
HE683_12-4	56° 30.014' N	003° 20.521' E	09.05.2026	08:25:17	67	BWS	in the water
HE683_12-4	56° 30.007' N	003° 20.525' E	09.05.2026	08:38:55	66	BWS	on deck
HE683_12-5	56° 30.013' N	003° 20.526' E	09.05.2026	08:42:45	66	vV-Grab	max depth/on ground
HE683_12-6	56° 30.000' N	003° 20.540' E	09.05.2026	08:53:08	66	MUC	max depth/on ground
HE683_12-6	56° 29.984' N	003° 20.545' E	09.05.2026	09:00:00	67	MUC	station end
HE683_13-1	56° 40.012' N	003° 19.986' E	09.05.2026	10:05:53	62	Secchi	station start
HE683_13-1	56° 40.003' N	003° 20.017' E	09.05.2026	10:08:03	62	Secchi	in the water
HE683_13-1	56° 39.996' N	003° 20.030' E	09.05.2026	10:09:58	62	Secchi	on deck
HE683_13-2	56° 39.996' N	003° 20.032' E	09.05.2026	10:10:16	62	Plankton Net	in the water
HE683_13-2	56° 39.994' N	003° 20.036' E	09.05.2026	10:11:16	62	Plankton Net	on deck
HE683_13-3	56° 39.989' N	003° 20.050' E	09.05.2026	10:17:41	63	CTD	max depth/on ground
HE683_13-3	56° 39.976' N	003° 20.036' E	09.05.2026	10:25:44	63	CTD	on deck
HE683_13-4	56° 39.972' N	003° 20.023' E	09.05.2026	10:28:20	62	BWS	in the water
HE683_13-4	56° 39.967' N	003° 20.020' E	09.05.2026	10:41:59	63	BWS	on deck
HE683_13-5	56° 39.962' N	003° 20.019' E	09.05.2026	10:45:23	62	vV-Grab	max depth/on ground
HE683_13-6	56° 39.957' N	003° 20.028' E	09.05.2026	10:53:52	62	MUC	max depth/on ground
HE683_13-6	56° 39.950' N	003° 20.034' E	09.05.2026	11:00:22	63	MUC	station end
HE683_14-1	56° 49.982' N	003° 19.998' E	09.05.2026	12:10:03	64	Secchi	station start
HE683_14-1	56° 49.982' N	003° 19.999' E	09.05.2026	12:10:09	64	Secchi	in the water
HE683_14-1	56° 49.983' N	003° 19.996' E	09.05.2026	12:11:27	64	Secchi	on deck
HE683_14-2	56° 49.983' N	003° 19.994' E	09.05.2026	12:11:45	64	Plankton Net	in the water
HE683_14-2	56° 49.980' N	003° 19.982' E	09.05.2026	12:12:35	64	Plankton Net	on deck
HE683_14-3	56° 49.982' N	003° 19.902' E	09.05.2026	12:20:34	65	CTD	max depth/on ground
HE683_14-3	56° 49.985' N	003° 19.896' E	09.05.2026	12:23:52	64	CTD	on deck
HE683_14-4	56° 49.985' N	003° 19.934' E	09.05.2026	12:27:34	64	BWS	in the water
HE683_14-4	56° 49.992' N	003° 19.919' E	09.05.2026	12:38:51	65	BWS	on deck
HE683_14-5	56° 49.990' N	003° 19.920' E	09.05.2026	12:42:13	65	vV-Grab	max depth/on ground
HE683_14-6	56° 50.000' N	003° 19.917' E	09.05.2026	12:49:53	65	MUC	max depth/on ground
HE683_14-6	56° 50.004' N	003° 19.921' E	09.05.2026	12:55:14	65	MUC	station end
HE683_15-1	56° 59.965' N	003° 20.001' E	09.05.2026	14:07:24	64	Secchi	station start
HE683_15-1	56° 59.966' N	003° 20.000' E	09.05.2026	14:07:48	63	Secchi	in the water
HE683_15-1	56° 59.967' N	003° 20.000' E	09.05.2026	14:08:19	64	Secchi	on deck
HE683_15-2	56° 59.967' N	003° 20.000' E	09.05.2026	14:08:37	64	Plankton Net	in the water
HE683_15-2	56° 59.966' N	003° 19.997' E	09.05.2026	14:09:14	63	Plankton Net	on deck
HE683_15-3	56° 59.963' N	003° 19.989' E	09.05.2026	14:15:34	64	CTD	max depth/on ground
HE683_15-4	56° 59.969' N	003° 20.030' E	09.05.2026	14:24:28	64	BWS	in the water
HE683_15-4	56° 59.976' N	003° 20.021' E	09.05.2026	14:37:44	64	BWS	on deck
HE683_15-5	56° 59.977' N	003° 20.023' E	09.05.2026	14:42:02	65	vV-Grab	max depth/on ground

Station No.	Latitude	Longitude	Date	Time [UTC]	Water Depth [m]	Device	Action
HE683_15-6	56° 59.970' N	003° 20.026' E	09.05.2026	14:53:17	64	MUC	max depth/on ground
HE683_15-6	56° 59.975' N	003° 20.020' E	09.05.2026	14:54:26	64	MUC	station end
HE683_16-1	56° 59.875' N	003° 20.103' E	09.05.2026	15:06:37	64	Multibeam	station start
HE683_16-1	56° 59.846' N	003° 19.995' E	09.05.2026	15:07:24	64	Multibeam	profile start
HE683_16-1	56° 19.998' N	003° 10.004' E	10.05.2026	05:21:20	68	Multibeam	profile end
HE683_16-1	56° 20.003' N	003° 10.001' E	10.05.2026	05:21:26	69	Multibeam	station end
HE683_17-1	56° 19.991' N	003° 09.965' E	10.05.2026	05:55:21	69	Secchi	station start
HE683_17-1	56° 19.996' N	003° 09.962' E	10.05.2026	05:57:53	69	Secchi	in the water
HE683_17-1	56° 20.000' N	003° 09.972' E	10.05.2026	06:00:12	68	Secchi	on deck
HE683_17-2	56° 20.000' N	003° 09.994' E	10.05.2026	06:03:32	69	Plankton Net	in the water
HE683_17-2	56° 20.002' N	003° 09.998' E	10.05.2026	06:05:17	70	Plankton Net	on deck
HE683_17-3	56° 19.993' N	003° 09.996' E	10.05.2026	06:13:42	69	CTD	max depth/on ground
HE683_17-3	56° 19.992' N	003° 09.977' E	10.05.2026	06:19:37	69	CTD	on deck
HE683_17-4	56° 19.991' N	003° 09.948' E	10.05.2026	06:23:58	70	BWS	in the water
HE683_17-4	56° 20.004' N	003° 09.926' E	10.05.2026	06:37:38	69	BWS	on deck
HE683_17-5	56° 19.997' N	003° 09.933' E	10.05.2026	06:41:59	69	vV-Grab	max depth/on ground
HE683_17-6	56° 20.003' N	003° 09.926' E	10.05.2026	06:53:11	69	MUC	max depth/on ground
HE683_17-6	56° 20.004' N	003° 09.907' E	10.05.2026	07:00:01	69	MUC	station end
HE683_18-1	56° 29.641' N	003° 10.002' E	10.05.2026	08:15:21	69	Secchi	station start
HE683_18-1	56° 29.686' N	003° 09.980' E	10.05.2026	08:19:25	68	Secchi	in the water
HE683_18-1	56° 29.692' N	003° 09.953' E	10.05.2026	08:22:15	69	Secchi	on deck
HE683_18-2	56° 29.692' N	003° 09.951' E	10.05.2026	08:23:42	69	Plankton Net	in the water
HE683_18-2	56° 29.691' N	003° 09.956' E	10.05.2026	08:24:53	68	Plankton Net	on deck
HE683_18-3	56° 29.689' N	003° 09.946' E	10.05.2026	08:32:10	69	CTD	max depth/on ground
HE683_18-3	56° 29.698' N	003° 09.926' E	10.05.2026	08:38:57	68	CTD	on deck
HE683_18-4	56° 29.700' N	003° 09.922' E	10.05.2026	08:42:38	69	BWS	in the water
HE683_18-4	56° 29.696' N	003° 09.912' E	10.05.2026	08:54:29	69	BWS	on deck
HE683_18-5	56° 29.703' N	003° 09.908' E	10.05.2026	09:00:36	69	BWS	in the water
HE683_18-5	56° 29.708' N	003° 09.921' E	10.05.2026	09:10:49	68	BWS	on deck
HE683_18-6	56° 29.714' N	003° 09.919' E	10.05.2026	09:14:44	68	vV-Grab	max depth/on ground
HE683_18-7	56° 29.711' N	003° 09.927' E	10.05.2026	09:24:32	69	MUC	max depth/on ground
HE683_18-7	56° 29.700' N	003° 09.923' E	10.05.2026	09:33:55	68	MUC	max depth/on ground
HE683_18-7	56° 29.699' N	003° 09.945' E	10.05.2026	09:40:34	68	MUC	station end
HE683_19-1	56° 40.543' N	003° 10.014' E	10.05.2026	11:05:17	63	MUC	station start
HE683_19-1	56° 40.542' N	003° 10.003' E	10.05.2026	11:10:23	65	MUC	max depth/on ground
HE683_19-2	56° 40.681' N	003° 10.019' E	10.05.2026	11:24:04	65	Secchi	in the water
HE683_19-2	56° 40.680' N	003° 10.012' E	10.05.2026	11:27:43	65	Secchi	on deck
HE683_19-3	56° 40.679' N	003° 10.011' E	10.05.2026	11:28:00	64	Plankton Net	in the water
HE683_19-3	56° 40.673' N	003° 10.011' E	10.05.2026	11:30:00	64	Plankton Net	on deck
HE683_19-4	56° 40.679' N	003° 10.025' E	10.05.2026	11:36:19	66	CTD	max depth/on ground
HE683_19-5	56° 40.705' N	003° 10.041' E	10.05.2026	11:45:50	64	BWS	in the water
HE683_19-5	56° 40.709' N	003° 10.017' E	10.05.2026	11:57:15	65	BWS	on deck
HE683_19-6	56° 40.730' N	003° 10.029' E	10.05.2026	12:00:34	65	vV-Grab	max depth/on ground
HE683_19-6	56° 40.764' N	003° 10.050' E	10.05.2026	12:05:35	65	vV-Grab	station end
HE683_20-1	56° 49.971' N	003° 10.047' E	10.05.2026	13:10:22	61	Secchi	station start
HE683_20-1	56° 50.011' N	003° 10.046' E	10.05.2026	13:13:40	61	Secchi	in the water

Station No.	**Latitude**	**Longitude**	**Date**	**Time [UTC]**	**Water Depth [m]**	**Device**	**Action**
HE683_20-1	56° 50.011' N	003° 10.043' E	10.05.2026	13:14:38	62	Secchi	on deck
HE683_20-2	56° 50.011' N	003° 10.043' E	10.05.2026	13:14:54	63	Plankton Net	in the water
HE683_20-2	56° 50.010' N	003° 10.040' E	10.05.2026	13:15:29	62	Plankton Net	on deck
HE683_20-3	56° 49.996' N	003° 10.013' E	10.05.2026	13:23:58	63	CTD	max depth/on ground
HE683_20-4	56° 49.997' N	003° 10.101' E	10.05.2026	13:31:39	62	BWS	in the water
HE683_20-4	56° 50.004' N	003° 10.130' E	10.05.2026	13:42:59	63	BWS	on deck
HE683_20-5	56° 50.011' N	003° 10.175' E	10.05.2026	13:46:17	63	vV-Grab	max depth/on ground
HE683_20-6	56° 50.066' N	003° 10.287' E	10.05.2026	13:58:36	63	MUC	max depth/on ground
HE683_20-6	56° 50.081' N	003° 10.306' E	10.05.2026	14:00:58	63	MUC	station end
HE683_21-1	56° 50.114' N	003° 10.512' E	10.05.2026	14:07:56	61	Multibeam	station start
HE683_21-1	56° 50.477' N	003° 10.078' E	10.05.2026	14:14:01	63	Multibeam	profile start
HE683_21-1	56° 20.429' N	004° 08.321' E	11.05.2026	01:17:58	65	Multibeam	profile end
HE683_21-1	56° 20.277' N	004° 08.546' E	11.05.2026	01:20:00	65	Multibeam	station end
HE683_22-1	54° 40.698' N	007° 52.828' E	11.05.2026	18:00:22	12	Multibeam	station start
HE683_22-1	54° 39.977' N	007° 53.699' E	11.05.2026	18:09:53	12	Multibeam	profile start
HE683_22-1	54° 14.668' N	008° 09.299' E	12.05.2026	05:24:08	13	Multibeam	profile end
HE683_22-1	54° 14.657' N	008° 09.298' E	12.05.2026	05:24:14	12	Multibeam	station end
HE683_0	53° 31.918' N	008° 34.677' E	12.05.2026	11:38:42	3	DWD	station end
HE683_0	53° 53.324' N	008° 04.099' E	12.05.2026	08:03:01	16	TSG	station end
HE683_0	56° 20.602' N	004° 08.258' E	11.05.2026	01:16:00	66	ADCP 600 kHz	station end
HE683_0	56° 20.602' N	004° 08.258' E	11.05.2026	01:16:00	66	SES2000	station end

7 Data and Sample Storage and Availability

The hydrographic raw data collected by the CTD and the data from the thermosalinograph will be uploaded to the PANGAEA database. Data from analysis of filtration and sediment samples will be shared on PANGAEA later on. The hydroacoustic data (MULTIBEAM, PARASOUND) will be transferred to the Norwegian authorities and will not be published until permission. Hydroacoustic and ADCP data will be shared upon request. Contact information can be found in Table 7.1 below (see also Felden et al., 2023).

Table 7.1 Overview of data availability.

Type	**Database**	**Contact**
Hydrography data (CTD & TSG)	PANGAEA	niko.lahajnar@uni-hamburg.de
Sediment data (vVG, MUC)	PANGAEA	niko.lahajnar@uni-hamburg.de
MULTIBEAM, PARASOUND and ADCP data	Upon request	thomas.luedmann@uni-hamburg.de

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9 Abbreviations

ADCP – Acoustic Doppler Current Profiler

APSTEIN – Plankton net (25 µm mesh)

AWZ – Ausschließliche Wirtschaftszone (German term for EEZ)

BWS – Bottom Water Sampler

CTD – Conductivity, Temperature, Depth

DFG – Deutsche Forschungsgemeinschaft

EEZ – Exclusive Economic Zone

EM712 – Multibeam echosounder model (Kongsberg EM712)

FS – Forschungsschiff (research vessel)

HE – HEINCKE Expedition (cruise numbering prefix)

IfGeol – Institute for Geology (University of Hamburg)

KDM – Konsortium Deutsche Meeresforschung

MBES – Multibeam Echosounder

MUC – MULTICORER

NISKIN – Standard oceanographic water sampling bottle

OSPAR – Convention for the Protection of the Marine Environment of the North-East Atlantic

RV – Research Vessel

SBP / SES – Sub-Bottom Profiler (INNOMAR SES system)

TSG – Thermosalinograph

UHH – Universität Hamburg

UTC – Coordinated Universal Time

vVG – van-Veen Grab

10 Acknowledgements

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11 Appendices

11.1 SECCHI Disk

Table 11.1 Detailed overview of SECCHI sampling.

Cruise	Station	Date	Time	Lon	Lat	Bot. Depth	Secchi Depth
		day/mon/yr	[UTC]	(dE)	(dN)	[m]	[m]
HE683	01	07.05.2026	10:13	003°49.95' E	56°19.99' N	73.8	16
HE683	02	07.05.2026	13:04	003°50.00' E	56°30.01' N	66.7	16
HE683	03	07.05.2026	16:10	003°50.02' E	56°49.97' N	60.5	13
HE683	05	08.05.2026	06:21	003°40.05' E	56°56.99' N	64.0	13
HE683	06	08.05.2026	08:25	003°40.04' E	56°50.00' N	60.8	11
HE683	07	08.05.2026	10:40	003°40.07' E	56°40.01' N	53.5	13
HE683	08	08.05.2026	12:43	003°39.97' E	56°30.00' N	65.4	16
HE683	09	08.05.2026	15:44	003°39.99' E	56°15.02' N	69.0	16
HE683	11	09.05.2026	06:05	003°19.99'E	56°19.99'N	67.2	17
HE683	12	09.05.2026	08:07	003°20.32'E	56°30.03'N	66.4	17
HE683	13	09.05.2026	10:13	003°20.02'E	56°40.00'N	62.4	17
HE683	14	09.05.2026	12:03	003°19.90'E	56°49.98'N	64.6	12
HE683	15	09.05.2026	14:11	003°20.00'E	56°59.97'N	63.0	6
HE683	17	10.05.2026	06:06	003°09.99'E	56°20.01'N	69.1	11
HE683	18	10.05.2026	08:22	003°09.98'E	56°29.69'N	68.3	14
HE683	19	10.05.2026	11:33	003°10.01'E	56°40.68'N	64.5	11
HE683	20	10.05.2026	13:20	003°10.02'E	56°50.01'N	62.0	7

11.2 APSTEIN Net

Table 11.2 Detailed overview of APSTEIN net sampling, with descriptions of the fauna at station.

Cruise	Station	Date	Time	Lon	Lat	Bot. Depth	Depth	Description
		mon/day/yr	[UTC]	(dE)	(dN)	[m]	[m]	
HE683	1	05/07/2026	10:08	003°49.95' E	56°19.99' N	71	5	Diatomeen: *Pseudo-nitzschia serinta*, *Coscinodiscus*, (little occurence of life)
HE683	2	05/07/2026	12:54	003°50.00' E	56°30.01' N	63	5	Diatomeen: *Coscinodiscus*, Crustacea: *Calocalanus* sp. (Copepoda)
HE683	3	05/07/2026	16:05	003°50.02' E	56°49.97' N	56	5	Echinodermata: *Spatangus* sp. (very high abundance), Annelida (Polychaeta) *Nectochaes*
HE683	5	05/08/2026	06:05	003°40.05' E	56°56.99' N	64	5	Echinodermata: *Late pluteus* (high abundance)
HE683	6	05/08/2026	08:20	003°40.04' E	56°50.00' N	57	5	Siphonophora**:** *Lensia subtilis***,** Crustacea: *Calanus* sp. (Copepoda)
HE683	7	05/08/2026	10:35	003°40.07' E	56°40.01' N	53	5	Diatomeen, Crustacea: *Calanus* sp.
HE683	8	05/08/2026	12:38	003°39.97' E	56°30.00' N	65	5	Crustacea: *Calanus* sp. (Copepoda) (high abundance), Echinodermata: *Late pluteus* (high abundance)
HE683	9	05/08/2026	15:30	003°39.99' E	56°15.02' N	69	5	Crustacea: *Calanus* sp. (Copepoda) (very high abundance), Echinodermata: *Late pluteus* (high abundance),
HE683	11	05/09/2026	05:59	003°19.99'E	56°19.99'N	67	5	Echinodermata: *Spatangus* sp. *pluteus* (very high abundance), Copepoda, Crustacea: *Calanus finmarcus* (Copepoda)
HE683	12	05/09/2026	08:05	003°20.32'E	56°30.03'N	66	5	Echinodermata: *Spatangus* sp. *pluteus*, Crustacea: *Calocalanus* (Copepoda), (little occurence of life)
HE683	13	05/09/2026	10:10	003°20.02'E	56°40.00'N	62	5	Diatomeen: *Coscinodiscus* spp., Echinodermata: *Spatangus* sp. *pluteus*, (little occurence of life)
HE683	14	05/09/2026	12:11	003°19.90'E	56°49.98'N	64	5	Diatomeen, Echinodermata: *Spatangus* sp. *pluteus* (very high abundance), Crustacea: *Calocalanus*, *Acartia*, *Calanus* (Copepoda)
HE683	15	05/09/2026	14:08	003°20.00'E	56°59.97'N	64	5	Diatomeen: *Coscinodiscus*, Echinodermata: *Late pluteus*, Copepoda (mostly)

Cruise	**Station**	**Date**	**Time**	**Lon**	**Lat**	**Bot. Depth**	**Depth**	**Description**
		mon/day/yr	[UTC]	(dE)	(dN)	[m]	[m]	
HE683	17	05/10/2026	06:03	003°09.99'E	56°20.01'N	69	5	Crustacea: *Calocalanus* sp., *Monstrilla helgolandica* (Copepoda), Echinodermata: *Spatangus* sp. *pluteus* (very high abundance)
HE683	18	05/10/2026	08:23	003°09.98'E	56°29.69'N	69	5	Crustacea: *Calocalanus* sp., Echinodermata: *Spatangus* sp. (very high abundance)
HE683	19	05/10/2026	11:28	003°10.01'E	56°40.68'N	64	5	Crustacea: *Calocalanus* sp., Echinodermata: *Spatangus* sp. (high abundance)
HE683	20	05/10/2026	13:14	003°10.02'E	56°50.01'N	63	5	Echinodermat: *Spatangus* sp. *pluteus*, Copepoda (very high abundance)

11.3 CTD Rosette

Table 11.3 Detailed overview of CTD sampling with bottom depth and filtered amount.

Cruise	Station	Type	Date	Time	Longitude	Lattitude	Bot. Depth	Sample Depth	Filtrated Amount	Comment
			day/mon/yr	[UTC]	[dE]	[dN]	[m]	[m]	[l]	
HE683	1	CTD	07.05.2026	10:13	003°49.95' E	56°19.99' N	73.80	69.60	10.00	
HE683	1	CTD	07.05.2026	10:13	003°49.95' E	56°19.99' N	73.80	30.40	9.00	
HE683	1	CTD	07.05.2026	10:13	003°49.95' E	56°19.99' N	73.80	2.30	6.00	
HE683	2	CTD	07.05.2026	13:04	003°50.00' E	56°30.01' N	66.70	63.00	9.00	
HE683	2	CTD	07.05.2026	13:04	003°50.00' E	56°30.01' N	66.70	32.70	10.00	
HE683	2	CTD	07.05.2026	13:04	003°50.00' E	56°30.01' N	66.70	3.20	6.00	
HE683	3	CTD	07.05.2026	16:10	003°50.02' E	56°49.97' N	60.50	57.70	9.00	
HE683	3	CTD	07.05.2026	16:10	003°50.02' E	56°49.97' N	60.50	29.00	8.00	
HE683	3	CTD	07.05.2026	16:10	003°50.02' E	56°49.97' N	60.50	3.00	7.00	
HE683	5	CTD	08.05.2026	06:21	003°40.05' E	56°56.99' N	64.00	63.50	10.00	
HE683	5	CTD	08.05.2026	06:21	003°40.05' E	56°56.99' N	64.00	30.40	7.00	Fluorescence max.
HE683	5	CTD	08.05.2026	06:21	003°40.05' E	56°56.99' N	64.00	5.40	9.00	
HE683	6	CTD	08.05.2026	08:25	003°40.04' E	56°50.00' N	60.80	57.20	9.00	
HE683	6	CTD	08.05.2026	08:25	003°40.04' E	56°50.00' N	60.80	23.00	8.00	Fluorescence max.
HE683	6	CTD	08.05.2026	08:25	003°40.04' E	56°50.00' N	60.80	6.20	9.00	
HE683	7	CTD	08.05.2026	10:40	003°40.07' E	56°40.01' N	53.50	51.80	9.00	
HE683	7	CTD	08.05.2026	10:40	003°40.07' E	56°40.01' N	53.50	30.70	7.00	Fluorescence max.
HE683	7	CTD	08.05.2026	10:40	003°40.07' E	56°40.01' N	53.50	6.00	8.00	
HE683	8	CTD	08.05.2026	12:43	003°39.97' E	56°30.00' N	65.40	64.10	8.00	
HE683	8	CTD	08.05.2026	12:43	003°39.97' E	56°30.00' N	65.40	34.00	7.00	Fluorescence max.
HE683	8	CTD	08.05.2026	12:43	003°39.97' E	56°30.00' N	65.40	4.20	10.00	

Cruise	**Station**	**Type**	**Date**	**Time**	**Longitude**	**Lattitude**	**Bot. Depth**	**Sample Depth**	**Filtrated Amount**	**Comment**
			day/mon/yr	[UTC]	[dE]	[dN]	[m]	[m]	[l]	
HE683	9	CTD	08.05.2026	15:44	003°39.99' E	56°15.02' N	69.00	67.40	10.00	
HE683	9	CTD	08.05.2026	15:44	003°39.99' E	56°15.02' N	69.00	34.60	8.00	Fluorescence max.
HE683	9	CTD	08.05.2026	15:44	003°39.99' E	56°15.02' N	69.00	5.30	8.00	
HE683	11	CTD	09.05.2026	06:05	003°19.99'E	56°19.99'N	67.20	66.50	8.00	
HE683	11	CTD	09.05.2026	06:05	003°19.99'E	56°19.99'N	67.20	33.60	6.00	Fluorescence max.
HE683	11	CTD	09.05.2026	06:05	003°19.99'E	56°19.99'N	67.20	3.30	7.00	
HE683	12	CTD	09.05.2026	08:07	003°20.32'E	56°30.03'N	66.40	65.00	7.00	
HE683	12	CTD	09.05.2026	08:07	003°20.32'E	56°30.03'N	66.40	35.70	7.00	Fluorescence max.
HE683	12	CTD	09.05.2026	08:07	003°20.32'E	56°30.03'N	66.40	3.00	9.00	
HE683	13	CTD	09.05.2026	10:13	003°20.02'E	56°40.00'N	62.40	61.20	8.00	
HE683	13	CTD	09.05.2026	10:13	003°20.02'E	56°40.00'N	62.40	37.70	7.00	Fluorescence max.
HE683	13	CTD	09.05.2026	10:13	003°20.02'E	56°40.00'N	62.40	2.70	8.00	
HE683	14	CTD	09.05.2026	12:03	003°19.90'E	56°49.98'N	64.60	62.70	7.00	
HE683	14	CTD	09.05.2026	12:03	003°19.90'E	56°49.98'N	64.60	38.50	6.00	Fluorescence max.
HE683	14	CTD	09.05.2026	12:03	003°19.90'E	56°49.98'N	64.60	4.60	7.00	
HE683	15	CTD	09.05.2026	14:11	003°20.00'E	56°59.97'N	63.00	60.50	7.00	
HE683	15	CTD	09.05.2026	14:11	003°20.00'E	56°59.97'N	63.00	32.70	7.00	Fluorescence max.
HE683	15	CTD	09.05.2026	14:11	003°20.00'E	56°59.97'N	63.00	5.50	8.00	
HE683	17	CTD	10.05.2026	06:06	003°09.99'E	56°20.01'N	69.10	67.00	9.00	
HE683	17	CTD	10.05.2026	06:06	003°09.99'E	56°20.01'N	69.10	34.00	10.00	
HE683	17	CTD	10.05.2026	06:06	003°09.99'E	56°20.01'N	69.10	6.00	9.00	
HE683	18	CTD	10.05.2026	08:22	003°09.98'E	56°29.69'N	68.30	66.70	8.00	
HE683	18	CTD	10.05.2026	08:22	003°09.98'E	56°29.69'N	68.30	32.80	8.00	
HE683	18	CTD	10.05.2026	08:22	003°09.98'E	56°29.69'N	68.30	6.30	8.50	

Cruise	Station	Type	Date	Time	Longitude	Lattitude	Bot. Depth	Sample Depth	Filtrated Amount	Comment
			day/mon/yr	[UTC]	[dE]	[dN]	[m]	[m]	[l]	
HE683	19	CTD	10.05.2026	11:33	003°10.01'E	56°40.68'N	64.50	60.00	10.00	
HE683	19	CTD	10.05.2026	11:33	003°10.01'E	56°40.68'N	64.50	34.00	9.00	
HE683	19	CTD	10.05.2026	11:33	003°10.01'E	56°40.68'N	64.50	5.00	10.00	
HE683	20	CTD	10.05.2026	13:20	003°10.02'E	56°50.01'N	62.00	57.50	12.00	
HE683	20	CTD	10.05.2026	13:20	003°10.02'E	56°50.01'N	62.00	36.00	7.00	
HE683	20	CTD	10.05.2026	13:20	003°10.02'E	56°50.01'N	62.00	5.00	8.00	

11.4 Bottom Water Sampler (BWS)

Table 11.4 List of the location of stations and sampled depth above the seafloor from the BWS.

Cruise	Station	Type	Date	Time	Longitude	Lattitude	Waterdepth	Depth o.G.	Filtr. Amount	Filter empty	Comment
			day/mon/yr	[UTC]	[°E]	[°N]	[m]	[cm]	[l]	[mg]	
HE683	1	BWS	07.05.2025	10:30	003°49.95'E	56°19.99'N	70.90	103.50	4.00	123.81	
HE683	1	BWS	07.05.2025	10:30	003°49.95'E	56°19.99'N	70.90	59.50	4.00	130.70	
HE683	1	BWS	07.05.2025	10:30	003°49.95'E	56°19.99'N	70.90	28.00	4.00	125.07	
HE683	2	BWS	07.05.2025	13:15	003°49.99'E	56°30.01'N	63.30	103.50	5.00	128.89	
HE683	2	BWS	07.05.2025	13:15	003°49.99'E	56°30.01'N	63.30	59.50	5.00	129.99	
HE683	2	BWS	07.05.2025	13:15	003°49.99'E	56°30.01'N	63.30	28.00	5.00	134.08	
HE683	3	BWS	07.05.2025	16:27	003°50.01'	56°49.98'N	57.00	103.50	5.00	131.45	
HE683	3	BWS	07.05.2025	16:27	003°50.01'	56°49.98'N	57.00	59.50	5.00	129.11	
HE683	3	BWS	07.05.2025	16:27	003°50.01'	56°49.98'N	57.00	28.00	5.00	128.69	
HE683	5	BWS	08.05.2026	06:22	003°40.04'E	59°59.95'N	63.40	103.50	4.50	127.13	
HE683	5	BWS	08.05.2026	06:22	003°40.04'E	59°59.95'N	63.40	59.50	4.50	126.64	
HE683	5	BWS	08.05.2026	06:22	003°40.04'E	59°59.95'N	63.40	28.00	4.00	133.20	
HE683	6	BWS	08.05.2026	08:38	-	-	-	103.50	-	-	BWS failed
HE683	6	BWS	08.05.2026	08:38	-	-	-	59.50	-	-	
HE683	6	BWS	08.05.2026	08:38	-	-	-	28.00	-	-	
HE683	7	BWS	08.05.2026	-	-	-	-	103.50	-	-	BWS failed
HE683	7	BWS	08.05.2026	-	-	-	-	59.50	-	-	
HE683	7	BWS	08.05.2026	-	-	-	-	28.00	-	-	
HE683	8	BWS	08.05.2026	12:56	003°39.96'E	56°30.00'N	65.50	103.50	4.60	132.30	
HE683	8	BWS	08.05.2026	12:56	003°39.96'E	56°30.00'N	65.50	59.50	4.00	131.61	
HE683	8	BWS	08.05.2026	12:56	003°39.96'E	56°30.00'N	65.50	28.00	4.50	125.81	
HE683	9	BWS	08.05.2026	15:48	003°40.00'E	56°15.02'N	69.00	103.50	4.20	129.10	

Cruise	Station	Type	Date	Time	Longitude	Lattitude	Waterdepth	Depth o.G.	Filtr. Amount	Filter empty	Comment
			day/mon/yr	[UTC]	[°E]	[°N]	[m]	[cm]	[l]	[mg]	
HE683	9	BWS	08.05.2026	15:48	003°40.00'E	56°15.02'N	69.00	59.50	4.10	125.06	
HE683	9	BWS	08.05.2026	15:48	003°40.00'E	56°15.02'N	69.00	28.00	4.45	126.90	
HE683	11	BWS	09.05.2026	06:00	003°20.01'E	56°20.00'N	67.50	103.50	4.00	131.73	Cast #02
HE683	11	BWS	09.05.2026	06:00	003°20.01'E	56°20.00'N	67.50	59.50	4.80	133.17	
HE683	11	BWS	09.05.2026	06:00	003°20.01'E	56°20.00'N	67.50	28.00	4.63	125.70	
HE683	12	BWS	09.05.2026	08:40	003°20.50'E	56°30.01'E	66.40	103.50	4.63	128.50	Cast #01
HE683	12	BWS	09.05.2026	08:40	003°20.50'E	56°30.01'E	66.40	59.50	4.60	126.21	
HE683	12	BWS	09.05.2026	08:40	003°20.50'E	56°30.01'E	66.40	28.00	4.40	128.49	
HE683	13	BWS	09.05.2026	10:27	003°20.02'E	56°40.00'N	62.50	103.50	5.00	129.48	Cast #02
HE683	13	BWS	09.05.2026	10:27	003°20.02'E	56°40.00'N	62.50	59.50	5.30	125.19	
HE683	13	BWS	09.05.2026	10:27	003°20.02'E	56°40.00'N	62.50	28.00	3.30	126.90	
HE683	14	BWS	09.05.2026	12:10	003°20.00'E	56°49.98'N	64.50	103.50	4.90	133.03	Cast #02
HE683	14	BWS	09.05.2026	12:10	003°20.00'E	56°49.98'N	64.50	59.50	4.60	129.26	
HE683	14	BWS	09.05.2026	12:10	003°20.00'E	56°49.98'N	64.50	28.00	4.20	128.89	
HE683	15	BWS	09.05.2026	14:10	003°19.99'E	56°59.96'N	64.00	103.50	5.25	125.44	
HE683	15	BWS	09.05.2026	14:10	003°19.99'E	56°59.96'N	64.00	59.50	5.50	126.35	
HE683	15	BWS	09.05.2026	14:10	003°19.99'E	56°59.96'N	64.00	28.00	4.00	129.67	
HE683	17	BWS	10.05.2026	06:20	003°09.99'E	56°20.01'N	69.10	103.50	4.25	132.22	Cast #01
HE683	17	BWS	10.05.2026	06:20	003°09.99'E	56°20.01'N	69.10	59.50	4.50	134.23	
HE683	17	BWS	10.05.2026	06:20	003°09.99'E	56°20.01'N	69.10	28.00	4.50	127.98	
HE683	18	BWS	10.05.2026	08:39	003°09.98'E	56°29.69'N	68.30	103.50	5.00	126.08	
HE683	18	BWS	10.05.2026	08:39	003°09.98'E	56°29.69'N	68.30	59.50	6.00	130.06	
HE683	18	BWS	10.05.2026	08:39	003°09.98'E	56°29.69'N	68.30	28.00	4.00	125.99	
HE683	19	BWS	10.05.2026	11:42	003°10.01'E	56°40.68'N	64.50	103.50	4.00	128.44	

Cruise	**Station**	**Type**	**Date**	**Time**	**Longitude**	**Lattitude**	**Waterdepth**	**Depth o.G.**	**Filtr. Amount**	**Filter empty**	**Comment**
			day/mon/yr	[UTC]	[°E]	[°N]	[m]	[cm]	[l]	[mg]	
HE683	19	BWS	10.05.2026	11:42	003°10.01'E	56°40.68'N	64.50	59.50	4.00	132.00	
HE683	19	BWS	10.05.2026	11:42	003°10.01'E	56°40.68'N	64.50	28.00	4.00	128.94	
HE683	20	BWS	10.05.2026	13:29	003°10.02'E	56°50.01'N	62.00	103.50	4.00	126.14	
HE683	20	BWS	10.05.2026	13:29	003°10.02'E	56°50.01'N	62.00	59.50	4.00	125.81	
HE683	20	BWS	10.05.2026	13:29	003°10.02'E	56°50.01'N	62.00	28.00	4.00	126.41	

11.5 VAN-VEEN grab

Table 11.5 Detailed overview of VAN VEEN sampling, including grain sizes, permeability and a short description of the sediment.

Key for Grain size: 1=clay, 2=fine silt, 3=coarse silt, 4=fine sand, 5=middle sand, 6=coarse sand, 7=gravel/rubble

Cruise	Station	Date	Time	Longitude	Latitude	Bot. Depth	Grain Size	Permeabilität	Description
		mon/day/yr	[UTC]	(dE)	(dN)	[m]		[cm s^{-1}]	
HE683	1	07.05.2026	10:48	003°49.95'E	56°19.95'N	70.2	4	0.00029	Total core length: 9 cm: 0-4,5cm 10Y 3/2, fine sand; 4,5-9,5 cm, darker layer with black spots; 7,5Y 3/1 to 6 cm, scattered shell fragments and worms.
HE683	2	07.05.2026	13:32	003°50.03'E	56°29.21'N	63	4.5	0.00136	Total core lenght: 6 cm, no layering, but darker spots visible. darker spots; 10Y 4/2, fine sand. Brighter areas; 5Y 5/6 medium, big shell fragments.
HE683	3	07.05.2026	16:39	003°49.91'E	56°38.60°N	56.7	4.5	0.00384	Total core lenght: 14 cm; 0-7 cm: 5Y 6/4, medium sand to fine sand, 7- 14 cm: 5Y 3/2 fine sand to medium sand, a few mussel shells- some whole mussels and worms.
HE683	5	08.05.2026	06:43	003°40.02' E	56°59.99' N	63.5	4.5	0.00248	Upper layer :5Y 4/6 light brown, lower layer: 5Y 3/2 dark gray-green, bivalve shell fragments
HE683	6	08.05.2026	08:58	003°40.02' E	56°50.00' N	58	4.5	0.00008	Upper layer: 5Y 4/6 light brown, lower layer: 5Y 3/2 dark gray-green, with some large shell fragments of Bivalvia.

Cruise	Station	Date	Time	Longitude	Latitude	Bot. Depth	Grain Size	Permeabilität	Description
		mon/day/yr	[UTC]	(dE)	(dN)	[m]		[cm s^{-1}]	
HE683	7	08.05.2026	11:16	003°40.07' E	56°40.01' N	53	4.5	0.00000	Upper layer: 5Y 4/6 light brown, lower layer: 5Y 3/2 dark gray-green, dark area 5Y 2/1, sulfurous odor, shell fragments of bivalves, sea urchins.
HE683	8	08.05.2026	13:13	003°39.98' E	56°30.00' N	65.8	4.5	0.00120	Upper layer: 5Y 4/6 light brown, lower layer: 5Y 3/1 dark gray-green, faint sulfur odor, shell fragments of bivalves, some of which are very large (up to 10 cm in diameter).
HE683	9	08.05.2026	16:05	003°40.02'E	56°15.01'N	69	4.5	0.00008	Upper layer: 5Y 4/6 light brown, lower layer: 5Y 3/2 dark gray-green, bivalve shell fragments, some large (up to 5 cm in diameter), sea urchins .
HE683	11	09.05.2026	05:55	003° 20.01' E	56° 20.00' N	70.6	4.5	0.00003	Upper layer: 2.5Y 5/4, Lower layer: 5Y 4/1, bivalve shell fragments; sulfurous odor; partially organic.
HE683	12	09.05.2026	08:03	003° 20.53' E	56° 30.03' N	66.4	4.5	0.00646	Upper layer: 5Y 6/4, Lower layer: 5Y 2/4, worms (alive), shell fragments of bivalves; sea urchins; organic material.
HE683	13	09.05.2026	10:07	003° 20.02' E	56° 40.00' N	62.5	4.5	0.00177	Upper layer: 5Y 6/4, lower layer: 5Y 2/4, bivalve shell fragments; partially organic material.

Cruise	**Station**	**Date**	**Time**	**Longitude**	**Latitude**	**Bot. Depth**	**Grain Size**	**Permeabilität**	**Description**
		mon/day/yr	[UTC]	(dE)	(dN)	[m]		[cm s^{-1}]	
HE683	14	09.05.2026	12:10	003° 19.90' E	56° 49.98' N	64.7	4.5	0.00195	Upper layer: 2.5Y 5/4, Lower layer: 5Y 4/1, many bivalve shell fragments; sulfurous odor; partially organic (greasy texture).
HE683	15	09.05.2026	14:07	003° 20.00' E	56° 59.97' N	63.7	4.5	0.00161	Upper layer: 5Y 6/4, Lower layer: 5Y 3/2, bivalve shell fragments, whole bivalves; sulfurous odor; little organic matter.
HE683	17	10.05.2026	06:35	003° 10.00' E	56° 20.01' N	69.1	4.5	0.00095	Upper Layer: 2.5y 5/3, Lower Layer: 2.5y 3/1, Shell Fragments.
HE683	18	10.05.2026	09:11	003° 09.96' E	56° 29.69' N	68	4.5	0.00064	Upper Layer: 2.5y 5/6, Lower Layer: 2.5y 3/1, shell fragments.
HE683	19	10.05.2026	11:58	003° 10.01' E	56° 40.68' N	64.5	4.5	0.00088	Upper Layer: 2.5y 5/6, Lower Layer: 2.5y 3/1, shell fragments.
HE683	20	10.05.2026	13:43	003° 10.02' E	56° 50.01' N	62	4.5	0.00257	Upper Layer: 5y 6/4, Lower Layer: 5y 2/4, Large shell, shell fragments, organic matter in a cohesive matrix, many shell fragments.

11.6 MULTICORER (MUC)

Table 11.6 Detailed overview of MUC sampling, including penetration depth and descriptions of the aquired cores.

Key for Grain size: 1=clay, 2=fine silt, 3=coarse silt, 4=fine sand, 5=middle sand, 6=coarse sand, 7=gravel/rubble

Cruise	Station	Date	Time	Longitude	Lattitude	Bot. Depth	Sample Depth	Penetration depth	Grain Size	Description
		day/mon/yr	[UTC]	(dE)	(dN)	[m]	[cm]	[m]		
HE683	1	07.05.2026	11:30	003°49.95'E	56°19.99'N	70.7	0-5	0.19	4	0–5 cm: light brown, 5Y6/4; 5–13 cm: dark gray, 5Y4/2; 13–19 cm: light gray, 5Y4/3; fS.
HE683	1	07.05.2026	11:30	003°49.95'E	56°19.99'N	70.7	0-2	0.19	4	0–5 cm: light brown, 5Y6/4; 5–13 cm: dark gray, 5Y4/2; 13–19 cm: light gray, 5Y4/3; fS.
HE683	2	07.05.2026	14:00	003°49.99'E	56°30.01'N	63.5	0-5	0.13	4	0–5 cm: light brown, 5Y6/4, fS; 5–9 cm: dark green-gray, 5Y4/2, fS; shell fragments.
HE683	2	07.05.2026	14:00	003°49.99'E	56°30.01'N	63.5	0-2	0.13	4	0–5 cm: light brown, 5Y6/4, fS; 5–9 cm: dark green-gray, 5Y4/2, fS; shell fragments.
HE683	3	07.05.2026	16:50	003°50.03'E	56°49.98'N	57	0-2	0.18	4	0–6 cm: light brown, 5Y6/4, fS; 6–13 cm: gray-green, 5Y4/3, fS; shell fragments.
HE683	3	07.05.2026	16:50	003°50.03'E	56°49.98'N	57	0-5	0.18	4	0–6 cm: light brown, 5Y6/4, fS; 6–13 cm: gray-green, 5Y4/3, fS; shell fragments.
HE683	5	08.05.2026	6:55	003°40.04'E	56°59.95'N	63	0-5	0.14	4	Surface: Organic, 0–7 cm fine sand, colour: 2.5 Y6/4; 8–13 fine sand,

Cruise	Station	Date	Time	Longitude	Lattitude	Bot. Depth	Sample Depth	Penetration depth	Grain Size	Description
		day/mon/yr	[UTC]	(dE)	(dN)	[m]	[cm]	[m]		
										colour: 5Y4/1, black streaks in the lower part, shell fragments.
HE683	5	08.05.2026	6:55	003°40.04'E	56°59.95'N	63	0-2	0.14	4	Surface: Organic, 0–7 cm fine sand, colour: 2.5 Y6/4; 8–13 fine sand, colour: 5Y4/1, black streaks in the lower part, shell fragments.
HE683	6	08.05.2026	9:05	003°40.02'E	56°50.00'N	57.5	0-5	0.14	4	Surface: Organic material and shell fragments, 0–14 cm fine sand in various colours; 0–8 cm: 2.5Y6/4, 9–14 cm: 5Y4/1; both contain black streaks and shell fragments (7–13 cm).
HE683	6	08.05.2026	9:05	003°40.02'E	56°50.00'N	57.5	0-2	0.14	4	Surface: Organic material and shell fragments, 0–14 cm fine sand in various colours; 0–8 cm: 2.5Y6/4, 9–14 cm: 5Y4/1; both contain black streaks and shell fragments (7–13 cm).
HE683	7	08.05.2026	11:26	003°40.02'E	56°40.01'N	53	0-5	0.04	4	Surface: OM and broken shells, fine sand interspersed with black silt; benthic organisms such as worms visible; colour of fine sand: 2.5Y6/4; colour of silt: 7.5Y3/2.
HE683	7	08.05.2026	11:26	003°40.02'E	56°40.01'N	53	0-2	0.04	4	Surface: Organic material and broken shells, fine sand interspersed

Cruise	Station	Date	Time	Longitude	Lattitude	Bot. Depth	Sample Depth	Penetration depth	Grain Size	Description
		day/mon/yr	[UTC]	(dE)	(dN)	[m]	[cm]	[m]		
										with black silt; benthic organisms such as worms visible; colour of fine sand: 2.5Y6/4; colour of silt: 7.5Y3/2.
HE683	8	08.05.2026	13:18	003°39.98´E	56°30.00'N	65.4	0-5	0.08	4	Surface: Organic material and shell fragments, 0–4 cm fine sand; Colour: 2.5Y6/4, with shell fragments and streaks; 4–8 cm fine sand, darker colour: 5Y6/3.
HE683	8	08.05.2026	13:18	003°39.98´E	56°30.00'N	65.4	0-2	0.08	4	Surface: Organic material and shell fragments, 0–4 cm fine sand; Colour: 2.5Y6/4, with shell fragments and streaks; 4–8 cm fine sand, darker colour: 5Y6/3.
HE683	9	08.05.2026	16:10	003°39.98'E	56°15.02'N	69	0-5	0.1	4	Surface: Organic material and shell fragments, 0–3 cm fine sand; Colour: 2.5y 6/4, 3–10 cm fine sand N 3/0, black streaks between 2 and 10 cm.
HE683	9	08.05.2026	16:10	003°39.98'E	56°15.02'N	69	0-2	0.1	4	Surface: Organic material and shell fragments, 0–3 cm fine sand; Colour: 2.5y 6/4, 3–10 cm fine sand N 3/0, black streaks between 2 and 10 cm.

Cruise	Station	Date	Time	Longitude	Lattitude	Bot. Depth	Sample Depth	Penetration depth	Grain Size	Description
		day/mon/yr	[UTC]	(dE)	(dN)	[m]	[cm]	[m]		
HE683	11	09.05.2026	6:43	003°20.10'E	56°20.00'N	70.6	0-5	0.154	4	Surface: a few shell fragments on the surface, 0–5.2 cm fine sand, colour 2.5y, 5/4; 5.2–15.2 fine sand, 2.5y, 3/1.
HE683	11	09.05.2026	6:43	003°20.10'E	56°20.00'N	70.6	0-2	0.154	4	Surface: a few shell fragments on the surface, 0–5.2 cm fine sand, colour 2.5y, 5/4; 5.2–15.2 fine sand, 2.5y, 3/1.
HE683	12	09.05.2026	8:45	003°20.53'E	56°30.03'N	66.5	0-5	14.5	4	0–6 cm 2.5y 5/4, 6–10 cm 2.5y 3/1, 10–14.5 2.5y 4/2 shell fragments.
HE683	12	09.05.2026	8:45	003°20.53'E	56°30.03'N	66.5	0-2	14.5	4	0–6 cm 2.5y 5/4, 6–10 cm 2.5y 3/1, 10–14.5 2.5y 4/2 shell fragments.
HE683	13	09.05.2026	10:48	003°20.02'E	56°40.00'N	62.5	0-5	8.5	4	0–3.5 cm: silt, 2.5 y 5/3, shell fragments throughout, silt 2.5 y 3/2
HE683	13	09.05.2026	10:48	003°20.02'E	56°40.00'N	62.5	0-2	8.5	4	0–3.5 cm silt 2.5y 5/3, silt 2.5y 3/2.
HE683	14	09.05.2026	12:45	003°19.94'E	56°49.98'N	64.4	0-5	13	4	0–4.5 cm: 2.5 y 4/4, 4.5–13 cm: 2.5 y 4/2 silt.
HE683	14	09.05.2026	12:45	003°19.94'E	56°49.98'N	64.4	0-2	13	4	0-4.5 cm: 2.5y 4/4, 4.5-13 cm: 2.5y 4/2.
HE683	15	09.05.2026	14:44	003°10.00'E	56°39.97'N	64	0-5	15	4	0-4 cm: 2.5y 4/2, 4-15cm: 2.5y 4/1.
HE683	15	09.05.2026	14:44	003°10.00'E	56°39.97'N	64	0-2	15	4	0-4cm: 2.5y 4/2, 4-15cm 2.5y 4/1.
HE683	17	10.05.2026	6:45	003°09.93'E	56°19.99'N	69.1	0-5	0.16	4,5	Layer: 0–4 cm: 2.5Y 5/6 fine to medium sand; 4–8.5 cm: 2.5Y 5/3 fine to medium sand; 8.5–16 cm:

Cruise	**Station**	**Date**	**Time**	**Longitude**	**Lattitude**	**Bot. Depth**	**Sample Depth**	**Penetration depth**	**Grain Size**	**Description**
		day/mon/yr	[UTC]	(dE)	(dN)	[m]	[cm]	[m]		
										2.5Y 4/2 silt; shell fragments on the surface.
HE683	17	10.05.2026	6:45	003°09.93'E	56°19.99'N	69.1	0-2	0.16	4,5	Layer: 0–4 cm: 2.5Y 5/6 fine to medium sand; 4–8.5 cm: 2.5Y 5/3 fine to medium sand; 8.5–16 cm: 2.5Y 4/2 silt; shell fragments on the surface.
HE683	18	10.05.2026	9:19	003°09.96	56°29.69'N	68	0-5	0.7	4	No layering visible: fine sand, 2.5Y 5/3; some dark flecks, 5Y 3/2; orange areas: 2.5Y 5/6; the first attempt did not trigger a reaction; the second attempt yielded only one core.
HE683	18	10.05.2026	9:19	003°09.96	56°29.69'N	68	0-2	0.7	4	No layering visible: fine sand, 2.5Y 5/3; some dark flecks, 5Y 3/2; orange areas: 2.5Y 5/6; the first attempt did not trigger a reaction; the second attempt yielded only one core.
HE683	19	10.05.2026	11:05	003°10.01	56°40.54'N	64.5	0-5	0.16	4	Top layer, 0–3 cm: medium sand with shell fragments: 2.5Y 4/6; 3–11 cm: fine sand to silt: 2.5Y 3/1; gradual transition to fine sand to silt 2.5Y 4/2 up to 16.5 cm.

Cruise	Station	Date	Time	Longitude	Lattitude	Bot. Depth	Sample Depth	Penetration depth	Grain Size	Description
		day/mon/yr	[UTC]	(dE)	(dN)	[m]	[cm]	[m]		
HE683	19	10.05.2026	11:05	003°10.01	56°40.54'N	64.5	0-2	0.16	4	Top layer, 0–3 cm: medium sand with shell fragments: 2.5Y 4/6; 3–11 cm: fine sand to silt: 2.5Y 3/1; gradual transition to fine sand to silt 2.5Y 4/2 up to 16.5 cm.
HE683	20	10.05.2026	13:50	003°10.04'E	56°50.01'N	61	0-5	0.135	4	Top layer 0–3.5 cm: medium sand to fine sand: 2.5Y 4/3. A heart shell (approx. 2.5 cm wide, 1.5 cm long) and other shell fragments are visible; 3.5–13.5 cm of fine sand to silt, with a colour gradient from dark to light, 2.5Y 4/3; dark areas 2.5Y 3/1.
HE683	20	10.05.2026	13:50	003°10.04'E	56°50.01'N	61	0-2	0.135	4	Top layer 0–3.5 cm: medium sand to fine sand: 2.5Y 4/3. A cockle (approx. 2.5 cm wide, 1.5 cm long) and shell fragments are visible; 3.5–13.5 cm of fine sand to silt, with a colour gradient from dark to light, 2.5Y 4/3, dark areas 2.5Y 3/1.

11.7 Selected Pictures of Samples

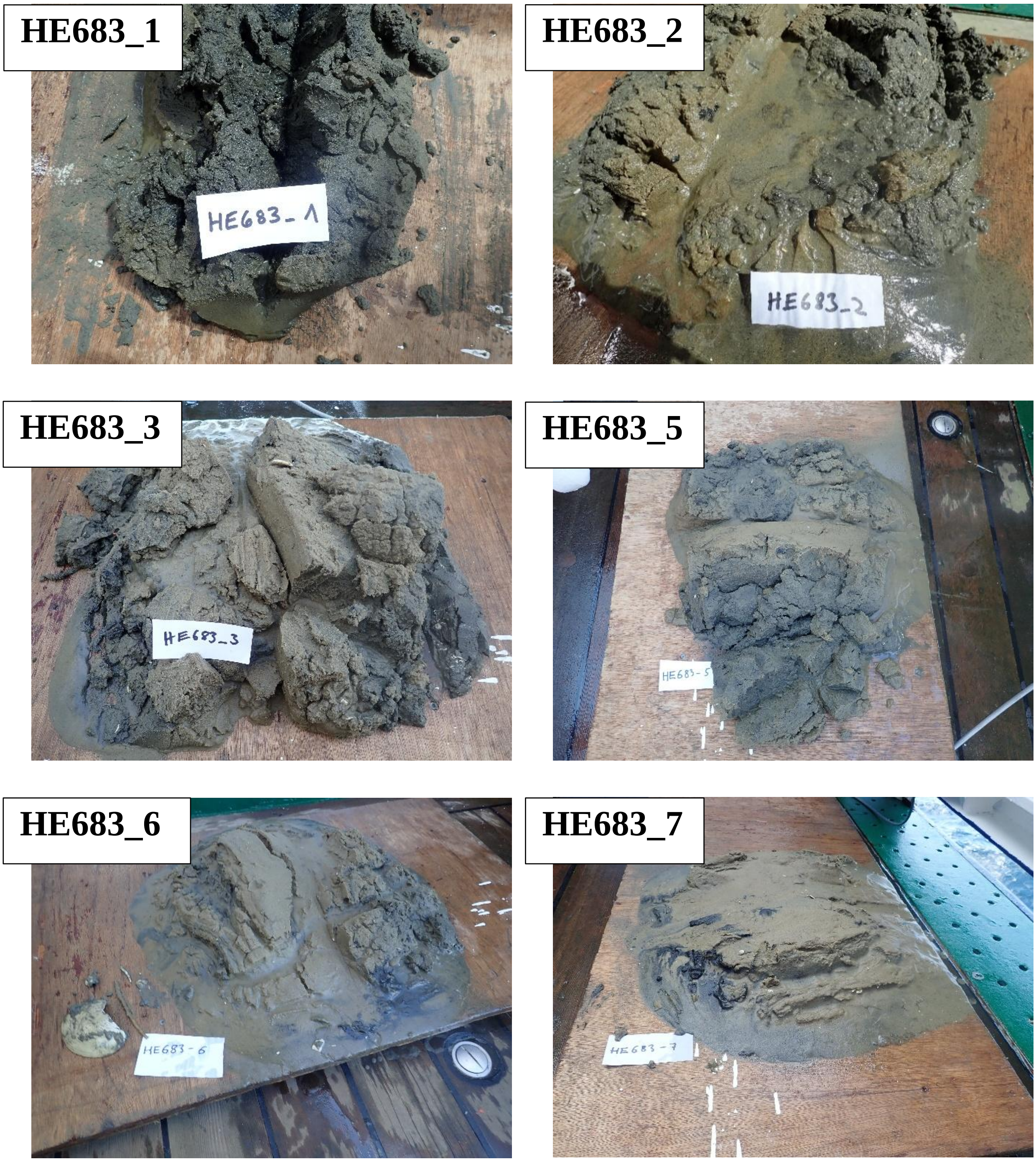

Fig. 11.1 VAN VEEN samples station 1-7.

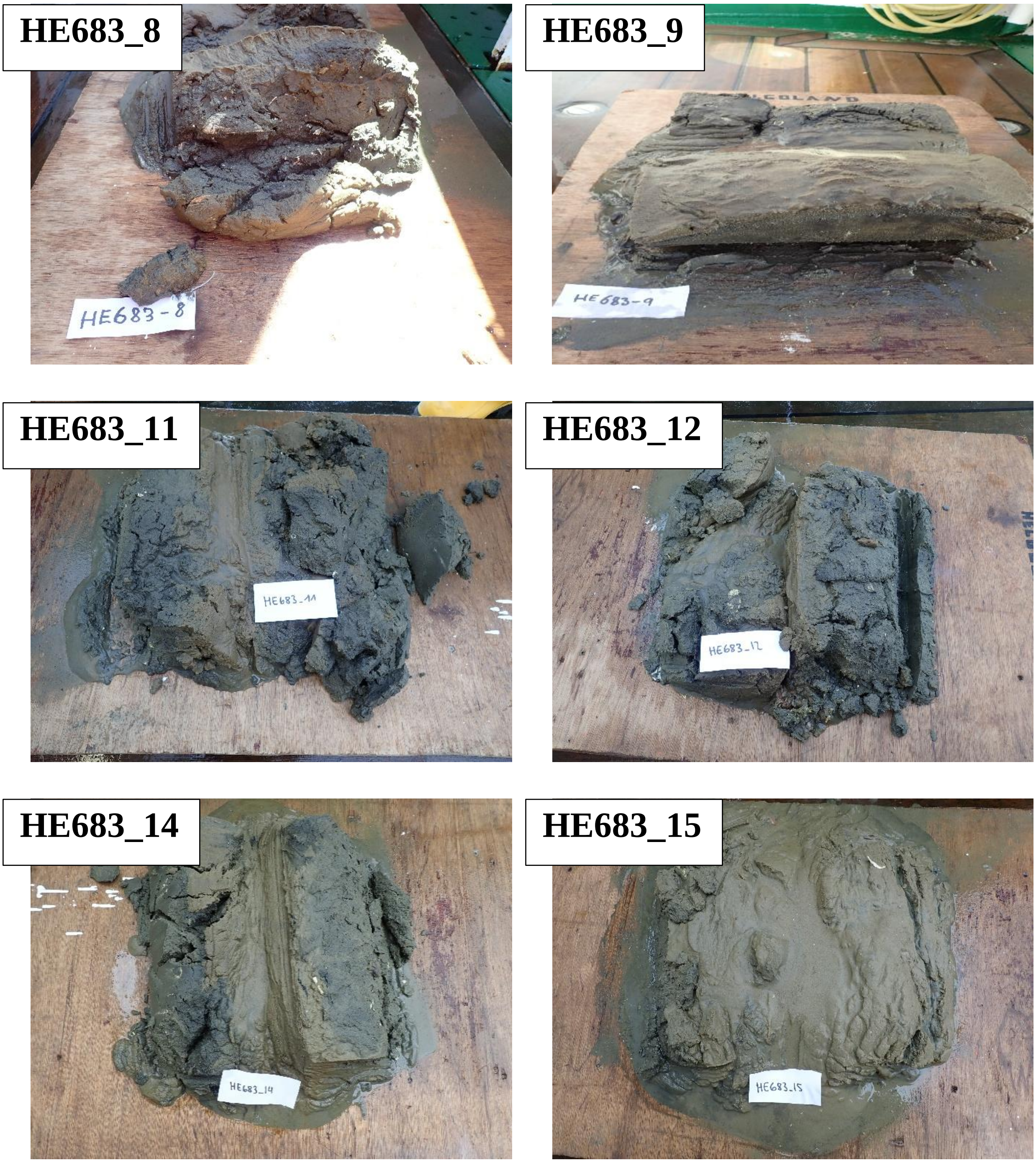

Fig. 11.2 VAN VEEN samples stations 8-15.

Fig. 11.3 VAN VEEN samples stations 17-20.

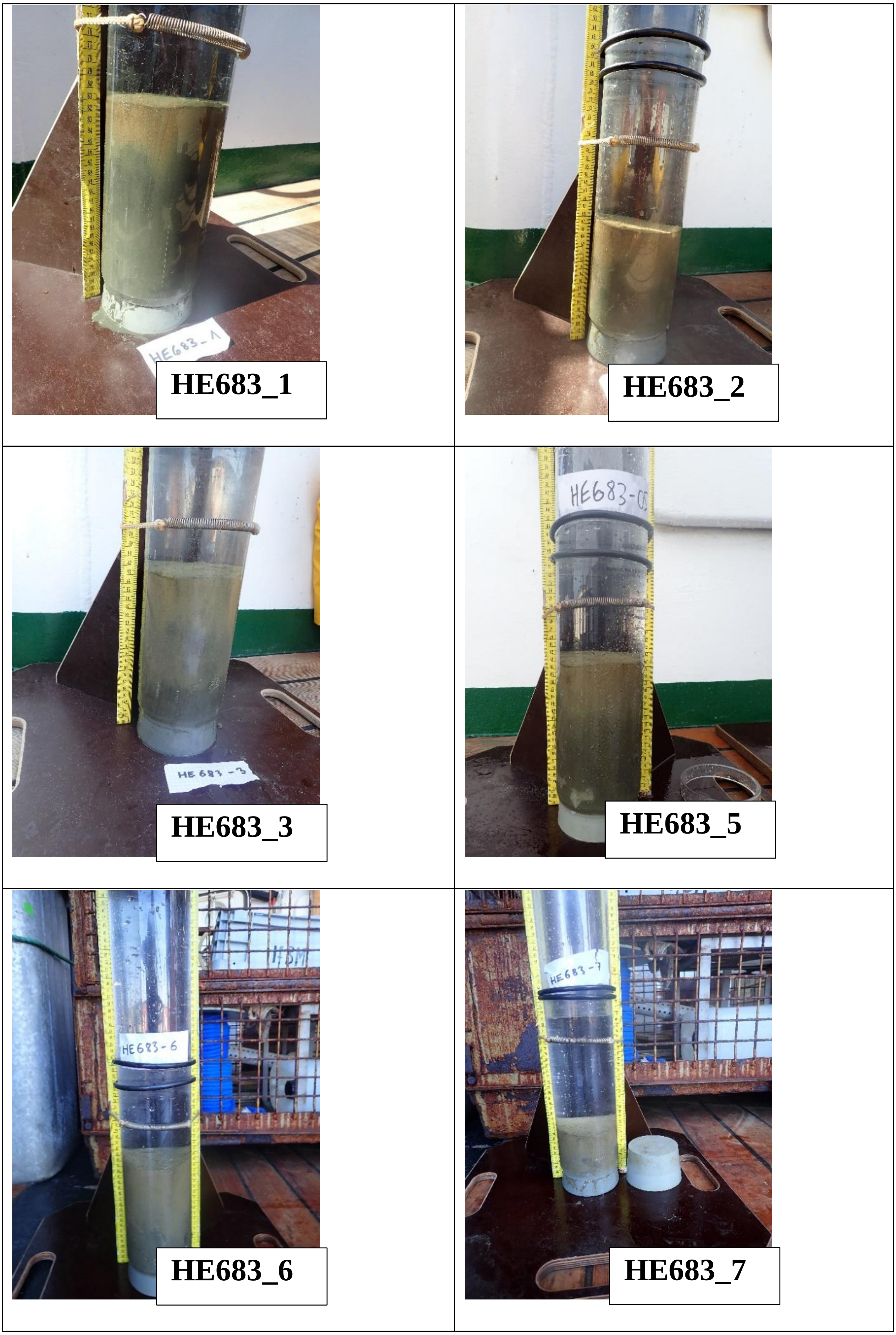

Fig. 11.4 MULTICORER samples stations 1-7.

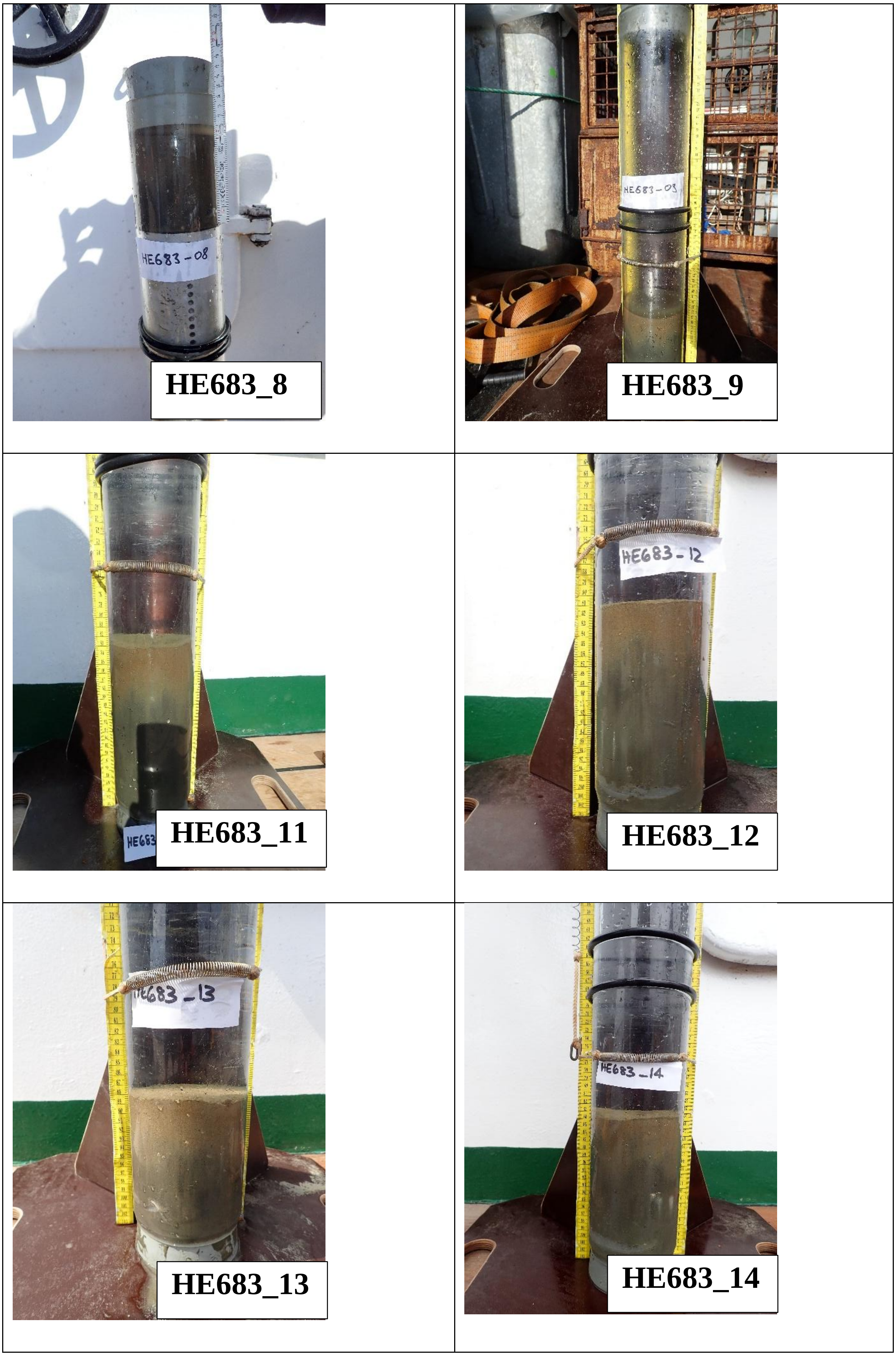

Fig. 11.5 MULTICORER samples stations 8-14.

Fig. 11.6 MULTICORER samples stations 15-19.

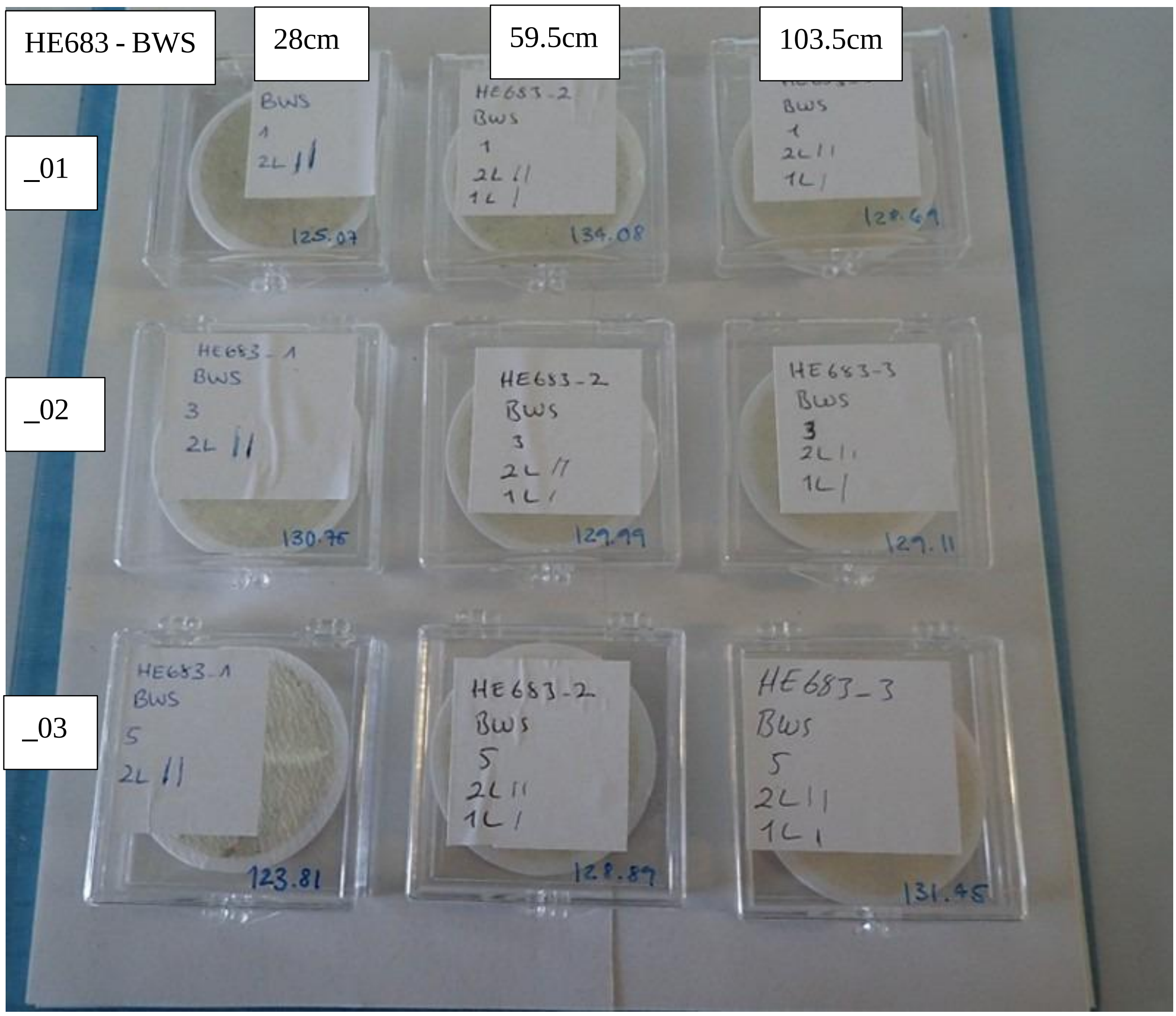

Fig. 11.7 BWS samples 1-3.

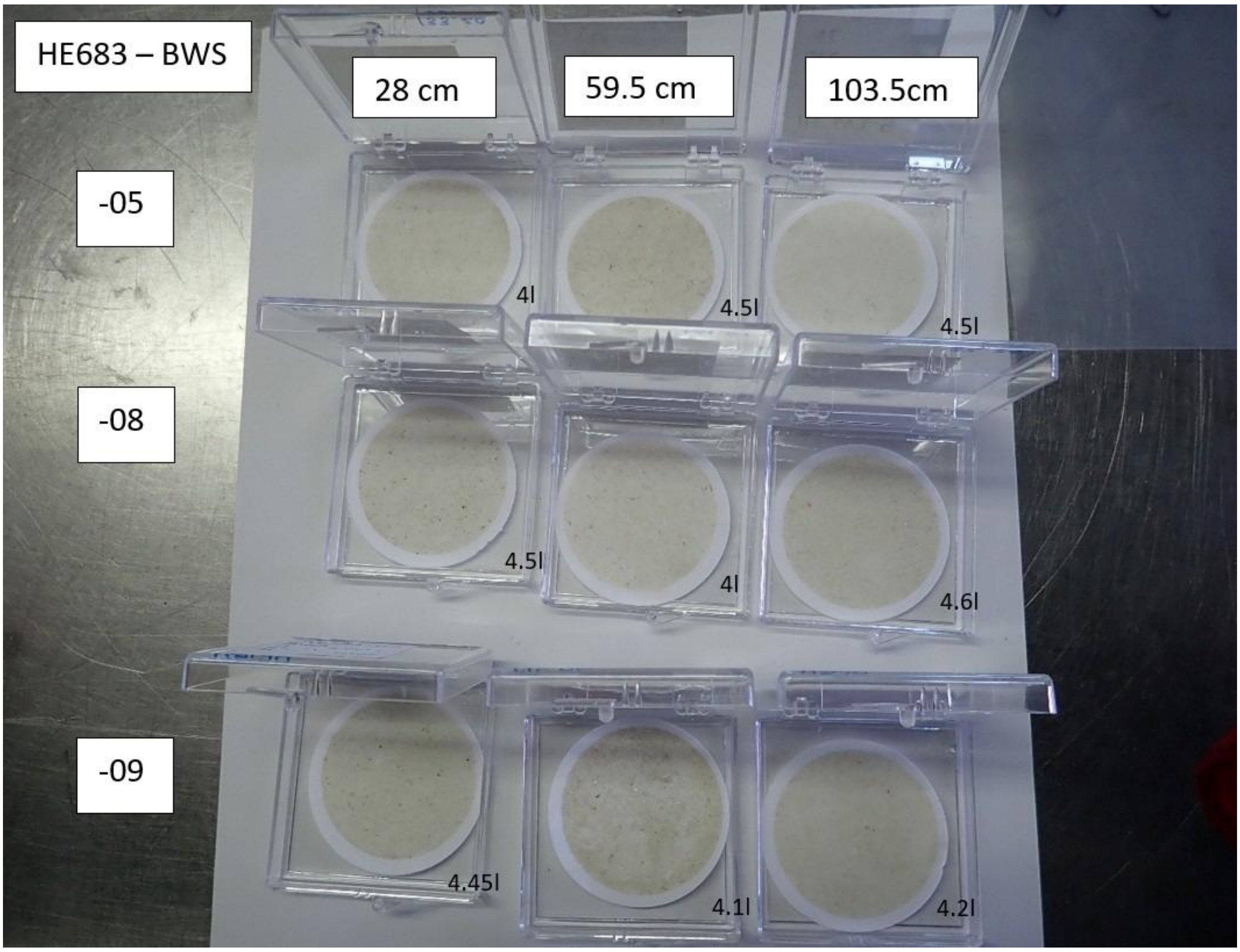

Fig. 11.8 BWS samples 5-9.

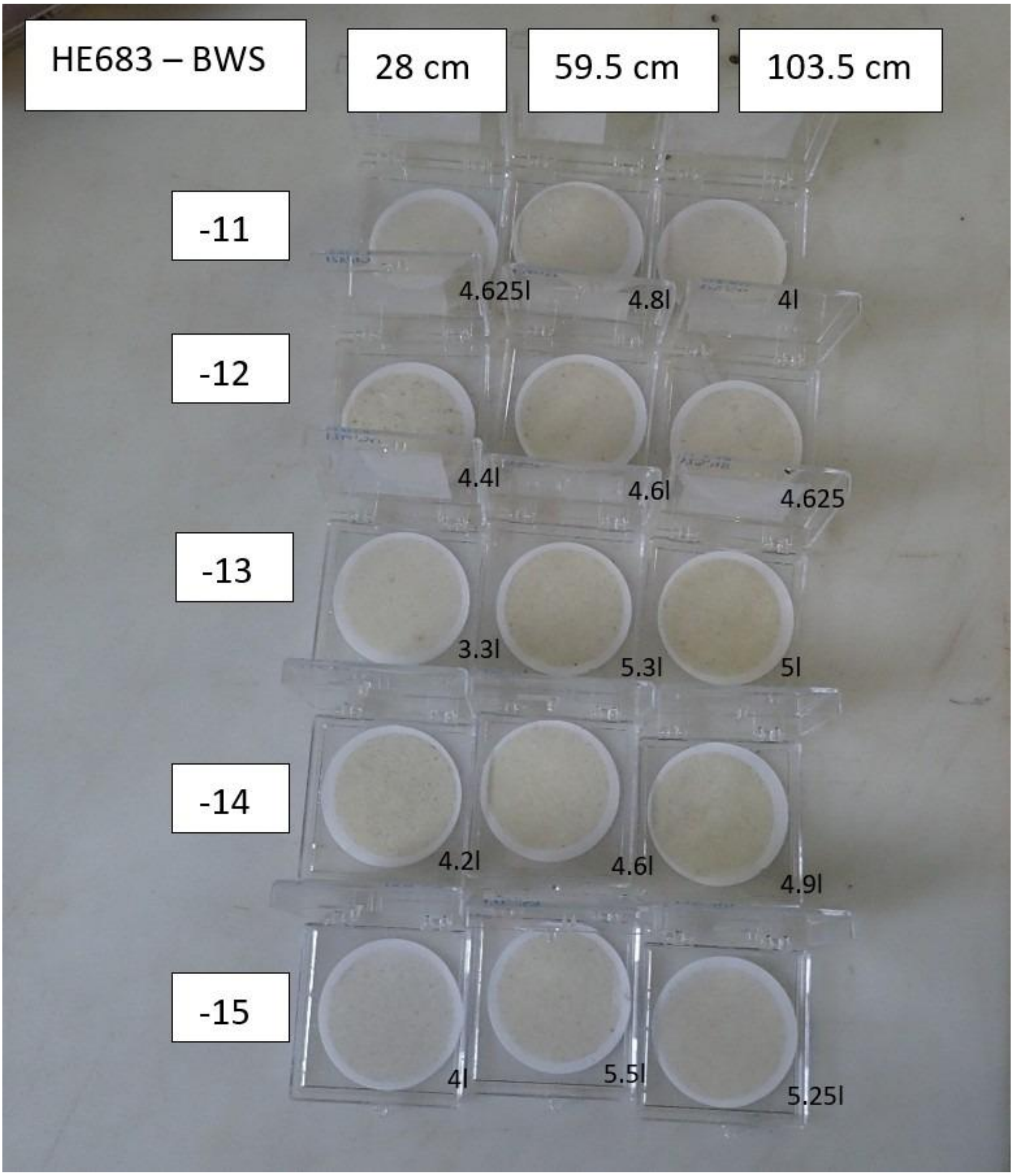

Fig. 11.9 BWS samples 11-15.

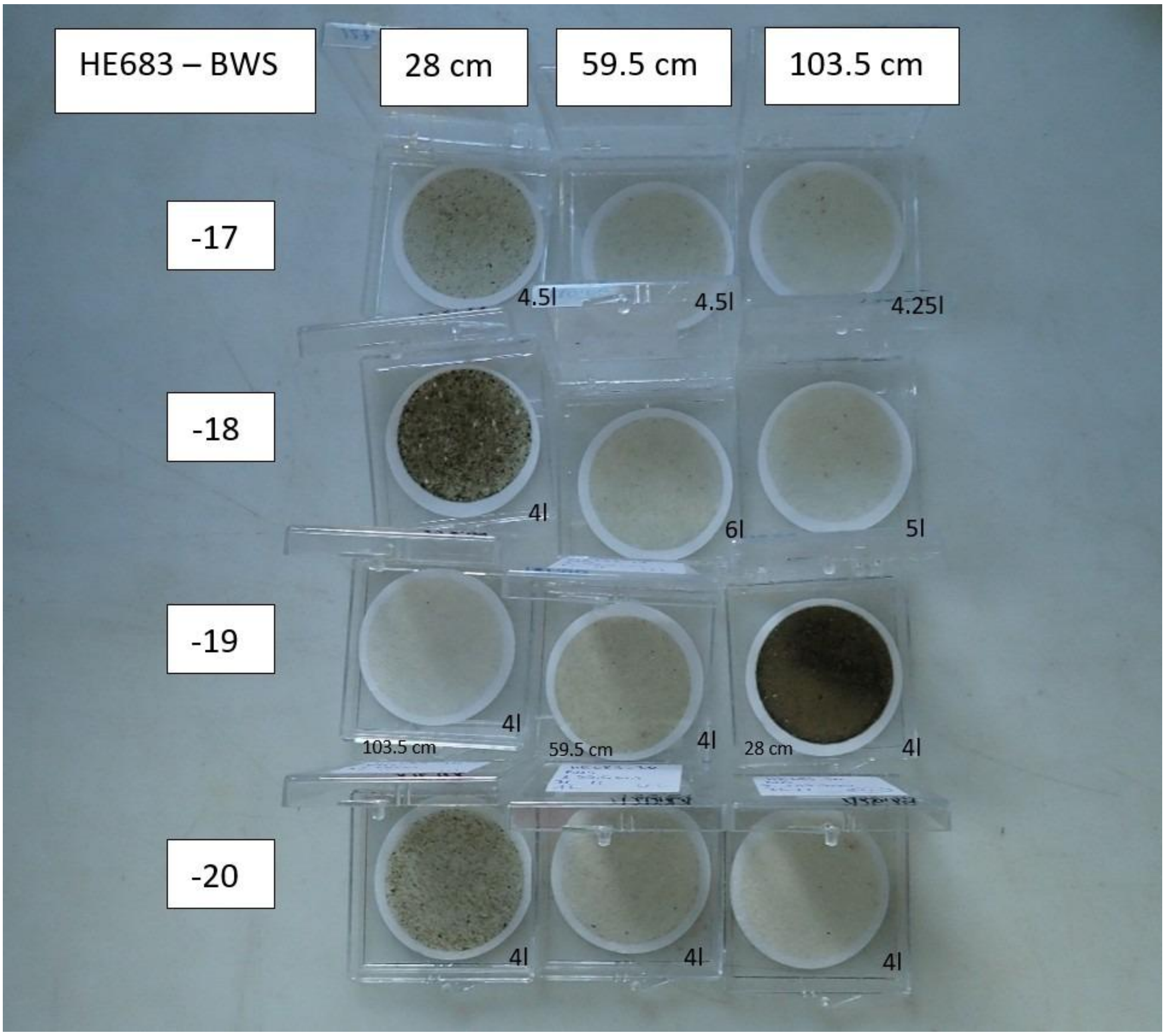

Fig. 11.10 BWS samples 17-20.

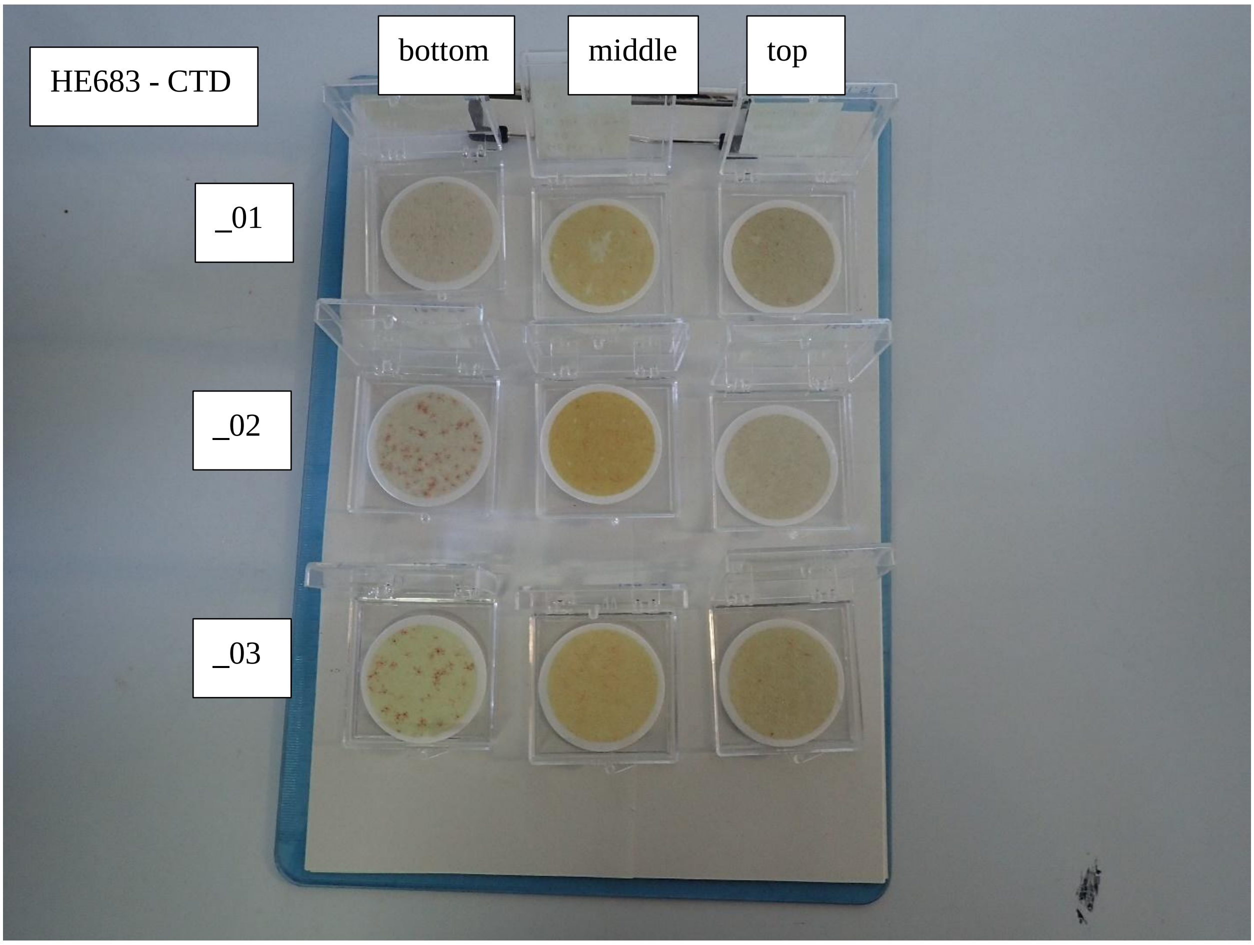

Fig. 11.11 CTD samples 1-3.

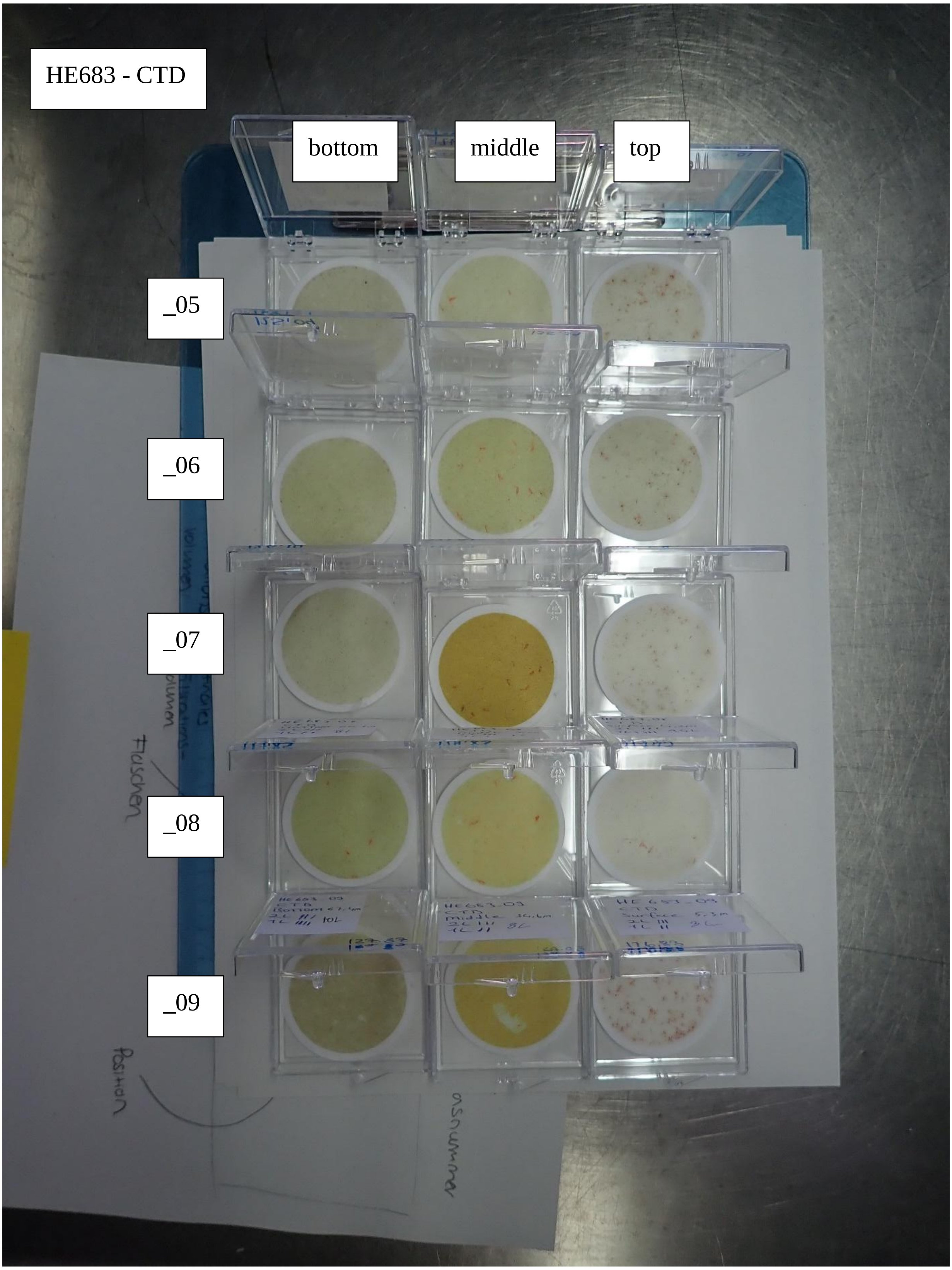

Fig. 11.12 CTD samples 5-9.

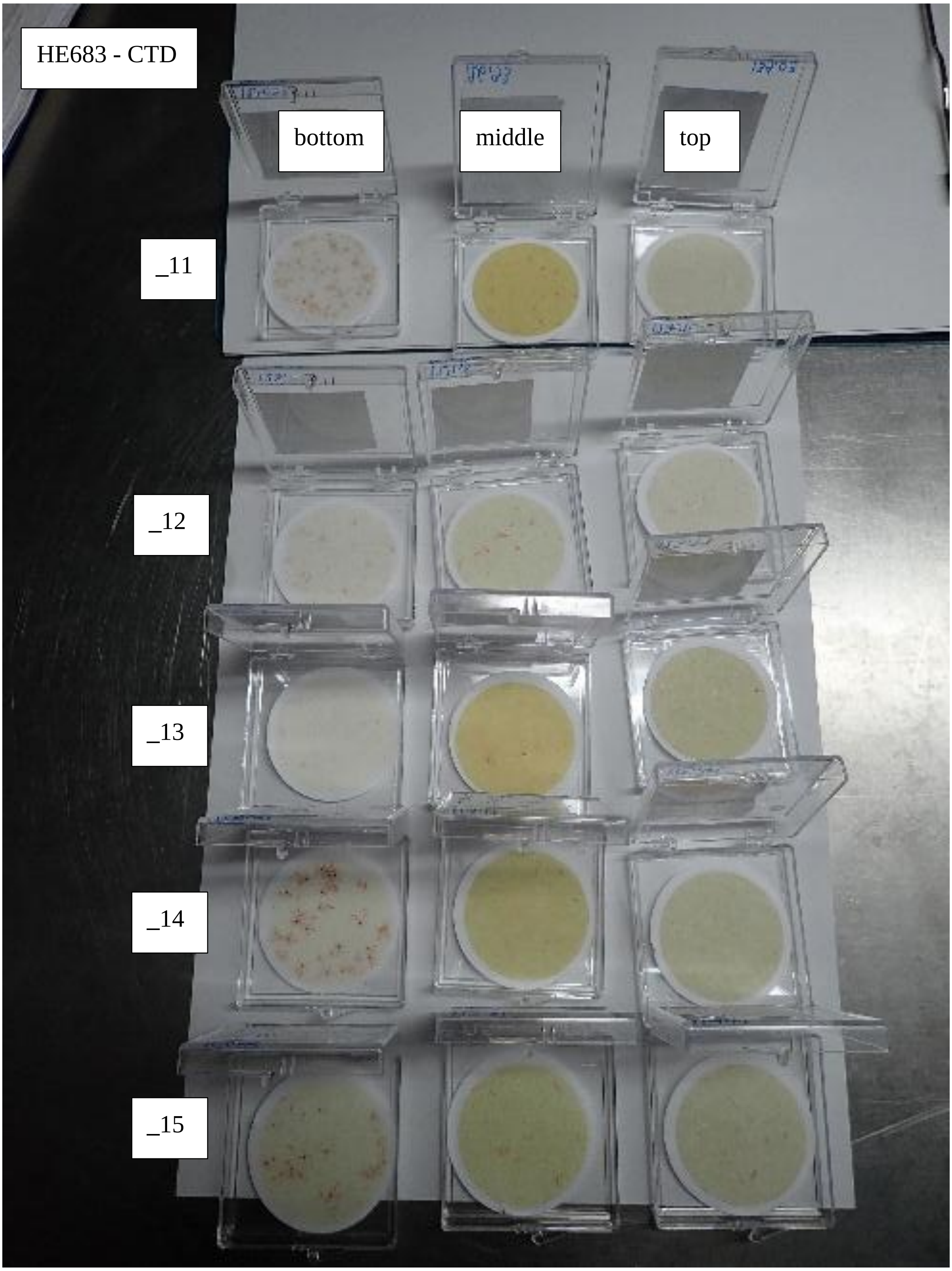

Fig. 11.13 CTD samples 11-15.

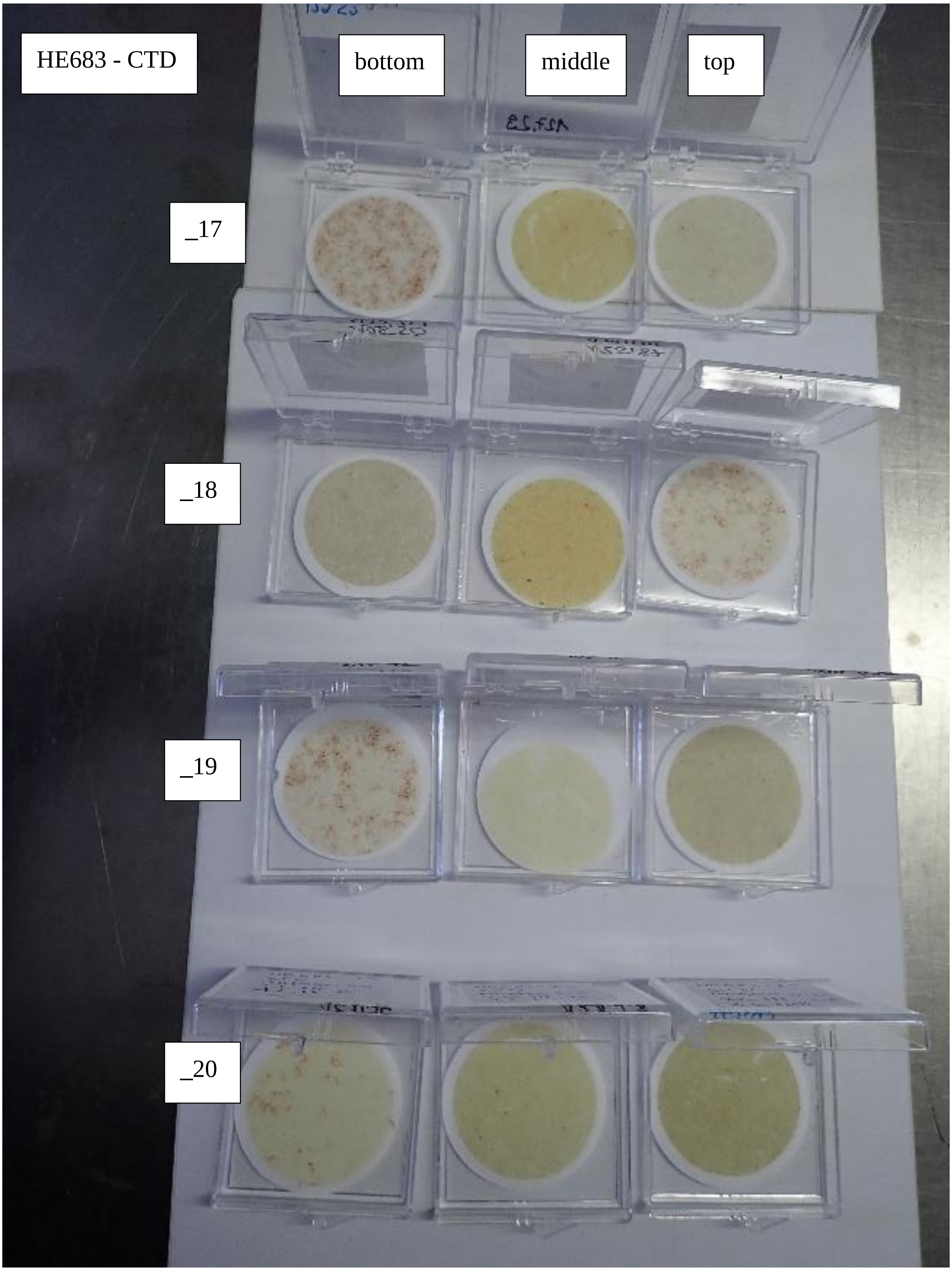

Fig. 11.14 CTD samples 17-20.

11.8 Selected Pictures of Onboard Operations

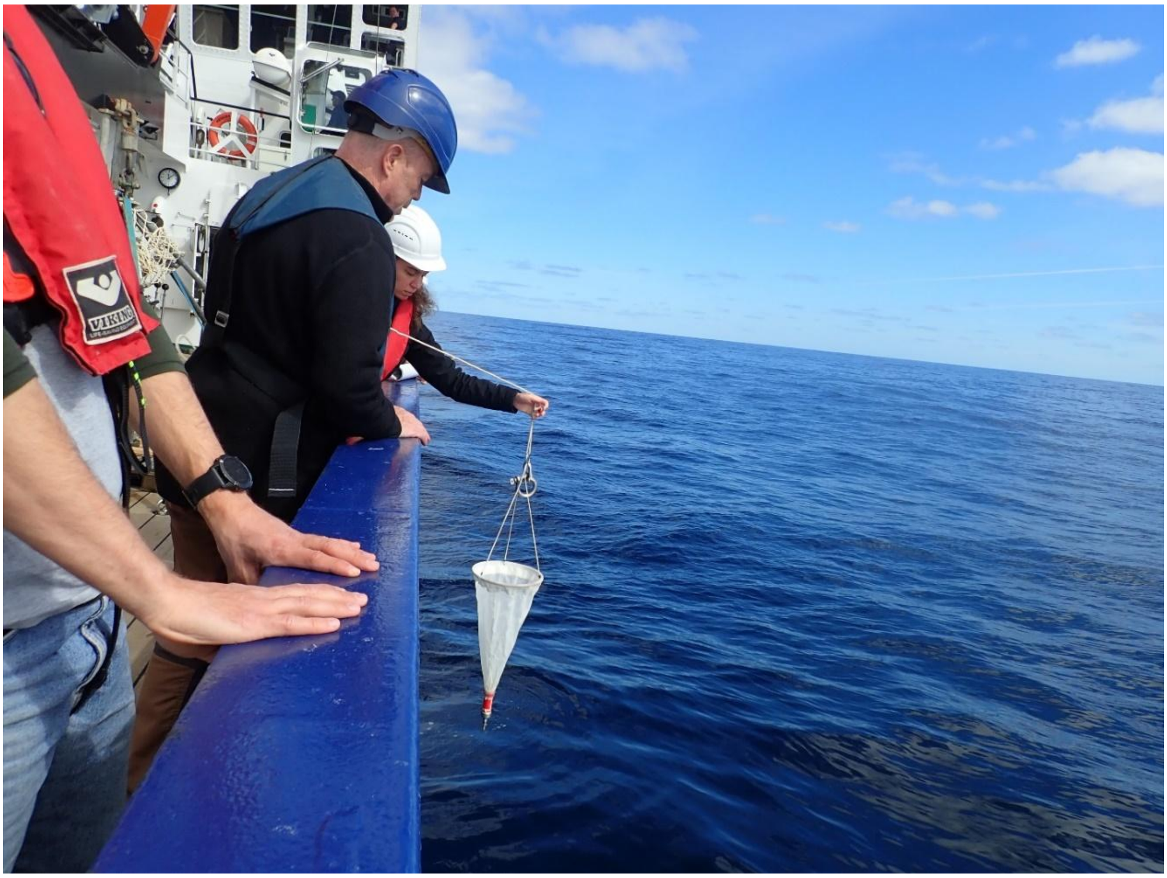

Fig. 11.15 Deployment of the APSTEIN net.

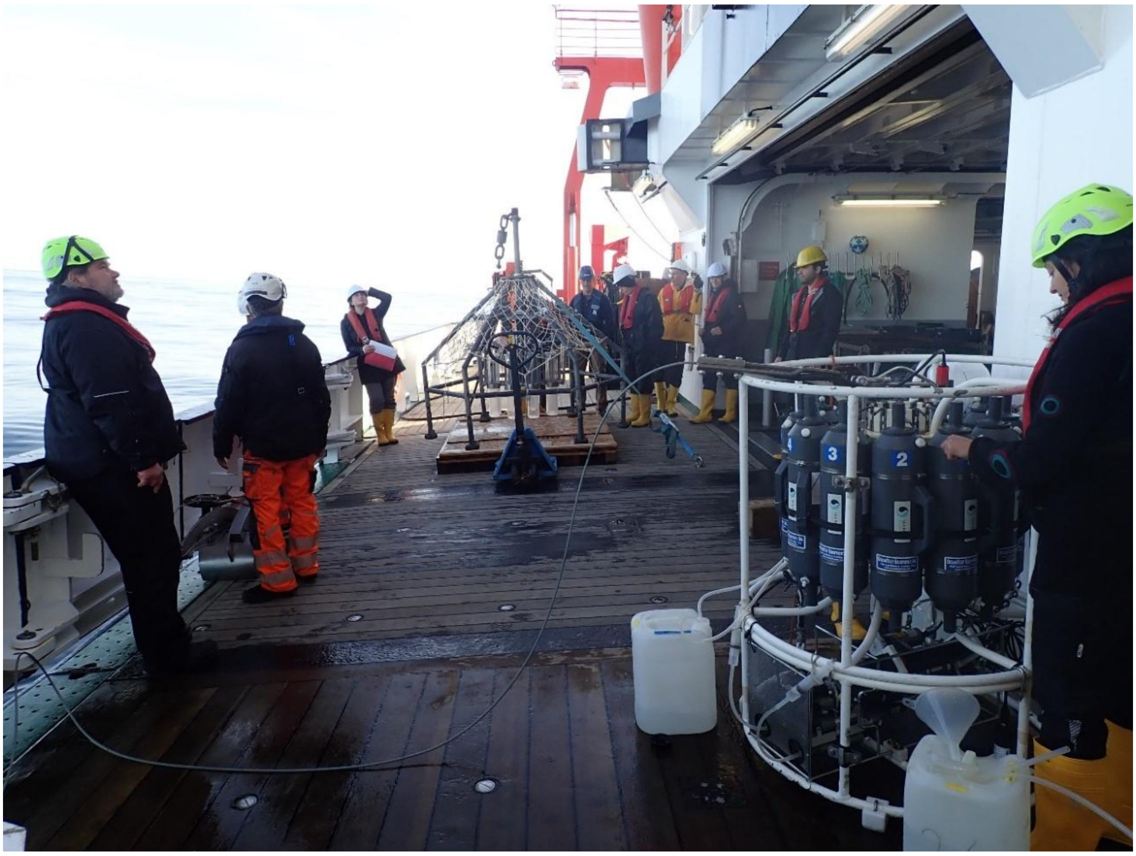

Fig. 11.16 Station work on deck.

Fig. 11.17 Permeability sampling.

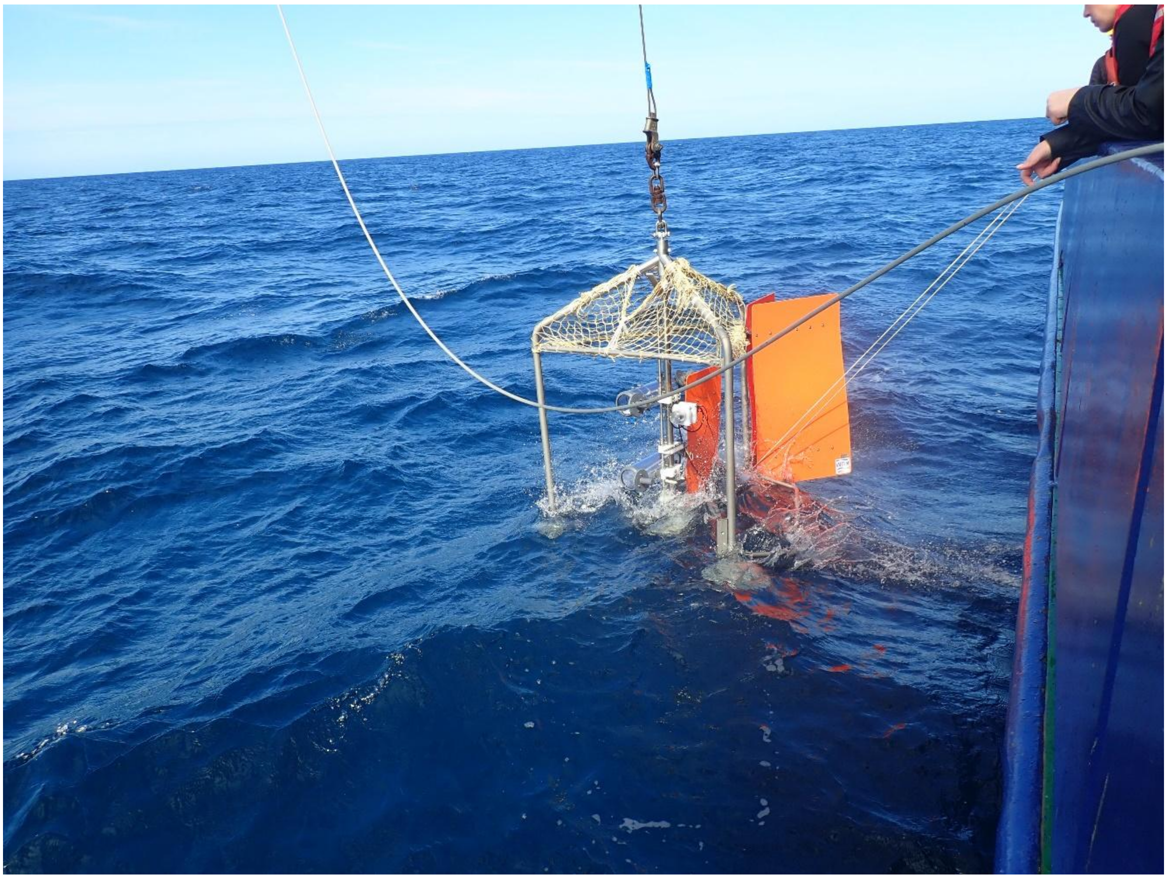

Fig. 11.18 The Bottom Water Sampler in action.

Fig. 11.19 Successful CTD sampling.