ELISABETH MANN BORGESE-Berichte

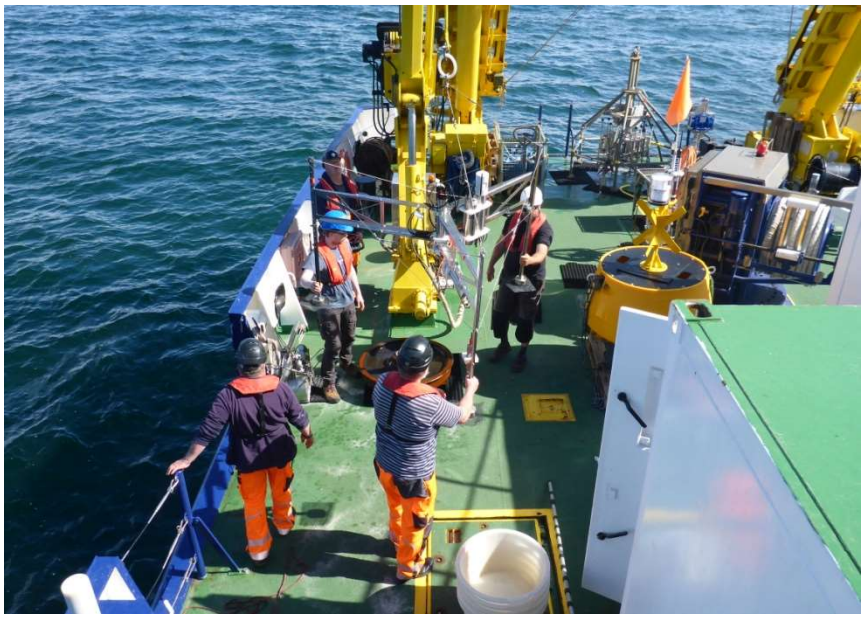
MGF-Ostsee Project: Potential effects of closure for bottom fishing in the marine protected areas (MPAs) of the western Baltic Sea - baseline observations

Cruise No. EMB267 / Leg1+2

01.06.2021 – 16.06.2021,

Rostock (Germany) – Rostock (Germany)

MGF



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2021

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1 Cruise Summary

1.1 Summary in English

The cruise was a second of a series of planned cruises under the framework of the DAM MGF-Ostsee Project: Potential effects of closure for bottom fishing in the marine protected areas (MPAs) of the western Baltic Sea – baseline observations (funded by BMBF). Its major aim is the initial assessment of variability and environmental state in the pre-closure condition in the sandy habitat of designated marine protected area "Oderbank". Within the German part of the Baltic Sea, effects of the planned closure for bottom fishing are expected to be less pronounced in non-cohesive sandy sediments comparing to the study area in cohesive sediments of "Fehmarnbelt". The control area outside MPA (and thus outside closure areas) in similar habitat and (based on available data) under initially comparable fishing intensities was also sampled. First, baseline hydroacoustic survey was done to characterize and monitor the development of the trawl marks on the seafloor. Then sampling for obtaining a comprehensive picture and estimate of variability of biological sediment communities (key players, diversity and activity in prokaryotes, protists, meiofauna, macrozoobenthos) and sediment composition and biogeochemical processes was carried out.

1.2 Zusammenfassung

Die Reise erfolgt im Rahmen eines vom Bundesministerium für Bildung und Forschung (BMBF) geförderten interdisziplinärem Forschungsprojektes zur „Untersuchung der erwarteten Auswirkung des Ausschlusses mobiler, grundberührender Fischerei in marinen Schutzgebieten der Ostsee" (Kürzel: „MGF-Ostsee"). Dies ist gleichzeitig ein Pilotprojekt der Deutschen Allianz für Meeresforschung (DAM) (DAM Pilotmission - Schutzgebiete Ostsee, FKZ: 03F0848A). In diesem Forschungsprojekt untersucht ein Konsortium von WissenschaftlerInnen wie sich die Ökosysteme der Natura 2000-Gebiete in der deutschen ausschließlichen Wirtschaftszone (AWZ) der Ostsee nach Ausschluss der mobilen grundberührenden Fischerei (MGF) entwickeln. Hauptziele sind ein besseres Verständnis der Nachhaltigkeit von Meeresbodenlebensräumen und Biota in den Natura 2000 Gebieten unter dem derzeitigen Grundschleppnetzbetrieb, eine generelle Bewertung der Auswirkungen der bodenberührenden Fischerei auf benthische Gemeinschaften und Sedimentfunktionen sowie deren Entwicklung nach Fischerei-Ausschluss. Die Fahrt ist die erste Aufnahme aller Komponenten des benthischen Nahrungsnetzes, von Prokaryonten bis Makrozoobenthos, Sedimenteigenschaften und biogeochemischen Prozessen in ausgewählten Untersuchungsflächen (Weichbodensedimente) innerhalb und außerhalb des Schutzgebietes Oderbank. Bei der Reise war es aufgrund der Corona-Einschränkungen (Einzelkammerbelegung) und militärischen Übungen nur möglich ein Schutzgebiet komplett zu beproben. Das Programm umfasste hydroakustische Kartierungen zur exakten Bestimmung der Positionen sowie geologische, biogeochemische, physikalische und biologische Ansätze. Im zweiten Arbeitsgebiet Fehmarn Belt wurden ausschließlich akustische Kartierungsarbeiten zur Erstellung einer Zeitreihe der Meeresbodenmorphologie durchgeführt.

2 Participants

2.1 Principal Investigators

Name	Institution
Jürgens, Klaus, Prof.	IOW

2.2 Scientific Party

Name	Discipline	Institution
Leg 1 (02.06.-11.06.2021)		
Dr. Feldens, Peter	Chief Scientist, Geophysics	IOW
Dr. Roeser, Patricia	Geochemistry	IOW
Kitte, Axel	Geochemistry	GFZ
Clemens, David	Sediment-Water Fluxes	GEOMAR
Dr. Piontek, Judith	Biology	IOW
Pohl, Frank	Technician	IOW
Hoffmann, Sven	Biology, Technician	Senckenberg
Sachs, Maria	Biology	Uni-Köln
Leg 2 (11.06.-16.06.2021)		
Dr. Gogina, Mayya	Chief Scientist, Biology	IOW
Pohl, Frank	Technician	IOW
Dr. Kern, Ramona	Biology	Uni-Rostock
Dr. Powilleit, Martin	Biology	Uni-Rostock
Schmüser, Thore	Student, Biology	Uni-Rostock
Prof. Dr. Arndt, Hartmut	Biology	Uni-Köln
Clemens, David	Sediment-Water Fluxes	GEOMAR

2.3 Participating Institutions

IOW	Leibniz Institute for Baltic Sea Research Warnemünde
GFZ	Geoforschungszentrum Potsdam
GEOMAR	GEOMAR - Helmholtz-Zentrum für Ozeanforschung Kiel
Senckenberg	Senckenberg am Meer, Deutsches Zentrum für Marine Biodiversitätsforschung
Uni-Köln	Die Universität zu Köln
Uni-Rostock	Die Universität Rostock

3 Research Program

3.1 Description of the Work Area

The main working area of EMB267 cruise was the Oderbank in the Pommeranian Bay of the southern Baltic Sea (see Figure 3.1). This is the largest and highly representative sandbank in the German Baltic Sea, mainly located in water depths between 10 and 16 m (most sampled stations were located at ~15 m depth), composed of well-sorted fine sand. In the focus area surface salinity during the cruise ranged from 7.4 to 8.1, and bottom salinity was 8.1 to 8.2. Near-bottom water temperature ranged from 11.8 to 14.6°C. Near-bottom oxygen concentration varied from 4.73 to 6.53 ml/l (based on the data from CTD casts).

At Oderbank water dynamics restrict the development of macrophytes, and seafloor mainly represents bare fine sand, often as ripples, with scattered unattached mussel clusters and drifting

algae. The area is important as feeding ground for fish species like cod, herring and flat-fish, and wintering seabirds.

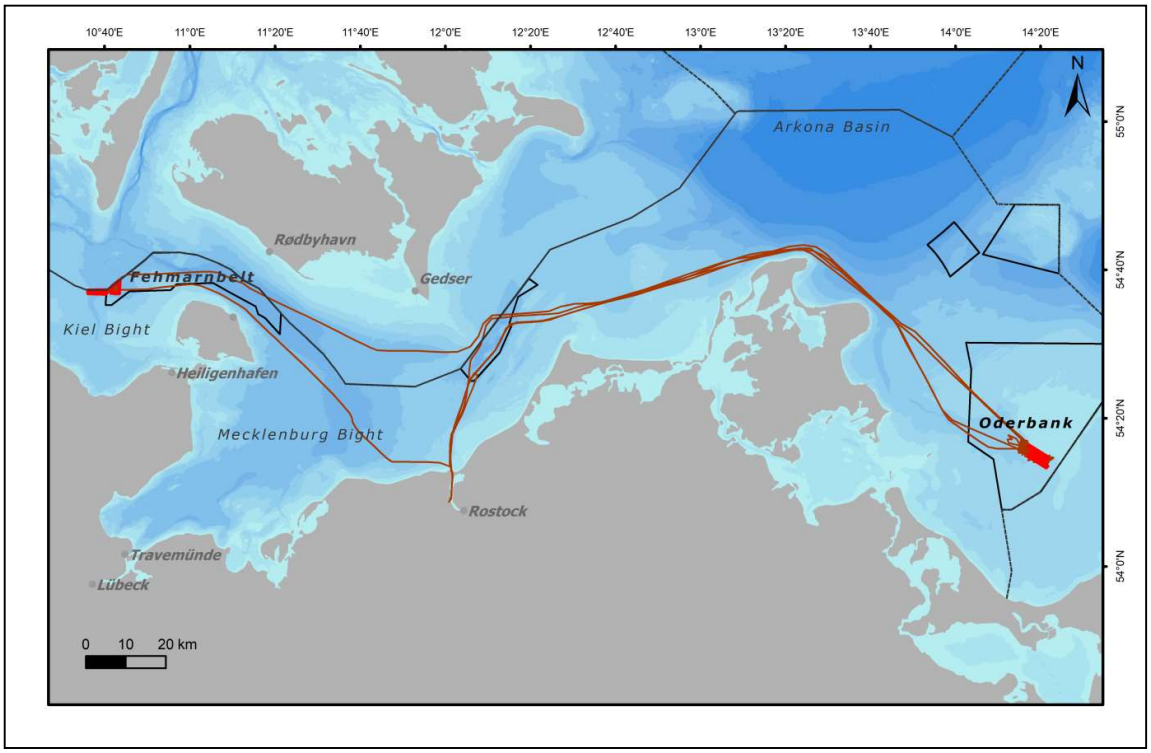
3.2 Aims of the Cruise

As part of an interdisciplinary research project to investigate the effects of mobile bottom-fishing in the marine protected areas (Natura 2000) in the German Baltic Sea, the general aims of the cruise included obtaining a comprehensive picture of biological sediment communities (key players, diversity and activity in prokaryotes, protists, meiofauna, macrozoobenthos) and sediment composition and biogeochemical activity, and the variability of the different components and sediment-water interface fluxes in Oderbank MPA. The special feature of the cruise was a combined assessment of sedimentological, micro- and macrobiological and biogeochemical parameters, and provide a baseline for a serious of following monitoring cruises planned in the future. It was particularly targeting the investigation (both quantitatively and mechanistically) of interactions between micro-/macrofauna and sediment biogeochemistry.

3.3 Agenda of the Cruise

Despite limitations due to COVID-19, that forced separation of the cruise into two legs, reducing the program to only one MPA allowed a comprehensive sampling and allowed all project Work Packages (WPs) to obtain data, optimize joint sampling and screen for gaps (scale, sufficient and feasible number of samples) to consider for future monitoring in 2022.

List of equipment used: R2Sonic 2024 Edgetech 4000 Sidescan System, Evo Logistig Ultra Short Baseline Acoustic System (USBL), small Sound velocity probe kleine Schallsonde, Multicorer (MUC), Frahm-Lot, 2 van-Veen Greifer, Lander BIGO with benthic chambers (GEOMAR), Eddy Correlation system (GEOMAR), Dredge, SeaViewer UW Video System, CTD, MilliQ, Titrino.



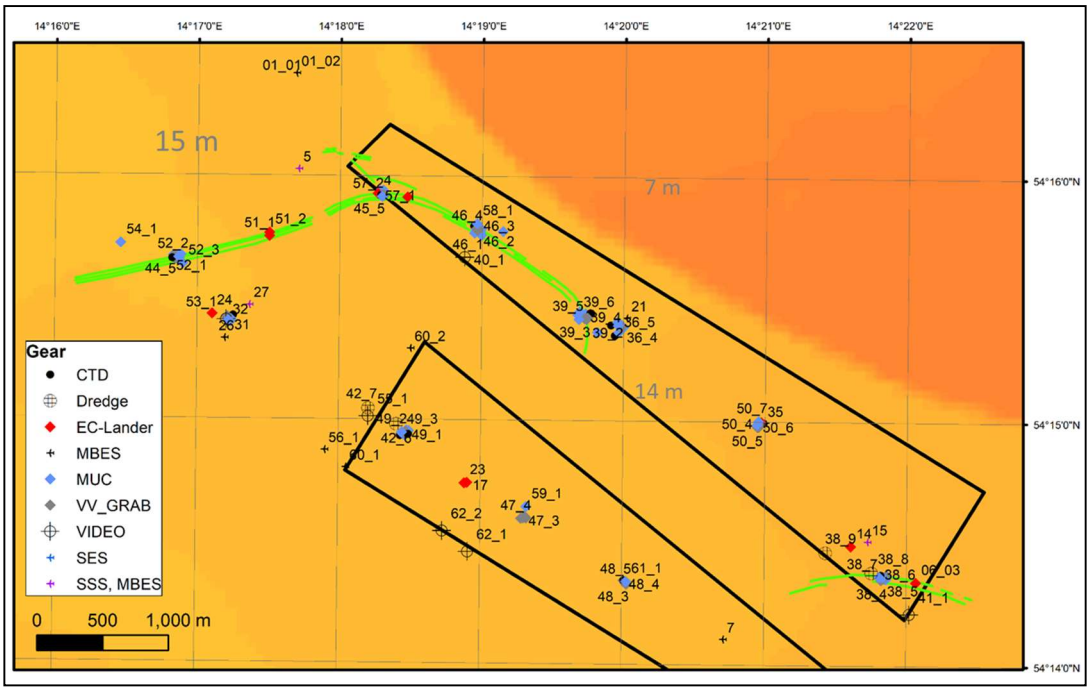


Figure 3.1 Track chart of the cruise EMB267 (upper pane). The two working areas are shown in bright red. Fehmarn Belt was only shortly visited at the end of the 1st leg in order to establish the hydroacoustic time series, whereas most work was carried out in the Oderbank (lower pane).

4 Narrative of the Cruise

The final preparations for cruise EMB267 were carried out onboard RV Elisabeth Mann Borgese in the harbour of Rostock (Fischereihafen Rostock-Bramow) on 1 June. 01.06.

On 2 June departure was delayed due to technical defect onboard, however directly initiated repair work allowed to depart at 13:30. Adjustment of the night-program allowed to start the planned work in the study area of Oderbank in time, around 23:45. The work started with measuring of sound velocity profiles, recording MBES calibration profiles and hydroacoustic mapping in the focus area "Inside MPA". Weather conditions were calm, and no restrictions in the work program were necessary.

Early in the morning on 3 June hydroacoustic mapping ended at 06:00 am. After the breakfast the USBL system was commissioned and 2 x CTD stations were done at the so far the only trawl mark found that was identified in the “Inside MPA” area. Afterwards the deployment of the lander was carried out. In the afternoon the work continued with collection of the first MUC samples. Processing of the samples took place until dinner. The position of lander on the seafloor was exactly determined by passing with the MBES. No mapping work was possible at night, as the ship was anchored near the lander.

On 4 June at 6:00 am two more CTD casts in the Inside MPA area, followed by the collection of sediment cores with multicorer (MUC), were carried out. This time, several casts were necessary to collect samples of sufficient quality, because most of the cores at several attempts were < 15 cm in length. However, a sufficient number of suitable cores could be taken by repeated MUC casts at same station. At 16:00 shipboard time the lander was recovered from its first deployment during this campaign. Subsequently, side scan sonar (SSS) profiles were recorded in the "Inside" and "Outside MPA" areas until 23:30 to find additional sampling locations of interest.

More trawl marks were found in the “Inside MPA” area. However, no trawling activity could be detected in area “Outside MPA”. Acoustic work was over at 23:30. A 24h-operations could not be carried out due to corona-related personnel.

On 5 June another two CTD stations (in a trawl mark in the eastern part of the “Inside MPA” area) were sampled, followed by the deployment of lander and collection of sediment cores with 2 MUC casts. Time in the morning was also used to check the USBL system. In the afternoon work continued with another MUC cast and localization of lander by means of MBES. No trawl marks were found in the designated area "Outside MPA". Relocation of the area is considered in order to have detected fishery in the control area, as comparable as possible to the future closure area “Inside MPA”.

Two stations from a total of eight stations for sediment collection planned as feasible for Leg1 were scheduled on 6 June, and work with CTD and MUC started in the morning and continued in the afternoon. Adjustments on multicorer gear (including increased weight combined with reduced number of liners) allowed for the first time the penetration below the shell layer at 15-20 cm, and length of collected sediment cores of about 30 cm. In the afternoon, the lander was retrieved from the second deployment, before proceeding with SSS mapping work in the western part of the study area. The goal of mapping was again to find trawl marks in the control area. Mapping was completed around 23:00 shipboard time, coordinates for remaining MUC stations could be identified. The control area "Outside MPA" was moved a few hundred meters to the west for this purpose (see above).

In the morning of 7 June, after a CTD cast, 2 MUC casts were done (in the east of shifted control area "Outside MPA" in sand without trawl marks). The 5-day Corona-test was performed, and the lander was deployed again (in the control area without trawl marks). In the afternoon, a second CTD station was done. Generally, there was an observation that CTD profiels at each position are quite different in salinity and in vertical location of thermocline. In the afternoon one station (11-02) was repeated. At this station, peat was found beneath the widespread mussel layer, complicating the extractions of pore water. Samples for dating were retrieved. At the end of the day, the exact position of lander was detected using MBES.

Next morning, on 8 June, CTD sampling was followed by 2 MUC stations in a trawl mark in the adjusted control area "Outside MPA". Afterwards, the lander was recovered around 10:00 am. The lander was immediately prepared for another deployment and was released around 13:00 pm. The next MUC station located in the control area was sampled. In the afternoon MUC sampling continued in the located trawl mark, and another CTD cast for control of oceanographic conditions was carried out. In the evening, SSS mapping continued in the western work area, and the gap between the control area "Outside MPA" and area “Inside MPA” was closed.

The morning of 9 June started with the final CTD and MUC station outside a trawl mark in the control area "Outside MPA", near the lander deployed of the previous day. In the afternoon, a nearby MUC station was repeated, as problems during sample processing occurred and additional material was needed. Following the retrieval of lander, RV Elisabeth Mann Borgese started the 14h transit to Fehmarn Belt, where acoustic mapping of the past year was planned to be repeated.

On 10 June in the morning the CTD profile was taken in the working area Fehmarn Belt. Subsequently, the “Inside MPA” and “Outside MPA” areas of Fehmarn Belt were re-surveyed to

establish an acoustic time series (together with data from previous year) and to detect changes and dynamics of trawl marks. Work was completed late in the evening and RV Elisabeth Mann Borgese headed towards the harbour of Rostock, to return for the exchange of scientific crew.

On 11 June six scientists left the ship and five scientists boarded the ship. Departure from Rostock after the transfer of data and exchange of scientific staff delayed until 12:00. Due to technical problems on board (there was a defect of cooling room), additional equipment was secured for the incubation and measurements of primary production carried out by scientists from the University of Rostock. Another delay occurred due to missing essential equipment (dredge), and the need to quickly return to Warnemünde pier to pick it up. Fortunately, those delays had no consequences for the schedule of the further work due initially planned long transit (at least 10h) and late arrival to the Oderbank area.

On the next day, 12 June, sampling work started in the morning at 6:30 am shipboard time in the "Inside MPA" area of Oderbank and continued until 6:30 pm. First two CTD casts were carried out for the profiles and water samples collection, and afterward lander was deployed. Work continued at 3 stations "Inside MPA" with the collection of a total of 12 Van Veen grab samples (3 replicates for benthic macrofauna and 1 sample for analysis of properties of surface sediments at each location) and 6 MUC casts (2 per location). Dredge (type Kieler Kinderwagen) was deployed twice, each time for 5 minutes, in order to attempt to collect sufficient number of individuals of macrofauna key species for characterisation of their condition, as well as common species for isotopic analysis (though low penetration of gear in this relatively hard-packed sandy seafloor, despite adjustments with additional weights, prevented to heave more than a handful of material, and those were almost exclusively epi- or hyperbenthic species. At the end of the day, 2 underwater video transects were recorded, but no visible trawl marks were detected.

Next day, 13 June, MUC operations were not possible until evening due to weather conditions: gusty wind and waves. Lander recovery also was not possible until after 4:30 pm, and as it was not desired so late, instead the longer deployment was chosen, with the recovery and the beginning of new deployment planned for the next day. Sampling work was carried out from 6:30 am to 5:00 pm at stations "Outside MPA", and included 4 CTD casts, a collection of 28 Van Veen grabs samples, and another attempt with 2 dredge deployments to also cover mobile fauna in this area.

After weather limitation of the previous day, the work on 14 June started with a CTD cast and the collection of missing MUC samples in the area "Outside MPA". Another CTD profile was recorded in the area "Inside MPA", followed by the collection of remaining 4 grab samples and sediment cores, that required 2 MUC casts. Lander was recovered from the "Inside MPA" deployment and immediately prepared for the subsequent new deployment in the area "Outside MPA". The location of lander position was detected using MBES. Sampling continued in the area with a CTD station and 4 MUC casts. Two underwater video transects were carried out.

In the evening multibeam profiling was devoted to "tracking of trawl mark" from the gears deployed by RV SOLEA with the team of scientists from the Baltic Sea Fisheries - Thünen-Institut, who were also involved in the project and communicated their detailed program on the previous night. Whereas the "fresh" traces of the 3 m beam trawl gear (i.e. "Baumkurre" in German, deployed on same day, 14 June) were clearly visible in the reflection of the acoustic signal, the

trawling marks from the previous day otter trawl deployment ("Schleppnetz" from 13 June) were not clearly detectable.

On the last day of planned works at the sea, 15 June, to complete the planned sampling program, the work first started in the area "Inside MPA", were a CTD station and two MUC casts were done, and then proceeded in the area "Outside MPA" with repeated records of multibeam profiles to cover "trawl marks" from RV SOLEA from the 13 and 14 June, to capture any possible short term dynamics. The last required sediment cores were collected with two MUC casts, MBES was deployed to record the positioning of lander "Outside MPA", and underwater video transects were done crossing the previously derived positions of trawl marks of RV SOLES, with an intention to check if any visual disturbances of the seafloor could be detected. At 16:15, after all the planned station work were completed, RV Elisabeth Mann Borgese began her transit to Rostock.

The RV Elisabeth Mann Borgese arrived at the port of Rostock on the morning of 16 June, having successfully completed cruise EMB267.

5 Preliminary Results

5.1 Sedimentology and geophysics (WP 1.1)

(P. Feldens, M. Schönke)

The main task of the acoustic mapping during the cruise was to visualize the impacts of bottom fisheries on seafloor morphology and composition. In this study two different types of echo sounder system were used. The main recording device was the towed sidescan sonar system (SSS, Klein 4000), with the advantage of a large areal coverage in shallow water to obtain high-quality, high-resolution backscatter maps. The common drawback of the towed system is the difficulty to determine the device position relative to the ship positioning could be significantly improved by the usage of an ultrashort baseline (USBL) positioning system attached to the SSS. Unfortunately, due to system failure the USBL was non-functional most of time. However, side scan sonar position was not changed, and the derived offsets of approx. -22.0 m aft of the USBL and 8.9 m towards the starboard can be used for data correction with reasonable accuracy. Cable length was held constant throughout the survey.

The second device was the hull mounted R2Sonic 2024 multibeam system (MBES) with the advantage to obtain seafloor bathymetry and multifrequency backscatter map simultaneously. The disadvantage compared to the SSS are the lower area coverage, and no complete coverage of the investigation area could be achieved for time reasons. Before each hydroacoustic survey a sound velocity profile (SVP) was recorded to determine the raytracing of the acoustic waves through the water column during the postprocessing.

5.1.1 Methods

Multibeam system (MBES) R2Sonic

Seafloor bathymetry and multifrequency backscatter data were recorded by using the hull mounted MBES R2Sonic. The MBES was operated by (mostly) using a swath width of 140 deg and a 400 kHz recording frequency. Best results (based on waterfall mode observation in the recording software) were achieved with the following settings: pulse length 15 µs, gain 7 dB,

spreading 40, absorption according to frequency 30/80/110. Vessel speed during MBES data acquisition was 4.5-5 knots. During the cruise, no processing software was available for a screening of the recorded data quality (Figure 5.1.1). For a later processing the software QPS Marine software solution was used. In addition, the MBES was used to localize the positions of the eddy correlation lander once deployed on the seafloor (Figure 5.1.2).

Sidescan echosounder system (SSS)

For sidescan backscatter data, the dual frequency (100/500 kHz) Klein Marine System, Series 4000 was used. Additionally, a USBL transponder (see paragraph EvoLogics S2C R for system description) was attached to the SSS to improve the positioning (Fig. 5.1.3). The system was towed 13-17 m over ground distance with a vessel speed of 4.5 knots resulting and a ground coverage of 120 m on port and starboard. Water column stratification, which significantly reduces data quality was partially observed during data recording but could not be fixed, as it was not possible to tow the sidescan towfish below the interface. Onboard data were processed with the program SonarWiz 7 by Chesapeake. The processing on board included slant range correction, auto time-variant-gain correction, empirical gain normalization, nadir filter and layback correction. The resulting backscatter map was used to determine sampling location in both areas.

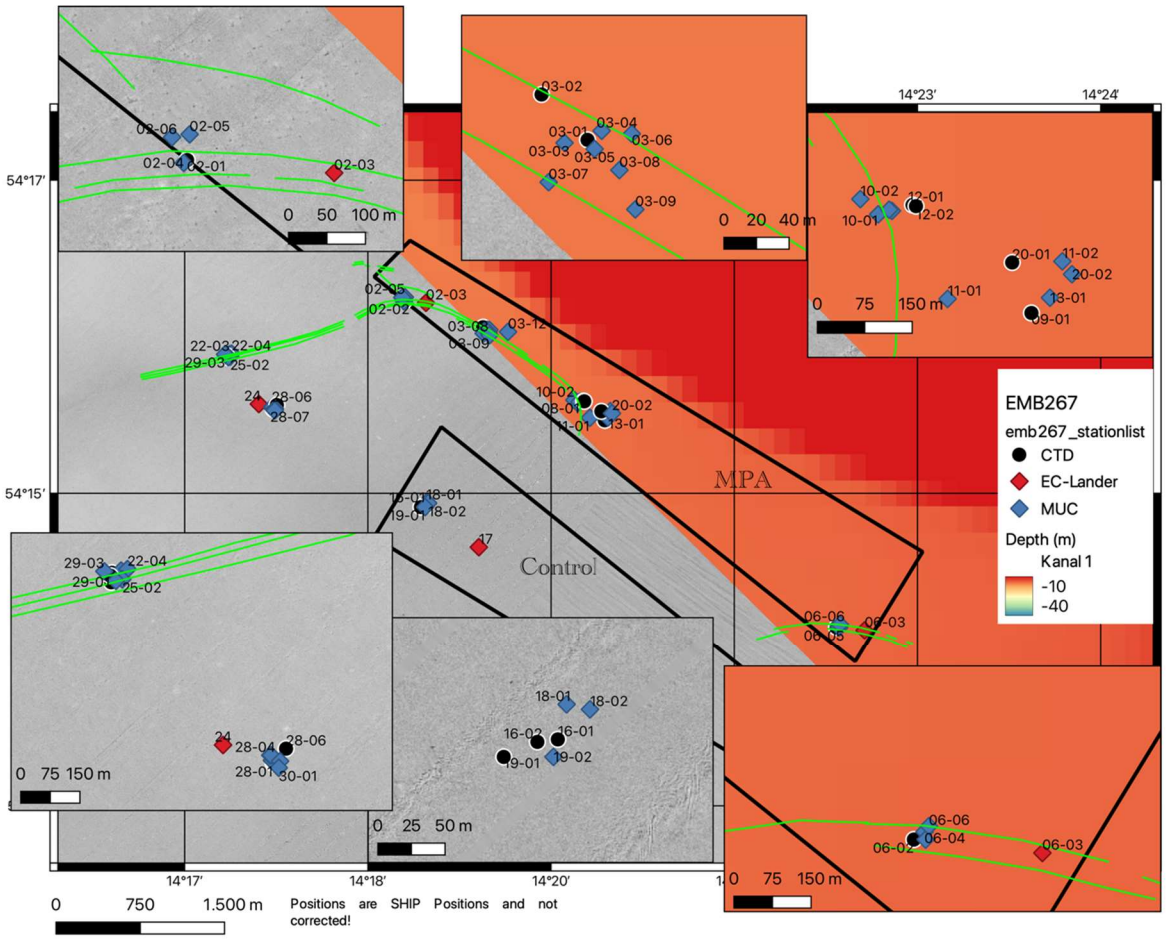


Figure 5.1.1 Overview of station during EMB267-Leg 1. Bright green line represents the approximate position of identified trawl marks. Inset show the distance of the individual station to the nearest identified trawl

mark.

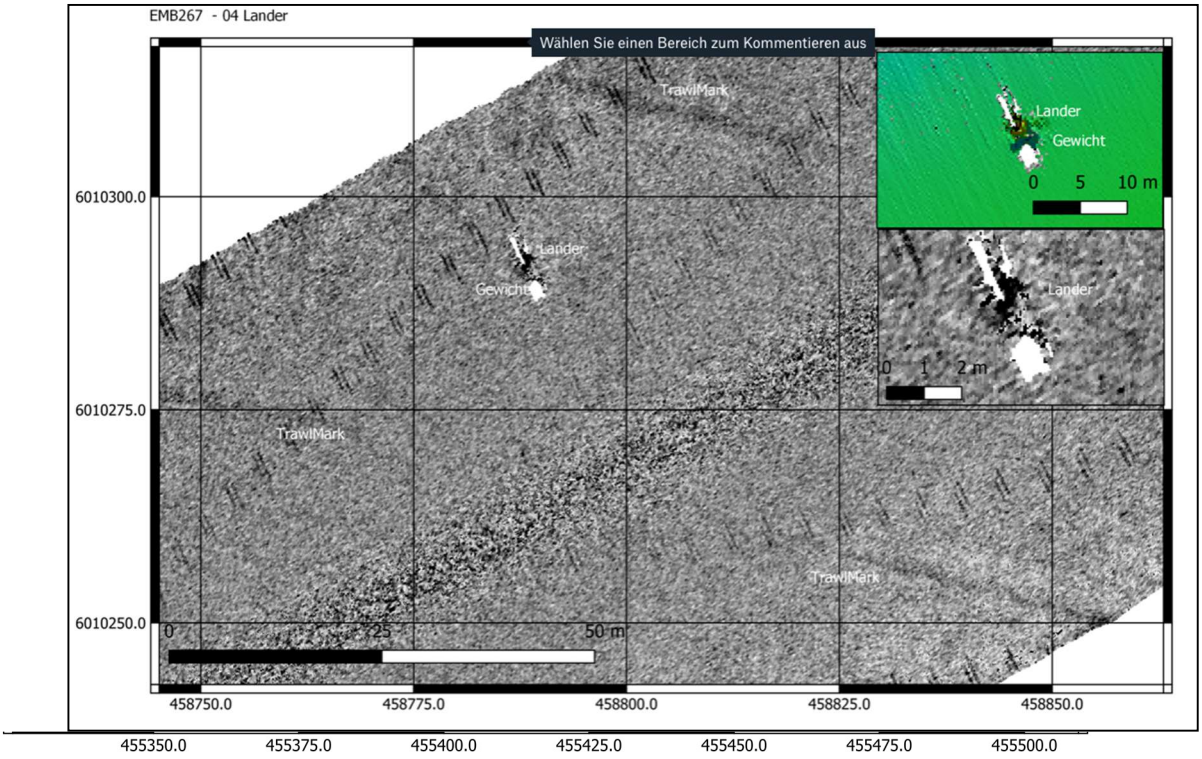


Figure 5.1.2 The eddy correlation lander is localized using MBES bathymetry and backscatter information.

EvoLogics S2C R ultrashort baseline (USBL) positioning System

The ultrashort baseline (USBL) positioning System is an underwater positioning system designed for shallow water operation to a maximum operation depth of 200 m and an operation range of 3500 m. The USBL transceiver is mounted to the vessel hull and communicates (13,9 kbps) within a frequency range of 18 -34 kHz with a transponder attached to a target device. It is possible to use the USBL system to track multiple targets at once, that on the EMB238 the SSS and the Lander system could be tracked parallel. The USBL measures the travel time between the transceiver and the transponder to determine the distance between the instruments. By using the phase-difference method, the transceiver (consisting of multiple hydrophones) computes the angle to the transponder to calculate the relative position. By implementing the USBL SINAPS client recording software (by EvoLogics GmbH) to the AHRS and GPS ship sensor, the positions of the transponders are displayed and recorded as real-world coordinate.

Sediment samples

At each sampling location a short core was taken for sedimentological and geophysical analysis. The short cores were sealed directly after recovery and stored in an upright position (Figure 5.1.3). Some of the cores are used for x-ray imaging (Itrax), with the aim to visualize sediment density changes caused by bioturbation processes. The remaining short cores will be used to test vertical core logging, with the aim to measure p-waves velocity, shear strength and grain size with a resolution of 1 cm. Grain size analysis will be based on porosity samples taken by WP 1.2

Figure 5.1.3 Sidescan system with mounted USBL positioning system

5.1.2 Expected results

The trawl marks identified in the fine-sand Oderbank area and the distance to the individual MUC stations are indicated in figure 5.1.1. In the Fehmarn Belt, a hydroacoustic time series was established, to determine the morphological changes of trawl marks from one year to the next. While the time-series analysis is not finished, first maps of the Fehmarn Belt Control area were processed on board and are show in figure 5.1.4.

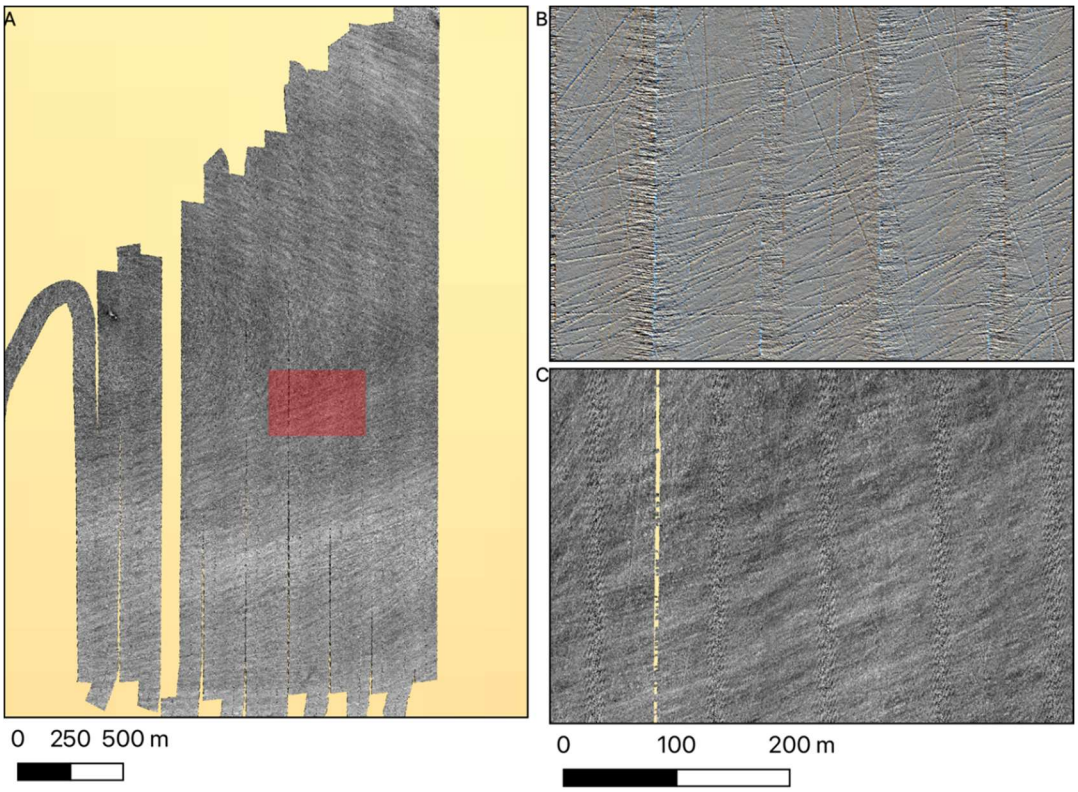


Figure 5.1.4 (A) Backscatter map of the Fehmarn Belt Control Area. The impact of trawl marks on bathymetry (B) and local backscatter (C) is apparent.

5.2 Biogeochemical processes in the surface sediments (WP 1.2)

(P. Roeser, M. A. Zeller, M. E. Böttcher)

5.2.1 Methods and sampling on board

Sediments and pore-waters

Biogeochemical processes in the sediments are evaluated by the coupled analysis of the solid and liquid phases of the sedimentary milieu. Establishing intercorrelations and connections between biogeochemical processes and other aspects of the benthic ecosystem is a central aspect of the MGF. Thus, MUC cores for further assessing the sediments' particulate phase and pore waters' composition and stable isotope signatures, were always taken from the same MUC casts and as close as possible to the cores used for sulfate reduction rate (SRR) investigations (also WP 1.2), and selectively in parallel to cores used for microbiome/prokaryote investigations (WP 2.1). In addition, all cores used for pore water extraction were later sampled by slicing the solid phase, for assessing the biodiversity of the macrofauna (WP 3.2). All cores sampled for sediments and pore-waters were photo-documented.

Sediment cores for solid phase analysis were sliced in 1cm steps in the upper 5 cm interval, and in 2 cm steps below until core bottom. Sediment slices were split in two major fractions which were both frozen (-20°C), one of which was conserved in 10 ml Zinc acetate solution. For the upper slices (1 cm thick), each fraction was made of half a slice. For the 2 cm thick slices, ¼ of a slice was enough for each sub-sample. Any remaining material was discarded. The freeze-dried sediments will undergo selected geochemical analysis for their inorganic and organic composition, e.g., total organic carbon (TOC), total inorganic carbon (TIC), and Mercury contents. In the fraction preserved in Zinc acetate, the contents of Chromium-reducible Sulfur (CRS) and Acid volatile Sulfur (AVS) will be determined. Aside that, a third sub-sample type from each sediment slice with a defined volume of 2 mL was sampled with a syringe (plastic, top cut off) during slicing procedures. This latter sample will be used for determination of sample dry weight, and calculations of dry bulk density and porosity. Afterwards it will be used for grain size determinations by laser analysis (WP 1.1). In addition, pH values were measured from the sediments for each sampled depth, with an ion-selective electrode introduced directly into the moist sediment before slicing the individual samples. In case of spatial heterogeneity of pH values, maximum and minimum values were noted. A total of 9 MUC cores were sliced for sampling their sediments, generating 90 sampled depths, and a total of ca. 270 sediment sub-samples (Table S1). The sampling resolution for pore water extraction was of 1cm steps in the upper 5 cm – beginning at the sediment water interface, 2 cm steps below that until 15 cm depth, and 5 cm steps below that. The exact sampling depths may vary +/-2cm according to the core characteristics, e.g., surface sediment inclination, lithology, and pore water flow rates. Pore waters were extracted from pre-perforated liners, using rhizones (Rhizosphere,Wageningen, The Netherlands, 0.2 um pore width) and 10 mL plastic syringes. The sampling was initially planned to be undertaken in a cold room, however, due to technical problems with the ship, the lab temperature varied around 20°C. Water above the sediment-water interface (SWI) was siphoned and further sampled at selected stations. To guarantee pore-water flow, topmost waters were siphoned to 5 to 8 cm above the SWI. Pore water extraction was initiated from the topmost samples, usually extracted one-by-one until 5 cm

core depth, below which extraction was either undertaken for individual samples or in parallel. Pore waters were sub-sampled for distinct future analysis in the (Isotope) Biogeochemistry Group at IOW: (a) metals by ICP-OES, (b) dissolved inorganic carbon (DIC) and its' stable isotope signature ($DI^{13}C$) by continuous-flow isotope-ratio-monitoring mass spectrometry, (c) sulfides by spectrophotometry, (d) nutrients by an autoanalyzer, (e) total alkalinity by titration and (f) water isotopes by laser CRDS. The sub-samples were preserved and/or treated according to the analyses to follow with (a) HNO_3, (b) HgCl, (c) Zn acetate, (d) frozen, or with (e) HCl. Aside the nutrient samples, all samples were stored at 4°C. Usually, an approximate volume of 15 mL guaranteed obtaining all sub-samples. Values of pore waters' pH were obtained directly after extraction measured with an ion selective electrode, either from individual samples if enough water was available, or measured in the same vial-sample which will be used for nutrient analysis. Pore waters were extracted from 16 MUC cores, accounting for some selected replicate stations, generating a total of 162 sampled depths, and about 1,000 pore water sub-samples (Table S2).

First cores obtained with DZMB multicorer (MUC) had a maximum penetration depth of circa 20 cm, as recovery sediment depth was restricted by occurrence of shell layer at that depth (Figure 5.2.1 A, C). Addition of weight to the MUC gear and reducing the number of liners (thereby reducing the overall sediment penetration area) allowed recovery beyond the initial 20 cm sediment depth (Figure 5.2.1, B).

After achievement of deeper sediment recovery exceeding 20 cm, by adaptations in the MUC equipment, a distinct dark organic rich layer was found below the shell layer. In the field it was interpretated as a possible paleo-peat deposit. This was documented especially for station 29_3. To further characterize this layer, samples for radiocarbon dating were taken at the contact between this organic layer and the overlaying shells (Figure 5.2.1 D, E, F).

Water column

In intending to assess benthic and sedimentary biogeochemical processes, knowledge on the bottom waters and their interaction with the upper water column are essential to assess potential elements sources and fluxes. Water column characterization was undertaken mainly with the CTD equipped at the EMB, through which double sensor measurements of the following parameters were obtained: conductivity, temperature, salinity, dissolved oxygen; in addition to chlorophyl-*a*, turbity, and density values. Aside the automatized sensor measurements, water samples were taken at selected water depths. Usually a first profile was run, to have an overview of water column characteristics and stratification, allowing to identify sampling depths of interest. Water was sampled in a second run during the downcast, and by automatized bottle closing, mostly in four selected water depths. The only manually closed bottles were those of the bottom water, in order to allow closest proximity to the sediment water interface through visual inspection using the equipped cross laser system. During Leg 1, usually the CTD runs were conducted as first station during the mornings, followed by the MUC deployments. Only exception was the 07.06 with alternating stations.

For the biogeochemistry working group, water samples were taken with the CTD, in general from 4 different water depths, and for same future analysis as the pore waters, however in larger volumes; (a) metals by ICP-OES, (b) dissolved inorganic carbon (DIC) and its' stable isotope signature ($DI^{13}C$) by continuous-flow isotope-ratio-monitoring mass spectrometry, (c) nutrients by an QuAAtro autoanalyzer, (d) total alkalinity by titration and (e) water isotopes by laser CRDS.

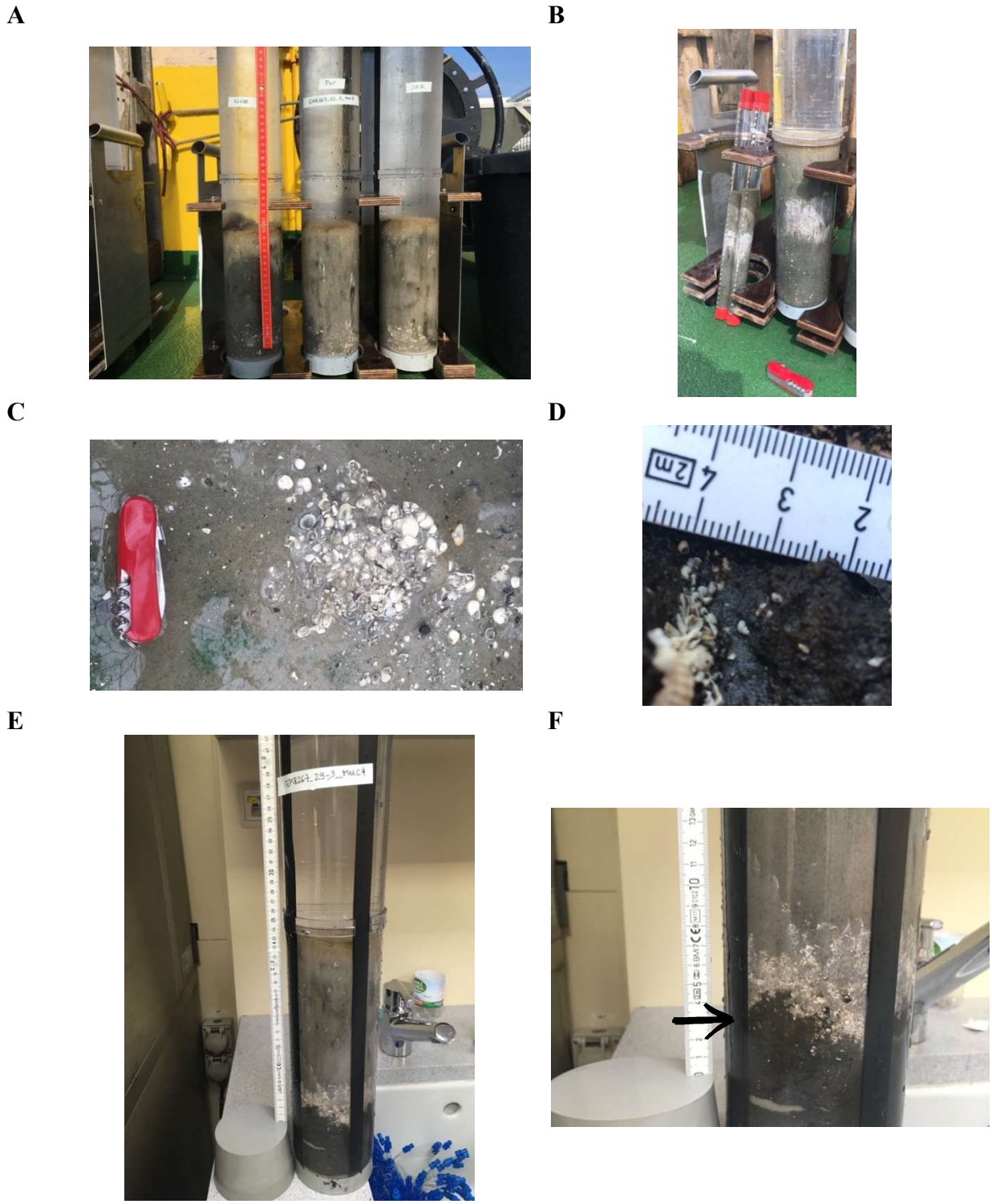


Figure 5.2.1 (A) Exemplary parallel MUC cores from station 22_3, as chosen for slicing, pore water extraction and Determination of Sulfur reduction rates (SRR); (B) sub-sampled small liners for SRR, and typical shell layer lithology of the Oderbank sediments between circa 15-20 cm core depth. (C) Content details of shell layer as found on deck. (D) Detail of snails found in the organic layer (limnic assemblage?). (E) Pore-water extraction core of station 29_3 MUC cast 4, with organic peat below the shell layer. (F) Detail of 29_3_MUC4 with arrow indicating sample depth for radiocarbon analysis.

The sub-samples were preserved and/or treated according to the analysis to follow with (a) HNO_3, (b) HgCl, (c) Zn acetate, (d) frozen, (e) HCl. In addition, pH values were measured on site.

A total of 9 water column stations was processed during Leg 1, with circa 4 water depths samples in each. Summing to that the bottom waters sampled siphoned from MUC cores, a total of 40 water depths were sampled during EMB267, generating a total of 216 water column sub-samples, only for WP1.2 (Table S3).

5.2.2 Tentative results and planed investigations

Sediments and pore waters

Aside pH measurements of moist sediments and pore-waters, no other analytical measurements were undertaken on board in the frame of this working package. To date, both sample types are being processed. First results herein are of bulk sediment characterization (Table 5.2.1), pH, and selected ICP measurements of pore-waters.

The sediments' water content and the derived dry bulk density and porosity values are in agreement with expectations according to previous knowledge from the overall Oderbank deposits (e.g. Lipka et al., 2018, Table 5.2.1, Figure 5.2.2, a), with average water content about 25 w% and porosity values of 0.46 (Table 5.2.1). The depth profiles show a slight increase in porosity in the upper 2-3 cm, which then return to values approximated to those from the surface sediments. Overall, the porosity trends in the sandy material are rather constant around the average value.
The pH values measured from the MUC sediments and from the extracted pore waters show an overall consistency within the Oderbank area, variating within the same ranges. Between surface down to approximately 15 cm, the pH values range between ~7 to 8.5. Below this depth, the pH range is smaller, variating between ~7.3 and 7.95 (Figure 5.2.2, b).

First results were obtained in the home laboratory for pore water chemical composition, given as concentrations of dissolved Na, K, Mg, Ca, Li, Ba, S, Mn, Fe, and P. The data are summarized herein for simplicity reason. From pore-water compositional *clr*-biplots, the first three axis explain together 93% or the variability retained in the dataset. The *clr*-biplots show that most of the variance is retained in the distribution of Fe, Mn, Si, and P, and as expected this variance is linked to the depth in the sediment profile (Figure 5.2.2, c). The behavior of the other metals shows smaller variance with respect to each other. Exemplary, the depth profiles of dissolved P, Fe and Mn are shown (Figure 5.2.3). Their concentrations in the pore waters of sandy Oderbank sediments is in the lower range when taken in comparison to other sites in the Baltic (e.g., compare Lipka et al., 2018); Phosphorous up to 15 µM, Manganese up to 6 µM, and Iron up to 12 µM. The Fe

Table 5.2.1 Bulk sediment characterization (n=90): gravimetric water contents estimated in doubles, from whole frozen samples and samples with defined volume; calculated dry bulk density; calculated porosity. Assuming a particle density of 2.65 g/cm^3. Stdev=Standartdeviation.

Parameter	Water Cont. Grav. [%] Whole sample	Water Cont. Grav. [%] 2 mL sample	Dry Bulk Density [g.cm^{-3}]	Porosity
Average	24.8	24.5	1.43	0.46
Stdev	2.1	1.87	0.04	0.04
Median	24.3	24.5	1.43	0.46
Maximum	31.9	30	1.76	0.55
Minimum	21.6	21.4	1.18	0.33

concentrations are generally more elevated in the pore waters of the upper few cm in the sediment column, whereas Mn concentrations show a general trend of increasing downcore, with exception of two sites (10_3 and 29_3, see also Figure 5.2.1 e). Accordingly, compositional statistical summary, analyzed for the individual depth intervals show that in the group of the upper 5 cm (n=69), Mn and Fe have consistently the highest variances with respect to the other elements.

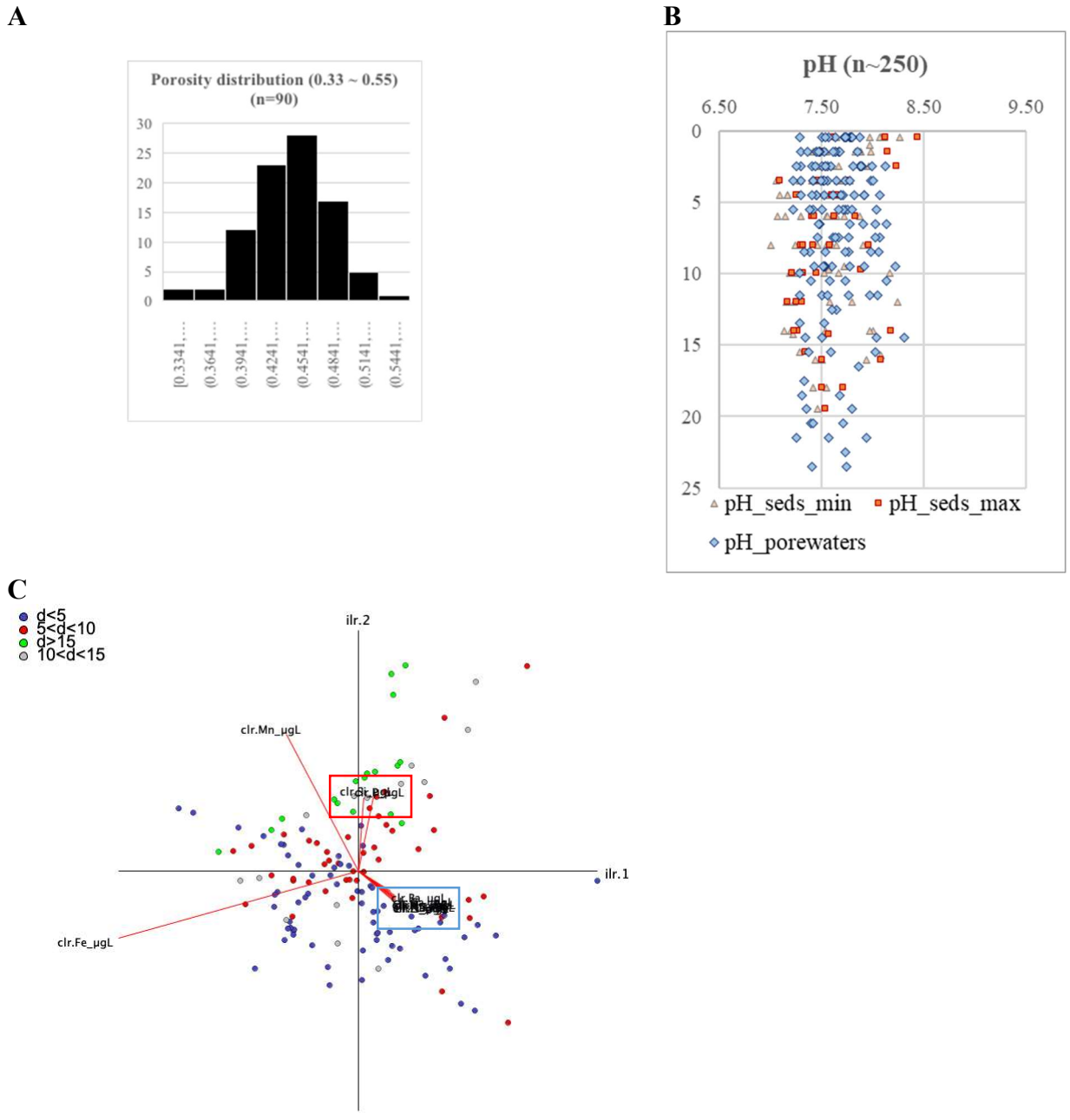


Figure 5.2.2 (a.) Overal distribution of porosity for the Oderbank sediments (n=90); (b) pH values from upper ca 25 cm of Oderbank deposits, obtained on-board for pore-waters (PW, n~160), and for moist sediments (n~90), the latter shown as maxima and minima values, due to spatial heterogeneity encountered within the samples; (c) *clr*-biplot of geochemical composition of pore waters from Oderbank. In the biplot, "d" stands for the depth, in 5 cm intervals; red rectangle surrounds Si and P, while blue rectangle highlights Na, Mg, Ca, K, Ba and Sr.

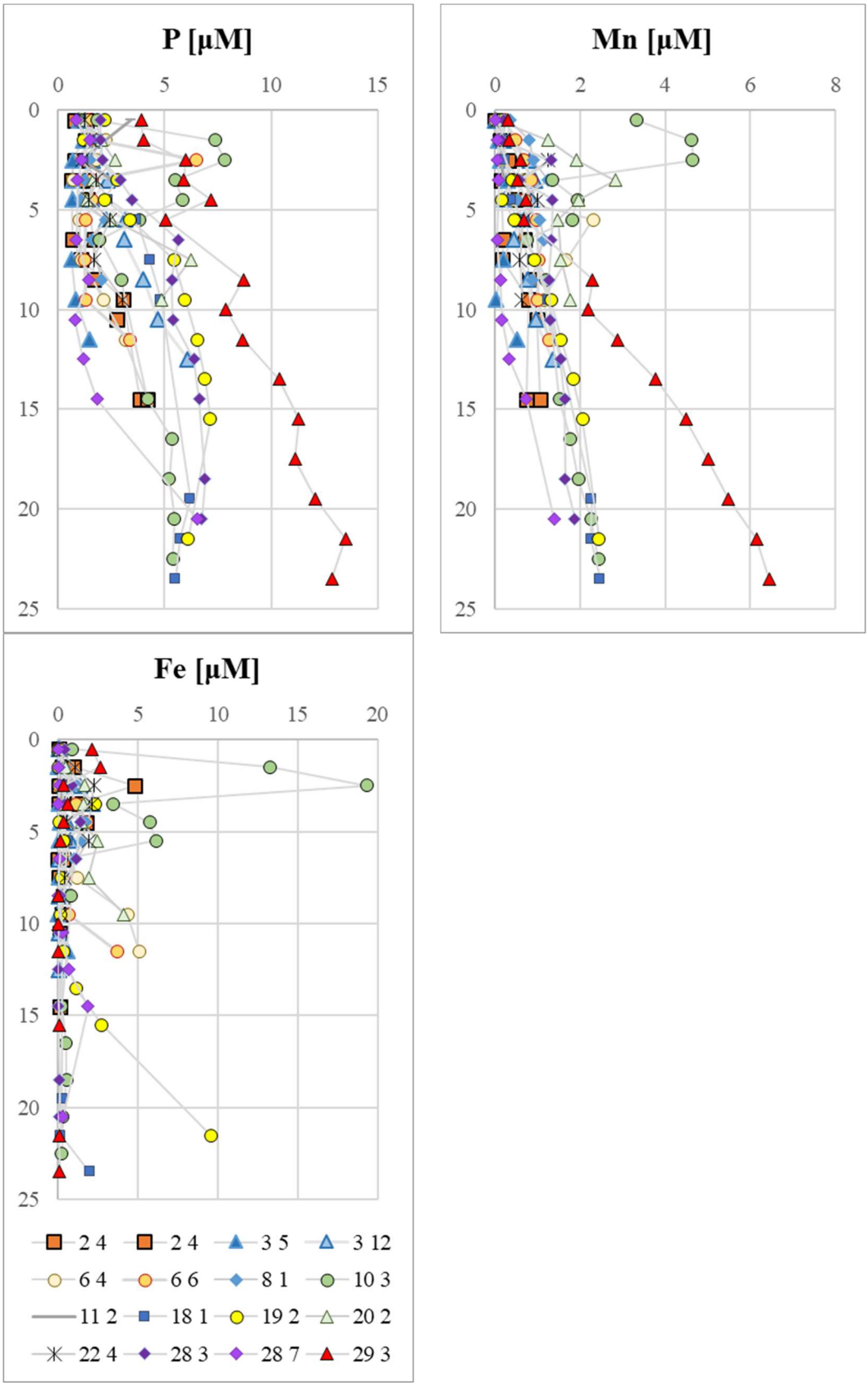


Figure 5.2.3 Depth profiles of selected dissolved elements in Oderbank pore waters (d) phosphorous and the redox sensitive elements (e) iron and (f) manganese. Legend shows the cruise station and gear numbers. (n~160)

Water column

During Leg 1, EMB267 accompanied a freshening of the uppermost water at the Oderbank, eventually related to freshwater input. At the same time, a change in slope in the salinity versus density plot is observed (Figure 5.2.5, at density 5.5 and salinity 8.25), which could suggest two different water masses: the bottom waters (density >5.5), and an upper mixing zone (density <5.5). Planed measurements of water isotopes should further support this aspect. Apparent anomalous values of enhanced salinity at densities <5, for the period between 07 – 09 of June, correspond to the days with temperatures higher than 17 °C in the uppermost 5 meters of the water column (Figure 5.2.4 a).

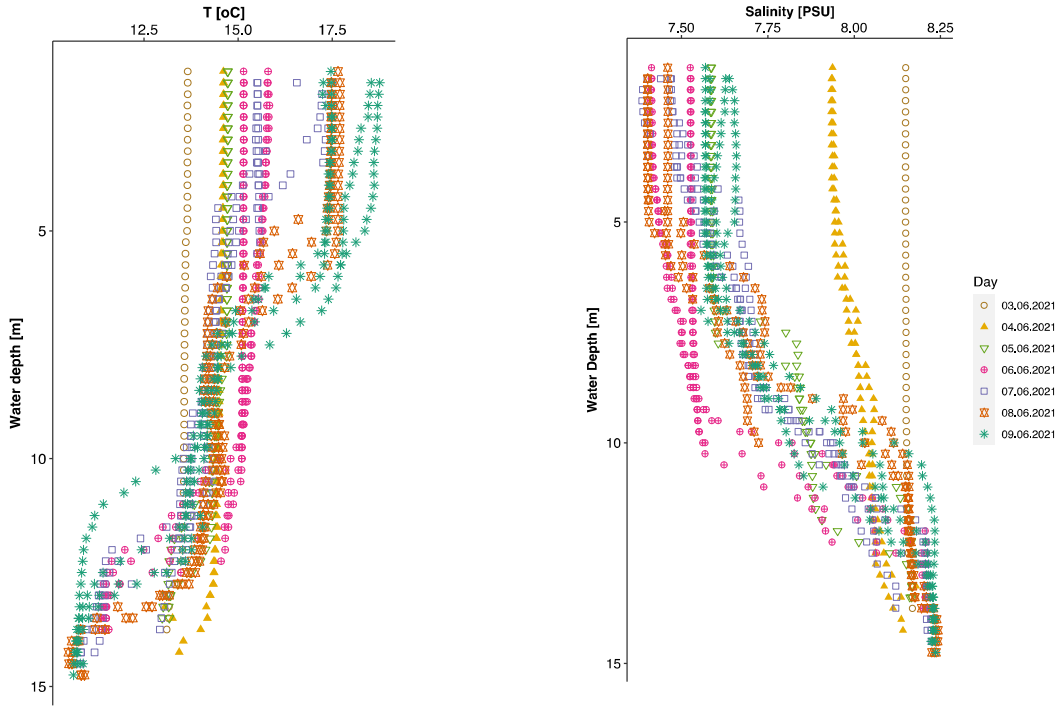


Figure 5.2.4 Temperature and salinity profiles at the Oderbank between the 3rd of June and the 9th of June.

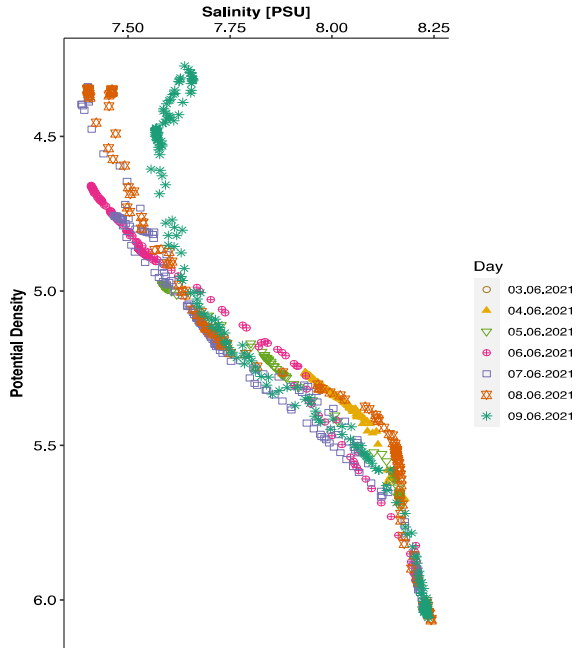


Figure 5.2.5 Salinity versus potential density EMB267

5.3 Sulfate reduction rate measurements (WP 1.2)

(J. Kallmeyer, A. Kitte)

5.3.1 Method

Sulfate reduction rates (SRR) were quantified using incubations of intact sediment cores with radioactive $^{35}SO_4^{2-}$ radiotracer (Jørgensen, 1978). Using a single MUC core per sampling site, three 40 cm-long acrylic tubes (30 mm OD, 24 mm ID) were pushed vertically into the sediment to retrieve mechanically undisturbed subcores. Each tube has a single row of 2 mm holes drilled in 1 cm resolution drilled along its side, the holes are sealed with silicone, to avoid seepage of porewater but allow injection of radiotracer. The acrylic subsampling tubes had to be hammered into the MUC cores because of sandy sediment and shell layers. However, major compression was not observed. Subsampling tubes contained between 13 and 22 cm sediment with bottom water on top. Immediately after retrieval of the MUC, the core was subsampled and the three subsampling tubes stored in an incubator at approximately in-situ temperature (10 °C). After termination of deck operations in the afternoon all samples from this day were incubated. Bottom water except for approximately 5 mL was siphoned off. For incubation, 200 kBq of radiotracer was injected into each hole from the sediment-water interface down to the bottom of each core. Immediately after injection of radiotracer, the core tube was put back into the incubator and incubated for 24 hrs. Incubations were terminated by pushing the sediment out of the subsampling tubes, slicing them into depth sections and transferring the sediment into 50 ml centrifuge tubes, filled with 10 ml of 20% (w/v) zinc acetate solution. Before slicing, the remaining bottom water was siphoned off with a syringe and treated the same way as sediment samples. The following depth resolution was used on all cores:

0-6 cm: 1 cm
6-10 cm: 2 cm
10-20 cm: 5 cm

The vials were thoroughly shaken to break up all sedimentary structures and effectively stop all microbial activity. Due to space limitations on board the samples could not be frozen but were stored at room temperature for the remainder of the cruise. Additionally, from the bulk leftover sediment of each sampled MUC, a sample was taken, followed by injection of 15 µL radiotracer and immediate mixing with Í10 mL, 20 % (w/v) zinc acetate solution These Time Zero blank samples are treated like regular samples. A total of 299 samples were collected.

5.3.2 Expected and preliminary results

No analyses were performed on board. Upon return to the home lab at GFZ Potsdam the biologically produced radioactive reduced sulfur species (TRIS, total reduced inorganic sulfur) is currently extracted from the sample using cold chromium distillation (Kallmeyer et al., 2004).

5.4 Benthic flux measurements using the aquatic eddy correlation technique (WP 1.3)

(D. Clemens)

5.4.1 Method

In-situ oxygen fluxes across the sediment-water interface were measured by aquatic eddy (EC) correlation technique using the GEOMAR EC-lander (Figure 5.4.1). The lander's centerpieces are a Nortek acoustic doppler velocimeter (ADV) in combination with 2 Pyroscience Piccolo2 ultra-high-speed fiber-optic oxygen (O_2) probes. Together they are used to measure turbulent vertical fluxes of oxygen close to the sediment-water interface (Berg et al. 2003, Huettel et al. 2020). The O_2 sensors were 2-point calibrated whilst they were installed on the lander before and after each deployment with seawater of 0 and 100 % air saturation. Additionally, auxiliary sensors are attached to the lander's frame include an independent Aanderaa oxygen optode, a SBE 37-SM CTD and a GoPro camera. After each lander deployment, its position at the seafloor was precisely mapped using the ship's Multibeam Echosounder.

5.4.2 Expected results

We performed 3 EC deployments in the control area and the MPA of the Oder Bank respectively (6 total, Figure 5.4.1 right panel). With the upcoming data analysis, we will determine O_2 fluxes in combination with oceanographic parameters for both the MPA and the respective control area. O_2 fluxes over multiple diurnal cycles in the sandy sediments of the Oder Bank will become available. This will provide a measure of the organic matter degradation rates.

The precise position data of the lander on the sediment will allow to interpret the O_2 fluxes in context with the results of the geophysical working group concerning measures of trawling impacts.

Figure 5.4.1 The EC lander during deployment (left) and at the seafloor (right) of the Oder Bank at 15 m depth.

5.5 Prokaryotes (WP 2.1)

(Judith Piontek)

The major goal of this work package is to investigate how bottom trawl fisheries affect the composition and functioning of benthic prokaryotic communities. Prokaryotic cell numbers, heterotrophic activity, the phylogenetic composition and the functional potential of communities in sediment samples from the surface to 15-20 cmbsf will be analysed. Total abundances will be quantified by fluorescence microscopy using a DNA-binding dye. On-board incubations were conducted to estimate rates of enzymatic protein hydrolysis and heterotrophic biomass production,

respectively. The phylogenetic community composition will be analysed by partial sequences of the 16S rRNA using high-throughput sequencing. Furthermore, metagenomic and -transcriptomic approaches will be used to assess the functional potential of the communities. The analysis of gene abundances and gene expression patterns will be focused on metabolic processes that are directly linked to important sediment ecosystem services. These processes include carbon remineralization, the release of inorganic nutrients and transformations within the sulfur cycle at the sediment-water interface.

5.5.1 Methods

At eight stations, four located in the envisaged exclusion zone and four in a reference area, sediment cores were collected by MUC hauls. For the enumeration of prokaryotic cells, 16S rRNA amplicon sequencing and analyes by *omics* techniques, seven discrete samples evenly distributed over the whole core length were collected. Three replicate cores were sampled at each station. Samples were stored frozen until further analysis. Heterotrophic activity was analyzed on board in surface sediment samples. For this purpose, rates of leucine-aminopeptidase were determined using the fluorescent substrate analogue 7-amino-4-methylcoumarin. Prokaryotic biomass production was estimated from the uptake of ^{3}H-leucine. In addition to the sediment sampling, water samples were collected at 6 m and at bottom depth by a rosette sampler for the analysis of the phylogenetic community composition. Stations and sampling efforts are summarized in Table 5.5.1.

Table 5.5.1 Sampling of sediments and water column for the analysis of benthic prokaryotic communities at Oderbank (MPA: Marine Protected Area, REF: Reference Area).

Station/ Cast	Area	Gear	Sample Type	Sampling Depths	Analysis
2-2	MPA	CTD/Rosette	Water	6 m, 13 m	Cell counting, 16S rRNA amplicon sequencing
2-4	MPA	MUC	Sediment	0-1 cmbsf	Cell counting, Heterotrophic activity
2-6	MPA	MUC	Sediment	Core 1: 0-1, 1-2, 2-3, 3-4, 8-9, 9-10, 10-11 cmbsf Core 2: 0-1, 1-2, 2-3, 3-4, 6-7, 8-9, 10-11 cmbsf Core 3: 0-1, 1-2, 2-3, 3-4, 6-7, 8-9, 10-11 cmbsf	Cell counting, 16S rRNA amplicon sequencing, *omics*
3-1	MPA	CTD/Rosette	Water	6 m, 13 m	Cell counting, 16S rRNA amplicon sequencing
3-5	MPA	MUC	Sediment	0-1 cmbsf	Heterotrophic activity
3-12	MPA	MUC	Sediment	Core 1: 0-1, 1-2, 2-3, 3-4, 6-7, 8-9, 10-11 cmbsf Core 2: 0-1, 1-2, 2-3, 3-4, 6-7, 7-8, 8-9 cmbsf Core 3: 0-1, 1-2, 2-3, 3-4, 6-7, 8-9, 10-11 cmbsf	Cell counting, 16S rRNA amplicon sequencing, *omics*
6-1	MPA	CTD/Rosette	Water	6 m, 13 m	Cell counting, 16S rRNA amplicon sequencing
6-4	MPA	MUC	Sediment	0-1 cmbsf	Cell counting, Heterotrophic activity
6-6	MPA	MUC	Sediment	Core 1: 0-1, 1-2, 2-3, 3-4, 6-7, 8-9, 10-11 cmbsf Core 2: 0-1, 1-2, 2-3, 3-4, 6-7, 8-9, 10-11 cmbsf Core 3: 0-1, 1-2, 2-3, 3-4, 6-7, 8-9, 10-11 cmbsf	Cell counting, 16S rRNA amplicon sequencing, *omics*

8-1	MPA	MUC	Sediment	0-1 cmbsf	Cell counting, Heterotrophic activity
9-2	MPA	CTD/Rosette	Water	6 m, 13 m	Cell counting, 16S rRNA amplicon sequencing
10-2	MPA	MUC	Sediment	Core 1: 0-1, 1-2, 2-3, 3-4, 5-6, 7-8, 8-9 cmbsf Core 2: 0-1, 1-2, 2-3, 3-4, 5-6, 7-8, 8-9 cmbsf	Cell counting, 16S rRNA amplicon sequencing, *omics*
10-3	MPA	MUC	Sediment	Core 1: 0-1, 1-2, 2-3, 3-4, 6-7, 9-10, 10-15 cmbsf	Cell counting, 16S rRNA amplicon sequencing, *omics*
11-1	MPA	MUC	Sediment	0-1 cmbsf	Cell counting, Heterotrophic activity
13-1	MPA	MUC	Sediment	Core 1: 0-1, 1-2, 2-3, 3-4, 6-7, 9-10, 14-15 cmbsf Core 2: 0-1, 1-2, 2-3, 3-4, 6-7, 9-10, 14-15 cmbsf Core 3: 0-1, 1-2, 2-3, 3-4, 6-7, 9-10, 14-15 cmbsf	Cell counting, 16S rRNA amplicon sequencing, *omics*
16-2	REF	CTD/Rosette	Water	6 m, 13 m	Cell counting, 16S rRNA amplicon sequencing
18-2	REF	MUC	Sediment	0-1 cmbsf	Cell counting, Heterotrophic activity
19-2	REF	MUC	Sediment	Core 1: 0-1, 1-2, 2-3, 3-4, 6-7, 9-10, 14-15 cmbsf Core 2: 0-1, 1-2, 2-3, 3-4, 6-7, 9-10, 14-15 cmbsf Core 3: 0-1, 1-2, 2-3, 3-4, 6-7, 9-10, 14-15 cmbsf	Cell counting, 16S rRNA amplicon sequencing, *omics*
20-2	MPA	MUC	Sediment	0-1 cmbsf	Cell counting, Heterotrophic activity
22-2	REF	CTD/Rosette	Water	6 m, 13 m	Cell counting, 16S rRNA amplicon sequencing
22-3	REF	MUC	Sediment	0-1 cmbsf	Cell counting, Heterotrophic activity
25-2	REF	MUC	Sediment	Core 1: 0-1, 1-2, 2-3, 3-4, 6-7, 9-10, 13.5-14.5 cmbsf Core 2: 0-1, 1-2, 2-3, 3-4, 6-7, 9-10, 12-13 cmbsf Core 3: 0-1, 1-2, 2-3, 3-4, 6-7, 9-10, 13.5-14.5 cmbsf	Cell counting, 16S rRNA amplicon sequencing, *omics*
28-2	REF	CTD/Rosette	Water	6 m, 13 m	Cell counting, 16S rRNA amplicon sequencing
28-3	REF	MUC	Sediment	0-1 cmbsf	Cell counting, Heterotrophic activity
28-7	REF	MUC	Sediment	Core 1: 0-1, 1-2, 2-3, 3-4, 6-7, 9-10, 14-15 cmbsf Core 2: 0-1, 1-2, 2-3, 3-4, 6-7, 9-10, 14-15 cmbsf Core 3: 0-1, 1-2, 2-3, 3-4, 6-7, 9-10, 14-15 cmbsf	Cell counting, 16S rRNA amplicon sequencing, *omics*

5.5.2 Preliminary Results

First results revealed largely similar rates of extracellular aminopeptidase across the sampling stations. Only station 28-3 showed lower activity (Figure 5.5.1 A). Prokaryotic cell numbers have already been counted for three out of twenty-four profiles. In line with aminopeptidase activity, also these first profiles revealed high similarity between the stations. The profiles further showed the tendency of decreasing cell numbers with sediment depth (Figure 5.5.1 B).

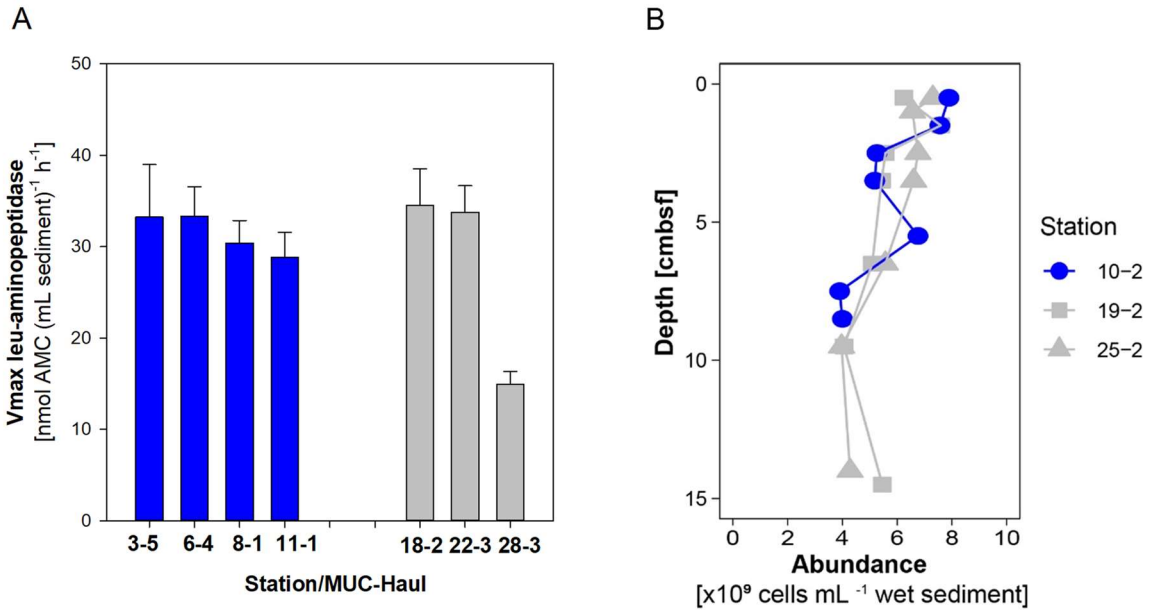


Figure 5.5.1 (A) Maximum velocity (Vmax) of extracellular aminopeptidase, (B) Prokaryotic cell abundances (blue: MPA, grey: Reference Area).

5.6 Nano-and Microfauna (WP 2.2)

(M. Sachs, H. Arndt)

Unicellular eukaryotes comprise the majority of all eukaryotic genotypes in the world's oceans (e.g. de Vargas et al., 2015; Gooday et al. 2020). Protists in the size range from 1-20 µm (nanofauna: mainly heterotrophic nanoflagellates and small amoebae) and in the size range from 20-200 µm (microfauna: ciliates, heterotrophic dinoflagellates, amoeboid protists etc.) are essential parts of the benthic food web as they channel bacterial production to higher trophic levels (meiofauna, macrozoobenthos) which in turn act as nutritional basis for demersal fish. The bacterial abundance and production are assumed to be regulated by the predation pressure of the nano- and microfauna. Thereby also a variety of geochemical processes determined by the oxygen consumption of bacteria should be influenced by protists. We assumed, that a disturbance of the sediment structure through trawling would significantly change the microbial food web and its functions.

We planned to use a combination of different methods to investigate the diversity, abundance and activity of the nano- and microfauna inside and outside of the marine protected area (MPA) in order to successfully compare the benthic nano- and microfauna of the two above mentioned areas. We used different approaches since all methods have their advantages and disadvantages (Schoenle et al., 2016). To estimate abundances and to investigate the diversity and activity of protists, we carried out sampling that allows for a combined analysis of live-counting, counting of fixed samples, and the use of metabarcoding techniques. (Figure 5.6.1).

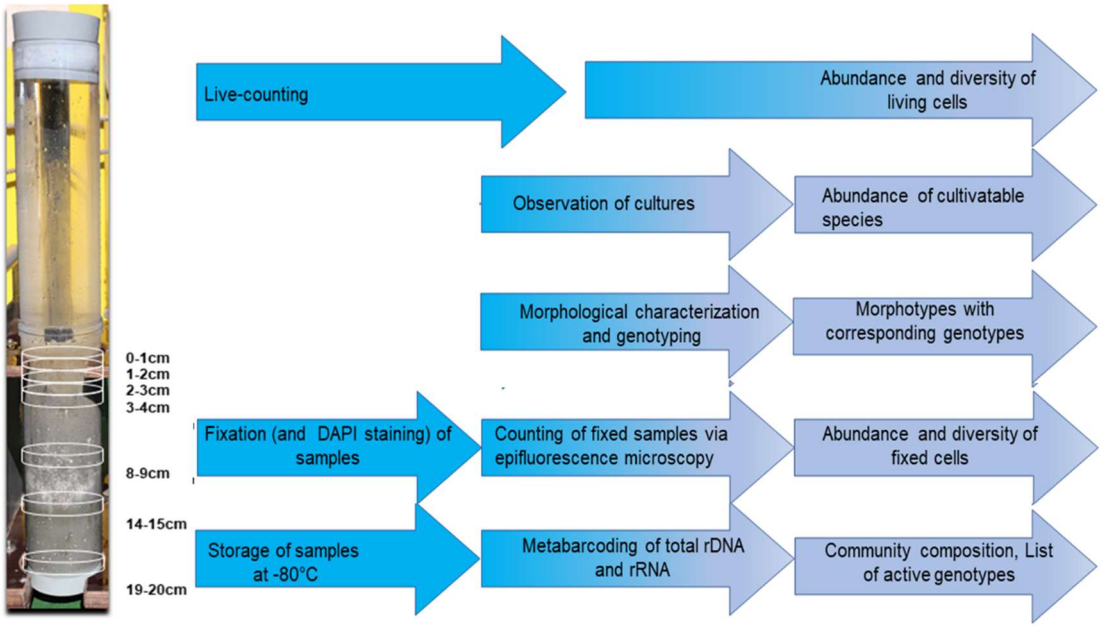


Figure 5.6.1 Sampling overview for sediment samples to estimate the abundance and diversity of benthic nano- and microfauna. During leg1 we fixed and stained samples with DAPI, established crude cultures and froze material for metabarcoding analyses. During leg2 Live-counting was conducted.

To investigate benthic protist communities regarding their diversity, abundance and activity inside the marine protected area (MPA) as well as in a reference area of this year's targeted area at the Oderbank, we estimated abundances and diversity and combined live counting on board and cultivation (leg 2), counting of fixed samples and preservation for metabarcoding analyses though rDNA and RNA (leg 1).

5.6.1 Methods

Sediment sampling:

Sediment samples were taken at 8 stations, 5 within the marine protected area, and 3 in the reference area, with the Multicorer system (MUC). Samples of each one core were utilized for fixation and cultivation (Stations 2-2, 3-5, 6-4, 8-1, 11-1, 18-2, 22-3,28-3), sediment of each 3 cores per station (2-6, 3-12, 6-6, 10-2, 13-1, 19-2, 25-2, 28-7) were used for DNA/RNA metabarcoding samples (Table 1). It was planned to slice cores in seven layers (0-1 cm, 1-2 cm, 2-3 cm, 3-4 cm, 8-9 cm, 14-15 cm, 19-20 cm). Due to a shell layer that inhibited deep cores, the position of layers had to be adapted from station to station. After MUC deployment, cores were processed as fast as possible and subsamples were stored in a cooling box to minimize possible temperature stress on the protist community.

Table 5.6.1 List of stations and sample types for benthic nano- and microfauna analyses of fixed and deep-frozen samples for molecular studies

Station	Gear	Core Nr.	Date	Sample type	Area
EMB267-02-04	MUC	10	03.06.2021	DAPI, cultivation	INSIDE MPA
EMB267-02-06	MUC	7,8,12	03.06.2021	DNA/RNA	INSIDE MPA
EMB267-03-05	MUC	10	04.06.2021	DAPI, cultivation	INSIDE MPA
EMB267-03-12	MUC	2,4,7	04.06.2021	DNA/RNA	INSIDE MPA
EMB267-06-04	MUC	12	05.06.2021	DAPI, cultivation	INSIDE MPA
EMB267-06-06	MUC	4,5,6	05.06.2021	DNA/RNA	INSIDE MPA
EMB267-10-02	MUC	1,6,8	06.06.2021	DNA/RNA	INSIDE MPA
EMB267-11-01	MUC	1	06.06.2021	DAPI, cultivation	INSIDE MPA
EMB267-13-01	MUC	1,2,4	06.06.2021	DNA/RNA	INSIDE MPA
EMB267-18-01	MUC	8	07.06.2021	DAPI, cultivation	OUTSIDE MPA
EMB267-19-02	MUC	8,9,10	07.06.2021	DNA/RNA	OUTSIDE MPA
EMB267-22-03	MUC	1	08.06.2021	DAPI, cultivation	OUTSIDE MPA
EMB267-25-02	MUC	10,11,5	08.06.2021	DNA/RNA	OUTSIDE MPA
EMB267-28-03	MUC	11	09.06.2021	DAPI, cultivation	OUTSIDE MPA
EMB267-28-07	MUC	5,7,12	09.06.2021	DNA/RNA	OUTSIDE MPA

Abundance estimation of benthic nano-and microfauna using fixed samples

With limited time on board, fixation methods are advantageous when a large number of samples have to be treated at the same time. It allows for a long-term storage and delayed observation of samples. For abundance estimations we used DAPI staining for a subsequent analysis via epifluorescence microscopy. For staining, we suspended 156 µl of fresh sediment from each layer with 2 ml filtered Baltic Sea water (obtained from CTD, filtered with pore size 0.2 µm). This suspension was then fixed with 2 ml of 4% formaldehyde to a final concentration of 2%. After approx. 8h, samples were filtered in triplicates of each 200 µl on polycarbonate filters (0.2 µm pore size) at a vacuum of maximum 200 mbar (Morgan-Smith et al., 2011) and stained with 20 µl DAPI (10mg/l) for 5 minutes). DAPI (4′,6-diamidino-2-phenylin-dole) works as a DNA-specific probe, forming a fluorescent complex by attaching in the minor grove of A-T rich sequences of DNA (Kapuscinski, 1995). Filters were applied to glass-slides and covered with a drop of oil and a cover slip and subsequently deep frozen at -20°C until further processing in the lab in Cologne via epifluorescence microscopy.

Analyses of abundance, biomass and community structure of benthic nano-and microfauna using the live-counting technique

Live counting was conducted to simultaneously quantify protists and to identify taxonomic groups, sometimes to species level (Arndt et al. 2000). Counting commenced within one hour after sampling in the laboratory, sample storage was at ambient temperatures. At each station, seven layers (generally layers 0-1cm, 1-2 cm, 2-3 cm, 3-4 cm, 6-7 cm, 9-10 cm 14-15 cm) were analysed by suspending three times 0.5 ml aliquots of sediment of the respective layer in 6 ml <0.2 µm filtered biotope water. Several aliquots of 5-10 µl of these suspensions were analysed in a miniaturised version of a Sedgewick-Rafter chamber. Enumeration took place under a phase contrast microscope (ZEISS Axioskop 50; phase contrast Neofluars and Long-Distance-Apochromates 20x, 40x). For the taxonomic identification a ≥400x magnification and the help of video recording was employed. Protozoans were determined to the level of functional groups, in

most cases to the level of families and in some cases down to the level of genera or species (e.g. following Carey 1992 Marine Interstitial Ciliates, Chapman and Hall; Jeuck & Arndt 2014). In general, we followed the taxonomic systems of Adl et al. (2019). Biovolumes of protozoans were calculated from measurements of dimensions of living organisms and approximations to simple geometrical forms.

Table 5.6.2 List of stations used for live-counting and cultivation of benthic nano- and microfauna

Station	Gear	Core Nr.	Date	Sample type	Area
EMB267-36-04	MUC	1	12.06.2021	Live-counting, cultivation	INSIDE MPA
EMB267-38-07	MUC	1	12.06.2021	Live-counting, cultivation	INSIDE MPA
EMB267-39-06	MUC	10	12.06.2021	Live-counting, cultivation	INSIDE MPA
EMB267-49-02	MUC	11	14.06.2021	Live-counting, cultivation	INSIDE MPA
EMB267-50-07	MUC	6	14.06.2021	Live-counting, cultivation	INSIDE MPA
EMB267-52-03	MUC	5	14.06.2021	Live-counting, cultivation	INSIDE MPA
EMB267-54-02	MUC	4	14.06.2021	Live-counting, cultivation	INSIDE MPA
EMB267-57-02	MUC	1	15.06.2021	Live-counting, cultivation	INSIDE MPA
EMB267-58-01	MUC	5	15.06.2021	Live-counting, cultivation	INSIDE MPA
EMB267-59-01	MUC	10	15.06.2021	Live-counting, cultivation	OUTSIDE MPA

Cultivation of benthic nano- and microfauna

Currently, most data for nano- and microfauna are obtained via metabarcoding studies. Due to many mistakes in GeneBank regarding sequences and assignment to species, it is crucial to update public reference databases with precise data on certain species. In addition, there are only a few sequence records from protists of the Baltic. Morphological and molecular identification are a prerequisite to analyse the function of protists in the benthic microbial food web and to get reliable results of the planned metabarcoding studies. Most cultures were obtained from samples taken during leg 2, since the time between sampling and the analysis of samples in the home lab was not more than 1-2 weeks. For cultivation on board, we added 1.5 ml of each of the seven sediment layers from each station to 50 ml-tissue-culture flasks filled with 20ml of autoclaved biotope water and one autoclaved wheat grain as a nutrient source for autochthonous bacteria communities to support the growth of protists. Back in Cologne, either the liquid aliquot method or a micromanipulator will be used to obtain mono-clonal cultures for genotyping and phylogeny. In addition, samples taken during leg 1 were used. Here, 156 µl of each sediment layer were suspended in 4 ml of filtered Baltic Sea water and split to two culture flasks filled with 20 ml <2 µm filtered Baltic Sea water and two grains of autoclaved quinoa to enrich co-occurring bacteria as a food source for the protists.

Environmental sequencing of benthic nano-and microfauna

For analyses of bulk DNA from sediments via metabarcoding, we sampled each 7 seven layers of sediment of 3 MUC cores per station. Approximately 20 ml of sediment per layer were shock frozen in liquid nitrogen and then immediately stored at -80°C. As a backup, 2 ml of sediment per layer of one core were fixed in 10 ml RNAlater solution and stored at -20°C.

A large proportion of DNA in marine sediments is extracellular (Dell'Anno and Danovaro, 2005). Thus, it is uncertain whether protist species, detected by environmental sequencing are actually active or if sequences originate from sedimented cells from the water column, cysts or

extracellular DNA (e.g. Stoeck et al., 2007). To reduce this bias, we will use rRNA libraries to gain information on the active part of the microbial community. Additionally, the cultivated strains (see above) should serve as a valuable reference.

Pelagic nano- and microfauna

To allow a comparison between benthic and pelagic nano- and mircofauna in terms of abundance and diversity, water samples from the depth of 6 m were taken with a CTD rosette at 4 stations of the MPA and all stations of the reference area (Table). At each station between 500-750 ml of sample water were filtered (maximum 200 mbar) in triplicates on cellulose nitrate filters with a pore size of 0.2 µm. Filters were immediately shock frozen in liquid nitrogen and stored at -80°C for subsequent molecular analysis that will be performed in Cologne.
For microscopic investigations of pelagic nano- and microfauna, each 100 ml sea water from 6 m depth were fixed with 350 µl of Lugol solution to be screened in Cologne.

Table 5.6.3 List of CTD stations (water samples) for comparison between benthic and pelagic nano- and mircofauna in terms of abundance and diversity

Station	Gear	Date	Depth	Area
EMB267-02-02	CTD	03.06.2021	6 m	INSIDE MPA
EMB267-03-01	CTD	04.06.2021	6 m	INSIDE MPA
EMB267-06-02	CTD	05.06.2021	6 m	INSIDE MPA
EMB267-09-02	CTD	06.06.2021	6 m	INSIDE MPA
EMB267-16-02	CTD	07.06.2021	6 m	OUTSIDE MPA
EMB267-22-02	CTD	08.06.2021	6 m	OUTSIDE MPA
EMB267-28-02	CTD	09.06.2021	6 m	OUTSIDE MPA

5.6.2 Preliminary results

On board, we could only obtain preliminary results from protozoan live-counting. Highest abundances of heterotrophic protists were always revealed from the two surface layers of sediment (0-2cm). Abundances at Oderbank were higher than those obtained in the previous year from studies at Fehmarn Belt (EMB 238) and in the lower range of values we obtained from the nearby coastal waters of Ruegen Island several years ago (Dietrich & Arndt, 2000). In contrast to studies of Fehmarn Belt sediments, protists were found also in the deepest sediment layers and also at sites which obviously contained no oxygen. The great advantage during cruise EMB 267 was that we could take part in a second leg and carry out live-counting of all stations which was not possible at cruise EMB 238. All molecular work and work with fixed samples with delicate protists requires an accompanying study of undisturbed living samples to analyse the presence of protists which are very sensitive to handling and fixatives (Jeuck et al., 2015). At our present stage of knowledge, it is indispensable to combine live-counting, molecular techniques and the use of fixatives. Due to live counting, we could state that the role of ciliates is increasing towards greater depth (and lower concentrations of oxygen). Forms we could register are known to contain hydrogenosomes. The diversity of protists obtained from the interstitial of the comparatively coarse sediment of

Oderbank seemed to be much higher than that we found at Fehmarn Belt. Interestingly, special protist taxa, we discovered originally in littoral sediments in nearby waters in depths of 1-2 meters were also found during our studies at Oderbank (e.g., *Amastigomonas klosteris, Multicilia marina, Discocelis saleuta, Metromonas simplex*). Regarding the microfauna, a typical interstitial fauna could be recorded (not present at Fehmarn Belt). Predators occurred already at the size class of 5µm (*Metromonas*) and among the microfauna (scuticociliates, litostomatids etc.) a complex trophic food web, obviously connected to the abundant meiofauna could be recorded. One can anticipate that the impact of ground fishery might be very different in the different regions of the Baltic from the view point of nano- and microfauna and the microbial food web. The selection of the different stations (up to now Fehmarn Belt and Oderbank) will reveal interesting comparative results.

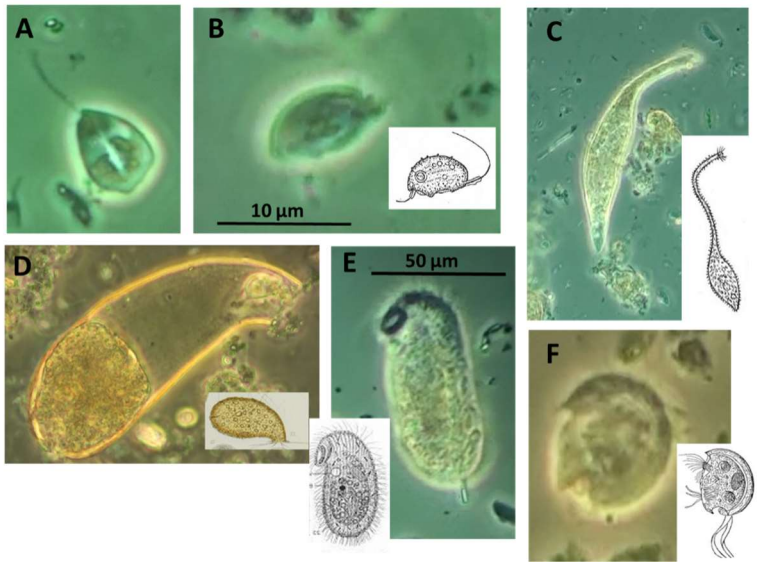


Figure 5.6.2 Examples of live nano- and microprotists from different phyla observed during direct live-counting at Oderbank (11-14m water depth). A. Petalomonas (Euglenida), B. Amastigomonas klosteris (Apusozoa), C. Lacrymaria (Ciliophora), D. Cyphoderia ampulla (Testaceafilosea), E. Cryptopharynx (Ciliophora), F. Epalxella (Ciliophora).

5.7 Microphytobenthos (WP 2.3)

(Ramona Kern)

In work package 2.3, biodiversity, biomass and primary production of microphytobenthos (MPB) will be investigated for the first time for the Natura 2000 site Oderbank. Furthermore, we want to compare the diversity and productivity of MPB in areas in which the mobile contact fisheries will be excluded (MPAs) with reference areas of similar fishing intensities, sediment characteristics etc. (control).

Primary production

The primary production was measured *in vitro* via oxygen consumption in the overlaying water phase in sediment cores (diameter 5 cm) using planar oxygen sensor spots (diameter: 5 mm) in combination with an OXY-4 Mini optode (Figure 5.7.1). The sediment cores were directly subsampled from Multicorer cores (diameter 10 cm) during the second leg of the EMB267 cruise. The oxygen measurements took place on board and were than continued in the lab. We sampled 4

stations for the MPA and 3 stations in the reference area. For each station 4 replicate cores were analysed. In total we got 28 sediment cores (Table 5.7.1).

After the incubation experiment the top centimetre was pre-incubated in the dark, the cores were incubated in a temperate water bath at 11 to 16°C. The measurement starts with a dark incubation for at least 1 h and followed by incubation at increasing light intensities.

After the incubation experiment the upper centimetre of the sediment cores were cut off, homogenised and divided into subsamples for water content and organic matter. Furthermore, the chlorophyll a, carbon and nitrogen content will be analysed.

One subsample will be used for morphological identification of diatoms.

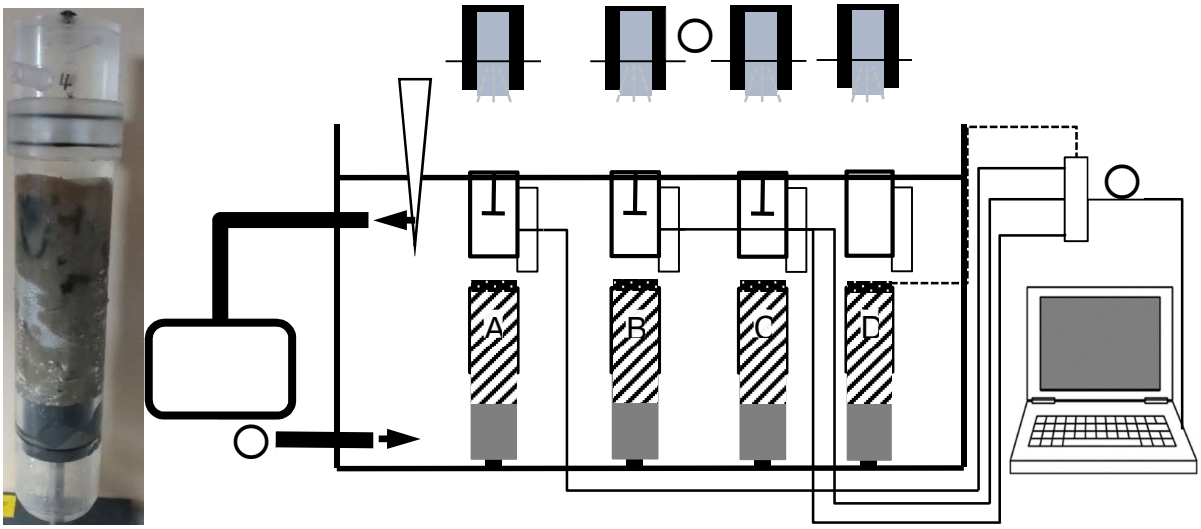


Figure 5.7.1 Sediment core with a measuring module on the top and closed with adjustable rubber plug (left) and the experimental set-up. A-D: sediment cores, 1: flow-through thermostat, 2: light source, 3: control unit.

Biodiversity

For the molecular identification of the algal community J. Piontek (IOW) and M. Sachs (Universität Köln) took samples of the upper two slices of a sediment core taken by the Multicorer during leg 1. The DNA of the samples will be isolated and corresponding marker genes will be amplified and sequenced. In the MPA area 5 stations and in the reference area 3 stations were sampled, whereby for each station 3 replicate cores (diameter 10 cm) were sliced and the first two slices (0-1 and 1-2 cm) will be analysed for MPB diversity (in total 48 samples, Table 5.7.2).

Table 5.7.1: Sediment cores for primary production taken during leg 2.

#	Area	Station-Cast	Sampling date	Measuring date
1	MPA	36-5	12.06.2021	12.06.2021
2	MPA	36-5	12.06.2021	12.06.2021
3	MPA	36-5	12.06.2021	12.06.2021
4	MPA	36-5	12.06.2021	12.06.2021
5	MPA	38-5	12.06.2021	13.06.2021
6	MPA	38-5	12.06.2021	13.06.2021
7	MPA	38-5	12.06.2021	13.06.2021
8	MPA	38-5	12.06.2021	13.06.2021
9	MPA	39-6	12.06.2021	13.06.2021
10	MPA	39-5	12.06.2021	13.06.2021
11	MPA	39-5	12.06.2021	13.06.2021
12	MPA	39-5	12.06.2021	13.06.2021
13	Control	49-2	14.06.2021	14.06.2021
14	Control	49-2	14.06.2021	14.06.2021
15	Control	49-2	14.06.2021	14.06.2021
16	Control	49-2	14.06.2021	14.06.2021
17	Control	52-2	14.06.2021	14.06.2021
18	Control	52-6	14.06.2021	14.06.2021
19	Control	52-2	14.06.2021	14.06.2021
20	Control	52-2	14.06.2021	14.06.2021
21	Control	54-1	14.06.2021	15.06.2021
22	Control	54-1	14.06.2021	15.06.2021
23	Control	54-1	14.06.2021	15.06.2021
24	Control	54-1	14.06.2021	15.06.2021
25	MPA-Lander	50-6	14.06.2021	18.06.2021
26	MPA-Lander	50-6	14.06.2021	18.06.2021
27	MPA-Lander	50-6	14.06.2021	18.06.2021
28	MPA-Lander	50-6	14.06.2021	18.06.2021

Table 5.7.2 Stations which were sampled for MPB biodiversity during leg 1. The samples were taken from J. Piontek and M. Sachs. They sampled 5 stations in the MPA and 3 station in the reference area. For each station 3 replicates in two depth (0-1 and 1-2 cm) were sampled. In total they provided 48 samples.

Area	Station-Cast
MPA	2-6
MPA	3-12
MPA	6-6
MPA	10-2
MPA	13-1
Reference	19-2
Reference	25-2
Reference	28-7

5.8 Meiobenthos (WP 2.4)

(S. Hoffmann, K. H. George, S. Khodami, P. Martínez Arbizu, J. Packmor)

The sampling took place in 2 areas of the Odra bank region; a marine protected area (MPA) and a reference site. Altogether 8 locations were sampled for meiofauna, 5 within the MPA area and 3 at the reference site (Table 5.8.1). The meiofauna sampling on board was performed by Sven Hoffmann using a Multicorer (MUC; Figure 5.8.1). Usually, the MUC is equipped with 12 cores, and each core covers a sampling area of 72.4 cm². Due to the structure of the sediment, the MUC was deployed with 8 cores only and with additional weight, to obtain samples of higher quality.

From each MUC-Haul 4 to 6 cores were taken for the meiofauna investigations. The overlaying water of each sample and the uppermost 5 cm of sediment were preserved either with buffered formalin (approx. 4 %) for the morphological investigations or with DESS (20 % solution of di-methyl-sulfoxide) for the metabarcoding. In total, 120 samples were taken, of which 60 were stored with Formalin and DESS, respectively (Table 5.8.1).

Fig. 5.8.1 A: Multicorer (MUC) prior to deployment on board, B: Three MUC cores containing benthos samples (photos: Sven Hoffmann).

Sample processing will be conducted at the laboratories of the DZMB (German Centre for Marine Biodiversity Research, Senckenberg am Meer, Wilhelmshaven). Both, the formalin and DESS-samples, will be centrifuged with 40 % Levasil® and kaolin to extract the meiofauna. For morphological faunistics, the meiofauna will be sorted manually by means of a Leica M125 stereomicroscope and benthic copepods (predominantly Harpacticoida) will be determined at species level. For metabarcoding the DNA will be extracted from the meiofauna of the DESS samples and two gene fragments, COI mtDNA and V1V2 hypervariable region of 18S rRNA, will be amplified and sequenced using MiSeq Illumina platform. Both fragments will be used to assess and compare the diversity of the meiofauna communities in general and of harpacticoid copepods in particular.

Table 5.8.1 List of stations sampled for the meiofauna investigation. MPA = Marine Protected Area, REF = Reference site

Station	Location	No. Cores	No. formalin	No. DESS
2-4	MPA1	5	2	3
2-5	MPA1	5	3	2
2-6	MPA1	6	3	3
3-4	MPA2	6	3	3
3-5	MPA2	5	3	2
3-6	MPA2	6	3	3
6-4	MPA3	4	2	2
6-5	MPA3	4	2	2
6-6	MPA3	6	3	3
8-1	MPA4	5	3	2
10-1	MPA4	6	3	3
10-2	MPA4	5	2	3
10-3	MPA4	4	2	2
11-1	MPA5	4	2	2
11-2	MPA5	4	2	2
13-1	MPA5	4	2	2
18-1	REF1	4	2	2
18-2	REF1	4	2	2
19-2	REF1	4	2	2
20-2	MPA5	4	2	2
22-3	REF2	4	2	2
22-4	REF2	4	2	2
25-2	REF2	4	2	2
28-4	REF3	4	2	2
28-5	REF3	4	2	2
30-1	REF3	5	2	3
Total		**120**	**60**	**60**

5.9 Macrozoobenthos (WP 3.2)

(M. Gogina, S. Forster, M. Powilleit)

5.9.1 Method

The sampling of the benthic macrofauna (responsible Mayya Gogina, Stefan Forster, Martin Powilleit) was performed mostly in the second part of the cruise (11/06/2020 – 16/06/2021) using a van Veen grab (75 kg, sieve lid) with a sampling area of 0.1 m² and Multicorer (MUC, provided by DZMB, OKTOPUS GmbH version MC 08-12) with each core tube sampling area of 0.00709 m². Successive fractionated sieving (1.0 mm and 0.5 mm) of sediment material from 33 grab hauls was carried out (15 and 18 hauls from future exclusion area inside MPA and reference area outside MPA, respectively). Collected samples (Figure 5.9.1, Table 5.9.1) will be sorted at the University of Rostock and at IOW, including a mutual exchange, to ensure the correctness of identification and completeness of benthic macrofauna data, particularly to capture population dynamics of infauna key species *Mya arenaria*, and other dominating bivalves *Limecola balthica* and *Cerastoderma glaucum* and by covering full size-spectrum of individuals down to 0.5 mm. To estimate the occurrence, distribution and spatial variability of the benthic macrofaunal species and communities, and analyse the influence of MGF intensity on them, species abundance, dry and wet biomass, biological traits structure, as well as size classes distribution and condition of key species will be determined in the home laboratory.

Figure 5.9.1 Photos illustrating sampling procedure. The two right-most photos show the fractions left on the 1.0 mm and 0.5 mm sieves.

To record quick moving, epibentic, rare or large species at each area (within and outside MPA) and in the attempt to collect more individuals of key species for the analysis of shell damage and for isotopic analysis for WP4, the Kieler Kinderwagen dredge has been used (inner opening wide - 92 cm, mesh size - 5 mm, towed with speed of up to 1 knot over the ground). The towing time due to the predominant substrate type (sand) was set to 5 minutes. However, the penetration of dredge gear into the non-cohesive sandy sediment was too low and insufficient to collect M. *arenaria*, *L. balthica* and *C. glaucum*, those infaunal bivalves are mainly positioned below the sediment surface. Thus, characterization of key macrofauna species for shell damage caused by MGF in this sandbank habitat was not possible, and most likely not relevant.

At each MUC station surface sediment sample was taken from one core for later sediment granulometry and organic content analysis.

During the first part of the cruise (02.-11.6.2021) 15 cores (remaining after pore water extraction for subsequent biogeochemical analysis) were sliced and sieved through 0.5 mm sieve

to analyse the vertical distribution of macrofauna, e.g. to potentially later identify species responsible for alteration of porewater nutrients profiles. Another 12 cores were sliced during second cruise leg to increase the dataset and allow for more robust inferences.

For all macrofauna samples, animals together with the remaining substrate were preserved with 4% formaldehyde seawater solution in sea water mixture, marble gravel was used as buffer to prevent the leaching of calcium from shell material within the sample.

Table 5.9.1 List of samples that will be analysed in IOW Benthos Labor.

Station	Date	Sample No.	Number of Kautex	Comment	Area
2-4	03.06.2021	Core 3, Core 1	7	pw, sliced	INSIDE MPA
3-5	04.06.2021	Core 3	6	pw, sliced	INSIDE MPA
3-12	04.06.2021	Core 11	6	pw, sliced	INSIDE MPA
6-4	05.06.2021	Core 8	6	pw, sliced	INSIDE MPA
6-6	05.06.2021	Core 10	6	pw, sliced	INSIDE MPA
10-3	06.06.2021	Core 4	7	pw, sliced	INSIDE MPA
8-1	06.06.2021	Core 7	5	pw, sliced	INSIDE MPA
11-2	06.06.2021	Core 4	7	pw, sliced	INSIDE MPA
19-2	07.06.2021	Core 7	7	pw, sliced	INSIDE MPA
18-1	07.06.2021	Core 3	7	pw, sliced	OUTSIDE MPA
22-4	08.06.2021	Core 6	7	pw, sliced	OUTSIDE MPA
28-7	09.06.2021	Core 1	7	pw, sliced	OUTSIDE MPA
29-3	09.06.2021	Core 4	7	pw, sliced	OUTSIDE MPA
28-3	09.06.2021	Core 10	6	pw, sliced	OUTSIDE MPA
36-5	12.06.2021	Core 4	7	sliced	INSIDE MPA
38-7	12.06.2021	Core 10	6	sliced	INSIDE MPA
39-6	12.06.2021	Core 11	6	sliced	INSIDE MPA
36	12.06.2021	1-3	3		INSIDE MPA
38	12.06.2021	1-3	3		INSIDE MPA
38-8	12.06.2021	Dredge	1	qualitative	INSIDE MPA
39	12.06.2021	1-3	3		INSIDE MPA
42	13.06.2021	1-3	3		OUTSIDE MPA
42-6	13.06.2021	Dredge	1	qualitative	OUTSIDE MPA
43	13.06.2021	1-3	3		OUTSIDE MPA
44	13.06.2021	1-3	3		OUTSIDE MPA
45	13.06.2021	1-3	3		OUTSIDE MPA
46	13.06.2021	1-3	3		INSIDE MPA
47	13.06.2021	1-3	3		OUTSIDE MPA
48	13.06.2021	1-3	3		OUTSIDE MPA
49-3	14.06.2021	Core 11	7	sliced	OUTSIDE MPA
50	14.06.2021	1-3	3		INSIDE MPA
50-6	14.06.2021	Core 7	6	sliced	INSIDE MPA
52-2	14.06.2021	Core 7	7	sliced	OUTSIDE MPA
54-2	14.06.2021	Core 12	6	sliced	OUTSIDE MPA
57-2	15.06.2021	Core 12	7	sliced	INSIDE MPA
58-1	15.06.2021	Core 10	7	sliced	INSIDE MPA
59-1	15.06.2021	Core 11	7	sliced	OUTSIDE MPA
61-1	15.06.2021	Core 6	7	sliced	OUTSIDE MPA
2-4	03.06.2021	Core 3	7	sliced	INSIDE MPA

To derive accompanying information on environmental conditions at each station near-bottom values for salinity, temperature and oxygen content were obtained from CTD.

5.9.2 Preliminary results

Biodiversity of macrofauna

Based on the first visual estimate taxonomic composition of macrofauna was relatively similar in the exclusion and control areas, with some variations in sedimentary features observed more from west to east (thereby generally justifying the choice of focus areas), and seem to represent the typical for the Oderbank HUB biotope type AA.J3L9, photic sand dominated by multiple infaunal bivalve species including *C. glaucum*, *L. balthica* and *M. arenaria*. Among the species dominating community abundance and biomass, besides the listed above bivalves, are species like polychaetes *Hediste diversicolor, Marenzelleria* spp., *Pygospio elegans,* epibenthic bivalves *Mytilus edulis* and barnacles *Amphibalanus improvises,* mysids, gastropods *Peringia ulvae.*

Habitat characteristics were also investigated using a hand-held underwater video system with HD resolution (two transects ca 30 min each were recorded per area, and additional video transects were done in the attempt to capture fresh trawling marks from bottom fishing gears deployed by project partner scientists from Fischerei - Thünen-Institut from RV SOLEA on 13-14.06.2021). However, visual impact even shortly after trawling on with Oderbank sand was literally invisible, as opposite to long-prevailing marks observed on muddy habitats of Fehmarnbelt during the expedition in the previous year 2020, EMB238).

Preliminary results suggest that sediment organic content (estimated by loss on ignition) ranged from 0.25 to 0.4%. Sediment grain size distribution is very well sorted, with median grain size of fine sand ranging within MPA 174±8 µm (MEAN±SD) and in the control area outside MPA 180±14 µm.

Table 5.9.2 Preliminary results of sediment grain size distribution (analysed by sieving), sediment organic content values estimated by loss on ignition, depth and accompanying environmental variables from closest CTD casts at stations inside and outside MPA.

Area Station_cast	Inside MPA						Control outside MPA				
	36	**38**	**39**	**46**	**50**	**45**	**48**	**42**	**43**	**44**	**47**
Date	12.06.	12.06.	12.06.	13.06.	14.06.	13.06.	13.06.	13.06.	13.06.	13.06.	13.06.
Close to visible trawl mark	n	y	y	y	n	y	n	n	n	y	n
Median grain size [µm]	176	167	172	172	172	189	168	173	182	186	204
Fraction finer 63 µm [%]	0.5	0.8	0.4	0.4	0.5	0.4	0.6	0.6	0.5	0.5	0.2
Fraction coarser 2000 µm [%]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sorting [phi]	0.3	0.3	0.4	0.4	0.3	0.4	0.3	0.4	0.4	0.4	0.4
Skewness [phi]	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.2
Total organic content [%]	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.3
Depth [m]	14.5	14.2	14.9	15.5	14.5	15.6	15.2	15.6	15.5	16.0	15.6
Salinity (near bottom)	8.2	8.2	8.2	8.1	8.1	8.1	8.2	8.1	8.1	8.1	8.2
Temperature (near bottom) [°C]	12.9	11.8	11.8	13.9	14.5	14.6	13.9	13.9	14.5	14.5	13.9
Oxygen (near bottom) [ml/l]	6.418	4.735	6.418	6.534	6.005	6.530	6.083	5.741	6.360	6.360	6.083

Bioturbation and permeability of sediment

Samples for the measurement of depth distribution of chlorophyll-*a* as particle tracer were obtained from 11 sediment cores on six/five MUC hauls in each of the areas (excl/ref).

Additionally, about 500 ml surface sediment (0-1 cm) was accumulated and a 10°C chlorophyll decomposition experiment started to determine the rate constant of chlorophyll-*a* decay in this sediment. Permeability of the sediment was checked on board using a constant head set-up. It can be concluded that these sandy sediments in both areas (exclusion, reference) are permeable and therefore diagenetically relevant transports are expected in these Oderbank sediments ($k > 10^{-12}$ m^2). Permeability results suggest that there is no significant difference between both areas (Figure 5.9.2):

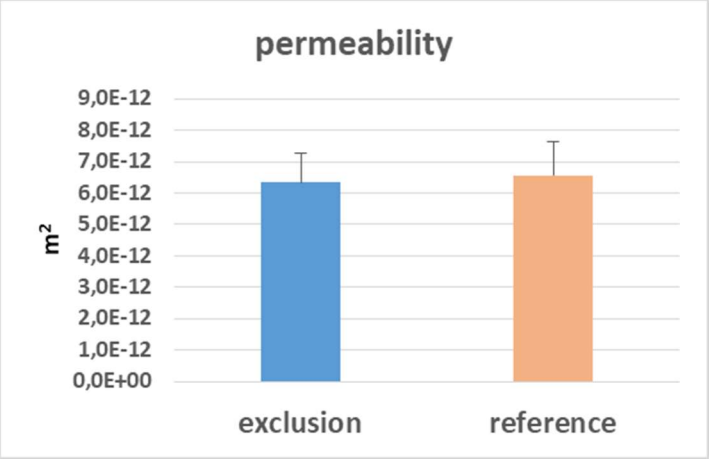


Figure 5.9.2 Permeability k (m^2) (means + sd) of Oderbank sediments in the exclusion (n=6) and in the reference (n = 5) area in June 2021.

6 Ship's Meteorological Station

According to the data from ship weather station, average air temperature was around 16.6 °C, generally with high amplitudes observed between day and night (Figure 6.1). The general meteorological conditions during the 1 leg were characterized by continuous high pressure and moderate wind conditions, whereas it changed to low pressure after 11.6.

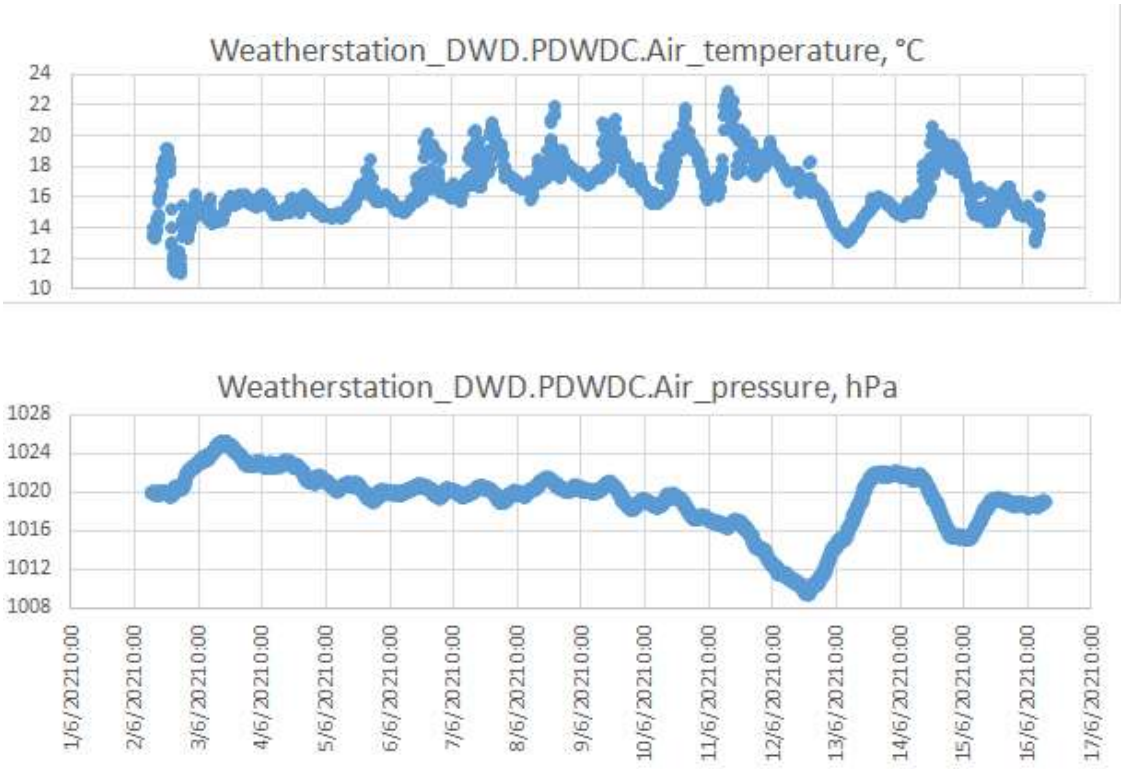


Figure 6.1. Air temperature and pressure measured by the ship weather station of RV Elisabeth Mann Borgese.

7 Station List EMB267

7.1 Overall Station List

Station No.		Date	Gear	Time	Latitude	Longitude	Depth	Remarks
MGF-Ostsee	ShipID	2021		[UTC]	[°N]	[°W]	[m]	
EMB267-01-01	EMB267_1	02.06.	HySo	22:20	54°16.'42'	14°17.69	15.2	INSIDE
EMB267-01-02	EMB267_1	02.06.	MBES	22:30	54°16.'42'	14°17.69	15.2	INSIDE
EMB267-02-01	EMB267_2-1	03.06.	CTD	06:43	54°15.922	14°18.300	15.6	INSIDE
EMB267-02-02	EMB267_2-1	03.06.	CTD	06:51	54°15.922	14°18.300	15.6	INSIDE
EMB267-02-03	EMB267_2-2	03.06.	EC-Lander	08:57	54°15.913	14°18.476	15.4	INSIDE
EMB267-02-04	EMB267_3-1	03.06.	MUC	11:09	54°15.920	14°18.296	15.3	INSIDE
EMB267-02-05	EMB267_3-2	03.06.	MUC	11:59	54°15.940	14°18.303	15.5	INSIDE
EMB267-02-06	EMB267_3-3	03.06.	MUC	13:25	54°15.938	14°18.282	15.4	INSIDE
EMB267-03-01	EMB267_4-1	04.06.	CTD	06:19	54°15.781	14°18.970	15.3	INSIDE
EMB267-03-02	EMB267_4-1	04.06.	CTD	06:27	54°15.796	14°18.944	15.3	INSIDE
EMB267-03-03	EMB267_4-2	04.06.	MUC	06:56	54°15.780	14°18.957	15.3	INSIDE
EMB267-03-04	EMB267_4-3	04.06.	MUC	07:05	54°15.784	14°18.978	15.3	INSIDE
EMB267-03-05	EMB267_4-4	04.06.	MUC	07:21	54°15.778	14°18.974	15.4	INSIDE
EMB267-03-06	EMB267_4-5	04.06.	MUC	08:41	54°15.783	14°18.995	15.3	INSIDE
EMB267-03-07	EMB267_4-6	04.06.	MUC	11:09	54°15.767	14°18.948	15.3	INSIDE
EMB267-03-08	EMB267_4-7	04.06.	MUC	11:22	54°15.771	14°18.988	15.3	INSIDE
EMB267-03-09	EMB267_4-8	04.06.	MUC	11:48	54°15.758	14°18.997	15.3	INSIDE

EMB267-03-10	EMB267_4-9	04.06.	FRAHM	12:01	54°15.770	14°19.022	15.3	INSIDE
EMB267-03-11	EMB267_4-10	04.06.	FRAHM	12:03	54°15.770	14°19.024	15.3	INSIDE
EMB267-03-12	EMB267_4-11	04.06.	MUC	12:27	54°15.774	14°19.148	15.3	INSIDE
EMB267-04		04.06.	EC-Lander	14:00	54°15.927	14°18.267	15.4	INSIDE
EMB267-05	EMB267_5	04.06.	SSS, MBES	14:30	54°16.027	14°17.711	15.3	
EMB267-06-01	EMB267_6-1	05.06.	CTD	05:34	54°14.357	14°21.838	14.5	INSIDE
EMB267-06-02	EMB267_6-1	05.06.	CTD	00:00	54°14.357	14°21.838	14.5	INSIDE
EMB267-06-03	EMB267_6-2	05.06.	EC-Lander	07:05	54°14.343	14°22.068	14.4	INSIDE
EMB267-06-04	EMB267_6-3	05.06.	MUC	07:32	54°14.365	14°21.857	14.5	INSIDE
EMB267-06-05	EMB267_6-4	05.06.	MUC	08:25	54°14.357	14°21.859	14.5	INSIDE
EMB267-06-06	EMB267_6-5	05.06.	MUC	11:03	54°14.371	14°21.865	14.5	INSIDE
EMB267-07	EMB267_6-6	05.06.	MBES	12:10	54°14.106	14°20.718		
EMB267-08-01	EMB267_7-1	06.06.	MUC	05:49	54°15.437	14°19.737	14.9	INSIDE
EMB267-09-01	EMB267_7-2	06.06.	CTD	06:22	54°15.35	14°19.94	14.7	INSIDE
EMB267-09-02	EMB267_7-2	06.06.	CTD	06:27	54°15.35	14°19.94	14.7	INSIDE
EMB267-10-01	EMB267_7-3	06.06.	MUC	06:57	54°15.434	14°19.717	14.9	INSIDE
EMB267-10-02	EMB267_7-4	06.06.	MUC	07:43	54°15.447	14°19.691	14.9	INSIDE
EMB267-10-03	EMB267_7-5	06.06.	MUC	08:47	54°15.438	14°19.733	14.9	INSIDE
EMB267-11-01	EMB267_7-6	06.06.	MUC	11:09	54°15.362	14°19.818	14.8	INSIDE
EMB267-11-02	EMB267_7-6	06.06.	MUC	11:25	54°15.394	14°19.985	14.8	INSIDE
EMB267-12-01	EMB267_7-7	06.06.	CTD	11:56	54°15.442	14°19.767	14.9	INSIDE
EMB267-12-02	EMB267_7-7	06.06.	CTD	11:59	54°15.441	14°19.772	14.9	INSIDE
EMB267-13-01	EMB267_7-8	06.06.	MUC	13:03	54°15.363	14°19.967	14.7	INSIDE
EMB267-14		06.06.	EC-Lander	14:00	54°14.49	14°21.61	14.4	
EMB267-15	EMB267_8	06.06.	SSS, MBES	14:28	54°14.511	14°21.729		
EMB267-16-01	EMB267_9-1	07.06.	CTD	06:02	54°14.941	14°18.472	15.4	OUTSIDE
EMB267-16-02	EMB267_9-1	07.06.	CTD	06:07	54°14.940	14°18.458	15.4	OUTSIDE
EMB267-17	EMB267_9-2	07.06.	EC-Lander	06:31	54°14.742	14°18.909	15.3	OUTSIDE
EMB267-18-01	EMB267_9-3	07.06.	MUC	07:22	54°14.955	14°18.478	15.4	OUTSIDE
EMB267-18-02	EMB267_9-4	07.06.	MUC	10:12	54°14.953	14°18.494	15.5	OUTSIDE
EMB267-19-01	EMB267_9-5	07.06.	CTD	11:12	54°14.934	14°18.435	15.5	OUTSIDE
EMB267-19-02	EMB267_9-6	07.06.	MUC	11:33	54°14.934	14°18.469	15.3	OUTSIDE
EMB267-20-01	EMB267_9-7	07.06.	CTD	12:08	54°15.393	14°19.912	14.8	INSIDE
EMB267-20-02	EMB267_9-8	07.06.	MUC	12:21	54°15.383	14°19.999	14.8	INSIDE
EMB267-21		07.06.	MBES	13:40	54°15.423	14°20.025	15.3	OUTSIDE
EMB267-22-01	EMB267_10-1	08.06.	CTD	06:09	54°15.664	14°16.849	15.8	OUTSIDE
EMB267-22-02	EMB267_10-1	08.06.	CTD	06:15	54°15.654	14°16.855	15.8	OUTSIDE
EMB267-22-03	EMB267_10-2	08.06.	MUC	06:28	54°15.667	14°16.870	15.8	OUTSIDE
EMB267-22-04	EMB267_10-3	08.06.	MUC	07:31	54°15.669	14°16.885	15.7	OUTSIDE
EMB267-23		08.06.	EC-Lander	00:00	54°14.740	14°18.890	15.3	
EMB267-24	EMB267_11-1	08.06.	EC-Lander	11:00	54°15.428	14°17.108	15.6	OUTSIDE
EMB267-25-01	EMB267_11-2	08.06.	CTD	11:28	54°15.651	14°16.847	15.8	OUTSIDE
EMB267-25-02	EMB267_11-3	08.06.	MUC	11:38	54°15.655	14°16.873	15.9	OUTSIDE
EMB267-26		08.06.	MBES	11:54	54°15.33	14°17.198	15.6	OUTSIDE
EMB267-27	EMB267_11-4	08.06.	SSS, MBES	12:04	54°15.467	14°17.370		OUTSIDE

EMB267-28-01	EMB267_12-1	09.06.	CTD	06:08	54°15.403	14°17.225	15.5	OUTSIDE
EMB267-28-02	EMB267_12-1	09.06.	CTD	06:12	54°15.404	14°17.227	15.5	OUTSIDE
EMB267-28-03	EMB267_12-2	09.06.	MUC	06:19	54°15.407	14°17.222	15.5	OUTSIDE
EMB267-28-04	EMB267_12-3	09.06.	MUC	06:34	54°15.414	14°17.218	15.5	OUTSIDE
EMB267-28-05	EMB267_12-4	09.06.	MUC	07:21	54°15.414	14°17.220	15.5	OUTSIDE
EMB267-28-06	EMB267_12-5	09.06.	CTD	11:06	54°15.423	14°17.255	15.5	OUTSIDE
EMB267-28-07	EMB267_12-6	09.06.	MUC	11:18	54°15.406	14°17.241	15.5	OUTSIDE
EMB267-29-01	EMB267_12-7	09.06.	CTD	11:41	54°15.660	14°16.845	15.8	OUTSIDE
EMB267-29-02	EMB267_12-8	09.06.	MUC	11:53	54°15.653	14°16.858	15.8	OUTSIDE
EMB267-29-03	EMB267_12-9	09.06.	MUC	12:02	54°15.666	14°16.831	15.8	OUTSIDE
EMB267-30-01	EMB267_12-10	09.06.	MUC	12:26	54°15.397	14°17.238	15.4	OUTSIDE
EMB267-31		09.06.	EC-Lander	12:59	54°15.397	14°17.223	15.6	OUTSIDE
EMB267-32		09.06.	SES	13:00	54°15.397	14°17.223		TRANSIT
EMB267-33-01	EMB267_13-1	10.06.	CTD	06:13	54°32.6489	10°44.2888	26.8	Fehmarn Belt
EMB267-34	EMB267_14-1	10.06.	SSS, MBES	06:30	54°32.77	10°44.60	26.7	Fehmarn Belt
EMB267-35	EMB267_15-1	12.06.	CTD	04:35	54°14.995	14°20.991	14.2	INSIDE
EMB267-36-1	EMB267_16-1	12.06.	van Veen grab	06:08	54°15.3897	14°19.9832	14.7	INSIDE
EMB267-36-2	EMB267_16-2	12.06.	van Veen grab	06:13	54°15.3853	14°19.9741	14.9	INSIDE
EMB267-36-3	EMB267_16-3	12.06.	van Veen grab	06:17	54°15.3863	14°19.9883	15	INSIDE
EMB267-36-4	EMB267_16-4	12.06.	van Veen grab	06:20	54°15.3853	14°19.9828	14.8	INSIDE
EMB267-36-5	EMB267_16-5	12.06.	MUC	06:31	54°15.3910	14°19.9641	14.9	INSIDE
EMB267-36-6	EMB267_16-6	12.06.	MUC	06:59	54°15.4043	14°19.9574	14.7	INSIDE
EMB267-37-1	EMB267_17-1	12.06.	EC-Lander	07:26	54°14.9980	14°20.9743	14.6	INSIDE
EMB267-38-1	EMB267_18-1	12.06.	van Veen grab	08:24	54°14.3709	14°21.8593	14.3	INSIDE
EMB267-38-2	EMB267_18-2	12.06.	van Veen grab	08:28	54°14.3640	14°21.8353	14.6	INSIDE
EMB267-38-3	EMB267_18-3	12.06.	van Veen grab	08:31	54°14.3614	14°21.8381	14.5	INSIDE
EMB267-38-4	EMB267_18-4	12.06.	van Veen grab	08:34	54°14.3533	14°21.8230	14.5	INSIDE
EMB267-38-5	EMB267_18-5	12.06.	MUC	08:41	54°14.3656	14°21.8374	14.2	INSIDE
EMB267-38-6	EMB267_18-6	12.06.	CTD	09:15	54°14.3739	14°21.8221	14.4	INSIDE
EMB267-38-7	EMB267_18-7	12.06.	MUC	11:02	54°14.3659	14°21.8110	14.4	INSIDE
EMB267-38-8	EMB267_18-8	12.06.	Dredge	11:23	54°14.3832	14°21.7565	14.5	INSIDE
EMB267-38-9	EMB267_18-9	12.06.	Dredge	11:37	54°14.4648	14°21.4320	14.3	INSIDE
EMB267-39-1	EMB267_19-1	12.06.	van Veen grab	12:18	54°15.4210	14°19.7479	15.1	INSIDE
EMB267-39-2	EMB267_19-3	12.06.	van Veen grab	12:20	54°15.4160	14°19.7408	14.8	INSIDE
EMB267-39-3	EMB267_19-4	12.06.	van Veen grab	12:23	54°15.4204	14°19.7370	15.1	INSIDE
EMB267-39-4	EMB267_19-5	12.06.	van Veen grab	12:25	54°15.4194	14°19.7267	14.8	INSIDE
EMB267-39-5	EMB267_19-6	12.06.	MUC	12:35	54°15.4161	14°19.6860	14.8	INSIDE
EMB267-39-6	EMB267_19-7	12.06.	MUC	13:02	54°15.4334	14°19.6792	14.9	INSIDE
EMB267-40-1	EMB267_20-1	12.06.	VIDEO	13:47	54°15.6680	14°18.8800	15.2	INSIDE
EMB267-41-1	EMB267_21-1	12.06.	VIDEO	14:56	54°14.2137	14°22.0229	14.7	INSIDE
EMB267_42-1	EMB267_22-1	13.06.	CTD	04:42	54°14.9402	14°18.4931	16.3	OUTSIDE
EMB267_42-2	EMB267_22-2	13.06.	van Veen grab	05:59	54°14.9450	14°18.4738	16.2	OUTSIDE
EMB267_42-3	EMB267_22-3	13.06.	van Veen grab	06:03	54°14.9455	14°18.4642	15.6	OUTSIDE
EMB267_42-4	EMB267_22-4	13.06.	van Veen grab	06:05	54°14.9475	14°18.4719	15.8	OUTSIDE
EMB267_42-5	EMB267_22-5	13.06.	van Veen grab	06:08	54°14.9475	14°18.4787	15.6	OUTSIDE

EMB267_42-6	EMB267_22-6	13.06.	Dredge	06:35	54°14.9808	14°18.4073	15.6	OUTSIDE
EMB267_42-7	EMB267_22-7	13.06.	Dredge	06:45	54°15.0448	14°18.2107	15.3	OUTSIDE
EMB267_43-1	EMB267_23-1	13.06.	van Veen grab	07:18	54°15.3994	14°17.2292	16.1	OUTSIDE
EMB267_43-2	EMB267_23-2	13.06.	van Veen grab	07:21	54°15.4086	14°17.2185	15.5	OUTSIDE
EMB267_43-3	EMB267_23-3	13.06.	van Veen grab	07:23	54°15.4130	14°17.2110	15.9	OUTSIDE
EMB267_43-4	EMB267_23-4	13.06.	van Veen grab	07:26	54°15.4166	14°17.2142	15.9	OUTSIDE
EMB267_44-1	EMB267_24-1	13.06.	CTD	07:58	54°15.6608	14°16.8452	16	OUTSIDE
EMB267_44-2	EMB267_24-2	13.06.	van Veen grab	08:22	54°15.6623	14°16.8480	16.7	OUTSIDE
EMB267_44-3	EMB267_24-3	13.06.	van Veen grab	08:25	54°15.6527	14°16.8494	15.7	OUTSIDE
EMB267_44-4	EMB267_24-4	13.06.	van Veen grab	08:27	54°15.6564	14°16.8432	16.9	OUTSIDE
EMB267_44-5	EMB267_24-5	13.06.	van Veen grab	08:30	54°15.6676	14°16.8411	16.1	OUTSIDE
EMB267_45-1	EMB267_25-1	13.06.	CTD	09:16	54°15.9223	14°18.2889	15.1	OUTSIDE
EMB267_45-2	EMB267_25-2	13.06.	van Veen grab	11:02	54°15.9200	14°18.3127	15.5	OUTSIDE
EMB267_45-3	EMB267_25-3	13.06.	van Veen grab	11:07	54°15.9218	14°18.2973	15.6	OUTSIDE
EMB267_45-4	EMB267_25-4	13.06.	van Veen grab	11:09	54°15.9188	14°18.2935	15.8	OUTSIDE
EMB267_45-5	EMB267_25-5	13.06.	van Veen grab	11:12	54°15.9216	14°18.2952	15.6	OUTSIDE
EMB267_46-1	EMB267_26-1	13.06.	van Veen grab	12:24	54°15.7780	14°18.9711	15.8	INSIDE
EMB267_46-2	EMB267_26-2	13.06.	van Veen grab	12:27	54°15.7805	14°18.9701	15.4	INSIDE
EMB267_46-3	EMB267_26-3	13.06.	van Veen grab	12:29	54°15.7837	14°18.9705	15.2	INSIDE
EMB267_46-4	EMB267_26-4	13.06.	van Veen grab	12:32	54°15.7857	14°18.9627	15.8	INSIDE
EMB267_47-1	EMB267_27-1	13.06.	van Veen grab	13:28	54°14.6039	14°19.3174	15.6	OUTSIDE
EMB267_47-2	EMB267_27-2	13.06.	van Veen grab	13:30	54°14.5973	14°19.3265	15.8	OUTSIDE
EMB267_47-3	EMB267_27-3	13.06.	van Veen grab	13:33	54°14.5978	14°19.3054	15.6	OUTSIDE
EMB267_47-4	EMB267_27-4	13.06.	van Veen grab	13:36	54°14.5957	14°19.2888	15.8	OUTSIDE
EMB267_48-1	EMB267_28-1	13.06.	van Veen grab	14:30	54°14.3338	14°20.0278	15	OUTSIDE
EMB267_48-2	EMB267_28-2	13.06.	van Veen grab	14:32	54°14.3288	14°20.0337	15.1	OUTSIDE
EMB267_48-3	EMB267_28-3	13.06.	van Veen grab	14:36	54°14.3354	14°20.0303	15.1	OUTSIDE
EMB267_48-4	EMB267_28-4	13.06.	van Veen grab	14:40	54°14.3453	14°20.0138	15.2	OUTSIDE
EMB267_48-5	EMB267_28-5	13.06.	CTD	14:53	54°14.3454	14°20.0141	15.1	OUTSIDE
EMB267_49-1	EMB267_29-1	14.06.	CTD	04:39	54°14.9397	14°18.4919	15.6	OUTSIDE
EMB267_49-2	EMB267_29-2	14.06.	MUC	05:56	54°14.9467	14°18.4477	15.6	OUTSIDE
EMB267_49-3	EMB267_29-3	14.06.	MUC	06:18	54°14.9454	14°18.4454	15.6	OUTSIDE
EMB267_50-1	EMB267_30-1	14.06.	CTD	07:49	54°14.9861	14°20.9595	14.6	INSIDE
EMB267_50-2	EMB267_30-2	14.06.	van Veen grab	07:58	54°14.9895	14°20.9589	14.6	INSIDE
EMB267_50-3	EMB267_30-3	14.06.	van Veen grab	08:01	54°14.9825	14°20.9589	14.6	INSIDE
EMB267_50-4	EMB267_30-4	14.06.	van Veen grab	08:03	54°14.9785	14°20.9563	14.5	INSIDE
EMB267_50-5	EMB267_30-5	14.06.	van Veen grab	08:06	54°14.9791	14°20.9478	14.7	INSIDE
EMB267_50-6	EMB267_30-6	14.06.	MUC	08:22	54°14.9880	14°20.9449	14.6	INSIDE
EMB267_50-7	EMB267_30-7	14.06.	MUC	08:40	54°15.0022	14°20.9558	14.6	INSIDE
EMB267_51-1	EMB267_31-1	14.06.	EC-Lander	09:17	54°15.7492	14°17.5074	15.6	OUTSIDE
EMB267_52-1	EMB267_32-1	14.06.	CTD	10:34	54°15.6557	14°16.8237	15.9	OUTSIDE
EMB267_52-2	EMB267_32-2	14.06.	MUC	11:34	54°15.6595	14°16.8701	15.8	OUTSIDE
EMB267_52-3	EMB267_32-3	14.06.	MUC	11:51	54°15.6329	14°16.8985	15.8	OUTSIDE
EMB267_53-1	EMB267_33-1	14.06.	VIDEO	12:34	54°15.4056	14°17.2061	15.9	OUTSIDE
EMB267_54-1	EMB267_34-1	14.06.	MUC	13:33	54°15.7162	14°16.4605	15.7	OUTSIDE

EMB267_54-2	EMB267_34-2	14.06.	MUC	13:50	54°15.4014	14°17.2227	15.6	OUTSIDE
EMB267_55-1	EMB267_35-1	14.06.	VIDEO	14:27	54°15.0125	14°18.2097	15.6	OUTSIDE
EMB267_56-1	EMB267_36-1	14.06.	MBES	16:20	54°14.8733	14°17.9072		OUTSIDE
EMB267_57-1	EMB267_37-1	15.06.	CTD	06:01	54°15.9186	14°18.2865	15.4	INSIDE
EMB267_57-2	EMB267_37-2	15.06.	MUC	06:07	54°15.9143	14°18.2973	15.3	INSIDE
EMB267_58-1	EMB267_38-1	15.06.	MUC	06:41	54°15.8062	14°18.9653	15.4	INSIDE
EMB267_60-1	EMB267_40-1	15.06.	MBES	07:20	54°14.8027	14°18.0549		OUTSIDE
EMB267_59-1	EMB267_39-1	15.06.	MUC	08:59	54°14.6442	14°19.3258	16	OUTSIDE
EMB267_60-2	EMB267_40-2	15.06.	MBES	09:53	54°15.2930	14°18.5054		OUTSIDE
EMB267_61-1	EMB267_41-1	15.06.	MUC	11:38	54°14.3402	14°20.0312	15.1	OUTSIDE
EMB267_62-1	EMB267_42-1	15.06.	VIDEO	12:11	54°14.4582	14°18.9158	15.4	OUTSIDE
EMB267_62-2	EMB267_42-2	15.06.	VIDEO	13:16	54°14.5429	14°18.7360	15.5	OUTSIDE
EMB267_51-2	EMB267_31-2	15.06.	EC-Lander	00:00	54°15.7632	14°17.5065	15.6	OUTSIDE

7.2 Profile Station List

Station No.	ShipID	Date	Time	Latitude	Longitude	Max. Depth	Bottom	Profile numbers
EMB267		2021	h	[°N]	[°W]	[m]	[m]	
02-01	2-1	03.06.	06:43	54°15.922	14°18.300	15.6	13.5	V0001_1
02-02	2-1	03.06.	06:51	54°15.922	14°18.300	15.6	13.75	V0001F02
03-01	4-1	04.06.	06:19	54°15.781	14°18.970	15.3	15.3	V0001_01
03-02	4-1	04.06.	06:27	54°15.796	14°18.944	15.3	14.25	V0002 F01
06-01	6-1	05.06.	05:34	54°14.357	14°21.838	14.5	13.5	V0003 F01
06-02	6-1	05.06.	00:00	54°14.357	14°21.838	14.5	13.5	V0003 F02
09-01	7-2	06.06.	06:22	54°15.35	14°19.94	14.7	13.75	V0004_01
09-02	7-2	06.06.	06:27	54°15.35	14°19.94	14.7	13.75	V0004F02
12-01	7-7	06.06.	11:56	54°15.442	14°19.767	14.9	13.75	V0005_01
12-02	7-7	06.06.	11:59	54°15.441	14°19.772	14.9	13.75	V0005F03
16-01	9-1	07.06.	06:02	54°14.941	14°18.472	15.4	14.25	V0006_01
16-02	9-1	07.06.	06:07	54°14.940	14°18.458	15.4	13.75	V0006F02
19-01	9-5	07.06.	11:12	54°14.934	14°18.435	15.5	13.75	V0007_01
20-01	9-7	07.06.	12:08	54°15.393	14°19.912	14.8	13.75	V0008_01
22-01	10-1	08.06.	06:09	54°15.664	14°16.849	15.8	14.75	V0009_01
22-02	10-1	08.06.	06:15	54°15.654	14°16.855	15.8	14.75	V0009F02
25-01	11-2	08.06.	11:28	54°15.651	14°16.847	15.8	14.75	V0010_01
28-01	12-1	09.06.	06:08	54°15.403	14°17.225	15.5	14.5	V0011_01
28-02	12-1	09.06.	06:12	54°15.404	14°17.227	15.5	14.5	V0011F02
28-06	12-5	09.06.	11:06	54°15.423	14°17.255	15.5	14.5	V0012_01
29-01	12-7	09.06.	11:41	54°15.660	14°16.845	15.8	14.75	V0013_4
33-01	13-1	10.06.	06:13	54°32.6489	10°44.2888	26.8	22	V0014_01
35	15-1	12.06.	04:35	54°14.995	14°20.991	14.2	13.5	V0015F01
38-6	18-6	12.06.	09:15	54°14.3739	14°21.8221	14.4	13.25	V0016F01
42-1	22-1	13.06.	04:42	54°14.9402	14°18.4931	16.3	14.75	V0017F01
44-1	24-1	13.06.	07:58	54°15.6608	14°16.8452	16	14.75	V0018F01
45-1	25-1	13.06.	09:16	54°15.9223	14°18.2889	15.1	14.5	V0019F01
48-5	28-5	13.06.	14:53	54°14.3454	14°20.0141	15.1	14	V0020F01
49-1	29-1	14.06.	04:39	54°14.9397	14°18.4919	15.6	14.5	V0021F01
50-1	30-1	14.06.	07:49	54°14.9861	14°20.9595	14.6	13.5	V0022F01
52-1	32-1	14.06.	10:34	54°15.6557	14°16.8237	15.9	14.75	V0023F01
57-1	37-1	15.06.	06:01	54°15.9186	14°18.2865	15.4	14.25	V0024F01

8 Data and Sample Storage and Availability

Data collected during the cruise EMB267 will be used in MGF-Ostsee project. After the scientific publication or at the latest 3 years after the end of the project, all data will be places into

the PANGAEA database for access of wider scientific public. The metadata for this cruise will be made publicly available immediately after the cruise (via MARUM). The raw and processed acoustic data will be archived on the dedicated data servers (see Table 8.1). The data collected by all sub-projects will be critically checked and made available to the project partners via an internal database within the deadlines that result from the milestones. For the data collected at the Leibniz Institute for Baltic Sea Research Warnemünde, the metadata information system IOWMETA (http://iowmeta.io-warnemuende.de) is available. In addition, research data of the project from various sub-projects are archived in the PANGAEA database or DNA / RNA sequence data in the public databases Genbank, GFBio, NCBI and/or IOW database "BenthosDB" (for details see MGF-Ostsee data management plan).

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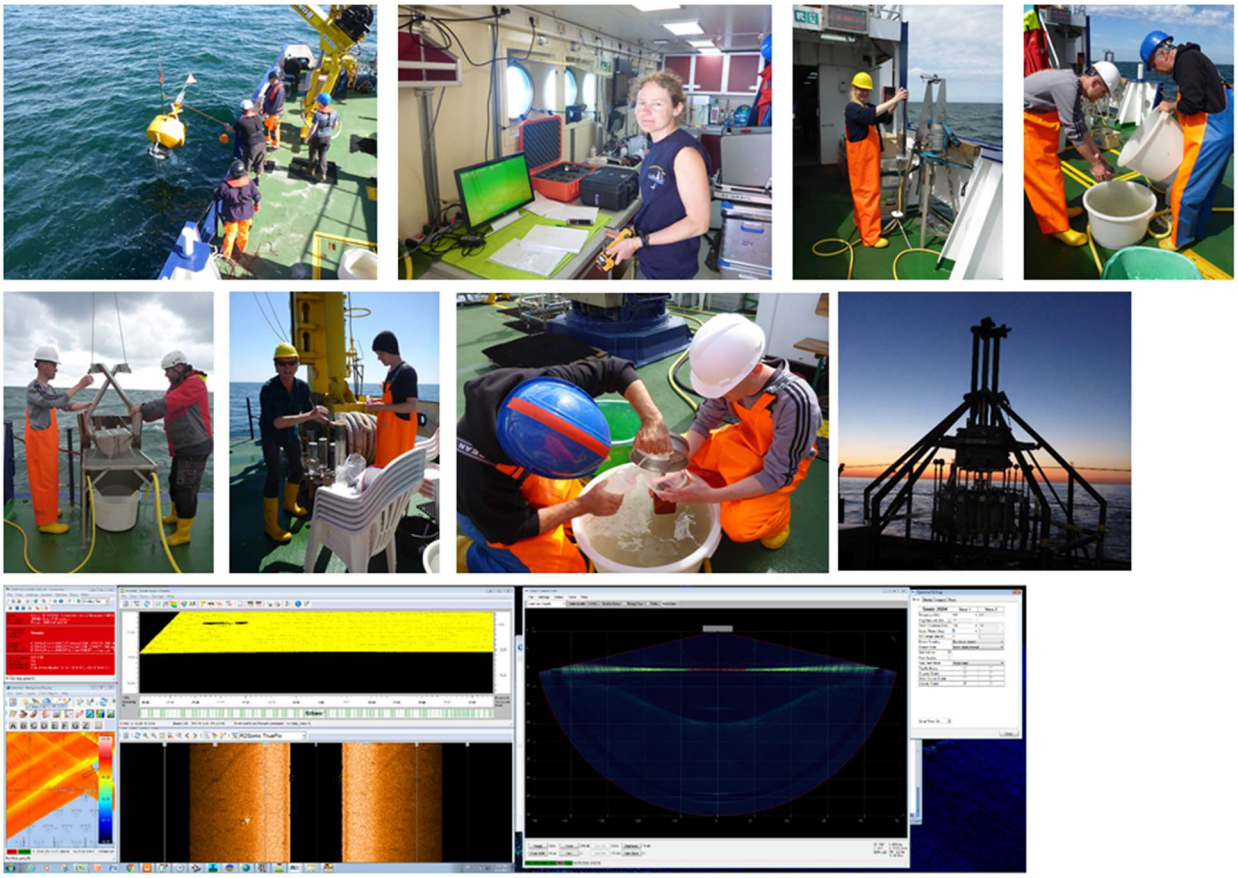
11 Abbreviations

MBES:	Multibeam Echosounder
HySo:	Hydrosonde
CTD:	CTD
EC-Lander:	Eddy Correlation- Lander
MUC:	Multi Corer
FRAHM:	Frahmlot core sampler
SSS:	Sidescan Sonar Echosounder
van Veen grab:	Van Veen Grap
Dredge:	Dredge
VIDEO:	Underwater Video System

12 Appendices

12.1 Selected Pictures of Samples

12.2 Selected Pictures of Shipboard Operations



12.3 Supplementary tables

Table S1: Sediment samples EMB267, research group (Isotope) Biogeochemistry IOW. *Por: porosity, GS: grain size (1/2).*

SampleNr.		Infos			Depth [cm]		Existing Sample? (Y/N)		
		DATE	STATION	MUC core nr	from	to	Freeze Drying	ZnOAc	Por. & GS (vol 2mL)
EMB267	OB-1	03.06.21	2_4	12	0	1	1	1	1
EMB267	OB-2	03.06.21	2_4	12	1	2	1	1	1
EMB267	OB-3	03.06.21	2_4	12	2	3	1	1	1
EMB267	OB-4	03.06.21	2_4	12	3	4	1	1	1
EMB267	OB-5	03.06.21	2_4	12	4	5	1	1	1
EMB267	OB-6	03.06.21	2_4	12	5	7	1	1	1
EMB267	OB-7	03.06.21	2_4	12	7	9	1	1	1
EMB267	OB-8	03.06.21	2_4	12	9	11	1	1	1
EMB267	OB-9	03.06.21	2_4	12	11	13	1	1	1
EMB267	OB-10	03.06.21	2_4	12	13	15	1	1	1
EMB267	OB-11	03.06.21	2_4	12	15	16.5	1	1	1
EMB267	OB-12	04.06.21	3_5	1	0	2	1	1	1
EMB267	OB-13	04.06.21	3_5	1	2	3	1	1	1
EMB267	OB-14	04.06.21	3_5	1	3	4	1	1	1
EMB267	OB-15	04.06.21	3_5	1	4	5	1	1	1
EMB267	OB-16	04.06.21	3_5	1	5	7	1	1	1
EMB267	OB-17	04.06.21	3_5	1	7	9	1	1	1
EMB267	OB-18	04.06.21	3_5	1	9	10	1	1	1
EMB267	OB-19	05.06.21	6_6	3	0	1	1	1	1
EMB267	OB-20	05.06.21	6_6	3	1	2	1	1	1
EMB267	OB-21	05.06.21	6_6	3	2	3	1	1	1
EMB267	OB-22	05.06.21	6_6	3	3	4	1	1	1
EMB267	OB-23	05.06.21	6_6	3	4	5	1	1	1
EMB267	OB-24	05.06.21	6_6	3	5	7	1	1	1
EMB267	OB-25	05.06.21	6_6	3	7	9	1	1	1
EMB267	OB-26	05.06.21	6_6	3	9	10.5	1	1	1
EMB267	OB-27	06.06.21	11_2	2	0	1	1	1	1
EMB267	OB-28	06.06.21	11_2	2	1	2	1	1	1
EMB267	OB-29	06.06.21	11_2	2	2	3	1	1	1
EMB267	OB-30	06.06.21	11_2	2	3	4	1	1	1
EMB267	OB-31	06.06.21	11_2	2	4	5	1	1	1
EMB267	OB-32	06.06.21	11_2	2	5	7	1	1	1
EMB267	OB-33	06.06.21	11_2	2	7	9	1	1	1
EMB267	OB-34	06.06.21	11_2	2	9	11	1	1	1
EMB267	OB-35	06.06.21	11_2	2	11	13	1	1	1
EMB267	OB-36	06.06.21	11_2	2	13	15	1	1	1
EMB267	OB-37	06.06.21	11_2	2	15	17	1	1	1
EMB267	OB-38	06.06.21	11_2	2	17	19	1	1	1
EMB267	OB-39	06.06.21	11_2	2	19	20	1	1	1
EMB267	OB-40	06.06.21	10_2	12	0	1	1	1	1
EMB267	OB-41	06.06.21	10_2	12	1	2	1	1	1
EMB267	OB-42	06.06.21	10_2	12	2	3	1	1	1
EMB267	OB-43	06.06.21	10_2	12	3	4	1	1	1
EMB267	OB-44	06.06.21	10_2	12	4	5	1	1	1
EMB267	OB-45	06.06.21	10_2	12	5	7	1	1	1
EMB267	OB-46	06.06.21	10_2	12	7	9	1	1	1

Table S1: *continued (2/2)*

SampleNr.		Infos			Depth [cm]		Existing Sample? (Y/N)		
		DATE	STATION	MUC core nr	from	to	Freeze Drying	ZnOAc	Por. & GS (vol 2mL)
EMB267	OB-47	07.06.21	18_01	10	0	1	1	1	1
EMB267	OB-48	07.06.21	18_01	10	1	2	1	1	1
EMB267	OB-49	07.06.21	18_01	10	2	3	1	1	1
EMB267	OB-50	07.06.21	18_01	10	3	4	1	1	1
EMB267	OB-51	07.06.21	18_01	10	4	5	1	1	1
EMB267	OB-52	07.06.21	18_01	10	5	7	1	1	1
EMB267	OB-53	07.06.21	18_01	10	7	9	1	1	1
EMB267	OB-54	07.06.21	18_01	10	9	11	1	1	1
EMB267	OB-55	07.06.21	18_01	10	11	13	1	1	1
EMB267	OB-56	07.06.21	18_01	10	13	15	1	1	1
EMB267	OB-57	07.06.21	18_01	10	15	17	1	1	1
EMB267	OB-58	08.06.21	20_02	2	0	1	1	1	1
EMB267	OB-59	08.06.21	20_02	2	1	2	1	1	1
EMB267	OB-60	08.06.21	20_02	2	2	3	1	1	1
EMB267	OB-61	08.06.21	20_02	2	3	4	1	1	1
EMB267	OB-62	08.06.21	20_02	2	4	5	1	1	1
EMB267	OB-63	08.06.21	20_02	2	5	7	1	1	1
EMB267	OB-64	08.06.21	20_02	2	7	9	1	1	1
EMB267	OB-65	08.06.21	20_02	2	9	11	1	1	1
EMB267	OB-66	08.06.21	20_02	2	11	13	1	1	1
EMB267	OB-67	08.06.21	20_02	2	13	15	1	1	1
EMB267	OB-68	08.06.21	20_02	2	15	17	1	1	1
EMB267	OB-69	08.06.21	20_02	2	17	19	1	1	1
EMB267	OB-70	08.06.21	22_04	5	0	1	1	1	1
EMB267	OB-71	08.06.21	22_04	5	1	2	1	1	1
EMB267	OB-72	08.06.21	22_04	5	2	3	1	1	1
EMB267	OB-73	08.06.21	22_04	5	3	4	1	1	1
EMB267	OB-74	08.06.21	22_04	5	4	5	1	1	1
EMB267	OB-75	08.06.21	22_04	5	5	7	1	1	1
EMB267	OB-76	08.06.21	22_04	5	7	9	1	1	1
EMB267	OB-77	08.06.21	22_04	5	9	11	1	1	1
EMB267	OB-78	08.06.21	22_04	5	11	13	1	1	1
EMB267	OB-79	08.06.21	22_04	5	13	15.5	1	1	1
EMB267	OB-80	09.06.21	28_03	2	0	1	1	1	1
EMB267	OB-81	09.06.21	28_03	2	1	2	1	1	1
EMB267	OB-82	09.06.21	28_03	2	2	3	1	1	1
EMB267	OB-83	09.06.21	28_03	2	3	4	1	1	1
EMB267	OB-84	09.06.21	28_03	2	4	5	1	1	1
EMB267	OB-85	09.06.21	28_03	2	5	7	1	Obs.	1
EMB267	OB-86	09.06.21	28_03	2	7	9	1	1	1
EMB267	OB-87	09.06.21	28_03	2	9	11	1	1	1
EMB267	OB-88	09.06.21	28_03	2	11	13	1	1	1
EMB267	OB-89	09.06.21	28_03	2	13	15	1	1	1
EMB267	OB-90	09.06.21	28_03	2	15	16	1	1	1

Table S2: Pore-water samples EMB267, research group (Isotope) Biogeochemistry IOW. *Met: metals, DIC: dissolved inorganic carbon, nut: nutrients, T.A.: total alkalinity, DOC: dissolved organic carbon, w.i.: water isotopes. (1/3)*

SampleNr.		Infos						Depth [cm]		Sampled? (Y/N/w:wenig,few)						
		DATE	STATION	Gear/Cast nr.	MUC core Nr.	SRR core	Slice core	from	to	Met.	DIC	Sulf.	Nut.	T.A.	DOC	w.i.
EMB267	OB-1	03.06.21	2	4	1	2	12	0	1	1	1	1	1	1	1	w
EMB267	OB-2	03.06.21	2	4	1	2	12	1	2	1	1	1	1	1	1	w
EMB267	OB-3	03.06.21	2	4	1	2	12	2	3	1	1	1	1	1	1	0
EMB267	OB-4	03.06.21	2	4	1	2	12	3	4	1	1	1	1	1	1	1
EMB267	OB-5	03.06.21	2	4	1	2	12	5	6	0	0	0	0	0	0	0
EMB267	OB-6	03.06.21	2	4	1	2	12	6	7	1	1	1	1	1	1	1
EMB267	OB-7	03.06.21	2	4	1	2	12	9	10	1	1	1	1	1	1	1
EMB267	OB-8	03.06.21	2	4	1	2	12	7	8	1	1	1	1	1	1	1
EMB267	OB-9	03.06.21	2	4	1	2	12	11	12	1	1	1	1	1	1	1
EMB267	OB-10	03.06.21	2	4	1	2	12	14	15	1	1	1	1	1	1	1
EMB267	OB-11	03.06.21	2	4	3	2	12	0	1	1	1	1	1	1	1	0
EMB267	OB-12	03.06.21	2	4	3	2	12	1	2	1	1	1	1	1	1	1
EMB267	OB-13	03.06.21	2	4	3	2	12	2	3	1	1	1	1	1	1	1
EMB267	OB-14	03.06.21	2	4	3	2	12	3	4	1	1	1	1	1	1	0
EMB267	OB-15	03.06.21	2	4	3	2	12	4	5	1	1	1	1	1	1	1
EMB267	OB-16	03.06.21	2	4	3	2	12	6	7	1	1	1	1	1	1	1
EMB267	OB-17	03.06.21	2	4	3	2	12	8	9	1	1	1	1	1	1	1
EMB267	OB-18	03.06.21	2	4	3	2	12	10	11	1	1	1	1	1	1	1
EMB267	OB-19	03.06.21	2	4	3	2	12	12	13	0	0	0	0	0	0	0
EMB267	OB-20	03.06.21	2	4	3	2	12	14	15	1	1	1	1	1	1	1
na	na	03.06.21	2	4	3	2	12	15	16	0	0	0	0	0	0	0
EMB267	OB-21	04.06.21	3	5	3	2	1	0	1	1	0	1	1	1	0	0
EMB267	OB-22	04.06.21	3	5	3	2	1	1	2	1	1	1	1	1	1	1
EMB267	OB-23	04.06.21	3	5	3	2	1	2	3	1	1	1	1	1	1	1
EMB267	OB-24	04.06.21	3	5	3	2	1	3	4	1	1	1	1	1	1	1
EMB267	OB-25	04.06.21	3	5	3	2	1	4	5	1	1	1	1	1	1	1
EMB267	OB-26	04.06.21	3	5	3	2	1	5	6	1	1	1	1	1	0	1
EMB267	OB-27	04.06.21	3	5	3	2	1	7	8	1	1	1	1	1	1	1
EMB267	OB-28	04.06.21	3	5	3	2	1	9	10	1	1	1	1	1	1	1
EMB267	OB-29	04.06.21	3	5	3	2	1	11	12	1	1	1	1	1	1	1
EMB267	OB-30	04.06.21	3	12	11	12	na	0	1	1	1	1	1	1	0	0
EMB267	OB-31	04.06.21	3	12	11	12	na	1	2	1	1	1	1	1	0	1
EMB267	OB-32	04.06.21	3	12	11	12	na	2	3	1	1	1	0	1	0	0
EMB267	OB-33	04.06.21	3	12	11	12	na	3	4	1	1	1	1	1	1	1
EMB267	OB-34	04.06.21	3	12	11	12	na	4	5	1	1	1	1	1	0	0
EMB267	OB-35	04.06.21	3	12	11	12	na	5	6	1	1	1	1	1	0	0
EMB267	OB-36	04.06.21	3	12	11	12	na	6	7	1	1	1	1	1	1	w
EMB267	OB-37	04.06.21	3	12	11	12	na	8	9	1	1	1	1	1	1	1
EMB267	OB-38	04.06.21	3	12	11	12	na	10	11	1	1	1	1	1	1	1
EMB267	OB-39	04.06.21	3	12	11	12	na	12	13	1	1	1	1	TA	1	1
EMB267	OB-40	05.06.21	6	4	8	7	na	0	1	1	1	1	1	1	1	1
EMB267	OB-41	05.06.21	6	4	8	7	na	1	2	1	1	1	1	1	1	w
EMB267	OB-42	05.06.21	6	4	8	7	na	2	3	1	1	1	1	1	1	1
EMB267	OB-43	05.06.21	6	4	8	7	na	3	4	1	1	1	1	1	1	1
EMB267	OB-44	05.06.21	6	4	8	7	na	4	5	1	1	1	1	1	1	1
EMB267	OB-45	05.06.21	6	4	8	7	na	5	6	1	1	1	1	1	1	1
EMB267	OB-46	05.06.21	6	4	8	7	na	7	8	1	1	1	1	1	1	1
EMB267	OB-47	05.06.21	6	4	8	7	na	9	10	1	1	1	1	1	1	?
EMB267	OB-48	05.06.21	6	4	8	7	na	11	12	1	1	1	1	1	?	1
EMB267	OB-49	05.06.21	6	6	10	na	3	0	1	1	1	1	1	1	1	0
EMB267	OB-50	05.06.21	6	6	10	na	3	1	2	1	1	1	1	1	1	1
EMB267	OB-51	05.06.21	6	6	10	na	3	2	3	1	1	1	1	1	1	0
EMB267	OB-52	05.06.21	6	6	10	na	3	3	4	1	1	1	1	1	1	1
EMB267	OB-53	05.06.21	6	6	10	na	3	4	5	1	1	1	1	1	1	0
EMB267	OB-54	05.06.21	6	6	10	na	3	5	6	1	1	1	1	1	1	w
EMB267	OB-55	05.06.21	6	6	10	na	3	7	8	1	1	1	1	1	1	1
EMB267	OB-56	05.06.21	6	6	10	na	3	9	10	1	1	1	1	1	1	1
EMB267	OB-57	05.06.21	6	6	10	na	3	11	12	1	1	1	1	1	1	1

Table S2: *continued (2/3)*

SampleNr.		Infos						Depth [cm]		Sampled? (Y/N/w:wenig,few)						
		DATE	STATION	Gear/Cast nr.	MUC core Nr.	SRR core	Slice core	from	to	Met.	DIC	Sulf.	Nut.	T.A.	DOC	w.i.
EMB267	OB-58	06.06.21	8	1	7	8	na	0	1	1	1	1	1	1	1	1
EMB267	OB-59	06.06.21	8	1	7	8	na	1	2	1	1	1	1	1	1	1
EMB267	OB-60	06.06.21	8	1	7	8	na	2	3	1	1	1	1	1	1	1
EMB267	OB-61	06.06.21	8	1	7	8	na	3	4	1	1	1	1	1	1	1
EMB267	OB-62	06.06.21	8	1	7	8	na	4	5	1	1	1	1	1	1	1
EMB267	OB-63	06.06.21	8	1	7	8	na	5	6	1	0	1	0	0	0	0
EMB267	OB-64	06.06.21	8	1	7	8	na	6	7	1	1	1	1	1	1	1
EMB267	OB-65	06.06.21	8	1	7	8	na	8	9	1	0	1	0	0	0	0
EMB267	OB-66	06.06.21	10	3	4	3	2	0	1	1	1	1	1	1	1	1
EMB267	OB-67	06.06.21	10	3	4	3	2	1	2	1	1	1	1	1	1	1
EMB267	OB-68	06.06.21	10	3	4	3	2	2	3	1	1	1	1	1	1	1
EMB267	OB-69	06.06.21	10	3	4	3	2	3	4	1	1	1	1	1	1	1
EMB267	OB-70	06.06.21	10	3	4	3	2	4	5	1	1	1	1	1	1	0
EMB267	OB-71	06.06.21	10	3	4	3	2	5	6	1	1	1	1	1	1	1
EMB267	OB-72	06.06.21	10	3	4	3	2	6	7	1	0	1	0	1	0	0
EMB267	OB-73	06.06.21	10	3	4	3	2	8	9	p	0	1	0	0	0	0
EMB267	OB-74	06.06.21	10	3	4	3	2	10	11	p	0	1	0	0	0	0
EMB267	OB-75	06.06.21	10	3	4	3	2	12	13	p	0	0	0	0	0	0
EMB267	OB-76	06.06.21	10	3	4	3	2	14	15	1	0	1	0	0	0	0
EMB267	OB-77	06.06.21	10	3	4	3	2	16	17	1	1	1	1	1	1	1
EMB267	OB-78	06.06.21	10	3	4	3	2	18	19	1	1	1	1	1	1	1
EMB267	OB-79	06.06.21	10	3	4	3	2	20	21	1	1	1	1	1	1	1
EMB267	OB-80	06.06.21	10	3	4	3	2	22	23	1	1	1	1	1	1	1
EMB267	OB-81	06.06.21	11	2	4	3	12	0	1	1	0	1	0	0	0	0
EMB267	OB-82	06.06.21	11	2	4	3	12	1	2	0	0	0	0	0	0	0
EMB267	OB-83	06.06.21	11	2	4	3	12	2	3	1	0	1	0	0	0	0
EMB267	OB-84	06.06.21	11	2	4	3	12	3	4	w	0	1	0	0	0	0
EMB267	OB-85	07.06.21	18	1	3	2	10	0	1	1	1	1	1	1	1	1
EMB267	OB-86	07.06.21	18	1	3	2	10	1	2	1	1	1	1	1	1	1
EMB267	OB-87	07.06.21	18	1	3	2	10	2	3	1	1	1	1	1	1	1
EMB267	OB-88	07.06.21	18	1	3	2	10	3	4	0	0	0	0	0	0	0
EMB267	OB-89	07.06.21	18	1	3	2	10	4	5	1	1	1	?	1	0	0
EMB267	OB-90	07.06.21	18	1	3	2	10	5	6	1	1	1	0	1	0	0
EMB267	OB-91	07.06.21	18	1	3	2	10	7	8	1	1	1	1	1	1	1
EMB267	OB-92	07.06.21	18	1	3	2	10	9	10	1	1	1	1	1	1	1
EMB267	OB-93	07.06.21	18	1	3	2	10	17	18	0	0	0	0	0	0	0
EMB267	OB-94	07.06.21	18	1	3	2	10	19	20	1	1	1	1	1	1	1
EMB267	OB-95	07.06.21	18	1	3	2	10	23	24	1	1	1	1	1	1	1
EMB267	OB-96	07.06.21	18	1	3	2	10	21	22	1	1	1	1	1	1	0
EMB267	OB-97	07.06.21	19	2	7	na	na	0	1	1	1	1	1	1	1	1
EMB267	OB-98	07.06.21	19	2	7	na	na	1	2	1	1	1	1	1	1	1
EMB267	OB-99	07.06.21	19	2	7	na	na	2	3	1	1	1	1	1	1	1
EMB267	OB-100	07.06.21	19	2	7	na	na	3	4	1	1	1	1	1	1	?
EMB267	OB-101	07.06.21	19	2	7	na	na	4	5	1	1	1	1	1	0	w
EMB267	OB-102	07.06.21	19	2	7	na	na	5	6	1	1	1	1	1	1	1
EMB267	OB-103	07.06.21	19	2	7	na	na	7	8	1	1	1	1	1	1	1
EMB267	OB-104	07.06.21	19	2	7	na	na	9	10	1	1	1	1	1	1	w
EMB267	OB-105	07.06.21	19	2	7	na	na	11	12	1	1	1	1	1	1	w
EMB267	OB-106	07.06.21	19	2	7	na	na	13	14	1	1	1	1	1	1	1
EMB267	OB-107	07.06.21	19	2	7	na	na	15	16	1	1	1	1	1	1	1
EMB267	OB-108	07.06.21	19	2	7	na	na	21	22	1	1	1	1	1	1	1
EMB267	OB-109	07.06.21	20	2	10	9	2	0	1	1	1	1	1	1	1	1
EMB267	OB-110	07.06.21	20	2	10	9	2	1	2	1	1	1	1	1	1	1
EMB267	OB-111	07.06.21	20	2	10	9	2	2	3	1	1	1	1	1	1	1
EMB267	OB-112	07.06.21	20	2	10	9	2	3	4	1	1	1	1	1	1	1
EMB267	OB-113	07.06.21	20	2	10	9	2	4	5	1	1	1	1	1	1	1
EMB267	OB-114	07.06.21	20	2	10	9	2	5	6	1	1	1	1	1	1	?
EMB267	OB-115	07.06.21	20	2	10	9	2	7	8	1	1	1	?	1	0	0
EMB267	OB-116	07.06.21	20	2	10	9	2	9	10	1	1	1	1	1	0	w

Table S2: *continued (3/3)*

SampleNr.		Infos						Depth [cm]		Sampled? (Y/N/w:wenig,few)						
		DATE	STATION	Gear/Cast nr.	MUC core Nr.	SRR core	Slice core	from	to	Met.	DIC	Sulf.	Nut.	T.A.	DOC	w.i.
EMB267	OB-117	08.06.21	22	4	6	7	5	0	1	1	1	1	1	1	1	1
EMB267	OB-118	08.06.21	22	4	6	7	5	1	2	1	1	1	1	1	1	1
EMB267	OB-119	08.06.21	22	4	6	7	5	2	3	1	1	1	1	1	1	1
EMB267	OB-120	08.06.21	22	4	6	7	5	3	4	1	1	1	1	1	1	1
EMB267	OB-121	08.06.21	22	4	6	7	5	4	5	1	1	1	1	1	1	1
EMB267	OB-122	08.06.21	22	4	6	7	5	5	6	1	1	1	1	1	1	1
EMB267	OB-123	08.06.21	22	4	6	7	5	7	8	1	1	1	1	1	0	w
EMB267	OB-124	08.06.21	22	4	6	7	5	9	10	1	1	1	1	1	0	1
EMB267	OB-125	09.06.21	28	3	7	6	1	0	1	1	1	1	1	1	1	1
EMB267	OB-126	09.06.21	28	3	7	6	1	1	2	1	1	1	1	1	1	0
EMB267	OB-127	09.06.21	28	3	7	6	1	2	3	1	1	1	1	1	1	1
EMB267	OB-128	09.06.21	28	3	7	6	1	3	4	1	1	1	1	1	1	1
EMB267	OB-129	09.06.21	28	3	7	6	1	4	5	1	1	1	1	1	1	1
EMB267	OB-130	09.06.21	28	3	7	6	1	6	7	1	1	1	1	1	1	1
EMB267	OB-131	09.06.21	28	3	7	6	1	8	9	1	1	1	1	1	w	1
EMB267	OB-132	09.06.21	28	3	7	6	1	18	19	1	1	1	1	1	1	1
EMB267	OB-133	09.06.21	28	3	7	6	1	10	11	1	1	1	1	1	1	1
EMB267	OB-134	09.06.21	28	3	7	6	1	12	13	1	1	1	0	1	0	0
EMB267	OB-135	09.06.21	28	3	7	6	1	14	15	1	1	1	1	1	1	1
EMB267	OB-136	09.06.21	28	3	7	6	1	20	21	1	1	1	?	1	1	1
EMB267	OB-137	09.06.21	28	7	1	na	na	0	1	1	1	1	1	1	1	1
EMB267	OB-138	09.06.21	28	7	1	na	na	1	2	1	1	1	1	1	1	1
EMB267	OB-139	09.06.21	28	7	1	na	na	2	3	1	1	1	1	1	1	1
EMB267	OB-140	09.06.21	28	7	1	na	na	3	4	1	1	1	1	1	1	1
EMB267	OB-141	09.06.21	28	7	1	na	na	4	5	1	1	1	1	1	1	1
EMB267	OB-142	09.06.21	28	7	1	na	na	6	7	1	1	1	1	1	1	1
EMB267	OB-143	09.06.21	28	7	1	na	na	8	9	1	1	1	1	1	1	1
EMB267	OB-144	09.06.21	28	7	1	na	na	10	11	1	1	1	1	1	1	1
EMB267	OB-145	09.06.21	28	7	1	na	na	12	13	1	1	1	1	1	1	1
EMB267	OB-146	09.06.21	28	7	1	na	na	14	15	1	1	1	1	1	1	1
EMB267	OB-147	09.06.21	28	7	1	na	na	20	21	1	1	1	1	1	1	1
EMB267	OB-148	09.06.21	29	3	4	na	na	0	1	1	1	1	1	1	1	1
EMB267	OB-149	09.06.21	29	3	4	na	na	1	2	1	1	1	1	1	1	1
EMB267	OB-150	09.06.21	29	3	4	na	na	2	3	1	1	1	1	1	1	1
EMB267	OB-151	09.06.21	29	3	4	na	na	3	4	1	1	1	1	1	1	1
EMB267	OB-152	09.06.21	29	3	4	na	na	4	5	1	1	1	1	1	1	1
EMB267	OB-153	09.06.21	29	3	4	na	na	5	6	1	1	1	1	1	1	1
EMB267	OB-154	09.06.21	29	3	4	na	na	8	9	1	1	1	1	1	1	1
EMB267	OB-155	09.06.21	29	3	4	na	na	9	11	1	1	1	1	1	1	1
EMB267	OB-156	09.06.21	29	3	4	na	na	11	12	1	1	1	1	1	1	1
EMB267	OB-157	09.06.21	29	3	4	na	na	13	14	1	1	1	1	1	1	1
EMB267	OB-158	09.06.21	29	3	4	na	na	15	16	1	1	1	1	1	1	1
EMB267	OB-159	09.06.21	29	3	4	na	na	17	18	1	1	1	1	1	1	1
EMB267	OB-160	09.06.21	29	3	4	na	na	19	20	1	1	1	1	1	1	1
EMB267	OB-161	09.06.21	29	3	4	na	na	21	22	1	1	1	1	1	1	1
EMB267	OB-162	09.06.21	29	3	4	na	na	23	24	1	1	1	1	1	?	1

Table S3: Water column samples EMB267, research group (Isotope) Biogeochemistry IOW. *SWI: sediment-water-interface; BW: bottom water, Met: metals, DIC: dissolved inorganic carbon, nut: nutrients, T.A.: total alkalinity, DOC: dissolved organic carbon, w.i.: water isotopes. (obs.: individual samples (na's) had only pH determinations on ship.)*

SampleNr.		cruise and general							Water Depth [m]	Existing Sample? (Y/N)					
		DATE	STATION_Gear	GearNr	GearType	bottle nr./core nr.	Lat	Lon	from	Met.	DIC	Nut.	T.A.	DOC	w.i.
EMB267	OB-1	03.06.21	2	2	CTD	3	54o15.9219'N	14o18.2995'E	1	1	1	1	1	1	1
EMB267	OB-2	03.06.21	2	2	CTD	6	54o15.9219'N	14o18.2995'E	6	1	1	1	1	1	1
EMB267	OB-3	03.06.21	2	2	CTD	8	54o15.9219'N	14o18.2995'E	9	1	1	1	1	1	1
EMB267	OB-4	03.06.21	2	2	CTD	10	54o15.9219'N	14o18.2995'E	13	1	1	1	1	1	1
EMB267	OB-5	03.06.21	2	4	MUC	3	54o15.9204'N	14o18.2959'E	SWI	1	1	1	1	1	1
EMB267	OB-6	03.06.21	2	4	MUC	1	54o15.9204'N	14o18.2959'E	SWI	1	1	1	1	1	1
EMB267	OB-7	04.06.21	3	2	CTD	1	54o15.796'N	14o18.9440'E	1	1	1	1	1	1	1
EMB267	OB-8	04.06.21	3	2	CTD	4	54o15.796'N	14o18.9440'E	6	1	1	1	1	1	1
EMB267	OB-9	04.06.21	3	2	CTD	5	54o15.796'N	14o18.9440'E	9	1	1	1	1	1	1
EMB267	OB-10	04.06.21	3	2	CTD	7	54o15.796'N	14o18.9440'E	BW 12.7	1	1	1	1	1	1
EMB267	OB-11	04.06.21	3	5	MUC	3	54o15.778'N	14o18.974'E	SWI	1	1	1	1	1	1
EMB267	OB-12	05.06.21	6	2	CTD	1	54o14.357'N	14o21.838'E	1	1	1	1	1	1	1
EMB267	OB-13	05.06.21	6	2	CTD	3+4	54o14.357'N	14o21.838'E	6	1	1	1	1	1	1
EMB267	OB-14	05.06.21	6	2	CTD	7	54o14.357'N	14o21.838'E	9	1	1	1	1	1	1
EMB267	OB-15	05.06.21	6	2	CTD	9	54o14.357'N	14o21.838'E	BW (>13)	1	1	1	1	1	1
EMB267	OB-16	06.06.21	9	2	CTD	1	54o14.35'N	14o19.94'E	1	1	1	1	1	1	1
EMB267	OB-17	06.06.21	9	2	CTD	2	54o14.35'N	14o19.94'E	6	1	1	1	1	1	1
EMB267	OB-18	06.06.21	9	2	CTD	4	54o14.35'N	14o19.94'E	11	1	1	1	1	1	1
EMB267	OB-19	06.06.21	9	2	CTD	9	54o14.35'N	14o19.94'E	BW	1	1	1	1	1	1
EMB267	OB-20	06.06.21	12	2	CTD	1	54o15.4413'N	14o19.7720'E	1	1	1	?	1	1	1
EMB267	OB-21	06.06.21	12	2	CTD	2	54o15.4413'N	14o19.7720'E	6	1	1	1	0	1	1
EMB267	OB-22	06.06.21	12	2	CTD	3	54o15.4413'N	14o19.7720'E	11.5	1	1	1	1	1	1
EMB267	OB-23	06.06.21	12	2	CTD	13	54o15.4413'N	14o19.7720'E	BW	1	1	1	1	1	1
EMB267	OB-24	07.06.21	16	2	CTD	4	54o14.940'N	14o18.458'E	6	1	1	1	1	?	1
EMB267	OB-25	07.06.21	16	2	CTD	5	54o14.940'N	14o18.458'E	11	1	1	1	0	1	1
EMB267	OB-26	07.06.21	16	2	CTD	7	54o14.940'N	14o18.458'E	BW	1	1	1	1	1	1
EMB267	na	07.06.21	19	1	CTD	na	54o14.934'N	14o18.4346'E	BW	0	0	0	0	0	0
EMB267	na	07.06.21	20	1	CTD	1	54o15.393'N	14o19.912'E	BW	0	0	0	0	0	0
EMB267	OB-27	08.06.21	22	2	CTD	1	54o15.6537'N	14o16.8551'E	1	1	1	1	0	1	1
EMB267	OB-28	08.06.21	22	2	CTD	2	54o15.6537'N	14o16.8551'E	6	1	1	1	0	1	1
EMB267	OB-29	08.06.21	22	2	CTD	4	54o15.6537'N	14o16.8551'E	9.5	1	1	1	1	1	1
EMB267	OB-30	08.06.21	22	2	CTD	5	54o15.6537'N	14o16.8551'E	12	1	1	1	1	1	1
EMB267	OB-31	08.06.21	22	2	CTD	10	54o15.6537'N	14o16.8551'E	BW	1	1	1	1	1	1
EMB267	na	08.06.21	25	1	CTD	13	54o15.655'N	14o16.873'E	BW	0	0	0	0	0	0
EMB267	OB-32	09.06.21	28	2	CTD	1	54o15.4043'N	14o17.2272'E	1	1	1	1	1	1	1
EMB267	OB-33	09.06.21	28	2	CTD	na	54o15.4043'N	14o17.2272'E	6	1	1	1	1	1	1
EMB267	OB-34	09.06.21	28	2	CTD	4	54o15.4043'N	14o17.2272'E	11.5	1	1	1	0	1	1
EMB267	OB-35	09.06.21	28	2	CTD	na	54o15.4043'N	14o17.2272'E	BW	1	1	1	1	1	1
EMB267	n.a.	09.06.21	28	6	CTD	na	54o15.4228'N	14o17.2545'E	BW	0	0	0	0	0	0
EMB267	OB-36	09.06.21	29	1	CTD	na	54o15.6601'N	14o16.8446'E	BW	1	1	1	0	1	1
EMB267	FB-2	10.06.21	33	1	CTD	4	54o32.6482'N	10o44.2871'E	2	1	0	0	0	0	1
EMB267	FB-9	10.06.21	33	1	CTD	3	54o32.6482'N	10o44.2871'E	9	1	0	0	0	0	1
EMB267	FB-15	10.06.21	33	1	CTD	2	54o32.6482'N	10o44.2871'E	15	1	0	0	0	0	1
EMB267	FB-BW	10.06.21	33	1	CTD	1	54o32.6482'N	10o44.2871'E	BW (~21m)	1	0	0	0	0	1