ALKOR-Berichte

Potential effects of the exclusion of bottom fishing in the marine protected areas (MPAs) of the western Baltic Sea – third year observations

Cruise No. AL570

22.03. – 11.04.2022,
Kiel (Germany) – Kiel (Germany)
MGF-OSTSEE-2022

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2022

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1 Cruise Summary

1.1 Summary in English

The expedition AL570 with the RV ALKOR was carried out within the framework of the interdisciplinary 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 the Ministry of Education and Research (BMBF). Within MGF-OSTSEE a consortium of scientists from various institutions investigates how benthic ecosystems in MPAs within the German exclusive economic zone develop after the exclusion of bottom trawling. Major goals of the project are **i.** the initial assessment of the environmental state and its variability in- and outside the three MPAs Fehmarnbelt, Oder- and Rönnebank under the ongoing pressure of bottom trawling and **ii.** the assessment of the effect of bottom trawling on benthic communities and benthic biogeochemical functioning. The cruise AL570 concludes a series of three previous expeditions EMB238 (2020) and EMB267/268 (2021) and aimed to survey all components of the benthic food web including prokaryotes, protozoans, meiofauna and macrofauna, as well as sediment properties and biogeochemical processes in selected working areas in- and outside of the MPA. The working program comprised 156 station activities of various gears for biological and biogeochemical sampling of sediments. Solute exchange between the sediment and the water column was investigated using Landers and a novel underwater vehicle. Investigations in the water column, seafloor observation and deployments of a dredge supplemented the station work.

1.2 Zusammenfassung

Die Reise AL570 mit dem FS ALKOR erfolgte im Rahmen des vom Bundesministerium für Bildung und Forschung (BMBF) geförderten interdisziplinärem DAM Forschungsprojektes zur „Untersuchung der erwarteten Auswirkungen des Ausschlusses mobiler, grundberührender Fischerei (MGF) in marinen Schutzgebieten der Ostsee" (MGF-OSTSEE). In diesem Forschungsprojekt untersucht ein Konsortium von Wissenschaftler*innen wie sich die Ökosysteme der Natura 2000 Gebiete in der deutschen ausschließlichen Wirtschaftszone (AWZ) der Ostsee nach Ausschluss der MGF entwickeln. Hauptziele sind **i.** die Zustandsbewertung des benthischen Ökosystems innerhalb und außerhalb der Natura 2000 Gebiete Fehmarnbelt, Oder- und Rönnebank unter dem Einfluss des derzeitigen Grundschleppnetzbetriebs und **ii.** die generelle Bewertung der Auswirkungen der bodenberührenden Fischerei auf benthische Gemeinschaften und biogeochemische Sedimentfunktionen. Die Fahrt AL570 schließt die Serie bisheriger Expeditionen EMB238 in 2020 und EMB267/268 in 2021 ab und diente der Bestandsaufnahme aller Komponenten des benthischen Nahrungsnetzes, von den Prokaryonten bis zum Makrozoobenthos, sowie der Untersuchung von Sedimenteigenschaften und biogeochemischen Prozessen in ausgewählten Untersuchungsflächen inner- und außerhalb der Natura 2000 Gebiete. Das Arbeitsprogramm umfasste insgesamt 156 Stationsarbeiten zur biologischen und biogeochemischen Beprobung der Sedimente. Der Stoffaustausch zwischen den Sedimenten und der Wassersäule wurde in situ mittels Lander und einem neuartigen Unterwasserfahrzeug erfasst. Das Arbeitsprogramm wurde durch Begleitmessungen in der Wassersäule, die visuelle Beobachtung des Meeresbodens sowie durch Dredge Einsätze ergänzt.

2 Participants

2.1 Principal Investigators

Name	Institution
Sommer, Stefan, Dr.	GEOMAR
Arndt, Hartmut, Prof. Dr.	University Köln
Gogina, Mayya, Dr.	IOW Warnemünde
Kallmeyer, Jens, Dr.	GFZ Potsdam
Piontek, Judith, Dr.	IOW Warnemünde
Roeser, Patricia Dr.	IOW Warnemünde

2.2 Scientific Party

Name	Discipline	Institution
Sommer, Stefan, Dr.	Biogeochemistry / Chief Scientist	GEOMAR
Hartmut, Arndt, Prof. Dr.*	Protozoan Biology	University Köln
Clemens, David	Benthic Biogeochemisty	GEOMAR
Gogina, Mayya, Dr.	Macrobenthos	IOW Warnemünde
Hoffmann, Sven	Meiobenthos	Senckenberg am Meer
Kallmeyer, Jens, Dr.*	Biogeochemistry	GFZ Potsdam
Kitte, Axel	Biogeochemistry	GFZ Potsdam
Piontek, Judith, Dr.	Microbiology	IOW Warnemünde
Roeser, Patricia, Dr.	Biogeochemistry	IOW Warnemünde
Sachs, Maria	Protozoan Biology	University Köln
Surberg, Regina	Biogeochemistry	GEOMAR
Türk, Matthias	Electr. Engineer	GEOMAR
Janßen, Markan, Dr.*	Epiphytobenthos	University Rostock
Bernsee, Simone*	Biogeochemistry	GFZ Potsdam

* Crew exchange

2.3 Participating Institutions

GEOMAR	Helmholtz-Zentrum für Ozeanforschung Kiel
GFZ Potsdam	Helmholtz-Zentrum Potsdam – Deutsches GeoForschungsZentrum
IOW Warnemünde	Leibniz Institute for Baltic Sea Research, Warnemünde
Senckenberg am Meer	Senckenberg am Meer Wilhelmshaven
University Köln	Universität zu Köln
University Rostock	Universität Rostock

3 Research Program

3.1 Description of the Work Area

The main working areas of the AL570 cruise were the Fehmarnbelt, the Oderbank in the Pommeranian Bay of the southern Baltic Sea and to a minor extent the Rönnebank (Figures 3.1 – 3.4). The Oderbank is the largest and a highly representative sandbank in the German Baltic Sea, mainly located in water depths between 10 and 16 m, composed of well-sorted fine sand. 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.

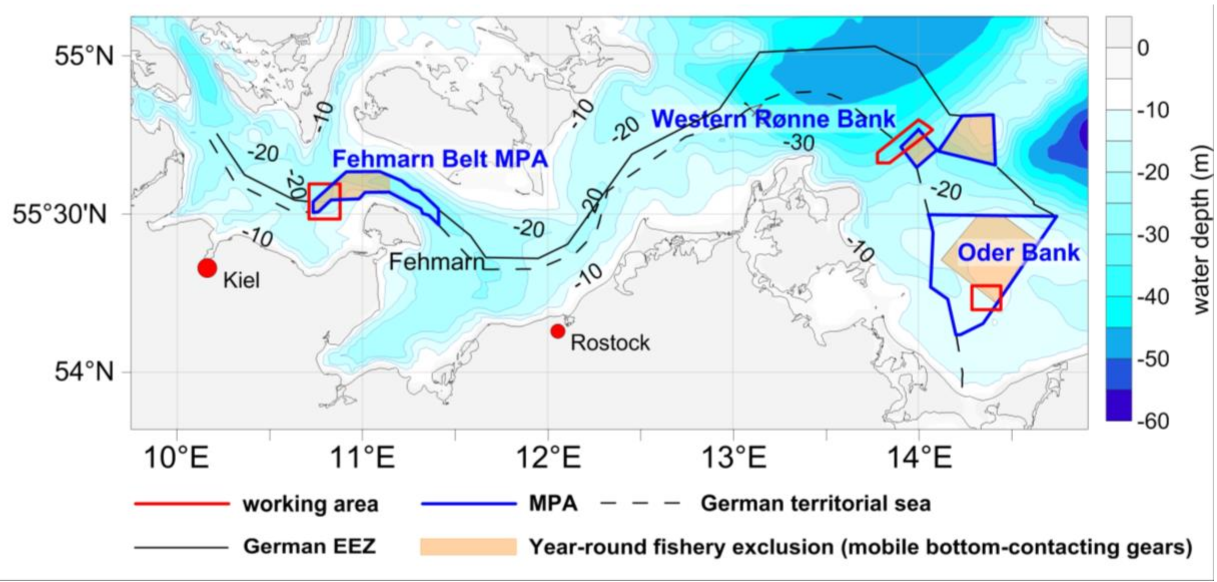

Fig. 3.1 Working areas of the cruise AL570. Major focus was on the Fehmarnbelt and the Oderbank.

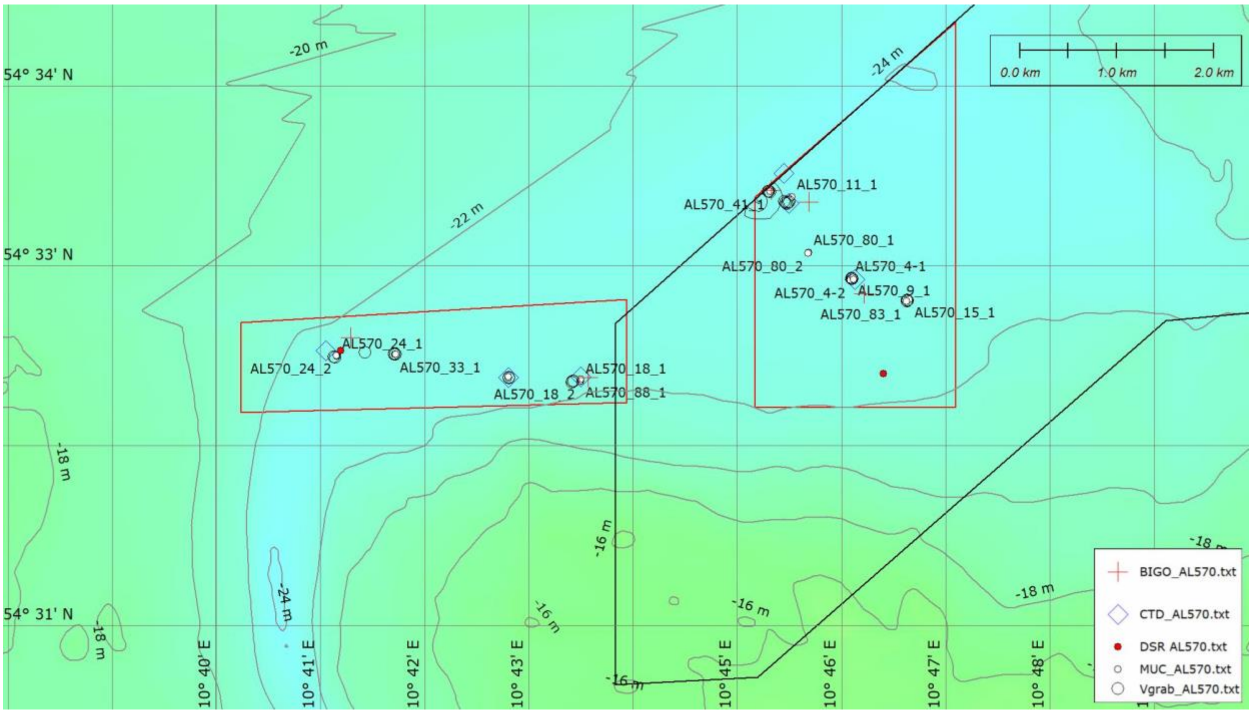

Fig. 3.2 Working areas (red lines) in- and outside the Fehmarnbelt MPA (black line). Mercator WGS84. Batymetric data: BSH www.geoseaportal.de. Only stations of the MUC are annotated

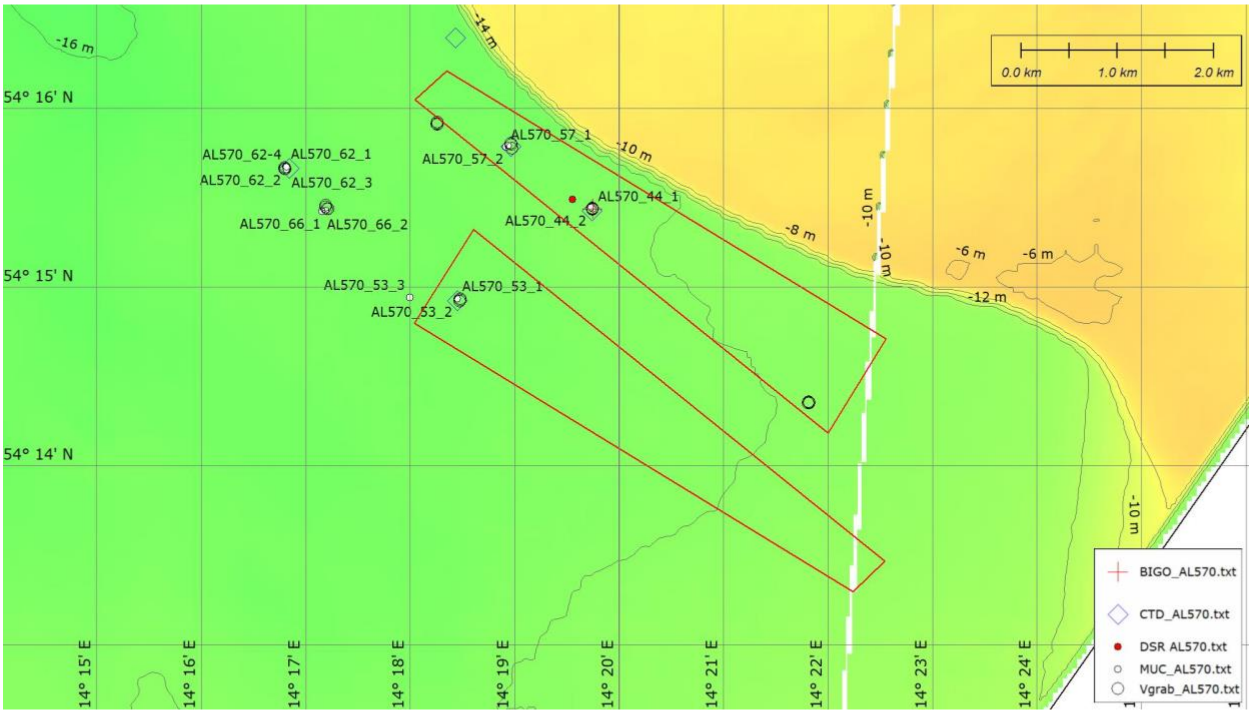

Fig. 3.3 Working areas at the Oderbank (red lines). MercatorWGS84. Batymetric data: BSH www.geoseaportal.de. Only stations of the MUC are annotated

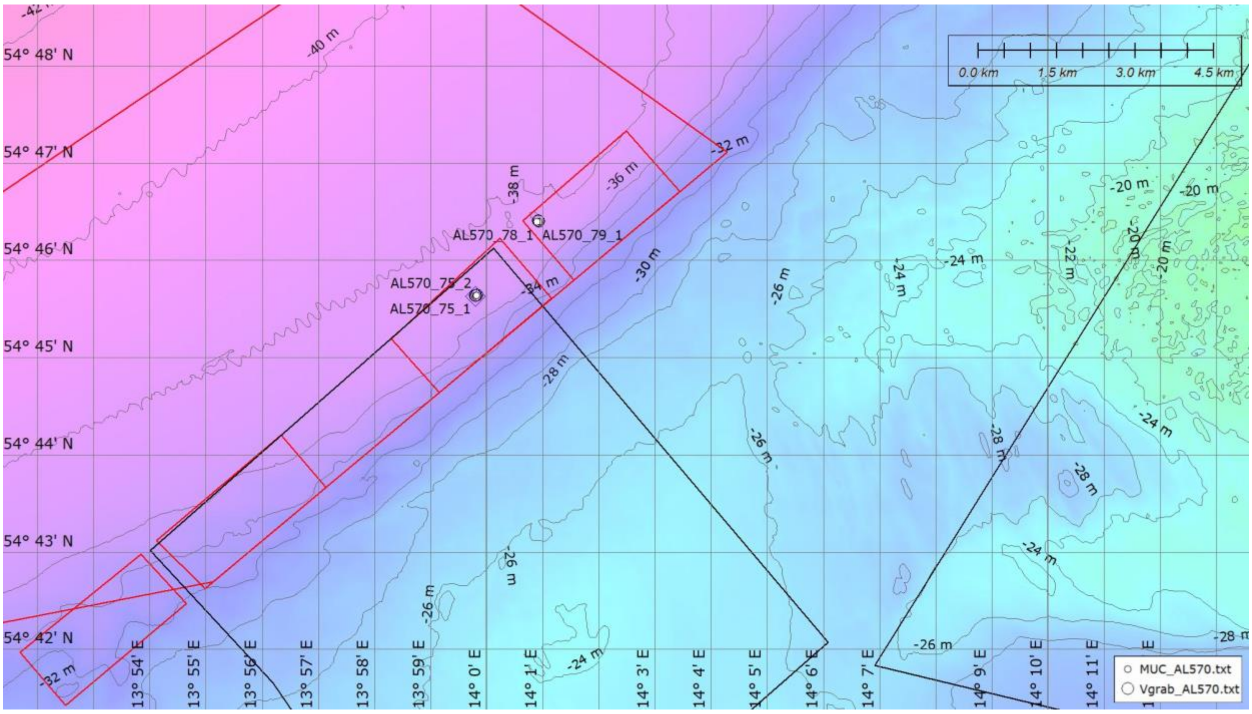

Fig. 3.4 Working areas (red lines) in- and outside the Rönnebank MPA (black lines). Mercator WGS84. Batymetric data: BSH www.geoseaportal.de. Only stations of the MUC ara annotated.

3.2 Aims of the Cruise

The cruise AL570, completes the series of expeditions under the framework of the project MGF_OSTSEE funded by BMBF in order to assess the development of sediments and benthic communities in marine protected areas of the German EEZ after exclusion of bottom trawling. One main hypothesis in the project is that sediment communities and biogeochemical sediment functions will gradually develop differently after the exclusion of bottom fishing compared to adjacent reference sites outside of the MPAs, with immediate effects on sediment microbial communities and biogeochemical processes, and with a time lag on larger organisms (macrozoobenthos, demersal fish populations), which again indirectly impact the lower trophic levels of the benthic food chain and associated processes. The overarching aim of this cruise was to provide a complete series of flux measurements, biogeochemical rate measurements and porewater geochemistry to assess benthic element cycling in relation to the benthic community (incl. all size classes) at all three MPAs and the respective reference sites during the same time period. The results will serve as a base line framework for future investigations after the exclusion of bottom fishery in the investigated MPAs, whose gradual recovery can then be related to the reference sites where fishing activities still occur. The special feature of the cruise was a combined assessment of sedimentological, micro- and macrobiological and biogeochemical parameters, and to provide a baseline for monitoring cruises planned in the future. It was particularly targeting the investigation of interactions between micro-/macrofauna and sediment biogeochemistry.

3.3 Agenda of the Cruise

As outlined in the cruise proposal we performed biogeochemical and biological measurements at all three working areas focusing on selected stations that were already sampled during the previous cruises EMB238/Leg1+2 (26.05. – 09.06.2020) and EMB267/Leg1+2 (01.06. – 16.06.2021).

Overall, we conducted 126 deployments (not considering recoveries of e.g. the lander) in the three working areas, which included 12 CTD casts, 58 Van Veen grabs, 36 Multiple Corer casts (MUC), 6 deployment of the BIGO type lander (Biogeochemical Observatory), 3 deployments of the novel Deep Sea Rover (DSR) Panta Rhei, 4 oxygen Eddy Correlation measurements (EC), 3 deployments of the OFOS (Ocean Floor Observation System) and a towed camera system and 4 dredge deployments. Station work predominated at the Fehmarnbelt working area. At the Fehmarnbelt, the Oder- and the Rönnebank 66, 48 and 12 deployments were carried out respectively. Due to bad weather conditions at the Rönnebank no in situ measurements using the Lander or the Deep-Sea Rover (DSR) Panta Rhei were performed.

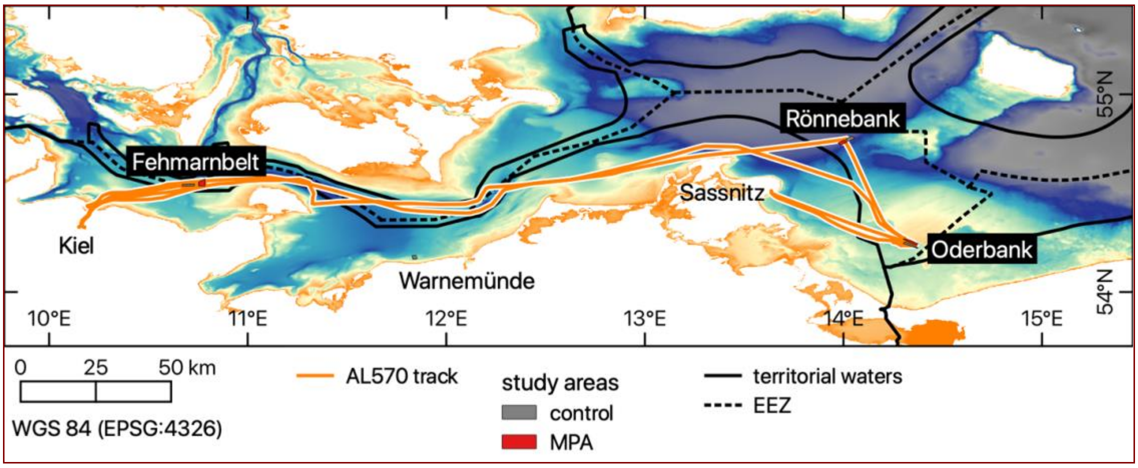

Fig. 3.3.1 Track chart of R/V ALKOR cruise AL570. Station work focused in- and outside the Marine Protected Areas in the three main working areas Fehmarnbelt, Oder- and Rönnebank. Bathymetry from Seifert et al. (2001).

4 Narrative of the Cruise

After having solved major problems with COVID tests that endangered the participation of three researchers from GEOMAR, laboratories were established on board. The scientific teams consisted of scientists from GEOMAR, IOW, University of Köln, GFZ Potsdam and Senckenberg am Meer covering the following disciplines: biogeochemistry, biology of protozoans, meiobenthology, microbiology and macrobenthos. At the 22nd of March 12:00 (LT) we left Kiel harbor and headed towards our first working area in the Fehmarnbelt MPA under perfectly calm weather conditions (see also section 6). Station work started in the afternoon using the CTD water sampling rosette and the Van Veen grab (Vgrab). The first working day was concluded with the deployment of a BIGO type Lander. The scientific sampling equipment comprised the following gears i. the CTD water sampling rosette (CTD), ii. a Van Veen grab, iii. a Multiple Corer (MUC), iv, a dredge of the type “Kieler Kinderwagen”, v. two BIGO type Landers for in situ flux measurements across the sediment water interface, vi. the newly developed under water vehicle (Deep-Sea Rover [DSR] Panta Rhei) and lastly vii. an Eddy Correlation Lander for non-invasive oxygen flux measurements. These gears were deployed during the daytime hours, whereas sample processing and onboard analyses continued until the late evening. Fortunately, the weather conditions remained calm enabling swift station work inside and outside the Fehmarnbelt MPA. Station selection and planning was adapted to the station work that was conducted during an earlier cruise with RV Elisabeth Mann Borgese (EMB238). Every day a brief science meeting was held after dinner to plan the station activities of the next day. At the 24th of March after a brief pre-site survey of the seafloor, the DSR was deployed inside the MPA for measurements of the total oxygen uptake of the sediment from which the organic carbon turnover can be calculated. Subsequently, the deployment of the Eddy Correlation Lander for the non-invasive benthic oxygen uptake concluded the station work of this day. Station work at the Fehmarnbelt was continued until the morning of the 28th of March. Subsequently, we headed towards Kiel harbor (westshore pier) to exchange scientists (see Section 2.2) the captain and another crew member. We arrived in Kiel at about 13:00 and stayed for three hours.

After a longer transit, we started station work in the morning of the 29th of March at the Oderbank in water depths of ca. 15 m. The research program was similar to that already performed off Fehmarn, again station planning was based on stations that were sampled during the EMB cruise 267 Leg 1+2 (01.06. – 16.06.2021, Feldens & Gogina 2021). At the 30th of March, we deployed the DSR at the Oderbank to measure a time series of oxygen fluxes and bottom water O_2 concentrations for several days. With this deployment, we hoped to bridge several days of bad weather with in situ flux measurements. In face of the bad weather forecast the BIGO and the Eddy Correlation Lander were recovered. On Friday the 1st of April with progressively increasing wave heights we headed towards the harbor of Sassnitz and stayed there until Sunday the 3rd of April.

In the morning the 3rd of April we left Sassnitz and headed towards the Oderbank to recover the DSR Panta Rhei and the surface buoys marking its working area. Subsequently after a short transit we started station work at the Rönnebank, which was not sampled during previous cruises. Thanks to Dr. Papenmeier (IOW), who provided maps of seafloor lithology we were able to select locations suitable for sediment, sampling. Deployments of the MUC and Van Veen grabs inside and outside the MPA were successful. Yet again, due to bad weather forecasts predicting wave heights of up to 3 m, we decided to leave the Rönnebank area and headed towards the Fehmarnbelt in the hope to continue station work there.

On Monday the 4th of April stormy weather prevented safe station work off Fehmarn. We used this time and went into the harbor of Kiel to unload the DSR Panta Rhei for its repair and stayed overnight. During its deployment in the Oderbank working area the DSR got damaged. Sand, suspended during the storm blocked all mechanical bearings, which are important for the movement of the Rover as well as of the two benthic flux chambers. A fast repair became necessary as the Rover and the Lander would be shipped to Mindelo (Cape Verde) for the RV Meteor cruise M182 just after our return from this cruise. On Tuesday the 5th of April we left Kiel harbor in the morning to continue station work off Fehmarn. Besides other stations, station work focused on a site close to a wreck, where we hoped to encounter sediments not affected by fishing activities. In the evening hours of the Wednesday the 6th of April after the station work at Fehrmarnbelt was concluded, we decided not to steam back to the Rönnebank due to forecasts of heavy storms. Instead, we decided to continue with extra stations at the Fehmarnbelt working area that are highly impacted by fishing activities/trawling. Finally, station work was concluded on the 7th of April at about 16:00. Subsequently, the scientific gear was packed, maintained and the labs cleaned. On the 10th of April at 08:00 we arrived in Kiel harbor.

5 Preliminary Results

5.1 Water Sampling with the CTD/Rosette

(D. Clemens, R. Surberg, S. Sommer)

GEOMAR

For measurements and sampling in the water column a Sea-Bird Scientific CTD (SBE 9) with a 12 bottle water sampling rosette was used. The CTD setup was equipped with a double conductivity sensor (SN: 3300 and 4062), a double temperature sensor (SN: 5806 and 5807), one Digiquartz pressure sensor (SN: 0410), 2 oxygen optodes (SN: 2686 and 2669), one altimeter (SN: 41840) and one WET Labs fluoro- and turbidity meter (SN: FLNTURTD-2928). Data were acquired with the Sea-Bird Seasave software (v7.26.7). We conducted 12 CTD casts in total (Table 5.1.1) covering all three research areas (Fehmarnbelt, Oderbank and Rönnebank).

Table 5.1.1 List of CTD deployments

station	gear	area	latitude	longitude
1-1	CTD 01	FB MPA	54.555783	10.758242
13-1	CTD 02	FB MPA	54.548697	10.768846
27-1	CTD 03	FB control	54.542111	10.684277
43-1	CTD 04	OB MPA	54.257103	14.329076
51-1	CTD 05	OB MPA	54.263106	14.316127
52-1	CTD 06	OB control	54.248675	14.307531
64-1	CTD 07	OB control	54.261015	14.280705
67-1	CTD 08	OB MPA	54.273200	14.307316
73-1	CTD 09	RB MPA	54.760478	13.996828
82-1	CTD 10	FB MPA	54.558530	10.757454
87-1	CTD 11	FB control	54.539706	10.725033
92-1	CTD 12	FB control	54.539626	10.713450

FB: Fehmarnbelt, OB: Oderbank, RB: Rönnebank

The physical properties of the water column are depicted in Figure 5.1.1. Overall, the water temperature was between 4.5 and 5.6 °C. The salinity was highest at Fehmarnbelt as expected from its proximity to the North Sea. The shallow water column at Oderbank was well mixed throughout the cruise with no significant gradient or stratification in salinity nor oxygen. At Fehmarnbelt, the water column changed slightly between the beginning of the cruise and towards the end of the cruise. Oxygen decreased by approximately 50 µM, the water mass got fresher by about 5 PSU and slightly warmer. Only at Rönnebank a well stratified bottom boundary layer was obvious with higher salinity and decreased oxygen content. In addition to the physical parameters, nutrient samples from the water sampling rosette were taken to resolve geochemical properties of the water column.

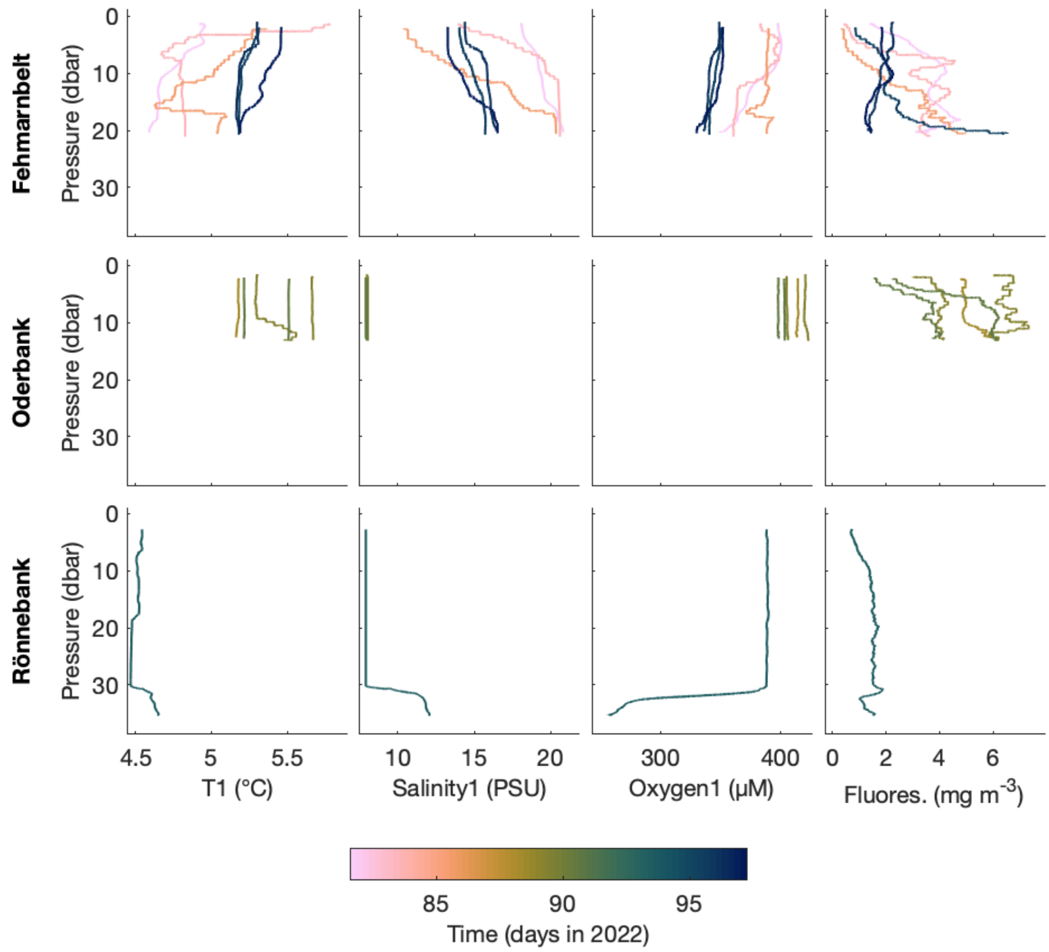

Fig. 5.1.1 Preliminary results of the CTD deployments, showing water column profiles of temperature, salinity, oxygen concentration and fluorescence for all three research areas. The color coding shows the absolute time of the measurements in days in 2022.

As a side program, we took further water sample for virus analyses in cooperation with the University of Hamburg (L. Listmann).

<u>*Ostreococcus* and virus isolation from the Baltic Sea (L. Listmann)</u>

As part of our ongoing projects (ELVIRA; ECOPHYCA) on the ecological and evolutionary effects of different temperatures and salinities in the Baltic Sea on host-virus dynamics of *Ostreococcus* and its viruses, we aim to answer the following questions: From which regions of the Baltic Sea can we isolate *Ostreococcus* sp. and its associated viruses? And, subsequently, how do the viral dynamics differ between the origins of the hosts and viruses.

To answer these questions, we took surface water samples at 12 stations along the cruise track of AL570. On board, water samples were filtered to obtain two size fractions (<3µm and <0.45µm) to isolate picoplankton and viruses, respectively, back in the laboratory at the IMF in Hamburg. From water samples taken on previous cruises (2018-2021) we have already successfully isolated 30 new strains of *Ostreococcus* sp. However, success was mainly restricted to water samples form Spring or Autumn cruises. First results on the isolations show potential *Ostreococcus* in 4 of the 12 stations (Fig. 5.1.2).

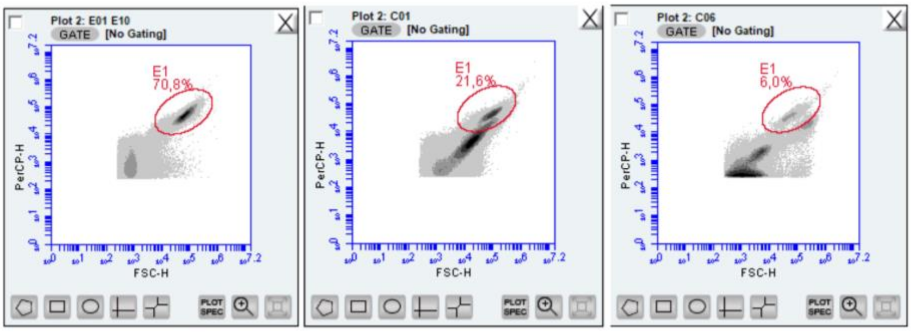

Fig. 5.1.2 Cytometric analysis of a potential Ostreococcus populations in water samples of different stations. The left panel shows an identified Ostreococcus strain, the middle and right panel show cytometric fingerprints of the water samples taken on AL570.

Previously, viral isolations of *Ostreococcus* viruses have also been highly successful yielding ca. 120 new viral strains from water samples ranging from the Kiel Bight up to the Bornholm Basin (water samples from cruises in 2019-2021). Since virus isolations take months we have not yet isolated new virus strains from water samples taken on AL570. However, first results show, that viruses are present in the water samples collected on board AL570 (Fig. 5.1.3). With previous high success rates, we are confident, that also from the water samples of the latest cruise, we will successfully isolate new virus strains. Both virus and host strains from *Ostreococcus* will then be used for investigation of infection dynamics in relation to geographical distribution over the Baltic Sea and environmental change that include temperature and salinity changes.

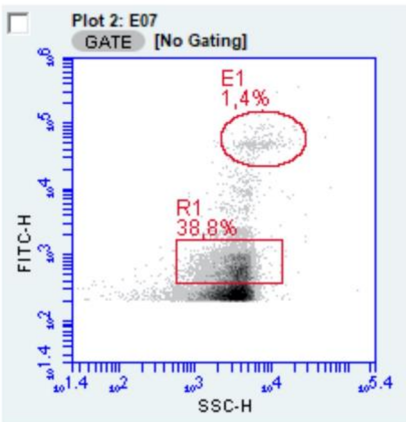

Fig. 5.1.3 Cytometric analysis of concentrated water sample from the cruise. It shows that in the water sample from the cruise a virus signal (R1) is present and isolation success is therefore likely. The population in E1 represents bacteria in the water sample.

5.2 Benthic Biogeochemical Measurements

5.2.1 Benthic In Situ Flux Measurements Using BIGO

(D. Clemens, R. Surberg, M. Türk, S. Sommer)

GEOMAR

Methods

For the measurement of solute fluxes across the sediment water interface and sediment retrieval two structurally similar BIGOs (BIGO I and BIGO II, Biogeochemical Observatory) were deployed as described in detail by Sommer et al. (2009) and Pfannkuche & Linke (2003). In brief, each BIGO contained two circular flux chambers (internal diameter 28.8 cm area 651.4 cm^2). For their deployment, the observatories were connected to surface buoys enabling their fast retrieval after the end of their measurement program and to show their position to other ships passing our research area. The buoyancy of the lander was removed prior to the cruise.

After a delay of few hours after the observatories were placed on the sea floor the chambers were slowly driven into the sediment (~ 30 cm h^{-1}). During this initial time period when the bottom of the chambers were not closed by the sediment, the water inside the flux chamber was periodically replaced with ambient bottom water. The water body inside the chamber was replaced once more with ambient bottom water after the chamber was driven into the sediment to flush out solutes that might have been released from the sediment during chamber insertion. To trace fluxes of nitrate (NO_3^-), nitrite (NO_2^-), ammonium (NH_4^+), phosphate (PO_4^{3-}), silicic acid (H_4SiO_4), and sulfide 8 sequential water samples were removed from either flux chamber with a glass syringe (volume of each syringe ~ 47 ml) by means of glass syringe water samplers. The syringes were connected to the chambers using 1 m long Vygon tubes with a dead volume of 5.2 ml. Prior to deployment these tubes were filled with distilled water. These samples were further used for IC and ICP measurements.

Eight undiluted water samples were taken from the water body enclosed by the benthic chambers using an eight-channel peristaltic pump, which slowly filled glass tubes (quartz glass). These samples will be used for the analyses of TA and DIC. To monitor the ambient bottom water geochemistry an additional syringe water sampler and another series of eight glass tubes were used. The positions of the sampling ports were about 30 – 40 cm above the sediment water interface. Oxygen was measured inside the chambers and in the ambient seawater using optodes (Aandera). They were two point calibrated before each lander deployment using well oxygenated seawater and anoxic seawater, which was produced by adding 5 to 15 gr of sodium sulfite.

The volume of the enclosed water body by the benthic chamber was determined by using a ruler to measure the distance between the sediment surface and the lid and/or by injecting a known amount of bomide into either chamber. From the change of the conductivity, which was recorded using Aanderaa Conductivity cells, the volume of the enclosed water body can be calculated. At the end of the incubation the chamber content (sediment & overlying water) is enclosed and is recovered together with the lander for subsequent sediment and porewater sampling on deck. The water samples were stored in the cool room until subsampling and further processing. The water samples for DIC and total alkalinity analysis were taken according to the slightly modified Standard Operation Procedures described by Dickson et al. (2007). The water samples obtained in the glass tubes were transferred into Pyrex test tubes (volume: 10 ml). Subsequently, a small headspace was applied removing 0.12 ml of the water sample. After headspace application, the samples were poisoned with 20 µl of mercury chloride solution using an Eppendorf Vario pipette. The test tubes were closed using greased (Apiezon vacuum grease) glass stoppers, which were secured using plastic clamps and stored.

The water samples from the in situ incubations were measured onboard immediately after recovery of the lander for nutrients using the auto-analyzer Quattro Seal. The measurements of other parameters (DIC, TA, IC and ICP) will be conducted at the GEOMAR laboratories. Additionally, from the intact sediment that was recovered in the lander chambers samples are taken by multiple groups of the project (more details below).

Preliminary results

The goal of this cruise was completing the baseline study of the MGF-OSTSEE project phase I in the three working areas Fehmarnbelt, Oderbank and Rönnebank. A total of 6 BIGO deployments were performed (Table 5.2.1.1).

Table 5.2.1.1 Station list of the BIGO deployments

station	gear	area	depth (m)	sediment
3-1	BIGO-II-1	FB MPA	22.9	silt
5-1	BIGO-I-1	FB MPA	22.5	silt
21-1	BIGO-I-2	FB control	21.9	silt
32-1	BIGO-II-2	FB control	22.3	silt
47-1	BIGO-II-3	OB MPA	14.3	fine sand
81-1	BIGO-II-4	FB MPA	23.1	silt

FB: Fehmarnbelt, OB: Oderbank

After all deployments except for the Oderbank station the BIGO recovered the sediment enclosed in the chambers (Fig. 5.2.1.1 B1-B3). At the Oderbank the slide was unable to penetrate the fine sand in order to close the chamber.

Due to the weather situation, described in previous sections, we were able to visit the Fehmarnbelt area another time towards the end of the cruise. Using recent multibeam echo sounder data (kindly provided by M. Schönke and P. Feldens), a station close to a known shipwreck was chosen. According to the multibeam map a small region close to the wreck is very little if at all influenced by trawl marks. Here, we wanted to test if there are obvious differences compared to the strongly affected surrounding sites in the Fehmarnbelt.

The BIGOs were additionally used in the following project overarching activities. In cooperation with S. Forster (University of Rostock) we injected bromide at the beginning of the incubations in order to being able to determine bioturbation as well as the chamber volume (see the salinity increase in Fig. 5.2.1.1 A). Additionally, benthic sulfate reduction rates were measured via radiotracers in triplicates in each chamber during all deployments by J. Kallmeyer, S. Bernsee and A. Kitte (GFZ Potsdam). In partnership with P. Roeser (IOW) the porewater and solid phase geochemistry of the recovered chamber sediments will be measured. Moreover, the remaining sediment in the chambers was sieved for microbenthic organisms by M. Gogina (IOW, see section 5.3.5). In one chamber (station 81-1) a core for microbiological analysis (cell numbers, 16S rRNA sequencing, heterotrophic activity and metagenomes) was taken by J. Piontek (IOW, see section 5.3.1) as well as a core for nano- and microfaunal analysis (abundances, species and metabarcoding) by M. Sachs and H. Arndt (Universität Köln, see section 5.3.3). Lastly, in cooperation with A. Neumann (DAM pilot project MGF

NORDSEE, Helmholtz Center hereon) the stable nitrogen isotope tracer $^{15}NO_3^-$ was injected in one of the two chambers during 4 Lander deployments (see detailed methods below).

The geochemical data available on board (Figure 5.2.1.1 A) show that all incubations were successful. The injection of bromide in the beginning of the incubation was also successful as becomes evident by the sharp increase in salinity.

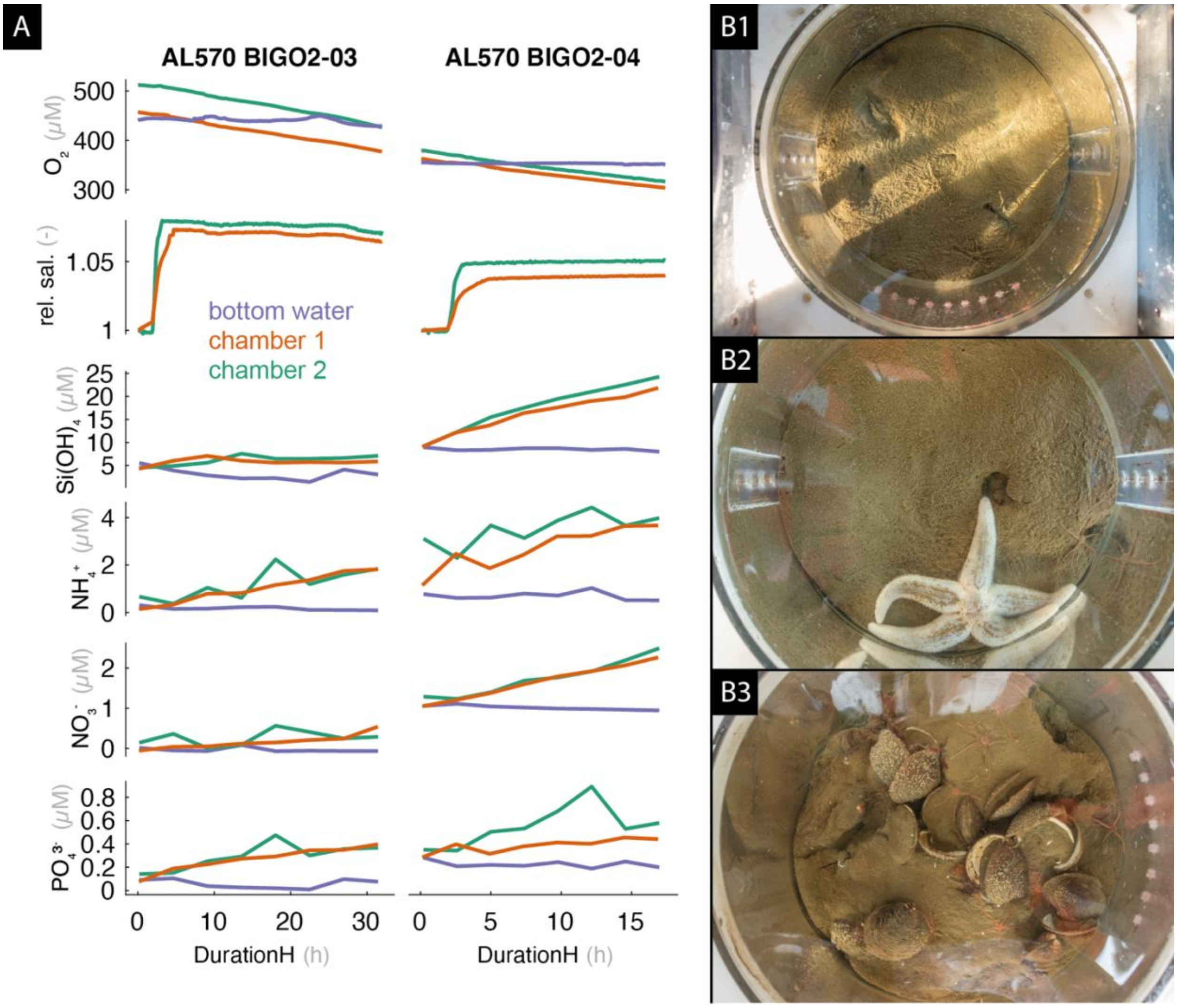

Fig. 5.2.1.1 (A) preliminary examples of in-situ incubation data for a BIGO deployment at Fehmarnbelt (left column) and one from Oderbank (right column) showing changes O_2, relative salt content, silicic acid, NH_4^+, NO_3^- and PO_4^{3-} concentrations in the two chambers in comparison to the ambient bottom water. The initial increase in salinity is due to the injection of bromide (see main text). The presence of macrofauna is obvious from the recovered sediments in the benthic chambers with *Arctica islandica* siphons extending into the bottom water (B1, BIGO-I 2 Ch2), a large seastar *Asterias rubens* (B2, BIGO-I 01 Ch1) and several dead and alive *A. islandica* covering the sediment (B3, BIGO-II 04 Ch1).

As expected from reactive coastal water sediments, O_2 is rapidly consumed and metabolites from organic carbon remineralization such as NH_4^+ and PO_4^{3-} are released. At Fehmarnbelt O_2 uptake was higher than 16.6 mmol m^{-2} d^{-1} (Figure 5.2.1.2), which is comparable to our previous cruise to the region (EMB238, Gogina & Schönke, 2020).

Several flux measurements were obviously influenced by macrofaunal activity, for example sea *Arctica islandica* filtering the chamber water via their siphons (Figure 5.2.1.1 B1), a large sea star *Asterias rubens* (Figure 5.2.1.1 B2) or dead and alive *A. islandica* covering the sediment surface together with brittle stars (Figure 5.2.1.1 B3). The chamber hosting the large sea star has an exceptionally high oxygen uptake of 46.2 mmol m^{-2} d^{-1} (Figure 5.2.1.1). For the careful interpretation of the benthic fluxes we will consider the presence of macrofauna (see section 5.3.5) and bioirrigation, which was measured via bromide injection.

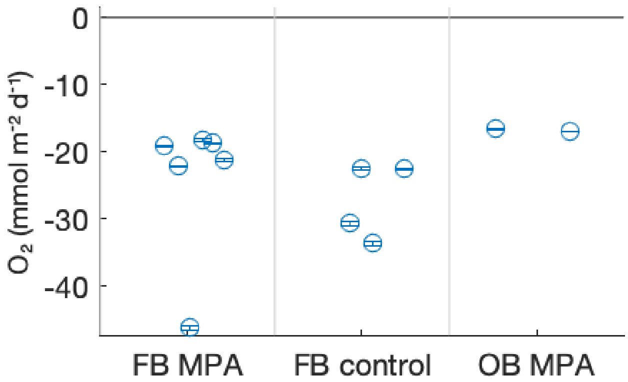

Fig. 5.2.1.2 Preliminary in-situ total O_2 uptake rates measured in the different working areas. The high O_2 uptake at FB MPA is caused by the sea star (see Fig. 5.2.1.1 B2). FB: Fehmarnbelt, OB Oderbank.

In addition to our flux measurement in cooperation with A. Neumann (hereon, MGF-NORDSEE) an isotopic labeling experiment was conducted during selected BIGO deployments to resolve major benthic nitrogen turnover processes.

^{15}N Isotope Dilution Experiment (A. Neumann)

During BIGO deployments, the incubated volume of one chamber per lander was spiked with a $^{15}NO_3^-$ stable isotope tracer whenever the ambient nitrate concentration was sufficiently high (> 2 µmol l^{-1}). Then, additional water samples were collected from the lander for $^{15}NO_3^-$ isotopic ratio analysis in the laboratory at hereon. These measurements will contribute to disentangle the tightly coupled nitrogen turnover processes ammonification, nitrification, and denitrification. Each of these processes has a specific effect on concentration and isotopic ratio of nitrate, which enables to distinguish the individual nitrogen turnover processes. For example, nitrification increases the nitrate concentration and reduces the $^{15}N/^{14}N$ isotopic ratio, while denitrification reduces the nitrate concentration and does (almost) not change the isotopic ratio.

5.2.2 Benthic In Situ Flux Measurements Using the Eddy Correlation technique

(D. Clemens, R. Surberg, M. Türk, S. Sommer)

GEOMAR

In-situ O_2 fluxes across the sediment water interface were measured using an Eddy Correlation (EC) lander (Fig. 5.2.2.1). The lander's centerpieces are a Nortek acoustic doppler velocimeter (ADV) in combination with 2 Pyroscience Piccolo2 ultra-high-speed fiber-optic 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). Additionally, an Aanderaa oxygen optode and a SBE 37-SM CTD were attached to the lander frame. Whilst the O_2 sensors were installed in the lander frame they were 2 point calibrated before and after each deployment in 0 and 100 % air saturated MilliQ and sea water respectively.

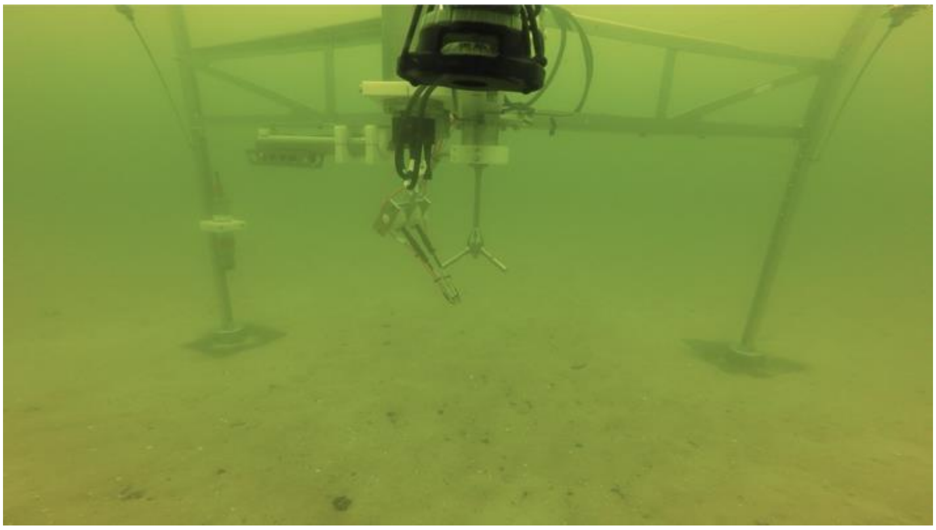

Fig. 5.2.2.1 The EC lander at the seafloor cruise EMB267.

We performed 4 EC deployments in total (Table 5.2.2.1) of which deployment EC 01 failed to record data. With the upcoming data processing, we will determine O_2 fluxes in combination with physical properties of the bottom water for both the MPA and the respective control area. This will give an impression of the overall organic matter degradation. Fluxes will be compared to the data from the Rover, as they have been deployed side by side.

Table 5.2.2.1 Station list of the Eddy Correlation lander

station	gear	area	depth (m)	sediment
17-1	EC 01	FB MPA	22.0	silt
32-1	EC 02	FB control	22.3	silt
50-1	EC 03	OB MPA	13.8	fine sand
85-1	EC 04	FB MPA	23.5	silt

FB: Fehmarnbelt, OB: Oderbank

5.2.3 In situ oxygen Uptake Using the Deep-Sea Rover (DSR) Panta Rhei

(S. Sommer, M. Türk, D. Clemens, R. Surberg)

GEOMAR

In addition to the fluxes measured using the BIGO's and EC Lander, the novel Deep Sea Rover (DSR) Panta Rhei was used to repeatedly measure O_2 uptake of the sediment at Fehmarnbelt and at the Oderbank. The DSR represents a six-wheeled vehicle (weight in air 1200 kg, 80 kg in water, dimensions 3 x 2 x 1.7 m (L, W, H)), which is specifically designed to carry out repeated benthic oxygen flux measurements inside two benthic incubation chambers at the front of the vehicle for prolonged time periods of up to one year, Figure 5.2.3.1. O_2 is measured using fibre-optic O_2 sensors (Pyroscience, Bremen), three were placed inside each chamber, two sensors record the oxygen variability in the ambient bottom water. The volume of the two benthic chambers is determined automatically by injecting pure water into the benthic chambers after the measurement and simultaneously recording the change of the conductivity (Aanderaa conductivity sensors). Additionally, the Rover carries two camera systems, one of which is forward looking, the other one takes photographs of the seafloor behind the vehicle. Similar to the BIGOs during its deployment the Rover was connected to a sea surface buoy for easy recovery and to secure its deployment site. After several tests in the Baltic Sea, during this cruise the novel vehicle was deployed for the first time for real in situ O_2 uptake measurements.

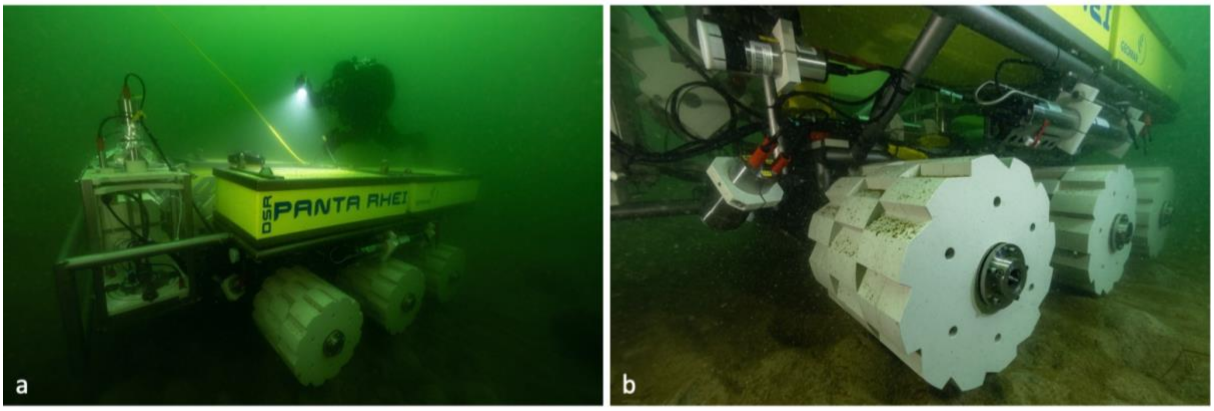

Fig. 5.2.3.1 The DSR Panta Rhei during the first field tests in the Baltic Sea (AL552b, 2021), the diving team Submaris (Kiel) is documenting the driving behavior on different types of the seabed. (a) The key components, two chambers for benthic flux measurements, are visible at the front of the vehicle. (b) Detail image of the wheels and the front camera system, which documents the seafloor before and after each flux measurement. Photos Submaris Diving Team.

During deployment, the following sequence of activities is performed by the Rover: **i.** after it's placement at the seafloor it moves a distance of 10 m away from its landing site into an undisturbed area, **ii.** subsequently the benthic chambers are flushed, **iii.** it takes photos of the area that will be sampled by the two benthic chambers **iv.** then the benthic chambers are inserted into the sediment and flushed prior to the start of flux measurement, **v.** directly thereafter photos are taken of either chamber whilst inserted into the sediment, **vi.** measurement phase, duration was set to 8 hours, the sampling interval of the optodes was set to 5 min. **vii.** when the measurement phase is terminated, pure water is injected to determine the volume of both chambers, the change of conductivity is monitored for 20 min at an increased sampling rate, **viii.** Subsequently, the chambers were retrieved out of the sediment and photos of the sampled area are made, **ix.** the Rover moves a distance of 0.7m to the next measurement area and repeat this sequence. Flux measurements are conducted until the Rover is recovered.

Table 5.2.3.1 Station list of the Deep-Sea Rover Panta Rhei

Station	Gear	Date	Lat. N	Long. W	Depth (m)	Station/deployment
AL570_16	DSR-1	24.03 - 25.03.2022	54°32.397’	10°46.405’	24	**Fehmarnbelt / failed**
AL570_26	DSR-2	26.03. – 27.03.2022	54°32.527’	10°41.198’	38	**Fehmarnbelt / successful**
AL570_58	DSR-3	30.03 – 03.04.2022	54°15.487’	14°19.557’	15	**Oderbank / successful got damaged**

During the 2nd deployment the DSR almost completed 3 cycles of O_2 flux measurements as can be easily recognized from the decreasing O_2 concentration when the chambers were inserted into the sediment. After each flux measurement, when the chambers were retrieved out of the sediment O_2 concentration in each chamber increased again Figure 5.2.3.2. Figure 5.2.3.3 depicts the investigated sediment area of both chambers before, during and after the flux measurement indicating that the sediment surface was not disturbed during the measurement procedure. Brittle stars and sea stars as well as holes indicting burrowing infauna can be observed at the sediment surface. Unfortunately, the DSR did only move about 0.1 m between the flux measurements and not as planned 0.7 m. This might be caused by low traction of the wheels on the soft, muddy ground.

Preliminary average O_2 fluxes of the first two measurement cycles were 10 and 12 mmol m^{-2} d^{-1} in the left chamber as well as 10 and 11 mmol m^{-2} d^{-1} in the right chamber. Please note that these fluxes need to be corrected for the precise volume of their enclosed water body.

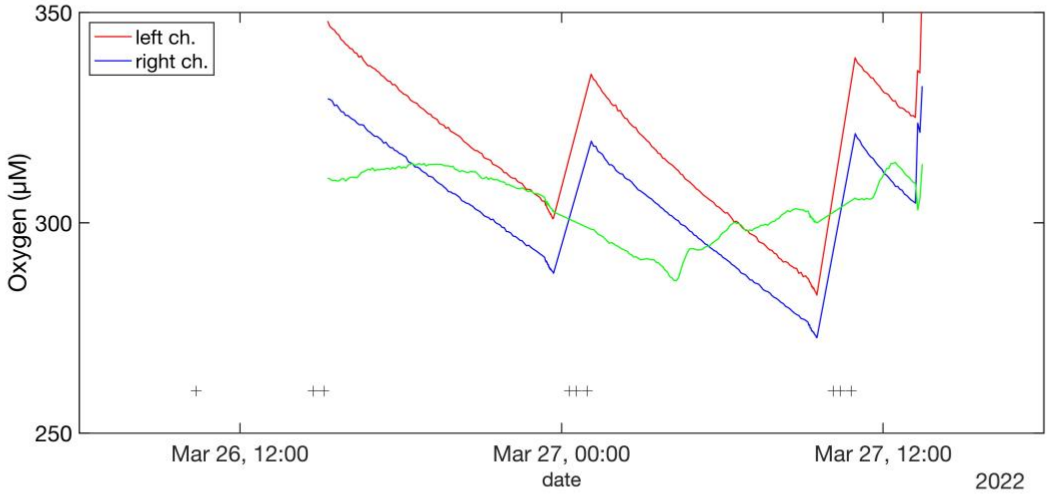

Fig. 5.2.3.2 Raw O_2 concentration measured inside the left (sensor #2) and the right chamber (sensor #6) as well as in the ambient bottom water (sensor #9) during DSR-2 deployment at Fehmarnbelt. The + signs indicate the time when photos of the sediment were taken.

Fig. 5.2.3.3 Photos taken before, during and after the flux measurement of both chambers of the DSR-2 at the Fehmarnbelt, showing that the sediments were not disturbed at all.

The 3rd deployment of the DSR was carried out at the Oderbank on sandy sediments. The first two cycles of flux measurements worked very well (Figures 5.2.3.4, 5.2.3.5). Thereafter the O_2 concentration resembled that of the bottom water indicating that the chambers didn't penetrate into the sediment anymore. During the time period of the 1st to the 3rd of April when there was a storm (see section 6), the Rover, which was connected to a surface buoy was apparently lifted off the sea floor several times due to high waves. This is also indicated by photos taken and the protocol file of the Rover. After recovery of the Rover it turned out that all bearings of the drives for moving the chambers or the Rover where blocked due to sand particles that have been suspended. During the first two measurement cycles preliminary fluxes in the left and the right chamber were 18 and 11mmol m^{-2} d^{-1} as well as 12 and 10 mmol m^{-2} d^{-1}. Please note these values need still to be corrected for the precise volume of the enclosed chamber water.

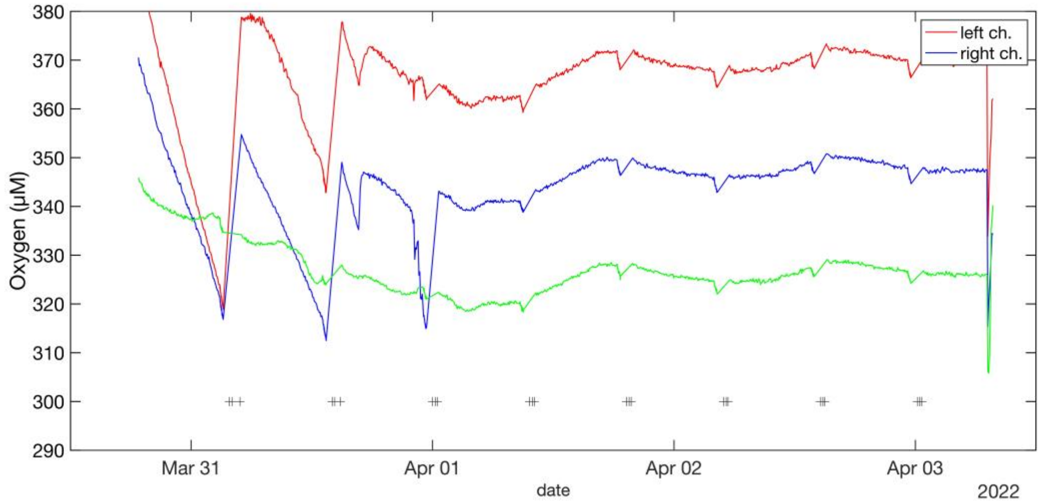

Fig. 5.2.3.4 Raw O_2 concentration measured inside the left (sensor #2) and the right chamber (sensor #6) as well as in the ambient bottom water (sensor #9) during DSR-3 deployment at the Oderbank. The + signs indicate the time when photos of the sediment were taken.

Fig. 5.2.3.5 Photos taken before and during the flux measurements of both chambers of the DSR-3 at the Oderbank.

5.2.4 Biogeochemical Processes in the Surface Sediment

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

IOW Warnemünde

Methods and sampling on board

General sampling scheme

The aim of this working package is the investigation of benthic and sedimentary biogeochemical processes, which is accomplished primarily by investigations of pore water coupled to the sediment solid phase. Therefore, samples were gained from sediment cores recovered with a MUC or from BIGO chambers. Information on the water column is essential to evaluate potential elemental sources and fluxes. Thus, at the day of coring, the upper and lower water column were sampled using a Niskin bottles rosette mounted to a CTD. Bottom waters (BW) were additionally recovered directly from the MUC cores or the BIGO chambers. MUC cores for assessing the sediments' particulate phase and pore waters' composition and stable isotope signatures were taken from the same MUC casts and side-by-side from cores used for sulfate reduction rate (SRR) investigations (WP 1.2), and selectively in parallel to cores used for microbiome and prokaryote investigations (WP 2.1). From the BIGO chambers, biogeochemistry cores (for pore water and solid phase) were also recovered side-by-side to SRR cores, and their location in the chambers was documented in detail. In addition, the MUC and BIGO cores used for pore water extractions were later sampled for assessing the biodiversity of the macrofauna (WP 3.2), by slicing the remaining solid matrix. All the cores sampled on board of AL570 for biogeochemical sediment- and pore-water- investigations were photo-documented.

Sediment solid phase characterization

Sediment cores for solid phase analysis were sliced in 1cm steps in the upper 5 cm interval, and in 2 cm steps below until the bottom of the core was reached. 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. Sediment material directly in contact with the liner walls was not sampled to avoid a dragging effect. The freeze-dried sediments are intended for geochemical analysis for their inorganic and organic composition such as total organic carbon (TOC), total inorganic carbon (TIC), and total mercury (Hg) contents. The fraction preserved in Zinc acetate is intended to determine the contents of chromium-reducible sulfur (CRS) and acid volatile sulfur (AVS). Aside that, a third sub-sample with a defined volume of 2 ml was sampled with a syringe (plastic, top cut off) from each sediment slice, and is intended for determination of sample porosity. Also, 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, as was a temperature sensor coupled to the same Schott equipment. A total of 16 MUC cores and 8 BIGO cores were sliced for sediment sampling, making 341 sampled depths, and a total of ca. 1,020 sediment sub-samples (appendix Table S1).

Pore water characterization: rhizone sampling, DETs and DGTs

Discrete pore water samples were extracted from pre-perforated liners – with available holes in an overall depth resolution of 1cm, using rhizones (Rhizosphere, Wageningen, The Netherlands, max 0.2 um pore width) and 10 ml syringes. In the upper 5 cm sediments of the MUC cores – beginning at the sediment water interface – the final sampling resolution for pore water extraction was 1cm steps; between 5 and 15 cm depth the resolution was 2 cm steps; and below 15 cm sediment depth samples were taken in up to 5 cm depth intervals. In general, the final chosen sampling depths may vary from core to core, according to characteristics of the sediments in the MUC, e.g. sediment surface inclination, lithology, and pore water flow rates. The pore water extraction was undertaken in a cold room, with temperature regulated between 9 and 11°C, which was found to be the optimal metabolism temperature. Water above the sediment water interface (SWI) was siphoned off as a bottom water (BW) sample, to a distance of ca. 5 cm from the SWI. Pore water sampling was initiated from the topmost samples, usually extracted one-by-one until 5 cm, below which, extraction was either undertaken for individual samples or in parallel. Pore waters were sub-sampled for determination of the following variables: (a) metals, (b) dissolved inorganic carbon (DIC, e.g. Figure 5.2.4.1) and its' stable isotope signature ($DI^{13}C$, e.g. Figure 5.2.4.1), (c) sulfides, (d) nutrients, (e) total alkalinity, and (f) dissolved organic carbon (DOC), the latter variable only for selected samples (ca. 3 per core). 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 & f) HCl. Aside from the nutrient samples, all samples were stored at 4°C. Values of pore waters' pH were obtained directly after extraction measured with an ion selective electrode. Pore waters were extracted from 20 MUC cores – accounting for replicates in selected stations, and 7 BIGO cores – accounting for cores taken in both chambers of a same deployment, making a total of 329 sampled depths, and about 1,650 pore water sub-samples (appendix Table S2).

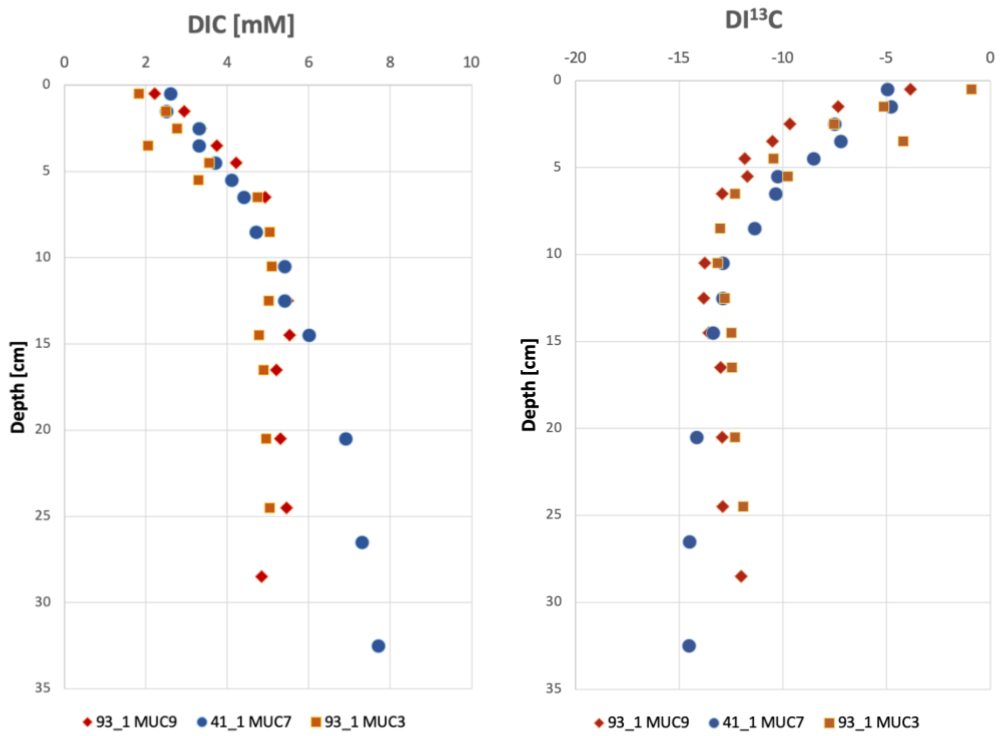

Fig. 5.2.4.1 First results of dissolved inorganic carbon concentrations and its respective stable isotope signature for selected stations with expected distinct degrees of bottom trawling impact.

In addition to the above described discrete pore water sampling, diffusive passive samplers were applied to obtain high-resolution profiles of concentrations/fluxes of variables of interest.

For selected sites, DETs were employed for high-resolution determination of Fe and Mn; and DGTs were employed for high-resolution determination of sulfides. The employment of DET's and DGT's samplers was undertaken in parallel using the holders back-to-back to one another (Figure 5.2.4.2a). During reaction time, the sediment cores with the inserted DET/DGTs were kept in a cooler at 4 ± 1.5 °C. Both samplers were deployed according to manufacturer's instructions, including a previous deoxygenation step in a 0.03M NaCl solution subject to argon flow (about 1 hour), and the insertion of the DETs in a NaOH solution for fixation of Fe and Mn phases in the diffusive gel. A 10 second time frame of transfer from the samplers from solution to sediment and vice-versa was considered. Processing of the DET gels was undertaken on board, and the 15 cm long gels were sub-sampled in a resolution of 2 mm, by cutting with a ceramic scalpel on an acid cleaned plastic surface. The 2 mm gel strips are stored at 4°C. The DGTs were processed afterwards, using the flat-bed scanner imagery method and color calibration strips that ideally allow a conversion of gray tones into sulfide concentrations (e.g. Figure 5.2.4.2b).

Fig. 5.2.4.2 (a) parallel back-to-back deployment of DET and DGT in one MUC core, (b) open DGT displaying the transparent diffusive gel at bottom picture half, and the sulfide-colored binding gel still in the sample holder, indicating a gradual and continuous increase of sulfide concentrations towards sediment depth, with absence of micro-niches.

5.2.5 Sulfate Reduction Rate Measurements

(S. Bernsee, A. Kitte, J. Kallmeyer)

GFZ Potsdam

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 sub-cores. The bottom of the acrylic tube was closed with a silicone stopper to avoid the sediment from falling out. Suction was employed to avoid compression of the soft sediment during insertion of the tubes. For sandy sediments, the acrylic tubes were carefully hammered into the sediment. Each tube has a single row of 2 mm holes in 1 cm resolution drilled along its side over the length of the core, the holes are sealed with silicone, to avoid seepage of pore water but allow injection of radiotracer.

Immediately after retrieval of the MUC, the core was subsampled and the three acrylic tubes stored in an incubator at approx. in-situ temperature (10 °C). After termination of deck operations in the late afternoon all samples from this day were incubated. For incubation, 15 µl of radiotracer (activity ca. 200 kBq) was injected into each hole from the sediment-water interface down to 20 cm below sea floor (cmbsf). Immediately after injection of radiotracer, the core tube was put back into the incubator and incubated for 24 hrs. As all sampling sites had oxygenated bottom waters, the core tubes were left open at the top to avoid oxygen deficiencies. Changes in salinity due to evaporation can be neglected at such temperatures.

Incubations were terminated by pushing the sediment out of the core 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. The following resolution was used on all cores 0-6 cm: 1 cm; 6-10 cm: 2 cm; and 10-20 cm: 5 cm.

The vials were thoroughly shaken to break up all sedimentary structures and effectively stop all microbial activity. Samples were frozen overnight but then stored at room temperature for the remainder of the cruise due to space limitations on board. Additional samples were taken for blank measurements, usually by inserting an acrylic core tube in left over MUC tubes. Different types of blanks were taken:

Time Zero (t_0): Samples were injected with radiotracer like regular samples, but incubation was stopped within 10 minutes after injection. *Killed Controls:* Sediment was first mixed with 10 ml of 20% (w/v) zinc acetate solution, tracer was added after fixation of the sample. Both types of blank samples are treated like regular samples.

Additional SRR samples were taken from the two chambers of the BIGO Lander. From each of the two chambers a triplicate of acrylic core tubes could be retrieved and was incubated like regular tubes from MUC cores. Table 5.2.5.1 provides an overview of the samples taken.

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 being extracted from the samples using cold chromium distillation (Kallmeyer et al., 2004). From each triplicate two sets of samples are distilled in a sequential three-step distillation to retrieve the different reduced sulfur species (acid volatile sulfur, AVS; chromium reducible sulfur, CRS; elemental sulfur, ES) separately in order to assess sequestration pathways of the microbially produced hydrogen sulfide. For the third replicate we employ the single-step distillation to quantify total turnover. Initial results show measurable activity in almost all samples that were processed so far (about half). As we do not have access to the pore water sulfate and porosity profiles yet, it is not possible to draw any conclusion, other than the fact that sulfate reducing activity is ubiquitous in the near-surface sediment of the studied areas.

Table 5.2.5.1 Sampling list sulfate reduction rate measurements

	Stationsliste AL 570				
Area	Core	Station EMB 238	Position	Station EMB 267	Position
Fehmarn Belt	4-1	18	MPA		
	9-1	18	MPA		
	11-1	2	MPA		
	BIGO II-1 Ch1	tween 5 and 18	MPA		
	BIGO II-1 Ch2	tween 5 and 18	MPA		
	15-1	5	MPA		
	18-1	10	outside MPA		
	BIGO I-1 Ch1	tween 5 and 18	MPA		
	BIGO I-1 Ch2	tween 5 and 18	MPA		
	24-2	17	outside MPA		
	33-1	15	outside MPA		
	BIGO I-2 Ch1	near 10 and	outside MPA		
	BIGO I-2 Ch2	near 10 and	outside MPA		
	BIGO II-2 Ch2	near 14 BIGO and 17 MUC	outside MPA		
	BIGO II-2 Ch1	near 14 BIGO and 17 MUC	outside MPA		
	41-1	Wreck	MPA		
Oderbank	44-1			10	inside MPA
	53-3			19	outside MPA
	57-1			3	MPA
	62-4			29	outside MPA
	66-1			28	outside MPA
Rønnebank	75-1				
	78-1				
Fehmarn Belt	80-1	8	MPA		
	BIGO II-4 Ch2	new Station			
	BIGO II-4 Ch1	new Station			
	83-1	5	MPA		
	93-1	new Station	high impact,		
		sampling dates		Number of samples	
	Fehmarn Belt	22.03. - 28.03.2022 /		505 + 166	
	Oderbank	29.03. - 31.03.2022		162	
	Rønnebank	03.04.22		66	
			total samples	899	
			Blanks/t0	11	
			Total vials	910	

5.3 Benthic Biological Measurements

5.3.1 Prokaryotes

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Objectives

The main objective of this work package is to investigate the impact of bottom trawling on the composition and functioning of benthic prokaryotic communities in the Baltic Sea. For this purpose, stations in the marine protected areas (MPAs) Fehmarnbelt and Pomeranian Bay - Rönnebank (Area I Western Rönnebank and Area III Oderbank) and a similar number of reference stations near but outside these MPAs are compared. Currently, fishing also continues within the MPAs, but exclusion from parts of the MPAs will occur in the next few years. The development of benthic communities following fishery exclusion will be studied to better understand the impact and the potential for recovery from bottom trawling. Prokaryotic cell numbers, heterotrophic activity, the taxonomic composition and the inventory and expression of functional genes in sediment samples from the surface to 15-20 cmbsf will be analyzed. Total prokaryotic abundances will be quantified by fluorescence microscopy using a DNA-binding dye. On-board incubations were conducted to estimate rates of extracellular aminopeptidase activity and heterotrophic bacterial biomass production. The taxonomic community composition will be analyzed by partial sequences of the 16S rRNA using high-throughput sequencing. Analysis of gene abundances and gene expression will focus on metabolic processes that are important for ecosystem services. These processes include carbon remineralization, inorganic nutrient release, and sulfur cycling at the sediment-water interface.

Methods

Thirty-one sediment cores collected by MUC hauls at sixteen stations (10 stations in Fehmarnbelt, 4 stations at Oderbank and 2 stations at western Rönnebank), were sampled for this work package. At station 81, samples were taken from the sediment chamber of the BIGO lander. From each MUC core, seven discrete samples were taken evenly distributed over the top 15-20 cm to analyze prokaryotic abundance, 16S rRNA sequences, and metagenomes. For metatranscriptomes, sub-cores were sliced under argon atmosphere in centimeter increments down to 6-8 cmbsf. 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. Stations and sampling efforts are summarized in Table 5.3.1.1.

Table 5.3.1.1 **S**ampling for microbiological analyses in sediment samples of the Fehmarnbelt, Oder- and western Rönnebank (Cell no.: Cell numbers, 16S: 16S rRNA amplicon sequencing, MetaG: Metagenome, MetaT: Metatranscriptome). For metagenomes and metatranscriptomes, selected samples will be analyzed.

Station/ Cast	Core	Gear	Sampling Depths	Cell no.	16S	Rates	MetaG	MetaT
4-1	8	MUC	0-1, 1-2, 3-4, 5-6, 9-10, 14-15, 19-20 cmbsf	x	x	x	x	
9-1	8	MUC	0-1, 1-2, 3-4, 5-6, 9-10, 14-15, 19-20 cmbsf	x	x	x	x	
9-1	9	MUC	0-1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7 cmbsf			x	x	x
11-1	5	MUC	0-1, 1-2, 3-4, 5-6, 9-10, 14-15, 19-20 cmbsf	x	x	x	x	
11-1	6	MUC	0-1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7 cmbsf			x	x	x
15-1	1	MUC	0-1, 1-2, 3-4, 5-6, 9-10, 14-15, 19-20 cmbsf	x	x	x	x	
15-1	2	MUC	0-1 cmbsf			x		
18-1	1	MUC	0-1, 1-2, 3-4, 5-6, 9-10, 14-15, 19-20 cmbsf	x	x	x	x	
18-1	2	MUC	0-1, 1-2, 2-3, 3-4, 4-5, 5-6 cmbsf			x	x	x
24-1	3	MUC	0-1, 1-2, 2-3, 3-4, 4-5, 5-6 cmbsf			x	x	x
24-2	9	MUC	0-1, 1-2, 3-4, 5-6, 9-10, 14-15, 19-20 cmbsf	x	x	x	x	
24-2	10	MUC	0-1 cmbsf			x		
33-1	7	MUC	0-1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7 cmbsf			x	x	x
33-1	12	MUC	0-1, 1-2, 3-4, 5-6, 9-10, 14-15, 19-20 cmbsf	x	x	x	x	
41-1	5	MUC	0-1, 1-2, 3-4, 5-6, 9-10, 14-15, 19-20 cmbsf	x	x	x	x	
41-1	6	MUC	0-1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7 cmbsf			x	x	x
44-1	2	MUC	0-1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7 cmbsf			x	x	x
44-1	3	MUC	0-1, 1-2, 2-3, 3-4, 6-7, 9-10, 14-15 cmbsf	x	x	x	x	
53-3	3	MUC	0-1, 1-2, 2-3, 3-4, 6-7, 9-10, 14-15 cmbsf	x	x	x	x	
53-3	4	MUC	0-1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7, 7-8 cm cmbsf			x	x	x
62-1	4	MUC	0-1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7, 7-8 cm cmbsf			x	x	x
62-4	12	MUC	0-1, 1-2, 2-3, 3-4, 6-7, 9-10, 14-15 cmbsf	x	x	x	x	
66-1	11	MUC	0-1, 1-2, 2-3, 3-4, 6-7, 9-10, 10-11 cmbsf	x	x		x	
75-1	10	MUC	0-1, 1-2, 3-4, 5-6, 9-10, 14-15, 19-20 cmbsf	x	x	x	x	
75-1	11	MUC	0-1, 1-2, 3-4, 5-6, 9-10, 14-15, 19-20 cmbsf	x	x		x	
75-1	12	MUC	0-1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7, 7-8 cmbsf			x	x	x
78-1	4	MUC	0-1, 1-2, 3-4, 5-6, 9-10, 14-15, 19-20 cmbsf	x	x	x	x	
78-1	5	MUC	0-1, 1-2, 3-4, 5-6, 9-10, 14-15, 19-20 cmbsf	x	x		x	
80-1	5	MUC	0-1, 1-2, 3-4, 5-6, 9-10, 14-15, 17-18 cmbsf	x	x		x	
81-1		BIGO	0-1, 1-2, 3-4, 5-6, 9-10, 11-12 cmbsf	x	x	x	x	
93-1	5	MUC	0-1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7, 7-8 cmbsf			x	x	x
93-1	6	MUC	0-1, 1-2, 3-4, 5-6, 9-10, 14-15, 19-20 cmbsf	x	x	x	x	

Onboard Results

First results revealed different levels of bacterial biomass production in Fehmarnbelt and Rönnebank samples on the one hand and in Oderbank samples on the other hand. The average rates of 0.13±0.05 nmol leu cm^{-3} h^{-1} and 0.13±0.02 nmol leu cm^{-3} h^{-1} in Fehmarnbelt and Rönnebank surface sediments, respectively, were about seven times higher than in Oderbank surface samples (0.02±0.01 nmol leu cm^{-3} h^{-1}) (Figure 5.3.1.1).

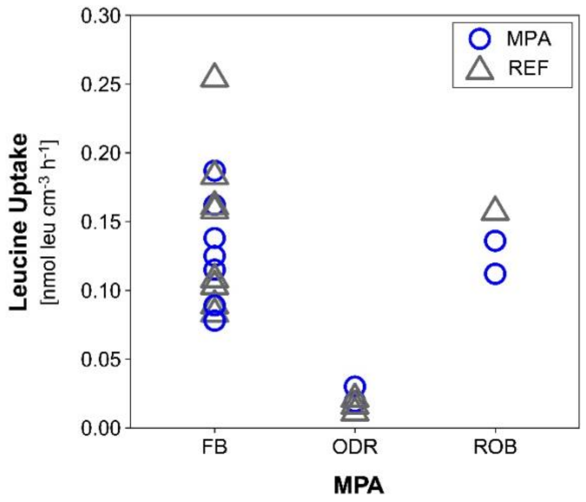

Fig. 5.3.1.1 Leucine uptake as a measure for bacterial biomass production in Fehmarnbelt (FB), the western Rönnebank (ROB) and the Oderbank (ODR).

Converting the average leucine uptake rates into carbon units results in average values of 0.21 µg C cm^{-3} h^{-1} in surface sediments of Fehmarnbelt and Oderbank and of 0.03 µg C cm^{-3} h^{-1} in Rönnebank samples. Lower biomass production in surface sediments of the Oderbank reflected a lower bacterial carbon turnover in this area with sandy sediments and a low seawater salinity. No significant differences were found between the MPAs and the reference stations in any of the study areas.

5.3.2 Microphytobenthos

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The sampling of the cores used for primary production measurements of the microphytobenthos took place at Fehmarnbelt, Oderbank and Rönnebank. The cores were sampled in marine protected areas (MPA) and at reference sites for each location. Overall 17 different stations were sampled for microphytobenthos and 58 sediment cores were taken in total (38 for Fehmarnbelt, 10 for Oderbank and 10 for Rönnebank), Table 5.3.2.1. The sediment cores (diameter 5 cm) used for in vitro oxygen measurements were subsampled from Multicorer cores (diameter 10 cm), Figure 5.3.2.1. The measurements were conducted directly on board and later continued in the lab Figure 5.3.2.1. The oxygen consumption was detected using a 4-channel fiber optic oxygen transmitter (OXY-4 SMA, PreSens) and planar oxygen sensor spots.

The oxygen production was measured in the overlaying water phase of the sediment cores. The cores were incubated in a temperature water bath at 10 °C. The measurement starts with a dark period of one hour and is followed by 5 different light intensities ranging from 0 to 1500 µmol m^{-2} s^{-1}. Each light intensity step lasted for 35 minutes. The end of the experiment was followed by a second dark period of 35 minutes. After the experiments the upper layer (1 cm) of the sediment cores were cut off, homogenized and divided into subsamples for further analysis such as water content, as well as carbon, nitrogen and chlorophyll a content.

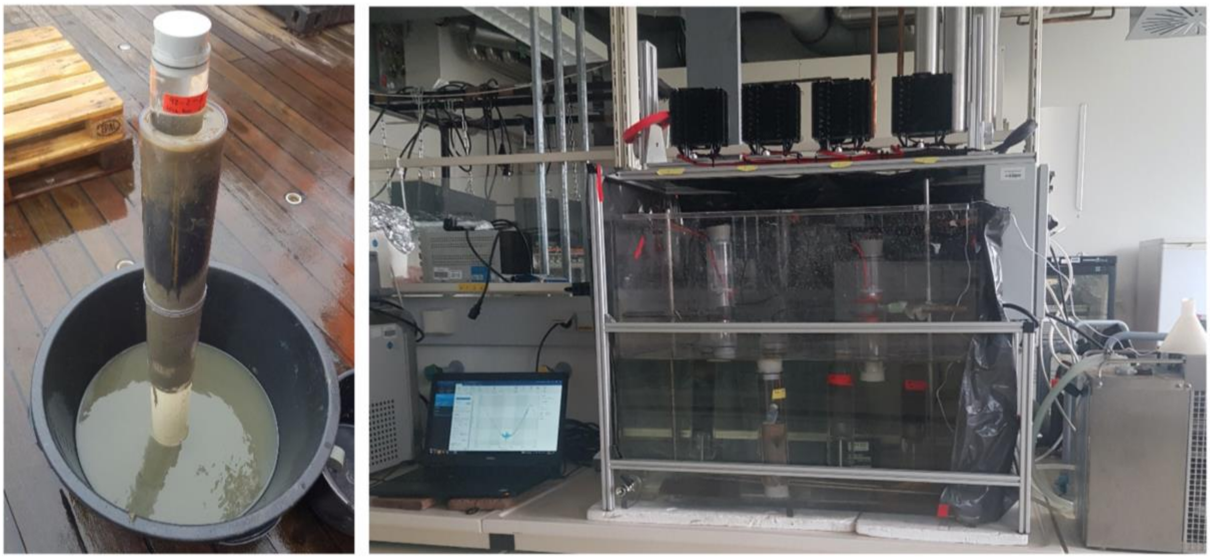

Fig. 5.3.2.1 (left panel) Sediment core (Ø 5 cm) subsampled from MUC core (Ø 10 cm). (right panel) Experimental set-up in the laboratory.

The data collected from prior cruises to the Fehmarnbelt (EMB238 2020) and the Oderbank (2021) show no significant differences in terms of gross primary production between MPA and reference areas. The yielded values for Fehmarnbelt lie between 20 to 50 mg C m^{-2} h^{-1} (MPA) and 8 to 37 mg C m^{-2} h^{-1} (reference). The values for Oderbank are between 14.2 to 18.2 mg C m^{-2} h^{-1} (MPA) and 13.8 to 16.6 mg C m^{-2} h^{-1} (reference). Therefore, similar values are also expected for the collected samples from the Fehmarnbelt and the Oderbank. The Rönnebank was sampled for the first time during this cruise. Due to the depth of approximately 38 m the expected values for gross primary production and chl.-a content are likely significantly lower in comparison to Fehmarnbelt and Oderbank. However, the preliminary results show primary production even at 38 m depth (Figure 5.3.2.2).

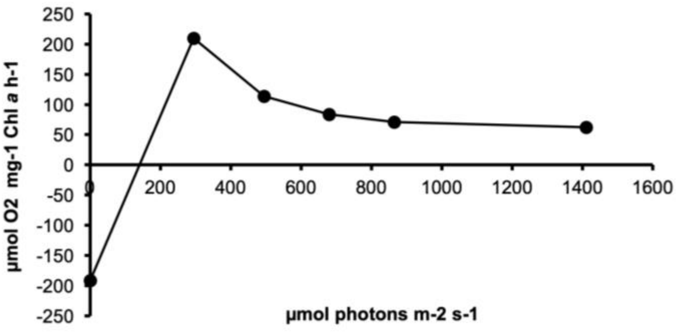

Fig. 5.3.2.2 An example PI- curve from a core collected at the Rönnebank.

Fig. 5.3.2.1 Sample list of Fehmarnbelt, Oder- and Rönnebank

#	Station-Cast	Location	Area	Sampling date	Measuring date
1	4-1-11	Fehmarnbelt	MPA	23.03.2022	2.4.22
2	4-1-12	Fehmarnbelt	MPA	23.03.2022	1.4.22
3	4-2-3	Fehmarnbelt	MPA	23.03.2022	2.4.22
4	4-2-4	Fehmarnbelt	MPA	23.03.2022	30.3.22
5	9-1-1	Fehmarnbelt	MPA	23.03.2022	29.3.22
6	9-1-6	Fehmarnbelt	MPA	23.03.2022	29.3.22
7	11-1-4	Fehmarnbelt	MPA	24.03.2022	29.3.22
8	15-1-11	Fehmarnbelt	MPA	24.03.2022	31.3.22
9	80-1-1	Fehmarnbelt	MPA	05.04.2022	5.4.22
10	80-1-6	Fehmarnbelt	MPA	05.04.2022	11.4.22
11	80-2-9	Fehmarnbelt	MPA	05.04.2022	11.4.22
12	80-2-10	Fehmarnbelt	MPA	05.04.2022	5.4.22
13	80-2-11	Fehmarnbelt	MPA	05.04.2022	11.4.22
14	80-2-12	Fehmarnbelt	MPA	05.04.2022	12.4.22
15	84-1-1	Fehmarnbelt	MPA	05.04.2022	11.4.22
16	84-1-4	Fehmarnbelt	MPA	05.04.2022	12.4.22
17	84-1-6	Fehmarnbelt	MPA	05.04.2022	13.4.22
18	84-1-7	Fehmarnbelt	MPA	05.04.2022	12.4.22
19	18-1-7	Fehmarnbelt	Reference	25.03.2022	1.4.22
20	18-1-8	Fehmarnbelt	Reference	25.03.2022	31.3.22
21	18-2-5	Fehmarnbelt	Reference	25.03.2022	30.3.22
22	18-2-6	Fehmarnbelt	Reference	25.03.2022	30.3.22
23	18-2-11	Fehmarnbelt	Reference	25.03.2022	31.3.22
24	18-2-12	Fehmarnbelt	Reference	25.03.2022	1.4.22
25	24-1-7	Fehmarnbelt	Reference	26.03.2022	1.4.22
26	24-1-8	Fehmarnbelt	Reference	26.03.2022	1.4.22
27	24-2-3	Fehmarnbelt	Reference	26.03.2022	2.4.22
28	24-2-4	Fehmarnbelt	Reference	26.03.2022	1.4.22
29	33-2-5	Fehmarnbelt	Reference	27.03.2022	2.4.22
30	33-2-6	Fehmarnbelt	Reference	27.03.2022	1.4.22
31	88-1-2	Fehmarnbelt	Reference	06.04.2022	13.4.22
32	88-1-3	Fehmarnbelt	Reference	06.04.2022	13.4.22
33	88-1-6	Fehmarnbelt	Reference	06.04.2022	13.4.22
34	88-1-12	Fehmarnbelt	Reference	06.04.2022	12.4.22
35	92-2-1	Fehmarnbelt	Reference	07.04.2022	9.4.22
36	92-2-2	Fehmarnbelt	Reference	07.04.2022	9.4.22
37	92-2-3	Fehmarnbelt	Reference	07.04.2022	9.4.22
38	92-2-7	Fehmarnbelt	Reference	07.04.2022	9.4.22
39	44-2-3	Oderbank	MPA	29.03.2022	4.4.22
40	44-2-4	Oderbank	MPA	29.03.2022	6.4.22
41	57-1-4	Oderbank	MPA	30.03.2022	4.4.22
42	57-1-10	Oderbank	MPA	30.03.2022	4.4.22
43	57-2-3	Oderbank	MPA	30.03.2022	4.4.22
44	53-2-9	Oderbank	Reference	30.03.2022	4.4.22
45	53-2-10	Oderbank	Reference	30.03.2022	6.4.22
46	62-1-3	Oderbank	Reference	31.03.2022	4.4.22
47	62-2-4	Oderbank	Reference	31.03.2022	4.4.22
48	62-2-7	Oderbank	Reference	31.03.2022	4.4.22
49	75-1-5	Rönnebank	MPA	03.04.2022	5.4.22
50	75-2-7	Rönnebank	MPA	03.04.2022	5.4.22
51	75-2-8	Rönnebank	MPA	03.04.2022	10.4.22
52	75-2-9	Rönnebank	MPA	03.04.2022	5.4.22
53	78-1-10	Rönnebank	Reference	03.04.2022	5.4.22
54	78-1-11	Rönnebank	Reference	03.04.2022	5.4.22
55	78-2-9	Rönnebank	Reference	03.04.2022	10.4.22
56	78-2-10	Rönnebank	Reference	03.04.2022	5.4.22
57	78-2-11	Rönnebank	Reference	03.04.2022	5.4.22
58	78-2-12	Rönnebank	Reference	03.04.2022	5.4.22

5.3.3 Nano- and Microfauna

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Up to our present knowledge, 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; Schoenle et al., 2021). 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 is 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 by trawling would significantly change the microbial food web and its functions.

For an estimation of protist abundance, diversity and activity we used a combination of different methods inside of the marine protected areas (MPA) and a reference area each in the Fehmarnbelt, Oderbank and Rönnebank region. In order to compare the benthic nano- and microfauna of the above-mentioned areas, we used four different approaches since all methods have their advantages and disadvantages (Schoenle et al., 2016). To estimate abundances and investigate the diversity and activity of protists, we carried out sampling to allow for a combined analysis of live-counting, counting of fixed samples, determination of cultivable protist species and preserved samples for metabarcoding analyses of the rRNA.

Methods:

Sediment sampling

Sediment samples were taken at eighteen stations, in the three marine protected areas (Natura 2000) in the German Baltic Sea, seven within the MPA and four in the reference area of Fehmarnbelt, two within and three outside the MPA at the Oderbank area and one within and one outside the Rönnebank area with the multi-corer (MUC) system (Table 5.3.3.1). Undisturbed sediment cores obtained by the MUC were used for quantitative and qualitative analyses of benthic nano- and microfauna.

At the Fehmarnbelt region, at each station (4-1, 9-11, 11-1, 15-1, 18-1, 24-2, 33-1, 33-2, 41-1, 80-1, 81-1 and 93-1) at least one sediment core was sampled for the DNA/RNA metabarcoding samples and abundance estimations (life counting and fixed samples). All cores were sliced into seven sediment layers (0-1cm, 1-2 cm, 3-4 cm, 5-6 cm, 9-10 cm, 14-15 cm, 19-20 cm) except for station 33-2 where we created a microprofile (0-2.5 mm, 2.5-5 mm, 5-7.5 mm, 7.5-10 mm) and station 81-1 that resulted from a BIGO chamber (0-1 cm, 1-2 cm, 3-4 cm, 5-6 cm, 9-10 cm, 11-12 cm).

At the Oderbank region, at stations 44-1, 53-3, 57-2, 62-4 and 66-1, each sediment core was sampled for the DNA/RNA metabarcoding samples and abundance estimations (fixed samples). All cores were sliced into seven sediment layers (0-1cm, 1-2 cm, 2-3 cm, 3-4 cm, 6-7 cm, 9-10 cm, 14-15 cm) except for station 57-2 where the sediment core was too short and the depth profile had to be adapted (0-1cm, 1-2 cm,2-3 cm, 3-4 cm, 6-7 cm, 8-9 cm, 9-10 cm) as well as station 66-1 (0-1 cm, 1-2 cm, 2-3 cm,3-4 cm, 6-7 cm, 9-10 cm, 10-11 cm).

At the Rönnebank region, at each station (75-1 and 78-1), two sediment cores were sampled for the DNA/RNA metabarcoding samples, abundance estimations (fixed samples) and the cultivation approach. All cores were sliced into seven sediment layers (0-1cm, 1-2 cm, 3-4 cm, 5-6 cm, 9-10 cm, 14-15 cm, 19-20 cm).

Table 5.3.3.1 Station list for sampling protists including date of sampling, core number per haul, sampling region (FB= Fehmarnbelt, OB=Oderbank, RB= Rönnebank), area (MPA= marine protected area, ref= reference area), gear and sample type (method).

Station AL570	Date	Core	Region	Area	Depth profile [cm]	Gear	Method
4-1	23.03.2022	8	FB	MPA	0-1,1-2,3-4,5-6,9-10, 14-15,19-20	MUC	DNA/RNA, life counting
9-1	23.03.2022	8	FB	MPA	0-1,1-2,3-4,5-6,9-10, 14-15,19-20	MUC	DNA/RNA, DAPI, life counting
11-1	24.03.2022	6	FB	MPA	0-1,1-2,3-4,5-6,9-10, 14-15,19-20	MUC	DNA/RNA, DAPI, life counting
15-1	24.03.2022	2	FB	MPA	0-1,1-2,3-4,5-6,9-10, 14-15,19-20	MUC	DNA/RNA, DAPI, life counting
18-1	25.03.2022	2	FB	Ref	0-1,1-2,3-4,5-6,9-10, 14-15,19-20	MUC	DNA/RNA, DAPI, life counting
24-2	26.03.2022	10	FB	Ref	0-1,1-2,3-4,5-6,9-10, 14-15,19-20	MUC	DNA/RNA, DAPI, life counting
33-1	27.03.2022	7	FB	Ref	0-1,1-2,3-4,5-6,9-10, 14-15,19-20	MUC	DNA/RNA, DAPI, life counting
33-2	27.03.2022	11	FB	Ref	0-2.5, 2.5-5, 5-7.5,7.5-10	MUC	DNA/RNA, life counting
41-1	28.03.22	5	FB	MPA	0-1,1-2,3-4,5-6,9-10, 14-15,19-20	MUC	DNA/RNA, DAPI, life counting
44-1	29.03.22	3	OB	MPA	0-1,1-2,2-3,3-4,6-7,9-10,14-15	MUC	DNA/RNA, DAPI, life counting
53-3	30.03.22	3	OB	Ref	0-1,1-2,2-3,3-4,6-7,9-10,14-15	MUC	DNA/RNA, DAPI
57-2	30.03.22	9	OB	MPA	0-1,1-2,2-3,3-4,6-7,8-9,9-10	MUC	DNA/RNA, DAPI
62-4	31.03.22	12	OB	Ref	0-1,1-2,2-3,3-4,6-7,9-10,14-15	MUC	DNA/RNA, DAPI
66-1	31.03.22	11	OB	Ref	0-1,1-2,2-3,3-4,6-7,9-10,10-11	MUC	DNA/RNA, DAPI
75-1	03.04.22	C1=10	RB	MPA	0-1,1-2,3-4,5-6,9-10, 14-15,19-20	MUC	DNA/RNA, cultures
75-1	03.04.22	C2=11	RB	MPA	0-1,1-2,3-4,5-6,9-10, 14-15,19-20	MUC	DNA/RNA
78-1	03.04.22	C1=4	RB	Ref	0-1,1-2,3-4,5-6,9-10, 14-15,19-20	MUC	DNA/RNA, DAPI, cultures
78-1	03.04.22	C2=5	RB	Ref	0-1,1-2,3-4,5-6,9-10, 14-15,19-20	MUC	DNA/RNA
80-1	05.04.22	5	FB	MPA	0-1,1-2,3-4,5-6,9-10, 14-15,17-18	MUC	DNA/RNA, DAPI
81-1	06.04.22	Ch. 1	FB	MPA	0-1,1-2,3-4,5-6,9-10,11-12	BIGO Chamber	DNA/RNA, DAPI
93-1	07.04.22	6	FB	MPA	0-1,1-2,3-4,5-6,9-10, 14-15,19-20	MUC	DNA/RNA, DAPI

Abundance estimations of benthic nano- and microfauna

For abundance estimations of all seven sediment layers per station, a volume of 1.5 cm^3 sediment was mixed with 6 ml of autoclaved Baltic Sea water. These suspensions were stored on water with a temperature of ~10°C and used to detect living protists under the microscope. Inspection and counting of 10-500 µl subsamples of sediment suspensions were conducted using a light microscope (20-40 x phase-contrast objectives) combined with video recording (Arndt et al., 2000). Besides quantitative estimations, live-counting techniques offer the opportunity to determine several living specimens up to the morphospecies level and to verify the presence of living specimens of genotypes only known from metagenomic studies. Limitation of this method is the narrow time frame for observations of sediment suspensions on board, since several nanofauna organisms die after a few minutes due to rising temperatures and light. However, the direct counts can serve as a cultivation-independent record of species being active at the time of sampling and which cannot yet be identified from the study of data bases since reliable morphological and molecular identifications are missing. Fixation and staining methods are advantageous due to the possibility of long-term storage and observation of samples. For abundance estimations of fixed samples, we used DAPI staining with subsequent epifluorescence. For DAPI staining, we used a volume of 156 µl sediment and mixed it with 2 ml of filtered Baltic Sea water (filter with a pore size of 0.2 µm). This suspension was fixed with 2 ml of 4% formaldehyde (final concentration 2%). After 2-3 hours, samples (200 µl) were filtered as triplicates on 0.2 µm polycarbonate filters at a vacuum of less than 200 mbar and stained with 20 µl DAPI (10mg/l) for 5 minutes. Filters were mounted on microscopic slides, deep frozen at -20°C and kept until further processing in Cologne. 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 (Porter and Feig, 1980). Counting of fixed DAPI stained filters will be carried out under an epifluorescent microscope in the laboratory in Cologne.

Cultivation of benthic nano- and microfauna

Cultivation of protist species aims to relate the molecular identity of species to their morphology and ecology to derive an idea on the functioning of the benthic microbial food web. From each sediment layer, a volume of 1.5 cm^3 sediment was mixed with 6 ml autoclaved Baltic Sea water. This suspension was divided between two 50 ml tissue culture flasks filled with 25 ml autoclaved Baltic Sea water. All cultures were supplied with autoclaved quinoa grains to enrich co-occurring bacteria as a food source for protists. In the home laboratory in Cologne, the liquid-aliquot method will be used to establish monoclonal cultures to analyze species’ genotype, taxonomy, phylogeny and their ecology.

Environmental sequencing of benthic nano- and microfauna

The analyses of bulk DNA or RNA from marine sediments by high-throughput sequencing methods allow for a qualitative analysis of the protist community (e.g. Bik et al., 2012) and a rough assignment to trophic functions of the nano- and microfauna (e.g. Arndt et al., 2000). From all sampled sediment cores, seven sediment layers were sampled, but the depth profile was adapted according to the sampled region (Table 5.3.3.1). Each approx. 20 ml per layer of sediment was deep frozen in liquid nitrogen and stored at -80°C. In addition, from each core and layer at each station, 2 ml of sediment were fixed with 10 ml RNA Later and stored at -20°C as backup for metabarcoding analysis of RNA.

A large proportion of DNA in marine sediments is extracellular (Dell'Anno & 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 decided that we will use only 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.

Preliminary results

Up to now, we could only obtain preliminary results from protozoan live-counting from the Fehmarnbelt region. Highest abundances of heterotrophic protists were always revealed from the upper surface layer of sediment (0-1cm). Abundances at Fehmarnbelt were lower than those obtained in the previous year from studies at Oderbank (EMB267) and in the lower range of values we obtained from the nearby coastal waters of Rügen Island several years ago (Dietrich & Arndt, 2000). In contrast to studies from the Oderbank, protists were not found at sediment depths below 5 cm depth. For the Fehmarnbelt region, we could carry out live-counting at most stations, which we visited during cruise EMB238. During the present cruise, we could combine molecular work and work with fixed samples with the live-counting of the delicate protists and to analyze the presence also of those protists, which are very sensitive to handling and fixatives (Jeuck et al., 2017) or are lacking in GenBank. 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 living protists at Fehmarnbelt are mostly restricted to the surface layer of sediments during the period of investigation. Dominating groups of nanofauna were kinetoplastids (neobodonids), euglenids, less important were bicosoecids, colourless cryptomonads, ancyromonads, amastigomonads, cercomonads, colourless dinoflagellates, and thaumatomonads. Among microfauna, ciliates dominated the sediment samples with representatives of predatory litostomatids and several bacterivorous spirotrichs and scuticociliates. A complex trophic food web connected to the abundant meiofauna taxa could be recorded at Fehmarnbelt. Compared to our earlier data from the Oderbank one can derive that the impact of ground fishery might be very different in the different regions of the Baltic due to the different sediment types and the vertical distribution pattern of nano- and microfauna.

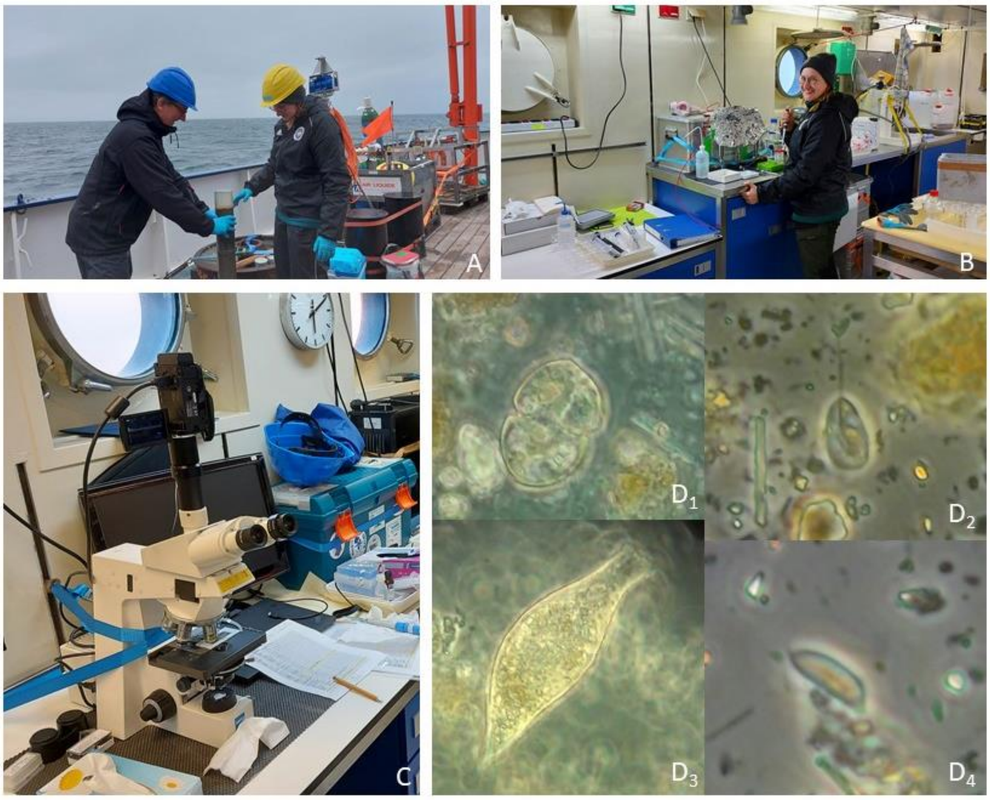

Fig. 5.3.3.1 Several impressions on board – A – Core slicing for subsequent life counting, freezing and fixation of sediment samples, B – fixated samples are filtered and stained with DAPI, C – Microscopy workstation, D – different protozoan species observed during life counting; D_1 – colourless dinoflagellate, D_2 – Petalomonas (euglenid), D_3 – Lacrymaria-like ciliate; D_4 – Amastigomonas (Apusomonadida).

5.3.4 Meiobenthos

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

Senckenberg am Meer

The sampling took place in three research areas of the Baltic Sea; the Fehmarnbelt, the Oderbank and the Rönnebank. In all research areas we took samples within a marine protected area (MPA) and outside of the MPA (reference site REF). Altogether 19 stations were sampled for meiofauna, 12 within the Fehmarnbelt (7 MPA, 5 REF), 5 within the Oderbank (2 MPA, 3 REF) and 2 within the Rönnebank (1 MPA, 1 REF; Tab. 1). The meiofauna sampling on board was performed by Sven Hoffmann using a Multicorer (MUC). 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 at the Oderbank (sandy substrate), the MUC was deployed with 8 cores only in this research area, to obtain samples of adequate quality.

At each station meiofauna samples were taken during one or two MUC-casts. From each MUC-cast 2 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, 108 samples were taken, of which 55 were stored with Formalin and 53 with DESS, respectively (Table 5.3.4.1). 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 the morphological approach, the meiofauna will be sorted and counted manually by means of a Leica M125 stereomicroscope, and benthic copepods (predominantly Harpacticoida) will be determined at family, genus and species level. For metabarcoding the DNA will be extracted from the meiofauna of the DESS samples and two gene fragments, COI mtDNA and the 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 5.3.4.1 List of stations sampled for the meiofauna investigation. MPA = Marine Protected Area, REF = Reference site

Area	Type	Station	Haul	Gear	No. Cores Formalin	No. Cores DESS	latitude ship	longitude ship	date	depth (m)
Fehmarn Belt	MPA	4	1	MUC	1	1	54° 32,924′ N	10° 46,097′ E	23.03.2022	23
Fehmarn Belt	MPA	4	2	MUC	1	1	54° 32,921′ N	10° 46,095′ E	23.03.2022	23
Fehmarn Belt	MPA	11	1	MUC	2	2	54° 33,3822′ N	10° 45,5229′ E	24.03.2022	22.9
Fehmarn Belt	MPA	15	1	MUC	2	2	54° 32,8065′ N	10° 46,6514′ E	24.03.2022	22.4
Fehmarn Belt	REF	18	1	MUC	2	2	54° 32,3527′ N	10° 43,4903′ E	25.03.2022	22
Fehmarn Belt	REF	18	2	MUC	3	3	54° 32,3532′ N	10° 43,4846′ E	25.03.2022	22
Fehmarn Belt	REF	24	1	MUC	3 *	2	54° 32,4940′ N	10° 41,1565′E	26.03.2022	22.2
Fehmarn Belt	REF	24	2	MUC	2	2	54° 32,5004′ N	10° 41,1498′ E	26.03.2022	22.3
Fehmarn Belt	REF	33	1	MUC	2	2	54° 32,5105′ N	10° 41,7161′ E	27.03.2022	22.5
Fehmarn Belt	REF	33	2	MUC	3	3	54° 32,5101′ N	10° 41,7253′ E	27.03.2022	22.5
Fehmarn Belt	MPA	41	1	MUC	2	2	54° 33,4132′ N	10° 45,3101′ E	28.03.2022	22.9
Fehmarn Belt	MPA	80	1	MUC	2	2	54° 33,0714′ N	10° 45,6778′ E	05.04.2022	22.7
Fehmarn Belt	MPA	80	2	MUC	2	2	54° 33,0677′ N	10° 45,6772′ E	05.04.2022	22.7
Fehmarn Belt	MPA	83	1	MUC	2	2	54° 32,7994′ N	10° 46,6189′ E	05.04.2022	22.9
Fehmarn Belt	MPA	84	1	MUC	2	2	54° 32,9237′ N	10° 46,1084′ E	05.04.2022	23.2
Fehmarn Belt	REF	88	1	MUC	2	2	54° 32,3622′ N	10° 43,4922′ E	06.04.2022	21.9
Fehmarn Belt	REF	93	1	MUC	2	2	54° 32,3704′ N	10° 42,8102′ E	07.04.2022	22.5
Fehmarn Belt	REF	93	2	MUC	2	2	54° 32,3745′ N	10° 42,8102′E	07.04.2022	22.6
Oderbank	MPA	44	1	MUC	1	1	54° 15,4362′ N	14° 19,7488′ E	29.03.2022	14.6
Oderbank	MPA	44	2	MUC	1	2	54° 15,4403′ N	14° 19,7291′ E	29.03.2022	14.6
Oderbank	REF	53	2	MUC	2	2	54° 14,9331′ N	14° 18,4618′ E	30.03.2022	14.8
Oderbank	MPA	57	1	MUC	0	2	54° 15,7911′ N	14° 18,9526′ E	30.03.2022	14.7
Oderbank	MPA	57	2	MUC	2	0	54° 15,7911′ N	14° 18,9526′ E	30.03.2022	14.7
Oderbank	REF	62	1	MUC	0	2	54° 15,6699′ N	14° 16,8169′ E	31.03.2022	15.1
Oderbank	REF	62	2	MUC	2	0	54° 15,6699′ N	14° 16,8169′ E	31.03.2022	15.1
Oderbank	REF	66	2	MUC	2	0	54° 15,4229′ N	14° 17,1664′ E	31.03.2022	14.9
Rönnebank	MPA	75	1	MUC	2	2	54° 46,3945′ N	14° 00,9317′ E	03.04.2022	38.1
Rönnebank	MPA	75	2	MUC	2	2	54° 46,4020′ N	14° 00,9292′ E	03.04.2022	38.1
Rönnebank	REF	78	1	MUC	2	2	54° 46,3899′ N	14° 00,9283′ E	03.04.2022	38
Rönnebank	REF	78	2	MUC	2	2	54° 46,3911′ N	14° 00,8955′ E	03.04.2022	38.1

5.3.5 Benthic Macrofauna

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Objectives

The benthic macrofauna was investigated during the cruise in order to characterize the influence of bottom trawling (MGF) on this important component of biodiversity and benthic food chain and on its relationships with ecosystem functioning. The structure and density of zoobenthos community changes with intensity of sediment disturbance by bottom trawling. This in turn may result in changes of bioturbation and bioirrigation intensity by benthic fauna that are among key processes in marine sediments considered to have a profound implication on biogeochemistry including solute transport, nutrient cycling and remineralisation of organic material at the sediment-water interface.

Methods

Macrofauna sampling was performed using a van Veen grab (75 kg, sieve lid) with a sampling area of 0.1 m² and multicorer (MUC) with sampling area of 0.00709 m². Grab samples were sieved on-board using 1.0 mm sieve and cores were sliced vertically and each interval was sieved separately using 0.5 mm sieve. Afterwards material was fixed in the 4% seawater-formaldehyde solution buffered with marble chippings. Collected samples will be sorted at the Benthos laboratory at the Leibniz Institute for Baltic Sea Research, Warnemünde.

Samples were collected at all 3 visited MGF-OSTSEE focus areas, including 8 locations in the Fehmarnbelt (FB), 7 locations in the Oderbank (OB), and 2 locations in the Rönnebank (RB) MPAs (see Fig. 5.3.5.1). Locations were more or less evenly distributed between the future exclusion area within MPA and in the reference or control area outside MPA in each region. At each location 3 van Veen grab replicates were collected. Additionally, to resolve vertical distribution and burrowing depth of macrofauna in each region, we sliced 57 cores (30, 14 and 13 cores in FB, OB and RB, respectively), of which 24 were analyzed for pore-water biogeochemistry prior to slicing and sieving (including pore-water cores collected from BIGO chambers). Cores were sliced using intervals 0-2, 2-4, 4-6, 6-8, 8-10, 10-15 and >15 cm sediment depth.

To estimate the occurrence, distribution and spatial and temporal variability of the benthic macrofaunal species and communities, and analyze the influence of MGF intensity on them, species abundance, dry and wet biomass, biological traits structure and traits-derived functional indices, as well as size classes distribution of key species will be determined in the laboratory.

To collect relevant abiotic parameters CTD near-bottom water measurements were used (as the CTD was directly deployed at only some of the van Veen and MUC stations, near-bottom water temperature, salinity and oxygen concentrations were obtained from the closest CTD cast) and a surface sediment sample was taken from one core or grab replicate at each location for later sediment granulometry and organic content analysis.

To capture qualitatively quick moving, rare or large species at each area 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 for approximately 1 min in mud and for 5 min in sand, see Fig. 5.3.5.2). One haul was towed within and outside the MPA in FB and OB respectively, whereas only a single dredge sample was collected in the RB region reference area due to bad weather conditions. A few qualitative samples were also collected from the left-over sediments after collection of granulometry samples. At selected locations in the FB region habitat characteristics were also investigated using a hand-held underwater video system with a SeaViewer HD camera.

In order to quantify overall community irrigation intensity, it is planned to combine the information on macrozoobenthos abundance and biomass, with bromide tracer experiments performed in the flux chambers of the BIGO (D. Clemens, S. Forster, S. Sommer, see section 5.2.1), with bioirrigation values derived from bromide tracer pore water profiles (responsible is S. Forster, University of Rostock, where bromide measurements will be carried out). Bromide is a conservative tracer, that is, unlike nutrients, not subject to consumption, making it very well suited to deciphering transport processes.

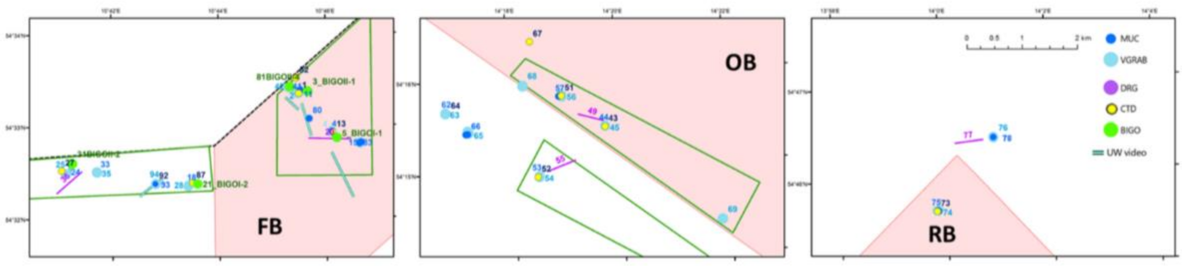

Fig. 5.3.5.1 Locations sampled for benthic macrofauna – 8 stations in the Fehmarnbelt (FB), 7 in the Oderbank (OB), and 2 in the Rönnebank (RB) MPAs.

Based on the first visual estimate of taxonomic composition in the Fehmarnbelt area, among the species dominating abundance and biomass, besides *A. islandica* (Fig. 5.3.5.2), other bivalves like *Abra alba*, polychaetes like *Nephtys ciliate* and *Terebellides stroemii*, echinoderms *Ophiura albida* and *Asterias rubens* (Figure 5.3.5.3), cumaceans *Diastylis rathkei* were present. In a grab sample collected in Fehmarnbelt within the MPA near the wreck where lowest trawling intensity is expected, a rare sea snail *Aporrhais pespelecani* (listed in the category "Threat of Unknown Extent" in the German Red List, and as "Near Threatened" according to the international IUCN Red List categories) and a large individual of polychaete family Terebellidae were recorded (Figure 5.3.5.4).

Fig. 5.3.5.2 From left to right: Van Veen grab, dredge, multicorer and the organisms that commonly remained on the 1 mm sieve in the Fehmarnbelt area (key dominant species mollusc *Arctica islandica* and brittle star *Ophiura albida*).

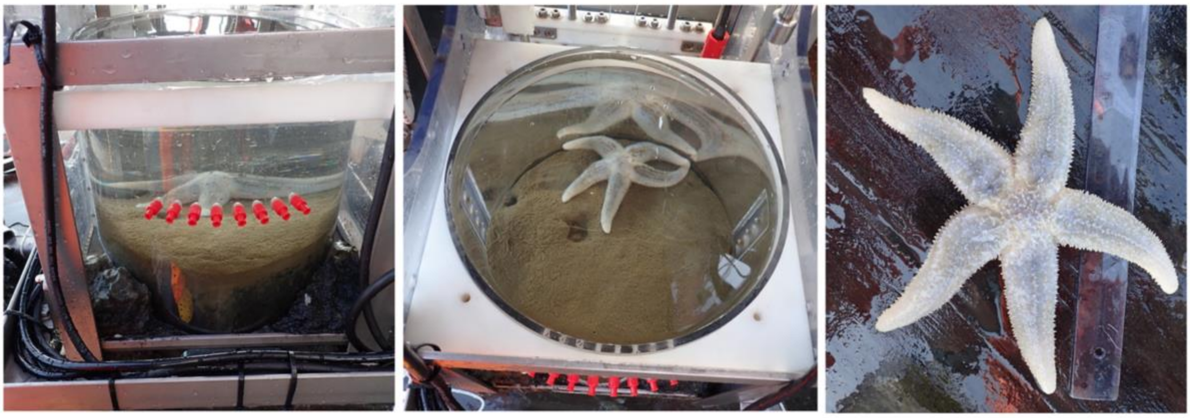

Fig. 5.3.5.3 An impressively large representative of common sea star *Asterias rubens* captured within one of the BIGO lander chambers in Fehmarnbelt.

Fig. 5.3.5.4 In the grab sample collected in Fehmarnbelt within the MPA near the wreck, where the seafloor was almost free from trawling marks according to the recent acoustic mapping data, the other two charismatic species were found, a sea snail *Aporrhais pespelecani* and an individual of polychaete family Terebellidae (two left panels). Exceptionally high number of *A. islandica* individuals were collected from chamber 1 of the BIGO after deployment at that location, (AL570-81_BIGOII-4, whereas the chamber 2 apparently contained few or no living individuals of this key species (two right panels). This suggests contrasting conditions within the two replicates in terms of macrofaunal metabolism, which is expected to be reflected in the measured biochemical fluxes.

In the Oderbank area the bivalves *Mya arenaria* (deep burrowing suspension feeder), *Macoma balthica* (surface deposit feeder), the epibenthic suspension feeder *Mytilus edulis* (blue mussel), and *Cerastoderma glaucum* (shallowly burrowing suspension feeder), as well as gastropods *Peringia ulvae* (surface deposit feeder that is known to favour microphytobenthos, particularly benthic diatoms, as food source), and the polychaete *Hediste diversicolor* (an active burrowing sediment reworking generalist, able to widely adapt its diet and to trap in its burrows plankton, diatoms and bacteria) were among frequent species dominating the sampled macrobenthic biomass (Figure 5.3.5.5).

Fig. 5.3.5.5 Samples obtained at Oderbank stations are representative for HELCOM 'HUB' Underwater Biotope AA.J3L9 'Baltic photic sand dominated by multiple infaunal bivalve species: multiple infaunal bivalve species including *Cerastoderma glaucum*, *Macoma balthica* and *Mya arenaria*'. From left to right, central species on the snapshots are: *M. arenaria*, *M. balthica*, *M. edulis* (mostly in dredge samples), shell of *C. glaucum* on sand, and *H. diversicolor*.

The habitat sampled at RB is classified according to HELCOM HUB as AB.H3L1 Baltic aphotic muddy sediment dominated by Baltic tellin (*Macoma balthica*). At first glance, in contrast to the FB and OB, at the two visited RB stations the dominance of bivalves was lower, especially at the REF area station AL570_76 (Figure 5.3.5.6).

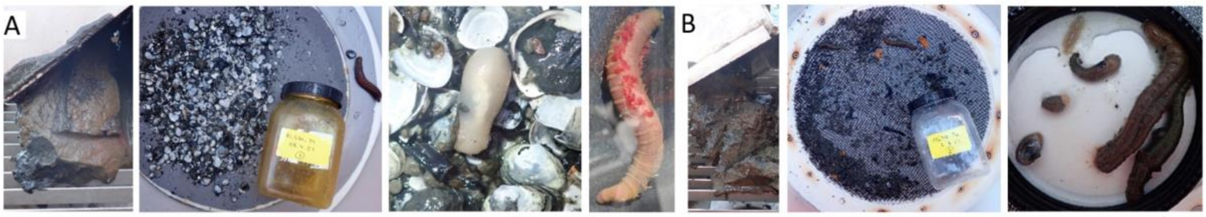

Fig. 5.3.5.6 Photos of exemplary grab samples from Rönnebank (A) MPA station AL570_74, with priapulid worm *Halicryptus spinulosus* and lugworm *Arenicola marina* and (B) REF station AL570_76, with species pictured in the Kautex container lid including one bivalve *M. balthica*, two individuals of *H. spinulosus*, one scale-worm *Bylgides sarsi* and another two individuals of *A. marina*.

Table 5.3.5.1 shows some preliminary estimates of environmental variables relevant for macrofauna distribution, including sediment organic content (estimated by loss on ignition) that ranged in FB from 2.6 to 8.8%, in OB from 0.16 to 2.38% and was in 8.9 and 9.9% in the REF and MPA areas or RB, respectively. The list of samples that will be analyzed in “IOW Benthos Labor” to quantify macrofauna diversity, densities and functional attributes is given in Table 5.3.5.2.

Video transects were recorded near the wreck within the FB MPA and in the south-east of FB REF area, expected to be most impacted by trawling (according to acoustics). In the high impact area, indeed multiple trawling marks were visually captured.

Table 5.3.5.1 Nomenclature of sampled locations based on previous MGF cruises displayed aside with AL570 stations (left side). Accompanying environmental variables (middle panel provides a summary of values from previous sampling events, and the right side displays the preliminary AL570 results collected from the closest CTD casts and samples taken for analysis of sediment properties). The grain size distribution for sands was derived using dry sieving, for finer sediments it will be done with Mastersizer 3000 (ip = in progress). Sediment organic content values are estimated by loss on ignition.

				Number of station at AL570						Abiotic parameters previous cruises										Abiotic parameters AL570									
	Stations clusters at location, numbers based on first MGF cruise visit (mostly FB-EMB238, OB-EMB267, RB-AL570, else - !)	Disturbance expected based on preliminary acoustic mapping results (on board)	MGF_Station_Catalog_v02 (Schönke, Sept 2021) Prelim. TM density L-low, M-medium, H-high	MUC	VV	CTD	UW video (close to)	Dredge (close to)	BIGO	Median grain size [µm]	Fraction finer 63 µm [%]	Fraction coarser 2000 µm [%]	Sorting [phi]	Skewness [phi]	Total organic content [%]	Depth [m]	Salinity (near bottom)	Temperature (near bottom) [°C]	Oxygen (near bottom) [mg/l]	Median grain size [µm]	Fraction finer 63 µm [%]	Fraction coarser 2000 µm [%]	Sorting [phi]	Skewness [phi]	Total organic content [%]	Depth [m]	Salinity (near bottom)	Temperature (near bottom) [°C]	Oxygen (near bottom) [mg/l]
FB REF	15,26,34	DIST	M	33	35			36		58	52.1	0	1.9	-0.3	6	23.8	17.6	10	4.5	ip	ip	ip	ip	ip	8.23	22.4	20.35	5.04	6.19
	17,27	DIST	H	24	25	27	39	39	31_BIGOII-2	48	58.2	0.3	1.9	0	5.4	23.8	17.6	10	4.5	ip	ip	ip	ip	ip	5.42	22.2	20.35	5.04	6.19
	10,23,28	BG	L	18	28[§]				21_BIGOI-2	63	50.1	0	1.9	-0.4	4.4	23.9	18.6	9.6	4	ip	ip	ip	ip	ip	2.63	22.1	20.35	5.04	6.19
	13,24,31	BG	L-M^							61	50.6	0.6	2	-0.1	3.5	23.7	18.6	9.6	4										
	25,29	DIST	M							55	53.3	0	2	-0.2	7.8	24.1	18.6	9.6	4										
	most impact!	DIST	H	93	94	92	97													ip	ip	ip	ip	ip	4.37	22.5	16.53	5.19	6.07
FB MPA	5,30,36	DIST	M	15,83	14			20	5_BIGOI-1**	51	55.9	0	1.9	-0.2	6.4	22.9	17.2	10.3	4.9	ip	ip	ip	ip	ip	3.48	22.4	20.61	4.83	5.80
	2,37,45,(uv47)	DIST	L	11'''	2	1			3_BIGOII-1	50	56.4	0.4	2	0.1	7.2	23.8	18.2	9.5	4.8	ip	ip	ip	ip	ip	5.62	22.9	20.84	4.59	5.40
	8,38,44,(uv47)	BG	M-H^^	80			89			39	64.2	0	1.8	0	6.1	23.4	18.2	9.5	4.8	ip	ip	ip	ip	ip	8.88	22.7	15.72	5.18	5.47
	39,43	BG	H							43	60.7	0	1.9	-0.1	6.3	23.7	17.7	9.8	4.3										
	18,40,42,48	BG	M	4	4[&]	13		20	5_BIGOI-1**	68	48	1.8	2.3	-0.1	6.5	23.4	17.7	9.8	4.3	ip	ip	ip	ip	ip	5.58	22.5	20.61	4.83	5.80
	wrack!	BG	L	41	42		90		81_BIGOII-4											ip	ip	ip	ip	ip	6.22	22.9	15.72	5.18	5.47
OB REF	18,19,42,49	BG		53	54	52		55		173	0.6	0	0.4	0.2	0.3	15.6	8.1	13.9	5.741	170	0.1	0	ip	ip	0.24	14.9	8.03	5.53	6.62
	24,28,43,53	BG		66	65					182	0.5	0	0.4	0.2	0.3	15.5	8.1	14.5	6.36	174	0.1	0	ip	ip	0.16	14.9	7.90	5.22	6.36
	22,25,29,44,52	DIST		62	63	64				186	0.5	0	0.4	0.1	0.3	16	8.1	14.5	6.36	175	0.2	0	ip	ip	0.23	15.1	7.90	5.22	6.36
	47,59	BG								204	0.2	0	0.4	0.2	0.3	15.6	8.2	13.9	6.083										
	48,61	BG								168	0.6	0	0.3	0.2	0.3	15.2	8.2	13.9	6.083										
	2,45,57	DIST			68					189	0.4	0	0.4	0.1	0.4	15.6	8.1	14.6	6.53	170	0.1	0	ip	ip	0.64	14.7	7.98	5.51	6.33
OB MPA	10,39	DIST		44	45	43	46	49	47_BIGOII-3	172	0.4	0	0.4	0.2	0.3	14.9	8.2	11.8	6.418	168	0.2	0	ip	ip	0.23	14.6	7.91	5.16	6.55
	3,46,58	DIST		57	56	51				172	0.4	0	0.4	0.2	0.3	15.5	8.1	13.9	6.534	167	0.1	0	ip	ip	0.18	14.7	8.04	5.67	
	6,38	DIST			69					167	0.8	0	0.3	0.2	0.3	14.2	8.2	11.8	4.735	159	0.2	0	ip	ip	2.38	13.9	7.98	5.51	6.33
	11,13,20,36	BG								176	0.5	0	0.3	0.2	0.3	14.5	8.2	12.9	6.418										
	50	BG								172	0.5	0	0.3	0.2	0.3	14.5	8.1	14.5	6.005										
RB REF	78			78	76			77												ip	ip	ip	ip	ip	9.86	38.1	12.09	4.65	4.20
RB MPA	75			75	74	73														ip	ip	ip	ip	ip	8.89	37.7	12.09	4.65	4.20

expected MED to HIGH disturbance based on sediment biogeochemistry and trawling marks density (red)

expected LOW disturbance based on sediment biogeochemistry and trawling marks density (green)

^ medium for 13_2,3,4,5; ^^ medium for MUC 38; '''no MZB cores:(; [&]7,8,9 in AL570_ActionLog; **between EMB238 st. 5 and st. 18; [§] in AL5760 log book VVG 28,29,30 - 3 replicates at same station; ip - in progress

Table 5.3.5.2 List of samples that will be analyzed in “IOW Benthos Labor”

Station	Date	Samples №s	Number of Kautex	Comment	Region	Area
AL570_2	22.03.	1-3	1*3	3 grab replicates	FB	MPA
AL570_3 BIGOII-1	24.03.	Chamber 1, Chamber 2	1*2		FB	MPA
AL570_4	23.03.	1-3	1*3	3 grab replicates	FB	MPA
AL570_20_1	25.03.	Dredge	1	qualitative	FB	MPA
AL570_14	22.03.	1-3	1*3	3 grab replicates	FB	MPA
AL570_5 BIGOI-1	25.03.	Chamber 1, Chamber 2	1*2		FB	MPA
AL570_28	26.03.	1-3	1*3	3 grab replicates	FB	REF
AL570_25	26.03.	1-3	1*3	3 grab replicates	FB	REF
AL570_35	27.03.	1-3	1*3	3 grab replicates	FB	REF
AL570_36	27.03.	Dredge	1	qualitative	FB	REF
AL570_21 BIGOI-2	27.03.	Chamber 1, Chamber 2	1*2		FB	REF
AL570_42	28.03.	1-3	1*3	3 grab replicates	FB	MPA
AL570_31 BIGOII-2	28.03.	Chamber 1, Chamber 2	1*2		FB	REF
AL570_45	29.03.	1-3	1*3	3 grab replicates	OB	MPA
AL570_49	29.03.	Dredge	1	qualitative	OB	MPA
AL570_54	30.03.	1-3	1*3	3 grab replicates	OB	REF
AL570_55	30.03.	Dredge	1	qualitative	OB	REF
AL570_56	30.03.	1-3	1*3	3 grab replicates	OB	MPA
AL570_56	30.03.	Dredge	1	qualitative	OB	MPA
AL570_63	31.03.	1-3	1*3	3 grab replicates	OB	REF
AL570_65	31.03.	1-3	1*3	3 grab replicates	OB	REF
AL570_68	31.03.	1-3	1*3	3 grab replicates	OB	MPA
AL570_69	31.03.	1-3	1*3	3 grab replicates	OB	MPA
AL570_63	31.03.	Dredge	1	qualitative from rest of sediment	OB	REF
AL570_65	31.03.	Dredge	1	qualitative from rest of sediment	OB	REF
AL570_74	03.04.	1-3	1*3	3 grab replicates	RB	MPA
AL570_76	03.04.	1-3	1*3	3 grab replicates	RB	REF
AL570_77	03.04.	Dredge	1	qualitative	RB	REF
AL570_81 BIGOII-4	05.04.	Chamber 1, Chamber 2	1*2		FB	MPA
AL570_94	07.04.	1-3	1*3	3 grab replicates	FB	REF
AL570_80_1	05.04.	Kern 3 PW	7	sliced	FB	MPA
AL570_83_1	05.04.	Kern 9 PW	7	sliced	FB	MPA
AL570_93	07.04.	Kern 4,5,6,7,8	7	sliced together	RB	REF
AL570_4_2	23.03.	Kern 7, Kern 8	7,7	sliced	FB	MPA
AL570_4_1	23.03.	Kern 4 PW, Kern 3 (DET)	7*2	sliced	FB	MPA
AL570_15_1	23.03.	Kern 8, Kern 9, Kern 12	7	sliced	FB	MPA
AL570_18_1	25.03.	Kern 12, Kern 10 PW	7,7	sliced	FB	REF
AL570_5 BIGOI-1	25.03.	Ch.1 Kern PW,Ch.2 Kern PW	6,6	sliced	FB	MPA
AL570_18_2	25.03.	Kern 10	7	sliced	FB	REF
AL570_24_1	26.03.	Kern 4	7	sliced	FB	REF
AL570_21 BIGOI-2	27.03.	Ch.1 Kern PW,Ch.2 Kern PW	6,6	sliced	FB	REF
AL570_33_1	27.03.	Kern 10 PW	7	sliced	FB	REF
AL570_41_1	28.03.	Kern7PW,Kern8PW,Kern9PW	7,7,7	sliced	FB	MPA
AL570_31 BIGOII-2	28.03.	Ch.1 Kern PW, Ch.2 Kern PW	6,6	sliced	FB	REF
AL570_44_2	29.03.	Kern 9	7	sliced	OB	MPA
AL570_53_2	30.03.	Kern 3	4	sliced	OB	REF
AL570_57_2	30.03.	Kern 1, Kern 8	4,5	sliced	OB	MPA
AL570_53_3	30.03.	Kern 8 PW, Kern 9 PW	7,7	sliced	OB	REF
AL570_57_1	30.03.	Kern 8 PW	6	sliced	OB	MPA
AL570_66_1	31.03.	Kern 6 PW	7	sliced	OB	REF
AL570_62_1	31.03.	Kern 9, Kern 10	6	sliced	OB	REF
AL570_62_4	31.03.	Kern 5 PW	7	sliced	OB	REF
AL570_62_2	31.03.	Kern 10	4	sliced	OB	REF
AL570_75_2	03.04.	Kern 5,10	7	sliced together	RB	MPA
AL570_78_2	03.04.	Kern 6,7,8	7	sliced together	RB	REF
AL570_75_1	03.04.	Kern 8 PW, Kern 9 (DET)	7,7	sliced	RB	MPA
AL570_78_1	03.04.	Kern 2 PW	7	sliced	RB	REF
AL570_80_2	05.04.	Kern 5,6,7,8,12	7	sliced together	FB	MPA
AL570_83_1	05.04.	Kern 8 PW, Kern 7 DET	7,1	sliced	FB	MPA
AL570_81 BIGOII-4	05.04.	Ch. 1 Kern PW	6	sliced	FB	MPA
AL570_93_1	07.04.	Kern 3 PW	7	sliced	FB	REF

To quantitatively assess bioirrigation a bromide tracer was injected into the bottom water enclosed by the benthic chambers at the beginning of each BIGO flux incubation (see section 5.2.1., Figure 5.2.1.1) and porewater for bromide measurments was sampled from the collected sediments after recovering the lander (Figure 5.3.5.7) where sediment retrieval by the chambers was successful (only at FB stations).

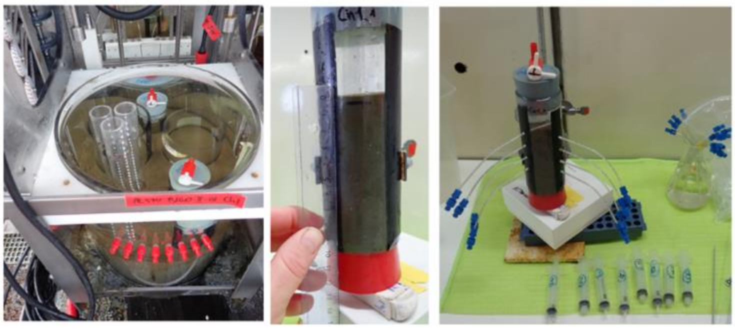

Fig. 5.3.5.7 Photos of subsampled cores within the lander chamber – those with red valves on the grey lids are for sampling the porewater for Br tracer that irrigated into the sediment during the incubation on the seafloor (Ø=3.6 cm).

6 Ship's Meteorological Station

(S. Sommer)

The weather conditions within the first few days were ideal with low wind speeds and low wave heights enabling fast station work at the Fehmarnbelt, Figure 6.1. Thereafter, the weather conditions changed profoundly for the remaining station days of the cruise. Strong winds with associated high waves only allowed for restricted sampling and almost no in situ measurements at the Oderbank and the Rönnebank. During the time period from the 1st to the 3rd of April RV ALKOR sought shelter from the storm in Sassnitz (indicated by rectangle in Figure 6.1). At the 4th of April again due to stormy conditions we went to Kiel harbor to hand over the damaged Rover for maintenance.

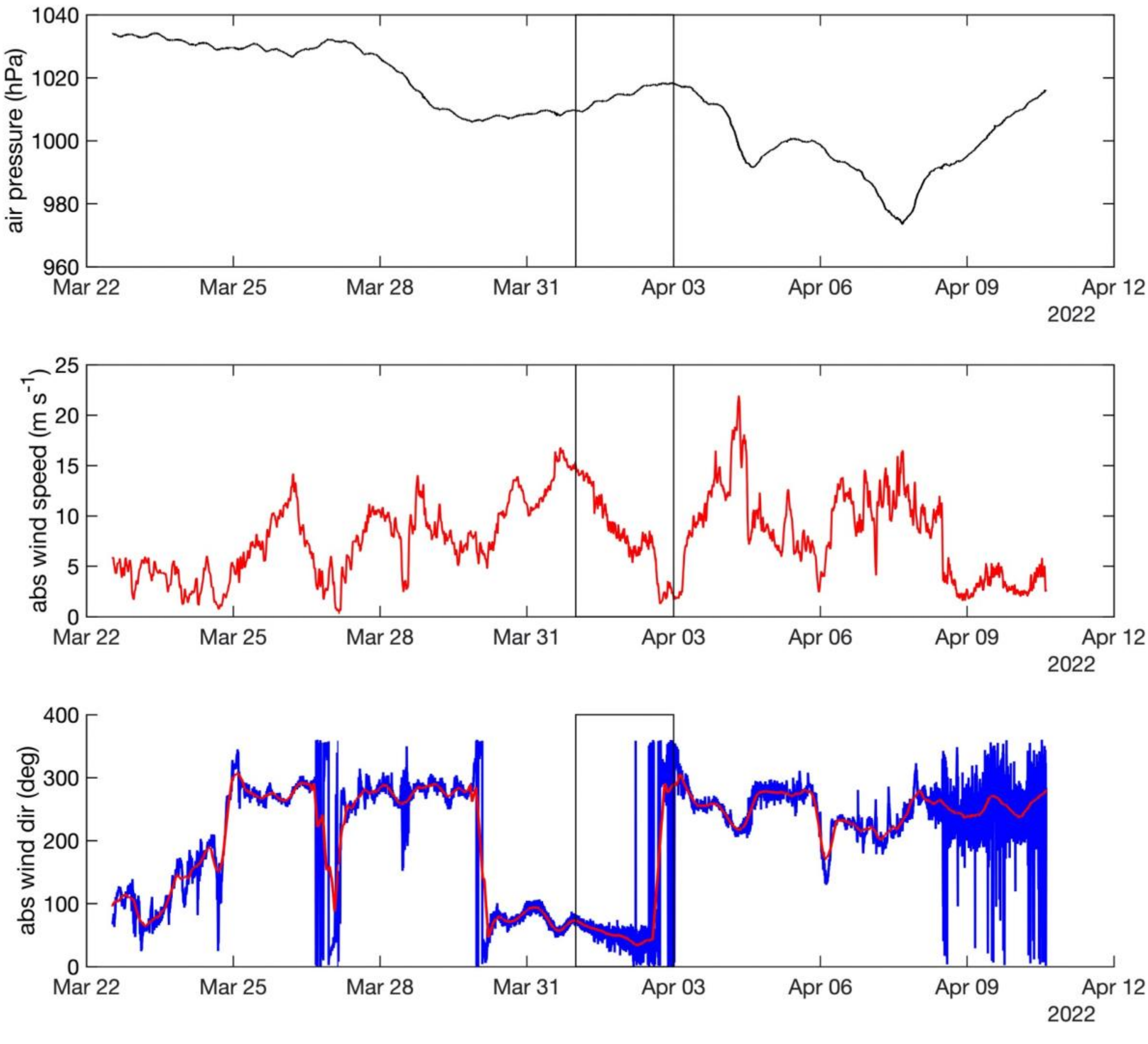

Fig. 6.1 Weather data (source RV ALKOR D-SHIP WERUM) from RV ALKOR cruise AL570. The source data were extracted from D-SHIP using a time interval of 1 min. The absolute wind speed (middle panel) and the absolute wind direction (lower panel, red line) were smoothed using a moving mean over sliding window lengths of 60 and 360 min respectively. The rectangle indicates the time period when RV ALKOR was in the harbor of Sassnitz.

7 Station List AL570/2022

7.1 Overall Station List, MGF-OSTSEE refers to the station names during EMB238.

Station No.		Date	Gear	Time	Latitude	Longitude	Water Depth	Remarks/Recovery
ALKOR	MGF-Ostsee	2022		[UTC]	[°N]	[°E]	[m]	
AL570_1-1	FB 2 inside	22.03.	CTD 1	14:37	54°33.347'	10°45.495'	23	
AL570_2-1	FB 2 inside	22.03.	Vgrab	14:56	54°33.353'	10°45.502'	23	
AL570_2-2	FB 2 inside	22.03.	Vgrab	15:06	54°33.345'	10°45.477'	23	
AL570_2-3	FB 2 inside	22.03.	Vgrab	15:12	54°33.356'	10°45.453'	23	
AL570_2-4	FB 2 inside	22.03.	Vgrab	15:19	54°33.350'	10°45.466'	23	
AL570_2-5	FB 2 inside	22.03.	Vgrab	15:24	54°33.350'	10°45.489'	23	
AL570_3	close to FB2	22.03.	BIGO-II-1	18:40	54°33.353'	10°45.687'	23	deployment
AL570_4-1	FB 18 inside	22.03.	MUC#1	07:05	54°32.925'	10°46.090'	23	
AL570_4-2	FB 18 inside	22.03.	MUC#2	07:35	54°32.920'	10°46.091'	23	
AL570_5_1	close to FB 18	23.03.	BIGO-I-1	12:03	54°32.843'	10°46.222'	23	deployment
AL570_6_1	FB 18 inside	23.03.	Vgrab	12:42	54°32.926'	10°46.108'	23	
AL570_7_1	FB 18 inside	23.03.	Vgrab	12:48	54°32.927'	10°46.098'	23	
AL570_8_1	FB 18 inside	23.03.	Vgrab	13:52	54°32.931'	10°46.103'	23	
AL570_9_1	FB 18 inside	23.03.	MUC#3	14:03	54°32.932'	10°46.111'	23	
AL570_10_1		23.03.	OFOS	14:54	54°33.034'	10°45.975'	23	
AL570_11_1	FB 2 inside	24.03.	MUC#4	07:07	54°33.383'	10°45.526'	23	
AL570_12_1	recovery	24.03.	BIGO-II-1	07:49	54°33.357'	10°45.657'	23	recovery
AL570_13_1	FB 18 inside	24.03.	CTD 2	11:01	54°32.922'	10°46.132'	23	
AL570_14_1	FB 5 inside	24.03.	Vgrab	11:55	54°32.807'	10°46.632'	22	
AL570_14_2	FB 5 inside	24.03.	Vgrab	12:01	54°32.804'	10°46.636'	22	
AL570_14_3	FB 5 inside	24.03.	Vgrab	12:07	54°32.804'	10°46.641'	22	
AL570_14_4	FB 5 inside	24.03.	Vgrab	12:12	54°32.803'	10°46.634'	22	
AL570_15_1	next to 5	24.03.	MUC#5	13:04	54°32.812'	10°46.656'	22	
AL570_16_1		24.03.	DSR-1	14:50	54°32.397'	10°46.405'	22	deployment
AL570_17_1	south of FB 5 inside	24.03.	EC 1	15:43	54°32.289	10°46.676'	22	deployment
AL570_18_1	FB 10/28	25.03.	MUC#6	07:08	54°32.355'	10°43.500'	22	
AL570_18_2	FB 10/28	25.03.	MUC#7	07:28	54°32.356'	10°43.492'	22	
AL570_19_1	recovery	25.03.	BIGO-I-1	08:14	54°32.835'	10°46.243'	23	recovery
AL570_20_1		25.03.	Dredge	13:02	54°32.846'	10°46.448'	23	
AL570_21_1	close to FB 10/28/13	25.03.	BIGO-I-2	14:42	54°32.377'	10°43.572'	22	deployment
AL570_22_1		25.03.	DSR-1	15:25	54°32.411'	10°46.427'	22	recovery
AL570_23_1	recovery	25.03.	EC 1	16:01	54°32.306'	10°46.742'	22	recovery
AL570_24_1	FB 17 outside	26.03.	MUC#8	07:03	54°32.495'	10°41.162'	22	
AL570_24_2	FB 17 outside	26.03.	MUC#9	07:22	54°32.499'	10°41.156'	22	
AL570_25_1	FB 17 outside	26.03.	Vgrab	07:55	54°32.491'	10°41.135'	22	
AL570_25_2	FB 17 outside	26.03.	Vgrab	08:00	54°32.489'	10°41.142'	22	
AL570_25_3	FB 17 outside	26.03.	Vgrab	08:06	54°32.493'	10°41.131'	22	
AL570_26_1		26.03.	DSR-2	09:39	54°32.527'	10°41.198'	22	deployment
AL570_27_1	FB 17 outside	26.03.	CTD 3	11:07	54°32.527'	10°41.057'	22	
AL570_28_1	FB 10/28 outside	26.03.	Vgrab	13:01	54°32.356'	10°43.420'	22	
AL570_29_1	FB 10/28 outside	26.03.	Vgrab	13:06	54°32.356'	10°43.434'	22	
AL570_30_1	FB 10/28 outside	26.03.	Vgrab	13:12	54°32.348'	10°43.419'	22	
AL570_31_1	FB 17 outside	26.03.	BIGO-II-2	14:33	54°32.600'	10°41.292'	22	deployment

Station No. continued		**Date**	**Gear**	**Time**	**Latitude**	**Longitude**	**Water Depth**	**Remarks/Recovery**
ALKOR	**MGF-Ostsee**	**2022**		**[UTC]**	**[°N]**	**[°E]**	**[m]**	
AL570_32_1	west of FB 15 outside	26.03.	EC 2	16:54	54°32.529'	10°41.536'	22	deployment
AL570_33_1	FB 15 outside	27.03.	MUC#10	06:08	54°32.506'	10°41.716'	22	
AL570_33_2	FB 15 outside	27.03.	MUC#11	06:33	54°32.506'	10°41.723'	23	
AL570_34_1	recovery	27.03.	BIGO-I-2	07:07	54°32.353'	10°43.591'	22	recovery
AL570_35_1	FB 15 outside	27.03.	Vgrab	09:56	54°32.507'	10°41.712'	22	
AL570_35_2	FB 15 outside	27.03.	Vgrab	10:02	54°32.511'	10°41.713'	22	
AL570_35_3	FB 15 outside	27.03.	Vgrab	10:07	54°32.506'	10°41.722'	22	
AL570_36_1		27.03.	Vgrab	12:03	54°32.515'	10°41.429'	22	
AL570_37_1		27.03.	DSR-2	13:15	54°32.491'	10°41.183'	22	recovery
AL570_38_1	recovery	27.03.	EC 2	13:45	54°32.524'	10°41.512'	22	recovery
AL570_39_1		27.03.	Video Sl.	14:23	54°32.635'	10°41.199'	22	
AL570_40_1	recovery	28.03.	BIGO-II-2	06:16	54°32.619'	10°41.274'	22	recovery
AL570_41_1	FB Wreck	28.03.	MUC#12	07:03	54°33.414'	10°45.317'	23	
AL570_42_1	FB Wreck	28.03.	Vgrab	07:33	54°33.410'	10°45.315'	23	
AL570_42_2	FB Wreck	28.03.	Vgrab	07:38	54°33.412'	10°45.304'	23	
AL570_42_3	FB Wreck	28.03.	Vgrab	07:44	54°33.414'	10°45.298'	23	
AL570_43_1	OB 10	29.03.	CTD 4	06:00	54°15.426'	14°19.745'	15	
AL570_44_1	OB 10	29.03.	MUC#13	06:20	54°15.437'	14°19.755'	15	
AL570_44_2	OB10	29.03.	MUC#14	06:38	54°15.441'	14°19.737'	15	
AL570_45_1	OB 10	29.03.	Vgrab	07:03	54°15.438'	14°19.746'	15	
AL570_45_2	OB 10	29.03.	Vgrab	07:08	54°15.433'	14°19.746'	15	
AL570_45_3	OB 10	29.03.	Vgrab	07:11	54°15.435'	14°19.750'	15	
AL570_46_1		29.03.	OFOS	07:34	54°15.503'	14°19.896'	15	
AL570_47_1	OB 10	29.03.	BIGO-II-3	12:00	54°15.435'	14°19.749'	14	deployment
AL570_49_1		29.03.	Dredge	12:24	54°15.491'	14°19.726'	14	
AL570_50_1	OB	29.03.	EC 3	14:16	54°14.998'	14°20.986'	14	deployment
AL570_51_1	OB 3	30.03.	CTD 5	06:00	54°15.786'	14°18.968'	15	
AL570_52_1	OB 19	30.03.	CTD 6	06:37	54°14.921'	14°18.452'	15	
AL570_53_1	OB 19	30.03.	MUC#15	07:08	54°14.933'	14°18.456'	15	
AL570_53_2	OB19	30.03.	MUC#16	07:20	54°14.931'	14°18.457'	15	
AL570_53_3	next to OB 19	30.03.	MUC#17	07:39	54°14.941'	14°18,474'	15	
AL570_54_1	OB 19	30.03.	Vgrab	08:09	54°14.917'	14°18.480'	15	
AL570_54_2	OB 19	30.03.	Vgrab	08:11	54°14.924'	14°18.483'	15	
AL570_54_3	OB 19	30.03.	Vgrab	08:14	54°14.931'	14°18.481'	15	
AL570_55_1		30.03.	Dredge	08:23	54°14.984'	14°18.677'	15	
AL570_56_1	OB 3	30.03.	Vgrab	10:43	54°15.776'	14°18.979'	15	
AL570_56_2	OB 3	30.03.	Vgrab	10:45	54°15.795'	14°18.973'	15	
AL570_56_3	OB 3	30.03.	Vgrab	10:48	54°15.803'	14°18.965'	15	
AL570_57_1	OB 3	30.03.	MUC#18	11:33	54°15.781'	14°18.919'	15	
AL570_57_2	OB 3	30.03.	MUC#19	11:48	54°15.789'	14°18.945'	15	
AL570_58_1		30.03.	DSR-3	12:52	54°15.487'	14°19.557'	15	deployment
AL570_59_1		30.03.	Tonne	13:02	54°15.547'	14°19.468'	15	DSR
AL570_60_1	recovery	31.03.	BIGO-II-3	06:03	54°15.446'	14°19.740'	14	recovery
AL570_61_1	recovery	31.03.	EC 3	06:59	54°15.003'	14°21.011'	14	recovery
AL570_62_1	OB 29	31.03.	MUC#20	07:37	54°15.673'	14°16.812'	15	
AL570_62_2	OB 29	31.03.	MUC#21	07:49	54°15.668'	14°16.811'	15	
AL570_62_3	OB 29	31.03.	MUC#22	08:08	54°15.656'	14°16.817'	15	
AL570_62-4	OB 29	31.03.	MUC#23	08:11	54°15.669'	14°16.819'	15	
AL570_63_1	OB 29	31.03.	Vgrab	08:42	54°15.659'	14°16.800'	15	
AL570_63_2	OB 29	31.03.	Vgrab	08:45	54°15.667'	14°16.803'	15	
AL570_63_3	OB 29	31.03.	Vgrab	08:48	54°15.658'	14°16.807'	15	
AL570_64_1	OB 29	31.03.	CTD 7	08:51	54°15.661'	14°16.842'	15	
AL570_65_1	OB 28	31.03.	Vgrab	10:04	54°15.437'	14°17.220'	15	
AL570_65_2	OB 28	31.03.	Vgrab	10:06	54°15.436'	14°17.206'	15	

Station No. continued		Date	Gear	Time	Latitude	Longitude	Water Depth	Remarks/Recovery
ALKOR	MGF-Ostsee	2022		[UTC]	[°N]	[°E]	[m]	
AL570_65_3	OB 28	31.03.	Vgrab	10:08	54°15.447'	14°17.193'	15	
AL570_65_4	OB 28	31.03.	Vgrab	10:11	54°15.458'	14°17.196'	15	
AL570_66_1	no station	31.03.	MUC# 24	10:29	54°15.425'	14°17.193'	15	
AL570_66_2	no station	31.03.	MUC#25	10:41	54°15.422'	14°17.161'	15	
AL570_67_1	north of OB 2	31.03.	CTD 8	11:25	54°16.392'	14°18.439'	15	
AL570_68_1	OB 2	31.03.	Vgrab	13:39	54°15.920'	14°18.265'	15	
AL570_68_2	OB 2	31.03.	Vgrab	13:41	54°15.912'	14°18.256'	15	
AL570_68_3	OB 2	31.03.	Vgrab	13:43	54°15.908'	14°18.261'	15	
AL570_68_4	OB 2	31.03.	Vgrab	13:45:	54°15.913'	14°18.264'	15	
AL570_69_1	OB 38	31.03.	Vgrab	14:11	54°14.348'	14°21.824'	14	
AL570_69_2	OB 38	31.03.	Vgrab	14:13	54°14.354'	14°21.824'	14	
AL570_69_3	OB 38	31.03.	Vgrab	14:15	54°14.355'	14°21.818'	14	
AL570_69_4	OB 38	31.03.	Vgrab	14:17	54°14.350'	14°21.814'	14	
AL570_70_1		03.04.	Tonne	06:54	54°15.396'	14°19.773'	14	
AL570_71_1		03.04.	DSR-4	07:10	54°15.480'	14°19.539'	14	recovery
AL570_72_1		03.04.	Tonne	07:25:	54°15.541'	14°19.446'	14	
AL570_73_1	RB inside	03.04.	CTD 9	10:18	54°45.629'	13°59.810'	38	
AL570_74_1	RB inside	03.04.	Vgrab	10:33	54°45.633'	13°59.821'	38	
AL570_74_2	RB inside	03.04.	Vgrab	10:41	54°45.637'	13°59.808'	38	
AL570_74_3	RB inside	03.04.	Vgrab	10:49	54°45.642'	13°59.836'	38	
AL570_75_1	RB inside	03.04	MUC#26	11:05	54°45.637'	13°59.823'	38	
AL570_75_2	RB inside	03.04.	MUC#27	11:32	54°45.632'	13°59.834'	38	
AL570_76_1	RB outside	03.04.	Vgrab	12:15	54°46.399'	14°00.938'	38	
AL570_76_2	RB outside	03.04.	Vgrab	12:21	54°46.398'	14°00.935'	38	
AL570_76_3	RB outside	03.04.	Vgrab	12:27	54°46.405'	14°00.931'	38	
AL570_77_1		03.04.	Dredge	13:39	54°46.382'	14°00.734'	38	
AL570_78_1	RB outside	03.04.	MUC#28	14:10	54°46.393'	14°00.934'	38	
AL570_79_1	RB ouside	03.04.	MUC#29	14:39	54°46.394'	14°00.901'	38	
AL570_80_1	FB 8 inside	05.04.	MUC#30	07:40	54°33.072'	10°45.686'	23	inside
AL570_80_2	FB 8 inside	05.04.	MUC#31	08:00	54°33.069'	10°45.684'	23	inside
AL570_81_1	close wreck	05.05.	BIGO-II-4	08:39	54°33.419'	10°45.331'	23	deployment
AL570_81_2	recovery	05.05.	Tonne	08:49	54°33.474'	10°45.377'	23	recovery
AL570_82_1	close wreck	05.05.	CTD 10	08:53	54°33.512'	10°45.447'	23	
AL570_83_1	FB 5 inside	05.05.	MUC#32	11:05	54°32.800'	10°46.625'	23	
AL570_84_1	FB 18 inside	05.05.	MUC#33	12:30	54°32.922'	10°46.116'	23	
AL570_85_1	close wreck	05.05.	EC#4	13:38	54°33.290'	10°45.402'	24	deployment
AL570_86_1		05.05.	OFOS #3	14:10	54°32.801'	10°46.471'	23	start profile
AL570_86_1		05.05.	OFOS #3	14:59	54°32.952'	10°46.122'	23	end profile
AL570_87_1	FB 10/28 out	06.04.	CTD 11	05:59	54°32.382'	10°43.502'	22	
AL570_88_1	FB 10/28 out	06.04.	MUC#34	06:24	54°32.366'	10°43.497'	22	
AL570_89_1		06.04.	Video Sl.	07:40	54°33.237'	10°45.537'	23	start profile
AL570_89_ 1		06.04.	Video Sl.	08:31	54°32.885'	10°45.723'	22	end profile
AL570_90_1		06.04.	Video Sl.	08:51	54°33.311'	10°45.244'	23	start profile
AL570_90_1		06.04.	Video Sl.	09:17	54°33.163'	10°45.491'	23	end profile
AL570_91_1	recovery	06.04.	BIGO-II-4	13:04	54°33.394'	10°45.345'	23	recovery
AL570_92_1	next FB 29	07.04.	CTD 12	05:59	54°32.378'	10°42.807'	22	
AL570_93_1	next FB 29	07.04.	MUC#35	06:44	54°32.374'	10°42.806'	23	high impact
AL570_93_2	next FB 29	07.04.	MUC#36	07:02	54°32.379'	10°42.807'	23	high impact
AL570_94_1	next FB 29	07.04.	Vgrab	07:23	54°32.377'	10°42.812'	23	high impact
AL570_94_2	next FB 29	07.04.	Vgrab	07:28	54°32.375'	10°42.813'	23	high impact
AL570_94_3	next FB 29	07.04.	Vgrab	07:34	54°32.378'	10°42.813'	23	high impact
AL570_95_1		07.04.	Tonne	08:41	54°33.475'	10°45.390'	23	bei BIGO
AL570_96_1	recovery	07.04.	EC#4	12:07	54°33.275'	10°45.427'	23	recovery
AL570_97_1		07.04.	Video Sl.	13:14	54°32.440'	10°42.945'	23	profile start high Impact

Station No. continued		Date	Gear	Time	Latitude	Longitude	Water Depth	Remarks/Recovery
ALKOR	MGF-Ostsee	2022		[UTC]	[°N]	[°E]	[m]	
AL570_97_1		07.04.	Video Sl.	14:02	54°32.255'	10°42.541'	22	profile end
AL570_98_1		07.04.	Video Sl.	14:04	54°32.252'	10°42.532'	22	short deployment

8 Data and Sample Storage and Availability

The data were collected during the cruise AL570 will be used in the MGF-OSTSEE project. After the scientific publication or at the latest 3 years after the end of the project, all data will be transferred to the PANGAEA database allowing the access for a broader scientific community. The metadata for AL570 will be made publicly available via GEOMAR data management. 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 data collected by GEOMAR data sharing and exchange will take place within the Ocean Science Information System (OSIS-Kiel) hosted at GEOMAR. 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).

Table 8.1 Overview of data availability

Data type	Database	Available internal	Free Access	Contact person
Water column				
CTD (physical data, nutrients)	Pangaea	28.02.2023	01.03.26	S. Sommer, ssommer@geomar
Seafloor images	Pangaea	28.02.2023	01.03.26	M. Gogina, mayya.gogina@io-warnemuende.de
Ostreococcus/Virus	Pangaea	28.02.2023	01.03.26	L. Listmann, luisa.listmann@uni-hamburg
Benthos				
Porewater geochemistry	Pangaea	28.02.2023	01.03.26	P. Roeser, patricia.roeser@io-warnemuende.de
Sulfate reduction	Pangaea	28.02.2023	01.03.26	J. Kallmeyer, kallm@gfz-potsdam.de
In situ fluxes Lander/Rover	Pangaea	28.02.2023	01.03.26	S. Sommer, ssommer@geomar.de
Microbenthos	Pangaea	28.02.2023	01.03.26	J. Piontek, judith.piontek@io-warnemuende.de
Protozoobenthos	Pangaea	28.02.2023	01.03.26	Hartmut Arndt, Hartmut.Arndt@uni-koeln.de
Meiofauna	Pangaea	28.02.2023	01.03.26	K. George, Senckenberg am Meer, kgeorge@senckenberg.de
Macrofauna	Pangaea	28.02.2023	01.03.26	M. Gogina, mayya.gogina@io-warnemuende.de
Epiphytobenthos	Pangaea	28.02.2023	01.03.26	M. Janßen, marjan.janssen@uni-rostock.de

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11 Abbreviations

BIGO	Biogeochemical Observatory
CTD	CTD (conductivity, temperature, depth) water sampling rosette
Dredge	Dredge type “Kieler Knderwagen”
DSR	Deep-Sea Rover (DSR) Panta Rhei
EC	Eddy Correlation
MUC	Multiple Corer
Vgrab	Van Veen grap
Video Sl.	Video Sledge

12 Appendices

12.1 Supplementary tables (Section 5.2.4 Biogeochemical processes in the Sediment)

Table: S1 (page 1 from 8)

ALK570_SEDIMENTS_Biogeochemistry

SampleNr.		Infos			Depth [cm]		Existing Sample? (Y/N)		
		DATE	STATION	MUC / BIGO	from	to	F. Drying	ZnOAc	Poros.
ALK 570	1	23.03.22	4_1	MUC_2	0	1	1	1	1
ALK 570	2	23.03.22	4_1	MUC_2	1	2	1	1	1
ALK 570	3	23.03.22	4_1	MUC_2	2	3	1	1	1
ALK 570	4	23.03.22	4_1	MUC_2	3	4	1	1	1
ALK 570	5	23.03.22	4_1	MUC_2	4	5	1	1	1
ALK 570	6	23.03.22	4_1	MUC_2	5	7	1	1	1
ALK 570	7	23.03.22	4_1	MUC_2	7	9	1	1	1
ALK 570	8	23.03.22	4_1	MUC_2	9	11	1	1	1
ALK 570	9	23.03.22	4_1	MUC_2	11	13	1	1	1
ALK 570	10	23.03.22	4_1	MUC_2	13	15	1	1	1
ALK 570	11	23.03.22	4_1	MUC_2	15	17	1	1	1
ALK 570	12	23.03.22	4_1	MUC_2	17	19	1	1	1
ALK 570	13	23.03.22	4_1	MUC_2	19	21	1	1	1
ALK 570	14	23.03.22	4_1	MUC_2	21	23	1	1	1
ALK 570	15	23.03.22	4_1	MUC_2	23	25	1	1	1
ALK 570	16	23.03.22	4_1	MUC_2	25	27	1	1	1
ALK 570	17	23.03.22	4_1	MUC_2	27	30.5	1	1	1
ALK 570	18	24.03.22	12	BIGO_II_1_Ch1	0	1	1	1	1
ALK 570	19	24.03.22	3, 12	BIGO_II_1_Ch1	1	2	1	1	1
ALK 570	20	24.03.22	3, 12	BIGO_II_1_Ch1	2	3	1	1	1
ALK 570	21	24.03.22	3, 12	BIGO_II_1_Ch1	3	4	1	1	1
ALK 570	22	24.03.22	3, 12	BIGO_II_1_Ch1	4	5	1	1	1
ALK 570	23	24.03.22	3, 12	BIGO_II_1_Ch1	5	7	1	1	1
ALK 570	24	24.03.22	3, 12	BIGO_II_1_Ch1	7	9	1	1	1
ALK 570	25	24.03.22	3, 12	BIGO_II_1_Ch1	9	11	1	1	1
ALK 570	26	24.03.22	3, 12	BIGO_II_1_Ch1	11	13	1	1	1
ALK 570	27	24.03.22	3, 12	BIGO_II_1_Ch1	13	15	1	1	1
ALK 570	28	24.03.22	3, 12	BIGO_II_1_Ch1	15	17.5	1	1	1
ALK 570	29	24.03.22	11_1	MUC_1	0	1	1	1	1
ALK 570	30	24.03.22	11_1	MUC_1	1	2	1	1	1
ALK 570	31	24.03.22	11_1	MUC_1	2	3	1	1	1
ALK 570	32	24.03.22	11_1	MUC_1	3	4	1	1	1
ALK 570	33	24.03.22	11_1	MUC_1	4	5	1	1	1
ALK 570	34	24.03.22	11_1	MUC_1	5	7	1	1	1
ALK 570	35	24.03.22	11_1	MUC_1	7	9	1	1	1
ALK 570	36	24.03.22	11_1	MUC_1	9	11	1	1	1
ALK 570	37	24.03.22	11_1	MUC_1	11	13	1	1	1
ALK 570	38	24.03.22	11_1	MUC_1	13	15	1	1	1
ALK 570	39	24.03.22	11_1	MUC_1	15	17	1	1	1
ALK 570	40	24.03.22	11_1	MUC_1	17	19	1	1	1
ALK 570	41	24.03.22	11_1	MUC_1	19	21	1	1	1
ALK 570	42	24.03.22	11_1	MUC_1	21	23	1	1	1
ALK 570	43	24.03.22	11_1	MUC_1	23	25	1	1	1
ALK 570	44	24.03.22	11_1	MUC_1	25	27	1	1	1
ALK 570	45	24.03.22	11_1	MUC_1	27	29	1	1	1

Table: S1 continued (page 2 from 8)

SampleNr.		Infos			Depth [cm]		Existing Sample? (Y/N)		
		DATE	STATION	MUC / BIGO	from	to	F. Drying	ZnOAc	Poros.
ALK 570	46	25.03.22	18_1	MUC_9	0	1	1	1	1
ALK 570	47	25.03.22	18_1	MUC_9	1	2	1	1	1
ALK 570	48	25.03.22	18_1	MUC_9	2	3	1	1	1
ALK 570	49	25.03.22	18_1	MUC_9	3	4	1	1	1
ALK 570	50	25.03.22	18_1	MUC_9	4	5	1	1	1
ALK 570	51	25.03.22	18_1	MUC_9	5	7	1	1	1
ALK 570	52	25.03.22	18_1	MUC_9	7	9	1	1	1
ALK 570	53	25.03.22	18_1	MUC_9	9	11	1	1	1
ALK 570	54	25.03.22	18_1	MUC_9	11	13	1	1	1
ALK 570	55	25.03.22	18_1	MUC_9	13	15	1	1	1
ALK 570	56	25.03.22	18_1	MUC_9	15	17	1	1	1
ALK 570	57	25.03.22	18_1	MUC_9	17	19	1	1	1
ALK 570	58	25.03.22	18_1	MUC_9	19	21	1	1	1
ALK 570	59	25.03.22	18_1	MUC_9	21	23	1	1	1
ALK 570	60	25.03.22	18_1	MUC_9	23	25	1	1	1
ALK 570	61	25.03.22	18_1	MUC_9	25	27	1	1	1
ALK 570	62	25.03.22	18_1	MUC_9	27	29.5	1	1	1
ALK 570	63	25.03.22	5,19	BIGO_I_1_Ch1	0	1	1	1	1
ALK 570	64	25.03.22	5,19	BIGO_I_1_Ch1	1	2	1	1	1
ALK 570	65	25.03.22	5,19	BIGO_I_1_Ch1	2	3	1	1	1
ALK 570	66	25.03.22	5,19	BIGO_I_1_Ch1	3	4	1	1	1
ALK 570	67	25.03.22	5,19	BIGO_I_1_Ch1	4	5	1	1	1
ALK 570	68	25.03.22	5,19	BIGO_I_1_Ch1	5	7	1	1	1
ALK 570	69	25.03.22	5,19	BIGO_I_1_Ch1	7	9	1	1	1
ALK 570	70	25.03.22	5,19	BIGO_I_1_Ch1	9	11	1	1	1
ALK 570	71	25.03.22	5,19	BIGO_I_1_Ch1	11	13	1	*	1
ALK 570	72	25.03.22	5,19	BIGO_I_1_Ch1	13	15	1	1	1
ALK 570	73	25.03.22	5,19	BIGO_I_1_Ch2	0	1	1	1	1
ALK 570	74	25.03.22	5,19	BIGO_I_1_Ch2	1	2	1	1	1
ALK 570	75	25.03.22	5,19	BIGO_I_1_Ch2	2	3	1	1	1
ALK 570	76	25.03.22	5,19	BIGO_I_1_Ch2	3	4	1	1	1
ALK 570	77	25.03.22	5,19	BIGO_I_1_Ch2	4	5	1	1	1
ALK 570	78	25.03.22	5,19	BIGO_I_1_Ch2	5	7	1	1	1
ALK 570	79	25.03.22	5,19	BIGO_I_1_Ch2	7	9	1	1	1
ALK 570	80	25.03.22	5,19	BIGO_I_1_Ch2	9	11	1	1	1
ALK 570	81	25.03.22	5,19	BIGO_I_1_Ch2	11	13	1	1	1
ALK 570	82	25.03.22	5,19	BIGO_I_1_Ch2	13	15	1	1	1
ALK 570	83	25.03.22	5,19	BIGO_I_1_Ch2	15	17	1	1	1
ALK 570	84	26.03.22	24_2	MUC_6	0	1	1	1	1
ALK 570	85	26.03.22	24_2	MUC_6	1	2	1	1	1
ALK 570	86	26.03.22	24_2	MUC_6	2	3	1	1	1
ALK 570	87	26.03.22	24_2	MUC_6	3	4	1	1	1
ALK 570	88	26.03.22	24_2	MUC_6	4	5	1	1	1
ALK 570	89	26.03.22	24_2	MUC_6	5	7	1	1	1
ALK 570	90	26.03.22	24_2	MUC_6	7	9	1	1	1
ALK 570	91	26.03.22	24_2	MUC_6	9	11	1	1	1

Table: S1 continued (page 3 from 8)

SampleNr.		Infos			Depth [cm]		Existing Sample? (Y/N)		
		DATE	STATION	MUC / BIGO	from	to	F. Drying	ZnOAc	Poros.
ALK 570	92	26.03.22	24_2	MUC_6	11	13	1	1	1
ALK 570	93	26.03.22	24_2	MUC_6	13	15	1	1	1
ALK 570	94	26.03.22	24_2	MUC_6	15	17	1	1	1
ALK 570	95	26.03.22	24_2	MUC_6	17	19	1	1	1
ALK 570	96	26.03.22	24_2	MUC_6	19	21	1	1	1
ALK 570	97	26.03.22	24_2	MUC_6	21	23	1	1	1
ALK 570	98	26.03.22	24_2	MUC_6	23	25	1	1	1
ALK 570	99	26.03.22	24_2	MUC_6	25	27	1	1	1
ALK 570	100	26.03.22	24_2	MUC_6	27	30	1	1	1
ALK 570	101	27.03.22	33_1	MUC_8	0	1	1	1	1
ALK 570	102	27.03.22	33_1	MUC_8	1	2	1	1	1
ALK 570	103	27.03.22	33_1	MUC_8	2	3	1	1	1
ALK 570	104	27.03.22	33_1	MUC_8	3	4	1	1	1
ALK 570	105	27.03.22	33_1	MUC_8	4	5	1	1	1
ALK 570	106	27.03.22	33_1	MUC_8	5	7	1	1	1
ALK 570	107	27.03.22	33_1	MUC_8	7	9	1	1	1
ALK 570	108	27.03.22	33_1	MUC_8	9	11	1	1	1
ALK 570	109	27.03.22	33_1	MUC_8	11	13	1	1	1
ALK 570	110	27.03.22	33_1	MUC_8	13	15	1	1	1
ALK 570	111	27.03.22	33_1	MUC_8	15	17	1	1	1
ALK 570	112	27.03.22	33_1	MUC_8	17	19	1	1	1
ALK 570	113	27.03.22	33_1	MUC_8	19	21	1	1	1
ALK 570	114	27.03.22	33_1	MUC_8	21	23	1	1	1
ALK 570	115	27.03.22	33_1	MUC_8	23	25	1	1	1
ALK 570	116	27.03.22	33_1	MUC_8	25	27	1	1	1
ALK 570	117	27.03.22	33_1	MUC_8	27	29	1	1	1
ALK 570	118	27.03.22	33_1	MUC_8	29	31	1	1	1
ALK 570	119	27.03.22	21, 34	BIGO_I_02_Ch2	0	1	1	1	1
ALK 570	120	27.03.22	21, 34	BIGO_I_02_Ch2	1	2	1	1	1
ALK 570	121	27.03.22	21, 34	BIGO_I_02_Ch2	2	3	1	1	1
ALK 570	122	27.03.22	21, 34	BIGO_I_02_Ch2	3	4	1	1	1
ALK 570	123	27.03.22	21, 34	BIGO_I_02_Ch2	4	5	1	1	1
ALK 570	124	27.03.22	21, 34	BIGO_I_02_Ch2	5	7	1	1	1
ALK 570	125	27.03.22	21, 34	BIGO_I_02_Ch2	7	9	1	1	1
ALK 570	126	27.03.22	21, 34	BIGO_I_02_Ch2	9	11	1	1	1
ALK 570	127	27.03.22	21, 34	BIGO_I_02_Ch2	11	13	1	1	1
ALK 570	128	27.03.22	21, 34	BIGO_I_02_Ch1	0	1	1	1	1
ALK 570	129	27.03.22	21, 34	BIGO_I_02_Ch1	1	2	1	1	1
ALK 570	130	27.03.22	21, 34	BIGO_I_02_Ch1	2	3	1	1	1
ALK 570	131	27.03.22	21, 34	BIGO_I_02_Ch1	3	4	1	1	1
ALK 570	132	27.03.22	21, 34	BIGO_I_02_Ch1	4	5	1	1	1
ALK 570	133	27.03.22	21, 34	BIGO_I_02_Ch1	5	7	1	1	1
ALK 570	134	27.03.22	21, 34	BIGO_I_02_Ch1	7	9	1	1	1
ALK 570	135	27.03.22	21, 34	BIGO_I_02_Ch1	9	11	1	1	1
ALK 570	136	27.03.22	21, 34	BIGO_I_02_Ch1	11	13	1	1	1
ALK 570	137	27.03.22	21, 34	BIGO_I_02_Ch1	13	15	1	1	1

Table: S1 continued (page 4 from 8)

SampleNr.		Infos			Depth [cm]		Existing Sample? (Y/N)		
		DATE	STATION	MUC / BIGO	from	to	F. Drying	ZnOAc	Poros.
ALK 570	138	27.03.22	21, 34	BIGO_I_02_Ch1	15	17	1	1	1
ALK 570	139	28.03.22	41_1	MUC_9	0	1	1	1	1
ALK 570	140	28.03.22	41_1	MUC_9	1	2	1	1	1
ALK 570	141	28.03.22	41_1	MUC_9	2	3	1	1	1
ALK 570	142	28.03.22	41_1	MUC_9	3	4	1	1	1
ALK 570	143	28.03.22	41_1	MUC_9	4	5	1	1	1
ALK 570	144	28.03.22	41_1	MUC_9	5	7	1	1	1
ALK 570	145	28.03.22	41_1	MUC_9	7	9	1	1	1
ALK 570	146	28.03.22	41_1	MUC_9	9	11	1	1	1
ALK 570	147	28.03.22	41_1	MUC_9	11	13	1	1	1
ALK 570	148	28.03.22	41_1	MUC_9	13	15	1	1	1
ALK 570	149	28.03.22	41_1	MUC_9	15	17	1	1	1
ALK 570	150	28.03.22	41_1	MUC_9	17	19	1	1	1
ALK 570	151	28.03.22	41_1	MUC_9	19	21	1	1	1
ALK 570	152	28.03.22	41_1	MUC_9	21	23	1	1	1
ALK 570	153	28.03.22	41_1	MUC_9	23	25	1	1	1
ALK 570	154	28.03.22	41_1	MUC_9	25	27	1	1	1
ALK 570	155	28.03.22	41_1	MUC_9	27	29	1	1	1
ALK 570	156	28.03.22	41_1	MUC_9	29	31	1	1	1
ALK 570	157	28.03.22	41_1	MUC_9	31	33	1	1	1
ALK 570	158	28.03.22	41_1	MUC_9	33	35	1	1	1
ALK 570	159	28.03.22	41_1	MUC_9	35	37	1	1	1
ALK 570	160	28.03.22	31, 40	BIGO_II_02_Ch1	0	1	1	1	1
ALK 570	161	28.03.22	31, 40	BIGO_II_02_Ch1	1	2	1	1	1
ALK 570	162	28.03.22	31, 40	BIGO_II_02_Ch1	2	3	1	1	1
ALK 570	163	28.03.22	31, 40	BIGO_II_02_Ch1	3	4	1	1	1
ALK 570	164	28.03.22	31, 40	BIGO_II_02_Ch1	4	5	1	1	1
ALK 570	165	28.03.22	31, 40	BIGO_II_02_Ch1	5	7	1	1	1
ALK 570	166	28.03.22	31, 40	BIGO_II_02_Ch1	7	9	1	1	1
ALK 570	167	28.03.22	31, 40	BIGO_II_02_Ch1	9	11	1	1	1
ALK 570	168	28.03.22	31, 40	BIGO_II_02_Ch1	11	13	1	1	1
ALK 570	169	28.03.22	31, 40	BIGO_II_02_Ch1	13	15	1	1	1
ALK 570	170	28.03.22	31, 40	BIGO_II_02_Ch1	15	17	1	1	1
ALK 570	171	28.03.22	31, 40	BIGO_II_02_Ch2	0	1	1	1	1
ALK 570	172	28.03.22	31, 40	BIGO_II_02_Ch2	1	2	1	1	1
ALK 570	173	28.03.22	31, 40	BIGO_II_02_Ch2	2	3	1	1	1
ALK 570	174	28.03.22	31, 40	BIGO_II_02_Ch2	3	4	1	1	1
ALK 570	175	28.03.22	31, 40	BIGO_II_02_Ch2	4	5	1	1	1
ALK 570	176	28.03.22	31, 40	BIGO_II_02_Ch2	5	7	1	1	1
ALK 570	177	28.03.22	31, 40	BIGO_II_02_Ch2	7	9	1	1	1
ALK 570	178	28.03.22	31, 40	BIGO_II_02_Ch2	9	11	1	1	1
ALK 570	179	28.03.22	31, 40	BIGO_II_02_Ch2	11	13	1	1	1
ALK 570	180	28.03.22	31, 40	BIGO_II_02_Ch2	13	15	1	1	1
ALK 570	181	28.03.22	31, 40	BIGO_II_02_Ch2	15	17	1	1	1
ALK 570	182	28.03.22	31, 40	BIGO_II_02_Ch2	17	18.5	1	1	1
ALK 570	183	29.03.22	44_1	MUC_10	0	1	1	1	1

Table: S1 continued (page 5 from 8)

SampleNr.		Infos			Depth [cm]		Existing Sample? (Y/N)		
		DATE	STATION	MUC / BIGO	from	to	F. Drying	ZnOAc	Poros.
ALK 570	184	29.03.22	44_1	MUC_10	1	2	1	1	1
ALK 570	185	29.03.22	44_1	MUC_10	2	3	1	1	1
ALK 570	186	29.03.22	44_1	MUC_10	3	4	1	1	1
ALK 570	187	29.03.22	44_1	MUC_10	4	5	1	1	1
ALK 570	188	29.03.22	44_1	MUC_10	5	7	1	1	1
ALK 570	189	29.03.22	44_1	MUC_10	7	9	1	1	1
ALK 570	190	29.03.22	44_1	MUC_10	9	11	1	1	1
ALK 570	191	29.03.22	44_1	MUC_10	11	13	1	1	1
ALK 570	192	29.03.22	44_1	MUC_10	13	15	1	1	1
ALK 570	193	29.03.22	44_1	MUC_10	15	17	1	1	1
ALK 570	194	29.03.22	44_1	MUC_10	17	19	1	1	1
ALK 570	195	29.03.22	44_1	MUC_10	19	21	1	1	1
ALK 570	196	29.03.22	44_1	MUC_10	21	23.5	1	1	1
ALK 570	197	30.03.22	53_3	MUC_10	0	1	1	1	1
ALK 570	198	30.03.22	53_3	MUC_10	1	2	1	1	1
ALK 570	199	30.03.22	53_3	MUC_10	2	3	1	1	1
ALK 570	200	30.03.22	53_3	MUC_10	3	4	1	1	1
ALK 570	201	30.03.22	53_3	MUC_10	4	5	1	1	1
ALK 570	202	30.03.22	53_3	MUC_10	5	7	1	1	1
ALK 570	203	30.03.22	53_3	MUC_10	7	9	1	1	1
ALK 570	204	30.03.22	53_3	MUC_10	9	11	1	1	1
ALK 570	205	30.03.22	53_3	MUC_10	11	13	1	1	1
ALK 570	206	30.03.22	53_3	MUC_10	13	15	1	1	1
ALK 570	207	30.03.22	53_3	MUC_10	15	17	1	1	1
ALK 570	208	30.03.22	53_3	MUC_10	17	19	1	1	1
ALK 570	209	30.03.22	53_3	MUC_10	19	21	1	1	1
ALK 570	210	30.03.22	53_3	MUC_10	21	23	1	1	1
ALK 570	211	30.03.22	57_1	MUC_9	0	1	1	1	1
ALK 570	212	30.03.22	57_1	MUC_9	1	2	1	1	1
ALK 570	213	30.03.22	57_1	MUC_9	2	3	1	1	1
ALK 570	214	30.03.22	57_1	MUC_9	3	4	1	1	1
ALK 570	215	30.03.22	57_1	MUC_9	4	5	1	1	1
ALK 570	216	30.03.22	57_1	MUC_9	5	7	1	1	1
ALK 570	217	30.03.22	57_1	MUC_9	7	9	1	1	1
ALK 570	218	30.03.22	57_1	MUC_9	9	11	1	1	1
ALK 570	219	31.03.22	62_4	MUC_11	0	1	1	1	1
ALK 570	220	31.03.22	62_4	MUC_11	1	2	1	1	1
ALK 570	221	31.03.22	62_4	MUC_11	2	3	1	1	1
ALK 570	222	31.03.22	62_4	MUC_11	3	4	1	1	1
ALK 570	223	31.03.22	62_4	MUC_11	4	5	1	1	1
ALK 570	224	31.03.22	62_4	MUC_11	5	7	1	1	1
ALK 570	225	31.03.22	62_4	MUC_11	7	9	1	1	1
ALK 570	226	31.03.22	62_4	MUC_11	9	11	1	1	1
ALK 570	227	31.03.22	62_4	MUC_11	11	13	1	1	0
ALK 570	228	31.03.22	62_4	MUC_11	13	15	1	1	1
ALK 570	229	31.03.22	62_4	MUC_11	15	17	1	1	1

Table: S1 continued (page 6 from 8)

SampleNr.		Infos			Depth [cm]		Existing Sample? (Y/N)		
		DATE	STATION	MUC / BIGO	from	to	F. Drying	ZnOAc	Poros.
ALK 570	230	31.03.22	62_4	MUC_11	17	19	1	1	1
ALK 570	231	31.03.22	62_4	MUC_11	19	21	1	1	0
ALK 570	232	31.03.22	62_4	MUC_11	21	23	1	1	1
ALK 570	233	31.03.22	66_1	MUC_12	0	1	1	1	1
ALK 570	234	31.03.22	66_1	MUC_12	1	2	1	1	1
ALK 570	235	31.03.22	66_1	MUC_12	2	3	1	1	1
ALK 570	236	31.03.22	66_1	MUC_12	3	4	1	1	1
ALK 570	237	31.03.22	66_1	MUC_12	4	5	1	1	1
ALK 570	238	31.03.22	66_1	MUC_12	5	7	1	1	1
ALK 570	239	31.03.22	66_1	MUC_12	7	9	1	1	1
ALK 570	240	31.03.22	66_1	MUC_12	9	11	1	1	1
ALK 570	241	31.03.22	66_1	MUC_12	11	13	1	1	1
ALK 570	242	03.04.22	71_1	MUC_6	0	1	1	1	1
ALK 570	243	03.04.22	71_1	MUC_6	1	2	1	1	1
ALK 570	244	03.04.22	71_1	MUC_6	2	3	1	1	1
ALK 570	245	03.04.22	71_1	MUC_6	3	4	1	1	1
ALK 570	246	03.04.22	71_1	MUC_6	4	5	1	1	1
ALK 570	247	03.04.22	71_1	MUC_6	5	7	1	1	1
ALK 570	248	03.04.22	71_1	MUC_6	7	9	1	1	1
ALK 570	249	03.04.22	71_1	MUC_6	9	11	1	1	1
ALK 570	250	03.04.22	71_1	MUC_6	11	13	1	1	1
ALK 570	251	03.04.22	71_1	MUC_6	13	15	1	1	1
ALK 570	252	03.04.22	71_1	MUC_6	15	17	1	1	1
ALK 570	253	03.04.22	71_1	MUC_6	17	19	1	1	1
ALK 570	254	03.04.22	71_1	MUC_6	19	21	1	1	1
ALK 570	255	03.04.22	71_1	MUC_6	21	23	1	1	1
ALK 570	256	03.04.22	71_1	MUC_6	23	25	1	1	1
ALK 570	257	03.04.22	71_1	MUC_6	25	27	1	1	1
ALK 570	258	03.04.22	71_1	MUC_6	27	29	1	1	1
ALK 570	259	03.04.22	71_1	MUC_6	29	31	1	1	1
ALK 570	260	03.04.22	71_1	MUC_6	31	33	1	1	1
ALK 570	261	03.04.22	71_1	MUC_6	33	35	1	1	1
ALK 570	262	03.04.22	71_1	MUC_6	35	37.5	1	1	1
ALK 570	263	03.04.22	78_1	MUC_12	0	1	1	1	1
ALK 570	264	03.04.22	78_1	MUC_12	1	2	1	1	1
ALK 570	265	03.04.22	78_1	MUC_12	2	3	1	1	1
ALK 570	266	03.04.22	78_1	MUC_12	3	4	1	1	1
ALK 570	267	03.04.22	78_1	MUC_12	4	5	1	1	1
ALK 570	268	03.04.22	78_1	MUC_12	5	7	1	1	1
ALK 570	269	03.04.22	78_1	MUC_12	7	9	1	1	1
ALK 570	270	03.04.22	78_1	MUC_12	9	11	1	1	1
ALK 570	271	03.04.22	78_1	MUC_12	11	13	1	1	1
ALK 570	272	03.04.22	78_1	MUC_12	13	15	1	1	1
ALK 570	273	03.04.22	78_1	MUC_12	15	17	1	1	1
ALK 570	274	03.04.22	78_1	MUC_12	17	19	1	1	1
ALK 570	275	03.04.22	78_1	MUC_12	19	21	1	1	1

Table: S1 continued (page 7 from 8)

SampleNr.		Infos			Depth [cm]		Existing Sample? (Y/N)		
		DATE	STATION	MUC / BIGO	from	to	F. Drying	ZnOAc	Poros.
ALK 570	276	03.04.22	78_1	MUC_12	21	23	1	1	1
ALK 570	277	03.04.22	78_1	MUC_12	23	25	1	1	1
ALK 570	278	03.04.22	78_1	MUC_12	25	27	1	1	1
ALK 570	279	03.04.22	78_1	MUC_12	27	29	1	1	1
ALK 570	280	03.04.22	78_1	MUC_12	29	31	1	1	1
ALK 570	281	03.04.22	78_1	MUC_12	31	33	1	1	1
ALK 570	282	03.04.22	78_1	MUC_12	33	35	1	1	1
ALK 570	283	03.04.22	78_1	MUC_12	35	37	1	1	1
ALK 570	284	05.04.22	80_1	MUC_4	0	1	1	1	1
ALK 570	285	05.04.22	80_1	MUC_4	1	2	1	1	1
ALK 570	286	05.04.22	80_1	MUC_4	2	3	1	1	1
ALK 570	287	05.04.22	80_1	MUC_4	3	4	1	1	1
ALK 570	288	05.04.22	80_1	MUC_4	4	5	1	1	1
ALK 570	289	05.04.22	80_1	MUC_4	5	7	1	1	1
ALK 570	290	05.04.22	80_1	MUC_4	7	9	1	1	1
ALK 570	291	05.04.22	80_1	MUC_4	9	11	1	1	1
ALK 570	292	05.04.22	80_1	MUC_4	11	13	1	1	1
ALK 570	293	05.04.22	80_1	MUC_4	13	15	1	1	1
ALK 570	294	05.04.22	80_1	MUC_4	15	17	1	1	1
ALK 570	295	05.04.22	80_1	MUC_4	17	19	1	1	1
ALK 570	296	05.04.22	80_1	MUC_4	19	21	1	1	1
ALK 570	297	05.04.22	80_1	MUC_4	21	23	1	1	1
ALK 570	298	05.04.22	80_1	MUC_4	23	25	1	1	1
ALK 570	299	05.04.22	83_1	MUC_10	0	1	1	1	1
ALK 570	300	05.04.22	83_1	MUC_10	1	2	1	1	1
ALK 570	301	05.04.22	83_1	MUC_10	2	3	1	1	1
ALK 570	302	05.04.22	83_1	MUC_10	3	4	1	1	1
ALK 570	303	05.04.22	83_1	MUC_10	4	5	1	1	1
ALK 570	304	05.04.22	83_1	MUC_10	5	7	1	1	1
ALK 570	305	05.04.22	83_1	MUC_10	7	9	1	1	1
ALK 570	306	05.04.22	83_1	MUC_10	9	11	1	1	1
ALK 570	307	05.04.22	83_1	MUC_10	11	13	1	1	1
ALK 570	308	05.04.22	83_1	MUC_10	13	15	1	1	1
ALK 570	309	05.04.22	83_1	MUC_10	15	17	1	1	1
ALK 570	310	05.04.22	83_1	MUC_10	17	19	1	1	1
ALK 570	311	05.04.22	83_1	MUC_10	19	21	1	1	1
ALK 570	312	05.04.22	83_1	MUC_10	21	23	1	1	1
ALK 570	313	06.04.22	81,91	BIGO_II_04_Ch1	0	1	1	1	1
ALK 570	314	06.04.22	81,91	BIGO_II_04_Ch1	1	2	1	1	1
ALK 570	315	06.04.22	81,91	BIGO_II_04_Ch1	2	3	1	1	1
ALK 570	316	06.04.22	81,91	BIGO_II_04_Ch1	3	4	1	1	1
ALK 570	317	06.04.22	81,91	BIGO_II_04_Ch1	4	5	1	1	1
ALK 570	318	06.04.22	81,91	BIGO_II_04_Ch1	5	7	1	1	1
ALK 570	319	06.04.22	81,91	BIGO_II_04_Ch1	7	9	1	1	1
ALK 570	320	06.04.22	81,91	BIGO_II_04_Ch1	9	11	1	1	1
ALK 570	321	06.04.22	81,91	BIGO_II_04_Ch1	11	13	1	1	1

Table: S1 continued (page 8 from 8)

SampleNr.		Infos			Depth [cm]		Existing Sample? (Y/N)		
		DATE	STATION	MUC / BIGO	from	to	F. Drying	ZnOAc	Poros.
ALK 570	322	06.04.22	81,91	BIGO_II_04_Ch1	13	15	1	1	1
ALK 570	323	07.04.22	93_1	MUC_8	0	1	1	1	1
ALK 570	324	07.04.22	93_1	MUC_8	1	2	1	1	1
ALK 570	325	07.04.22	93_1	MUC_8	2	3	1	1	1
ALK 570	326	07.04.22	93_1	MUC_8	3	4	1	1	1
ALK 570	327	07.04.22	93_1	MUC_8	4	5	1	1	1
ALK 570	328	07.04.22	93_1	MUC_8	5	7	1	1	1
ALK 570	329	07.04.22	93_1	MUC_8	7	9	1	1	1
ALK 570	330	07.04.22	93_1	MUC_8	9	11	1	1	1
ALK 570	331	07.04.22	93_1	MUC_8	11	13	1	1	1
ALK 570	332	07.04.22	93_1	MUC_8	13	15	1	1	1
ALK 570	333	07.04.22	93_1	MUC_8	15	17	1	1	1
ALK 570	334	07.04.22	93_1	MUC_8	17	19	1	1	1
ALK 570	335	07.04.22	93_1	MUC_8	19	21	1	1	1
ALK 570	336	07.04.22	93_1	MUC_8	21	23	1	1	1
ALK 570	337	07.04.22	93_1	MUC_8	23	25	1	1	1
ALK 570	338	07.04.22	93_1	MUC_8	25	27	1	1	1
ALK 570	339	07.04.22	93_1	MUC_8	27	29	1	1	1
ALK 570	340	07.04.22	93_1	MUC_8	29	31	1	1	1
ALK 570	341	07.04.22	93_1	MUC_8	31	33	1	1	1

Table: S2 (page 1 from 8)

ALK570_POREWATERS_Biogeochemistry

SampleNr.		Infos			Depth [cm]		Sampled? (Y/N)					
		DATE	STATION	Gear/Cast nr.	from	to	Met.	DIC	Sulf.	Nut.	T.A.	DOC
ALK 570	1	23.03.22	4_1	MUC_4	0	1	1	1	1	1	1	1
ALK 570	2	23.03.22	4_1	MUC_4	1	2	1	1	1	1	1	0
ALK 570	3	23.03.22	4_1	MUC_4	2	3	1	1	1	1	1	0
ALK 570	4	23.03.22	4_1	MUC_4	3	4	1	1	1	1	1	0
ALK 570	5	23.03.22	4_1	MUC_4	4	5	1	1	1	1	1	0
ALK 570	6	23.03.22	4_1	MUC_4	5	6	1	1	1	1	1	0
ALK 570	7	23.03.22	4_1	MUC_4	6	7	1	1	1	1	1	0
ALK 570	8	23.03.22	4_1	MUC_4	8	9	1	1	1	1	1	0
ALK 570	9	23.03.22	4_1	MUC_4	10	11	1	1	1	1	1	0
ALK 570	10	23.03.22	4_1	MUC_4	12	13	1	1	1	1	1	1
ALK 570	11	23.03.22	4_1	MUC_4	14	15	1	1	1	1	1	0
ALK 570	12	23.03.22	4_1	MUC_4	19	20	1	1	1	1	1	0
ALK 570	13	23.03.22	4_1	MUC_4	25	26	1	1	1	1	0	0
ALK 570	14	23.03.22	4_1	MUC_4	30	31	1	1	1	1	1	1
ALK 570	15	24.03.22	11_1	MUC_1	0	1	1	1	1	1	1	0
ALK 570	16	24.03.22	11_1	MUC_1	1	2	1	1	1	1	1	1
ALK 570	17	24.03.22	11_1	MUC_1	2	3	1	1	1	1	*	0
ALK 570	18	24.03.22	11_1	MUC_1	4	5	1	1	1	1	1	0
ALK 570	19	24.03.22	11_1	MUC_1	5	6	1	1	1	1	1	0
ALK 570	20	24.03.22	11_1	MUC_1	6	7	1	1	1	1	1	0
ALK 570	21	24.03.22	11_1	MUC_1	8	9	1	1	1	1	1	0
ALK 570	22	24.03.22	11_1	MUC_1	10	11	1	1	1	1	*	0
ALK 570	23	24.03.22	11_1	MUC_1	12	13	1	1	1	1	1	0
ALK 570	24	24.03.22	11_1	MUC_1	14	15	1	1	1	1	1	0
ALK 570	25	24.03.22	11_1	MUC_1	20	21	1	1	1	1	*	1
ALK 570	26	24.03.22	11_1	MUC_1	26	27	1	1	1	1	1	1
ALK 570	27	25.03.22	18_1	MUC_10	0	1	1	1	1	1	1	1
ALK 570	28	25.03.22	18_1	MUC_10	1	2	1	1	1	1	1	0
ALK 570	29	25.03.22	18_1	MUC_10	2	3	1	1	1	1	1	0
ALK 570	30	25.03.22	18_1	MUC_10	3	4	1	1	1	1	1	0
ALK 570	31	25.03.22	18_1	MUC_10	4	5	1	1	1	1	1	0
ALK 570	32	25.03.22	18_1	MUC_10	6	7	1	1	1	1	1	0
ALK 570	33	25.03.22	18_1	MUC_10	8	9	1	1	1	1	1	0
ALK 570	34	25.03.22	18_1	MUC_10	10	11	1	1	1	1	1	1
ALK 570	35	25.03.22	18_1	MUC_10	12	13	1	1	1	1	1	0
ALK 570	36	25.03.22	18_1	MUC_10	14	15	1	1	1	1	1	0
ALK 570	37	25.03.22	18_1	MUC_10	20	21	1	1	1	1	1	0
ALK 570	38	25.03.22	18_1	MUC_10	24	25	1	1	1	1	1	0
ALK 570	39	25.03.22	18_1	MUC_10	30	31	1	1	1	1	1	1
ALK 570	40	25.03.22	5,19	BIGO_I_1_Ch2	0	1	1	1	1	1	1	1
ALK 570	41	25.03.22	5,19	BIGO_I_1_Ch2	1	2	1	1	1	1	1	0
ALK 570	42	25.03.22	5,19	BIGO_I_1_Ch2	2	3	1	1	1	1	1	0
ALK 570	43	25.03.22	5,19	BIGO_I_1_Ch2	3	4	1	1	1	1	1	0
ALK 570	44	25.03.22	5,19	BIGO_I_1_Ch2	4	5	1	1	1	1	1	0
ALK 570	45	25.03.22	5,19	BIGO_I_1_Ch2	6	7	1	1	1	1	*	0

Table: S2 (page 2 from 8)

SampleNr.		Infos			Depth [cm]		Sampled? (Y/N)					
		DATE	STATION	Gear/Cast nr.	from	to	Met.	DIC	Sulf.	Nut.	T.A.	DOC
ALK 570	46	25.03.22	5,19	BIGO_I_1_Ch2	8	9	1	1	1	1	1	0
ALK 570	47	25.03.22	5,19	BIGO_I_1_Ch2	10	11	1	1	1	1	1	1
ALK 570	48	25.03.22	5,19	BIGO_I_1_Ch2	12	13	1	1	1	1	1	0
ALK 570	49	25.03.22	5,19	BIGO_I_1_Ch2	14	15	1	1	1	1	1	0
ALK 570	50	25.03.22	5,19	BIGO_I_1_Ch1	0	1	1	1	1	1	1	1
ALK 570	51	25.03.22	5,19	BIGO_I_1_Ch1	1	2	1	1	1	1	1	0
ALK 570	52	25.03.22	5,19	BIGO_I_1_Ch1	2	3	1	1	1	1	1	0
ALK 570	53	25.03.22	5,19	BIGO_I_1_Ch1	3	4	1	1	1	1	1	0
ALK 570	54	25.03.22	5,19	BIGO_I_1_Ch1	4	5	1	1	1	1	1	0
ALK 570	55	25.03.22	5,19	BIGO_I_1_Ch1	5	6	1	1	1	1	1	0
ALK 570	56	25.03.22	5,19	BIGO_I_1_Ch1	7	8	1	1	1	1	1	1
ALK 570	57	25.03.22	5,19	BIGO_I_1_Ch1	9	10	1	1	1	1	1	0
ALK 570	58	25.03.22	5,19	BIGO_I_1_Ch1	11	12	1	1	1	1	1	0
ALK 570	59	25.03.22	5,19	BIGO_I_1_Ch1	13	14	1	1	1	1	1	0
ALK 570	60	26.03.22	24_2	MUC_7	0	1	1	1	1	1	1	0
ALK 570	61	26.03.22	24_2	MUC_7	1	2	1	1	1	1	1	1
ALK 570	62	26.03.22	24_2	MUC_7	2	3	1	1	1	1	1	0
ALK 570	63	26.03.22	24_2	MUC_7	4	5	1	1	1	1	1	0
ALK 570	64	26.03.22	24_2	MUC_7	5	6	1	1	1	1	1	0
ALK 570	65	26.03.22	24_2	MUC_7	6	7	1	1	1	1	1	0
ALK 570	66	26.03.22	24_2	MUC_7	8	9	1	1	1	1	1	1
ALK 570	67	26.03.22	24_2	MUC_7	10	11	1	1	1	1	1	0
ALK 570	68	26.03.22	24_2	MUC_7	12	13	1	1	1	1	1	0
ALK 570	69	26.03.22	24_2	MUC_7	14	15	1	1	1	1	1	0
ALK 570	70	26.03.22	24_2	MUC_7	20	21	1	1	1	1	1	1
ALK 570	71	26.03.22	24_2	MUC_7	26	27	1	1	1	1	1	0
ALK 570	72	27.03.22	33_1	MUC_10	0	1	1	1	1	1	1	0
ALK 570	73	27.03.22	33_1	MUC_10	1	2	1	1	1	1	1	1
ALK 570	74	27.03.22	33_1	MUC_10	2	3	1	1	1	1	1	0
ALK 570	75	27.03.22	33_1	MUC_10	3	4	1	1	1	1	1	0
ALK 570	76	27.03.22	33_1	MUC_10	4	5	1	1	1	1	1	0
ALK 570	77	27.03.22	33_1	MUC_10	5	6	1	1	1	1	1	0
ALK 570	78	27.03.22	33_1	MUC_10	7	8	1	1	1	1	1	1
ALK 570	79	27.03.22	33_1	MUC_10	9	10	1	1	1	1	1	0
ALK 570	80	27.03.22	33_1	MUC_10	11	12	1	1	1	1	1	0
ALK 570	81	27.03.22	33_1	MUC_10	13	14	1	1	1	1	1	0
ALK 570	82	27.03.22	33_1	MUC_10	15	16	1	1	1	1	1	0
ALK 570	83	27.03.22	33_1	MUC_10	21	22	1	1	1	1	*	0
ALK 570	84	27.03.22	33_1	MUC_10	27	28	1	1	1	1	1	1
ALK 570	85	27.03.22	21, 34	BIGO_I_02_Ch2	0	1	1	1	1	1	1	0
ALK 570	86	27.03.22	21, 34	BIGO_I_02_Ch2	1	2	1	1	1	1	1	0
ALK 570	87	27.03.22	21, 34	BIGO_I_02_Ch2	2	3	1	1	1	1	*	0
ALK 570	88	27.03.22	21, 34	BIGO_I_02_Ch2	3	4	1	1	1	1	1	0
ALK 570	89	27.03.22	21, 34	BIGO_I_02_Ch2	4	5	1	1	1	1	1	0
ALK 570	90	27.03.22	21, 34	BIGO_I_02_Ch2	5	6	1	1	1	1	*	0
ALK 570	91	27.03.22	21, 34	BIGO_I_02_Ch2	7	8	1	1	1	1	1	0

Table: S2 (page 3 from 8)

SampleNr.		Infos			Depth [cm]		Sampled? (Y/N)					
		DATE	STATION	Gear/Cast nr.	from	to	Met.	DIC	Sulf.	Nut.	T.A.	DOC
ALK 570	92	27.03.22	21, 34	BIGO_I_02_Ch2	9	11	1	1	1	1	1	0
ALK 570	93	27.03.22	21, 34	BIGO_I_02_Ch2	11	12	1	1	1	1	1	1
ALK 570	94	27.03.22	21, 34	BIGO_I_02_Ch2	13	14	1	1	1	1	*	0
ALK 570	95	27.03.22	21, 34	BIGO_I_02_Ch1	0	1	1	1	1	1	1	1
ALK 570	96	27.03.22	21, 34	BIGO_I_02_Ch1	1	2	1	1	1	1	1	0
ALK 570	97	27.03.22	21, 34	BIGO_I_02_Ch1	2	3	1	1	1	1	1	0
ALK 570	98	27.03.22	21, 34	BIGO_I_02_Ch1	3	4	1	1	1	1	1	0
ALK 570	99	27.03.22	21, 34	BIGO_I_02_Ch1	4	5	1	1	1	1	1	0
ALK 570	100	27.03.22	21, 34	BIGO_I_02_Ch1	6	7	1	1	1	1	1	0
ALK 570	101	27.03.22	21, 34	BIGO_I_02_Ch1	8	9	1	1	1	1	1	0
ALK 570	102	27.03.22	21, 34	BIGO_I_02_Ch1	10	11	1	1	1	1	1	0
ALK 570	103	27.03.22	21, 34	BIGO_I_02_Ch1	12	13	1	1	1	1	1	1
ALK 570	104	27.03.22	21, 34	BIGO_I_02_Ch1	14	15	1	1	1	1	1	0
ALK 570	105	28.03.22	41-1	MUC 7	0	1	1	1	1	1	1	
ALK 570	106	28.03.22	41-1	MUC 7	1	2	1	1	1	1	*	0
ALK 570	107	28.03.22	41-1	MUC 7	2	3	1	1	1	1	1	0
ALK 570	108	28.03.22	41-1	MUC 7	3	4	1	1	1	1	1	0
ALK 570	109	28.03.22	41-1	MUC 7	4	5	1	1	1	1	1	0
ALK 570	110	28.03.22	41-1	MUC 7	5	6	1	1	1	1	1	0
ALK 570	111	28.03.22	41-1	MUC 7	6	7	1	1	1	1	1	0
ALK 570	112	28.03.22	41-1	MUC 7	8	9	1	1	1	1	1	0
ALK 570	113	28.03.22	41-1	MUC 7	10	11	1	1	1	1	1	1
ALK 570	114	28.03.22	41-1	MUC 7	12	13	1	1	1	1	1	0
ALK 570	115	28.03.22	41-1	MUC 7	14	15	1	1	1	1	1	0
ALK 570	116	28.03.22	41-1	MUC 7	20	21	1	1	1	1	1	
ALK 570	117	28.03.22	41-1	MUC 7	26	27	1	1	1	1	1	0
ALK 570	118	28.03.22	41-1	MUC 7	32	33	1	1	1	1	1	
ALK 570	119	28.03.22	31, 40	BIGO_II_02_Ch2	0	1	1	1	1	1	1	0
ALK 570	120	28.03.22	31, 40	BIGO_II_02_Ch2	1	2	1	1	1	1	1	1
ALK 570	121	28.03.22	31, 40	BIGO_II_02_Ch2	2	3	1	1	1	1	1	1
ALK 570	122	28.03.22	31, 40	BIGO_II_02_Ch2	3	4	1	1	1	1	1	1
ALK 570	123	28.03.22	31, 40	BIGO_II_02_Ch2	4	5	1	1	1	1	1	0
ALK 570	124	28.03.22	31, 40	BIGO_II_02_Ch2	6	7	1	1	1	1	1	0
ALK 570	125	28.03.22	31, 40	BIGO_II_02_Ch2	8	9	1	1	1	1	1	0
ALK 570	126	28.03.22	31, 40	BIGO_II_02_Ch2	10	11	1	1	1	1	1	1
ALK 570	127	28.03.22	31, 40	BIGO_II_02_Ch2	12	13	1	1	1	1	1	0
ALK 570	128	28.03.22	31, 40	BIGO_II_02_Ch2	13	14	1	1	1	1	1	1
ALK 570	129	28.03.22	31, 40	BIGO_II_02_Ch1	0	1	1	1	1	1	1	1
ALK 570	130	28.03.22	31, 40	BIGO_II_02_Ch1	1	2	1	1	1	1	1	0
ALK 570	131	28.03.22	31, 40	BIGO_II_02_Ch1	2	3	1	1	1	1	1	0
ALK 570	132	28.03.22	31, 40	BIGO_II_02_Ch1	3	4	1	1	1	1	1	0
ALK 570	133	28.03.22	31, 40	BIGO_II_02_Ch1	4	5	1	1	1	1	1	0
ALK 570	134	28.03.22	31, 40	BIGO_II_02_Ch1	6	7	1	1	1	1	1	0
ALK 570	135	28.03.22	31, 40	BIGO_II_02_Ch1	8	9	1	1	1	1	1	1
ALK 570	136	28.03.22	31, 40	BIGO_II_02_Ch1	10	11	1	1	1	1	1	0
ALK 570	137	28.03.22	31, 40	BIGO_II_02_Ch1	12	13	1	1	1	1	1	1

Table: S2 (page 4 from 8)

SampleNr.		Infos			Depth [cm]		Sampled? (Y/N)					
		DATE	STATION	Gear/Cast nr.	from	to	Met.	DIC	Sulf.	Nut.	T.A.	DOC
ALK 570	138	29.03.22	44_1	MUC_8	0	1	1	1	1	1	1	1
ALK 570	139	29.03.22	44_1	MUC_8	1	2	1	1	1	1	1	0
ALK 570	140	29.03.22	44_1	MUC_8	2	3	1	1	1	1	1	0
ALK 570	141	29.03.22	44_1	MUC_8	3	4	1	1	1	1	1	0
ALK 570	142	29.03.22	44_1	MUC_8	4	5	1	1	1	1	1	0
ALK 570	143	29.03.22	44_1	MUC_8	6	7	1	1	1	1	1	0
ALK 570	144	29.03.22	44_1	MUC_8	8	9	1	1	1	1	1	0
ALK 570	145	29.03.22	44_1	MUC_8	10	11	1	1	1	1	1	0
ALK 570	146	29.03.22	44_1	MUC_8	12	13	1	1	1	1	1	0
ALK 570	147	29.03.22	44_1	MUC_8	14	15	1	1	1	1	1	0
ALK 570	148	29.03.22	44_1	MUC_8	16	17	1	1	1	1	1	0
ALK 570	149	29.03.22	44_1	MUC_8	18	19	1	1	1	1	1	0
ALK 570	150	29.03.22	44_1	MUC_8	20	21	1	1	1	1	1	1
ALK 570	151	29.03.22	44_1	MUC_9	0	1	1	1	1	1	1	1
ALK 570	152	29.03.22	44_1	MUC_9	1	2	1	1	1	1	1	0
ALK 570	153	29.03.22	44_1	MUC_9	2	3	1	1	1	1	1	0
ALK 570	154	29.03.22	44_1	MUC_9	3	4	1	1	1	1	1	0
ALK 570	155	29.03.22	44_1	MUC_9	4	5	1	1	1	1	1	0
ALK 570	156	29.03.22	44_1	MUC_9	6	7	1	1	1	1	1	0
ALK 570	157	29.03.22	44_1	MUC_9	8	9	1	1	1	1	1	0
ALK 570	158	29.03.22	44_1	MUC_9	10	11	1	1	1	1	1	0
ALK 570	159	29.03.22	44_1	MUC_9	12	13	1	1	1	1	1	0
ALK 570	160	29.03.22	44_1	MUC_9	14	15	1	1	1	1	1	0
ALK 570	161	29.03.22	44_1	MUC_9	16	17	1	1	1	1	1	0
ALK 570	162	29.03.22	44_1	MUC_9	18	19	1	1	1	1	1	1
ALK 570	163	30.03.22	53_3	MUC_8	0	1	1	1	1	0	0	0
ALK 570	164	30.03.22	53_3	MUC_8	1	2	1	1	1	1	1	0
ALK 570	165	30.03.22	53_3	MUC_8	2	3	1	1	1	1	1	0
ALK 570	166	30.03.22	53_3	MUC_8	3	4	1	1	1	1	1	0
ALK 570	167	30.03.22	53_3	MUC_8	4	5	1	1	1	1	1	0
ALK 570	168	30.03.22	53_3	MUC_8	6	7	1	1	1	1	1	0
ALK 570	169	30.03.22	53_3	MUC_8	8	9	1	1	1	0	0	0
ALK 570	170	30.03.22	53_3	MUC_8	10	11	1	1	1	0	0	0
ALK 570	171	30.03.22	53_3	MUC_8	12	13	1	1	1	0	0	0
ALK 570	172	30.03.22	53_3	MUC_8	14	15	1	1	1	0	0	0
ALK 570	173	30.03.22	53_3	MUC_8	16	17	1	1	1	0	0	0
ALK 570	174	30.03.22	53_3	MUC_8	18	19	0	0	0	0	0	0
ALK 570	175	30.03.22	53_3	MUC_8	19	20	1	1	1	1	1	0
ALK 570	176	30.03.22	53_3	MUC_9	0	1	1	1	1	1	1	0
ALK 570	177	30.03.22	53_3	MUC_9	1	2	1	1	1	1	1	0
ALK 570	178	30.03.22	53_3	MUC_9	2	3	1	1	1	1	1	0
ALK 570	179	30.03.22	53_3	MUC_9	3	4	1	1	1	1	1	0
ALK 570	180	30.03.22	53_3	MUC_9	4	5	1	1	1	0	0	0
ALK 570	181	30.03.22	53_3	MUC_9	6	7	1	1	1	1	1	0
ALK 570	182	30.03.22	53_3	MUC_9	8	9	1	1	1	1	1	0
ALK 570	183	30.03.22	53_3	MUC_9	10	11	1	1	1	1	1	0

Table: S2 (page 5 from 8)

SampleNr.		Infos			Depth [cm]		Sampled? (Y/N)					
		DATE	STATION	Gear/Cast nr.	from	to	Met.	DIC	Sulf.	Nut.	T.A.	DOC
ALK 570	184	30.03.22	53_3	MUC_9	12	13	1	1	1	1	1	0
ALK 570	185	30.03.22	53_3	MUC_9	14	15	1	1	1	1	1	0
ALK 570	186	30.03.22	53_3	MUC_9	16	17	1	1	1	1	1	0
ALK 570	187	30.03.22	53_3	MUC_9	18	19	1	1	1	1	1	0
ALK 570	188	30.03.22	57_1	MUC_8	0	1	1	1	1	1	1	?
ALK 570	189	30.03.22	57_1	MUC_8	2	3	1	1	1	1	1	0
ALK 570	190	30.03.22	57_1	MUC_8	3	4	1	1	1	1	1	0
ALK 570	191	30.03.22	57_1	MUC_8	4	5	1	1	1	1	1	0
ALK 570	192	30.03.22	57_1	MUC_8	6	7	1	1	1	1	1	0
ALK 570	193	30.03.22	57_1	MUC_8	7	8	1	1	1	1	1	1
ALK 570	194	31.03.22	62_4	MUC_5	0	1	1	1	1	1	1	0
ALK 570	195	31.03.22	62_4	MUC_5	1	2	1	1	1	1	1	0
ALK 570	196	31.03.22	62_4	MUC_5	2	3	1	1	1	1	1	0
ALK 570	197	31.03.22	62_4	MUC_5	3	4	1	1	1	1	1	0
ALK 570	198	31.03.22	62_4	MUC_5	4	5	1	1	1	1	1	1
ALK 570	199	31.03.22	62_4	MUC_5	6	7	1	1	1	1	1	0
ALK 570	200	31.03.22	62_4	MUC_5	8	9	1	1	1	1	1	0
ALK 570	201	31.03.22	62_4	MUC_5	10	11	1	1	1	1	1	0
ALK 570	202	31.03.22	62_4	MUC_5	12	13	1	1	1	1	1	0
ALK 570	203	31.03.22	62_4	MUC_5	14	15	1	1	1	1	1	1
ALK 570	204	31.03.22	62_4	MUC_5	16	17	1	1	1	1	1	0
ALK 570	205	31.03.22	62_4	MUC_5	18	19	1	1	1	1	1	0
ALK 570	206	31.03.22	62_4	MUC_5	20	21	1	1	1	1	1	0
ALK 570	207	31.03.22	66_1	MUC_6	0	1	1	1	1	1	1	1
ALK 570	208	31.03.22	66_1	MUC_6	1	2	1	1	1	1	1	0
ALK 570	209	31.03.22	66_1	MUC_6	2	3	1	1	1	1	1	0
ALK 570	210	31.03.22	66_1	MUC_6	3	4	1	1	1	1	1	0
ALK 570	211	31.03.22	66_1	MUC_6	4	5	1	1	1	1	1	0
ALK 570	212	31.03.22	66_1	MUC_6	6	7	1	1	1	1	1	0
ALK 570	213	31.03.22	66_1	MUC_6	8	9	1	1	1	1	1	0
ALK 570	214	31.03.22	66_1	MUC_6	10	11	1	1	1	1	1	0
ALK 570	215	31.03.22	66_1	MUC_6	12	13	1	1	1	1	1	0
ALK 570	216	31.03.22	66_1	MUC_6	14	15	1	1	1	1	1	0
ALK 570	217	31.03.22	66_1	MUC_6	16	17	1	1	1	1	1	1
ALK 570	218	03.04.22	75_1	MUC_8	0	1	1	1	1	1	1	1
ALK 570	219	03.04.22	75_1	MUC_8	1	2	1	1	1	1	1	0
ALK 570	220	03.04.22	75_1	MUC_8	2	3	1	1	1	1	1	0
ALK 570	221	03.04.22	75_1	MUC_8	3	4	1	1	1	1	1	0
ALK 570	222	03.04.22	75_1	MUC_8	4	5	1	1	1	1	1	0
ALK 570	223	03.04.22	75_1	MUC_8	6	7	1	1	1	1	1	0
ALK 570	224	03.04.22	75_1	MUC_8	8	9	1	1	1	1	1	0
ALK 570	225	03.04.22	75_1	MUC_8	10	11	1	1	1	1	1	1
ALK 570	226	03.04.22	75_1	MUC_8	12	13	1	1	1	1	1	0
ALK 570	227	03.04.22	75_1	MUC_8	14	15	1	1	1	1	1	0
ALK 570	228	03.04.22	75_1	MUC_8	16	17	1	1	1	1	1	0
ALK 570	229	03.04.22	75_1	MUC_8	18	19	1	1	1	1	1	0

Table: S2 (page 6 from 8)

SampleNr.		Infos			Depth [cm]		Sampled? (Y/N)					
		DATE	STATION	Gear/Cast nr.	from	to	Met.	DIC	Sulf.	Nut.	T.A.	DOC
ALK 570	230	03.04.22	75_1	MUC_8	20	21	1	1	1	1	1	1
ALK 570	231	03.04.22	75_1	MUC_8	24	25	1	1	1	1	1	0
ALK 570	232	03.04.22	75_1	MUC_8	28	29	1	1	1	1	1	0
ALK 570	233	03.04.22	75_1	MUC_8	32	33	1	1	1	1	1	1
ALK 570	234	03.04.22	78_1	MUC_2	0	1	1	1	1	1	1	1
ALK 570	235	03.04.22	78_1	MUC_2	1	2	1	1	1	1	1	0
ALK 570	236	03.04.22	78_1	MUC_2	2	3	1	1	1	1	1	0
ALK 570	237	03.04.22	78_1	MUC_2	3	4	1	1	1	1	1	0
ALK 570	238	03.04.22	78_1	MUC_2	4	5	1	1	1	1	1	0
ALK 570	239	03.04.22	78_1	MUC_2	5	6	1	1	1	1	1	0
ALK 570	240	03.04.22	78_1	MUC_2	7	8	1	1	1	1	1	0
ALK 570	241	03.04.22	78_1	MUC_2	9	11	1	1	1	1	1	0
ALK 570	242	03.04.22	78_1	MUC_2	11	12	1	1	1	1	1	0
ALK 570	243	03.04.22	78_1	MUC_2	13	14	1	1	1	1	1	1
ALK 570	244	03.04.22	78_1	MUC_2	15	16	1	1	1	1	1	0
ALK 570	245	03.04.22	78_1	MUC_2	19	20	1	1	1	1	1	0
ALK 570	246	03.04.22	78_1	MUC_2	23	24	1	1	1	1	1	0
ALK 570	247	03.04.22	78_1	MUC_2	27	28	1	1	1	1	1	0
ALK 570	248	03.04.22	78_1	MUC_2	31	32	1	1	1	1	1	1
ALK 570	249	05.04.22	80_1	MUC_3	0	1	1	1	1	1	1	1
ALK 570	250	05.04.22	80_1	MUC_3	2	3	1	1	1	1	1	0
ALK 570	251	05.04.22	80_1	MUC_3	3	4	1	1	1	1	1	0
ALK 570	252	05.04.22	80_1	MUC_3	4	5	1	1	1	1	1	0
ALK 570	253	05.04.22	80_1	MUC_3	5	6	1	1	1	1	1	0
ALK 570	254	05.04.22	80_1	MUC_3	6	7	1	1	1	1	1	0
ALK 570	255	05.04.22	80_1	MUC_3	8	9	1	1	1	1	1	0
ALK 570	256	05.04.22	80_1	MUC_3	10	11	1	1	1	1	1	1
ALK 570	257	05.04.22	80_1	MUC_3	12	13	1	1	1	1	1	0
ALK 570	258	05.04.22	80_1	MUC_3	14	15	1	1	1	1	1	0
ALK 570	259	05.04.22	80_1	MUC_3	16	17	1	1	1	1	1	0
ALK 570	260	05.04.22	80_1	MUC_3	20	21	1	1	1	1	1	0
ALK 570	261	05.04.22	80_1	MUC_3	24	25	1	1	1	1	1	1
ALK 570	262	05.04.22	83_1	MUC_9	0	1	1	1	1	1	1	?
ALK 570	263	05.04.22	83_1	MUC_9	1	2	1	1	1	1	1	0
ALK 570	264	05.04.22	83_1	MUC_9	2	3	1	1	1	1	1	0
ALK 570	265	05.04.22	83_1	MUC_9	3	4	1	1	1	1	1	?
ALK 570	266	05.04.22	83_1	MUC_9	4	5	1	1	1	1	1	?
ALK 570	267	05.04.22	83_1	MUC_9	6	7	1	1	1	1	1	?
ALK 570	268	05.04.22	83_1	MUC_9	8	9	1	1	1	1	1	?
ALK 570	269	05.04.22	83_1	MUC_9	10	11	1	1	1	1	1	?
ALK 570	270	05.04.22	83_1	MUC_9	12	13	1	0	1	0	0	0
ALK 570	271	05.04.22	83_1	MUC_9	14	15	1	1	1	1	1	0
ALK 570	272	05.04.22	83_1	MUC_9	16	17	1	1	1	1	1	0
ALK 570	273	05.04.22	83_1	MUC_9	20	21	1	1	1	1	1	0
ALK 570	274	05.04.22	83_1	MUC_9	24	25	1	1	1	1	1	1
ALK 570	275	05.04.22	83_1	MUC_8	0	1	1	1	1	1	1	?

Table: S2 (page 7 from 8)

SampleNr.		Infos			Depth [cm]		Sampled? (Y/N)					
		DATE	STATION	Gear/Cast nr.	from	to	Met.	DIC	Sulf.	Nut.	T.A.	DOC
ALK 570	276	05.04.22	83_1	MUC_8	1	2	1	1	1	1	1	0
ALK 570	277	05.04.22	83_1	MUC_8	2	3	1	1	1	1	1	0
ALK 570	278	05.04.22	83_1	MUC_8	3	4	1	1	1	1	1	0
ALK 570	279	05.04.22	83_1	MUC_8	4	5	1	1	1	1	1	0
ALK 570	280	05.04.22	83_1	MUC_8	6	7	1	1	1	1	1	0
ALK 570	281	05.04.22	83_1	MUC_8	8	9	1	1	1	1	1	0
ALK 570	282	05.04.22	83_1	MUC_8	10	11	1	1	1	1	1	?
ALK 570	283	05.04.22	83_1	MUC_8	12	13	1	1	1	1	1	0
ALK 570	284	05.04.22	83_1	MUC_8	14	15	1	1	1	1	1	0
ALK 570	285	05.04.22	83_1	MUC_8	16	17	1	0	0	0	0	0
ALK 570	286	05.04.22	83_1	MUC_8	20	21	1	1	1	0	0	0
ALK 570	287	05.04.22	83_1	MUC_8	24	25	1	1	1	0	0	0
ALK 570	288	05.04.22	83_1	MUC_8	28	29	1	0	0	0	0	0
ALK 570	289	06.04.22	81,91	BIGO_II_04_Ch1	0	1	1	1	1	1	1	1
ALK 570	290	06.04.22	81,91	BIGO_II_04_Ch1	1	2	1	1	1	1	1	0
ALK 570	291	06.04.22	81,91	BIGO_II_04_Ch1	2	3	1	1	1	1	1	0
ALK 570	292	06.04.22	81,91	BIGO_II_04_Ch1	3	4	1	1	1	1	1	0
ALK 570	293	06.04.22	81,91	BIGO_II_04_Ch1	4	5	1	1	1	1	1	0
ALK 570	294	06.04.22	81,91	BIGO_II_04_Ch1	5	6	1	1	1	1	1	0
ALK 570	295	06.04.22	81,91	BIGO_II_04_Ch1	6	7	1	1	1	1	1	0
ALK 570	296	06.04.22	81,91	BIGO_II_04_Ch1	7	8	1	1	1	1	1	0
ALK 570	297	06.04.22	81,91	BIGO_II_04_Ch1	8	9	1	1	1	1	1	0
ALK 570	298	06.04.22	81,91	BIGO_II_04_Ch1	9	10	1	1	1	1	1	0
ALK 570	299	06.04.22	81,91	BIGO_II_04_Ch1	11	12	1	1	1	1	1	0
ALK 570	300	06.04.22	81,91	BIGO_II_04_Ch1	13	14	1	1	1	1	1	1
ALK 570	301	07.04.22	93_1	MUC_3	0	1	1	1	1	1	1	?
ALK 570	302	07.04.22	93_1	MUC_3	1	2	1	1	1	1	1	0
ALK 570	303	07.04.22	93_1	MUC_3	2	3	1	1	1	1	1	0
ALK 570	304	07.04.22	93_1	MUC_3	3	4	1	1	1	1	1	0
ALK 570	305	07.04.22	93_1	MUC_3	4	5	1	1	1	1	1	0
ALK 570	306	07.04.22	93_1	MUC_3	5	6	1	1	1	1	1	0
ALK 570	307	07.04.22	93_1	MUC_3	6	7	1	1	1	1	1	0
ALK 570	308	07.04.22	93_1	MUC_3	8	9	1	1	1	1	1	0
ALK 570	309	07.04.22	93_1	MUC_3	10	11	1	1	1	1	1	0
ALK 570	310	07.04.22	93_1	MUC_3	12	13	1	1	1	1	1	0
ALK 570	311	07.04.22	93_1	MUC_3	14	15	1	1	1	0	0	0
ALK 570	312	07.04.22	93_1	MUC_3	16	17	1	1	1	1	1	0
ALK 570	313	07.04.22	93_1	MUC_3	20	21	1	1	1	1	1	0
ALK 570	314	07.04.22	93_1	MUC_3	24	25	1	1	1	0	0	0
ALK 570	315	07.04.22	93_1	MUC_9	0	1	1	1	1	1	1	1
ALK 570	316	07.04.22	93_1	MUC_9	1	2	1	1	1	1	1	0
ALK 570	317	07.04.22	93_1	MUC_9	2	3	1	1	1	1	1	0
ALK 570	318	07.04.22	93_1	MUC_9	3	4	1	1	1	1	1	0
ALK 570	319	07.04.22	93_1	MUC_9	4	5	1	1	1	1	1	0
ALK 570	320	07.04.22	93_1	MUC_9	5	6	1	1	1	1	1	0
ALK 570	321	07.04.22	93_1	MUC_9	6	7	1	1	1	1	1	0

Table: S2 (page 8 from 8)

SampleNr.		Infos			Depth [cm]		Sampled? (Y/N)					
		DATE	STATION	Gear/Cast nr.	from	to	Met.	DIC	Sulf.	Nut.	T.A.	DOC
ALK 570	322	07.04.22	93_1	MUC_9	8	9	1	1	1	1	1	0
ALK 570	323	07.04.22	93_1	MUC_9	10	11	1	1	1	1	1	1
ALK 570	324	07.04.22	93_1	MUC_9	12	13	1	1	1	0	0	0
ALK 570	325	07.04.22	93_1	MUC_9	14	15	1	1	1	0	0	0
ALK 570	326	07.04.22	93_1	MUC_9	16	17	1	1	1	0	0	0
ALK 570	327	07.04.22	93_1	MUC_9	20	21	1	1	1	0	0	0
ALK 570	328	07.04.22	93_1	MUC_9	24	25	1	1	1	1	1	1
ALK 570	329	07.04.22	93_1	MUC_9	28	29	1	1	1	0	0	0

Table: S3

ALK570_WATERCOLUMN_Biogeochemistry

SampleNr.		cruise and sample info				Water	Existing Sample? (Y/N)						TA in DIC
		DATE	STATION	Gear	nr.	Depth [m]	Met.	DIC	Nut.	T.A. (HCl)	TA (DIC)	DOC	label
ALK570	1	22.03.22	1	CTD#1	2	21	1	1	1	1	1	1	1A-D
ALK570	2	22.03.22	1	CTD#1	5	6	1	1	1	1	1	1	2A-D
ALK570	3	23.03.22	4_1	MUC	4	BW	1	1	1	1	1	1	3A-D
ALK570	4	24.03.22	11_1	MUC	1	BW	1	1	1	1	1	1	4A-D
ALK570	5	24.03.22	13	CTD#2	1	bottom	1	1	1	1	1	1	5A-D
ALK570	6	24.03.22	13	CTD#2	7	4	1	1	1	1	1	1	6A-D
ALK570	7	25.03.22	18_1	MUC	10	BW	1	1	1	1	1	1	7A-D
ALK570	8	25.03.22	5,19	BIGO_I_1_Ch2	Ch2	BW	1	1	0	0	0	1	NA
ALK570	9	25.03.22	5,19	BIGO_I_1_Ch1	Ch1	BW	1	1	1	1	1	1	9A-D
ALK570	10	26.03.22	24_2	MUC	7	BW	1	1	1	1	1	1	10A-D
ALK570	11	26.03.22	27	CTD#3	10	5	1	1	1	1	1	1	11A-D
ALK570	12	26.03.22	27	CTD#3	3	bottom	1	1	1	1	1	1	12A-D
ALK570	13	27.03.22	33_1	MUC	10	BW	1	1	1	1	0	1	NA
ALK570	14	27.03.22	21, 34	BIGO_I_02_Ch1	Ch1	BW	1	1	0	0	0	0	NA
ALK570	15	27.03.22	21, 34	BIGO_I_02_Ch2	Ch2	BW	1	1	1	1	0	1	NA
ALK570	16	28.03.22	41_1	MUC	7	BW	1	1	1	1	0	1	NA
ALK570	17	28.03.22	31, 40	BIGO_II_02_Ch2	Ch2	BW	1	1	1	1	0	1	NA
ALK570	18	28.03.22	31, 40	BIGO_II_02_Ch1	Ch1	BW	1	1	1	1	0	1	NA
ALK570	19	29.03.22	43	CTD#4	11	5	1	1	1	1	0	1	NA
ALK570	20	29.03.22	43	CTD#4	6	bottom	1	1	1	1	0	1	NA
ALK570	21	29.03.22	44_1	MUC	8	8.28	1	1	1	1	0	1	NA
ALK570	22	29.03.22	44_1	MUC	9	8.29	1	1	1	1	0	1	NA
ALK570	23	30.03.22	53_3	MUC	8	BW	1	1	1	1	0	1	NA
ALK570	24	30.03.22	53_3	MUC	9	BW	1	1	1	1	0	1	NA
ALK570	25	30.03.22	57_1	MUC	8	BW	1	1	1	1	0	1	NA
ALK570	26	31.03.22	62_4	MUC	5	BW	1	1	1	1	0	1	NA
ALK570	27	31.03.22	64	CTD#7	5	5	1	1	1	1	0	1	NA
ALK570	28	31.03.22	64	CTD#7	1	bottom	1	1	1	1	0	1	NA
ALK570	29	31.03.22	66_1	MUC	6	BW	1	1	1	1	0	1	NA
ALK570	30	03.04.22	73	CTD#9	9	5	1	1	1	1	0	1	NA
ALK570	31	03.04.22	73	CTD#9	2	BW	1	1	1	1	0	1	NA
ALK570	32	03.04.22	75_1	MUC	8	BW	1	1	1	1	0	1	NA
ALK570	33	03.04.22	75_1	MUC	9	BW	1	1	1	1	0	1	NA
ALK570	34	03.04.22	78_1	MUC	2	BW	1	1	1	1	0	1	NA
ALK570	35	05.04.22	80_1	MUC	3	BW	1	1	1	1	0	1	NA
ALK570	36	05.04.22	82_1	CTD#10	10	5	1	1	1	1	0	1	NA
ALK570	37	05.04.22	82_1	CTD#10	3	bottom	1	1	1	1	0	1	NA
ALK570	38	05.04.22	83_1	MUC	8	BW	1	1	1	1	0	1	NA
ALK570	39	05.04.22	83_1	MUC	9	BW	1	1	1	1	0	1	NA
ALK570	40	06.04.22	81, 91	BIGO_II_04_Ch1	Ch1	BW	1	1	1	1	0	1	NA
ALK570	41	07.04.22	92	CTD#12	5	5	1	1	1	1	0	1	NA
ALK570	42	07.04.22	92	CTD#12	3	bottom	1	1	1	1	0	1	NA
ALK570	43	07.04.22	93_1	MUC	3	BW	1	1	1	1	0	1	NA
ALK570	44	07.04.22	93_1	MUC	9	BW	1	1	1	1	0	1	NA

Table: S4 (page 1 from 7)

ALK570_POREWATERS_Biogeochemistry_DET_Sampling

SampleNr.			Infos			Depth [mm]	
			Slicing_DATE	STATION	Gear/Cast	from	to
ALK 570	DET	1	24.03.22	4_1	MUC3	0	2
ALK 570	DET	2	24.03.22	4_1	MUC3	2	4
ALK 570	DET	3	24.03.22	4_1	MUC3	4	6
ALK 570	DET	4	24.03.22	4_1	MUC3	6	8
ALK 570	DET	5	24.03.22	4_1	MUC3	8	10
ALK 570	DET	6	24.03.22	4_1	MUC3	10	12
ALK 570	DET	7	24.03.22	4_1	MUC3	12	14
ALK 570	DET	8	24.03.22	4_1	MUC3	14	16
ALK 570	DET	9	24.03.22	4_1	MUC3	16	18
ALK 570	DET	10	24.03.22	4_1	MUC3	18	20
ALK 570	DET	11	24.03.22	4_1	MUC3	20	22
ALK 570	DET	12	24.03.22	4_1	MUC3	22	24
ALK 570	DET	13	24.03.22	4_1	MUC3	24	26
ALK 570	DET	14	24.03.22	4_1	MUC3	26	28
ALK 570	DET	15	24.03.22	4_1	MUC3	28	30
ALK 570	DET	16	24.03.22	4_1	MUC3	30	32
ALK 570	DET	17	24.03.22	4_1	MUC3	32	34
ALK 570	DET	18	24.03.22	4_1	MUC3	34	36
ALK 570	DET	19	24.03.22	4_1	MUC3	36	38
ALK 570	DET	20	24.03.22	4_1	MUC3	38	40
ALK 570	DET	21	24.03.22	4_1	MUC3	40	42
ALK 570	DET	22	24.03.22	4_1	MUC3	42	44
ALK 570	DET	23	24.03.22	4_1	MUC3	44	46
ALK 570	DET	24	24.03.22	4_1	MUC3	46	48
ALK 570	DET	25	24.03.22	4_1	MUC3	48	50
ALK 570	DET	26	24.03.22	4_1	MUC3	50	52
ALK 570	DET	27	24.03.22	4_1	MUC3	52	54
ALK 570	DET	28	24.03.22	4_1	MUC3	54	56
ALK 570	DET	29	24.03.22	4_1	MUC3	56	58
ALK 570	DET	30	24.03.22	4_1	MUC3	58	60
ALK 570	DET	31	24.03.22	4_1	MUC3	60	62
ALK 570	DET	32	24.03.22	4_1	MUC3	62	64
ALK 570	DET	33	24.03.22	4_1	MUC3	64	66
ALK 570	DET	34	24.03.22	4_1	MUC3	66	68
ALK 570	DET	35	24.03.22	4_1	MUC3	68	70
ALK 570	DET	36	24.03.22	4_1	MUC3	70	72
ALK 570	DET	37	24.03.22	4_1	MUC3	72	74
ALK 570	DET	38	24.03.22	4_1	MUC3	74	76
ALK 570	DET	39	24.03.22	4_1	MUC3	76	78
ALK 570	DET	40	24.03.22	4_1	MUC3	78	80
ALK 570	DET	41	24.03.22	4_1	MUC3	80	82
ALK 570	DET	42	24.03.22	4_1	MUC3	82	84
ALK 570	DET	43	24.03.22	4_1	MUC3	84	86
ALK 570	DET	44	24.03.22	4_1	MUC3	86	88
ALK 570	DET	45	24.03.22	4_1	MUC3	88	90

Table: S4 (page 2 from 7)

SampleNr.			Infos			Depth [mm]	
			Slicing_DATE	STATION	Gear/Cast	from	to
ALK 570	DET	46	24.03.22	4_1	MUC3	90	92
ALK 570	DET	47	24.03.22	4_1	MUC3	92	94
ALK 570	DET	48	24.03.22	4_1	MUC3	94	96
ALK 570	DET	49	24.03.22	4_1	MUC3	96	98
ALK 570	DET	50	24.03.22	4_1	MUC3	98	100
ALK 570	DET	51	24.03.22	4_1	MUC3	100	102
ALK 570	DET	52	24.03.22	4_1	MUC3	102	104
ALK 570	DET	53	24.03.22	4_1	MUC3	104	106
ALK 570	DET	54	24.03.22	4_1	MUC3	106	108
ALK 570	DET	55	24.03.22	4_1	MUC3	108	110
ALK 570	DET	56	24.03.22	4_1	MUC3	110	112
ALK 570	DET	57	24.03.22	4_1	MUC3	112	114
ALK 570	DET	58	24.03.22	4_1	MUC3	114	116
ALK 570	DET	59	24.03.22	4_1	MUC3	116	118
ALK 570	DET	60	24.03.22	4_1	MUC3	118	120
ALK 570	DET	61	24.03.22	4_1	MUC3	120	122
ALK 570	DET	62	24.03.22	4_1	MUC3	122	124
ALK 570	DET	63	24.03.22	4_1	MUC3	124	126
ALK 570	DET	64	24.03.22	4_1	MUC3	126	128
ALK 570	DET	65	24.03.22	4_1	MUC3	128	130
ALK 570	DET	66	24.03.22	4_1	MUC3	130	132
ALK 570	DET	67	24.03.22	4_1	MUC3	132	134
ALK 570	DET	68	24.03.22	4_1	MUC3	134	136
ALK 570	DET	69	24.03.22	4_1	MUC3	136	138
ALK 570	DET	70	24.03.22	4_1	MUC3	138	140
ALK 570	DET	71	27.03.22	24_2	MUC5	0	2
ALK 570	DET	72	27.03.22	24_2	MUC5	2	4
ALK 570	DET	73	27.03.22	24_2	MUC5	4	6
ALK 570	DET	74	27.03.22	24_2	MUC5	6	8
ALK 570	DET	75	27.03.22	24_2	MUC5	8	10
ALK 570	DET	76	27.03.22	24_2	MUC5	10	12
ALK 570	DET	77	27.03.22	24_2	MUC5	12	14
ALK 570	DET	78	27.03.22	24_2	MUC5	14	16
ALK 570	DET	79	27.03.22	24_2	MUC5	16	18
ALK 570	DET	80	27.03.22	24_2	MUC5	18	20
ALK 570	DET	81	27.03.22	24_2	MUC5	20	22
ALK 570	DET	82	27.03.22	24_2	MUC5	22	24
ALK 570	DET	83	27.03.22	24_2	MUC5	24	26
ALK 570	DET	84	27.03.22	24_2	MUC5	26	28
ALK 570	DET	85	27.03.22	24_2	MUC5	28	30
ALK 570	DET	86	27.03.22	24_2	MUC5	30	32
ALK 570	DET	87	27.03.22	24_2	MUC5	32	34
ALK 570	DET	88	27.03.22	24_2	MUC5	34	36
ALK 570	DET	89	27.03.22	24_2	MUC5	36	38
ALK 570	DET	90	27.03.22	24_2	MUC5	38	40
ALK 570	DET	91	27.03.22	24_2	MUC5	40	42

Table: S4 (page 3 from 7)

SampleNr.			Infos			Depth [mm]	
			Slicing_DATE	STATION	Gear/Cast	from	to
ALK 570	DET	92	27.03.22	24_2	MUC5	42	44
ALK 570	DET	93	27.03.22	24_2	MUC5	44	46
ALK 570	DET	94	27.03.22	24_2	MUC5	46	48
ALK 570	DET	95	27.03.22	24_2	MUC5	48	50
ALK 570	DET	96	27.03.22	24_2	MUC5	50	52
ALK 570	DET	97	27.03.22	24_2	MUC5	52	54
ALK 570	DET	98	27.03.22	24_2	MUC5	54	56
ALK 570	DET	99	27.03.22	24_2	MUC5	56	58
ALK 570	DET	100	27.03.22	24_2	MUC5	58	60
ALK 570	DET	101	27.03.22	24_2	MUC5	60	62
ALK 570	DET	102	27.03.22	24_2	MUC5	62	64
ALK 570	DET	103	27.03.22	24_2	MUC5	64	66
ALK 570	DET	104	27.03.22	24_2	MUC5	66	68
ALK 570	DET	105	27.03.22	24_2	MUC5	68	70
ALK 570	DET	106	27.03.22	24_2	MUC5	70	72
ALK 570	DET	107	27.03.22	24_2	MUC5	72	74
ALK 570	DET	108	27.03.22	24_2	MUC5	74	76
ALK 570	DET	109	27.03.22	24_2	MUC5	76	78
ALK 570	DET	110	27.03.22	24_2	MUC5	78	80
ALK 570	DET	111	27.03.22	24_2	MUC5	80	82
ALK 570	DET	112	27.03.22	24_2	MUC5	82	84
ALK 570	DET	113	27.03.22	24_2	MUC5	84	86
ALK 570	DET	114	27.03.22	24_2	MUC5	86	88
ALK 570	DET	115	27.03.22	24_2	MUC5	88	90
ALK 570	DET	116	27.03.22	24_2	MUC5	90	92
ALK 570	DET	117	27.03.22	24_2	MUC5	92	94
ALK 570	DET	118	27.03.22	24_2	MUC5	94	96
ALK 570	DET	119	27.03.22	24_2	MUC5	96	98
ALK 570	DET	120	27.03.22	24_2	MUC5	98	100
ALK 570	DET	121	27.03.22	24_2	MUC5	100	102
ALK 570	DET	122	27.03.22	24_2	MUC5	102	104
ALK 570	DET	123	27.03.22	24_2	MUC5	104	106
ALK 570	DET	124	27.03.22	24_2	MUC5	106	108
ALK 570	DET	125	27.03.22	24_2	MUC5	108	110
ALK 570	DET	126	27.03.22	24_2	MUC5	110	112
ALK 570	DET	127	27.03.22	24_2	MUC5	112	114
ALK 570	DET	128	27.03.22	24_2	MUC5	114	116
ALK 570	DET	129	27.03.22	24_2	MUC5	116	118
ALK 570	DET	130	27.03.22	24_2	MUC5	118	120
ALK 570	DET	131	27.03.22	24_2	MUC5	120	122
ALK 570	DET	132	27.03.22	24_2	MUC5	122	124
ALK 570	DET	133	27.03.22	24_2	MUC5	124	126
ALK 570	DET	134	27.03.22	24_2	MUC5	126	128
ALK 570	DET	135	27.03.22	24_2	MUC5	128	130
ALK 570	DET	136	27.03.22	24_2	MUC5	130	132
ALK 570	DET	137	27.03.22	24_2	MUC5	132	134

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SampleNr.			Infos			Depth [mm]	
			Slicing_DATE	STATION	Gear/Cast	from	to
ALK 570	DET	138	27.03.22	24_2	MUC5	134	136
ALK 570	DET	139	27.03.22	24_2	MUC5	136	138
ALK 570	DET	140	27.03.22	24_2	MUC5	138	140
ALK 570	DET	141	NA	NA	NA	NA	NA
ALK 570	DET	142	NA	NA	NA	NA	NA
ALK 570	DET	143	NA	NA	NA	NA	NA
ALK 570	DET	144	NA	NA	NA	NA	NA
ALK 570	DET	145	NA	NA	NA	NA	NA
ALK 570	DET	146	NA	NA	NA	NA	NA
ALK 570	DET	147	NA	NA	NA	NA	NA
ALK 570	DET	148	NA	NA	NA	NA	NA
ALK 570	DET	149	NA	NA	NA	NA	NA
ALK 570	DET	150	NA	NA	NA	NA	NA
ALK 570	DET	151	04.04.22	75_1	MUC_9	0	2
ALK 570	DET	152	04.04.22	75_1	MUC_9	2	4
ALK 570	DET	153	04.04.22	75_1	MUC_9	4	6
ALK 570	DET	154	04.04.22	75_1	MUC_9	6	8
ALK 570	DET	155	04.04.22	75_1	MUC_9	8	10
ALK 570	DET	156	04.04.22	75_1	MUC_9	10	12
ALK 570	DET	157	04.04.22	75_1	MUC_9	12	14
ALK 570	DET	158	04.04.22	75_1	MUC_9	14	16
ALK 570	DET	159	04.04.22	75_1	MUC_9	16	18
ALK 570	DET	160	04.04.22	75_1	MUC_9	18	20
ALK 570	DET	161	04.04.22	75_1	MUC_9	20	22
ALK 570	DET	162	04.04.22	75_1	MUC_9	22	24
ALK 570	DET	163	04.04.22	75_1	MUC_9	24	26
ALK 570	DET	164	04.04.22	75_1	MUC_9	26	28
ALK 570	DET	165	04.04.22	75_1	MUC_9	28	30
ALK 570	DET	166	04.04.22	75_1	MUC_9	30	32
ALK 570	DET	167	04.04.22	75_1	MUC_9	32	34
ALK 570	DET	168	04.04.22	75_1	MUC_9	34	36
ALK 570	DET	169	04.04.22	75_1	MUC_9	36	38
ALK 570	DET	170	04.04.22	75_1	MUC_9	38	40
ALK 570	DET	171	04.04.22	75_1	MUC_9	40	42
ALK 570	DET	172	04.04.22	75_1	MUC_9	42	44
ALK 570	DET	173	04.04.22	75_1	MUC_9	44	46
ALK 570	DET	174	04.04.22	75_1	MUC_9	46	48
ALK 570	DET	175	04.04.22	75_1	MUC_9	48	50
ALK 570	DET	176	04.04.22	75_1	MUC_9	50	52
ALK 570	DET	177	04.04.22	75_1	MUC_9	52	54
ALK 570	DET	178	04.04.22	75_1	MUC_9	54	56
ALK 570	DET	179	04.04.22	75_1	MUC_9	56	58
ALK 570	DET	180	04.04.22	75_1	MUC_9	58	60
ALK 570	DET	181	04.04.22	75_1	MUC_9	60	62
ALK 570	DET	182	04.04.22	75_1	MUC_9	62	64
ALK 570	DET	183	04.04.22	75_1	MUC_9	64	66

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SampleNr.			Infos			Depth [mm]	
			Slicing_DATE	STATION	Gear/Cast	from	to
ALK 570	DET	184	04.04.22	75_1	MUC_9	66	68
ALK 570	DET	185	04.04.22	75_1	MUC_9	68	70
ALK 570	DET	186	04.04.22	75_1	MUC_9	70	72
ALK 570	DET	187	04.04.22	75_1	MUC_9	72	74
ALK 570	DET	188	04.04.22	75_1	MUC_9	74	76
ALK 570	DET	189	04.04.22	75_1	MUC_9	76	78
ALK 570	DET	190	04.04.22	75_1	MUC_9	78	80
ALK 570	DET	191	04.04.22	75_1	MUC_9	80	82
ALK 570	DET	192	04.04.22	75_1	MUC_9	82	84
ALK 570	DET	193	04.04.22	75_1	MUC_9	84	86
ALK 570	DET	194	04.04.22	75_1	MUC_9	86	88
ALK 570	DET	195	04.04.22	75_1	MUC_9	88	90
ALK 570	DET	196	04.04.22	75_1	MUC_9	90	92
ALK 570	DET	197	04.04.22	75_1	MUC_9	92	94
ALK 570	DET	198	04.04.22	75_1	MUC_9	94	96
ALK 570	DET	199	04.04.22	75_1	MUC_9	96	98
ALK 570	DET	200	04.04.22	75_1	MUC_9	98	100
ALK 570	DET	201	04.04.22	75_1	MUC_9	100	102
ALK 570	DET	202	04.04.22	75_1	MUC_9	102	104
ALK 570	DET	203	04.04.22	75_1	MUC_9	104	106
ALK 570	DET	204	04.04.22	75_1	MUC_9	106	108
ALK 570	DET	205	04.04.22	75_1	MUC_9	108	110
ALK 570	DET	206	04.04.22	75_1	MUC_9	110	112
ALK 570	DET	207	04.04.22	75_1	MUC_9	112	114
ALK 570	DET	208	04.04.22	75_1	MUC_9	114	116
ALK 570	DET	209	04.04.22	75_1	MUC_9	116	118
ALK 570	DET	210	04.04.22	75_1	MUC_9	118	120
ALK 570	DET	211	04.04.22	75_1	MUC_9	120	122
ALK 570	DET	212	04.04.22	75_1	MUC_9	122	124
ALK 570	DET	213	04.04.22	75_1	MUC_9	124	126
ALK 570	DET	214	04.04.22	75_1	MUC_9	126	128
ALK 570	DET	215	04.04.22	75_1	MUC_9	128	130
ALK 570	DET	216	04.04.22	75_1	MUC_9	130	132
ALK 570	DET	217	04.04.22	75_1	MUC_9	132	134
ALK 570	DET	218	04.04.22	75_1	MUC_9	134	136
ALK 570	DET	219	04.04.22	75_1	MUC_9	136	138
ALK 570	DET	220	04.04.22	75_1	MUC_9	138	140
ALK 570	DET	221	04.04.22	75_1	MUC_9	140	142
ALK 570	DET	222	NA	NA	NA	NA	NA
ALK 570	DET	223	NA	NA	NA	NA	NA
ALK 570	DET	224	NA	NA	NA	NA	NA
ALK 570	DET	225	NA	NA	NA	NA	NA
ALK 570	DET	226	NA	NA	NA	NA	NA
ALK 570	DET	227	NA	NA	NA	NA	NA
ALK 570	DET	228	NA	NA	NA	NA	NA
ALK 570	DET	229	NA	NA	NA	NA	NA

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SampleNr.			Infos			Depth [mm]	
			Slicing_DATE	STATION	Gear/Cast	from	to
ALK 570	DET	230	NA	NA	NA	NA	NA
ALK 570	DET	231	06.04.22	83_1	MUC_7	0	2
ALK 570	DET	232	06.04.22	83_1	MUC_7	2	4
ALK 570	DET	233	06.04.22	83_1	MUC_7	4	6
ALK 570	DET	234	06.04.22	83_1	MUC_7	6	8
ALK 570	DET	235	06.04.22	83_1	MUC_7	8	10
ALK 570	DET	236	06.04.22	83_1	MUC_7	10	12
ALK 570	DET	237	06.04.22	83_1	MUC_7	12	14
ALK 570	DET	238	06.04.22	83_1	MUC_7	14	16
ALK 570	DET	239	06.04.22	83_1	MUC_7	16	18
ALK 570	DET	240	06.04.22	83_1	MUC_7	18	20
ALK 570	DET	241	06.04.22	83_1	MUC_7	20	22
ALK 570	DET	242	06.04.22	83_1	MUC_7	22	24
ALK 570	DET	243	06.04.22	83_1	MUC_7	24	26
ALK 570	DET	244	06.04.22	83_1	MUC_7	26	28
ALK 570	DET	245	06.04.22	83_1	MUC_7	28	30
ALK 570	DET	246	06.04.22	83_1	MUC_7	30	32
ALK 570	DET	247	06.04.22	83_1	MUC_7	32	34
ALK 570	DET	248	06.04.22	83_1	MUC_7	34	36
ALK 570	DET	249	06.04.22	83_1	MUC_7	36	38
ALK 570	DET	250	06.04.22	83_1	MUC_7	38	40
ALK 570	DET	251	06.04.22	83_1	MUC_7	40	42
ALK 570	DET	252	06.04.22	83_1	MUC_7	42	44
ALK 570	DET	253	06.04.22	83_1	MUC_7	44	46
ALK 570	DET	254	06.04.22	83_1	MUC_7	46	48
ALK 570	DET	255	06.04.22	83_1	MUC_7	48	50
ALK 570	DET	256	06.04.22	83_1	MUC_7	50	52
ALK 570	DET	257	06.04.22	83_1	MUC_7	52	54
ALK 570	DET	258	06.04.22	83_1	MUC_7	54	56
ALK 570	DET	259	06.04.22	83_1	MUC_7	56	58
ALK 570	DET	260	06.04.22	83_1	MUC_7	58	60
ALK 570	DET	261	06.04.22	83_1	MUC_7	60	62
ALK 570	DET	262	06.04.22	83_1	MUC_7	62	64
ALK 570	DET	263	06.04.22	83_1	MUC_7	64	66
ALK 570	DET	264	06.04.22	83_1	MUC_7	66	68
ALK 570	DET	265	06.04.22	83_1	MUC_7	68	70
ALK 570	DET	266	06.04.22	83_1	MUC_7	70	72
ALK 570	DET	267	06.04.22	83_1	MUC_7	72	74
ALK 570	DET	268	06.04.22	83_1	MUC_7	74	76
ALK 570	DET	269	06.04.22	83_1	MUC_7	76	78
ALK 570	DET	270	06.04.22	83_1	MUC_7	78	80
ALK 570	DET	271	06.04.22	83_1	MUC_7	80	82
ALK 570	DET	272	06.04.22	83_1	MUC_7	82	84
ALK 570	DET	273	06.04.22	83_1	MUC_7	84	86
ALK 570	DET	274	06.04.22	83_1	MUC_7	86	88
ALK 570	DET	275	06.04.22	83_1	MUC_7	88	90

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SampleNr.			Infos			Depth [mm]	
			Slicing_DATE	STATION	Gear/Cast	from	to
ALK 570	DET	276	06.04.22	83_1	MUC_7	90	92
ALK 570	DET	277	06.04.22	83_1	MUC_7	92	94
ALK 570	DET	278	06.04.22	83_1	MUC_7	94	96
ALK 570	DET	279	06.04.22	83_1	MUC_7	96	98
ALK 570	DET	280	06.04.22	83_1	MUC_7	98	100
ALK 570	DET	281	06.04.22	83_1	MUC_7	100	102
ALK 570	DET	282	06.04.22	83_1	MUC_7	102	104
ALK 570	DET	283	06.04.22	83_1	MUC_7	104	106
ALK 570	DET	284	06.04.22	83_1	MUC_7	106	108
ALK 570	DET	285	06.04.22	83_1	MUC_7	108	110
ALK 570	DET	286	06.04.22	83_1	MUC_7	110	112
ALK 570	DET	287	06.04.22	83_1	MUC_7	112	114
ALK 570	DET	288	06.04.22	83_1	MUC_7	114	116
ALK 570	DET	289	06.04.22	83_1	MUC_7	116	118
ALK 570	DET	290	06.04.22	83_1	MUC_7	118	120
ALK 570	DET	291	06.04.22	83_1	MUC_7	120	122
ALK 570	DET	292	06.04.22	83_1	MUC_7	122	124
ALK 570	DET	293	06.04.22	83_1	MUC_7	124	126
ALK 570	DET	294	06.04.22	83_1	MUC_7	126	128
ALK 570	DET	295	06.04.22	83_1	MUC_7	128	130
ALK 570	DET	296	06.04.22	83_1	MUC_7	130	132
ALK 570	DET	297	06.04.22	83_1	MUC_7	132	134
ALK 570	DET	298	06.04.22	83_1	MUC_7	134	136
ALK 570	DET	299	06.04.22	83_1	MUC_7	136	138
ALK 570	DET	300	06.04.22	83_1	MUC_7	138	140