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Iversen, M. H.,

Flintrop, C., Grotheer, H., Hildebrandt, N., Kattein, L., Klann, M., Konrad, C., Meinecke, G., Ruhland, G., van der Jagt, H.

Report and preliminary results of R/V POSEIDON cruise POS508

Las Palmas (Canary Islands) – Las Palmas (Canary Islands) 22.01.2017 – 06.02.2017

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2017

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1 Participants

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2 Narrative of the Cruise

(Morten Iversen)

R/V Poseidon left the port of Las Palmas, Gran Canaria, Spain, on January 22nd, 2017 at 10:00 to start our voyage towards the study area off Cape Blanc, Mauritania (Fig. 2.1). The research cruise POS508 is a collaboration between the Marum Excellence Cluster 'The Ocean in the Earth System' in the Research Area 'Geosphere Biosphere Interactions' and the Helmholtz Young Investigator Group Project 'SeaPump'. We will service the two long-term Marum moorings off Cape Blanc, Mauritania. Both moorings are equipped with two deep ocean sediment traps that collect sinking particles during short periods (weeks) throughout a year. Sinking particles control carbon dioxide removal from the atmosphere and its movement to the deep ocean. They feed life below the ocean's surface, sustaining the biomass of deep sea fish and other organisms and determine sediment formation on the seafloor. However, most of the organic matter produced by photosynthetic plants in the surface ocean is eaten by small animals or degraded by bacteria before it sinks deeper than 100 meters. This means that the carbon dioxide is only removed from the atmosphere for a few weeks before it is outgassed from the ocean again. The particles need to sink below 1000 meter depth to be removed from the atmosphere for more than 1000 years and only those particles reaching the seafloor will have their organic matter stored for millennia. Unfortunately we know very little about processes that remove and transform the particles as they sink through the water column and, hence, the sequestration of atmospheric carbon dioxide in the world's oceans is only poorly understood. Only by understanding the processes that form and degrade organic settling aggregates can we make any hopes of mitigating atmospheric carbon dioxide levels.

The two long-term moorings are placed in a mesotrophic (CB) and a eutrophic (CBi) region. The mesotrophic mooring site CB is located about 210 nm offshore Cape Blanc and is operated since 1988. It provides one of the longest time series sites for particle fluxes worldwide (Fischer et al. 2016). The eutrophic site CBi was first deployed in 2003 and has been operated continuously since. The moorings off Cape Blanc are deployed in the Canary Current System within one of the four major Eastern Boundary Upwelling Ecosystems (EBUEs). Though the EBUEs only cover 1% of the ocean surface, they contribute with up to 15% of the total oceanic primary production (Carr 2002, Behrenfeld and Falkowski 1997). The EUBEs are important regions for commercial fishing and supply approximately 40% of the global fisheries (Pauly and Christensen 1995). It has also been estimated that the EBUEs are responsible for more than 40% of the yearly carbon sequestration in the ocean (Muller-Karger et al. 2005). It is therefore a key region to study and results from the long-term moorings helps us understanding how the EBUEs are affected by environmental alterations.

Both the CB and CBi mooring arrays were re-deployed during the R/V POS495 cruise in February 2016 (see report No. 310, Fischer et al. 2016). During this cruise, we deployed a newly developed Bio-Optical Platform (BOP) at the CBi-14 mooring, equipped with 40 cups for time-series collection of intact marine snow particles (gel-filled cups) and combined with a high resolution particle camera to detect *in situ* particle sinking rates within the sinking tube. We will recover the BOP during the POS508 cruise and re-deploy it at the CB site.

During the cruise we will perform optical, microbial, biological and geochemical studies of the water column as well as service the two long-term moorings off Cape Blanc (CB and CBi). The overall goal of the cruise is to study export fluxes and particle dynamics off Cape Blanc, Mauritania, with a special focus on the role of sinking particles for vertical flux of organic matter. To understand the processes controlling export flux, we have one decade drifting array deployments where we deploy cylindrical sediment traps to capture the fluxes in the upper 400 m of the water column. This is done in parallel with in situ camera systems to capture the vertical distribution and abundance of particles (In Situ Camera) and zooplankton (LOKI). These studies are complemented by direct laboratory studies of sinking velocities, sizes, composition, microbial degradation of marine snow aggregates collected in situ with a Marine Snow Catcher (MSC).

On board the cruise were 6 scientists from the University of Bremen (Marum) and the AWI, one engineer (AWI/Marum) and three technicians (Marum).

R/V Poseidon left the port of Las Palmas, Gran Canaria, Spain, on 22nd January 2017 at 09:00 on schedule and started the voyage in a SW direction towards our study area off Cape Blanc, Mauritania. Tuesday morning the 24th January we started our station work at the eutrophic site 'CBi' by recovering the 1500 m long mooring array CBi-14. The mooring consisted of two deep ocean sediment traps, one upper trap at 1356 m depth and one lower trap at 1913 m depth. Both traps had continuously collected sinking material in one 18.5 days interval and 14 intervals 21.5 days since the 25th February 2016. CBi-14 was further equipped with a newly developed BioOptical Platform (BOP) at 1251 m depth. BOP was equipped with 40 cups for time-series collection of intact marine snow particles (gel-filled cups), which had continuously sampled in the programmed intervals since the 25th February 2016. Above the gel-filled cups, BOP was equipped with a settling cylinder and a high resolution particle camera to detect particle sizes, abundance, and sinking rates. The camera had captured five minutes of image sequences once a day since the 25th February 2016. All in all, the CBi-14 mooring was successful. We redeployed the CBi mooring as CBi-15 on Wednesday 25th of February, this time without the BOP system since we planned to deploy this system on the CB mooring 223 km further offshore. Between the recovery and deployment of the CBi mooring we investigated the relationship between falling particles and microbes and larger organisms through the water column. To do this we deployed one secchi disk, two CTD Rosettes with water sampling, one Marine Snow Catcher to catch sinking particles, two In Situ Camera profiles to quantify size-distribution and abundance of particles through the water column, two plankton net samples with a camera attached (LOKI) to image the vertical distribution of zooplankton at high resolution, one hand-net haul for zooplankton, and one overnight deployment of four In Situ Pumps. We also deployed a Multi Net two times, but unfortunately the closing mechanism on the Multi Net was not functioning and we had to make do without those samples.

On Wednesday morning at 11:00, after recovery of the In Situ Pumps and deployment of CBi-15, we steamed towards the CB site. We made four short stations during the transit, where we deployed of the LOKI and the In Situ Camera at each station. On Thursday 26th January we recovered the CB-27 mooring at 08:30. The CB-27 mooring consisted of two deep ocean sediment traps, one at 1201 m depth and one at 3616 m depth. Both traps had sampled continuously in 21.5 days intervals since the 22nd of February 2016. While preparing for the re-deployment of the CB mooring, we investigated the particle dynamics through the water column at the CB site. This was done by deployments of one secchi disk, two In Situ Camera profiles, two LOKI deployments, one CTD-Rosette deployment, one Marine Snow Catcher, and deployment of four In Situ Pumps overnight. In addition, we deployed our first drifting array, DF-15, at the CB site. The drifting array consisted of four cylindrical sediment traps at each of the three target depths; 100, 200 and 400 m. One of the four cylinders at each depth was filled with a viscous gel to preserve the shape and structure of the fragile settling particles.

On Thursday 27th January we deployed the CB-28 mooring, which consisted of two deep ocean sediment traps and the BioOptical Platform. After the deployment we steamed to the position of the drifting trap where we made one In Situ Camera profile and one camera net profile to determine the vertical distribution of zooplankton and particles near the trap position. Thereafter, we recovered the DF-15 drifting trap successfully. At 18:00 on Thursday we started our transect back in the direction of the more coastal CBi site. We made one station every 25 km and deployed the In Situ Camera and LOKI to 500 m at each station. In total we made nine stations before we arrived at our next drifting trap station (20°50.21'N, 18°29.50'W) at 14:00 on Sunday 29th January. After a Secchi disk deployment we deployed the second drifting trap, DF-16, and started our investigations of the particle dynamics at this more coastal influenced station. This was again done with deployments of In Situ Camera, LOKI, Marine Snow Catcher, CTD-Rosette, Hand-nets, and In Situ Pumps.

Monday morning the 30th of January, after recovery of In Situ Pumps, we investigated the particle dynamics at this more coastal influenced station until noon, when it was time to recover the second drifting trap (DF-16). The second drifting trap had also collected a good amount of material. Since we are deploying the drifting trap with gel-traps as well, it is important that the particles collected in the gel are not so abundance that they overlap with each other. Overlapping particles will be analysed as one large aggregate when we perform image processing of the gels and would return incorrect size-distribution and abundance of the settling aggregate. However, the 24 hours deployments of the drifting traps turned out to be perfect for having enough material collected at all depths for biogeochemical analysis and still avoid having overlapping particles in the gel-traps. We deployed the In Situ Pumps overnight and recovered those Tuesday morning the 31st of January.

Tuesday 31st of January we started a short transect from CBi towards the upper part of the continental slope, where we wanted to sample the formation origin of the nephloid layers that we often observe in the study region. We investigated two stations before we arrived at the upper continental slope on Wednesday the 1st of February. This station was only 280 m deep. We deployed the CTD-Rosette, LOKI, and In Situ Camera before we sampled particulate matter with the In Situ Pump during a 4 h period between 11:00 and 16:00. Once the In Situ Pumps were recovered, we headed back towards the CBi station in order to reach deeper waters with less ship traffic so we could deploy our third and last drifting trap. We again made two transect stations on the way to deploy the LOKI and the In Situ Camera to 500 m.

On Thursday the 2nd of February we arrived at our drifting trap station 20°51.28'N 18°36.40'W where we first deployed the CTD-Rosette to 400 m and determined the Secchi depth before we deployed the drifting trap DF-17. After the deployment of DF-17, we investigated the particle dynamics with deployments of In Situ Camera, LOKI, Marine Snow Catcher, CTD-Rosette, Hand-nets, and In Situ Pumps.

Friday morning the 3rd of February we recovered the drifting traps and made a short CTD-Rosette deployment to 400 m before we began return journey to Las Palmas, Grand Canaria.

During the rest of Friday, Saturday, and Sunday we finished the last analyses in the laboratories and started packing and preparing for demobilization of the ship in Las Palmas. The pilot boarded Poseidon at 09:00 Monday the 6th of February. The container was waiting for us on the pier and all was packed, unloaded, and cleaned at 16:00 when we were brought to our hotel to was for our flight back to Bremen on Tuesday the 7th of February at noon.

During the cruise, we launched 103 instrument deployments: In Situ Camera (34x), Rosette-CTD (16x), Multi-net (1x, instrument failed), Hand-net (4x), Marine Snow Catcher (5x), Secchi disc (6x), LOKI (31x), and In Situ Pumps (6x four pumps). Additionally, we recovered and redeployed two long-term mooring arrays with sediment traps (CB-27/28 and CBi-14/15), recovered the BOP on CBi-14 and deployed it on CB-28. We deployed and recovered three drifting arrays (DF-15/16/17). We had mostly winds of 5-7 Bft and a relatively high swell of 3-5 m throughout the cruise. In summary, we had a successful cruise and we would like to thank Capt. Günther and his crew for supporting us.

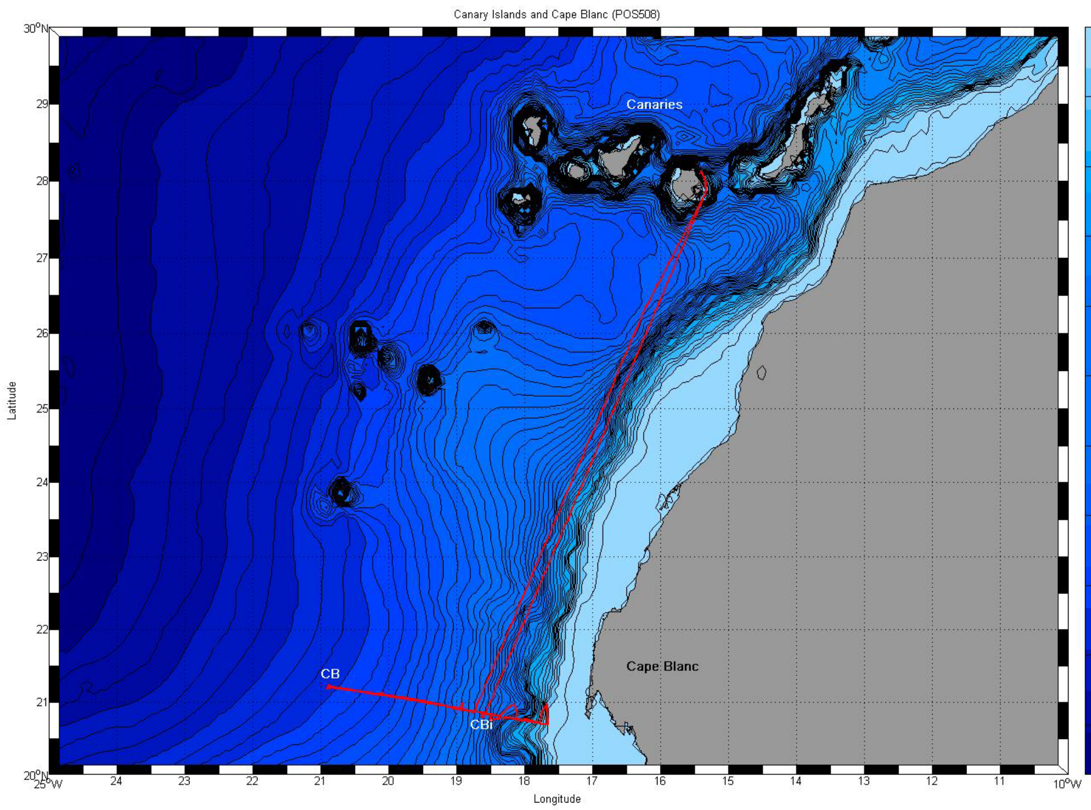

Fig. 2.1. Track and study area of R/V Poseidon cruise 508 (Las Palmas–Las Palmas, 22.01.2017 - 06.02.2017) with the two long-term mooring sites CB (mesotrophic) and CBi (eutrophic). The tracks of the three drifting arrays DF-15/16/17 were only a few miles long and cannot be recognized on this scale.

3 Preliminary Results

3.1 Marine Microbiology

3.1.1 Formation and bacterial colonization of marine snow

(Clara Flintrop, Helga van der Jagt, Christian Konrad, and Morten Iversen)

Background

The sedimentation of marine snow aggregates (>0.5 mm) plays an important role in the ocean's carbon cycle. Marine snow aggregates are composed of phytoplankton cells, detritus, faecal pellets and inorganic mineral grains, and by settling the aggregates remove organic matter from the surface ocean layer. Since the organic matter is formed by the fixation of atmospheric carbon dioxide (CO_2) that is absorbed in the surface ocean, the removal of organic aggregates via settling allows for more CO_2 uptake from the atmosphere by the surface ocean. However, very little is known about the interactions between the food web and the export of organic matter. For instance, how does the composition of phytoplankton in upper water column influence the formation of marine snow and subsequent export to the deep sea. The role of bacteria versus zooplankton for the degradation and attenuation of organic matter flux is not fully understood. Therefore, we need a better understanding of the attenuation processes for different ecosystem in order to improve global ocean model predictions of carbon sequestration. The aim of this experiment was to gain a better understanding of aggregation and colonization potential of marine snow (aggregates with ESD >500 μm) by comparing the occurrence and abundance of phytoplankton and heterotrophic organisms in the water column with that inside the aggregates.

Methods and sampling

At four stations (Table 3.1), water samples were collected from several depths using a CTD-rosette. From each depth, 100-160 ml were fixed with 5% Lugol and 50 ml were fixed with hexamine-buffered 2% formaldehyde to assess phytoplankton and flagellate abundance. 2.0 L from each depth were size-fractionated and filtered onto burnt GFF filters for Chl. *a* measurements.

1.0 L per depth was size-fractionated by subsequent filtering onto PC filters with decreasing pore size for taxonomic identification and relative abundance assessment by DNA extraction and sequencing. To quantitatively assess bacterial abundance according to certain bacterial clades and phytoplankton size fraction, 50 ml per depth were fixed with 2% formaldehyde at 4°C overnight and size-fractionated for Fluorescence In Situ Hybridization (FISH) and counting. Filters were stored at -20°C until further processing.

A Marine Snow Catcher (MSC, from OSIL, Fig. 3.1) was deployed at each station below the Chl. *a* maximum to collect in situ formed marine snow. The MSC consists of a 100 l upper part and a removable bottom section. After deployment, the MSC was left standing overnight to let the collected aggregates settle into the bottom section, from which the aggregates can be easily sampled. Between 20-40 aggregates per station were fixed with 2% formaldehyde at 4°C overnight and washed several times with sterile filtered seawater. Aggregates were either filtered onto 0.2 μm polycarbonate filters for sequencing and FISH or embedded in TissueTek OCT cryogel for thin-sectioning.

Drifting sediment traps (DF) were deployed in three locations for 24h with collection tubes at 100m, 200m and 400m (see *Marine Geology*). From each depth, samples from one collection tube were filtered onto a 0.2μm PC filter for sequencing.

At two stations, 1.0 L water samples from 4 depths (including the Chlα maximum) were split into 0.2-3.0 μm and <0.2 μm (neg. control) size fractions and incubated in 12 ml gas tight exetainers for 24h to measure carbon demand. Samples were measured in replicates of fives at three time points.

Fig. 3.1 The Marine Snow Catcher (MSC) on board of R/V Poseidon. The water volume sampled by the collector is 100 l. Marine snow particles settle downwards into a collector where they can be sampled.

Table 3.1 List of sampling for with the CTD-Rosette and Marine Snow Catcher.

Station no./ Instrument deployed	**GeoB22106-3** (CTD <400m), **GeoB22106-4** (MSC) **GeoB22106-7** (CTD 1000m, DF 15)	**GeoB22117-3** (CTD <400m, CTD 1000m) **GeoB22117-4** (MSC, DF 16)	**GeoB22120-1** (CTD)	**GeoB22126-1** (CTD <400m), **GeoB22126-7** (CTD 1000m), **GeoB22126-4** (MSC) **GeoB22126-3** (DF 17)	**GeoB22126-15** (CTD <400m)
CTD depths (m)	1000, 400, 200, 100, 50, 30, 15	1000, 400, 100, 80, 65, 30, 15	400, 200, 100, 48	1000, 400, 200, 100, 65, 30, 15	400, 200, 100, 65, 30, 15
MSC depth (m)	65	65	n/a	65	
Size fractions recovered for DNA sequencing	180-10	180-10	n/a	1. 180-10 2. 10-3 3. 3-0.2	1. 180-10 2. 10-3 3. 3-0.2
Size fractions recovered for FISH (µm)	1. >25 2. 25-10 3. 10-3	1. >25 2. 25-10	n/a	1. >25 2. 25-10 3. 10-3 4. 3-0.2	1. >25 2. 25-10 3. 10-3 4. 3-0.2
Drift trap deployed/ retrieved?	deployed	deployed	n/a	deployed	retrieved
Respiration measurements (m)?	no	no	yes (400, 200, 100, 48)	yes (400, 200, 100, 30)	no
Size fractions recovered for chlα measurement (µm)	1. 180-25 2. <25 (all depths except 1000m)	1. 180-25 2. <25 (all depths except 1000m)	n/a	1. 180-25 2. <25 (all depths except 1000m)	1. 180-25 2. <25 (all depths except 1000m)
Aggregates fixed and filtered for DNA?	yes	yes	yes	yes	yes
Aggregates embedded for slicing?	yes	yes	yes	yes	yes
Samples from drift traps fixed and filtered for DNA?	yes	yes	yes	yes	yes
Samples fixed for phytoplankton counting?	yes	yes	yes	yes	yes
Samples fixed for flagellate counting?	yes	yes	yes	yes	yes

3.2 *Marine Zoology*

3.2.1 Mesozooplankton recorded with the camera-net "LOKI" (Light On-sight Key species Investigations)

(*Nicole Hildebrandt*)

Background

Zooplankton organisms are key players in pelagic ecosystems as they provide the link between primary production and higher trophic levels such as fish and seabirds. They also have an important role for the biological pump. During nighttime, zooplankton organisms feed in surface waters and produce fecal pellets that can contribute to the carbon export by sinking out of the mixed layer. During daytime, the organisms migrate to deeper water layers where they release carbon via respiration and also provide a food source for deeper living animals. The aim of this study is to analyze the small-scale distribution of mesozooplankton organisms (0.2-20 mm) in correlation with the hydrography in the upwelling area off Cape Blanc during both day- and nighttime. These data will complement data obtained from Multinet samples during previous cruises (POS-425, 445, 464, 481, 495) and will aid in understanding the role of zooplankton for carbon flux processes in the epi- and mesopelagic zone of the upwelling system off Cape Blanc.

System description

Optical methods are becoming increasingly important in zooplankton studies. The Lightframe On-sight Key Species Investigation system (LOKI; see Fig. 3.2A) is a tool to investigate the small-scale distribution of mesozooplankton organisms and correlate their abundance with hydrographical parameters. LOKI consists of a plankton net (opening: 60 cm diameter; 150 µm mesh size) that leads to a flow-through chamber. This chamber is illuminated by a high-power LED flashlight and photographed by a 6.1 mpix CCD camera with a maximum frame rate of 19.8 fps. A built-in computer immediately detects objects (zooplankton and particles) in the pictures, cuts them out and saves the vignettes (Fig. 3.2B). Simultaneously, environmental parameters (depth, temperature, salinity, oxygen concentration, fluorescence) are recorded. A flowmeter was attached to the opening of the plankton net to measure the amount of water passing through the system, thus allowing us to calculate zooplankton densities. A net with 1 cm mesh size covered the opening of the plankton net to prevent large animals from entering the system and clogging the narrow flow-through chamber. The maximum depth rating of the LOKI system is 1000 m.

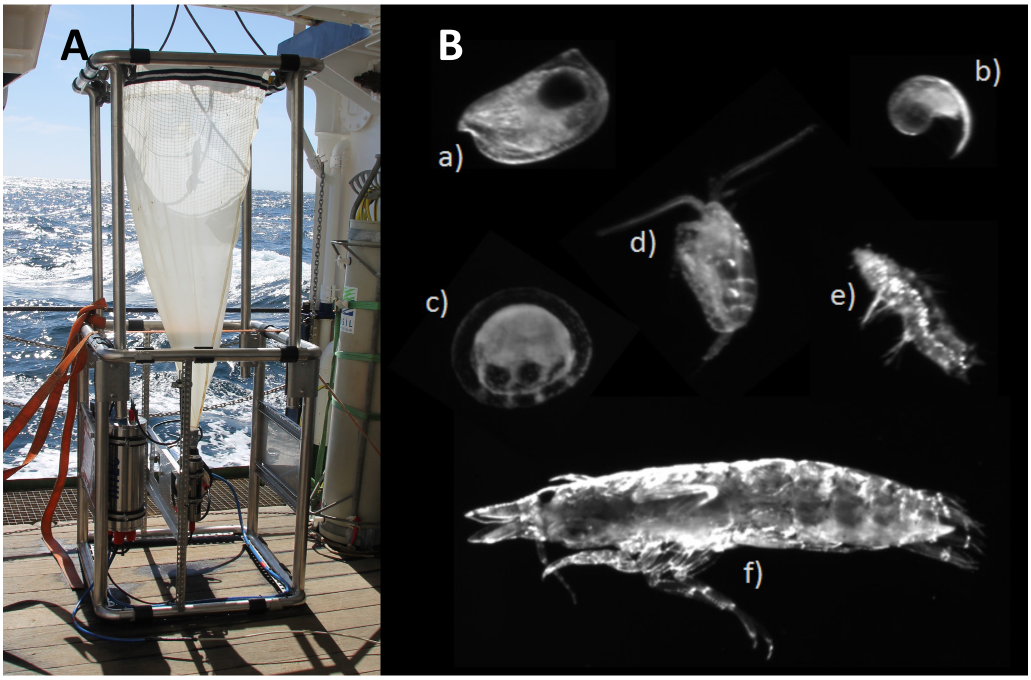

Fig. 3.2 (A) The LOKI system onboard R/V Poseidon, POS508. (B) A compilation of photographs taken with LOKI: (a) an ostracod, (b) a gastropod, (c) a jelly fish, (d) a calanoid copepod, (e) a polychaete, (f) an amphipod. Zooplankton pictures are not to scale.

Methods and sampling

In total, 31 vertical profiles were accomplished with the LOKI, following a depth transect across the continental slope off Cape Blanc from ~290 to ~4160 m water depth (Table 3.2, Fig. 3.3). The first station (GeoB22101_6), however, was not successful as the net detached from the camera unit during the haul.

Vertical profiles with the LOKI were performed during daytime (14 stations), dusk (6 stations), and nighttime (11 stations) in order to study diel vertical migration patterns of the zooplankton species.

In total, more than 1.4 million pictures were taken with the LOKI system during the POS508 cruise. A first look at these pictures showed that copepods (Calanoida, Cyclopoida) dominated the zooplankton community off Cape Blanc during our cruise. Other taxa that occurred regularly were ostracods, rhizarians, chaetognaths, polychaetes, gastropods and jellyfish. A detailed analysis of the pictures for zooplankton abundance and depth distribution in correlation with environmental parameters will be done at the home laboratory.

Table 3.2 List of LOKI deployments.

Station No.	Date [yyyy-mm-dd]	Time at profile start [UTC]	Latitude [N]	Longitude [W]	Water depth [m]	Sampling depth [m]
GeoB22101-6	2017-01-24	16:32	20° 52.473'	18° 44.738'	2763.4	1000
GeoB22101-11	2017-01-24	22:30	20° 52.393'	18° 44.762'	2789.4	1000
GeoB22102-2	2017-01-25	13:25	20° 55.312'	18° 59.199'	3116.5	500
GeoB22103-1	2017-01-25	15:55	20° 58.196'	19° 13.297'	3354.9	500
GeoB22104-2	2017-01-25	19:35	21° 01.110'	19° 27.371'	3519.2	500
GeoB22105-1	2017-01-25	21:44	21° 03.527'	19° 41.466'	3646.3	500
GeoB22106-8	2017-01-26	18:56	21° 12.819'	20° 52.158'	4151.8	1000
GeoB22106-10	2017-01-26	21:26	21° 12.890'	20° 52.193'	4153.4	1000
GeoB22107-2	2017-01-27	14:28	21° 13.756'	20° 53.262'	4161.8	1000
GeoB22108-1	2017-01-27	18:29	21° 11.076'	20° 37.604'	4083.1	500
GeoB22109-2	2017-01-27	22:40	21° 08.638'	20° 23.485'	4017.3	500
GeoB22110-1	2017-01-28	08:24	21° 06.361'	20° 09.244'	3884.7	500
GeoB22111-2	2017-01-28	12:32	21° 04.235'	19° 55.178'	3769.8	500
GeoB22112-1	2017-01-28	15:20	21° 02.064'	19° 40.580'	3644.5	500
GeoB22113-2	2017-01-28	19:24	20° 59.484'	19° 26.423'	3514	500
GeoB22114-1	2017-01-28	21:47	20° 57.339'	19° 12.271'	3349.2	500
GeoB22115-2	2017-01-29	09:02	20° 55.043'	18° 58.094'	3090.8	500
GeoB22116-1	2017-01-29	11:31	20° 52.473'	18° 44.764'	2750.3	500
GeoB22117-6	2017-01-29	18:28	20° 50.144'	18° 29.441'	2141.3	1000
GeoB22117-9	2017-01-29	20:37	20° 50.074'	18° 29.457'	2138.4	500
GeoB22118-2	2017-01-30	11:46	20° 45.180'	18° 30.261'	1910.5	1000
GeoB22119-2	2017-01-30	19:04	20° 47.577'	18° 15.363'	1845.5	1000
GeoB22119-5	2017-01-30	21:46	20° 47.534'	18° 15.343'	1843.1	500
GeoB22120-2	2017-01-31	11:46	20° 45.367'	18° 01.218'	1175.1	1000
GeoB22121-2	2017-01-31	18:13	20° 43.028'	17° 47.173'	557.5	540
GeoB22122-3	2017-02-01	10:26	20° 41.690'	17° 39.806'	289.4	260
GeoB22123-1	2017-02-01	18:40	20° 44.099'	17° 54.035'	833.9	500
GeoB22124-2	2017-02-01	22:57	20° 46.312'	18° 07.891'	1514.9	500
GeoB22125-1	2017-02-02	08:37	20° 49.016'	18° 22.198'	2017.7	500
GeoB22126-6	2017-02-02	15:45	20° 51.323'	18° 36.253'	2384.6	1000
GeoB22126-8	2017-02-02	18:09	20° 51.301'	18° 36.363'	2385.1	500

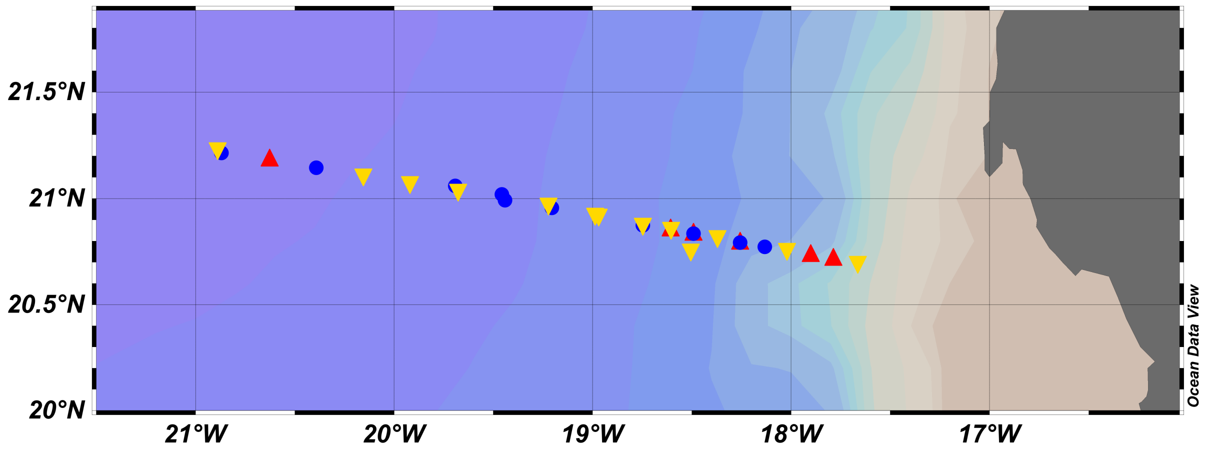

Fig. 3.3 Map of stations sampled with LOKI. Stations were sampled during daytime (yellow inverted triangles), dusk (red triangles) and nighttime (blue circles) in order to analyze daily vertical migrations of zooplankton organisms.

3.2.2 Mesozooplankton collected with the multi-net and the hand-net

(Helga van der Jagt, Marco Klann, and Morten Iversen)

Sampling

We planned to use a multi-net from HYROBIOS, Kiel, fitted with five nets of 200 µm mesh size to sample meso-zooplankton in various depth ranges from the water column in the Cape Blanc area and used standard collection depths of 300-150, 150-100, 100-80, 80-40 and 40-0 m. Unfortunately there was a leak in the seal for the pressure housing and the electronics were short-circuited by sea-water during the first deployment. The multi-net was beyond repair during the cruise.

In addition to the multi-net, we made four vertical hauls with a small hand-net (Fa. Hydrobios, Kiel). They were made from 50 m water depth up to the surface with a plankton hand-net of 75 µm mesh size (see Table 3.3). The hand-nets were deployed after sunset in order to have as much zooplankton in the surface waters as possible. The zooplankton collected with the hand-nets was incubated in roller tanks together with marine snow aggregates and video recordings were made with illumination from infrared light. The goal of these recordings was to capture the feeding behavior of different zooplankton species on marine snow.

Table 3.3. Samples taken with the hand-net (HN) equipped with a mesh size of 75 µm.

GeoB-No.	Date 2017	Time HN at depth [UTC]	Latitude [N]	Longitude [W]	Water depths [m]	Remarks
22101-10	24.1.	21:46	20°52.46’	18°44.77’	2784	50m
22117-8	29.1.	20:12	20°50.16’	18°29.47’	2140	50m
22119-6	30.1.	22:02	20°47.52’	18°15.32’	1840	50m
22121-4	31.1.	20:02	20°44.37’	17°46.78’	620	50m

3.3 Organic Biogeochemistry

3.3.1 Composition, alteration, lateral transport and sources of particulate and dissolved organic matter fractions

(*Laura Kattein and Hendrik Grotheer*)

Background

Organic matter (OM) composition from sediment traps and core tops documented relationships and interactions between marine production, particulate organic matter (POM; OM fraction > 0.45 µm) flux and composition and final burial in the sediments. Recent studies emphasized that lateral transport (advection); alteration and degradation of POM during sinking through the water column have a strong imprint on the POM flux and composition. Molecular and isotopic analysis of the POM fraction taken in previous years (MSM 11-1 (2009); POS396 (2010); MSN 18-1 (2011); POS425 (2012); POS445 (2013); POS464 (2014); and POS495 (2016)) in the same sampling area, have indicated significant variations in the composition and abundance of lipid biomarkers and Intact Polar Lipids (IPL's) throughout the water column. Further, a low resolution, preliminary data set of the radiocarbon (^{14}C) composition of the POM fraction, collected in previous years, suggests a complex interplay and mixing of OM phases in water layers of elevated turbidity, potentially reflective of OM resuspension and lateral transport. $\Delta^{14}C_{POM}$ data suggests that the POM fraction transported, within the nepheloid layers, contains variable amounts of pre-aged, re-suspended material potentially originating from at least two sites of erosion. To complement and confirm previous findings, OM fractions (particulate and dissolved) were collected from water layers with elevated turbidity to be evaluated at the home laboratory.

Sampling

POM samples from different water depths were collected during this cruise at six locations for molecular and isotopic analysis. Large volumes of water (up to 1500 L; Table 3.4) were filtered with four In Situ Pumps (ISP; McLane Large Volume Water Transfer System, WTS-LV-4/-8) on 142 mm pre-combusted GF/F filters. To investigate particle size dependent lipid distribution and isotopic composition, ISPs were equipped with a stack of two filters (0.75 and 0.45 µm pore size) in subsequent order. Two ISPs further allowed the recovery of filtered *in-situ* water samples containing the OM fraction < 0.45 µm, conventionally defined as dissolved organic matter (DOM).

In addition high-resolution water samples were collected for radiocarbon analysis of POM, DOM and dissolved inorganic carbon (DIC) at nine locations complementing the ISP collected samples for lipid and isotope analysis (Table 3.5). Water samples were collected with 10 L Niskin-bottles of the CTD-ROS system and subsequently filtered under vacuum over 47 mm pre-combusted GF/F filters with a 0.75 µm pore size. Care was taken to collect and filter sufficient water to yield a minimum amount of 30 µgC per sample depth to allow ^{14}C dating of the POM fraction. Filtered water containing the DOM fraction was collected in HDPE bottles and acidified (pH < 2) with concentrated hydrochloric acid for DOM quantification and ^{14}C analysis. DIC sample splits were collected prior to filtering in 330 ml brown-glass, flip-top bottles, fixated with mercury chloride ($HgCl_2$) and tightly sealed without a headspace to prevent outgassing.

Supplementary surface water samples (ca. 3 m, Table 3.6) were obtained from the ship's seawater inlet system and directly filtered over pre-combusted 142 mm / 0.45 µm GF/F filters.

All filters were stored frozen (-20 °C) on board immediately after recovery and transported frozen to home laboratory. At the home laboratory, the POM samples will be subjected to a robust organic geochemical screening. Screening will include compound identification and quantification *via* gas chromatography – mass spectrometry (GC-MS); liquid chromatography – mass spectrometry (HPLC-MS); and compound specific stable carbon isotope analysis *via* gas chromatography – isotope ratio mass spectrometry (GC-IRMS). Further, POM, DOM and DIC samples will be quantified (bulk C content) and their radiocarbon signature analyzed on the recently commissioned micro carbon dating system (MICADAS).

Table 3.4: Particulate organic carbon (POC) and dissolved organic carbon (DOC) samples taken with in-situ pumps (ISP), two stacked filters (0.75 and 0.45 µm) at each depth.

GeoB#	Date 2017	Lat [N]	Lon [W]	Water Depth [m]	Sample Depth [m]	Water Volume [l]	Run time [hh:mm]	DOC Sample
22101-12	25.01	20°52.45'	18°44.71'	2761	900	1342	06:00	
					1300	1423	06:00	X
					2400	1445	06:00	
					2710	830	04:55	X
22106-11	27.01	21°12.94'	20°52.15'	4156	40	1075	07:00	
					105	1519	07:00	X
					540	1536	07:00	
					800	1597	07:00	X
22117-11	30.01	20°50.14'	18°29.39'	2150	40	1259	07:00	
					200	1719	07:00	X
					418	1465	07:00	X
					800	1541	07:00	
22119-7	31.01	20°47.57'	18°15.41'	1849	200	1595	07:00	
					500	1487	07:00	X
					1740	1444	07:00	
					1820	1679	07:00	X
22122-5	01.02	20°41.69'	17°39.88'	295	20	576	04:00	

GeoB#	Date 2017	Lat [N]	Lon [W]	Water Depth [m]	Sample Depth [m]	Water Volume [l]	Run time [hh:mm]	DOC Sample
					150	865	04:00	
					210	780	04:00	
					280	920	04:00	
22126-11	02.02	20°51.27'	18°36.33'	2378	1385	1490	07:00	
					1700	1401	06:37	

Table 3.5: Particulate organic carbon (POC), dissolved organic carbon (DOC) and dissolved inorganic carbon (DIC) samples collected with Niskin-bottles from the CTD-Rosette. On-board filtration over 0.75 µm GF/F filters for POC.

GeoB#	Date 2017	Lat [N]	Lon [W]	Water Depth [m]	Water Temp. [°C]	Sample Depth [m]	POM Volume [l]	DIC Sample	DOC Sample
22101-8	24.01	20°52.46'	18°44.77'	2776	19.6	43.7	6.9	X	X
					15.6	103	5.9	X	X
					13.5	270	6.9		X
					11.6	397	15.9	X	X
					8.8	666.2	16.0	X	X
					7.0	892.6	7.5		X
					5.3	1304.2	8.6		X
					3.4	2383	7.7	X	X
					2.9	2678	8.7	X	X
22106-7	26.01	21°12.77'	20°52.04'	4156	21.1	44.3	7.6	X	X
					16.5	101.4	14.4	X	X
					15.3	162.2	7.9	X	X
					13.4	330.2	16.8	X	X
					11.7	448.6	14.5	X	X
					10.1	538.2	16.6	X	X
					7.3	793.7	7.8	X	X
22117-7	29.01	20°50.16'	18°29.48'	2150	19.6	44.7	7.5	X	X
					15.6	99.3	8.3	X	X
					14.7	163	16.0	X	X
					13.5	202.8	7.9	X	X
					12.8	251.5	8.4	X	X
					11.2	418	8.3	X	X
					9.2	596.5	17.2	X	X
					7.6	794.2	8.0	X	X
					3.6	2074	8.1	X	X
22118-4	30.01	20°44.94'	18°30.29'	1910	3.9	1700	53.4	X	X
					4.3	1800	49.5	X	X
22119-3	31.01	20°47.56'	18°15.38'	1894	17.2	33.95	7.9	X	X
					15.9	62.6	7.9	X	X
					13	270.8	16.8	X	X
					11	417.8	16.4	X	X
					9.8	517.7	7.8	X	X
					7.1	792.6	17.1	X	X
					4.2	1715	7.9	X	X
					1	1816.2	8.2	X	X
22120-5	31.01	20°45.39'	18°01.26'	1180	6.1	912.6	15.2	X	X
					6.2	1067	26.1	X	X
					6.4	1138	26.0	X	X
					7.3	1168	25.9	X	X

GeoB#	Date 2017	Lat [N]	Lon [W]	Water Depth [m]	Water Temp. [°C]	Sample Depth [m]	POM Volume [l]	DIC Sample	DOC Sample
22121-3	31.01	20°43.05'	17°47.17'	562	17.1	30	8.2	X	X
					15	120	17.8	X	X
					13.5	240	8.3	X	X
					12.1	360	17.2	X	X
					10.5	460	17.4	X	X
					10.3	490	16.4	X	X
					9.3	547.5	17.0	X	X
22122-1	01.02	20°41.70'	17°39.88'	295	12.25	288	17.6	X	X
22122-2	01.02	20°41.70'	17°39.88'	295	16.5	51	17	X	X
					16.1	100	8.2	X	X
					15.3	179	17.6	X	X
					15.3	208	16.8	X	X
					14.7	245	17.3	X	X
					13.6	279	18.2	X	X
22126-1	02.02	20°51.27'	18°36.39'	2381	19.5	33.3	8.25		X
					15.9	102	8.8		X
					14.3	200.6	18.1		X
					12	324.7	17.7		X
22126-7	02.02	20°51.33'	18°36.32'	2390	11.6	404	17.5	X	X
					9.4	598	13	X	X
					6.6	990	26.3	X	X
					5.1	1385	8.3	X	X
					4.2	1689	8.7	X	X
					3.6	2077	7.8	X	X
					3.1	2365	8.5	X	X

Table 3.6: Particulate organic carbon (POC) surface water samples (~ 3-5 m), on-board filtration (0.45 µm)

Station	Date 2017	Time	Lat (N)	Lon (W)	Volume (l)	SST (°C)
Transit	23.01	13:00 20:00	23°55.90' 22°55.96'	19°20.99' 17°49.94'	104	20.0
CBi	24.01	14:30	20°52.51'	18°44.76'	100	19.9
Transit	25.01	15:15	20°53.60' 20°57.57'	18°52.25' 19°11.78'	78	19.9
CB	26.01	9:30 22:20	21°13.03' 21°12.93'	20°51.39' 20°52.13'	80	21.1
Transit	27.01	13:40 21:45	21°13.71' 21°08.56'	20°53.36' 20°23.43'	88	21.3 20.5
Transit	28.01	11:10 21:30	21°04.47' 20°57.34'	19°56.65' 19°12.24'	103	19.8
GeoB 22117	29.01	15:00 22:30	20°50.16'	18°29.51'	127	19.7
GeoB 22119	30.01	17:30 00:15	20°47.55'	18°15.39'	102	19.3 18.4
Transit	31.01	11:30 20:30	20°45.30' 20°44.67'	18°01.28' 17°46.58'	77	17.7

3.4 Optical Particle Studies

3.4.1 Vertical profiles of marine snow aggregates with the In Situ Camera (ISC)

(Christian Konrad and Morten Iversen)

System description

The In Situ Camera (ISC) consisted of an industrial camera with removed infrared filter (from Basler) that was connected to a single board PC (Raspberry Pi) and a fixed focal length lens (16mm Edmund Optics). Some custom made electronics is included in the system for power configuration and timing. Furthermore a DSPL battery (24V, 38Ah) was used to power the system (Fig. 3.4).

The Raspberry Pi was both used as the operating system for the ISC and to acquire the images from the camera and send them to a SSD hard drive where they were stored. The illumination was provided by a custom made light source that consisted of infrared LEDs which were placed in an array in front of the camera. With this geometrical arrangement of the camera and the light source we obtained shadow images of particles through the water column. The field of view was 24x36 mm and a depth of field of ~24 mm resulting in a volume of approx. 20 ml. We captured 2 images per second and lowered the ISC with 0.3 meters per second (lowest possible speed of winch), which resulted in a total imaged water volume of 120 ml per meter. We lowered the ISC to 15 m and waited one minute before we took it back to 5 m and started the profile. This was to avoid air-bubbles in the images captured in the upper 20 m. We further left the camera some minutes at the maximum water profile depth to image particles in a larger water volume, which will allow us to estimate the statistical errors induced by the relatively small water volume captured per depth.

Sampling

We made 34 vertical profiles with the In Situ Camera (ISC). The vertical profiles were down to 1000 m at stations where water samples were collected, while we only made profiles to 500 m at transect stations where only ISC and LOKI were deployed (Table 3.7).

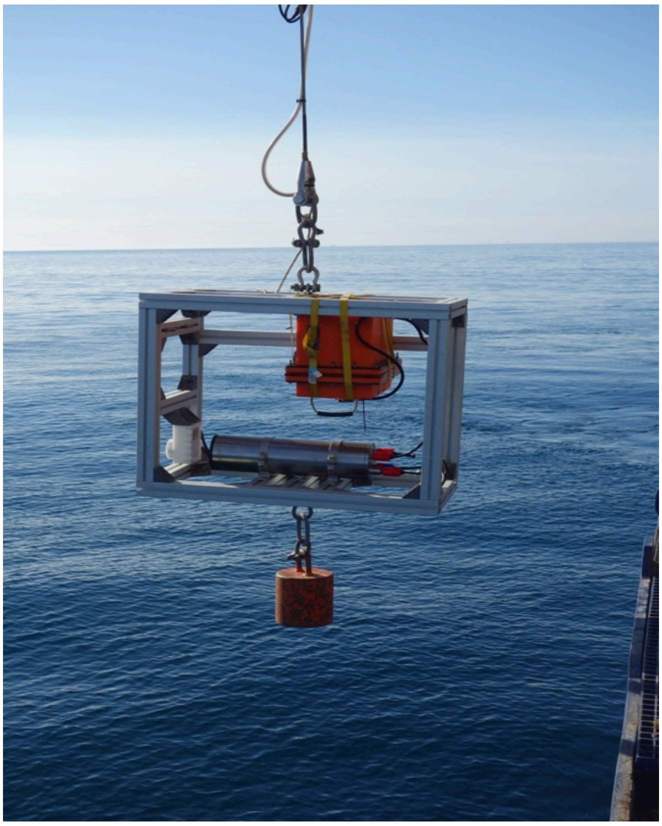

Fig. 3.4 Deployment of the Infrared camera (IRCam), consisting of an industrial camera and lens with electronics, an infrared light source and the DSPL battery.

Table 3.7 List of stations where the In Situ Camera (ISC) was deployed.

Number [#]	GeoB [#]	Date 2017 [MM-DD]	Deploy time [UTC]	LAT [° N]	LONG [° W]	Water depth [m]	Profiling depth/wire length [m]
Profile 01	22101-5	24.01	15:09	20°52.50	18°44.77	2753	1000
Profile 02	22101-9	24.01	21:01	20°52.48	18°44.89	2764	1000
Profile-03	22102-1	25.01	12.42	20°55.30	18°59.19	3110	500
Profile 04	22103-2	25.01	16:39	20°58.19	19°13.29	3359	500
Profile 05	22104-1	25.01	18:52	21°01.11	19°27.41	3526	500
Profile-06	22105-2	25.01	22:57	21°03.51	19°41.52	3644	500
Profile 07	22106-5	26.01	14:33	21°12.82	20°52.12	4150	1000
Profile 08	22106-9	26.01	20:18	21°12.81	20°52.19	4151	1000
Profile 09	22107-1	27.01	13:18	21°13.70	20°53.39	4159	1000
Profile-10	22108-2	27.01	19:17	21°11.08	20°37.56	4084	500
Profile-11	22109-1	27.01	22:02	21°08.61	20°23.44	4018	500
Profile-12	22110-2	28.01	09:17	21°06.34	20°09.29	3885	500
Profile-13	22111-1	28.01	11:48	21°04.23	19°55.14	3820	500

Profile-14	22112-2	28.01	16:07	21°02.09	19°40.59	3677	500
Profile-15	22113-1	28.01	18:42	20°59.46	19°26.44	3502	500
Profile-16	22114-2	28.01	22:32	20°57.46	19°12.30	3348	500
Profile-17	22115-1	29.01	08:26	20°55.04	18°58.14	3095	500
Profile-18	22116-2	29.01	12:15	20°52.50	18°44.83	2756	500
Profile-19	22117-5	29.01	17:20	20°50.17	18°29.44	2153	1000
Profile-20	22117-10	29.01	21:23	20°50.11	18°29.40	2136	500
Profile-21	22118-1	30.01	10:44	20°45.35	18°30.24	1920	1000
Profile-22	22119-1	30.01	18:01	20°47.55	18°15-37	1843	1000
Profile-23	22119-4	30.01	21:12	20°47.53	18°15.31	1841	500
Profile-24	22120-3	31.01	13:18	20°45.39	18°01.21	1159	1000
Profile-25	22121-1	31.01	17:36	20°43.01	17°47.19	557	500
Profile-26	22122-4	01.02	10:52	20°41.71	17°39.83	289	260
Profile-27	22123-2	01.02	19:38	20°44.16	17°54.08	839	820
Profile-28	22124-1	01.02	22:20	20°46.35	18°08.06	1519	500
Profile-29	22125-2	02.02	09:21	20°48.91	18°22.09	1953	500
Profile-30	22126-5	02.02	14:32	20°51.30	18°36.15	2379	1000
Profile-31	22126-9	02.02	18:55	20°51.29	18°36.41	2394	500
Profile-32	22126-10	02.02	19:28	20°51.27	18°36.40	2388	200
Profile-33	22126-11	02.02	19:53	20°51.28	18°36.37	2389	200
Profile-34	22126-12	02.02	19:53	20°51.27	18°36.34	2386	200

3.4.2 Using the Bio-Optical Platform to study long-term aggregate dynamics

(Christian Konrad, Götz Ruhland, and Morten Iversen)

System description

During the Poseidon cruise POS495 we deployed a BioOptical Platform (BOP) on the CBi-14 mooring at the CBi station off Cape Blanc. We developed the BOP system to be able to follow aggregate dynamics at high temporal resolution at different seasons throughout a whole year. BOP uses an in situ camera system to determine daily size-distribution, abundance and size-specific sinking velocities of settling particles at one particular depth throughout one year. This is done by having a settling cylinder where particles sink through. At the bottom part of the settling cylinder we have attached a perpendicular camera system that records 5 minutes image sequences daily. At the bottom of the settling cylinder we attached two rotation tables with 20 collection cups each, resulting in 40 sample collection periods. Each cup can be placed under the settling column for a pre-determined collection period (Table 3.8). The cups are filled with a viscous gel which preserves the size and three dimensional structures of particles sinking into the gel. This makes it possible to identify and quantify different particle types as well as their compositions.

The BOP system is based on a modified sediment trap (KUM GmbH) where the collection funnel was replaced with a polycarbonate cylinder to avoid that the settling particles were sliding/rolling down the sides of the funnel, which may alter their physical structure. The polycarbonate cylinder has an inner diameter of 35 mm and functions as a settling cylinder that excludes ocean currents while the particles settling through it (Fig. 3.6). The camera system placed at the lower part of the settling cylinder consisted of an industrial camera (Basler), a fixed focal length lens (Edmund Optics) and a single board computer including a SSD hard disc and custom made power and time management circuitry. The images were illuminated by a custom made visible light source providing backlight. The whole camera system was powered by a Li-Ion battery (24V, 1670Wh, SubCTech GmbH) (Fig. 3.6).

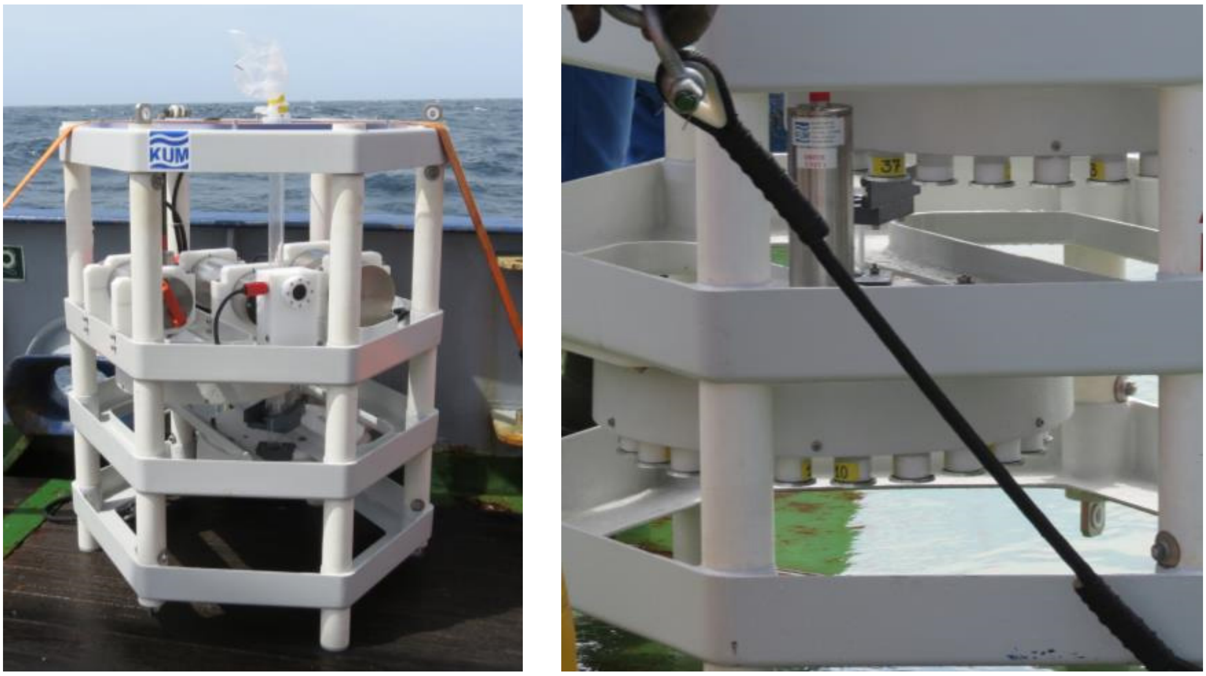

Fig. 3.5: The BioOptical Platform (BOP) system with the polycarbonate settling column (left image) and the two rotation tables with the sampling tubes filled with gels (right image).

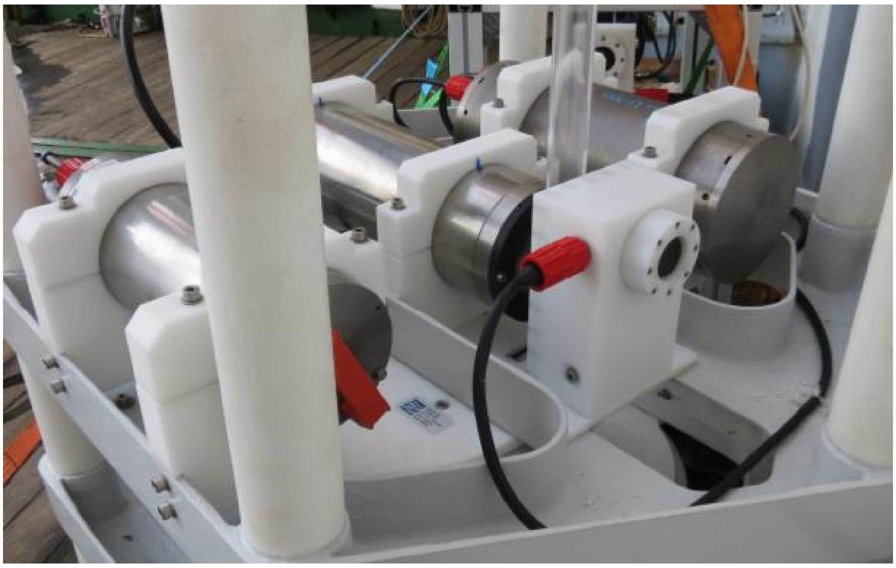

Fig. 3.6: The Camera System on the BOP with the camera housing in the middle (for camera, lens and system electronics), the VIS light source and the Li-Ion battery.

Recovery of the BOP at CBi-14 (deployed during POS495)

During this cruise (POS508), we recovered the BOP system at the CBi-14 mooring at station CBi (GeoB22101-1) on the 24 January 2017. The cups had all rotated and collected material. However, since we had planned to recover the system in May, the last nine collection cups had not sampled yet and cup 31 was open during recovery (see Table 3.8).

The camera system had captured 5 min of images every day from the 25 February 2016 and until recovery when we switched off the camera system on the 24 January 2017, which resulted in 335 days of image sequences.

Table 3.8: Programming of the BOP system that was deployed with CBi-14 mooring during POS495 and recovered during the POS508 cruise. Periodical measurements of the camera system for 5 minutes every day and changing of 40 gel cups in the sediment trap every 3 / 15.5 days alternately.

Date [YYYY-MM-DD]	Time [HH:MM:SS]	Remarks
2016-02-25	00:01:00	Trap: First bottom bottle
2016-02-25	12:00:00	Camera: auto start, 1 image per second for 5 minutes, auto shutdown, THIS PROCEDURE WILL BE REPEATED EVERY DAY WITHOUT END DATE
2016-02-28	00:01:00	Trap: Next bottom bottle
2016-03-14	12:01:00	Trap: Next bottom bottle
2016-03-17	12:01:00	Trap: Next bottom bottle
2016-04-05	00:01:00	Trap: Next bottom bottle
2016-04-08	00:01:00	Trap: Next bottom bottle
2016-04-26	12:01:00	Trap: Next bottom bottle
2016-02-29	12:01:00	Trap: Next bottom bottle
2016-05-18	00:01:00	Trap: Next bottom bottle
2016-05-21	00:01:00	Trap: Next bottom bottle
2016-06-08	12:01:00	Trap: Next bottom bottle
2016-06-11	12:01:00	Trap: Next bottom bottle
2016-06-30	00:01:00	Trap: Next bottom bottle
2016-07-03	00:01:00	Trap: Next bottom bottle

2016-07-21	12:01:00	Trap: Next bottom bottle
2016-07-24	12:01:00	Trap: Next bottom bottle
2016-08-12	00:01:00	Trap: Next bottom bottle
2016-08-15	00:01:00	Trap: Next bottom bottle
2016-09-02	12:01:00	Trap: Next bottom bottle
2016-09-05	12:01:00	Trap: Next bottom bottle
2016-09-24	00:01:00	Trap: Next bottom bottle
2016-09-27	00:01:00	Trap: Next top bottle
2016-10-15	12:01:00	Trap: Next top bottle
2016-10-18	12:01:00	Trap: Next top bottle
2016-11-06	00:01:00	Trap: Next top bottle
2016-11-09	00:01:00	Trap: Next top bottle
2016-11-27	12:01:00	Trap: Next top bottle
2016-11-30	12:01:00	Trap: Next top bottle
2016-12-19	00:01:00	Trap: Next top bottle
2016-10-22	00:01:00	Trap: Next top bottle
2017-01-09	12:01:00	Trap: Next top bottle
2017-01-12	12:01:00	Trap: Next top bottle
2017-01-31	00:01:00	Trap: Next top bottle
2017-02-03	00:01:00	Trap: Next top bottle
2017-02-21	12:01:00	Trap: Next top bottle
2017-02-24	12:01:00	Trap: Next top bottle
2017-03-15	00:01:00	Trap: Next top bottle
2017-03-18	00:01:00	Trap: Next top bottle
2017-04-05	12:01:00	Trap: Next top bottle
2017-04-08	12:01:00	Trap: Next top bottle
2017-04-27	00:01:00	Trap: Last bottle out; System open

Deployment of the BOP system at CB-28 (deployed during POS508)

We re-deployed the BOP system on the CB-28 mooring at station GeoB22106-12 on the 27 January 2017 at 21°12.30’N and 20°53.18’W. Please see further information about the mooring under the mooring cruise report. We timed the cup openings according to the deep ocean sediment traps on the same mooring, but ensured that we would have several gel cups with only three days of opening period at each collection period of the deep ocean sediment traps (Table 3.9). This was to ensure that we would not have particles falling on top of each other, which would prevent of from doing image analyses on the particles collected in the gel traps. We programmed the camera for measurements of particle type, size-distribution, abundance, and sinking velocities to switch on daily at 12:00 (UTC) and capture two image every second for 5 minutes.

Table 3.9: Programming schedule for the BOP deployment at CB-28.

Date/Time	Action	Group/Motor	Group/Pulses L/B	Group/Pulses SW	TimeOut[d:hh:mm]	Remarks
26-01-2017/00:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
29-01-2017/00:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
05-02-2017/12:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
08-02-2017/00:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
16-02-2017/00:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
19-02-2017/00:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
26-02-2017/12:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
01-03-2017/00:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
09-03-2017/00:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
12-03-2017/00:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
19-03-2017/12:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
22-03-2017/00:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
30-03-2017/00:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
02-04-2017/00:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
09-04-2017/12:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
12-04-2017/00:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
20-04-2017/00:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
23-04-2017/00:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
30-04-2017/12:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
03-05-2017/00:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
11-05-2017/00:01:00	1	1/ON	1/1	1/1	0:00:20	Next Bottom Bottle
14-05-2017/00:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle
21-05-2017/12:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle
24-05-2017/00:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle
01-06-2017/00:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle
04-06-2017/00:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle
11-06-2017/12:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle
14-06-2017/00:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle
22-06-2017/00:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle
25-06-2017/00:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle
02-07-2017/12:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle
05-07-2017/00:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle
13-07-2017/00:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle
16-07-2017/00:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle
23-07-2017/12:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle
26-07-2017/00:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle
03-08-2017/00:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle
06-08-2017/00:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle
13-08-2017/12:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle
16-08-2017/00:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle
24-08-2017/00:01:00	2	2/ON	2/1	2/1	0:00:20	Next Upper Bottle

3.5 Oceanography

3.5.1 Rosette with CTD-oxygen-fluorescence probe and the Secchi disk

(Clara Flintrop, Helga van der Jagt, Laura Kattein, Hendrik Grotheer, Christian Konrad, and Morten Iversen)

Background

We recorded 16 vertical profiles with the shipboard Seabird CTD (see Table 3.10). The SBE-5-CTD was equipped with additional oxygen and fluorescence sensors and mounted on a rosette with 12 Niskin bottles, which each collected 8 L of water. Water samples were collected on all CTD-Rosette casts. Water was used for incubations in roller tanks to form settling aggregates, for filtrations for particulate organic carbon, particulate organic nitrogen, chlorophyll*a*, DNA, and for up-concentrations of plankton cells larger than 25 µm. All samples will be processed in the home laboratory.

Table 3.10 List of Rosette-CTD (ROS + CTD) profiles and depths of water taken with the Niskin bottles of the rosette (ROS). Water samples were taken for studies of marine snow aggregation and organic and inorganic components of the particulate material through the water column.

Station No. GeoB	Latitude [N]	Longitude [W]	Water depth [m]	Water depths of samples [m]
22101-3	20°52.46'	18°44.79'	2755	4x14, 2x24, 2x43, 2x63, 2x100 – CTD 1<100 m
22101-8	20°52.49'	18°44.77'	2785	1x44, 1x103, 1x270, 1x 397, 1x666, 1x893, 2x1302, 2x2383, 2x2678, CTD <2700 m
22106-3	21°12.86'	20°52.10'	4152	1x18, 1x34, 1x53, 1x102, 1x199, 1x398 – CTD <400 m
22106-7	21°12.80'	20°52.19'	4151	1x44 1x101, 1x162, 1x330, 1x448, 1x538, 1x794 – CTD <800 m
22117-3	20°50.20'	18°29.40'	2142	1x15, 1x30, 1x65, 1x100, 1x200, 1x400, 1x1000, CTD <1000 m
22117-7	20°50.18'	18°29.45'	2142	1x45, 1x99, 1x163, 1x202, 1x253, 1x418, 1x597, 1x794, 1x2074 – CTD <2100 m
22118-4	20°44.88'	18°30.28'	1898	6x1700, 6x1800 – CTD <1850 m
22119-3	20°47.56'	18°15.39'	1850	1x34, 1x63, 1x270, 1x418, 1x518, 1x793, 1x1715, 1x1816 – CTD <1800 m
22120-1	20°45.30'	18°01.23'	1171	8x100, 2x200, 2x400 – CTD <400 m
22120-5	20°45.46'	18°01.23'	1181	3x913, 3x1067, 3x1138, 3x1168 – CTD <1168 m
22121-3	20°43.04'	17°47.16'	558	1x30, 1x120, 2x240, 2x360, 2x460, 2x490, 2x548 – CTD<550 m
22122-1	20°41.63'	17°39.99'	270	Cable short-circuited
22122-2	20°41.69	17°39.82'	290	2x51, 2x100, 2x179, 2x208, 2x245, 2x279 – CTD<290 m
22126-1	20°51.26'	18°36.39'	2387	1x15, 2x30, 1x65, 2x100, 3x200, 2x325, 1x400 – CTD<400 m
22126-7	20°51.32'	18°36.39'	2390	1x404, 1x598, 2x990, 2x1385, 2x1689, 2x2077, 2x2365 – CTD<2365 m
22126-15	20°46.85'	18°36.73'	2397	2x15, 2x30, 2x65, 2x100, 2x200, 2x400 – CTD<400 m

Preliminary Results

The vertical CTD profiles were obtained along a transect in an off-shore direction off Cape Blanc. The different water layers were characterized by their temperature and salinity, showing a strong vertical temperature gradient at around 100 m, while a strong salinity gradient was observed in the upper 50 meters of the water column. We observed fairly high oxygen concentrations in the upper 100 m of the water column, which seemed well correlated to the higher fluorescence concentrations, suggesting that the high oxygen was a result of primary production. We additionally measured the Secchi depths to be between 14 and 20 m.

3.6 Marine Geology

3.6.1 Upper ocean particle flux measured with free-drifting particle traps

(Götz Ruhland, Helga van der Jagt, Christian Konrad, Clara Flintrop, Marco Klann, and Morten Iversen)

Background

Previous studies in the research area off Cape Blanc have shown that biological activity from vertical migrating zooplankton in the epi- and upper mesopelagic and deposition of Saharan dust determines the flux attenuation (Iversen et al. 2010, Nowald et al. 2015, van der Jagt et al. accepted). Iversen et al. (2010) observed that zooplankton organisms migrate to shallow depths to feed during night and it seems that interactions between settling aggregates and zooplankton organisms have a large impact on the amount of exported material. This results in higher retention of settling particles during night while dust input can result in the formation of fast sinking aggregates that may escape zooplankton grazing during their descend. We hope to both capture some of these interactions and to follow to particle transformations from marine snow to zooplankton fecal pellets with the In Situ Camera investigations.

Sampling

We used an array of free-drifting sediment traps to measure the export fluxes at 100 m, 200 m, and 400 m depth (Table 3.11, Fig. 3.7). Each collection depth had a trap station that consisted of four cylindrical collection tubes with a gyroscopical attachment (Fig. 3.8). Three of the four collection cylinders at each depth were used to collect samples for biogeochemical measurements of total dry weight, particulate organic carbon, particulate organic nitrogen, particulate inorganic carbon, and silica. The fourth trap cylinder at each depth was equipped with a viscous gel that preserved the structure, shape and size of the fragile settling particles (Fig. 3.8). After recovery of the drifting trap, the samples for bulk fluxes were frozen for later analysis in the home laboratory. The particles collected in the gel traps were photographed with a digital camera on board and frozen for further detailed investigations in the home laboratory. The image analyses of the gel traps will be used to determine the composition, abundance and size distribution of the sinking particles.

The bulk fluxes were preserved with $HgCl_2$ after recovery and will be used to determine mass fluxes of carbon, nitrogen, biogenic opal, calcium carbonate, and lithogenic material. The different particle types collected in the gel cylinder were photographed using a digital camera and will be used to create particle size distribution of the flux and to identify transformation processes between the different trap depths. Three deployments were carried out during the cruise (DF-15, DF-16, and DF-17, Table 3.11).

Table 3.11 Overview of deployment and recovery dates for the two drifting sediment trap arrays DF-13 and DF-14.

Trap name GeoB	Deployment Recovery	LAT [°N]	LON [°W]	Time UTC	Equipment
DF-15	2017.01.26	21°12.72'	20°52.05'	15:58	Traps at 100 m, 200 m, and 400
22106-6	2017.01.27	21°13.79'	20°53.13'	16:01	m
DF-16	2017.01.29	20°50.13'	18°29.44'	15:04	Traps at 100 m, 200 m, and 400
22117-2	2017.01.30	20°45.22'	18°30.40'	14:22	m
DF-17	2017.02.02	20°51.17'	18°36.23'	13:20	Traps at 100 m, 200 m, and 400
22126-3	2017.02.03	20°46.99'	18°37.08'	08:52	m

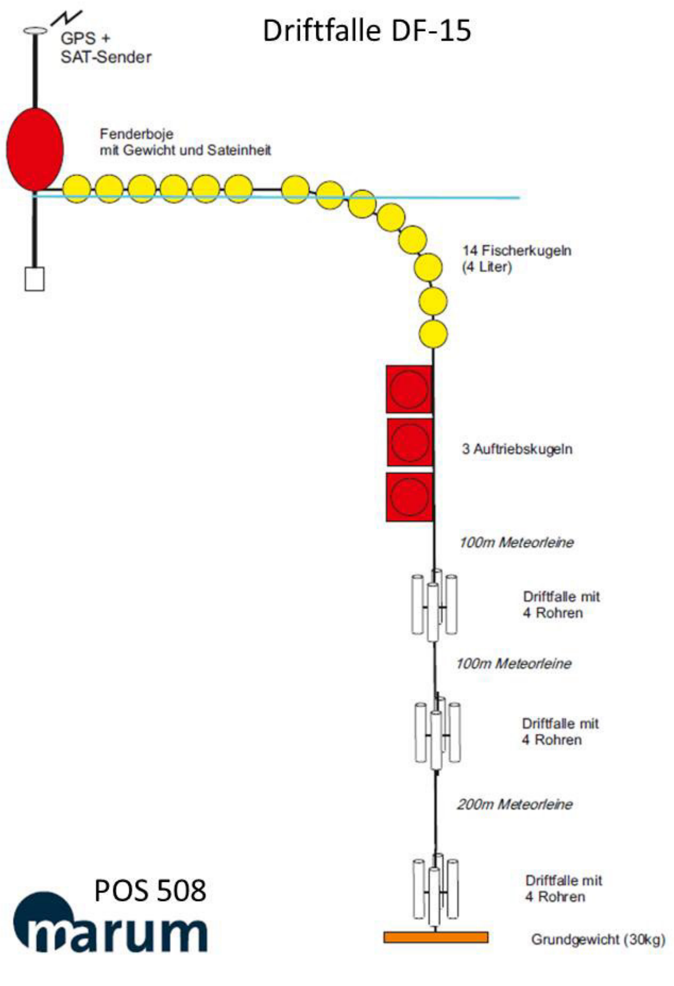

Fig. 3.7. Schematic of the deployments of the drifting arrays DF-15, DF-16, and DF-17. Each array consisted of three trap array with four traps at each. The trap arrays were placed at 100, 200 and 400 m water depth (see also Table 3.11).

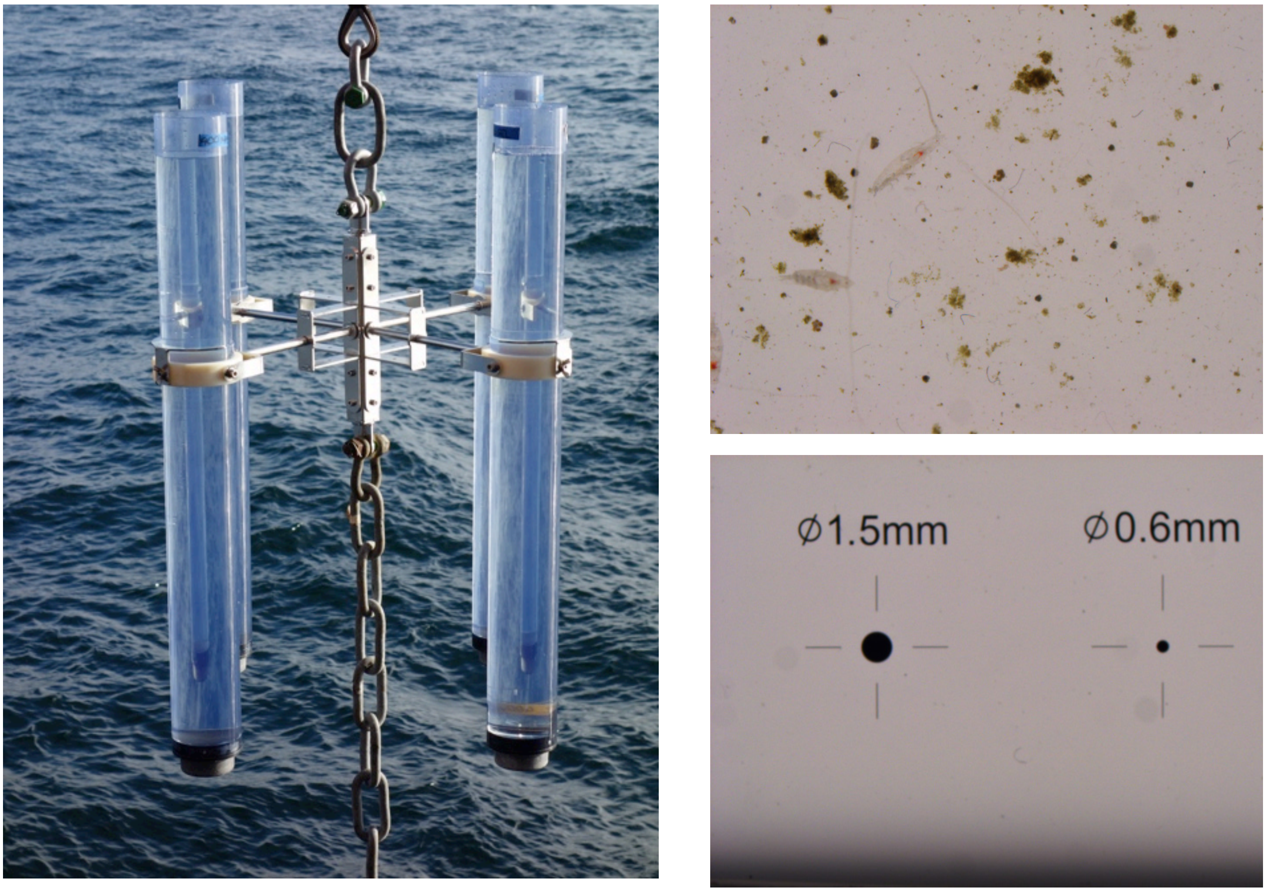

Fig. 3.8. Left column: Image of four drifting trap cylinders from one of the collection depths. One of the four cylinders contained a viscous gel that preserves the size, shape, and structure of the collected particles. Right column: Upper panel shows an image of the collected particles in the gel-trap. The lower panel provide the scale, the large black circle has a diameter of 1.5 mm and the smaller black circle has a diameter of 0.6 mm.

3.6.2 Seasonal and interannual particle fluxes measured with moored sediment traps

(Götz Ruhland, Gerit Meinecke, Marco Klann, Gerhard Fischer, and Morten Iversen)

Background

We have a long-term mass flux record from the mesotrophic study site CB starting in 1988 (Fischer et al., 2016) and from the eutrophic site CBi from 2003 onwards. Both sites are situated with in the ‘giant Cape Blanc filament (Van Camp et al., 1991) and were designed to monitor the long term (intradecadal to decadal) flux variability as well as potential trends in fluxes due to some climatic forcing or anthropogenic issues (e.g. ‘Bakun coastal upwelling intensification hypothesis’, Bakun, 1990; Cropper et al., 2014).

Sampling

As first scientific station of the cruise it was planned to recover the mooring CBi-14 and deploy it again as CBi-15 the following day. The mooring position which is located about 90 nm off Cape Blanc (Mauritania) is operated since 1988 as long term study site.

The mooring named CB-27 was deployed during Poseidon POS495 cruise around 120 nm further to the west and was also planned to be exchanged (CB-27 to CB-28). This mooring is operated as long-term monitoring station since 1988. It is situated in a mesotrophic area at the edge of the Cape Blanc filament in about 4150 m water depth. The mooring array is used to study the long-term change of particle fluxes in the Mauritanian offshore upwelling zone. The data of deployments and recoveries of the moorings are listed in Table 3.12 alongside with the sampling data of the traps.

Table 3.12. Data for recoveries and redeployments of the sediment particle trap mooring arrays. The eutrophic site CBi-14 is equipped with the Bio-Optical Platform (BOP, chapter 3.4.2).

Mooring	Position	Water Depth (m)	Interval	Instr.	Depth (m)	Intervals (no x days)
Mooring recoveries:						
Cape Blanc eutrophic						
CBi-14	20° 52.46’N	2750	25.02.16-	BOP		1251
	018° 44.74’W		27.04.17	SMT234NE	1356	1x 18.5d, 19x 21.5d
				SMT234NE	1913	1x 18.5d, 19x 21.5d
Cape Blanc mesotrophic						
CB-27	21°12.82’N	4154	22.02.16-	SMT243NE	1201	20x21.5d
	020° 52.14’W		27.04.17	SMT234NE	3616	20x21.5d
Mooring deployments:						
Cape Blanc eutrophic						
CBi-15	20°52.08’N	2750	26.01.17-	S/MT234NE		20x10.5d
	018°45.37’W		24.08.17	S/MT234NE		20x10.5d
Cape Blanc mesotrophic						
CB-28	21°12.57’N	4150	28.01.17-	BOP		
	020°52.64’W		24.08.17	S/MT234NE		1x8.5d, 19x10.5d
				S/MT234NE		

Instruments used:

SMT234 NE = particle trap, KUM, Kiel
SMT243 NE = particle trap (Titanium), KUM, Kiel
BOP = bio optical platform

Preliminary Results

After the transit from Las Palmas in the morning of January 24th, 2017 the 1500 m long mooring array CBi-14 was released and recovered. The mooring included two deep ocean sediment traps, each equipped with twenty sampling bottles. Both traps had been sampling successfully and recovered 16 samples from each of the traps on CBi-14. Our cruise was earlier than anticipated when we deployed CBi-14, hence 16 instead of 20 samples. This mooring also included the BOP system (see section 3.4.2). In the morning of January 25th, 2017, we deployed the mooring array CBi-15 with the two deep-ocean sediment traps, but without the BOP system, which were planned to be redeployed on the CB mooring.

R/V Poseidon moved immediately to the other mooring position of the CB mooring array 120 nm west of CBi. The next morning, January 26th, 2017 the recovery of CB-27 took place and the whole array was recovered successfully. The upper sediment trap yielded 16 samples while the lower trap had 15 successful samples The mooring was redeployed as CB-28 with a similar configuration of traps and the additionally installed BOP particle camera in the morning of the next day (January 27th, 2017).

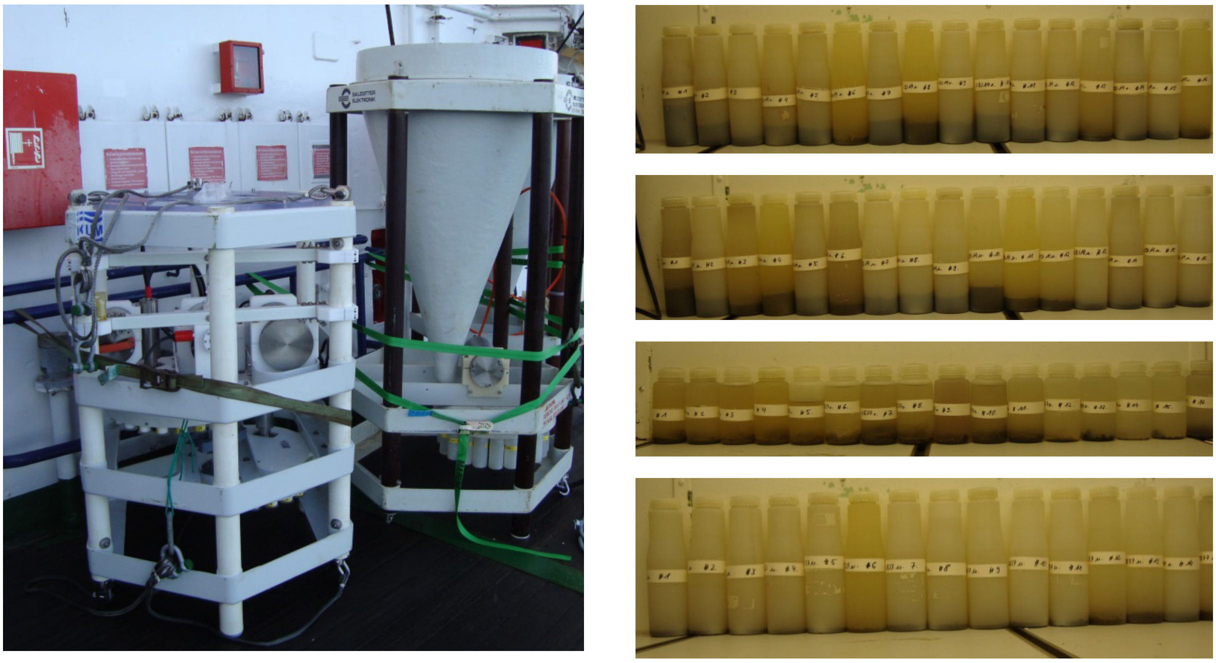

Fig. 3.9. Left column: Images of the BioOptical Platform (BOP) to the left and a deep ocean sediment trap to the right. Right column: Collection bottles from the four traps recovered during POS508. The upper two rows are for the CBi-14 mooring with the upper trap on top and the lower trap in the second row from above. The lower two rows are for the CB-27 mooring with the upper trap in the third row from above and the lower trap in the bottom row.

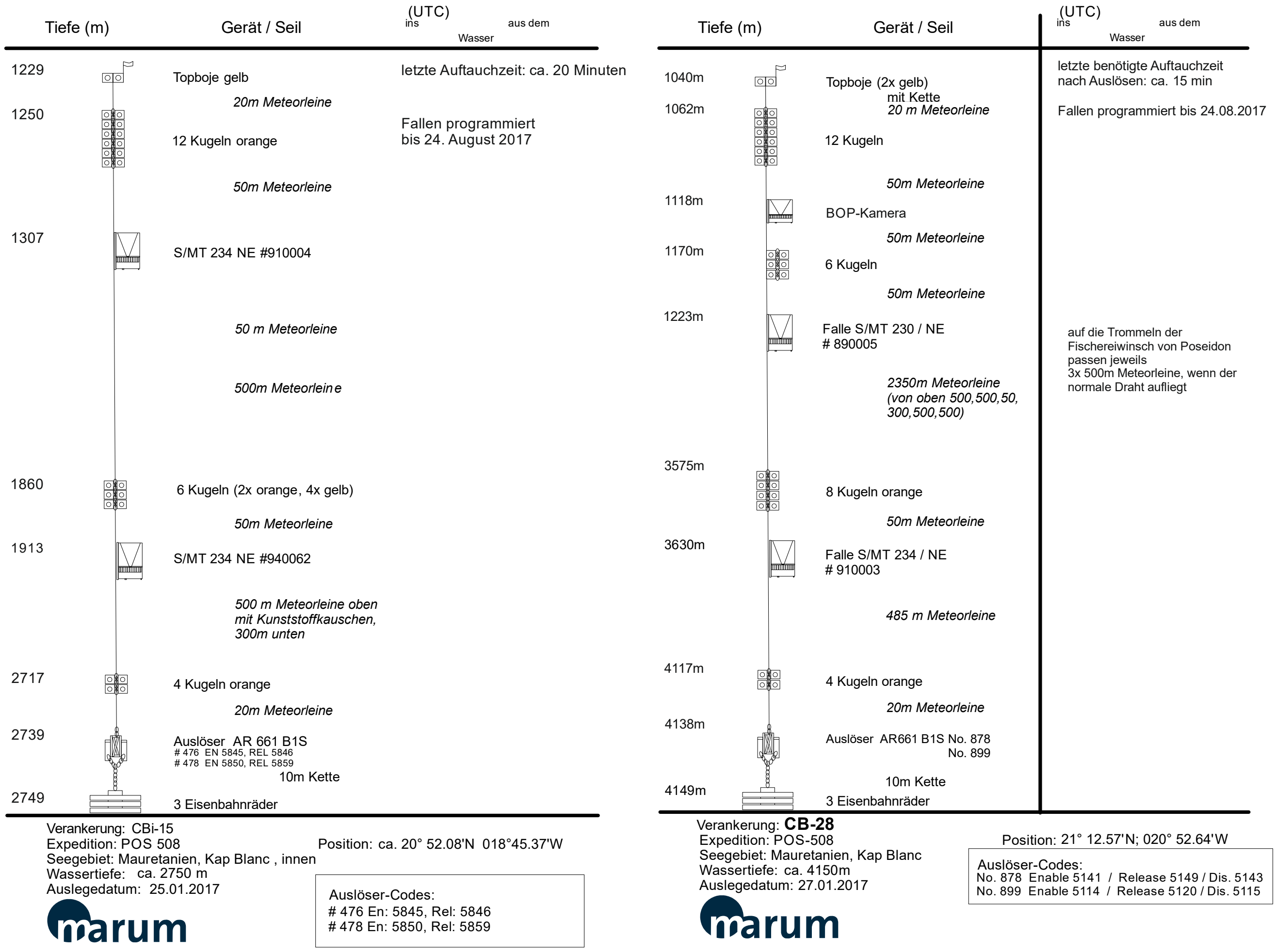

Fig. 3.10. Drawings of the mooring array CB-28 (mesotrophic, with BOP) and CBi-15 (eutrophic) deployed during the cruise. Recoveries are planned for summer 2017 with R/V Meteor.

4 Station List

GeoB#	Ship's Stat. No. POS508_	Date	Device	Time at max wire length [UTC]	Latitude [N]	Longitude [W]	Water depth [m]	Recovery / Remarks
22101-1	1	24.01.	CBi-14	9:23	20° 52.113'	18° 44.894'	2831.4	Release and recovery of sediment trap mooring. Upper and lower traps were ok. BOP ok.
22101-2	2		Secchi	13:06	20° 52.511'	18° 44.766'	2752.2	Needed two tries to get the weight correct. Secchi depth was 19 m.
22101-3	3		CTD-ROS	13:23	20° 52.461'	18° 44.794'	2755	Profile to 100 m.
22101-4	4		MSC	13:50	20° 52.516'	18° 44.762'	2753.6	Closed at 60 m
22101-5	5		ISC	15:09	20° 52.498'	18° 44.772'	2752.6	Profile to 1000 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22101-6	6		LOKI	16:30	20° 52.473'	18° 44.738'	2763.4	Profile to 1000 m with 0.5 m per sec. Net came loose from camera.
22101-7	7		MN	17:42	20° 52.469'	18° 44.719'	2771.8	Profile from 300 m. The nets did not close due to water in pressure housing.
22101-8	8		CTD-ROS	18:57	20° 52.488'	18° 44.720'	2784.7	Profile to 2678 m.
22101-9	9		ISC	21:01	20° 52.483'	18° 44.894'	2763.6	Profile to 1000 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22101-10	10		HN	21:46	20° 52.457'	18° 44.774'	2784.4	Hand-net in the upper 50 m with a mesh-size of 150 µm
22101-11	11		LOKI	22:30	20° 52.393'	18° 44.762'	2789.4	Profile to 1000 m with 0.5 m per sec.
22101-12	12	25.01.	ISP	0:18	20° 52.450'	18° 44.722'	2761	Four ISPs at depth xxx m. Filtered between 00:00 and 06:00.
22101-13	13		CBi-15	10:21	20° 51.856'	18° 45.697'	2765.2	Deployment with two sediment traps
22102-1	14		ISC	12:42	20° 55.304'	18° 59.189'	3109.9	Profile to 500 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22102-2	15		LOKI	13:24	20° 55.312'	18° 59.199'	3116.5	Profile to 500 m with 0.5 m per sec.
22103-1	16		LOKI	15:54	20° 58.196'	19° 13.297'	3354.9	Profile to 500 m with 0.5 m per sec.
22103-2	17		ISC	16:39	20° 58.194'	19° 13.292'	3359.1	Profile to 500 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22104-1	18		ISC	18:52	21° 01.107'	19° 27.414'	3526.4	Profile to 500 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22104-2	19		LOKI	19:35	21° 01.110'	19° 27.371'	3519.2	Profile to 500 m with 0.5 m per sec.
22105-1	20		LOKI	21:44	21° 03.527'	19° 41.466'	3646.3	Profile to 500 m with 0.5 m per sec.
22105-2	21		ISC	22:57	21° 03.514'	19° 41.520'	3644.2	Profile to 500 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22106-1	22	26.01.	CB-27	8:39	21° 12.524'	20° 52.350'	4155.5	Release and recovery of sediment trap mooring. Upper and lower traps were ok.
22106-2	23		Secchi	12:31	21° 12.857'	20° 52.150'	4151	Secchi depth was 17 m
22106-3	24		CTD-ROS	12:55	21° 12.863'	20° 52.100'	4152.4	Profile to 400 m.
22106-4	25		MSC	13:30	21° 12.825'	20° 52.109'	4150.1	Closed at 65 m
22106-5	26		ISC	14:33	21° 12.815'	20° 52.121'	4149.7	Profile to 1000 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22106-6	27		DF-15	15:58	21° 12.723'	20° 52.047'	4149	Drifting trap with four tubes at 100. 200. and 400 m.
22106-7	28		CTD-ROS	17:17	21° 12.796'	20° 52.186'	4151.4	Profile to 1000 m.

GeoB#	Ship's Stat. No. POS508_	Date	Device	Time at max wire length [UTC]	Latitude [N]	Longitude [W]	Water depth [m]	Recovery / Remarks
22106-8	29		LOKI	18:55	21° 12.819'	20° 52.158'	4151.8	Profile to 1000 m with 0.5 m per sec.
22106-9	30		ISC	20:18	21° 12.813'	20° 52.185'	4151.3	Profile to 1000 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22106-10	31		LOKI	21:26	21° 12.890'	20° 52.193'	4153.4	Profile to 1000 m with 0.5 m per sec.
22106-11	32		ISP	22:27	21° 12.949'	20° 52.114'	4150.6	Four ISPs. Filtered between 00:00 and 06:00.
22106-12	33	27.01.	CB-28	11:42	21° 12.302'	20° 53.175'	4166.8	Deployment with two sediment traps and the BOP systems
22107-1	34		ISC	13:18	21° 13.698'	20° 53.387'	4158.9	Profile to 1000 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22107-2	35		LOKI	14:27	21° 13.756'	20° 53.262'	4161.8	Profile to 1000 m with 0.5 m per sec.
22107-3	36		DF-15	16:01	21° 13.785'	20° 53.126'	4158.4	Recovery of drifting traps
22108-1	37		LOKI	18:28	21° 11.076'	20° 37.604'	4083.1	Profile to 500 m with 0.5 m per sec.
22108-2	38		ISC	19:17	21° 11.082'	20° 37.561'	4083.7	Profile to 500 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22109-1	39		ISC	22:02	21° 08.607'	20° 23.439'	4017.9	Profile to 500 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22109-2	40		LOKI	22:40	21° 08.638'	20° 23.485'	4017.3	Profile to 500 m with 0.5 m per sec.
22110-1	41	28.01.	LOKI	8:23	21° 06.361'	20° 09.244'	3884.7	Profile to 500 m with 0.5 m per sec.
22110-2	42		ISC	9:17	21° 06.338'	20° 09.294'	3885.2	Profile to 500 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22111-1	43		ISC	11:48	21° 04.225'	19° 55.138'	3819.8	Profile to 500 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22111-2	44		LOKI	12:32	21° 04.235'	19° 55.178'	3769.8	Profile to 500 m with 0.5 m per sec.
22112-1	45		LOKI	15:19	21° 02.064'	19° 40.580'	3644.5	Profile to 500 m with 0.5 m per sec.
22112-2	46		ISC	16:07	21° 02.085'	19° 40.591'	3677	Profile to 500 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22113-1	47		ISC	18:42	20° 59.460'	19° 26.442'	3502	Profile to 500 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22113-2	48		LOKI	19:23	20° 59.484'	19° 26.423'	3514	Profile to 500 m with 0.5 m per sec.
22114-1	49		LOKI	21:47	20° 57.339'	19° 12.271'	3349.2	Profile to 500 m with 0.5 m per sec.
22114-2	50		ISC	22:32	20° 57.457'	19° 12.302'	3348.2	Profile to 500 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22115-1	51	29.01.	ISC	8:26	20° 55.039'	18° 58.138'	3094.9	Profile to 500 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22115-2	52		LOKI	9:01	20° 55.043'	18° 58.094'	3090.8	Profile to 500 m with 0.5 m per sec.
22116-1	53		LOKI	11:30	20° 52.473'	18° 44.764'	2750.3	Profile to 500 m with 0.5 m per sec.
22116-2	54		ISC	12:15	20° 52.504'	18° 44.834'	2756.4	Profile to 500 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22117-1	55		Secchi	14:31	20° 50.177'	18° 29.563'	2143.9	Secchi depth was 18 m
22117-2	56		DF-16	15:04	20° 50.125'	18° 29.439'	2144.5	Drifting trap with four tubes at 100. 200. and 400 m.
22117-3	57		CTD-ROS	15:35	20° 50.204'	18° 29.399'	2142.4	Profile to 400 m.
22117-4	58		MSC	16:23	20° 50.195'	18° 29.528'	2143.6	Closed at 65 m
22117-5	59		ISC	17:20	20° 50.170'	18° 29.436'	2152.5	Profile to 1000 m with 0.3 m per sec.

GeoB#	Ship's Stat. No. POS508_	Date	Device	Time at max wire length [UTC]	Latitude [N]	Longitude [W]	Water depth [m]	Recovery / Remarks
								Upcast with 0.5 m per sec.
22117-6	60		LOKI	18:27	20° 50.144'	18° 29.441'	2141.3	Profile to 1000 m with 0.5 m per sec.
22117-7	61		CTD-ROS	19:32	20° 50.175'	18° 29.450'	2142.3	Profile to <2100 m.
22117-8	62		HN	20:12	20° 50.159'	18° 29.472'	2139.9	Hand-net in the upper 50 m with a mesh-size of 150 µm.
22117-9	63		LOKI	20:36	20° 50.074'	18° 29.457'	2138.4	Profile to 500 m with 0.5 m per sec.
22117-10	64		ISC	21:23	20° 50.112'	18° 29.404'	2136.3	Profile to 500 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22117-11	65		ISP	22:13	20° 50.110'	18° 29.420'	2151.3	Four ISPs. Filtered between 00:00 and 06:00.
22118-1	66	30.01.	ISC	10:44	20° 45.346'	18° 30.238'	1919.7	Profile to 1000 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22118-2	67		LOKI	11:46	20° 45.180'	18° 30.261'	1910.5	Profile to 1000 m with 0.5 m per sec.
22118-3	68		Secchi	12:20	20° 44.975'	18° 30.304'	1903	Secchi depth was 14 m
22118-4	69		CTD-ROS	13:01	20° 44.881'	18° 30.280'	1897.9	Profile to 1850 m.
22118-5	70		DF-16	14:22	20° 45.218'	18° 30.402'	1918.1	Recovery of drifting traps.
22118-6	71		MSC	14:58	20° 45.171'	18° 30.323'	1911.7	Closed at 65 m.
22119-1	72		ISC	18:01	20° 47.547'	18° 15.372'	1843	Profile to 1000 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22119-2	73		LOKI	19:03	20° 47.577'	18° 15.363'	1845.5	Profile to 1000 m with 0.5 m per sec.
22119-3	74		CTD-ROS	20:08	20° 47.561'	18° 15.386'	1849.8	Profile to 1900 m.
22119-4	75		ISC	21:12	20° 47.527'	18° 15.305'	1841.4	Profile to 500 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22119-5	76		LOKI	21:46	20° 47.534'	18° 15.343'	1843.1	Profile to 500 m with 0.5 m per sec.
22119-6	77		HN	22:02	20° 47.519'	18° 15.317'	1840.3	Hand-net in the upper 50 m with a mesh-size of 150 µm.
22119-7	78		ISP	22:44	20° 47.566'	18° 15.343'	1847.6	Four ISPs. Filtered between 00:00 and 06:00.
22120-1	79	31.01.	CTD-ROS	10:53	20° 45.304'	18° 01.232'	1171.3	Profile to 400 m.
22120-2	80		LOKI	11:47	20° 45.367'	18° 01.218'	1175.1	Profile to 1000 m with 0.5 m per sec.
22120-3	81		ISC	13:18	20° 45.393'	18° 01.206'	1159.1	Profile to 1000 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22120-4	82		Secchi	13:55	20° 45.398'	18° 01.263'	1176.9	Secchi depth was 13 m.
22120-5	83		CTD-ROS	14:29	20° 45.461'	18° 01.233'	1180.7	Profile to 1168 m.
22121-1	84		ISC	17:36	20° 43.013'	17° 47.190'	557	Profile to 500 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22121-2	85		LOKI	18:13	20° 43.028'	17° 47.173'	557.5	Profile to 500 m with 0.5 m per sec.
22121-3	86		CTD-ROS	18:46	20° 43.040'	17° 47.158'	558.3	Profile to 550 m.
22121-4	87		HN	20:02	20° 44.374'	17° 46.779'	619.7	Hand-net in the upper 50 m with a mesh-size of 150 µm.
22122-1	88	01.02.	CTD-ROS	8:15	20° 41.630'	17° 39.987'	270	Cable failure. Exchanged plug.
22122-2	89		CTD-ROS	9:59	20° 41.686'	17° 39.819'	295	Profile to 290 m.
22122-3	90		LOKI	10:26	20° 41.690'	17° 39.806'	289.4	Profile to 260 m with 0.5 m per sec.
22122-4	91		ISC	10:52	20° 41.709'	17° 39.833'	289	Profile to 260 m with 0.3 m per sec.

GeoB#	Ship's Stat. No. POS508_	Date	Device	Time at max wire length [UTC]	Latitude [N]	Longitude [W]	Water depth [m]	Recovery / Remarks
								Upcast with 0.5 m per sec.
22122-5	92		ISP	11:20	20° 41.702'	17° 39.899'	289	Four ISPs. Filtered for four hours.
22123-1	93		LOKI	18:39	20° 44.099'	17° 54.035'	833.9	Profile to 500 m with 0.5 m per sec.
22123-2	94		ISC	19:38	20° 44.156'	17° 54.077'	839	Profile to 820 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22124-1	95		ISC	22:20	20° 46.345'	18° 08.056'	1518.8	Profile to 500 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22124-2	96		LOKI	22:57	20° 46.312'	18° 07.891'	1514.9	Profile to 500 m with 0.5 m per sec.
22125-1	97	02.02.	LOKI	8:36	20° 49.016'	18° 22.198'	2017.7	Profile to 500 m with 0.5 m per sec.
22125-2	98		ISC	9:21	20° 48.910'	18° 22.087'	1952.8	Profile to 500 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22126-1	99		CTD-ROS	12:18	20° 51.256'	18° 36.393'	2387	Profile to 400 m.
22126-2	100		Secchi	12:49	20° 51.284'	18° 36.387'	2388.2	Secchi depth was 13 m
22126-3	101		DF-17	13:20	20° 51.169'	18° 36.233'	2375.4	Drifting trap with four tubes at 100. 200. and 400 m.
22126-4	102		MSC	13:35	20° 51.233'	18° 36.159'	2374.1	Closed at 65 m.
22126-5	103		ISC	14:32	20° 51.296'	18° 36.147'	2379.4	Profile to 1000 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22126-6	104		LOKI	15:44	20° 51.323'	18° 36.253'	2384.6	Profile to 1000 m with 0.5 m per sec.
22126-7	105		CTD-ROS	17:01	20° 51.323'	18° 36.390'	2389.7	Profile to 2365 m.
22126-8	106		LOKI	18:08	20° 51.301'	18° 36.363'	2385.1	Profile to 500 m with 0.5 m per sec.
22126-9	107		ISC	18:55	20° 51.289'	18° 36.412'	2393.7	Profile to 500 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22126-10	108		ISC	19:28	20° 51.273'	18° 36.393'	2387.8	Profile to 200 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22126-11	109		ISC	19:53	20° 51.280'	18° 36.369'	2389.4	Profile to 200 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22126-12	110		ISC	20:17	20° 51.269'	18° 36.344'	2385.5	Profile to 200 m with 0.3 m per sec. Upcast with 0.5 m per sec.
22126-13	111		ISP	21:16	20° 51.245'	18° 36.279'	2378	Three ISPs. Filtered for four hours.
22126-14	112	03.02.	DF-17	8:52	20° 46.992'	18° 37.079'	2424	Recovery of drifting traps.
22126-15	113		CTD-ROS	9:35	20° 46.848'	18° 36.729'	2397.3	Profile to 400 m.

Instruments/Devices used:

CB-27/28	mesotrophic sediment trap moorings off Cape Blanc, Mauritania, CB-28 with BOP
CBi-14/15	eutrophic sediment trap mooring, CBi-14 with BOP
DF-15-16-17	Drifting trap, each with 3 traps in the epi- and mesopelagic
ROS + CTD fluorescence sensor	Multi-water sampler (rosette) with 12 x 10l bottles and CTD-SBE 5 (Geomar), with oxygen and
MSC	Marine Snow Catcher (100 l volume)
In Situ Camera	Particle Camera System with infrared light, profiling
LOKI	Plankton net equipped with a camera system to make high vertical resotion of zooplankton abundance
ISP:	In Situ Pumps (4 each time)
MN:	multinet (5 depth ranges) with 200µm mesh size, standard depths: 300-150,150-100,100-80,80-40,40-0m
HN	handnet (75µm), generally lowered down to 50m
Secchi disc	Secchi depth/transparency

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6 References

Behrenfeld, M. J., Falkowski, P. G. (1997) Photosynthetic rates derived from satellite based chlorophyll concentration. Limnol. Oceanogr., 42, 1-20.

Carr, M.-E.: (2002) Estimation of potential productivity in Eastern Boundary Currents using remote sensing. Deep-Sea Res. Pt. 1, 49, 59-80.

Fischer, G. and cruise participants. (2016) Report and preliminary results of R/V POSEIDON cruise POS495. Las Palmas (Canary Islands) – Las Palmas (Canary Islands). 18.02.2016 – 02.03.2016. Berichte Marum – Fachbereich Geowissenschaften, No. 310, 29 pages, 2016.

Fischer, G., Iversen, M., Nowald, N., Reuter, C., Ruhland, G., Ratmeyer, V., Klann, M. and G. Wefer (2016) Deep ocean particle flux in the coastal upwelling off Mauritania from 1988 to 2012: variability on seasonal to decadal timescales. Biogeosciences, 13, 3071-3090.

Iversen, M. H., Nowald, N., Ploug, H., Jackson, G. A., Fischer, G. (2010) High resolution profiles of vertical particulate organic matter export off Cape Blanc, Mauritania: degradation processes and ballasting effects. Deep-Sea Res. Pt. I, 57, 771-784.

Muller-Karger, F. E., Varela, R., Thunell, R., Luerssen, R., Hu, C., Walsh, J. J. (2005) The importance of continental margins in the gloal carbon cylce. Geophys. Res. Lett., 32, L01602, doi:10.1029/2004GL021346.

Nowald, N., Iversen, M.-H., Fischer, G., Ratmeyer, V. Wefer, G. (2015) Time series of in-situ particle properties and sediment trap fluxes in the coastal upwelling filament off Cape Blanc, Mauritania. Prog Oceanogr., http://dx.doi.org/10.1016/j.pocean.2014.12.015

Pauly, D. Christensen, V. (1995) Primary production required to sustain global fisheries. Nature, 374, 255-257.

van der Jagt, H., Friese, C., Stuut, J.-B., Fischer, G., Iversen, M. H. (accepted) The ballasting effect of Saharan dust deposition on aggregate dynamics and carbon export: Aggregation, settling, and scavenging potential of marine snow. Limnol. Oceanogr. Accepted.

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No. 297 – Kopf, A. and cruise participants (2013). Report and preliminary results of R/V SONNE cruise SO222. MEMO: MeBo drilling and in situ Long-term Monitoring in the Nankai Trough accretionary complex, Japan. Leg A: Hong Kong, PR China, 09.06.2012 – Nagoya, Japan, 30.06.2012. Leg B: Nagoya, Japan, 04.07.2012 – Pusan, Korea, 18.07.2012. 121 pages.

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