POSEIDON -Berichte

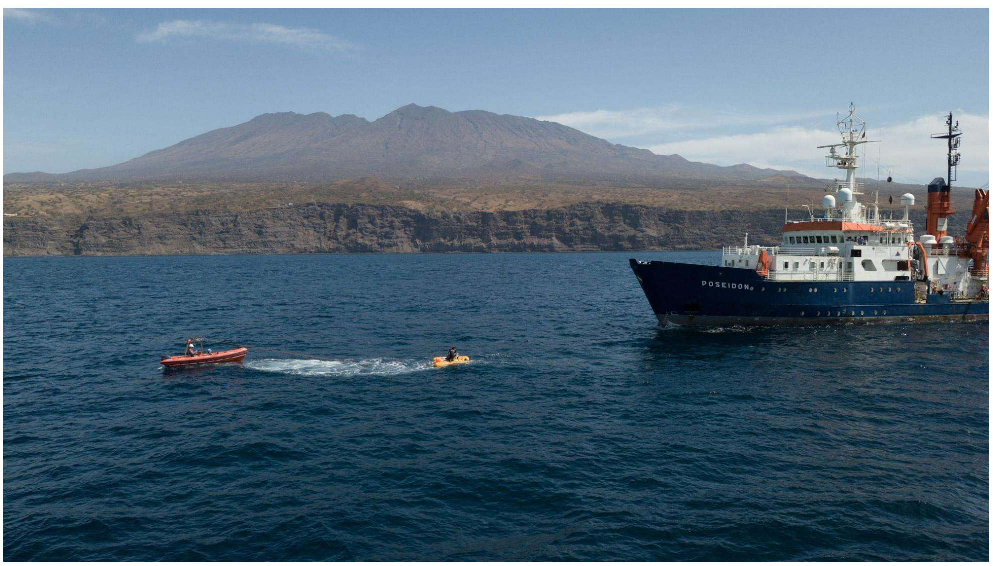
The role of gelatinous macrozooplankton in deep-sea carbon transport in Cape Verde

Cruise No. POS532

4/2/2019 – 24/2/2019,

Mindelo (Republic of Cape Verde) – Mindelo (Republic of Cape Verde)

DeepC-Jelly



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1 Cruise Summary

1.1 Summary in English

We proposed to test the hypothesis that large gelatinous macrozooplankton (e.g. tunicates, hydrozoans) are a significant carbon storage in midwater, and a vector for carbon from midwater to the ocean floor in Cape Verde. To test this hypothesis, we studied 1) the distribution, diversity and abundance of gelatinous organisms in the epi-, meso-, and bathypelagic zone, 2) their role in transporting carbon through the pelagic foodweb to the seafloor and 3) their behavior and associations. We worked in the coastal deep sea off Santo Antão and Fogo as well as in the open ocean at the time series station CVOO and an eddy. A manned submersible was used for mesopelagic surveys, to document the behaviour and associations of deep-sea organisms and to collect living specimens. We performed pelagic video transects, discrete net sampling, and eDNA sampling down to 3000 m. ADCP and CTD transects allowed a detailed reconstruction of the effect of the islands on currents and productivity. To quantify the carbon flux of pelagic foodfalls, we also surveyed the seafloor. Sample and video analysis is still in progress, but first results indicate the impact of the pelagic tunicate *Pyrosoma atlanticum,* which is an upwelling-favored species largely absent from the oligotrophic open ocean, in the nearshore regions of Cape Verde as well as in the cyclonic eddy sampled. It was also observed on the seafloor and resembles a food source and a habitat in the water column and in the benthos. Specimens of pelagic fauna were collected that allow new species descriptions. New records and a new species for the region were also observed during benthic surveys. The cruise was documented in various outreach activities including national television in Cabo Verde .

1.2 Zusammenfassung

Unsere Untersuchungen sollten zeigen, ob die Rolle des gelatinösen Makrozooplankton (z.B. Tunikaten und Hydrozoen) im Nahrungsnetz und als Kohlenstoffspeicher im Pelagial sowie als Vektoren für den Transport von der Wassersäule zum Meeresboden bisher unterschätzt wird. Unsere Ziele für der Forschungsreise POS532 waren daher, 1.) die Verteilung, Diversität und Abundanz dieser Organismen in der epi-, meso- und bathypelagischen Zone zu bestimmen, 2.) ihre Rolle im Kohlenstofftransport zu charakterisieren und 3.) ihr Verhalten und Assoziationen zu erforschen. Wir arbeiteten küstennah vor den Inseln Santo Antao und Fogo sowie ozeanisch an der Zeitserienstation CVOO und in einem Eddy. Ein bemanntes Tauchboot wurde genutzt, um das Verhalten von pelagischen Organismen und die Lebensgemeinschaft in der mittleren Wassersäule zu beschreiben und um schonend lebende Tiere zu sammeln. Es wurden Videotransekte mit einem geschleppten Kamerasystem sowie vertikal aufgelöste Netzfänge bis 3000m durchgeführt. Um den Kohlenstofftransport durch „Jelly Foodfalls“ zu bestimmen, wurden zeitlich und räumlich aufgelöste Beobachtungen am Meeresboden mit dem Tauchboot und dem geschleppten Kamerasystem OFOS gemacht. Die Proben- und Videoanalysen sind noch nicht beendet, jedoch zeigen erste Ergebnisse bereits den Einfuß des pelagischen Manteltiers Pyrosoma atlanticum. Diese Art profitiert von Auftrieb und ist im oligotrophen offenen Ozean nicht oder kaum vorhanden, wurde aber nahe der Inseln und in dem Zyklon in großer Zahl beobachtet. Es wurde auch an den Hägen der Inseln am Meeresboden gefunden und repräsentiert sowohl ein Substrat/Habitat in der Wassersäule wie auch eine Nahrungsquelle für benthische Organismen. Weiterhin wurden Exemplare pelagischer Arten gesammelt, die noch nicht beschrieben sind (und dies nun ermöglichen). Auch während der benthischen Beobachtungen wurde mindestens eine Art beobachtet, die bisher in der Region noch nicht erfasst wurde. Die Fahrt war Gegenstand verschiedener Aktivitäten in der Öffenlichkeitsarbeit, einschließlich eines Berichts im öffentlichen Fernsehen der Republik Cabo Verde.

2 Participants

2.1 Principal Investigators

Name	Institution
Hoving, Henk-Jan, Dr.	GEOMAR Helmholtz Centre for Ocean Research Kiel
Hauss, Helena, Dr.	GEOMAR Helmholtz Centre for Ocean Research Kiel

2.2 Scientific Party

Name	Discipline	Institution
Hoving, Henk-Jan, Dr.	Marine Biology/ Chief Scientist	GEOMAR
Hauss, Helena, Dr.	Biological Oceanography	GEOMAR
Hans, Anna Christina	Physical Oceanography	GEOMAR
Hampe, Hendrik	Marine Technology	GEOMAR
Fabrizius, Eduard	Marine Technology	GEOMAR
Hissmann, Karen	JAGO team	GEOMAR
Schauer, Jürgen	JAGO team	GEOMAR
Striewski, Peter	JAGO team	GEOMAR
Scheer, Stella	Marine Biology	GEOMAR
Freitas, Rui	Marine Biology	Universidade Cabo Verde
Osborn, Karen	Marine Biology	Smithsonian Institution

2.3 Participating Institutions

GEOMAR	Helmholtz-Zentrum für Ozeanforschung Kiel
SI	Smithsonian Institution
Uni CV	Universidade Cabo Verde

2.4 Crew

Name	Rank
Günther, Matthias	Kapitän / Master
Thürsam, Dirk	1. Offizier / 1. Naut. Officer
Franke, Remo	2. Offizier / 2. Naut. Officer
Rusik, Michael	Ltd. Ingenieur / 1. Engineer
Pieper, Carsten	2. Ingenieur / 2. Engineer
Neitzel, Gerd	Elektriker / Electrician
Langhans, Julian	Motorenwart / Motorman
Mischker, Joachim	Bootsmann / Bosun
Schrage, Frank	Schiffsmechaniker / Sea man
Kuhn, Ronald	Schiffsmechaniker / Sea man
Heßelmann, Dirk	Schiffsmechaniker / Sea man
Argetoianu, Ionut-Georgel	Schiffsmechaniker / Sea man
Maas, Matthias	Schiffsmechaniker / Sea man
Kluge, Sylvia	Stewardess
Kosanke, Patrick	Koch / cook

3 Research Program

3.1 Description of the Work Area

The working area was the Cape Verde region (Figure 3.1). The high concentrations of pelagic macrozooplankton in the coastal island waters of Cape Verde, as observed during POS520, provide ideal conditions to study the carbon flux associated with larger invertebrates. We mostly worked in the lee side of the islands Santo Antão and Fogo. These sites have been chosen because they allow repeat observations from POS520 and should provide detailed insight in the carbon flux associated with pyrosomes, larvaceans and other pelagic fauna. From the POS520 cruise and also now during POS532 we have experienced that the lee sides of these islands are ideal locations for studying deep-sea biology and ecological processes. We were able to execute an extensive research program including JAGO deployments with reduced chance of ship time loss due to bad weather. The newly established Ocean Science Centre Mindelo OSCM allowed for efficient logistic support. The Cape Verde region is the focus of large interdisciplinary research projects of GEOMAR. The sampling at the time series station CVOO, north of Mindelo, extended the biogeochemical, physical and ecological time series and allowed for comparison with our coastal sampling. The POS532 cruise, together with the previous POS520 cruise, is also be the baseline for an ecological time series in a coastal deep-sea area, in the Bay of Tarrafal.

The Cape Verde area is a hotspot for mesoscale eddies. Off the West African coast between Mauritania and Senegal, numerous eddies are generated throughout the year and propagate westward. In particular anticyclonic modewater eddies that contain the subsurface signature of the poleward undercurrent carry extremely isolated water masses. During their lifetime, which may be up to a year, oxygen consumption in their core leads to "open ocean dead zones" (Karstensen et al. 2015, Hauss et al. 2016) that pass the Cape Verde archipelago, mostly in boreal winter/spring. Such an eddy was within reach during POS532, and we could perform a detailed survey on it.

3.2 Aims of the Cruise

The overall goals were:
1) to establish a baseline of distribution, diversity and abundance of pelagic fauna in the Cape Verde deep sea from the surface the bathypelagic zone,
2) to investigate the variability of the baseline conditions by performing repeat observations (at Fogo, and the time series station CVOO) and to initiate a deep-sea ecological time series off Santa Antão, Bay of Tarrafal
3) to identify and quantify the ecological links between the epi- meso- and bathypelagic zones, and the seafloor with specific emphasis on the role of pelagic tunicates in carbon transport
4) to investigate the behaviour and associations of deep-sea organisms *in situ*
5) to investigate the trophic relationships of pelagic and benthic organisms
6) to characterize the island mass effect off Santo Antão (windward islands) and Fogo (leeward islands)
7) to characterize the impact of a productive mesoscale feature (either eastern boundary eddy or island induced eddy/filament) on the pelagic community
8) to extend the biogeochemical, physical and ecological CVOO time series data set

3.3 Agenda of the Cruise

The reach the above objectives, the overall agenda of the cruise was to sample an inshore and offshore station off the islands of Santo Antao and Fogo and to perform an extensive sampling and observation program at these islands to document the pelagic biodiversity and to establish the role of gelatinous fauna in the transport of carbon to the seafloor. In addition to these two research sites we performed standard sampling at the time series station CVOO, and sampled a mesoscale eddy.

Table 1: The working program of the cruise as defined in the proposal

Day #	Station	Comment	Transit (h)	Main Work Plan
1	1	leave Mindelo 09:00	3	JAGO test dive, deploy lander
2	1	Santo Antão coastal	0	Mesopelagic survey (PELAGIOS & Multinet D/N, CTD)
3	1	Santo Antão coastal	0	MSS transect 1 during night; 2 x JAGO dives
4	2	Santo Antão offshore	2.5	Bathypelagic survey (PELAGIOS & Multinet D/N, CTD)
5	1	Santo Antão coastal	2.5	2 x JAGO dives
6	1	Santo Antão coastal	5	CTD section (transect 1); OFOS survey; recovery lander
7	1	Santo Antão coastal	0	MSS transect 1 during night; 2 x JAGO dives
8	3	transit to Fogo coastal	20	deploy lander; CTD section (transect 2)
9	3	Fogo coastal	2.2	2 x JAGO dives
10	3	Fogo coastal	0	Mesopelagic survey (PELAGIOS & Multinet D/N, CTD)
11	3	Fogo coastal	0	MSS transect 2 during night; 2 x JAGO dives
12	4	Fogo offshore	2.2	Bathypelagic survey (PELAGIOS & Multinet D/N CTD)
13	3	Fogo coastal	2.2	MSS transect 2 during night; 2 x JAGO dives
14	3	Fogo coastal	0	OFOS survey; recover lander
15		transit to Eddy	max 24hrs	
16	5	Eddy		CTD and MSS section (transect 3)
17	5	Eddy Core		Mesopelagic survey (PELAGIOS & Multinet D/N, CTD)
18	6	Eddy Reference	5	Mesopelagic survey (PELAGIOS & Multinet D/N, CTD)
19		transit to CVOO	max 24hrs	
20	7	CVOO		Bathypelagic survey (PELAGIOS & Multinet D/N, CTD)
21		transit to Mindelo	7.5hrs	

The plan was to perform pelagic video transects and observations using the manned submersible JAGO and the towed camera platform PELAGIOS, and to collect organisms using the multinet maxi and midi at Santo Antao, Fogo and CVOO. (Aim 1 and 2). We combined the pelagic faunal observations of pelagic tunicates with seafloor observations to quantify the carbon flux associated with these organisms. Originally, we proposed to bring a deep-sea lander on board but this was not possible due to logistics and personnel (Aim 3). Using the pelagic observations obtained with JAGO and PELAGIOS we aimed to describe the associations and trophic relations between pelagic organisms (Aim 4, 5). By performing transects with ADCP and EK80 the aim was to quantify the island mass effect on oceanography and productivity off Santo Antão (windward islands) and Fogo (leeward islands) (aim 6). We did not perform the microstructure measurements. By tracking local mesoscale features via regular satellite inspections, a prominent and interesting mesoscale feature was identified and followed to launch a biological and oceanographic observation and sampling program in the mesoscale feature, as well in a reference region (aim 7). At the time series station CVOO we planned to perform standard sampling of biogeochemical, physical and biological parameters (aim 8).

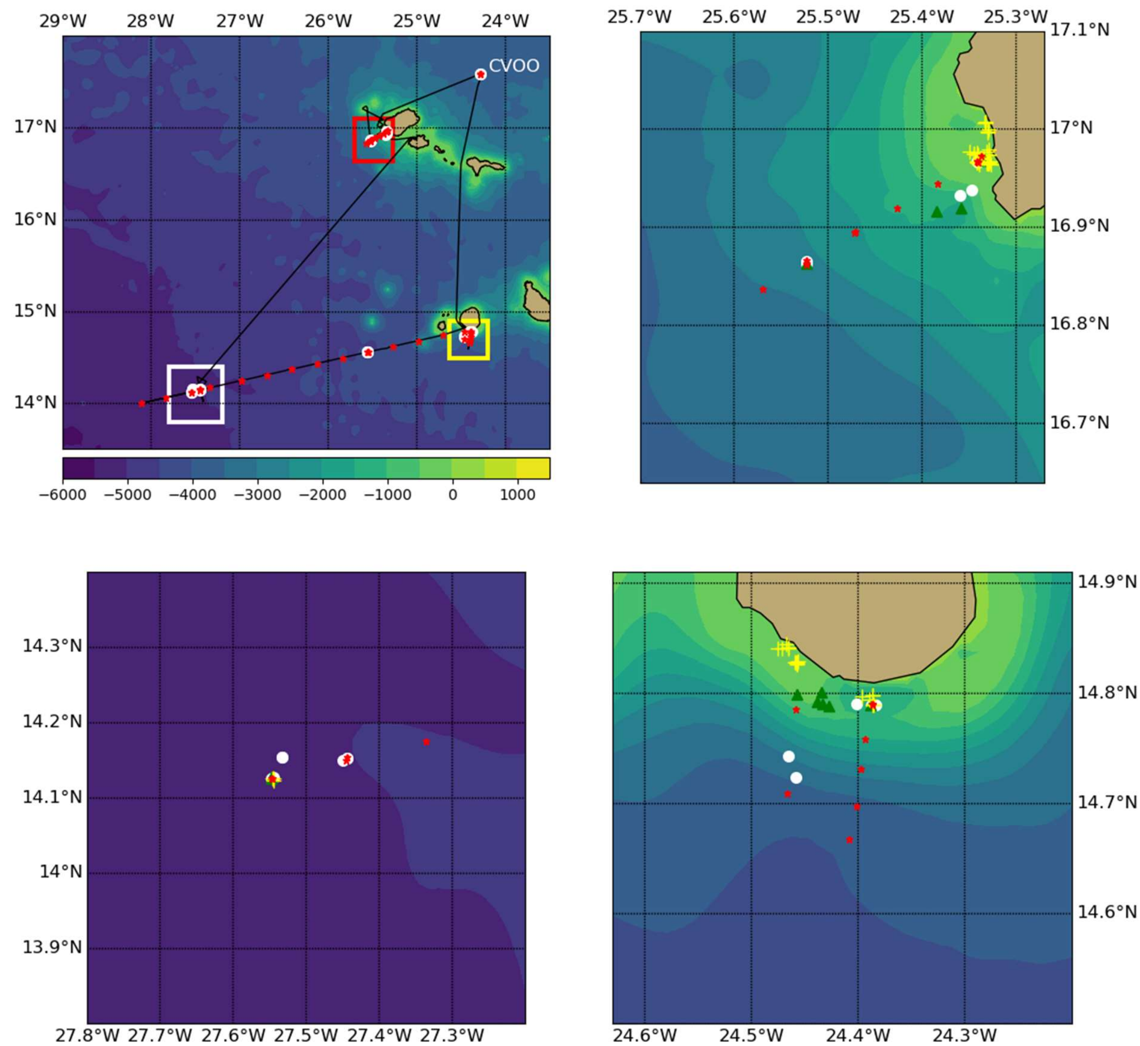

Fig. 3.1 Track chart of POS532 (panel A) with the three main working areas (Santo Antão, Fogo, Eddy) indicated as boxes and enlarged in panels B, C and D, respectively. Positions of CTD, Multinet, PELAGIOS and JAGO deployments are indicated with red stars, white circles, green triangles and yellow crosses, respectively.

4 Narrative of the Cruise

On 3/2/2019 we embarked on POSEIDON for POS532 at 14.30 and we started with a meeting with the captain and crew about the planning of activities on POS532. We then mobilized and prepared the lab until 20.00. The day before the advance party loaded the Werner winch on board, which was not easy due to the limited capacity of the crane, and the submersible container. The submersible JAGO team started with mobilization at the same day.

On 4/2/2019 at 8.15 we had a safety briefing and at 11.00 we had an inspection for stow aways. At 11.00 Jens Klimmeck made drone recordings of the POSEIDON in Mindelo harbor. Due to the significant swell we made sure to secure our lab equipment properly for departure out of the harbor to our first research site in the Bay of Tarrafal off the island Santo Antao. The ADCP was lowered into the moonpool in the harbor so the acoustic data collection could be started immediately after leaving port. The transducers of the USBL system and the EK80 echosounder were mounted on the starboard instrument pole. The first technical challenges consisted of the preparation of the fibre optic telemetry of PELAGIOS and the compatibility with the Werner winch. Lab preparations included setting up the eDNA filtering system and the photographic equipment as well as the multinet sieving and preserving station.

The POSEIDON left the port of Mindelo at 13.00 and arrived in the first working area at around 16.00. At 18.00 we had a test dive with JAGO and this showed major technical problems with the pressure air compensation system of the submersible. Water had entered the pressure compensated areas (stern thrusters, hydraulic system and submersible pump of the suction sampler). Our schedule had to be changed, and the JAGO team made a very long day to get rid of the saltwater in the pressure compensated parts to prevent corrosion of those parts.

We started a W2 program on 5/2/2019 at 06.00, starting with CTD casts at an offshore station as part of a CTD transect. At 13.00-14.00 the sea became too rough to allow for JAGO repairs on the shallow deck of POSEIDON and we postponed the last two offshore CTD stations. We therefore headed back inshore and used the JAGO repair time for further preparation of PELAGIOS and the USBL system. During the night we performed an acoustic survey.

On 6/2/2019 we started a W2 program at the offshore station, also to finish the CTD transect that we started before, and to perform a small multinet, a bathypelagic PELAGIOS tow and a bathypelagic eDNA sampling. We finished the CTD transect and performed a bathypelagic eDNA sampling at 1000, 1300, 1600 and 1900 in triplicates using the “dripping method”. While we planned an offshore bathypelagic PELAGIOS tow, we again discovered that the waters were too rough for the JAGO team to repair the submersible. Therefore we decided to go back inshore for a mesopelagic PELAGIOS tow and continue the JAGO repair. We faced problems with the PELAGIOS CTD unit and after switching to a depth sensor we discovered that the housing of this new sensor rated for 3000 m was flooded at <50 m. We performed a 500 m CTD at 15.00. Inshore we performed a PELAGIOS tow until 22.35.

On 7/2/2019 we started with a JAGO dive in the morning. A small leackage was discovered but this was quickly solved and the dive could continue. The dive was an open water survey with a short visit to the seafloor at 380 m bottom depth. On the seafloor we recorded pyrosomes and we made detailed observations of fishes. The second JAGO dive at 14.00 by Jürgen and Karen Osborn was successful. Captured organisms included a *Praya*, squid and amphipods. During this dive, however, the new EvoLogics USBL system was not working properly and it was questionable if we could dive the day after. In the evening the EvoLogics USBL system was switched to an older ORE Trackpoint 3 system which solved the navigation problems. A dust storm was not making the work easier, the filters of the Werner winch were being clogged.

On 8/2/2019 we performed two JAGO dives, one with HJ Hoving and one with the two JAGO pilots Peter Striewski and Jürgen Schauer. We captured the first ever specimens of Atlantic *Poeobius*, a pelagic polychaete worm which was only recently discovered in the Atlantic Ocean (Christiansen et al 2018). The specimens now allow a species description. Additional faunal collections included *Lilyopsis*, *Phronima*, *Doliolula* (*Doliolula* is also unknown from the region). Preparation work on the fibre optic telemetry continued, and the Ocean Floor Observation System was prepared for the next day. A CTD was performed at the 1000 m site followed by a small multinet to try to catch more *Poeobius*. At 20.00 we did another JAGO dive with Helena Hauss as the scientist. They captured another *Poeobius*, now a mature female with eggs and observed other organisms including a snipe eel. At midnight we performed an acoustic survey with EK80 from the inshore station to the offshore station.

An OFOS started on the morning of 9/2/2019 at 8.30. Connection failure of the fibre optics started at 700 m of depth. The OFOS was recovered and the conducting cable was reterminated, and the survey continued (from a depth of 570-1000 m) until 14.30. We then steamed offshore for a PELAGIOS deployment and a CTD cast. At 19:00 we completed a bathypelagic CTD sampling during which we sampled water at 1300, 1600, 1900 and 2200 m for eDNA. The plan was to deploy PELAGIOS but four of the LED arrays broke down during a test on deck. We then continued with a Multinet, CTD and ADCP during the night.

We started 10/2/2019 with an inshore JAGO dive, a survey along the seafloor between 310 and 380 m depth. In the meantime on deck the A-frame was being prepared for Werner winch operations and the deployment of the large multinet over the W6 winch. The JAGO dive was done by Peter Striewski and Jürgen Schauer and they collected pyrosomes from the seafloor for our work on bentho-pelagic coupling. The second JAGO dive of the day, again a bottom survey, was done by Jürgen and Rui Freitas. The dive was focused on benthic biodiversity observations on the slope environment. The dive ended at 17.30. The observed zonation in the slope during the JAGO dive was also observed in the OFOS survey on the following day.

In the morning of 11/2/2019 we started with an OFOS survey from 350-770 m, performing a benthic survey to quantify pyrosome foodfalls, as well as benthic biodiversity. The survey was fine but the deployment was stopped at 11.00 because the terrain became too ruggid, with sharp rocks. We then deployed a multinet maxi over the W6 winch. After a test deployment we then had a successful tow but we did not catch the pyrosomes we expected. We proceeded with the PELAGIOS system over the W6 winch. This is the first deployment of the new system and the fibre optic connection was stable. We stopped the PELAGIOS at 17.30 and continued with a multinet. We then steamed offshore for a deep CTD for eDNA collection. During the night we steamed back to the 400 m site so we could start the next day with a JAGO dive. This JAGO dive in 400 m depth on 12/2/2019 had a multi purpose; seafloor observations for pyrosomes, fish observations for Rui Freitas and a training dive for submersible pilot Peter Striewski. In the afternoon we had two short JAGO dives, both with Peter Striewski as the pilot and one with Stella Scheer and the other with Eduard Fabrizius as observer.

After the JAGO dives we proceeded to the time series station Cape Verde Ocean Observatory, which is a transit of 9 hours, to collect the standard set of samples (Nutrients, DIC, paired day/nigth multinet haul) for this time series station.. In addition, we collected eDNA samples and deployed a PELAGIOS over the W6. At the end of the day, when leaving the station, we took a small detour to look for the surface buoy of the CVOO mooring. We had two positions where it was last seen by GEOMAR colleagues and the captain steered the ship in between those points. From the bridge we could spot the buoy in the high swell and bright sunshine. We photographed the mooring and communicated the position to the responsible scientists at GEOMAR. Then we transited to our next research site, the island of Fogo.

In the morning of Valentine’s day (14/2/2019) we started with a JAGO dive in the leeway of Fogo. We observed knife fishes vertically oriented. We captured *Poeobius* as well as many different amphipod species. We performed a CTD cast before we proceeded with the second JAGO dive of the day, which was with Karen Osborn as the scientist.

The next two days (15/2/2019 and 16/2/2019) were focused on deploying vertical and towed instruments over the W2 and W6 winch, and the Werner winch. We performed a PELAGIOS deployment, followed by a multinet maxi and another PELAGIOS deployment. The PELAGIOS was equipped with two cameras, one fish eye lens and another camera with a fixed 80° angle. The scenery off Fogo is really spectacular and the high topography provided calm conditions for our operations. We deployed the PELAGIOS and Multinet maxi during the day and during the night to document the migration of pelagic fauna. The migration of pyrosomes was clearly visible. The multinet maxi casts collected very interesting samples, many of which were photographed and preserved in the lab. The scheduled OFOS dive was canceled due to too strong current. During the night we did a deep CTD transect at the offshore station. The plan was to end with a bathypelagic CTD for eDNA but the station offshore was subject to high seas which prevented a CTD cast.

On 16/2/2019 we searched along the 3000 bathymetry line for another more sheltered position to deploy the CTD and after this CTD we towed a multinet in the direction of the inshore 1000 m site. The multinet was a success and even a small histioteuthid squid was captured. After arriving on the inshore station we deployed PELAGIOS and observed snipe eels repeatedly, although the deployment was subject to high swell. We performed a CTD cast to 1800 m. The subsequent multinet maxi deployments did not work and the evening PELAGIOS deployment had to be canceled due to unsuitable seastate.

We performed an ADCP track in the night, steaming at 5 knots, and looked for a suitable dive spot for the morning JAGO dive. The weather off Fogo was less favorable than last year. We found a suitable diving location for JAGO and the morning dive on 17/2/2019 was a success. Henk-Jan Hoving was the scientist in JAGO and the dive was done over 800 m of water. Detailed recording were made of large siphonophores as well as *Doliolula* and other gelata. Two "large" specimens of *Poeobius* were captured which likely will be the holotypes for the species description. In the afternoon, Rui Freitas made a JAGO dive for additional seafloor observations. Together with pilot Jürgen Schauer they went along a steep slope of 50°. Although the conditions were challenging, the observations were valuable and included pyrosomes in the water column and on the seafloor. Scavengers were observed to consume the pyrosomes. They also discovered a giant oyster bed.

On 18/2/2019 Karen Osborn was the scientist to make a JAGO dive in the morning. Associations between pyrosomes and other organisms were documented in detail. Henk-Jan Hoving made a JAGO dive in the evening and again pyrosomes were observed in detail, as well as their associated organisms. Several close up observations of gelatinous fauna were made and a dense layer of sergestid like shrimp were observed. Six *Poeobius* polychaetes were captured. In between the JAGO dives we performed an OFOS survey and documented the pyrosomes on the seafloor.

On 19/2/2019 we started the next and last part of the cruise, which included the sampling of a mesoscale eddy in the open Atlantic southwest of the island Brava. We started this work today with a series of CTD casts to find the core of the eddy. The CTD casts were followed by a series of small multinets, and a pelagic OFOS day and night deployment. The multinets showed pteropods in shallow waters.

The eddy survey work continued on 20/2/2019 and we were getting closer to the core of the cyclonic eddy. The anomaly was becoming more visible and the weather improved.

The core of the eddy was found on 21/2/2019 and we deployed our different gears on this core station. On the pelagic OFOS deployment, we observed a shark and the large squid *Taningia danae*. Sargassum, birds, dolphins, and even myctophids were visible at the surface from the ship, a unique sight. The chlorophyll-*a* conentration was very high. While the weather continued to improve during the day, it was still too rough for a JAGO dive and we continue our winch work.

On 22/2/2019 the large swell at this offshore site went slightly down and we prepared ourselves for a historical moment. To our knowledge, we performed the first submersible dive inside a mesoscale eddy. Helena Hauss was the scientist in the submersible. The deployment went smooth, and a full dive could be completed. Particle feeding organisms such as *Poeobius*, giant larvaceans, and many salps were observed, but also a squid and a pelagic octopus. This was the 17th and last dive of JAGO for this cruise. JAGO again proved to be an excellent tool for midwater research! The rest of the day after 12.00 was filled with deployments of PELAGIOS and the Multinet. With the multinet maxi over the W6 winch we collected many pyrosomes. We did another multinet sampling in the evening, and we observed a clear shift of the pyrosome layer to the upper 40-60 m of the water column, as we observed by PELAGIOS which was deployed in the evening for comparison. We collected beautiful observations of the dense pyrosome layer. The program ended "pünktlich" at 00.00 with a small multinet. We were all excited about the work in the eddy and it perfectly connects with our work in the coastal regions of Cape Verde. We were lucky with the calm seastate which allowed all our work to be done at this station 350 miles offshore.

We used the transit of 23/2/2019 back to Mindelo to pack our instruments and boxes, and cleaned the labs.

On 24/2/2019 we entered Mindelo harbor at 9.00 and docked, and at 10.00 we were already cleared by customs. At 12.00 we started packing the container since the forklift was already present. At 15.00 all packing was done and part of the team could go to the beach and enjoy a swim after seeing the ocean for almost three weeks. At 17.00 we said goodbye to the POSEIDON captain and crew and a taxi picked us up for bring us to the hotel. In the evening we met at 19.00 with our Cape Verdean colleagues from OSCM and INDP for a group diner at a local restaurant.

The next morning we (HJ Hoving, H Hauss, R Freitas) gave presentations at the OSCM. Despite the unexpected tough weather situation and instrumental challenges we had a very successful cruise with new data, discoveries, experiences and ideas. We look forward to return to the Cape Verde to learn more about this pristine deep-sea environment with its hidden biodiversity and ecology.

5 Preliminary Results

5.1 Physical oceanography and hydrography

(Helena Hauss, Anna-Christina Hans, Gerd Krahmann/Florian Schütte (not on board)[1])

[1]GEOMAR

5.1.1 CTD and Niskin samples

During P532, 41 profiles of pressure (p), temperature (T), conductivity (c), oxygen (O_2) and chlorophyll-a (Chl) were recorded. Most of the CTD-O_2 profiles ranged to less than 1000m. A Seabird Electronics (SBE) 9plus system was used, which is attached to a water sampler carousel, and the latest Seabird Seasave software. The SBE underwater unit had double sensor sets for T, c and O_2 , and a single sensor for chlorophyll-*a* fluorescence, which worked properly during the entire cruise except that one oxygen sensor produced very noisy data and was excluded from the post-processing. Oxygen was calibrated using a relation linear in T and O, and quadratic in p. Winkler titration was not performed during POS532, but during POS533, while salinity samples were only collected during POS532, therefore calibration was conducted for both cruises jointly. The data will be used to provide the other working groups with the hydrographic background. Of special interest are the oxygen data because of the strong impact on the marine life. In total, 480 nutrient samples were taken from the CTD rosette (with triplicate sampling at CVOO and single samples at all other stations) to quantify nutrient flux into the euphotic zone in conjunction with ADCP measurements (see below). The nutrient samples were snap-frozen at -80°C and stored at -20°C until analysis at GEOMAR, Kiel, where they were measured in May 2019 after Grasshoff (1999) using a Quaatro autoanalyzer for NO_3, NO_2, PO_4 and SiO.

5.1.2 Vessel mounted ADCP

Underway-current measurements were performed continuously throughout the entire cruise using a vessel mounted ADCP (VMADCP): a 350kHz RDI Ocean Surveyor placed in the moon pool. The ADCP worked well throughout the cruise. The ADCP was configured with 34 bins of 4 m, pinging 30 times per minute. The first bin was at 10.26 m depth with a subsequent vertical resolution of 4 m. To ensure precise data (good quality range up to 146,26 m.), it was run in the more precise but less robust broadband mode. During the entire cruise, the navigational data was delivered by fibre optic gyro. The data will be used to provide the background water velocities.

5.1.3 Thermosalinograph

Underway measurements of sea surface temperature (SST) and sea surface salinity (SSS) were continuously done by the ship's thermosalinograph. It is located at the bow of the ship in around 2m depth. The temperature sensor and the conductivity sensors will be calibrated against the 2dbar values from the CTD-O_2 profiles taken during the cruise. In general, the system worked well throughout the cruise.

5.2 JAGO operations

(K. Hissmann, J. Schauer and P. Striewski[1])

[1]GEOMAR

The largest research gear used during POS532 was the GEOMAR-owned manned submersible JAGO that can take two persons -– a pilot and a scientific observer – to water depths of maximum 400 m (Fig. 4) (GEOMAR, Hissmann, Schauer, 2017). The submersible has a compact size and a low weight of 3 tons that enables shipment in a single 20' ISO container and deployment from a wide variety of support vessels that have sufficient crane capacity. JAGO is equipped with USBL navigation and positioning system for tracking the submersible under water, fluxgate compass, vertical and horizontal sonar, underwater telephone for voice communication, LED lamps, digital video (HD) and still cameras, CTD sensors and a manipulator arm for collecting and handling various sampling devices and instruments. The buoyancy of the vehicle can be adjusted by variable ballast (water) to neutral at any depth for hovering in the water column or drifting with the current without using any thruster. JAGO is therefore an ideal tool to study blue water inhabitants. The submersible operates worldwide and is regularly used from on board the German research vessels including FS POSEIDON. POSEIDON is very suitable for handling JAGO since it has a low working deck of only 1.5 meters. Periods during which the submersible is lifted and transferred from deck into the water and vice versa are therefore short.

The mobilization of the submersible on board the POSEIDON took place from 02-04th of February in the port of Mindelo (installation of the USBL underwater navigation and positioning system, UT-communication, sampling devices etc). On deck, JAGO was lashed amidships, and lifted and transferred into and out of the water over the ship's side by the main deck crane (SWL 5 tons). The vessel's Rigid Inflatable Boat (RIB, 5.5 m TL, 60 HP Yamaha outboard engine), steered by a crew member, was used to tow the submersible away from the ship's side after deployment and back under crane position for recovery.

While submerged, JAGO was tracked by means of a USBL underwater positioning and navigation system (ORE Trackpoint 3, GEOMAR equipment). The position data were integrated into the navigation software OFOP to display and follow both JAGO and POSEIDON tracks geographically and in real time on a computer screen (www.ofop-by-sams.eu/). Position data were logged in column-based ASCII files. Dive tracks can be combined for annotation with individual dive logs, visual and video observations and sampling. Time codes were all set and synchronised to UTC. Voice communication between the JAGO crew and the dive supervisor on board the POSEIDON during dives were maintained by acoustic underwater telephone (Subphone 580 by Subsea Import).

The water column and sea floor in front of the submersible's bow window, as well as all activities performed with the manipulator arm were continuously HD video-documented from inside the submersible with a CANON XA25 HD-Camcorder. The camera was mounted forward-looking in the centre of the large acrylic bow window (Fig. 4, 5). The camera's 3.67-73.4mm zoom lens allowed wide-angle and detailed close up footage of the pelagic and benthic fauna. The footages were recorded directly from the camera sensor onto an external hard drive (Shogun from Atomos) in ProRes 422 LT format as .mov file. After each dive, the original HD video files were copied onto a NAS-server for storage and further processing. Metadata, like the recording time in UTC, can be made visible if videos are played back and viewed with Quicktime 7 or an image annotation software like OFOP. In addition, a compressed copy of each video file was produced in H.264/MPEG-4 AVC format and overlaid with UTC time stamp for quick and easier geo-referencing and annotation by the science party while still on board the vessel. Video still images can be captured from the original HD footage by frame-grabbing. A dive protocol was written by the dive participants to log observations and activities during the course of the dive.

Two green laser points were projected into the water column and on the seafloor for quantifying the size of objects that were observed in the water column and on the seafloor and captured on video and still images. The distance between the two parallel laser beams was 20 cm. A CTD (SAIV A/S SD204 Norway), attached to the stern of the submersible, usually continuously records depth, temperature, salinity and density during the entire dive. Due to technical failure of the sensor, CTD data are available only for two dives.

Pelagic organisms were collected alive and intact with two different devices that were especially designed and manufactured for this purpose by the JAGO-Team and colleagues at the GEOMAR technology and logistics centre. One of these devices is a suction sampler with controllable inflow rate. A long flexible suction tube is brought close to the animals with the manipulator arm of the submersible. Once sucked in, the animal then lands gently in a large Plexiglas container filled with seawater (Fig. 4). The second device is a cluster of three acrylic collecting cylinders, so called scoop tubes, that are open on one end and closed on the other by a mesh screen. A hand knob is attached to the closed end. The tubes can be placed around an animal with the manipulator arm and then safely stored in tubulars mounted on a rack in front of the submersible until it is brought back on board the vessel (Fig. 4). Both devices worked very well for the different types and sizes of organisms. Most of the caught animals were in excellent condition when they were transferred into different containers for close up observation and photography in the lab.

First Results Submersible JAGO Dives

During POS532, JAGO was used for (1) visual *in situ* observation, (2) high-resolution video documentation and (3) highly selective non-intrusive collection of pelagic organisms in the upper 400 m of the water column, mostly above ± 1000 m bottom depth, and (4) first video documentation of the benthic community during upslope transects at the steep slopes of Santo Antao and Fogo island. In total, seventeen JAGO dives were performed during POS532; ten dives took place in the first working area off the Bay of Tarrafal at Santo Antao, six dives in the second working area off the south coast of Fogo and one final dive in the core of a cyclic eddy in the open Atlantic Ocean west of Brava island (Table 1). Total dive time was 45 hours and 42 minutes, during which 38 hours of HD video footage were recorded. Eight members of the scientific team participated in a dive.

The dive sites – with one exception – were located in inshore waters not far from shore in the lee side of the islands. The high volcanic mountains on Santo Antao (Tope de Coroa 1979 m) and Fogo (Pico do Fogo 2829 m) provided sufficient shelter from the constant northeast wind. Therefore, sea conditions were usually calm and in favour for a routine of up to two JAGO dives per day. Dives were performed during day- and night time hours between 06:00 am and midnight (local time). The surveys took place in water depths between 20 and 385 m. Horizontal transects at target depth ranged from relatively short distances covered (e.g. during intense sampling dives) to transects of up to 2 km total length. During all dives, the visibility was excellent. Pelagic organisms were collected during most dives, beside video images. Four dives were dedicated to bottom video surveys for baseline observations and documentation of the benthopelagic fauna and of foodfalls i.e. carcasses of pelagic animals that are deposited on the seafloor. Three bottom dives were performed in the working area at Santo Antao, and one dive in the working area at Fogo. Surveys started in depths between 383 and 330 and ended in depths of 231 to 156 meter.

Table 1. Metadata of submersible JAGO dives conducted during RV POSEIDON cruise POS532 (time is related to submerging and surfacing, position is related to dive start and end at seabed). Max D: maximum water depth during the survey

Dive #	Station #		Date [ddmm]	Time [UTC]	Longitude [N]	Latitude [E]	Max D [m]	Remarks
Bay of Tarrafal / Santo Antao								
1404/01	1	Start	04-02	17:31	16°57.85’	25°19.65’	30	Test dive, deployment training for crew
		End	04-02	17:53	16°57.85’	25°19.65’		
1405/02	11	Start	07-02	09:16	16°58.06’	25°19.70’	380	Mid-water, brief bottom survey at 380m (Pyrosomes)
		End	07-02	12:24	16°58.64’	25°19.81’		
1406/03	12	Start	07-02	15:14	16°57.91’	25°20.49’	363	Mid-water, Squid, *Praya* siphonophore, Pyrosomes
		End	07-02	18:15	no USBL signal			
1407/04	13	Start	08-02	09:25	16°58.25’	25°20.30’	340	Mid-water, *Phronima*, *Lilyosis*, shrimps, amphipods, *Poeobius*, *Doliolula*
		End	08-02	12:12	16°58.37’	25°20.26’		
1408/05	15	Start	08-02	21:13	16°58.47’	25°20.72’	330	Mid-water, *Poeobius*, *Phronima*, Pyrosomes
		End	09-02	00:31	16°58.80’	25°20.96’		
1409/06	20	Start	10-02	09:24	16°58.53’	25°19.73’	383	Bottom survey, pyrosomes at seabed, fish collected
		End	10-02	12:15	16°58.79’	25°19.69’		
1410/07	21	Start	10-02	15:14	16°59.83’	25°19.78’	378	Bottom survey, megafauna documented, sixgill shark
		End	10-02	18:05	17°00.12’	25°19.63’		
1411/08	26	Start	12-02	09:16	17°00.40’	25°19.85’	365	Bottom survey, megafauna documented,
		End	12-02	12:24	17°00.45’	25°19.85’		
1412/09	27-1	Start	12-02	15:10	16°58.06’	25°20.43’	132	Shallow water dive
		End	12-02	16:40	16°58.42’	25°20.54’		
1413/10	27-2	Start	12-02	16:50	16°58.53’	25°20.55’	300	Mid-water, sampling
		End	12-02	18:16	16°58.54’	25°20.49’		
Fogo south coast								
1414/11	29	Start	14-02	10:57	14°47.88’	24°23.13’	370	Mid-water, sampling *Poeobius*, amphipods
		End	14-02	13:57	14°47.94’	24°23.86’		
1415/12	31	Start	14-02	21:08	14°47.42’	24°23.21’	237	Mid-water, *Rhabdosoma*, ctneophores
		End	15-02	00:44	14°47.58’	24°23.38’		
1416/13	43	Start	17-02	10:05	14°49.65’	24°27.46’	210	Mid-water, *Doliolula*, *Apolemia*, *Beroe*, *Poeobius*
		End	17-02	12:20	14°49.74’	24°27.46’		
1417/14	44	Start	17-02	15:56	14°50.55’	24°27.93’	330	Bottom survey, giant oyster banks, spiny lobsters, black corals
		End	17-02	18:57	14°50.75’	24°28.09’		
1418/15	45	Start	18-02	07:15	14°49.66’	24°27.48’	360	Mid-water, lobate ctenonphores, *Beroe*
		End	18-02	11:03	14°50.60’	24°28.65’		
	47	Start	18-02	21:31	14°49.78’	24°27.67’	385	

1419/16		End	19-02	00:42	14°50.42’	24°28.58’		Mid-water, full moon, *Poeobius*, Pyrosomes, *Phronima* etc
Eddy – Open Atlantic west of Brava								
1420/17	65	Start	22-02	09:44	14°07.51’	27°32.74’	345	Mid-water, eddy fauna sampled (*Poeobius*)
		End	22-02	12:13	14°07.47’	27°32.70’		

The documented slopes of the volcanic islands are – especially in shallower water depth – very rugged and steep and manoeuvring the submersible in a close distance to the sea floor became increasingly difficult with decreasing depth. Bottom currents were partly strong. The last open-water JAGO dive of the cruise took place in the centre of a cyclonic current eddy in the open Atlantic Ocean west of Brava Island, above ca. 5100 m bottom depth. Mesopelagic fauna – in particular the planktonic polychaet worm *Poeobius* – were well documented and sampled between 345 and the water surface. The handling of the submersible from on board the POSEIDON went very safe and smooth. Deployment and recovery of the submersible took usually only few minutes. The teamwork between the three work stations (the captain and officers on the bridge, the bosun and his deck hands, the work boat team and the JAGO-Team) during launch and recovery was as professional as during previous JAGO-POSEIDON cruises.

5.3 Pelagic faunal observations and collections

5.3.1 Bioacoustics and net sampling

(H. Hauss[1], H.J. Hoving[1])

[1]GEOMAR

During POS532, a total of 12 vertical hauls with a Hydrobios Multinet Midi (5 nets, 200µm mesh) and a total of eight oblique hauls (over the A-frame) with the Hydrobios Multinet Maxi (9 nets, 2mm mesh) were conducted. Both systems worked well except for a broken steel spring at the Multinet Midi, which could not be replaced and therefore reduced the number of nets that could be fired during one haul to four. Both nets carried a full CTD-O_2 sensor set (Hydrobios) which will be calibrated against the Seabird CTD and will allow the estimation of mean environmental conditions experienced by the pelagic fauna caught in the respective depth stratum. A Simrad EK80 (WBT mini with a 70kHz transducer ES70-18CD) was used to quantify zooplankton and fish in relation to hydrographic features. Because there was not enough room in the moon pool, the transducer could only be lowered on the ship’s pole over the starboard side during station work or slow steaming (<2kn). Acoustic transects were mainly conducted after or prior to JAGO work, as this allowed efficient collection of underway data during resting hours of the deck crew.

5.3.2 DNA barcoding, specimens and scientific photography

(K. Osborn[1], H.J. Hoving[2])

[1]Smithsonian Institute

[2]GEOMAR

We collected a diversity of midwater animals using multi-nets and the submersible JAGO with a goal of exploring the oft-missed midwater diversity, collecting vouchers for the PELAGIOS video transects, and contributing to a variety of projects within the Hoving, Osborn and Robison labs (542 samples). Midwater animals are traditionally assumed to have limited diversity because of the presumed high connectivity between geographic locations. Traditional taxonomic methods are not capable of distinguishing species in many cases, but by adding genetic data to the character dataset for each population allows us to recognize and identify previously unrecognized diversity. Genetic data is used not only to delimit geographic ranges of species but is also critical to match morphologically dissimilar life stages. Up to now, the 517 specimens sampled for genetic work have been extracted for total DNA and the first and second rounds of amplification and sequencing completed. This single genetic marker (COI) is a good indicator for what further work should be done and we are currently working through the COI data to identify samples for further sequencing and use in various projects.

Projects to which genetic data is critical include: comparison of the doliolid *Doliolula* and its hydroid symbiont are the same species as found in the Pacific basin and similar projects looking at the ctenophore *Kiyohimea*, the siphonophore *Lilyopsis,* and the polychaetes *Pelagobia longicirrata* and *Lopadorrhynchus*. Genetic projects identifying and allowing us to phylogenetically place unknown species include: an unknown gammarid amphipod observed repeatedly both last year and this, two species of hydroids symbiotic on the shells of *Diacria trispinosa*, and a new species of *Poeobius* (polychaetous annelid). In addition to the above projects, producing high-quality genetic barcodes, which are specifically defined and flagged in GenBank, makes genetically identifying the components of a mixed community plausible and increases the value of eDNA and metabarcode monitoring efforts. Three hundred and three specimens were successfully barcoded in the first round of benchwork with an additional 67 specimens successfully barcoded with further optimization work. Photography of live specimens (Fig. 1) is valuable because when preserved, most midwater animals lose their shape and coloration, yet there is a lot of valuable information in these features. In addition, photos are often the only voucher possible when specimens are very small or extremely delicate. Many of these photographs can also be used for outreach and education. Three thousand fifty-four photographs were taken at sea, have been prepared for cataloguing, and will be an integral part of all of the above manuscripts.

5.3.3 eDNA collection

(S. Scheer[1], V. Merten[1])

[1]GEOMAR

Environmental DNA (eDNA) metabarcoding, is becoming a powerful molecular tool capable of non-invasively surveying species richness (Port et al., 2016; Thomsen et al., 2016) and species distribution (Guardiola et al., 2016; Doi et al., 2017). Environmental DNA is defined as genomic DNA extracted from environmental samples such as soil, sediment, water, air or faeces without first isolating the organisms. It includes intracellular DNA (from living cells) and extracellular DNA (from dead cells resulting in the destruction of cell structures). Only few studies exist that apply eDNA analysis for deep water environments. However, it is a promising tool to detect cephalopod and gelatinous zooplankton biodiversity and distribution in the deep sea, where traditional methods have problems to catch or investigate especially elusive, rare or fragile species. Our goal is to reconstruct the vertical distribution of selected pelagic invertebrates in Cape Verde waters by analyzing eDNA samples from various depths. The eDNA in the water can be collected on filters and then amplified and sequenced with sensitive next-generation DNA sequencing. The barcodes obtained by sequencing give information about the biodiversity in the sampled area.

We sampled at 5 different stations between 100 and 3000 m resulting in 180 water samples. Two stations were close to the islands (Santo Antão, Fogo), one station was a reference station (CVOO) and two stations were located in an eddy dipole (first anticyclone, then cyclone) (Fig. 3.1). One sample consists of 2 liters of filtered seawater (0.22 µm filter pore size) and was sampled via a

CTD rosette with attached 10L Niskin bottles (Fig. 6). Each depth was sampled in (pseudo) triplicates. There are no preliminary results available yet. The DNA has been extracted from the filtered seawater samples and will be prepared for next-generation sequencing at GEOMAR. We will use two universal cephalopod primer pairs targeting the mitochondrial 16S rRNA gene and the nuclear 18S rRNA gene. The prepared libraries of the samples will be send to the IKMB for Illumina sequencing. The obtained sequencing data will be analyzed for sequence variants to assess the biodiversity around Cape Verde. Therefore, the sequences will be compared with existing databases such as GenBank. Some of the samples will be analyzed for pyrosome DNA using specific pyrosome primers and universal eukaryotic primers. The eDNA samples of POS532 will contribute to the PhD theses of Mrs. V. Merten and Mr. M. Guerreiro.

5.3.4 In situ pelagic observations with PELAGIOS

(H.J. Hoving[1])

[1]GEOMAR

The pelagic in situ observation system or PELAGIOS is an ocean observation instrument that is slowly towed at 1 knot either over the side of the ship on the W2 winch (on the conducting cable) (Hoving et al 2019). The PELAGIOS was used in standard operation mode at Santa Antao in the Bay of Tarrafal. Unfortunately there were several problems with CTD, depth sensor and LED lights which prevented deployments. This was disappointing since the instrument has been a very reliable tool on previous cruises. Therefore we used the OFOS in the midwater at the eddy station. On this cruise we tested the PELAGIOS in a new form, via the fibre optic Werner Winch at the stern over the A-frame, and connecting it to a fibre optic telemetry, and a wide angle camera. The tests with the fibre optic application were successful. Overall we had 17 deployments during which we collected pelagic observations in a towed modus. We had 4 deployments with the standard PELAGIOS set up (Hoving et al 2019), 9 deployments over the fibre optic winch and 4 deployments with the OFOS in midwater. We collected pelagic observations down to 990 m, and documented gelatinous fauna including large numbers of pyrosomes as well as their associations (Fig. 7). The pelagic observations are part of the MSc thesis of V. Stenvers.

5.4 Benthic Biodiversity

(R. Freitas[1])

[1]Universidade Cabo Verde

The deeper slopes of the Cabo Verde islands have never been carefully explored. Most of our knowledge about the marine fauna of the Cabo Verde Archipelago is from SCUBA diving in shallow water, fisheries surveys using traps, longliners and also few surveys with Remotely Operated Vehicles (ROV) at some of the seamounts and insular shelf within the archipelago. The POS532 resulted in various new findings on benthic fauna using the combination of the various deep-sea instrumentation on board POSEIDON (JAGO and OFOS).

Dives with the manned submersible JAGO (GEOMAR) took place at the lee side of the youngest Cape Verdean islands Santo Antão and Fogo, not very far from shore, to explore for the very first time the steep slopes of these volcanic islands. Massive volcanic boulders alternated with sandy patches. The slopes were mainly covered with sandy sediment with rocky outcrop in between and large volcanic boulders – so called drop stones. Black and soft corals are the most abundant organisms that colonize the rocks. The deep underwater landscape off Fogo was even more rugged than off Santo Antão. Massive volcanic rocks altered with sandy patches. Some of the rocks were densely colonized by an assortment of filter feeders. Different species of large bushy black corals dominated the benthic community.

Related to fishes, a bluntnose sixgill shark (*Hexanchus griseus*) was noted once at 350 meter. We documented the native scorpionfish sp. of *Sebastes*, which seems to be common between 150-300 m depth, and several other deep-sea fish species, like the shortnose greeneye (*Chlorophthalmus agassizi*), blacktail comber (*Serranus atricauda*), Darwin's slimehead (*Gephyroberyx darwinii*) (Fig. 3) and the brightly coloured swallowtail seapearch (*Anthias anthias*), all filmed by JAGO. We observed the lophiidae monkfish *Sladenia* cf. *shaefersi* , which is a new record in the Eastern Atlantic, as confirmed by the FAO specialist of the group that evaluated the video images. At 213 meter we encountered two specimens of the endemic Cabo Verdean spiny lobster (*Palinurus charlestoni*) and captured the first video images of those animals in their natural habitat. Another exciting finding was at deep slope off Santo Antão and involved the fourhorn octopus (*Pteroctopus tetracirrhus*). At Fogo we documented banks of deep-sea oysters that probably belong to the giant deep-sea oyster *Neopycnodonte zibrowii*, a species that was only recently described for the Macaronesian area. The oysters are so far known from the Azores, Canary Islands, Golf of Cadiz and from the Mediterranean, and now from Cabo Verde. Seafloor surveys were also perfomed with the OFOS system (Ocean Floor Observation System), a frame with a vertically down-looking deep-sea camera that is slowly towed by the ship and lowered and lifted on a wired cable with data connection. Benthic scavengers were relatively frequently seen on transects from 600 to 1000 m. Other frequently observed organisms included sea urchins, seastars and sea cucumbers. Some of the rocks were densely colonized by assemblages of benthic invertebrate filter feeders. Different species of large bushy black corals dominated the benthic community. A special species of the Dendrophylliidae family of stony corals was identified by photo as a new species and to date undescribed in the scientific literature (Oscar Ocaña pers comm.).

Our first insights into the vertical zonation of the benthic habitat and community represent the first information of this kind on the deep water fauna around the Cabo Verde islands. A very preliminary check-list tentatively on OFOS video-frame identification is presented in Figure 2. The video of both JAGO and OFOS seafloor surveys is currently processed in more detail for benthic biodiversity at the Universidade Cabo Verde by Mr. Freitas and students. We plan to summarize our first observations on the different deep-sea organisms and their habitat in a manuscript (Freitas et al in prep.).

5.5 Bentho-pelagic coupling

(H.J. Hoving, H. Hauss[1])

[1]GEOMAR

One goal of this cruise was to investigate the ecological link between the pelagic realm and the benthic environment. When pelagic organisms die, and sink to the seafloor, they become food for benthic organisms. The process of energy transfer from the pelagic zone to the seafloor is part of the biological carbon pump. During POS532 we observed a significant example of this very important process. Pyrosomes are pelagic tunicates that occur in areas of high productivity (Fig. 7). As we did during POS520, we observed pyrosomes during POS532 off Fogo and also in the eddy. We were able to sample pelagic pyrosomes with JAGO and the multinet in the water column and we observed them with PELAGIOS. We also observed pyrosomes on the seafloor with JAGO and with OFOS during benthic video transects. Various organisms were found to be associated with pyrosomes in the water column, and pyrosomes were being consumed by benthic organisms as well. The finding of pyrosomes during POS532 allows a quantitative assessment of local carbon contribution of pyrosome carcasses to the benthic foodweb. This topic is directly relevant to Hoving's Emmy Noether Junior Research Group. The data collected for pyrosomes is combined with observations from 2018 (POS520) and is part of the MSc thesis of V. Stenvers, and a peer reviewed publication.

5.6 Mesoscale features

(H. Hauss, Hoving[1])

[1]GEOMAR

One of the goals of POS532 was a survey of the biological anomalies in an “extreme” mesoscale eddy in the Cape Verde region. In the past, low-oxygen eddies have been observed that spun off the West African coast and propagate westward (Hauss et al. 2016, Christiansen et al. 2018). At the time of the cruise, remote sensing did not indicate a promising eddy originating from the West African coast within the reach of RV Poseidon. However, an extremely productive cyclone had formed in lee of Fogo in beginning of December and could be monitored since by its distinct surface SST (negative) and Chl-a (positive) anomaly. This type of wake eddies is formed by alternating wind curl behind the islands (Fig. 3.1). Such island wakes have been observed and described at tall open-ocean archipelagos, e.g. Canary Islands by Sangrà et al. (2007). Up to now, little knowledge exists regarding the physical characteristics (and none regarding the biological impact) of wake eddies off Cape Verde, but a pilot study has been carried out by Hans (2019) using shipboard as well as satellite and glider observations. At the time of the cruise, the cyclone had traveled 355 km south-west off the island Fogo with a mean propagation speed of 5.1 km d-1. It had a radius of approximately 44 km. As this region is far out of the island lee, and conditions were rough, it was decided to wait for calmer conditions predicted by the weather forecast towards the end of the cruise. This strategy proved successful, and during the ADCP transect it became evident that the wake line was composed of alternating eddies with different signatures (Fig. 8).

CTDs were performed along the entire section (Fig. 9) and included sampling for nutrients (NO3, NO2, PO4, SiO). The tracked cyclone still proved being the most productive one in terms of chl-a concentrations and nutricline depth. A day/night multinet midi station was conducted at minimal velocity at 14.56N/25.55W, and full biological station (day/night, including multinet midi and maxi, PELAGIOS, an EK80 transect, and finally a JAGO dive) was conducted on a station in the core of the targeted cyclone at 14.15N/27.5W. It became evident that its high primary productivity translated to higher trophic levels and high particle export flux. Its core hosted the highest recorded abundance of the pelagic tunicate *Pyrosoma atlanticum* to the best of our knowledge (MSc thesis Vanessa Stenvers, in prep) as well as *Cyclosalpa* sp. (both are filter feeders). Processing of samples and data is still ongoing.

5.7 Communication, media and outreach activities

We also had several activities to communicate the work onboard to the general public. Jens Klimmeck (Communication and Media Department GEOMAR) joined the cruise as a dedicated participant to document the scientific activities on board for outreach purposes. The ways of documenting included photography, filming, drone filming and interviews. Jens made 480 photographs and 19 hours of video recordings. Jens produced on board an interview with Rui Freitas, Helena Hauss, the JAGO team and Henk-Jan Hoving which was broadcasted on Cape Verdean national television while we were sailing. Jens also produced a videoclip that supported the seminars that Henk-Jan Hoving, Rui Freitas and Helena Hauss gave at the Ocean Science Centre Mindelo after the end of the cruise on 25.2.2019. The POS532 team wrote in total five contributions to the Oceanblogs, the blog portal of Kiel Marine Sciences (jointly hosted by GEOMAR and Future Ocean) https://www.oceanblogs.org/capeverde/. The cruise was also described in a publication „Von Wasserwirbeln und Feuerwalzen“ for the GEOMAR News magazine issue 01/2019.

5.8 Expected results

One manuscript will focus on the ecological role of pyrosomes in the waters of Cape Verde, with emphasis on bentho-pelagic coupling and role in the biological carbon pump, biological associations and vertical distribution and migration. The eDNA samples will be part of a manuscript that will compare the cephalopod biodiversity in Cape Verde waters obtained via different census. The JAGO video has all been annotated and will be part of the Oceanic Biodiversity Observation Database at GEOMAR. Different studies, manuscripts and funding applications are in progress that use this database. The benthic biodiversity observations and the ecological zonation of the slope will be the topic of a publication in collaboration with Rui Freitas. Part of the specimens collected with the multinet support biodiversity and phylogenetic studies that are in progress in collaboration with Karen Osborn.

6 Ship’s Meteorological Station *(not applicable)*

7 Station List POS532

7.1 Overall Station List

Station number	Date and Time	Gear	Action	Latitude	Longitude	Depth	Comment
	2019 [UTC]			[°N]	[°W]	[m]	
POS532_1-1	2/4/2019 17:13	JAGO	in the water	16° 57,887' N	025° 19,767' W	581.8	
POS532_1-1	2/4/2019 18:09	JAGO	on deck	16° 57,662' N	025° 19,443' W	401.5	
POS532_2-1	2/5/2019 7:08	Multinet	in the water	16° 58,044' N	025° 20,464' W	1016.6	
POS532_2-1	2/5/2019 7:41	Multinet	max depth/on ground	16° 58,039' N	025° 20,466' W	1011.5	SL max = 985m
POS532_2-1	2/5/2019 8:00	Multinet	on deck	16° 58,051' N	025° 20,451' W	1016.5	
POS532_2-2	2/5/2019 8:19	CTD	in the water	16° 58,025' N	025° 20,461' W	1022.4	
POS532_2-2	2/5/2019 8:40	CTD	max depth/on ground	16° 58,046' N	025° 20,454' W	988.0	SL max = 978m
POS532_2-2	2/5/2019 8:57	CTD	on deck	16° 58,035' N	025° 20,459' W	1000.1	
POS532_3-1	2/5/2019 9:36	CTD	in the water	16° 56,644' N	025° 23,042' W	1334.5	
POS532_3-1	2/5/2019 9:58	CTD	max depth/on ground	16° 56,652' N	025° 23,030' W	1334.1	1031 m max
POS532_3-1	2/5/2019 10:15	CTD	on deck	16° 56,640' N	025° 23,067' W	1335.6	
POS532_4-1	2/5/2019 10:52	CTD	in the water	16° 55,190' N	025° 25,626' W	1489.9	
POS532_4-1	2/5/2019 11:14	CTD	max depth/on ground	16° 55,140' N	025° 25,628' W	1488.5	1014 m max
POS532_4-1	2/5/2019 11:30	CTD	on deck	16° 55,127' N	025° 25,645' W	1487.1	
POS532_5-1	2/5/2019 12:07	CTD	in the water	16° 53,657' N	025° 28,299' W	2214.1	
POS532_5-1	2/5/2019 12:27	CTD	max depth/on ground	16° 53,514' N	025° 28,348' W	2203.8	1019 m max
POS532_5-1	2/5/2019 12:46	CTD	on deck	16° 53,374' N	025° 28,376' W	2227.1	JAGO repairs, no ops
POS532_6-1	2/5/2019 23:00	EK80	profile start	16° 57,779' N	025° 20,052' W	773.8	
POS532_6-1	2/6/2019 6:12	EK80	profile end	16° 50,172' N	025° 34,091' W	3013.1	
POS532_7-1	2/6/2019 7:04	CTD	in the water	16° 50,209' N	025° 34,150' W	3007.3	
POS532_7-1	2/6/2019 7:25	CTD	max depth/on ground	16° 50,224' N	025° 34,127' W	3031.3	SL max = 1013m

POS532_7-1	2/6/2019 7:43	CTD	on deck	16° 50,232' N	025° 34,161' W	3013.5	
POS532_8-1	2/6/2019 8:30	CTD	in the water	16° 51,774' N	025° 31,385' W	2664.0	
POS532_8-1	2/6/2019 9:16	CTD	max depth/on ground	16° 51,762' N	025° 31,379' W	2688.8	SL max = 2533 m
POS532_8-1	2/6/2019 10:03	CTD	on deck	16° 51,767' N	025° 31,380' W	2675.2	
POS532_8-2	2/6/2019 10:14	Multinet	in the water	16° 51,769' N	025° 31,402' W	2662.4	
POS532_8-2	2/6/2019 10:46	Multinet	max depth/on ground	16° 51,712' N	025° 31,400' W	2665.2	1005 m max
POS532_8-2	2/6/2019 11:07	Multinet	on deck	16° 51,663' N	025° 31,362' W	2668.2	
POS532_9-1	2/6/2019 12:31	CTD	in the water	16° 53,722' N	025° 28,224' W	2193.8	
POS532_9-1	2/6/2019 12:51	CTD	max depth/on ground	16° 53,756' N	025° 28,142' W	2190.8	1018 m max
POS532_9-1	2/6/2019 13:07	CTD	on deck	16° 53,788' N	025° 28,069' W	2173.0	
POS532_10-1	2/6/2019 16:00	CTD	in the water	16° 58,376' N	025° 20,188' W	603.2	
POS532_10-1	2/6/2019 16:14	CTD	max depth/on ground	16° 58,394' N	025° 20,190' W	636.2	
POS532_10-1	2/6/2019 16:26	CTD	on deck	16° 58,404' N	025° 20,177' W	598.5	
POS532_10-2	2/6/2019 18:24	Pelagios	in the water	16° 58,131' N	025° 19,939' W	486.7	
POS532_10-2	2/6/2019 23:54	Pelagios	on deck	16° 59,888' N	025° 22,218' W	735.3	
POS532_11-1	2/7/2019 9:16	JAGO	in the water	16° 57,897' N	025° 19,866' W	631.4	Boat in the water
POS532_11-2	2/7/2019 12:39	JAGO	on deck	16° 58,741' N	025° 19,833' W	325.4	JAGO on deck
POS532_12-1	2/7/2019 15:10	JAGO	in the water	16° 57,960' N	025° 20,459' W	1001.6	JAGO in the water
POS532_12-1	2/7/2019 18:36	JAGO	on deck	16° 57,640' N	025° 20,476' W	1012.8	Jago
POS532_13-1	2/8/2019 9:21	JAGO	in the water	16° 58,205' N	025° 20,288' W	1012.8	JAGO in the water
POS532_13-1	2/8/2019 12:24	JAGO	on deck	16° 58,527' N	025° 20,204' W	1012.8	JAGO on deck
POS532_14-1	2/8/2019 19:02	CTD	in the water	16° 57,980' N	025° 20,416' W	984.8	
POS532_14-1	2/8/2019 19:21	CTD	max depth/on ground	16° 58,008' N	025° 20,423' W	1019.7	SL max = 924m
POS532_14-1	2/8/2019 19:39	CTD	on deck	16° 57,995' N	025° 20,429' W	1003.0	
POS532_14-2	2/8/2019 19:51	Multinet	in the water	16° 58,009' N	025° 20,448' W	1001.8	
POS532_14-2	2/8/2019 20:10	Multinet	max depth/on ground	16° 58,157' N	025° 20,545' W	1045.4	SL max = 612m
POS532_14-2	2/8/2019 20:35	Multinet	on deck	16° 58,379' N	025° 20,689' W	1027.0	
POS532_15-1	2/8/2019 21:01	JAGO	in the water	16° 58,494' N	025° 20,689' W	999.3	Boat in the water
POS532_15-1	2/9/2019 0:53	JAGO	on deck	16° 58,988' N	025° 21,142' W	993.9	Boat on deck
POS532_16-1	2/9/2019 2:15	EK80	profile start	16° 57,922' N	025° 19,929' W	993.9	
POS532_16-1	2/9/2019 7:37	EK80	profile end	16° 51,774' N	025° 31,360' W	993.9	
POS532_16-2	2/9/2019 7:51	ADCP	profile start	16° 51,737' N	025° 31,407' W	993.9	
POS532_16-2	2/9/2019 9:22	ADCP	profile end	16° 58,067' N	025° 19,684' W	993.9	
POS532_17-1	2/9/2019 9:36	OFOS	in the water	16° 58,022' N	025° 20,466' W	993.9	
POS532_17-1	2/9/2019 10:11	OFOS	max depth/on ground	16° 58,092' N	025° 20,406' W	1011.7	952 m max
POS532_17-1	2/9/2019 10:40	OFOS	on deck	16° 58,208' N	025° 20,461' W	1036.2	Device failed
POS532_17-2	2/9/2019 11:02	OFOS	in the water	16° 58,154' N	025° 20,427' W	1001.6	
POS532_17-2	2/9/2019 11:33	OFOS	max depth/on ground	16° 58,126' N	025° 20,386' W	959.4	1001 m max, BoSi
POS532_17-2	2/9/2019 11:46	OFOS	profile start	16° 58,098' N	025° 20,368' W	953.0	
POS532_17-2	2/9/2019 15:31	OFOS	profile end	16° 59,649' N	025° 20,131' W	576.1	
POS532_17-2	2/9/2019 15:47	OFOS	on deck	16° 59,743' N	025° 20,167' W	569.7	
POS532_18-1	2/9/2019 17:45	CTD	in the water	16° 51,755' N	025° 31,373' W	2685.4	
POS532_18-1	2/9/2019 18:27	CTD	max depth/on ground	16° 51,782' N	025° 31,342' W	2669.8	SL max = 2534m
POS532_18-1	2/9/2019 19:12	CTD	on deck	16° 51,783' N	025° 31,396' W	2683.3	

POS532_18-2	2/9/2019 19:24	Pelagios	in the water	16° 51,770' N	025° 31,381' W	2672.0	
POS532_18-2	2/9/2019 19:33	Pelagios	information	16° 51,829' N	025° 31,370' W	2674.0	SL = 50m
POS532_18-2	2/9/2019 19:44	Pelagios	on deck	16° 51,873' N	025° 31,357' W	2672.3	malfunction
POS532_18-3	2/9/2019 20:19	Multinet	in the water	16° 51,898' N	025° 31,362' W	2674.8	
POS532_18-3	2/9/2019 20:49	Multinet	max depth/on ground	16° 51,927' N	025° 31,329' W	2675.4	SL max = 1006m
POS532_18-3	2/9/2019 21:08	Multinet	on deck	16° 51,951' N	025° 31,337' W	2676.9	
POS532_18-4	2/9/2019 21:39	CTD	in the water	16° 52,011' N	025° 31,355' W	2666.1	
POS532_18-4	2/9/2019 21:59	CTD	max depth/on ground	16° 52,046' N	025° 31,389' W	2637.3	1014 m max
POS532_18-4	2/9/2019 22:18	CTD	on deck	16° 52,131' N	025° 31,432' W	2629.8	
POS532_19-1	2/10/2019 2:13	ADCP	profile start	17° 13,929' N	025° 34,668' W	637.0	
POS532_19-1	2/10/2019 8:44	ADCP	profile end	16° 58,437' N	025° 19,734' W	314.2	
POS532_20-1	2/10/2019 9:20	JAGO	in the water	16° 58,455' N	025° 19,721' W	296.4	JAGO in the water
POS532_20-1	2/10/2019 12:30	JAGO	on deck	16° 59,174' N	025° 19,738' W	296.4	JAGO on deck
POS532_20-1	2/10/2019 12:36	JAGO	on deck	16° 59,253' N	025° 19,755' W	296.4	Boat on deck
POS532_21-1	2/10/2019 15:11	JAGO	in the water	16° 59,841' N	025° 19,812' W	339.0	JAGO in the water
POS532_21-1	2/10/2019 18:20	JAGO	on deck	17° 00,107' N	025° 19,678' W	168.0	Jago
POS532_22-1	2/10/2019 19:11	EK80	profile start	16° 59,865' N	025° 19,913' W	311.0	
POS532_22-1	2/10/2019 21:16	EK80	alter course	16° 56,626' N	025° 23,031' W	311.0	
POS532_22-1	2/10/2019 23:33	EK80	profile end	16° 59,887' N	025° 19,817' W	332.8	
POS532_23-1	2/11/2019 7:04	OFOS	in the water	16° 59,894' N	025° 19,785' W	354.2	
POS532_23-1	2/11/2019 10:58	OFOS	on deck	16° 58,310' N	025° 20,366' W	904.5	
POS532_24-1	2/11/2019 12:11	Multinet	in the water	16° 57,993' N	025° 20,413' W	978.0	
POS532_24-1	2/11/2019 12:45	Multinet	max depth/on ground	16° 57,159' N	025° 20,575' W	1017.0	1059 m max
POS532_24-1	2/11/2019 13:08	Multinet	on deck	16° 56,635' N	025° 20,704' W	988.3	
POS532_24-2	2/11/2019 13:22	Multinet	in the water	16° 56,305' N	025° 20,821' W	144.3	
POS532_24-2	2/11/2019 14:10	Multinet	max depth/on ground	16° 55,035' N	025° 21,796' W	72.4	
POS532_24-2	2/11/2019 14:36	Multinet	on deck	16° 55,059' N	025° 22,990' W	39.1	
POS532_24-3	2/11/2019 14:56	Pelagios	in the water	16° 54,951' N	025° 23,050' W	46.6	
POS532_24-3	2/11/2019 16:38	Pelagios	on deck	16° 55,014' N	025° 21,637' W	1542.6	heaven
POS532_24-4	2/11/2019 17:27	Pelagios	in the water	16° 55,192' N	025° 21,519' W	1522.4	
POS532_24-4	2/11/2019 18:11	Pelagios	on deck	16° 55,764' N	025° 21,707' W	1457.7	
POS532_24-5	2/11/2019 18:54	Multinet	in the water	16° 55,961' N	025° 21,587' W	1394.3	
POS532_24-5	2/11/2019 19:28	Multinet	max depth/on ground	16° 56,805' N	025° 21,776' W	1321.5	SL max = 1229m
POS532_24-5	2/11/2019 19:52	Multinet	on deck	16° 57,447' N	025° 21,980' W	1231.7	
POS532_25-1	2/11/2019 21:25	CTD	in the water	16° 51,764' N	025° 31,377' W	2690.5	
POS532_25-1	2/11/2019 22:11	CTD	max depth/on ground	16° 51,770' N	025° 31,362' W	2686.0	2533 m max
POS532_25-1	2/11/2019 22:55	CTD	on deck	16° 51,780' N	025° 31,352' W	2677.7	

POS532_26-1	2/12/2019 9:11	JAGO	in the water	17° 00,416' N	025° 19,978' W	327.0	JAGO in the water
POS532_26-1	2/12/2019 12:35	JAGO	on deck	17° 00,540' N	025° 19,867' W	189.3	JAGO on deck
POS532_27-1	2/12/2019 15:06	JAGO	in the water	16° 58,006' N	025° 20,469' W	95.6	JAGO in the water
POS532_27-1	2/12/2019 18:36	JAGO	on deck	16° 58,635' N	025° 20,331' W	95.6	Jago
POS532_28-1	2/13/2019 5:10	Multinet	in the water	17° 34,976' N	024° 16,978' W	3592.7	
POS532_28-1	2/13/2019 5:37	Multinet	max depth/on ground	17° 34,996' N	024° 16,980' W	3593.6	SL max = 1005m
POS532_28-1	2/13/2019 5:54	Multinet	on deck	17° 35,002' N	024° 16,964' W	3592.0	
POS532_28-2	2/13/2019 6:02	CTD	in the water	17° 34,999' N	024° 16,965' W	3600.0	
POS532_28-2	2/13/2019 7:05	CTD	max depth/on ground	17° 34,991' N	024° 16,984' W	3594.1	SL max = 3612m
POS532_28-2	2/13/2019 8:05	CTD	on deck	17° 34,989' N	024° 16,990' W	3594.7	
POS532_28-3	2/13/2019 8:14	Multinet	in the water	17° 34,983' N	024° 16,989' W	3596.5	
POS532_28-3	2/13/2019 8:42	Multinet	max depth/on ground	17° 34,976' N	024° 16,991' W	3592.1	SL max = 1005m
POS532_28-3	2/13/2019 9:00	Multinet	on deck	17° 34,981' N	024° 16,991' W	3598.9	
POS532_28-4	2/13/2019 10:18	CTD	in the water	17° 34,998' N	024° 16,994' W	3592.8	
POS532_28-4	2/13/2019 10:20	CTD	max depth/on ground	17° 34,996' N	024° 16,987' W	3593.2	19 m max
POS532_28-4	2/13/2019 10:22	CTD	on deck	17° 34,987' N	024° 16,981' W	3592.9	
POS532_28-5	2/13/2019 10:33	CTD	in the water	17° 34,998' N	024° 16,943' W	3593.4	
POS532_28-5	2/13/2019 10:53	CTD	max depth/on ground	17° 35,010' N	024° 16,841' W	3597.6	1017 m max
POS532_28-5	2/13/2019 11:10	CTD	on deck	17° 35,009' N	024° 16,808' W	3594.6	
POS532_28-6	2/13/2019 11:43	CTD	in the water	17° 34,997' N	024° 16,736' W	3593.5	
POS532_28-6	2/13/2019 12:18	CTD	max depth/on ground	17° 35,005' N	024° 16,673' W	3591.8	1924 m max
POS532_28-6	2/13/2019 12:50	CTD	on deck	17° 35,005' N	024° 16,599' W	3592.1	
POS532_28-7	2/13/2019 13:02	Pelagios	in the water	17° 35,084' N	024° 16,571' W	3593.1	
POS532_28-7	2/13/2019 14:05	Pelagios	on deck	17° 36,076' N	024° 16,275' W	3594.4	
POS532_28-8	2/13/2019 14:24	Pelagios	in the water	17° 36,237' N	024° 16,377' W	3611.2	
POS532_28-8	2/13/2019 15:52	Pelagios	on deck	17° 37,848' N	024° 16,606' W	3601.9	SL 512 m
POS532_29-1	2/14/2019 10:53	JAGO	in the water	14° 47,922' N	024° 23,182' W	510.0	JAGO in the water
POS532_29-1	2/14/2019 14:13	JAGO	on deck	14° 47,925' N	024° 23,648' W	456.0	JAGO on deck
POS532_30-1	2/14/2019 14:59	CTD	in the water	14° 47,386' N	024° 23,202' W	983.5	
POS532_30-1	2/14/2019 15:17	CTD	max depth/on ground	14° 47,398' N	024° 23,220' W	978.5	961 m
POS532_30-1	2/14/2019 15:35	CTD	on deck	14° 47,396' N	024° 23,224' W	975.4	
POS532_31-1	2/14/2019 21:03	JAGO	in the water	14° 47,387' N	024° 23,152' W	990.6	Jago
POS532_31-1	2/15/2019 0:59	JAGO	on deck	14° 47,632' N	024° 23,737' W	57.0	JAGO on deck
POS532_32-1	2/15/2019 2:12	EK80	profile start	14° 48,183' N	024° 23,158' W	57.0	
POS532_32-1	2/15/2019 5:04	EK80	profile end	14° 41,902' N	024° 24,198' W	57.0	
POS532_33-1	2/15/2019 9:08	Pelagios	in the water	14° 47,391' N	024° 23,314' W	1005.2	
POS532_33-1	2/15/2019 9:30	Pelagios	on deck	14° 47,355' N	024° 23,731' W	1000.0	

POS532_33-2	2/15/2019 10:05	Multinet	in the water	14° 47,405' N	024° 24,084' W	1032.9	
POS532_33-2	2/15/2019 10:59	Multinet	max depth/on ground	14° 47,539' N	024° 26,289' W	1363.3	1756 m max
POS532_33-2	2/15/2019 11:35	Multinet	on deck	14° 47,905' N	024° 27,411' W	1621.5	
POS532_33-3	2/15/2019 11:50	Pelagios	in the water	14° 47,951' N	024° 27,448' W	1611.7	
POS532_33-3	2/15/2019 12:30	Pelagios	on deck	14° 47,758' N	024° 26,746' W	1411.8	
POS532_33-4	2/15/2019 13:01	Pelagios	in the water	14° 47,557' N	024° 26,333' W	1364.8	
POS532_33-4	2/15/2019 13:17	Pelagios	on deck	14° 47,478' N	024° 26,074' W	1328.3	
POS532_33-4	2/15/2019 13:20	Pelagios	in the water	14° 47,449' N	024° 26,022' W	1346.4	
POS532_33-4	2/15/2019 16:17	Pelagios	on deck	14° 46,865' N	024° 22,953' W	1326.8	max 1000m
POS532_33-5	2/15/2019 17:13	CTD	in the water	14° 47,409' N	024° 23,168' W	970.4	
POS532_33-5	2/15/2019 17:31	CTD	max depth/on ground	14° 47,408' N	024° 23,202' W	977.6	SL max = 911m
POS532_33-5	2/15/2019 17:49	CTD	on deck	14° 47,398' N	024° 23,229' W	966.2	
POS532_33-6	2/15/2019 17:55	Multinet	in the water	14° 47,403' N	024° 23,236' W	964.2	
POS532_33-6	2/15/2019 18:13	Multinet	max depth/on ground	14° 47,425' N	024° 23,269' W	955.5	SL max = 600m
POS532_33-6	2/15/2019 18:24	Multinet	on deck	14° 47,441' N	024° 23,288' W	935.6	
POS532_33-7	2/15/2019 19:27	Multinet	in the water	14° 47,403' N	024° 23,006' W	977.9	
POS532_33-7	2/15/2019 20:19	Multinet	max depth/on ground	14° 47,630' N	024° 25,059' W	1060.4	SL max = 1619m
POS532_33-7	2/15/2019 20:54	Multinet	on deck	14° 47,795' N	024° 26,228' W	1204.2	
POS532_33-8	2/15/2019 21:22	Pelagios	in the water	14° 48,044' N	024° 26,057' W	984.0	
POS532_33-8	2/16/2019 0:49	Pelagios	on deck	14° 47,105' N	024° 22,266' W	1135.9	
POS532_34-1	2/16/2019 1:28	CTD	in the water	14° 45,519' N	024° 23,616' W	2037.0	
POS532_34-1	2/16/2019 1:50	CTD	max depth/on ground	14° 45,498' N	024° 23,669' W	2050.3	max 1046m
POS532_34-1	2/16/2019 2:08	CTD	on deck	14° 45,502' N	024° 23,716' W	2046.8	
POS532_35-1	2/16/2019 2:52	CTD	in the water	14° 43,911' N	024° 23,827' W	2730.6	
POS532_35-1	2/16/2019 3:12	CTD	max depth/on ground	14° 43,898' N	024° 23,861' W	2749.9	max 1005m
POS532_35-1	2/16/2019 3:28	CTD	on deck	14° 43,872' N	024° 23,963' W	2746.3	
POS532_36-1	2/16/2019 4:27	CTD	in the water	14° 41,873' N	024° 24,107' W	3332.6	
POS532_36-1	2/16/2019 4:48	CTD	max depth/on ground	14° 41,864' N	024° 24,240' W	3328.6	max 913m
POS532_36-1	2/16/2019 5:01	CTD	on deck	14° 41,881' N	024° 24,209' W	3308.0	
POS532_37-1	2/16/2019 5:59	CTD	in the water	14° 40,085' N	024° 24,494' W	3631.1	
POS532_37-1	2/16/2019 6:16	CTD	max depth/on ground	14° 40,105' N	024° 24,485' W	3629.3	SL max = 910m
POS532_37-1	2/16/2019 6:31	CTD	on deck	14° 40,123' N	024° 24,479' W	3639.9	
POS532_38-1	2/16/2019 9:24	CTD	in the water	14° 42,537' N	024° 27,967' W	3247.8	
POS532_38-1	2/16/2019 10:09	CTD	max depth/on ground	14° 42,800' N	024° 27,818' W	3192.9	2561 m max
POS532_38-1	2/16/2019 10:54	CTD	on deck	14° 43,132' N	024° 27,669' W	3124.6	
POS532_38-2	2/16/2019 11:09	Multinet	in the water	14° 43,420' N	024° 27,525' W	3121.7	
POS532_38-2	2/16/2019 12:04	Multinet	max depth/on ground	14° 45,591' N	024° 26,472' W	2362.2	1848 m max

POS532_38-2	2/16/2019 12:38	Multinet	on deck	14° 46,934' N	024° 25,977' W	1637.7	
POS532_39-1	2/16/2019 13:43	Pelagios	in the water	14° 47,333' N	024° 25,655' W	1414.8	
POS532_39-1	2/16/2019 16:03	Pelagios	on deck	14° 45,884' N	024° 23,832' W	1921.3	max 600m
POS532_40-1	2/16/2019 18:04	CTD	in the water	14° 47,158' N	024° 27,517' W	1919.2	
POS532_40-1	2/16/2019 18:28	CTD	max depth/on ground	14° 47,176' N	024° 27,525' W	1919.2	SL max = 1352m
POS532_40-1	2/16/2019 18:51	CTD	on deck	14° 47,160' N	024° 27,522' W	1936.3	
POS532_41-1	2/16/2019 19:37	Multinet	in the water	14° 44,568' N	024° 27,919' W	2824.8	
POS532_41-1	2/16/2019 19:59	Multinet	information	14° 45,508' N	024° 27,823' W	2561.9	interrupted
POS532_41-1	2/16/2019 20:05	Multinet	on deck	14° 45,766' N	024° 27,772' W	2488.8	
POS532_42-1	2/17/2019 1:02	ADCP	profile start	14° 47,764' N	024° 23,238' W	741.7	
POS532_42-1	2/17/2019 3:47	ADCP	profile end	14° 36,098' N	024° 25,207' W	54.3	
POS532_43-1	2/17/2019 9:59	JAGO	in the water	14° 49,665' N	024° 27,434' W	776.7	JAGO in the water
POS532_43-1	2/17/2019 12:39	JAGO	on deck	14° 49,919' N	024° 27,647' W	778.6	JAGO on deck
POS532_44-1	2/17/2019 15:51	JAGO	in the water	14° 50,504' N	024° 27,927' W	366.5	JAGO in the water
POS532_44-1	2/17/2019 19:17	JAGO	on deck	14° 51,073' N	024° 28,409' W	220.9	Jago on deck
POS532_45-1	2/18/2019 7:10	JAGO	in the water	14° 49,609' N	024° 27,460' W	816.8	Jago
POS532_45-1	2/18/2019 11:21	JAGO	on deck	14° 50,807' N	024° 28,821' W	839.2	JAGO on deck
POS532_46-1	2/18/2019 11:49	OFOS	in the water	14° 50,594' N	024° 27,901' W	263.1	
POS532_46-1	2/18/2019 12:43	OFOS	on deck	14° 50,473' N	024° 27,934' W	372.1	
POS532_47-1	2/18/2019 21:27	JAGO	in the water	14° 49,685' N	024° 27,571' W	845.4	JAGO in the water
POS532_47-1	2/19/2019 0:53	JAGO	on deck	14° 50,484' N	024° 28,751' W	864.0	JAGO on deck
POS532_48-1	2/19/2019 9:01	CTD	in the water	14° 44,992' N	024° 42,003' W	2530.7	
POS532_48-1	2/19/2019 9:16	CTD	max depth/on ground	14° 44,983' N	024° 42,025' W	2583.2	711 m max
POS532_48-1	2/19/2019 9:28	CTD	on deck	14° 44,978' N	024° 42,016' W	2514.4	
POS532_49-1	2/19/2019 11:49	CTD	in the water	14° 41,239' N	024° 59,084' W	3515.8	
POS532_49-1	2/19/2019 12:03	CTD	max depth/on ground	14° 41,242' N	024° 59,101' W	3519.9	661 m max
POS532_49-1	2/19/2019 12:15	CTD	on deck	14° 41,253' N	024° 59,106' W	3517.7	
POS532_50-1	2/19/2019 14:56	CTD	in the water	14° 37,471' N	025° 16,206' W	347.1	
POS532_50-1	2/19/2019 15:10	CTD	max depth/on ground	14° 37,613' N	025° 16,303' W	336.0	max 669m
POS532_50-1	2/19/2019 15:22	CTD	on deck	14° 37,629' N	025° 16,274' W	357.1	
POS532_51-1	2/19/2019 17:54	Multinet	in the water	14° 33,749' N	025° 33,285' W	4454.2	
POS532_51-1	2/19/2019 18:19	Multinet	max depth/on ground	14° 33,704' N	025° 33,351' W	4458.1	SL max = 603m
POS532_51-1	2/19/2019 18:30	Multinet	on deck	14° 33,679' N	025° 33,387' W	4461.1	
POS532_51-2	2/19/2019 18:42	Multinet	in the water	14° 33,695' N	025° 33,380' W	4454.1	
POS532_51-2	2/19/2019 18:54	Multinet	max depth/on ground	14° 33,637' N	025° 33,429' W	4454.3	SL max = 301m
POS532_51-2	2/19/2019 19:01	Multinet	on deck	14° 33,615' N	025° 33,454' W	4455.1	

POS532_51-3	2/19/2019 19:17	OFOS	in the water	14° 33,785' N	025° 33,217' W	4510.9	
POS532_51-3	2/19/2019 21:28	OFOS	on deck	14° 33,751' N	025° 33,244' W	4454.9	
POS532_51-4	2/19/2019 21:35	CTD	in the water	14° 33,755' N	025° 33,253' W	4474.4	
POS532_51-4	2/19/2019 21:56	CTD	max depth/on ground	14° 33,760' N	025° 33,226' W	4455.8	1014 m max
POS532_51-4	2/19/2019 22:16	CTD	on deck	14° 33,799' N	025° 33,211' W	4473.0	
POS532_51-5	2/19/2019 22:27	Multinet	in the water	14° 33,791' N	025° 33,212' W	4454.8	
POS532_51-5	2/19/2019 22:48	Multinet	max depth/on ground	14° 33,772' N	025° 33,259' W	4459.2	604 m max
POS532_51-5	2/19/2019 23:00	Multinet	on deck	14° 33,745' N	025° 33,302' W	4456.6	
POS532_51-6	2/19/2019 23:06	Multinet	in the water	14° 33,732' N	025° 33,294' W	4454.3	
POS532_51-6	2/19/2019 23:13	Multinet	max depth/on ground	14° 33,729' N	025° 33,293' W	4453.8	203 m max
POS532_51-6	2/19/2019 23:18	Multinet	on deck	14° 33,728' N	025° 33,286' W	4455.2	
POS532_51-7	2/19/2019 23:26	OFOS	in the water	14° 33,712' N	025° 33,310' W	4455.8	
POS532_51-7	2/20/2019 1:15	OFOS	max depth/on ground	14° 33,867' N	025° 33,088' W	4453.0	
POS532_51-7	2/20/2019 1:42	OFOS	on deck	14° 33,910' N	025° 32,940' W	4452.4	
POS532_51-8	2/20/2019 1:49	CTD	in the water	14° 33,928' N	025° 32,901' W	4450.6	
POS532_51-8	2/20/2019 2:04	CTD	max depth/on ground	14° 33,925' N	025° 32,830' W	4451.0	max 602m
POS532_51-8	2/20/2019 2:16	CTD	on deck	14° 33,932' N	025° 32,776' W	4453.0	
POS532_52-1	2/20/2019 5:27	CTD	in the water	14° 29,984' N	025° 50,321' W	4514.8	
POS532_52-1	2/20/2019 5:41	CTD	max depth/on ground	14° 29,997' N	025° 50,289' W	4513.5	SL max = 664m
POS532_52-1	2/20/2019 5:52	CTD	on deck	14° 30,010' N	025° 50,302' W	4515.0	
POS532_53-1	2/20/2019 8:49	CTD	in the water	14° 26,258' N	026° 07,409' W	4595.6	
POS532_53-1	2/20/2019 9:02	CTD	max depth/on ground	14° 26,272' N	026° 07,429' W	4596.8	SL max = 644 m
POS532_53-1	2/20/2019 9:14	CTD	on deck	14° 26,284' N	026° 07,435' W	4598.2	
POS532_54-1	2/20/2019 11:35	CTD	in the water	14° 22,642' N	026° 24,524' W	4734.5	
POS532_54-1	2/20/2019 11:49	CTD	max depth/on ground	14° 22,759' N	026° 24,577' W	4740.8	609 m max
POS532_54-1	2/20/2019 12:02	CTD	on deck	14° 22,866' N	026° 24,614' W	4769.9	
POS532_55-1	2/20/2019 14:25	CTD	in the water	14° 18,787' N	026° 41,596' W	4832.2	
POS532_55-1	2/20/2019 14:38	CTD	max depth/on ground	14° 18,878' N	026° 41,629' W	4827.9	max 610m
POS532_55-1	2/20/2019 14:53	CTD	on deck	14° 18,986' N	026° 41,653' W	4829.2	
POS532_56-1	2/20/2019 17:20	CTD	in the water	14° 15,101' N	026° 58,640' W	4860.4	
POS532_56-1	2/20/2019 17:33	CTD	max depth/on ground	14° 15,120' N	026° 58,664' W	4865.0	SL max = 642m
POS532_56-1	2/20/2019 17:43	CTD	on deck	14° 15,117' N	026° 58,713' W	4860.6	
POS532_57-1	2/20/2019 21:08	CTD	in the water	14° 10,527' N	027° 20,158' W	5043.6	
POS532_57-1	2/20/2019 21:22	CTD	max depth/on ground	14° 10,602' N	027° 20,238' W	5040.2	653 m max
POS532_57-1	2/20/2019 21:34	CTD	on deck	14° 10,645' N	027° 20,289' W	5037.0	
POS532_58-1	2/20/2019 22:48	CTD	in the water	14° 09,028' N	027° 26,757' W	5083.5	

POS532_58-1	2/20/2019 23:02	CTD	max depth/on ground	14° 09,084' N	027° 26,699' W	5082.5	627 m max
POS532_58-1	2/20/2019 23:14	CTD	on deck	14° 09,135' N	027° 26,695' W	5112.4	
POS532_58-2	2/20/2019 23:23	OFOS	in the water	14° 09,187' N	027° 26,665' W	5082.2	
POS532_58-2	2/21/2019 0:42	OFOS	max depth/on ground	14° 09,321' N	027° 26,274' W	5082.2	500 m max
POS532_58-2	2/21/2019 1:01	OFOS	on deck	14° 09,289' N	027° 26,132' W	5086.7	
POS532_59-1	2/21/2019 1:06	EK80	profile start	14° 09,386' N	027° 26,086' W	5079.1	
POS532_59-1	2/21/2019 3:43	EK80	profile end	14° 14,417' N	027° 22,662' W	5088.7	
POS532_60-1	2/21/2019 3:48	ADCP	profile start	14° 14,483' N	027° 22,614' W	5077.3	
POS532_60-1	2/21/2019 8:52	ADCP	profile end	14° 09,199' N	027° 26,559' W	5083.4	
POS532_61-1	2/21/2019 9:13	CTD	in the water	14° 09,249' N	027° 26,644' W	5081.6	
POS532_61-1	2/21/2019 9:59	CTD	max depth/on ground	14° 09,282' N	027° 26,616' W	5096.1	2531 m max
POS532_61-1	2/21/2019 10:42	CTD	on deck	14° 09,198' N	027° 26,588' W	5096.6	
POS532_61-2	2/21/2019 10:53	Multinet	in the water	14° 09,189' N	027° 26,608' W	5083.6	
POS532_61-2	2/21/2019 11:12	Multinet	max depth/on ground	14° 09,157' N	027° 26,646' W	5082.5	600 m max
POS532_61-2	2/21/2019 11:24	Multinet	on deck	14° 09,180' N	027° 26,646' W	5089.4	
POS532_61-3	2/21/2019 11:31	Multinet	in the water	14° 09,202' N	027° 26,659' W	5082.4	
POS532_61-3	2/21/2019 11:39	Multinet	max depth/on ground	14° 09,214' N	027° 26,655' W	5081.7	203 m max
POS532_61-3	2/21/2019 11:44	Multinet	on deck	14° 09,202' N	027° 26,656' W	5096.6	
POS532_61-4	2/21/2019 11:57	OFOS	in the water	14° 09,206' N	027° 26,648' W	5082.5	
POS532_61-4	2/21/2019 14:10	OFOS	max depth/on ground	14° 08,538' N	027° 27,238' W	5084.6	max 600m
POS532_61-4	2/21/2019 14:26	OFOS	on deck	14° 08,428' N	027° 27,357' W	5087.7	
POS532_61-5	2/21/2019 14:56	Multinet	in the water	14° 08,997' N	027° 27,028' W	5083.0	
POS532_61-5	2/21/2019 15:14	Multinet	max depth/on ground	14° 08,928' N	027° 27,123' W	5083.1	max 104m
POS532_61-5	2/21/2019 15:24	Multinet	on deck	14° 08,886' N	027° 27,157' W	5084.6	
POS532_62-1	2/21/2019 16:58	CTD	in the water	14° 07,559' N	027° 32,786' W	5091.4	
POS532_62-1	2/21/2019 17:12	CTD	max depth/on ground	14° 07,601' N	027° 32,773' W	5096.8	SL max = 656m
POS532_62-1	2/21/2019 17:23	CTD	on deck	14° 07,606' N	027° 32,757' W	5094.5	
POS532_63-1	2/21/2019 20:10	CTD	in the water	14° 03,879' N	027° 49,941' W	5152.1	
POS532_63-1	2/21/2019 20:22	CTD	max depth/on ground	14° 03,861' N	027° 49,922' W	5167.4	SL max = 645m
POS532_63-1	2/21/2019 20:33	CTD	on deck	14° 03,906' N	027° 49,919' W	5149.5	
POS532_64-1	2/21/2019 23:21	CTD	in the water	14° 00,117' N	028° 06,886' W	5253.4	
POS532_64-1	2/21/2019 23:35	CTD	max depth/on ground	14° 00,157' N	028° 06,888' W	5252.6	650 m max
POS532_64-1	2/21/2019 23:47	CTD	on deck	14° 00,153' N	028° 06,904' W	5252.3	
POS532_65-1	2/22/2019 9:40	JAGO	in the water	14° 07,543' N	027° 32,715' W	5107.3	JAGO in the water
POS532_65-1	2/22/2019 12:23	JAGO	on deck	14° 07,429' N	027° 32,711' W	5094.9	JAGO on deck
POS532_65-2	2/22/2019 13:33	Multinet	in the water	14° 07,613' N	027° 32,849' W	5094.9	

POS532_65-2	2/22/2019 13:59	Multinet	max depth/on ground	14° 08,289' N	027° 32,818' W	5094.9	max 697m
POS532_65-2	2/22/2019 14:34	Multinet	on deck	14° 09,226' N	027° 32,603' W	5094.9	
POS532_65-3	2/22/2019 15:15	Pelagios	in the water	14° 07,697' N	027° 32,815' W	5094.9	
POS532_65-3	2/22/2019 18:24	Pelagios	on deck	14° 10,724' N	027° 33,003' W	5094.9	
POS532_65-4	2/22/2019 19:07	CTD	in the water	14° 07,549' N	027° 32,836' W	5094.9	
POS532_65-4	2/22/2019 19:26	CTD	max depth/on ground	14° 07,530' N	027° 32,820' W	5092.4	SL max = 1012m
POS532_65-4	2/22/2019 19:45	CTD	on deck	14° 07,534' N	027° 32,792' W	5091.3	
POS532_65-5	2/22/2019 19:57	Multinet	in the water	14° 07,666' N	027° 32,674' W	5106.7	
POS532_65-5	2/22/2019 20:27	Multinet	max depth/on ground	14° 08,499' N	027° 31,951' W	5088.5	SL max = 984m
POS532_65-5	2/22/2019 21:01	Multinet	on deck	14° 09,357' N	027° 31,190' W	5096.6	
POS532_65-6	2/22/2019 21:51	Pelagios	in the water	14° 07,568' N	027° 32,836' W	5097.9	
POS532_65-6	2/22/2019 23:59	Pelagios	on deck	14° 09,181' N	027° 32,030' W	5091.9	
POS532_65-7	2/23/2019 0:07	Multinet	in the water	14° 09,298' N	027° 32,008' W	5084.2	
POS532_65-7	2/23/2019 0:25	Multinet	max depth/on ground	14° 09,269' N	027° 31,986' W	5084.3	604 m max
POS532_65-7	2/23/2019 0:38	Multinet	on deck	14° 09,296' N	027° 31,941' W	5084.5	
POS532_65-8	2/23/2019 0:45	Multinet	in the water	14° 09,269' N	027° 31,941' W	5093.0	
POS532_65-8	2/23/2019 0:52	Multinet	max depth/on ground	14° 09,236' N	027° 31,959' W	5091.7	205 m max
POS532_65-8	2/23/2019 0:57	Multinet	on deck	14° 09,237' N	027° 31,954' W	5086.3	

8 Data and Sample Storage and Availability

All hydrographic data as well as nutrient data are stored in OSIS (GEOMAR data management), allowing rapid transfer to PANGAEA upon publication. All JAGO and part of the PELAGIOS video collected during POS532 has been annotated using the VARS annotation software (MBARI) and annotations as well as framegrabs are now part of the Oceanic Biodiversity Observations Database at GEOMAR. This growing database is part of the Deep-Sea Biology working group of Hoving. The database can be queried for annotated taxa. Video is stored on harddrives. Samples collected with the multinet are archived in the facilities at GEOMAR, and abundance data from the multinet will be stored on OSIS/published on PANGAEA. For those samples that will be analysed with the Zooscan, sorted images are stored on EcoTaxa (https://ecotaxa.obs-vlfr.fr). DNA samples are processed at the Smithsonian Institute and once sequences have successfully been obtained, the data will be shared with and jointly published. After publication the data will become available on Genbank.

Table 8.1 Overview of data availability

Type	**Database**	**Available**	**Free Access**	**Contact**
		Date	Date	E-Mail
CTD, ADCP, nutrients	OSIS PANGAEA	06/2019	06/2021	hhauss@geomar.de
JAGO video	Oceanic Biodiversity Observation Database	Upon request	After publication	khissmann@geomar.de hhoving@geomar.de
PELAGIOS video	Oceanic Biodiversity Observation Database	Upon request	After publication	hhoving@geomar.de
OFOS video	Universidade Cabo Verde	Upon request	After publication	hhoving@geomar.de
Multinet data	OSIS PANGAEA EcoTaxa	06/2020	06/2022	hhauss@geomar.de
Photograph s	Smithsonian Institute	Upon request	After publication	OsbornK@si.edu
DNA barcodes	Smithsonian Institute	Genbank	As soon as possible	OsbornK@si.edu

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11 Abbreviations

NA

12 Appendices

12.1 Selected Pictures of Samples

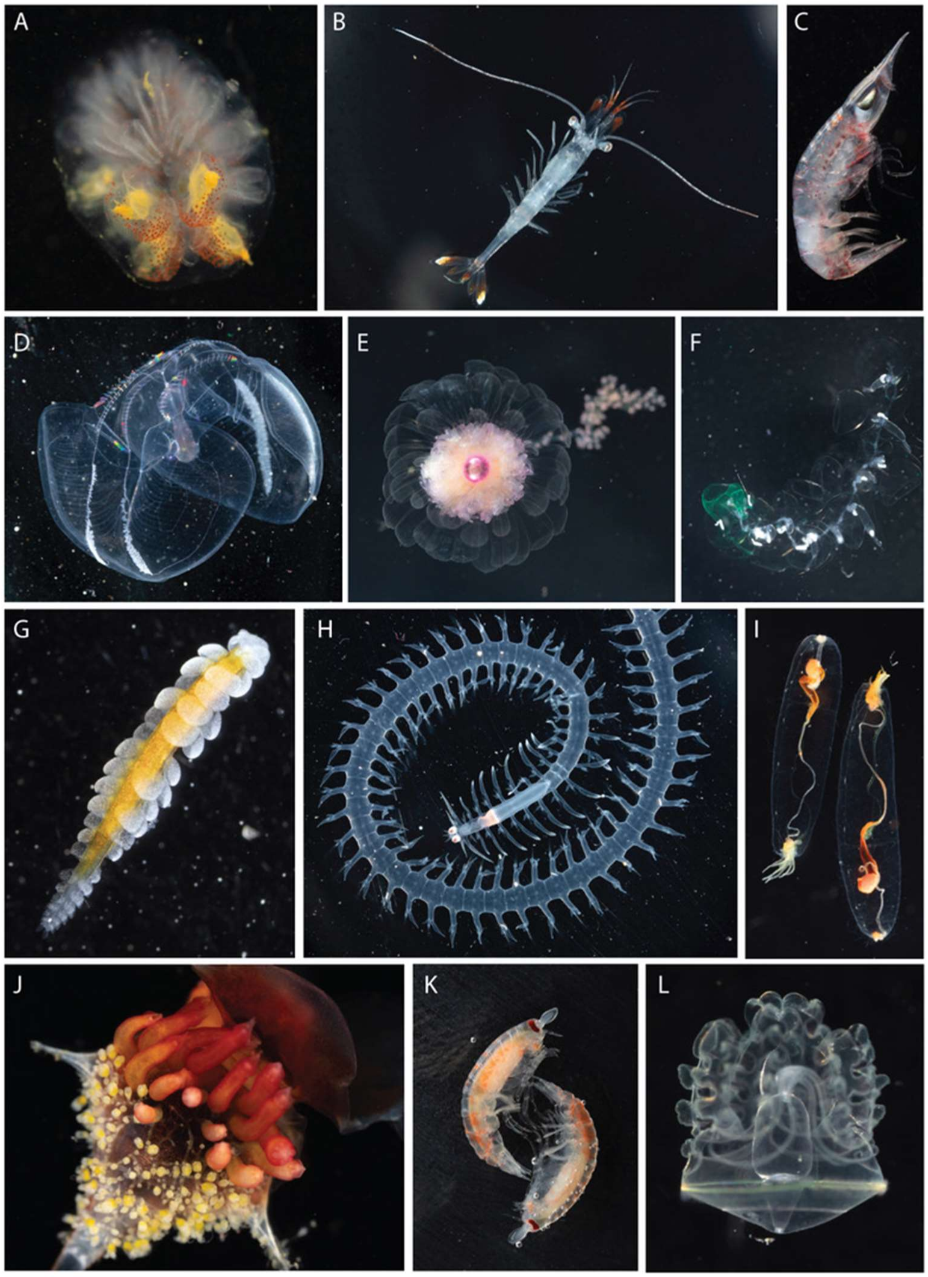

Figure 1. Exemplar animals collected. A. A pyrosome (Chordata, Tunicata), *Pyrosoma atlanticum*. B. An unknown shrimp (Crustacea, Decapoda) repeatedly found associated with *P. atlanticum*. C. A hyperiid amphipod (Crustacea) *Leptocotis*. D. A lobate ctenophore, *Ocyropsis*. Two siphonophores (Cnidaria, Hydrozoa) E. *Athorybia* and F. *Lilyopsis*. Three polychaete worms (Annelida) G. Typhloscolidae, H. Alciopidae, and I. a male and female specimens of a new species of *Poeobius*. J. A thecosomate pteropod Diacria trispinosa densly inhabitated by a hydroid with two morphs, one polyp form (large, red) defend the other (small, yellow, reproductive) from the host and potential predators. K. A hyperiid amphiopod (Crustacea) *Vibilia*. L. The tornaria larval form of an acorn worm (Hemichordata, Enteropneusta).

	
Holothuroide indet.	Desmospongia indet
	
Actiniaria	Antipatharia
	
Hexactinellida indet	Decapoda, Pandalidae, *Plesionika* cf. *williamsi*
	
Demospongia, Hexactinellida, Cnidaria	Decapoda, omolidae, *Paromola cuvieri*

Figure 2: Organisms on the deep seafloor of the Cape Verde Archipelago, as observed by the Ocean Floor Observation System

Figure 3: Shortnose greeneye (*Chlorophthalmus agassizi*), blacktail comber (*Serranus atricauda*), Darwin's slimehead (*Gephyroberyx darwinii*). Photo: JAGO-Team GEOMAR.

12.2 Selected Pictures of Shipboard Operations

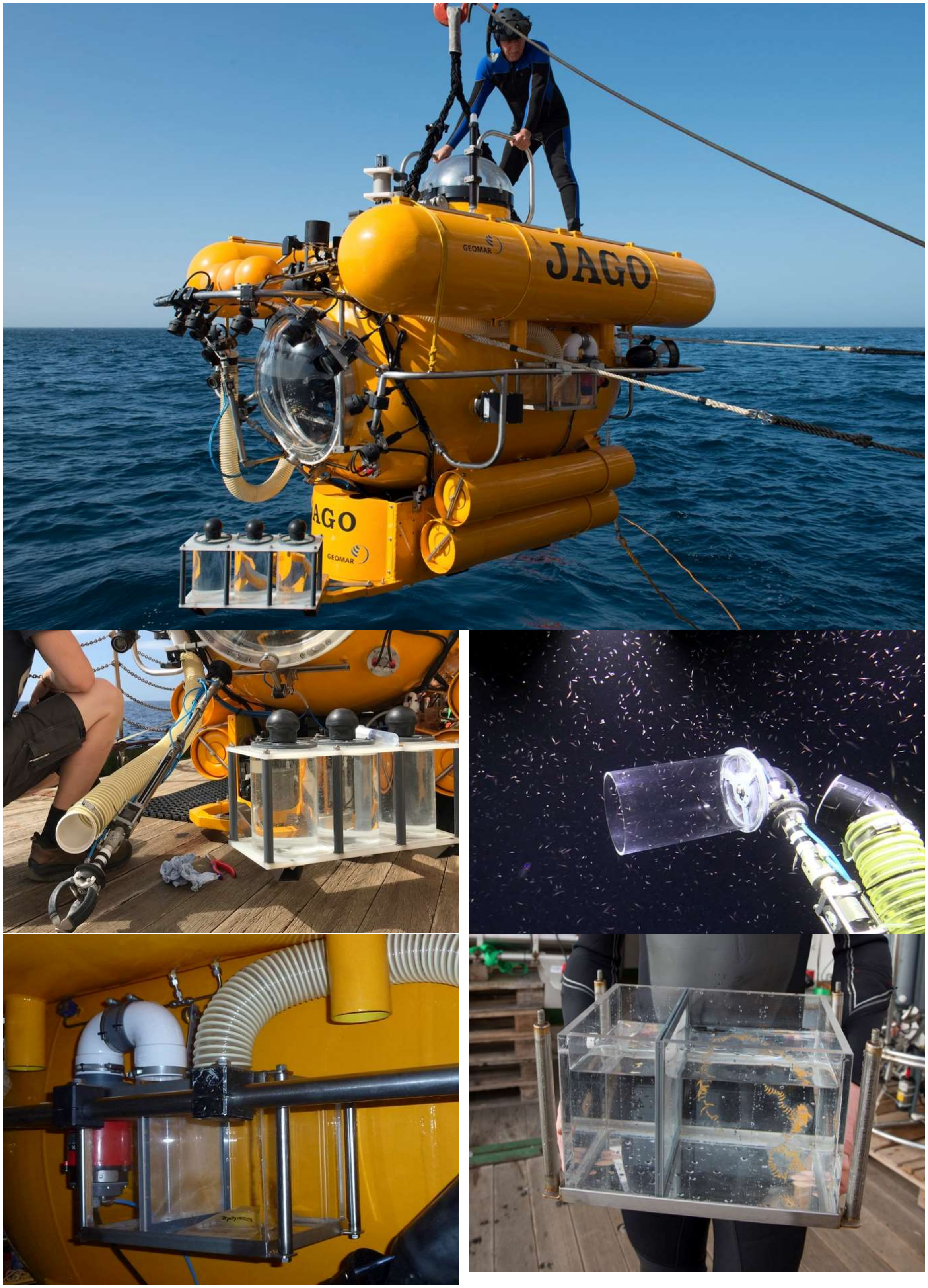

Figure 4. Top: Submersible JAGO with mounted scoop tube rack and suction sampler during a deployment off Santo Antao. Middle left: rack with three collecting cylinders (Ø 133, L 200mm) and manipulator arm with flexible suction tube. Middle right: scoop tube in use during a dive.

Lower left: Collecting container at the starboard side of JAGO, divided in an inflow and an outflow chamber by an exchangeable mesh screen (mesh size 1mm), adjustable underwater suction pump (red, 130 l/min) and flexible suction tube. Lower right: detached collecting container with large pelagic siphonophore in inflow chamber.

Figure 5. Front view into manned submersible JAGO while drifting through a cloud of *Phronima* amphipods (top), inside view of the submersible with survey camera mounted in JAGO's front window during a bottom survey along the steep slopes of Santo Antao (bottom).

Figure 6: Set up for eDNA filtration. Between the Niskin and the 2L bottle there is a sterivex filter for water filtration.

Figure 7: Pyrosomes in the water column as observed and recorded by the Pelagic in situ observation system PELAGIOS

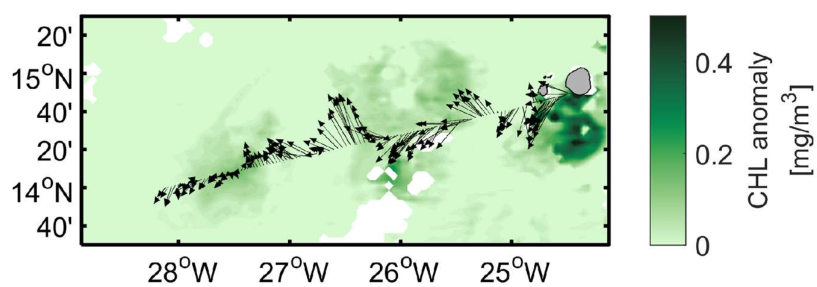

Figure 8: Satellite-derived surface chl-*a* distribution with superimposed geostrophic velocities (from vmADCP) during Feb 19 - Feb 21, 2019. Note “green” patch south of Fogo as well as alternating currents (indicating eddies) on the ship’s track associated with increased chl-*a*.

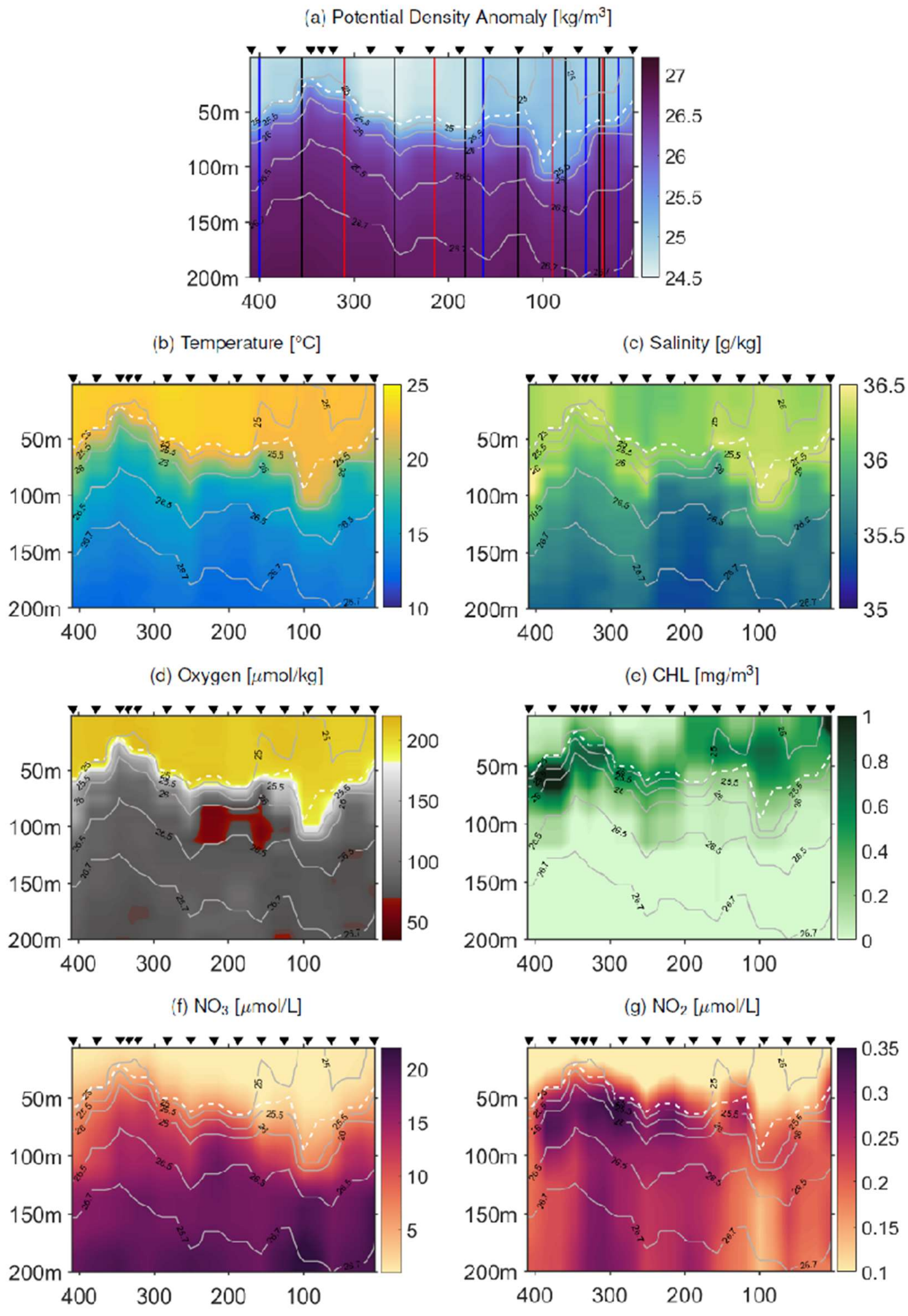

Figure 9: Section of physical and chemical parameters along the wake transect (distance from Fogo). Triangles denote location of CTD stations. In panel (a), black, blue and red lines denote zero, minimal and maximal meridional current velocities.