Leibniz-Institut für
Ostseeforschung Warnemünde

Date: 12.07.13

Cruise Report

Compiled by: Dr. Joanna Waniek

R.V. Poseidon Cruise No.: 452

Dates of Cruise: from 04.05.2013 to 19.05.2013

Areas of Research: Biogeochemistry, Physical Oceanography, Maritime Technology

Port Calls: Lisbon (Portugal), Vigo (Spain)

Institute: Leibniz Institut für Ostseeforschung Warnemünde, Seestraße 15, 18119 Rostock

Chief Scientist: PD. Dr. habil. Joanna Waniek

Number of Scientists: 10

Project: DFG: WA2157/5-1, BMWI: 03SX276 A/B

Cruise Report

This cruise report consists of 20 pages including cover:

1. Scientific crew:

Name	Function	Institute	Cruise/Leg
Dr. Waniek, Joanna	Chief scientist	IOW	452
Fründt, Birte	PhD Student	IOW	452
Hand, Ines	Technician	IOW	452
Götte, Johann	Student	IOW	452
Hehl, Uwe	Technician	IOW	452
Dr. Thiede, Carl	Scientist	Enitech	452
Albrecht, Jonathan	Scientist	Enitech	452
Kebkal, Oleksiy	Technician	Evologics	452
Yakovlyev, Sergiy	Technician	Evologics	452
Schmidt, Tino	Scientist	TU Berlin	452
Total : 10			

IOW	Leibniz Institut für Ostseeforschung Warnemünde
Evologics	EvoLogics GmbH, FuE Bionik, Berlin
Enitech	Enitech GmbH, Rostock
TU Berlin	Technische Universität Berlin

Chief scientist:

PD. Dr. habil. Joanna Waniek

Leibniz Institut für Ostseeforschung Warnemünde
Seestrasse 15
18119 Rostock, Germany

Telefon: +49 (0) 381 5197 300
Telefax: +49 (0) 381 5197 302
e-mail: joanna.waniek@io-warnemuende.de

2. Research programme (J. Waniek, IOW)

The objectives of the cruise P452 from Lisbon (Portugal) to Vigo (Spain) in May 2013 (04.05-19.05.2013) on board R/V Poseidon were:

1) To investigate the water column properties along a meridional transect (22°W from 30°N to 37°N) in order to localize the position of the Azores Front and to understand the changes in biogeochemical properties.
2) Recovering of the mooring Kiel276-28 (33°N, 22°W) and deployment of Kiel276-29
3) To perform deep sea trials (at depth greater than 5000 m) with the newly developed acoustic modems and DNS (Druck Neutrale Systeme) devices.

3. Narrative of the cruise with technical details (J. Waniek, IOW)

02.05.2013 - The scientific crew arrives at 9am on board of RV Poseidon for unloading the containers. The unpacking of the containers began at 2pm after considerable waiting time and was finished shortly after 4pm.

03.05.2013 - At 9am we have boarded RV Poseidon and immediately started preparing our gear and setting up the instruments in the ship laboratories for the cruise.

04.05.2013 - At 9am after safety instructions for all scientists Poseidon left Lisbon for the cruise heading towards 37°N, 22°W. According to weather forecast we will arrive in the working area on 07.05.2013.

05.05.2013/06.05.2013 – We are on the transit to the working area, the weather conditions including the sea are good. However, the forecast for the working area is not good, high sea and up to 4 m swell. The test station (CTD) down to 200 m was carried out without any problems, so we are confident it will be a successful cruise.

07.05.2013 – We are heading further south to 30°N, 22°W as in the northern part of the working area the sea would not allow us to deploy any instruments. We will arrive there approximately on the 08.05.2013 at 6:00. Thermosalinograph and the surface near Fluorometer are working continuously from now on.

08.05.2013 – We are at the southern limit of our working area (30°N, 22°W). Our work starts with a CTD cast down to the bottom (5200 m). Near the bottom we experience problems closing the Niskin bottles. The CTD returns to the surface without any water samples. We immediately start the search for the source of the problem and find short after that out, the pylon is not working properly. We are not able to solve the problem immediately, so the work continues with tests of the ERNO system. First deployment of TMS and the trim unit is partly successful, as some water intruded the

trim unit. This however can be eliminated before next deployments. Overnight we continue our work with the CTD (without water samples) along 22W.

09.05.2013 – The work with CTD continues combined with TMS-ERNO trial and access point releaser test.

10.05.2013 – At 8am we area near the Kiel276-28 mooring and start the preparation for recovery of the mooring. We have triggered both releasers. After 30 long minutes of waiting the sub-surface buoy was sighted ahead of the ship. At noon the entire mooring was recovered. The lowest buoyancy pack had 3 damaged buoys, one additional was missing and the current meter above showed damage as well. Releaser test on the CTD in 5200 m depth as a preparation for the deployment of Kiel276-29 was successful. We had the entire day good weather conditions with 3-4 Bft. All scientists work intensively to prepare the deployment of Kiel276-29 next day.

11.05.2013 – At 8am we start with the deployment of Kiel276-29, the weather is getting bad. At lunchtime the entire mooring string is deployed and we are heading to the upper most buoy to watch it descending for another 2 years deployment. The sub-surface buoy vanished for few minutes, but unfortunately appeared again at surface. We are immediately starting preparation to recover the moorings or parts of it. At 4pm the upper 3000 m of the mooring are recovered. The 14 mm line broke directly at the second sediment trap (3000 m), meaning that the sediment trap, buoyancy spheres, one current meter and both releaser are at the sea floor. Fortunately for us this part of the mooring has positive buoyancy, and we might be able to recover it later on, weather permitting. During the unexpectedly necessary recovery of Kiel276-29 the weather conditions worsen up to 7 Bft with strong swell and heavy rain.

12.05.2013 – We are waiting at 34°N, 22°W for the weather to improve (high swell and 6-7 Bft) as working is not possible.

13.05.2013/14.05.2013 – We continue our work going northward with CTD (without water) and several trials of the DNS systems along the 22°W transect. At 34°N45' we have located the Azores Front. The weather conditions are continuously bad (3-4 Bft, but 3-4 m waves), just allowing for CTD work on 14.05.

15.05.2013 – Today we arrive at the northern most position (37°N, 22°W) which is our last station to be sampled. Again as the weather is not really good only the CTD is deployed. After completing the CTD cast we begin our transit to Vigo. We have 6-7 Bft and high sea conditions.

16.05.2013/18.05.2013 - The weather conditions are getting continuously worse reaching at time 8-9 Bft during the entire transit time to Vigo.

19.05.2013 – In the morning we arrive in Vigo and the cruise terminates here. After customs we start unloading our gear and packing the containers with our instruments.

20.05.2013 – This morning at 9am the scientific crew disembarks and moved to hotel before departing home on 23 of May.

4. Scientific report and first results

4.1 Hydrographic sections (B. Fründt, J. Waniek, IOW)

One of the objectives of the cruise P452 was to investigate the water column properties along a meridional transect at 22°W from 30°N to 37°N in order to localize the position of the Azores Front and to understand the changes in the biogeochemical properties corresponding to the frontal area (Fig. 1).

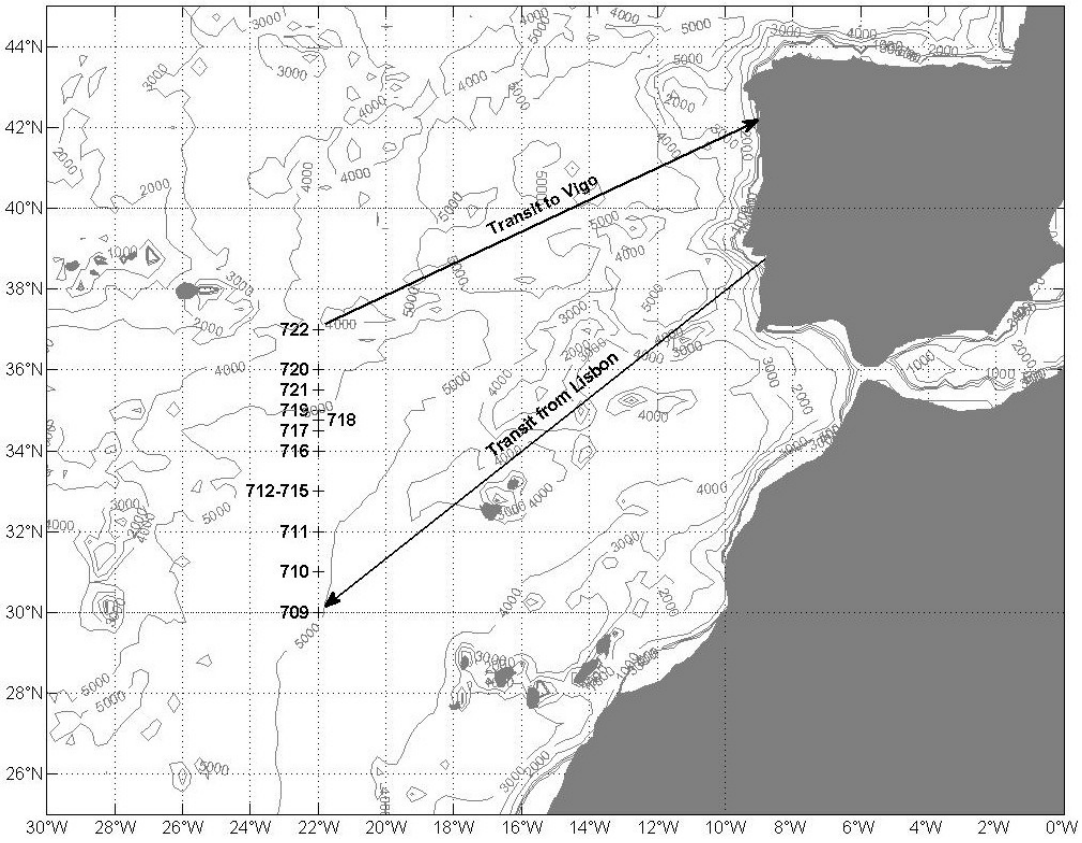

Figure 1: CTD stations sampled during the POS452 cruise.

For this purpose, CTD measurements were done at 11 stations along the 22°W. Most of them were performed down to 1000 m depth, two of them (on 30°N and 33°N) down to the bottom of roughly 5000 m. Additionally, oxygen and fluorescence data were recorded at all stations. Water sampling with the CTD rosette was not possible because the pylon failed and did not allow closing the bottles at depth. The CTD (type SBE 911plus) was equipped with a double sensor system to monitor the quality of the data: the temperature sensors had the serial numbers 1589 and 2424; the conductivity device had the serial number 1389. The oxygen was measured with a SBE 43 instrument with the serial number 0506 10V. For the fluorescence measurements a fluorometer WET Labs ECO-AFL/FL, serial number FLRTD-1528_10V, was used.

To detect the Azores Front, in-situ measurements of temperature and salinity are necessary because the front does not have any surface indication and therefore cannot be detected via remote sensing. The position of the frontal system is defined where the 15°C isotherm moves upward from depth below 300 m to above 200 m depth. Figure 2 shows the vertical temperature, salinity and fluorescence distribution in the upper 500 m of the watercolumn. During this cruise in May 2013 the Azores Front was detected at 34.5°N with a steep slope of the 15°C-isotherm between 34° and 35°N. Compared to the previous cruise in September 2012, the Azores Front moved two degrees southward. Directly at the front, the deep chlorophyll maximum is shifted upwards from about 90 m to about 70 m. Furthermore, due to frontal upwelling, the highest fluorescence values up to 1 mg m^{-3} were found at 34.75°N, i.e. in the northern part of the Azores Front.

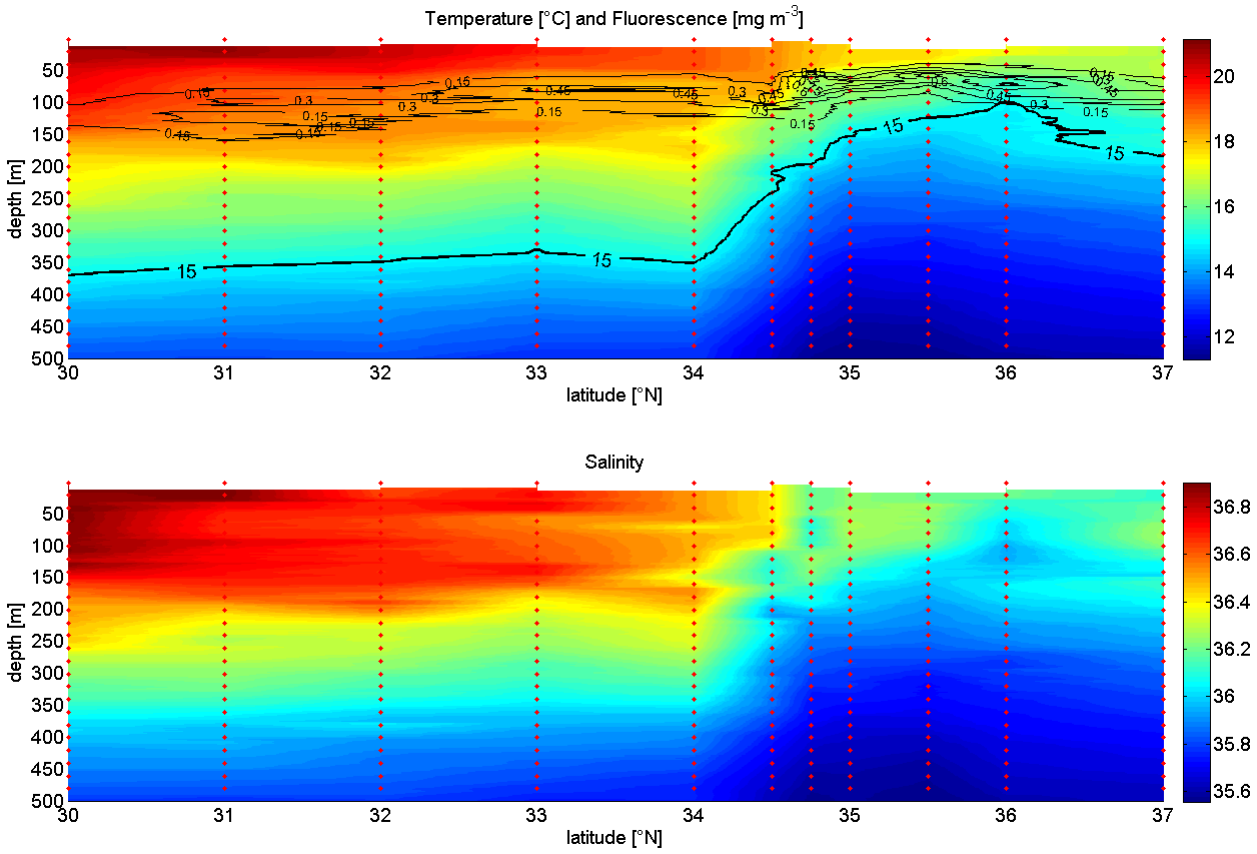

Figure 2: Vertical temperature, fluorescence and salinity distribution (0 - 500 m depth) along the 22°W transect from 30°N to 37°N. The red dotted lines show the locations of the measurements. The bold black line indicates the 15°C isotherm; the thin black lines indicate the deep chlorophyll maximum. The Azores Front was detected at 34.5°N.

4.2 Recovery of Kiel276-28 and deployment of Kiel276-29

In the morning of 10th May 2013 we have reached the position of Kiel276-28 (33°05.58N, 021°59.90W) and initiated the recovery of the mooring line by activating the releasers. Kiel276-28 was deployed during the MSM18/1 cruise in May 2011. The sub-surface buoy emerged some 30 minutes after release ahead of

the ship. At 09:08 UTC we started the recovery of the 5200 m of line with buoyancy spheres, current meters and two sediment traps. At noon the entire Kiel276-28 was safely on deck of RV Poseidon. Visual inspection showed that the lowest buoyancy pack containing 6 spheres was damaged, three spheres were imploded and one entirely missing. Additionally, the Aanderaa current meter showed some damaged as well, which was confirmed after opening the pressure case. Both sediment traps were recovered at the 17th position, and worked properly. Time series covering two years period of particle flux data was successfully obtained.

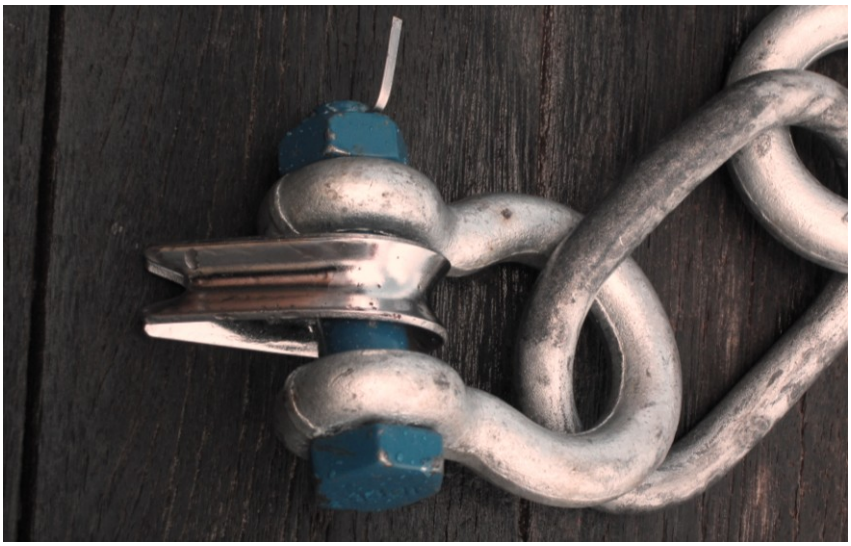

Figure 3: The thimble where the 14 mm Meteor line is missing causing the preliminary loss of 2 km of the instrument line.

In the morning of 11th May we were ready to deploy Kiel276-29 for another two years of registrations. All six Aanderaa current meters, 46 buoyancy spheres, 2 sediment traps, sub-surface buoy and two releases were deployed at relatively rough sea conditions. The anchor weight was launched at 11:24 UTC at 32°58.90N, 022°03.187W. At 12:07 the sub-surface buoy re-appeared at surface indicating problems within the mooring line and making a recovery of the mooring necessary. During this procedure the weather conditions were continuously worsening, however at 13:00 UTC the sub-surface buoy was on deck again and the recovery continued until the point where the second sediment trap was primarily attached. The 14 mm strong line in the thimble opened at this position causing the temporary lost of the lower part of the mooring (Fig. 3). This means that 2000 m of line, 12 buoyancy spheres, 1 sediment trap, 1 current meter and both releaser units were not recovered. As the entire mooring is designed in a way that all parts are positively buoyancy there is a chance to recover this part of the Kiel276-29 under better weather conditions some time later. The estimated position of the anchor is 32°58.74N, 022°03.85W. During P452 we have no possibility to recover the instruments due to heavy weather conditions.

4.3. DNS Tiefsee work packages of ENITECH GmbH (C. Thiede, J. Albrecht, Enitech).

The main objectives of the project "DNS Tiefsee" with the work packages of ENITECH GmbH during the cruise P452 was testing the ERNO system together with TMS (Teather Management System) and ROV (Remotely Operated Vehicle): 1) to investigate the behavior of the entire system while connected to a single-core cable of 6000 m length, 2) to examine the possible data transmission rate and power transmission characteristics at maximum attenuation and 3) the general handling of the ROV's. Additionally we planned to film anchor stones from the previous Kiel276 deployments while diving with ERNO. Furthermore, we aimed at testing navigating the acoustic network implemented via four access points and an attempt to recover one of the access point from the seabed with the ERNO system. Furthermore, we attempted together with the Technical University of Berlin (TUB) to test the buoyancy trim system together with the TMS ERNO system at full depth (> 5000 m). Finally, pressure neutral components like batteries as well as samples will be recovered. They were installed two years ago at the mooring Kiel276 on a sediment trap in approx. 3000 m.

4.3.1. Test - buoyancy trim system with TMS

Station: POS452/709-2, Date: 08.05.13, Position: 30° 0.05' N, 22° 0.01' W, Wind speed 7 m/s

Figure 4: Buoyancy trim system under TMS ready for deployment.

For the test of the buoyancy trim system under realistic environmental conditions, the buoyancy trim system was bolted under the TMS and electrically connected. Thus, it can be controlled and monitored via the control of ERNO system before using the software and the hardware was put into operation. This was completed without problems. After installation of the buoyancy trim system under the TMS (figure 4) PLC (pre-launch check) was successfully carried out. The system was deployed and was slacked with 1 m/s to the depths of 500 m, 1000 m, 1500 m and 3000 m. At those depths levels additional measurements were performed. Parallel measurements were carried out on the performance of the single-core cable with the TMS. In the buoyancy trim system technical problems occurred (water intrusion in pressure vessels). However, the test was continued up to 3000.

Station: POS452/714-4, Date: 10.05.13, Position: 33° 5.90' N, 21° 58.41' W Wind speed: 7 m/s

The buoyancy trim system was tested again 2 days later and worked satisfactorily after repair and modification. The planned measurements were successfully performed. The system was tested to a depth of 4317 m.The parallel functional testing of the repaired TMS coupling system could also be carried out to this depth successfully and without technical problems. There were no malfunctions. All systems worked properly and were safely recovered again.

4.3.2 Test ERNO-System full depth (5211 m), filming of anchor stones.

Station: POS452/712-1, Date: 09.05.13, Position: 33°0.01' N, 21°59.98' W, Wind speed 4m/s

In this dive we were aiming to test the complete ERNO system and to film three of the Kiel276 anchor stones. The PLC was successful passed after pairing the devices TMS and ROV was completed. The system was slacked on the single-core cable with 0.5 m/s down to 50 m (figure 5) to perform a first blue-water test (decouple and short coupling). Unfortunately due to relevant technical problems on the coupling system we had to terminate the dive and the mission.

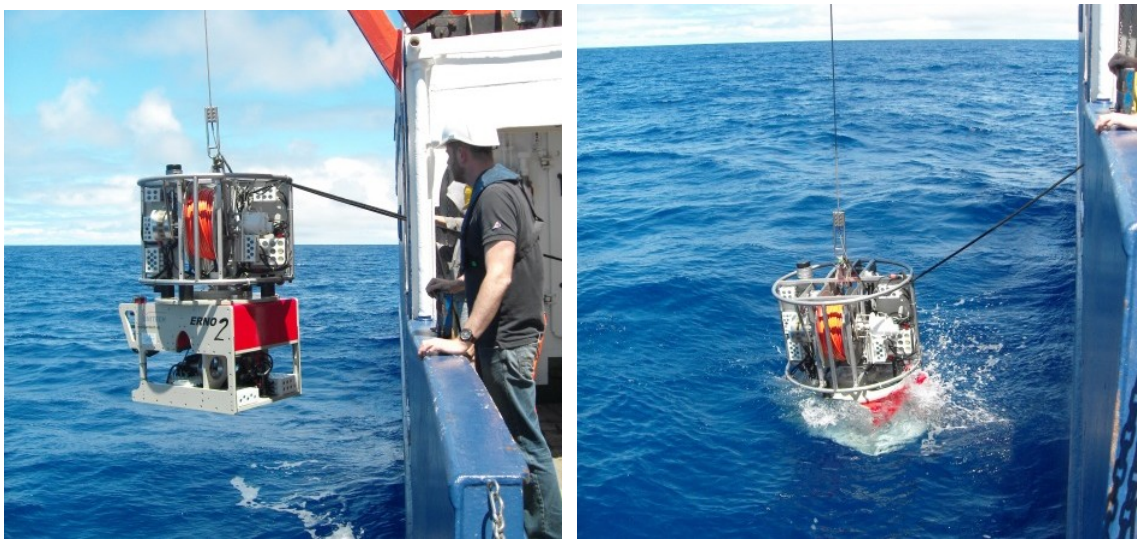

Figure 5: Deployment of the ERNO-System.

Despite the very tight time frame and partly very bad weather conditions a variety of information were gained. In the first test of the buoyancy trim system, together with the TMS technical problems occurred. However, a variety of data were obtained, which considerably simplified the subsequent error analysis. The TMS functioned without difficulty up to the water depth of 3000 m. The data connection was very stable despite an attenuation of 40.1 dB at 3.6 Mbps transmission speed. The power transmission of 400 V at 0.9 A was also very satisfactory for a cable length of 6000 Meters. This demonstrated that the data

transmission system used can be employed on a research vessel under natural conditions using a cable length of about 6000 very well.

4.3.3 Recovery of pressure neutral samples

Station: POS452/713-1, Position: 33° 4.41' N, 21° 58.98' W, Wind speed: 7 m/s

After the successful recovery of the mooring Kiel276-28 with the sediment traps, the samples were also safely recovered (figure 6). They were also immediately examined and measured on board.

Figure 6: Pressure neutral samples on sediment trap after two years into 3000 m depth.

The over two years in 3000 m mounted samples were remarkably well preserved. All with silicone encapsulated samples showed no signs of corrosion. In the pressure-neutral battery which was also deployed in 3000 m a self-discharge of only 0.032 V was observed. This confirms the optimal ability of lithium polymer cells as pressure-neutral energy storage.

Significantly increasing wind and sea conditions prevented unfortunately the continued safe use of the ERNO system in combination with the access points.

4.4. NAVKOMON Components Tests: Acoustic Modems and USBL Positioning (S. Yakovlyev, O. Kebkal, Evologics)

Project foresees implementation of hydroacoustic navigation and communication systems, operating in low frequency range (intended for long-range communications between Access Points and AUV, as well as from research vessel to systems, deployed at depth) and in high-frequency range (for short-range

communications and positioning between TMS and ROV). EvoLogics prepared following systems for the Poseidon trials: 1) Based on S2CR 7/17 – low-frequency, long-range modems with USBL positioning, hemispherical directivity; 2) Based on modified for deep-water S2CR 48/78 – high-frequency, short range modems with USBL positioning, toroidal directivity. Four S2CR 7/17 (LF-modems) were installed on the Access-Points (AP), shown below (Fig. 7).

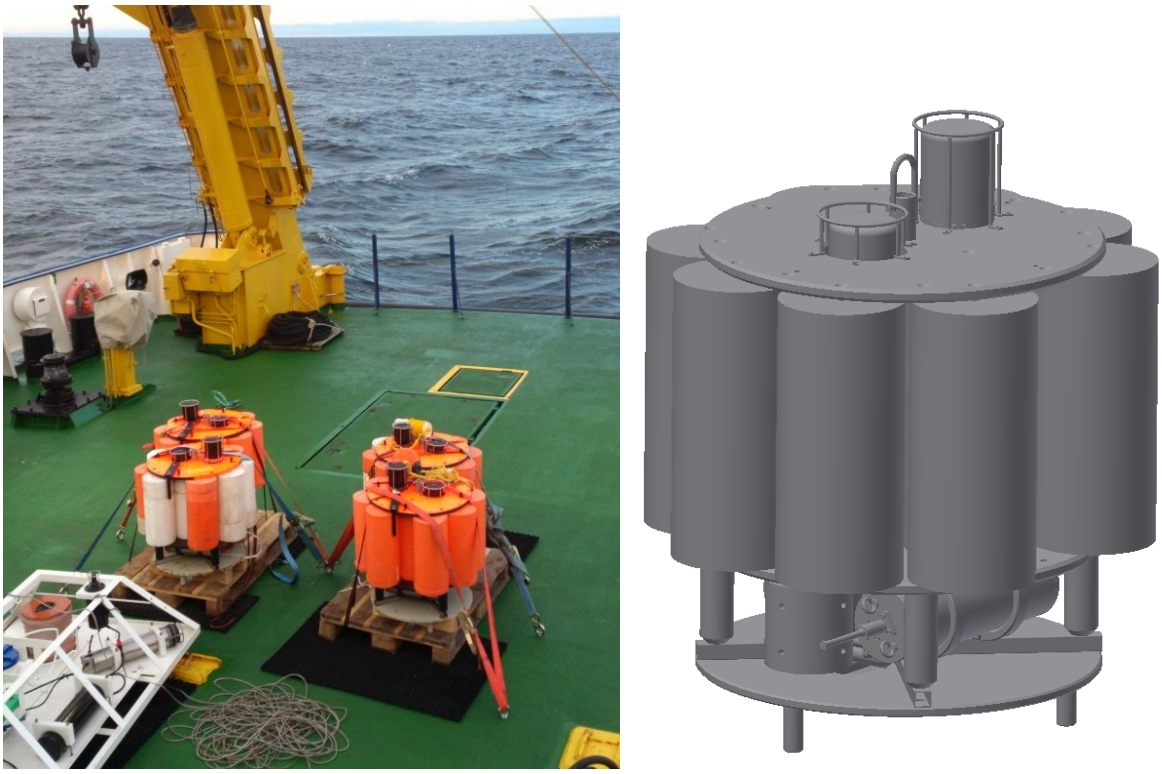

Figure 7: Access-Points on deck of RV Poseidon and as schematic drawing.

Every AP was equipped with acoustic release (original pressure-tolerant design made by EvoLogics in collaboration with TU Berlin). Additional release was installed for redundancy purposes. The LF-modems, installed on APs were configured for operations with low-power consumption (15mW in Listen mode) making them suitable for long-term operations. Every LF-modem includes integrated non-volatile data storage with capacity of 32 Gbytes allowing recording of the project-specific data and communications logs for further offline analysis. The systems were tested in a practical environment during Atlantic cruise RV Poseidon in May-2013; main parameters of the communication link were measured.

4.4.1 Test Environment

Research Vessel "Poseidon" provides following possibilities for testing of the hydroacoustic communication systems: 1) Positioning the LF-modem in the moon pool; 2) positioning LF-modem at the CTD-Rosette; 3) positioning LF-modem at the TMS; 4) positioning the HF-modem at the ROV "ERNO-2".

Most convenient way to communicate with underwater objects is to position the surface modem unit in the vessel's moon pool. S2CR 7/17 modem (hemispherical directivity) is affected by the vessel's and environmental noise. Special rubber baffles were installed to reduce effect of noise.

4.4.2 Trials plan

- Noise measurements
- Communication test between USBL-modem (Zeus) and modem (Kuckuck+Battery) on CTD
- Communication test between USBL-modem (Zeus) and modem (Kuckuck) on TMS during ERNO-mission. HF-USBL-Positioning during ERNO-mission
- Deployment of first AP with TMS. Check communication and positioning during descent and after deployment.
- Search and recovery of deployed AP with ERNO's claws (Greifer).
- Installation of underwater network: deployment of 4 APs with ERNO-2. Distance appr. 1km.
- Check communication and positioning during deployment and after releasing the AP from TMS. Ensure stable positioning of the deployed APs
- LBL-nodes geo-referencing. Ship must move around the deployment area with 3-4 knots, positions of APs will be collected and processed (LBL).
- Circulating messages between deployed APs, checking networking algorithms.
- Recovery of APs by activating release. Free ascending one by one.
- Check the AP's on deck (charge battery, attach new weight, check releasers, download saved log-data)
- Repeat deployments with greater distance up to 6km depending on communication quality. Free descend. Follow descending AP from the vessel's modem "Zeus" till final landing on the sea-floor. Ensure stable position of the deployed AP's by measuring their depths and positions.

The basic components of the NAVKOMON are shown in figure 8. During the trials of the hydroacoustic communication link, different test files from 1 kbytes to 5 kbytes along with Instant Messages (IM's) were transmitted. Every successful data exchange between modems was supported with measurements of RSSI

(receive signal strength), signal integrity (cross-correlation), distance between modems, and relative velocity, and service information, including modem's address, timestamp, multipath structure, bit rate, etc.

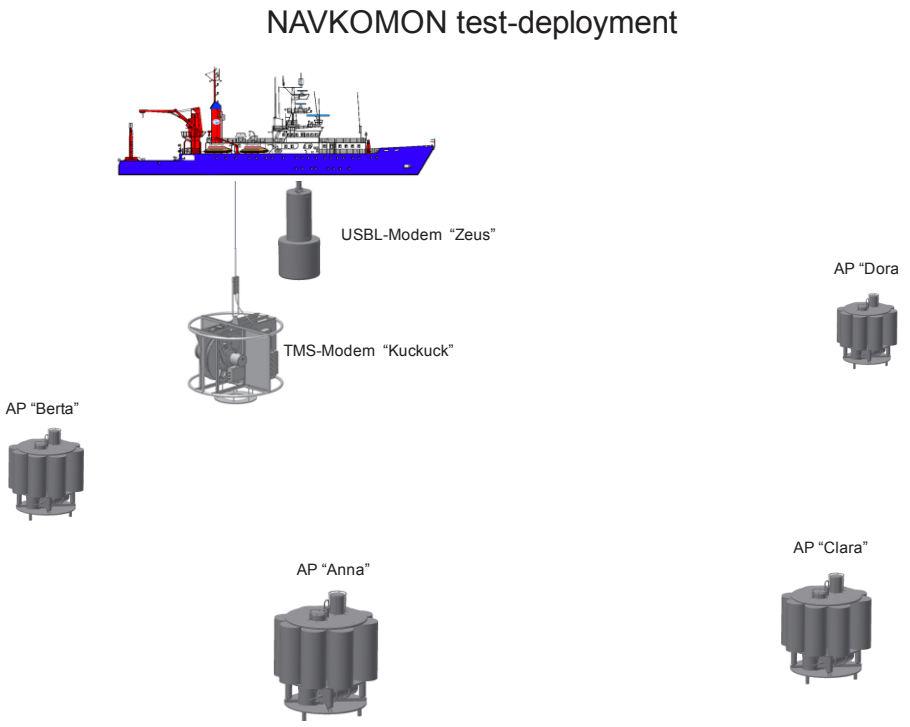

Figure 8: NAVKOMON test-deployment.

The LF-modems were successfully tested during descend of the CTD-rosette to depth of 5200 m. The communication channel is characterized as vertical. Additionally, the releases were successfully tested, activating them via acoustic link, when deploying APs on 500 m depth under the ship. The modems have shown functionality, required by the DNS project. Bidirectional data transmissions for depth up to 5200 m were confirmed. The trials program was not executed completely due to bad weather conditions in a trials area.

4.5 Tests of variable buoyancy system (T. Schmidt, TU Berlin)

Within the framework of the expedition P452, the Department for Electromechanical and Optical Systems of the Technical University Berlin tested a variable buoyancy system of a pressure-tolerant autonomous underwater vehicle. The aim of the exploration was to validate the correct function of the pressure tolerant system components, for example the actuator controlled high pressure pump, the flow rate sensor, the liquid level sensor, and the microcontroller. To raise the buoyancy of the system, hydraulic fluid is pumped out of a high pressure vessel into a flexible bag. To reduce the buoyancy, a high pressure valve

may be opened which causes a flow back of the fluid into the pressure vessel. To control the transfer of the fluid, a pressure tolerant flow rate sensor is applied.

The buoyancy system was assembled and fixed to a steel frame which was mechanically connected to a tether-management-system and the single-conductor cable of the research vessel Poseidon. A microcontroller transferred the data of the variable buoyancy system to a computer located on Poseidon which is used for remote operation.

The motor driven pump, the liquid level sensor and the pressure tolerant flow rate sensor worked well up to a depth of 3500 m.

Date: 05/08/2013/ Position: 29.98' N, 21° 59.95' N: The electromagnetic high pressure valve and the motor driven pump worked up to a depth of 500 m properly. At a depth of 1500 m, the high pressure valve accidentally opened without a remote order and without any current at the magnetic coil. Due to that, the hydraulic fluid was pushed out of the flexible bag, back into the high pressure vessel, until the bag was empty. Because of the pressure difference between the sea water and the vessel of the buoyancy system, the flexible bag got a leak and sea water flowed into the system. After cleaning the high pressure valve at the working deck of Poseidon, the system operated well again. Nevertheless, the high pressure valve was removed from the hydraulic circuit in order to avoid any further conflict with this component, which is negligible for this test, since the aim of the exploration was to check the correct function of the motor driven pump. Additionally, the dysfunctional flexible bag was substituted.

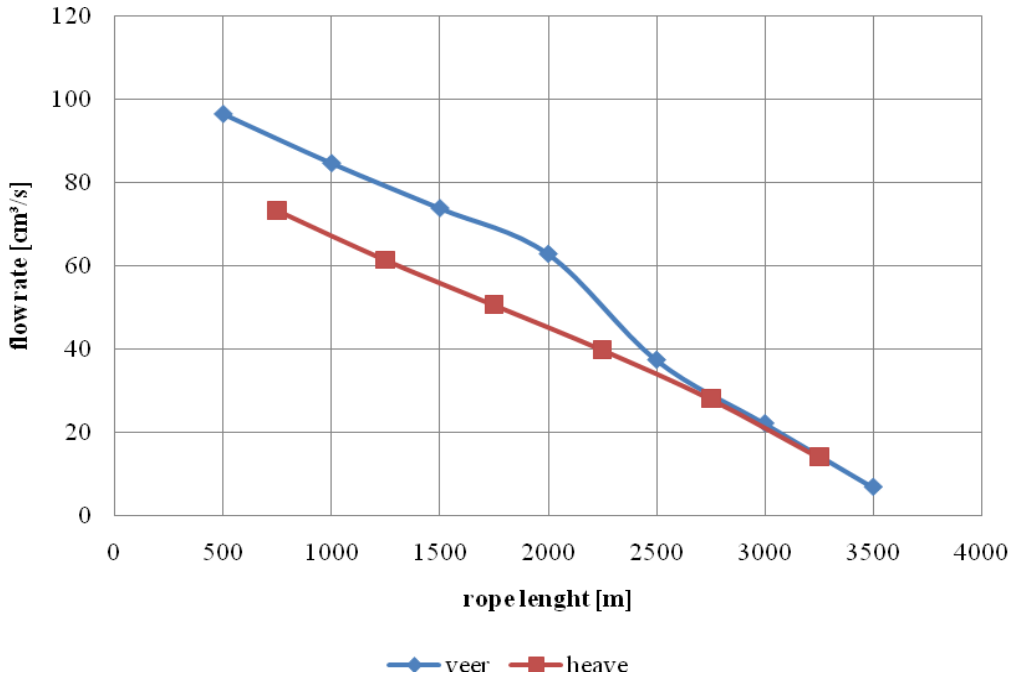

Figure 9: Flow rate according to diving depth (length of rope).

Date: 05/10/2013/ Position: 33° 5.9' N, 21° 58.41' W: The motor pump was activated for ten seconds at different diving depths. The following figure shows the flow rate of the motor pump corresponding to different diving depths (rope length). With increasing diving depth (rope length), a flow rate offset appears between a rope length of 2000 and 2500 m. An explanation could be that the hydraulic fluid cools down slowly due to the thick pressure hull made from glass, which isolates effectively against heat. The gradual change of temperature affects the viscosity of the fluid, which slows down the pumping speed of the motor driven pump. Tests of the variable buoyancy system in a pressure vessel at constant temperature showed, that the flow rate decreases linearly with increasing pressure.

The motor pump and the actuator worked properly up to a rope length of 3500 m (Fig. 9.). The system stopped at an increasing depth. This is based on a limit for the motor current in the software of the controller, which could only be changed on board and not remotely. The software limit was removed after this test in order to supply full power to the motor. However, the bad weather and rough sea did not allow further explorations.

5. Scientific equipment, moorings and instruments

5.1. CTD/ Water Sampling

The CTD was a SBE 911plus with a double sensor system. The temperature sensors have the serial numbers 1589 and 2424, and conductivity sensor 1389. Oxygen was measured with SBE 43, serial number 0506 10V; the Fluorometer was a Wetlab ECO-AFL/FL instrument, serial number FLRTD 1528.

5.2 Moorings

Kiel276-28: Recovered 6 Aanderaa current meters, 46 buoyancy spheres, 2 sediment traps, 1 sub-surface buoy, 2 releases, Argos beacon

Kiel276-29: Initially was fully deployed; due to failure of the line at 3000 m (just above the second sediment trap), emergency recovery was carried out. All instruments and lines down to 3000m were successfully recovered; unfortunately 1 sediment trap, 12 buoyancy spheres, 2 releasers and 1 current meter are preliminary missing. The assumed position of the lower part of the mooring is:32°58.74'N, 022°03.85'W.

6. Acknowledgements

We thank Captain M. Günther and the crew of RV Poseidon for their cooperation and help during this cruise.

7. Appendices

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Appendix A: Station list P452 May 2013

Station	Date	Time	Position Lat	Position Lon	depth [m]	device	action	notice
709-1	08.05.2013	05:06	30° 0,01' N	21° 59,98' W	4995,9	CTD/RO	information	start of station work
709-1	08.05.2013	05:24	29° 59,97' N	21° 59,99' W	4994,2	CTD/RO	to water	
709-1	08.05.2013	06:55	29° 59,97' N	22° 0,03' W	5032,1	CTD/RO	at depth	SL max.: 4931m
709-1	08.05.2013	08:50	29° 59,98' N	22° 0,00' W	4994,9	CTD/RO	on deck	
709-2	08.05.2013	10:11	30° 0,05' N	22° 0,01' W	5046,1	TMAS	to water	
709-2	08.05.2013	10:21	30° 0,08' N	22° 0,01' W	5013,2	TMAS	at depth	SL max.: 500 m
709-2	08.05.2013	10:40	30° 0,06' N	22° 0,02' W	5007,4	TMAS	at depth	SL max.: 1000 m
709-2	08.05.2013	10:53	30° 0,02' N	22° 0,01' W	5002,3	TMAS	at depth	SL max.: 1500 m
709-2	08.05.2013	11:29	29° 59,96' N	21° 59,96' W	4999,6	TMAS	at depth	SL max.: 3000m
709-2	08.05.2013	12:28	29° 59,98' N	21° 59,93' W	5004,4	TMAS	on deck	
710-1	08.05.2013	20:13	30° 59,97' N	21° 59,95' W	5014,8	CTD/RO	to water	
710-1	08.05.2013	20:42	30° 59,94' N	21° 59,93' W	5006,5	CTD/RO	at depth	SL max.: 1011 m
710-1	08.05.2013	21:05	30° 59,91' N	21° 59,92' W	5007,8	CTD/RO	on deck	
711-1	09.05.2013	04:26	31° 59,99' N	21° 59,96' W	5061	CTD/RO	to water	
711-1	09.05.2013	04:52	31° 59,99' N	22° 0,00' W	5051,3	CTD/RO	at depth	SL max.: 1012m
711-1	09.05.2013	05:13	32° 0,01' N	21° 59,99' W	5053,9	CTD/RO	on deck	
712-1	09.05.2013	12:19	33° 0,01' N	21° 59,98' W	5211,5	TMAS	to water	
712-1	09.05.2013	12:21	33° 0,00' N	21° 59,98' W	5211,6	TMAS	at depth	SL 50m, test depth
712-1	09.05.2013	12:36	33° 0,03' N	22° 0,01' W	5211,6	TMAS	on deck	techn. Problems
712-2	09.05.2013	13:00	33° 0,02' N	21° 59,99' W	5211,9	CTD/RO	to water	
712-2	09.05.2013	14:37	33° 0,02' N	21° 59,98' W	5211,2	CTD/RO	at depth	SL max.: 5171m
712-2	09.05.2013	14:46	33° 0,01' N	21° 59,98' W	5211	CTD/RO	information	start heave
712-2	09.05.2013	16:14	33° 0,02' N	21° 59,96' W	5219,3	CTD/RO	on deck	
712-3	09.05.2013	16:27	33° 0,01' N	21° 59,94' W	5212,1	AP	to water	Access point releaser test at 200 m
712-3	09.05.2013	16:34	33° 0,01' N	21° 59,94' W	5217,3	AP	at depth	SL max.: 200 m
712-3	09.05.2013	16:35	33° 0,01' N	21° 59,94' W	5213,4	AP	information	Release anchor at Access Point
712-3	09.05.2013	16:43	33° 0,03' N	21° 59,98' W	5214,5	AP	on deck	Access Point on deck
712-4	09.05.2013	17:25	33° 0,01' N	21° 59,98' W	5211	ISP	to water	KISP (in-situ pump)
712-4	09.05.2013	18:17	33° 0,01' N	21° 59,97' W	5210,5	ISP	pump at depth	SL max.: 3000 m
712-4	10.05.2013	05:47	33° 0,00' N	21° 59,99' W	5209,9	ISP	on deck	
713-1	10.05.2013	07:02	33° 5,08' N	21° 59,06' W	5273,1	MOR	hydrophone	
							to water	mooring Kiel 276-28

713-1	10.05.2013	07:10	33° 5,11' N	21° 59,06' W	5223,3	MOR	hydrophone on deck	
713-1	10.05.2013	07:16	33° 5,36' N	21° 58,96' W	5225,9	MOR	hydrophone to water	
713-1	10.05.2013	07:23	33° 5,35' N	21° 58,97' W	0	MOR	released	no answer of releaser
713-1	10.05.2013	07:26	33° 5,34' N	21° 58,97' W	0	MOR	hydrophone on deck	
713-1	10.05.2013	07:38	33° 5,32' N	21° 58,98' W	0	MOR	emerged	
713-1	10.05.2013	08:08	33° 5,87' N	21° 58,43' W	5221,5	MOR	head buoy picked	
713-1	10.05.2013	08:20	33° 5,72' N	21° 58,47' W	5239,3	MOR	action	8 Benthos and RCM-8 Nr.: 10816 on deck
713-1	10.05.2013	08:46	33° 5,42' N	21° 58,61' W	5223,2	MOR	action	6 Benthos and RCM-8 Nr.: 5881 on deck
713-1	10.05.2013	08:52	33° 5,33' N	21° 58,61' W	5221	MOR	action	2 Benthos on deck
713-1	10.05.2013	09:06	33° 5,15' N	21° 58,67' W	5221,6	MOR	action	4 Benthos and RCM-8 Nr.: 4562 on deck
713-1	10.05.2013	09:25	33° 4,94' N	21° 58,75' W	5225	MOR	action	3 Benthos and RCM-8 Nr.: 9730 on deck
713-1	10.05.2013	09:36	33° 4,83' N	21° 58,79' W	5221	MOR	action	5 Benthos on deck
713-1	10.05.2013	09:42	33° 4,78' N	21° 58,83' W	5231,9	MOR	action	sediment trap 2 (DL 1111) on deck
713-1	10.05.2013	10:13	33° 4,49' N	21° 58,91' W	5235,8	MOR	action	5 Benthos and RCM-8 Nr.: 9832 on deck
713-1	10.05.2013	10:24	33° 4,41' N	21° 58,98' W	5234,5	MOR	action	sediment trap 1 on deck
713-1	10.05.2013	10:38	33° 4,26' N	21° 59,04' W	5232,7	MOR	action	2 Benthos on deck
713-1	10.05.2013	10:56	33° 4,06' N	21° 59,11' W	5218,9	MOR	action	2 Benthos on deck
713-1	10.05.2013	11:11	33° 3,93' N	21° 59,16' W	5219,2	MOR	action	2 Benthos on deck
713-1	10.05.2013	11:17	33° 3,88' N	21° 59,20' W	5219,8	MOR	mooring on deck	Benthos (4 imploded) RCM-8 Nr.: 10578 a. Releaser AR-2 on deck
714-1	10.05.2013	12:51	33° 5,90' N	21° 58,42' W	5222	CTD/RO	to water	
714-1	10.05.2013	14:26	33° 5,90' N	21° 58,41' W	5224,3	CTD/RO	at depth	SL max.: 5172 m
714-2	10.05.2013	14:26	33° 5,90' N	21° 58,41' W	5224,3	HYDRO	to water	
714-2	10.05.2013	14:29	33° 5,90' N	21° 58,42' W	5222,4	HYDRO	start Observation	Releaser test
714-2	10.05.2013	14:32	33° 5,90' N	21° 58,42' W	5242,7	HYDRO	stop Observation	Releaser test stopped
714-2	10.05.2013	14:34	33° 5,90' N	21° 58,42' W	5223,4	HYDRO	on deck	
714-1	10.05.2013	16:05	33° 5,90' N	21° 58,39' W	5223,1	CTD/RO	on deck	

714-3	10.05.2013	16:27	33° 5,89' N	21° 58,40' W	5221,8	AP	to water	Access Point Releaser Test
714-3	10.05.2013	16:32	33° 5,88' N	21° 58,38' W	5250	AP	at depth	SL max.: 200 m
714-3	10.05.2013	16:41	33° 5,92' N	21° 58,39' W	5222,5	AP	at depth	SL max.: 500m
714-3	10.05.2013	16:55	33° 5,89' N	21° 58,40' W	5348,4	AP	released	SL: 450m
714-3	10.05.2013	17:07	33° 5,90' N	21° 58,42' W	5222,2	AP	on deck	
714-4	10.05.2013	17:35	33° 5,90' N	21° 58,41' W	5221,8	TMAS	to water	TMAS + Trimm-System
714-4	10.05.2013	18:49	33° 5,88' N	21° 58,41' W	5221,2	TMAS	at depth	SL max.: 4317 m
714-4	10.05.2013	20:00	33° 5,86' N	21° 58,37' W	5221,4	TMAS	on deck	
714-5	10.05.2013	20:15	33° 5,87' N	21° 58,37' W	5221,1	ISP	to water	KISP (in-situ pump)
714-5	10.05.2013	21:11	33° 5,88' N	21° 58,42' W	5221,3	ISP	pump at depth	SL max.: 3000 m
714-5	11.05.2013	05:49	33° 5,92' N	21° 58,41' W	5221,5	ISP	on deck	
715-1	11.05.2013	07:39	32° 57,40' N	22° 7,09' W	5225,9	MOR	head buoy to water	
715-1	11.05.2013	07:43	32° 57,43' N	22° 6,99' W	5225,2	MOR	buoys package to water	8 Benthos with RCM-8 (AVTP)
715-1	11.05.2013	08:03	32° 57,56' N	22° 6,53' W	5228,7	MOR	buoys package to water	6 Benthos and RCM-8 (AVT)
715-1	11.05.2013	08:17	32° 57,68' N	22° 6,27' W	5227,4	MOR	buoys package to water	2 Benthos
715-1	11.05.2013	08:35	32° 57,82' N	22° 5,87' W	5227,3	MOR	buoys package to water	4 Benthos and RCM-8 (AVT)
715-1	11.05.2013	08:50	32° 57,94' N	22° 5,54' W	5497,7	MOR	buoys package to water	3 Benthos and RCM-8 (AVTP)
715-1	11.05.2013	09:02	32° 58,02' N	22° 5,29' W	5230,9	MOR	buoys package to water	5 Benthos
715-1	11.05.2013	09:10	32° 58,04' N	22° 5,21' W	5229,5	MOR	sediment trap to water	sediment trap 1
715-1	11.05.2013	09:39	32° 58,33' N	22° 4,52' W	5230,5	MOR	buoys package to water	5 Benthos with RCM-8 (AVT LR)
715-1	11.05.2013	09:50	32° 58,33' N	22° 4,52' W	5221,3	MOR	sediment trap to water	sediment trap 2
715-1	11.05.2013	10:08	32° 58,46' N	22° 4,15' W	5232,3	MOR	buoys package to water	2 Benthos
715-1	11.05.2013	10:36	32° 58,63' N	22° 3,52' W	5143,6	MOR	buoys package to water	2 Benthos
715-1	11.05.2013	10:53	32° 58,75' N	22° 3,27' W	5222,4	MOR	buoys package to water	2 Benthos and RCM-8 (AVT LR)

715-1	11.05.2013	11:00	32° 58,78' N	22° 3,27' W	5233,7	MOR	buoys package to water	6 Benthos and Releaser AR-2
715-1	11.05.2013	11:00	32° 58,78' N	22° 3,27' W	5233,7	MOR	Releaser to water	Releaser AR-2
715-1	11.05.2013	11:24	32° 58,90' N	22° 3,19' W	5228,7	MOR	ground weight slipped	
715-1	11.05.2013	11:59	32° 58,46' N	22° 4,90' W	5223,4	MOR	action	8 Benthos emerged
715-1	11.05.2013	12:07	32° 58,54' N	22° 4,61' W	5221,2	MOR	action	mooring broken, emerges
715-1	11.05.2013	12:53	32° 58,64' N	22° 4,65' W	5222	MOR	head buoy picked	
715-1	11.05.2013	13:00	32° 58,58' N	22° 4,84' W	5223,8	MOR	action	head buoy on deck
715-1	11.05.2013	13:10	32° 58,51' N	22° 5,03' W	5229,5	MOR	action	8 Benthos with RCM on deck
715-1	11.05.2013	13:26	32° 58,41' N	22° 5,35' W	5226,1	MOR	action	6 Benthos with RCM on deck
715-1	11.05.2013	13:43	32° 58,32' N	22° 5,69' W	5228	MOR	action	2 Benthos on deck
715-1	11.05.2013	13:59	32° 58,22' N	22° 6,01' W	5232,7	MOR	action	4 Benthos with RCM on deck
715-1	11.05.2013	14:15	32° 58,15' N	22° 6,32' W	5229,7	MOR	action	3 Benthos with RCM on deck
715-1	11.05.2013	14:26	32° 58,10' N	22° 6,50' W	5249,3	MOR	action	5 Benthos on deck
715-1	11.05.2013	14:32	32° 58,06' N	22° 6,60' W	5238,1	MOR	action	sediment trap 1 on deck
715-1	11.05.2013	14:53	32° 57,88' N	22° 7,00' W	5230	MOR	action	5 Benthos with RCM on deck
716-1	13.05.2013	07:06	34° 0,01' N	22° 0,02' W	5294,1	CTD/RO	to water	
716-1	13.05.2013	07:32	34° 0,00' N	22° 0,03' W	5292,4	CTD/RO	at depth	SL max.: 1010 m
716-1	13.05.2013	07:51	33° 59,98' N	22° 0,01' W	5290,1	CTD/RO	on deck	
717-1	13.05.2013	12:32	34° 29,98' N	21° 59,93' W	5166,9	CTD/RO	to water	
717-1	13.05.2013	12:57	34° 30,00' N	21° 59,75' W	5166,1	CTD/RO	at depth	SL max.: 1012 m
717-1	13.05.2013	13:16	34° 30,00' N	21° 59,56' W	6167	CTD/RO	on deck	
718-1	13.05.2013	15:44	34° 45,00' N	22° 0,05' W	5124,4	CTD/RO	to water	
718-1	13.05.2013	16:10	34° 45,00' N	22° 0,00' W	5047,1	CTD/RO	at depth	SL max.: 1014 m
718-1	13.05.2013	16:29	34° 45,00' N	21° 59,97' W	5121,5	CTD/RO	on deck	
719-1	13.05.2013	19:08	34° 59,95' N	22° 0,01' W	0	CTD/RO	information	
719-1	13.05.2013	19:10	34° 59,96' N	22° 0,00' W	4949,4	CTD/RO	to water	
719-1	13.05.2013	19:43	34° 59,91' N	21° 59,91' W	4994,5	CTD/RO	at depth	SL max 1011 m
719-1	13.05.2013	20:01	34° 59,93' N	21° 59,82' W	0	CTD/RO	on deck	
719-1	13.05.2013	20:08	34° 59,94' N	21° 59,79' W	5018,3	CTD/RO	information	
720-1	14.05.2013	06:27	35° 59,99' N	22° 0,08' W	4204,9	CTD/RO	to water	
720-1	14.05.2013	06:51	35° 59,99' N	22° 0,07' W	4207,4	CTD/RO	at depth	SL max.: 1013 m
720-1	14.05.2013	07:09	35° 59,96' N	22° 0,04' W	4211,1	CTD/RO	on deck	
721-1	14.05.2013	10:49	35° 30,00' N	21° 59,99' W	4937,8	CTD/RO	to water	
721-1	14.05.2013	11:13	35° 29,99' N	21° 59,97' W	4938,8	CTD/RO	at depth	SL max.: 1010 m

721-1	**14.05.2013**	**11:31**	**35° 29,99' N**	**21° 59,95' W**	**4938,1**	**CTD/RO**	**on deck**	
722-1	**15.05.2013**	**06:17**	**37° 0,02' N**	**21° 59,96' W**	**4116,6**	**CTD/RO**	**to water**	
722-1	**15.05.2013**	**06:40**	**37° 0,02' N**	**21° 59,94' W**	**4084,1**	**CTD/RO**	**at depth**	**SL max.: 1009 m**
722-1	**15.05.2013**	**06:56**	**37° 0,03' N**	**21° 59,94' W**	**4094,4**	**CTD/RO**	**on deck**	**08:00 LT finish of station work**