Leibniz-Institut für
Ostseeforschung Warnemünde **Date: 11.11.13**

Cruise Report

Compiled by: Dr. Joanna Waniek

R.V. Poseidon Cruise No.: 459

Dates of Cruise: from 18.09.2013 to 02.10.2013

Areas of Research: Biogeochemistry, Physical Oceanography, Maritime Technology

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

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

Chief Scientist: PD. Dr. habil. Joanna Waniek

Number of Scientists: 11

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

Cruise Report

This cruise report consists of 24 pages including cover:

1. Scientific crew:

Name	Function	Institute	Cruise/Leg
Dr. Waniek, Joanna	Chief scientist	IOW	459
Henkel, Jan	Student	IOW	459
Huth, Hartmut	Technician	IOW	459
Gelze, Johannes	PhD student	TU Berlin	459
Hehl, Uwe	Technician	IOW	459
Geißler, Andre	Scientist	Enitech	459
Körner, Gerhard	Scientist	Enitech	459
Kebkal, Oleksiy	Technician	Evologics	459
Yakovlyev, Sergiy	Technician	Evologics	459
Schmidt, Tino	PhD student	TU Berlin	459
Chakrabarti, Romon	PhD student	TU Berlin	459
Total : 11			

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 P459 from Vigo (Spain) to Funchal (Portugal) in September 2013 (18.09-02.10.2013) on board R/V Poseidon were:

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

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

16.09.2013 - The scientific crew arrives in the morning on board of RV Poseidon for unloading of the 3 containers.

07.09.2013 - At 9 am we have boarded RV Poseidon and immediately started preparing our gear and setting up the instruments in the ship laboratories for the cruise.

18.09.2013 - At 9am after safety instructions for all scientists Poseidon left Vigo for the cruise heading towards the working area. The original working plan was adjusted based on weather/sea forecast. We will start our work with deployment of Kiel276-29 in the area next to 33°30'N, 21°30W. According to weather forecast we will arrive in the working area on 22.09.2013.

19.09.2013/21.09.2013 – We are on the transit to the working area, the weather conditions including the sea are good. The test station (CTD) including releaser test for the mooring was carried out without any problems. Thermosalinograph and the surface near fluorometer are working continuously from now on.

22.09.2013 – At 8 am we started with the deployment of the Kiel276-29 mooring at 33°19.49'N, 21°30.60W. The almost 5200 m long mooring consists of 6 current meters (RCM), 2 sediment traps, 46 buoyancy spheres, 2 releaser units, anchor weight and subsurface buoy. Just after lunch the entire mooring is deployed and we are continuing our work with setting up of the LARS system and a ROV deployment down to 1500 m.

23.09.2013 – We are at 32°N, 22°W, where we continue our hydrographic work with CTD deployments and first test of the LARS (Launch and recovery system) system. For the LARS test we decided to proceed with the AUV dummy, to ensure the functionality of the LARS first, before we proceed with the first deployment of the AUV.

24.09.2013 – Our work continued over night with CTD deployments (full depth) at selected locations, whereas during the day we are testing the LARS and will deploy the AUV and/or the AUV dummy.

The weather conditions for this kind of work are really good, the wind is below 5 m/s and there is almost no swell and the waves are really low. The AUV was launched via the LARS and sailed initially at surface and dived to 6 m. During the deployment communication tests between the modems mounted in the moon pool and the AUV were successfully carried out. We have also tested successfully the communication via funk. After the trial the AUV was successfully recovered using the LARS. We continue our work with CTD casts and deployment of 4 access points in a rectangle with a 1NM distance from each other. During the night communication test with the access points and dynamic calibration were performed.

25.09.2013 – Around 8 am the access points are released one by one. They are rising very slowly (0.2m/s) to the surface. In early afternoon all four of them are back on deck. The weather conditions are getting rough, we will be continuing just with CTD work as long as possible.

26.09.2013 – The weather is rough, we are having 6-7 Bft and almost 4 m swell, making work even with the CTD not safe. We decide to wait as the weather forecast promises improvement from next day on.

27.09.2013 – The weather conditions improved slightly allowing us to continue our hydrographic work, we will run a CTD cast every 30 NM to localise the Azores Front.

28.09.2013 – We are now at 35°30'N, we have localised the front between 34°30'N and 35°N. In comparison to the May cruise (POS452) the front moved towards north by approximately 60 miles, suggesting moving speed of 875 m/d or 0.01 m/s. The ROV deployment was terminated near the sea floor as we have lost communication with the ROV and one of the thrusters malfunctioned. After deployment of the ROV over full depth we are heading south as the forecast shows better sea conditions for work with the AUV in the southern part of the working area.

29.09.2013 – We are on the way to 33°N, 22°W, where the AUV will be deployed for 2nd time during this cruise. After arrival at the position the AUV was deployed using LARS and recovered after cruising at surface, within the surface layer (at 6 m and 30 m) and a descent to 250 m depth. Unfortunately due to problems with the AUV at 250 m depth we had to abandon the test and recover the AUV. We continue our work with CTD casts and deployment of the access points.

30.09.2013 – Until lunch time all access points are back on deck again and as the weather conditions are getting continuously worse we decide to end the scientific work and are sailing to Funchal.

02.10.2013 – In the morning we have arrived in Funchal and the cruise terminates here. We started unloading our gear and packing the containers with our instruments under inspection of the Portuguese customs.

03.10.2013 – At 9 am the scientific crew disembarks and moves to hotel before departing home on the 04. of October.

4. Scientific report and first results

4.1 Hydrographic sections (J. Waniek, IOW)

One of the objectives of the cruise P459 was to investigate the water column properties along a meridional transect at 22°W between 30°N to 37°N in order to localize the Azores Front and to understand the changes in the biogeochemical properties corresponding to the frontal area (Fig. 1).

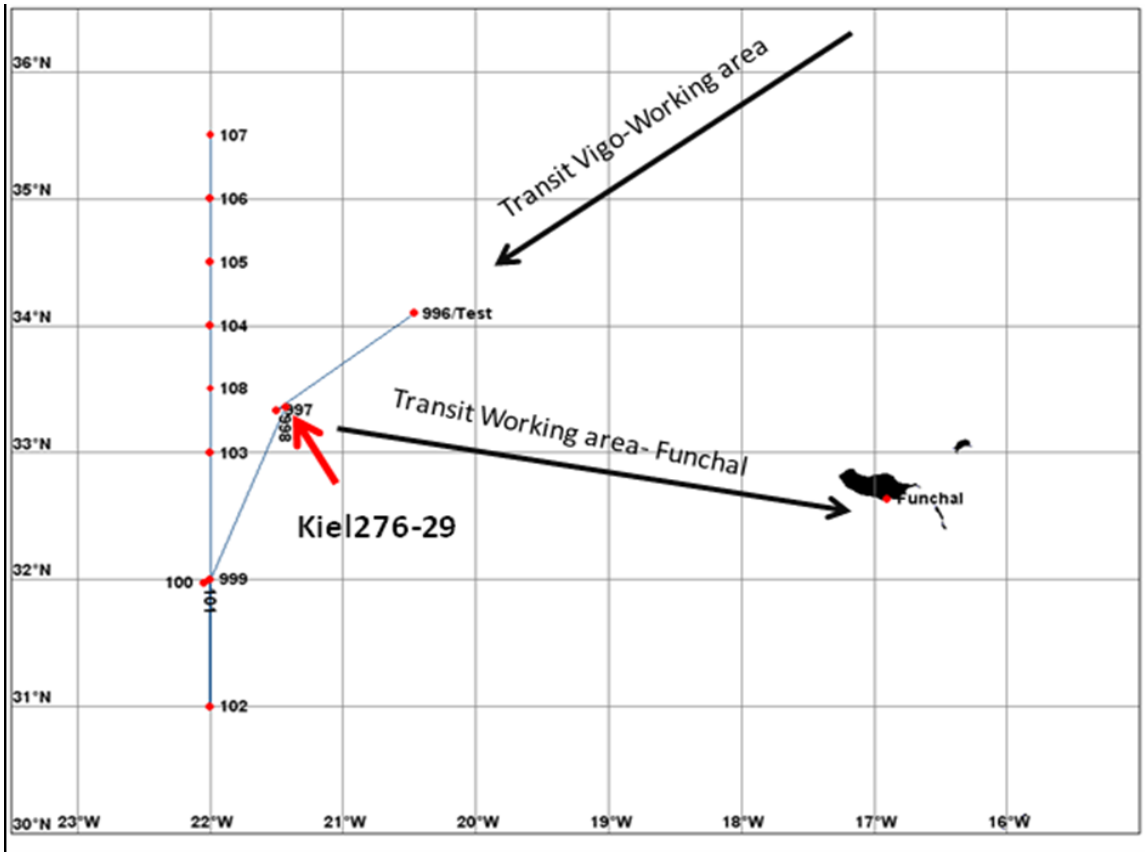

Figure 1: CTD stations sampled during the POS459 cruise and the site of the deployment of the mooring Kiel276-29.

For this purpose, CTD measurements were done at 10 stations along the 22°W. Most of them were performed down to the bottom and at selected depth samples for a number of parameters were taken (Chlorophyll a, suspended particulate matter, nutrients, and particulate organic carbon). Additionally, oxygen and fluorescence data were recorded at all stations. 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.

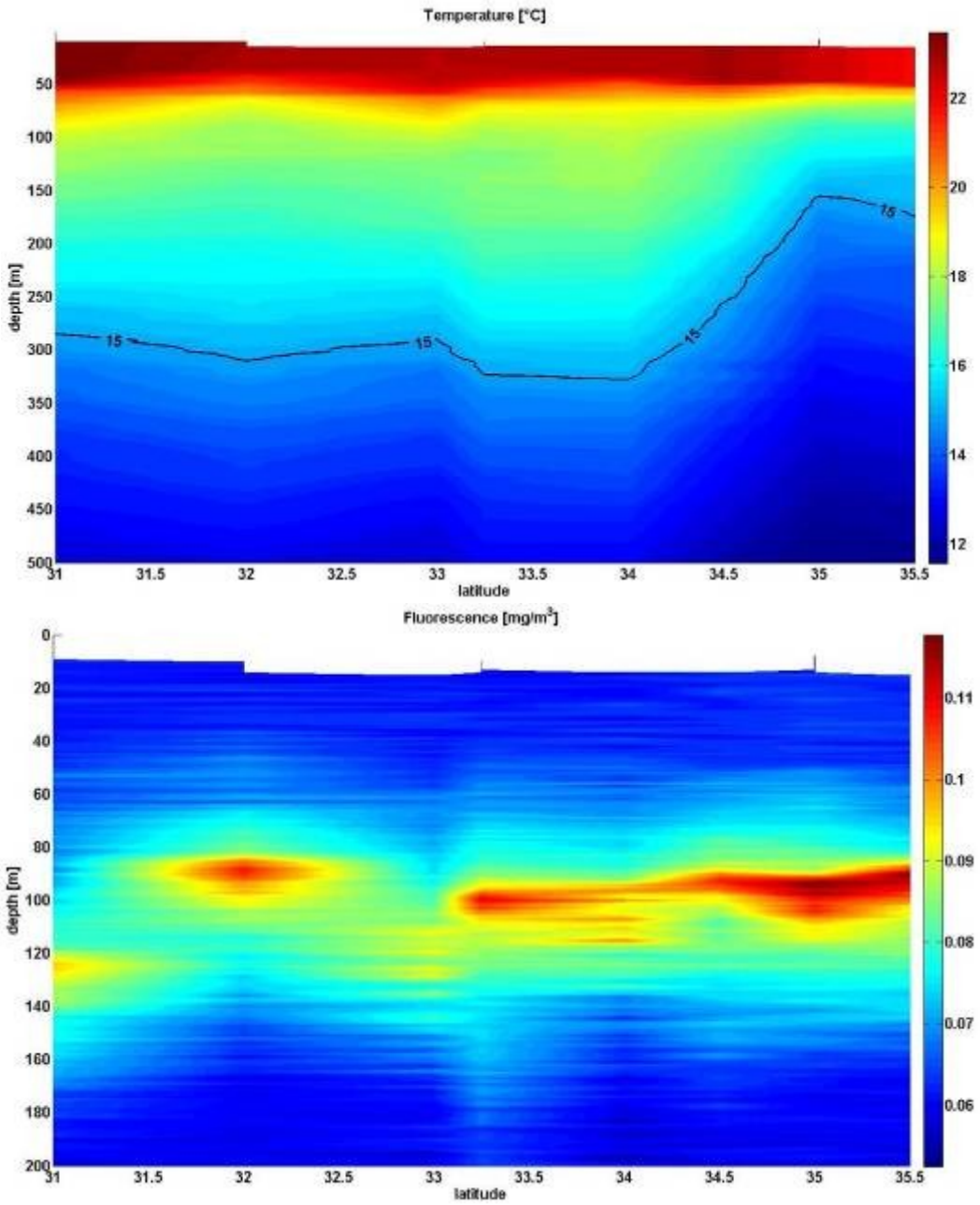

Figure 2: Vertical temperature and fluorescence distribution (0 - 500 m depth / 0-200 m depth) along the 22°W transect from 31°N to 35.5°N. The bold black line indicates the 15°C isotherm (upper panel); clearly visible is the weak deep chlorophyll maximum (colour coded, in mgm^{-3}) between 80 m and 110 m depth (lower panel). The Azores Front was centred at 34.5°N. Please note the different scales on the y-axes and the missing of surface registrations due to the restrictions to CTD deployments caused by the weather conditions.

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 and fluorescence distribution in the upper 500 m and 200 m of the water column, respectively.

During this cruise in September 2013 the Azores Front was detected between 34°N and 35°N with a steep slope of the 15°C-isotherm moving up from 300 m to 200 m depth followed by rather surface parallel isotherm distribution north of 35°N (Fig. 2). Compared to the previous cruise in May 2012, the Azores Front moved roughly one degree towards north and was confined to a cmparably narrow area. Directly at the front and north of the front, the deep chlorophyll maximum is slightly stronger with concentrations > 0.1 mgm^{-3}. Along almost the entire transect the DCM was present, but very weak (late summer conditions). The slightly higher fluorescence values were found at 35°N, i.e. in the northern part of the Azores Front (Fig. 2, lower panel) were most likely due to the frontal upwelling.

4.2 Deployment of Kiel276-29 (J. Waniek, U. Hehl, IOW)

In the morning of the 22nd September 2013 we have reached the position 33°21.45'N, 21°26.27'W and started the deployment of the 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 without any problems under good weather and sea conditions. The anchor weight was launched at 11:44 UTC at 33° 19.28'N, 21°31.64'W. At 12:07 the sub-surface buoy disappeared below the surface at 33° 19.52'N, 21° 30.53'W. The estimated position of the anchor is 33°19.49‘N, 21°30.60‘W.

4.3 Tests of LARS with AUV (T. Schmidt, J. Gelze, R. Chakrabati, TU Berlin)

During the expedition P459 on the RV Poseidon the Department for Electrical and Optical Systems of the Technical University Berlin tested the usability of a new Launch and Recovery System (LARS) for the Autonomous Underwater Vehicle (AUV) PreToS and took data with an inertial measurement unit. The LARS test was carried out to verify it’s functioning and handling in case of up to three meter waves. Another question was the secure handling for the ship and scientific crew at any time.

The LARS consists of two bearing bocks aligned with the research vessel, a tiltable steel frame and a docking device (Fig. 3). The docking device, in which the AUV may be fixed, can be lifted by a winch, which is located on the A-frame and can be deployed from the stern. Insecure pivoting is eliminated through the use of the steel frame which is mounted to the bearing bock. The AUV is fixed to the docking device with a locking mechanism. The mechanism can be operated by two hand winches with Bowden cables. In order to pull the AUV into the docking device, an electrical winch is present.

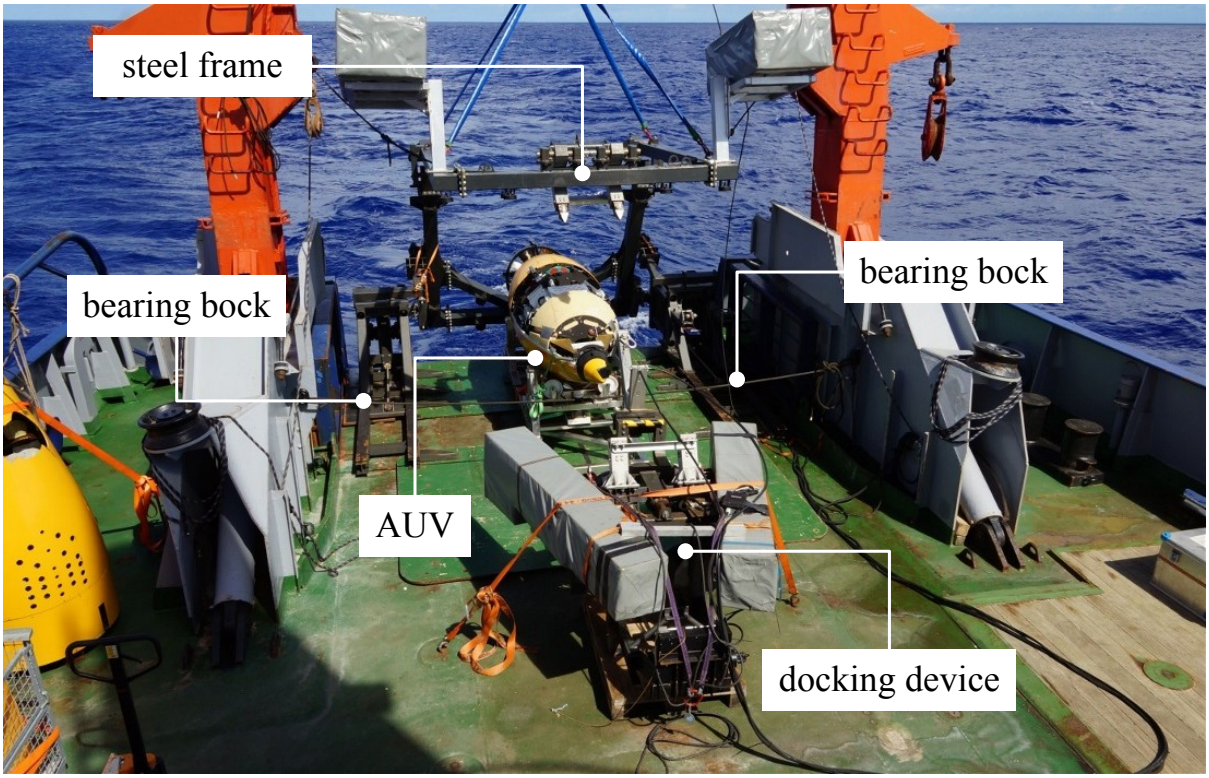

Figure 3: Launch And Recovery System (LARS) and it's components.

The "Inertial Measurement Unit" (IMU), consisting of a sensor unit and a pressure tolerant computer, is fitted in the payload section of the AUV. The trials focused on collecting datasets during various AUV missions.

The construction is assembled on the stern of the research vessel. Then, the AUV cradle is positioned between the two bearing bocks. After connecting the docking device with the AUV, the device can be deployed by using the winch from the A-frame. With two hand winches, the docking device's locking mechanism may be released and the AUV is ready to depart. For hauling up the AUV, the nose of the AUV will be detached. The nose is connected to the AUV with a rope which can be recovered from the research vessel. Afterwards, the rope of the nose is connected to the electrical winch on the docking device and the AUV can be drawn in.

The log function of the IMU starts automatically with the startup of the AUV. Every mission which was executed by the AUV was logged.

Outcome: Secure launch and recovery procedures with the AUV were successfully carried out. The hauling was made with the vessel after a collision of the AUV. The wave height of two meters could be handled. The relative movement between the vessel and the ocean caused by waves of two meters were

higher than estimated, however the compensation by the LARS was possible at every time. The datasets of the mission were recorded.

Date: 22.09.2013 afternoon / Position: 32° N / 22° W

The LARS was set up on the stern of the research vessel within three hours. A successful electronic winch test was performed. A Bowden cable had to be exchanged. Due to the contact with seawater, the old Bowden cable had gotten rusty, and a normal lubrication did not solve the problem. A complete replacement had to be made. Thus, the LARS was ready for testing.

Date 23.09.2013 / Position: 32° N / 22° W

Last steps of the set up were made. The handling of the LARS was trained with the use of a dummy. The wave height amounted up to two meters. First tests were made with waves from the fore of the research vessel. The relative movement between vessel and sea was too high. Same results were achieved with waves from the stern. Best results were achieved with a transverse movement of the vessel relative to the waves. The cross swell of the ocean could be eliminated, so that the LARS was only exposed to the relative movement of the waves. Swinging and deployment tests were successfully made. Only a few technical changes were necessary to improve the performance. The main improvement aimed at the degree of freedom of the LARS, which was reduced by using some additional belts following the suggestions of the boson.

Date 24.09.2013 / Position: 32° N / 22° W

The AUV was deployed with a working crane. After a successful surface test the nose could not be released. During the recovery process the AUV collided with the vessel and the nose got damaged. After attaching a new rope to the AUV from a dinghy, the AUV was pulled into the docking device by the electrical winch and fixed with the hand winches. Afterwards the pivoting was started (Fig. 5). The recovery proceeded without problems. Repair work on the AUV took two days.

Date 29.09.2013 / Position: 33.28° N / 22° W

The AUV was launched with the LARS. No problems occurred during this process. The docking device was put on the AUV and mounted to the steel frame. By swinging out the A-frame, the docking device was deployed into the water. The AUV was then released by opening the locking mechanism. During the entire process the handling of the AUV posed no risk to the safety of the crew (Fig.4). The recovery was

carried out with the working crane, because the propulsion unit and the steering rudders of the AUV PreToS failed.

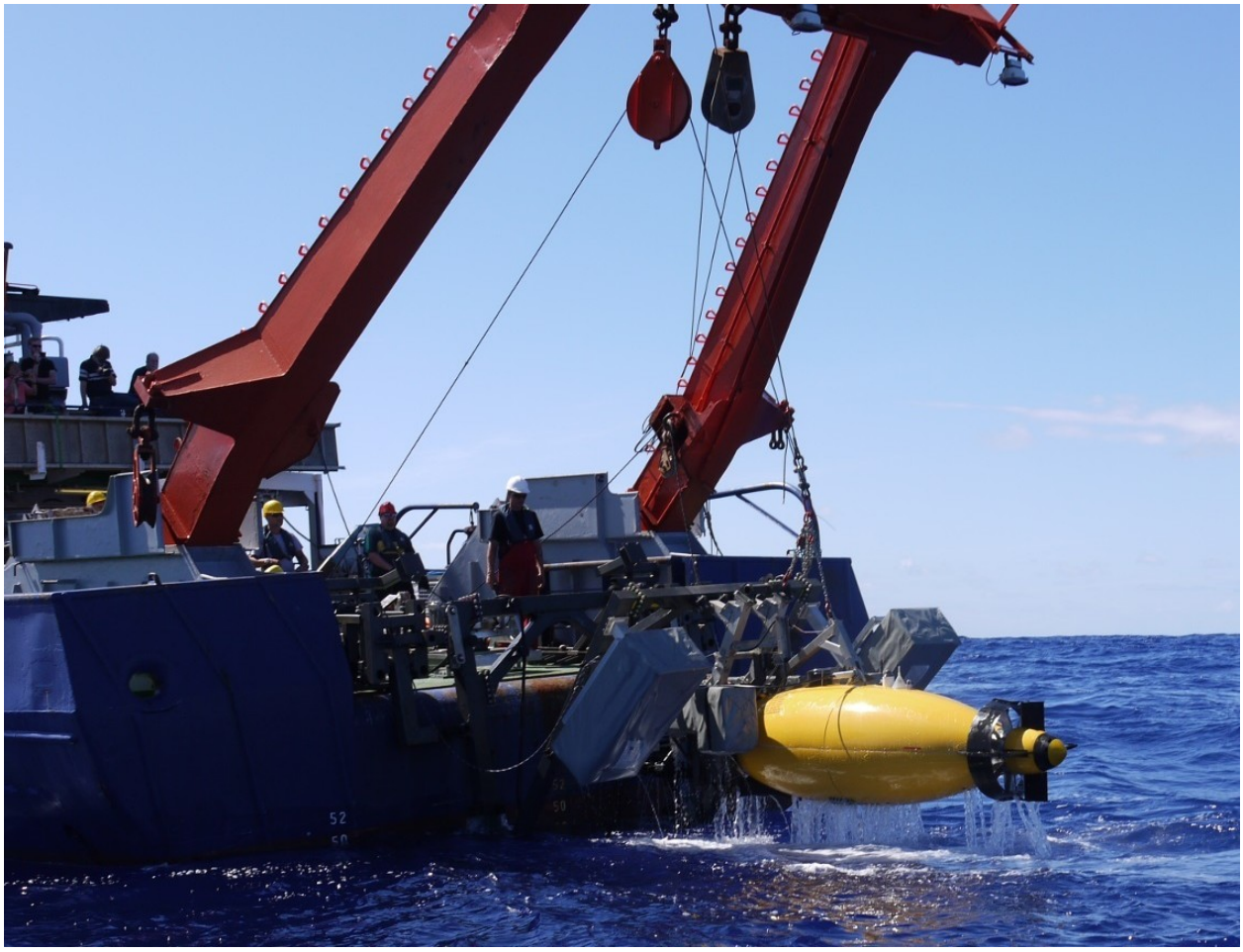

Figure 4: Lifting the AUV out of the sea.

Since no further tests with the AUV could be carried out due to weather and time constraints the full depth test of the pressure tolerant computer was done on the CTD winch. In this test, the computer and a battery pack were mounted to the single-conductor cable of the CTD winch. The computer was heaved to 5.300 m. After a short time, the components were lifted. The test showed that the pressure tolerant computer is capable to work under high pressure and low temperature conditions without pressure housing.

Date 30.09.2013 / Position: 33.28° N / 22° W

The LARS was dismantled for the ocean freight.

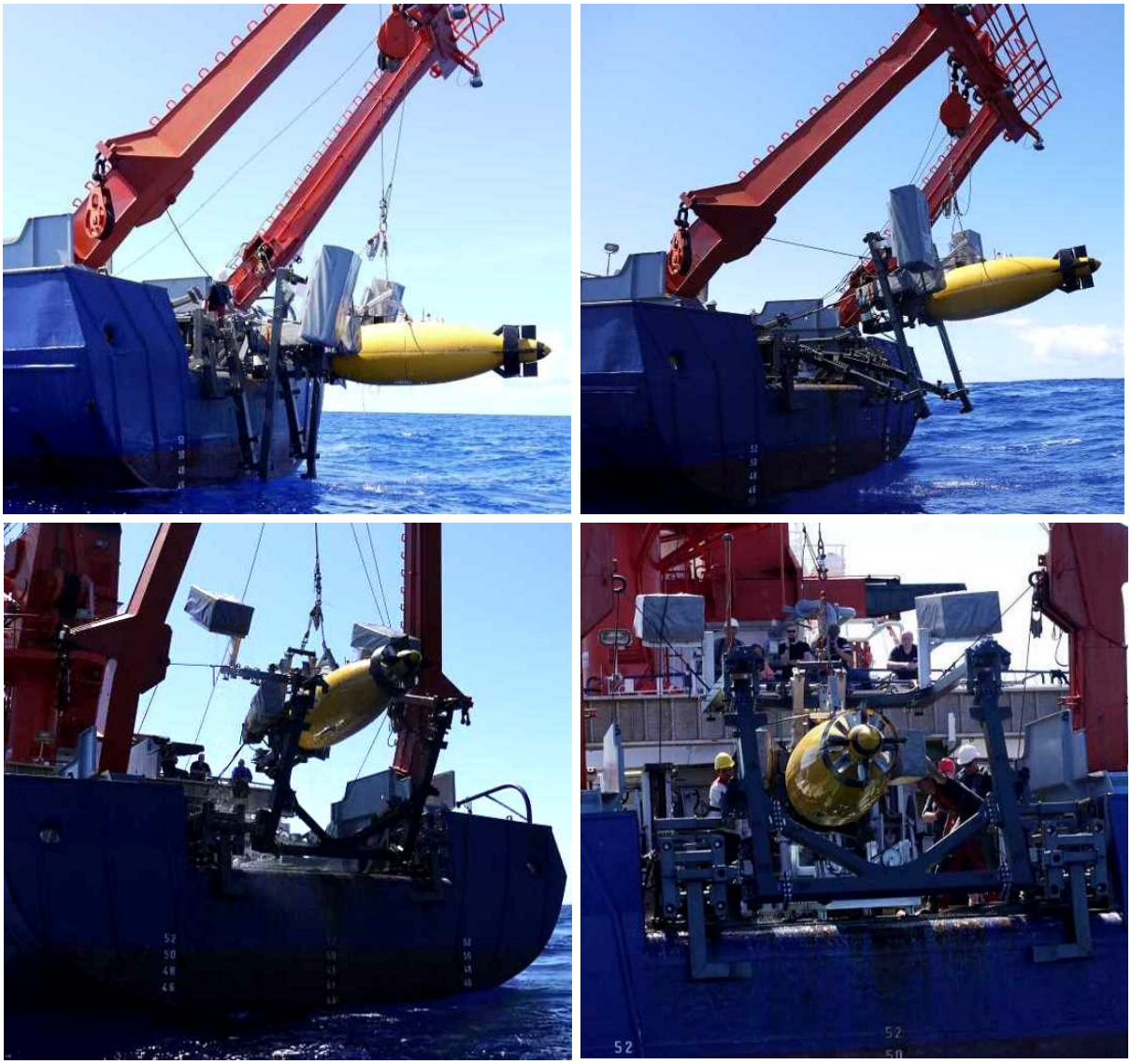

Figure 5: Pivoting process beginning in upper left corner to lower right corner.

4.4 „DNS Tiefsee“ work packages (G. Körner, A. Geissler, ENITECH GmbH)

The main focus of our work during the cruise was to test the AUV testing platform PreToS in the Atlantic. For safety reasons the tests were conducted with fixed positive buoyancy trim. Part of the objective was the controlling and monitoring of longer missions underwater via acoustic modem with abeam moving research vessel. We aimed at running under water the temperature depth control first manually and later on to perform tests with the prepared course drive controller. In the cross section of the Azores front the 15 ° C isotherm should be followed and the temperature measured at depth. Furthermore, the LARS system developed by TU Berlin should be tested in connection with the AUV.

Methods used: From 17/09/2013 to 21/09/2013 vehicles PreToS (AUV) and ERNO2 (ROV, TMS) were prepared for use. To check the single conductor cable measurements and a test dive with the ERNO2-System were conducted on 22/09/2013, revealing the damage of the single conductor cable. Measurement of single conductor cable (without cable to the drum, behind the sliding contact, without single conductor cable connectors); Center conductor against steel layers / ship >200 MOhm; Ring conductor against steel layers / ship about 2 MOhm, swaying, faulty. Resistance center conductor against ring conductor, page single conductor cable short circuited 158 Ohms. Following that a test run was performed with ERNO2 to 1.500 m without undocking. All systems functioned correctly. We archived a transmission rate 3.504 B/s without grounding and 2.200 B/s with grounding the power supply.

On 24/09/2013, the functionality test of PreToS (Fig. 6) was conducted near the surface after safety testing routine (Wind speed 2 m/s, quiet sea). The vehicle was deployed by crane from the slipway on the work side. The test run was positive except for the recovery. The main drive bearing were dried out, initially difficult to move (Run-in after drying). After the RF Range Testing (about 2 h in water) ran the main drive back to normal. The Range Testing showed secure connections for WLAN over 1.000 m, RF modem over more than 2.000 m and emergency radio over about 2.000 m. The underwater navigation and USBL function did not work at the beginning of the trial or were not set correctly, causing an emergency surfacing over time out.

During Range Testing with inflatable accompaniment despite drives being shown as turned off for about 20 seconds ran to the main drives. The vehicle submerged over a short time. The unpredictable behavior was caused by a command from an old mission stored in the acoustic modem. After the Range Testing and having passed routine safety test the AUV was tested without a buoyancy buoy, resulting in a better control and diving. Several dives in a circle and with course controller at depths between 0-15 m were performed. The pre-driving in the vicinity of the ship was normal. As PreToS lay close to the stern the nose for the LARS recovery could not be released. The AUV had to stay close to the stern. The main drives suddenly started to work in a very short time peak of 40 A (maximum output). PreToS came sideways under the RV Poseidon and surfaced on regular time out after 30 s. PreToS was then salvaged with the dinghy and the LARS.

The damage caused by the touch to the ship was not severe and could be repaired within half a day. For better handling, an additional attachment points at the rear of PreToS was installed. In evaluating the function tests the maximum power specification in hand driving console was limited to ¼. Furthermore, the set point potentiometer was replaced as a precaution. Software changes were also incorporated for improved deleting of old commands and records from the acoustic modem.

Figure 6: AUV like testing platform PreToS.

Figure 7: ERNO2 and the TMS.

The planned PreToS deployment was canceled due to long swell with wave height up to 3 m (28/09/2013). Instead an ERNO2 - test drive was performed. Through the pre-damaged single core cable did not allow a battery-feeding. Upon check in the park position 20 m above the ground a communication error in thruster 1 occurred, probably due to contact problem at the connector. All other modules worked correctly. The test at depth was aborted. Further tests were conducted on the way back to the surface. At 4.500 m no more communication error occurred and thruster 1 was functional again. Therefore ERNO2 was submerged again and a permanent thruster test was carried out (Fig.7).

At 4.900 m, the power supply switched off in the TMS at 24, 6 V. The TMS has switched off by deep discharge protection cell 5th. On deck, the TMS battery has been replaced as a precaution and the Subconn connector for communication thruster 1 cleaned and re-greased. The entire cabling has been re-examined and tested several times. The ERNO2 - system was then ready for use again.

Figure 8: Course controller with DVL Is rate, bottom course controller with compass.

On Sunday, 29/09/2013, a test mission was conducted with PreToS (Wind speed 8.5 m/s, wave height 1.5 to 2 m). PreToS was launched using the LARS system. The routine safety test revealed that the XSens compass had failed. The vehicle was of the course set value of DVL changed. The course set values from

DVL were now provided with 1 s updating otherwise over 100 ms, leading to the oscillation of the course controller.

ENITECH has insisted to finish the routine safety test in shallow water, in particular the test of acoustic modem connection in the vicinity of PreTos to the research vessel and underwater vehicle from hedged circle tests with fixed rudder. Later on underwater testing with vibrating course controller, particularly rectangle tours, was conducted at various depths down to 250 m. In addition a longer distance mission of about 3 nm at 200 m water was carried out with a research vessel abeam moving. However, when descending to 250 m water depth, the drive chain communication bus has failed, the main drives switched off and the vehicle surfaced (Fig. 9). The Microcat-CTD recorded examples of temperature and salinity values during each test The vehicle was recovered on the side with the crane.

Figure 9: Display of the Depth controller during the tests in 200 m depth.

On board a gross error analysis was made. The drive chain communication bus of the vehicle was functional again. In the compass pressure body was no water. The coarse control of the compass module revealed no errors.

Summary of the tests: With PreToS we were able to conduct just a shorter test dive near the surface and a test mission at depth south of the Azores Front between 200 and 250 m, but were not able to dive at

the Azores Front itself. With the testing platform PreToS we safely submerged under oceanic conditions despite the large buoyancy with reasonable main drive performance. The maneuverability was very good. The safe control via the communication systems was given by a very low latency period. This was seen especially during the maneuver near the research vessel for launch and recovery. The control and monitoring of trips underwater via acoustic modem with abeam moving research vessel over a length of about 3 nm was also positive. The ship's leadership had at any time an overview of the location, depth and movement of the vehicle and was able to follow the submerged vehicle with the research vessel. The tests of temperature-depth-controller during course controlling in the Azores Front as well as the cross-sectional survey were due to weather conditions and time constraints not performed.

Only exemplarily hydrographic measurements outside of the Azores Front were carried out. During the trials, there were no hardware failures of pressure-tolerant modules and components. Problems were only determined on underwater connectors and cables. Software functions were not adequately tested. Controller optimizations (e.g. pitch- depth and temperature-depth-controller) could not be performed. In the communication system, a software error was identified and eliminated (independent start-up of main drives due to obsolete command sets stored in the acoustic modem). With the boson and the captain a debriefing was hold for the PreToS operation leading to the following suggestions for improving the instruments:

- On the vehicle front and rear above the water line additional eyelets for security ropes must be mounted.
- Ready towing gear is urgently needed.
- Installation of a manual circuit breaker for the main drives above the water line including visual feedback.
- The need for rubber matting hanging over side for safe recovery of the vehicle over vessel's side if no LARS system is used.

4.5 NAVKOM tests (S. Yakovlev, O. Kebkal, Evologics)

The NAVKOMON system were developed in accordance to technical specification of the Druck Neutrale Systeme (DNS) project. The system components, prepared for POS459 sea-trials are listed below: four access points (AP) for deep-water deployments with acoustic modem and two releaser systems (Figure 10); USBL (featuring Ultra-Short BaseLine positioning) acoustic modem on the vessel; Acoustic modem on Tether Management System (TMS); Two USBL acoustic modems, installed on AUV; High-frequency (HF) modem, installed on ROV; and high-frequency (HF) USBL-modem, installed on TMS.

Corresponding embedded software for APs was implemented on the modem's host computer. Instrumentation software, allowing for signal analysis (time- and spectral domains) online was developed and used for the tests. Graphical user interface and positioning software SiNAPS was provided topside, allowing to visualize AUV and APs positions in a real geographic coordinates and to distribute navigation and positioning information across the vessel's network. All positioning data were logged for post-processing.

Figure 10: Access point ready for deployments.

Communication tests: Testing of the communication link was carried out by installing acoustic modems on CTD and establishing an acoustic link from USBL-modem in moonpool during CTD descends. There were four different acoustic systems prepared for the CTD tests. Each modem's acoustic system was configured with different baffling, allowing steering the transducer's directivity patterns (Figure 11 & 12).

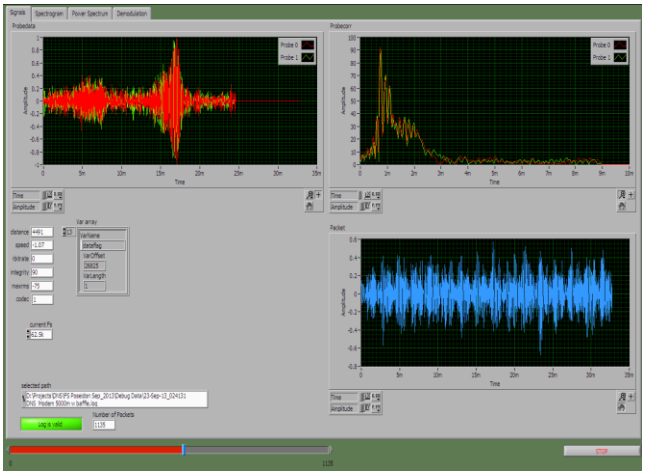

Figure 11: Signal processing software (time domain).

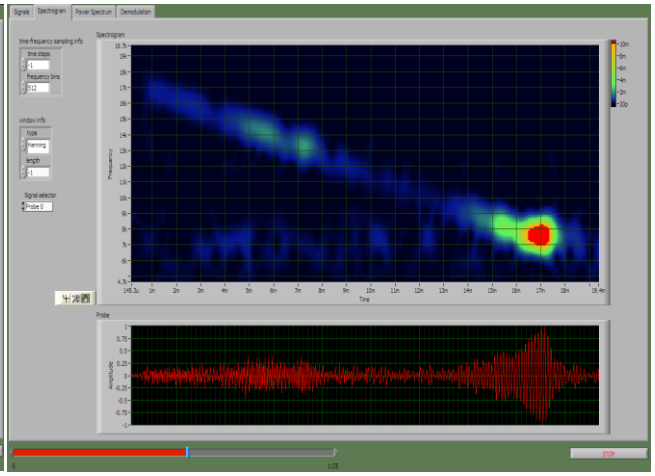

Figure 12: Signal processing software (time-frequency analysis).

As result of the modem tests on the CTD a decision was made to install 8 mm thick rubber baffle on the acoustic transducer. Installation of the baffle reduced the ship's noise by 5-6 dB and improved received signals quality. During CTD tests following exercises were made: Noise level measurements; range test; integrity and signal level measurements; transmissions of Instant Messages (IM) and burst

data packets in both directions and data logging and online estimations of spectral density and time-frequency variations.

AUV positioning: The ship's USBL-modem, placed in a moon pool was used to estimate position of the AUV under water. Vessel's available navigation equipment (GPS, AHRS, GPS compass) were integrated into SiNAPS environment, allowing recalculating relative USBL-coordinates in absolute geographic coordinates of the AUV (Figure 13).

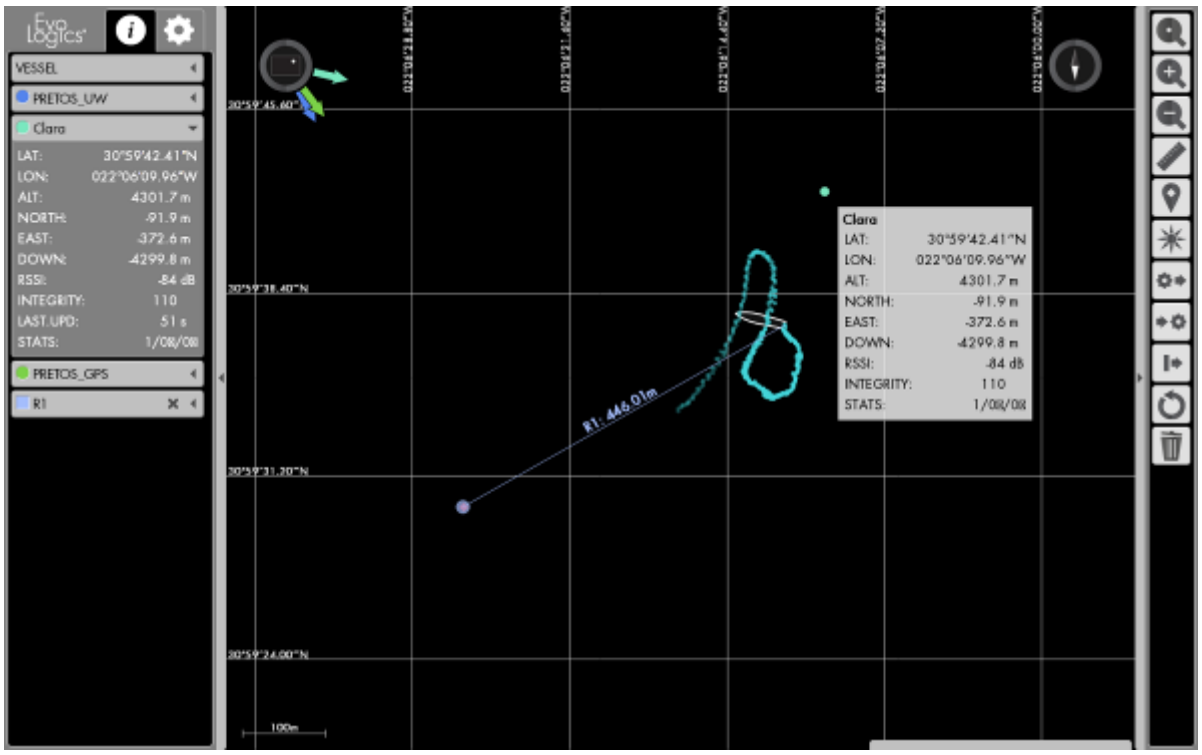

Figure 13: The SiNAPS user interface.

Access points networking and LBL positioning: The task was aiming at establishing a deep-water acoustic network of four APs and moving AUV. Due to AUV technical failure, complete NAVKOMON testing with AUV was not possible, therefore we've concentrated our efforts on autonomous network functionality and LBL positioning of the deployed nodes. The APs were deployed as one by one "free-falling". Measured descend rate was approximately 0.3-0.4 m/s. Deployment geometry – square with side length of 1 NM and the coordinates of the deployments at water depth of 5050 m were:

AP "Anna": 30° 58.480N 022° 5.232W
AP "Clara": 30° 59.500N 022° 6.441W
AP "Berta": 30° 58.502N 022° 6.448W
AP "Dora": 30° 59.490N 022° 5.242W

LBL positioning and geo-referencing was achieved by communication between surface modem, mounted under the ship and the access points from difference ship positions. The ship moved on circular

trajectory around the deployment area, collecting data from deployed APs via acoustic link. The APs carried out internal communications in the depth, transmitting data packages around the network. Same exercise was repeated within smaller square area. Coordinates of the new deployments at 5200 m water depth were:

AP ”Berta”: 33° 16.342N 022° 0.263W
AP “Clara”: 33° 15.805N 022° 0.927W
AP “Dora”: 33° 16.339N 022° 0.937W
AP “Anna”: 33° 15.794N 022° 0.248W

Access point’s recovery: All access points were recovered by activating acoustic releasers. In case of failure of DNS-developed releasers, redundant KUM releaser was activated. Ascend rate was measured and reported as 0.25-0.3m/s.

Conclusions: Main trials goals were achieved: the acoustic modems shown specified performance, USBL-positioning system is functional and allowed estimating the position of submersed AUV.

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

Kiel276-29: On 22 September 2013 the mooring Kiel276-29 was deployed for another two years of registrations consisting of six Aanderaa current meters, 46 buoyancy spheres, 2 sediment traps, sub-surface buoy and two releases. The estimated position of the anchor is 33°19.49‘N, 21°30.60‘W.

6. Acknowledgements

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

7. Appendices

Appendix A: Station list P459 September 2013 (ship)

Station	Date	Time	Latitude	Longitude	Depth [m]	Wind [m/s]	Course [°]	Speed [kn]	Gear	Action/Comment
996-1	21.09.13	12:00	34° 5,69' N	20° 28,73' W	5117,3	S 1	298,0	3,0	CTD/rosette water sampler CTD/RO	Information 13:00 LT
	Beginn der Forschungs- und Stationsarbeiten, Modem & Schachtplatte heruntergelassen, verriegelt und zu Wasser									
996-1	21.09.13	12:08	34° 5,81' N	20° 28,73' W	5117,8	S 2	306,0	1,0	CTD/rosette water sampler CTD/RO	zu Wasser Aussetzen CTD
996-1	21.09.13	12:47	34° 5,95' N	20° 28,81' W	5119,3	SSW 3	23,0	0,5	CTD/rosette water sampler CTD/RO	auf Tiefe SL max.: 2000 m
996-2	21.09.13	12:50	34° 5,96' N	20° 28,82' W	5117,4	SSW 3	0,0	0,0	Hydrophon HYDRO	zu Wasser Releaser-Test
996-2	21.09.13	12:54	34° 5,97' N	20° 28,84' W	5119,4	SSW 2	109,0	0,8	Hydrophon HYDRO	an Deck
996-1	21.09.13	13:34	34° 6,01' N	20° 29,02' W	5117,6	WSW 2	337,0	0,3	CTD/rosette water sampler CTD/RO	an Deck
997-1	21.09.13	21:03	33° 20,07' N	21° 30,07' W	5285,2	N 2	71,0	0,6	CTD/rosette water sampler CTD/RO	zu Wasser
997-1	21.09.13	22:32	33° 20,00' N	21° 30,02' W	5250,2	NW 2	343,0	0,4	CTD/rosette water sampler CTD/RO	auf Tiefe SLmax.: 5166m
997-1	22.09.13	00:09	33° 19,99' N	21° 30,08' W	5257,2	WNW 2	317,0	0,7	CTD/rosette water sampler CTD/RO	an Deck
997-2	22.09.13	00:32	33° 20,03' N	21° 29,99' W	5253,6	WNW 3	160,0	0,3	CTD/rosette water sampler CTD/RO	zu Wasser
997-2	22.09.13	01:57	33° 20,04' N	21° 29,90' W	5254,1	W 3	322,0	0,5	CTD/rosette water sampler CTD/RO	auf Tiefe SL max.: 5066 m
997-2	22.09.13	03:13	33° 20,12' N	21° 29,98' W	5266,1	WSW 5	254,0	1,0	CTD/rosette water sampler CTD/RO	an Deck
998-1	22.09.13	07:19	33° 21,45' N	21° 26,27' W	5257,6	WSW 6	292,0	1,2	Mooring MOR	Kopfboje zu Wasser
998-1	22.09.13	07:23	33° 21,41' N	21° 26,37' W	5251,0	WSW 6	246,0	1,5	Mooring MOR	Kugelpaket zu Wasser 8 Benthos mit RCM-8 AVTP
998-1	22.09.13	07:49	33° 21,17' N	21° 26,99' W	5288,2	WSW 5	225,0	0,9	Mooring MOR	Kugelpaket zu Wasser 6 Benthos mit RCM-8 AVT
998-1	22.09.13	08:07	33° 21,01' N	21° 27,36' W	5256,3	WSW 5	236,0	1,1	Mooring MOR	Kugelpaket zu Wasser 2 Benthos
998-1	22.09.13	08:28	33° 20,89' N	21° 27,75' W	5249,6	SW 5	287,0	1,3	Mooring MOR	Kugelpaket zu Wasser 4 Benthos mit RCM-8 AVT
998-1	22.09.13	08:47	33° 20,66' N	21° 28,21' W	5250,7	WSW 6	240,0	1,1	Mooring MOR	Kugelpaket zu Wasser 3 Benthos mit RCM-8 AVPT
998-1	22.09.13	09:03	33° 20,57' N	21° 28,48' W	5250,6	WSW 6	270,0	0,5	Mooring MOR	Kugelpaket zu Wasser 5 Benthos mit Wirbel zu Wasser
998-1	22.09.13	09:11	33° 20,54' N	21° 28,58' W	5250,3	WSW 6	212,0	0,4	Mooring MOR	Sedimentfalle zu Wasser Sedimentfalle 1 mit Wirbel
998-1	22.09.13	09:54	33° 20,17' N	21° 29,44' W	5291,4	WSW 6	239,0	1,4	Mooring MOR	Kugelpaket zu Wasser 5 Benthos RCM AVT LR & Wirbel
998-1	22.09.13	10:00	33° 20,12' N	21° 29,59' W	5270,4	SW 6	274,0	0,9	Mooring MOR	Sedimentfalle zu Wasser Sedimentfalle 2 mit Wirbel
998-1	22.09.13	10:21	33° 19,94' N	21° 30,05' W	5264,4	WSW 6	282,0	1,3	Mooring MOR	Kugelpaket zu Wasser 2 Benthos
998-1	22.09.13	11:00	33° 19,64' N	21° 30,82' W	5253,0	SW 6	251,0	0,7	Mooring MOR	Kugelpaket zu Wasser 2 Benthos
998-1	22.09.13	11:19	33° 19,45' N	21° 31,26' W	5271,7	SW 6	256,0	1,1	Mooring MOR	Kugelpaket zu Wasser 2 Benthos
998-1	22.09.13	11:26	33° 19,41' N	21° 31,37' W	5252,6	SW 5	238,0	0,8	Mooring MOR	Kugelpaket zu Wasser 6 Benthos mit RCM-8 AVT LR
998-1	22.09.13	11:26	33° 19,41' N	21° 31,37' W	5252,6	SW 5	238,0	0,8	Mooring MOR	Auslöser zu Wasser Releaser AR-2

998-1	22.09.13	11:44	33° 19,28' N	21° 31,64' W	5250,8	SSW 7	313,0	0,4	Mooring MOR Grundgewicht geslipt	
998-1	22.09.13	12:31	33° 19,52' N	21° 30,53' W	5288,3	SW 6	233,0	1,1	Mooring MOR Aktion Kopfboje abgetaucht	
998-2	22.09.13	13:54	33° 16,96' N	21° 33,79' W	5239,3	SW 8	217,0	0,5	Remote operated vehicle ROV zu Wasser	
998-2	22.09.13	14:31	33° 16,90' N	21° 33,77' W	5240,1	SW 7	304,0	0,5	Remote operated vehicle ROV auf Tiefe SL max.: 1500 m	
998-2	22.09.13	16:23	33° 16,57' N	21° 34,34' W	5240,9	SW 8	237,0	1,1	Remote operated vehicle ROV Information Aubau LARS	
999-1	23.09.13	01:38	32° 0,01' N	21° 59,96' W	5053,2	WSW 9	65,0	0,6	CTD/rosette water sampler CTD/RO zu Wasser	
999-1	23.09.13	01:49	32° 0,00' N	21° 59,98' W	5059,8	WSW 8	0,0	0,2	CTD/rosette water sampler CTD/RO an Deck	
999-1	23.09.13	01:59	32° 0,00' N	21° 59,99' W	5054,2	WSW 9	345,0	0,4	CTD/rosette water sampler CTD/RO zu Wasser	
999-1	23.09.13	03:22	31° 59,98' N	21° 59,97' W	5055,2	WSW 8	197,0	0,8	CTD/rosette water sampler CTD/RO auf Tiefe SL max.: 5064 m	
999-1	23.09.13	04:49	32° 0,00' N	21° 59,97' W	5052,9	WSW 9	156,0	0,9	CTD/rosette water sampler CTD/RO an Deck	
1000-1	23.09.13	12:32	31° 58,34' N	22° 5,19' W	5080,0	SW 11	19,0	0,4	Autonomous Underwater Vehicle AUV AUVDunny zu Wasser	
1000-1	23.09.13	12:32	31° 58,34' N	22° 5,19' W	5080,0	SW 11	19,0	0,4	Autonomous Underwater Vehicle AUV AUV an Deck/Dummy an Deck	
1000-2	23.09.13	13:29	31° 58,17' N	22° 4,03' W	5061,0	WSW 11	149,0	0,6	CTD/rosette water sampler CTD/RO zu Wasser	
1000-2	23.09.13	13:29	31° 58,17' N	22° 4,03' W	5061,0	WSW 11	149,0	0,6	CTD/rosette water sampler CTD/RO auf Tiefe SL max.: 1519 m	
1000-2	23.09.13	14:26	31° 58,21' N	22° 3,96' W	5061,0	NNW 4	0,0	0,4	CTD/rosette water sampler CTD/RO an Deck	
1001-1	23.09.13	17:02	31° 59,98' N	21° 59,99' W	5052,9	N 7	142,0	0,4	CTD/rosette water sampler CTD/RO zu Wasser	
1001-1	23.09.13	18:24	32° 0,01' N	21° 59,99' W	5059,5	N 5	90,0	0,3	CTD/rosette water sampler CTD/RO auf Tiefe SL max.: 4969 m	
1001-1	23.09.13	19:45	31° 59,96' N	22° 0,08' W	5054,3	N 6	90,0	1,0	CTD/rosette water sampler CTD/RO an Deck	
1002-1	24.09.13	02:11	30° 59,99' N	21° 59,99' W	5008,8	N 4	75,0	3,1	CTD/rosette water sampler CTD/RO zu Wasser	
1002-1	24.09.13	03:02	30° 59,99' N	22° 0,01' W	5009,3	N 5	270,0	0,4	CTD/rosette water sampler CTD/RO auf Tiefe SL max.: 4874m	
1002-1	24.09.13	04:46	31° 0,04' N	21° 59,96' W	5013,8	N 5	82,0	0,9	CTD/rosette water sampler CTD/RO an Deck	
1002-2	24.09.13	09:31	31° 0,63' N	22° 5,67' W	5021,1	NNW 5	215,0	0,0	Autonomous Underwater Vehicle AUV Schlauchboot zu Wasser	
1002-2	24.09.13	09:42	31° 0,57' N	22° 5,76' W	5027,6	N 6	241,0	0,4	Autonomous Underwater Vehicle AUV AUV zu Wasser	
1002-2	24.09.13	09:43	31° 0,57' N	22° 5,77' W	5044,6	N 6	230,0	0,6	Autonomous Underwater Vehicle AUV Testfahrt mit AUV	
1002-2	24.09.13	09:56	31° 0,47' N	22° 5,83' W	5025,2	NNW 5	262,0	1,0	Autonomous Underwater Vehicle AUV Information AUV auf 8 m	
1002-2	24.09.13	11:55	31° 0,92' N	22° 6,88' W	5027,6	NW 4	334,0	1,8	Autonomous Underwater Vehicle AUV 2070 m Entfernung Abbruch Funkübertragung (max. Reichweite)	
1002-2	24.09.13	13:32	30° 59,17' N	22° 5,78' W	5054,4	NW 5	165,0	1,1	Autonomous Underwater Vehicle AUV abgetaucht / Test	
1002-2	24.09.13	13:36	30° 59,15' N	22° 5,77' W	5016,6	NW 4	0,0	0,2	Autonomous Underwater Vehicle AUV Information aufgetaucht	
1002-2	24.09.13	14:34	30° 59,00' N	22° 6,10' W	5024,4	NW 5	196,0	1,1	Autonomous Underwater Vehicle AUV Nase abgesprengt	
1002-2	24.09.13	14:51	30° 58,62' N	22° 6,29' W	5021,4	NW 5	215,0	1,6	Autonomous Underwater Vehicle AUV Information In LARS	
1002-2	24.09.13	14:53	30° 58,57' N	22° 6,31' W	5062,9	WNW 5	176,0	2,1	Autonomous Underwater Vehicle AUV AUV an Deck	

1002-3	24.09.13	15:38	30° 58,51' N	22° 6,45' W	5020,8	WNW	5	0,0	0,0	Access Point	AP	zu Wasser	
1002-3	24.09.13	16:10	30° 59,50' N	22° 6,44' W	5017,5	NW	5	207,0	0,3	Access Point	AP	zu Wasser	
1002-3	24.09.13	16:36	30° 59,51' N	22° 5,25' W	5014,1	NW	5	180,0	0,3	Access Point	AP	zu Wasser	
1002-3	24.09.13	17:12	30° 58,48' N	22° 5,23' W	5017,5	WNW	5	214,0	0,5	Access Point	AP	zu Wasser	
1002-3	24.09.13	17:39	30° 59,00' N	22° 5,87' W	5016,6	WNW	5	309,0	0,8	Access Point	AP	Information	Einmessen der "Access-Points"
1002-3	25.09.13	01:39	30° 58,36' N	22° 6,21' W	0,0	WSW	5	279,0	1,4	Access Point	AP	Information	Einmessen beendet
1002-3	25.09.13	02:40	30° 59,59' N	22° 6,36' W	0,0	W	5	94,0	2,0	Access Point	AP	Information	Einmessen gestartet
1002-3	25.09.13	05:33	30° 59,58' N	22° 6,41' W	0,0	WSW	7	45,0	2,0	Access Point	AP	Information	Einmessen beendet
1002-3	25.09.13	06:54	30° 59,54' N	22° 6,21' W	0,0	W	8	0,0	0,5	Access Point	AP	ausgelöst	AP 1
1002-3	25.09.13	08:31	30° 59,71' N	22° 6,19' W	0,0	W	8	19,0	0,8	Access Point	AP	ausgelöst	AP 2
1002-3	25.09.13	09:55	30° 59,38' N	22° 6,31' W	0,0	W	7	201,0	0,5	Access Point	AP	ausgelöst	erneut mit Transducer ausgelöst
1002-3	25.09.13	11:36	30° 58,82' N	22° 6,41' W	0,0	WSW	7	317,0	0,3	Access Point	AP	ausgelöst	
1002-3	25.09.13	12:16	30° 58,29' N	22° 5,27' W	0,0	WSW	8	332,0	3,2	Access Point	AP	Oberfläche	
1002-3	25.09.13	12:24	30° 58,63' N	22° 5,48' W	0,0	WSW	8	332,0	2,5	Access Point	AP	Information	gesichtet
1002-3	25.09.13	12:41	30° 58,90' N	22° 5,94' W	0,0	WSW	7	147,0	1,3	Access Point	AP	an Deck	AP1
1002-3	25.09.13	14:38	30° 59,17' N	22° 4,74' W	0,0	W	8	129,0	2,0	Access Point	AP	Oberfläche	
1002-3	25.09.13	14:40	30° 59,14' N	22° 4,72' W	0,0	WSW	7	153,0	0,8	Access Point	AP	Information	gesichtet
1002-3	25.09.13	15:04	30° 58,89' N	22° 4,76' W	0,0	WSW	7	173,0	1,9	Access Point	AP	an Deck	AP 2
1002-3	25.09.13	15:43	30° 58,45' N	22° 5,12' W	0,0	WSW	8	41,0	0,7	Access Point	AP	Oberfläche	
1002-3	25.09.13	15:44	30° 58,46' N	22° 5,11' W	0,0	WSW	8	77,0	0,8	Access Point	AP	Information	gesichtet
1002-3	25.09.13	16:02	30° 58,10' N	22° 4,90' W	0,0	WSW	7	147,0	1,1	Access Point	AP	an Deck	AP 3
1002-3	25.09.13	16:17	30° 57,95' N	22° 5,48' W	0,0	WSW	7	275,0	3,3	Access Point	AP	Oberfläche	
1002-3	25.09.13	16:24	30° 57,89' N	22° 5,87' W	0,0	W	7	236,0	3,6	Access Point	AP	Information	gesichtet
1002-3	25.09.13	16:34	30° 57,55' N	22° 5,87' W	0,0	WSW	7	34,0	0,0	Access Point	AP	an Deck	
1003-1	27.09.13	07:12	32° 59,92' N	21° 59,98' W	5248,4	WNW	8	55,0	0,7	CTD/rosette water sampler	CTD/RO	zu Wasser	
1003-1	27.09.13	08:51	32° 59,99' N	21° 59,96' W	5216,3	W	8	33,0	0,3	CTD/rosette water sampler	CTD/RO	auf Tiefe	SL max.: 5228 m
1003-1	27.09.13	10:26	32° 59,98' N	21° 59,96' W	5216,4	WNW	7	34,0	0,3	CTD/rosette water sampler	CTD/RO	an Deck	
1004-1	27.09.13	18:01	34° 0,02' N	21° 59,93' W	0,0	WNW	7	50,0	0,4	CTD/rosette water sampler	CTD/RO	zu Wasser	
1004-1	27.09.13	18:34	34° 0,12' N	21° 59,86' W	5279,8	WNW	7	240,0	0,6	CTD/rosette water sampler	CTD/RO	auf Tiefe	SL max.: 2022 m
1004-1	27.09.13	19:15	34° 0,22' N	21° 59,85' W	5285,9	WNW	8	344,0	0,9	CTD/rosette water sampler	CTD/RO	an Deck	
1005-1	27.09.13	23:37	34° 30,07' N	21° 59,99' W	5209,8	W	5	14,0	2,5	CTD/rosette water sampler	CTD/RO	zu Wasser	
1005-1	28.09.13	00:14	34° 30,51' N	21° 59,78' W	5158,7	WNW	4	37,0	0,3	CTD/rosette water sampler	CTD/RO	auf Tiefe	SL max.: 2048 m

1005-1	28.09.13	00:46	34° 30,76' N	21° 59,52' W	5158,5	W	3	55,0	1,7	CTD/rosette water sampler	CTD/RO	an Deck	
1006-1	28.09.13	04:54	35° 0,14' N	21° 59,97' W	5018,8	WSW	4	47,0	1,4	CTD/rosette water sampler	CTD/RO	zu Wasser	
1006-1	28.09.13	05:29	35° 0,47' N	21° 59,90' W	5002,1	WSW	4	50,0	0,6	CTD/rosette water sampler	CTD/RO	auf Tiefe	SL max.: 2042 m
1006-1	28.09.13	06:11	35° 0,84' N	21° 59,70' W	4892,5	WSW	4	23,0	0,4	CTD/rosette water sampler	CTD/RO	an Deck	
1007-1	28.09.13	09:45	35° 30,04' N	21° 59,92' W	4941,6	S	3	0,0	0,9	CTD/rosette water sampler	CTD/RO	zu Wasser	
1007-1	28.09.13	10:25	35° 30,22' N	21° 59,53' W	4941,6	SSW	4	32,0	1,2	CTD/rosette water sampler	CTD/RO	auf Tiefe	max. SL: 2055 m
1007-1	28.09.13	11:07	35° 30,58' N	21° 59,41' W	4942,9	SW	7	8,0	1,9	CTD/rosette water sampler	CTD/RO	an Deck	
1007-2	28.09.13	12:57	35° 31,81' N	21° 58,79' W	4959,2	WSW	9	120,0	0,5	Remote operated vehicle	ROV	zu Wasser	
1007-2	28.09.13	15:17	35° 32,86' N	21° 58,35' W	4967,2	SW	6	301,0	0,4	Remote operated vehicle	ROV	auf Tiefe	SL. max: 5125 m
1007-2	28.09.13	15:17	35° 32,86' N	21° 58,35' W	4967,2	SW	6	301,0	0,4	Remote operated vehicle	ROV	20m über Boden - Beginn checks	
1007-2	28.09.13	15:30	35° 32,91' N	21° 58,36' W	4967,2	SW	6	90,0	0,0	Remote operated vehicle	ROV	Information	Beginn Hieven
1007-2	28.09.13	15:39	35° 32,92' N	21° 58,32' W	4967,4	SW	6	43,0	1,2	Remote operated vehicle	ROV	Thruster COMM Port wieder aktiv, offensichtlich Drahtbruch im ROV, nochmals fieren mit 0,7 m/s	
1007-2	28.09.13	16:16	35° 33,11' N	21° 58,28' W	4978,0	SW	7	40,0	0,6	Remote operated vehicle	ROV	Winde Stop bei 4922 m, Tests ROV	
1007-2	28.09.13	16:18	35° 33,13' N	21° 58,29' W	4972,6	SW	7	9,0	1,7	Remote operated vehicle	ROV	Information	Hieven mit 0,7 m/s
1007-2	28.09.13	18:01	35° 33,65' N	21° 58,09' W	4977,8	SW	6	0,0	0,2	Remote operated vehicle	ROV	an Deck	
1008-1	29.09.13	10:08	33° 16,83' N	22° 0,17' W	5234,8	WSW	9	90,0	0,5	Autonomous Underwater Vehicle	AUV	AUV zu Wasser	
1008-1	29.09.13	11:14	33° 16,82' N	22° 0,04' W	5229,7	WSW	8	90,0	0,5	Autonomous Underwater Vehicle	AUV	Beginn Oberflächenfahr/test	
1008-1	29.09.13	11:36	33° 16,78' N	21° 59,99' W	5234,2	WSW	8	168,0	1,1	Autonomous Underwater Vehicle	AUV	Beginn Tauchtestfahrten	
1008-1	29.09.13	12:26	33° 16,81' N	21° 59,99' W	5232,0	WSW	8	28,0	1,3	Autonomous Underwater Vehicle	AUV	Information	Auftauchen
1008-1	29.09.13	12:43	33° 16,77' N	22° 0,05' W	5231,3	WSW	8	180,0	0,0	Autonomous Underwater Vehicle	AUV	Beginn Kursfahrten über Wasser	
1008-1	29.09.13	12:47	33° 16,78' N	22° 0,05' W	5230,9	WSW	8	262,0	2,0	Autonomous Underwater Vehicle	AUV	abgetaucht	Tauchfahrt 32m Tiefe
1008-1	29.09.13	13:43	33° 16,75' N	22° 0,04' W	5232,3	WSW	8	204,0	0,4	Autonomous Underwater Vehicle	AUV	Information	aufgetaucht
1008-1	29.09.13	14:23	33° 16,53' N	22° 1,46' W	5255,6	WSW	9	108,0	0,6	Autonomous Underwater Vehicle	AUV	Information	Tauchtiefe 240m
1008-1	29.09.13	14:42	33° 16,44' N	22° 1,87' W	4899,7	WSW	9	153,0	1,3	Autonomous Underwater Vehicle	AUV	Information	aufgetaucht
1008-1	29.09.13	14:55	33° 16,19' N	22° 1,78' W	5246,8	WSW	9	20,0	0,5	Autonomous Underwater Vehicle	AUV	Schlauchboot zu Wasser	
1008-1	29.09.13	15:46	33° 15,94' N	22° 1,25' W	5244,5	WSW	8	121,0	0,0	Autonomous Underwater Vehicle	AUV	Information	AUV längsseits
1008-1	29.09.13	15:59	33° 15,95' N	22° 1,09' W	5255,6	SW	8	180,0	0,7	Autonomous Underwater Vehicle	AUV	AUV an Deck	
1008-1	29.09.13	16:10	33° 15,86' N	22° 0,99' W	5253,2	WSW	8	122,0	0,8	Autonomous Underwater Vehicle	AUV	Schlauchboot an Deck	
1008-2	29.09.13	16:29	33° 15,78' N	22° 0,93' W	5189,5	WSW	8	117,0	0,4	CTD/rosette water sampler	CTD/RO	zu Wasser	
1008-2	29.09.13	17:03	33° 15,80' N	22° 0,94' W	5279,1	SW	8	202,0	0,3	CTD/rosette water sampler	CTD/RO	auf Tiefe	SL max.: 2020 m
1008-2	29.09.13	17:43	33° 15,77' N	22° 0,96' W	5245,9	SW	8	0,0	0,0	CTD/rosette water sampler	CTD/RO	an Deck	

1008-3	29.09.13	18:51	33° 15,81' N	22° 0,93' W	5252,9	SW	7	0,0	0,4	Access Point	AP zu Wasser	AP 1
1008-3	29.09.13	19:15	33° 16,34' N	22° 0,93' W	5235,9	WSW	8	136,0	0,5	Access Point	AP zu Wasser	AP 2
1008-3	29.09.13	19:40	33° 16,34' N	22° 0,26' W	5248,4	SW	8	270,0	0,4	Access Point	AP zu Wasser	AP 3
1008-3	29.09.13	20:00	33° 15,79' N	22° 0,25' W	5243,7	SW	8	228,0	0,4	Access Point	AP zu Wasser	AP 4
1008-3	29.09.13	20:25	33° 16,04' N	22° 0,68' W	5252,3	WSW	8	199,0	0,3	Access Point	AP Information	Beginn Einmessen Access-Points
1008-3	30.09.13	02:32	33° 16,08' N	22° 1,03' W	0,0	SW	9	16,0	1,7	Access Point	AP Information	Ende Einmessen Access-Points
1008-3	30.09.13	03:49	33° 16,34' N	22° 0,87' W	0,0	SW	9	270,0	0,0	Access Point	AP Information	Hydrophon zu Wasser
1008-3	30.09.13	04:10	33° 16,36' N	22° 0,91' W	0,0	SW	9	200,0	1,3	Access Point	AP ausgelöst	AP 2
1008-3	30.09.13	04:14	33° 16,36' N	22° 0,88' W	0,0	SW	9	107,0	0,9	Access Point	AP Information	Hydrophon an Deck
1008-3	30.09.13	04:38	33° 16,31' N	22° 0,19' W	0,0	SW	10	131,0	0,4	Access Point	AP Information	Hydrophon zu Wasser
1008-3	30.09.13	05:03	33° 16,37' N	22° 0,17' W	0,0	SW	11	206,0	0,6	Access Point	AP ausgelöst	AP 3
1008-3	30.09.13	05:04	33° 16,36' N	22° 0,18' W	0,0	SW	11	238,0	1,2	Access Point	AP Information	Hydrophon an Deck
1008-3	30.09.13	05:24	33° 15,77' N	22° 0,11' W	0,0	SW	10	298,0	0,4	Access Point	AP Information	Hydrophon zu Wasser
1008-3	30.09.13	05:35	33° 15,79' N	22° 0,12' W	0,0	SW	9	338,0	0,6	Access Point	AP ausgelöst	AP 4
1008-3	30.09.13	05:36	33° 15,79' N	22° 0,12' W	0,0	SW	9	299,0	0,6	Access Point	AP Information	Hydrophon an Deck
1008-3	30.09.13	05:54	33° 15,82' N	22° 0,86' W	0,0	SW	11	0,0	0,6	Access Point	AP Information	Hydrophon zu Wasser
1008-3	30.09.13	06:03	33° 15,88' N	22° 0,90' W	0,0	SW	12	186,0	1,0	Access Point	AP ausgelöst	AP 1
1008-3	30.09.13	06:04	33° 15,88' N	22° 0,90' W	0,0	SW	11	180,0	0,0	Access Point	AP Information	Hydrophon an Deck
1008-3	30.09.13	08:50	33° 16,03' N	22° 0,64' W	0,0	WSW	12	24,0	3,3	Access Point	AP Oberfläche	AP 3
1008-3	30.09.13	08:55	33° 16,20' N	22° 0,52' W	0,0	WSW	11	354,0	1,8	Access Point	AP Information	gesichtet
1008-3	30.09.13	09:00	33° 16,18' N	22° 0,59' W	0,0	WSW	11	157,0	0,4	Access Point	AP an Deck	AP 3
1008-3	30.09.13	09:10	33° 16,37' N	22° 0,51' W	0,0	SW	13	15,0	0,7	Access Point	AP Oberfläche	AP 2
1008-3	30.09.13	09:14	33° 16,44' N	22° 0,49' W	0,0	SW	10	355,0	1,4	Access Point	AP Information	gesichtet
1008-3	30.09.13	09:30	33° 16,11' N	22° 1,21' W	0,0	SW	11	270,0	1,1	Access Point	AP an Deck	AP 2
1008-3	30.09.13	09:40	33° 15,80' N	22° 0,94' W	0,0	SW	11	113,0	3,5	Access Point	AP Oberfläche	AP 4
1008-3	30.09.13	09:47	33° 15,67' N	22° 0,47' W	0,0	SW	1	279,0	4,2	Access Point	AP Information	gesichtet
1008-3	30.09.13	09:55	33° 15,65' N	22° 0,45' W	0,0	SW	11	198,0	1,1	Access Point	AP an Deck	AP 4
1008-3	30.09.13	13:21	33° 15,58' N	22° 0,98' W	0,0	SW	12	300,0	1,4	Access Point	AP Oberfläche	AP 1
1008-3	30.09.13	13:22	33° 15,60' N	22° 1,01' W	0,0	SW	12	303,0	2,3	Access Point	AP Information	gesichtet
1008-3	30.09.13	13:33	33° 15,69' N	22° 1,36' W	0,0	SW	11	334,0	0,9	Access Point	AP an Deck	AP 1
1008-3	30.09.13	14:00	33° 13,74' N	22° 1,20' W	5252,0	SW	14	166,0	8,0	Access Point	AP on Deck	

Ende Forschungs- und Stationsarbeiten POS 459