

Cruise Report

Compiled by: Dipl.-Ing. Siegfried Krueger

R.V. Poseidon Cruise No.: P432

Dates of Cruise: from 30.04.2012 to 13.05.2012

Areas of Research: Physical Oceanography,
Oceanographic Instrumentation & Engineering

Port Calls: Lisbon (PT), Ponta Delgada (Acores, PT)

Institute: Institut fuer Ostseeforschung Warnemuende,
Seestrasse 15, D-18119 Rostock-Warnemuende

Chief Scientist: Dipl.-Ing. Siegfried Krueger

Number of Scientists: 10

Projects: DFG: BMBF: 03SC276B, WA2157/2-1, WA2157/3-1

Cruise Report

This cruise report consists of 19 pages including cover:

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4. Scientific report and first results
5. Moorings, scientific equipment and instruments
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1. Scientific crew

Name	Function	Institution	Leg
Krueger, Siegfried	Chief Scientist	IOW	432
Huth, Hartmut	Technician	IOW	432
Fruendt, Birte	PhD Student	IOW	432
Fiskal, Annika	Student	IOW/Uni. Rostock	432
Koerner, Gerhard	Project leader	ENITECH	432
Dr. Thiede, Carl	Engineer/ Scientist	ENITECH	432
Albrecht, Jonathan	Technician	ENITECH	432
Yakovlyev, Sergiy	Engineer/ Scientist	EVOLGICS	432
Kebkal, Oleksiy	Engineer/ Scientist	EVOLGICS	432
Schmidt, Tino	Engineer/ Scientist	TU Berlin	432
Total: 10			

IOW	Institut für Ostseeforschung Warnemünde
Uni. Rostock	Universität Rostock (Biowissenschaften)
ENITECH	ENITECH Energietechnik-Elektronik GmbH, Rostock
EVOLGICS	EvoLogics GmbH, Berlin
TU Berlin	Technische Universität Berlin (Mikrotechnik)

Chief scientist:
Dipl.-Ing. Siegfried Krueger
hd. IOW instr. department
Institut für Ostseeforschung Warnemünde
Seestrasse 15
18119 Rostock, Germany
Telefon: +49 (0) 381 5197 160
Telefax: +49 (0) 381 5197 4823
e-mail: siegfried.krueger@io-warnemuende.de

2. Research program (S. Krueger, IOW)

The objectives of the cruise P432 from Lisbon to Ponta Delgada in April/May 2012 (30.04-13.05.2012) on board R/V Poseidon were:

- 1) To investigate the water column properties along a meridional transect (22°W from 37°N to 31°N) in order to localize the position of the Azores Front and to understand the changes in biogeochemical properties.
- 2) To perform deep sea trials (at water depth of minimum 4000 m) with newly developed pressure neutral marine technology and acoustic under water networks (DNS – Druck-Neutrale Systeme - pressure neutral systems).

3. Narrative of the cruise with technical details (S. Krueger, IOW)

The cruise P432 was carried out in collaboration between the Institute für Ostseeforschung Warnemünde (IOW), Universität Rostock (Biowissenschaften), ENITECH Energietechnik-Elektronik GmbH, Rostock, EvoLogics GmbH, Berlin and Technische Universität Berlin (Mikrotechnik)

Time schedule

30.04: Lisbon - participants of cruise P432 embarked on RV Poseidon at 8:00 LT (6:00 UTC) and started unloading, installing equipment and setting up the laboratories. Embarkation was completed at 11:30 LT (9:30 UTC).

30.04.: at 10:00 UTC RV Poseidon left Lisbon towards 37°N, 22°W. After leaving the port channel the complete scientific crew participated in the obligatory safety instruction training. The sailing time of approximately 3 days was used to prepare the in-situ measurement and lab technology for the Azores Front investigations as well as to check up all pressure neutral testing equipment.

Weather conditions developed drizzly with north westerly winds of more than 20 kn. The work plan had to be adapted to the relatively inconvenient weather conditions. CTD-measurements and sampling in combination with instrument testing trials were scheduled beginning from 37°N, 22°W southward in 30 nm distances to detect the Azores Front as quick as possible, leaving out the planned 0,15° locations for later. Portuguese authorities (CORMAR) were informed about the first 72 h program according to their verbal note - permission NV/USEN/N° 1759/2012 from 2012-04-24. Shifts for CTD- and sampling work were established mainly for night times as well as shifts for instrument testing at day light times.

03.05.: The first transect station (37°N, 22°W) was reached at 17:45 UTC with north-easterly winds of appr. 10 m/s. Underway surface water observation was activated. Station work was started at 17:50 UTC. An USBL modem for directional acoustic networking was installed into the ships' moon pool and tested.

Ships' rolling was acceptable for CTD work and the CTD system was prepared. A CTD testing cast down to 50 m was carried out from 19:20 to 20:00 followed by planned regular CTD and Azores Front investigation work:

03.05. 20:04-21:00 UTC 37,0°N, 22°W #0001 CTD cast w. 7 samp. depth's to 1000m

03.05. 22:32 passing of the 18°C isothermal by surface TSG measurements was observed at 36,81°N as a rough sign of the front

04.05. 00:54-11:45 UTC further three CTD casts w. 7 samp. depth's to max.1030m.

After complete data processing of St. #0001-0004 the Azores Front was identified as detected at 36,375°N, as the 15°C isotherm moved do wnward from 200m at appr. 36,75°N to 300 m at 36,125°N.

According to the prepared planning it was decided to start first instrument testing and move northwards from now, measuring the intermediate 0,15° locations for fine investigation of the front and to carry out instrument testing at daytimes if possible. Authorities were informed.

To be on the next 0,15° location for continued CTD work over night we moved to 35,75°N, 22°W on 04.05. afternoon. Unfortunately it was impossible to carry out any deployments at 35,75° because authorities had not r esponded to our 24 h in advance announcement and we had to wait until our 72 h in advance announcement was valid. So we returned to 35,5°N and could carry out first acoustic modem trials at slowly improving weather conditions (10 m/s -> 5 m/s):

04.05. 16:30-21:30 UTC two more CTD casts w. acoustic modems to max. 4750m

04.05. 22:00 UTC 35,5°N, 22°W interruption of CTD work, preparation of DNS trails

05.05. overnight: further improving weather conditions, (wind 3-4 m/s).

05.05. 08:00 UTC 35,5°N, 22°W start of DNS testing deployments, especially the new ROV, which operates from a docking station (TMS), installed at the CTD cable instead of the CTD.

Testing work started as St.#0006 immediately after sun rise and continued as follows:

05.05. 07:40 launching of new ROV docked under docking station TMS, christening of the new ROV, named ERNO2 (by Birte), lowering to pre-launch check depth of 150m, power fault - recovery

05:05. 10:05 deployment of TMS w. buoyancy control system TS, checks – OK lowering to pre-launch check depth of 100m – OK

05.05. 11:00 ERNO2/ TMS/TS on Deck – end of first tests

05.05. 11:30 Transfer to 35,75°N, 22°W for continua tion of CTD work

05.05. 13:30 07:35 UTC three more CTD casts w. acoustic modems to max. 4098m

05:05. 07:45 deployment of TMS w. buoyancy control system TS, 233m, checks – OK

06.05. 10:18-12:50 UTC at 36,50°N, 22°W one more CT D w. 7 sampl. dept. to 4095m

06.05. 13:00-20:00 DNS / ROV testing work to max 4100m

07.05. 06:00-12:00 UTC 36,50°N, 22°W moon pool USBL modem calibration

07.05. 12:00-16:15 UTC 36,50°N, 22°W TMS w. buoyanc y control system TS, 1500m

07.05. 16:30-20:45 UTC transfer to 36,375°N, 22°W f or continuation of CTD work

07.05. 20:47-21:40 UTC 36,375°N, 22°W #0010 CTD cas t, 7 sampl. dept. to 1015m

07.05. 22:00 UTC transfer to 36,50°N, 22°W as #0 011

08.05. 05:30-11:30 UTC two more CTD casts, w.7 sampl. dept. to 4065m

08.05. 12:00-15:45 UTC 36,50°N, 22°W TMS w. buoyancy control system TS, 4000m

08.05. 16:00 UTC transfer to 36,375°N, 22,15°W for continuation of CTD work

08.05. 20:20-08:00 UTC three more CTD casts, w. 7 sampl. dept. to 4065m

09.05. 08:00 UTC 36,50°N, 22°W preparation for acoustic access point testing

09.05. 11:30 UTC 36,50°N, 22°W access point deployment by TMS (max cable 4051m)

09.05. 12:56 UTC 36,50°N, 22°W AP1 released, sinking approx. 15m to seabed

09.05. 13:10 UTC TMS 3800m track to 36°29,43N, 22°07,72°W w. ac. Communication

09.05. 14:30-15:40 UTC recovery of TMS, acoustic communication w.access point OK

09.05. 17:00-19:25 UTC 36°28,41N, 22°1,87°W TMS w. buoyancy system TS, 1000m

09.05. 19:00-20:50 UTC Transfer to 36,50°N, 22,15°W for continuation of CTD work

09.05. 20:55-06:10 UTC three more CTD casts, w. 7 sampl. to 1015m

10.05. 06:15-08:15 UTC Transfer to 36,50°N, 22°W for continuation of DNS work

10.05. 08:20-15:50 UTC 36,50°N, 22°W TMS/ROV operation near depth AP1 at 4100m

10.05. 13:56 UTC 36,50°N, 22°W AP released by acoustic com./ac. guidance w. TMS

10.05. 16:32 UTC 36,50°N, 22°W surfacing of AP1, radio contact

10.05. 16:50 UTC 36,50°N, 22°W easy recovery of AP1

10.05. 18:26 UTC 36,50°N, 22°W overboard deployment of AP2 and AP2a (flash light)

11.05. 08:00 UTC 36,50°N, 22°W deployment TMS/ROV, search of AP2/AP2a 4100m

11.05. 09:30-11:00 UTC 36,50°N, 22°W near seabed ROV op., infinite AP2 response

11.05. 11:05 UTC 36,50°N, 22°W problem w. TMS winch, start recovery of TMS/ROV

11.05. 13:20 UTC 36,50°N, 22°W separated recovery of TMS / ROV on deck

11.05. 13:30-13:50 UTC 36,50°N, 22°W radio contact with self-released AP2, in sight

11.05. 13:57 UTC 36°29,21N, 21°59,7W AP2 received., no harm flasher left on seabed

11.05. 14:25 UTC 36°29,21N, 21°59,7W end of work, heading direction Ponta Delgada

12.05. 09:30-19:30 UTC lab demobilization, container packing, cleaning; arrival P. Del.

13.05. 10:00 disembarking of scientific crew by agent transportation to hotel in P. Del.

14.05. 06:30 agent transportation to airport – flights back to Germany

4. Scientific report and first results

4.1 Hydrographic sections and sampling of suspended particles in the water column (B. Fründt, A. Fiskal, S. Krüger, IOW)

One of the objectives of the cruise P432 was to investigate the water column properties along a meridional transect on 22°W from 35.5°N to 37°N to localize the position of the Azores Front and to understand the changes in the biogeochemical properties according to the front.

For this purpose CTD measurements were done on 15 stations, eight of them along transect on 22°W from 37°N to 35.5°N. Four of them were done directly on the position of the Azores Front from 03.05.2012 to 09.05.2012 to study short term variability in hydrography and biogeochemical properties at the front. Furthermore four stations were realized in a distance of 7.5 nautical miles around the frontal position to observe a possible meandering of the front. Most of the measurements were performed down to 1000 m depth, some down to 4000 m depth. Additionally oxygen and fluorescence data were recorded at all stations. Figure 1 shows the vertical temperature and salinity distribution in the top 500 m of the water column. The position of the Azores Front is defined where the 15°C isotherm rises from 300 m to above 200 m depth. During this cruise in May 2012 the frontal position was found on roughly 36.5°N. In comparison to the former cruise P404 in September 2010 the front has moved 2.5° northwards.

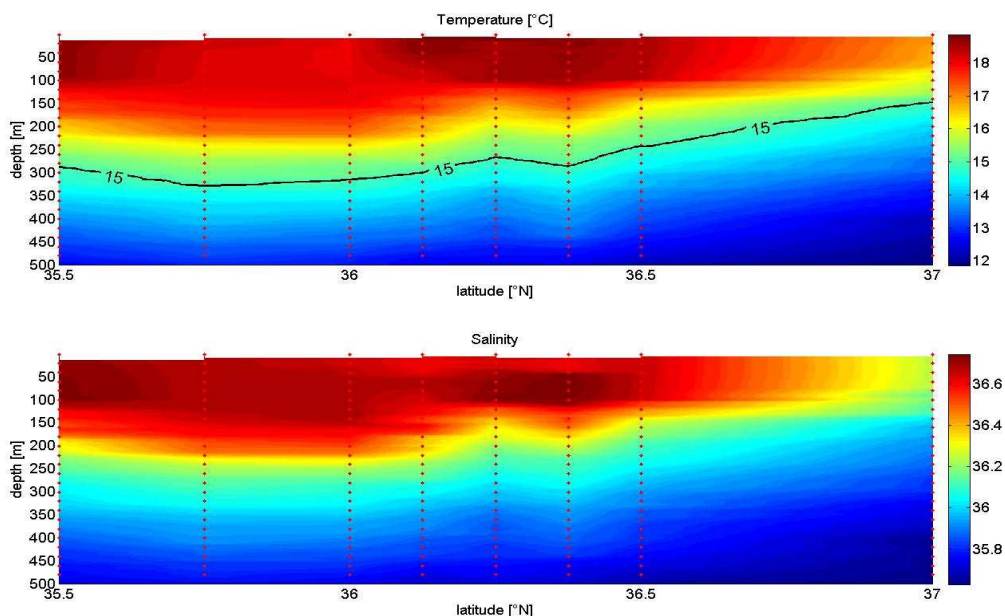


Figure 1: Vertical temperature and salinity distribution (0 - 500 m depth) along the 22°W transect from 35.5°N to 36.5°N.

The red dotted lines show the stations. The black line indicates the 15°C isotherm. The Azores Front was detected at 36.5°N where the 15°C isotherm moves upward from 300 m to 200 m.

Parallel water sampling was done on all stations down to 1000 m depth using the rosette to obtain chlorophyll a, nutrient concentrations, particulate organic carbon (POC), and suspended particulate matter (SPM). These samples provide knowledge about the composition and distribution of dispersed particles in the water column to characterize differences in biogeochemistry of water masses across the Azores Front. Sampling was performed with IOW/HYDROBIOS-FreeFlow-bottles during CTD rosette runs in three predefined depth levels (5m, 200m, 1000m) and in four different depths according to the deep chlorophyll maximum (i.e. start, maximum, end). Overall, 105 samples were taken for nutrient concentration, POC and SPM, respectively, 90 samples for chlorophyll a and 45 for determination of mineral phases. For SPM, Chl-a and POC two liters of sea water were filtrated through GF/F filters (0.7 µm pore size; for SPM: weighted Ø 47mm filters, Chl-a and POC: Ø 25mm filters, glowd filters for POC analysis) and frozen at -20°C for further sample processing at the home laboratory at IOW. During SPM filtration 150ml of filtrated sea water was collected for the purpose of nutrient measurements. For the determination of mineral phases which are dispersed in the water column 2 liters of sea water were filtered through Nucleopore polycarbonate filters (0.4 µm pore size). The filters were dried at room temperature. All water filter samples meant for the different analytical and scientific purposes were desalinized by rinsing with "Milli-Q" clean fresh water before storage.

4.2 Deep sea trials with pressure neutral marine technology and acoustic under water networks (G. Körner, C. Tiede; ENITECH; S. Krüger, H. Huth; IOW; S. Yakovlev, O. Kebkal; EVOLOGICS, T. Schmidt; TU Berlin)

The testing program for the complex DNS systems had to be carried out according to the following agenda:

1. Assembly and mobilization
2. Function tests on deck and at shallow depth levels
3. TMS / ROV operation over ground, unlocking of ROV & operation over ground, video/acoustic positioning and modem testing (depth min 4000m)
4. Launching of a testing object over ground
5. Testing of the acoustic access point network
6. Testing of a buoyancy balancing system

4.2.1. Pressure tolerant launching and recovery system with new ROV (ERNO 2 - ENITECH)

The ERNO 2 system consists of a newly developed remotely operated vehicle (ROV) and a docking station (TMS) which is operated on a conventional single wire conductor cable as it is commonly used for under water probe deployment. This allows the use of the ERNO system on any research vessel which has a winch with a single conductor for CTD deployment over the full ocean depth range. The docking station holds up to 200 m of a new strengthened ROV cable on an automatic winch. This allows easy ROV operation around the TMS in each depth available using the standard CTD single conductor cable. The operating depth of the ERNO-system was tested in the lab down to 6.000 m. Except the camera and telemetry modules all components of the ERNO system are manufactured in pressure tolerant technology. Pressure-tolerant accumulators provide energy for all system components. Via the single conductor cable they can buffer energy so that the operating time can be extended to several hours. The following figure shows the actual ERNO 2 system.



Figure 2: ERNO2 ROV and TMS docking station 2012 separated on deck

All systems had to prove themselves at this cruise after a complete redesign and under relatively inconvenient weather conditions. Launching and recovery were a challenge in relatively rough seas.

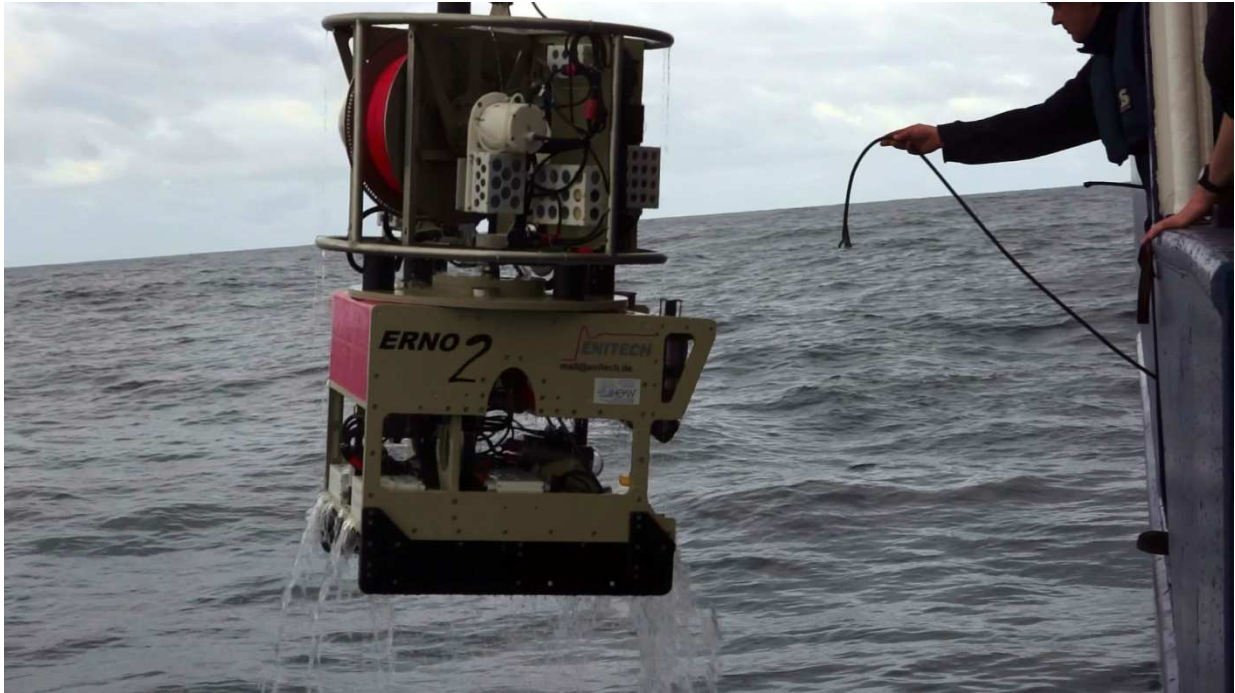


Figure 3: Recovery of ERNO2 2012

All DNS components could be tested successfully step by step over day times down to max. 4100 m, adapting permanently to the highly variable weather conditions, interchanging with CTD work mainly over night, as to be seen in the narrative of the cruise.

Driving behavior of the new ROV (ENITECH) was qualified as very well with the newly designed, strengthened ROV cable (IOW/FALMAT) and elastic winch as well as the docking and camera systems (ENITECH, Sea&Sun-Technology). A flashing test beacon could be easily deployed by the ROV at the seabed.

Slide problems occurred with the TMS lock but secure recovery from 4000m was no problem with the new strengthened ROV cable. Systems had been deployed partly up to 8 hours at ocean depth. No systematic failures for the DNS systems had to be noticed with the moulding technology, materials, electric motors and power supply units anymore. Recovery of heavy acoustic access points by the ROV was left out because of the bad weather conditions (they were recovered using their integrated releasing technology, see 4.2.2.)

Pressure tolerant technology has fully proven at this cruise. DSL cable communication as well as acoustic short and long distance navigation and communication worked absolutely reliable over more than 5000 m of CTD cable resp. more than 4100 m of water depth.

The newly designed ROV carried out impressive rides above the seabed in 4100m as the following snapshots demonstrate:



Figure 4: Animals at 4100 m of water depth on 35,5 °N, 22 °W

4.2.2. Optimization and testing of the DNS-TS acoustic digital data communication system in conjunction with USBL positioning (EvoLogics)

EvoLogics participated the Atlantic cruise of the RS "Poseidon" P432 headed by IOW as partner of the joint project "DNS-Tiefsee".

The scientific and engineering part of EvoLogics work was concentrated on development, optimization and testing of acoustic digital data communication system in conjunction with USBL positioning. The acoustic modems, prepared and tested during P432 cruise are listed below:

- S2CR 7/17 (low frequency modem for deep water data transmissions);
- S2CR 7/17 USBL (low frequency modem with USBL-positioning functionality for deep water data transmissions and positioning);
- S2CR 7/17 AP (low frequency modem, specially optimized for operations with deep-water deployments. Includes data-logger and acoustic releaser);
- S2CR 7/17 DNS (low frequency modem in pressure-tolerant configuration);
- S2CR 48/78 (8000m depth-rated high frequency modem for short-range (up to 300m) acoustic communication between ROV and TMS);
- S2CR 48/78 USBL (8000m depth-rated high frequency modem with USBL-positioning functionality for short-range (up to 300m) acoustic communication between ROV and TMS).

High-frequency modems were installed on TMS (S2CR 48/78 USBL) and on ERNO-2 ROV (S2CR 48/78). Digital acoustic link to ROV-mounted modem was established and ROV's positioning information was delivered from TMS to the operator console in the lab. All test-results are positive.

Low-frequency modems were tested initially with CTD-rosette up to 4100m water depth. Communication link was established from the moonpool-installed S2CR 7/17 USBL modem to the S2CR 7/17 modem, attached to the CTD-rosette. Acoustic signals and link-parameters were logged during the tests.

Communication link is classified as stable and reliable.

The pressure-tolerant modem S2CR 7/17 DNS was tested by descending with CTD-rosette down to 4000m depth with continuous communication with moonpool-mounted S2CR 7/17 USBL modem. The pressure-neutral modem survived multiple CTD runs without any affect to its mechanical structures. Signals parameters were measured during the tests, showing same performance as standard S2CR 7/17 device. Result can be classified as positive, pressure-neutral configuration can be used for next project phases.

Two deep-water deployments (Access Points or AP) were prepared for installation on the sea-floor. First deployment was done by using the TMS as a "lift" – putting the AP on the sea-floor gently. Research vessel was drifted away up to 2000m, having TMS under water. Repetitive tests of the acoustic link were done from the low-frequency modem, installed on TMS, to AP (horizontal link). The S2CR 7/17 USBL modem,

installed in the moonpool, was used in promiscuous mode, listening modems, communicating in the depth. All communication sessions along with the received signals were logged topside for further analysis. The communication-log was recorded on the non-volatile memory (uSD-card storage) at the modems, installed on AP. Communication result was classified as successful. The following figure shows the universal acoustic access points at deployments / recoveries.

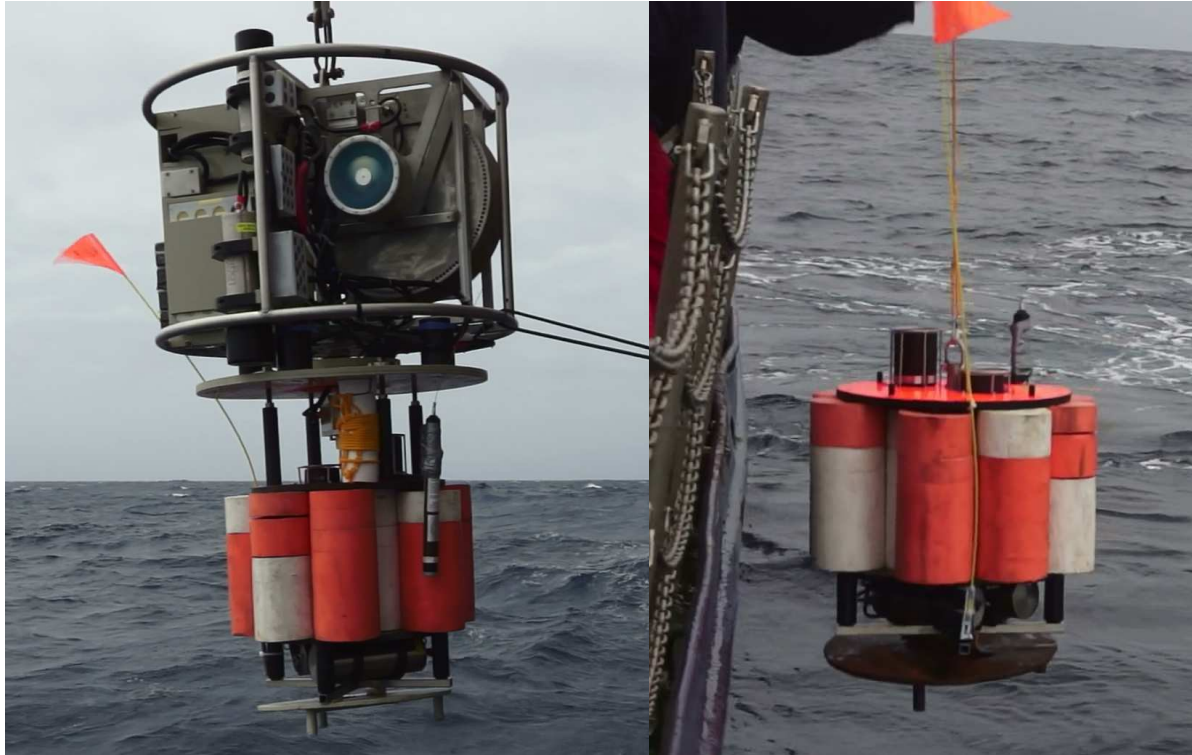


Figure 5: Deployments / recoveries of Acoustic access points (TMS supported)

After finishing the communications, the acoustic releaser was activated by sending an acoustic command from TMS to AP. The command was received by the AP's modem (successful reception was acknowledged), but release was not opened. After multiple tries, the AP was released by using spare releaser (commercial device, manufactured by firma KUM). Log-analysis on deck has shown that the failure was caused by improper software configuration at the AP's modem.

Conclusions: The acoustic modems, provided for P432 cruise have shown stable and reliable functionality. The pressure-tolerant modem was successfully tested multiple times up to 4100m water depth and shown its reliability. USBL positioning info was collected both by high-frequency modems, operating in great depth and measuring ROV position, and by low-frequency USBL-modem from the sea-surface to the modems at the sea-floor. All positioning data were collected without interruption of the communication sessions, confirming ability of S2C systems to transmit data bi-directionally and simultaneously collect positioning information.

The Acoustic releaser must be inspected in lab and prepared for coming sea-trials.

4.2.3. Implementation and testing of a universal pressure tolerant buoyancy balancing system (TU Berlin, Department for Electromech. and Optical Systems)

Within the framework of the expedition P432 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 system was assembled and fixed to a steel frame, which was mechanically and electronically connected to the ERNO/TMS docking and tether management system via the single-conductor cable of RV Poseidon (see Fig. 6/7).

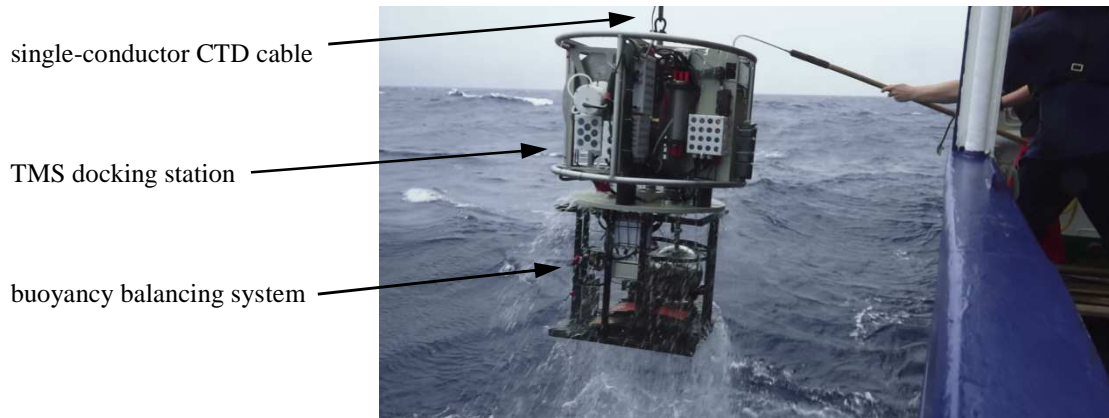


Fig. 6 Universal buoyancy balancing system connected to TMS docking station

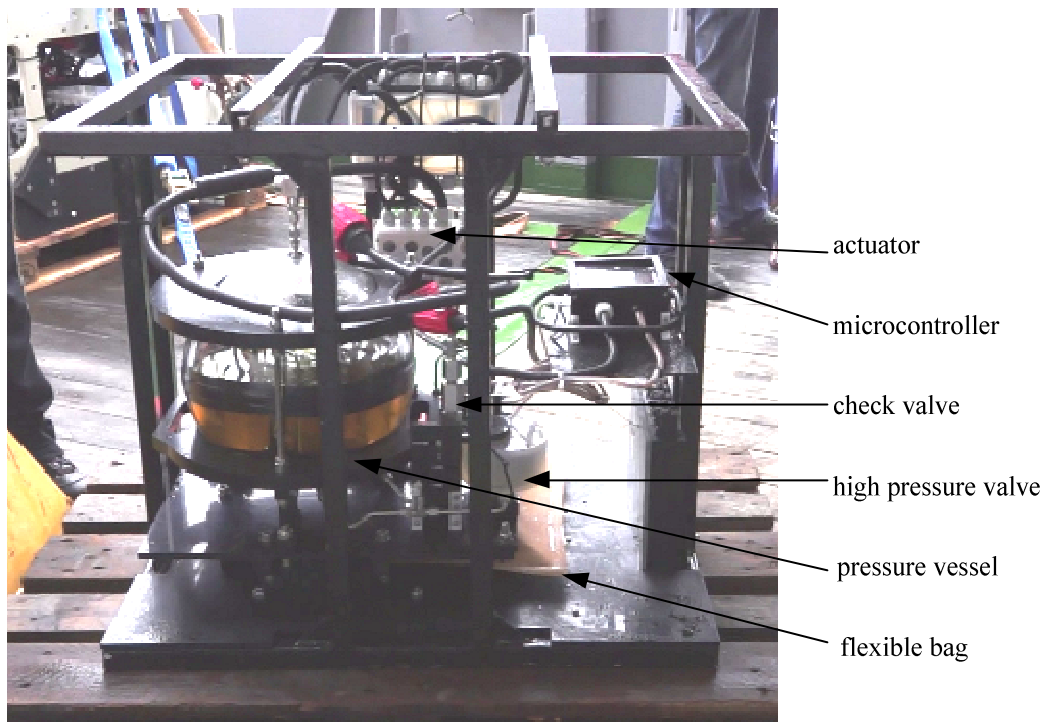


Fig. 7 Universal buoyancy balancing system in detail

The universal buoyancy balancing system is shown in Fig. in detail. An actuator-controlled motor driven pump pumps hydraulic fluid out of the pressure vessel through a high pressure valve and through sensors into a flexible bag. Due to that the buoyancy of the system is raising. To reduce the buoyancy, a high pressure valve can be opened. The pressure difference causes the fluid to flow into the pressure vessel. A microcontroller handles the signals of the applied sensors and sends them via the single-conductor-cable to the research vessel. With the aid of a computer on the research vessel, the buoyancy system can be remote controlled.

During the test cruise, pump motor speeds were varied to ensure a secure starting of the motor in different diving depths. Within a diving depth of 500 meters, the actuator from the company ENITECH was short-circuited. Hence, the operation of the pump motor was not possible. The fault could not be found during the test cruise. The post-processing showed that a “cold” solder joint caused the short-circuit.

The high pressure valve, operated by a pressure-tolerant coil, the pressure-tolerant flow rate sensor, and the fluid level sensor in the pressure vessel operated well up to a diving depth of 4,000 meters. Fig. shows the flow rate with an activated high pressure valve at different diving depths, measured by the flow rate sensor. It can be seen that the flow rate increases with increasing depth.

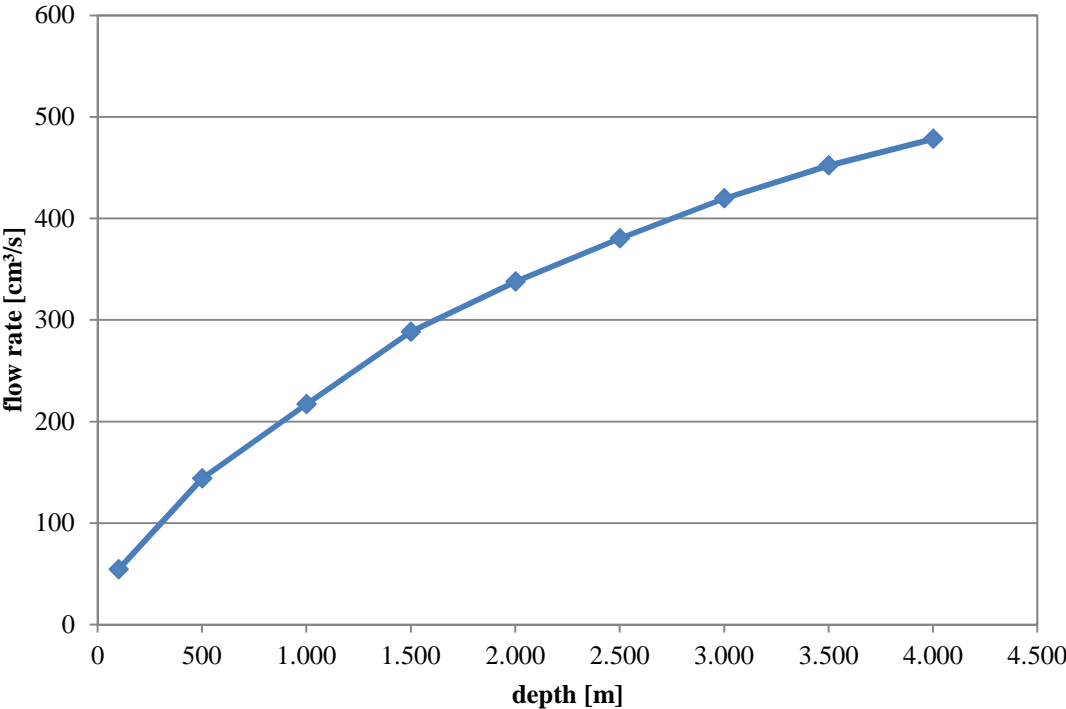


Fig. 8 Buoyancy balancing system - flow rate according to depth

In addition, a pressure-tolerant computer was exposed to the condition of the deep sea with diving depth of 4,000 meters. The electronic components performed well without damages.

5. Scientific equipment – CTD / Water Sampling

The CTD system was a deep sea SBE 911plus version with a standard sensor system including pressure, conductivity, a duplicated temperature sensor, oxygen, Wetlabs FLNTU (ChlA/light backscatter) and an altimeter for bottom distance. The rosette was equipped with 14 pcs. of 5 l - IOW/HYDROBIOS FreeFlow bottles.

Serial-Numbers:

CTD 911 plus	SN 09P23329-0603
T-Sensors:	T4249, T4525
C-Sensor:	C2815,
O2-Sensor:	O1341,
FLNTU-Sensor:	1528
Altimeter-Sensor:	51996
Pump:	2626

6. Acknowledgements

We thank Captain Bernhard Windscheid and his crew of RV POSEIDON for their cooperation and extraordinary help during this cruise, to manage all tasks with no damages and no losses under really difficult weather conditions.

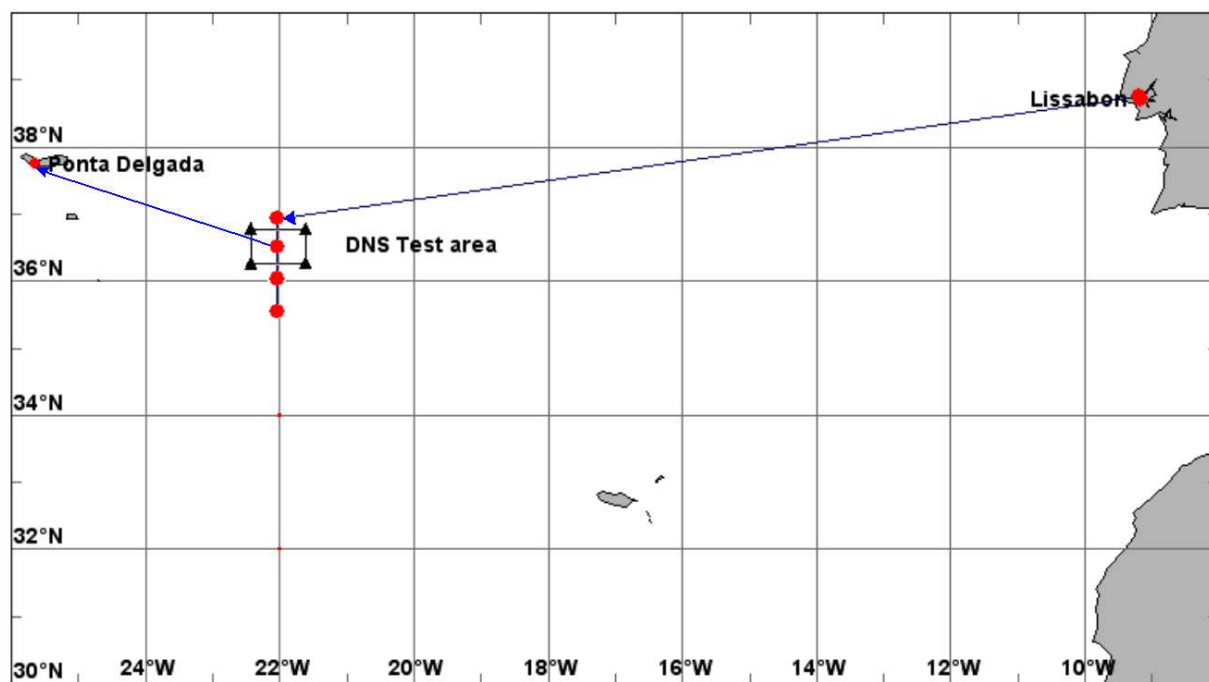
Signed:

Siegfried Krueger

Chief scientist

7. Appendices

Appendix A: Map P432 May 2012



Appendix B: Station list P432 May 2012

station	date	time	LAT	LON	action	information	wire/ remarks
POS432/117-1	03.05.2012	17:54	36° 59,96' N	22° 0,00' W	Calibration	start	begin of. sc. work
POS432/117-1	03.05.2012	19:12	36° 59,96' N	22° 0,17' W	Calibration	stop	mod. in moon pool
POS432/118-1	03.05.2012	19:24	36° 59,99' N	21° 59,97' W	CTD/rosette water sampler	to water	10 m
POS432/118-1	03.05.2012	19:32	37° 0,00' N	21° 59,94' W	CTD/rosette water sampler	at depth	WL max.: 53 m
POS432/118-1	03.05.2012	19:33	36° 59,99' N	21° 59,94' W	CTD/rosette water sampler	on deck	
POS432/118-2	03.05.2012	19:51	36° 59,97' N	21° 59,97' W	CTD/rosette water sampler	to water	10 m
POS432/118-2	03.05.2012	20:29	36° 59,97' N	21° 59,95' W	CTD/rosette water sampler	at depth	WL max.: 1001 m
POS432/118-2	03.05.2012	20:59	36° 59,97' N	21° 59,98' W	CTD/rosette water sampler	on deck	
POS432/119-1	04.05.2012	00:53	36° 30,00' N	21° 59,99' W	CTD/rosette water sampler	to water	10 m
POS432/119-1	04.05.2012	01:20	36° 30,01' N	21° 59,98' W	CTD/rosette water sampler	at depth	WL max.: 1015 m
POS432/119-1	04.05.2012	01:49	36° 29,98' N	21° 59,98' W	CTD/rosette water sampler	on deck	
POS432/120-1	04.05.2012	05:55	36° 0,08' N	21° 59,91' W	CTD/rosette water sampler	to water	10 m

POS432/120-1	04.05.2012	06:05	36° 0,09' N	21° 59,91' W	CTD/rosette water sampler	to water	10 m
POS432/120-1	04.05.2012	06:31	36° 0,10' N	21° 59,90' W	CTD/rosette water sampler	at depth	WL max.: 1014 m
POS432/120-1	04.05.2012	07:01	36° 0,11' N	21° 59,90' W	CTD/rosette water sampler	on deck	
POS432/121-1	04.05.2012	10:52	35° 30,06' N	21° 59,98' W	CTD/rosette water sampler	to water	
POS432/121-1	04.05.2012	11:17	35° 30,01' N	21° 59,97' W	CTD/rosette water sampler	at depth	WL max.: 1028 m
POS432/121-1	04.05.2012	11:42	35° 30,02' N	22° 0,00' W	CTD/rosette water sampler	on deck	
POS432/122-1	04.05.2012	16:25	35° 30,00' N	22° 0,01' W	CTD/rosette water sampler	to water	10 m
POS432/122-1	04.05.2012	17:52	35° 30,05' N	22° 0,06' W	CTD/rosette water sampler	at depth	WL max.: 4750 m
POS432/122-1	04.05.2012	18:02	35° 30,03' N	22° 0,06' W	CTD/rosette water sampler	information:	lift up
POS432/122-1	04.05.2012	19:12	35° 30,04' N	22° 0,00' W	CTD/rosette water sampler	information:	depth 10 m
POS432/122-1	04.05.2012	20:27	35° 30,04' N	22° 0,03' W	CTD/rosette water sampler	at depth	WL max.: 3588 m
POS432/122-1	04.05.2012	20:29	35° 30,04' N	22° 0,03' W	CTD/rosette water sampler	information:	lift up
POS432/122-1	04.05.2012	21:29	35° 30,09' N	22° 0,04' W	CTD/rosette water sampler	on deck	
POS432/123-1	05.05.2012	08:41	35° 30,02' N	21° 59,99' W	Remote operated vehicle	to water	
POS432/123-1	05.05.2012	08:47	35° 30,04' N	22° 0,02' W	Remote operated vehicle	at depth	WL max.: 150 m
POS432/123-1	05.05.2012	08:57	35° 30,08' N	22° 0,08' W	Remote operated vehicle	information:	ROV free diving
POS432/123-1	05.05.2012	09:12	35° 30,17' N	22° 0,21' W	Remote operated vehicle	information:	stop
POS432/123-1	05.05.2012	09:15	35° 30,18' N	22° 0,24' W	Remote operated vehicle	on deck	
POS432/123-2	05.05.2012	10:06	35° 29,97' N	22° 0,05' W	TMS/ Docking Station	to water	
POS432/123-2	05.05.2012	10:08	35° 29,98' N	22° 0,08' W	TMS/ Docking Station	at depth	WL max.: 150 m
POS432/123-2	05.05.2012	10:08	35° 29,98' N	22° 0,08' W	Acoustic Modem	to water	
POS432/123-2	05.05.2012	10:14	35° 30,02' N	22° 0,17' W	TMS/ Docking Station	information:	Cont. to 500m
POS432/123-2	05.05.2012	10:18	35° 30,06' N	22° 0,21' W	Acoustic Modem	to water	2. Modem
POS432/123-2	05.05.2012	10:26	35° 30,13' N	22° 0,30' W	TMS/ Docking Station	at depth	WL max.: 500 m
POS432/123-2	05.05.2012	10:30	35° 30,16' N	22° 0,34' W	Acoustic Modem	on deck	modems on deck
POS432/123-2	05.05.2012	11:00	35° 30,41' N	22° 0,55' W	Acoustic Modem	on deck	
POS432/124-1	05.05.2012	13:21	35° 45,02' N	21° 59,96' W	CTD/rosette water sampler	to water	
POS432/124-1	05.05.2012	13:54	35° 45,04' N	21° 59,98' W	CTD/rosette water sampler	at depth	WL max.: 1012 m
POS432/124-1	05.05.2012	14:24	35° 45,07' N	21° 59,96' W	CTD/rosette water sampler	on deck	
POS432/125-1	05.05.2012	19:00	36° 14,99' N	22° 0,02' W	CTD/rosette water sampler	to water	10 m
POS432/125-1	05.05.2012	19:25	36° 15,02' N	22° 0,05' W	CTD/rosette water sampler	at depth	WL max.: 1014 m
POS432/125-1	05.05.2012	19:51	36° 15,06' N	22° 0,07' W	CTD/rosette water sampler	on deck	
POS432/126-1	06.05.2012	05:05	36° 29,99' N	21° 59,97' W	CTD/rosette water sampler	to water	10 m
POS432/126-1	06.05.2012	06:24	36° 30,01' N	21° 59,98' W	CTD/rosette water sampler	at depth	WL max.: 4097 m
POS432/126-1	06.05.2012	07:34	36° 30,00' N	22° 0,01' W	CTD/rosette water sampler	on deck	
POS432/126-2	06.05.2012	07:45	36° 30,02' N	21° 59,99' W	TMS/ Docking Station	to water	
POS432/126-2	06.05.2012	08:00	36° 29,99' N	22° 0,00' W	TMS/ Docking Station	at depth	WL max.: 233 m
POS432/126-2	06.05.2012	08:21	36° 30,01' N	21° 59,99' W	TMS/ Docking Station	on deck	
POS432/126-3	06.05.2012	10:12	36° 30,00' N	21° 59,99' W	CTD/rosette water sampler	to water	
POS432/126-3	06.05.2012	11:32	36° 30,01' N	21° 59,98' W	CTD/rosette water sampler	at depth	WL max.: 4095 m
POS432/126-3	06.05.2012	12:47	36° 30,02' N	21° 59,97' W	CTD/rosette water sampler	on deck	
POS432/126-4	06.05.2012	13:17	36° 30,01' N	21° 59,99' W	Remote operated vehicle	to water	
POS432/126-4	06.05.2012	13:30	36° 30,02' N	21° 59,99' W	Remote operated vehicle	depth 150m	ROV free diving
POS432/126-4	06.05.2012	13:56	36° 30,02' N	21° 59,98' W	Remote operated vehicle	information:	stop

POS432/126-4	06.05.2012	13:57	36° 30,03' N	21° 59,98' W	Remote operated vehicle	surfacing	
POS432/126-4	06.05.2012	14:03	36° 30,02' N	21° 59,99' W	Remote operated vehicle	on deck	
POS432/126-5	06.05.2012	15:09	36° 30,01' N	21° 59,96' W	Remote operated vehicle	to water	
POS432/126-5	06.05.2012	16:33	36° 30,02' N	22° 0,00' W	Remote operated vehicle	at depth	WL max.: 4100 m
POS432/126-5	06.05.2012	17:03	36° 29,99' N	22° 0,00' W	Remote operated vehicle	information:	test ROV
POS432/126-5	06.05.2012	17:16	36° 30,01' N	22° 0,01' W	Remote operated vehicle	information:	ROV free diving
POS432/126-5	06.05.2012	17:42	36° 30,01' N	22° 0,00' W	Remote operated vehicle	information:	ROV lift up
POS432/126-5	06.05.2012	19:06	36° 30,02' N	21° 59,99' W	Remote operated vehicle	on deck	
POS432/127-1	07.05.2012	06:06	36° 29,93' N	22° 0,00' W	Calibration	to water	mod. in moon pool
POS432/127-1	07.05.2012	06:12	36° 29,93' N	22° 0,00' W	Calibration	Beginn	
POS432/127-1	07.05.2012	11:45	36° 29,77' N	22° 0,86' W	Calibration	Ende	
POS432/127-2	07.05.2012	12:17	36° 30,01' N	21° 59,94' W	TMS/ Docking Station	to water	
POS432/127-2	07.05.2012	12:58	36° 30,01' N	21° 59,92' W	TMS/ Docking Station	at depth	WL max.: 1500 m
POS432/127-2	07.05.2012	13:38	36° 30,01' N	21° 59,90' W	TMS/ Docking Station	on deck	
POS432/127-3	07.05.2012	15:47	36° 30,07' N	22° 0,06' W	TMS/ Docking Station	to water	
POS432/127-3	07.05.2012	15:53	36° 30,08' N	22° 0,06' W	TMS/ Docking Station	at depth	WL max.: 200 m
POS432/127-3	07.05.2012	16:06	36° 30,09' N	22° 0,05' W	TMS/ Docking Station	information:	finish, lift up
POS432/127-3	07.05.2012	16:13	36° 30,07' N	22° 0,07' W	TMS/ Docking Station	on deck	
POS432/128-1	07.05.2012	20:47	36° 22,50' N	22° 0,04' W	CTD/rosette water sampler	to water	
POS432/128-1	07.05.2012	21:09	36° 22,52' N	22° 0,09' W	CTD/rosette water sampler	at depth	WL max.: 1011 m
POS432/128-1	07.05.2012	21:35	36° 22,50' N	22° 0,14' W	CTD/rosette water sampler	on deck	
POS432/129-1	08.05.2012	05:30	36° 29,98' N	22° 0,04' W	CTD/rosette water sampler	to water	10 m
POS432/129-1	08.05.2012	06:59	36° 30,02' N	22° 0,25' W	CTD/rosette water sampler	at depth	WL max.: 4064 m
POS432/129-1	08.05.2012	08:22	36° 29,90' N	22° 0,01' W	CTD/rosette water sampler	on deck	
POS432/130-1	08.05.2012	08:23	36° 29,91' N	22° 0,01' W	CTD/rosette water sampler	to water	10 m
POS432/130-1	08.05.2012	10:19	36° 29,98' N	22° 0,11' W	CTD/rosette water sampler	at depth	WL max.: 4061 m
POS432/130-1	08.05.2012	11:33	36° 29,93' N	22° 0,05' W	CTD/rosette water sampler	on deck	
POS432/130-2	08.05.2012	11:57	36° 29,95' N	22° 0,01' W	TMS/ Docking Station	to water	
POS432/130-2	08.05.2012	12:15	36° 29,97' N	22° 0,02' W	TMS/ Docking Station	information:	finish, lift up
POS432/130-2	08.05.2012	12:25	36° 29,99' N	22° 0,03' W	TMS/ Docking Station	on deck	
POS432/130-2	08.05.2012	13:12	36° 30,01' N	22° 0,02' W	TMS/ Docking Station	to water	
POS432/130-2	08.05.2012	14:31	36° 29,99' N	22° 0,05' W	TMS/ Docking Station	at depth	WL max.: 4000 m
POS432/130-2	08.05.2012	15:45	36° 30,01' N	22° 0,01' W	TMS/ Docking Station	on deck	
POS432/131-1	08.05.2012	20:19	36° 22,52' N	22° 8,98' W	CTD/rosette water sampler	to water	
POS432/131-1	08.05.2012	20:49	36° 22,50' N	22° 9,12' W	CTD/rosette water sampler	at depth	WL max.: 1013 m
POS432/131-1	08.05.2012	21:13	36° 22,52' N	22° 9,09' W	CTD/rosette water sampler	on deck	
POS432/132-1	09.05.2012	01:02	36° 22,50' N	21° 50,93' W	CTD/rosette water sampler	to water	
POS432/132-1	09.05.2012	01:29	36° 22,44' N	21° 50,97' W	CTD/rosette water sampler	at depth	WL max.: 1016 m
POS432/132-1	09.05.2012	01:57	36° 22,49' N	21° 50,97' W	CTD/rosette water sampler	on deck	
POS432/133-1	09.05.2012	05:22	36° 30,08' N	22° 0,06' W	CTD/rosette water sampler	to water	10 m
POS432/133-1	09.05.2012	06:42	36° 30,04' N	22° 0,08' W	CTD/rosette water sampler	at depth	WL max.: 4063 m
POS432/133-1	09.05.2012	08:00	36° 30,02' N	21° 59,96' W	CTD/rosette water sampler	on deck	
POS432/133-2	09.05.2012	11:29	36° 30,00' N	22° 0,01' W	Access Point	to water	
POS432/133-2	09.05.2012	12:55	36° 30,01' N	22° 0,00' W	Access Point	at depth	WL max: 4051m

POS432/133-2	09.05.2012	12:56	36° 30,02' N	21° 59,99' W	Access Point	information:	deployment
POS432/133-2	09.05.2012	13:10	36° 30,01' N	22° 0,03' W	Access Point	info: 3800m	w. TMS/ROV
POS432/133-2	09.05.2012	14:32	36° 29,43' N	22° 0,72' W	Access Point	information:	finish, lift up
POS432/133-2	09.05.2012	15:43	36° 29,41' N	22° 0,61' W	TMS/ Docking Station	on deck	
POS432/134-1	09.05.2012	17:00	36° 28,41' N	22° 1,87' W	TMS/ Docking Station	to water	Dist. measurem.
POS432/134-1	09.05.2012	17:09	36° 28,42' N	22° 1,89' W	TMS/ Docking Station	at depth	WL max.: 500 m
POS432/134-1	09.05.2012	17:21	36° 28,42' N	22° 1,91' W	TMS/ Docking Station	at depth	WL max.: 1000 m
POS432/134-1	09.05.2012	17:30	36° 28,40' N	22° 1,93' W	TMS/ Docking Station	information:	finish, lift up
POS432/134-1	09.05.2012	17:47	36° 28,38' N	22° 1,98' W	TMS/ Docking Station	on deck	
POS432/135-1	09.05.2012	18:36	36° 28,29' N	21° 59,96' W	TMS/ Docking Station	to water	Dist. measurem.
POS432/135-1	09.05.2012	18:47	36° 28,31' N	21° 59,97' W	TMS/ Docking Station	at depth	WL max.: 500 m
POS432/135-1	09.05.2012	18:57	36° 28,30' N	21° 59,99' W	TMS/ Docking Station	at depth	WL max.: 1000 m
POS432/135-1	09.05.2012	19:06	36° 28,27' N	22° 0,04' W	TMS/ Docking Station	information:	finish, lift up
POS432/135-1	09.05.2012	19:23	36° 28,24' N	22° 0,11' W	TMS/ Docking Station	on deck	
POS432/136-1	09.05.2012	20:55	36° 30,01' N	22° 8,95' W	CTD/rosette water sampler	to water	
POS432/136-1	09.05.2012	21:19	36° 30,05' N	22° 9,06' W	CTD/rosette water sampler	at depth	WL max.: 1015 m
POS432/136-1	09.05.2012	21:45	36° 30,09' N	22° 9,09' W	CTD/rosette water sampler	on deck	
POS432/137-1	10.05.2012	01:06	36° 7,51' N	21° 59,97' W	CTD/rosette water sampler	to water	
POS432/137-1	10.05.2012	01:34	36° 7,51' N	22° 0,03' W	CTD/rosette water sampler	at depth	WL max.: 1022 m
POS432/137-1	10.05.2012	02:00	36° 7,50' N	22° 0,04' W	CTD/rosette water sampler	on deck	
POS432/138-1	10.05.2012	05:17	36° 29,92' N	21° 51,02' W	CTD/rosette water sampler	to water	10 m
POS432/138-1	10.05.2012	05:43	36° 29,78' N	21° 51,10' W	CTD/rosette water sampler	at depth	WL max.: 1014 m
POS432/138-1	10.05.2012	06:08	36° 29,65' N	21° 51,11' W	CTD/rosette water sampler	on deck	
POS432/139-1	10.05.2012	08:21	36° 29,82' N	22° 0,21' W	Remote operated vehicle	to water	
POS432/139-1	10.05.2012	10:06	36° 29,81' N	22° 0,21' W	Remote operated vehicle	at depth	max. WL: 4096 m
POS432/139-1	10.05.2012	13:35	36° 30,01' N	21° 59,99' W	Remote operated vehicle	information:	lift up from 4097m
POS432/139-1	10.05.2012	13:56	36° 30,01' N	21° 59,99' W	Access Point	released	
POS432/139-1	10.05.2012	15:51	36° 30,01' N	21° 59,95' W	Remote operated vehicle	on deck	
POS432/139-1	10.05.2012	16:32	36° 29,95' N	22° 0,06' W	Access Point	surface	
POS432/139-1	10.05.2012	16:50	36° 30,07' N	21° 59,60' W	Access Point	on deck	
POS432/140-1	10.05.2012	18:09	36° 30,00' N	22° 0,00' W	Access Point	to water	
POS432/140-1	10.05.2012	18:26	36° 30,00' N	22° 0,00' W	Access Point	information:	Access/flasher
POS432/141-1	11.05.2012	08:03	36° 30,02' N	22° 0,03' W	Remote operated vehicle	to water	
POS432/141-1	11.05.2012	10:00	36° 30,01' N	22° 0,03' W	Remote operated vehicle	at depth	max. WL: 4088 m
POS432/141-1	11.05.2012	11:05	36° 30,02' N	22° 0,09' W	Remote operated vehicle	information:	finish, lift up
POS432/141-1	11.05.2012	13:21	36° 30,05' N	22° 0,03' W	TMS/ Docking Station	information:	on deck
POS432/141-1	11.05.2012	13:23	36° 30,07' N	22° 0,02' W	Remote operated vehicle	on deck	
POS432/142-1	11.05.2012	13:50	36° 29,10' N	21° 59,96' W	Access Point / radio	information:	detected
POS432/142-1	11.05.2012	13:57	36° 29,21' N	21° 59,70' W	Access Point	on deck	end of sc. work