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Jung, S., Langer, J., Ratmeyer, V., Rodrigues, T., Wunderlich, J.

REPORT AND PRELIMINARY RESULTS OF POSEIDON CRUISE 304
Galway – LISBON; 5. – 22. OCT. 2003

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1. Scientific crew

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Phillip	Franke	Scientist	GeoB	304a + b
Daniel	Hüttich	Technician	GeoB	304a + b
Simon	Jung	Scientist	VUA	304b
Jens	Langer	Scientist	GeoB	304a + b
Volker	Ratmeyer	Scientist	GeoB	304a + b
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Monika	Segl	Chief-Scientist	GeoB	304a + b
Jens	Wunderlich	Scientist	Uni Rostock	304b

Total:11

IGMP: Instituto Geológico e Mineiro de Portugal, Lisbon, Portugal

VUA: Vrije Universiteit Amsterdam, Amsterdam, Netherlands

GeoB: Dept. of Geosciences, University of Bremen, Bremen, Germany

Fielax: Fielax, company for scientific data management, Bremerhaven, Germany

Uni Rostock: Institute for communications and highfrequency techniques, University of Rostock, Rostock, Germany

2. Research programme

Sedimentologic and paleoclimatic investigations in the framework of the SEDPORT project, which is embedded in the ESF (European Science Foundation) EUROCORES / EUROMARGINS Progamm.
SEDPORT = Sedimentation prcesses at the Portugiese continental margin: influence of continental climate, ocean circulation, sealevel, and tectonic.

3. Narrative of cruise with technical details

After leaving Galway in the early morning of the 5.October the ship headed to the first mooring location, at 39°19,76N, 010°20,00W. On 13.October mooring SP1 with one sediment trap in a water depth of 870m was deployed. In the late afternoon of the same day, mooring SP2 was deployed at 37°50,98N, 009°45,46W. Mooring SP2 has two sediment traps at 870 and 1400m water depth.
On the next day in Lisbon the scientific equipment for cruise part 304b was loaded and 5 more scientists came on board. After leaving the port of Lisbon in the morning of 15.October, we started with two sediment stations not far from the river mouth of the river Tejo and continued working in area A, between 38°40N to 39°20N and 009°25W to 10°00W for 3 days. We used gravity corer, multinet, a small plancton net, and the ROV (remotly operated vehicle) and during the nights we did some echosound mapping.
After three days, during the night from 18. to 19. October we headed to working area B, between 37°30N to 38°00N and 008°50 to 009°50W, were we used the same tools as in working area A for another three days. On Sunday, 19.October the weather conditions were to bad to do any station work, so we tried more echosound mapping. The results of this day were quite poor, as, caused by wind and waves, there were air bubbles under the ship, disturbing the echo-sounder. On the next two days, weather improved and we could do two more ROV-stations and several plancton net stations
In the morning of the 22. October, station work ended and the ship headed to Las Palmas.

4. Preliminary results

4.1 Acoustic Sub-bottom Profiling

Jens Wunderlich and watchkeepers Lucia de Abreu, Ullrich Alt-Epping, and Teresa Rodrigues

Equipment: Nonlinear Sediment Echo Sounder System SES-2000

For high-resolution sub-bottom profiling during Poseidon cruise 304 the nonlinear sediment echo sounder system SES-2000 was used. This system was developed by the underwater acoustics research group of Rostock University (Prof. G. Wendt).
The nonlinear echo sounder system SES-2000 is a flexible mobile system that can be easily adapted to different tasks and operational areas. It was developed for shallow water to detect small buried objects and sediment structures at high resolution. Sound pulses are generated by a small piezoceramic phase shifted transducer array with up to 32 separately controlled elements. Electronic beam stabilizing and steering is possible in roll direction.
Nonlinear echo sounders transmit at least two signals of slightly different high frequencies at high sound pressures (primary frequencies f1 and f2). Because of nonlinearities in the sound propagation at high pressures both signals interact and new frequencies arise. The difference frequency (f2 - f1, also called secondary frequency) is low and penetrates the sea bottom. The high frequent signal from the primary transmitter frequency is processed separately to detect the bottom surface exactly.
The beamwidth only depends on the primary frequency related to the transducer aperture, even for the secondary frequency. There are no significant sidelobes and you will get a constant directivity for different secondary frequencies. Therefore the sounded area is the same for different frequencies which is important if echo prints at different frequencies are compared.
Parametric systems have a small beamwidth in spite of small transducer dimensions, independent of the difference frequency. The extremely high bandwidth of parametric systems allows to generate very short sound pulses for high vertical resolution.
Real time signal processing produces echo prints to detect sediment layers and buried objects with high three-dimensional resolution. High repetition rates are used to improve the signal to noise ratio and to raise the degree of probability to find small single objects and small bottom structures.

The SES-2000 echo sounder system consists of a main device, a host PC and a transducer array. The main device contains transmitters, receivers and modules for analog and digital real time signal processing. Analog to digital converters (ADC) are used for digitizing the receiver signal with 16-bit resolution at sampling rates up to 200 kHz depending on signal bandwidth.
All received data are stored digitally on hard-disk including GPS data and other important system parameters. The echo sounder file format is device specific but may be converted into

the SEG-Y format for post processing using other equipment. Analog data storage is possible, but was not used during cruise PO304.
The transducer is an array of several elements that are controlled separately for beam steering and stabilizing. Therefore all the ship movements are detected by a motion reference unit (MRU). This sensor, made by SEATEX (Norway), outputs absolute roll, pitch and yaw, and dynamic heave.
All the signal and image processing is done in real time but digitally stored data may be reprocessed at home to get more information.
A color echo print is generated immediately using 12 colors at a logarithmic scale. The echo print includes all important parameters, e.g. GPS position, time (UTC), pulse frequency, pulse length and echo stacking rate.
All transmitter and recording parameters are controlled by software, designed for this purpose. Echo prints are heave compensated by the MRU heave value.

water depth range	0.5 ... 1500 m
vertical resolution	up to 6 cm
penetration depth (near the bottom surface)	up to 50 m
primary transmitter frequency	100 kHz
secondary transmitter frequency	4 ... 15 kHz
transmitter pulse length	0.07 ... 1 ms
repetition rate	1 ... 50 s^{-1}
Beamwidth	±2x2 deg @ 4...12kHz
beam steering range	± 16 deg roll
transducer principle	piezoceramic
separately controlled transducer elements	up to 32
transducer dimensions	ca. 20 x 20 cm^2
transducer weight (in air, incl. 40m cable)	ca. 35 kg

Table 1: SES-2000 main parameters

SES-2000 at RV Poseidon
During cruise Poseidon 304 the transducer of the SES-2000 system was installed in the ship's moon-pool. Figure 1 shows the mounting of the SES-2000 system components at RV Poseidon.
Because of the limited size of the moon-pool it was not possible to use a transducer with 32 array elements but only a small one with 16 elements. Therefore the water depth at the operational area was limited to about 800 m.
Although the transducer mounting was sound optimized in advance there were a lot of noise depending mostly on the ship's speed. At high speed, about 10 knots, there was a noise minimum. This noise is probably generated by vibrations of the moon-pool device carrier. Corrective actions should be taken in advance of further echo sounding applications to get best results.

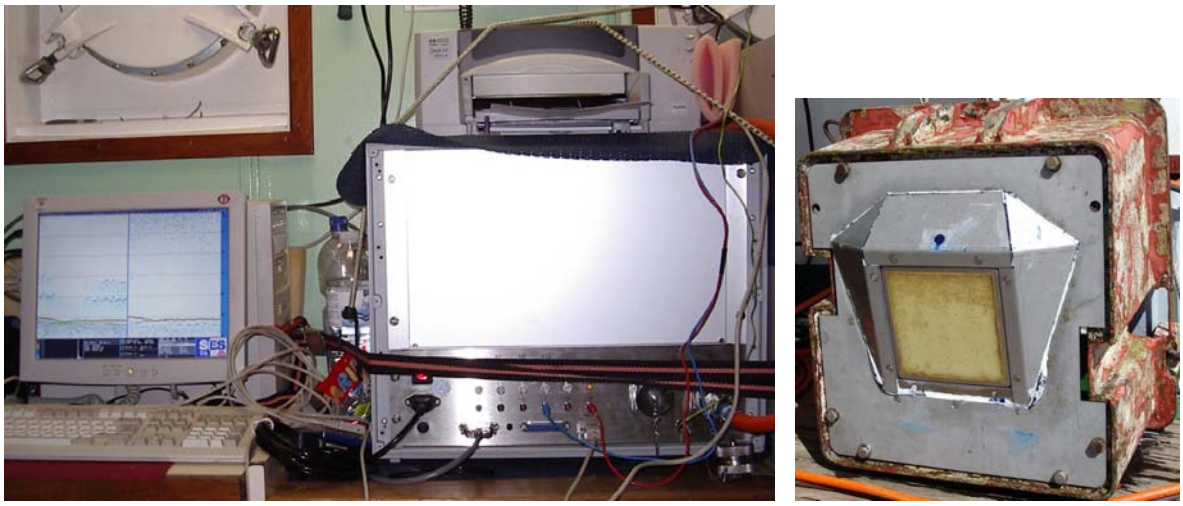

Figure 1: Echo sounder system SES-2000 at RV Poseidon
(left: main and control unit; right: transducer mounted in moon-pool device carrier)

Results

During cruise Poseidon 304 echo sounder profiles with a total length of more than 900 km (ca. 490 nm) were obtained, see map in figure 2.

All received signals were stored digitally on hard-disk together with the GPS data and system parameters. The total volume of digitally stored echo sounding information is about 18 GB.

The investigated area included different regions with water depths between 50 and 1000 m. Depending on water depth and sediment type a penetration up to 20 m was achieved.

Echo print examples are shown in fig. 3...8. Depth values have been computed from travel times assuming a constant sound velocity of 1500 m/s. The data are plotted time sequentially from the left to the right. Heave components are removed from the echo prints using the heave data delivered by the motion reference unit (MRU).

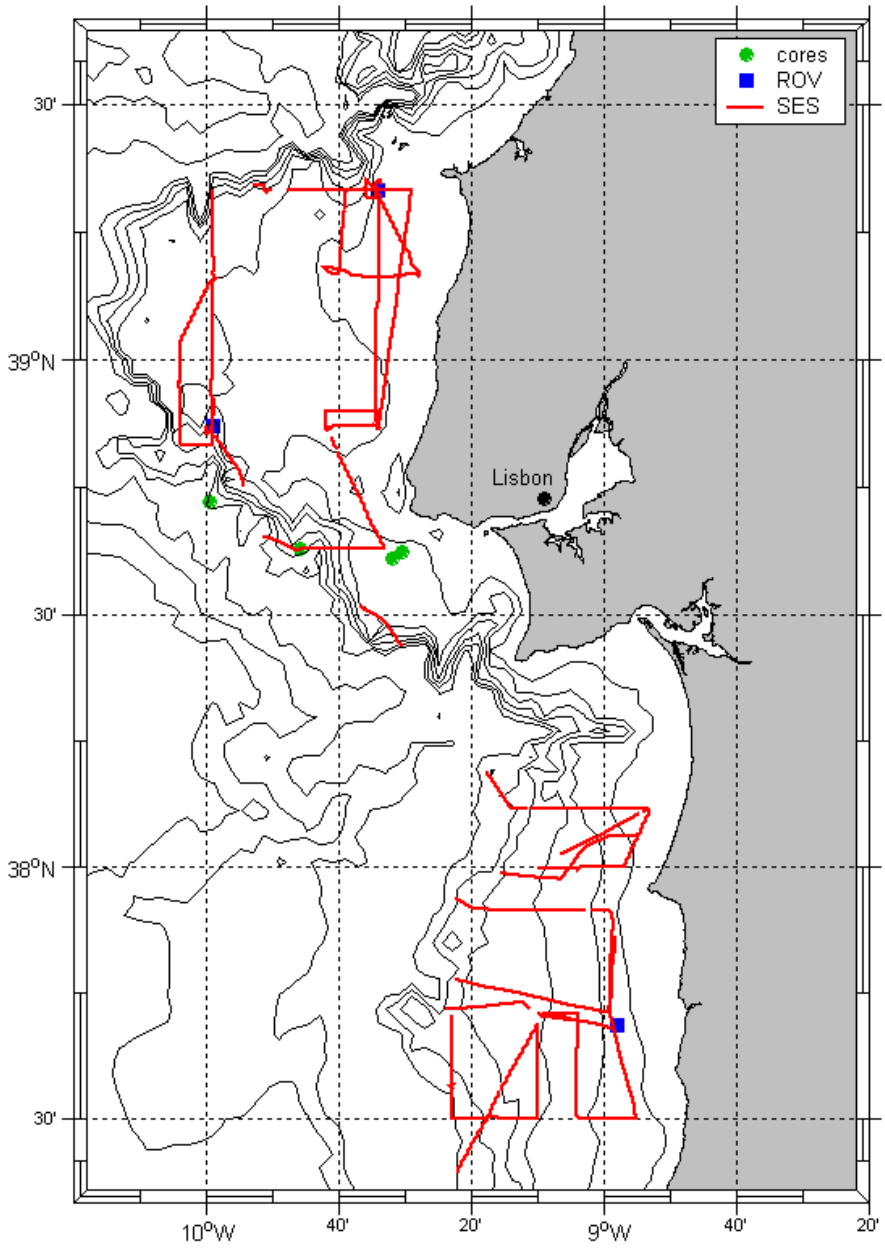

Figure 2: Echo sounder profiles at cruise PO304

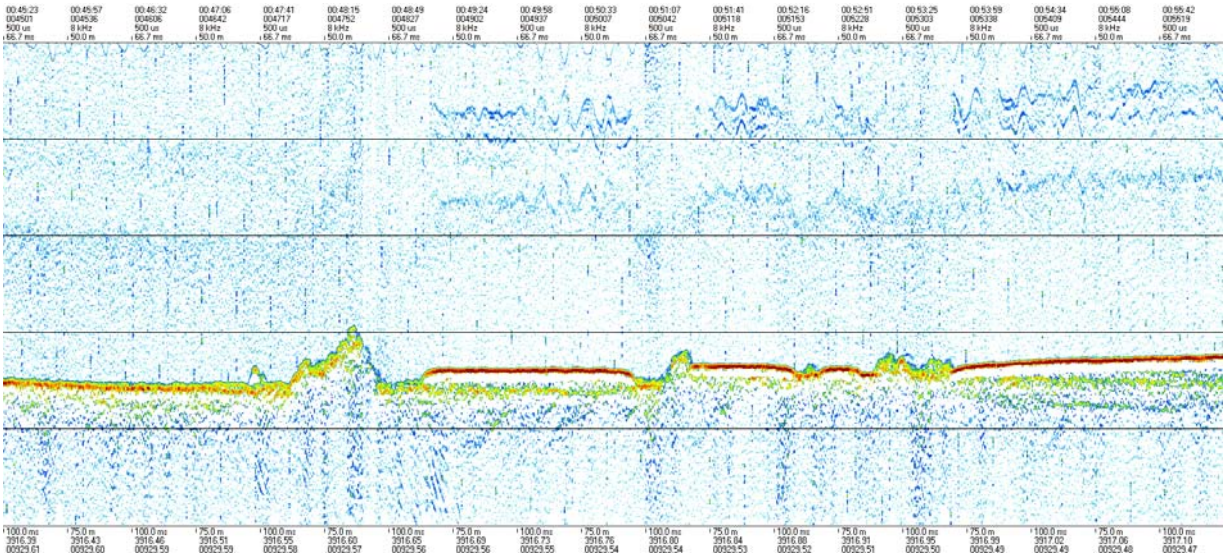

Figure 3: Echo print 2003/10/16 00:45-00:56; 8kHz / 0.5ms; Range: 50…75m

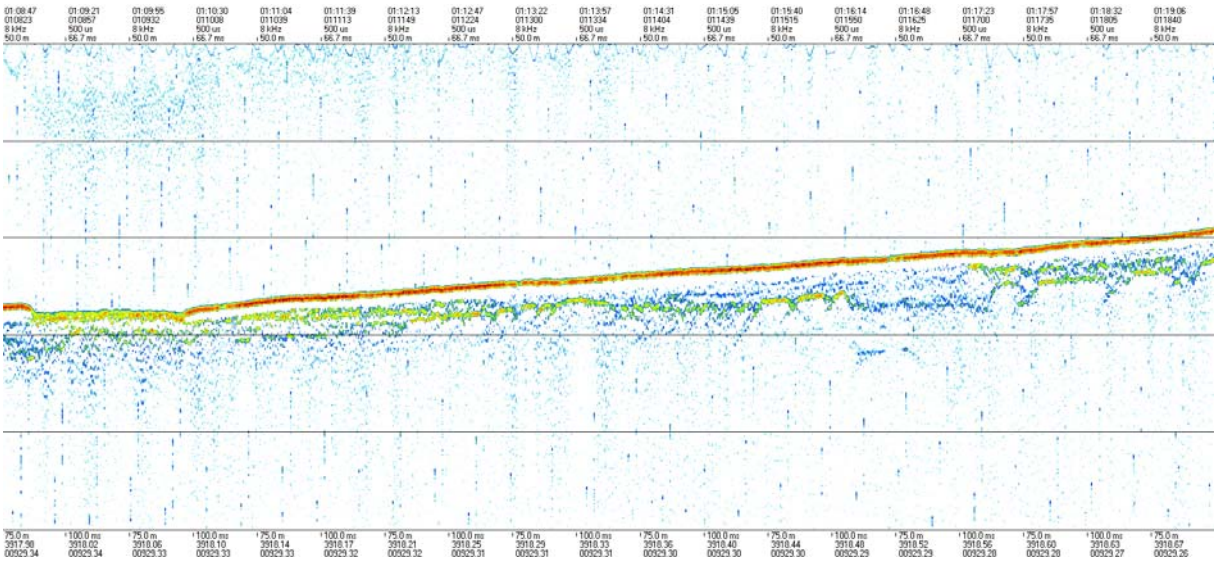

Figure 4: Echo print 2003/10/16 01:08-01:20; 8kHz / 0.5ms; Range: 50…75m

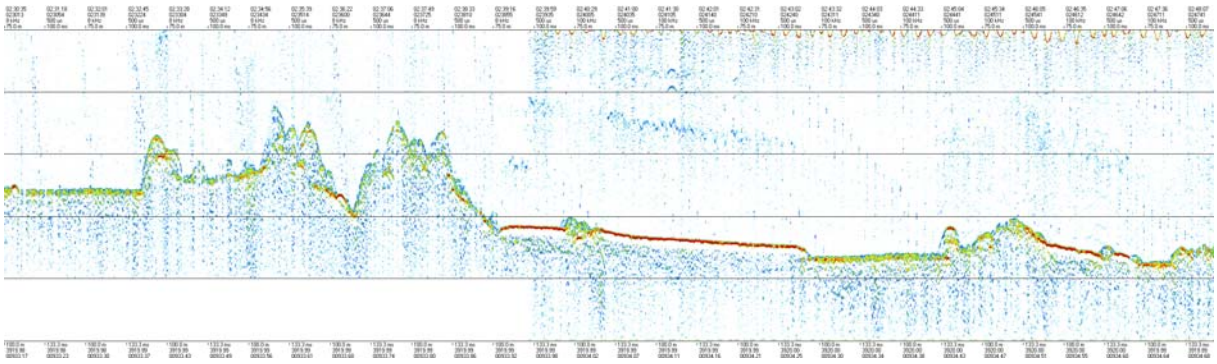

Figure 5: Echo print 2003/10/16 02:30-02:48; 8kHz / 0.5ms; Range: 75…100m

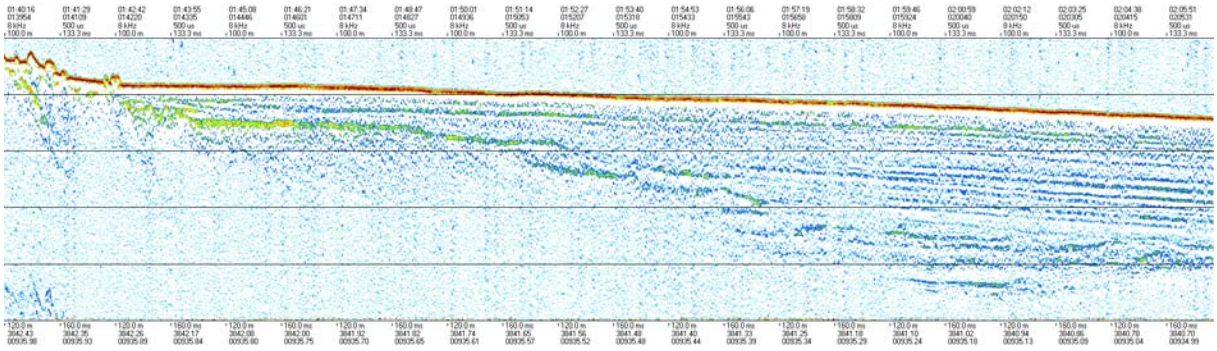

Figure 6: Echo print 2003/10/18 01:40-02:05; 8kHz / 0.5ms; Range: 100…120m

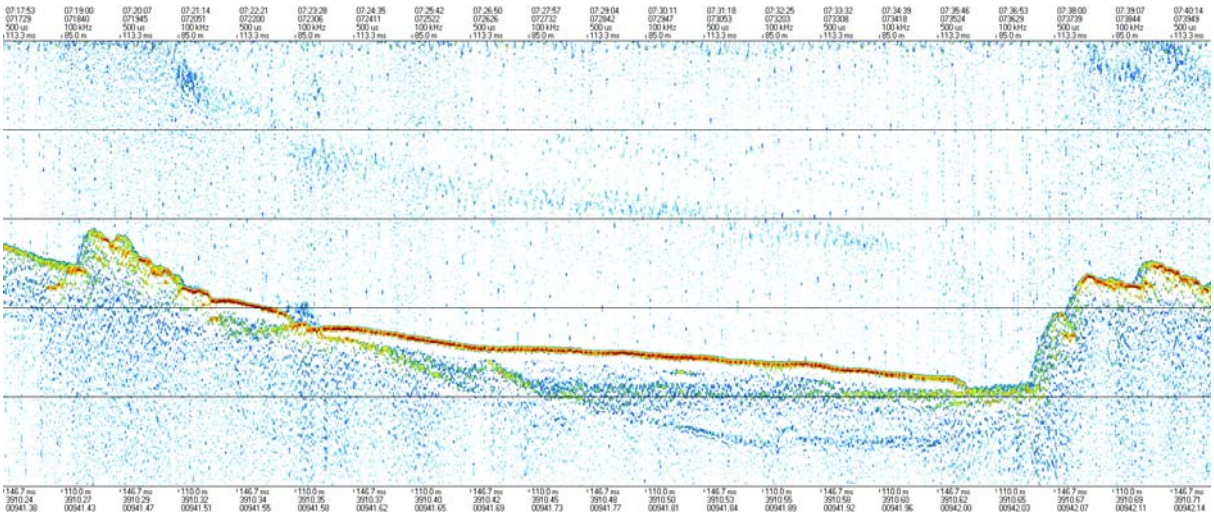

Figure 7: Echo print 2003/10/16 07:18-07:40; 8kHz / 0.5ms; Range: 85…110m

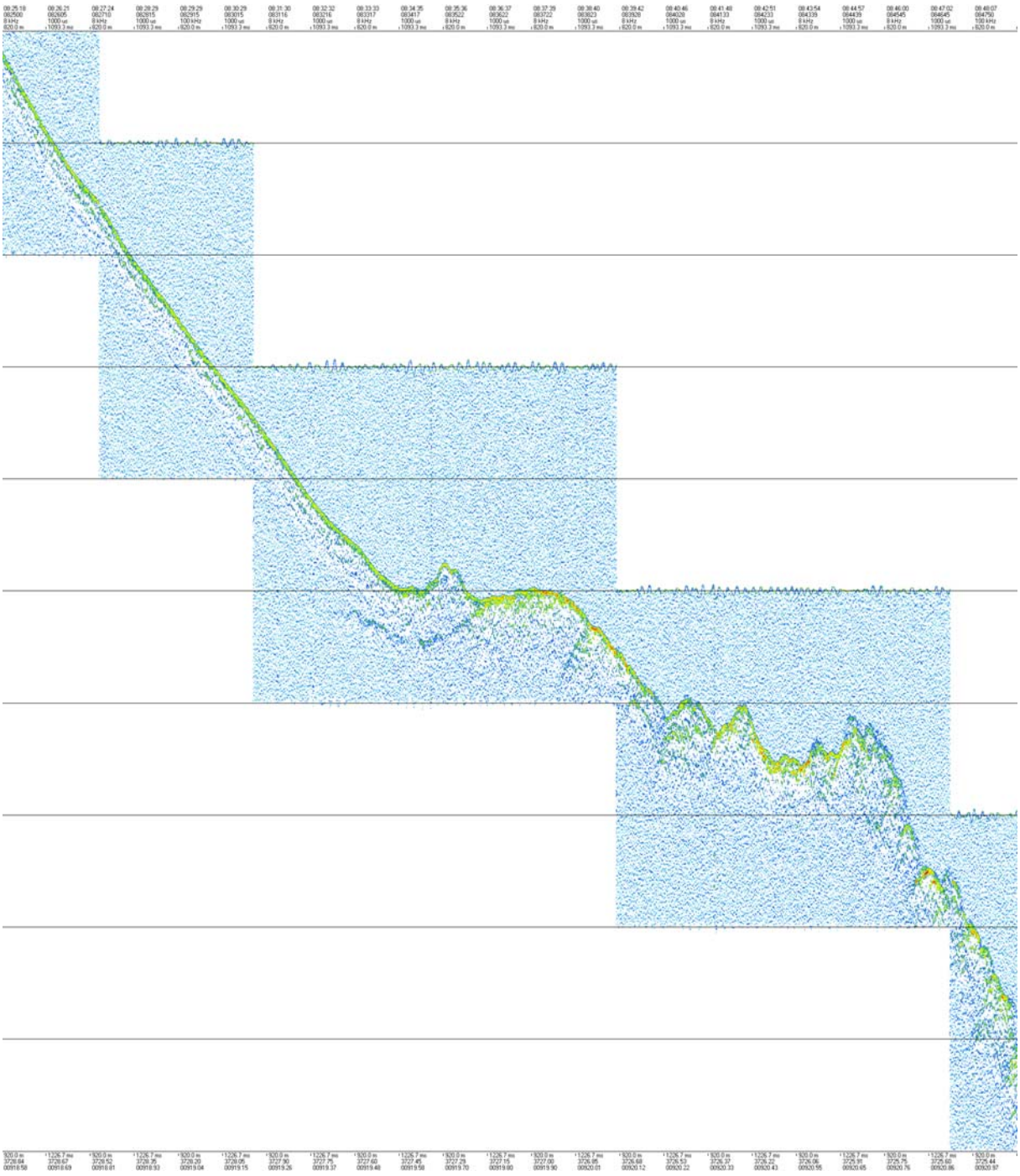

Figure 8: Echo print 2003/10/22 08:25-08:49; 8kHz / 1ms; Range: 820…920m

Nr.	Time	Latitude	Longitude	Length [km]	Time [hh:mm]	Speed [knots]
01	10/15/2003 13:27:51 10/15/2003 13:31:51	38.874332 38.876167	-9.578333 -9.580667	0.3	00:04	2.4
02	10/15/2003 13:46:05 10/15/2003 14:00:49	38.866833 38.874332	-9.569000 -9.576167	1.1	00:15	0.9
03	10/15/2003 16:12:08 10/16/2003 06:05:46	38.864834 39.166500	-9.686167 -9.667334	106.8	13:53	4.1
04	10/16/2003 06:08:06 10/16/2003 11:15:32	39.167000 39.333500	-9.668000 -9.572333	46.9	05:07	4.9
05	10/16/2003 11:31:46 10/16/2003 13:35:14	39.340668 39.332832	-9.561666 -9.572500	14.6	02:04	3.8
06	10/16/2003 15:07:18 10/16/2003 15:12:24	39.334835 39.332500	-9.573334 -9.565333	1	00:05	6.5
07	10/16/2003 15:26:58 10/16/2003 15:35:30	39.319832 39.325165	-9.562000 -9.566000	0.7	00:08	2.8
08	10/16/2003 16:33:19 10/16/2003 17:34:20	39.334332 39.332668	-9.600833 -9.798000	17	01:01	9.2
09	10/16/2003 17:45:22 10/16/2003 18:04:37	39.331665 39.340832	-9.834500 -9.881833	5.4	00:19	8.7
10	10/16/2003 18:41:07 10/17/2003 07:05:28	39.331833 39.166500	-9.983833 -9.980833	102	12:24	4.4
11	10/17/2003 17:48:41 10/17/2003 22:53:28	39.317001 38.862667	-9.567166 -9.692500	63.7	05:05	6.7
12	10/17/2003 23:11:47 10/17/2003 23:44:36	38.853168 38.822498	-9.686833 -9.670500	3.7	00:33	3.9
13	10/18/2003 06:03:28 10/18/2003 06:32:29	38.627335 38.653500	-9.768833 -9.856667	8.5	00:29	9.2
14	10/18/2003 09:07:32 10/18/2003 09:37:26	38.851334 38.867668	-9.999333 -9.998333	2.2	00:30	2.4
15	10/18/2003 10:37:00 10/18/2003 11:47:38	38.853668 38.896999	-9.997000 -9.979834	11.7	01:10	5.4
16	10/18/2003 18:53:05 10/18/2003 19:37:19	38.852501 38.752834	-9.979000 -9.904000	13	00:44	9.5
17	10/18/2003 21:39:08 10/18/2003 22:24:35	38.518333 38.437668	-9.615833 -9.507667	13.3	00:45	9.6
18	10/17/2003 23:44:36 10/18/2003 05:16:26	38.822498 38.629333	-9.670500 -9.764000	42.8	05:32	4.2
19	10/18/2003 05:29:25 10/18/2003 06:01:02	38.629333 38.628166	-9.765833 -9.768666	0.4	00:32	0.4
20	10/19/2003 00:21:47 10/19/2003 01:26:44	38.189167 38.116833	-9.293834 -9.189333	13.5	01:05	6.7
21	10/19/2003 01:27:59 10/19/2003 09:07:27	38.116833 37.998833	-9.187500 -9.166667	60.1	07:40	4.2
22	10/19/2003 10:56:21 10/19/2003 12:08:09	38.025333 38.107498	-9.111500 -8.908667	19.9	01:12	8.8
23	10/19/2003 12:10:00 10/19/2003 12:23:18	38.109833 38.116333	-8.903334 -8.887500	1.8	00:13	4.5

Table 2: Sediment echo sounder profiles

Nr.	Time	Latitude	Longitude	Length [km]	Time [hh:mm]	Speed [knots]
24	10/19/2003 13:11:40 10/19/2003 15:54:10	38.069500 37.988167	-8.912833 -9.261666	35.4	03:05	6.2
25	10/19/2003 17:13:21 10/19/2003 18:59:26	37.939499 37.916500	-9.372167 -9.043834	29.5	01:46	9
26	10/19/2003 19:03:32 10/20/2003 00:14:56	37.916332 37.777168	-9.030500 -9.373667	62	05:11	6.4
27	10/20/2003 16:48:25 10/20/2003 19:40:58	37.856167 37.866665	-8.978000 -8.977167	1.8	02:52	0.3
28	10/20/2003 20:03:59 10/21/2003 07:25:30	37.864834 37.707668	-8.970667 -9.166333	87.2	11:21	4.1
29	10/21/2003 07:28:46 10/21/2003 08:46:50	37.706165 37.680332	-9.163333 -8.973500	17.1	01:18	7.1
30	10/21/2003 16:52:58 10/21/2003 17:23:35	37.699665 37.706501	-9.080334 -9.160500	7.1	00:30	7.6
31	10/21/2003 19:37:44 10/21/2003 21:07:01	37.719666 37.717499	-9.188666 -9.398167	19.1	01:29	6.8
32	10/22/2003 00:33:00 10/22/2003 07:02:20	37.707500 37.688667	-9.383333 -9.167500	63.5	06:29	5.3
33	10/22/2003 07:03:45 10/22/2003 07:55:23	37.685833 37.557335	-9.169500 -9.260500	16.4	00:52	10.2
34	10/22/2003 07:55:23 10/22/2003 08:59:53	37.557335 37.394333	-9.260500 -9.369333	20.5	01:54	5.8
	Total:			**910**	**92:37**	**5.3**

Table 2 (cont.): Sediment echo sounder profiles

Nr.	Time	Latitude	Longitude	Length [km]	Time [hh:mm]	Speed [knots]
R1a	10/17/2003 12:43:28 10/17/2003 14:57:53	39.333168 39.333332	-9.572166 -9.570833	1.4	02:14	0.3
R1b	10/17/2003 15:26:01 10/17/2003 17:12:33	39.333500 39.333668	-9.570167 -9.567667	0.9	01:46	0.3
R2	10/18/2003 15:09:07 10/18/2003 18:22:12	38.875332 38.864166	-9.982166 -9.981667	2.3	03:13	0.4
R3	10/21/2003 09:49:01 10/21/2003 15:30:28	37.679501 37.696499	-8.968500 -8.966333	3.1	05:41	0.3
				7.7	**12:54**	**0.3**

Table 3: Sediment echo sounder data during ROV dives

4.2 Sediment sampling

Lucia de Abreu, Ullrich Alt-Epping, Daniel Hüttich, Jens Langer, Teresa Rodrigues, and Monika Segl

A total of three sediment cores were taken in the working area north of Lisbon. The locations have been allready selected on former cruises of RV Marion Dufresne and RV Poseidon. More sediment cores were planned in the southern working area, but due to bad weather conditions, coring was not possible. The cores were not opened on board, but cut in pieces of 1 meter and stored. The cores will be opened and sampled in the home laboratory. Planned are investigations of the foraminiferal assemblage and stable isotope meassurements.

4.3 Sediment trap moorings

Phillip Franke, and Volker Ratmeyer

Two sediment trap moorings SP1 and SP2 were deployed. Both moorings will be recovered after one year, in September or October 2004. They have one sediment trap in water-depths between 800 and 900m. SP2 has an additional trap at 1376m waterdepth. The Sediment Traps are SMT 234 type, with 20 cups that are changed in a 20 day interval. On the Sediment Trap samples investigation of the foraminiferal assemblage will be carried out and stable carbon and oxygen isotopes will be measured to examine the seasonal variabilities.

Fig.9 shows the setup of the mooring SP2

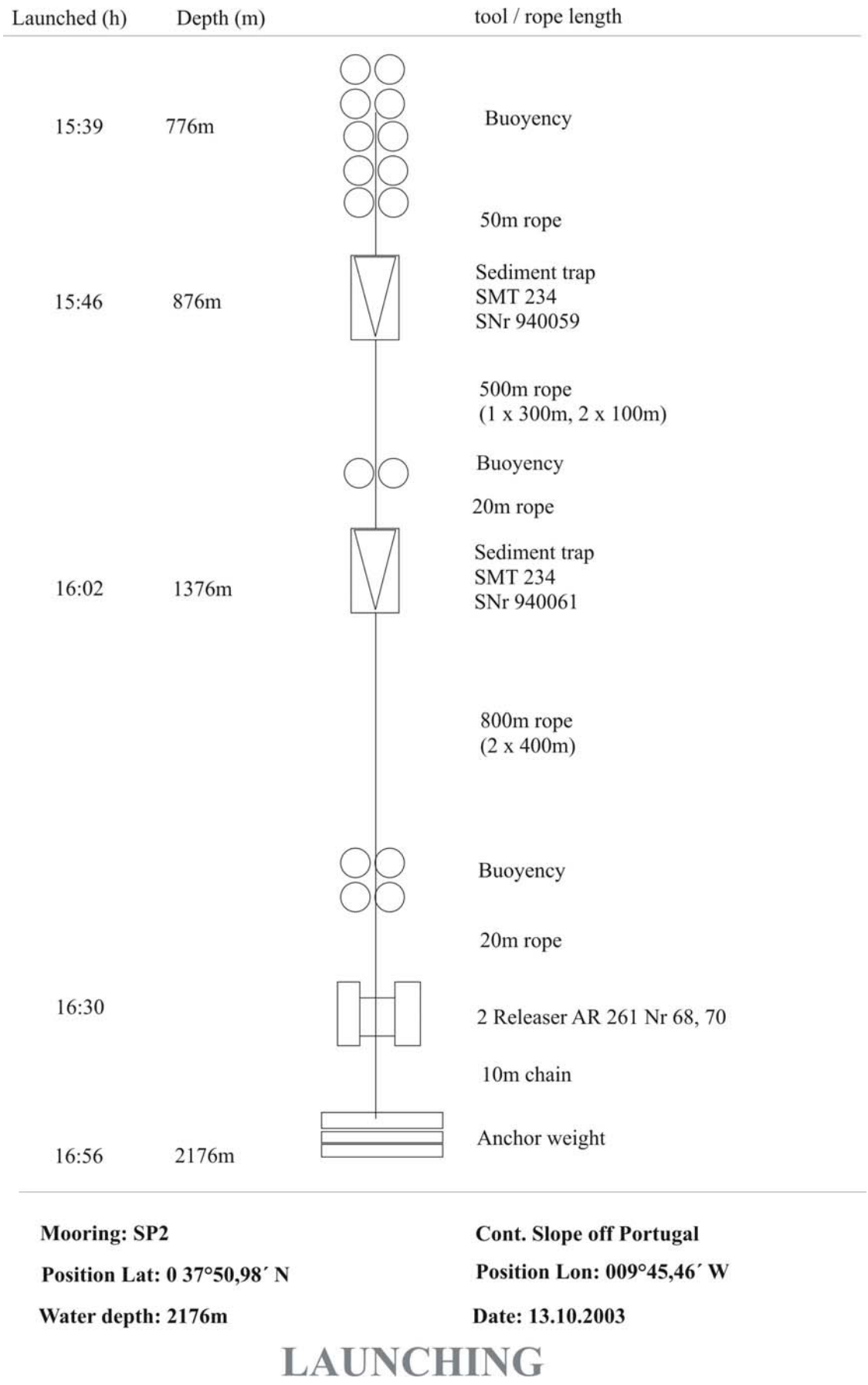

Fig.9 Sediment Trap Mooring SP2

4.4 Plankton and water sampling

Lucia de Abreu, Simon Jung, and Teresa Rodrigues

One of the major aspects of the SEDPORT project is to improve our understanding of the processes that control the frequency distribution of planktic foraminifera in the water column, their variation throughout the year and the stable O- isotope composition found in the different species. SEDPORT aims to improve our understanding of the processes controlling these parameters and their preservation in deep sea sediments in a triplet strategy: by (a) sampling living foraminifera in the surface ocean based on plankton tows, use (b) sediment trap samples to assess the settling history of planktic foraminifera throughout the year and (c) apply those calibration results on surface sediments in order to assess the preservation potential as a paleo proxy.
As part of the SEDPORT cruise team aboard POSEIDON members of the Vrije Universiteit Amsterdam (Simon Jung) and the Instituto Geológico e Mineiro de Portugal, (Lucia de Abreu and Teresa Rodrigues) were responsible for sampling living plankton at stations on a number of transects perpendicular to the Portuguese coast (see figure xxx). A vertically towed plankton hand net and a Multi-closure net (Multinet towed horizontally with a speed of up to 2 knots) that allows depth-controlled sampling of different water levels were used. In total 15 stations were sampled. In case water depth permitted the plankton hand net was deployed to a standard depth of 75 m. The sampling intervals of the Multinet varied according to the water depth and the available ship time. Except for one at all stations shallow casts down up to 150 m water depth were carried out (for details see table xxx). In addition a deep cast (down to 700 m) and standard shallow cast at the location of sediment trap GeoB 8902 safeguard the envisaged coupling of living plankton population dynamics, species specific stable isotope signatures and their variation throughout the year. All Multinet samples were frozen to be stored for later analysis of stable oxygen isotpes on the foraminifera. The hand net samples were poisoned with Formaldehyde for later processing. The composition of the fauna will be investigated on these samples.
Stable O-isotopes in foraminifera depend on the water temperature during calcification and the O-isotope composition of the ambient seawater. The water temperatures at the intervals sampled with the Multinet were determined using turnaround thermometers (see table 4 for results). In parallel water samples were taken at those depth intervals for onshore salinity and stable O-isotope analysis (see table 4).

Station	Sample depth Multinet	Sample depth hand net	salinity, O-isotope sampling depth (m)	temperatures (depth in prev. column)
GeoB 8905		0-75	0	
			10	
			20	
			30	
			40	
			50	
GeoB 8906		0-75	0	
			10	
			20	
			30	
			40	
			50	

Table 4: multinet and handnet samples

Station	Sample depth Multinet	Sample depth hand net	salinity, O-isotope sampling depth (m)	temperatures (depth in prev. column)
GeoB 8907	0-10	0-75	0	18,31
	10-20		10	18,29
	20-30		20	18,28
	30-40		30	16,81
	40-50		40	15,86
			50	15,51
GeoB 8908	0-25	0-40	0	18,07
			25	16,93
GeoB 8910	0-25	0-50	0	19,62
	0-50		10	19,61
	25-50		25	19,63
	50-90		50	18,85
			90	14,65
			150	13,54
GeoB 8912	0-10	0-75	0 (taken at station GeoB 8905)	18,57
	10-20		10 (taken at station GeoB 8905)	18,42
	20-30		20 (taken at station GeoB 8905)	18,19
	30-40		30 (taken at station GeoB 8905)	17,53
	40-50		40 (taken at station GeoB 8905)	16,34
			50 (taken at station GeoB 8905)	15,77
GeoB 8913	0-10	0-75	0 (taken at station GeoB 8906)	18,06
	10-20		10 (taken at station GeoB 8906)	17,92
	20-30		20 (taken at station GeoB 8906)	17,71
	30-40		30 (taken at station GeoB 8906)	16,66
	40-50		40 (taken at station GeoB 8906)	15,62
			50 (taken at station GeoB 8906)	15,02
GeoB 8916		0-75		
GeoB 8917	0-25	0-75	0	19,1
	25-50		25	17,27
	50-90		50	15,21
			90	14,06
GeoB 8919	no Multinet sampling due to heavy sea	0-75	0	19,42
			10	18,98
			25	17,52
			50	15,86
			90	14,64
			150	13,67

Table 4 (cont.): multinet and handnet samples

Station	Sample depth Multinet	Sample depth hand net	salinity, O-isotope sampling depth (m)	temperatures (depth in prev. column)
GeoB 8920	0-10	0-75	0	19,25
	10-25		10	19,25
	25-50		25	19,11
	50-90		50	16,13
	90-150		90	14,55
	0-150		150	13,78
	150-200		200	13,33
	200-300		300	12,38
	300-500		500	11,52
	500-700		700	11,92
GeoB 8922		0-75		
GeoB 8923	0-10	0-75	0	20,08
	10-25		10	20,07
	25-50		25	18,62
	50-90		50	16,73
	90-150		90	14,52
			150	13,8
GeoB 8924	0-10	0-75	0	20,1
	10-25		10	20,07
	25-50		25	19,77
	50-90		50	16,71
	90-150		90	15,15
			150	14,17

Table 4 (cont.): multinet and handnet samples

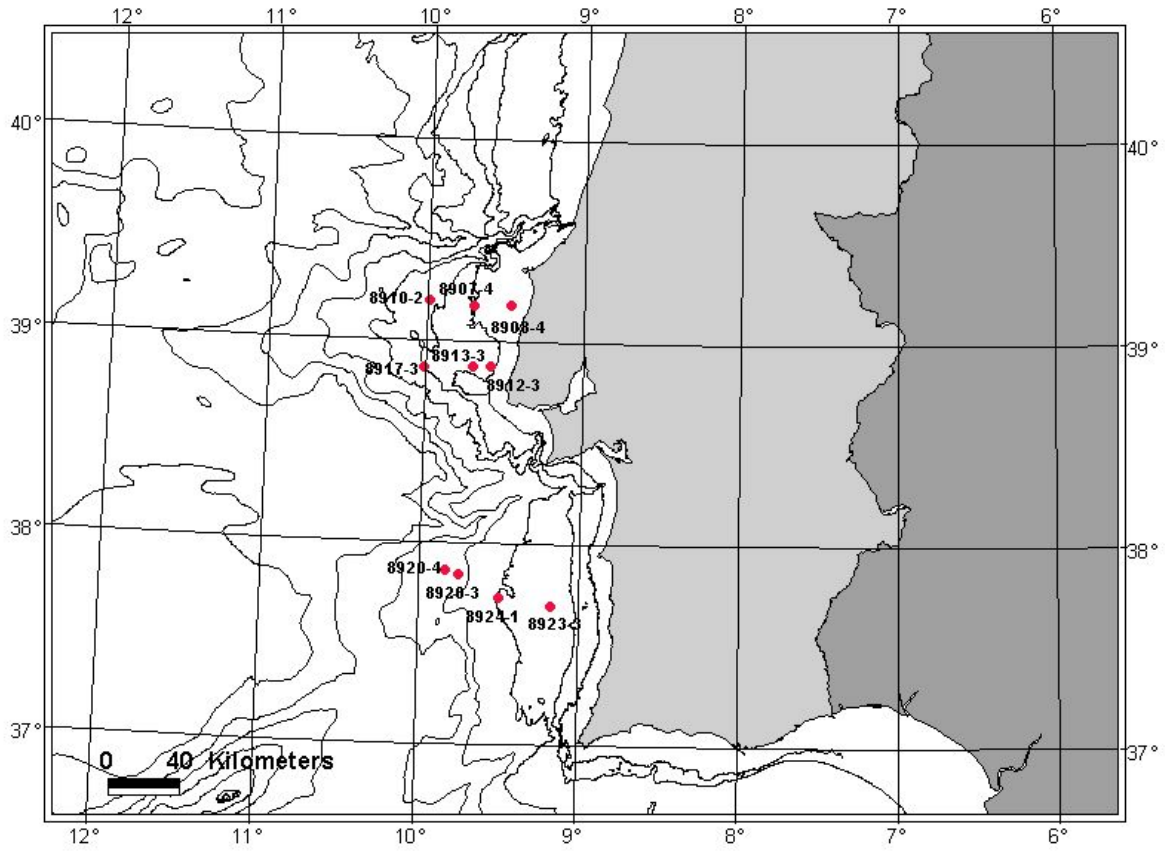

Fig. 10: Map of Multinet-Stations

4.5 Mapping of the Sediment Facies with ROV Cherokee

(U. Alt-Epping, W. Dimmler, P. Franke, V. Ratmeyer)

The aim of the ROV dives was observation, documentation and mapping of the transitions from sandy to clayey facies on the upper shelf off the Portuguese coast. The clayey facies is distributed on the shelf as lenticular mud patches of several km² surface area. To manage this task, the ROV (Remotely Operated Vehicle) Cherokee was used. The maximum diving depth of the Cherokee is 1000m water depth (Fig.10)
It was successfully used for seefloor observations on several former cruises (see also cruise reports Poseidon 292 and 293 and Polarstern ANT XXI-2)
Equipped with 3 videocameras, a scanning sonar, a digital foto camera, and a grab, it is an excellent tool for documentation and plain sampling.
In the course of this cruise, the ROV was used on 5 Stations (Tab. 5). During the dives, about 25 hours of digital video was recorded. Exemplary dive No. 2 is shown.

GeoB Station	date	Time	Latitude	Longitude	waterdepth
8909-1	16. Okt	14:21	39°19.9N	009°34.3W	89
8911-1	17. Okt	12:28	39°19.99N	009°34.31W	88
8918-1	18. Okt	13:03	38°52.6N	009°58.96W	122
8921-1	20. Okt	16:19	37°51.40N	008°58.75W	134
8922-2	21. Okt	09:49	37°40.77N	008°58.10W	135

Tab.5: ROV dives during P304

4.5.1. ROV dive 2 (GeoB 8918-1)

During dive 2 at station GeoB 8918-1 the following observations were made using the videos and fotos (Fig. 11):
First, there are large symmetric sand waves with wave-lengths of ≤ 0,7m and continuous crests. The height of the crests is some dm. The sediment is very coarse (grainsize ≤ 1 cm), The coarsest material accumulates in the valleys of the sand waves and consists mainly of shell fragments. The general orientation of the waves is northeast to southwest.

Furtheron to the north the sand waves become smaller (height about 10cm) and the crests become discontinuously. Near the northern turning point, the large sand waves disappeared and the sediment surface looks like erodet. Structures like crosswise waves are visible.
In the southern part of the ROV operation area, there is a rapid transition to rock. It is not possible to recognize, if it is solid rock or debris. A sample of this rock was identified as greenisch micritic limestone. It is densely populated with filtering organisms and penetrated with piddocks. Here and there the rock is covered with loose sediments. In the southern part of the operation area, there are several aprupt changes between rocks and soft ground.

Due to the limited operation radius the ROV profiles were not longer than 2km, the transitions from clayey to sandy structures could not be mapped on larger areas during this short cruise. In prinziple such a ROV mapping is possible. A detailed analysis of the videos and photos of all dives will be done in Bremen, using the software “Adelie” (IFREMER) to create the basis for the mapping. “Adelie” makes it possible to present the track-plot time-code controlled georeferenced similar to the presentation in Fig. 12. The results will be published later.

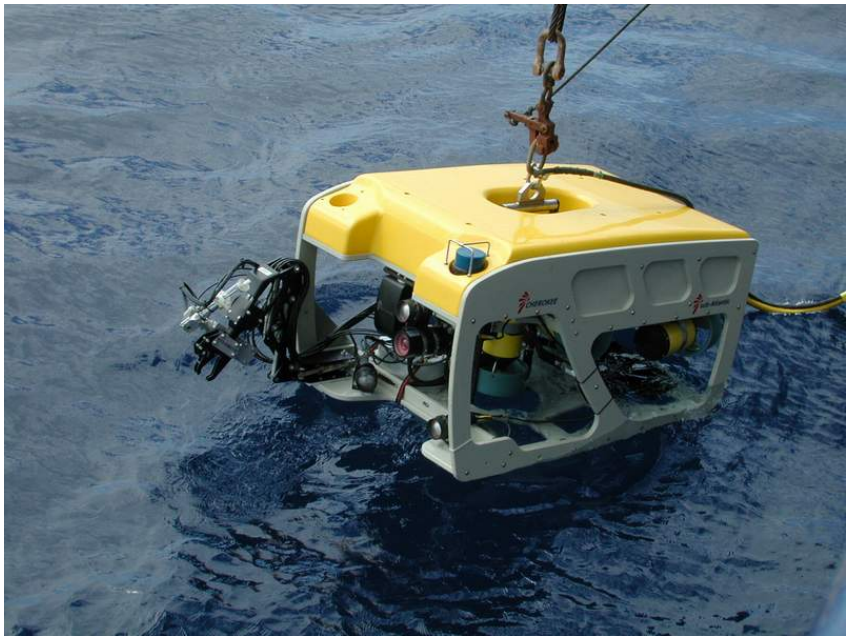

Fig. 11: ROV Cherokee (Bremen University)

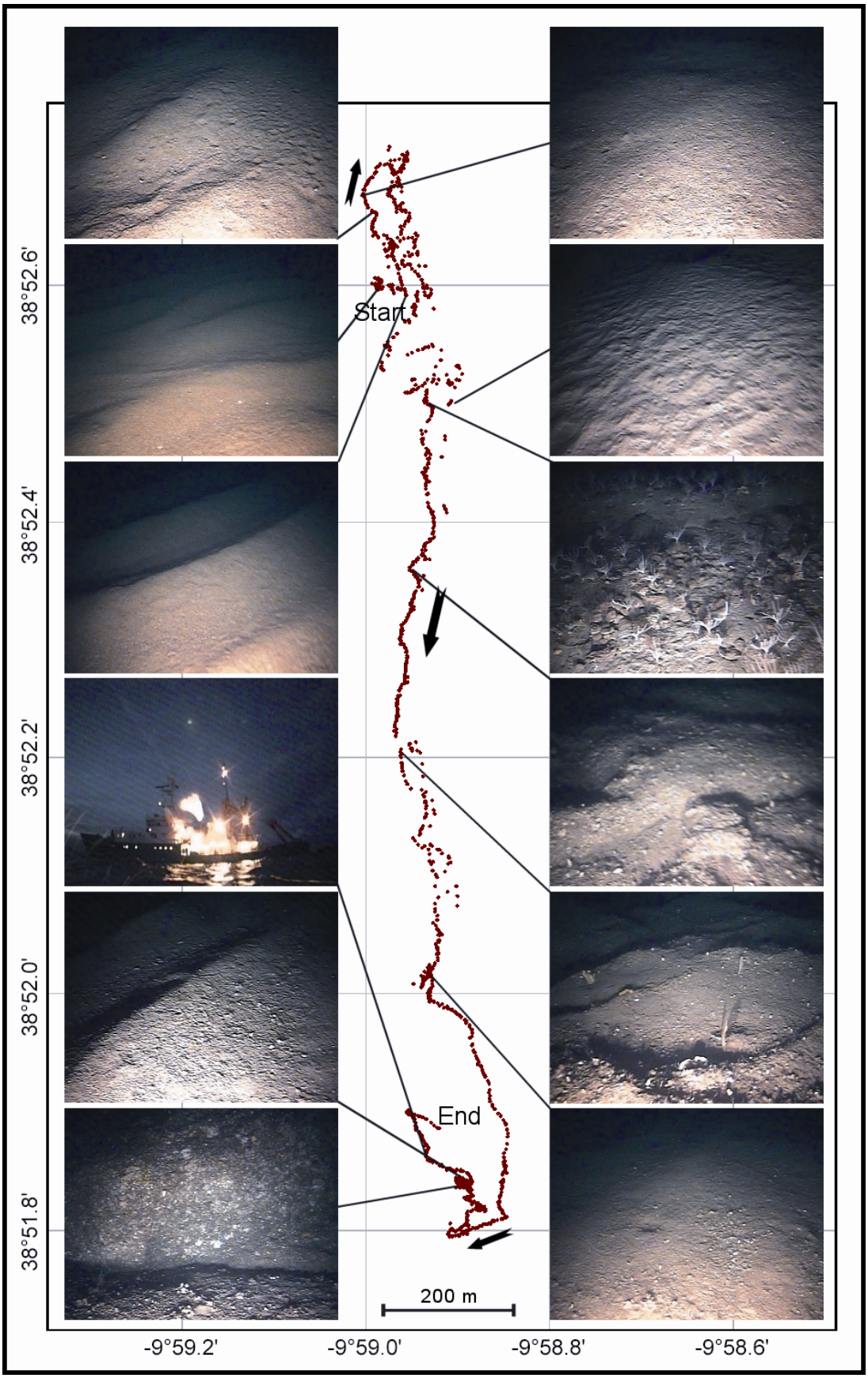

Fig. 11: Course-plot (ship´s GPS) of the ROV during GeoB 8918-1 dive 2, with pictures of the locations with clear-cut sediment-wave and mud-facies structures.

5. Acknowledgements

The success of the cruise was made possible by the exemplary performance of the crew. In work at deck and in maneuvering the ship, specially during the ROV dives, the highest competence was displayed. Throughout the cruise, there was outstanding teamwork and friendly companionship between the crew and the scientists. For this we sincerely thank Captain L. Mallon and the entire crew.

Table 6: Station list
Poseidon cruise 304

GeoB-. No.	Ships No.	date 2003	time [UTC]	Position		water depth[m]	tool	recovery	comments
8901-1	817	13. Okt	06:29	39°19,76N	010°20,00W	1544	mooring SP1		mooring SP1 deployed
8902-1	818	13. Okt	16:56	37°50,98`N	009°45,46`W	2176	mooring SP2		mooring SP2 deployed
8903-1	819	15. Okt	10:24	38°37.5N	009°30.5W	102	SL6	556 cm	
8904-1	820	15. Okt	11:14	38°36,7N	009°32,0W	112	SL6	556+63cm	63cm in weight recovered into a liner
8905-1	821	15. Okt	13:46	38°52.01N	009°34.02W	99	MN		failed, electronic problems
8905-2			14:13	38°52.12N	009°34,07W	92	WS	5 samples	samples at 10,20,30,40,50m water depth
8905-4			14:40	38°52.18N	009°33.93W	91	HN	1 sample	Sample at 75 m water depth
8906-1	822	15. Okt	15:32	38°51.96N	009°41.88W	116	HN	1 sample	Sample at 75 m water depth
8906-2			15:50	38°51.98N	009°41.65W	115	WS	6 samples	Samples at 0, 10, 20, 30, 40, 50m water depth
	823	15. Okt	Echo-sound track 1						
			16:20	38°52.00N	009°42.00W				
			16:47	38°54.00N	009°34.00W				
			18:15	38°54.00N	009°34.00W				
			23:00	39°08.86N	009°30.95W				
		16. Okt	01:42	39°20.00N	009°29.00W				
			03:36	39°20.00N	009°39.00W				
			06:00	39°10.00N	009°40.00W				
8907-1	824	16. Okt	06:08	39°10.03N	009°40.06W	84	WS	6 samples	Samples at 0, 10, 20, 30, 40, 50m water depth
8907-2			06:23	39°10.06N	009°40.33W	85	WS + Thermom.	6 samples	Samples at 0, 10, 20, 30, 40, 50m water depth
8907-3			06:34	39°10.03N	009°40.76W	84	HN	1 sample	Sample at 75 m water depth
8907-4			07:12	39°10.14N	009°41.23W	90	MN	5 samples	Samples at 0 - 10, 10 - 20, 20 - 30 30 - 40, 40 - 50m water depth
8908-1	825	16. Okt	09:12	39°10.00N	009°28.00W	49	WS	2 samples	Samples at 0 and 25m water depth
8908-2			09:20	39°10.02N	009°27.89W	49	WS + Thermom.	2 samples	Samples at 0 and 25m water depth
8908-3			09:29	39°10.07N	009°27.82W	49	HN	1 sample	Sample at 40 m water depth
8908-4			09:44	39°10.16N	009°27.76W	49	MN	1 sample	Sample at 0 - 25m water depth
8909-1	826	16. Okt	14:21	39°19.9N	009°34.3W	89	ROV dived		failed,electronic problems
			14:52	39°19.9N	009°34.32W	88	ROV recovered		
	827	16. Okt	Echo sound track 2						
			18:40	39°20.00N	009°59.00W				
			23:00	39°02.03N	009°59.02W				
		17. Okt	01:58	38°50.00N	009°59.00W				
			02:57	38°50.00N	010°03.95W				
8910-1	828	17. Okt	07:11	39°10.04N	009°58.88W	228	WS	5 samples	Sample at 0, 10, 25, 50, 90, 150m water depth
8910-2			09:49	39°10.96N	009°58.81W	239	MN	4 samples	Samples at 0 - 25, 0 - 50, 25 - 50 50 - 90m water depth

8911-1	829	17. Okt	12:28	39°19.99N	009°34.31W	88	ROV dived		Video and Photographs
			17:06	39°20.05N	009°34.01W	88	ROV recovered		
8912-1	830	17. Okt	20:33	38°52.06N	009°33.96W	95	WS + Thermom.	6 samples	Samples at 0, 10, 20, 30, 40, 50m water depth
8912-2			20:57	38°52.17N	009°33.96W	93	HN	1 sample	Sample at 75m water depth
8912-3			21:10	38°52.20N	009°34.88W	94	MN	5 samples	Samples at 0 - 10, 10 - 20, 20 - 30, 30 - 40, 40 - 50m water depth
8913-1	831	17. Okt	22:24	38°51.95N	009°41.85W	115	HN	1 sample	Sample at 75m water depth
8913-2			22:34	38°51.87N	009°41.73W	114	WS	6 samples	Sample at 0, 10, 20, 30, 40, 50m water depth
8913-3			22:55	38°51.71N	009°41.51W	114	MN	5 samples	Samples at 0 - 10, 10 - 20, 20 - 30, 30 - 40, 40 - 50m water depth
8914-1	Number missing by mistake								
	832	18. Okt	Echo-sound track 3						
			23:17	38°51.05N	009°41.13W				
			02:55	38°37.80N	009°33.00W				
8915-1	833	18. Okt	05:27	38°37.75W	009°45.93W	728	SL6	500cm	5cm surface in bag
8916-1	834	18. Okt	07:42	38°43.3N	009°59.50W	860	SL6	567cm	
8916-2			08:04	38°43.11N	009°59.25W	843	HN	1 sample	Sample at 75m water depth
8917-1	835	18. Okt	09:20	38°52.05N	009°59.97W	144	HN	1 sample	Sample at 75m water depth
8917-2			09:32	38°52.05N	009°59.89W	142	WS	4 samples	Samples at 0, 25, 50, 90m water depth
8917-3			10:01	38°51.37N	009°59.95W	140	MN	3 samples	Samples at 0 - 25, 25 - 50, 50 - 90m water depth
8918-1	836	18. Okt	13:03	38°52.6N	009°58.96W		ROV dived		video and photos
			18:15	38°51.85N	009°58.97W		ROV recovered		
	837	19. Okt	Echo-sound track 4						
			00:58	38°07.90N	009°13.98W				
			01:34	38°07.00N	009°10.68W				
			01:39	38°07.00N	009°10.35W				
			01:45	38°06.99N	009°09.56W				
			02:04	38°07.01N	009°04.81W				
			03:00	38°06.99N	009°01.00W				
			04:41	38°06.98N	008°53.00W				
			06:40	38°00.00N	008°59.05W				
			09:00	37°59.91N	009°09.81W				
8919-1	838	19. Okt	09:09	37°59.9N	009°10.01W	424	WS	6 samples	Samples at 0, 10, 25, 50, 90, 150m water depth
8919-2			10:08	37°59.74N	009°10.55W	434	HN	1 sample	Sample at 75m water depth
8919-3							MN		cancelled due to bad weather conditions
	839	19. Okt	Echo-sound track 5						
			12:58	38°05.53N	008°54.02W				
			13:07	38°04.60N	008°54.30W				
			13:16	38°03.70N	008°55.10W				
			13:48	38°03.68N	008°59.56W				
			14:13	38°02.46N	009°03.08W				
			14:49	37°58.70N	009°06.54W				
			16:44	37°59.92N	009°22.78W				
			16:25	37°55.00N	009°23.00W				
			19:22	37°55.00N	008°59.00W				
			20:50	37°42.66N	008°59.45W				
			23:00	37°45.21N	009°14.20W				
		20. Okt	01:00	37°47.61N	009°27.34W				
			03:00	37°50.02N	009°40.20W				
			03:30	37°50.64N	009°43.62W				

8920-1	840	20. Okt	04:32	37°50.96N	009°45.31W	2130	WS	10 samples	Samples at 0, 10, 25, 50, 90, 150, 200, 300, 500, 700m water depth
8920-2			06:23	37°49.99N	009°45.10W	2130	HN	1 sample	Sample at 75m water depth
8920-3			06:58	37°49.64N	009°45.26W	2130	MN	5 samples	Samples at 0 - 150, 150 - 200, 200- 300, 300 - 500, 500 – 700m water depth
8920-4			11:09	37°50.83N	009°49.86W	2327	MN		Samples at 0 - 10, 10 - 25, 25 - 50, 50 - 90, 90 - 150m water depth
8921-1	841	20. Okt	16:19	37°51.40N	008°58.75W	134	ROV dived		video and photos
			19:45	37°51.97N	008°58.50W	125	ROV recovered		
	842	Echo-sound track 6							
		20. Okt	20:04	37°51.87N	008°58.23W				
			22:14	37°42.50N	008°58.97W				
		21. Okt	00:00	37°35.26N	008°56.66W				
			01:20	37°30.07N	008°55.08W				
			03:07	37°30.00N	009°04.00W				
			06:11	37°42.50N	009°04.00W				
			07:25	37°42.99N	009°10.00W				
8922-1	843	21. Okt	08:53	37°40.81N	008°58.39W	137	HN	1 sample	Sample at 75m water depth
8922-2	844		09:49	37°40.77N	008°58.10W	135	ROV dived		video and photos
			15:48	37°41.74N	008°57.93W	104	ROV recovered		
8923-1	845	21. Okt	17:35	37°42.46N	009°09.99W	415	WS	6 samples	Samples at 0, 10, 25, 50, 90, 150m water depth
			18:24	37°42.40N	009°10.14W	419	HN	1 sample	Sample at 75 m water depth
			19:09	37°42.50N	009°10.40W	425	MN		Samples at 0 - 10, 10 - 25, 25 - 50, 50 - 90, 90 - 150m water depth
8924-1	846	21. Okt	21:51	37°42.50N	009°29.83W	836	WS	6 samples	Samples at 0, 10, 25, 50, 90, 150m water depth
			22:14	37°42.56N	009°29.79W	809	HN	1 sample	Sample at 75 m water depth
			22:47	37°42.69N	009°29.80W	768	MN		Samples at 0 - 10, 10 - 25, 25 - 30, 50 - 90, 90 - 150m water depth
	847	Echo-sound track 7							
		22. Okt	00:33	37°42.50N	009°23.00W				
			03:00	37°30.00N	009°23.00W				
			05:00	37°30.00N	009°10.00W				
			07:00	37°41.10N	009°09.95W				

MN – Multinet
HN - Handnet (small plancton net, 20 micrometer mesh)
SL6 – Gravity corer, 6m pipe length
ROV – remotly orerated vehicle “Cherokee”

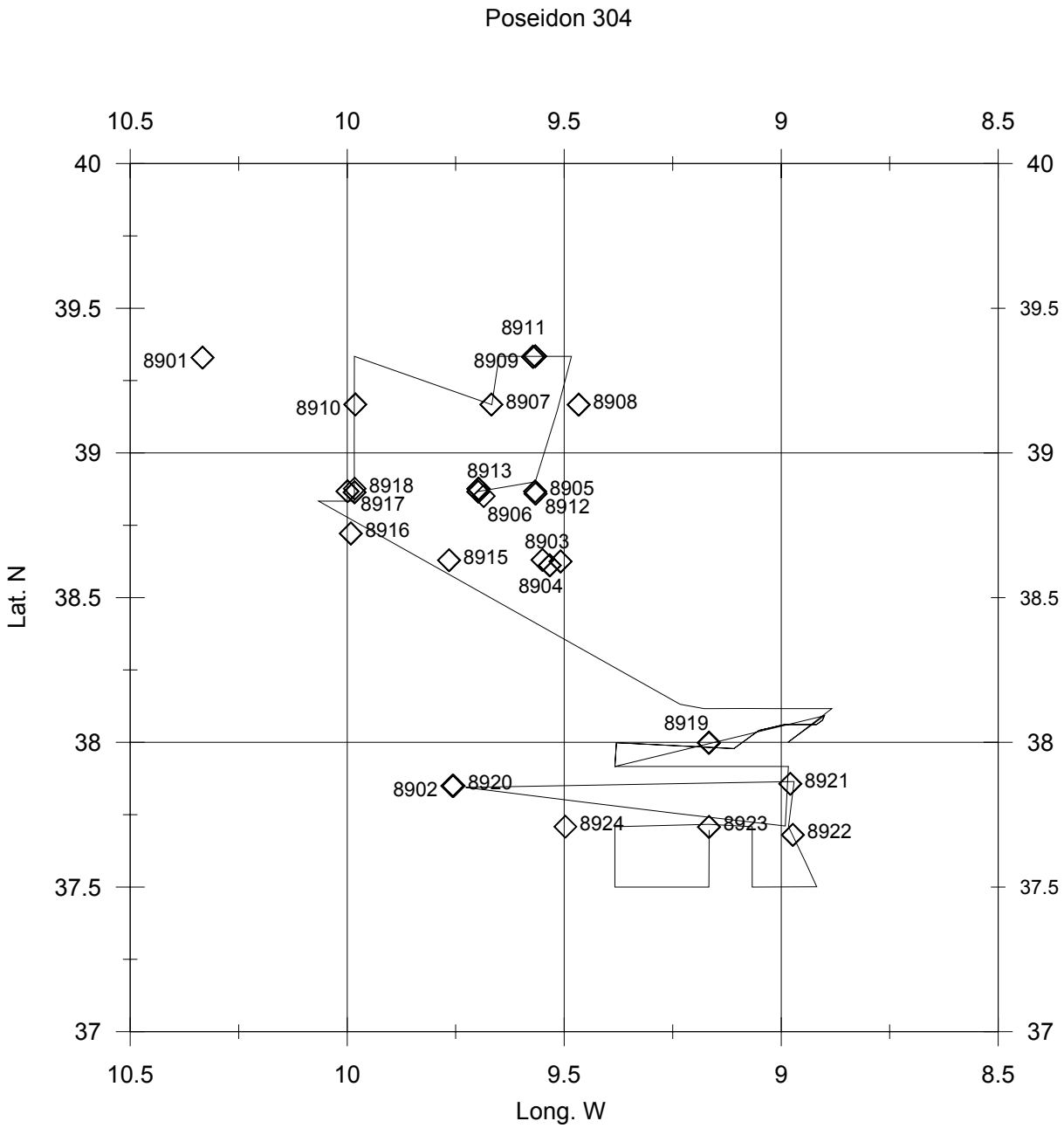

Fig. 12: Stations and echo-sound tracks of Poseidon 304 cruise

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