STUDIES TO MINIMIZE THE ACOUSTIC IMPACT OF THE ATLAS HYDROSWEEP AND PARASOUND ECHOSOUNDERS ON THE MARINE ENVIRONMENT IN THE BAY OF BISCAY

Monika Breitzke, Saad El Naggar, Dorothea Graffe, Gerhard Kuhn, Fred Niederjasper, (AWI), Ulrich Lütticke (Atlas Hydrographic GmbH)

Objectives and System Description

To minimize the acoustic impact of RV Polarstern's hull-mounted scientific sonars on the marine environment the ATLAS Hydrographic GmbH developed various options to reduce the source levels of its Hydrosweep and Parasound echosounder systems.

Hydrosweep. Hydrosweep is a multibeam sonar, which transmits and receives acoustic waves of 15.5 kHz frequency within a fan of 90° to 120° opening angle athwart ship and 2° opening angle along the ship. The travel times of the reflections from the sea floor, combined with the sound velocity (profile) of the water column, are used to derive high-resolution bathymetric maps which reveal the topography of the ocean floor in great detail. The amplitudes of the reflections from the sea floor, sampled by 2000 points along the swath, simultaneously provide sidescan sonar images which indicate high and low scattering areas on the sea floor by light and dark gray-shaded colours. The currently installed Hydrosweep DS-2 system includes an upgrade which allows (1) to use 240 "soft" beams (HDBE Mode = High Definiton Bearing Estimation Mode) instead of the conventional 59 "hard" beams of the former system versions for high-resolution bathymetric surveys and (2) to reduce the source level manually and automatically (ASLC mode = Automatic Source Level Control Mode). A correctly working HDBE mode is mandatory for an application of the ASLC mode. Three different settings can be used to control the source level: (1) Standard, (2) Maximum Source Level, (3) Automatic Source Level Control (ASLC).

In case of a "Standard" source level control the system is running in the high-resolution HDBE mode with a maximum constant source level of 239 dB in the deep sea, an operator-defined coverage of the transmission and receiver swaths of 90° to 120°, a "Start Time Variable Gain" (Start TVG) set by the operator, and an automatically determined "Actual Time Variable Gain"(Actual TVG) optimized according to the level of the received data.

In case of a "Maximum Source Level" control the transmitted source level and the transmission and receiver swath widths are defined manually by the operator. The time variable gain can either be determined automatically or manually. In case of an automatic gain control the "Start TVG" is set by the operator and the "Actual TVG" is optimized within a range of ±12 dB according to the computed S/N ratio of the received data. Ideally, a value of 18 dB is chosen for the "Start TVG" so that a maximum gain of 30 dB can be reached. In case of a manual gain control both "Start TVG" and "Actual TVG" are set manually to the same constant value, maximum to 18 dB. If the maximum source level and the (manually defined) gain are chosen too low, the outer beams of the swath might become unusuable.

In case of an "Automatic Source Level Control (ASLC)" the system tries to optimize and reduce the source level automatically so that operator-defined values for the maximum source level, the receiver swath width and the S/N ratio of the received data are fulfilled. This is reached by decreasing the transmission source level and increasing the "Actual TVG" simultaneously such that the computed S/N-ratio and the desired coverage of the received data is higher than or equal to the operator-defined value. Again, a "Start TVG" of maximum 18 dB can be chosen by the operator, whereas the "Actual TVG" is varied automatically by ±12 dB. Shortly before RV Polarstern left the shipyard and Bremerhaven for the ANT XXIII/1 cruise a new, improved software version has been installed for the Hydrosweep DS-2 system in which some bugs of the preceding version particularly regulating the automatic source level control have been fixed and newly programmed.

Parasound. Parasound works as both low-frequency sediment echosounder to image the upper 5 - 100 m of the sediment coverage of the ocean floor and as high-frequency echosounder to determine the water depth. It makes use of the parametric effect, which produces waves of low secondary frequency through non-linear acoustic interaction of two finite, high-amplitude waves of high primary frequencies. If these two frequencies are very similar and the corresponding sound waves are emitted simultaneously with sufficient high amplitudes, a signal of the difference frequency is generated. This new low-frequency signal is traveling within the emission cone of the original high-frequency waves, which is limited to an opening angle of 4° for the Parasound system. Frequencies of 18 kHz and 20.5 - 23.5 kHz are used for the high-amplitude primary signals to produce user-selectable frequencies of 2.5 - 5.5 kHz for the secondary parametric signal. Signal durations can be varied between 1 - 8 periods of the emitted sine wave signals. Typically, parametric signals of 4 kHz and 2 periods length are used for sediment echosounding, whereas the 18 kHz primary signal serves for the water depth determination. Since the two-way travel time in the deep sea is long compared to the length of the reception window (max. 266 ms), Parasound first determines the water depth using the 18 kHz signal, and then sends out a burst of pulses at 400 ms intervals (pulse trains) until the first echo returns (Pilot-tone mode). This emission sequence produces non-equidistant shot intervals and a non-equidistant, water depth dependent coverage on the sea floor. The current Parasound DS-2 system uses a software version which was completely renewed and installed in spring 2003. In addition to the new windows-driven Parastore-3 control and recording software it includes options to record reflections from the complete water column and to swivel the roll and pitch angles of the transmission and receiving cone by ±5°, so that the signal penetration can always be perpendicular to the sea floor within these limits. An automatic source level control comparable to the ASLC mode of the current Hydrosweep DS-2 version is not available yet but will be included in the future Parasound DS-3 system probably scheduled for installation in RV Polarstern in 2007.

Objectives. During the first leg of ANT XXIII/1 both echosounder systems have been applied to pursue the following objectives:

(1) Detailed test of the newly installed software version of the Hydrosweep DS-2 system, particularly of the high-resolution HDBE mode and without and with manually and automatically controlled source levels (ASLC mode).

(2) Comparison of the data quality of the new high-resolution Hydrosweep bathymetric data (HDBE mode) without and with manually and automatically (ASLC mode) reduced source levels recorded during this cruise with formerly recorded conventional Hydrosweep data (59 "hard" beams, no source level reduction) at already established test sites.

(3) Verification of a correct operation of the current Parasound DS-2 system version and test of some new options like swiveling the emission and receiving cone.

(4) Recording of a digital Parasound reference data set which allows comparing the data quality of future Parasound system versions and upgrades (e.g. DS-3 in 2007) with that of the preceding system. Such a reference data set does not exist up to now.

Work at Sea

To meet these objectives we mainly followed the tracks of the former RV Polarstern cruises ANT VIII/1 and ANT XV/1 and revisited three well-known sites and two new sites in the Bay of Biscay where bathymetric data has already been collected with the Hydrosweep DS-1 and the first version of the Hydrosweep DS-2 system (59 "hard" beams only). These well-known sites are Location 1, 2b and the Canyon de Noirmoutier. The two new sites are named Location 1a and 2d (Fig. X.1). Usually, Hydrosweep and Parasound data were collected simultaneously with few exceptions, where Parasound was switched off to test its influence on the quality of the Hydrosweep data (Tabs. X.1, X.2). Data recording started

shortly after RV Polarstern had passed the Strait of Dover and had left the 12 nm zones of Great Britain and France. On approaching the Bay of Biscay both systems were either run with their standard parameter settings, or different software options were tested to collect experience for the detailed surveys at Locations 1a, 1, 2b, 2d and the Canyon de Noirmoutier. As standard parameter settings a frequency of 4 kHz and a signal duration of 2 periods was used for the Parasound system, and the HDBE mode with 120°/100° transmission/receiver swath widths and no source level limitation ("Standard" source level control) was used for the Hydrosweep system. Additionally, the Hydrosweep data received by the 59 hard beams was continuously recorded via a serial interface installed on RV Polarstern. In what follows the local setting of the test sites and the experiments conducted there are described. Tables X.1 and X.2 give an overview on the different parameter settings of the Hydrosweep and Parasound systems.

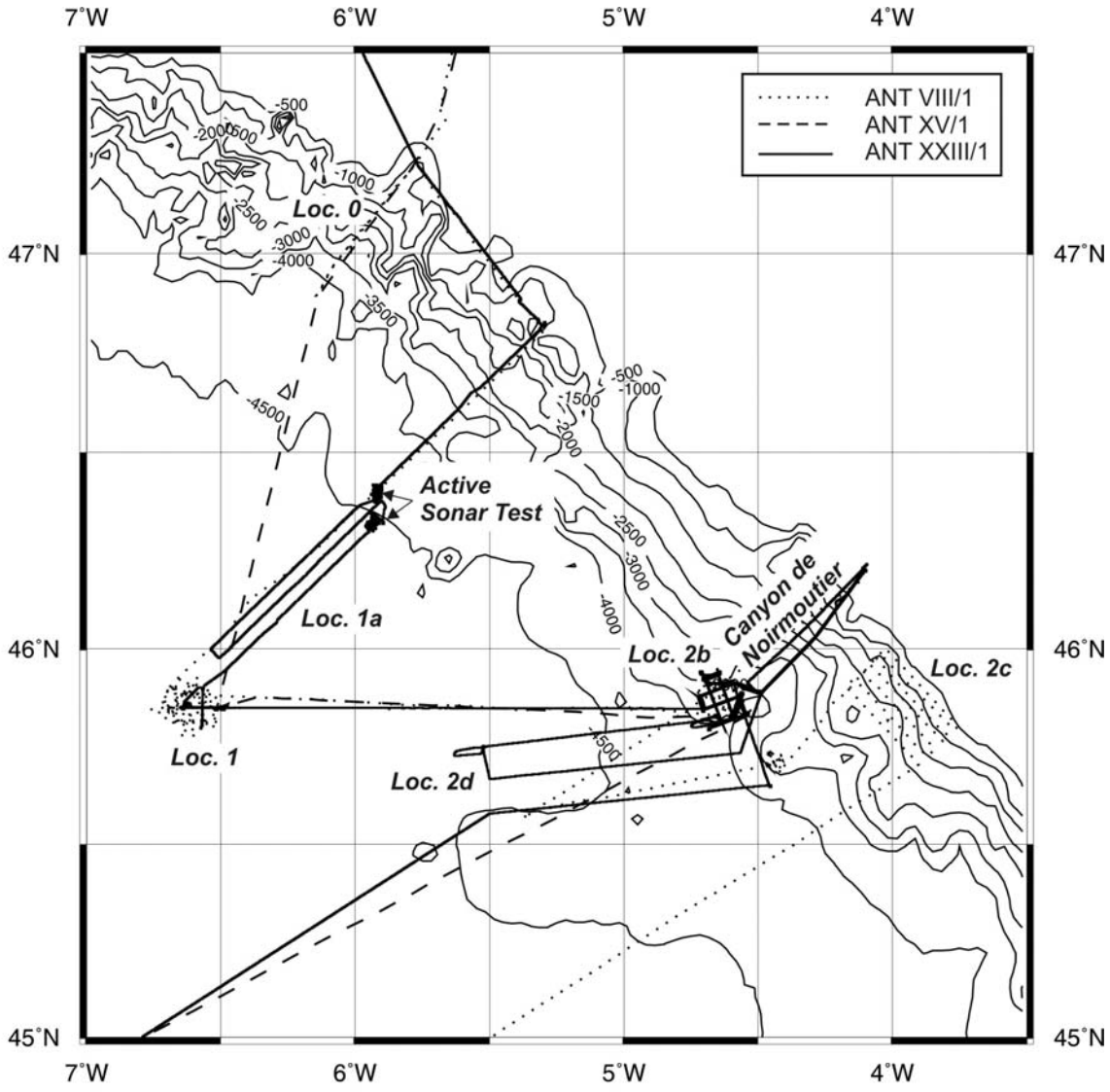

Fig. X.1: ANT XXIII/1 cruise track and test sites for the acoustic Parasound and Hydrosweep echosounder systems in the Bay of Biscay in comparison to the tracks of the former Polarstern cruises ANT VIII/1 and ANT XXIII/1.

Location 1a. Location 1a lies on the continental slope northeast of location 1, between about 46°22.5'N 5°54.4'W and 45°58.5'N 6°30.4'W (Fig. X.2). The water depth varies between about 4600 and 4800 m. It was chosen because during the test of an active sonar system at the northeastern end of the profile lines the barely visible target buoy was lost during daytime, and some time had to be spent with other experiments until nighttime when the buoy could more easily be found again and recovered by its blinking flash light.

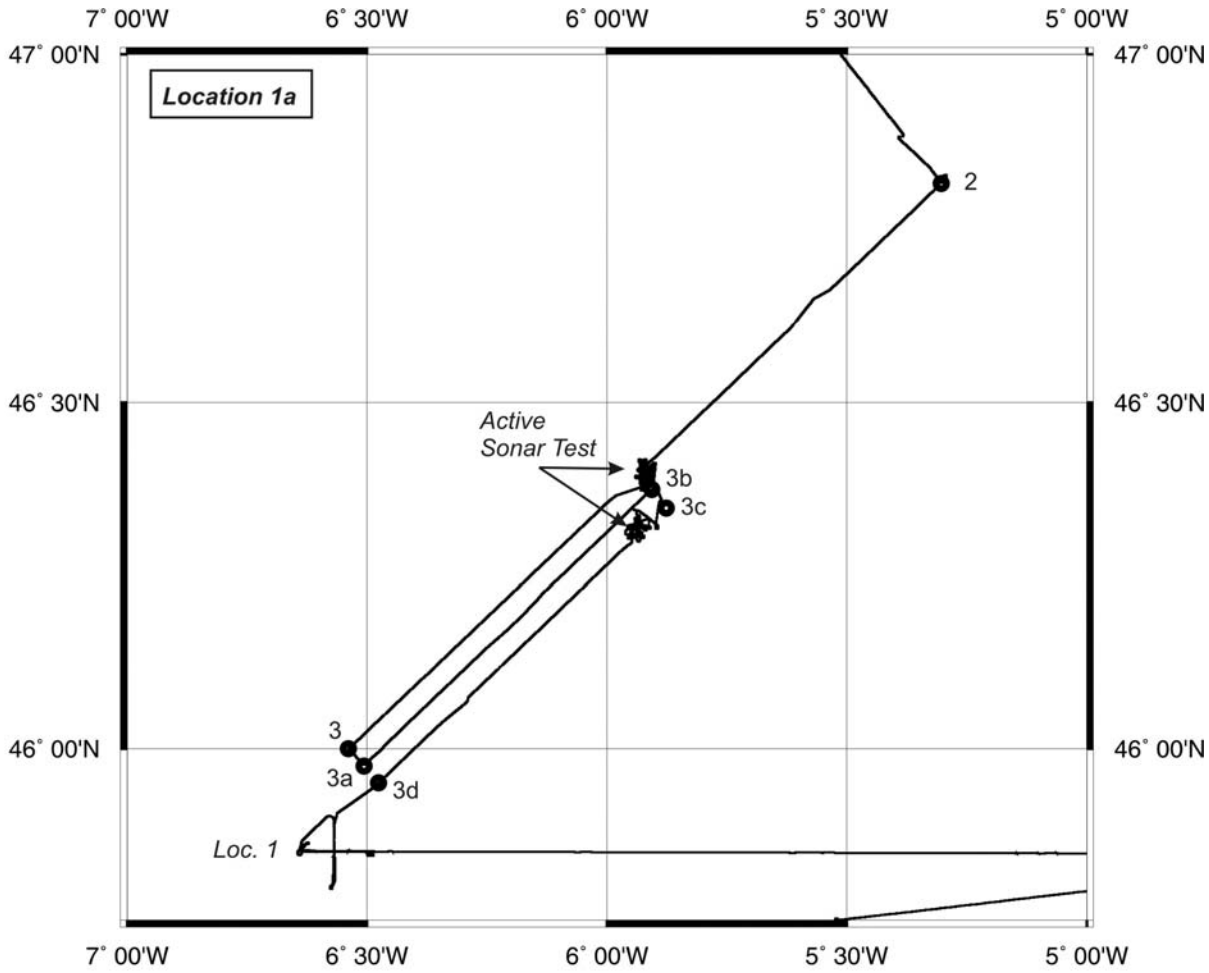

Fig. X.2: ANT XXIII/1 cruise track and waypoint numbers at the acoustic test site "Location 1a" in the Bay of Biscay.

Three parallel, NE-SW oriented lines were surveyed up- and downslope. For Parasound a range of 5000 m was used along the first two lines, whereas a range of 10'000 m was used along the third line so that the influence of the different non-equidistant shot intervals and the different number of pulses per pulse train on the image of the sediment coverage can be compared.

Hydrosweep was run in the HDBE mode ("Standard" source level control) with 120° transmission swath width and variations in the receiver swath widths of 120°, 100° and 90° along the first line to study the bathymetric data quality for different receiver coverages. Additionally, it was tested and observed, if the mean sound velocity c_{mean} was computed

correctly by the new Hydrosweep software. Along the second line tests with an automatic source level control using the HDBE and ASLC modes and a maximum source level of 239 dB, transmission/receiver swath widths of 120°/90° and variations of the S/N-ratio were carried out to study if the new software adjusts the source level in a sensible way. The third line was routinely run in the HDBE mode ("Standard" source level control) with 120°/100° transmission/receiver coverages.

Location 1. Location 1 is a deep sea site with an average water depth of 4800 m, located at 45°51.0'N 6°34.15'W (Fig. X.3). According to the Hydrosweep data collected during ANT VIII/1 the bathymetry is almost flat with maximum depth variations of 75 m.

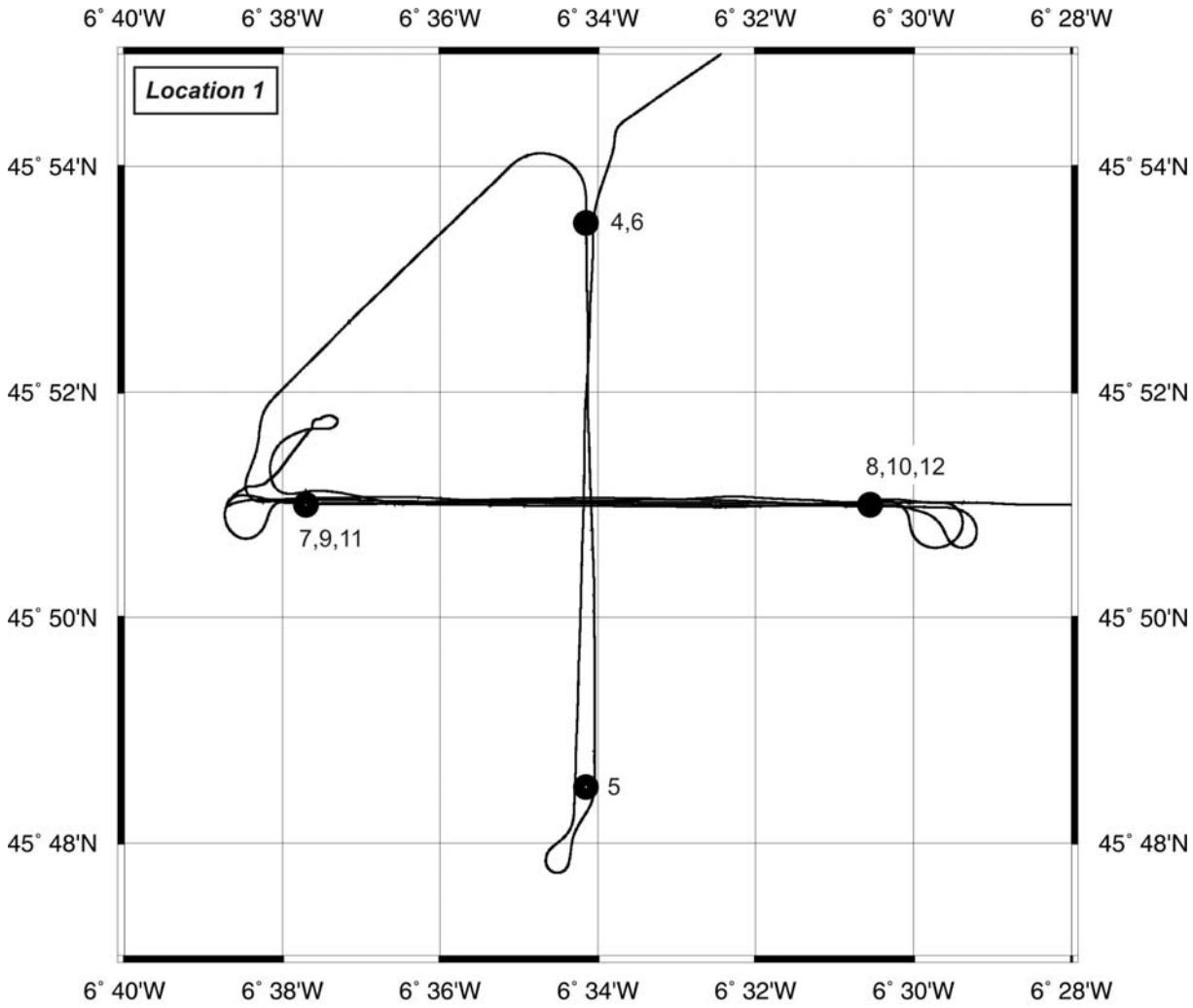

Fig. X.3: ANT XXIII/1 cruise track and waypoint numbers at the acoustic test site "Location 1" in the Bay of Biscay.

Two crossing lines of 5 nm length oriented N-S and W-E were studied. Each line was surveyed at least twice with courses in opposite directions to calibrate the two motion sensors (MINS 1, MINS 2) of RV Polarstern, each along one line. For this purpose,

Hydrosweep was run in the HDBE calibration mode with alternate soundings forward and athwart ship, 90°/90° transmission/receiver swath widths and "Standard" source level control. An analysis of this data will provide the roll and pitch offsets of both motion sensors.

The Parasound range was set constantly to 10'000 m along both lines, so that the reproducibility of the image of the sediment coverage by opposite course directions can be verified and a potential inaccuracy in the vertical beam-steering can be identified. Furthermore, during the way back on the W-E profile, the values for the positions of the Parasound transducer and the motion and heave sensors were varied because a residual, uncompensated heave was noticed in the Parasound data collected in the shallow water of the English Channel.

Additionally, the W-E profile was surveyed three more times. During these runs Hydrosweep was switched back to the HDBE survey mode with 120°/120° transmission/receiver swath widths, "Maximum Source Level" control, a manually fixed "Start" and "Actual TVG" of 18 dB during the first two, and an automatically adjusted "Actual TVG" during the third of these three runs. As maximum source level we began with 239 dB on the first line and reduced it to 233 dB after about 2.5 nm distance. The second line began with a source level limited to 230 dB and continued with 227 dB after 2.5 nm distance. Along the third line, where an automatically adjusted "Actual TVG" was used, maximum source levels were limited to 239 and 227 dB along the first and last 2.5 nm distance.

Parasound was switched back to a range of 5000 m during the first two of these three runs, with values for the positions of the Parasound transducer and the motion and heave sensors kept constant compared to the last line surveyed with range 10'000 m. Thus, the reproducibility of the image of the sediment coverage by opposite course directions, and a potential inaccuracy in the vertical beam-steering can be verified again for a range setting of 5000 m. Additionally, the different images of the sediment coverage achieved by the different number of pulses per train and the different, non equidistant shot-intervals in the 5000 and 10'000 m ranges can be compared. During the third of these three lines Parasound was switched off to study its influence on the quality of the Hydrosweep data.

Canyon de Noirmoutier, Location 2b, Location 2d. The Canyon de Noirmoutier incises the French continental slope between 46°11.6'N 04°06.7'W and 45°53.3'N 04°29.3'W (Fig. X.4). Water depths range from about 200 to 4300 m. At the canyon's southern end, on the lower continental slope, Location 2b covers a small NW-SE oriented ridge rising from about 4300 to 3300 m water depth (Fig. X.5). Both the Canyon de Noirmoutier and Location 2b were already studied twice with RV Polarstern by a small grid of profile lines, first during ANT VIII/1 with Hydrosweep DS-1 and second during ANT XV/1 with the first version of Hydrosweep DS-2. The site named Location 2d is new and connects the lower continental slope with about 4300 m water depth to the deep sea with about 4800 m water depth by three parallel profile lines (Fig. X.6).

During this cruise, first Location 2b and the Canyon de Noirmoutier were surveyed by a small grid and several up- and downslope profiles. A break for a geochemical water sampling station in the deep sea at the eastern end of the profiles of Location 2d followed. After having finished this station Location 2b and the Canyon de Noirmoutier were revisited again for Hydrosweep and Parasound surveys with other parameter settings. By leaving, approaching and leaving Location 2b for the geochemical sampling station in the deep sea and for Vigo the three profiles of Location 2d were collected automatically.

On the way from Location 1 to Location 2b several parameter settings for the source level control of Hydrosweep were tested. First, Hydrosweep was run in the HDBE mode with 120° transmission swath width and "Maximum Source Level" control. The receiver swath was confined to 120°, 110° and 100°, and the maximum source level was fixed to 239, 233 and 230 dB. Subsequently, a test with the HDBE and ASLC modes and fixed maximum source level was conducted, including transmission/receiver coverages of 120°/100°, a maximum source level of 233 dB and an S/N-ratio of 15 dB.

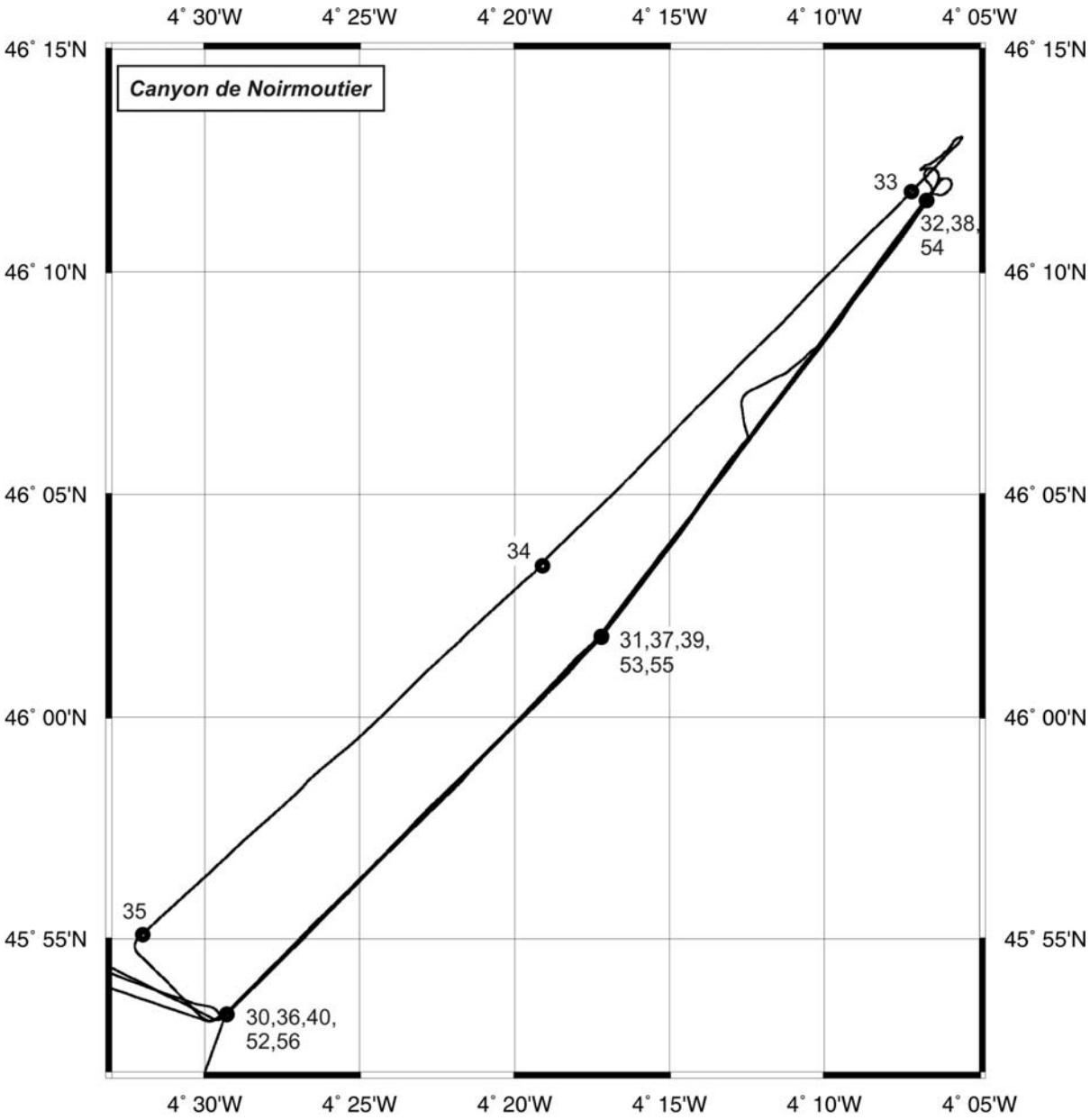

Fig. X.4: ANT XXIII/1 cruise track and waypoint numbers at the acoustic test site "Canyon de Noirmoutier 1" on the French continental slope northeast of the test site "Location 2b" in the Bay of Biscay.

The two southernmost profiles of Location 2b were surveyed 3 and 4 times in opposite directions with different ship velocities and each line with another motion sensor to calibrate and determine potential offsets of the MINS 1 and MINS 2, to verify possible time and position errors produced by the data filtering of the motion sensors, and to identify possible roll, pitch and heading errors. During these studies Hydrosweep was run in the HDBE survey mode ("Standard" source level control) with 90°/90° transmission/receiver swath widths and a "Start TVG" of 10 dB. Subsequently, the complete grid of profile lines was surveyed once in the HDBE mode ("Standard" source level control) with 120°/100° transmission/receiver swath widths and a "Start TVG" of 10 dB. The grid was studied a second time after the Canyon de Noirmoutier had been surveyed twice with Hydrosweep in the HDBE mode and a "Maximum

Source Level" control" set to 233 dB, 120°/100° transmission/receiver swath widths and an automatic gain control with 18 dB "Start TVG". After a break for the geochemical water sampling station in the deep sea, this grid was surveyed twice again, first in the HDBE mode with a "Maximum Source Level" control" set to 230 dB, a transmission/receiver coverage of 120°/100° and an automatic gain control with 18 dB "Start TVG", and second in the HDBE mode with "Standard" source level control, 120°/120° transmission/receiver coverages and an automatic gain control with 18 dB a "Start TVG".

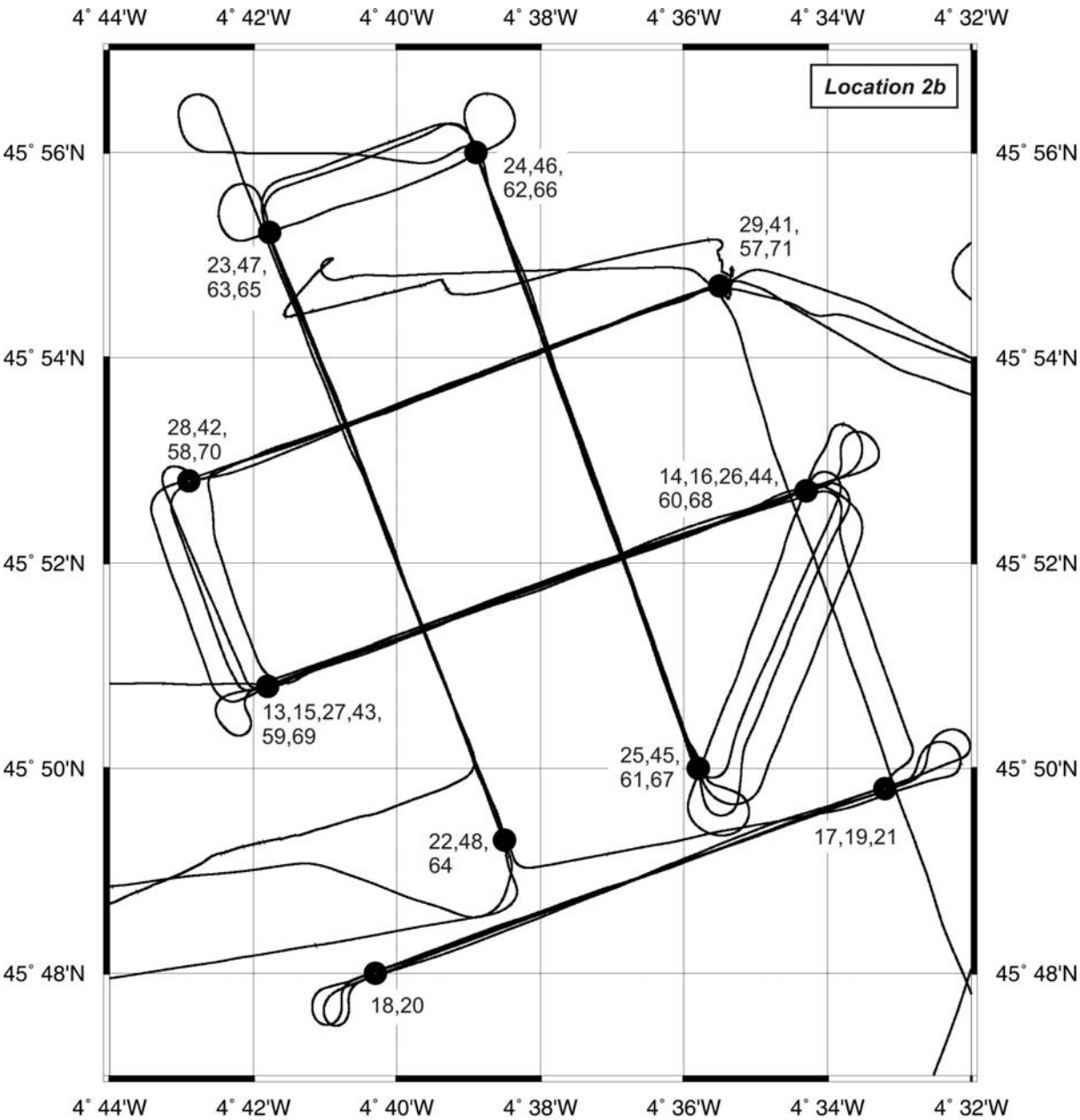

Fig. X.5: ANT XXIII/1 cruise track and waypoint numbers at the acoustic test site "Location 2b" at the southwestern end of the Canyon de Noirmoutier in the Bay of Biscay.

The Canyon de Noirmoutier was first surveyed by two different profile lines, one in the canyon axis, the other slightly shifted to the northwestern canyon flank. The line in the canyon axis was run three times, first upslope in the HDBE mode ("Standard" source level control) with 120°/100° transmission/receiver coverages and 10 dB "Start TVG", a second time upslope in the HDBE and ASLC modes with no source level limitation, 120°/100° transmission/receiver coverages, a S/N ratio of 15 dB and a "Start TVG" of 18 dB, and third downslope with the same parameter settings for about 60 - 70% of the profile line and a limitation of the maximum source level to 233 dB in the lower part of the canyon. The line shifted to the northwestern flank was run in the HDBE mode ("Standard" source level control) with 120°/100° transmission/receiver swath widths and 10 dB "Start TVG". After the break for the geochemical water sampling station two additional lines were recorded along the canyon axis, one upslope, and one downslope. This survey started with the HDBE mode and a "Maximum Source Level" control confined to 230 dB, 18 dB "Start TVG" and an automatically adjusted "Actual TVG". During the survey the operator tried to optimize the source level manually such that sufficient receiver coverage and a sufficient S/N-ratio could be reached with a minimum source level.

The three lines of Location 2d were mainly dedicated to collect Parasound data in an area with rather flat topography and significant signal penetration. Hydrosweep was run in the HDBE mode ("Standard" source level control) with 120°/120° transmission/receiver coverages along the northernmost line and 120°/100° coverages along the two southern lines.

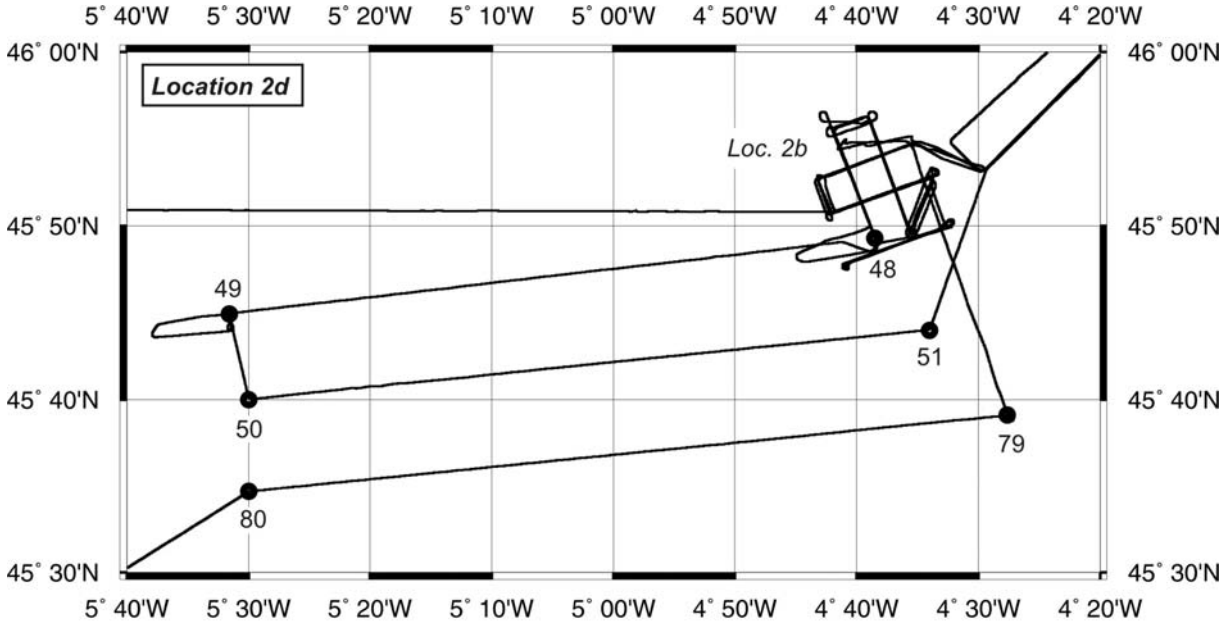

Fig. X.6: ANT XXIII/1 cruise track and waypoint numbers at the acoustic test site "Location 2d" between the test site "Location 2b" and a geochemical water sampling station in the deep sea.

For all Parasound data collected along the Canyon de Noirmoutier and at Locations 2b and 2d the standard parameter settings of 4 kHz frequency, 2 periods length and a range of 5000 m were used. Only in the shallow parts of the canyon with water depths shallower than 1000 m the range was adjusted appropriately to 1000, 500 and 200 m. Additionally,

Parasound was switched off when Location 2b and the Canyon de Noirmoutier were revisited after the geochemical water sampling station in the deep sea, because the rather rough topography in this area did not allow to collect high-quality data suitable to act as reference data for future Parasound recordings, and because there was no need to collect data along the same lines several times. Thus, it was a good occasion to study if the Hydrosweep data quality is affected if both systems run simultaneously.

Preliminary Results

The Hydrosweep and Parasound tests were finished and the data recording was switched off about 12 - 24 hours before RV Polarstern arrived in Vigo, having recorded multibeam and echosounder data of about 650 nm track length. A detailed data analysis particularly for the Hydrosweep data has still to be carried out at home. This includes a detailed, careful comparison of single shots, of single track lines and of the bathymetric maps which can be created from the small grid of profile lines collected at Location 2b for the different parameter settings during this cruise and with the data of the former cruises ANT VIII/1 and ANT XV/1. Nevertheless, some general conclusions can be drawn from the "online" observation of the Hydrosweep system during the surveys:

(1) The HDBE mode seemed to work correctly without any problems or artefacts.

(2) The ASLC mode (with no source level limitation) only reduced the source level appropriately without significant loss of data quality and according to the given S/N-ratio and receiver coverage in the rather smooth, flat area of Location 1b. Along the steep slope of the Canyon de Noirmoutier it completely failed upslope, and lost a complete package of the outer beams downslope. Hence, generally the source level regulation algorithm does not work correctly but has still to be improved so that it could be used with less manual control than was necessary during this test cruise.

(3) If a "Maximum Source Level Control" (239, 233, 230, 227 dB) is used in combination with fixed values for the "Start" and "Actual TVG" (18 dB) the quality of the outer beams increasingly worsens, so that the coverage usable to create bathymetric maps decreases. In case of a maximum source level of 227 dB the usable coverage only amounts to about the single water depth, even in flat areas.

(4) If a "Maximum Source Level Control" is used in combination with an automatic gain control (18 dB "Start TVG") the "Actual TVG" obviously enhances the received data such that the reduction in the source level is compensated, at least in flat areas. Nevertheless, though a detailed data analysis is remaining, a source level reduction to less than 230 dB did not seem to be appropriate in the deep sea.

(5) Generally, the operation of the Hydrosweep system with reduced source levels obviously need more experienced operators than were necessary for the "standard" system because the operator continuously has to watch the data quality online and may have to change parameters appropriately.

The Parasound system still incorporates some major and minor bugs:

(1) In shallow water the heave compensation is not completely removing the ship's up and down movements, but there is still some residual heave obvious in the data. It is not clear if this is due to a remaining error in the Parastore-3 software or due to some time delay introduced by the transfer of the heave sensor data via the motion sensors MINS 1 or MINS 2 to the recording program.

(2) The range 2000 m does not work correctly (PAR pilot mode). Parasound always transmits only one pulse instead of a pulse train and in intervals of about 8 s instead of 3.34 s. A transmission interval of about 8 s is typical for a range of 5000 m, whereas an interval 3.34 s is required for a range of 2000 m and is displayed correctly in the corresponding menu of the Parastore-3 program.

(3) The range 7000 m does not work correctly. The number of pulses per train and the transmission intervals are equivalent to those used with a range setting of 10'000 m, though a shorter transmission interval is displayed in the menu of the Parastore-3 program.

(4) The tick increment and the position of the labels along the time/depth axis of both online screen and online plot are confusing if a recording window length of 100 m is used. It would be more appropriate and easier to read if the total window length would be divided into 10 parts instead of the 8 parts used now. This would lead to a depth increment of 10 m in case of a 100 m window and to a depth increment of 20 m in case of a 200 m window instead of the 12 and 25 m used now.

Apart from these bugs the Parasound system worked well and allowed to collect a useful reference data set. Figures X.7 - X.10 present some examples from the English Channel, Locations 1a, 1, and 2d.

The English Channel southwest of Dover is characterized by pronounced, asymmetric sand ripples of about 5 to 10 m height and about 50 - 500 m length. (Fig. X.7). They lie on the erosional surface of the "normal" sea floor which cuts older dipping, outcropping layers. The type and shape of these ripples strongly vary along the ship's track. For example, the three profiles shown in Figure X.7. were recorded continuously along about 41 km length and over 2 hours duration.

The lower French continental slope at location 1a between waypoints 3a and 3b shows typical hemipelagic sedimentation with parallel subbottom layers and a signal penetration of about 30 m at the southwestern end of the profile (Fig. X.8). These layers are cut by a large slump of unknown thickness because the Parasound signals did not penetrate the slump body but only show its surface at the sea floor.

The sediments at Location 1 at the southwestern end of the profiles of Location 1a as well reveal this hemipelagic parallel subbottom layering with a signal penetration between 30 and 50 m on both the N-S and the W-E profile line (Fig. X.9). Accordingly, Location 2d between waypoints 50 and 51 is characterized by the same type of hemipelagic sedimentation (Fig. X.10).

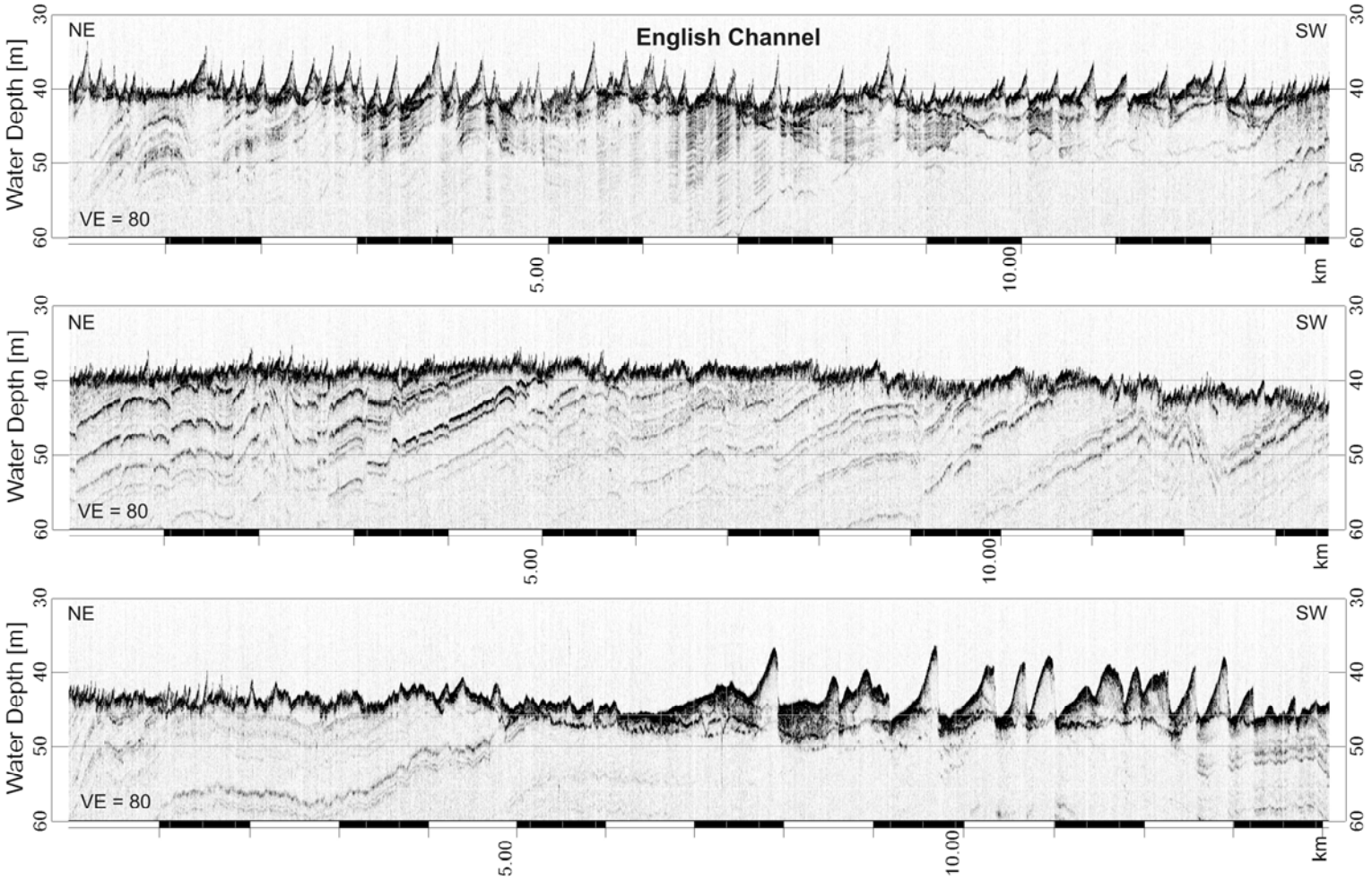

Fig. X.7: Continuous Parasound profile recorded in the English Channel southwest of the Strait of Dover over about 2 hours duration and along about 41 km track length. Sediments are characterized by pronounced sand ripples and a heavily eroded sea surface.

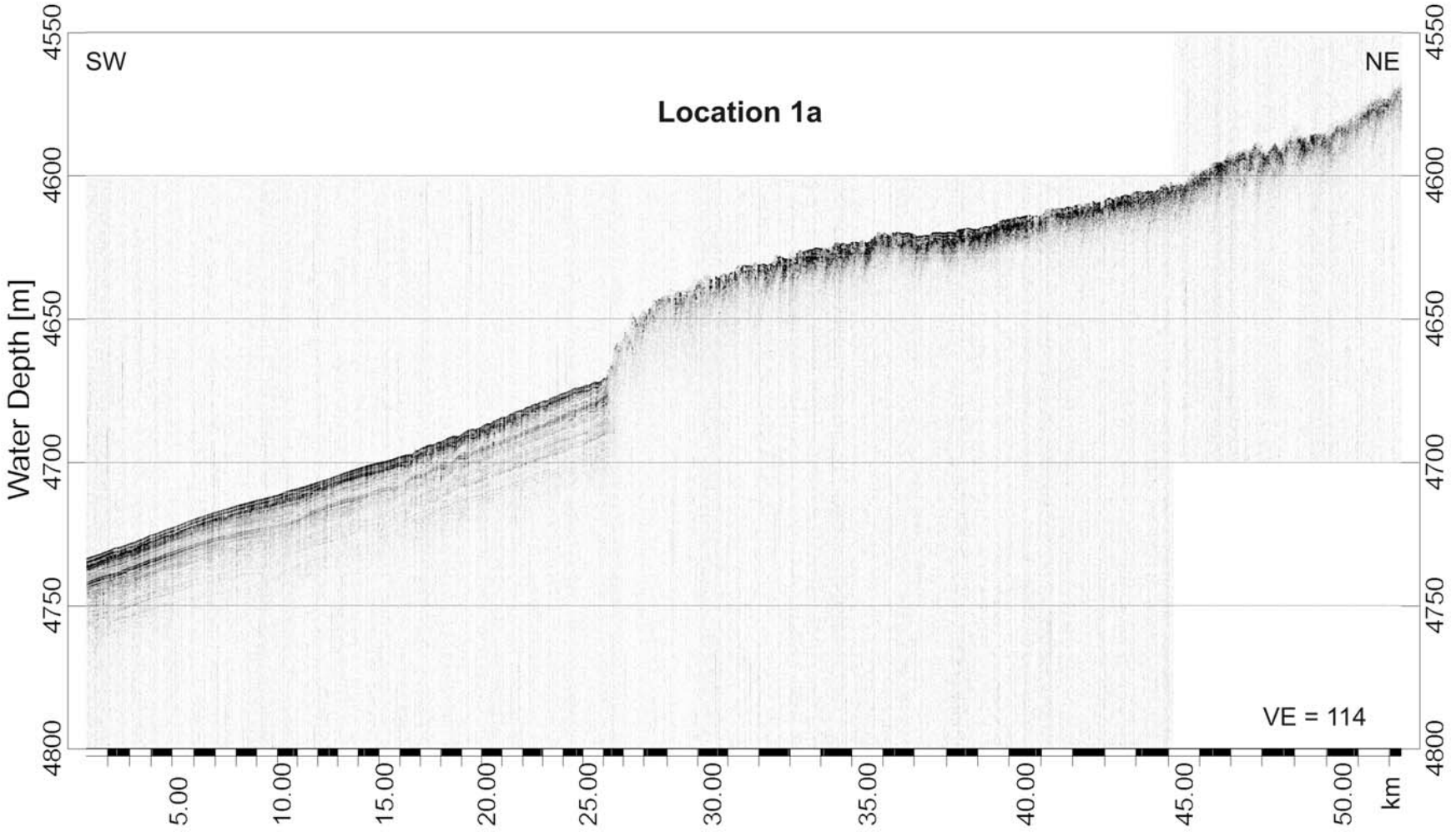

Fig. X.8: Parasound profile recorded at Location 1a (between waypoints 3a and 3b) on the lower French continental slope. The profile is characterized by subparallel hemipelagic layers and a transparent slump of unknown thickness.

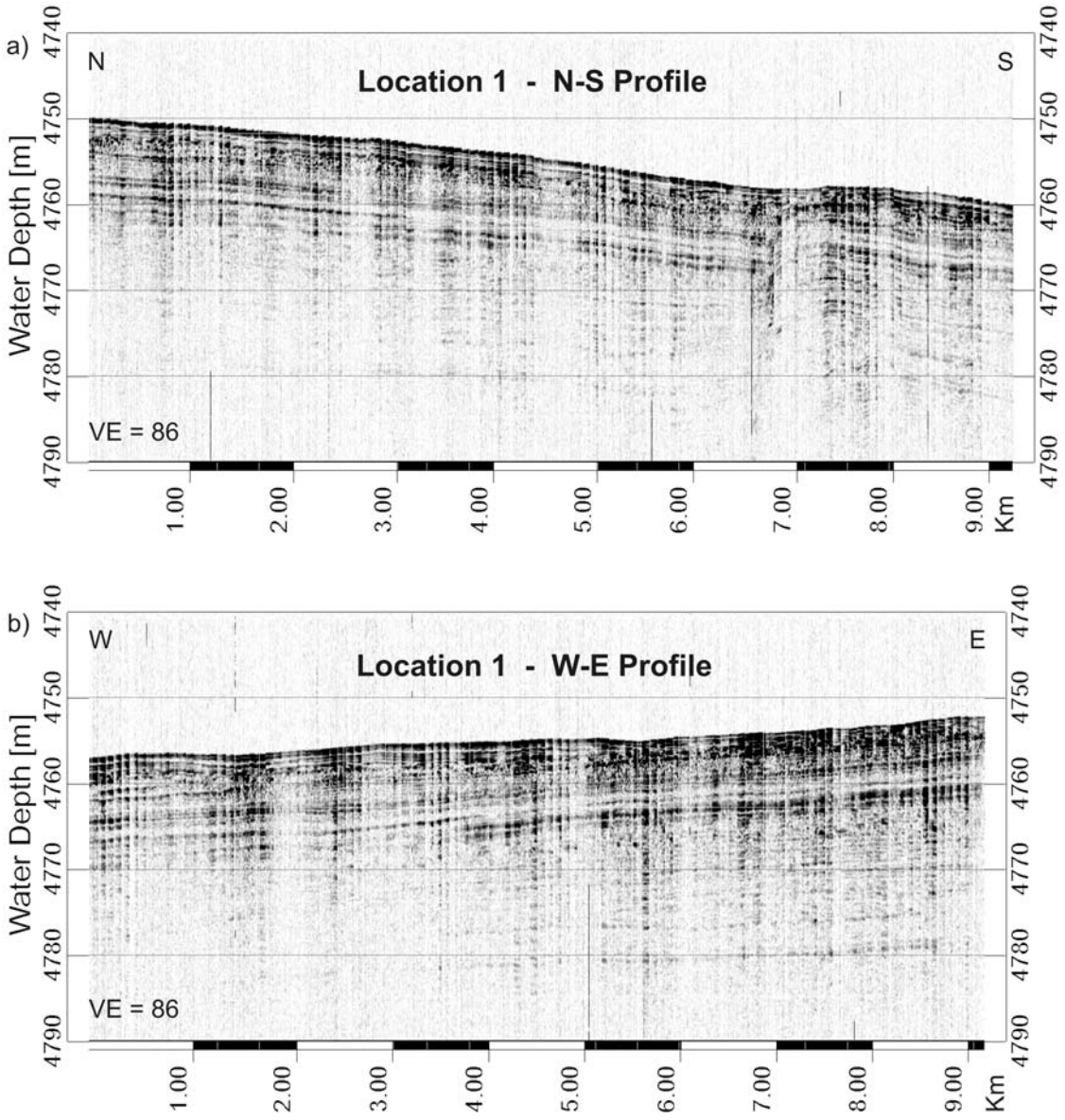

Fig. X.9: N-S and W-E running Parasound profiles recorded at Location 1 in the deep sea. Both profiles show the typical subparallel hemipelagic sedimentation.

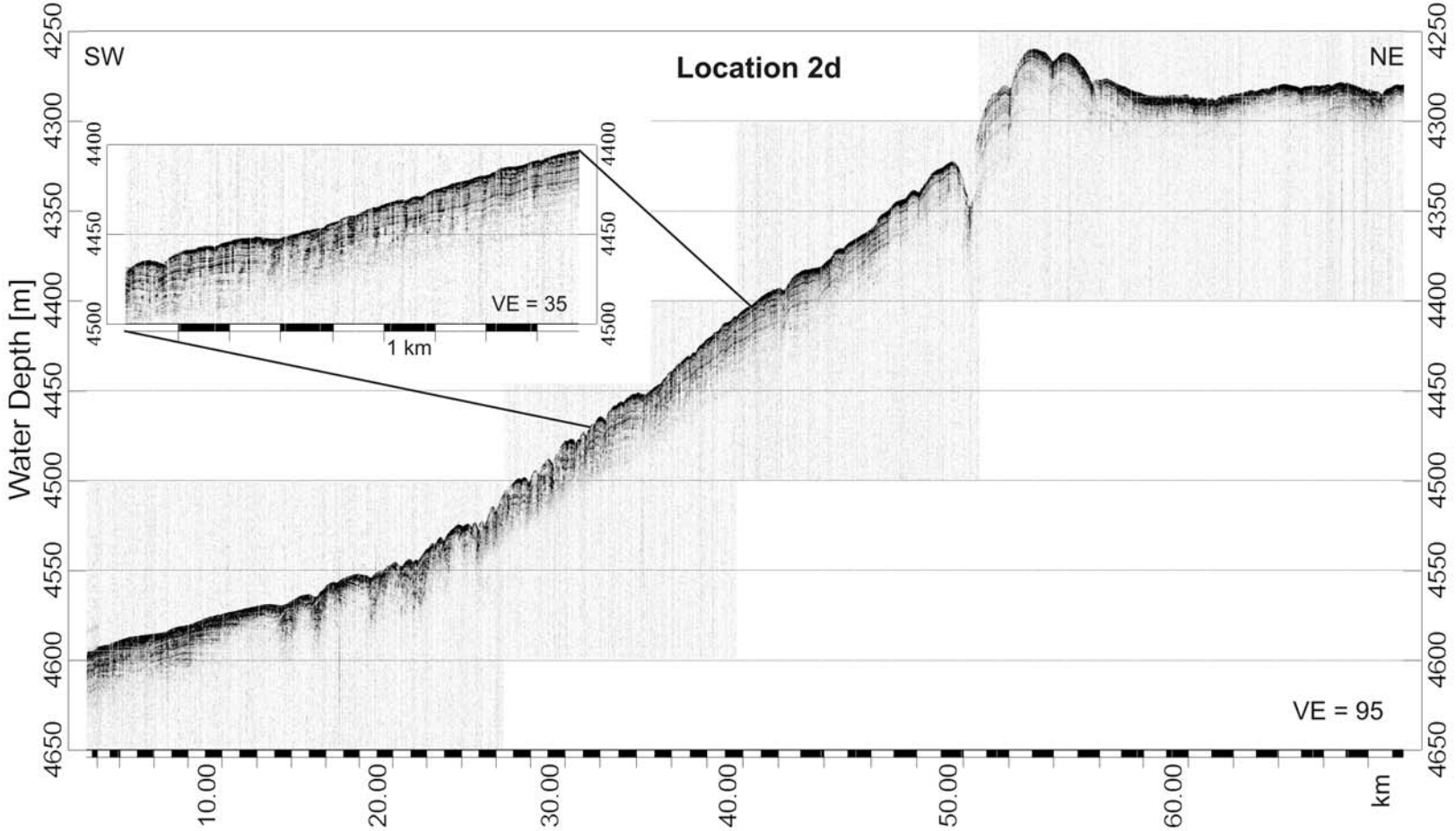

Fig. X.10: Parasound profile recorded at Location 2d on the lower French continental slope between waypoints 50 and 51. Similar to the profiles displayed in Figures X.7, X.8 and X.9 it is characterized by subparallel hemipelagic layers, too.

Tab. X.1: List of waypoints, geographical coordinates, date and time of the Hydrosweep profiles and variation of the Hydrosweep parameter settings

Waypoint (begin of profile	*Date*	*Time UTC*	*Latitude*	*Longitude*	*Waypoint (end of profile)*	*Time (end)*	*Distance [nm] between WP*	*Survey Speed (schedule)*	*Gyro/Motion Sensor #*	*Transmit Angle*	*Receive Angle*	*HDBE Mode*	*Parameters*	*TVG*	*Calibration Mode*	*Parasound On/Off*	*Comment*
																	Approaching Location 1
1	16.10.05	08:10	47 13.320	-5 46.080	**2**		30.9	-	2	120	100	Standard			never	on	start of data recording; WP1 to WP2: test of various parameter settings
2	?	?	46 48.900	-5 18.190	**3**	12:58	70.7		2	120	100	Standard			never	on	
3	17.10.05	12:58	46 00.000	-6 32.330	**3a**	13:11	2.0	-	2	120	100	Standard			never	on	connection between waypoints
3a	17.10.05	13:11	45 58.500	-6 30.400			34.6	-	2	120	100	Standard			never	on	WP 3a to WP 3b: test of various parameter settings
	17.10.05	13:59	46 05.000	-6 20.800			-	-	2	120	90	ASLC	Max. Source Lev. 239 dB Desired S/N 10 dB Desired Coverage 90° **EqFp** (= Equal Footprint)		never	on	
	17.10.05	14:35	46 09.000	-6 14.200			-	-	2	120	90	ASLC	Max. Source Lev. 239 dB Desired S/N 20 dB Desired Coverage 90° EqFp		never	on	
~3b	17.10.05	16:28	46 22.400	-5 54.400			-	-	2	120	90	ASLC	Max. Source Lev. 239 dB Desired S/N 15 dB Desired Coverage 90° EqFp		never	on	WP 3b: Stop for active sonar test station
	18.10.05	04:51	46 18.100	-5 56.900			34.5	-	2	120	100	Standard	**EqSp** (= Equal Spacing)		never	on	leaving active sonar test station towards WP 3d
3d	18.10.05	08:03	45 57.000	-6 28.600			5.2	-	2	120	100	Standard	EqSp		never	on	
	18.10.05	08:32	45 54.000	-6 33.900	**4**	08:37	-	-	2	90	90	Standard	EqSp		alternate	on	alternate calibration mode for roll/pitch calibration
																	Location 1 (N-S Profile)
4	18.10.05	08:37	45 53.500	-6 34.150	**5**	09:07	5.0	10	2	90	90	Standard	EqSp		alternate	on	N-S profile

Waypoint (begin of profile	*Date*	*Time UTC*	*Latitude*	*Longitude*	*Waypoint (end of profile)*	*Time (end)*	*Distance [nm] between WP*	*Survey Speed (schedule)*	*Gyro/Motion Sensor #*	*Transmit Angle*	*Receive Angle*	*HDBE Mode*	*Parameters*	*TVG*	*Calibration Mode*	*Parasound On/Off*	*Comment*
5	18.10.05	09:20	45 48.500	-6 34.150	**6**	09:49	5.0	10	2	90	90	Standard	"		alternate	on	S-N profile
6	18.10.05	09:49	45 53.500	-6 34.150	**7**	10:22	3.5	10	**1**	90	90	Standard	"		alternate	on	connection to W-E profiles; change from MINS 2 to MINS 1
																	Location 1 (W-E Profile)
7	18.10.05	10:22	45 51.000	-6 37.700	**8**	10:51	5.0	10	1	90	90	Standard	"		alternate	on	W-E profile
8	18.10.05	11:07	45 51.000	-6 30.550	**9**	11:37	5.0	10	1	90	90	Standard	"		alternate	on	E-W Profile; stop for station
9	18.10.05	13:30	45 51.000	-6 37.700			5.0	10	**2**	**120**	**120**	Max Level	Max. SL 239 dB	manual 18 dB	never	on	begin of profile (W-E)
	18.10.05	13:47	45 51.000	-6 34.500				10	2	120	120	Max Level	Max. SL 233 dB	"	never	on	middle of profile
	18.10.05				**10**	14:00								"	never	on	end of profile
10	18.10.05	14:14	45 51.000	-6 30.550			5.0	10	2	120	120	Max Level	Max. SL 230 dB	"	never	on	begin of profile (E-W)
	18.10.05	14:33	45 51.000	-6 34.500						120	120	Max Level	Max. SL 227 dB	"	never	on	middle of profile
	18.10.05				**11**	14:49									never	on	end of profile
11	18.10.05	15:03	45 51.000	-6 37.700	**12**	15:29	5.0	10	2	120	120	Max Level	Max. SL 227 dB	Start 18 Act. 18	never	**off**	profile WP 11 to WP 12 (W-E); TVG Act. at end of profile: 30 dB
																	Location 1 to 2b
12	18.10.05	15:30	45 51.000	-6 30.800			75.9	10	2	120	120	Max Level	Max. SL 230 dB	Start 18 Act. 30	never	**on**	
	18.10.05	16:04	45 51.000	-6 21.500			-	10	2	120	120	Max Level	Max. SL 233 dB	Start 18 Act. 29	never	on	
	18.10.05	16:38	45 51.000	-6 12.900			-	10	2	120	120	Max Level	Max. SL 239 dB	Start 18 Act. 24	never	on	
	18.10.05	17:18	45 51.000	-6 05.800			-	10	2	120	120	Max Level	Max. SL 239 dB opt (s. Comment)	Start 18 Act. 25	never	on	opt = manually optimized depth window
	18.10.05	17:53	45 51.000	-5 55.000			-	10	2	**120**	**100**	ASLC	Max. SL 233 dB, S/N 15 dB, Coverage 100°	Start 18 Act. 30	never	on	
	18.10.05	21:52	45 50.800	-4 54.800				10	2	90	90						sound velocity profile changed
	18.10.05	21:57	45 50.000	-4 53.000				10	**1**	90	90						change from MINS 2 to MINS 1

Waypoint (begin of profile	*Date*	*Time UTC*	*Latitude*	*Longitude*	*Waypoint (end of profile)*	*Time (end)*	*Distance [nm] between WP*	*Survey Speed (schedule)*	*Gyro/Motion Sensor #*	*Transmit Angle*	*Receive Angle*	*HDBE Mode*	*Parameters*	*TVG*	*Calibration Mode*	*Parasound On/Off*	*Comment*
	18.10.05				**13**	22:46											end of profile
																	Location 2b (parallel profiles and grid)
13	18.10.05	22:46	45 50.800	-4 41.800	**14**	00:05	5.6	**4**	**1**	**90**	**90**	Standard			never	on	northern SW-NE profiles
14	19.10.05	00:21	45 52.700	-4 34.300	**15**	00:59	5.6	**10**	1	90	90	Standard			never	on	"
15	19.10.05	01:12	45 50.800	-4 41.800	**16**	01:44	5.6	10	1	90	90	Standard			never	on	"
16	19.10.05	01:44	45 52.700	-4 34.300	**17**	02:07	3.0	10	1	90	90	Standard			never	on	connection
17	19.10.05	02:07	45 49.800	-4 33.200	**18**	02:47	5.3	10	1	90	90	Standard			never	on	southern SW-NE profile
18	19.10.05	03:01	45 48.000	-4 40.300	**19**	03:29	5.3	10	1	90	90	Standard			never	on	"
19	19.10.05	03:45	45 49.800	-4 33.200	**20**	04:23	5.3	10	**2**	90	90	Standard			never	on	"
20	19.10.05	04:35	45 48.000	-4 40.300	**21**	05:04	5.3	10	2	90	90	Standard			never	on	"
21	19.10.05	05:17	45 49.800	-4 33.200	**22**	05:44	3.7	10	2	**120**	**100**	Standard			never	on	connection
22	19.10.05	05:44	45 49.300	-4 38.500	**23**	06:25	6.3	10	2	120	100	Standard	EqFp		never	on	survey of the total grid
23	19.10.05	06:25	45 55.220	-4 41.770	**24**	06:41	2.1	10	2	120	100	Standard	"		never	on	
24	19.10.05	06:41	45 56.000	-4 38.900	**25**	07:18	6.4	10	2	120	100	Standard	"		never	on	
25	19.10.05	07:18	45 50.000	-4 35.800	**26**	07:55	2.9	10	2	120	100	Standard	"		never	on	
26	19.10.05	07:55	45 52.700	-4 34.300	**27**	08:20	5.6	10	2	120	100	Standard	"		never	on	
27	19.10.05	08:20	45 50.800	-4 41.800	**28**	08:36	2.1	10	2	120	100	Standard	"		never	on	
28	19.10.05	08:36	45 52.800	-4 42.900	**29**	09:10	5.5	10	2	120	100	Standard	"		never	on	
29	19.10.05	09:10	45 54.700	-4 35.500	**30**	09:38	4.5	10	2	120	100	Standard	"		never	on	connection
																	Canyon de Noirmoutier
30	19.10.05	09:38	45 53.300	-4 29.300	**31**	10:48	12.0	10	2	120	100	Standard			never	on	
31	19.10.05	10:48	46 01.800	-4 17.200	**32**	11:56	12.2	10	2	120	100	Standard			never	on	
32	19.10.05	11:56	46 11.600	-4 06.700	**33**		0.4	10	2	120	100	Standard			never	on	station on the shelf; connection
33	19.10.05	13:35	46 11.800	-4 07.200	**34**	14:58	11.8	10	2	120	100	Standard			never	on	

Waypoint (begin of profile	*Date*	*Time UTC*	*Latitude*	*Longitude*	*Waypoint (end of profile)*	*Time (end)*	*Distance [nm] between WP*	*Survey Speed (schedule)*	*Gyro/Motion Sensor #*	*Transmit Angle*	*Receive Angle*	*HDBE Mode*	*Parameters*	*TVG*	*Calibration Mode*	*Parasound On/Off*	*Comment*
34	19.10.05	14:58	46 03.400	-4 19.100	**35**	16:19	12.2	10	2	120	100	Standard			never	on	
35	19.10.05	16:19	45 55.100	-4 32.000	**36**	16:38	2.6	10	2	120	100	Standard			never	on	connection
36	19.10.05	16:38	45 53.300	-4 29.300	**37**	17:44	12.0	10	2	120	100	ASLC	Max. SL 239 dB Desired S/N 15 dB Desired Coverage 100°		never	on	
37	19.10.05	17:44	46 01.800	-4 17.200	**38**	18:52	12.2	10	2	120	100	ASLC	"		never	on	17:50 HDBE failed (ASLC automatically changed parameter settings such that HDBE could not work correctly any more)
38	19.10.05	19:04	46 11.600	-4 06.700	**39**	20:22	12.2	10	2	120	100	ASLC	"		never	on	
39	19.10.05	20:22	46 01.800	-4 17.200			12.0	10	2	120	100	ASLC	"		never	on	
	19.10.05	20:56:50			**40**	21:40	-	"	"	"	"	ASLC	Max. SL. 233 dB		never	on	Max. Source Level reduced to 233 dB
																	Location 2b (grid)
40	19.10.05	21:40	45 53.300	-4 29.300			4.5	10	2	120	100	ASLC	Max. SL 233 dB		never	on	connection
	19.10.05	22:05			**41**	22:11						Max Level	Max. SL 233 dB				change from ASLC to Max. Level
41	19.10.05	22:11	45 54.700	-4 35.500	**42**	22:45	5.5	10	2	120	100	Max Level	"		never	on	
42	19.10.05	22:45	45 52.800	-4 42.900	**43**	23:03	2.1	10	2	120	100	Max Level	Max. SL 233 dB		never	on	connection
43	19.10.05	23:03	45 50.800	-4 41.800	**44**	23:36	5.6	10	2	120	100	Max Level	"		never	on	
44	19.10.05	23:37	45 52.700	-4 34.300	**45**	00:05	2.9	10	2	120	100	Max Level	"		never	on	connection
45	20.10.05	00:05	45 50.000	-4 35.800	**46**	00:44	6.4	10	2	120	100	Max Level	"		never	on	
46	20.10.05	00:44	45 56.000	-4 38.900	**47**	01:01	2.1	10	2	120	100	Max Level	"		never	on	connection
47	20.10.05	01:01	45 55.220	-4 41.770	**48**	01:38	6.3	10	2	120	100	Max Level	"		never	on	WP 48: end of grid survey
																	From Loc. 2b to station at WP 49 and back to Canyon de Noirmoutier
48	20.10.05	01:38	45 49.300	-4 38.500				10	2	120	100	Standard			never	on	leaving towards station at WP 49
~49 (an)	20.10.05	06:50	45 44.933	-5 31.596				10	2	120	100	Standard			never	on	arriving at station; standby
~49	20.10.05	14:51	45 44.933	-5 31.596	**50**	15:25	5.1	10	2	120	100	Standard	EqFp		never	on	leaving station

Waypoint (begin of profile	*Date*	*Time UTC*	*Latitude*	*Longitude*	*Waypoint (end of profile)*	*Time (end)*	*Distance [nm] between WP*	*Survey Speed (schedule)*	*Gyro/Motion Sensor #*	*Transmit Angle*	*Receive Angle*	*HDBE Mode*	*Parameters*	*TVG*	*Calibration Mode*	*Parasound On/Off*	*Comment*
50	20.10.05	15:25	45 40.000	-5 30.000	**51**	19:16	39.3	10	2	120	100	Standard	"		never	on	
51	20.10.05	19:16	45 44.000	-4 34.000	**52**	20:09	9.9	10	2	120	100	Standard	"		never	on	connection
																	Canyon de Noirmoutier
52	20.10.05	20:09	45 53.300	-4 29.300			12.0	10	2	120	100	Max Level	Max. SL 230 dB, EqFp		never	**off**	Maximum Level mode with varying Max. SL; Parasound off
	20.10.05	20:22						10	2	120	100	Max Level	Max. SL 227 dB		never	off	EqFp until end of 21.10.05
	20.10.05	20:37						10	2	120	100	Max Level	Max. SL 224 dB		never	off	
	20.10.05	20:47						10	2	120	100	Max Level	Max. SL 222 dB		never	off	
	20.10.05	20:58						10	2	120	100	Max Level	Max. SL 221 dB		never	off	
	20.10.05	21:07						10	2	120	100	Max Level	Max. SL 218 dB		never	off	
					53	21:21											end of profile
53	20.10.05	21:21	46 01.800	-4 17.200			12.2	10	2	120	100	Max Level	Max. SL 213 dB		never	off	
	20.10.05	21:32						10	2	120	100	Max Level	Max. SL 218 dB		never	off	
	20.10.05	21:59						10	2	120	100	Max Level	Max. SL 213 dB		never	off	
	20.10.05	22:03						10	2	120	100	Max Level	Max. SL 212 dB		never	off	
	20.10.05	22:07						10	2	120	100	Max Level	Max. SL 207 dB		never	off	
	20.10.05	22:28	46 12.000	-4 06.500	**~54**	22:28		10	2	120	100	Max Level	Max. SL 207 dB		never	off	end of profile 22:28; note written somewhat later
54	20.10.05	22:39	46 11.600	-4 06.700			12.2	10	2	120	100	Max Level	Max. SL 207 dB		never	off	
	20.10.05	23:13						10	2	120	100	Max Level	Max. SL 207 dB		never	**on**	Parasound on
	20.10.05	23:19						10	2	120	100	Max Level	Max. SL 207 dB		never	**off**	Parasound off
	20.10.05	23:20						10	2	120	100	Max Level	Max. SL 212 dB		never	off	
	20.10.05	23:22								120	100	Max Level	Max. SL 218 dB		never	off	
	20.10.05	23:37								120	100	Max Level	Max. SL 222 dB		never	off	

Waypoint (begin of profile	*Date*	*Time UTC*	*Latitude*	*Longitude*	*Waypoint (end of profile)*	*Time (end)*	*Distance [nm] between WP*	*Survey Speed (schedule)*	*Gyro/Motion Sensor #*	*Transmit Angle*	*Receive Angle*	*HDBE Mode*	*Parameters*	*TVG*	*Calibration Mode*	*Parasound On/Off*	*Comment*
	20.10.05	23:45								120	100	Max Level	Max. SL 227 dB		never	off	
	21.10.05	00:04			**55**	00:05				120	100	Max Level	Max. SL 224 dB		never	off	
55	21.10.05	00:05	46 01.800	-4 17.200			12.0	10	2	120	100	Max Level	Max. SL 224 dB		never	off	
	21.10.05	00:41								120	100	Max Level	Max. SL 222 dB		never	off	
	21.10.05	00:44			**56**	01:24				120	100	Max Level	Max. SL 218 dB		never	off	
56	21.10.05	01:24	45 53.300	-4 29.300	**57**	01:50	4.5	10	2	120	100	Max Level	Max. SL 218 dB		never	off	connection
																	Location 2b (grid 2x)
57	21.10.05	01:50	45 54.700	-4 35.500	**58**	02:30	5.5	10	2	120	100	Max Level	Max. SL 230 dB EqFp		never	off	Maximum Level mode Max. SL 230 dB
58	21.10.05	02:32	45 52.800	-4 42.900	**59**	02:45	2.1	10	2	120	100	Max Level	"		never	off	connection
59	21.10.05	02:47	45 50.800	-4 41.800	**60**	03:15	5.6	10	2	120	100	Max Level	"		never	off	
60	21.10.05	03:29	45 52.700	-4 34.300	**61**	03:52	2.9	10	2	120	100	Max Level	"		never	off	connection
61	21.10.05	04:06	45 50.000	-4 35.800	**62**	04:48	6.4	10	2	120	100	Max Level	"		never	off	
62	21.10.05	05:01	45 56.000	-4 38.900	**63**	05:23	2.1	10	2	120	100	Max Level	"		never	off	connection
63	21.10.05	05:37	45 55.220	-4 41.770	**~64**	06:16	6.3	10	2	120	100	Max Level	"		never	off	
~64 (an)	21.10.05	06:16	45 40.800	-4 39.100													course changed for station shortly before WP 64
64	21.10.05	08:18	45 49.300	-4 38.500	**65**	09:02	6.3	10	2	120	120	Standard	EqFp		never	off	
65	21.10.05	09:02	45 55.220	-4 41.770	**66**	09:34	2.1	10	2	120	120	Standard	"		never	off	connection
66	21.10.05	09:34	45 56.000	-4 38.900	**67**	10:13	6.4	10	2	120	120	Standard	"		never	off	
67	21.10.05	10:13	45 50.000	-4 35.800	**68**	10:39	2.9	10	2	120	120	Standard	"		never	off	connection
68	21.10.05	10:40	45 52.700	-4 34.300	**69**	11:20	5.6	10	2	120	120	Standard	"		never	off	
69	21.10.05	11:20	45 50.800	-4 41.800	**70**	10:40	2.1	10	2	120	120	Standard	"		never	off	connection
70	21.10.05	11:41	45 52.800	-4 42.900	**71**	12:14	5.5	10	2	120	120	Standard	"		never	off	WP 71: station started at 12:14

Waypoint (begin of profile	*Date*	*Time UTC*	*Latitude*	*Longitude*	*Waypoint (end of profile)*	*Time (end)*	*Distance [nm] between WP*	*Survey Speed (schedule)*	*Gyro/Motion Sensor #*	*Transmit Angle*	*Receive Angle*	*HDBE Mode*	*Parameters*	*TVG*	*Calibration Mode*	*Parasound On/Off*	*Comment*
																	Leaving for Vigo
71	21.10.05	15:58	45 54.700	-4 35.500				10	2	120	100	Standard	"		never	**on**	Parasound on
79	21.10.05	?	45 39.100	-4 27.600				10	2	120	100	Standard	"		never	on	
80	21.10.05	21:30	45 34.700	-5 30.000				10	2	120	100	Standard	"		never	on	end of profile 21.30
-	22.10.05	07:00	44 33.000	-7 47.600									"				data recording off

Tab. X.2: List of waypoints, geographical coordinates, date and time of the Parasound profiles and variation of the Parasound parameter settings

Waypoint (begin of profile)	*Date*	*Time UTC*	*Latitude*	*Longitude*	*Waypoint (end of profile)*	*Time (end)*	*Distance [nm] between WP*	*Survey Speed (schedule)*	*Gyro/Motion Sensor#*	*Frequency [kHz]*	*Number of Periods*	*Range [m]*	*Position of Parasound Transducer (x/y/z)*	*Position of Motion Sensor (x/y/z)*	*Comment*
															Location 1a
	14.10.05	22:20			**2**	ca. 11:00		-	2	4	2	100, 200, 500, 1000, 5000			start of data recording
2	?	?	46 48.900	-5 18.190	**3**	12:58	70.7		2	4	2	5000			profile interrupted for sonar test
3	17.10.05	12:58	46 00.000	-6 32.330	**3a**	13:11	2.0	-	2	4	2	5000			connection between waypointsl
3a	17.10.05	13:11	45 58.500	-6 30.400	**~3b**	16:28	34.6	-	2	4	2	5000			at the end of the profile stop for search of the triple mirror and active sonar test
~3b	17.10.05	16:28	46 22.400	-5 54.400	**3d**	08:03	34.5	-	2	4	2	5000			
3d	18.10.05	08:03	45 57.000	-6 28.600	**4**	08:37	5.2	-	2	4	2	5000			leaving towards location 1
															Location 1 (N-S Profile)
4	18.10.05	08:37	45 53.500	-6 34.150	**5**	09:07	5.0	10	2	4	2	10000	0/0/0	0/0/0	N-S profile
5	18.10.05	09:20	45 48.500	-6 34.150	**6**	09:49	5.0	10	2	4	2	10000	0/0/0	0/0/0	S-N profile; verification of the N-S profile and a potential residual error in vertical beam steering
6	18.10.05	09:49	45 53.500	-6 34.150	**7**	10:22	3.5	10	1	4	2	10000	0/0/0	0/0/0	connection to W-E profiles; change from MINS 2 to MINS 1
															Location 1 (W-E Profile)
7	18.10.05	10:22	45 51.000	-6 37.700	**8**	10:51	5.0	10	1	4	2	10000	0/0/0	0/0/0	W-E profile
8	18.10.05	11:07	45 51.000	-6 30.550	**9**	11:37	5.0	10	1	4	2	10000	0.97/0.00/0.00	- 4.10/0.35/8.50	E-W Profile; position of transducer and motion sensor according to values noted by the bathymetry group; check, if and how the positions of the transducer and motion sensor affect the recorded data; after WP 9: stop for station; on station test of different transducer and motion sensor positions; tests with beam steering
9	18.10.05	13:30	45 51.000	-6 37.700	**10**	14:00	5.0	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	W-E profile; comparison of data quality recorded with ranges 10000 and 5000 m
10	18.10.05	14:14	45 51.000	-6 30.550	**11**	14:49	5.0	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	E-W profile; check, if and how the positions of the transducer and motion sensor affect

Waypoint (begin of profile)	*Date*	*Time UTC*	*Latitude*	*Longitude*	*Waypoint (end of profile)*	*Time (end)*	*Distance [nm] between WP*	*Survey Speed (schedule)*	*Gyro/Motion Sensor#*	*Frequency [kHz]*	*Number of Periods*	*Range [m]*	*Position of Parasound Transducer (x/y/z)*	*Position of Motion Sensor (x/y/z)*	*Comment*
															the recorded data
11	18.10.05	15:03	45 51.000	-6 37.700	**12**	15:29	5.0	10	2	off	off	off			W-E profile; Parasound off
															Location 1 to 2b
12	18.10.05	15:30	45 51.000	-6 30.800	**13**	22:46	75.9	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	connection between Loc. 1 and 2b/Canyon de Noirmoutier
															Location 2b (parallel profiles and grid)
13	18.10.05	22:46	45 50.800	-4 41.800	**14**	00:05	5.6	4	1	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	northern SW-NE profiles
14	19.10.05	00:21	45 52.700	-4 34.300	**15**	00:59	5.6	10	1	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	"
15	19.10.05	01:12	45 50.800	-4 41.800	**16**	01:44	5.6	10	1	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	"
16	19.10.05	01:44	45 52.700	-4 34.300	**17**	02:07	3.0	10	1	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	connection
17	19.10.05	02:07	45 49.800	-4 33.200	**18**	02:47	5.3	10	1	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	southern SW-NE profile
18	19.10.05	03:01	45 48.000	-4 40.300	**19**	03:29	5.3	10	1	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	"
19	19.10.05	03:45	45 49.800	-4 33.200	**20**	04:23	5.3	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	"
20	19.10.05	04:35	45 48.000	-4 40.300	**21**	05:04	5.3	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	southern SW-NE profile; Parastore-3 break down at 04:28; restart
21	19.10.05	05:17	45 49.800	-4 33.200	**22**	05:44	3.7	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	connection
22	19.10.05	05:44	45 49.300	-4 38.500	**23**	06:25	6.3	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	survey of the grid
23	19.10.05	06:25	45 55.220	-4 41.770	**24**	06:41	2.1	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	"
24	19.10.05	06:41	45 56.000	-4 38.900	**25**	07:18	6.4	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	"
25	19.10.05	07:18	45 50.000	-4 35.800	**26**	07:55	2.9	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	"
26	19.10.05	07:55	45 52.700	-4 34.300	**27**	08:20	5.6	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	"
27	19.10.05	08:20	45 50.800	-4 41.800	**28**	08:36	2.1	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	"
28	19.10.05	08:36	45 52.800	-4 42.900	**29**	09:10	5.5	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	"
29	19.10.05	09:10	45 54.700	-4 35.500	**30**	09:38	4.5	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	connection

Waypoint (begin of profile)	*Date*	*Time UTC*	*Latitude*	*Longitude*	*Waypoint (end of profile)*	*Time (end)*	*Distance [nm] between WP*	*Survey Speed (schedule)*	*Gyro/Motion Sensor#*	*Frequency [kHz]*	*Number of Periods*	*Range [m]*	*Position of Parasound Transducer (x/y/z)*	*Position of Motion Sensor (x/y/z)*	*Comment*
															Canyon de Noirmoutier
30	19.10.05	09:38	45 53.300	-4 29.300	**31**	10:48	12.0	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	upslope
31	19.10.05	10:48	46 01.800	-4 17.200	**32**	11:56	12.2	10	2	4	2	5000, 1000, 500, 200	0.97/0.00/0.00	- 4.10/0.35/8.50	upslope
32	19.10.05	11:56	46 11.600	-4 06.700	**33**		0.4	10	2	4	2	200	0.97/0.00/0.00	- 4.10/0.35/8.50	station on the shelf; connection
33	19.10.05	13:35	46 11.800	-4 07.200	**34**	14:58	11.8	10	2	4	2	200, 500, 1000, 5000	0.97/0.00/0.00	- 4.10/0.35/8.50	downslope
34	19.10.05	14:58	46 03.400	-4 19.100	**35**	16:19	12.2	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	downslope
35	19.10.05	16:19	45 55.100	-4 32.000	**36**	16:38	2.6	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	connection
36	19.10.05	16:38	45 53.300	-4 29.300	**37**	17:44	12.0	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	upslope
37	19.10.05	17:44	46 01.800	-4 17.200	**38**	18:52	12.2	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	upslope
38	19.10.05	19:04	46 11.600	-4 06.700	**39**	20:22	12.2	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	downslope
39	19.10.05	20:22	46 01.800	-4 17.200	**40**	21:40	12.0	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	downslope
															Location 2b (grid)
40	19.10.05	21:40	45 53.300	-4 29.300	**41**	22:11	4.5	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	connection
41	19.10.05	22:11	45 54.700	-4 35.500	**42**	22:45	5.5	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	survey of the grid
42	19.10.05	22:45	45 52.800	-4 42.900	**43**	23:03	2.1	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	"
43	19.10.05	23:03	45 50.800	-4 41.800	**44**	23:36	5.6	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	"
44	19.10.05	23:37	45 52.700	-4 34.300	**45**	00:05	2.9	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	"
45	20.10.05	00:05	45 50.000	-4 35.800	**46**	00:44	6.4	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	"
46	20.10.05	00:44	45 56.000	-4 38.900	**47**	01:01	2.1	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	"
47	20.10.05	01:01	45 55.220	-4 41.770	**48**	01:38	6.3	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	WP 48: end of grid survey

Waypoint (begin of profile)	Date	Time UTC	Latitude	Longitude	Waypoint (end of profile)	Time (end)	Distance [nm] between WP	Survey Speed (schedule)	Gyro/Motion Sensor#	Frequency [kHz]	Number of Periods	Range [m]	Position of Parasound Transducer (x/y/z)	Position of Motion Sensor (x/y/z)	Comment
															From Loc. 2b to station at WP 49 and back to Canyon de Noirmoutier
48	20.10.05	01:38	45 49.300	-4 38.500	**~49**	06:50		10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	leaving towards station at WP 49; standby on station
~49	20.10.05	14:51	45 44.933	-5 31.596	**50**	15:25	5.1	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	leaving station
50	20.10.05	15:25	45 40.000	-5 30.000	**51**	19:16	39.3	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	
51	20.10.05	19:16	45 44.000	-4 34.000	**52**	20:09	9.9	10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	connection
															Canyon de Noirmoutier
52	20.10.05	20:09	45 53.300	-4 29.300	**53**	21:21	12.0	10	2	off	off	off			Parasound off
53	20.10.05	21:21	46 01.800	-4 17.200	**~54**	22:28	12.2	10	2	off	off	off			"
54	20.10.05	22:39	46 11.600	-4 06.700	**55**	00:05	12.2	10	2	off	off	off			"
55	21.10.05	00:05	46 01.800	-4 17.200	**56**	01:24	12.0	10	2	off	off	off			"
56	21.10.05	01:24	45 53.300	-4 29.300	**57**	01:50	4.5	10	2	off	off	off			"
															Location 2b (grid 2x)
57	21.10.05	01:50	45 54.700	-4 35.500	**58**	02:30	5.5	10	2	off	off	off			Parasound off
58	21.10.05	02:32	45 52.800	-4 42.900	**59**	02:45	2.1	10	2	off	off	off			"
59	21.10.05	02:47	45 50.800	-4 41.800	**60**	03:15	5.6	10	2	off	off	off			"
60	21.10.05	03:29	45 52.700	-4 34.300	**61**	03:52	2.9	10	2	off	off	off			"
61	21.10.05	04:06	45 50.000	-4 35.800	**62**	04:48	6.4	10	2	off	off	off			"
62	21.10.05	05:01	45 56.000	-4 38.900	**63**	05:23	2.1	10	2	off	off	off			"
63	21.10.05	05:37	45 55.220	-4 41.770	**~64**	06:16	6.3	10	2	off	off	off			"
64	21.10.05	08:18	45 49.300	-4 38.500	**65**	09:02	6.3	10	2	off	off	off			"
65	21.10.05	09:02	45 55.220	-4 41.770	**66**	09:34	2.1	10	2	off	off	off			"
66	21.10.05	09:34	45 56.000	-4 38.900	**67**	10:13	6.4	10	2	off	off	off			"

Waypoint (begin of profile)	*Date*	*Time UTC*	*Latitude*	*Longitude*	*Waypoint (end of profile)*	*Time (end)*	*Distance [nm] between WP*	*Survey Speed (schedule)*	*Gyro/Motion Sensor#*	*Frequency [kHz]*	*Number of Periods*	*Range [m]*	*Position of Parasound Transducer (x/y/z)*	*Position of Motion Sensor (x/y/z)*	*Comment*
67	21.10.05	10:13	45 50.000	-4 35.800	**68**	10:39	2.9	10	2	off	off	off			"
68	21.10.05	10:40	45 52.700	-4 34.300	**69**	11:20	5.6	10	2	off	off	off			"
69	21.10.05	11:20	45 50.800	-4 41.800	**70**	10:40	2.1	10	2	off	off	off			"
70	21.10.05	11:41	45 52.800	-4 42.900	**71**	12:14	5.5	10	2	off	off	off			"
															Leaving for Vigo
71	21.10.05	15:58	45 54.700	-4 35.500				10	2	4	2	5000	0.97/0.00/0.00	- 4.10/0.35/8.50	Parasound on
79	21.10.05	?	45 39.100	-4 27.600	**80**	21:30		10	2	4	2	5000, 10000	0.97/0.00/0.00	- 4.10/0.35/8.50	end of profile 21.30
-	22.10.05	07:00	44 33.000	-7 47.600					2	4	2	5000		"	data recording off