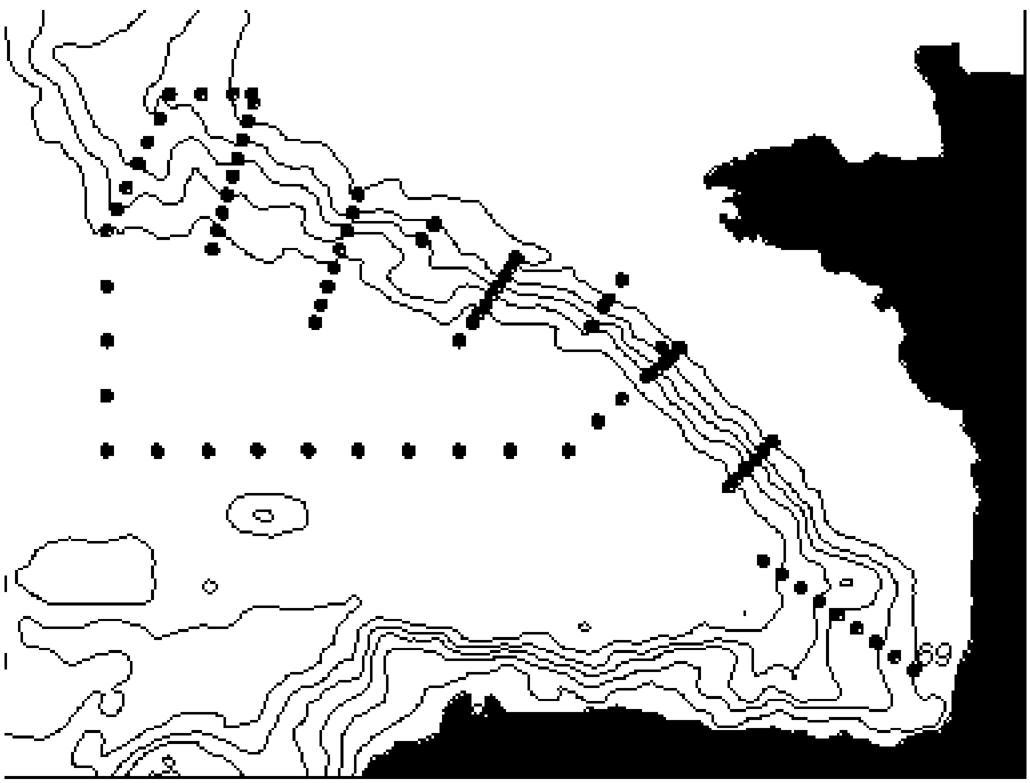
RV Pelagia Cruise Report:

Cruise 64PE96N/1, Project TripleB,

WHP repeat area AR12

H.M. van Aken
Chief Scientist



Bay of
Biscay
Boundary

NIOZ, Texel, 1997

Table of contents

The research reported here was funded by the Foundation for Geological, Oceanographic and Atmospheric Research (GOA), subsidiary of the Netherlands Organization for Scientific Research (NWO)

1 Cruise Narrative

1.1 Highlights

a: WOCE Repeat Section AR12, RV Pelagia cruise 96N/1 in the Bay of Biscay

b: Expedition Designation (EXPOCODE): 64PE96N/1

c: Chief Scientist:

Dr. Hendrik M. van Aken
Netherlands Institute for Sea Research (NIOZ)
P.O.Box 59
1790AB Den Burg/Texel
The Netherlands
Telephone: 31(0)222-369416
Telefax: 31(0)222-319674
e-mail: aken@nioz.nl

d: Ship: RV Pelagia,

Call Sign:	PGRQ
length	66 m.
beam	12.8 m
draft	4 m
maximum speed 12.5 knots	

e: Ports of Call: Texel (the Netherlands) via Brest (France) to Brest (France)

f: Cruise dates: June 18, 1996 to July 15, 1996

1.2 Cruise Summary Information

1.2.1 Summary

In the afternoon of 17 June RV Pelagia departed from Texel, and headed for the Bay of Biscay. We arrived at the northern Biscay continental slope in the early evening of 19 June. Test stations with the CTD-rosette system were performed there on 19 and 20 June in order to establish the functioning of the newly developed sampler closing system.

During the night an echo sounder survey of the continental slope was carried out, in the afternoon of 20 June the ADCP bottom lander was deployed on the continental slope at an uncorrected depth of 835 m. The bottom slope was estimated to be slightly less than 5°. After two CTD stations near the lander deployment site and the deployment of 5 ARGOS drifters over the continental slope course was set to the mooring section deployed in 1995.

On both 21 and 22 June all 8 current meter moorings (BB1 to BB8) were recovered. Serious internal damage due to leaking was observed on 4 of the 13 NBA current meters. The cause of the leakage was found to be tiny cracks in the PVS bolts filling the empty sensor holes in the in instrument cone. However data from 2 of the 4 damaged current meters could be recovered. All 19 Aanderaa current meters as well as the ADCP were found to be in good order. During the nights of 21 and 22 June extra echo sounder surveys were carried out over the continental slope in order to extend the information on the topographic structure near the mooring line as observed in 1995.

After a final test station on the morning of 23 June it was decided that the new sampler closing system did not function reliable, and the old G.O. rosette system was reinstalled. That same morning the survey of the large scale hydrographic section A started near 46°56'N, 6°W. The survey of this section was ended at 29 June over Goban Spur. Small-scale hydrographic section B over the continental slope south of Goban Spur was surveyed on 29 and 30 June. After ending this section course was set to Brest. During this passage an extra echo sounder survey was carried out of the site were the ADCP lander had been deployed. The Pelagia arrived in Brest about noon of July 1. In port C. Veth disembarked and F.P. Lam embarked as a replacement. Also some supplies for the moorings to be deployed were brought in as well as "patches" to overcome problems with the newly updated SUN operating system of the computer network.

On 2 July Brest was left after breakfast. In the afternoon and evening moorings T2 and T1, fitted with current meters and thermistor strings, were deployed over the continental shelf, and shortly before midnight the 25 hours CTD yo-yo station over the continental slope for the "hunting" of solitons in the seasonal thermocline started. This time series station coincided with spring tide. After finishing the yo-yo station, shortly after midnight on 4 July, course was set to the position of mooring T1 which could be recovered although part of the buoyancy was lost. From mooring T2 no trace could be found, also not after sweeping the mooring area with a grappling iron on a long steel wire for about 7 hours. Mooring T2 is considered to be lost.

Moorings BB9 to BB16 were deployed on 5 to 7 July on two lines across the continental slope after performing echo sounder surveys of the mooring sections. Hereafter the hydrographic survey was continued with several sections across the continental slope. The first of these sections, C was in the south-eastern corner of the Bay of Biscay, in the direction of Biarritz, while section D was close to, and nearly parallel to the section where moorings BB13 to BB16 were deployed before. Section E was surveyed on 11 and early 12 July. In the afternoon of 12 July the ADCP bottom lander was recovered. The lander surfaced upside down, but due to the fair weather it could easily be turned in the right position before hoisting the instrument aboard. In the night from 12 to 13 July an echo sounder survey of the continental slope was carried out steaming from the lander position towards the first station of hydrographic section F. The survey of the latter section was finished in the morning of 14 July. On the last two stations of this section it was not possible to take water samples due to the final break down of the G.O. rosette sampler. After finishing section F course was set towards Brest, via the area of the ADCP lander deployment for a last echo sounder section. On Monday morning 15 July R.V. Pelagia arrived in Brest for debarkation of the scientific crew.

1.2.2 Cruise Track

The cruise was carried out in the Bay of Biscay east of 12°W. The cruise track is shown in figure 1.

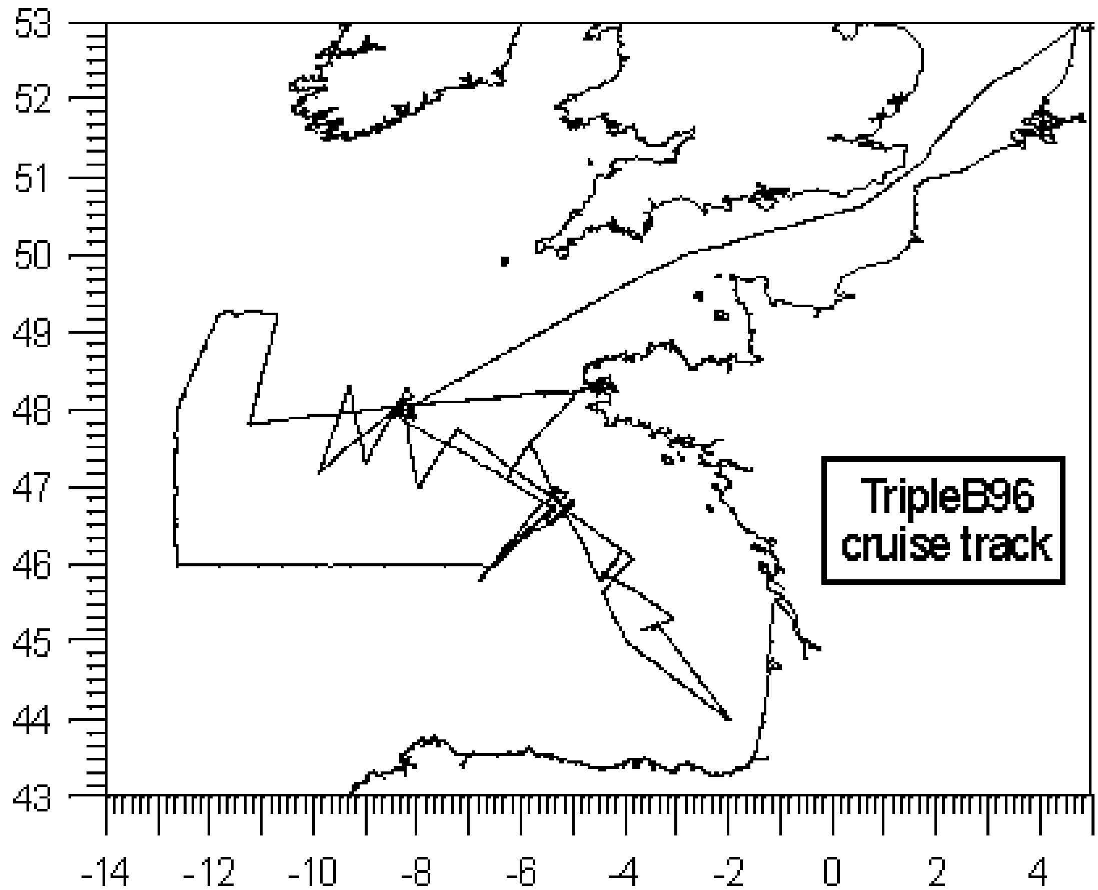


Figure 1. Cruise track of T.V. Pelagia cruise 64PE96N/1

1.2.3 Number of Hydrographic Stations

A total of 91 hydrographic casts was collected (fig. 2). At the hydrographic stations the SBE9/11+ CTD was lowered with a speed of about 1 m/s. Due to the use of a bottom indicator switch we were able to sample to within quite a short distance from the bottom, 4 m until station 60, and 6 m afterwards. After station 27 damage at the till then unused part of the CTD cable was discovered. Thereupon it was decided to limit the veering of the CTD cable to 4780 m, leaving only about the lowest 200 m of the deep basin out of reach from the observations. This applies only to stations 28 to 33 of section A. The CTD system was fitted with a sensor for pressure, with artificially flushed sensors for temperature, conductivity, and oxygen, and sensors for light transmission and fluorescence. An extra suite of not-flushed temperature and conductivity sensors was fitted in the system too. During the down-casts the data from the sensors were collected and stored on computer hard disk with data cycle frequency of 24 Hz.

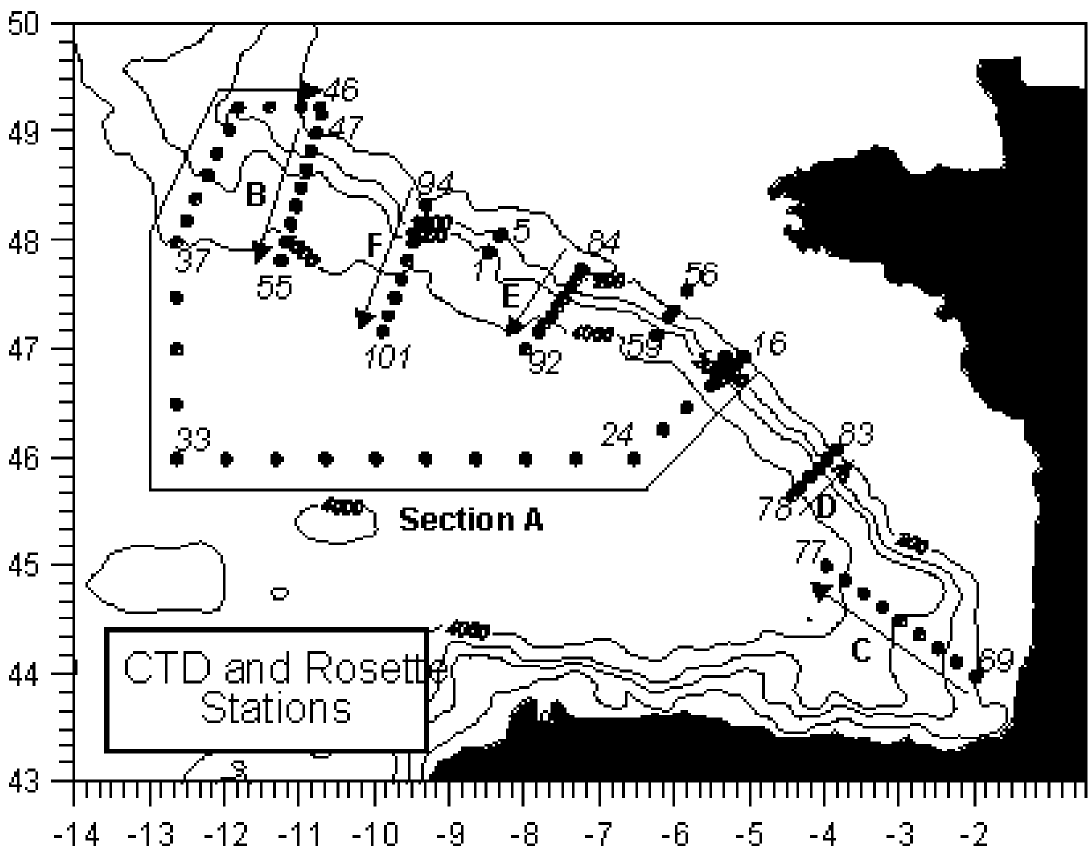


Figure 2. Distribution of hydrographic stations and sections.

1.2.4 Hydrographic Sampling

During the up-cast of each CTD/rosette station water samples were taken. The vertical resolution of these water samples was 250 m in deep water with a better resolution in the upper 1200 m and at shallower stations. From the samplers water was drawn for the determination of dissolved oxygen, nutrients (silica, nitrite, nitrate and phosphate) as well as salinity. At sampler positions 2, 4, 6, and 8 reversing racks were mounted, fitted with SIS reversing electronic thermometers and SIS reversing pressure sensors. Additionally at a limited number of stations an SBE35 temperature sensor was used to record the water temperature at the closing of each sampler bottle. The vertical distribution of the sampling locations is indicated in figure 3.

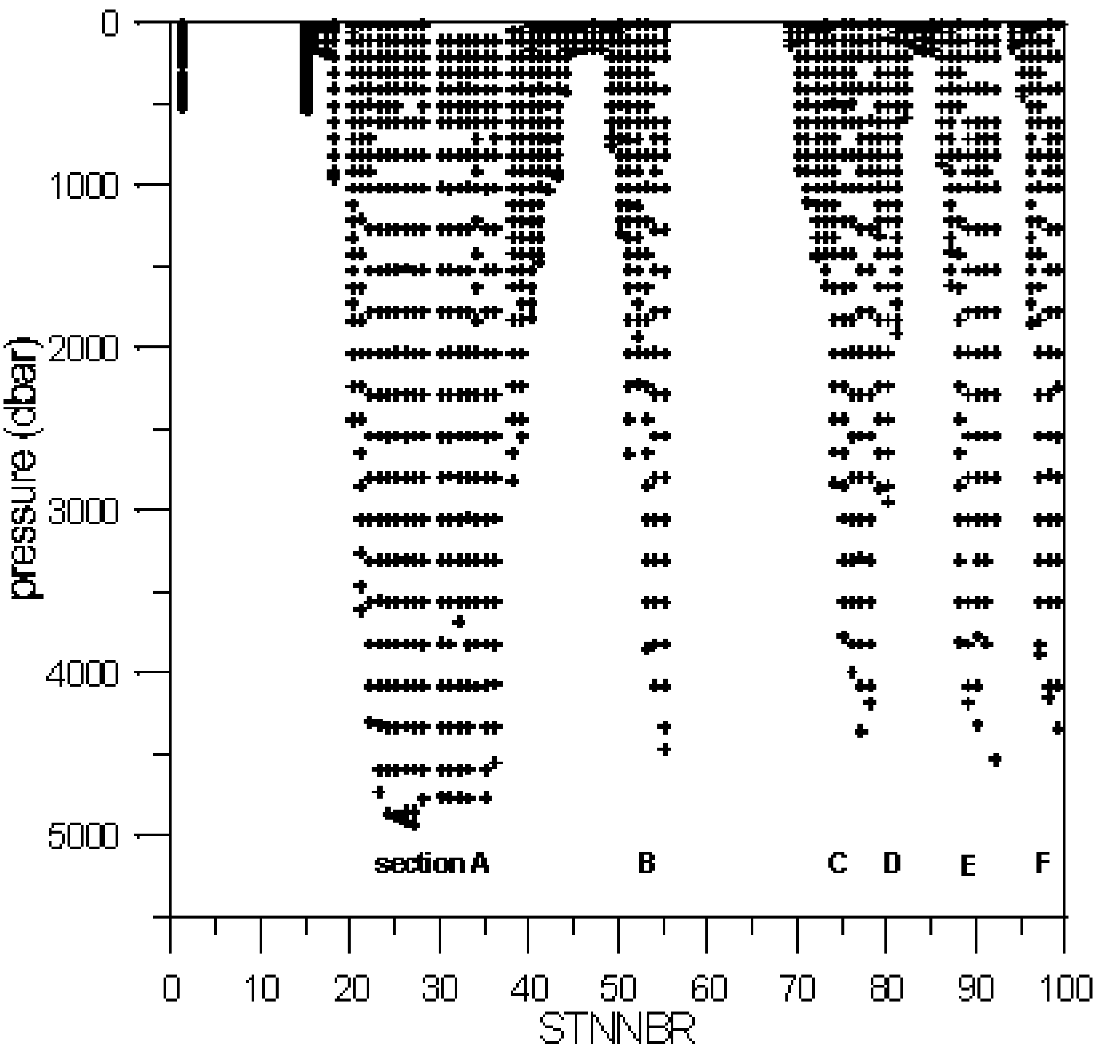


Figure 3. Vertical distribution of the water samples versus station number.

1.2.5 Drifters and Moorings

A total of 5 ARGOS surface drifters were deployed, on 20 June 1996, over the continental slope near 48°N, 8°20'W. These drifters (ptt ID numbers 16118 to 16122) were standard WOCE/TOGA surface drifters manufactured by Clearwater Inc., each fitted with an 8 meter holey sock drogue at an average depth of 15 m. Each drifter has a temperature sensor as well as a submergence sensor. For the following 6 month the drifters mainly moved in SSE direction towards the Spanish continental margin.

Eight current meter moorings, deployed in 1995 on a line from the continental slope to the abyssal plain (BB1 to BB8), were recovered. Three short-term moorings were deployed (ADCP lander, T1, and T2) were deployed from which two could be recovered; mooring T2 was lost. Eight newly prepared current meter moorings were deployed over the continental slope in the SE Bay of Biscay (BB9 to BB16).

The positions of the drifter deployments and of the moorings is indicated in figure 4.

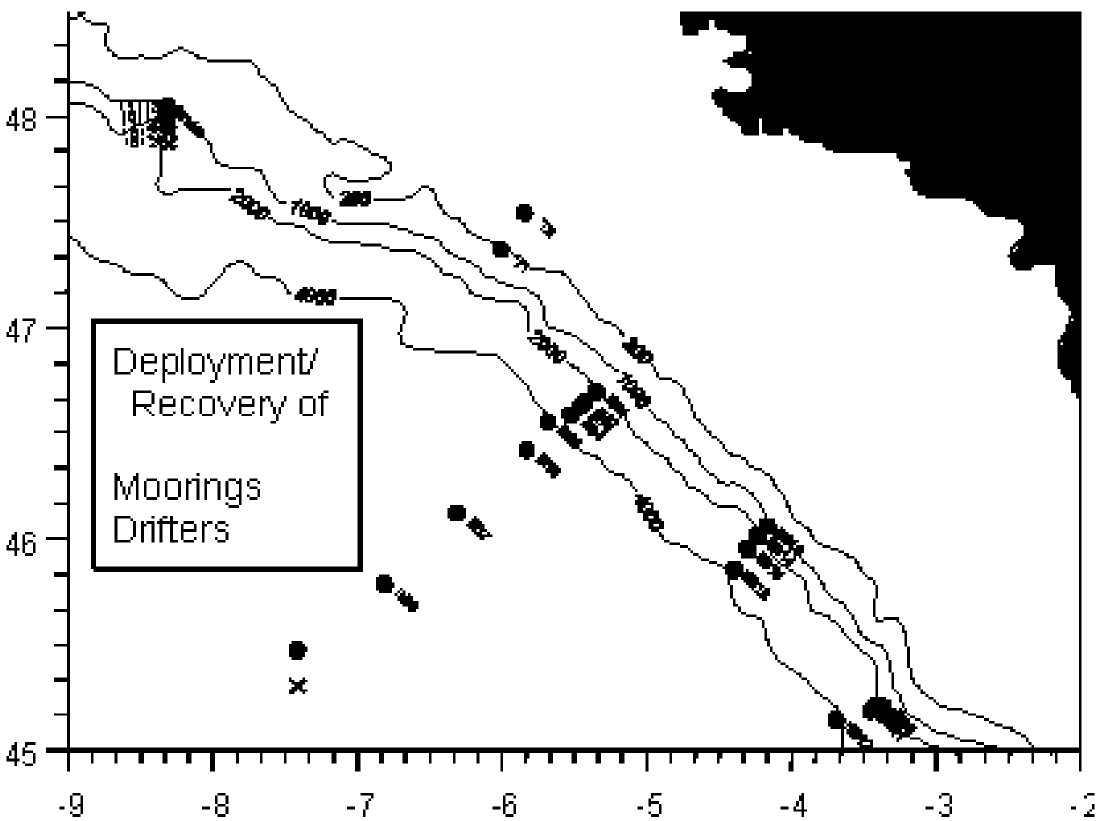


Figure 4. Positions of moorings and of drifter deployments

***.SUM file**

A hard copy of the *.SUM file describing all stations and casts is added in the appendix.

1.3 List of Principal Investigators

Name	Responsibility	Affiliation
Dr. H.M. van Aken	Ocean hydrography, ARGOS drifters.	NIOZ/Texel
Dr. J. van Haren	Boundary mixing	NIOZ/Texel
Drs. F.-P. Lam	Tide-topography interaction	NIOZ/Texel
Ing. S. Ober	CTD & rosette-technology	NIOZ/Texel
Drs. C. Veth	Current measurements.	NIOZ/Texel

1.4 Scientific Programme and Methods

The principal goal of the research carried out during the cruise was to establish the structure, course and transport of the eastern boundary current in the Bay of Biscay, as well as the hydrographic structure of the Bay of Biscay and the nearby eastern North Atlantic, as it is affected by the eastern boundary current. For this purpose a hydrographic survey has been carried out in the Bay of Biscay up to 12°W, 8 long term current meter moorings and 5 ARGOS surface drifters have been deployed. The hydrographic survey covers a large part of the WOCE Hydrographic Research Programme repeat area AR12.

The CTD-rosette frame was fitted with lead filled steel pipes in order to secure a fast enough falling rate. This package was lowered with a velocity of about 1 m/s, except in the lowest 100 m, where the veering velocity was reduced. Measurements during the down-cast went on to within 4 m from the bottom, until the bottom switch indicated the proximity of the bottom. During the up-cast water samples where taken at prescribed depths, when the CTD winch was stopped. After each cast the CTD/rosette frame was placed on deck. Subsequently water samples were drawn for the determination of dissolved oxygen, nutrients and salinity, and the readings of the electronic reversing thermometers and pressure sensor were recorded.

Additional to the main hydrographic research programme ADCP observations have been carried out by means of a benthic lander to study the low frequency turbulent mixing over the continental slope. Short term high frequency temperature observations have been performed with moored thermistor strings and with CTD yo-yos to study internal solitons and other internal waves in the seasonal thermocline over the continental slope and the nearby continental shelf, generated by tide-topography interaction.

1.4.1 Preliminary Results

The raw data, as collected during the cruise, have been processed after the cruise at NIOZ, Texel, as described in chapters 2 and 3. An overview of the preliminary results is given below.

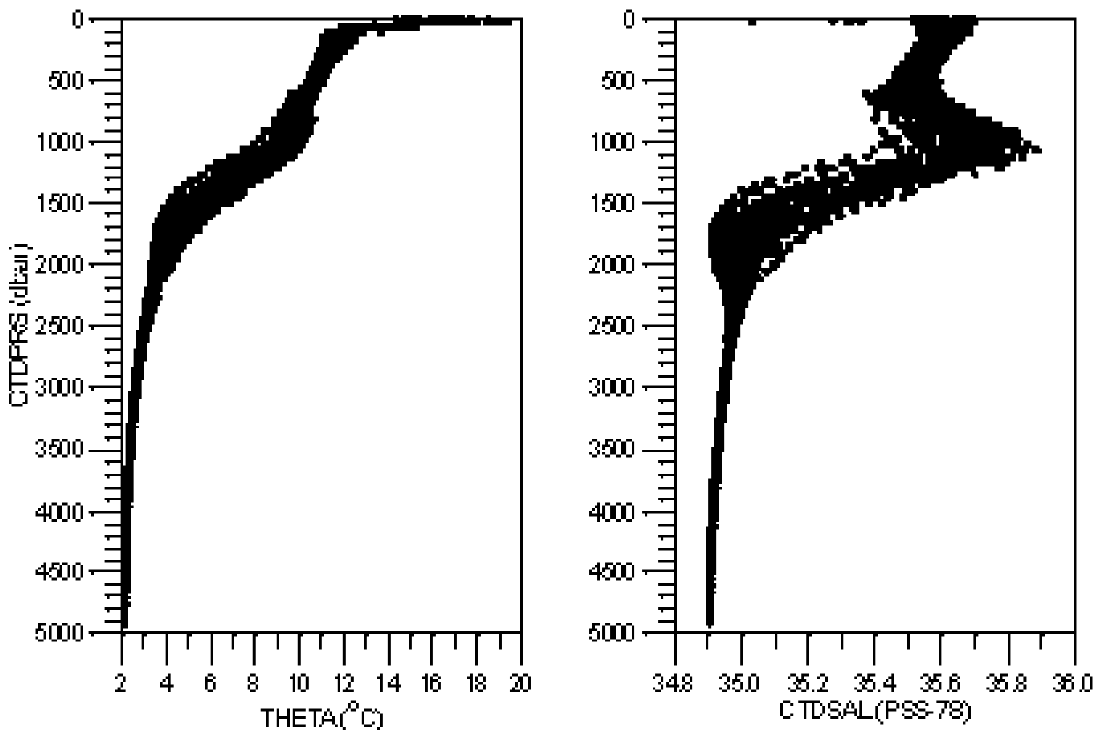


Figure 5. Vertical distribution of potential temperature (THETA) and salinity (CTDSAL) from all CTD down-casts, sub-sampled every 50 dbar.

The vertical distributions of potential temperature (THETA) and salinity (CTDSAL) show a lot of variation between 500 and 2000 dbar (fig. 5), This is due to the presence of variable amounts of Mediterranean Sea Water (MSW) with a salinity maximum at about 1000 dbar and Labrador Sea Water (LSW) with a salinity minimum at about 2000 dbar. The highest salinities at 2000 dbar are observed over the continental slope, probably due to vertical boundary mixing with the saline MSW core. At about 2400 dbar North East Atlantic Deep Water (NEADW) is found, characterized by a relative salinity maximum, although even higher salinities are found over the continental slope, probably also due to boundary mixing with MSW. Between 3000 and 5000 dbar the nearly homogeneous low salinity Lower Deep Water (LDW) is found. This vertical stratification also can be observed in the potential temperature-salinity plot (Fig. 6), while combination with the potential temperature-potential vorticity plot (Fig. 6, second plot) indicates that overlying the MSW core and the permanent pycnocline horizontally nearly homogeneous Mode Water is found with a low vertical stratification at potential temperatures around 11.5 C. The overlying seasonal pycnocline is characterized by high potential vorticity values at temperature over 12.5°C. At the level of the salinity minimum due to the presence of LSW (~3.5°C) no clear minimum in the potential vorticity distribution could be discerned.

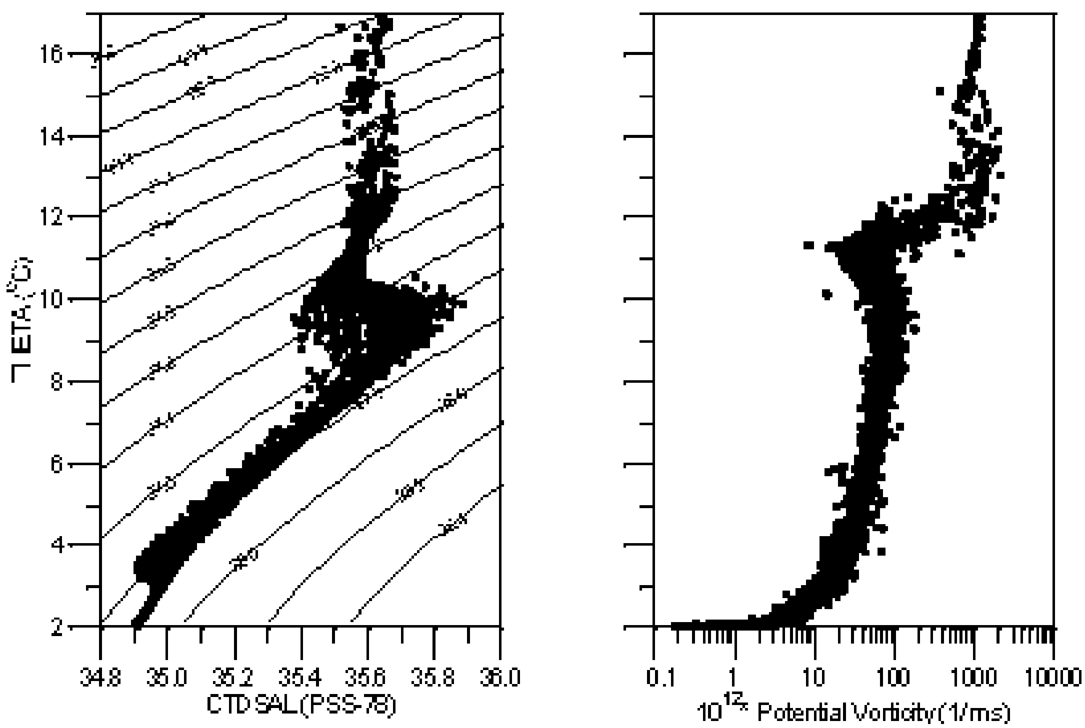


Figure 6. Diagrams of salinity and potential vorticity versus potential temperature. The data are from all CTD casts, sub-sampled every 50 dbar.

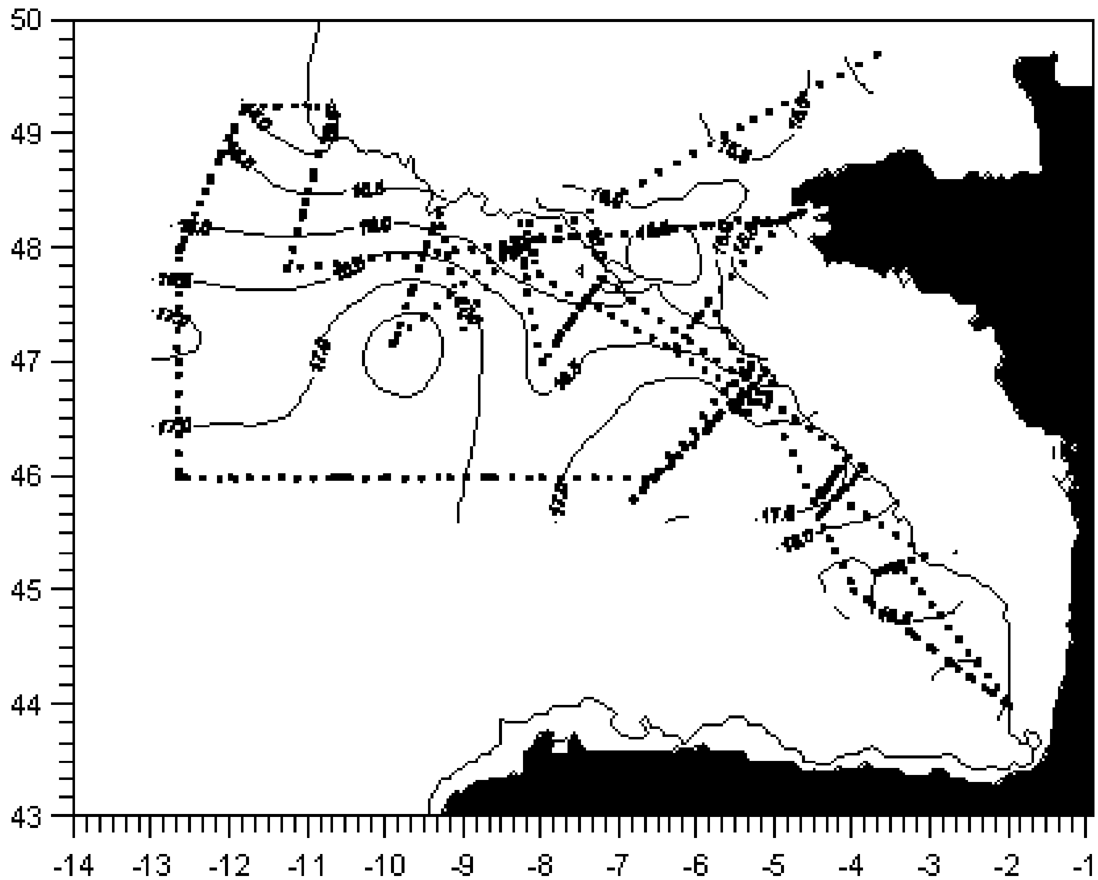


Figure 7. Distribution of the Sea Surface Temperature (SST), as observed with the AQUAFLOW thermosalinograph system. The thick line indicates the position of the 200 m isobath, while the dots show the ship track.

The distribution of the Sea Surface Temperature (SST, Fig. 7) shows SST values in the range between 14.5 and 19°C. The coldest surface water is found over the western Celtic shelf edge near Goban Spur, and the warmest water in the SE corner of the survey area. Over the deeper parts of the Bay of Biscay the SST amounts to about 17°C. The largest SST gradients are found perpendicular to the Celtic Shelf edge over the slope and abyssal plain. Although not completely clear due to the lack of SST data over the continental shelf the SST distribution suggests that an SST minimum is connected to the position of the continental break.

The distribution of the Sea Surface Salinity (SSS, Fig. 8) shows a picture different from the SST distribution, with the highest SSS gradients near the shelf edge in the SE part of the survey area. This is due to the presence of a thin surface layer, considerably diluted by river runoff from the nearby continent. The SSS in the centre of the Bay of Biscay is about 35.65, with values of 35.55 to 35.60 over the Celtic shelf edge. Salinities below 35 were observed in the coastal water near Brittany.

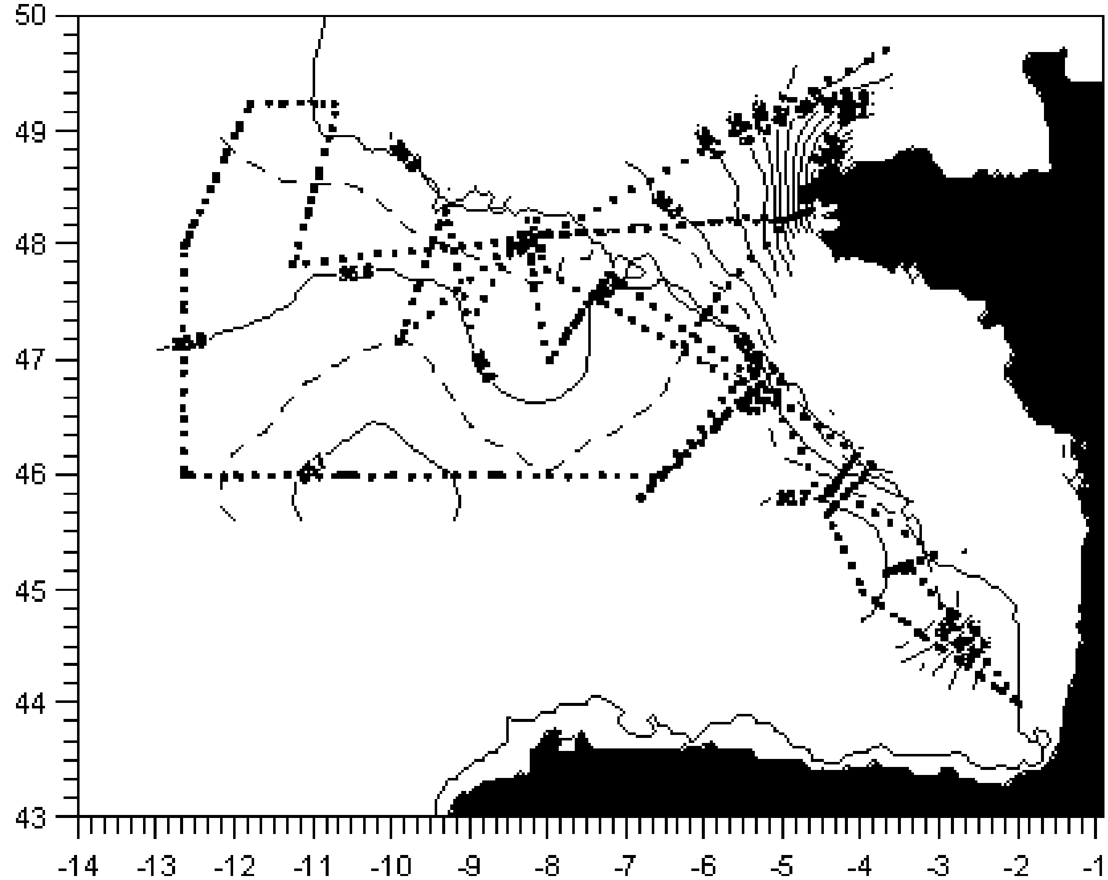


Figure 8. Distribution of Sea Surface Salinity (SSS) as observed at the AQUAFLOW thermosalinograph system. The thick line indicates the position of the 200 m isobath, while the dots show the ship track.

The vertical distribution of the dissolved oxygen concentration (OXYGEN, Fig. 9) reflects the vertical distribution of water types described above. The MSW layer is characterized by an OXYGEN minimum of about 185 _ mol/kg. While in the LSW core near 2000 dbar maximum OXYGEN values of over 270 _ mol/kg are observed at potential temperature of about 3.5°C. Over the continental slope this OXYGEN maximum is decreased or absent, probably due to increased vertical mixing. In the low potential vorticity Mode Water layer near THETA ≈ 11.5°C relatively high OXYGEN values of about 240 _ mol/kg are observed, with even higher values in the seasonal thermocline near THETA ≈ 15°C. The latter oxygen maximum was, according to the fluorescence measurements connected with the presence of a deep chlorophyll maximum in the seasonal thermocline.

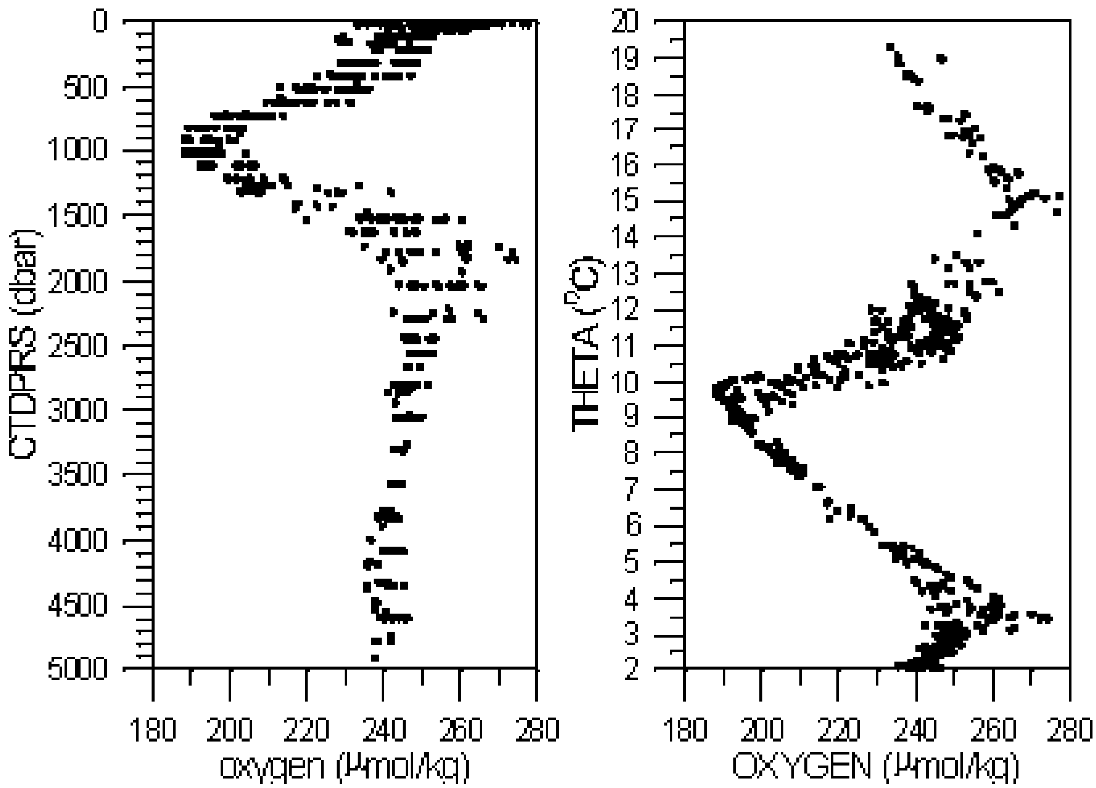


Figure 9. Plots of the dissolved oxygen concentration (OXYGEN) versus the pressure (CTDPRS), and the potential temperature (THETA). All the reliable bottle samples with quality flags 2 (reliable) or 6 (reliable duplicate) are shown.

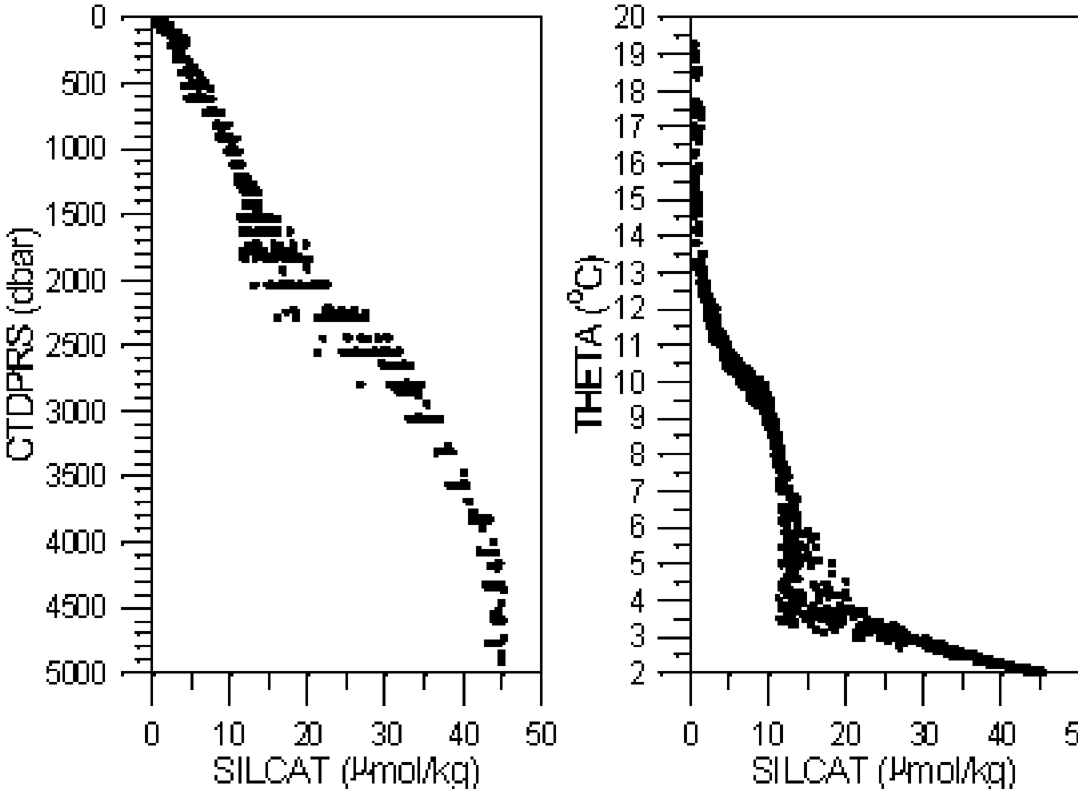


Figure 10. Plots of dissolved silica (SILCAT) versus the pressure (CTDPRS), and the potential temperature (THETA). All reliable bottle samples are shown.

The vertical distribution of dissolved silica (SILCAT, Fig. 10)) shows that the MSW core is characterized by SILCAT values of about 10 _ mol/kg, from there slowly increasing downward, and steadily decreasing to the surface where values below 1 _ mol/kg were observed. Over the continental slope this minimum was absent, probably due to increased vertical mixing. At the level of the LSW core (2000 dbar, ~3.5°C) a relative SILCAT minimum of about 11 _ mol/kg was observed. Below this level SILCAT increases downward to values of about 45 _ mol/kg below 4000 dbar. This is due to the relatively large contribution of Antarctic Bottom Water (AABW) to the formation of the LDW core.

The distribution of dissolved nitrite (NITRIT, Fig. 11) shows generally low values below 0.05 _ mol/kg with the exception of the near surface layer where higher values up to 0.5 _ mol/kg were found. The plot of NITRIT versus THETA indicates that these high values are found in the seasonal thermocline near THETA ≈ 13°C.

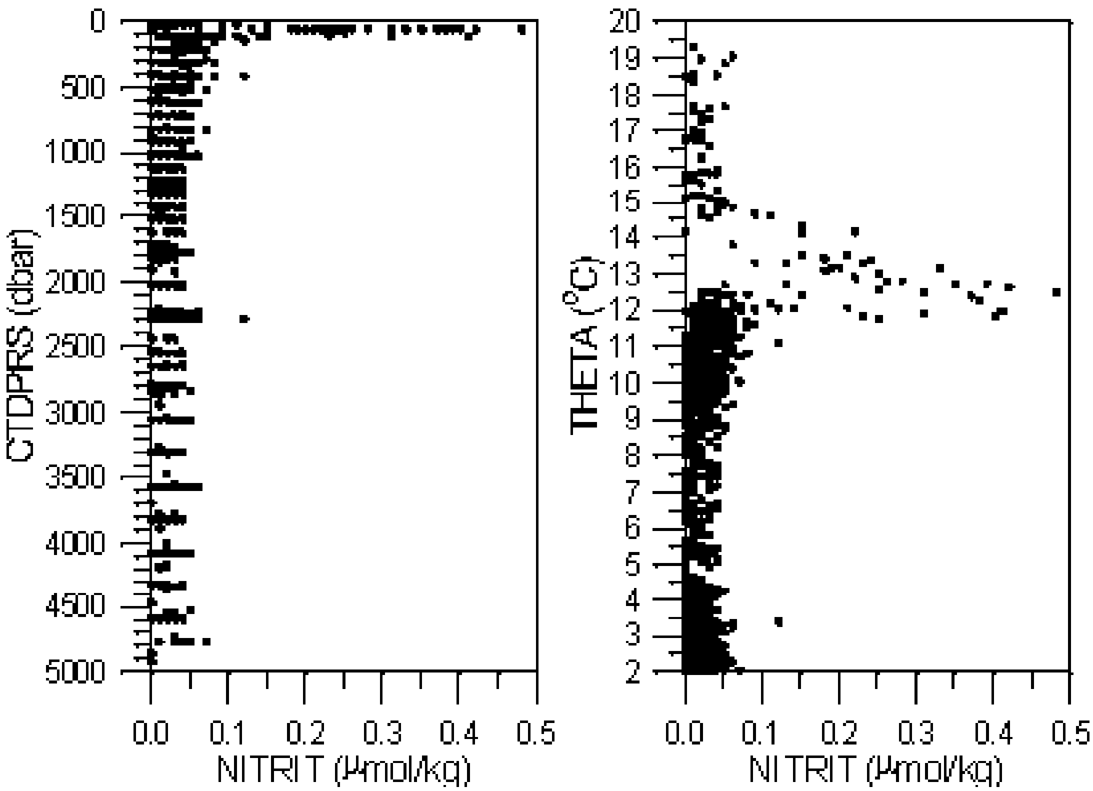


Figure 11. Plots of the dissolved nitrite concentration (NITRIT) versus the pressure (CTDPRS), and the potential temperature (THETA). All reliable bottle samples are shown

The vertical distributions of dissolved nitrate (NITRAT) and dissolved phosphate (PHSPHT) is given in Figs. 12 and 13. In the surface mixed layer with THETA > 15°C NITRAT is nearly zero, while PHSPHT has values of about 0.05 _ mol/kg. From there downward both NITRAT and PHSPHT increase to values of respectively about 17 and 1.05 respectively in the MSW core and of 17.5 and 1.1 _ mol/kg respectively in the LSW core. Below the LSW core the both NITRAT and PHSPHT increase steadily downward to values of respectively about 22.5 and 1.5 _ mol/kg in the LDW core below 4000 dbar.

The values of NITRAT and PHSPHT in the cores of MSW and LSW already indicate the N/P Redfield ratio amounts to about 16. This is confirmed in a PHSPHT versus NITRAT plot (fig. 14) for NITRAT values between 7 and 18°_ mol/kg. At lower concentrations in the near surface layers there appears to be a slight excess of PHSPHT relative to the N/P ratio of 16. Also at the higher concentrations as found in the LDW a slight PHSPHT excess is observed, probably due to the different N\P ratio in the Southern Ocean, from where AABW spreads northward and contributes to the formation of LDW. The differing biogeochemistry of SILCAT relative to NITRAT and NITRIT is reflected in a much more curved SILCAT versus NITRAT line as shown in the second plot in Fig. 14.

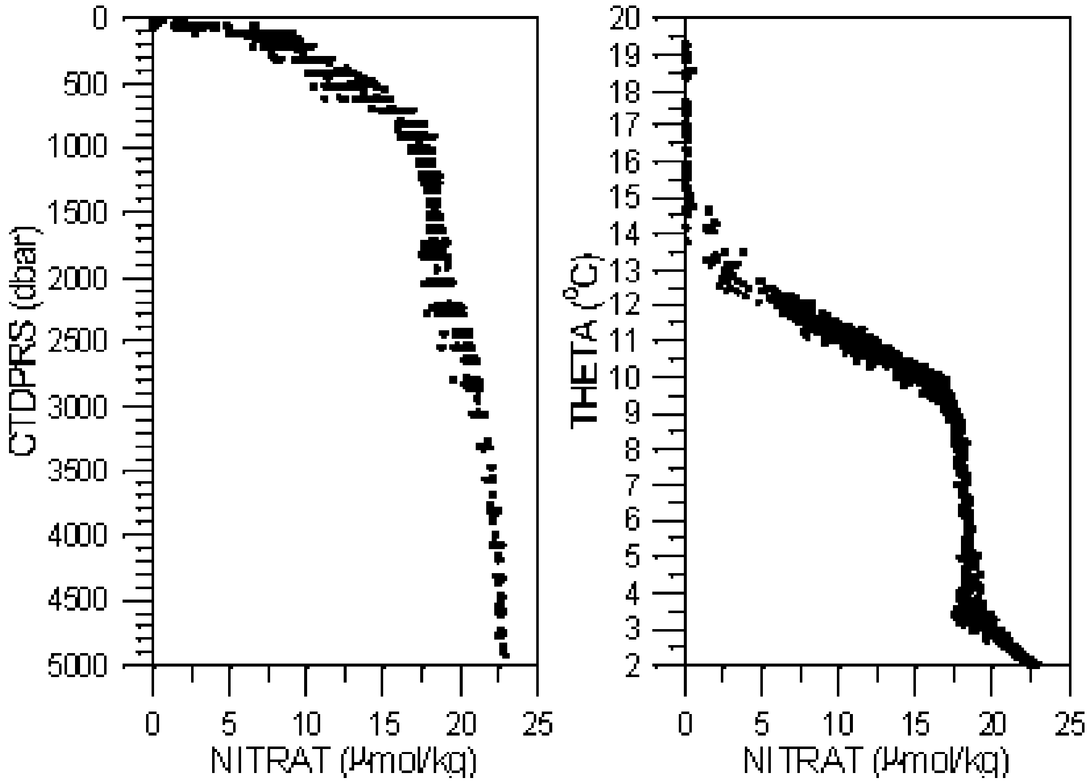


Figure 12. Plots of the dissolved nitrate concentration (NITRAT) versus the pressure (CTDPRS), and the potential temperature (THETA). All reliable bottle samples are shown

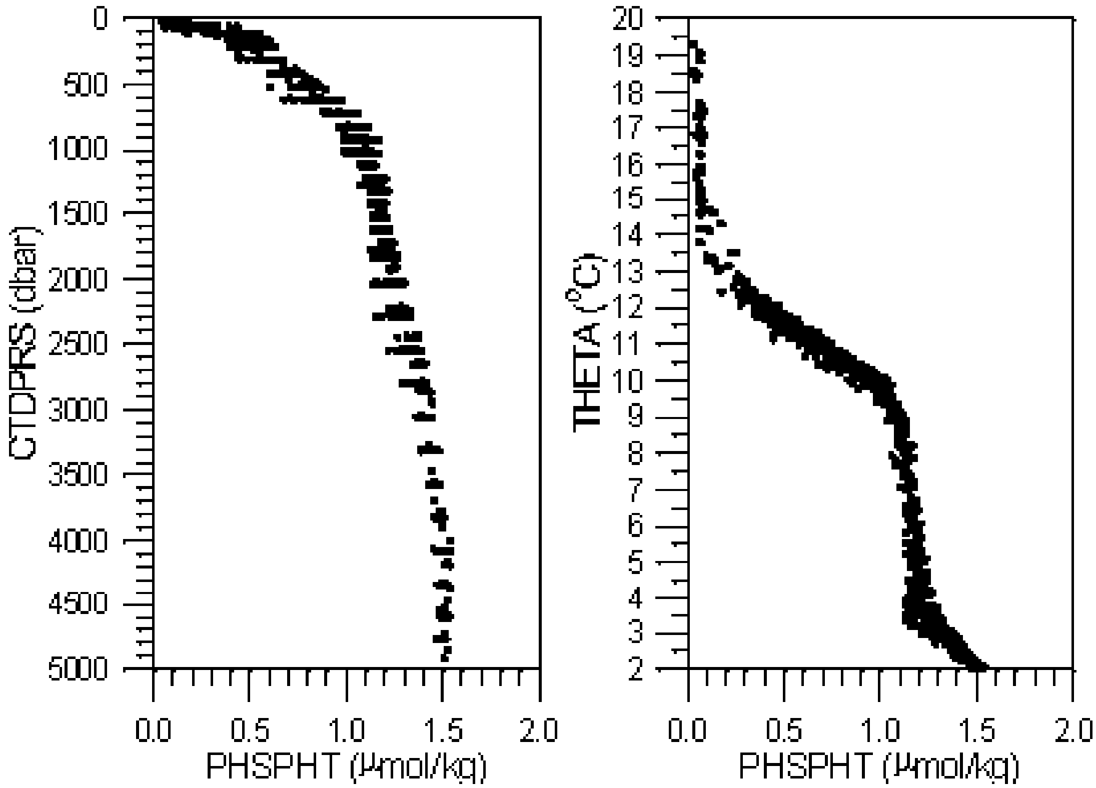


Figure 13. Plots of dissolve phosphate concentration versus the pressure (CTDPRS), and the potential temperature (THETA). All reliable bottle samples are shown.

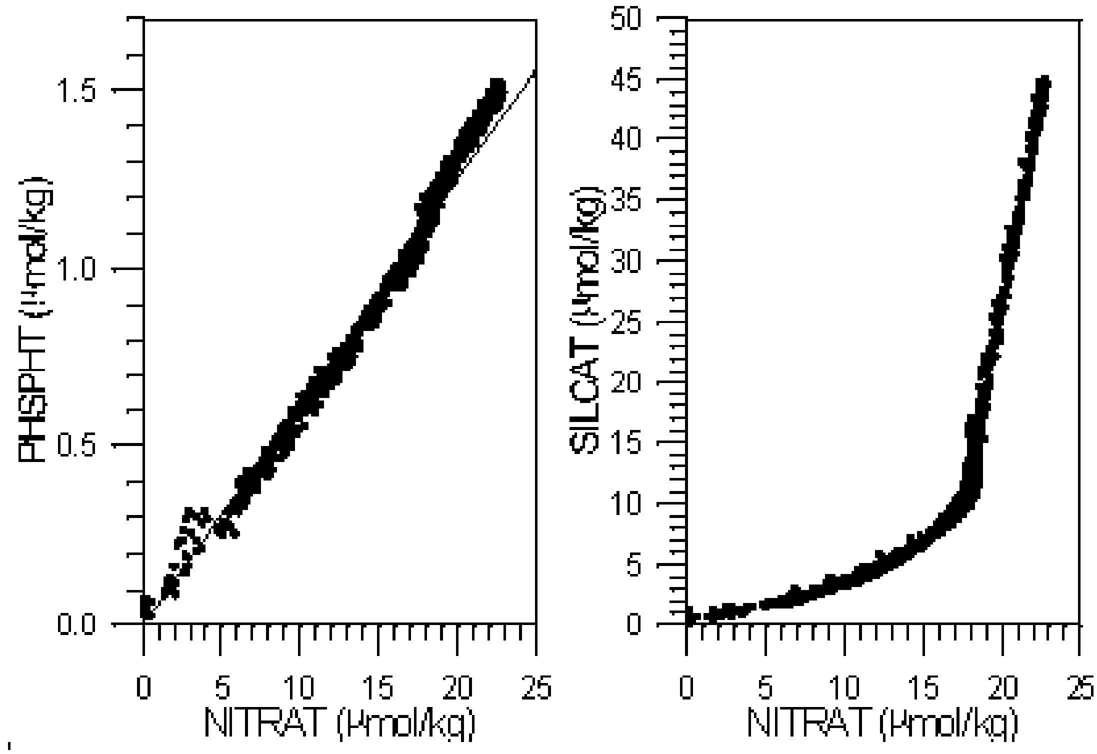


Figure 14. Plots of the concentrations of dissolved phosphate (PHSPHT) and silica (SILCAT) versus the concentration of dissolved nitrate (NITRAT). All reliable bottle sample are shown. In the phosphate versus nitrate plot the straight line represents the N/P Redfield ratio of 16.

The data from the current meters as well as from the ADCP from the recovered long term moorings have been analysed in a preliminary way. One ADCP and 30 current meters were recovered. Two current meters did not hold any data, while in one current meter the digitized direction missed the most significant bit. One current meter was stalled for about 10 days because of the presence of XBT wire in the impeller rack.. The quality of the current meter data turns out to be very good. Both in the low sub-tidal frequencies as well as at tidal frequencies large phase differences have been observed over relatively short vertical distances (100 to 250 m). The Richardson number is estimated to be regularly at or below the critical value of 0.25. At super-tidal frequencies spectral peaks for all kinds of combinations of tidal and inertial frequencies have been observed. At the level of the core of the MSW near 1000 m an eleven months mean velocity of 5 to 6 cm/s was observed over the continental slope, directed in an north-westward direction, parallel to the continental slope. At the level of the LSW core near 2000 m the currents over the continental slope had an eastward component.

The ADCP lander was deployed on the slope of a narrow canyon in the continental slope near La Chapelle Bank. Tidal current up to 60 cm/s were observed in the lowest 50 m above the bottom, with a considerable shear mainly due to a shift of phase of the internal tides. The estimated Richardson number was regularly at the critical value for turbulence of 0.25.

At the CTD yo-yo station internal solitons were observed in the seasonal pycnocline with a vertical magnitude of about 50 m. The number of solitons per tidal period however was smaller than observed in 1995, although in 1996 the measurements were performed at spring tide, contrary to 1995, when similar observations where performed about 5 days before spring tide. Also from the instruments of the recovered mooring T1 on the nearby shelf signs of solitons were found.

1.5 Major Problems Encountered during the Cruise

No major problems were encountered during the cruise so that all observations planned for the cruise could be carried out. The fair weather during our four weeks in the Bay of Biscay limited the strain on the instrumentation as well as on the personnel.

Occasionally the CTD/rosette system had failures due to malfunctioning of the water samplers and the rosette system. The resulting data loss due amounted to 8%, mostly caused by problems due to leakage of the G.O. rosette system, and due to closing problems with the ill designed NOEX samplers. For hydrographic small-volume sampling the simpler and more reliable Niskin bottles should be preferred. The problems with the G.O. rosette are well known, and hard to solve. But due to lack of systematic maintenance of these systems problems have become worse. At the end of the cruise the sensor package of the CTD nearly was lost, because the stainless steel band used for the fixation of the sensors was torn. This is the second time such a failure occurred with the SBE CTD, and it is recommended to use other material for fixation of the sensors. The glass tube of one of the SIS pressure sensors was found to be broken at station 99. This is probably due to a design problem. The manufacturer is aware of this problem and is looking for a solution.

During the first two weeks the computer network regularly failed due to bugs in the newly installed operating system of the SUN server. After the halfway break in Brest “patches” were installed in the server to repair this problem. After that major problems with the network did not occur.

Occasionally the level B of the data logging system, responsible for the data archiving, broke down, causing data loss for periods of half an hour to about 10 hours. In the last week of the cruise this system completely failed and was replaced by the level B back up system.

Four of the current meters deployed in 1995 and recovered during this cruise had internal damage by leaking. On a first inspection no direct cause could be discovered, but later on it was found out that the PVC stoppers on empty sensor holes had become fragile from ageing, causing leakage through hair cracks.

The mooring T1, deployed on the continental shelf preceding the CTD yo-yo appeared to be halfway sunk when we came back for recovery. Probably leakage of one of the “Floatex” buoyancy elements was the cause of this problem. Due to the extra buoyancy of the spar buoy, used as a surface marker for the mooring, and which resurfaced during neap tide, the mooring could be recovered. With mooring T2 we were not so lucky. When we arrived no trace of the mooring could be found. Also during neap tide the spar buoy of this mooring did not come to the surface. Thereafter we swept with a grappling iron for 7 hours in the vicinity of the mooring location, but did not find a trace of the mooring. No cause for the loss of this mooring could be established.

At station 27 it appeared that the CTD cable was damaged on the winch drum at about 5000 m from the CTD. For safety reasons it was decided to limit the amount of cable to be veered out to 4780 m. This prevented us to reach the bottom within 200 m for the few remaining deep stations, but hardly interfered with the programme.

1.6 Lists of Cruise Participants

Scientific crew

person	responsibility	Institute
H.M. van Aken	Chief Scientist, ARGOS drifters	NIOZ
J. Adema	Salinity Measurements, Hydro Watch	IMAU
M. Bakker	Mooring Operations, CTD Winch Operations	NIOZ
P. Berkhout	Oxygen Determinations	IMAU
J. Derksen	Computer Network, Acoustic Releases, Hydro Watch	NIOZ
J. van Haren	ADCP-lander, Current Meters, Hydro Watch	NIOZ
M. Hiehle	Salinity Determination/Data Management	NIOZ
R.X. de Koster	Data Management, Hydro Watch	NIOZ
F.-P. Lam	CTD yo-yo, Hydro Watch	NIOZ
M. Manuels	Oxygen Determination	NIOZ
S. Ober	$CTDO_2$ system, Hydro Watch, Current Meters	NIOZ
J. van Ooijen	Nutrients	NIOZ
W. Polman	Mooring Operations, CTD Winch Operations	NIOZ
L.A. te Raa	Hydro Watch, Salinity Determination	IMAU
C. Veth	Current Meters, Hydro Watch	NIOZ
E. van Weerlee	Nutrients	NIOZ

Ships crew

J. Groot	captain
A. Schoo	first mate
M. Molenaar	second mate
J. Pieterse	first engineer
J. Kalf	second engineer
D. Benne	cook
P.-W. Saalmink	ships technician
R van der Heide	ships technician
G.M. Gouka	ships technician

2 Underway Measurements

2.1 Navigation

RV Pelagia has several different navigational systems. We used the Differential GPS receiver for the determination of the position. The data from this receiver were recorded every ten seconds in the ABC data logging system. After removal of a few spikes these data were sub-sampled every five minutes.

2.2 Echo Sounding

The 3.5 kHz echo sounder as well as the navigational Furuno echo sounder were used on board to determine the water depth. The uncorrected depths from these echo sounders were recorded in the ABC data logging system. Over the steepest parts of the continental slope the depth digitizer of the 3.5 KC echo sounder was occasionally not able to find a reliable depth. The maximum range of the Furuno echo sounder to obtain reliable results was about 800 m.

Near the deployment site of the benthic ADCP lander and near the positions of the recovered current meter moorings on the continental slope additional echo sounder surveys were carried out to determine the topography of the deployment locations. Preceding the deployment of the current meter moorings a line was surveyed to determine the deployment sites, which were bound to predetermined depth ranges.

The SIMRAD EK 500 multiple frequency echo sounder was used to observe the variations in the depth of the scattering layer due to internal waves in the seasonal thermocline. Whenever the ship was near the continental slope data from this instrument were recorded on the ship's computer as well as on a colour printer.

2.3 Thermosalinograph Measurements

The Sea Surface Temperature, Salinity, and Oxygen concentration were measured with an AQUAFLOW thermosalinograph with a water intake at a depth of about 3 m. The primary temperature sensor, mounted near the water inlet, had been calibrated just prior to the cruise. For the calibration of the salinity sensor, and the oxygen sensor, water samples were taken three times per day. With these samples the calibration of the conductivity sensor and the oxygen sensor were determined. The observed salinity and oxygen values were corrected accordingly. The accuracy of the temperature, salinity and oxygen concentration from the thermosalinograph system was estimated to amount to 0.01°C, 0.05 and 3 _ mol/kg respectively.

3 Hydrographic measurements - Descriptions, Techniques, and Calibrations

3.1 Rosette Sampler and Sampler Bottles

A General Oceanics 24 position rosette sampler was used, fitted with 10 litre NOEX sampler bottles. On most stations only 22 sampler bottles were placed in the rosette. Their general behaviour was good, but a number of bottles had to be replaced during the cruise. This was mainly because of failure of the silicon rubber tubes of the closing system causing failures of closing in time. The sampling had a resulting failure rate of 8 percent because of malfunctioning of the sampler bottles and the rosette system. The samplers from which oxygen samples were drawn were mostly fitted with gas tight PETP sampler lids. Only at the near surface samplers silicon rubber lids were used. Oxygen samples from these bottles were corrected according to the algorithm determined during cruise 64PE95N/1, but corrections were small, less than 1 _ mol/kg.

3.2 Temperature Measurements

On sampler bottles 2, 4, 6, and 8 thermometer racks were mounted, fitted with SIS electronic reversing thermometers with a numerical resolution of 1 mK. On samplers 2 and 8 one SIS sensor was mounted, and on samplers 4 and 6 three sensors. Also mounted on the CTD was a high precision SBE35 temperature sensor. This sensor was well calibrated before the cruise, and on board zero point checks were performed in a H_2O triple point cell. The temperatures of the SBE35 sensor were recorded with all samples at 14 deep CTD casts. The accuracy of the SBE35 sensor is well below 1 mK.

The standard deviations of the individual readings of the SIS reversing thermometers after correction for the systematic offset was estimated from the triplicate reading from the SIS sensors mounted on sampler bottles 4 and 6 to amount to 1.5 mK. The readings from SIS sensors and the SBE35 sensor were, if necessary, averaged, and are reported in the *.SEA file as REVTMP.

The readings from the SBE35 and SIS sensors (REVTMP) were compared with the temperature readings from the CTD system when the samplers were closed. The CTD temperature (CTDTMP) was corrected for heating due to viscous dissipation in the viscous sub-layer around the sensor, and were also corrected for the pressure dependence of the sensor as supplied by the manufacturer. The mean difference REVTMP-CTDTMP for all reliable samples amounted to 0.2 mK with a standard deviation of 4.4 mK (428 samples). When using only the samples obtained below 2000 dbar, where vertical gradients are small, and connected errors due to differences in response time of the different sensors involved are also assumed to be small, the standard deviation was reduced to 2.1 mK, while restriction to samples obtained below 3000 dbar resulted in a mean difference of -0.1 mK and a standard deviation of 1.3 mK (105 samples). Therefore it was decided to apply the manufactures calibration of the CTD temperature sensor unaltered. The plot of CTDTMP versus REVTMP is given in fig. 15.

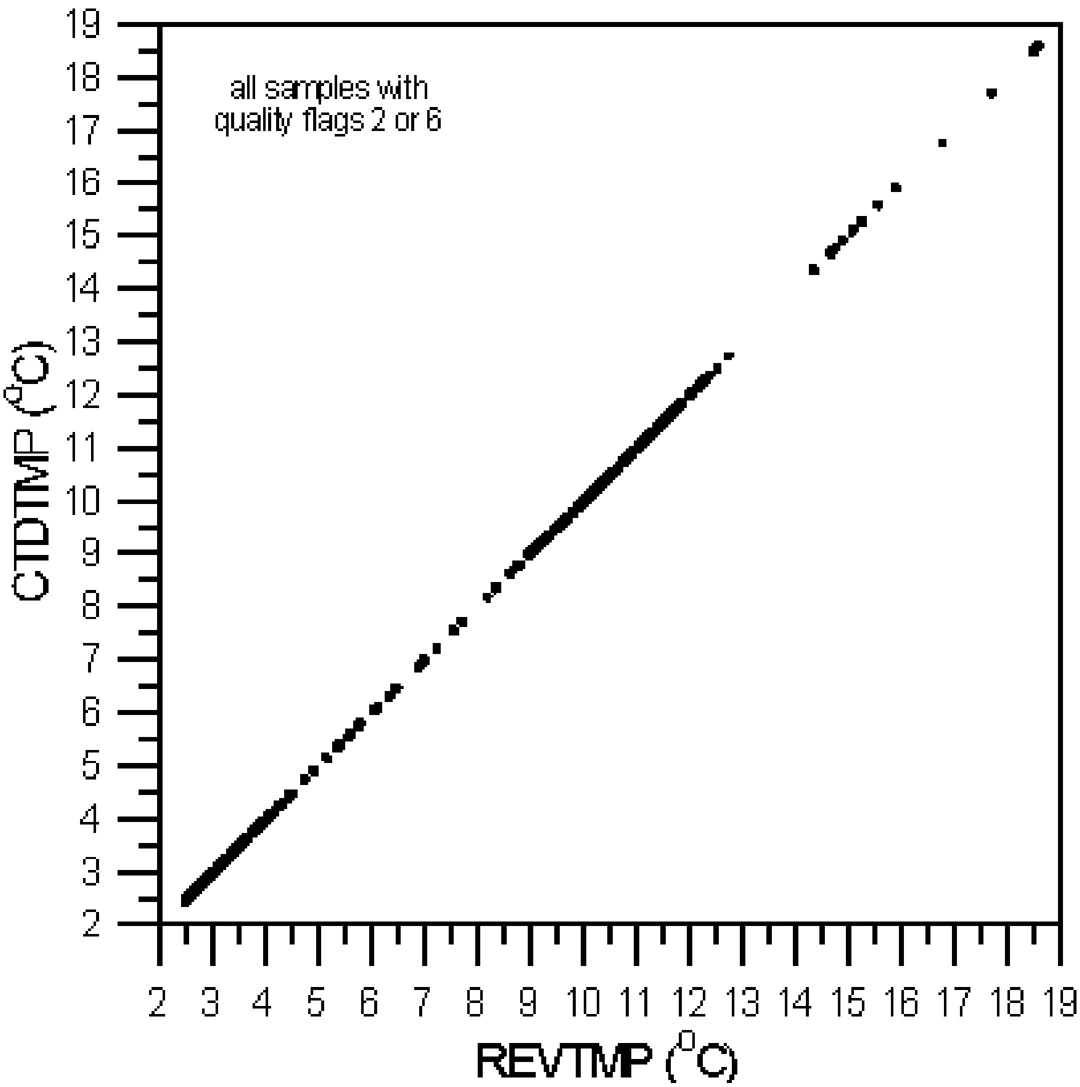


Figure 15. Plot of the temperature determined with the CTD (CTDTMP) versus the temperature determined with the SIS sensors and the SBE35 sensor (REVTMP). All reliable data points are shown.

3.3 Pressure Measurements

In each of the thermometer racks, mounted on sampler bottles 2 and 8, 2 SIS electronic reversing pressure sensors were placed. Before the cruise these sensors were calibrated by the manufacturer. A total of 93 reliable pressures were obtained. Also readings of the deck pressure was performed with the SIS sensors to determine an additional zero offset. Previous experience has shown that such offset readings before and after each CTD cast give identical results. In our case the application of the zero offset more than halved the RMS value of the difference between the pressure readings from the SIS sensors and the CTD system. The mean data from the SIS pressure sensors have been reported in the *.SEA files as REVPRS.

From comparison of the readings of the pairs of sensors mounted in the same thermometer rack it was found that the differences between individual sensors had an RMS value of 1.4 dbar.

The readings from the SIS pressure sensors (REVPRS) were compared with the pressure reading from the CTD when the samplers were closed (CTDTMP). The mean difference REVTMP-CTDTMP was found to have an RMS value of 2.1 dbar. Therefore it was decided to apply the manufacturers calibration for the pressure sensor unaltered. The plot of CTDPRS versus REVPRS is given in Fig. 16.

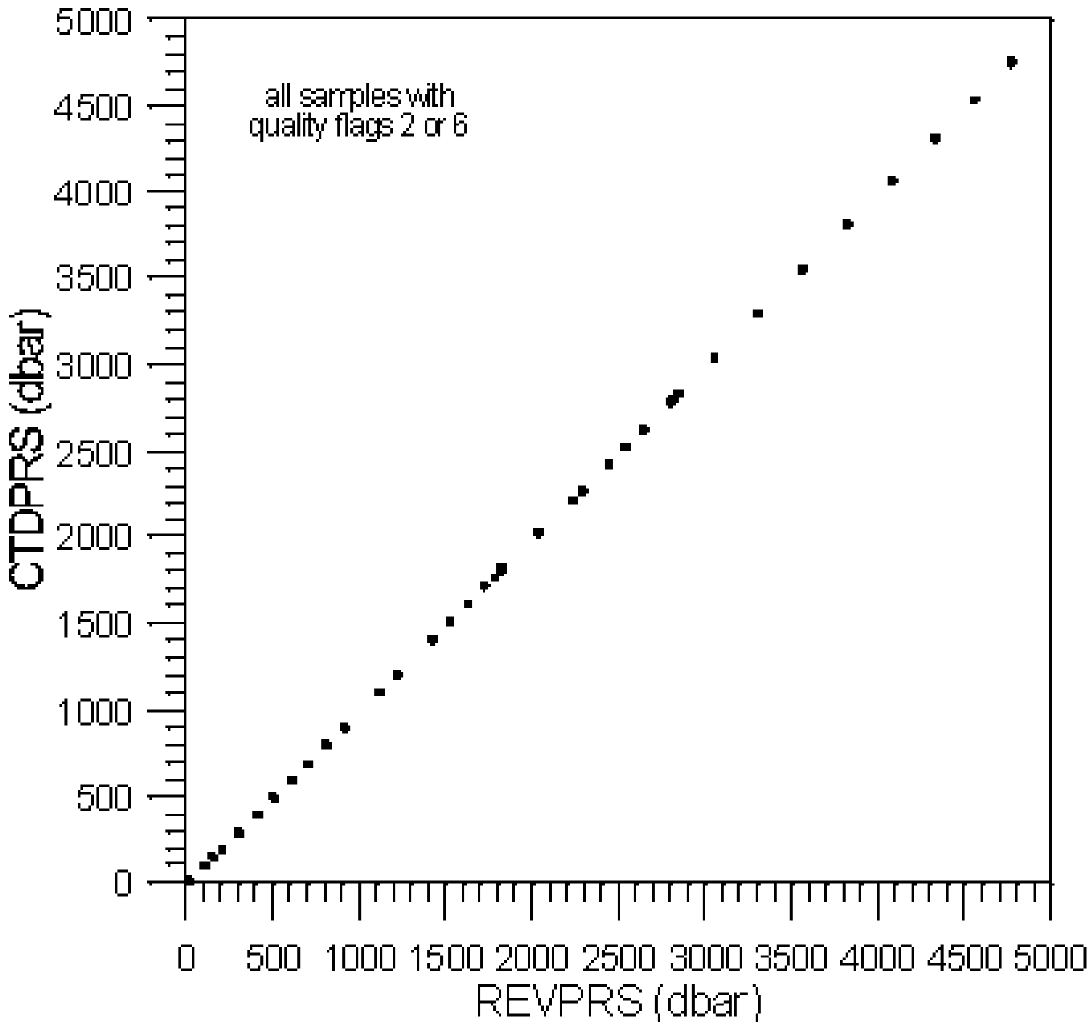


Figure 16. Plot of the pressure determined with the CTD versus the pressure (CTDPRS) determined with the SIS sensors (REVPRS). All reliable data points are shown.

3.4 Salinity Measurements

Water was drawn from the samplers into a 0.5 litre glass sample bottle for the salinity determination after 3 times rinsing. The sample bottles had a massive rubber stopper as well as a screw lid. Salinity of water samples (SALNTY) was determined within 36 hours by means of an Guildline Autosal 8400A salinometer. Care was taken that the temperature of the sample bottles was well adapted to the laboratory temperature. The readings of the salinometer were performed by computer, giving the average and statistics of 10 consecutive readings. For each sample 3 salinity determinations were carried out. The standard water used was from batch P119 with a K_{15} ratio of 0.99990 (S=34.996), prepared at 28 February 1992.

From most deep CTD/rosette casts two extra duplicate samples were drawn. Salinity determinations from the duplicate samples obtained from independent salinometer runs were used to determine the reproducibility of the salinity determination. The RMS value of the salinity difference between the duplicate samples amounted to 0.0008 (115 samples).

The salinity from the water samples (SALNTY) was compared with the salinity reading from the CTD (CTDSAL). A persistent difference of 0.0038 was found which forced us to alter the manufacturers calibration of the conductivity sensor of the CTD system. After applying the new calibration the difference SALNTY-CTDSAL for all reliable samples had an RMS value of 0.0016 (503 samples). When using only the samples taken below 3000 dbar, where vertical gradients are small and less prone to cause differences between SALNTY and CTDSAL, the RMS value of the difference was reduced to 0.0011 (74 samples). A plot of CTDSAL versus SALNTY is given in Fig. 17.

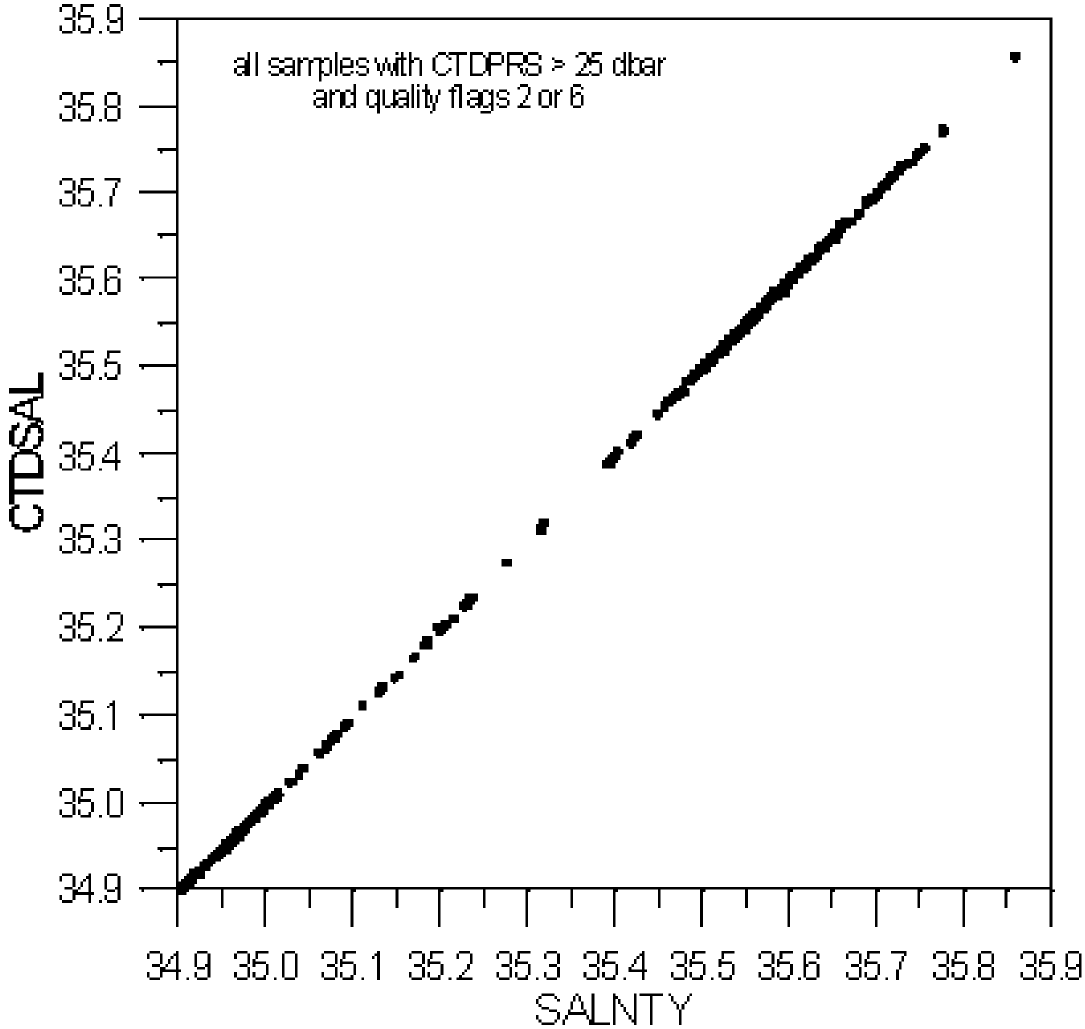


Figure 17. Plot of the salinity determined by the CTD (CTDSAL) versus the salinity determined from water samples by means of a salinometer (SALNTY). All reliable data obtained at depths below the 25 dbar level are shown.

3.5 Oxygen Measurements

For the oxygen determination water samples were drawn in volume calibrated 120 ml Pyrex glass bottles. Before drawing the sample each bottle was flushed with at least 3 times its volume. When the samples were drawn the temperature of the sample was determined. The determination of the volumetric dissolved oxygen concentration of water samples was carried out by means of a high precision automated oxygen Winkler titration system, based on an optical end point determination. The stock solution of KJO_3 used in the analysis was prepared and calibrated in the laboratory by using gravimetric methods. The stock solutions were stored at low temperature (~4°C). Final calibration of the 0.2 Mol $Na_2S_2O_3$ titrant on board took place by tritration of at least 6 samples of stock solution samples of 3 different concentration levels with the 0.2 Mol titrant. The densimetric oxygen concentration was determined by dividing the volumetric concentration by the sea water density at sample temperature and salinity and zero pressure.

At each cast duplicate samples were drawn from the deepest an shallowest water sampler, and at a number of stations also from an intermediate sampler. The difference between the duplicate samples had an RMS value of 0.20 _ mol/kg over the whole cruise (123 samples). This was mainly due to inexperience at the beginning of the cruise. From station 33 onwards the RMS value of the difference was reduced to 0.15 _ mol/kg (102 samples).

For each CTD/rosette cast also 1 to 3 samples were taken for the determination of the sea water blank. In the surface layer the mean sea water blank amounted to 0.60 (±0.07) _ mol/kg, in the sub-surface layer (50 to 250 dbar) the sea water blanks had a mean value of 0.67 (±0.03) _ mol/kg, while deeper sea water blanks had a mean value of 0.72 (±0.03) _ mol/kg These sea water blank values are nearly similar to the values found in the previous year. In the reported densimetric oxygen concentrations (OXYGEN) these sea water blanks have been subtracted from the determined oxygen concentration.

The calibration of the oxygen sensor of the CTD system was determined by comparison of the raw dissolved oxygen values from the CTD system (CTDOXY), according to the manufacturers calibration, with the OXYGEN values from samples taken at the same depth. It appeared that the calibration differed from station to station., and also between up-cast and down-cast Therefore a separate calibration for each station, and for up-cast and down-cast separately, was determined with a multiple regression of OXYGEN versus the CTDOXY value, and the logarithms of CTDTMP and CTDPRS. The raw CTDOXY values for each cast were corrected according to the resulting calibration in order to get the final CTDOXY. THE RMS value of the resulting differences OXYGEN-CTDOXY for the up-casts and down-casts amounted to 2.2 _ mol/kg and 1.9 _ mol/kg respectively. A plot of CTDOXY versus OXYGEN is given in Fig. 18.

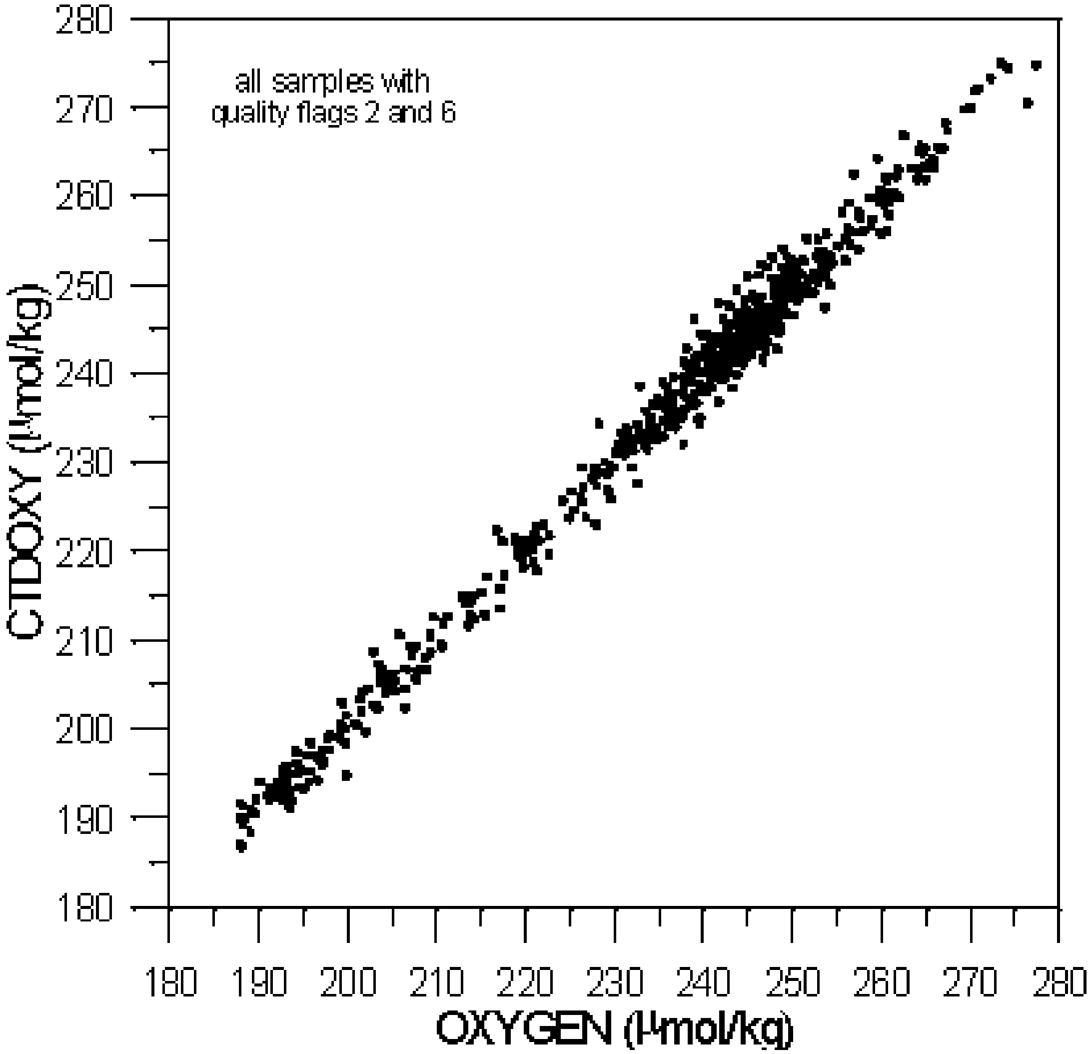


Figure 18. Plot of the dissolved oxygen concentration determined with the CTD system (CTDOXY) versus the dissolved oxygen concentration determined from water samples by means of an automated Winkler titration. All reliable data are shown.

3.6 Nutrient Measurements

From all sampler bottles samples were drawn for the determination of the nutrients silica, nitrite, nitrate and phosphate. The samples were collected in polyethylene sample bottles after three times rinsing. From the deepest sampler a duplicate sample was taken at each station, to be analyzed during an independent autoanalyzer run in order to determine the precision of the nutrient concentrations The samples were stored dark and cool at 4°C. All samples were analysed for the nutrients silicate, phosphate, nitrate and nitrite within 10 hours with an autoanalyzer based on colorimetry. The lab container was equipped with a Technicon TRAACS 800 autoanalyzer. The different nutrients were measured colorimetrical as described by Grashoff (1983). The samples, taken from the refrigerator, were directly pored in open polyethylene vials (6 ml) and put in the auto sampler trays. A maximum of 60 samples in each run was analysed. Because of the large differences in nutrient content between the upper ocean and the deep water, the analyses were carried out in two different calibration ranges. A low concentration range for the samples from the upper 1500 m, and a high concentration range for the samples collected deeper than 1500 m. Based on the experience gained in 1995 it was decided not to filtrate the samples before analysis.

The different nutrients were measured colorimetrical as described by Grashoff (1983);

- Silicate reacts with ammoniummolybdate to a yellow complex, after reduction with ascorbic acid the obtained blue silica-molybdenum complex was measured at 800nm (oxalic acid was used to prevent formation of the blue phosphate-molybdenum).

- Phosphate reacts with ammoniummolybdate at pH 1.0, and potassiumantimonyltartrate was used as an inhibitor. The yellow phosphate-molybdenum complex was reduced by ascorbic acid to blue and measured at 880nm.

- Nitrate was mixed with a buffer imidazole at pH 7.5 and reduced by a copperized-cadmium coil (efficiency> 98%) to nitrite, and measured as nitrite (see nitrite). The reduction-efficiency of the cadmium-column was measured in each run.

- Nitrite was diazotated with sulphanilamide and naftylethylenediamine to a pink coloured complex and measured at 550nm.

- The difference of the last two measurements gave the nitrate content

Standards were prepared by diluting stock solutions of the different nutrients in the same nutrient depleted surface ocean water as used for the baseline water. The standards were kept dark and cool in the same refrigerator as the samples. Standards were prepared fresh every two days. The samples were measured from the surface to the bottom to get the smallest possible carry-over-effects. In every run a mixed nutrient standard containing silicate, phosphate and nitrate in a constant and well known ratio, a so-called nutrient-cocktail, was measured in duplicate. This cocktail is used as a guide to check the performance of the analysis, and to allow corrections for the small errors in the calibration line. The reduction-efficiency of the cadmium-column in the nitrate lane was measured in each run by the use of extra nitrate and nitrite standards.

The autoanalyzer determined the volumetric concentration at a standard temperature of 20°C. In order to calculate the densimetric concentration in _ mol/kg the volumetric concentrations were divided by the density of sea water at 20°C, sample salinity and zero pressure.

Duplicate measurements carried out on the deepest sample from each cast gave RMS values of the differences of 0.28 _ mol/kg, 0.02 _ mol/kg, 0.19 _ mol/kg, and 0.01 _ mol/kg for dissolved silica (SILCAT), nitrite (NITRIT), nitrate (NITRAT), and phosphate (PHSPHT) respectively. Possible variations in gain factor for the different channels of the autoanalyzer was determined by means of the mixed nutrient cocktail. Only for SILCAT and NITRAT this gain factor appeared to differ significantly from 1 for a number of stations. A gain factor correction for these two parameters was applied to the duplicate samples. This resulted in reduced RMS values of the difference between the duplicate samples of SILCAT and NITRAT of 0.19 _ mol/kg and 0.14 _ mol/kg. Thereupon it was decided to apply the gain factor correction to all SILCAT and NITRAT values.

3.7 Fluorescence Measurements

Fluorescence was measured with an AQUATRACKA III fluorimeter adapted to measure Chlorophyll A. The excitation wavelength was centred near 440 nm, with a bandwidth of 80 nm. The fluorescence was measured near 670 nm with a bandwidth of 30 nm. The instrument was calibrated against a chlorophyll solution in acetone. No specific in situ chlorophyll samples were taken for the calibration of the instrument. The fluorescence value was transformed into an equivalent concentration of chlorophyll dissolved in acetone (the parameter FLUOR).

3.8 Transmissometer Measurements

A Sea Tech transmissometer was mounted in the CTD rack next to the CTD probe. The instrument had a path length in water of 25 cm. The light transmission of a parallel light beam was measured at a wavelength of 650 nm. No specific in situ suspended matter samples were taken for the calibration of the instrument. Since it was known that the calibration of the instrument may change from cast to cast, it was decided that in first order the existing calibration in air should be used. Thereafter the individual transmission profiles were shifted in order to get matching transmission values in the deep transmission maximum. This resulted in transmission profiles which agreed well with the profiles measured during Pelagia cruise PE95N/1 in the Bay of Biscay in the previous year. Note that the transmission (the parameter XMISS) depends on the path length which was 25 cm, and is expressed as percent values.

3.9 CTD Data Collection and Processing

For the data collection the Seasave software, supplied by SBE, was used. The CTD data were recorded with a frequency of 24 data cycles per second. After each CTD cast the data were copied to a hard disk of the ship's computer network, and a back-up copy was made on another disk. At the end of the cruise back up copies were made on tape, and brought to NIOZ, together with the hard disk unit, containing all data.

On board the up-cast data files were sub-sampled to produce files with CTD data corresponding to each water sample, taken with the rosette sampler. On board the down-cast CTD data were processed with the preliminary calibration data, and reduced to 1 dbar average ASCII files, in order to allow a first analysis, and to be used in the calibration procedure for OXYGEN and XMISS on the down-casts.

After determining the calibration of the CTD system, as described above, the up-cast CTD data were corrected accordingly. The raw down-cast CTD data were processed with the Seasoft software supplied by SBE. Corrections were applied for the sampling time difference due to the forced flushing of the water along the different sensors, for the heating of the water in the flushing system between the temperature sensor and the conductivity sensor, and the different response times of the sensors. A time series of mean values of the readings was produced for 0.5 s time intervals. This is, given the typical veering velocity, equivalent to a pressure interval of about 0.5 dbar. Consecutively the parameter values were determined in physical units, using the calibration constants, determined as described above. For the CTD casts where no water samples were taken for the determination of OXYGEN, no calibration constants could be determined for CTDOXY . For these casts the CTDOXY values were set at the default value of -9.0 for missing data.

It appeared that the Seasoft software did not remove all spikes in the data record, especially in CTDSAL, CTDOXY, and XMISS. In order to remove the remaining spikes by applying a median filter over 5 consecutive time bins was applied. Hereafter the time series was filtered by means of a low pass filter with a width of 5 time bins. Finally the time series was interpolated on equidistant 1 dbar intervals, only using the first downward crossing of the interpolation pressure by the time series. Since no pressure bin averaging was applied, the parameter NUMBER OF OBS. in the *.CTD files was set to 12, the number of individual data points used to obtain the time series 0.5 s averages which were used for the interpolation at equidistant pressure intervals.

The research reported here was funded by the Foundation for Geological, Oceanographic and Atmospheric Research (GOA), subsidiary of the Netherlands Organisation for Scientific Research (NWO)

We thank the ships crew and the personnel of the supporting technical departments of NIOZ for their professional support and active participation in the preparation and execution of the TripleB programme, especially for the cruise reported here.

ADDENDUM

Search and recovery of mooring BB9

After mooring in the Port of Brest we got a message relayed via NIOZ that the ARGOS CLS had monitored mooring BB9 to be at the sea surface. This mooring was fitted with an ARGOS emergency transmitter. After a quick conference with NIOZ by telephone, and further discussions at NIOZ, it was decided that Pelagia got 48 hours to recover the mooring. At 12:30 local time Pelagia left Brest again and reached the position of the last ARGOS fix the following morning. At 08:45 the mooring was discovered, and at 09:23 everything was hauled on board. Then course was set immediately to Brest again to minimize the time loss for the following OMEX cruise of R.V. Pelagia.

The cause of the near loss of the BB9 mooring was the unintended release of one of the acoustic releases due to leakage. The cause of the leakage is unknown yet.

The GOA management group for moored systems did not consider the use of emergency transmitters for scientific moorings in GOA programmes. On the initiative of ing. S. Ober the NIOZ Department of Physical Oceanography did purchase an ARGOS emergency transmitter from the NIOZ budget and fitted it on the 75 kHz ADCP which formed the top of mooring BB9. Only due to this initiative the release of the mooring was observed, and the mooring could be recovered. It is recommended to the GOA management group for moored systems to reconsider their policy regarding the use of ARGOS emergency transmitters and to apply for a budget to use such a transmitter in every GOA mooring.

Appendix

cruise summary (*.SUM file) of Pelagia cruise 64PE96N/1

SHIP/CRS. EXPOCODE	WOCE SECT.	STNNBR	CASTNO	CAST TYPE	CAST DATE	UTC TIME	EVENT CODE	LATITUDE	LONGITUDE	NAV	UNC. DEPTH	MAXI. PRESS.	NO OF BOTTLES	PARAMETER	COMMENTS
64PE96N/1	AR12	001	01	ROS	061996	2015	BE	47 54.93 N	008 29.95 W	GPS					
64PE96N/1	AR12	001	01	ROS	061996	2021	BO	47 54.92 N	008 29.94 W	GPS	2500	516	22	1-6	test
64PE96N/1	AR12	001	01	ROS	061996	2115	EN	47 54.98 N	008 29.98 W	GPS					
64PE96N/1	AR12	002	01	CTD	062096	0714	BE	47 55.05 N	008 30.02 W	GPS					
64PE96N/1	AR12	002	01	CTD	062096	0800	BO	47 55.01 N	008 30.01 W	GPS	2519	2541			test
64PE96N/1	AR12	002	01	CTD	062096	0938	EN	47 55.01 N	008 30.03 W	GPS					
64PE96N/1	AR12	003	01	MOR	062096	1245	DE	48 03.78 N	008 19.91 W	GPS	835				ADCP lander
64PE96N/1	AR12	004	01	CTD	062096	1326	BE	48 04.57 N	008 19.05 W	GPS					
64PE96N/1	AR12	004	01	CTD	062096	1346	BO	48 04.52 N	008 19.14 W	GPS	-9	1056			
64PE96N/1	AR12	004	01	CTD	062096	1402	EN	48 04.50 N	008 18.99 W	GPS					
64PE96N/1	AR12	005	01	CTD	062096	1427	BE	48 03.46 N	008 21.12 W	GPS					
64PE96N/1	AR12	005	01	CTD	062096	1441	BO	48 03.46 N	008 21.04 W	GPS	735	736			
64PE96N/1	AR12	005	01	CTD	062096	1454	EN	48 03.50 N	008 21.00 W	GPS					
64PE96N/1	AR12	006	01	DRF	062096	1457	DE	48 03.30 N	008 20.96 W	GPS					ptt 16118
64PE96N/1	AR12	006	02	DRF	062096	1511	DE	48 00.84 N	008 20.51 W	GPS					ptt 16119
64PE96N/1	AR12	006	03	DRF	062096	1524	DE	47 58.44 N	008 20.04 W	GPS					ptt 16120
64PE96N/1	AR12	006	04	DRF	062096	1536	DE	47 56.03 N	008 19.63 W	GPS					ptt 16122
64PE96N/1	AR12	006	05	DRF	062096	1553	DE	47 53.01 N	008 19.18 W	GPS					ptt 16121
64PE96N/1	AR12	007	01	MOR	062196	0629	RE	46 42.96 N	005 22.19 W	GPS					BB1
64PE96N/1	AR12	008	01	MOR	062196	0829	RE	46 39.82 N	005 26.93 W	GPS					BB2

SHIP/CRS. EXPOCODE	WOCE SECT.	STNNBR	CASTNO	CAST TYPE	CAST DATE	UTC TIME	EVENT CODE	LATITUDE	LONGITUDE	NAV	UNC. DEPTH	MAXI. PRESS.	NO OF BOTTLES	PARAMETER	COMMENTS
64PE96N/1	AR12	009	01	MOR	062196	1130	RE	46 38.67 N	005 29.05 W	GPS					BB3
64PE96N/1	AR12	010	01	MOR	062196	1525	RE	46 36.11 N	005 32.87 W	GPS					BB4
64PE96N/1	AR12	011	01	MOR	062296	0643	RE	46 25.89 N	005 51.00 W	GPS					BB5
64PE96N/1	AR12	012	01	MOR	062296	0915	RE	46 33.87 N	005 42.40 W	GPS					BB6
64PE96N/1	AR12	013	01	MOR	062296	1420	RE	46 08.00 N	006 19.98 W	GPS					BB7
64PE96N/1	AR12	014	01	MOR	062296	1843	RE	45 48.04 N	006 50.00 W	GPS					BB8
64PE96N/1	AR12	015	01	ROS	062396	0621	BE	46 56.37 N	005 20.02 W	GPS					
64PE96N/1	AR12	015	01	ROS	062396	0636	BO	46 56.40 N	005 20.11 W	GPS	967	536	22	1-6	test
64PE96N/1	AR12	015	01	ROS	062396	0714	EN	46 56.45 N	005 20.18 W	GPS					
64PE96N/1	AR12	016	01	ROS	062396	0833	BE	46 56.01 N	005 05.91 W	GPS					
64PE96N/1	AR12	016	01	ROS	062396	0838	BO	46 56.01 N	005 05.90 W	GPS	146	152	4	1-6	
64PE96N/1	AR12	016	01	ROS	062396	0849	EN	46 56.02 N	005 05.89 W	GPS					
64PE96N/1	AR12	017	01	ROS	062396	0936	BE	46 51.72 N	005 12.05 W	GPS					
64PE96N/1	AR12	017	01	ROS	062396	0942	BO	46 51.74 N	005 12.05 W	GPS	183	189	5	1-6	
64PE96N/1	AR12	017	01	ROS	062396	0956	EN	46 51.73 N	005 12.06 W	GPS					
64PE96N/1	AR12	018	01	ROS	062396	1111	BE	46 48.03 N	005 18.05 W	GPS					
64PE96N/1	AR12	018	01	ROS	062396	1129	BO	46 48.12 N	005 18.04 W	GPS	907	960	12	1-6	
64PE96N/1	AR12	018	01	ROS	062396	1201	EN	46 48.13 N	005 17.83 W	GPS					
64PE96N/1	AR12	019	01	CTD	062396	1319	BE	46 44.08 N	005 24.02 W	GPS					
64PE96N/1	AR12	019	01	CTD	062396	1346	BO	46 44.14 N	005 23.98 W	GPS	1536	1563			

SHIP/CRS. EXPOCODE	WOCE SECT.	STNNBR	CASTNO	CAST TYPE	CAST DATE	UTC TIME	EVENT CODE	LATITUDE	LONGITUDE	NAV	UNC. DEPTH	MAXI. PRESS.	NO OF BOTTLES	PARAMETER	COMMENTS
64PE96N/1	AR12	019	01	CTD	062396	1407	EN	46 44.20 N	005 23.98 W	GPS					
64PE96N/1	AR12	020	01	ROS	062396	1800	BE	46 42.03 N	005 28.20 W	GPS					
64PE96N/1	AR12	020	01	ROS	062396	1847	BO	46 42.08 N	005 28.24 W	GPS	-9	2469	24	1-6	
64PE96N/1	AR12	020	01	ROS	062396	2000	EN	46 42.05 N	005 28.19 W	GPS					
64PE96N/1	AR12	021	01	ROS	062396	2116	BE	46 39.86 N	005 32.39 W	GPS					
64PE96N/1	AR12	021	01	ROS	062396	2224	BO	46 40.02 N	005 32.31 W	GPS	-9	3620	24	1-6	
64PE96N/1	AR12	021	01	ROS	062396	2338	EN	46 40.05 N	005 32.19 W	GPS					
64PE96N/1	AR12	022	01	ROS	062496	0203	BE	46 28.05 N	005 52.28 W	GPS					
64PE96N/1	AR12	022	01	ROS	062496	0319	BO	46 27.96 N	005 52.23 W	GPS	-9	4301	24	1-6	
64PE96N/1	AR12	022	01	ROS	062496	0454	EN	46 27.96 N	005 52.26 W	GPS					
64PE96N/1	AR12	023	01	ROS	062496	0651	BE	46 16.03 N	006 10.18 W	GPS					
64PE96N/1	AR12	023	01	ROS	062496	0811	BO	46 15.95 N	006 10.14 W	GPS	4607	4733	24	1-6	
64PE96N/1	AR12	023	01	ROS	062496	0954	EN	46 15.95 N	006 10.13 W	GPS					
64PE96N/1	AR12	024	01	ROS	062496	1227	BE	46 00.01 N	006 34.00 W	GPS					
64PE96N/1	AR12	024	01	ROS	062496	1344	BO	46 00.04 N	006 34.05 W	GPS	4731	4863	24	1-6	
64PE96N/1	AR12	024	01	ROS	062496	1521	EN	46 00.01 N	006 34.04 W	GPS					
64PE96N/1	AR12	025	01	ROS	062496	1827	BE	45 59.99 N	007 20.06 W	GPS					
64PE96N/1	AR12	025	01	ROS	062496	1952	BO	46 00.01 N	007 20.07 W	GPS	4758	4885	24	1-6	
64PE96N/1	AR12	025	01	ROS	062496	2130	EN	46 00.04 N	007 20.00 W	GPS					
64PE96N/1	AR12	026	01	ROS	062596	0047	BE	46 00.03 N	008 00.01 W	GPS					

SHIP/CRS. EXPOCODE	WOCE SECT.	STNNBR	CASTNO	CAST TYPE	CAST DATE	UTC TIME	EVENT CODE	LATITUDE			LONGITUDE			NAV	UNC. DEPTH	MAXI. PRESS.	NO OF BOTTLES	PARAMETER	COMMENTS
64PE96N/1	AR12	026	01	ROS	062596	0203	BO	45	59.96	N	007	59.96	W	GPS	4783	4914	24	1-6	
64PE96N/1	AR12	026	01	ROS	062596	0334	EN	45	59.87	N	008	00.08	W	GPS					
64PE96N/1	AR12	027	01	ROS	062596	0623	BE	45	59.93	N	008	40.06	W	GPS					
64PE96N/1	AR12	027	01	ROS	062596	0751	BO	45	59.98	N	008	40.07	W	GPS	4800	4934	24	1-6	partial up-cast
64PE96N/1	AR12	027	01	ROS	062596	1123	EN	46	00.14	N	008	40.00	W	GPS					
64PE96N/1	AR12	028	01	ROS	062596	1410	BE	46	00.02	N	009	19.99	W	GPS					
64PE96N/1	AR12	028	01	ROS	062596	1535	BO	45	59.99	N	009	20.02	W	GPS	4793	4769	24	1-6	not to bottom
64PE96N/1	AR12	028	01	ROS	062596	1740	EN	45	59.98	N	009	19.98	W	GPS					
64PE96N/1	AR12	029	01	CTD	062596	2036	BE	45	59.99	N	010	00.00	W	GPS					
64PE96N/1	AR12	029	01	CTD	062596	2156	BO	46	00.00	N	009	59.96	W	GPS	4772	4758			not to bottom
64PE96N/1	AR12	029	01	CTD	062596	2351	EN	46	00.00	N	009	59.89	W	GPS					
64PE96N/1	AR12	030	01	ROS	062696	0410	BE	46	00.02	N	010	39.99	W	GPS					
64PE96N/1	AR12	030	01	ROS	062696	0522	BO	46	00.02	N	010	39.97	W	GPS	4780	4757	24	1-6	not to bottom
64PE96N/1	AR12	030	01	ROS	062696	0727	EN	46	00.00	N	010	39.92	W	GPS					
64PE96N/1	AR12	031	01	ROS	062696	1026	BE	45	59.97	N	011	20.06	W	GPS					
64PE96N/1	AR12	031	01	ROS	062696	1141	BO	45	59.96	N	011	20.02	W	GPS	4773	4765	24	1-6	not to bottom
64PE96N/1	AR12	031	01	ROS	062696	1334	EN	46	00.00	N	011	20.01	W	GPS					
64PE96N/1	AR12	032	01	ROS	062696	1633	BE	45	59.98	N	011	59.98	W	GPS					
64PE96N/1	AR12	032	01	ROS	062696	1744	BO	45	59.95	N	012	00.02	W	GPS	4785	4762	24	1-6	not to bottom
64PE96N/1	AR12	032	01	ROS	062696	1941	EN	46	00.05	N	012	00.00	W	GPS					

SHIP/CRS. EXPOCODE	WOCE SECT.	STNNBR	CASTNO	CAST TYPE	CAST DATE	UTC TIME	EVENT CODE	LATITUDE			LONGITUDE			NAV	UNC. DEPTH	MAXI. PRESS.	NO OF BOTTLES	PARAMETER	COMMENTS
64PE96N/1	AR12	033	01	ROS	062696	2243	BE	46	00.04	N	012	40.00	W	GPS					
64PE96N/1	AR12	033	01	ROS	062796	0000	BO	46	00.03	N	012	40.00	W	GPS	4780	4766	24	1-6	not to bottom
64PE96N/1	AR12	033	01	ROS	062796	0146	EN	46	00.09	N	012	39.92	W	GPS					
64PE96N/1	AR12	034	01	ROS	062796	0446	BE	46	29.99	N	012	40.01	W	GPS					
64PE96N/1	AR12	034	01	ROS	062796	0550	BO	46	30.01	N	012	40.00	W	GPS	3995	4083	24	1-6	
64PE96N/1	AR12	034	01	ROS	062796	0730	EN	46	29.96	N	012	40.05	W	GPS					
64PE96N/1	AR12	035	01	ROS	062796	1050	BE	47	00.00	N	012	39.95	W	GPS					
64PE96N/1	AR12	035	01	ROS	062796	1207	BO	47	00.00	N	012	39.90	W	GPS	4653	4766	24	1-6	
64PE96N/1	AR12	035	01	ROS	062796	1346	EN	47	00.02	N	012	39.80	W	GPS					
64PE96N/1	AR12	036	01	ROS	062796	1649	BE	47	30.00	N	012	40.00	W	GPS					
64PE96N/1	AR12	036	01	ROS	062796	1755	BO	47	29.99	N	012	40.07	W	GPS	4438	4551	24	1-6	
64PE96N/1	AR12	036	01	ROS	062796	1947	EN	47	30.00	N	012	39.97	W	GPS					
64PE96N/1	AR12	037	01	CTD	062796	2304	BE	48	00.01	N	012	39.98	W	GPS					
64PE96N/1	AR12	037	01	CTD	062896	0006	BO	48	00.01	N	012	39.95	W	GPS	4306	4406			
64PE96N/1	AR12	037	01	CTD	062896	0143	EN	48	00.02	N	012	40.02	W	GPS					
64PE96N/1	AR12	038	01	ROS	062896	0701	BE	48	11.97	N	012	31.95	W	GPS					
64PE96N/1	AR12	038	01	ROS	062896	0748	BO	48	11.99	N	012	31.98	W	GPS	2775	2817	24	1-6	
64PE96N/1	AR12	038	01	ROS	062896	0855	EN	48	12.02	N	012	31.95	W	GPS					
64PE96N/1	AR12	039	01	ROS	062896	1037	BE	48	24.08	N	012	24.00	W	GPS					
64PE96N/1	AR12	039	01	ROS	062896	1117	BO	48	24.10	N	012	24.03	W	GPS	2505	2542	24	1-6	

SHIP/CRS. EXPOCODE	WOCE SECT.	STNNBR	CASTNO	CAST TYPE	CAST DATE	UTC TIME	EVENT CODE	LATITUDE			LONGITUDE			NAV	UNC. DEPTH	MAXI. PRESS.	NO OF BOTTLES	PARAMETER	COMMENTS
64PE96N/1	AR12	039	01	ROS	062896	1220	EN	48	24.12	N	012	24.01	W	GPS					
64PE96N/1	AR12	040	01	ROS	062896	1417	BE	48	37.00	N	012	15.01	W	GPS					
64PE96N/1	AR12	040	01	ROS	062896	1444	BO	48	36.97	N	012	15.10	W	GPS	1784	1811	22	1-6	
64PE96N/1	AR12	040	01	ROS	062896	1535	EN	48	37.00	N	012	15.09	W	GPS					
64PE96N/1	AR12	041	01	ROS	062896	1658	BE	48	48.96	N	012	07.03	W	GPS					
64PE96N/1	AR12	041	01	ROS	062896	1720	BO	48	49.00	N	012	07.18	W	GPS	1445	1468	17	1-6	
64PE96N/1	AR12	041	01	ROS	062896	1800	EN	48	48.98	N	012	07.36	W	GPS					
64PE96N/1	AR12	042	01	ROS	062896	1931	BE	49	01.97	N	011	57.96	W	GPS					
64PE96N/1	AR12	042	01	ROS	062896	1950	BO	49	01.97	N	011	57.96	W	GPS	1006	1024	12	1-6	
64PE96N/1	AR12	042	01	ROS	062896	2019	EN	49	01.97	N	011	58.02	W	GPS					
64PE96N/1	AR12	043	01	ROS	062896	2211	BE	49	15.00	N	011	49.93	W	GPS					
64PE96N/1	AR12	043	01	ROS	062896	2228	BO	49	14.99	N	011	49.96	W	GPS	932	948	12	1-6	
64PE96N/1	AR12	043	01	ROS	062896	2257	EN	49	15.01	N	011	49.90	W	GPS					
64PE96N/1	AR12	044	01	ROS	062996	0106	BE	49	15.00	N	011	25.03	W	GPS					
64PE96N/1	AR12	044	01	ROS	062996	0114	BO	49	15.02	N	011	25.03	W	GPS	414	416	8	1-6	
64PE96N/1	AR12	044	01	ROS	062996	0128	EN	49	15.02	N	011	25.03	W	GPS					
64PE96N/1	AR12	045	01	ROS	062996	0325	BE	49	14.98	N	010	59.98	W	GPS					
64PE96N/1	AR12	045	01	ROS	062996	0332	BO	49	14.99	N	010	59.99	W	GPS	173	171	6	1-6	
64PE96N/1	AR12	045	01	ROS	062996	0339	EN	49	14.98	N	010	59.98	W	GPS					
64PE96N/1	AR12	046	01	ROS	062996	0447	BE	49	15.05	N	010	45.06	W	GPS					

SHIP/CRS. EXPOCODE	WOCE SECT.	STNNBR	CASTNO	CAST TYPE	CAST DATE	UTC TIME	EVENT CODE	LATITUDE	LONGITUDE	NAV	UNC. DEPTH	MAXI. PRESS.	NO OF BOTTLES	PARAMETER	COMMENTS
64PE96N/1	AR12	046	01	ROS	062996	0453	BO	49 15.01 N	010 45.02 W	GPS	150	153	4	1-6	
64PE96N/1	AR12	046	01	ROS	062996	0500	EN	49 14.94 N	010 44.99 W	GPS					
64PE96N/1	AR12	047	01	ROS	062996	0541	BE	49 09.96 N	010 44.02 W	GPS					
64PE96N/1	AR12	047	01	ROS	062996	0544	BO	49 09.98 N	010 44.08 W	GPS	153	156	4	1-6	
64PE96N/1	AR12	047	01	ROS	062996	0554	EN	49 09.98 N	010 44.05 W	GPS					
64PE96N/1	AR12	048	01	ROS	062996	0700	BE	48 59.99 N	010 48.05 W	GPS					
64PE96N/1	AR12	048	01	ROS	062996	0704	BO	49 00.00 N	010 48.07 W	GPS	151	157	4	1-6	
64PE96N/1	AR12	048	01	ROS	062996	0712	EN	48 59.91 N	010 48.17 W	GPS					
64PE96N/1	AR12	049	01	ROS	062996	0819	BE	48 49.99 N	010 51.99 W	GPS					
64PE96N/1	AR12	049	01	ROS	062996	0836	BO	48 49.96 N	010 52.07 W	GPS	772	753	10	1-6	
64PE96N/1	AR12	049	01	ROS	062996	0901	EN	48 49.95 N	010 52.15 W	GPS					
64PE96N/1	AR12	050	01	ROS	062996	1012	BE	48 40.00 N	010 56.03 W	GPS					
64PE96N/1	AR12	050	01	ROS	062996	1035	BO	48 40.00 N	010 56.02 W	GPS	1268	1300	15	1-6	
64PE96N/1	AR12	050	01	ROS	062996	1111	EN	48 40.00 N	010 56.09 W	GPS					
64PE96N/1	AR12	051	01	ROS	062996	1242	BE	48 30.00 N	011 00.03 W	GPS					
64PE96N/1	AR12	051	01	ROS	062996	1327	BO	48 30.00 N	011 00.02 W	GPS	-9	2649	22	1-6	
64PE96N/1	AR12	051	01	ROS	062996	1420	EN	48 30.00 N	010 59.99 W	GPS					
64PE96N/1	AR12	052	01	ROS	062996	1537	BE	48 20.05 N	011 04.01 W	GPS					
64PE96N/1	AR12	052	01	ROS	062996	1610	BO	48 20.00 N	011 03.98 W	GPS	-9	2217	22	1-6	
64PE96N/1	AR12	052	01	ROS	062996	1707	EN	48 19.97 N	011 04.00 W	GPS					

SHIP/CRS. EXPOCODE	WOCE SECT.	STNNBR	CASTNO	CAST TYPE	CAST DATE	UTC TIME	EVENT CODE	LATITUDE		LONGITUDE		NAV	UNC. DEPTH	MAXI. PRESS.	NO OF BOTTLES	PARAMETER	COMMENTS
64PE96N/1	AR12	053	01	ROS	062996	1817	BE	48	10.03 N	011	07.98 W	GPS					
64PE96N/1	AR12	053	01	ROS	062996	1921	BO	48	09.97 N	011	07.95 W	GPS	3761	3850	22	1-6	
64PE96N/1	AR12	053	01	ROS	062996	2042	EN	48	09.98 N	011	07.96 W	GPS					
64PE96N/1	AR12	054	01	ROS	062996	2151	BE	48	00.00 N	011	11.98 W	GPS					
64PE96N/1	AR12	054	01	ROS	062996	2301	BO	47	59.93 N	011	11.92 W	GPS	4234	4336	22	1-6	
64PE96N/1	AR12	054	01	ROS	063096	0015	EN	47	59.99 N	011	11.91 W	GPS					
64PE96N/1	AR12	055	01	ROS	063096	0146	BE	47	50.00 N	011	15.98 W	GPS					
64PE96N/1	AR12	055	01	ROS	063096	0252	BO	47	49.96 N	011	15.98 W	GPS	4363	4470	22	1-6	
64PE96N/1	AR12	055	01	ROS	063096	0426	EN	47	49.98 N	011	16.04 W	GPS					
64PE96N/1	AR12	056	01	MOR	070296	1522	DE	47	33.11 N	005	51.88 W	GPS	148				T2
64PE96N/1	AR12	056	02	CTD	070296	1553	BE	47	33.37 N	005	51.95 W	GPS					
64PE96N/1	AR12	056	02	CTD	070296	1558	BO	47	33.43 N	005	51.84 W	GPS	149				
64PE96N/1	AR12	056	02	CTD	070296	1603	EN	47	33.45 N	005	51.77 W	GPS					
64PE96N/1	AR12	057	01	MOR	070296	1839	DE	47	22.96 N	006	02.00 W	GPS	159				T1
64PE96N/1	AR12	057	02	CTD	070296	1849	BE	47	22.87 N	006	02.21 W	GPS					
64PE96N/1	AR12	057	02	CTD	070296	1855	BO	47	22.86 N	006	02.22 W	GPS	161				
64PE96N/1	AR12	057	02	CTD	070296	1859	EN	47	22.83 N	006	02.22 W	GPS					
64PE96N/1	AR12	058	01	CTD	070296	1932	BE	47	18.97 N	006	05.91 W	GPS					
64PE96N/1	AR12	058	01	CTD	070296	1938	BO	47	18.89 N	006	05.88 W	GPS	188				
64PE96N/1	AR12	058	01	CTD	070296	1942	EN	47	18.84 N	006	05.91 W	GPS					

SHIP/CRS. EXPOCODE	WOCE SECT.	STNNBR	CASTNO	CAST TYPE	CAST DATE	UTC TIME	EVENT CODE	LATITUDE			LONGITUDE			NAV	UNC. DEPTH	MAXI. PRESS.	NO OF BOTTLES	PARAMETER	COMMENTS
64PE96N/1	AR12	059	01	CTD	070296	2120	BE	47	08.04	N	006	15.98	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	02	CTD	070296	2230	BE	47	08.01	N	006	15.86	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	03	CTD	070296	2330	BE	47	08.00	N	006	15.83	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	04	CTD	070396	0030	BE	47	08.02	N	006	15.82	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	05	CTD	070396	0130	BE	47	08.03	N	006	15.81	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	06	CTD	070396	0230	BE	47	08.02	N	006	15.83	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	07	CTD	070396	0330	BE	47	08.01	N	006	15.85	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	08	CTD	070396	0430	BE	47	08.08	N	006	15.99	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	09	CTD	070396	0530	BE	47	08.03	N	006	15.88	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	10	CTD	070396	0630	BE	47	08.06	N	006	15.94	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	11	CTD	070396	0730	BE	47	08.03	N	006	15.97	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	12	CTD	070396	0830	BE	47	08.05	N	006	15.99	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	13	CTD	070396	0930	BE	47	08.00	N	006	15.83	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	14	CTD	070396	1030	BE	47	08.01	N	006	15.93	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	15	CTD	070396	1130	BE	47	08.01	N	006	15.85	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	16	CTD	070396	1230	BE	47	08.00	N	006	15.90	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	17	CTD	070396	1330	BE	47	08.00	N	006	15.94	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	18	CTD	070396	1430	BE	47	08.01	N	006	16.03	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	19	CTD	070396	1530	BE	47	08.02	N	006	15.99	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	20	CTD	070396	1630	BE	47	08.01	N	006	15.99	W	GPS	-9	140			CTD yo-yo

SHIP/CRS. EXPOCODE	WOCE SECT.	STNNBR	CASTNO	CAST TYPE	CAST DATE	UTC TIME	EVENT CODE	LATITUDE			LONGITUDE			NAV	UNC. DEPTH	MAXI. PRESS.	NO OF BOTTLES	PARAMETER	COMMENTS
64PE96N/1	AR12	059	21	CTD	070396	1730	BE	47	08.01	N	006	15.99	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	22	CTD	070396	1830	BE	47	08.00	N	006	15.94	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	23	CTD	070396	1930	BE	47	07.95	N	006	15.86	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	24	CTD	070396	2030	BE	47	07.92	N	006	16.00	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	25	CTD	070396	2130	BE	47	07.93	N	006	15.99	W	GPS	-9	140			CTD yo-yo
64PE96N/1	AR12	059	26	CTD	070396	2242	BE	47	07.86	N	006	15.82	W	GPS					
64PE96N/1	AR12	059	26	CTD	070396	2315	BO	47	07.84	N	006	15.83	W	GPS	2034	2064			
64PE96N/1	AR12	059	26	CTD	070396	2340	EN	47	07.65	N	006	15.89	W	GPS					
64PE96N/1	AR12	060	01	CTD	070496	0643	BE	47	22.79	N	006	01.79	W	GPS					
64PE96N/1	AR12	060	01	CTD	070496	0649	BO	47	22.78	N	006	01.82	W	GPS	159	159			
64PE96N/1	AR12	060	01	CTD	070496	0651	EN	47	22.79	N	006	01.86	W	GPS					
64PE96N/1	AR12	060	02	MOR	070496	0733	RE	47	22.91	N	006	01.95	W	GPS	153				T1
64PE96N/1	AR12	061	01	MOR	070596	1302	DE	45	57.79	N	004	19.43	W	GPS	2910				BB15
64PE96N/1	AR12	062	01	MOR	070596	1533	DE	46	04.55	N	004	11.26	W	GPS	1490				BB13
64PE96N/1	AR12	063	01	MOR	070596	1803	DE	46	01.59	N	004	14.89	W	GPS	2000				BB14
64PE96N/1	AR12	064	01	MOR	070696	0926	DE	45	52.27	N	004	24.98	W	GPS	4106				BB16
64PE96N/1	AR12	065	01	MOR	070696	1959	DE	45	09.11	N	003	42.42	W	GPS	4000				BB12
64PE96N/1	AR12	066	01	MOR	070796	0747	DE	45	11.87	N	003	28.49	W	GPS	3280				BB11
64PE96N/1	AR12	067	01	MOR	070796	1015	DE	45	12.99	N	003	25.62	W	GPS	2611				BB10
64PE96N/1	AR12	068	01	MOR	070796	1934	DE	45	12.93	N	003	23.47	W	GPS	1410				BB9

SHIP/CRS.	WOCE			CAST	CAST	UTC	EVENT				UNC.	MAXI.	NO OF		
EXPOCODE	SECT.	STNNBR	CASTNO	TYPE	DATE	TIME	CODE	LATITUDE	LONGITUDE	NAV	DEPTH	PRESS.	BOTTLES	PARAMETER	COMMENTS
64PE96N/1	AR12	069	01	ROS	070896	0626	BE	44 00.01 N	001 59.96 W	GPS					
64PE96N/1	AR12	069	01	ROS	070896	0630	BO	43 59.97 N	001 59.85 W	GPS	138	140	4	1-6	
64PE96N/1	AR12	069	01	ROS	070896	0639	EN	43 59.98 N	002 00.05 W	GPS					
64PE96N/1	AR12	070	01	ROS	070896	0824	BE	44 07.45 N	002 14.92 W	GPS					
64PE96N/1	AR12	070	01	ROS	070896	0839	BO	44 07.50 N	002 15.00 W	GPS	894	905	11	1-6	
64PE96N/1	AR12	070	01	ROS	070896	0910	EN	44 07.51 N	002 14.98 W	GPS					
64PE96N/1	AR12	071	01	ROS	070896	1053	BE	44 14.99 N	002 29.93 W	GPS					
64PE96N/1	AR12	071	01	ROS	070896	1113	BO	44 14.98 N	002 29.99 W	GPS	1091	1104	13	1-6	
64PE96N/1	AR12	071	01	ROS	070896	1150	EN	44 14.99 N	002 29.98 W	GPS					
64PE96N/1	AR12	072	01	ROS	070896	1410	BE	44 22.47 N	002 45.00 W	GPS					
64PE96N/1	AR12	072	01	ROS	070896	1432	BO	44 22.50 N	002 44.99 W	GPS	1427	1442	17	1-6	
64PE96N/1	AR12	072	01	ROS	070896	1513	EN	44 22.49 N	002 44.98 W	GPS					
64PE96N/1	AR12	073	01	ROS	070896	1638	BE	44 30.01 N	003 00.05 W	GPS					
64PE96N/1	AR12	073	01	ROS	070896	1705	BO	44 29.98 N	002 59.99 W	GPS	1592	1617	18	1-6	
64PE96N/1	AR12	073	01	ROS	070896	1748	EN	44 29.97 N	002 59.97 W	GPS					
64PE96N/1	AR12	074	01	ROS	070896	1941	BE	44 37.52 N	003 14.90 W	GPS					
64PE96N/1	AR12	074	01	ROS	070896	2032	BO	44 37.60 N	003 14.90 W	GPS	-9	2833	22	1-6	
64PE96N/1	AR12	074	01	ROS	070896	2148	EN	44 37.53 N	003 14.93 W	GPS					
64PE96N/1	AR12	075	01	ROS	070896	2327	BE	44 44.99 N	003 29.95 W	GPS					
64PE96N/1	AR12	075	01	ROS	070996	0019	BO	44 44.98 N	003 30.00 W	GPS	-9	3773	22	1-6	

SHIP/CRS.	WOCE			CAST	CAST	UTC	EVENT				UNC.	MAXI.	NO OF		
EXPOCODE	SECT.	STNNBR	CASTNO	TYPE	DATE	TIME	CODE	LATITUDE	LONGITUDE	NAV	DEPTH	PRESS.	BOTTLES	PARAMETER	COMMENTS
64PE96N/1	AR12	075	01	ROS	070996	0139	EN	44 45.01 N	003 30.00 W	GPS					
64PE96N/1	AR12	076	01	ROS	070996	0325	BE	44 52.50 N	003 45.00 W	GPS					
64PE96N/1	AR12	076	01	ROS	070996	0426	BO	44 52.50 N	003 45.00 W	GPS	3906	3993	22	1-6	
64PE96N/1	AR12	076	01	ROS	070996	0557	EN	44 52.52 N	003 45.03 W	GPS					
64PE96N/1	AR12	077	01	ROS	070996	0722	BE	44 59.98 N	004 00.01 W	GPS					
64PE96N/1	AR12	077	01	ROS	070996	0831	BO	45 00.01 N	003 59.99 W	GPS	4254	4358	22	1-6	
64PE96N/1	AR12	077	01	ROS	070996	1006	EN	45 00.00 N	003 59.96 W	GPS					
64PE96N/1	AR12	078	01	ROS	070996	1422	BE	45 39.99 N	004 26.97 W	GPS					
64PE96N/1	AR12	078	01	ROS	070996	1524	BO	45 39.97 N	004 26.94 W	GPS	4086	4184	22	1-6	
64PE96N/1	AR12	078	01	ROS	070996	1659	EN	45 39.99 N	004 27.05 W	GPS					
64PE96N/1	AR12	079	01	ROS	070996	1819	BE	45 45.02 N	004 19.98 W	GPS					
64PE96N/1	AR12	079	01	ROS	070996	1910	BO	45 45.00 N	004 19.98 W	GPS	2801	2865	22	1-6	
64PE96N/1	AR12	079	01	ROS	070996	2027	EN	45 44.98 N	004 20.02 W	GPS					
64PE96N/1	AR12	080	01	ROS	070996	2150	BE	45 50.03 N	004 13.09 W	GPS					
64PE96N/1	AR12	080	01	ROS	070996	2236	BO	45 50.03 N	004 12.96 W	GPS	-9	2945	22	1-6	
64PE96N/1	AR12	080	01	ROS	070996	2330	EN	45 50.04 N	004 13.11 W	GPS					
64PE96N/1	AR12	081	01	ROS	071096	0142	BE	45 55.02 N	004 06.00 W	GPS					
64PE96N/1	AR12	081	01	ROS	071096	0212	BO	45 55.02 N	004 05.88 W	GPS	1876	1910	21	1-6	
64PE96N/1	AR12	081	01	ROS	071096	0321	EN	45 54.95 N	004 06.06 W	GPS					
64PE96N/1	AR12	082	01	ROS	071096	0448	BE	45 59.98 N	003 59.07 W	GPS					

SHIP/CRS.	WOCE			CAST	CAST	UTC	EVENT				UNC.	MAXI.	NO OF		
EXPOCODE	SECT.	STNNBR	CASTNO	TYPE	DATE	TIME	CODE	LATITUDE	LONGITUDE	NAV	DEPTH	PRESS.	BOTTLES	PARAMETER	COMMENTS
64PE96N/1	AR12	082	01	ROS	071096	0503	BO	46 00.00 N	003 59.02 W	GPS	600	580	8	1-6	
64PE96N/1	AR12	082	01	ROS	071096	0525	EN	45 59.97 N	003 58.98 W	GPS					
64PE96N/1	AR12	083	01	CTD	071096	0637	BE	46 05.00 N	003 51.99 W	GPS					
64PE96N/1	AR12	083	01	CTD	071096	0643	BO	46 05.01 N	003 51.98 W	GPS	142	145			
64PE96N/1	AR12	083	01	CTD	071096	0641	EN	46 04.99 N	003 51.98 W	GPS					
64PE96N/1	AR12	083	02	ROS	071096	0703	BE	46 04.97 N	003 51.98 W	GPS					
64PE96N/1	AR12	083	02	ROS	071096	0708	BO	46 05.00 N	003 52.01 W	GPS	144	146	4	1-6	
64PE96N/1	AR12	083	02	ROS	071096	0716	EN	46 05.01 N	003 51.99 W	GPS					
64PE96N/1	AR12	084	01	ROS	071196	0005	BE	47 45.02 N	007 14.98 W	GPS					
64PE96N/1	AR12	084	01	ROS	071196	0010	BO	47 45.03 N	007 14.89 W	GPS	174	174	4	1-6	
64PE96N/1	AR12	084	01	ROS	071196	0017	EN	47 45.00 N	007 14.89 W	GPS					
64PE96N/1	AR12	085	01	ROS	071196	0116	BE	47 39.99 N	007 19.95 W	GPS					
64PE96N/1	AR12	085	01	ROS	071196	0121	BO	47 39.98 N	007 19.96 W	GPS	161	165	4	1-6	
64PE96N/1	AR12	085	01	ROS	071196	0129	EN	47 39.98 N	007 19.97 W	GPS					
64PE96N/1	AR12	086	01	ROS	071196	0235	BE	47 34.95 N	007 25.04 W	GPS					
64PE96N/1	AR12	086	01	ROS	071196	0253	BO	47 34.95 N	007 25.00 W	GPS	812	863	11	1-6	
64PE96N/1	AR12	086	01	ROS	071196	0321	EN	47 34.98 N	007 25.00 W	GPS					
64PE96N/1	AR12	087	01	ROS	071196	0428	BE	47 30.02 N	007 30.05 W	GPS					
64PE96N/1	AR12	087	01	ROS	071196	0456	BO	47 29.97 N	007 29.97 W	GPS	1482	1612	18	1-6	
64PE96N/1	AR12	087	01	ROS	071196	0548	EN	47 29.98 N	007 30.00 W	GPS					

SHIP/CRS. EXPOCODE	WOCE SECT.	STNNBR	CASTNO	CAST TYPE	CAST DATE	UTC TIME	EVENT CODE	LATITUDE	LONGITUDE	NAV	UNC. DEPTH	MAXI. PRESS.	NO OF BOTTLES	PARAMETER	COMMENTS
64PE96N/1	AR12	088	01	ROS	071196	0702	BE	47 24.98 N	007 34.99 W	GPS					
64PE96N/1	AR12	088	01	ROS	071196	0805	BO	47 25.02 N	007 35.03 W	GPS	3698	3806	22	1-6	
64PE96N/1	AR12	088	01	ROS	071196	0933	EN	47 25.04 N	007 35.03 W	GPS					
64PE96N/1	AR12	089	01	ROS	071196	1120	BE	47 19.99 N	007 39.98 W	GPS					
64PE96N/1	AR12	089	01	ROS	071196	1225	BO	47 20.00 N	007 39.98 W	GPS	4085	4181	22	1-6	
64PE96N/1	AR12	089	01	ROS	071196	1355	EN	47 20.02 N	007 39.99 W	GPS					
64PE96N/1	AR12	090	01	ROS	071196	1602	BE	47 15.02 N	007 45.04 W	GPS					
64PE96N/1	AR12	090	01	ROS	071196	1709	BO	47 14.99 N	007 45.02 W	GPS	4157	4315	22	1-6	
64PE96N/1	AR12	090	01	ROS	071196	1842	EN	47 14.98 N	007 44.98 W	GPS					
64PE96N/1	AR12	091	01	ROS	071196	2002	BE	47 10.02 N	007 49.94 W	GPS					
64PE96N/1	AR12	091	01	ROS	071196	2113	BO	47 10.00 N	007 49.98 W	GPS	4220	4325	20	1-6	
64PE96N/1	AR12	091	01	ROS	071196	2242	EN	47 09.97 N	007 49.96 W	GPS					
64PE96N/1	AR12	092	01	ROS	071296	0038	BE	47 00.00 N	008 00.00 W	GPS					
64PE96N/1	AR12	092	01	ROS	071296	0159	BO	47 00.00 N	008 00.04 W	GPS	4417	4526	18	1-6	
64PE96N/1	AR12	092	01	ROS	071296	0333	EN	47 00.07 N	008 00.04 W	GPS					
64PE96N/1	AR12	093	01	MOR	071296	1038	RE	48 03.78 N	008 19.90 W	GPS					
64PE96N/1	AR12	094	01	ROS	071396	0605	BE	48 20.00 N	009 20.07 W	GPS					
64PE96N/1	AR12	094	01	ROS	071396	0610	BO	48 20.02 N	009 20.09 W	GPS	146	149	4	1-6	
64PE96N/1	AR12	094	01	ROS	071396	0622	EN	48 19.92 N	009 20.00 W	GPS					
64PE96N/1	AR12	095	01	ROS	071396	0732	BE	48 09.99 N	009 24.95 W	GPS					

SHIP/CRS.	WOCE			CAST	CAST	UTC	EVENT				UNC.	MAXI.	NO OF		
EXPOCODE	SECT.	STNNBR	CASTNO	TYPE	DATE	TIME	CODE	LATITUDE	LONGITUDE	NAV	DEPTH	PRESS.	BOTTLES	PARAMETER	COMMENTS
64PE96N/1	AR12	095	01	ROS	071396	0742	BO	48 10.00 N	009 24.97 W	GPS	440	449	7	1-6	
64PE96N/1	AR12	095	01	ROS	071396	0801	EN	48 10.00 N	009 24.99 W	GPS					
64PE96N/1	AR12	096	01	ROS	071396	0913	BE	48 00.01 N	009 30.02 W	GPS					
64PE96N/1	AR12	096	01	ROS	071396	0946	BO	48 00.00 N	009 29.98 W	GPS	1812	1844	20	1-6	
64PE96N/1	AR12	096	01	ROS	071396	1037	EN	48 00.01 N	009 30.03 W	GPS					
64PE96N/1	AR12	097	01	ROS	071396	1207	BE	47 50.04 N	009 35.03 W	GPS					
64PE96N/1	AR12	097	01	ROS	071396	1307	BO	47 50.02 N	009 35.03 W	GPS	3805	3884	22	1-6	
64PE96N/1	AR12	097	01	ROS	071396	1432	EN	47 50.00 N	009 35.00 W	GPS					
64PE96N/1	AR12	098	01	ROS	071396	1548	BE	47 40.00 N	009 40.00 W	GPS					
64PE96N/1	AR12	098	01	ROS	071396	1646	BO	47 40.01 N	009 39.97 W	GPS	4059	4152	22	1-6	
64PE96N/1	AR12	098	01	ROS	071396	1823	EN	47 39.99 N	009 39.98 W	GPS					
64PE96N/1	AR12	099	01	ROS	071396	2051	BE	47 29.98 N	009 45.00 W	GPS					
64PE96N/1	AR12	099	01	ROS	071396	2202	BO	47 29.98 N	009 45.01 W	GPS	4232	4339	20	1-6	
64PE96N/1	AR12	099	01	ROS	071396	2326	EN	47 30.02 N	009 45.03 W	GPS					
64PE96N/1	AR12	100	01	CTD	071496	0057	BE	47 20.04 N	009 49.97 W	GPS					
64PE96N/1	AR12	100	01	CTD	071496	0206	BO	47 20.00 N	009 49.96 W	GPS	4349	4455			
64PE96N/1	AR12	100	01	CTD	071496	0315	EN	47 20.03 N	009 49.97 W	GPS					
64PE96N/1	AR12	101	01	CTD	071496	0442	BE	47 10.01 N	009 55.02 W	GPS					
64PE96N/1	AR12	101	01	CTD	071496	0554	BO	47 09.99 N	009 55.00 W	GPS	4432	4538			
64PE96N/1	AR12	101	01	CTD	071496	0655	EN	47 09.99 N	009 55.00 W	GPS					