SHIPBOARD REPORT CRUISE PELAGIA 64/109

OMEX II-Leg b
VIGO-TEXEL
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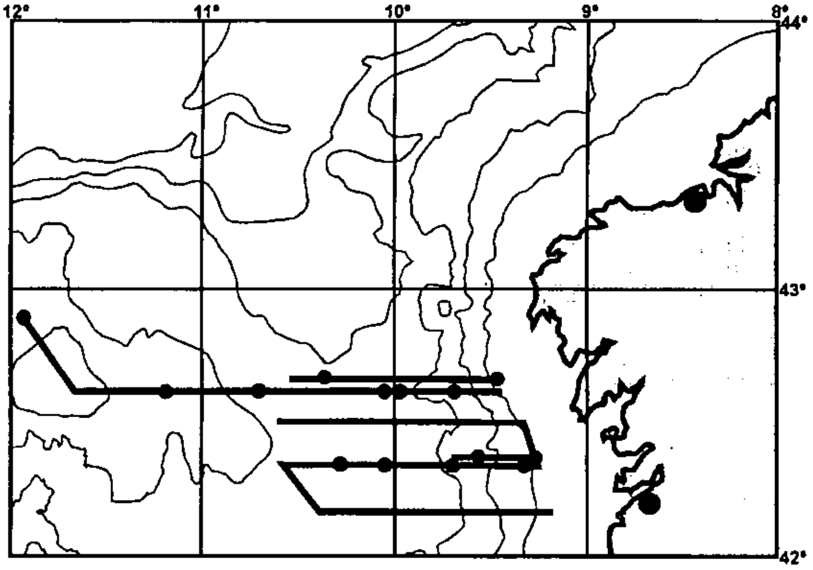
By
Dr.Tj.C.E.van Weering
(Chief Scientist)
&
Shipboard Scientific Party



OCEAN MARGIN EXCHANGE II
"THE IBERIAN MARGIN"

CONTENTS

Appendices:

SUMMARY AND ACKNOWLEDGEMENTS

In the framework of the OMEX II project a cruise was held with RV Pelagia of NIOZ, Texel, to study upwelling effects along the Iberian Margin. An acoustic survey along 5 transects perpendicular to the bathymetry allowed distinction of 5 types of echo, characterizing a variety of sedimentary conditions, mainly pointing to vigorous bottom currents preventing recent sedimentation at the upper and middle slope, and in the saddle between the Iberian Margin and the Galicia Bank.

Subsequently the water column, the sediment-water interface and the bottom sediments were sampled along transects at 42°40 and 42°20 N. In addition, at two stations a long-term sediment trap mooring was deployed and at one mid-slope station the long term lander BOBO for measuring the near bed sediment dynamics was deployed.

CTD profiles, salinity, oxygen, transmission and SPM were determined at discrete depths at all stations. There is little difference between the composition and characteristics of the water column at stations along 42°40 N, including the distribution of nutrients. Based on transmission profiles the Bottom, Intermediate and Surface Nepheloid Layer were sampled for isotope studies of residence time and age of particles. A well-developed BNL is particularly well-developed near the shelf break and upper slope. At selected stations sediment-water exchange processes were additionally studied by means of short term deployments of a benthic lander for measurement of oxygen concentration and resistivity in the benthic boundary layer.

Critical shear velocities (U*cr) were calculated to define erosion resistance of Iberian Margin sediments including aggregates in the BBL, for sediments between 197 and 3000 m values were above1.1 cm/sec. Benthic carbon and nitrogen mineralisation studies were carried out in multicore samples and occasionally in box-core samples; the pore-water profiles indicate coastal stations to have a significant contribution of anoxic processes to the overall mineralisation.

At stations PE109-03, -10 and -11 recent sediments were absent (in box-core tops), indicating local erosion or only temporary sedimentation, in line with the bottom echo character.

A preliminary conclusion of the cruise is that upwelling is concentrated in a narrow zone at the shelf edge and upper slope.

Acknowledgements:

The support and technical assistance provided by captain A. Souwer and crew of R.V. Pelagia is highly appreciated. Thanks are especially due to Harry de Porto for taking immediate action to order and replace essential parts of a failing hydraulic crane. John Huthnance provided a detailed map of the seabed which was essential to accurate positioning to deploy the sediment trap moorings and to select proper sample positions, we thank him as well. The cruise described in this report was funded by NIOZ, as NIOZ contribution to the OMEX II project (contract MAS 3-CT97-0076) by the EU, DG-XII.

1. INTRODUCTION

1.1 General

An important part (10-50%) of the global marine primary production occurs at the continental margin, and continental margin sediments play an important role in the cycling of organic matter. Indeed, over 90% of the organic carbon in marine sediments is stored in continental margin settings (Berner, 1982).

It is the main objective of the studies outlined below, to contribute to understanding, quantification and modeling of the benthic processes involved in exchange of carbon, elements and energy at the Iberian Margin. By comparison and integration of the results and models obtained with data and results from other well studied European and other continental margins, it is the intention to contribute to the main objective of OMEX II Phase II "to measure and model exchange processes at the ocean margins as a basis for the development of global models to predict the impact of environmental changes on the oceanic system, and more specifically, on the coastal zone".

Continental margins and adjacent shelves are areas with high rates of primary productivity and large standing stocks of particulate organic carbon, and therefore are important in the cycling of organic matter (Walsh, 1991). Continental margin sediments account for over 90% of the global organic matter sedimentation (Berner, 1982; Jørgensen, 1983). The enhanced organic matter input is generally caused by a combination of river-induced nutrient input, the coupling of pelagic and benthic systems and local or regional upwelling of fertile, highly productive deep water (Mantoura et al., 1991; Biscaye et al., 1994), as for example at the Iberian margin.

More recently it was established that the apparent vertical primary sedimentation determined by sediment trap analysis is not sufficient to balance material and energy budgets, and lateral advection of organic matter was held responsible (Graf, 1992). The processes that laterally distribute and sort the material derived from vertical settling appear to be as important as is vertical settling in making this material available as food (Smith et al., 1986; Graf et al., 1995).

In recent years the role of continental margins in the transfer, accumulation and cycling of organic carbon has become considered as more important, following the initial suggestion by Walsh et al. (1981) that there could be a net export of organic carbon from the shelf to the continental slope. Here locally organic carbon enriched "depocenters" would be found that on a global scale would include a significant amount of organic carbon. Since then a number of areas with enhanced carbon accumulation have been identified such as the Yemen and Oman continental slope (Pedersen et al., 1992), the Gulf of Lions slope (Monaco et al., 1990) and, although during the more recent SEEP II experiment this amount proved to be much lower than expected, the Mid Atlantic Bight (Biscaye et al., 1994; Walsh, 1994).

The presence of upwelling may lead to enhanced carbon burial rates in the sediments underneath the upwelling systems (such as off NW Africa, off Peru, off NW Arabia and off Benguela). The amount of organic carbon stored in the continental shelf and slope sediments underneath and adjacent to upwelling centers depends largely on the supply, on the preservation conditions, on the dilution with terrigenous sediments and on the near bed hydrodynamic situation (Pedersen et al, 1992), and varies from 0-6% (wt) in surface sediments (Calvert and Pedersen, 1993). The presence of upwelling does however, not a priori indicate that enhanced storage of carbon in bottom sediments will occur.

The OMEX I results from the North Biscay margin indicated the absence of an obvious organic carbon depocentre. Slightly enhanced remineralisation and accumulation rates, however, were found to occur at mid slope areas (Thomsen and Graf, 1996; Helder and Epping, 1996; van Weering and de Stigter, 1996); on the other hand, the benthic organic carbon requirement to sustain the benthic fauna on the Goban Spur shelf and upper slope represented a major fraction of the total organic carbon input (Heip et al, 1996).

The quality and the quantity of the organic matter input is strongly influenced by decomposition during sedimentation, lateral sediment transport and resuspension (Auffret et al., 1994) under the influence of physical processes dominating in the benthic boundary layer (BBL), and by microbial and benthic activity at and near the sediment-water interface and in the surface sediments (Graf et al., 1995). A complete investigation of a sedimentation event must therefore trace the pathways of particles from production to final geological deposition (Graf, 1992), including assessment of the importance of lateral transport.

Lateral transport mainly takes place in the Benthic Boundary Layer, which is most important for the exchange processes between the sediment and the water column (Jumars and Nowell, 1984; Jahnke et al., 1990). However, detailed measurements within the BBL are scarce (Townsend et al., 1992).

Research at the Porcupine Bank and margin area (Dickson and McCave, 1986; Thorpe and White, 1988) and more recently at the Goban Spur slope and margin during OMEX I (see final report OMEX I), showed that aside from vertical settling, the major transport of particles is in the bottom nepheloid layer (BNL). Intermediate nepheloid layer (INL) transport, however, may be a temporary, seasonal transport mechanism (McCave and Hall, 1996; van Weering and de Stigter, 1996), capable of transporting considerable amounts of particulate organic and inorganic matter.

Aside from particle input from continental sources and the shelf through BNL transport, resuspension at the shelf-slope boundary and upper slope by either currents at depth, breaking internal waves or the occurrence of medium and large-scale eddies reaching the seabed (Pingree and LeCann, 1992; Pingree, 1995), may contribute to the formation of intermediate (INL) or bottom (BNL) nepheloid layers transporting particulates across the shelf edge and margin to the deep sea. In addition to these processes, focusing of internal waves at the shelf edge may be of importance for the formation of bottom nepheloid layers, resulting in active supply of material from the shelf edge to the slope (Gardner, 1989). The shelf edge is also susceptible to sediment resuspension and transport under the influence of long-period forerunner swells from major North Atlantic storms.

Temporal and spatial variability of the benthic boundary layer dynamics, however, is largely unknown over the greater part of the European continental margins, and is unknown for the Iberian margin.

Understanding the benthic degradation, recycling and diagenetic processes at the sediment water interface and during burial is, in addition to budget studies, also essential for the interpretation of paleoceanographic sequences in the sedimentary record. Previous studies on early diagenesis have established the progressive role and utilization of oxidants according to the greatest free energy yield, thus sequentially using molecular oxygen in the oxic zone, Mn-oxides and nitrate in the suboxic zone and iron and sulphide in the anoxic zone (Froelich et al., 1979; Bender and Heggie, 1984). Mathematical modeling of pore-water profiles of oxidants and/or reaction products can be used to estimate carbon mineralisation rates (Rabouille and Gaillard, 1991; Soetaert et al, 1996) and considerably increases our knowledge of diagenetic processes and fluxes across the sediment-water interface.

1.2 Oceanographic and geologic setting

The northwestern Iberian margin is characterised by intense, wind-driven seasonal upwelling in summer (Fiuza, 1983; Fraga, 1981; McClain et al., 1986; Frouin et al., 1990). This is clearly reflected in the character and distribution of surface sediments off Galicia (Lopez-Jamar et al., 1992). At the Iberian shelf south of Vigo the shelf sediments and shelf sediment dispersal by bottom currents and resuspension (Oliveira, 1995) is rather well known (Dias and Nittrouer, 1984; Dias et al., 1984). Transport of matter across the slope and margin sediments, however, is unknown.

Water-mass transport and currents beneath the surface layer are directed to the north and a southerly directed surface flow is associated with the upwelling. Pingree (1995) and Pingree and LeCann (1992) have shown that filaments and patches of the upwelled productive water may be dispersed offshore in a northerly and northwesterly direction by the presence of eddies. They tend to recur every year and may extend up to 250 km offshore (Haynes et al., 1993). The filaments are believed to foster enhanced production and have an as yet unknown importance for the offshore transport of organic and inorganic matter.

Internal waves and tides have been noticed at the shelf edge off Iberia (Sherwin et al., 1996), but it is unknown if the transfer of energy at the continental shelf edge results in the formation of nepheloid layers and mass particle transport, as previously noticed off Porcupine and at the Goban Spur (Dickson and McCave,1986; Thorpe and White,1988; OMEX I Final report).

Upwelling off Portugal is documented in planktic foraminiferal and diatom species found far offshore in the surface sediments (Lebreiro, 1995; Abrantes, 1988), and there are indications that upwelling was more intense during the last glaciation than at present (Abrantes, 1991). However, the amount of carbon in surface sediments of the Iberian margin north of 41° N is nearly unknown and the upwelling-induced carbon exchange processes over the margin are not well constrained.

The late Quaternary depositional history of the Iberian margin reflects the major climatic zonations of the Iberian peninsula (Monteiro, 1980), resulting in Holocene margin sediments of predominant biogenic composition and pre-Holocene margin sediments reflecting increased terrigenous input from local and distant sources (Baas et al, 1996). Again, however, sedimentation off the shelf is not well studied. The shelf sediments were reworked during the last low-stand of sea level, and present deposition and accumulation of sands and fines on the shelf is constrained by geomorphology of the seabed (Drago, 1995).

1.3 Objectives

The major goal of the OMEX-II project is to gain a better understanding of the physical, chemical and biological processes at the shelf break, responsible for the exchange of matter and energy between the coastal zone and the open ocean. Emphasis, however, is on the carbon cycle.

It is the objective of the studies carried out during this cruise to contribute to understanding, definition, quantification and modelling of the organic and inorganic particle transport and accumulation, of the diagenetic and burial processes and fluxes and the time scales involved in relation to the oceanographic conditions and benthic boundary layer dynamics along shelf-slope-margin-abyssal plain transects across the Iberian Margin.

The data and results of these studies will be used as input to, verification and validation of ecological and diagenetic models of shelf-slope-margin exchange processes and relate directly to better understanding of the global carbon cycle and budget.

2. GENERAL CRUISE INFORMATION

The preliminary cruise results of Pelagia Cruise PE 64-109 described in this report were obtained in the period July 15th - August 5th, 1997. The cruise started from Vigo, NW Spain, and formed the second leg of two cruises of RV Pelagia as contribution to the OMEX II Project Workpackages I, III and IV. See Appendix 1 for participants. For a map of cruise tracks and sampling stations see Fig. 2.1.

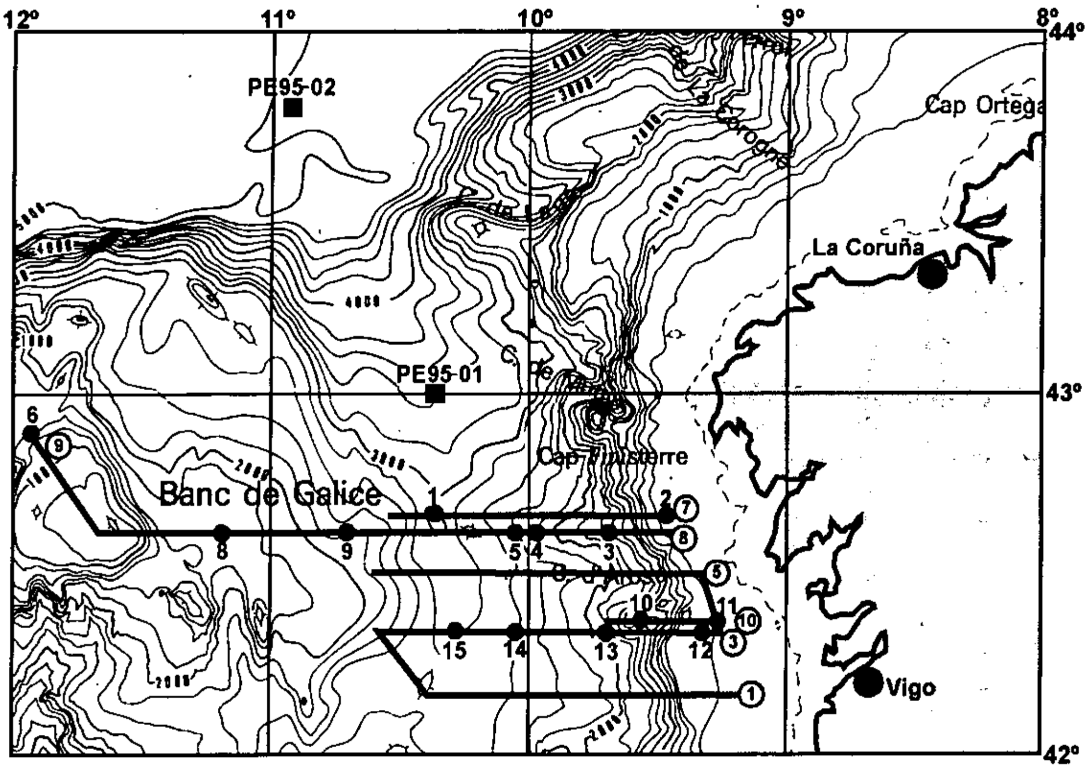


Fig. 2.1. Map of cruise tracks and sampling stations.

After relocation of the containerised laboratories and loading of the equipment transported to Vigo by the IfM and the Lab CNRS, Pelagia left the harbour of Vigo on July 15th and started with a 3.5 kHz penetrating echosounder survey (line 1) across the NW Iberian margin along 42°10 N. This line was continued to the North but subsequently interrupted to search for a lost sailor. This search was stopped in the evening of July 16th to resume 3.5 kHz penetrating echosounder recording of a transect (line 3) across the Iberian Margin along 42°20 N. Subsequently station 64PE109-01 in the deepest part (see Appendix 3) of the channel between the Iberian slope and the slope towards the Galician Bank was made in order to check equipment and methods.

Following completion of this station further profiling was done across the Iberian Margin along 42°40 N (line 7), with the aim to accurately locate potential station and bottom sampling sites, as well as to define in detail the location of sites for the deployment of the sediment trap moorings (see section 3.8). At the end of this line shelf edge station PE109-02 was occupied .

Because the spare parts for repair of the hydraulic crane had arrived in the harbour of Vigo course was set to Vigo upon completion of the station, and Vigo was reentered on July 18th. Loading of spare parts, repair and installation of the crane was done on July 19th, when we left the harbour of Vigo to resume sampling of station PE109-03 followed by a penetrating echosounder survey line slightly south of the 42°40N line (line 8), preceding the deployment of sediment trap mooring IM2 .

After the deployment of the mooring course was set to station PE109-04 at the mid/lower slope plateau, where in addition to the standard sampling of water column and seabed, the BOBO lander was deployed. In the immediate vicinity the second mooring (IM3)was deployed on July 23rd at station PE109-05.

The line along 42°38N was then continued towards the Galician Bank, where along the margin stations PE109-06 - PE109-09 were occupied during the next days. After finishing station PE109-09 a total of 8 stations along 42°38N was realized, extending from 198 to about 3000 m depth, and allowing us to study the possible effects and occurrence of filaments from the Iberian Margin along a transect from 9-2°W.

Upon completion of station PE109-09 on July 26th a penetrating echosounder line (line 5) was recorded along 42°30N, to obtain a better overview and study the regional variability of sedimentation patterns along the margin.

After recording line 5 bottomsampling was done from July 27th until July 31st, at stations PE109-10 - PE109-15, selected on the basis of the previously recorded line. In addition a long-term test with the underwater pumps meant for installation in the moorings was done .

Because of deteriorating weather conditions it was decided, after a day of waiting, to leave the study area and set course to Texel, where we safely arrived on August 5th, 1997.

In total sampling was carried out along two transects as projected in the OMEX Working Package III, in agreement with the overall OMEX objectives. Some additional equipment tests were performed aiming at optimizing equipment meant for long-term underwater particle sampling.

3. PRELIMINARY RESULTS

A. Water column studies

3.1.CTD

Tjeerd van Weering and Bob Koster (NIOZ)

All CTD casts have been made with a Seabird SBE 911 (S/N:247) CTD with a temperature sensor (Seabird SBE-3 (S/N:1337) calibrated: 25/01/96) and a conductivity sensor (Seabird SBE-4 (S/N:1023) calibrated : 03/01/96). The instrument was in addition equipped with an oxygen sensor (Seabird SBE-13 (S/N:130263) calibrated: 16/01/96), a 25 cm beam Seatech transmissometer (S/N:160-D) and a Chelsea fluorometer ((S/N:88/2050/92) calibrated: 29/03/94). At station PE109-03 we mounted in addition a Seapoint OBS (Optical Back Scatter)/Turbidity sensor (200 mV/FTU, connected to external voltage input no. 4) for calibration of the transmissometer against OBS and fluorometer. These measurements were subsequently done on all stations where the CTD was lowered.

Water samples were taken with a General Oceanics Rosette sampler equipped with 24x 12 litre Noex bottles. The shipboard derived CTD profiles including the transmissometer data are given for each station in Appendix 4 and 5. Bottle files including the shipboard determinations of oxygen and nutrients are presented in Appendix 6. The water column was sampled at all stations at 3 m above the seabed, and at selected levels above the bed, depending on the salinity/temperature profile and on the transmission profile. Characteristically the Mediterranean Outflow Water (MOW), characterized by higher salinity and temperatures, bathes the Iberian Margin from ~450 m water depth down to 1450 m. Often a reduction of transmission is found associated with the upper boundary of MOW.

Most CTD profiles of stations along the transects studied show little variation, indicating a similar water-mass structure over the entire study area.

B. Shipboard chemical analysis

3.2.Oxygen measurements and calibrations

Rikus Kloosterhuis (NIOZ)

Oxygen samples were taken from the NOEX 12 l water sampling bottles mounted on the Rosette-CTD frame. Also samples were analyzed from overlying water of multicores and from core incubation experiments.

Oxygen was measured on board using a combination of the Winkler method and a modified spectrophotometric detection of the yellow / brown colour, as described by Su-Cheng Pai , Marine Chemistry 41 (1993) 343-351. The acidified brown precipitation will give a iodine and iodide clear mixture with an absorption max. at 353-356 nm. Detection occurred at the shoulder off the absorption max. At 456 nm , this requires a stable spectrophotometer with a narrow monochromatic band range.

Oxygen was calculated by :

$[O_2](\mu mol/l) = (V_{corr} \times Abs_{corr}) / F$

in which:

$V_{corr} = (V_{bottle}+V_{acid}) / (V_{bottle} - V_{precipitation} \text{ reagents})$

$Abs_{corr} = (Abs_{sample} - Abs_{reagents\ seawater\ Blank} - \text{turbidity Blank} - \text{zero reading})$

F = factor determined by measuring the absorbency of different KIO_3 concentrations, in relation with the equipment we used. F was set during the cruise to 0.001125 l / µmol and can be slightly adjusted after recalibration in the laboratory.

All oxygen analyses are reported in the bottle files (Appendix 6).

Preliminary Results

A plot of oxygen concentrations measured in the water column samples of one transect over the Iberian Margin is presented in Figure 3.2.1, while in Fig. 3.2.2 a comparison with the CTD oxygen sensor at station PE109-01 is given, showing a constant offset between sensor and chemical analysis.

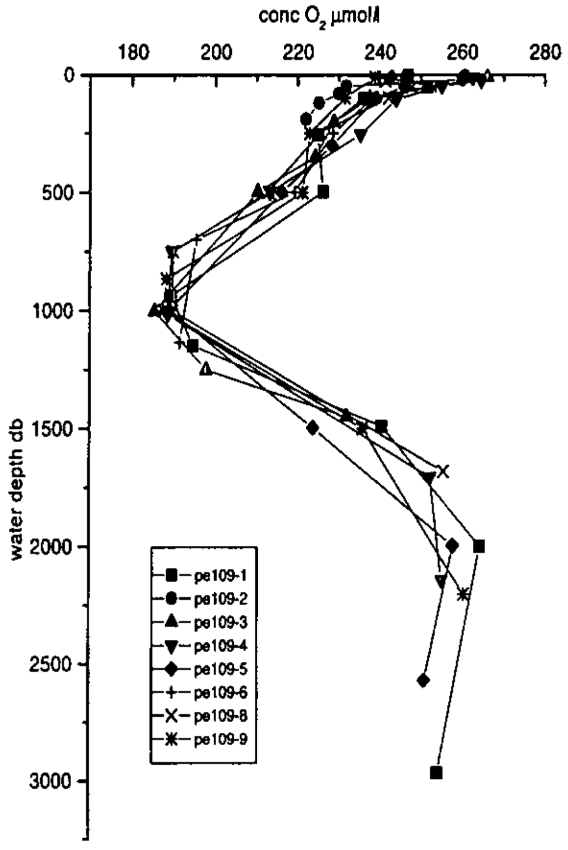


Fig. 3.2.1. Oxygen concentrations measured in the water column.

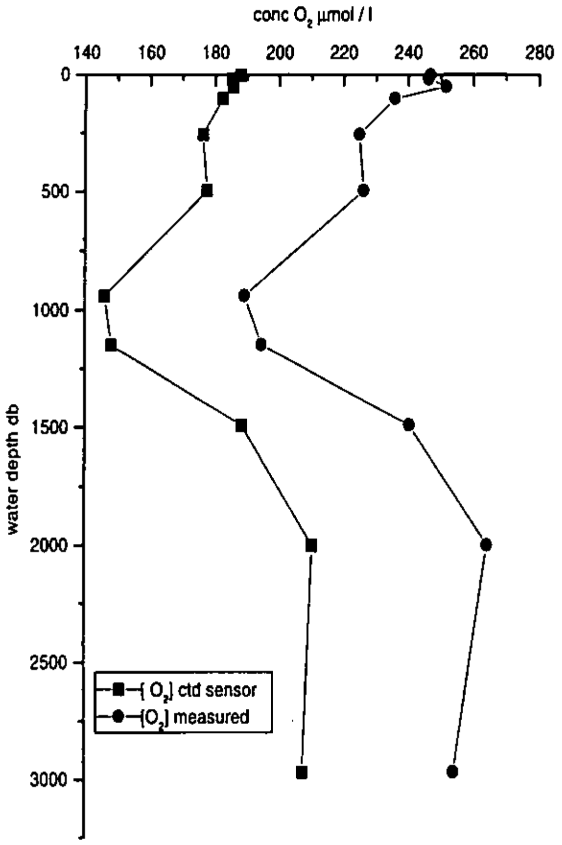


Fig. 3.2.2. Comparison of oxygen values as produced by CTD oxygen sensor and by chemical analysis.

3.3 Salinity

Rikus Kloosterhuis (NIOZ)

Samples for salinity determinations were collected from the NOEX bottles in order to validate the Conductivity probe from the CTD and from the Aquaflow unit. Measurements will be performed upon return in the laboratory, using a Guildline Autosal (model 8400) salinity meter and subsequent calculation by NIOZ-made software. Values will be calibrated using standard sea water and will be corrected for instrumental drift.

3.4 Nutrient Analysis

Karel Bakker and Jan van Ooijen (NIOZ)

General

During the cruise water samples were taken from:

- CDT-rosette sampler and from the overlying water from box core- and multicore samples. All these samples were analyzed for Ammonium, Silicate, Nitrate, Nitrite and Phosphate and, for three stations also for TIC.
- Pore-water samples were analyzed for nutrients as above and for TIC, Iron and Manganese.
-Samples originating from core incubations were, apart for nutrients also analyzed for Total Inorganic Carbon (TIC) All measurements were performed on a Bran and Luebbe Traacs 800 Autoanalyser based on colorometry. Pore-water and Core-incubation samples were stored frozen (-18°C) and will be analysed in the NIOZ laboratory for Urea .The total number of analyzed samples was about 850.

Sampling procedures and methods

Samples from the CTD-rosette were taken in polyethylene bottles. These samples were filtered through a 0.20 µm acrodisc filter and analyzed mostly within 10 hours. All other samples were filtered through a 0.20 or 0.45 µm filter and analyzed within 48 hours, in the meantime they were stored dark and cool (2-4°C).The pore-water samples for the analyses of Iron and Manganese were, after filtering, acidified with hydrochloric acid Supra pure to a 0.01 N acid solution.

Working standards were freshly prepared every day by diluting stock standards to the required concentration with natural aged sea water (low nutrients concentration). This water was also used as wash water between the samples. The concentration of nutrients in the natural aged sea water was determined manually. Every day we used a second mixed nutrient stock as an independent external check. This external standard is poisoned with 20 mg/l Mercury(II)chloride. The calibration stocks are poisoned with 0.2% Chloroform.

Pipettes and volumetric flasks were calibrated before the cruise and fresh stock standards were measured against the previous ones and against our external standard.
The accuracy of our analyses is about 1% of full scale values. The results of our analyses are written elsewhere in this report.

The nutrients were measured colorimetrically 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 800 nm. To prevent the formation of the blue phosphate-molybdenum complex we used oxalic acid.
-Phosphate reacts with ammoniummolybdate at pH 1.0 and potassiumantimonyltartrate was used as a inhibitor. The yellow phosphate-molybdenum complex was reduced by ascorbic acid to a blue coloured complex measured at 880 nm.
-Nitrate was mixed with imidazol at pH 7.5 and reduced by a copperized cadmium colomn to nitrite. The efficiency of this colomn was always better than 96% and measured every run. The reduced nitrate was measured in the same way as the nitrite analyses.
-Nitrite was diazotated with naphtylethylenediamine and sulphanilamide to a pink-coloured complex and measured at 550 nm. The difference of the last two measurements gave the nitrate content.
-Ammonium reacts with phenol and sodiumhypochlorite at pH 10.5 to form a indophenolblue complex. Citrate is used as a buffer and complexant for calcium and magnesium at this pH. The colour is measured at 630 nm.

-Iron is first converted to Fe(II) by using hydroxylamine in a buffered medium of sodiumacetate and is then coloured with "ferrospectral" and measured at 550 nm.
The analyses of manganese is based on a modification of the formaldoxime reaction. The manganese-formaldoxime colour is formed in an alkaline solution and is measured at 480 nm. Interference of iron-formaldoxime is removed by addition of EDTA and hydroxylammoniumchloride.
-The analyses of Total Inorganic Carbon was performed by taking a sample into a primary acidified stream were all the carbonate was transferred to carbondioxide. This carbondioxide is transported through a membrane into a secondary stream containing phenolftaleine at pH 9-10. The phenolftaleine, which has a purple colour at that pH, is decolourized by the CO_2. The amount of decolourization, which is measured at 520 nm, is related to the CO_2-concentration.

Results

All shipboard results of nutrient analyses in the water column are given in the bottle files (Appendix 6). Pore water analysis results and those from core incubations are dealt with in paragraph 3.11 and 3.12. The results of analysis of Si, NO_3, PO_4 along the northern transect (42°40 N) are given as examples in Figs. 3.4.1, 3.4.2, and 3.4.3, respectively.

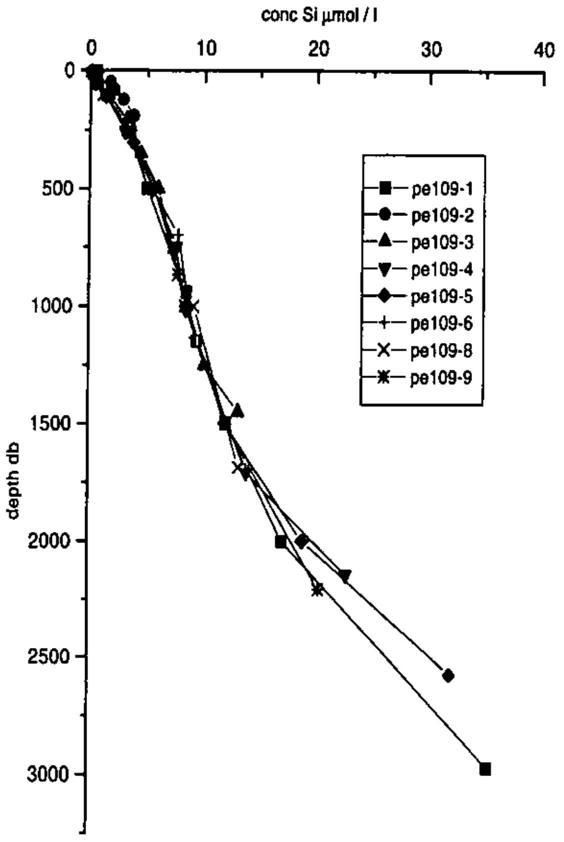


Fig. 3.4.1. Distribution of Si in the water column.

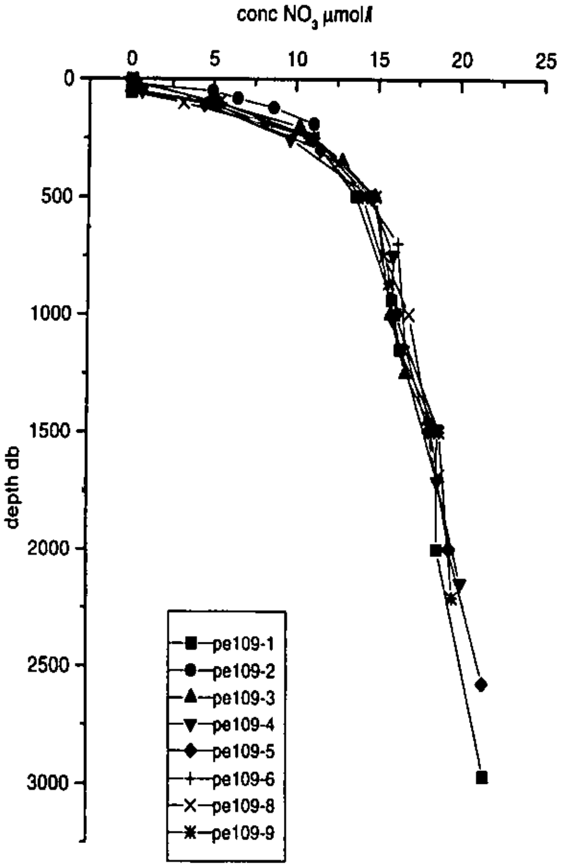


Fig. 3.4.2. Distribution of NO_3 in the water column.

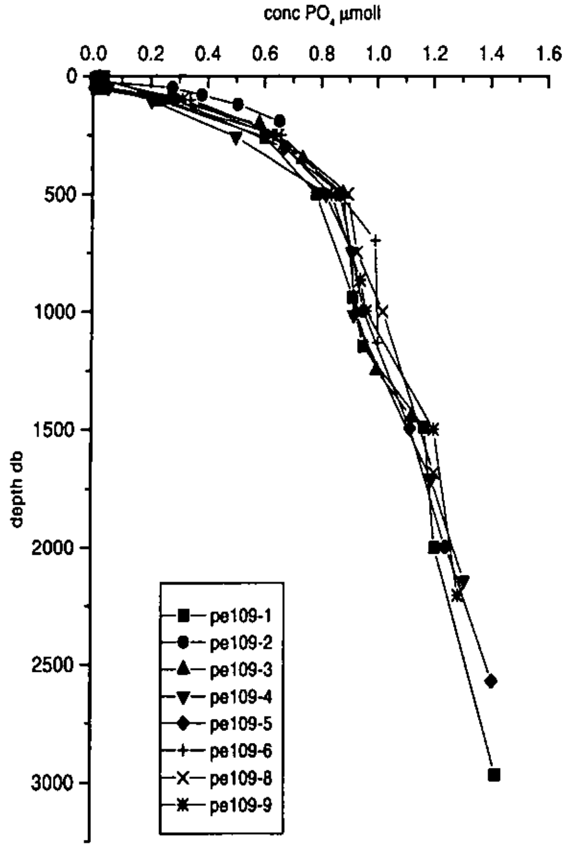


Fig. 3.4.3. Distribution of PO_4 in the water column.

3.5 Transmission

Tjeerd van Weering and Bob Koster (NIOZ)

Transmission in the water column was measured continuously during down- and upcast by means of a 25 cm beam-length Seatech Transmissometer. In addition, from station PE109-04 onwards we mounted a Seapoint Turbidity meter. Unprocessed results are presented as plots in Appendix 5.

The Seatech transmissometer accuracy depends on the particle concentration, the path- length and the calibration of the instrument. The transmissometer employs a LED light-source with a wave-length of 670 nm, in the red part of the spectrum. The measurement made by the instrument is intended to provide insight into the concentration and presence of suspended particulates in relatively clear water. However, we noticed that up- and downcast of the transmissometer gave variable results, possibly induced by a temperature effect. Correlation with the OBS data shows that some INL's (measured by the Seatech) appear to be not true.

The Seapoint turbidity meter uses a light-source of 880 nm LED, formed by silicon diodes with light-blocking filters, and measures the light scattered at angles between 15 and 150° through the detector window. The amount of light reaching the detector is proportional to the turbidity or particle concentration in the water. The sensing volume of the water is within 5 cm of the sensor windows.

Presence of particles in the water column is often seen as surface nepheloid layers (SNL), intermediate nepheloid layers (INL) and bottom nepheloid layers (BNL).

Both the transects sampled across the Iberian Margin at 42°40 N and at 42°20 N have well developed BNL's, often, but not at all stations showing a two-stepped pattern, reflected in both the transmissometer and the OBS data.

The BNL is particularly well-developed near the shelf break and upper slope. At the shelf break stations PE109-02 and -11 the thickness of the BNL was 25-30 m, the upper slope stations showed the two stepped profile with increasing thickness (335-350 m) of the BNL towards the stations PE109-05 and -13 . The near bottom layer of the BNL here was 125-100m thick. Galician Bank stations PE109-08 and -09 show both a BNL, decreasing in thickness towards the W.

It appears that the northerly directed currents affecting the Iberian slope and margin are effectively transporting considerable amounts of fines within the BNL, parallel to the slope and locally inhibiting sedimentation of fresh particles. This is confirmed by the critical shear stress measurements, the penetrating echosounder profiles and the results of box- and piston coring.

INL's do occur and appear to have a shelf origin, detached layers may be present but a more detailed analysis of the SPM contents and the study of the transmission/OBS profiles upon return in the lab is needed.

3.6 Radionuclides

^{234}Th particulate fluxes and residence time of particles in the nepheloid layer (NL).

Pieter van Beek (Gif-sur-Yvette)

Introduction

^{234}Th ($T_{1/2}$=24.1 d) is produced continuously from the radioactive decay from ^{238}U in the sea water. Dissolved uranium is relatively unreactive to particulate adsorption whereas thorium can be removed from dissolved phase by adsorption onto particles. ^{234}Th scavenging allow to quantify ^{234}Th particulate fluxes and residence time of particles. This tool has been already used in the euphotic zone where biogenic particles related to primary productivity remove the dissolved ^{234}Th.

In this study, measurements of dissolved and particulate ^{234}Th in Bottom and Intermediate NL will be compared to measurements in the seawater out of the NL to check if significant scavenging of dissolved ^{234}Th onto suspended particles can be observed in the NL. At the same time, $^{226\text{-}228}$Ra measurements in the dissolved phase will be performed.

Methods

Sea water was collected with 11 liters Noex bottles. 65 liters are passed through a 142 mm Millipore membrane filter (0.45 μm pore size).

Particulate ^{234}Th will be measured directly on the filter with a well-type, low-background, high efficiency Ge γ detector settled in the "Laboratoire Souterrain de Modane" (LSM), protected for cosmic interactions under 1700 m rock.

Fe carrier and ^{229}Th yield tracer are added in 42 liters of dissolved samples acidified with HCl (pH=1-2). $Fe(OH)_3$ is precipitated by adding NH_4OH (pH=7). Barium as chloride is added to make barite ($BaSO_4$) precipitate. Thorium isotopes co-precipitate with $Fe(OH)_3$ whereas Radium co-preciptates with barite.

After settling, the hydroxyde precipitate is collected by filtration on a Wathman filter and dissolved with 8 N HCl. Barite remains on the filter. Radium activities of barite will be measured by γ detection. The solution is then passed on a cationic-exchange column (Dowex

1x8, 100-200 mesh, 8 cm^3) under 8 N HCl conditions. The iron is retained whereas the thorium passed through the column. Back to the laboratory, the thorium will be extracted with TTA in benzene after evaporation and dissolution in 0.1N HNO_3 and then will be plated onto an aluminium foil. Chemical yield is determined by α-counting of ^{229}Th, and ^{234}Th activities are measured by γ-counting of its 63 and 93 keV gamma rays.

3.7 SPM

Henk de Haas and Tjeerd van Weering (NIOZ)

For determination of the concentration and composition of the SPM in the water column, specifically in the BNL (bottom nepheloid layer) and in the INL (intermediate nepheloid layer) - if present -, water samples collected with the CTD-Rosette sample were filtered on board.

At each station one to three 12 liter NOEX bottles were filled in the BNL at 3 m above the bottom, and in case the transmission profile indicated a multi-stepped BNL also in the upper part of the BNL, and in the INL.

Bottles were well shaken before collecting the tapped water into 5 liter polyethylene bottles. Subsequently the water was filtered over preweighed 0.45 µm polycarbonate filters, applying underpressure by means of a vacuum pomp. Total amount of water filtered per sample was noted. After filtration the filters were rinsed with demi-water and subsequently flushed with alcohol, to remove salt and avoid contamination by organic ingrowth. Filters were then stored in sealed petri-dishes for further treatment in the laboratory. Sample depths per station are given in Table 3.7.1.

Table 3.7.1. Depth of water samples for SPM filtration.

STATION	SAMPLE DEPTH (m)	STATION	SAMPLE DEPTH (m)
PE109-01	2970 / 200 / 50	PE109-10	1146 / 141
PE109-02	190	PE109-11	199 / 139
PE109-03	1444 / 350	PE109-12	330 / 293 / 188
PE109-04	2147 / 1710 / 1017	PE109-13	1771
PE109-05	2537 / 302	PE109-14	2606
PE109-08	1685 / 750	PE109-15	2786
PE109-09	2206 / 865		

In addition to the filtration, a subsample was taken for immediate shipboard determination of turbidity measured by the Lamotte Model 2008 turbidity meter. This is done by putting the sample in a glass tube and measuring the amount of light scattered 90° by the suspended particles. A light of known strength is beamed through the sample tube, where the particles will cause the light to scatter. The intensity of this scattered light is measured by sensors located on the sides of the chamber, compared to light intensity transmitted and the difference caused by the scattering converted into Nephelometric Turbidity Units (NTU). These are similar to other values like FTU (Formazin Turbidity Units).

3.8 Particle flux at the Iberian Continental Margin

Avan N. Antia and Eric Labahn (IfM, Baltec)

One of the primary aims of the OMEX II project is to determine material flux at the Iberian Margin and contrast this with the Goban Spur that was the site of the first 3-year OMEX investigation. The deployment of long-term moorings at the Iberian slope constitutes one method of this study and these are equipped with sediment traps, current meters and optical particle sensors. A site was chosen within the central OMEX study area near Vigo on the northern margin that provides a comparison and contrast to the Goban Spur site so as to compare the quantity and quality of particulate flux between the regions. These contrast greatly in both the extent and intensity of upwelling, which has a stronger, more seasonal signal at the Iberian Margin, and in topographic setting, with the Iberian Margin having a narrow shelf and abrupt, steep decline to the adjoining abyssal plain.

Two mooring systems have been deployed along a transect at about 42°38 N. The heavily canyonated margin rises into a small, gradual spur at this latitude, making it locally a suitable site for comparison with the Goban Spur. Filament formation, thought to be related to the capes (in this case the Cap d'Arosa), is also seen to occur at this transect, during which times water upwelled at the shelf break can be transported over the mooring sites, losing particles over the outer slope. Mooring deployments are at water depths of 1450 m and 2250 m and consist of taut wire moorings with a net positive buoyancy of 700 kg and bottom anchor of 1200 kg, with instruments placed at varying depths (Table 3.8.1).

Table 3.8.1. Configurations and positions of the OMEX IM Moorings.

Mooring	Latitude N	Longitude W	Water depth	Instrument depth	Instrument
IM2	42° 38.753'	9° 41.859'	1450 m	618 m	ST
				641 m	RCM + OBS
				1075 m	ST
				1099 m	RCM + OBS
IM3	42° 37.719'	10° 01.672'	2240 m	598 m	ST
				621 m	RCM + OBS
				1078 m	ST
				1102 m	RCM + OBS
				1718 m	ST
				1741 m	RCM + TRS.

ST: Sediment trap
RCM: Recording Current Meter
OBS: Optical Backscatter Sensor
TRS.: Transmissiometer

As at the Goban Spur, depths of the instruments were chosen so as to: a) have the uppermost sediment traps below the depth of seasonal mixing b) have the lowermost traps above the depth of local benthic resuspension and c) place the mid-water trap at IM 3 below the bottom gradient of the water with Mediterranean imprint. The expectation is that the 600 m traps will intercept the primary biogenic flux from surface layers, whereas resuspended and advected material will contribute increasingly to mid-water and deeper traps; varied analyses of sediment-trap samples will enable us to distinguish the quantitative and qualitative differences in these fluxes and thus delineate the transport of different elements across the slope. During OMEX I the importance of the transport of fine suspended particles in mediating fluxes was recognized and will be recorded by the OBS and transmission sensors mounted on the current meters, which additionally give long-term recordings of current speed and direction and water temperature and salinity at hourly intervals.

During the cruise newly developed in-situ filtration systems of Baltec GmbH, were tested at depth on a wire. These systems enable collection of SPM at pre-programmed times during the deployment by filtration of up to 50 l water in situ on 47 mm Æ membrane filters. The filters are subsequently poisoned and stored sealed until recovery. This will allow us to make parallel analyses on the total particulate spectrum (sinking and suspended) that mediate fluxes in this environment. The in-situ filtration systems will be deployed adjacent to the sediment traps in a subsequent period when the moorings are recovered and redeployed in March 1998.

We are particularly grateful to all those who gave us so generously of their time and expertise and were responsible for the smooth deployment of the mooring systems. So "tausend Dank" especially to Arie on the bridge, and Marcel, Roel, Lorendz, Cor and Stefan on deck!

Mast und Schotbruch und immer 'ne handbreit Wasser unter'm Kiel!

C: Benthic Boundary Layer

3.9. Deployment BOBO

Bob Koster and Tjeerd van Weering (NIOZ)

BOBO (BOttom BOundary Lander) was deployed on 21/07/97 near station PE109-04 at a depth of 2152 m, near the site where sediment trap mooring IM3 was deployed.

After extensive repair following the recovery on September 19th, 1995 during OMEX I, the lander now contains a rewired acoustic current meter which measures current velocities and directions at 25, 50 75 and 100 cm above the seabed every six minutes. Simultaneous recording of the salinity and temperature of the near-bed sea water is made by a Sea Cat CT probe. Two Camera Alive camera's for still photography are mounted for the observation of changes of the seabed morphology during the deployment.

For the study of the variability of the particle distribution in the near-bed boundary layer one Seatech transmissometer (25 cm beam length) and a Seapoint OBS are mounted at 100 and 200 cm above the seabed. Data are stored in a central data command and processing unit (CPU), as well as in the individual instruments.

3.10.Deployments TROL

Wim Helder and Rikus Kloosterhuis (NIOZ)

The profiling TROL (Temperature Resistivity Oxygen Lander) was during this cruise housed in a new frame, developed to carry out oxygen profiling simultaneously with in-situ benthic chamber experiments. TROL itself was equipped with 5 single-cathode oxygen microelectrodes, a four-wire resistivity probe to determine the sediment formation factor (F) and with two ISFET (Ion Sensitive Field Effect Transistor) probes to measure pore-water profiles of pH. The ISFET probes as well as the O_2 sensors had a common reference electrode which consisted of an Ag/AgCl wire housed in a small tube containing 3M KCl and KCl cristals and connected to outside sea water by means of a porous membrane in the bottom of the tube.

Deployments of TROL were done at 9 stations, covering a depth range of 190 - 2590 m (Table 3.10.1). Some examples of oxygen profiles are given in Fig.3.10.1.

Table 3.10.1. TROL deployments.

Station	depth (m)	Bottom-water temp. (°C)	Profile range (mm)
PE109-02	190	12.24	50
-04	2157	3.69	80
-05	2575	3.19	80
-08	1680	4.9	80
-09	2210	3.81	85
-11	200	12.34	60
-12	330	12.12	80
-13	1760	5.04	80
-14	2590	3.36	85

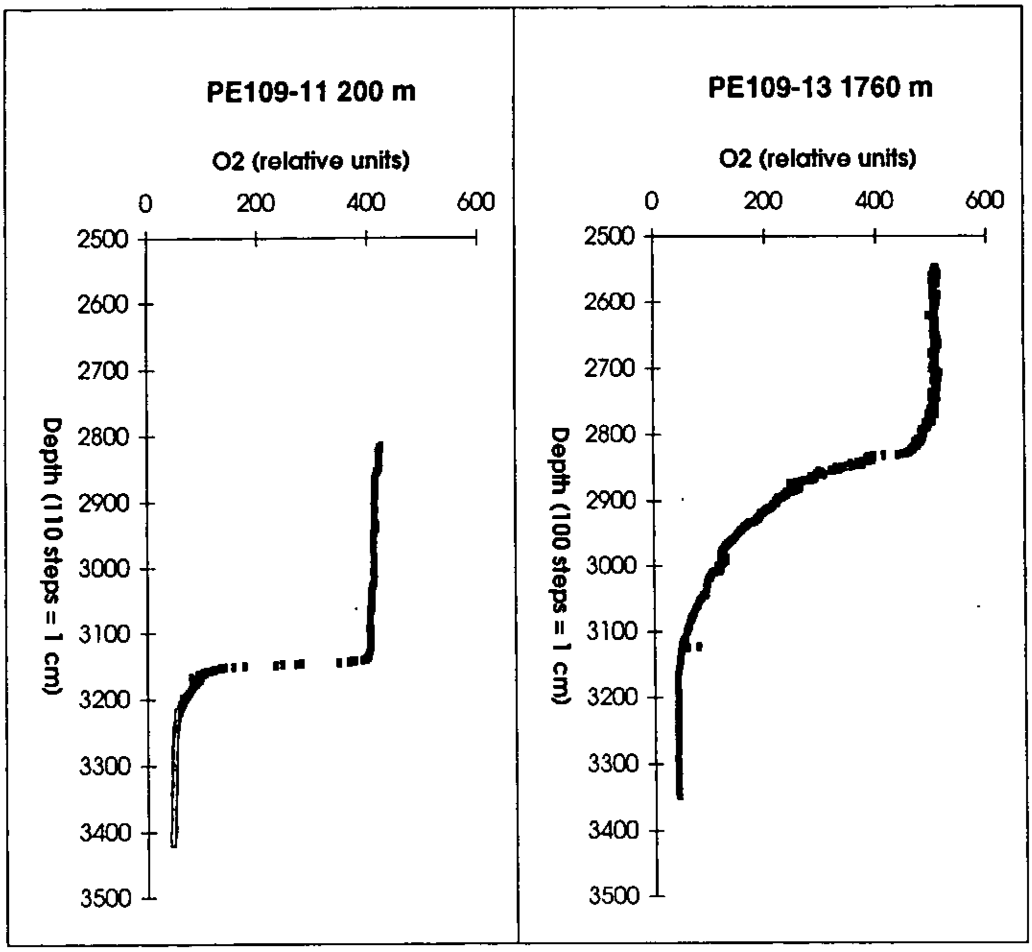


Fig.3.10.1. Examples of oxygen profiles measured in-situ by TROL.

The TROL profiles will be modeled with reaction diffusion models to calculate a.o. oxygen fluxes across the sediment-water interface.

From the resistivity profiles the formation factor (F) can be derived by:

$$F_z = R_z/R_o,$$

where F_z is formation factor at depth z in the sediment and R_z and R_o are the resistivity at depth z and in the overlying water, respectively. F is related to the porosity (ϕ) by:

$$F = A\phi^{-n}$$

($2<n<3$, going from sandy sediments to clays).
Fig. 3.10.2a, b, c give the R profiles of TROL stations at different depth ranges. It can be seen that steepest interfacial R gradients occur at the shallow "sandy" stations PE109-02 and -11.

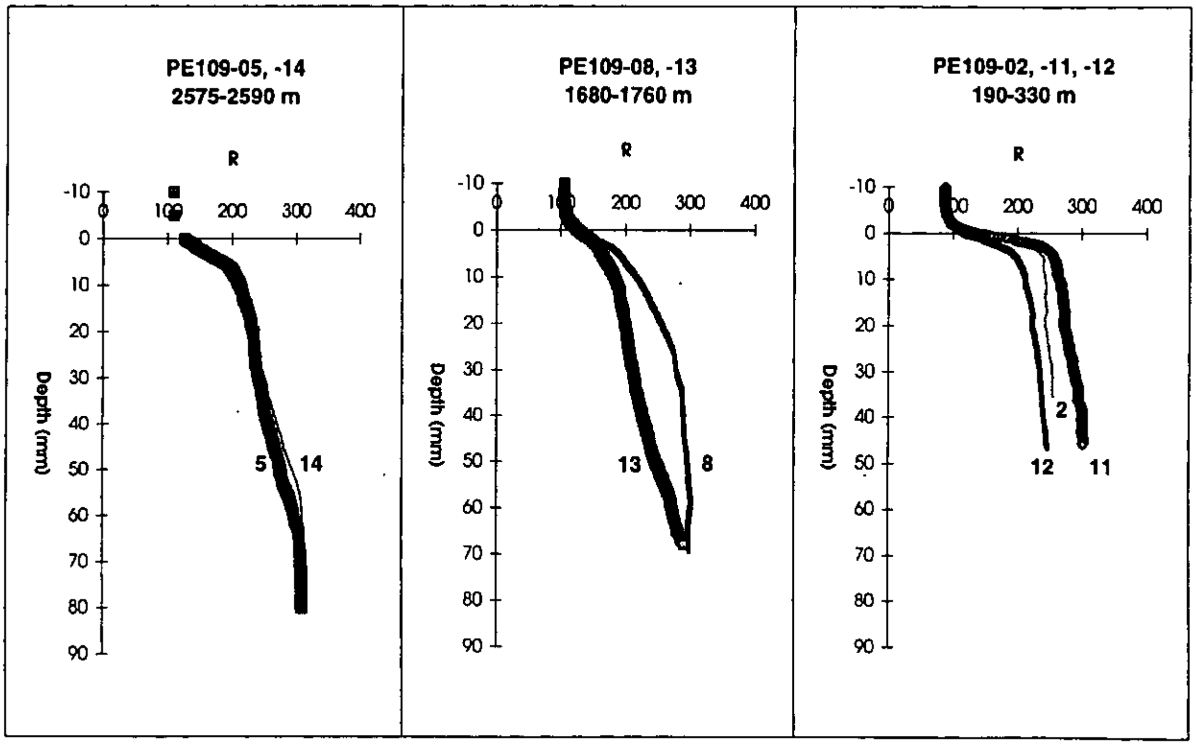


Fig. 3.10.2. R profiles of TROL stations at different depth ranges.

Preliminary results from the pH-ISFET sensors mounted on the TROL indicate that the ISFETS can work well. The sensors registrated well at stations PE109-04, -08, -09 and -11. At the other stations we found that, due to improper sealing with epoxy resin between the sensor stainless-steel shaft and the connector, erroneous results were produced. The progress since the OMEX 95 cruise is that obviously frequent refreshing of the internal solution in the reference probe allows for suppression of drift of the signal. Leaking ISFET probes proved to be responsible for considerable noise increase on the oxygen electrode signals. An example of a pH profile is given in Fig.3.10.3.

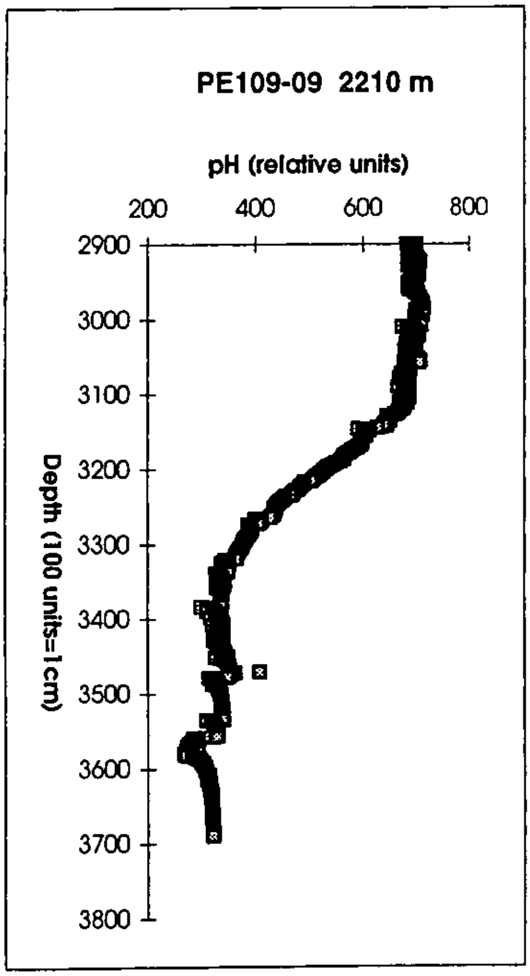


Fig.3.10.3. Example of a pH profile measured in-situ by TROL.

3.11. Critical shear velocity

Claudia Thomsen (GEOMAR)

Aim of the study is to investigate the spatial and temporal variability of biological relevant processes in the benthic boundary layer including aggregates under narrow shelf / upwelling influenced conditions, which are characteristic for the Iberian continental margin.

For the determination of the erosion resistance of margin sediments, sediments of 10 stations (multicorer and box-corer samples) were exposed to increasing shear velocities within an erosion chamber of 10 cm and 20 cm diameter (in cooperation with the Technical University of Hamburg, FRG, G. Gust). The bottom shear velocity to transport organic fluff varied between 0.2 and 0.8 cm/s. Resuspension in form of aggregates occurred at u*cr of 0.7 - 1.2 cm/s. The critical shear velocity u*cr for the sediments of water depth between 197 m and 2959 m were dominated by values above 1.1 cm/s, only at the stations PE109-01, -08, and -09 the sediments were resuspended with u*cr between 0.2 and 0.5 cm/s, presuming a contribution of finer grain-size fractions (see also Table 3.11.1).

During the experiments turbidity values were recorded and POC samples taken. Aggregates on the sediment surface were resuspended, sampled and the POC content will be analyzed upon return in the lab.

*Table 3.11.1 Critical shear velocities (u*cr).*

STATION	U*cr	STATION	U*cr
PE109-01	0.2 - 0.8	-10	0.2-1.2
-04	>1.3	-11	1.3
-05	>1.3	-12	1.3
-06	0.9	-13	>1.3
-08	0.5- 0.9	-14	1.0

Additionally, experiments on effluxes of nutrients under different flow conditions with u* of 0.0, 0.2, 0.4 and 0.6 cm/s were carried out at 5 stations (Stations PE109-01, -04, -06, -09 and -14) and will give information about the permeability of different continental margin sediments.

3.12 Benthic carbon and nitrogen mineralisation

Lutz Lohse (NIOZ), Maria Jesus Belzunce Segarra (Vigo) and Rikus Kloosterhuis (NIOZ).

In order to discern differences in the pattern of benthic organic matter dynamics in the Goban Spur and at the Iberian Margin areas, we investigated mineralization and burial rates along two transects along the Iberian margin.

Organic matter deposited at the sea floor can either be mineralized or be buried in the sediment. The release and uptake of redox-sensitive compounds (e.g. oxygen, nitrate etc.) within the sediments and across the sediment-water interface can be used to calculate the mineralization rates. Organic matter which survives mineralization becomes buried. The percentage of this fraction may depend on environmental (e.g.. oxygen minima) microbial (oxic vs. anoxic mineralization) and textural parameters (e.g. surface area)

The following parameters were or will be studied:

- porosity
- resistivity
- sediment surface area
- organic carbon and nitrogen content
- Solid iron and manganese
- Amino acids (samples taken for M. Grutters, NIOZ)

-depth distribution of:

- oxygen
- ammonium
- nitrate/nitrite
- phosphate
- sulphate
- dissolved manganese and iron
- silicate
- ΣCO_2

Methods

Sediment cores were obtained by multicoring (Barnett et al., 1983). The corer retrieves four 10 cm (inner diameter) cores and eight 6.5 cm (i.d.) cores. While the first set of cores was used for sediment-water fluxes and oxygen profiling, the second set was sliced into intervals (Table 3.12.1) and the pore water was obtained by centrifugation.

The multicorer retrieved undisturbed sediment cores at all stations, except at stations PE109-01, PE109-03, PE109-06. At these stations, the sampling was prevented, most probably by the sediment structure which did not allow for multicoring. Bad weather conditions prevented sampling at station PE109-15.

Table 3.12.1. Sampling intervals used for multicore slicing.

Sediment intervals to collect (mm)			
0.0-2.5	10.0-15.0	30.0-40.0	70.0-90.0
2.5-5.0	15.0-20.0	40.0-50.0	90.0-110.0
5.0-7.5	20.0-25.0	50.0-60.0	110.0-130.0
7.5-10.0	25.0-30.0	60.0-70.0	130.0-150.0

Oxygen profiling

Oxygen profiles were obtained by using Clarke type oxygen microelectrodes. The profiles were made with a vertical resolution of 100 to 500 μm using a computerised micromanipulator. All measurements were carried out in 10 cm (i.d.) multicores with a stirred water column.

Sediment-water fluxes

Sediment-water fluxes were estimated in by monitoring the concentration of solutes in the overlying water of 3 10 cm (i.d.) multicores. In order to preserve the microtopography of the sediment-water interface, the overlying water of the cores was not replaced by filtered bottom water. Instead, the bottom water reservoir was monitored for concentration changes.

All incubations were performed under gas-tight conditions, which allowed the simultaneous determination of nutrients, oxygen and total inorganic carbon. The cores were stirred with a central clockwise-anticlockwise rotating magnet. The diffusive boundary layer created by this way of stirring ranged between 200 and 500 μm in thickness.

Core warming experiment

In deep-sea sediments, pore-water profiles of ammonium very often exhibit subsurface peaks. Diffusive fluxes calculated from these profiles are not in accordance with measured fluxes, the latter usually being zero. This suggest that the elevated pore-water concentrations of ammonium are of artificial nature, probably induced by the sampling procedure. Temperature has been put forward as a potential factor to cause these artifacts. We designed an experiment in which the pore-water extraction procedure was performed under various temperatures.

Preliminary results

At first sight it appears that the pore-water profiles at both transects comprise coastal stations having a significant contribution of anoxic processes to the overall mineralization as well as oceanic stations in which organic material is mineralized entirely by oxygen. Examples of nitrate and ammonium profiles are given for the northern transect for stations

PE109-02 (189 m), -04 (2145 m), -05 (2570 m), -08 (1681 m) and PE109-09 (2207 m) in Fig. 3.12.1. Although no sediment samples could be obtained from a depth range of 500 to 1500 m a tentative impressions reveals that the sediments in this transect reveal lower mineralization rates than stations with comparable depths from the Goban Spur area. To support this hypothesis, a detailed analysis of all redox-sensitive pore water compounds will be performed by the application of diffusion-reaction models.

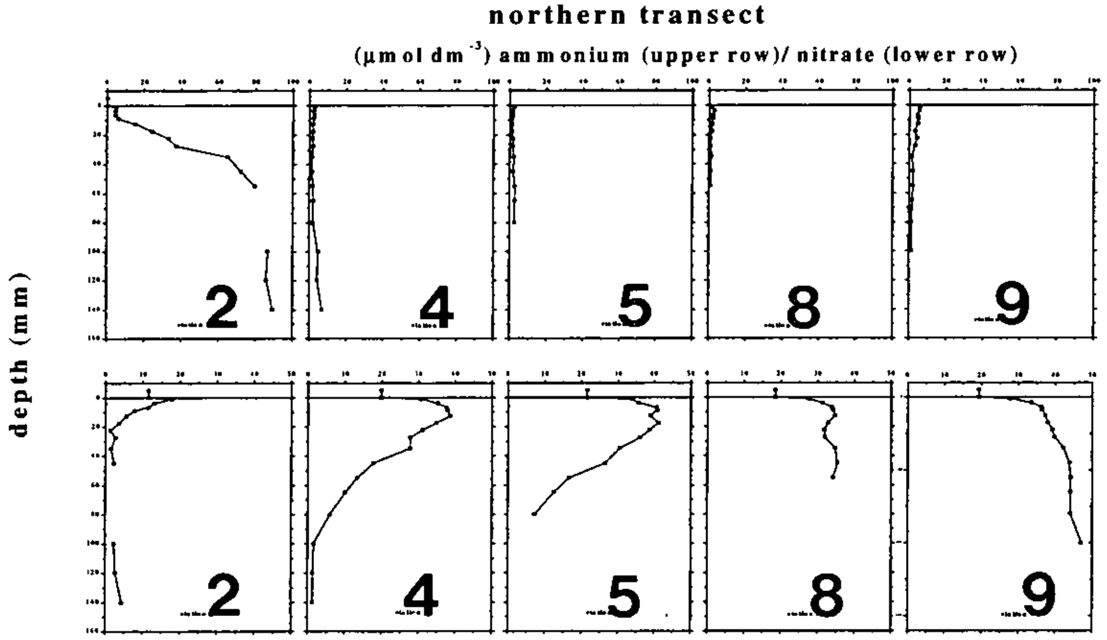


Fig.3.12.1. Ammonium and nitrate pore water profiles obtained at the northern transect.

Fluxes of solutes measured in sediment-water incubations were performed during a 5 to 8 h period. An example for nitrate fluxes across the sediment water interface is given in Figure 3.12.2. Nitrate as well as all other compounds were released from the sediment. Ammonium fluxes were often undetectable. A separate water sample was incubated in order to monitor potential changes of nutrient concentrations in the overlying water.

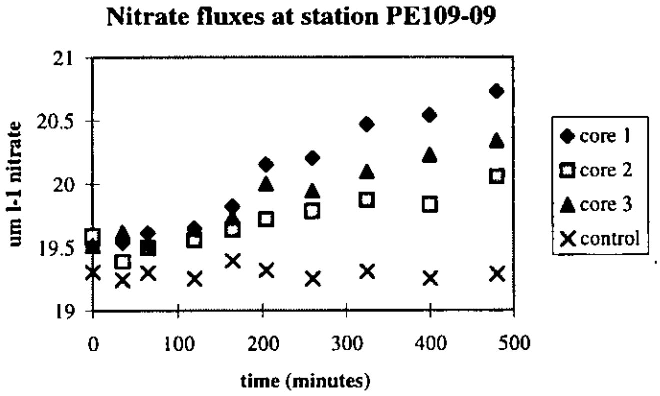


Fig. 3.12.2. Nitrate fluxes at station PE109-09.

Core warming experiment

As has been ascertained during previous cruises, ammonium concentrations in the upper sediment column were artificially higher than in deeper layers. The overlying water of the multicores increases about 4 to 10°C during the up-cast. As a consequence, mineralization processes in the uppermost layer may have been accelerated by these increased temperatures. In a pilot experiment, sediment cores obtained from station PE109-14 were processed as described above. Four additional cores from the same multicore deployment were treated identically, except that the cores were processed outside the cool laboratory at 25°C. In a second experiment, we allowed the overlying water of sediment cores retrieved from station PE109-09 to warm up to 20°C. Subsequently, the cores were processed as described previously.

The ammonium pore-water profiles obtained by conventional methods displayed high ammonium concentrations in the top layer of the sediment. Immediate pore-water extraction outside the cool container led to two- to threefold higher concentrations throughout the upper layers of sediment (Fig.3.12.3). Similar observations were obtained when the sediment core was allowed to warm-up. A further evaluation will take into account the temperature dependence of the distribution coefficient of adsorbed and free ammonium as well as the comparison with nitrate profiles.

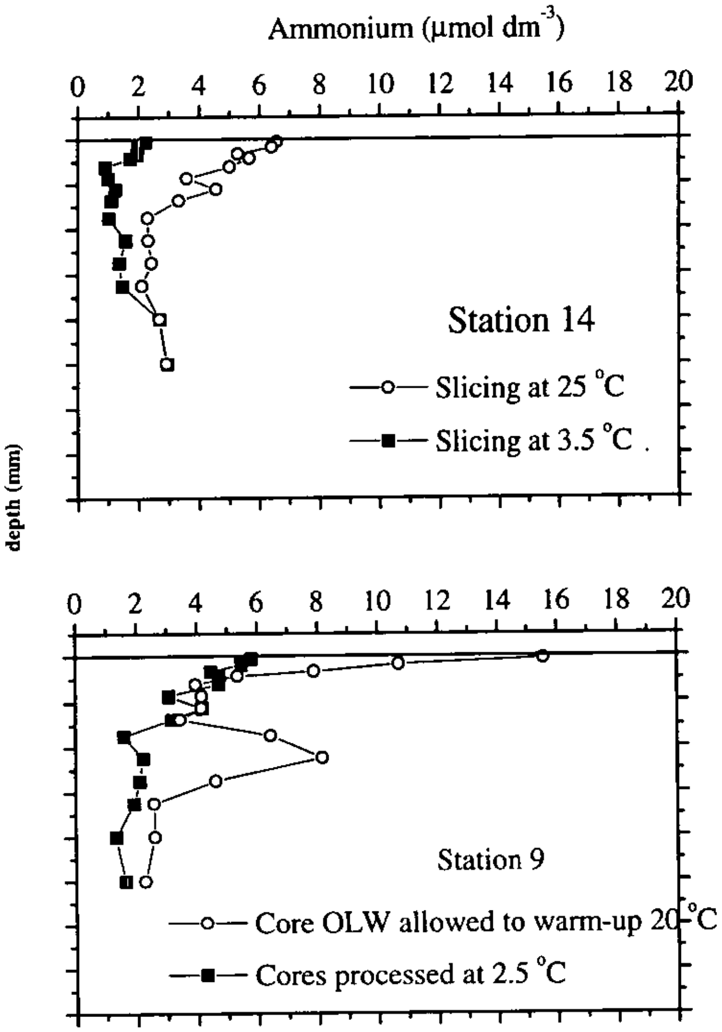


Fig. 3.12.3. Ammonium pore water profiles obtained during the core warming experiments.

D: Sediments

3.13 3.5kHz profiles

Tjeerd van Weering and Henk de Haas (NIOZ)

3.5kHz recording was done perpendicular to the slope along 10 lines (see Appendix 2) and while on station, in order to obtain an overview of regional sedimentation pattern, sediment character and distribution. Data recording was on a Dowty dry paper recorder with a setting of 0.5 second (750 m) recording interval. Ship's speed during recording was 5 m/hr. The seabed can be characterized in terms of the character and reflectivity of the sedimentary layers at the surface and directly underneath, following the definitions of Damuth (1974, 1979). The shelf and shelf break are characterized by a strong slightly diffuse reflector representing the seabed, with a lack of well-defined layers below (Type 1 reflector; see Fig. 3.13.1). Occasionally patches of finer-grained sediment of a more transparent character fill the irregularities in the seabed morphology.

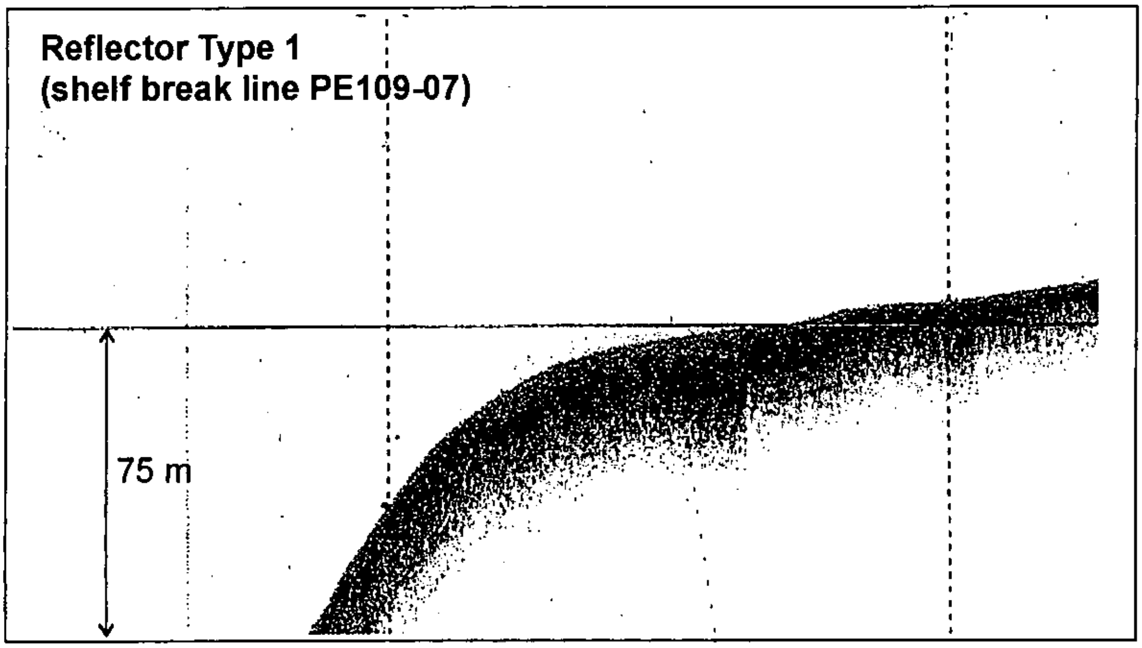


Fig. 3.13.1. Type 1 bottom echo. Distance between horizontal grid lines is 75 m, distance between vertical dotted lines is 0.5 h (~2.5 mile).

The upper and middle continental slope are characterized by strong irregular hyperbolic reflectors (Type 2; Fig. 3.13.2), indicating local outcrops of indurated rocks and lack of an appreciable sediment cover. The lower part of the continental slope and part of the channel floor between Galicia Bank and the NW Spanish margin is characterized by well-layered, continuous reflectors (Type 3; Fig. 3.13.3), consisting of intercalations of transparent and strongly reflective beds, with a strong reflector forming the seabed in the deepest part of the channel and with less reflectivity at the slope. This indicates current scour in some part of the deep channel in combination with a coarser grain size or better compaction of sediments caused by high current velocities. Finer-grained sediments at the lower slope have a lower reflectivity and somewhat more transparent character, the echo-character is also described as Type 3 (well-bedded and continuous).

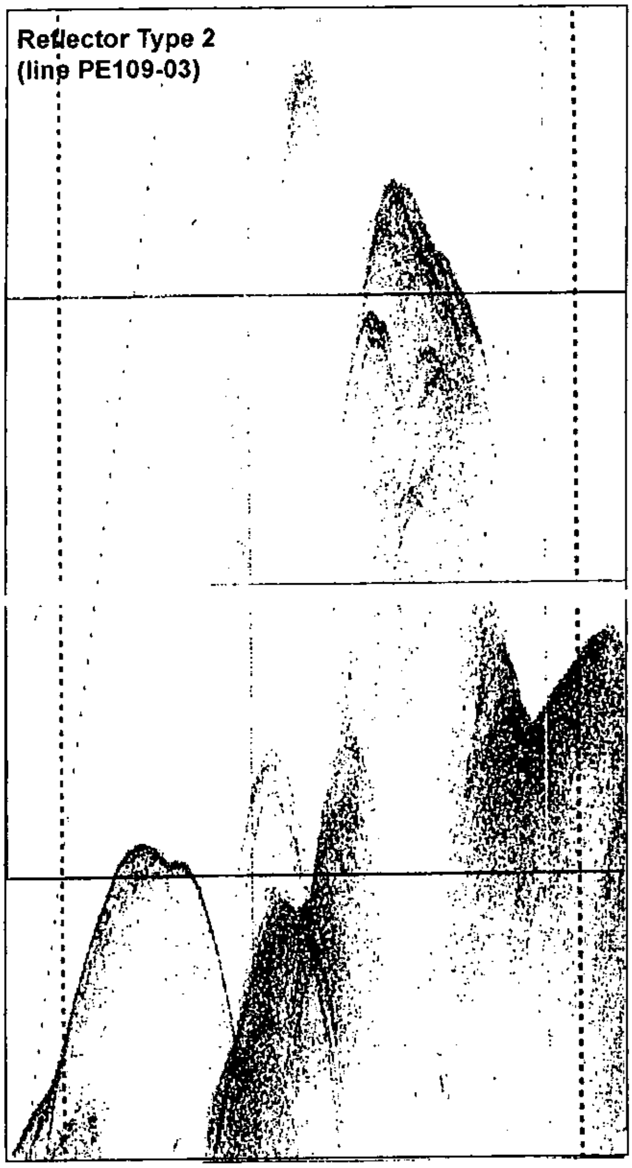


Fig. 3.13.2. Type 2 bottom echo. Scale as in Fig. 3.13.1.

Occasionally, in the deepest part of the channel irregular, discontinuous reflectors, with strong reflectivity at the surface and little penetration or diffuse character (Type 4; Fig. 3.13.4) is found, forming the channel floor.

The eastern slope toward the Galicia Bank is showing a characteristic pattern of well-layered and subsequently truncated layers (Type 5; Fig. 3.13.5), the structural depressions of the truncated layers have being filled up and again eroded.

A vigorous current appears to sweep the E margin of the Galicia Bank and the deeper part of the channel (creating Type 5 and 4 seabed reflectors). Sedimentation is mainly on the lower and lower-middle section of the NW Spanish continental margin, the well-layered Type 3 sediments here draping the slope, and thus indicative for sedimentation dominated by pelagic settling. The latter is more clearly illustrated along 42°20 N and becomes less along the northern transect at 42°40 N. The different echo-types will be regionally mapped.

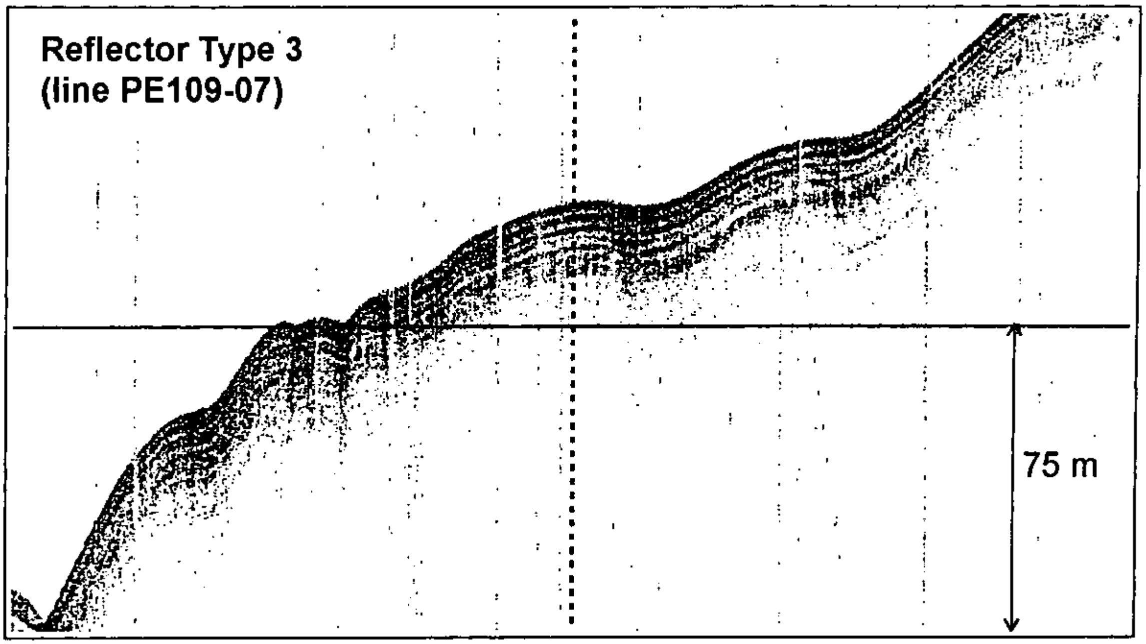


Fig. 3.13.3. Type 3 bottom echo. Scale as in Fig. 3.13.1.

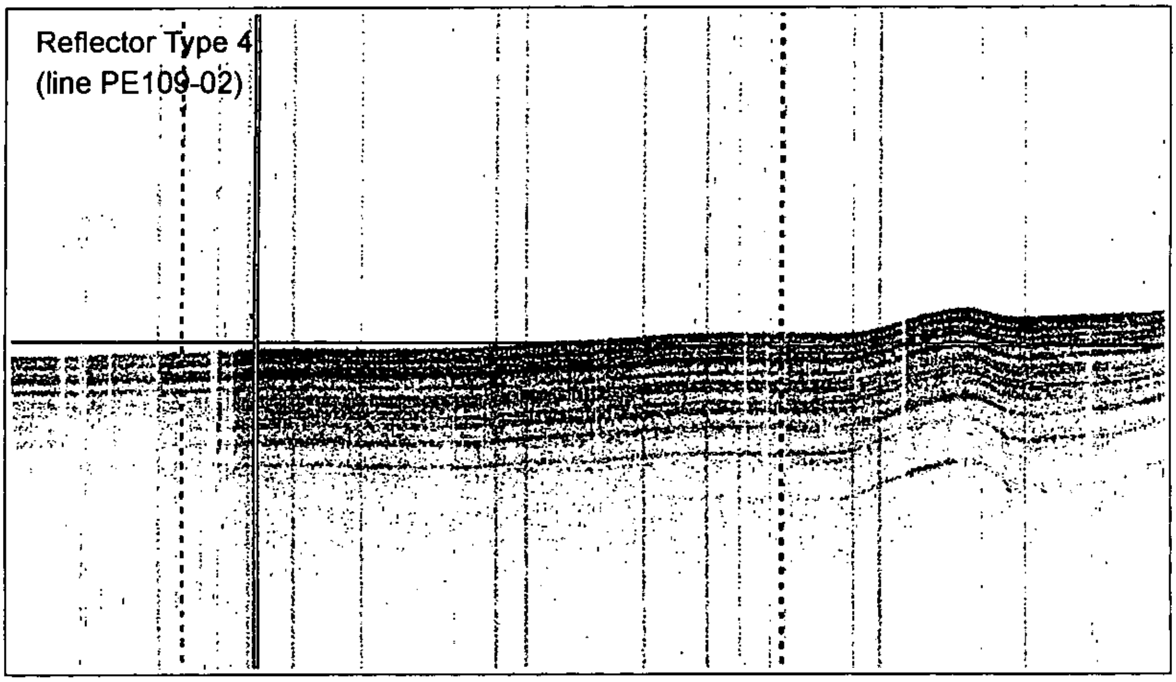


Fig. 3.13.4. Type 4 bottom echo. Scale as in Fig. 3.13.1.

The hyperbolic reflectors (Type 2) characterizing the upper middle and middle slope indicate the irregular, steep character of the slope and the local outcropping of older compact and indurated, presumably Tertiary and Quaternary sediments. The diffusive, locally strongly reflective character of the shelf break , with local transparent infill in topographic lows indicates a coarse-grained, sandy shelf break with irregular patches of fine-grained sediments filling the lows. Reworking may have caused the discontinuous character of the shelf break and lower shelf sediments.

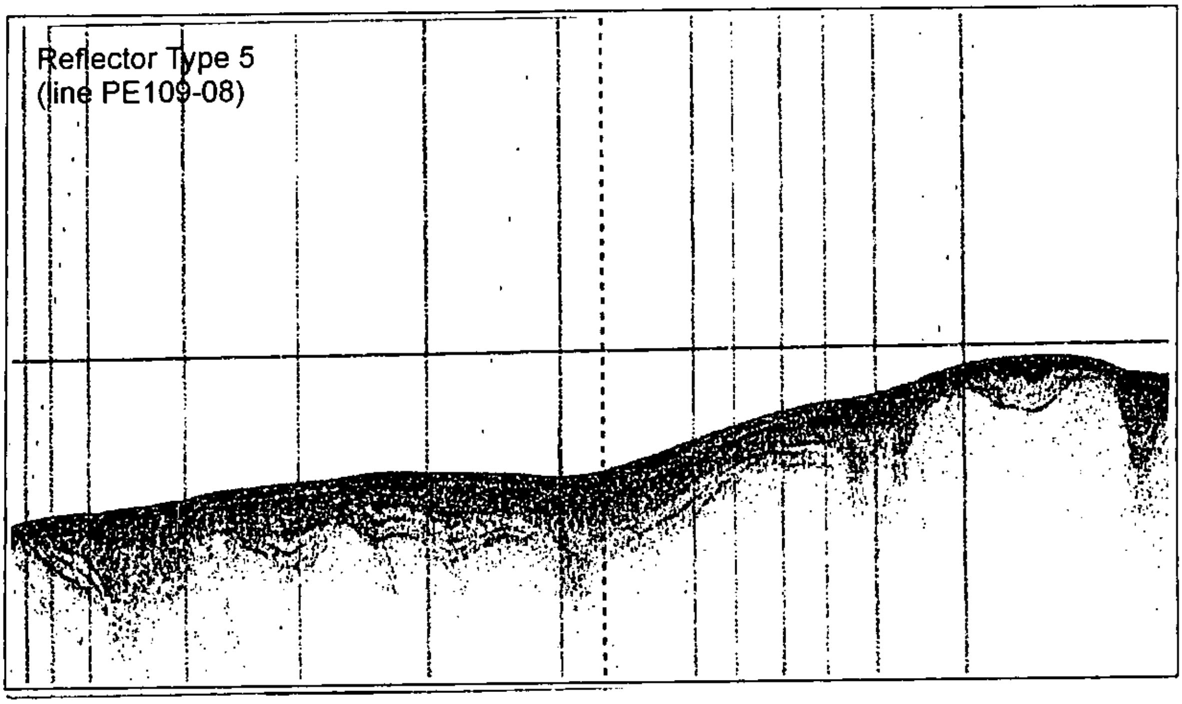


Fig. 3.13.5. Type 5 bottom echo. Scale as in Fig. 3.13.1.

3.14 Box coring

Tjeerd van Weering and Henk de Haas (NIOZ)

Box cores were made at all stations by means of cylindrical boxes with a closing lid on top, preserving an intact sea bottom surface and the overlying bottom water. Subsamples were made by slowly inserting liners of 9 cm diameter in the sediment after siphoning off the overlying water. Positions and water depths of the box-core stations are given in Appendix 3.

The subsamples were stored cool (4°C) and will be used in the laboratory for the determination of grain size and composition, age and sediment accumulation rate and for the downcore variation of the organic carbon content, in order to make carbon burial flux calculations.

At stations PE109-03, -10 and -11 recent sediments were either absent or very thin, indicating local erosion (stations -03, -10) or only temporary sedimentation (-11). Station PE109-11 in addition showed at 30 cm below top the presence of numerous in situ oyster shells, indicating a possible sea-level low stand, and thus subsequent low sedimentation rates.

Sediments at stations PE109-04, -05, -08, -09 and -13 - -15 consist of carbonate mud , mainly formed by foraminifera and Pteropod skeletons. At a few stations gravel was found in the surface sediments in amounts below 3%, predominantly fine gravel. The shallow station at the Galicia Bank yielded coarse carbonate sand with gravel and biogenic clasts, representative of absence of recent sedimentation and the local occurrence of erosion.

3.15 Mineralogical analyses

Maria Jesus Belzunce Segarra (Vigo)

The distribution patterns of heavy metals as well as their chemical behaviour from the coastal ecosystems to the open sea are studied in order to reach a better understanding in the land-ocean interactions. For this purpose, preliminary studies on the chemical forms of metals in the Galician Rias have already been done. It is our intention to complete the geochemical cycles of trace metals along the Galician Bank and Goban Spur area.

The clay mineralogy in San Simon inlet, Ria de Vigo, the Galician Margin and the Goban Spur area have been studied. Expectedly the obtained preliminary results can be complemented with further studies on the sediments of the Galician Bank.

Transects across the Galician Bank were made during the OMEX II cruise on board RV Pelagia in July/August 1997. The sampling was made by box coring and multicoring. Core sediments of 10 cm wide x 30 cm lenght were sliced on deck in at least three sections of 2 cm each: the upper layer, the middle part of the core and at the bottom part. The core subsamples were kept at 4°C on board. Prior to chemical and mineralogical analysis, the samples will be air-dried at 60°C and their water content will be analyzed.

Organic carbon and nitrogen analysis will be performed. Grain-size fractionation will be done and the <63 μm and <2 μm fractions will be used for further chemical and mineralogical analysis. The distribution patterns of heavy metals and the speciation of metals in the sediments will be studied following Tessier et al. (1979).

IR, XRD, SEM and TEM techniques will be used to study the bulk and clay mineralogy of the marine sediments.

3.16 Radionuclides

Pieter van Beek (Gif-sur-Yvette)

Sedimentation rates and mixing rates in the sediment

Box cores and multicores of stations PE109-01, -04, -06, -08, -09, -11, -12, -13, -15 were sliced on board (each half centimeter until 6 cm and then each centimeter). The samples will be dried once back in the laboratory. A few grams will be measured in a low-background Ge γ detector in the LSM to quantify : $^{234}Th_{ex}$ (24 d), $^{228}Th_{ex}$ (1.8 a), $^{210}Pb_{ex}$ (22.4 a), and $^{230}Th_{ex}$ (75,200 a) activities for each level of the core.

Profiles of radionuclides in sediment show characteristic distinct parts. The upper part is homogenized by mixing by animals (bioturbation) which allow to determine mixing rates. Deeper, radioactive decay of long half-live nuclides will give the sedimentation rate.

3.17. Pistoncoring

Tjeerd van Weering and Henk de Haas (NIOZ)

During this cruise four piston cores were taken from the Iberian Margin (see Appendix 3), of which only core PE109-05 was opened on board. All other cores were cut in 110 cm long sections and stored at 4°C for further study in the laboratory. Core PE109-05 showed a top layer of about 30 cm thick of yellowish gray-grayish olive foraminiferal silty clay, with some diagenetic boundaries at 8 and 13 cm depth.

The core section below 30 cm consists of homogenous silty clay with irregular occurrence of sandy intervals of either turbiditic or current induced origin. Burrowing is extensive. In view of the composition of the lower part of the core it is expected that this core reflects a reduced Holocene sedimentary record and that the lower part (30-688 cm) is not older than isotope stage 4. Further research will be done upon return in the lab.

3.18 Magnetic susceptibility

Henk de Haas and Tjeerd van Weering (NIOZ)

All cores collected during the Pelagia OMEX 1997 cruise (PE109-05, -09, -11 and -14) were scanned for their downcore magnetic susceptibility using a Bartington MS2 C magnetic susceptibility meter and applying a 12 cm spool. Measurements have a relative value and are expressed in cgs units. The results of the measurements of cores PE109-05, -09, -13 and -14 are shown in Fig 3.18.1.

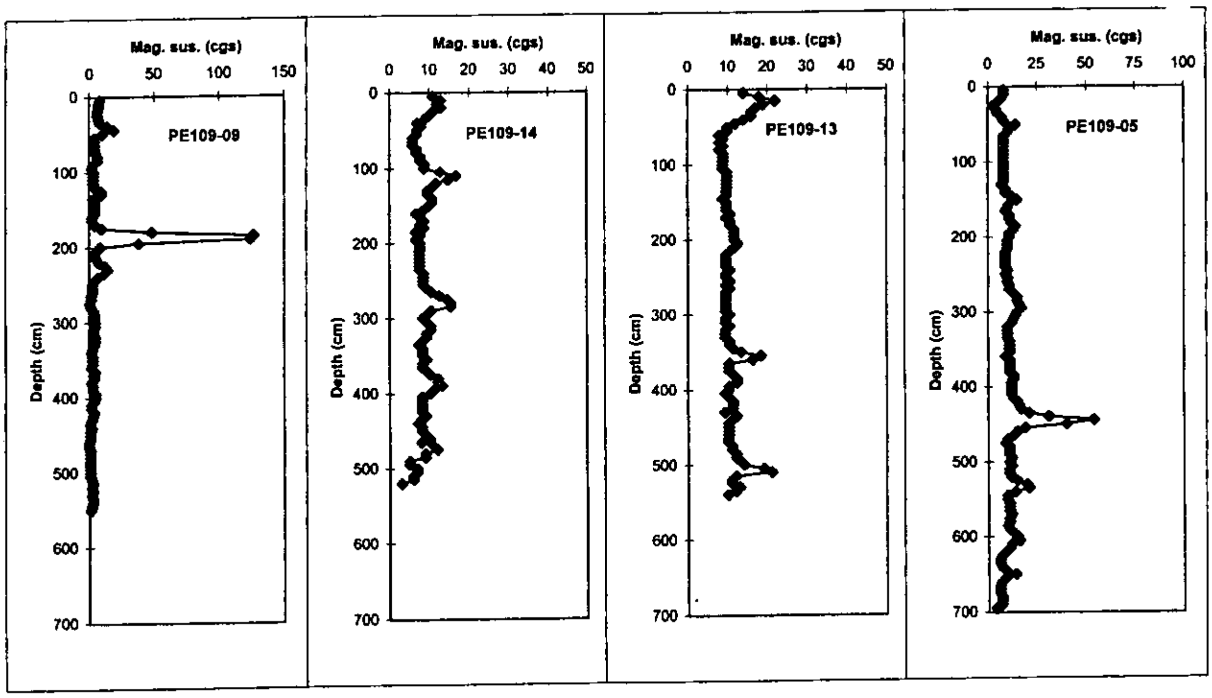


Fig. 3.18.1. Magnetic susceptibility profiles of piston cores.

Initial results show that a few peaks are noticeable, especially a strong peak in core PE109-09 at about 185 cm sediment depth. This may represent the presence of Heinrich layer 1, providing a provisional age datum, as this layer is dated at 14,500 y BP. Peaks in the other cores are as yet not considered to represent Heinrich layers (with the possible exception of the peak in PE109-05 at 450 cm depth, which does not coincide with a sedimentation/turbidite event), but are rather interpreted as representing single influxes of terrigenous material in a dominantly fine-grained sedimentary environment.

4. PRELIMINARY CONCLUSIONS

An acoustic survey along 5 transects perpendicular to the bathymetry allowed distinction of 5 types of echo, characterizing a variety of sedimentary conditions, mainly pointing to vigorous bottom currents preventing recent sedimentation at the upper and middle slope, and in the saddle between the Iberian Margin and the Galicia Bank.

CTD profiles, salinity, oxygen, transmission and SPM determined at discrete depths at all stations showed little difference between the composition and characteristics of the watercolumn at stations along 42°40 N, including the distribution of nutrients.

The Bottom Nepheloid Layer is particularly well-developed near the shelf break and upper slope.

Critical shear velocities (U*cr) were calculated to define erosion resistance of Iberian Margin sediments including aggregates in the BBL, for sediments between 197 and 3000 values were above 1.1 cm/sec.

Benthic carbon and nitrogen mineralization studies were carried out in multicore samples and occasionally in box-core samples; the pore-water profiles indicate coastal stations to have a significant contribution of anoxic processes to the overall mineralization.

At stations PE109-03, -10 and -11 the absence of recent sediments on top of local hardgrounds and indurated mudstones indicates erosion, non- or only temporary sedimentation, in line with the distribution of subbottom echo characteristics.

A preliminary conclusion of the cruise is that upwelling is concentrated in a narrow zone at the shelf edge and upper slope. Little effect of possible transport of nutrients and organic carbon by filaments could be observed on board, but still needs verification in the laboratory.

5. TECHNICAL REPORT (MECHANICS)

Marcel Bakker and Lorendz Boom (NIOZ)

On this cruise we used the box corer, the multicorer, and the piston corer. The winch for coring equipped with Kevlar cable was specially installed on board of the Pelagia.

The box corer

The box corer we used on board is the K12. The box is approximately 55 cm high and the diameter is 50 cm. Because one of the fittings broke 2 boxes were heavily damaged. All the other samples had a stable, good quality.

The multicorer

The multicorer is special designed for a gentle penetration of the sediment and to obtain undisturbed core samples of the surface sediments. The multicore is made of 4 tubes, diameter 90 mm and 8 tubes, diameter 65 mm. The caps on top of the tubes close immediately when the multicorer starts penetrating the sediment. The caps on the bottom of the tubes will close when the tubes come out of the sediment. A piston takes care for the gentle penetration when the multicorer is on the bottom. When the multicorer is on the bottom, penetration of the sediment takes about one minute. For that reason the multicorer can only be used when the weather is good.

The piston corer

The piston corer we used was the PC005, with 12 m barrels and liner. The plastic liners inside the core barrels are 90 mm diameter. One piston corer was damaged. The tube was bent. Initially a mistake was made in using a wrong - too short - trip cable. The best result obtained was a core length of 698 cm.

The deep-sea traction winch

The deep-sea traction winch is specially designed for deep-sea sampling with the several coring systems. The cable on the winch is a Kevlar cable 16 mm with a very low weight in sea water. The winch is provided with its own diesel-hydraulic powerpack.

Deployment of BOBO and TROL

The deployments of the BOBO and TROL were without any problems.

The deployment of the sediment trap mooring systems

The deployment of the 2 mooring systems for Dr. A.N. Antia (IfM, Kiel) were without any problems. There was good cooperation during preparation and deployment of the mooring systems.

APPENDIX 1

List of Participants

Name	**First**	**Affiliation**	**Function**
Antia	Avan	IfM-Kiel	Biologist WP I
Bakker	Karel	NIOZ-Texel	Analyst (Nutrients)
Bakker	Marcel	idem	Technician
Belzunce	Maria	VIGO	Chemist
Boom	Lorendz	NIOZ-Texel	Technician
de Haas	Henk	idem	Mar.Geologist
Helder	Willem	idem	Mar.Chemist
Kloosterhuis	Rikus	idem	Analyst (Oxygen)
Koster	Bob	idem	Electronician
Labahn	Erik	BALTEC- Kiel	Electronician
Lohse	Lutz	NIOZ-Texel	Mar.Chemist
Thomsen	Claudia	GEOMAR-Kiel	Mar.Biologist
van Beek	Pieter	Lab.CNRS-Gif.	Mar.Chemist
van Ooijen	Jan	NIOZ-Texel	Analyst (Nutrients)
van Weering	Tjeerd	idem	Mar.Geologist

APPENDIX 2

3.5 kHz profiling survey lines

Line nr.	Date/Time	Position SOL		Date/Time	Position EOL	
109-01	15/7 19:45	42°10.002 N	009°10.064 W	16/7 06:28	42°10.002 N	010°25.114 W
109-02	16/7 06:28	42°10.002	010°25.114	16/7 08:53	42°20.058	010°35.202
109-03	16/7 08:53	42°20.058	010°35.202	16/7 09:45	42°20.05	010°29.50
03(con)	16/7 20:36	42°20.109	009°15.25	16/7 07:00	42°19.965	010°28.186
109-04	27/7 07:43	42°29.807	009°20.089	27/7 09:13	42°21.840	009°19.957
109-05	26/7 19:43	42°29.89	010°40.05	27/7 07:47	42°29.807	009°20.089
109-06						
109-07	17/7 20:23	42°40.025	010°21.954	18/7 03:15	42°40.0	009°23.999
109-08	20/7 17:36	42°37.964	009°30.00	21/7 01:30	42°38.09	010°26.76
109-08b	23/7 12:06	42°38.0	010°26.8	24/7 00:24	42°38.06	011°41.18
109-09	24/7 00:24	42°38.06	011°41.18	24/7 03:04	42°59.801	011°58.828
109-10	27/7 09:13	42°21.840	009°19.957	27/7 12:24	42°21.91	009°44.00

APPENDIX 3

List of Stations
(Cruise summary sheet)

OMEX II-leg b

Cruise Summary Pelagia cruise 64PE109

ROS	ctd-rosette
BX	boxcore
MC	multicore
PC	pistoncore
TROL	lander
BOBO	lander

BO	bottom
EN	end
DE	deployment
RE	recovered

2 oxygen
3-7 nutrients

SHIP/CRS. EXPO CODE	STATION	CAST NUMBER	CAST TYPE	dd/mm/yy CAST DATE	UTC TIME	EVENT CODE	LAT. (N)		LONG. (W)	NAV	UNC. DEPTH	NO OF BOTTLES	PARAMETER	COMMENTS
64 PE109	1	1	ROS		9.57	BE	42.39.95	10	22.118	gps				test
	1	1	ROS	17/07/97	10.45	BO	42.40.1	10	22.1	gps	2962	24	1, 2-8	
	1	1	ROS		11.38	EN	42.40.29	10	22.22	gps				
	1	2	BX							gps				
	1	2	BX	17/07/97	13.14	BO	42.39.92	10	22.14	gps	2958			
	1	2	BX			EN				gps				
	1	3	PUMPS	17/07/97	15.13	BE	42.40.08	10	22.44	gps	2963			test
	1	3	PUMPS	17/09/97	15.52	EN	42.39.861	10	23.12	gps	2954			
64PE109	2	1	ROS	18/07/97	4.55	BE	42.40.002	9	29.785	gps	184		1,2-8	
	2	1	ROS		5.03	BO	42.39.994	9	29.795	gps	185			
	2	1	ROS		5.18	EN	42.39.994	9	29.806	gps	185			
	2	2	ROS		6.21	BE	42.39.963	9	29.832	gps	187		1,2-8	
	2	2	ROS		6.3	BO	42.39.987	9	29.813	gps	186			
	2	2	ROS		6.38	EN	42.39.995	9	29.809	gps	186			
	2	3	BX		7.07	BO	42.40.008	9	29.826	gps	186			
	2	4	BX		8.24	BO	42.39,991	9	29.812	gps	185			
	2	5	BX		9.05	BO	42.40.017	9	29.832	gps	187			
	2	6	MC		9.35	BO	42.39.991	9	29.838	gps	186			
	2	6	TROL	20/07	13	DE	42.39.957	9	29.86	gps	191			
	2	6	TROL	20/07	61.5	REC	42.39.793	9	29.986	gps	191			
64PE109	3	1	ROS	19/07/97	15.59	BE	42.39.753	9	41.769	gps	1446		1,2-8	
	3	1	ROS		16.2	BO	42.39.768	9	41.827	gps	1443			
	3	1	ROS		16.55	EN	42.39.764	9	41.827	gps	1440			
	3	2	ROS		17.37	BE	42.39.765	9	41.747	gps	1444		1,2-8	
	3	2	ROS		17.58	BO	42.39.713	9	41.799	gps	1444			
	3	2	ROS		18.15	EN	42.39.711	9	41.98	gps	1444			
	3	3	MC	20/7	6.49	BO	42.39.761	9	42.005	gps	1425			
	3	4	MC		7.55	BO	42.39.727	9	41.915	gps	1435			
	3	5	BX		9.09	BO	42.39.823	9	41.824	gps	1435			
	3	6	SED.TR#1	21/7	9	DE	42.38.759	9	41.859	gps	1453			
64PE109	4	1	ROS	21/07	11.22	BE	42.37.93	9	59.45	gps	2145		1,2-8	
	4	1	ROS		12	BO	42.37,85	9	59.55	gps	2148			
	4	1	ROS		12.4	EN	42.37.94	9	59.53	gps	2146			
	4	2	ROS		13.34	BE	42.37.97	9	59.48	gps	2148		1,2-8	

SHIP/CRS. EXPO CODE	STATION	CAST NUMBER	CAST TYPE	CAST DATE	UTC TIME	EVENT CODE	LAT. (N)		LONG. (W)	NAV	UNC. DEPTH	NO OF BOTTLES	PARAMETER	COMMENTS
	4	2	ROS		14.21	BO	42.38.083	9	59.613	gps	2148			
	4	3	MC		14.38	BO	42.37.971	9	59.478	gps	2144			
	4	4	MC		17.06	BO	42.37.971	9	59.47	gps	2149			
	4	5	BOBO		18.03	DE	42.37.999	9	59.54	gps	2152			
	4	6	TROL		18.28	DE	42.37.480	9	59.802	gps	2172			
	4	6	TROL	22/07	5.45	REC	42.35.9	10	2.4	gps	2170			
	4	7	BX		6.47	BO	42.37.71	10	0.66	gps	2171			
64PE109	5	1	ROS		10.47	BE	42.37.94	10	9.75	gps	2568		1,2-8	
	5	1	ROS		11.26	BO	42.37.95	10	9.89	gps	2569			
	5	1	ROS		12.1	EN	42.38.04	10	9.94	gps	2573			
	5	2	MC		13	BO	42.38.06	10	9.89	gps	2570			
	5	3	BX		14.58	BO	42.38.106	10	9.842	gps	2570			
	5	4	PC		17.5	BO	42.38.061	10	9.784	gps	2573			
	5	5	TROL		20.3	DE	42.37.954	10	9.879	gps	2572			
	5	5	TROL	23/07	10.27	REC	42.37.70	10	9.91	gps	2572			
	5	6	SED.TR#2		7.58	DE	42.37.719	10	1.672	gps	2238			
64PE109	6	1	ROS	24/07	6.16	BE	42.52.117	11	52.235	gps	1128		1,2-8	
	6	1	ROS		6.36	BO	42.52.132	11	52.273	gps	1130			
	6	1	ROS		6.58	EN	42.52.131	11	52.369	gps	1136			
	6	2	BX		11.35	BO	42.51.99	11	52.27	gps	1123			
	6	3	MC	25/07	6.22	BO	42.52.14	11	52.22	gps	1129			
64PE109	7	CANCEL								gps				
64PE109	8	1	ROS	25/07	10.24	BE	42.38.07	11	11.47	gps	1681		1,2-8	
	8	1	ROS		10.5	BO	42.38.10	11	11.53	gps	1680			
	8	1	ROS		11.24	EN	42.38.26	11	11.46	gps				
	8	2	MC		12.12	BO	42.38.17	11	11.31	gps	1681			
	8	3	TROL		12.47	DE	42.38.02	11	11.29	gps	1680			
	8	4	BX		13.43	BO	42.37.96	11	11.19	gps	1680			CANCEL
	8	5	BX		14.31	BO	42.38.09	11	11.14	gps	1679			CANCEL
	8	6	PC		16.09	BO	42.38.06	11	11.23	gps	1679			
	8	7	MC		17.48	BO	42.37.90	11	11.2	gps	1684			
	8	8	BX		19.15	BO	42.37.91	11	11.29	gps	1685			
	8		TROL		20.24	REC	42.37.87	11	11.4	gps				
	8	9	PC		21.39	BO	42.37.97	11	11.34	gps	1683			
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	9		ROS		8.56	BO	42.38.00	10	43.38	gps	2207			
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	9	3	TROL		11.44	DE	42.38.10	10	42.48	gps	2210			
	9		TROL		17.48	RE	42.37.92	10	42.62	gps				
	9	4	BX		12.04	BO	42.38.06	10	42.6	gps	2207			
	9	5	MC		13.54	BO	42.38.02	10	42.97	gps	2205			
	9	6	PC		15.38	BO	42.37.91	10	42.52	gps	2196			
64PE109	10	1	ROS	27/07	14.15	BE	42.21.86	9	35.02	gps	1144		1,2-8	
	10	1	ROS		14.35	BO	42.28.14	9	35.17	gps	1138			
	10	1	ROS		15	EN	42.21.96	9	35.28	gps	1130			

SHIP/CRS. EXPO CODE	STATION	CAST NUMBER	CAST TYPE	CAST DATE	UTC TIME	EVENT CODE	LAT. (N)		LONG. (W)	NAV	UNC. DEPTH	NO OF BOTTLES	PARAMETER	COMMENTS
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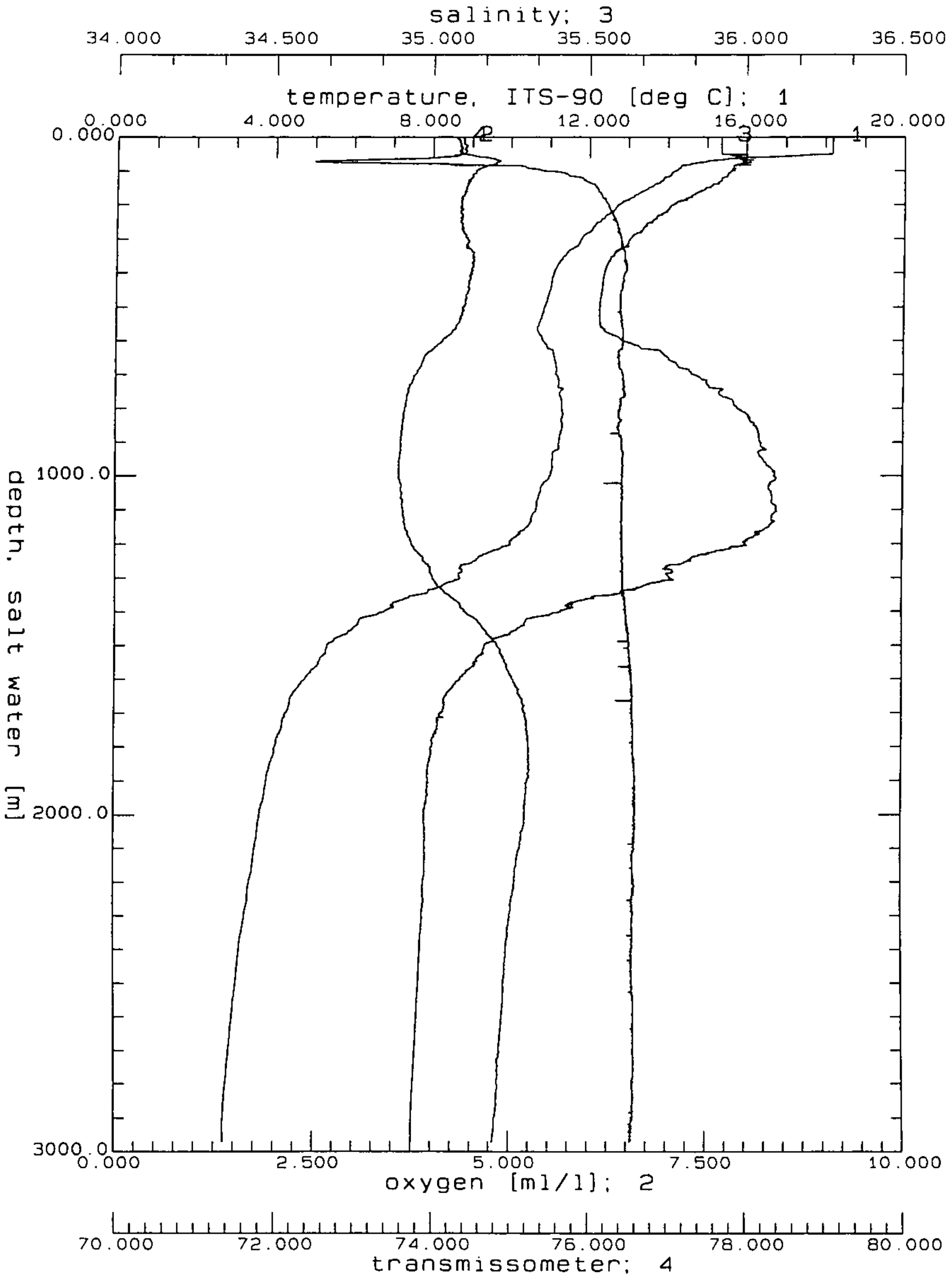
	10	3	BX		17.21	BO	42.21.82	9	34.79	gps	1142			
64PE109	11	1	ROS	28/07	6.19	BE	42.20.14	9	15.21	gps	197		1,2-8	
	11	1	ROS		6.26	BO	42.20.17	9	15.19	gps	197			
	11	1	ROS		6.36	EN	42.20.20	9	15.17	gps	196			
	11	2	ROS		7.07	BE	42.20.12	9	15.21	gps	197		1,2-8	
	11	2	ROS		7.09	BO	42.20.16	9	15.25	gps	197			
	11	2	ROS		7.19	EN	42.20.13	9	15.25	gps	197			
	11	3	MC		8.09	BO	42.20.14	9	15.28	gps	198			
	11	4	TROL		8.28	DE	42.20.63	9	15.06	gps	194			
	11	5	BX		8.44	BO	42.20.11	9	15.34	gps	200			
	11	6	BX		9.26	BO	42.20.15	9	15.31	gps	199			
	11	7	MC		9.54	BO	42.20.25	9	15.28	gps	199			
64PE109	12	1	ROS		12.37	BE	42.23.71	9	20.79	gps	329		1,2-8	
	12	1	ROS		12.46	BO	42.23.77	9	20.85	gps	328			
	12	1	ROS		12.58	EN	42.23.71	9	20.97	gps	329			
	12	2	BX		13.43	BO	42.23.81	9	20.81	gps	330			
	12	3	TROL		14.06	DE	42.23.76	9	20.62	gps	330			
	12	3	TROL		17.2	RE	42.23.66	9	20.67	gps				
	12	4	BX		14.39	BO	42.23.67	9	20.77	gps	326			
	12	5	MC		15.05	BO	42.23.68	9	20.75	gps	327			
64PE109	13	1	ROS	29/07	5	BE	42.19.948	9	41.053	gps	1760		1,2-8	
	13	1	ROS		5.38	BO	42.20.023	9	41.074	gps	1761			
	13	1	ROS			EN				gps				
	13	2	MC		7	BO	42.20.095	9	41.197	gps	1761			
	13	3	TROL			DE			.	gps				
	13	3	TROL		11.42	RE	42.20.25	9	40.96	gps	1745			
	13	4	BX		9	BO	42.19.920	9	41.023	gps	1768			
	13	5	PC		10.39	BO	42.19.97	9	41.03	gps	1764			
64PE109	14	1	ROS		14.41	BE	42.20.01	10	3.24	gps	2600		1,2-8	
	14	1	ROS		15.2	BO	42.20.04	10	3.25	gps	2600			
	14	1	ROS		16.02	EN	42.20.12	10	3.24	gps	2600			
	14	2	PUMPS		17.2	BE	42.20.09	10	3.17	gps	2600			
	14	2	PUMPS		17.53	EN	42.19.39	10	4	gps	2600			
	14	3	PUMPS		18.57	BE	42.19.54	10	3.77	gps	2610			
	14	3	PUMPS	30/07	5.1	EN	42.20.10	10	10.83	gps	2760			
	14	4	MC		6.24	BO	42.20.12	10	3.34	gps	2600			
	14	5	TROL		7.02	DE	42.19.90	10	3.81	gps	2606			
	14	5	TROL		13.11	RE	42.19.57	10	3.94	gps	2582			
	14	6	BX		7.47	BO	42.20.05	10	3.06	gps	2601			
	14	7	PC		9.57	BO	42.20.09	10	3.16	gps	2602			
	14	8	MC		12.29	BO	42.20.07	10	3.08	gps	2604			
64PE109	15	1	ROS		15.43	BE	42.29.96	10	17.33	gps	2780		1,2-8	
	15	1	ROS		16.24	BO	42.19.88	10	17.39	gps	2780			
	15	1	ROS		17.1	EN	42.19.89	10	17.3	gps	2780			
	15	2	BX		18.3	BO	42.19.88	10	17.4	gps	2781			

APPENDIX 4

CTD profiles



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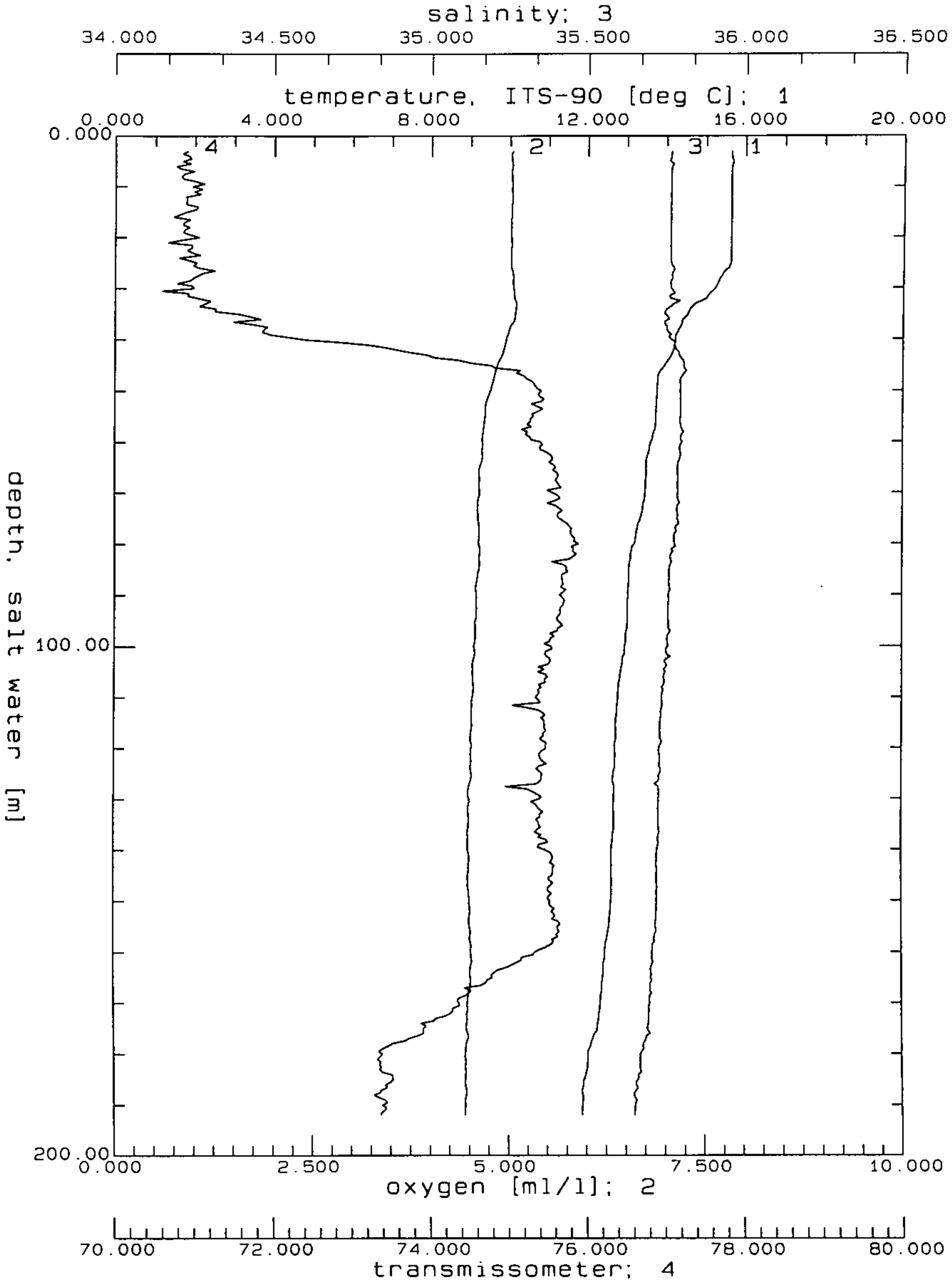

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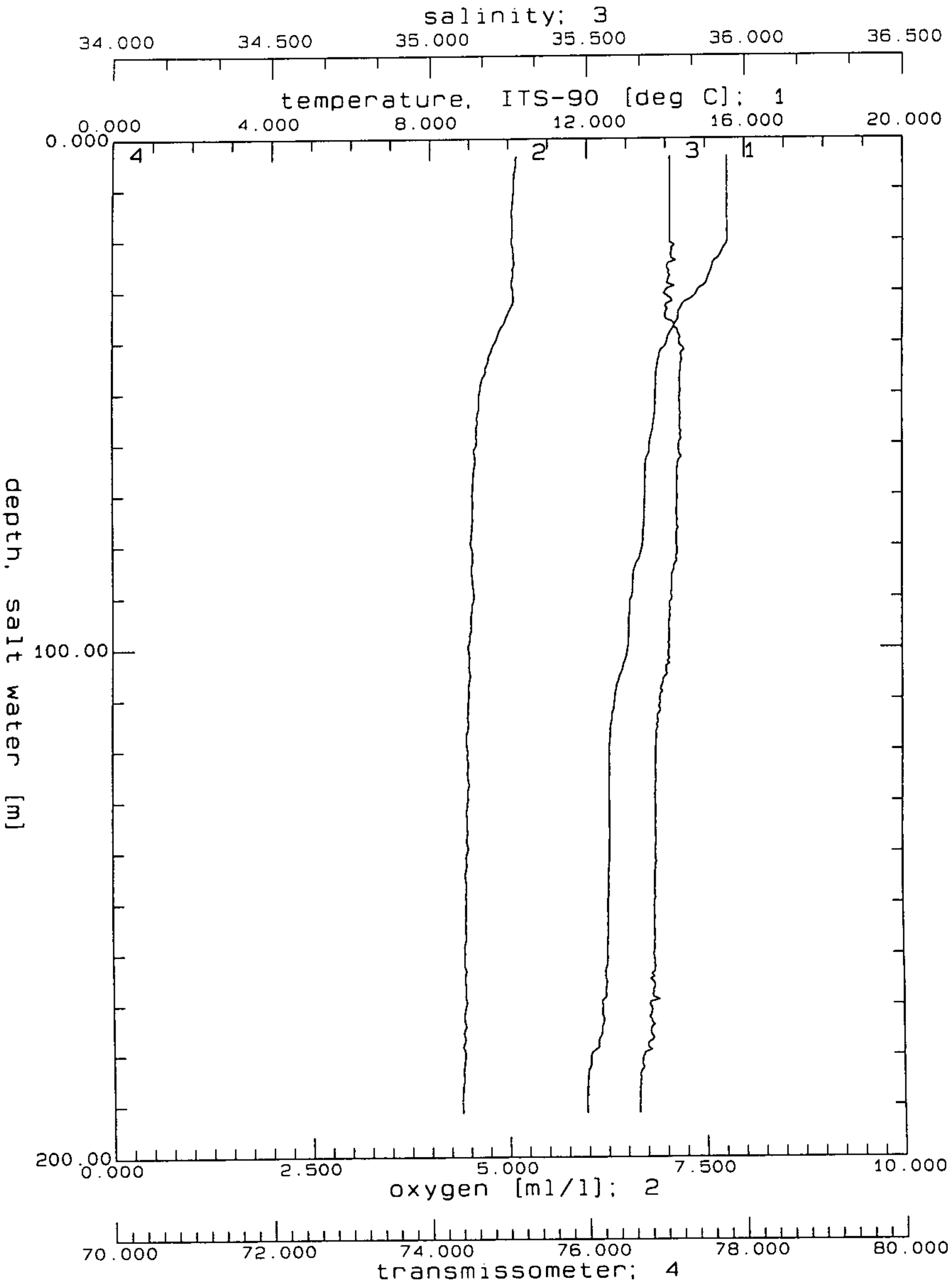

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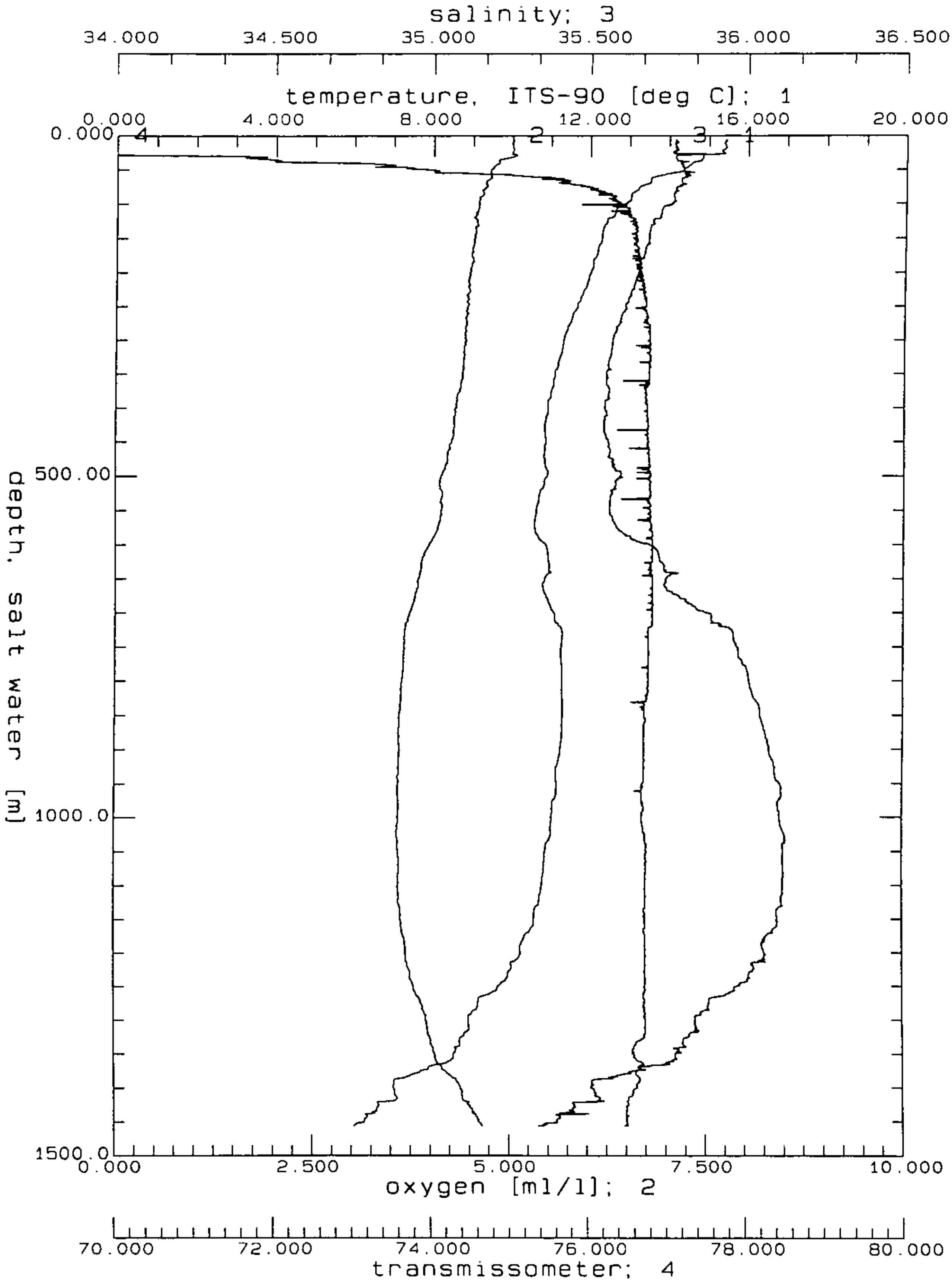
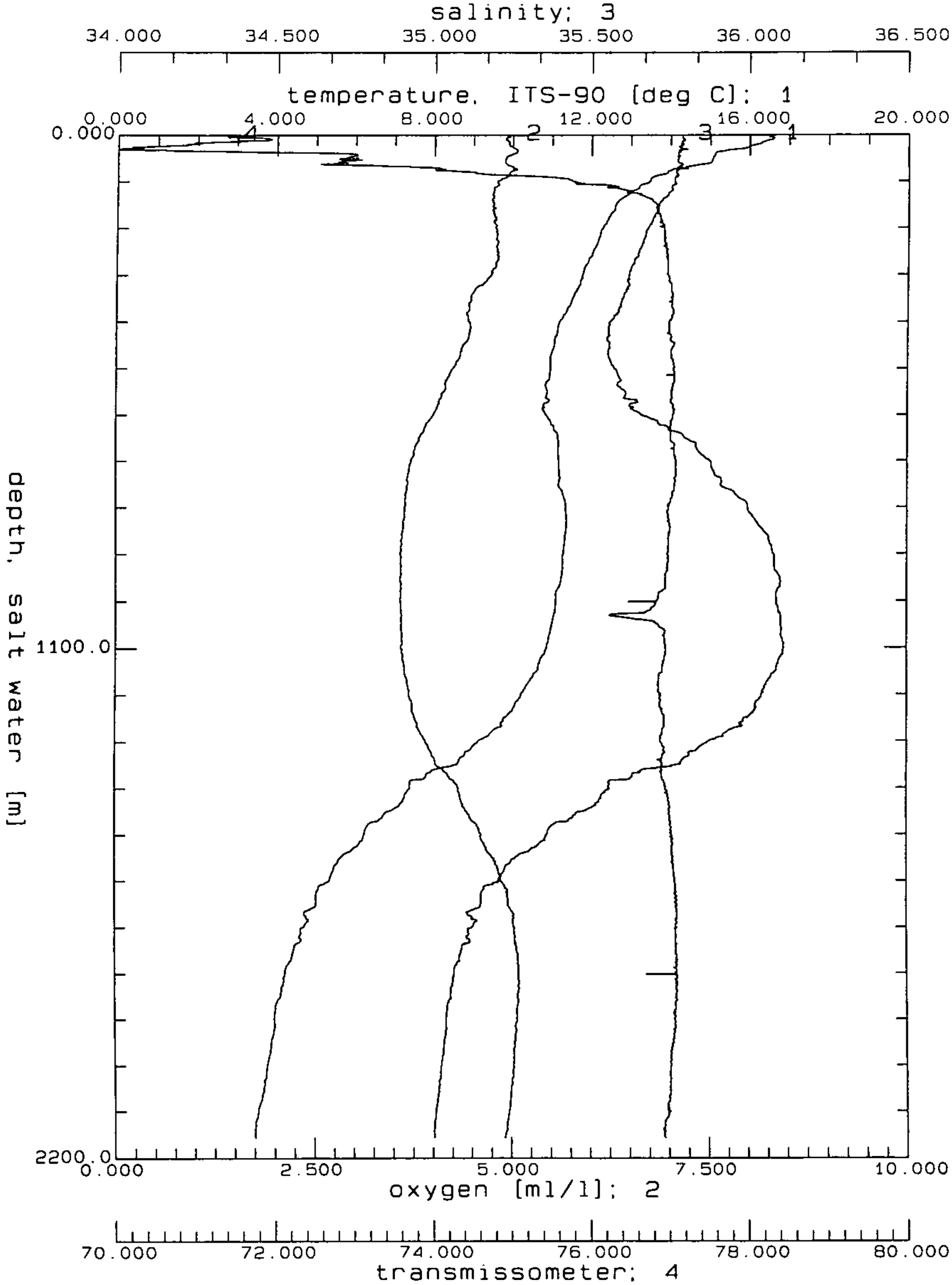
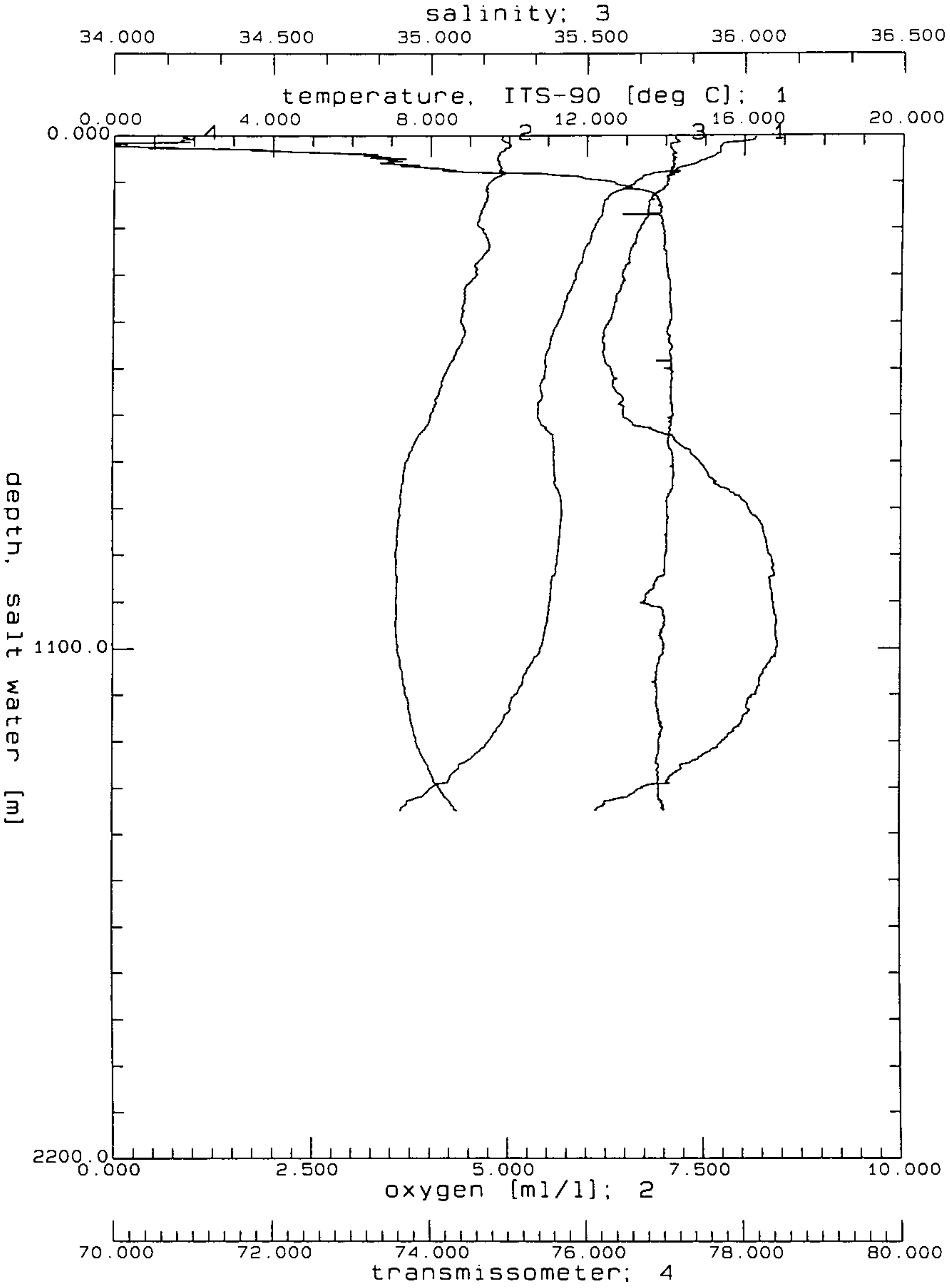


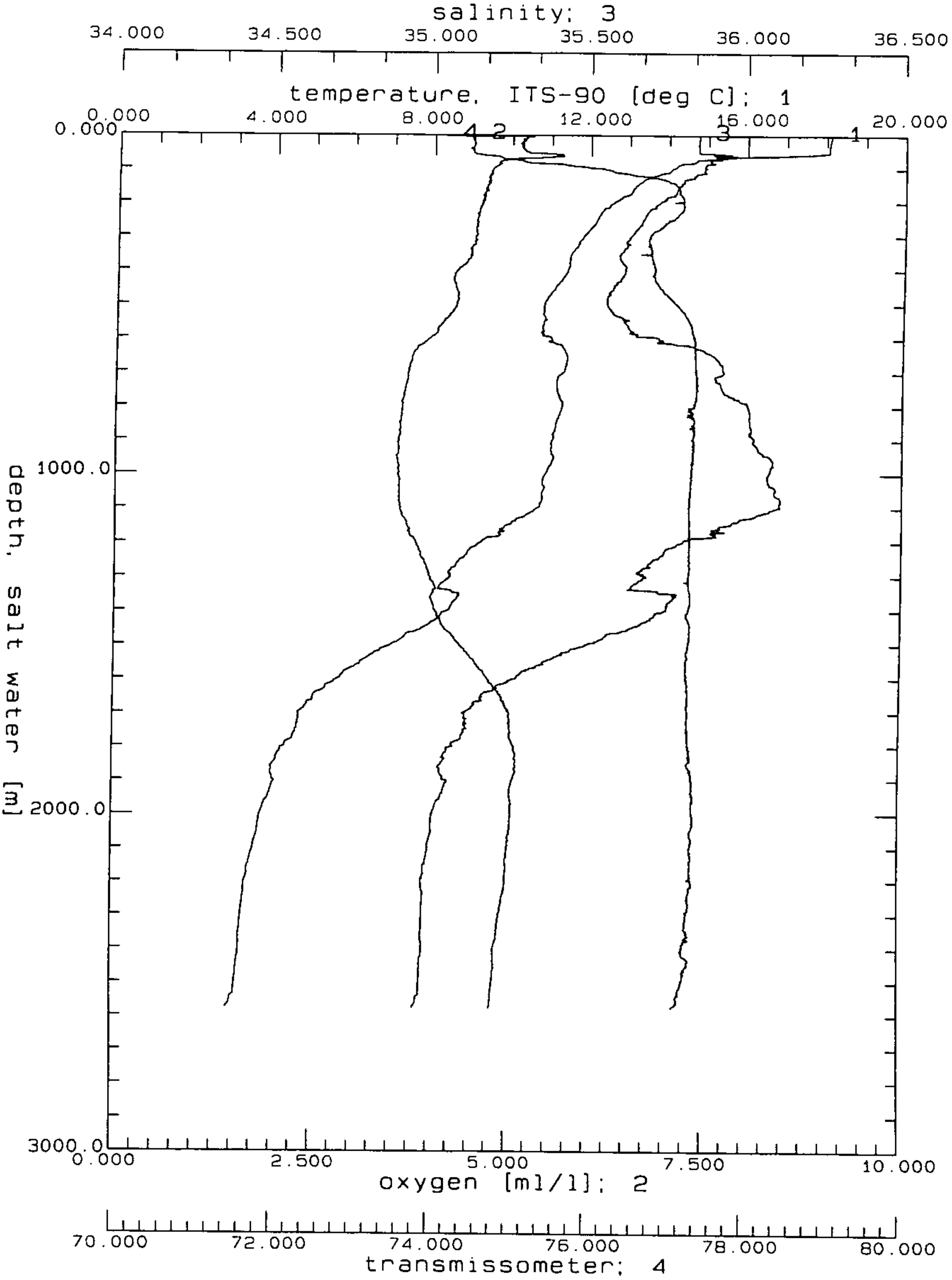
D10931.CNV: OMEX-II Leg 2 1997 Station: PE109-3 Cast: 1



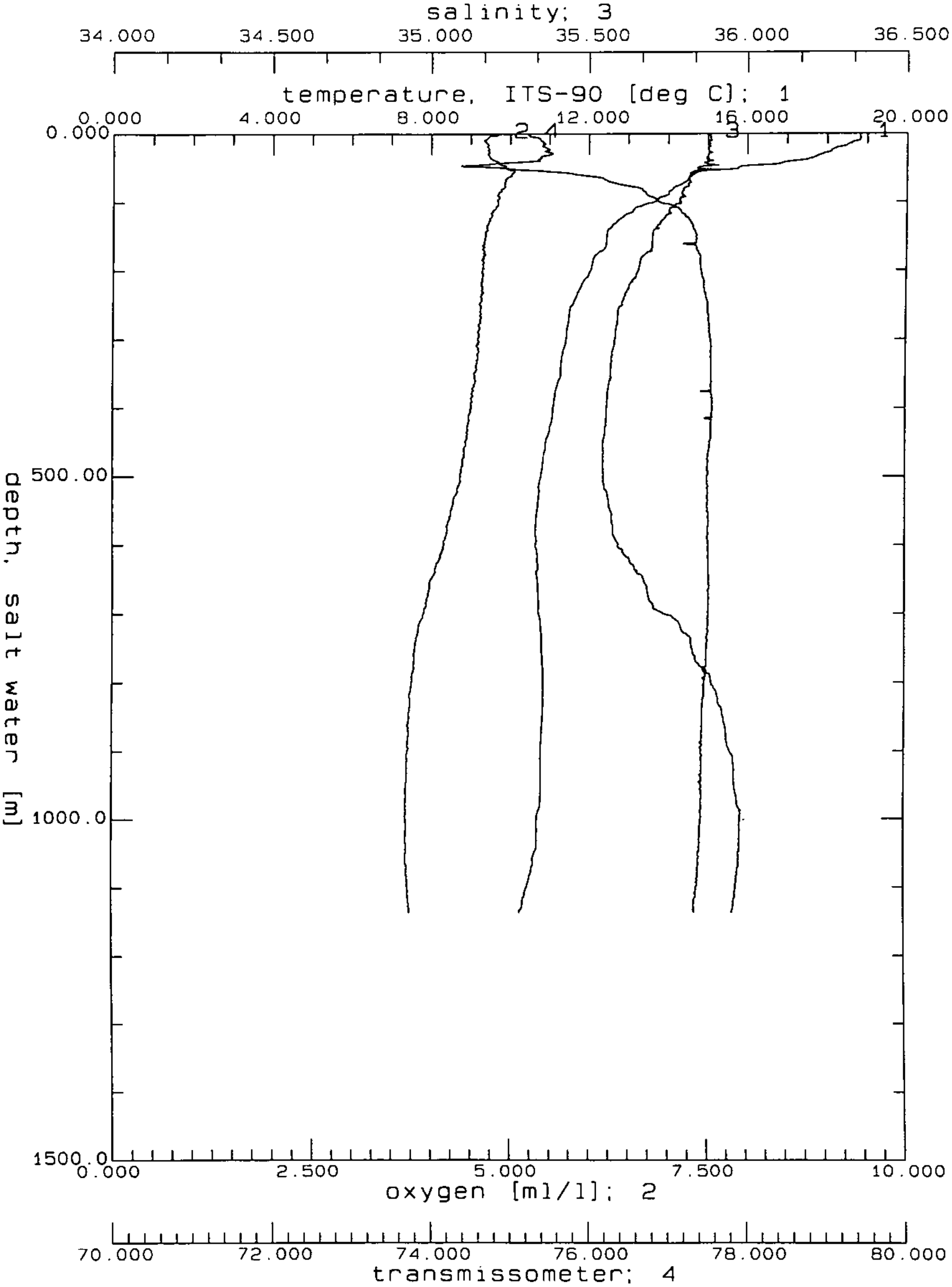
D10941.CNV: OMEX-II Leg 2 1997 Station: PE109-4 Cast: 1



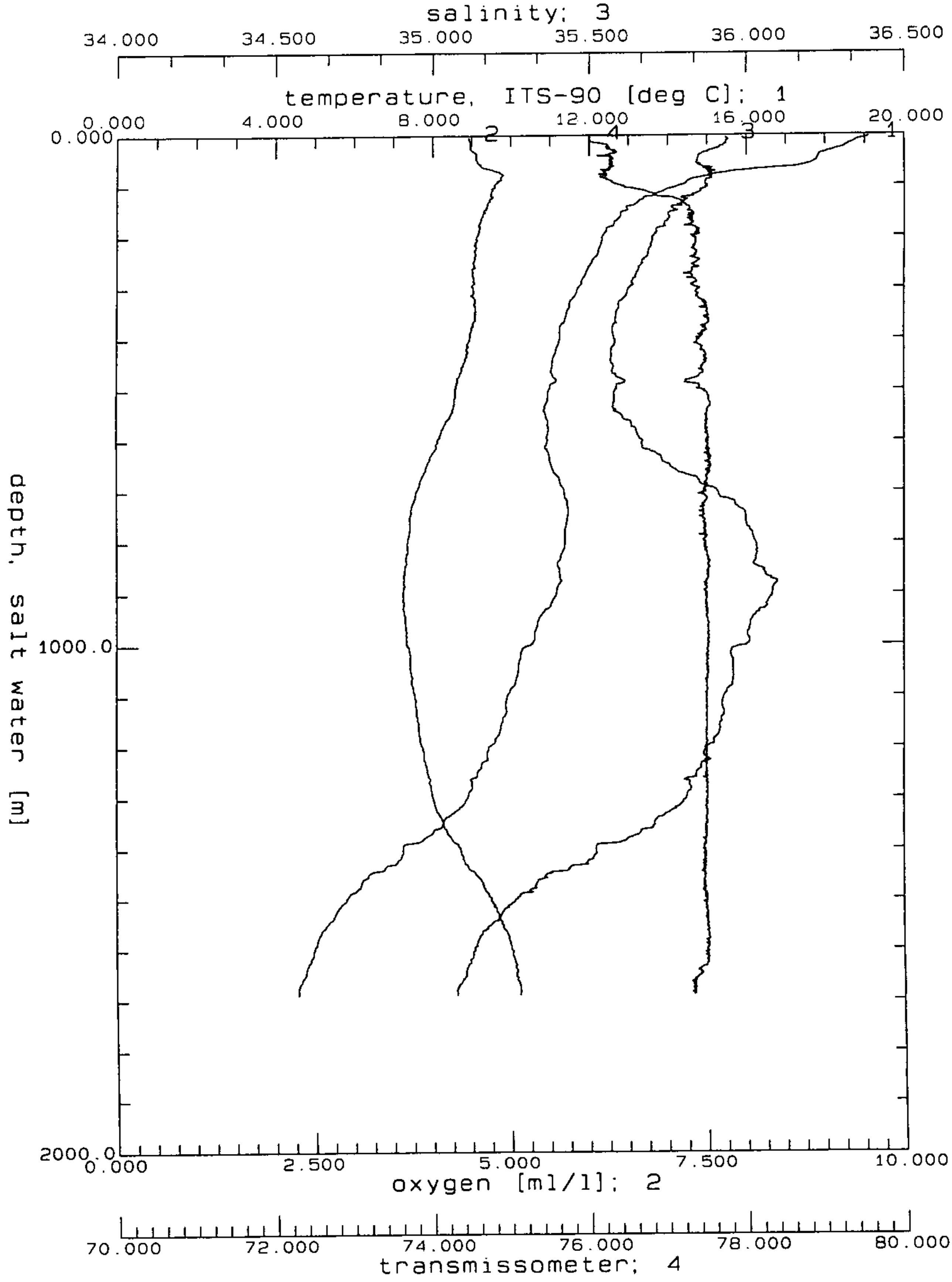
D10942.CNV: OMEX-II Leg 2 1997 Station: PE109-4 Cast: 2



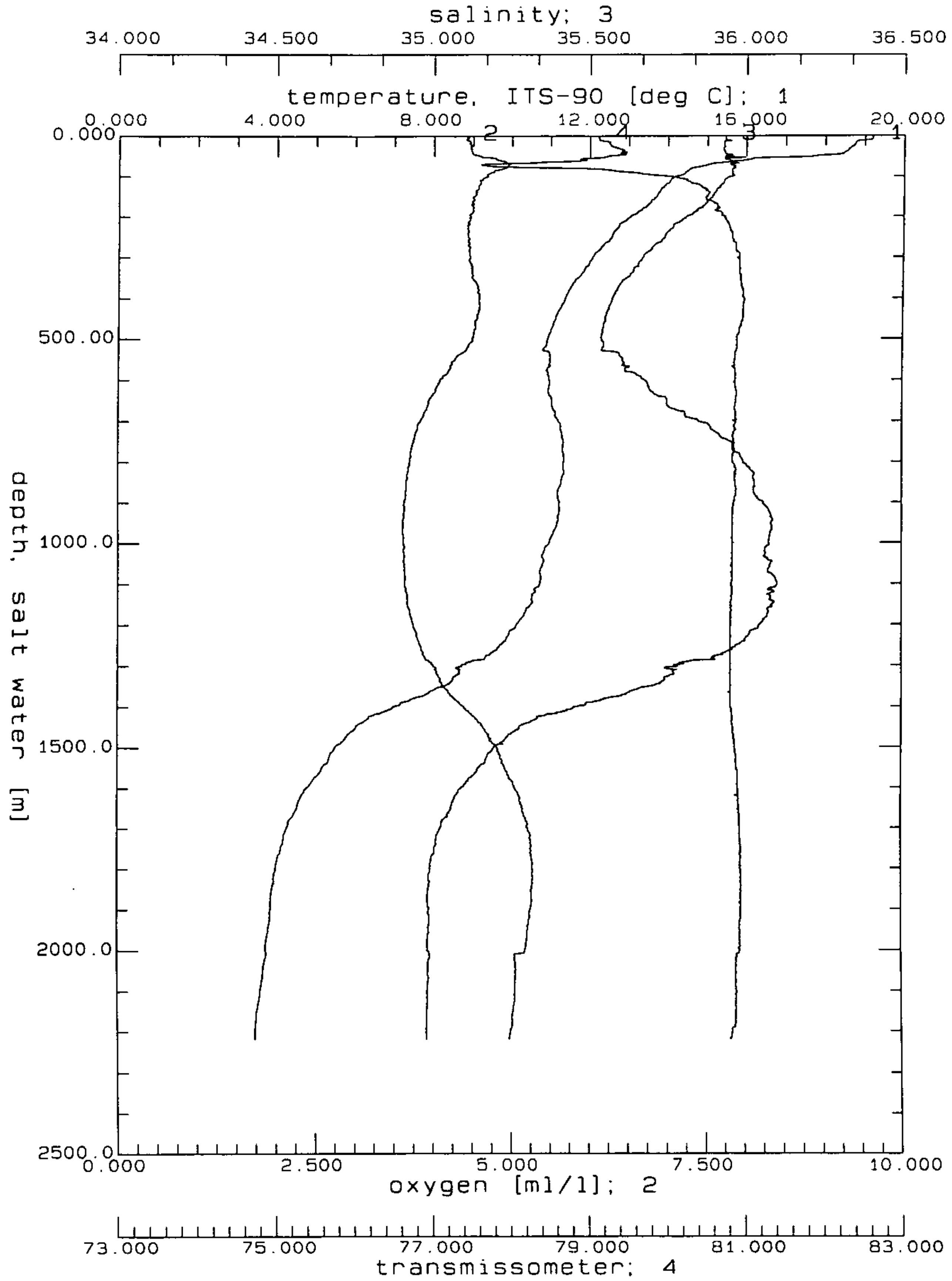
D10951.CNV: OMEX-II Leg 2 1997 Station: PE109-5 Cast: 1



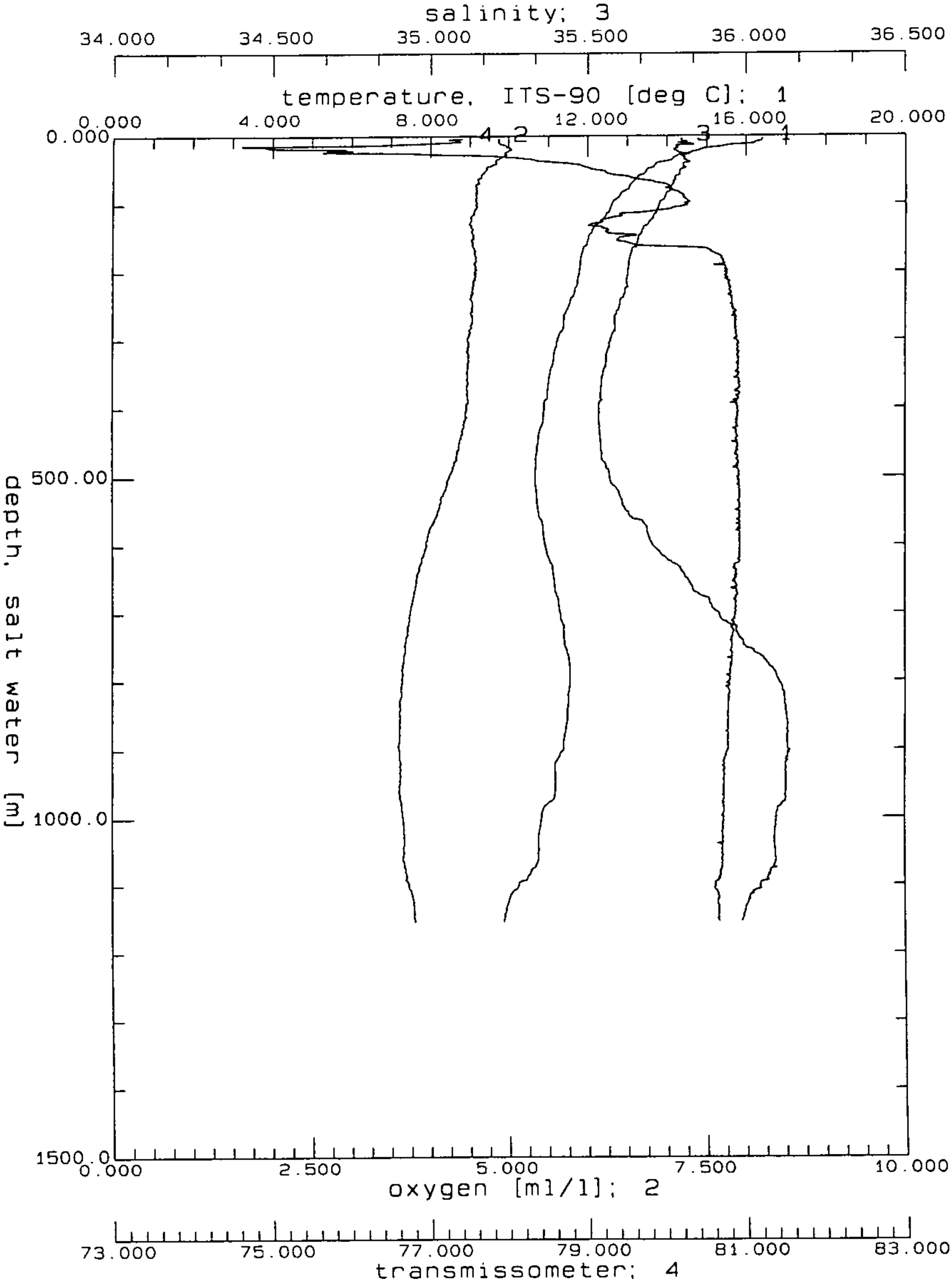
D10961.CNV: OMEX-II Leg 2 1997 Station: PE109-6 Cast: 1



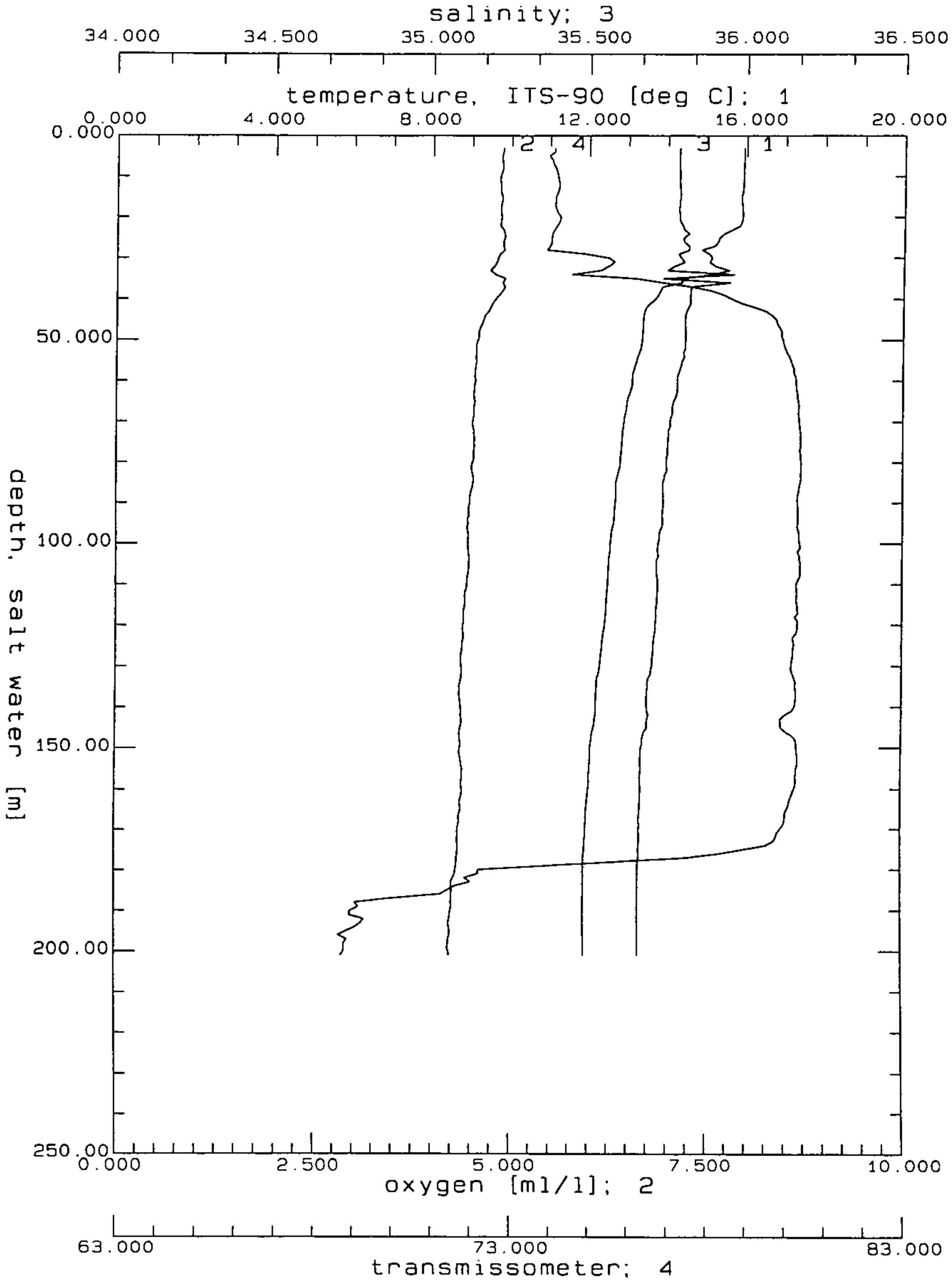
D10981.CNV: OMEX-II Leg 2 1997 Station: PE109-8 Cast: 1



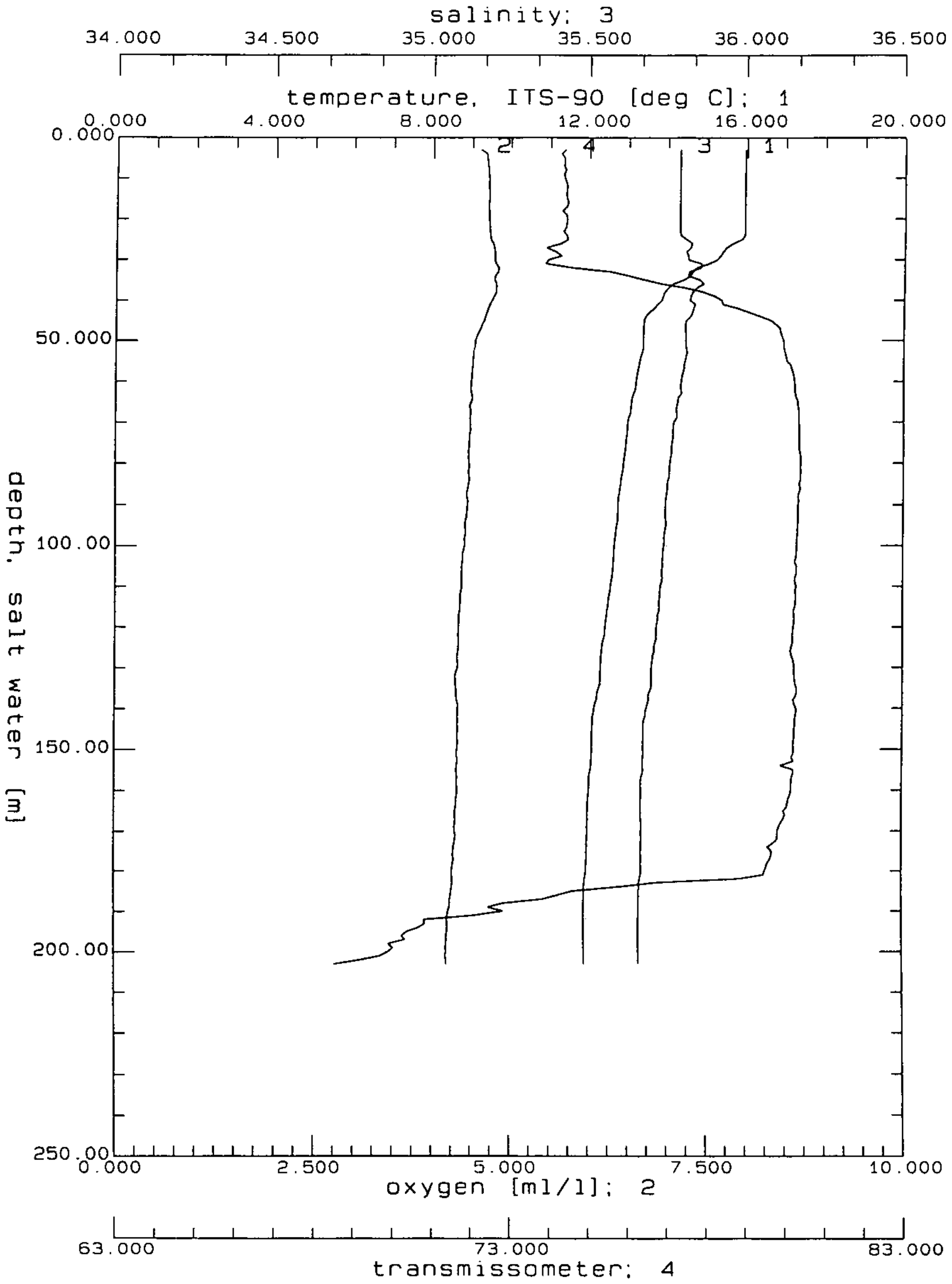
D10991.CNV: OMEX-II Leg 2 1997 Station: PE109-9 Cast: 1



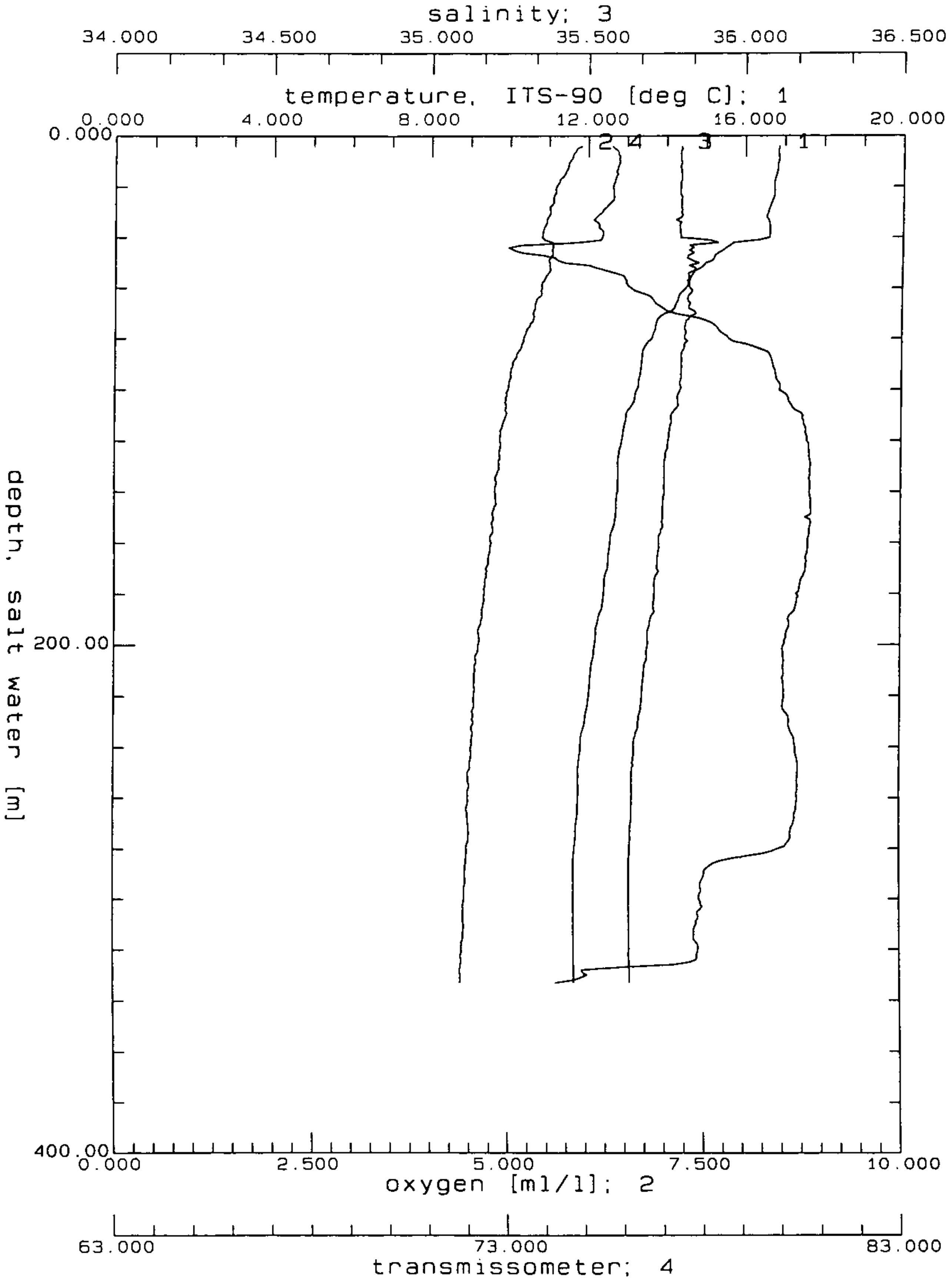
D109101.CNV: OMEX-II Leg 2 1997 Station: PE109-10 Cast: 1



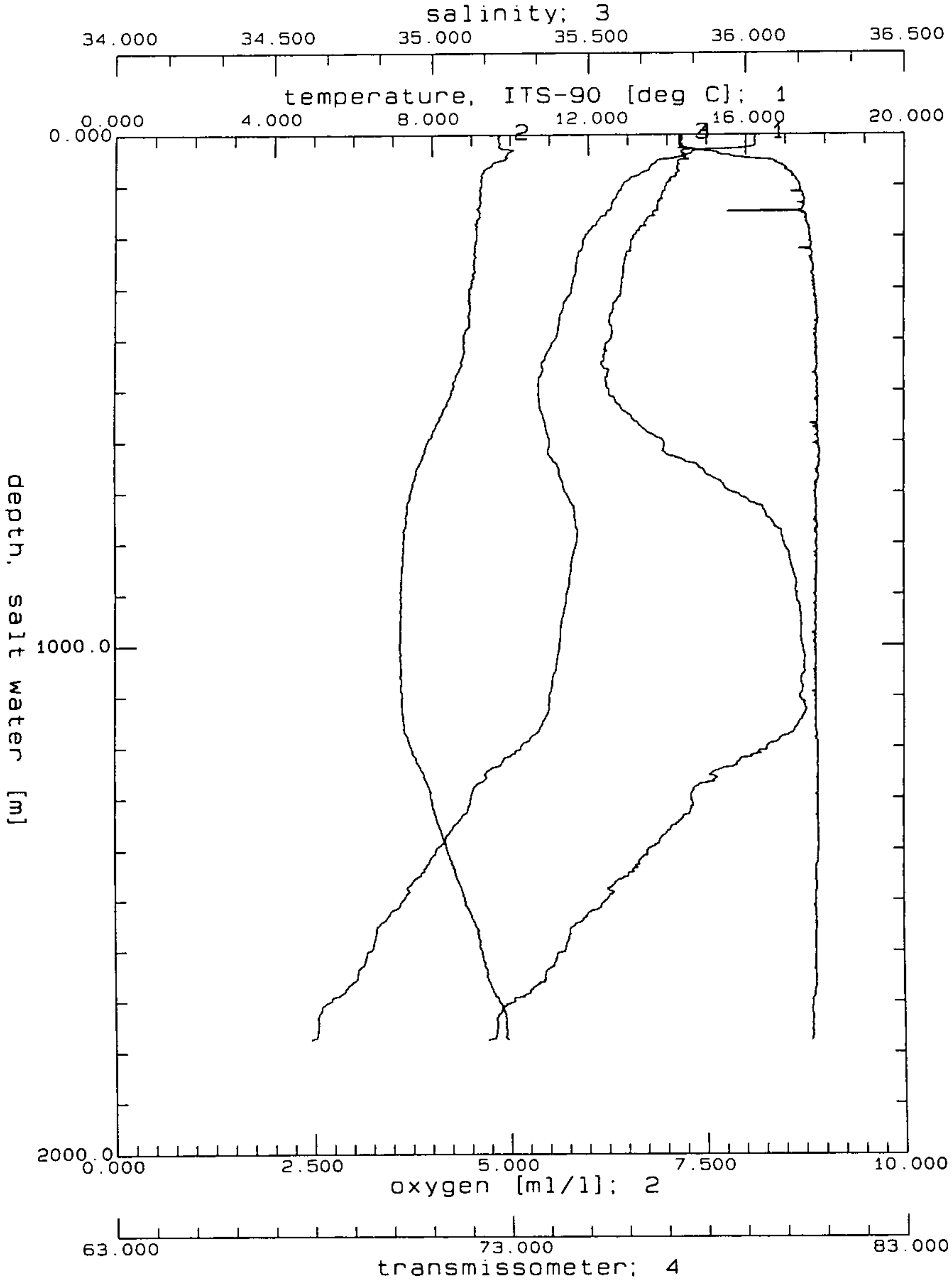
D109111.CNV: OMEX-II Leg 2 1997 Station: PE109-11 Cast: 1



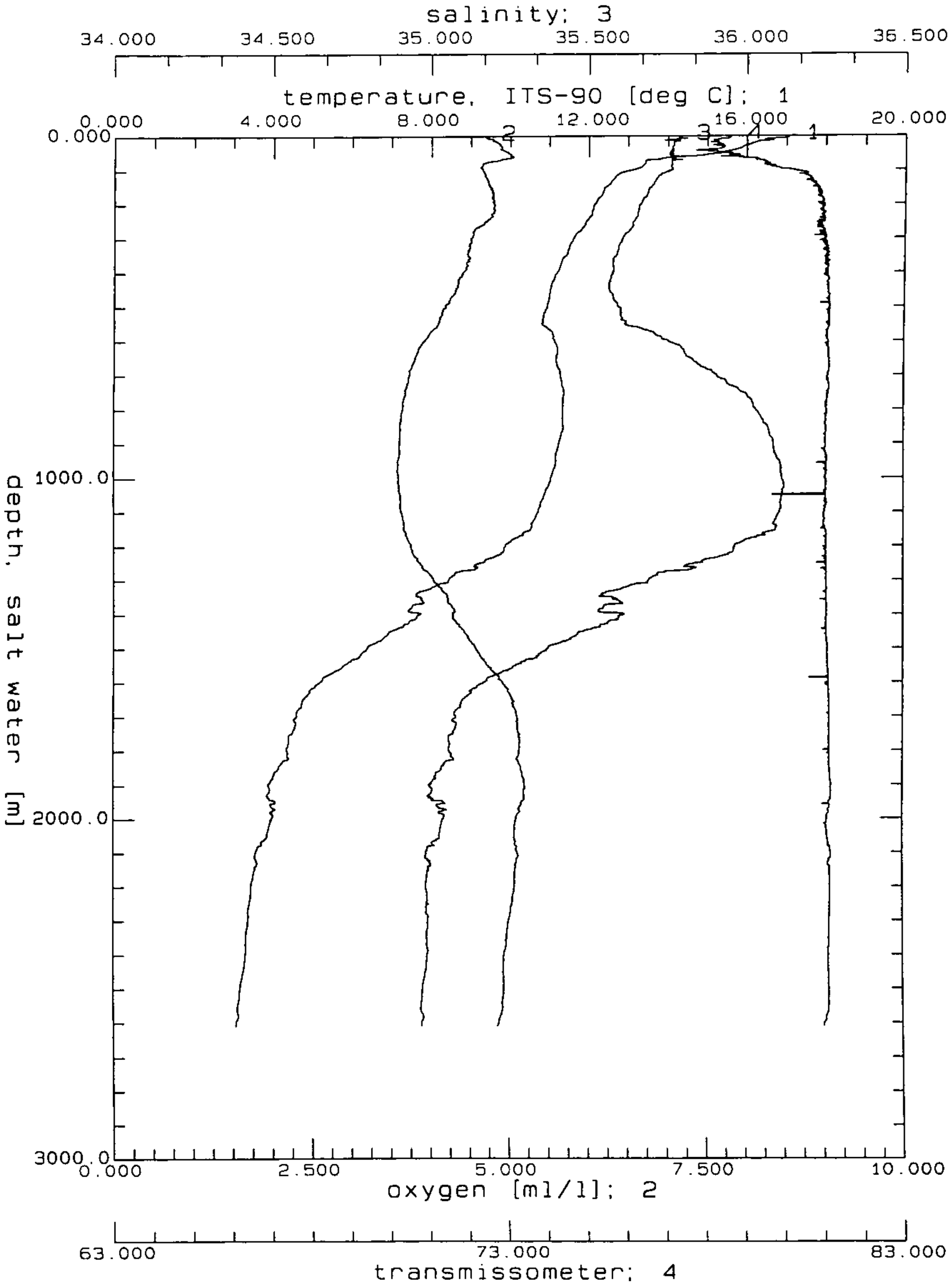
D109112.CNV: OMEX-II Leg 2 1997 Station: PE109-11 Cast: 2



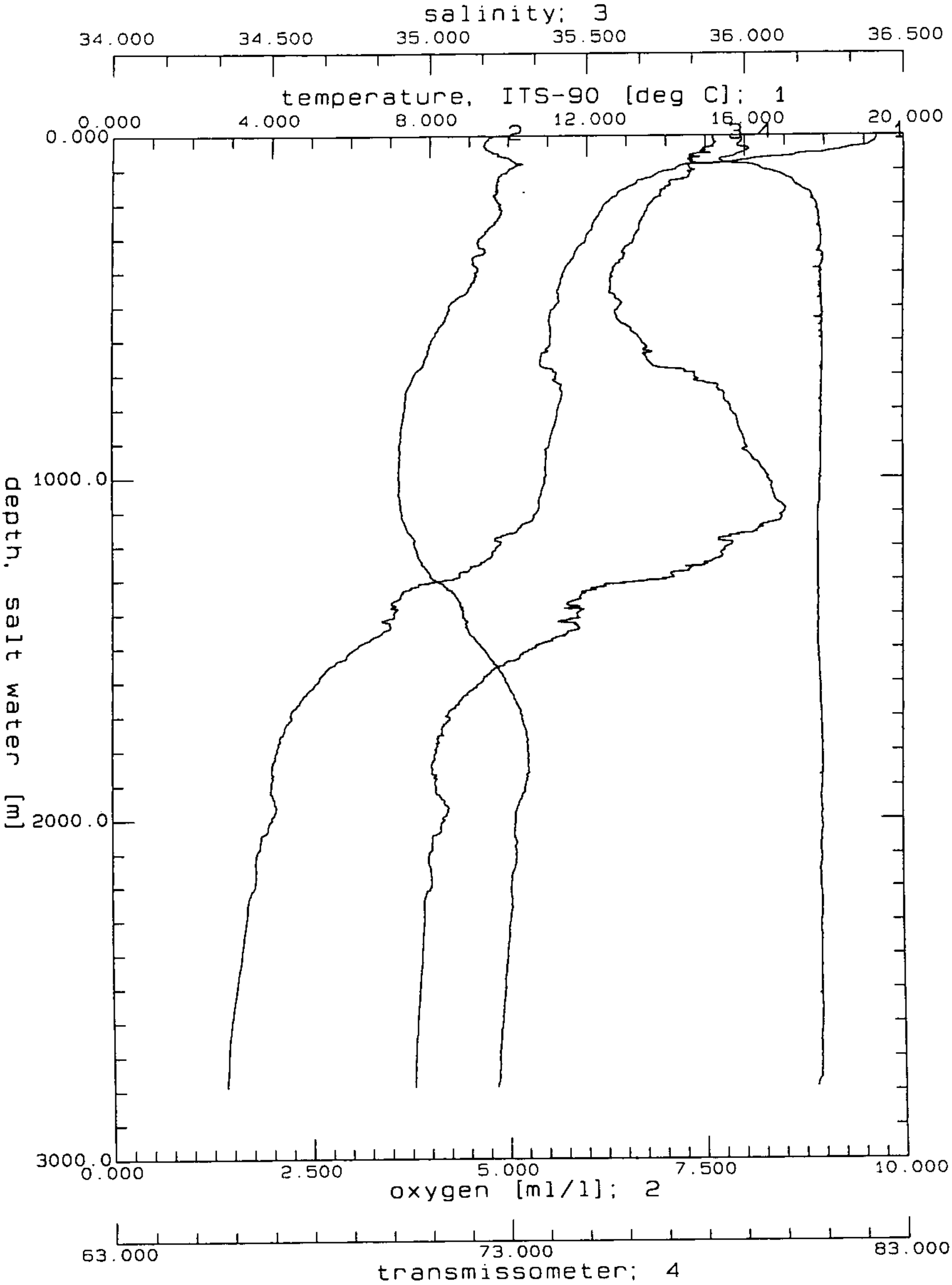
D109121.CNV: OMEX-II Leg 2 1997 Station: PE109-12 Cast: 1



D109131.CNV: OMEX-II Leg 2 1997 Station: PE109-13 Cast: 1



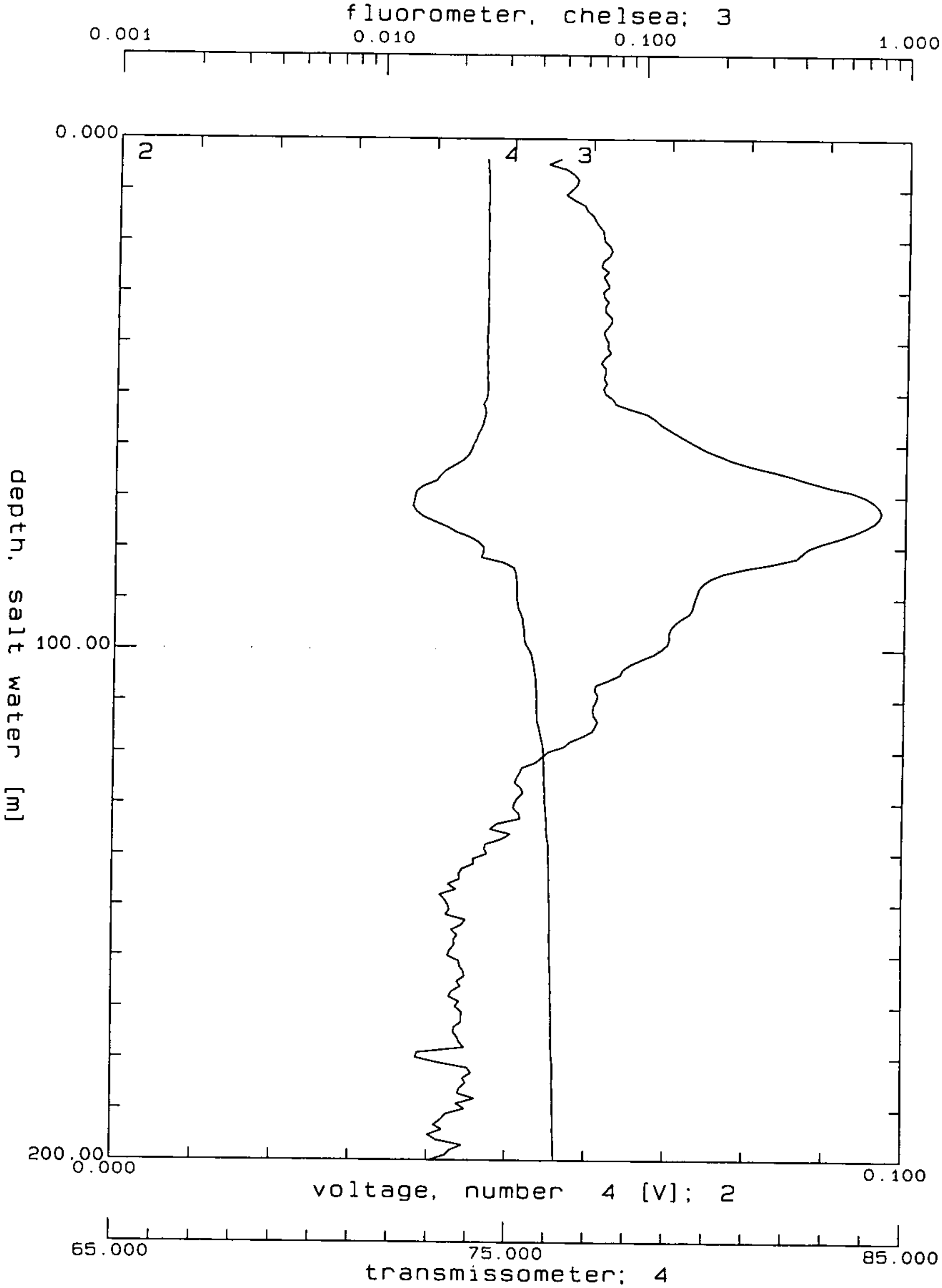
D109141.CNV: OMEX-II Leg 2 1997 Station: PE109-14 Cast: 1



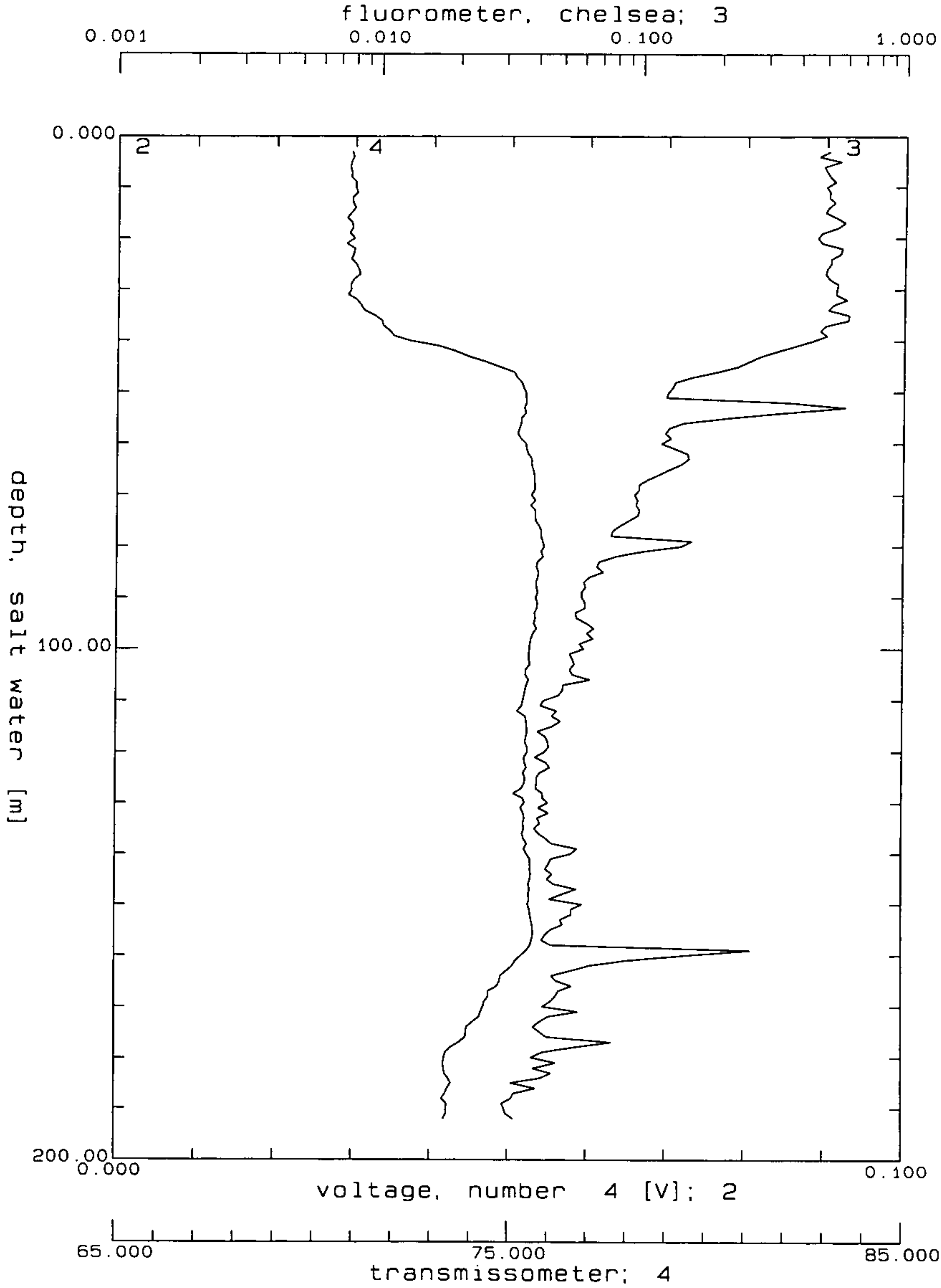
D109151.CNV: OMEX-II Leg 2 1997 Station: PE109-15 Cast: 1

APPENDIX 5

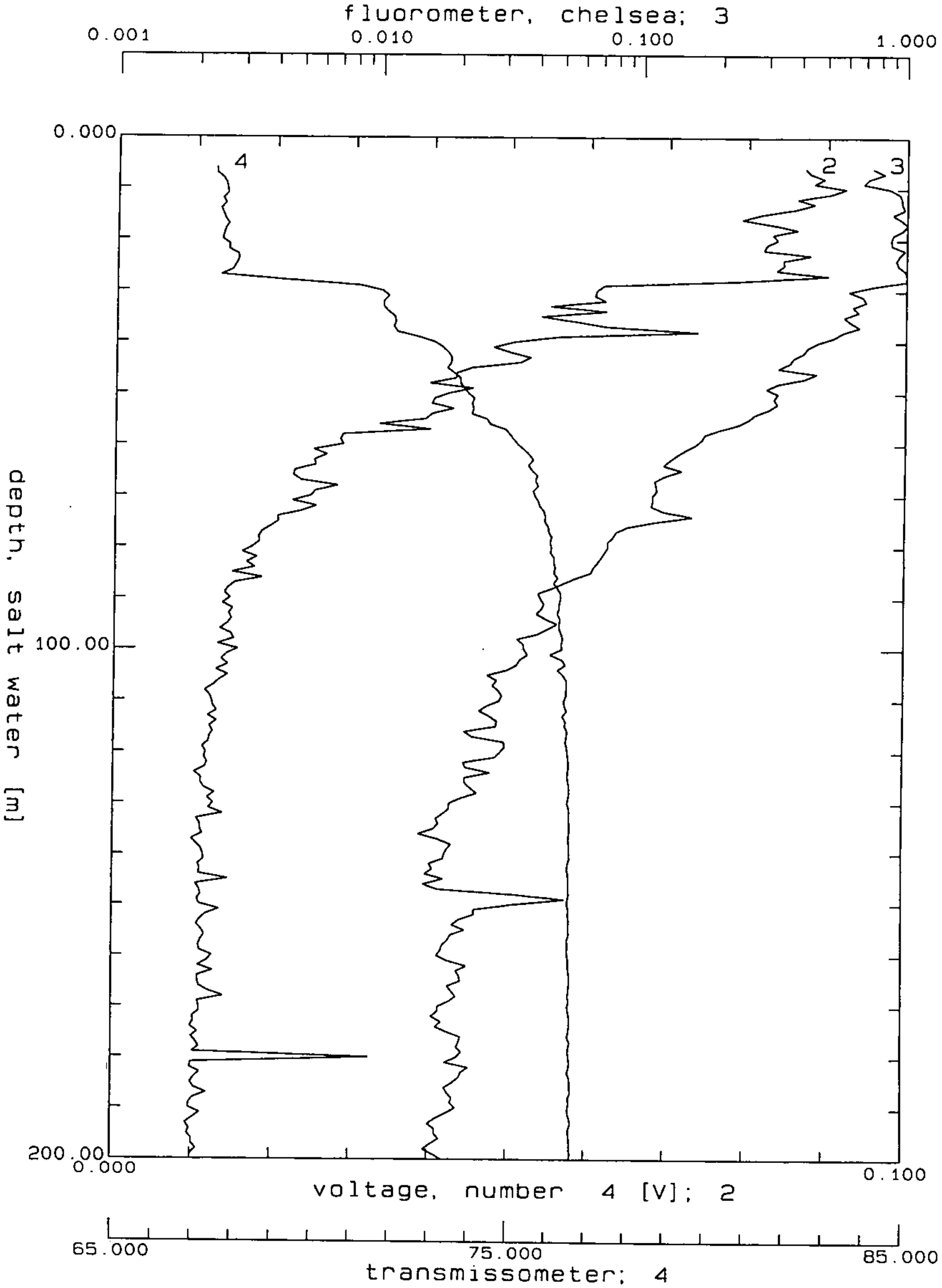
Transmission Profiles



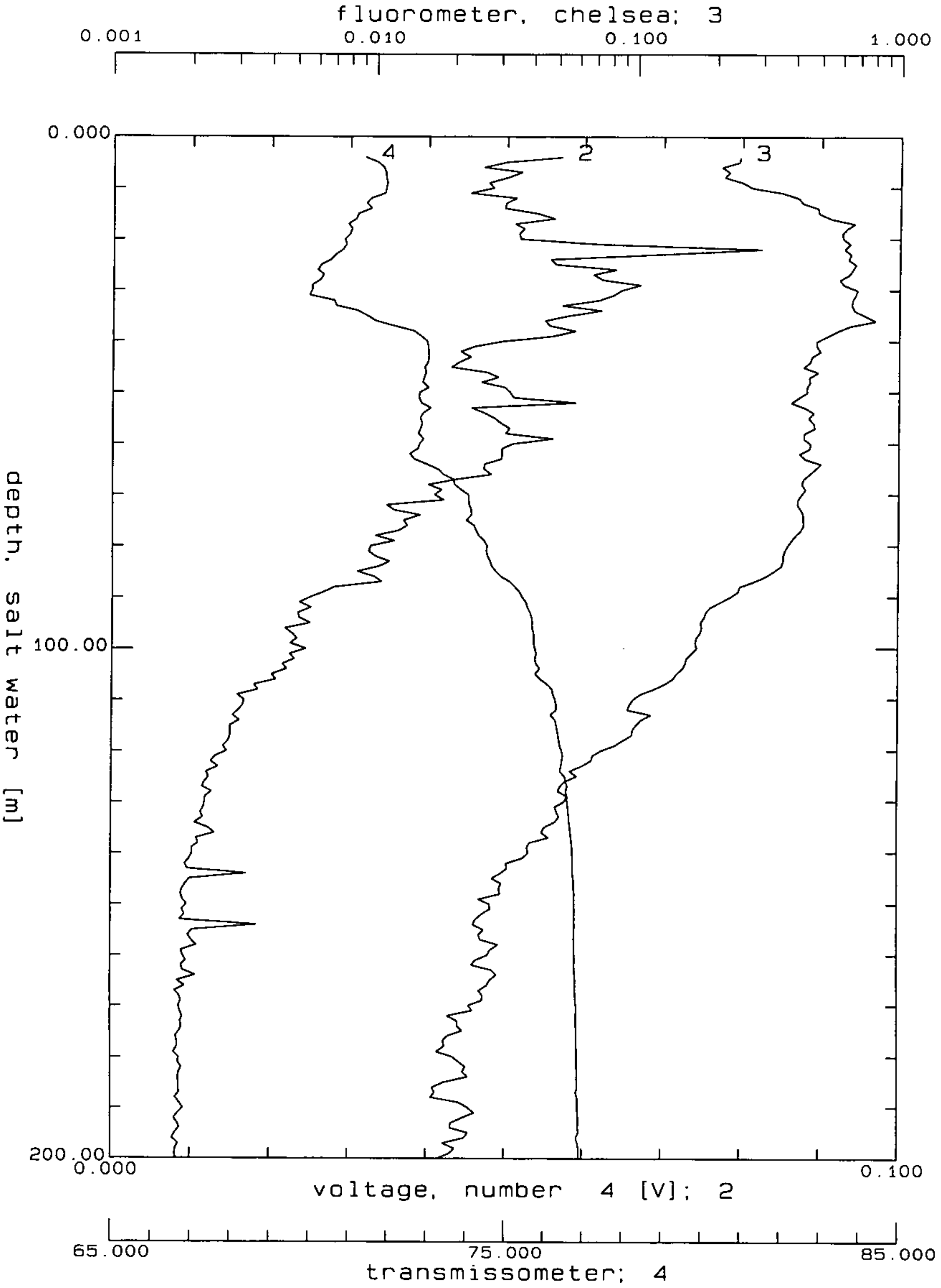
PE109-1.CNV: OMEX-II Leg 2 1997 Station: PE109-01 Cast: 1



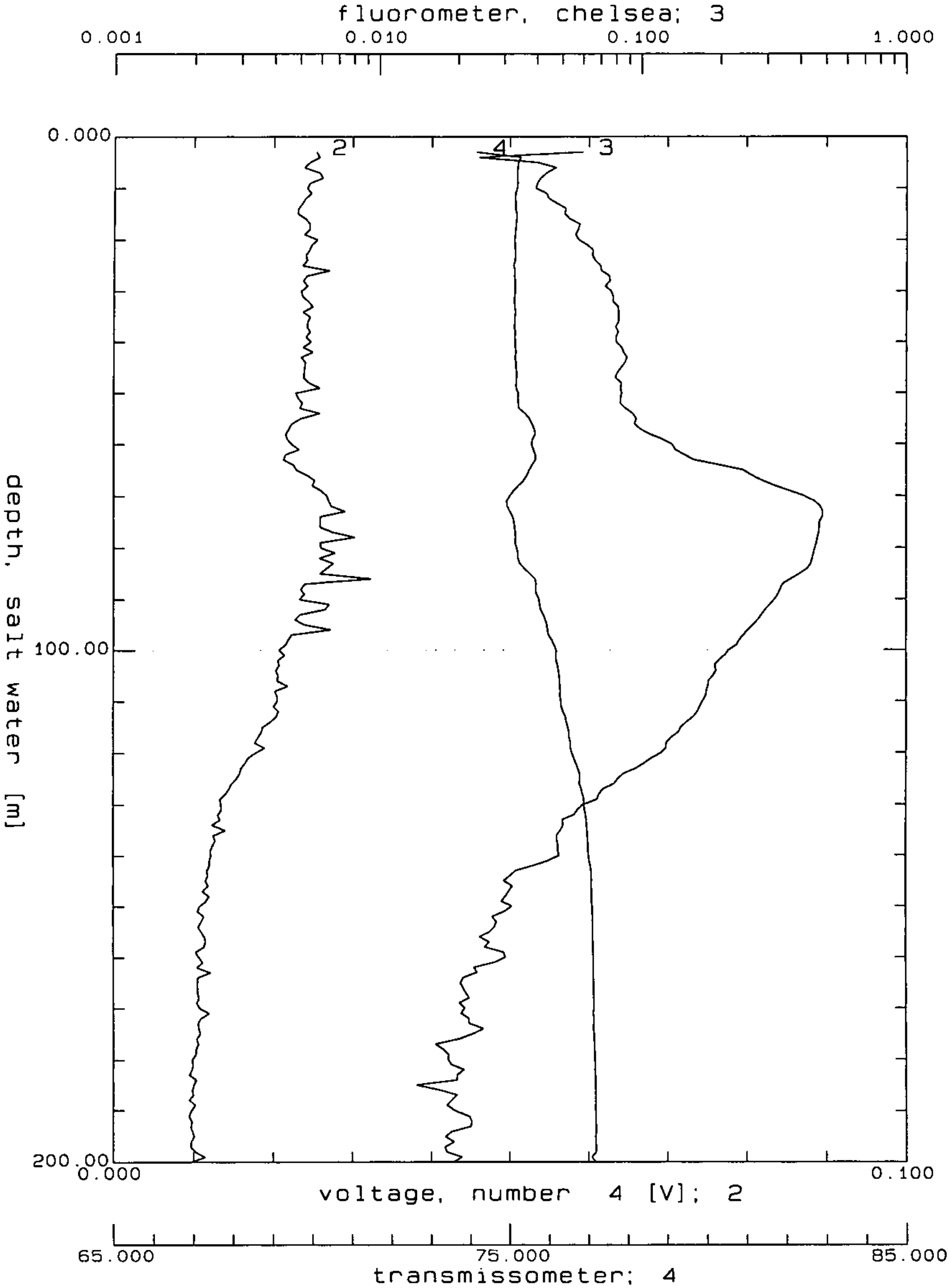
PE109-2.CNV: OMEX-II Leg 2 1997 Station: PE109-02 Cast: 1



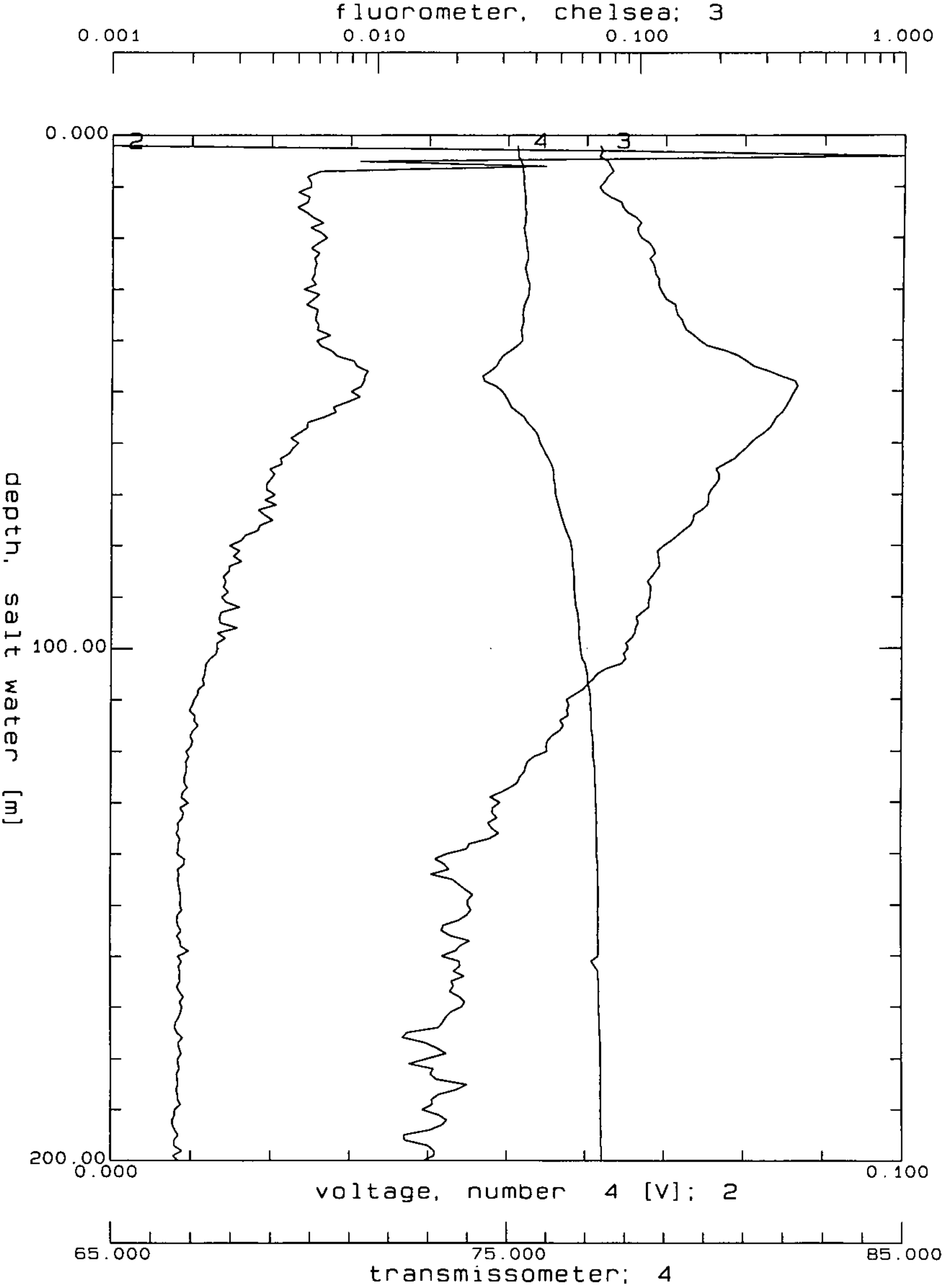
10931.CNV: OMEX-II Leg 2 1997 Station: PE109-03 Cast: 1



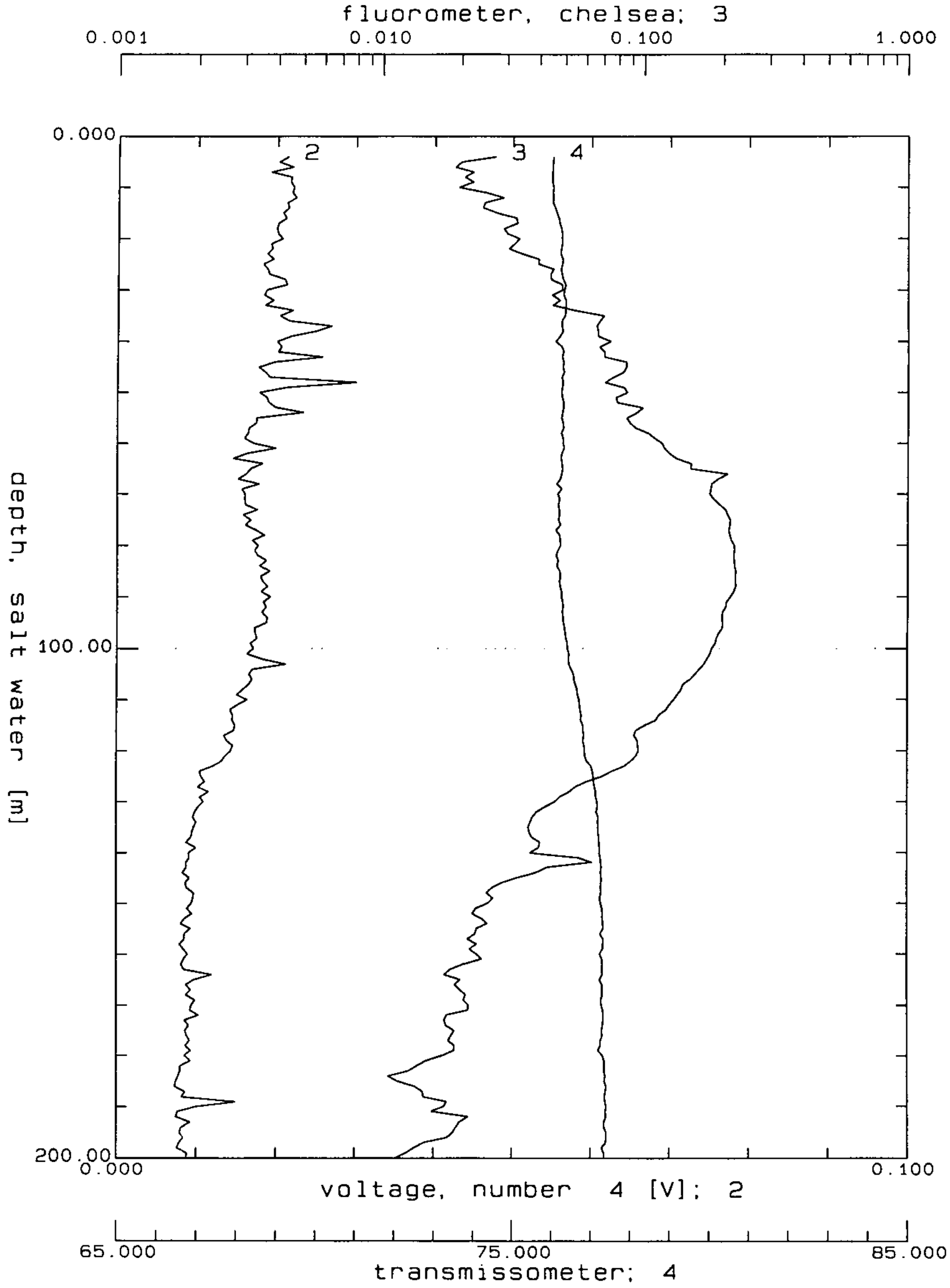
10941.CNV: OMEX-II Leg 2 1997 Station: PE109-04 Cast: 1



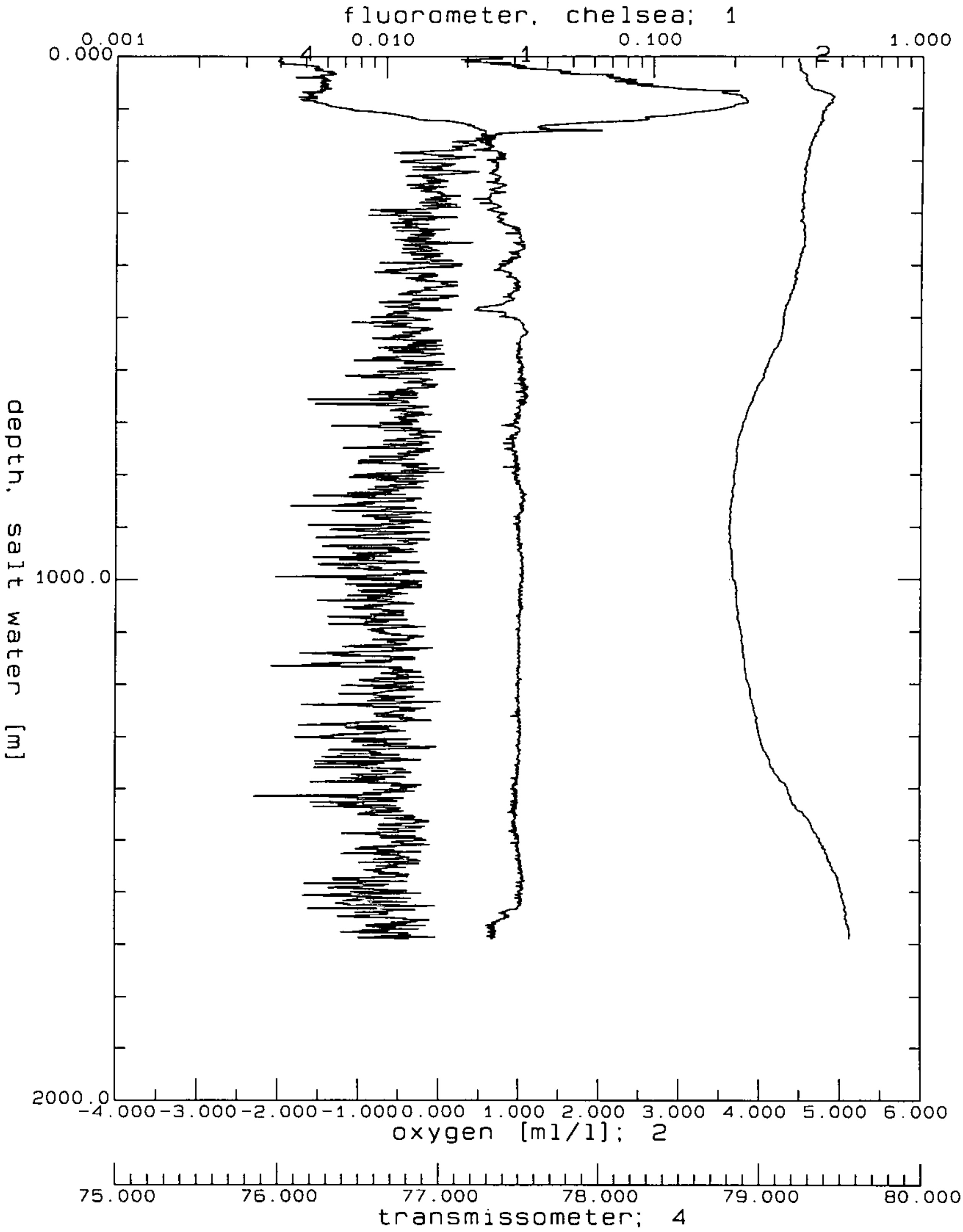
10951.CNV: OMEX-II Leg 2 1997 Station: PE109-05 Cast: 1



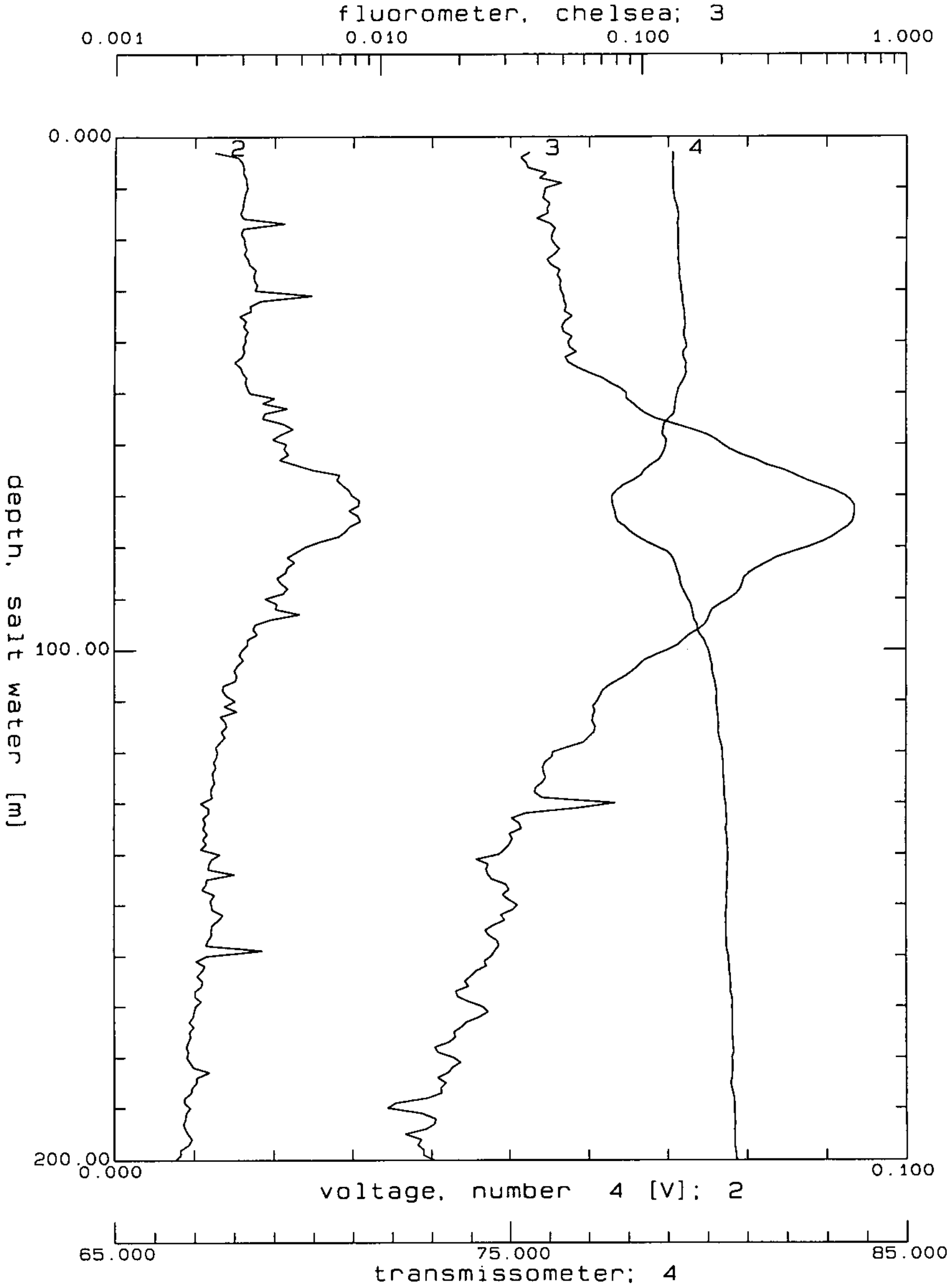
10961.CNV: OMEX-II Leg 2 1997 Station: PE109-06 Cast: 1



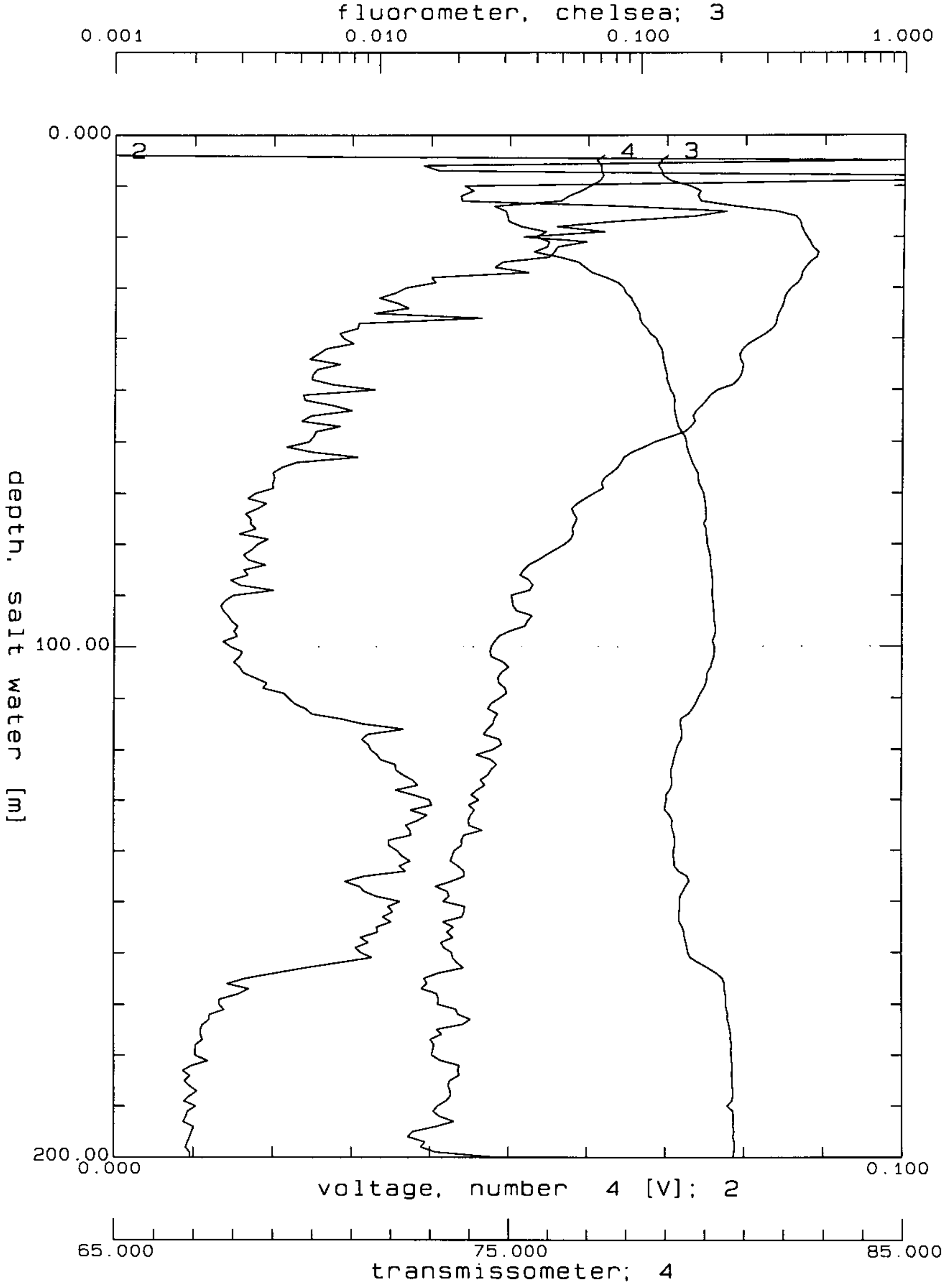
10981.CNV: OMEX-II Leg 2 1997 Station: PE109-08 Cast: 1



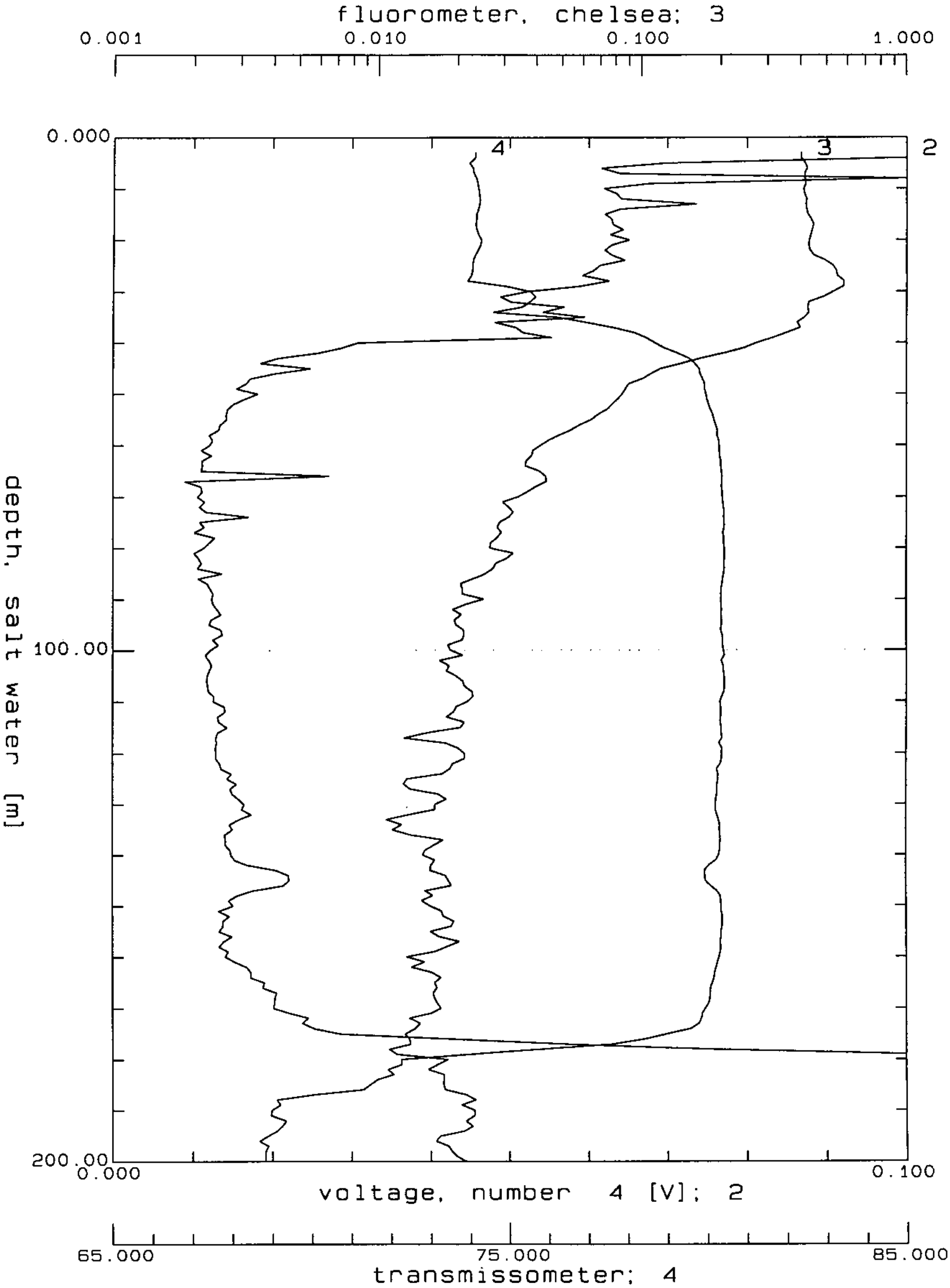
D10981.CNV: OMEX-II Leg 2 1997 Station: PE109-8 Cast: 1



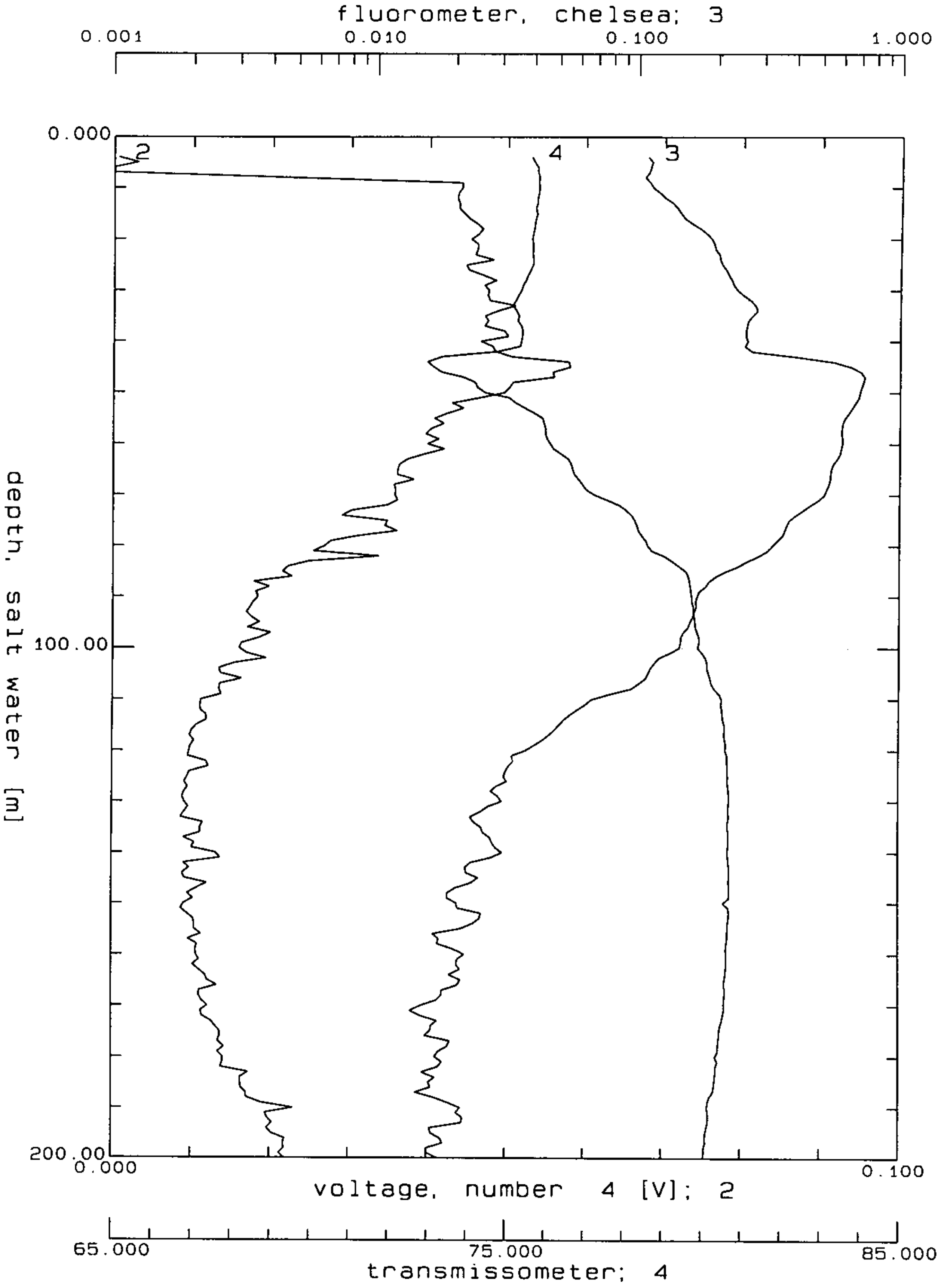
10991.CNV: OMEX-II Leg 2 1997 Station: PE109-09 Cast: 1



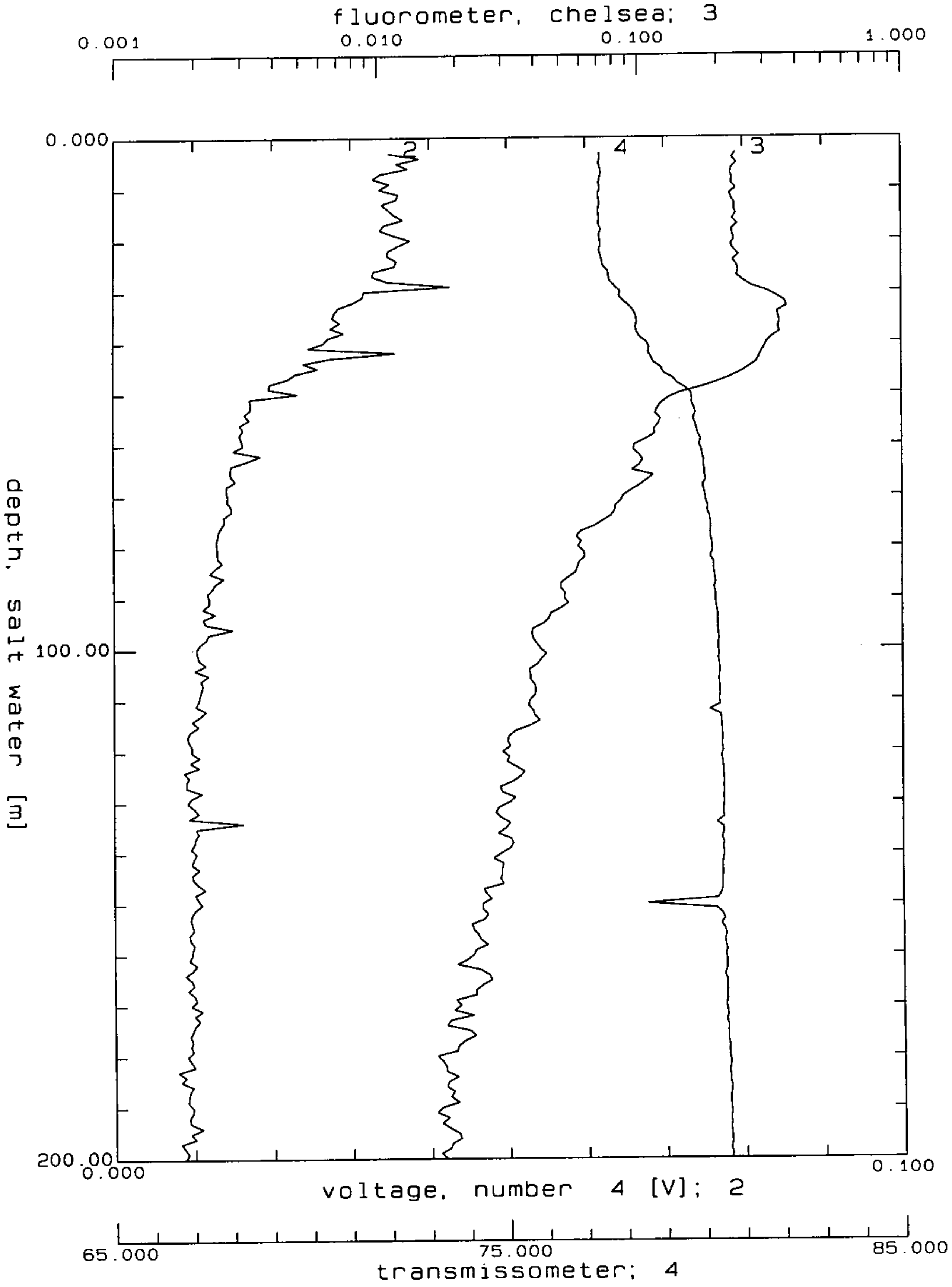
109101.CNV: OMEX-II Leg 2 1997 Station: PE109-10 Cast: 1



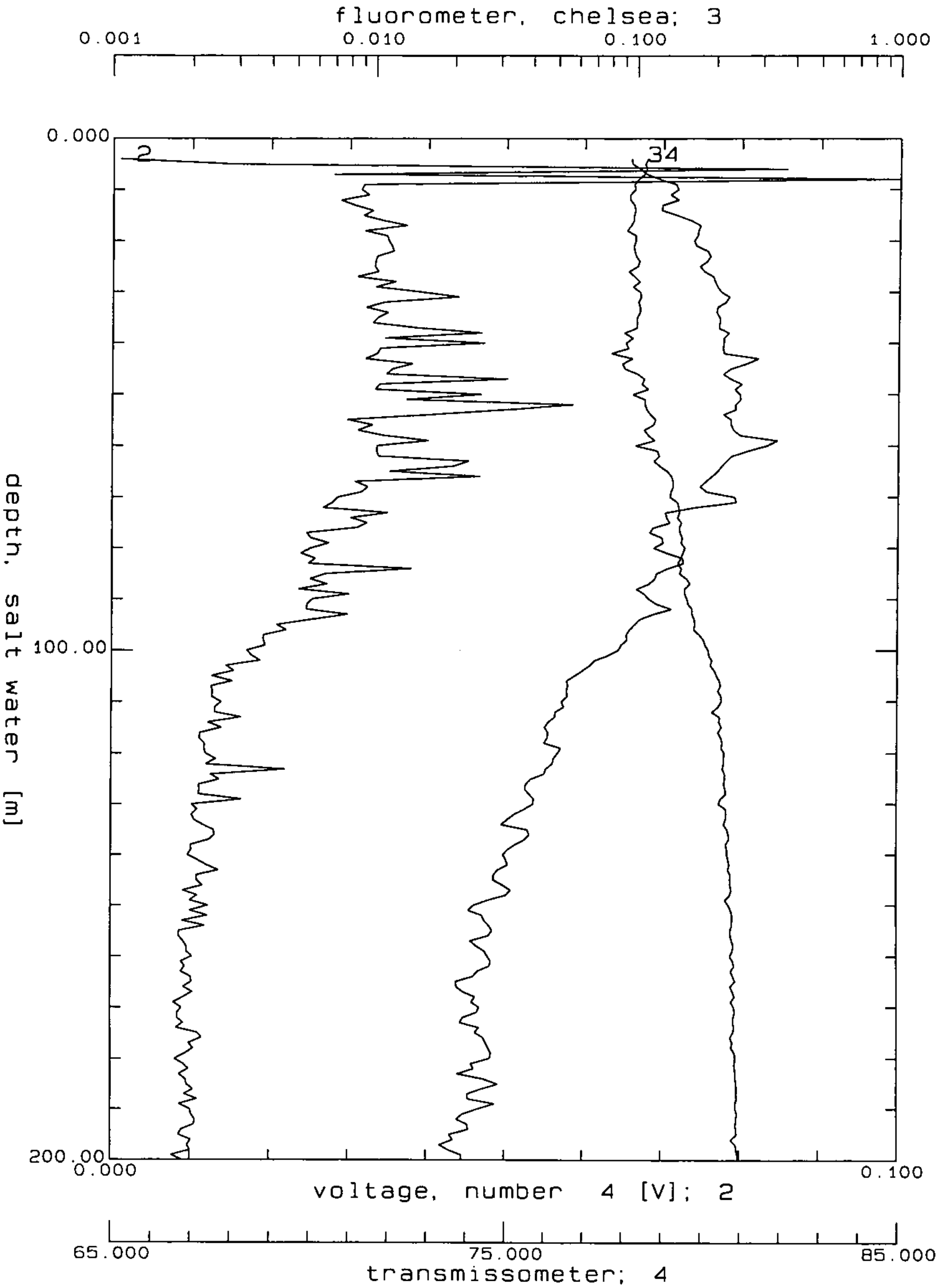
109111.CNV: OMEX-II Leg 2 1997 Station: PE109-11 Cast: 1



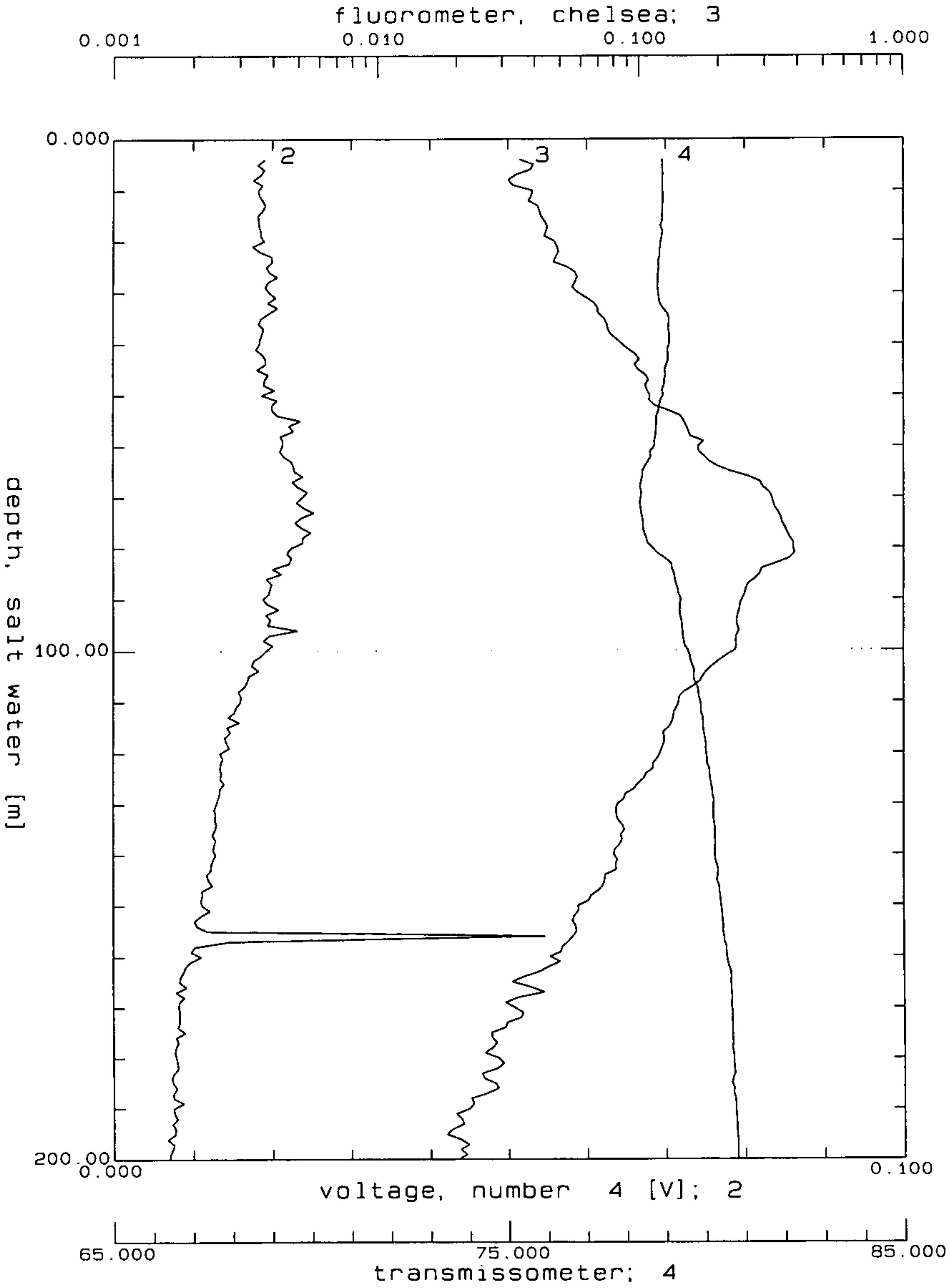
109121.CNV: OMEX-II Leg 2 1997 Station: PE109-12 Cast: 1



109131.CNV: OMEX-II Leg 2 1997 Station: PE109-13 Cast: 1



109141.CNV: OMEX-II Leg 2 1997 Station: PE109-14 Cast: 1



109151.CNV: OMEX-II Leg 2 1997 Station: PE109-15 Cast: 1

APPENDIX 6

Bottle files

When auditing ensure that there isn't another source of these data (new accession)

** Ship: Pelagia
** Cruise: OMEX-II leg 2 1997
** Date: 17/07/97
** Time (GMT): 09:53
** Station: PE109-1 CTD01
** Cast: 1
** Latitude: 42 39.94 N
** Longitude: 10 22.10 W
** Depth echo: 2959 M

Bottle Nr.	Depth [m]	Salinity [PSU]	Oxygen [uM/kg]	Temp. [Deg. C]	O2Sample [uM/l]	O2Sample [uM/l]
24	3	35.9182	187.9	18.211	247.21	246.33
23	20	35.9177	185.3	18.207	246.21	246.08
22	52	35.9193	185.8	18.060		
21	51	35.9129	185.7	18.089	251.40	251.82
20	101	35.9445	182.9	14.170		
19	101	35.9438	182.5	14.168	235.73	236.03
18	258	35.6865	175.8	12.201		
17	256	35.6897	176.3	12.225	224.69	225.13
16	496	35.5350	178.0	10.916		
15	497	35.5346	177.6	10.912	226.45	226.02
14	950	36.0673	147.6	11.104		
13	939	36.0588	146.0	11.124	189.26	189.44
12	1149	36.0596	148.4	10.380		
11	1148	36.0591	148.1	10.378	194.72	
10	1492	35.2244	189.1	5.722		
9	1492	35.2266	188.7	5.724	240.64	
8	2003	34.9855	211.0	3.687		
7	2003	34.9854	210.3	3.686		
6	2002	34.9855	210.6	3.687	264.67	264.38
5	2500	34.9660	206.3	3.086		
4	2500	34.9661	206.3	3.085		
3	2971	34.9392	207.9	2.736		
2	2971	34.9391	208.0	2.736		
1	2970	34.9390	207.6	2.736	251.51	257.01

Pressure logged, not depth

BC1-0

	Salinity	Si	PO4	NH4	NO2	NO3	
	[]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	
		0.53	0.04	0.11	-0.01	0.04	
		0.43	0.03	0.09	0.00	0.02	
		0.55	0.03	0.09	-0.01	0.01	
		0.52	0.03	0.12	-0.01	0.01	
		1.35	0.22	0.09	0.01	4.72	
		1.45	0.23	0.10	0.02	4.79	
		3.47	0.60	0.08	0.00	11.01	
		3.46	0.60	0.09	-0.01	11.02	
		5.06	0.78	0.07	0.00	13.65	
		5.02	0.78	0.07	0.00	13.69	
950		8.37	0.92	0.07	0.01	15.85	
959		8.49	0.92	0.09	-0.02	15.89	
939		9.42	0.95	0.08	0.01	16.34	
		9.42	0.95	0.08	-0.01	16.43	
		11.99	1.16	0.09	0.00	18.62	
		12.03	1.17	0.13	0.01	18.71	
		17.00	1.21	0.11	-0.03	18.68	
		17.04	1.20	0.12	-0.01	18.73	
		17.05	1.21	0.10	0.00	18.69	
		27.73	1.34	0.07	-0.01	20.49	
		27.76	1.33	0.10	-0.03	20.48	
		35.20	1.42	0.14	-0.01	21.50	
		35.23	1.43	0.12	0.00	21.59	
		35.27	1.43	0.10	-0.01	21.48	
		25.82	1.17	0.17	0.00	17.61	

** Ship: Pelagia
** Cruise: OMEX-II leg 2 1997
** Date: 18/07/97
** Time (GMT): 04:56
** Station: PE109-2 CTD02
** Cast: 1
** Latitude: 42 40.00 N
** Longitude: 9 29.79 W
** Depth echo: 186 m

Bottle Nr.	Depth	Salinity	Oxygen	Temp.	O2Sample	O2Sample
	[m]	[PSU]	[uM/kg]	[Deg. C]	[uM/l]	[uM/l]
22	4	35.7634	209.0	15.638	260.44	260.63
21	21	35.7600	205.3	15.624	259.90	260.07
20	48	35.7963	189.1	13.854	231.74	231.69
19	80	35.7775	189.2	13.335	229.77	230.11
18	121	35.7276	186.9	12.685	225.13	225.09
17	167	35.7087	188.3	12.472		
16	167	35.7081	188.4	12.464		
15	167	35.7078	188.2	12.460		
14	167	35.7076	188.3	12.459		
13	167	35.7077	188.4	12.459		
12	167	35.7075	188.1	12.463		
11	190	35.6552	188.4	11.913	221.83	222.28
10	190	35.6539	188.4	11.900		
9	189	35.6547	188.8	11.907		
8	190	35.6558	189.6	11.916		
7	190	35.6552	189.8	11.913		
6	190	35.6550	190.4	11.911		
5	190	35.6552	189.4	11.911		
4	190	35.6552	190.5	11.912		
3	190	35.6553	190.7	11.913		
2	190	35.6552	190.4	11.913		
1	190	35.6542	192.0	11.901		

MC1-OLW

Salinity	**Si**	**PO4**	**NH4**	**NO2**	**NO3**	
[]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	
	0.13	0.01	0.09	0.02	0.10	
	0.16	0.01	0.18	0.01	0.32	
	1.73	0.28	0.07	0.12	4.93	
	2.09	0.38	0.09	0.05	6.45	
	2.86	0.51	0.11	0.01	8.64	
	3.80	0.65	0.09	0.03	11.08	
	3.9935	0.6906	0.3851	0.0212	11.412	

** Ship: Pelagia
** Cruise: OMEX-II leg 2 1997
** Date: 19/07/97
** Time (GMT): 15:55
** Station: PE109-3 CTD04
** Cast: 1
** Latitude: 42 39.78 n
** Longitude: 09 41.79 w
** Depth echo: 1446 m

Bottle Nr.	**Depth**	**Salinity**	**Oxygen**	**Temp.**	**O2Sample**	**O2Sample**
	[m]	[PSU]	[uM/kg]	[Deg. C]	[uM/l]	[uM/l]
21	10	35.7676	207.6	15.447	266.27	265.80
20	100	35.7731	187.0	13.322	237.52	237.47
19	202	35.6546	181.9	12.051	228.99	228.54
18	351	35.5623	179.6	11.231		
17	351	35.5621	179.6	11.232	224.30	224.39
16	499	35.5864	169.1	10.861	210.21	210.52
15	1003	36.1130	149.1	11.105	185.34	185.63
14	1252	35.9519	160.3	9.620	197.93	197.80
13	1251	35.9538	160.8	9.633		
12	1251	35.9533	160.7	9.628		
11	1251	35.9544	160.5	9.636		
10	1251	35.9546	161.2	9.637		
9	1250	35.9565	160.8	9.653		
8	1250	35.9550	161.1	9.643		
7	1448	35.4016	198.5	6.352		
6	1448	35.4112	198.5	6.395		
5	1449	35.4113	198.0	6.400		
4	1450	35.4132	198.9	6.412		
3	1450	35.4124	198.8	6.409		
2	1450	35.4074	199.8	6.381		
1	1450	35.4001	200.3	6.338		232.11
MC3-1						
MC3-2						
MC3-3						
MC3-4						
MC3-5						

Salinity	Si	PO4	NH4	NO2	NO3	Comments
[]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	
	0.13	0.02	0.31	0.03	0.27	
	1.56	0.26	0.15	0.03	5.25	
	3.18	0.58	0.12	0.00	10.21	
	4.44	0.73	0.17	0.00	12.65	
	4.46	0.74	0.14	-0.01	12.83	
	5.99	0.88	0.15	0.00	14.84	
	8.51	0.93	0.14	-0.01	15.83	
	10.07	1.00	0.14	0.00	16.76	
	10.06	1.01	0.17	0.00	16.70	
	10.08	1.00	0.13	-0.01	16.65	
	10.07	0.99	0.11	0.00	16.86	
	10.09	1.00	0.10	0.00	16.78	
	10.11	1.00	0.14	0.00	16.73	
	10.06	1.00	0.17	-0.01	16.76	
	~~9.05~~	~~0.97~~	~~0.15~~	~~0.00~~	~~16.16~~	**Leaking!**
	13.06	1.13	0.16	-0.01	18.14	
	13.17	1.13	~~0.27~~	-0.01	18.17	
	13.20	1.14	0.15	0.00	17.94	
	13.03	1.13	0.15	-0.01	17.94	
	13.12	1.14	0.14	0.00	18.13	
	13.15	1.13	0.16	-0.01	18.19	
	12.37	1.17	0.25	0.01	17.56	**Leaking!**
	12.96	1.17	0.20	0.01	18.50	
	13.02	1.17	0.18	0.01	18.44	
	13.01	1.17	0.21	0.01	18.45	
	13.09	1.20	0.19	0.01	18.41	

** Ship: Pelagia
** Cruise: OMEX-II leg 2 1997
** Date: 21/07/97
** Time (GMT): 11:20
** Station: PE109-4 CTD06
** Cast: 1
** Latitude: 42 37.93 N
** Longitude: 09 59.44 W
** Depth echo: 2145 m

Bottle Nr.	**Depth**	**Salinity**	**Oxygen**	**Temp.**	**O2Sample**	**O2Sample**
	[m]	[PSU]	[uM/kg]	[Deg. C]	[uM/l]	[uM/l]
22	11	35.7777	202.9	16.192	262.13	262.62
21	11	35.7761	203.6	16.180	262.41	262.72
20	25	35.7691	203.4	15.856	264.30	264.74
19	49	35.7697	198.1	15.065	254.91	255.12
18	103	35.7545	191.1	13.418	243.88	244.20
17	255	35.6347	186.1	11.913	235.15	235.38
16	501	35.5743	169.9	10.990	213.29	213.35
15	749	35.9145	150.7	11.231	189.55	189.64
14	1017	36.1017	146.6	11.097		
13	1017	36.1016	146.1	11.096		
12	1017	36.1020	146.3	11.092	188.62	188.44
11	1711	35.1351	203.1	4.815		
10	1711	35.1346	203.2	4.809		
9	1710	35.1346	202.6	4.808	252.37	252.62
8	2148	35.0045	211.9	3.506		
7	2148	35.0045	212.0	3.506		
6	2148	35.0044	212.3	3.506		
5	2148	35.0045	212.3	3.506		
4	2147	35.0045	212.5	3.507		
3	2147	35.0044	212.8	3.507		
2	2147	35.0046	212.7	3.507		
1	2147	35.0045	213.3	3.506	255.13	255.53
MC4-1					259.83	259.88
MC4-2						
MC4-3						
MC4-4						
MC4-5						
MC4-6						
MC4-7						
MC4-8						
MC4-9						
MC4-10						
MC4-11						
MC4-12						

Salinity	Si	PO4	NH4	NO2	NO3	TIC
[]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	[mM/l]
	0.12	0.02	0.12	0.00	-0.02	2.222
	0.08	0.02	0.16	0.00	0.02	2.212
	0.13	0.03	0.18	0.00	0.02	2.207
	0.42	0.05	0.36	0.08	0.63	2.229
	1.35	0.20	0.15	0.05	4.42	2.246
	3.03	0.50	0.14	-0.01	9.65	2.280
	5.53	0.82	0.14	0.00	14.61	2.302
	7.60	0.91	0.14	-0.01	15.96	2.335
	8.49	0.92	0.15	-0.01	15.86	2.356
	8.48	0.91	0.17	-0.01	15.93	2.347
	8.47	0.92	0.10	-0.01	15.95	2.350
	13.81	1.19	0.17	-0.02	18.66	2.310
	13.94	1.19	0.13	-0.01	18.79	2.308
	13.90	1.20	0.10	-0.01	18.73	2.316
	22.66	1.32	0.13	-0.02	20.05	2.317
	22.75	1.30	0.16	0.00	20.14	2.311
	22.78	1.30	0.18	0.00	20.09	2.316
	22.79	1.30	0.17	-0.01	20.00	2.310
	22.74	1.30	0.08	-0.01	20.09	2.312
	22.76	1.32	0.13	0.00	20.02	2.317
	22.77	1.31	0.11	-0.01	20.12	2.319
	22.75	1.31	0.14	0.00	20.10	2.318
	22.69	1.32	0.21	0.00	20.13	
	22.42	1.30	0.19	-0.01	19.93	
	22.46	1.30	0.15	0.01	20.00	
	22.53	1.30	0.17	0.00	19.92	
	21.81	1.29	0.21	-0.01	19.64	
	22.14	1.30	0.19	0.01	19.80	
	22.07	1.29	0.22	0.00	19.90	
	22.46	1.31	0.16	0.00	19.99	
	22.48	1.31	0.26	0.00	20.01	
	22.29	1.30	0.29	0.00	19.86	
	22.12	1.29	0.29	-0.01	19.90	
	22.52	1.31	0.22	0.00	20.01	

** Ship: Pelagia						
** Cruise: OMEX-II leg 2 1997						
** Date: 22/07/97						
** Time (GMT): 10:45						
** Station: PE109-5			CTD28			
** Cast: 1						
** Latitude: 42 37.96 N						
** Longitude: 10 09.77 W						
** Depth echo: 2570 m						
Bottle Nr.	**Depth** [m]	**Salinity** [PSU]	**Oxygen** [uM/kg]	**Temp.** [Deg. C]	**O2Sample** [uM/l]	**O2Sample** [uM/l]
24	9	35.8495	185.5	18.142		
23	9	35.8499	185.6	18.146	242.96	242.50
22	50	35.8208	187.1	17.800		
21	50	35.8184	188.1	17.809	245.83	245.84
20	99	35.8469	186.7	13.811		
19	99	35.8456	186.2	13.801	239.07	239.04
18	302	35.6114	181.5	11.711		
17	302	35.6114	180.8	11.711		
16	302	35.6113	180.5	11.712	228.16	228.57
15	502	35.5610	172.0	10.862		
14	501	35.5607	170.9	10.861	215.89	216.42
13	998	36.0834	145.3	11.014		
12	998	36.0836	144.6	11.015	189.18	188.64
11	1498	35.5321	174.0	7.218		
10	1498	35.5173	174.7	7.136	224.17	223.47
9	2000	35.0244	206.2	3.806	257.93	257.98
8	2000	35.0245	206.2	3.807	257.75	258.41
7	2575	34.9585	206.6	2.920		
6	2575	34.9587	207.1	2.924		
5	2574	34.9588	207.0	2.924		
4	2574	34.9588	207.2	2.922		
3	2574	34.9589	207.4	2.924		
2	2574	34.9589	207.4	2.925		
1	2573	34.9590	207.6	2.926	251.44	250.76
MC5-2					250.96	250.70
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
BC5-0						

Salinity	Si	PO4	NH4	NO2	NO3	
[]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	
	0.49	0.01	0.15	0.01	-0.03	
	0.45	0.01	0.12	-0.01	0.00	
	0.39	0.00	0.12	-0.01	-0.03	
	0.41	0.00	0.08	0.00	-0.03	
	1.39	0.27	0.05	0.00	4.55	
	1.41	0.28	0.10	0.03	4.73	
	3.75	0.67	0.11	-0.01	11.44	
	3.76	0.67	0.09	-0.01	11.57	
	3.77	0.67	0.11	0.01	11.51	
	5.61	0.86	0.10	-0.01	14.61	
	5.64	0.87	0.12	-0.01	14.73	
	8.58	0.95	0.12	0.01	16.14	
	8.60	0.95	0.10	0.00	16.20	
	11.89	1.12	0.11	0.00	18.16	
	11.94	1.12	0.11	0.00	18.19	
	18.85	1.25	0.11	0.00	19.45	
	18.92	1.25	0.11	-0.01	19.40	
	31.76	1.40	0.12	-0.01	21.37	
	31.76	1.40	0.12	-0.01	21.43	
	31.87	1.41	0.13	0.01	21.35	
	31.88	1.41	0.12	0.00	21.45	
	31.86	1.41	0.13	0.00	21.46	
	31.93	1.41	0.13	0.00	21.41	
	31.5	1.42	0.20	-0.01	21.43	
	32.1	1.43	0.25	-0.01	21.53	
	32.2	1.44	0.31	0.00	21.57	
	26.5	1.31	0.47	0.01	20.10	**LEAKING**
	31.8	1.41	0.32	-0.01	21.47	
	32.0	1.43	0.40	-0.01	21.56	
	32.0	1.43	0.34	-0.01	21.62	
	32.1	1.43	0.32	-0.01	21.64	
	31.5	1.43	0.32	-0.01	21.53	
	32.0	1.42	0.39	0.00	21.56	
	28.5	1.34	0.27	-0.01	20.26	**LEAKING**
	29.86	1.37	0.34	0.08	20.68	

** Ship: Pelagia						
** Cruise: OMEX-II leg 2 1997						
** Date: 24/07/97						
** Time (GMT): 06:13						
** Station: PE109-6			ox209			
** Cast: 1						
** Latitude: 42 52.12 N						
** Longitude: 11 52.24 W						
** Depth echo: 1127 m						
Bottle Nr.	**Depth**	**Salinity**	**Oxygen**	**Temp.**	**O2Sample**	**O2Sample**
	[m]	[PSU]	[uM/kg]	[Deg. C]	[uM/l]	[uM/l]
20	8	35.8789	186.9	18.819		
19	8	35.8783	186.0	18.817	239.46	239.50
18	49	35.8407	197.5	15.806		
17	49	35.8387	198.5	15.811	253.37	253.61
16	102	35.7647	190.4	13.412		
15	102	35.7689	189.4	13.489	238.04	238.40
14	249	35.6196	185.3	11.775	228.94	228.15
13	249	35.6200	185.1	11.780		
12	500	35.5473	178.9	10.861		
11	500	35.5472	178.8	10.860	219.82	218.80
10	700	35.7292	162.0	10.758		
9	699	35.7303	162.1	10.758		
8	699	35.7315	160.9	10.759	195.52	195.43
7	1136	35.9609	162.5	10.303		
6	1136	35.9609	163.5	10.306		
5	1136	35.9609	163.2	10.305		
4	1136	35.9610	163.0	10.305		
3	1136	35.9610	162.9	10.302		
2	1135	35.9607	163.3	10.305		
1	1135	35.9613	163.4	10.308	191.37	191.37
BC6-0						
MC6-7					196.83	193.59
8						
10						

Salinity	**Si**	**PO4**	**NH4**	**NO2**	**NO3**	
[]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	
	0.66	0.01	0.15	0.00	-0.03	
	0.65	0.01	0.14	0.00	-0.04	
	0.85	0.05	0.16	0.03	0.26	
	0.84	0.04	0.16	0.04	0.25	
	1.73	0.33	0.06	0.05	5.39	
	1.76	0.34	0.18	0.04	5.48	
	3.61	0.66	0.06	0.01	11.15	
	3.63	0.67	0.09	0.01	11.20	
	5.44	0.86	0.09	0.00	14.29	
	5.45	0.87	0.15	0.00	14.35	
	7.55	0.98	0.12	0.00	16.16	
	7.76	0.98	0.07	0.01	16.29	
	7.77	0.99	0.15	0.01	16.25	
	9.25	1.00	0.14	0.01	16.68	
	9.24	1.02	0.10	0.01	16.66	
	9.23	1.01	0.13	0.00	16.72	
	9.21	1.01	0.16	0.01	16.71	
	9.21	1.02	0.11	0.00	16.76	
	9.19	1.01	0.10	0.01	16.69	
	9.21	1.01	0.09	0.01	16.74	
	9.72	1.05	0.33	0.07	16.41	
	9.33	1.01	0.53	0.04	16.52	
	9.32	1.00	0.58	0.04	16.47	
	9.30	1.01	0.50	0.05	16.30	

** Ship: Pelagia						
** Cruise: OMEX-II leg 2 1997						
** Date: 25/7/97						
** Time (GMT): 10:18						
** Station: PE109-8		CTD10				
** Cast: 1						
** Latitude: 42 38.02 N						
** Longitude: 11 11.45 W						
** Depth echo: 1681 m						
Bottle Nr.	**Depth**	**Salinity**	**Oxygen**	**Temp.**	**O2Sample**	**O2Sample**
	[m]	[PSU]	[uM/kg]	[Deg. C]	[uM/l]	[uM/l]
23	26	35.9048	188.3	18.396		
22	26	35.9033	188.1	18.385	241.52	241.28
21	52	35.8433	193.3	17.530		
20	52	35.8450	191.7	17.566	247.83	247.68
19	98	35.8514	192.2	14.124		
18	98	35.8509	191.2	14.137	242.22	241.94
17	248	35.6590	180.9	12.042		
16	248	35.6592	180.3	12.045	225.36	225.55
15	499	35.5716	172.5	10.863		
14	499	35.5718	171.5	10.863	213.09	212.70
13	751	35.9962	151.5	11.483		
12	751	35.9959	151.6	11.484		
11	750	35.9965	151.0	11.481	189.79	190.03
10	1001	35.9517	152.4	10.290		
9	1001	35.9530	151.7	10.293	189.59	189.74
8	1684	35.0788	219.6	4.592		
7	1684	35.0792	220.3	4.595		
6	1685	35.0789	220.2	4.593		
5	1685	35.0789	220.3	4.594		
4	1684	35.0785	220.8	4.592		
3	1685	35.0784	221.1	4.592		
2	1685	35.0785	221.4	4.591		
1	1685	35.0785	221.5	4.592	255.58	255.88
BC8-0						
MC8-1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						

Salinity	**Si**	**PO4**	**NH4**	**NO2**	**NO3**	
[]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	
	0.45	0.02	0.11	0.00	0.05	
	0.41	0.02	0.14	-0.01	0.00	
	0.36	0.02	0.14	0.01	-0.03	
	0.33	0.01	0.12	-0.01	-0.02	
	1.11	0.21	0.17	0.11	3.16	
	1.10	0.22	0.12	0.12	3.17	
	3.36	0.65	0.15	0.00	10.94	
	3.38	0.65	0.14	-0.01	11.06	
	5.67	0.88	0.11	0.00	14.80	
	5.69	0.90	0.15	0.00	14.86	
	7.27	0.92	0.15	-0.01	15.43	
	7.29	0.92	0.14	-0.01	15.47	
	7.29	0.93	0.18	0.00	15.44	
	9.13	1.03	0.13	-0.01	17.01	
	9.16	1.02	0.15	-0.01	16.94	
	13.14	1.21	0.16	0.00	18.76	
	13.17	1.21	0.16	-0.01	18.88	
	13.14	1.22	0.17	-0.01	18.84	
	7.41	0.91	0.14	0.01	14.64	**Leaking!**
	13.14	1.21	0.15	-0.01	18.71	
	13.19	1.20	0.18	0.00	18.86	
	13.17	1.22	0.19	0.00	18.71	
	13.20	1.21	0.12	-0.01	18.83	
	10.10	0.99	0.47	0.07	15.59	
	13.47	1.20	0.58	0.02	18.51	
	13.80	1.21	0.60	0.04	18.55	
	13.27	1.20	0.64	0.03	18.44	
	13.42	1.27	0.63	0.04	18.53	
	12.79	1.19	0.61	0.02	17.86	**Leaking!**
	13.34	1.20	0.53	0.02	18.46	
	12.88	1.17	0.74	0.02	18.09	
	13.67	1.30	1.37	0.04	18.75	
	13.32	1.21	0.56	0.02	18.58	
	12.98	1.18	0.63	0.03	18.24	
	12.08	1.14	0.64	0.03	17.28	**Leaking!**

** Ship: Pelagia						
** Cruise: OMEX-II leg 2 1997						
** Date: 26/07/97						
** Time (GMT): 08:53						
** Station: PE109-9			CTD11			
** Cast: 1						
** Latitude: 42 38.00 N						
** Longitude: 10 43.30 W						
** Depth echo: 2207 m						
Bottle Nr.	**Depth**	**Salinity**	**Oxygen**	**Temp.**	**O2Sample**	**O2Sample**
	[m]	[PSU]	[uM/kg]	[Deg. C]	[uM/l]	[uM/l]
23	11	35.9302	181.0	19.194	238.48	238.95
22	99	35.9293	183.6	14.039		
21	99	35.9297	183.4	14.045	231.38	231.43
20	249	35.7087	178.4	12.381		
19	249	35.7073	178.9	12.373	223.06	222.94
18	501	35.5463	177.8	10.934		
17	502	35.5461	178.0	10.934	221.31	221.12
16	866	36.0377	149.3	11.333		
15	867	36.0377	149.9	11.333		
14	866	36.0379	149.3	11.333	188.23	188.34
13						
12	1001	36.0834	146.9	11.127		
11	1001	36.0837	146.6	11.131	187.57	187.54
10	1504	35.2572	188.6	5.918		
9	1503	35.2611	188.5	5.944	235.56	236.34
8	2207	34.9833	214.9	3.490		
7	2207	34.9833	214.5	3.491		
6	2207	34.9832	215.0	3.490		
5	2207	34.9832	215.1	3.490		
4	2207	34.9833	215.0	3.489		
3	2206	34.9833	215.1	3.489		
2	2207	34.9831	215.4	3.489		
1	2207	34.9832	215.3	3.489	260.20	261.03
BC9-0						
MC9-1					260.61	260.46
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						

Salinity	Si	PO4	NH4	NO2	NO3	
[]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	
	0.51	0.01	0.03	0.00	0.01	
	1.47	0.31	0.08	0.01	5.27	
	1.48	0.31	0.06	-0.01	5.33	
	3.22	0.62	0.07	-0.01	10.62	
	3.25	0.63	0.01	-0.02	10.77	
	5.09	0.85	0.07	-0.03	14.07	
	5.11	0.84	0.07	-0.01	14.09	
	7.71	0.94	0.05	-0.02	15.64	
	7.73	0.94	0.05	-0.02	15.73	
	7.74	0.94	0.08	-0.02	15.71	
	8.36	0.96	0.10	-0.02	16.17	
	8.38	0.96	0.05	-0.02	16.11	
	12.05	1.20	0.09	-0.02	18.80	
	12.07	1.21	0.09	-0.01	18.84	
	20.25	1.28	0.03	-0.02	19.60	
	20.35	1.29	0.09	-0.02	19.63	
	20.32	1.29	0.06	-0.03	19.67	
	20.29	1.28	0.09	-0.02	19.59	
	20.30	1.30	0.11	-0.02	19.60	
	20.26	1.29	0.09	-0.01	19.56	
	20.26	1.30	0.10	-0.02	19.55	
	20.29	1.29	0.09	-0.02	19.60	
	18.65	1.19	1.52	0.28	18.1	
	20.48	1.25	0.18	0.00	19.18	
	20.27	1.23	0.19	0.01	19.14	
	20.59	1.24	0.30	0.00	19.31	
	20.25	1.24	0.25	0.01	19.12	
	10.30	0.74	0.29	0.00	11.76	**LEAKING**
	19.61	1.20	0.25	0.01	18.45	**LEAKING**
	20.73	1.36	0.32	0.02	19.26	
	20.66	1.24	0.53	0.00	19.28	
	19.24	1.21	0.37	0.00	18.32	**LEAKING**
	18.37	1.16	0.29	0.01	18.02	**LEAKING**
	16.32	1.05	0.15	0.03	15.68	**LEAKING**

** Ship: Pelagia						
** Cruise: OMEX-II leg 2 1997						
** Date: 27/07/97						
** Time (GMT): 14:10						
** Station: PE109-10			CTD12			
** Cast: 1						
** Latitude: 42 21.86 N						
** Longitude: 09 34.86 W						
** Depth echo: 1144 m						
Bottle Nr.	**Depth**	**Salinity**	**Oxygen**	**Temp.**	**O2Sample**	**O2Sample**
	[m]	[PSU]	[uM/kg]	[Deg. C]	[uM/l]	[uM/l]
23	10	35.7862	199.2	16.290		
22	10	35.7845	198.7	16.287	258.01	257.80
21	99	35.7506	184.9	12.933		
20	100	35.7500	185.1	12.923	228.30	228.46
19	143	35.6731	183.6	12.147		
18	142	35.6734	183.4	12.151		
17	140	35.6742	183.6	12.166		
16	251	35.5894	182.9	11.451		
15	251	35.5894	182.6	11.452		
14	500	35.5969	169.6	10.713		
13						
12	500	35.6002	169.0	10.716	206.49	205.98
11	777	36.0574	153.8	11.539		
10	776	36.0561	153.4	11.538		
9	776	36.0557	153.1	11.538	188.12	187.80
8	1141	35.9978	164.5	9.944		
7	1142	35.9959	165.2	9.934		
6	1143	35.9968	165.3	9.939		
5	1144	35.9969	165.3	9.939		
4	1144	35.9956	165.4	9.932		
3	1145	35.9960	165.1	9.934		
2	1146	35.9957	165.1	9.931		
1	1146	35.9964	165.3	9.938	195.34	195.16

Salinity	**Si**	**PO4**	**NH4**	**NO2**	**NO3**	**TIC**
[]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	[mM/l]
	0.80	0.06	0.19	0.04	0.36	2.226
	0.75	0.05	0.10	0.03	0.28	2.225
	2.44	0.41	0.13	0.05	7.34	2.269
	2.46	0.42	0.10	0.05	7.51	2.269
	3.35	0.57	0.13	0.02	9.93	2.274
	3.35	0.56	0.10	0.02	9.94	2.278
	3.35	0.58	0.14	0.02	9.89	2.277
	4.19	0.71	0.09	0.01	12.19	2.288
	4.21	0.70	0.11	0.01	12.24	2.292
	6.52	0.90	0.12	0.02	14.99	2.306
	6.54	0.90	0.04	0.01	15.24	2.309
	7.50	0.88	0.12	0.01	14.98	2.335
	7.51	0.87	0.09	0.01	15.01	2.337
	7.51	0.86	0.13	0.00	15.07	2.338
	9.80	0.97	0.13	0.00	16.33	2.354
	9.81	0.96	0.09	0.00	16.49	2.354
	9.81	0.97	0.11	0.00	16.39	2.352
	9.83	0.97	0.09	0.00	16.48	2.356
	9.81	0.98	0.11	0.01	16.45	2.356
	9.82	0.98	0.04	-0.01	16.69	2.348
	9.82	0.98	0.09	0.01	16.45	2.347
	9.83	0.98	0.11	-0.01	16.64	2.344

** Ship: Pelagia
** Cruise: OMEX-II leg 2 1997
** Date: 28/07/97
** Time (GMT): 06:14
** Station: PE109-11 CTD13
** Cast: 1
** Latitude: 42 20.14 N
** Longitude: 09 15.23 W
** Depth echo: 197 m

Bottle Nr.	**Depth** [m]	**Salinity** [PSU]	**Oxygen** [uM/kg]	**Temp.** [Deg. C]	**O2Sample** [uM/l]	**O2Sample** [uM/l]
17	10	35.7844	206.2	15.927		
16	10	35.7842	204.8	15.919	258.61	259.09
15	50	35.8109	191.4	13.558		
14	51	35.8106	191.7	13.532	232.76	232.92
13	50	35.8096	190.4	13.501		
12	100	35.7259	188.3	12.613		
11	100	35.7256	188.9	12.617	227.49	227.38
10	139	35.6938	184.0	12.236		
9	139	35.6935	184.1	12.234		
8	139	35.6935	183.8	12.234	221.61	221.72
7	199	35.6662	181.7	11.950		
6	199	35.6663	182.4	11.951		
5	200	35.6663	182.4	11.951		
4	199	35.6664	182.9	11.951		
3	199	35.6664	183.2	11.952		
2	200	35.6665	183.0	11.950		
1	199	35.6665	183.6	11.951	215.57	215.56
MC11-1					215.02	215.43
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12						
BC11-0						

Salinity	**Si**	**PO4**	**NH4**	**NO2**	**NO3**	
[]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	
	0.83	0.02	0.19	0.01	0.17	
	0.79	0.04	0.17	-0.01	0.09	
	1.76	0.32	0.14	0.04	5.71	
	1.74	0.31	0.12	0.04	5.71	
	2.71	0.48	0.11	0.01	8.69	
	2.73	0.49	0.11	0.01	8.78	
	3.46	0.60	0.11	0.00	10.62	
	3.46	0.60	0.06	0.00	10.58	
	3.45	0.61	0.12	0.00	10.62	
	4.36	0.69	0.14	0.08	11.67	
	4.40	0.69	0.13	0.08	11.74	
	4.40	0.69	0.12	0.09	11.72	
	4.39	0.69	0.11	0.08	11.72	
	4.39	0.69	0.11	0.09	11.70	
	4.38	0.70	0.13	0.08	11.73	
	4.38	0.69	0.10	0.09	11.72	
	4.64	0.74	0.34	0.08	11.78	
	4.53	0.72	0.19	0.07	11.78	
	4.52	0.73	0.17	0.08	11.78	
	4.65	0.76	0.24	0.08	11.81	
	4.54	0.72	0.28	0.08	11.52	
	4.54	0.73	0.30	0.08	11.73	
	4.68	0.74	0.27	0.08	11.78	
	4.67	0.74	0.31	0.08	11.79	
	4.58	0.73	0.20	0.08	11.77	
	4.66	0.74	0.35	0.08	11.82	
	4.62	0.73	0.45	0.10	11.75	
	5.17	0.77	1.92	0.33	11.97	

** Ship: Pelagia						
** Cruise: OMEX-II leg 2 1997						
** Date: 28/07/97						
** Time (GMT): 12:36						
** Station: PE109-12			CTD15			
** Cast: 1						
** Latitude: 42 23.72 N						
** Longitude: 09 20.79 W						
** Depth echo: 328 m						
Bottle Nr.	**Depth**	**Salinity**	**Oxygen**	**Temp.**	**O2Sample**	**O2Sample**
	[m]	[PSU]	[uM/kg]	[Deg. C]	[uM/l]	[uM/l]
18	10	35.7907	200.9	16.902		
17	10	35.7909	199.9	16.911	253.95	253.98
16	24	35.7890	200.2	16.504	256.10	255.87
15	24	35.7855	197.9	16.459		
14	100	35.7487	189.5	12.837		
13						
12	99	35.7471	188.7	12.824	230.72	230.40
11	188	35.6836	183.8	12.141		
10	187	35.6838	183.6	12.144	220.16	219.73
9	293	35.6419	184.9	11.728		
8	293	35.6420	185.1	11.728		
7	331	35.6434	186.4	11.729	216.58	216.77
6	331	35.6434	187.0	11.728		
5	331	35.6435	187.1	11.730		
4	331	35.6436	187.6	11.730		
3	331	35.6436	189.3	11.729		
2	331	35.6438	188.8	11.731		
1	331	35.6438	189.1	11.732	216.35	216.44
MC12-4						
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12						
BC12-0						

Salinity	**Si**	**PO4**	**NH4**	**NO2**	**NO3**	
[]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	
	0.62	0.03	0.15	0.01	0.12	
	0.58	0.02	0.09	-0.01	-0.01	
	0.70	0.03	0.08	0.00	0.16	
	2.36	0.44	0.09	0.02	7.59	
	2.38	0.44	0.09	0.02	7.72	
	3.66	0.63	0.09	0.00	10.92	
	3.65	0.63	0.09	0.00	10.96	
	4.37	0.72	0.09	0.02	12.31	
	4.37	0.72	0.09	0.02	12.33	
	4.44	0.72	0.09	0.02	12.33	
	4.45	0.72	0.05	0.02	12.36	
	4.43	0.72	0.09	0.04	12.34	
	4.42	0.73	0.08	0.02	12.38	
	4.41	0.73	0.08	0.02	12.30	
	4.40	0.72	0.08	0.02	12.34	
	4.40	0.73	0.11	0.02	12.50	
	4.96	0.80	0.29	0.03	12.27	
	2.55	0.40	0.20	0.02	6.30	**Leaking**
	2.50	0.40	0.18	0.02	6.17	**Leaking**
	4.57	0.73	0.18	0.03	12.16	
	4.49	0.74	0.20	0.03	12.31	
	4.61	0.74	0.21	0.04	12.30	
	4.61	0.76	0.25	0.03	12.37	
	4.62	0.76	0.19	0.02	12.33	
	3.48	0.57	0.21	0.02	9.36	**Leaking**
	5.13	0.8	2.05	0.32	12.49	

** Ship: Pelagia						
** Cruise: OMEX-II leg 2 1997						
** Date: 29/07/97						
** Time (GMT): 04:59						
** Station: PE109-13			CTD16			
** Cast: 1						
** Latitude: 42 19.94 N						
** Longitude: 09 41.07 W						
** Depth echo: 1768 m						
Bottle Nr.	**Depth**	**Salinity**	**Oxygen**	**Temp.**	**O2Sample**	**O2Sample**
	[m]	[PSU]	[uM/kg]	[Deg. C]	[uM/l]	[uM/l]
23	10	35.7871	202.0	16.224		
22	10	35.7855	200.4	16.223	255.03	255.53
21	24	35.7878	199.7	14.511		
20	25	35.7886	198.7	14.466	250.00	250.03
19	49	35.7767	188.0	13.480		
18	49	35.7771	188.3	13.497	233.51	233.66
17	100	35.7230	187.6	12.653		
16	100	35.7214	187.3	12.634	232.60	232.91
15	249	35.6058	182.1	11.594		
14	249	35.6057	181.6	11.595	223.45	223.48
13	249	35.6056	181.6	11.595		
12	498	35.5599	173.5	10.756		
11	498	35.5599	172.6	10.757	212.91	212.78
10	999	36.1737	147.2	11.313		
9	999	36.1737	147.3	11.311	185.41	186.71
8	1772	35.2009	211.7	5.065		
7	1772	35.2007	212.0	5.064		
6	1772	35.2001	211.8	5.061		
5	1771	35.2005	212.3	5.063		
4	1772	35.2010	213.1	5.066		
3	1771	35.2007	213.5	5.065		
2	1772	35.2009	213.6	5.066		
1	1772	35.2008	213.7	5.067	245.85	245.80
MC13-1						
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BC13-0						

Salinity	Si	PO4	NH4	NO2	NO3	
[]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	
	0.37	0.02	0.12	-0.01	0.13	
	0.37	0.02	0.09	0.00	0.10	
	0.96	0.13	0.16	0.13	1.68	
	0.99	0.13	0.17	0.14	1.81	
	1.79	0.33	0.11	0.16	5.48	
	1.80	0.34	0.10	0.16	5.55	
	2.51	0.47	0.10	0.03	8.07	
	2.52	0.47	0.08	0.02	8.13	
	4.08	0.70	0.10	0.00	11.93	
	4.10	0.70	0.10	0.00	11.98	
	5.99	0.87	0.11	0.00	14.71	
	5.98	0.88	0.13	0.00	14.73	
	8.49	0.91	0.10	0.01	15.44	
	8.50	0.91	0.10	0.00	15.48	
	15.27	1.18	0.10	-0.01	18.45	
	15.33	1.18	0.11	-0.01	18.50	
	15.34	1.18	0.10	-0.01	18.50	
	15.37	1.19	0.09	-0.01	18.55	
	15.45	1.18	0.11	-0.01	18.52	
	15.38	1.18	0.10	0.00	18.50	
	15.40	1.19	0.10	-0.01	18.51	
	15.32	1.18	0.10	0.00	18.53	
	16.10	1.22	0.27	0.00	18.76	
	15.81	1.22	0.23	0.00	18.52	
	16.14	1.21	0.25	0.00	18.66	
	16.10	1.25	0.23	0.00	18.72	
	16.22	1.21	0.35	0.00	18.70	
	15.55	1.19	0.25	0.00	18.39	
	15.65	1.20	0.15	0.00	18.48	
	16.02	1.21	0.30	0.01	18.57	
	16.09	1.21	0.24	0.00	18.66	
	16.06	1.22	0.23	0.00	18.51	
	15.34	1.16	0.23	0.02	18.07	**LEAKING**
	16.13	1.30	0.21	0.00	18.74	
	11.20	1.00	1.3	0.45	15.69	

** Ship: Pelagia						
** Cruise: OMEX-II leg 2 1997						
** Date: 29/07/97						
** Time (GMT): 14:38						
** Station: PE109-14			CTD17			
** Cast: 1						
** Latitude: 42 20.01 N						
** Longitude: 10 03.24 W						
** Depth echo: 2605 m						
Bottle Nr.	**Depth**	**Salinity**	**Oxygen**	**Temp.**	**O2Sample**	**O2Sample**
	[m]	[PSU]	[uM/kg]	[Deg. C]	[uM/l]	[uM/l]
23	10	35.7929	194.8	17.364		
22	10	35.7905	195.7	17.264	250.67	250.59
21	30	35.7687	200.4	16.211		
20	30	35.7690	199.6	16.309	257.32	256.94
19	51	35.7493	199.8	14.927		
18	51	35.7466	198.0	14.930	255.31	255.68
17	102	35.7092	191.2	12.621		
16	102	35.7094	191.4	12.626	239.28	239.55
15	498	35.6153	165.2	10.943		
14	499	35.6155	165.6	10.943	205.42	205.61
13	499	35.6149	165.1	10.943		
12	989	36.1152	145.7	11.108		
11	989	36.1152	145.7	11.108	186.23	186.33
10	1990	35.0328	209.0	3.964		
9	1990	35.0270	208.8	3.931	258.49	258.68
8	2605	34.9744	209.2	3.079		
7	2605	34.9744	209.5	3.079		
6	2606	34.9743	209.3	3.078		
5	2606	34.9744	209.7	3.078		
4	2606	34.9744	209.6	3.078		
3	2606	34.9743	210.2	3.079		
2	2606	34.9744	210.2	3.079		
1	2606	34.9744	210.7	3.079	249.72	249.80
MC14-3						
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BC14-0						

Salinity	Si	PO4	NH4	NO2	NO3	
[]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	
	0.41	0.03	0.15	0.00	0.20	
	0.39	0.02	0.15	0.01	0.13	
	0.29	0.04	0.18	0.02	0.24	
	0.28	0.03	0.17	0.02	0.26	
	0.49	0.11	0.36	0.11	1.34	
	0.47	0.10	0.34	0.11	1.22	
	2.07	0.42	0.07	0.02	6.99	
	2.08	0.43	0.10	0.05	6.98	
	6.13	0.89	0.11	-0.01	15.00	
	6.17	0.90	0.10	0.00	15.00	
	8.53	0.94	0.13	-0.02	15.69	
	8.55	0.94	0.13	0.00	15.70	
	17.16	1.22	0.10	-0.02	18.78	
	17.21	1.22	0.10	0.00	18.79	
	30.17	1.39	0.11	-0.02	20.88	
	30.25	1.39	0.11	0.00	20.85	
	30.22	1.39	0.09	-0.02	20.98	
	30.22	1.39	0.12	-0.01	20.83	
	30.21	1.40	0.09	-0.02	20.94	
	30.23	1.39	0.10	-0.01	20.85	
	30.27	1.40	0.28	-0.02	20.85	
	30.32	1.39	0.15	-0.01	20.88	
29.98	29.98	1.40	0.11	0.01	20.65	
30.74	30.74	1.40	0.11	0.01	21.22	
27.84	27.84	1.32	0.15	0.01	19.92	**Leaking**
30.11	30.12	1.38	0.11	0.00	20.95	
30.43	30.43	1.39	0.12	-0.01	21.06	
30.58	30.59	1.39	0.12	0.00	21.19	
30.54	30.54	1.40	0.09	0.00	21.14	
30.49	30.49	1.39	0.13	0.00	21.06	
7.76	7.76	0.56	0.21	0.03	8.16	**Leaking**
1.47	1.47	0.15	0.14	0.02	1.75	**Leaking**
	14.70	0.94	0.3	0.04	14.43	

** Ship: Pelagia						
** Cruise: OMEX-II leg 2 1997						
** Date: 30/07/97						
** Time (GMT): 15:40						
** Station: PE109-15			CTD18			
** Cast: 1						
** Latitude: 42 19.89 N						
** Longitude: 10 17.33 W						
** Depth echo: 2781 m						
Bottle Nr.	**Depth**	**Salinity**	**Oxygen**	**Temp.**	**O2Sample**	**O2Sample**
	[m]	[PSU]	[uM/kg]	[Deg. C]	[uM/l]	[uM/l]
23	10	35.8869	183.4	19.251	239.21	239.55
22	20	35.8852	183.4	19.220	239.74	239.71
21	39	35.8660	187.7	18.604	245.45	245.69
20	69	35.8147	198.8	15.625	256.27	256.60
19	100	35.8224	191.1	13.915		
18	100	35.8215	191.1	13.921	242.40	242.69
17	248	35.6564	182.7	12.053		
16	248	35.6559	181.5	12.053	228.66	228.79
15	499	35.5893	167.9	11.101		
14	499	35.5893	168.1	11.102	212.82	215.33
13	499	35.5892	167.6	11.100		
12	1096	36.1290	145.0	10.803		
11	1096	36.1288	144.6	10.801	189.27	189.37
10	1999	35.0543	205.5	4.066		
9	1999	35.0535	204.9	4.062	257.33	
8	2786	34.9471	208.4	2.830		
7	2785	34.9473	208.6	2.830		
6	2785	34.9471	208.7	2.830		
5	2786	34.9473	208.8	2.830		
4	2786	34.9472	209.2	2.831		
3	2786	34.9473	209.1	2.831		
2	2786	34.9472	209.8	2.831		
1	2785	34.9474	209.7	2.831	251.41	251.69
BC15-0						

Salinity	**Si**	**PO4**	**NH4**	**NO2**	**NO3**	
[]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	[uM/l]	
	0.45	0.02	0.19	0.01	0.13	
	0.40	0.01	0.15	-0.01	0.02	
	0.40	0.01	0.14	0.03	0.01	
	0.66	0.04	0.15	0.03	0.36	
	1.24	0.24	0.13	0.08	3.84	
	1.25	0.24	0.13	0.07	3.92	
	3.30	0.60	0.10	0.01	10.44	
	3.32	0.62	0.13	0.01	10.48	
	5.43	0.85	0.13	0.00	14.57	
	5.43	0.85	0.10	0.01	14.53	
	9.01	0.95	0.14	-0.01	16.10	
	9.05	0.96	0.14	0.00	15.95	
	17.55	1.21	0.13	-0.01	19.13	
	17.56	1.22	0.13	0.00	19.04	
	32.75	1.40	0.14	-0.01	21.25	
	32.84	1.40	0.11	0.00	21.26	
	32.81	1.40	0.14	0.01	21.31	
	32.95	1.39	0.15	0.00	21.37	
	32.97	1.40	0.13	0.00	21.30	
	0.61	0.02	0.13	-0.01	0.20	**Leaking!**
	32.78	1.39	0.12	0.01	21.17	
	32.96	1.39	0.14	0.00	21.32	
	16.74	1.04	0.8	0.04	15.23	