CRUISE REPORT OMEX
18/5-13/6 1994,
WITH R.R.S. CHARLES DARWIN,

BY

DR. TJ.C.E.VAN WEERING (CHIEF SCIENTIST)
&
SHIPBOARD SCIENTIFIC PARTY (* See App.1)

Cruise 86

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THIS REPORT AND THE STUDIES DESCRIBED IN IT, FORM A CONTRIBUTION TO THE SUBPROJECT "BENTHIC PROCESSES" OF THE OMEX PROGRAM 1993-1996

CRUISE REPORT

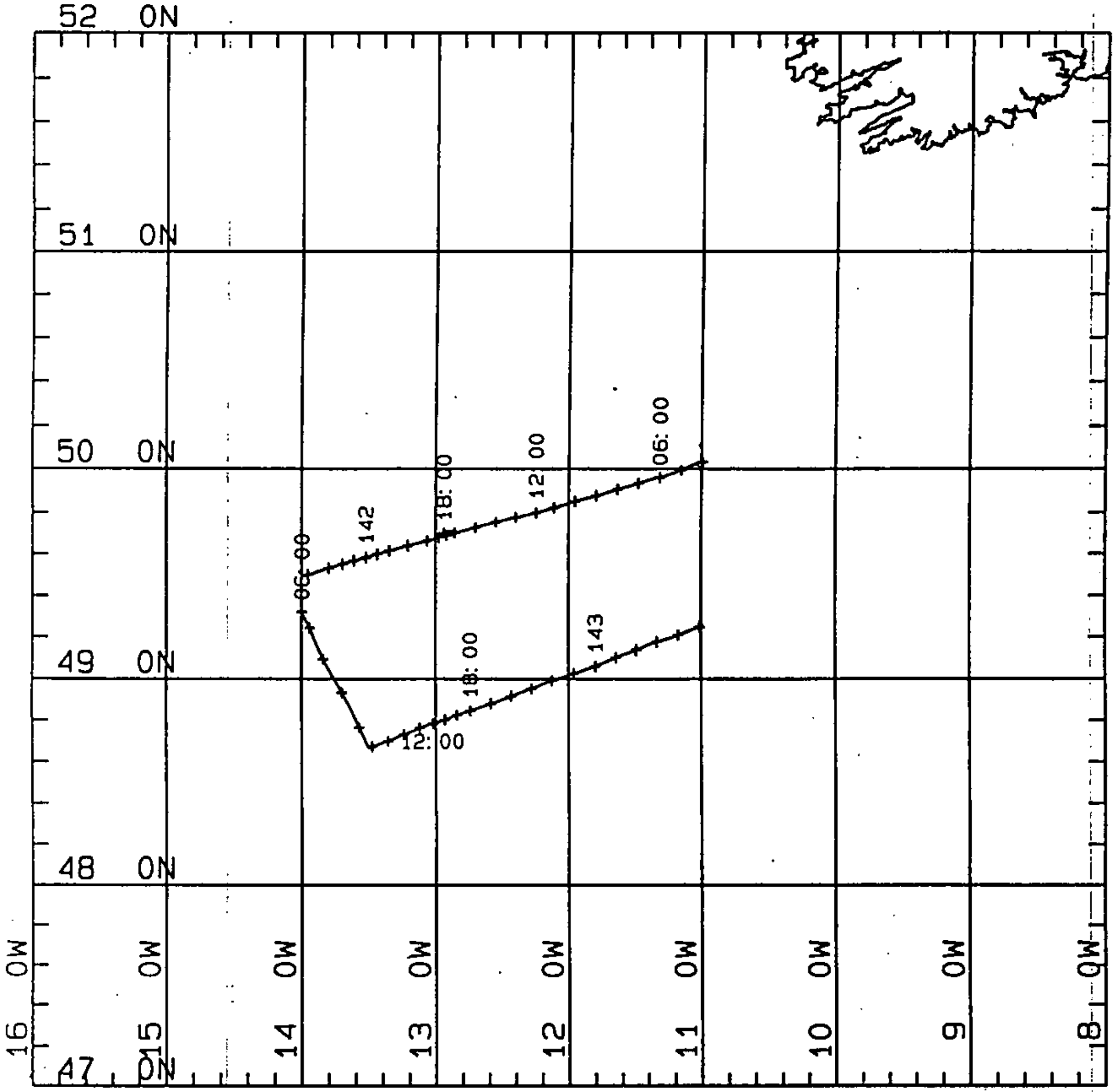
CONTENTS:

APPENDICES:

1.Introduction

The OMEX (Ocean Margin Exchange) programme is an EC-Mast II funded multidisciplinary research programme directed towards an understanding of fluxes of particles and organic carbon across a transect from the continental shelf- via the continental slope into the deep sea , via a thorough study of the relationships between the biological processes in the watercolumn in relation to the air sea exchange and biogeochemistry of the watercolumn, the physical oceanography, and the benthic processes acting at and in the seabed.
Within the subproject benthic processes the focus is on an understanding of the relationship between the benthic boundary layer dynamics and composition of the upper part of the sedimentary column, in relation to organic carbon input, early diagenesis, biological utilisation and benthic community development, mixing and burial.

The present campaign with R.V.Charles Darwin (Cruise Darwin 86) was held from Barry to Barry (UK) from May 18th-June 13th, 1994, as a contribution to the Benthic Processes Studies of OMEX.
During the cruise an acoustic survey of limited extent was held along two transects (Fig 1.1) in order to complement data on regional sediment distribution obtained in 1993 with an OMEX cruise by NIOZ with R.V.Pelagia.
The major aims of the cruise however, were to collect data at stations along the OMEX transect (see Fig.2 and Appendix 3) regarding the composition of the watercolumn, to establish the salinity, temperature, nutrient and oxygen conditions and distribution of these parameters in the watercolumn and in the near bottom waters and surface sediments (see 3.4), and to recognize, discriminate, and sample bottom nepheloid layers in the watercolumn by application of transmissometer, nephelometer and watersampling (see 4.5) simultaneous with CTD (see appendices 5 and 6) in the Goban Spur area.
Furthermore to carry out sediment sampling by piston- and boxcoring (see 3.3), and to carry out porewater sampling in boxcores for studies of early diagenesis (see 3.6), in relation to in-situ measurements of oxygen profiles and electrical resistivity in the bottomwater and the surface sediments by deployment of the TROL (Temperature Resistivity Oxygen) lander (see 3.7).
Benthic fluxes of oxygen and nutrients were measured in situ with the NIOZ BOLAS (Benthix Oxygen Lander System) lander, and by sediment deck incubation of boxcores



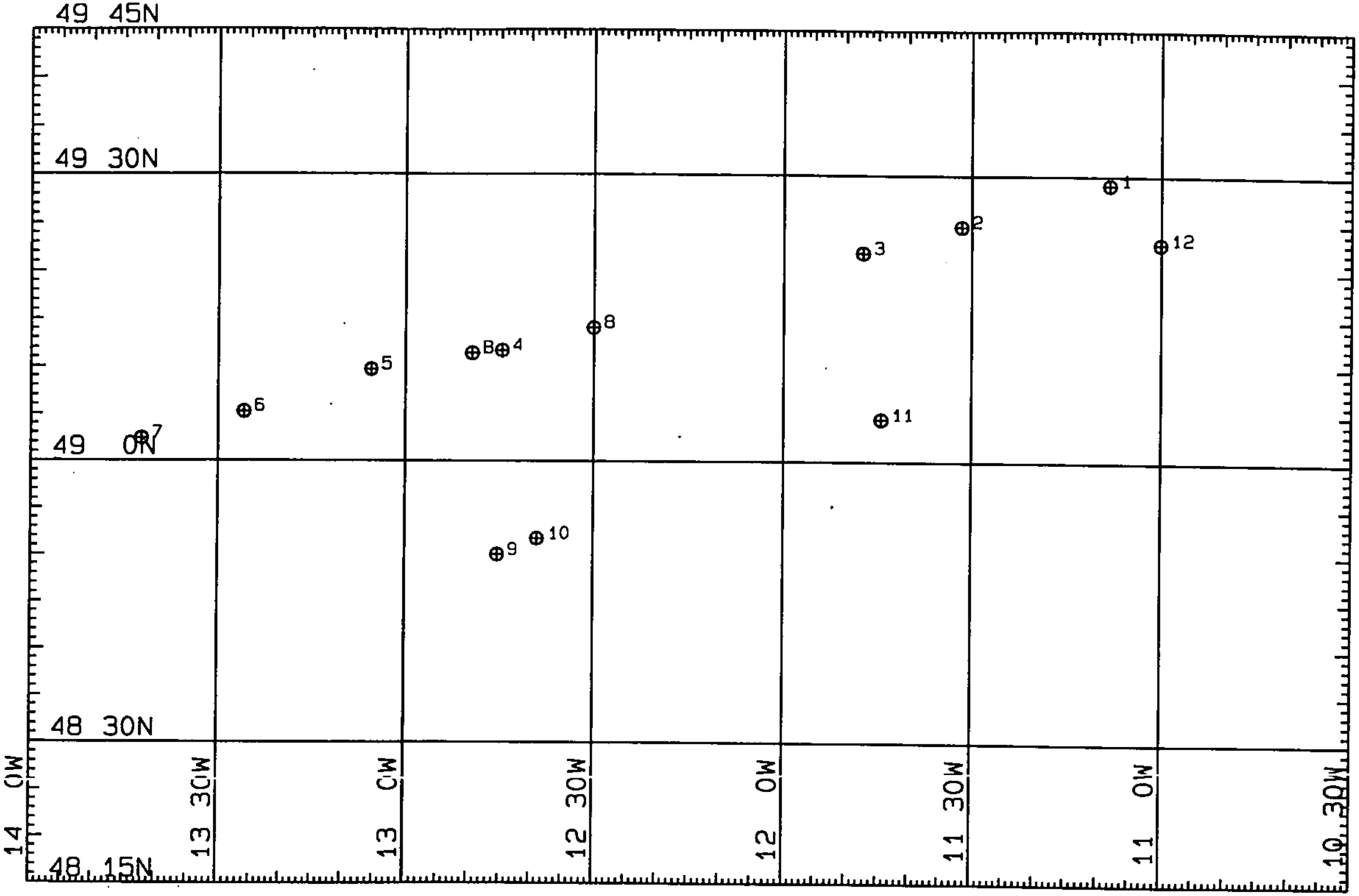
MERCATOR PROJECTION

GRID NO. 1

SCALE 1 TO 3584958 (NATURAL SCALE AT LAT. 50)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

Charkes Darwin 86 3.5 KHz Acoustic Survey May 94



MERCATOR PROJECTION

GRID NO. 1

SCALE 1 TO 1000000 (NATURAL SCALE AT LAT. 55)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

Charles Darwin 86 May-June 1994 CTD Stations

to similarly obtain benthic fluxes of oxygen and nutrients across the sediment water interface (see 3.8).
Additional boxcore samples were taken to establish the benthic macro-and meifaunal community structure in the near surface sediments (see 3.9).
During Poseidon cruise 200 leg 7, at 26th of June 1993, a lander for studies of the Benthic Boundary Layer Dynamics (BOBO) had been put at the seabottom near site OMEX II. This lander has been recovered and data were collected, followed by redeployment near OMEX II at a slightly different position than before.
At the request of E.Edwards (PML), samples were taken for microzooplankton studies (see 3.11).

Acknowledgements

The scientific crew wishes to express its sincere gratitude to Captain, Staff and Crew members of the RRS "Charles Darwin" for the excellent cooperation and atmosphere, these being the ultimate basis for good scientific results. We are also greatly indebted to T. Buisman, H. de Porto and J. Schilling for their technical and logistic support.

2. General cruise information

The cruise was prepared at NIOZ and started in Barry by charter of R.V." Darwin " on May 18th, 1994. After loading and installation of equipment the vessel left Barry on May 20th, 1994, and set course to the research area. An underway CTD routine check station was held on May 20th.

Acoustic recording by towed 3.5 kHz fish started on May 21st, followed by approximately 2 days of recording. Tracklines are given in Fig.1.

Subsequently a watercolumn and bottomsampling programme along the OMEX transect was carried out at stations (based on CTD postions) shown on Fig.2. A list of activities per station is shown in Appendix 3. The positions of individual sampling sites and positions of TROL and BOLAS landers at stations are given in Appendix 4.

The lander BOBO, equipped with 4 acoustic current sensors at 25, 50, 75, and 100 cm above the seabed, with nephelometers at 1 & 2 m above the sediment, with CT sensors at 2 m above the bed and with two underwater cameras was recovered on May 25th and

redeployed on Wednesday June 8th, after reprogramming of the central datalogger, calibration with CTD and after servicing of releases and instruments at position 49.11,24 N and 12.49,31 W.

During the cruise an attempt was made (in vain) on June 9th to release the sediment traps emplaced in 1993 by Geomar at site OMEX 1. No contact with the Benthos release could be made and the site was left shortly afterwards.

Weather was generally good with a short interruption causing a break in the activities from Thursday June 2nd to Saturday June 4th, after which sampling was resumed until June 10 th, when the Darwin set out for return to Barry. Further details concerning the cruise can be found in the diary of events, composed by the Master of R.V.Darwin, and included in this report as Appendix 7.

3. Initial results

3.1 Acoustic recording

(H.Franken,E.Okkels,H.de Stigter,Tj.C.E.van Weering)

Acoustic recording was carried out by means of towing an EDO Western 3.5 kc transducer in a towfish at 20 m below the surface. The sound source used was an ORE

3010 S 10 kW transceiver. Recording was done directly on a DOWTY 96 type drypaper recorder. A TSS annotator was used for registration of fixed time/position, the latter derived from the Darwins shipboard datasystem. Results show that the lower continental slope and upper Porcupine Abyssal Plain are characterized by strong hyperbolic echoes along the northernmost of the two transects, followed upslope by irregular distributed, parallel
reflectors with initially a discontinuous character and of variable intensity and more upslope a more regular, continuous character. Incisions by canyons are frequent.
The southernmost profile shows a similar structure on the lower and middle slope, but shows parallel bedded reflectors indicating local draping and continuous, thick sediments more upslope between 2500 and 1500 m. Indications for sediment waves do locally occur. Incisions by canyons are less frequent than on the northern transect and in general sedimentation seems higher. On the basis of the acoustical profiles a number of additional stations to the south of the OMEX transect were selected for further sampling (D 86-9,-10,-11 and -12), allowing for a comparison of benthic processes and activity along a line parallel to the OMEX transect.

3.2 CTD

(H.Franken,W.Helder,Tj.C.E.van Weering)

CTD profiles of the watercolumn and watersamples at discrete horizons were made applying a Seabird SBE 911+ mounted in a Rosette multibottle array. The Rosette frame was equipped with 22 Noex bottles of 12 l. Other sensors mounted were a Seatech 25 cm beam Transmissometer, a Chelsea Mk III Aquatrack Nephelometer, and a Chelsea Mark III Aquatrack Fluorometer, as well as an oxygen sensor.
Positions of the CTD stations were taken as the positions of the stations, are given in figure 2 and can also be found in the Diary of events (Appendix 7).
Watercolumn profiles of salinity, temperature, oxygen and transmission are given for each station in Appendix 5. Datalists and bottle files of each cast are provided in Appendix 6 In all bottles the following parameters were measured on board: oxygen, nutrients (nitrate, nitrite, ammonia, phosphate, silicate).
Bottles from 10 m above the seabed were sampled in addition for suspended sediment concentration and composition by filtering 5 liters over a 0,4 um Nucleopore filter.
At all casts samples were made for salinity determination, partially directly on board, and partially to be done in the laboratory for calibration.

Transmission

At all stations transmissometer profiles showed the presence of a surface nepheloid layer of variable intensity and thickness.

Along the OMEX transect from shallow to deep (stations D 86-01 to D 86-07) there is an increase in the thickness of the SNL from 30 m at D86-01 to 120 m at station D 86-07. The transmission is lowest in the shallower stations (minimum 75% at station D86-01) and less in the deeper (~ 84%, station D 86-07). At a number of stations two steps in the SNL could be observed, indicating probably that particles are kept entrained at the picnocline.

No stations showed the presence of an intermediate nepheloid layer, but a bottom nepheloid layer (BNL) could be observed in all stations along the OMEX transect except at Station D 86-5. At the two deeper stations the transmissometer failed, but the nephelometer also showed no BNL at the mid- and lower continental margin. BNL thickness ranged from 40 m with a reduction in transmission of 2% compared with (clear) midwater level in station D 86-01 via 80 m and a decrease of ~ 3% in D 86-03 to 50 m and 1% difference in D 86-04 at OMEX II.

Similarly, in the parallel transect southeast of the OMEX transect thicknesses ranged from 60 m at D 86-12 via 80 m at D 86-11 to 100 m at D 86-09. Transmission difference in the BNL at the latter station is about 1%. Similar thicknesses were shown on the Nephelometer logs, indicating the presence of a down slope increasingly thick BNL of decreasing intensity. At station D 86-10 however this layer was found to be only 10 m thick.

3.3 Boxcoring and Pistoncoring

(E.Okkels, H.de Stigter, Tj.C.E.van Weering)

Boxcores were taken by means of cilindrical cores of either 30 or 50 cm diameter equipped with a lid on top that closes at the moment of retrieval, thus preserving bottomwater and an intact seabottom surface.At all stations subsampling was done by inserting liners of 90 mm diameter in the sediment, after siphoning off the overlying bottomwater. Positions and waterdepths of the boxcore stations are given in Appendix 4.

Subsequently pistoncores were made with a NIOZ built modified Alpine pistoncorer with liners of 90mm diameter and a length of 12 m. The tripcores were recovered and stored for studying the surface sediments in the laboratory, the pistoncores were cut in sections of 110 cm and subsequently stored cool at 4 °C. Positions and waterdepths of

stations where pistoncores were obtained can also be found in Appendix 4. On board most cores were opened, split and microscopically described and subsequently subsampled for analysis in the laboratory.
Samples from the boxcores were taken at discrete intervals for on-board sieving and microscopic studies. Initial results are presented below.

3.3.1 Boxcores

Foraminiferal analysis

Planktic foraminifera were studied onboard to establish the age of sediments recovered in boxcores. From the resulting age determinations Holocene sediment accumulation rates were estimated. For this purpose, small quantities (<10 ml) of sediment were collected at 5 or 10 cm depth intervals, from one or two boxcores per station, and washed over a 150 µm sieve. Referring to the planktic foraminiferal biozonation established by Pujol (1980) for the Bay of Biscay, coiling ratios determined for the planktic species *Neogloboquadrina pachyderma, Globorotalia truncatulinoides* and *G. hirsuta* served to distinguish sediments of Late Holocene (0-7 Ka), Early Holocene (7-10 Ka) and Pleistocene (>10 Ka) age. Fig. 3.3.1 gives an overview of the biostratigraphic subdivision of the studied boxcores. Estimates of Late Holocene sediment accumulation rates are given in Table 3.3.1.

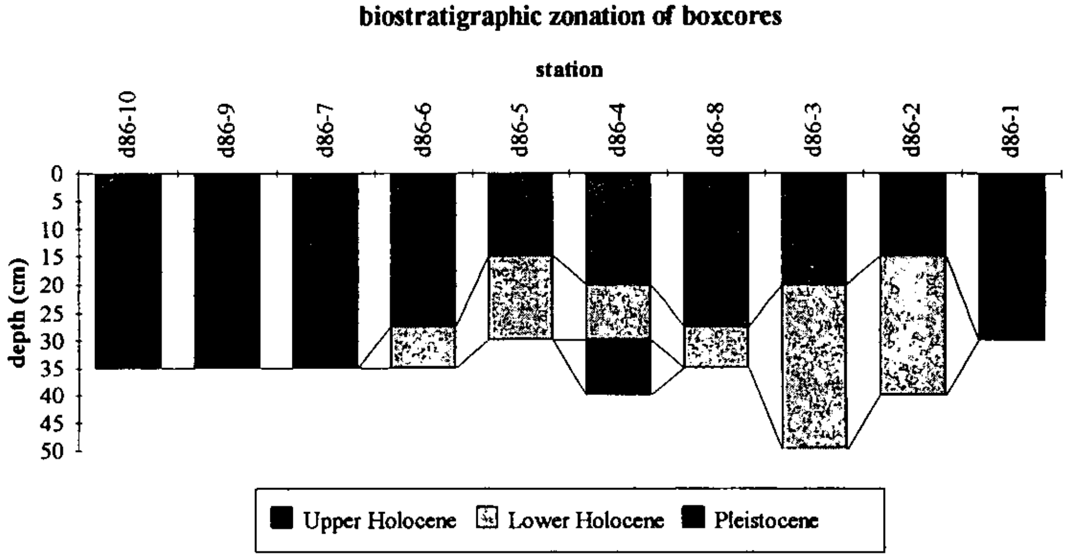


Fig. 3.3.1 Biostratigraphic zonation of boxcores

station:									
D86-1	D86-2	D86-3	D86-4	D86-5	D86-6	D86-7	D86-8	D86-9	D86-10
SAR cm/ka:									
>4.3	2.1	<2.9	2.9	2.1	3.9	>5.0	3.9	>5.0	>5.0

Table 3.3.1 Late Holocene sediment accumulation rates

For a study of living benthic foraminifera, boxcores were subsampled using a 9 cm diameter PVC tube. The sediment was subsequently extruded from the tube and cut in 0.5 cm thick slices between 0 and 2 cm depth, and 1 cm thick slices between 2 and 10 cm, and the sediment slices were stored in a Rose Bengal ethanol solution for further treatment on land. Below 10 cm depth, 1 cm thick slices were collected at regular 5 cm intervals and stored for study of fossil foraminifera.

3.3.2 Pistoncoring

Pistoncores D86-03, D86-04, D86-05, D86-06 and D86-08 were opened directly on board. Colours were noted following the standard Rock Colour Charts after initial macroscopic description. The cores all showed a surface layer consisting of foraminiferal ooze with a minor mixture of clay and or silt, considered as representing the Holocene (last interglacial, isotope stage 1). In the foraminiferal analyses of the boxcores given above this is also shown. The Holocene is underlain by a suite of grayish olive silty clays, locally heavily bioturbated with rare indications of layering, and with irregularly distributed vf.gravel or coarse sand grains within the generally homogeneous silty clays. In intervals where gravel or sand grains are found with a somewhat higher concentration, angular and subrounded mudstone clasts of a greenish and dark gray colour also are present.In all cores the lower part of the sediment column sampled consisted of light gray calcareous deposits of variable thickness and separated by transitional intervals with a lower carbonate content. The first appearance of the calcareous ooze below the homogenous muds has been taken as the transition from stage 4 to stage 5, indicating an age here of 72 KYears. In core D 86-05 there is below isotopic stage 5 another interval of homogenous silty clay with vf gravel and sand, indicating cold climatic conditions.
This in turn is again followed by a carbonate rich interval indicating warm climatic conditions. This interval may either represent isotopic substage 5.5 and in that case the age of the lower part of the warm interval is 128 K years (following the stage boundary divisions after Imbrie et al, 1984), or the lower most part is substage 6 and the corresponding age is max 179 K Years.

Applying these initial and preliminary ages to the sediment column, it is clear that sedimentation at the upper continental slope and shelf represents climatic influenced sedimentation fluxes . A more detailed study needs to be done in the laboratory.

3.4 Chemical analysis

3.4.1 Nutrients

(J. van Ooijen and K. Bakker)

Summary

During this cruise we analysed the following nutrients: Ammonium, Phosphate, Nitrate, Nitrite and Silicate in overlying water and porewater and dissolved Iron, dissolved Manganese and Sulphate in pore water.

Samples were obtained from a CTD-rosette sampler, a box corer and a benthic lander.

We also analysed porewater samples and samples of incubation experiments.

The analyses were carried out on a TRAACS 800 autoanalyser except for the determination of Sulphate, which was carried out manually on a Skalar 6100 field spectrophotometer.

Due to filtering of all the CTD samples, the ammoniumprofiles were as expected; rich in the euphotic zone and decreasing to almost zero in deeper water.

The total amount of analyses done on this cruise was almost 6000.

Methods

Samples from the CTD-rosette were taken in polyethylene bottles. These samples were filtered through a 0.45 um acrodisc filter and analysed mostly within an hour, as we used Silicate and Nitrate as a tracer for leaking CTD-bottles.

All other samples were also filtered through a 0.20 or 0.45 um filter and analysed within 24 hours, in the meantime they were stored dark and cool (2-4 °C). The porewater for the analyses of Iron and Manganese were, after filtering, acidified with hydrochloric acid Supra pure to a 0.4% 5 N acid solution and analysed within 3 days. Working standards were freshly prepared every day by diluting stock standards to the required concentration with natural aged seawater (low nutrients concentration). This water was also used as washwater between the samples. The concentration of nutrients in the natural aged seawater was determined manually. Every day a second mixed nutrient stock was used 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. In the case of Phosphate this is about 2%. The results of our analyses are published elsewhere in this report.

Methods used for the analyses:

Ammonium	: Phenol method
Phosphate	: Ammoniummolybdate/Ascorbic acid method
Nitrate/Nitrite	: Sulphanylamide/Naphtylethylenediamine method using a copperized Cadmium coil for nitrate reduction
Silicate	: Ammoniummolybdate/Oxalic acid/Ascorbic acid method
Diss. Iron	: Ferrozine/Hydroxylammonium method
Diss. Manganese	: Ammoniumironsulphate/Hydroxylammoniumchloride method
Sulphate	: Bariumchloride/Gelatine method (Turbidimetric)

3.4.2 Oxygen

(M. Dekker)

Samples came from the NOEX bottles mounted on the CTD-Rosette frame and from the overlaying water in the boxcores.

The method of analyses followed, with minor modifications the classical Winkler procedure, as given in Strickland and Parsons (1968). Calibrated glass stopperd oxygen bottles (about 100 ml) were carefully rinsed and filled with sample. The oxygen bottles were stoppered after at least three times flow-trough of sample, without trapping of air.

Directly after sampling 1 ml of reagent A and 2 ml of reagent B (see below for composition) were added and the closed bottles were well shaken, which was repeated after settling of the precipitate. Samples were stored under water. The stoppers were closed well.

Prior to analyses about 25 ml of the supernatant was removed by syringe and then 1 ml 20 n sulphuric acid was added. Titration was carried out with 0.01 n sodiumthiosulphate in a Brand Digital Burette. When the solution in the bottles turn light yellow 0.5 ml 1 % starch solution was added and titration was continued till the solution became colourless. The thiosulphate solution was made by dilution from a 0.01 n ampouled stock solution (Merck) and its strength was regularly checked by titration with 0.001 n Potassium-Iodate.

Blanks were made by the procedure as given in Strickland and Parsons.
The accuracy of the method is estimated to be within 1 %. All samples were at least run duplicate. All oxygen data are given in the data section of this report.

Composition Reagent A: 600 gram $MnCl_2.4H_2O$ /L
Reagent B: 250 gram NaOH and 350 gram KI /L

3.5 Benthic Boundary Layer characteristics

3.5.1 Bioprobe measurements

(Laurenz Thomsen, Eric Epping)

At the request of Laurenz Thomsen (GEOMAR, Kiel) an in situ bottom water sampler (Bioprobe) and a particle camera were to be deployed to quantify near bed transport of particulate and dissolved matter and the flow velocity at 30 cm height above the sediment. Due to mechanical damage, the particle camera could not be deployed. The water sampler unit has been deployed concommittantly with the BOLAS lander at station D86-3, D86-4, D86-6, D86-8 and D86-10. Watersamples have been analysed for nutrients and oxygen onboard. Aliquots have been fixed for bacterial counts and particle analysis.
Due to atmospheric gas contamination in the polyethylene sample bag and tubings, oxygen determination can not be done properly. Flow velocity data have been stored till further analysis.

3.5.2 Benthic Boundary Layer characteristics: Lander BOBO

(Tjeerd van Weering, Henk Franken)

Lander BOBO (BOttom BOundary Layer Research), consisting of 4 acoustic current meters at 25, 50, 75 and 100 cm from the seabed, a central data storage and command logger, two 25 cm beam Seatech Transmissometers, a conductivity/temperature logger and two underwatercameras and flashlight unit, was deployed near station OMEX II during Poseidon cruise 200 leg 7, on June 26th, 1993 for continuous measurement of the parameters mentioned above. BOBO is equipped with two Benthos acoustic releases.
The position of deployment was 49.11,31 N/12.44,00 W, at 1296 m waterdepth.

It was released after almost one year of deployment on 25th of May, 1994 at 17.03 hrs, and appeared at the surface at 17.26 hrs.
The general condition was good. After one year there was only minor overgrowth at flagmast, frame and instruments by bryozoa and small , branching animals. Little overgrowth was noticed at the camera lenses and flashlight, and at the transmissometer lenses.
The anodisation of the camera's and flashlight proved totally gone, as well as the extra anode mounted on the camera frame. Upon recovery the radio transmitter mounted on the upper part of the frame was working, though weak (2 on receiver). The antenna was completely dissolved.
The flashlight mounted on top was not working.
A check of the datalogger and command unit showed that power problems initiated by the current meter affected the total system on 18.08.1994.

Current meters.
The logger showed that current measurements were stopped at: event 5258,18/08/1993.
Then data to event 5374, 19/8/1993 were not recorded in the datalogger.
Subsequently recording of data without current mete was continued until event 7053 (5/9/1994). This was due to too low battery voltage of the main battery pack.

Underwater photography.
The underwater camera and flash system functioned normal until 5258 (18/08/1993).
Registration of events then was lacking to 5374, after which it was recontinued until 7053(5/9/93).
No pictures onto event 7802 (14/9/93), followed by restart until 8535, 21/9/1993.In the mean time the battery voltage had come down to 7.0 V, which was not enough for the flashlight.
Restart 8581, last picture at 8905 25/9/1993 03.30 hrs.
Recording of both transmissometers stopped at event 8905, 25/9/1993.

CT measurements.
Recording of the conductivity/temperature measurements in its own data logger stopped approximately 8 months after deployment.
After repair, reprogramming of the data command and logger system and replacement of the battery packs in the individual devices, BOBO was redeployed near OMEX II again on June 8th, preceeded by a short acoustic survey on:
position 49.11,24 N/12 49,31 W at 1453 m waterdepth.

In order to have a calibration of data at the time of deployment the CTD was lowered before BOBO was deployed and a profile of transmission salinity and temperature obtained (Figure included in Appendix 5).

Transmissometers.
Recording of the transmissometer readings was interrupted similar as the camera and flash system and came to a stop at event 8905 on 25/9/1993, yielding a three months record.
A calibration test of BOBO transmissometers against the CTD mounted transmissometer was done at station D 86-05.Here the transmissometers were lowered to 100 m depth.
Test of transmissometer SN 118 D, mounted at 1m above the seabed (see fig TEST 1 DATA- not included here) showed a clear water transmission level of 76,4 %.
Transmissometer SN 178 D, mounted at two meters above the seabed (Fig Test 2 Dat, not included here) showed a pressure dependent transmission.
Test 3 DATA (see fig.TEST 3 DAT, not included here) showed clear water values of the CTD mounted transmissometerduring cruise Darwin 86/94 of 85,6 %.
Test 4 was in open air with cleaned lenses:
100 % = 93,6 % ON SN 118 D
100 % = 88.4 % ON SN 178 D

Initial results of BOBO will become available only after return and further data conversion at NIOZ, Texel.

3.6 Early Diagenesis

(Wim Helder, Marlèn Dekker, Eric Epping)

Introduction
Organic carbon present in sediments in principle originate from pelagic production, *in situ* benthic production or from lateral transport processes. This carbon can be classified with respect to its degradability. In fact this characteristic reflects the 'life history', or ' apparent age' of the carbon. Well degradable fractions like proteins, sugars, short chain fatty acids and other low molecular weight compounds will be removed at the onset of mineralisation, leaving the more refractory carbon. Assuming regular sedimentation and the absence of bioturbation, the age of organic carbon can be expected to increase with depth in the sediment and therefore its degradability will

decrease with depth. However, lateral transport processes may be catastrophically by nature thus disturbing the carbon gradients.

In order to calculate carbon budgets, in- and output variables for carbon must be estimated. The most important output variables are lateral transport and mineralisation. Carbon mineralisation can be assessed from turn over rates of the electron acceptors involved, like oxygen, nitrate/nitrite, ferric iron, manganese oxide, sulphate and carbon dioxide. Mineralisation can also be calculated from production rates of end products of mineralisation, like ammonium. Turn-over or production rates can be estimated by applying ion specific transport-reaction models on depth distribution of the solutes. If turn-over rates of these compounds are known, the amount of decomposed carbon can be calculated from stoichiometric relations.

In order to calculate sediment carbon mineralisation at sites ranging from 200 to 4400 m waterdepth, the following set of parameters were determined;

- porosity
- resistivity
- organic carbon and organic nitrogen content
- solid iron and manganese
- depth distribution of :

  oxygen
  nitrate/nitrite
  ammonium
  ferrous iron
  dissolved manganese
  sulphate
  silicate
- sediment-water exchange of ammonium, phosphate, nitrate, nitrite and also silicate

Methods

Sampling

Boxcores were taken at two transects. The first transect has been covered during the first OMEX cruise in the Goban Spur area. The second transect comprises three stations at corresponding depths of the first transect which allows a comparison. At the first transect the following stations were sampled:

OMEX 94 Station	OMEX93 reference	date	pos. N	pos. W	depth	temperature	salinity
D86-1	station A2	23/5/94	49°30'0"	11°09'3"	218	10.51	35.48
D86-2	OMEX-I	23/5/94	49°25'1"	11°31'4"	666	9.97	35.48
D86-3	station B	24/5/94	49°22'42"	11°47'58"	1016	8.69	35.53
D86-4	OMEX-II	26/5/94	49°11'37"	12°48'60"	1423	7	35.38
D86-5	station F	28/5/94	49°09'5"	13°05'8"	2266	3.2	34.96
D86-6	OMEX-III	30/5/94	49°05'0"	13°25'4"	3663	2.5	34.91
D86-7	station E	1/6/94	49°02'5"	13°42'3"	4500	2.53	34.9
D86-8	not covered	5/6/94	49°13'51'	12°29'41"	1146	8.23	35.53
D86-9	not covered	6/6/94	48°50'42"	12°42'55"	2192	3.36	34.97
D86-10	not covered	7/6/94	48°52'19"	12°39'11"	2282	3.27	34.97
D86-11	not covered	9/6/94	49°04'28"	11°44'71"	1132	7.54	35.45

The overlying water was analysed for oxygen and nutrient concentration. Subsamples for porewater analysis were taken from 'virtually undisturbed' boxcores by inserting plexi-glass tubes (i.d.54 mm), leaving approximately 4 cm of overlying water. Samples were taken to the laboratory, conditioned at *in situ* temperature.

Oxygen measurements

The sediment was monitored as soon as possible for oxygen by microelectrode techniques. Commercial Clark type electrodes (Diamond #737) with a 60 µm tip diameter were used. Oxygen concentrations were recorded at every 100 micrometer or when high penetration depth was to be expected at every 1 or 5 mm.

Porewater collection

Sixteen cores were sliced according to the following scheme:

sample	depth interval (mm)
1	0 - 2.5
2	2.5 - 5
3	5 - 7.5
4	7.5 - 10
5	10 - 15
6	15 - 20

7	20 - 25
8	25 - 30
9	30 - 40
10	40 - 50
11	50 - 60
12	60 - 70
13	70 - 90
14	90 - 110
15	110 - 130
16	130 - 150

Sediment from corresponding depth intervals were collected in teflon Reeburgh squeezers and squeezed at 3 atm. nitrogen pressure. Porewater was analysed for solutes as described before by Jan van Ooyen and Karel Bakker.

Porosity

Two cores were sliced down to 5 cm with a resolution comparable to the porewater analysis. Slices were collected in glass vials. Porosity will be calculated from weight loss after drying 24 h at 105 °C.

Resistivity

Resistivity was measured with a four wired platinum electrode after Andrews and Bennett, at 1 mm depth intervals. From these profiles the formation factor can be calculated at the sediment-water interface, necessary for converting a free solution molecular diffusion coefficient into a sediment molecular diffusion coefficient.

Sediment-water exchange

Nutrient fluxes were estimated by triplicate whole core incubation (i d. 10cm) at in situ temperature. The original overlying water was removed and replaced by filtered (poresize 0.45 µm) bottomwater. The water phase was gently stirred to create a diffusive boundary layer of about 500 µm. The overlying water was monitored for nutrient concentrations.

Results

A few examples of the porewater results are given in the following figures.

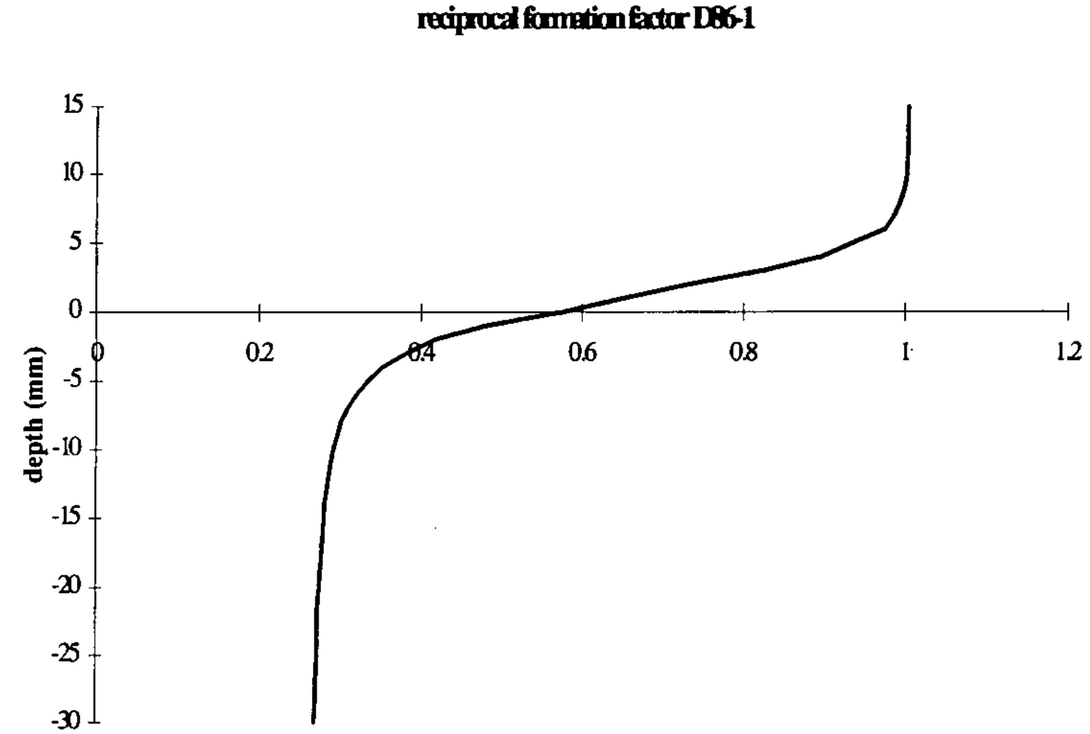


Fig 3.6.1 Reciprocal formation factor at station D86-1, 217 m waterdepth.

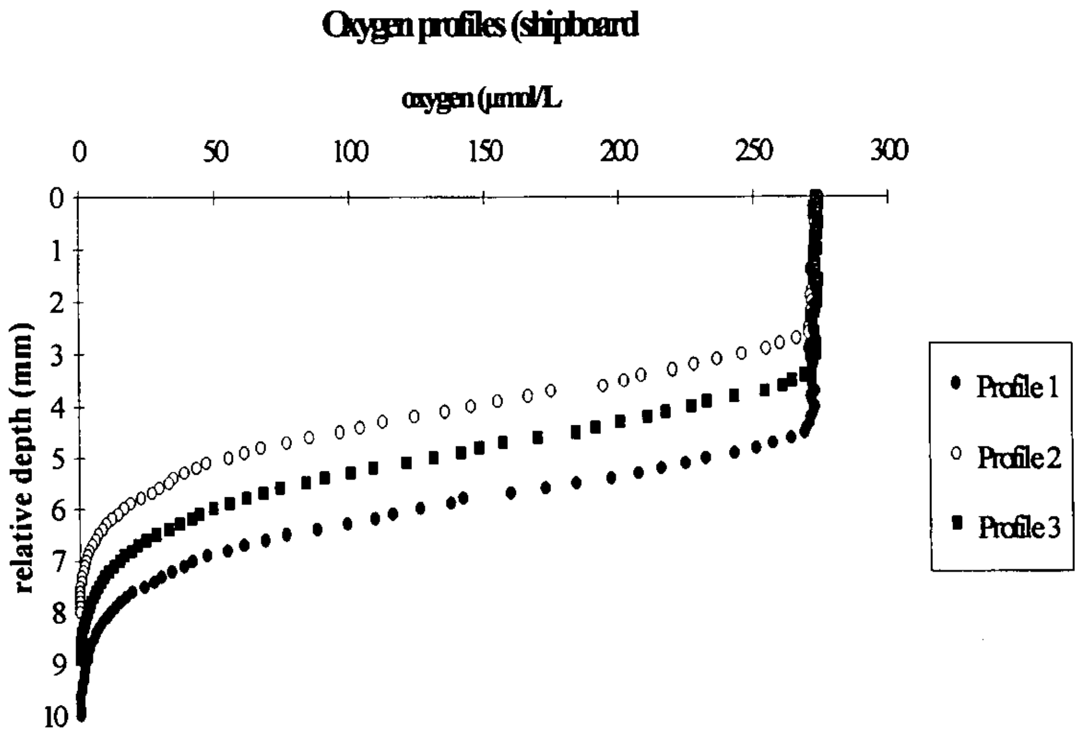


Fig. 3.6.2 Sediment oxygen profiles (shipboard) at station D86-1, 217 m waterdepth.

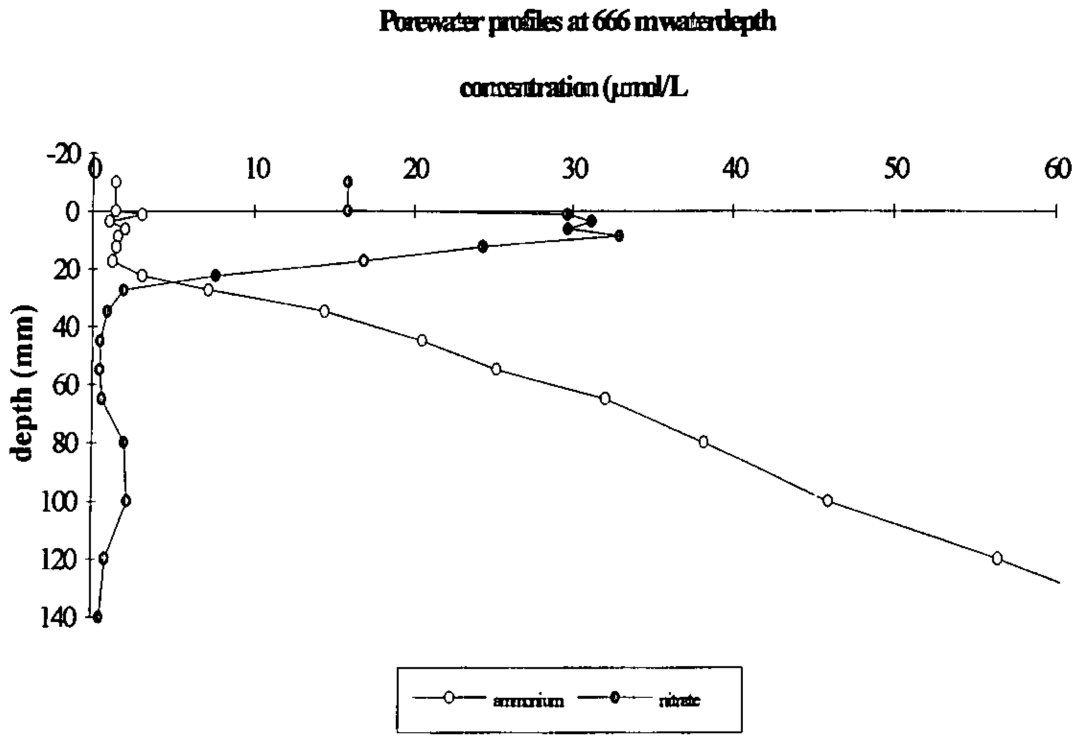


Fig.3.6.3 Ammonium and nitrate porewater profiles at station D86-2, 666 m waterdepth.

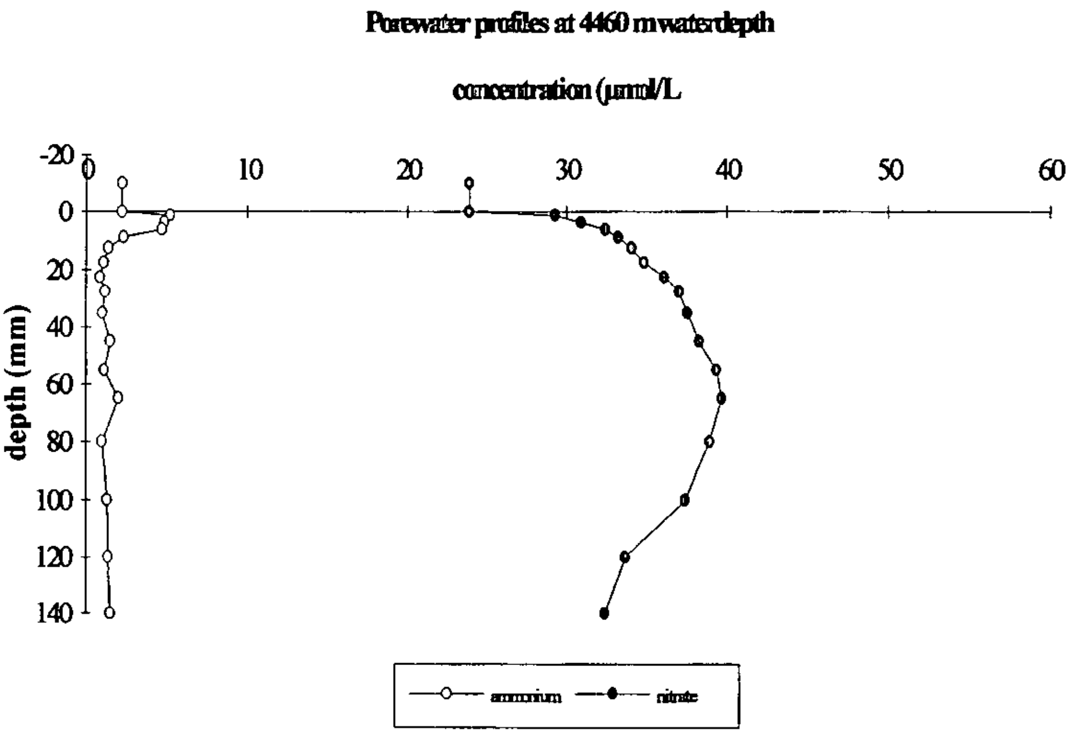


Fig.3.6.4 Ammonium and nitrate porewater profiles at station D86-7, 4460 m waterdepth.

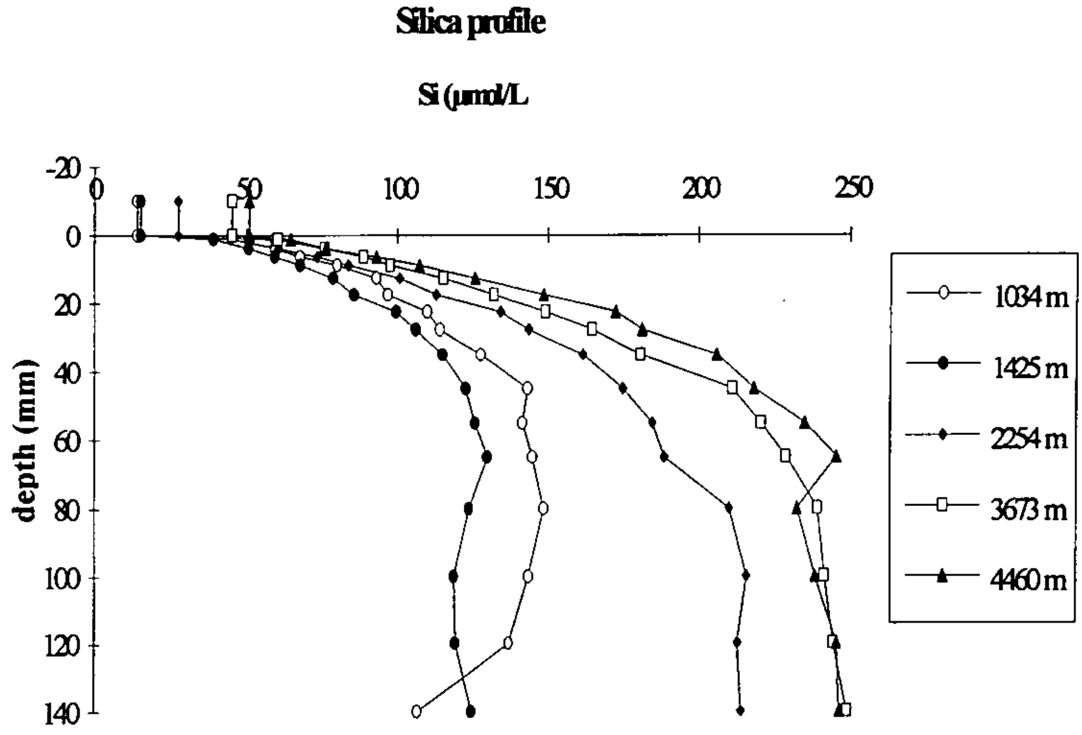


Fig. 3.6.5 Silica porewater profiles five subsequent stations at indicated waterdepth.

3.7 TROL Deployments

(Willem Helder, Eric Epping)

The Temperature, Resistivity, Oxygen Lander (TROL) is a tripodal lander equipped with six oxygen micro-electrodes and a resistivity probe. Also the bottom water temperature is registrated by an inbuilt thermistor

Porewater oxygen profiles are made with single cathode oxygen micro-electrodes (tipdiameter 15 - 20µm) which have typically an output of < 1.5 nA. The common reference electrode is of the Ag/AgCl type.

The resistivity probe functions to indicate by an increase of 12% in resistivity the position of the sediment-water interface, and triggers the profiler to shift to a downward stepping mode (steps of 100 µm every 5 seconds). Moreover the resistivity profiles are used to modify the free diffusion coefficients (Do) to sediment diffusion coefficients (Ds) with:

Formationfactor (F) = Rs/Ro,

in which Rs and Ro are the resistivity in respectively the overlying water and sediment. With

$$Ds = Do/\phi F,$$

where ϕ is the porosity, the Ds value can now be derived.
During the OMEX94 BP cruise with the RV Charles Darwin, TROL was deployed 11 times, covering a depth range from 200 -4500m. The positions and depths of the TROL stations are given in Table 3.7.1.

TROL Stat.nr.	Pos.	Date	Depth (m)	TROL O2-Penetr. depth (mm)	On deck penetr. depth (mm)
D86-1	49 29.2N 11 08.8W	23/05/94	217	6	4.5
D86-2	49 35.0N 11 31.4W	23/05/94	667	20	20
D86-3	49 22.2W 11 48.0W	24/05/94	1015	23	25
D86-4	49 11.2N 12 49.1W	26/05/94	1465	35	32
D86-5	49 09.7N 13 05.9W	27/05/94	2250	60	60
D86-6	49 05.1N 13 25.8W	30/05/94	3670	70	75
D86-7	49 02.3N 13 42.2W	31/05/94	4475	80	70 - 75
D86-8	49 13.8N 12 30.1W	4/6/94	1150	8 - 45	55
D86-9	48 50.4N 12 44.8W	6/6/94	2200	80	70
D86-10	48.52.0N 12 38.7W	7/6/94	2290	65	60

The quality of the in-situ oxygen profiles is on average of a moderate quality; they are "noisy". We had the same experience during the OMEX93 cruise. Although a definite explanation can not be given yet, the reason for the noise on the signals might be associated with the abundance of foraminifera in the sediment (all sediments are well above the CCD). Sofar, nowhere else than in the OMEX area we have experienced this phenomenon.

In Fig. 3.7.1 - 3.7.3 examples of TROL profiles are given.

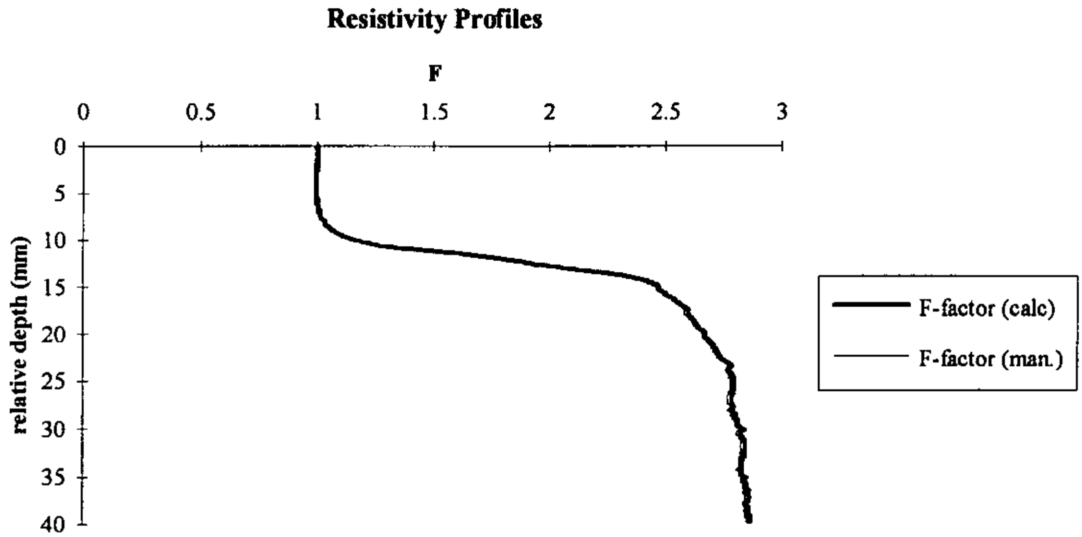


Fig. 3.7.1a Resistivity profile at station D86-1, 217 m waterdepth.

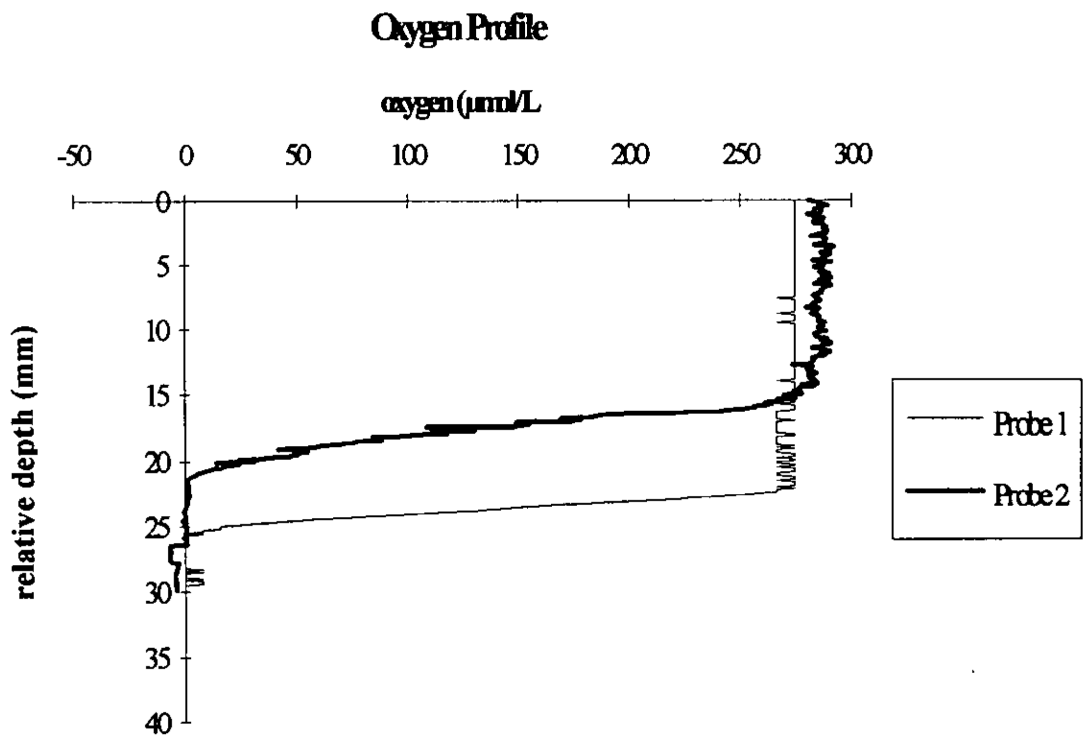


Fig. 3.7.1b Oxygen profiles at station D86-1, 217 m waterdepth.

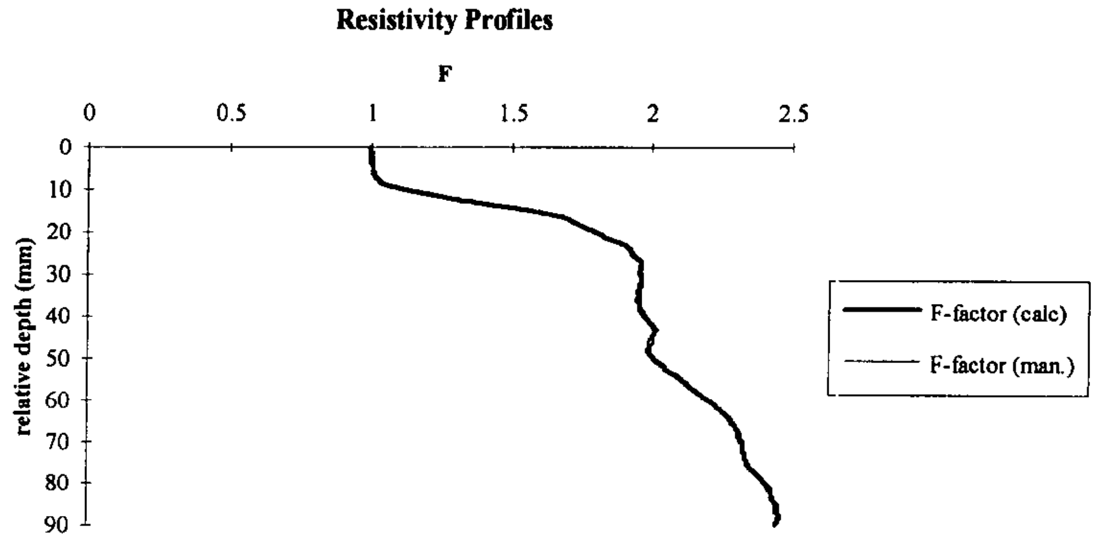


Fig. 3.7.2a Resistivity profile at station D86-7, 4475 m waterdepth.

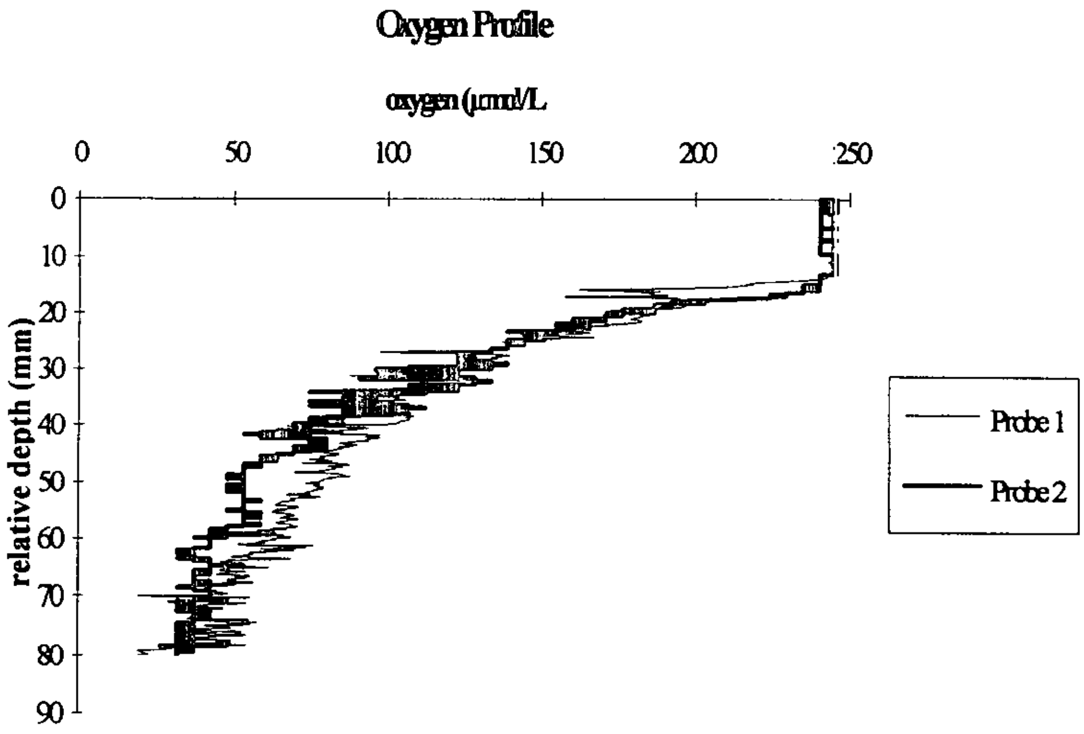


Fig. 3.7.2b Oxygen profiles at station D86-7, 4475 m waterdepth.

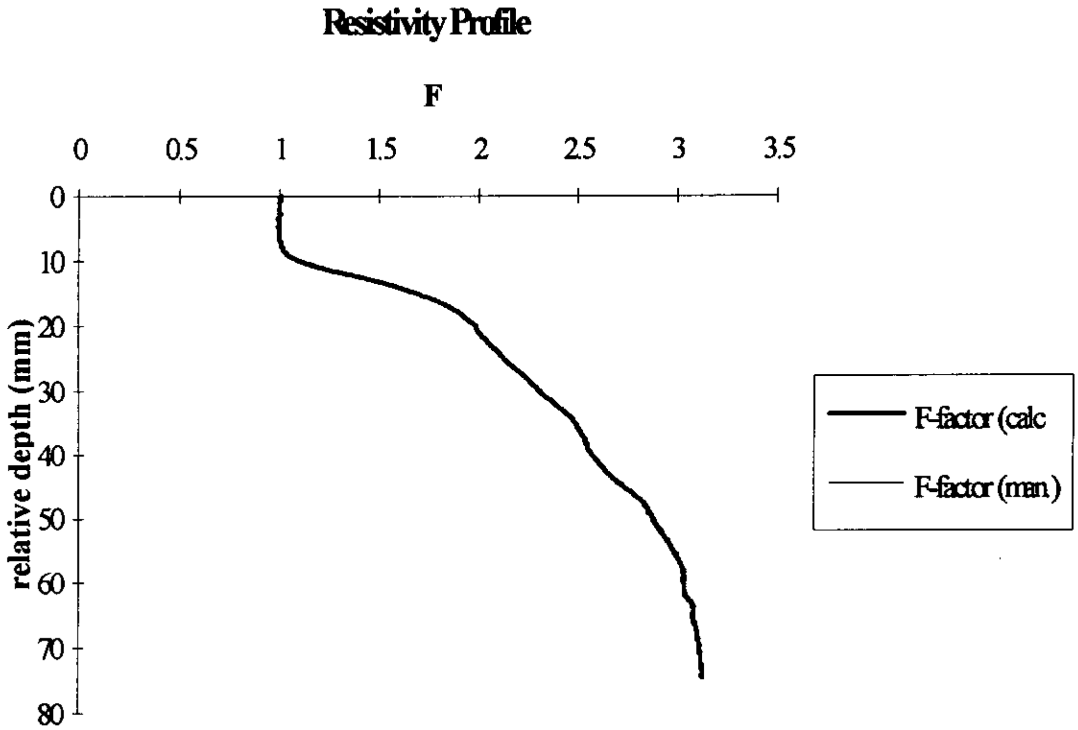


Fig. 3.7.2a Resistivity profile at station D86-8, 1150 m waterdepth.

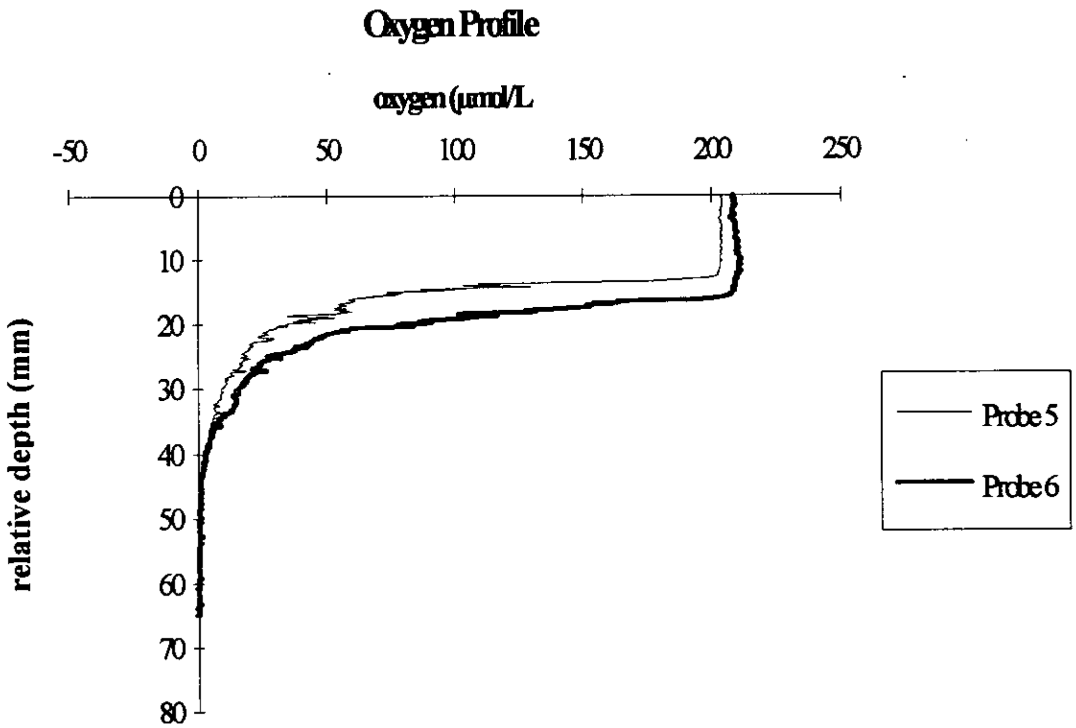


Fig. 3.7.3.b Oxygen profiles at station D86-8, 1150 m waterdepth.

The penetration depth of oxygen into the sediment increased systematically with increasing depth (200 - 4500 m) at the stations of the Goban Spur transect. In Table 3.7.1 the in-situ penetration depths are compared with those found from shipboard measurements (see also report on early diagenesis). From this last comparison it can be concluded that only at the deeper stations (D86-7,9,10: all >2200m depth) a trend of higher penetration depth during in-situ measurements seems to exist.
The shapes of the oxygen profiles at the deeper stations indicate the presence of a top layer of about 2-3mm with relatively high oxygen consumption, followed by lower oxygen consumption deeper down in the cores. In contrast the oxygen profiles at the shallow stations D86-1, and -2 have uniform oxygen consumption along the entire oxygen penetration profiles.
A first comparison of the resistivity profiles indicates that the formation factor (F) decreases with increasing station depth, probably due to changing sediment composition, e.g. a decrease in coarse sand fraction.

Oxygen profiles will be modeled to calculate the depth dependent oxygen respiration rates and the sediment-water oxygen fluxes. They will be also compared in more detail with the shipboard profiles.

3.8 Sediment Oxygen Uptake in relation to Phytodetritus and Benthic Biomass

(Gerard Duineveld, Eilke Berghuis, Jacob van der Weele)

The contribution by the department of Benthic Systems to the OMEX'94 cruise consisted, similar to the OMEX'93 October cruise, of the measurement of sediment oxygen uptake in shipboard incubated cores as well as in-situ. Because oxygen uptake by the sediment is in general positively related to the amount of degradable organic carbon at a given temperature, seasonal inputs can be evaluated from time series of respiration measurements. As the OMEX transect covers a wide range of waterdepths and, consequently, bottom water temperatures, differences in sediment activity between OMEX stations may for an important part be governed by temperature differences. Therefore, the respiration measurements that were made, will be supported by the analysis the infaunal standing stock and the sediment phytodetritus content, both of which are expected to vary in response to temporal and spatial fluctuations in sedimentation of organic material. Further indications for variations in the flux of organic material to the sediment at the OMEX transect are to be derived from phytopigmentanalysis in samples that were taken from bottom and surface water.

Sediment oxygen demand

Sediment Oxygen Demand was measured on deck in intact boxcore samples of 30cm diameterunder in-situ temperature conditions. The oxygen decrease in the overlying water in the cores was recorded by means of electrodes whereas sediment-water fluxes of nutrients were analysed by means of sequential samples drawn from the headspace. The duration of the incubation measurements varied between 12 and 30 hours depending on the depth. In-situ measurements of SOD and nutrient fluxes were performed with a benthic lander (BOLAS) equipped with two open-ended measurement chambers that are inserted into the sediment by hydraulic action. Programmable valves, in which photocameras are mounted, close the measurement chamber on top. At preset times water samples can be drawn from the headspace for nutrient and oxygen flux measurements. The lander holds furthermore two sedimentcorers (100 cm2 each) and two sediment traps which are opened and closed at the start resp. end of the measurement.

Sediment sampling

Cores that were previously used for deck measurements of SOD were sieved over a 0.5mm screen size for the the analysis of the macrofauna. For assessment of the meiofaunal biomass additional cores were collected. The total biomass of smaller organisms, including bacteria, will be estimated from the DNA content in small sediment sections. The RNA content of these samples, measured simultaneously with DNA, may in combination with DNA provide information about the activity of the DNA pool in terms of protein synthetis. Samples of 10 cm cores that were sliced for this purpose were immediately deep frozen in liquid nitrogen and stored at -80°C. The same procedure was followed for sediment samples taken for the analysis of the phytopigment content.

Water sampling

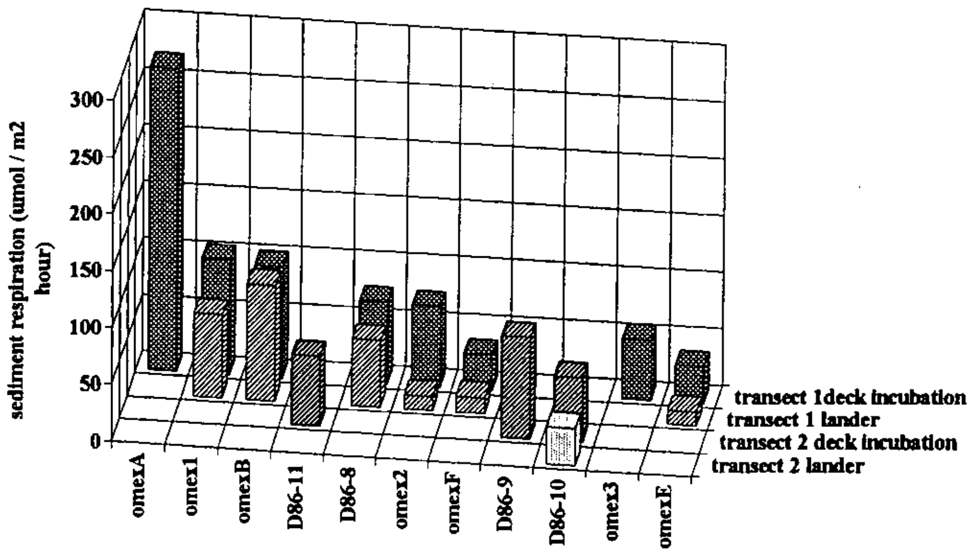
Samples from bottom and surface water were collected with a CTD-rosettesampler. Approximately 10 l of bottom water was filtered over a GF/F filter which was subsequently deep frozen (liquid nitrogen) and stored at -80°C. Surface water samples were handled identically but the volume that passed over a filter was less.

Preliminary results

The following Table 3.8.1 shows a list of stations with the types of respiration measurements that were carried out. Sediment and bottomwater samples, for phytodetritus and DNA analysis, were collected at every station. Station names between brackets refer to stations sampled during the OMEX cruise with the RV Pelagia in October 1993. Transect 1 is the main OMEX transect with another transect parallel to it.

STATION	TRANSECT	DECK-INCUBATION	BOLAS-DEPLOYMENT
D86-1 (OMEX-A)	1	+	-
D86-2 (OMEX-1)	1	+	+
D86-3 (OMEX-B)	1	+	+
D86-4 (OMEX-2)	1	+	+
D86-5 (OMEX-F)	1	+	+
D86-6 (OMEX-3)	1	+	+
D86-7 (OMEX-E)	1	+	+
D86-8	1	+	+
D86-9	2	+	-
D86-10	2	+	+
D86-11	2	+	-
D86-12	2	+	-

The uncorrected data from the respiration measurements by BOLAS and by deck-incubations are shown in Fig. 3.8.1.



Due to various technical reasons, lander deployments were partly unsuccesful. However, in a later stage of the cruise a 100% functioning was attained, which showed that in-situ rates are apparently lower than rates obtained with shipboard incubations, notably at deeper stations. The same seems to hold for the nitrate efflux (data not shown).

3.9 Macro- and Meiofauna

(Adri Sandée)

In order to characterize the abundance, biomass, and functional and species diversity of benthic organisms as related to sediment characteristics, sediment samples were taken that allowed for detailed investigation of meio-as well as macrofauna. The sampling strategy represented a balance between statistical requirements and availibility of sediment material.

Meiofauna:
At each station duplicate 10 cm^2 subsamples were taken from two boxcores. Sampling was done at various depht intervals to a maximum of 15 cm.

Macrofauna:
At each station, the intervals 0-1, 1-5, 5-10 and 10-15 cm from two or three boxcores were sampled. To further document the samples, at each station photographs and samples for organic carbon, nitrogen, chlorophyll and grain-size distribution have been taken.

3.10 Microzooplankton

(Elaine Edwards, Ellen Okkels)

At the request of Elaine Edwards (PML), the watercolumn at station D86-1 through D86-10 has been sampled for zooplankton analysis. A rosette sampler has been applied to collect water at 100, 50, 30, 20, 10 and 2 m waterdepth with concommittant recording of physico-chemical parameters. At station D86-10 only at three waterdepths samples were taken.
Aliquots (500 ml) were fixed with a Lugol's solution and stored for further analysis (identification and abundancy).

Appendix 1: Participants

The Shipboard Scientific Party consisted of:

K.M.Bakker	-NIOZ, Marine Chemistry.
E.M.Berghuis	-NIOZ, Marine Biology.
M.Dekker	-NIOZ, Marine Biogeochemistry.
E.Bos	-NIOZ, Mech.Engineer.
H.C. de Stigter	-NIOZ, Marine Geology
G.Duineveld	-NIOZ, Marine Biology.
H.G.Epping	-NIOZ, Marine Chemistry
H.Franken	-NIOZ, Electr.Engineer.
W.Helder	-NIOZ, Marine Chemistry.
E.Okkels	-NIOZ, Marine Geology.
A.J.Sandee	-NIOO, Estuarine Foodchains.
J.A. van der Weele	-NIOZ, Marine Biology.
J.van Heerwaarden	-NIOZ, Instr.Engineer.
J.C.van Ooyen	-NIOZ, Marine Chemistry.
Tj.C.E.van Weering	-NIOZ, Marine Geology.

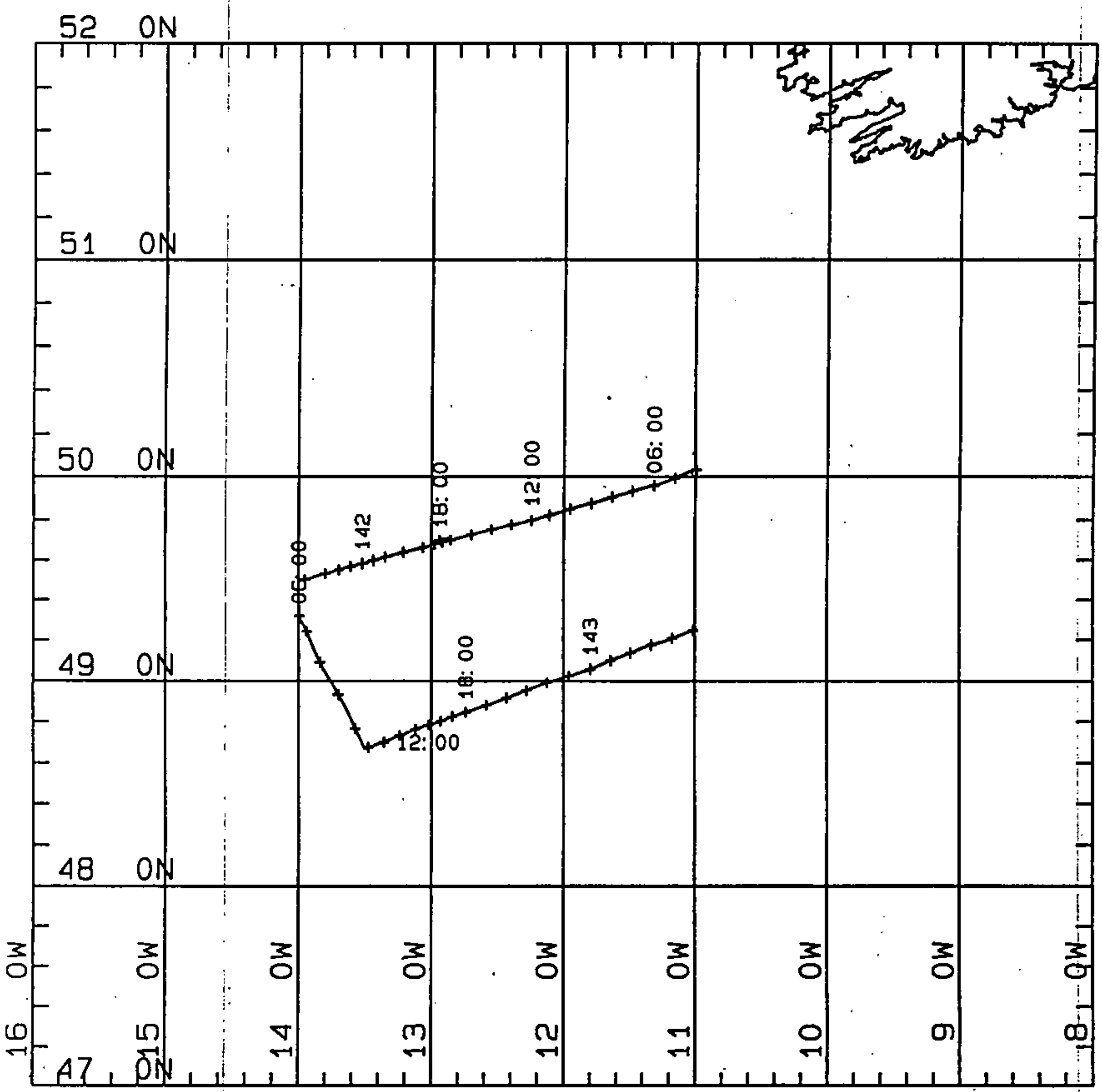
Shipboard support:

R.O.Pearce	-NERC, Computer/Data Handling.
W.K.Smith	-NERC, Mech.Engineer.
C.H.Woodley	-NERC, Electr. Engineer.

NIOZ	-Netherlands Institute for Sea Research, Texel, the Netherlands
NIOO	-Netherlands Institute for Ecological Research, Yerseke, the Netherlands.
NERC	-National Environmental Research Council, Research Vessel Services, Barry, UK.

List of Crew members

Bourne, R.A.	Master
Chamberlain, R.J.	C.O
Newton, P.W.	2nd O
Burridge, P.A.	2nd O
Baker, J.G.	R.O
Moss, S.A.	C.E
Dean, S.F.	2nd E
Holmes, J.S.	3rd E
Phillips, C.J.	3rd E
Trevaskis, M.	CPO (D)
Lewis, T.G.	PO(D)
Dean, P.H.	SG1A
Hebson, H.R.	SG1A
Perkins, J.R.	SG1A
Avery, R.W.	SG1A
Elliott, C.J.	SCM
Welch, G.A.	CHEF
Stephen, R.M.	STWD
Murphy, R.F.	STWD
Hardacre, F.	STWD
Pringle, K.	MM1A



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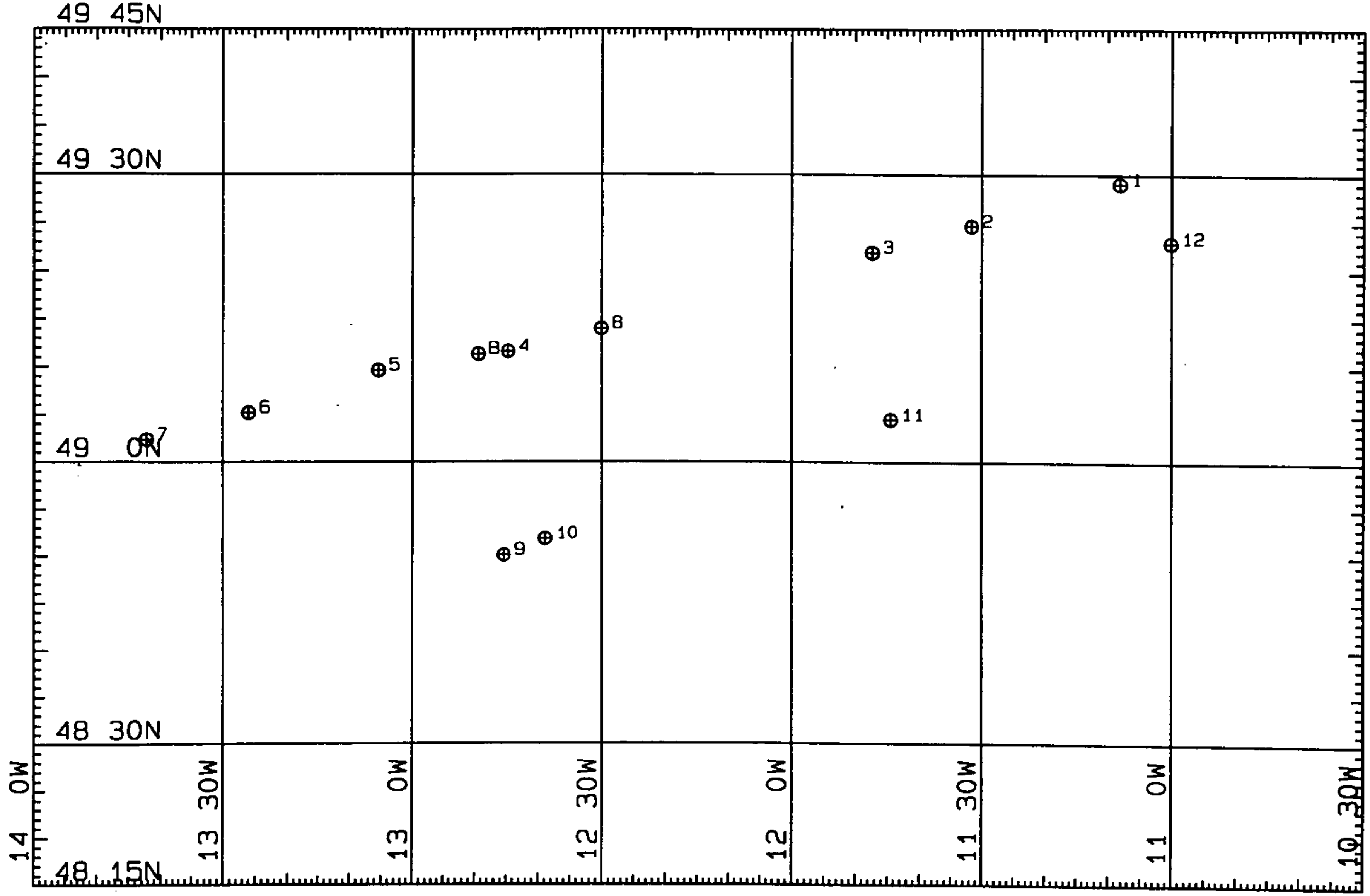
Charkes Darwin 86 3.5 KHz Acoustic Survey May 94



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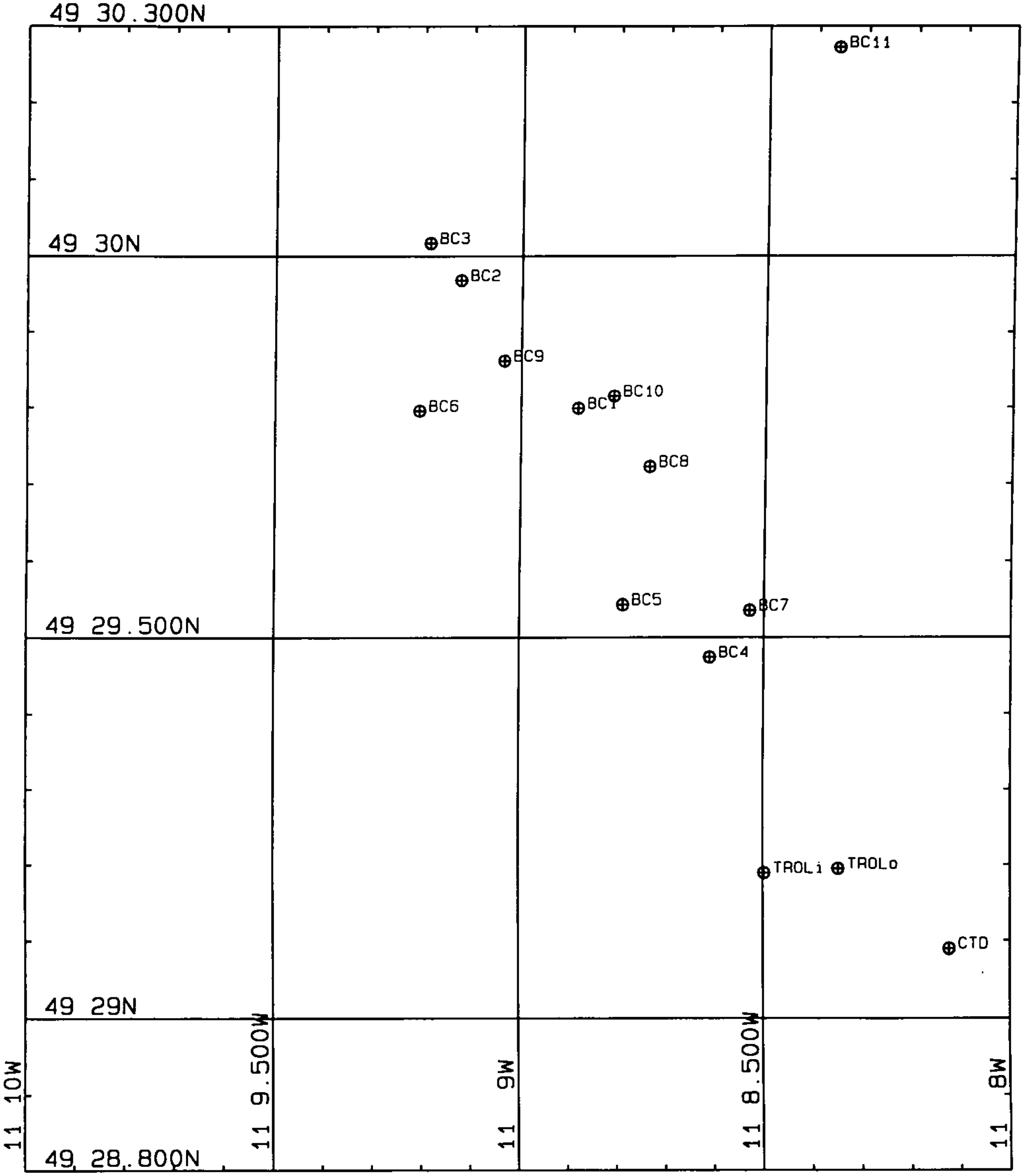
Charles Darwin 86 May-June 1994 CTD Stations



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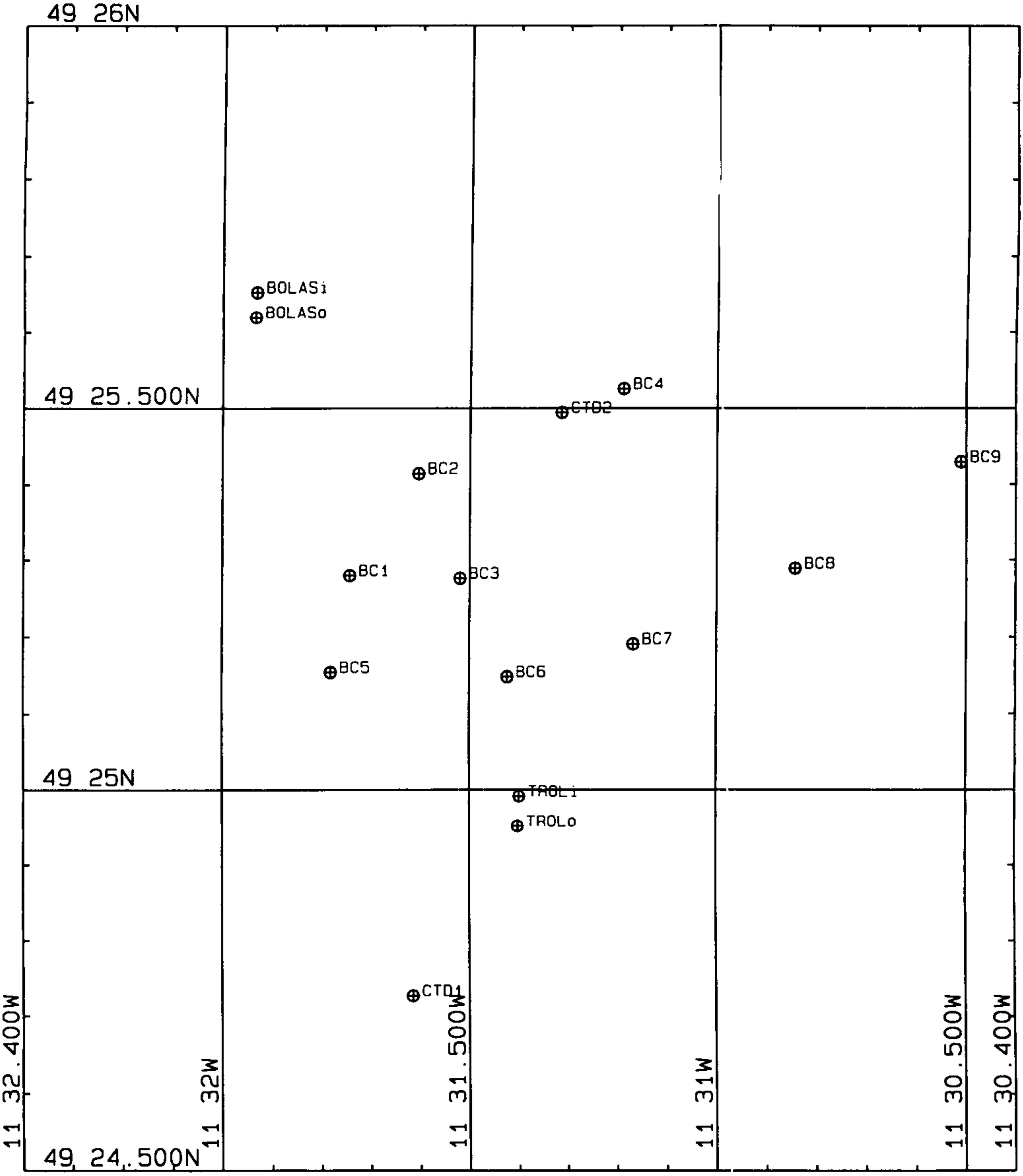

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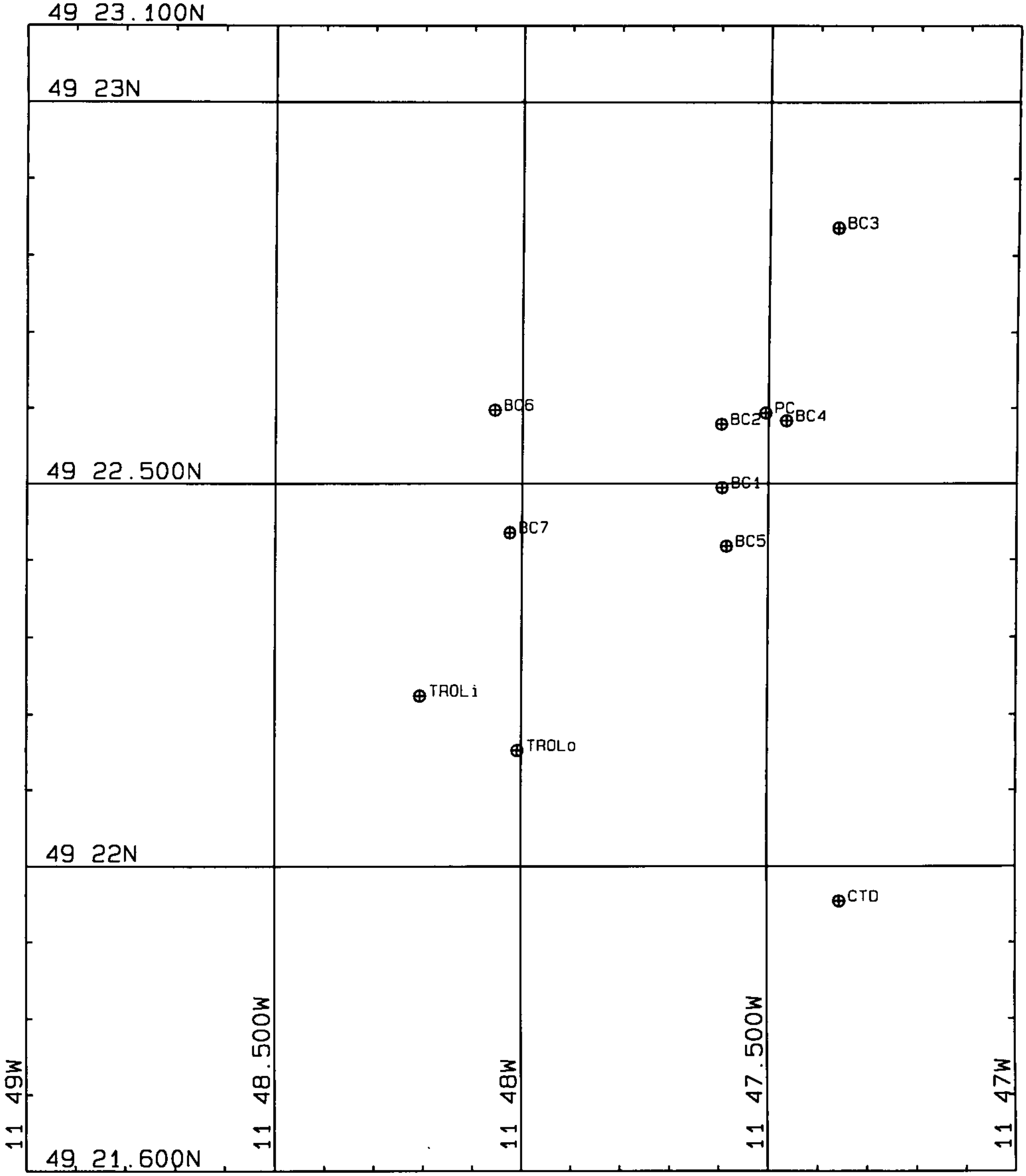

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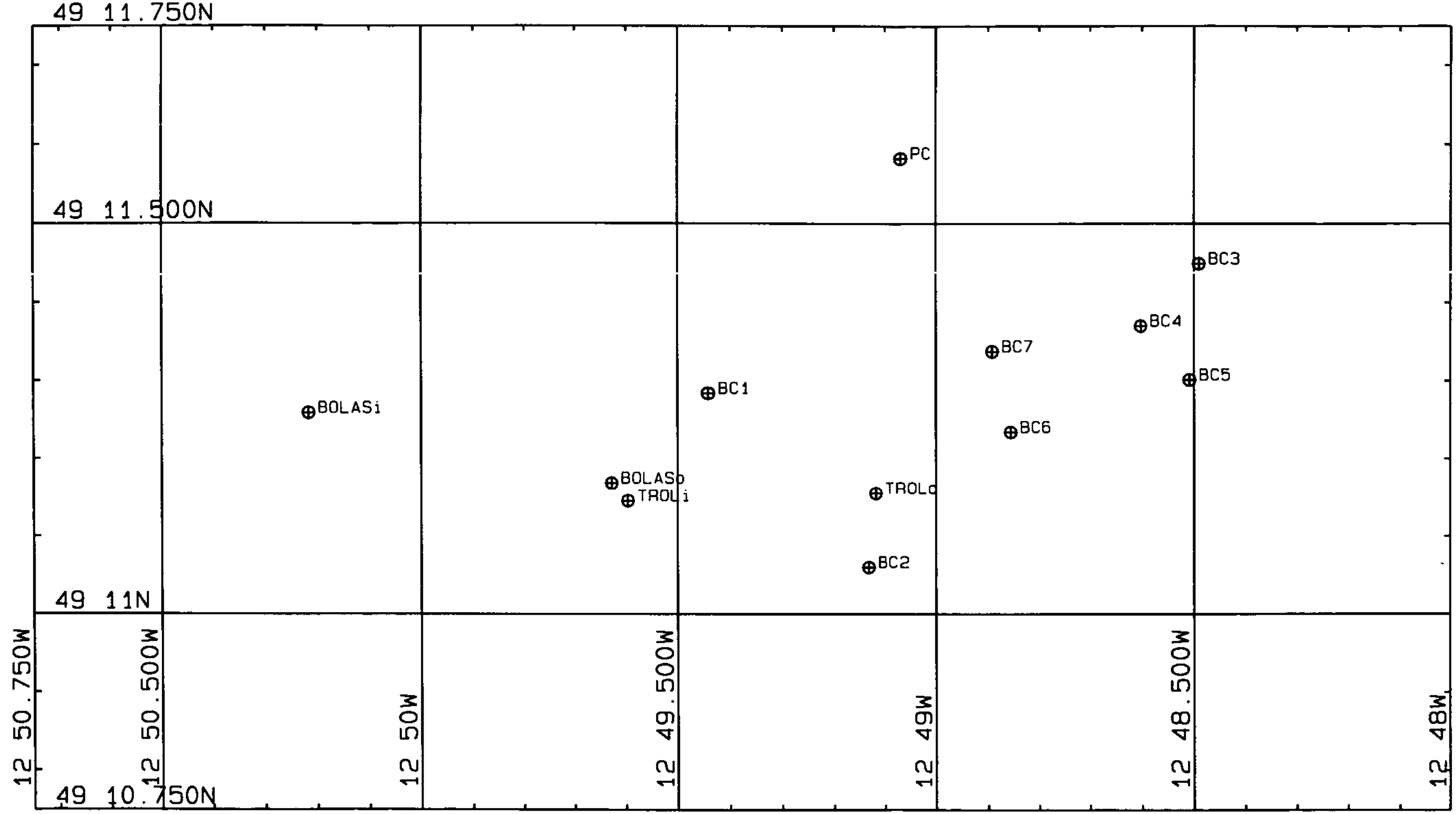

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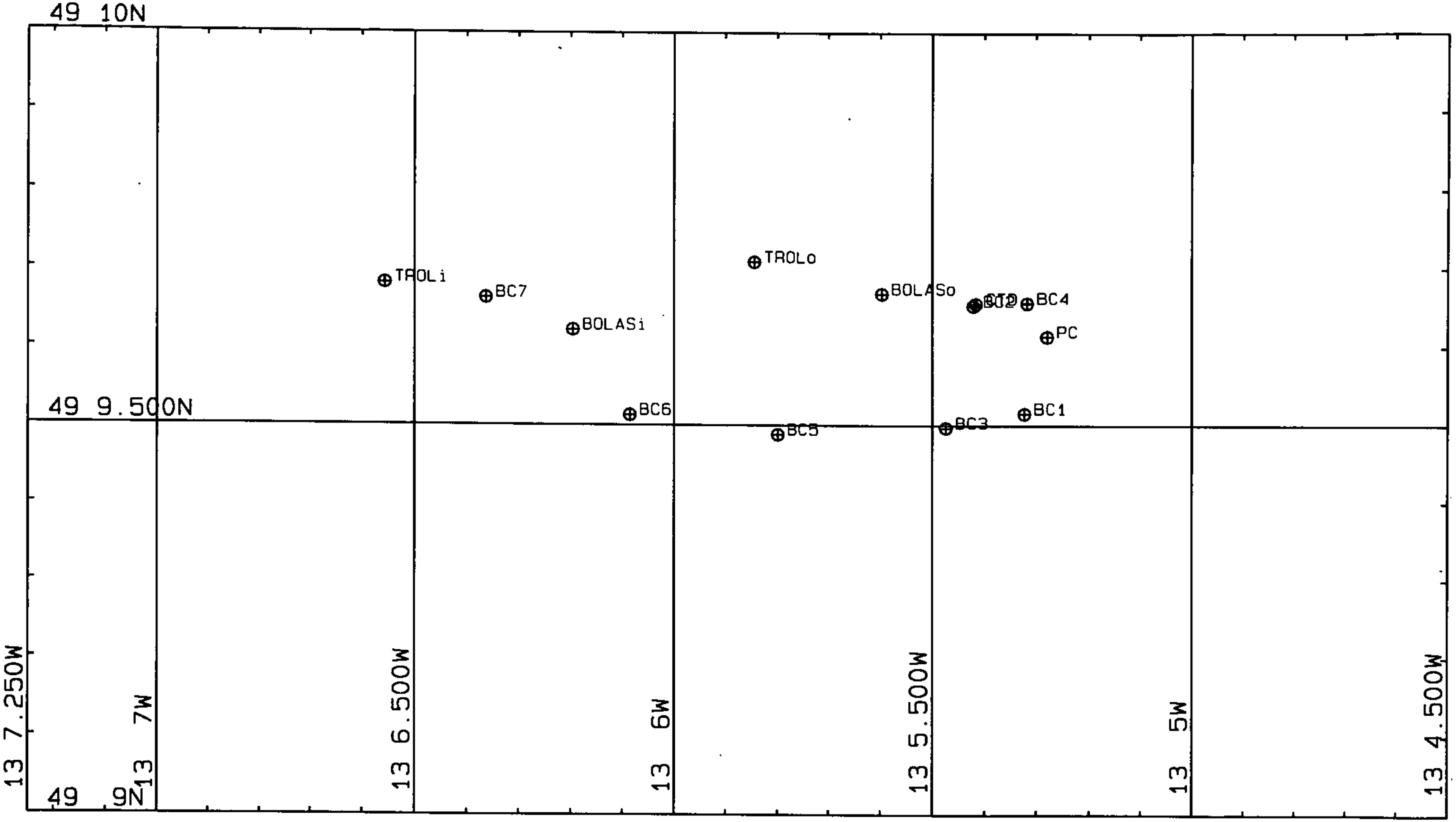

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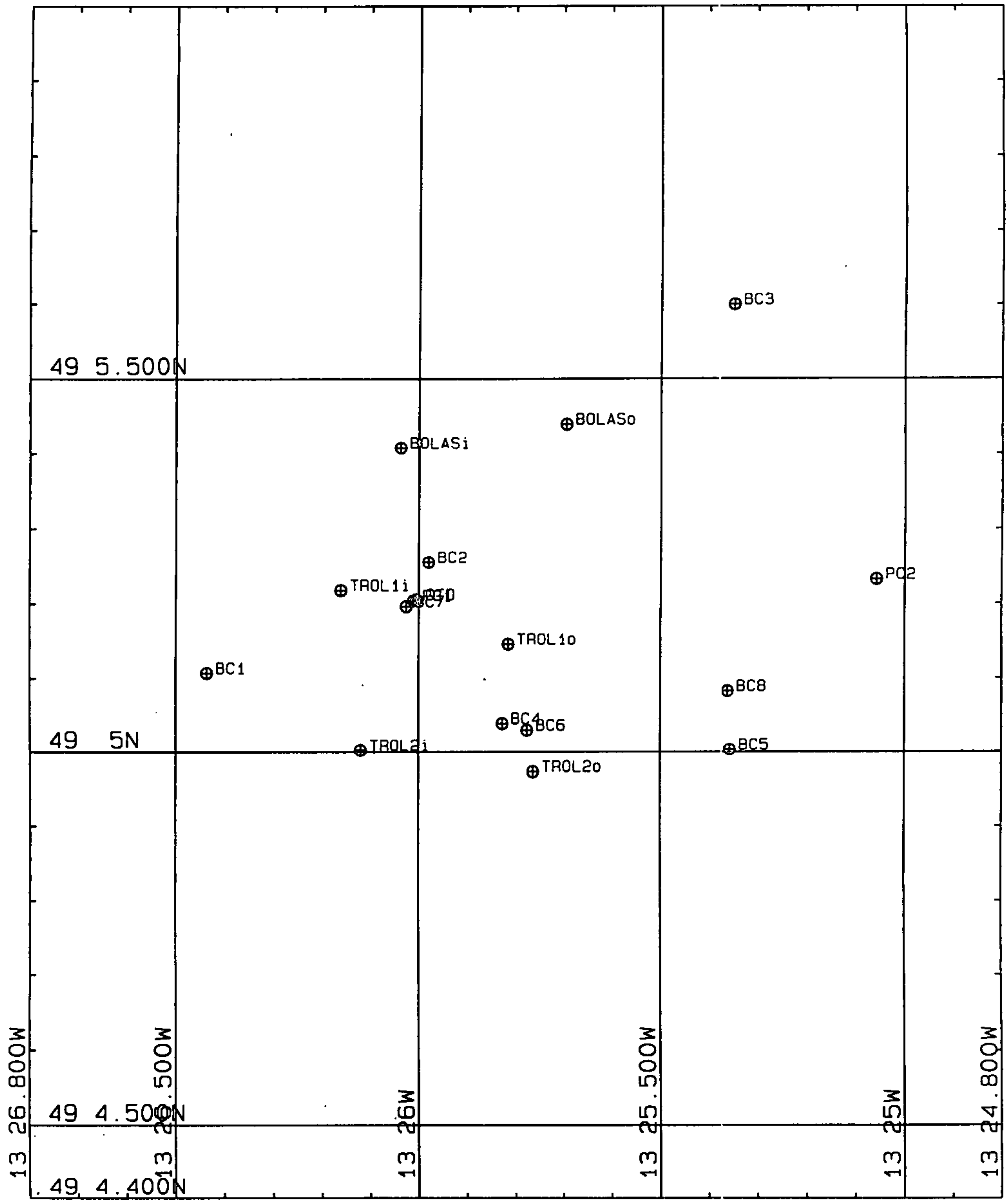

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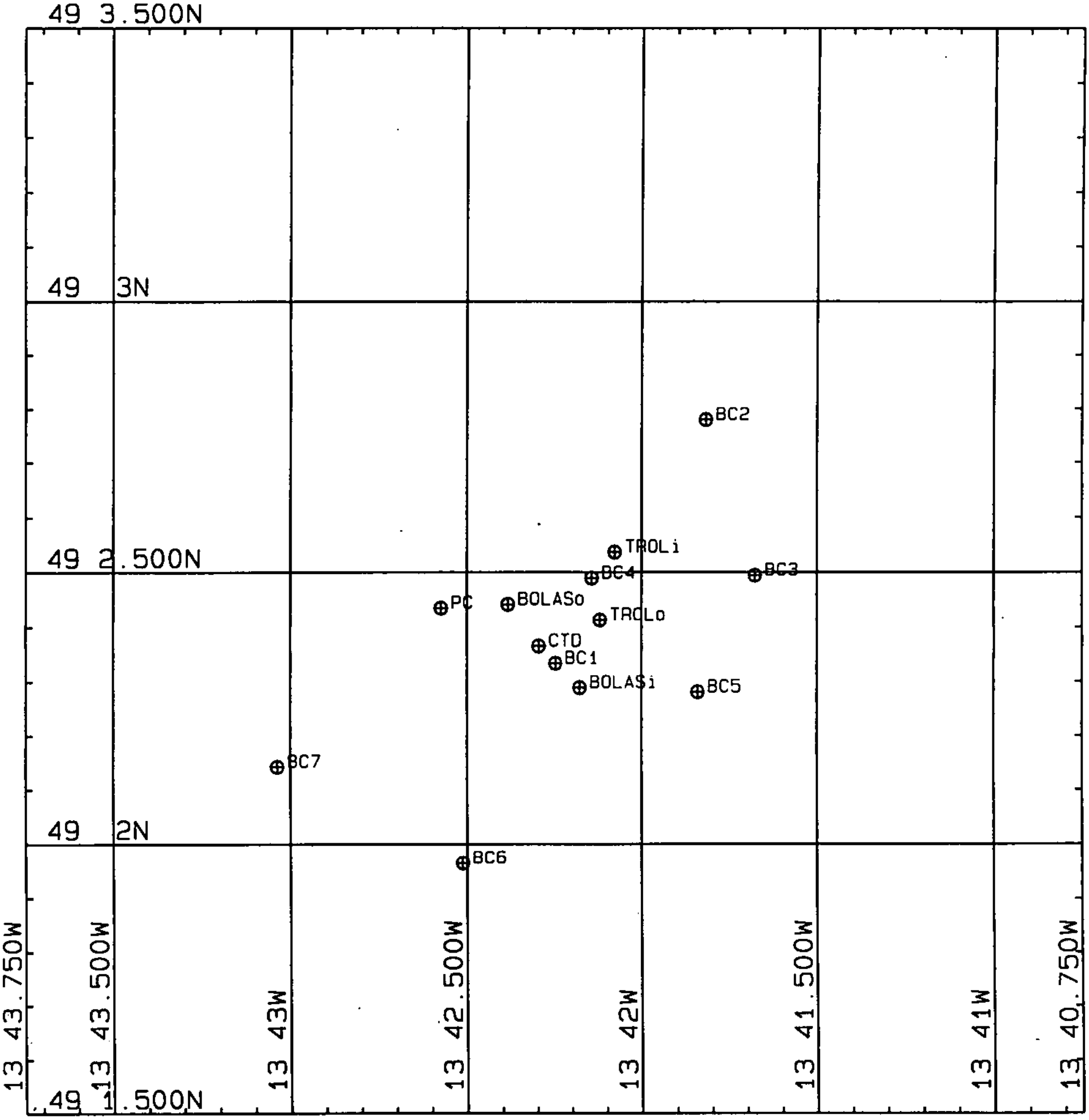

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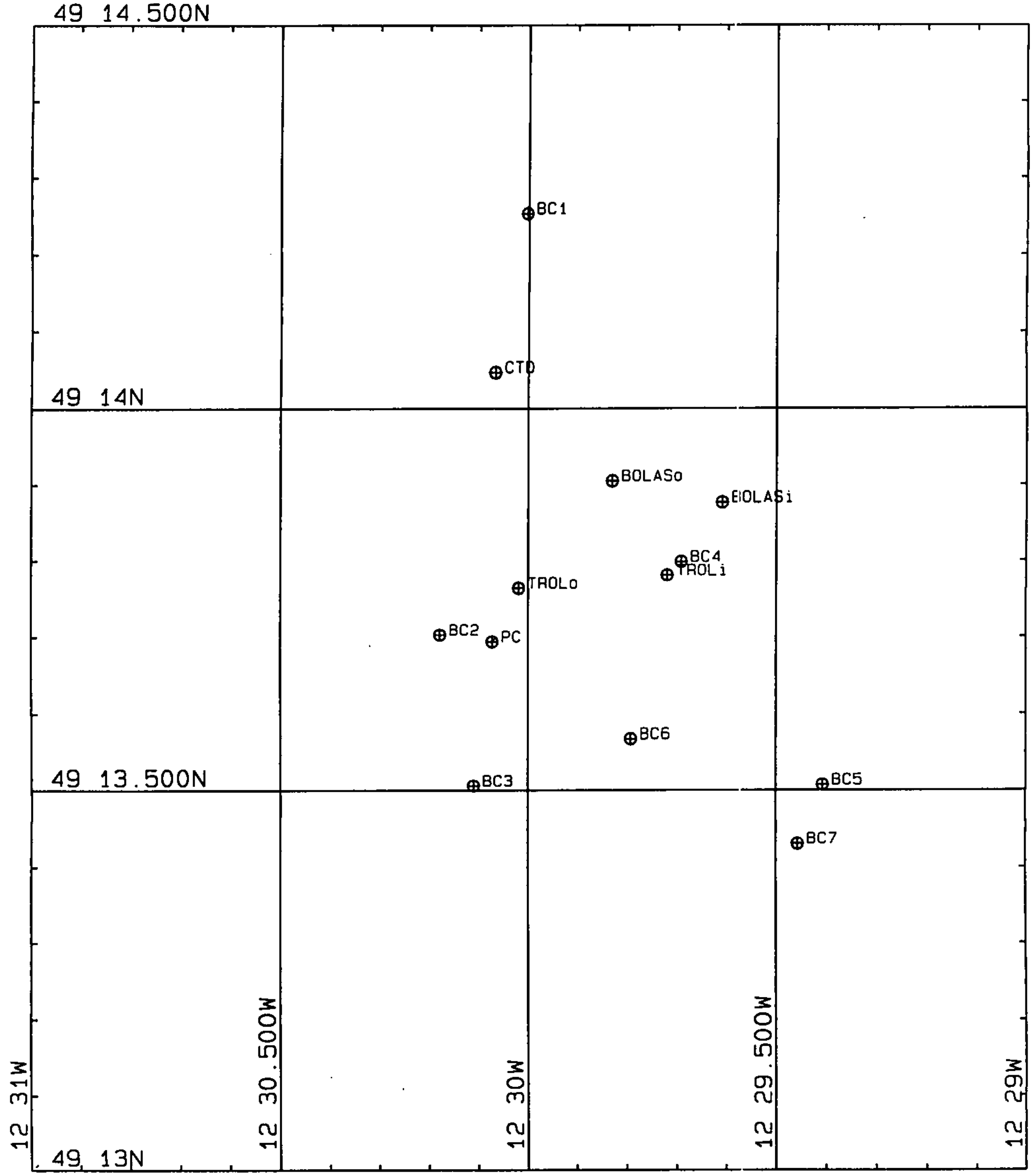

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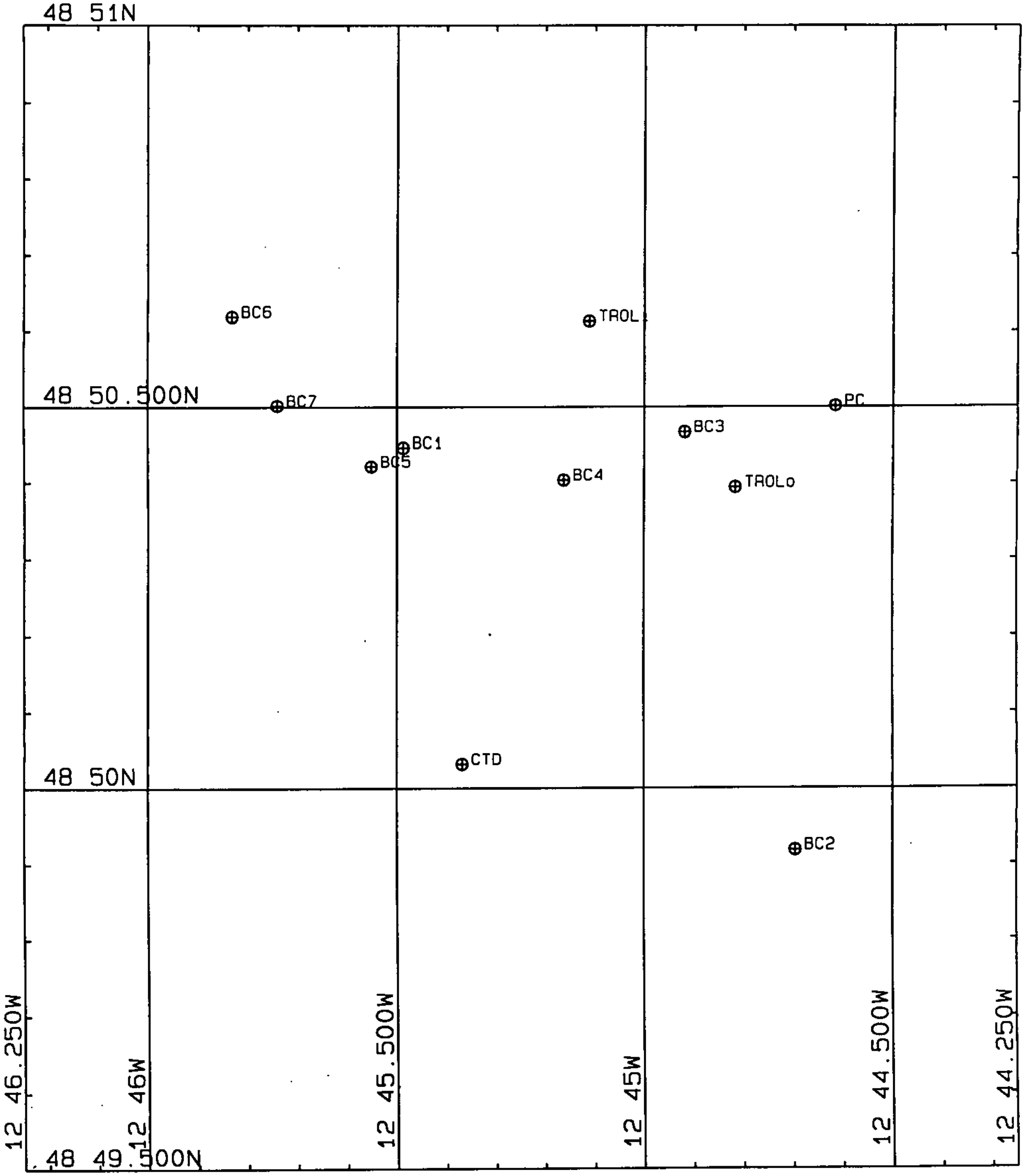

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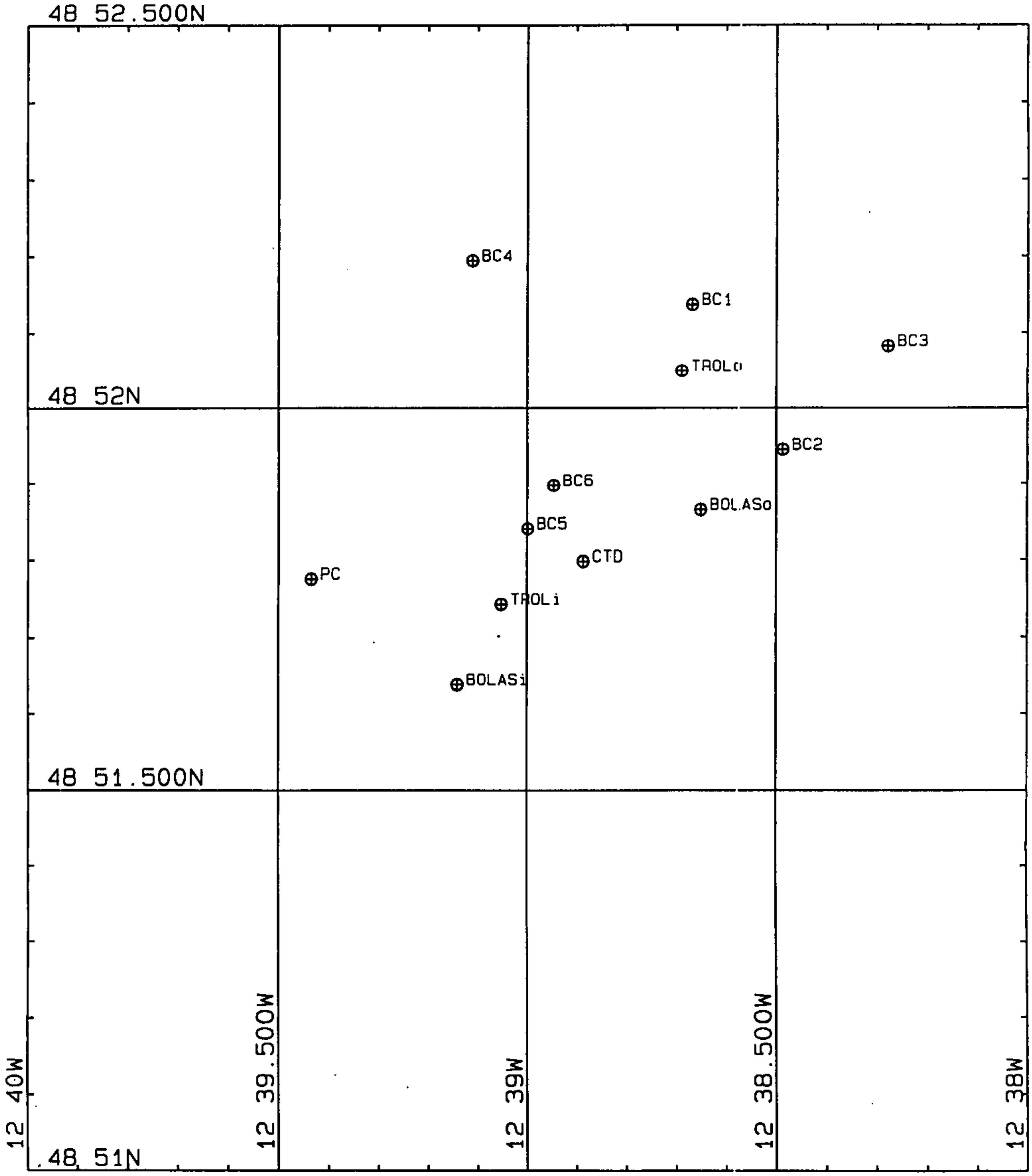

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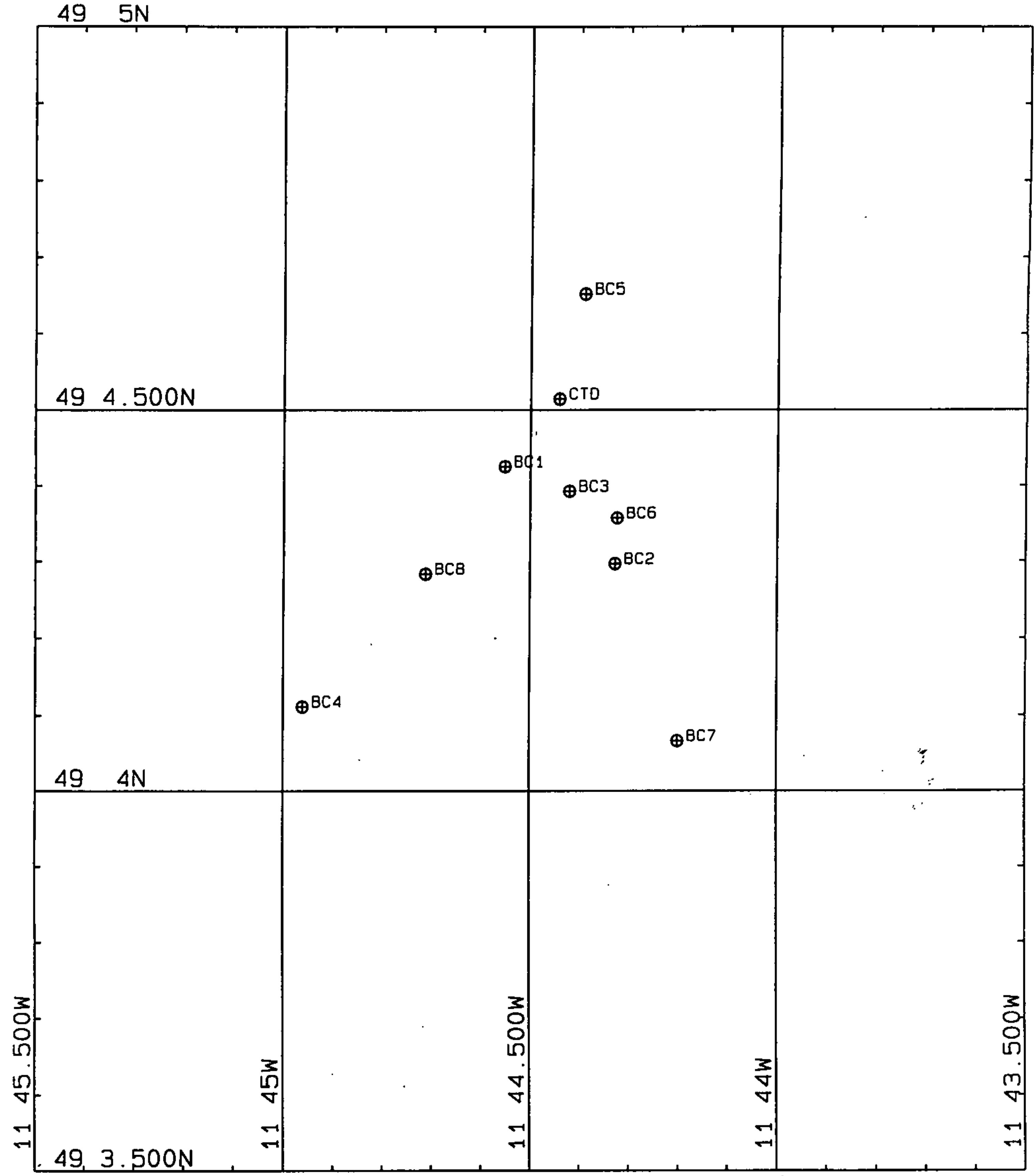

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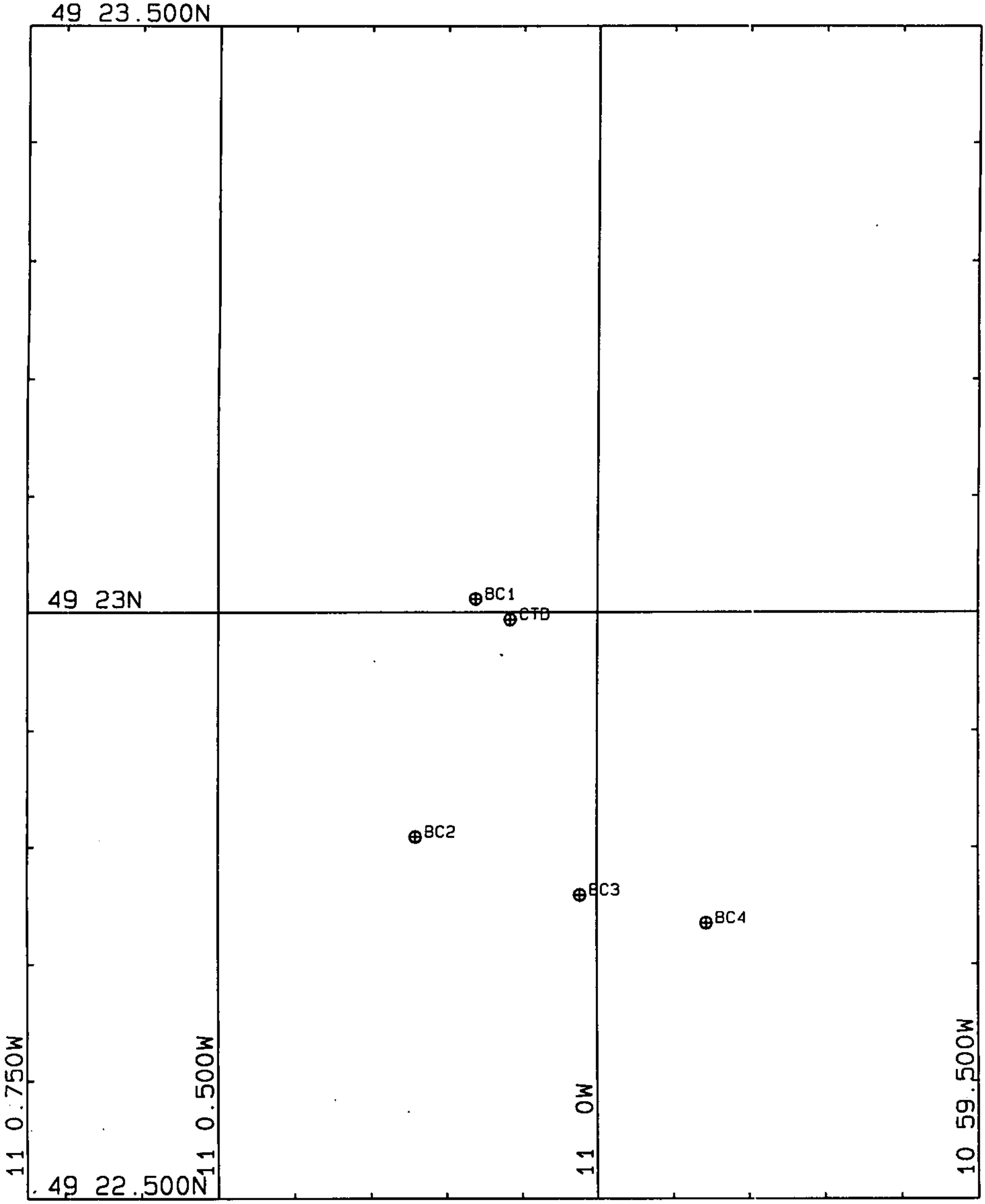

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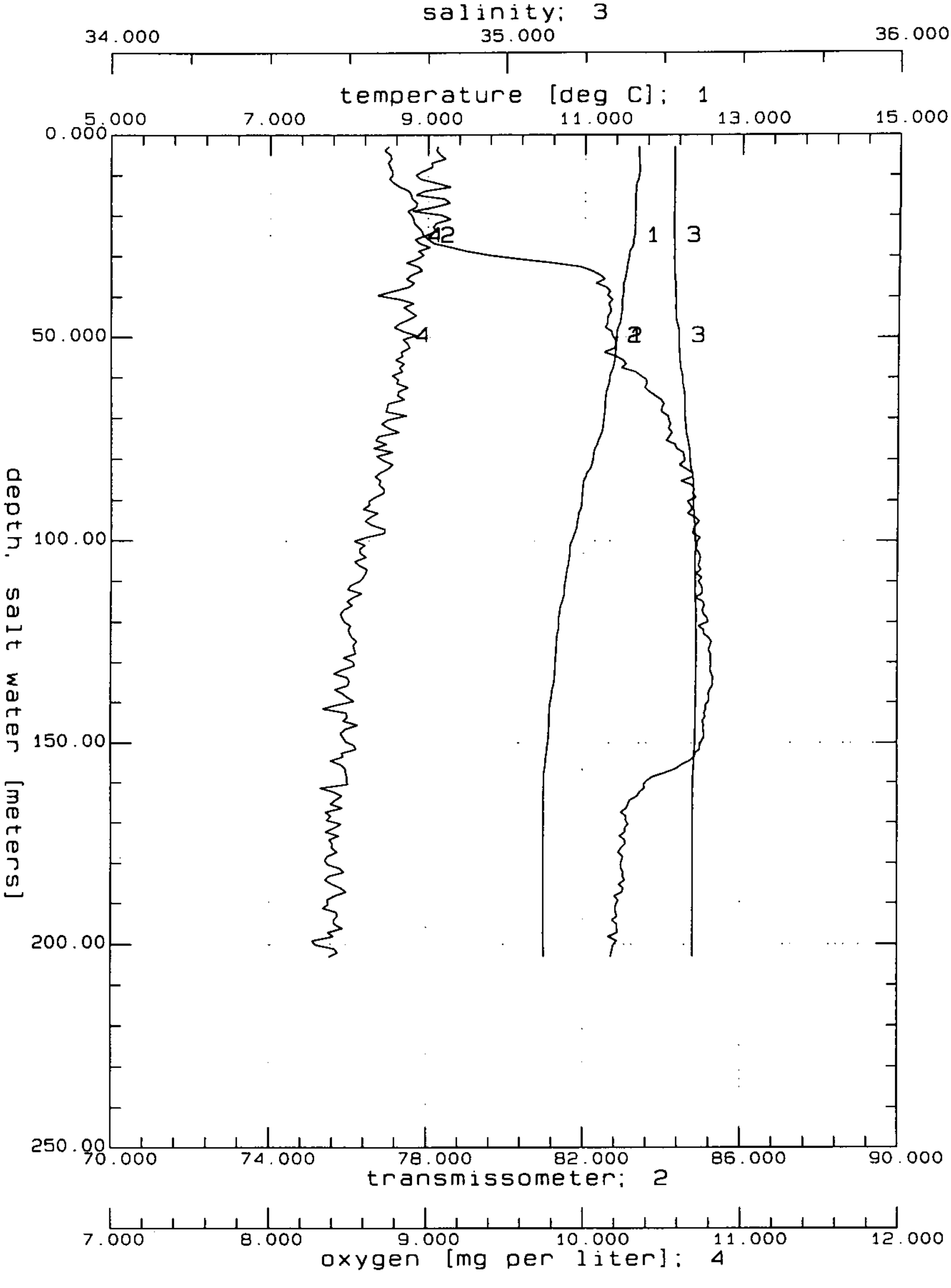
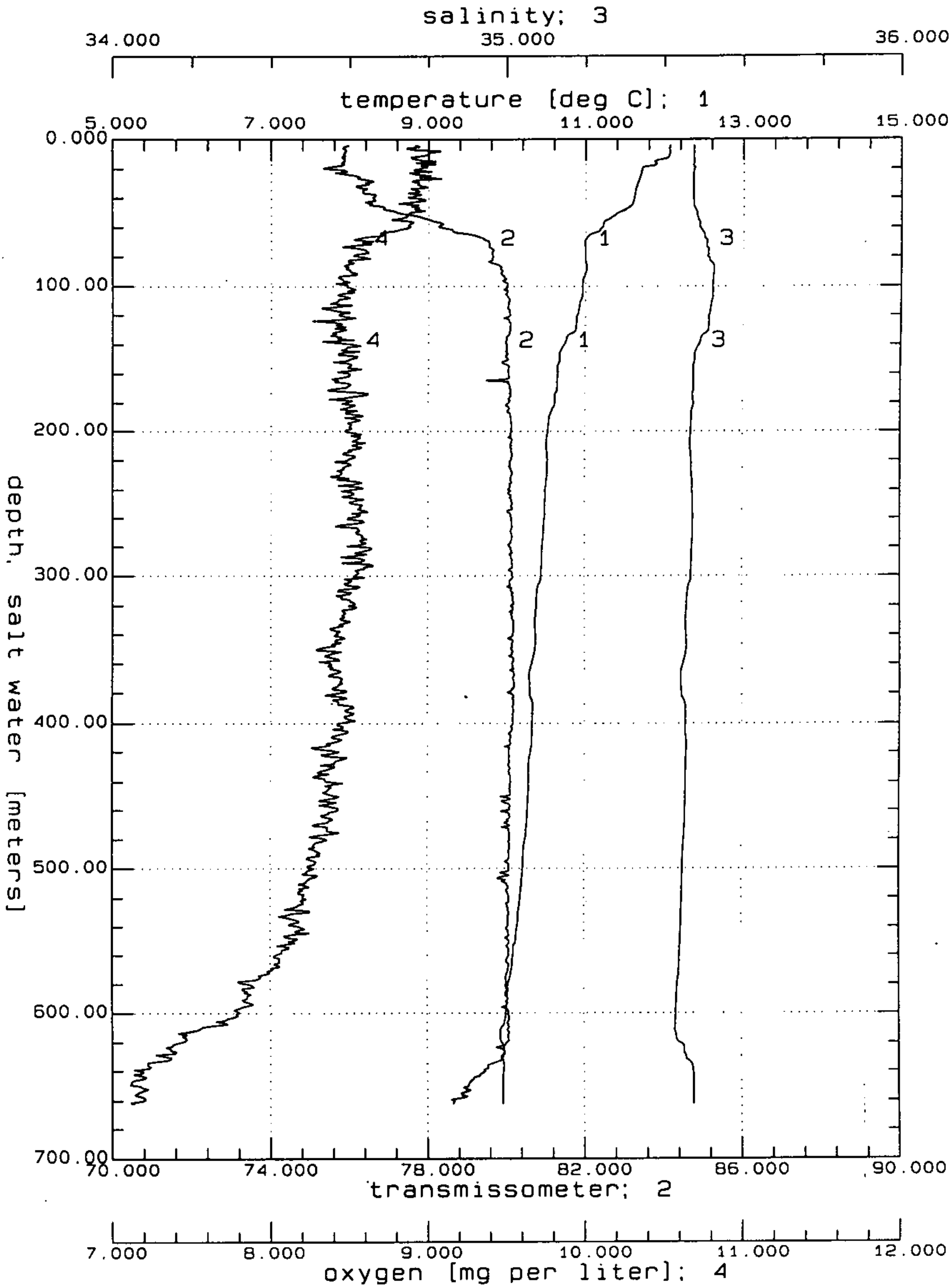


DOM94D1B.CNV: om94d-1b station d86-1



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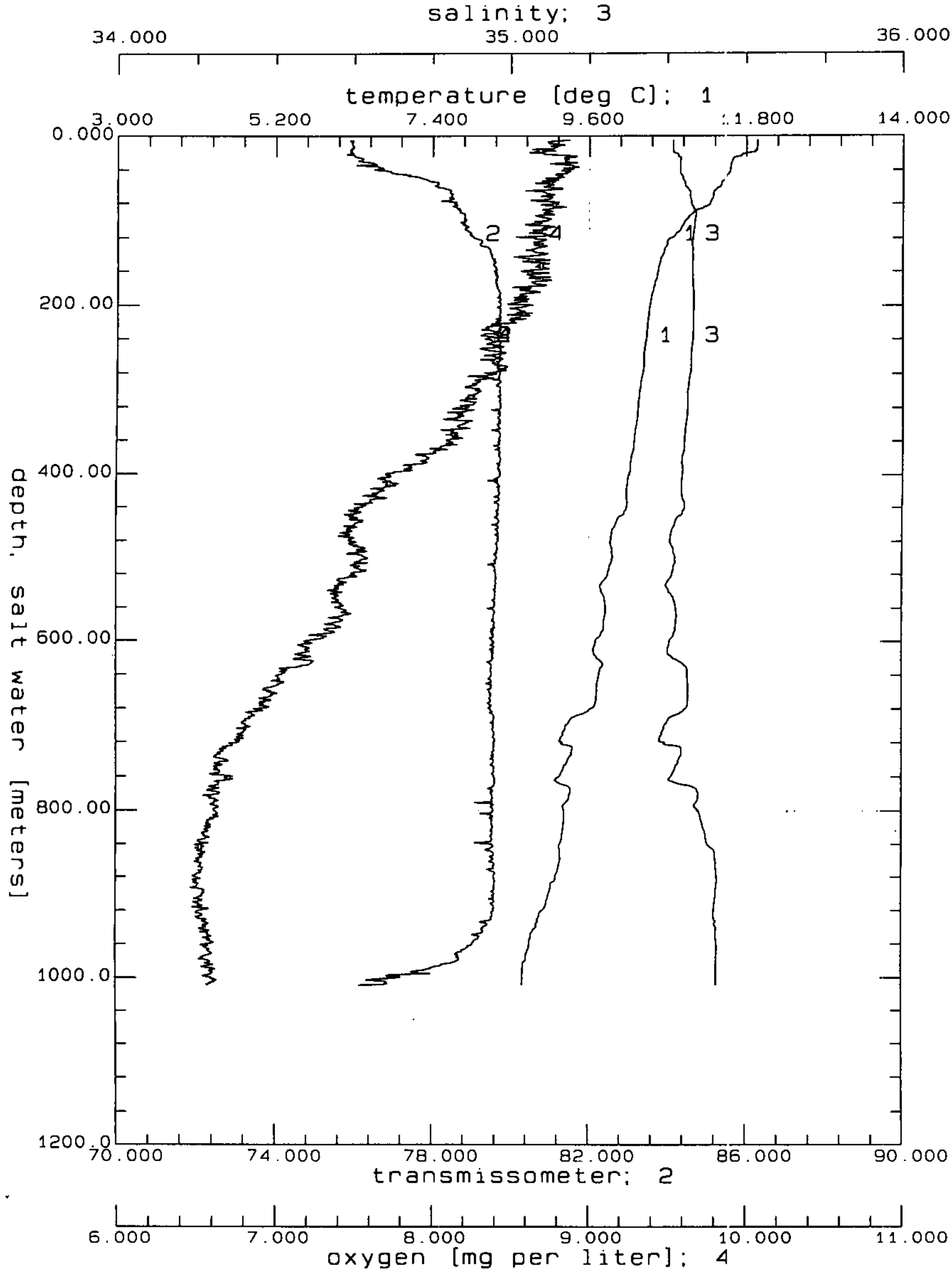

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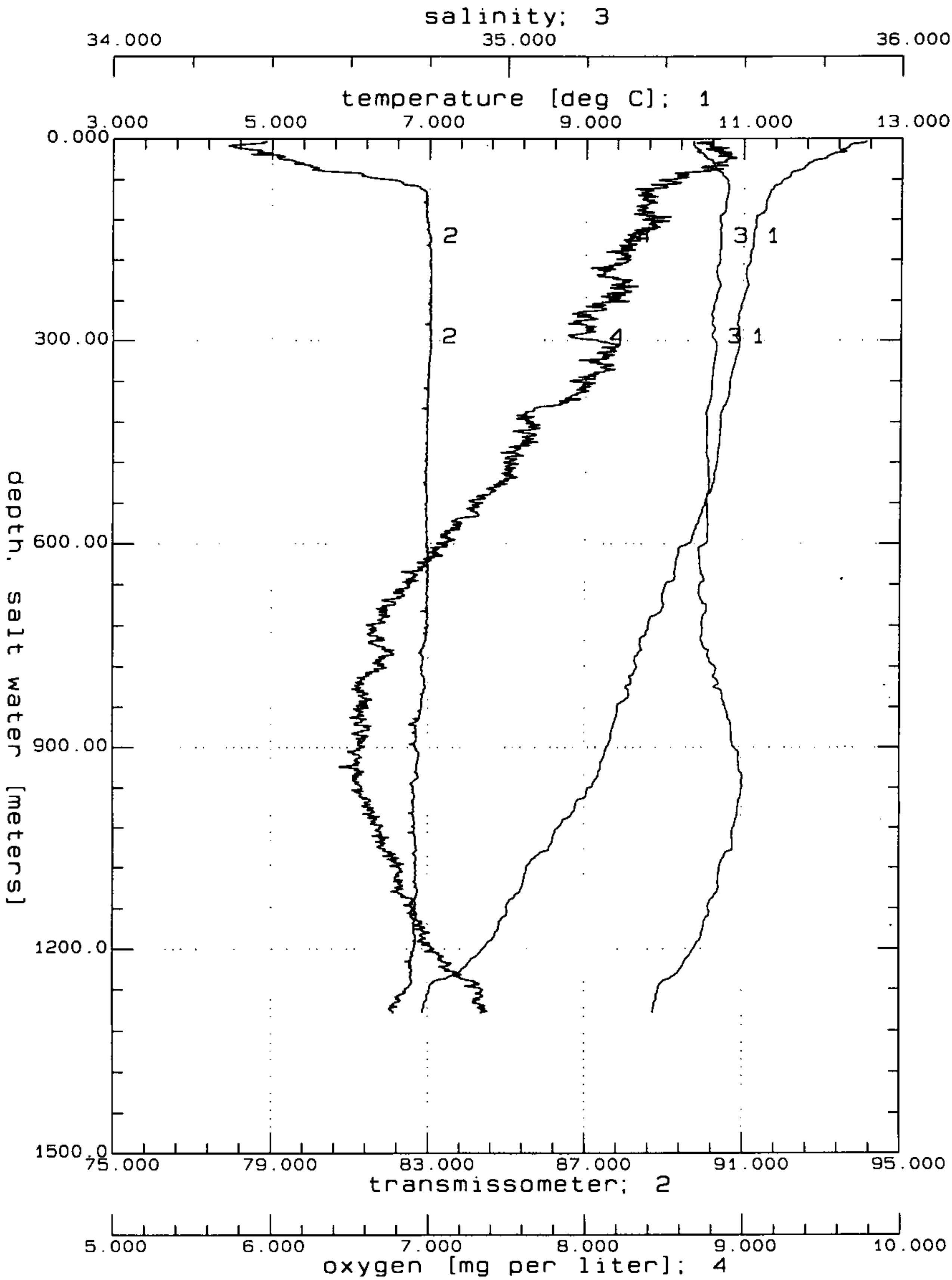

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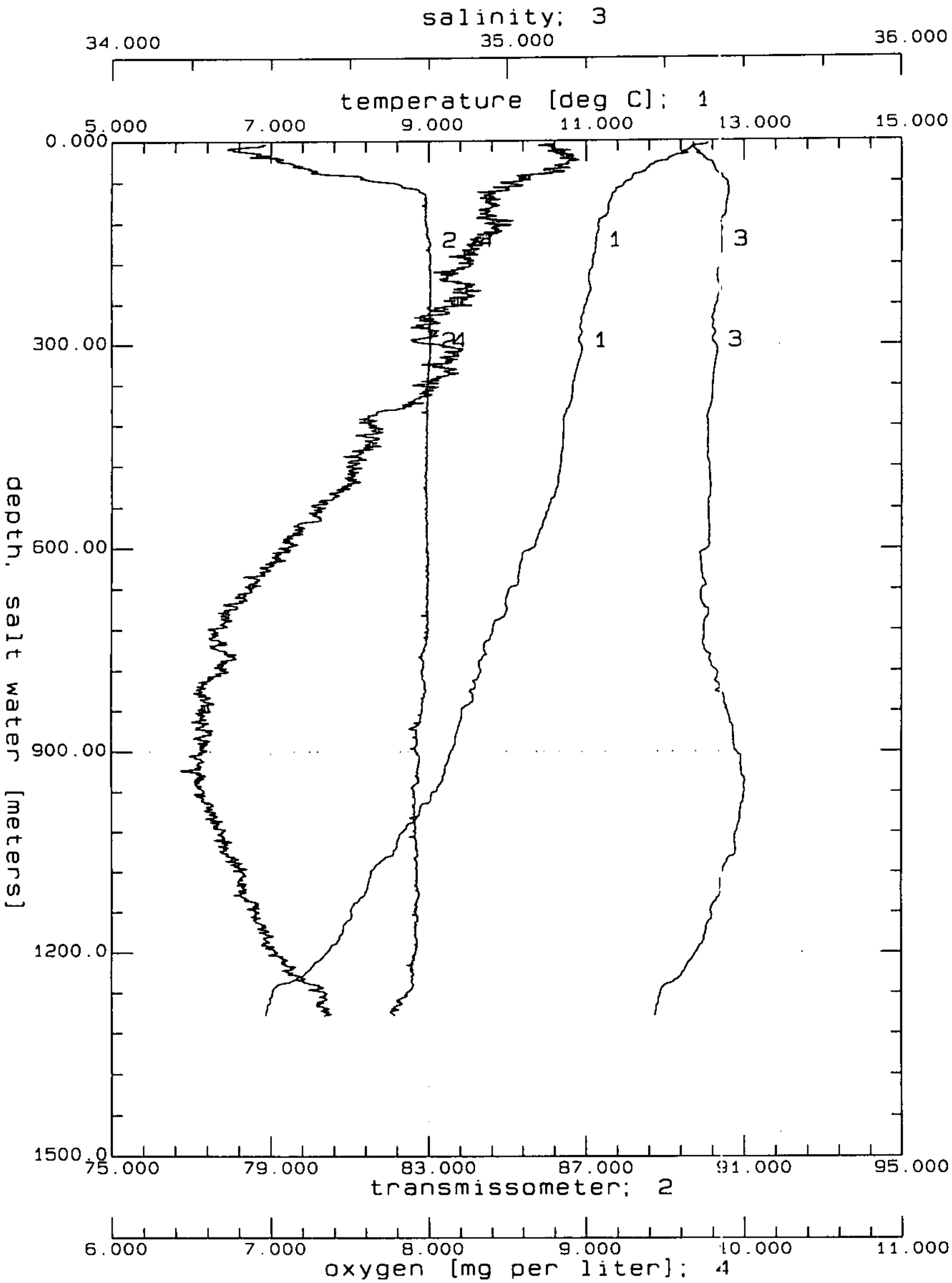

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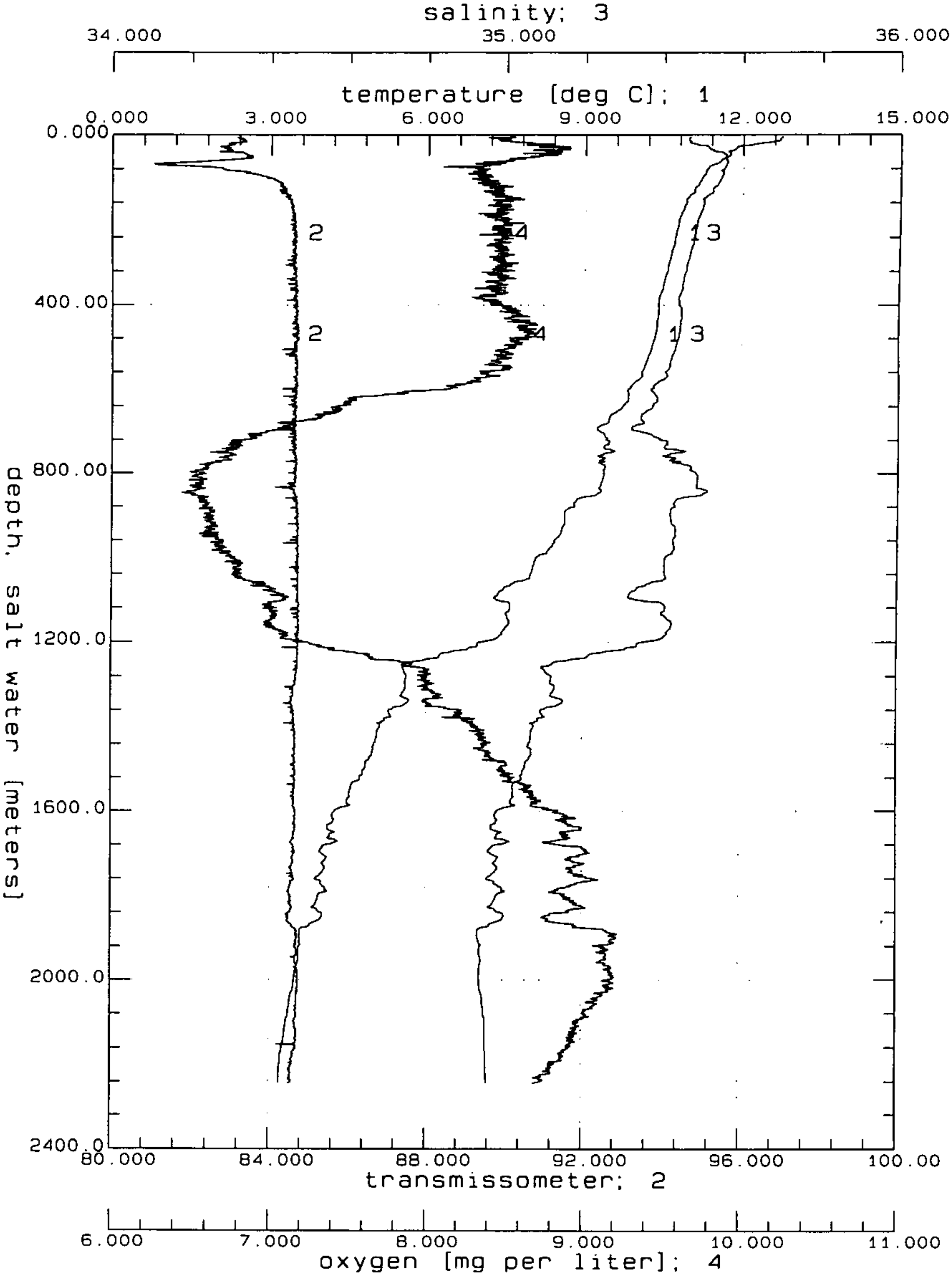

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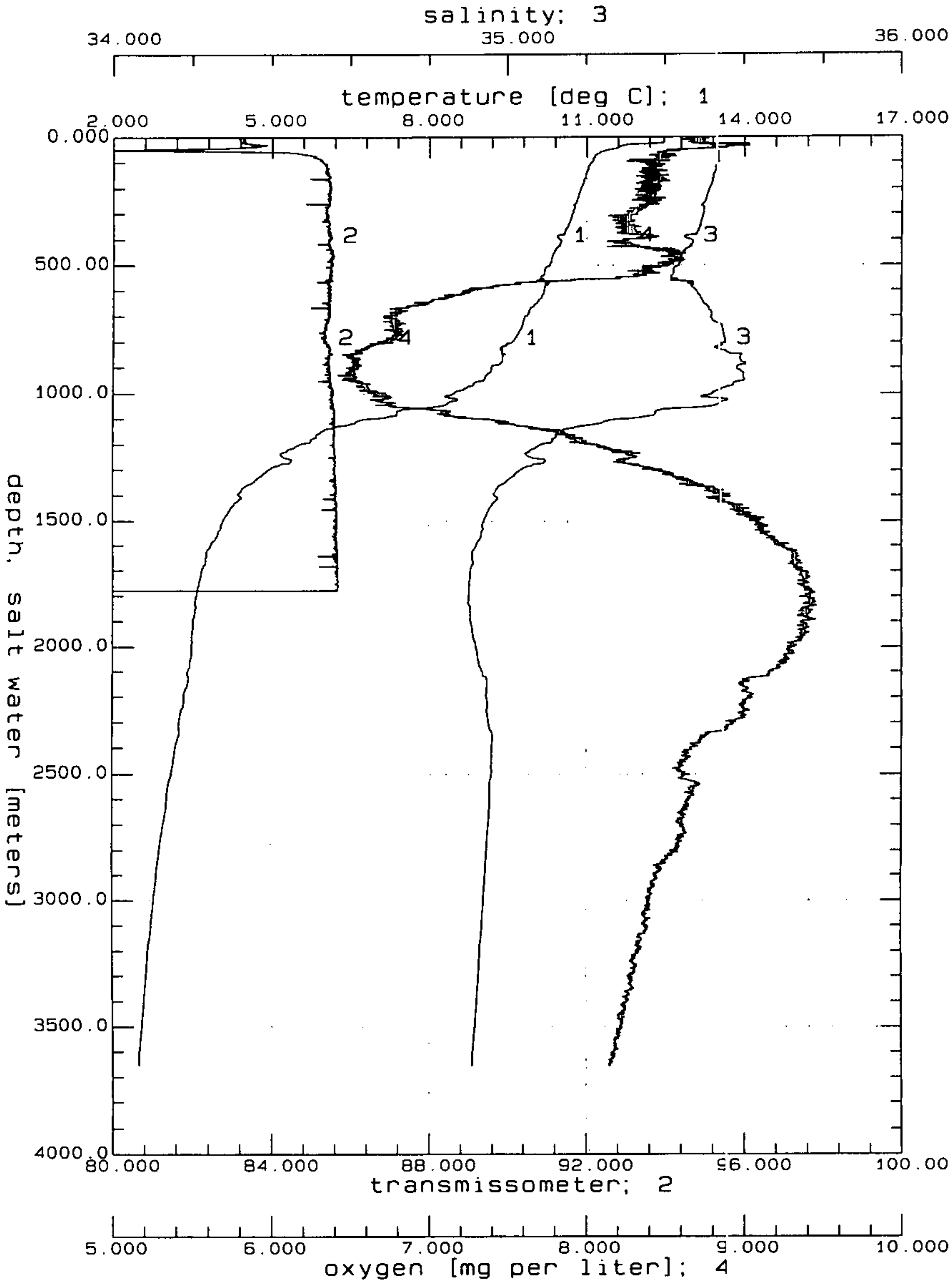

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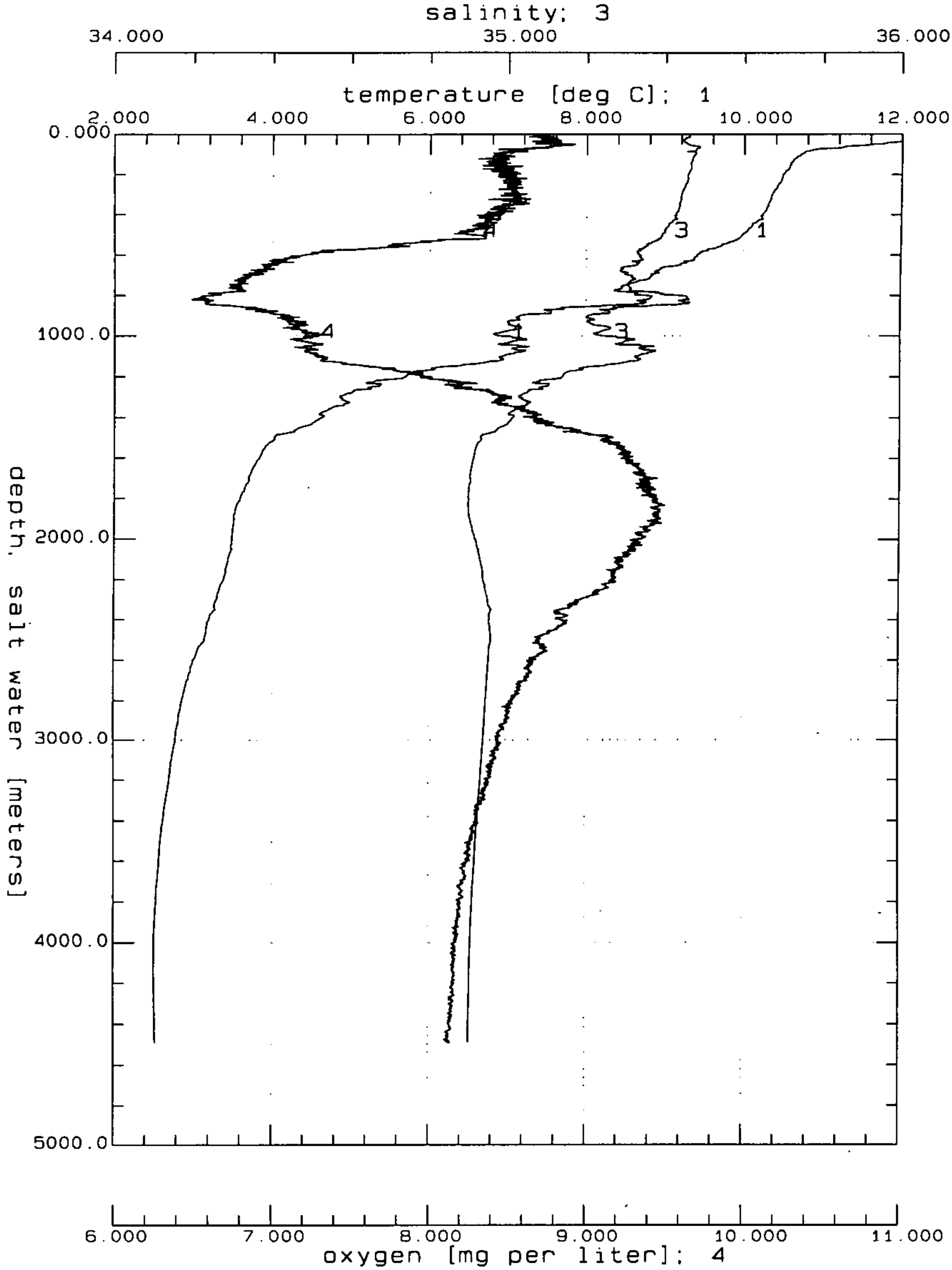

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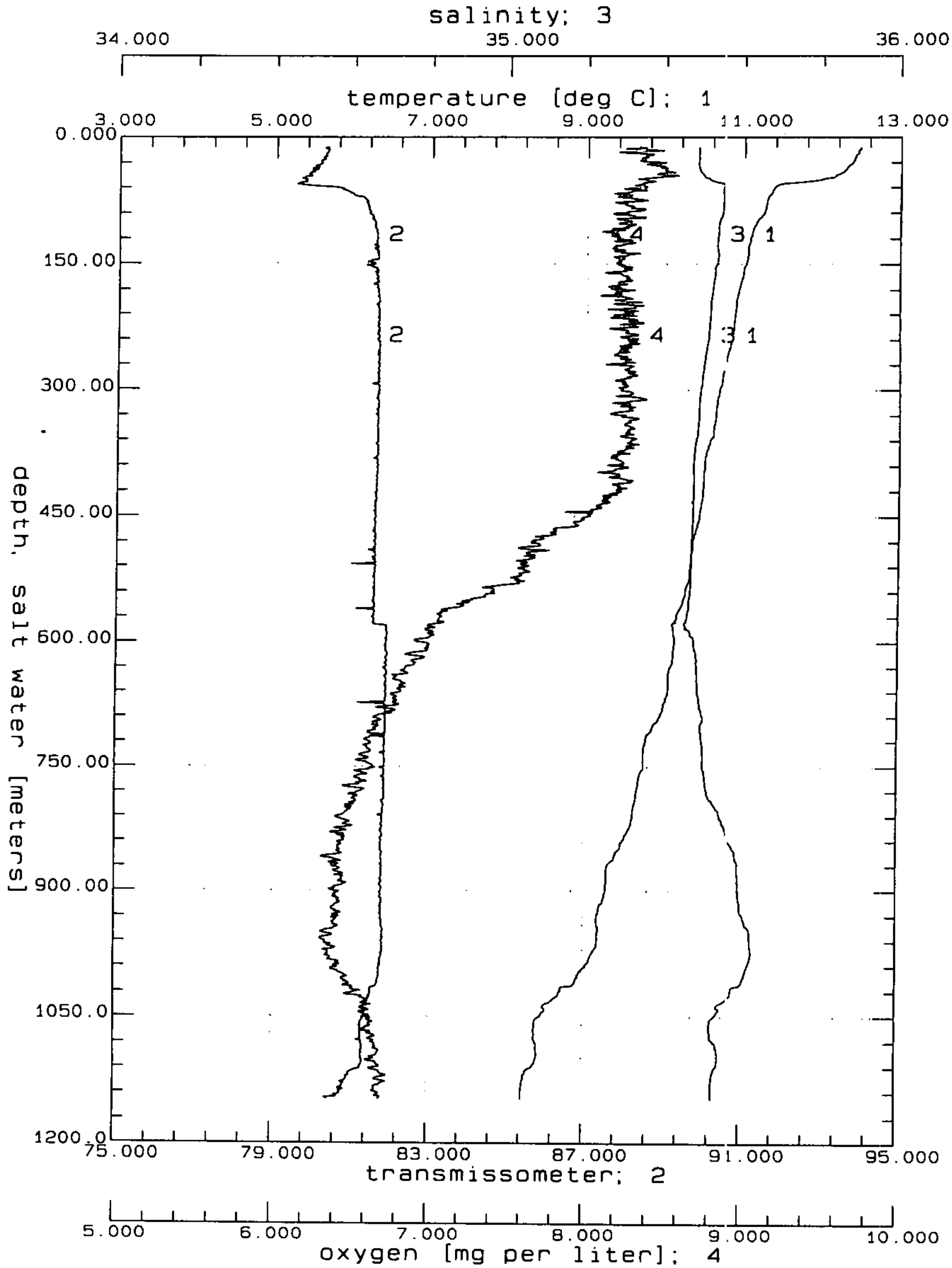
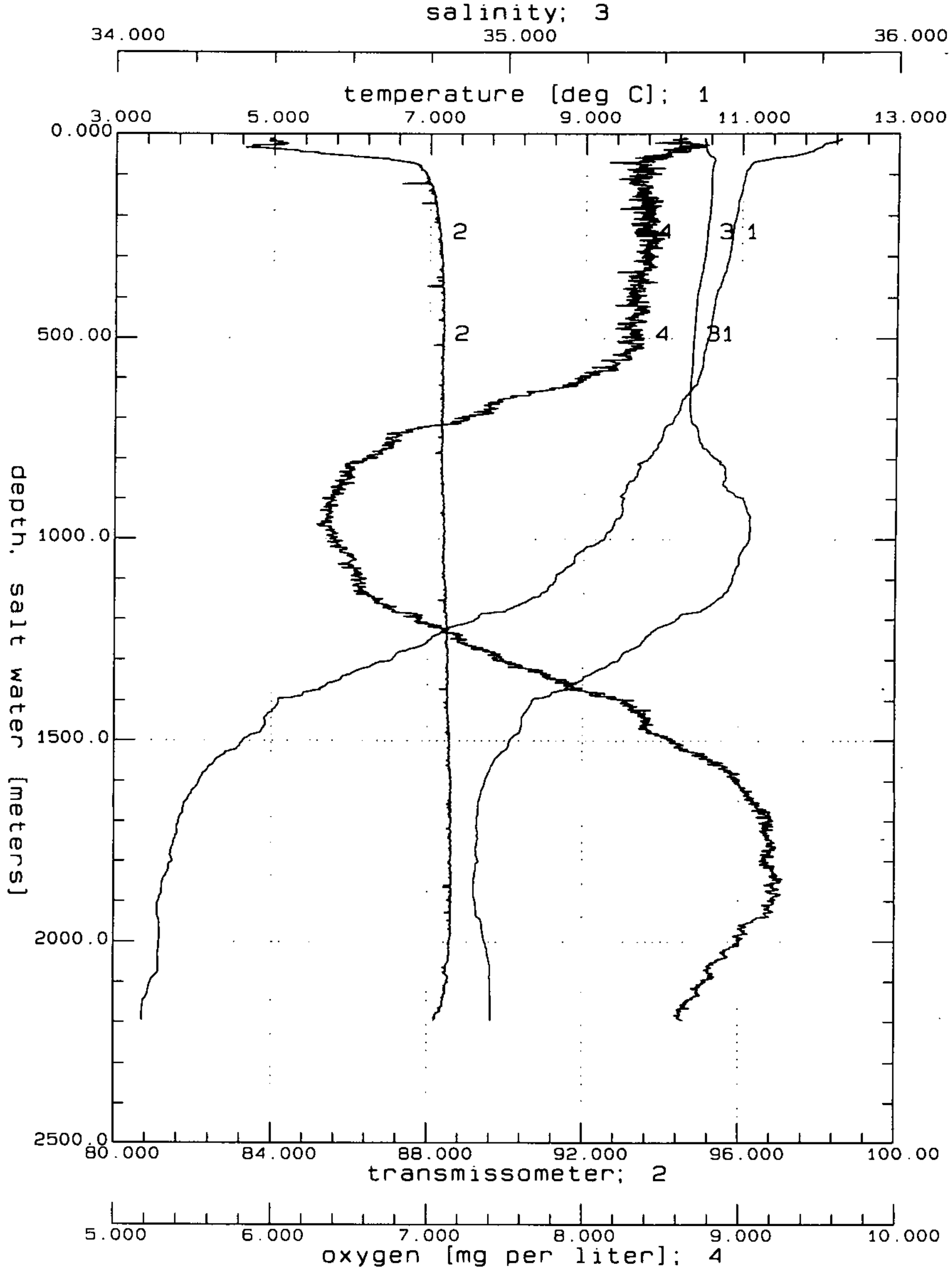
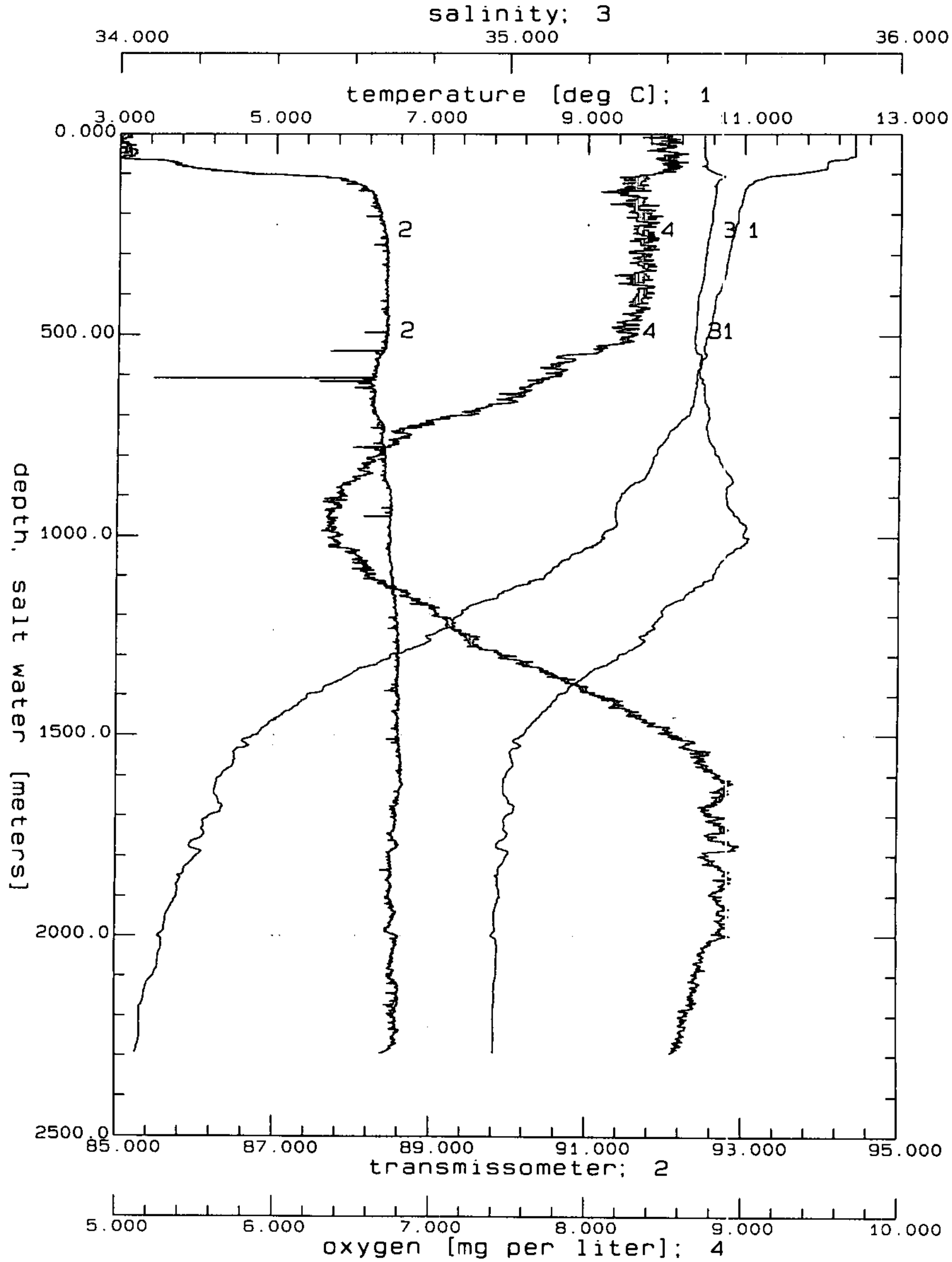


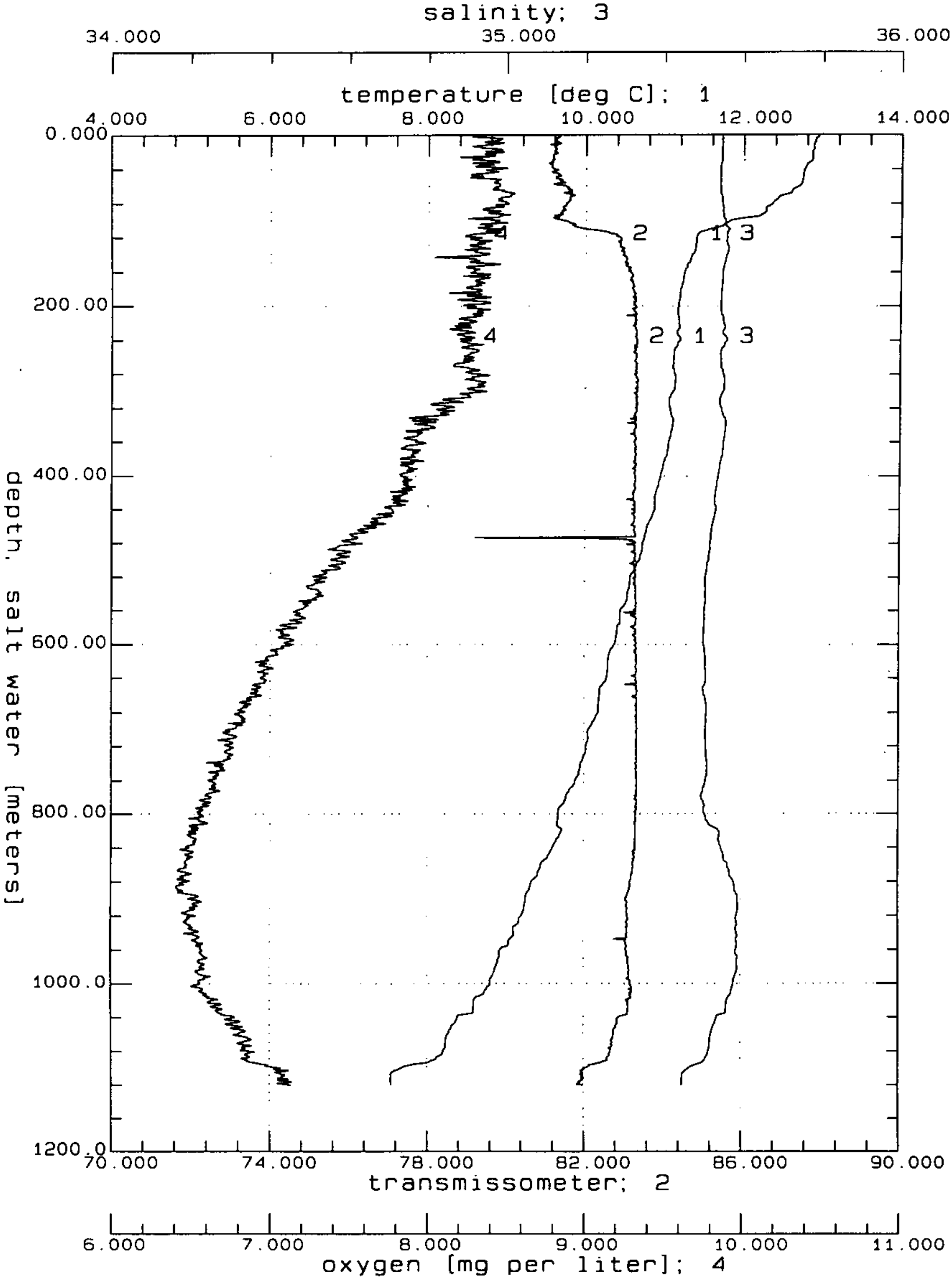
DOM94D08.CNV: STATION D86-8



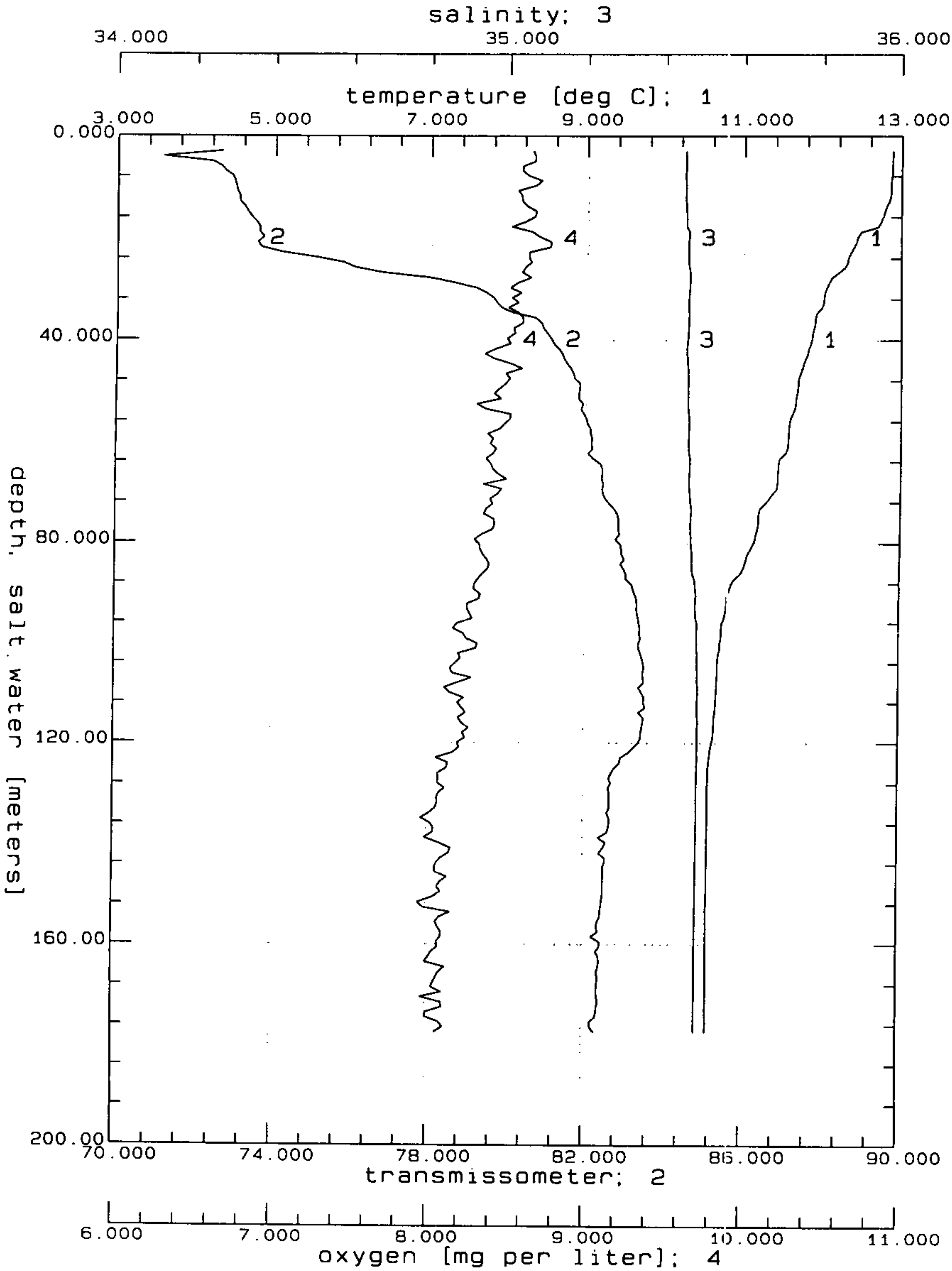
DOM94D09.CNV: STATION D86-9



DOM94D10.CNV: STATION D86-10



DOM94D11.CNV: STATION D86-11



DOM94D12.CNV: STATION D86-12

Appendix 6 Datalist bottlefiles/station

Date	Station	Bottle		Depth m	Temp C	Salinity ‰	O2 Winkler µmol/l	Silicate µmol/l	Phosphate µmol/l	Ammonia µmol/l	Nitrite µmol/l	Nitrate µmol/l
23/05/94	D86-1 (A2)	11		3	11.74	35.43	287	0.66	0.19	0.48	0.09	2.70
	49 29.7 N	10		12	11.68	35.43	289	0.61	0.20	0.61	0.09	2.67
	11 08.4 W	9		23	11.61	35.43	285	0.60	0.21	0.68	0.07	2.86
		8		33	11.52	35.43	282	0.70	0.26	0.94	0.10	3.38
	Depth 208 m	7		53	11.36	35.44	278	1.19	0.39	1.05	0.16	5.31
		6		103	10.76	35.49	274	3.41	0.59	0.63	0.50	8.47
		5		198	10.51	35.48		4.91	0.64	0.17	0.03	10.26
		4	Lek!	198	10.51	35.48		4.60	0.63	0.26	0.10	9.99
		3		198	10.51	35.48	262	4.89	0.64	0.15	0.03	10.29
		2		198	10.51	35.48		4.88	0.64	0.16	0.03	10.27
		1		198	10.51	35.48		4.83	0.64	0.16	0.03	10.27
		BoxWater					274	5.45	0.65	0.34	0.07	10.42

Date	Station	Bottle		Depth m	Temp C	Salinity ‰	O2 Winkler µmol/l	Silicate µmol/l	Phosphate µmol/l	Ammonia µmol/l	Nitrite µmol/l	Nitrate µmol/l
23/05/94	D86-2(OMEX-I	14		4	12.13	35.47	286	0.30	0.25	0.52	0.14	4.75
		13		15	11.9	35.47	286	0.34	0.25	0.61	0.12	4.80
	49 24.9 N	12		25	11.77	35.47	285	0.35	0.27	0.68	0.13	4.91
	11 31.4 W	11		35	11.59	35.47	284	0.68	0.33	1.12	0.14	5.52
		10		55	11.11	35.49	281	2.24	0.47	1.29	0.18	7.22
	Depth 670 m	9		105	10.99	35.53	268	3.80	0.56	0.24	0.05	9.70
		8		204	10.56	35.47	271	4.41	0.62	0.20	0.07	10.69
		7		352	10.38	35.46	225	4.69	0.66	0.22	-0.01	11.24
		6		560	10.08	35.44	252	5.96	0.78	0.22	0.02	12.94
		5	Lek!	658	9.97	35.48		7.06	0.85	0.22	0.01	14.23
		4		658	9.97	35.48		7.59	0.89	0.21	0.03	14.92
		3		658	9.97	35.48		7.59	0.89	0.21	0.04	14.95
		2		657	9.97	35.48		7.55	0.89	0.21	0.01	14.95
		1		656	9.97	35.48	226	7.57	0.89	0.21	0.02	14.95
		Box Water					227	7.75	0.95	0.19	0.00	15.02

Date	Station	Bottle		Depth m	Temp C	Salinity ‰	O2 Winkler µmol/l	Silicate µmol/l	Phosphate µmol/l	Ammonia µmol/l	Nitrite µmol/l	Nitrate µmol/l
24/05/94	D86-3 (B)	16		4	12.12	53.41	289	0.52	0.30	0.59	0.10	4.60
		15		13	11.93	35.4	287	0.52	0.30	0.59	0.09	4.59
	49 22.4 N	14		33	11.62	35.43	291	0.55	0.31	0.74	0.10	4.53
	11 45.1 W	13		23	11.82	35.42	289	0.52	0.31	0.67	0.10	4.54
		12		53	11.56	35.43	284	0.57	0.35	1.05	0.10	4.85
	Depth 1034 m	11		102	10.86	35.46	286	2.48	0.57	1.74	0.13	7.20
		10		201	10.45	35.47	279	4.37	0.68	0.11	0.17	10.59
		9		450	10.08	35.44	246	6.41	0.88	0.14	0.00	13.85
		8		598	9.68	35.4	234	7.78	0.99	0.21	0.00	15.61
		7		794	9.26	35.47	230	7.50	0.95	0.18	0.02	14.88
		6		892	9.08	35.53	205	10.11	1.12	0.12	-0.01	17.75
		5	Lek!	1001	8.69	35.53		9.80	1.10	0.15	0.00	17.10
		4		1000	8.69	35.53		11.11	1.15	0.19	-0.01	18.02
		3		1000	8.69	35.53		11.07	1.16	0.16	-0.01	18.06
		2		1000	8.69	35.53	208	11.12	1.15	0.17	-0.01	18.02
		1		999	8.69	35.53	213	11.10	1.15	0.17	-0.01	18.09
		Box Water					203	11.33	1.15	0.17	0.02	18.00

Date	Station	Bottle		Depth m	Temp C	Salinity %o	O2 Winkler µmol/l	Silicate µmol/l	Phosphate µmol/l	Ammonia µmol/l	Nitrite µmol/l	Nitrate µmol/l
25/05/94	D86-4 (OMEX-II)	17		4	12.71	35.47		0.80	0.28	0.32	0.10	4.54
		16		5	12.72	35.47		0.82	0.28	0.35	0.10	4.50
CTD:	49 11.4 N	15		4	12.71	35.47	280	0.80	0.28	0.28	0.09	4.54
	12 44.4 W	14		13	12.48	35.47	279	0.80	0.29	0.31	0.08	4.61
		13		21	12.33	35.47	281	0.79	0.28	0.31	0.12	4.66
Box:	49 11.3 N	12		34	12.25	35.48	281	0.84	0.30	0.25	0.10	4.75
	12 49.7 W	11		55	11.72	35.53	281	1.66	0.43	0.89	0.16	6.22
		10		104	11.33	35.56	258	3.32	0.57	0.19	0.17	8.71
	Depth box 1425 m	9		203	11.07	35.54	259	4.00	0.64	0.15	0.01	10.17
	Depth CTD 1293m	8		303	10.93	35.52	253	4.42	0.69	0.19	0.02	10.97
		7		579	10.39	35.5	227	6.65	0.88	0.15	-0.01	14.20
		6		922	9.23	35.59	203	10.41	1.09	0.18	0.00	17.37
		5	Lek!	1275	6.98	35.38		7.99	0.92	0.16	0.01	14.49
		4		1275	6.99	35.38		13.27	1.19	0.13	0.01	18.36
		3		1276	6.97	35.38		13.29	1.19	0.16	-0.02	18.33
		2		1275	6.99	35.38	222	13.30	1.19	0.16	-0.02	18.46
		1		1275	7	35.38	224	13.42	1.19	0.14	-0.03	18.47
		BoxWater					231	14.06	1.20	0.24	0.03	18.66

Date	Station	Bottle		Depth m	Temp C	Salinity ‰	O2 Winkler µmol/l	Silicate µmol/l	Phosphate µmol/l	Ammonia µmol/l	Nitrite µmol/l	Nitrate µmol/l
27-05-94	D 86-05 (F)	17		4	12.74	35.46		0.60	0.31	0.73	0.12	4.47
		16		4	12.74	35.46		0.72	0.30	0.66	0.15	4.46
	49 09.5 N	15		4	12.74	35.46	279	0.69	0.31	0.80	0.12	4.51
	13 05.3 W	14		15	12.67	35.46	283	0.63	0.33	0.76	0.15	4.53
		13		25	12.37	35.46	286	0.66	0.34	0.80	0.15	4.82
		12		35	11.88	35.51	287	0.72	0.38	1.02	0.18	5.65
	Depth 2254m	11		54	11.67	35.56	281	0.77	0.49	1.03	0.24	7.05
		10		104	11.19	35.54	275	4.14	0.63	0.40	0.17	9.71
		9		203	10.82	35.49	277	4.51	0.66	0.40	0.08	10.43
		8		401	10.49	35.45	272	4.87	0.70	0.37	0.04	11.14
		7		781	9.3	35.43	216	9.36	1.07	0.34	0.02	17.29
		6		1916	3.61	34.94	282	14.74	1.19	0.38	0.02	18.24
		5		2235	3.2	34.96		23.54	1.29	0.31	0.02	19.52
		4	Lek!	2236	3.2	34.96		8.17	0.84	0.46	0.08	13.32
		3	Lek!	2235	3.2	34.96		8.31	0.87	0.31	0.08	13.66
		2		2235	3.2	34.96	268	23.51	1.30	0.35	0.01	19.54
		1		2235	3.2	34.96	269	23.78	1.30	0.29	0.02	19.47
		Box Water					263	25.01	1.28	0.16	0.00	19.78

Date	Station	Bottle	Depth m	Temp C	Salinity ‰	O2 Winkler µmol/l	Silicate µmol/l	Phosphate µmol/l	Ammonia µmol/l	Nitrite µmol/l	Nitrate µmol/l
29/05/94	D86-06(OMEXIII)	20	4	12.56	35.47		0.61	0.28	0.51	0.12	4.51
		19	4	12.56	35.47		0.62	0.29	0.55	0.13	4.46
		18	4	12.56	35.47	281	0.62	0.29	0.54	0.12	4.49
	Pos. 49 05.21N	17	13	12.53	35.47	281	0.65	0.29	0.55	0.13	4.45
	13 25.9W	16	28	12.11	35.48	284	0.74	0.34	0.60	0.13	5.13
		15	36	11.61	35.51	285	0.79	0.39	0.77	0.16	5.96
		14	57	11.42	35.52	274	2.44	0.51	1.10	0.20	7.10
		13	107	11.06	35.53	271	3.76	0.60	0.26	0.18	9.33
	Depth 3673 m	12	206	10.88	35.51	267	4.17	0.63	0.23	0.03	10.11
		11	562	10.19	35.43	255	5.75	0.78	0.20	0.04	12.50
		10	881	9.33	35.6	206	10.27	1.06	0.24	0.03	17.26
		9	1841	3.55	34.9	289	11.63	1.15	0.23	0.04	17.57
		8	3178	2.69	34.93	260	37.01	1.50	0.22	0.03	21.59
		7	3647	2.5	34.91		43.08	1.52	0.17	0.04	22.62
		6	3646	2.5	34.91		43.34	1.52	0.09	0.03	22.61
		5	3647	2.5	34.91		43.22	1.52	0.21	0.03	22.67
		4	3648	2.5	34.91		43.14	1.52	0.10	0.00	22.73
		3	3649	2.5	34.91		43.34	1.56	0.21	0.01	22.68
		2	3649	2.5	34.91	248	43.52	1.51	0.12	0.02	22.71
		1	3649	2.5	34.91	259	43.56	1.54	0.04	0.02	22.53
		Box Water				250	43.06	1.57	0.26	0.08	22.75

Date	Station	Bottle	Depth m	Temp C	Salinity ‰	O2 Winkler µmol/l	Silicate µmol/l	Phosphate µmol/l	Ammonia µmol/l	Nitrite µmol/l	Nitrate µmol/l
310594	D86-07(E)	22	2	12.22	35.45		0.67	0.30	0.74	0.14	4.52
		21	2	12.22	35.45		0.65	0.30	0.79	0.14	4.51
		20	3	12.22	35.45	281	0.58	0.30	0.81	0.12	4.58
	Pos 49 02.3N	19	11	12.22	35.45	282	0.60	0.30	0.81	0.15	4.55
	13 42.2W	18	26	12.19	35.45	289	0.62	0.31	0.97	0.16	4.56
		17	35	11.89	35.44	290	0.71	0.33	1.05	0.15	4.78
		16	55	11.51	35.47	285	1.19	0.45	1.56	0.20	6.28
		15	105	10.67	35.47	280	4.15	0.67	0.83	0.40	9.67
	Depth 4460 m	14	204	10.47	35.45	274	4.65	0.68	0.23	0.05	10.93
		13	391	10.27	35.43	271	5.08	0.72	0.27	0.03	11.58
		12	826	35.46	8.81	209	10.37	1.12	0.19	0.01	18.04
		11	1089	7.08	35.36	228	11.86	1.18	0.30	0.03	18.68
		10	1899	3.51	34.91	285	12.25	1.18	0.27	0.03	17.81
		9	2984	2.79	34.94	262	33.91	1.43	0.16	0.03	21.21
		8	4467	2.53	34.9		45.18	1.58	0.22	0.03	22.92
		7	4467	2.53	34.9		45.33	1.58	0.28	0.03	22.98
		6	4468	2.53	34.9		45.46	1.56	0.13	0.03	22.95
		5	4468	2.53	34.9		45.20	1.61	0.13	0.04	22.97
		4	4468	2.53	34.9		45.56	1.58	0.20	0.02	23.03
		3	4468	2.53	34.9		45.64	1.58	0.15	0.04	23.14
		2	4468	2.53	34.9	246	45.47	1.58	0.17	0.00	23.21
		1	4468	2.53	34.9	250	44.38	1.57	0.10	0.03	23.08
		Box Water				246	46.31	1.55	0.19	0.01	23.21

Date	Station	Bottle		Depth m	Temp C	Salinity ‰	O2 Winkler µmol/l	Silicate µmol/l	Phosphate µmol/l	Ammonia µmol/l	Nitrite µmol/l	Nitrate µmol/l
4/6/94	08	18		11	12.51	35.48		0.80	0.30	0.82	0.13	4.26
		17		11	12.51	35.48		0.79	0.29	0.78	0.10	4.31
	Pos.	16		11	12.52	35.48		0.77	0.30	0.80	0.08	4.41
	49 14.0N	15		10	12.51	35.48	276	0.84	0.31	0.80	0.10	4.40
	12 30.0 W	14		21	12.46	35.48	277	0.81	0.31	0.86	0.09	4.37
		13		35	12.33	34.9	276	0.90	0.33	0.83	0.14	4.62
		12		55	11.86	35.52	277	1.64	0.44	0.88	0.23	6.03
	Depth	11		104	11.25	35.54	267	3.52	0.57	0.42	0.24	8.78
	1140 m	10		203	10.92	35.52	265	4.01	0.63	0.27	0.05	9.98
		9		603	10.12	35.48	219	7.36	0.94	0.28	0.03	15.08
		8		980	9.07	35.62	205	10.75	1.09	0.34	0.04	17.57
		7	Lek!	1134	8.23	35.53		8.98	0.97	0.32	0.00	15.32
		6		1135	8.23	35.53		12.54	1.14	0.28	0.03	17.84
		5		1134	8.23	35.53		12.66	1.15	0.33	0.04	17.91
		4		1135	8.23	35.53		12.69	1.13	0.34	0.02	17.95
		3		1134	8.23	35.53		12.63	1.14	0.35	0.04	17.92
		2		1133	8.23	35.53	212	12.55	1.15	0.32	0.03	17.92
		1		1135	8.23	35.53	209	12.64	1.14	0.31	0.04	17.98
	box						211	12.27	1.16	0.24	0.01	17.83

Date	Station	Bottle		Depth m	Temp C	Salinity ‰	O2 Winkler µmol/l	Silicate µmol/l	Phosphate µmol/l	Ammonia µmol/l	Nitrite µmol/l	Nitrate µmol/l
5/6/94	D86-09											
		18		4	12.23	35.5		1.21	0.35	0.49	0.16	5.44
		17		4	12.23	35.5		1.16	0.36	0.42	0.16	5.54
	Pos.	16		5	12.23	35.5	278	1.18	0.36	0.38	0.17	5.51
	48 50.54N	15		12	12.2	35.5	278	1.18	0.36	0.45	0.16	5.47
	12 45.0 W	14		21	12.15	35.5	278	1.11	0.35	0.45	0.12	5.53
		13		31	12.04	35.5	279	1.10	0.37	0.47	0.17	5.54
		12		55	11.75	35.51	274	1.83	0.44	0.62	0.22	6.47
	Depth	11		104	11.11	35.52	268	3.61	0.61	0.31	0.26	9.16
	2190 m	10		200	10.9	35.51	269	4.12	0.64	0.29	0.05	9.97
		9		997	9.26	35.63	202	10.41	1.09	0.27	0.01	17.42
		8		1811	3.64	34.92	280	12.63	1.20	0.31	0.03	17.92
		7		2189	3.36	34.965		22.63	1.29	0.26	0.04	19.42
		6		2188	3.36	34.965		22.73	1.31	0.33	0.02	19.28
		5		2189	3.36	34.965		22.83	1.31	0.30	0.04	19.44
		4		2189	3.36	34.965		23.03	1.31	0.34	0.02	19.39
		3		2187	3.36	34.965	264	23.18	1.31	0.30	0.05	19.41
		2		2187	3.36	34.965	263	23.08	1.32	0.28	0.05	19.37
		1		2187	3.36	34.965	264	22.83	1.31	0.32	0.05	19.50
		box					259	25.08	1.36	0.17	0.01	19.67

Date	Station	Bottle		Depth m	Temp C	Salinity ‰	O2 Winkler µmol/l	Silicate µmol/l	Phosphate µmol/l	Ammonia µmol/l	Nitrite µmol/l	Nitrate µmol/l
7/6/94												
		18		4	12.48	35.5		1.16	0.30	0.40	0.15	4.78
	D86-10	17		3	12.48	35.5		1.10	0.28	0.39	0.14	4.90
	Pos.	16		4	12.48	35.5	281	1.20	0.29	0.38	0.14	4.82
	48 51.93N	15		12	12.48	35.5	278	1.11	0.30	0.41	0.14	4.82
	12 38.80W	14		21	12.45	35.5	279	1.36	0.29	0.42	0.13	4.84
		13		34	12.3	35.5	279	1.25	0.31	0.46	0.15	4.95
		12		53	12.19	35.5	281	1.31	0.31	0.50	0.15	5.13
	Depth	11		105	11.08	35.52	265	3.63	0.58	0.28	0.10	9.48
	2290 m	10		197	10.92	35.52	269	4.07	0.62	0.32	0.04	9.98
		9		996	9.25	35.61	201	10.34	1.08	0.26	0.02	17.50
		8		1638	4.3	35	267	13.52	1.19	0.32	0.02	18.43
		7		2281	3.27	34.97		25.97	1.33	0.27	0.00	20.00
		6		2281	3.28	34.97		25.93	1.34	0.20	0.03	19.94
		5		2281	3.28	34.97		26.13	1.34	0.27	0.01	20.02
		4		2279	3.28	34.97		26.34	1.34	0.24	0.02	20.01
		3		2281	3.27	34.97		25.98	1.35	0.31	0.01	19.97
		2		2279	3.28	34.97	259	25.88	1.35	0.28	0.01	20.05
		1		2282	3.27	34.97	260	26.16	1.36	0.18	0.04	19.96
		Boxwater					262	25.95	1.29	0.18	0.01	19.83

Date	Station	Bottle		Depth m	Temp C	Salinity ‰	O2 Winkler µmol/l	Silicate µmol/l	Phosphate µmol/l	Ammonia µmol/l	Nitrite µmol/l	Nitrate µmol/l
9/6/94												
		17		3	13.03	35.54		0.71	0.28	0.57	0.14	4.18
	D86-11	16		2	13.02	35.54		0.68	0.27	0.52	0.15	4.17
		15		2	13	35.54	281	0.68	0.28	0.57	0.15	4.11
	Pos.	14		13	12.86	35.54	282	0.69	0.27	0.51	0.15	4.10
	49 04.5 N	13		23	12.82	35.54	281	0.69	0.27	0.59	0.15	4.13
	11 44.5 W	12		33	12.78	35.54	282	0.72	0.27	0.58	0.15	4.13
		11		53	12.64	35.54	280	0.82	0.32	0.83	0.20	4.61
	Depth	10		102	11.43	35.56	270	3.02	0.53	0.27	0.28	8.47
	1120 m	9		200	11.15	35.54	270	3.63	0.59	0.19	0.05	9.71
		8		903	9.25	35.59	213	10.22	1.08	0.24	0.03	17.44
		7	LEK!	1113	7.54	35.45		9.33	0.97	0.18	0.02	15.74
		6		1113	7.54	35.45		12.88	1.18	0.30	0.03	18.31
		5		1114	7.55	35.45		13.02	1.17	0.21	0.01	18.38
		4		1114	7.55	35.45		13.12	1.18	0.49	0.02	18.40
		3		1114	7.54	35.45		12.97	1.19	0.48	0.02	18.44
		2		1114	7.54	35.45	221	12.88	1.17	0.47	0.03	18.43
		1		1114	7.54	35.45	223	12.84	1.17	0.44	0.02	18.41
		Boxwater					219	12.99	1.14	0.24	0.05	18.05

Date	Station	Bottle		Depth m	Temp C	Salinity ‰	O2 Winkler µmol/l	Silicate µmol/l	Phosphate µmol/l	Ammonia µmol/l	Nitrite µmol/l	Nitrate µmol/l
9/6/94		15		3	12.88	35.45		0.99	0.17	0.09	0.08	2.59
	D86-12	14		3	12.88	35.45		0.99	0.16	0.09	0.04	2.67
		13		3	12.88	35.45		0.99	0.27	0.21	0.06	2.65
	Pos.	12		13	12.84	35.45		1.01	0.19	0.25	0.07	2.77
	49 21.99N	11		22	12.74	35.45		1.08	0.19	0.22	0.09	3.04
	11 48.09W	10		33	12.46	35.45		1.28	0.21	0.24	0.11	3.30
		9		51	12.2	35.46		1.34	0.29	0.42	0.13	4.36
		8		101	11.32	35.46		2.08	0.47	1.15	0.30	6.24
	Depth	7		174	10.58	35.49		5.08	0.67	0.17	0.05	10.86
	185 m	6		174	10.58	35.49		5.12	0.68	0.23	0.06	10.97
		5		173	10.58	35.49		5.06	0.68	0.18	0.02	10.93
		4		174	10.58	35.49		5.16	0.69	0.16	0.03	10.98
		3		174	10.58	35.49		5.12	0.69	0.21	0.04	10.91
		2		173	10.58	35.49		5.14	0.70	0.17	0.06	10.94
		1		173	10.58	35.49		5.15	0.70	0.22	0.05	10.98
		Boxwater						4.92	0.65	0.24	0.07	10.69

RRS CHARLES DARWIN. CRUISE CD86/94.

DIARY OF EVENTS.

Wednesday 18th. May '94.

0800 - Vessel on Charter to NIOZ, The Netherlands Institute for Sea Research. Principal Scientist - Dr.Tj.C.E. van Weering.

Friday 20th. May '94.

0000 - Commenced Singling up.

0015 - Let Go For'd and Aft.

0024 - Vessel Resecured to re-check Bow-Thrust & Engine responses.

0048 - Let Go For'd and Aft.

0105 - Vessel entering Lock.

0121 - Vessel Clear of Lock.

0124 - Vessel Clear of Breakwater.

0130 - Pilot Disembarked.

0148 - Vessel Hove To, SE of Merkur Buoy, to Instal Piston Corer Beam.

0230 - Full Away on Passage, at Breaksea Light Float.

1200 - Position Lat: 50 55.1 N. Long: 06 26.8 W.

1525 - 1540 - CTD Deployed for Calibration Test.

Saturday 21st. May '94.

0337 - NIOZ 3.5 Khz.Fish Deployed Aft; Commenced Survey. 255 T. 6 Kts.

1200 - Position Lat: 49 47.8 N. Long: 12 14.9 W.

1733 - 3.5 Khz Fish Recovered, due to fault.

1828 - 3.5 Khz Fish Deployed, Resume Survey.

Sunday 22nd. May '94.

0416 - Lat: 49 29.97 N. Long: 13 59.90 W. Alter Course to 180 True.

0603 - Lat: 49 18.88 N. Long: 13 59.82 W. Alter Course to 153 True.

0710 - 3.5 Khz Fish Recovered.

1043 - Lat: 48 40.0 N. Long: 13 30.0 W. 3.5 Khz Fish Deployed, Course 070 True, Speed 4 knots.

1200 - Position Lat: 48 41.9 N. Long: 13 21.4 W.

Monday 23rd. May '94.

0512 - Lat: 49 15.1 N. Long: 10 59.4 W. 3.5 Khz Fish Recovered, Co.338T.

0757 - Lat: 49 29.0 N. Long: 11 08.0 W. Vessel Hove To, Station D 86-01.

0804 - 0823 - CTD Deployed. Water Depth 208 metres.

0834 - Lat: 49 29.7 N. Long: 11 08.4 W. TROL Lander Deployed to Sea-Bed.

0905 - 0917 - Lat: 49 29.8 N. Long: 11 08.9 W. Small Box Corer Deployed.

0930 - 0943 - Lat: 49 30.0 N. Long: 11 09.1 W. Small Box Corer Deployed.

0955 - 1006 - Lat: 49 30.0 N. Long: 11 09.3 W. Small Box Corer Deployed.

1030 - 1037 - Lat: 49 29.5 N. Long: 11 08.6 W. Small Box Corer Deployed.

1050 - 1058 - Lat: 49 29.6 N. Long: 11 08.8 W. Small Box Corer Deployed.

1121 - 1131 - Lat: 49 29.8 N. Long: 11 09.2 W. Small Box Corer Deployed.

1200 - Position Lat: 49 29.2 N. Long: 11 08.6 W.

1203 - Lat: 49 29.2 N. Long: 11 08.6 W. TROL Lander Recovered.

1218 - 1227 - Lat: 49 29.5 N. Long: 11 08.5 W. Small Box Corer Deployed.

1235 - 1243 - Lat: 49 29.7 N. Long: 11 08.7 W. Small Box Corer Deployed.

1253 - 1305 - Lat: 49 29.8 N. Long: 11 09.0 W. Small Box Corer Deployed.

1311 - Completed Station D 86-01, Set Course 250 True.

1442 - Lat: 49 24.7 N. Long: 11 31.8 W. Vessel Hove To, Station D 86-02.

1454 - 1537 - CTD Deployed. Water Depth 670 metres.

1540 - Lat: 49 24.9 N. Long: 11 31.4 W. TROL Lander Deployed to Sea-Bed.

1612 - 1637 - Lat: 49 25.3 N. Long: 11 31.7 W. Small Box Corer Deployed.

1644 - 1709 - Lat: 49 25.4 N. Long: 11 31.6 W. Small Box Corer Deployed.

1718 - Lat: 49 25.6 N. Long: 11 31.9 W.BOLAS Lander Deployed to Sea-Bed.

1746 - 1811 - Lat: 49 25.4 N. Long: 11 31.5 W. Small Box Corer Deployed.

1823 - 1846 - Lat: 49 25.5 N. Long: 11 31.3 W. CTD Deployed.

1855 - 1917 - Lat: 49 25.5 N. Long: 11 31.2 W. Small Box Corer Deployed. 02_BOLAS

2030 - Lat: 49 25.0 N. Long: 11 31.4 W. TROL Lander Recovered.

2100 - Vessel Stopped and Drifting; Science to be resumed early AM.

<u>Tuesday 24th. May '94.</u>

0643 - Lat: 49 25.7 N. Long: 11 32.0 W. BOLAS Lander Recovered.

0712 - 0737 - Lat: 49 25.1 N. Long: 11 31.8 W. Small Box Corer Deployed.

0754 - 0817 - Lat: 49 25.1 N. Long: 11 31.4 W. Small Box Corer Deployed.

0829 - 0852 - Lat: 49 25.1 N. Long: 11 31.2 W. Small Box Corer Deployed.

0904 - 0927 - Lat: 49 25.3 N. Long: 11 30.8 W. Small Box Corer Deployed.

0934 - 0952 - Lat: 49 25.4 N. Long: 11 30.5 W. Small Box Corer Deployed.

1037 - Lat: 49 24.7 N. Long: 11 31.9 W. Vessel Hove To at OMEX-1 Site, attempting to release mooring.

1107 - Abandoned Mooring; Set Course for Station D 86-03.

1200 - Position Lat: 49 22.4 N. Long: 11 45.1 W.

1218 - Lat: 49 21.9 N. Long: 11 47.9 W. Vessel Hove To, Station D 86-03.

1227 - 1320 - CTD Deployed. Water Depth 1034 metres.

1347 - Lat: 49 22.1 N. Long: 11 48.0 W. TROL Lander Deployed to Sea-Bed.

1408 - 1442 - Lat: 49 22.5 N. Long: 11 47.6 W. Large Box Corer Deployed.

1525 - 1617 - Lat: 49 22.6 N. Long: 11 47.5 W. Piston Corer Deployed.

1632 - 1707 - Lat: 49 22.6 N. Long: 11 47.6 W. Large Box Corer Deployed.

1707 - 1850 - Re-Terminating and Re-Testing Coring Warp.

1856 - 1927 - Lat: 49 22.8 N. Long: 11 47.3 W. Large Box Corer Deployed.

2020 - Lat: 49 22.2 N. Long; 11 48.2 W. TROL Lander Recovered.

2039 - 2116 - Lat: 49 22.6 N. Long: 11 47.4 N. Large Box Corer Deployed.

2116 - Vessel Hove To; Overside Activities be resumed in following AM.

Wednesday 25th. May '94.

0705 - 0745 - Lat: 49 22.4 N. Long: 11 47.6 W. Large Box Corer Deployed.

0834 - 0907 - Lat: 49 22.7 N. Long: 11 48.0 W. Small Box Corer Deployed.

0925 - 0959 - Lat: 49 22.5 N. Long: 11 48.0 W. Small Box Corer Deployed.

1018 - Complete Station D 86-03, Course 255 True, for D 86-04, OMEX 2.

1200 - Position Lat: 49 16.7 N. Long: 12 16.9 W.

1344 - Lat: 49 11.5 N. Long: 12 44.2 W. Vessel Hove To at BOBO Site.

1350 - 1458 - CTD Deployed. Water Depth 1425 metres.

1513 - Lat: 49 11.4 N. Long: 12 44.4 W. Acoustic Interrogation of BOBO.

1545 - Lat: 49 11.2 N. Long: 12 49.6 W. Vessel Hove To at D 86-04 Site.

1626 - Lat: 49 11.1 N. Long: 12 49.6 W. BOLAS Lander Deployed to Sea-Bed.

1703 - BOBO Acoustically Released from Sea-Bed.

1709 - Sea Rider Launched, with crew of four.

1726 - BOBO on Surface, distance 0.3 miles.

1740 - Stray-Line attached to Lander and Sea-Rider Recovered.

1810 - Lat: 49 11.3 N. Long: 12 44.4 W. BOBO Lander Recovered.

1917 - 2005 - Lat: 49 11.3 N. Long: 12 49.7 W. Large Box Corer Deployed.

2051 - 2138 - Lat: 49 11.1 N. Long: 12 49.2 W. Large Box Corer Deployed.

2138 - Vessel Hove To; Overside Activities to be resumed following AM.

Thursday 26th. May '94.

0805 - Lat: 49 11.2 N. Long: 12 49.1 W. TROL Lander Deployed to Sea-Bed.

0820 - 0905 - Lat: 49 11.5 N. Long: 12 48.5 W. Large Box Corer Deployed.

0948 - 1033 - Lat: 49 11.4 N. Long: 12 48.6 W. Large Box Corer Deployed.

1111 - 1149 - Lat: 49 11.4 N. Long: 12 48.6 W. Small Box Corer Deployed.

1200 - Position Lat: 49 11.4 N. Long: 12 48.6 W.

1241 - 1322 - Lat: 49 11.2 N. Long: 12 48.8 W. Small Box Corer Deployed.

1337 - 1419 - Lat: 49 11.3 N. Long: 12 48.8 W. Small Box Corer Deployed.

1448 - 1548 - Lat: 49 11.5 N. Long: 12 48.9 W. Piston Corer Deployed.

1820 - Lat: 49 11.2 N. Long: 12 49.7 W. TROL Lander Recovered.

1920 - BOLAS Lander Acoustically Released from Sea-Bed.

2019 - BOLAS Lander on Surface.

2045 - Lat: 49 11.2 N. Long: 12 50.3 W. BOLAS Lander Recovered.

2045 - Overside Scientific Activities be resumed in following AM. Set Co. 265 True Speed 1.5 K.

Friday 27th. May '94.

0256 - Lat: 49 09.5 N. Long: 13 05.1 W. Vessel Hove To at St'n.D 86-05.

0708 - 0845 - Lat: 49 09.7 N. Long: 13 05.4 W. CTD Deployed to 2250 m.

0908 - 1018 - Lat: 49 09.5 N. Long: 13 05.3 W. Large Box Corer Deployed.

1054 - 1200 - Lat: 49 09.7 N. Long: 13 05.4 W. Large Box Corer Deployed.

1200 - Position Lat: 49 09.6 N. Long: 13 05.4 W.

1224 - 1330 - Lat: 49 09.5 N. Long: 13 05.4 W. Large Box Corer Deployed.

1336 - 1444 - Lat: 49 09.6 N. Long: 13 05.3 W. Large Box Corer Deployed.

1512 - 1638 - Lat: 49 09.6 N. Long: 13 05.3 W. Piston Corer Deployed.

1815 - Lat: 49 09.73 N. Long: 13 05.56 W. BOLAS Lander Deployed.

1912 - Lat: 49 09.72 N. Long: 13 05.86 W. TROL Lander Deployed.

1912 - Overside Scientific Activities be resumed in following AM.

Saturday 28th. May '94.

0757 - Lat: 49 09.6 N. Long: 13 06.7 W. TROL Lander Recovered.

0817 - 0931 - Lat: 49 09.5 N. Long: 13 05.8 W. Large Box Corer Deployed.

1000 - 1112 - Lat: 49 09.5 N. Long: 13 06.1 W. Small Box Corer Deployed.

1124 - 1238 - Lat: 49 09.7 N. Long: 13 06.3 W. Small Box Corer Deployed.

1200 - Position Lat: 49 09.6 N. Long: 13 06.3 W.

1707 - 1726 - CTD Deployed to 100 metres, for Test of BOBO Equipment.

1735 - 1754 - Lat: 49 11.6 N. Long: 13 04.6W. CTD Deployed to 100 m.

1804 - 1824 - CTD Deployed to 100 metres, for Equipment Testing.

1930 - BOLAS Lander Acoustically Released from Sea-Bed.

2041 - Lat: 49 09.6 N. Long: 13 06.2 W. BOLAS Lander Recovered.

2041 - Overside Scientific Activities be resumed in following AM.

Sunday 29th. May '94.

0000 - Set Course 243 True, for Station D 86-06, OMEX 3.

0330 - Lat: 49 05.1 N. Long: 13 25.7 W. V/l. Stopped in vicinity of Stn.

0700 - Vessel Hove To on Station D 86-06.

0722 - 0951 - Lat: 49 05.2 N. Long: 13 26.1 W. CTD Deployed to 3675 m.

1006 - 1200 - Lat: 49 05.1 N. Long: 13 26.4 W. Large Box Corer Deployed, Box Corer Failed Mechanically.

1200 - Position Lat: 49 05.0 N. Long: 13 26.4 W.

1211 - 1408 - Lat: 49 05.3 N. Long: 13 25.9 W. Large Box Corer Deployed.

1429 - Lat: 49 05.5 N. Long: 13 25.7 W. BOLAS Lander Deployed to Sea-Bed. Modifying and Overhauling Large Box Corer Trigger Mechanism.

1556 - 1755 - Lat: 49 05.6 N. Long: 13 25.4 W. Large Box Corer Deployed.

1821 - 2010 - Lat: 49 05.0 N. Long: 13 25.8 W. Large Box Corer Deployed.

2030 - Lat: 49 05.1 N. Long: 13 25.8 W. TROL Lander Deployed to Sea-Bed.

2030 - Overside Scientific Activities to be resumed in following AM.

Monday 30th. May '94. 06-BOLAS

0640 - Lat: 49 04.7 N. Long: 13 26.4 W. TROL Lander Sighted on Surface.

0658 - Lat: 49 05.3 N. Long: 13 26.1 W. TROL Lander Recovered.

0718 - 0908 - Lat: 49 05.0 N. Long: 13 25.4 W. Large Box Corer Deployed.

0908 - Box Corer Recovered with Holothurian, Olive Green in colour, with Back Spines. Dimensions:- 39 cms long, 11 cms wide and 11 cms high.

0936 - 1116 - Lat: 49 05.0 N. Long: 13 25.8 W. Small Box Corer Deployed.

1139 - 1316 - Lat: 49 05.2 N. Long: 13 26.0 W. Small Box Corer Deployed.

1200 - Position Lat: 49 05.1 N. Long: 13 26.0 W.

1342 - 1545 - Lat: 49 05.2 N. Long: 13 26.0 W. Piston Corer Deployed.

1554 - 1738 - Lat: 49 05.5 N. Long: 13 25.3 W. Small Box Corer Deployed.

1835 - Lat: 49 05.0 N. Long: 13 25.8 W. TROL Lander Deployed to Sea-Bed.

1906 - BOLAS Lander Acoustically Released from Sea-Bed.

2041 - Lat: 49 05.4 N. Long: 13 26.0 W. BOLAS Lander Recovered.

2041 - Overside Scientific Activities to be resumed in following AM.

Tuesday 31st. May '94.

0630 - Lat: 49 04.7 N. Long: 13 26.8 W. TROL Lander Sighted on Surface.

0653 - Lat: 49 05.0 N. Long: 13 26.1 W. TROL Lander Recovered.

0707 - All Secure. Complete Station D 86-06. Set Course 255T .Full Sp'd.

0819 - Lat: 49 02.3 N. Long: 13 42.3 W. Vessel Hove To on St'n. D 86-07.

0821 - 1110 - Lat: 49 02.4 N. Long: 13 42.3 W. CTD Deployed to 4500 m.

1120 - 1355 - Lat: 49 02.3 N. Long: 13 42.2 W. Large Box Corer Deployed.

1200 - Position Lat: 49 02.3 N. Long: 13 42.2 W.
1431 - Lat: 49 02.4 N. Long: 13 42.4 W. BOLAS Lander Deployed to Sea-Bed.
1449 - 1702 - Lat: 49 02.8 N. Long: 13 41.8 W. Large Box Corer Deployed.
1728 - 1934 - Lat: 49 02.5 N. Long: 13 41.6 W. Large Box Corer Deployed.
1958 - Lat: 49 02.4 N. Long: 13 42.1 W. TROL Lander Deployed to Sea-Bed.
1958 - Overside Scientific Activities to be resumed in following AM.

Wednesday 1st. June '94.

0712 - Lat: 49 02.6 N. Long: 13 42.4 W. TROL Lander Sighted on Surface.
0728 - Lat: 49 02.6 N. Long: 13 42.0 W. TROL Lander Recovered.
0741 - 0953 - Lat: 49 02.5 N. Long: 13 42.3 W. Large Box Corer Deployed.
1018 - 1243 - Lat: 49 02.3 N. Long: 13 41.8 W. Small Box Corer Deployed.
1200 - Position Lat: 49 02.3 N. Long: 13 41.9 W.
1256 - 1500 - Lat: 49 01.9 N. Long: 13 42.5 W. Small Box Corer Deployed.
1522 - 1725 - Lat: 49 02.1 N. Long: 13 43.0 W. Small Box Corer Deployed.
1745 - 2019 - Lat: 49 02.4 N. Long: 13 42.6 W. Piston Corer Deployed.
2019 - Overside Scientific Activities to be resumed in following AM.

07-80543

Thursday 2nd. June '94.

0612 - Lat: 49 02.5 N. Long: 13 41.5 W. BOLAS Acoustically Released.
0735 - Lat: 49 02.7 N. Long: 13 41.9 W. BOLAS Sighted on Surface.
0801 - Lat: 49 02.5 N. Long: 13 42.2 W. BOLAS Lander Recovered.
0829 - Complete Station D 86-07 (E), Set Course 075 True.
0938 - Lat: 49 05.3 N. Long: 13 24.8 W. Vessel Hove To, St'n. D 86-06 B.
0951 - 1153 - Lat: 49 05.2 N. Long: 13 25.1 W. Piston Corer Deployed.
1200 - Position Lat: 49 05.1 N. Long: 13 24.8 W.
1311 - Completed Core Sampling; All secure on deck. Set Course 074 True.
1643 - Lat: 49 12.4 N. Long: 12 48.9 W. 3.5 Khz. Acoustic Survey Aborted at this time, due to rising sea conditions. Set Course 083 True.
1800 - Lat: 49 14.5 N. Long: 12 28.8 W. Vessel Hove To, in vicinity of Station D86-08. Science Suspended due to deteriorating weather conditions. Wind:230, 28 Knots. Barometer: 995.7 mbs.
2000 - Lat: 49 12.7 N. Long: 12 31.0 W. Wind: 260, 45 Knots. Baro: 996.2.
2359 - Lat: 49 09.5 N. Long: 12 37.7 W. Wind: 270, 45/50 K. Baro: 1002.1.

Friday 3rd. June '94.

0400 - Lat: 49 06.0 N. Long: 12 49.5 W. Wind: 270, 35/45 K. Baro: 1005.5.
0700 - Lat: 49 06.2 N. Long: 12 59.0 W. Wind: 280, 35/45 K. Baro: 1009.5.

1200 - Lat: 49 09.5 N. Long: 13 16.6 W. Wind: 270, 28/38 K. Baro: 1012.5.
1600 - Lat: 49 10.0 N. Long: 13 31.2 W. Wind: 260, 20/30 K. Baro: 1013.4.
Alter Course 085 True, to Relocate to Station, in Weather Window.
1900 - Lat: 49 13.6 N. Long: 12 39.3 W. Alter Course 135 True.
2000 - Lat: 49 11.4 N. Long: 12 24.4 W. Wind: 260, 20/30 K. Baro: 1010.7.
2359 - Lat: 49 01.3 N. Long: 12 15.3 W. Wind: 220, 35/45 K. Baro: 1003.6.

Saturday 4th. June '94.

0400 - Lat: 48 56.8 N. Long: 12 25.8 W. Wind: 270, 30/40 K. Baro: 1003.7.
0600 - Lat: 48 55.3 N. Long: 12 31.4 W. Wind: 280, 35/40 K. Baro: 1004.7.
0636 - Lat: 48 55.0 N. Long: 12 32.4 W. Alter Course 060 True.
0700 - Lat: 48 56.9 N. Long: 12 26.9 W. Wind: 290, 30 Knots. Baro: 1005.7.
0801 - Lat: 49 02.0 N. Long: 12 12.8 W. Alter Course 310 True.

Saturday 4th. June '94. Continued.

1155 - Lat: 49 14.2 N. Long: 12 30.6 W. Wind: 310, 20 Knots. Baro: 1014.7.
1200 - Lat: 49 14.2 N. Long: 12 30.6 W. Vessel Hove To, at Station D 86-08. Water Depth 1175 metres. Assessing Swell Conditions for Deployment.
1229 - Received Urgency Message from Portishead Radio. Yacht 'Seaflo' with severe structural damage to mast, unable to sail and running low on fuel, in position Lat: 49 14 N. Long: 13 03 W. Co.090, Sp'd. 6-7 K.
1240 - Contact made with yacht 'Seaflo', (Call-Sign ZCAA3), on VHF, and Rendezvous arranged. Charles Darwin 21 miles due east of yacht.
1430 - 1524 - Lat: 49 14.1 N. Long: 12 30.1 W. CTD Deployed to 1158 metres.
1536 - Lat: 49 14.2 N. Long: 12 30.2 W. Yacht 'Seaflo' close by starboard side; Commenced RASing at 2.5 knots, head to wind.
1606 - Lat: 49 14.8 N. Long: 12 31.0 W. Completed supplying 'Seaflo' with 250 litres of diesel oil and other supplies. Returning to Station.
1624 - Lat: 49 14.1 N. Long: 12 30.1 W. Vessel Hove To, on Station.
1644 - 1724 - Lat: 49 14.2 N. Long: 12 30.0 W. Large Box Corer Deployed.
1750 - 1839 - Lat: 49 13.7 N. Long: 12 30.2 W. Large Box Corer Deployed.
1904 - 1937 - Lat: 49 13.5 N. Long: 12 30.1 W. Large Box Corer Deployed.
2031 - Lat: 49 13.9 N. Long: 12 29.9 W. BOLAS Lander Deployed to Sea-Bed. 08_BOLAS
2051 - Lat: 49 13.8 N. Long: 12 30.1 W. TROL Lander Deployed to Sea-Bed.
2051 - Overside Scientific Activities to be resumed in following AM.

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Sunday 5th. June '94.

0700 - Lat: 49 13.9 N. Long: 12 29.6 W. TROL Lander Sighted on Surface.

0716 - Lat: 49 13.8 N. Long: 12 29.6 W. TROL Lander Recovered.
0731 - 0818 - Lat: 49 13.8 N. Long: 12 29.6 W. Large Box Corer Deployed.
0847 - 0925 - Lat: 49 13.5 N. Long: 12 29.4 W. Large Box Corer Deployed.
0950 - 1025 - Lat: 49 13.5 N. Long: 12 29.8 W. Small Box Corer Deployed.
1040 - 1112 - Lat: 49 13.4 N. Long: 12 29.5 W. Small Box Corer Deployed.
1200 - Position: Lat: 49 13.8 N. Long: 12 30.2 W.
1214 - 1300 - Lat: 49 13.7 N. Long: 12 30.1 W. Piston Corer Deployed.
1410 - Lat: 49 13.8 N. Long; 12 29.4 W. BOLAS Acoustically Released.
1430 - Lat: 49 14.0 N. Long: 12 29.3 W. BOLAS Sighted on Surface.
8-80cAS 1446 - Lat: 49 13.8 N. Long: 12 29.6 W. BOLAS Lander Recovered.
1500 - All Secure on Deck, Complete Station D 86-08, Set Course 203 True.
1745 - Lat: 48 50.5 N. Long: 12 44.9 W. Hove To at Station D 86-09,
1752 - 1916 - Lat: 48 50.0 N. Long: 12 45.4 W. CTD Deployed to 2218 m.
1939 - 2046 - Lat: 48 50.4 N. Long: 12 45.5 W. Large Box Corer Deployed.
2046 - Overside Scientific Activities to be resumed in following AM.

Monday 6th. June '94.

0715 - Lat: 48 51.9 N. Long: 12 38.7 W. BOLAS Lander Deployed to Sea-Bed, at Station D 86-10,(Water Depth 2290 metres). 09-30cAS
0720 - All Secure on Deck, Set Course 253 True, for Station D 86-09.
0842 - Lat: 48 50.4 N. Long: 12 44.8 W. TROL Lander Deployed to Sea-Bed.
0859 - 0955 - Lat: 48 50.0 N. Long: 12 44.7 W. Large Box Corer Deployed.
1015 - 1127 - Lat: 48 50.5 N. Long: 12 45.0 W. Large Box Corer Deployed.
1146 - 1248 - Lat: 48 50.4 N. Long: 12 45.3 W. Large Box Corer Deployed.
1200 - Position: Lat: 48 50.4 N. Long: 12 45.2 W.
1320 - 1418 - Lat: 48 50.4 N. Long: 12 45.6 W. Large Box Corer Deployed.
1445 - 1600 - Lat: 48 50.6 N. Long: 12 45.8 W. Small Box Corer Deployed.
1622 - 1724 - Lat: 48 50.4 N. Long: 12 45.8 W. Small Box Corer Deployed.
1730 - Lat: 48 50.2 N. Long: 12 46.1 W. TROL Acoustically Released.
1753 - TROL Lander Sighted on Surface.
1818 - Lat: 48 50.8 N. Long: 12 45.1 W. TROL Lander Recovered.
1917 - 2042 - Lat: 48 50.5 N. Long: 12 44.6 W. Piston Corer Deployed.
2042 - Overside Scientific Activities to be resumed in following AM.

Tuesday 7th. June '94.

0703 - Lat: 48 51.9 N. Long: 12 38.7 W. Vessel Hove To, Station D 86-10.
0707 - 0839 - Lat: 48 51.8 N. Long: 12 38.9 W. CTD Deployed to 2294 m.
0900 - 1012 - Lat: 48 52.1 N. Long: 12 38.7 W. Large Box Corer Deployed.

1039 - 1148 - Lat: 48 52.0 N. Long: 12 38.5 W. Large Box Corer Deployed.

1200 - Position: Lat: 48 52.0 N. Long: 12 38.2 W.

1210 - 1316 - Lat: 48 52.1 N. Long: 12 38.3 W. Large Box Corer Deployed.

1336 - Lat: 48 52.0 N. Long: 12 38.7 W. TROL Lander Deployed to Sea-Bed.

1355 - 1454 - Lat: 48 52.2 N. Long: 12 39.1 W. Large Box Corer Deployed.

1527 - 1642 - Lat: 48 51.8 N. Long: 13 39.4 W. Piston Corer Deployed.

1725 - Lat: 48 50.7 N. Long: 12 39.0 W. TROL Released from Sea-Bed.

1800 - TROL Lander Sighted on Surface.

1819 - Lat: 48 51.7 N. Long: 12 39.1 W. TROL Lander Recovered.

1901 - BOLAS Lander Acoustically Released from Sea-Bed.

1940 - BOLAS Sighted on Surface.

1954 - Lat: 48 51.6 N. Long: 12 39.3 W. BOLAS Lander Recovered.

1954 - Overside Scientific Activities to be resumed in following AM.

Wednesday 8th. June '94.

0800 - Lat: 48 51.9 N. Long: 12 38.9 W. Vessel Hove To on St'n. D 86-10.

0804 - 0912 - Lat: 48 51.9 N. Long: 12 39.0 W. Small Box Corer Deployed.

0930 - 1029 - Lat: 48 51.9 N. Long: 12 38.9 W. Small Box Corer Deployed.

1044 - Complete Station D 86-10. Set Course 336 True for BOBO Site.

1200 - Position: Lat: 49 03.5 N. Long: 12 47.2 W.

1250 - Lat: 49 10.7 N. Long: 12 51.9 W. Commence Acoustic Survey.

1448 - Lat: 49 11.1 N. Long: 12 51.4 W. Complete Acoustic Survey.

1502 - Lat: 49 11.4 N. Long: 12 49.5 W. Vessel Hove To at BOBO Site.

1509 - 1556 - Lat: 49 11.4 N. Long: 12 49.4 W. CTD Deployed to 1454 metres.

1700 - Lat: 49 11.24 N. Long: 12 49.31 W. Long-Term, Sea-Bed Sampling Lander BOBO Deployed.

1700 - Overside Scientific Activities to be resumed in following AM.

Thursday 9th. June '94.

0245 - Lat: 49 04.7 N. Long: 12 41.8 W. Set Co. 064 True for St'n. D 86-03.

0700 - Lat: 49 22.0 N. Long: 11 48.1 W. Vessel Hove To, at Station D 86-03.

Liner Q.E.II. Spoken to on VHF, as she passes 1.7 miles to North, on a Course of 264 True, Speed 29.4 Knots.

0712 - Lat: 49 22.0 N. Long: 11 48.1 N. BOLAS Lander Deployed to Sea-Bed.

.03_BOLAS

0718 - Set Course 172 True, for Station D 86-11.

0900 - Lat: 49 04.6 N. Long: 11 44.4 W. Vessel Hove To, at Station D 86-11.

0926 - 1010 - Lat: 49 04.5 N. Long: 11 44.5 W. CTD Deployed to 1120 metres.

1028 - Starboard Lifeboat Lowered into Water and sent away under Power for

Drill and Engine Testing purposes.

1045 - Lifeboat Hoisted and Resecured.

1119 - 1152 - Lat: 49 04.4 N. Long: 11 44.6 W. Small Box Corer Deployed.

1200 - Position: Lat: 49 04.5 N. Long: 11 44.5 W.

1205 - 1240 - Lat: 49 04.3 N. Long: 11 44.2 W. Small Box Corer Deployed.

1300 - 1333 - Lat: 49 04.4 N. Long: 11 44.5 W. Large Box Corer Deployed.

1351 - 1425 - Lat: 49 04.1 N. Long: 11 45.0 W. Large Box Corer Deployed.

1455 - 1524 - Lat: 49 04.6 N. Long: 11 44.4 W. Large Box Corer Deployed.

1550 - 1628 - Lat: 49 04.3 N. Long: 11 44.3 W. Large Box Corer Deployed.

1648 - 1718 - Lat: 49 04.1 N. Long: 11 44.2 W. Small Box Corer Deployed.

1738 - 1808 - Lat: 49 04.3 N. Long: 11 44.7 W. Small Box Corer Deployed.

1808 - Complete Station D 86-11, Set Course 353 True, for BOLAS Position.

1948 - Lat: 49 21.7 N. Long: 11 47.9 W. Vessel Hove To, BOLAS Acoustically Released from Sea-Bed.

2031 - Lat: 49 21.9 N. Long: 11 48.2 W. BOLAS Lander Recovered.

2044 - All Secure; Set Course 075 True, for Site of OMEX 1 Mooring.

2149 - Lat: 49 24.8 N. Long: 11 31.8 W. Vessel Stopped at Site of OMEX 1 Mooring. Listening on Acoustics.

2214 - No Response from Mooring. Set Course 095 True, for Station D86-12.

<u>Friday 10th. June '94.</u>

0316 - Lat: 49 23.4 N. Long: 10 59.9 W. Vessel Stopped by Station D 86-12.

0700 - Lat; 49 23.1 N. Long: 11 00.1 W. V/l. Hove To on St'n. Depth 230 m.

0706 - 0722 - Lat: 49 23.0 N. Long: 11 00.1 W. CTD Deployed to 173 metres.

0802 - 0808 - Lat: 49 23.0 N. Long: 11 00.2 W. Small Box Corer Deployed.

0821 - 0831 - Lat: 49 22.8 N. Long: 11 00.2 W. Small Box Corer Deployed.

0842 - 0849 - Lat: 49 22.8 N. Long: 11 00.0 W. Small Box Corer Deployed.

0856 - 0906 - Lat: 49 22.8 N. Long: 10 59.8 W. Small Box Corer Deployed.

0916 - Complete Station D 86-12. Set Course 320 True for Station D 86-01.

1020 - Lat: 49 29.9 N. Long: 11 08.7 W. Vessel Hove To on Station D 86-01.

1038 - 1046 - Lat: 49 29.8 N. Long: 11 08.8 W. Small Box Corer Deployed.

1046 - Commenced Unshipping Piston Corer Frame from Bulwarks.

1107 - Vessel moved 0.5 miles NE of Station, to avoid fishing floats.

1107 - 1120 - Lat: 49 30.3 N. Long: 11 08.4 W. Small Box Corer Deployed.

1124 - Overside Scientific Activities Completed, Set Course 067 True.

1200 - Position: Lat: 49 32.7 N. Long: 10 59.7 W.