Management Unit of the North Sea
Mathematical Models

RV BELGICA CRUISE 99/19
OMEX II phase 2 - Biochemistry Programme

Belgian GLOBAL CHANGE and SUSTAINABLE DEVELOPMENT Programme

- 1999 -

RV BELGICA CRUISE 99/19

CONTENTS

1. INTRODUCTION 2

2. COMPUTER LOGGED OCEANOGRAPHIC, NAVIGATIONAL AND METEOROLOGIC DATA 4

2.1 Navigational instrumentation
2.2 Oceanographic instrumentation
2.3 Meteorological instrumentation

3.THE DATA ACQUISITION SYSTEM 7

3.1 ODAS II data acquisition and processing system
3.2 STD - Horizontal profiling system
3.3 STD - Vertical profiling system
3.4 Data file inventory

4. REMARKS CONCERNING DATA ACQUISITION AN DATA VALIDITY 9

4.1 Position data
4.2 Salinity measurements
4.3 Chlorophyll a measurements
4.4 ODAS data quality monitoring

5. REVIEW OF TABLES AND PLOTS 12

Appendix 1. STD stations positions and track plot
Appendix 2. Horizontal profiles of the meteo data
Appendix 3 Horizontal profiles of the oceanographic data
Appendix 4 Sea-Bird SBE09plus data at the sampling depths
Appendix 5 Sea-Bird SBE09plus data vertical profiles
Appendix 6 Vertical profiles of light penetration
Appendix 7 Comparison Sea-Bird SBE09plus versus Guildline Portasal salinometer data

MUMM is the "Management of the marine ecosystem" department of the Royal Institute for Natural Sciences, Federal office for scientific, technical and cultural affairs.

R/V BELGICA CRUISE 99/19 - OMEX II

MUMM contribution - Track plots and sampling stations STD- profiles and horizontal profiles (S, T, fluorescence, meteo)

---

1. INTRODUCTION.

On 30th August 1999 the RV Belgica left Zeebrugge and headed for the Golf of Biskay La Chapelle Bank for the first part of the cruise 99/19 (**leg A**) which has been conducted in the frame of the **Belgian Global Change and sustainable development programme.** During **leg A** of cruise 99/19 stations 1 to 9 have been sampled and underway parameters were measured continuously.

The RV Belgica arrived in La Coruña (Spain) on the 3rd September for the embarkation of 7 additional scientists.

The second part (**leg B and leg C**) of the cruise 99/19 took place in the framework of the Ocean Margin Exchange project "OMEX II" (EEC MAST III programme) with the research efforts focussed on the up welling zone along the Spanish coast. The Belgica left La Coruña for **leg B** on the 4th of September and arrived in La Coruña again on the 11th. **Leg C** started on the 14th September and was finished on the 18th, one day earlier then planned due to bad weather conditions. During **leg B and leg C** 36 stations have been sampled in front of the Spanish coast. On 18th September 8 scientists were disembarked at La Coruña and then the Belgica left the harbour the same day and headed for Zeebrugge arriving at the home port on the 21th September.

Dr M. Frankignoulle (ULg) was the chief scientist for this cruise. The following laboratories have participated:

* Management Unit of the North Sea Mathematical Model (MUMM), Belgium.
* British Oceanographic Data Centre (BODC), Merseyside, U.K.
* Université de Liège (Ulg) - Laboratoire d'Océanologie, Belgium.
* Université Libre de Bruxelles (ULB) - Laboratoire d'Oceanographie, Belgium.
* Vrije Universiteit Brussel - Laboratorium voor Analytische Scheikunde, Belgium
* Plymouth Marine Laboratory (PML), Plymouth ,U.K.
* University of Plymouth, Plymouth, U.K.
* University of Algarve, Faro, Portugal.

MUMM was responsible for the automatic data acquisition and logging of oceanographic, meteorological and navigational data (ODASII computer logging) and the Sea-Bird STD and light profile casts.

In addition to the data acquisition task, general assistance was offered in using the on board scientific instrumentation and related infrastructure, the Niskin bottle sampling, etc ...

Also discrete water samples have been taken by MUMM for post cruise laboratory salinity measurements as well as Chlorophyll a samples. Both series of samples have been analysed at MUMM's laboratory situated in Oostende.

The present report describes the computer logged oceanographic, meteorological and navigational data, including the Sea-Bird STD data (81 casts) and the Sea-Bird light profile data (39 casts), gathered during this cruise . Also the results of the laboratory salinity measurements and the data of the analysed discrete chlorophyll samples have been included.

2. COMPUTER LOGGED OCEANOGRAPHIC, NAVIGATIONAL AND METEOROLOGICAL DATA.

2.1. Navigational instrumentation

During this cruise, the data from the following navigational instruments connected to the ship born computer system were logged by the Oceanographic Data Acquisition System "ODASII" :

* SERCEL NR103 DGPS positioning system with an accuracy of 3 to 5 m using the Sercel beacons for differential corrections.
* MAGNAVOX 200MX DGPS positioning system with an accuracy of ca. 5 m using IALA beacons for the differential correction .
* Anshutz STD20 Gyro Compass.
* Raytheon DSN450 Doppler speed log and bathymetric depth.
* Atlas Deso 22 Scientific Echosounder.
  The Atlas Deso 22 is equipped with 2 transducers (33 kHz and 210 kHz). The 33 kHz transducer has a depth range of ca. 1500 m in good weather conditions.
* TSS 320B Heave Compensator.
  The data of the Atlas Deso 22 echosounder are corrected for the heave by the TSS 320B.
* Furuno Echosounder FCV381.
  The Furuno is also equipped with 2 transducers (28 kHz and 88 kHz). Only the 28 kHz transducer with a depth range of ca. 2000 m in good weather conditions is used .

2.2. Oceanographic instrumentation

The sea surface temperature was measured continuously with the remote temperature sensor of the Sea-Bird SBE21 thermosalinograph as well as with a Sea-Bird SBE38 temperature sensor, both installed at the inlet of the non-toxic seawater circuit situated at the bow of the vessel.

The Sea-Bird SBE21 thermosalinograph, installed in the wet lab, is also connected to the non-toxic seawater circuit. The salinity was measured continuously using a personal computer with a dedicated software package from Sea-Bird. The processed data were continuously (every 6 sec.) transmitted to the HP1000/A400 data acquisition computer. The specifications of this thermosalinograph are found in table 1.

Parameter	Units	Range	Accuracy
TEMPERATURE	°C	-5 - +35	0.01 °C / 6 months
CONDUCTIVITY	S/m	0 - 7	0.001 S / m / month

Table 1. Sea-Bird SBE21 thermosalinograph specifications.

Salinity and density are calculated from conductivity, temperature and depth, in accordance to the 1978 Practical Salinity Scale from the IEEE Journal of Oceanic Engineering, January 1980.

A Turner Designs 10-AU-005 fluorimeter, also connected to the non toxic seawater circuit, was used to measure chlorophyll concentrations during the full campaign. The data were also transmitted to the HP1000/A400 data acquisition computer.

Frequently samples have been taken from the seawater circuit in order to postcalibrate the SBE21 thermosalinograph and the Turner Designs Fluorimeter data.

STD vertical profiles have been taken with the Sea-Bird SBE09*plus* STD profiler integrated with the Sea-Bird carousel water sampling system SBE32. The specifications of this STD profiling system are given in table 2.

Parameter	Units	Range	Accuracy (guaranteed)
DEPTH	m	0 - 3000	0.1 % of full scale range
TEMPERATURE	°C	-5 - +35	0.01 °C / 6 months
CONDUCTIVITY	S/m	0 - 6	0.001 S / m / month
DIS. OXYGEN	µmol/kg	0 - 600	5 µmol / kg / day
Backscatterance (OBS)	FTU	0 - 200	2.5 % of full scale range

Table 2. Sea-Bird SBE09*plus* specifications.

2.3. Meteorological instrumentation

Following parameters were measured by the Friedrichs meteorological station :

- wind speed
- wind direction
- air temperature
- atmospheric pressure

In addition a solar radiation measuring device from Kipp & Zonen was installed.

The outputs of these sensors are analogous signals that are measured with the Hewlett Packard HP44701A 4 ½ digit digital voltmeter incorporated in the ODASII system. Table 3 gives a summary of the specifications of the meteo sensors.

Parameter	Units	Range	Precision
WIND SPEED	m/s	0 - 41	0.2
WIND DIRECTION	degrees	0 - 360	2
ATMOSPHERIC PRESSURE	mbar	950 - 1050	1.5
AIR TEMPERATURE	°C	-35 - +45	0.2
SOLAR RADIATION	Watt/m²	0 - 1000	10

Table 3. Meteo sensor specifications.

The meteo sensors as well as the digital voltmeter are calibrated at least once a year.

3. DATA ACQUISITION SYSTEM.

3.1.ODASII data acquisition and processing system.

A Hewlett Packard HP1000 Model A400 real-time minicomputer system with 26 RS-232 interfaces and a Hewlett Packard HP3852A data acquisition system (for analogous signals) were used to acquire meteorological, hydrological and navigational data at a 10 seconds interval.

The HP1000/A400 minicomputer is implemented as a black box. All input devices are connected through RS232 type interfaces to this real-time computer. The data acquisition software collects the sensor data and delivers this raw data to the data processing software implemented on a HP9000/748i-100 UNIX workstation. This on-line data processing software converts the raw data from the different input devices into physical units and stores the data in an Informix relational database.

The data presentation software is based on a Client Server model. The oceanographic data in the Informix database on the UNIX workstation are obtained on personal computer through a local area network (thin Ethernet LAN). These personal computer presentation units are installed in the labs, in the computer room and on the bridge and are accessible by all scientists on board for the production of real-time listings, graphs and track plots.

3.2. STD - Horizontal profiling system.

The Sea-Bird SBE21 thermosalinograph data were recorded continuously to obtain horizontal salinity and water temperature profiles during the trajectories or time profiles at the fixed stations. The sensors are interrogated every 6 seconds using the dedicated Sea-Bird data acquisition and presentation software installed on a personal computer. The converted values were transmitted in real-time to the ODASII system.

3.3. STD - Vertical profiling system.

The Sea-Bird SBE09*plus* STD system measures the depth of the sensor package, water temperature, conductivity and dissolved oxygen at a rate of 24 samples per second. These data were averaged in the Sea-Bird deck unit over a 0.5 sec. time interval.

The averaged data are plotted in real-time on the PC display, allowing for an immediate decision of the water sampling depths. The Sea-Bird STD software also allows to mark the STD data when water bottle samples are taken so that the STD and related parameters are known at the exact depth.

3.4. Data file inventory.

The underway data acquired with the ODASII system are stored in an Informix relational database and they have the following names :

- campaign : ST9919A
- PDC : N9910S
  N1601S
  O990S5

Filename	Acquisition rate	Type of data	Duration
st9919an9910s1	10"	navig. + meteo + oceano.	Full campaign.

Table 4.1 Data file inventory (ODAS II data).

The data files created with the Sea-Bird STD systems during the BELGICA cruise 99/19 have the following file names.

Filename (*)	Acquisition rate	Type of data	Stations
991901.DAT ... 991950.DAT	0.5"	STD vertical profiles	1 to 9 and 11 to 50
LI05A, LI05B, ... LI45A, LI45B	0.5"	STD light penetration profiles	5,44,45,29,30,11,33

Table 4.2 Data file inventory Sea-Bird data.

(*) for a complete list see appendix 1

These file names or derivatives occur on the different listings and plots.

4. REMARKS CONCERNING DATA PROCESSING AND DATA VALIDITY.

4.1. Navigational data.

During the whole OMEX cruise, the DGPS based navigation system Sercel NR103 was used as the primary positioning instrument. The Magnavox MX200 DGPS system was used as a backup system.

4.2. Meteorological data.

The meteo data are stored on board the Belgica in the Informix database with a 10 sec. interval. At the MUMM Measuring Service spikes have been eliminated while also the data have been averaged over a 10 min. interval. For the wind speed and - direction the data were vector averaged.

4.3. Oceanographic data.

4.3.1 Underway data.

4.3.1.1. Salinity calibrations.

The salinity data from the Sea-Bird SBE 21 thermosalinograph, connected to the non toxic seawater supply, have been compared with the data from the 79 discrete water samples taken during the cruise at regular intervals. The water samples have been analysed at MUMM's laboratory with the Guildline Portasal laboratory salinometer. An offset of - 0.004 (PSU) and a standard deviation of 0.006 (PSU) were observed. See appendix 7.

4.3.1.2. Chlorophyll measurements.

The range of the Turner Designs 10-AU-005 Fluorimeter is set at MUMM's laboratory using a dilution of standard chlorophyll a in acetone. The blank is set with Milli-Q water. This setting is done to get a fixed reference only.

The fluorescence data of the Turner Design fluorimeter have been correlated with the data of the analysed discrete chlorophyll samples taken at regular intervals during the cruise. The discrete chlorophyll samples have been analysed at MUMM's laboratory using the Lorenzen method.

The chlorophyll a concentration can be estimated from fluorescence as follows (see Appendix 8) :

chlorophyll a (μg/l) = -0.551 + 0.133 * fluorescence,
Correlation factor : $R^2 = 0.829$
Degrees of freedom : n = 81

4.3.2 STD data

4.3.2.1 Validation of the STD salinity measurements.

During the campaign vertical STD profiles have been taken with the SBE model 09*plus* STD system. The SBE09*plus* STD system was equipped with a SBE-3 temperature sensor and a SBE-4 conductivity sensor.

At different locations and multiple depths water samples have been taken to validate the salinity data of the SBE09*plus* system. The water samples (68) have been analysed in MUMM's laboratory Oostende with a Guildline Portasal Model 8410 laboratory salinometer.

The Guildline Portasal salinometer is calibrated using IAPSO standard seawater capsules obtained from the Ocean Scientific Ltd (UK).

The results of the Guildline Portasal salinometer have been compared with the Sea-Bird SBE09*plus* salinity measurements (see Appendix 9).

	Standard deviation	Mean error	Correlation coëff.
SBE09*plus* - Guildline	0.0035	-0.0002	0.9998

4.3.2.2 Validation of the Backscatterance data.

During the cruise problems occurred with the backscatterance sensor on the SBE09plus CTD. Jumps in the data were observed and also an increase of the measured value with depth. All backscatterance data from campaign 99/19 measured later than 9th September 1999 13h15 GMT should be used with extremely care (stations 00, 12, 13, 14, 16, 20, 22, 33,36,37, 42, 43, 44c and 44d).

4.4. ODAS data quality monitoring.

One of the features of the ODASII system is the monitoring of the data quality of all subsystems, instruments and parameters interrogated.

To each parameter value, subsequently logged in the ODASII database, two bytes are added to take into account these data validity checks.

The validity is also shown on the data listings and transferred to the ASCII files. The following code is used :

Code	Meaning
M	Malfunction of a subsystem.
U	No update of the data since the previous logged value.
V	Data not valid (e.g. test on data string format failed).
D	Range error of the DVM subsystem.
R	Lower/upper range test.
G	Gradient test.
=	Not used.
S	Suspected data indication given by e.g. a positioning system.

5. REVIEW OF LISTINGS AND PLOTS IN APPENDICES.

APPENDIX 1 :
Table 1 gives the position, the water depth, the date and the time of the STD vertical profiles. All these profiles have been taken with the Sea-Bird SBE09*plus* STD system.

Figure 1 gives a map with a view of the track plot and all the sampling stations while figures 2 and 3 show details of the transects of the cruise 99/19.

APPENDIX 2 :
The wind speed and direction, the air temperature, the solar radiation and the atmospheric pressure are plotted in function of time. These data were acquired with the Friedrichs meteo system.

APPENDIX 3 :
The surface water temperature, the salinity and the chlorophyll a are plotted in function of time. These data were acquired with the Sea-Bird SBE21 thermosalinograph and the Turner Designs fluorimeter.

APPENDIX 4 :
Table 2 gives the values of the oceanographic parameters at the STD water sampling points.

APPENDIX 5 :
The vertical profiles of the temperature, the salinity, the density the dissolved oxygen and the backscatterance are shown for all stations.

APPENDIX 6 :
The graphplots of the incident light vs. depth of all light profile casts are given.

APPENDIX 7:
Comparison of the Sea-Bird SBE21 thermosalinograph salinity data versus the Guildline Portasal salinometer data (table and a figure)

APPENDIX 8:
Evaluation of the Turner Designs fluorescence data versus the analysed discrete chlorophyll a samples (table and figure).

APPENDIX 9:
Comparison of the Sea-Bird SBE09plus CTD salinity data versus the Guildline Portasal salinometer data (table and a figure)

Appendix 1

Plot with station annotations and list of positions

SERCEL NR 103 : DGPS position

ATLAS DESO-22 : water depth

MUMM is the "Management of the marine ecosystem" department of the Royal Institute for Natural Sciences, Federal office for scientific, technical and cultural affairs.

Table 1. Position SCTD stations OMEX 99/19.

Station number	Date 1999	Time of V.P.(1)	Latitude	Longitude	Waterdepth (m)	Datafile
01	01-Sep	7:49 AM	N47 45 21.42	W 7 04 58.28	175	991901A
02	01-Sep	8:52 AM	N47 41 57.18	W 7 06 44.25	169	991902A
03	01-Sep	9:26 AM	N47 38 31.54	W 7 08 27.22	166	991903A
04	01-Sep	10:03 AM	N47 34 56.12	W 7 10 19.09	164	991904A
05	01-Sep	12:00 AM	N47 31 20.43	W 7 11 56.07	651	991905A
06	02-Sep	9:41 AM	N47 27 45.79	W 7 13 58.17	>2500	991906A
07	02-Sep	11:10 AM	N47 23 54.50	W 7 16 03.38	>2500	991907A
08	02-Sep	11:55 AM	N47 20 27.32	W 7 17 55.93	>2500	991908A
09	02-Sep	12:42 PM	N47 16 58.48	W 7 19 58.52	>2500	991909A
48	04-Sep	4:00 PM	N42 59 45.00	W 9 48 21.60	+/- 2300	991948A
44	04-Sep	7:43 PM	N42 50 05.40	W 9 46 25.80	+/- 1530	991944A
40	05-Sep	1:10 AM	N42 49 48.00	W 9 37 47.40	+/- 1100	991940A
44	05-Sep	4:56 AM	N43 00 00.00	W 9 19 09.60	40	991944A
46	05-Sep	3:55 PM	N43 00 06.36	W 9 30 58.80	206	991946A
39	05-Sep	5:55 PM	N42 50 06.00	W 9 21 06.60	156	991939A
38	05-Sep	6:50 PM	N42 50 03.00	W 9 19 15.60	126	991938A
31	05-Sep	8:00 PM	N42 39 58.80	W 9 22 00.00	130	991931A
24	05-Sep	10:00 PM	N42 29 59.40	W 9 10 48.00	98	991924A
25	05-Sep	10:40 PM	N42 30 14.40	W 9 16 54.00	140	991925A
26	05-Sep	11:47 PM	N42 30 01.20	W 9 26 18.60	+/- 1000	991926A
45	06-Sep	6:00 AM	N43 00 00.00	W 9 27 36.00	132	991945A
34	06-Sep	2:32 PM	N42 40 10.20	W 9 42 49.80	1649	991934A
32	06-Sep	6:48 PM	N42 40 03.60	W 9 30 18.60	197	991932A
27	06-Sep	8:16 PM	N42 30 12.00	W 9 39 45.60	+/- 1300	991927A
29	07-Sep	6:03 AM	N42 40 00.00	W 9 09 00.60	84	991929A
35	07-Sep	3:00 PM	N42 39 51.60	W 9 50 13.20	1988	991935A
36	07-Sep	5:20 PM	N42 39 59.40	W 9 00 01.80	2239	991936A
30	08-Sep	3:01 AM	N42 39 20.40	W 9 12 40.80	101	991930A
15	08-Sep	2:17 PM	N42 09 14.40	W 9 43 58.80	2103	991915A
21	08-Sep	6:47 PM	N42 19 50.40	W 9 37 38.40	1477	991921A
19	08-Sep	1:21 PM	N42 19 58.80	W 9 12 11.40	158	991919A
11	09-Sep	4:45 AM	N42 08 52.80	W 9 57 34.80	95	991911A
13	09-Sep	1:40 PM	N42 09 07.80	W 9 19 11.40	226	991913A
16	09-Sep	5:05 PM	N42 08 52.80	W 9 59 58.20	+/- 2570	991916A
20	09-Sep	10:35 PM	N42 19 42.60	W 9 27 48.60	670	991920A
33	10-Sep	2:15 AM	N42 40 05.40	W 9 36 16.80	991	991933A
49	10-Sep	6:35 PM	N42 59 59.40	W 10 00 58.20	+/- 3000	991949A
44	11-Sep	5:56 AM	N43 00 00.00	W 9 19 18.00	43	991944A
0	14-Sep	11:15 AM	N43 12 06.00	W 9 15 12.00	108	991900A
44	14-Sep	1:10 PM	N43 00 37.20	W 9 19 21.00	70	991944A
42	14-Sep	4:45 PM	N42 49 50.40	W 9 59 46.20	+/- 2800	991942A
43	14-Sep	7:30 PM	N42 49 45.00	W 10 17 27.60	+/- 3100	991943A
37	15-Sep	5:55 AM	N42 40 00.00	W 10 18 00.60	+/- 3000	991937A
36	15-Sep	11:37 AM	N42 40 06.60	W 10 00 10.20	+/- 2500	991936A
12	16-Sep	5:58 AM	N42 09 06.00	W 9 08 24.00	141	991912A
18	16-Sep	9:20 PM	N42 19 51.00	W 9 00 07.80	99	991918A
14	17-Sep	6:00 AM	N42 09 00.00	W 9 32 00.00	1656	991914A
22	17-Sep	1:50 PM	N42 19 53.40	W 9 46 00.00	2022	991922A

Remarks : (1) The time noted is the starttime (GMT) of the vertical profile.

Figure 1

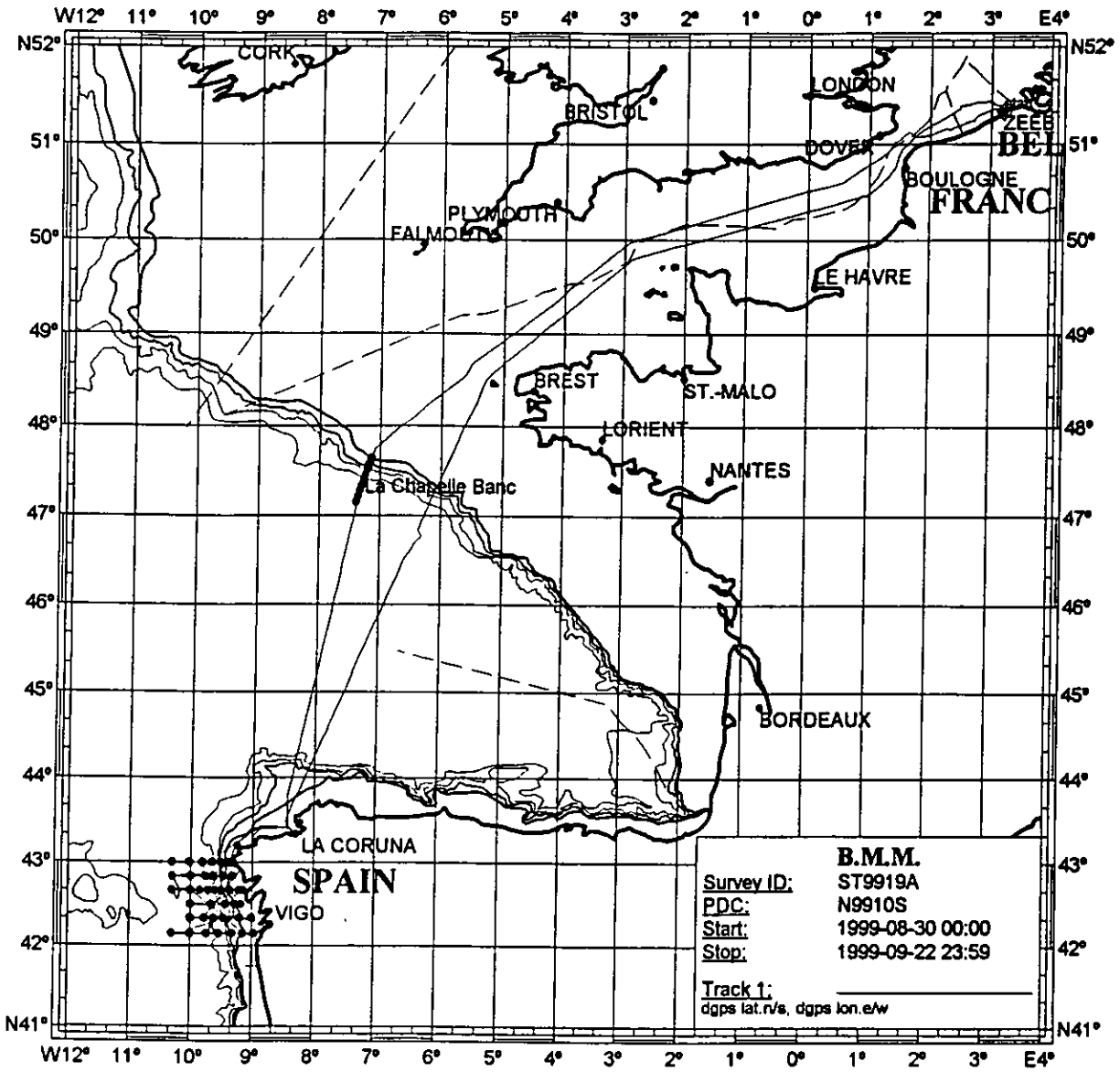

W12° 11° 10° 9° 8° 7° 6° 5° 4° 3° 2° 1° 0° 1° 2° 3° E4°
N52°
51°
50°
49°
48°
47°
46°
45°
44°
43°
42°
N41°
CORK
BRISTOL
LONDON
DOVER
ZEEB
BEL
BOULOGNE
FRANC
PLYMOUTH
FALMOUTH
LE HAVRE
BREST
ST.-MALO
LORIENT
NANTES
La Chapelle Banc
BORDEAUX
LA CORUNA
SPAIN
VIGO
B.M.M.
Survey ID: ST9919A
PDC: N9910S
Start: 1999-08-30 00:00
Stop: 1999-09-22 23:59
Track 1:
dgps lat.n/s, dgps lon.e/w

Figure 2

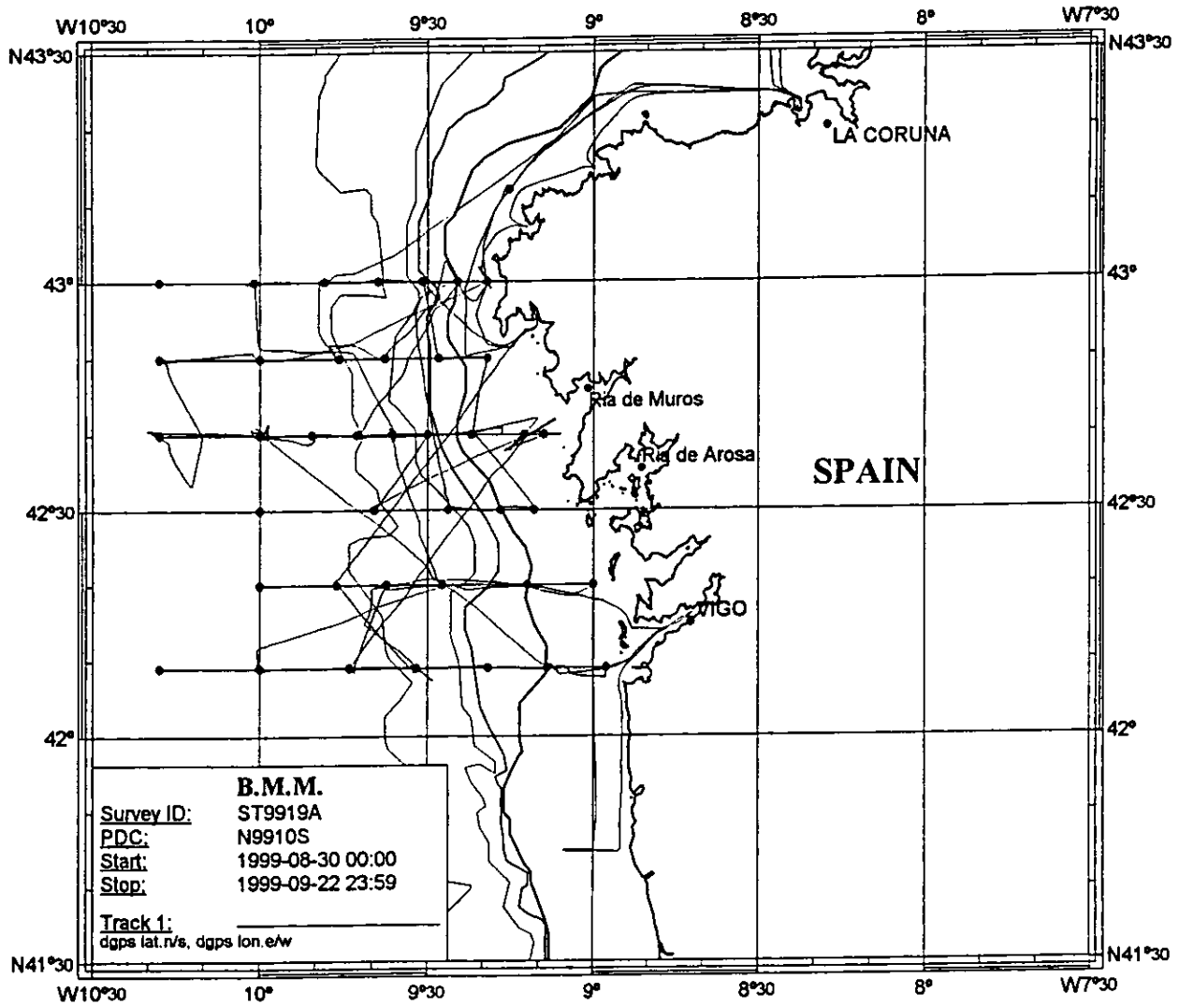
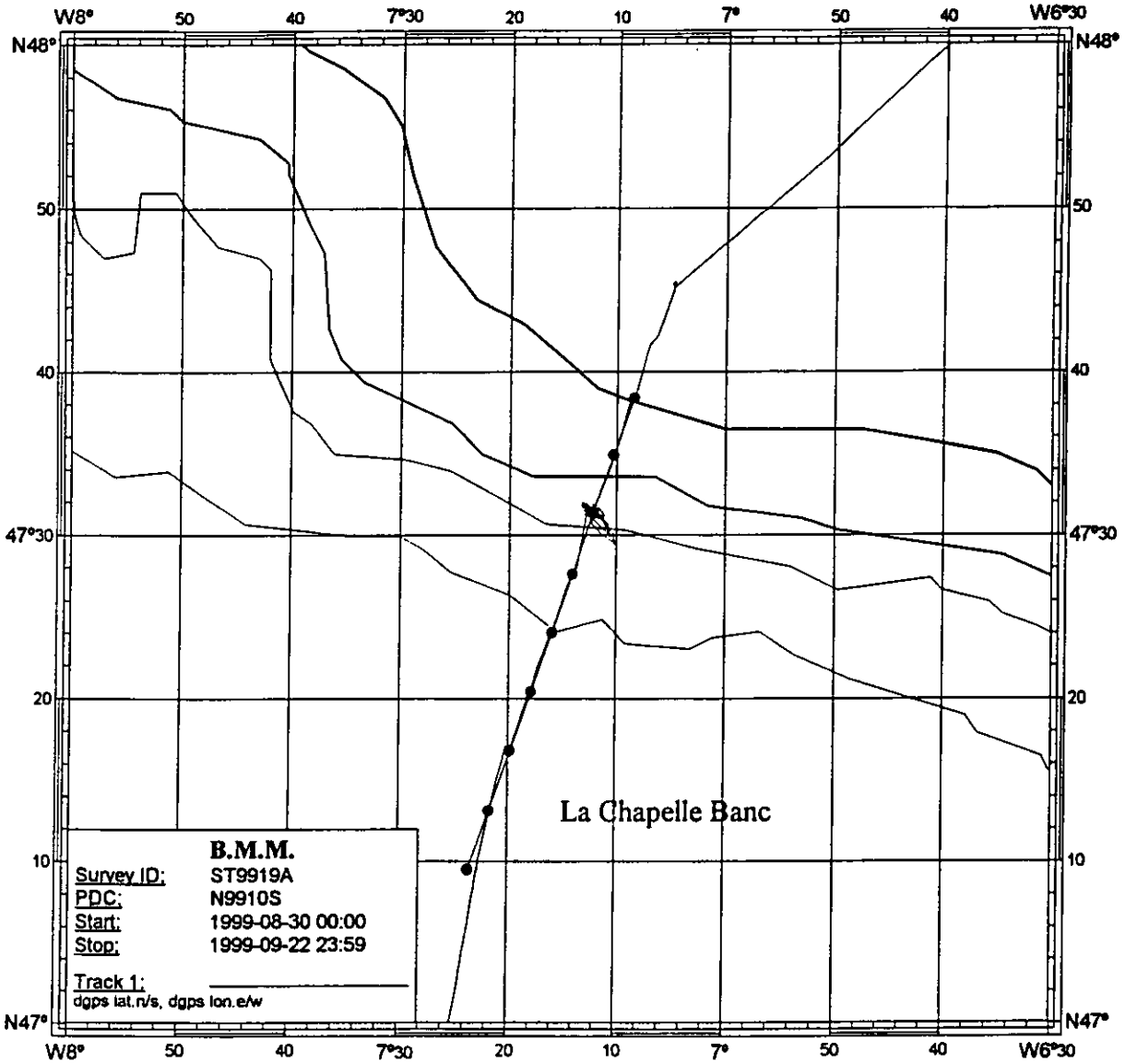

W10°30
10°
9°30
9°
8°30
8°
W7°30
N43°30
43°
42°30
42°
N41°30
LA CORUNA
Ria de Muros
Ria de Arosa
SPAIN
VIGO
B.M.M.
Survey ID: ST9919A
PDC: N9910S
Start: 1999-08-30 00:00
Stop: 1999-09-22 23:59
Track 1:
dgps lat.n/s, dgps lon.e/w

Figure 3


W8°
50
40
7°30
20
10
7°
50
40
W6°30
N48°
50
40
47°30
20
10
N47°
La Chapelle Banc
B.M.M.
Survey ID: ST9919A
PDC: N9910S
Start: 1999-08-30 00:00
Stop: 1999-09-22 23:59
Track 1:
dgps lat.n/s, dgps lon.e/w

Appendix 2

Meteorological data during the complete campaign

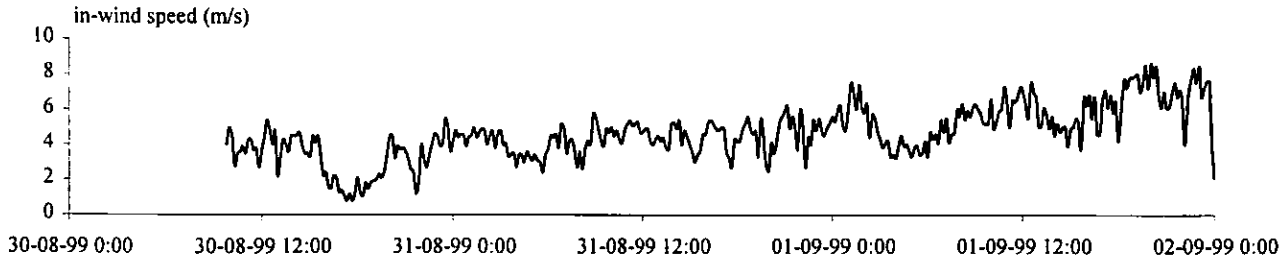
FRIEDRICHS : wind speed and -direction, air temperature, atmospheric pressure

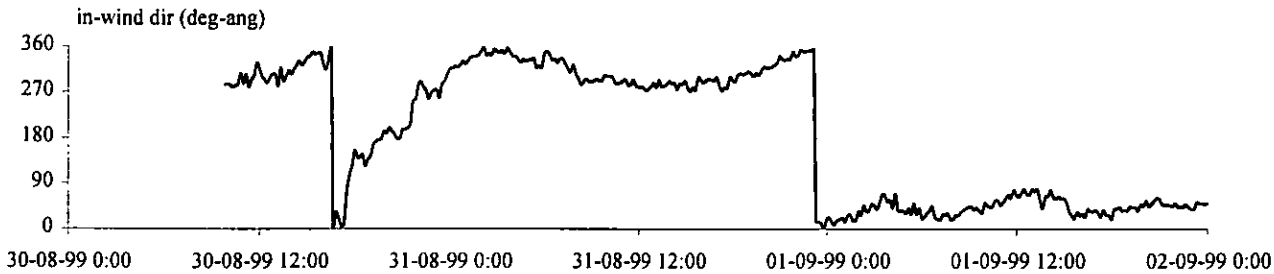
KIPP & ZONEN : solar radiation

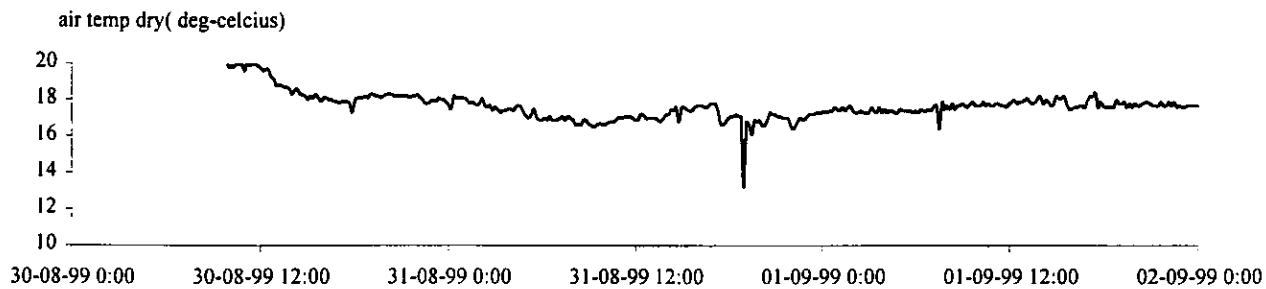
MUMM is the "Management of the marine ecosystem" department of the Royal Institute for Natural Sciences. Federal office for scientific, technical and cultural affairs.

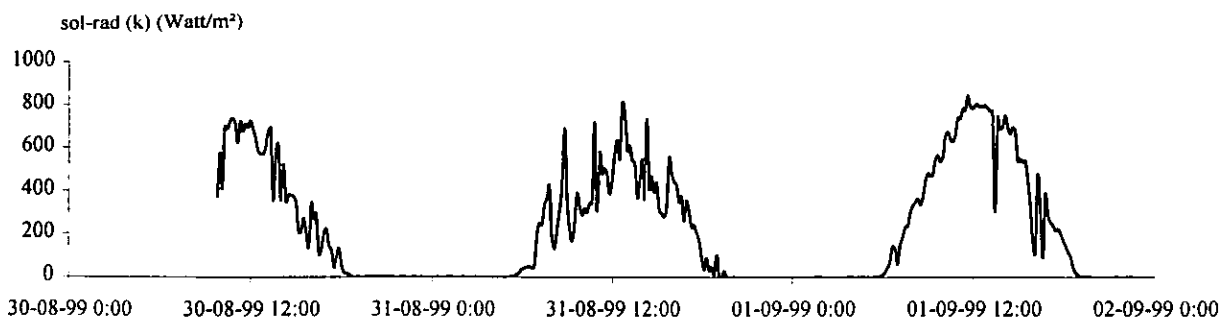
RV BELGICA - CRUISE 99/19

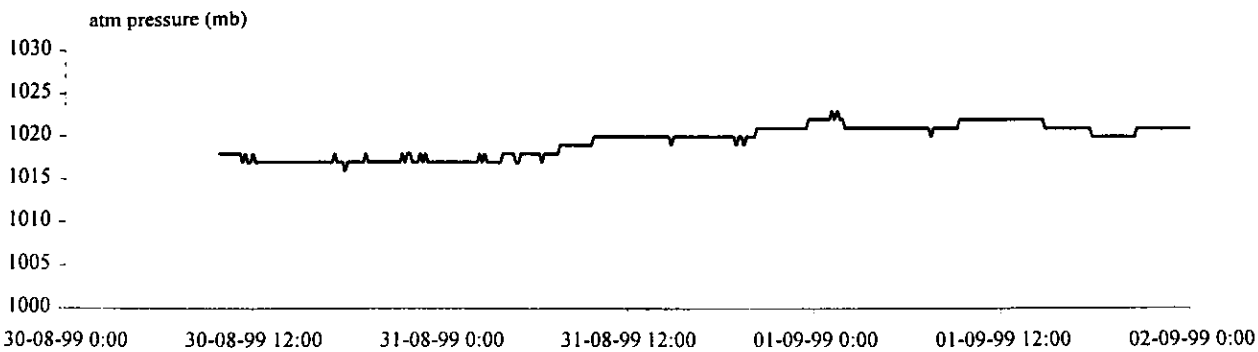
30.08.99 0:00 - 02.09.99 0:00





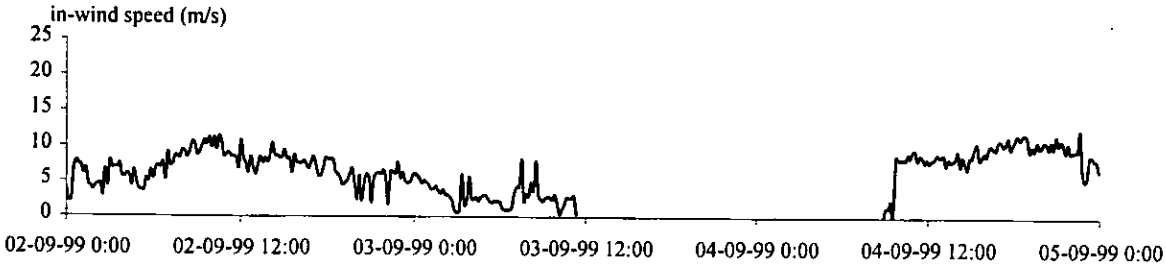


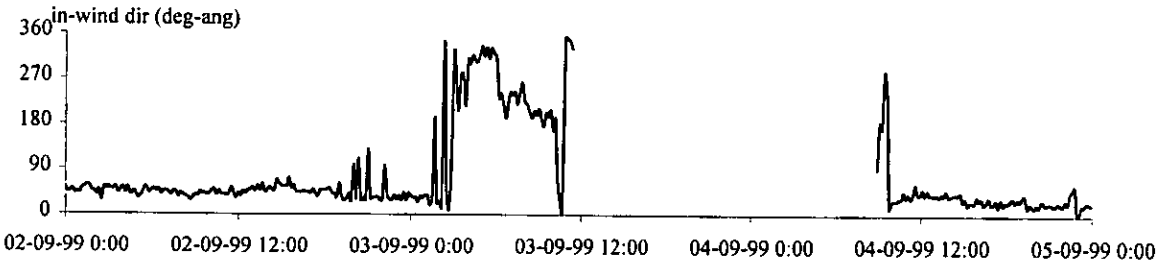


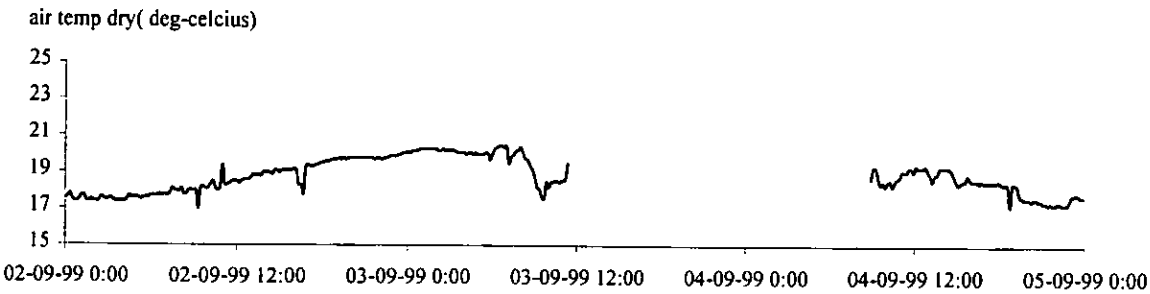


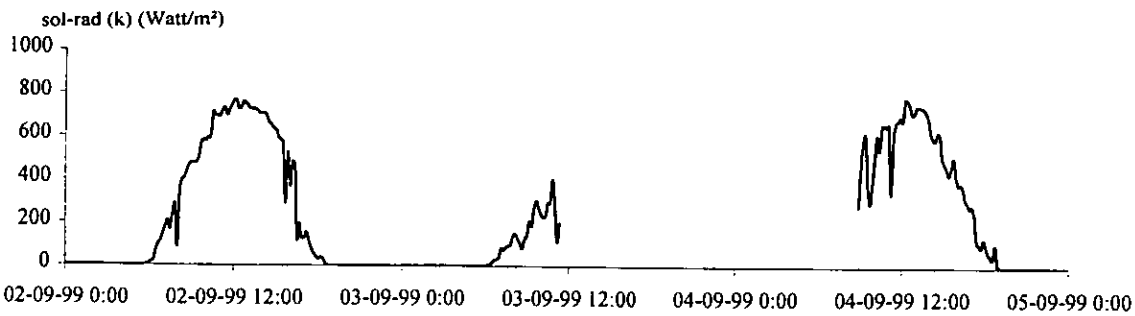
RV BELGICA - CRUISE 99/19

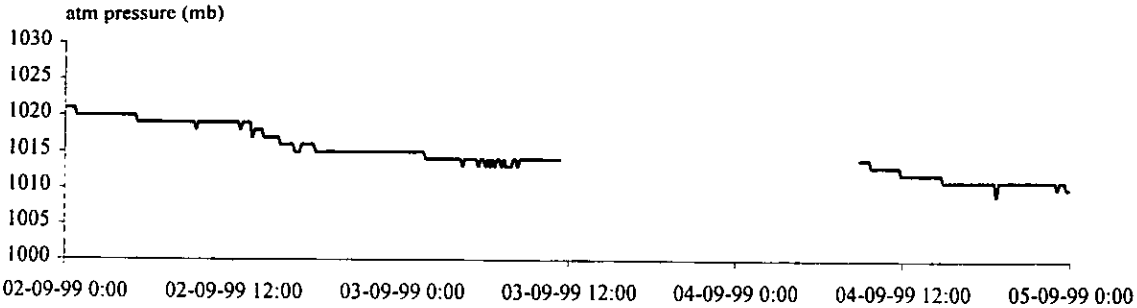
02.09.99 0:00 - 05.09.99 0:00





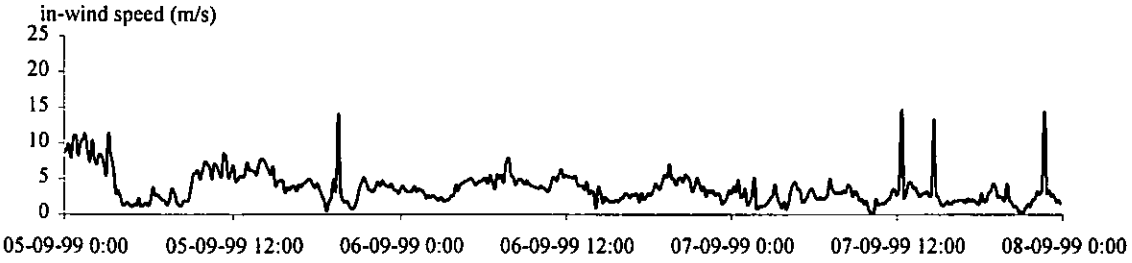


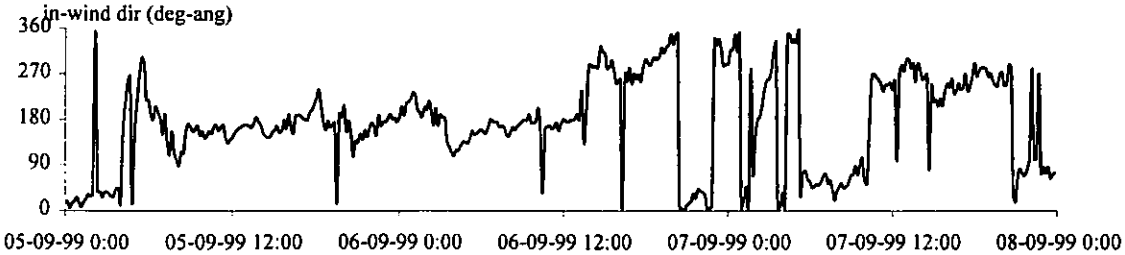


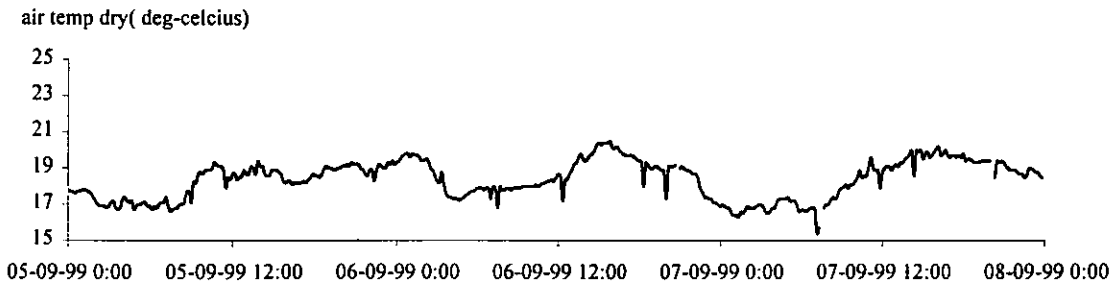


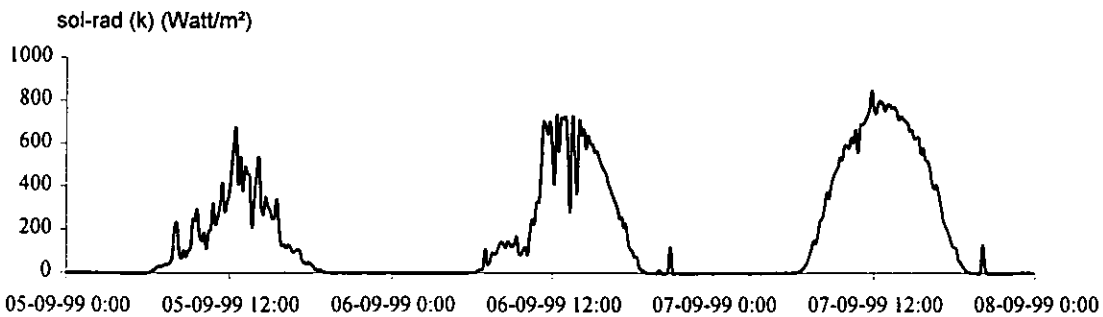
RV BELGICA - CRUISE 99/19

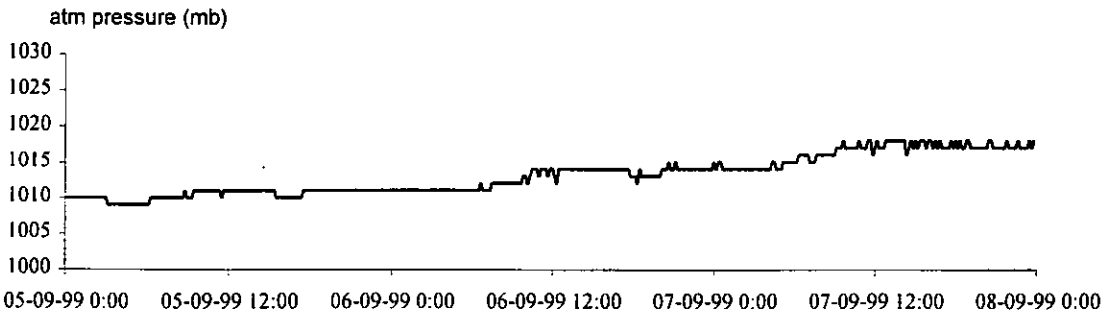
05.09.99 0:00 - 08.09.99 0:00





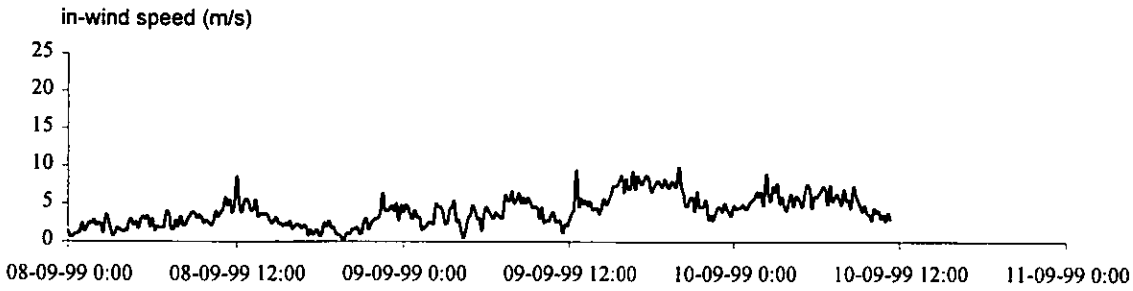


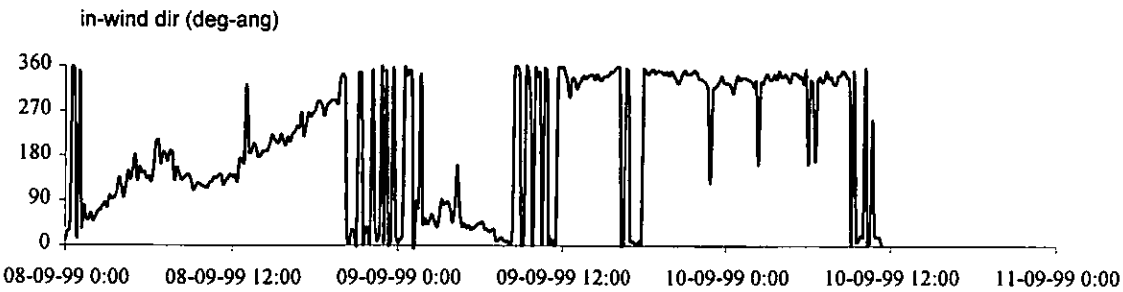


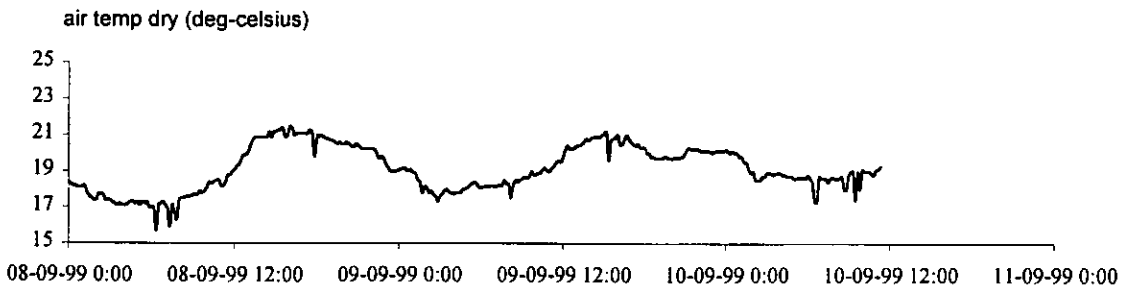


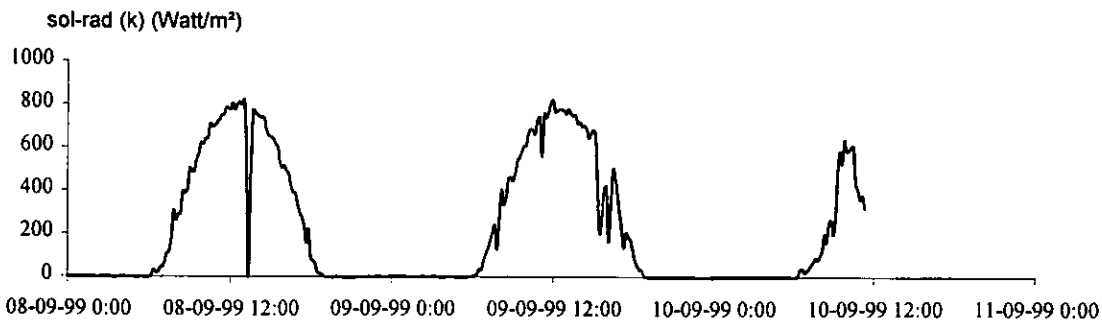
RV BELGICA - CRUISE 99/19

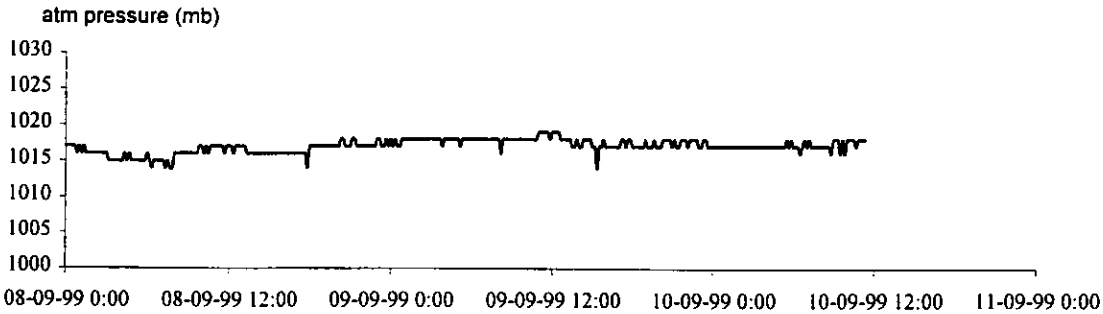
08.09.99 0:00 - 11.09.99 0:00







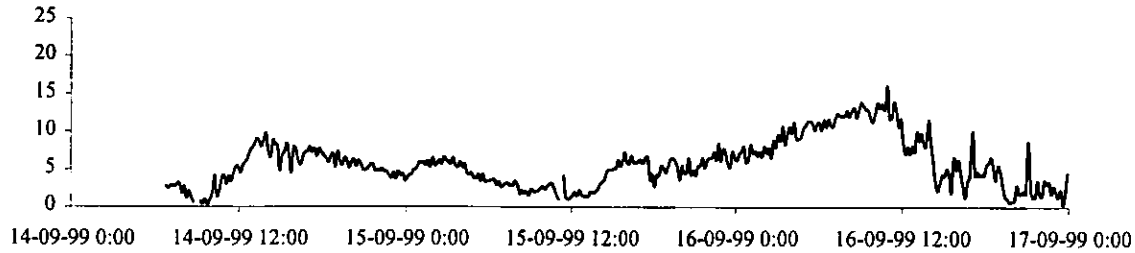




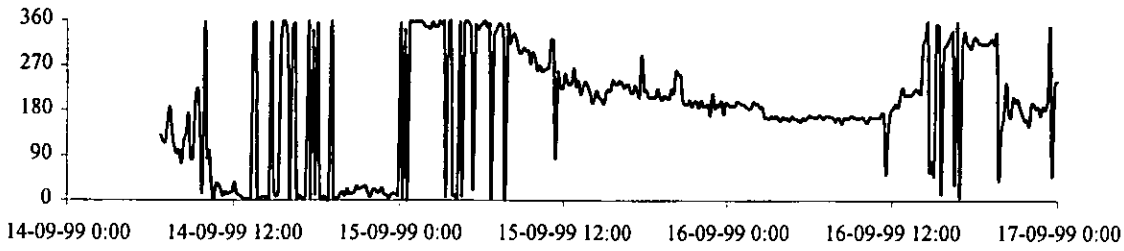
RV BELGICA - CRUISE 99/19

14.09.99 0:00 - 17.09.99 0:00

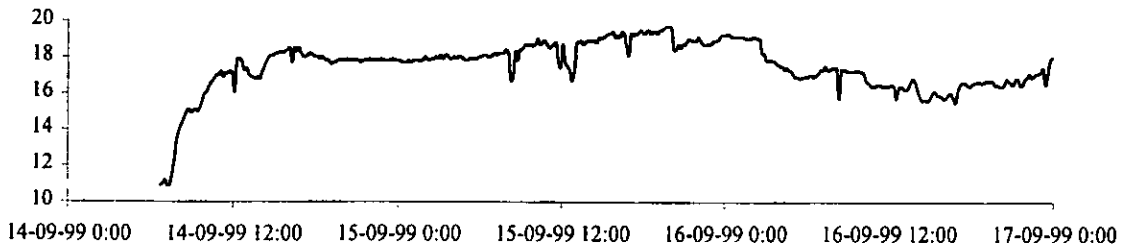
in-wind speed (m/s)



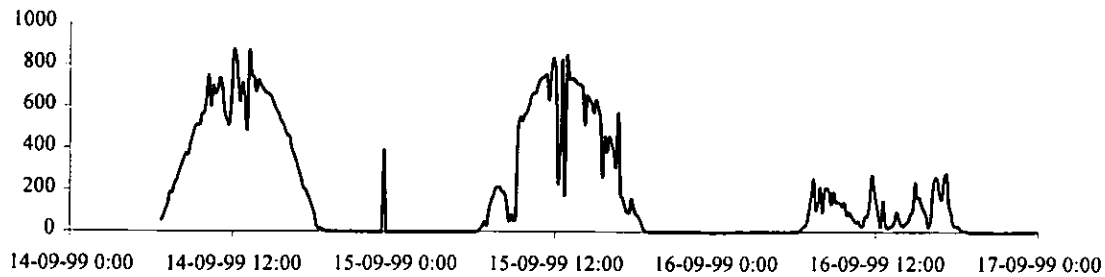
in-wind dir (deg-ang)



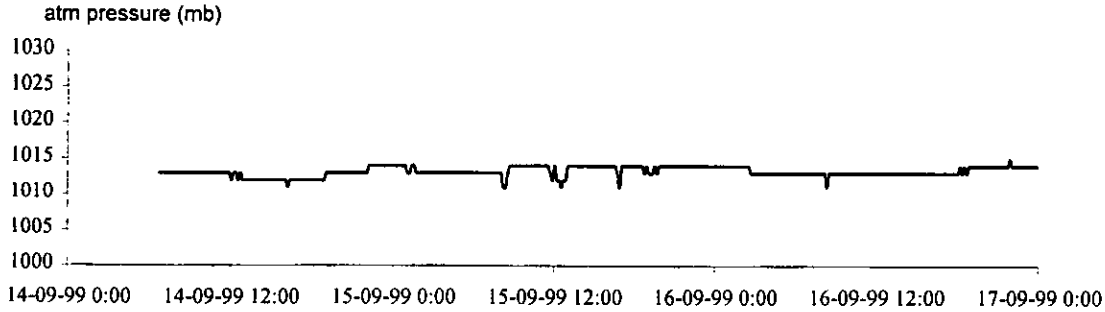
air temp dry (deg-celsius)



sol-rad (k) (Watt/m²)



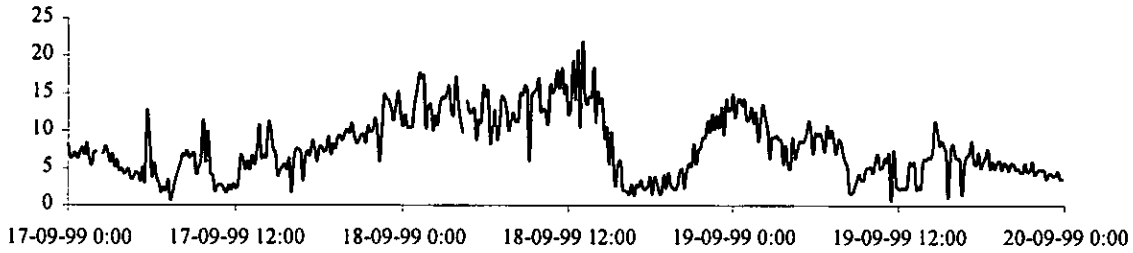
atm pressure (mb)



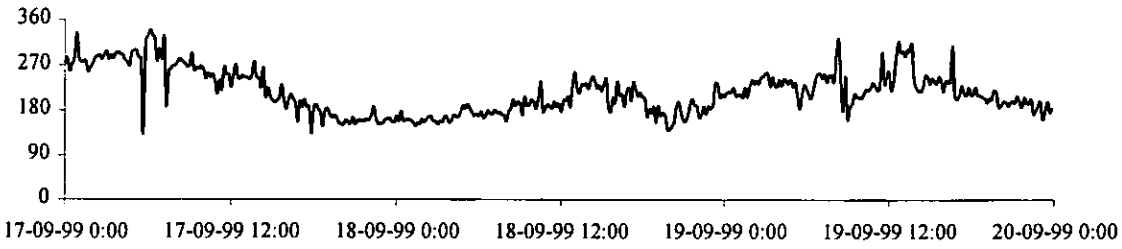
RV BELGICA - CRUISE 99/19

17.09.99 0:00 - 20.09.99 0:00

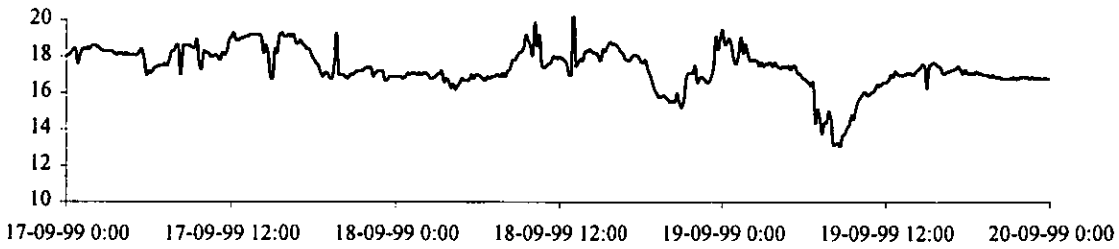
in-wind speed (m/s)



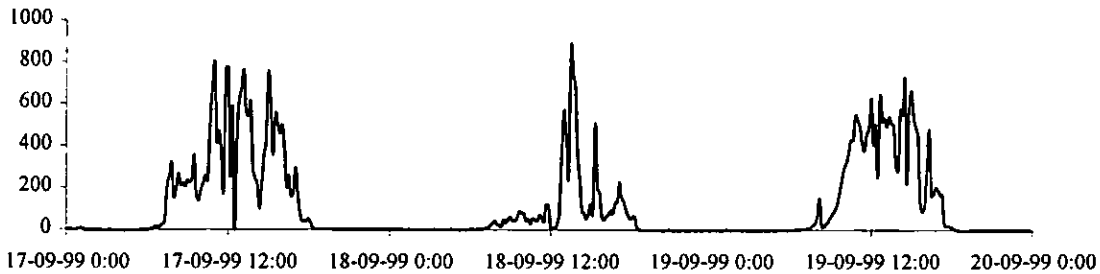
in-wind dir (deg-ang)



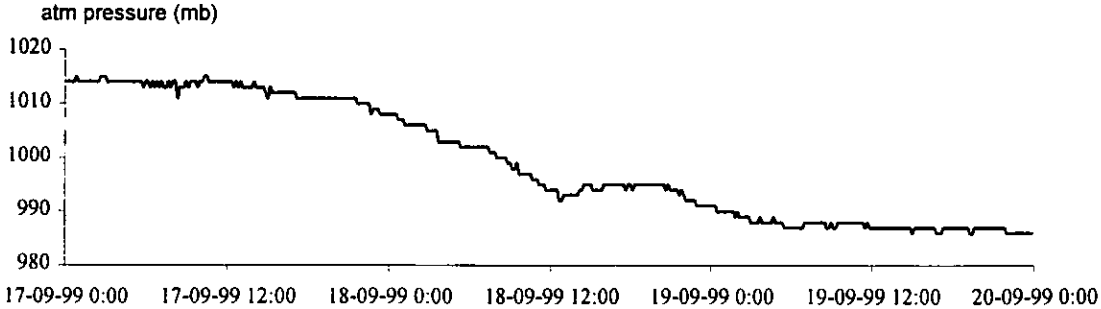
air temp dry (deg-celsius)



sol-rad (k) (Watt/m²)



atm pressure (mb)



Appendix 3

Horizontal profiles

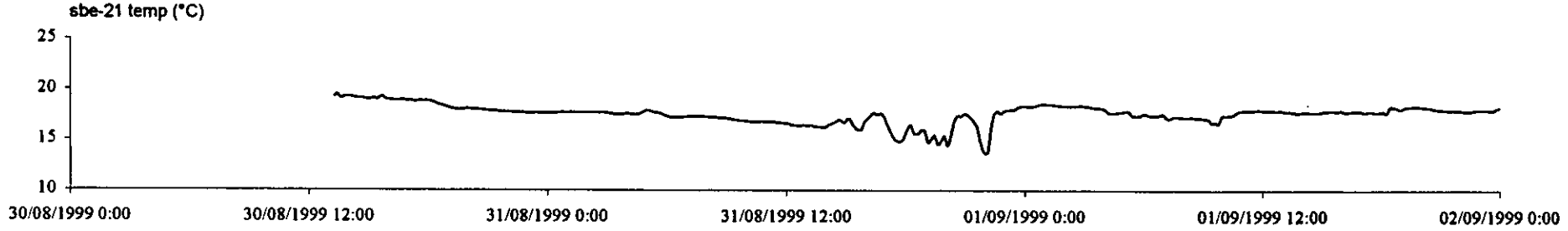
SEA-BIRD SBE21 : water temperature, salinity

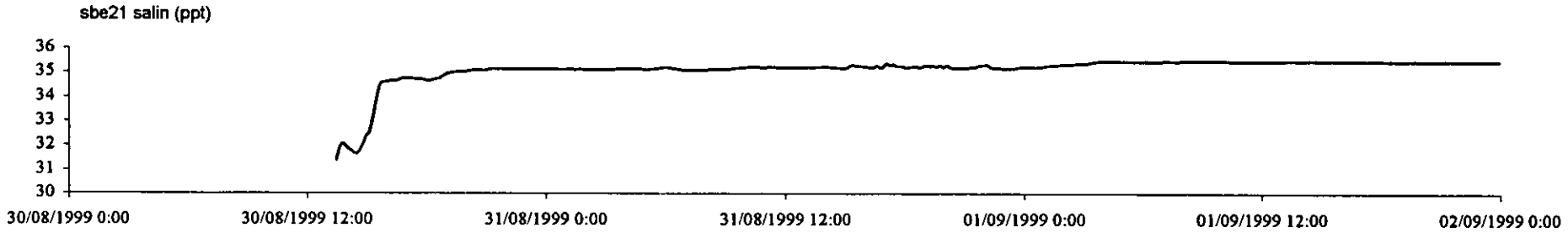
TURNER DESIGNS : chlorophyll a

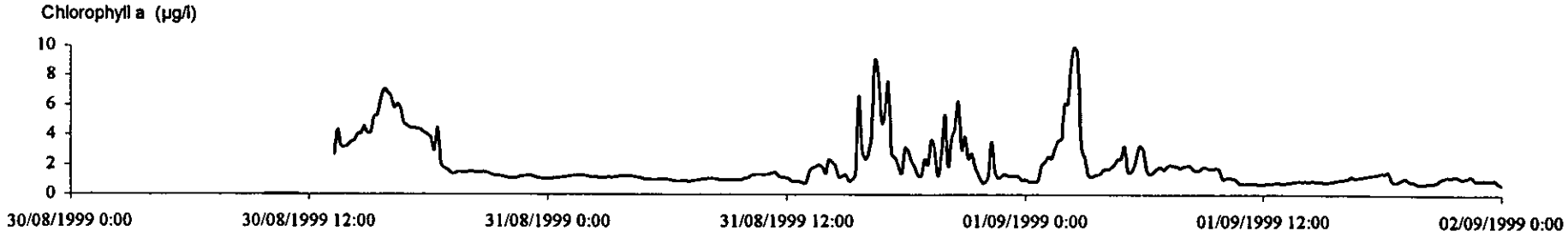
MUMM is the "Management of the marine ecosystem" department of the Royal Institute for Natural Sciences, Federal office for scientific, technical and cultural affairs.

RV BELGICA - CRUISE 99/19

30.08.99 0:00 - 02.09.99 0:00



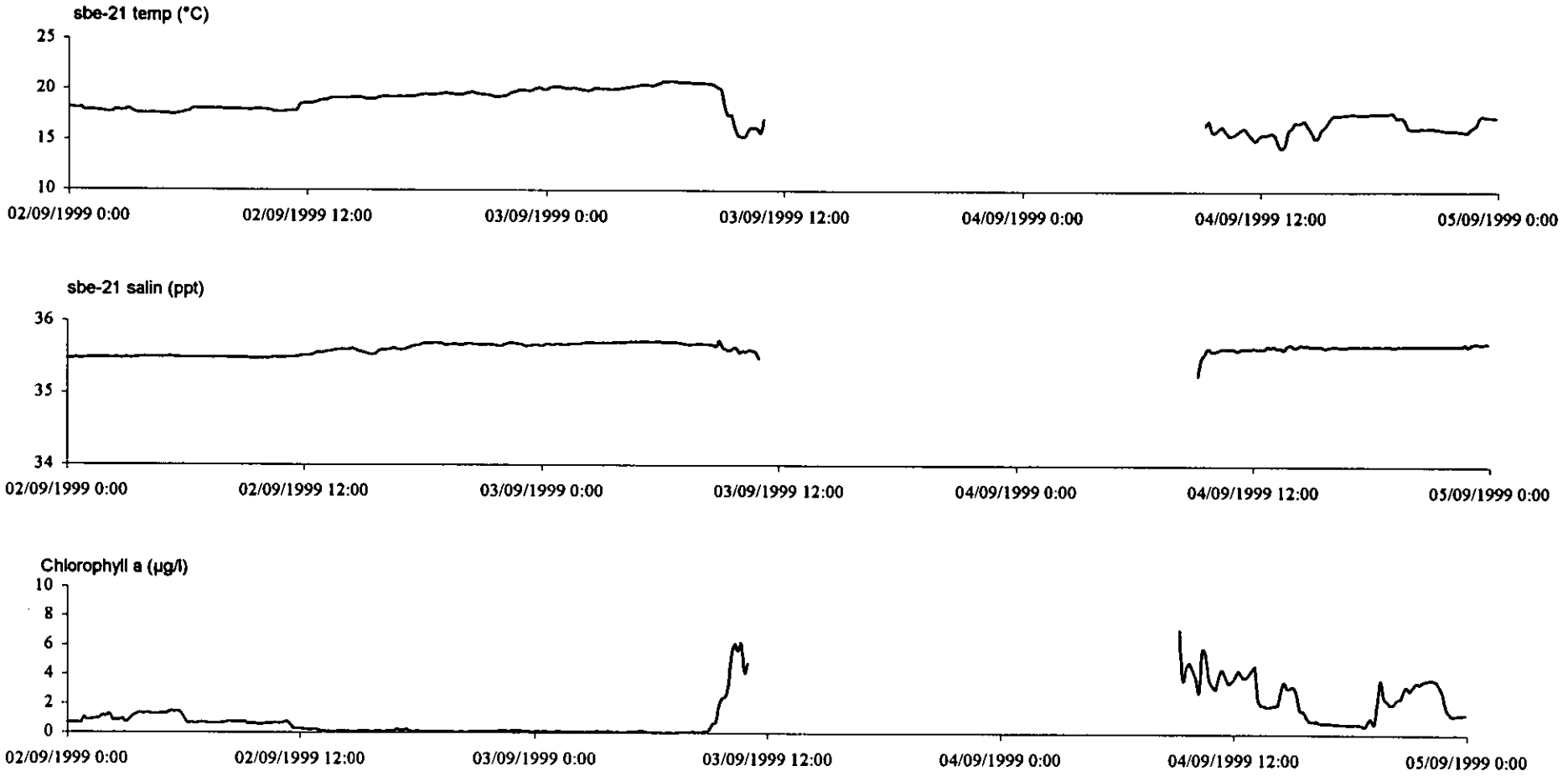




BMM-MEETDIENST OOSTENDE

RV BELGICA - CRUISE 99/19

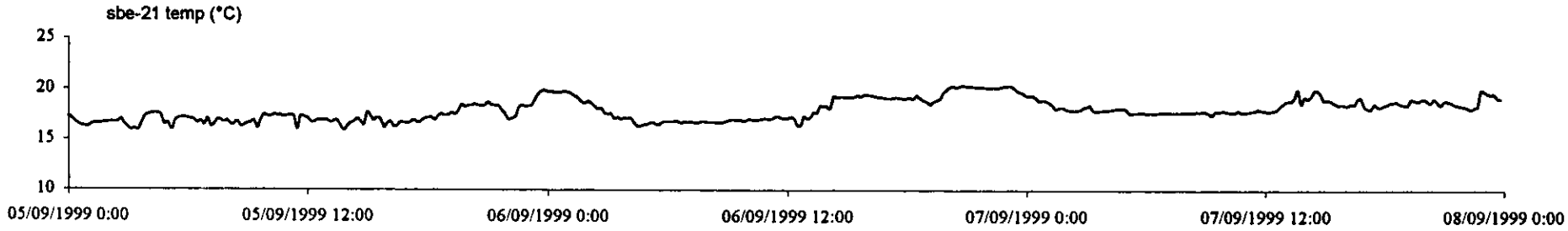
02.09.99 0:00 - 05.09.99 0:00

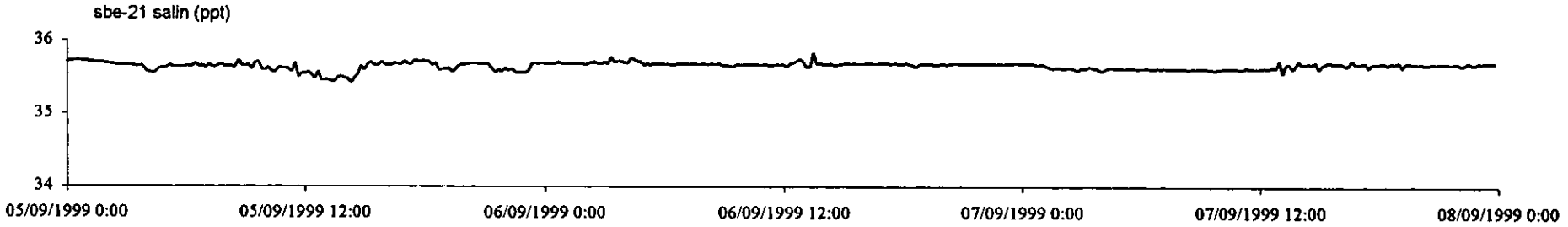


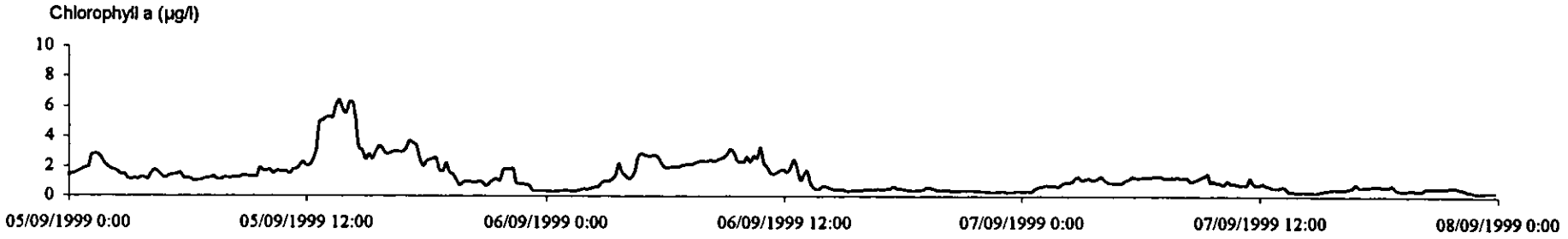
BMM-MEETDIENST OOSTENDE

RV BELGICA - CRUISE 99/19

05.09.99 0:00 - 08.09.99 0:00



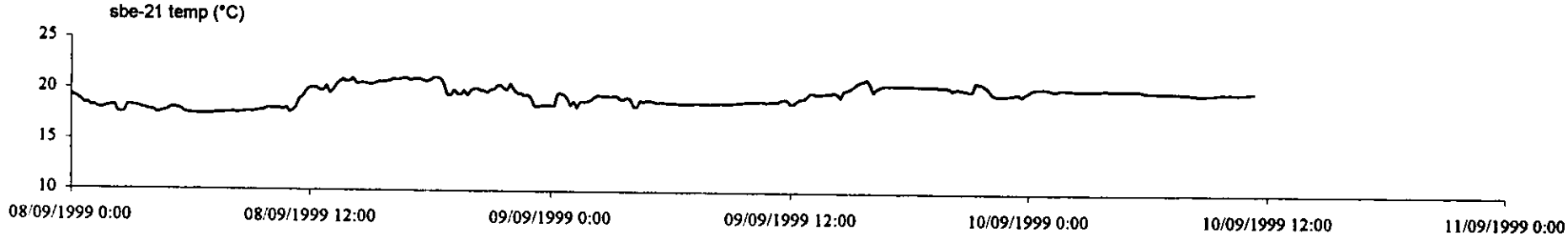


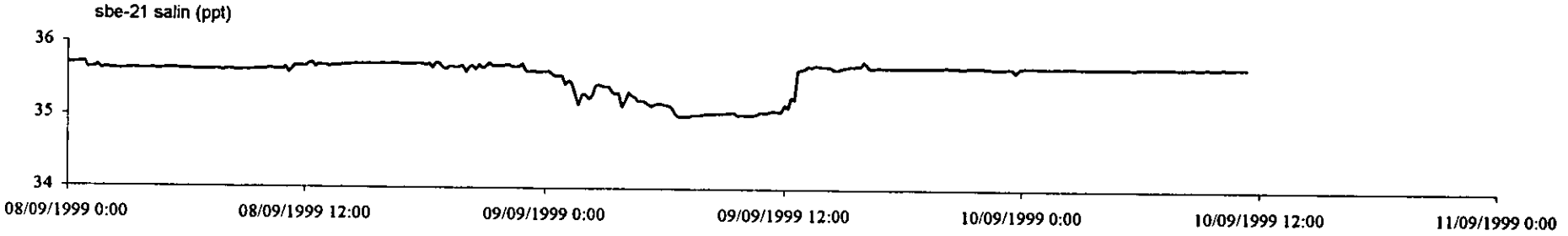


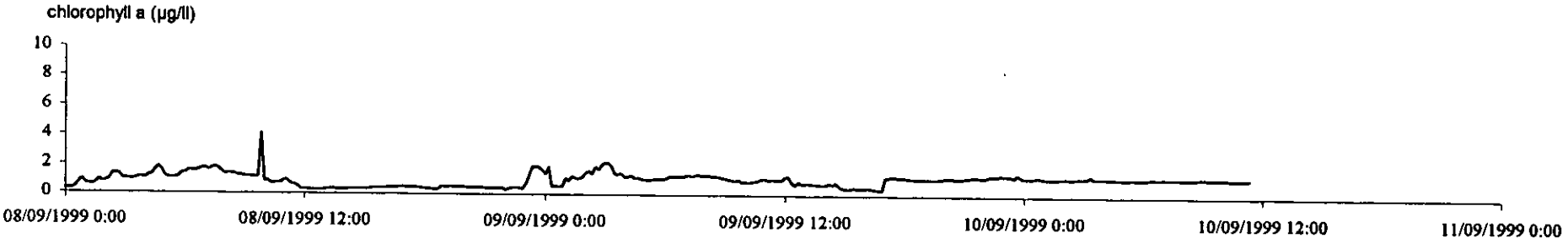
BMM-MEETDIENST OOSTENDE

RV BELGICA - CRUISE 99/19

08.09.99 0:00 - 11.09.99 0:00



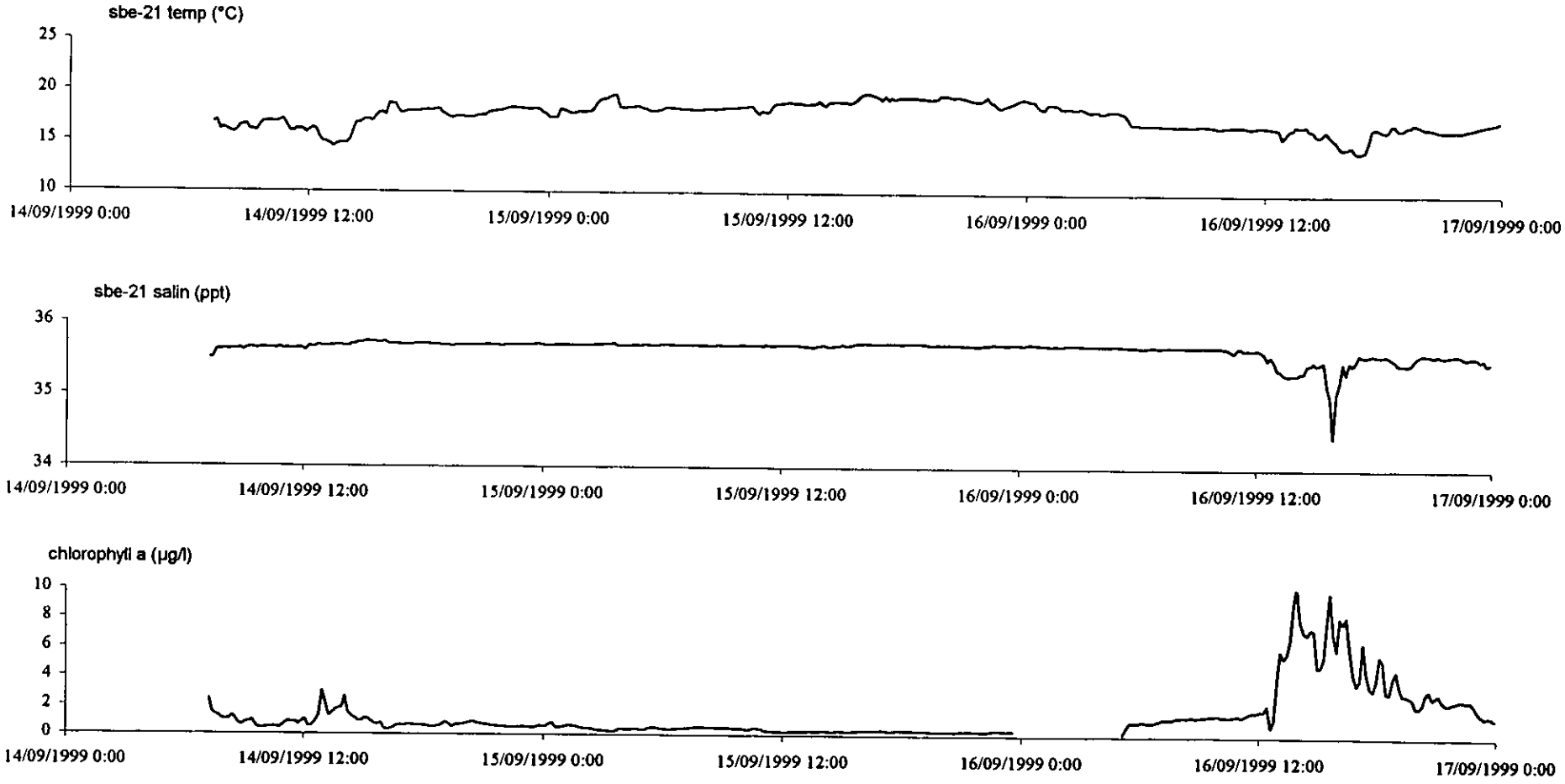




BMM-MEETDIENST OOSTENDE

RV BELGICA - CRUISE 99/19

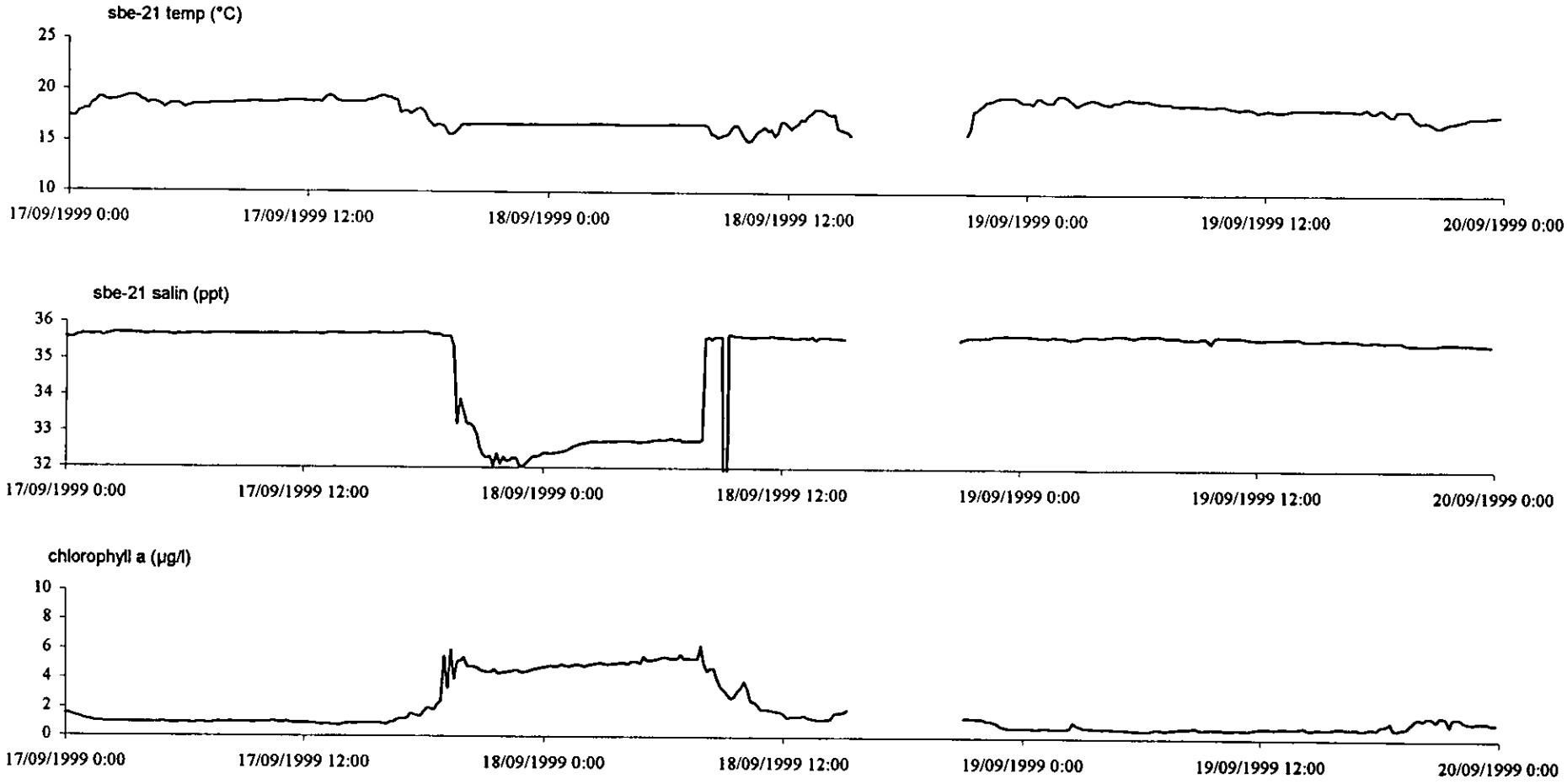
14.09.99 0:00 - 17.09.99 0:00



BMM-MEETDIENST OOSTENDE

RV BELGICA - CRUISE 99/19

17.09.99 0:00 - 20.09.99 0:00



BMM-MEETDIENST OOSTENDE

Appendix 4

STD data at the sampling depths

SEA-BIRD SBE09plus : salinity, water temperature, density, D.O., backscatterance

MUMM is the "Management of the marine ecosystem" department of the Royal Institute for Natural Sciences, Federal office for scientific, technical and cultural affairs.

Table 2. SCTD Data.

Cast Identifier	BODC Site	Bottle Depth [m]	Bottle Number(s)	CTD Pressure [db]	CTD Salinity [PSU]	CTD Temp. ITS-90 [°C]	CTD Density [Sigma-θ]	CTD OBS [FTU]	CTD Oxygen [μmol/kg]
01A	O2LC1	164.2	1 to 6	165.7	35.568	12.374	26.962	2.7	256.6
		5.1	7 to 12	5.2	35.497	17.255	25.835	3.0	263.4
02A	O2LC2	160.5	1 to 6	161.9	35.570	12.282	26.982	2.8	263.3
		5.3	7 to 12	5.4	35.491	17.134	25.859	3.0	269.6
03A	O2LC3	159.3	1 to 6	160.7	35.576	12.099	27.022	2.9	254.8
		4.2	7 to 12	4.2	35.500	16.725	25.963	3.0	267.0
04A	O2LC4	154.6	1 to 6	156.0	35.581	11.852	27.073	2.8	279.7
		4.5	7 to 12	4.6	35.496	17.391	25.802	3.1	280.8
05A	O2LC5	600.0	1 + 2	606.0	35.580	10.621	27.309	2.7	254.9
		399.0	3 + 4	402.7	35.588	11.354	27.178	2.7	265.6
		298.0	5 + 6	300.8	35.589	11.518	27.146	2.7	267.9
		198.9	7 + 8	200.7	35.584	11.888	27.069	2.7	269.7
		148.4	9 + 10	149.7	35.577	12.047	27.032	2.7	270.0
		4.6	11 + 12	4.7	35.476	17.907	25.660	2.9	275.9
05B	O2LC5B	301.0	1,2,3	303.7	35.591	11.613	27.129	2.6	274.0
		5.0	7,8,9	5.0	35.492	17.794	25.700	2.8	279.6
05C	O2LC5	301.4	1,2,3	304.1	35.590	11.493	27.152	2.6	270.4
		5.3	7,8,9	5.3	35.491	17.853	25.685	2.8	279.9
05D	O2LC5	299.7	1,2,3	302.4	35.591	11.480	27.155	2.5	276.4
		4.7	7,8,9	4.8	35.486	17.666	25.726	2.8	283.5
05E	O2LC5	300.1	1,2,3	302.8	35.589	11.461	27.157	2.6	273.2
		4.7	7,8,9	4.8	35.471	18.252	25.570	2.8	280.3
05F	O2LC5	299.8	1,2,3	302.5	35.587	11.343	27.177	2.6	274.4
		4.3	6,7,8	4.3	35.466	17.878	25.660	2.7	284.7
05G	O2LC5	300.4	1,2,3	303.1	35.589	11.446	27.160	2.6	282.5
		4.6	7,8,9	4.7	35.475	17.934	25.653	2.7	288.1
05H	O2LC5	80.2	1	80.9	35.559	13.038	26.821	2.8	271.4
		59.5	2	60.0	35.538	13.671	26.674	2.8	277.6
		41.1	3,4,5,6	41.4	35.538	14.585	26.479	2.8	276.0
		30.6	7	30.9	35.521	15.733	26.211	2.9	281.6
		18.9	8	19.1	35.495	17.480	25.779	2.9	285.0
		4.9	9,10,11,1	4.9	35.496	17.599	25.750	3.1	285.3
05I	O2LC5	101.0	1	101.9	35.566	12.117	27.009	2.7	261.5
		89.6	2	90.4	35.564	12.114	27.007	2.7	265.6
		80.0	3	80.7	35.561	12.126	27.003	2.6	267.2
		69.6	4	70.2	35.558	12.213	26.983	2.6	269.5
		58.8	5	59.3	35.544	12.578	26.900	2.7	271.2
		48.7	6	49.1	35.546	12.733	26.871	2.7	271.1
		39.1	7	39.4	35.548	13.369	26.744	2.7	274.6
		29.5	8	29.7	35.536	14.061	26.590	2.7	278.0
		20.0	9	20.2	35.522	15.681	26.222	2.8	282.7
		4.9	10,11,12	4.9	35.483	17.998	25.643	2.9	283.0

Cast Identifier	BODC Site	Bottle Depth [m]	Bottle Number(s)	CTD Pressure [db]	CTD Salinity [PSU]	CTD Temp. ITS-90 [°C]	CTD Density [Sigma-θ]	CTD OBS [FTU]	CTD Oxygen [μmol/kg]
06A	O2LC6	300.7	1,2,3	303.4	35.586	11.437	27.158	2.6	281.3
		4.9	7,8,9,12	4.9	35.481	17.981	25.645	2.9	288.0
07A	O2LC7	301.4	1,2,3	304.1	35.571	11.315	27.170	2.6	294.8
		5.5	7,8,9,12	5.6	35.492	17.857	25.685	2.9	296.1
08A	O2LC8	301.1	1,2,3	303.9	35.596	11.548	27.145	2.6	298.0
		5.9	7,8,9,12	6.0	35.511	18.583	25.518	2.8	296.0
09A	O2LC9	299.3	1,2,3	302.0	35.592	11.512	27.149	2.7	297.6
		5.2	7,8,9,12	5.2	35.553	18.887	25.473	2.8	294.3
48A	O2N48	1723.4	1	1745.8	35.243	5.354	27.845	3.1	301.0
		1500.8	2	1519.4	35.636	7.684	27.846	3.2	276.6
		1249.1	3	1263.8	36.088	10.185	27.797	3.2	245.8
		1100.4	4	1113.0	36.206	11.042	27.735	3.2	233.6
		999.7	5	1010.9	36.205	11.270	27.689	3.2	230.7
		898.4	6	908.2	36.181	11.533	27.619	3.2	229.6
		799.3	7	807.8	36.148	11.730	27.554	3.2	230.5
		601.0	8	607.2	35.778	11.086	27.380	3.1	234.9
		399.6	9	403.5	35.592	11.351	27.182	3.0	259.0
		299.9	10	302.7	35.621	11.678	27.140	3.0	266.4
		199.9	11	201.8	35.678	12.237	27.075	3.0	270.2
		148.2	12	149.5	35.721	12.643	27.027	3.0	280.0
48B	O2N48	99.4	1	100.2	35.750	12.948	26.988	3.2	291.7
		89.2	2	90.0	35.765	13.093	26.970	3.1	290.9
		80.7	3	81.4	35.769	13.151	26.960	3.1	290.1
		68.8	4	69.4	35.767	13.365	26.915	3.1	289.3
		59.4	5	59.9	35.738	13.514	26.862	3.1	288.0
		49.1	6	49.5	35.698	13.810	26.769	3.1	290.6
		40.0	7	40.3	35.698	14.310	26.662	3.1	292.6
		28.7	8	29.0	35.686	15.518	26.386	3.1	299.0
		20.1	9	20.3	35.661	16.984	26.026	3.2	312.4
		5.4	10	5.4	35.663	17.735	25.846	3.2	306.4
41A	O2O41	1708.5	1,4,7,10	1730.5	35.335	5.900	27.851	3.1	295.0
40A	O2O40	701.1	1,4,7,10	708.5	36.007	11.668	27.453	3.0	228.2
44A	O2N44	48.9	1	49.3	35.693	13.275	26.875	3.6	255.9
		39.1	2,3	39.4	35.679	13.714	26.773	3.2	249.9
		29.7	4,5	29.9	35.665	14.336	26.630	3.2	255.4
		20.6	6,7	20.8	35.647	15.241	26.418	3.0	268.1
		5.7	8,9,10,11	5.8	35.639	17.032	25.997	3.1	292.1
44B	O2N44	40.5	1,2,3	40.9	35.688	13.446	26.836	3.9	259.1
		29.3	4,5	29.6	35.674	13.867	26.737	3.4	257.6
		18.8	6,7	19.0	35.661	14.740	26.540	3.2	267.2
		10.1	8,9	10.2	35.653	15.928	26.267	3.2	285.6
		4.5	10,11,12	4.6	35.659	16.235	26.200	3.2	292.9
46A	O2N46	189.5	1	191.2	35.690	12.163	27.099	3.1	267.6
		149.1	2	150.4	35.712	12.399	27.069	2.8	270.9
		101.0	3	101.8	35.739	12.619	27.045	2.8	274.7
		90.0	4	90.7	35.740	12.634	27.042	2.8	275.3

Cast Identifier	BODC Site	Bottle Depth [m]	Bottle Number(s)	CTD Pressure [db]	CTD Salinity [PSU]	CTD Temp. ITS-90 [°C]	CTD Density [Sigma-θ]	CTD OBS [FTU]	CTD Oxygen [µmol/kg]
		79.1	5	79.7	35.739	12.648	27.038	2.8	274.9
		69.2	6	69.8	35.743	12.728	27.025	2.8	274.9
		60.8	7	61.3	35.749	12.905	26.994	2.8	275.9
		49.8	8	50.2	35.756	12.999	26.981	2.8	276.6
		39.8	9	40.2	35.757	13.055	26.970	2.8	277.1
		29.2	10	29.4	35.764	13.182	26.949	2.8	279.7
		20.0	11	20.2	35.735	14.057	26.744	2.8	286.5
		4.7	12	4.7	35.677	16.177	26.228	2.9	307.4
39A	O2O39	150.2	1,4,7,10	151.5	35.694	12.222	27.090	3.4	265.0
38A	O2O38	115.6	1,4,7,10	116.6	35.712	12.452	27.057	3.6	241.8
31A	O2P31	120.3	1	121.4	35.709	12.416	27.063	3.7	241.4
		100.1	2	101.0	35.710	12.424	27.061	3.4	242.4
		89.4	3	90.2	35.722	12.568	27.042	3.0	248.6
		79.6	4	80.3	35.733	12.686	27.026	3.0	222.5
		69.9	5	70.5	35.731	12.756	27.011	3.0	228.4
		59.3	6	59.8	35.733	12.874	26.988	3.0	236.2
		50.8	7	51.2	35.721	13.105	26.932	3.0	234.9
		38.7	8	39.0	35.692	14.911	26.526	3.1	266.3
		29.4	9	29.7	35.709	16.022	26.289	3.2	286.5
		18.7	10	18.8	35.704	16.974	26.061	3.2	299.4
		4.3	11	4.3	35.683	18.422	25.690	3.2	298.7
24A	O2Q24	80.9	1,7	81.6	35.743	12.743	27.022	3.5	248.1
25A	O2Q25	123.7	1,7	124.8	35.703	12.338	27.073	3.7	241.9
26A	O2Q26	799.6	1,7	808.2	36.092	11.734	27.510	3.1	225.9
45A	O2N45	79.5	1	80.2	35.709	12.620	27.021	3.2	248.7
		59.2	2	59.7	35.716	12.800	26.990	3.0	247.0
		44.1	3,4,5,6	44.5	35.709	13.430	26.856	3.1	249.5
		29.3	7	29.5	35.719	14.818	26.568	3.1	276.7
		20.3	8	20.5	35.717	15.184	26.484	3.2	289.3
		4.6	9,10,11,1	4.7	35.672	16.765	26.086	3.2	309.4
45B	O2N45	122.5	1	123.5	35.710	12.476	27.051	3.3	255.2
		101.7	2	102.6	35.711	12.500	27.046	3.3	254.1
		92.0	3	92.8	35.710	12.561	27.034	3.3	249.2
		82.7	4	83.4	35.711	12.593	27.028	3.3	246.7
		71.7	5	72.3	35.712	12.665	27.014	3.2	245.8
		61.7	6	62.2	35.717	12.718	27.007	3.1	246.0
		51.8	7	52.3	35.715	12.931	26.962	3.1	245.2
		41.6	8	42.0	35.714	13.050	26.938	3.2	243.9
		28.4	9	28.6	35.708	13.974	26.741	3.2	257.6
		20.2	10	20.3	35.725	14.931	26.547	3.2	287.8
		6.0	11	6.1	35.677	16.762	26.091	3.3	305.9
45C	O2N45	79.9	1	80.6	35.710	12.638	27.018	3.3	247.3
		59.2	2	59.7	35.713	12.739	26.999	3.2	245.8
		44.3	3	44.7	35.716	12.846	26.980	3.1	245.5
		30.1	4	30.4	35.709	13.242	26.894	3.1	245.5
		19.6	5	19.8	35.723	14.258	26.692	3.2	266.2

Cast Identifier	BODC Site	Bottle Depth [m]	Bottle Number(s)	CTD Pressure [db]	CTD Salinity [PSU]	CTD Temp. ITS-90 [°C]	CTD Density [Sigma-θ]	CTD OBS [FTU]	CTD Oxygen [μmol/kg]
		4.8	6,7,8	4.8	35.672	16.764	26.087	3.3	303.2
34A	O2P34	101.6	1	102.5	35.784	12.972	27.009	2.8	291.0
		89.4	2	90.2	35.786	13.074	26.990	2.8	292.1
		79.0	3	79.7	35.803	13.359	26.944	2.8	291.8
		68.9	4	69.5	35.797	13.669	26.875	2.8	292.3
		59.9	5	60.4	35.797	14.467	26.705	2.8	301.4
		48.9	6	49.3	35.748	15.174	26.512	2.9	313.2
		39.3	7	39.6	35.734	15.434	26.443	2.9	319.0
		29.3	8	29.5	35.698	16.472	26.176	2.9	321.2
		20.7	9	20.9	35.699	17.731	25.875	2.9	314.2
		4.4	10,11	4.4	35.686	19.215	25.491	3.2	303.3
34B	O2P34	1450.5	1	1468.3	35.647	7.848	27.829	3.0	254.7
		1250.1	2	1264.9	36.056	10.042	27.797	3.0	236.9
		1100.5	3	1113.1	36.155	10.983	27.705	3.0	221.7
		1001.3	4	1012.5	36.194	11.409	27.655	3.0	218.9
		900.5	5	910.3	36.173	11.615	27.597	3.0	219.4
		801.0	6	809.6	36.124	11.740	27.533	3.1	220.2
		599.8	7	606.0	35.824	11.267	27.383	3.0	224.0
		400.2	8	404.1	35.623	11.393	27.198	3.0	241.9
		300.2	9	303.0	35.632	11.670	27.151	3.0	248.8
		199.9	10	201.8	35.680	12.180	27.088	3.0	256.6
		150.1	11	151.4	35.729	12.546	27.053	3.0	255.6
32A	O2P32	194.9	1	196.6	35.700	12.283	27.083	3.3	266.5
		147.5	2	148.8	35.748	12.726	27.032	3.1	275.4
		100.2	3	101.1	35.757	12.795	27.024	3.1	278.7
		88.4	4	89.2	35.775	12.947	27.007	3.0	283.2
		80.1	5	80.8	35.783	13.042	26.994	3.0	285.2
		69.5	6	70.1	35.781	13.083	26.984	3.1	287.3
		58.4	7	58.9	35.791	13.260	26.955	3.0	285.6
		48.9	8	49.3	35.810	13.475	26.925	3.0	288.4
		39.0	9	39.3	35.796	14.227	26.756	3.1	296.0
		29.6	10	29.8	35.733	16.178	26.272	3.2	316.6
		19.0	11	19.2	35.734	16.368	26.228	3.2	311.7
		5.0	12	5.0	35.687	18.244	25.738	3.2	310.2
27A	O2Q27	1500.6	1,7	1519.2	35.612	7.656	27.831	3.3	255.2
29A	O2P29	58.8	1	59.3	35.713	13.148	26.917	3.1	229.4
		38.6	2	38.9	35.718	13.369	26.875	3.1	227.0
		29.0	3,4,5,6	29.3	35.693	13.988	26.726	3.2	234.7
		19.5	7	19.7	35.633	15.081	26.443	3.2	255.7
		4.4	8,9,10,11	4.5	35.615	17.464	25.875	3.2	324.7
29B	O2P29	80.0	1	80.7	35.712	12.890	26.969	3.4	233.3
		69.7	2	70.3	35.718	13.037	26.944	3.2	231.5
		59.2	3	59.7	35.714	13.152	26.918	3.2	228.4
		49.3	4	49.8	35.712	13.622	26.819	3.2	232.3
		40.0	5	40.3	35.642	15.080	26.451	3.2	260.1
		29.6	6	29.8	35.638	16.160	26.203	3.2	310.9

Cast Identifier	BODC Site	Bottle Depth [m]	Bottle Number(s)	CTD Pressure [db]	CTD Salinity [PSU]	CTD Temp. ITS-90 [°C]	CTD Density [Sigma-θ]	CTD OBS [FTU]	CTD Oxygen [μmol/kg]
		19.5	7	19.7	35.622	16.949	26.005	3.3	334.6
		4.2	8	4.3	35.621	17.722	25.816	3.2	336.2
29C	O2P29	70.8	1,2,3,4	71.4	35.719	13.098	26.932	3.3	244.7
		41.0	5	41.4	35.720	13.498	26.850	3.2	232.1
		30.3	6	30.6	35.690	14.055	26.710	3.2	238.8
		20.6	7	20.8	35.680	14.443	26.618	3.3	248.0
		5.6	8,9,10,11	5.6	35.638	16.946	26.017	3.2	318.8
29T	O2P29	No Bottles Fired - Test CTD							
35A	O2P35	101.1	1	102.0	35.756	12.825	27.017	2.6	292.0
		90.0	2	90.8	35.769	12.952	27.001	2.5	293.1
		80.1	3	80.8	35.769	12.968	26.998	2.6	292.1
		70.1	4	70.7	35.777	13.344	26.927	2.6	293.8
		59.8	5	60.3	35.772	13.593	26.872	2.7	292.4
		50.0	6	50.4	35.774	13.942	26.799	2.7	293.1
		39.4	7	39.7	35.758	14.788	26.604	2.7	300.0
		29.4	8	29.7	35.732	16.009	26.310	2.8	309.2
		19.8	9	19.9	35.714	16.630	26.151	2.8	312.0
		4.6	10	4.6	35.688	18.613	25.646	2.9	309.2
35B	O2P35	1708.6	1	1730.6	35.139	4.695	27.838	3.4	313.2
		1482.3	2	1500.6	35.508	6.987	27.842	3.3	284.4
		1249.6	3	1264.3	35.909	9.413	27.787	3.3	255.4
		1098.6	4	1111.2	36.077	10.600	27.713	3.3	239.9
		999.0	5	1010.1	36.089	10.945	27.658	3.3	234.9
		893.5	6	903.3	35.986	10.905	27.582	3.3	234.4
		805.6	7	814.2	35.923	11.002	27.513	3.2	236.1
		599.9	8	606.0	35.729	11.045	27.350	3.2	245.6
		399.6	9	403.5	35.592	11.264	27.198	3.1	267.4
		299.0	10	301.8	35.615	11.622	27.147	3.1	275.8
		199.7	11	201.6	35.675	12.151	27.089	3.1	282.3
		149.4	12	150.7	35.715	12.495	27.052	3.1	289.6
36A	O2P36	150.2	1	151.5	35.711	12.484	27.051	3.2	303.0
		99.8	2	100.6	35.765	12.964	26.996	3.1	296.4
		88.8	3	89.5	35.785	13.184	26.967	3.1	293.9
		79.8	4	80.5	35.788	13.253	26.954	3.1	293.4
		69.4	5	69.9	35.759	13.383	26.905	3.1	294.4
		59.2	6	59.7	35.744	13.627	26.843	3.2	294.9
		49.5	7	49.9	35.738	13.774	26.807	3.2	294.3
		39.2	8	39.6	35.730	14.358	26.676	3.2	298.0
		29.5	9	29.7	35.704	15.124	26.488	3.2	311.9
		19.9	10	20.1	35.682	16.710	26.107	3.2	321.0
		4.1	11	4.1	35.689	18.711	25.622	3.2	313.9
36B	O2P36	1741.6	1,2	1764.3	35.089	4.480	27.822	3.3	319.3
		1499.8	3	1518.4	35.407	6.446	27.836	3.3	293.9
		1249.9	4	1264.6	36.016	9.872	27.795	3.4	249.6
		1100.0	5	1112.6	36.234	11.150	27.736	3.3	235.4
		999.7	6	1010.9	36.078	10.852	27.666	3.3	234.0

Cast Identifier	BODC Site	Bottle Depth [m]	Bottle Number(s)	CTD Pressure [db]	CTD Salinity [PSU]	CTD Temp. ITS-90 [°C]	CTD Density [Sigma-θ]	CTD OBS [FTU]	CTD Oxygen [μmol/kg]
		899.8	7	909.6	36.044	11.106	27.592	3.2	233.8
		799.3	8	807.9	36.049	11.412	27.536	3.2	234.6
		600.0	9	606.1	35.765	11.169	27.355	3.2	244.5
		400.2	10	404.1	35.589	11.229	27.202	3.2	269.0
		299.2	11	302.0	35.615	11.615	27.148	3.2	285.0
		199.2	12	201.1	35.680	12.226	27.079	3.2	295.1
30A	O2P30	79.5	1	80.2	35.719	12.650	27.023	3.1	242.1
		59.2	2	59.7	35.736	12.785	27.008	3.2	229.3
		38.9	3,4,5,6	39.2	35.724	12.956	26.964	3.1	230.7
		29.3	7	29.6	35.680	14.314	26.647	3.0	249.8
		20.3	8	20.5	35.625	16.087	26.209	3.2	285.4
		5.4	9,10,11,1	5.4	35.611	17.472	25.870	3.2	335.3
30B	O2P30	91.0	1	91.7	35.722	12.595	27.036	3.5	242.0
		79.6	2	80.3	35.735	12.775	27.010	3.3	233.6
		69.5	3	70.1	35.734	12.793	27.005	3.3	228.7
		59.2	4	59.7	35.733	12.803	27.002	3.2	226.6
		50.1	5	50.5	35.735	12.856	26.993	3.2	223.4
		39.5	6	39.8	35.721	12.950	26.963	3.1	233.4
		29.9	7	30.1	35.704	13.581	26.821	3.1	239.6
		20.3	8	20.4	35.670	14.920	26.507	3.2	253.7
		4.7	9	4.7	35.612	17.378	25.894	3.2	328.1
30C	O2P30	78.6	1	79.3	35.734	12.776	27.009	3.3	231.9
		59.2	2	59.7	35.733	12.809	27.001	3.3	227.7
		39.5	3	39.8	35.737	13.161	26.933	3.2	236.5
		29.5	4	29.7	35.699	14.003	26.728	3.2	243.7
		19.5	5	19.7	35.663	15.186	26.443	3.2	266.4
		4.2	6,7,8	4.3	35.614	17.523	25.860	3.2	331.4
15A	O2S15	99.6	1	100.4	35.775	12.964	27.004	2.7	294.7
		89.4	2	90.1	35.789	13.098	26.987	2.7	296.1
		80.2	3	80.8	35.801	13.238	26.968	2.8	296.6
		70.3	4	70.9	35.803	13.304	26.956	2.8	296.7
		60.5	5	61.0	35.795	13.484	26.911	2.8	297.8
		49.3	6	49.7	35.791	13.842	26.833	2.8	301.4
		39.8	7	40.1	35.737	14.506	26.650	2.8	308.6
		29.8	8	30.0	35.679	16.725	26.102	2.9	332.9
		19.9	9	20.1	35.677	18.735	25.607	2.9	319.7
		4.4	10	4.5	35.699	20.542	25.150	3.2	301.8
15B	O2S15	1694.9	1	1716.7	35.163	5.045	27.817	3.2	312.5
		1501.1	2	1519.7	35.510	7.066	27.834	3.2	287.3
		1249.0	3	1263.7	36.181	10.560	27.805	3.2	245.8
		1099.9	4	1112.5	36.227	11.120	27.736	3.2	236.0
		1000.2	5	1011.4	36.231	11.358	27.694	3.1	235.0
		900.1	6	910.0	36.193	11.515	27.632	3.4	235.1
		801.2	7	809.7	36.151	11.691	27.564	3.3	236.3
		600.9	8	607.1	35.855	11.351	27.391	3.2	240.8
		400.2	9	404.1	35.630	11.308	27.220	3.3	259.8

Cast Identifier	BODC Site	Bottle Depth [m]	Bottle Number(s)	CTD Pressure [db]	CTD Salinity [PSU]	CTD Temp. ITS-90 [°C]	CTD Density [Sigma-θ]	CTD OBS [FTU]	CTD Oxygen [μmol/kg]
		301.0	10	303.9	35.634	11.683	27.150	3.2	270.6
		201.1	11	203.0	35.682	12.144	27.096	3.1	276.6
		149.4	12	150.7	35.728	12.546	27.052	3.2	283.2
21A	O2R21	1472.2	1,7	1490.4	35.867	8.948	27.834	3.7	259.5
19A	O2R19	140.1	1,7	141.3	35.712	12.393	27.070	3.5	266.3
11A	O2S11	80.2	1	80.9	35.775	12.936	27.009	3.7	211.7
		58.9	2	59.4	35.761	13.078	26.969	3.9	240.9
		39.5	3,4,5,6	39.9	35.646	14.628	26.553	3.8	247.5
		30.1	7	30.3	35.262	16.216	25.900	3.9	283.9
		19.6	8	19.7	35.116	18.687	25.190	3.8	329.4
		4.9	9,10,11,1	4.9	35.158	18.768	25.201	3.2	335.1
11B	O2S11	81.5	1	82.2	35.773	12.913	27.012	3.4	215.5
		69.9	2	70.4	35.777	13.012	26.995	3.3	198.0
		59.3	3	59.8	35.775	13.036	26.988	3.1	217.5
		49.1	4	49.5	35.781	13.137	26.972	3.1	206.4
		38.6	5	38.9	35.765	13.274	26.931	3.0	237.7
		29.7	6	29.9	35.729	13.827	26.788	3.1	254.2
		19.6	7	19.7	35.404	15.644	26.140	3.2	268.2
		4.3	8	4.3	35.001	18.663	25.108	3.3	329.7
11C	O2S11	80.9	1,2	81.5	35.775	12.927	27.011	3.3	216.0
		58.6	3	59.1	35.767	13.039	26.981	3.1	245.7
		40.1	4	40.4	35.757	13.324	26.915	3.1	245.3
		29.8	5	30.0	35.735	13.881	26.782	3.2	258.8
		18.2	6	18.4	35.488	15.253	26.293	3.2	256.8
		4.2	7,8	4.2	35.010	18.722	25.099	3.3	330.4
13A	O2S13	202.0	1	203.7	35.701	12.244	27.092	8.3	275.7
		149.2	2	150.4	35.723	12.470	27.063	6.8	279.0
		100.1	3	100.9	35.749	12.685	27.040	6.2	270.4
		89.7	4	90.4	35.757	12.778	27.027	5.9	266.1
		79.7	5	80.4	35.766	12.860	27.017	5.8	260.8
		69.3	6	69.8	35.781	12.998	27.000	5.6	265.5
		58.5	7	58.9	35.793	13.143	26.980	5.5	283.5
		49.7	8	50.2	35.798	13.362	26.939	5.3	291.2
		39.1	9	39.5	35.785	13.901	26.816	5.3	300.4
		29.2	10	29.5	35.759	14.684	26.628	5.2	305.8
		19.9	11	20.1	35.654	17.196	25.970	5.2	329.3
		4.6	12	4.6	35.692	19.706	25.367	9.6	313.6
16A	O2S16	102.0	1	102.9	35.740	12.822	27.005	6.8	300.5
		88.9	2	89.6	35.746	13.032	26.968	6.7	302.4
		79.5	3	80.2	35.747	13.182	26.937	6.5	298.7
		69.6	4	70.2	35.734	13.386	26.885	6.4	299.6
		60.5	5	61.0	35.699	13.615	26.810	6.2	301.5
		50.1	6	50.5	35.692	13.940	26.736	6.0	303.7
		40.5	7	40.8	35.670	14.739	26.548	5.8	317.0
		29.8	8	30.1	35.656	15.816	26.296	5.6	332.4
		19.1	9	19.3	35.646	17.839	25.808	5.3	337.7

Cast Identifier	BODC Site	Bottle Depth [m]	Bottle Number(s)	CTD Pressure [db]	CTD Salinity [PSU]	CTD Temp. ITS-90 [°C]	CTD Density [Sigma-θ]	CTD OBS [FTU]	CTD Oxygen [μmol/kg]
		4.8	10	4.8	35.678	20.577	25.125	8.1	300.5
16B	O2S16	1729.2	1	1751.6	35.221	5.276	27.837	11.4	308.4
		1500.9	2	1519.6	35.567	7.321	27.843	8.8	283.9
		1249.5	3	1264.3	36.183	10.605	27.798	7.6	242.8
		1100.1	4	1112.7	36.208	11.044	27.735	7.6	235.6
		998.2	5	1009.4	36.172	11.233	27.670	7.0	234.3
		899.4	6	909.2	36.113	11.296	27.610	6.3	234.9
		799.4	7	808.0	36.076	11.506	27.540	6.2	236.3
		599.8	8	606.0	35.796	11.194	27.374	6.2	242.9
		399.4	9	403.3	35.580	11.176	27.204	5.8	270.2
		298.4	10	301.2	35.620	11.634	27.148	5.6	278.3
		198.8	11	200.6	35.660	12.023	27.102	5.5	291.5
		148.7	12	150.0	35.689	12.293	27.072	5.5	293.3
20A	O2R20	641.0	1,7	647.6	35.922	11.581	27.402	7.5	249.2
33A	O2P33	80.8	3	81.5	35.807	13.600	26.898	5.5	295.9
		59.1	1	59.6	35.798	13.855	26.837	5.2	299.1
		38.4	2	38.7	35.753	14.959	26.563	5.5	310.9
		28.9	4	29.2	35.717	16.164	26.262	5.5	325.3
		18.5	5,6,7,8	18.7	35.681	18.910	25.566	5.5	316.0
		4.1	9,10,11,1	4.2	35.694	20.063	25.274	5.3	298.8
33B	O2P33	98.7	1	99.5	35.806	13.235	26.973	5.5	294.6
		89.9	2	90.6	35.805	13.322	26.954	5.5	296.7
		81.4	3	82.1	35.807	13.487	26.921	5.5	297.1
		69.8	4	70.4	35.807	13.611	26.895	5.4	297.8
		60.5	5	61.0	35.801	13.855	26.839	5.4	300.8
		50.0	6	50.4	35.782	14.368	26.714	5.4	303.9
		38.2	7	38.5	35.771	14.734	26.627	5.5	306.6
		30.3	8	30.5	35.742	15.596	26.412	5.5	320.9
		20.3	9	20.5	35.676	19.576	25.390	5.5	318.2
		4.7	10	4.8	35.694	19.979	25.297	5.7	300.0
33C	O2P33	1001.2	1	1012.4	36.209	11.425	27.664	8.7	238.1
		899.8	2	909.6	36.197	11.552	27.628	8.1	237.8
		800.0	3	808.6	36.111	11.770	27.517	8.2	240.2
		598.9	4	605.0	35.753	11.225	27.335	7.3	247.3
		399.5	5	403.4	35.635	11.322	27.220	6.6	261.8
		299.3	6	302.1	35.624	11.572	27.163	6.3	272.2
		200.3	7	202.2	35.690	12.214	27.089	6.0	280.8
		149.0	8	150.4	35.734	12.592	27.048	5.9	287.5
		39.1	9	39.5	35.751	15.118	26.526	5.6	312.3
		18.4	10,11,12	18.5	35.674	19.609	25.380	5.5	327.0
49A	O2N49	98.7	1	99.5	35.790	13.138	26.980	4.0	295.6
		89.4	2	90.2	35.786	13.260	26.951	3.9	295.4
		79.6	3	80.3	35.770	13.298	26.931	3.8	296.2
		70.0	4	70.5	35.740	13.574	26.851	4.0	298.1
		61.1	5	61.6	35.730	13.970	26.759	4.1	298.0
		50.9	6	51.3	35.715	14.356	26.666	4.0	300.3

Cast Identifier	BODC Site	Bottle Depth [m]	Bottle Number(s)	CTD Pressure [db]	CTD Salinity [PSU]	CTD Temp. ITS-90 [°C]	CTD Density [Sigma-θ]	CTD OBS [FTU]	CTD Oxygen [μmol/kg]
		40.2	7	40.5	35.699	14.851	26.545	4.0	306.5
		29.5	8	29.8	35.683	15.723	26.337	4.0	324.4
		20.1	9	20.3	35.664	16.929	26.042	3.9	331.3
		4.3	10	4.3	35.657	18.811	25.572	6.3	322.1
49B	O2N49	1001.2	1	1012.4	36.074	10.820	27.669	8.1	238.6
		898.2	2	908.1	36.068	11.158	27.600	7.2	237.1
		799.8	3	808.4	35.986	11.202	27.526	6.6	238.3
		599.4	4	605.5	35.753	11.165	27.346	6.4	248.3
		398.6	5	402.5	35.597	11.330	27.190	5.9	274.0
		299.3	6	302.1	35.631	11.761	27.133	5.8	284.6
		199.1	7	200.9	35.690	12.293	27.074	5.2	295.9
		149.5	8	150.8	35.727	12.614	27.038	5.5	298.8
44C	O2N44	40.3	1,2	40.6	35.696	13.382	26.855	4.2	246.7
		29.6	3,4	29.9	35.690	13.545	26.817	4.2	248.3
		19.5	5 to 8	19.7	35.661	14.414	26.611	4.2	263.3
		5.0	9 to 12	5.0	35.648	15.752	26.303	4.2	313.4
00A	O200	78.9	1	79.6	35.699	13.163	26.904	15.6	272.7
		69.4	2	70.1	35.696	13.199	26.894	16.3	271.1
		59.5	3	60.0	35.696	13.345	26.863	12.6	275.2
		48.9	4	49.4	35.676	13.887	26.736	11.7	286.8
		39.3	5	39.7	35.647	14.970	26.479	12.6	313.5
		30.1	6	30.4	35.637	15.857	26.272	7.3	330.3
		19.3	7	19.5	35.636	15.940	26.252	5.8	332.0
		4.9	8	4.9	35.637	16.004	26.237	5.2	333.7
44D	O2N44	39.8	1	40.2	35.708	12.858	26.971	11.7	253.4
		29.5	2	29.8	35.702	13.057	26.927	13.1	251.7
		19.5	3	19.7	35.685	13.923	26.733	25.8	282.6
		5.6	4	5.6	35.682	14.432	26.622	33.1	298.1
42A	O2O42	1666.0	1	1687.3	35.320	5.799	27.852	16.0	305.2
43A	O2O43	1740.0	1	1762.6	35.060	4.287	27.820	13.2	327.4
37A	O2P37	79.4	1	80.1	35.665	15.786	26.312	5.5	324.5
		59.4	2	59.9	35.677	16.756	26.094	5.2	323.2
		40.2	3 to 6	40.5	35.682	17.230	25.984	5.1	322.0
		29.9	7	30.1	35.685	17.696	25.873	5.1	320.4
		19.9	8	20.1	35.688	17.945	25.813	5.1	318.3
		4.2	9 to 12	4.3	35.703	18.377	25.717	5.3	311.7
37B	O2P37	150.4	1	151.7	35.747	12.894	26.998	5.6	300.5
		99.2	2	100.1	35.712	14.934	26.539	5.7	315.0
		89.1	3	89.9	35.680	15.309	26.431	5.9	323.0
		78.9	4	79.6	35.661	16.003	26.258	5.8	331.1
		69.1	5	69.7	35.669	16.259	26.205	5.6	329.8
		60.4	6	60.9	35.672	16.731	26.097	4.8	329.2
		49.2	7	49.6	35.677	16.830	26.077	5.3	324.1
		38.1	8	38.4	35.680	17.333	25.958	5.3	325.6
		29.2	9	29.4	35.687	17.686	25.877	5.4	322.6
		19.7	10	19.8	35.690	17.756	25.861	4.8	320.4
		4.6	11,12	4.6	35.696	18.174	25.762	5.2	315.5

Cast Identifier	BODC Site	Bottle Depth [m]	Bottle Number(s)	CTD Pressure [db]	CTD Salinity [PSU]	CTD Temp. ITS-90 [°C]	CTD Density [Sigma-θ]	CTD OBS [FTU]	CTD Oxygen [μmol/kg]
37C	O2P37	1716.6	1,2	1738.8	35.086	4.469	27.820	12.2	325.6
		1500.6	3	1519.2	35.275	5.705	27.826	9.0	306.2
		1249.4	4	1264.1	35.990	9.690	27.805	10.1	254.6
		1100.4	5	1113.0	36.233	11.036	27.756	9.1	239.0
		999.0	6	1010.1	36.219	11.218	27.710	7.9	237.3
		898.9	7	908.7	36.191	11.506	27.632	7.4	237.5
		801.0	8	809.6	36.143	11.637	27.568	6.8	238.6
		598.7	9	604.8	35.670	10.745	27.357	6.0	255.0
		399.2	10	403.1	35.596	11.237	27.206	5.9	273.9
		300.0	11	302.8	35.621	11.611	27.154	5.6	283.0
		198.3	12	200.2	35.691	12.214	27.090	6.1	286.3
12A	O2S12	79.9	1	80.6	35.754	12.726	27.034	6.2	282.0
		59.8	2	60.4	35.744	12.734	27.025	6.1	273.1
		39.8	3	40.1	35.757	13.169	26.946	5.8	269.8
		30.1	4,5,6	30.4	35.752	13.799	26.812	5.6	276.7
		18.9	7	19.1	35.734	14.840	26.574	5.4	291.8
		4.7	8 to 12	4.8	35.714	16.681	26.139	6.2	317.9
12B	O2S12	124.6	1	125.7	35.714	12.368	27.076	7.7	264.1
		99.7	2	100.6	35.727	12.527	27.054	7.7	266.4
		90.0	3	90.8	35.749	12.687	27.039	7.5	279.8
		80.4	4	81.1	35.755	12.736	27.033	7.5	282.9
		70.1	5	70.7	35.742	12.745	27.021	7.2	269.3
		60.5	6	61.0	35.751	13.021	26.972	7.0	262.4
		50.1	7	50.6	35.748	13.609	26.849	6.8	274.2
		39.3	8	39.7	35.734	14.721	26.601	6.8	291.5
		29.2	9	29.5	35.732	15.117	26.511	6.6	297.8
		19.9	10	20.1	35.702	16.246	26.232	6.5	315.2
		5.3	11	5.4	35.698	16.831	26.091	9.7	321.2
18A	O2R18	81.7	1	82.4	35.735	12.604	27.044	6.2	235.2
14A	O2S14	77.7	1	78.4	35.770	13.358	26.919	3.8	300.7
		47.2	2,3,4	47.6	35.710	15.837	26.333	4.2	330.5
		39.6	5	40.0	35.699	17.291	25.982	4.2	329.1
		29.5	6	29.8	35.675	18.202	25.740	4.4	315.9
		18.9	7	19.0	35.677	18.271	25.724	4.4	309.7
		4.4	8 to 12	4.4	35.680	18.521	25.663	4.9	307.5
14B	O2S14	151.0	1	152.4	35.732	12.629	27.039	6.2	302.4
		101.0	2	101.9	35.788	13.187	26.969	5.9	301.5
		87.4	3	88.2	35.781	13.304	26.939	5.7	300.5
		79.9	4	80.6	35.773	13.370	26.919	5.5	299.5
		68.3	5	68.9	35.759	13.482	26.884	5.4	300.3
		61.6	6	62.1	35.736	14.292	26.696	5.2	309.8
		50.6	7	51.0	35.706	16.062	26.278	5.1	330.2
		38.3	8	38.6	35.698	17.819	25.853	4.7	328.3
		29.6	9	29.9	35.704	18.030	25.806	4.7	312.0
		21.2	10	21.4	35.674	18.456	25.676	4.8	309.1
		5.1	11,12	5.1	35.676	18.584	25.644	5.3	306.5

Cast Identifier	BODC Site	Bottle Depth [m]	Bottle Number(s)	CTD Pressure [db]	CTD Salinity [PSU]	CTD Temp. ITS-90 [°C]	CTD Density [Sigma-θ]	CTD OBS [FTU]	CTD Oxygen [μmol/kg]
14C	O2S14	1502.0	1,2,3	1520.6	35.766	8.340	27.850	16.1	268.6
		1248.9	4	1263.7	36.210	10.767	27.791	11.9	244.1
		1101.8	5	1114.4	36.222	11.171	27.723	11.0	237.9
		998.6	6	1009.8	36.212	11.430	27.665	10.1	237.5
		901.0	7	910.8	36.190	11.608	27.612	9.5	238.2
		800.1	8	808.7	36.145	11.758	27.546	9.4	239.8
		598.7	9	604.9	35.863	11.340	27.400	9.3	244.8
		397.7	10	401.6	35.607	11.306	27.202	8.8	270.8
		299.5	11	302.3	35.617	11.575	27.157	8.4	282.0
		198.9	12	200.8	35.681	12.186	27.087	8.1	296.6
22A	O2R22	1298.5	1,2	1314.0	36.133	10.238	27.824	13.1	248.6

Appendix 5

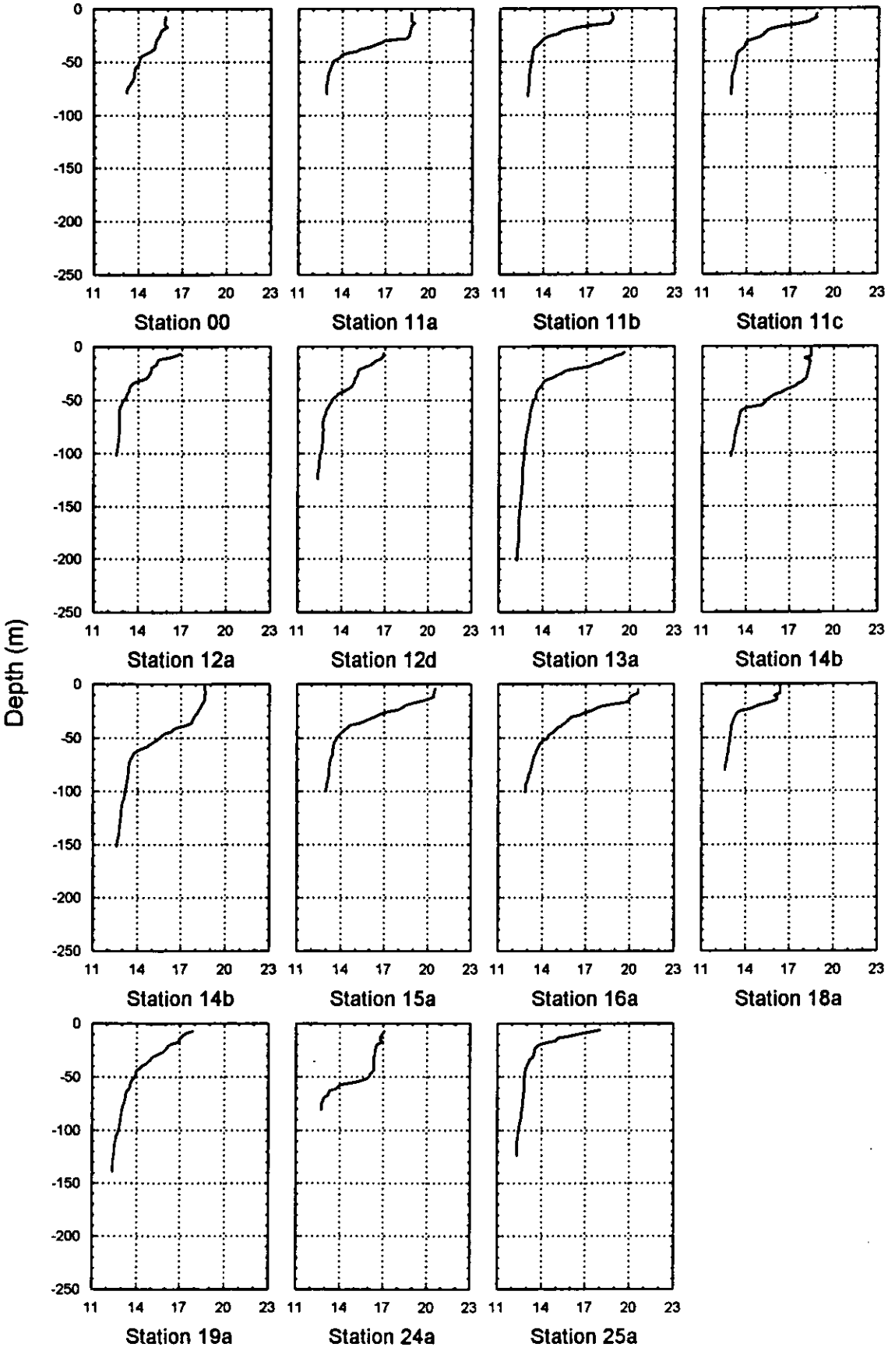
Vertical profiles with STD

SEA-BIRD SBE09plus : salinity, water temperature, density, D.O., backscatterance

MUMM is the "Management of the marine ecosystem" department of the Royal Institute for Natural Sciences, Federal office for scientific, technical and cultural affairs.

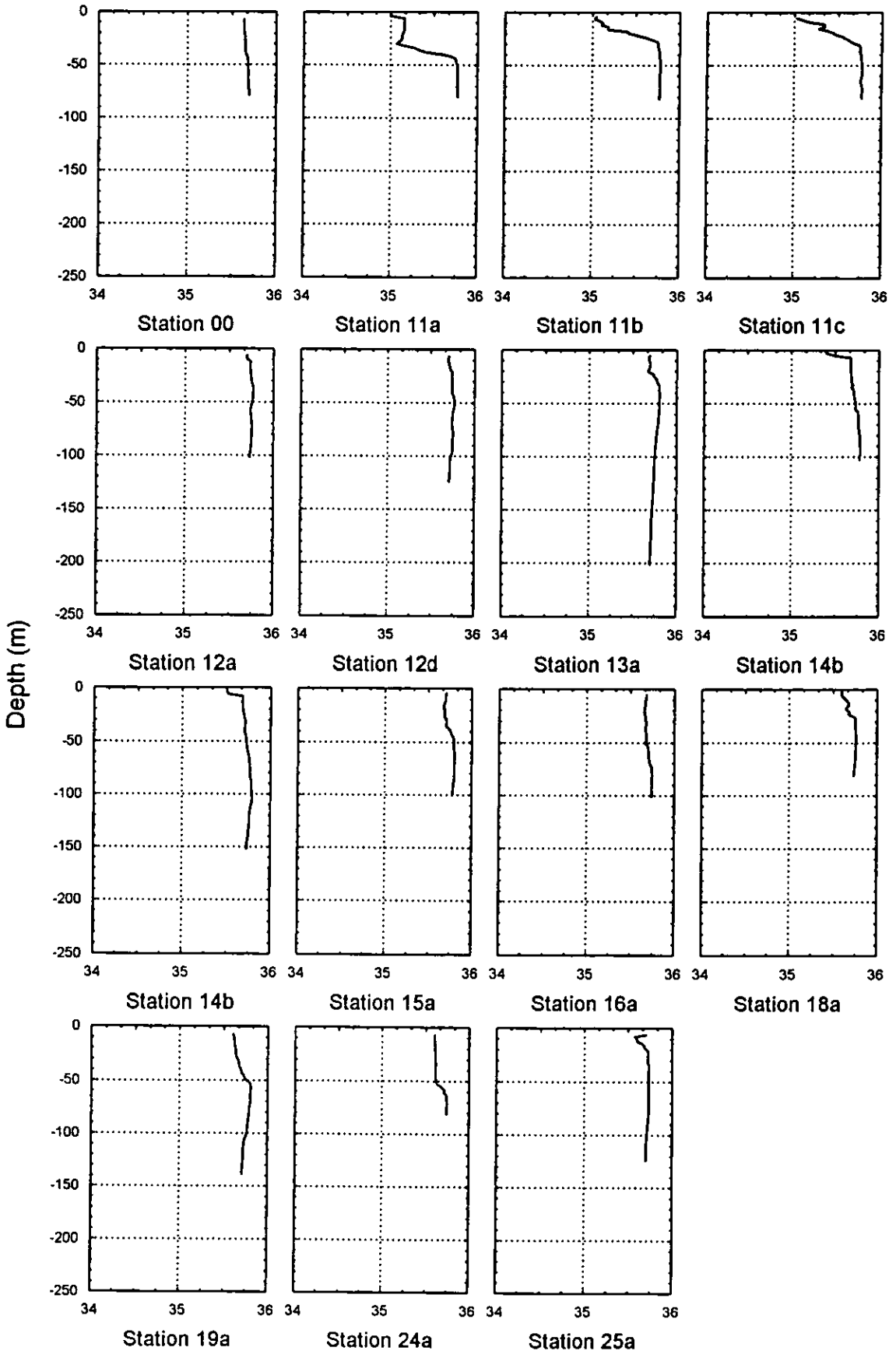
CTD Profiles cruise 99/19 OMEX II

Stations 00 - 25 surface casts



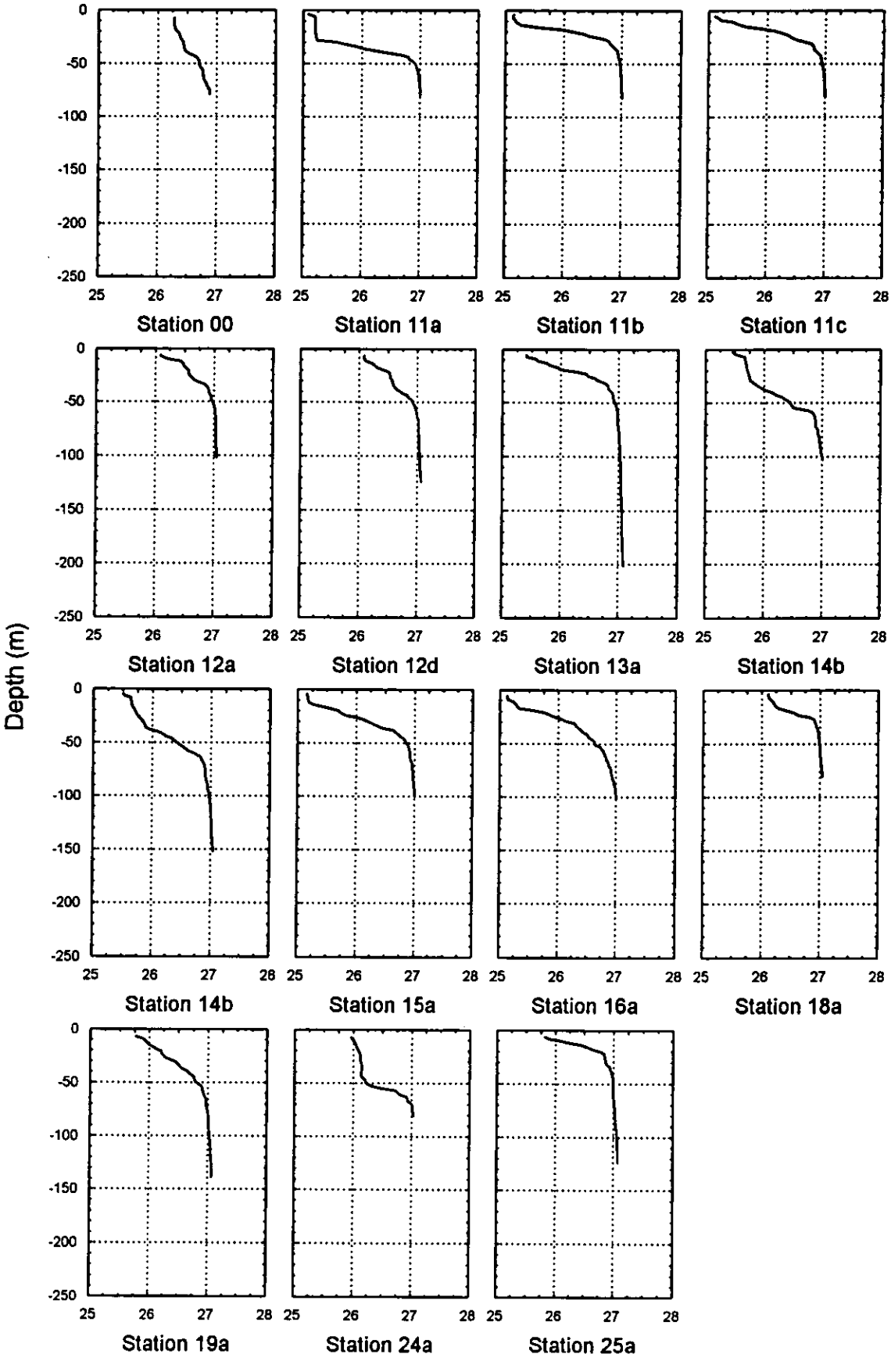
CTD Profiles cruise 99/19 OMEX II

Stations 00 - 25 surface casts



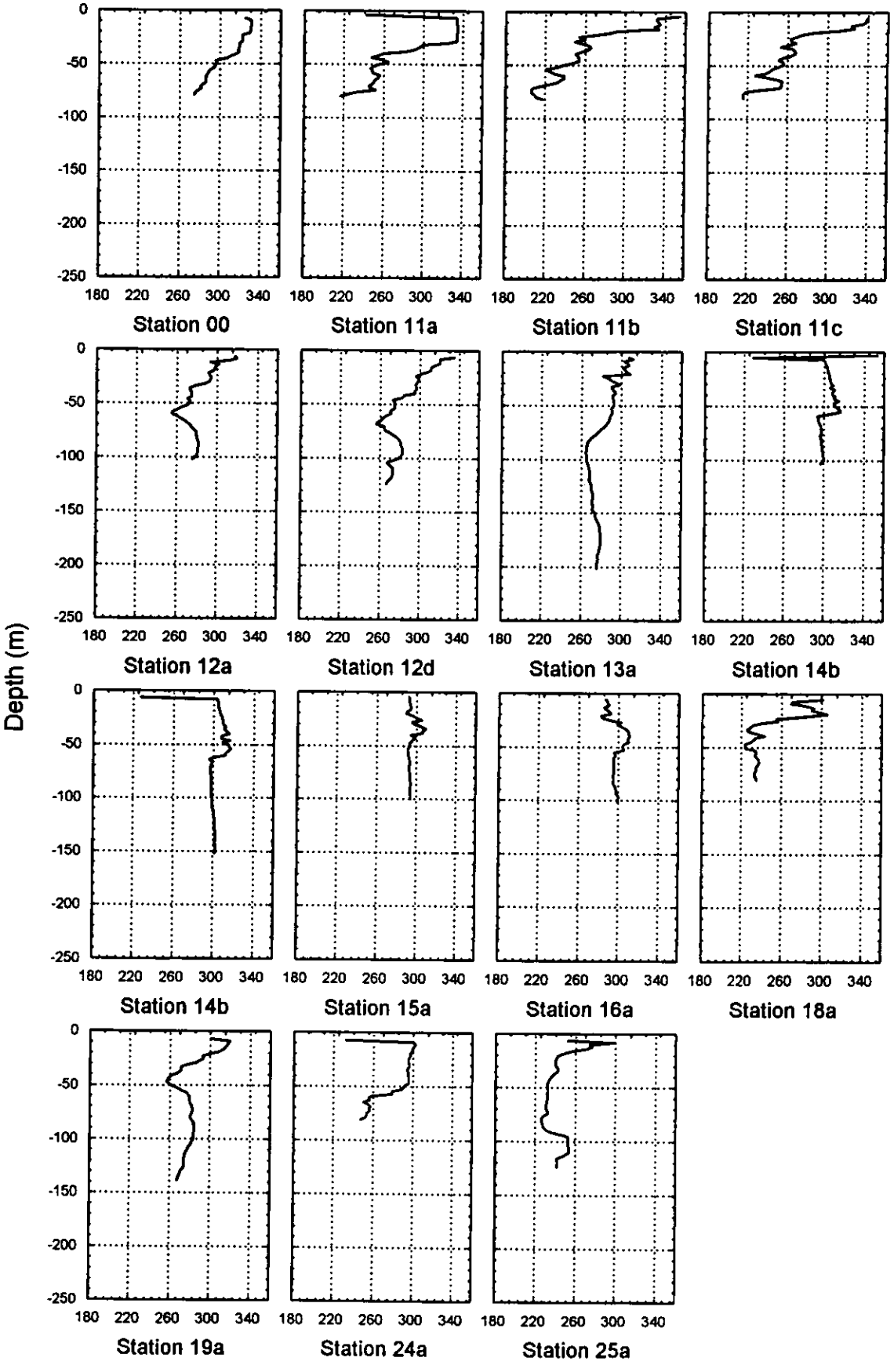
CTD Profiles cruise 99/19 OMEX II

Stations 00 - 25 surface casts



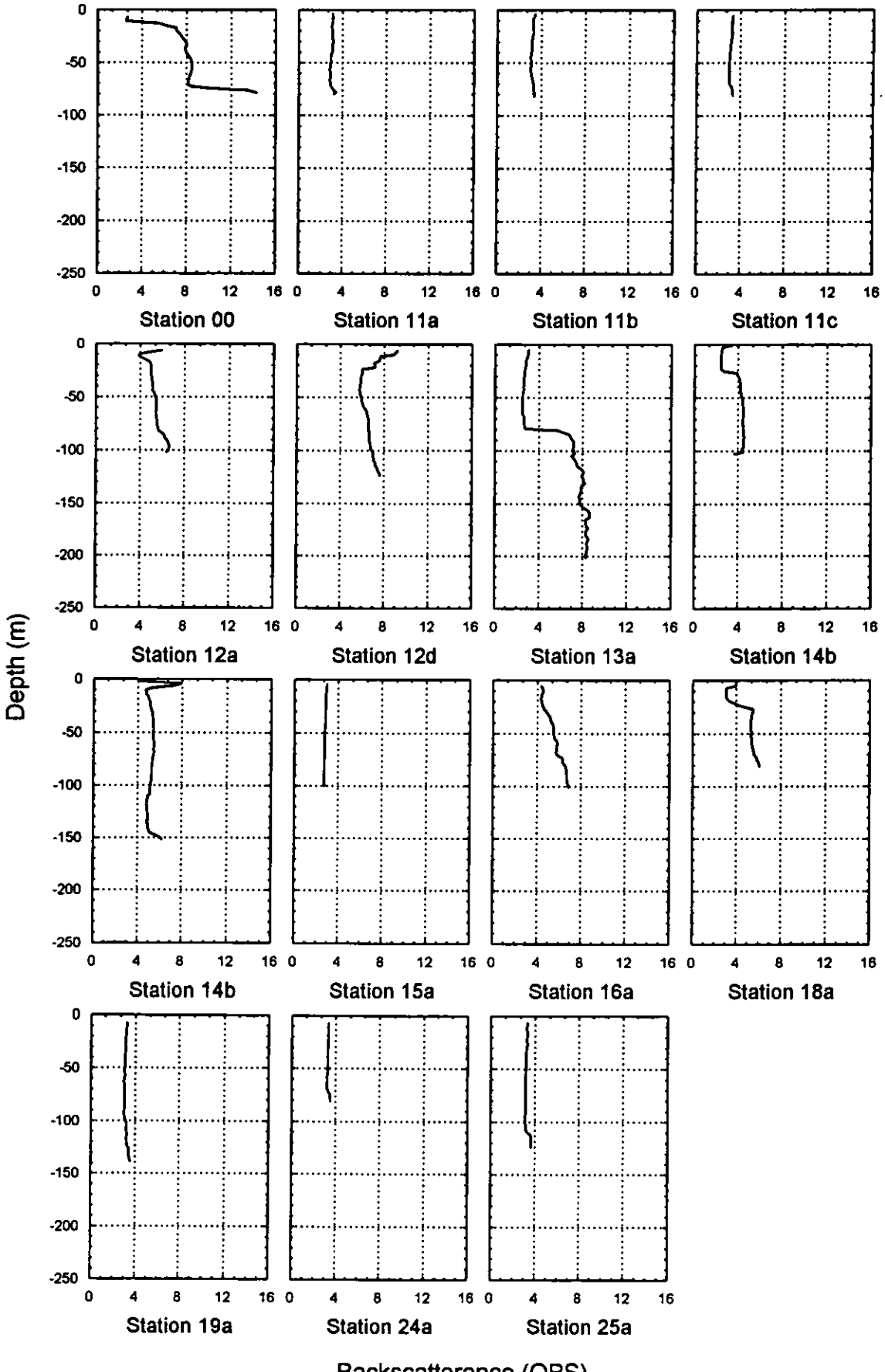
CTD Profiles cruise 99/19 OMEX II

Stations 00 - 25 surface casts



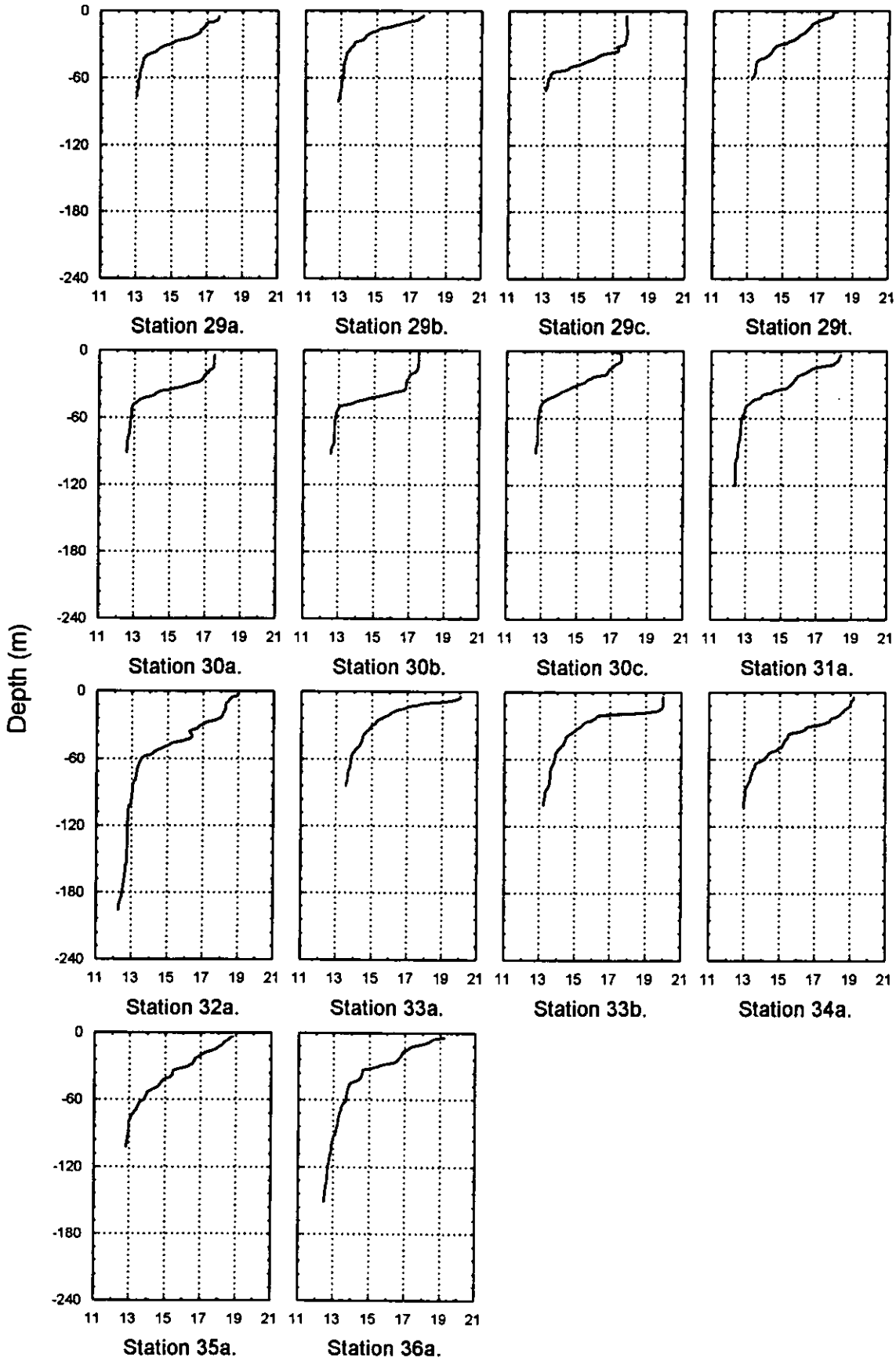
CTD Profiles cruise 99/19 OMEX II

Stations 00 - 25 surface casts



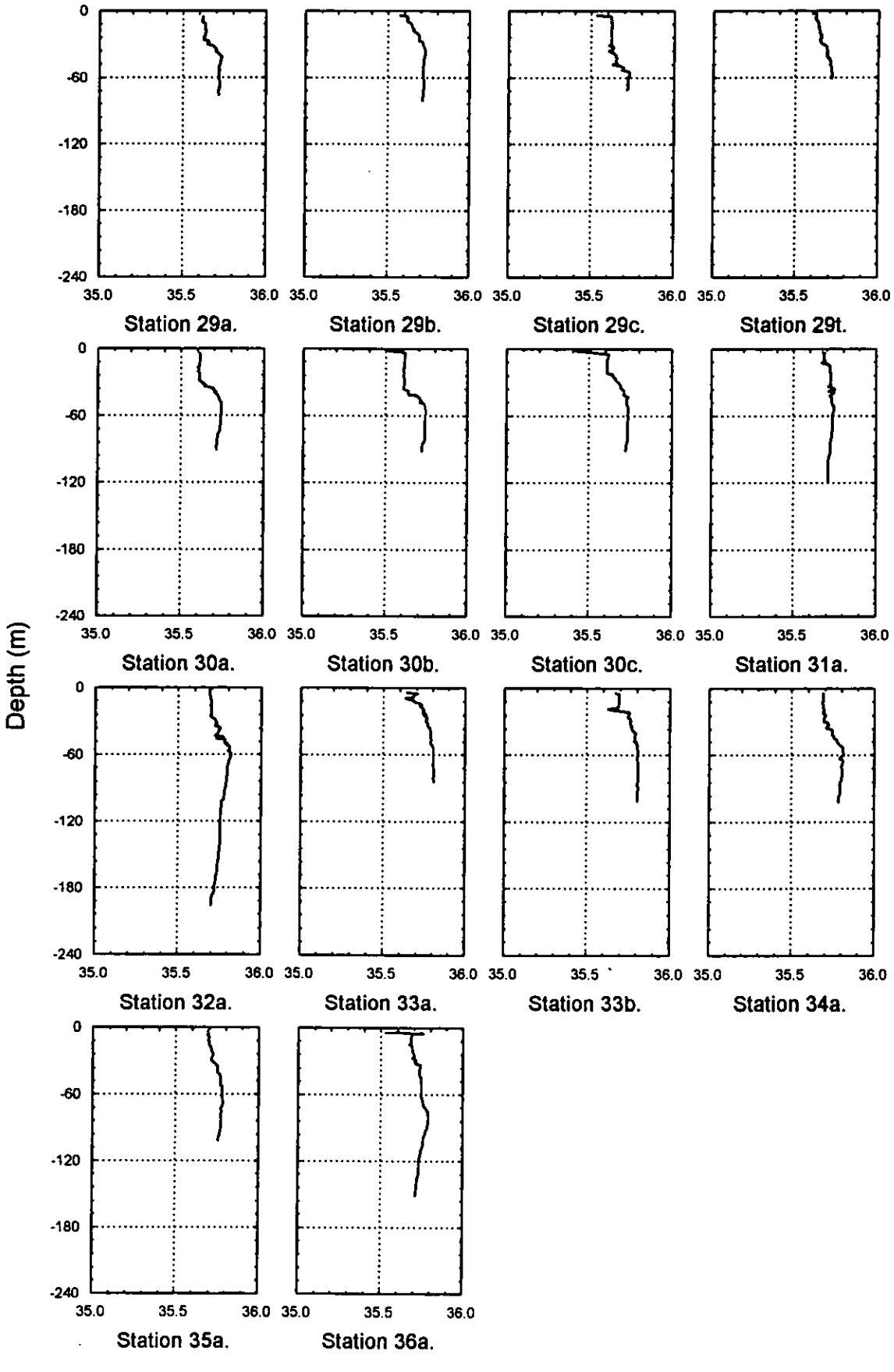
CTD Profiles cruise 99/19 OMEX II

Stations 29 - 36 surface casts



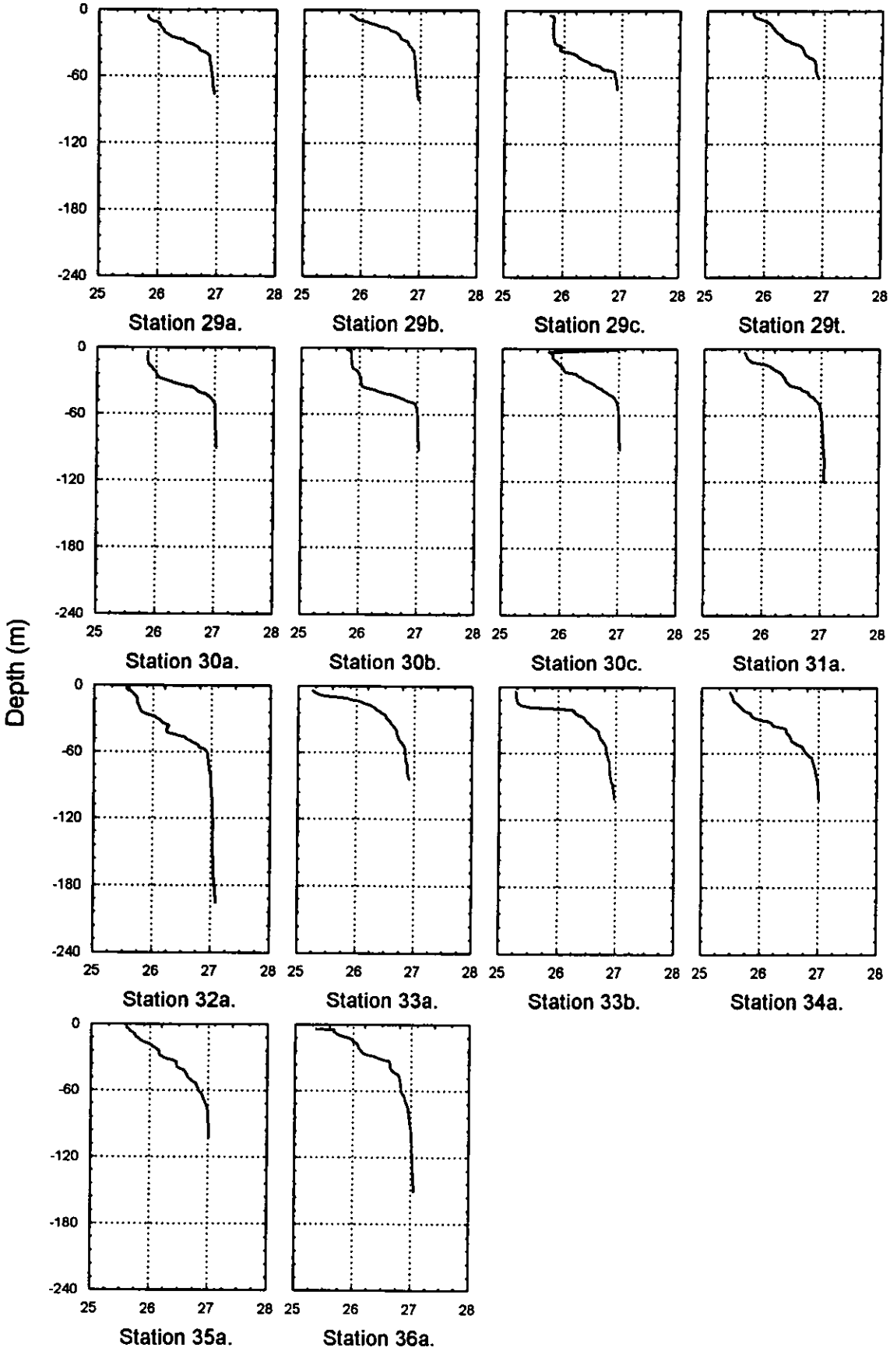
CTD Profiles cruise 99/19 OMEX II

Stations 29 - 36 surface casts



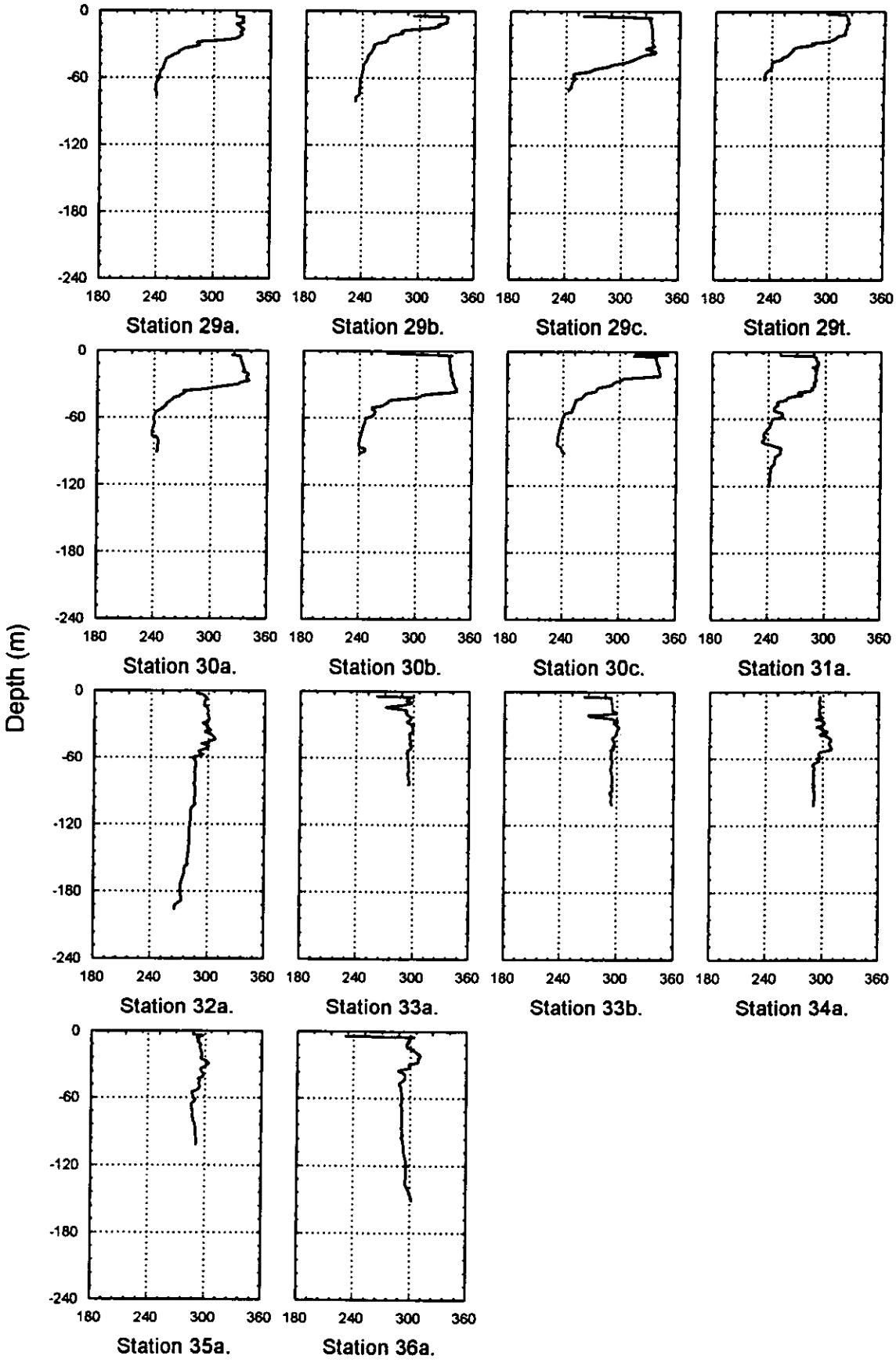
CTD Profiles cruise 99/19 OMEX II

Stations 29 - 36 surface casts



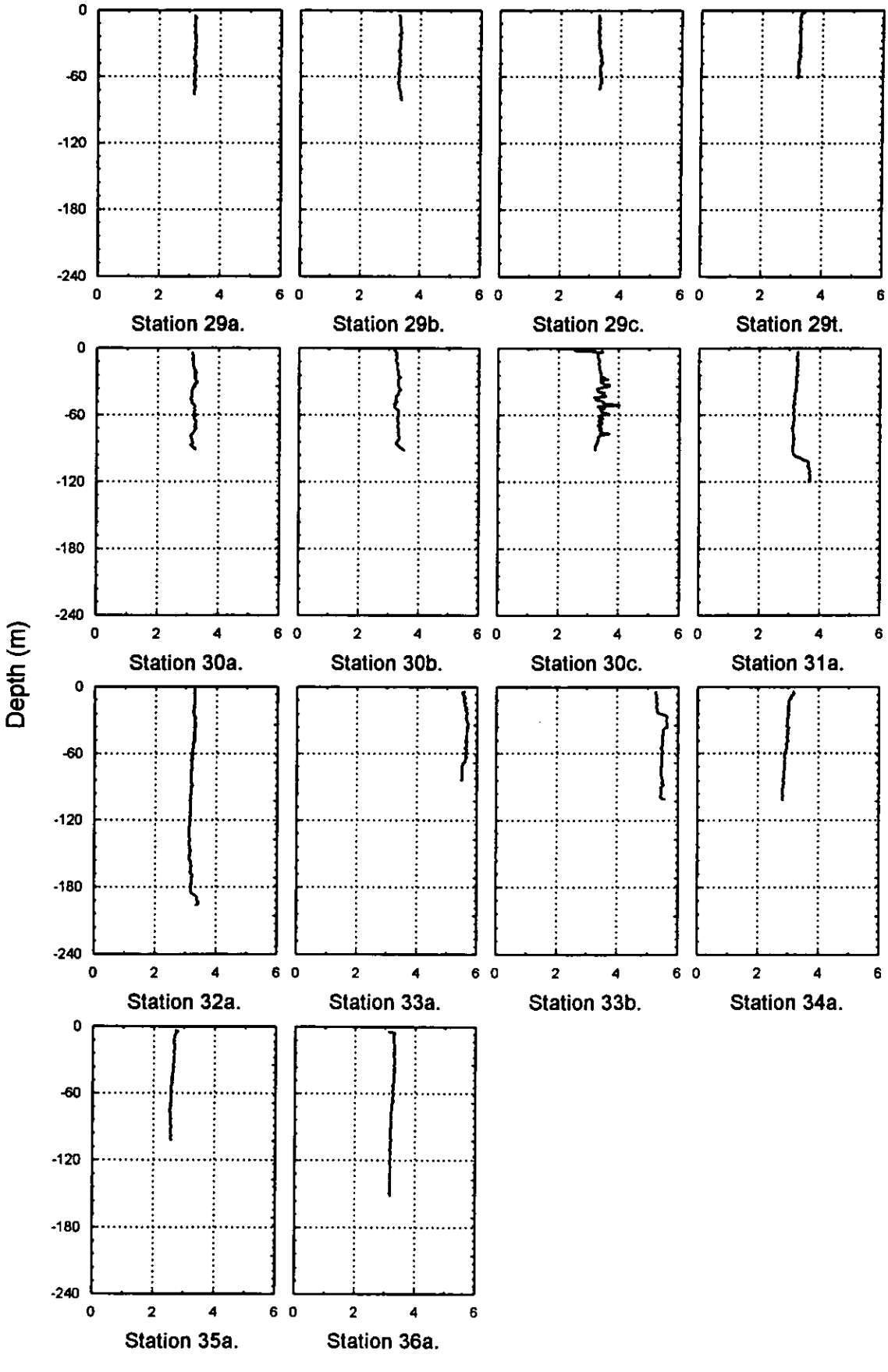
CTD Profiles cruise 99/19 OMEX II

Stations 29 - 36 surface casts



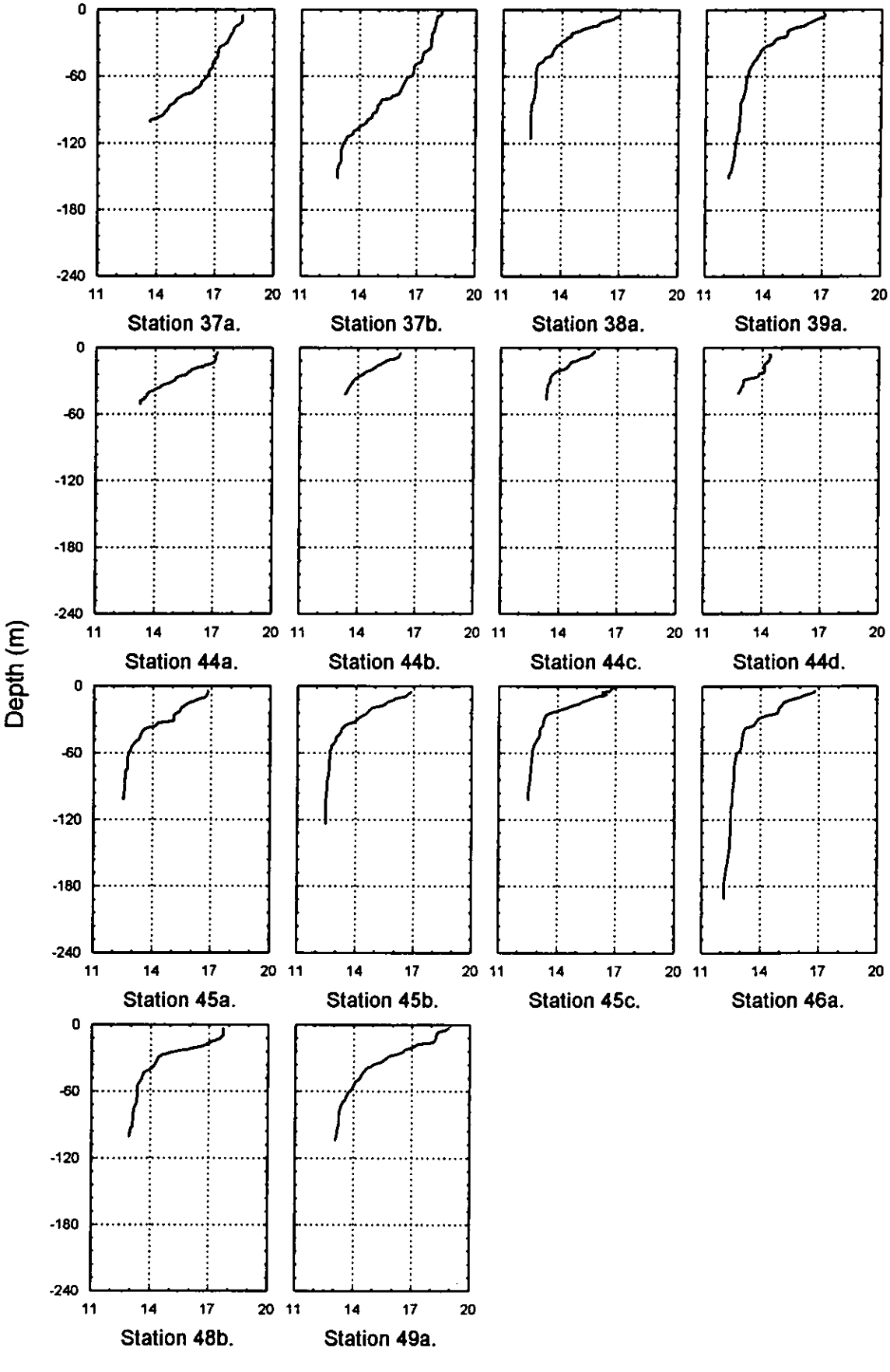
CTD Profiles cruise 99/19 OMEX II

Stations 29 - 36 surface casts



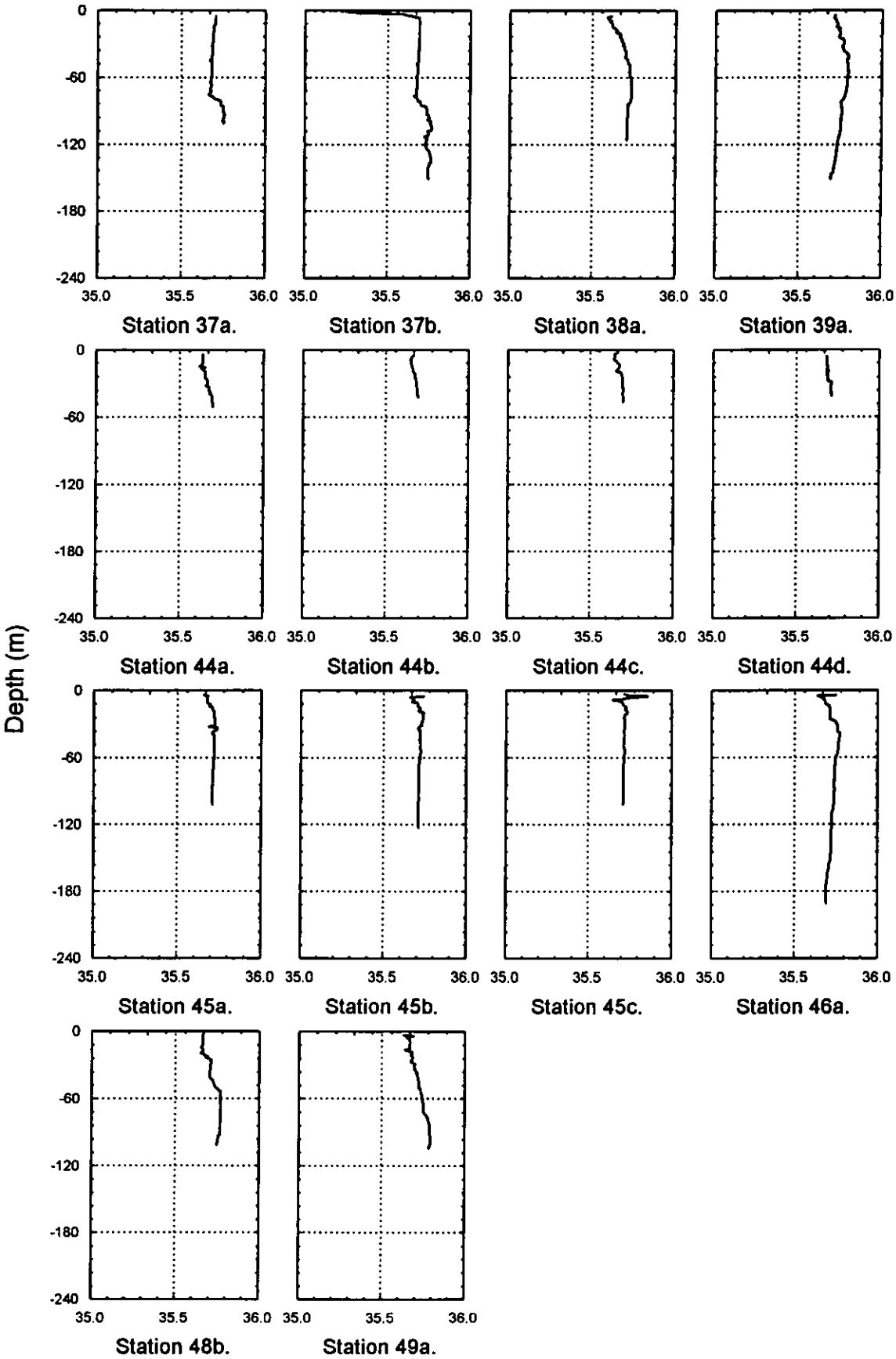
CTD Profiles cruise 99/19 OMEX II

Stations 37 - 49 surface casts



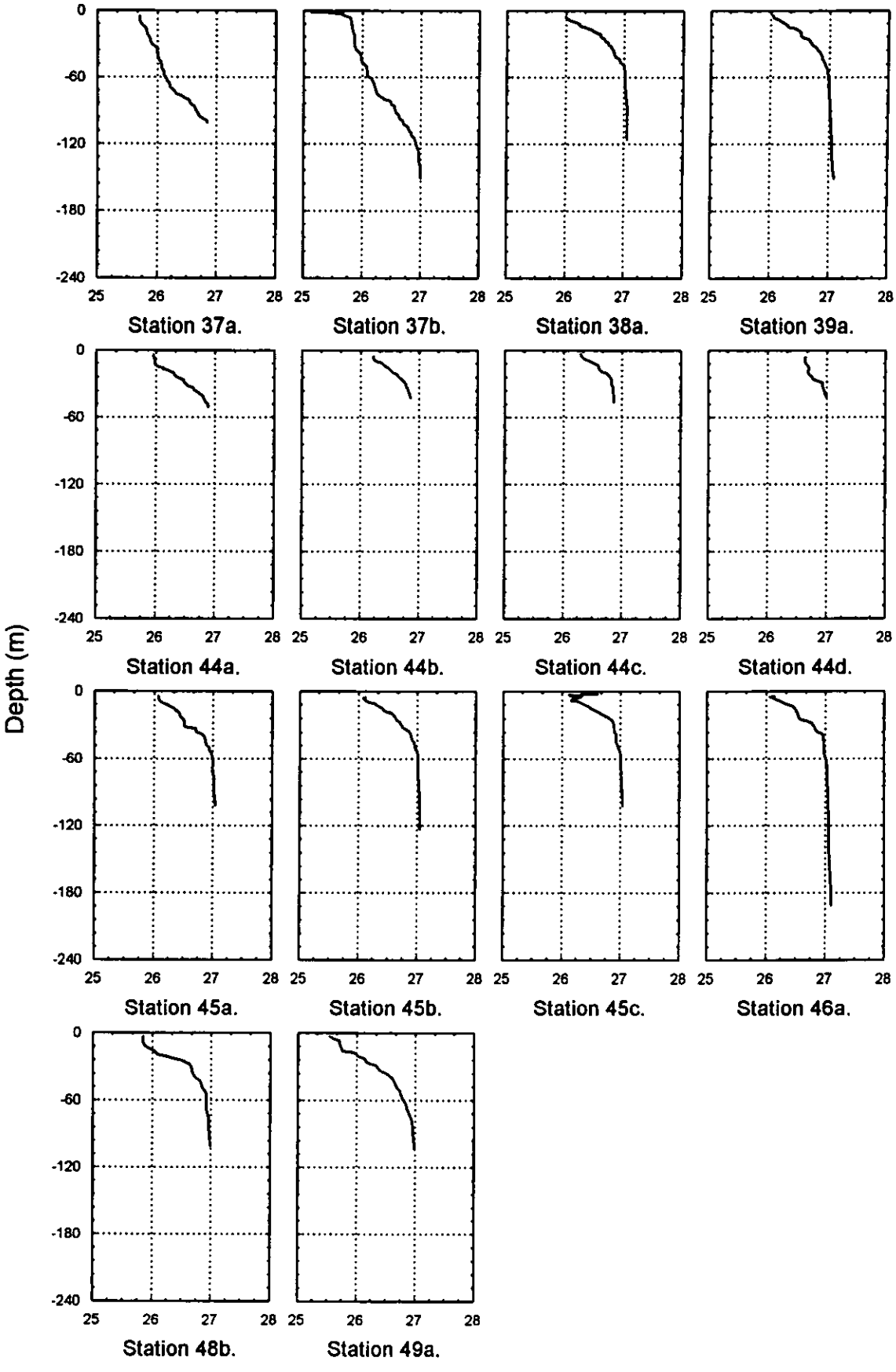
CTD Profiles cruise 99/19 OMEX II

Stations 37 - 49 surface casts



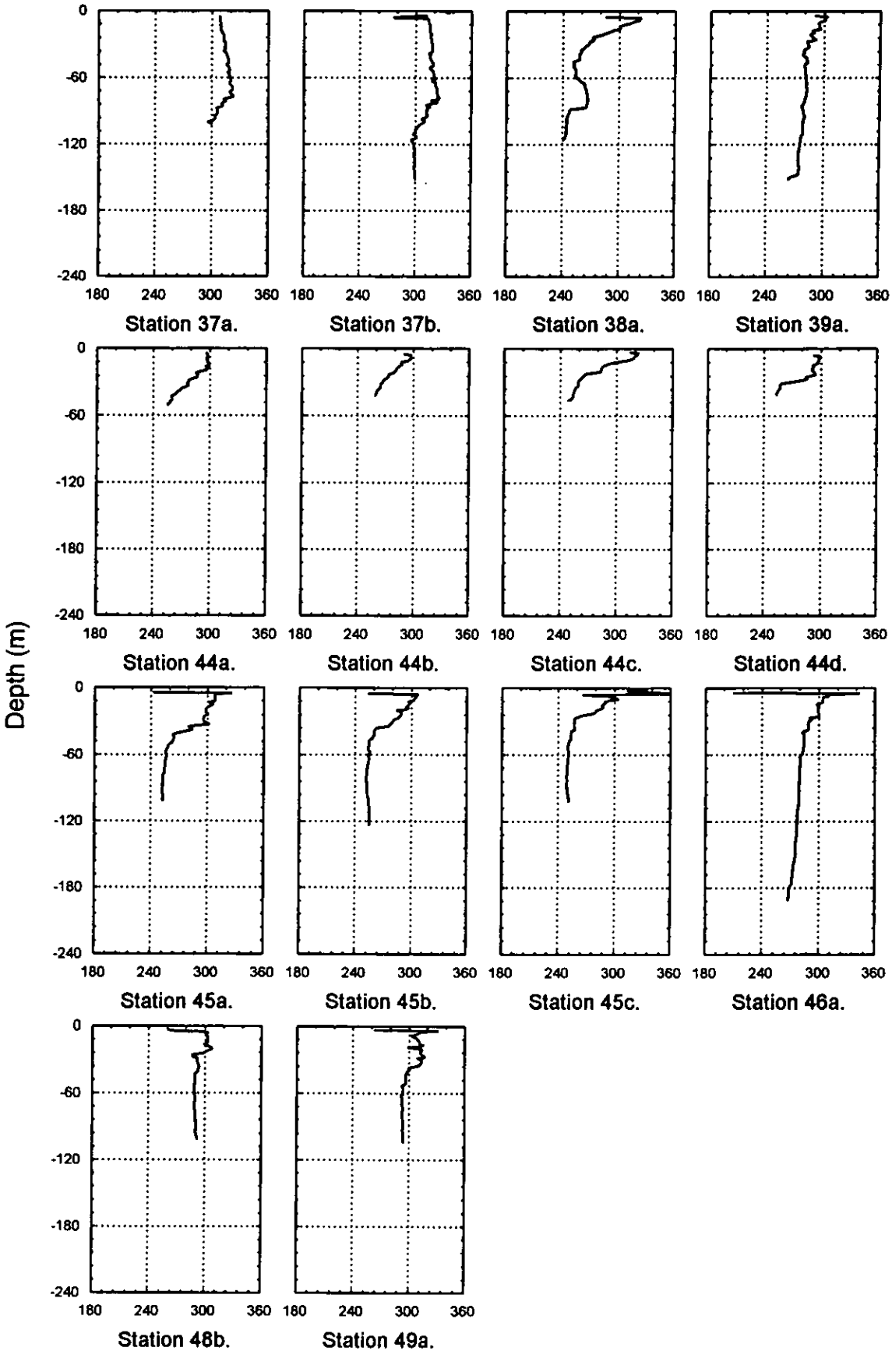
CTD Profiles cruise 99/19 OMEX II

Stations 37 - 49 surface casts



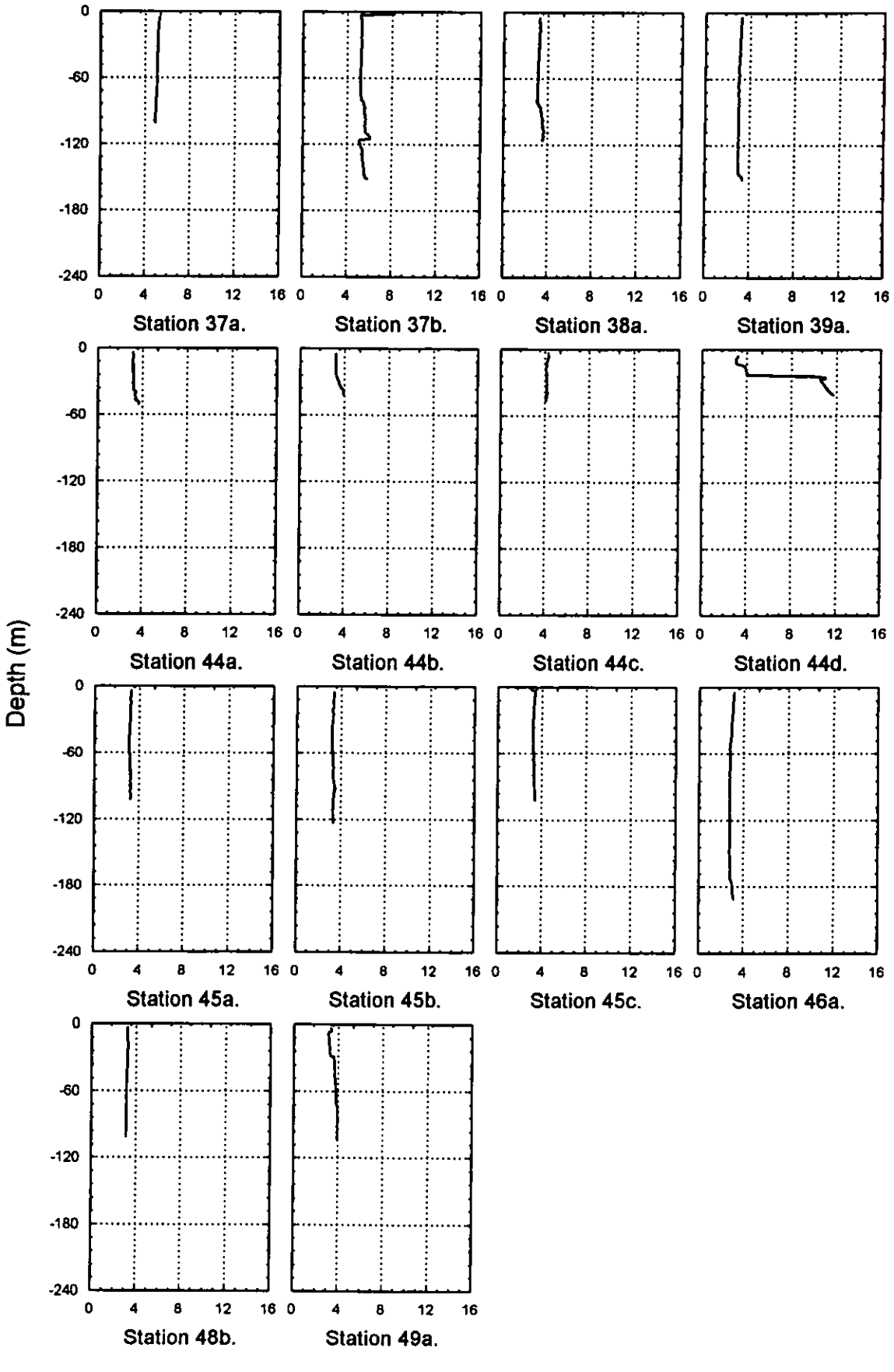
CTD Profiles cruise 99/19 OMEX II

Stations 37 - 49 surface casts



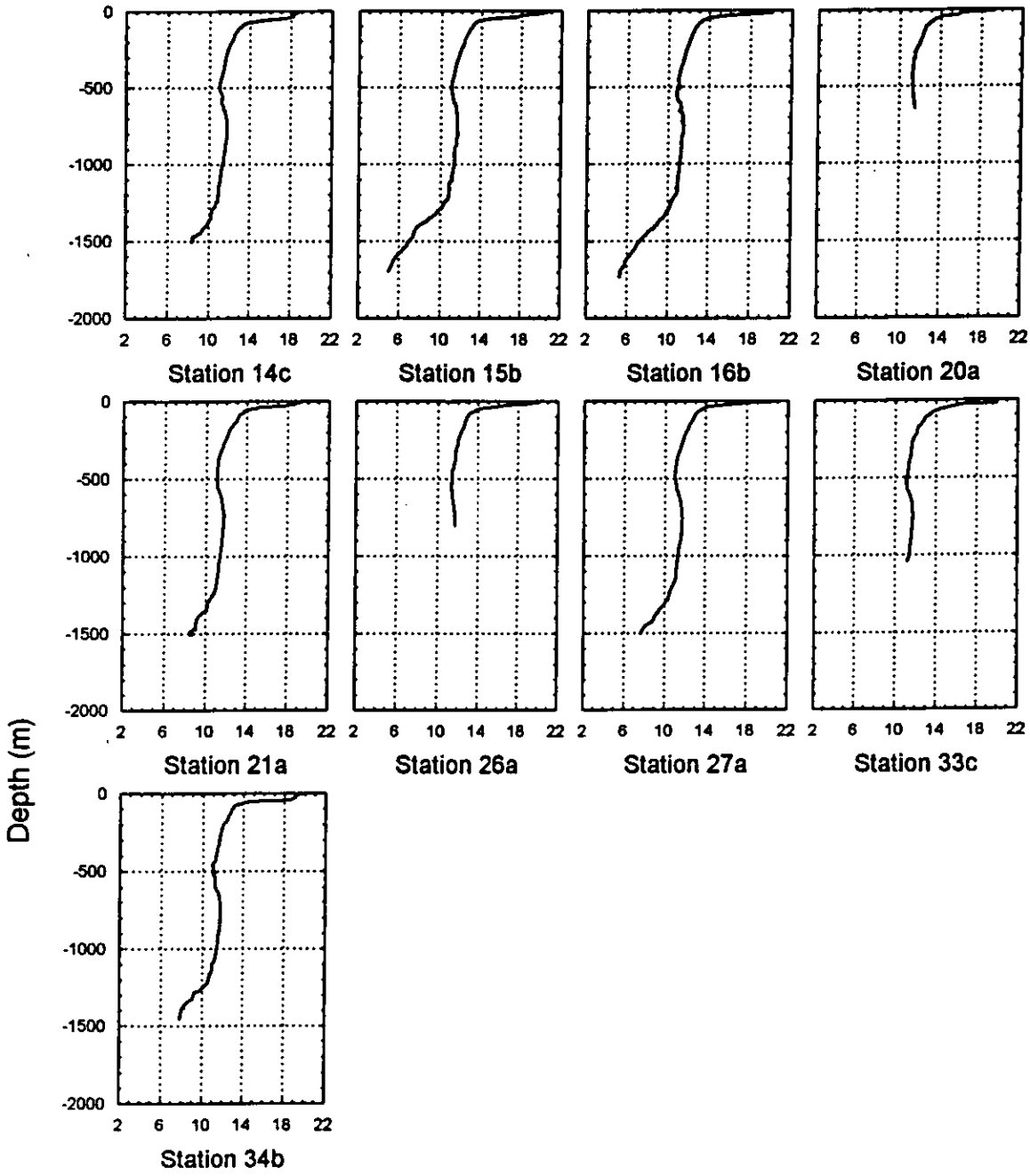
CTD Profiles cruise 99/19 OMEX II

Stations 37 - 49 surface casts



CTD Profiles cruise 99/19 OMEX II

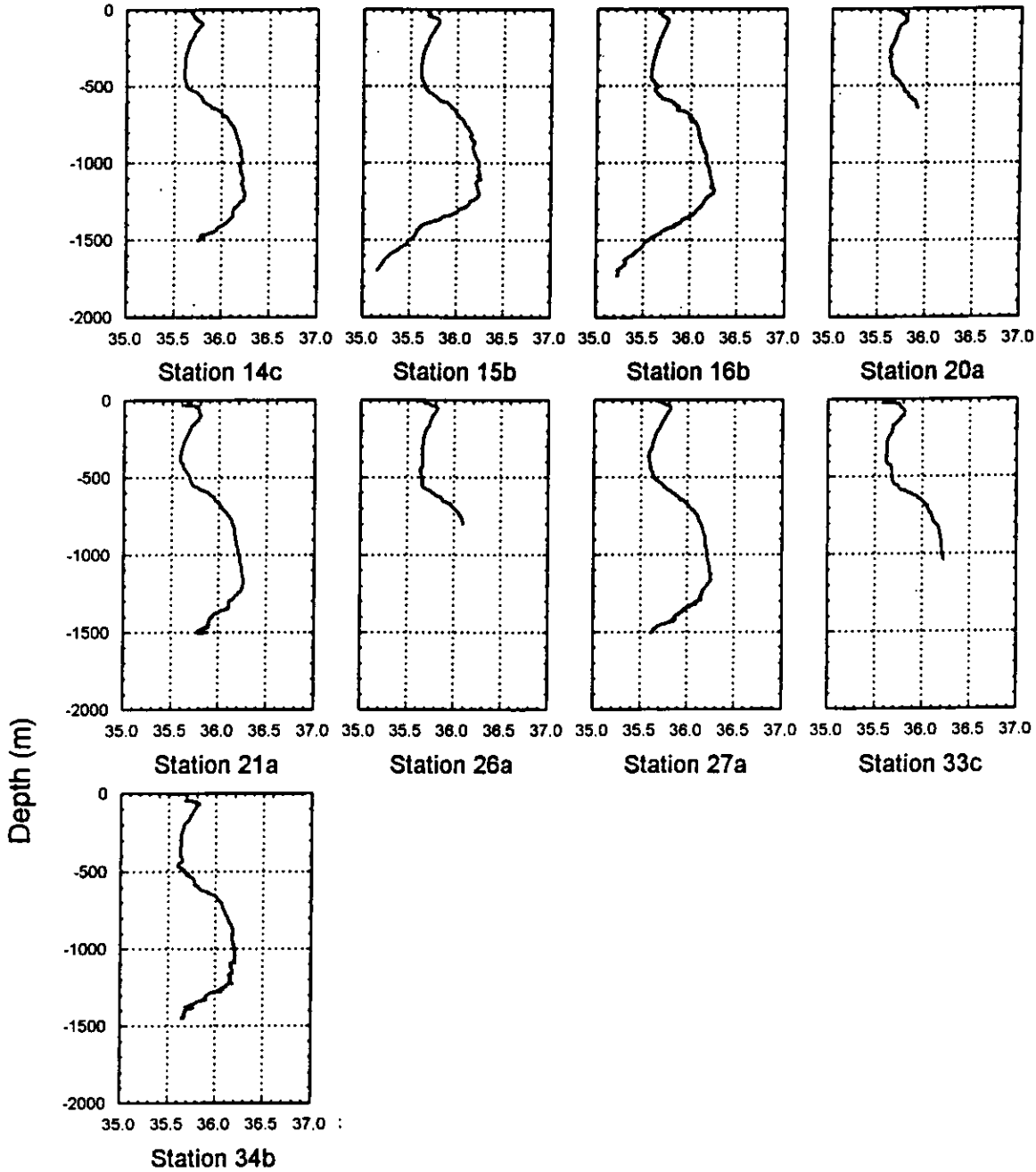
Stations 14c -34b deep casts



Temperature (°C)

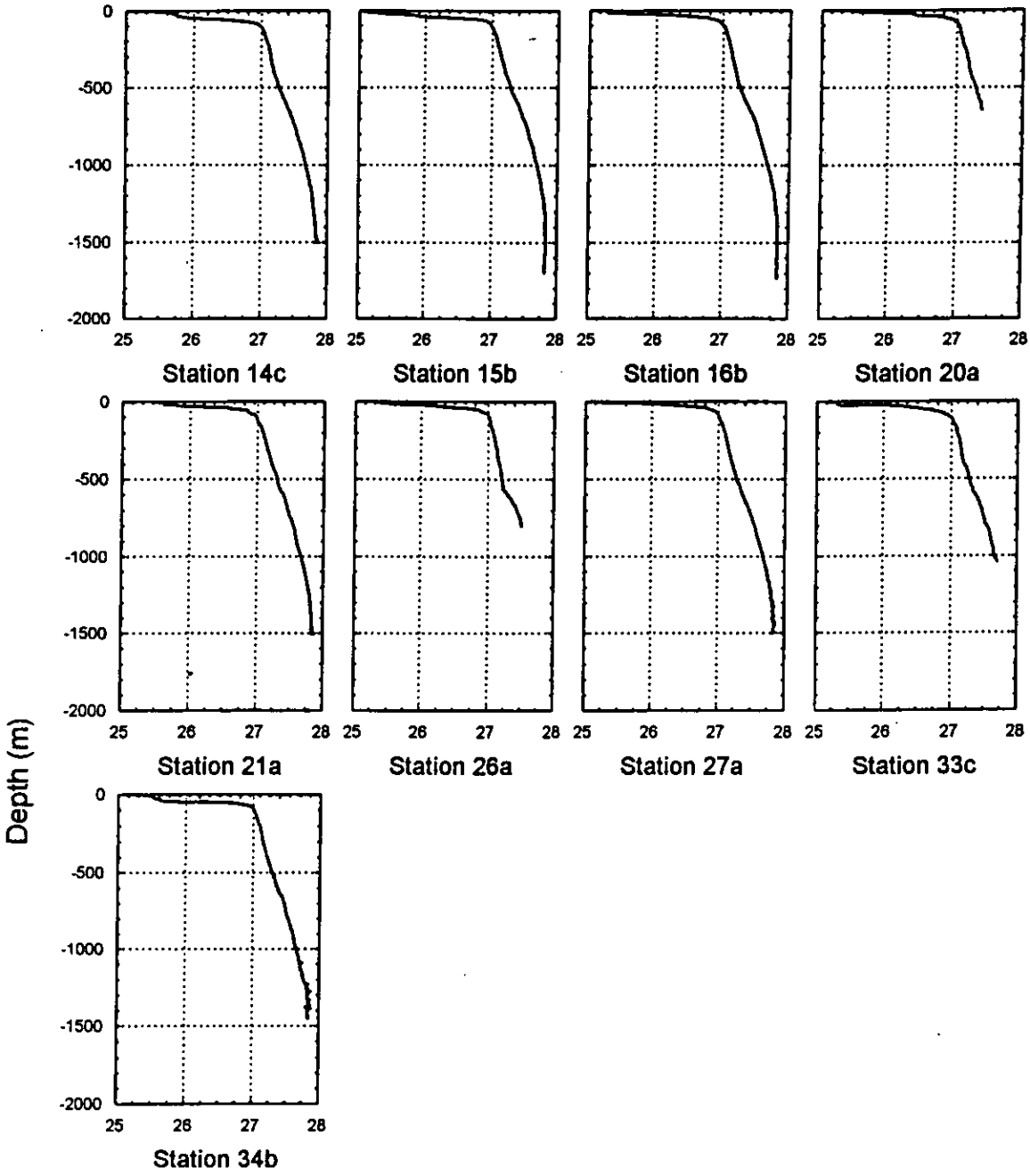
CTD Profiles cruise 99/19 OMEX II

Stations 14c -34b deep casts



CTD Profiles cruise 99/19 OMEX II

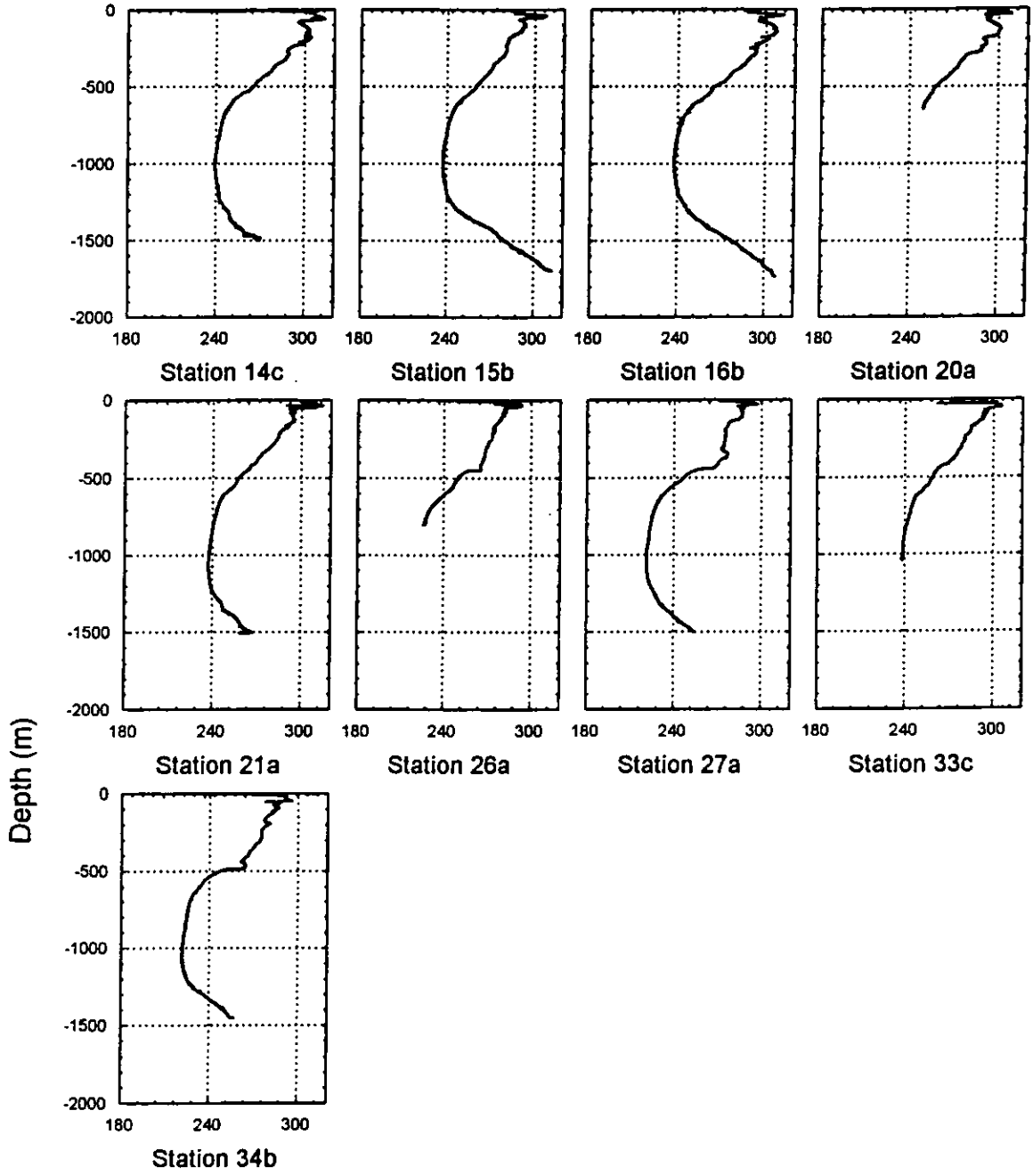
Stations 14c -34b deep casts



Density (Sigma-Theta)

CTD Profiles cruise 99/19 OMEX II

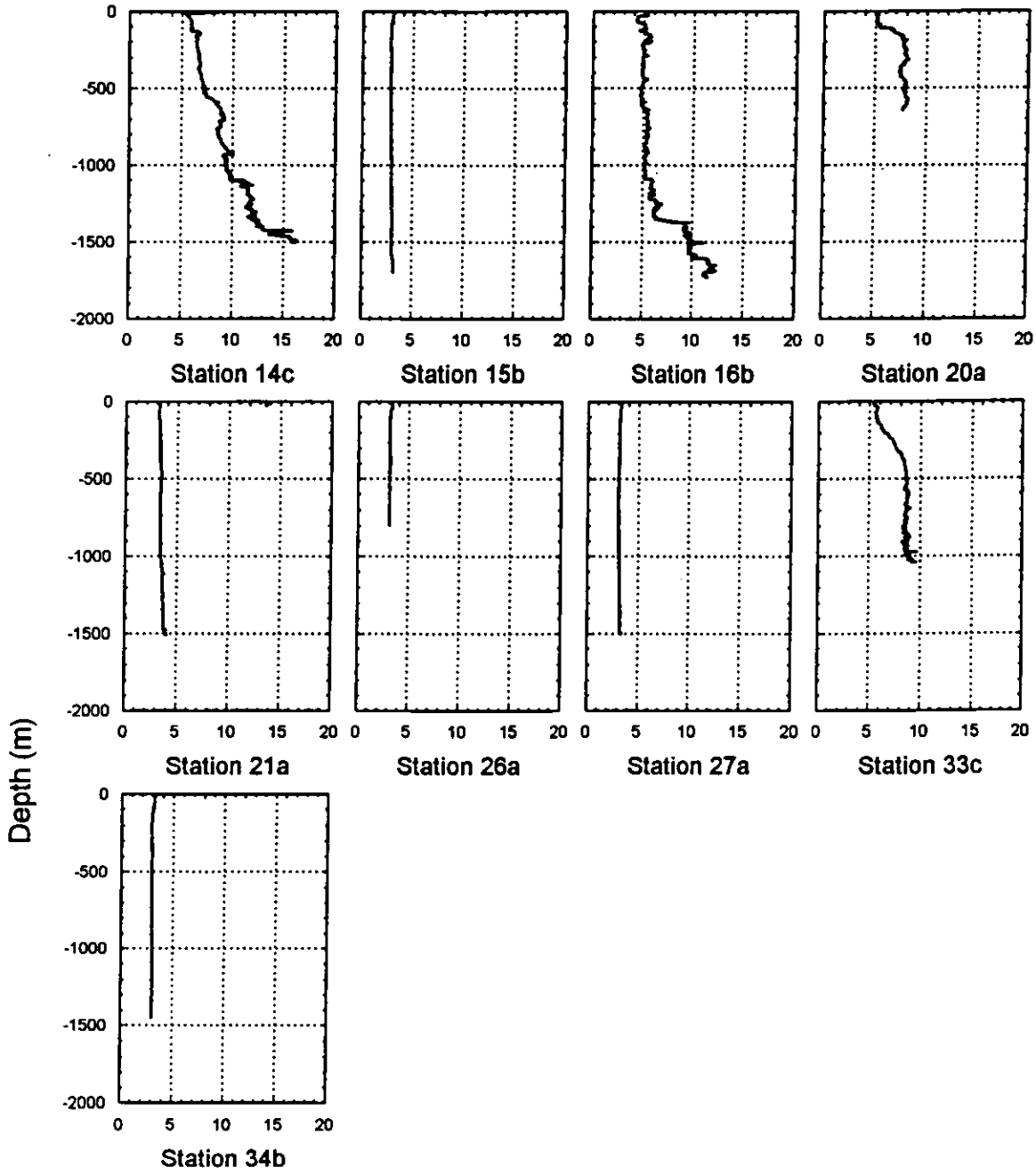
Stations 14c -34b deep casts



Dissolved Oxygen (µmol/kg)

CTD Profiles cruise 99/19 OMEX II

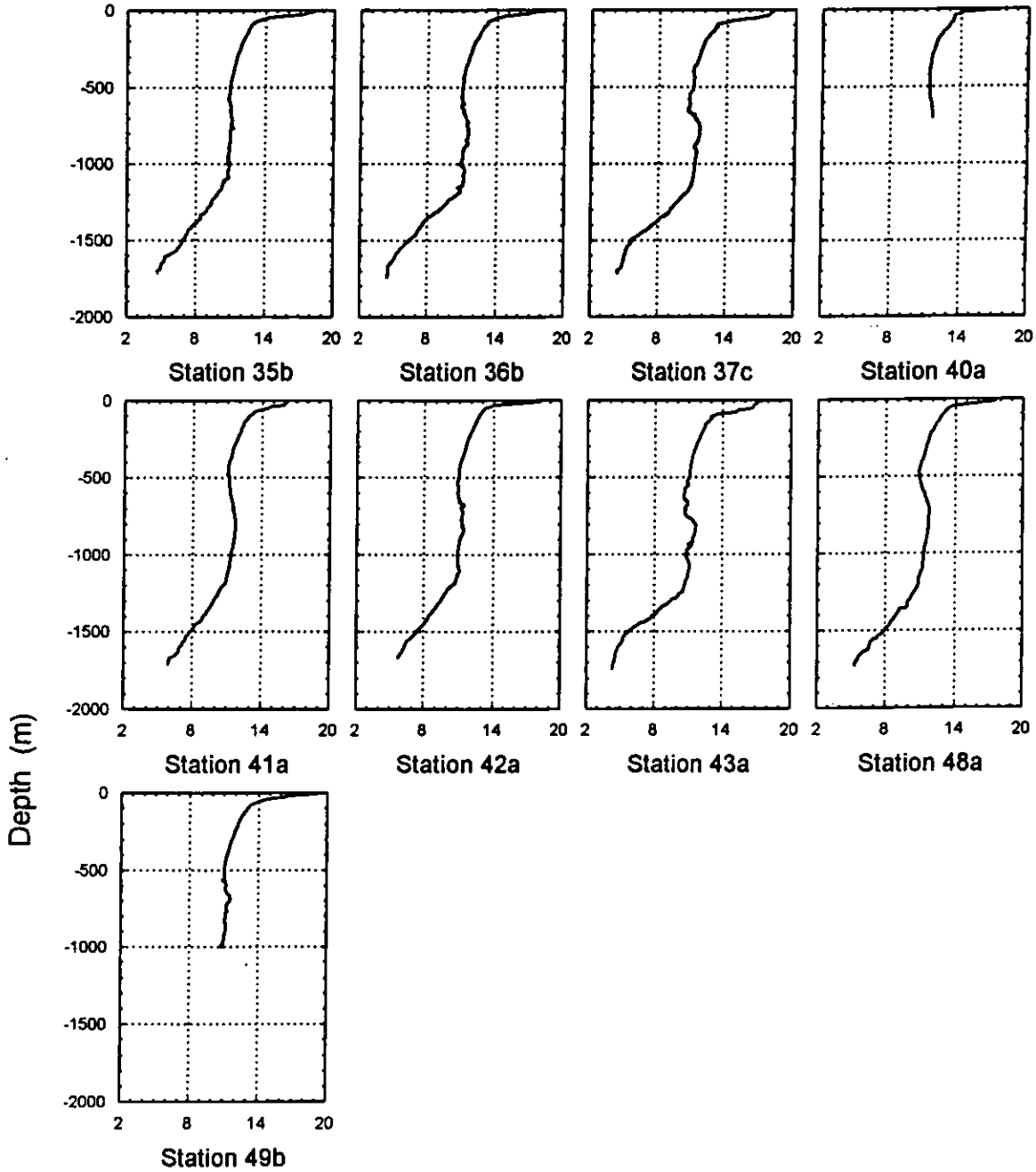
Stations 14c -34b deep casts



Backscatterance (OBS)

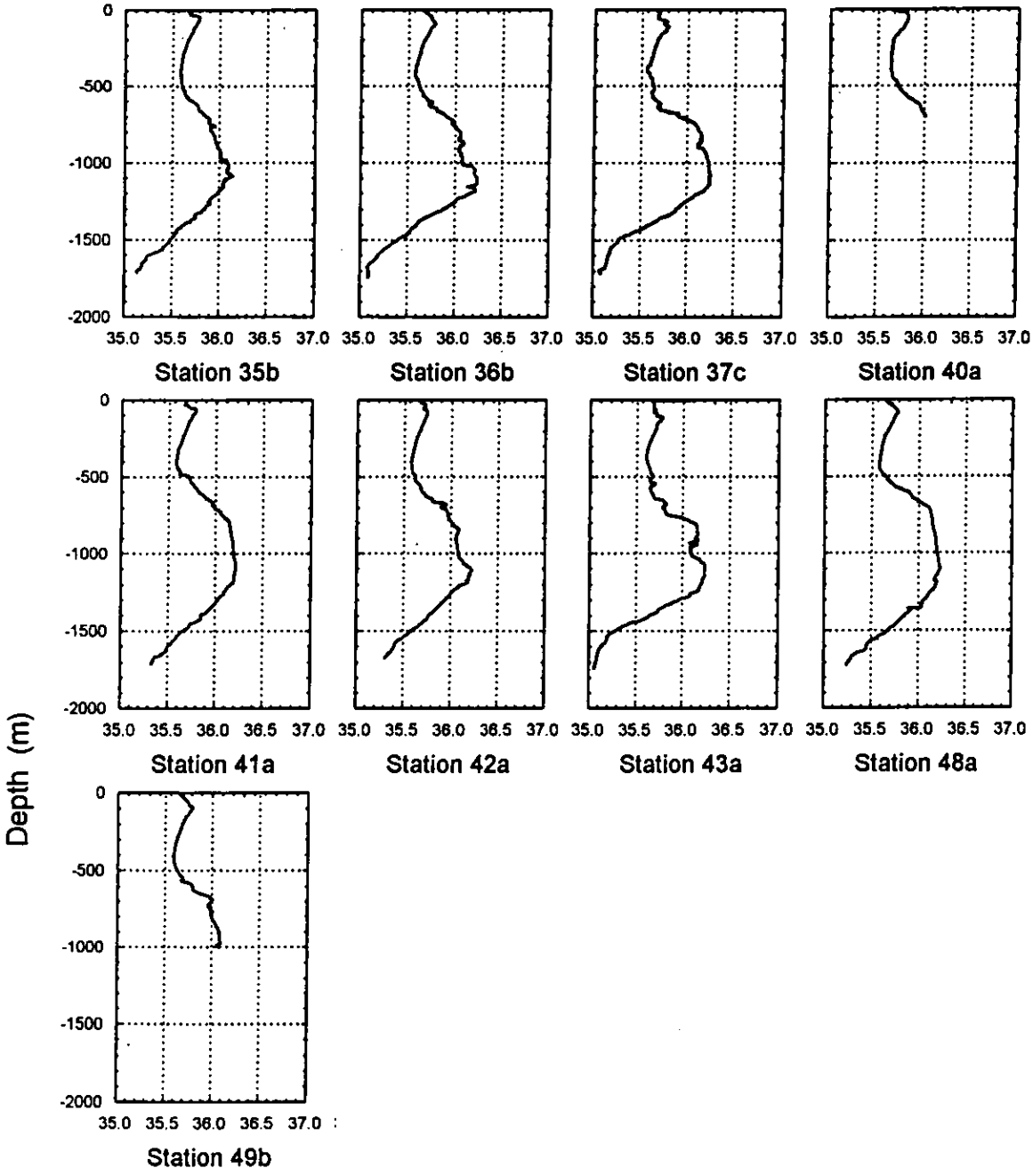
CTD Profiles cruise 99/19 OMEX II

Stations 35b - 49b deep casts



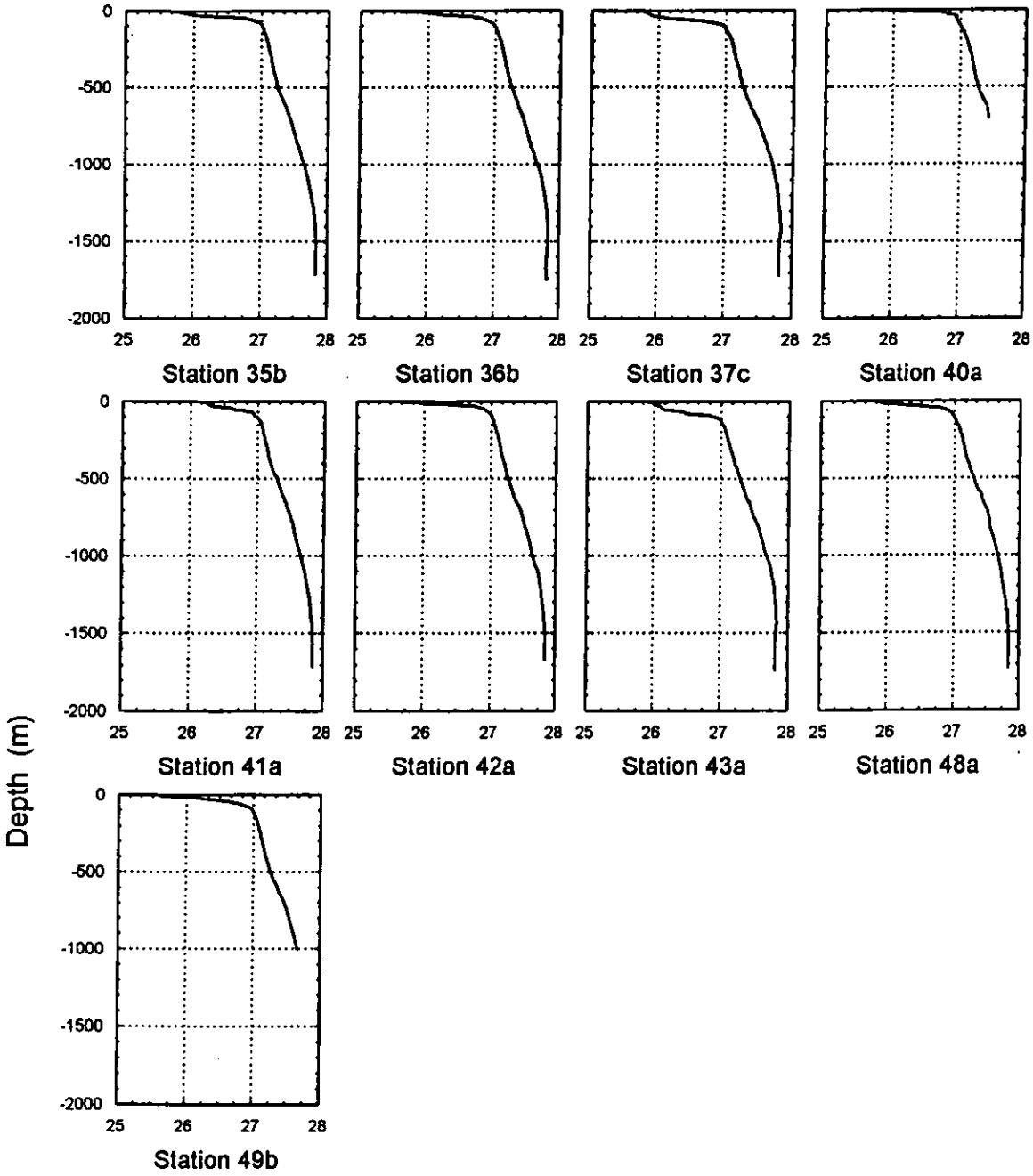
CTD Profiles cruise 99/19 OMEX II

Stations 35b - 49b deep casts



CTD Profiles cruise 99/19 OMEX II

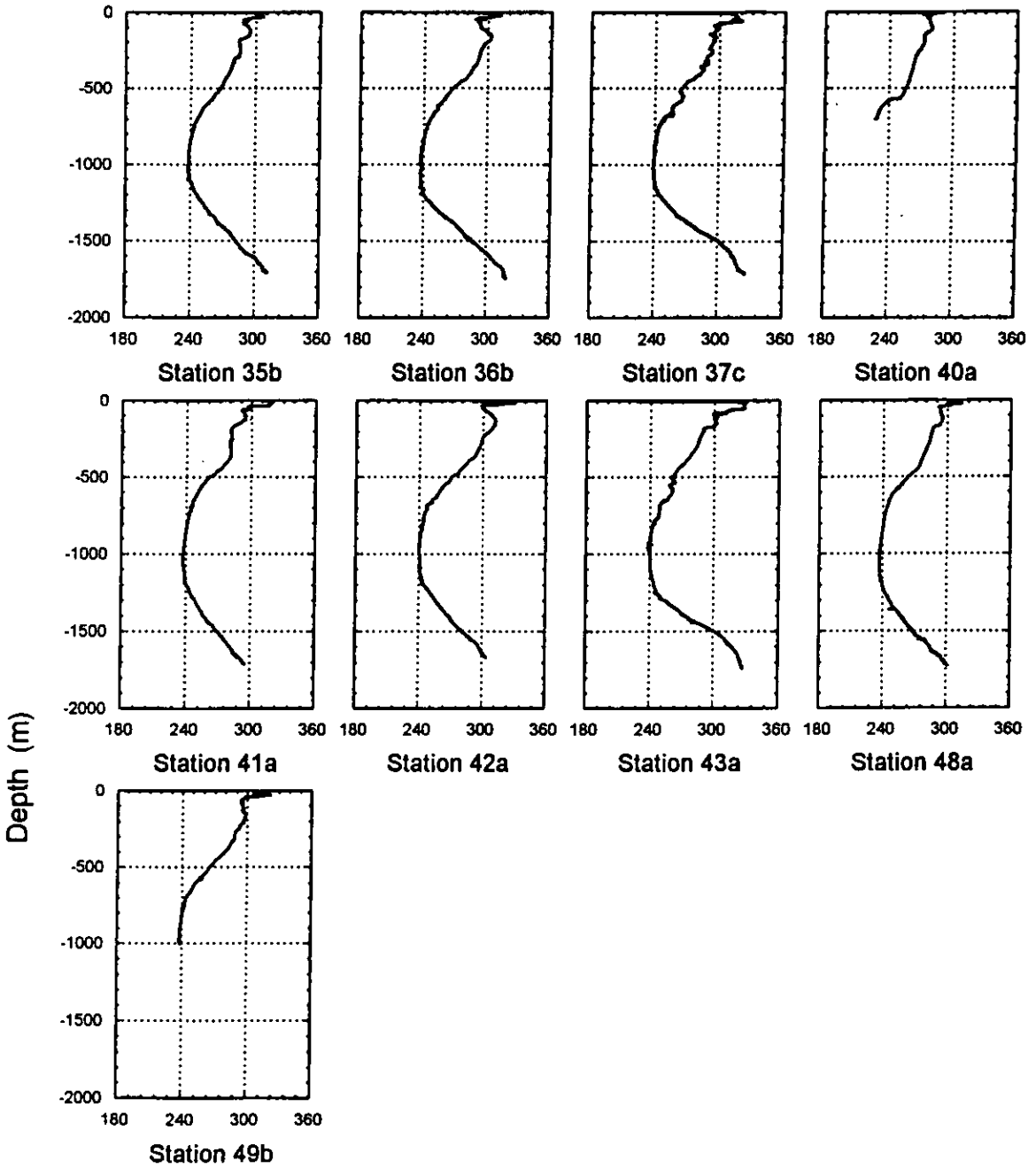
Stations 35b - 49b deep casts



Density (Sigma-Theta)

CTD Profiles cruise 99/19 OMEX II

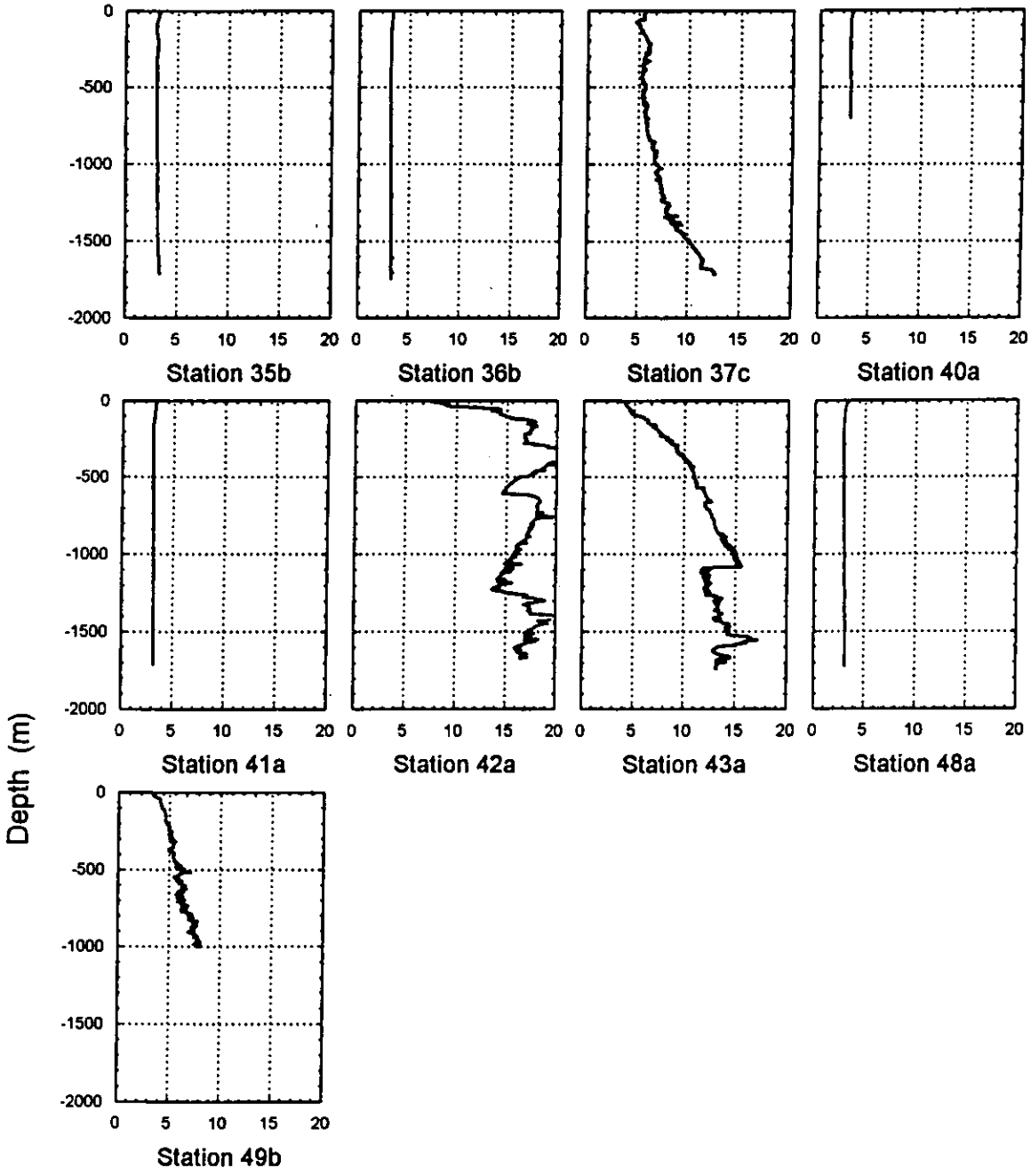
Stations 35b - 49b deep casts



Dissolved Oxygen (µmol/kg)

CTD Profiles cruise 99/19 OMEX II

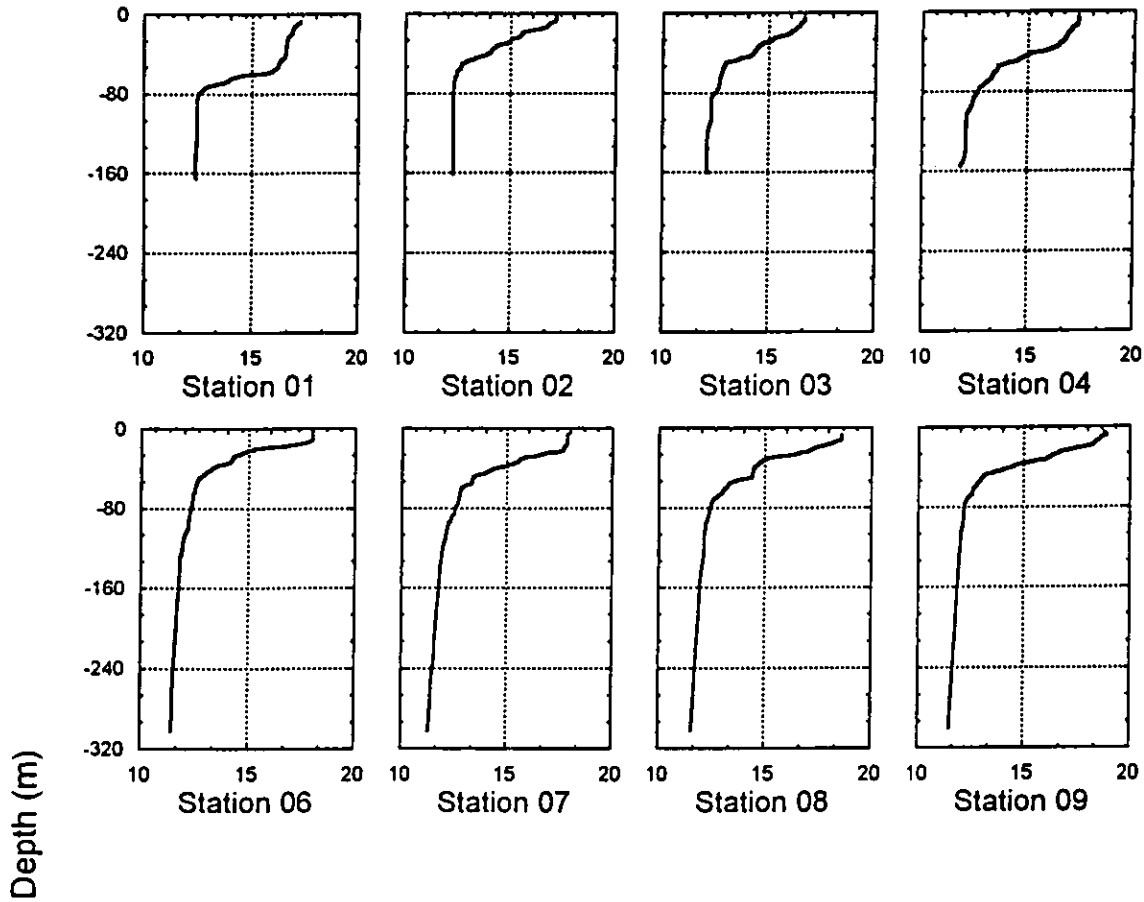
Stations 35b - 49b deep casts



Backscatterance (OBS)

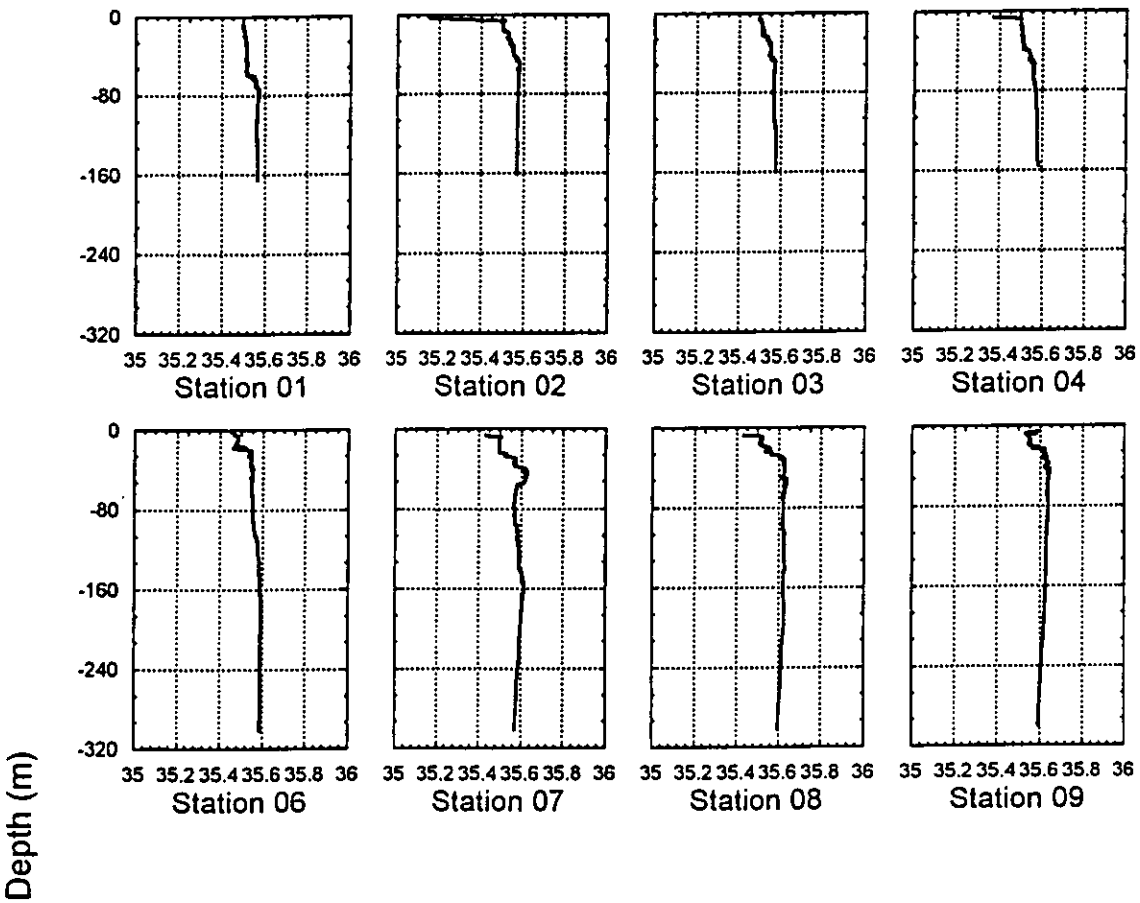
CTD Profiles cruise 99/19 OMEX II

Station La Chapelle Bank



CTD Profiles cruise 99/19 OMEX II

Stations La Chapelle Bank

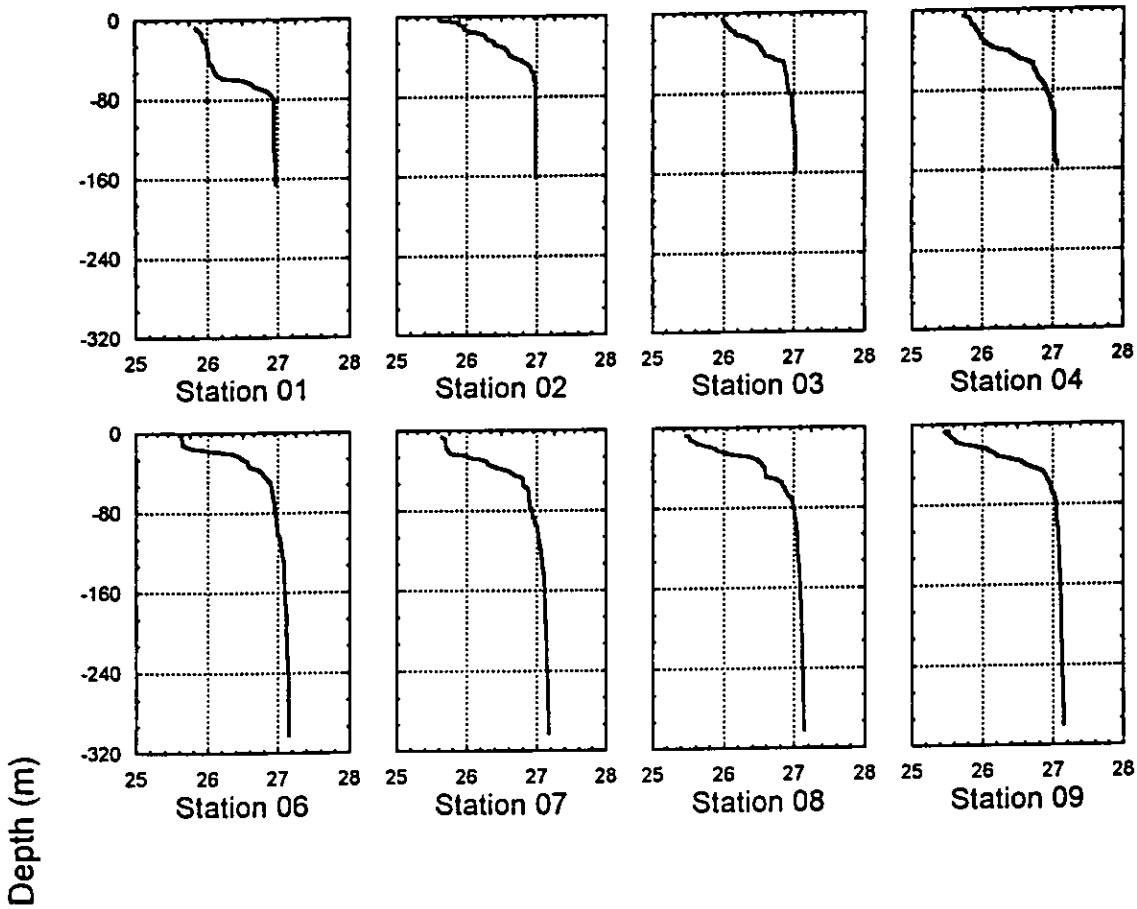


Depth (m)

Salinity (PSU)

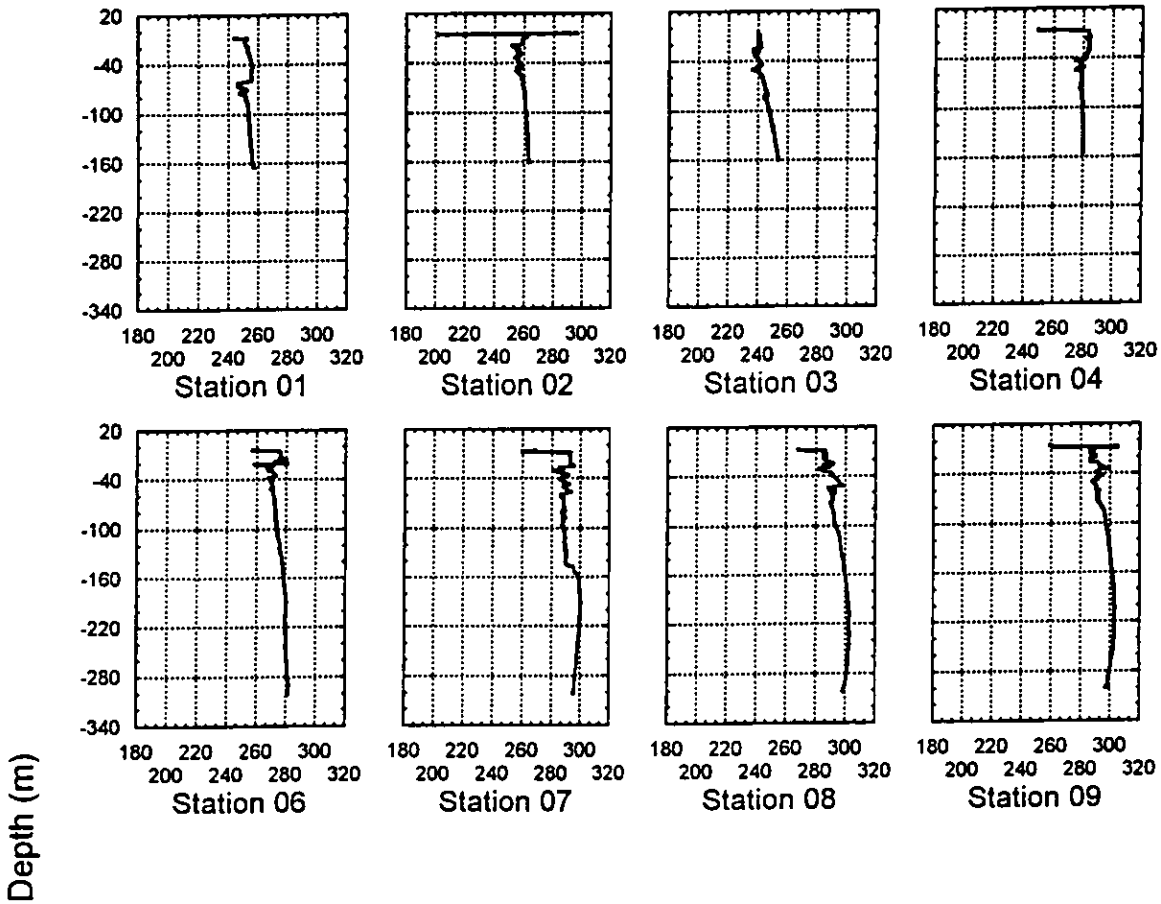
CTD Profiles cruise 99/19 OMEX II

Station La Chapelle Bank



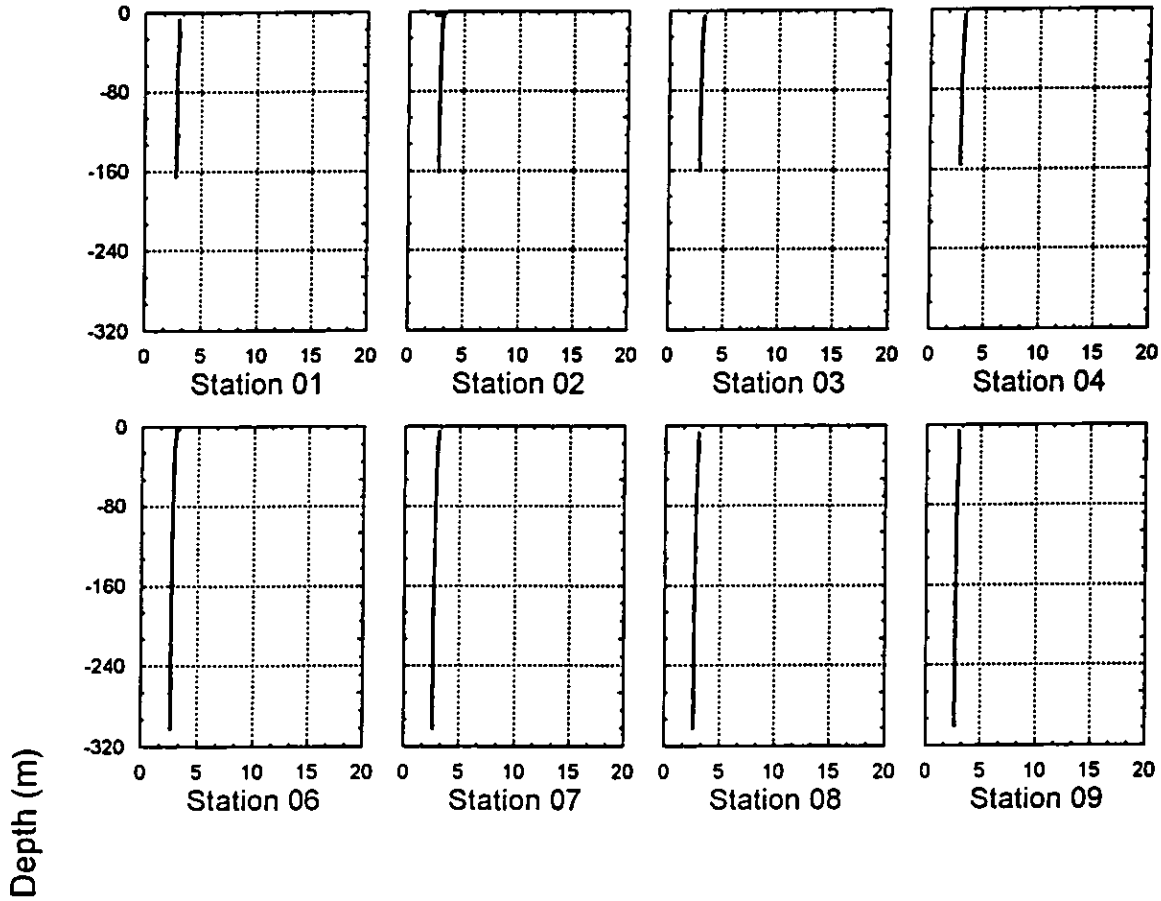
CTD Profiles cruise 99/19 OMEX II

Stations La Chapelle Bank



CTD Profiles cruise 99/19 OMEX II

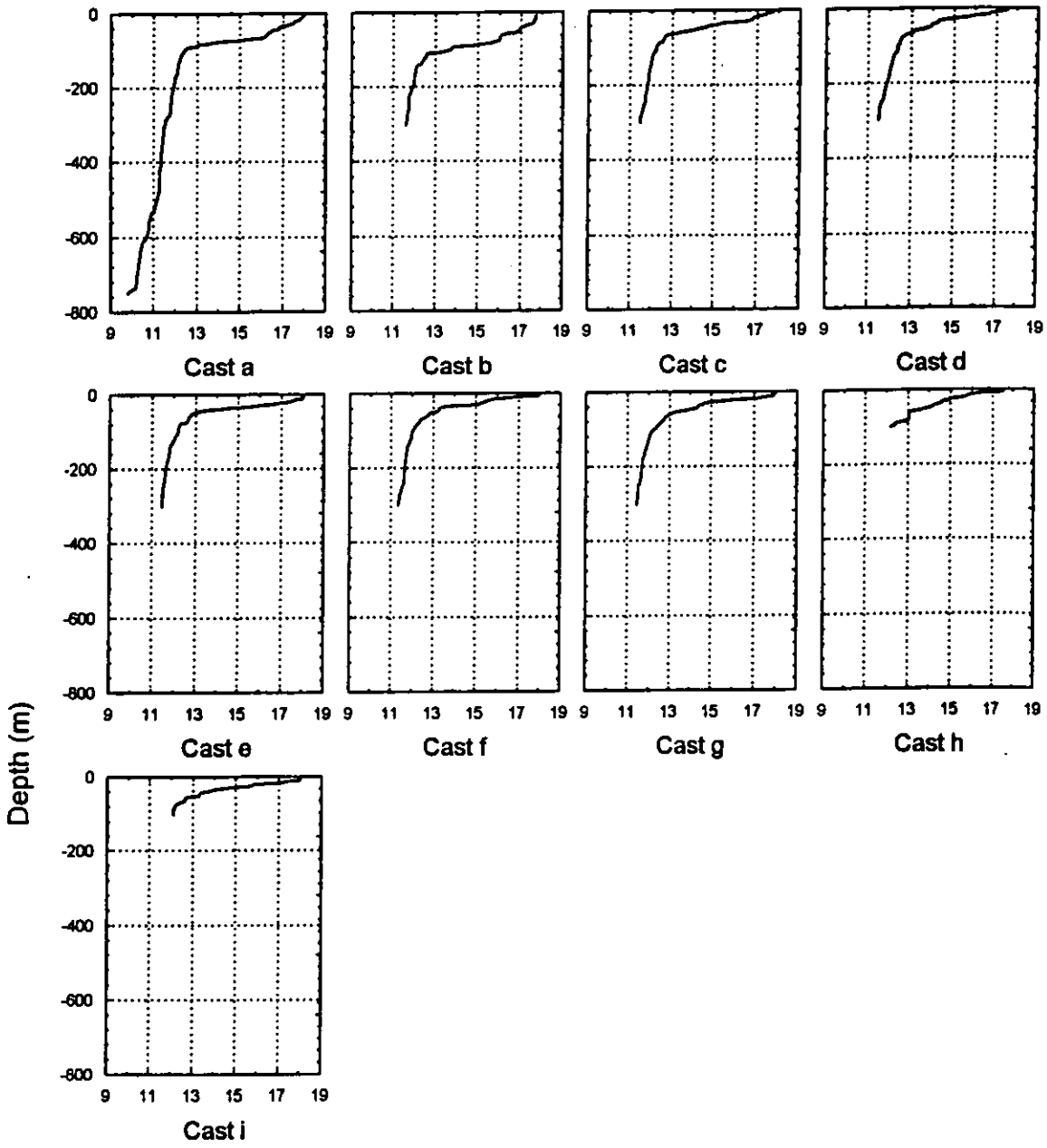
Stations La Chapelle Bank



Backscatterance (OBS)

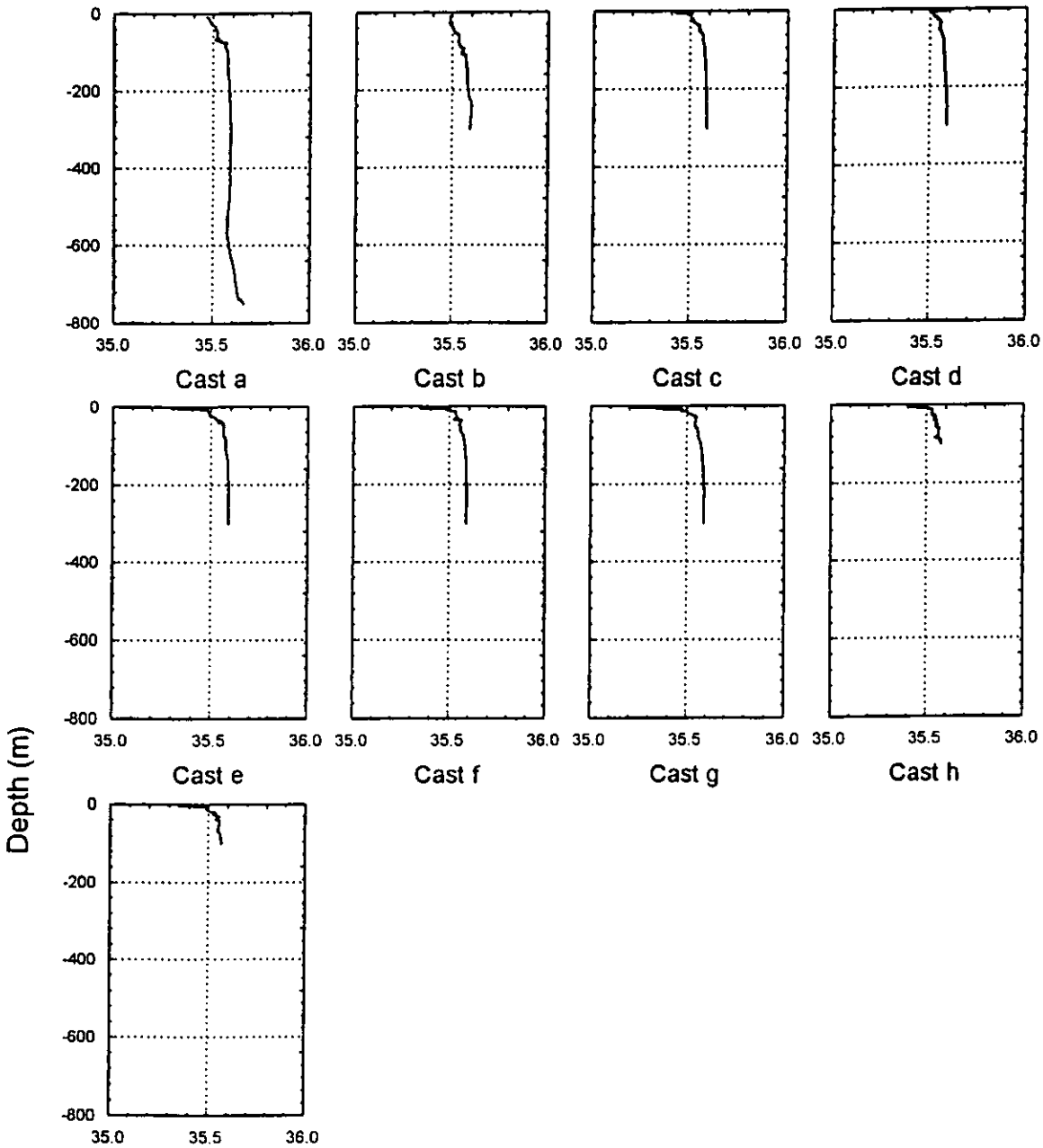
CTD Profiles cruise 99/19 OMEX II

Station 05 casts a - i



CTD Profiles cruise 99/19 OMEX II

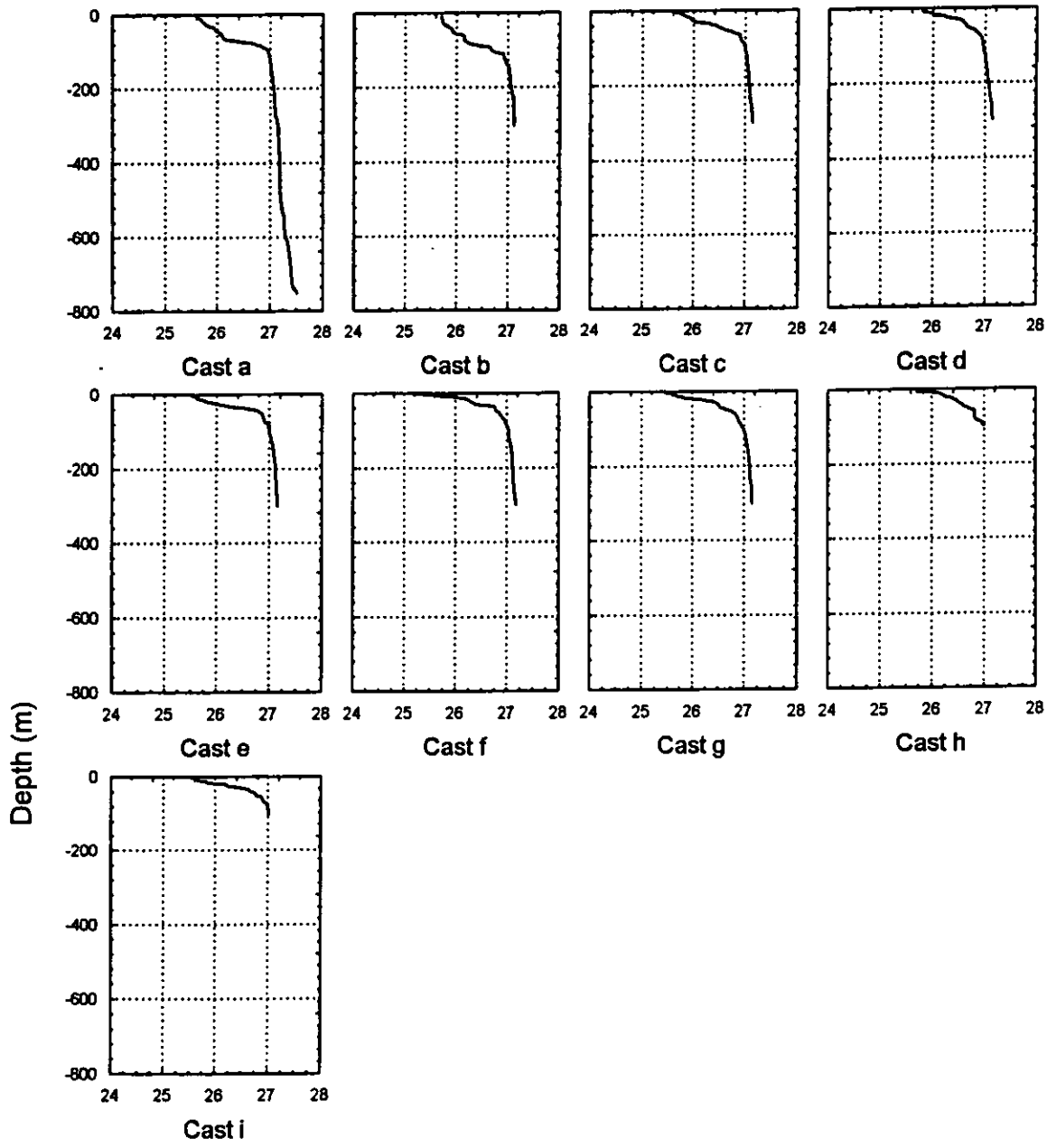
Station 05 casts a - i



Salinity (PSU)

CTD Profiles cruise 99/19 OMEX II

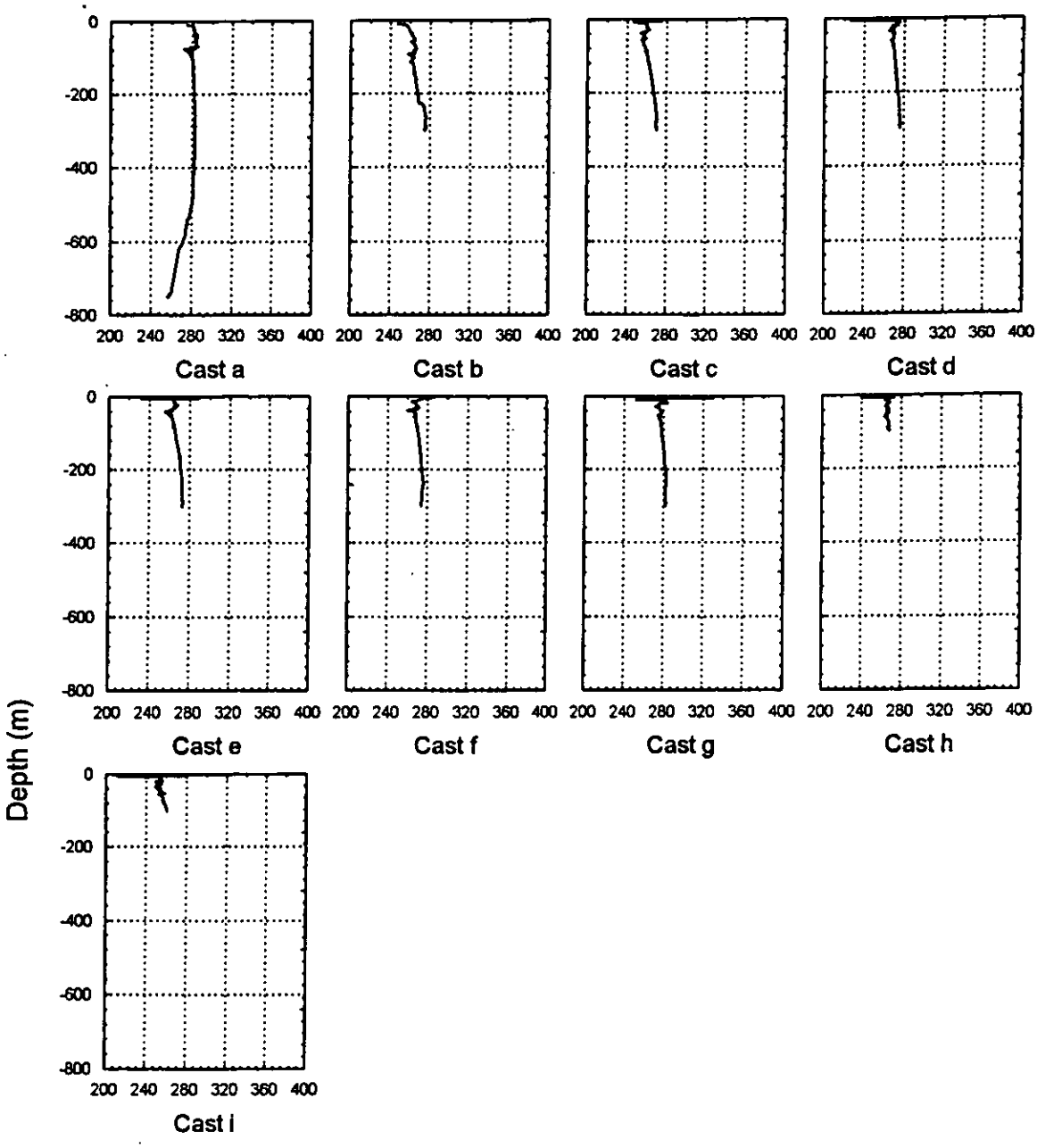
Station 05 casts a - i



Density (Sigma - Theta)

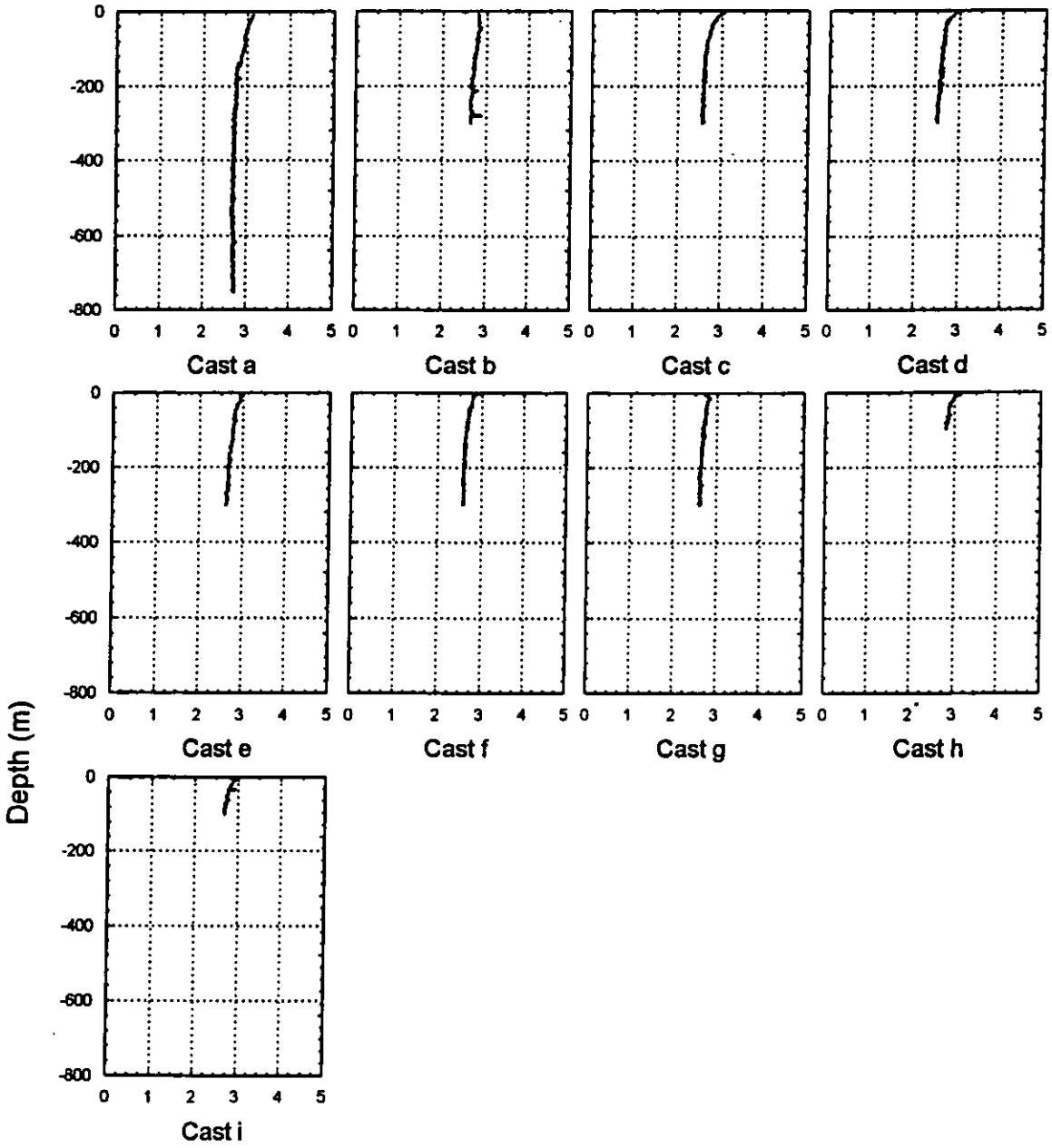
CTD Profiles cruise 99/19 OMEX II

Station 05 casts a - i



CTD Profiles cruise 99/19 OMEX II

Station 05 casts a - i



Backscatterance (OBS)

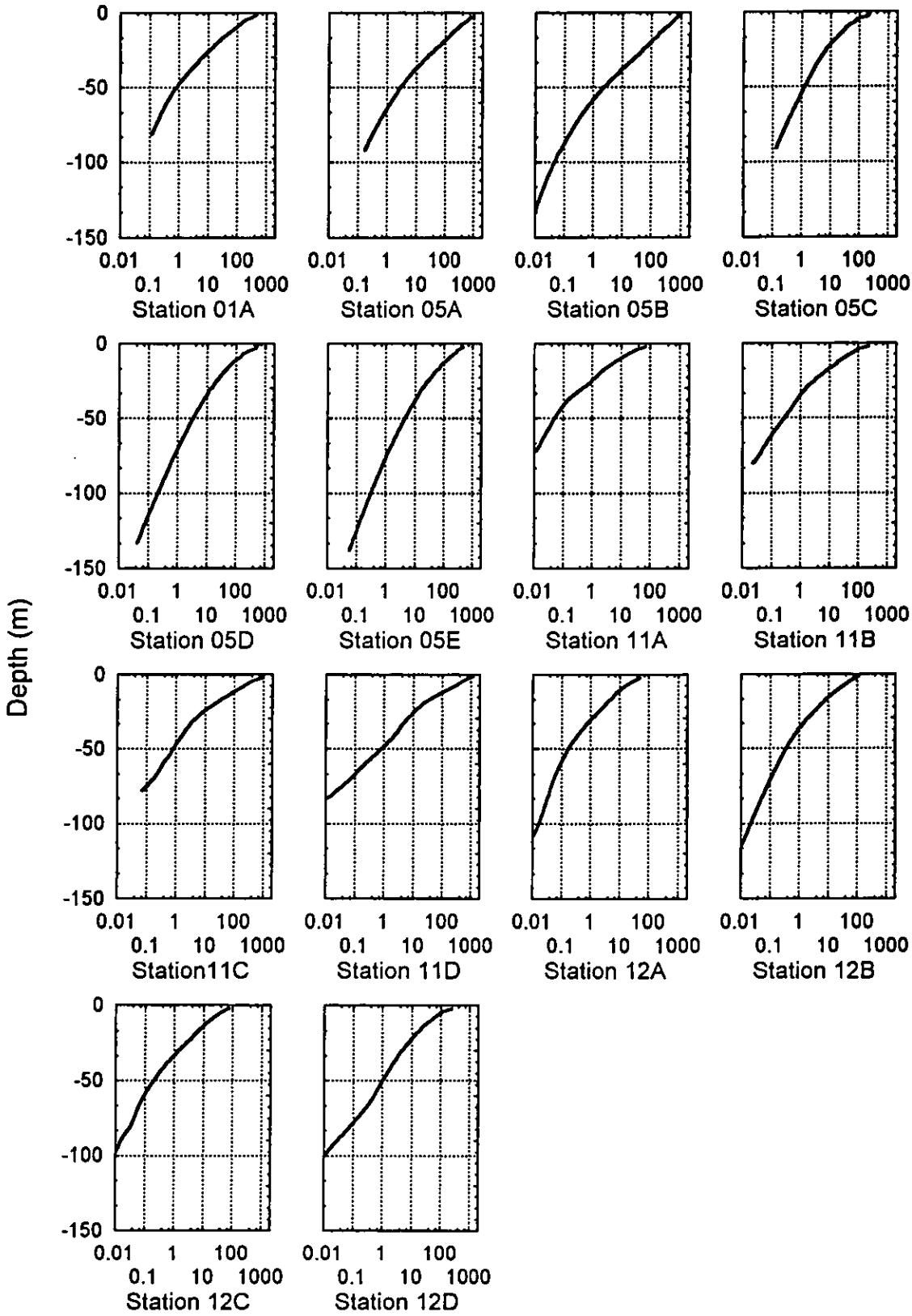
Appendix 6

Vertical profiles of incident light (PAR sensor)

MUMM is the "Management of the marine ecosystem" department of the Royal Institute for Natural Sciences, Federal office for scientific, technical and cultural affairs.

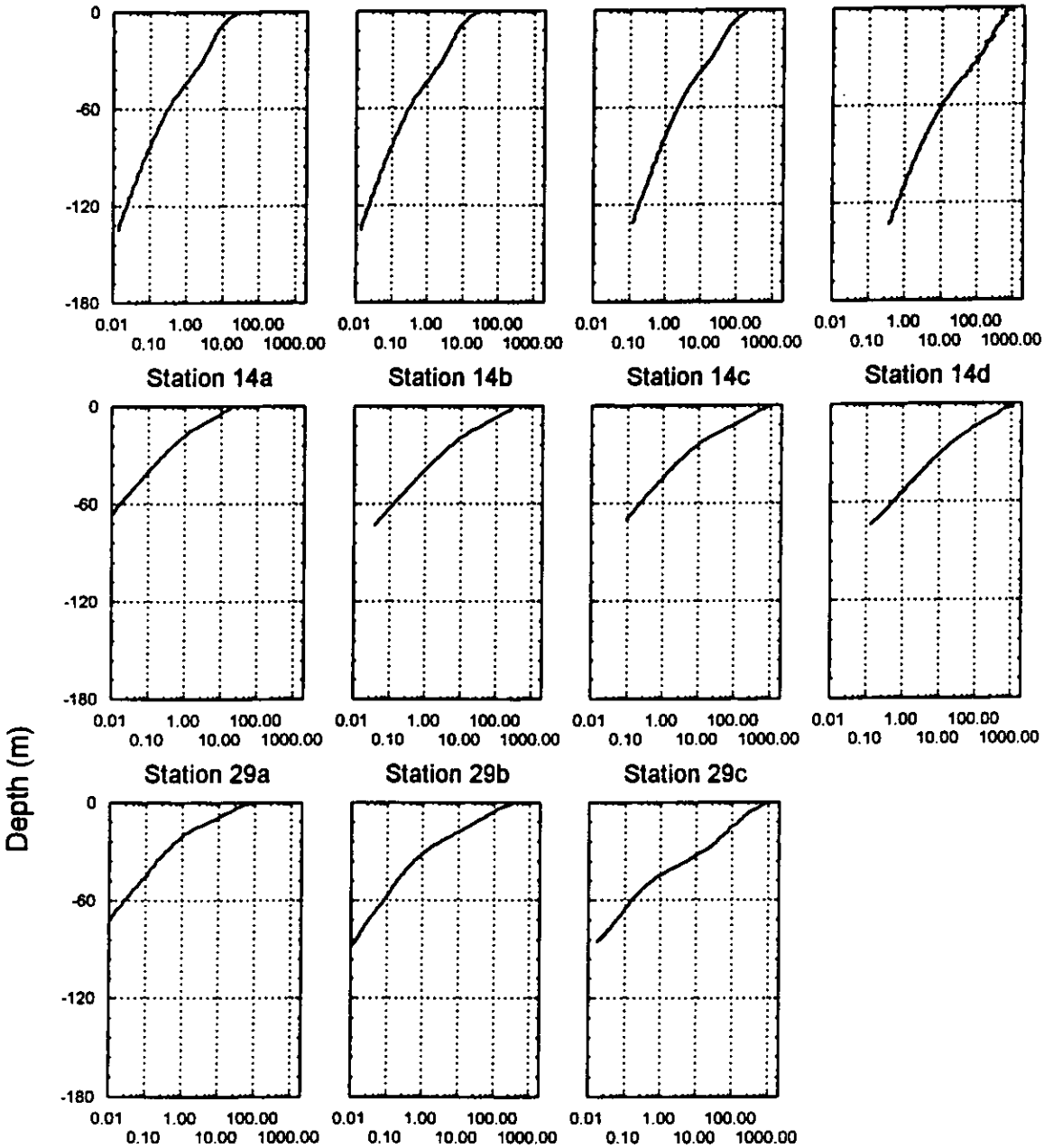
Light Profiles cruise 99/19 OMEX II

Stations 1A - 12D



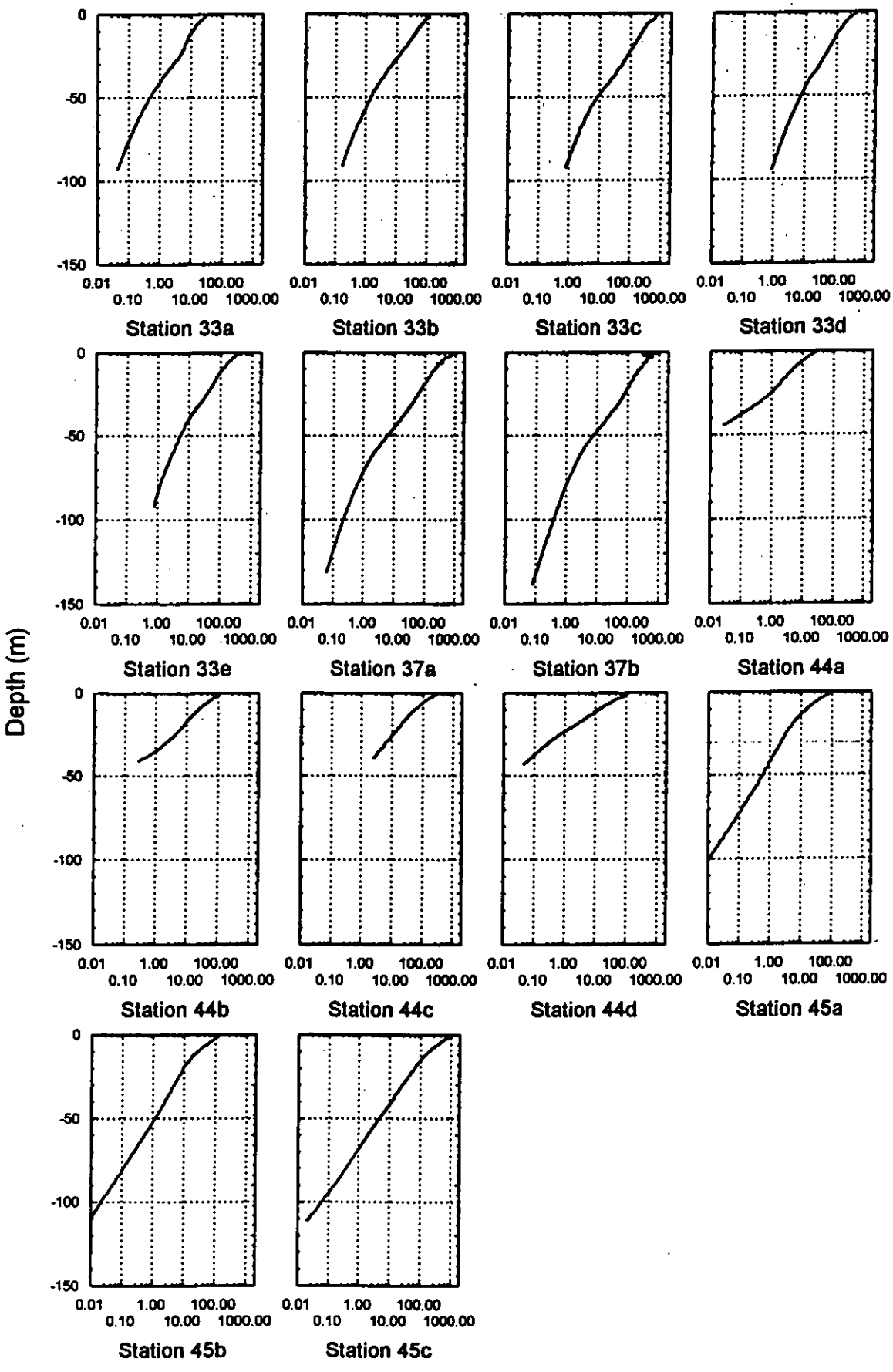
Light Profiles cruise 99/19 OMEX II

Stations 14 - 30



Light profiles cruise 99/19 OMEX II

Stations 33b - 45c



Appendix 7

Comparison of the SEA-BIRD SBE21 thermosalinograph salinity data versus the Guildline Portasal salinometer data.

Data an d Errors

BELGICA OMEX CRUISE 1999/19

(30.08.99 - 23.09.99)

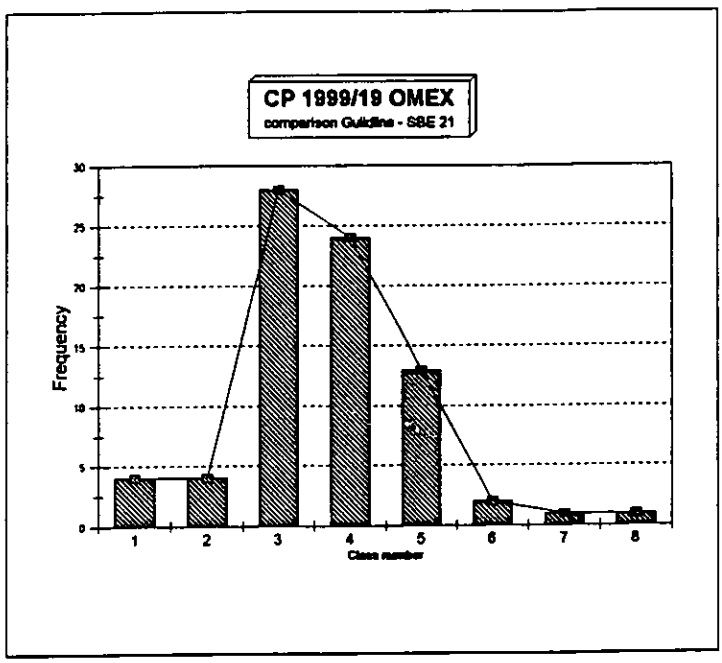
Salinity samples Non toxic conduct

Station	date	time (GMT)	Salinity SBE21	Salinity Portasal	Difference Portasal - SBE 21
SNT01	30-Aug-99	02:34 PM	31.660	31.6533	-0.0062
SNT03	30-Aug-99	10:31 PM	35.134	35.1312	-0.0030
SNT04	31-Aug-99	06:52 AM	35.119	35.1187	-0.0001
SNT05	31-Aug-99	10:17 AM	35.230	35.2273	-0.0027
SNT06	31-Aug-99	02:45 PM	35.233	35.2316	-0.0014
SNT08	31-Aug-99	09:52 PM	35.334	35.3246	-0.0098
SNT09	01-Sep-99	06:15 AM	35.486	35.4835	-0.0028
SNT10	02-Sep-99	06:40 PM	35.687	35.6989	0.0124
SNT11	03-Sep-99	06:35 AM	35.710	35.7109	0.0009
SNT12	03-Sep-99	09:37 AM	35.626	35.6279	0.0016
SNT13	04-Sep-99	10:07 AM	35.575	35.5722	-0.0031
SNT14	04-Sep-99	02:23 PM	35.673	35.6682	-0.0050
SNT15	04-Sep-99	07:00 PM	35.666	35.6666	0.0004
SNT16	04-Sep-99	10:28 PM	35.683	35.6706	-0.0120
SNT17	05-Sep-99	05:25 AM	35.633	35.6341	0.0013
SNT18	05-Sep-99	09:56 AM	35.626	35.6201	-0.0055
SNT19	05-Sep-99	02:14 PM	35.507	35.5030	-0.0035
SNT20	05-Sep-99	06:05 PM	35.718	35.7120	-0.0059
SNT21	05-Sep-99	10:19 PM	35.594	35.5981	0.0038
SNT22	06-Sep-99	06:33 AM	35.683	35.6761	-0.0069
SNT23	06-Sep-99	10:02 AM	35.679	35.6750	-0.0035
SNT24	06-Sep-99	02:06 PM	35.689	35.6943	0.0057
SNT25	06-Sep-99	05:57 PM	35.689	35.6827	-0.0059
SNT26	06-Sep-99	09:55 PM	35.696	35.6858	-0.0105
SNT27	07-Sep-99	06:13 AM	35.628	35.6215	-0.0067
SNT28	07-Sep-99	10:01 AM	35.626	35.6200	-0.0059
SNT29	07-Sep-99	02:16 PM	35.687	35.6884	0.0018
SNT30	07-Sep-99	06:16 PM	35.691	35.6844	-0.0067
SNT31	07-Sep-99	09:39 PM	35.683	35.6803	-0.0031
SNT32	08-Sep-99	06:07 AM	35.618	35.6140	-0.0043
SNT33	08-Sep-99	10:01 AM	35.630	35.6256	-0.0048
SNT34	08-Sep-99	02:00 PM	35.695	35.6977	0.0025
SNT35	08-Sep-99	06:02 PM	35.696	35.6983	0.0025
SNT36	08-Sep-99	10:16 PM	35.680	35.6785	-0.0017
SNT37	09-Sep-99	06:24 AM	35.123	35.1185	-0.0048
SNT38	09-Sep-99	10:09 AM	35.024	35.0200	-0.0036
SNT39	09-Sep-99	02:31 PM	35.659	35.6532	-0.0056
SNT40	09-Sep-99	06:19 PM	35.685	35.6823	-0.0022
SNT41	09-Sep-99	10:06 PM	35.701	35.6819	-0.0195
SNT42	10-Sep-99	06:23 AM	35.697	35.6927	-0.0044
SNT43	10-Sep-99	10:02 AM	35.700	35.6922	-0.0075
SNT44	10-Sep-99	02:05 PM	35.696	35.6921	-0.0042
SNT45	10-Sep-99	06:32 PM	35.662	35.6611	-0.0013
SNT46	10-Sep-99	10:06 PM	35.687	35.6814	-0.0057
SNT47	11-Sep-99	05:56 AM	35.664	35.6504	-0.0131

3. Frequency Distribution Table

Frequency Distribution Table

Class number	Class boundary		Frequency
1	< -.0.015		4
2	-0.015	-0.010	4
3	-0.010	-0.005	28
4	-0.005	0.000	24
5	0.000	0.005	13
6	0.005	0.010	2
7	0.010	0.015	1
8	> 0.015		1



SNT48	11-Sep-99	09:42 AM	35.665	35.6417	-0.0235
SNT49	14-Sep-99	07:28 AM	35.547	35.5282	-0.0184
SNT50	14-Sep-99	09:49 AM	35.640	35.6348	-0.0055
SNT51	14-Sep-99	01:46 PM	35.681	35.6743	-0.0065
SNT52	14-Sep-99	05:47 PM	35.708	35.7022	-0.0055
SNT53	14-Sep-99	09:37 PM	35.696	35.6903	-0.0060
SNT54	15-Sep-99	05:49 AM	35.700	35.6945	-0.0052
SNT55	15-Sep-99	09:42 AM	35.701	35.6970	-0.0042
SNT56	15-Sep-99	01:38 PM	35.704	35.6951	-0.0087
SNT57	15-Sep-99	05:38 PM	35.721	35.7223	0.0013
SNT58	15-Sep-99	09:33 PM	35.715	35.7072	-0.0078
SNT59	16-Sep-99	05:44 AM	35.702	35.6982	-0.0042
SNT60	16-Sep-99	09:35 AM	35.709	35.7001	-0.0086
SNT61	16-Sep-99	01:35 PM	35.327	35.3073	-0.0192
SNT62	16-Sep-99	04:41 PM	35.431	35.4219	-0.0087
SNT63	16-Sep-99	06:12 PM	35.605	35.6044	-0.0005
SNT64	16-Sep-99	07:01 PM	35.539	35.5377	-0.0010
SNT65	16-Sep-99	07:31 PM	35.447	35.4511	0.0037
SNT66	16-Sep-99	08:02 PM	35.542	35.5431	0.0008
SNT67	17-Sep-99	05:43 AM	35.690	35.6778	-0.0121
SNT68	17-Sep-99	09:34 AM	35.690	35.6837	-0.0067
SNT69	17-Sep-99	01:39 PM	35.707	35.7033	-0.0036
SNT70	17-Sep-99	05:40 PM	35.725	35.7197	-0.0053
SNT71	17-Sep-99	09:39 PM	32.090	32.1000	0.0098
SNT72	18-Sep-99	05:46 AM	32.755	32.7484	-0.0065
SNT73	18-Sep-99	09:39 AM	35.655	35.6472	-0.0078
SNT74	18-Sep-99	01:39 PM	35.622	35.6403	0.0181
SNT75	20-Sep-99	06:30 AM	35.311	35.3144	0.0032
SNT76	20-Sep-99	10:59 AM	35.241	35.2433	0.0020
SNT77	20-Sep-99	02:49 PM	35.177	35.1714	-0.0055
SNT78	20-Sep-99	07:08 PM	35.077	35.0724	-0.0044
SNT79	21-Sep-99	06:17 AM	34.859	34.8522	-0.0072

1. Regression

Regression Output:

Constant		-0.02739
Std Err of Y Est		0.006434
R Squared		0.999916
No. of Observations		77
Degrees of Freedom		75
X Coefficient(s)	1.000888	
Std Err of Coef.	0.001059	

2. Mean - Standard Deviation - Confidence interval

The Mean	-0.00407
St. Dev.	0.00638
Confidence interval	
-0.016833	0.008685

Appendix 8

Evaluation of the Turner Designs fluorescence data versus the analysed discrete chlorophyll a samples

Table and Figures

MUMM is the "Management of the marine ecosystem" department of the Royal Institute for Natural Sciences, Federal office for scientific, technical and cultural affairs.

Cruise 1999/19 OMEX

CHLOROPHYLL a + PHAEOPIGMENTS

Station	Sample Date	Sample Time (GMT)	Chlorophyll a (mg/m3)	Phaeopigments (mg/m3)	Fluorescence start	Fluorescence stop	Fluorescence mean	regression	residual
NT01	30.08.99	14h30	4.30	2.58	39.1	36.6	37.9	4.50	-0.20
NT02		18h10	4.36	0.95	29.2	28.4	28.8	3.29	1.07
NT03		22h07	0.51	0.17	12.3	12.4	12.4	1.10	-0.59
NT04	31.08.99	06h34	0.51	0.46	10.7	10.8	10.8	0.88	-0.37
NT05		10h03	0.82	0.19	12.7	13	12.9	1.16	-0.34
NT06		14h47	1.94	0.24	14.3	13.3	13.8	1.29	0.65
NT07		18h14	2.20	0.30	21	17.7	19.4	2.03	0.17
NT08		21h00	1.12	0.24	10.4	10.8	10.6	0.86	0.26
NT09	01.09.99	06h09	0.46	0.11	14.1	14.4	14.3	1.35	-0.89
NT10		09h49	0.82	0.18	16.2	17.2	16.7	1.68	-0.86
NT11		14h06	0.41	0.04	10.2	10.4	10.3	0.82	-0.41
NT12		18h02	0.46	0.08	15.1	14.4	14.8	1.42	-0.96
NT13		22h00	0.36	0.05	12	11.5	11.8	1.02	-0.66
NT14	02.09.99	06h07	0.31	0.09	9.3	9.16	9.2	0.68	-0.37
NT15		10h46	0.46	0.04	8.88	8.8	8.8	0.63	-0.17
NT16		14h05	0.05	0.06	4.7	4.84	4.8	0.09	-0.04
NT17		18h20	0.05	0.02	4.6	4.52	4.6	0.06	-0.01
NT18	03.09.99	06h00	0.10	0.02	4.5	4.5	4.5	0.05	0.05
NT19		09h40	3.02	0.34	19.3	20.4	19.9	2.10	0.92
NT20	04.09.99	09h49	4.00	0.70	43.6	41.7	42.7	5.14	-1.14
NT21		14h25	2.51	0.21	27.2	27.2	27.2	3.08	-0.57
NT22		18h45	0.26	0.10	9.1	8.2	8.7	0.60	-0.34
NT23		22h34	2.20	0.38	28.1	28.1	28.1	3.20	-1.00
NT24	05.09.99	05h09	0.82	0.30	14.9	14.7	14.8	1.42	-0.60
NT25		09h52	0.92	0.23	16.1	15.8	16.0	1.58	-0.66
NT26		14h28	5.05	0.20	48.8	50.1	49.5	6.04	-0.99
NT27		18h05	0.92	0.23	22.3	22.3	22.3	2.42	-1.50
NT28		22h05	1.02	0.31	18.1	17.9	18.0	1.85	-0.83
NT29	06.09.99	06h20	0.92	0.36	18.7	19.1	18.9	1.97	-1.05
NT30		09h52	1.02	0.52	22	21.5	21.8	2.35	-1.33
NT31		14h13	0.31	0.00	7.77	7.99	7.9	0.50	-0.19
NT32		18h00	0.20	0.03	7.9	8.12	8.0	0.52	-0.32
NT33		22h00	0.15	0.03	6.8	6.8	6.8	0.36	-0.21
NT34	07.09.99	06h16	0.76	0.10	13.7	13.8	13.8	1.28	-0.52
NT35		09h51	0.67	0.11	10.6	10.9	10.8	0.88	-0.21
NT36		14h04	0.15	0.10	6.9	6.19	6.5	0.32	-0.17
NT37		18h37	0.20	0.16	9.12	9.09	9.1	0.66	-0.46
NT38		21h45	0.25	0.00	8.91	8.75	8.8	0.63	-0.38
NT39	08.09.99	06h17	1.02	0.30	16.7	16.5	16.6	1.66	-0.64
NT40		09h51	0.61	0.06	13.2	11.3	12.3	1.08	-0.47
NT41		13h48	0.21	0.09	6.51	6.48	6.5	0.32	-0.11
NT42		18h07	0.15	0.01	6.77	6.89	6.8	0.36	-0.21
NT43		22h23	0.16	0.04	7.54	7.69	7.6	0.46	-0.31
NT44	09.09.99	06h07	0.89	0.23	13.7	13.7	13.7	1.28	-0.39
NT45		10h00	0.57	0.23	11.2	11.2	11.2	0.94	-0.37
NT46		14h20	0.31	0.09	9.96	9.9	9.9	0.77	-0.47
NT47		18h03	0.16	0.00	13.5	13.7	13.6	1.26	-1.11
NT48		22h12	0.15	0.01	13.9	11.1	12.5	1.12	-0.96
NT49	10.09.99	06h12	0.15	0.01	13.7	13.4	13.6	1.26	-1.10
NT50		09h52	0.00	0.11	13.3	13.2	13.3	1.22	-1.22
NT51		14h06	0.15	0.00	13.3	13.7	13.5	1.25	-1.10
NT52		18h20	0.10	0.08	15.4	15.2	15.3	1.49	-1.39
NT53		21h58	0.05	0.18	18.2	17.9	18.1	1.86	-1.81
NT54	11.09.99	06h03	2.96	0.49	32.5	33.2	32.9	3.83	-0.87
NT55		09h43	1.98	0.18	28.6	26.5	27.6	3.12	-1.15
NT56	14.09.99	07h00	0.98	0.40	15	14.1	14.6	1.39	-0.41
NT57		09h00	0.31	0.00	7.52	7.21	7.4	0.43	-0.12
NT58		13h51	1.72	0.36	17.9	18.4	18.2	1.87	-0.15
NT59		17h52	0.21	0.06	8.63	8.64	8.6	0.60	-0.39
NT60		21h46	0.15	0.15	8.65	8.7	8.7	0.61	-0.45
NT61	15.09.99	05h55	0.10	0.01	7.21	7.15	7.2	0.41	-0.30
NT62		09h45	0.10	0.15	7.59	7.48	7.5	0.45	-0.35
NT63		13h42	0.05	0.06	6.28	6.27	6.3	0.29	-0.23
NT64		17h42	0.05	0.00	6.75	6.75	6.8	0.35	-0.30

Cruise 1999/19 OMEX

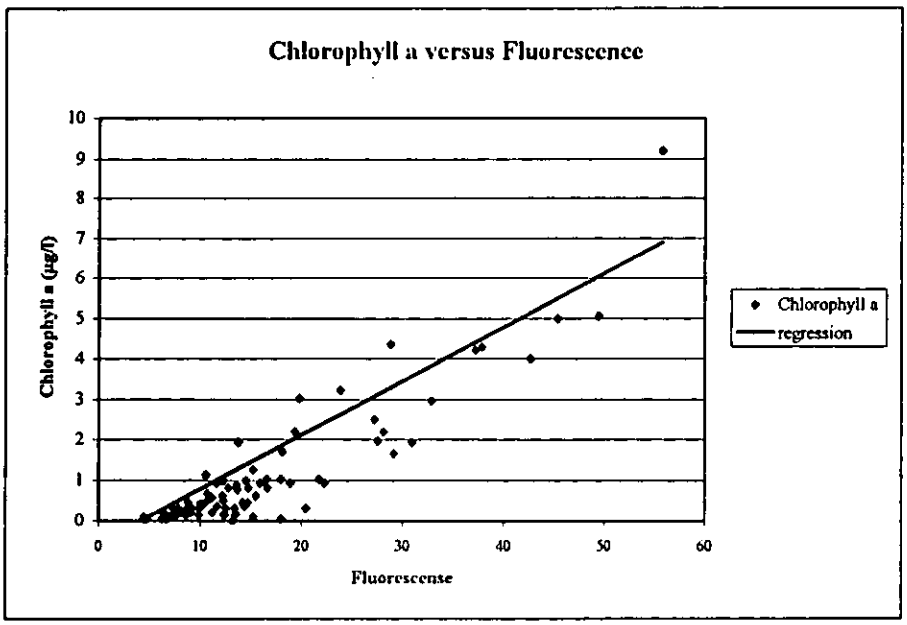
CHLOROPHYLL a + PHAEOPIGMENTS

Station	Sample Date	Sample Time (GMT)	Chlorophyll a (mg/m3)	Phaeopigments (mg/m3)	Fluorescence start	Fluorescence stop	Fluorescence mean	regression	residual
NT65		21h35	0.10	0.05	6.55	6.55	6.6	0.32	-0.22
NT66	16.09.99	05h47	0.93	0.09	11.7	11.6	11.7	1.00	-0.07
NT67		09h38	1.25	0.22	15.3	15.3	15.3	1.49	-0.24
NT68		13h41	9.20	1.23	56.2	55.4	55.8	6.89	2.31
NT69		17h39	1.93	0.15	31.4	30.4	30.9	3.57	-1.64
NT70		21h40	3.22	0.10	24.5	23.2	23.9	2.63	0.59
NT71	17.09.99	05h46	0.21	0.05	11.2	11.3	11.3	0.95	-0.74
NT72		09h37	0.15	0.08	13.6	11.1	12.4	1.10	-0.94
NT73		13h45	0.15	0.01	9.96	9.99	10.0	0.78	-0.63
NT74		17h43	0.36	0.00	14.8	14.1	14.5	1.38	-1.01
NT75		21h46	4.21	0.56	37.6	36.9	37.3	4.42	-0.20
NT76	18.09.99	05h51	4.99	0.57	45.5	45.3	45.4	5.50	-0.51
NT77		09h44	1.67	0.27	29	29.3	29.2	3.34	-1.67
NT78		13h38	0.31	0.07	13.4	13.5	13.5	1.24	-0.93
NT79	20.09.99	06h40	0.98	0.15	12.5	12.1	12.3	1.09	-0.11
NT80		11h03	0.42	0.20	10.1	10.1	10.1	0.80	-0.38
NT81		14h52	0.31	0.53	12.3	12.8	12.6	1.12	-0.81
NT82		19h11	0.62	0.32	15.7	15.3	15.5	1.52	-0.89
NT83	21.09.99	06h34	0.31	0.02	20.4	20.5	20.5	2.18	-1.86

Chlorophyll a = 0.133 * Fluorescence -0.551

stdev =	0.63
Slope =	0.133
Incpt =	-0.551
R^2 =	0.829
n =	83

55.8
4.5



Appendix 9

Comparison of the SEA-BIRD SBE9plus salinity data versus the Guildline Portasal salinometer data

Data and Errors

MUMM is the "Management of the marine ecosystem" department of the Royal Institute for Natural Sciences, Federal office for scientific, technical and cultural affairs.

BELGICA OMEX CRUISE 1999/19

(30.08.99 - 22.09.99)

Salinity samples Niskin bottles

Station	Depth	Niskin number	Salinity SBE 09 Marker Dat.	Salinity Guildline Portasal	Difference Portasal - SBE 09 (marker data)
00A	78.9	1	35.6990	35.6921	-0.0069
02A	160.5	1	35.5700	35.5729	0.0029
03A	159.3	1	35.5760	35.5770	0.0010
04A	154.6	4	35.5810	35.5831	0.0021
05A	600.0	1	35.5800	35.5857	0.0057
05C	301.4	1	35.5900	35.5936	0.0036
05D	299.7	1	35.5910	35.5920	0.0010
05E	300.1	1	35.5890	35.5898	0.0008
05F	299.8	1	35.5870	35.5881	0.0011
05H	80.2	1	35.5590	35.5628	0.0038
06A	300.7	1	35.5860	35.5872	0.0012
07A	301.4	1	35.5710	35.5712	0.0002
08A	301.1	1	35.5960	35.5969	0.0009
09A	299.3	1	35.5920	35.5919	-0.0001
11B	81.5	1	35.7730	35.7742	0.0012
11B	81.5	1	35.7730	35.7762	0.0032
12A	79.9	1	35.7540	35.7501	-0.0039
12B	124.6	1	35.7140	35.7134	-0.0006
13A	202.0	1	35.7010	35.7070	0.0060
14A	77.7	1	35.7700	35.7719	0.0019
14B	151.0	1	35.7320	35.7295	-0.0025
14C	1502.0	1	35.7660	35.7643	-0.0017
15A	99.6	1	35.7750	35.7787	0.0037
15B	1694.5	1	35.1630	35.1637	0.0007
16A	102.0	1	35.7400	35.7445	0.0045
16B	1729.2	1	35.2210	35.2262	0.0052
18A	81.7	1	35.7350	35.7317	-0.0033
19A	140.1	1	35.7120	35.7104	-0.0016
20A	641.0	7	35.9220	35.9218	-0.0002
22A	1298.5	1	36.1330	36.1285	-0.0045
24A	80.9	1	35.7430	35.7409	-0.0021
25A	123.7	1	35.7030	35.7039	0.0009
26A	799.6	1	36.0920	36.0950	0.0030
27A	1500.6	1	35.6130	35.6066	-0.0064
29A	58.8	1	35.7130	35.7123	-0.0007
29B	80.0	1	35.7120	35.7135	0.0015
29C	70.8	1	35.7190	35.7144	-0.0046
30A	79.5	1	35.7190	35.7182	-0.0008
30B	91.0	1	35.7220	35.7227	0.0007
30C	78.6	1	35.7340	35.7310	-0.0030
31A	120.3	1	35.7090	35.7158	0.0068
32A	147.5	2	35.7480	35.7510	0.0030
33A	80.8	3	35.8070	35.8032	-0.0038
33B	98.7	1	35.8060	35.8044	-0.0016
33C	1001.2	1	36.2090	36.2078	-0.0012
34A	101.6	1	35.7840	35.7839	-0.0001

34B	1450.5	1	35.6470	35.6468	-0.0002
35A	101.1	1	35.7560	35.7600	0.0040
35B	1708.6	1	35.1390	35.1385	-0.0005
36A	150.2	1	35.7110	35.7142	0.0032
36B	1741.7	1	35.0890	35.0884	-0.0006
37A	79.4	1	35.6650	35.6704	0.0054
37B	150.4	1	35.7470	35.7411	-0.0059
37C	1716.6	1	35.0860	35.0820	-0.0040
38A	115.6	4	35.7120	35.7155	0.0035
39A	150.2	1	35.6950	35.7001	0.0051
40A	701.1	1	36.0070	36.0068	-0.0002
41A	1708.5	1	35.3350	35.3372	0.0022
42A	1666.0	1	35.3200	35.3178	-0.0022
43A	1740.0	1	35.0600	35.0563	-0.0037
44A	48.9	1	35.6930	35.6880	-0.0050
44C	40.3	1	35.6960	35.6917	-0.0043
44D	39.8	1	35.7080	35.7035	-0.0045
45B	122.5	1	35.7100	35.7112	0.0012
46A	189.5	1	35.6900	35.6898	-0.0002
48A	1723.4	1	35.2430	35.2524	0.0094
49A	98.7	1	35.7900	35.7867	-0.0033
49B	1001.2	1	36.0740	36.0678	-0.0062

A. Comparison Guildline Portasal - SBE 09 (Marker Data)

1. Regression

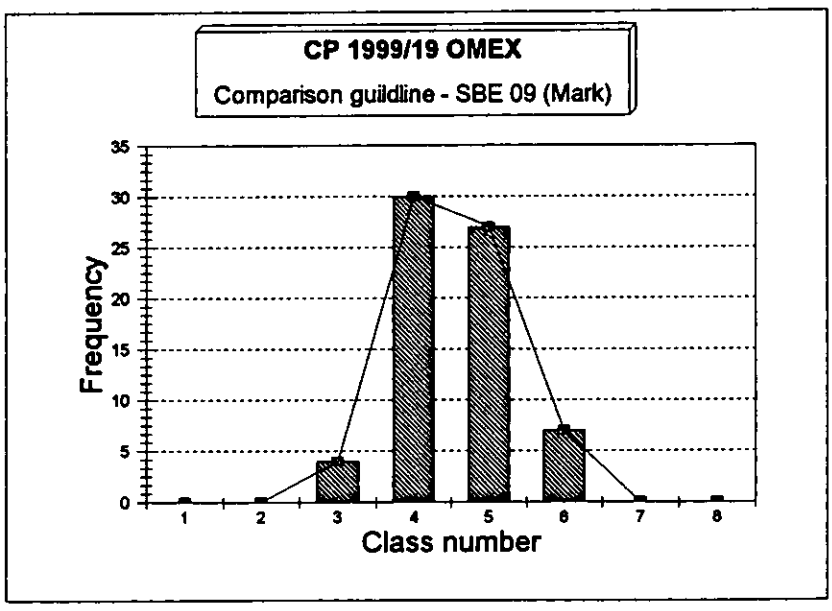
Regression Output:

Constant		-0.074436
Std Err of Y Est		0.003515
R Squared		0.999768
No. of Observations		68
Degrees of Freedom		66
X Coefficient(s)	1.002083	
Std Err of Coef.	0.001877	

2. Mean - Standard deviation - Confidence interval

The Mean	0.0002
St. Dev	0.0035
Confidence interval	
-0.0068	0.0071

3. Frequency Distribution Table

Frequency Distribution table

Class number	Class boundary		Frequency
1	< -0.015		0
2	-0.015	-0.010	0
3	-0.010	-0.050	4
4	-0.005	0.000	30
5	0.000	0.005	27
6	0.005	0.010	7
7	0.010	0.015	0
8	> 0.015		0