Belgian GLOBAL CHANGE Impulse Programme

and

OMEX BIOGEOCHEMISTRY Programme

RV BELGICA CRUISE 95/06

PARTICIPATING LABORATORIES FROM :

ULg - ULB - MUMM - VUB - CFR - Geomar - TNO - Risø

MUMM contribution

Sampling stations, trackplot, SCTD profiles and horizontal profiles of salinity, temperature and fluorescence.

REPORT

Authors : J. BACKERS, A. POLLENTIER.

Ministry of Social Affairs, Public Health and Environment

Management Unit of the North Sea and Scheldt Estuary Mathematical Model

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BMM_MDO/95-23/RV Belgica/OMEX/9506/Report

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R/V BELGICA CRUISE 95/06.

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R/V BELGICA CRUISE 95/06.

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1. INTRODUCTION.

The RV Belgica cruise 95/06 has been conducted in the frame of the Belgian Global Change Impulse Programme as well as the Ocean Margin Exchange project "OMEX" supported by EEC, that has been focussed the research efforts on the Banc de la Chapelle area and the upwelling zone along the Spanish coast. The cruise started on 03 March 1995 at Boulogne (France). During the first 2 days of the cruise , the R/V Belgica sailed in the direction of the planned OMEX1, OMEX2 and OMEX3 stations (Goban Spur area). Due to the very bad weather conditions (a swell of 8 to 10 m) it was not possible to take SCTD casts.

After 24 hours it was decided to shelter in the harbour of Brest. During the transit, the carousel water sampling system, fixed on deck, was damaged by incoming waves. Several Niskin bottles were repaired by courtesy of the "Marine Française". The R/V Belgica sailed again on 07 March and headed to the La Chapelle Bank. Unfortunately the weather conditions were still too bad for SCTD profiling, and consequently the Belgica left the area and headed for Bayonne. Underway the stations 1 and 2 were sampled. The Belgica berthed at Bayonne from 10 March to 12 March 1995.

The Belgica left the harbour of Bayonne 12 hours earlier than planned in order to recuperate some time lost during the first leg. The stations 3 to 6 were sampled on the La Chapelle Bank and on the Meriadzek Terrace.

The R/V BELGICA arrived at Zeebrugge on 17 March.

Dr. M. Frankignoulle was the principal scientist aboard the BELGICA for this cruise. The following laboratories have participated :

* Université de Liège (ULg) - Laboratoire d'Océanologie.
* Université Libre de Bruxelles (ULB) - Laboratoire d'Océanographie.
* Vrije Universiteit Brussel (VUB) - Laboratorium voor Analytische Scheikunde.
* CNRS/Cif (France) - Centre de Faibles Radioactivités (CFR).
* Geomar (Germany) - Christian - Albrechts - Universität zu Kiel
* TNO (The Netherlands) - Physics and Electronics Laboratory.
* RISØ (Denmark) National Laboratory - Department of Meteorology and Wind Energy.
* Ministry of Public Health and Environment - Management Unit of the North Sea and Scheldt Estuary Mathematical Model (MUMM).

MUMM was mainly entrusted with the automatic data acquisition and logging of oceanographic, meteorological and navigational data (ODAS computer logging and Sea-Bird SCTD casts).

In addition to the data acquisition task, general assistance was offered in using the on board scientific instrumentation and related infrastructure, the 30l Niskin bottle sampling, etc ...

Also samples for laboratory salinity measurements were taken, and these samples have been analyzed in MUMM's laboratory at Oostende.

The present report describes the computer logged oceanographic, meteorological and navigational data gathered during this cruise. Also the results of the laboratory salinity measurements are 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 shipborn computer system were logged by the so called Oceanographic Data Acquisition Software system "ODAS" :

* MAGNAVOX 200MX GPS navigation system with an accuracy of typically 50m.
* SHIPMATE RS4000 DECCA navigation system.
* NAVSTAR 602D DECCA navigation system.
  These DECCA navigation systems were kept operational as backup system.
* Anshutz STD12 Gyro Compass.
* Raytheon DSN450 Doppler speed log and bathymetric depth.
* Atlas Deso 20 Scientific Echosounder.
  The Atlas Deso 20 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.

2.2. Oceanographic instrumentation

The seasurface temperature was measured continuously with a Rosemount temperature sensor as well as with the remote temperature sensor of the Sea-Bird SBE21 thermosalinograph, both installed at the inlet of the special seawater circuit situated at the bow of the vessel.

The Sea-Bird SBE21 thermosalinograph, installed in the wet lab, is connected to the special seawater circuit. The salinity was measured continuously using a personal computer with a dedicated software package from Sea-Bird. The processed data was continuously (every 6 sec.) transmitted to the HP1000 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 special seawater circuit, was used to measure chlorophyll concentrations during the full campaign. The data were also transmitted to the HP1000 data acquisition system.

SCTD vertical profiles have been taken with the Sea-Bird SBE09*plus* CTD profiler integrated with the Sea-Bird carousel water sampling system model SBE32. The specifications of this CTD 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	ml/l	0 - 15	0.1 ml/l / day
TRANSMITTANCE	%	0 - 100	

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

2.3. Meteorological instrumentation

Following parameters were measured by the Friedrichs meteorological station :

- windspeed
- winddirection
- airtemperature
- 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 4 ½ digit digital voltmeter incorporated in the ODAS system. Table 3 gives a review 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.

3. DATA ACQUISITION SYSTEM.

3.1. HP1000 - ODAS system.

A Hewlett Packard HP1000 minicomputer system with a HP6942 multiprogrammer and an HP3497A digital voltmeter subsystem were used to provide continuously logged data at the following intervals :

01 min. : navigational, meteorological and oceanographic data during the whole cruise.

1.0 sec. : incident light data (quantameter) during vertical profiles.

The Oceanographic Data Acquisition System "ODAS" software package has been used for this purpose.

This ODAS software package was designed to interrogate the different subsystems, instruments and sensors installed, and to gather in real time several groups of parameters at different time intervals. The data are stored on Winchester disc while at the same time the data can be listed or plotted in real time or off line. Selected parameters can also be distributed in real time to the video monitors installed in the laboratories and on the bridge.

The data are transferred to the shore based data processing centre of MUMM situated at Oostende using the integral cartridge backup system of the Winchester drive.

At the shore station the data is stored on a identical HP1000 system, hence the same ODAS software package can be used for further processing.

Additionally the data stored in the internal ODAS format (binary) have been converted to ASCII for transportation to a PC MS-DOS or a UNIX system, using the KERMIT data transfer package.

3.2. SCTD - 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 by a personal computer supplied with dedicated Sea-Bird data acquisition and presentation software. The converted values were transmitted in real-time to the ODAS system.

3.3. SCTD - Vertical profiling system.

The Sea-Bird SBE09*plus* STD system measures the depth of the sensor package, water temperature, conductivity, transmittance 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 SeaTech 25 cm transmittometer (SN172D) used during this cruise was borrowed from the NIOZ institute (The Netherlands).

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 CTD software also allows to mark the SCTD data when water bottle samples are taken so that the SCTD and related parameters are known at the exact depth.

3.4. Data file inventory.

All datafiles created during the BELGICA campaign 95/06 have been concatenated into the following data files :

Filename	Acquisition rate	Type of data	Duration
O20600	1'	navig. + meteo + oceano.	Full campaign.
Q40600	0.5"	quantameter	Stations 01, 02, 03, 04 and 06.
OMX9501A.DAT	0.5"		
OMX9501B.DAT	0.5"		
OMX9502A.DAT	0.5"		
OMX9502B.DAT	0.5"		
OMX9502C.DAT	0.5"		
OMX9503A.DAT	0.5"	CTD	CTD profiles at the
OMX9503B.DAT	0.5"		
OMX9503C.DAT	0.5"	vertical	stations in the
OMX9503D.DAT	0.5"		
OMX9504A.DAT	0.5"	profile	Gulf of Biscay.
OMX9504B.DAT	0.5"		
OMX9504C.DAT	0.5"		
OMX9505A.DAT	0.5"		
OMX9505B.DAT	0.5"		
OMX9506A.DAT	0.5"		
OMX9506B.DAT	0.5"		

Table 4. Data file inventory.

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

4. REMARKS CONCERNING DATA ACQUISITION AND DATA VALIDITY.

4.1. Position registration.

During the whole OMEX cruise, the GPS based navigation system (Magnavox 200MX) was used as the primary positioning instrument.

The DECCA based systems (Shipmate RS4000 and NAVSTAR 602D) were used as backup systems. These navigation systems have an accuracy of typically 50 to 400 meter, mostly depending on atmospheric conditions. In the centre of the Gulf of Biscay, the lack of a good DECCA coverage leads to errors of almost 1 nautical mile.

4.2. Salinity measurements.

4.2.1. Validation of the SCTD salinity measurements.

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

At different locations and multiple depths water samples have taken to validate the salinity data of the SBE09*plus* system. The water samples have been analysed in MUMM's laboratory at Oostende with a Beckman RB7 laboratory salinometer.

The Beckman salinometer is calibrated using IAPSO standard seawater capsules obtained from the Institute of Oceanographic Sciences (UK).

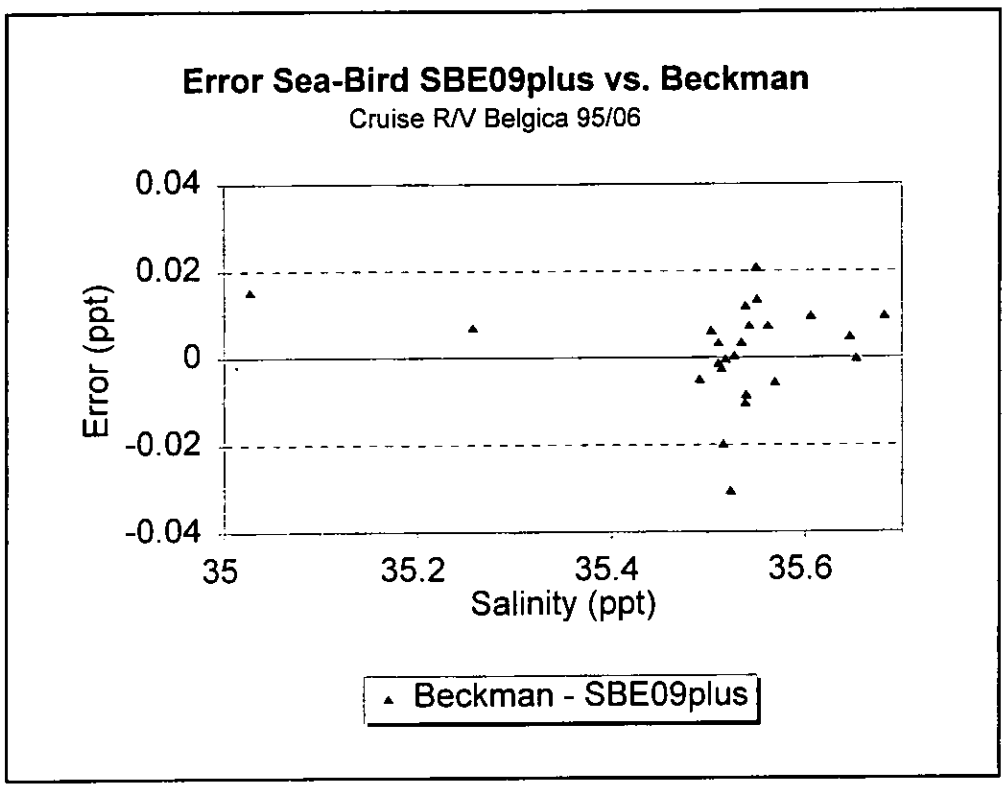
The results of the Beckman salinometer have been compared with the Sea-Bird SBE09*plus* salinity measurements (see Table 5 and Figure 1).

	Standard deviation ppt	Mean error ppt	Corrolation coëff.
SBE09*plus* - Beckman	0.0111	0.0016	0.9925

Table 5. Data Sea-Bird SBE 09*plus* versus Beckman RB7 salinometer.

Station	Sampling depth m	Salinity Beckman ppt	Salinity SBE09*plus* ppt	Difference ppt
1A	100	35.5148	35.5113	0.0035
1A	100	35.5101	35.5113	-0.0012
1B	40	35.5124	35.5148	-0.0024
1B	136	35.5187	35.5190	-0.0003
2A	600	35.5697	35.5623	0.0074
2A	1510	35.2643	35.2572	0.0071
2B	100	35.5290	35.5393	-0.0103
2B	200	35.5321	35.5405	-0.0084
3A	300	35.5511	35.5436	0.0075
3A	500	35.5716	35.5507	0.0209
3A	600	35.5638	35.5694	-0.0056
3A	800	35.6530	35.6531	-0.0001
3A	900	35.6515	35.6466	0.0049
3A	1000	35.6918	35.6821	0.0097
3A	1200	35.5653	35.5518	0.0135
3B	100	35.4967	35.5165	-0.0198
3B	150	35.4935	35.5240	-0.0305
3B	200	35.5519	35.5399	0.0120
4B	600	35.4868	35.4917	-0.0049
4B	800	35.5392	35.5356	0.0036
4B	1000	35.6159	35.6062	0.0097
4B	1600	35.0425	35.0272	0.0153
4C	100	35.5286	35.5281	0.0005
5A	100	35.5101	35.5038	0.0063

Figure 1. Error Sea-Bird SBE09*plus* versus Beckman RB7 salinometer.



4.2.2. Salinity spiking of the SCTD measurements.

In order to improve the performance of the salinity measurements, the Sea-Bird SBE09*plus* has a Temperature and Conductivity (TC) duct with an inertia-balanced pump flow.

The salinity spiking alignment computer program has been applied on the SCTD data (sampling speed 12 samples per second) to minimize the salinity spiking.
See also "JGOFS 90, RV BELGICA cruise 90/18, MUMM contribution Volume I : Report, J. Backers, A. Pollentier.".

4.3. Dissolved oxygen.

The Sea-Bird SBE09*plus* is equipped with a Dissolved Oxygen sensor model SBE-13-Y. This dissolved oxygen sensor is an "YSI" polarographic type which produces an oxygen-dependent electrical current and incorporates a thermistor for determination of the membrane temperature. The computation of dissolved oxygen is made arithmetically according to the methods outlined by Owens and Millard.

The DO sensor has not been recalibrated at sea. However the data of the SBE09*plus* DO sensor at the sampling depths have been corrected using the oxygen measurements from the Laboratoire d'Océanographie - Ulg (Winkler method). The deviation was found to be a function of the measured DO value (see figure 2- DO MUMM uncorrected). The following correction has been applied on the SBE09*plus* DO data : DO MUMM corrected = 146. + (DO MUMM uncorrected - 146.) * 0.78 (see figures 2 and 3 - DO MUMM corrected).

This deviation was only found in the upcast data (see tables 2 to 17 in appendix 4). The downcast data (see figures 12.b to 27.b in appendix 5) have not been corrected.

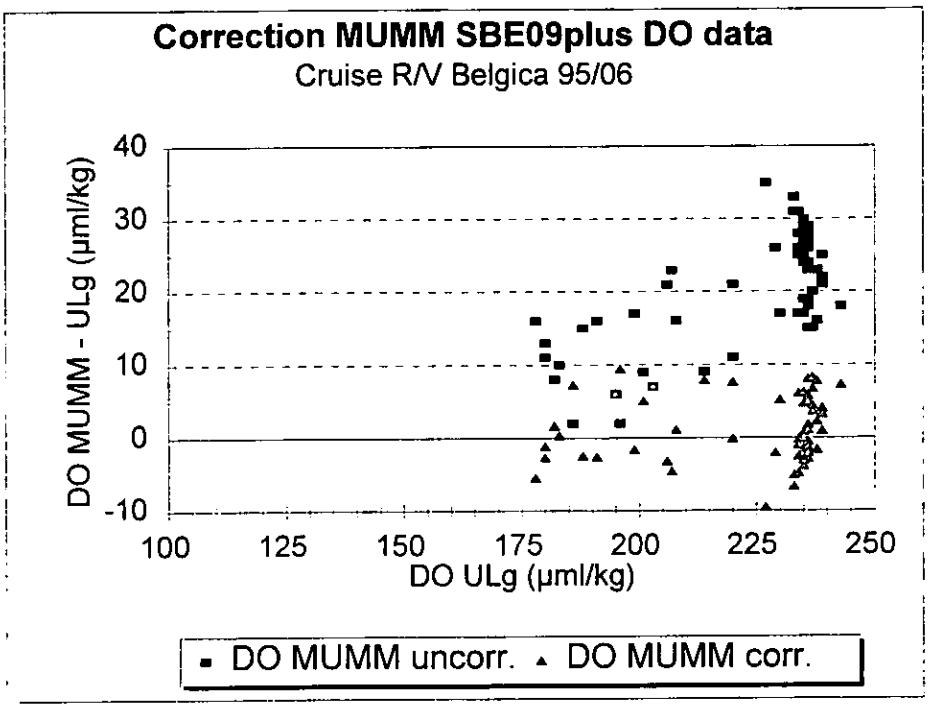


Figure 2. Deviation between DO data ULg and MUMM, before and after correction as a function of the measured DO values.

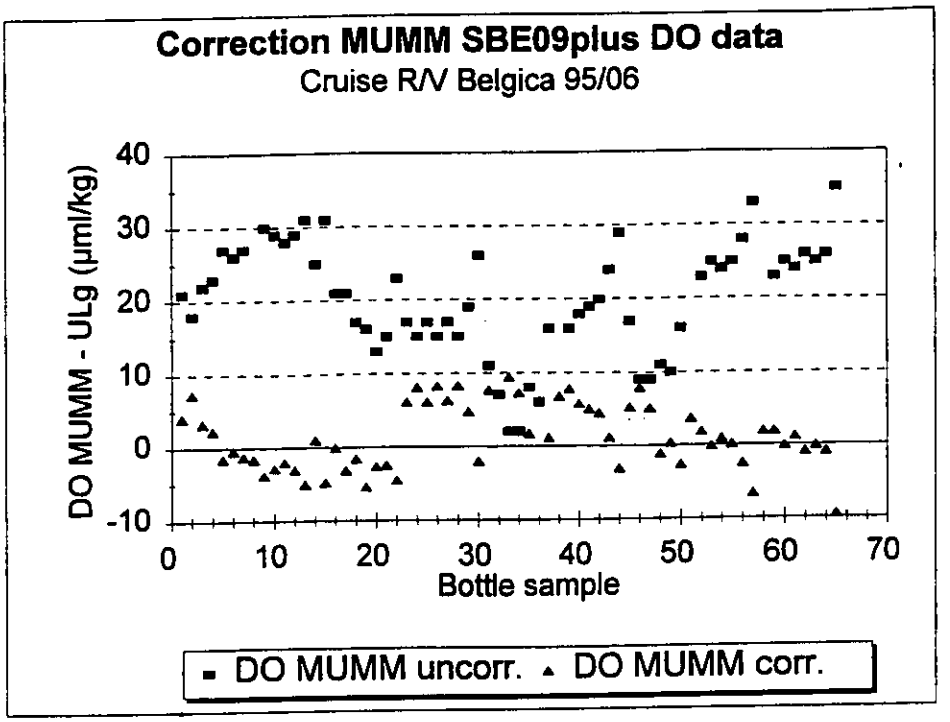


Figure 3. Deviation between DO data ULg and MUMM, before and after correction as a function of the sampling number.

4.4. Chlorophyll measurements.

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

The measurements have to be correlated to the chlorophyll data (Lorenzen method) of samples taken at regular intervals during the cruise. These data are to be obtained from ULB - Laboratoire d'Océanographie Chimique and/or ULg - Laboratoire d'Océanologie. The fluorescence data available at MUMM - Oostende has not (yet) been correlated to the chlorophyll sample data.

4.5. Data validity.

One of the features of the ODAS package is that it verifies all subsystems, instruments and parameters interrogated.

To each parameter value, subsequently logged in the ODAS files, one byte is 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.

Table 1 gives the position, the waterdepth, the date and the time of the SCTD vertical profiles. All these profiles have been taken with the Sea-Bird SBE09*plus* SCTD system.

Figure 1 gives a map with the position of the sampling stations while figure 2 shows a trackplot of the cruise.

In figures 3 to 8 the air temperature, solar radiation, atmospheric pressure, absolute windspeed and direction are plotted in function of time. These data are acquired with the Friedrichs meteo system.

In figures 9 to 11 the surface watertemperature, salinity, density and fluorescence are plotted in function of time. These data are acquired with the Sea-Bird SBE21 thermosalinograph and the Turner Designs fluorometer.

The tables 2 to 17 are giving the values of the oceanographic parameters at the SCTD water sampling points.

The verical profiles of temperature, salinity and density are shown in the figures 12a to 27a while the figures 12b to 27b are giving the dissolved oxygen and the transmittance.

The graphplots 28 to 32 are giving the incident light vs. depth for the stations 01,02,03,04 and 06.

Appendix 1.

Plot with station annotations and list of positions.

MAGNAVOX 200MX : GPS position

ATLAS DESO-20 : waterdepth

Table 1. Position SCTD stations OMEX 95/06.

Station number	Date 1995	Time of V.P.(1)	Latitude	Longitude	Water Depth [m]	Data file
01A	09.03	08h44	N 45 57.70	W 03 39.90	146	OMX9501A
01B	09.03	09h57	N 45 58.49	W 03 40.66	146	OMX9501B
02A	09.03	13h19	N 45 38.24	W 03 42.36	1850	OMX9502A
02B	09.03	16h12	N 45 37.28	W 03 42.76	1850	OMX9502B
02C	09.03	17h08	N 45 36.91	W 03 42.59	1850	OMX9502C
03A	14.03	04h39	N 47 26.02	W 07 15.94	1494	OMX9503A
03B	14.03	07h33	N 47 25.88	W 07 16.07	1620	OMX9503B
03C	14.03	08h34	N 47 26.01	W 07 16.05	1538	OMX9503C
03D	14.03	09h27	N 47 25.97	W 07 16.05	1544	OMX9503D
04A	14.03	14h52	N 47 26.94	W 08 32.24	>2100	OMX9504A
04B	14.03	15h36	N 47 27.07	W 08 32.15	>2100	OMX9504B
04C	14.03	18h18	N 47 27.24	W 08 32.32	>2100	OMX9504C
05A	14.03	23h09	N 47 58.10	W 07 53.39	242	OMX9505A
05B	15.03	00h09	N 47 58.05	W 07 53.23	246	OMX9505B
06A	15.03	08h01	N 47 34.42	W 07 05.75	215	OMX9506A
06B	15.03	09h29	N 47 35.08	W 07 05.54	215	OMX9506B

Remarks:

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

Figure 1. SCTD sampling stations R/V Belgica cruise 95/06.

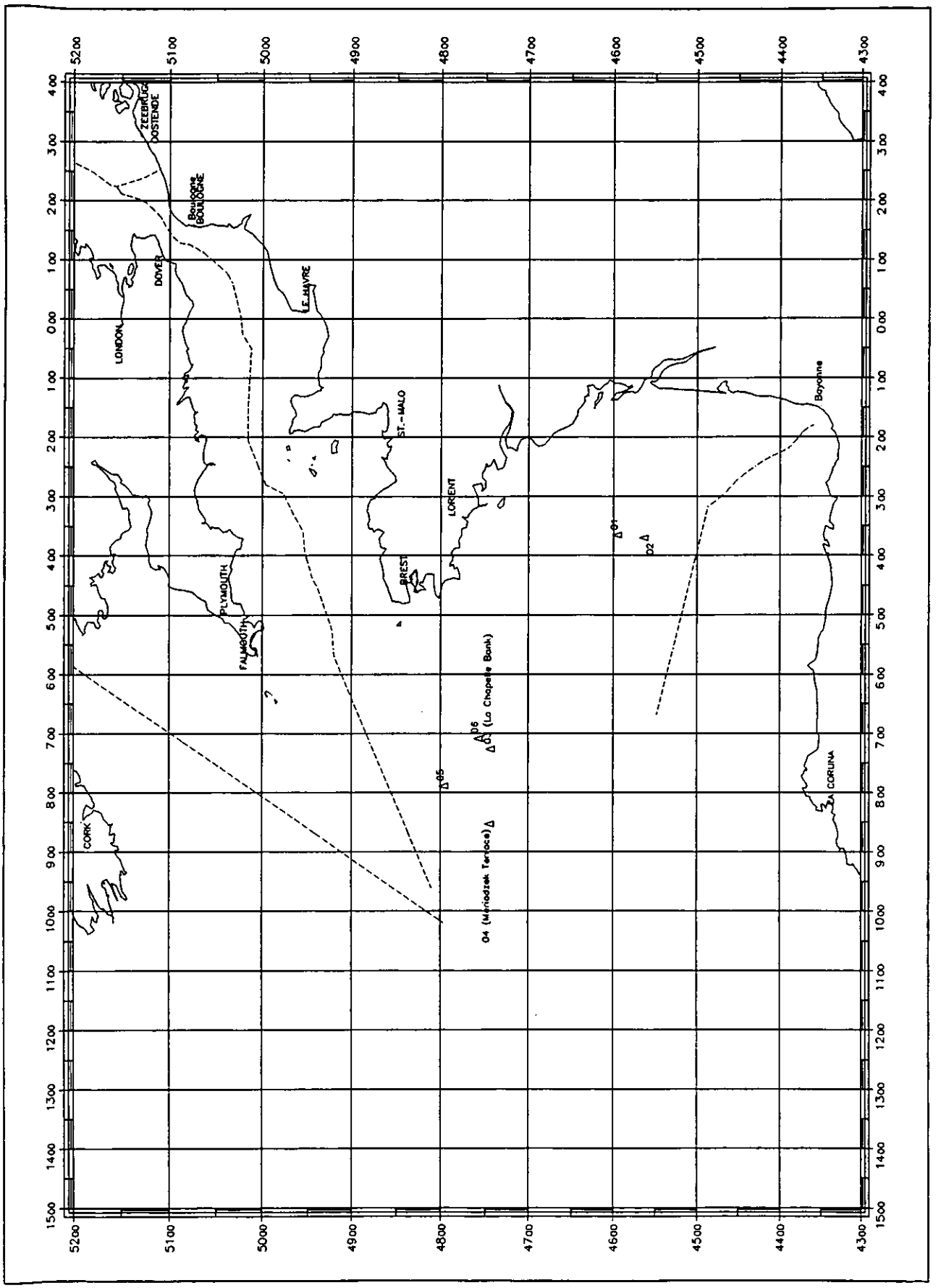
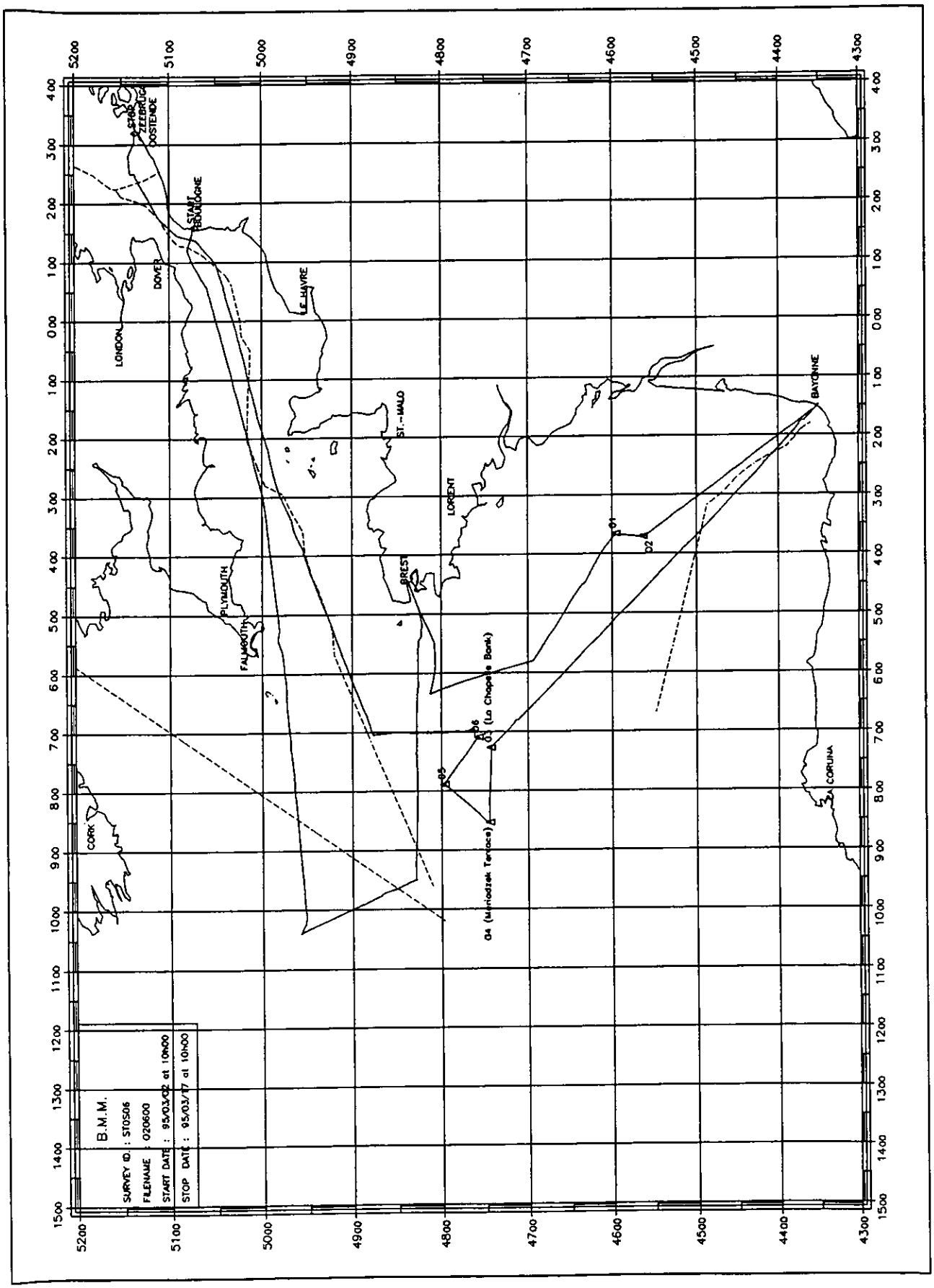


Figure 2. General Trackplot of R/V Belgica cruise 95/06.



Appendix 2.

Meteorological data during the complete campaign.

FRIEDRICHS : windspeed and -direction, airtemperature, atm. pressure

KIPP & ZONEN : solar radiation

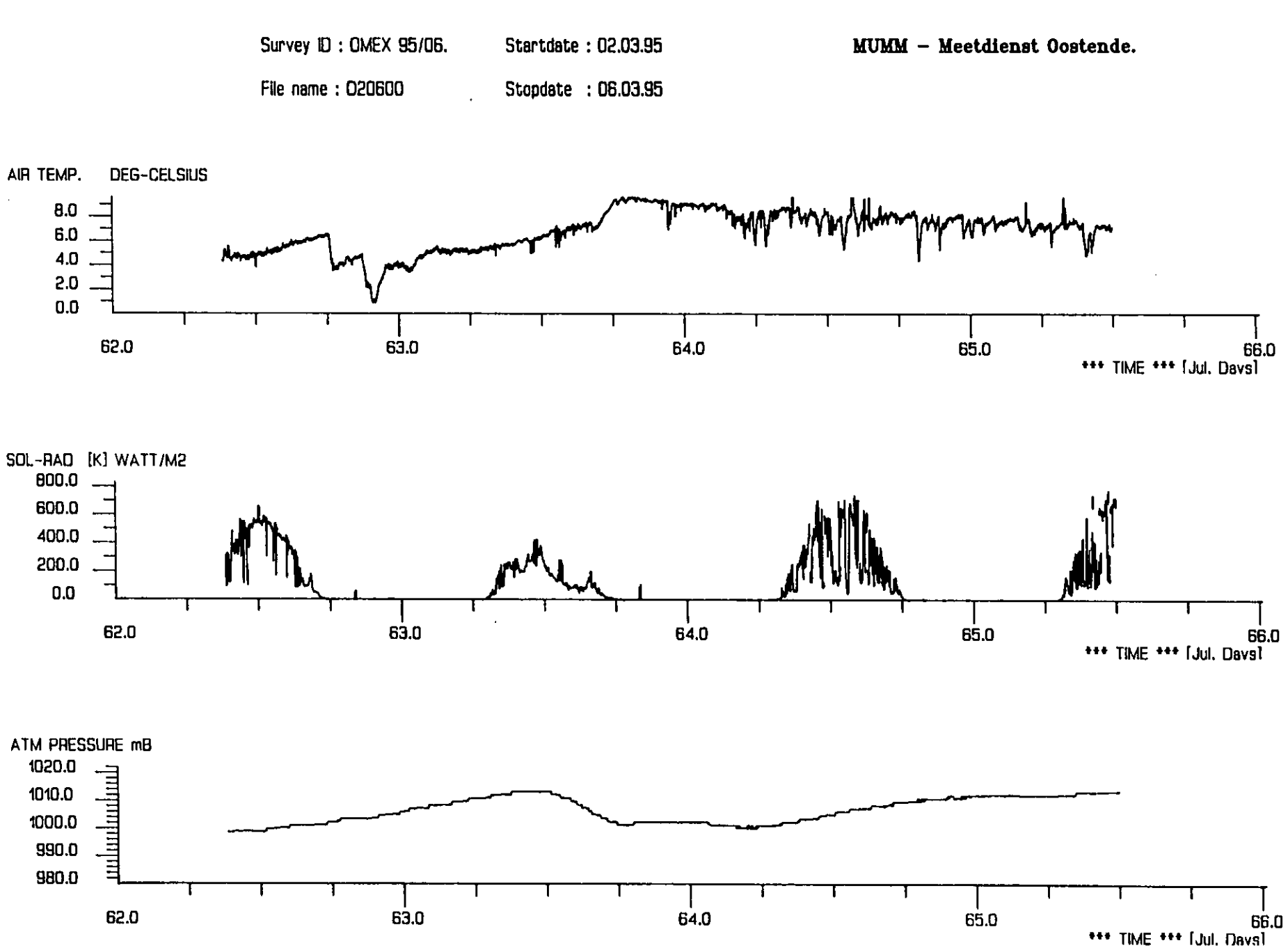


Figure 3. The passage Boulogne - Brest.

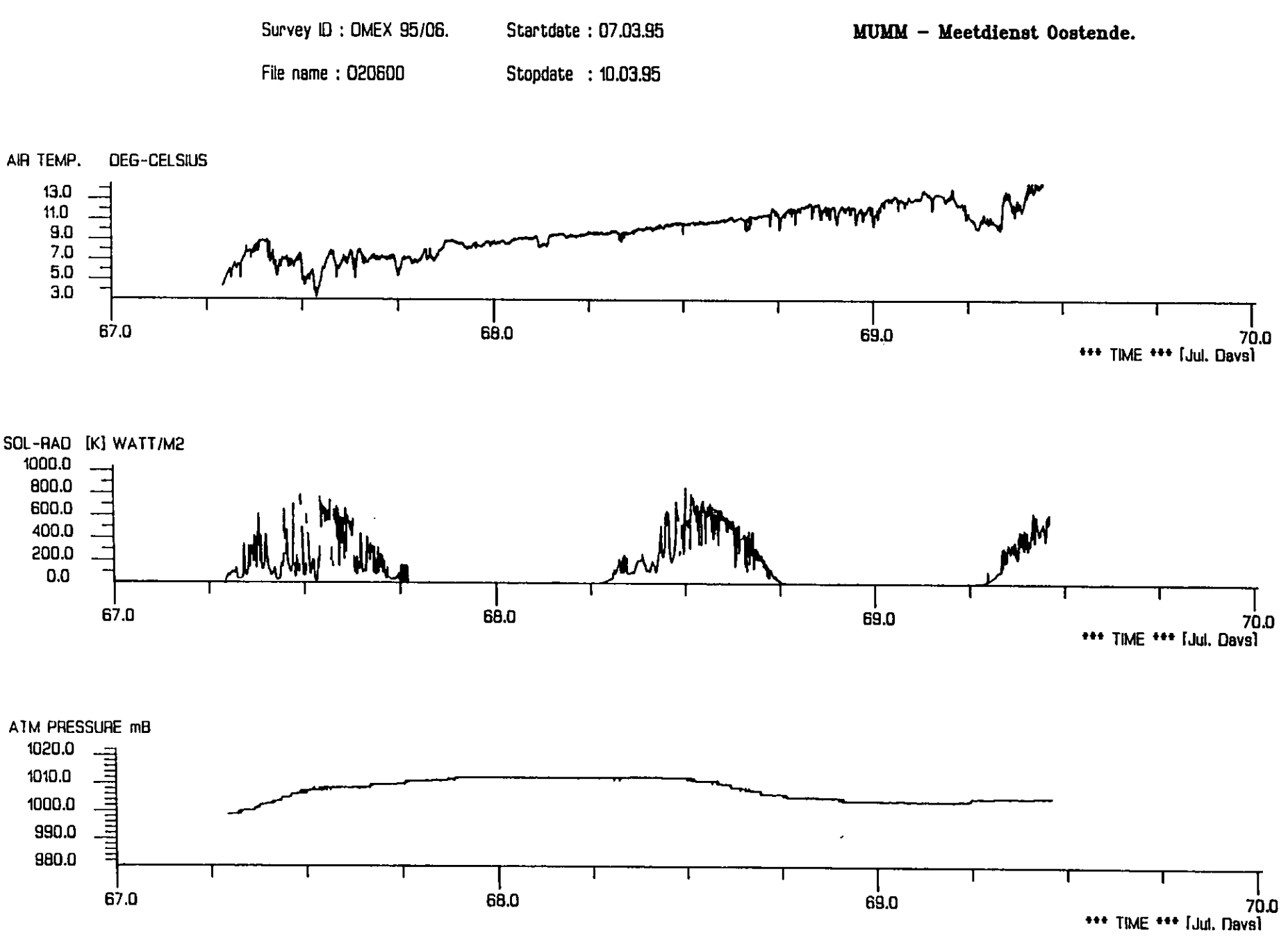


Figure 4. The passage Brest - Bayonne.

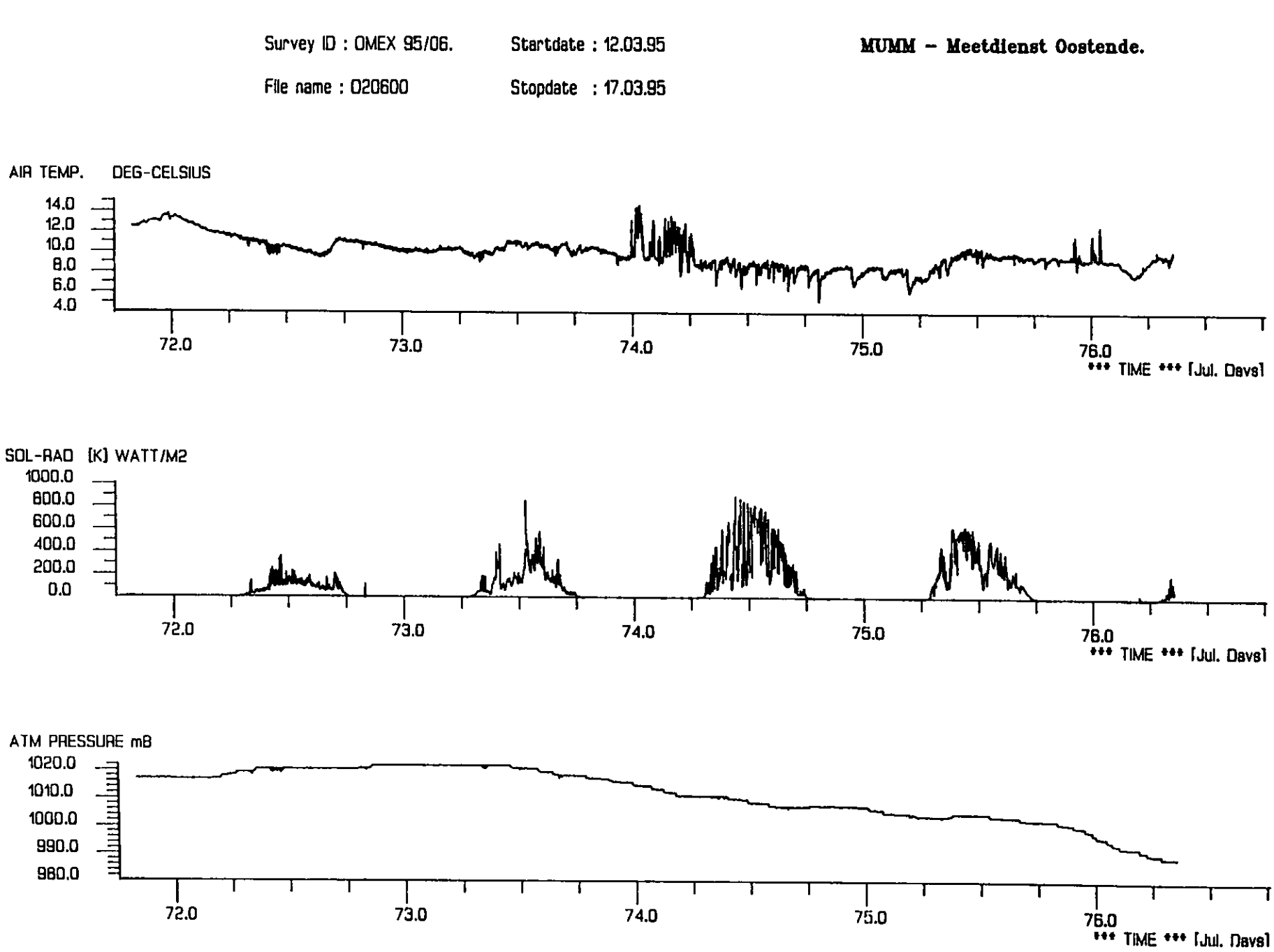


Figure 5. The passage Bayonne - Zeebrugge.

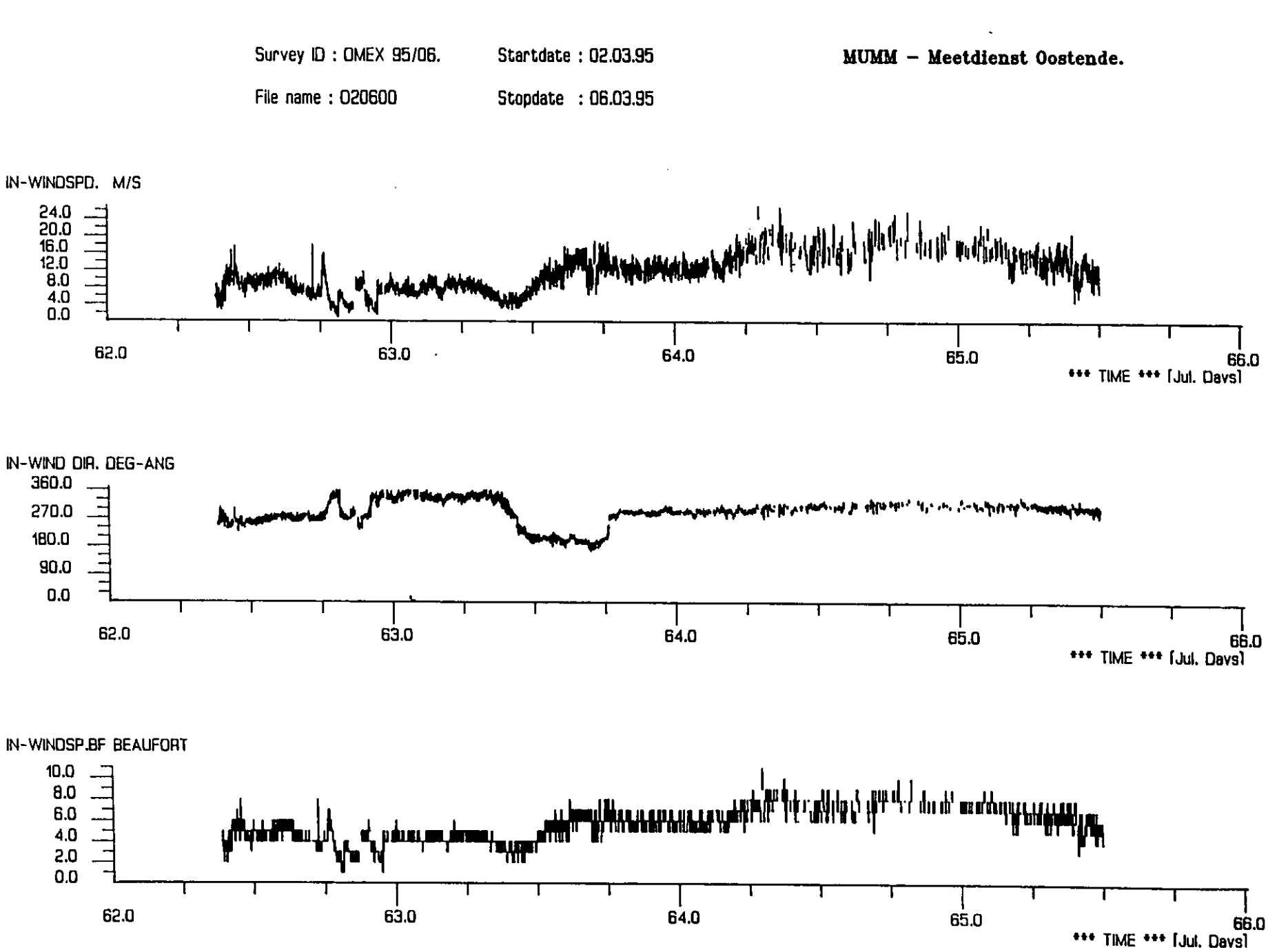


Figure 6. The passage Boulogne - Brest.

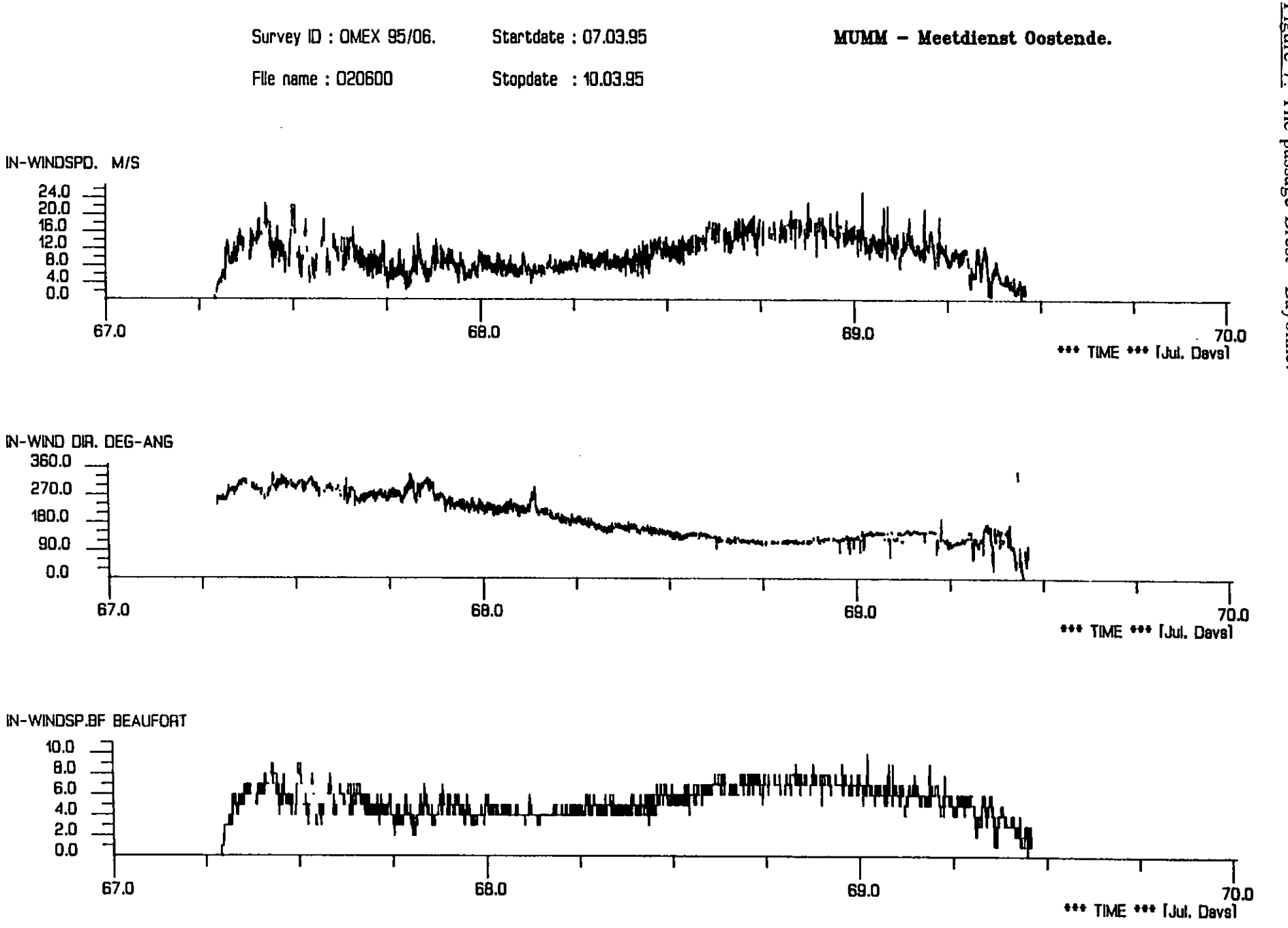


Figure 7. The passage Brest - Bayonne.

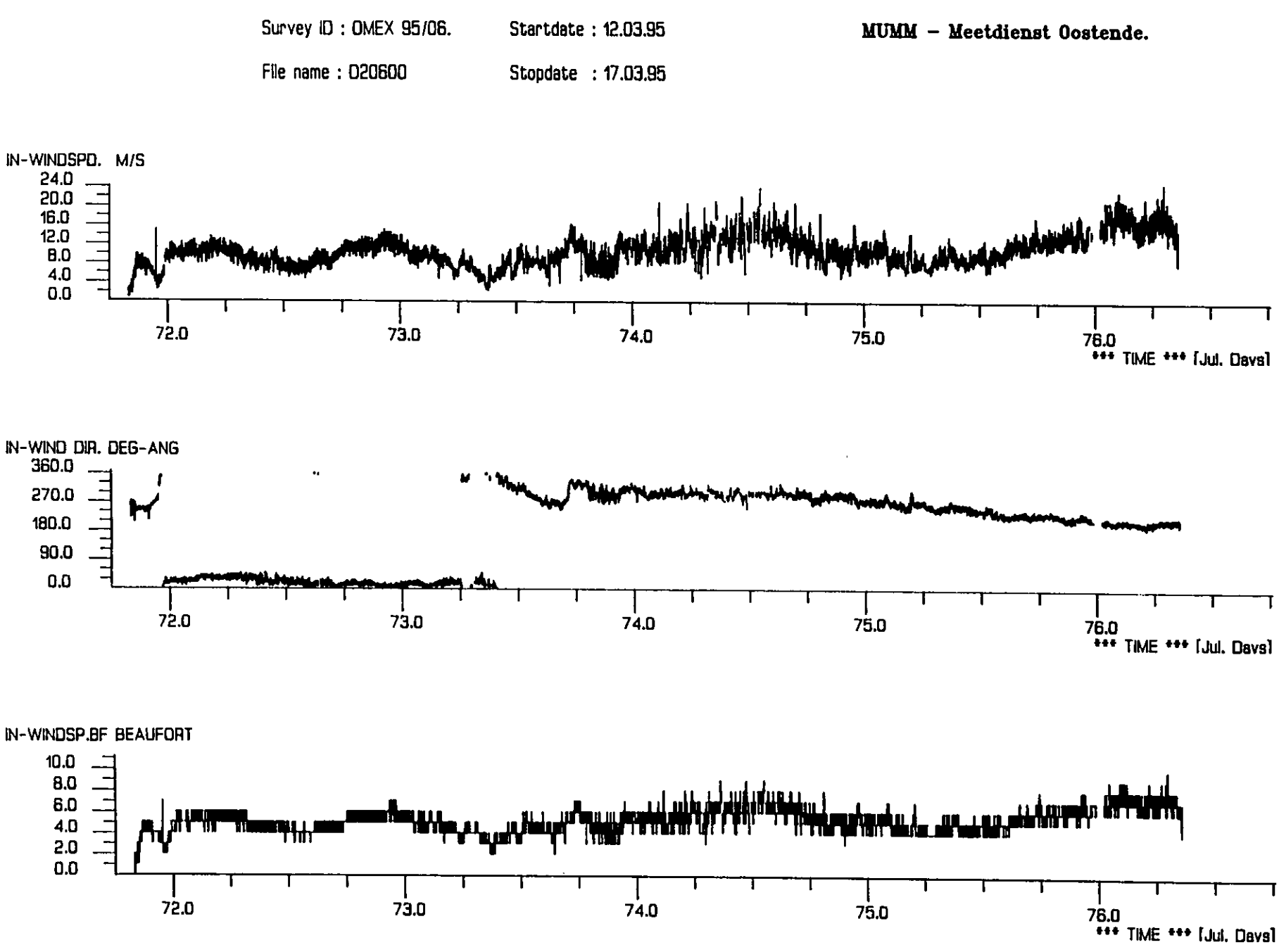


Figure 8. The passage Bayonne - Zeebrugge.

Appendix 3.

Horizontal profiles.

SEA-BIRD SBE 21 : watertemperature, salinity

TURNER DESIGNS : fluorescence

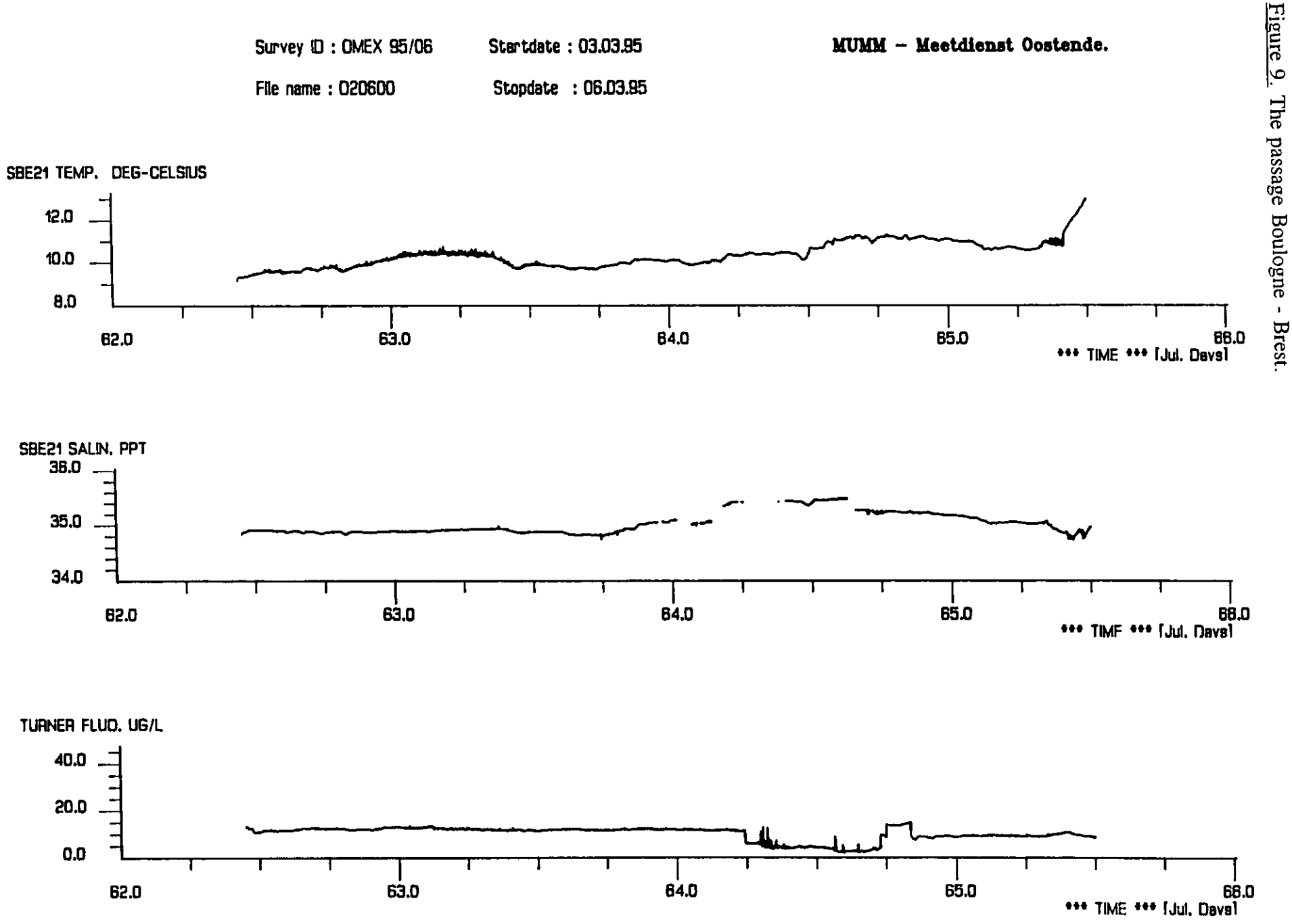


Figure 9. The passage Boulogne - Brest.

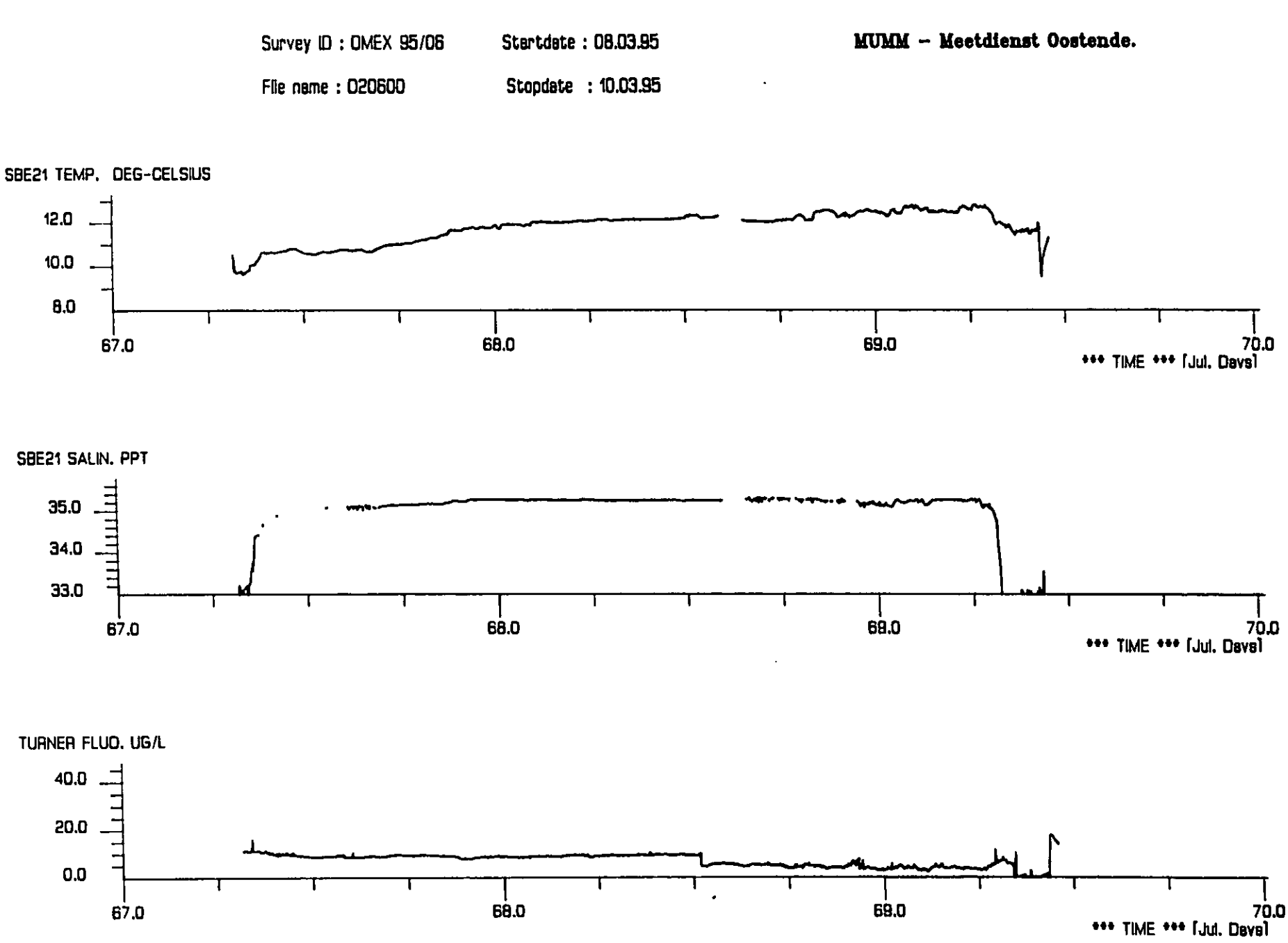


Figure 10. The passage Brest - Bayonne.

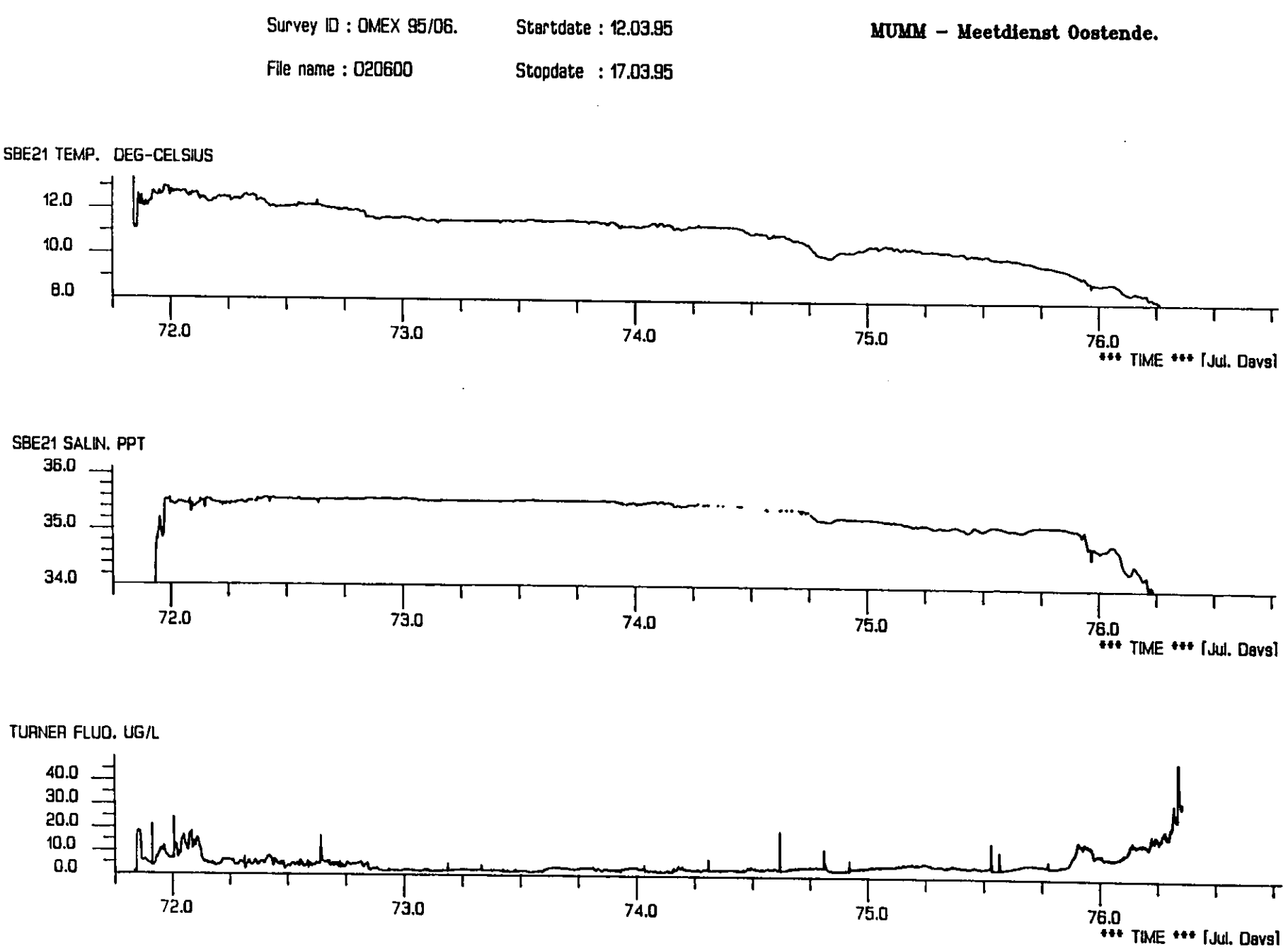


Figure 11. The passage Bayonne - Zeebrugge.

Appendix 4.

SCTD data at the sampling depths.

SEA-BIRD SBE09*plus* : salinity, watertemperature, density, DO

NIOZ transmittometer : transmittance

Table 2

Profile: Station 1 Cast A

Date: 09.03.95

DOWNCAST: starttime: 08h44 GMT

Bathy depth: 146 m

sampling			SCTD values					
depth	bottle type	bottle no.(s)	depth (m)	temp. (°C)	salinity (PSU)	DO (µml/kg)	transmit. (%)	density sig. Θ
3	Ni	9,10,11,12	4.43	12.10	35.50	236	85.5	26.96
20	Ni	5,6,7,8	21.4	12.11	35.50	236	85.5	26.96
40	Ni	3,4	40.7	12.12	35.50	236	85.5	26.96
100	Ni	1,2	99.7	12.13	35.51	237	85.5	26.96

Table 3

Profile: Station 1 Cast B

Date: 09.03.95

DOWNCAST: starttime: 09h57 GMT

Bathy depth: 146 m

sampling			SCTD values					
depth	bottle type	bottle no.(s)	depth (m)	temp. (°C)	salinity (PSU)	DO (µml/kg)	transmit. (%)	density sig. Θ
3	Ni	10,11,12	4.04	12.11	35.51	235	85.3	26.97
3	CFR	9	4.04	12.11	35.51	235	85.3	26.97
20	Ni	8	20.2	12.12	35.51	236	85.4	26.97
20	CFR	7	20.2	12.12	35.51	236	85.4	26.97
40	Ni	6	39.4	12.12	35.51	236	85.4	26.97
60	Ni	5	62.1	12.12	35.52	236	85.5	26.97
80	Ni	4	80.5	12.13	35.51	236	85.5	26.97
100	Ni	3	102.0	12.13	35.52	236	85.5	26.97
135	Ni	2	135.6	12.13	35.52	237	85.1	26.97
135	CFR	1	135.6	12.13	35.52	237	85.1	26.97

Table 4

Profile: Station 2 Cast A

Date: 09.03.95

DOWNCAST: starttime: 13h19 GMT

Bathy depth: 1850 m

sampling			SCTD values					
depth	bottle type	bottle no.(s)	depth (m)	temp. (°C)	salinity (PSU)	DO (µml/kg)	transmit. (%)	density sig. Θ
300	Ni	12	298	11.60	35.61	220	86.7	27.14
500	Ni	11	500	11.13	35.58	209	86.8	27.21
600	Ni	9,10	601	10.76	35.56	201	86.9	27.27
800	Ni	7,8	797	10.14	35.67	183	86.9	27.47
1000	Ni	5,6	999	9.53	35.72	183	86.7	27.62
1200	Ni	3,4	1201	8.54	35.64	190	86.9	27.71
1600	Ni	1,2	1540	5.83	35.26	212	86.8	27.80
Surf.			3.1	12.19	35.30	238	84.7	26.94

Table 5

Profile: Station 2 Cast B

Date: 09.03.95

DOWNCAST: starttime: 16h12 GMT

Bathy depth: 1850 m

sampling			SCTD values					
depth	bottle type	bottle no.(s)	depth (m)	temp. (°C)	salinity (PSU)	DO (µml/kg)	transmit. (%)	density sig. Θ
3	Ni	12	4.16	12.01	35.54	240	84.8	27.00
3	PP	11	4.16	12.01	35.54	240	84.8	27.00
3	CFR	10	4.16	12.01	35.54	240	84.8	27.00
20	Ni	9	18.3	12.01	35.54	239	85.0	27.00
40	Ni	8	38.6	12.02	35.54	239	85.0	27.00
40	CFR	7	38.6	12.02	35.54	239	85.0	27.00
60	Ni	6	60.4	12.00	35.54	238	85.6	27.01
80	Ni	5	81.6	12.00	35.54	238	85.6	27.01
100	Ni	4	98.8	12.01	35.54	238	85.7	27.01
150	Ni	3	148	12.01	35.54	238	85.7	27.01
200	Ni	2	203	12.02	35.54	239	85.8	27.01
200	CFR	1	203	12.02	35.54	239	85.8	27.01

Table 6

Profile: Station 2 Cast C

Date: 09.03.95

DOWNCAST: starttime: 17h08 GMT

Bathy depth: 1850 m

sampling			SCTD values					
depth	bottle type	bottle no.(s)	depth (m)	temp. (°C)	salinity (PSU)	DO (µml/kg)	transmit. (%)	density sig. Θ
3	Ni	7,8	3.62	12.00	35.54	240	85.0	27.01
20	Ni	3,4,5,6	19.5	12.00	35.54	239	85.0	27.01
40	Ni	1,2	39.1	12.00	35.54	238	85.3	27.01

Table 7

Profile: Station 3 Cast A

Date: 14.03.95

DOWNCAST: starttime: 04h39 GMT

Bathy depth: 1494 m

sampling			SCTD values					
depth	bottle type	bottle no.(s)	depth (m)	temp. (°C)	salinity (PSU)	DO (µml/kg)	transmit. (%)	density sig. Θ
300	Ni	11,12	299	11.33	35.54	212	86.0	27.15
400	Susp.	10	401	11.16	35.56	205	86.4	27.19
500	Ni	9	500	10.79	35.55	196	86.3	27.26
600	Ni	8	601	10.52	35.57	187	86.4	27.32
800	Ni	7	800	10.01	35.65	179	86.5	27.48
900	Ni	6	900	9.64	35.65	180	86.3	27.54
1000	Ni	5	999	9.30	35.68	180	86.5	27.62
1200	Ni	4	1199	8.21	35.55	189	86.4	27.70
1400	Ni	3	1399	6.41	35.30	202	86.5	27.75
1494	Susp.	2	1494	5.49	35.19	207	85.5	27.79
1494	Ni	1	1494	5.49	35.19	207	85.5	27.79

Table 8

Profile: Station 3 Cast B

Date: 14.03.95

DOWNCAST: starttime: 07h33 GMT

Bathy depth: 1620 m

sampling			SCTD values					
depth	bottle type	bottle no.(s)	depth (m)	temp. (°C)	salinity (PSU)	DO (µml/kg)	transmit. (%)	density sig. Θ
3	CFR	12	4.01	11.44	35.52	228	85.3	27.10
3	Ni	11	4.01	11.44	35.52	228	85.3	27.10
20	Ni	10	19.7	11.45	35.52	228	85.4	27.10
40	CFR	9	40.9	11.45	35.52	228	85.4	27.10
40	Ni	7,8	40.9	11.45	35.52	229	85.4	27.10
60	Ni	6	59.8	11.45	35.52	229	85.4	27.10
80	Ni	5	79.3	11.46	35.52	229	85.4	27.10
100	Ni	4	100.5	11.45	35.52	230	85.6	27.10
150	Ni	3	149.7	11.47	35.52	231	85.7	27.10
200	CFR	2	200.7	11.47	35.54	231	86.0	27.11
200	Ni	1	200.7	11.47	35.54	231	86.0	27.11

Table 9

Profile: Station 3 Cast C

Date: 14.03.95

DOWNCAST: starttime: 08h34 GMT

Bathy depth: 1538 m

sampling			SCTD values					
depth	bottle type	bottle no.(s)	depth (m)	temp. (°C)	salinity (PSU)	DO (µml/kg)	transmit. (%)	density sig. Θ
3	Ni	9,10,11,12	3.4	11.45	35.52	227	85.3	27.10
10	Ni	8	10.1	11.45	35.52	228	85.4	27.10
20	Ni	5,6,7	20.4	11.45	35.52	228	85.4	27.10
40	Ni	2,3,4	41.6	11.45	35.52	228	85.3	27.10
50	Ni	1	49.6	11.45	35.52	228	85.3	27.10

Table 10

Profile: Station 3 Cast D

Date: 14.03.95

DOWNCAST: starttime: 09h27 GMT

Bathy depth: 1544 m

sampling			SCTD values					
depth	bottle type	bottle no.(s)	depth (m)	temp. (°C)	salinity (PSU)	DO (µml/kg)	transmit. (%)	density sig. Θ
3	Ni	12	2.65	11.45	35.52	229	85.2	27.10
10	Ni	11	9.85	11.45	35.52	229	85.2	27.10
20	Ni	10	19.1	11.45	35.52	229	85.2	27.10
30	Ni	9	29.9	11.45	35.52	229	85.2	27.10
40	Ni	7,8	39.9	11.45	35.52	230	85.2	27.10
50	CFR	5,6	50.5	11.45	35.52	230	85.4	27.10
75	Ni	3,4	75.3	11.46	35.52	231	85.4	27.10
100	Ni	1,2	99.3	11.46	35.52	233	85.4	27.10

Table 11

Profile: Station 4 Cast A

Date: 14.03.95

DOWNCAST: starttime: 14h52 GMT

Bathy depth: > 2100 m

sampling			SCTD values					
depth	bottle type	bottle no.(s)	depth (m)	temp. (°C)	salinity (PSU)	DO (µml/kg)	transmit. (%)	density sig. Θ
3	Ni	9,10,11	4.3	11.46	35.53	228	84.5	27.10
20	Ni	3,5,7	20.1	11.46	35.53	228	84.5	27.10
40	Ni	1	38.5	11.45	35.53	228	84.5	27.10

Table 12

Profile: Station 4 Cast B

Date: 14.03.95

DOWNCAST: starttime: 15h36 GMT

Bathy depth: > 2100 m

sampling			SCTD values					
depth	bottle type	bottle no.(s)	depth (m)	temp. (°C)	salinity (PSU)	DO (µml/kg)	transmit. (%)	density sig. Θ
300	Ni	12	301	11.36	35.53	225	85.7	27.13
400	CH_4	11	397	11.12	35.54	212	86.2	27.19
500	Ni	10	499	10.65	35.49	206	86.3	27.23
600	Ni	9	600	10.40	35.49	196	86.3	27.29
700	CH_4	8	700	10.07	35.51	186	86.4	27.36
800	Ni	7	797	9.78	35.54	181	86.4	27.42
900	CH_4	6	900	9.52	35.60	180	86.4	27.52
1000	Ni	5	998	9.05	35.61	183	86.4	27.60
1100	CH_4	4	1099	8.51	35.58	187	86.5	27.67
1200	Ni	3	1201	7.89	35.51	194	86.5	27.71
1400	CH_4	2	1400	5.70	35.19	212	86.5	27.76
1600	Ni	1	1603	4.52	35.03	222	86.4	27.77

Table 13

Profile: Station 4 Cast C

Date: 14.03.95

DOWNCAST: starttime: 18h18 GMT

Bathy depth: > 2100 m

sampling			SCTD values					
depth	bottle type	bottle no.(s)	depth (m)	temp. (°C)	salinity (PSU)	DO (µml/kg)	transmit. (%)	density sig. Θ
3	Ni	11,12	3.1	11.45	35.53	230	84.8	27.10
3	CFR	10	3.1	11.45	35.53	230	84.8	27.10
20	Ni	9	20.7	11.45	35.53	230	84.8	27.10
40	Ni	8	38.1	11.45	35.53	230	85.4	27.10
40	CFR	7	38.1	11.45	35.53	230	85.4	27.10
60	Ni	6	58.5	11.45	35.53	231	85.5	27.11
80	Ni	5	80.2	11.45	35.53	232	85.4	27.11
100	Ni	4	99.5	11.44	35.53	233	85.3	27.11
150	Ni	3	150	11.36	35.53	235	85.7	27.12
200	Ni	2	197	11.35	35.53	238	85.9	27.13
200	CFR	1	197	11.35	35.53	238	85.9	27.13

Table 14

Profile: Station 5 Cast A

Date: 14.03.95

DOWNCAST: starttime: 23h09 GMT

Bathy depth: 242 m

sampling			SCTD values					
depth	bottle type	bottle no.(s)	depth (m)	temp. (°C)	salinity (PSU)	DO (µml/kg)	transmit. (%)	density sig. Θ
3	Ni	11,12	3.7	11.26	35.49	233	84.3	27.11
3	CFR	10	3.7	11.26	35.49	233	84.3	27.11
20	Ni	9	20.3	11.27	35.49	234	84.5	27.11
40	Ni	8	39.6	11.26	35.49	234	84.5	27.11
40	CFR	7	39.6	11.26	35.49	234	84.5	27.11
60	Ni	6	60.2	11.30	35.50	234	84.7	27.11
80	Ni	5	79.6	11.31	35.50	234	84.9	27.11
100	Ni	4	99.7	11.32	35.50	235	85.1	27.11
150	Ni	3	150	11.29	35.50	237	85.3	27.12
200	Ni	2	200	11.26	35.50	240	85.3	27.12
200	CFR	1	200	11.26	35.50	240	85.3	27.12

Table 15

Profile: Station 5 Cast B

Date: 15.03.95

DOWNCAST: starttime: 00h09 GMT

Bathy depth: 246 m

sampling			SCTD values					
depth	bottle type	bottle no.(s)	depth (m)	temp. (°C)	salinity (PSU)	DO (µml/kg)	transmit. (%)	density sig. Θ
3	Ni	8,9	4.7	11.23	35.48	236	84.7	27.11
20	Ni	4,5,6,7	18.5	11.23	35.48	237	84.7	27.11
40	Ni	2,3	40.6	11.24	35.48	238	84.8	27.11
40	Gases	1	40.6	11.24	35.48	238	84.8	27.11

Table 16

Profile: Station 6 Cast A

Date: 15.03.95

DOWNCAST: starttime: 08h01 GMT

Bathy depth: 215 m

sampling			SCTD values					
depth	bottle type	bottle no.(s)	depth (m)	temp. (°C)	salinity (PSU)	DO (µml/kg)	transmit. (%)	density sig. Θ
10	Ni	12	9.9	11.27	35.47	234	84.8	27.09
10	CFR	11	9.9	11.27	35.47	234	84.8	27.09
20	Ni	10	22.8	11.28	35.47	234	84.7	27.09
40	Ni	9	39.6	11.28	35.47	234	84.7	27.10
40	CFR	8	39.6	11.28	35.47	234	84.7	27.10
60	Ni	6	60.1	11.29	35.48	235	84.8	27.10
80	Ni	5	81.0	11.30	35.48	235	84.8	27.10
100	Ni	4	101	11.30	35.48	234	84.9	27.10
150	Ni	3	151	11.31	35.49	235	85.1	27.11
180	Ni	2	182	11.30	35.50	237	85.2	27.11
180	CFR	1	182	11.30	35.50	237	85.2	27.11

Table 17

Profile: Station 6 Cast B

Date: 15.03.95

DOWNCAST: starttime: 09h29 GMT

Bathy depth: 215 m

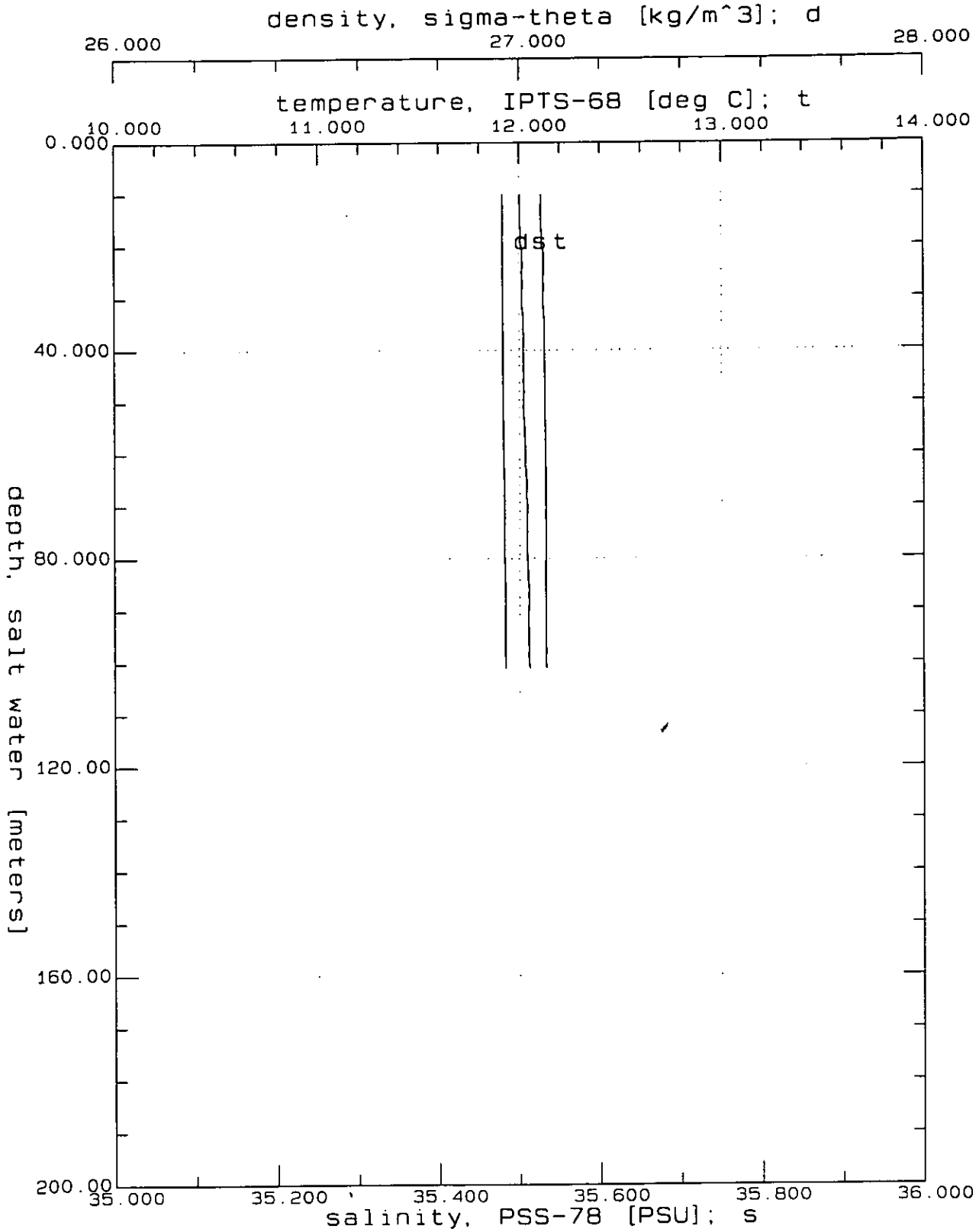
sampling			SCTD values					
depth	bottle type	bottle no.(s)	depth (m)	temp. (°C)	salinity (PSU)	DO (µml/kg)	transmit. (%)	density sig. Θ
20	Ni	1,3,5,6, 8,10,12	21.2	11.26	35.47	240	84.7	27.09

Appendix 5.

Vertical profiles with SCTD.

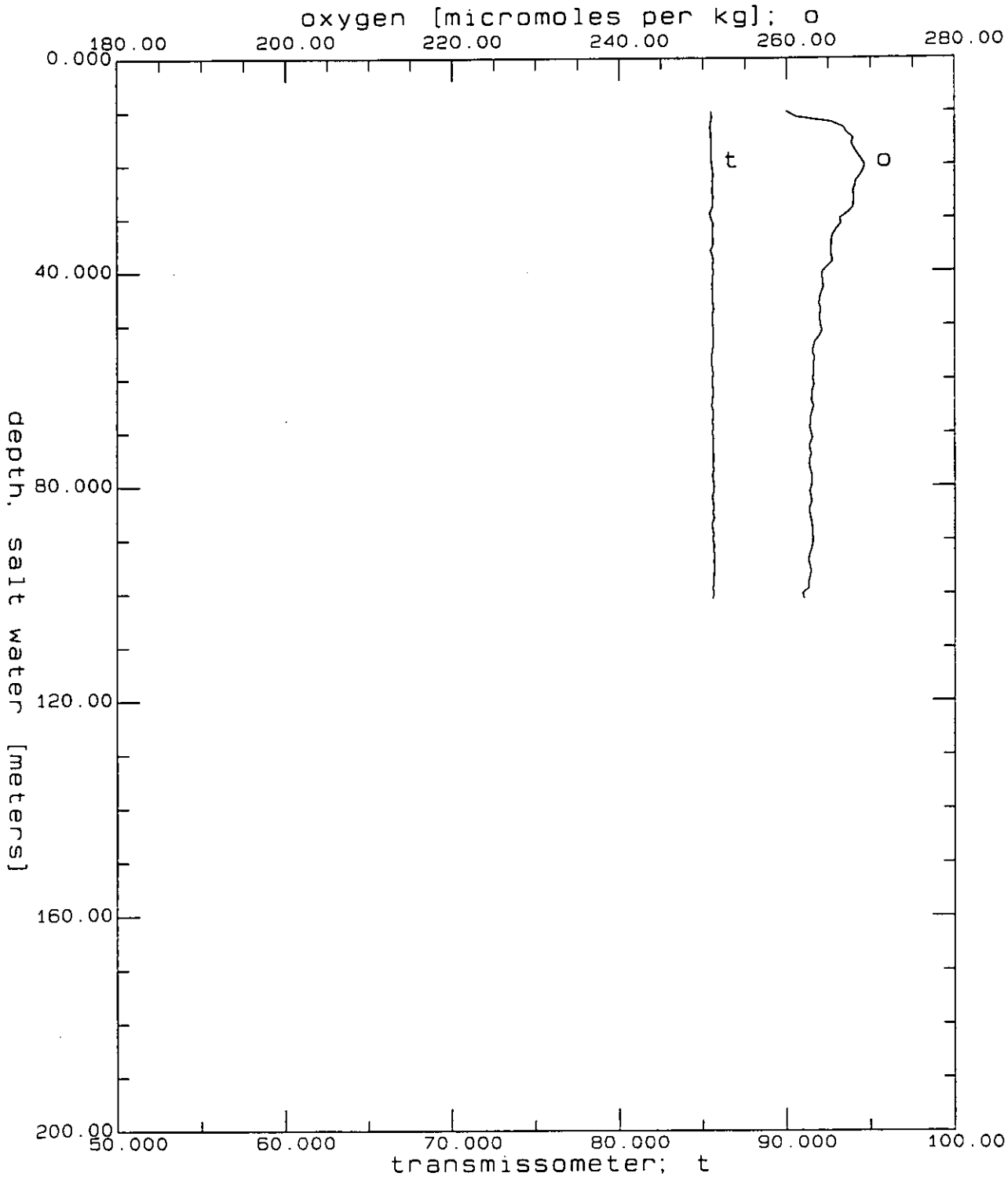
SEA-BIRD SBE 911 : salinity, watertemperature, density, DO

NIOZ transmittometer : transmittance



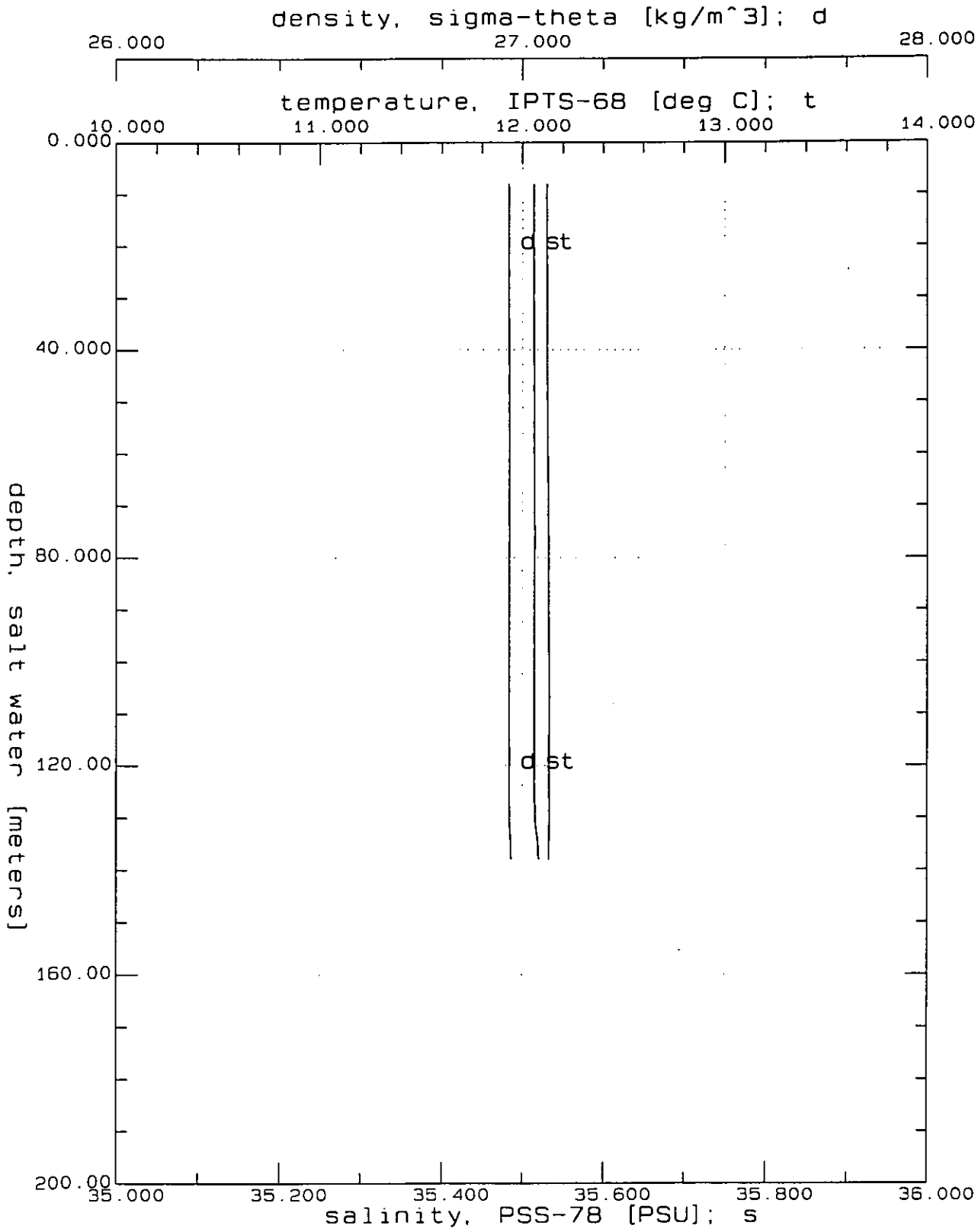
OMX9501A.CNV: OMEX 95/06 Station 1A 09.03.95 at 08h44.

Figure 12a.



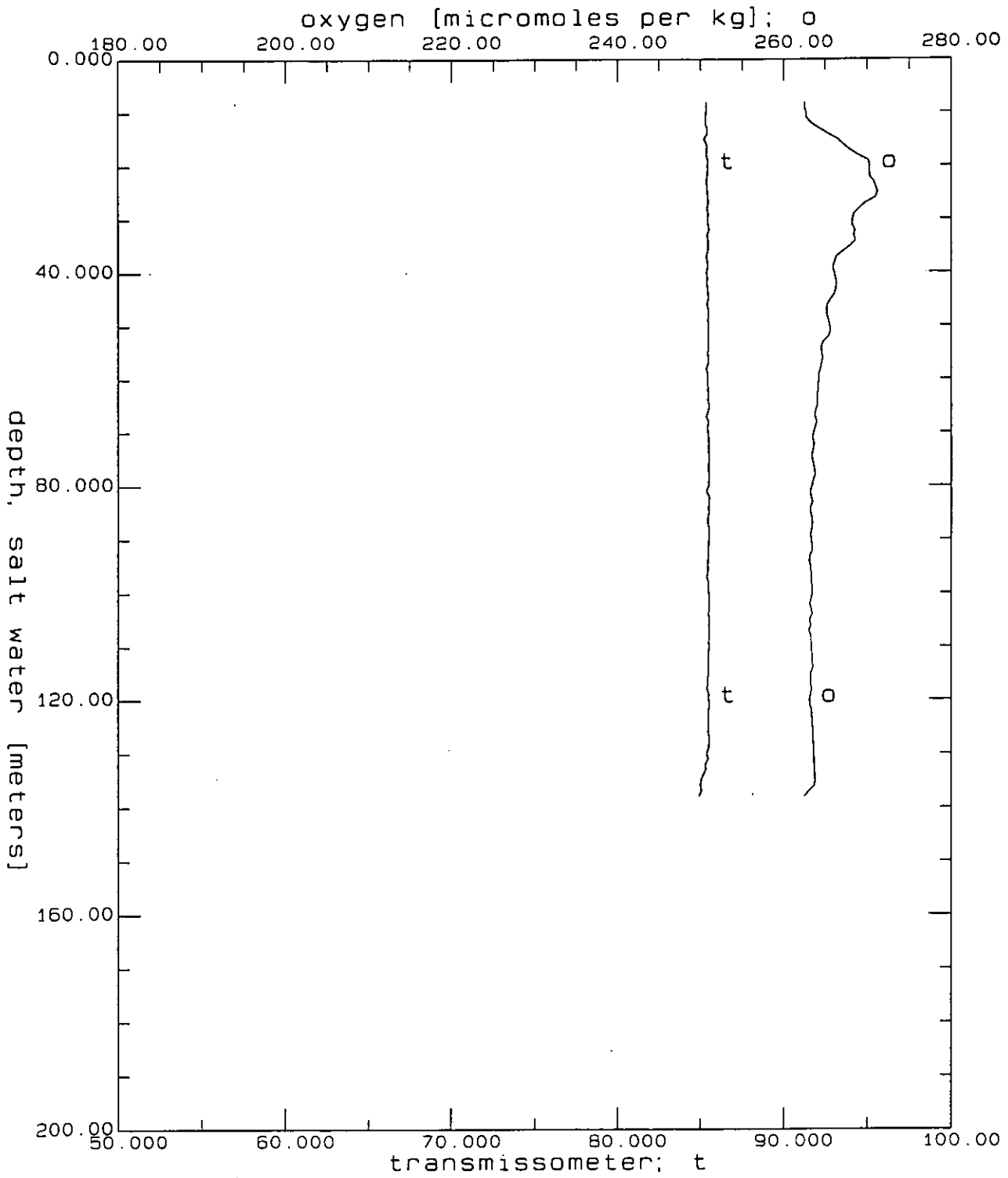
OMX9501A.CNV: OMEX 95/06 Station 1A 09.03.95 at 08h44.

Figure 12b.



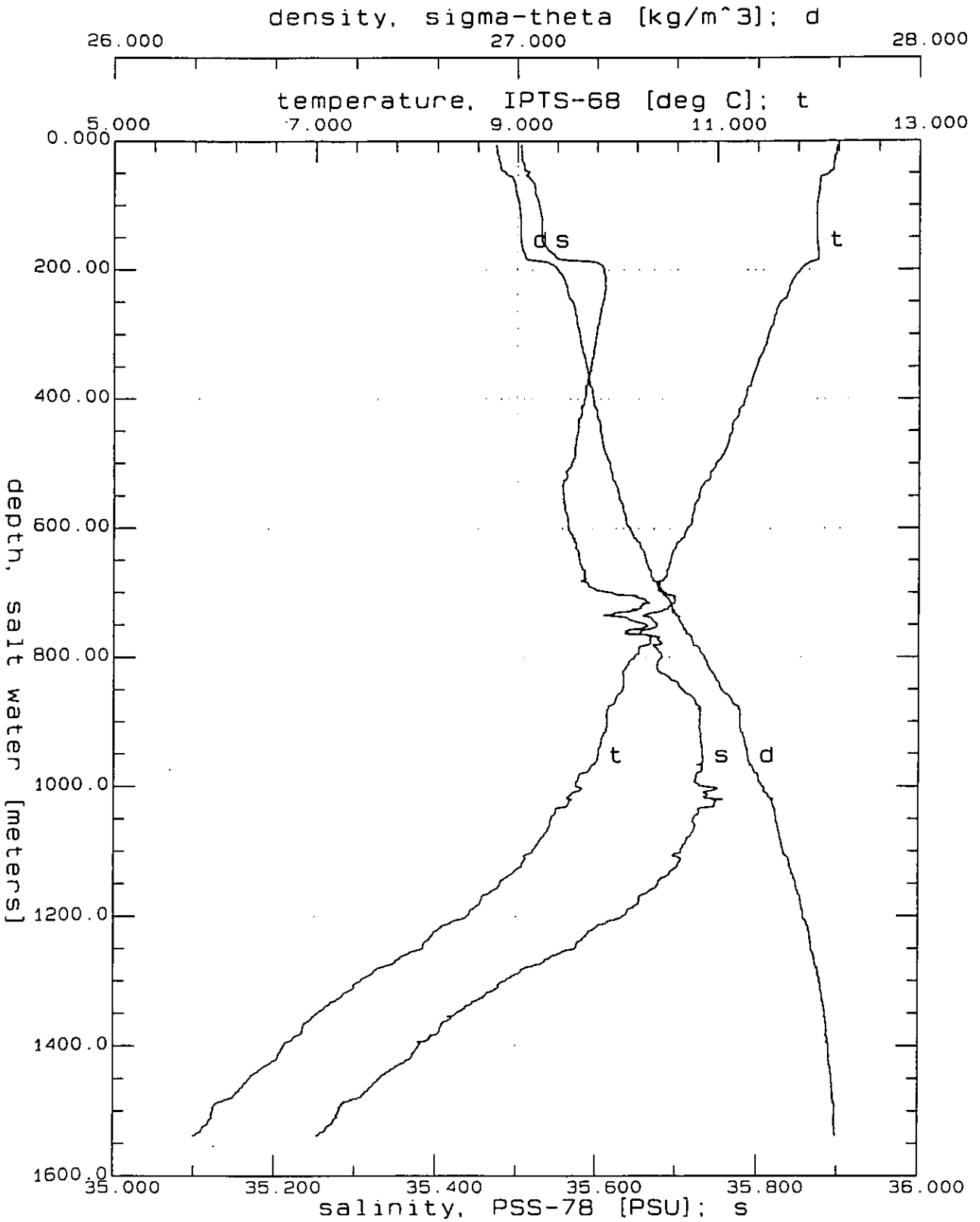
OMX9501B.CNV: OMEX 95/06 Station 1B 09.03.95 at 09h57

Figure 13a.



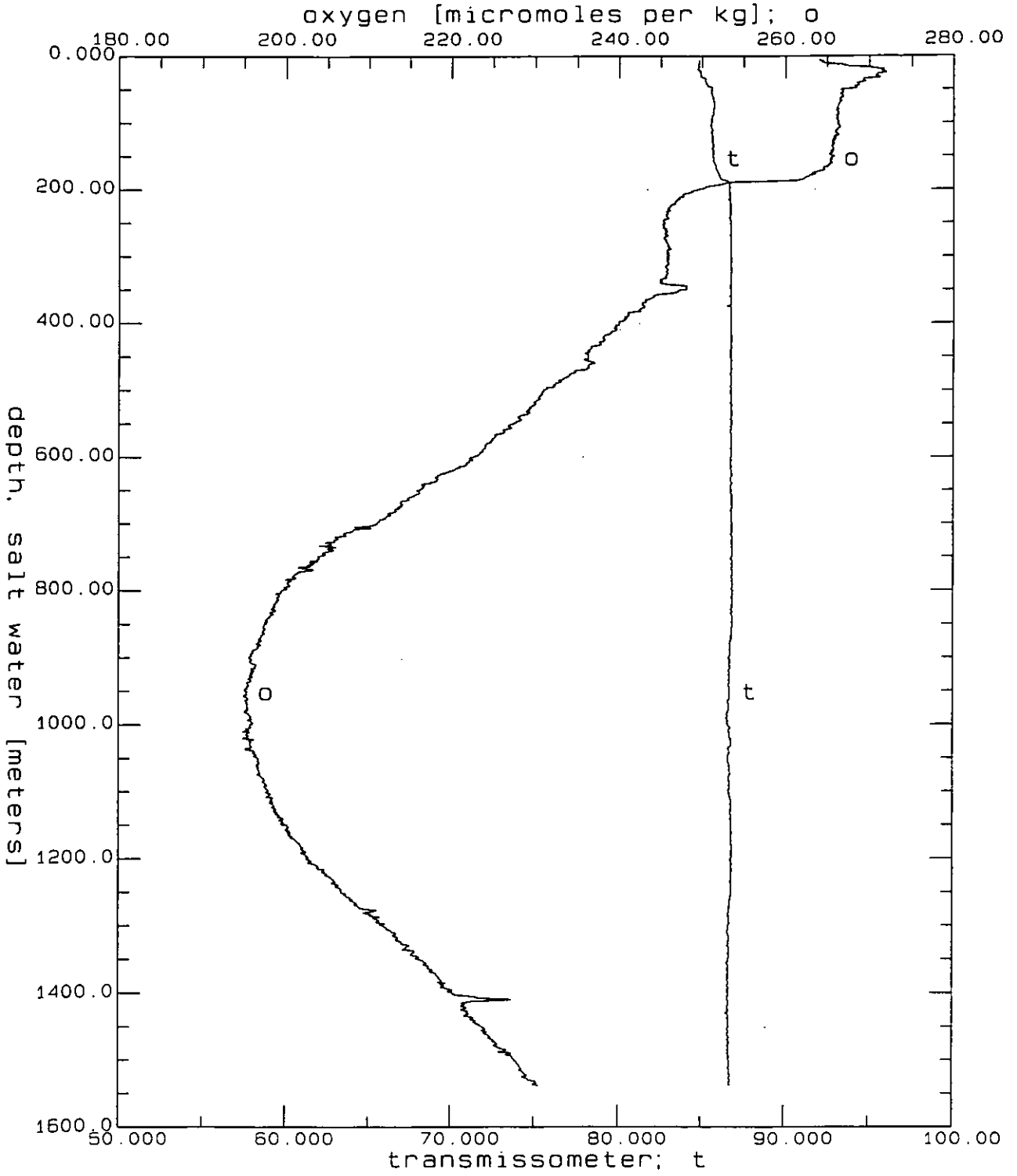
OMX9501B.CNV: OMEX 95/06 Station 1B 09.03.95 at 09h57

Figure 13b.



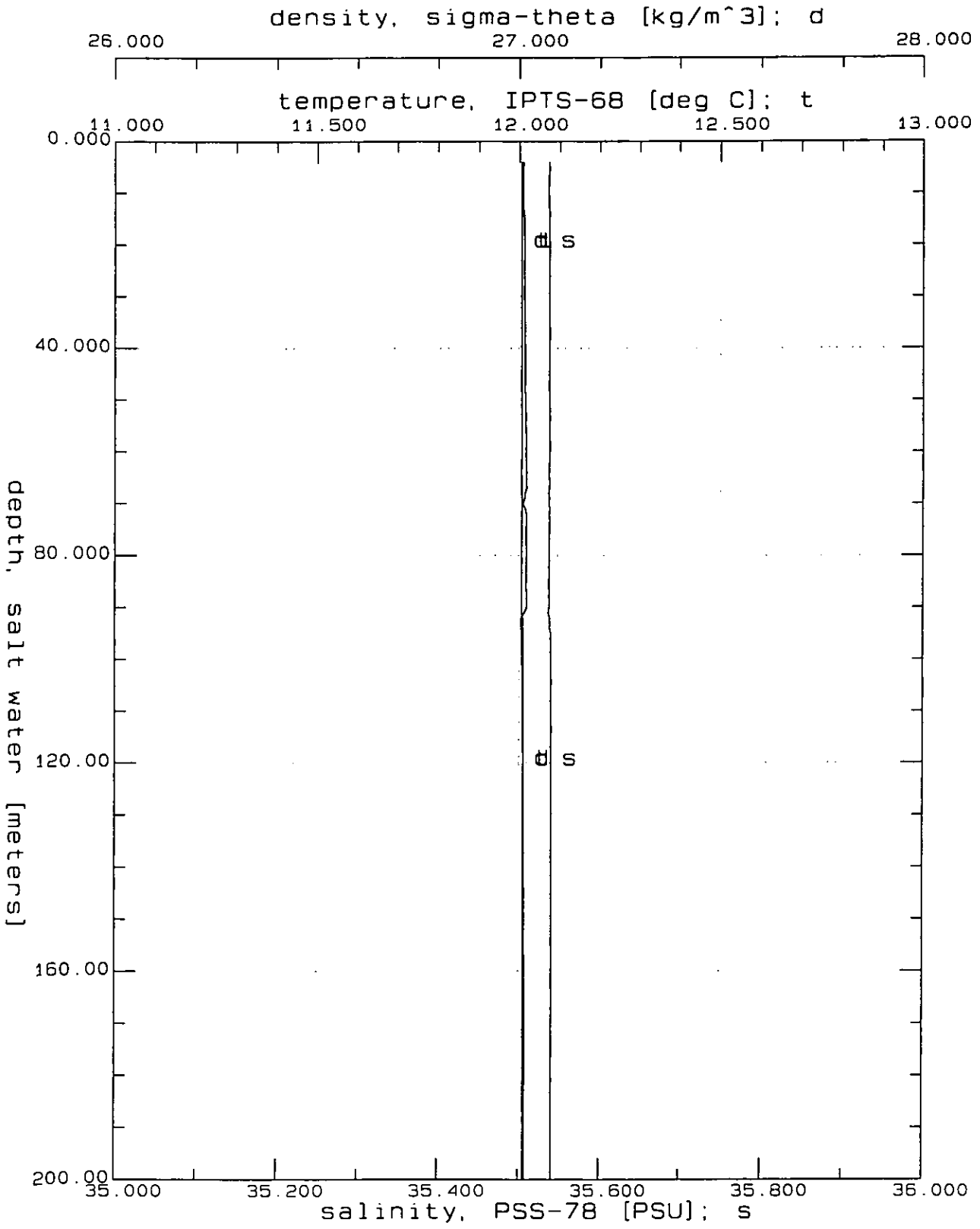
OMX9502A.CNV: OMEX 95/06 Station 2A 09.03.95 at 13h19.

Figure 14a.



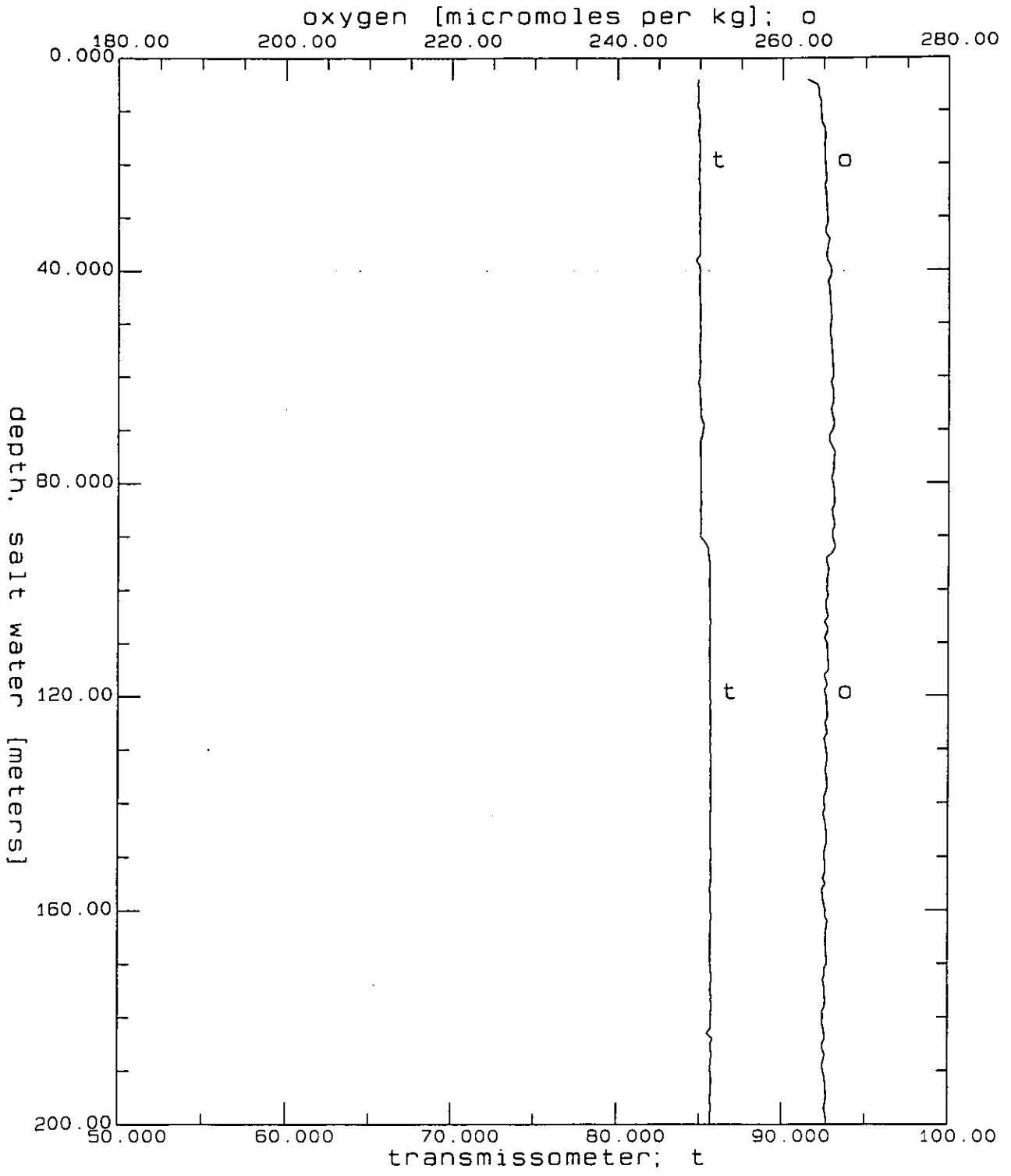
OMX9502A.CNV: OMEX 95/06 Station 2A 09.03.95 at 13h19

Figure 14b.



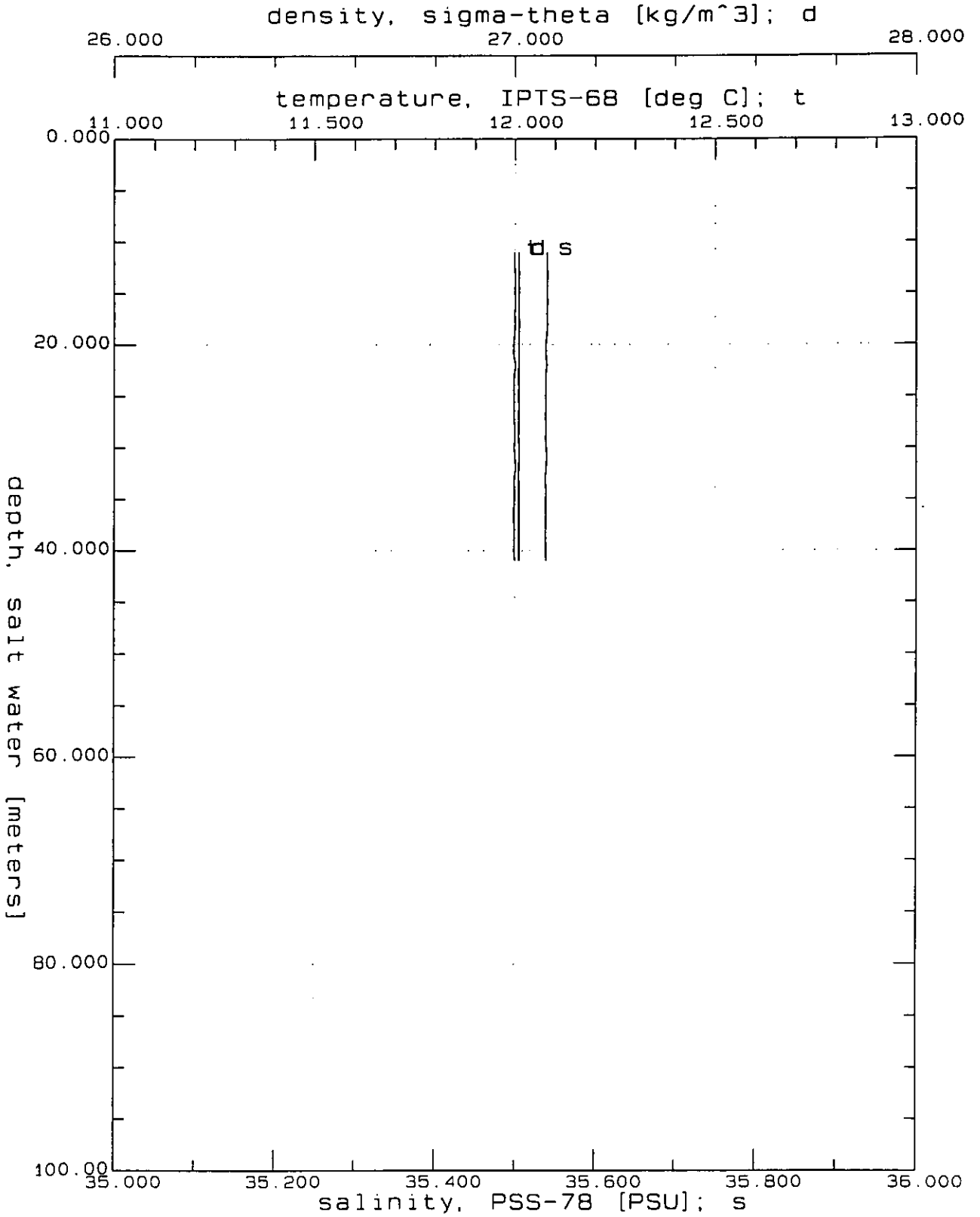
OMX9502B.CNV: OMEX 95/06 Station 2B 09.03.95 at 16h12

Figure 15a.



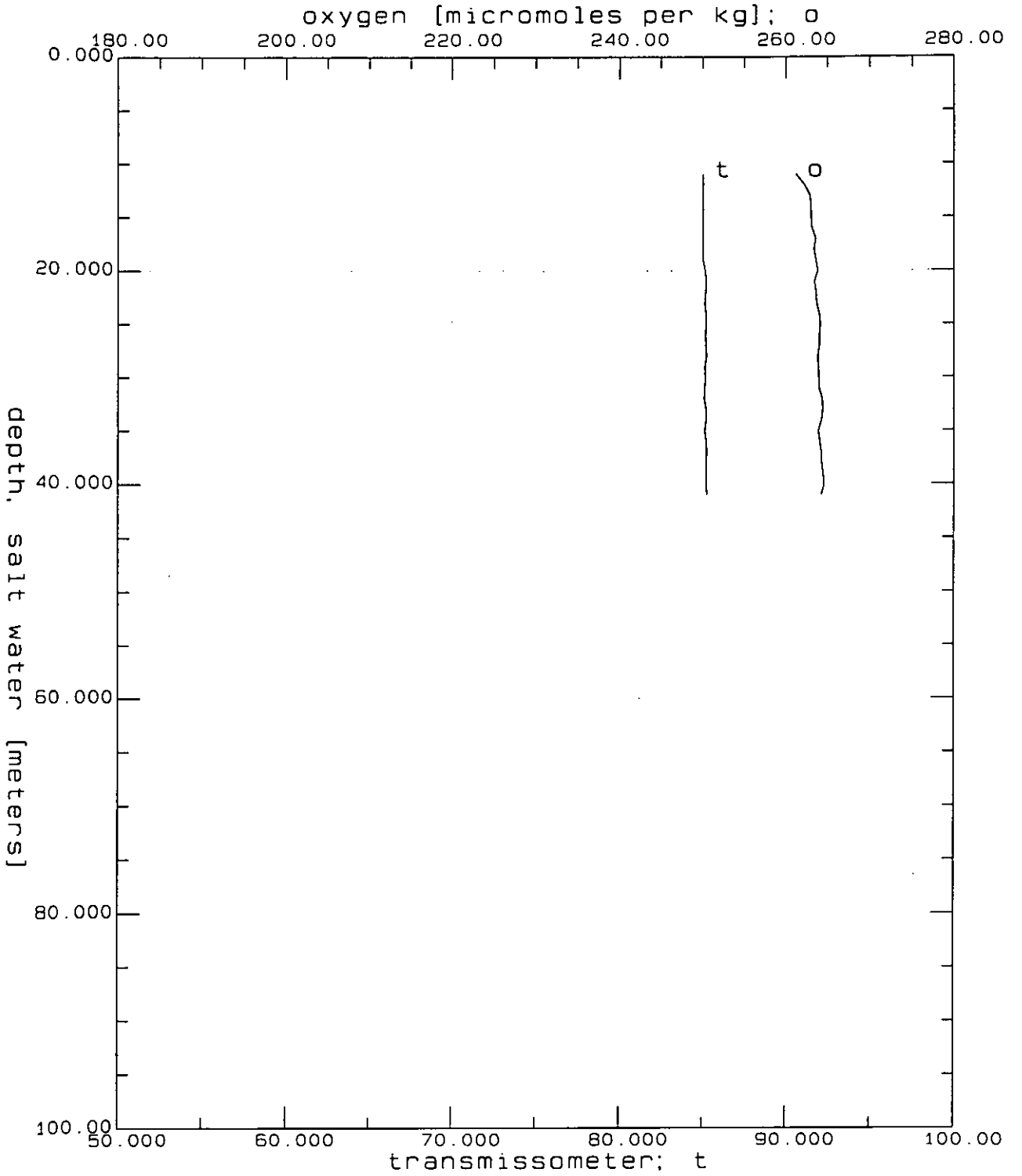
OMX9502B.CNV: OMEX 95/06 Station 2B 09.03.95 at 16h12

Figure 15b.



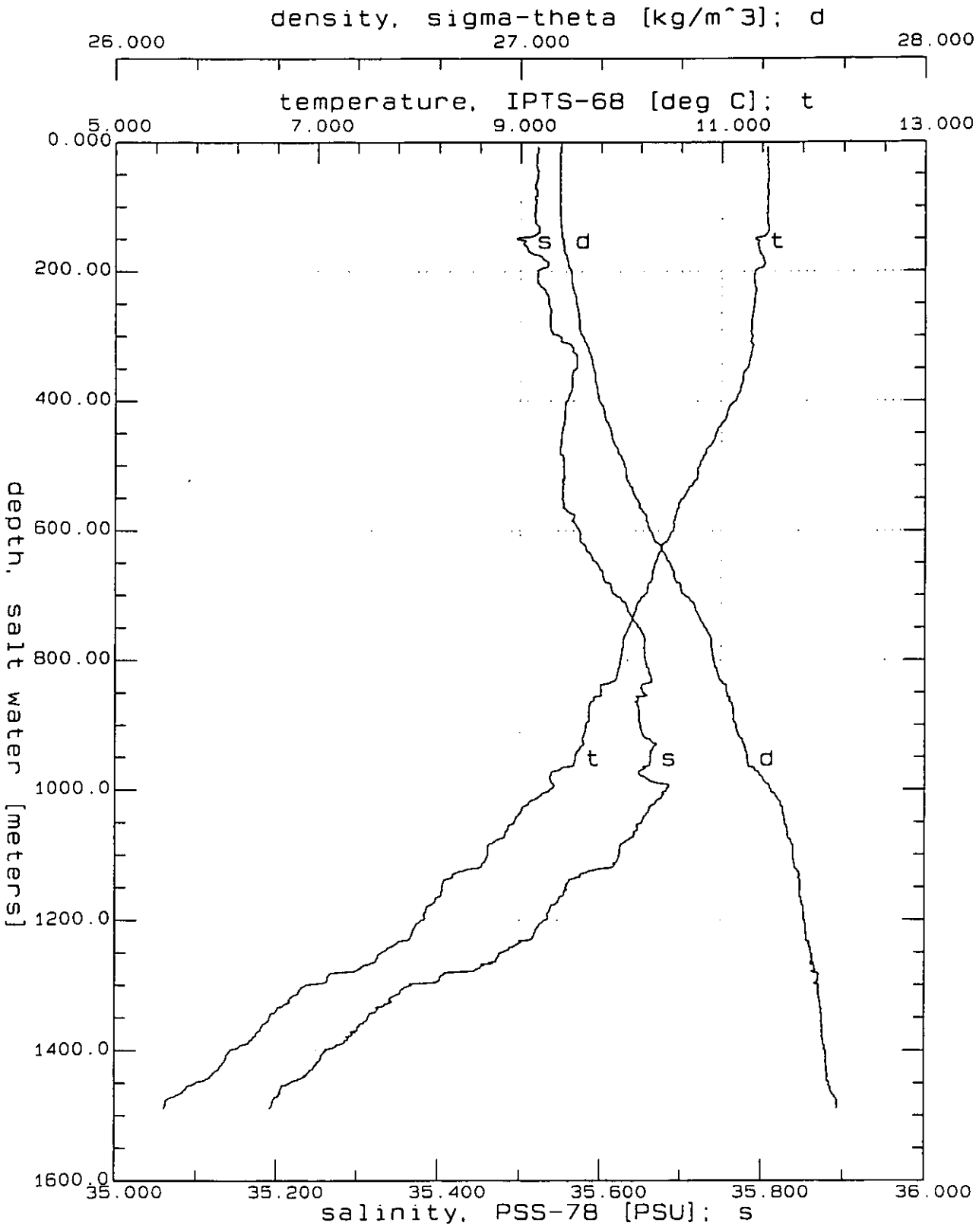
OMX9502C.CNV: OMEX 95/06 Station 2C 09.03.95 at 17h08

Figure 16a.



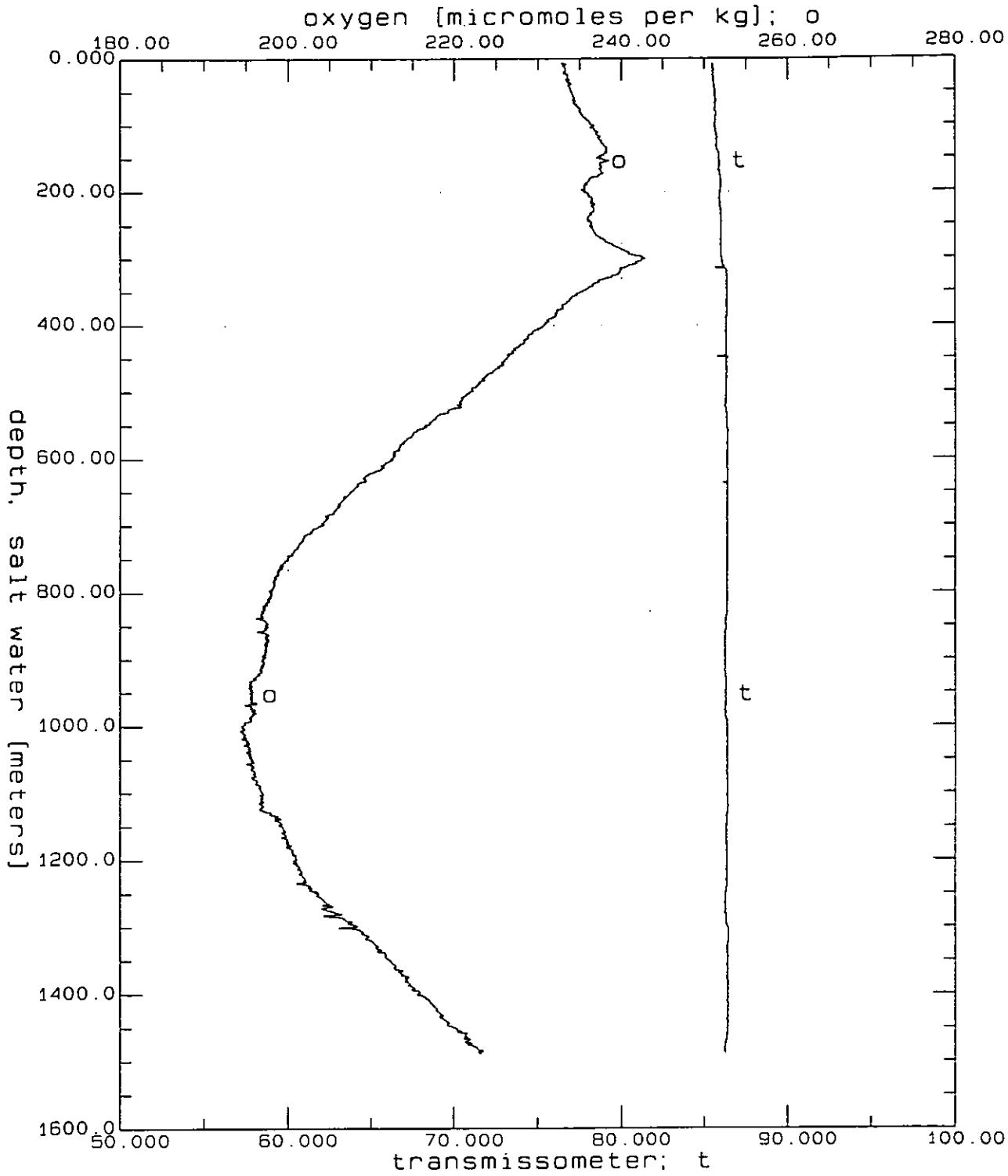
OMX9502C.CNV: OMEX 95/06 Station 2C 09.03.95 at 17h08

Figure 16b.



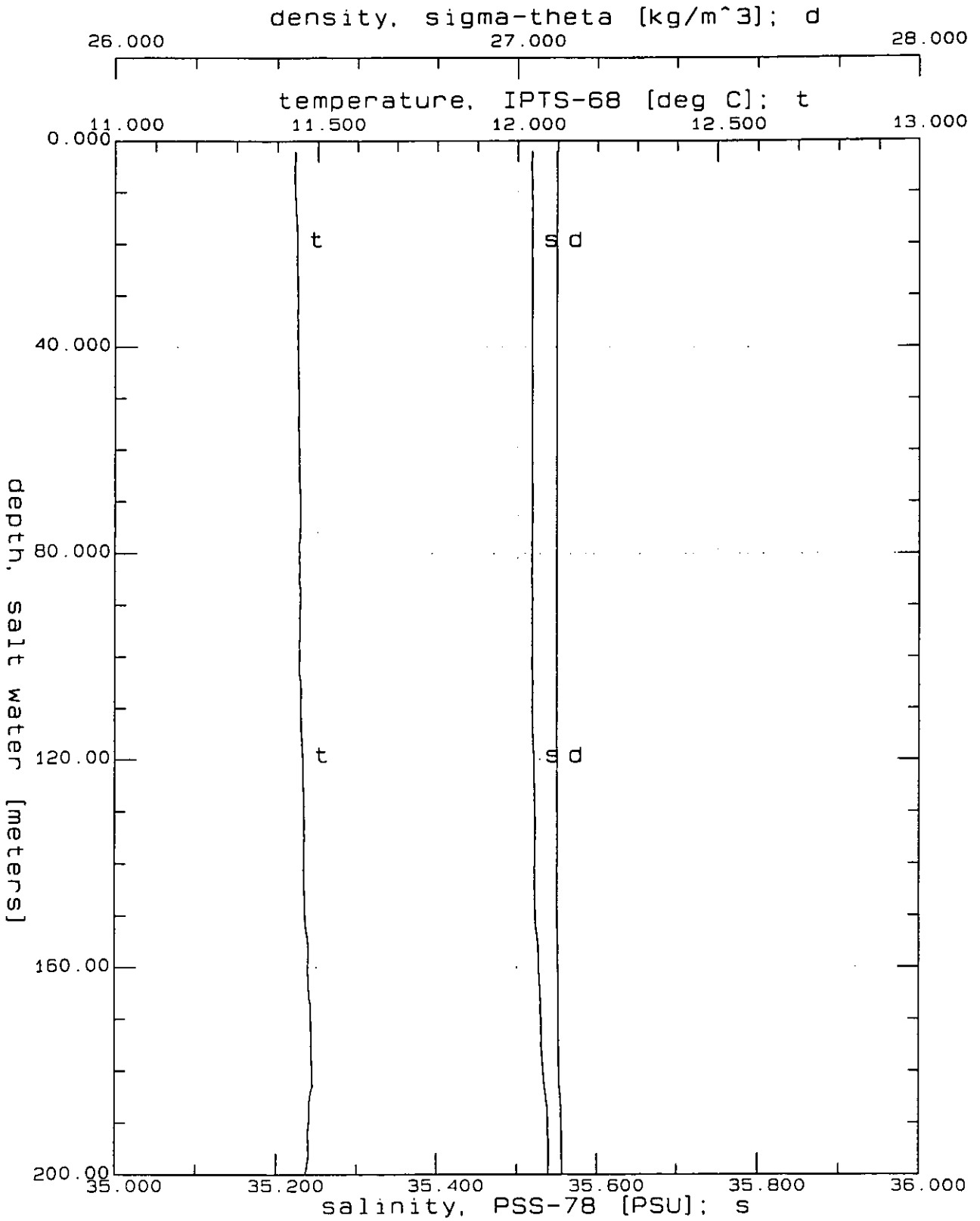
OMX9503A.CNV: OMEX 95/06 Station 3A 14.03.95 at 04h39

Figure 17a.



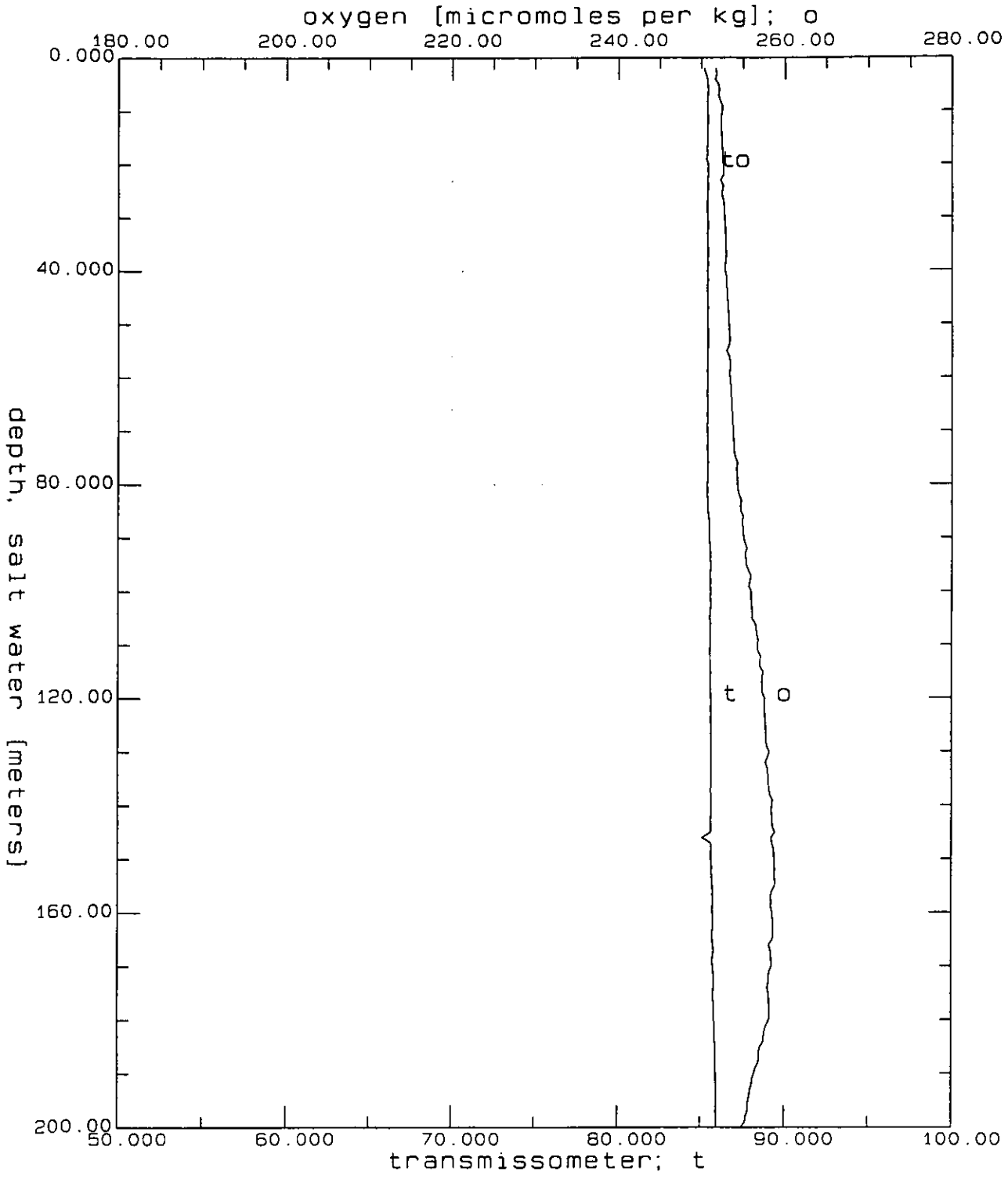
OMX9503A.CNV: OMEX 95/06 Station 3A 14.03.95 at 04h39.

Figure 17b.



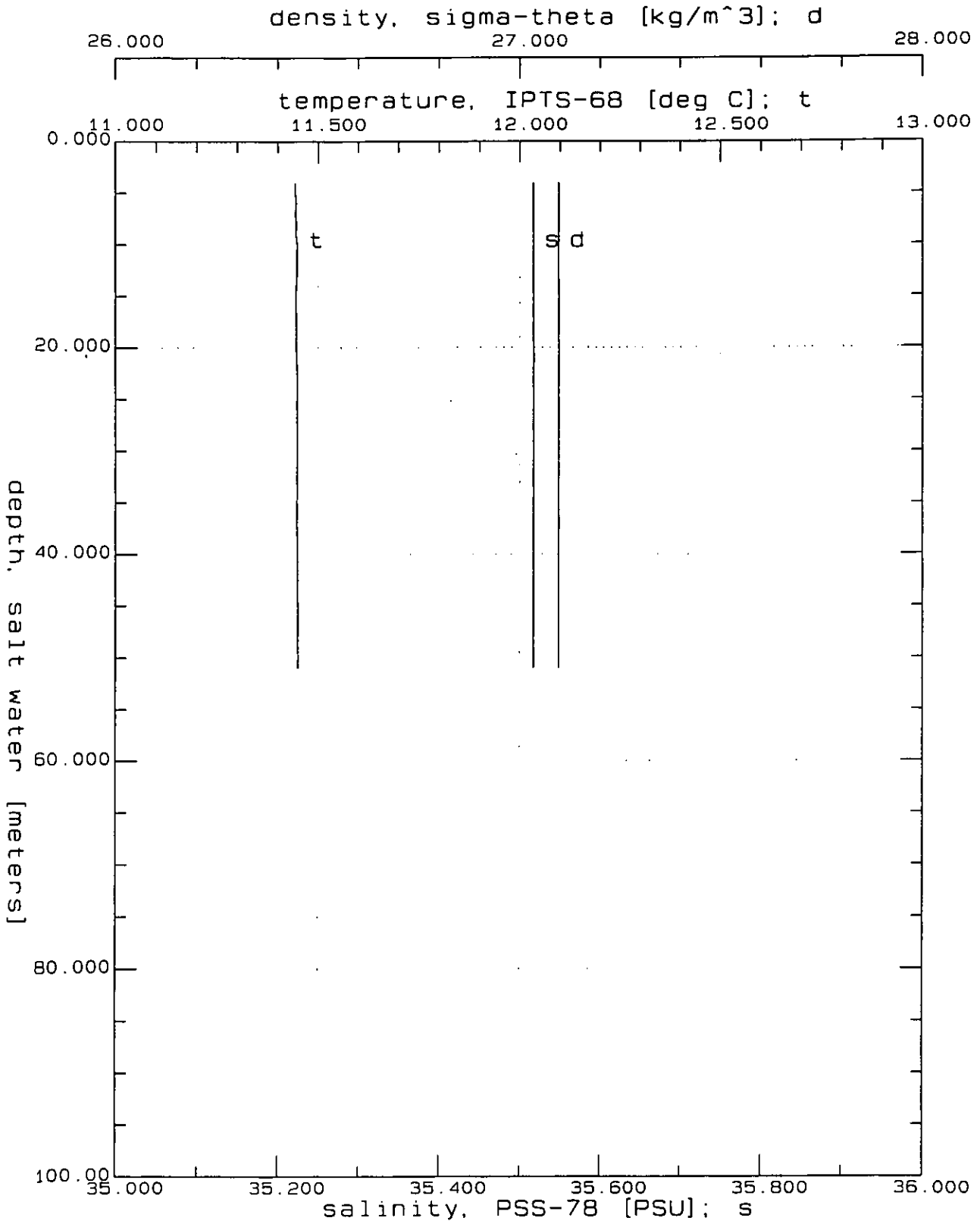
OMX9503B.CNV: OMEX 95/06 Station 3B 14.03.95 at 07h33

Figure 18a.



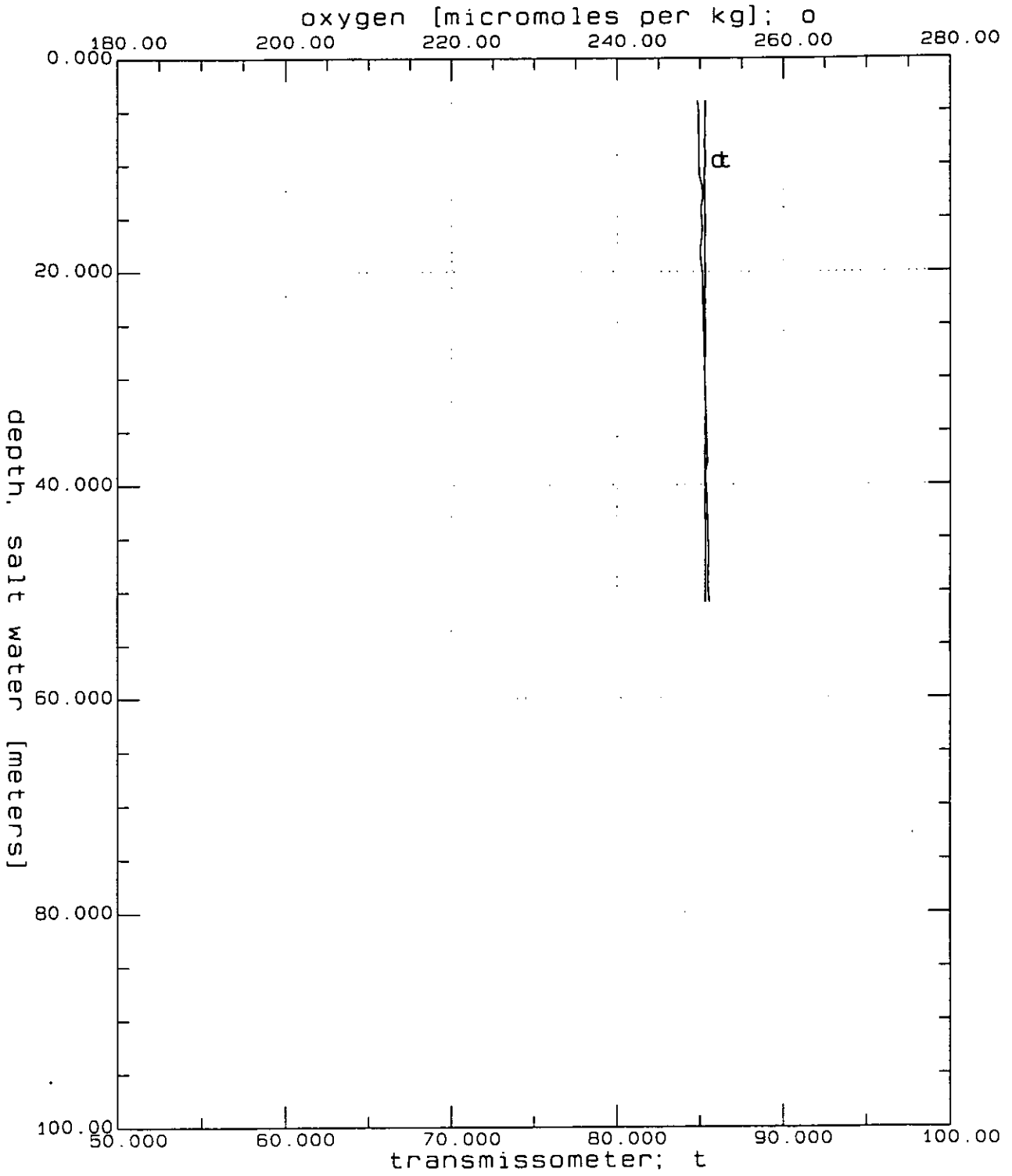
OMX9503B.CNV: OMEX 95/06 Station 3B 14.03.95 at 07h33

Figure 18b.



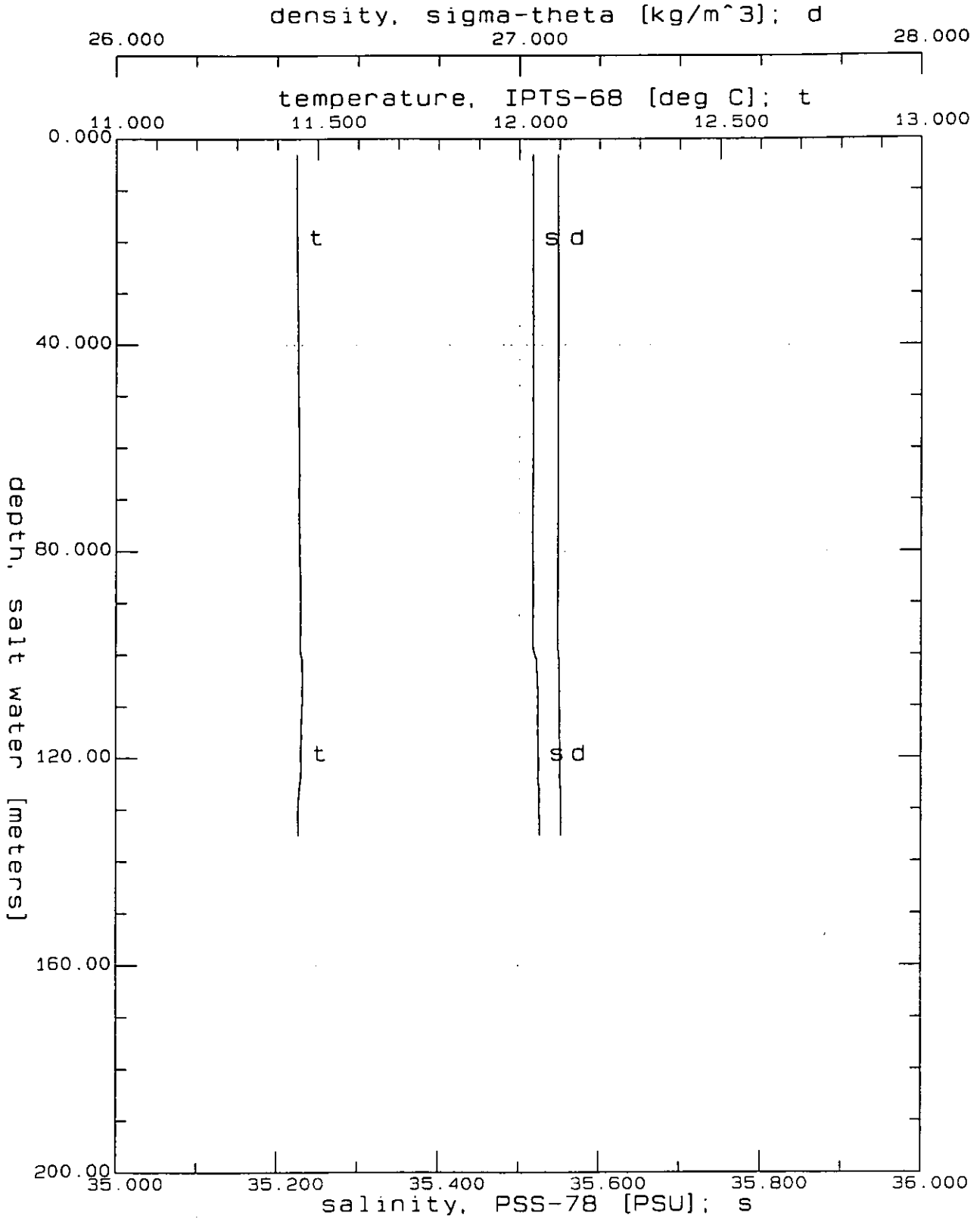
OMX9503C.CNV: OMEX 95/06 Station 3C 14.03.95 at 08h34

Figure 19a.



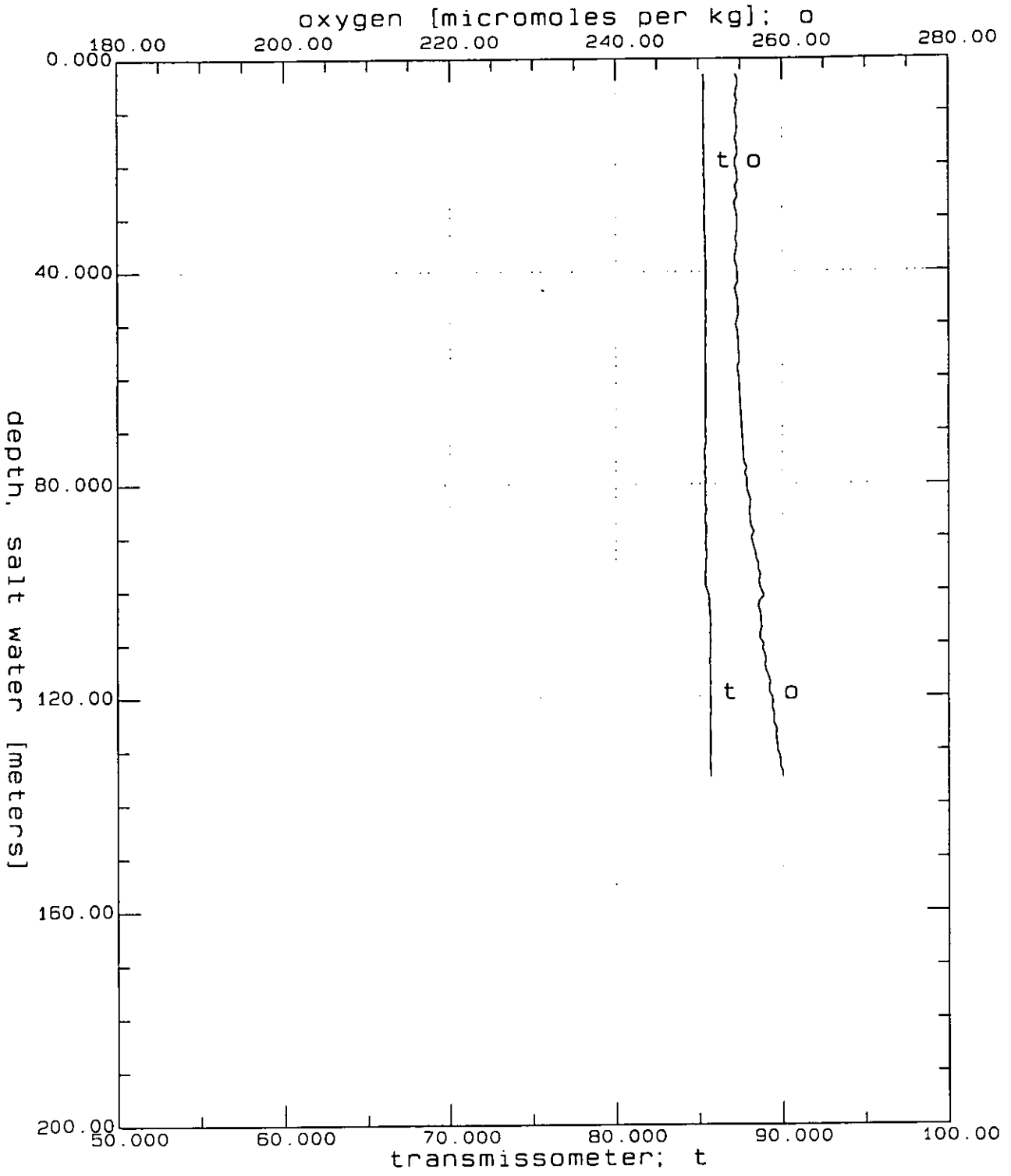
OMX9503C.CNV: OMEX 95/06 Station 3C 14.03.95 at 08h34

Figure 19b.



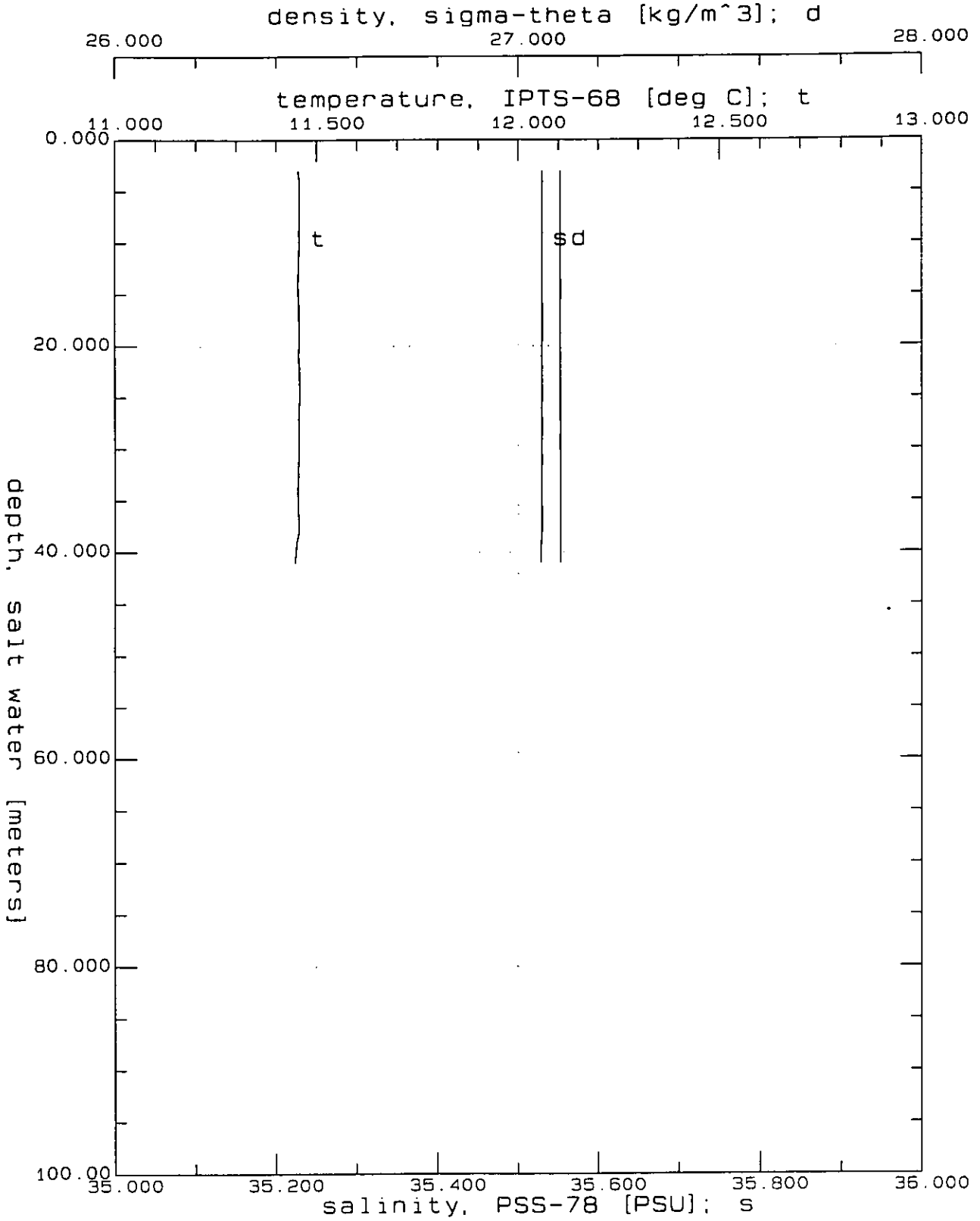
OMX9503D.CNV: OMEX 95/06 Station 3D 14.03.95 at 09h27

Figure 20a.



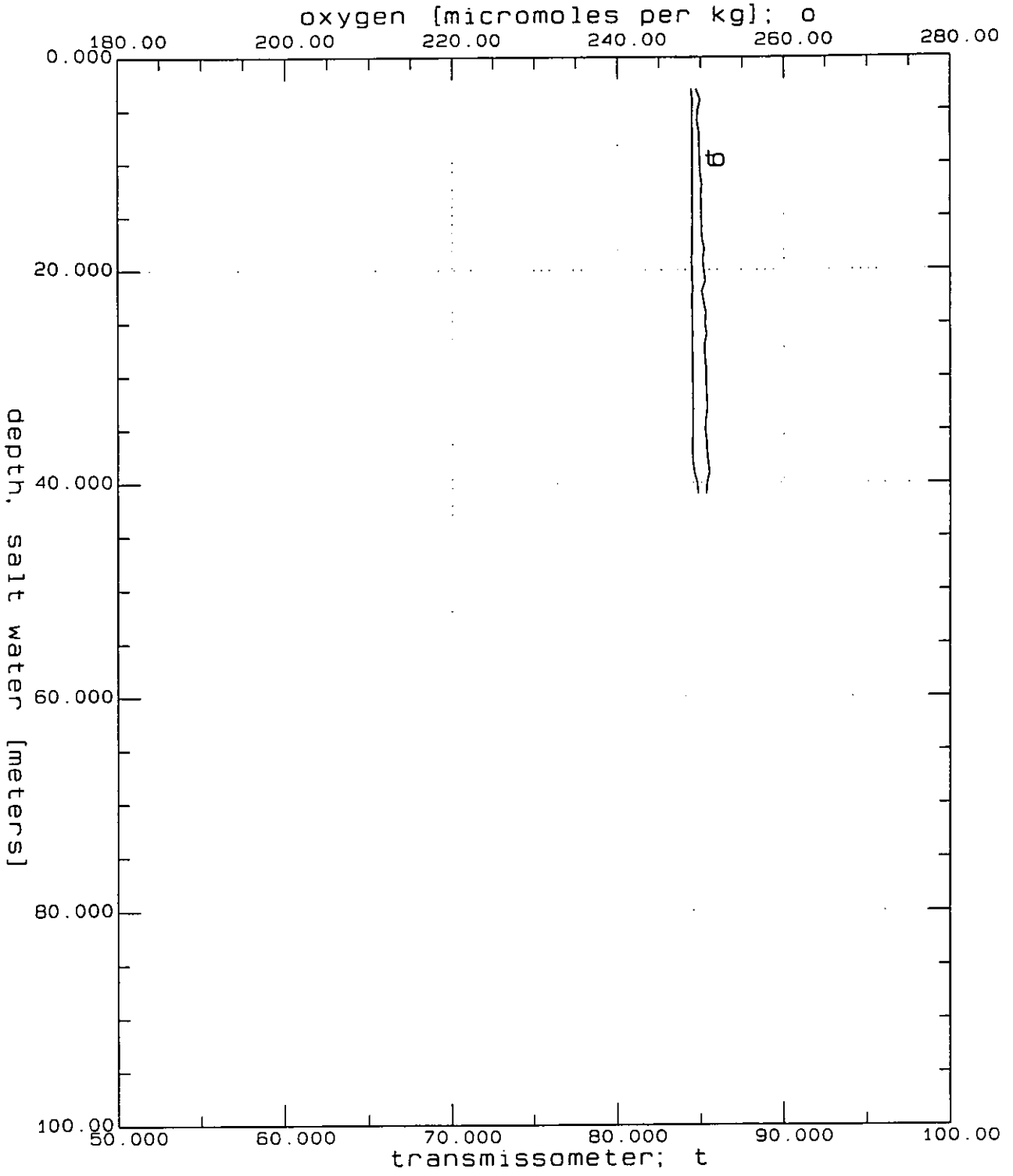
OMX9503D.CNV: OMEX 95/06 Station 3D 14.03.95 at 09h27

Figure 20b.



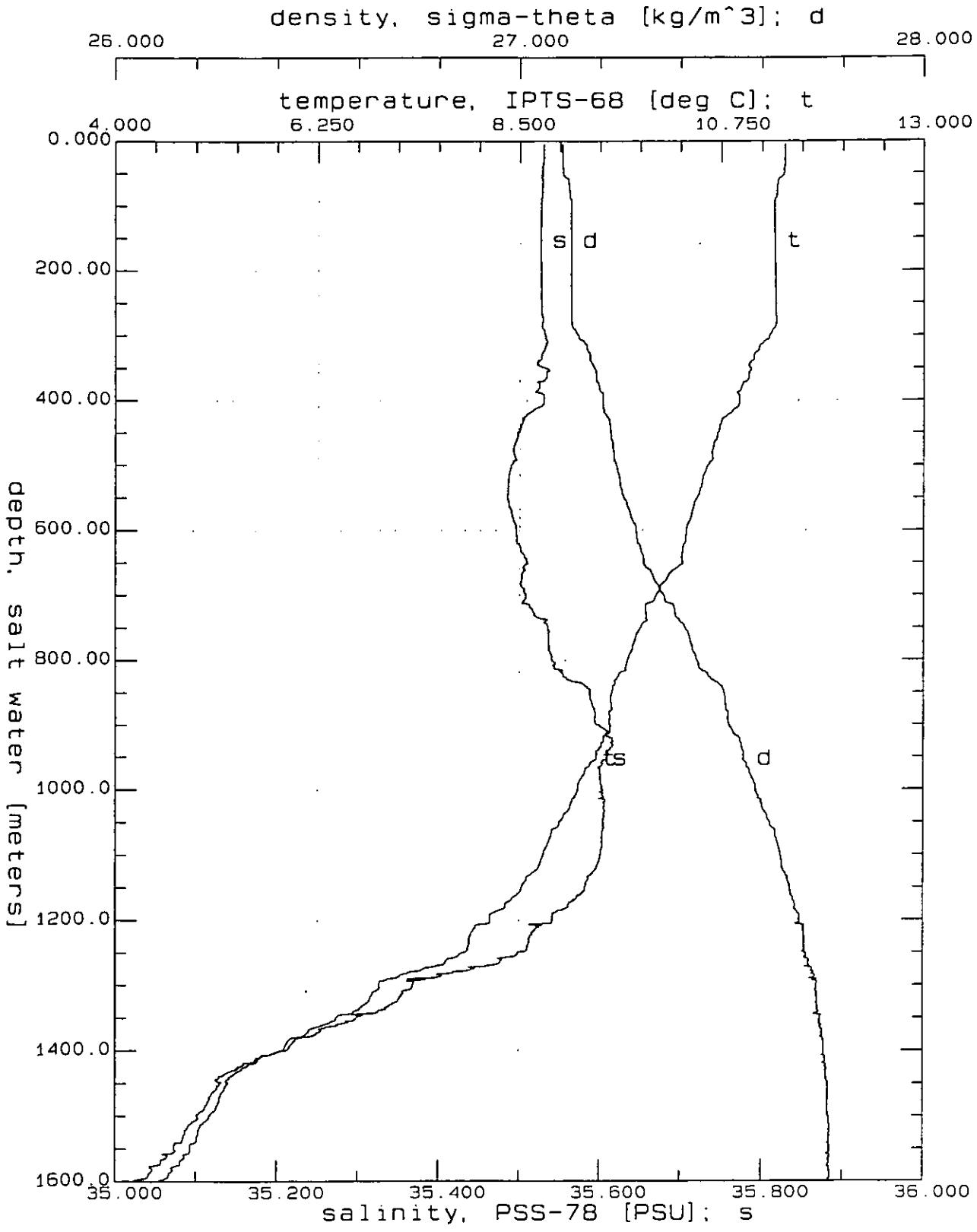
OMX9504A.CNV: OMEX 95/06 Station 4A 14.03.95 at 14h52

Figure 21a.



OMX9504A.CNV: OMEX 95/06 Station 4A 14.03.95 at 14h52.

Figure 21b.



OMX9504B.CNV: OMEX 95/06 Station 4B 14.03.95 at 15h36.

Figure 22a.

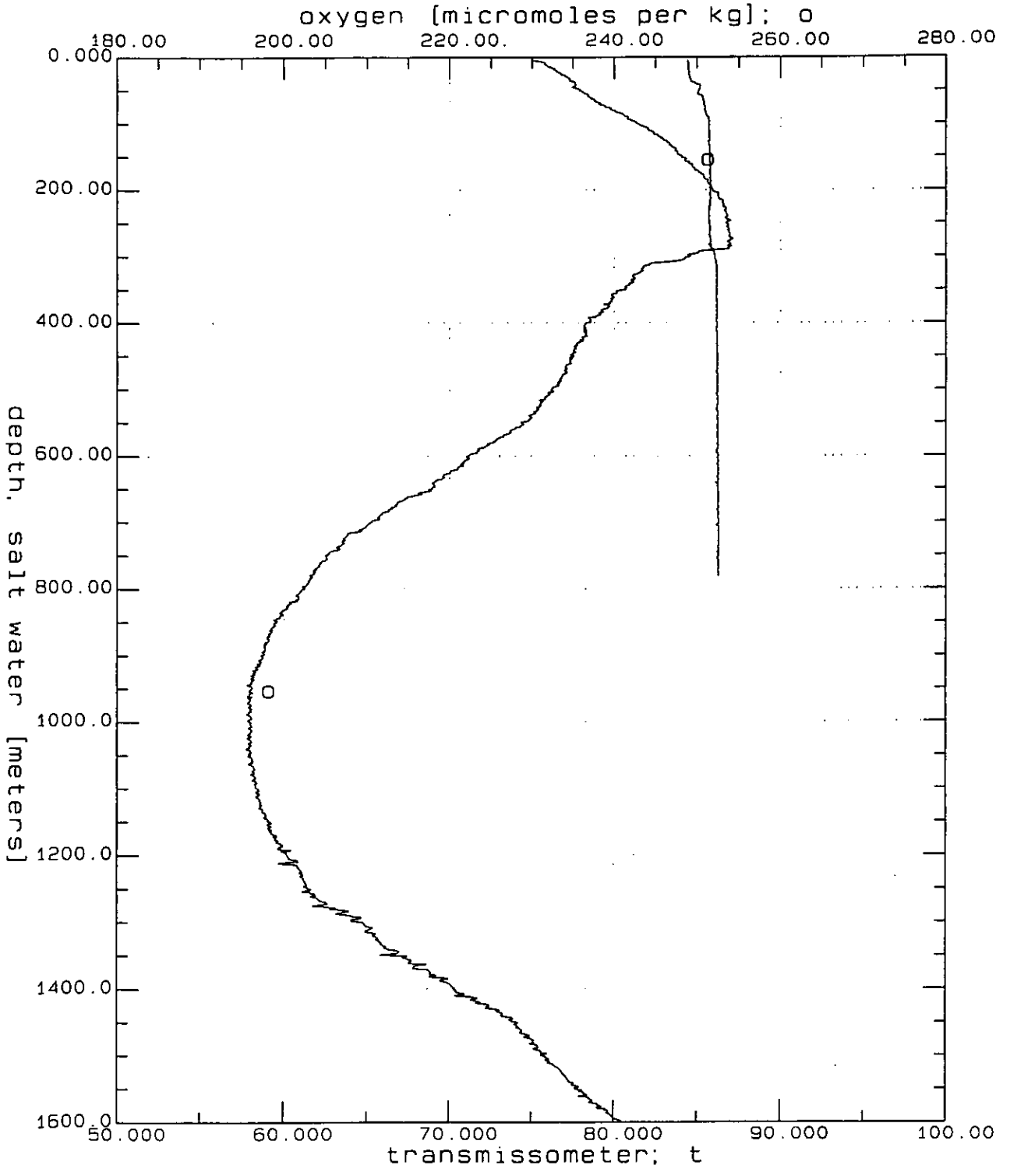
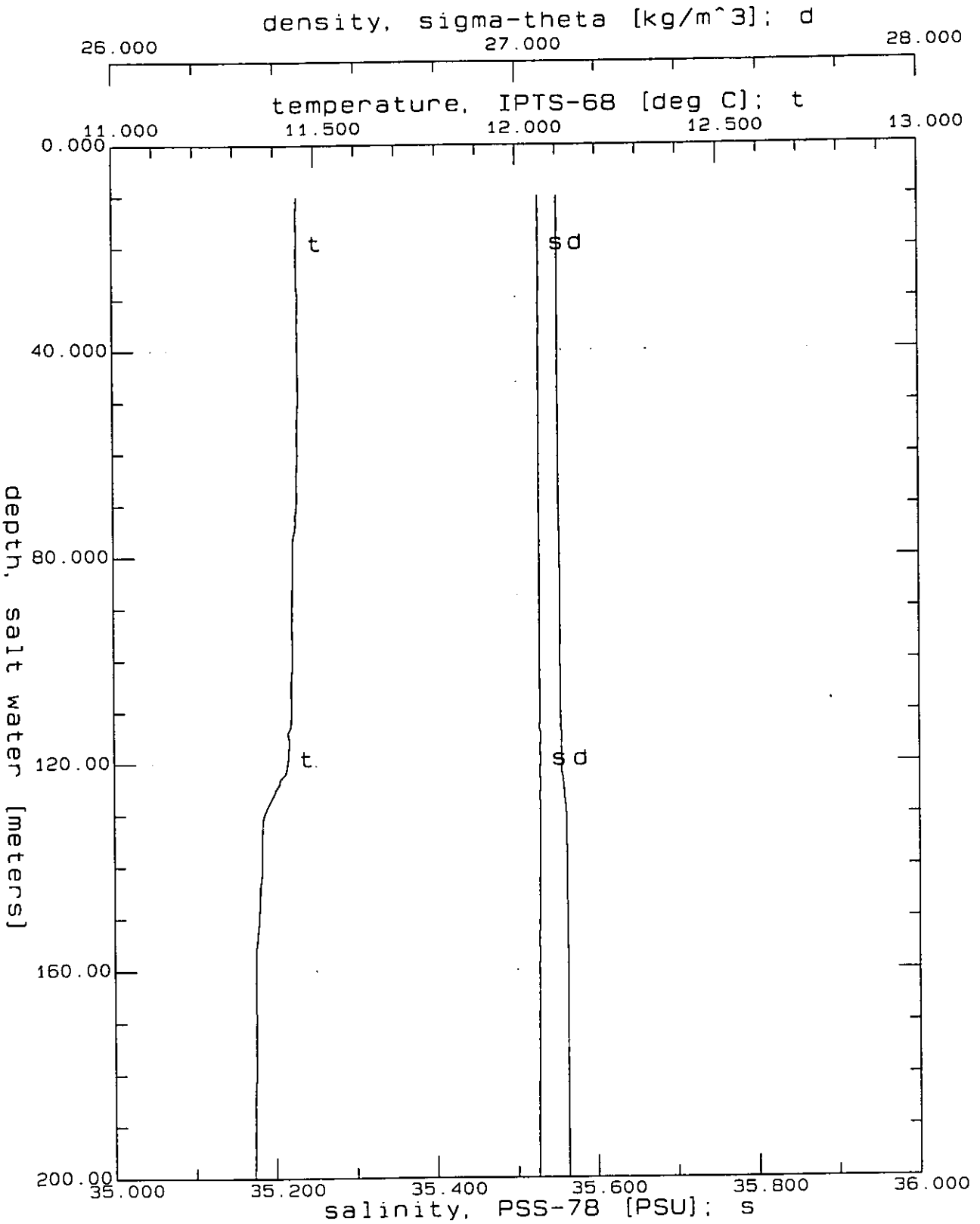
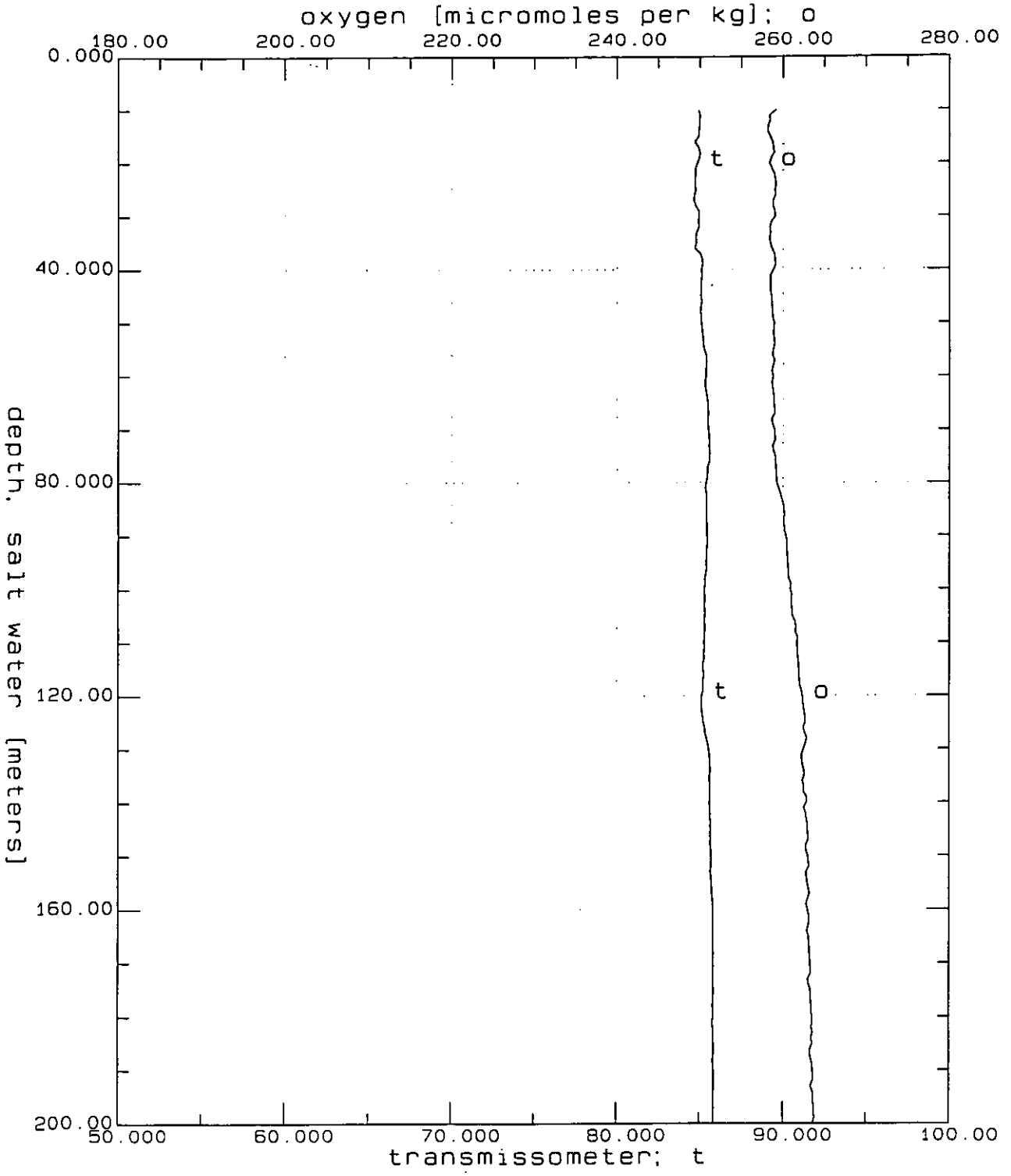

oxygen [micromoles per kg]; o
180.00
200.00
220.00
240.00
260.00
280.00
0.000
200.00
400.00
600.00
800.00
1000.0
1200.0
1400.0
1600.0
depth, salt water [meters]
50.000
60.000
70.000
80.000
90.000
100.00
transmissometer; t
OMX9504B.CNV: OMEX 95/06 Station 4B 14.03.95 at 15h36

Figure 22b.



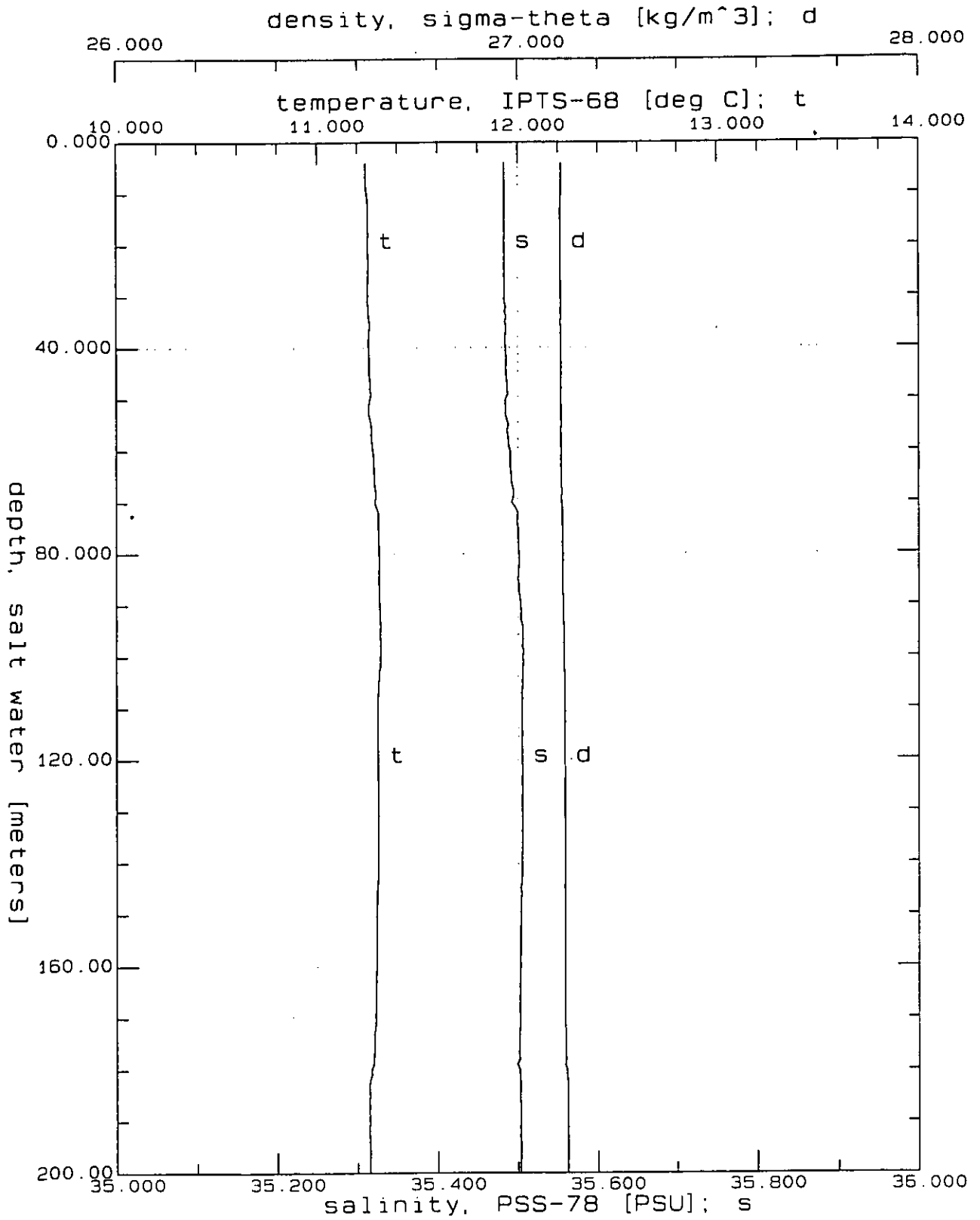
OMX9504C.CNV: OMEX 95/06 Station 4C 14.03.95 at 18h18

Figure 23a.



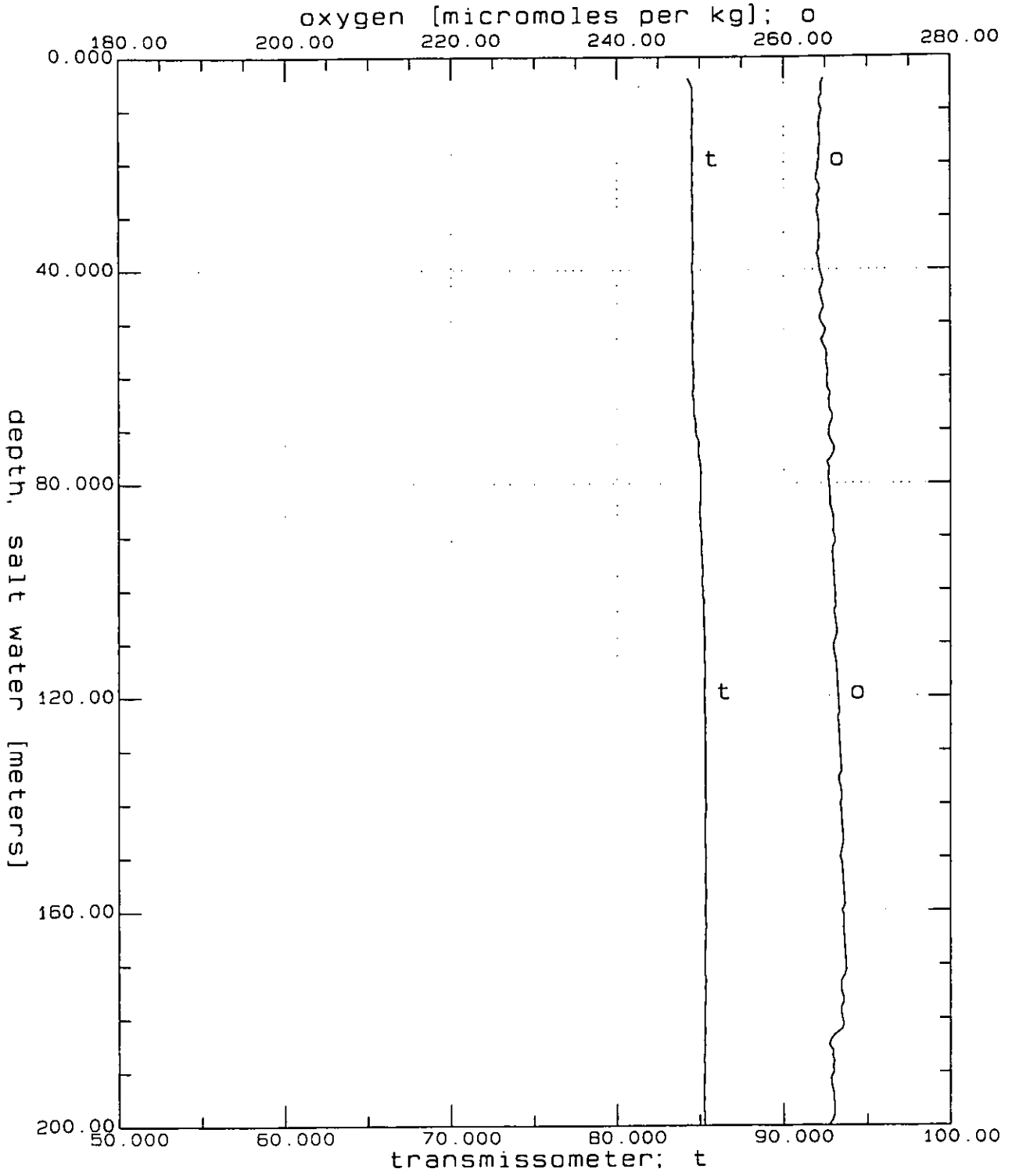
OMX9504C.CNV: OMEX 95/06 Station 4C 14.03.95 at 18h18.

Figure 23b.



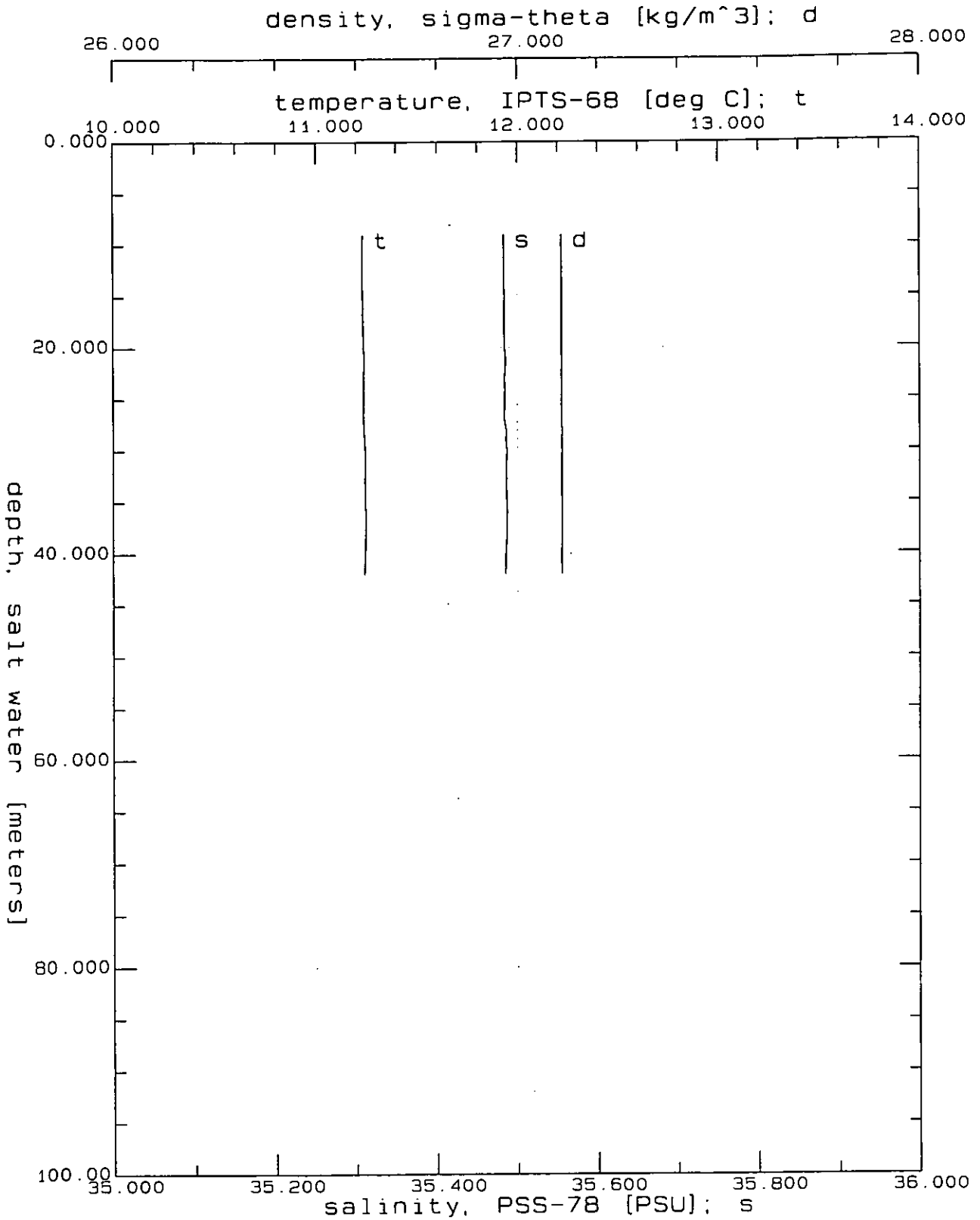
OMX9505A.CNV: OMEX 95/06 Station 5A 09.03.95 at 23h09

Figure 24a.



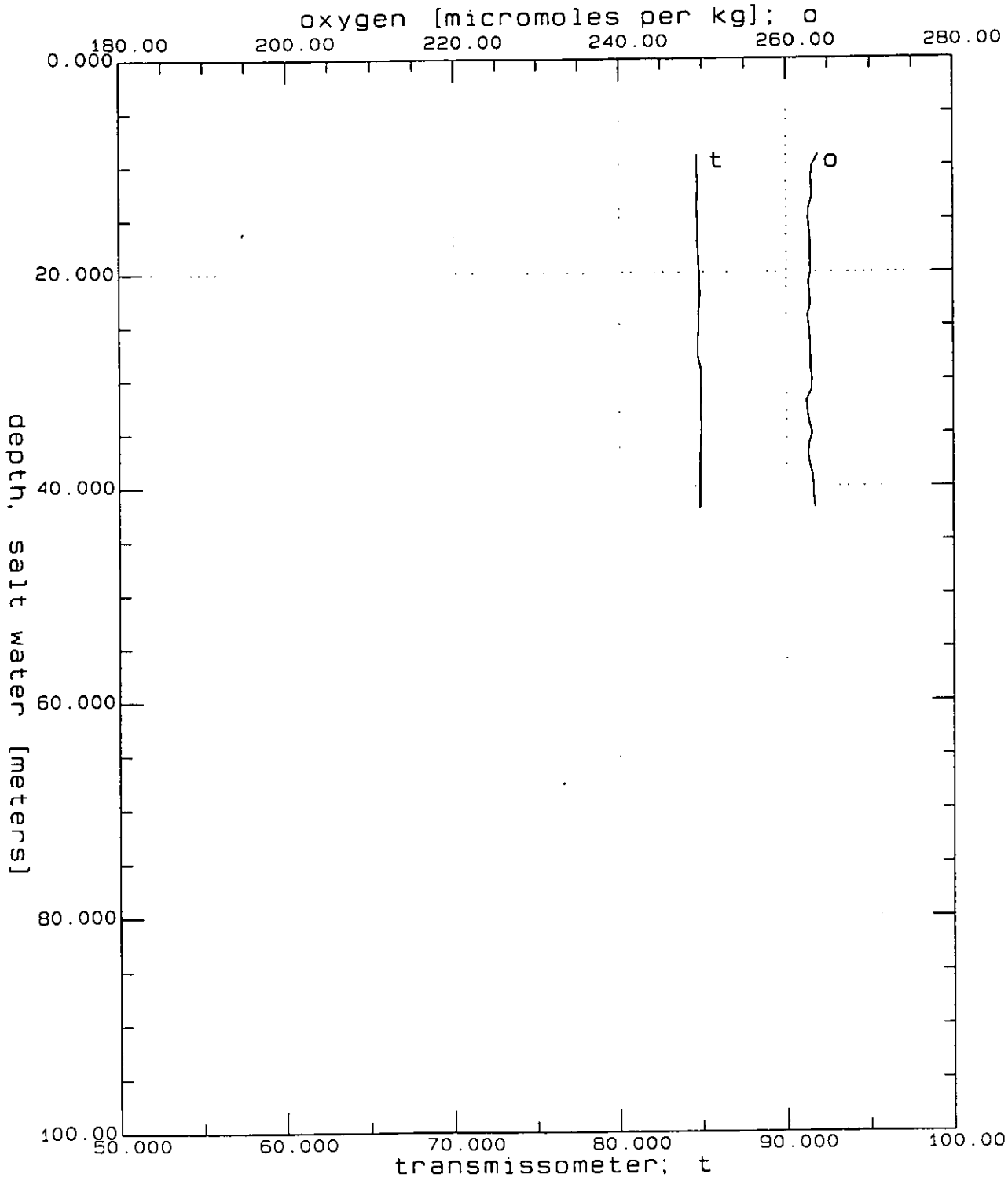
OMX9505A.CNV: OMEX 95/06 Station 5A 14.03.95 at 23h09.

Figure 24b.



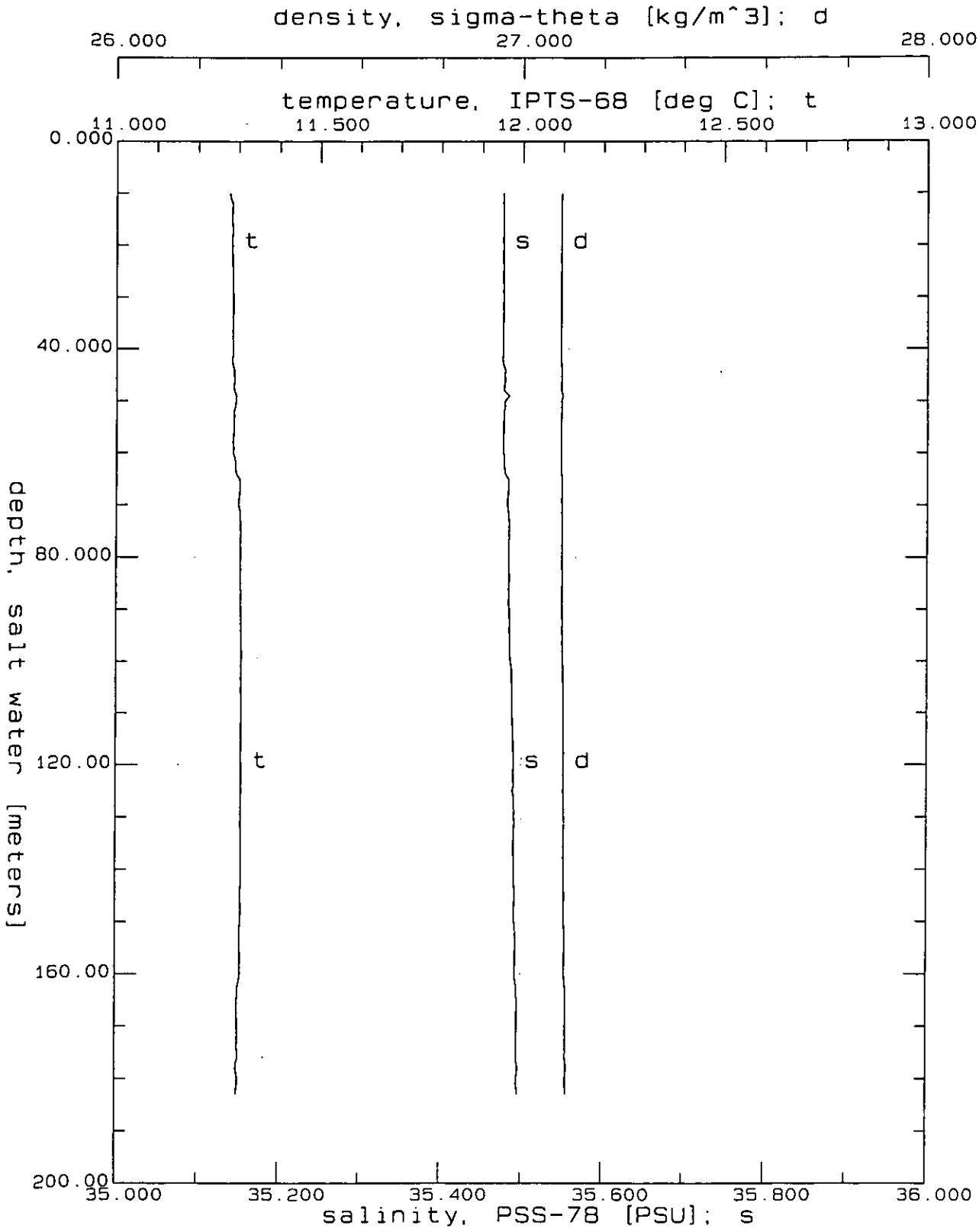
OMX9505B.CNV: OMEX 95/06 Station 5B 15.03.95 at 00h09

Figure 25a.



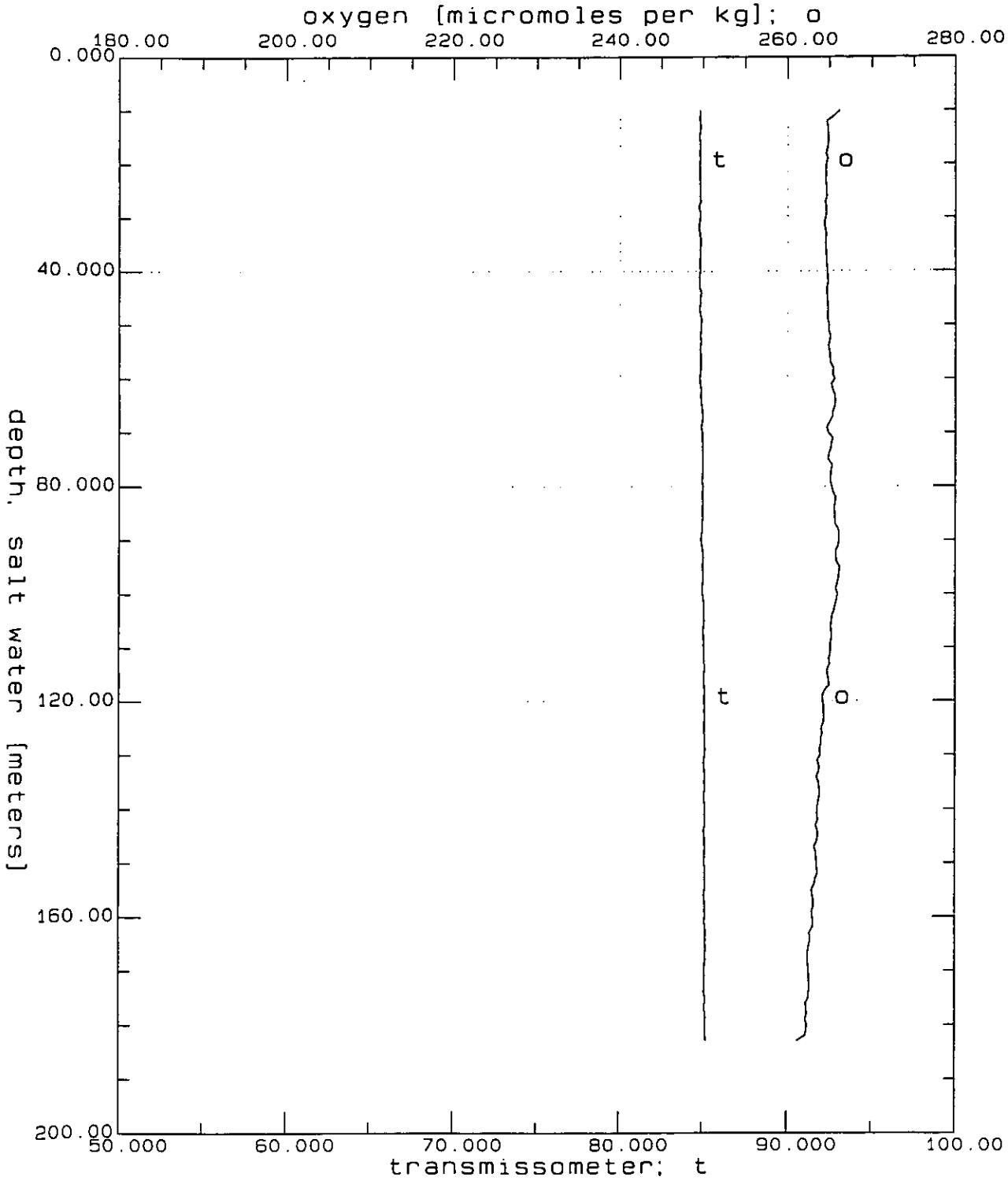
OMX9505B.CNV: OMEX 95/06 Station 5B 15.03.95 at 00h09

Figure 25b.



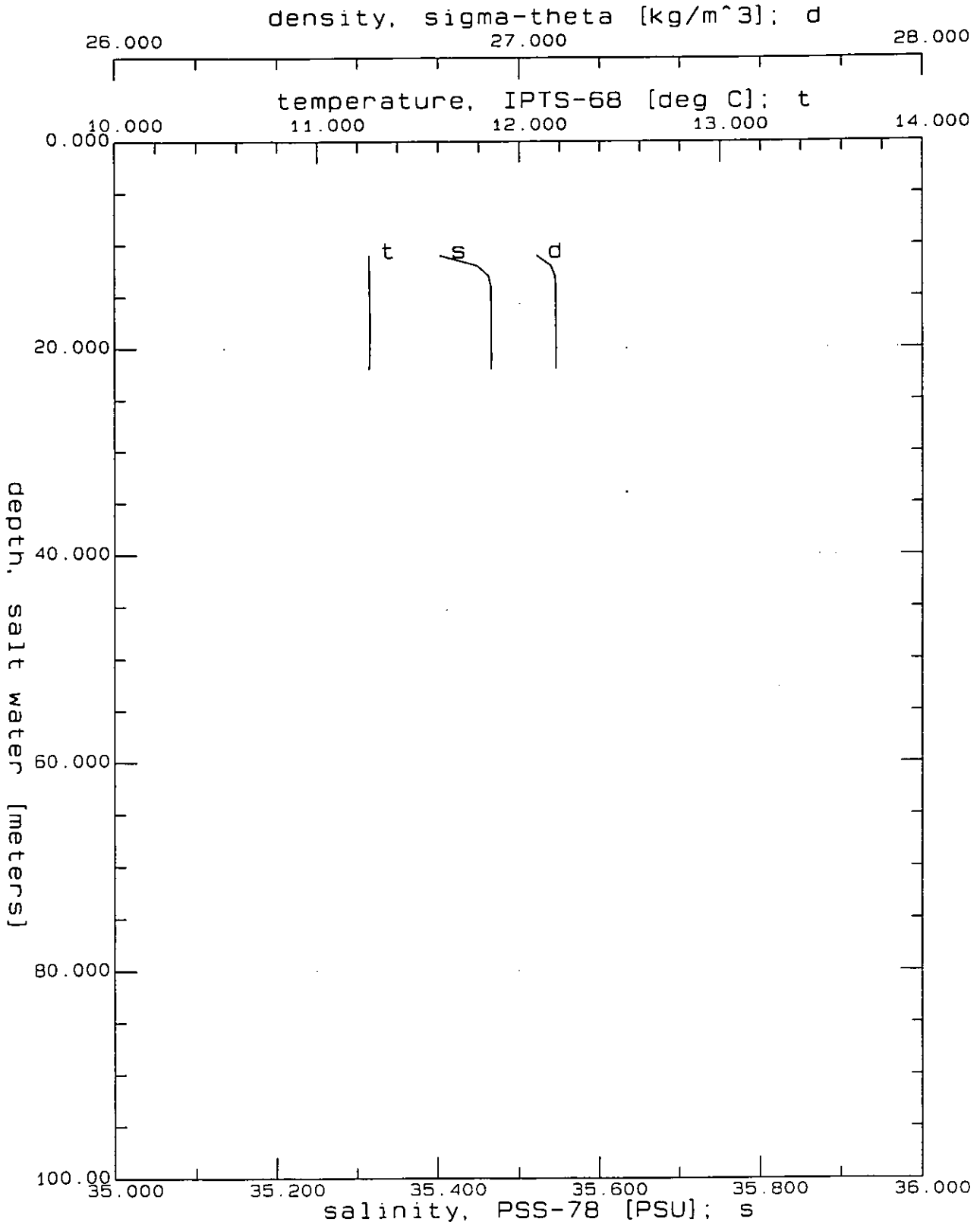
OMX9506A.CNV: OMEX 95/06 Station 6A 15.03.95 at 08h01

Figure 26a.



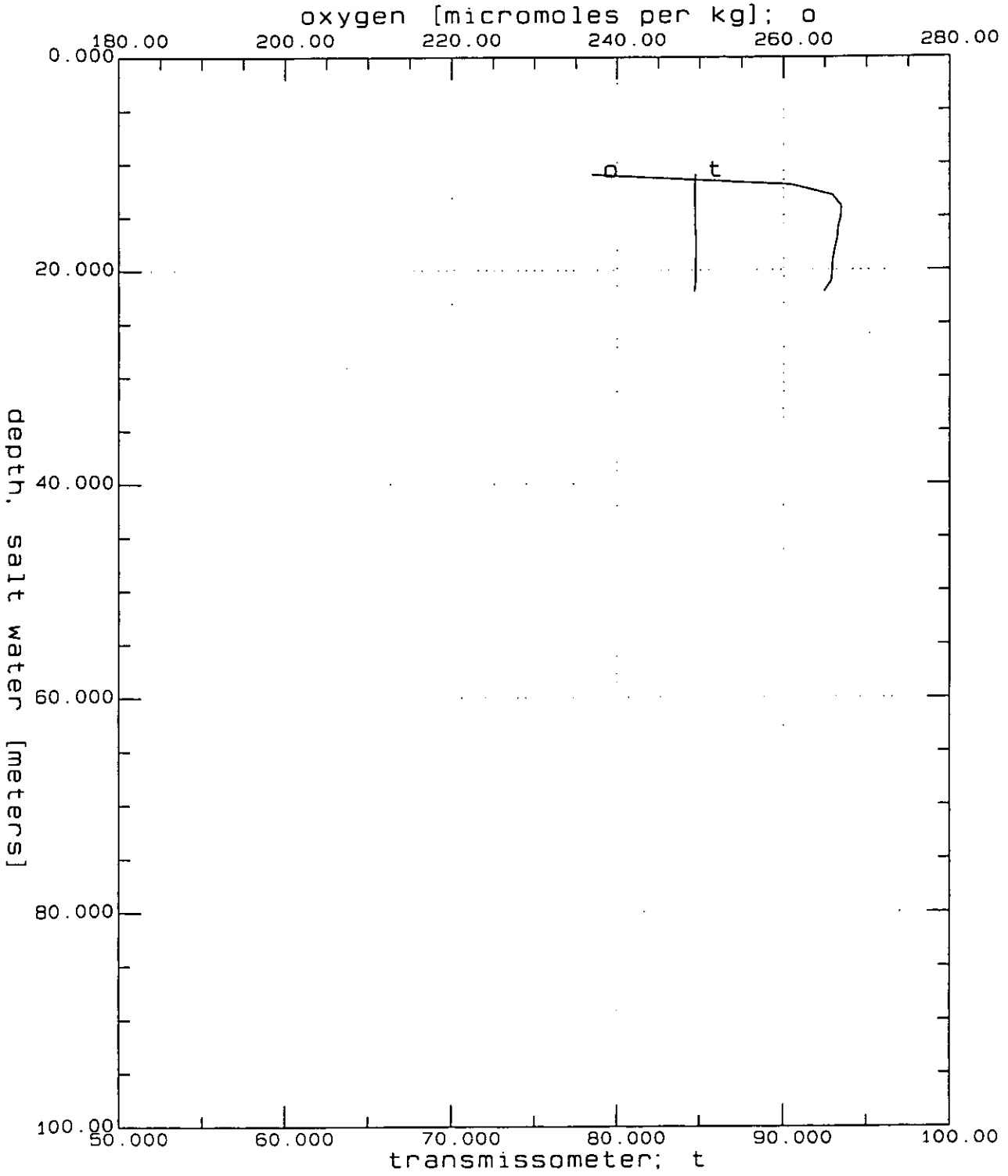
OMX9506A.CNV: OMEX 95/06 Station 6A 15.03.95 at 08h01

Figure 26b.



OMX95068.CNV: OMEX 95/06 Station 68 15.03.95 at 09h29.

Figure 27a.



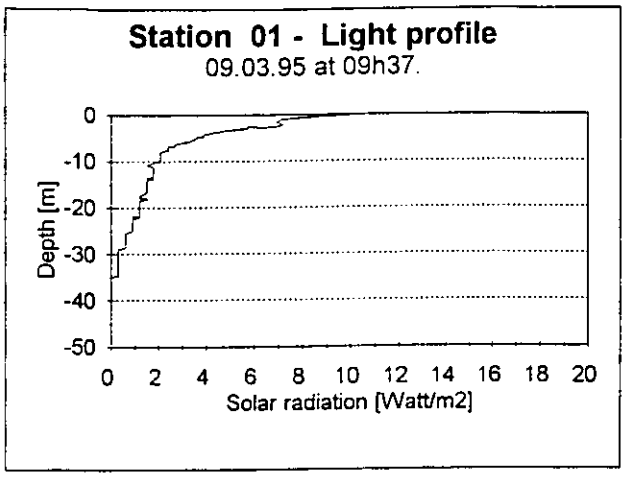
OMX9506B.CNV: OMEX 95/06 Station 6B 15.03.95 at 09h29.

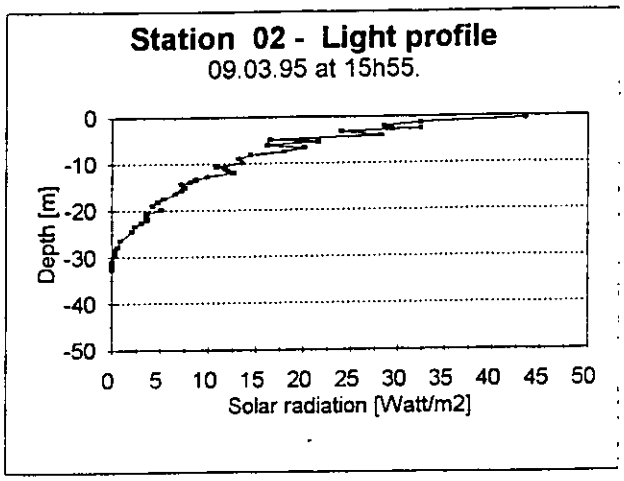
Figure 27b.

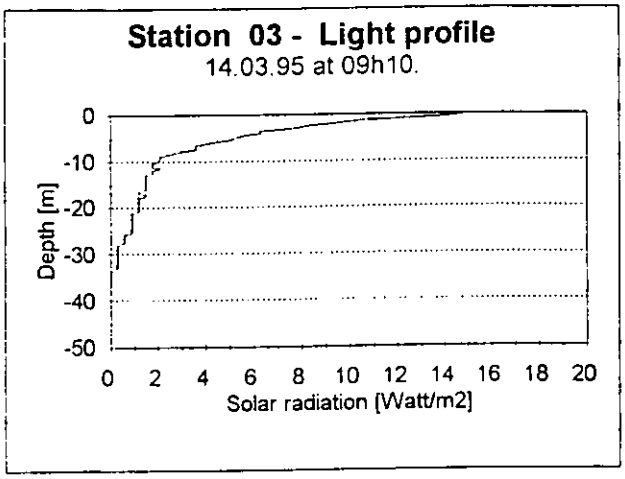
Appendix 6.

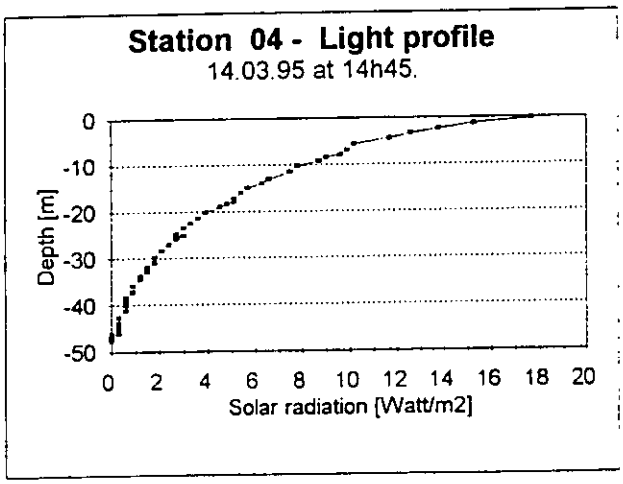
Vertical profiles of incident light (quantameter).

R/V Belgica Cruise 95/06 OMEX - Light profiles.









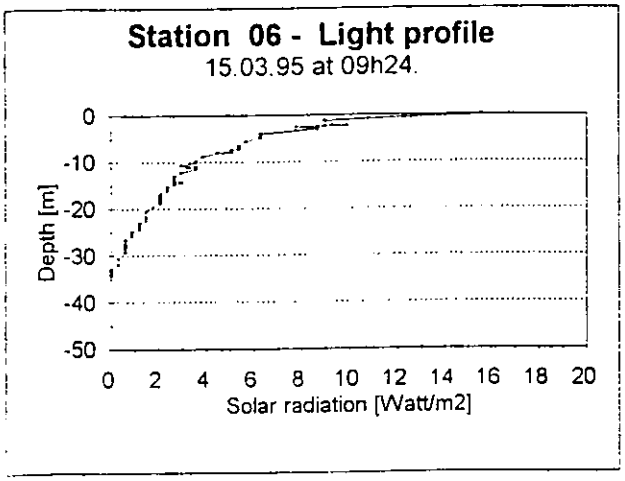


Figure 28 -32.