FILE

Institute of Oceanographic Sciences
Deacon Laboratory

INTERNAL DOCUMENT No. 321

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INTRODUCTION

RRS Discovery Cruise 198 (Fig. 1) was a joint cruise with the James Clark Ross, part of the BOFS Community Research Project, to survey the development of the spring bloom in the vicinity of the ice edge in the Bellingshausen Sea. A few CTD stations were worked on passage. In particular, a line of full-depth CTDs along 88°W was occupied on the final passage leg. This report describes the CTD data collected on that cruise.

The CTD system used was that belonging to RVS, comprising a Neil Brown Mark IIIb CTD (serial number 01-1195), new oxygen sensor (serial number 2-6-20), upward and downward looking PAR sensors, Chelsea Instruments aquatracka Mark II fluorimeter (serial number SA226) and a SeaTech 25D transmissometer (serial number 79D). Samples were drawn from a General Oceanics 1015, 12 bottle, 10 l rosette sampler (serial number RVS-02).

CTD casts (Table 1) can be divided into three kinds:

- shallow (150 - 300 m) casts to determine near-surface productivity and light levels for productivity casts using 30 l GoFlos that immediately followed;
- intermediate depth casts to 1000 m to determine the upper ocean water masses, often used also for light and productivity information;
- full depth casts to determine water masses and geostrophic transport through the whole water column.

After an initial trial cast (with the Discovery station number appropriately 12198) shortly after sailing from Port Stanley, the next five casts (12200-04) were shallow productivity casts usually in the morning. One of these (12203) was occupied during a rendezvous with the James Clark Ross, who made a CTD cast simultaneously. Duplicate salinity samples were drawn and exchanged between ships for calibration and intercalibration. Five casts to 1000 m (12205-09) were then made along 65°S at 20 n.m. intervals.

On reaching the working longitude of 85°W, the weather was too poor to launch SeaSoar, so the CTD section was continued down 85°W for two more casts (12210-11) at 20 n.m. intervals. The SeaSoar was then deployed for a 4-day survey, following which 12 more CTD stations (12212-23) were occupied along 85°W (Fig. 1b). These casts were designed to span the west to east front which had been repeatedly crossed during the SeaSoar survey. The casts were to 1000 m at 5 n.m. intervals, to resolve deeper structure than the 400 m SeaSoar could observe. The northern- and southern-most casts (12212 and 12223) were to full-depth to allow the geostrophic transport to be calculated.

Several problems were encountered on the first deep cast (12212), which was only to be expected on the first operational use of the new Discovery winch to full depth. A slack turn on the cable drum at the start of the haul caused cable lay problems which were not spotted until 2500 m of wire had been hauled in. Several hours were lost while the cable was paid out and the drum relaid. This teething problem was resolved thereafter by careful setting of the back-tension on the inboard accumulator. On analysis of the samples drawn from the 12 multisampler 10 l bottles, it was realised that all had been tripped at the same depth. Indeed, the multisampler could not be cocked at the start of 12213, so the cast was done without samples to obtain light levels so that productivity work could proceed, and the station was reworked with multisampler later as 12214. Similarly, the top 1000 m of the first deep cast (12212) were reworked as station 12218 once the multisampler had been replaced. At the beginning of 12213 it was also found that the conductivity cell had frozen, and the cast was restarted once it had defrosted.

After CTD12223, the SeaSoar was deployed for the second ice-edge survey, which terminated prematurely with the loss of the SeaSoar. The survey continued using the Undulating Oceanographic Recorder from the James Clark Ross, and stations 12224-26 were occupied for productivity work during the survey.

Finally, stations 12227-37 were worked along 88°W from 69°S to 51°30'S. Deep stations were occupied every 2.5° of latitude, occasionally preceded by a shallow cast for productivity work.

PROCESSING

CTD data were logged in the usual way through the RVS Level A/B/C computer system, then transferred into the IOSDL PSTAR system on another workstation. Each cast was split into down and up casts, the former being fully processed, the latter used only to obtain calibration values.

In processing the SeaSoar data, it was realised that the Level A software, which had been rewritten, no longer obeyed the correct algorithm for matching the time constant of the temperature sensor to that of the conductivity sensor in order to calculate salinity without bias and with minimal spiking. This problem was present in the CTD Level A also, but to a lesser extent because of its slower profiling rate, particularly during the first 6 casts, all of which were shallow

Revised Level A software was received and tested in time for use in all the 1000m casts, starting with station 12205. Final calibrations were derived and applied as described below.

CALIBRATION

Initial calibration was done by PSTAR program 'ctdcal', for which the calibration file is shown in Table 2. Further calibrations were applied later, as described below.

Pressure

The calibration used was:

$$P = -7.1 + 0.1 * 0.9987653 * Praw.$$

The constant offset supplied by RVS was -5.13287, but this was changed to -7.1 after noting the value of pressure when the CTD entered the water.

Temperature

The calibration supplied by RVS was used throughout:

$$T = 0.0044057 + Traw * 0.0005 * 0.9999902$$

A pair of SIS 4002 deep sea reversing thermometers (serial numbers 220 and 238) mounted in a single frame were used to record temperature on 27 casts. After correction, T220 read higher than T238 by between 0 and 2 mK, giving a difference of (0.85 + 0.82 mK) (mean + standard deviation). Thus the thermometers agreed to better than 0.001°C in the mean. The comparable CTD temperature was between 0 and 8 mK higher than the mean of the two thermometers, giving a correction to the CTD temperatures (if the SIS thermometers are absolutely correct) of (- 4.48 + 1.74 mK). However, experience has shown that the SIS reversing thermometer calibrations are no more reliable than the CTD calibration, so the CTD temperatures have not been adjusted. We conclude that the CTD calibration was stable throughout the cruise, and that temperatures are absoutely correct to within 0.004 - 0.005°C, and are possibly high by that amount.

Salinity

CTD salinity was first calculated using the default conductivity ratio

$$conductivity = 0.001 * raw\ conductivity.$$

To match the differing time constant of the temperature and conductivity cells, the temperature response was speeded up by 0.5 s. During the first part of the cruise salinity samples were drawn from all 12 Niskin bottles, fired at various depths. The samples were analysed on a Guildline 8400A salinometer (serial number 52395) belonging to RVS by three analysts. Once it was established that the conductivity cell was stable the number of samples drawn was reduced, first to 6 and later to 4 samples per cast. The exceptions were the two full depth casts (12212 and 12223) made on either side of a front in the Bellingshausen Sea. The first of these had problems and the bottles were all tripped together at an unknown depth. Samples from the second cast gave greater confidence to the calibration.

The difference between discrete bottle samples and CTD values was found to vary with salinity (fig 2) so a linear correction was calculated. Where the difference between bottle and CTD values was less than 0.025 and greater than 0.045 the values were ignored. The calibration coefficients calculated were:

$$Strue = SCTD * 0.99347 + 0.257$$

with a standard deviation of + 0.002

Oxygen

Oxygen is calculated for the Beckmann oxygen sensor attached to the CTD by

$$O2 = rho * oxyc * exp (- alpha * temp + beta * press)$$

where

$$temp = a * TCTD + oxyt$$

with

$$a + b = 1$$

and 'oxyc' and 'oxyt' are the oxygen sensor corrent and temperature readings respectively and 'press' is the CTD pressure.

The CTD oxygen sensor was calibrated from 126 discrete bottle samples drawn from various depths over 13 different casts up to 12223. The data were combined to produce the coefficients rho=1.276292, alpha=-0.02666 and beta=0.0001494 with a standard deviation of 0.12 ml l-1 . The residuals from this least squares regression varied from cast to cast, averaging from -0.14 to +0.15, and over depth, with the greatest residuals in the thermocline. Oxygen temperature was weighted to CTD temperature in the ratio b:a::0.25:0.75 for the calculations.

Considerable problems were experienced with the oxygen titration unit, so the bottle values may require further reworking and culling to improve the calibration. However, it was noted that the surface values of percent oxygen saturation for stations 12209-23 using the above calibrations were well correlated with the patchy blooms that were present, ranging from 104% in the strong bloom to 98% where the bloom was virtually absent. This suggests that the oxygens are correct within about 2%.

Chlorophyll

The Chelsea Instruments fluorometer has a range of 4096 counts for 0 to 10 volts. Conversion of counts to volts is thus

$$volts = 0.002441 * count.$$

Chlorophyll samples drawn from the multisampler were used to calibrate fluorescence values from the Chelsea Instruments fluorometer. The following calibrations have been kindly supplied by G Moore.

For the values presented in this report, no quench correction has been applied, and only dark values have been used to calculate the calibration factors.

For CTD casts 12198 and 12200, the calibration from volts to mg m-3 was

Chl = exp (-8.0345 + 6.6313 * volts -1.2020 * volts**2).

For CTD casts 12201 - 12223, the calibration was

Chl = exp (-7.5940 + 4.6029 * volts - 0.5721 * volts**2).

The latter calibration has also been applied to all casts along 88°W. While it is likely to be valid for casts close to the survey area (12224-29), the final calibration for the remaining casts may differ.

Transmissometer

The A to D converter in the transmissometer scales 4096 counts to 0 to 10 volts. The instrument converts 100% transmittence to 5 volts. The basic conversion equation is thus

percent transmittence = 0.002442 * 20.0 * count.

Aging of the light source may change this calibration, so the highest deck reading after thorough cleaning of the glass (4.763) was used to correct transmittence by comparison with the manufacturer's value (4.744) to give

corrected transmittence = (4.744 / 4.763) * percent transmittence.

Potential transmittence (potran) is then calculated by correcting for the index of refraction and compressibility of seawater using in situ values of pressure, temperature and salinity.

The RVS transmissometer has a 0.25 m path length. Thus, the beam attenuance per metre, independent of instrument, is given by the attenuance divided by path length:

beam attenuance (m-1) = - ln (potran / 100) / 0.25.

Light

The CTD was fitted with upward and downward looking PAR irradiance. Calibrations supplied were dwirr (downward) = 6.6470 - 0.001 * 12.353 * count

uwirr (upward) = 6.5746 - 0.001 * 12.427 * count.

DESCRIPTION OF PLOTS

Scatter plots of potential temperature against corrected salinity and potential temperature against dissolved oxygen are shown for (a) CTDs on passage along 65°S, (b) CTDs in the ice edge survey area and at 85°W and (c) full depth CTDs along 88°W.

Contoured sections of potential temperature, salinity, chlorophyll and density are shown for (a) 65°S, (b) 85°W land (c) 88°W.

For each CTD cast, two profiles are shown. One shows upward and downward irradiance, chlorophyll and density (sigma0) for the top 240 m. The other shows potential temperature (q), salinity, oxygen and beam attenuance over the full depth of the cast (300 m, 1000 m or 5000 m).

ACKNOWLEDGEMENTS

This was the first cruise of the rebuilt *RRS Discovery* and we would like to thank the Master, M Harding, officers and crew for their dedication and skill in making the cruise so successful, and the principal scientist, Dr D Turner for allowing us to complete the CTD section along 88°W.

TABLE 1

RRS Discovery Cruise 198

CTD Station List

Station number	Day	Date	Time GMT	Latitude S		Longitude W		Cast depth (m)	Water depth (m)	Comments
12198	316	11/11/92	2247	52	29.7	57	39.9	349	361	trial cast shortly after sailing
12200	322	17/11/92	1133	62	49.9	60	34.9	248	293	productivity
12201	323	18/11/92	1123	63	27.5	66	17.7	299	3246	productivity
12202	324	19/11/92	1122	64	05.7	73	28.6	298	3748	productivity
12203	325	20/11/92	1827	65	01.1	79	20.6	246	4109	intercalibration with JCR
12204	326	21/11/92	1116	64	54.9	79	26.3	297	4175	productivity
12205	326	21/11/92	2342	65	00.8	81	39.2	993	4299	start of line along 65°S
12206	327	22/11/92	0559	64	59.8	82	30.8	994	4478	
12207	327	22/11/92	1201	65	00.4	83	22.1	1000	4540	productivity
12208	327	22/11/92	1734	65	00.0	84	09.7	996	4547	
12209	327	22/11/92	2358	65	00.3	84	59.7	993	4591	start of line down 85°W
12210	328	23/11/92	0421	65	20.0	84	59.9	995	4537	
12211	328	23/11/92	1218	65	40.4	85	00.0	993	4533	productivity, then SeaSoar
										Line along 85°W between ice edge survey
12212	333	28/11/92	0010	66	45.2	85	01.3	4349	4389	multiple problems, see text
12213	334	29/11/92	1000	67	05.5	84	56.0	999	4310	low productivity station, no multisample
12214	334	29/11/92	1703	67	05.3	84	56.4	1000	4310	repeat of 12213 with multisampler
12215	334	29/11/92	1934	66	59.4	85	00.0	1001	4329	
12216	334	29/11/92	2131	66	55.0	84	59.3	999	4346	
12217	334	29/11/92	2334	66	49.9	84	59.6	998	4356	
12218	335	30/11/92	0143	66	45.0	84	59.9	998	4386	repeat of 12212 with multisampler
12219	335	30/11/92	0707	67	10.2	84	59.8	998	4291	
12220	335	30/11/92	1116	67	16.2	85	01.3	998	4281	high productivity station
12221	335	30/11/92	1423	67	20.3	84	59.3	999	4295	
12222	335	30/11/92	1636	67	25.4	84	59.7	1001	4243	
12223	335	30/11/92	1957	67	29.8	84	59.4	4185	4207	with 12212, deep casts spanning front
12224	339	4/12/92	1318	67	25.6	85	18.2	301	4220	productivity, near JCR
12225	341	6/12/92	0745	67	27.5	86	0.17	301	4159	productivity
12226	342	7/12/92	1307	67	35.9	85	03.7	300	4146	productivity
12227	344	9/12/92	0034	69	00.1	88	00.1	154	3440	productivity, same position as 12228
12228	344	9/12/92	0234	69	00.4	88	02.1	3423	3445	start of 88°W line
12229	344	9/12/92	2129	66	30.6	88	00.2	4459	4470	
12230	345	10/12/92	1505	63	59.9	87	59.3	295	4761	productivity, same position as 12231
12231	345	10/12/92	1737	63	58.4	87	59.7	4710	4763	
12232	346	11/12/92	1107	61	30.6	87	59.1	4781	4868	
12233	347	12/12/92	0549	59	00.4	88	00.1	5012	5023	
12234	347	12/12/92	2135	56	30.6	87	59.7	204	5476	productivity, same position as 12235
12235	347	12/12/92	2358	56	31.7	87	58.1	5071	5482	
12236	348	13/12/92	1827	53	59.8	88	0.96	5025	5060	
12237	349	14/12/92	1137	51	29.4	87	59.2	4700	4759	

TABLE 2

Listing of calibration file

'deepctd.cal'

```
:calibration file for rvs deep ctd on Discovery 198
:press       .1        -5.13287     0.9987653    .0     .0
:deck offset applied. so cal differs from Bill Millers
press        .1        -7.1         0.9987653    .0     .0
temp         .0005     0.0044057    .9999902     .0     .0
cond         .001      0.           1.0          .0     .0
:following Gerald Moore's recommendation, we move fluor
:coeffts about. First fvolts is .002441v/count (cf trans)
:for rvs A to D.
fvolts       .002441   .0           1.           .0     .0
:then cal(1,12) and cal(3,12) become
fluor        1.0       -3.7         1.696        .0     .0
:which he says is close to the manufacturer's values of
:-3.5 and 1.256. The values of -3.7 and 4.14=1.696*2.441
:came from an old Fasham calib, but we've been applying
:them this cruise so leave for consistency, and the
:answers look about right for default calibration.
oxyc         .001      0.           1.05         .0     .0
oxyt         .128      0.           1.0          .0     .0
oxyfrac      -.022     0.000135     1.0          .0     .0
oxygen       .0        0.0          0.0          .0     .0
:trans - 4096 counts is 10V for rvs system
:so 1 count = .002441V
:then 20 converts 5V fullscale to 100% transsmittance
:no offset,can't find where BAK's -.34 came from
trans        .002441   0.           20.0         .0     .0
:potran has 4 fields, first is deck reading when clean
:2nd and 3rd are manufacturers values
:4th is new 22/11/92 and is inst. path length, 1.0 for
:IOSDL but 0.25 for rvs. This is needed for atten
:if 4th is zero, it will be set to 1. to match previous
:IOS files
potran       4.763     4.738        1.0          .25    .0
deltat       .50       0.           0.0          .0     .0
dwirr        .001      6.6470       -12.353      .0     .0
uwirr        .001      6.5746       -12.427      .0     .0
```

Post cruise calibration check 26-2-93

barometric pressure: 0 ambient temperature: 20

Pressure coefficients:	-7.365239	9.987728E-02	std err est 0.4573134
Temperature coefficients:	6.413431E-03	4.998916E-04	std err est 8.011253E-04

FIGURES

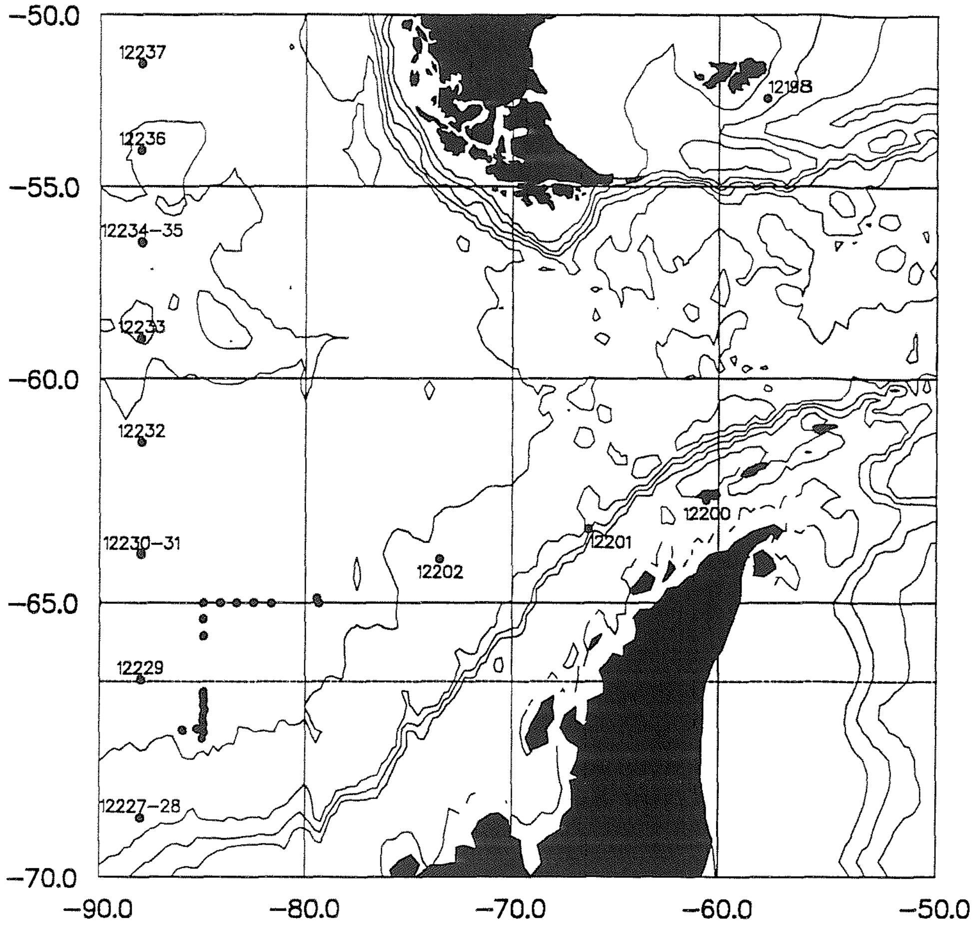


Fig. 1a Cruise 198 track plot to show CTDs on passage.

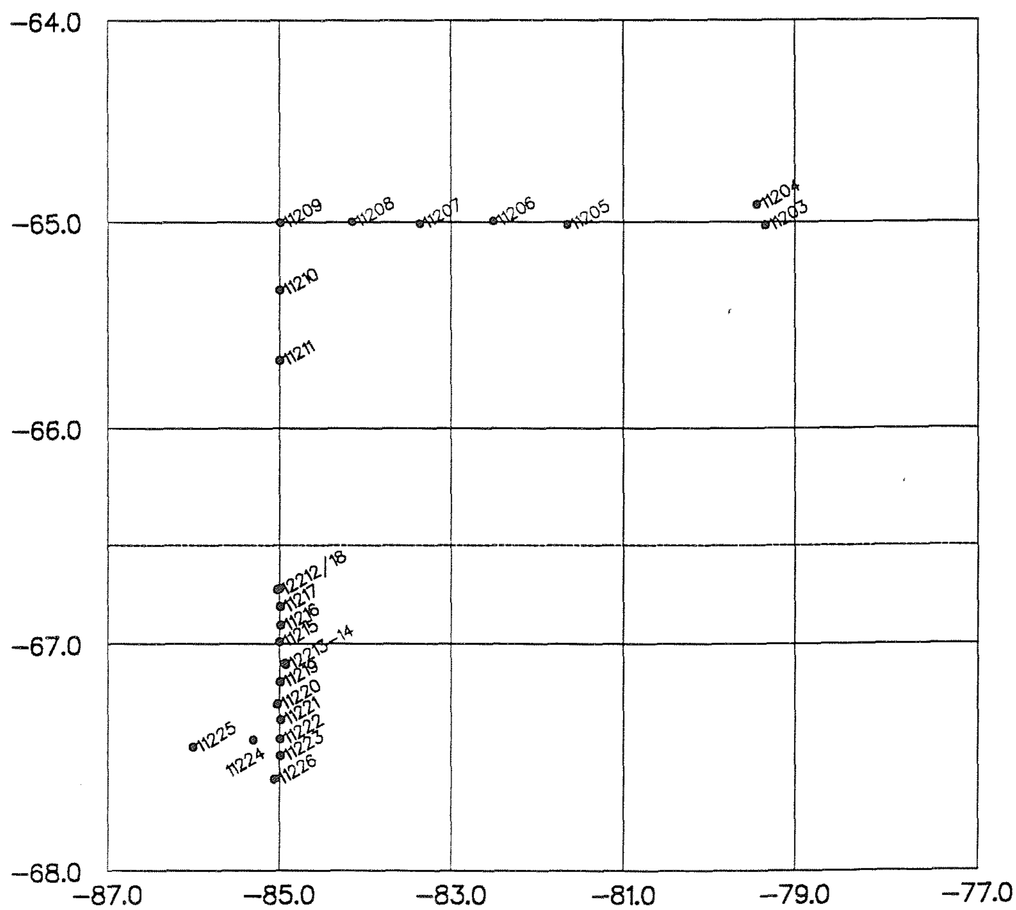


Fig. 1b Expanded track plot showing CTDs in the ice edge survey area.

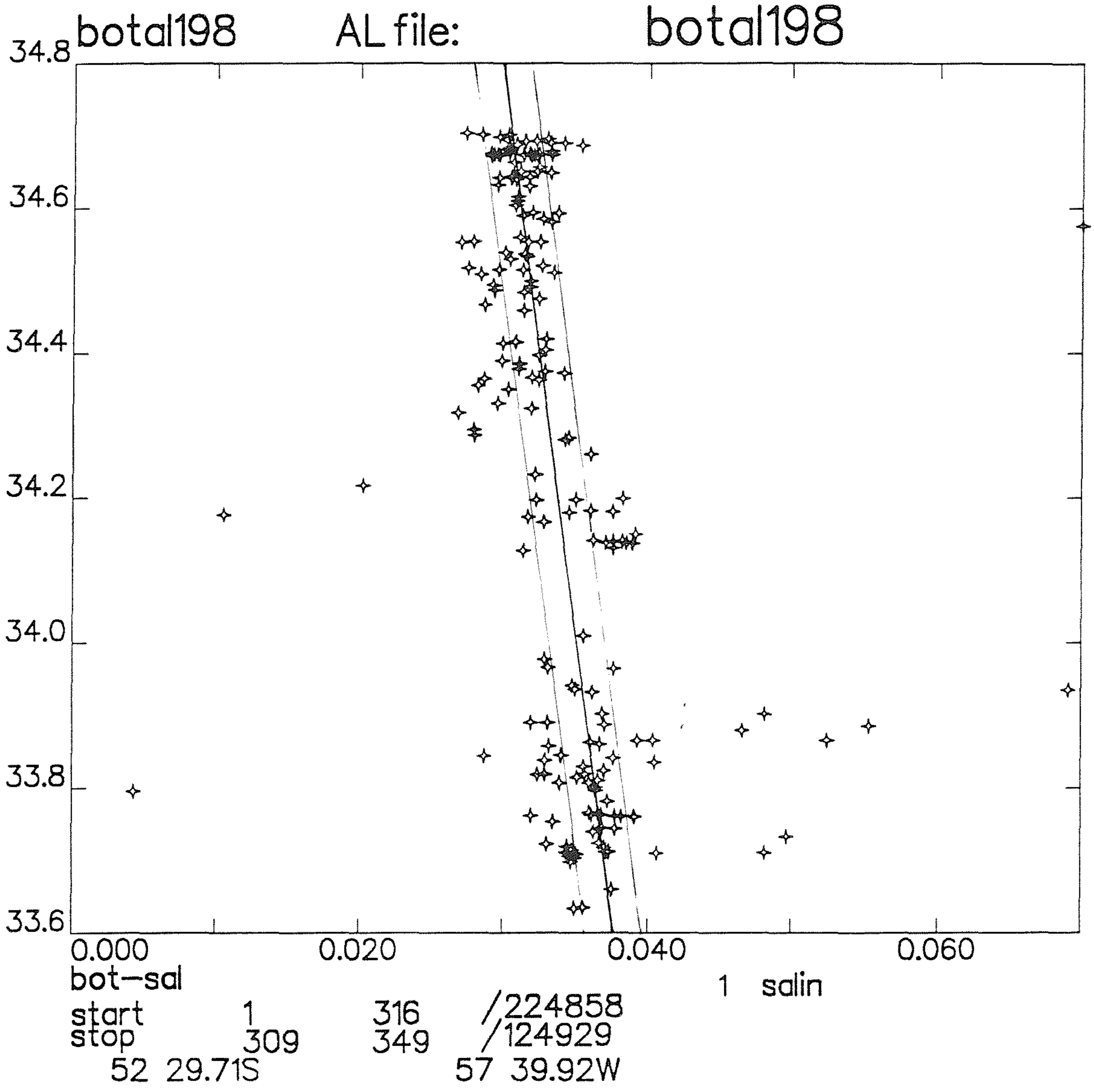
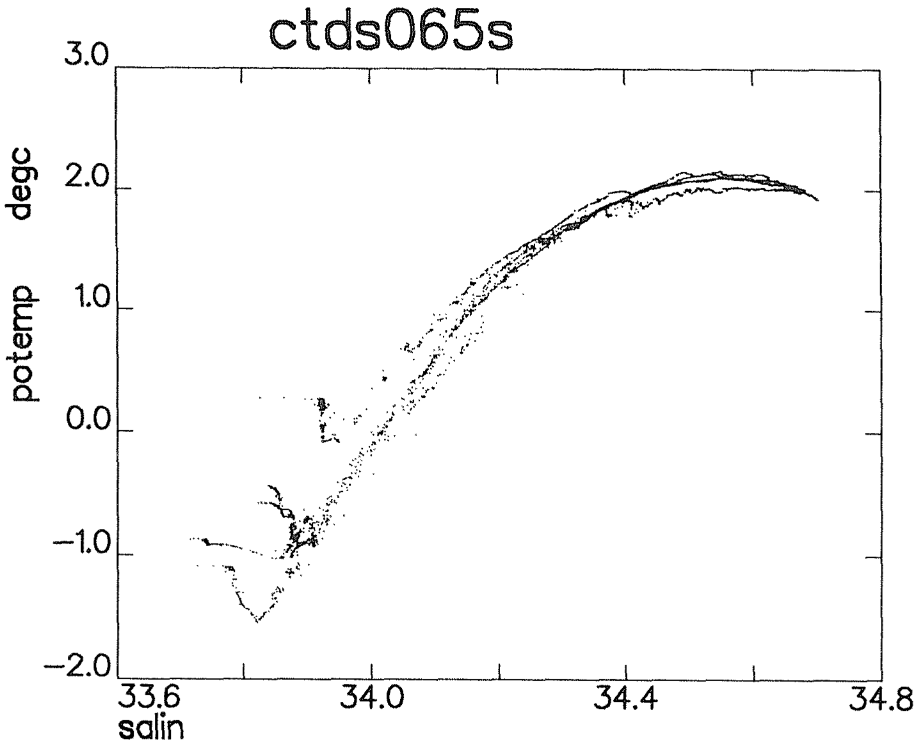


Fig.2 Corrections to salinity (Sbot-ctd) to be added to CTD salinity values, plotted against the uncorrected values.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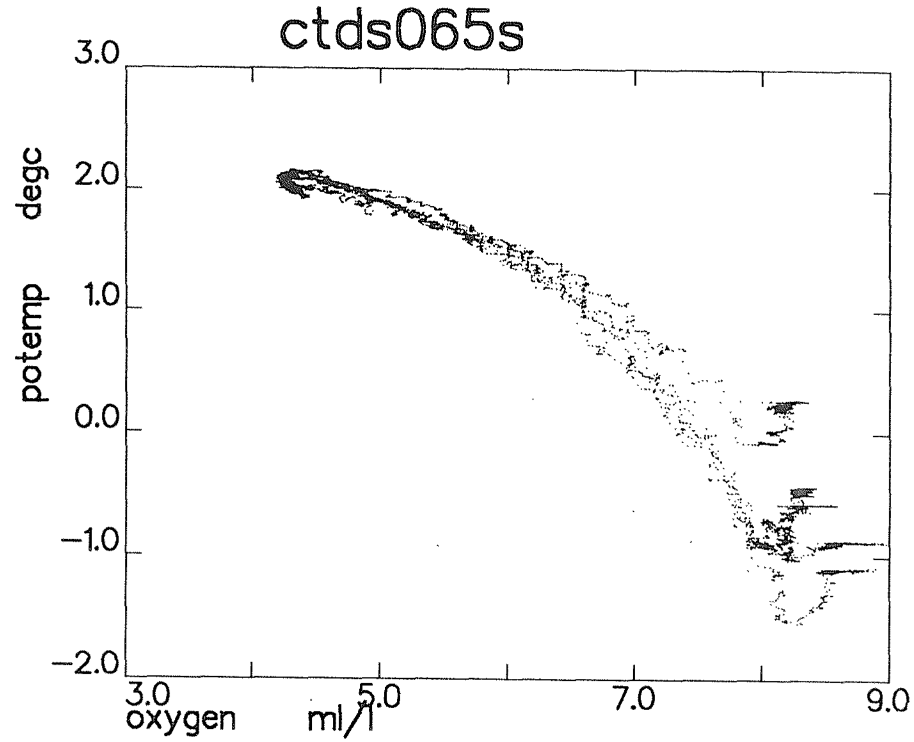
33.6
34.0
34.4
34.8
salin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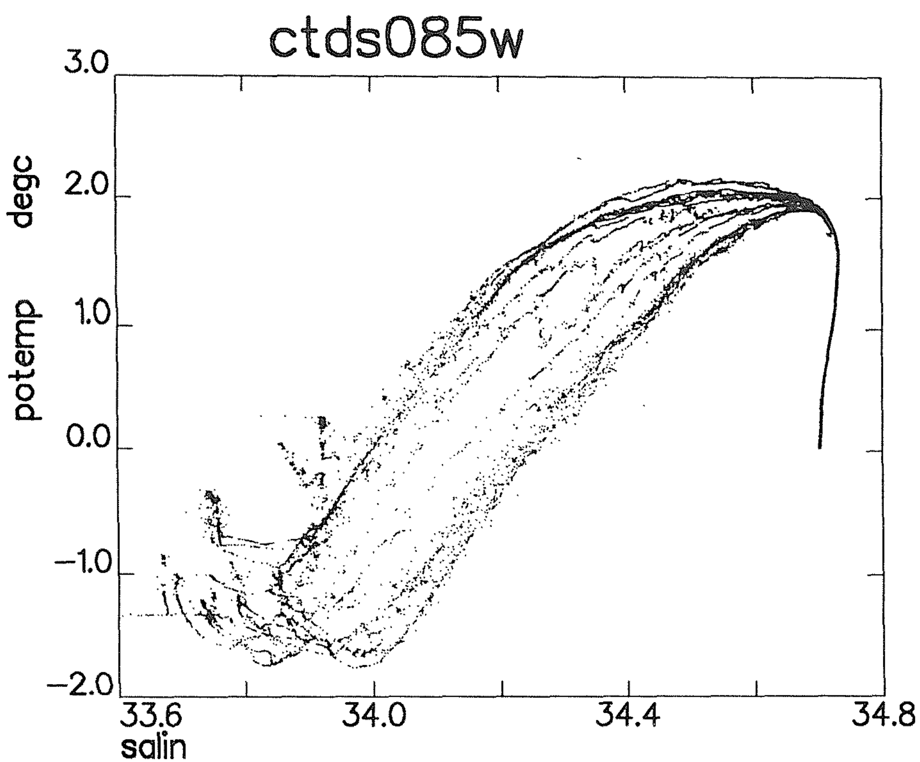
7.0
9.0
oxygen ml/l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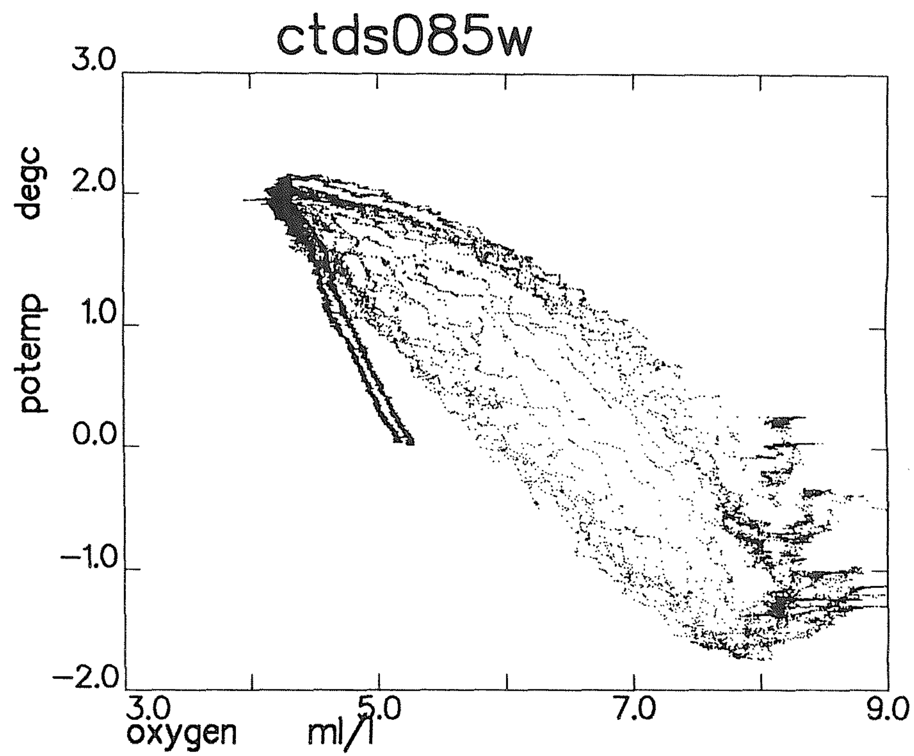
34.4
34.8
salin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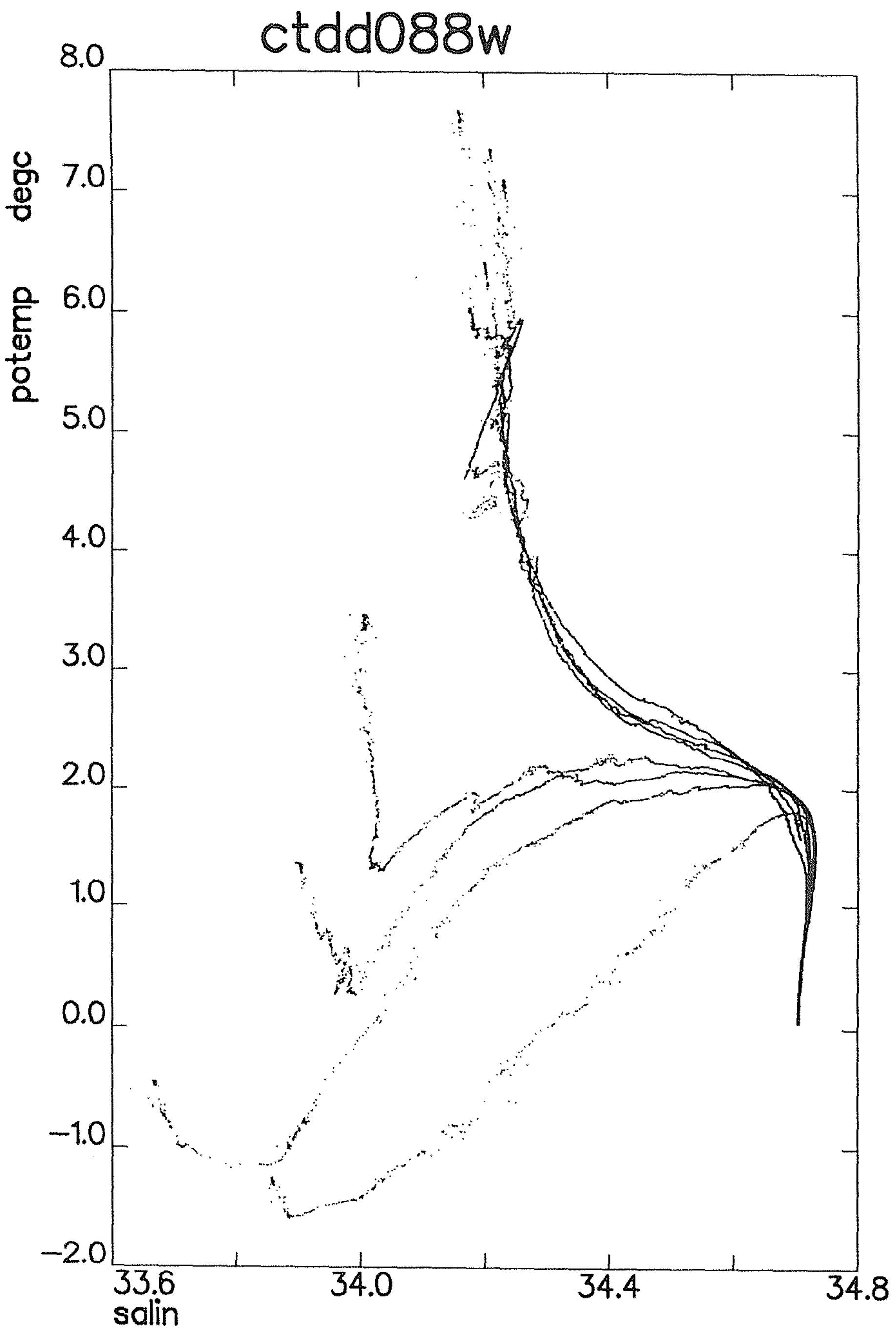
3.0
5.0
7.0
9.0
oxygen ml/l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33.6
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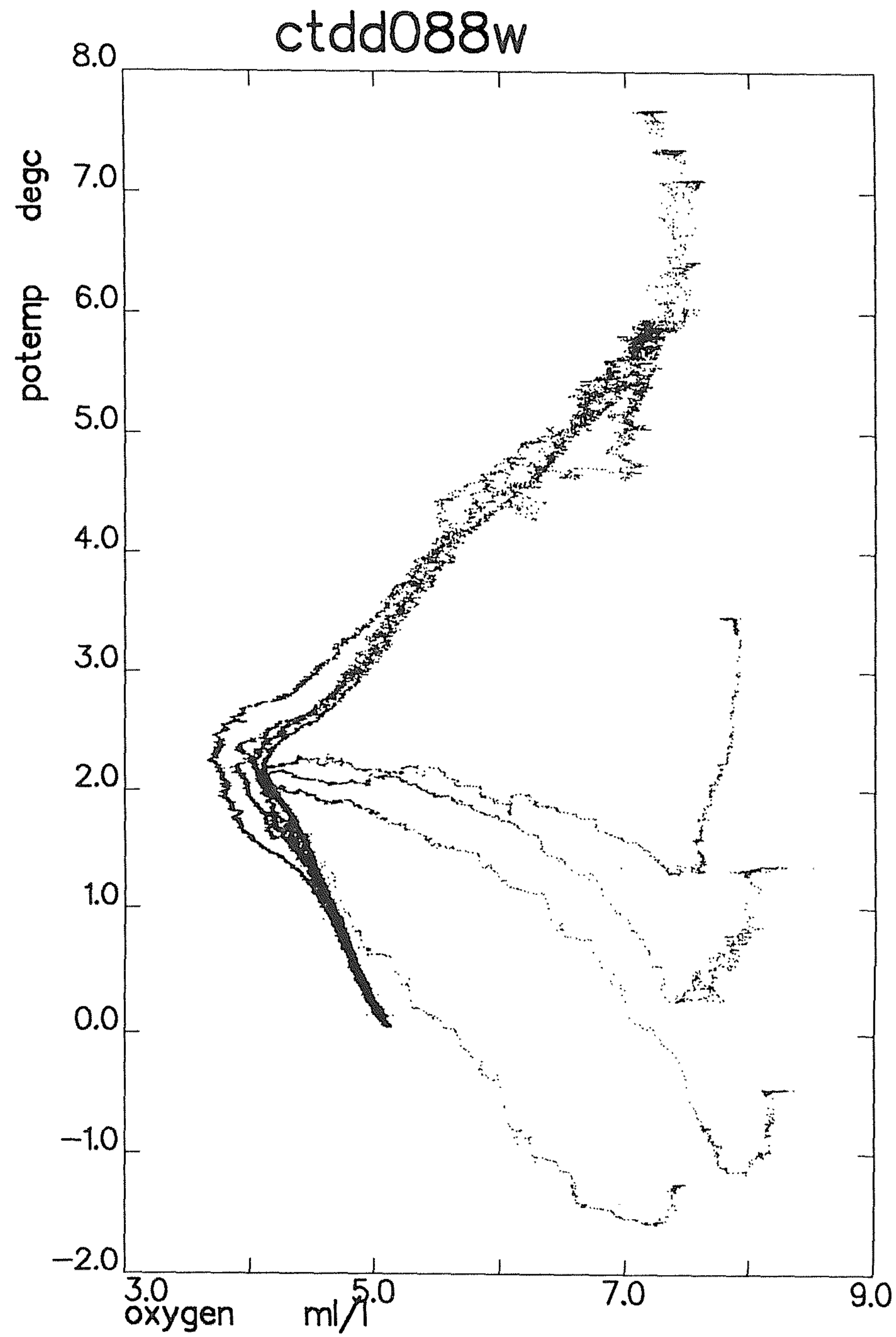
34.4
34.8
salin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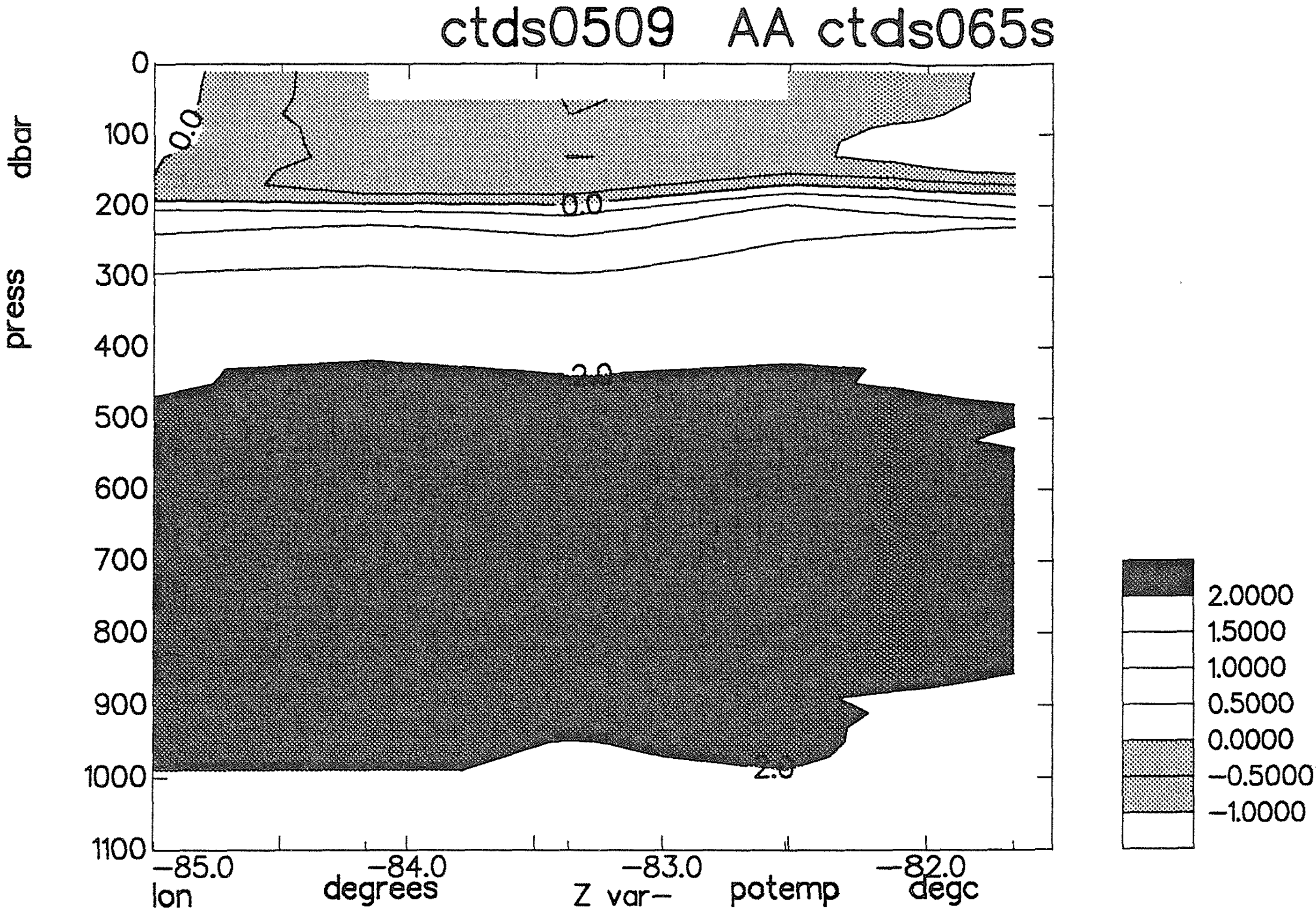
9.0
oxygen ml/l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2.0
2.0
2.0000
1.5000
1.0000
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Z var−
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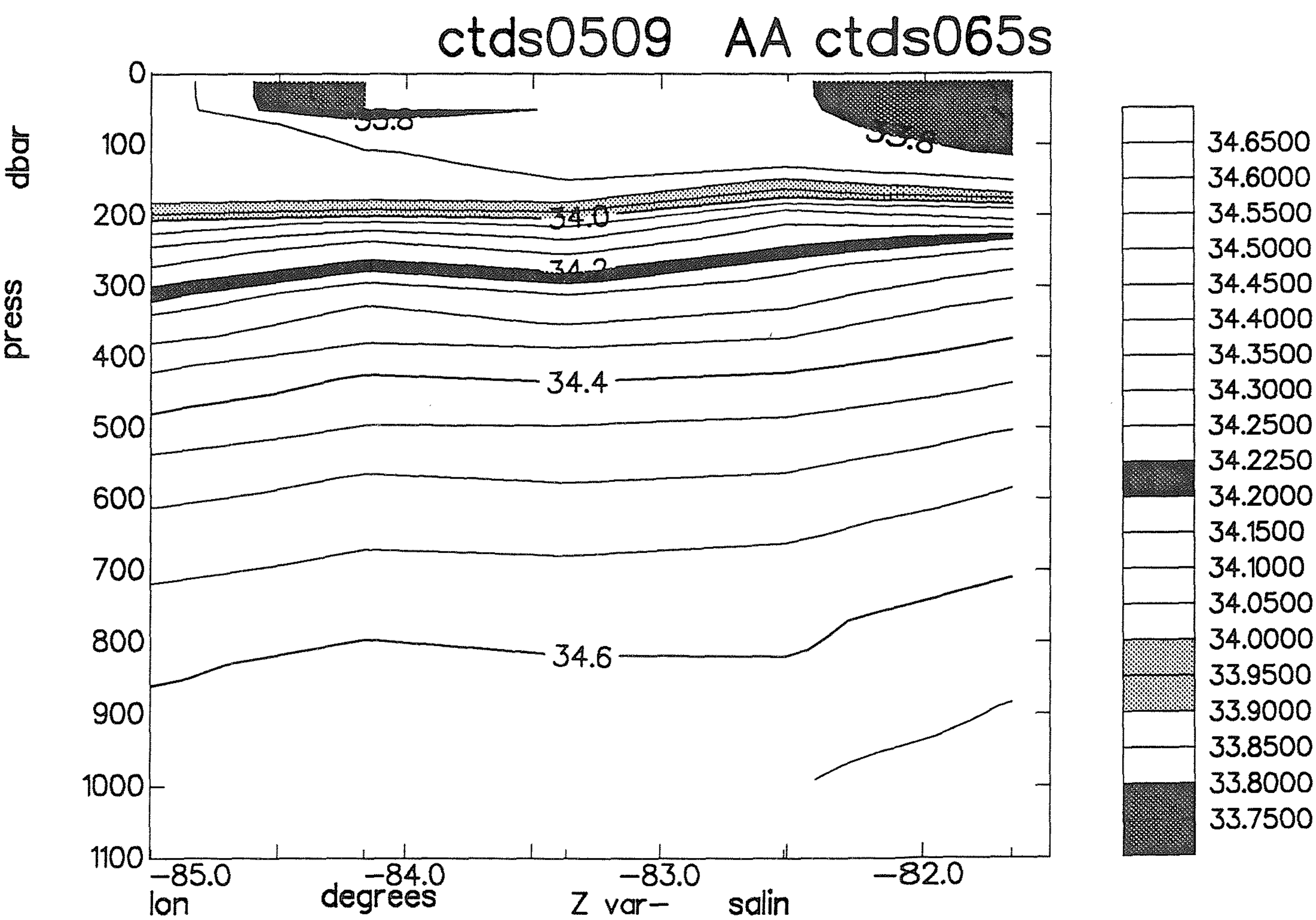
degc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34.6500
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34.5500
34.5000
34.4500
34.4000
34.3500
34.3000
34.2500
34.2250
34.2000
34.1500
34.1000
34.0500
34.0000
33.9500
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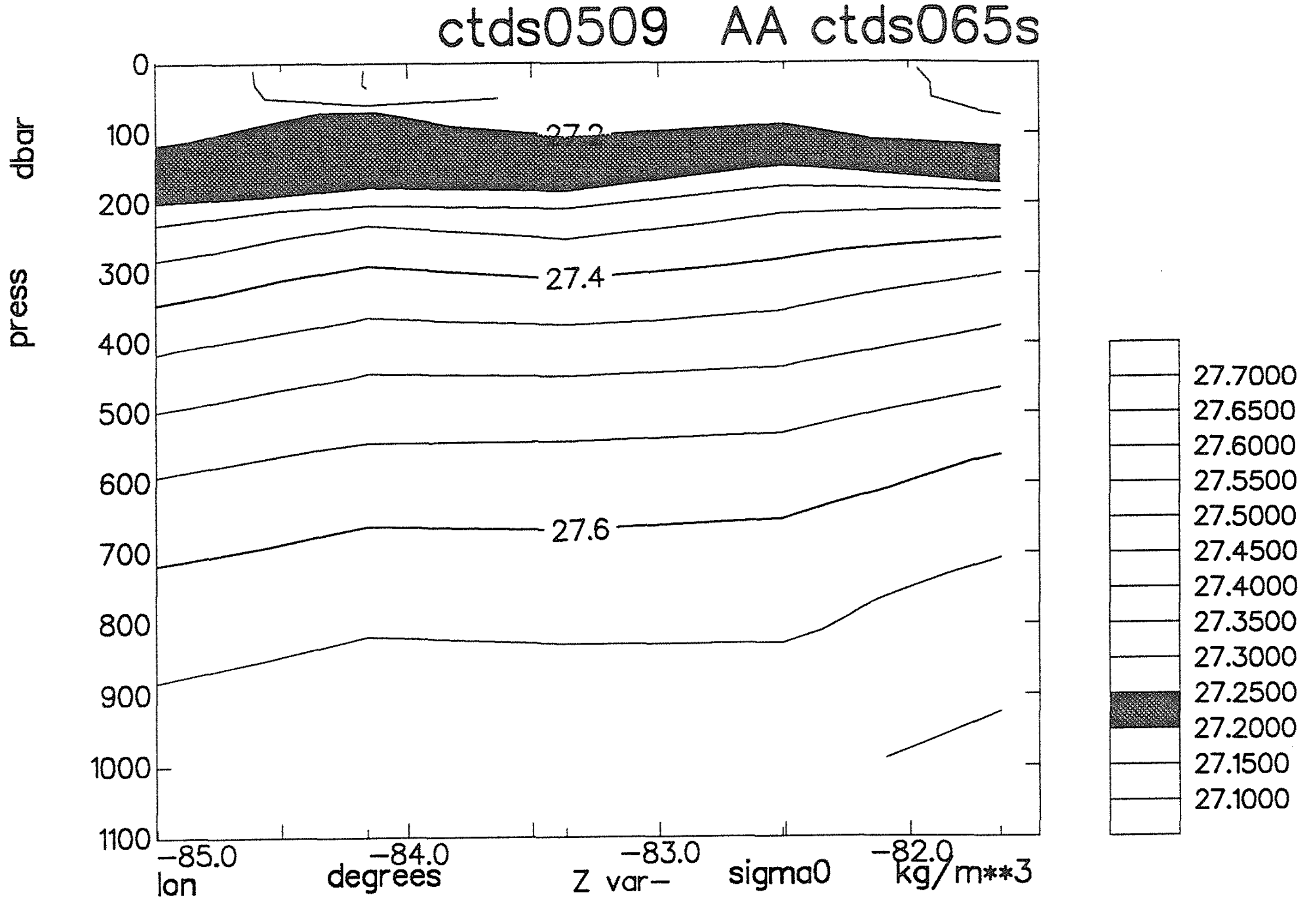
lon
degrees
Z var−
salin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200
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600
700
800
900
1000
1100
27.2
27.4
27.6
−85.0
−84.0
−83.0
−82.0
lon degrees Z var− sigma0 kg/m**3
27.7000
27.6500
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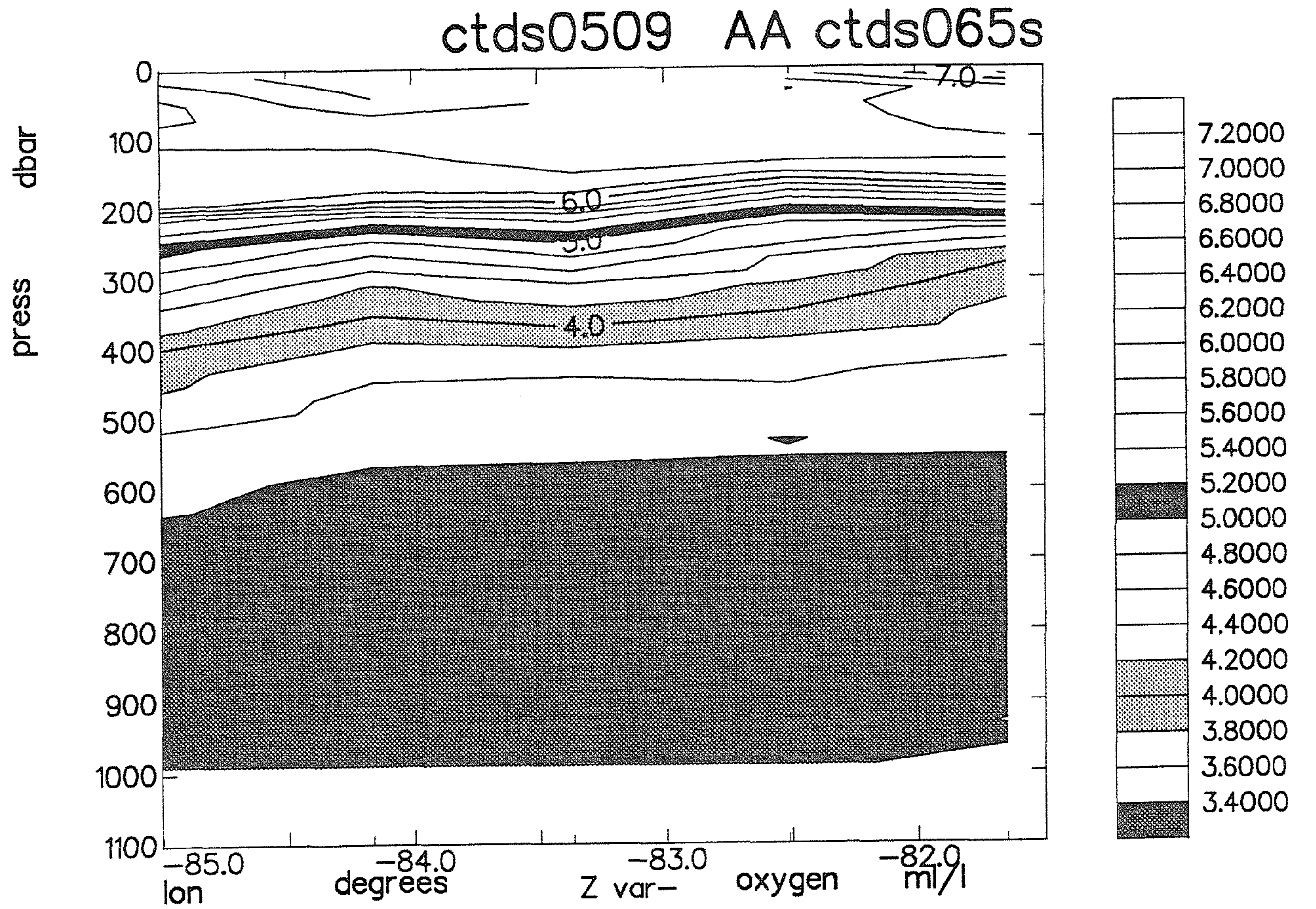
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−84.0
−83.0
−82.0
lon degrees Z var− oxygen ml/l
7.2000
7.0000
6.8000
6.6000
6.4000
6.2000
6.0000
5.8000
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5.2000
5.0000
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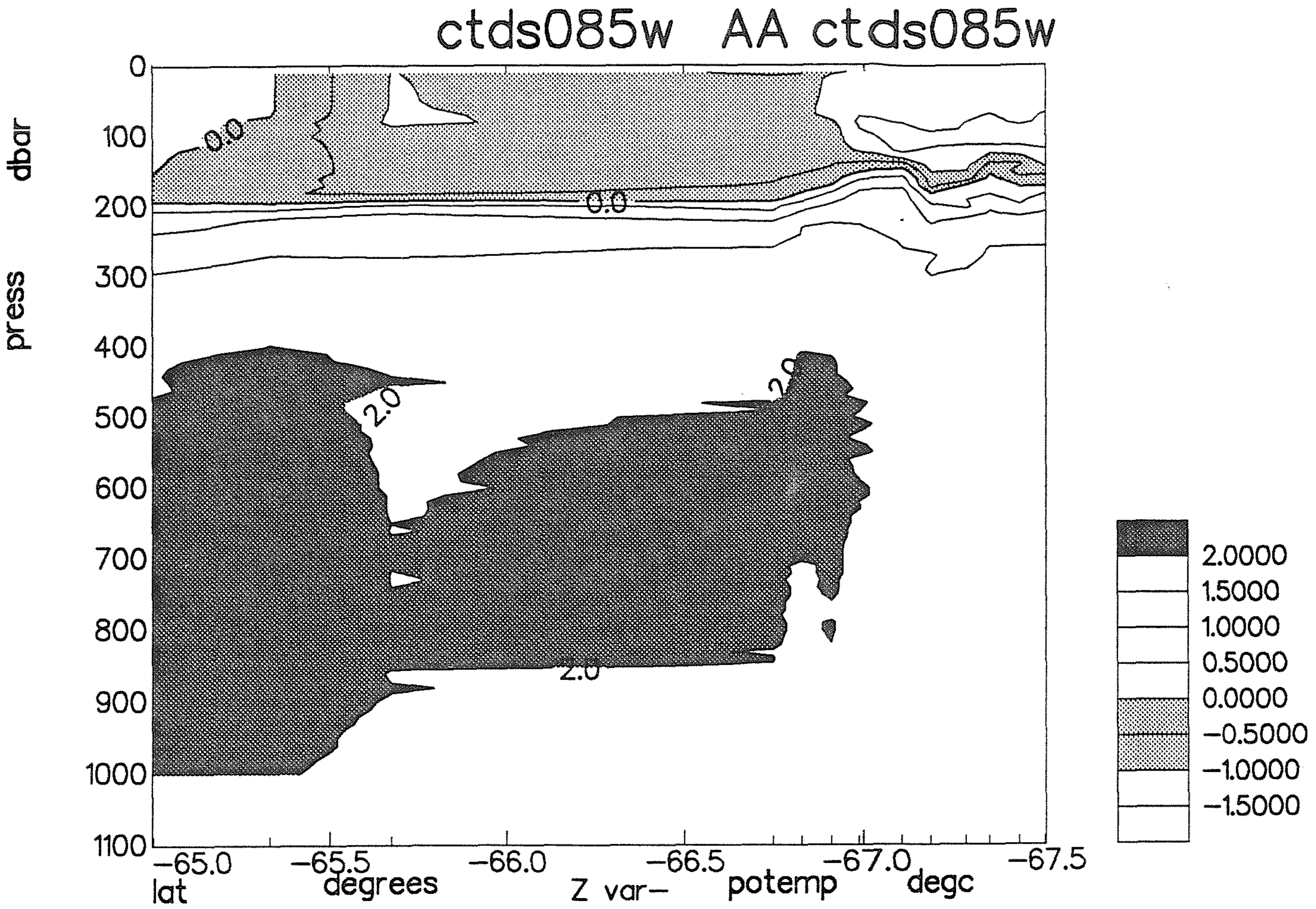
4.6000
4.4000
4.2000
4.0000
3.8000
3.6000
3.4000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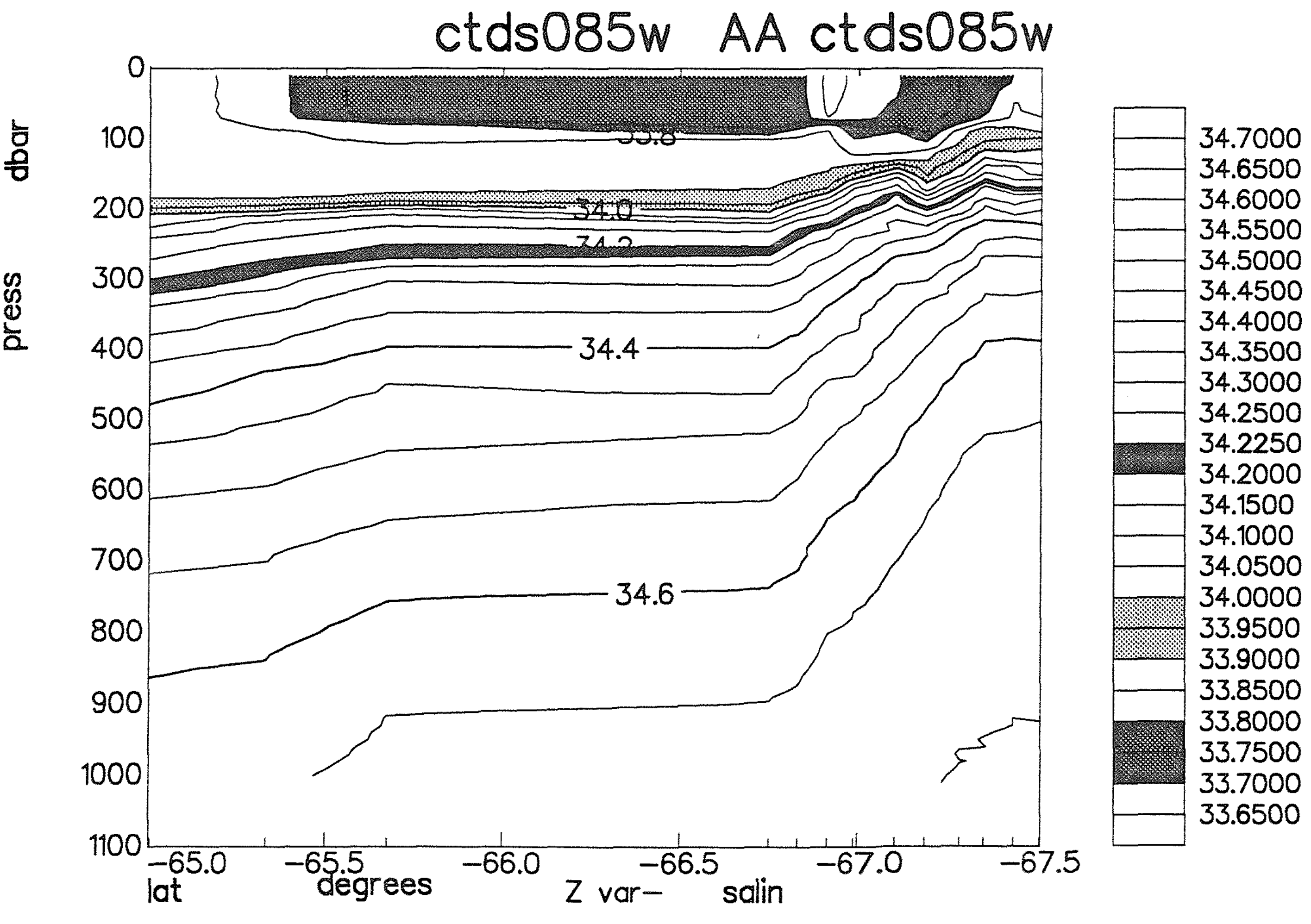
dbar
press
0
100
200
300
400
500
600
700
800
900
1000
1100
0.0
2.0
−65.0
−65.5
−66.0
−66.5
−67.0
−67.5
lat
degrees
Z var−
potemp
degc
2.0000
1.5000
1.0000
0.5000
0.0000
−0.5000
−1.0000
−1.5000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dbar
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300
400
500
600
700
800
900
1000
1100
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34.4
34.6
−65.0
−65.5
−66.0
−66.5
−67.0
−67.5
lat
degrees
Z var−
salin
34.7000
34.6500
34.6000
34.5500
34.5000
34.4500
34.4000
34.3500
34.3000
34.2500
34.2250
34.2000
34.1500
34.1000
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34.0000
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33.9000
33.8500
33.8000
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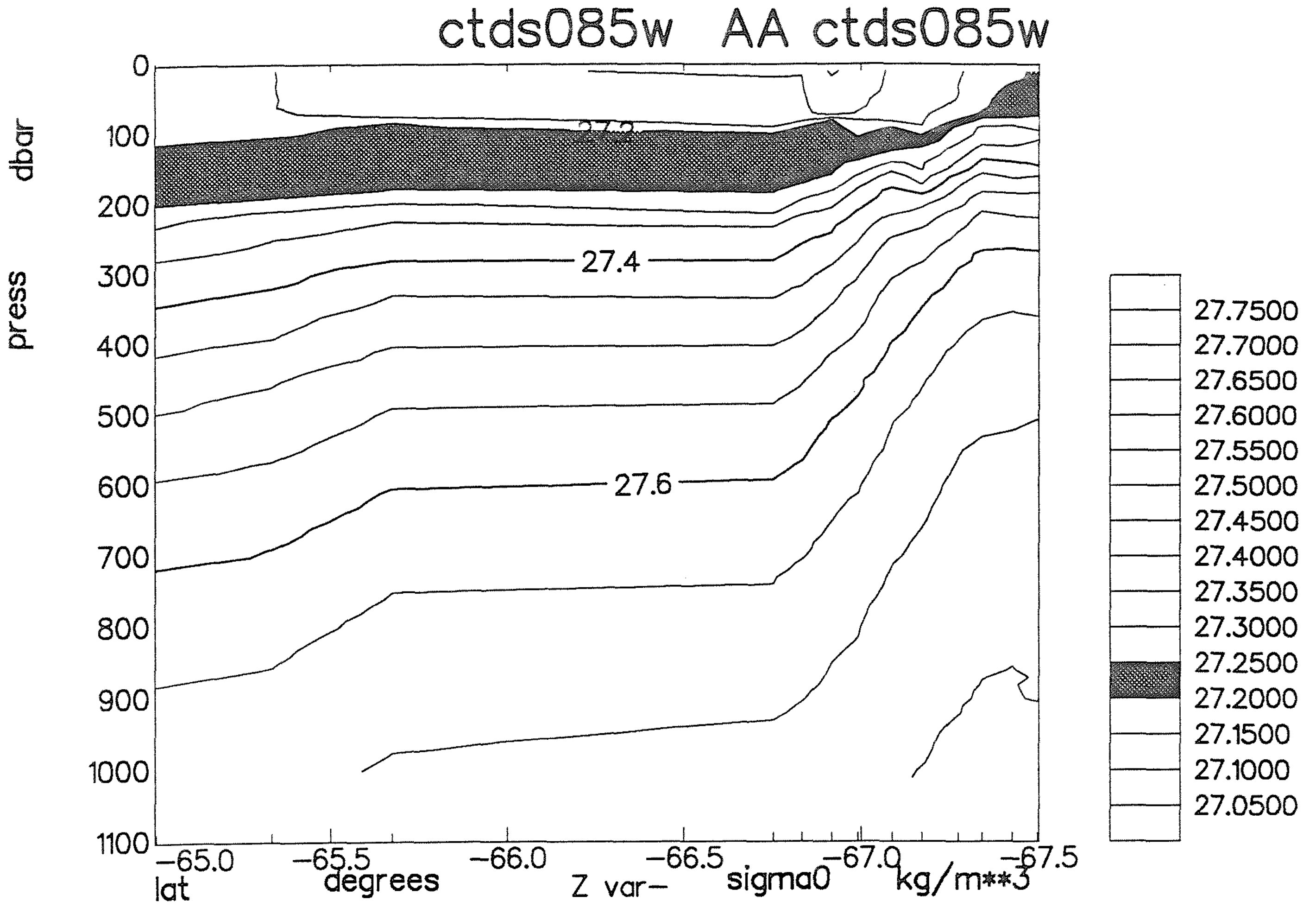
33.7000
33.6500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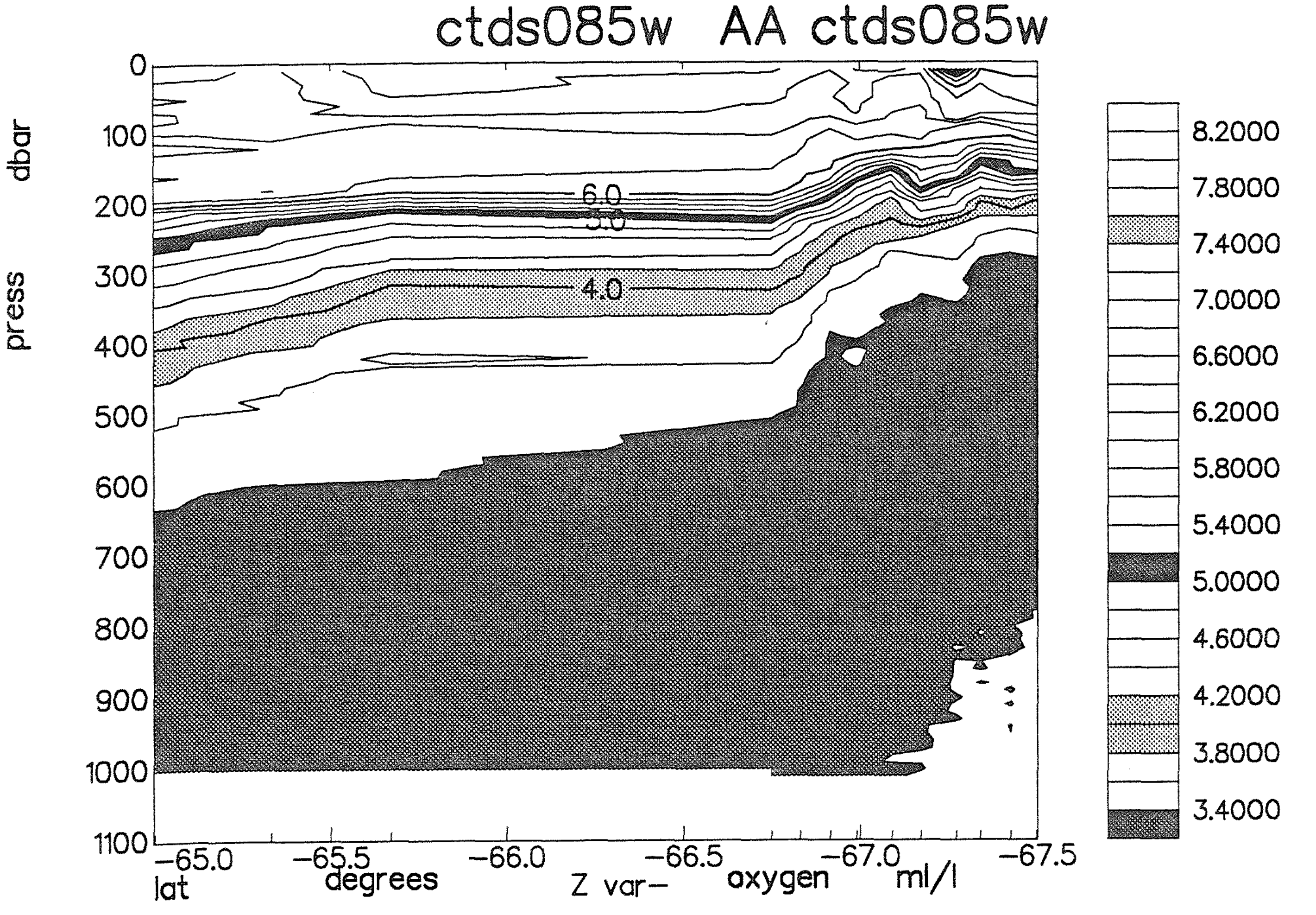
press dbar
0
100
200
300
400
500
600
700
800
900
1000
1100
27.2
27.4
27.6
−65.0
−65.5
−66.0
−66.5
−67.0
−67.5
lat
degrees
Z var−
sigma0
kg/m**3
27.7500
27.7000
27.6500
27.6000
27.5500
27.5000
27.4500
27.4000
27.3500
27.3000
27.2500
27.2000
27.1500
27.1000
27.0500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press dbar
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100
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300
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500
600
700
800
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1000
1100
6.0
5.0
4.0
−65.0
−65.5
−66.0
−66.5
−67.0
−67.5
lat
degrees
Z var−
oxygen
ml/l
8.2000
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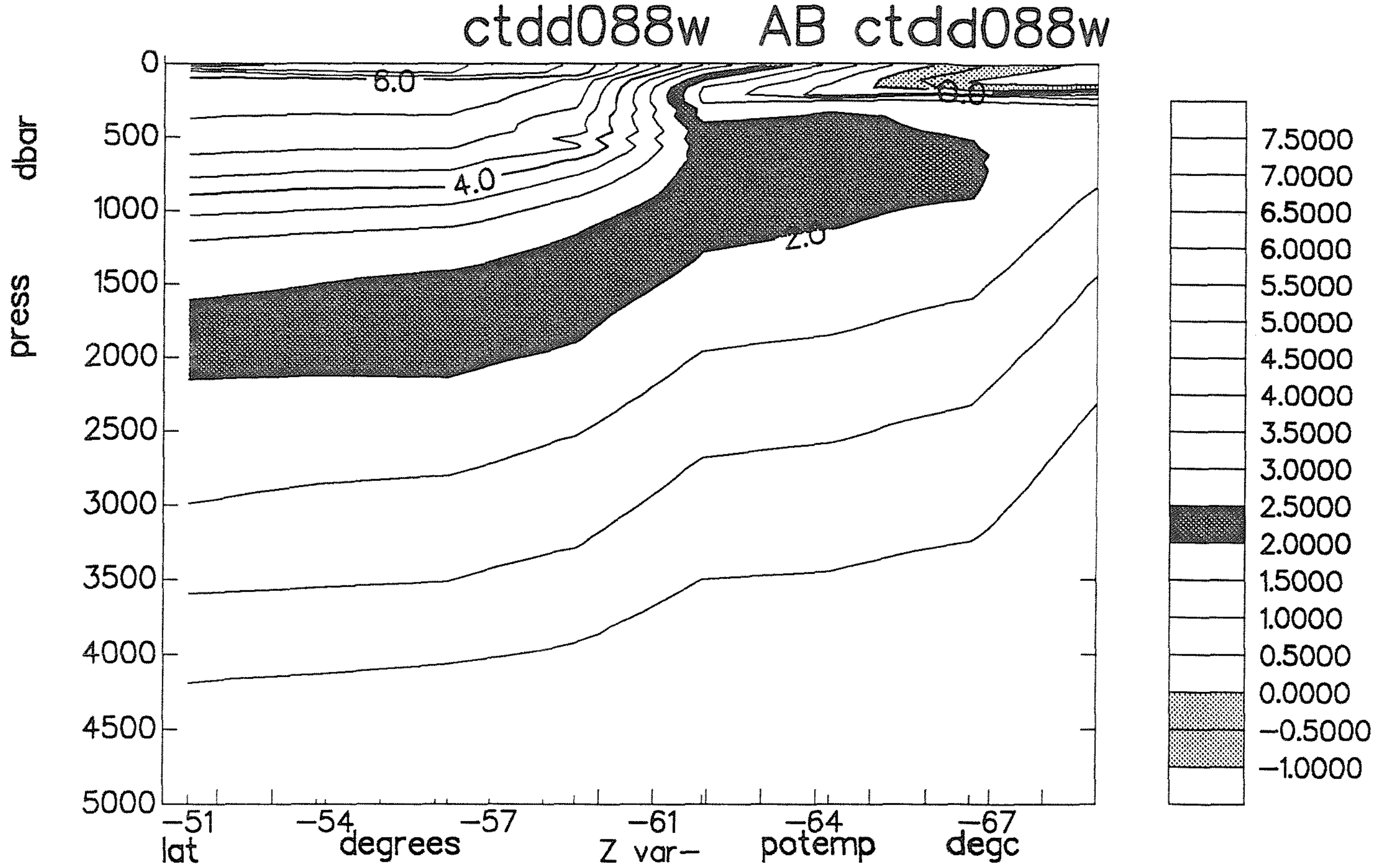
7.0000
6.6000
6.2000
5.8000
5.4000
5.0000
4.6000
4.2000
3.8000
3.4000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3500
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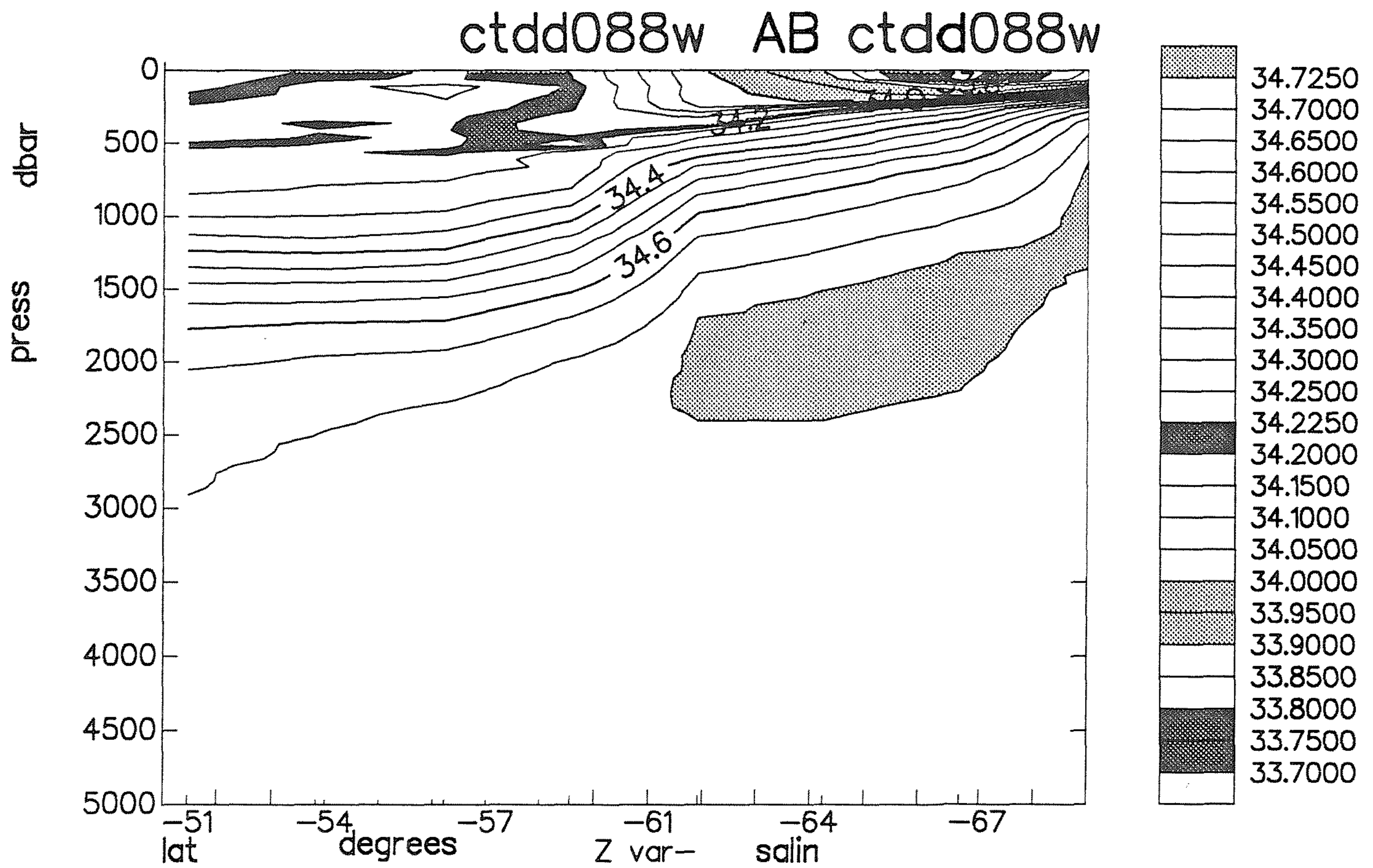
4500
5000
6.0
4.0
2.0
0.0
−51
−54
−57
−61
−64
−67
lat
degrees
Z var−
potemp
degc
7.5000
7.0000
6.5000
6.0000
5.5000
5.0000
4.5000
4.0000
3.5000
3.0000
2.5000
2.0000
1.5000
1.0000
0.5000
0.0000
−0.5000
−1.0000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press dbar
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1500
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2500
3000
3500
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4500
5000
34.2
34.4
34.6
−51
−54
−57
−61
−64
−67
lat
degrees
Z var−
salin
34.7250
34.7000
34.6500
34.6000
34.5500
34.5000
34.4500
34.4000
34.3500
34.3000
34.2500
34.2250
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34.0500
34.0000
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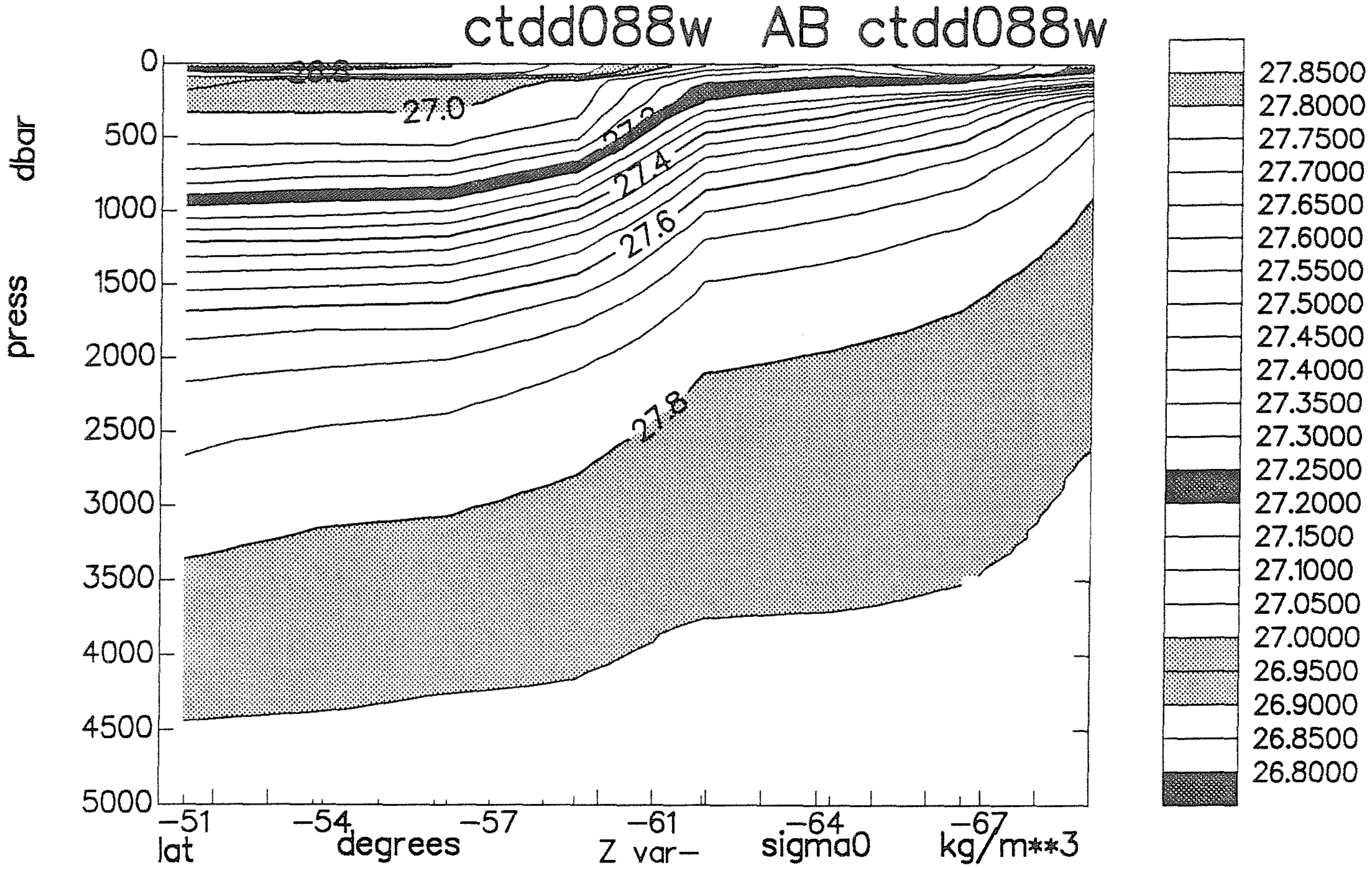
33.8500
33.8000
33.7500
33.7000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press dbar
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1000
1500
2000
2500
3000
3500
4000
4500
5000
27.0
27.2
27.4
27.6
27.8
−51
−54
−57
−61
−64
−67
lat degrees Z var− sigma0 kg/m**3
27.8500
27.8000
27.7500
27.7000
27.6500
27.6000
27.5500
27.5000
27.4500
27.4000
27.3500
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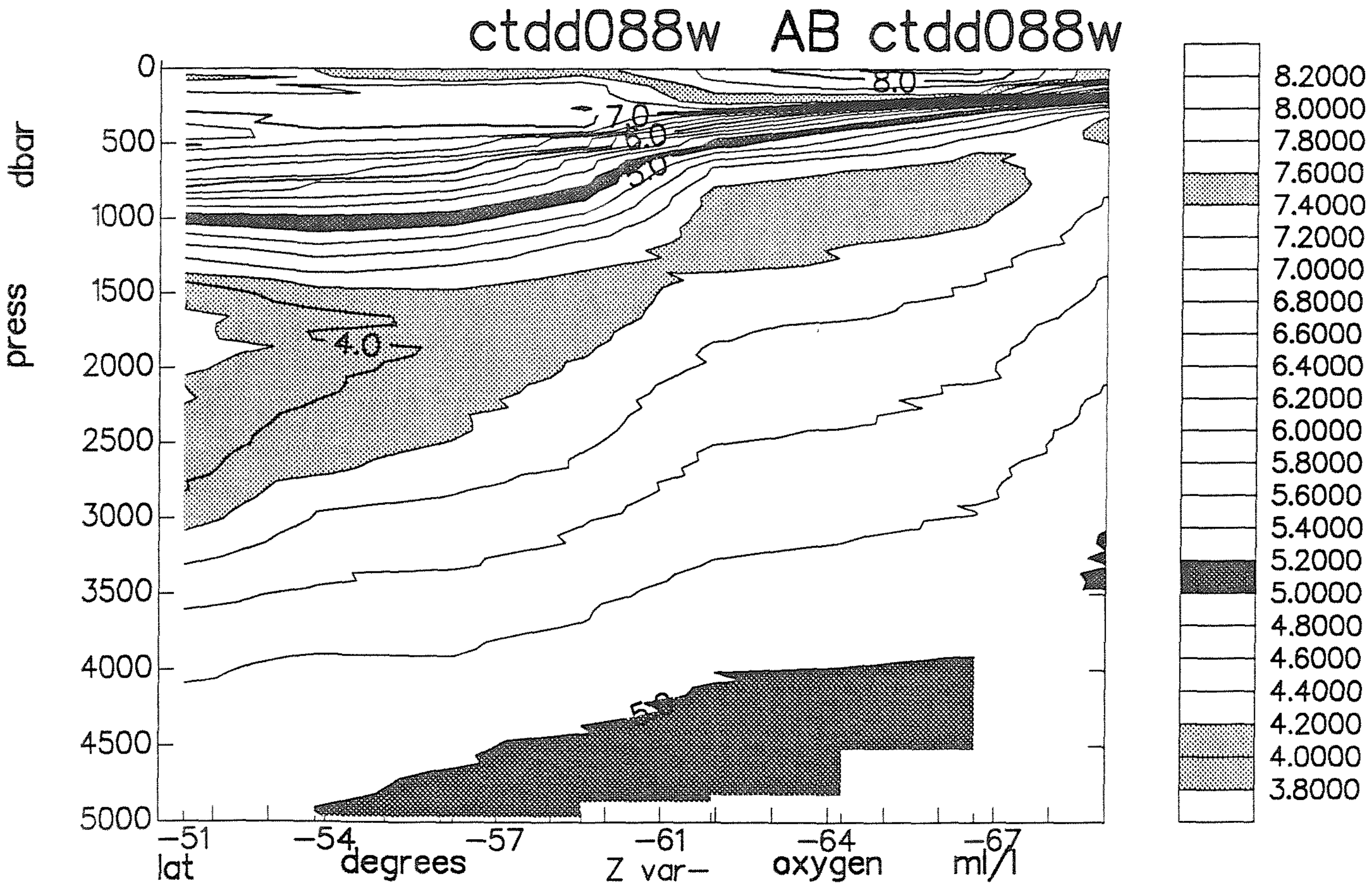
26.9000
26.8500
26.8000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press dbar
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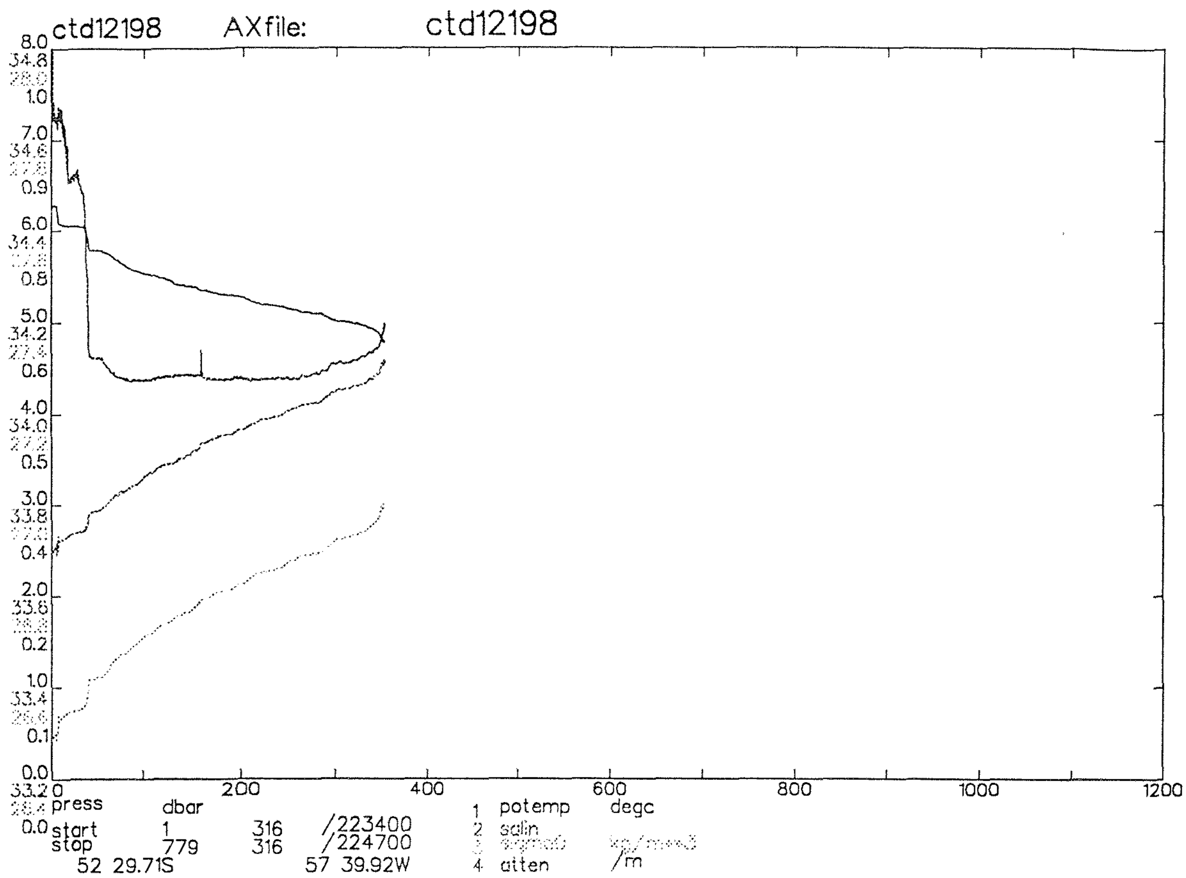
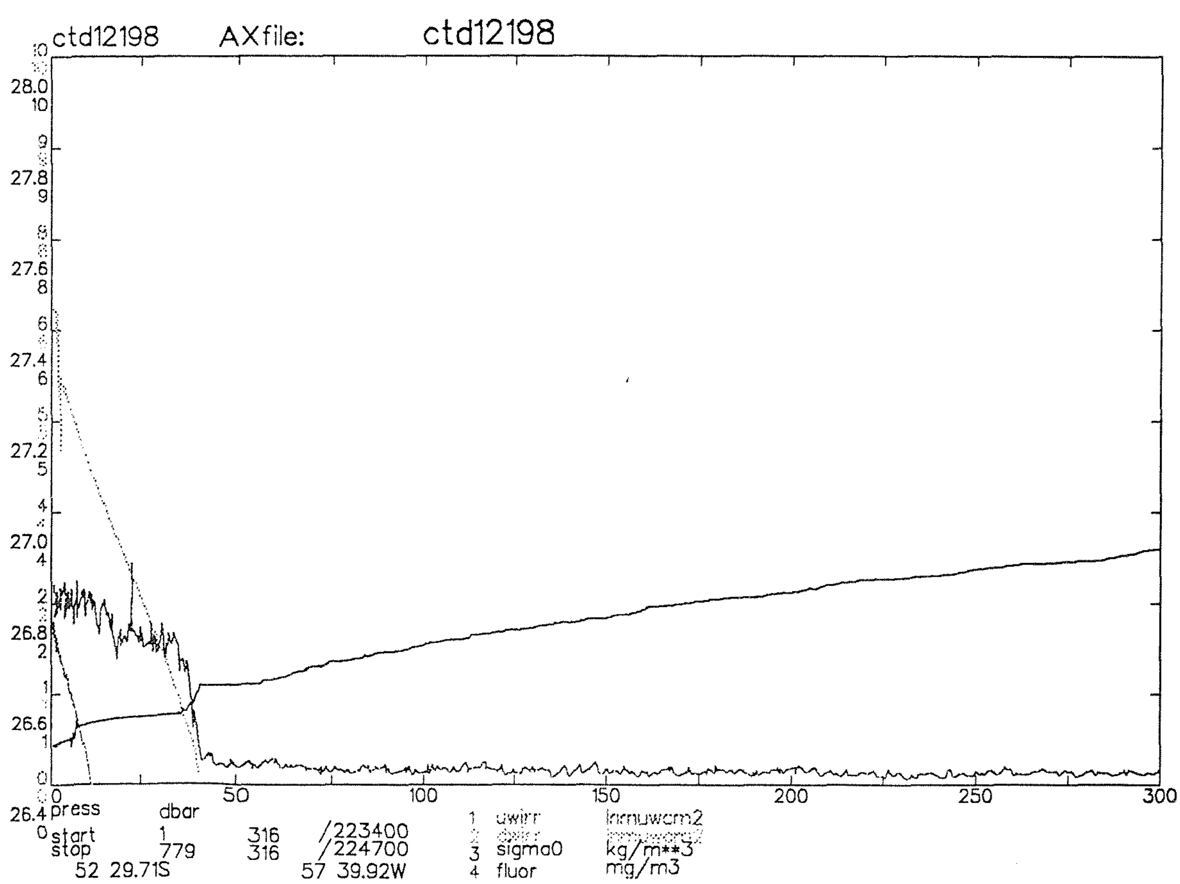
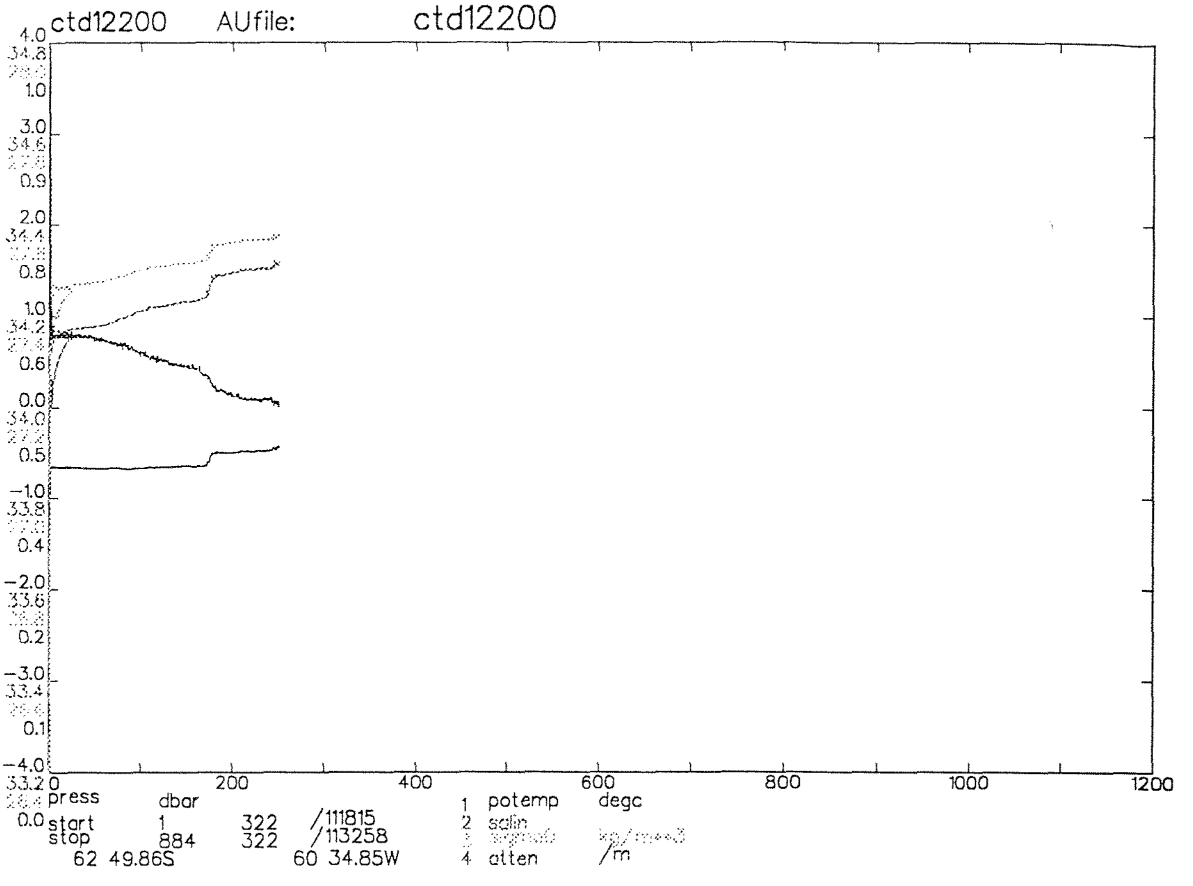
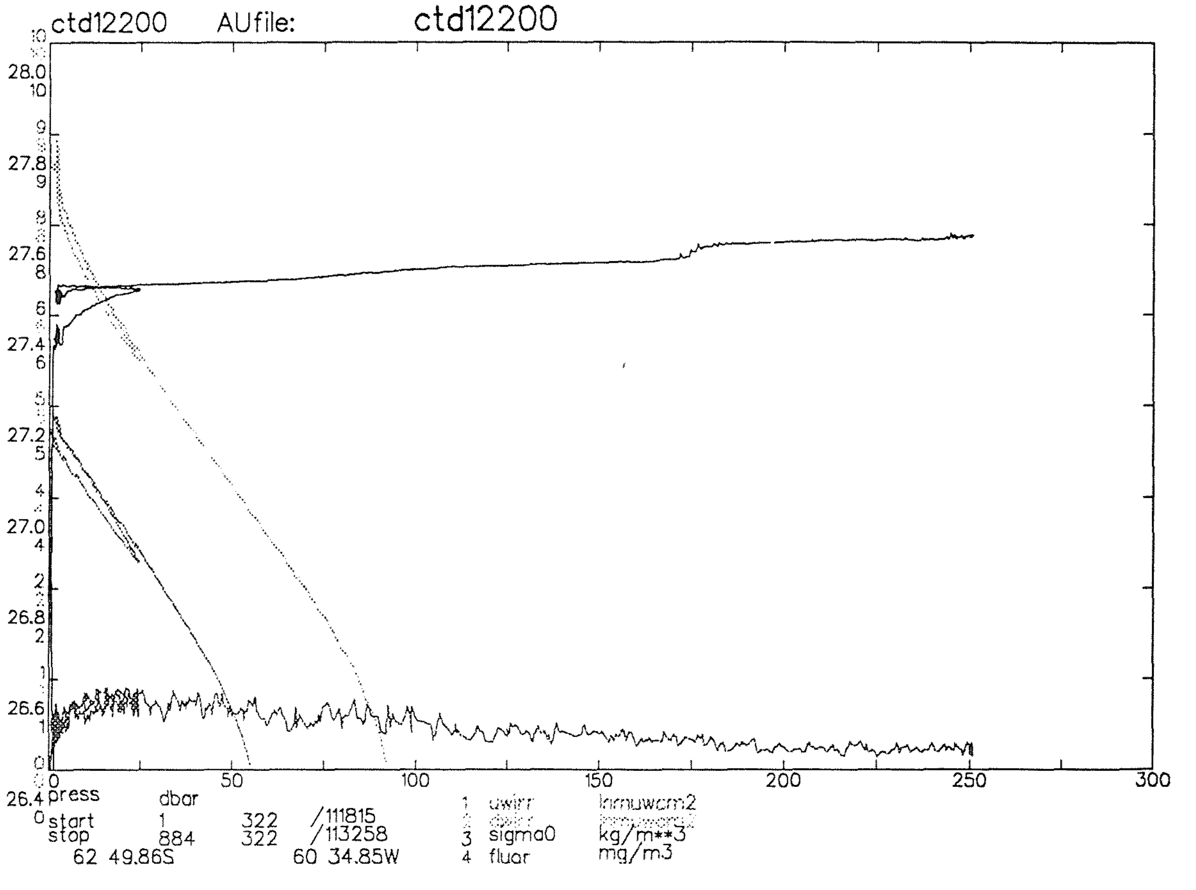
1000
1500
2000
2500
3000
3500
4000
4500
5000
8.0
7.0
6.0
5.0
4.0
−51
−54
−57
−61
−64
−67
lat degrees Z var− oxygen ml/l
8.2000
8.0000
7.8000
7.6000
7.4000
7.2000
7.0000
6.8000
6.6000
6.4000
6.2000
6.0000
5.8000
5.6000
5.4000
5.2000
5.0000
4.8000
4.6000
4.4000
4.2000
4.0000
3.8000


ctd12198 AXfile: ctd12198
press dbar
start 1 316 /223400
stop 779 316 /224700
52 29.71S 57 39.92W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m


ctd12198 AXfile: ctd12198
press dbar
start 1 316 /223400
stop 779 316 /224700
52 29.71S 57 39.92W
1 uwirr lnmuwcm2
3 sigma0 kg/m**3
4 fluor mg/m3


ctd12200 AUfile: ctd12200
press dbar
start 1 322 /111815
stop 884 322 /113258
62 49.86S 60 34.85W
1 potemp degc
2 salin
4 atten /m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stop 884 322 /113258
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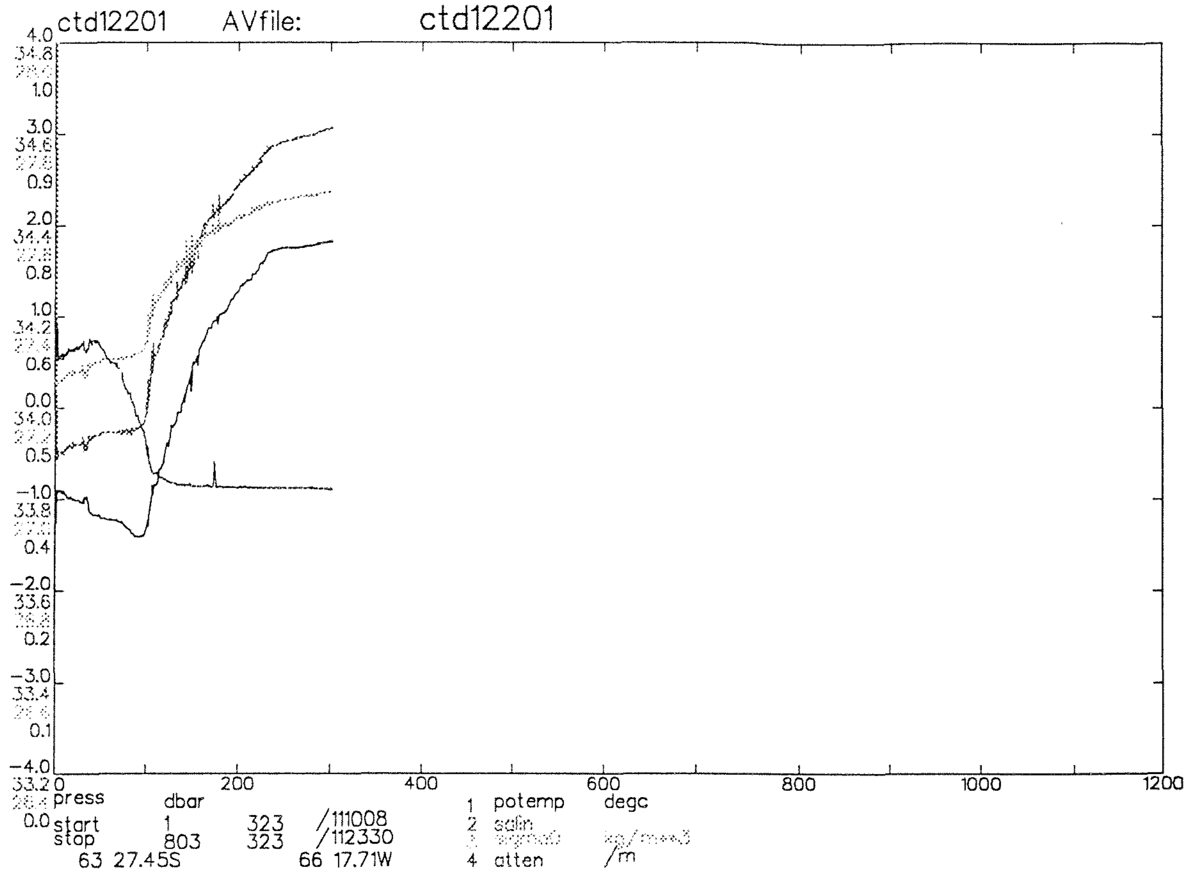
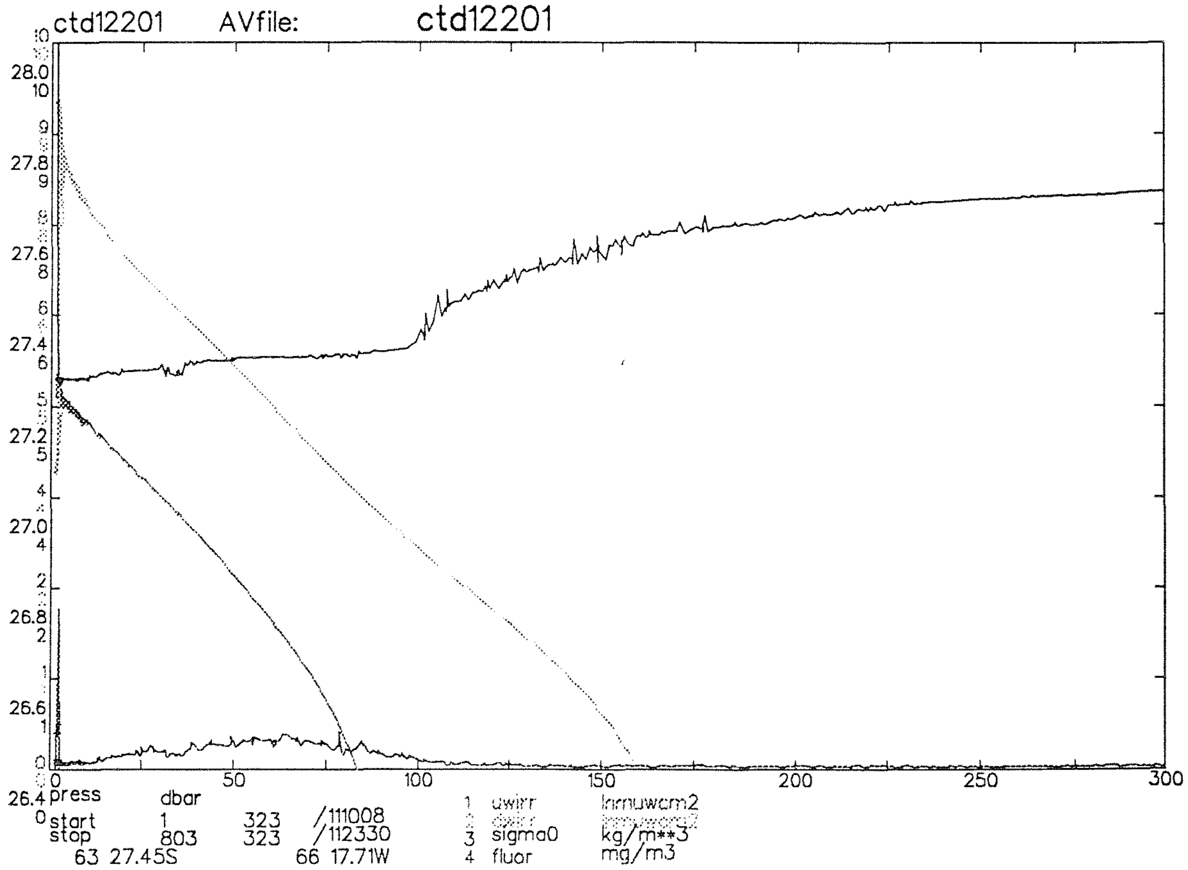
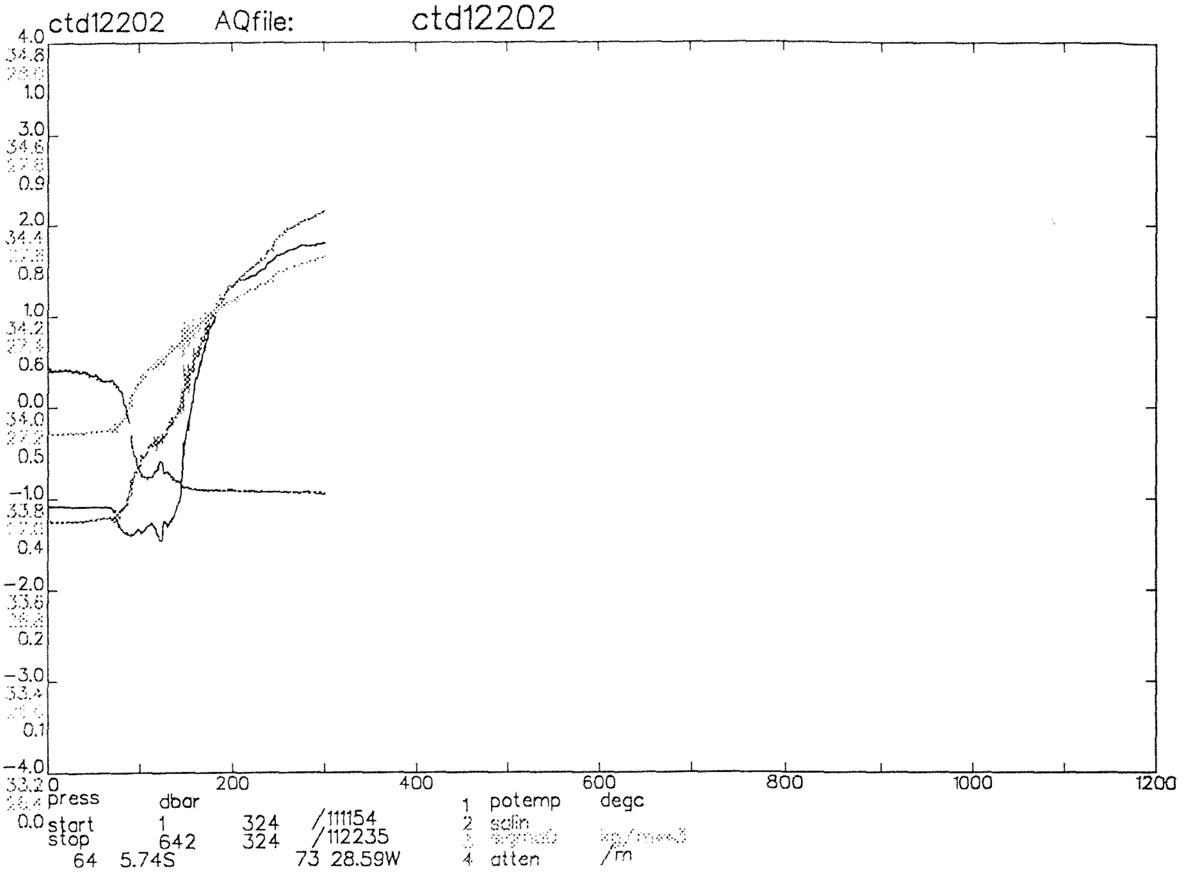
3 sigma0 kg/m**3
4 fluor mg/m3

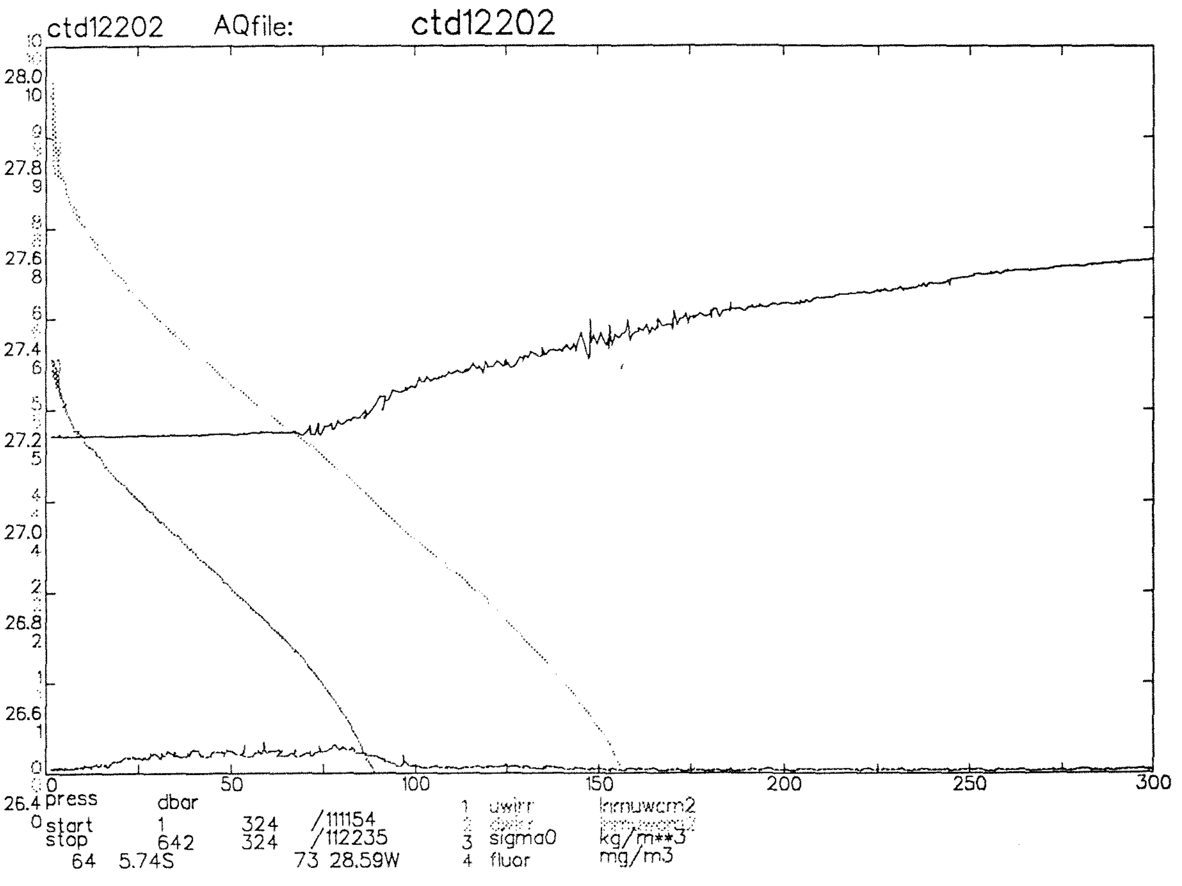

ctd12201 AVfile: ctd12201
press dbar
start 1 323 /111008
stop 803 323 /112330
63 27.45S 66 17.71W
1 potemp degc
2 salin
4 atten /m

×


ctd12201 AVfile: ctd12201
press dbar
start 1 323 /111008
stop 803 323 /112330
63 27.45S 66 17.71W
1 uwirr
3 sigma0 kg/m**3
4 fluor mg/m3

×


ctd12202 AQfile: ctd12202
press dbar
start 1 324 /111154
stop 642 324 /112235
64 5.74S 73 28.59W
1 potemp degc
2 salin
4 atten /m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press dbar
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stop 642 324 /112235
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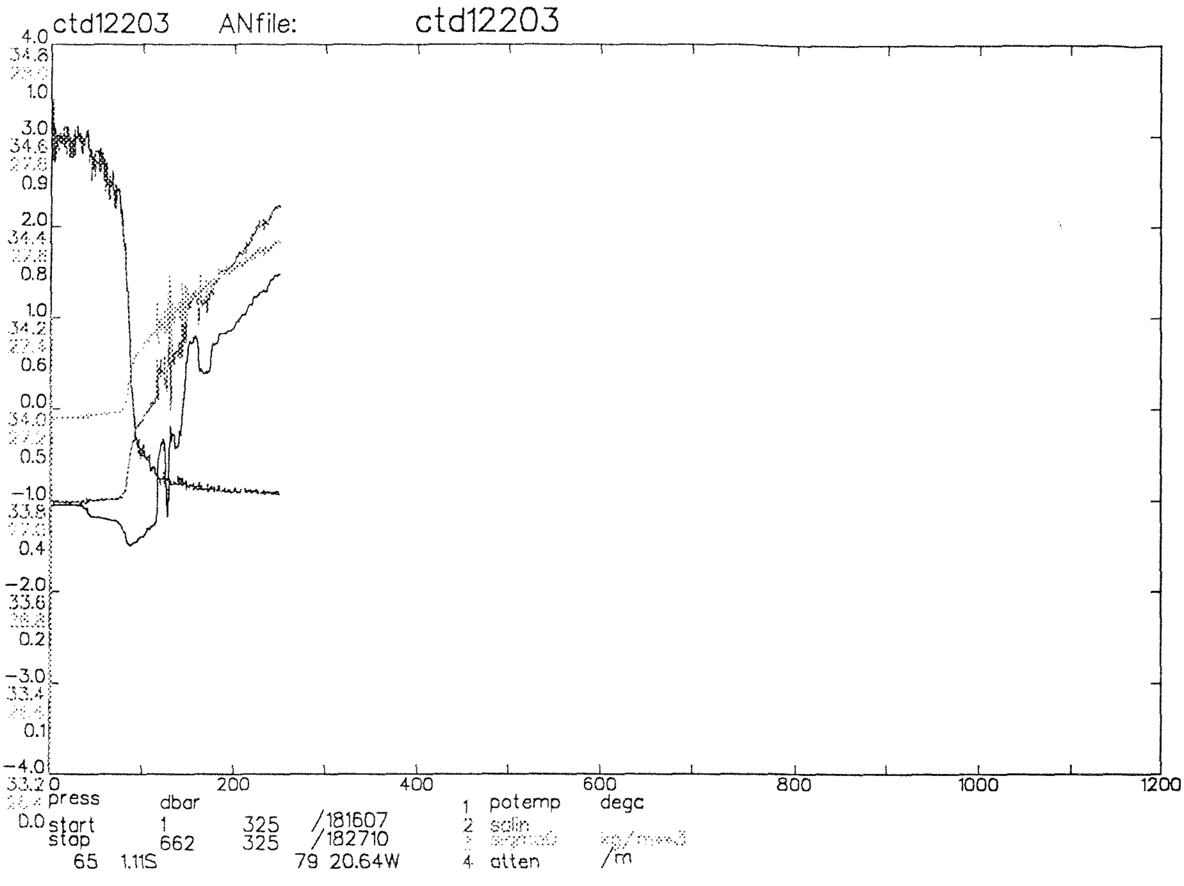
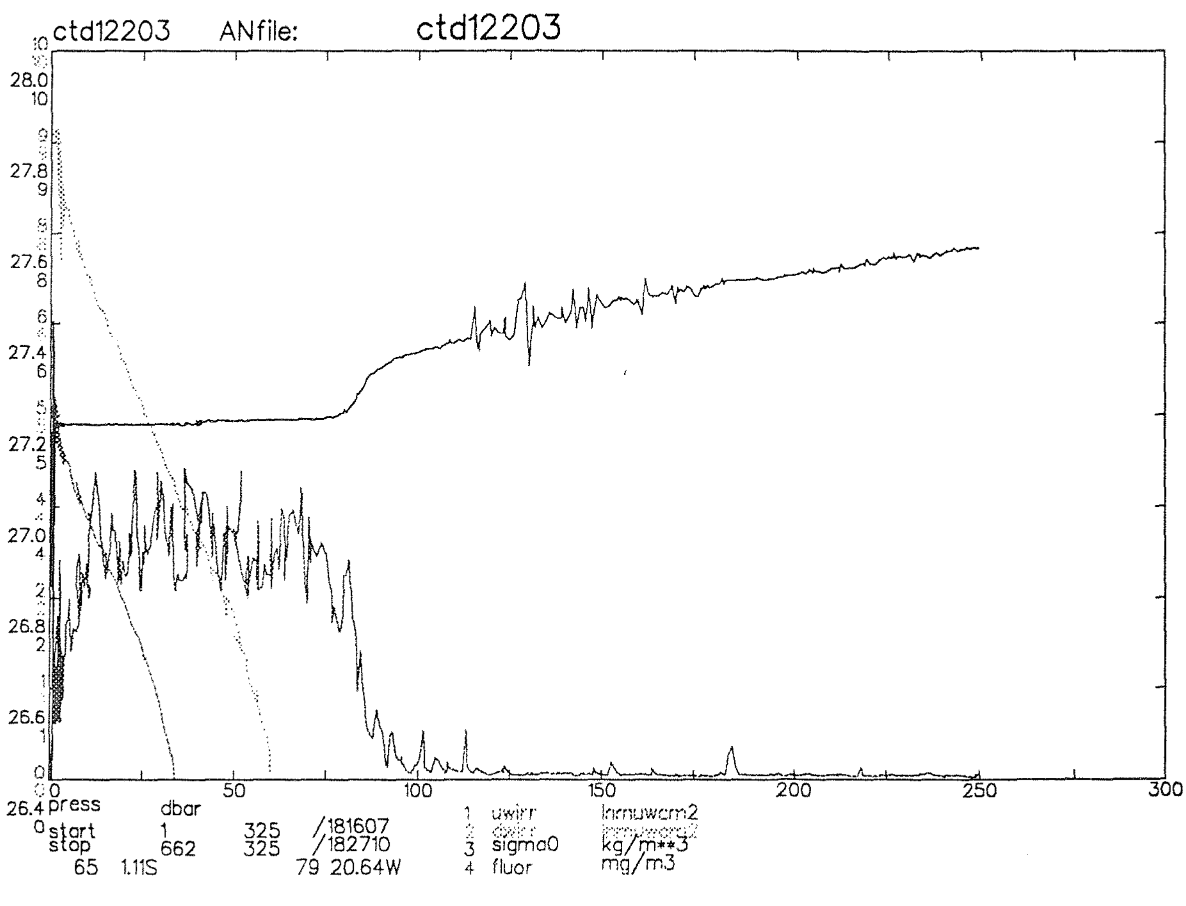
1 uwirr
3 sigma0 kg/m**3
4 fluor mg/m3


ctd12203 ANfile: ctd12203
press dbar
start 1 325 /181607
stop 662 325 /182710
65 1.11S 79 20.64W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m


ctd12203 ANfile: ctd12203
press dbar
start 1 325 /181607
stop 662 325 /182710
65 1.11S 79 20.64W
1 uwirr lnmuwcm2
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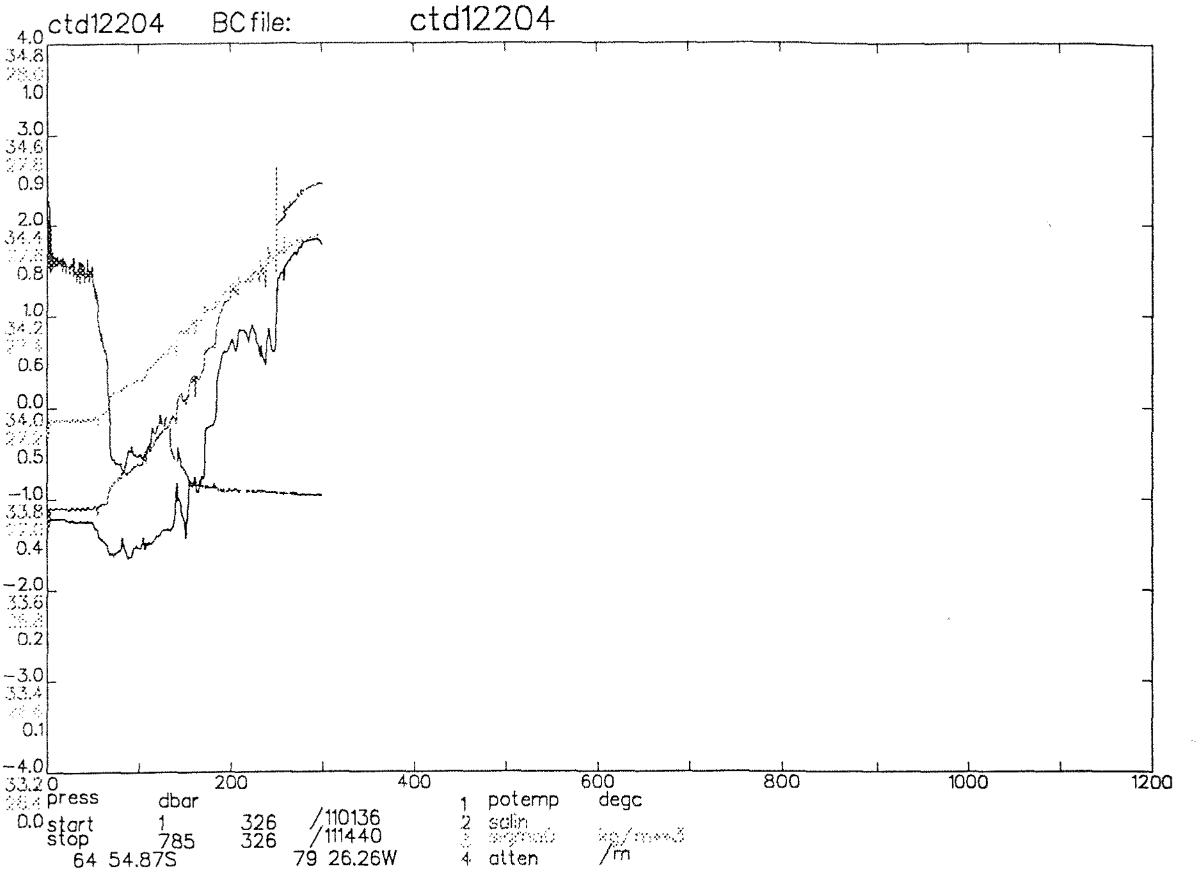
3 sigma0 kg/m**3
4 fluor mg/m3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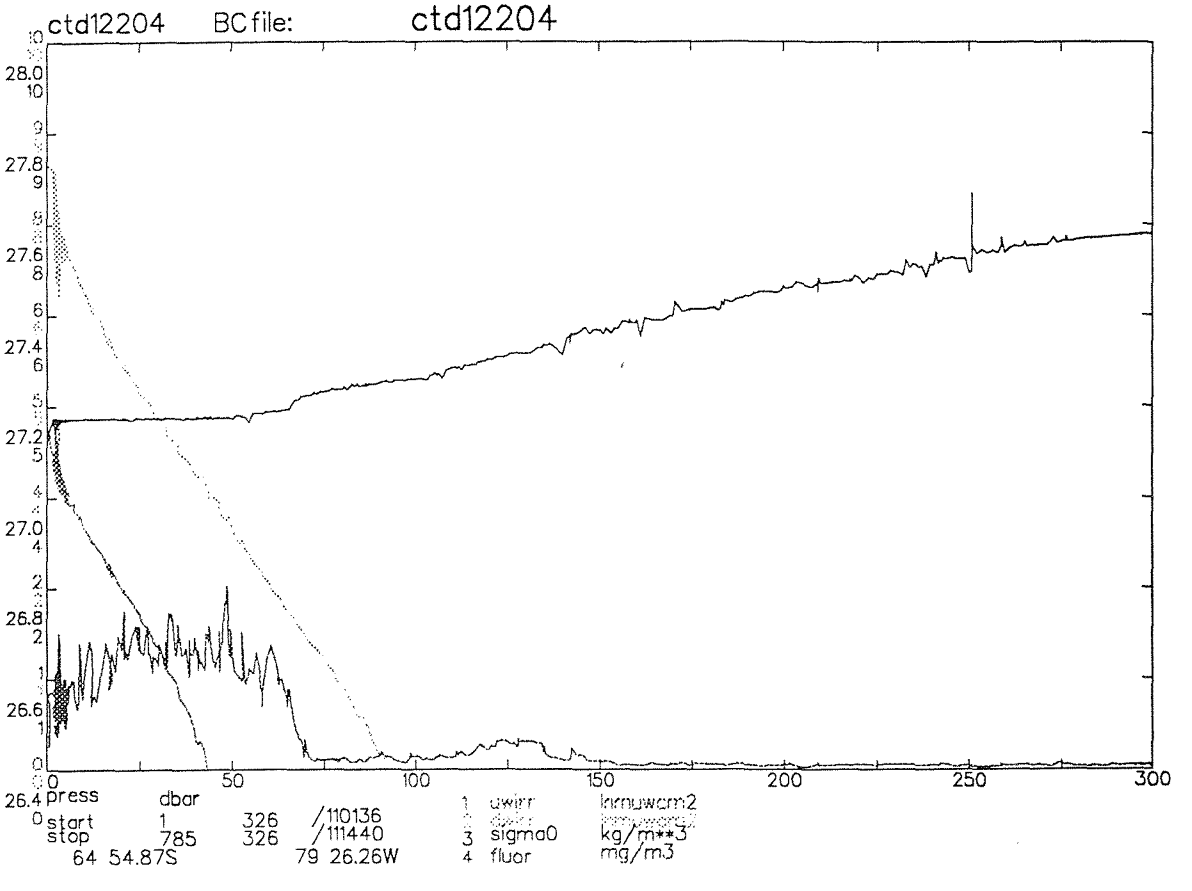
press dbar
start 1 326 /110136
stop 785 326 /111440
64 54.87S 79 26.26W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m


ctd12204 BC file: ctd12204
press dbar
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stop 785 326 /111440
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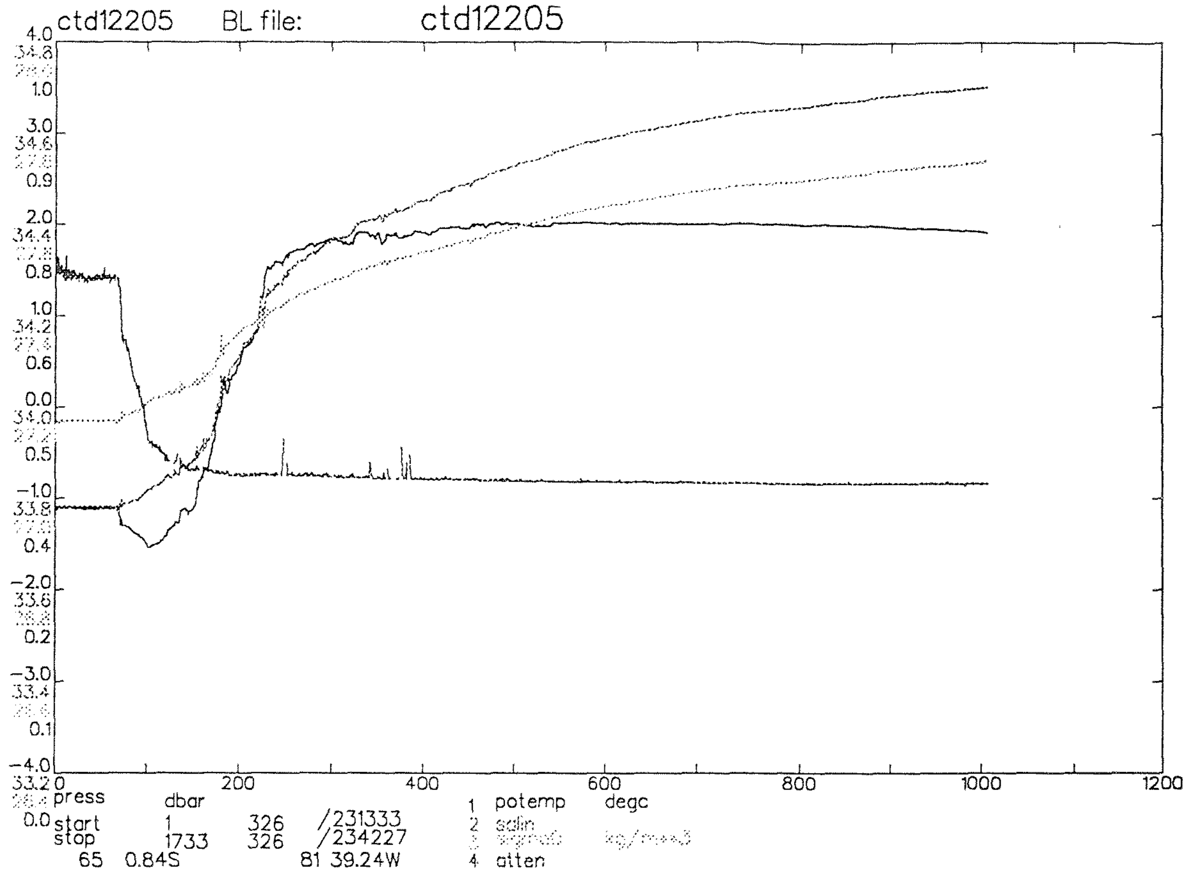
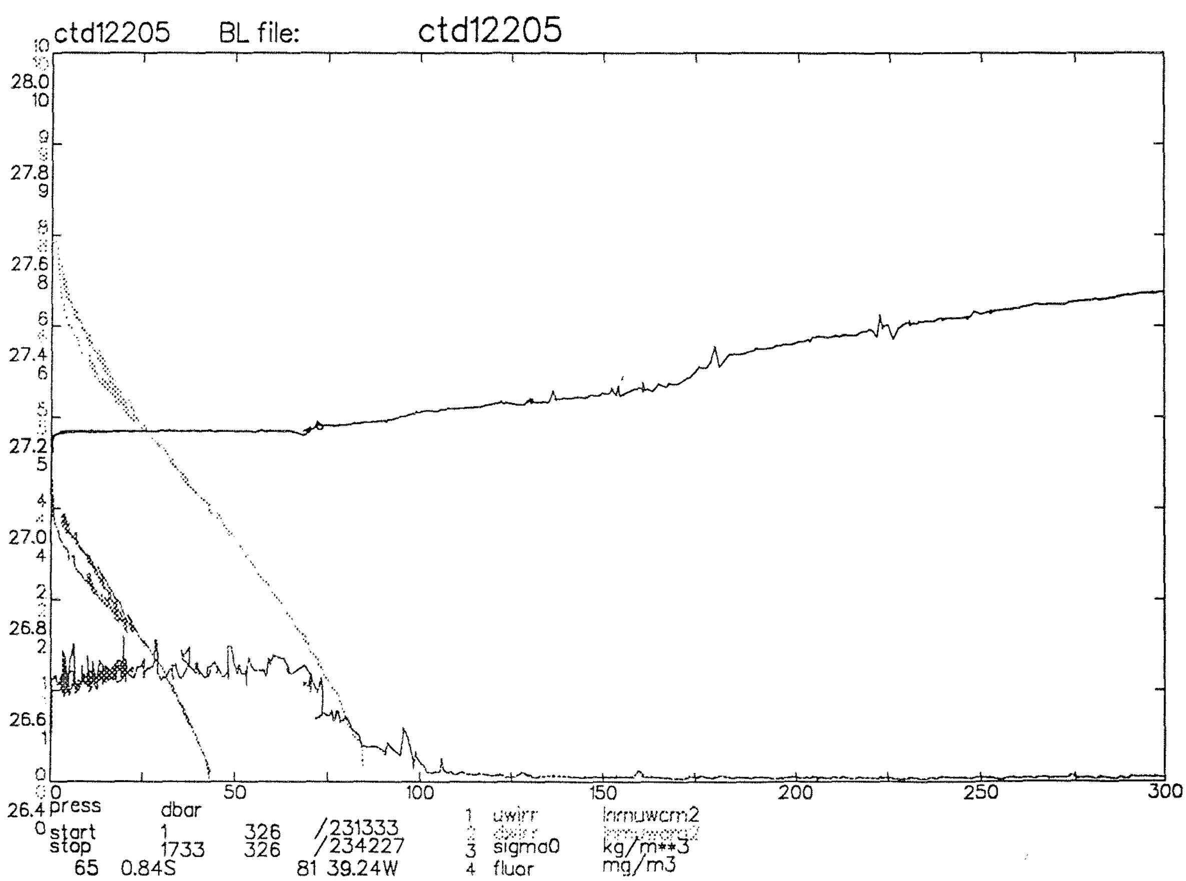
1 uwirr
3 sigma0 kg/m**3
4 fluor mg/m3


ctd12205
BL file:
ctd12205
press
dbar
start 1 326 /231333
stop 1733 326 /234227
65 0.84S
81 39.24W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten
0
200
400
600
800
1000
1200

×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BL file:
ctd12205
press
dbar
start 1 326 /231333
stop 1733 326 /234227
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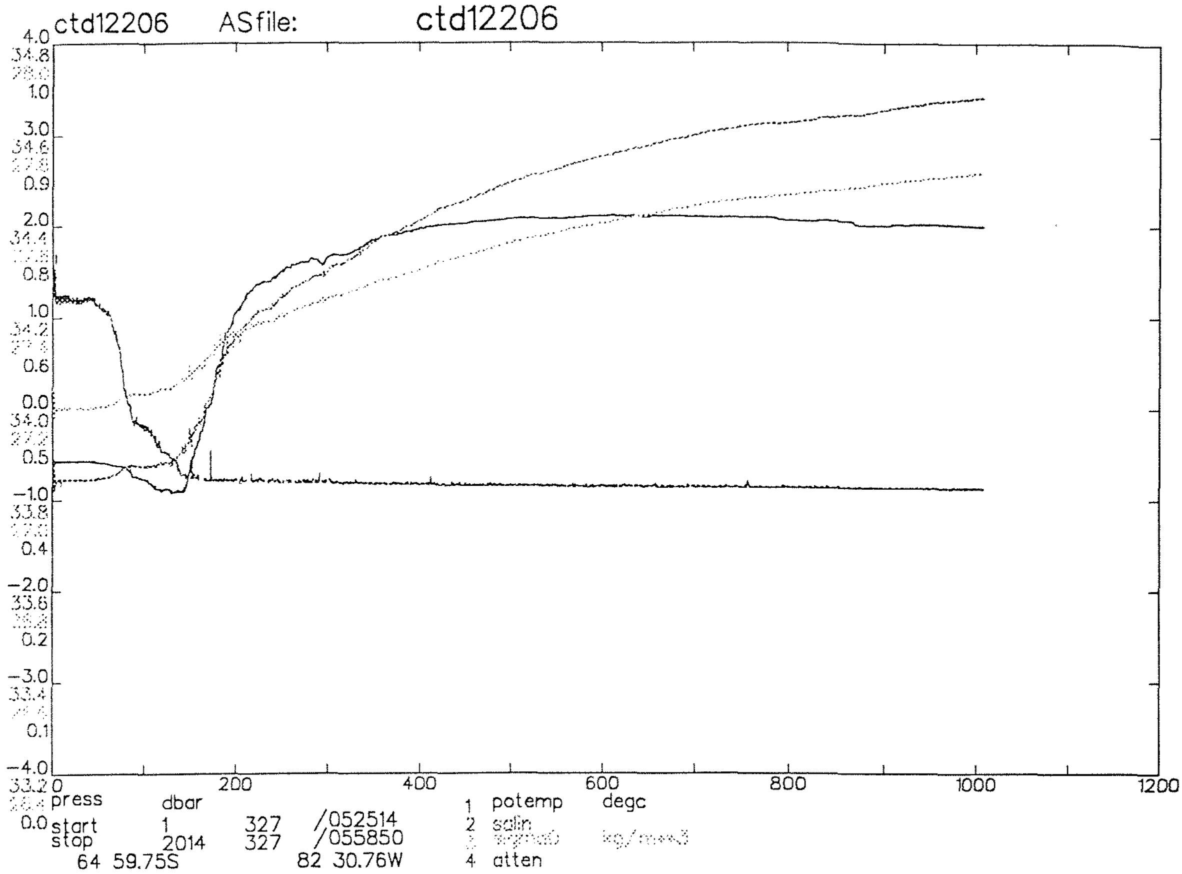
81 39.24W
1 uwirr lrmuwcm2
3 sigma0 kg/m**3
4 fluor mg/m3
0
50
100
150
200
250
300

×



ctd12206 ASfile: ctd12206
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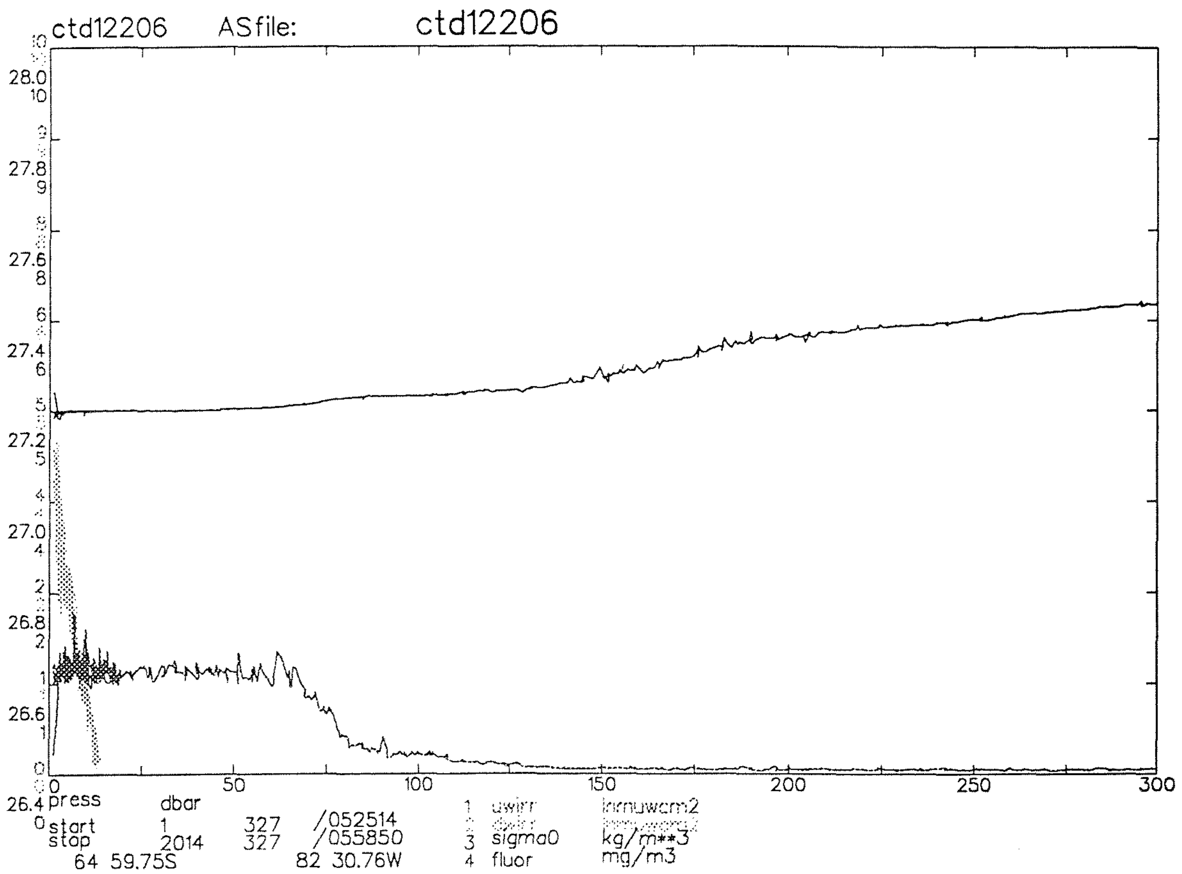
start 1 327 /052514
stop 2014 327 /055850
64 59.75S 82 30.76W
1 potemp degc
2 salin
4 atten

×



ctd12206 ASfile: ctd12206
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stop 2014 327 /055850
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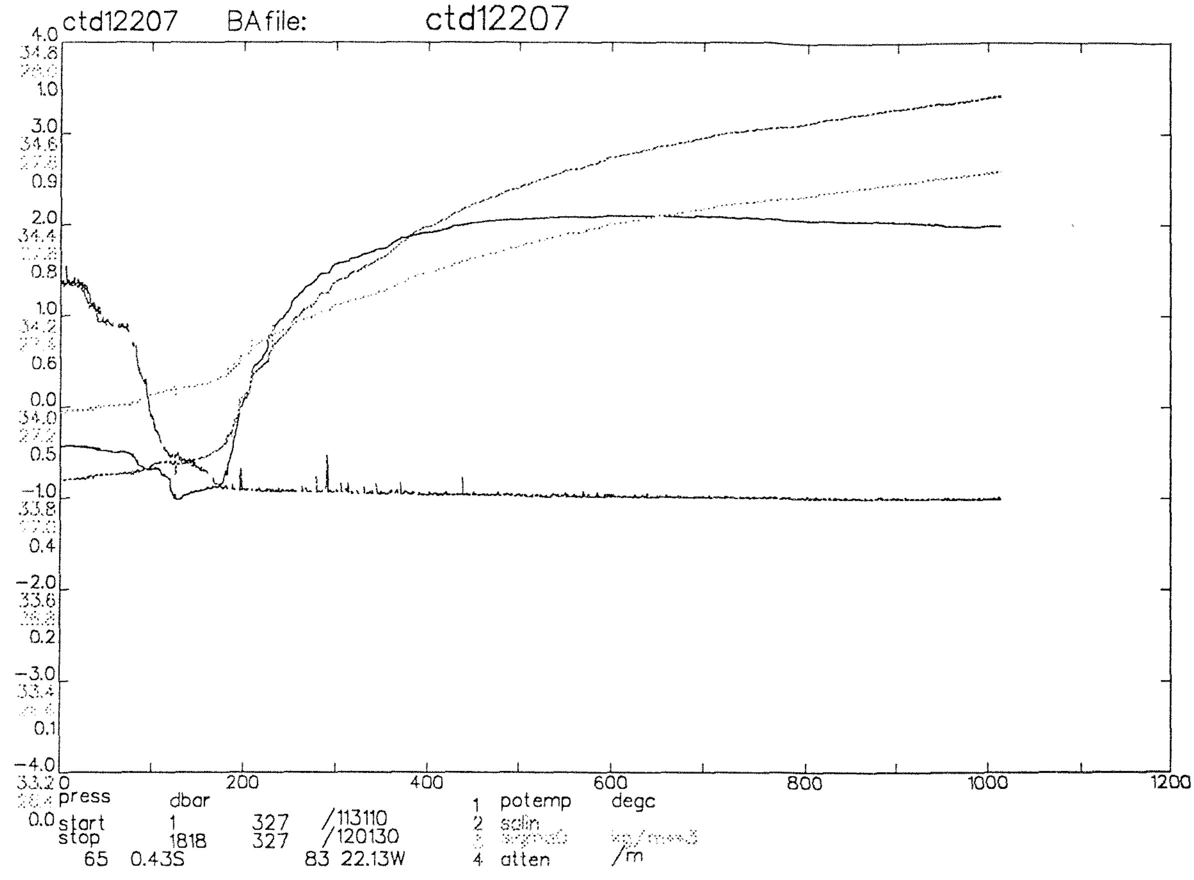
1 uwirr
3 sigma0 kg/m**3
4 fluor mg/m3

×


ctd12207 BAfile: ctd12207
press dbar
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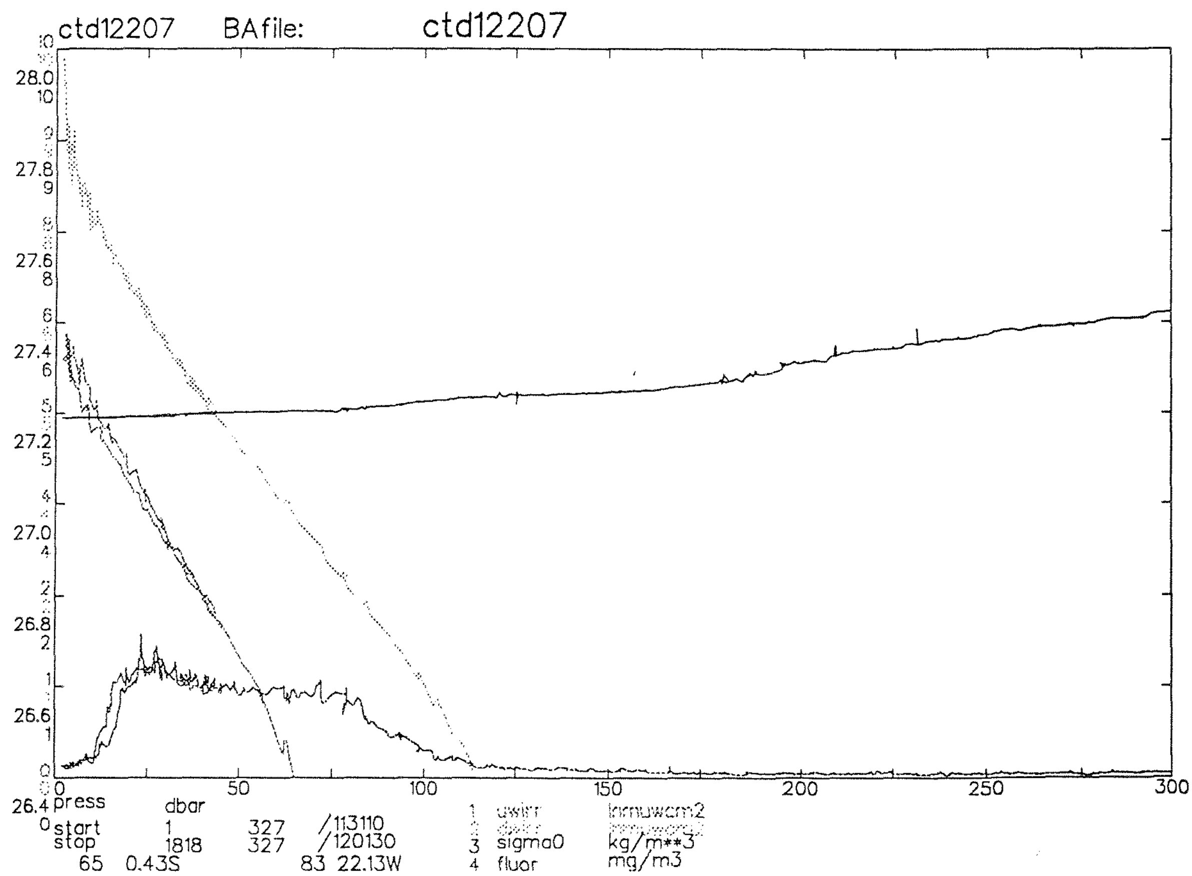
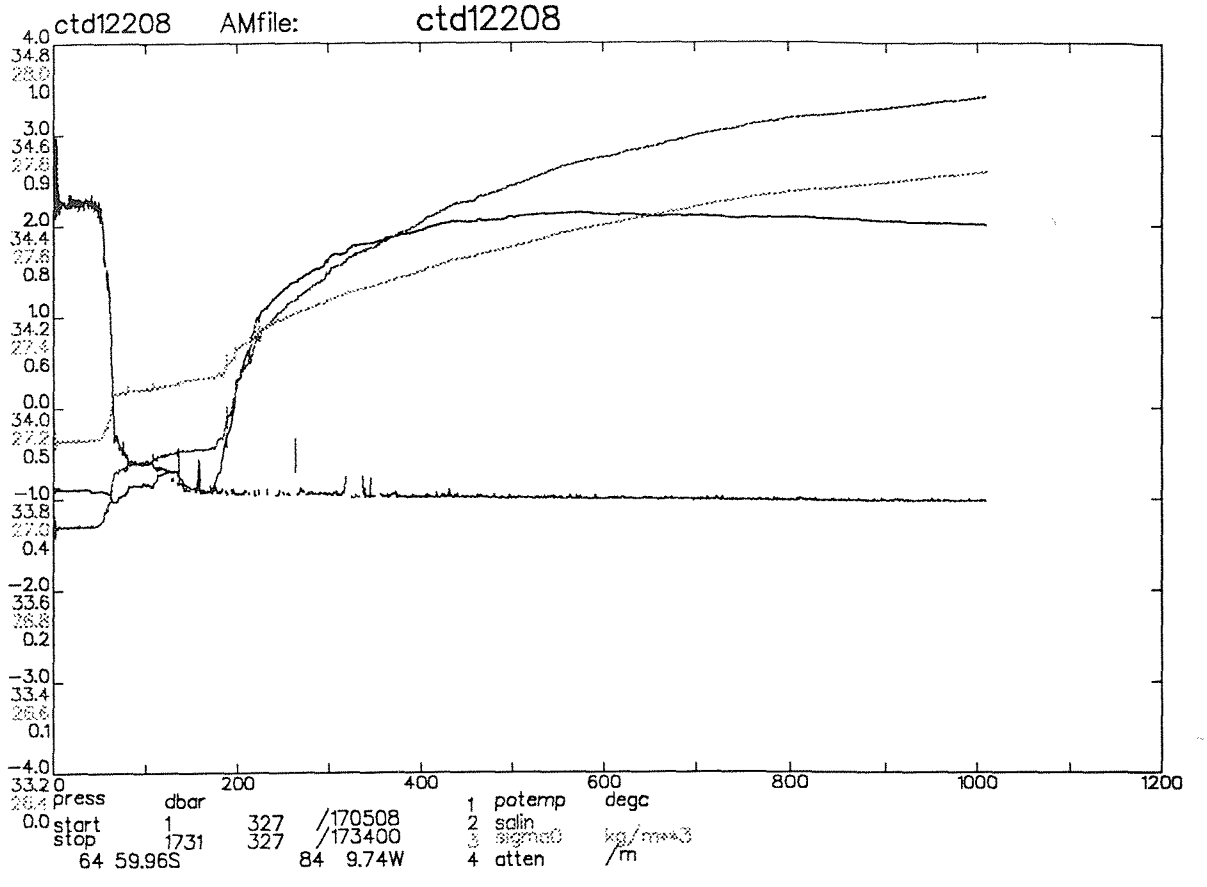
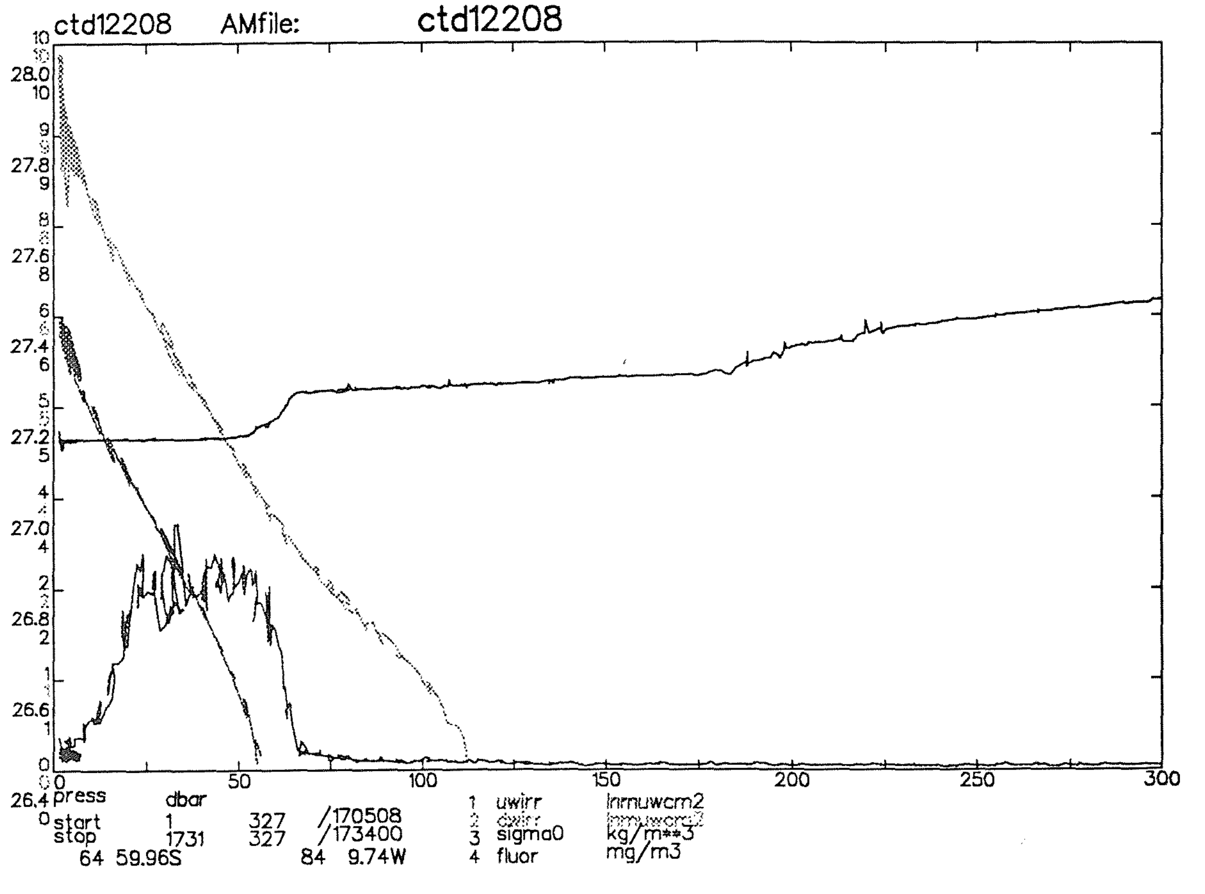
stop 1818 327 /120130
65 0.43S 83 22.13W
1 potemp degc
2 salin
4 atten /m
0 200 400 600 800 1000 1200


ctd12207 BAfile: ctd12207
press dbar
start 1 327 /113110
stop 1818 327 /120130
65 0.43S 83 22.13W
3 sigma0 kg/m**3
4 fluor mg/m3
0 50 100 150 200 250 300


ctd12208 AMfile: ctd12208
press dbar
start 1 327 /170508
stop 1731 327 /173400
64 59.96S 84 9.74W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m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press dbar
start 1 327 /170508
stop 1731 327 /173400
64 59.96S 84 9.74W
1 uwirr lnmuwcm2
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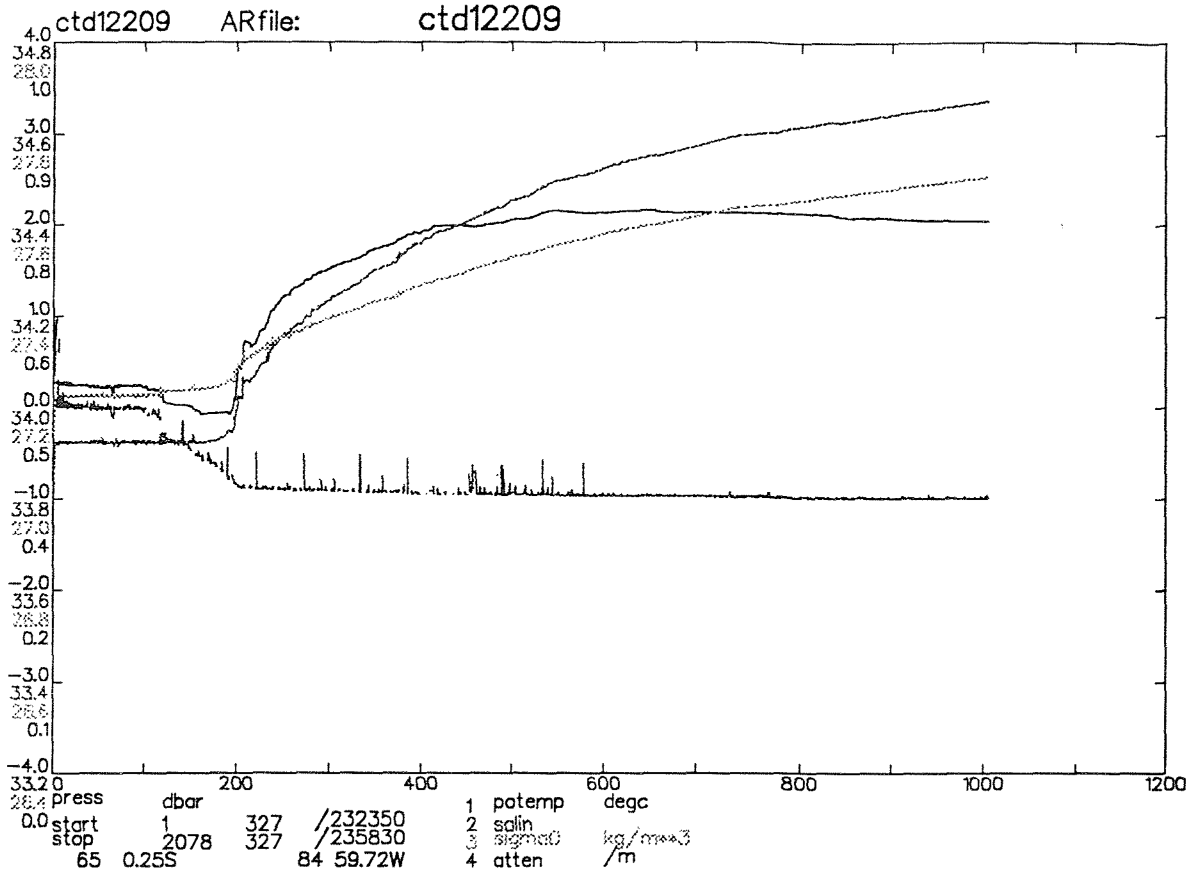
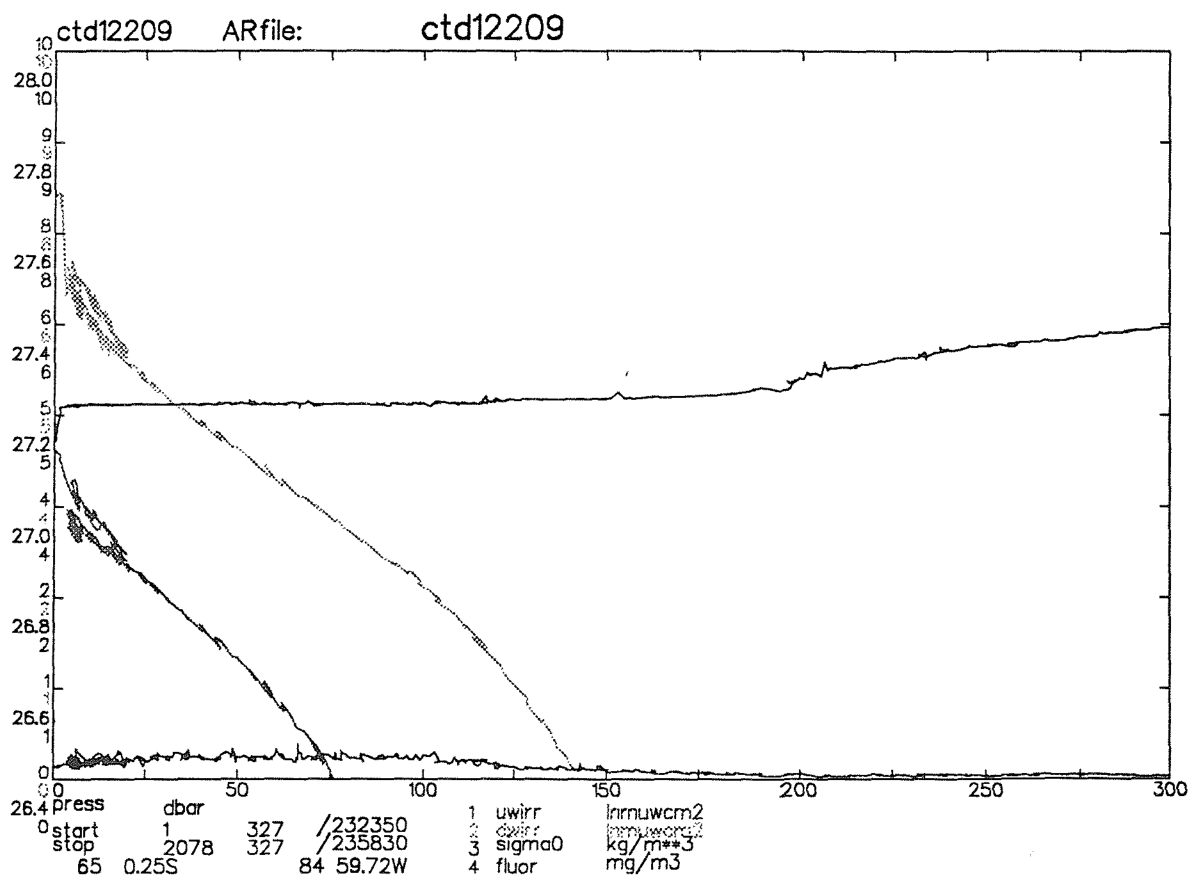
3 sigma0 kg/m**3
4 fluor mg/m3


ctd12209 ARfile: ctd12209
press dbar
start 1 327 /232350
stop 2078 327 /235830
65 0.25S 84 59.72W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m


ctd12209 ARfile: ctd12209
press dbar
start 1 327 /232350
stop 2078 327 /235830
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1 uwirr lnmuwcm2
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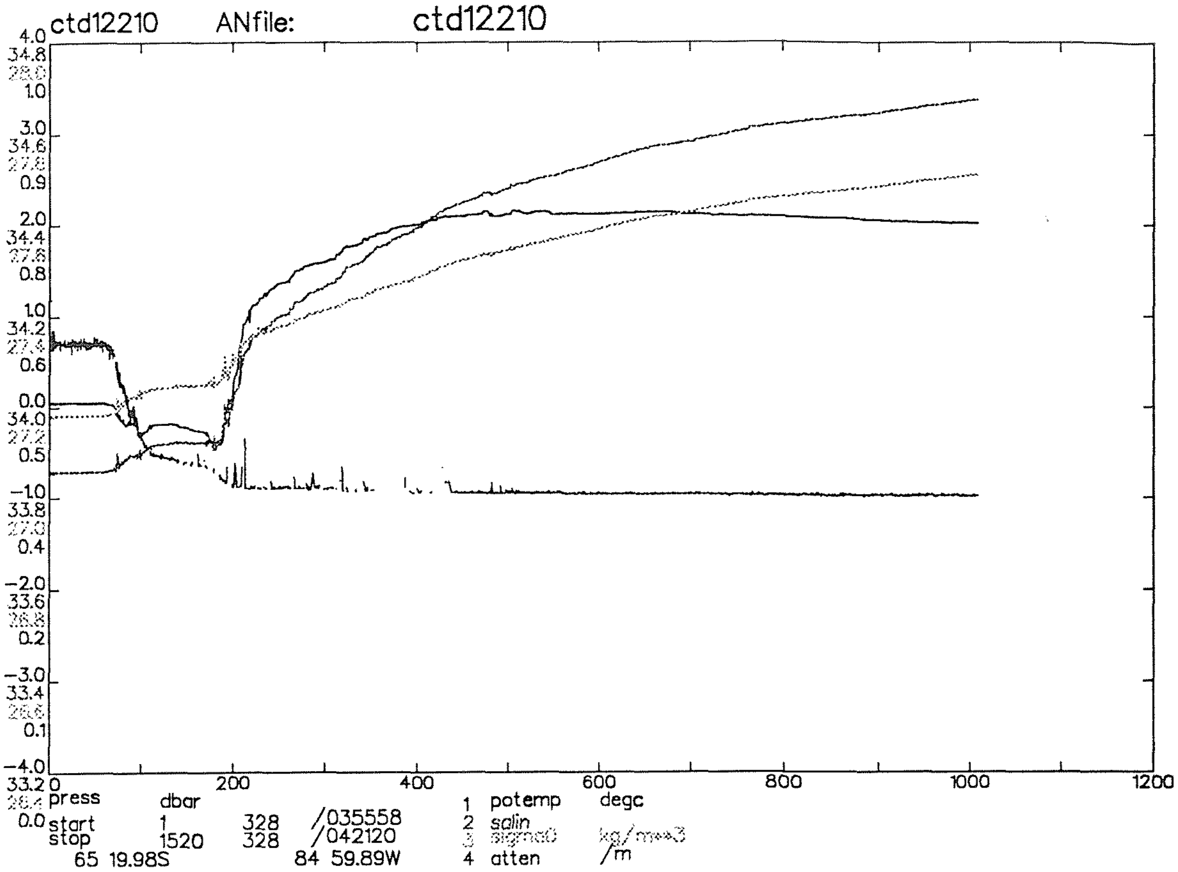
3 sigma0 kg/m**3
4 fluor mg/m3


ctd12210 ANfile: ctd12210
press dbar
start 1 328 /035558
stop 1520 328 /042120
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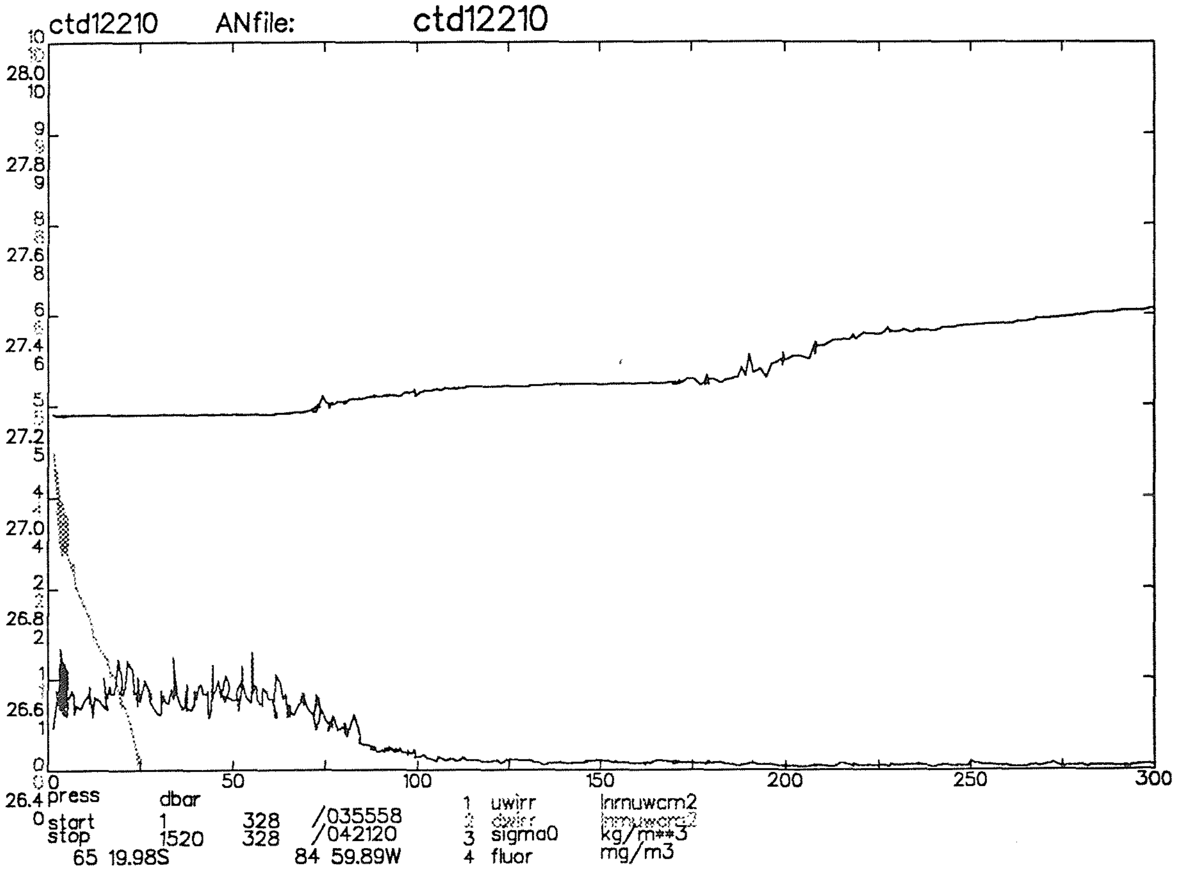
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m
0 200 400 600 800 1000 1200

×


ctd12210 ANfile: ctd12210
press dbar
start 1 328 /035558
stop 1520 328 /042120
65 19.98S 84 59.89W
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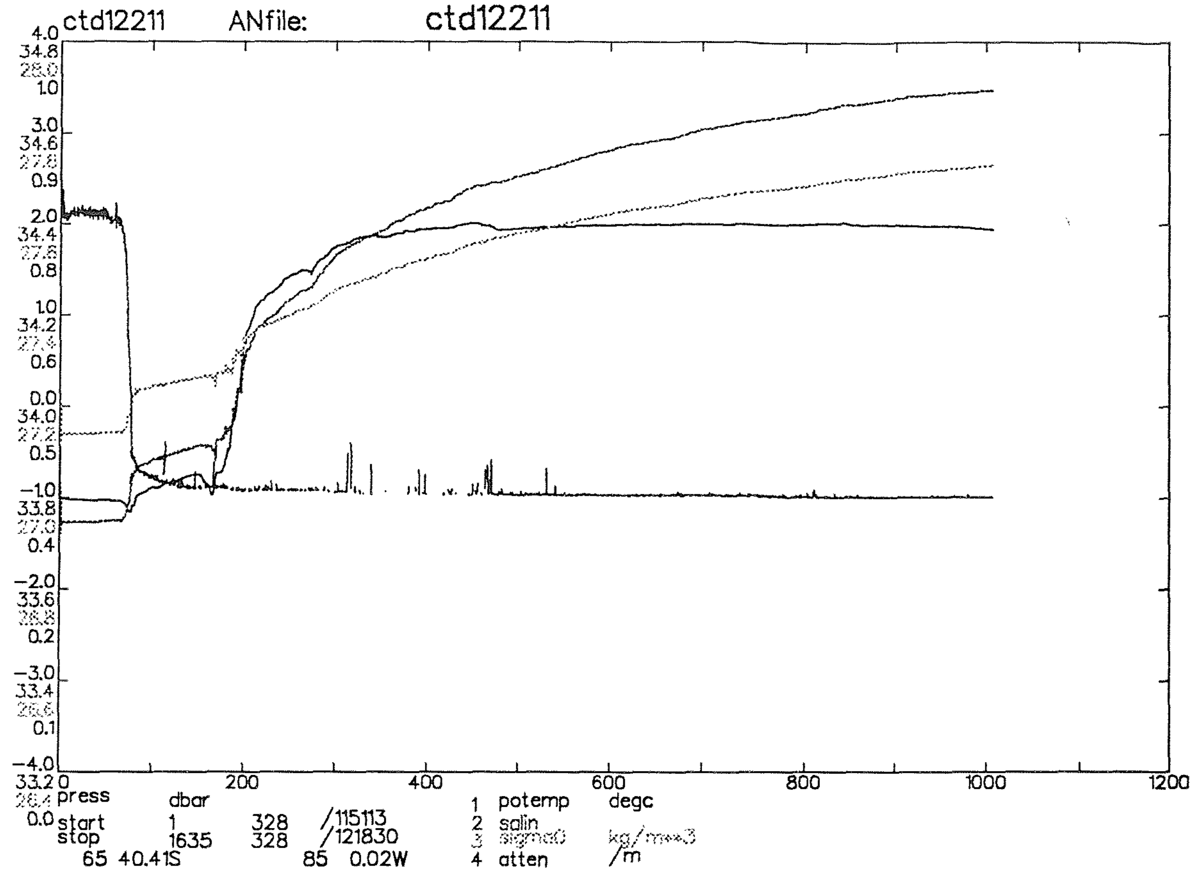
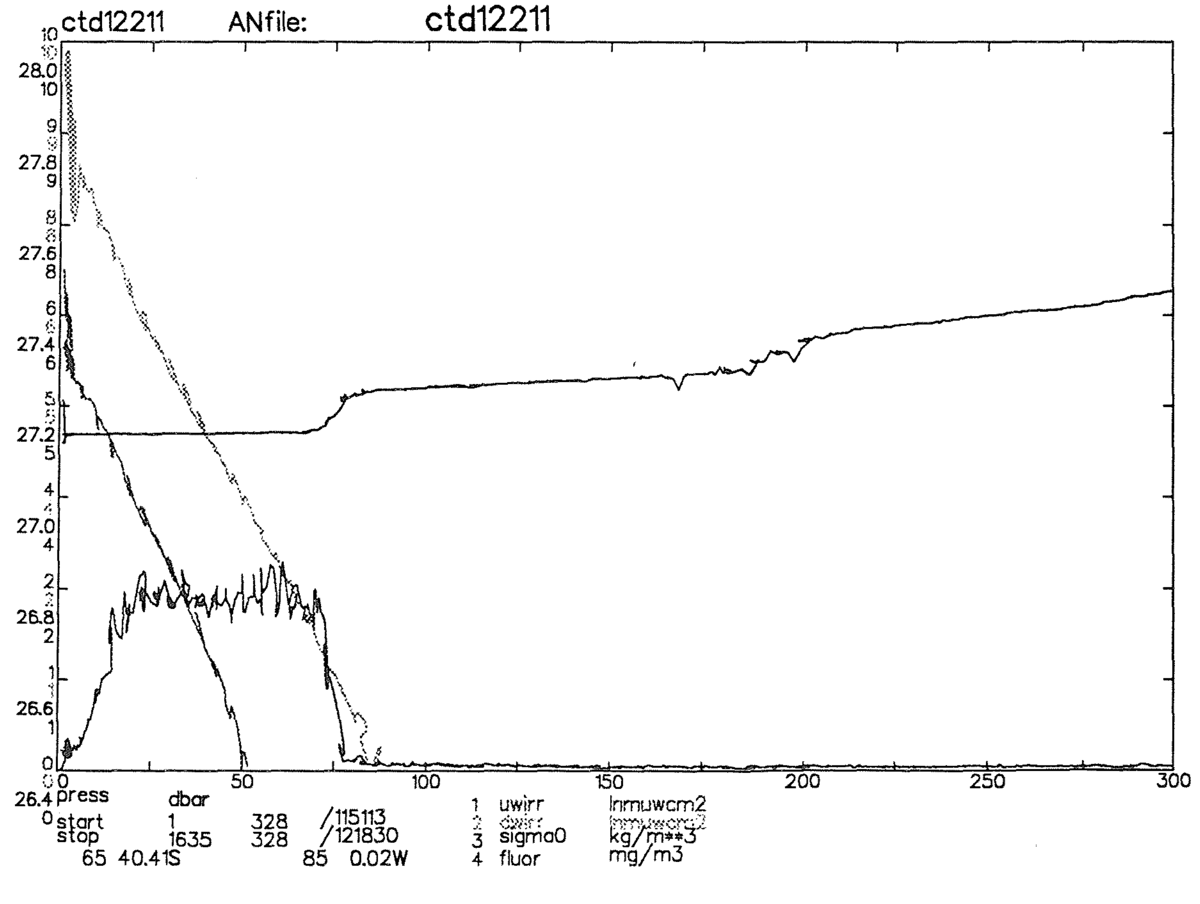
2 dwirr lnmuwcm2
3 sigma0 kg/m**3
4 fluor mg/m3
0 50 100 150 200 250 300

×


ctd12211
ANfile:
ctd12211
press
dbar
start 1 328 /115113
stop 1635 328 /121830
65 40.41S 85 0.02W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m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ANfile:
ctd12211
press
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stop 1635 328 /121830
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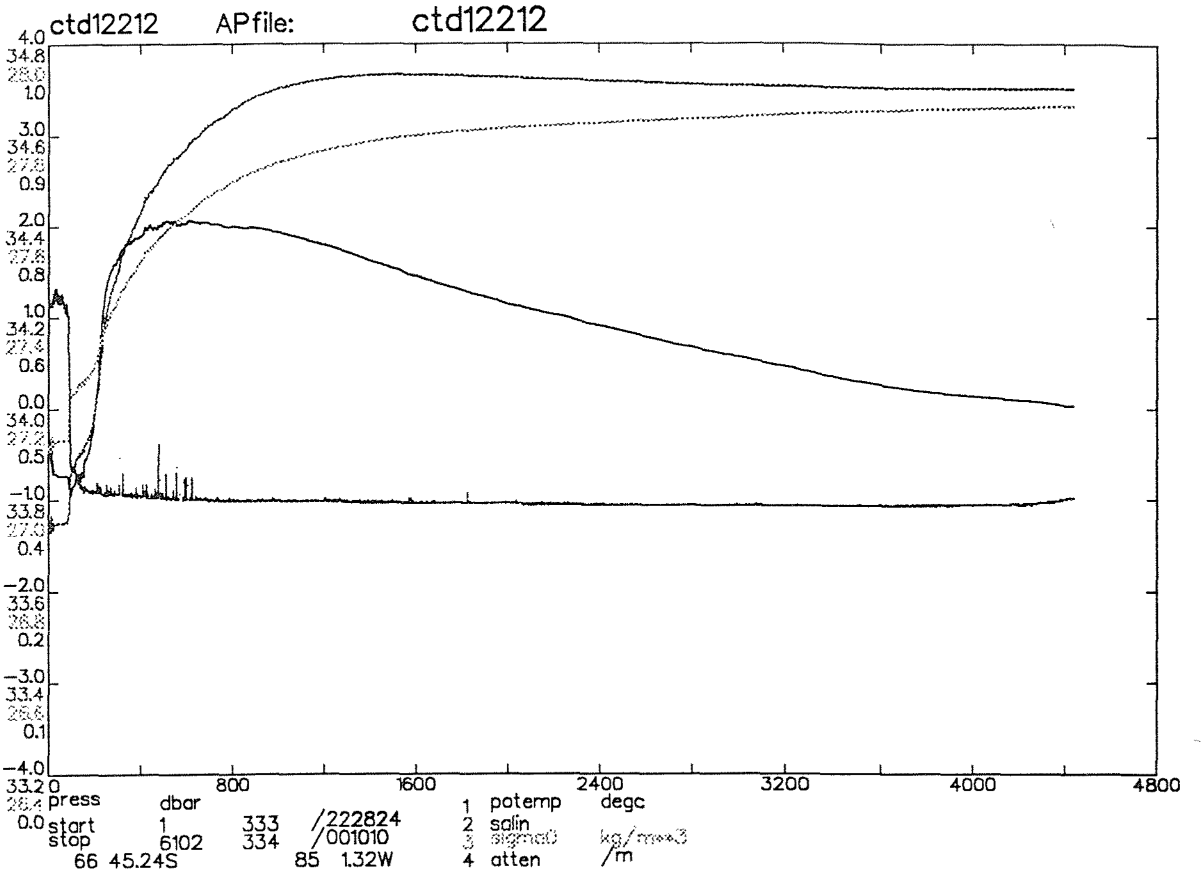
2 dwirr lnmuwcm2
3 sigma0 kg/m**3
4 fluor mg/m3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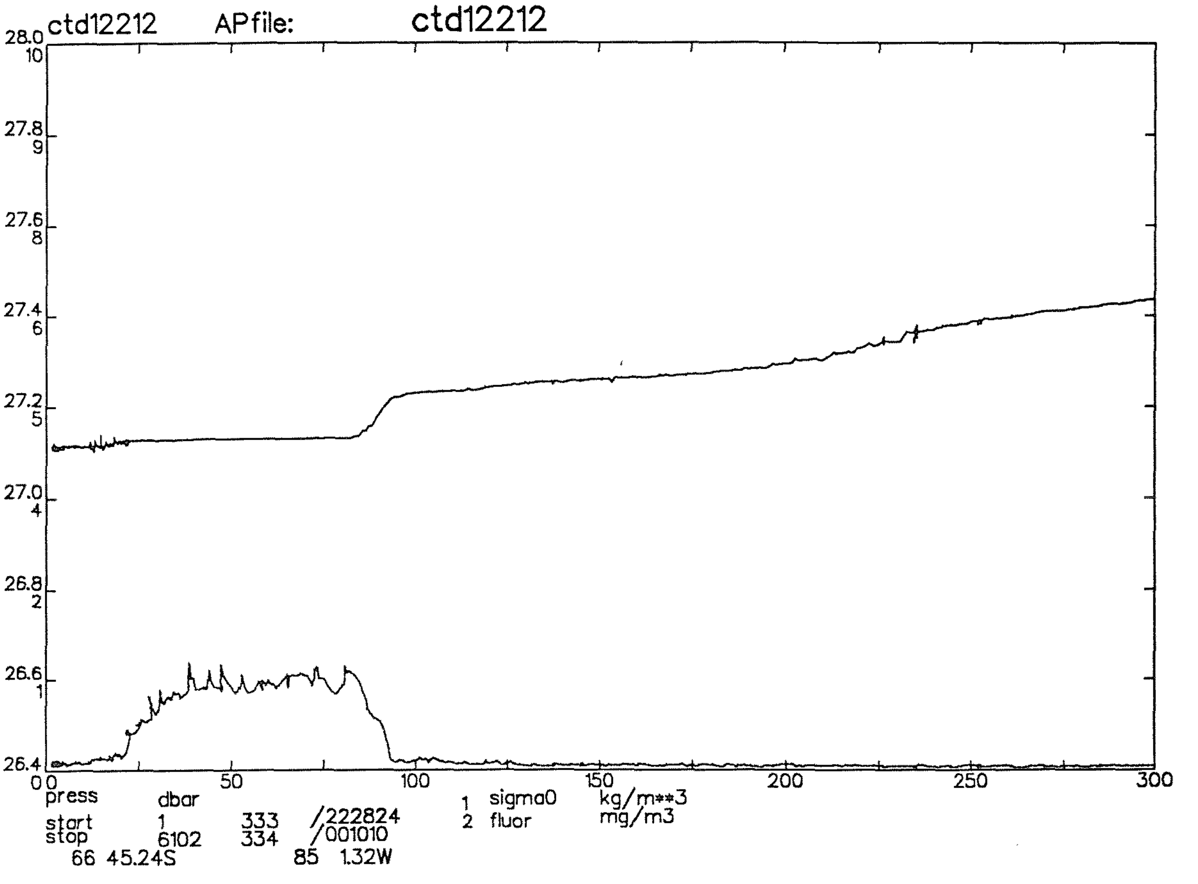
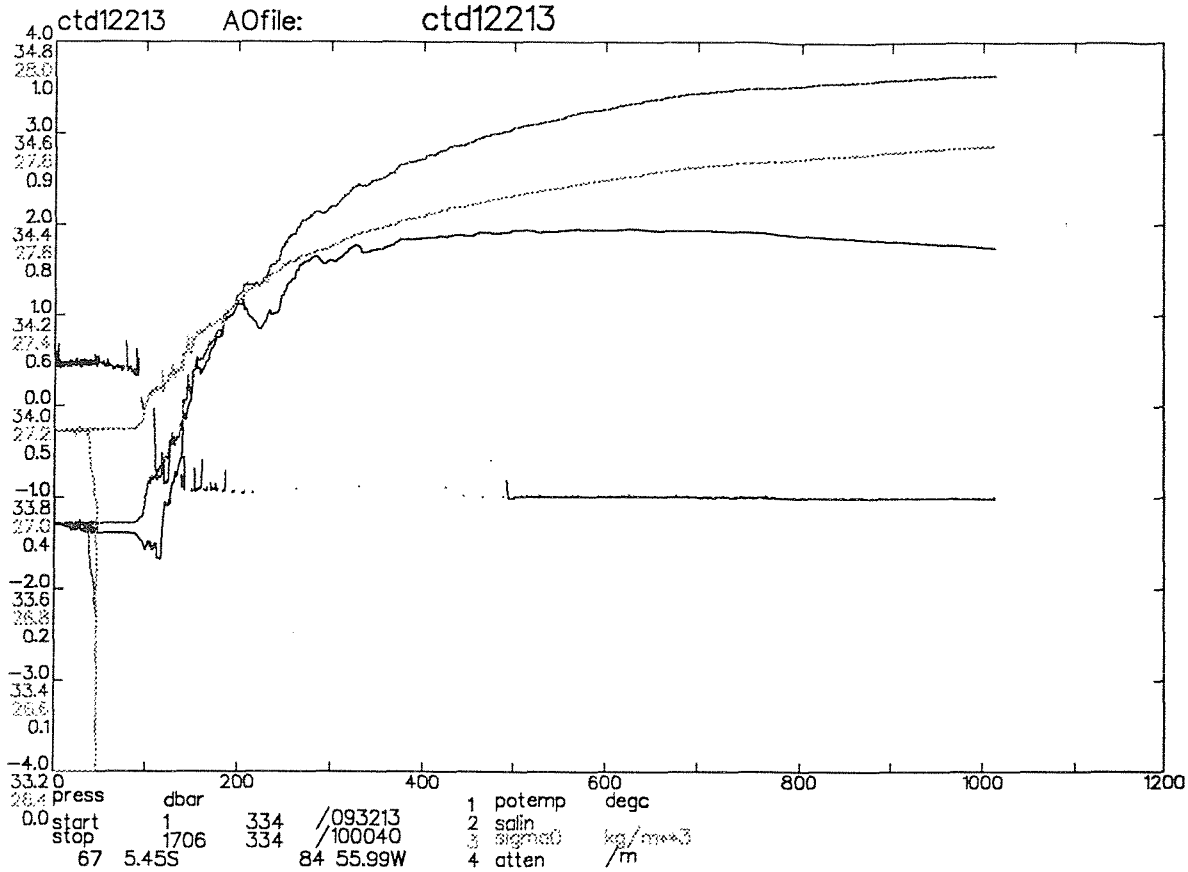
34.8
28.0
1.0
3.0
34.6
27.8
0.9
2.0
34.4
27.6
0.8
1.0
34.2
27.4
0.6
0.0
34.0
27.2
0.5
-1.0
33.8
27.0
0.4
-2.0
33.6
26.8
0.2
-3.0
33.4
26.6
0.1
-4.0
33.2
26.4
0.0
0
800
1600
2400
3200
4000
4800
press dbar
start 1 333 /222824
stop 6102 334 /001010
66 45.24S 85 1.32W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m

×


ctd12212 APfile: ctd12212
28.0
10
27.8
9
27.6
8
27.4
6
27.2
5
27.0
4
26.8
2
26.6
1
26.4
0
0
50
100
150
200
250
300
press dbar
start 1 333 /222824
stop 6102 334 /001010
66 45.24S 85 1.32W
1 sigma0 kg/m**3
2 fluor mg/m3

×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press dbar
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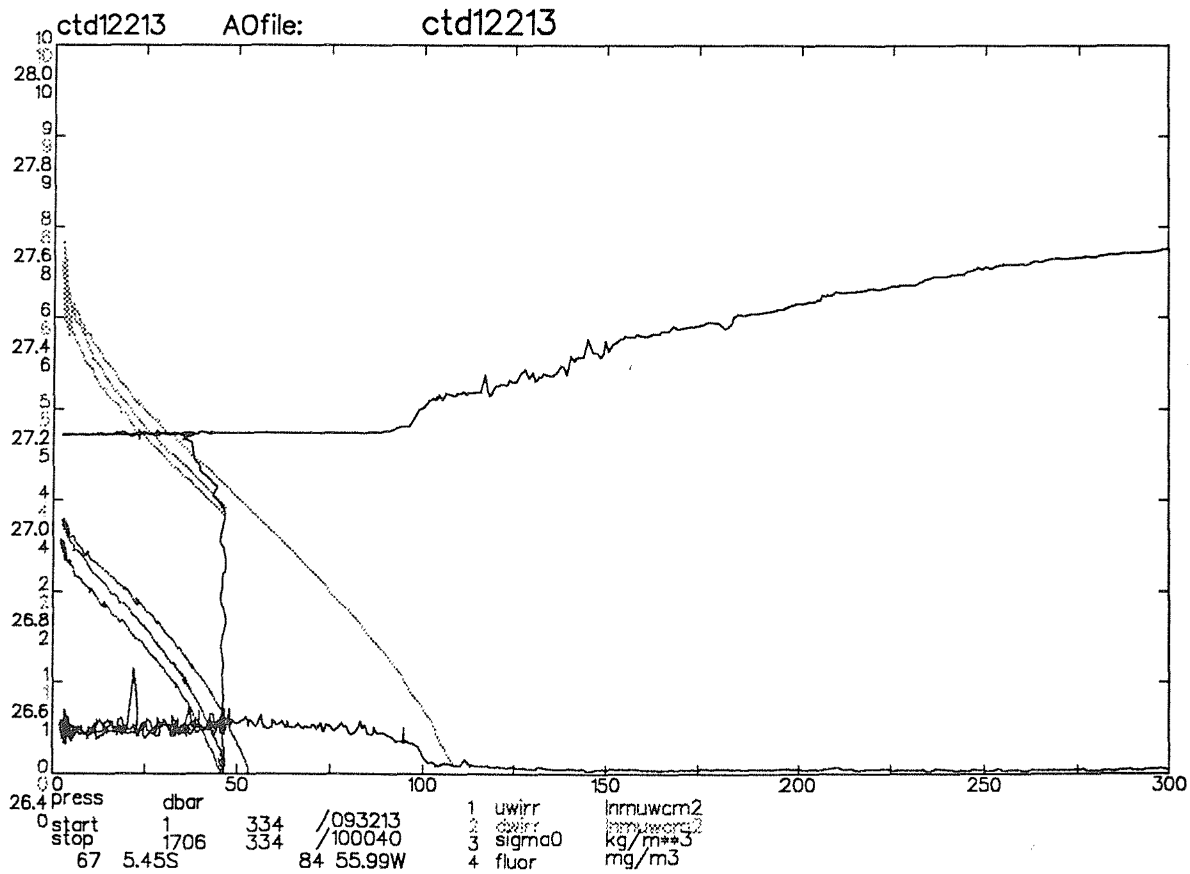
stop 1706 334 /100040
67 5.45S 84 55.99W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m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start 1 334 /093213
stop 1706 334 /100040
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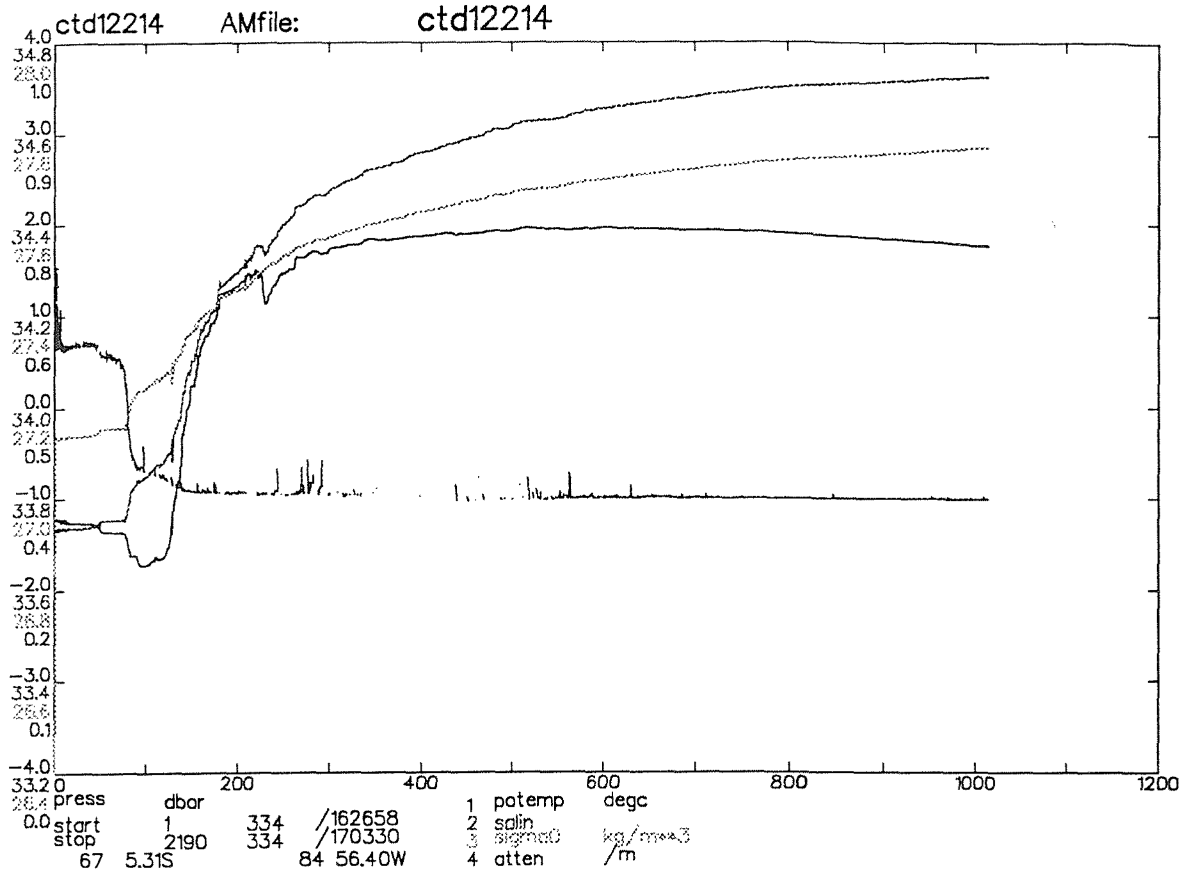
1 uwirr lnmuwcm2
2 dwirr lnmuwcm2
3 sigma0 kg/m**3
4 fluor mg/m3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200
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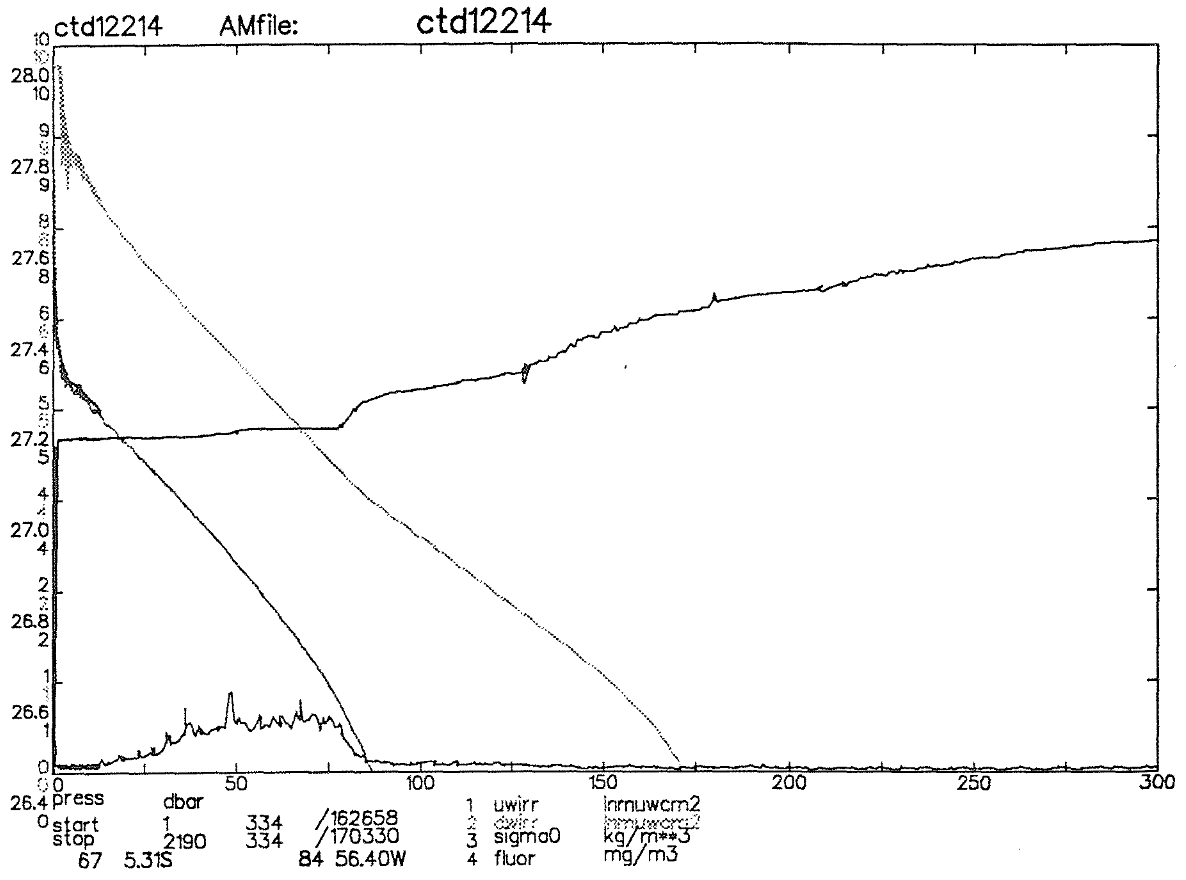
600
800
1000
1200
press dbar
start 1 334 /162658
stop 2190 334 /170330
67 5.31S 84 56.40W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m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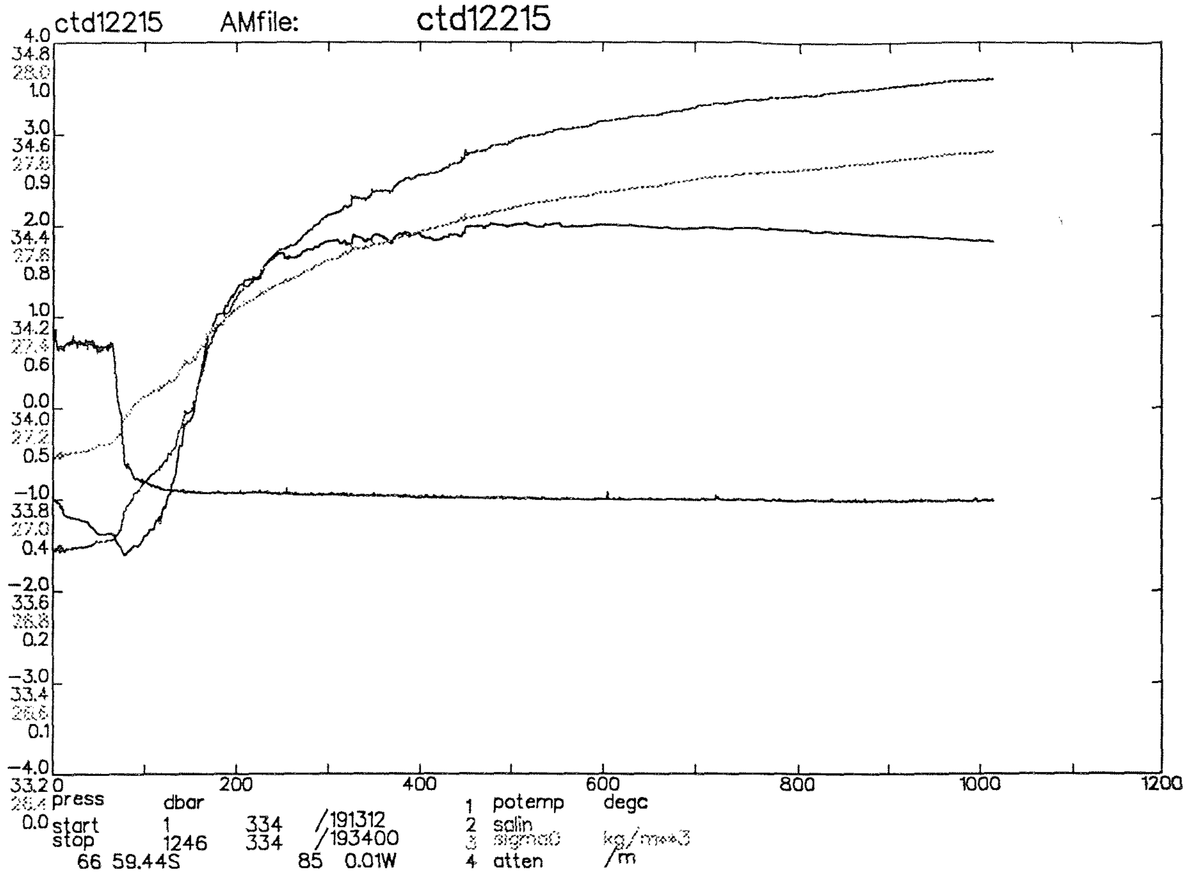
300
press dbar
start 1 334 /162658
stop 2190 334 /170330
67 5.31S 84 56.40W
1 uwirr lnmuwcm2
3 sigma0 kg/m**3
4 fluor mg/m3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press dbar
start 1 334 /191312
stop 1246 334 /193400
66 59.44S 85 0.01W
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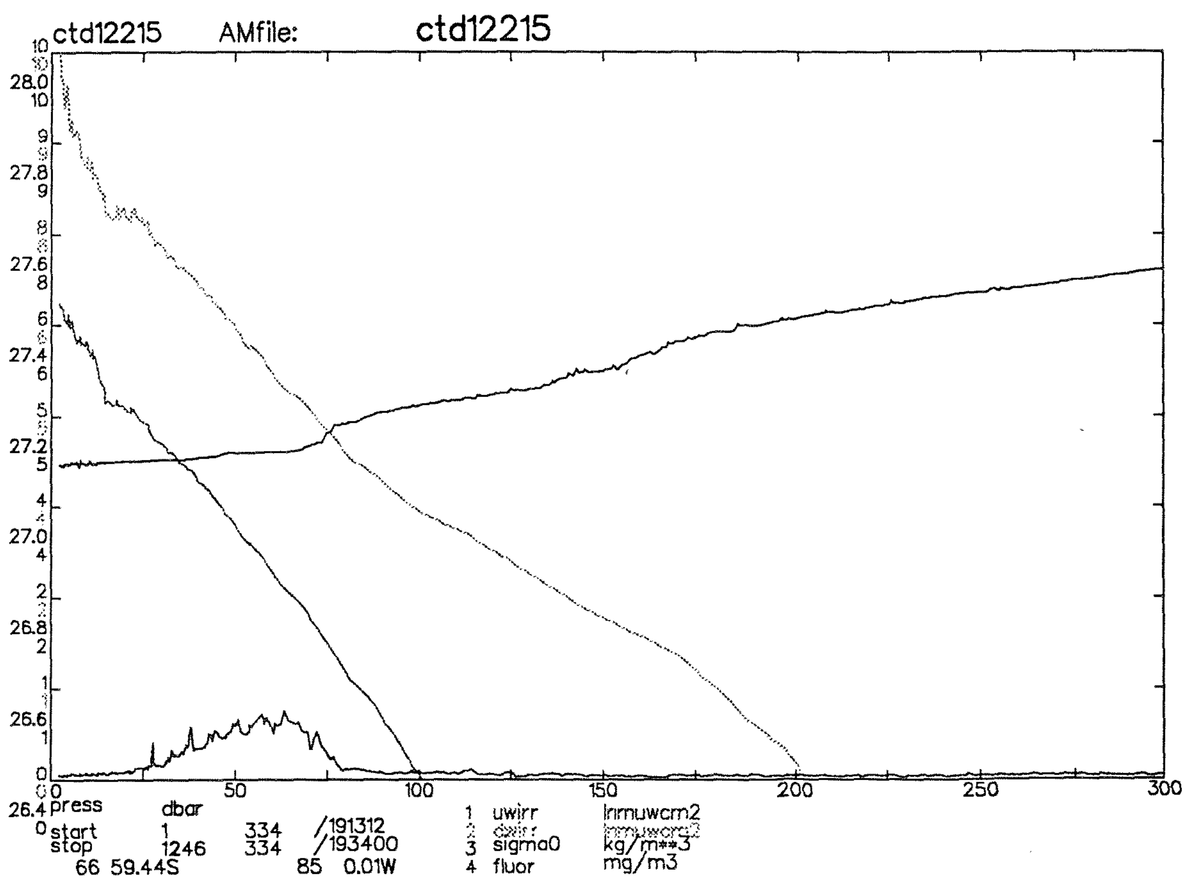
2 salin
3 sigma0 kg/m**3
4 atten /m
0
200
400
600
800
1000
1200

×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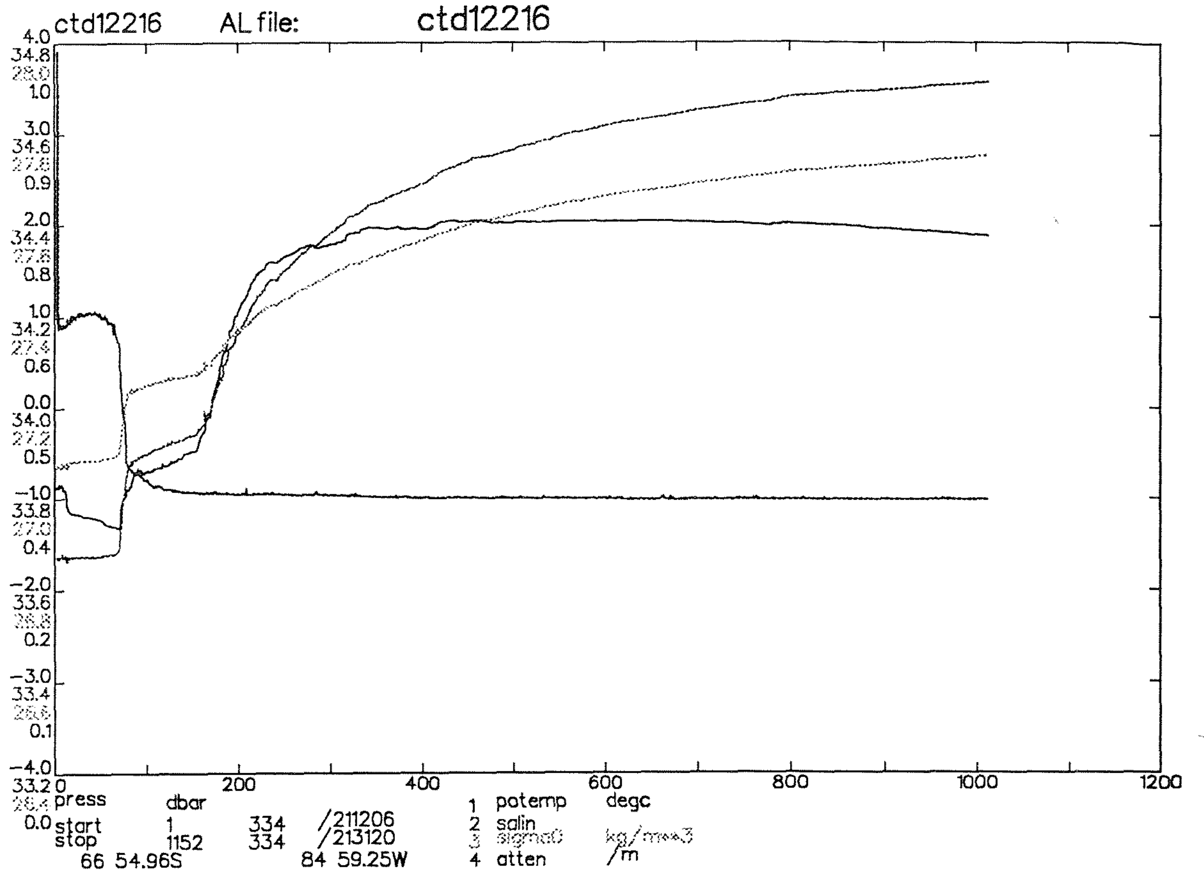
start 1 334 /191312
stop 1246 334 /193400
66 59.44S 85 0.01W
1 uwirr lnmuwcm2
3 sigma0 kg/m**3
4 fluor mg/m3
0
50
100
150
200
250
300

×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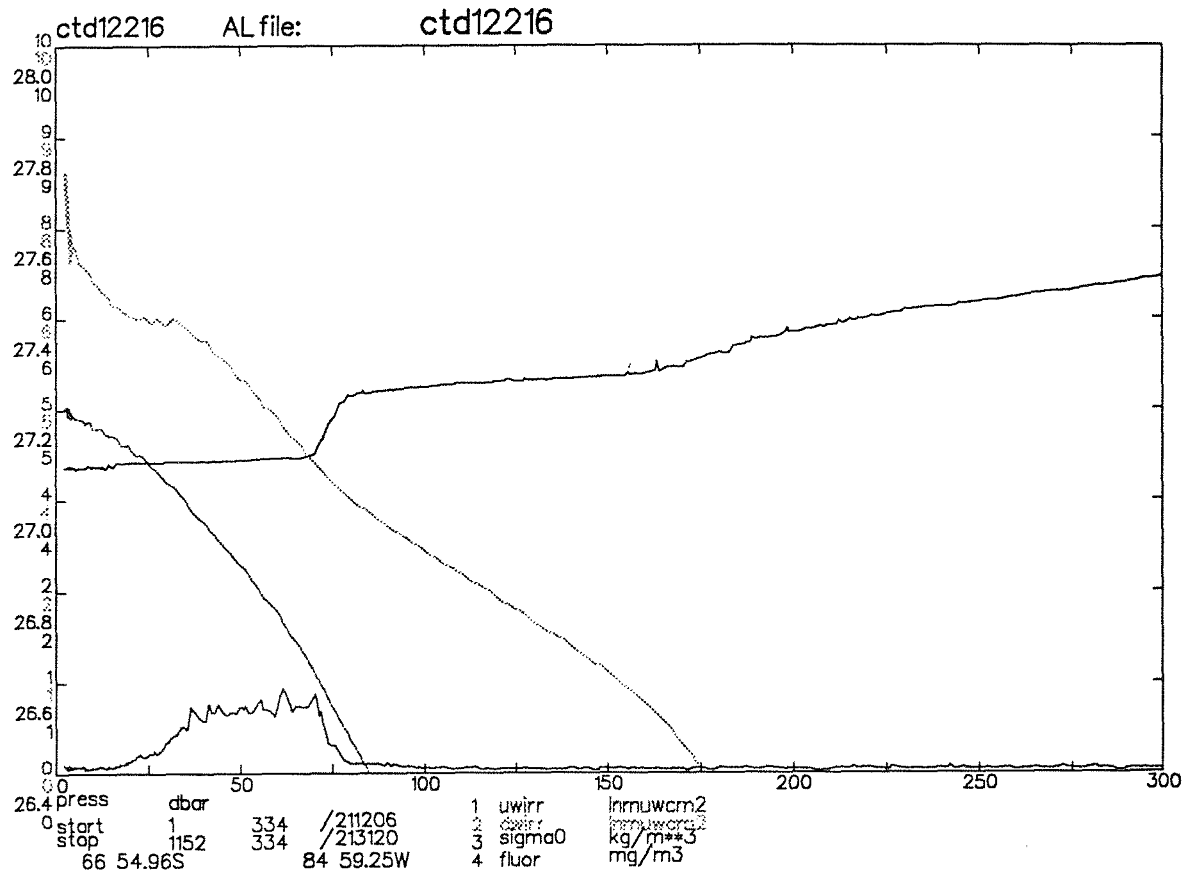
press dbar
start 1 334 /211206
stop 1152 334 /213120
66 54.96S 84 59.25W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m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press dbar
start 1 334 /211206
stop 1152 334 /213120
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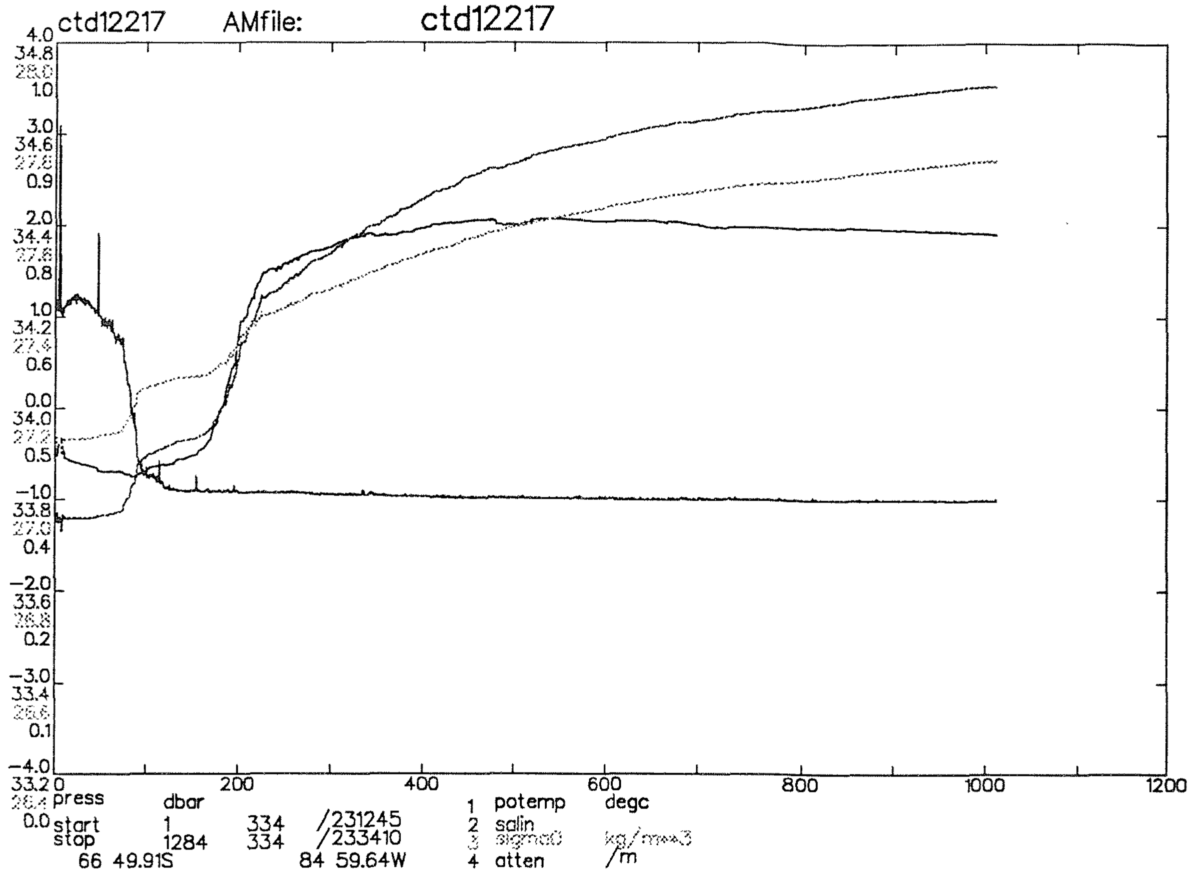
1 uwirr lnmuwcm2
2 dwirr lnmuwcm2
3 sigma0 kg/m**3
4 fluor mg/m3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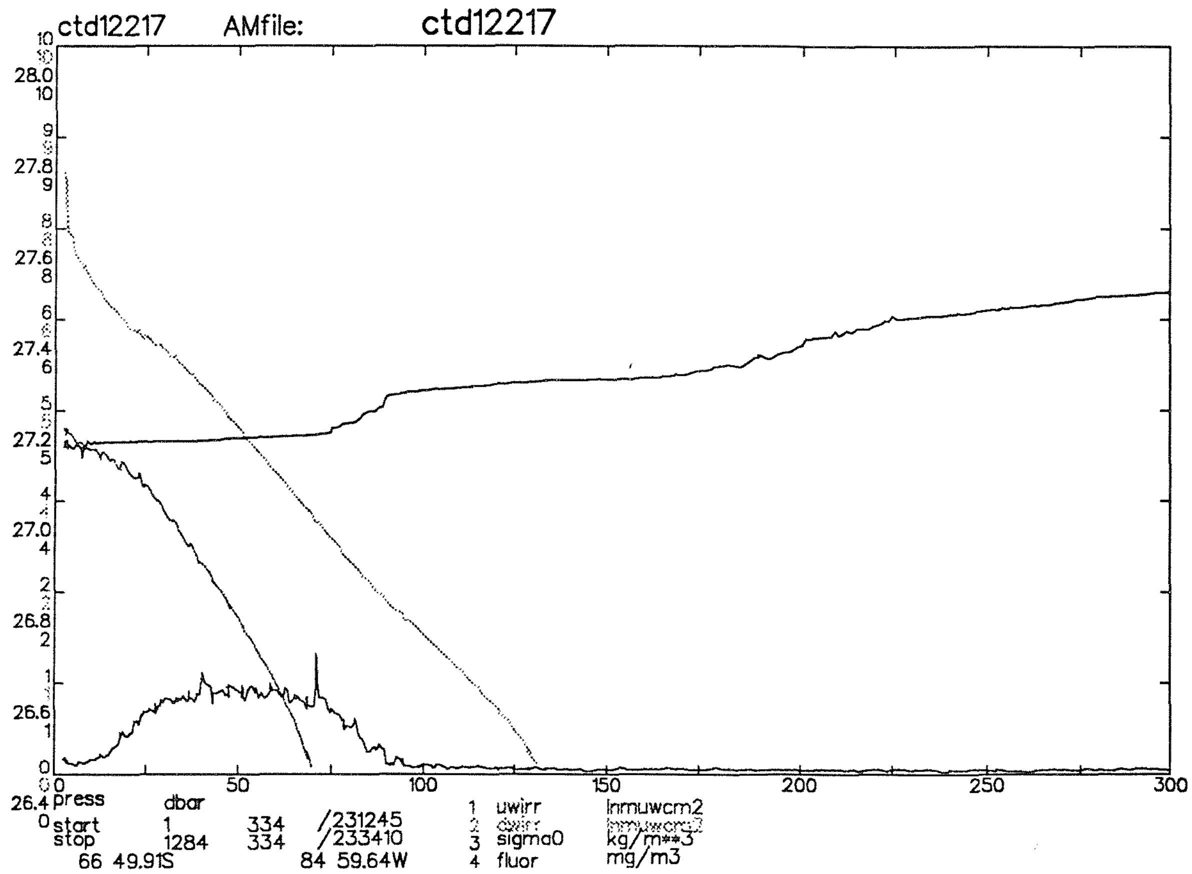
34.6
0.9
2.0
34.4
0.8
1.0
34.2
0.6
0.0
34.0
0.5
-1.0
33.8
0.4
-2.0
33.6
0.2
-3.0
33.4
0.1
-4.0
33.2
0.0
0
200
400
600
800
1000
1200
press
dbar
start
1
334
/231245
stop
1284
334
/233410
66 49.91S
84 59.64W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m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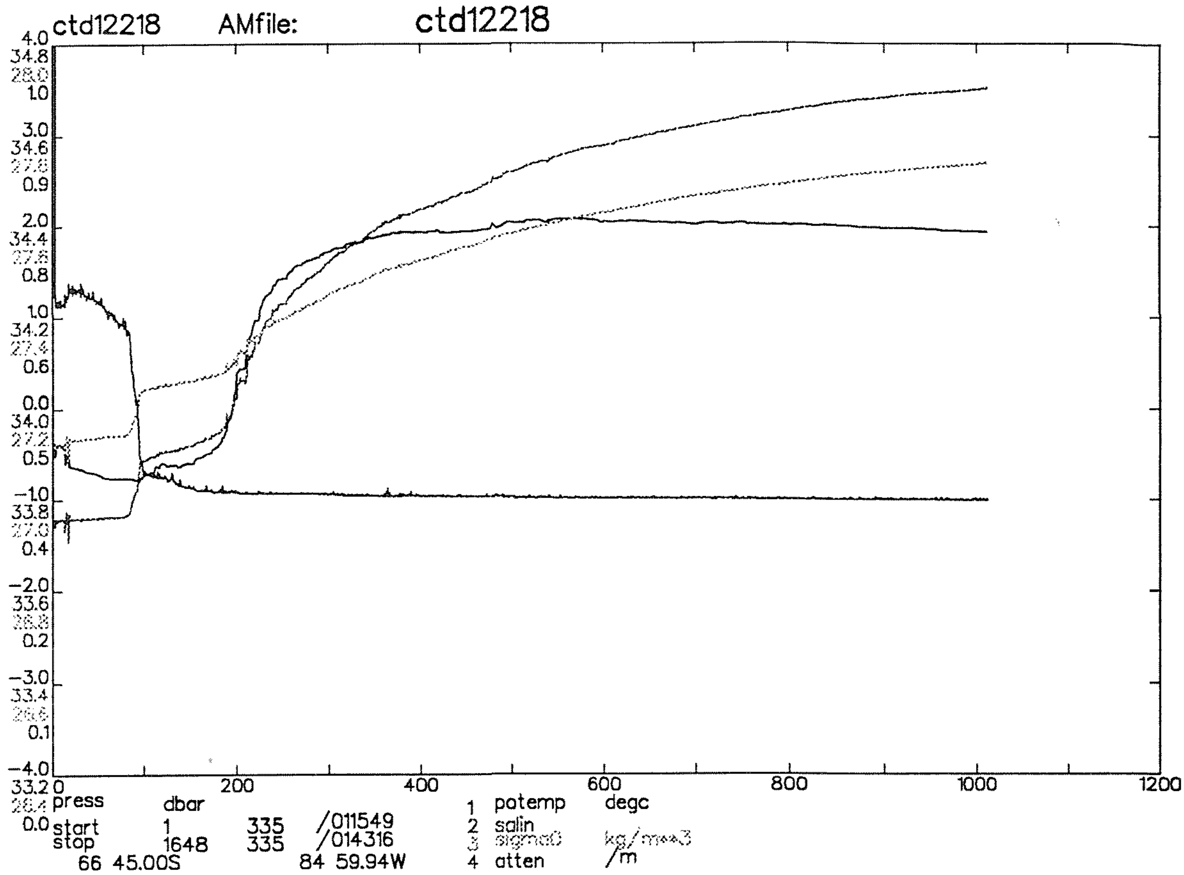
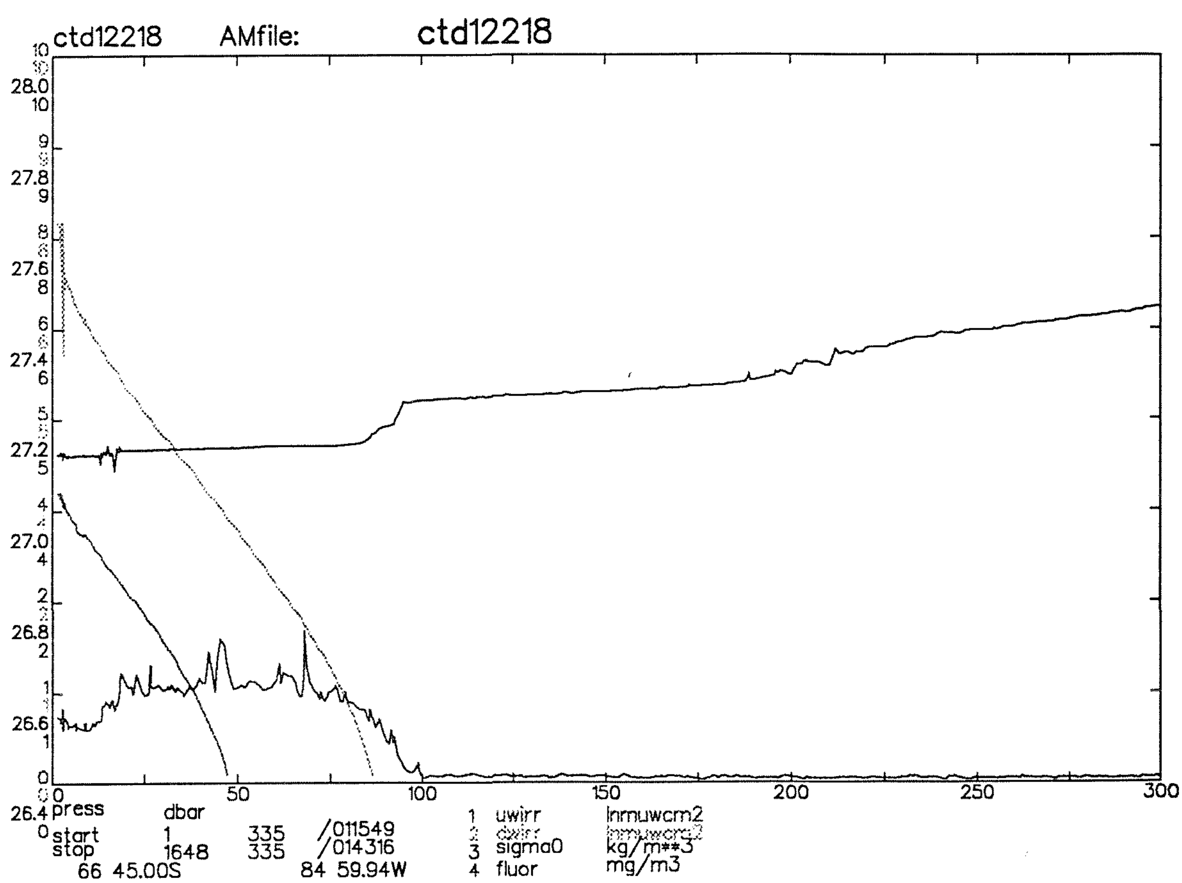
10
9
27.8
9
8
27.6
8
6
27.4
6
5
27.2
5
4
27.0
4
2
26.8
2
1
26.6
1
0
26.4
0
0
50
100
150
200
250
300
press
dbar
start
1
334
/231245
stop
1284
334
/233410
66 49.91S
84 59.64W
1 uwirr lnmuwcm2
2 dwirr lnmuwcm2
3 sigma0 kg/m**3
4 fluor mg/m3


ctd12218 AMfile: ctd12218
press dbar
start 1 335 /011549
stop 1648 335 /014316
66 45.00S 84 59.94W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m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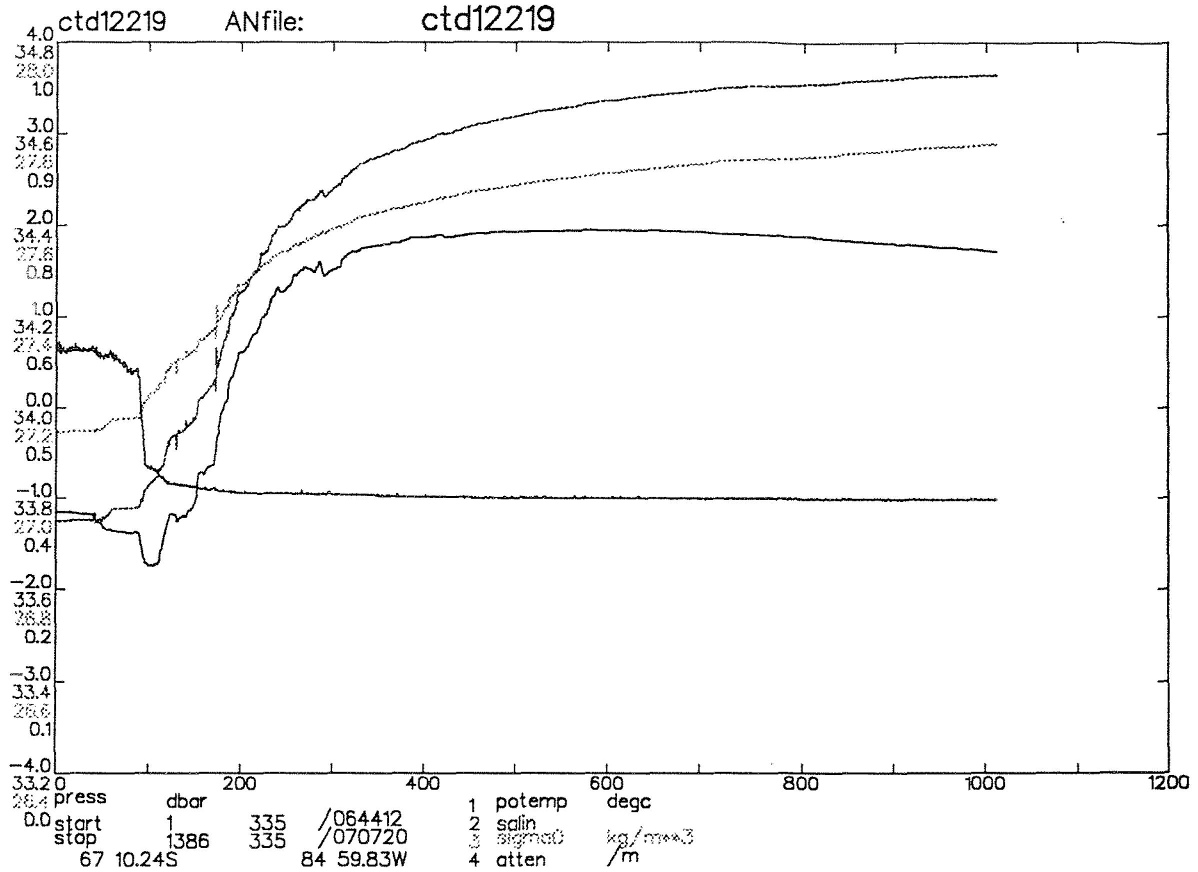
press dbar
start 1 335 /011549
stop 1648 335 /014316
66 45.00S 84 59.94W
1 uwirr lnmuwcm2
2 dwirr lnmuwcm2
3 sigma0 kg/m**3
4 fluor mg/m3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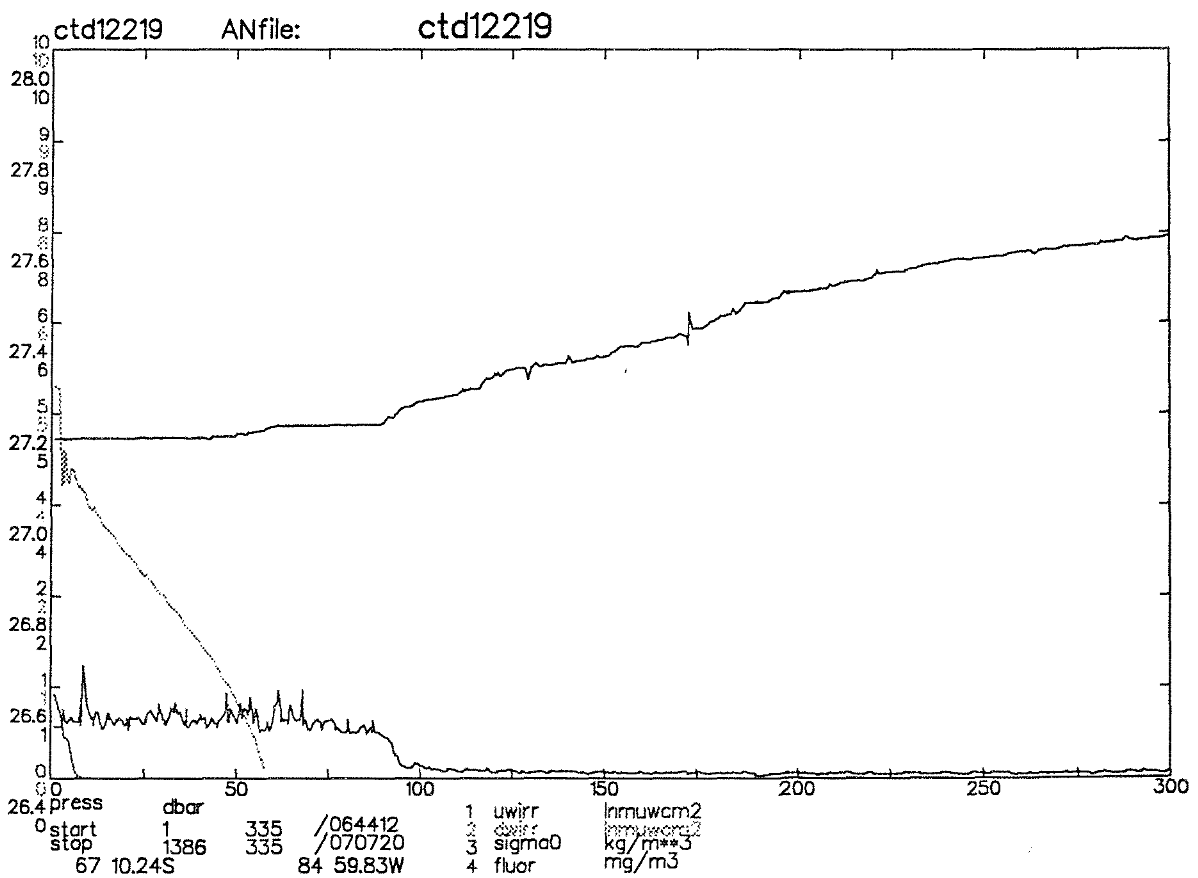
3.0 34.6 0.9
2.0 34.4 0.8
1.0 34.2 0.6
0.0 34.0 0.5
-1.0 33.8 0.4
-2.0 33.6 0.2
-3.0 33.4 0.1
-4.0 33.2 0.0
0 200 400 600 800 1000 1200
press dbar
start 1 335 /064412
stop 1386 335 /070720
67 10.24S 84 59.83W
1 potemp degc
2 salin
4 atten /m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ANfile:
ctd12219
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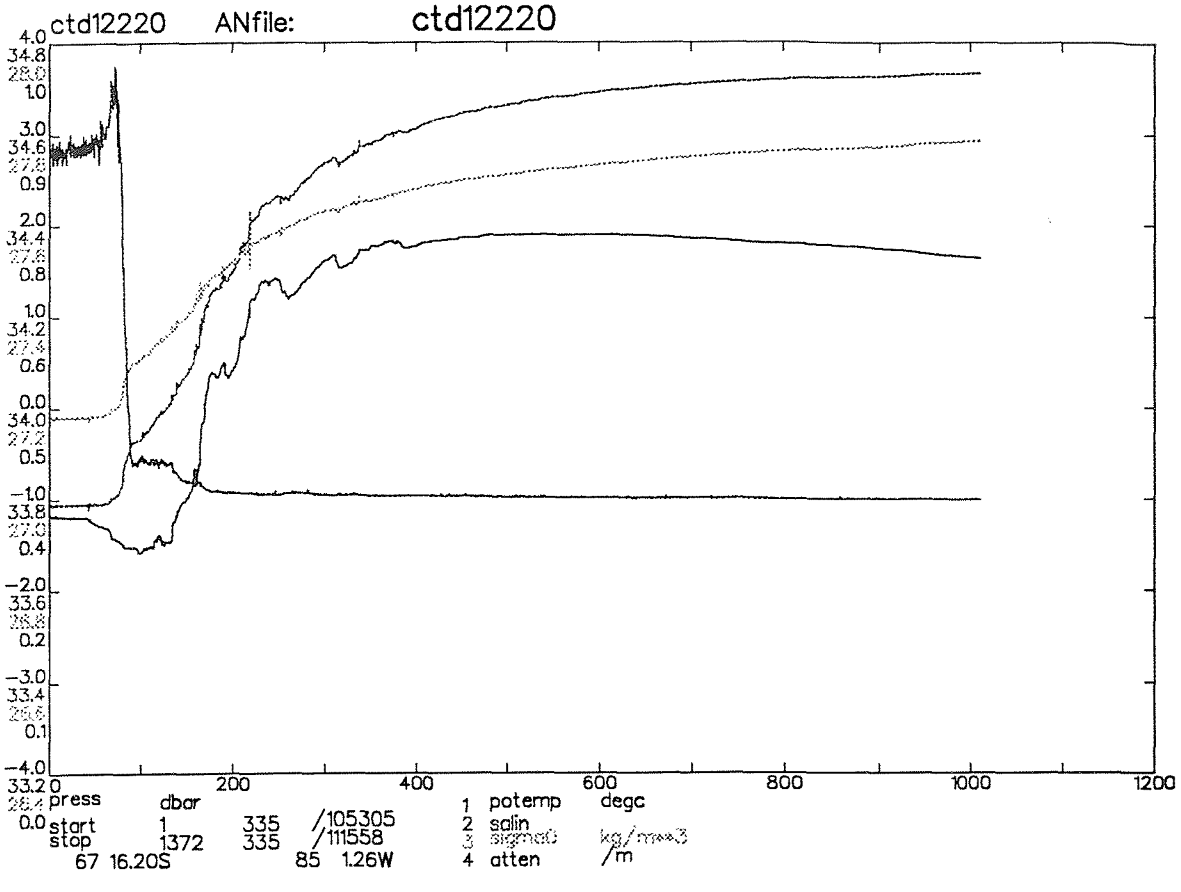
9 27.8 9
8 27.6 8
6 27.4 6
5 27.2 5
4 27.0 4
2 26.8 2
1 26.6 1
0 26.4 0
0 50 100 150 200 250 300
press dbar
start 1 335 /064412
stop 1386 335 /070720
67 10.24S 84 59.83W
1 uwirr lnmuwcm2
3 sigma0 kg/m**3
4 fluor mg/m3


ctd12220 ANfile: ctd12220
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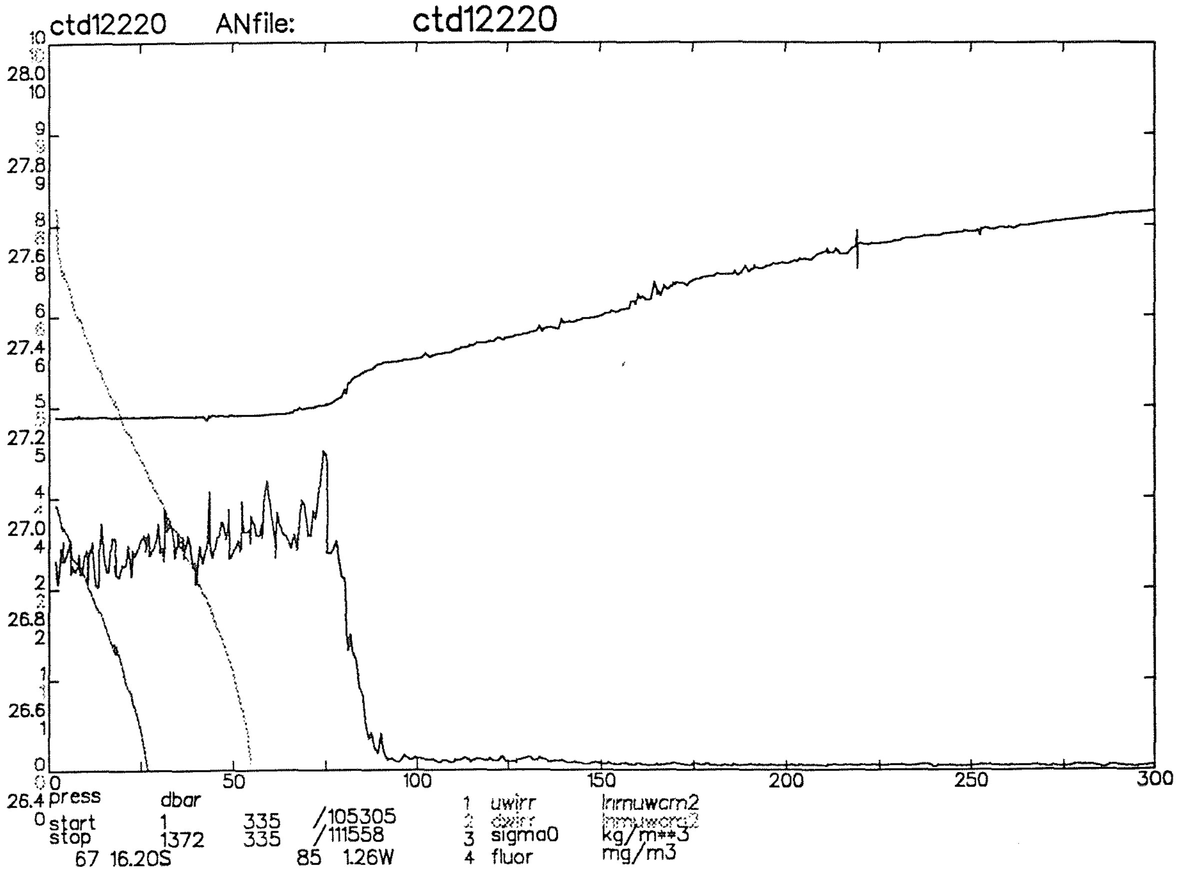
press dbar
start 1 335 /105305
stop 1372 335 /111558
67 16.20S 85 1.26W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m


ctd12220 ANfile: ctd12220
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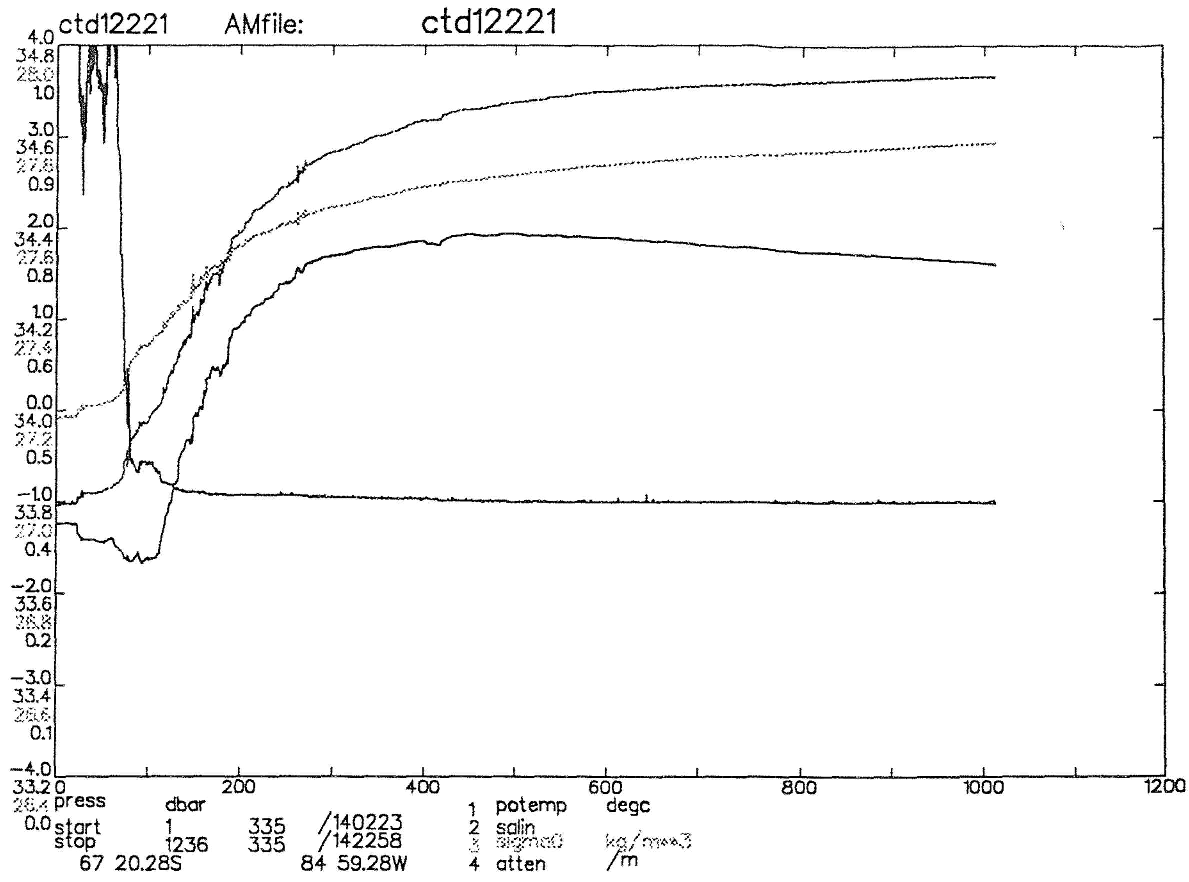
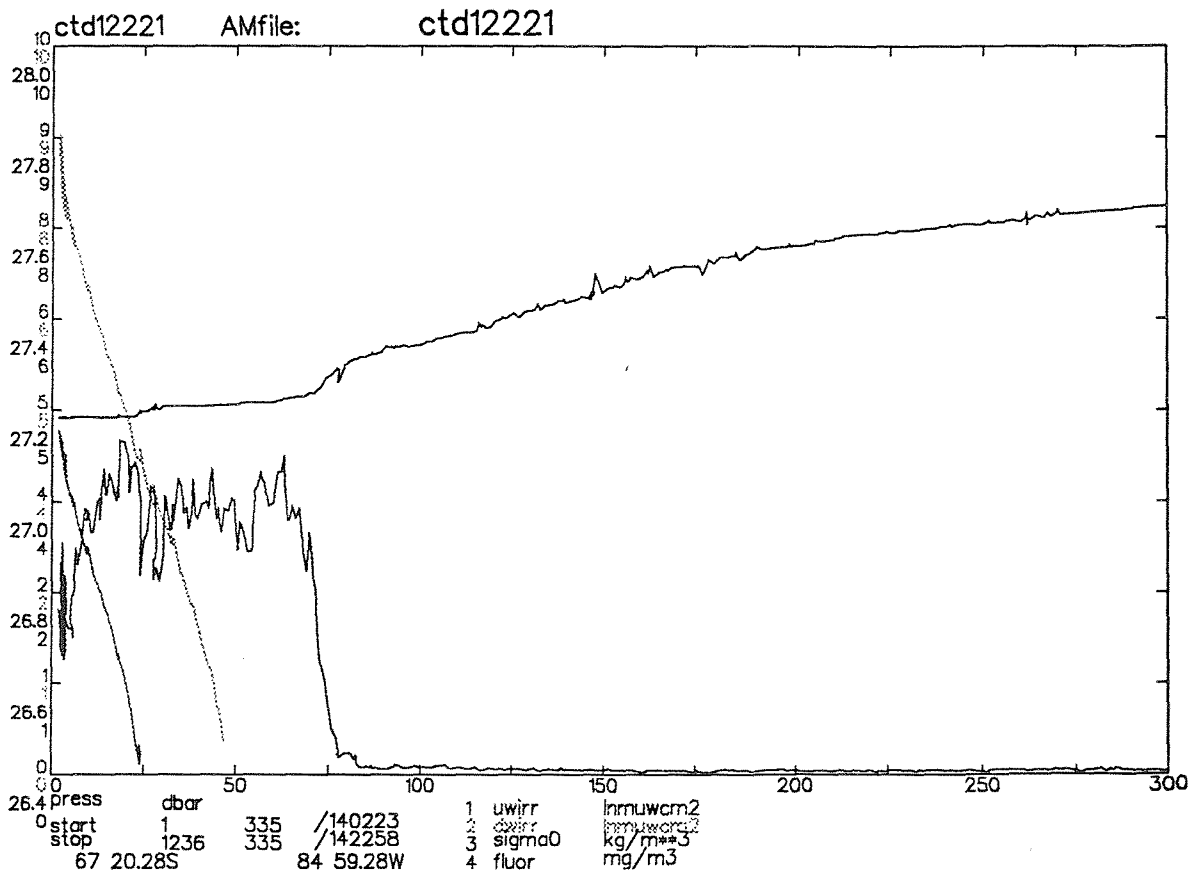
press dbar
start 1 335 /105305
stop 1372 335 /111558
67 16.20S 85 1.26W
1 uwirr lnmuwcm2
2 dwirr lnmuwcm2
3 sigma0 kg/m**3
4 fluor mg/m3


ctd12221 AMfile: ctd12221
press dbar
start 1 335 /140223
stop 1236 335 /142258
67 20.28S 84 59.28W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m


ctd12221 AMfile: ctd12221
press dbar
start 1 335 /140223
stop 1236 335 /142258
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1 uwirr lnmuwcm2
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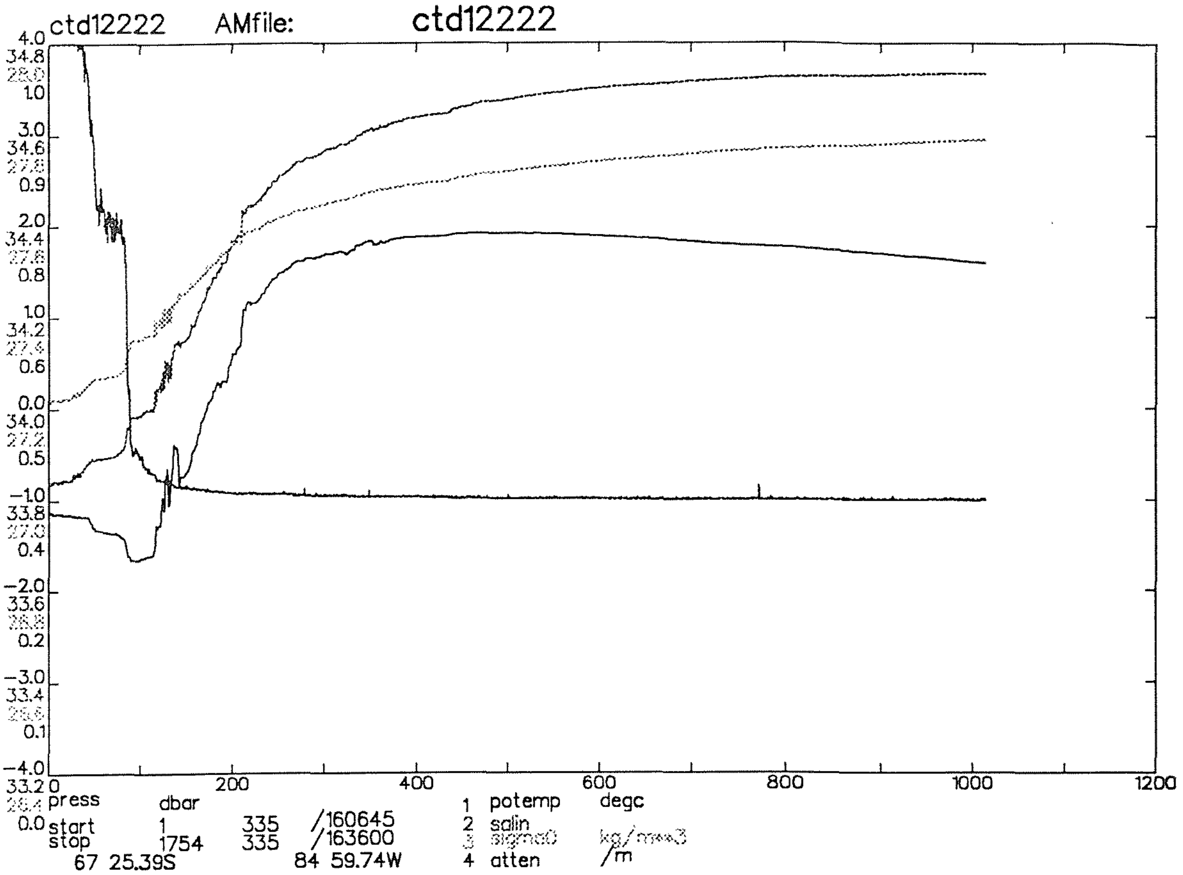
3 sigma0 kg/m**3
4 fluor mg/m3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1.0
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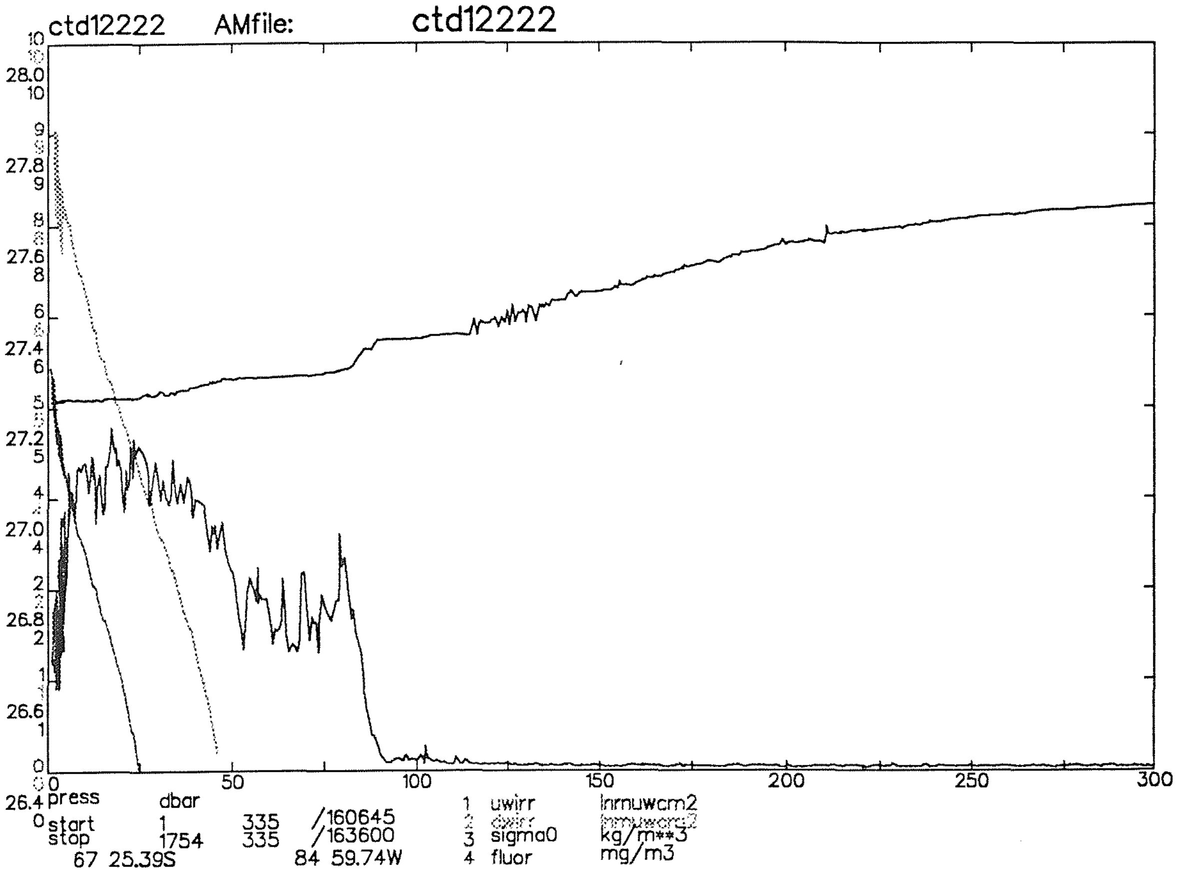
2.0
34.4
0.8
1.0
34.2
0.6
0.0
34.0
0.5
-1.0
33.8
0.4
-2.0
33.6
0.2
-3.0
33.4
0.1
-4.0
33.2
0.0
0
200
400
600
800
1000
1200
press dbar
start 1 335 /160645
stop 1754 335 /163600
67 25.39S 84 59.74W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m

×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27.8
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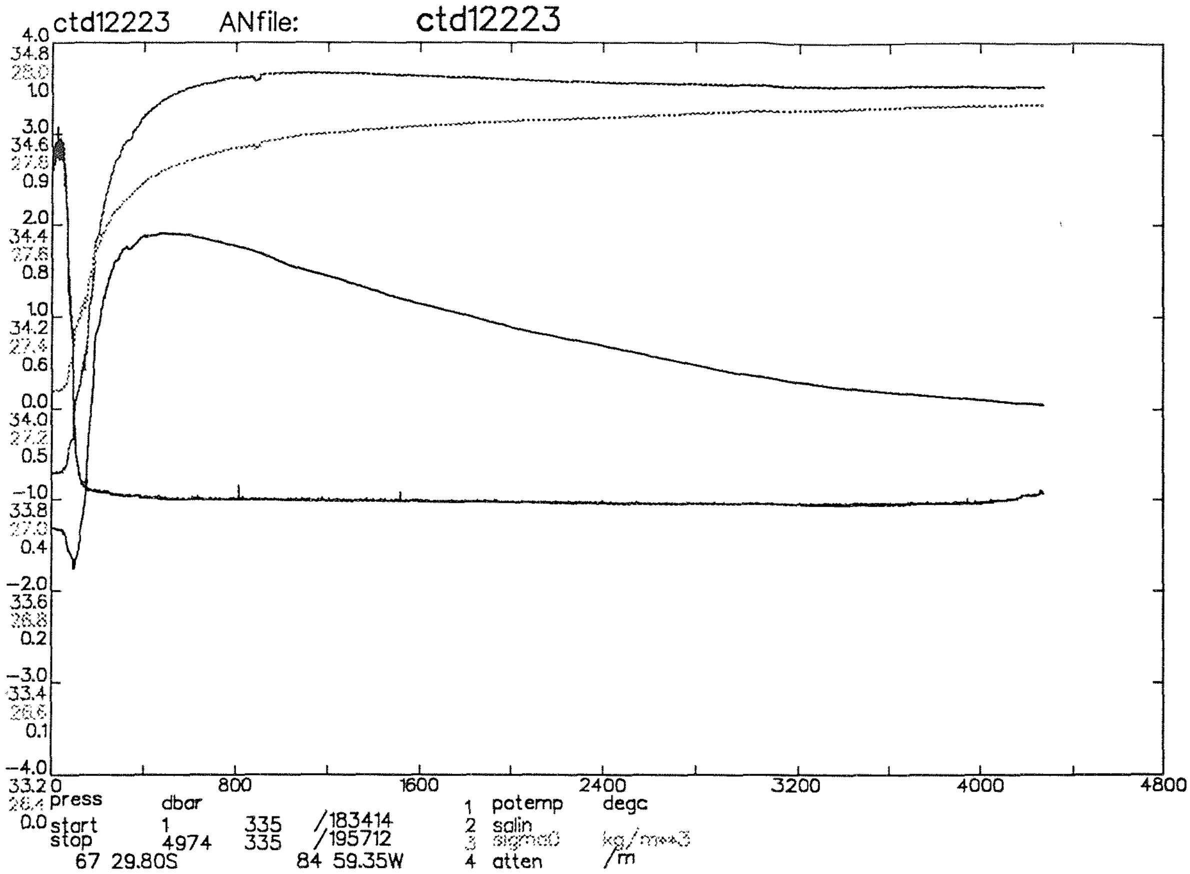
27.6
8
6
27.4
6
5
27.2
5
4
27.0
4
2
26.8
2
1
26.6
1
0
26.4
0
0
50
100
150
200
250
300
press dbar
start 1 335 /160645
stop 1754 335 /163600
67 25.39S 84 59.74W
1 uwirr lnmuwcm2
3 sigma0 kg/m**3
4 fluor mg/m3

×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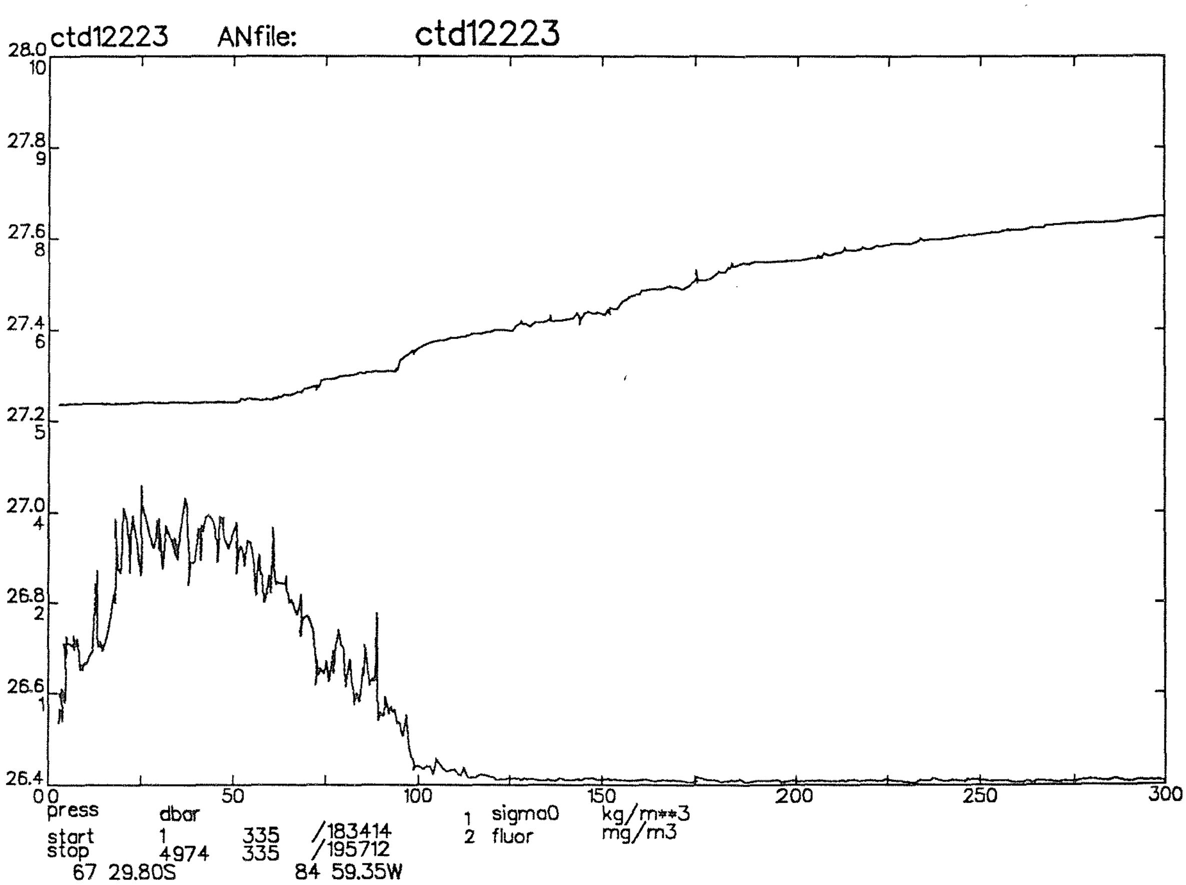
3.0
34.6
27.8
0.9
2.0
34.4
27.6
0.8
1.0
34.2
27.4
0.6
0.0
34.0
27.2
0.5
-1.0
33.8
27.0
0.4
-2.0
33.6
26.8
0.2
-3.0
33.4
26.6
0.1
-4.0
33.2
26.4
0.0
0
800
1600
2400
3200
4000
4800
press dbar
start 1 335 /183414
stop 4974 335 /195712
67 29.80S 84 59.35W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m

×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10
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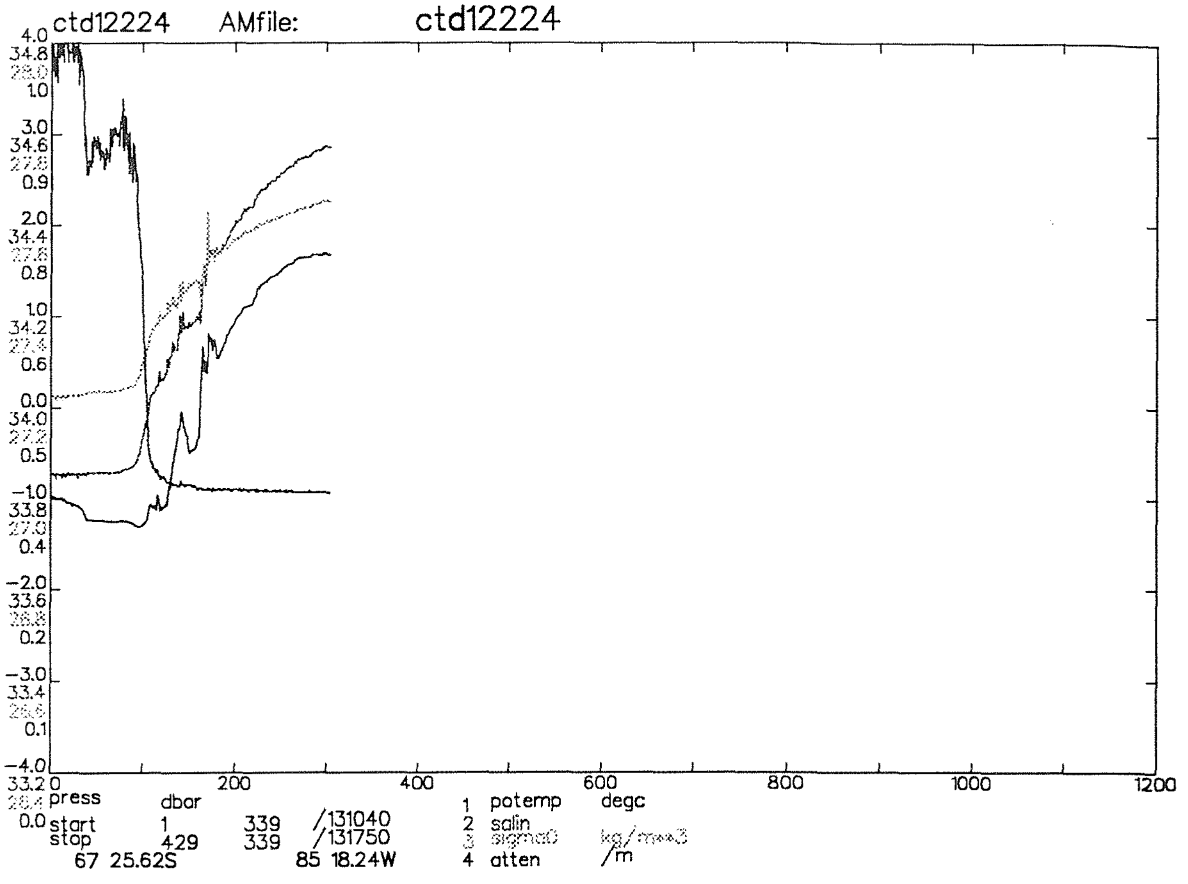
9
27.6
8
27.4
6
27.2
5
27.0
4
26.8
2
26.6
1
26.4
0
0
50
100
150
200
250
300
press dbar
start 1 335 /183414
stop 4974 335 /195712
67 29.80S 84 59.35W
1 sigma0 kg/m**3
2 fluor mg/m3

×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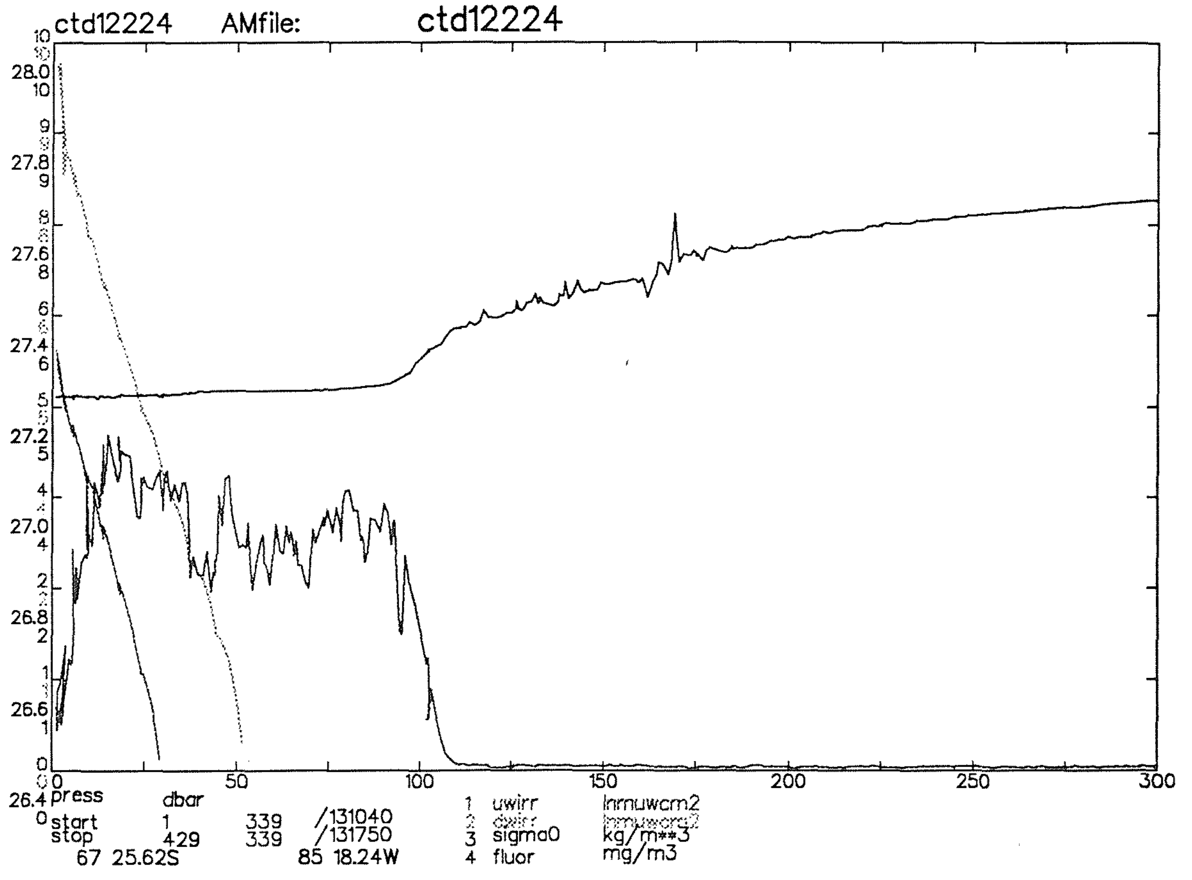
stop 429 339 /131750
67 25.62S 85 18.24W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m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press dbar
start 1 339 /131040
stop 429 339 /131750
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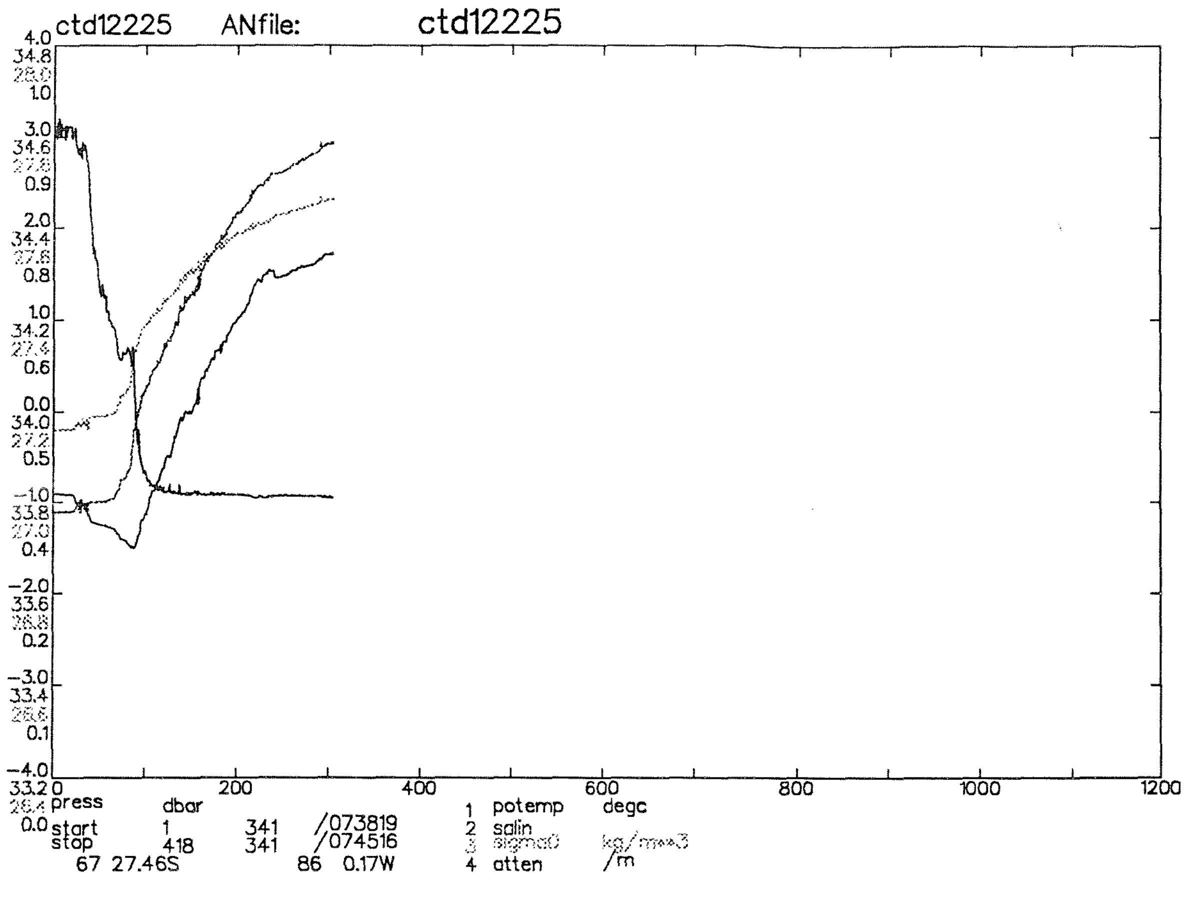
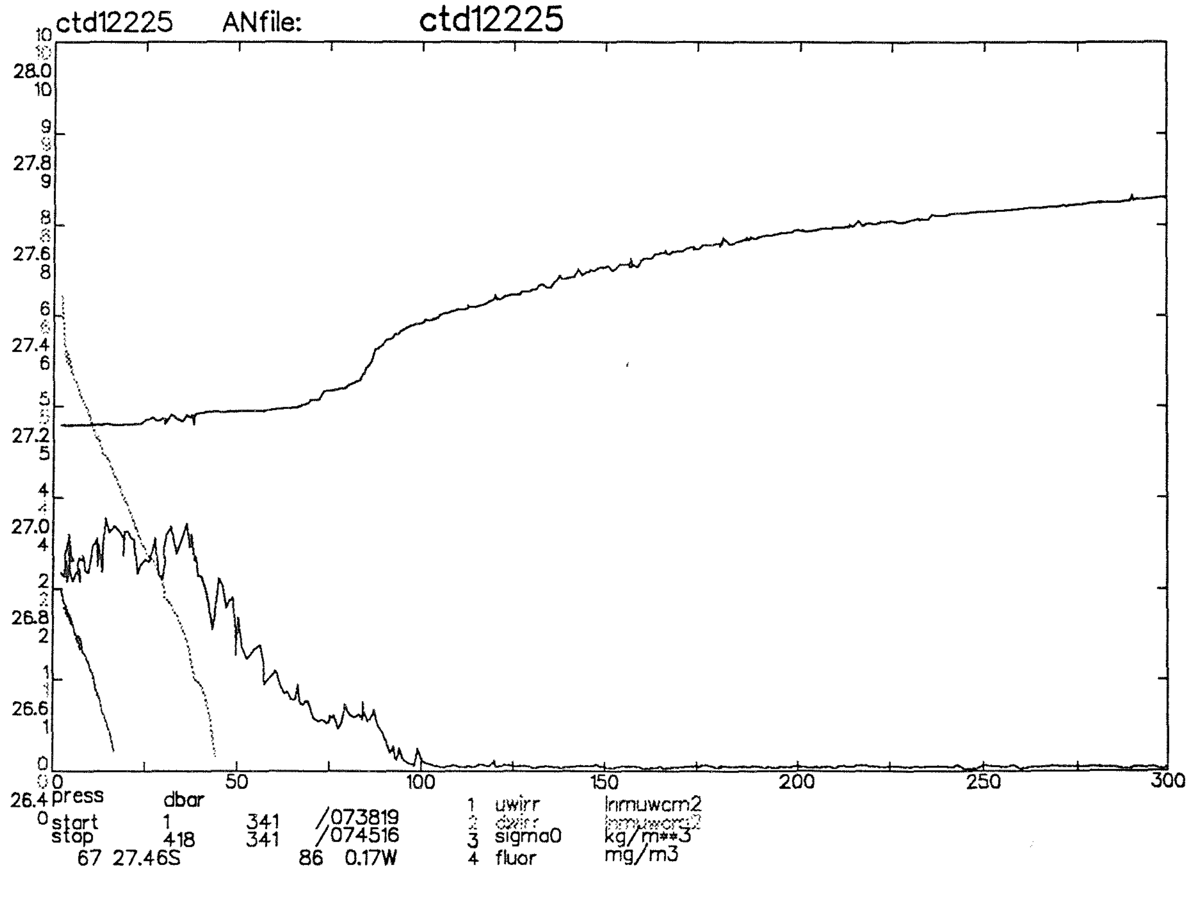
4 fluor mg/m3


ctd12225 ANfile: ctd12225
press dbar
start 1 341 /073819
stop 418 341 /074516
67 27.46S 86 0.17W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m


ctd12225 ANfile: ctd12225
press dbar
start 1 341 /073819
stop 418 341 /074516
67 27.46S 86 0.17W
1 uwirr lnmuwcm2
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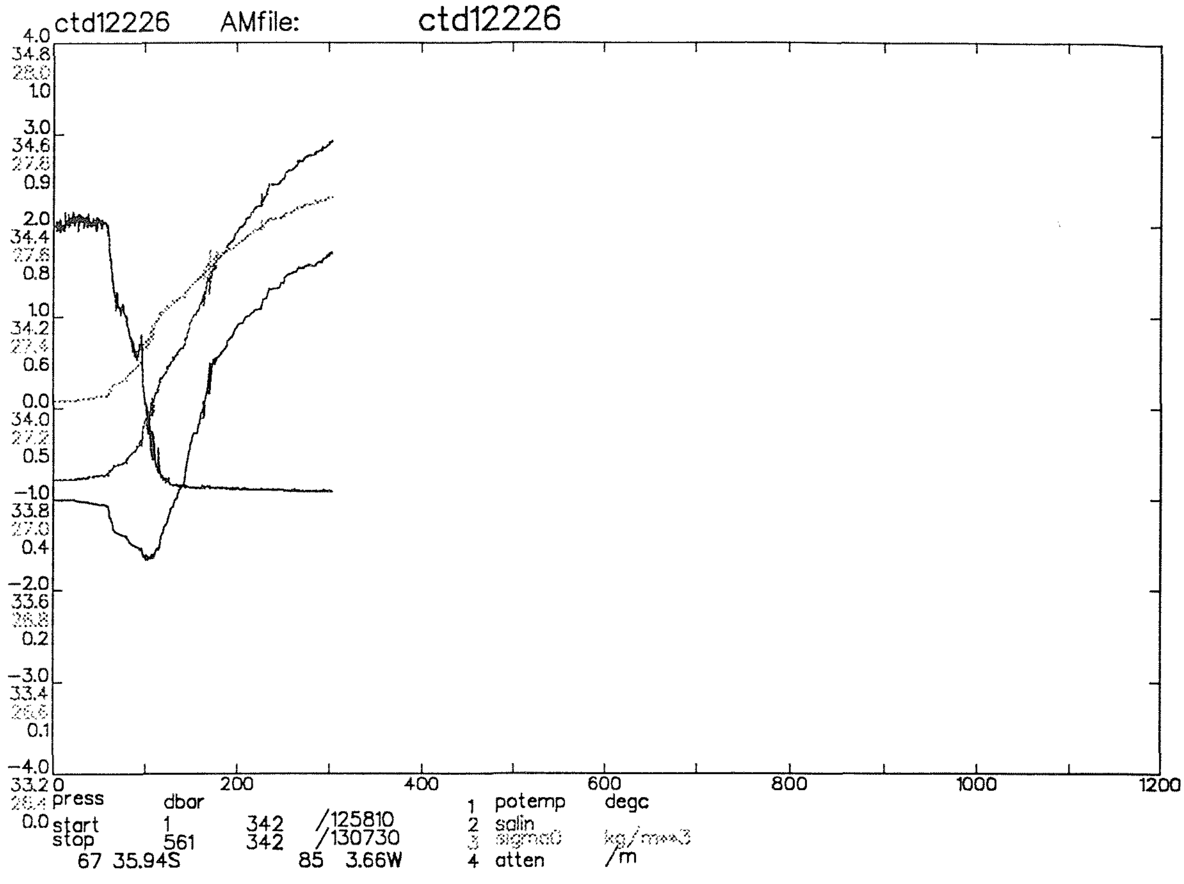
3 sigma0 kg/m**3
4 fluor mg/m3


ctd12226 AMfile: ctd12226
press dbar
start 1 342 /125810
stop 561 342 /130730
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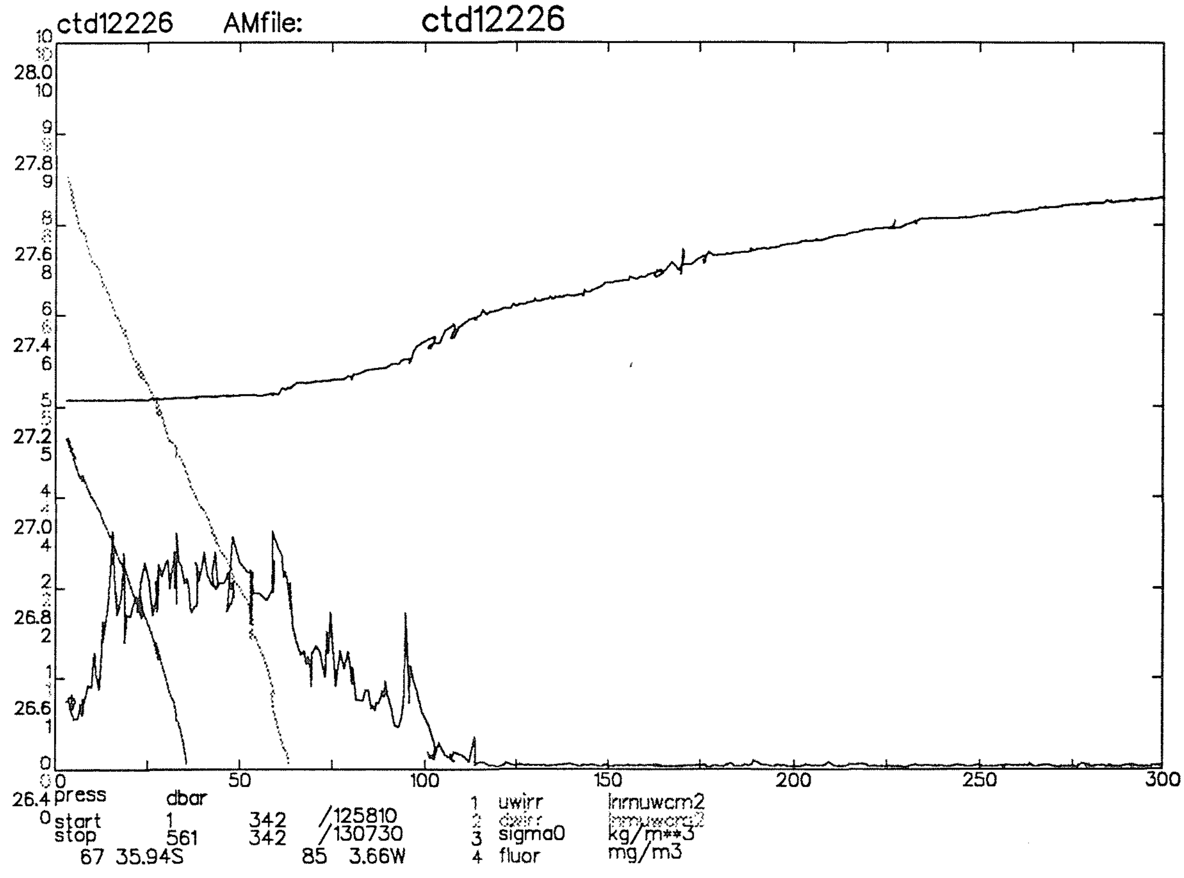
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m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press dbar
start 1 342 /125810
stop 561 342 /130730
67 35.94S 85 3.66W
1 uwirr lnmuwcm2
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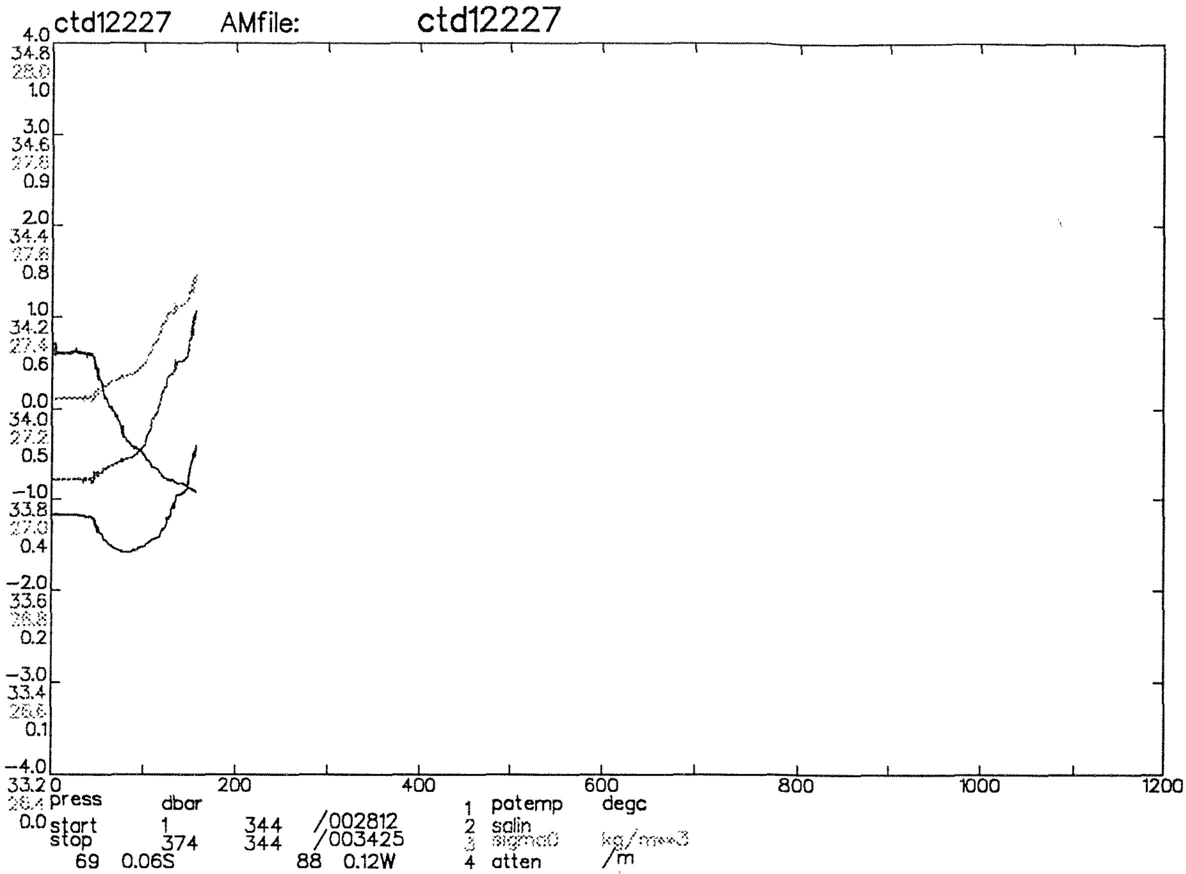
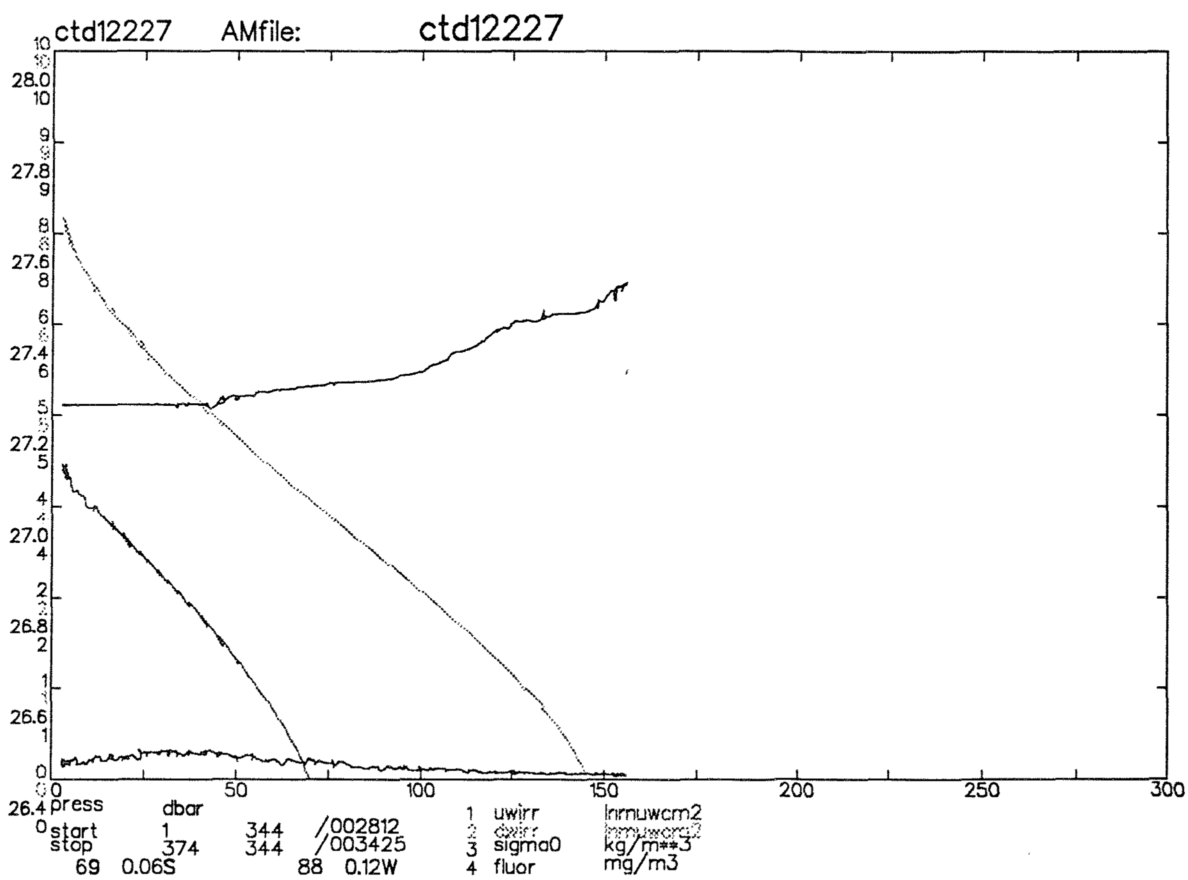
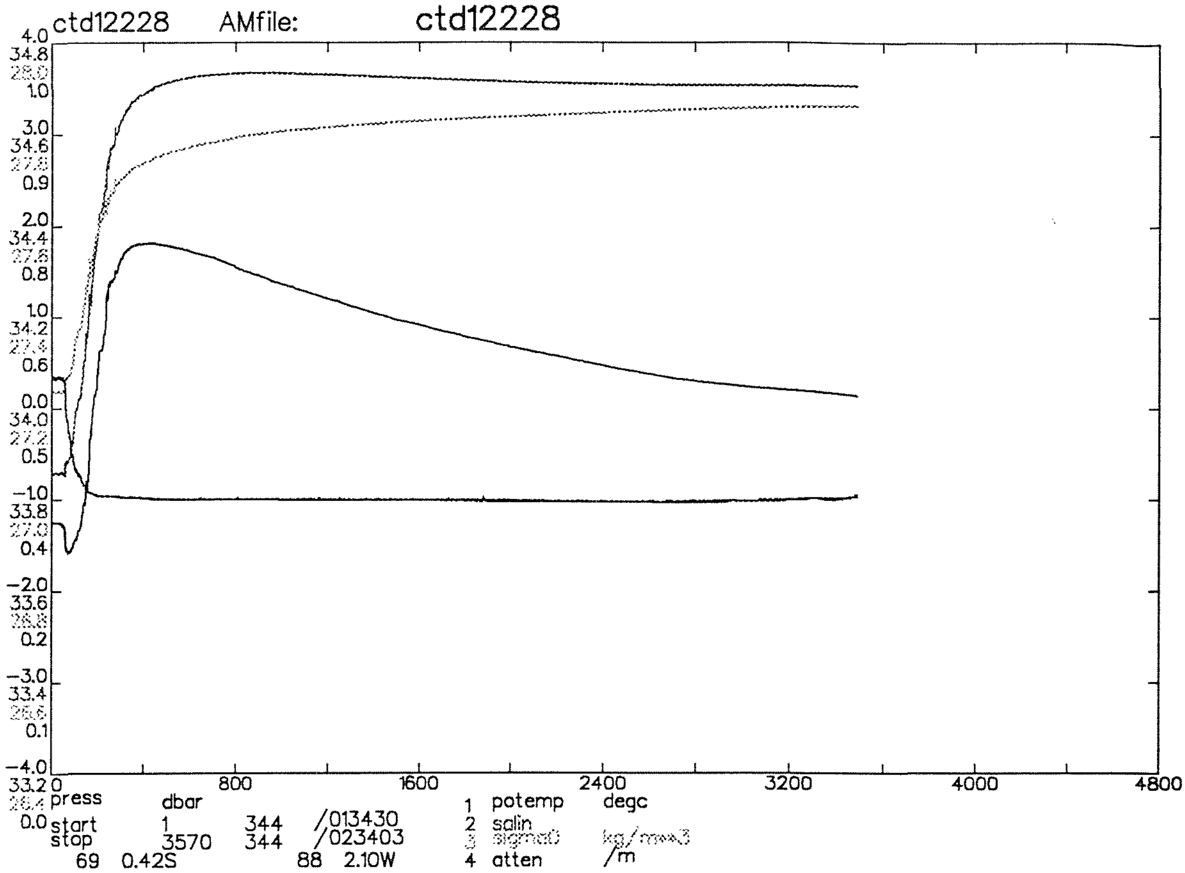
3 sigma0 kg/m**3
4 fluor mg/m3


ctd12227 AMfile: ctd12227
press dbar
start 1 344 /002812
stop 374 344 /003425
69 0.06S 88 0.12W
1 patemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m
0 200 400 600 800 1000 1200

×


ctd12227 AMfile: ctd12227
press dbar
start 1 344 /002812
stop 374 344 /003425
69 0.06S 88 0.12W
1 uwirr lnmuwcm2
3 sigma0 kg/m**3
4 fluor mg/m3
0 50 100 150 200 250 300

×


ctd12228 AMfile: ctd12228
press dbar
start 1 344 /013430
stop 3570 344 /023403
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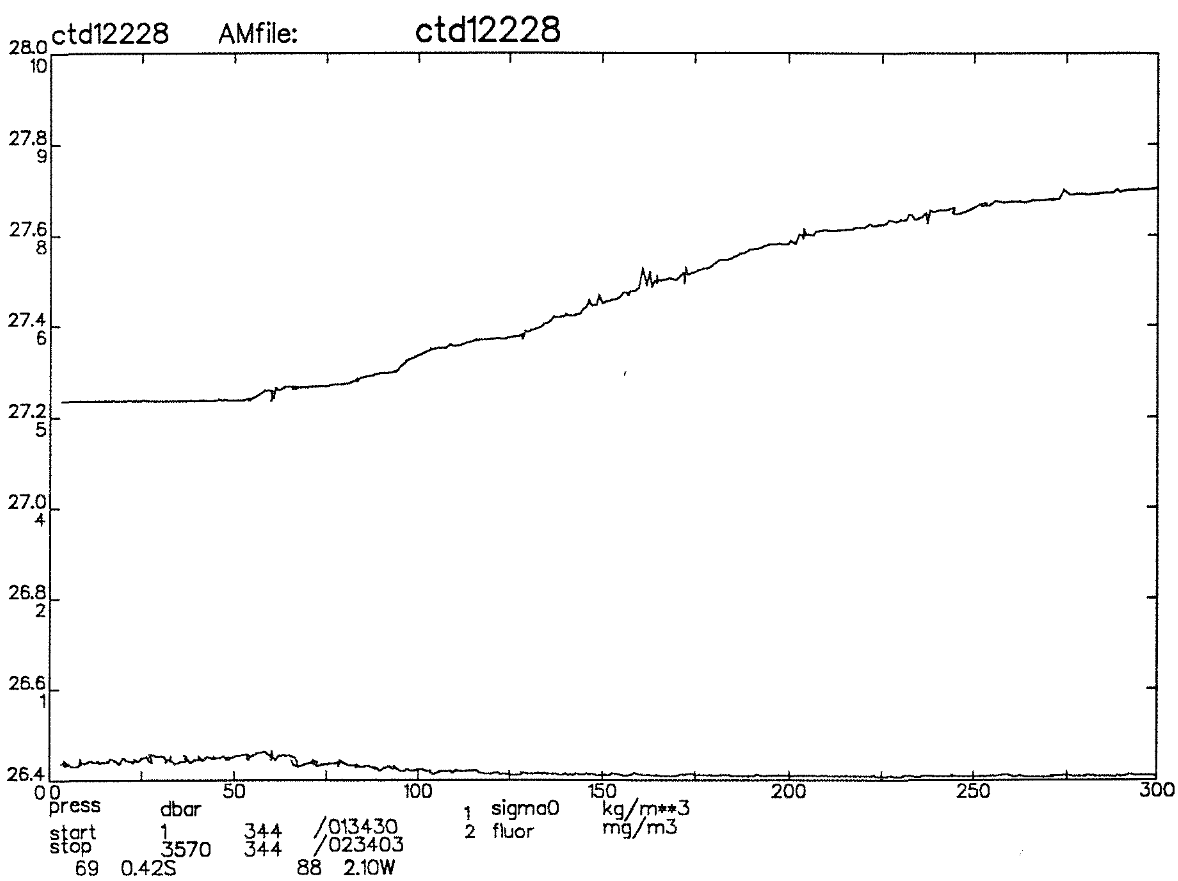
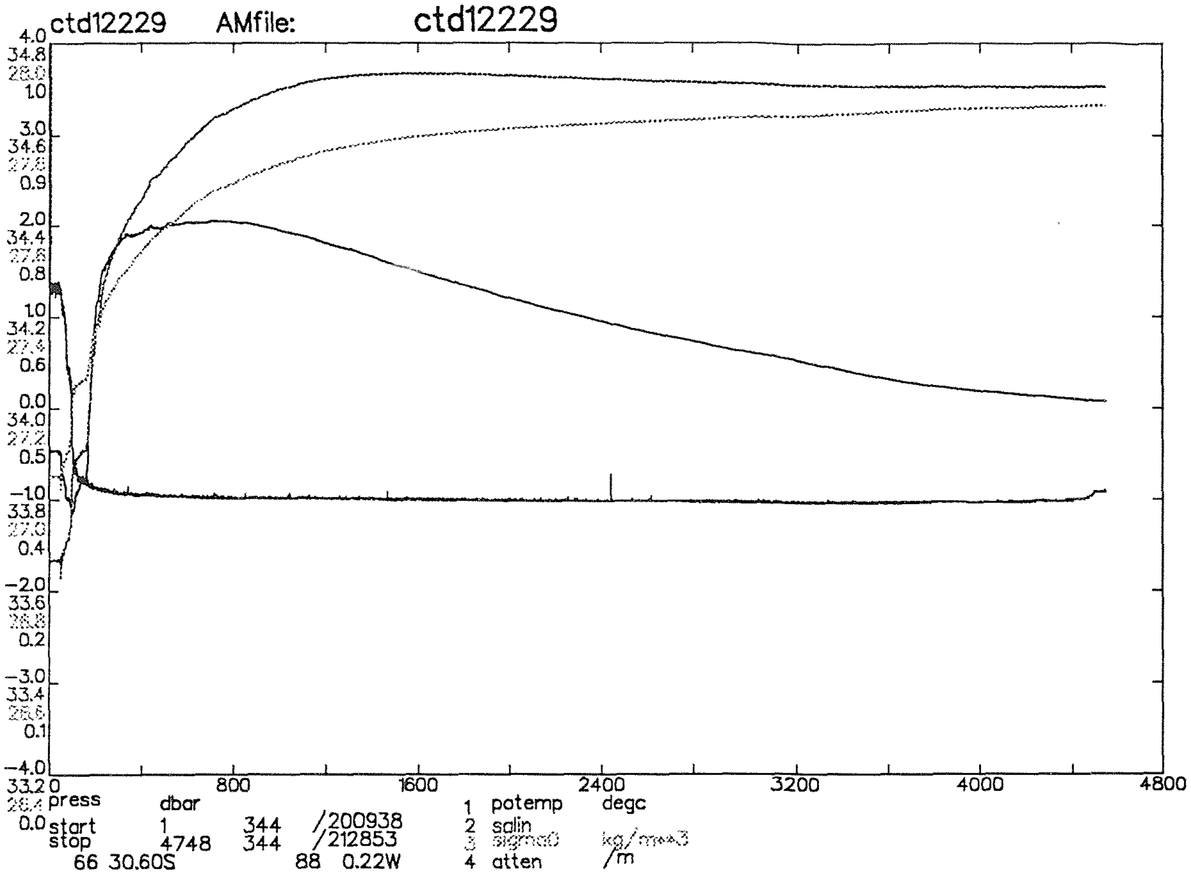
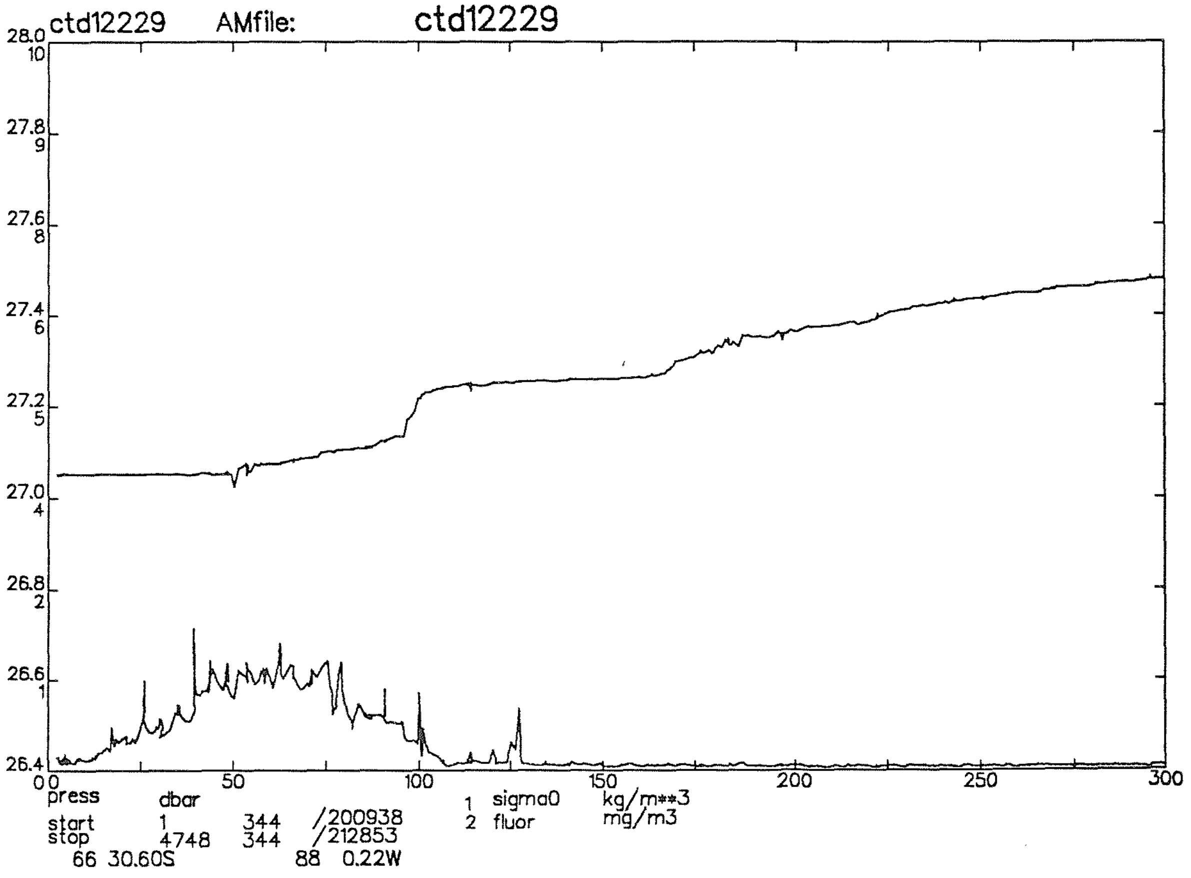
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m

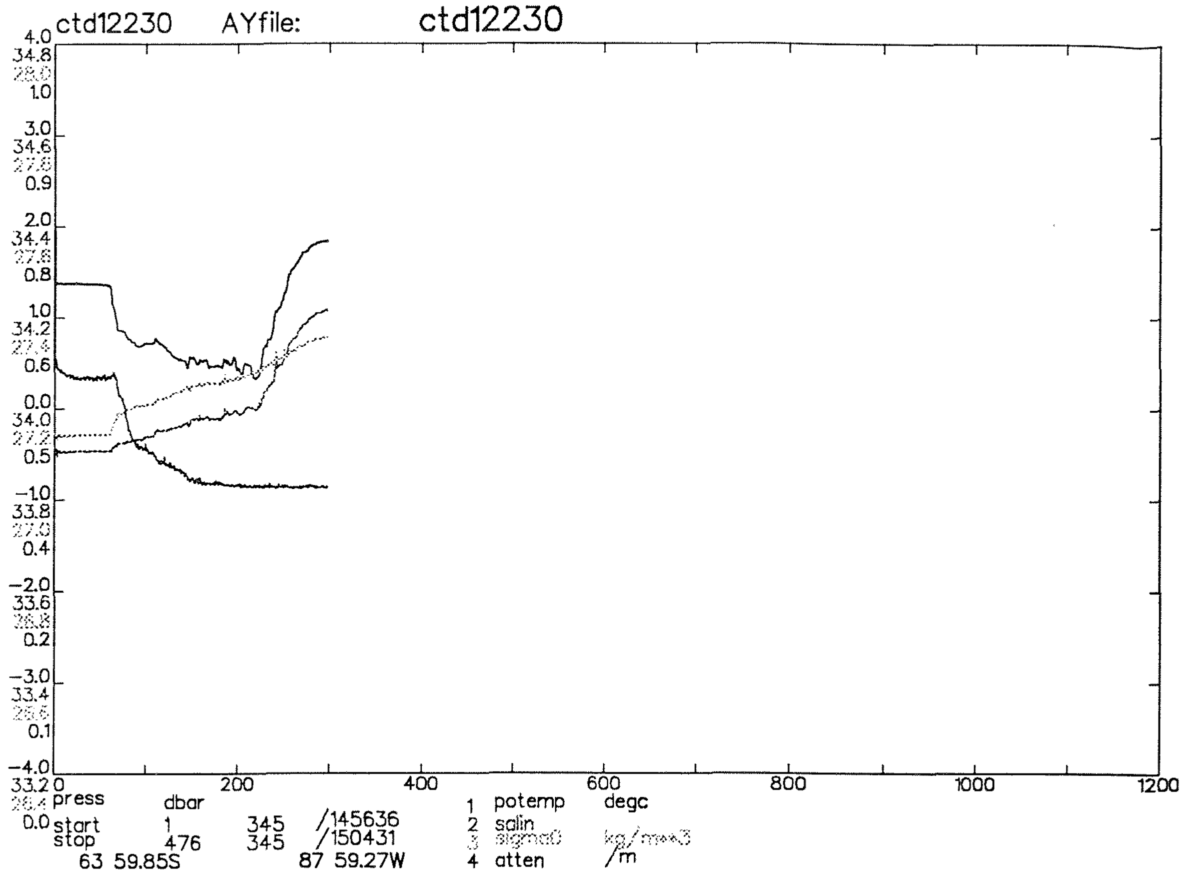

ctd12228 AMfile: ctd12228
press dbar
start 1 344 /013430
stop 3570 344 /023403
69 0.42S 88 2.10W
1 sigma0 kg/m**3
2 fluor mg/m3


ctd12229 AMfile: ctd12229
press dbar
start 1 344 /200938
stop 4748 344 /212853
66 30.60S 88 0.22W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m

×


ctd12229 AMfile: ctd12229
press dbar
start 1 344 /200938
stop 4748 344 /212853
66 30.60S 88 0.22W
1 sigma0 kg/m**3
2 fluor mg/m3

×


ctd12230 AYfile: ctd12230
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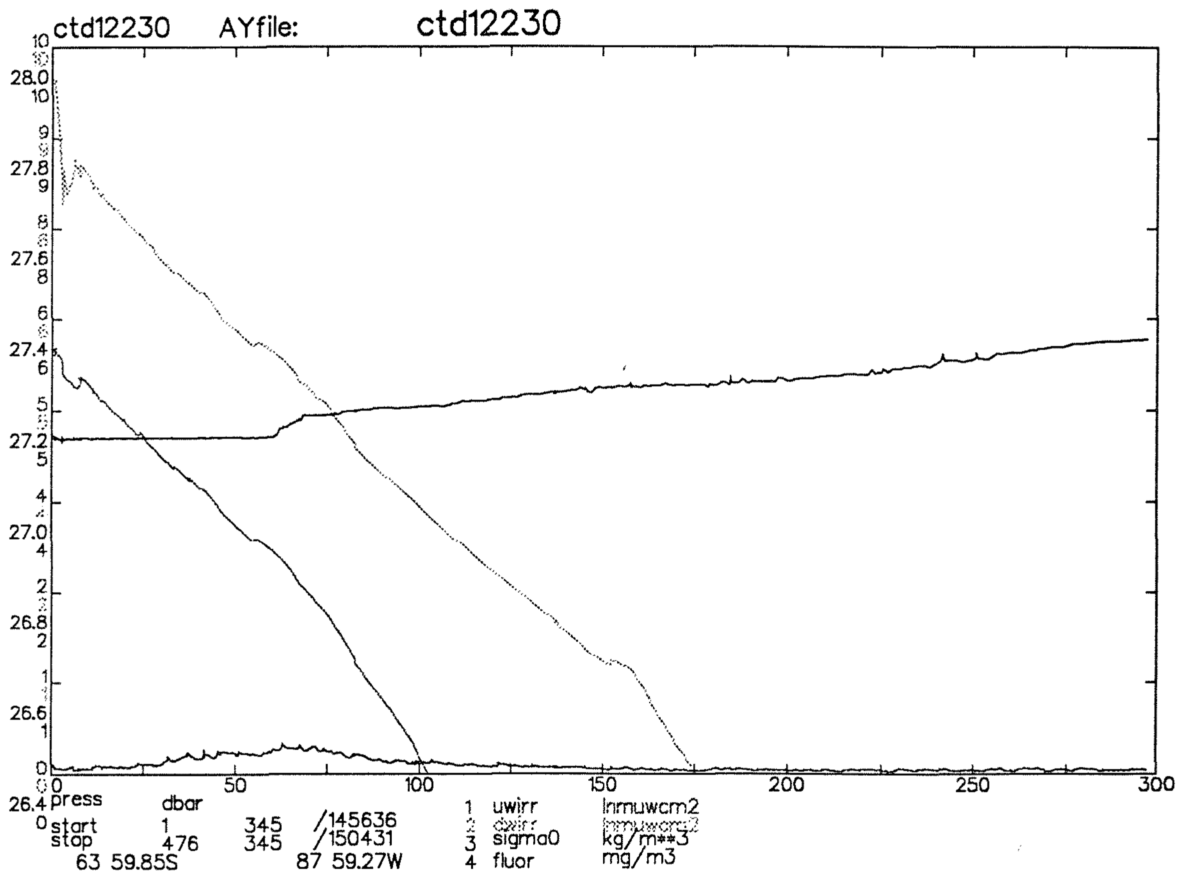
34.6
0.9
2.0
34.4
0.8
1.0
34.2
0.6
0.0
34.0
0.5
-1.0
33.8
0.4
-2.0
33.6
0.2
-3.0
33.4
0.1
-4.0
33.2
0.0
0 200 400 600 800 1000 1200
press dbar
start 1 345 /145636
stop 476 345 /150431
63 59.85S 87 59.27W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m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10
9
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9
8
27.6
8
6
27.4
6
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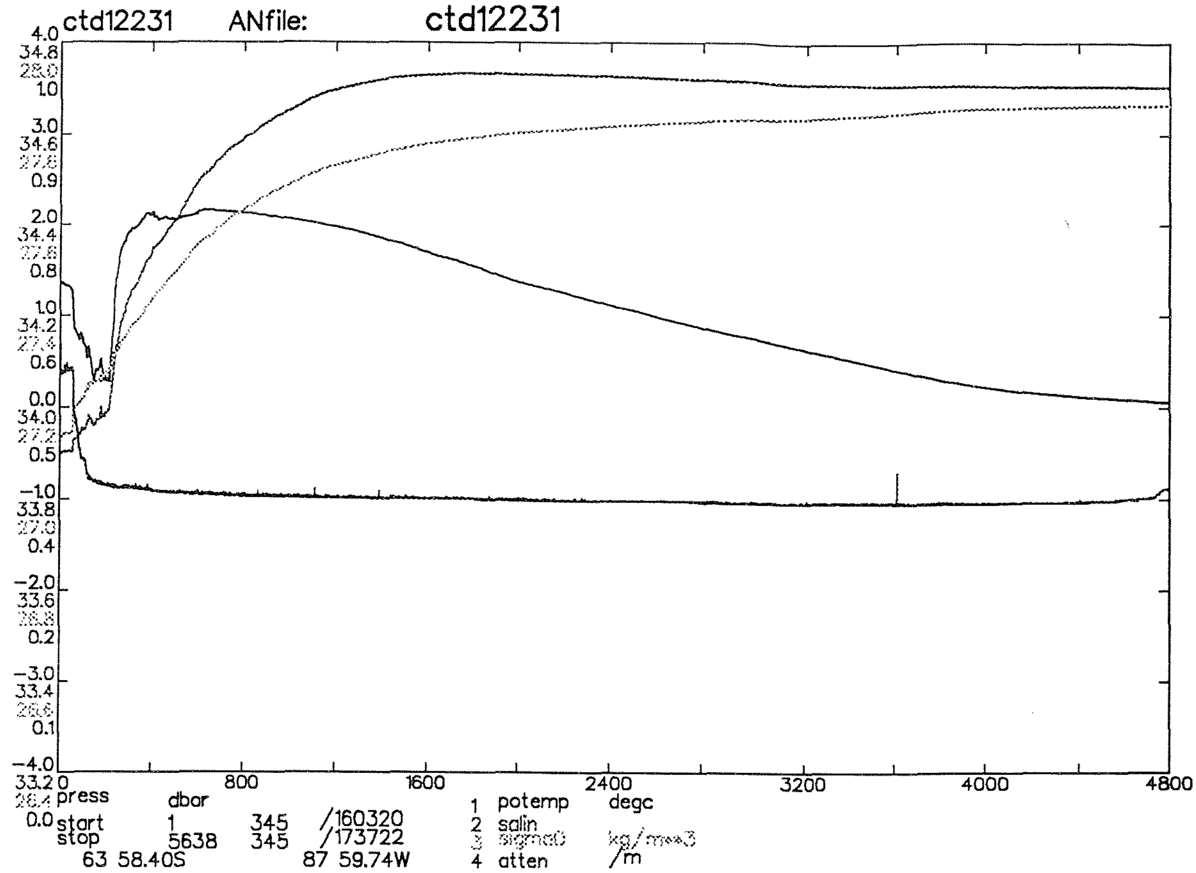
27.2
5
4
27.0
4
2
26.8
2
1
26.6
1
0
26.4
0
0 50 100 150 200 250 300
press dbar
start 1 345 /145636
stop 476 345 /150431
63 59.85S 87 59.27W
1 uwirr lnmuwcm2
2 dwirr lnmuwcm2
3 sigma0 kg/m**3
4 fluor mg/m3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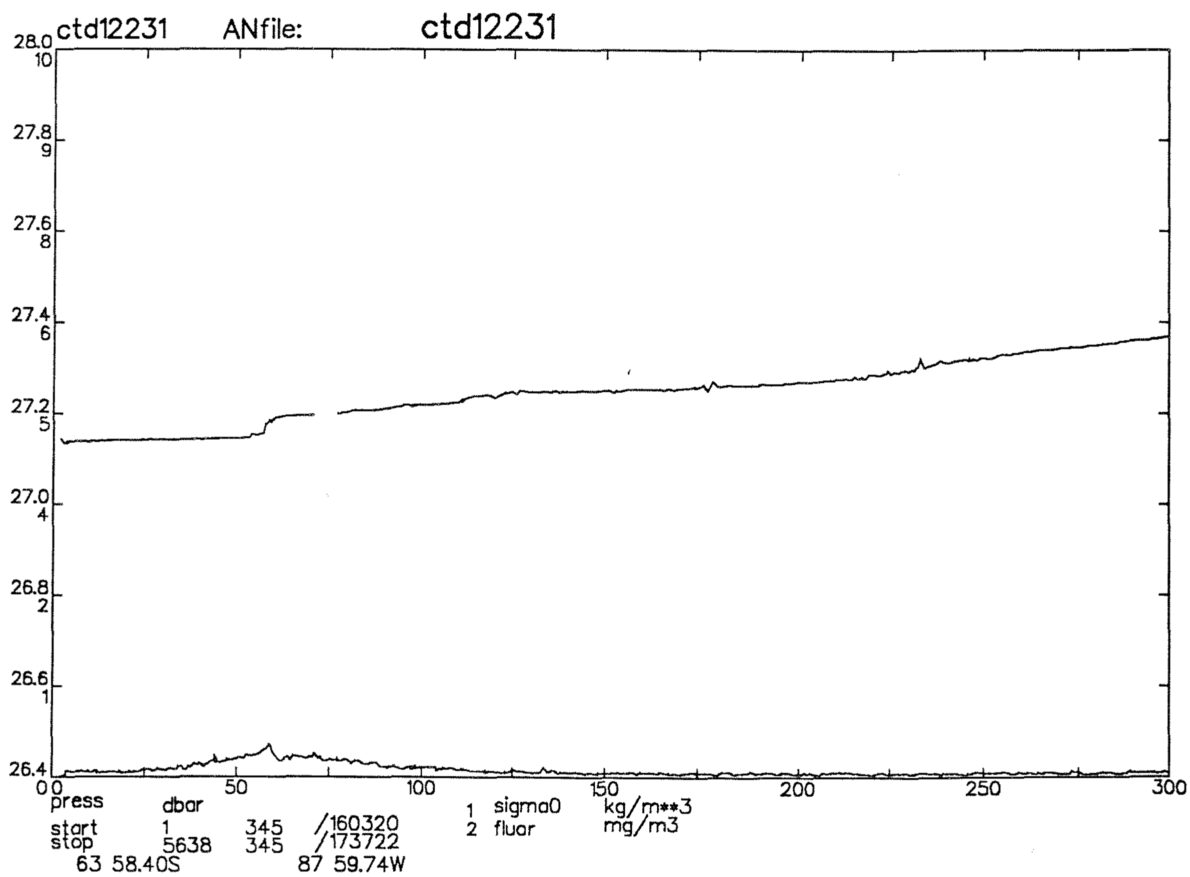
press dbar
start 1 345 /160320
stop 5638 345 /173722
63 58.40S 87 59.74W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m
0 800 1600 2400 3200 4000 4800

×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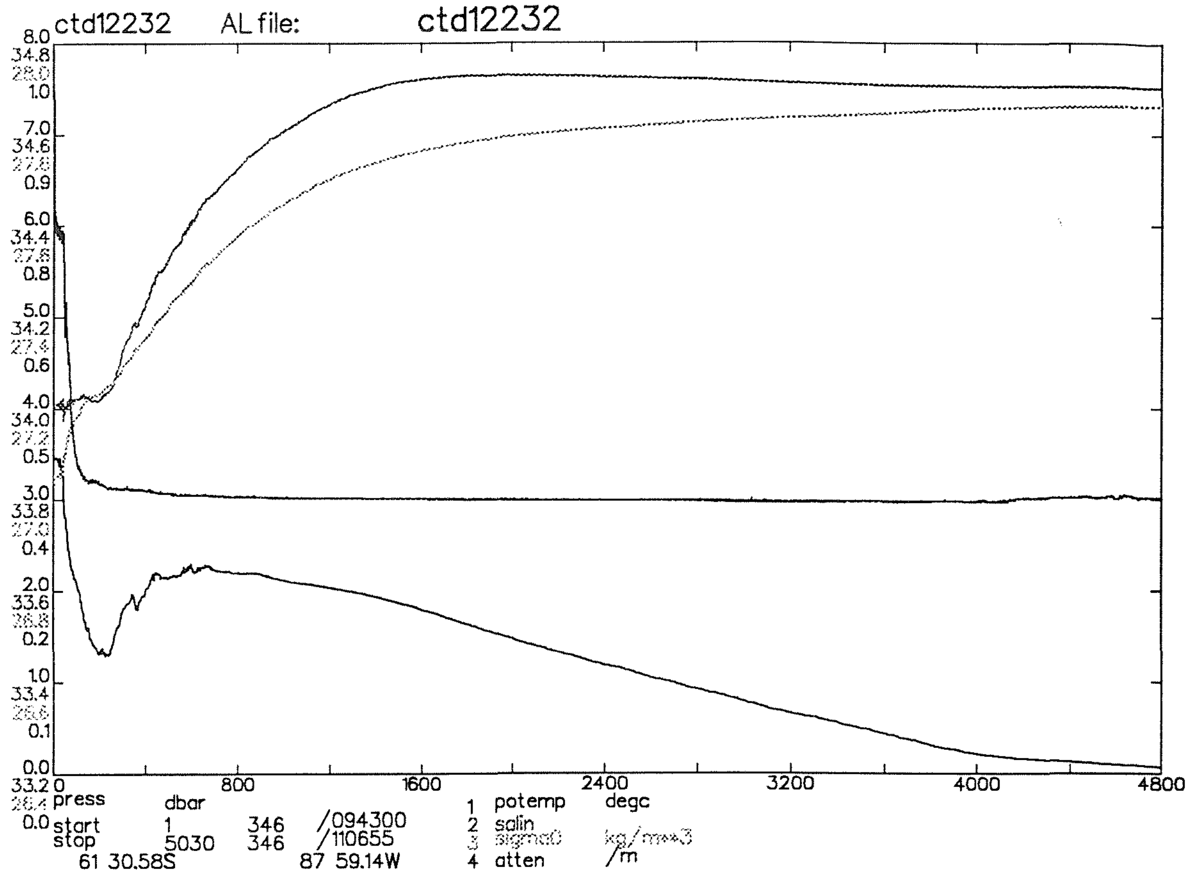
63 58.40S 87 59.74W
1 sigma0 kg/m**3
2 fluor mg/m3
0 50 100 150 200 250 300

×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7.0
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27.8
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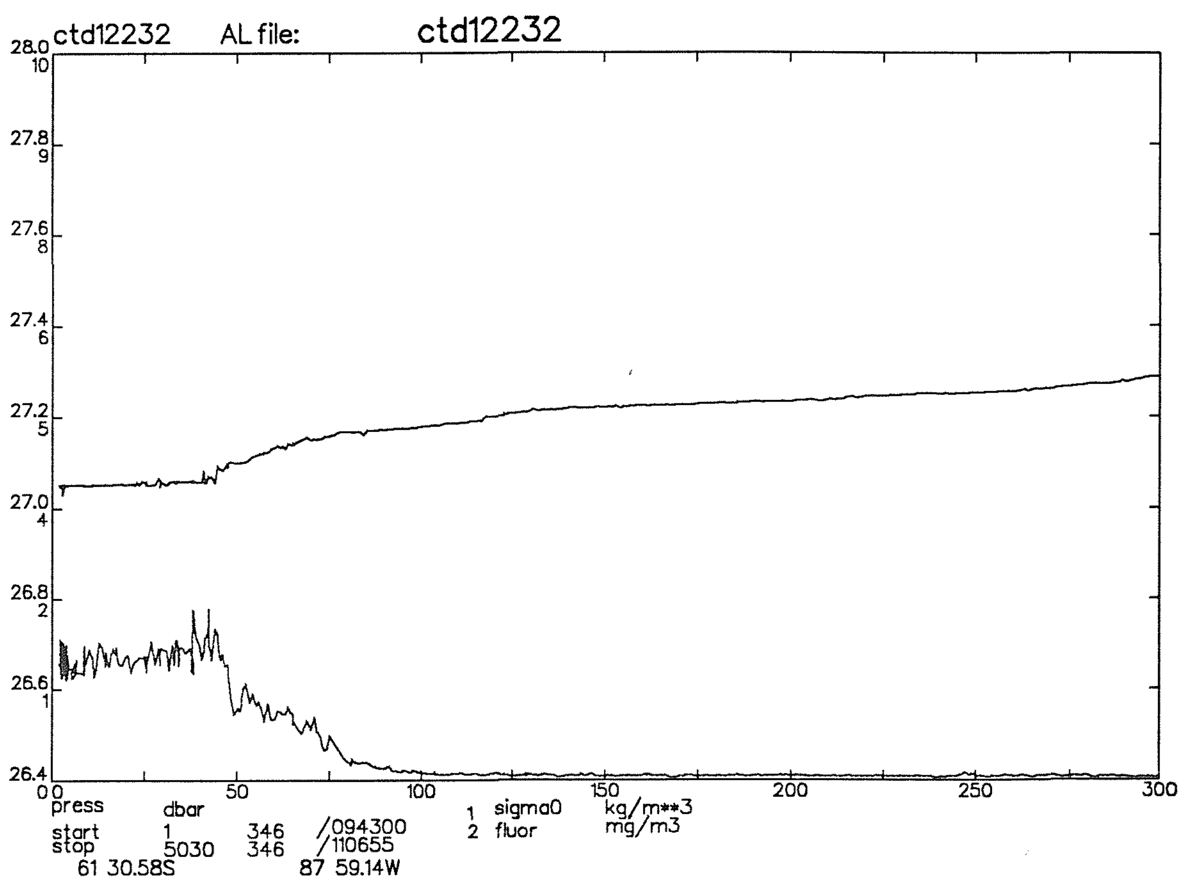
34.4
27.6
0.8
5.0
34.2
27.4
0.6
4.0
34.0
27.2
0.5
3.0
33.8
27.0
0.4
2.0
33.6
26.8
0.2
1.0
33.4
26.6
0.1
0.0
33.2
26.4
0.0
0
800
1600
2400
3200
4000
4800
press dbar
start 1 346 /094300
stop 5030 346 /110655
61 30.58S 87 59.14W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m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5
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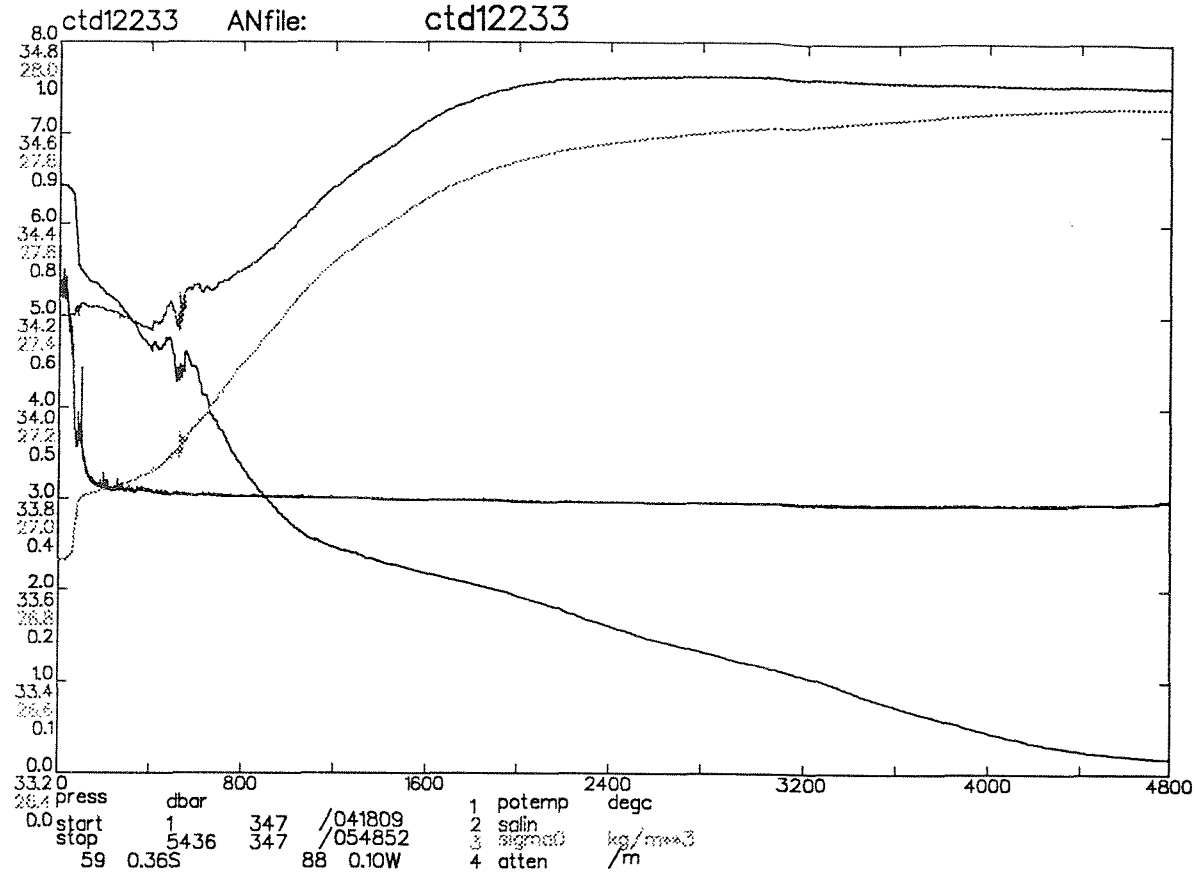
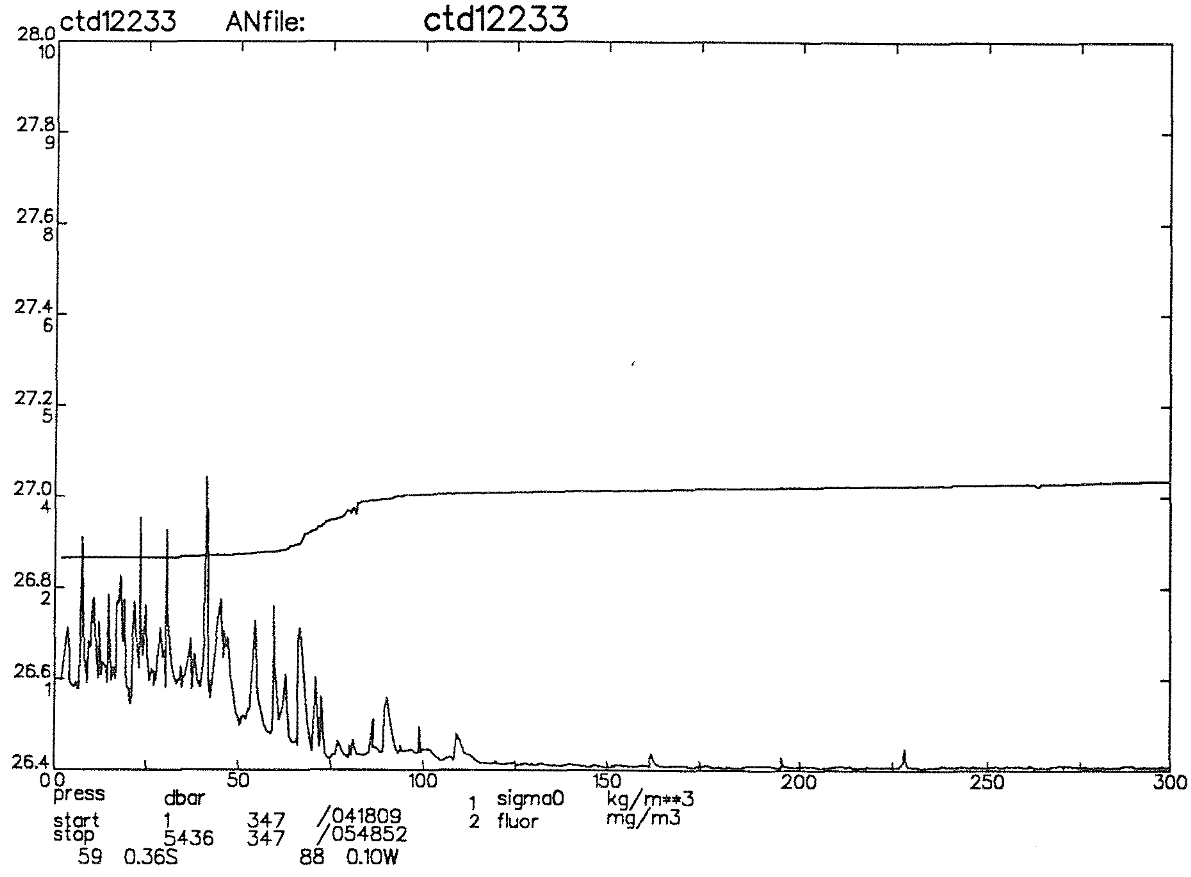
4
26.8
2
26.6
1
26.4
0
0
50
100
150
200
250
300
press dbar
start 1 346 /094300
stop 5030 346 /110655
61 30.58S 87 59.14W
1 sigma0 kg/m**3
2 fluor mg/m3


ctd12233 ANfile: ctd12233
press dbar
start 1 347 /041809
stop 5436 347 /054852
59 0.36S 88 0.10W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m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press dbar
start 1 347 /041809
stop 5436 347 /054852
59 0.36S 88 0.10W
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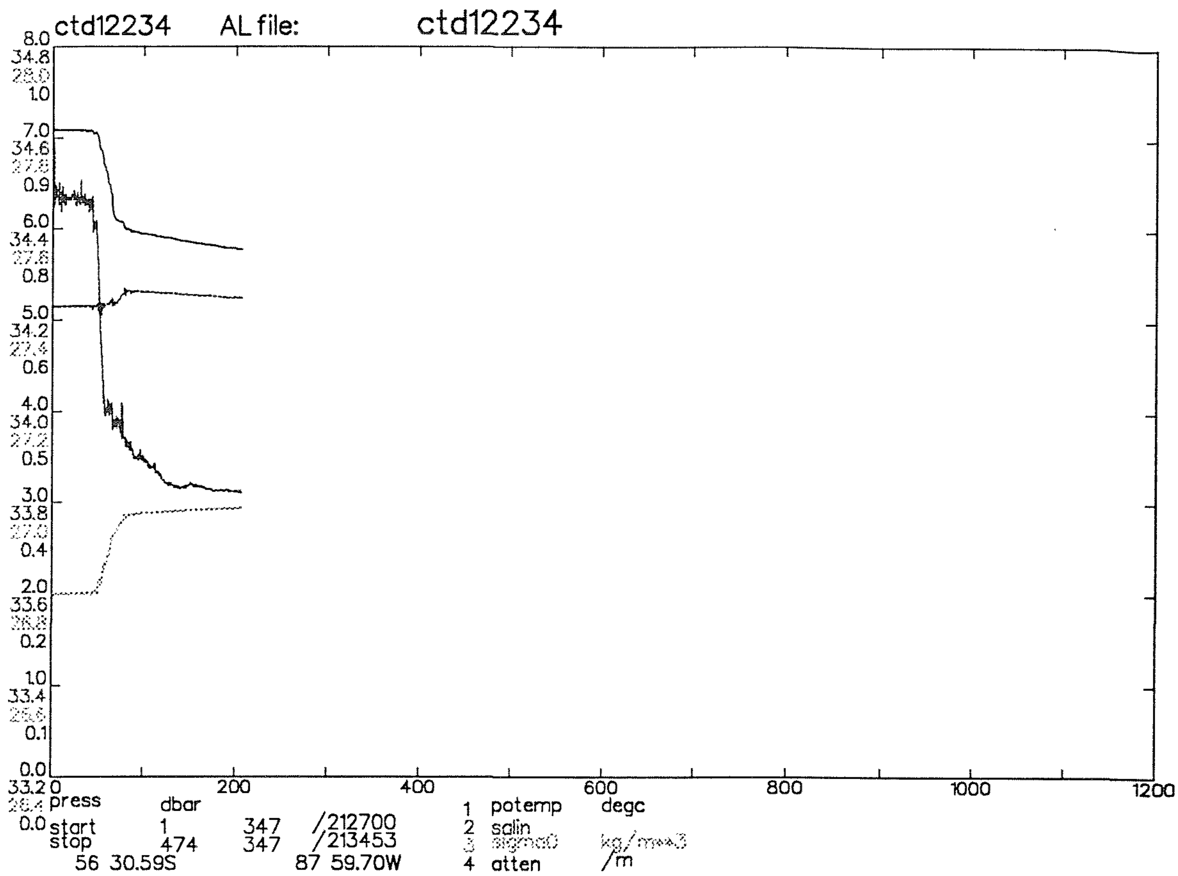
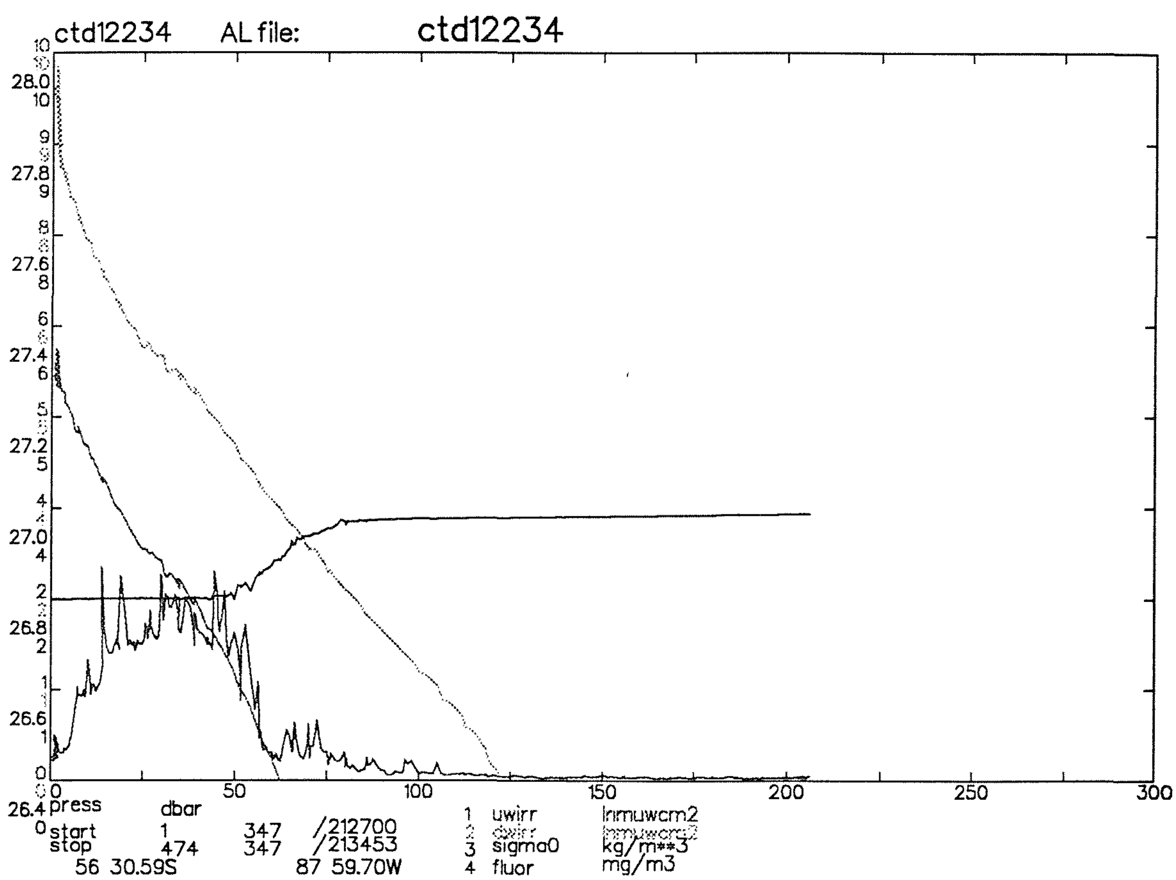
2 fluor mg/m3


ctd12234 AL file: ctd12234
press dbar
start 1 347 /212700
stop 474 347 /213453
56 30.59S 87 59.70W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m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press dbar
start 1 347 /212700
stop 474 347 /213453
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1 uwirr lnmuwcm2
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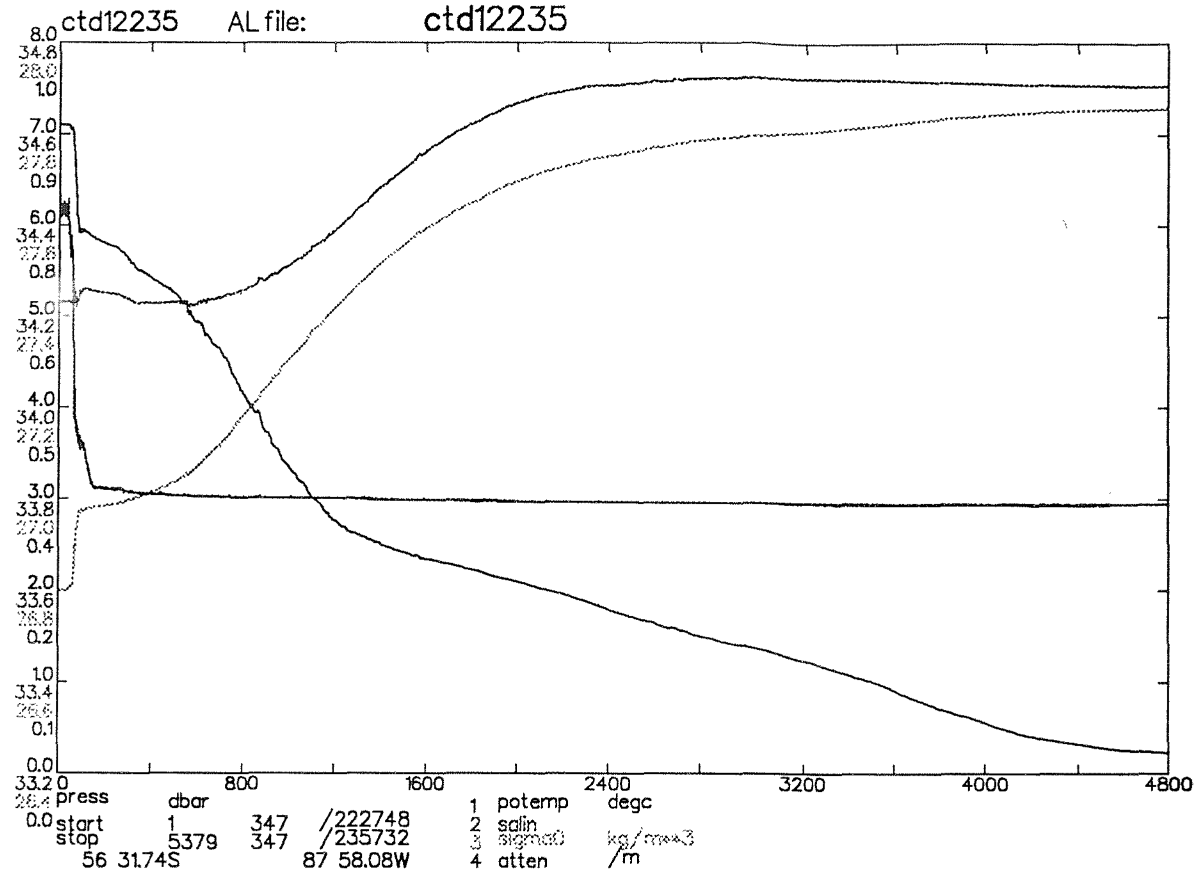
4 fluor mg/m3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press dbar
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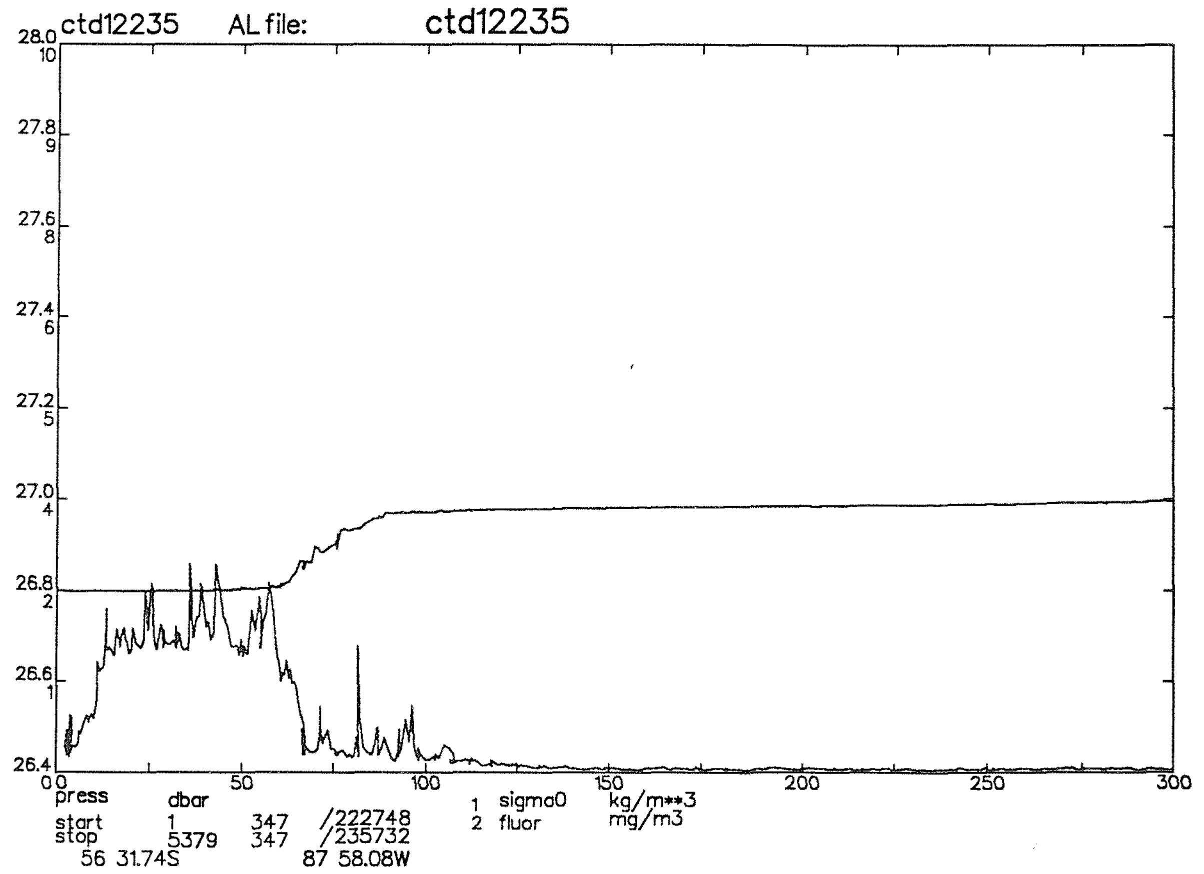
stop 5379 347 /235732
56 31.74S 87 58.08W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m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stop 5379 347 /235732
56 31.74S 87 58.08W
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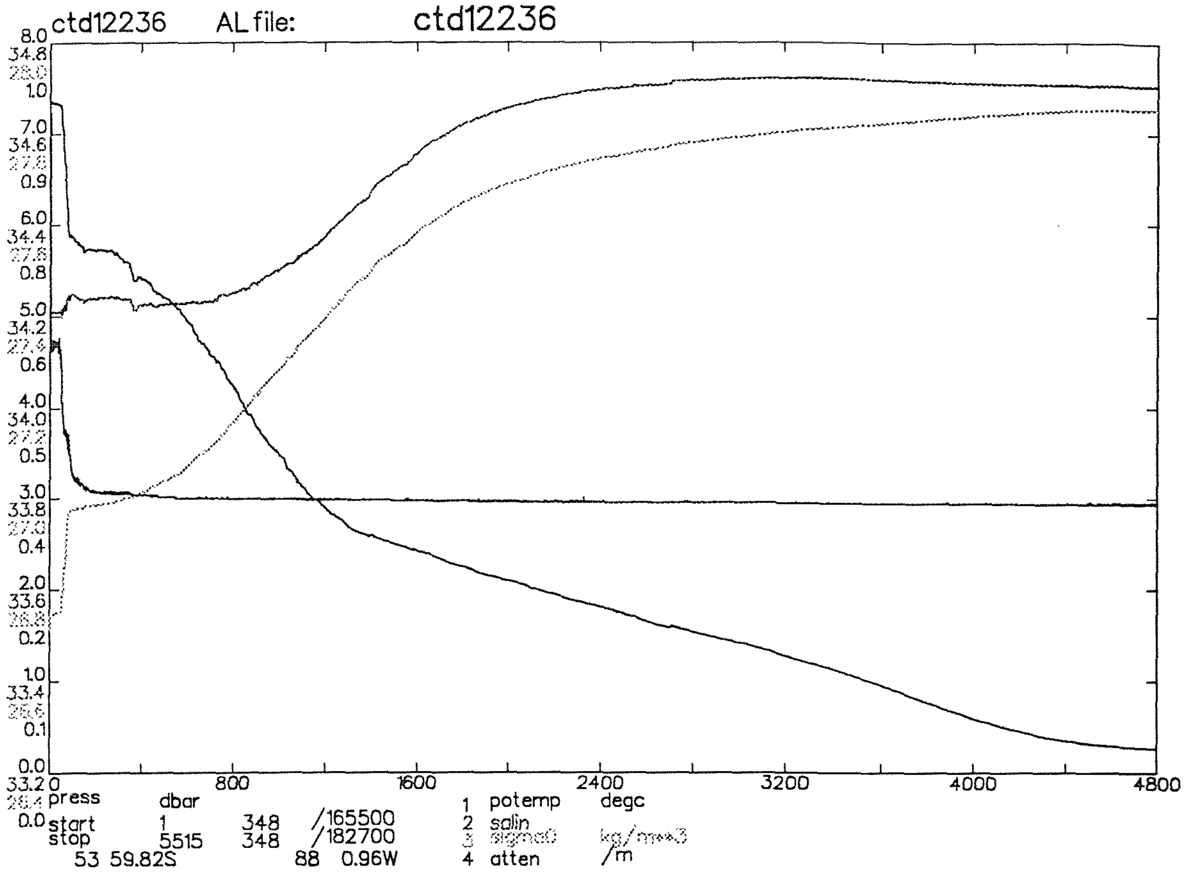
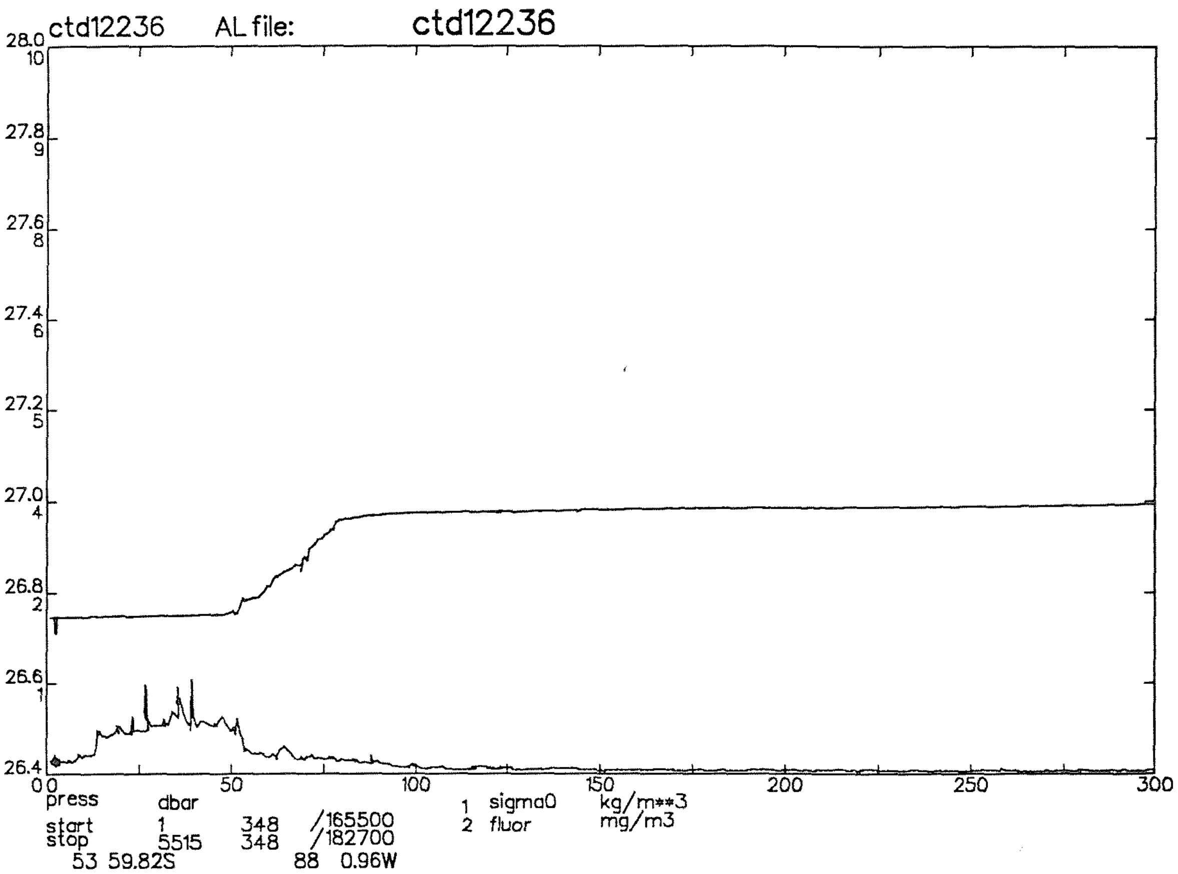
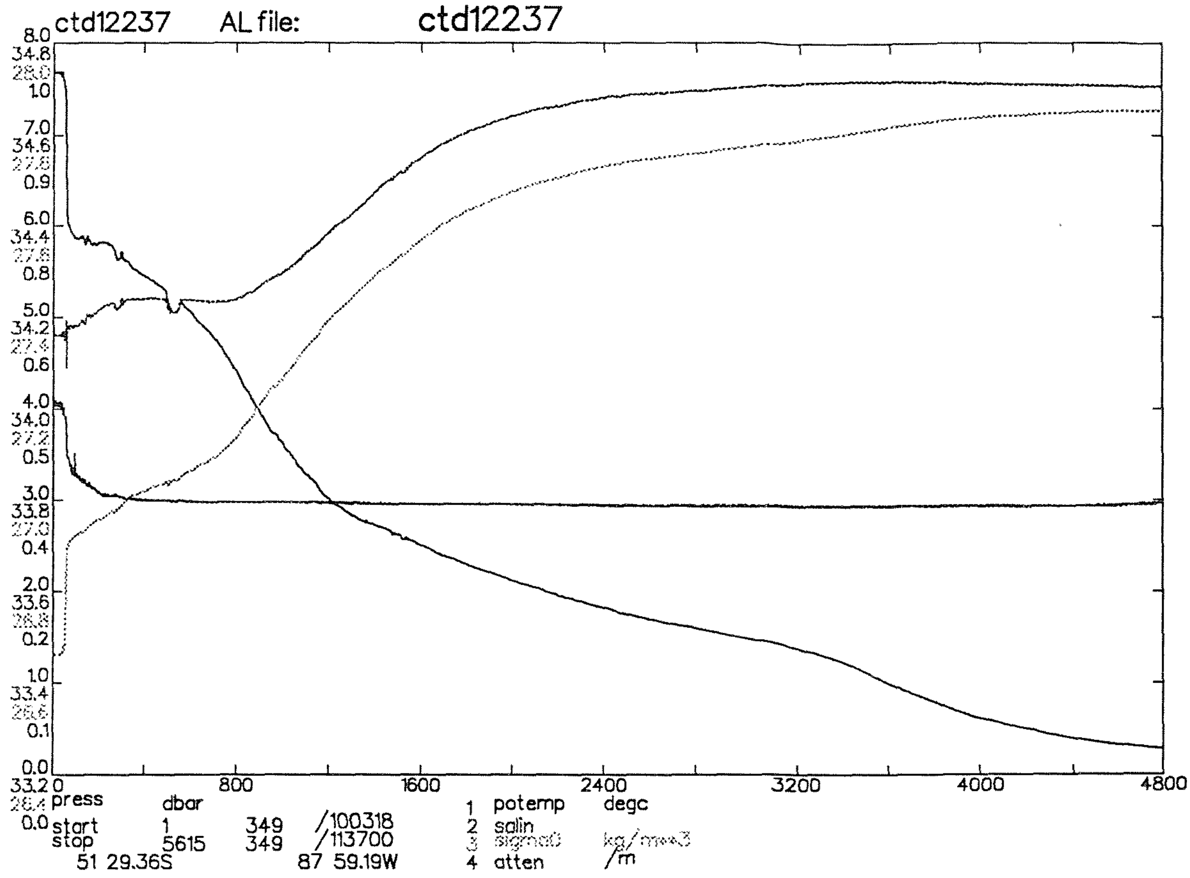
2 fluor mg/m3


ctd12236
AL file:
ctd12236
press
dbar
start 1 348 /165500
stop 5515 348 /182700
53 59.82S 88 0.96W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m
0
800
1600
2400
3200
4000
4800

×


ctd12236
AL file:
ctd12236
press
dbar
start 1 348 /165500
stop 5515 348 /182700
53 59.82S 88 0.96W
1 sigma0 kg/m**3
2 fluor mg/m3
0
50
100
150
200
250
300

×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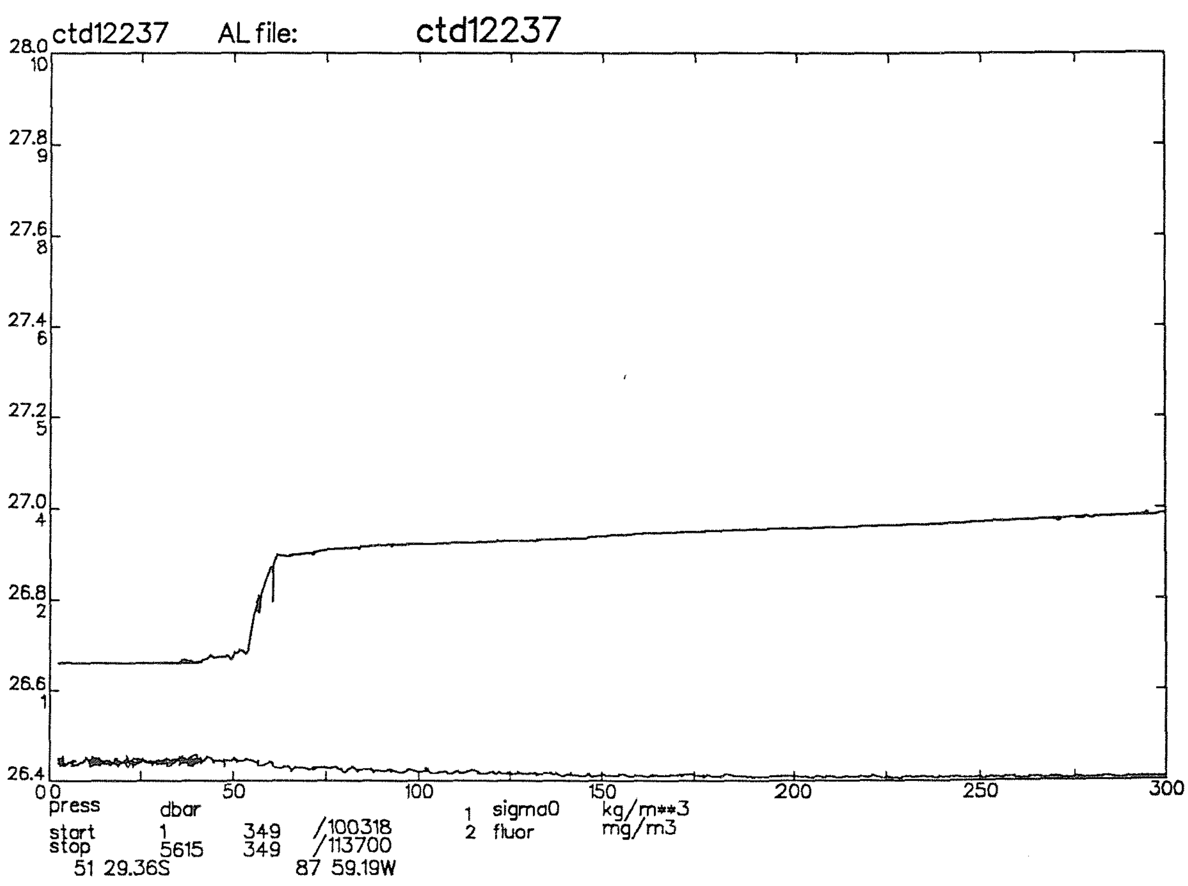
27.8
0.9
6.0
34.4
27.6
0.8
5.0
34.2
27.4
0.6
4.0
34.0
27.2
0.5
3.0
33.8
27.0
0.4
2.0
33.6
26.8
0.2
1.0
33.4
26.6
0.1
0.0
33.2
26.4
0.0
0
800
1600
2400
3200
4000
4800
press dbar
start 1 349 /100318
stop 5615 349 /113700
51 29.36S 87 59.19W
1 potemp degc
2 salin
3 sigma0 kg/m**3
4 atten /m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27.6
8
27.4
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5
27.0
4
26.8
2
26.6
1
26.4
0
0
50
100
150
200
250
300
press dbar
start 1 349 /100318
stop 5615 349 /113700
51 29.36S 87 59.19W
1 sigma0 kg/m**3
2 fluor mg/m3

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