Cruise Report

R/V OCEANUS Cruise 331 to Georges Bank

4 - 13 October 1998

Acknowledgments
R/V OCEANUS Cruise OC331
U.S. State Department Cruise No. 98-005
4 – 13 October 1998

This cruise and preliminary data report was prepared by Jim Irish, Jeff Van Keuren, Jim Doutt, Frank Bahr and Craig Lee from cruise logs and notes as a first draft of the activities, positions and data collected on R/V OCEANUS Cruise OC331. We acknowledge the excellent support of Captain Courtenay Barber Program effort would especially like to thank Bos'n Jeff Stolp and Seaman Horace Medeiros for their outstanding assistance during the mooring operations.

The U.S. GLOBEC Northwest Atlantic/Georges Bank program is jointly sponsored by the National Science Foundation and the National Oceanic and Atmospheric Administration. Support for the Long-term moored program was provided by NSF research grant OCE-96-32348. Support for the SeaSoar effort was provided by N00014-98-1-0369. All data and results in this report are to be considered preliminary.

OCE-9631468

Cruise Report
R/V OCEANUS Cruise OC331
U.S. State Department Cruise No. 98-005

Table of Contents

Table of Contents	2
List of Figures	2
List of Pictures	4
List of Tables	4
Purpose and Accomplishment Summary	5
Cruise Results:	6
Mooring Recovery	
Bottom Pressure	6
Guard Moorings	13
Science Mooring E	13
Mooring Deployment	
Buoy Farm Guard Buoys	25
Foam Guard Buoys	25
Science Mooring D	25
Bottom Pressure Instrumentation	30
CTD Sections	
In situ yo-yo calibrations	30
Northeast Peak Section	35
Mid-Bank Section	35
Southern Flank Long-Term Section	48
Repeat of part of Long-Term Section	48
Downwelling Surface Irradiance	48
Downwelling Underwater Irradiance	61
SeaSoar tests	65
Cruise Personnel	73
Cruise Event Log	74
Chief Scientist's Log of Daily Events	78

List of Figures

Figure 1. OC331 Cruise Track	6
Figure 2. Bottom Pressure Instrument data.	10
Figure 3. Comparison of bottom and 3 mab salinity.	11
Figure 4. Wave statistics	12
Figure 5. Southern flank mooring schematic for deployment 8	14
Figure 6. Southern flank mooring meteorology	15

Figure 7. Southern flank mooring winds 17
Figure 8. Southern flank mooring temperatures 18
Figure 9. Southern flank mooring salinity 19
Figure 10. Southern flank mooring Seacat temperatures 20
Figure 11. Southern flank mooring Seacat salinity 21
Figure 12. Southern flank mooring Seacat internal solitary waves 22
Figure 13. Southern flank bio-optical at 10 m 23
Figure 14. Southern flank bio-optical at 40 m 24
Figure 15. Southern flank mooring ADCP Eastgoing currents 26
Figure 16. Southern flank mooring ADCP Northgoing currents 27
Figure 17. Southern flank mooring ADCP backscattered intensity 28

Figure 18. Southern flank deployment positions 29
Figure 19. Southern flank mooring schematic for deployment 9 32
Figure 20. Southern flank end of deployment 8 yo-yo summary 33
Figure 21. Southern flank start of deployment 9 yo-yo summary 34

Figure 22. Northeast Peak section temperature 36
Figure 23. Northeast Peak section salinity 37
Figure 24. Northeast Peak section density 38
Figure 25. Northeast Peak section transmission 39
Figure 26. Northeast Peak section fluorescence 40
Figure 27. Northeast Peak T-S plot 41

Figure 28. Mid-Bank section temperature 42
Figure 29. Mid-Bank section salinity 43
Figure 30. Mid-Bank section density 44
Figure 31. Mid-Bank section transmission 45
Figure 32. Mid-Bank section fluorescence 46
Figure 33. Mid-Bank section T-S plot 47

Figure 34. Southern Flank first section temperature 49
Figure 35. Southern Flank first section salinity 50
Figure 36. Southern Flank first section density 41
Figure 37. Southern Flank first section transmission 52
Figure 38. Southern Flank first section fluorescence 53
Figure 39. Southern Flank first T-S plot 54
Figure 40. Southern Flank second section temperature 55
Figure 41. Southern Flank second section salinity 56
Figure 42. Southern Flank second section density 57
Figure 43. Southern Flank second section transmission 58
Figure 44. Southern Flank second section fluorescence 59
Figure 45. Southern Flank second T-S plot 60

Figure 46. Short-wave radiation time series 62
Figure 47. CTD39 at LT06 – Chlorophyll-a and PAR Profiles 63
Figure 48. CTD46 at LT06 – Chlorophyll-a and PAR Profiles 64
Figure 49. CTD06 at NEP11 – Chlorophyll-a and PAR Profiles 66

Figure 50. CTD12 at NEP05 – Chlorophyll-a and PAR Profiles 67
Figure 51. SeaSoar HiStar Absorption "a" record 70
Figure 52. SeaSoar HiStar Absorption "c" record 71
Figure 53. SeaSoar Hydroscat record 72

List of Pictures

Picture 1. Bottom Pressure Instrument frame after recovery. 7
Picture 2. Repaired Bottom Pressure Instrument 31
Picture 3. SeaSoar deployment on the R/V OCEANUS 68

List of Tables

Table 1. Sensor serial number and depth. 9
Table 2. Tidal Constituent Comparison 8
Table 3. Mooring Positions 29
Table 4. OC331 Event Log 74

Cruise Report
GLOBEC R/V OCEANUS Cruise OC331
US State Department Cruise No. 98-005
Woods Hole to Georges Bank to Woods Hole
4-13 October 1998

Purpose:

The primary purpose of R/V OCEANUS OC331 was to turnaround the two guard moorings and one science mooring at the Southern Flank site on Georges Bank to end the fourth year and start the fifth year of the GLOBEC Long-Term Moored effort. A bottom pressure instrument was also to be serviced, and CTD yo-yo calibration profiles were to be taken. CTD sections were to be made along standard lines (See Figure 1). Finally, a test of the SeaSoar vehicle was to be made with new bi-optical sensors. When working properly, a section was to be made along the Southern flank long-term section from deep water up to the southern flank moorings to look at the detailed water structure and compare these results with the CTD survey.

Accomplishments:

The Long-Term Moored Program's science buoy "E" and two guard buoys were recovered from the southern flank site. This science mooring was deployed in July after having been previously cut free by fishing activities. Data was dumped from the buoy, Seacats, ADCP, and a preliminary data check was made. The bottom pressure instrument was recovered, although damaged by fishing activities, and the recorded data was dumped and checked. All data recovered appears to be excellent, and the data return was good.

A new science buoy "D" and two new guard buoys were deployed for the start of the fifth and final year of the GLOBEC field effort. The bottom pressure instrument frame was rebuilt using a spare frame fortuitously brought along on the cruise, and deployed between a guard and the science mooring.

The standard long-term CTD sections (with temperature, salinity, beam transmissometer, fluorometer and PAR [phytosynthetically active radiation] observations) were made from the Atlantic up onto the crest of Georges Bank, and from the crest out into the Northeast Channel. Also, a Mid-bank Section was made to the east of the mooring. Solar radiation observations were made with a shipboard PAR sensor and shortwave radiation sensor, as well as with the CTD profiling and reference PAR sensors.

Finally, a test of the reconfigured SeaSoar towed instrument with new bio-optical sensors was made to assure that the system was functioning properly, and could be towed properly before being shipped to the Pacific. Our plan was to a conduct a detailed section across the shelf break up onto the Bank to the southern flank mooring when the instrument was working properly. However, bad weather prematurely terminated cruise activities and we were not able to obtain this section. The cruise track sailed is shown in Figure 1.

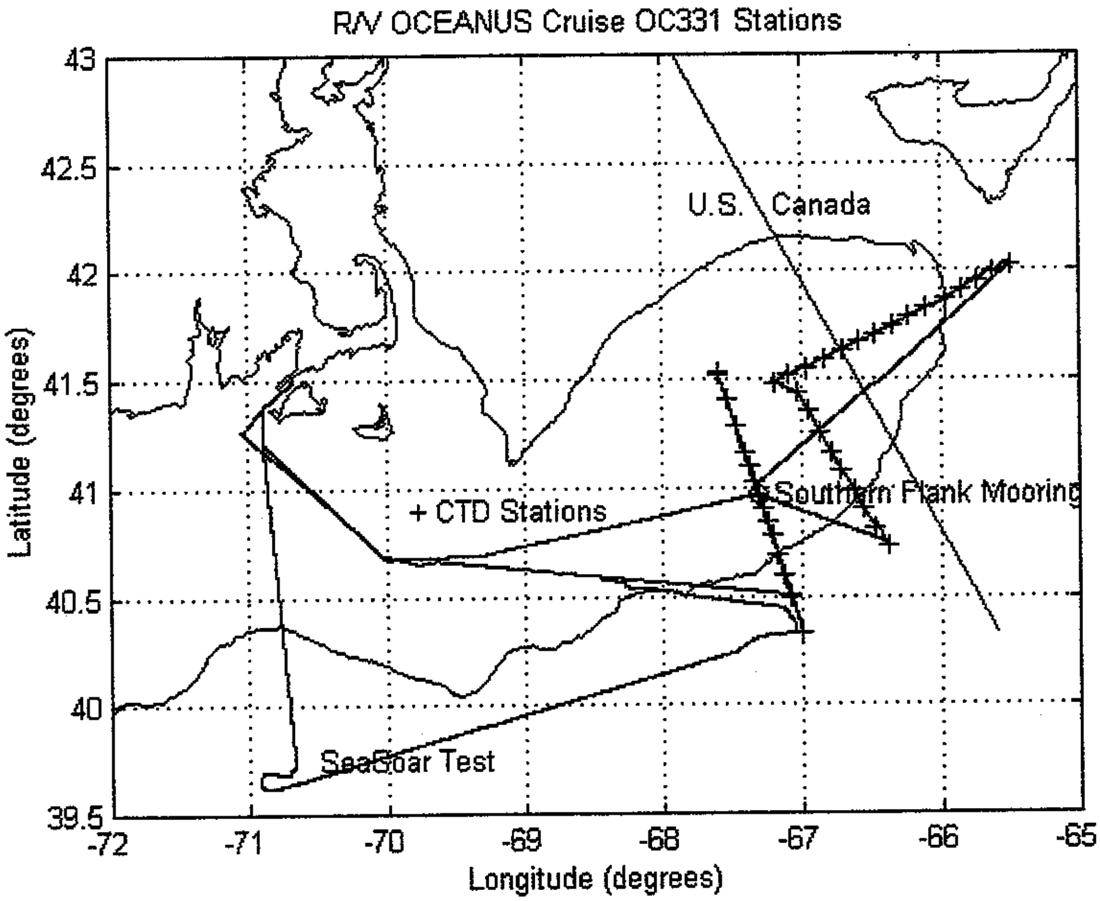


Figure 1. R/V OCEANUS Cruise OC331 ship track. The cruise track is shown with a line, the standard CTD stations are shown with a +, and the southern flank long-term mooring with an 'o.' The Northeast Peak CTD section extends into the Northeast Channel and Canadian waters. The SeaSoar was first tested directly south of WHOI in the nearest deep water. Then the ship steamed toward the offshore CTD station LT15 to start science work until the weather turned too bad to continue working.

Cruise Results:

Mooring Recovery

Bottom Pressure – The bottom pressure instrument was recovered first. It was recalled by acoustic command from the ship which separated the instrument package from the anchor. The instrument then floated to the surface on the buoyancy of 12 plastic floats. When commanding the release, the acoustic range from the ship to the bottom package was greater than expected from the ship's position and deployment position. When released, the package surfaced out of its deployment position. We believe that it had been snagged and moved by the fishing activities that cut science mooring "D" loose in June 1998. When approaching the package for recovery, it was noticed that some of the floats were not attached to the frame properly. Upon recovery it was discovered that the frame had in fact been hit (by a barn door?) and one leg had been

The frame was fouled by barnacle growth, especially on the orange plastic floats. The acoustic release had mild barnacle growth also. We have observed severe barnacle fouling in the bottom meter of the water column during the summer months on the southern flank of Georges Bank each year. The acoustic release and subsurface float 2 to 4 meters above the bottom on the science mooring nearby rarely have had a barnacle when recovered. Therefore, this heavy growth of barnacles is typical of this site, and is restricted to the bottom meter or two. Also, it is most rapid on previously deployed instruments which may have some previous fouling which acts as a base for new fouling to grow.

The Seagauge SBE-37 pressure recorder (See Table 1 for sensor serial numbers) was in good shape with mild hydroid growth. The conductivity cell was clean, and no growth noticed on the conductivity cell itself. About 180 days of good data were dumped from the instrument as shown in Figure 2. Although the bottom conductivity cell was clean, it was mounted horizontal and subject to contamination with sediments. We have observed on other deployments that when sediments, which are non-conducting material, settle in the cell, the conductivity (and hence calculated salinity) decrease. Occasionally during high current, the cell is "blown" clean and the conductivity returns toward the correct value. This can be seen by comparison with the 72-meter conductivity (Figure 3) where the bottom conductivity is plotted against the three shorter records at 72 meters. The 72-meter record agrees well with the moored conductivity higher in the water column. The bottom conductivity starts off about 0.05 PSU low and decreases to about 0.8 PSU low. Then about year day 255, this difference decreases to 0.4 PSU and remains so for the remainder of the record. The high frequency signals agree well. The temperatures from the 72-m Seacat agree extremely well with the bottom pressure instrument; they overlay almost exactly. No quantitative estimate of the difference was made at the present time since the sample intervals were not the same. However, we are making a new conductivity sensor mount so when the bottom instrument is turned around next time, the conductivity cell will be mounted on one of the legs with the cell more vertical and a longer cable will be obtained to connect it with the recorder.

To compare the results of the bottom pressure observations with the previous 6-month deployment of the same bottom pressure instrument at the southern flank site, a harmonic tidal analysis was done on the 4293 term, hourly averaged data. The results are shown in Table 2.

Table 2. Principal Bottom Pressure Tidal Harmonic Constants

	Deployment 7		Deployment 8	
Tidal Constituent	Amplitude (dbars)	Greenwich Phase (°)	Amplitude (dbars)	Greenwich Phase (°)
O1	6.014±0.52	178.2±4.3	6.033±0.14	179.8±1.1
K1	7.161±0.52	172.8±3.6	7.162±0.14	173.2±1.0
N2	9.228±0.52	342.9±2.8	9.432±0.14	341.3±0.7
M2	38.202±0.52	6.4±0.7	39.057±0.14	6.7±0.2
S2	8.390±0.52	28.8±3.1	7.780±0.14	29.2±0.9
Mean(Z_0)	76.871		76.7181	

Table 1. Sensor Type, Depth and Serial Number

				Buoy D	Buoy E
				Recovered	Deployed
Measurement	Sensor Type	Company	Model	Serial Number	Serial Number
Buoy Met	Air Temperature	Rotronics		35851	16302
	Relative Humidity	Rotronics		35851	16302
	Wind Speed and Dir	RM Young		-	23908
	PAR	LiCor	UWQ	5018	4949
	Short Wave Rad	Eppley		25418	28300
	Long Wave Rad	Eppley		27953F3	28379F3
Sea Surf Temp	Temp at 1 m	Sea Bird	SBE-3	32176	31624
	Cond at 1 m	Sea Bird	SBE-4	N/S	41340
Current Profiles	ABDP	RD Instruments	Workhorse	125	130
T/C at 5 m	Temp at 5 m	Sea Bird	SBE-3	32177	31628
	Cond at 5 m	Sea Bird	SBE-4	41333	41342
BIOP at 10 m		Luigi		2	4
	Temp at 10 m	Sea Bird	SBE-3	482	478
	Cond at 10 m	Sea Bird	SBE-4	41365	56
	OBS at 10 m	Sea Point		1222	N/S
	Trans at 10 m	Sea Tech	25 cm	621	628
	Fluor at 10 m	Sea Tech		296	306
	PAR at 10 m	LiCor	SPQA	1971	1659
T/C at 15	Temp at 15 m	Sea Bird	SBE-3	32178	N/S
	Cond at 15 m	Sea Bird	SBE-4	41368	N/S
T/C at 20	Temp/Cond at 20 m	Sea Bird	SBE-16 Seacat	1861	1736
T/C at 25	Temp at25 m	Sea Bird	SBE-3	32429	N/S
	Cond at 25 m	Sea Bird	SBE-4	41370	N/S
T/C at 30	Temp/Cond at 30 m	Sea Bird	SBE-16 Seacat	2360	1820
T/C at 35	Temp at 35 m	Sea Bird	SBE-3	32430	N/S
	Cond at 35 m	Sea Bird	SBE-4	41711	N/S
BIOP at 40 m		Luigi		3A	5
	Temp	Sea Bird	SBE-3	484	493
	Cond	Sea Bird	SBE-4	41367	68
	Trans	Sea Tech	25 cm	143pr	626
	Fluor	Sea Tech		290	305
	PAR	LiCor	SPQA	1661	1660
T/C at 45	Temp at 45 m	Sea Bird	SBE-3	32431	N/S
	Cond at 45 m	Sea Bird	SBE-4	41713	N/S
T/C at 50	Temp at 50	Sea Bird	SBE-3	32432	32173
	Cond at 50	Sea Bird	SBE-4	41890	41343
T/C at 72	Temp/Cond at 72 m	Sea Bird	SBE-37µcat	2006	716
Acoustic Release		EG&G	BACS	15050	15050
Bottom Pressure Instrumentation					
	Pressure Instrument	Sea Bird	SBE-26	49	49
	Conductivity	Sea Bird	SBE-4	41596	41596
	Acoustic Release	EG&G	BACS	17308	17308

N/S = no sensor deployed

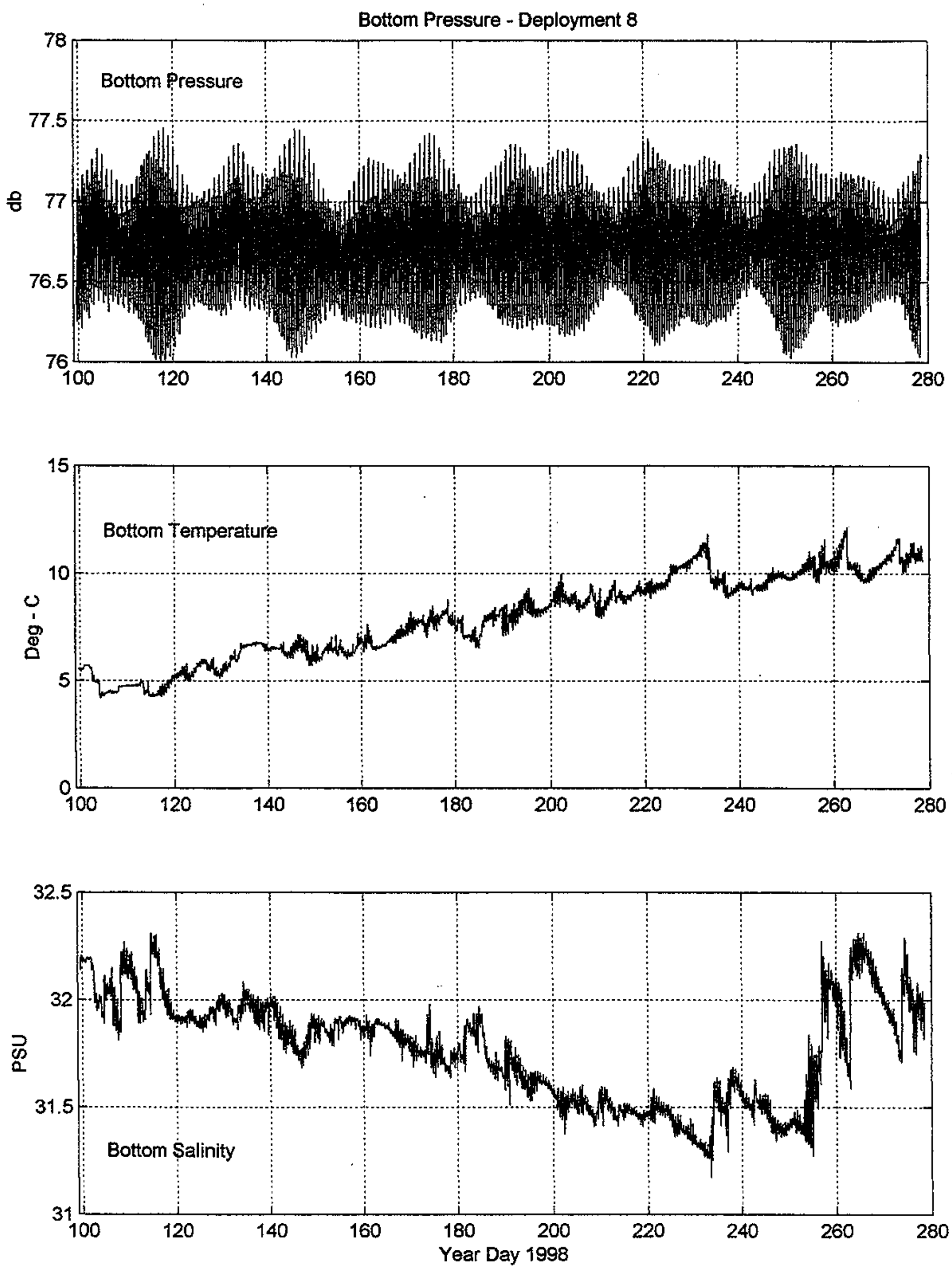


Figure 2. Bottom pressure instrument data. The top panel shows the raw, normalized pressure record in decibars relative to a standard atmosphere. The middle panel shows the raw, normalized temperature in degrees C. The bottom panel the raw, normalized salinity calculated from conductivity and temperature. The sample interval in tidal mode was 15 minutes. The salinity record includes an apparent sediment-induced drift.

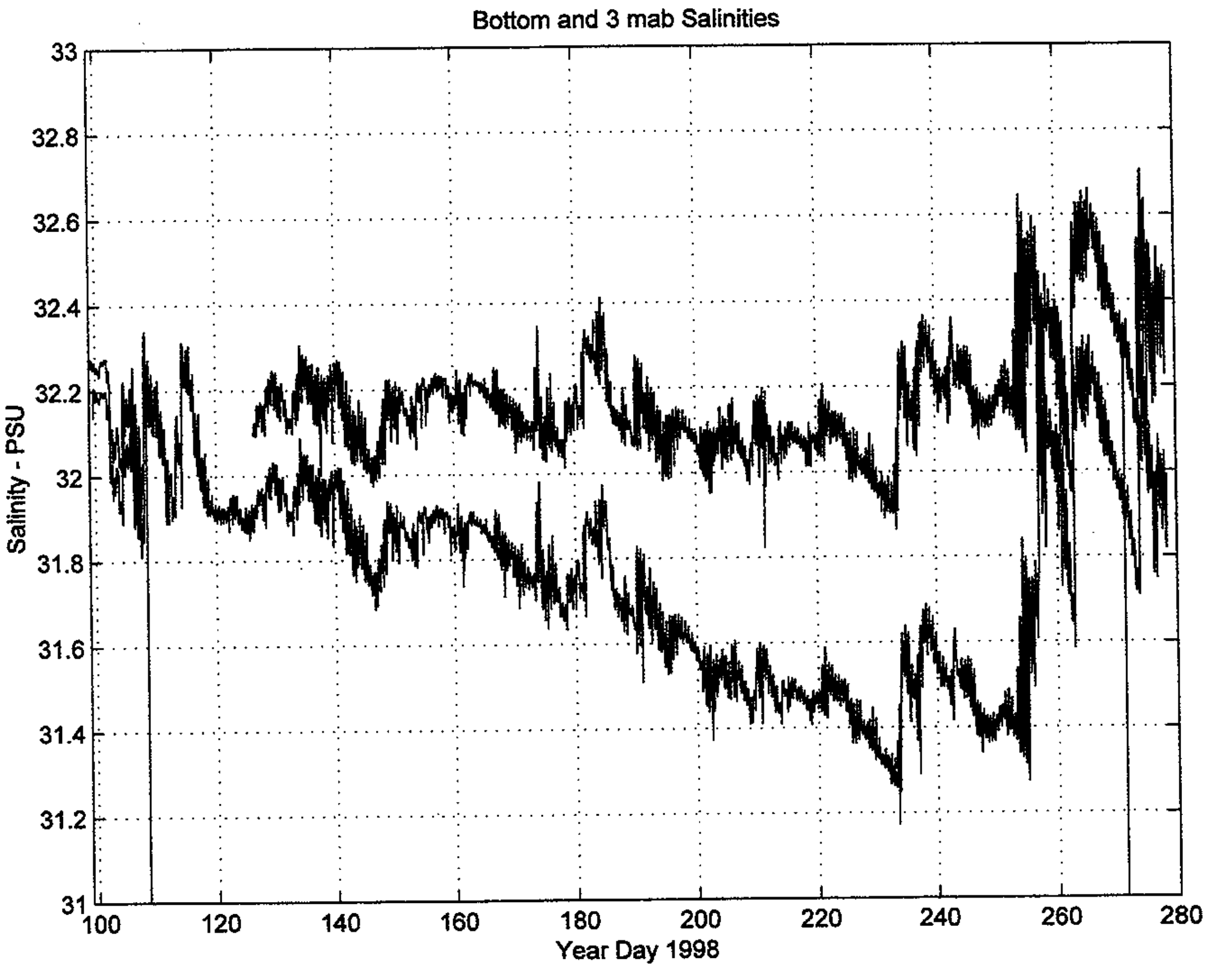


Figure 3. Comparisons of salinity. The bottom salinity is plotted with those measured at 72 meters depth, 3 meters above the bottom. The difference shows the effects of the non-conductive sediment in the horizontally mounted conductivity cell on the bottom frame as compared with the vertically mounted 72-meter conductivity cell.

It is obvious that the results are in excellent agreement. The slightly larger M2 amplitude in the summer months perhaps indicates some contamination of the pressure record with second order effects of the semidiurnal internal tidal solitary waves observed at the site (See Seacat high frequency data in Figure 12 below.) These results are in good agreement with our previous results at this site and tidal observations made as part of the Bureau of Land Management study on Georges Bank in the 1980's.

The Sea Bird bottom pressure instrument also made a burst sample of waves once a day to obtain an estimate of the long wave activity at the southern flank site. The long waves will penetrate to the bottom and be measured there. This data is then processed to obtain significant wave height and period as shown in Figure 4. Significant wave height is the average height of the highest 1/3 of the waves and close to what one estimates by eye when looking at the wave field.

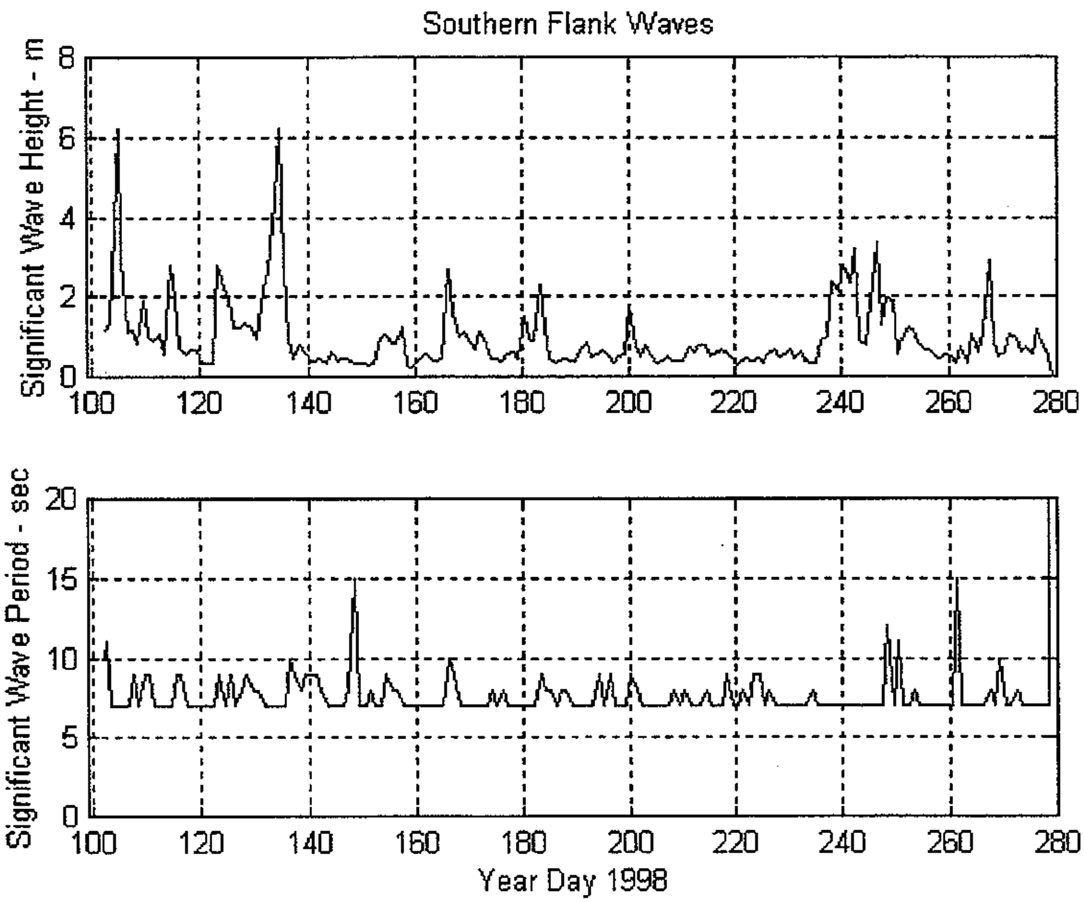


Figure 4. Wave statistics gathered once per day at 19:30 GMT from the bottom pressure sensor as an indication of the wave activity, especially the long waves, that can penetrate to the bottom in 76 meters of water. The minimum period of about 7 seconds reflects the attenuation with depth which removes the effects of waves with periods smaller than about 7 seconds.

Guard Moorings – Two steel buoy guard moorings were deployed in October 1997, and were recovered during this cruise. One was in the deployed position, but the second had been moved 2/3 of a mile out of position. They were successfully recovered along with their mooring chain and anchor. The anchors showed wear due to the rotary tidal currents. The chain showed wear in the bottom section that was dragged along the bottom, and was mildly biofouled over most of its length. The buoys were in good shape with the guard lights working, little biofouling, and no damage that could be attributed to the buoys being hit. These buoys will be serviced for deployment at the Northeast Peak in November.

Science Mooring E – Prior to recovering the science mooring, a 1 hour CTD yo-yo was taken as a post-cruise calibration (see below and Figure 38). The mooring was recovered after an acoustic release command separated the mooring from the anchor, and the bottom of the mooring surfaced on the buoyancy of a backup recovery float. The surface buoy was recovered first, and then the mooring cable pulled in by hand, with help in recovering the heavier bio-optical packages by the ship's crane. The GOES/ARGOS antenna on the buoy's tower was banged against the ship's rail which bent the connector where the cable from the transmitter connected to the antenna. Subsequent ARGOS and GOES transmissions did not indicate any electrical damage (power out was normal with no high reflected to transmitted power ratio).

The mooring appeared to be in good shape. No sensors appeared to be damaged or missing. See Table 1 for sensor type, serial number and depth of the recovered sensors. There was light biofouling on the 40-meter bio-optical packages and heavy fouling on the 10-meter package. The ADCP also had light to moderate fouling. The top of the tethers was lightly fouled with hydroids, but the bottom was clean. The subsurface float was nearly clean, as was the acoustic release. The mooring cable was lightly fouled at the bottom and more heavily fouled toward the top. The SeaBird temperature and conductivity sensors were all relatively clean. The poison tubes were removed for safely reasons. The buoy had a few gooseneck barnacles on the bottom, and was otherwise fairly clean. There were indications of fish parts on one side of the buoy, showing a bird had used it for a dinner table. The solar panels and meteorology sensors were clean and in good shape.

The mooring configuration is shown in Figure 5 with sensor type and serial numbers listed in Table 1. Data was lost at 5 and 35 meters depths due to a power switch in the data system that failed early in the deployment. The remaining buoy data appear good and are plotted in Figures 6, 7, 8, and 9.

The meteorology observations (Figure 6) include air temperature, relative humidity, PAR (photosynthetically active radiation, integrated radiation from 400 to 700 nm wavelength), short-wave radiation and long-wave radiation. All samples are hourly averages of more rapidly samples. For radiation, the basic sampling rate was 10 seconds. For air temperature and relative humidity (which required power) it was 1 minute. The air temperature shows the warmest air in August and the fall cooling. The PAR sensor and short wave radiation sensor are quite similar, and show a few days with no incoming radiation and the general decrease in peak radiation with the fall season. The long-wave radiation includes bad values caused by interference from the GOES transmitter and an unknown 3-day signal that is not observed in laboratory tests of the system. The zero drift of the short-wave data will be corrected for, and also used to correct any

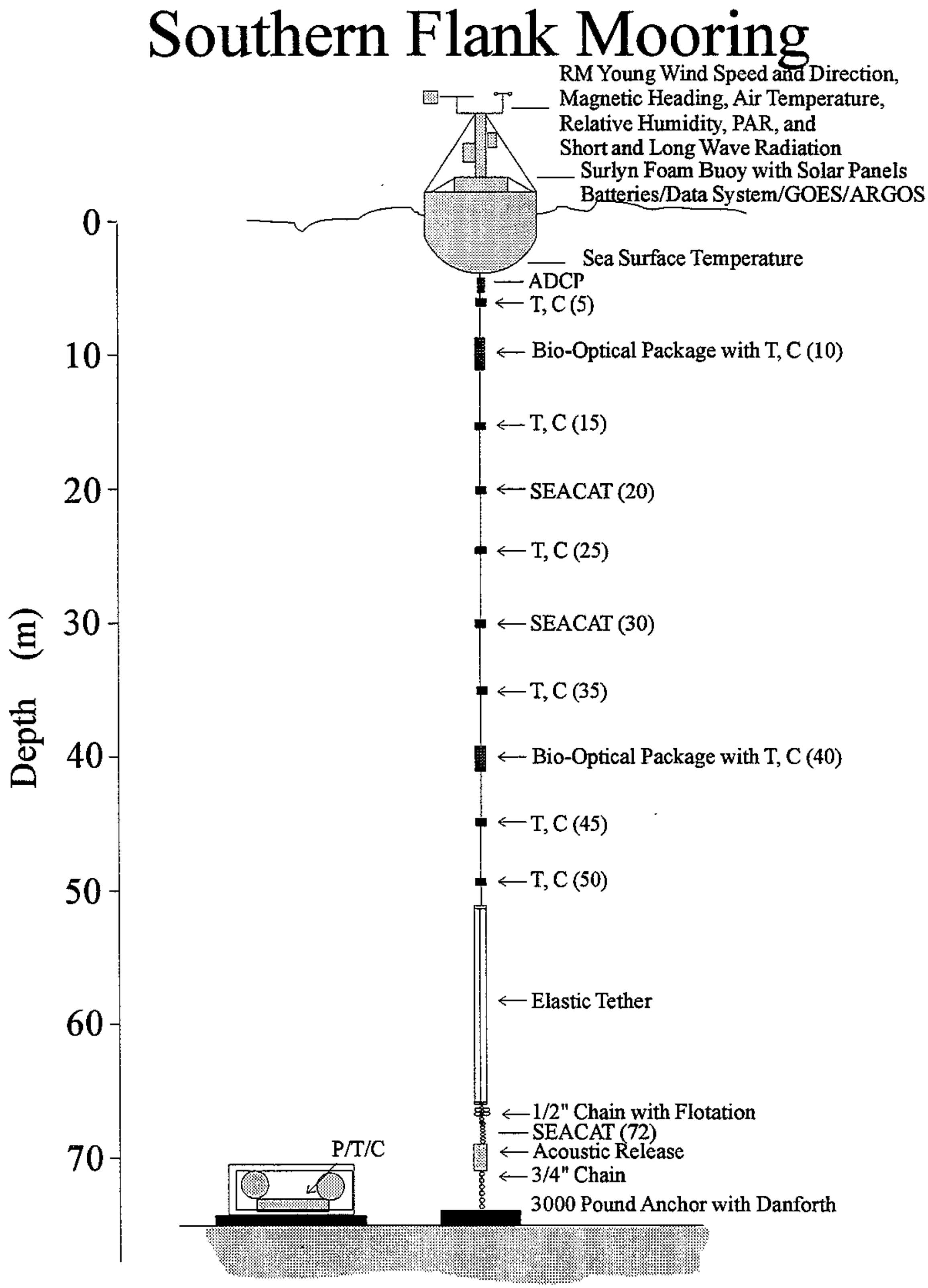


Figure 5. Southern Flank mooring configuration for deployment 8.

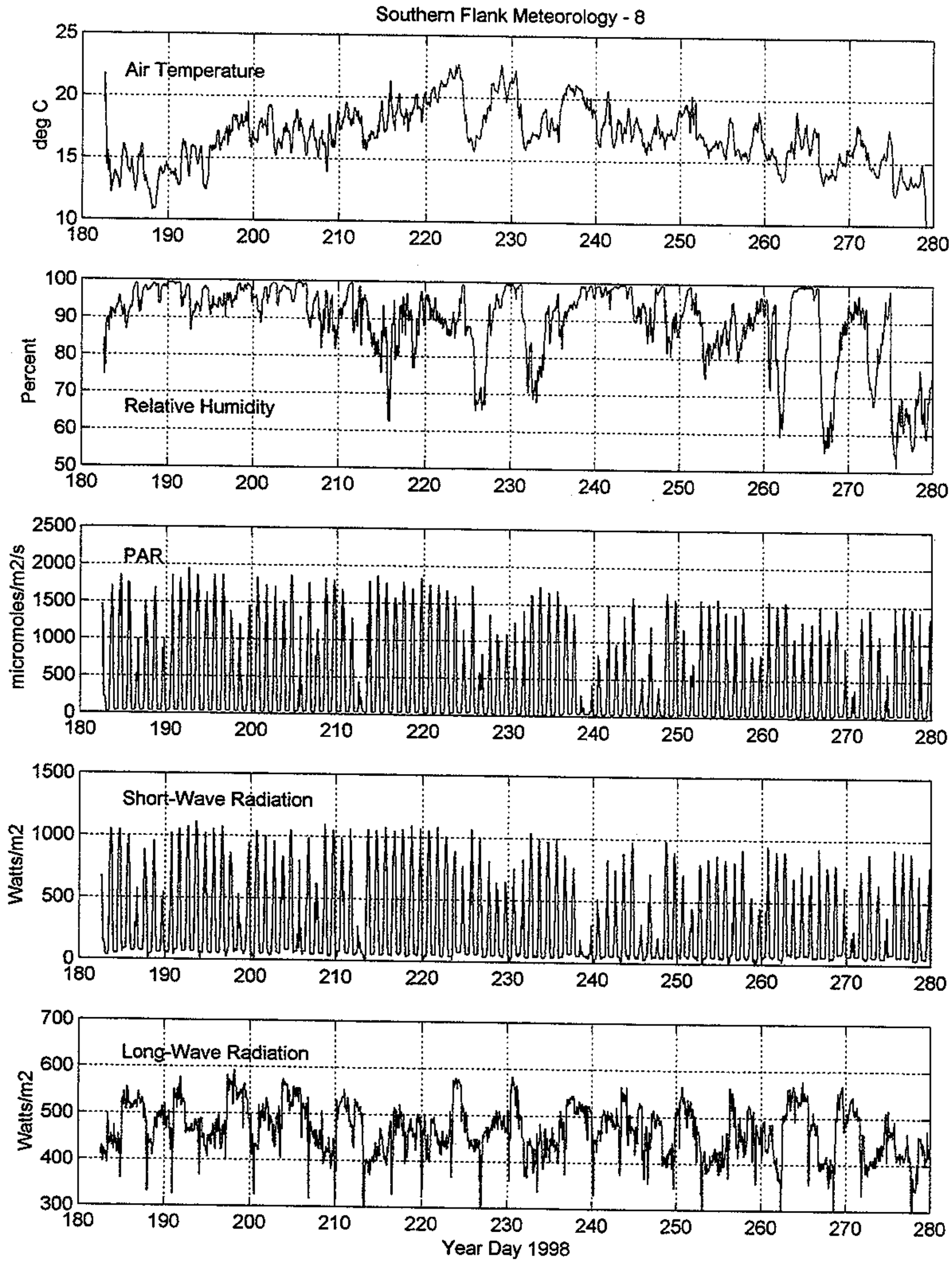


Figure 6. The Southern Flank Meteorology. The top panel shows the normalized, unedited air temperature observations. The next panel shows the normalized, unedited relative humidity. The third panel is a cosine, incoming PAR (photosynthetically active radiation from 400 to 700 nm) and the fourth short wave radiation (400 to 1500 nm). The bottom panel is long-wave radiation and includes interference due to the GOES transmissions and a mysterious 3-day cycle of minimum spikes.

zero drift of the long-wave radiation observations. Laboratory tests confirm that the two adjacent input channels with highest gain do drift about with about the same zero off set.

The southern flank winds (Figure 7) are again hourly averages. The wind observations are sampled at 10-second intervals and vector averaged relative to the buoy. Every minute the compass is powered up and the vector components are rotated and averaged relative to compass north. The wind speed is the direct average of the speed indicator. The Gust is the single highest 10-second sample during the hour. The gust is regularly 1.5 times the average wind speed. During the summer there were only a couple of storms where the wind speed reached 25 kts (13 m/sec).

The water temperature and salinity observations are shown in Figures 8 and 9 respectively. The bad 5-m and 35-m data are not plotted. There are no strong signals seen in temperature or salinity such as the fresh water from the Scotian Shelf or the warm, salty water from Gulf Stream rings that have been observed in past year. The maximum heating and stratification appears about mid-August as expected, and the surface cools after that with cooling extending deeper with time until the water column becomes entirely mixed about the end of the cruise. When the instrument was recovered the CTD showed mixing to below 40 meters and some stratification at the bottom (see Figure 38). The last CTD taken showed very little stratification in the water column. There is an indication of fresher water in the 15-meter salinity record in the later part of August. Generally the temperatures ended the year a bit warmer than usual – about 15° C rather than 13° C seen in past years. The salinity showed the continued freshening seen in the past two years, and ended the year just under 32 PSU. The year started about 32.25 PSU. As usual, the highest salinity is at the bottom where the effects of the mixing up from the saltier shelf slope front are evident.

The Seacats are sampled more rapidly than the buoy data. The 20 and 30 meter Seacats were sampled at 1-minute intervals and the 72-meter Seacat at 5-minute intervals. The one-minute intervals were used to resolve the internal solitary wave signatures seen in all past years as well as the current one when the water column was stratified. The temperature (Figure 10) and salinity (Figure 11) records show similar mean values as the buoy-recorded data. In addition, the high frequency signature of internal solitary waves appears as spikes in the records. Expanding the time scale to resolve these apparent spikes, the typical picture of rank ordered solitary waves groups is obtained (Figure 12). These waves are present throughout the stratified season and contribute significant energy which may increase mixing, preditor prey encouters and contribute to the tidally mixed front at about 60 meters depth.

The two bio-optical packages at 10 and 40 meters returned good data. The 10-meter optical sensors (Figure 13) fouled faster than usual, producing no useful data after year day 233. The PAR sensor also had some visible fouling, although not as great, and so the data shown is probably somewhat attenuated toward the end. This sensor was calibrated after the cruise, and salt water was found in the sensor. This may have occurred during pressure washing to remove bio-fouling, so the cleaning procedure will be changed in the future. The 40-meter package (Figure 14) produced usable data throughout the deployment, but probably needs some correction for biofouling after about year day 250. The data shown are sampled at 3.75 minute intervals (16 samples per hour), and show more high frequency variability than the hourly

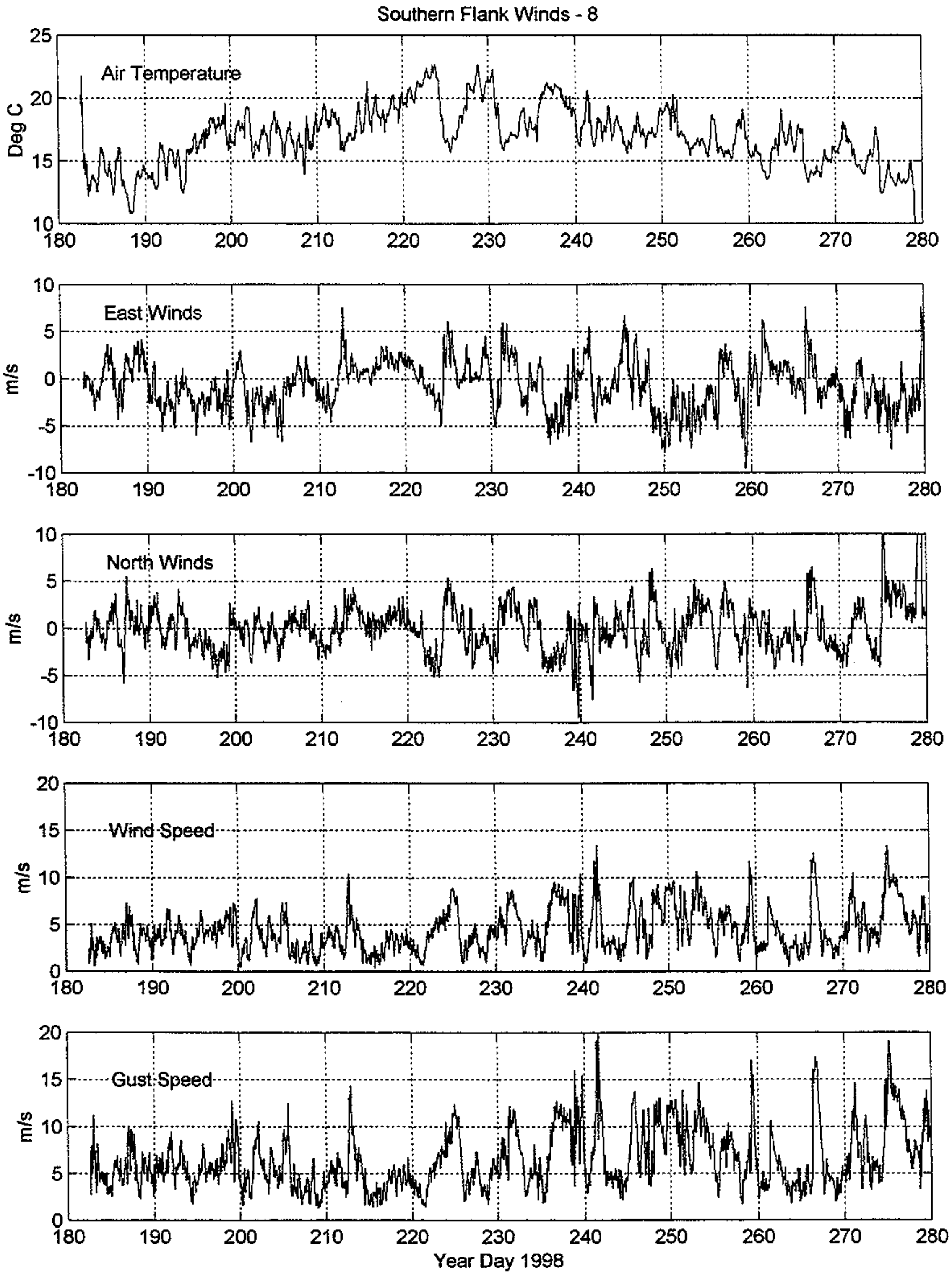


Figure 7. The Southern Flank Winds. The air temperature is again shown in the top panel. The normalized, unedited east and North winds (meteorology convention of direction from) are in the next two panels. The averaged wind speed is shown in the fourth panel and the individual measurement with the maximum speed, or gust, during the last hour is shown in the bottom panel.

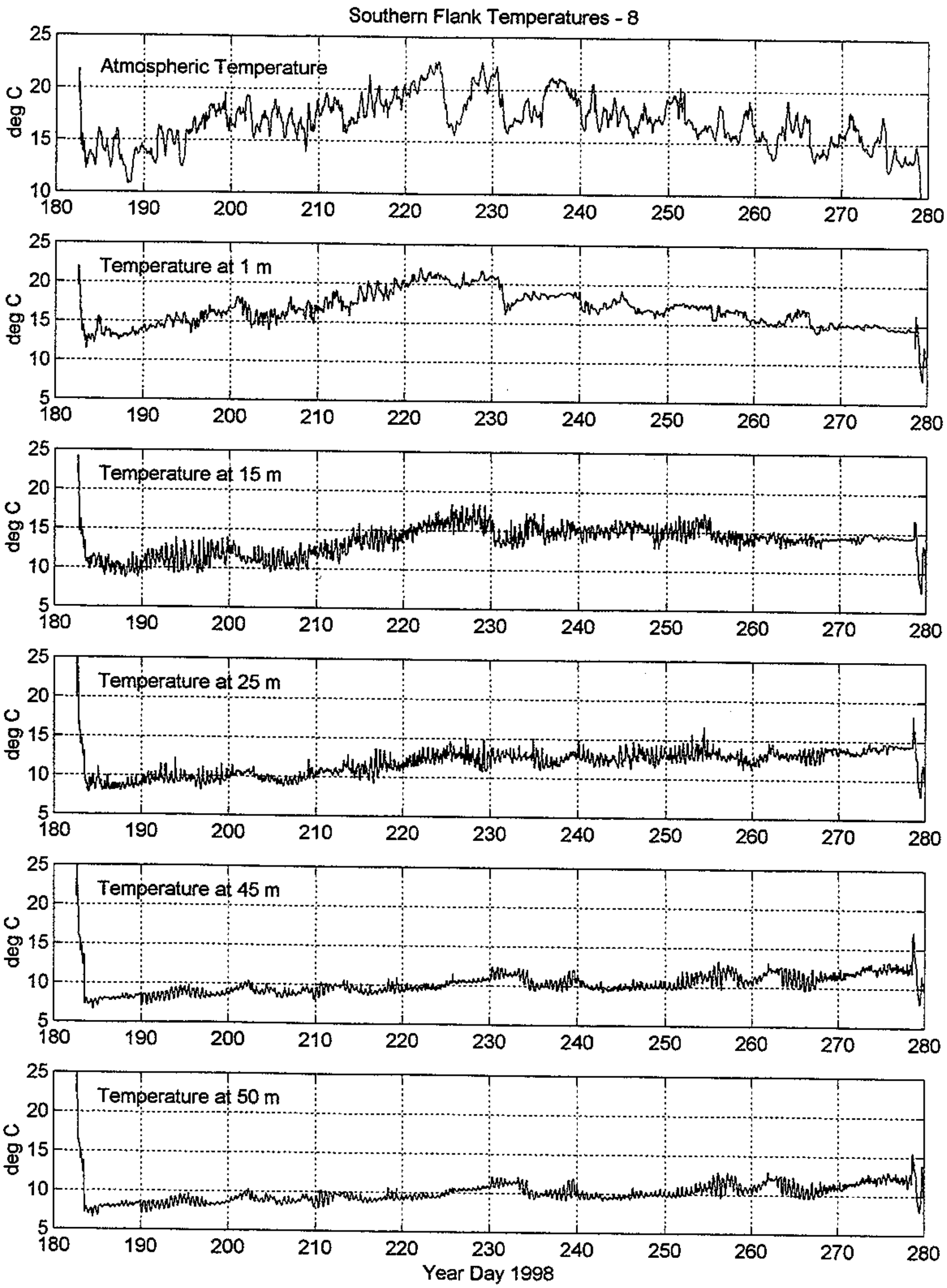


Figure 8. Southern Flank moored temperature. The raw, normalized but unedited temperatures are shown for depths 1, 15, 25, 45, and 50 meters depth with the air temperature in the top panel for reference.

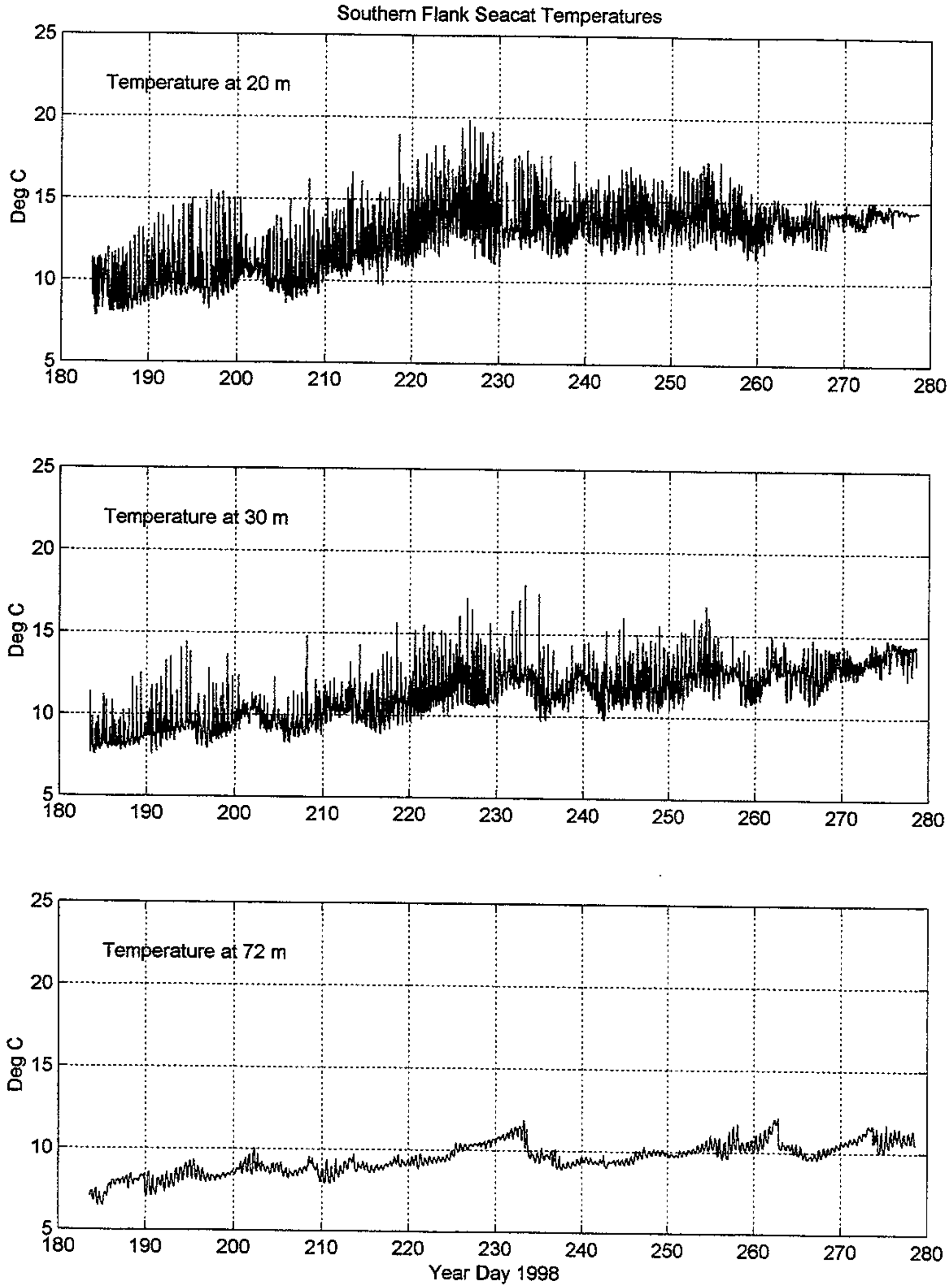


Figure 10. Seacat Temperature. The raw, normalized, but unedited temperatures are shown for 20 m (top panel), 30 m (center panel) and 72 m (bottom panel). The strongest signature seen is the tidally generated internal solitary waves with up to 5° C signals.

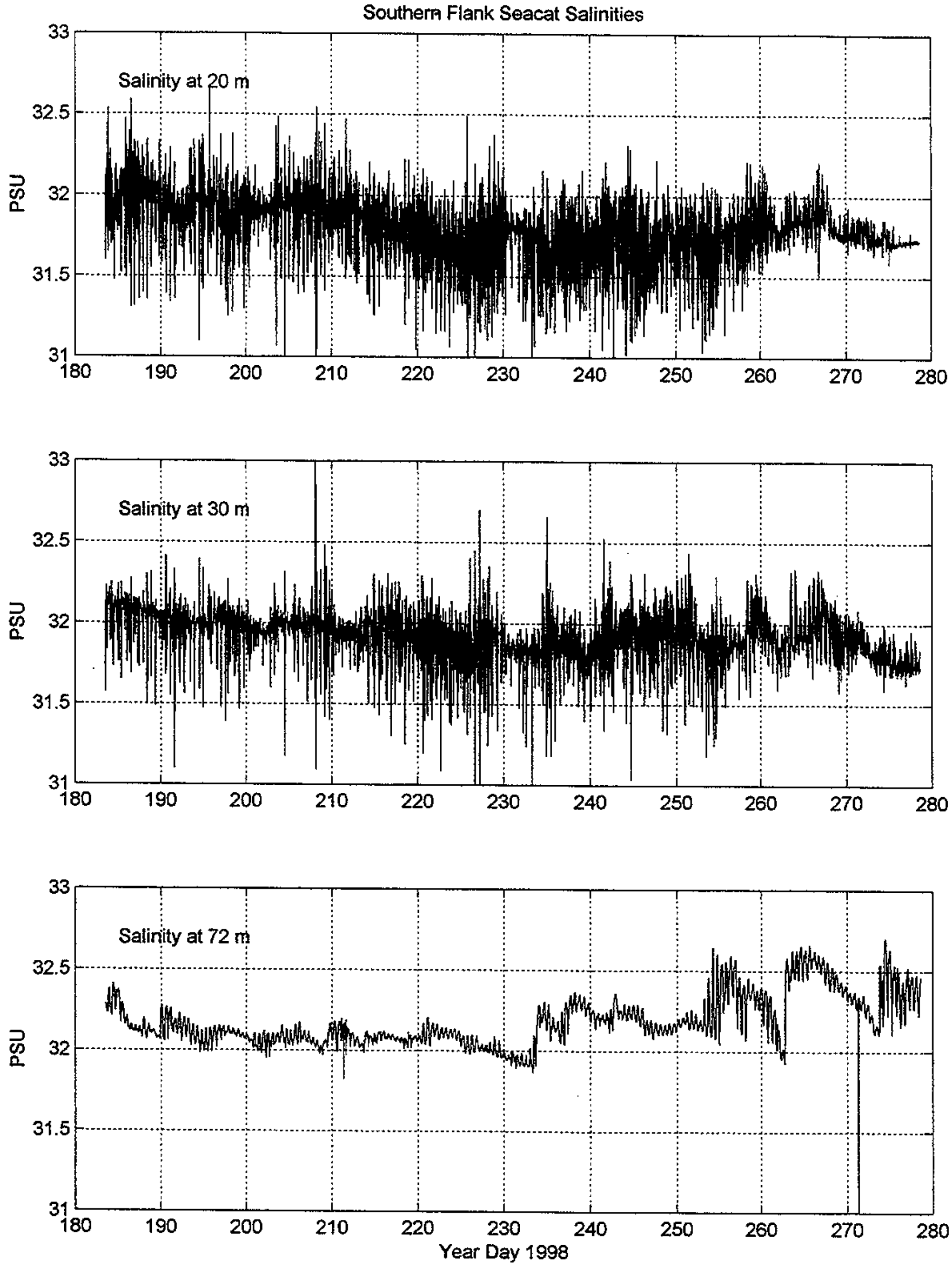


Figure 11. Seacat Salinity. The raw, normalized, but unedited salinity calculated from temperature and conductivity is shown for 20 m (top panel), 30 m (center panel) and 72 m (bottom panel). Again the internal solitary wave signals are seen as "nose" on the low frequency fluctuations.

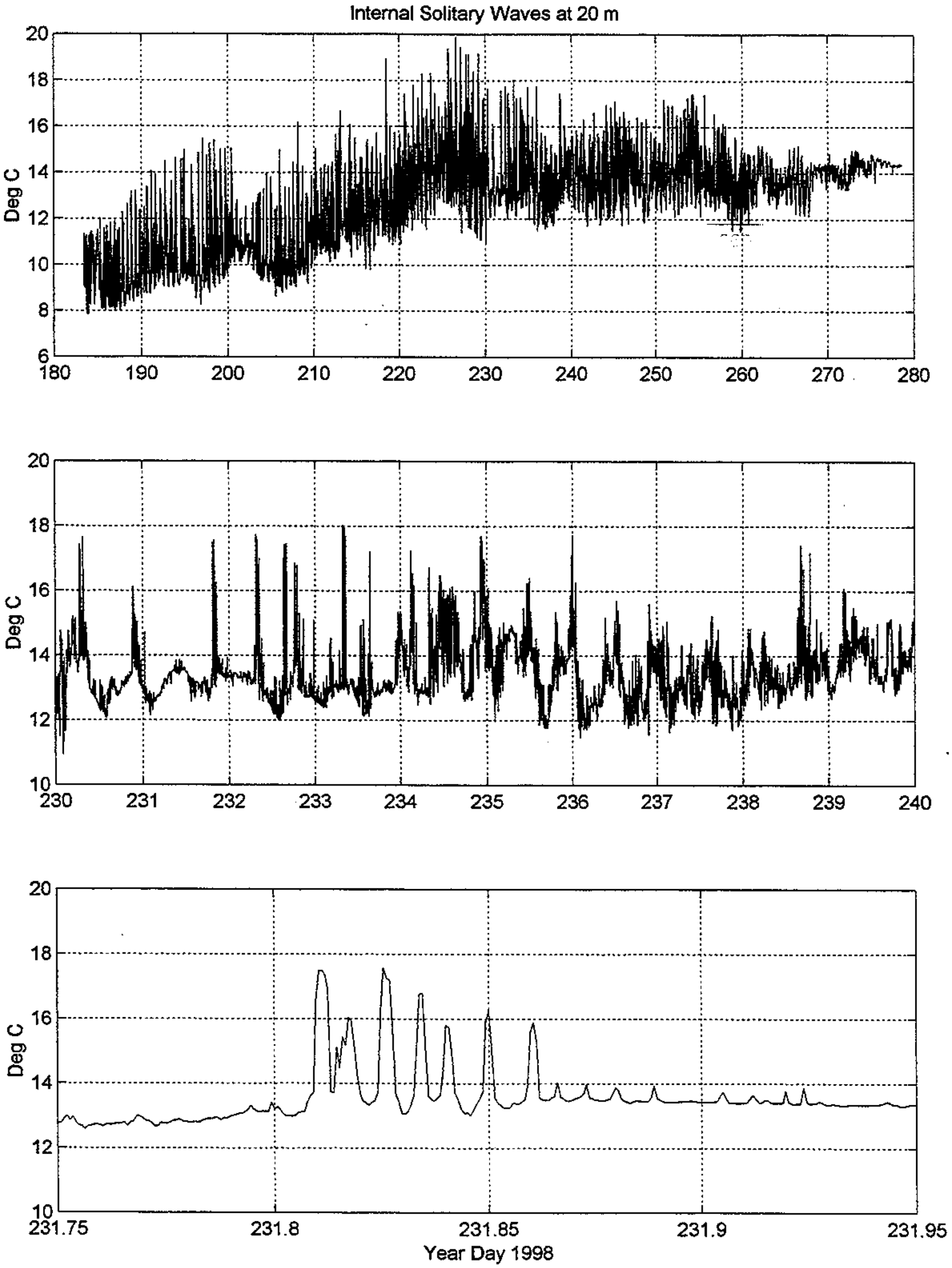


Figure 12. Seacat Internal Solitary Waves. The top panel shows the entire temperature record. The middle panel shows an arbitrary 10-day section from year day 230 to 240. The bottom panel shows a blowup of the large pulse group seen on the later part of year day 321. It is typical of many of the signals seen. Others may be a single pulse, or rougher grouping of pulses.

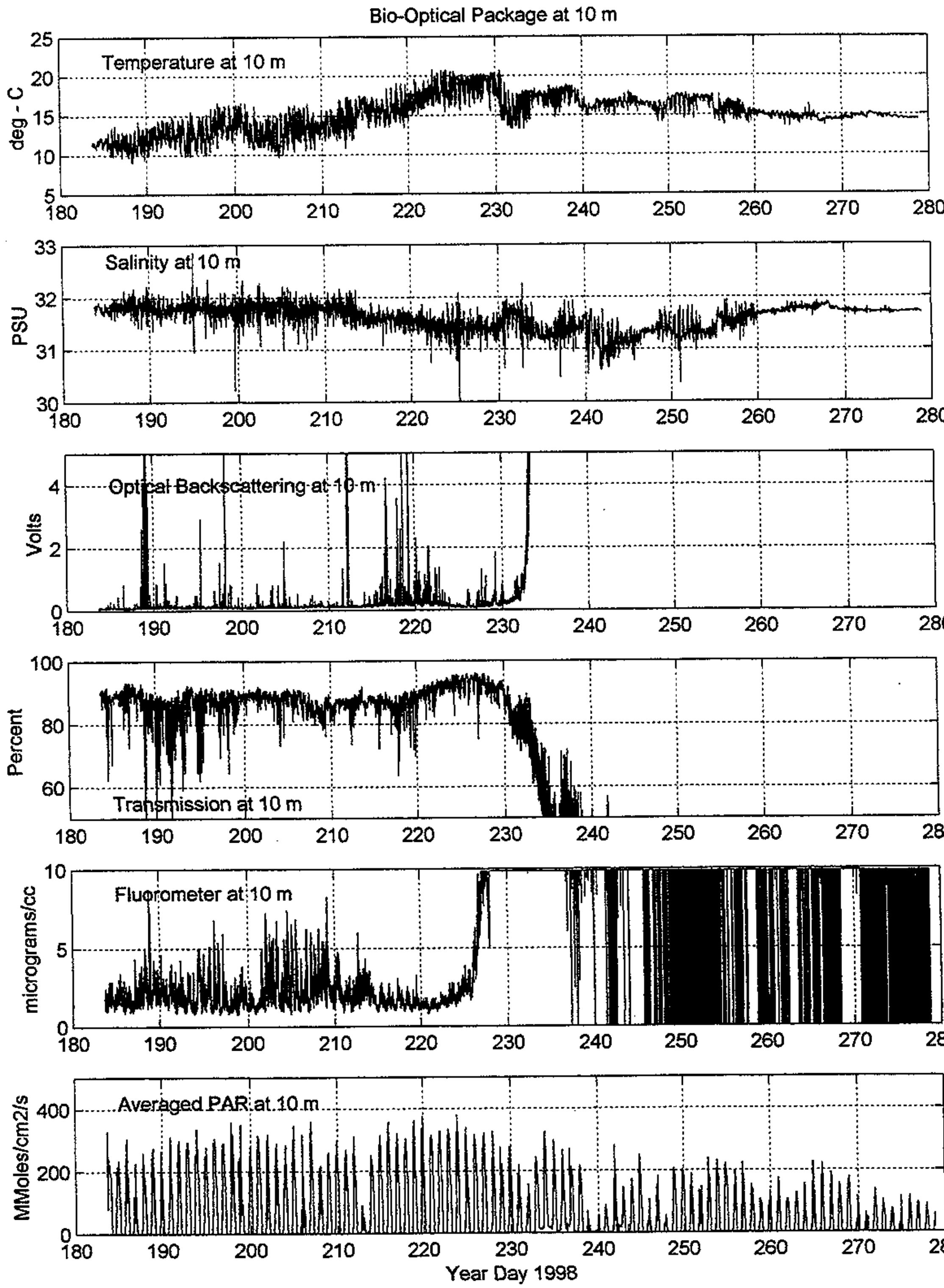


Figure 13. The unedited bio-optical results at 10 m. The top panel shows the temperature in degrees C, and the next panel the salinity in PSU. The third panel shows the Sea Point Optical Backscattering Sensor output (uncalibrated) in volts. The fourth panel shows the beam transmissometer in percent transmisiion, and the fifth panel the chlorophyll-a fluorometer with nominal calibration of 10 μg/l full scale. The bottom panel shows the 3.75 minute averaged PAR in microMoles/cm2/sec. The basic sample interval is 3.75 minutes or 16 samples/hour.

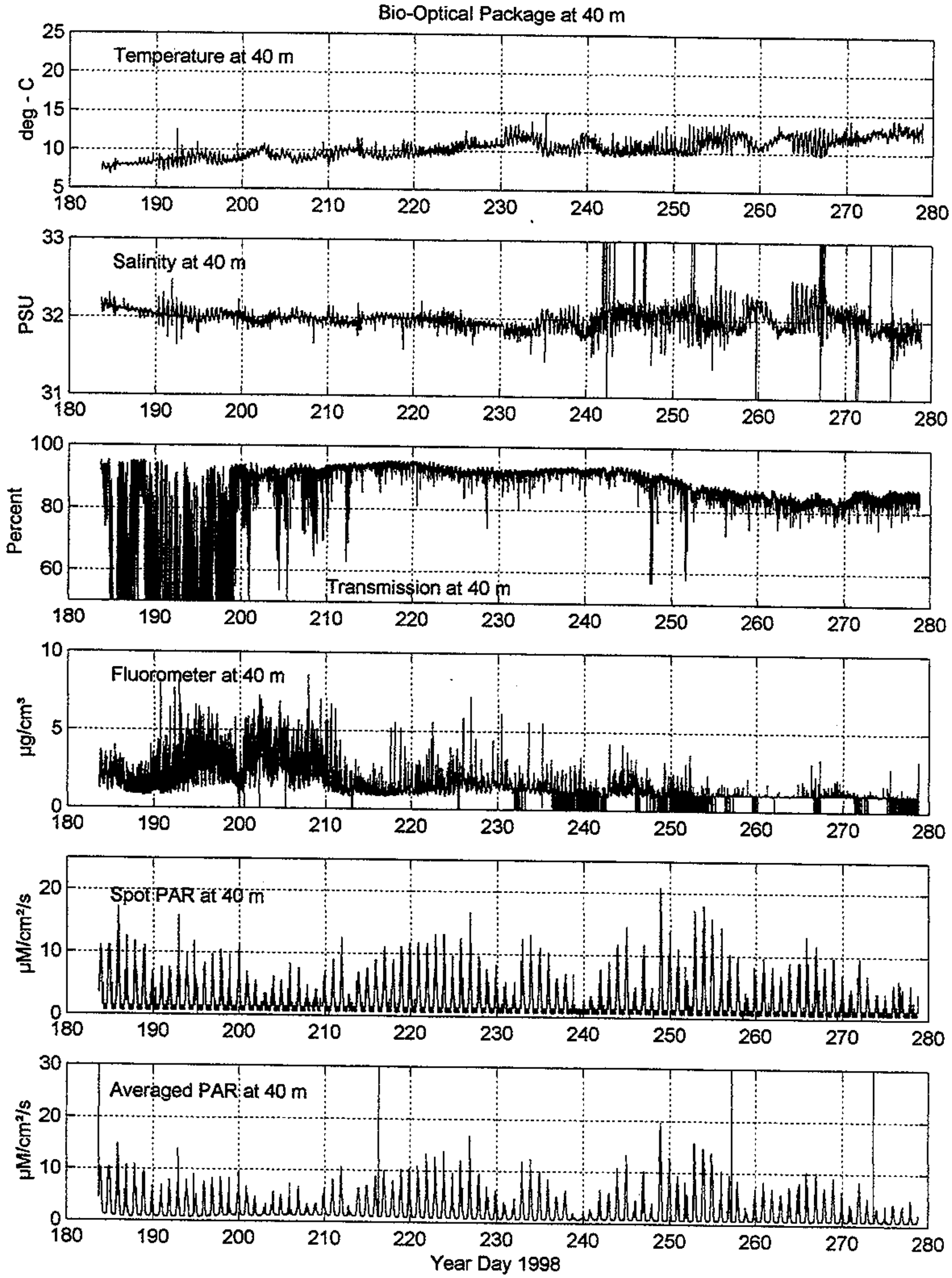


Figure 14. The unedited bio-optical results at 40 m. The top panel shows the temperature in degrees C, and the next panel the salinity in PSU. The third panel shows the beam transmissometer in percent transmission, and the fourth panel the chlorophyll-a fluorometer with nominal calibration of 10 µg/l full scale. The fifth panel shows the last individual PAR reading while the bottom panel shows the 3.75 minute averaged PAR reading in microMoles/cm2/sec. The basic sample interval is 3.75 minutes or 16 samples/hour.

averages from the moored sensors (Figures 8 and 9), but not rapidly enough to resolve the internal solitons seen in the Seacat results (Figures10 and 11).

The currents were observed by a downward looking RD Instruments Workhorse Acoustic Doppler Current Profiler (ADCP) moored inline below the buoy. The ADCP was set to make hourly averages of 70 1-meter depth bins from 6.5 to 76.5 meters depth. The bottom beams were contaminated by sidelobe reflections from the bottom. Figure 15 and 16 summarize the data obtained at six depths in the Eastgoing and Northgoing components rotated from compass magnetic heading to true heading. The dominant tidal component of currents is obvious. The downshelf low-frequency current is seen as an offset in the negative eastgoing direction. There is a drop in velocity in mid-water column seen around year day 230 which is correlated with a loss of internal wave signals as seen in the Seacat records (Figures 10 and 11). This may be an indication that the generation of the internal tides by currents exceeding the internal wave velocity (~30 cm/sec) is probably accurate.

The ADCP also returns the amplitude of the backscattered acoustic intensity (Figure 17). This is an indication of suspended particulate material (including biology). A higher signal implies more scatterers in the water column. A low signal implies less scatterers. The general decrease in scattering with depth is an indication of spreading losses.

2. Mooring Deployment

Buoy Farm Guard Moorings – In order to obtain the guard buoys required for the November deployment at the Northeast Peak of Georges Bank, one guard buoy deployed at the WHOI buoy farm needed to be recovered. It was initially planned to do this recovery on this cruise, but, in conjunction with a muscle-farming project, we switched work. The OCEANUS Cruise 331 deployed their new guard buoys, and they recovered our needed buoy. This cruise deployed four buoys as corner marker buoys at the positions listed in Table 3.

Foam Guard Buoys – For guard buoys at the southern flank site, two foam guard buoys were deployed. Guard F has been deployed previously, but Guard Q was borrowed from the WHOI rigging shop for the final year of GLOBEC. The moorings were ½" chain in the water column and ¾" chain on the bottom. The anchors were 2300 pounds each. The two buoys were deployed at positions listed in Table 3 and shown in Figure 18 with a separation of 0.23 nm at a heading of about 075° T. Both buoys had flashing lights and radar reflectors, and solar charged batteries powered the lights.

Science Mooring D – A new southern flank mooring was prepared for deployment at the site during this cruise. Because the water column is generally well mixed during the winter, fewer sensors were deployed as listed in Table 1 and shown in Figure 19. The number of sensors will be increased in the March turnaround to provide our standard 5-meter vertical sampling.

Refurbished ADCP and bio-optical packages were deployed at the surface, 10 and 40 meters depth as usual. The 72 meter Seacat was replaced with a new Sea Bird Microcat who's Titanium mounting frame was more easily bolted to the ½" mooring chain. The mooring was deployed between the two guard buoys, at the position shown in Figure 18 and listed in Table 3.

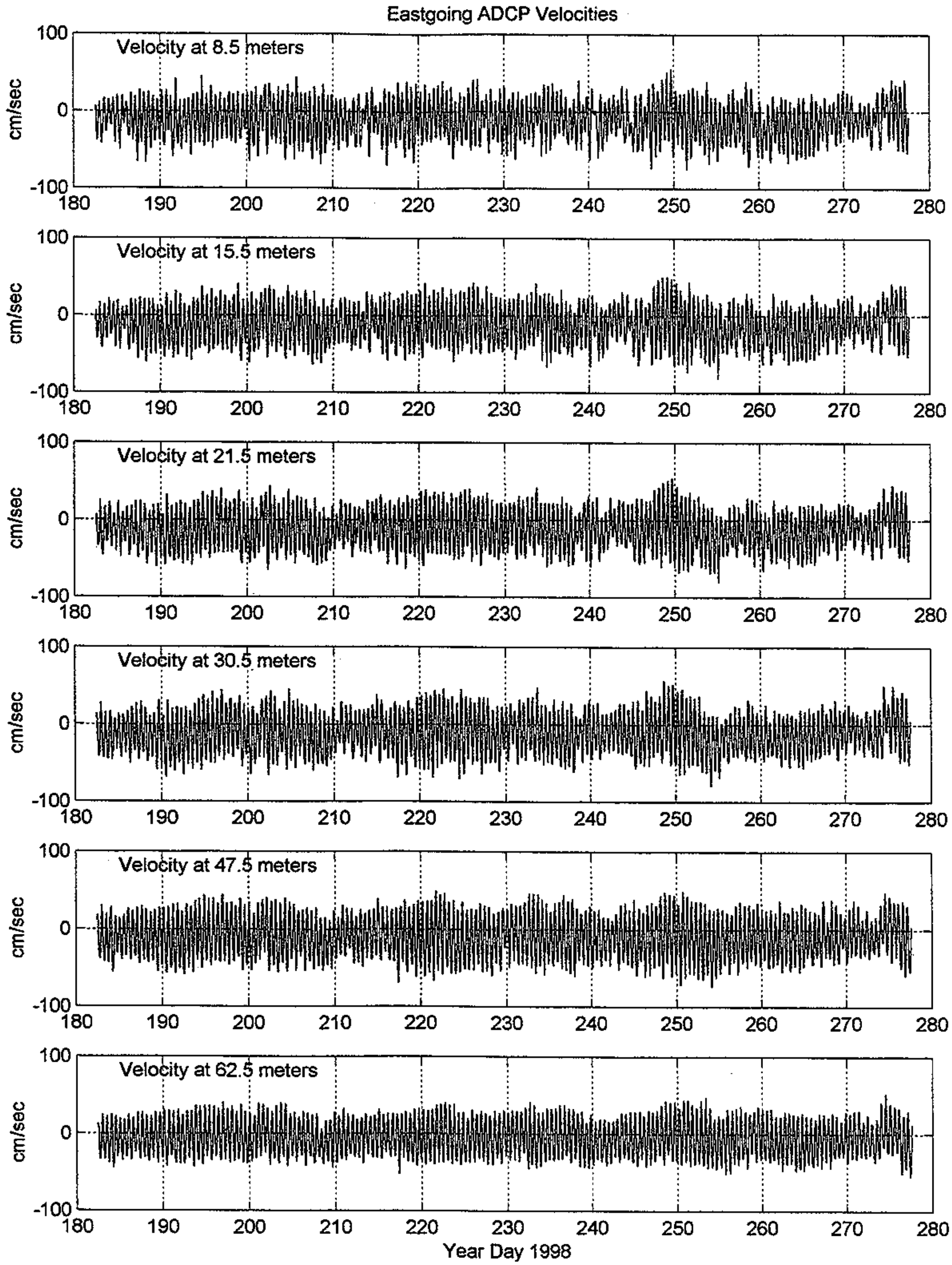


Figure 15. ADCP Eastgoing currents. A subset of the raw, normalized, but unedited eastgoing currents are shown at 8.5, 15.5, 21.5, 30.5, 47.5 and 62.5 meters depth.

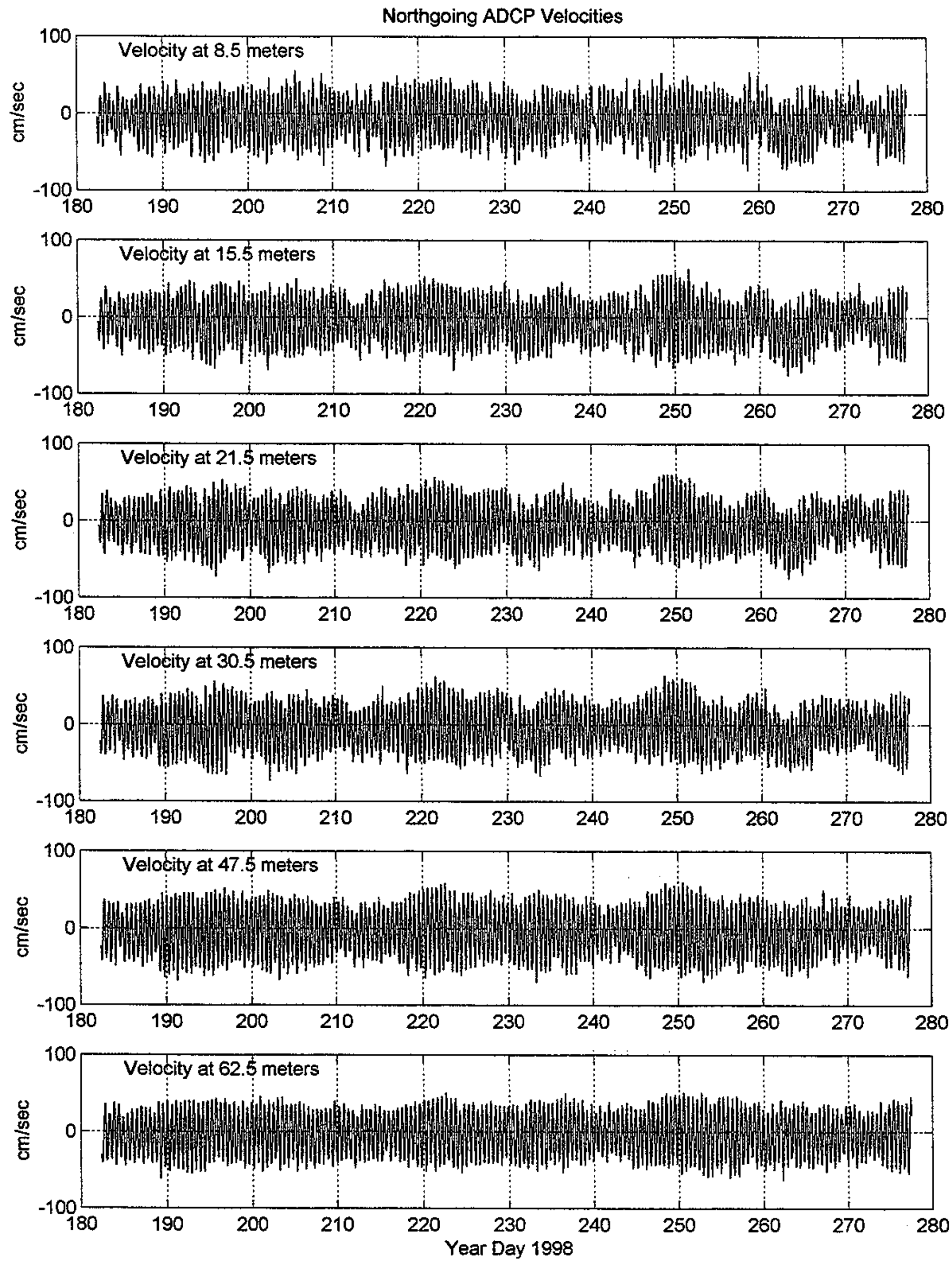


Figure 16. ADCP Northgoing currents. A subset of the raw, normalized, but unedited northgoing currents are shown at 8.5, 15.5, 21.5, 30.5, 47.5 and 62.5 meters depth.

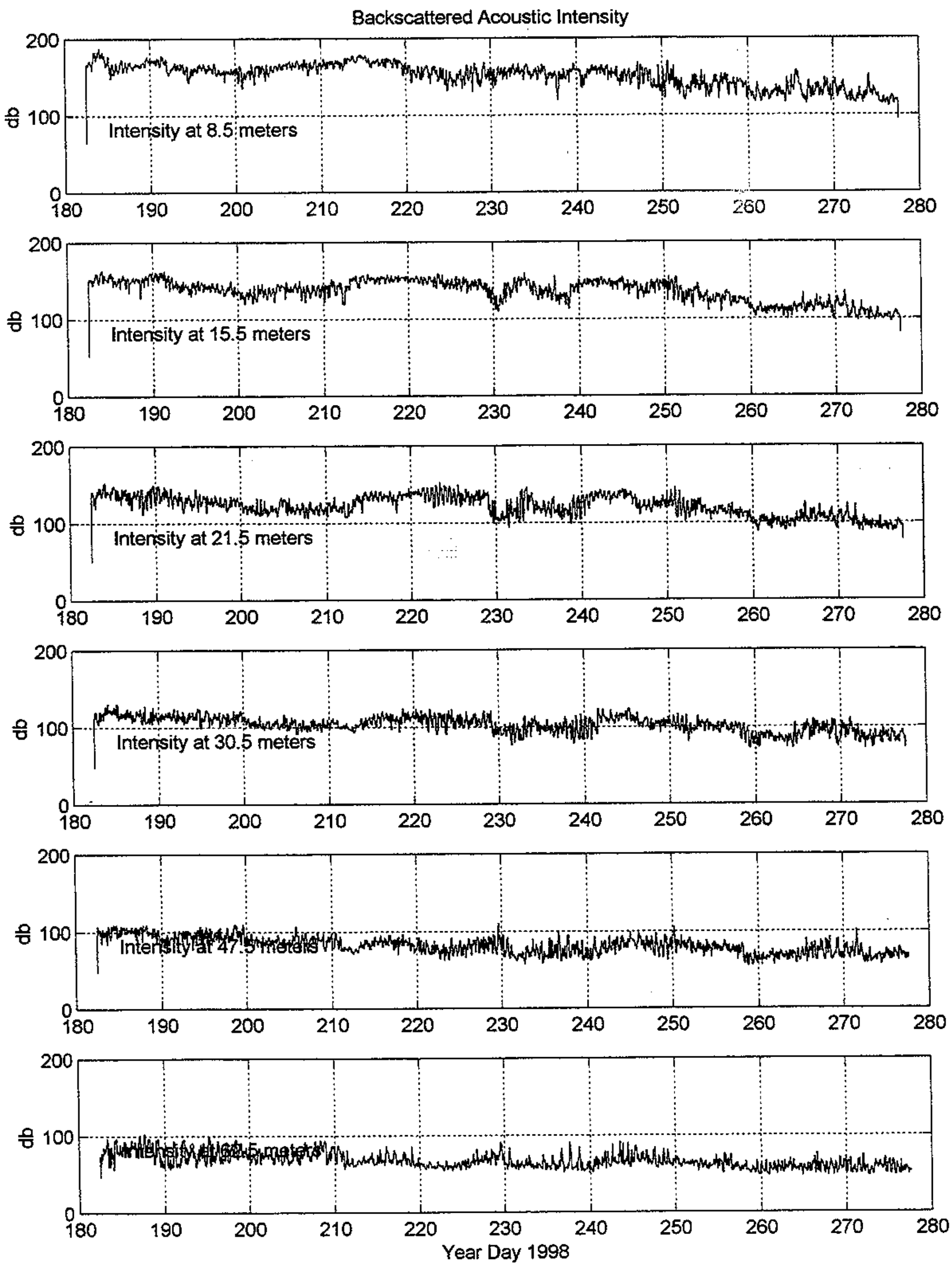


Figure 17. ADCP Backscattered Intensity. A subset of the raw, normalized, but unedited backscattered intensities from one transducer are shown at 8.5, 15.5, 21.5, 30.5, 47.5 and 62.5 meters depth.

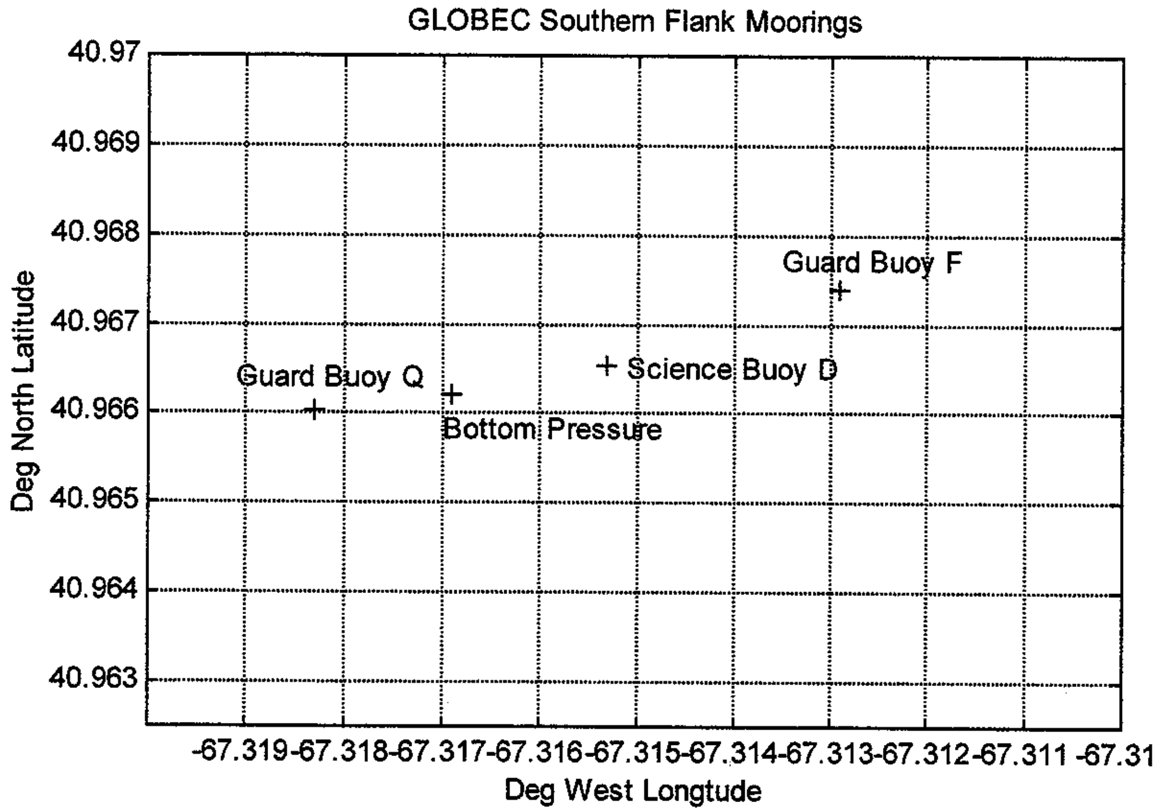


Figure 18. Southern Flank Mooring Positions for the two guard buoys, the science mooring and the bottom pressure instrument as listed in Table 3.

Table 3 – Mooring Positions

WHOI Buoy Farm		Date	GMT	Deploy N. Latitude	Deploy W. Longitude	Run-by N.Latitude	Run-by W. Longitude	
	Buoy A	4-Oct-98	16:24	41° 16.001	71° 01.604	41° 16.03	71° 01.56	deploy
	Buoy B	4-Oct-98	17:49	41° 15.700	71° 01.602	41° 15.67	71° 01.56	deploy
	Buoy C	4-Oct-98	17:29	41° 15.701	71° 02.000	41° 15.68	71° 02.04	deploy
	Buoy D	4-Oct-98	16:57	41° 16.982	71° 02.067	41° 15.98	71° 02.05	deploy
Southern Flank								
	Buoy A	22-Oct-98	18:48	40° 58.120	67° 18.907	40° 58.541	67° 18.665	recover
	Buoy B	22-Oct-98	17:30	40° 57.995	67° 19.199	40° 58.042	67° 19.196	recover
	Science E	2-Jul-98	12:00	40° 57.980	67° 18.940	40° 58.009	67° 18.942	recover
	Buoy F	5-Oct-98	17:43	40° 58.044	67° 18.775	40° 58.00	67° 18.77	deploy
	Buoy Q	5-Oct-98	20:59	40° 57.962	67° 19.097	40° 57.92	67° 19.11	deploy
	Science D	7-Oct-98	18:12	40° 57.992	67° 18.919	40° 57.95	67° 18.91	deploy
	Bottom Pressure	7-Oct-98	20:04	40° 57.972	67° 19.014	N/A	N/A	deploy

Bottom Pressure Instrumentation – The damaged bottom pressure instrument was repaired by combining the undamaged instrument, sensor mount, and acoustic release from the damaged frame with the incomplete new frame to make one complete instrument. This is seen attached to a new anchor with a turnbuckle and readied for deployment in Picture 3. The Sea Bird Seagauge bottom pressure recorder with parallel plate pressure port and conductivity sensor (see Table 1 for serial numbers) was attached to the frame as previously done. This instrument was then deployed between one guard and the science buoy D at the position listed in Table 3 and shown in Figure 18.

3. CTD Sections

***In Situ* yo-yo calibrations:** Before the science buoy E was recovered a 1-hour yo-yo CTD was made beside the mooring (See Table 4, Event 1, CTD01). These profiles (see Figure 20 for the first) shows a fairly well mixed upper 38 meters with some stratification in the lower 30 meters. The upper water column had become fairly well mixed by the end of the deployment which is in agreement with the time series results shown in Figures 8, 9, 10, 11, 13, and 14.

After buoy D was deployed at the southern flank site, another 1-hour yo-yo CTD series was made beside the mooring (See Table 4, Event 33, CTD26). These profiles (see Figure 21 for the first) show the mixing has increased to about 65 meters depth. This is considerably different than the first yo-yo (Figure 20) even though it was made only taken 2 days later. It is interesting to look at the transmissometer and fluorometer data from the two profiles. Figure 20 (first yo-yo) shows lower transmissions in the upper 20 meters of the water column, which are associated with higher chlorophyll-a levels. In Figure 21, neither the lower transmissometer nor higher chlorophyll-a is seen in the water column.

The southern flank science mooring was visited five different times when CTD profiles were taken. On 5 October (Figure 20) the water column is fairly well mixed to about 40 meters, with a hint of step at 20 meters. On 6 October the gradient is nearly linear from surface to bottom, significantly different than one day earlier. On 7 October (Figure 21) it appears nearly mixed down to 65 meters depth. Then early on the 8^{th} (10:18 UTC) it is mixed down to greater than 30 meters, and late on the 8^{th} (19:00 UTC), the profile has several steps down to 50 meters. In these last three profiles, the top and bottom values are nearly unchanged, it is the water in the middle of the water column which is changing. The largest chlorophyll-a signal is seen in the top 20 meters on 5 October, and is only beginning to come back late on the 8^{th}. Therefore, although we are getting to the end of the summer stratification, we still see significant advection of different water masses through the region which still makes it a dynamic site. The waters haven't mixed down to their usual winter nearly vertically mixed condition yet .

Picture 3. Repaired bottom pressure instrument. The SeaGauge recorder with conductivity on top is seen on the right of the aluminum frame which sits on the steel anchor.

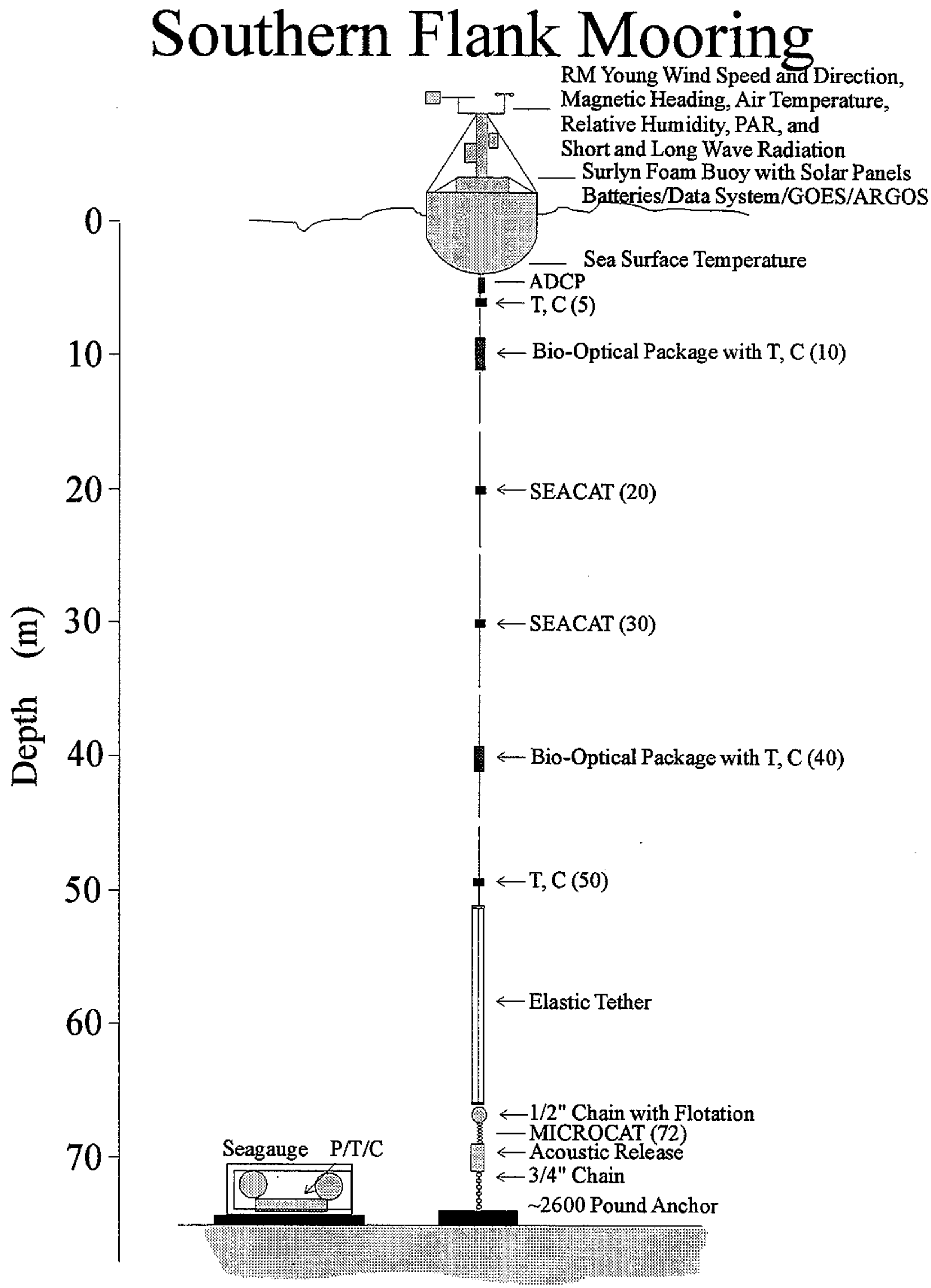


Figure 19. Southern Flank mooring configuration for deployment 9.

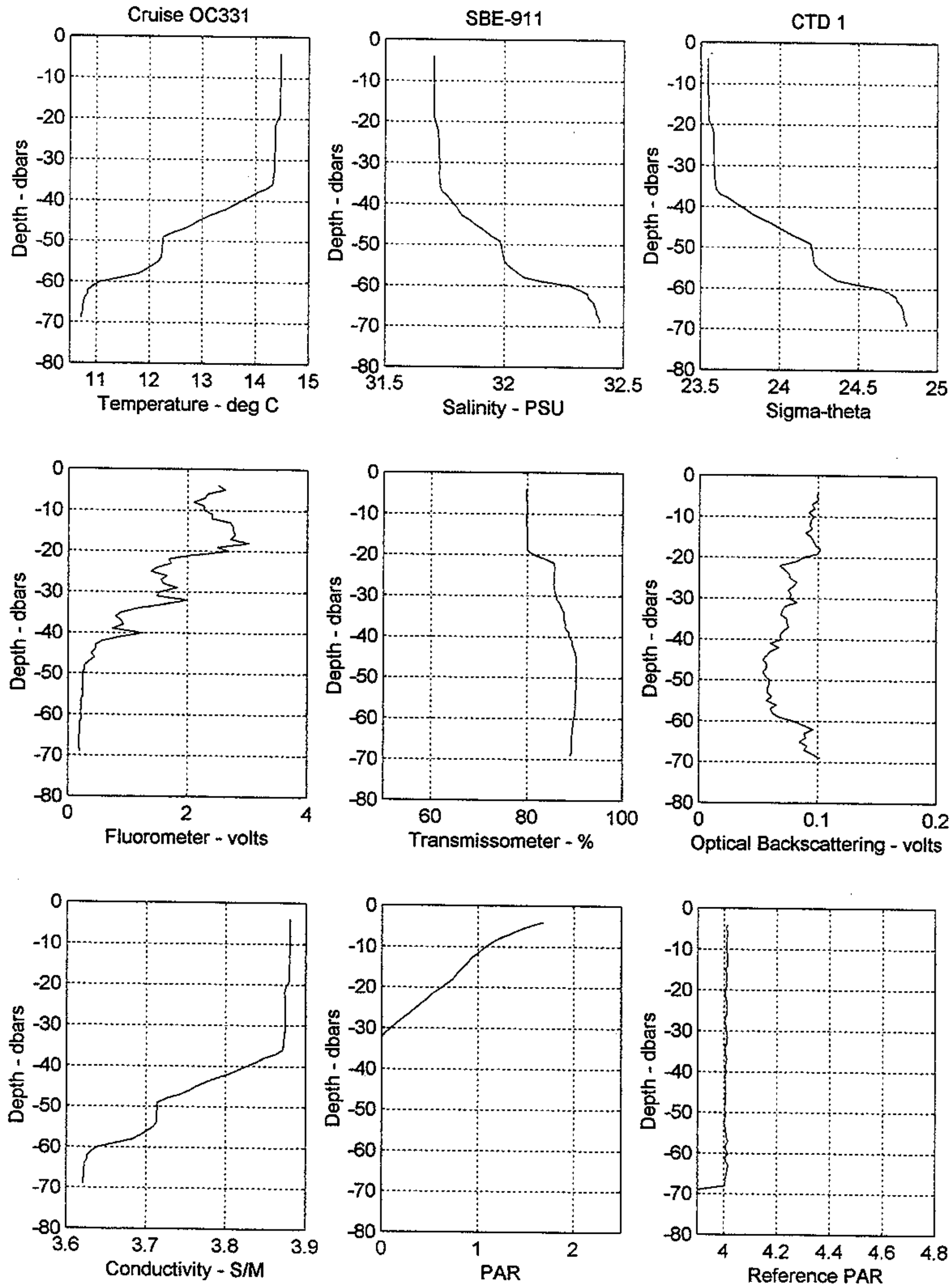


Figure 20. End of Deployment 8 *in situ* calibration yo-yo CTD. Event 1, CTD 1 summary made on 5 October 1998 starting as 1219 UTC.

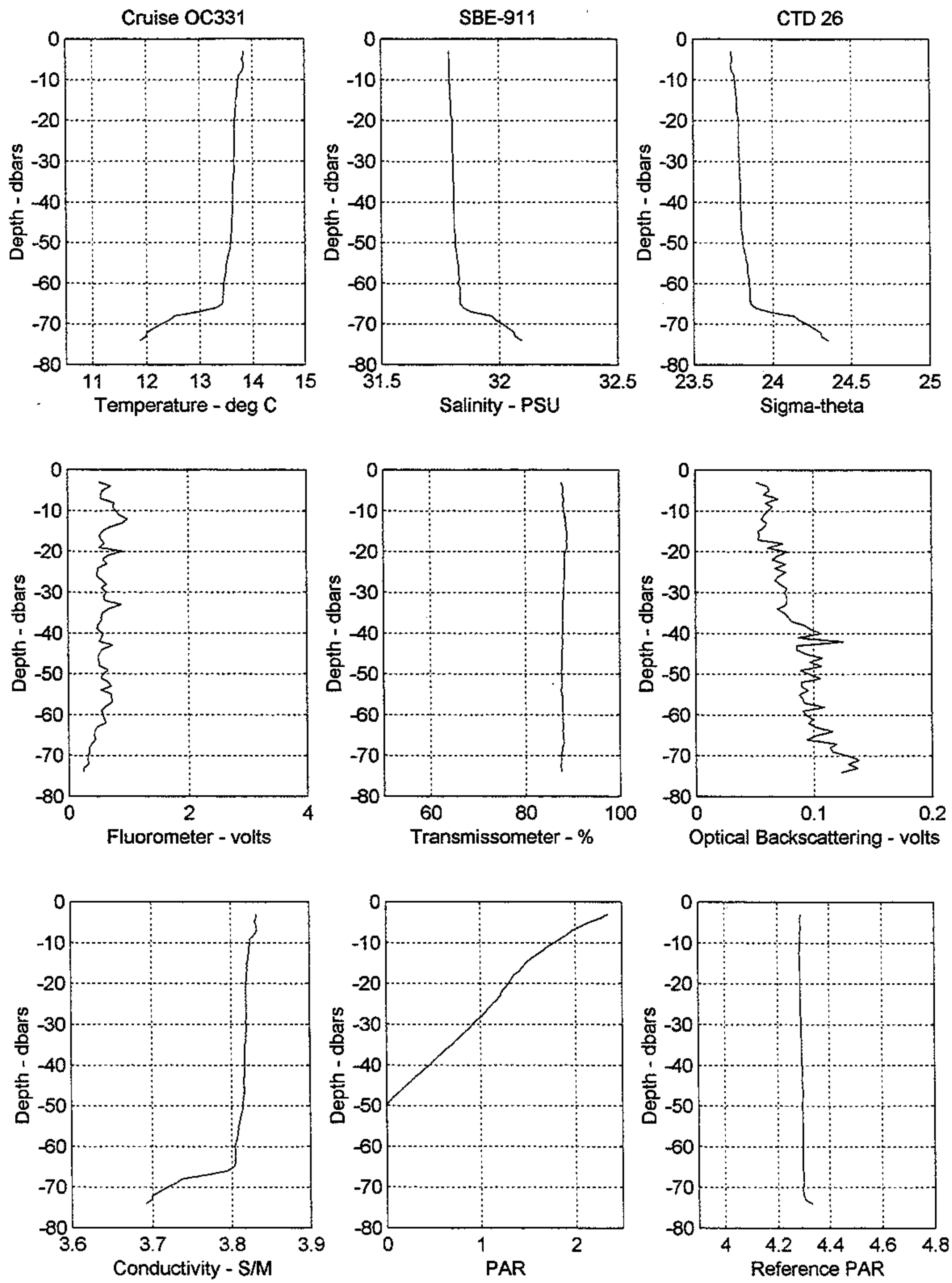


Figure 21. Start of deployment 9 *in situ* calibration yo-yo CTD. Event 33, CTD 26 summary made on 7 October 1998 starting as 1830 UTC.

Northeast Peak Section: The standard Northeast Peak Section (see Figure 1) was occupied on 6 and 7 October 1998. Contour plots of the data from this section are shown in Figures 22 to 26 (temperature, salinity, potential density, transmission and chlorophyll-a fluorometer output). A T-S plot of the data from this section is shown in Figure 27. The continuous series of 15 profiles in this section takes about 14 hours to make. It stretched from the generally well-mixed region over the crest of the Bank into the Northeast Channel.

The temperature section (Figure 22) shows the warmest water at the surface, and over the crest of Georges Bank. Here the water is well mixed from surface to bottom. The coldest water is along the slope into the Northeast Channel. The salinity (Figure 23) shows the same trend, with the freshest waters being on the surface and on the crest of the Bank. The highest salinity is found on the Brown's Bank side of the Northeast channel and associated with slope water intrusions into the Gulf of Maine. The beam transmission (Figure 25) and fluorometer (Figure 26) do not show strong signal changes. The lowest transmission and highest chlorophyll-a readings are over the crest of the bank, but in general they are fairly low. There are no very high productivity regions with lots of particulates in the water.

The T-S (Figure 27) shows the typical shelf/slope water of high salinity and temperatures of 5 to 10° C and 35 PSU in deeper waters, which grades into the warmer 14 to 16° C and 31.5 PSU water at the surface, and particularly over the crest of Georges Bank.

Mid-Bank Section: The standard Mid-Bank Section (see Figure 1) was occupied on 7 October 1998. Contour plots of the data from this section are shown in Figures 28 to 32 (temperature, salinity, potential density, transmission and chlorophyll-a fluorometer output). A T-S plot of the data from this section is shown in Figure 33. The continuous series of 9 profiles in this section takes about 8 hours to make. It stretched from the generally well-mixed region over the crest of the Bank out into the North Atlantic.

The mid-bank section extends out into the North Atlantic past the shelf slope front, and sees the warmer, higher salinity water found there. Inside of the front, the temperatures tend to be highest on the Bank. The waters over the crest did show some vertical structure at the shallowest depths. The coldest waters (9°·C) are found at the shelf break and represent the remnant Gulf of Maine intermediate water exiting the Gulf around the Northeast Peak. This is consistent with the Northeast Peak section, but no strong core was seen as colder water extends down the slope. The salinity is lowest on crest of the Bank and highest in the deeper offshore waters. There is no hint of Scotian shelf crossover water. The beam transmissometer and fluorometer again show no high productivity or high particulates present. There is a tendency for higher particulates and chlorophyll-a in shallower waters over the shallower regions.

The T-S (Figure 33) shows the duality of fresher waters over the bank (<33 PSU) and the saltier offshore waters. Here the maximum of 36 PSU and 18° C waters are seen offshore. There are not as clear mixing peaks in these T-S plots as in the spring. The spikes in low salinity at the surface are the result of poor CTD processing.

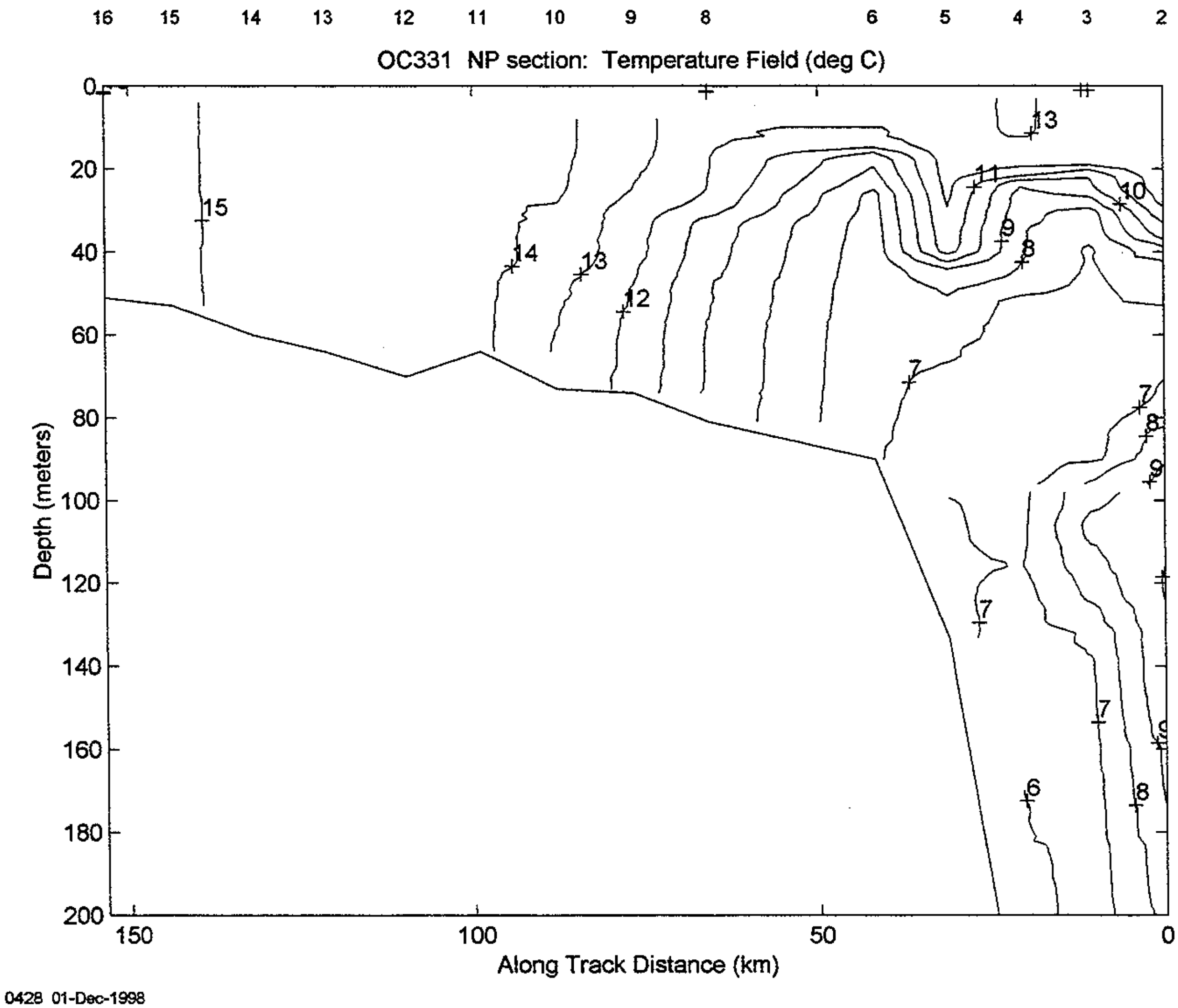


Figure 22. Contours of temperature at 1° intervals on the Northeast Peak Section conducted on 6 and 7 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

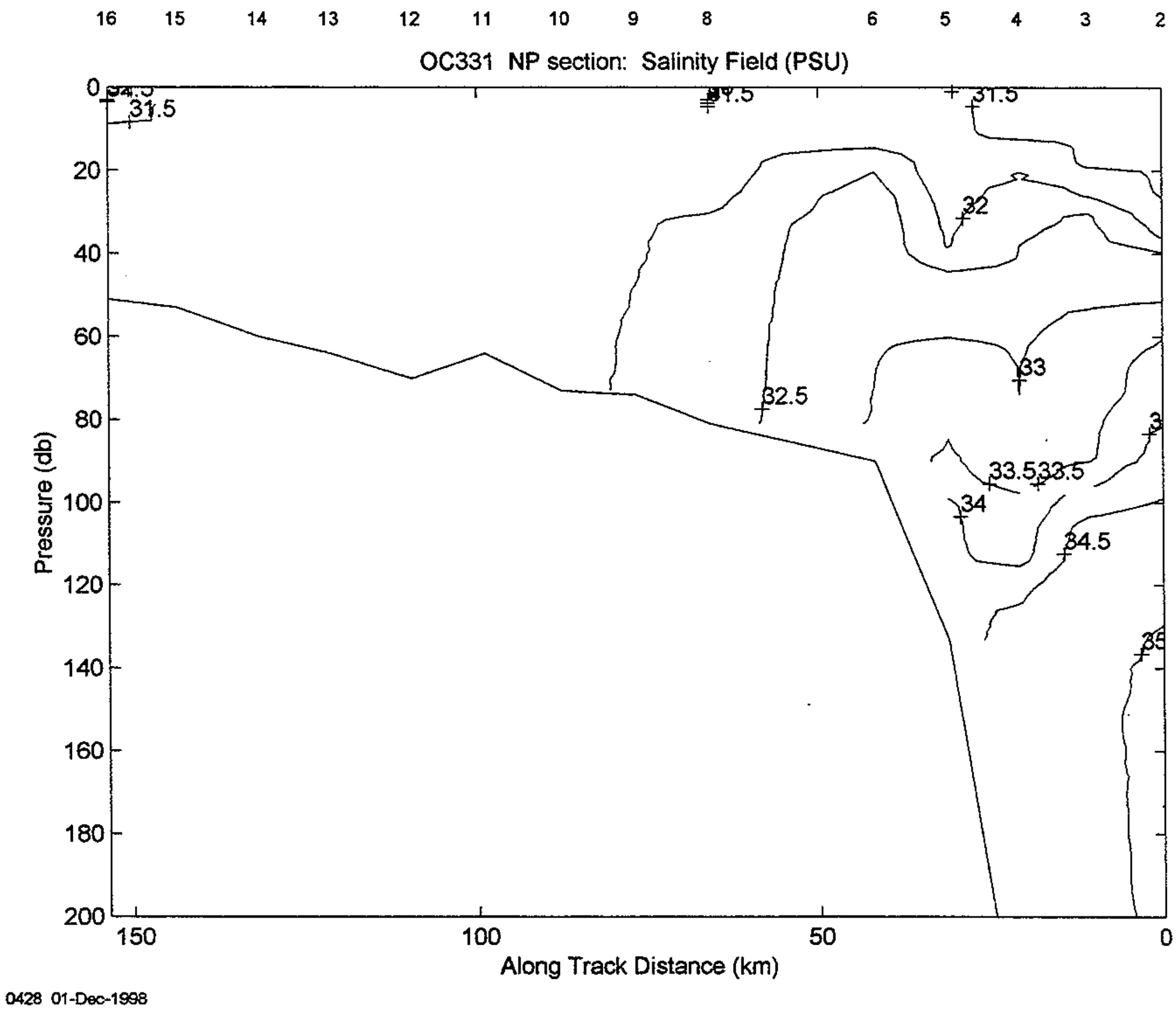


Figure 23. Contours of salinity at 0.5 PSU intervals on the Northeast Peak Section conducted on 6 and 7 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

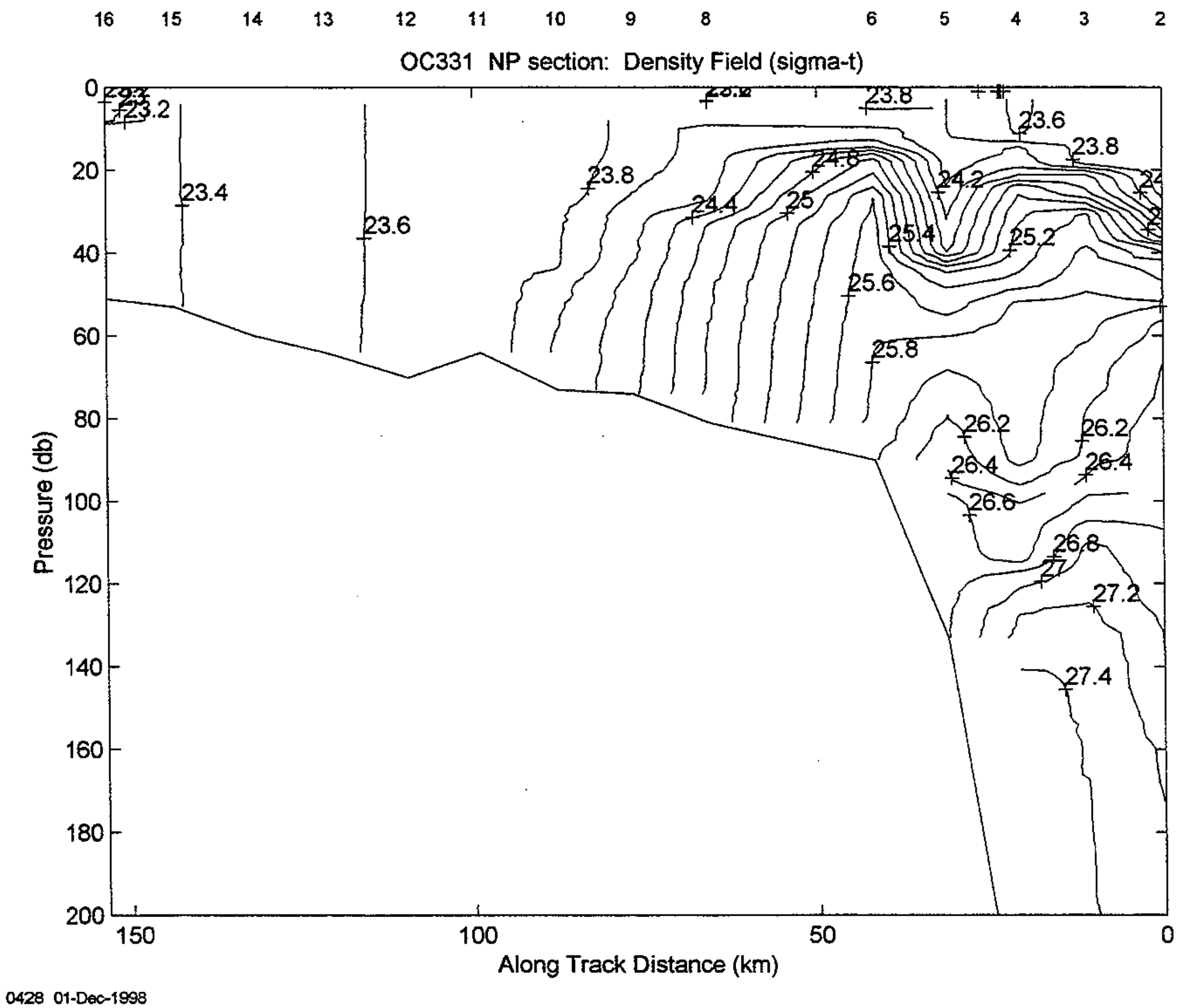


Figure 24. Contours of potential density at 0.2 kg/m^3 intervals on the Northeast Peak Section conducted on 6 and 7 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

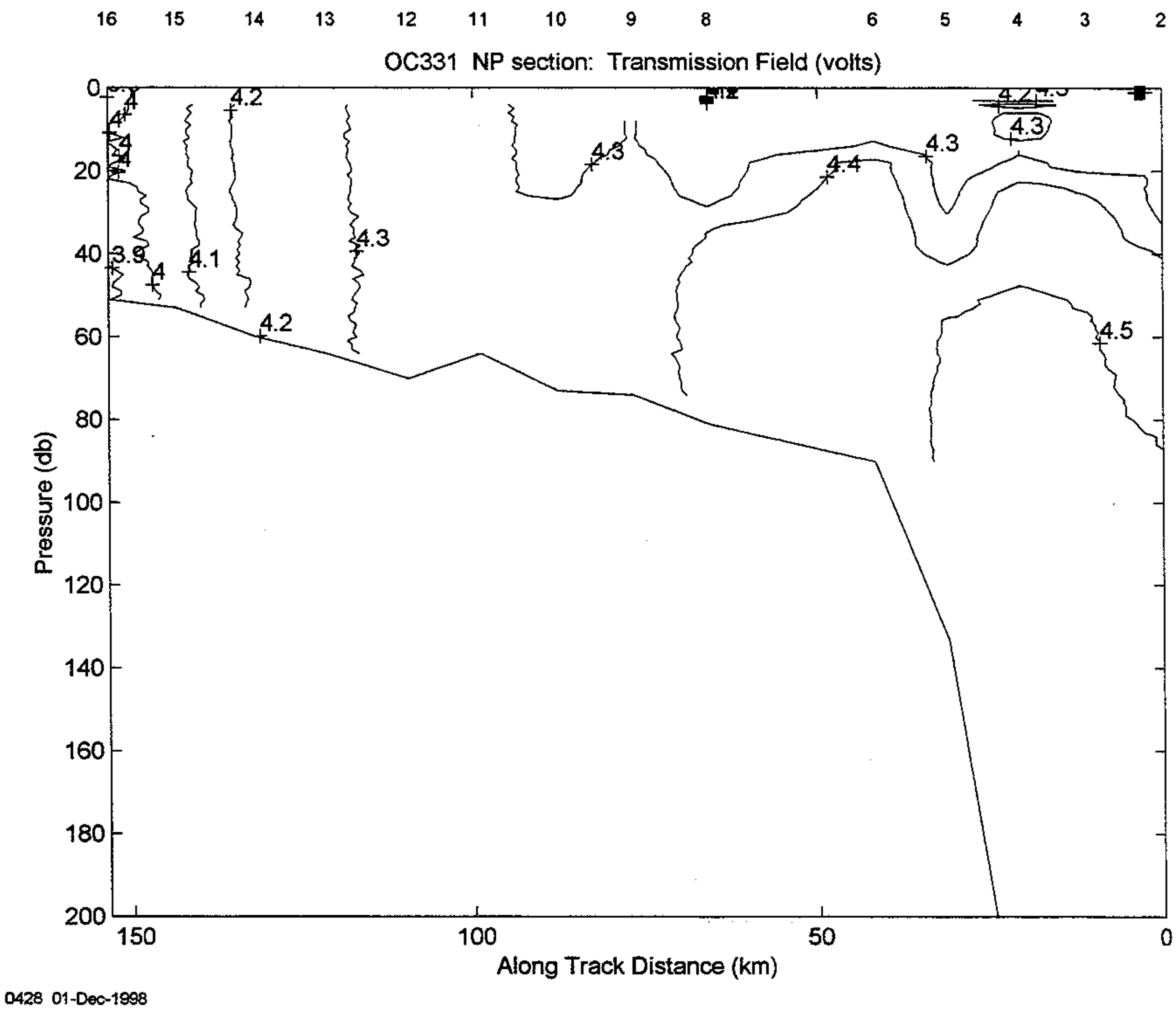


Figure 25. Contours of light transmission at 0.1 v intervals (where 4.9 v is ~100%) on the Northeast Peak Section conducted on 6 and 7 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

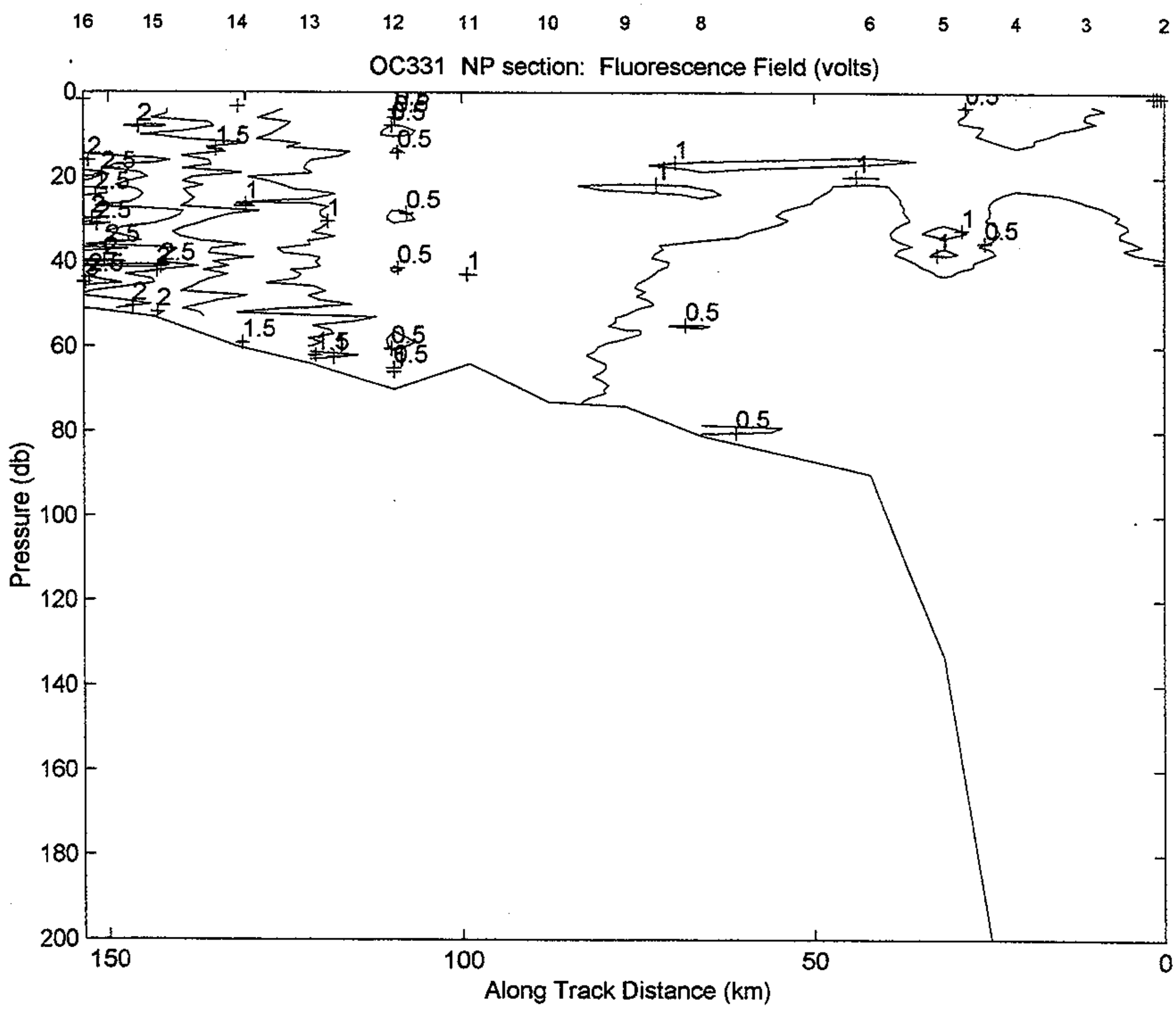


Figure 26. Contours of relative fluoresence at 0.5 volt intervals (where 5 v ~ 30 μg/l chlorophyll-a) on the Northeast Peak Section conducted on 6 and 7 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

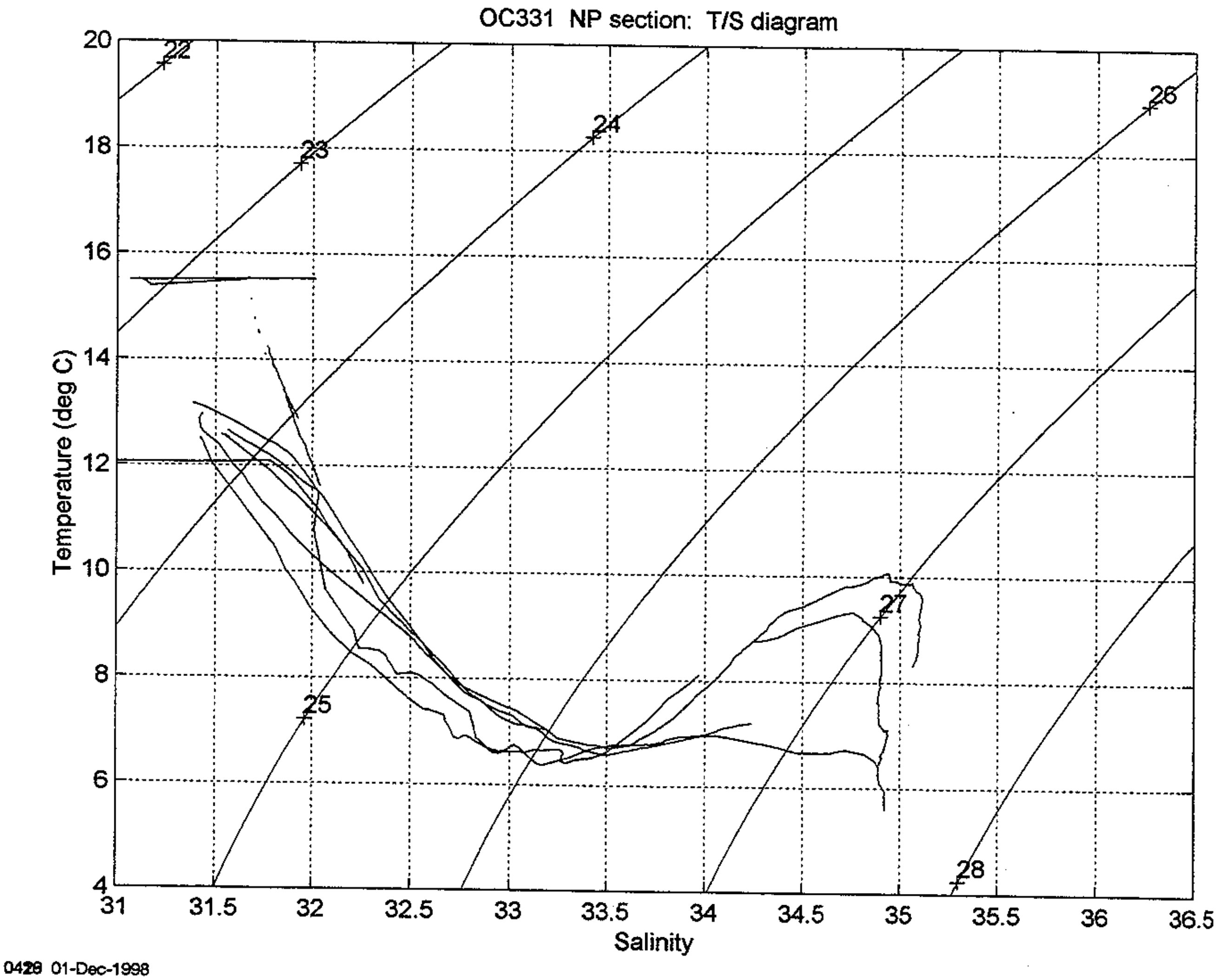


Figure 27. Northeast Peak Section temperature-salinity plot of all profiles for the section made on 6 and 7 October 1998. Lines of constant sigma-t are shown on the plot for reference

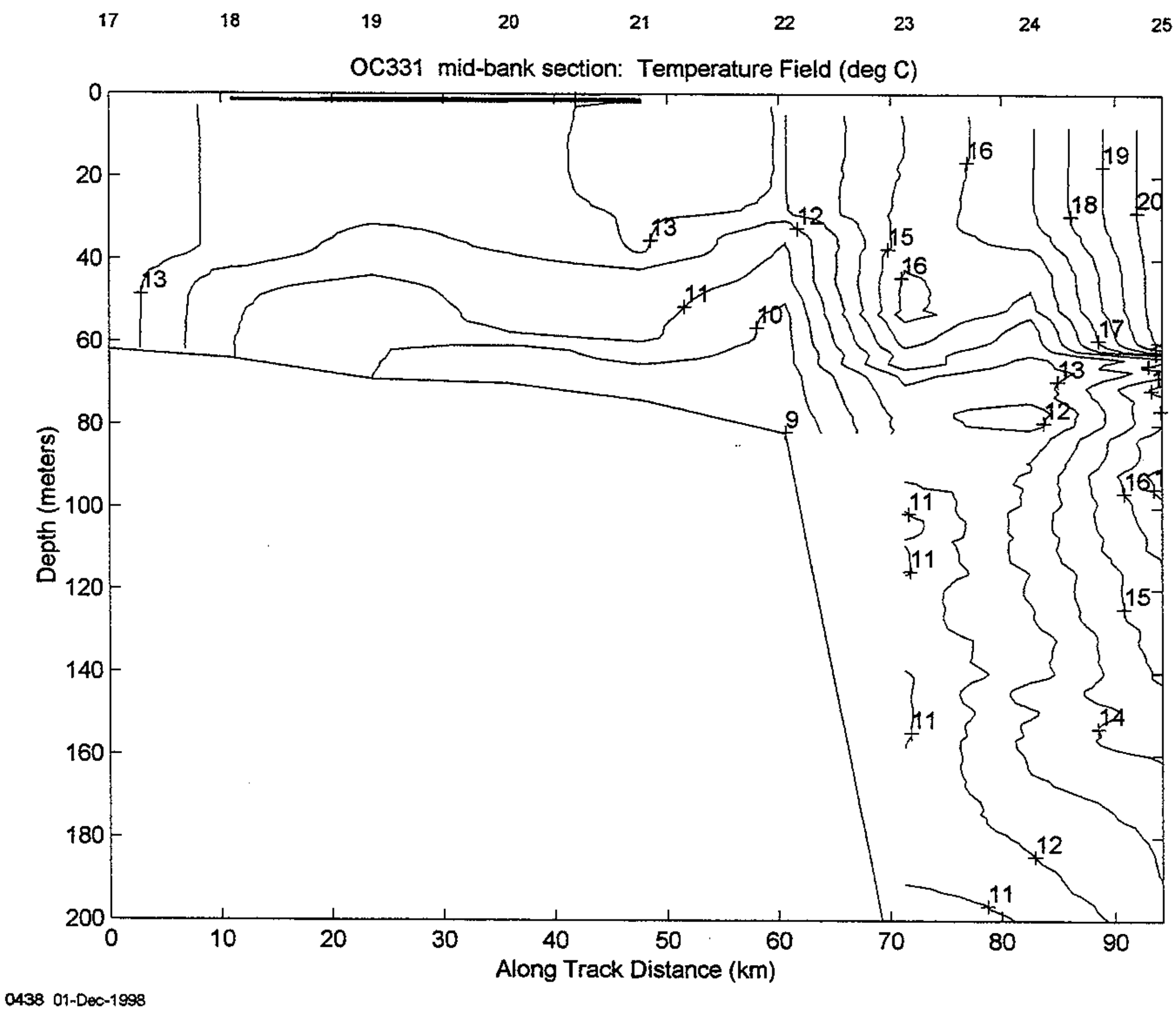


Figure 28. Contours of temperature at 1° intervals on the Mid-Bank Section conducted on 7 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

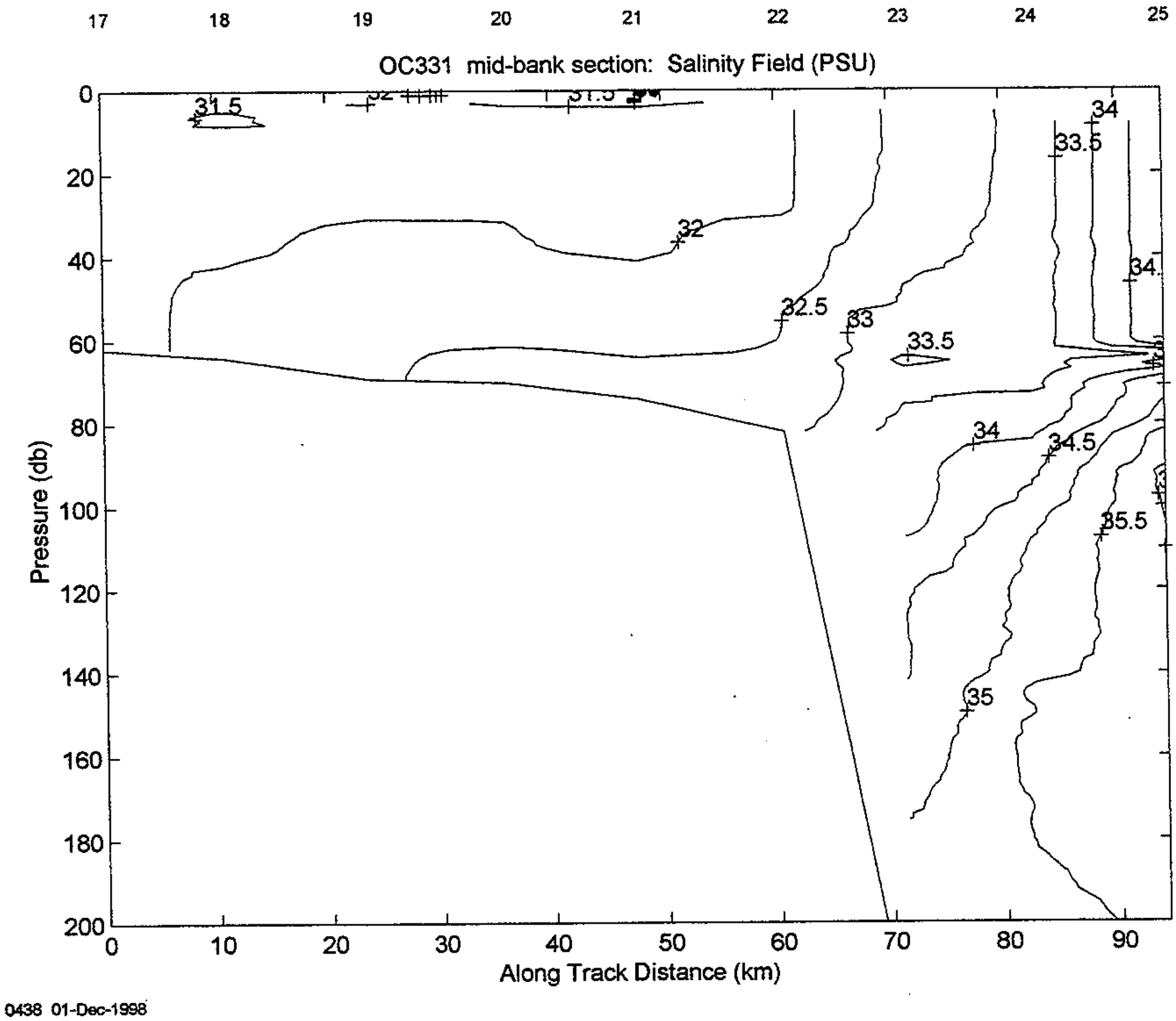


Figure 29. Contours of salinity at 0.5 PSU intervals on the Mid-Bank Section conducted on 7 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

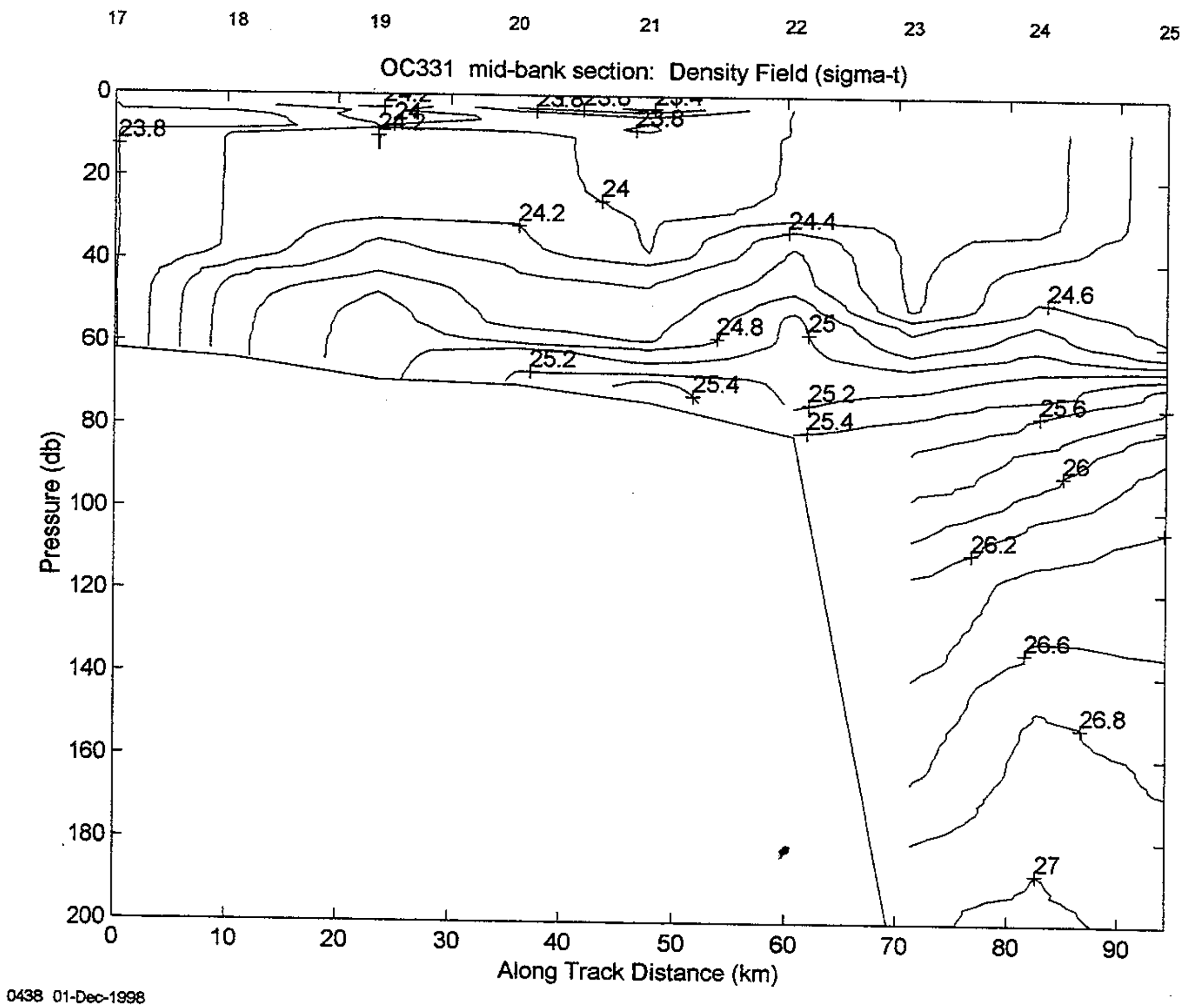


Figure 30. Contours of potential density at 0.2 kg/m^3 intervals on the Mid-Bank Section conducted on 7 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

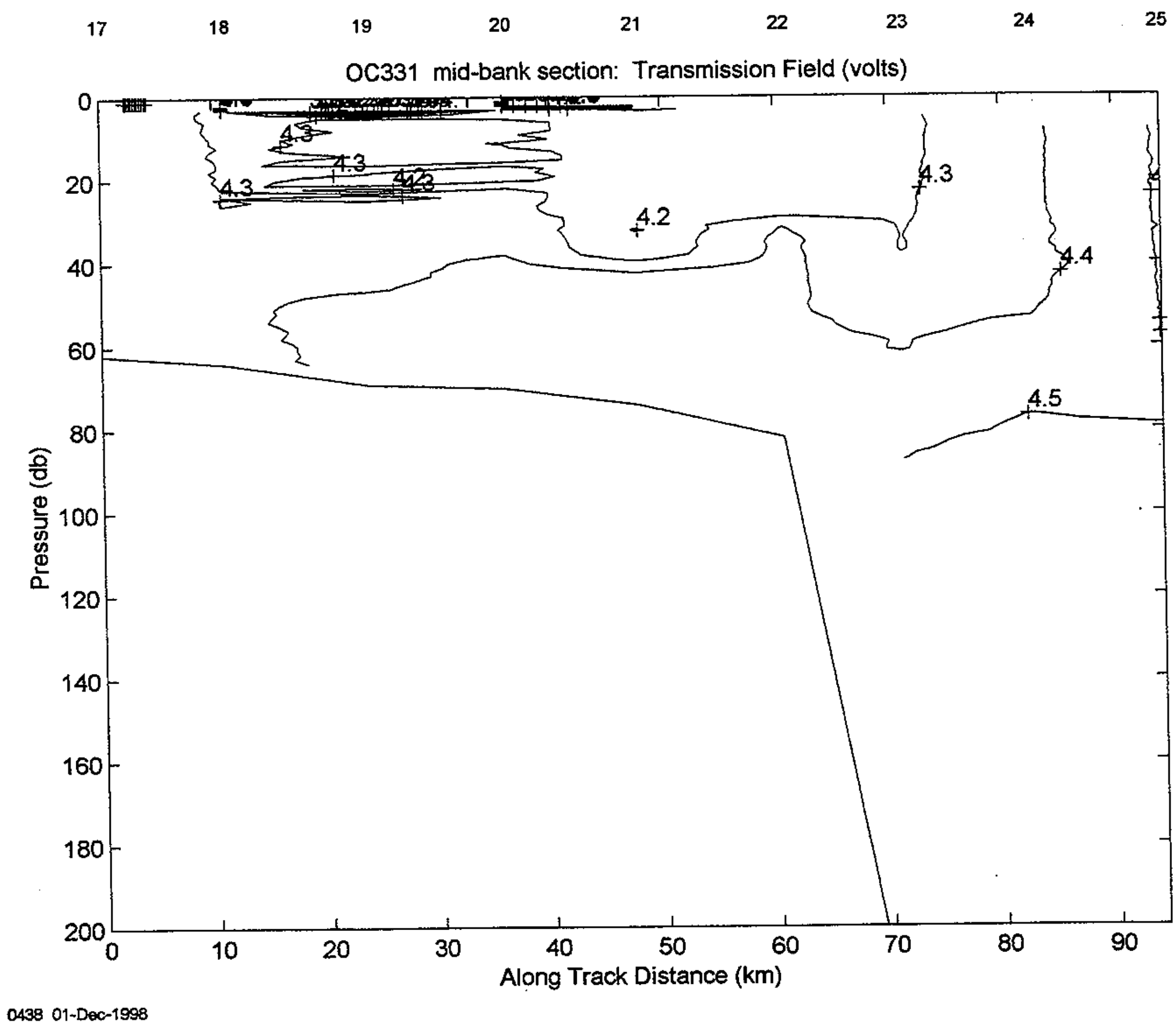


Figure 31. Contours of light transmission at 0.1 v intervals (where 4.9 v is ~100%) on the Mid-Bank Section conducted on 7 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

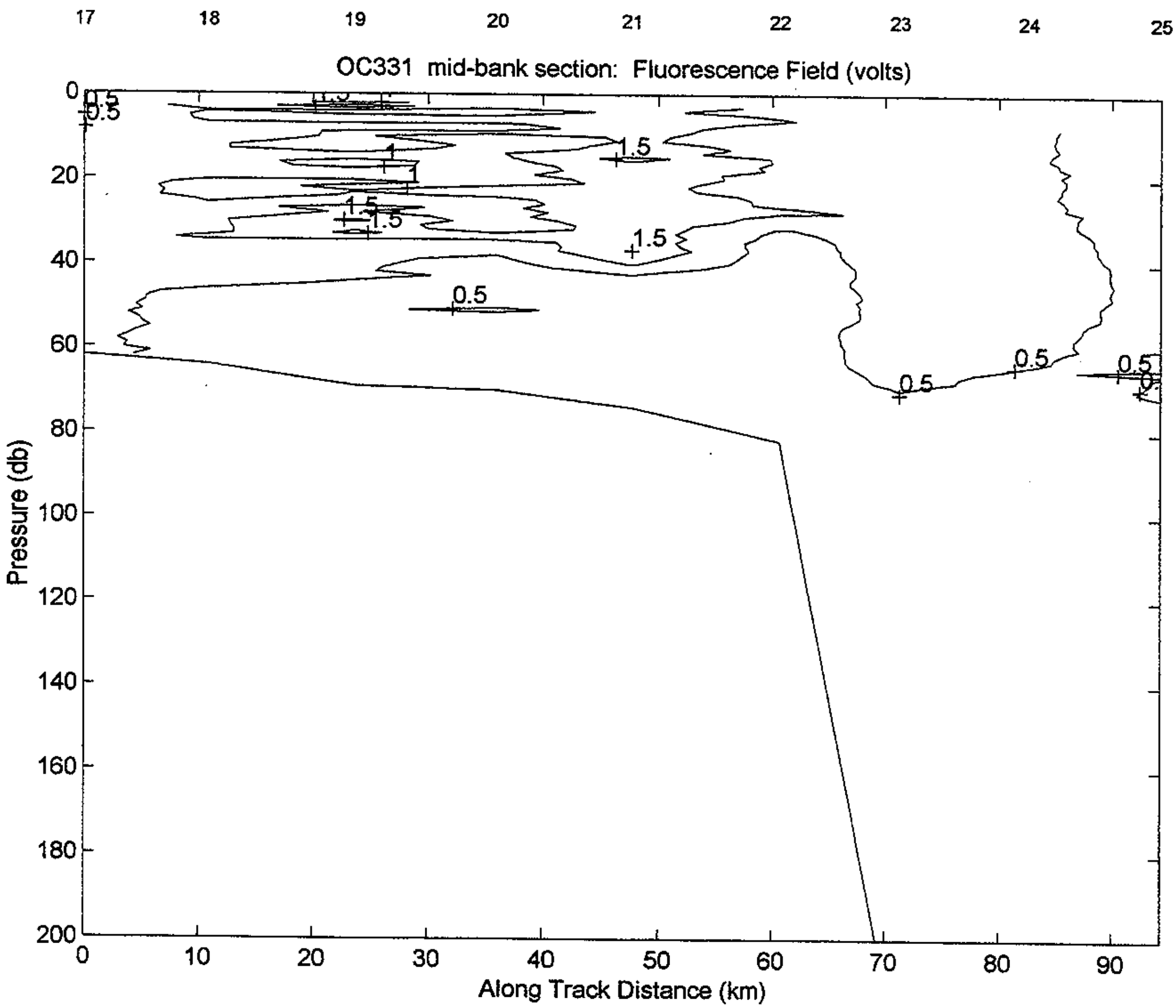


Figure 32. Contours of relative fluorescence at 0.5 volt intervals (where 5 v ~ 30 μg/l chlorophyll-a) on the Mid-Bank Section conducted on 7 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

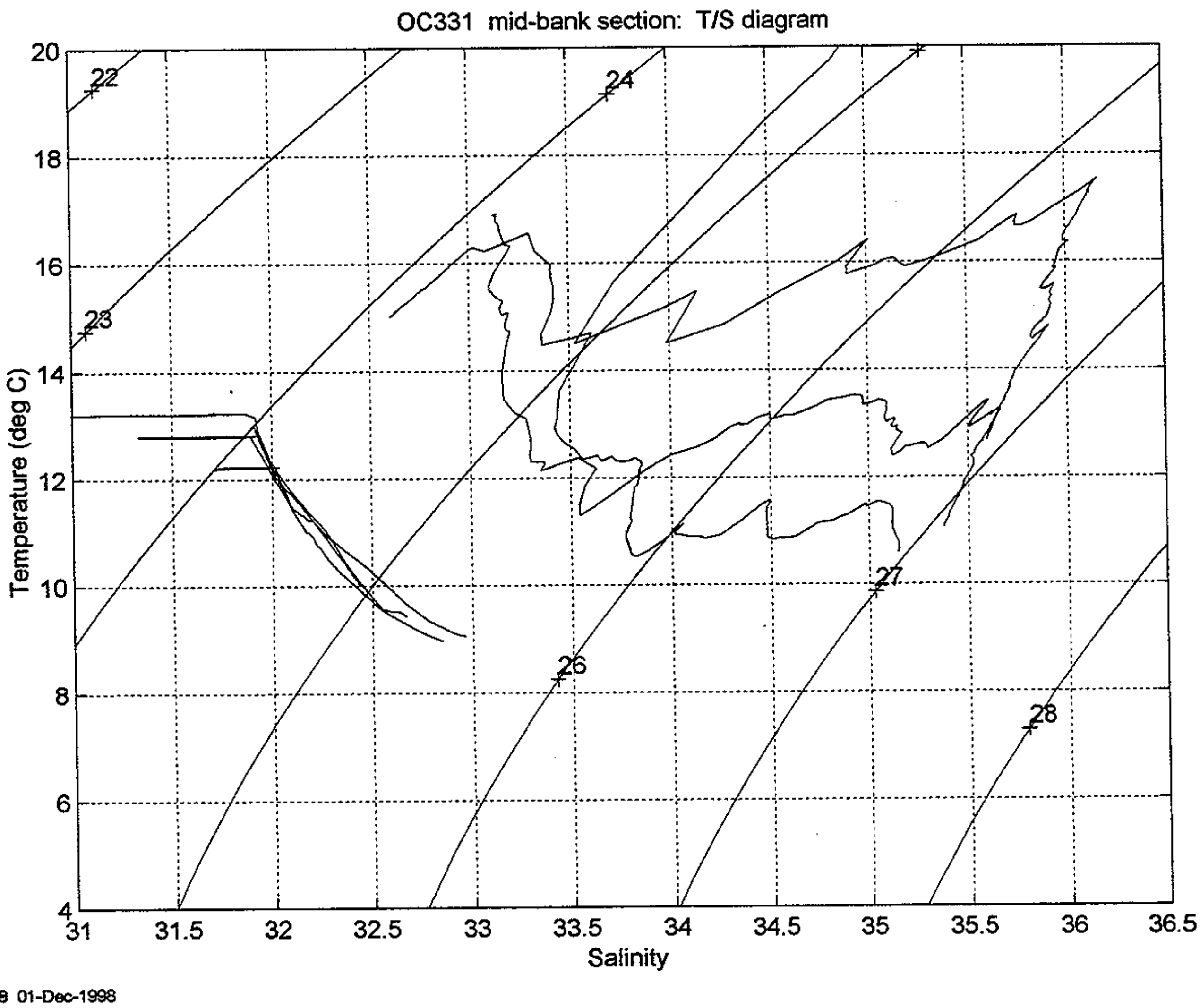


Figure 33. Mid-Bank Section temperature-salinity plot for all profiles in the section made on 6 and 7 October 1998. Lines of constant sigma-t are shown for reference.

First Southern Flank Long-Term Section: The Standard Southern Flank Section (see Figure 1) was occupied first on early 8 October 1998 (0100 to 1450 UTC). Contour plots of the data from this section are shown in Figures 22-26 (temperature, salinity, potential density, transmission and chlorophyll-a fluorometer output). A T-S plot of the data from this section is shown in Figure 27. The continuous series of 15 profiles in this section normally takes about 14 hours to make. In this case, some profiles had problems due to clogging of the temperature/conductivity intake and were repeated or eliminated from the section plots. The section extends from the well-mixed region over the crest of Georges Bank out into the North Atlantic.

The temperature section (Figure 22) shows the vertically well mixed water near the crest of Georges Bank. Near the shelf break, a cooler core of water ("cold pool") is seen (<10° C and 33 PSU). Offshore the warmer (>18° C and >34 PSU water) not found on the bank, but typical of seaward of the shelf slope front is encountered. The highest salinity water (Figure 23) are found deeper and offshore, while the freshest water (<32 PSU) is found over the crest of the Bank, showing the continuing freshening of the Bank seen over the last three years. The light transmission and fluorometer section show the lowest transmission and highest chlorophyll-a fluorescence over the crest of the Bank, but no extremely high productivity regions are seen.

The Temperature-Salinity plot (Figure 27) shows the offshore waters with salinity of 35 to 36 PSU and temperatures ranging from 8 to near 20° C. The onbank waters show mixing with water of less than 8° C and 32 PSU sometime in the past as the source peak has been relatively well mixed into a smooth curve. The warmer fresher waters found over the crest of the Bank.

Second Southern Flank Long-Term Section: The Standard Southern Flank Section (see Figure 1) was occupied again on late 8 October 1998 (1500 to 2300 UTC) because of problems with some stations in the first section due to biology plugging the temperature/conductivity cell intake. However, this time stations LT02 through LT06 were skipped because they were relatively well mixed vertically, and for lack of time. Contour plots of the data from this section are shown in Figures 22-26 (temperature, salinity, potential density, transmission and chlorophyll-a fluorometer output). A T-S plot of the data from this section is shown in Figure 27.

As this second section was made the same day as the first, it is not surprising that the results are quite similar. The interesting features are the differences which are due to the tidal advection of features on and off bank and the along bank advection of structure. It should also be noted that the most offshore station was not occupied on this section so it is shorter. The cooler lower salinity (<33 PSU) water is still seen near the surface just offshore of the shelf break, but is slightly warmed. The fluorometer and transmissometer sections show the higher chlorophyll-a fluorescence and lower transmission over the crest of the bank. However, the second section also shows a peak in fluorescence in surface waters (<20 m) just inside the shelf break, which is not seen (or maybe not spatially resolved) in the first section.

Downwelling Surface Irradiance Measurements: Continuous surface measurements of downwelling photosynthetically active radiation (PAR: 400-700nm) were taken on October 5 through 8 for use in the ongoing comparison with and calibration of the PAR sensors attached to the science buoys (science buoys "D" and "E"). Li-Cor cosine and 4π-quantum (Li-Cor, Inc; Lincoln, NE) sensors are standard components of the surface buoys and of the bio-optical

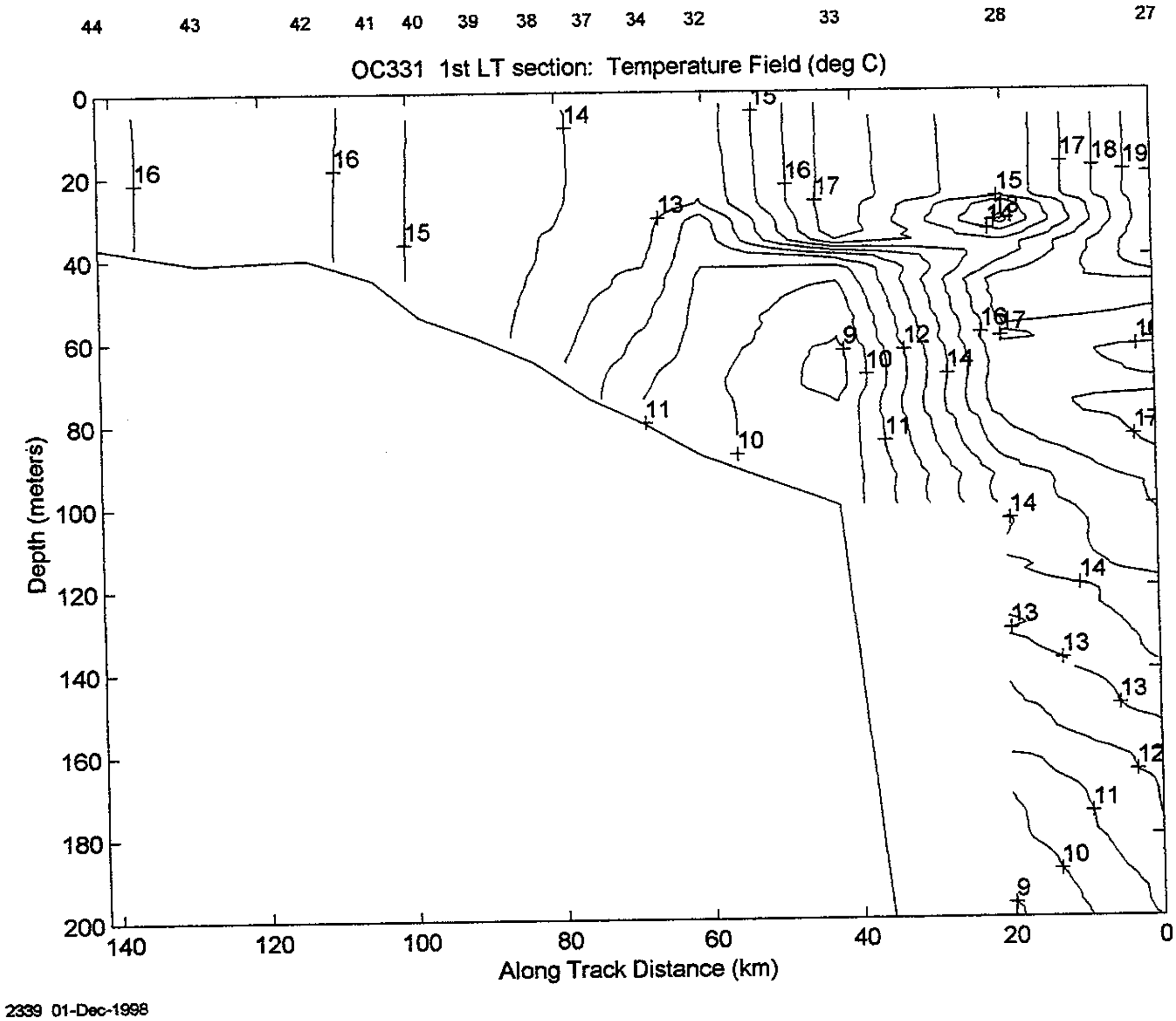


Figure 34. Contours of temperature at 1° intervals on the first Southern Flank Section conducted early on 8 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

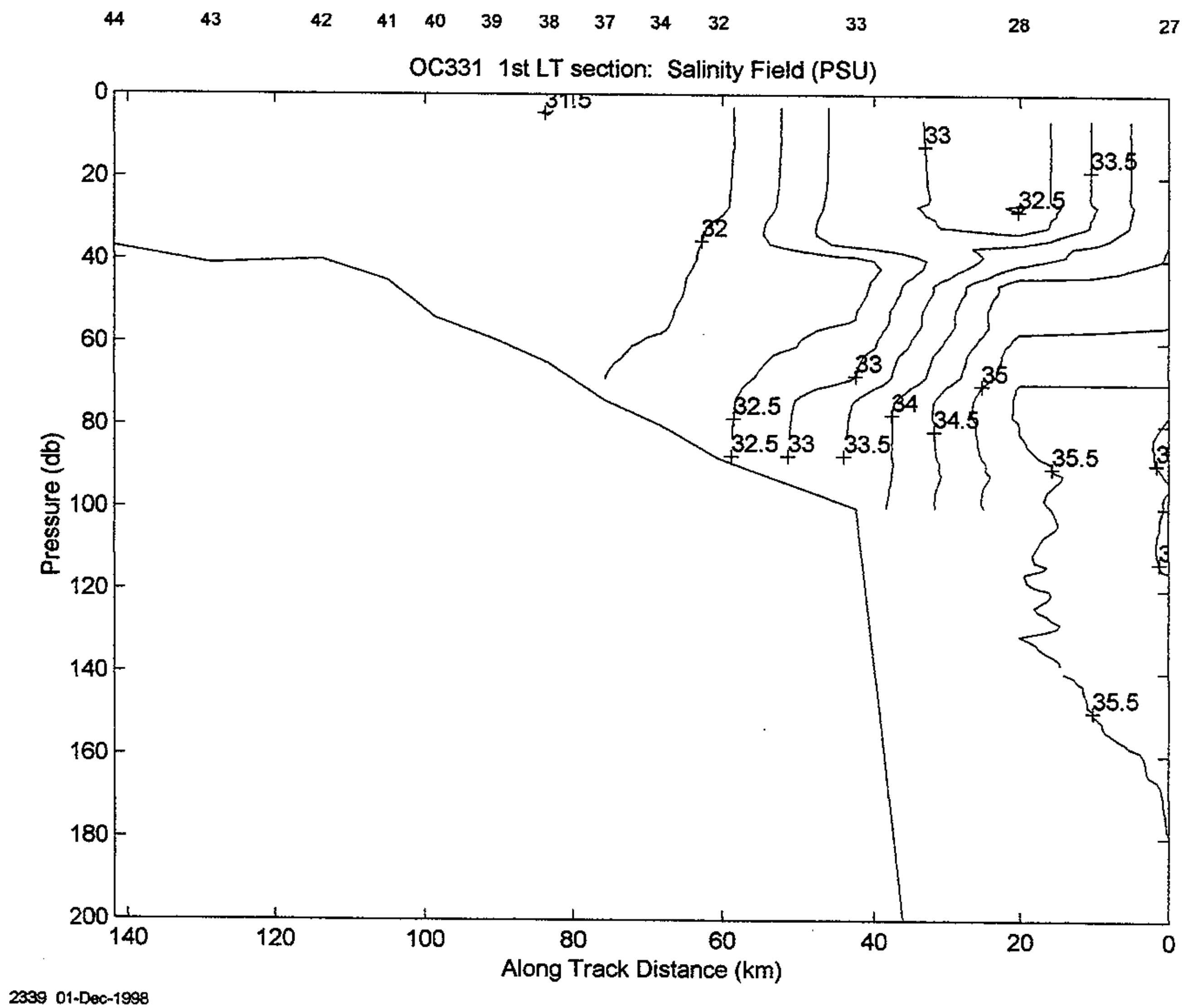


Figure 35. Contours of salinity at 0.5 PSU intervals on the first Southern Flank Section conducted early on 8 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

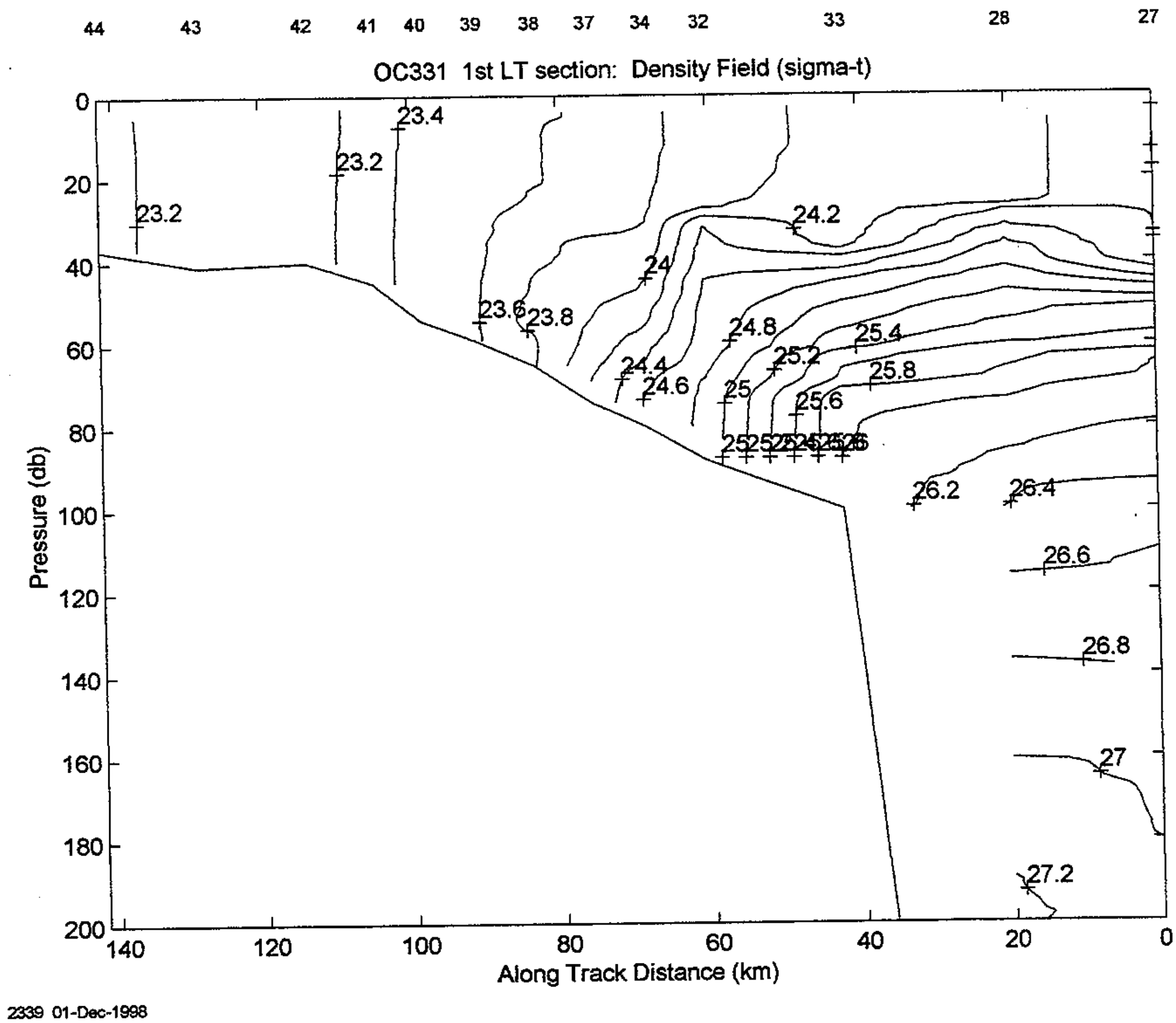


Figure 36. Contours of potential density at 0.2 kg/m^3 intervals on the first Southern Flank Section conducted early on 8 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

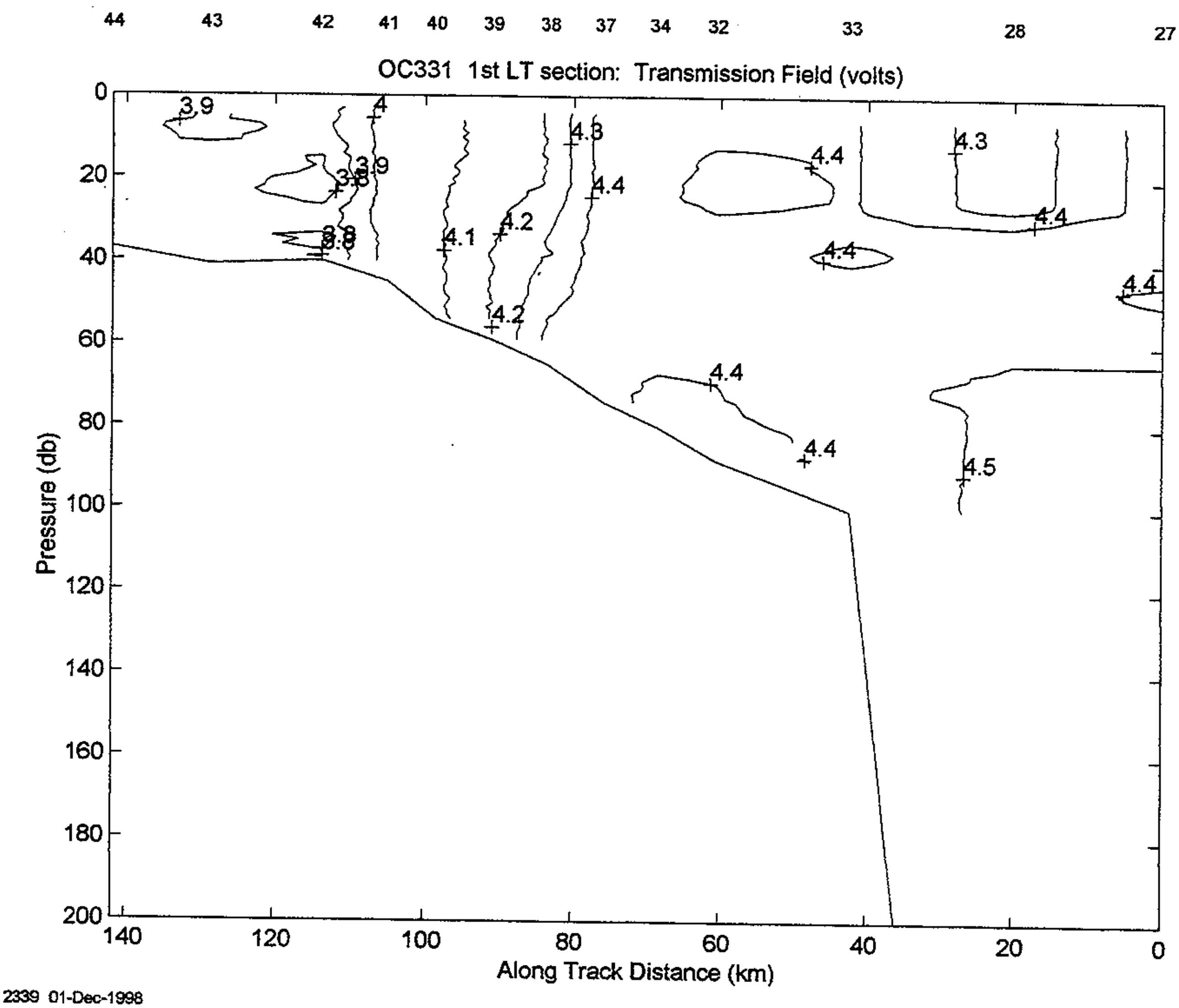


Figure 37. Contours of light transmission at 0.1 v intervals (where 4.9 v is ~100%) on the first Southern Flank Section conducted early on 8 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

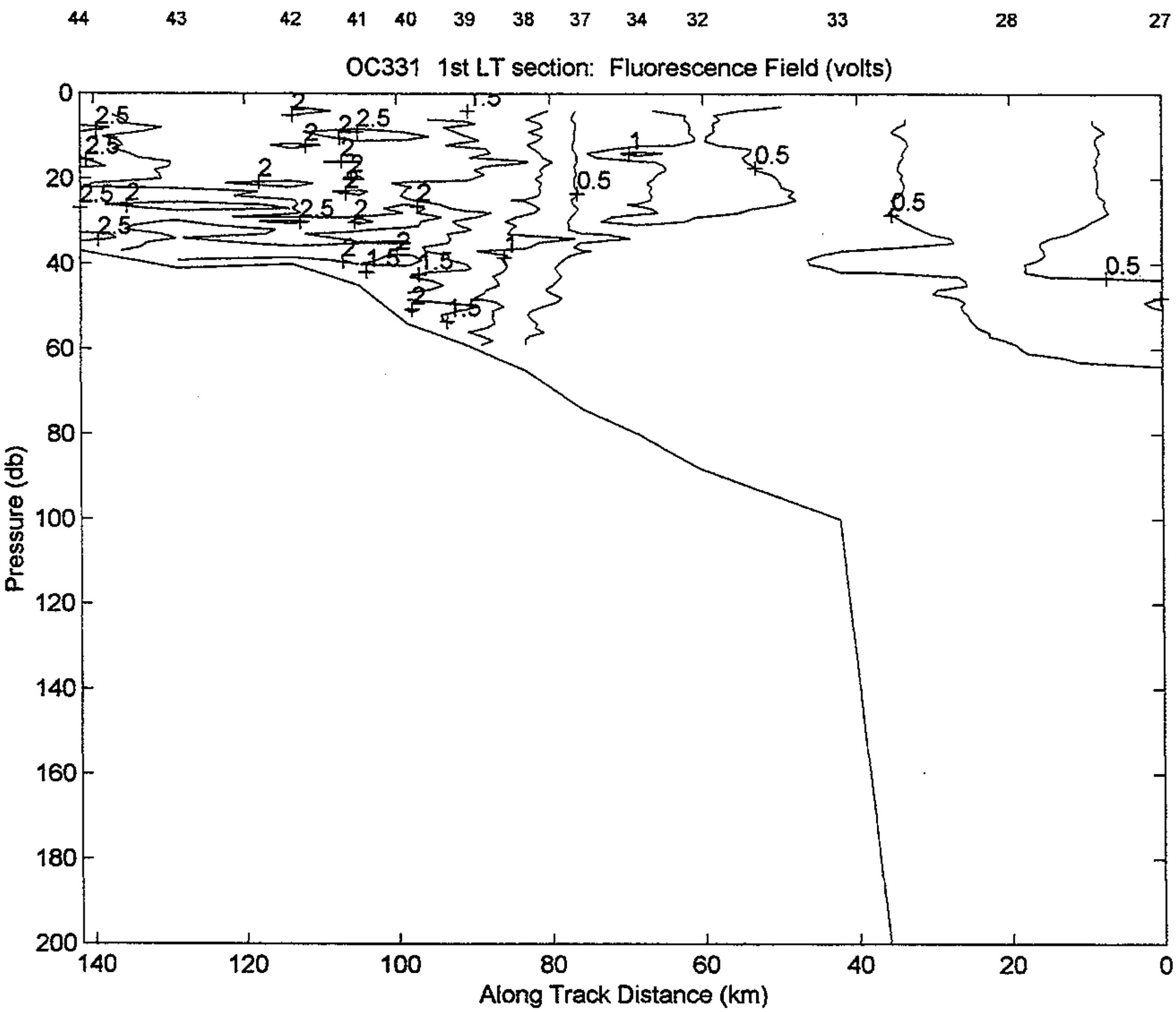


Figure 38. Contours of relative fluorescence at 0.5 volt intervals (where 5 v ~ 30 μg/l chlorophyll-a) on the first Southern Flank Section conducted early on 8 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

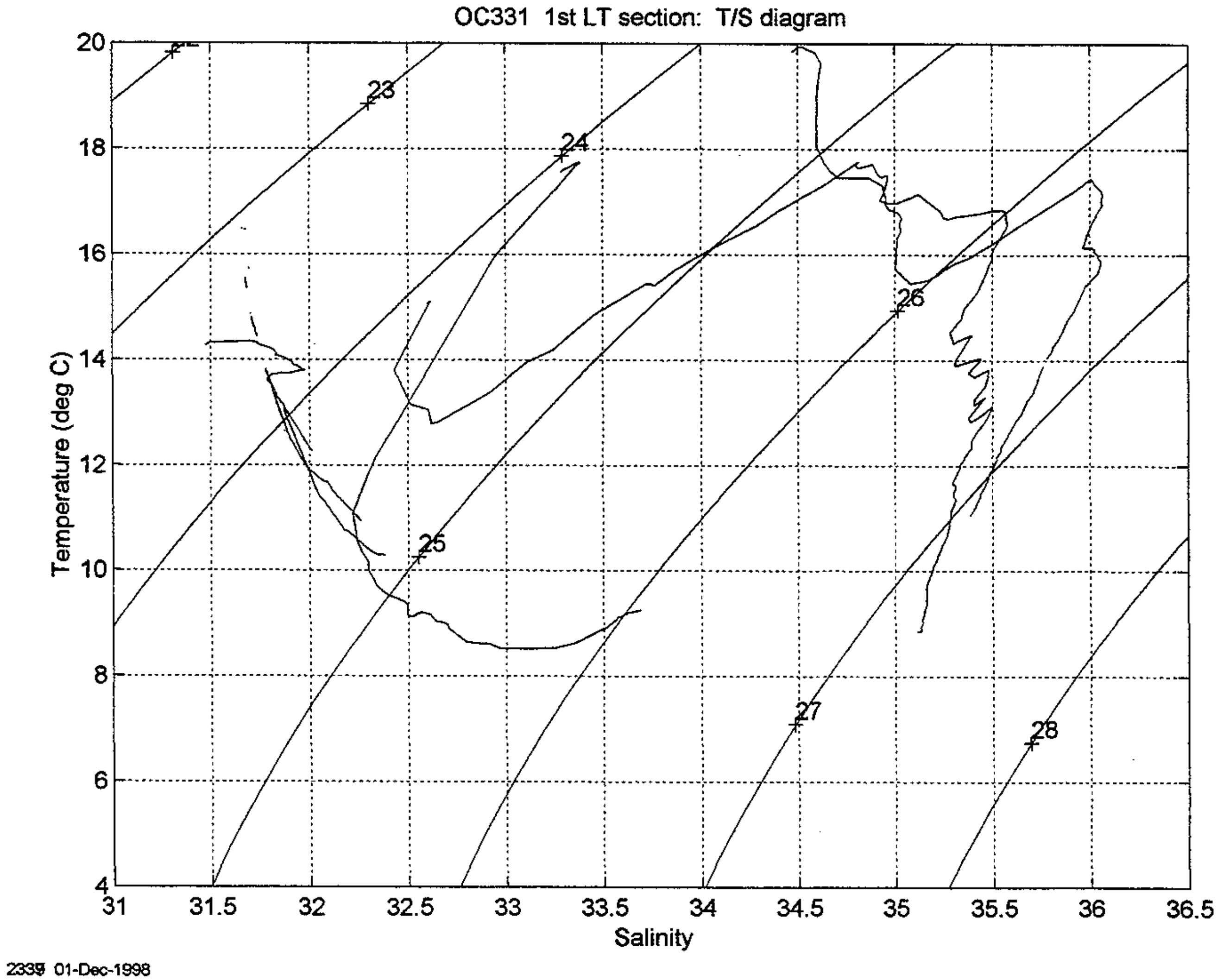


Figure 39. First Southern Flank Section temperature-salinity plot for all profiles in the section made early on 8 October 1998. Lines of constant sigma-t are shown for reference.

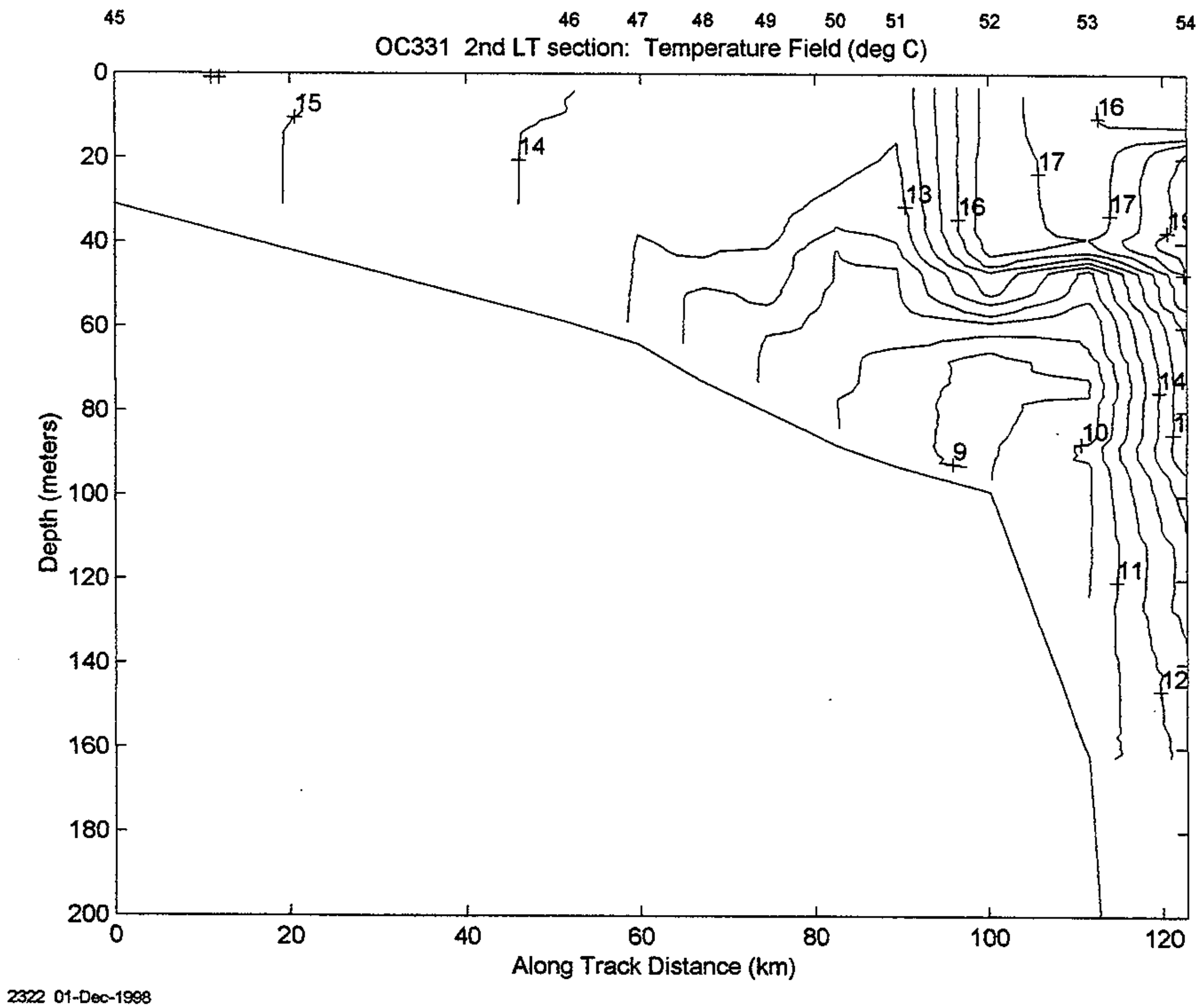


Figure 40. Contours of temperature at 1° intervals on the second Southern Flank Section conducted late on 8 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

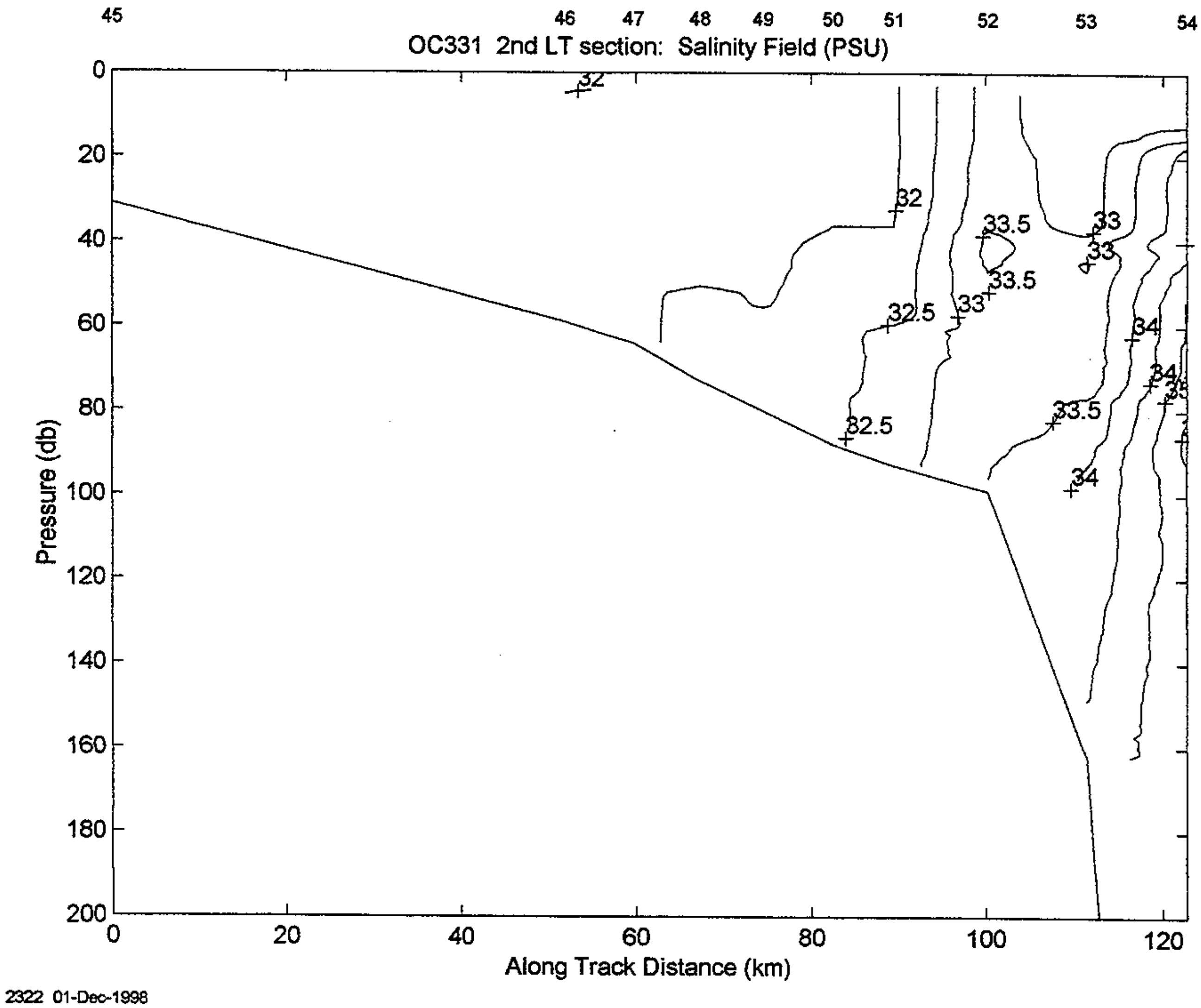


Figure 41. Contours of salinity at 0.5 PSU intervals on the second Southern Flank Section conducted late on 8 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

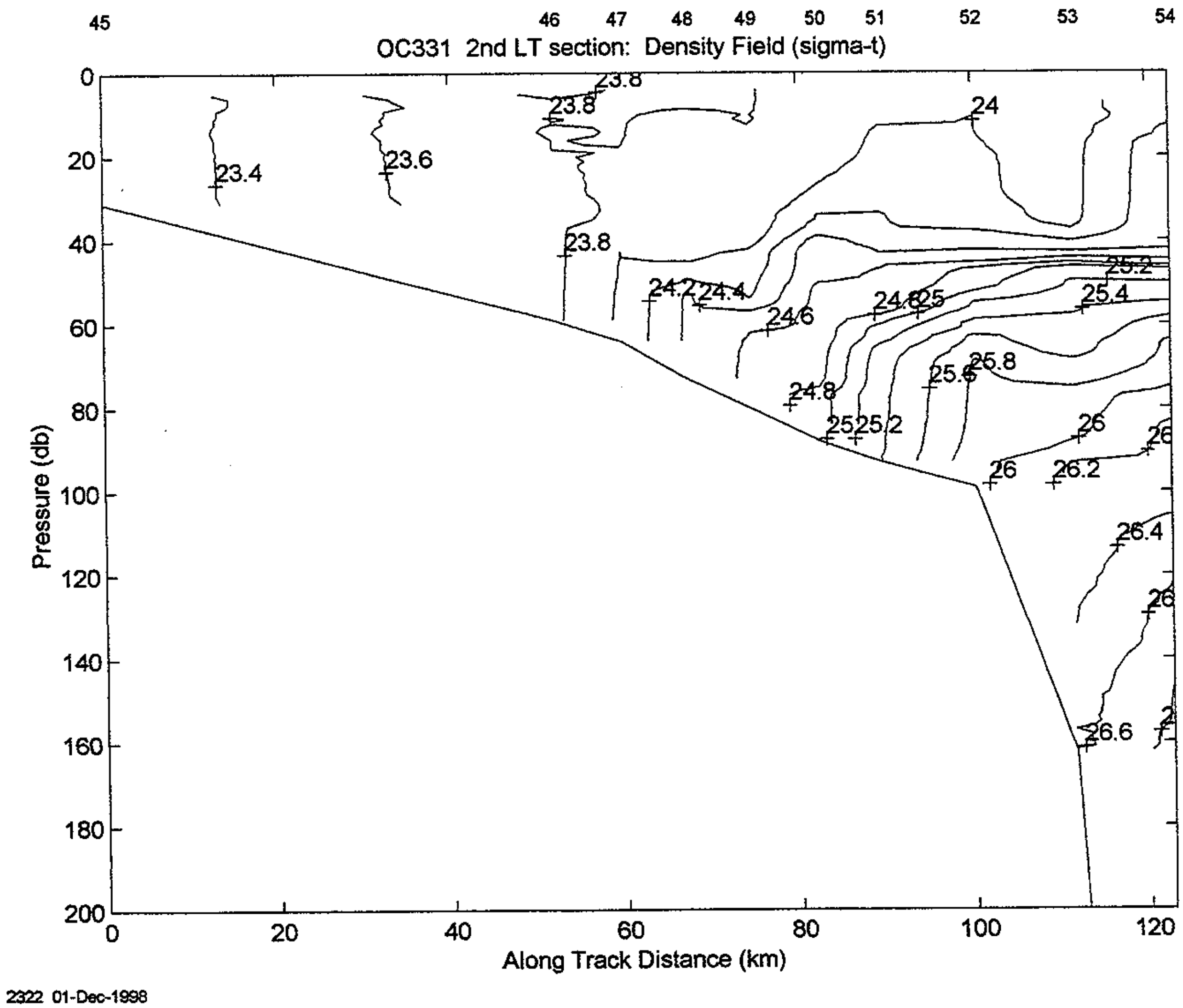


Figure 42. Contours of potential density at 0.2 kg/m^3 intervals on the second Southern Flank Section conducted late on 8 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

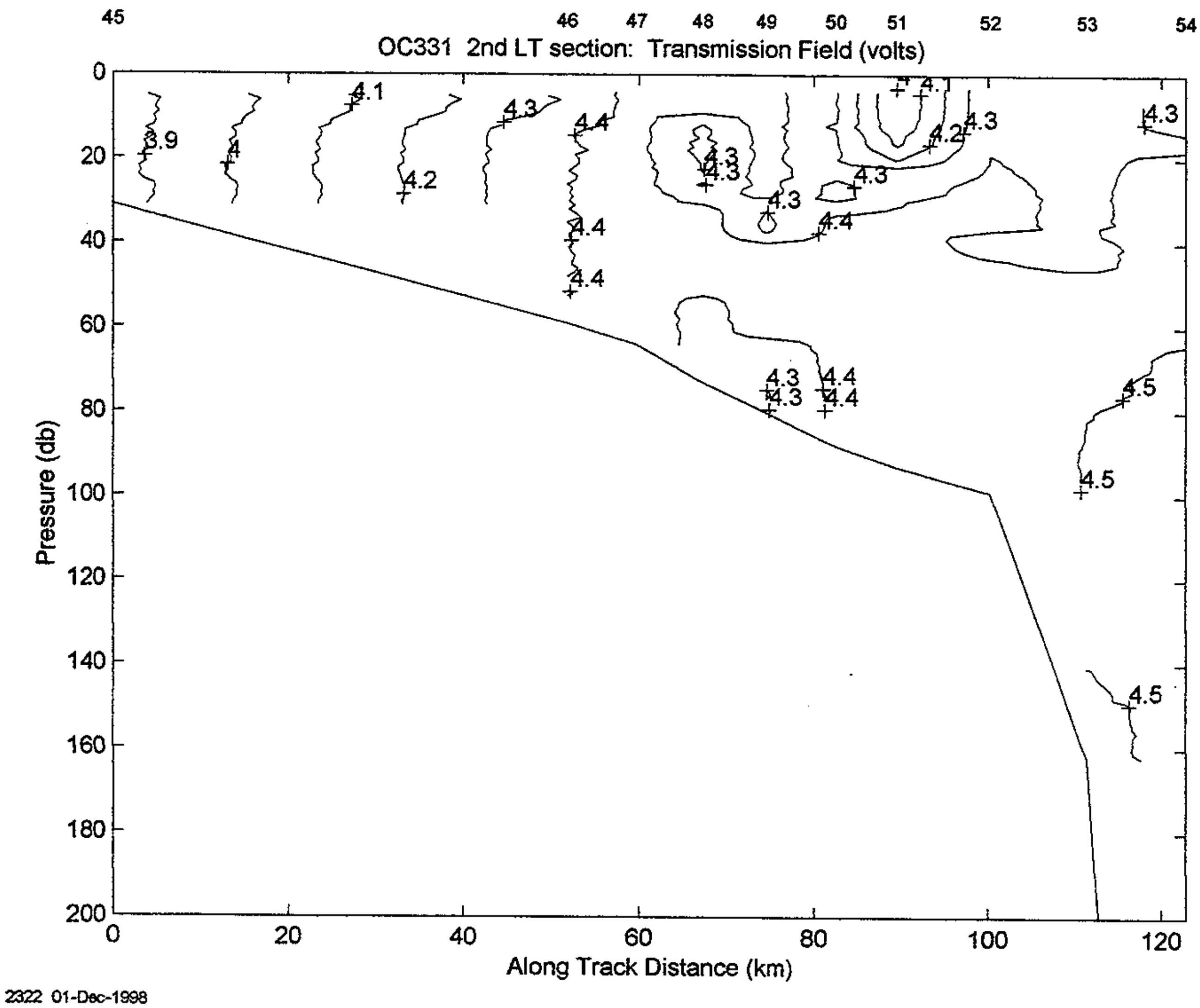


Figure 43. Contours of light transmission at 0.1 v intervals (where 4.9 v is ~100%) on the second Southern Flank Section conducted late on 8 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

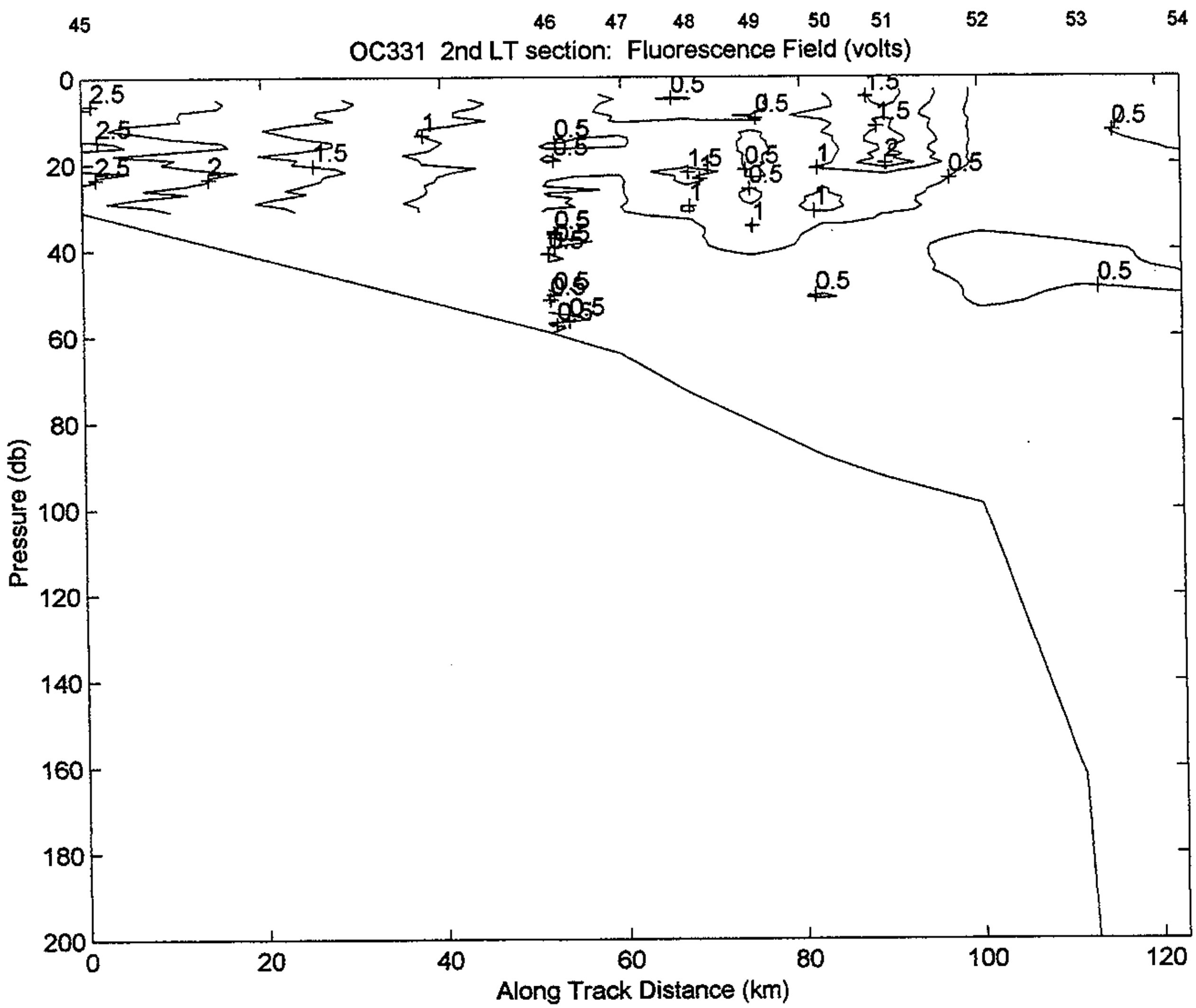


Figure 44. Contours of relative fluorescence at 0.5 volt intervals (where 5 v ~ 30 μg/l chlorophyll-a) on the second Southern Flank Section conducted late on 8 October 1998. The blanked out region at the bottom shows the depth to which data was collected and somewhat follows the bathymetry, except in the deep casts which do not go to the bottom. The numbers at the top of the figure are the CTD profile numbers and mark the position of each profile in the section.

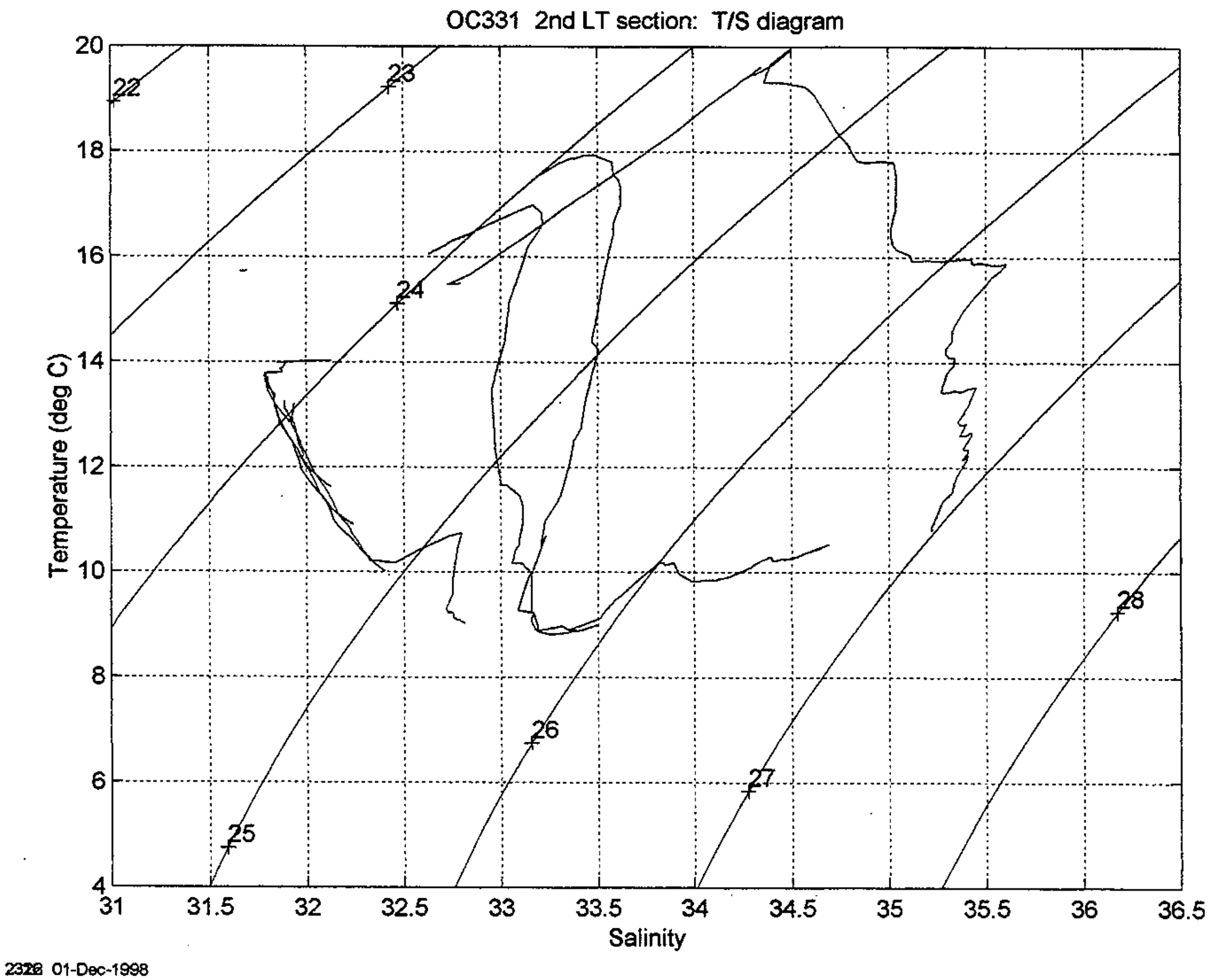


Figure 45. Second Southern Flank Section temperature-salinity plot for all profiles in the section made on late 8 October 1998. Lines of constant sigma-t are shown for reference.

packages deployed at 10 m and 40 m beneath the Southern Flank science buoy. The continuous shipboard PAR measurements were obtained at fifteen second intervals from an International Light (Newburyport, MA) Model SED003 UV-enhanced silicon photodiode with a PAR filter and a cosine-response input optical surface. The sensor was attached to the top of a four-meter pole which was positioned to avoid shadowing from the ship's superstructure. The discrete measurements were amplified using a standard International Light Model IL1700 radiometer and recorded on a standard DOS-based personal computer. These measurements were taken to augment the CTD-based deck measurements of PAR which only occured during periods when the CTD unit was in the water.

A second set of continuous surface irradiance measurements were taken throughout the cruise using the R/V Oceanus' automated underway data collection system. This system records data from sensors throughout the ship including an Eppley Laboratory (Newport, RI) spectral pyranometer (285-2,800nm). This permanently installed sensor is mounted on a special tower extending vertically from the bow of the ship. Figure 46 illustrates the data collected at one minute intervals from the Eppley pyranometer over the period 4 October through 9 October. October 5, when science mooring "E" was removed from the water, was a clear day with only a hint of clouds near the horizon. October 6, however, was essentially overcast (7/8 cumulus and stratocumulus clouds) in the morning with slight clearing in the afternoon (decrease to 3/8 stratocumulus by 1600 local). October 7, when science mooring "D" was deployed at the southern flank site, was clear early, although a thin shield of cirrus clouds developed over the area during the afternoon. The sky cleared by sunset on October 7. Finally, on October 8, overcast cumulus clouds existed throughout the day. This was exhibited in the reduced levels of both surface PAR and shortwave radiation.

Downwelling Underwater Irradiance Measurements: Preliminary analysis has been completed on the downwelling PAR measurements taken during each CTD cast. These data were collected within the CTD datastream (Seabird Instruments (Seattle, WA) model SBE 333) using a Biospherical Instruments (San Diego, CA) Model QSP-200L scalar-response PAR sensor. This underwater sensor was just recalibrated (calibration date: September 18, 1998). The same acquisition system also recorded simultaneous measurements from a Biospherical Instruments Model QSR-240 scalar-response, deck PAR sensor (calibration date: April 21, 1997). This sensor was mounted near to the International Light deck sensor and in a position to avoid shadowing by the ship's superstructure. In the ongoing analysis of underwater PAR attenuation, these simultaneous Biospherical deck PAR readings are used to normalize the underwater readings in addition to providing an additional independent record of surface PAR readings for comparison with buoy records. Data from the upper 10m of each cast have been excluded from these analyses due to potential contamination of the data due to ship effects (shadowing, reflection, etc).

Figures 47 and 48 contrast the rapid rate at which physical and biological conditions can change at a single station on Georges Bank due to the advection of different water masses across the site. CTD #39 (Station LT06; depth: 62m) was started at approximately 0720 hrs local on October 8. At this time the chlorophyll concentration throughout the water column resulted in a fluorescence signal averaging approximately 1.4 volts (Figure 47). Although the ambient light level was limited at this early hour of the morning, there was enough light such that an attenuation rate could be computed from the downwelling irradiance measurements (PAR).

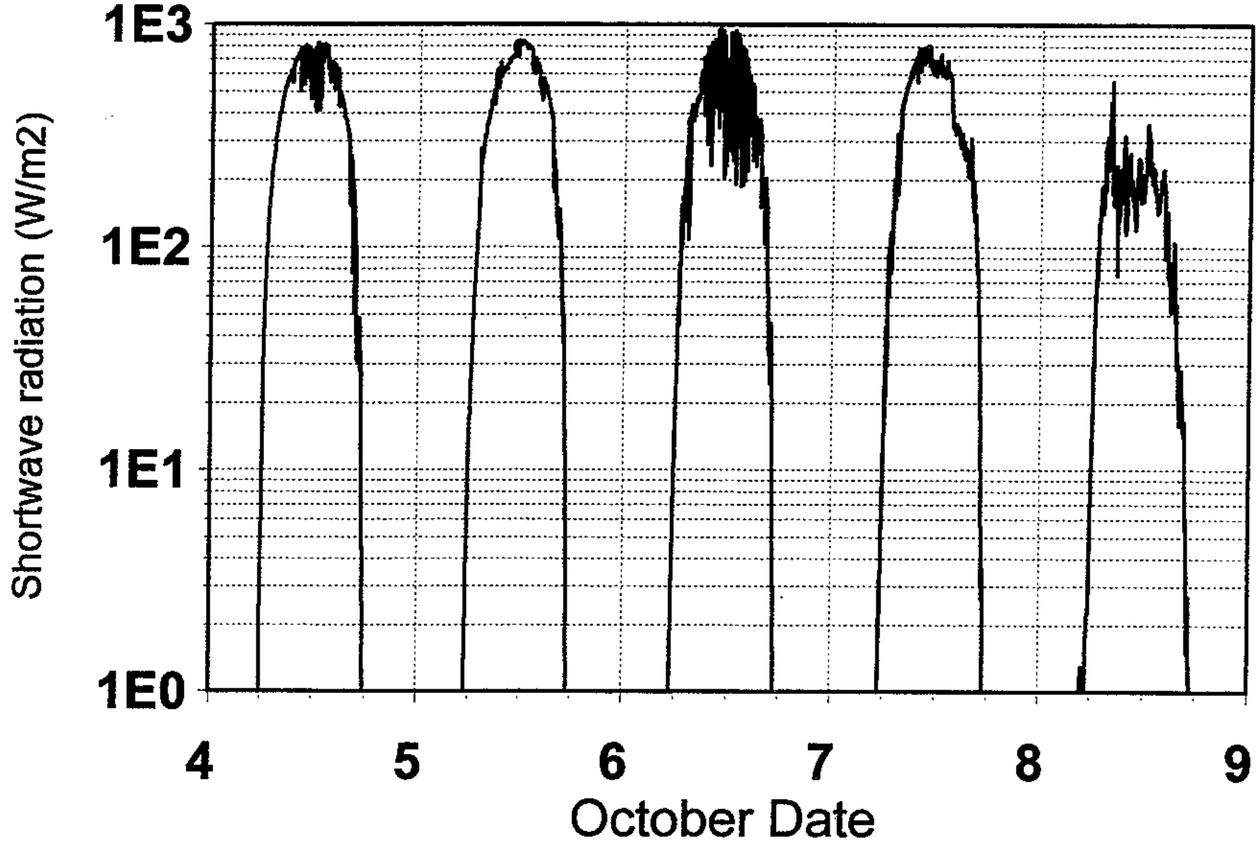


Figure 46. Time series of Shortwave Radiation (285 to 2,800 nm) in Watts/m^2 from the R/V OCEANUS underway sensor mounted on the bow mast.

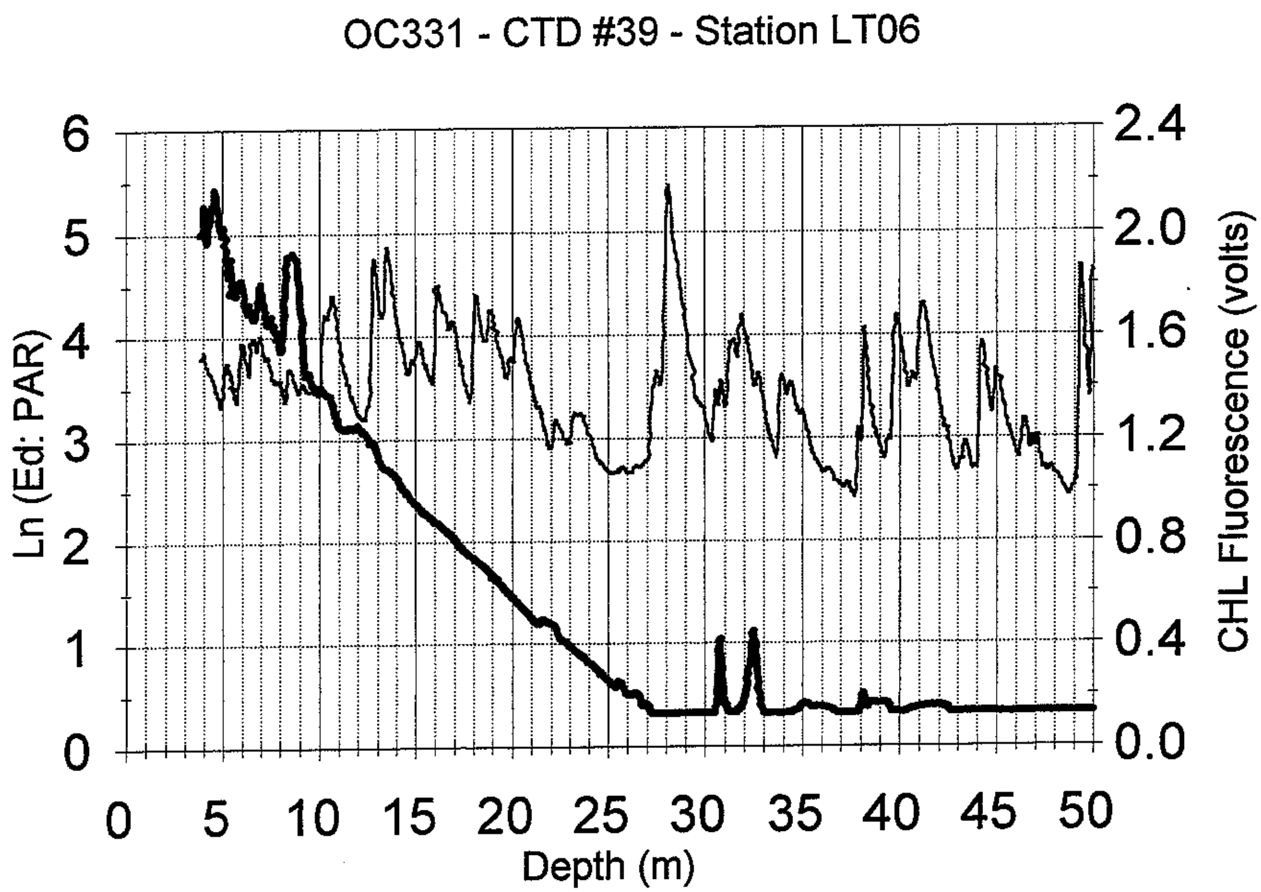


Figure 47. PAR and Chlorophyll-a profiles from CTD39 at station LT06.

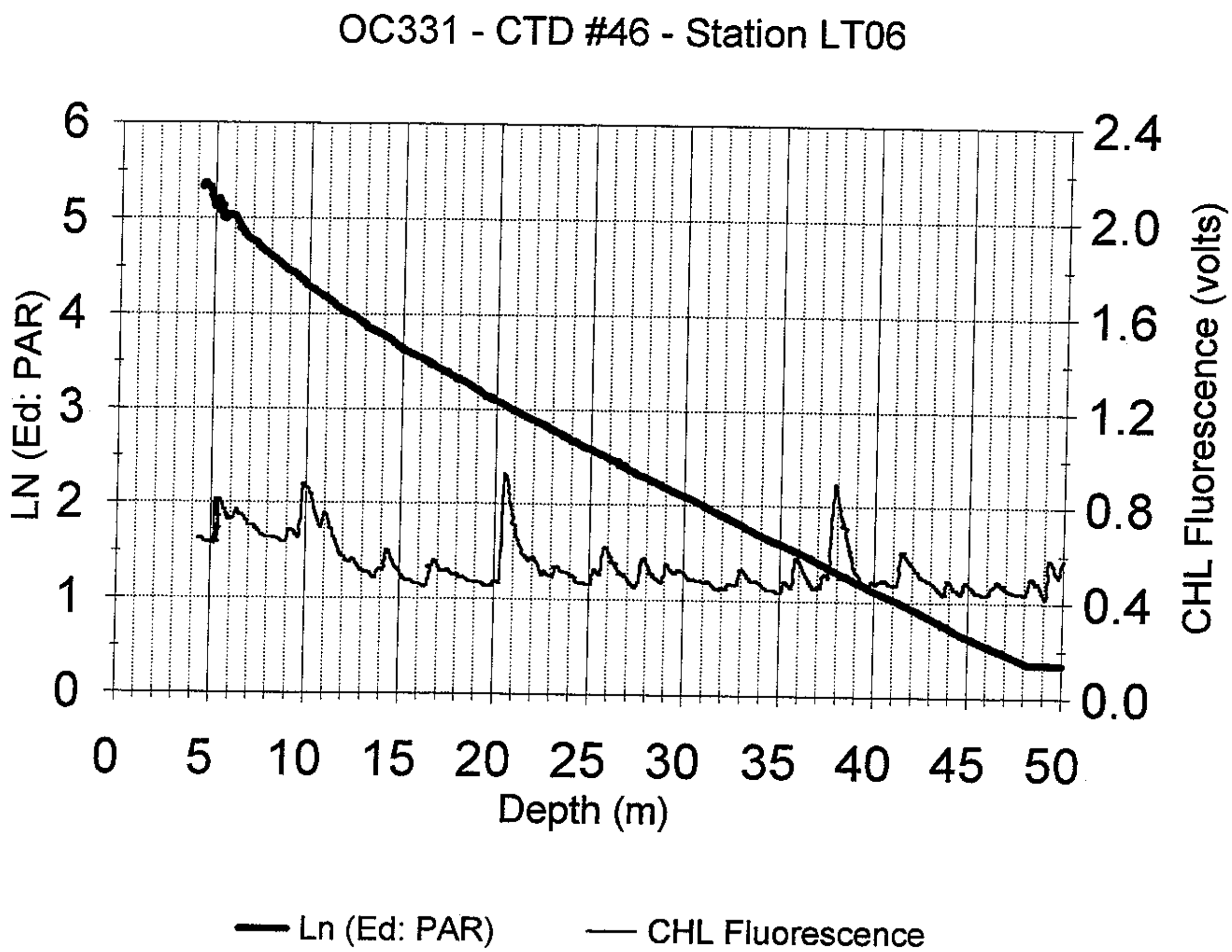


Figure 48. . PAR and Chlorophyll-a profiles from CTD46 at station LT06

These data indicate that the diffuse attenuation rate for the downwelling PAR averaged approximately 0.17 per meter between 15 and 27 meters (R^2=0.995, n=413). In contrast, when the same station was revisited approximately 6.5 hours later (Figure 48), the average fluorescence had decreased to 0.5 volts and the short-distance vertical structure in the chlorophyll signal was also diminished. In this water mass, the diffuse attenuation rate for downwelling PAR averaged less than 0.1 per meter over the interval 20-45 meters(R^2=0.999, n=960).

Figures 49 and 50 contrast the variations in conditions that existed along the Northeast Peak transect on October 6. Station NEP05 (CTD #12 - cast started at 1738 hrs)), located approximately midway along this transect in approximately 70 meters of water, suggests that relatively low, uniform chlorophyll concentrations existed throughout the water column on this portion of the bank. The diffuse attenuation rate for the downwelling PAR averaged approximately 0.11 per meter between 11 and 25 meters (R^2=0.998, n=499). In contrast, the conditions at Station NEP11 (CTD #06 - cast started at 1218 hrs; depth: 93m) closer to the eastern flank, suggest that chlorophyll-containing particles were concentrated in a relatively thin near surface layer (upper 20m) with relatively low chlorophyll concentrations at greater depths. The diffuse attenuation rates for the downwelling PAR agree with these observations. The diffuse attenuation (PAR) between 10 and 20m averaged at 0.14 (R^2=0.996, n=405) whereas the rate between 24 and 50 meters averaged around 0.08 (R^2=0.999,n=1078).

4. SeaSoar Operations

Japan/East Sea Test Cruise: Thanks to the generosity of Chief Scientist Jim Irish, we were able to execute a three-day cruise to test the SeaSoar configuration intended for use in the upcoming Japan/East Sea Experiment. We planned to perform extensive engineering tests on SeaSoar followed by a cross-bank section at the GLOBEC southern flank CTD section in support of the GLOBEC Long-Term moored effort.

The SeaSoar was tested in the configuration for Japan/East Sea cruise, including the full suite of physical and bio-optical instrumentation. New instrumentation added included a HiStar, also called AC100, which is a visible-light spectrophotometer manufactured by WetLabs. It measures light transmittance due to absorption and attenuation with approximately 3.3 nm resolution from 400 to 726 nm. A second new instrument was the Hydroscat, manufactured by HobiLabs, which measures light backscatter over six independent channels (wavelengths). To accommodate the high data rate of the AC100, a new data acquisition system was developed based on serial data transmission over optical fibers. The fiber-optic tow cable itself had already been used in earlier SeaSoar experiments (GLOBEC) to transmit video signals from cameras onboard SeaSoar. The large size of the added instrumentation required significant modification to the vehicle, including a replacement nose cone, new stabilization weight etc. SeaSoar's hydraulic unit, which turns its wings into dive and climb positions based on surface-supplied control commands, had undergone major repairs before the cruise. On the shipboard end, new data acquisition and display software for the optical sensors was to be tested as well. Since we had not yet taken delivery on the winch purchased for the Japan/East Sea experiment, we used our existing smaller winch with a shorter cable.

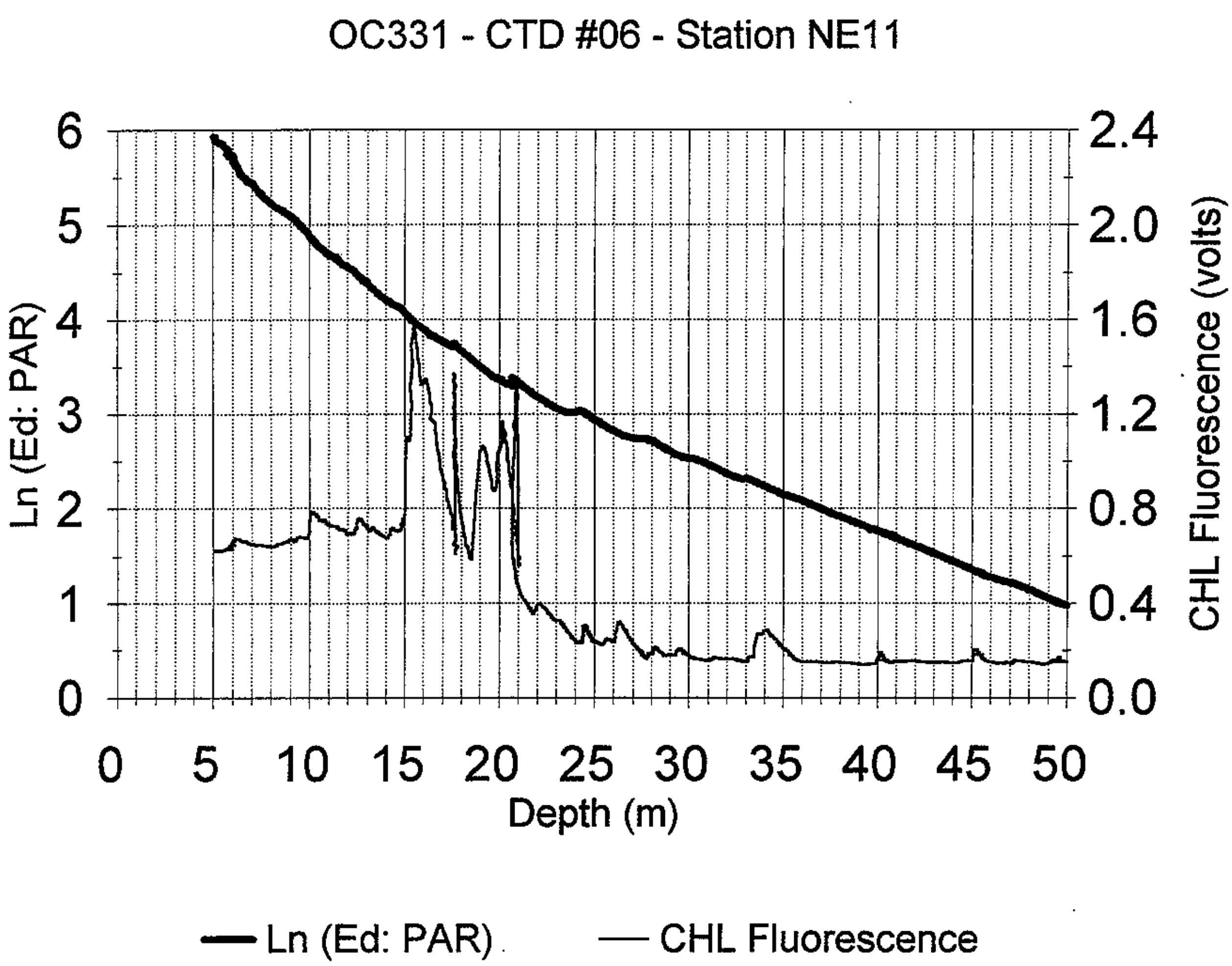


Figure 49. . PAR and Chlorophyll-a profiles from CTD06 at station NEP11

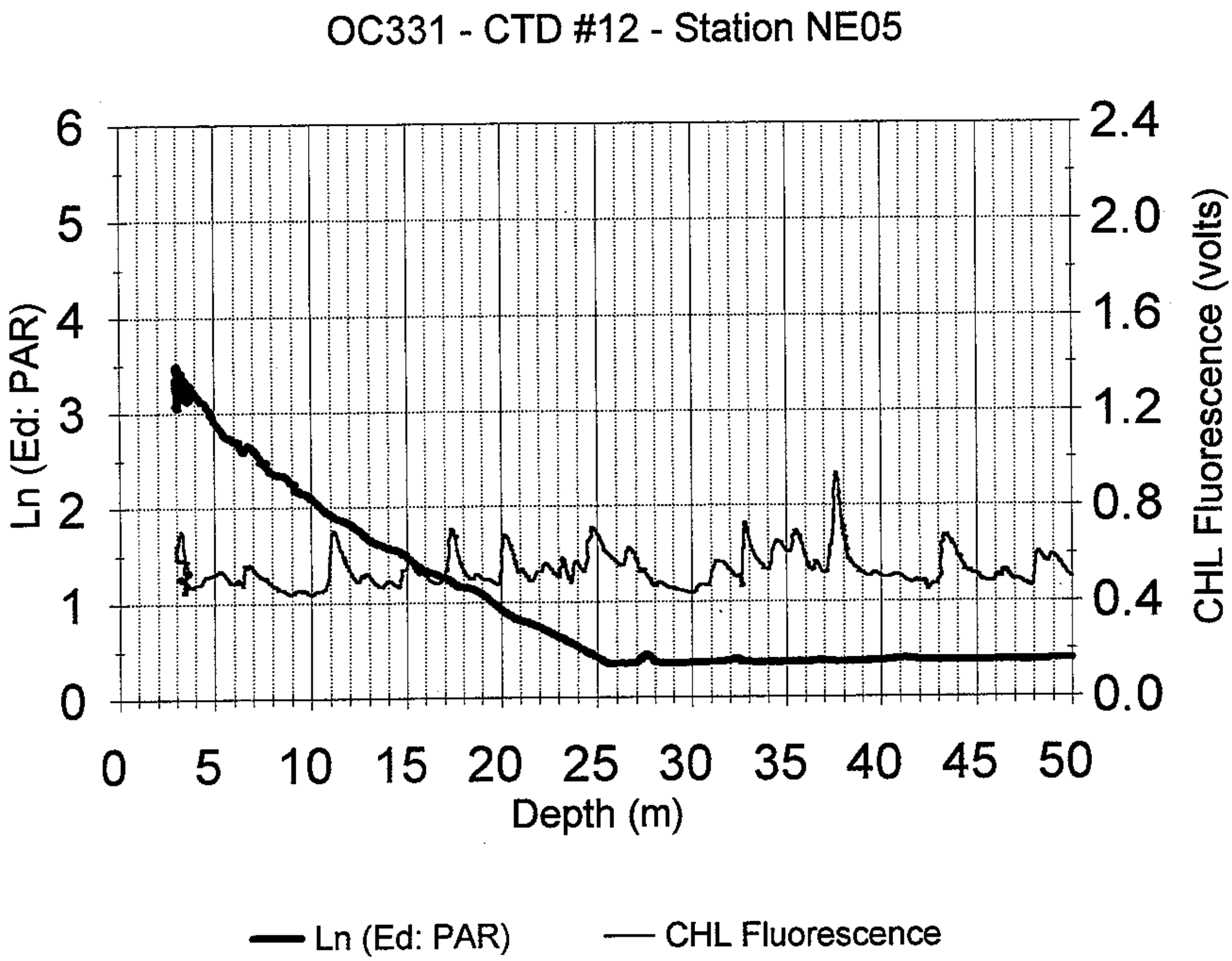
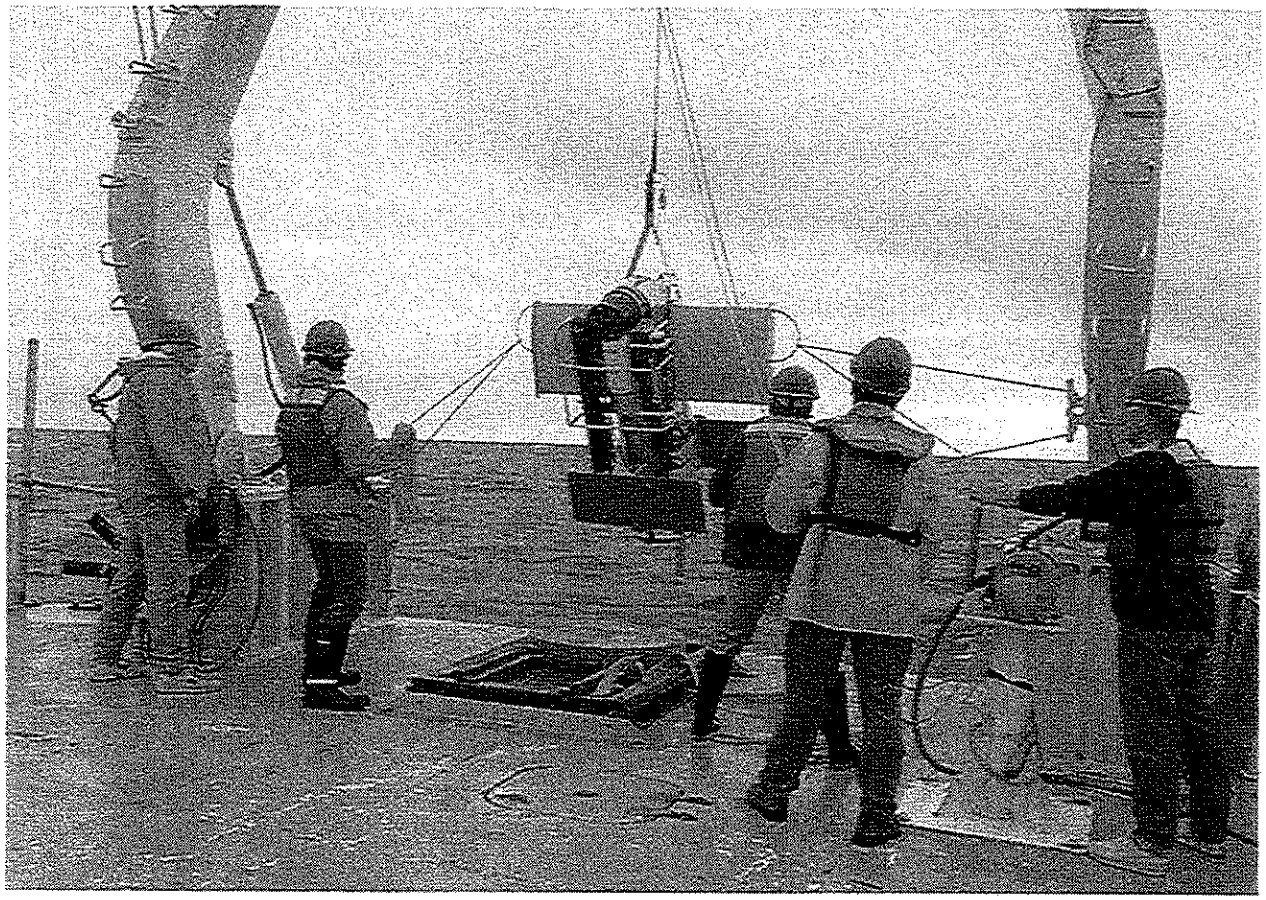


Figure 50. . PAR and Chlorophyll-a profiles from CTD12 at station NEP05.



Picture 3. SeaSoar Launch from R/V OCEANUS. Left to right Bos'n Jeff Stolp, Frank Bahr, Craig Marquitte, ananomous observer and Jerry Dean. The new bio-optical sensors under tow-test can be seen in the front and on both sides of the SeaSoar.

Following an approximately 12-hour steam to reach deep water, SeaSoar was initially deployed in the morning hours of October 11th (see Picture 3). Within the first hour, one of the main objectives was achieved in that SeaSoar still "flew" well following all the modifications.

The data acquisition system worked satisfactory as well. To test different sensor configurations (pumped versus unpumped CTD sensors, including the new fast-response oxygen sensor) and placements (top cover versus stabilizer fins), SeaSoar was recovered and re-deployed with slight modifications. This second, longer deployment provided further endurance testing of the vehicle and the acquisition system. Previously, the fiber-optic sea cable termination inside SeaSoar ("J-box") had been prone to flooding, likely due to the cyclical pressure changes inherent in SeaSoar's undulating flight path. The re-designed J-box performed very well, and post cruise inspection revealed no signs of leakage.

Good data was obtained on most systems. Some examples of the new optical sensor results are shown in Figures 51, 52 and 53 with 1 hour segments cut from the record. Figure 51 shows the HiStar attenuation “a” channel with four 15-minute averages. The wavenumber (400 to 730 nm), broken into 100 bands, is shown on the absissa and the depth on the ordinate. A similar plot of the HiStar absorption “c” channel is shown in Figure 52. The optical backscattering measured by the Hdorscat in the bow of the SeaSoar is shown in Figure 53. The six wavenumber bands are shown across the absissa for each 5-minute average.

Lessons were learned from failures as well. When recovering SeaSoar under the marginal weather conditions of the cruise, the vehicle was prone to slamming into the stern of the ship, potentially damaging the Hydroscat. A temporary "bumper" was attached during the cruise to the vehicle frame to protect the sensors. A more permanent version will be incorporated into the frame for the Japan Sea experiment. On the instrumentation side, the attenuation channels ("c") of the AC100 started to fail early into the first deployment, rapidly getting worse (Figure 52). After the cruise it was determined that an internal bulkhead connector had loosened. The new oxygen sensor, which behaved poorly in pre-cruise laboratory tests, failed to function properly and was returned to the manufacturer for repairs. Overall, the test cruise was extremely valuable and will prove critical to our success in the Japan/East Sea. Unfortunately, deteriorating weather prevented us from executing the section across the southern flank of Georges Bank.

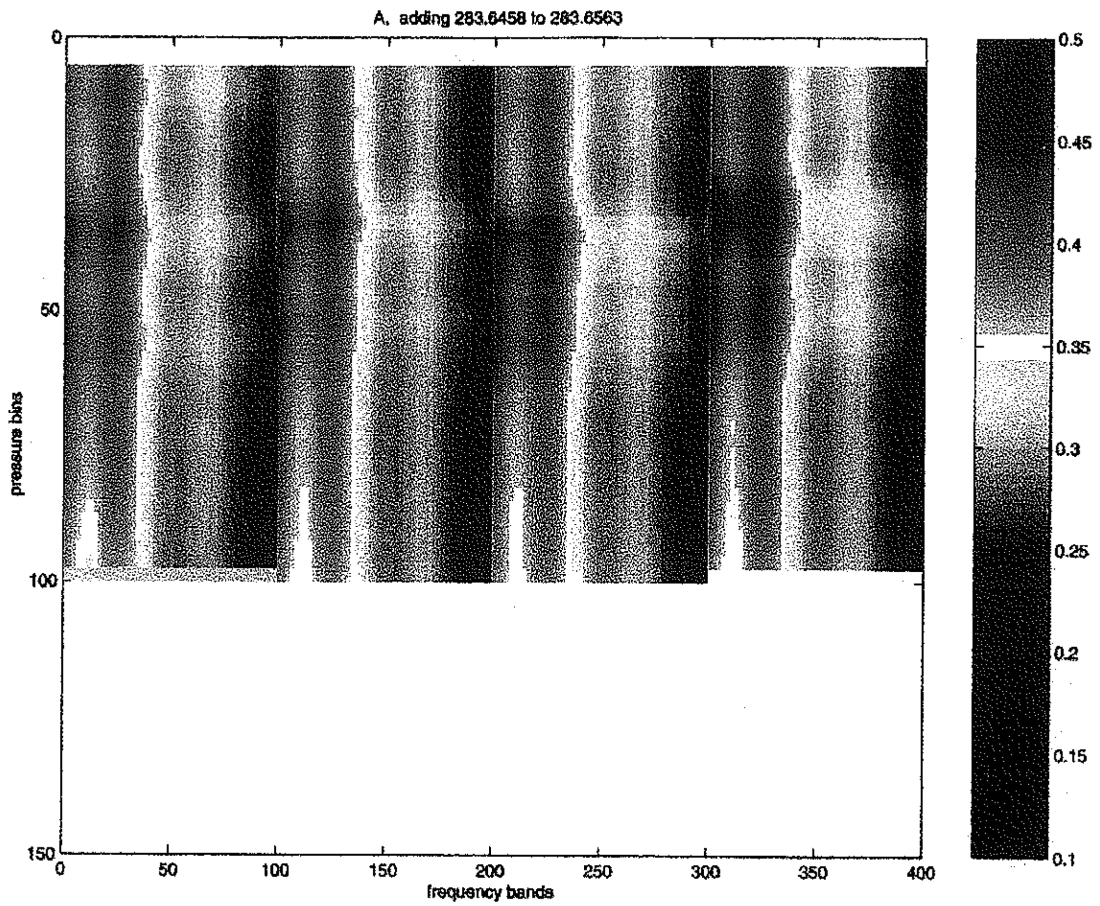


Figure 51. One hour of HiStar absorption ("a" channel) measurements as displayed by the real-time acquisition program. The graph shows four profiles, each derived from a 15-minute time average. Each profile gives "a" as function of depth (vertically) and wavelength (horizontally).

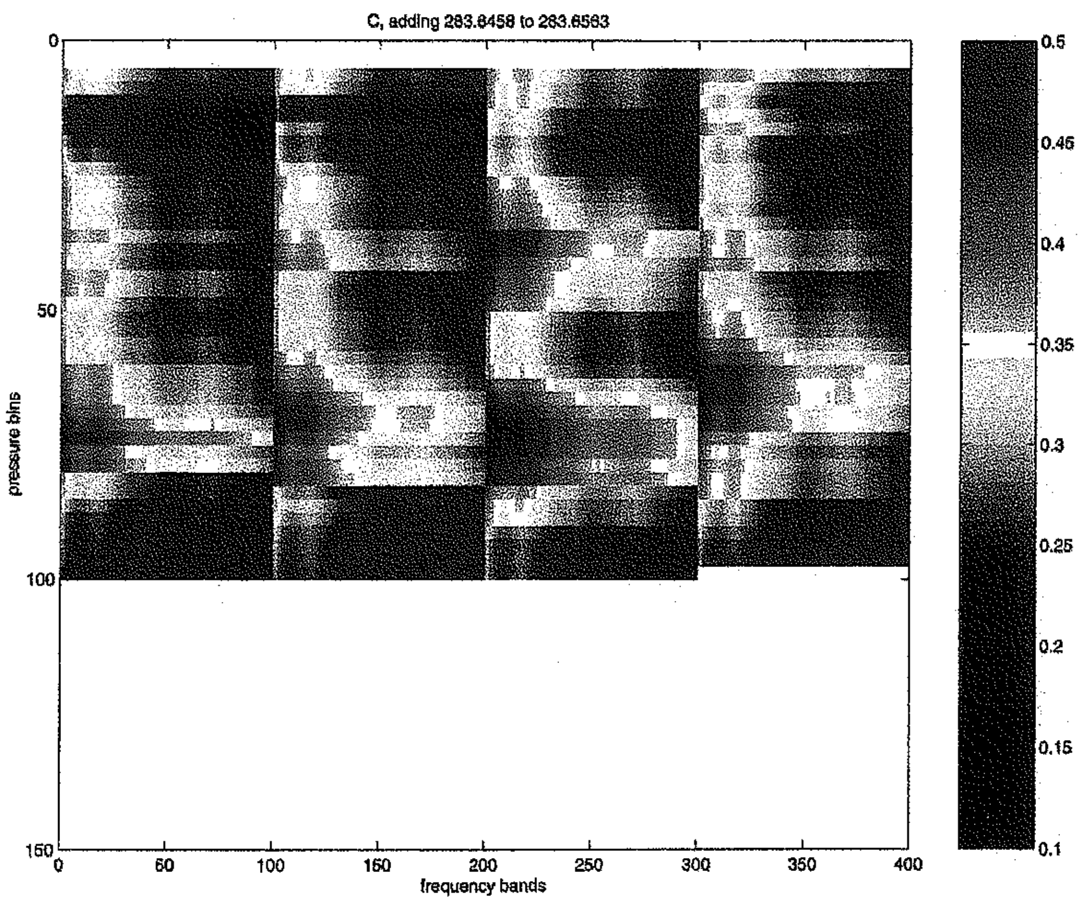


Figure 52. HiStar attenuation ("c" channels), derived like "a" in figure 51.

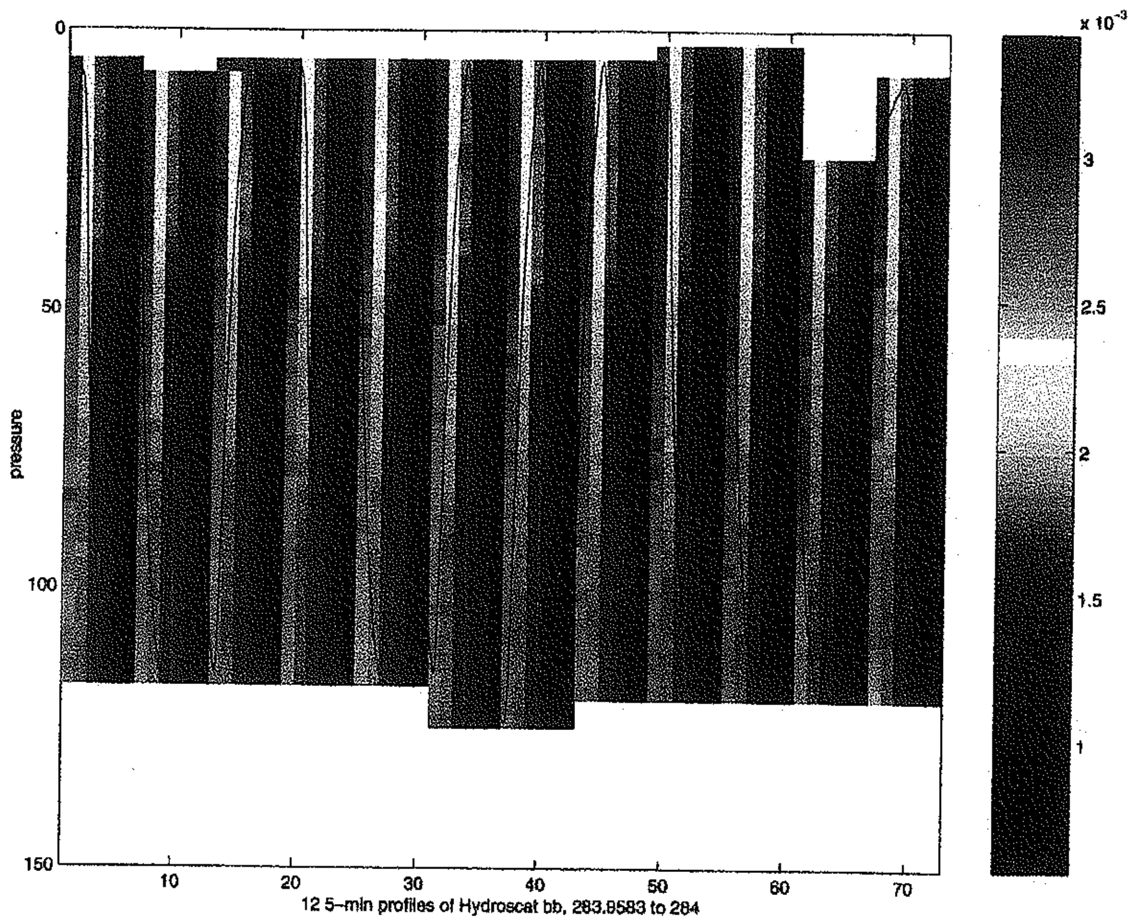


Figure 53. One hour of Hydroscat backscatter. The plot shows 12 profiles, each derived from a 5-minute time average. Each profile shows backscatter as a function of depth (vertically) and wavelength (horizontally). SeaSoaar's dive path is superimposed as a solid blue line.

Cruise Personnel

Scientific Party

Mooring Component - Leg 1: 4-9 October 1998

James D. Irish - Chief Scientist
Jeffrey Van Keuren, optical scientist
Kent Bradshaw, acoustic releases
Jeffrey Lord, head deck work
James M. Dunn, deck work
Warren E. Witzell, seacats
James Doutt, CTDs
Dave Schroeder, CTDs
Laura Stein, SSS Tech

SeaSoar Component - Leg 2: 10-13 October 1998

James D. Irish - Chief Scientist
Craig Lee, Scientist
Kenneth Brink, Scientist
Burt Jones, Scientist
Dan Walker, Scientist
Frank Bahr, Tech.
Al Gorden, Tech.
Ellen Levy, Tech.
Craig Marquette, Tech.
Paul Fucile, Tech.
Jerry Dean, Tech.
Laura Stein, SSSG Tech.

Ship's Party

Courenay Barber, Master
Anthony Diego Mello, Mate
Emily L. Sheasley, 2nd Mate
Jeffrey M. Stolp, Boatswain
Horace M. Medeiros, AB
Patrick Pike, AB
John R. Murphy, OS
Richard Morris, Chief Engineer
John Kevin Kay, Engineer
Algerto Collasius, Engineer
Torri Corbett, Steward
Linda Martholomee, Mess Attendant

Table 3. R/V OCEANUS

Cruise No OC331 - Event Log

Event	Instrument	Cast	Station	Year	Month	Day	Hr Mn	S/E	N. Latitude		W. Longitude		Cast	Water	Water Bottle	Comments
1	SBE-911	1	S. Flank	1998	Oct	5	1219	S	40	58.226	67	18.9386	65	76	none	1 hour yoyo
							1320	E	40	58.1993	67	18.681		77		
2	Bottom Pr		S. Flank	1998	Oct	5	1328	S						76		Recovery
3	Science E		S. Flank	1998	Oct	5	1355	S	40	58.009	67	18.942		76		Recovery
4	Guard F		S. Flank	1998	Oct	5	1743	S	40	58.044	67	18.775		76		Deploy
5	Guard B		S. Flank	1998	Oct	5	1803	S	40	58.042	67	19.186		76		Recovery
6	Guard F		S. Flank	1998	Oct	5	2059	S	40	58.044	67	18.775		76		Deploy
7	Guard A		S. Flank	1998	Oct	5	2125	S	40	58.541	67	18.665		76		Recovery
8	SBE-911	2	NE-15	1998	Oct	6	1114	S	42	1.6541	65	30.1959	860	895	none	
							1145	E	42	1.9004	65	31.3127		843		
9	SBE-911	3	NE-14	1998	Oct	6	1231	S	41	59.464	65	37.7842	455	460	BB3 @ 455	
							1303	E	42	.2177	65	38.8001				
10	SBE-911	4	NE-13	1998	Oct	6	1353	S	41	57.0573	65	44.597	235	239	none	bottle didn't fire
							1414	E	41	57.4645	65	44.7011		240		
11	SBE-911	5	NE-12	1998	Oct	6	1512	S	41	54.6056	65	51.4475	131	133	BB4 @ 131	
							1521	E	41	54.5315	65	51.2043				
12	SBE-911	6	NE-11	1998	Oct	6	1618	S	41	52.1169	65	58.412	90	93	BB5 @ 90	
							1626	E	41	51.9951	65	57.9856				
13	SBE-911	7	NE-10	1998	Oct	6	1728	S	41	49.713	66	6.4625	88	92	BB6 @ 88	
							1734	E	41	49.5898	66	6.2543				
14	SBE-911	8	NE-9	1998	Oct	6	1825	S	41	47.3007	66	14.368	80	85	BB7 @ 80	
							1834	E	41	46.9543	66	14.2924				
15	SBE-911	9	NE-8	1998	Oct	6	1919	S	41	45.0668	66	21.6096	74	79	BB8 @ 74	
							1925	E	41	44.8251	66	21.5704				
16	SBE-911	10	NE-7	1998	Oct	6	2008	S	41	42.6287	66	28.7641	72	75	BB9 @ 72	
							2015	E	41	42.4356	66	28.8239				
17	SBE-911	11	NE-6	1998	Oct	6	2055	S	41	40.2539	66	36.208	63	67	BB10 @ 63	
							2101	E	41	40.2539	66	36.4137				
18	SBE-911	12	NE-5	1998	Oct	6	2138	S	41	38.1484	66	43.2316	69	71	BB11 @ 69	
							2145	E	41	38.0216	66	43.5215				
19	SBE-911	13	NE-4	1998	Oct	6	2224	S	41	35.549	66	51.0275	63	68	BB12 @ 63	
							2231	E	41	35.5494	66	51.3683				
20	SBE-911	14	NE-3	1998	Oct	6	2305	S	41	33.4196	66	58.0288	59	62	NONE @ NaN	
							2312	E	41	33.5042	66	58.3453				
21	SBE-911	15	NE-2	1998	Oct	6	2353	S	41	31.2044	67	6.1012	53	57	BB13 @ 53	

Table 3. R/V OCEANUS Cruise No OC331 - Event Log

							0	E	41	31.3766	67	6.3174				
22	SBE-911	16	NE-1	1998	Oct	7	41	S	41	28.7164	67	12.3984	51	52	BB14 @ 52	
							48	E	41	28.9678	67	12.5666		53		
23	SBE-911	17	M-10	1998	Oct	7	159	S	41	26.184	67	1.9831	62	65	BB15 @ 62	
							205	E	41	26.3315	67	2.0087		62		
24	SBE-911	18	M-11	1998	Oct	7	257	S	41	21.4309	66	57.4682	65	67	BB16 @ 64	
							304	E	41	21.4309	66	57.5897		67		
25	SBE-911	19	M-12	1998	Oct	7	358	S	41	15.5373	66	52.8044	69	71	BB17 @ 68	
							403	E	41	15.5905	66	52.8385		70		
26	SBE-911	20	M-13	1998	Oct	7	450	S	41	9.8796	66	48.0943	70	74	BB18 @ 70	
							456	E	41	9.8672	66	48.0896		74		
27	SBE-911	21	M-14	1998	Oct	7	535	S	41	4.6515	66	43.3533	73	76	BB19 @ 73	
							542	E	41	4.6311	66	43.3698		76		
28	SBE-911	22	M-15	1998	Oct	7	625	S	40	59.0244	66	37.8957	81	85	BB20 @ 81	
							631	E	40	59.0087	66	37.925		85		
29	SBE-911	23	M-16	1998	Oct	7	710	S	40	54.0954	66	33.8874	222	234	BB21 @ 222	
							726	E	40	54.0498	66	34.1327		220		
30	SBE-911	24	M-17	1998	Oct	7	807	S	40	49.08	66	28.8569	950	1660	BB22 @ 950	
							845	E	40	49.8321	66	28.6222		1660		
31	SBE-911	25	M-18	1998	Oct	7	940	S	40	44.1119	66	23.787	952	2200	BB23 @ 952	
							1014	E	40	44.5875	66	23.8561		2200		
32	Science D		S. Flank	1998	Oct	7	1812	S	40	57.992	67	18.919		76	Deploy	
33	SBE-911	26	S. Flank	1998	Oct	7	1830	S	40	57.7039	67	18.966	71	76	BB24 @ 74	1 hour yo-yo
							1932	E	40	56.8479	67	19.1008				
34	Bottom Pr		S. Flank	1998	Oct	7	20+H9	S	40	57.927	67	19.014		76	Deploy	
34	SBE-911	27	LT-15	1998	Oct	8	33	S	40	19.9878	66	59.828	960	2100	BB25 @ 960	
							116	E	40	19.8455	66	59.9089				
35	SBE-911	28	LT-14	1998	Oct	8	NaN	S	40	30.0656	67	5.1144	440	443	BB26 @ 440	
							305	E	40	30.0033	67	5.4379		428		
36	SBE-911	29	LT-13	1998	Oct	8	425	S	40	35.6948	67	7.9849	160	164	BB27 @ 160	
							NaN	E	40	NaN	67	NaN				
37	SBE-911	30	LT-12	1998	Oct	8	NaN	S	40	41.5282	67	10.4825	99	102	V1 @ 99	
							528	E	40	41.5639	67	10.5868		102		
38	SBE-911	31	LT-11	1998	Oct	8	607	S	40	46.9682	67	13.2275	92	97	V2 @ 92	
							615	E	40	46.922	67	13.3267				
39	SBE-911	32	LT-10	1998	Oct	8	642	S	40	50.5044	67	15.2222	86	91	V3 @ 86	

Table 3. R/V OCEANUS

Cruise No OC331 - Event Log

							650	E	40	50.3797	67	15.3492				
40	SBE-911	33	LT-12	1998	Oct	8	745	S	40	41.377	67	10.4789	100	103	V4 @ 100	
							752	E	40	41.2774	67	10.6212				
41	SBE-911	34	LT-9	1998	Oct	8	938	S	40	54.4888	67	17.0661	80	83	V6 @ 80	was 35 but recorded
							944	E	40	54.4448	67	17.1312				as 34
42	SBE-911	36	LT-8	1998	Oct	8	1010	S	40	58.2446	67	18.9197	73	76	none	No Bottle for sta 036
							1017	E	40	58.211	67	19.0644				
43	SBE-911	37	LT-8	1998	Oct	8	1018	S	40	58.211	67	19.0644	73	76	V7 @ 73	
							1023	E	40	58.211	67	19.0644				
44	SBE-911	38	LT-7	1998	Oct	8	1048	S	41	2.0144	67	20.8007	63	67	V8 @ 63	
							1054	E	41	1.9762	67	20.9112				
45	SBE-911	39	LT-6	1998	Oct	8	1120	S	41	6.0254	67	22.5198	58	61	V10 @ 58	Bottle V9 NOT used
							1126	E	41	6.0223	67	22.2195				
46	SBE-911	40	LT-5	1998	Oct	8	1203	S	41	9.6238	67	24.715	54	59	V11 @ 54	
							1210	E	41	9.7526	67	24.715				
47	SBE-911	41	LT-4	1998	Oct	8	NaN	S	41	NaN	67	NaN	44	47	V12 @ 44	
							1243	E	41	12.7058	67	26.8905				
48	SBE-911	42	LT-3	1998	Oct	8	1314	S	41	17.0951	67	28.5637	40	44	V13 @ 40	
							1322	E	41	17.4789	67	28.8466				
49	SBE-911	43	LT-2	1998	Oct	8	1402	S	41	24.6192	67	32.5002	41	42	V14 @ 41	
							1409	E	41	24.9218	67	32.6149		43		
50	SBE-911	44	LT-1	1998	Oct	8	1444	S	41	31.1705	67	36.0166	36	40	V15 @ 36	
							1451	E	41	31.5093	67	36.0958		35		
51	SBE-911	45	LT-1	1998	Oct	8	1457	S	41	31.7457	67	36.1266	32	35	none	No bottle at sta 045
							1505	E	41	32.1568	67	36.1577		34		
52	SBE-911	46	LT-6	1998	Oct	8	1755	S	41	5.8943	67	22.4071	58	62	V16 @ 58	
							1802	E	41	5.9291	67	22.2428				
53	SBE-911	47	LT-7	1998	Oct	8	1828	S	41	1.9203	67	20.6618	64	67	V17 @ 64	
							1834	E	41	1.9107	67	20.532				
54	SBE-911	48	LT-8	1998	Oct	8	1900	S	40	58.0796	67	18.9418	73	76	V18 @ 73	
							1907	E	40	58.0271	67	18.8234				
55	SBE-911	49	LT-9	1998	Oct	8	1931	S	40	54.4756	67	16.9681	80	83	V19 @ 80	
							1938	E	40	54.4437	67	16.8655				
56	SBE-911	50	LT-10	1998	Oct	8	2004	S	40	50.4315	67	14.9979	88	91	V20 @ 88	
							2011	E	40	50.3329	67	15.0785				
57	SBE-911	51	LT-11	1998	Oct	8	2034	S	40	46.9401	67	12.9723	92	96	V21 @ 92	

Table 3. R/V OCEANUS Cruise No OC331 - Event Log

							2044	E	40	46.88	67	13.08					
58	SBE-911	52	LT-12	1998	Oct	8	2115	S	40	41.4106	67	10.5036	100	103	V22 @ 100		
							2123	E	40	41.3972	67	10.6469					
59	SBE-911	53	LT-13	1998	Oct	8	2204	S	40	35.6789	67	8.0406	162	164	V24 @ 162		
							2215	E	40	35.6919	67	8.2201					
60	SBE-911	54	LT-14	1998	Oct	8	2254	S	40	29.9671	67	4.9335	485	495	V25 @ 485		
							2317	E	40	30.0496	67	5.0677					

Chief Scientists Log

Sunday - 4 October 1998

EDT
1001 - underway to WHOI buoy farm
1025 - fire and safety talk
    ETA buoy farm 1200
1145 - buoy D status = 1508 -> 10 to 22° C
    no F/R errors
    46 to 48 db out
    12.5-13.0 v
    Seas flat < 1' with wind ~5 kts
1208 - Guard Buoy "A" - deploy with ship moving to west
    light works OK
    rigged ready to deploy
1210 - pick up buoy
1212 - towing on wire to site
1224 - anchor drop – 41° 16.001' N x 71° 01.604' W
1237 - Guard Buoy "D" - deploy with ship moving to west
    light works OK
12:44:00 - pick buoy
12:44:57 - buoy released in water
12:46:00 - towing buoy, 0.2 nm to go - paying out chain
12:54:40 - anchor drop – 41° 16.005' N x 71° 02.005' W
    anchor landed on deck, not over stern
12:57:17 - anchor redropped with quick release
    position 41° 15.982' N x 71° 02.067' W
1307 - Guard Buoy "C" - deploy with ship moving to east
    tipped and being rigged
    light works OK - bulb on #1
1312 - ready to deploy - 0.44 nm to site
1316 - pick buoy
1317 - buoy released in water
1318 - hooking anchor to quick release
    paying out chain
1322 - to anchor, towing on backup chain grab
1323 – towing into position
1329 - anchor drop – 41° 15.701' N x 71° 02.000' N
1338 - Guard Buoy "B" rigged and ready to go
    light works OK - bulb on #1
1342 - getting ship into position - deploy to North Northeast
1343 - 0.33 nm @ 1.6 kts
    pick buoy
1349 - on anchor paying out chain
    anchor drop – 41° 15.700' N x 71° 01.602' W

1400 - moving anchors into rails for SF mooring work
1455 - crane rerigged as 3 part for buoy recovery
start runby of buoys for position check
wind ~ 6 kts, seas 1-2'
1503 - heading for buoy "C" first
Buoy "C" passing by to SW – 41° 15.68' N x 71° 02.04' W
Buoy "D" passing by to NW – 41° 15.98' N x 71° 02.05' W
Buoy "A" passing by to NE – 41° 16.03' N x 71° 01.56' W
Buoy "B" passing by to E – 41° 15.67' N x 71° 01.56' W
1520 - done with survey, buoys in deployed positions
1525 - call to Walter Paul with positions and head for southern flank site

Monday - 5 October 1998

0745 - ETA at southern flank site
three buoys are there, guard A (NE) out of position to NE
Guard B ~40° 58.042' N x 67° 19.196' W
Science E ~40° 58.009' N x 67° 18.942' W
Guard A ~40° 58.541' N x 67° 18.665' W
current flowing to NNE
0800 - start 1 hour yo-yo CTD series
wind 11 kts with some whitecaps
Bottom pressure instrument release #17308 - deployed Oct '97, turned around April '98
CTD shows vertical structure in water column yet not mixed this year at this time, mixed down to ~30 m, two steps seen at bottom
ship drifting to North 0.6 to 0.9 kts
0920 - moving back to buoy for bottom pressure release
0926 - hydrophone in, sending enable command, range 492 m
range indicates bottom pressure out of position
0928 - command release, range 536 m
0930 - sited on surface in line with guard B, north of science buoy
damaged in some way as some balls hanging off to one side
0945 - picked up bottom pressure instrument on deck - leg missing, balls tied on rods saved instrument. No balls were missing, bottom pressure sensor and release looks good, although release covered with barnacles as is well as flotation spheres. Pressure port OK and removed
0953 - hydrophone in for science buoy, release #15050,
enable release, range 309 m
0955 - release command, acknowledged, OK.
subsurface float seen at surface
Science Buoy E recovered successfully, no damaged observed
Acoustic release has slight hair and one barnacle, zincs on release nearly gone
Seacat 2006 at 72 meters
Seacat 2360 at 30 meters
Seacat 1861 at 20 meters
Biop @ 10 m heavily fouled

OBS sensor completely covered with hair
PAR has some slime, but not heavily fouled
transmissometer windows are clear
Biop @ 40 m lightly fouled
A few gooseneck barnacles on buoy base
some fish pieces on deck of buoy and bird poop on hatch
met sensors look good
ARGOS/GOES antenna damaged at connector end on recovery (ARGOS doesn't give reflected power error, so damage not too bad)
Top of bungie clean
Bottom of bungie and bridle has moderate hair growth

1045 - system apart, cable wrapped on buoy waiting to pick up and put on O1 level.
Moving down steel buoy cradle.
waiting for fire and boat drill at 11 AM
1128 - secure from fire and boat drill
1208 - moving Science Buoy E to O1 level
1225 - starting ADCP to start at 12:30 (16:30 GMT)
winding guard buoy chain on winch
1230 - ADCP started on schedule
1250 - Guard Buoy "F" into launch position
Jim Dunn checked light and OK
1309 - ready to deploy "F"
1312 - picked buoy F
1313 - buoy released in water paying out chain from winch
heading 240° into wind, wind 12 kts
1334 - transfering chain to anchor finally
ship making 2.1 kts through water for 0.7 kts over ground
1343 - anchor away – 40° 58.044' N x 40° 18.775' W
1403 - going for steel guard B
buoy aboard, but ship lost head and put sideways load on crane.
1452 - pulling on chain
1502 - anchor on board
buoy light works
buoy in good shape
unplugged light, some corrosion on + connector
1528 - buoy upright and secured at port rail
1530 - hooked up seacat 2006 to 386sx, term 1621 OK
1534 - says time is 10/05/98 - 19:33:06 - 54 seconds slow
20545 samples at 5 minute intervals
1535 - wrote #765703DC6F80
19:39:56 GMT wrote #767203DC6F81
quit logging
offload to "SF82006.HEX"
1630 - status response on both buoys same - 1252 - OK
setting up for Guard Buoy Q deploy

1636 - pick buoy
1637 - buoy off crane, paying out chain
1659 - Anchor drop 40° 57.962' N x 67° 19.097' W
range 0.23 nm at 075° to Buoy F
Setting up Seacat 1861
21:10:5? - wrote #733C03DC33A8
21:11:01 - clock says 10/05/98 - 21:10:33 so 34 seconds slow
21:11:5? - sample interval 60 seconds
21:13:5? - wrote #733D03DC33AB
1725 - start pickup Buoy "A"
1747 - Anchor on board
22:31:47 - wrote #73Bc03DC33F9
quit logging
upload to "SF81861.HEX"
SeaCat 2360

Tuesday - 6 October 1998

06:34:00 GMT - wrote #6B9C03DC5D3
06:35:01 GMT - wrote
quit logging
06:36:00 GMT clock reads 10/06/98 - 06:35:20 - 40 seconds slow
took about 6 hours to dump 1.4 MB
0800 - wind 15-20 kts, seas 4-5'
0715 – CTD02 at NE15
Seagauge #49
0830 – CTD03 at NE14
1000 – CTD04 at NE13
13:58:00 GMT - clock says 10/06/98 - 13:55:18 - 2 min 42 sec slow!
within 10 s of hour wrote sample
14:15:04 GMT - power on
14:15:07 GMT - wrote sample - 10/06/98 - 14:12:22
1115 – CTD05 at NE12
1215 – CTD06 at NE11
1330 – CTD07 at NE10
10:16 - upload data to "SFBPTC8.HEX"
at term 82 instrument is on bottom
at term 17256 instrument is on bottom
record starts at 09/04/98 - 19:30 => yd=99.8125
mean pressure (0.6895 * - 10.0) = 76.84 dbars
Seacat 2006 @ 72 m - sample interval = 5 minutes
first good term at 1096
last good term at 28478,
starts 28/06/98 - 16:50 => yd=179.7014
1430 – CTD08 at NE09
1520 - CTD09 at NE08

1610 – CTD10 at NE07
1700 – CTD11 at NE06
1740 – CTD12 at NE05
1825 – CTD13 at NE04
1905 – CTD14 at NE03
23:30 UTC status
vmain = 11.2 v
tide @ 15 minutes
waves every 96 tides or once per day
300 wave samples/burst @ 0.5 samples/sec
recorded 17356 tide samples
180 wave bursts
0028 UTC - change batteries in Seagauge
new 1.6v cells - system says 13.7 v - ok
set clock 10/07/98 - 00:31:30 GMT
check @ 00:31:40 = 00:31:40.735 - OK
time is within 1 second of lab clock
initialize ram - 0 to 31 OK
Starting Seagauge
00:59:45 GMT started
got started response at 20 s after
2000 – CTD15 at NE02
2045 – CTD16 at NE01
01:45:27 UTC- power on
01:45:30 UTC- wrote but clock says 01:45:25 - OK
2200 – CTD17 at M10
2300 – CTD18 at M11

Wednesday - 7 October 1998

0000 – CTD19 at M12
0050 – CTD20 at M13
0135 – CTD21 at M14
0230 – CTD22 at M15
0310 – CTD23 at M16
0410 – CTD24 at M17
0540 – CTD25 at M18
1015 - back at southern flank station - both guard buoys there OK
Southern Flank Mooring - Buoy D
Wind Sensor - 23908
Atm. Temp/Rel. Hum. 16302
PAR UWQ-4949
Long-Wave Radiation - 28300
Short-Wave Radiation - 28379F3
Guard Light - 5A034
Sea Surface Temperature - 31624

Sea Surface Conductivity - 41340
Workhorse ADCP - 130
Workhorse Battery - 12
Temperature @ 5 m - 31628
Conductivity @ 5 m - 41342
Bio-Optical Package at 10 m
    Electronics #4
    PAR - SPQA-1659
    Transmissometer - 628
    Fluorometer -
    Temperature - 478
    Conductivity - 56
Seacat at 20 m - 1736
Seadat at 30 m - 1820
Bio-Optical Package at 40 m
    Electronics #5
    PAR - SPQA 1660
    Transmissometer - 626
    Flrorometer -
    Temperature - 493
    Conductivity - 56
Temperature @ 50 - 32173
Conductivity @ 50 - 41343
Microcat @ 72 m - 716
Acoustic Release 15050
Anchor weights 2700#

Science buoy D Launch
1345 - pick buoy
    slip 10 m bio-optical package
    sensors out a bit fast but manageable
1347 - strung out to bungies on snubber
    slip bungie over rail
    holding with slip line on bottom of sphere at rail
1412 - Anchor released - used quick release
    drop position - 40° 57.992' N x 67° 18.919' W

    radar positions of three buoys
        Guard Buoy F - 40° 57.92' N x 67° 19.11' W
        Science Buoy D - 40° 57.95' N x 67° 18.91' W
        Guard Buoy Q - 40° 58.00' N x 67° 18.77' W
1430 – Start of 1 hour yo-yo CTD26 at LT08
1518 - CTD yo-yo in progress - wind < 2 kts, Seas , 2' and glassy
1539 - starting bottom pressure deployment
    acoustiic release #17308

1604 - bottom pressure deployed
    40° 57.927' N x 67° 19.014' W
    between Guard F and Science buoy D.
    Acoustic Release Check
1614 - Bottom Pressure - #17308
    Enable all - 254 m range
    Disable B - OK
    Disable A - OK - extra pings, reduce sensitivity - OK
    no responses
1619 - Science Mooring - #15050
    Enable all - 559 m range
    Disable B - OK
    Disable A - OK
    no responses
    Run By Buoys:
        Guard Buoy F - 40° 57.880' N x 67° 19.130' W
        Science Buoy D - 40° 57.912' N x 67° 18.903' W
        Guard Buoy Q - 40° 57.972' N x 67° 18.747' W
1636 on way to LT15
    power washing tethers, bio-optical and ADCP packages
1804 - ADCP #125 still pinging
    stop experiment
    3.7 MB of data in one data file
    Dump to GLOB8C directory of notebook
2040 – CTD 27 at LT15
2300 – CTD28 at LT14

Thursday - 8 October 1998

0030 – CTD29 at LT13
0120 – CTD30 at LT12
0210 – CTD31 at LT11 – euphausid found blocking conductivity cell so T & S no good
0245 – CTD32 at LT10 – profiles look OK
0345 – CTD33 at LT12 – redo of LT12
0540 – CTD34 at LT09
0610 – CTD36 at LT08
0620 – CTD37 at LT08
0650 – CTD38 at LT07
0720 – CTD39 at LT06
0805 – CTD40 at LT05
0840 – CTD41 at LT04
0920 – CTD42 at LT03
1005 – CTD43 at LT02
1045 – CTD44 at LT01 – 3 profile yo-yo
1100 – CTD45 at LT01
1400 – CTD46 at LT06

1430 – CTD47 at LT07
1500 – CTD48 at LT08
1530 – CTD49 at LT09
1605 – CTD50 at LT10
1640 – CTD51 at LT11
1715 – CTD52 at LT12
1805 – CTD53 at LT13
2000 – CTD54 at LT14
heading for WHOI

Friday - 9 October 1998
1345 - Arrive WHOI dock
offload mooring equipment
1630 - offload complete crew gone

Saturday - 10 October 1998
0800 - Load SeaSoar Equipment
1730 - Science party aboard and ready to depart
1930 - Depart WHOI for deep water

Sunday - 11 October 1998
0815 – fire and boat drill
0900 – deploy Seasoar – appears to fly OK

Monday - 12 October 1998
Arrived at LT15 about 0930 – winds 25-3- kts, seas 8-10 ft
Unable to safely deploy/recover SeaSoar so aborted section
Headed home after lunch

Tuesday - 13 October 1998
1400 Arrive at WHOI dock