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Current Meter, CTD, and Meteorological Observations on the Northern Grand Banks (47°N, 48°W) for April-October 1986

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Canadian Data Report Of Hydrography and Ocean Sciences

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Les établissements des Sciences et levés océaniques dans les régions et à l'administration centrale ont cessé de publier leurs diverses séries de rapports en décembre 1981. Une liste complète de ces publications figure dans le volume 39, Index des publications 1982, du *Journal canadien des sciences halieutiques et aquatiques*. La série actuelle a commencé avec la publication du rapport numéro 1 en janvier 1982.

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ABSTRACT

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Data are presented from three current meter and thermistor chain moorings deployed on the northern Grand Banks near 47°N, 48°W. Approximately 174 days of data were collected from April to October 1986. In support of this mooring program, two cruises were conducted in the area: 15-28 April and 8-21 October. Batfish, CTD and Doppler current profiler data were collected on each cruise. Both cruise and mooring data are presented in this report. Meteorological data from a nearby oil rig are also presented.

RÉSUMÉ

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Des données sont présentées provenant de trois mouillages de moulinet hydrométrique et chaîne de thermistance déployés sur la partie nord des Grands Bancs près de 47°N, 48°O. Environ 174 jours de données furent recueillis d'avril à octobre 1986. À l'appui du programme de mouillage, deux croisières furent effectuées dans la région: 15-28 avril et 8-21 octobre. Des données de Batfish, conductivité-température-profondeur et profileur de courant Doppler furent recueillies durant chaque croisière. Les données de croisière et de mouillage sont présentées dans ce rapport. Des données météorologiques provenant d'une plateforme pétrolière sont aussi présentées.

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Introduction

The data presented in this report were collected as part of a study of current variability and mixed-layer dynamics on the Grand Banks. Some of the data presentation, complex demodulation for instance, reflects the research focus of this project. There were two cruises to the northern Grand Banks in 1986: the first (15-28 April) to deploy the moorings and collect CTD data on the spring conditions; the second cruise (8-21 October) was used to recover the moorings and collect data representing fall conditions. Several different types of data were collected on each cruise: Batfish, CTD and Doppler current profiles. All of the data underwent quality control in an attempt to remove bad values.

The presentation of data in this report is divided into two sections. In the first, current meter and thermistor chain data as well as some of the meteorological data collected at a nearby oil rig (see Fig. 1) are presented mostly as time series plots. In the second section, data from the two cruises are presented. With the exception of the Doppler current profiles, most of these data are temperature, salinity and density measurements.

Description of Time Series Data

The locations of the moorings deployed in this study are shown in Fi g. 1. The positions and times of the mooring instrumentation are given in Table 1. Nine Aanderaa current meters plus one Vector Averaging Current Meter (VACM) sampling every 30 minutes were deployed on the three moorings. Nearly all of the data were recovered except those from two of the Aanderaa current meters, the bottom instruments at 781 and 782. Four Aanderaa thermistor chains (one hour sampling) were also deployed, two on one mooring (781) and one on each of the other two moorings. Double legged moorings were used, all set in about 90 m of water. Only one leg of each mooring, with a subsurface float at about 30 m depth, two of the Aanderaa current meters were placed, nominally at 30 and 60 m depth. On the other leg of the mooring, connected to the first by a groundline, the surface float was placed just above the upper current meter, nominally at 20 m depth. On one of the moorings a

VACM was placed two meters above the uppermost Aanderaa current meters which had paddle wheel rotors. All of the other Aanderaa current meters used Savonius rotors. Estimated errors for the Aanderaa current meter and thermistor chain data are given in Table 2.

Some meteorological data were collected at an oil rig platform located near the mooring site (Fig. 1). These data were obtained from the Atmospheric Environment Service who performed most of the quality control on the data.

Figures 2-4 present sample time series of temperature, salinity and velocity from three different depths on mooring 783. A kinetic energy spectrum at 34 m at station 783 is shown in Fig. 5. A rotary autospectral at 24 and 64 m is presented in Fig. 6. Inner and outer spectra between these time series are presented in Fig. 7 and 8. Time series of low frequency temperature, salinity and velocity components are presented in Fig. 9-17. These time series were obtained by application of a low-pass sin x/x filter with a 32 hour cutoff. Progressive vector diagrams of the raw current meter data are shown in Fig. 18-25. Some information about the statistics of the current data are presented in Table 3. Monthly means and standard deviations are presented. The results of harmonic analysis of the current meter data are presented in Table 4. Complex demodulation was carried out on selected current meter records (Fig. 26-31). The local inertial period (16.2 hours) was used as the demodulation period. A low pass filter was then applied to yield the amplitude and phase of each component of the inertial signal which are plotted in Fig. 26-31. Time series of temperature from different depths at the three moorings, measured by thermistor chain, are presented in Fig. 32-43. Daily averaged temperatures at selected depths are plotted in Fig 44-46. More detailed plots of daily averaged temperature and temperature gradient profiles are presented in Fig. 47 and 48. Meteorological data (3-hour sampling) from a nearby oil rig (see Fig. 1) are plotted in Fig. 49 and 50. In Fig. 51, a 12.5 hour average of currents on day 285, as measured by the Doppler current profiler (ADCP) on CSS DAWSON at the CTD anchor station at 46°53'N, 48°44'W (see Fig 61-72 for CTD data).

Description of density data

Temperature and salinity data, from which density was computed, were collected with a towed depth-cycling CTD system (Batfish) and a vertically profiling CTD attached to a rosette water sampler. A Guildline digital CTD system (Model 8705) was used in both cases. Calibration of the CTD was checked by a salinity memasurement of water samples obtained using the rosette. After translation of the CTD data, spikes were removed from the data. The estimated errors in the processed CTD data are $T \pm 0.01°C$, $S \pm 0.01$ and $\sigma_t \pm 0.01$.

The Batfish tow lines conducted on the spring cruise (15-28 April 1986) are shown in Fig. 52. Not all of the data from this cruise, nor from the fall cruise, will be presented. A representative cross-shelf transect from each cruise will be plotted. Contours of temperature, salinity and σ_t are presented in Fig 53. CTD profiles from the spring cruise are shown in Fig. 54-56. The positions and times of these stations are given in Table 5.

Station positions for the fall Batfish section are shown in Fig. 57. The location of CTD stations from the fall cruise are shown in Fig. 58. Contours of temperature, salinity and σ_t for the Batfish section are shown in Fig. 59. CTD plots are presented in Fig. 60-75. The positions and times of these stations are given in Table. 6.

Table 1. Current meter and thermistor chain mooring information for 1986 deployments. Partial records are indicated by brackets. Approximate times of complete records are indicated in the last two columns.

Mooring	Position	Current Meter Depths (m)	Thermistor Chain Depths (m)	Start (hr. day)	End (hr. day)
781	46°51.54N 48° 43.06W	18, 20, 30, (60)	22,23,24, . . . 32 22,32,37,42, . . . 77	18:00 111	17:00 286
782	46°40.84N 48°37.56W	20, 30, (60)	21,26,31,. . . 77	21:30 111	21:00 286
783	46°53.62N 48°35.70W	24, 34, 64	25,30,35,40 . . . 75	16:30 112	13:00 286

Table 2. Aanderaa RCM4 current meter and Aanderaa thermistor chain specifications.

Sensor	Range	Accuracy	Resolution
RCM4 Speed	2.5 to 250 cms^{-1}	2% or 1 cms^{-1}	Threshold 2.0
RCM4 Temp.	-2.46 to 21.4°C	0.1	0.01
RCM4 Cond.	0 to 77 $k\Omega^{-1}/cm$	0.2	0.07
RCM4 Direction	1-360°	5 to 7.5	0.3
Thermistor Chain	-2.46 to 21.4°C	0.1	0.02

Table 3. Current meter statistics for 1986. Monthly means and standard deviations are given. The April and October averages are only partial. All units are cms^{-1}.

781, Month	20 m				30 m				60 m			
	$\bar{u}$	$\bar{v}$	U_{SD}	V_{SD}	$\bar{u}$	$\bar{v}$	U_{SD}	V_{SD}	$\bar{u}$	$\bar{v}$	U_{SD}	V_{SD}
April	-0.41	0.10	6.1	4.6	-0.63	0.15	6.2	5.2	-0.47	-0.47	16.5	8.6
May	-1.3	1.3	7.6	6.4	-1.7	1.4	8.0	6.9	-1.4	2.1	11.0	9.9
June	0.94	-0.56	9.4	8.2	0.0	-0.14	10.5	9.9				
July	-1.9	1.2	13.3	13.0	-3.6	1.9	10.6	10.2				
August	0.14	0.68	10.7	9.9	0.0	-0.45	9.6	9.0				
September	0.95	-1.1	12.8	10.3	0.30	-0.99	9.1	7.2				
October	0.43	-6.8	16.1	14.8	-	-	-	-				
Average	-0.22	-0.21	11.2	10.3	-1.1	0.45	9.6	8.8				
782												
April	-0.24	-1.3	7.7	6.5	-0.35	-1.4	8.5	6.4	0.51	-2.1	11.1	8.7
May	-0.46	1.4	9.3	8.3	-1.1	1.3	8.4	7.3	1.3	3.5	10.8	8.7
June	0.21	-2.2	10.4	9.5	1.0	-1.4	10.6	9.9				
July	-0.01	0.71	14.4	13.8	-1.7	2.6	11.0	10.2				
August	-0.88	0.62	12.5	11.2	-0.46	0.93	9.0	8.6				
September	-1.6	0.08	12.5	12.0	-1.8	0.54	11.6	10.5				
October	0.87	-9.4	17.1	17.6	-0.26	-8.4	17.4	17.2				
Average	-0.04	.67	15.1	14.1	-0.77	0.02	11.7	10.4				

Table 3. (Continued)

783, Month	24 m				34 m				64 m			
	$\bar{u}$	$\bar{v}$	U_{SD}	V_{SD}	$\bar{u}$	$\bar{v}$	U_{SD}	V_{SD}	$\bar{u}$	$\bar{v}$	U_{SD}	V_{SD}
April	-0.62	-0.86	5.9	5.1	-0.29	-0.98	6.2	4.8	0.58	-1.4	10.0	8.0
May	0.14	0.38	8.2	7.5	0.09	-0.17	7.1	6.4	0.58	-0.14	10.9	9.0
June	0.88	-0.67	10.5	9.9	0.19	-0.56	10.3	9.9	-1.3	-0.42	11.8	11.0
July	-1.2	0.29	13.8	13.8	-2.0	-1.1	10.6	9.9	0.28	-0.09	12.7	11.9
August	0.64	0.21	9.9	9.0	0.33	-0.20	8.4	7.6	1.4	-1.5	10.0	9.4
September	0.66	-0.48	13.1	10.9	-0.42	0.34	10.8	8.6	0.23	-0.38	12.7	11.0
October	-1.9	-0.87	15.7	15.7	-2.1	-6.3	15.1	14.6	0.27	-3.3	18.0	17.7
Average	0.03	-0.71	11.4	10.9	-0.49	-0.41	9.9	9.2	-0.89	-0.75	12.2	11.1

Table 4. Harmonic analysis of current meter records. Averages of a series of 29 day analyses are presented. Amplitude (cm s^{-1}) and phase (°) are presented for both components of velocity.

	781, 20				781, 30			
	u		v		u		v	
ZO	-0.2	-	-0.2	-	-1.1	-	0.6	-
K_1	3.2	352.	2.8	266.	3.8	0.	3.2	271.
O_1	2.6	266.	2.3	181.	2.8	269.	2.4	187.
M_2	6.7	59.	3.7	338.	7.1	62.	4.1	346.
S_2	1.7	66.	0.8	293.	2.1	81.	1.1	335.
M_4	0.3	288.	0.2	224.	0.2	263.	0.1	142.
MSF	0.1	52.	0.1	1.	0.2	52.	0.1	51.
MF	0.4	74.	0.3	157.	0.2	171.	0.2	193.
N2	2.0	37.	1.3	311.	1.8	33.	1.3	318.

Table 4. Harmonic analysis of current meter records. Averages of a series of 29 day analyses are presented. Amplitude (cm s^{-1}) and phase (°) are presented for both components of velocity.

	782, 20				782, 30			
	u		v		u		v	
ZO	0.3	-	0.2	-	-0.8	-	0.2	-
K_1	3.2	0.	2.5	274.	3.5	6.	2.9	285.
O_1	2.6	287.	2.5	206.	2.6	276.	2.5	192.
M_2	7.0	59.	4.1	332.	7.2	54.	4.4	325.
S_2	1.6	71.	1.0	317.	2.2	77.	1.4	322.
M_4	0.1	270.	0.1	123.	0.2	254.	0.3	124.
MSF	0.2	61.	0.1	12.	0.0	316.	0.0	12.1
MF	0.2	348.	0.8	148.	0.6	161.	0.2	155.
N2	1.9	32.	1.3	301.	1.6	31.	1.1	311.

Table 4. Harmonic analysis of current meter records. Averages of a series of 29 day analyses are presented. Amplitude (cm s^{-1}) and phase (°) are presented for both components of velocity.

	783, 24				783, 34			
	u		v		u		v	
ZO	-0.1	-	-0.6	-	-0.6	-	0.6	-
K_1	3.4	355.	2.8	270.	3.5	358.	3.1	275.
O_1	2.7	266.	2.4	184.	2.6	268.	2.2	183.
M_2	6.2	65.	3.7	345.	6.2	60.	3.6	340.
S_2	1.7	63.	1.2	292.	1.9	77.	1.1	316.
M_4	0.2	268.	0.1	210.	0.3	266.	0.2	195.
MSF	0.0	75.	0.2	116.	0.1	146.	0.1	163.
MF	0.1	224.	0.4	148.	0.3	219.	0.2	205.
N2	1.3	29.	0.9	305.	1.0	34.	0.5	314.

Table 4. Harmonic analysis of current meter records. Averages of a series of 29 day analyses are presented. Amplitude (cm s^{-1}) and phase (°) are presented for both components of velocity.

	783, 64			
	u		v	
ZO	0.8	-	-0.9	-
K_1	4.6	3	3.8	278.
O_1	3.4	274.	3.0	186.
M_2	7.5	65.	4.1	346.
S_2	2.5	89.	0.9	342.
M_4	0.1	312.	0.3	248.
MSF	0.1	83.	0.2	334.
MF	0.4	231.	0.3	332.
N2	1.6	34.	0.9	300.

Table 5. Positions and times (GMT) of CTD stations for spring cruise (15-28 April).

Station Number	Latitude	Longitude	Time	Date
1	46°52.3'	48°40.7'	5:24	21-4-1986
2	46°52.3'	48°40.7'	6:01	21-4-1986
3	46°52.3'	48°40.7'	6:59	21-4-1986
4	46°52.3'	48°40.6'	8:03	21-4-1986
5	46°52.4'	48°40.7'	9:01	21-4-1986
6	46°52.4'	48°40.7'	10:02	21-4-1986
7	46°52.4'	48°40.7'	11:00	21-4-1986
8	46°52.4'	48°40.7'	12:15	21-4-1986
9	46°46.1'	48°37.9'	21:38	21-4-1986
10	46°26.0'	47°16.0'	0:56	22-4-1986

Table 6. Positions and times of CTD stations for fall cruise (8-21 October).

Station Number	Latitude	Longitude	Time (GMT)	Date
2	46°53.3'	48°44.7'	23:06	11-10-1986
3	46°53.3'	48°44.7'	23:30	11-10-1986
4	46°53.3'	48°44.7'	23:59	11-10-1986
5	46°53.3'	48°44.7'	0:28	12-10-1986
6	46°53.3'	48°44.7'	0:58	12-10-1986
7	46°53.3'	48°44.7'	1:29	12-10-1986
8	46°53.3'	48°44.7'	2:00	12-10-1986
9	46°53.3'	48°44.7'	2:30	12-10-1986
10	46°53.3'	48°44.7'	3:03	12-10-1986
11	46°53.3'	48°44.7'	3:28	12-10-1986
12	46°53.3'	48°44.7'	3:57	12-10-1986
13	46°53.3'	48°44.7'	4:27	12-10-1986
14	46°53.3'	48°44.7'	4:58	12-10-1986
15	46°53.3'	48°44.7'	5:28	12-10-1986
16	46°53.3'	48°44.7'	5:58	12-10-1986
17	46°53.3'	48°44.7'	6:28	12-10-1986
18	46°53.3'	48°44.7'	6:57	12-10-1986
18	46°53.3'	48°44.7'	7:29	12-10-1986
20	46°53.3'	48°44.7'	8:00	12-10-1986
21	46°53.3'	48°44.7'	8:30	12-10-1986
22	46°53.3'	48°44.7'	9:00	12-10-1986
23	46°53.3'	48°44.7'	9:36	12-10-1986
24	46°53.3'	48°44.7'	9:59	12-10-1986
25	46°53.3'	48°44.7'	10:32	12-10-1986
26	46°53.3'	48°44.7'	11:03	12-10-1986
27	46°53.3'	48°44.7'	11:36	12-10-1986
28	46°53.3'	48°44.7'	12:07	12-10-1986

Table 6. (Continued)

Station Number	Latitude	Longitude	Time (GMT)	Date
29	46°53.3'	48°44.7'	12:33	12-10-1986
30	46°53.3'	48°44.7'	13:02	12-10-1986
31	46°53.3'	48°44.2'	13:28	12-10-1986
32	46°53.3'	48°44.2'	13:59	12-10-1986
33	46°53.3'	48°44.2'	14:30	12-10-1986
34	46°53.3'	48°44.2'	15:00	12-10-1986
35	46°53.3'	48°44.2'	15:27	12-10-1986
36	46°53.3'	48°44.2'	15:56	12-10-1986
37	46°53.3'	48°44.2'	16:26	12-10-1986
38	46°53.3'	48°44.2'	16:56	12-10-1986
39	46°53.3'	48°44.2'	17:25	12-10-1986
40	46°53.3'	48°44.2'	17:56	12-10-1986
41	46°53.3'	48°44.2'	18:25	12-10-1986
42	46°53.3'	48°44.2'	19:00	12-10-1986
43	46°53.3'	48°44.2'	19:30	12-10-1986
44	46°53.3'	48°44.2'	20:01	12-10-1986
45	46°53.3'	48°44.2'	20:31	12-10-1986
46	46°53.3'	48°44.2'	20:58	12-10-1986
47	46°53.3'	48°44.2'	21:30	12-10-1986
48	46°53.4'	48°43.7'	21:59	12-10-1986
49	46°53.4'	48°43.9'	22:30	12-10-1986
50	46°53.4'	48°43.9'	23:02	12-10-1986
51	46°53.4'	48°43.7'	23:31	12-10-1986
52	46°53.4'	48°43.7'	0:00	13-10-1986
53	46°53.2'	48°30.1'	1:25	13-10-1986
54	46°53.5'	48°15.4'	2:05	13-10-1986
55	46°53.5'	48°01.2'	4:21	13-10-1986

Table 6. (Continued)

Station Number	Latitude	Longitude	Time (GMT)	Date
56	46°40.2'	48°37.7'	20:17	13-10-1986
57	46°23.6'	47°2.0'	15:18	14-10-1986
58	46°24.9'	47°9.0'	16:43	14-10-1986
59	46°26.2'	47°15.8'	18:37	14-10-1986
60	46°27.4'	47°23.1'	19:38	14-10-1986
61	46°26.2'	47°33.2'	20:36	14-10-1986
62	46°26.0'	47°38.6'	22:18	14-10-1986

Figures

Figure 58. CTD station positions from the fall cruise. Detailed information on times and positions is given in Table 6.

Figure 59. a) Temperature, b) salinity and c) sigma-t contours for Batfish section from the fall cruise.

Figure 60. Temperature, salinity and sigma-t profiles (2-5) from fall cruise. All data are from the same location. Times (GMT) are given in the upper left corner of the temperature panel. Detailed information on these CTD is given in Table 6. CTD profiles stations 2-52 are at a fixed station.

Figure 61. Temperature, salinity and sigma-t profiles (6-9) from the fall cruise.

Figure 62. Temperature, salinity and sigma-t profiles (10-13) from the fall cruise.

Figure 63. Temperature, salinity and sigma-t profiles (14-17) from the fall cruise.

Figure 64. Temperature, salinity and sigma-t profiles (18-21) from the fall cruise.

Figure 65. Temperature, salinity and sigma-t profiles (22-25) from the fall cruise.

Figure 66. Temperature, salinity and sigma-t profiles (26-29) from the fall cruise.

Figure 67. Temperature, salinity and sigma-t profiles (30-33) from the fall cruise.

Figure 68. Temperature, salinity and sigma-t profiles (34-37) from the fall cruise.

Figure 69 Temperature, salinity and sigma-t profiles (38-41) from the fall cruise.

Figure 70. Temperature, salinity and sigma-t profiles (42-45) from the fall cruise.

Figure 71. Temperature, salinity and sigma-t profiles (46-49) from the fall cruise.

Figure 72. Temperature, salinity and sigma-t profiles (50-53) from the fall cruise. Station 52 marks the end of the anchor station. Positions of CTD casts beyond station 53 vary, and are indicated in Fig. 58.

Figure 73. Temperature, salinity and sigma-t profiles (54-57) from the fall cruise. See Fig. 58 for station positions.

Figure 74. Temperature, salinity and sigma-t profiles (58-61) from the fall cruise. See Fig. 58 for station positons.

Figure 75. Temperature, salinity and sigma-t profiles (62) from the fall cruise. See Fig. 58 for the station positions.

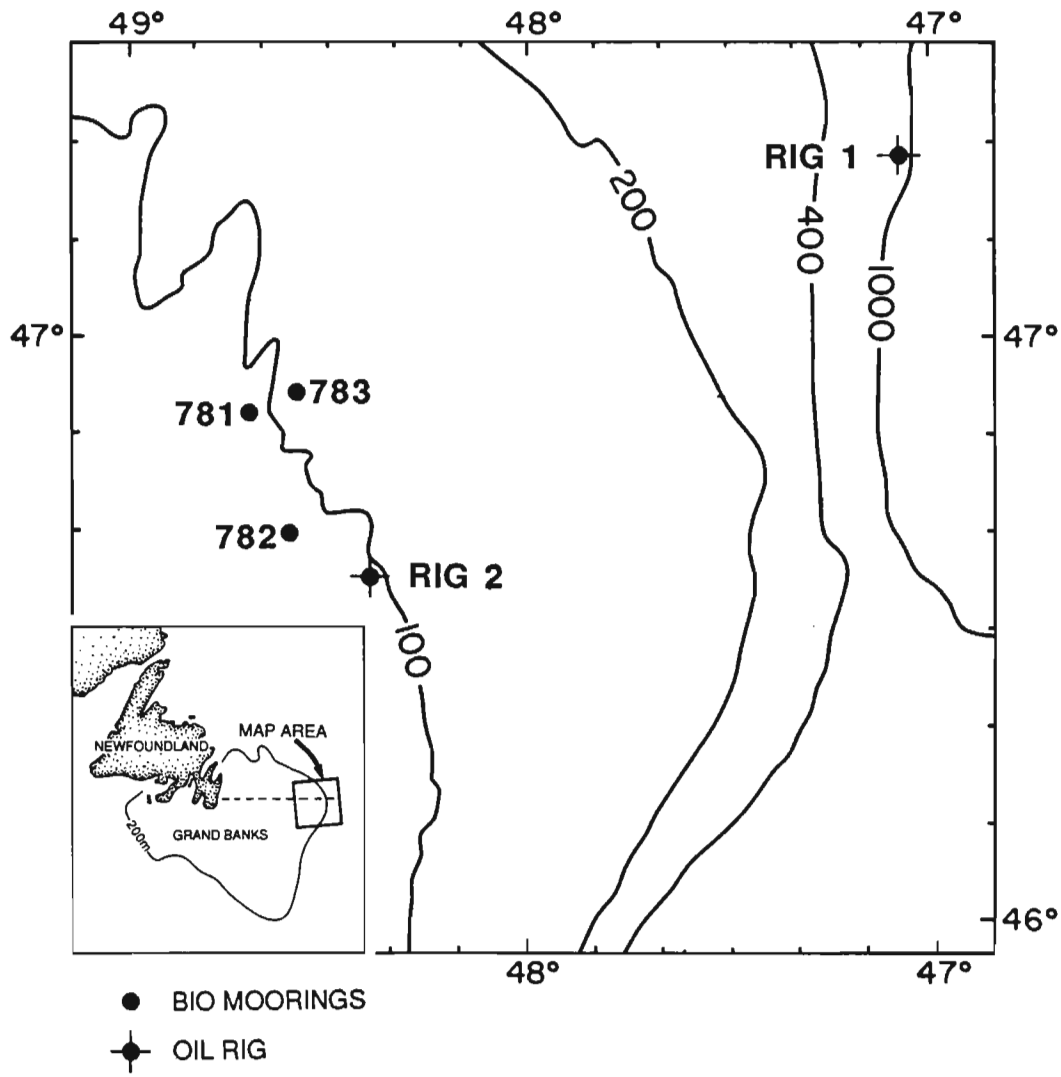

Figure 1. Area map showing the location of the three current meter moorings, 781, 782 and 783. The position of the rig, from which meteorological data were obtained, occupied two positions in 1986: Rig 1 (110-130) and Rig 2 (131 - 290).

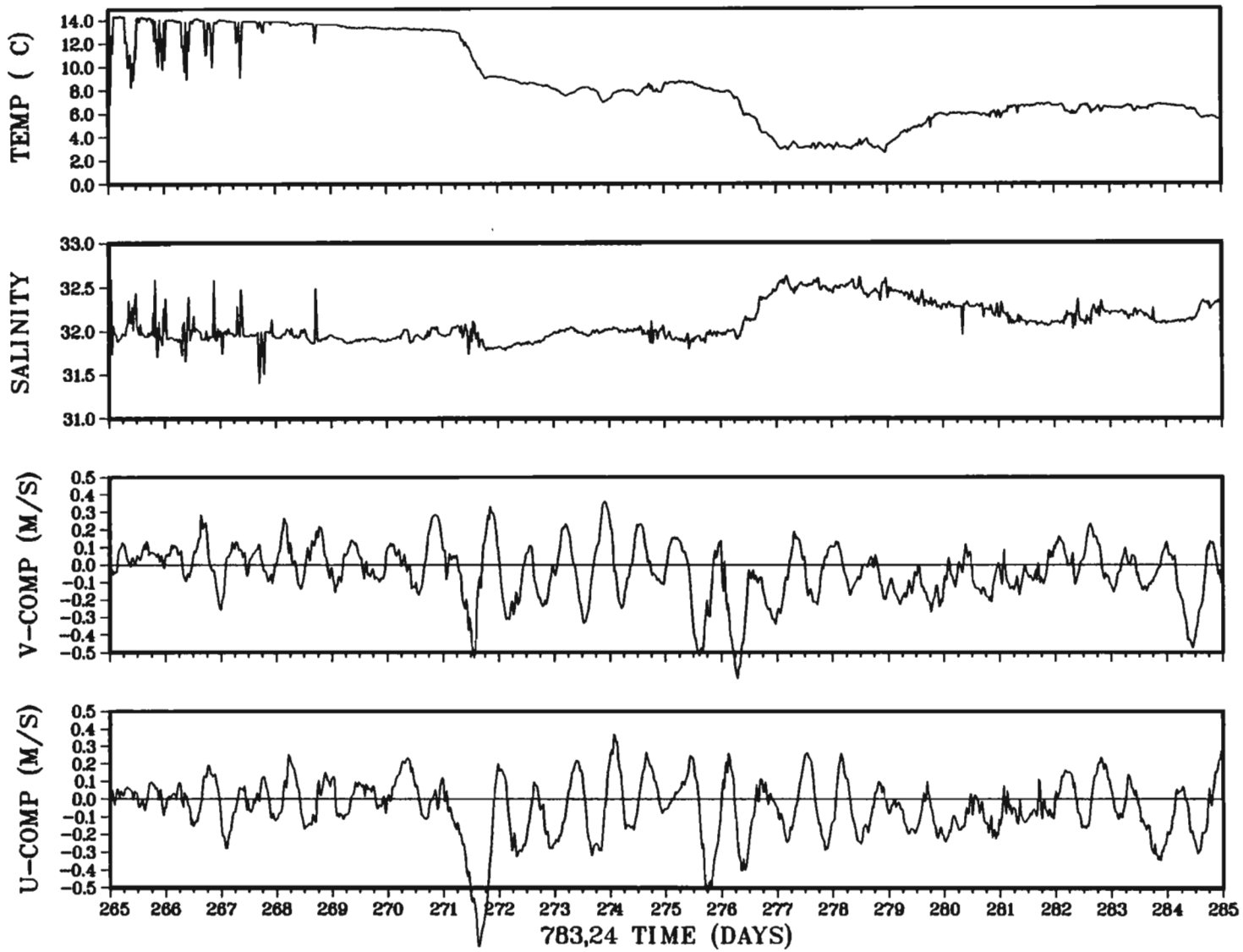

Figure 2. Sample time series of current components, salinity and temperature at 24 m at site 783. The sampling period is 0.5 hours.

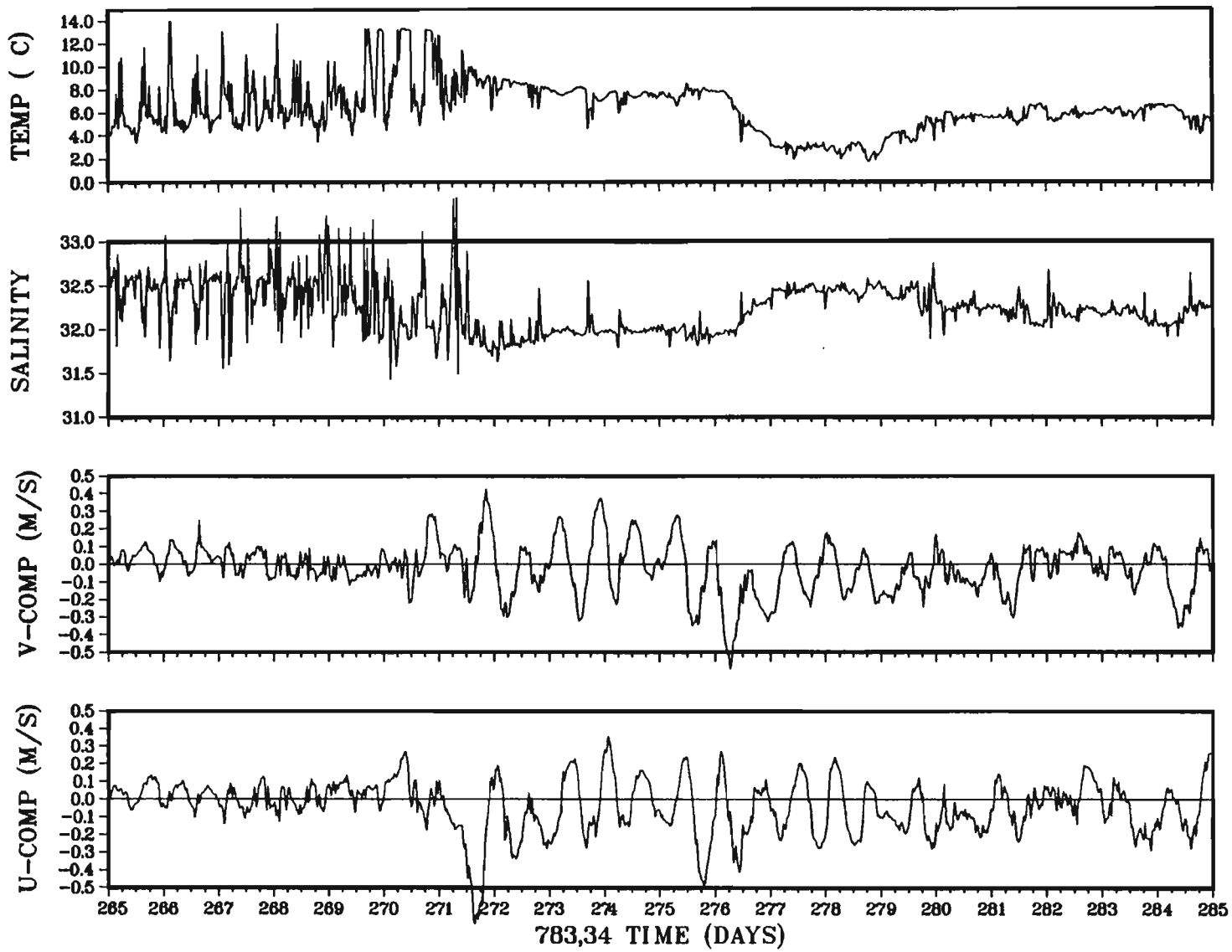

Figure 3. Sample time series of current components, salinity and temperature at 34 m at site

783 The sampling period is 0 5 hours

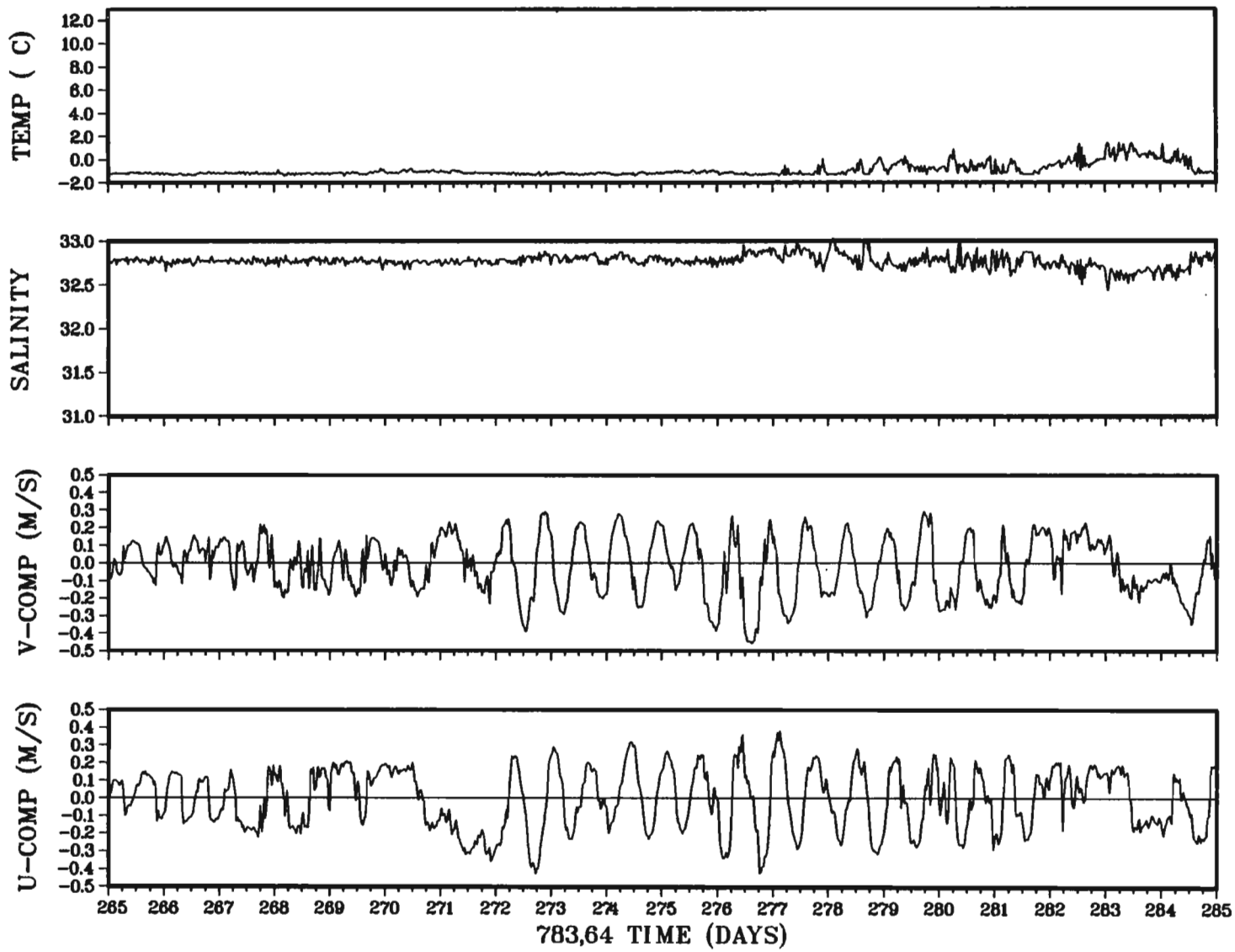

Figure 4. Sample time series of current components, salinity and temperature at 64 m at site 783. The sampling period is 0.5 hours.

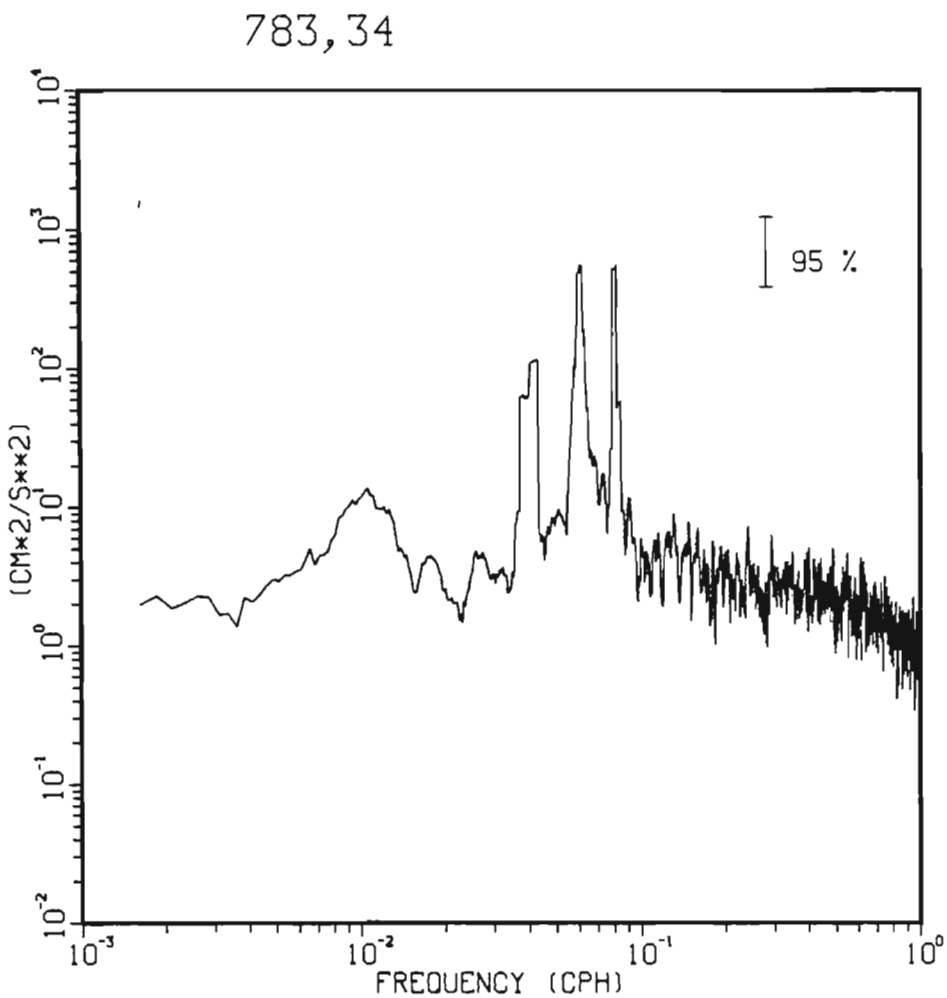

Figure. 5. Kinetic energy autospectra from the entire current time series at 34 m at site 783.

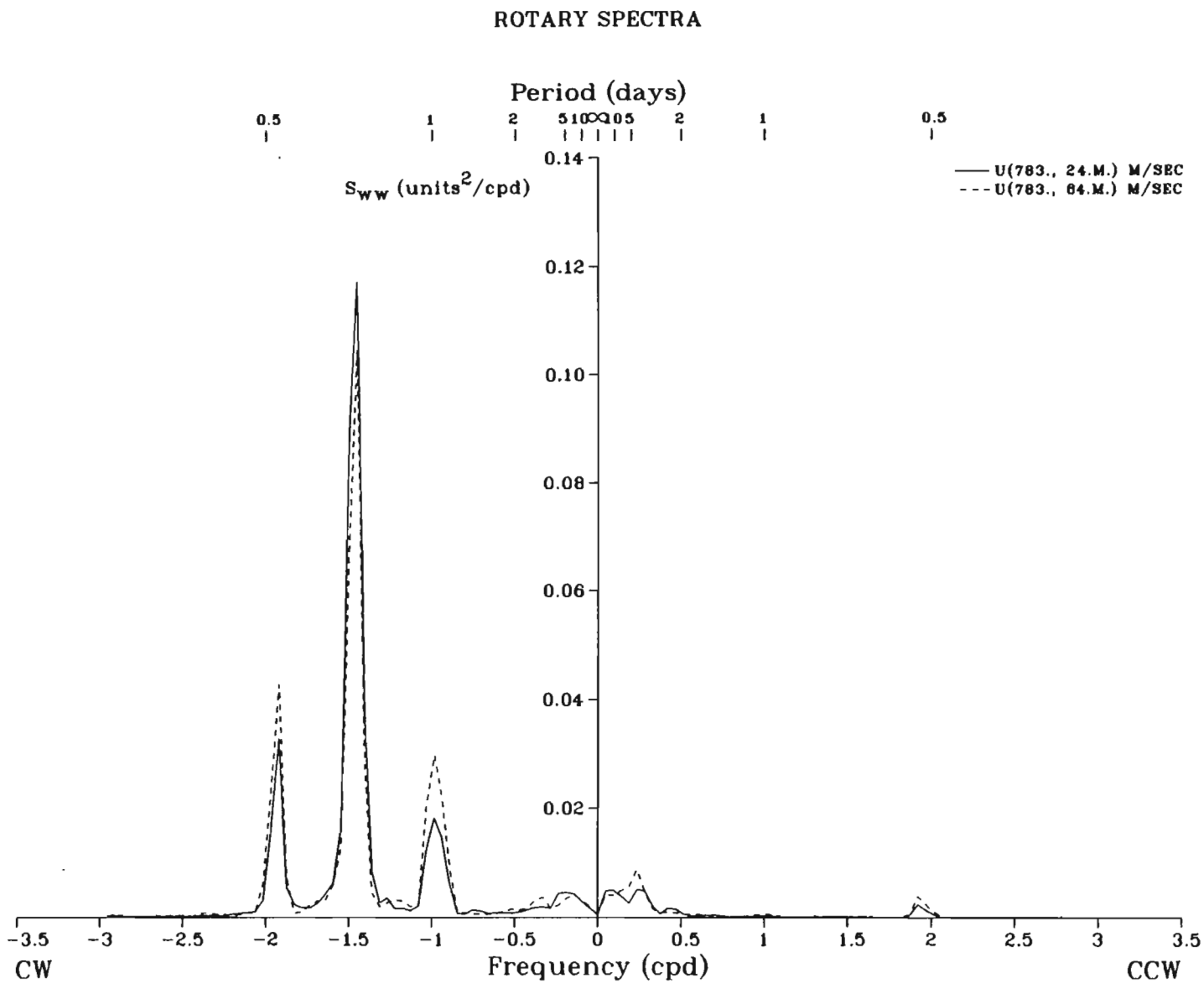

Figure 6. Rotary autospectra at 24 m (solid line) and 64 m (dashed line) at site 783.

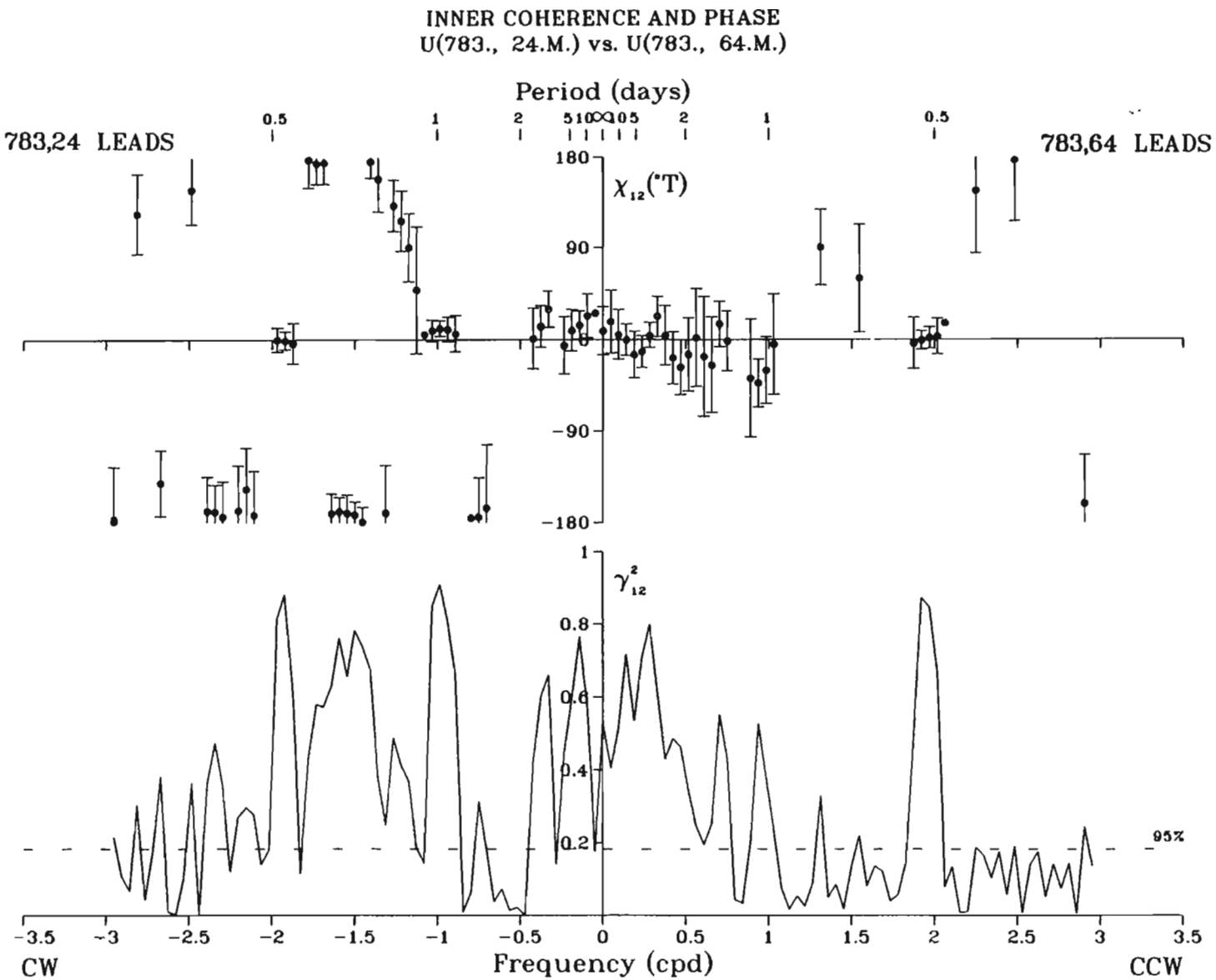

Figure 7. Inner coherence and phase between 783, 24 (series 1) and 783, 64 (series 2) for most of the record.

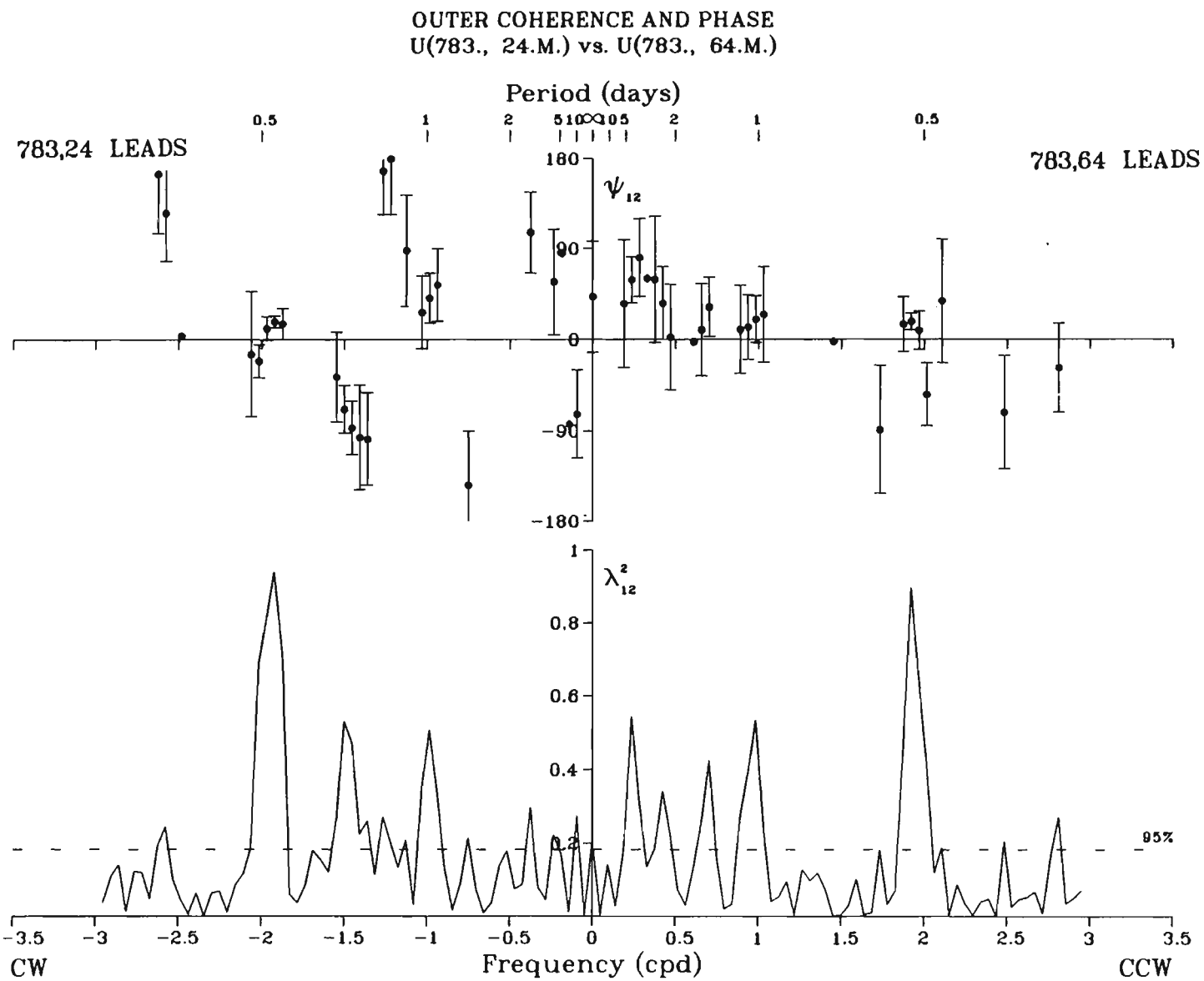

Figure 8. Outer coherence and phase between 783, 24 (series 1) and 783, 64 (series 2) for most of the record.

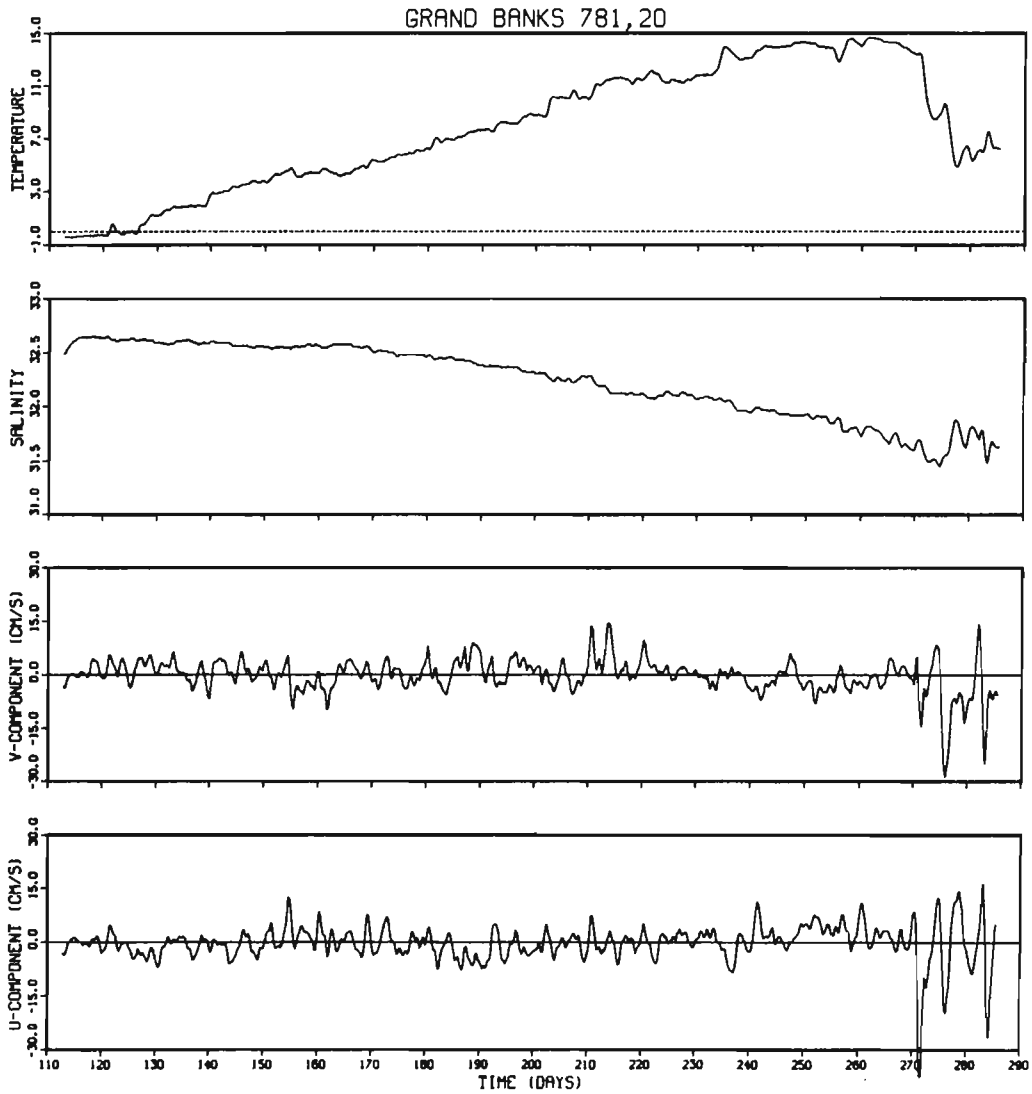

Figure 9. Low pass filtered current, salinity and temperature at 781, 20. More than 98% of the energy below 31 hours has been removed.

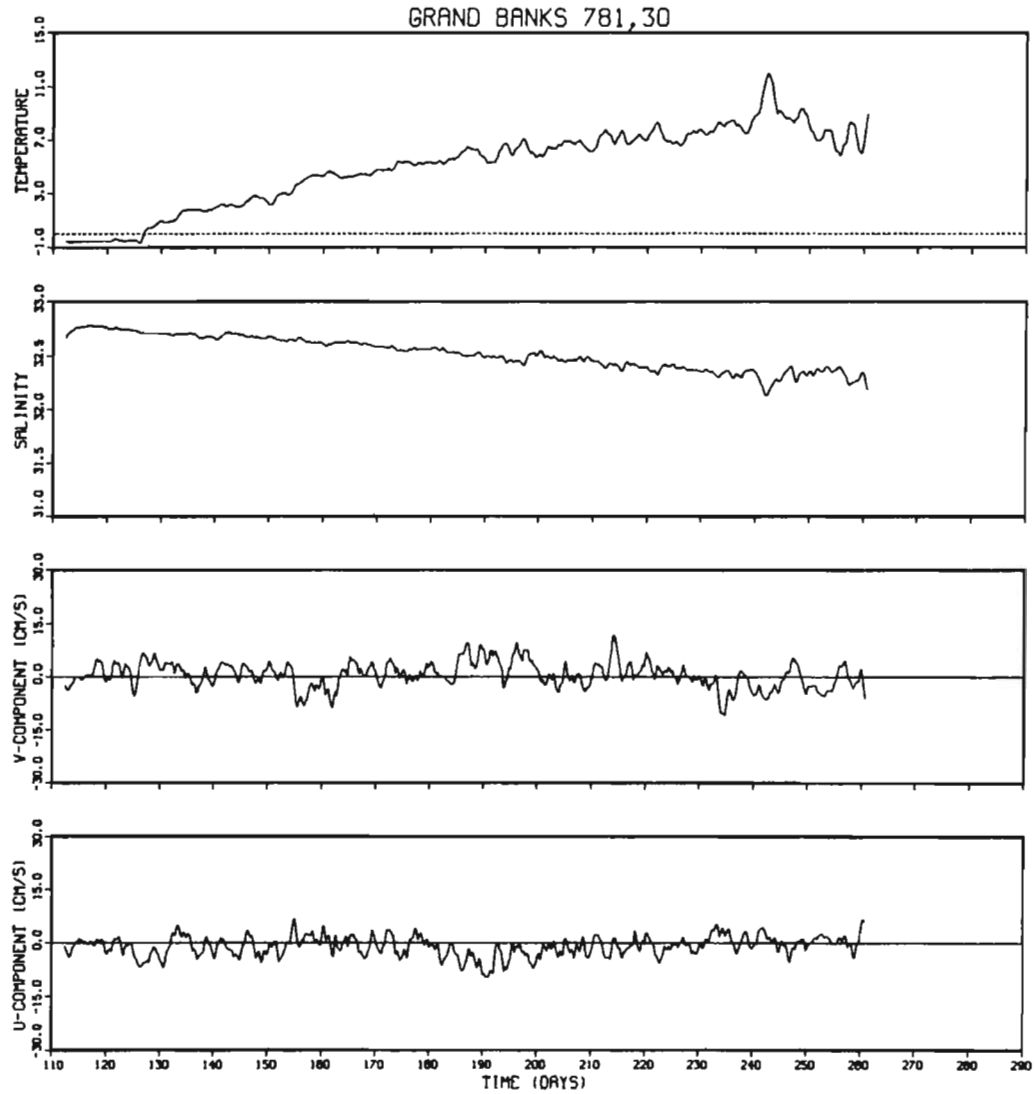

Figure 10. Low pass filtered current, salinity and temperature at 781, 30.

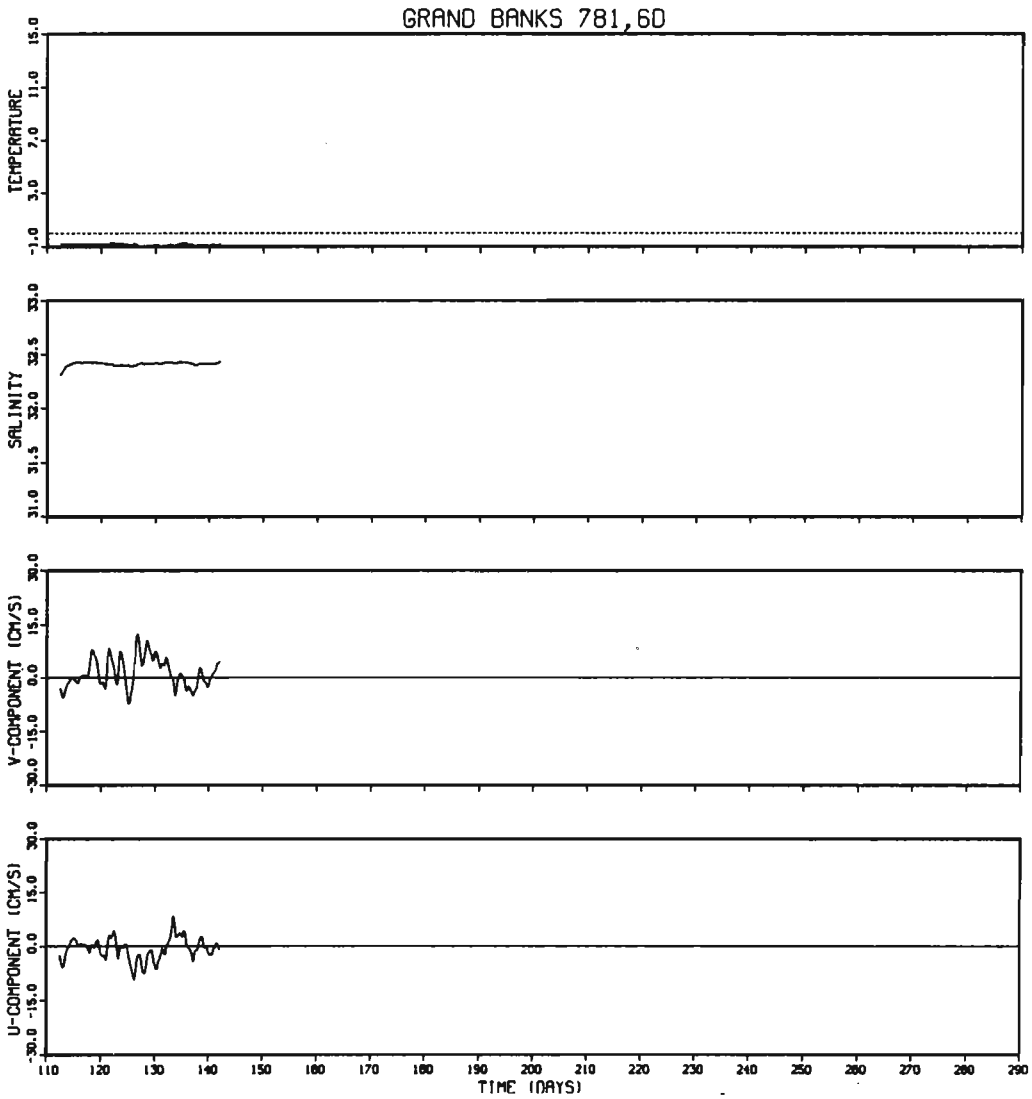

Figure 11. Low pass filtered current, salinity and temperature at 781, 60.

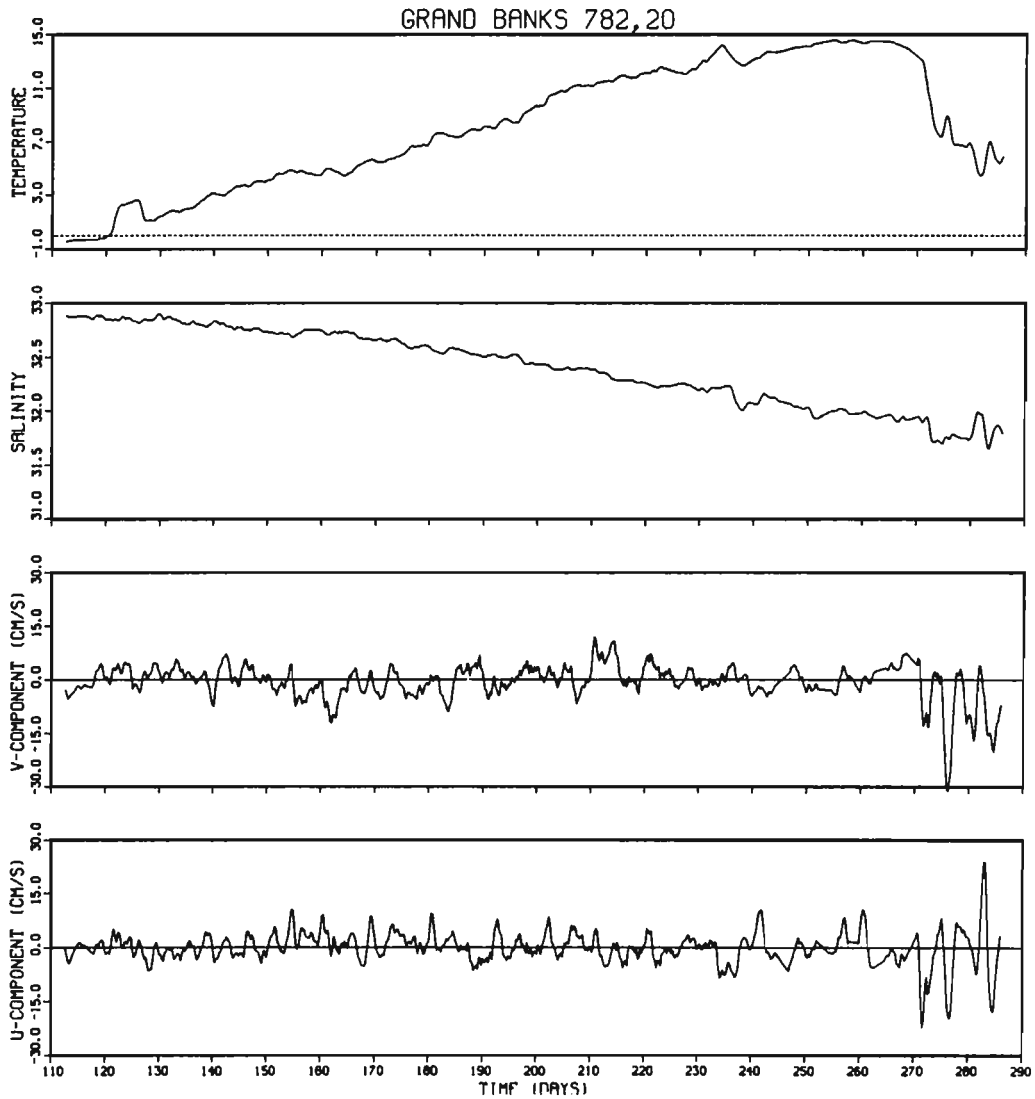

Figure 12. Low pass filtered current, salinity and temperature at 782, 20.

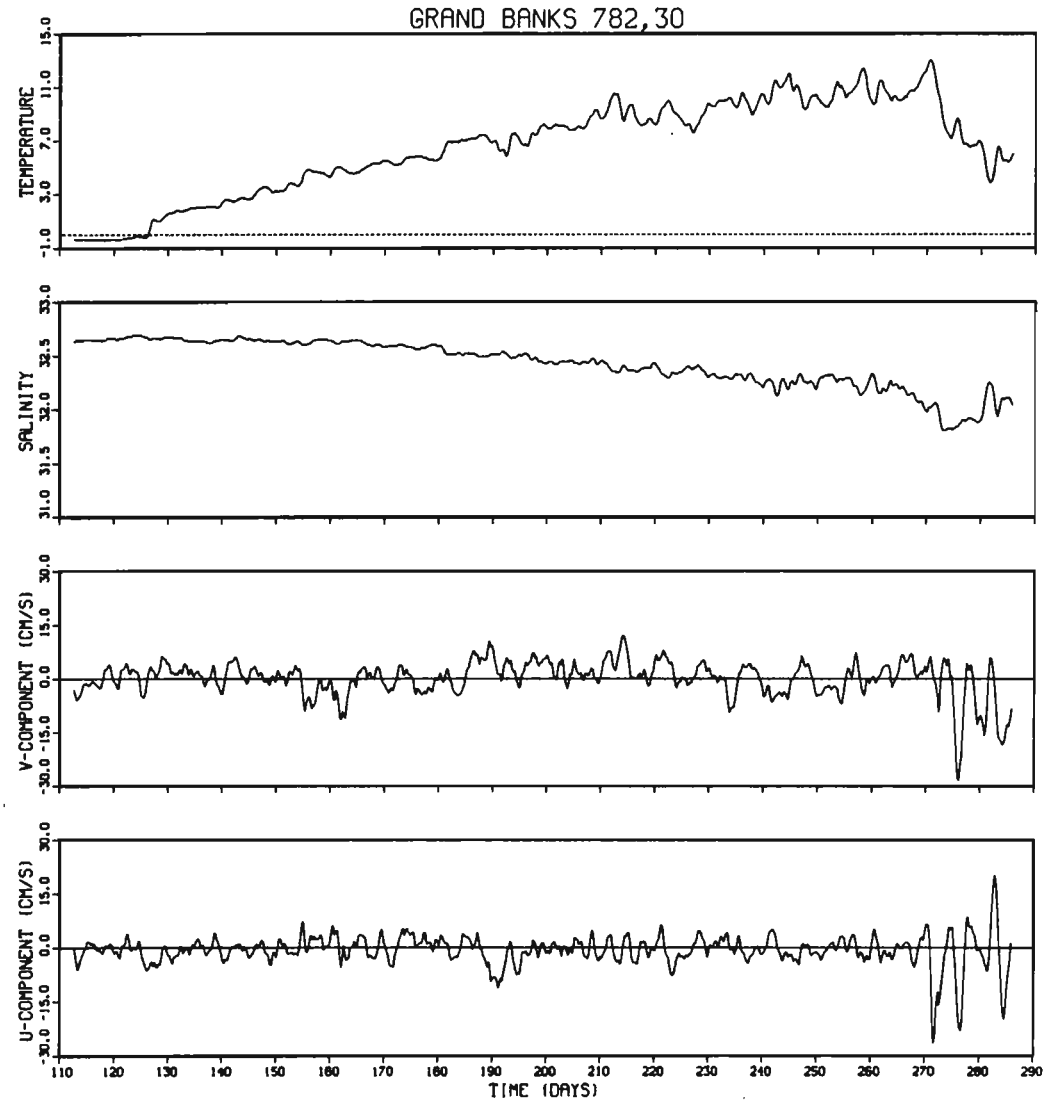

Figure 13. Low pass filtered current, salinity and temperature at 782, 30.

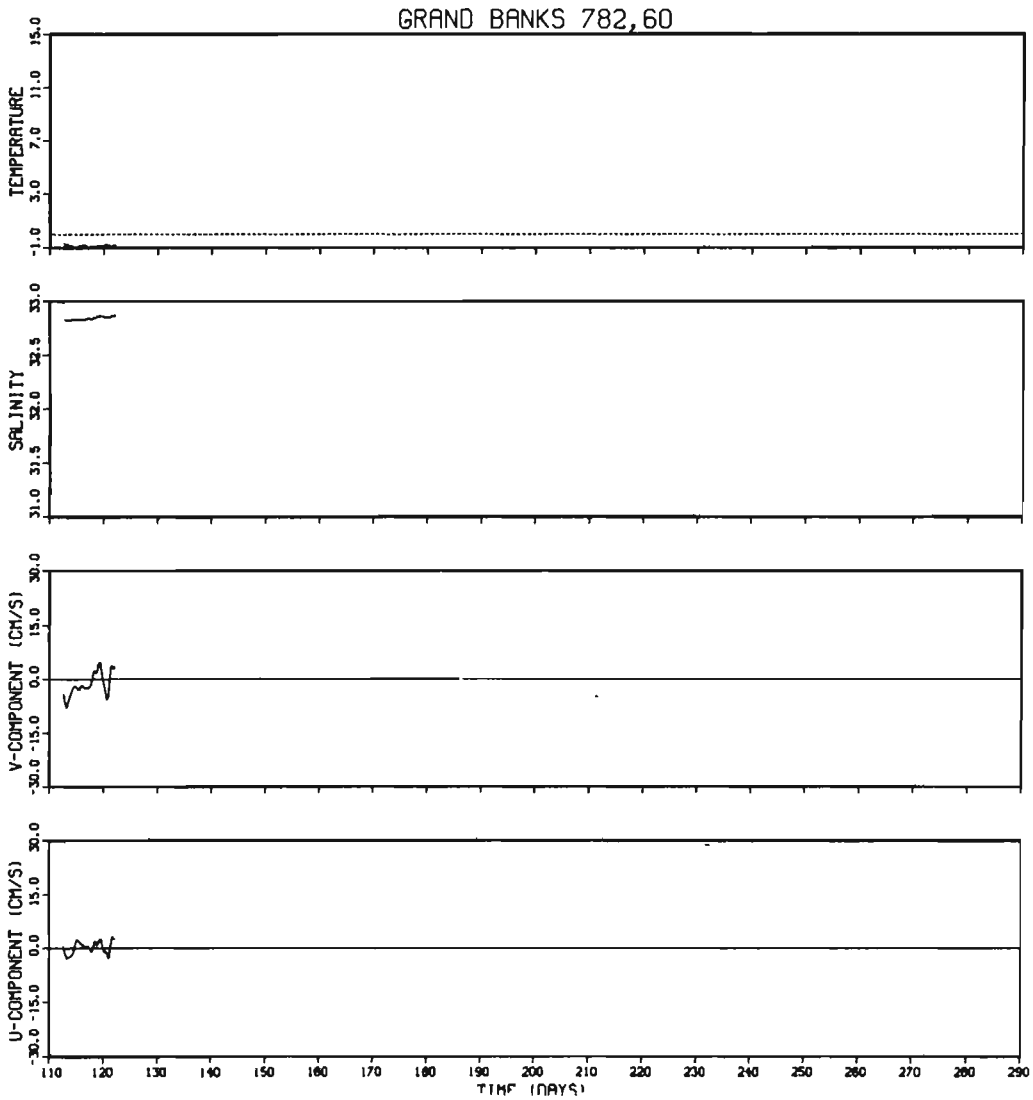

Figure 14. Low pass filtered current, salinity and temperature at 782, 60.

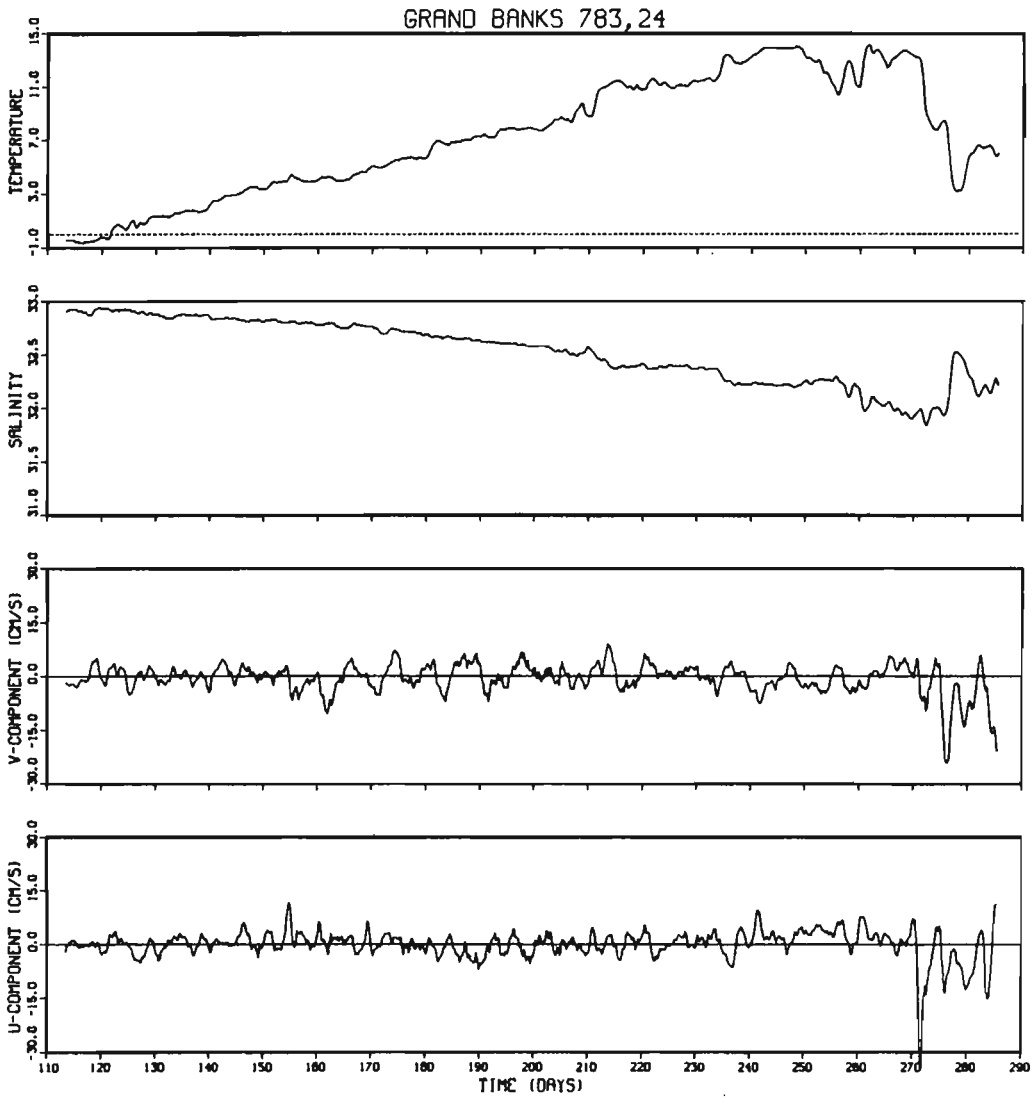

Figure 15. Low pass filtered current, salinity and temperature at 783, 24.

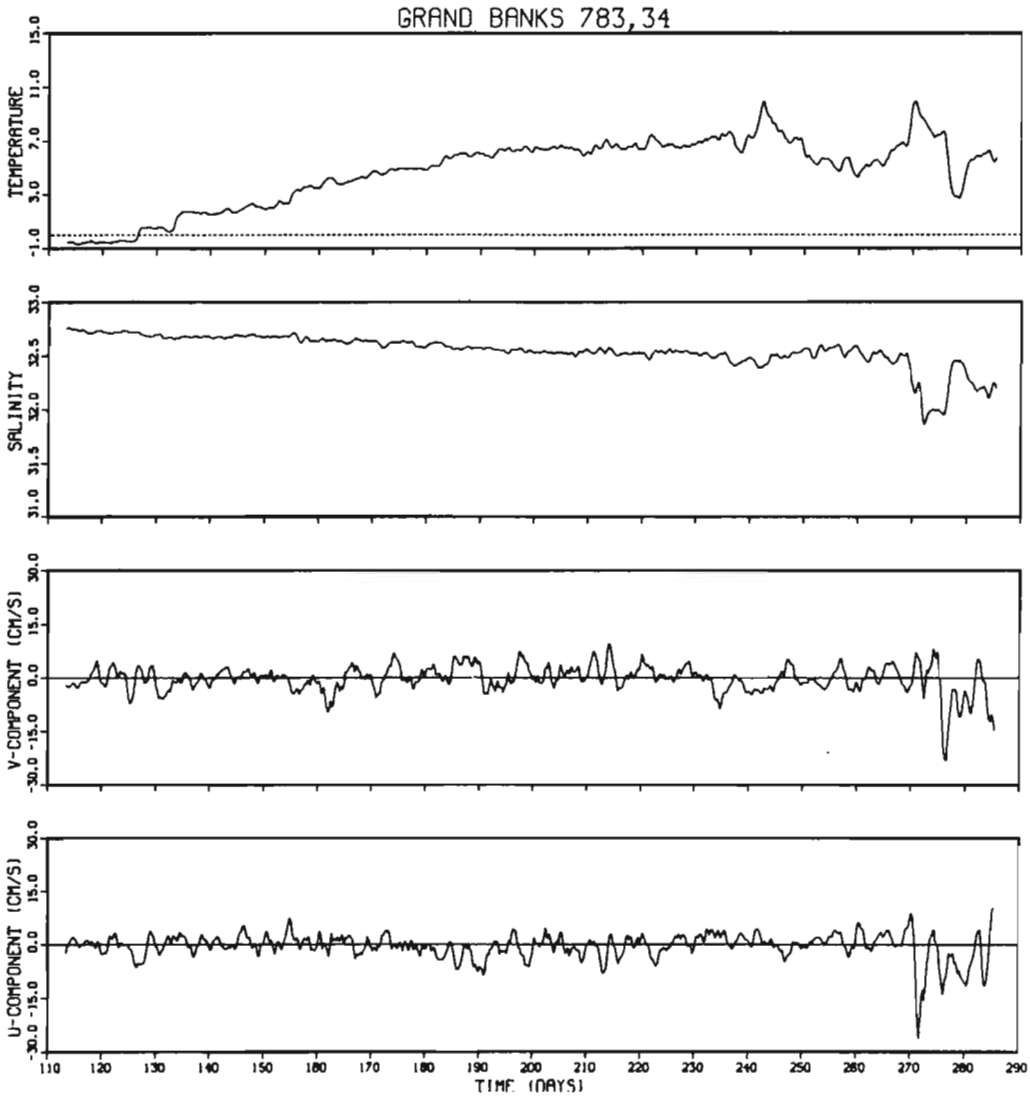

Figure 16. Low pass filtered current, salinity and temperature at 783, 34.

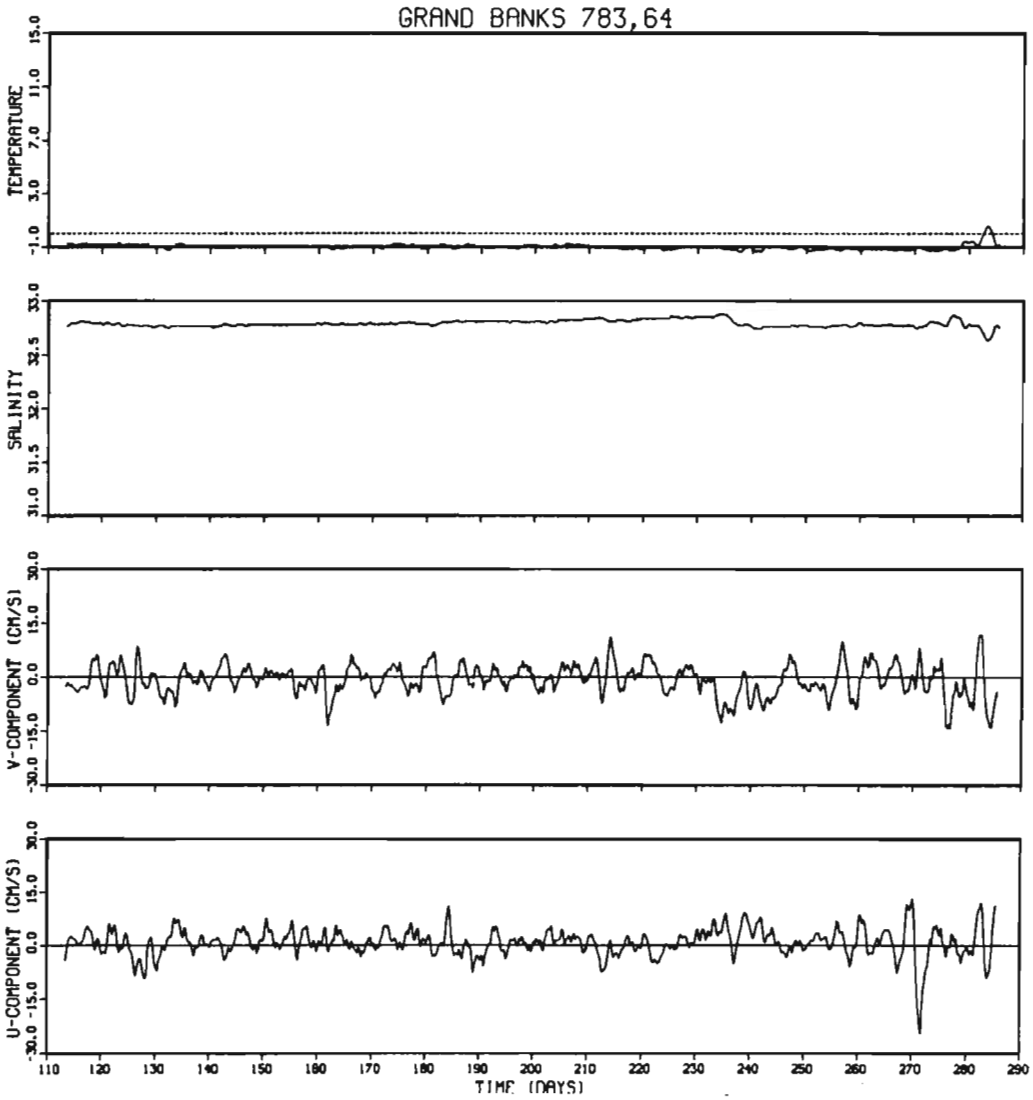

Figure 17. Low pass filtered current, salinity and temperature at 783, 64.

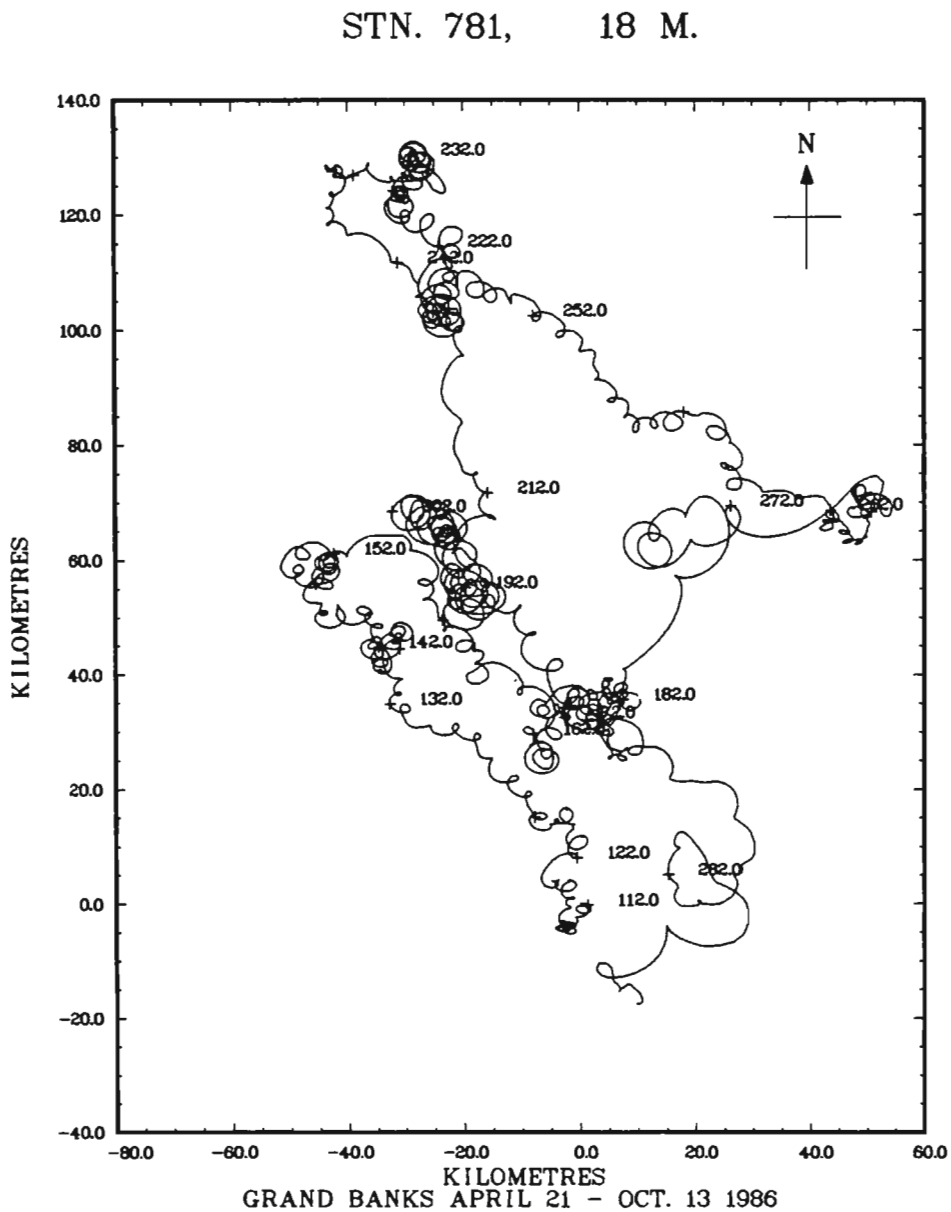

Figure 18. Progressive vector diagram at 18 m at station 781. The instrument used was a Vector Averaging Meter (VACM).

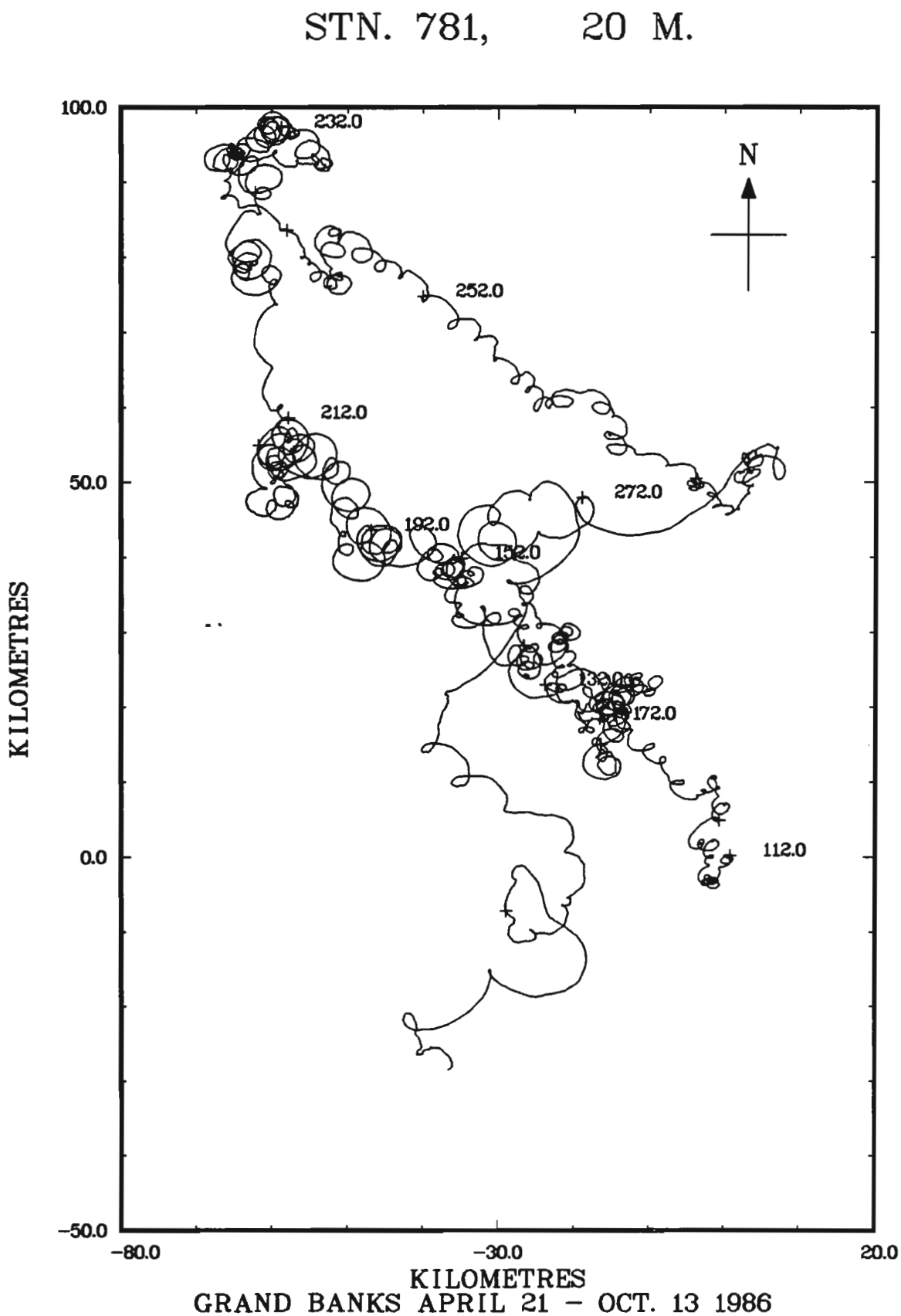

Figure 19. Progressive vector diagram at 781, 20.

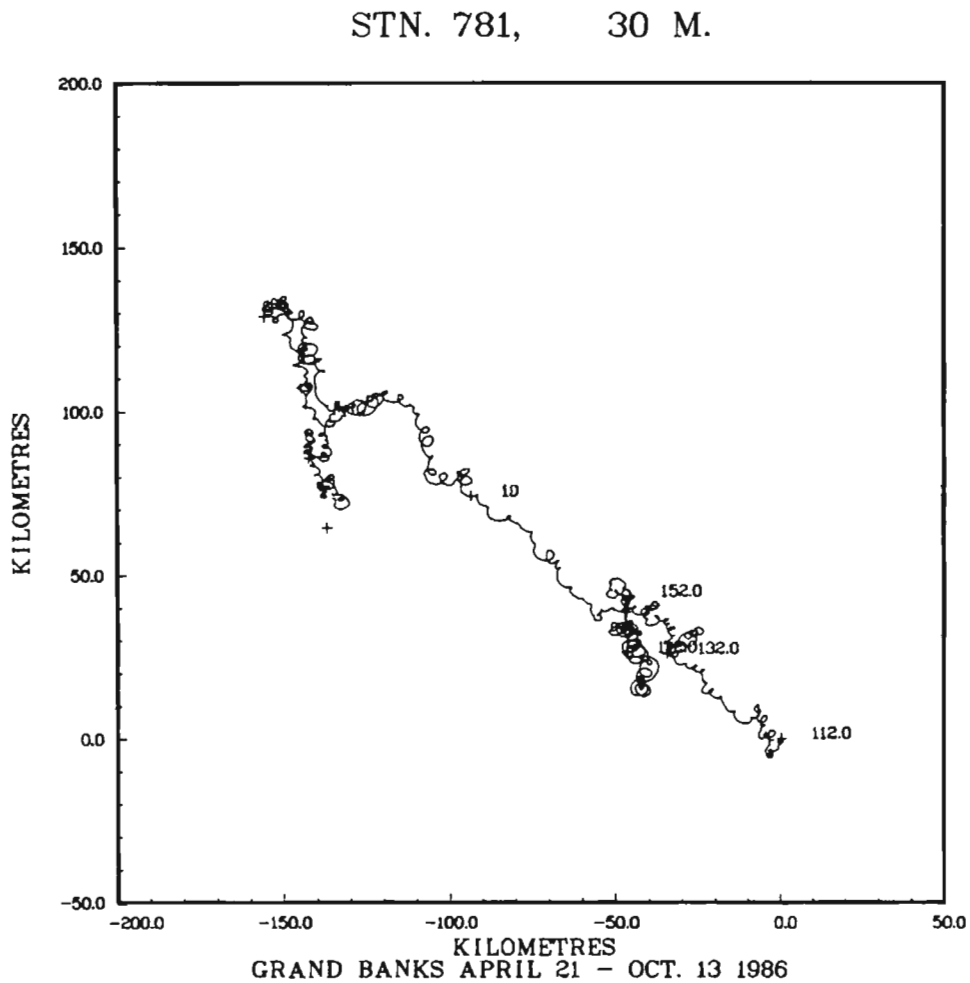

Figure 20. Progressive vector diagram at 781, 30.

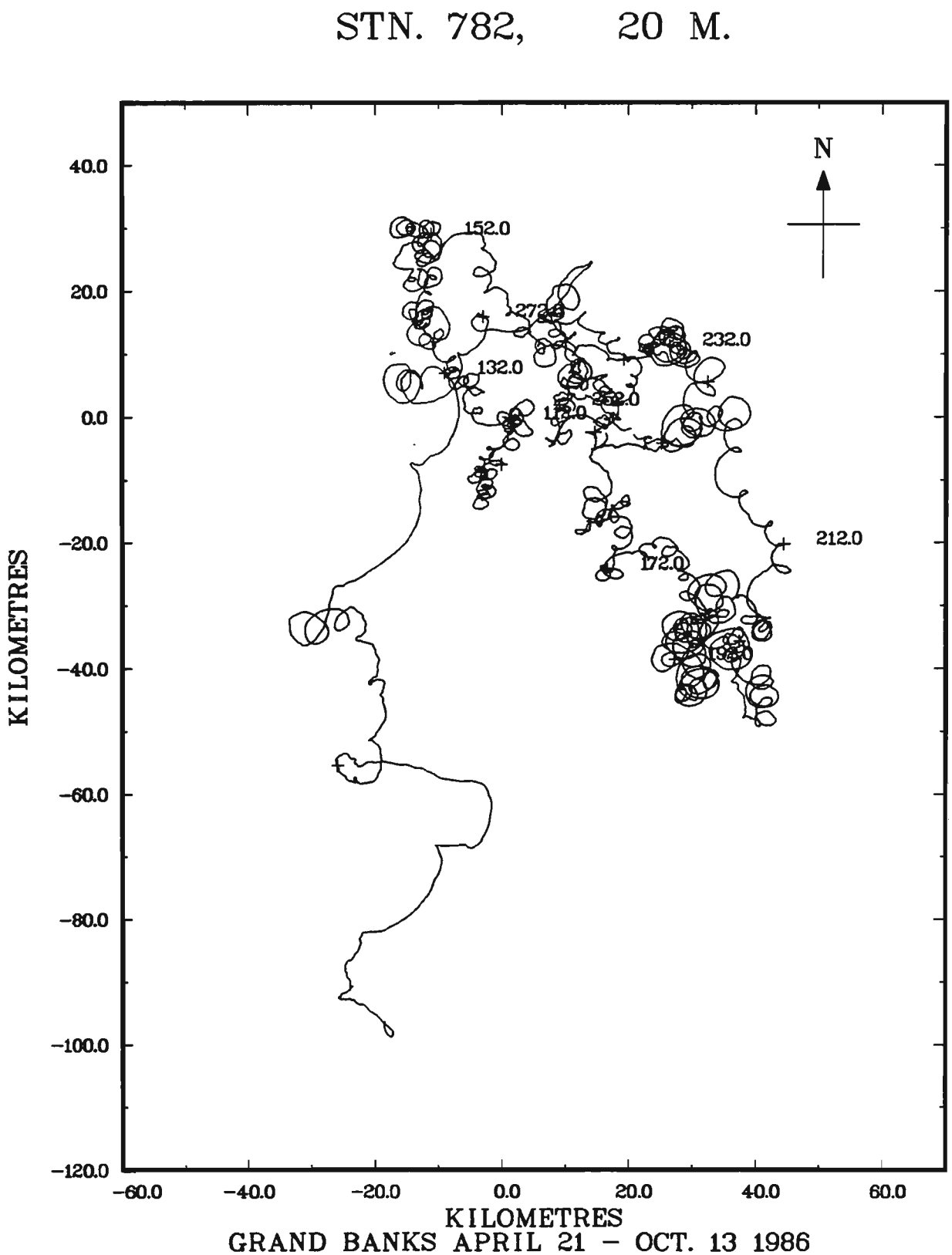

Figure 21. Progressive vector diagram at 782, 20.

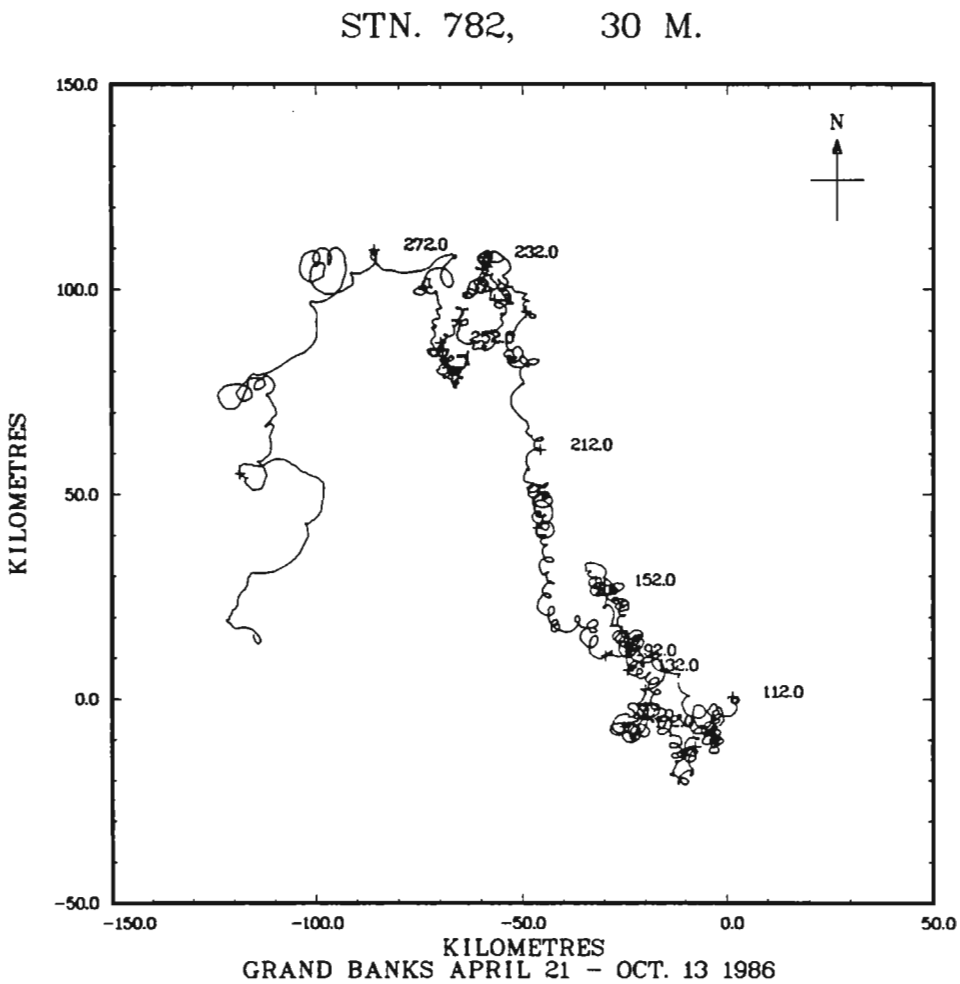

Figure 22. Progressive vector diagram at 782, 30.

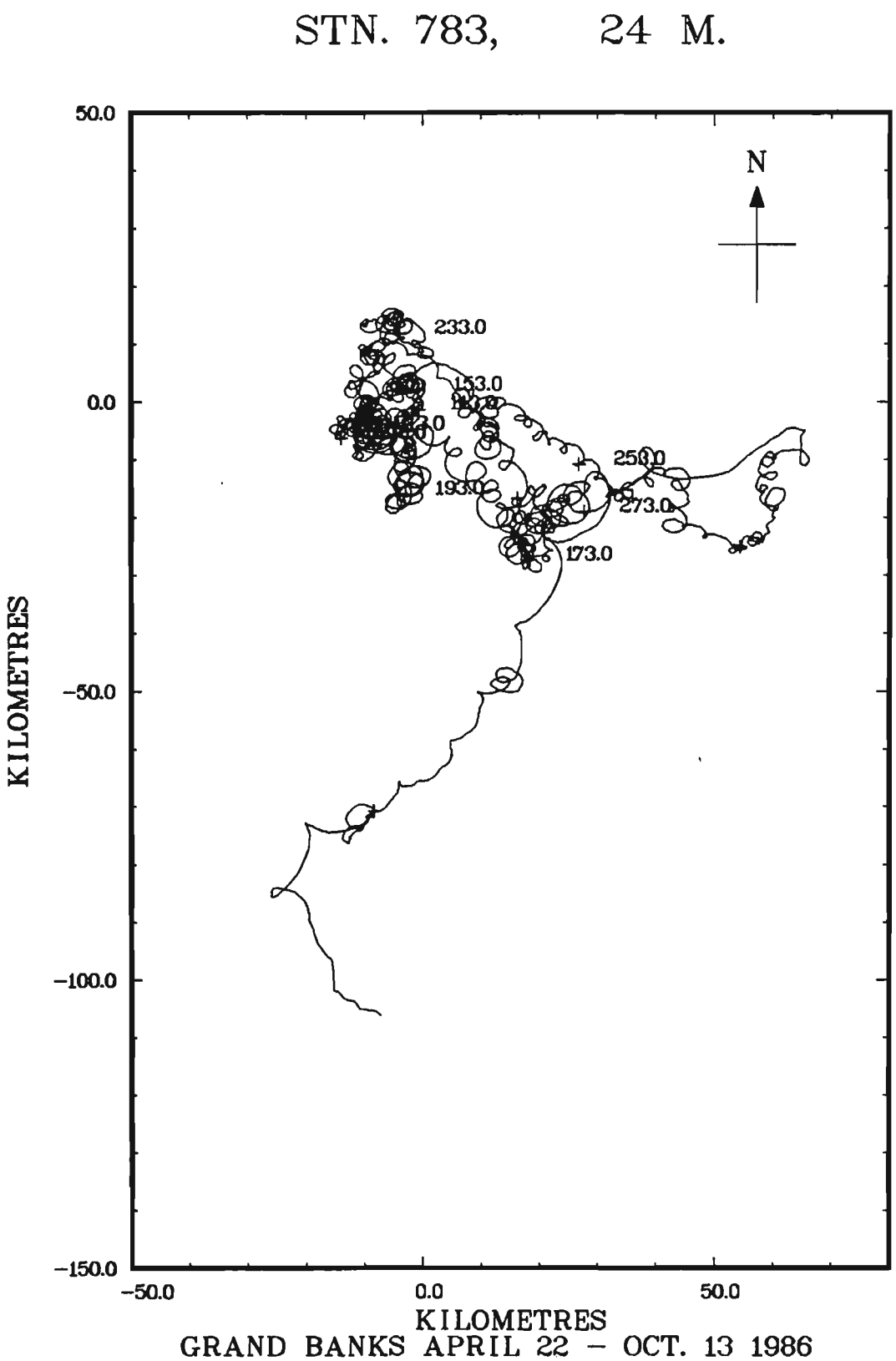

Figure 23. Progressive vector diagram at 783, 24.

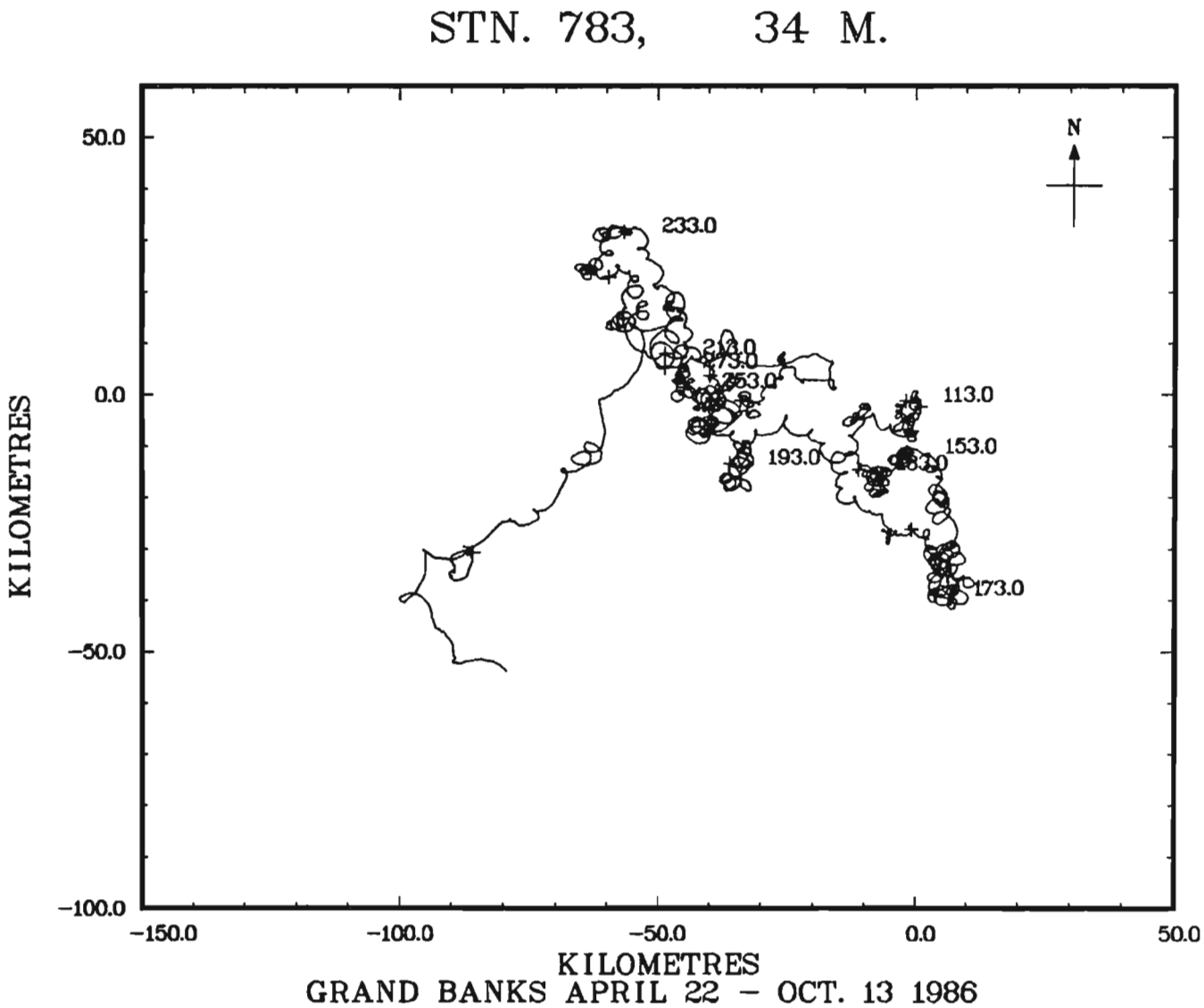

Figure 24. Progressive vector diagram at 783, 34.

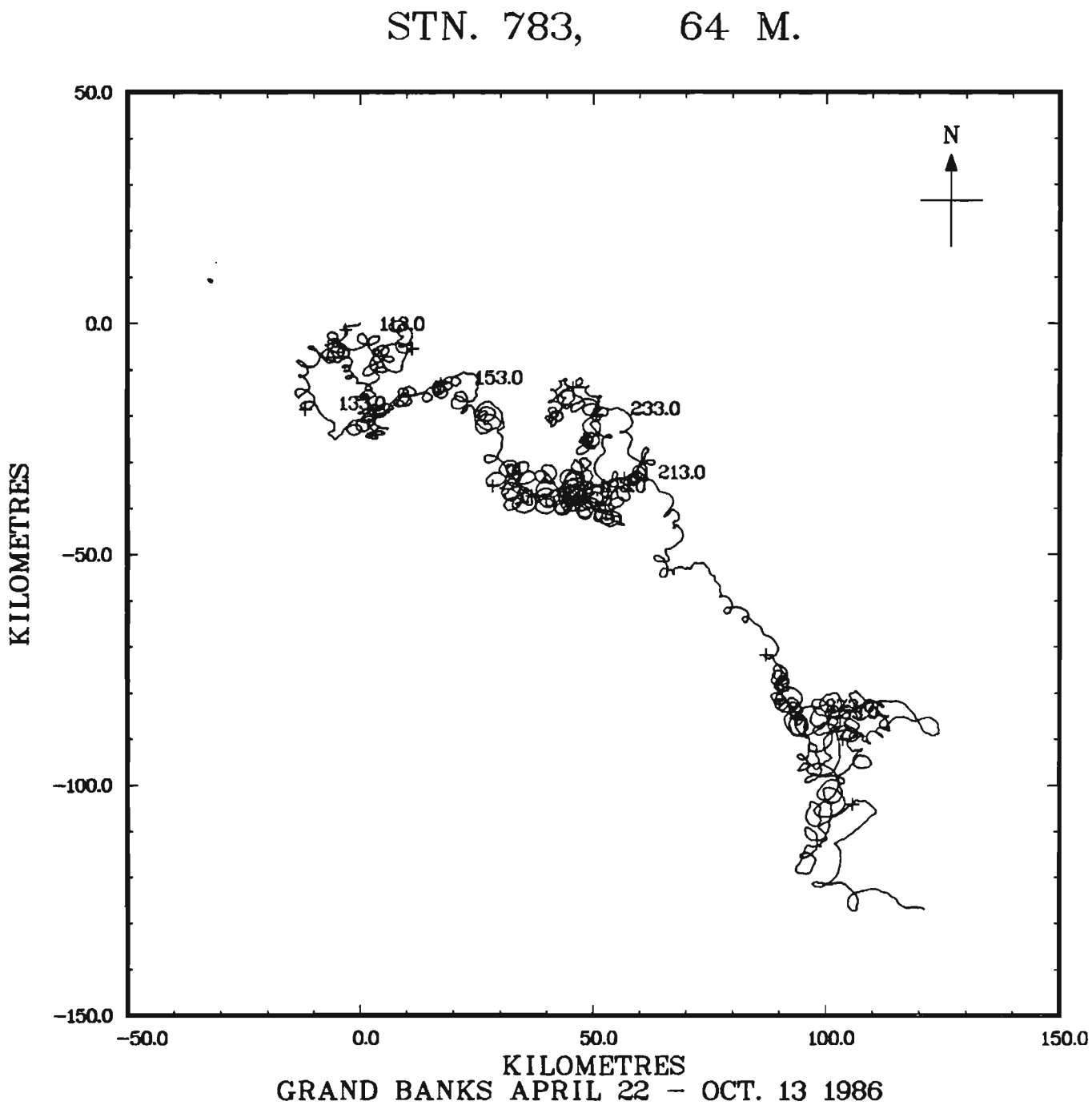

Figure 25. Progressive vector diagram at 783, 64.

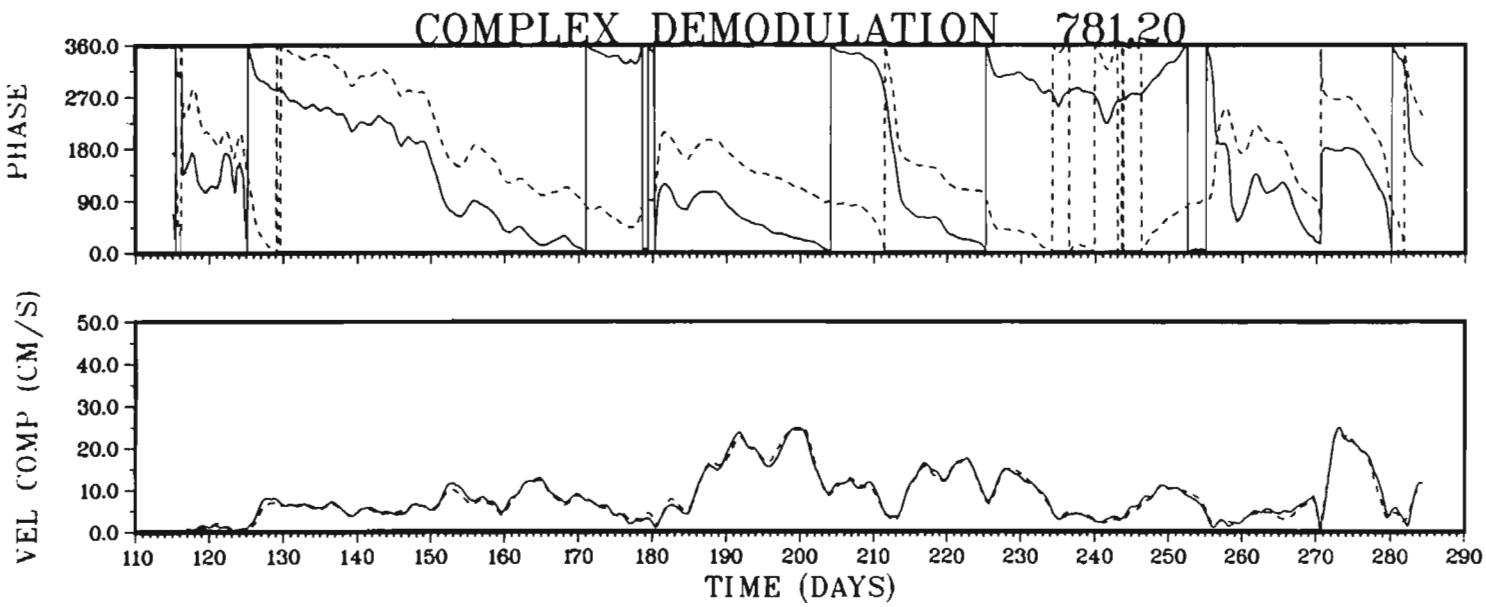

Figure 26. Complex demodulation of u (solid line) and v (dashed line) components of velocity at 781, 20. Demodulation was done at the local inertial frequency.

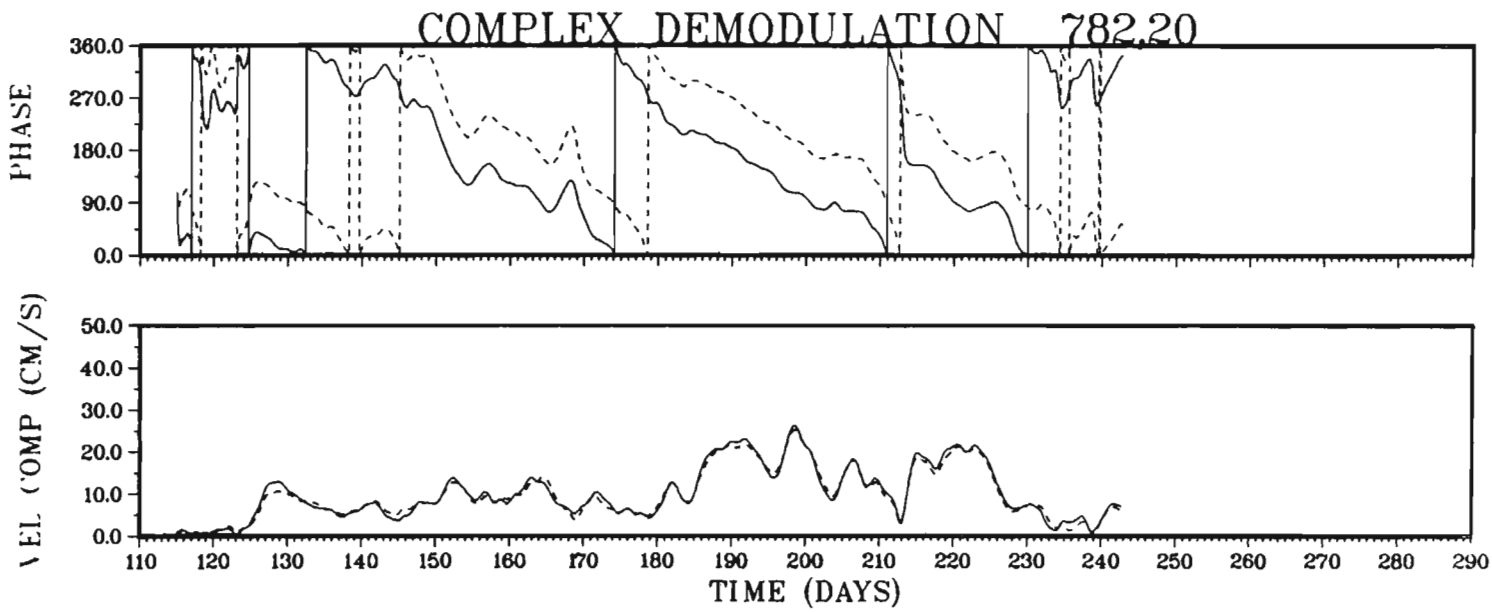

Figure 27. Complex demodulation of u (solid line) and v (dashed line) components of velocity at 782, 20. Demodulation was done at the local inertial frequency.

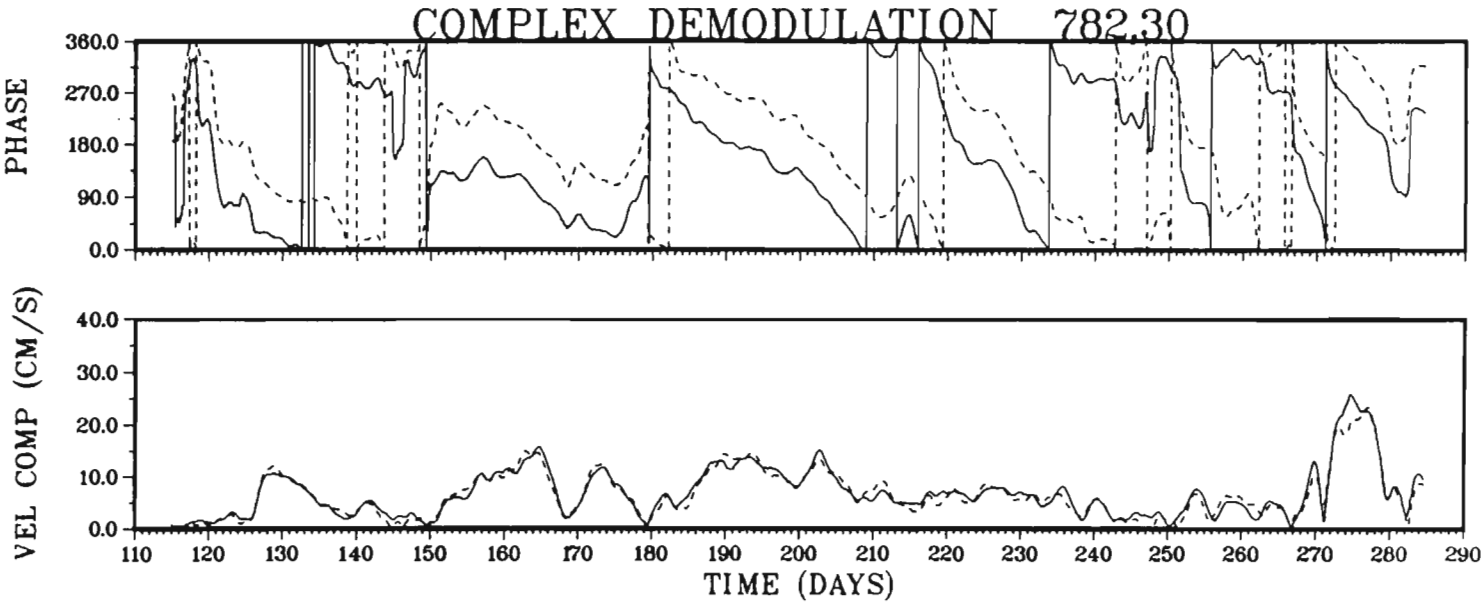

Figure 28. Complex demodulation of u (solid line) and v (dashed line) components of velocity at 782, 30. Demodulation was done at the local inertial frequency.

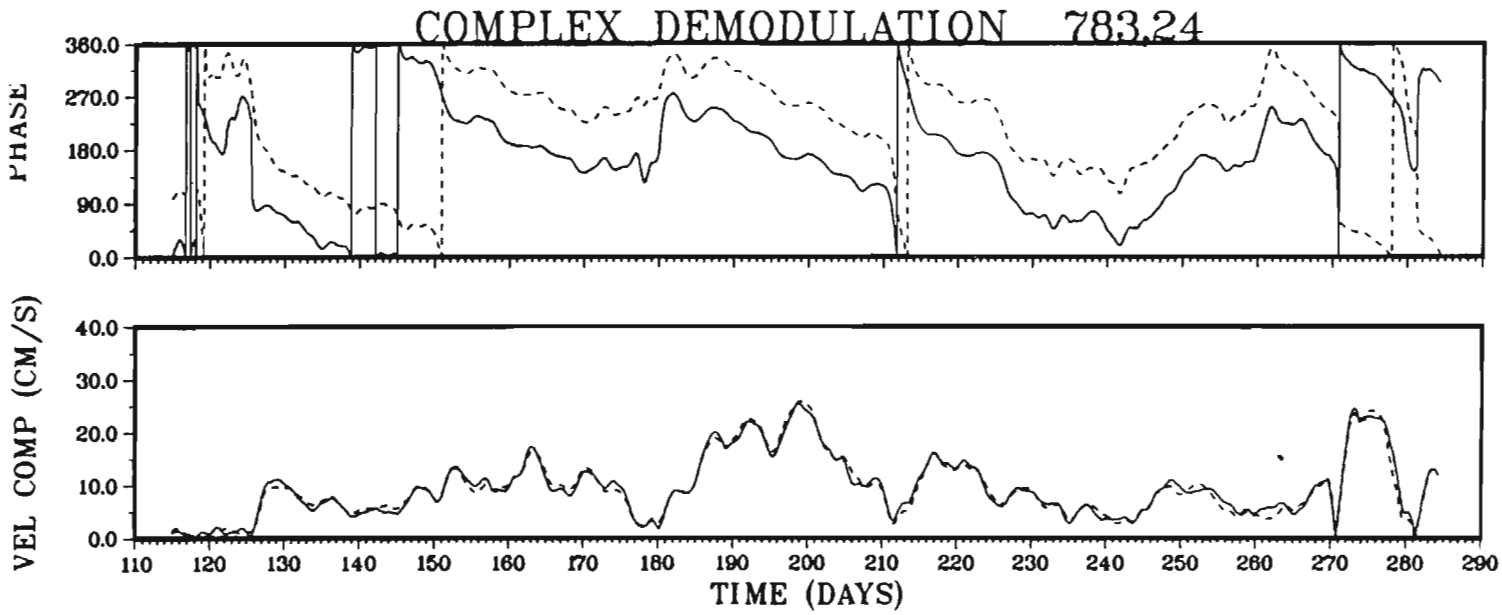

Figure 29. Complex demodulation of u (solid line) and v (dashed line) components of velocity at 783, 24. Demodulation was done at the local inertial frequency.

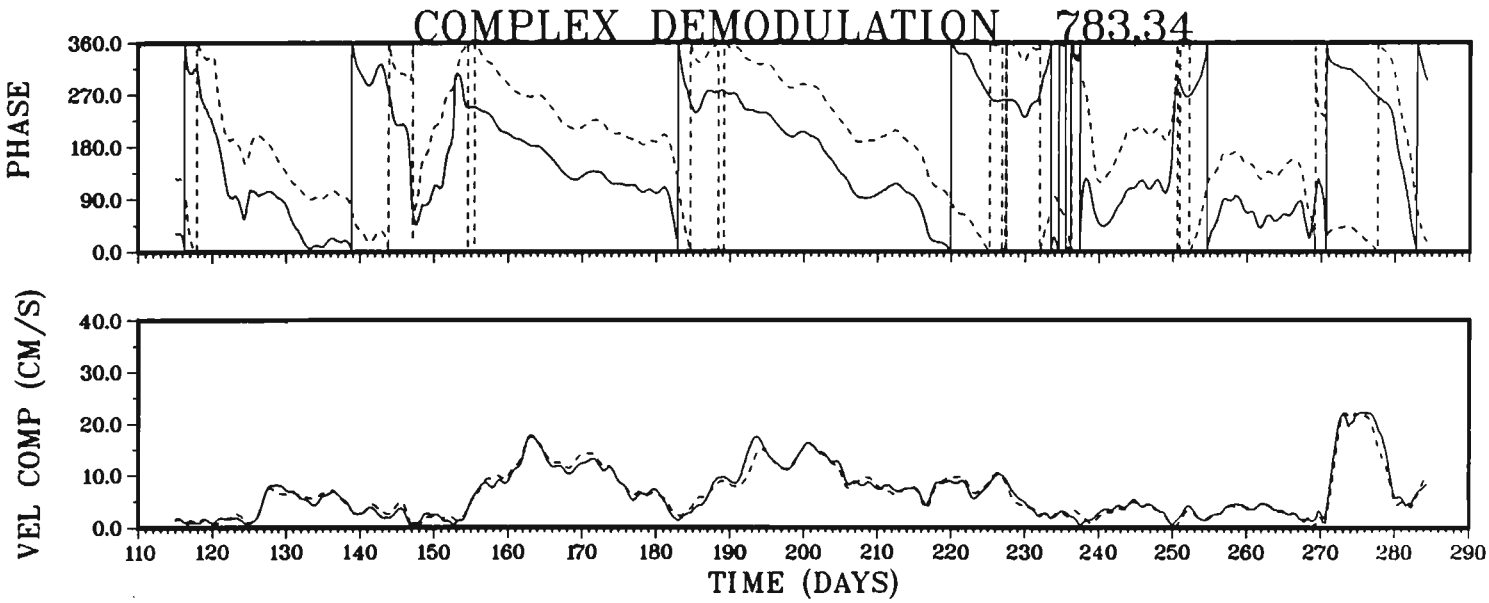

Figure 30. Complex demodulation of u (solid line) and v (dashed line) components of velocity at 783, 34. Demodulation was done at the local inertial frequency.

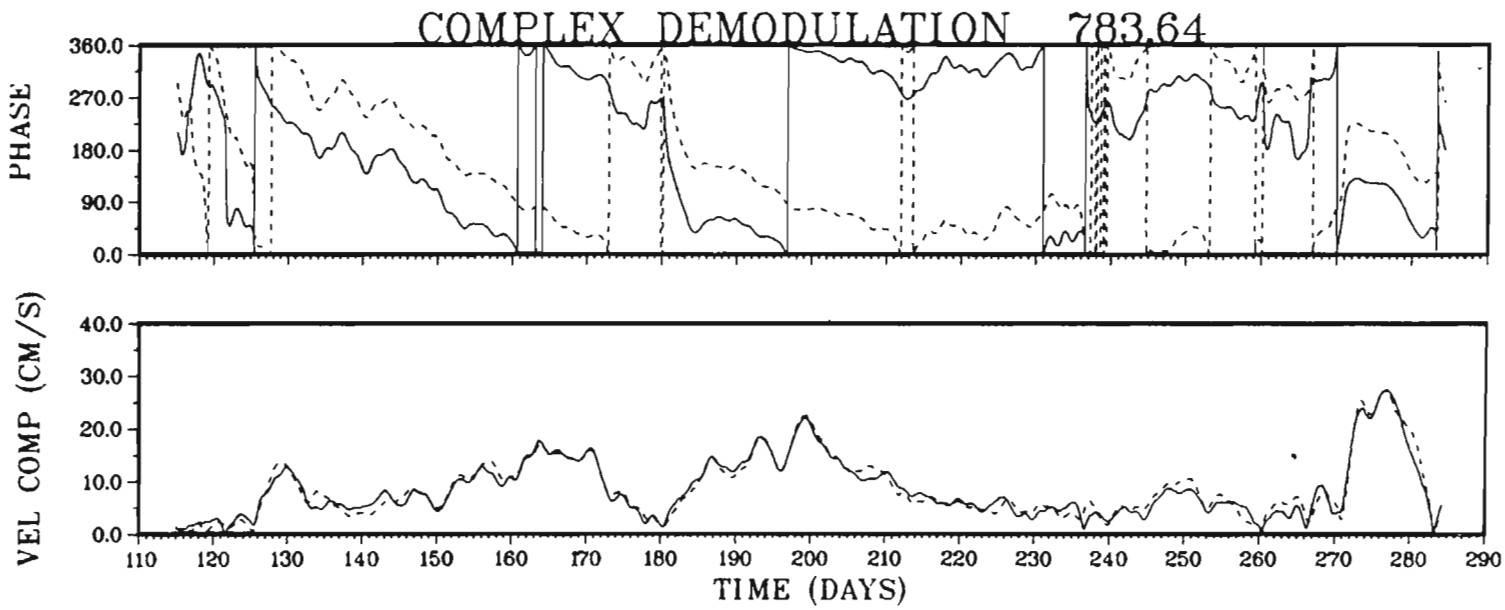

Figure 31. Complex demodulation of u (solid line) and v (dashed line) components of velocity at 783, 64. Demodulation was done at the local inertial frequency.

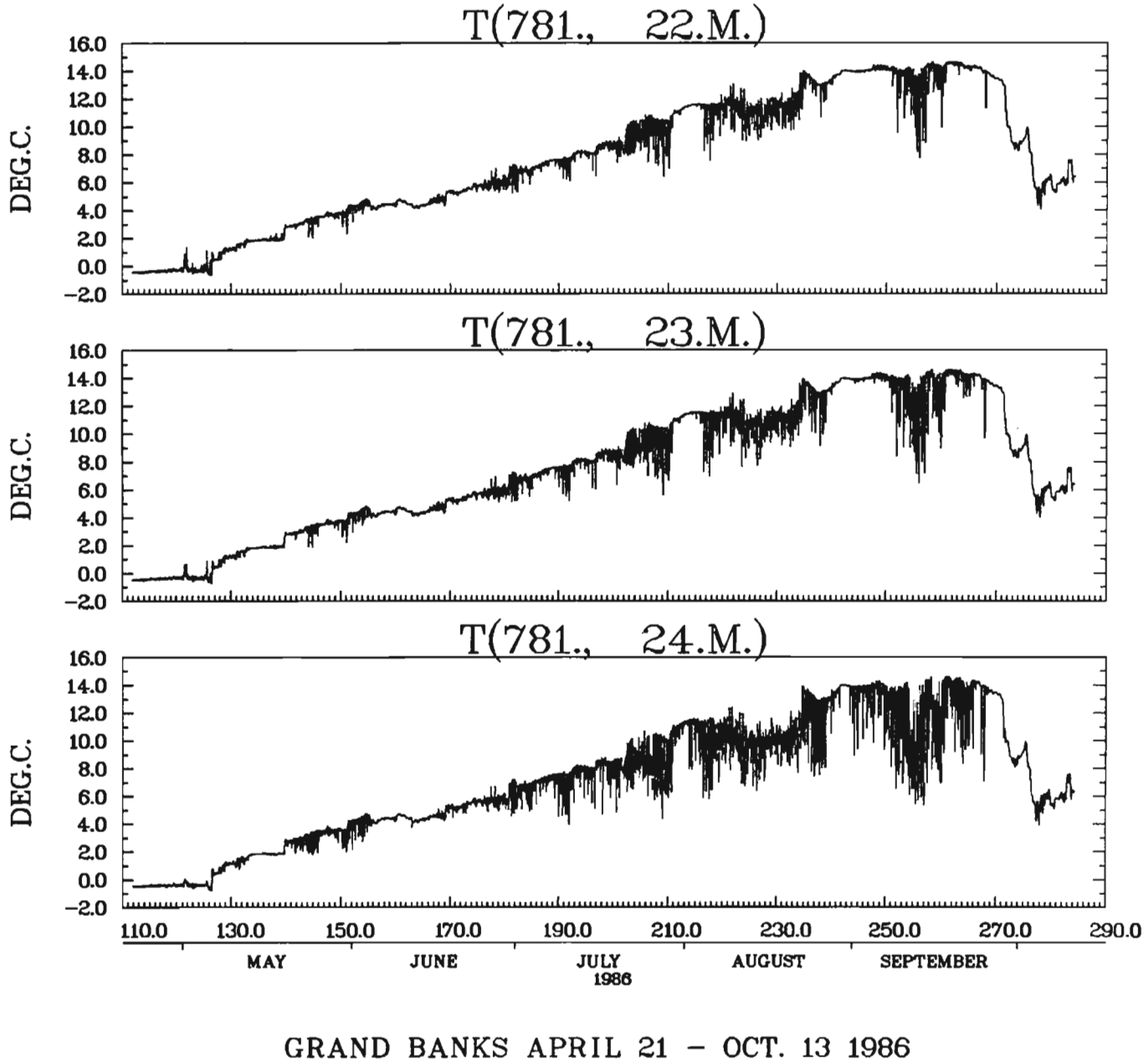

Figure 32. Thermistor chain temperatures at 22, 23 and 24 m at 781.

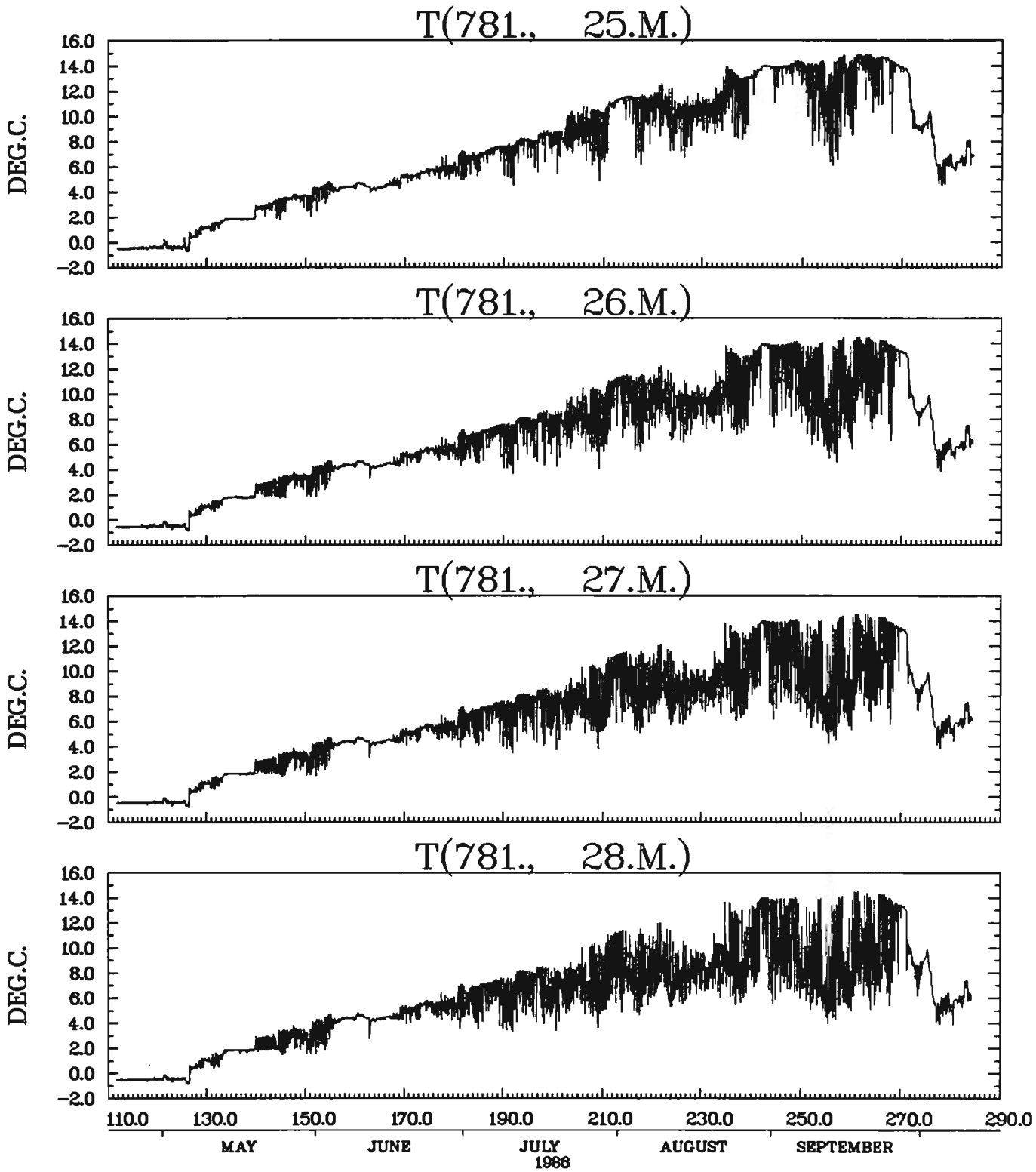

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Figure 33. Thermistor chain temperatures at 25, 26, 27 and 28 m at 781.

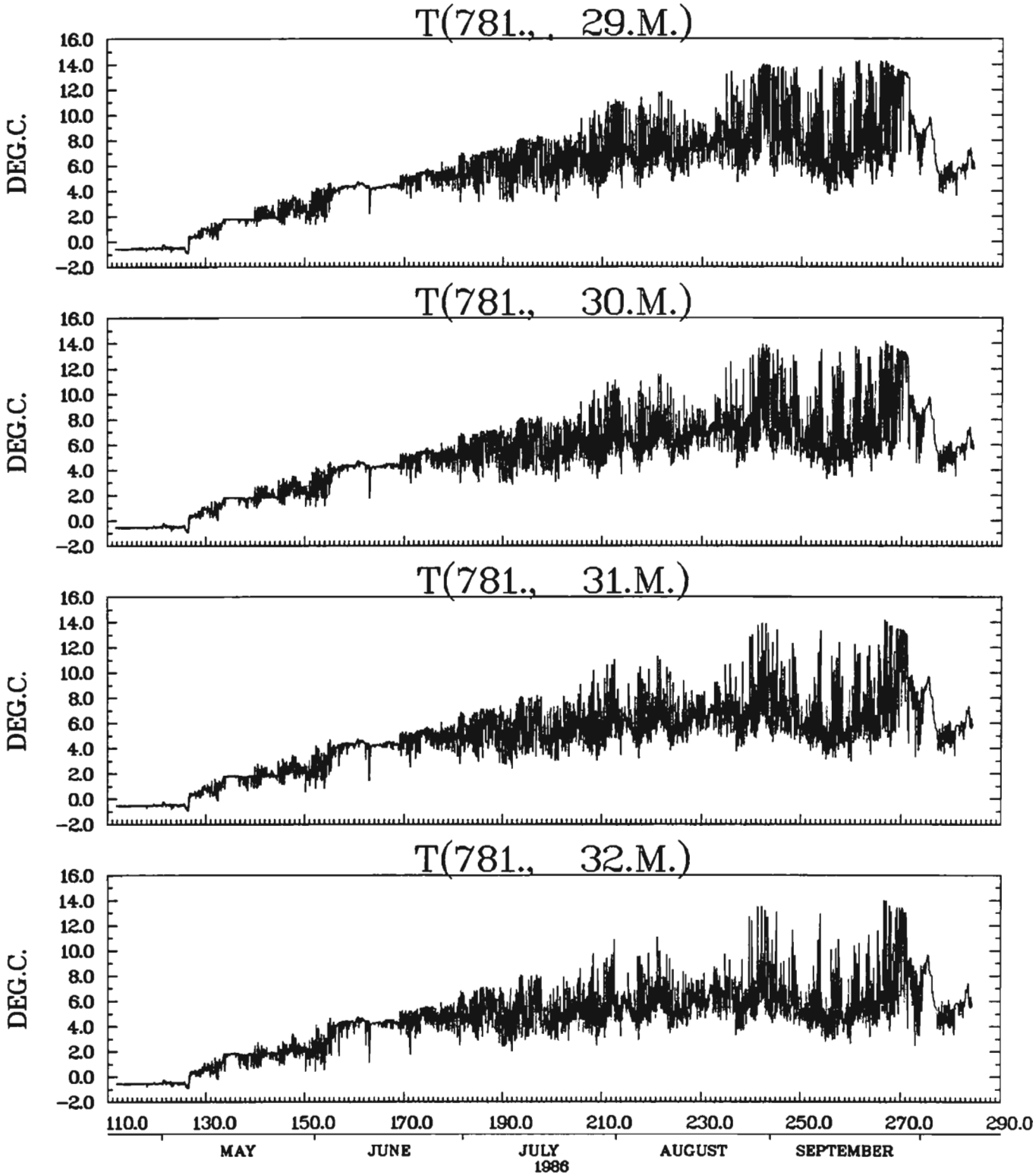

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Figure 34. Thermistor chain temperatures at 29, 30, 31 and 32 m at 781.

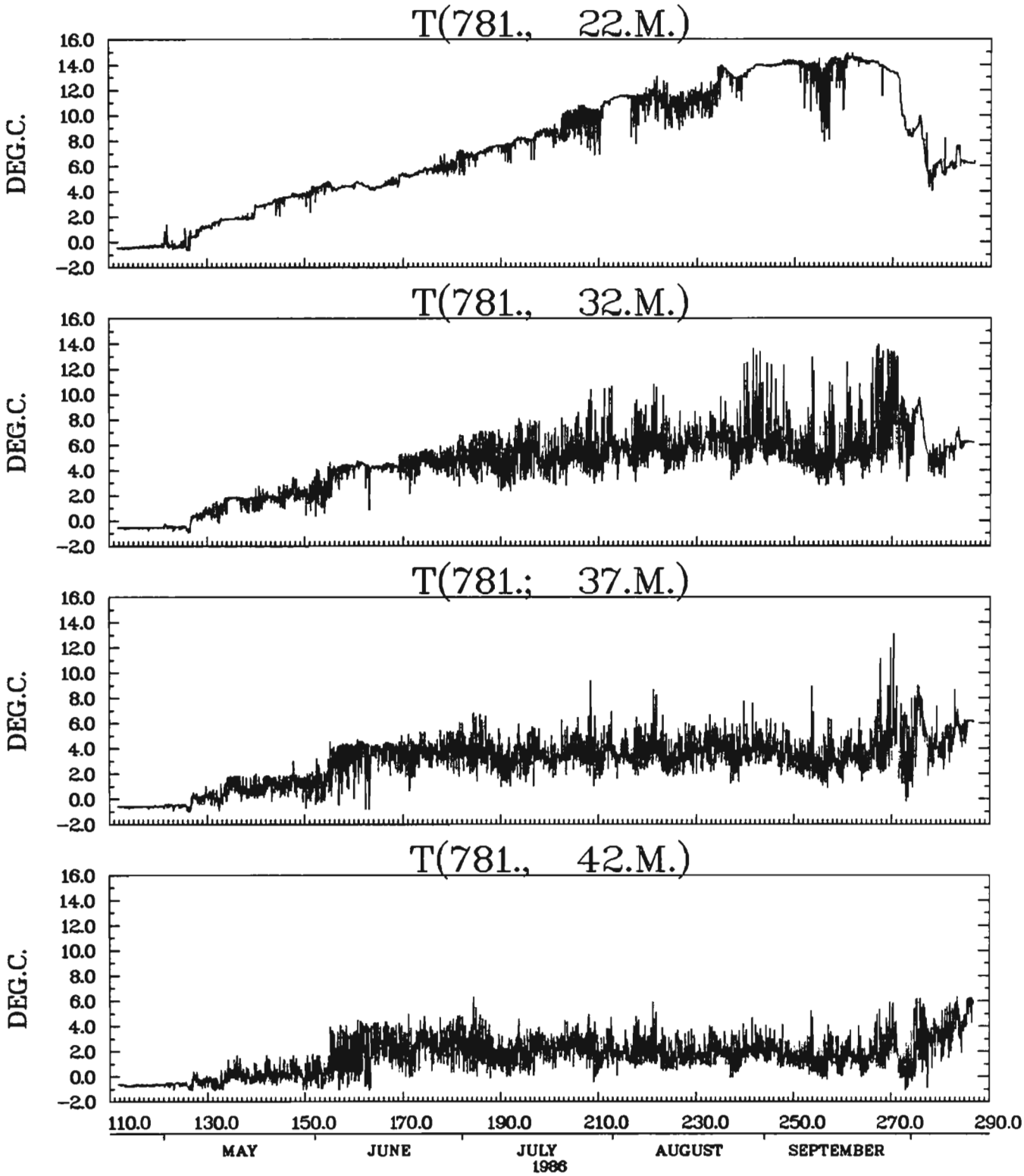

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Figure 35. Thermistor chain temperatures at 22, 32, 37 and 42 m at 781.

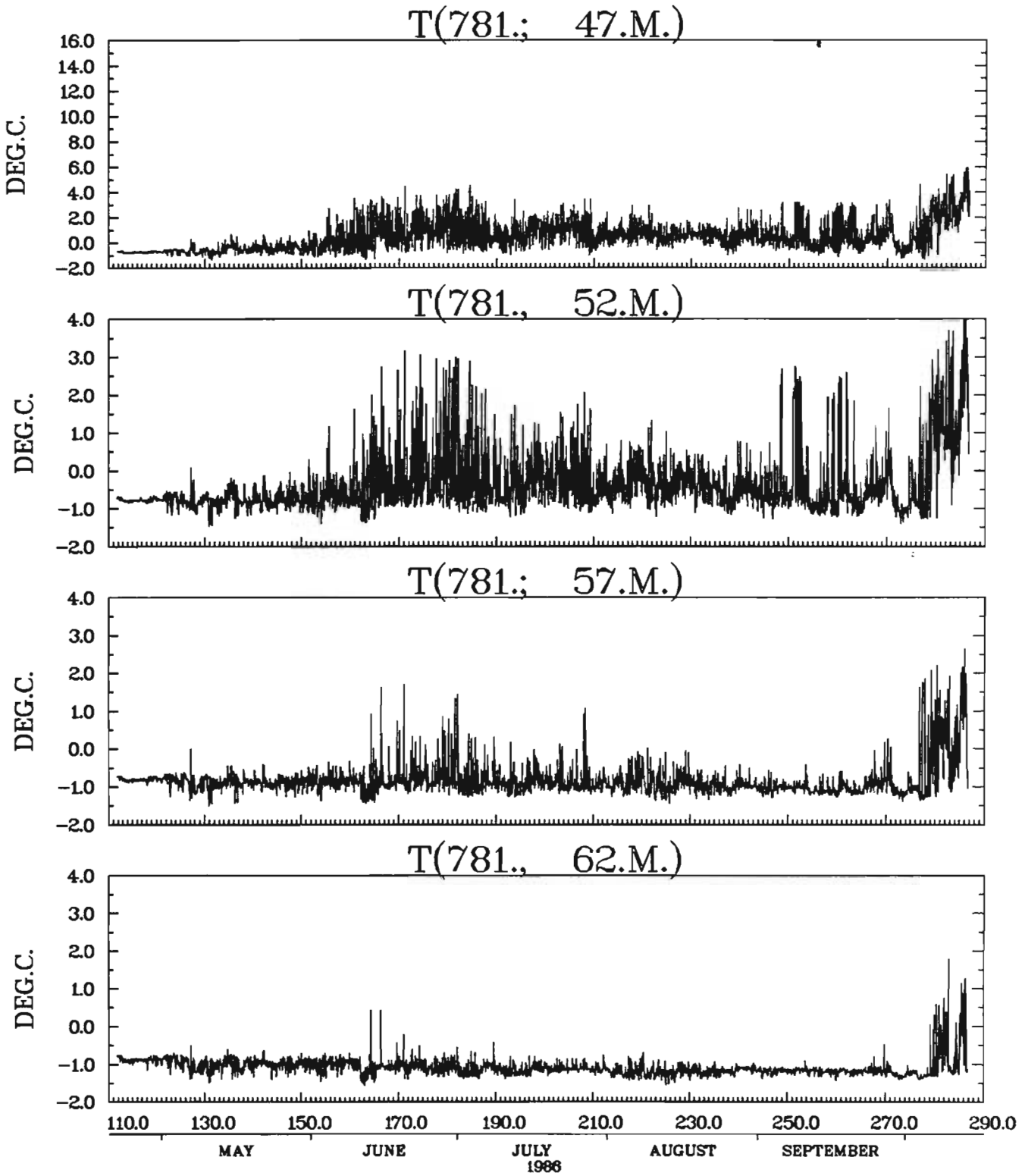

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Figure 36. Thermistor chain temperatures at 47, 52, 57 and 62 m at 781.

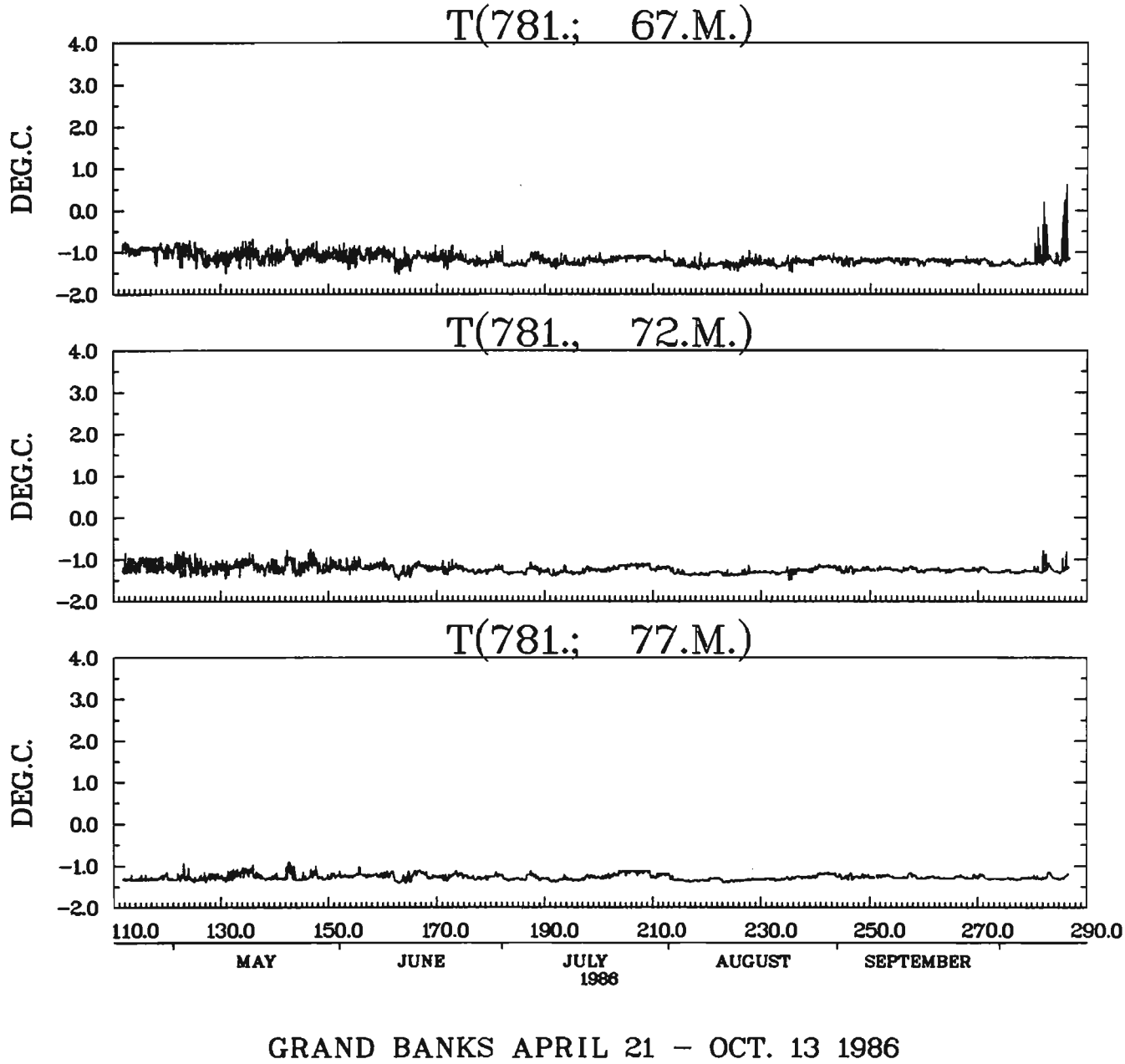

Figure 37. Thermistor chain temperatures at 67, 72 and 77 at 781.

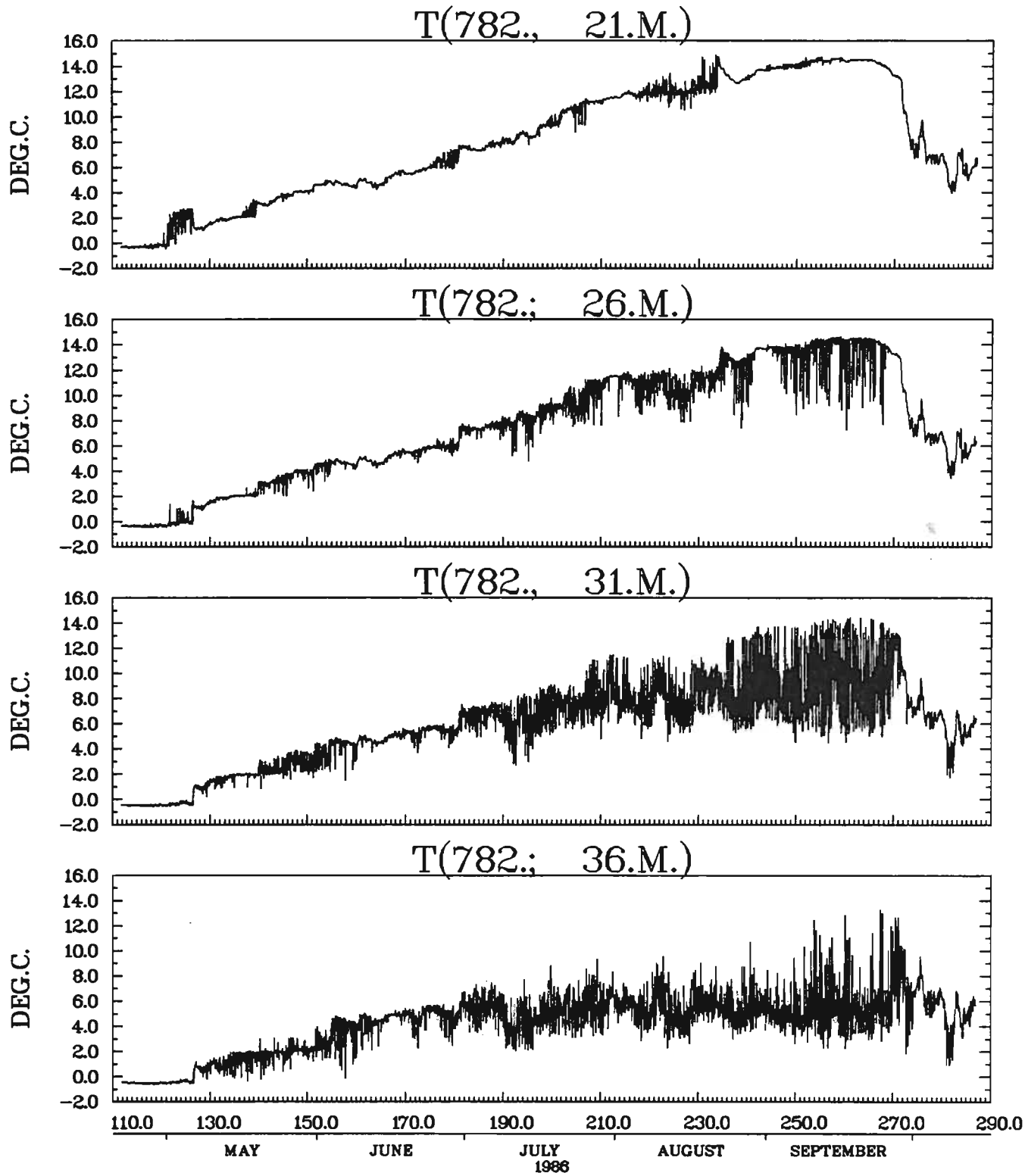

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Figure 38. Thermistor chain temperatures at 21, 26, 31 and 36 m at 782.

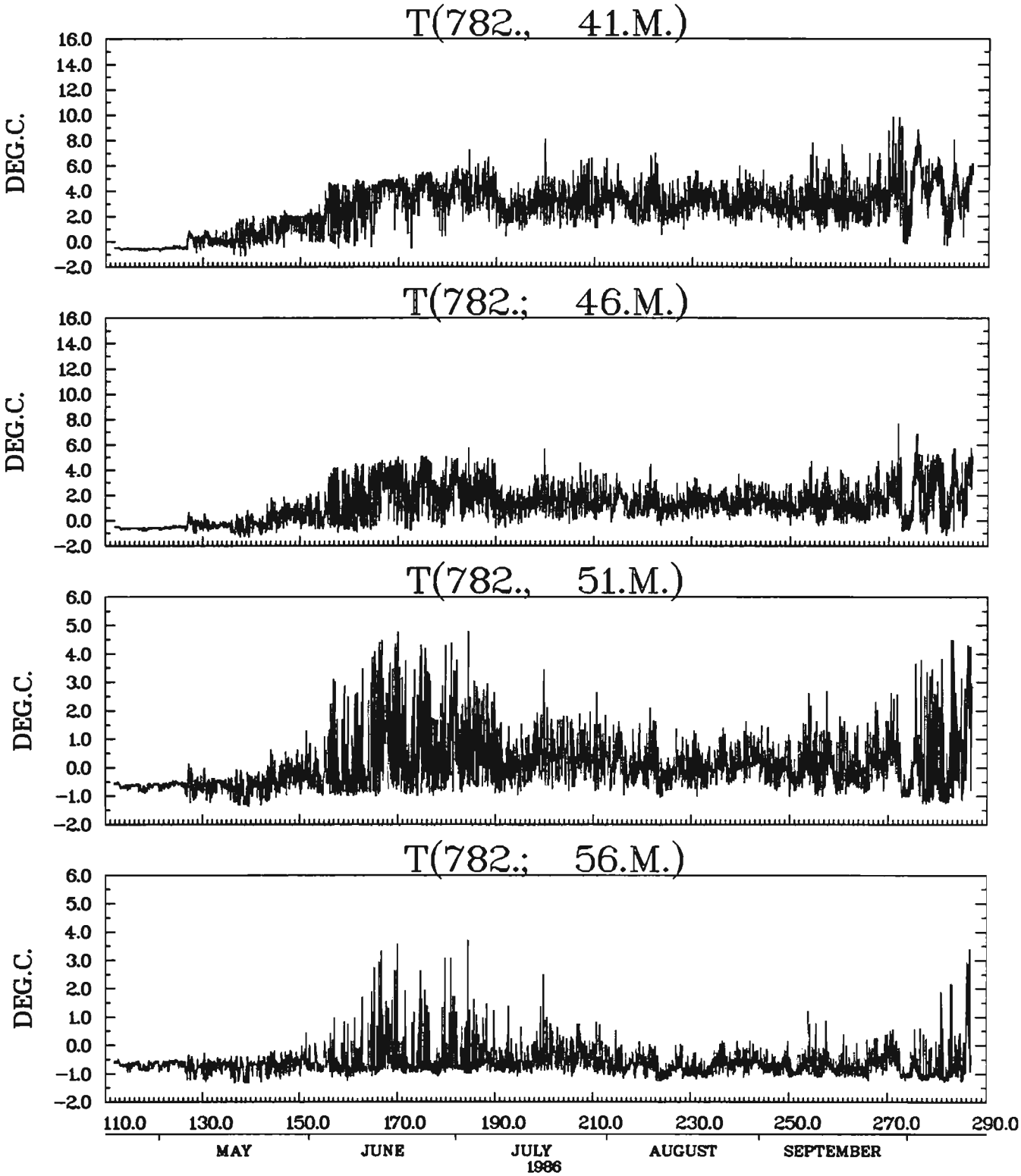

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Figure 39. Thermistor chain temperatures at 41, 46, 51 and 56 m at 782.

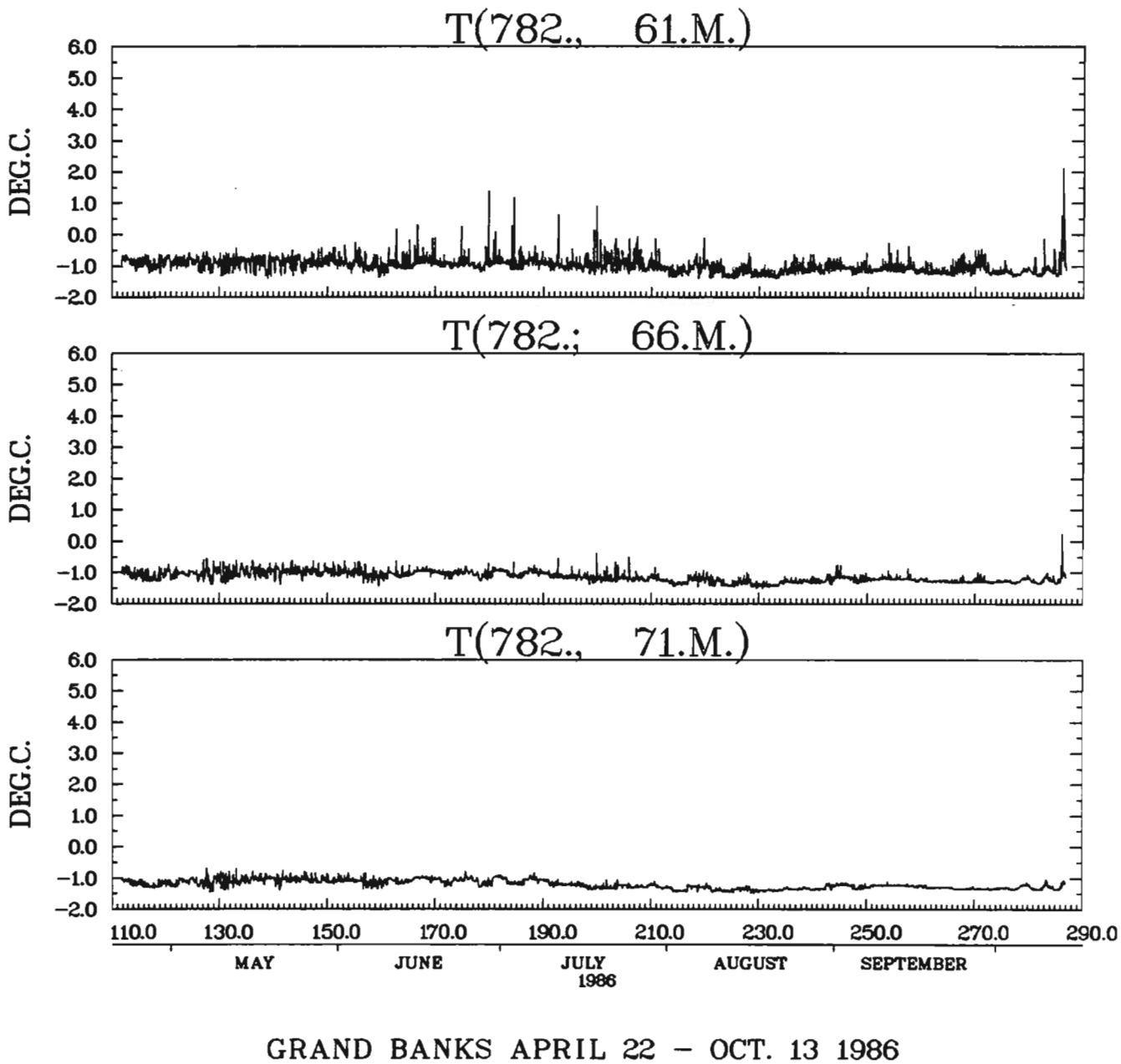

Figure 40. Thermistor chain temperatures at 61, 66 and 71 m at 782.

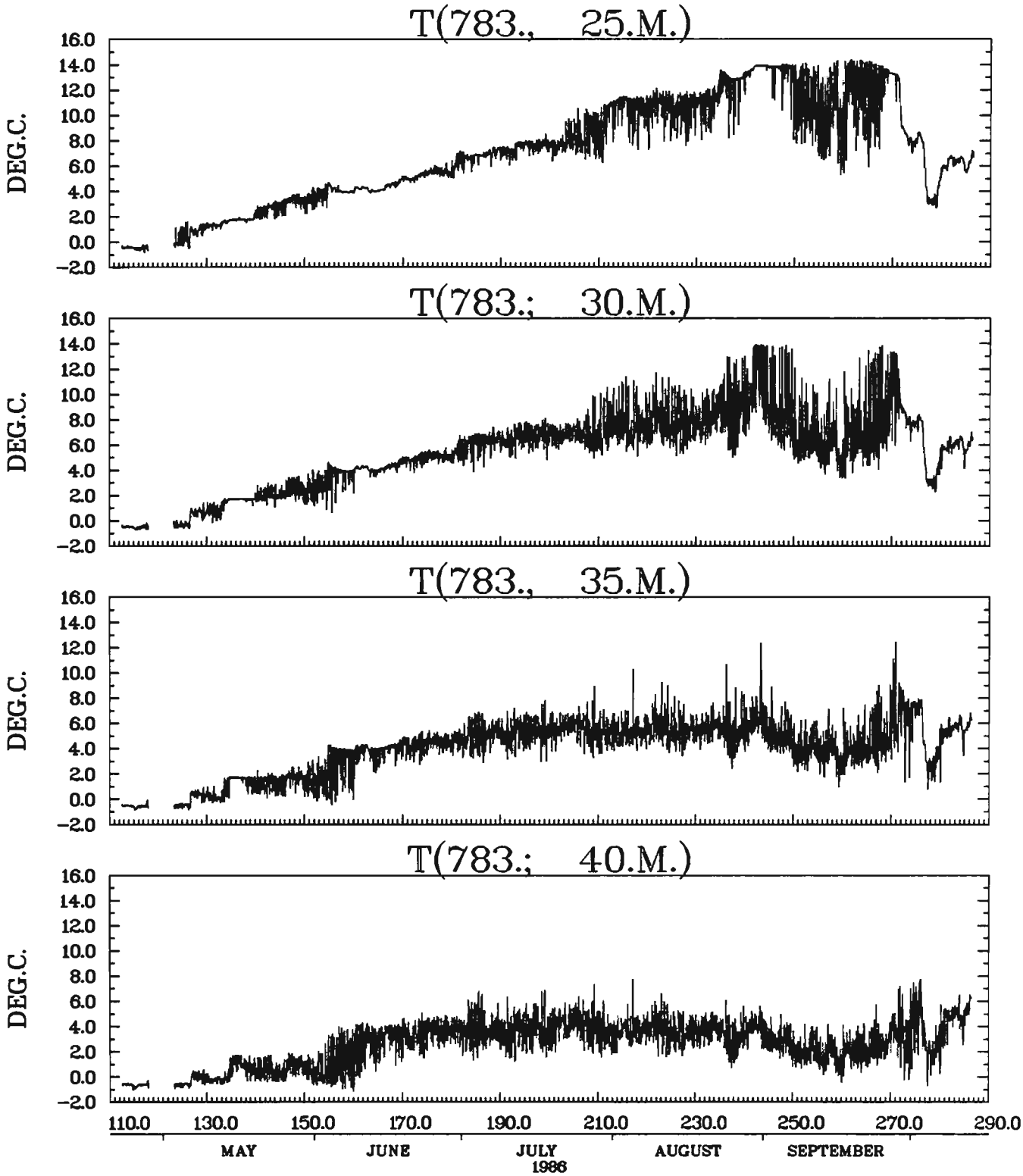

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Figure 41. Thermistor chain temperatures at 25, 30, 35 and 40 m at 783.

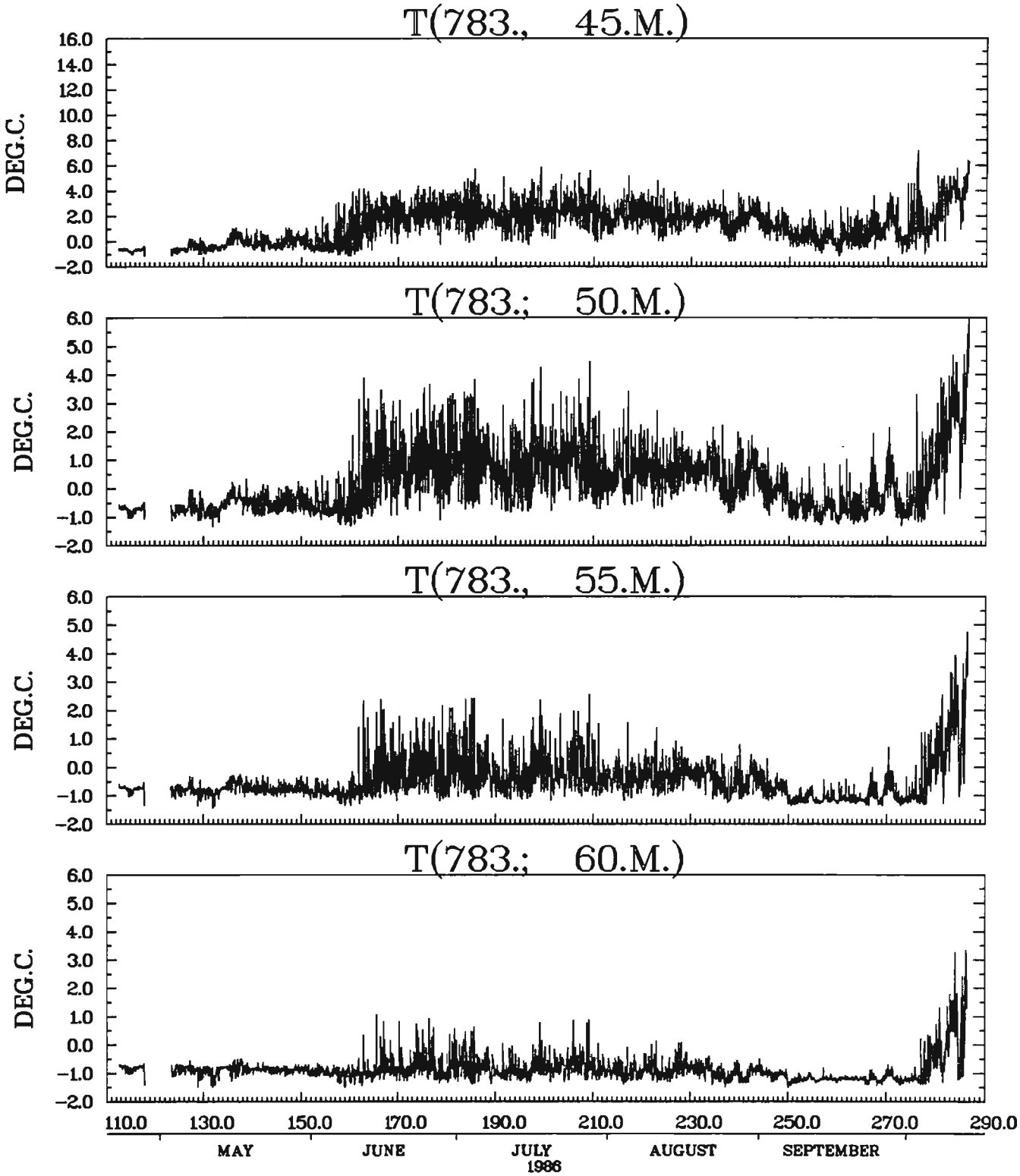

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Figure 42. Thermistor chain temperatures at 45, 50, 55 and 60 m at 783.

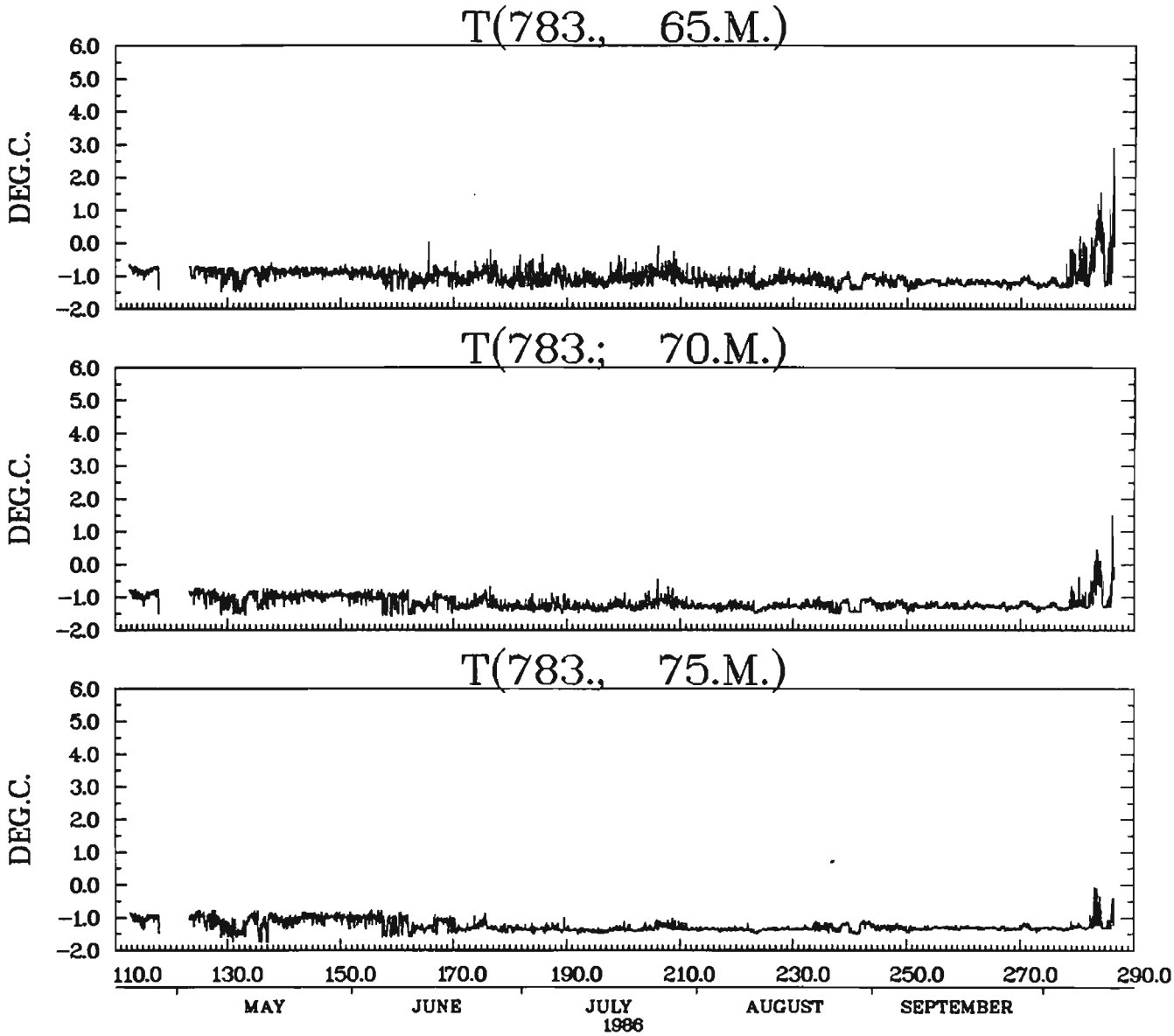

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Figure 43. Thermistor chain temperatures at 65, 70 and 75 m at 783.

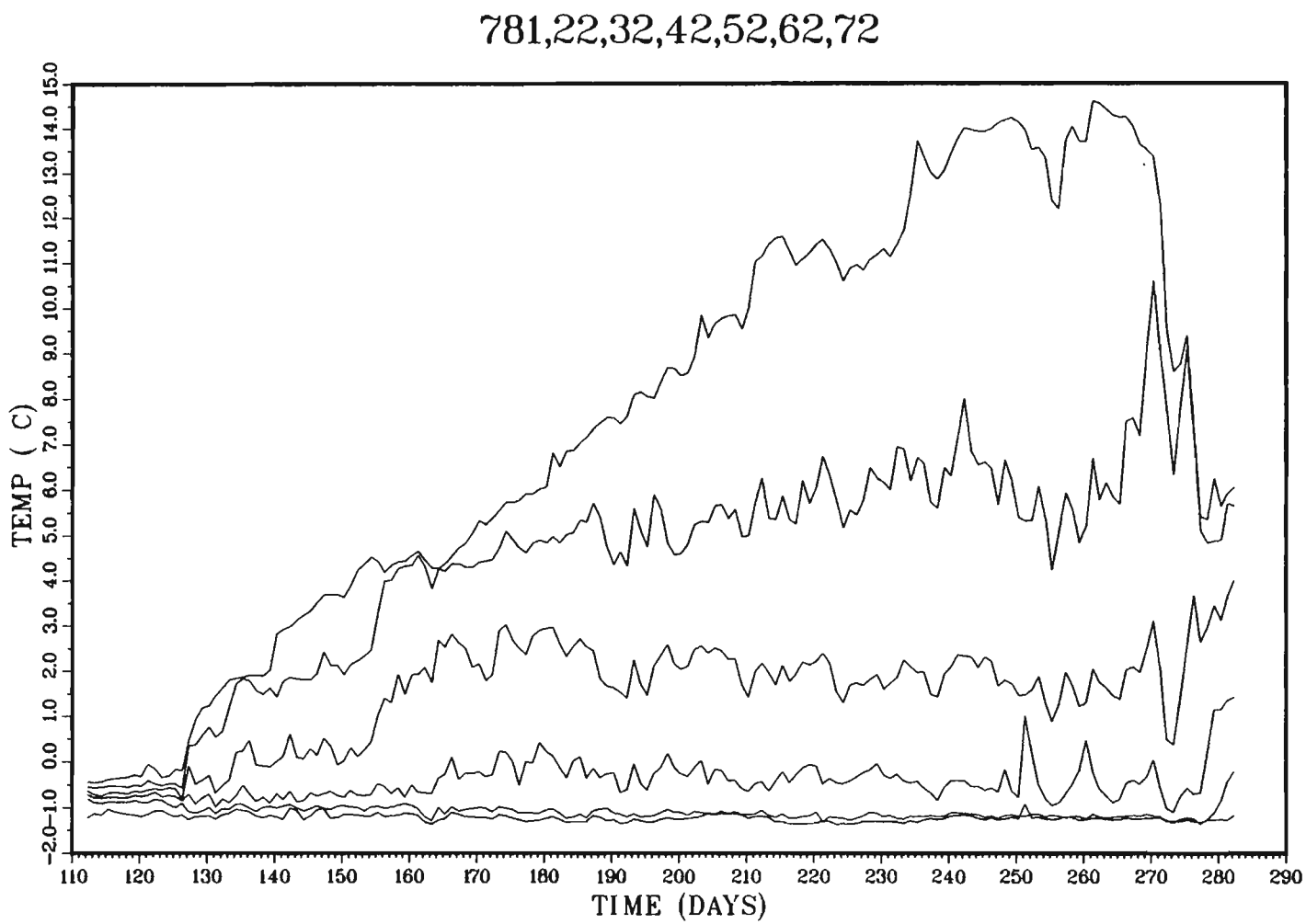

Figure 44. Daily averaged temperatures at 22, 32, 42, 52, 62 and 72 at 781.

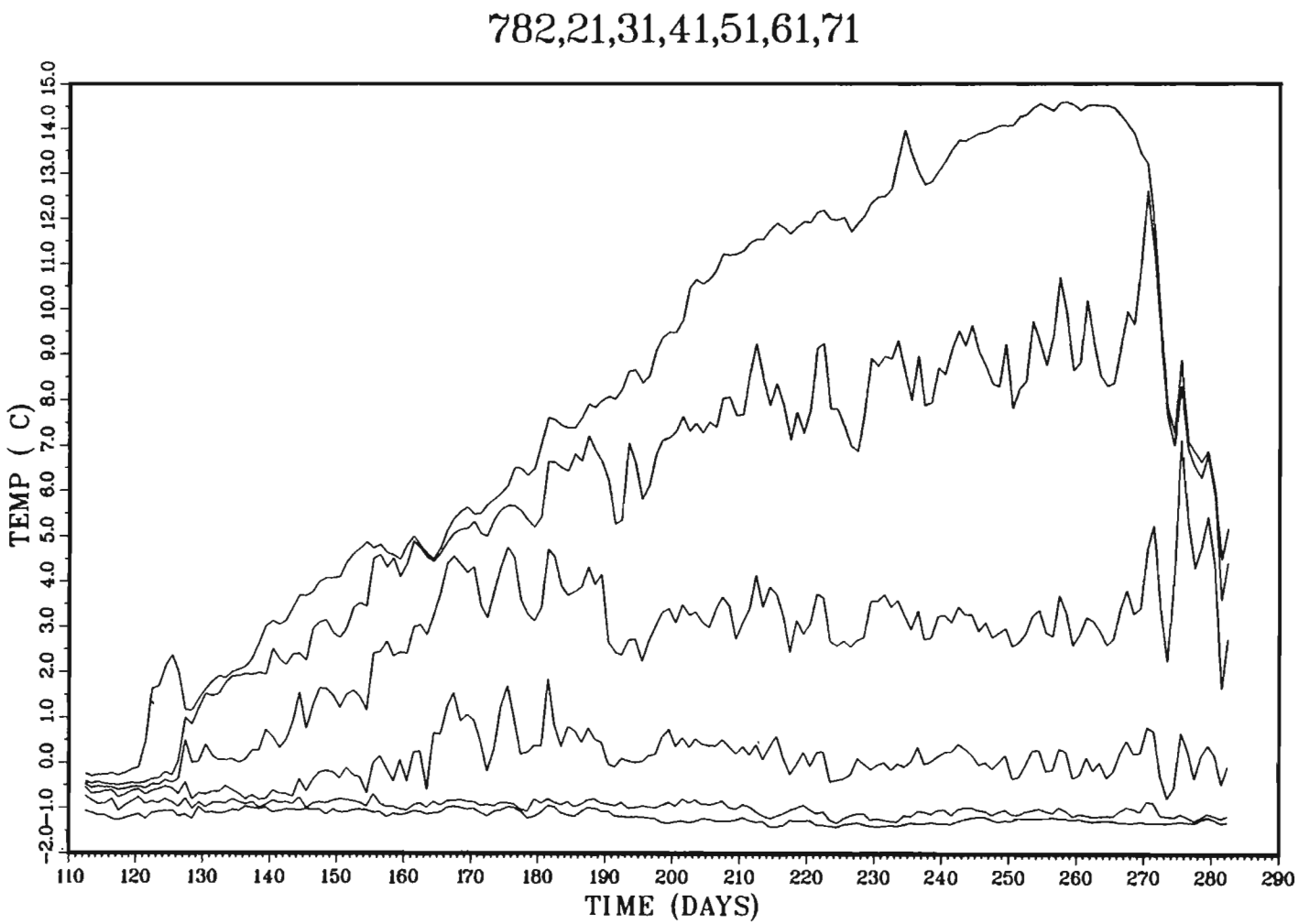

Figure 45. Daily averaged temperatures at 21, 31, 41, 51, 61 and 71 m at 782.

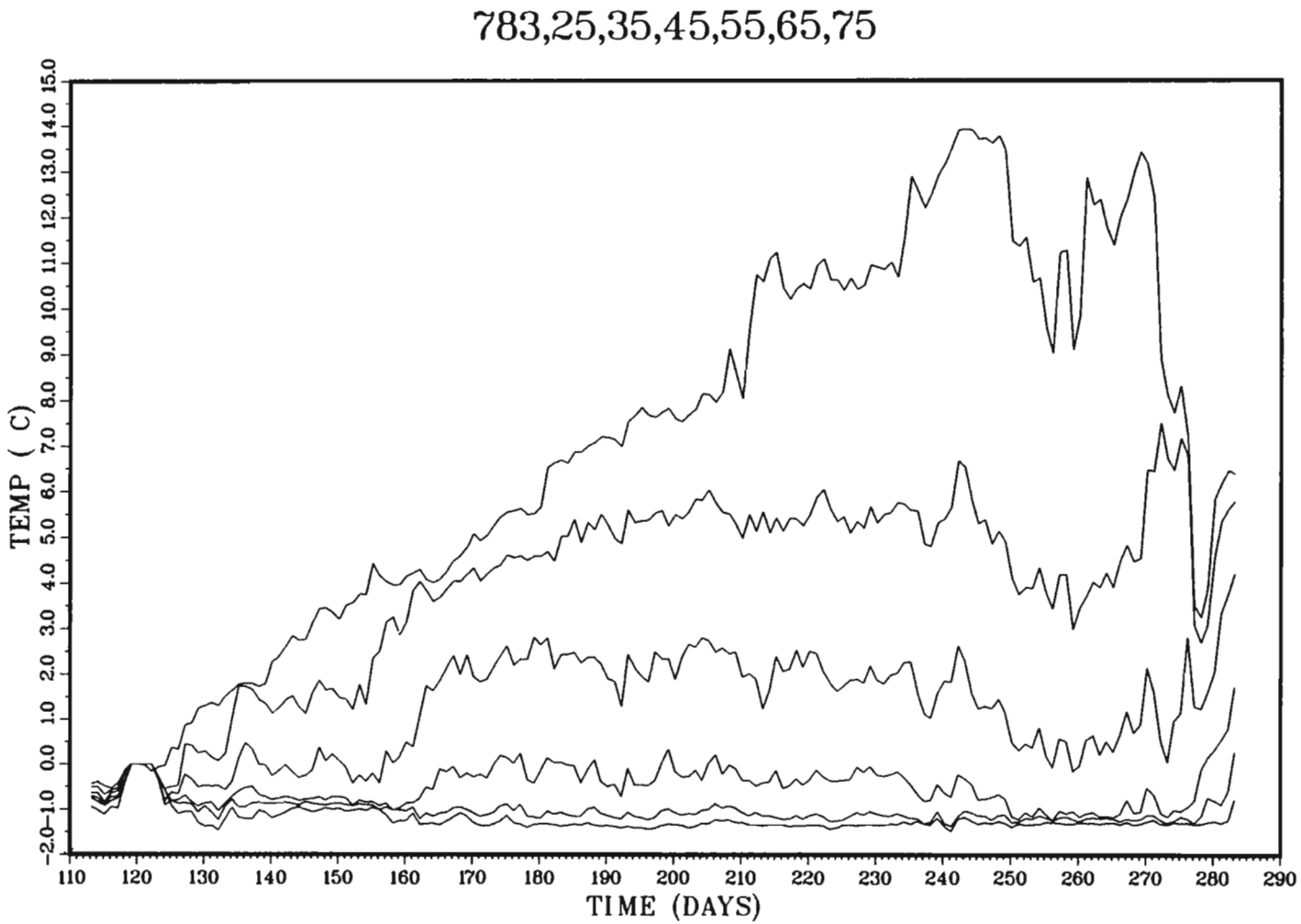

Figure 46. Daily averaged temperatures at 25, 35, 45, 55, 65 and 75 m at 783.

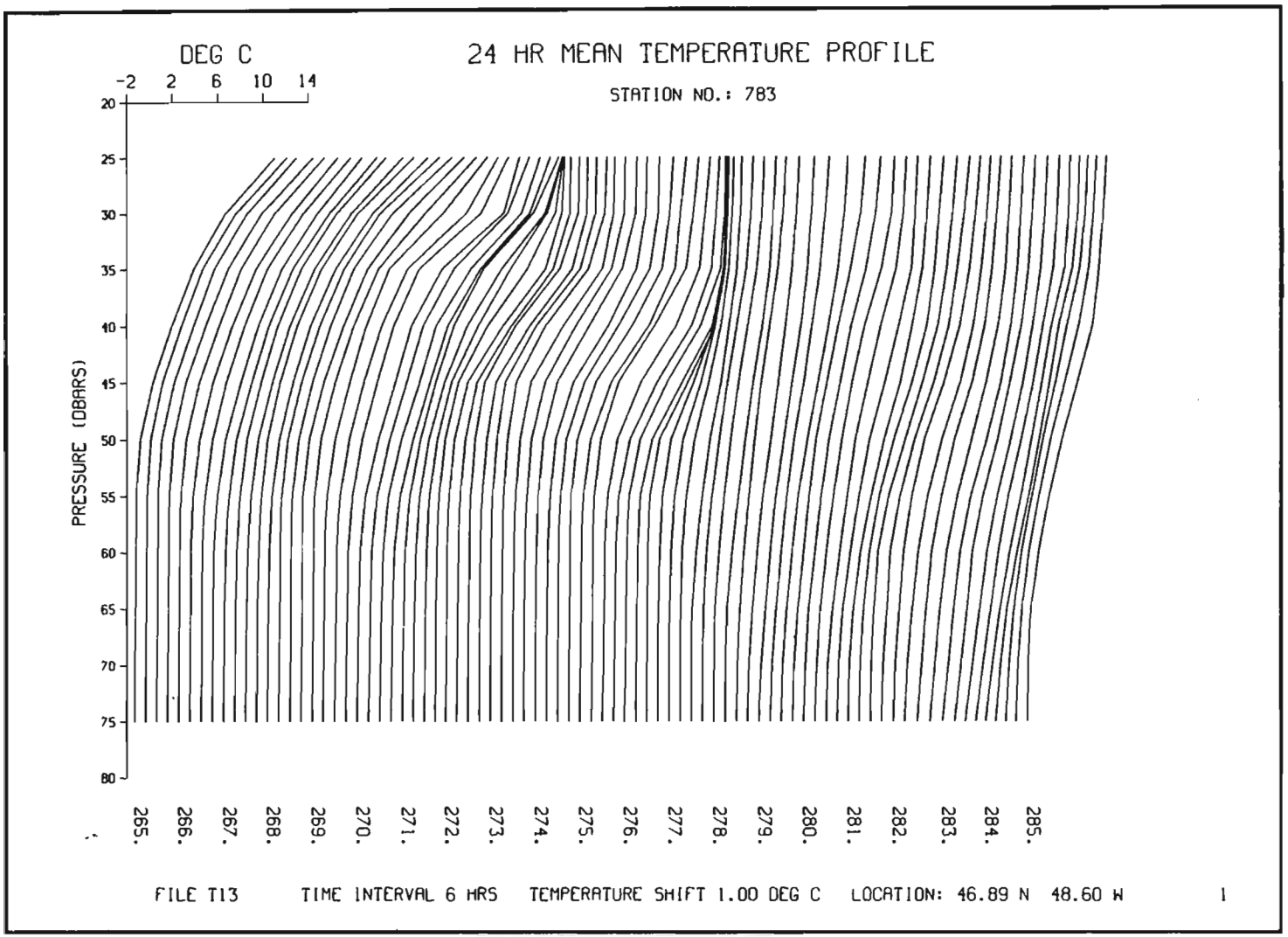

Figure 47. Daily averaged temperatures profiles for the last 20 days of the record.

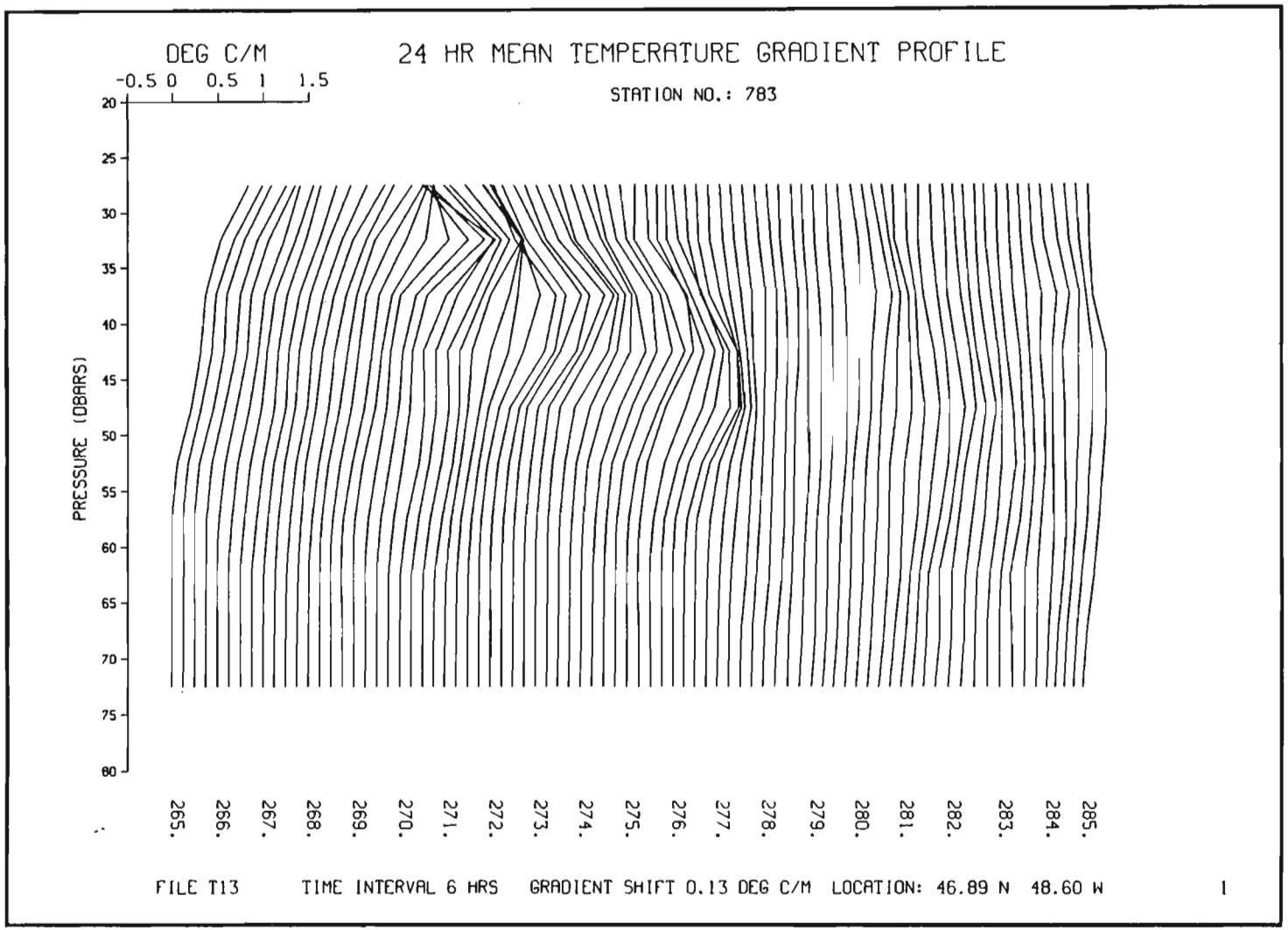

Figure 48. Daily averaged temperature gradient profiles for the last 20 days of the record.

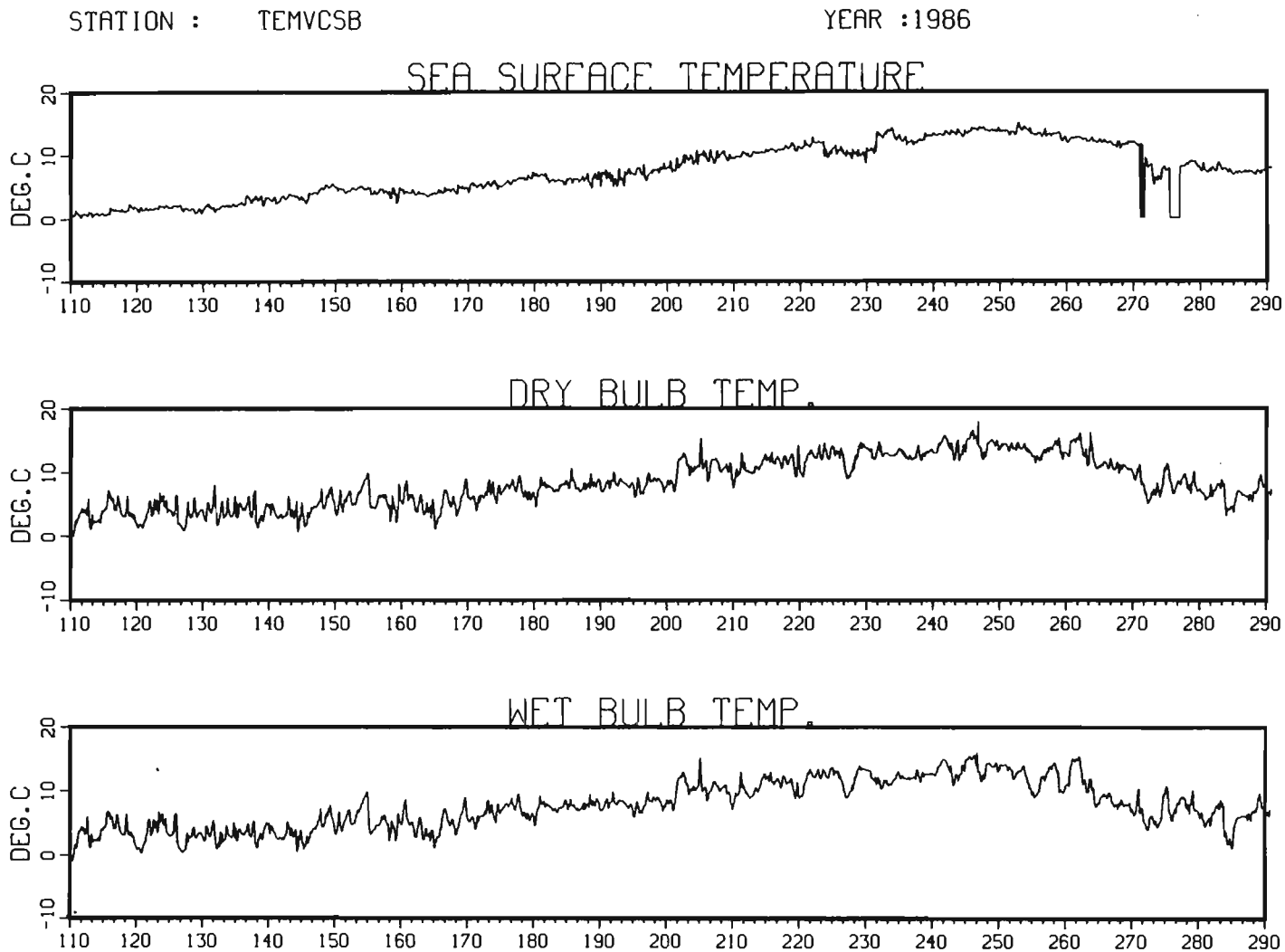

Figure 49. Sea surface temperature, dry bulb temperature and wet bulb temperature at the nearby rig (see Fig. 1).

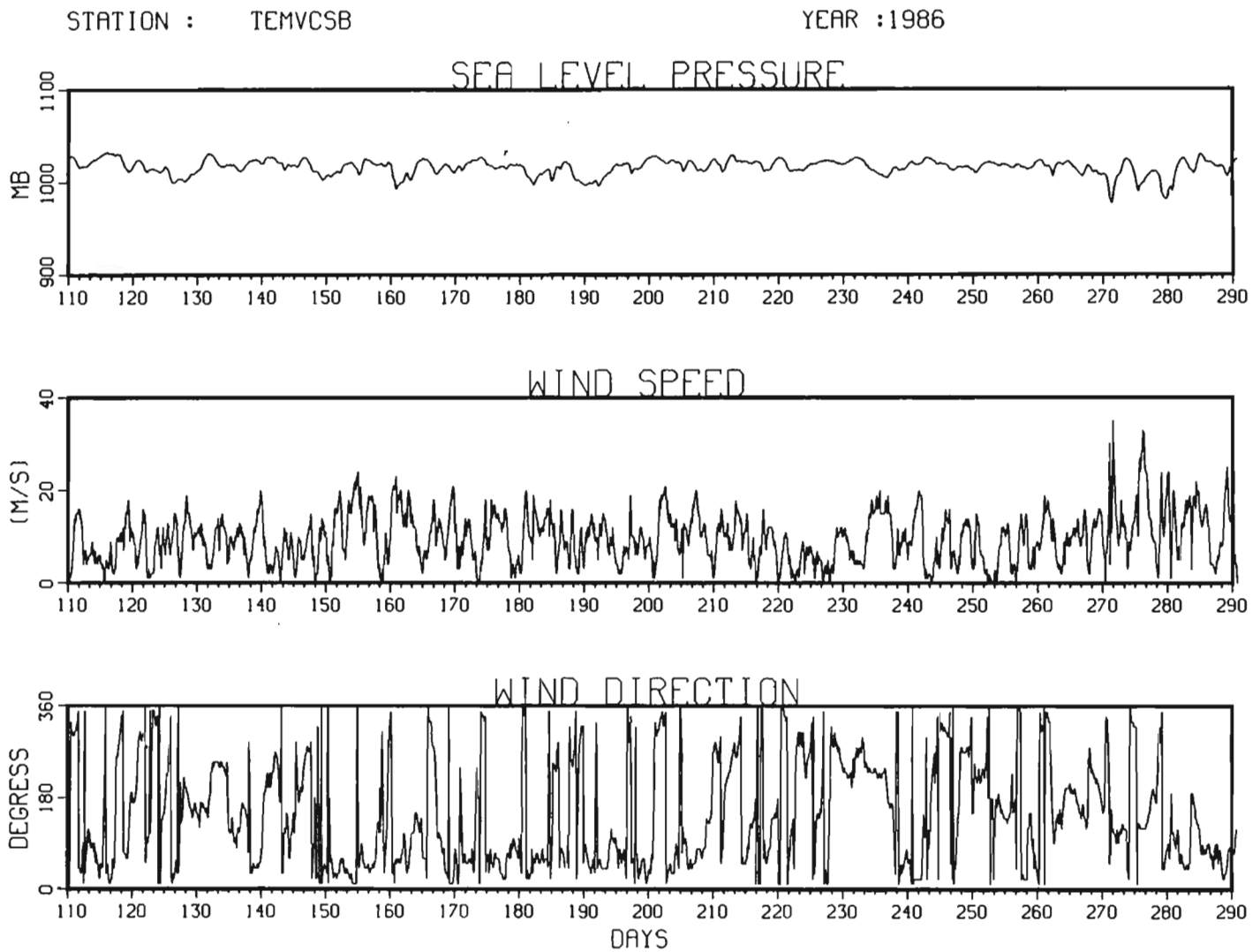

Figure 50. Sea level pressure, wind speed and wind direction at the rig. The wind speed and direction were measured at approximately 80 m above sea level.

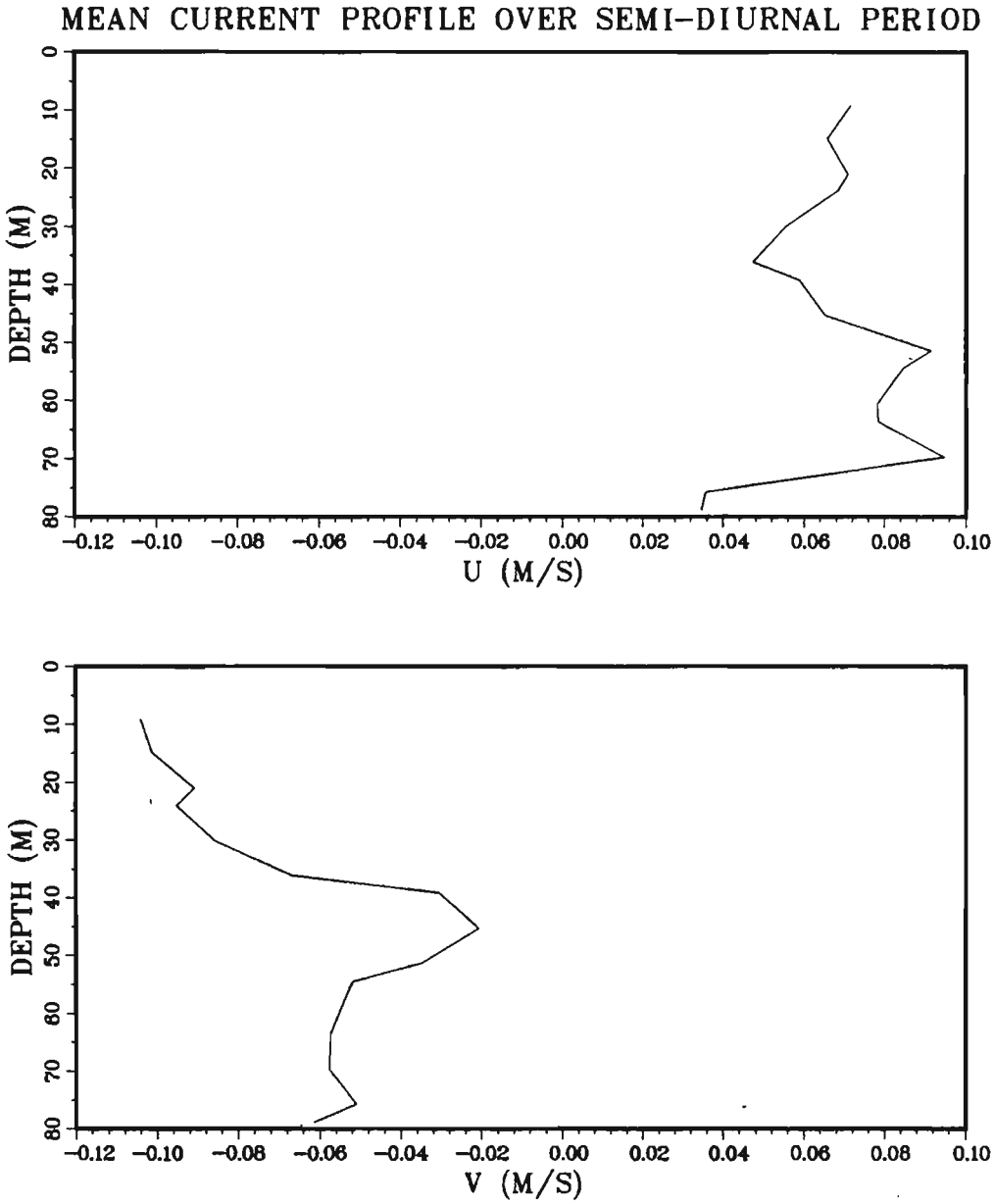

Figure 51. A 12.5 hour average of component velocities measured by the acoustic Doppler current profiler (ADCP) system on DAWSON.

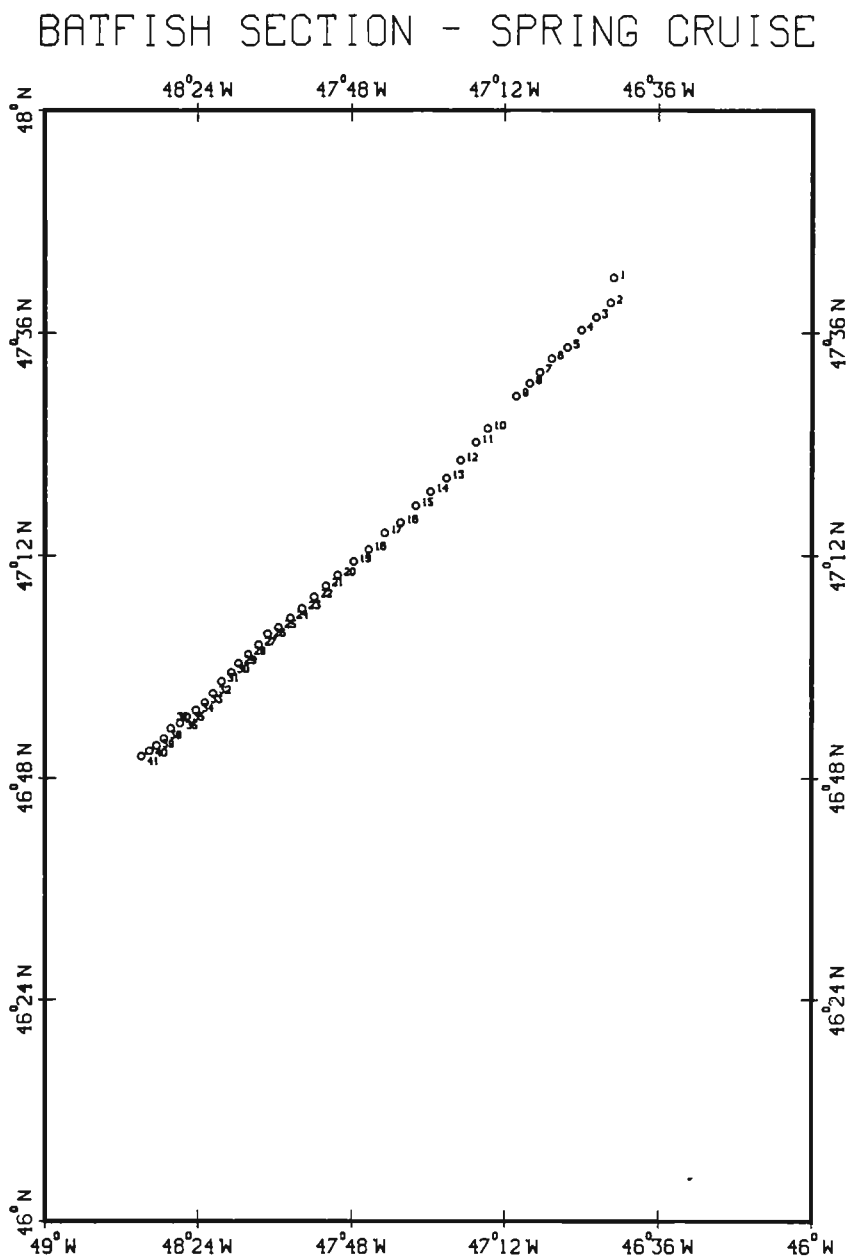

Figure 52. Station positions for the Batfish section from the spring cruise.

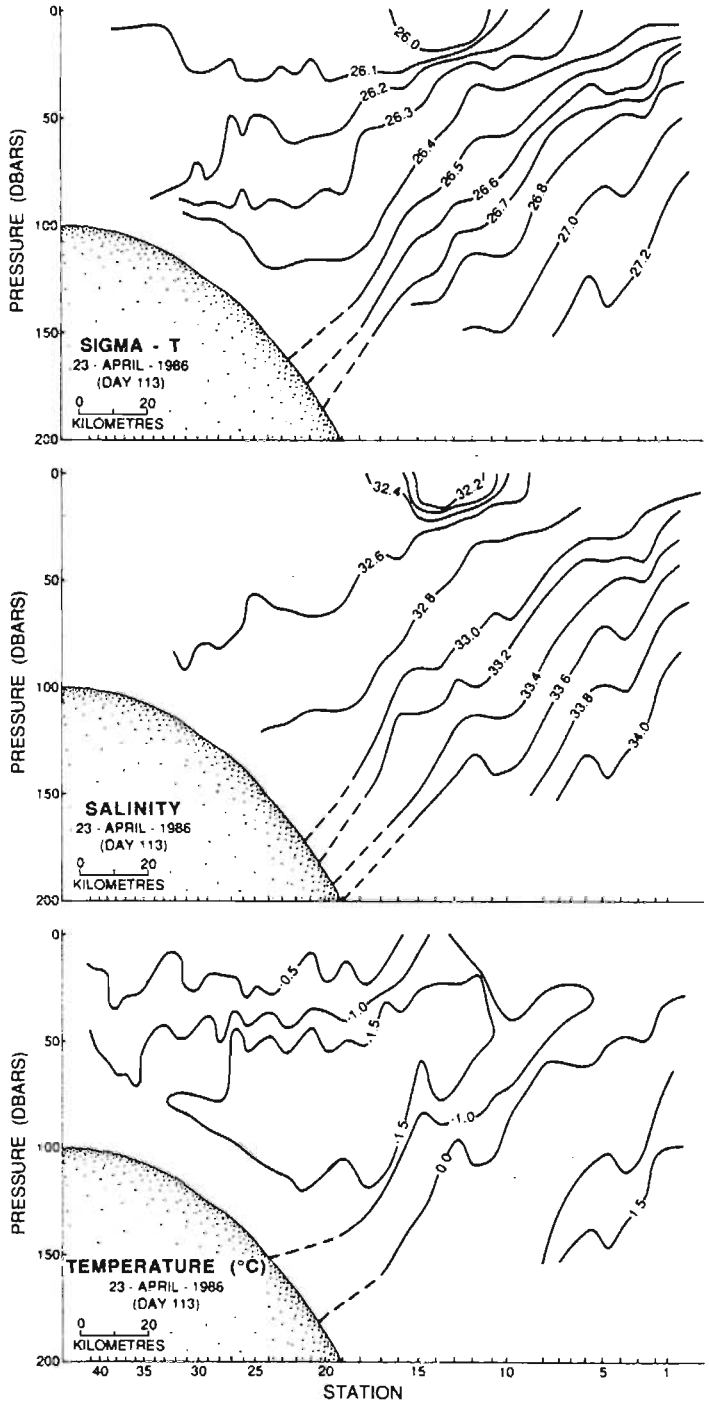

Figure 53. a) Temperature, b) salinity and c) sigma-t contours for Batfish section from the spring cruise. See Fig. 52 for station positions.

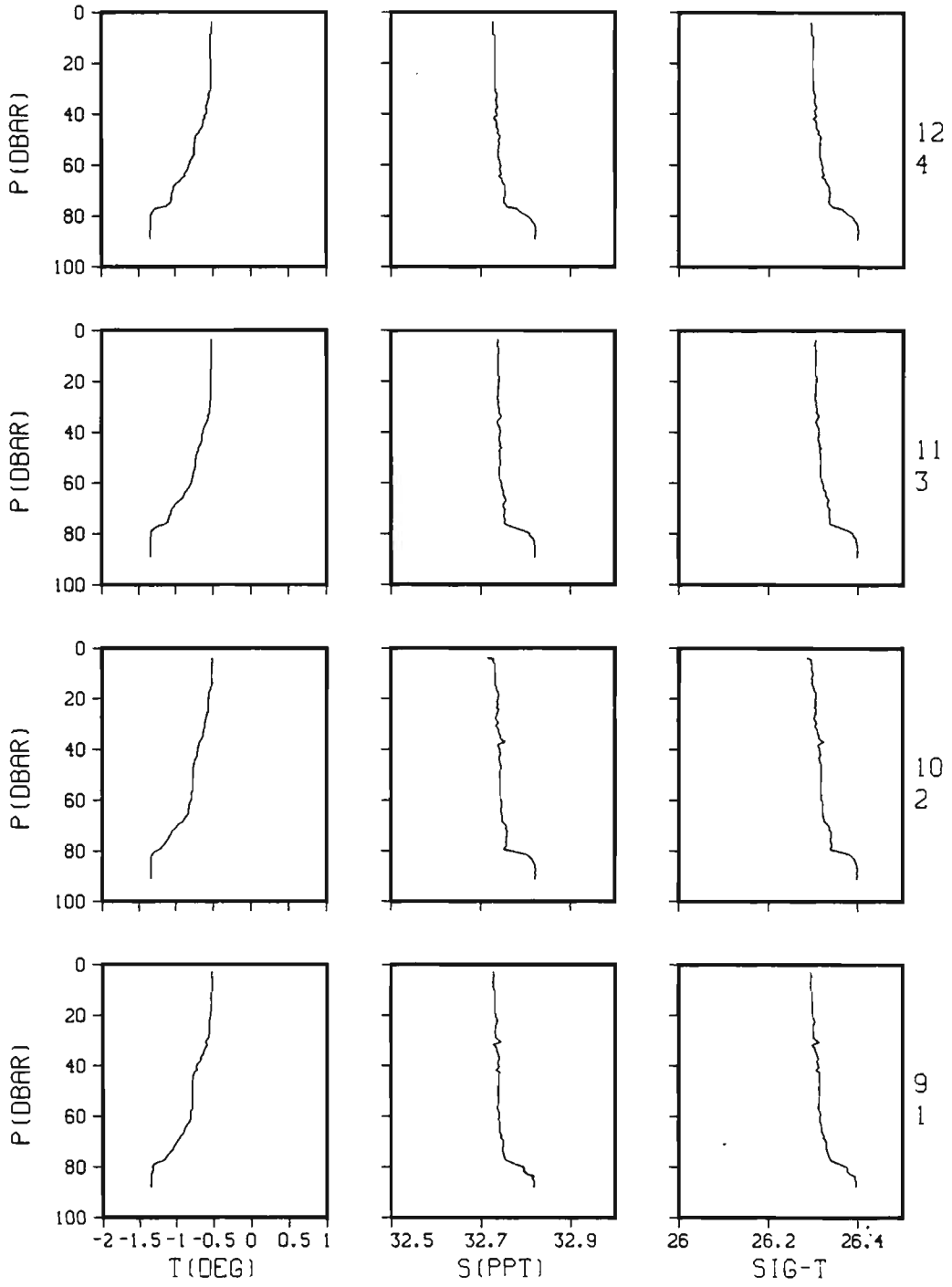

Figure 54. Temperature, salinity and sigma-t profiles from the spring cruise. Station positions are indicated in Table 5.

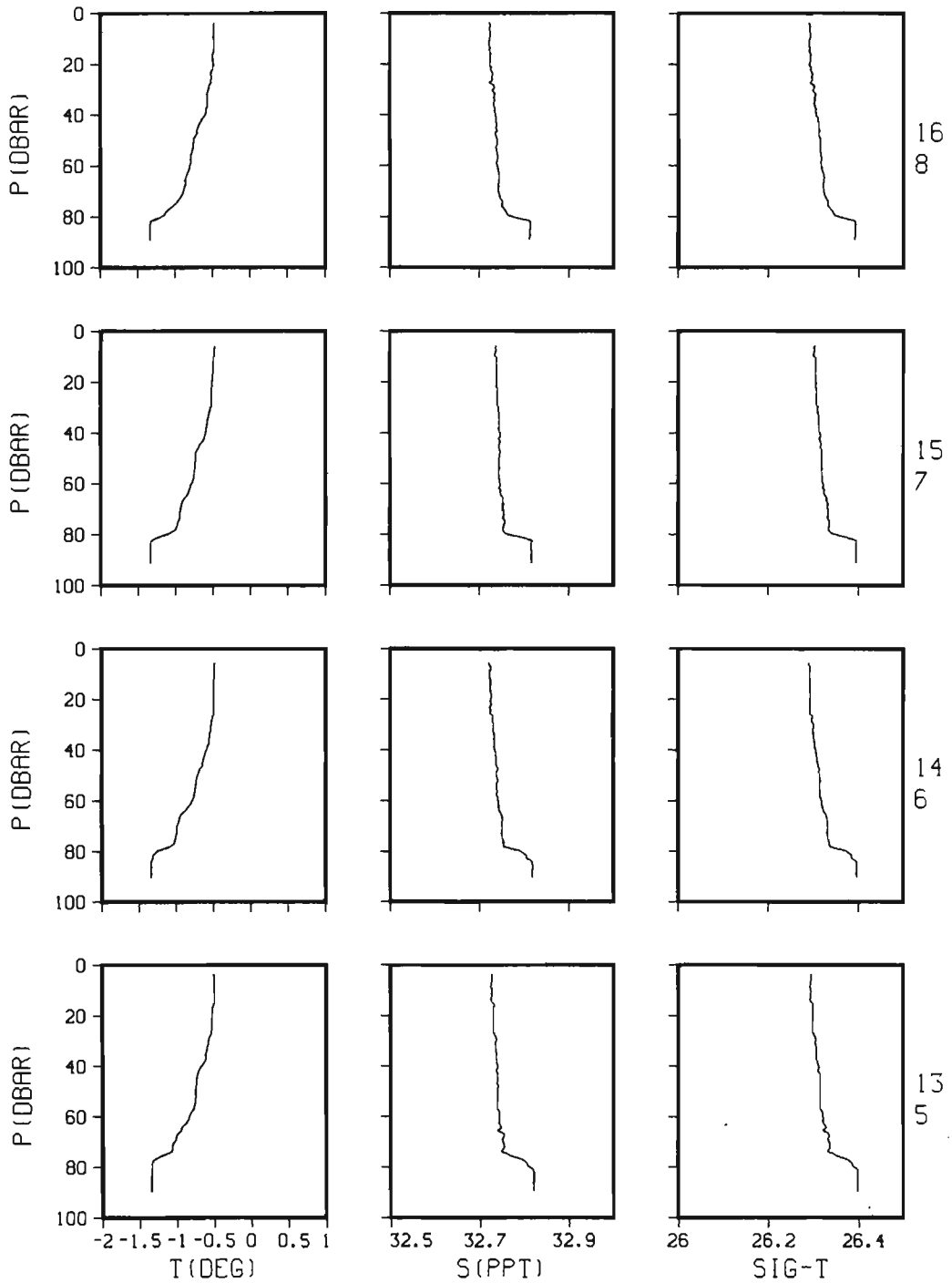

Figure 55. Temperature, salinity and sigma-t profiles from the spring cruise. Station positions are indicated in Table 5.

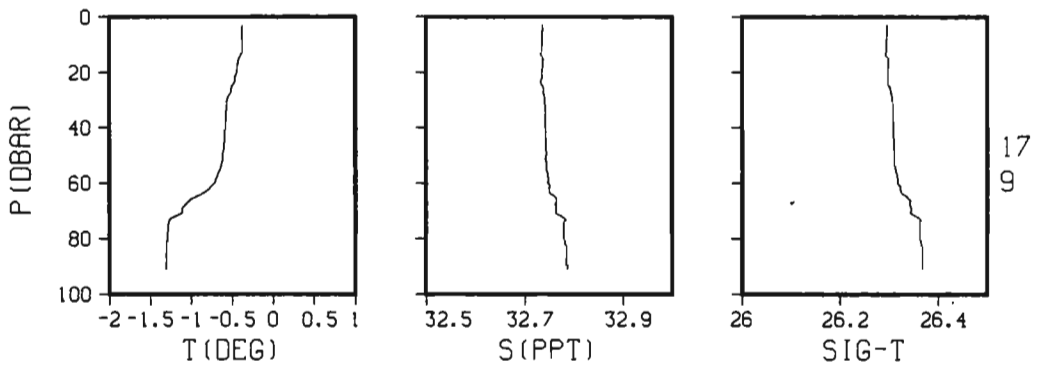

Figure 56. A temperature, salinity and sigma-t profile from the spring cruise. Station positions are indicated in Table 5.

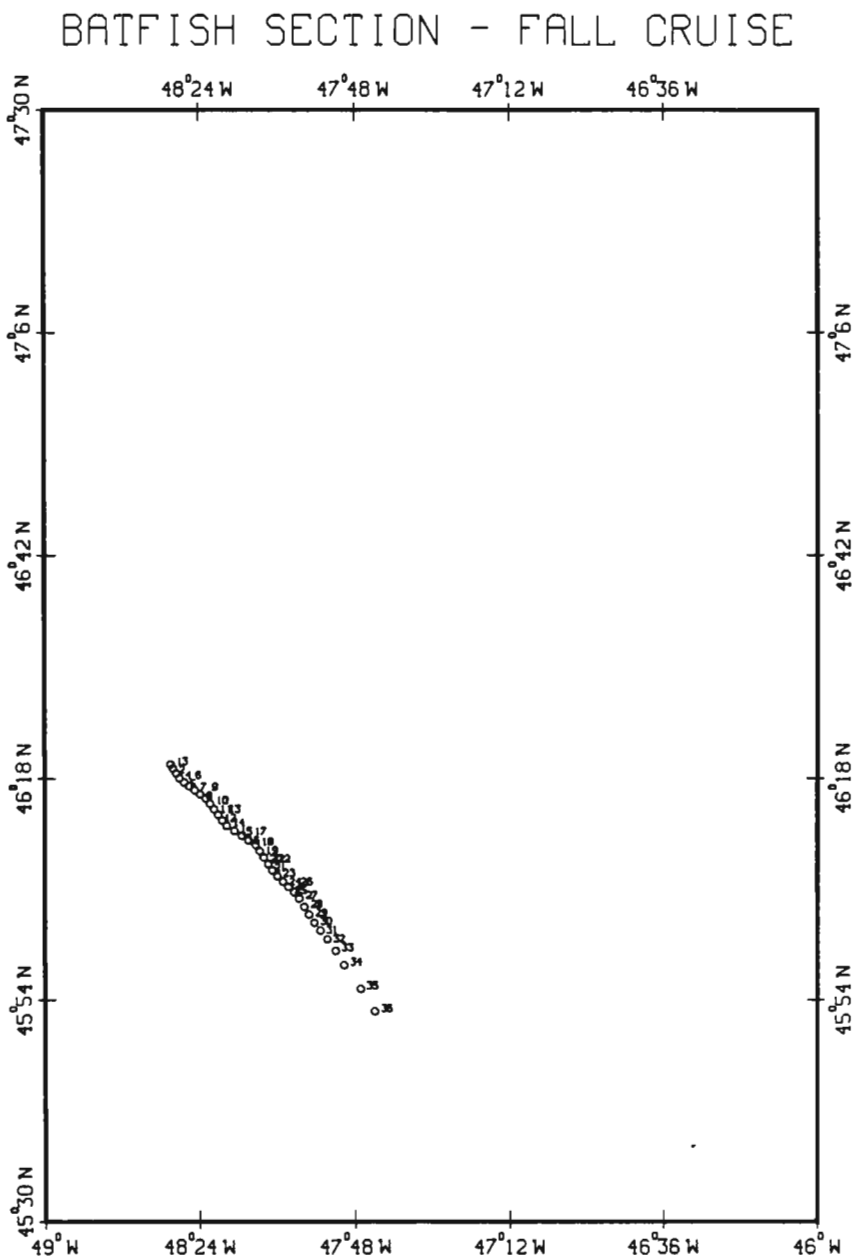

Figure 57. Station positions for the Batfish section from the fall cruise.

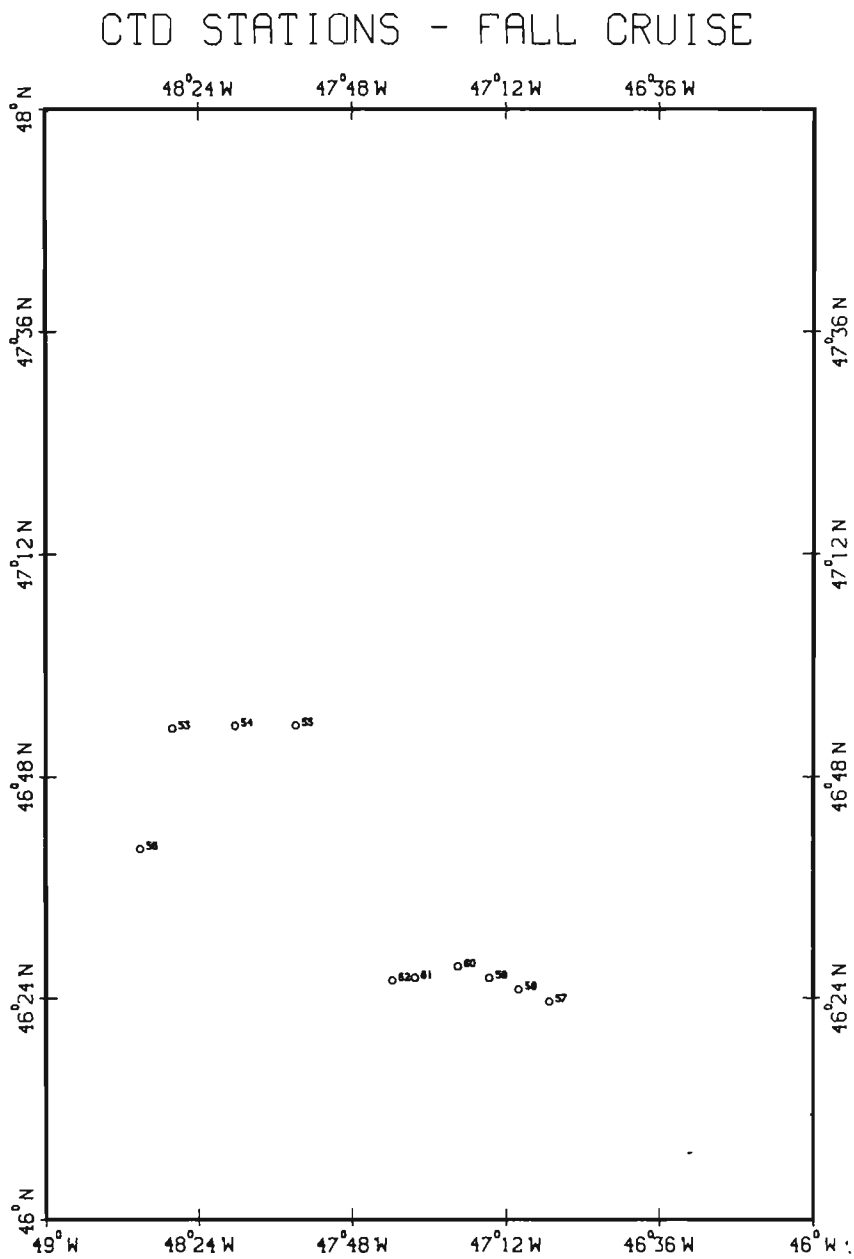

Figure 58. CTD station positions from the fall cruise. Detailed information on times and positions is given in Table 6.

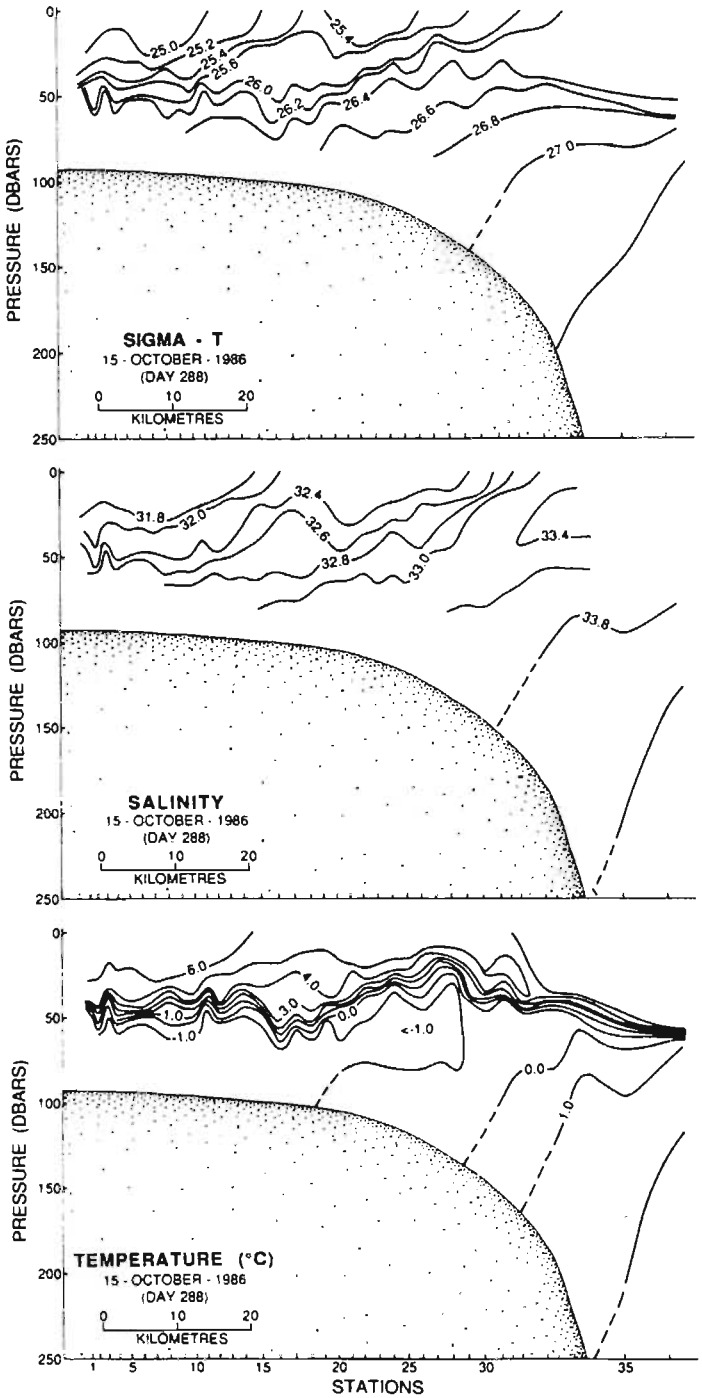

Figure 59. a) Temperature, b) salinity and c) sigma-t contours for Batfish section from the fall cruise.

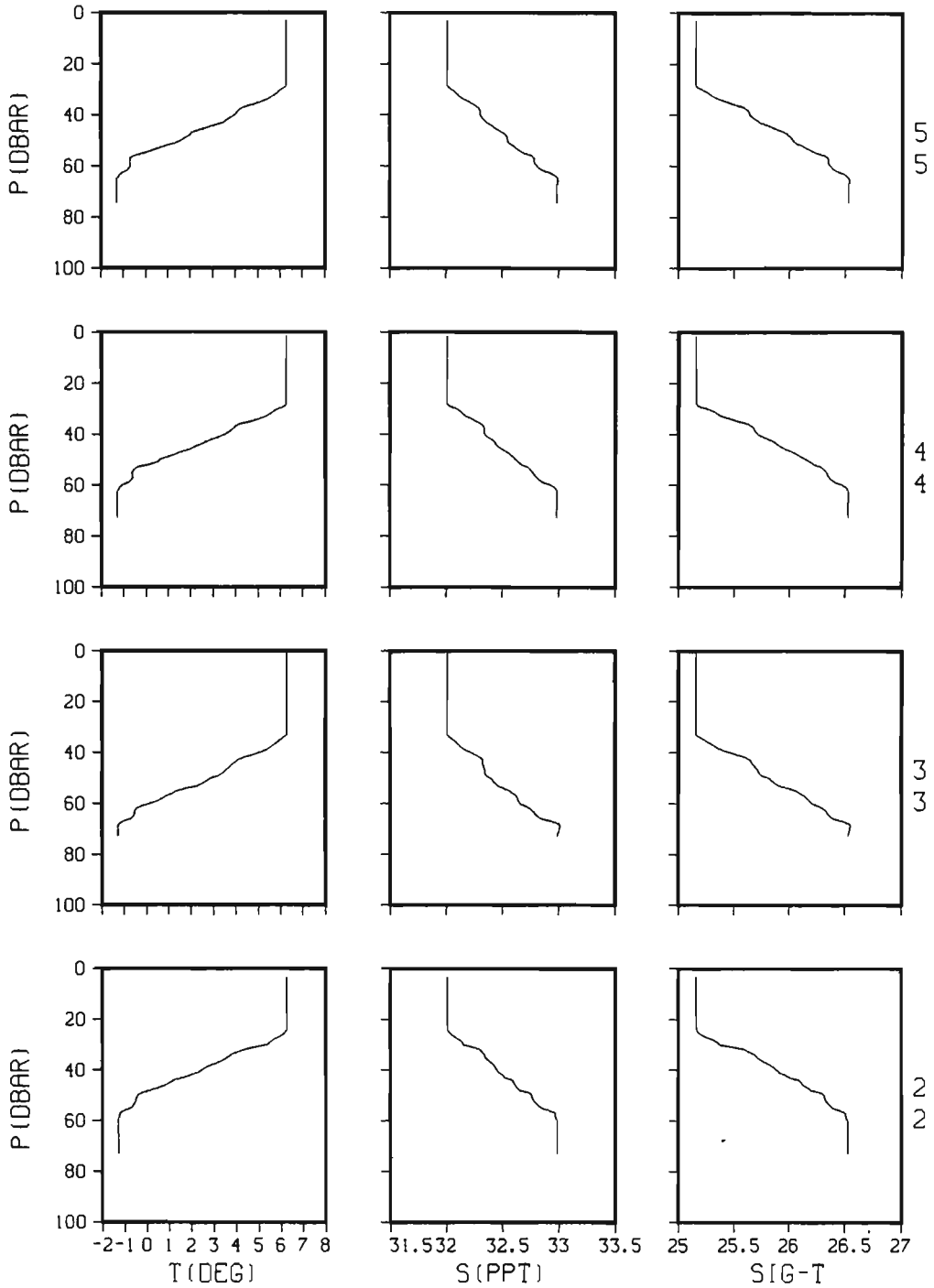

Figure 60. Temperature, salinity and sigma-t profiles (2-5) from fall cruise. All data are from the same location. Times (GMT) are given in the upper left corner of the temperature panel. Detailed information on these CTD is given in Table 6. CTD profiles from 2-52 are at a fixed station.

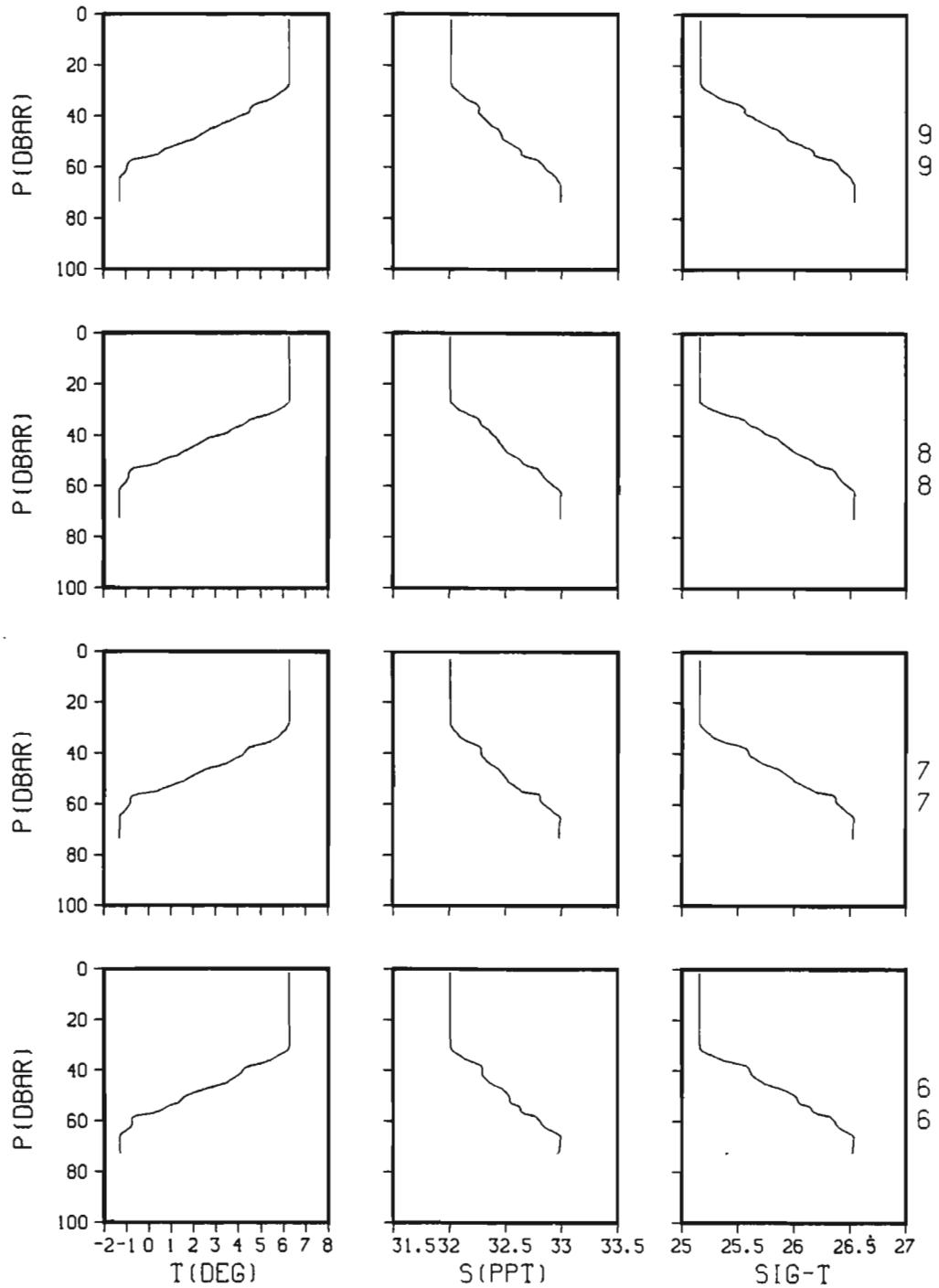

Figure 61. Temperature, salinity and sigma-t profiles (6-9) from the fall cruise.

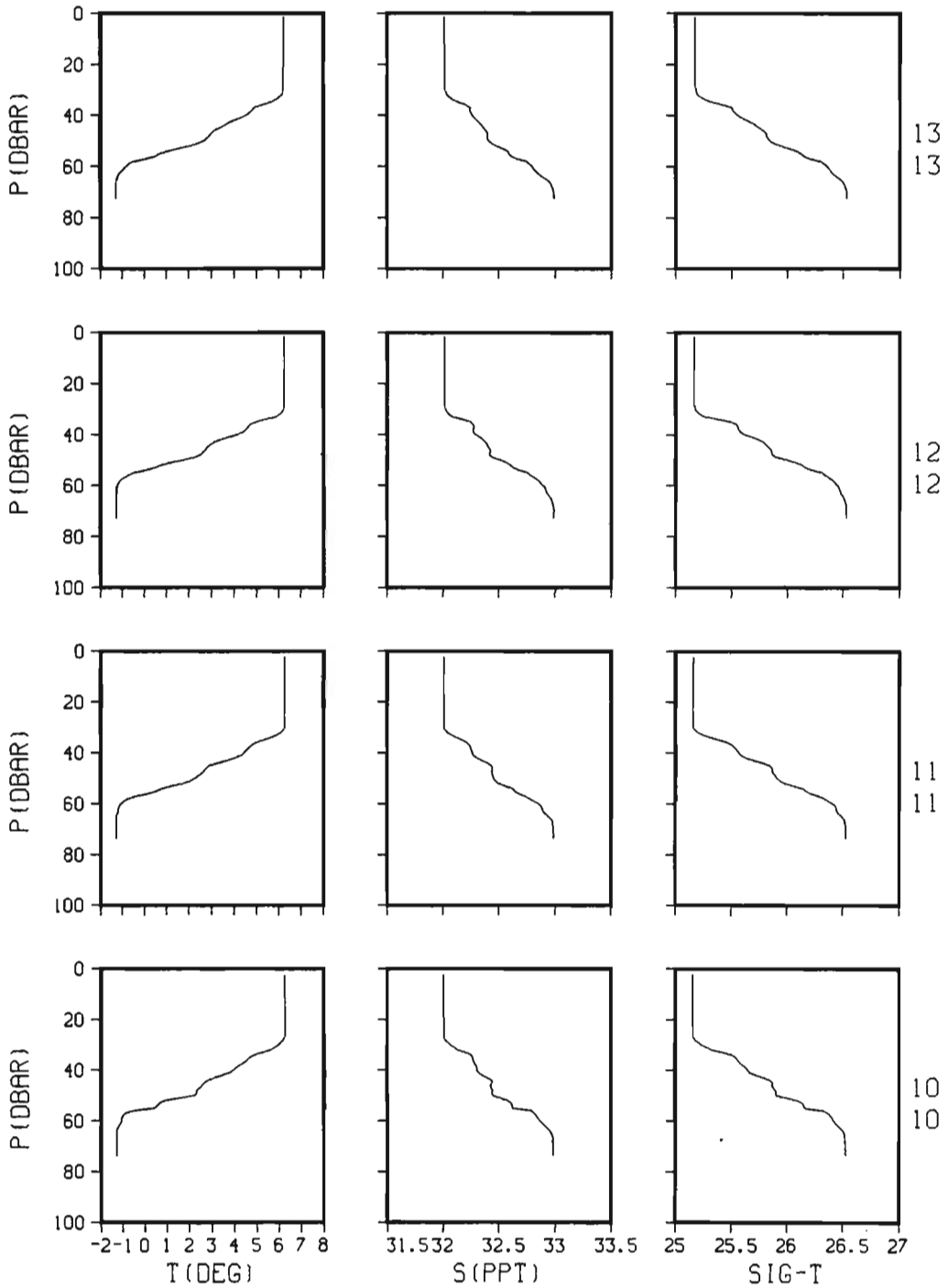

Figure 62. Temperature, salinity and sigma-t profiles (10-13) from the fall cruise.

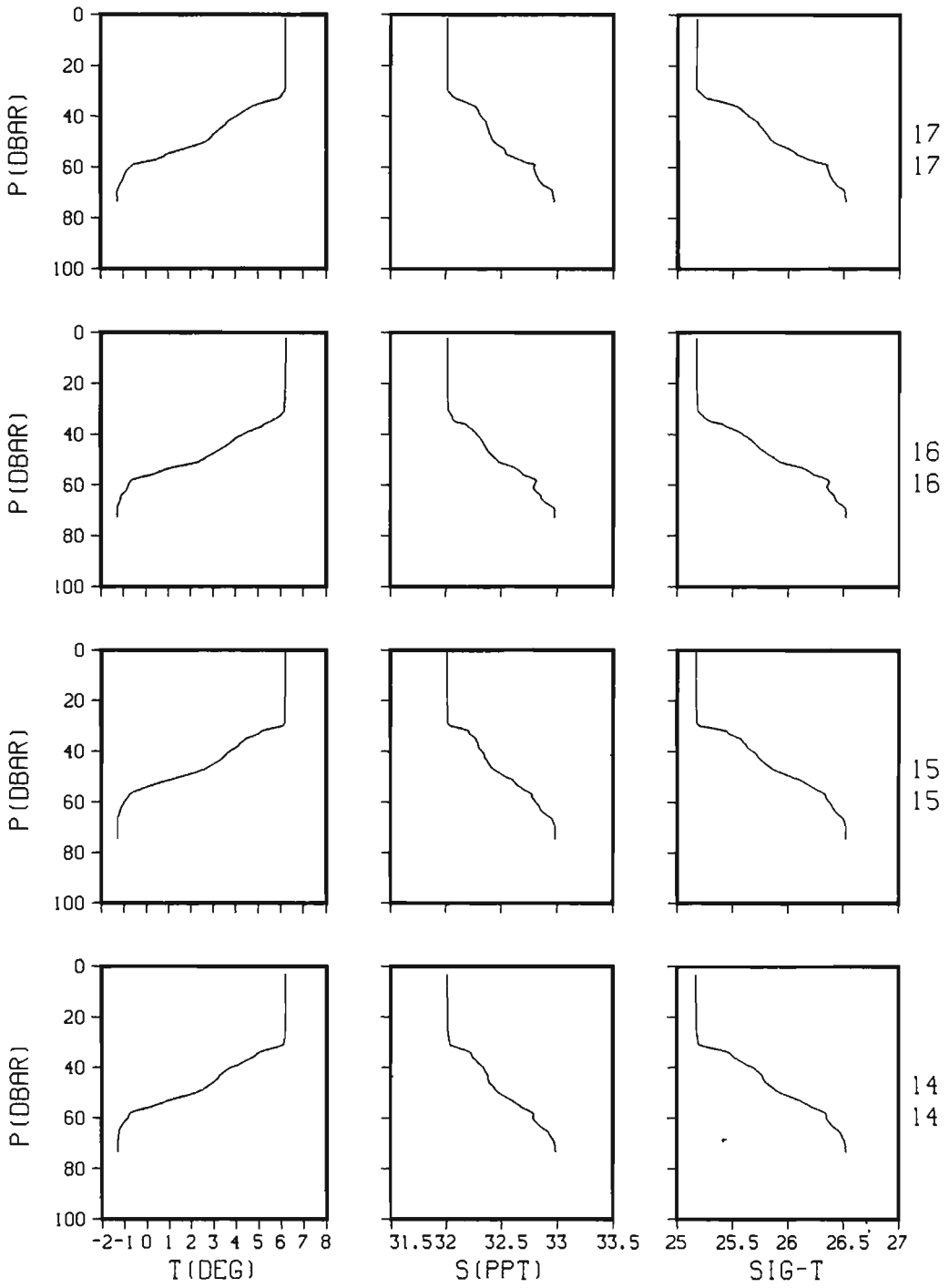

Figure 63. Temperature, salinity and sigma-t profiles (14-17) from the fall cruise.

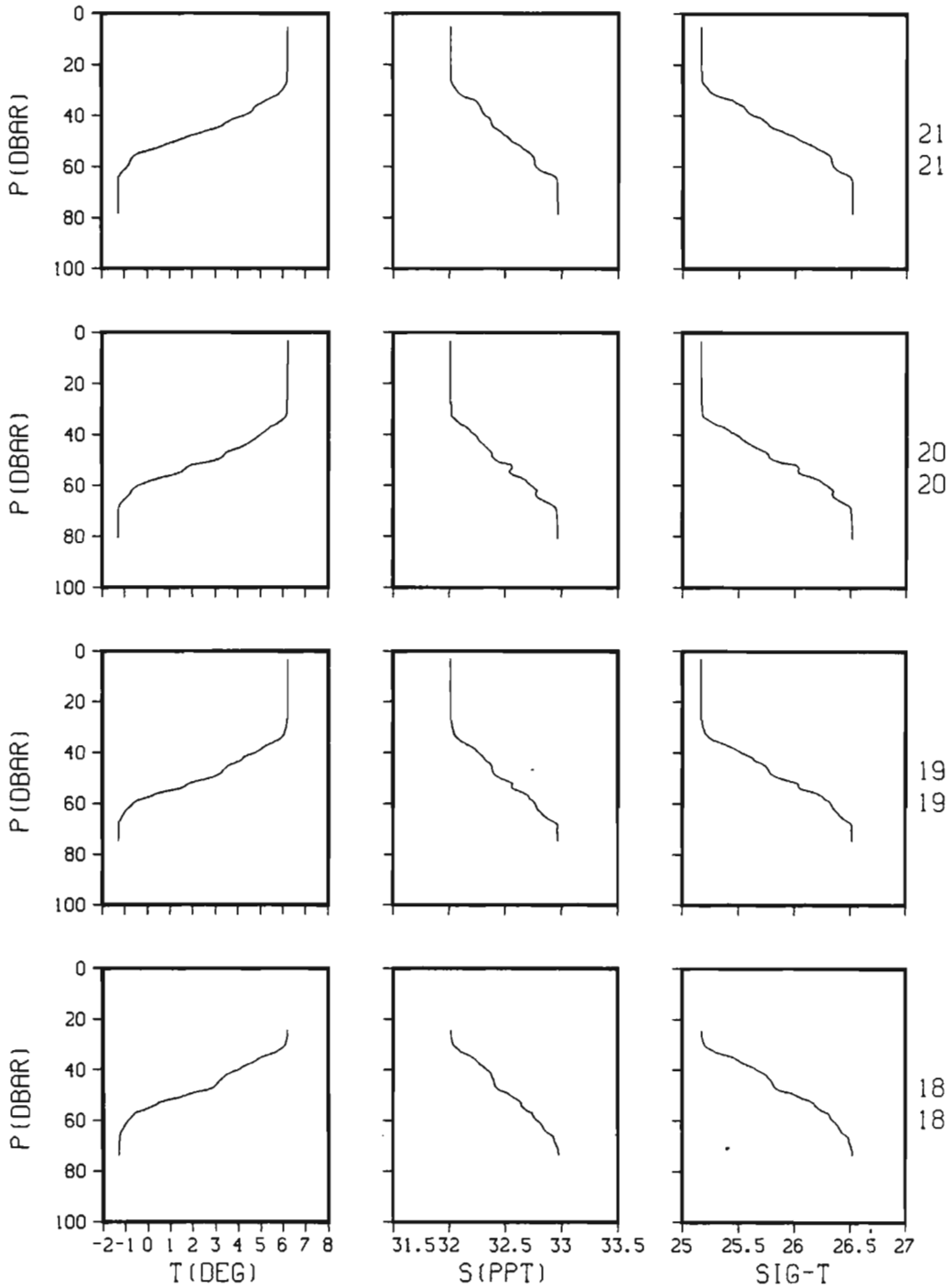

Figure 64. Temperature, salinity and sigma-t profiles (18-21) from the fall cruise.

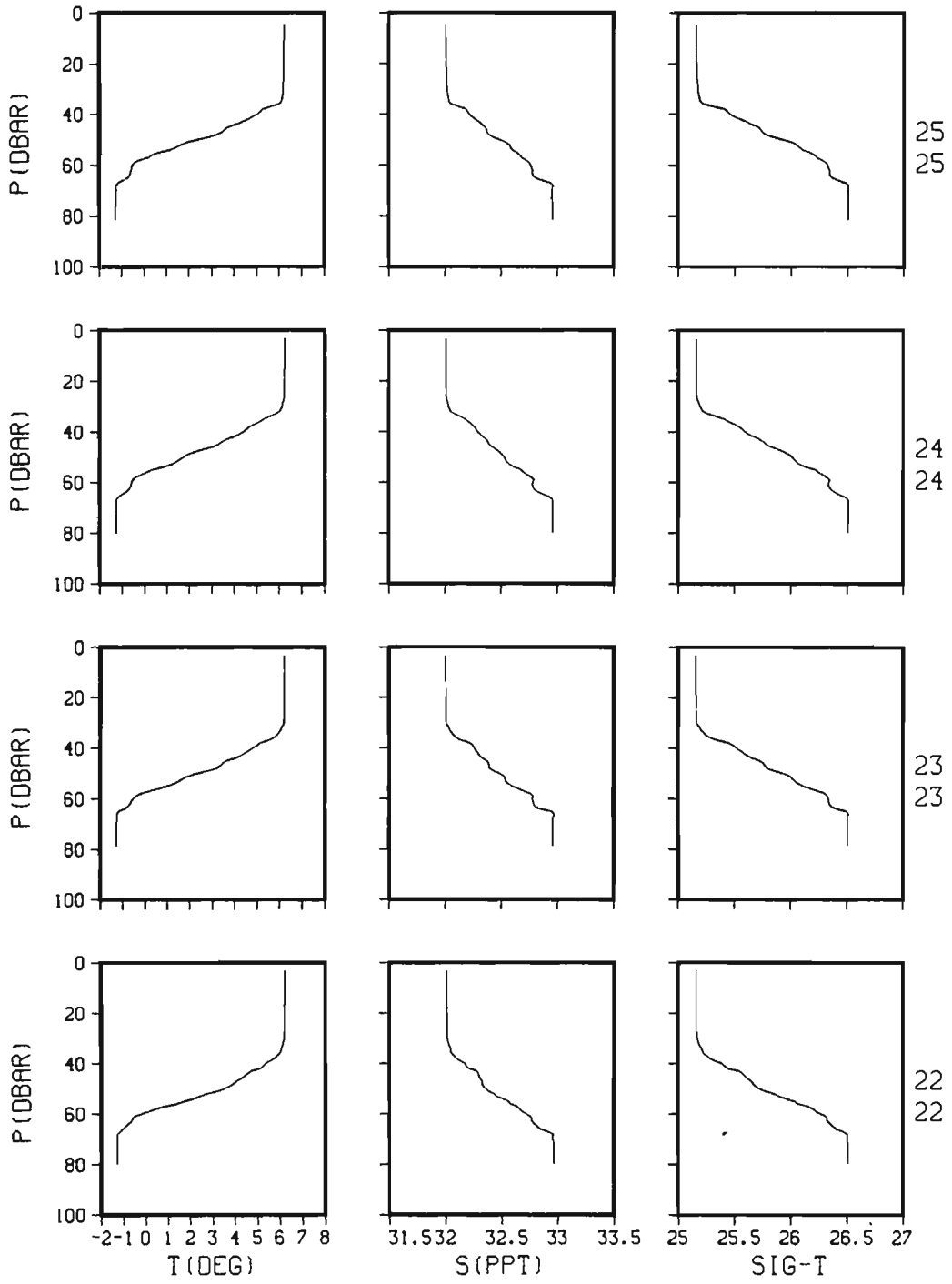

Figure 65. Temperature, salinity and sigma-t profiles (22-25) from the fall cruise.

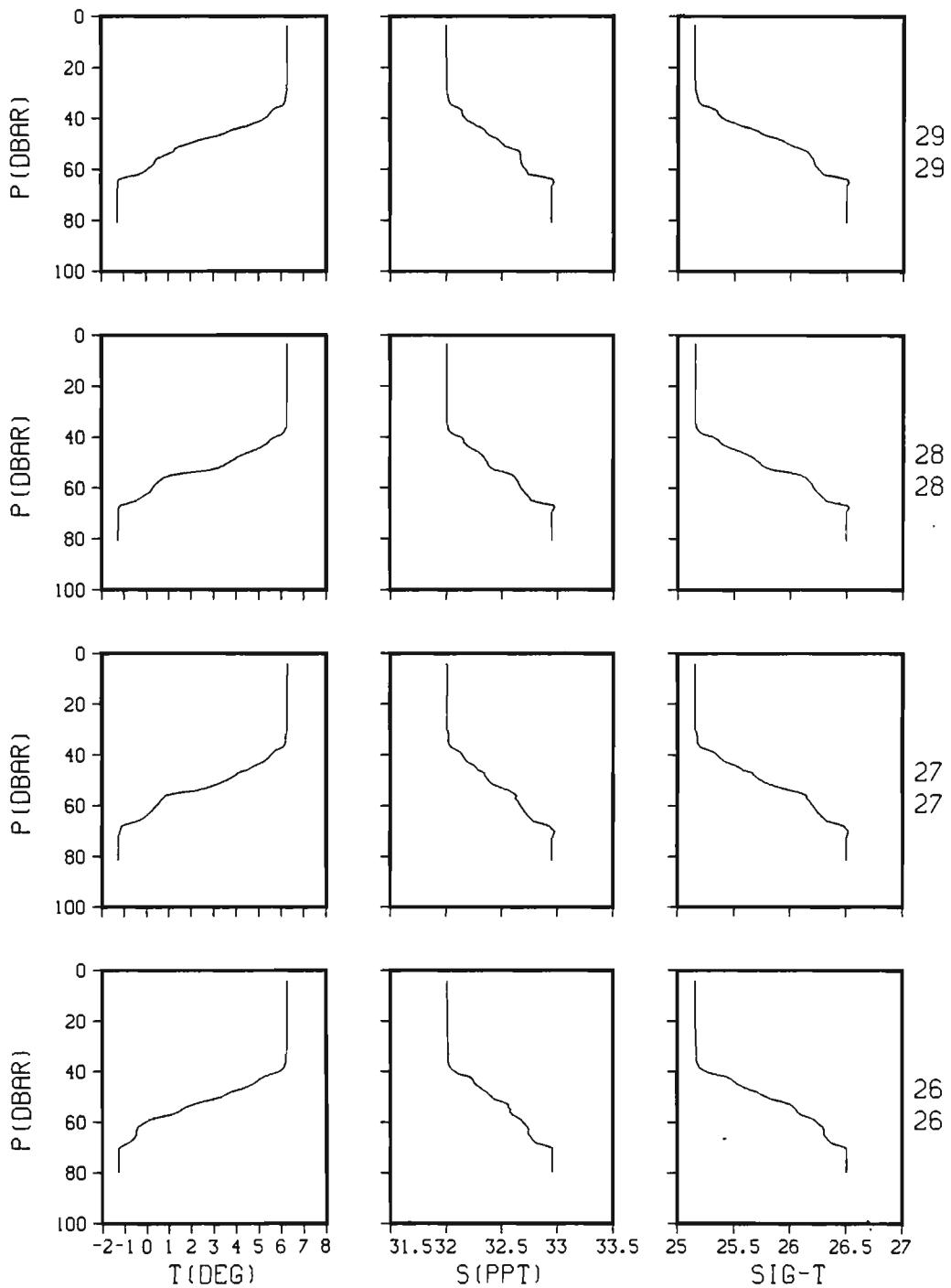

Figure 66. Temperature, salinity and sigma-t profiles (26-29) from the fall cruise.

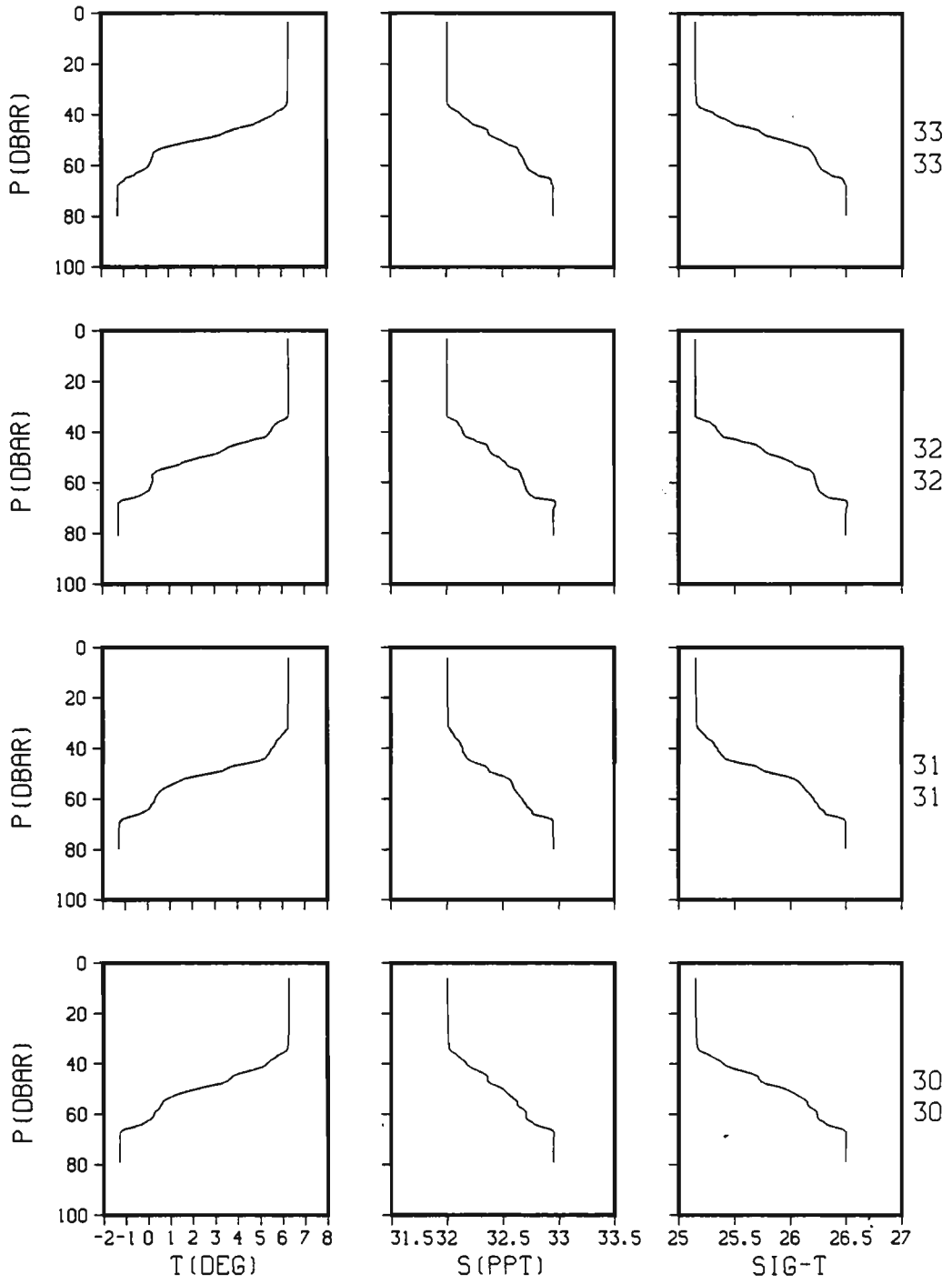

Figure 67. Temperature, salinity and sigma-t profiles (30-33) from the fall cruise.

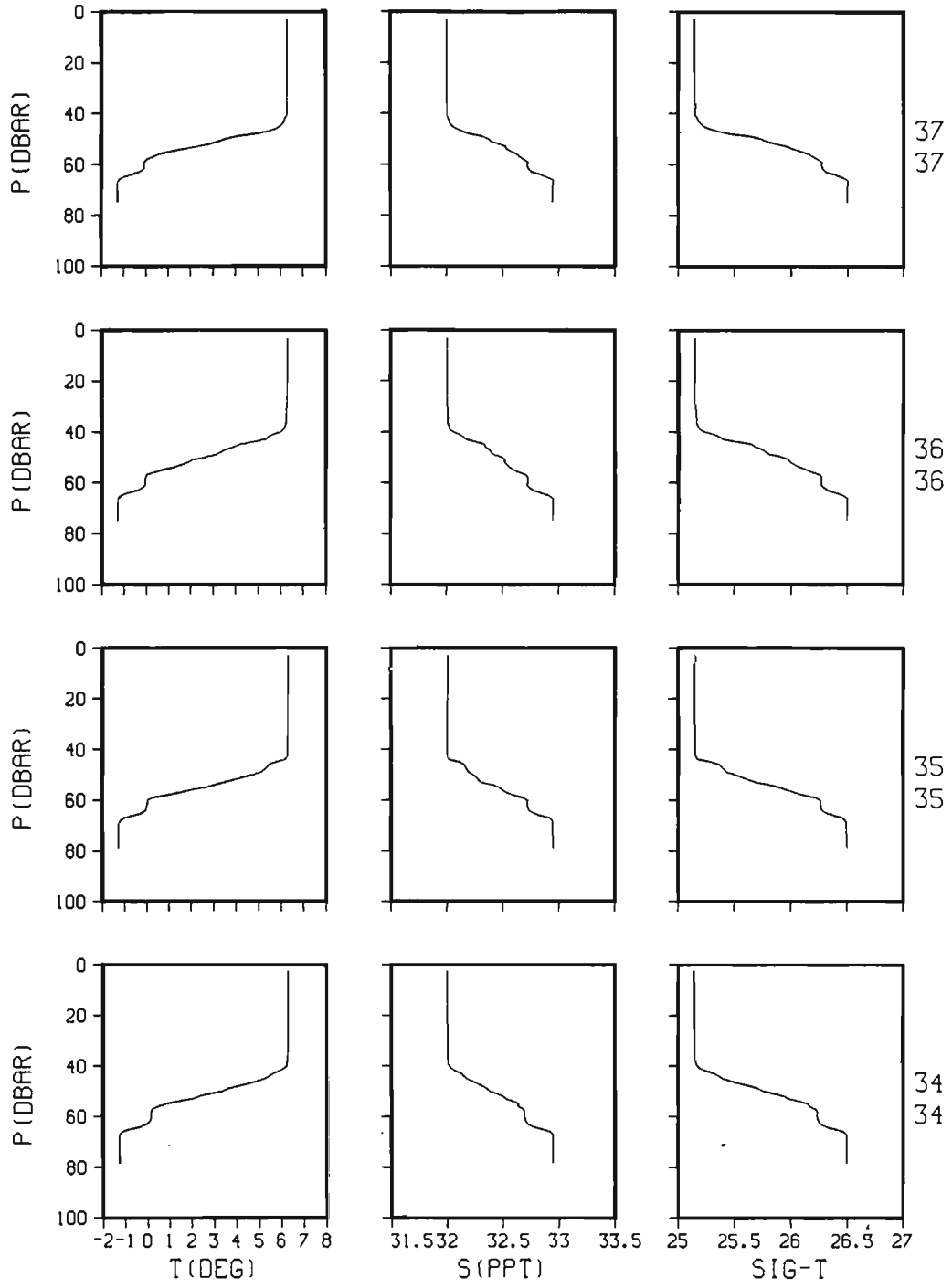

Figure 68. Temperature, salinity and sigma-t profiles (34-37) from the fall cruise.

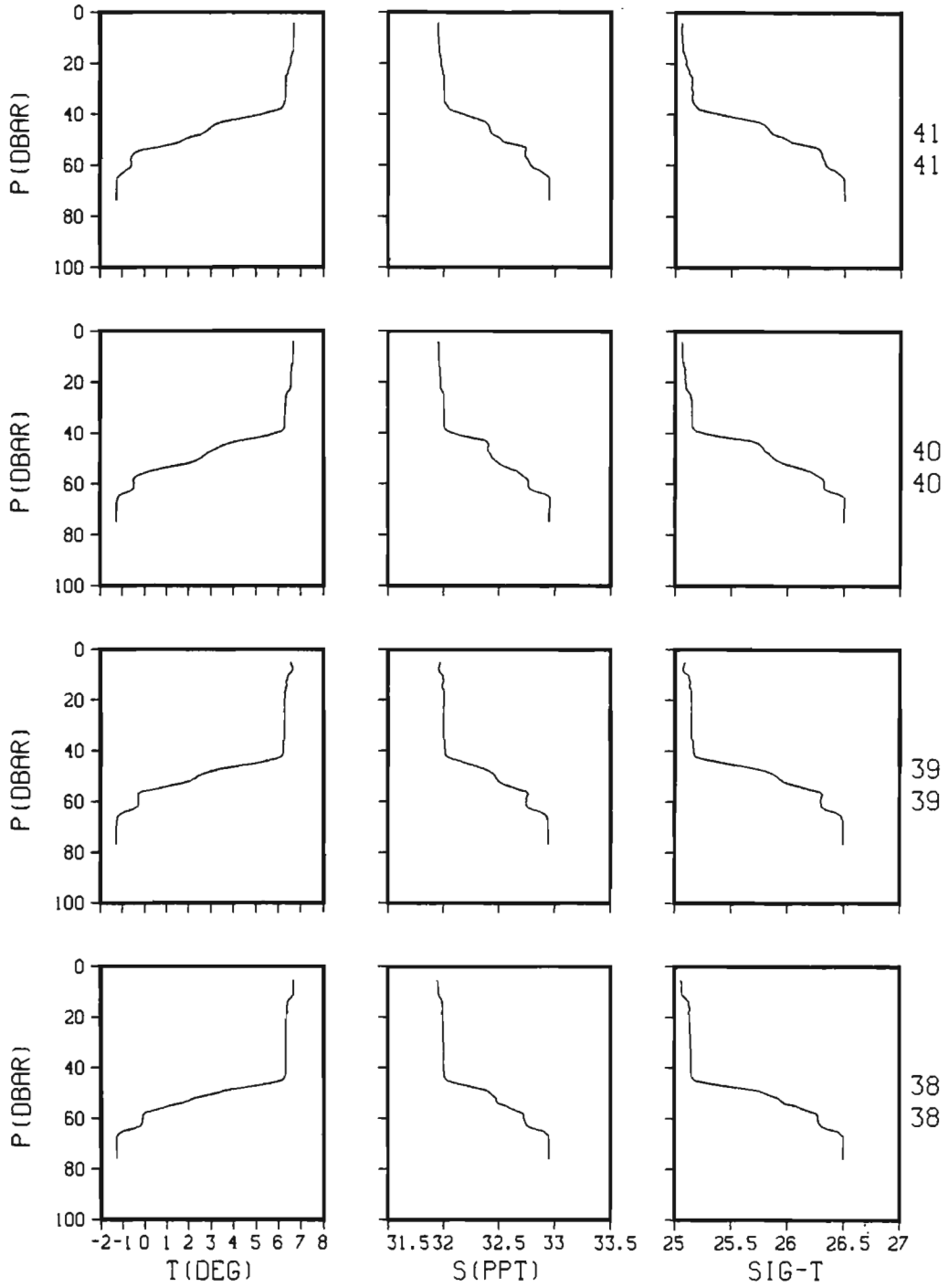

Figure 69 Temperature, salinity and sigma-t profiles (38-41) from the fall cruise.

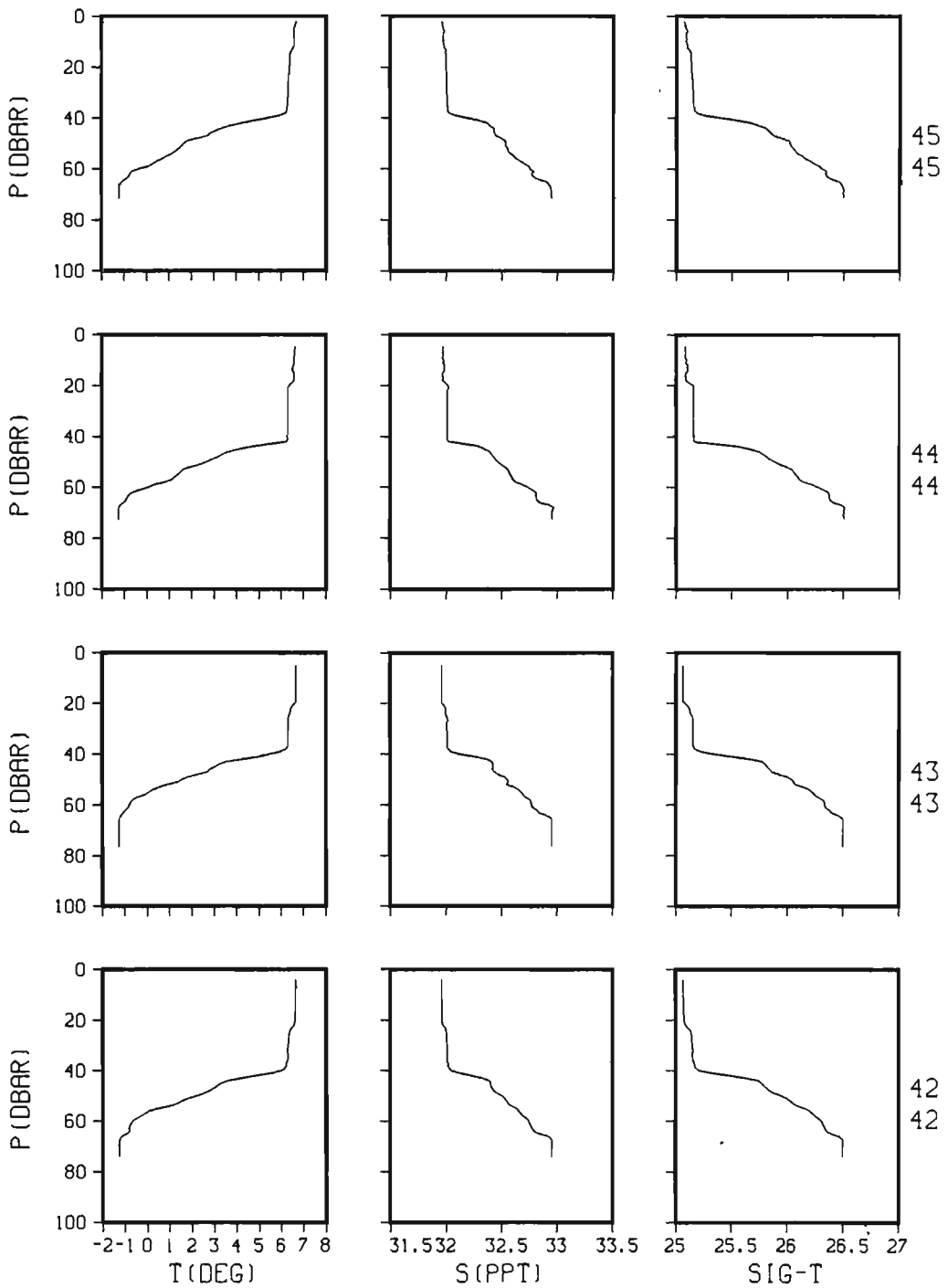

Figure 70. Temperature, salinity and sigma-t profiles (42-45) from the fall cruise.

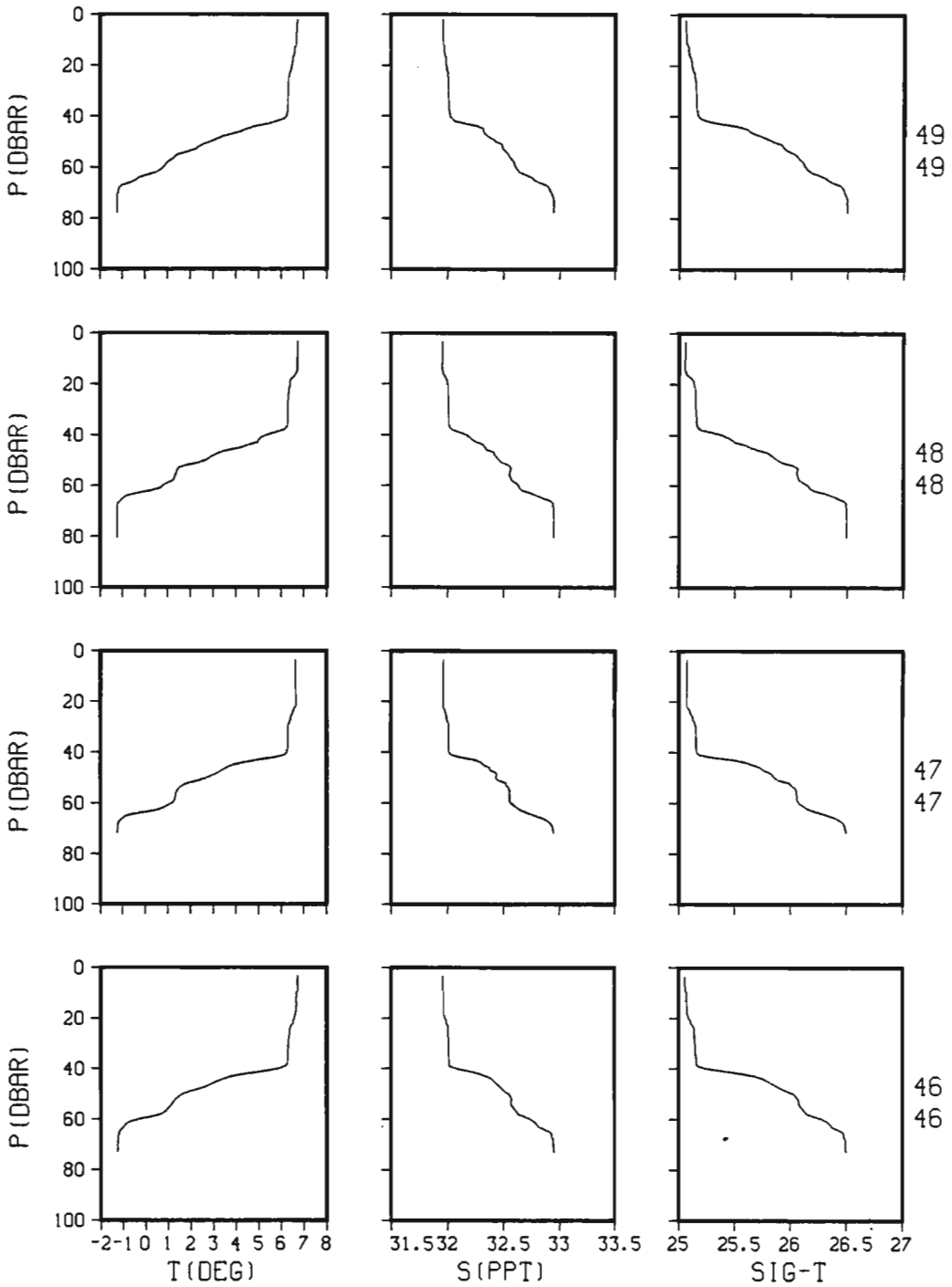

Figure 71. Temperature, salinity and sigma-t profiles (46-49) from the fall cruise.

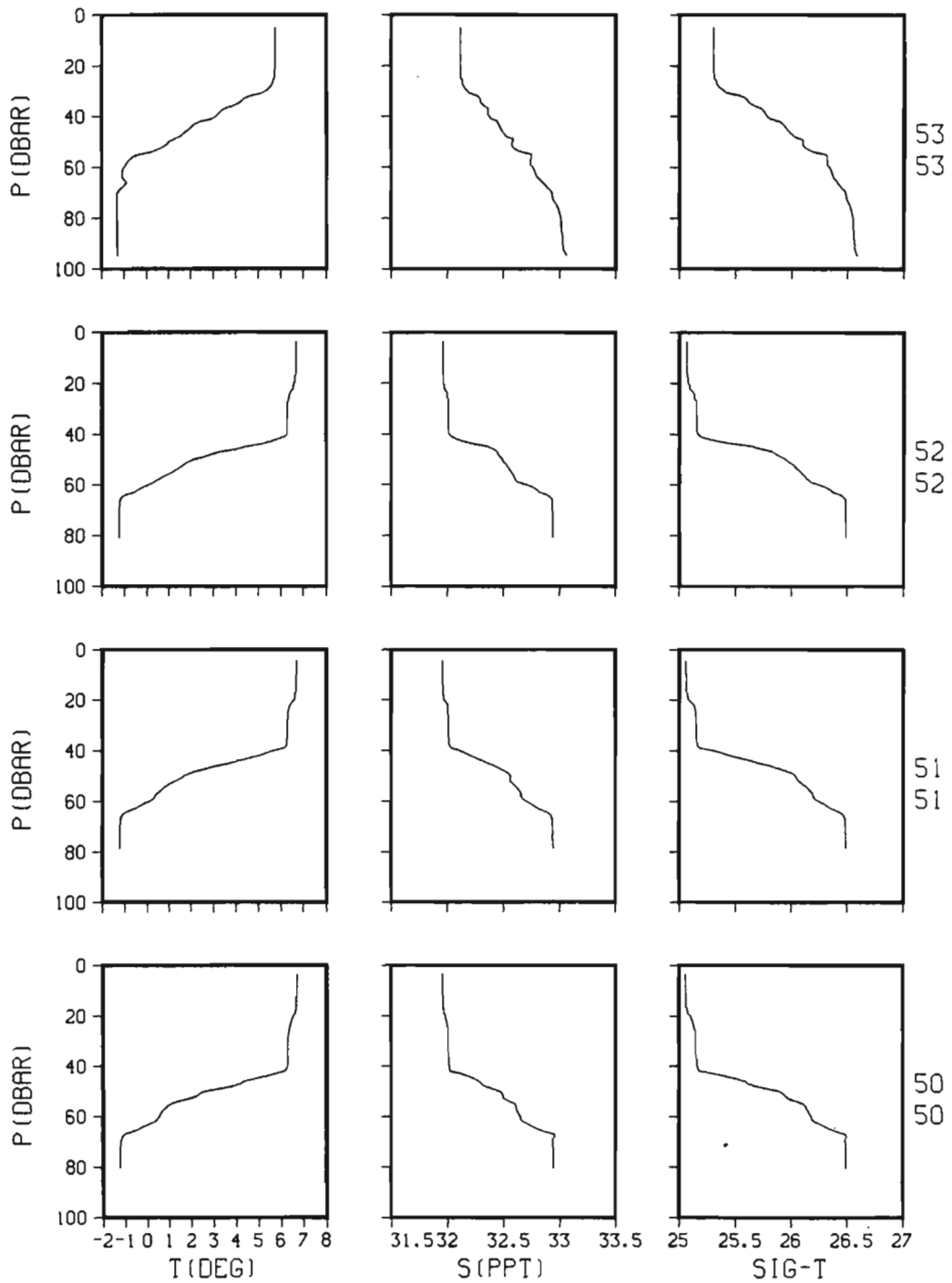

Figure 72. Temperature, salinity and sigma-t profiles (50-53) from the fall cruise. Station 52 marks the end of the anchor station. Positions of CTD casts beyond station 53 vary, and are indicated in Fig. 58.

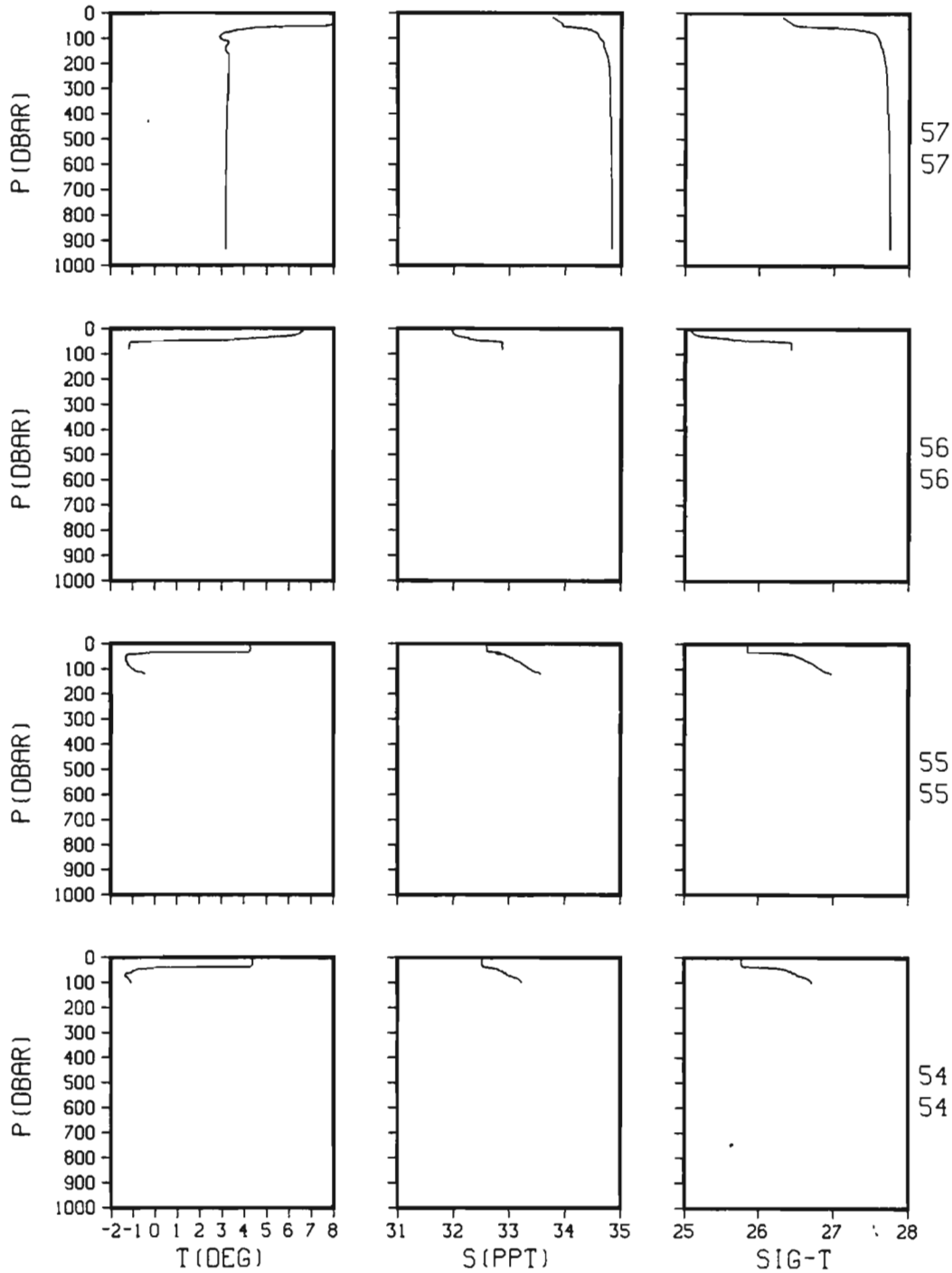

Figure 73. Temperature, salinity and sigma-t profiles (54-57) from the fall cruise. See Fig 58 for station positions.

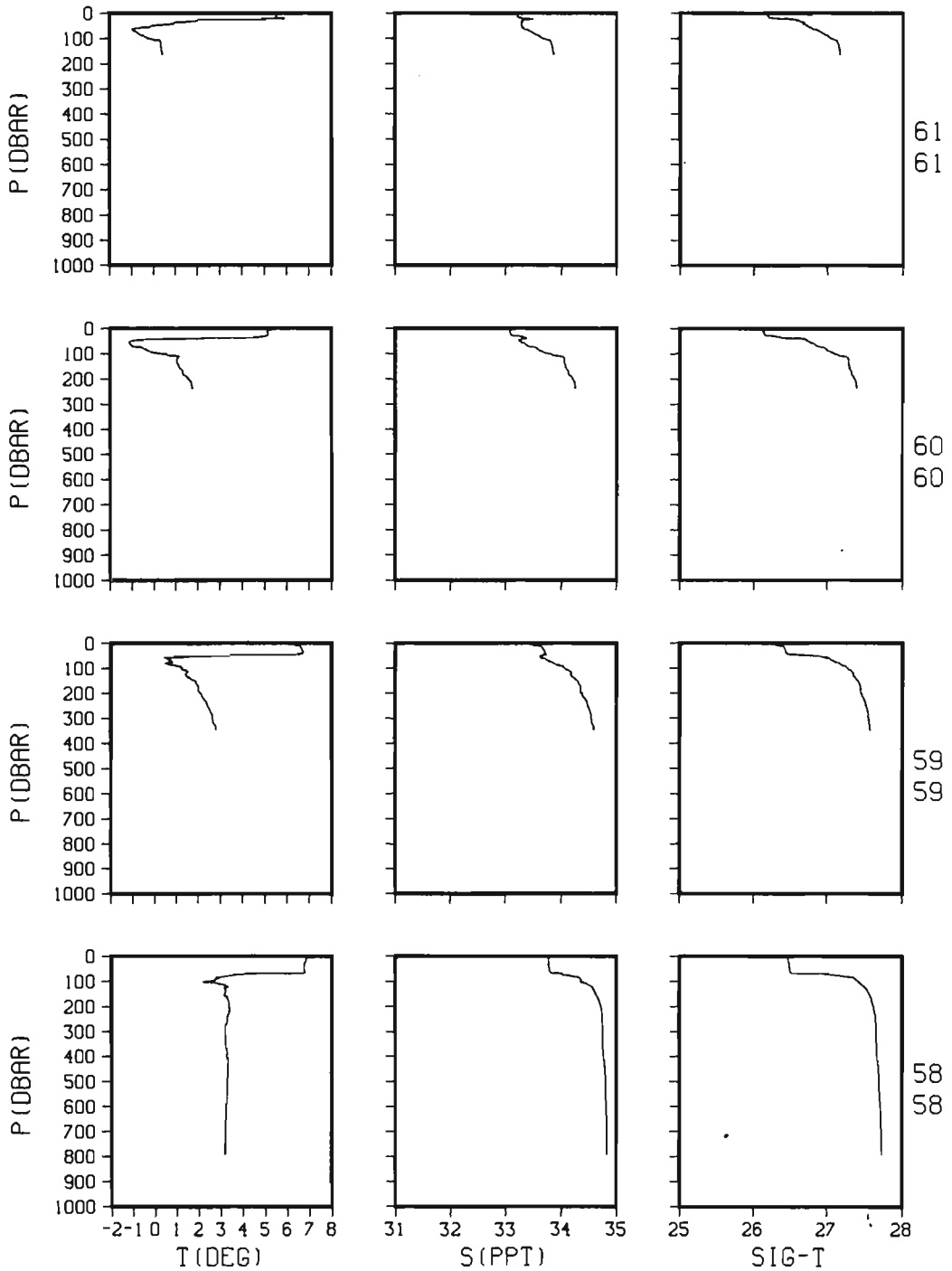

Figure 74. Temperature, salinity and sigma-t profiles (58-61) from the fall cruise. See Fig. 58 for station positions.

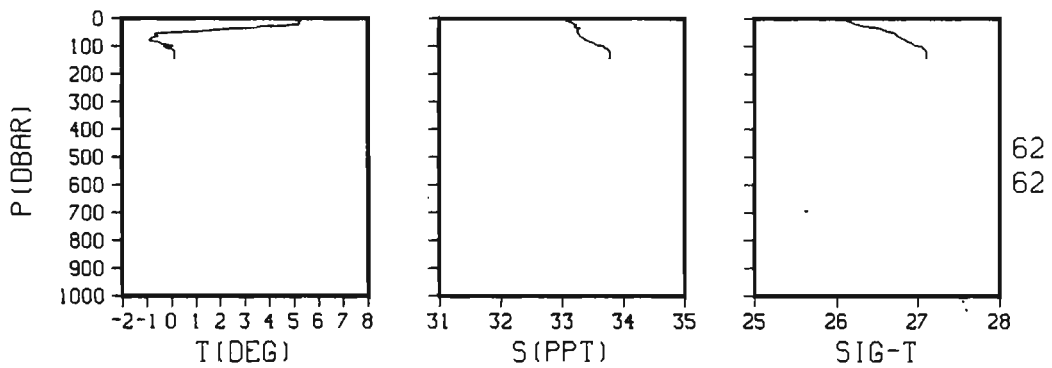

Figure 75. Temperature, salinity and sigma-t profiles (62) from the fall cruise. See Fig. 58 for the station positions.