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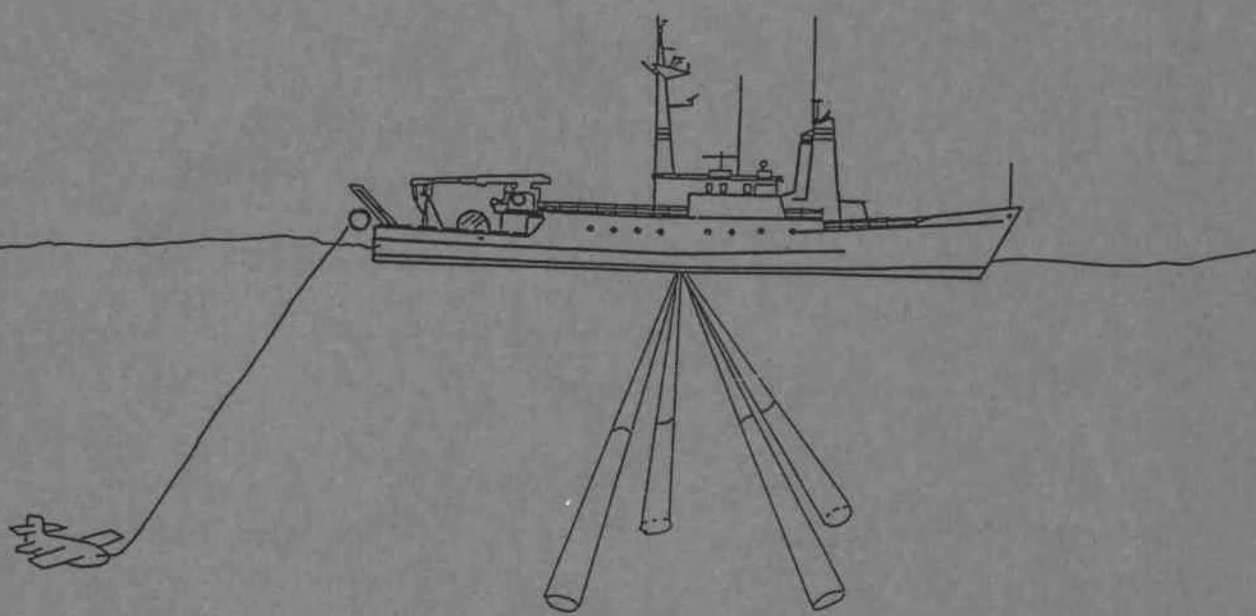

SEASOAR Observations
During a COARE Surveys Cruise, W9211B,
12 December 1992 to 16 January 1993

by
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Data Report 156
Reference 94-2
May 1994

Oregon State University

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Introduction

An international Coupled Ocean-Atmosphere Response Experiment (COARE) was conducted in the warm-pool region of the western equatorial Pacific Ocean over a four-month period from November 1992 through February 1993 (Webster and Lukas, 1992). Most of the oceanographic and meteorological observations were concentrated in the Intensive Flux Array (IFA) centered at 1°45'S, 156°00'E. As part of this experiment, the R/V Wecoma conducted three survey cruises; each cruise included measurements of the temperature, salinity and velocity distribution in the upper 300 m of the ocean, and continuous meteorological measurements of wind, air temperature, humidity, etc. Most of these measurements were along a butterfly pattern that was sampled repeatedly during the three COARE Surveys cruises, W9211A and W9211B, and W9211C.

Coordinates of the Standard Butterfly Pattern were chosen to measure zonal and meridional gradients across the center of the IFA, spanning the profiling current meter array, while avoiding moorings and stationary ships without frequent deviations from our track (Figure 1). The standard coordinates of the butterfly apexes are:

SBN	1°14'S	156°06'E
SBS	2°26'S	156°06'E
SBW	1°50'S	155°30'E
SBE	1°50'S	156°42'E

and sampling was done sequentially along the track joining these four points, i.e. along a meridional section (N2S) from SBN to SBS, a diagonal section (S2W) from SBS to SBW, a zonal section (W2E) from SBW to SBE, and a diagonal section (E2N) from SBE to SBN to complete the pattern. Along this track, we measured the upper ocean temperature and salinity by means of a towed undulating Seasoar vehicle (Figure 2) equipped with a SeaBird CTD system, while underway at 7-8 knots. CTD casts were made at the beginning and end of each tow, primarily to check calibration of the Seasoar sensors. Water velocity along the ship's track was measured by means of the ship-borne acoustic Doppler current profiler.

This report summarizes the Seasoar observations from Wecoma's second COARE Surveys cruise, W9211B. It also provides a cruise narrative, and a brief description of the data processing procedures.

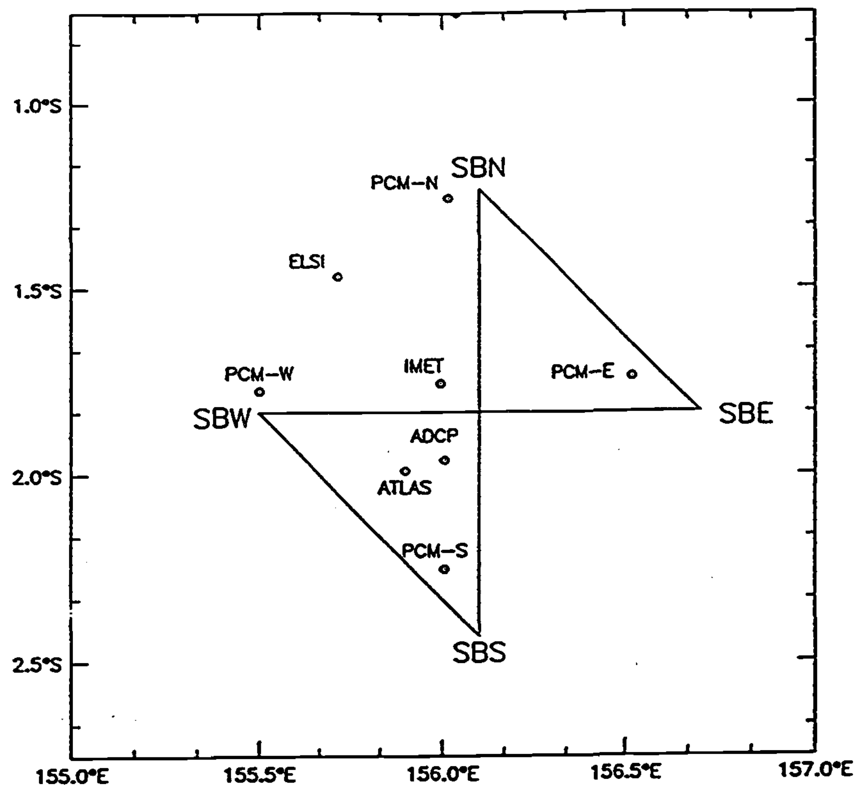

Figure 1. The Standard Butterfly Pattern in relation to the moorings of the COARE Intensive Flux Array.

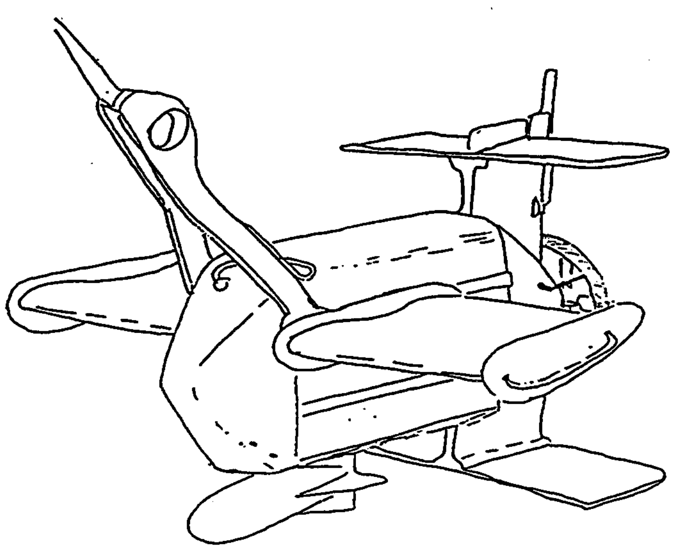

Figure 2. Sketch of the Seasoar vehicle used during W9211B.

Cruise Narrative, W9211B

Wecoma departed from Guam about 0200 UTC, 12 December 1992, and proceeded to Pohnpei, arriving at 1130 UTC, 15 December. Additional members of the scientific party embarked, and Wecoma departed again at 2200 UTC the same day. A transit to 5° N, 156° E followed, where a series of 1500 meter CTD casts were to begin. These casts would proceed into the IFA, with a spacing of every 0.5 degrees in latitude. See Table 1.

After arrival at 5° N on 16 December we made our first CTD cast (Station 1, Table 1) with an SBE 9/11 plus CTD with dual ducted temperature and conductivity sensors (Table 2). This first cast was approximately two nautical miles north of an ATLAS mooring (TCIPO mooring 09, also designated WMO 52008). We then proceeded south along 156° East longitude, obtaining 1500 meter CTD casts every 0.5 degrees in latitude. At 2° N we were near another ATLAS mooring (TCIPO mooring 10; WMO 52011), and after the 1500 meter cast (Station 7) we moved to within about 0.5 nautical miles of the ATLAS for a 200 meter cast. We then continued heading southward along 156° E. After we completed the final cast of this sequence at 2° S (Station 16) we did another 200 meter cast near the ATLAS mooring within the IFA (TCIPO mooring 22; WMO 52012) (Figure 1). We then proceeded to our first Seasoar deployment and sampling pattern along the Standard Butterfly Pattern.

The Seasoar vehicle was equipped with an SBE 9/11 plus CTD (SN 0258) with dual ducted temperature and conductivity sensors (Table 2; Figure 3). The maximum wing angle settings of the Seasoar are adjustable (Figure 4) and affect flight performance. We preceded the Seasoar deployment with a 500 meter CTD cast (Station 18), and the Seasoar was deployed for Tow 1 at about 0830 UTC, 19 December at 1° 50' S, 156° 6' E (Table 3). Tow 1 began at 0908 UTC heading southward toward SBS, and continued along the Standard Butterfly Pattern in the usual direction (Table 4). This was a short tow, less than 24 hours, ending on 20 December at about 0230 UTC. During the last four hours of towing the Seasoar was handling well, with no adjustments to its control signal needed. A cable fault, however, made the pressure signal drop out, and we slowed the ship for recovery while on the west-to-east section. A 500 meter CTD cast followed upon recovery.

While the Seasoar cable was being reterminated we continued towards SBE, taking 800 meter CTD casts with a spacing of approximately seven minutes of longitude (Stations 20, 21, and 22). Station 22 was at SBE, and preceded the Seasoar deployment for Tow 2.

The Seasoar was deployed for Tow 2 at about 1240 UTC, 20 December at 1° 47' S, 156° 41' E at the start of the east to north line. Tow 2 began northwestward

Table 1. Summary of CTD stations during W9211B.

Station No.	Date	Time (UTC)	Latitude	Longitude	Cast Depth (db)	Wind Dir. (T)	Wind Spd. (kts)	Atmos. P. (mbar)	Bottles (#)	Notes
1	16 Dec	14 33	05° 01.7' N	156° 01.4' E	1500	080	15	1009.0	4	2 miles north of ATLAS mooring
2	16 Dec	19 32	04° 30.1' N	156° 00.0' E	1500	075	16	1008.3	3	
3	16 Dec	23 46	04° 00.0' N	156° 00.0' E	1500	070	22	1009.1	6	
4	17 Dec	03 59	03° 29.9' N	156° 00.0' E	1500	070	18	1006.2	5	
5	17 Dec	08 17	02° 59.8' N	156° 00.2' E	1500	070	16	1007.4	4	
6	17 Dec	12 10	02° 30.0' N	156° 00.0' E	1500	085	12	1008.8	5	
7	17 Dec	16 14	02° 01.9' N	156° 00.0' E	1500	095	13	1006.8	4	
8	17 Dec	18 11	02° 00.7' N	156° 01.2' E	200	218	11	1007.3	0	0.5 nm from ATLAS mooring
9	17 Dec	21 20	01° 30.3' N	155° 59.9' E	1500	055	2	1009.1	4	
10	18 Dec	01 16	01° 00.0' N	156° 00.0' E	1500	270	7	1008.3	6	
11	18 Dec	05 27	00° 29.9' N	156° 00.1' E	1500	250	7	1006.2	4	
12	18 Dec	09 24	00° 00.4' N	156° 00.0' E	1500	255	6	1008.9	6	near PROTEUS mooring
13	18 Dec	13 32	00° 30.0' S	156° 00.0' E	1500	220	7	1007.5	5	
14	18 Dec	17 42	01° 00.0' S	156° 00.0' E	1500	220	6	1006.5	6	
15	18 Dec	22 15	01° 29.1' S	156° 00.6' E	1500	215	9	1008.5	5	
16	19 Dec	03 04	02° 00.0' S	155° 56.0' E	1500	270	5	1006.4	5	
17	19 Dec	05 09	01° 59.2' S	155° 54.7'E	200	240	5	1005.8	0	near ATLAS mooring
18	19 Dec	07 10	01° 50.0' S	156° 06.1' E	505	---	0	1007.1	3	prior to Seasoar deployment (Tow 1)
19	20 Dec	04 38	01° 50.0' S	156° 20.3' E	505	310	14	1005.8	2	after Seasoar recovery (Tow 1)
20	20 Dec	07 06	01° 50.0' S	156° 27.7' E	800	310	20	1007.2	3	
21	20 Dec	08 46	01° 49.9' S	156° 35.2' E	800	320	19	1008.5	3	
22	20 Dec	10 14	01° 50.0' S	156° 42.1' E	800	315	22	1009.1	3	prior to Seasoar deployment (Tow 2)
23	23 Dec	17 13	01° 20.5' S	156° 12.9' E	800	290	13	1005.5	4	after Seasoar recovery (Tow 2)
24	23 Dec	18 50	01° 16.9' S	156° 09.9' E	500	310	10	1005.6	3	

Table 1 (continued). Summary of CTD stations during W9211B.

Station No.	Date	Time (UTC)	Latitude	Longitude	Cast Depth (m)	Wind Dir. (T)	Wind Spd. (kts)	Atmos. P. (mbar)	Bottles (#)	Notes
25	23 Dec	20 03	01° 14.0' S	156° 06.0' E	500	307	11	1005.3	4	at SBN
26	23 Dec	21 20	01° 12.0' S	156° 01.1' E	250	303	13	1007.2	3	3.5 nm N of PCM$_{north}$
27	23 Dec	23 01	01° 12.0' S	156° 01.1' E	250	325	11	1007.5	1	3.5 nm N of PCM$_{north}$
28	24 Dec	00 11	01° 13.4' S	156° 01.1' E	250	320	10	1007.5	2	
29	24 Dec	01 21	01° 14.0' S	156° 06.2' E	800	340	12	1006.9	6	Seasoar deployment - Tow 3 (SBN)
30	26 Dec	03 24	01° 59.3' S	155° 36.5' E	800	290	22	1006.2	5	Seasoar recovery site - Tow 3
31	26 Dec	05 21	01° 54.9' S	155° 33.0' E	500	290	21	1005.3	5	
32	26 Dec	07 45	01° 50.0' S	155° 30.1' E	500	300	16	1007.2	4	3.5 nm S of PCM$_{west}$ - new sensors
33	26 Dec	09 16	01° 44.5' S	155° 30.1' E	250	315	12	1008.4	3	2 nm N of PCM$_{west}$
34	26 Dec	12 21	01° 58.0' S	155° 52.3' E	1500	300	16	1008.8	6	2 nm NW TOPEX/Poseidon mooring
35	26 Dec	17 00	01° 50.0' S	155° 30.0' E	800	300	18	1006.2	5	Seasoar deployment site - Tow 4
36	29 Dec	05 53	02° 07.0' S	156° 06.6' E	800	313	18	1006.3	4	Seasoar recovery site - Tow 4
37	29 Dec	07 25	02° 10.9' S	156° 05.9' E	500	330	18	1007.0	3	
38	29 Dec	08 37	02° 16.0' S	156° 06.0' E	500	335	9	1008.0	3	
39	29 Dec	10 02	02° 15.2' S	156° 02.4' E	250	295	20	1010.1	3	2 nm east of PCM$_{south}$
40	29 Dec	12 31	02° 00.0' S	156° 06.0' E	500	170	6	1010.0	3	Seasoar deployment site - Tow 5
41	02 Jan	04 41	01° 36.7' S	156° 28.7' E	800	325	24	1007.5	6	recovery Tow 5 - deployment Tow 6
42	04 Jan	08 26	01° 55.0' S	156° 06.0' E	800	?	?	1010.1	5	recovery Tow 6 - deployment Tow 7
43	07 Jan	23 41	01° 50.9' S	156° 42.2' E	1500	---	0	1011.3	6	recovery Tow 7 - deployment Tow 8
44	09 Jan	23 31	01° 40.8' S	156° 05.3' E	1500	040	6	1011.2	5	Seasoar recovery site - Tow 8
45	10 Jan	01 55	01° 45.5' S	156° 06.0' E	300	175	19	1009.5	0	cast to fill in N2S section
46	10 Jan	02 57	01° 50.0' S	156° 06.0' E	300	variable	4	1009.0	0	cast to fill in N2S section
47	10 Jan	06 11	01° 50.0' S	156° 42.0' E	500	320	4	1007.6	3	Seasoar deployment site - Tow 9
48	12 Jan	20 10	05° 01.9' N	156° 08.0' E	800	047	18	1009.7	6	Seasoar recovery site - Tow 9

Table 2. Instrument and sensors used for CTD, Seasoar, and underway salinity sampling, W9211B, and date of most recent manufacturer's pre-cruise calibration.

System (Instrument)	Sensor	SN	Pre-Cruise Calibration
CTD/rosette			
(SBE *9/11 plus,* SN 0256) (Stations 1-48)	P	50130	05 Mar 92
(Stations 1-31)	T1	1367	27 Mar 92 (modified 2 Dec 92)
	T2	1369	27 Mar 92 (modified 2 Dec 92)
	C1	1030	17 Apr 92
	C2	1041	24 Apr 92
(Stations 32-48)	T1	1364	06 Oct 92 (modified 2 Dec 92)
	T2	1366	06 Oct 92 (modified 2 Dec 92)
	C1	1018	16 Sept 92
	C2	1021	16 Sept 92
Seasoar			
(SBE *9/11 plus,* SN 0258) (Tows 1-7)	P	50506	23 April 92
(SBE *9/11 plus,* SN 2843) (Tows 8-9)	P	39017	07 Nov 89
(Tows 1-3)	T1	1364	06 Oct 92 (modified 2 Dec 92)
	T2	1366	06 Oct 92 (modified 2 Dec 92)
	C1	1018	16 Sept 92
	C2	1021	16 Sept 92
(Tows 4-9)	T1	1367	27 Mar 92 (modified 2 Dec 92)
	T2	1369	27 Mar 92 (modified 2 Dec 92)
	C1	1030	17 Apr 92
	C2	1041	24 Apr 92
5-m Intake (MIDAS)			
(entire cruise)	T	854	10 Aug 90
	C	830	29 Nov 90

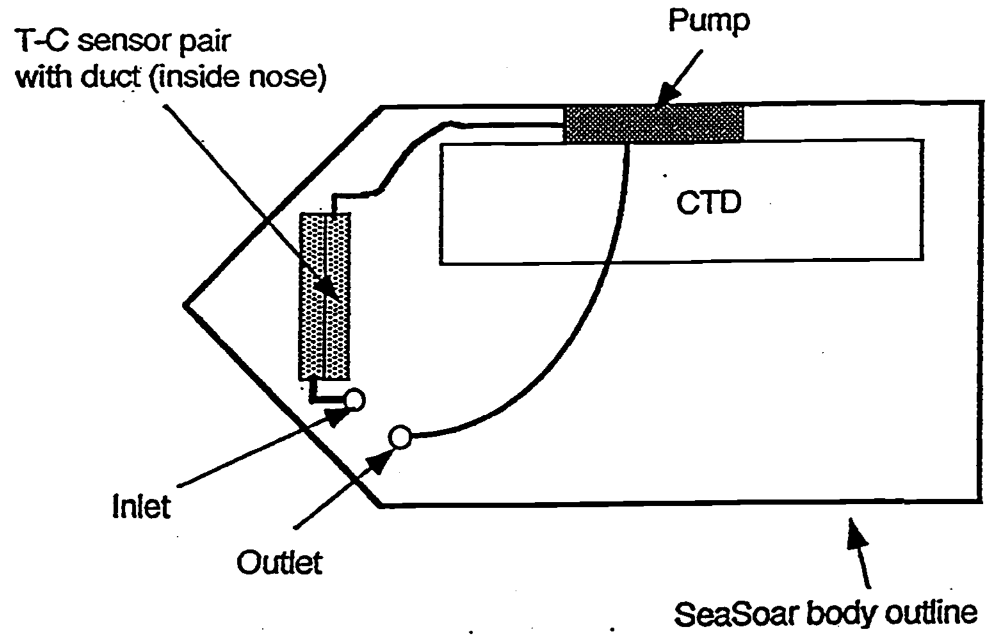

Figure 3. Schematic of the plumbing of the ducted T/C sensors inside the Seasoar vehicle. Primary sensor inlet and outlet ports were on the starboard side of the Seasoar nose; secondary sensor ports were on the port side.

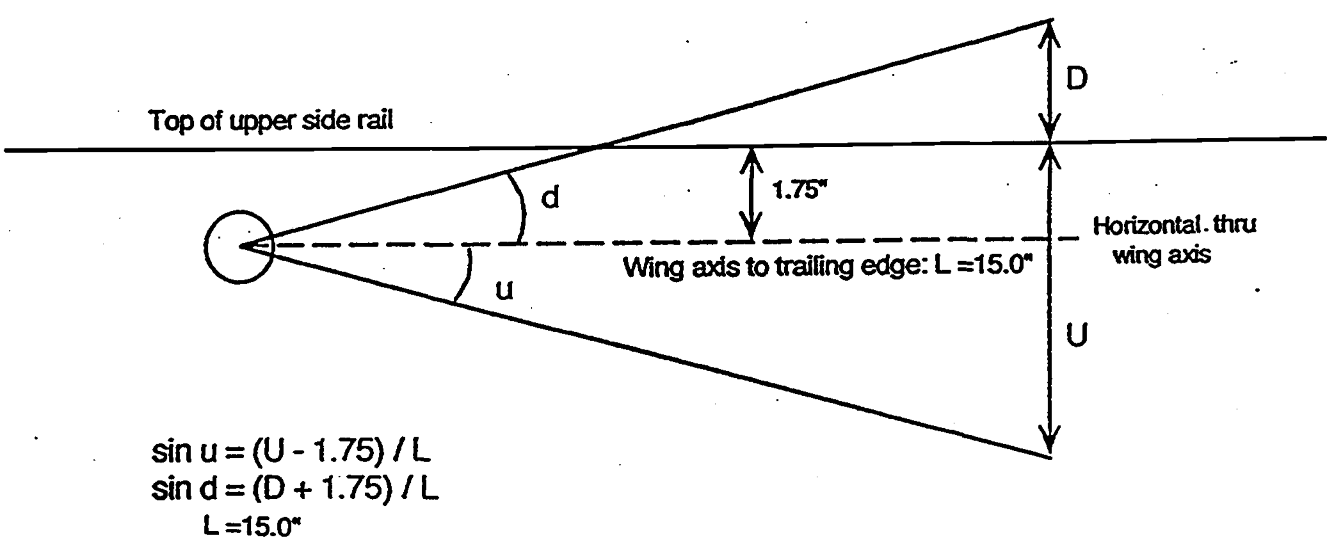

Figure 4. Schematics of Seasoar wing angle settings. During Tows 1 through 5, the value of D was $1^3/_4$" and U was 8", yielding an up-angle of 25° and a down-angle of 14°. During Tows 6 through 9, D was $2^1/_2$" and U was $7^3/_8$", yielding an up-angle of 22° and a down-angle of 16°.

Table 3. Summary of Seasoar tows, W9211B. Deployment and recovery information taken from first and last recorded data, respectively; underway start time is when Wecoma increased speed for towing, and underway stop time is when Wecoma decreased speed for recovery.

Seasoar	Deployment			Underway			Recovery		
Tow #	Date / time	Lat	Lon	Start	Stop	Hours	Date / time	Lat	Lon
1	19 Dec 92 08:25	1° 49.9' S	156° 06.3' E	19 Dec 92 09:08	20 Dec 92 02:27	17	20 Dec 92 02:32	1° 49.9' S	156° 19.5' E
2	20 Dec 92 12:41	1° 48.0' S	156° 41.2' E	20 Dec 92 13:20	23 Dec 92 14:05	72	23 Dec 92 16:02	1° 15.0' S	156° 14.8' E
3	24 Dec 92 02:38	1° 13.5' S	156° 07.1' E	24 Dec 92 03:46	26 Dec 92 02:15	47	26 Dec 92 03:07	1° 59.4' S	155° 37.5' E
4	26 Dec 92 19:15	1° 49.7' S	155° 30.0' E	26 Dec 92 20:17	29 Dec 92 04:26	56	29 Dec 92 05:35	2° 06.6' S	156° 06.5' E
5	29 Dec 92 13:33	2° 00.4' S	156° 06.1' E	29 Dec 92 14:15	02 Jan 93 02:30	84	02 Jan 93 03:42	1° 33.3' S	156° 29.5' E
6	02 Jan 93 08:08	1° 38.6' S	156° 30.9' E	02 Jan 93 08:46	04 Jan 93 04:33	44	04 Jan 93 05:41	1° 55.9' S	156° 10.4' E
7	04 Jan 93 10:03	1° 55.4' S	156° 06.4' E	04 Jan 93 11:12	07 Jan 93 22:34	83	07 Jan 93 23:16	1° 52.1' S	156° 41.8' E
8	08 Jan 93 02:51	1° 50.2' S	156° 42.1' E	08 Jan 93 03:20	09 Jan 93 22:09	43	09 Jan 93 23:00	1° 41.8' S	156° 04.9' E
9	10 Jan 93 07:12	1° 50.0' S	156° 42.7' E	10 Jan 93 07:49	12 Jan 93 19:03	59	12 Jan 93 19:48	5° 01.3'N	156° 07.4' E

toward SBN and continued along the Standard Butterfly in the usual direction (Table 5). After completing one full butterfly we went off section in order to test various bias settings for the Seasoar controller (starting at 0417 UTC on 22 December). At 0553 UTC we returned to the butterfly pattern near our point of departure, and continued towing for another day and a half. A cable fault brought about another Seasoar recovery at 1405 UTC on 23 December during an east-to-north section. A 500 meter CTD cast (station 23) followed the recovery.

While the cable was being reterminated, CTD Stations 24 and 25 were taken to complete the east-to-north section. We then did three shallow (250 m) CTD casts (Stations 26 - 28) near PCM-North (Figure 1), and returned to SBN. An 800 meter CTD cast (station 29) preceded the deployment of the Seasoar, beginning Tow 3.

The Seasoar was deployed for Tow 3 at 0240 UTC, 24 December at 1° 14' S, 156° 06' E at the start of the north-to south line. Tow 3 began southward toward SBS and continued along the Standard Butterfly in the regular direction (Table 6). A few hours after the start of the tow, the acquisition system locked up, and was restarted, resulting in a data gap of 80 seconds duration. Towards the end of the second day of towing, the Seasoar stopped responding, and simply undulated at about 60 meters depth. All signals appeared normal, and we swapped controller units. This had no effect, and we commenced recovery procedures. Recovery showed that the Seasoar had lost its rudder. During recovery there was an air-tugger failure, resulting in the Seasoar hitting the deck hard, damaging the body. All sensors were inspected; no damage was apparent, but it was decided to swap the conductivity and temperature sensor pairs with the CTD/rosette sensors. The Seasoar body was repaired and a fluorometer was bolted in place in an attempt to improve the Seasoar's hydrodynamics.

After the Tow 3 recovery of the Seasoar, an 800 meter CTD cast was taken (Station 30, Table 1). While the inspection of the Seasoar was taking place, we continued along the section (towards SBW) and took a 500 meter CTD cast (Station 31). The temperature and conductivity sensor pairs from the CTD/rosette system (SNs 1367, 1369, 1030 and 1041) were then swapped with the sensors from the Seasoar (SNs 1364, 1366, 1018 and 1021) (see Table 2). CTD Station 32, near PCM-West (Figure 1) was the first CTD station following the sensor exchange. We moved closer to PCM-West and did a 250 meter cast (Station 33). With repair work continuing on the Seasoar we steamed near the ATLAS mooring and did a 1500 meter cast (Station 34). We then proceeded back to SBW for the CTD cast preceding Tow 4 (Station 35).

The deployment for Tow 4 took place at about 1915 UTC, 26 December at the beginning of the west-to-east section (SBW). Tow 4 began eastward and proceeded along the Standard Butterfly Pattern (Table 7). We continued using the alternate Seasoar controller unit that was connected at the end of Tow 3. The tow proceeded

Table 4. Times (UTC) of standard waypoints during Tow 1 of W9211B. Positions of these waypoints are:

SBN (1° 14' S, 156° 06' E);
SBS (2° 26' S, 156° 06' E);
SBW (1° 50' S, 155° 30' E);
SBE (1° 50' S, 156° 42' E).

The begin time represents when the Wecoma increased speed after deployment of the Seasoar; the end time represents when the Wecoma slowed speed for recovery.

	Begin/End	**SBN**	**SBS**	**SBW**	**SBE**
19 December	0908		1355	2019	
20 December	0227				

Table 5. Times (UTC) of standard waypoints during Tow 2 of W9211B.

	Begin/End	**SBN**	**SBS**	**SBW**	**SBE**
20 December	1320	1945			
21 December			0516	1217	2048
22 December		0417 0553	1653		
23 December	1405			0000	0827

Table 6. Times (UTC) of standard waypoints during Tow 3 of W9211B.

	Begin/End	**SBN**	**SBS**	**SBW**	**SBE**
24 December	0346		1323	2026	
25 December		1138	2120		0455
26 December	0215				

Table 7. Times (UTC) of standard waypoints during Tow 4 of W9211B.

	Begin/End	**SBN**	**SBS**	**SBW**	**SBE**
26 December	2017				
27 December		1238	2225		0526
28 December		2209		0532	1450
29 December	0426				

Table 8. Times (UTC) of standard waypoints during Tow 5 of W9211B.

	Begin/End	**SBN**	**SBS**	**SBW**	**SBE**
29 December	1415		1721		
30 December		1607		0018	0846
31 December		2358	0124	0826	1715
1 January			0922	1602	
2 January	0230				0007

Table 9. Times (UTC) of standard waypoints during Tow 6 of W9211B.

	Begin/End	**SBN**	**SBS**	**SBW**	**SBE**
2 January	0846	1349	2316		
3 January		1224	2343	0637	
4 January	0433				

Table 10. Times (UTC) of standard waypoints during Tow 7 of W9211B.

	Begin/End	**SBN**	**SBS**	**SBW**	**SBE**
4 January	1112		1532	2230	
5 January		1336	2311		0639
6 January		2123		0603	1443
7 January	2234		0728	1354	

Table 11. Times (UTC) of standard waypoints during Tow 8 of W9211B.

	Begin/End	SBN	SBS	SBW	SBE
8 January	0320	1017	2017		
9 January	2209	1842		0250	1139

Table 12. Times (UTC) of standard waypoints during Tow 9 of W9211B. SBC (center) is the point where the N2S and W2E lines cross, and is located at:

SBC (1° 50' S, 156° 06' E).

	Begin/End	SBN	SBS	SBW	SBC (center)
10 January	0749	1756			1316
11 January					
12 January	1903				

until 0426 UTC on 29 December, when a cable fault brought about the end of Tow 4 while on the north-to-south section. Recovery took place, and an 800 meter CTD cast followed (Station 36). The Seasoar cable had broken cable strands again, and this time the cowtail was broken. The cable was cut back to obtain clean wire prior to retermination, and Samson braid was fitted over the cable near the Seasoar, in an attempt to reduce cable strumming.

While the Seasoar's cable was being worked on, we continued the section southward, taking 500 meter CTD casts (Stations 37 and 38). We then moved closer to PCM-South (Figure 1) and did a 250 meter cast. We then steamed about seven nautical miles north of where Tow 4 ended and did a 500 meter CTD cast (Station 40) prior to Seasoar deployment.

The deployment for Tow 5 took place at 1333 UTC on 29 December at 2° 00' S and 156° 06' E, along the north-to-south section. We headed towards SBS in the Standard Butterfly Pattern (Table 8). This became one of our longest tows (at three and a half days) but the Seasoar had very poor flight characteristics, with numerous stalls and frequent need to switch to manual override on the controller unit. While on the east-to-north section we were unable to get the Seasoar deeper than 240 meters, and we decided to recover it. An 800 meter CTD cast (Station 41) immediately followed recovery.

After 80+ hours of flight, there were some loose bolts on the wings that required tightening, along with the usual need to replace fairing that had been damaged or lost. We also decided to change the current wing angle configuration to improve flight characteristics. The wing angle values were measured both prior to and after changing the pushrod settings, and are summarized in Figure 4. We also switched back to our original controller unit, the one that had been in use for Tows 1, 2, and 3. The turnaround time on this recovery was very quick, since no cable retermination was required. We directly proceeded with the Seasoar deployment. The CTD cast at the end of Tow 5 (Station 41) would also be used for the beginning of Tow 6.

The deployment for Tow 6 started at 0808 UTC on 02 January at 1° 50' S and 156° 42' E. Wecoma headed northwestward towards SBN and initially followed the Standard Butterfly Pattern (Table 9). Flight performance and handling was much better, presumably due to the change in wing angle settings. It was not uncommon to go several hours without having to adjust the controller settings. We arranged to do parallel north-south sections with the Noroit, a French ship that was doing long Seasoar north-south sections along 156° E as part of the COARE project. In order to join the Noroit, we broke from the Standard Butterfly, and proceeded from SBW to SBN on 03 January. The Noroit met us at SBN and we proceeded to SBS obtaining parallel Seasoar sections. We then turned at SBS and continued back to SBN, getting a second parallel section. The Seasoar was then recovered to allow transfer of equipment and personnel from the Noroit. After the Seasoar was recovered and the Noroit transfer complete, we did an 800 meter CTD cast (Station 42) in preparation for deployment of the Seasoar for Tow 7. CTD Station 42 would serve for both the end of Tow 6 and the beginning of Tow 7.

The deployment for Tow 7 began at about 1000 UTC on 04 January at 1° 55' S and 156° 06' E, at the start of the north-to-south section. The Standard Butterfly Pattern proceeded as usual (Table 10) and the Seasoar flew well in general. On 06 January at about 2149 UTC we may have hit floating debris, as the cable strain meter gauge went momentarily off-scale. The next day, while covering the west-to-east section, we realized that the Seasoar's pressure sensor was no longer functioning properly; it apparently had acquired a five-meter offset at the surface. Later analysis of the data showed that the pressure sensor had already started to malfunction prior to the possible impact with surface debris. We slowed the ship for Seasoar recovery after getting to SBE. A 1500 meter CTD cast (Station 43) followed the recovery.

The offset in the Seasoar's pressure sensor was due to a failure of its digiquartz temperature sensor (Figure 5). Our means to remedy this was to remove the entire Sea Bird *9/11 plus* unit and put in our spare (which was mounted in the bow of the ship). The temperature and conductivity sensors would come off the damaged *9/11 plus* unit and be reattached to the spare. This was done, along with some minor fairing repair, and the Seasoar was ready for deployment about an hour after Station 43 was completed. Station 43 would be used as the CTD cast ending Tow 7 and beginning Tow 8.

Deployment for Tow 8 began at about 0250 UTC, 08 January at 1° 50' S and 156° 42' E. Starting at SBE we then proceeded towards SBN along the Standard Butterfly Pattern (Table 11). This tow was not of long duration, however, as a cable failure occurred before the end of the second day of towing (we had not had a cable failure since the end of Tow 4). Failure occurred while traversing the north-to-south section, and we slowed the ship for recovery. A 1500 meter CTD cast (Station 44) immediately followed recovery.

While the cable was being reterminated, we proceeded southward, taking two more 300 meter CTD casts (Stations 45 and 46) and completing the north-to-south section up to the midpoint of the line (where the east-to-west section crosses the north-to-south section). At that point we then headed for SBE in preparation for exiting the IFA and doing a 700 kilometer cross-equatorial section. A 500 meter CTD (Station 47) preceded deployment.

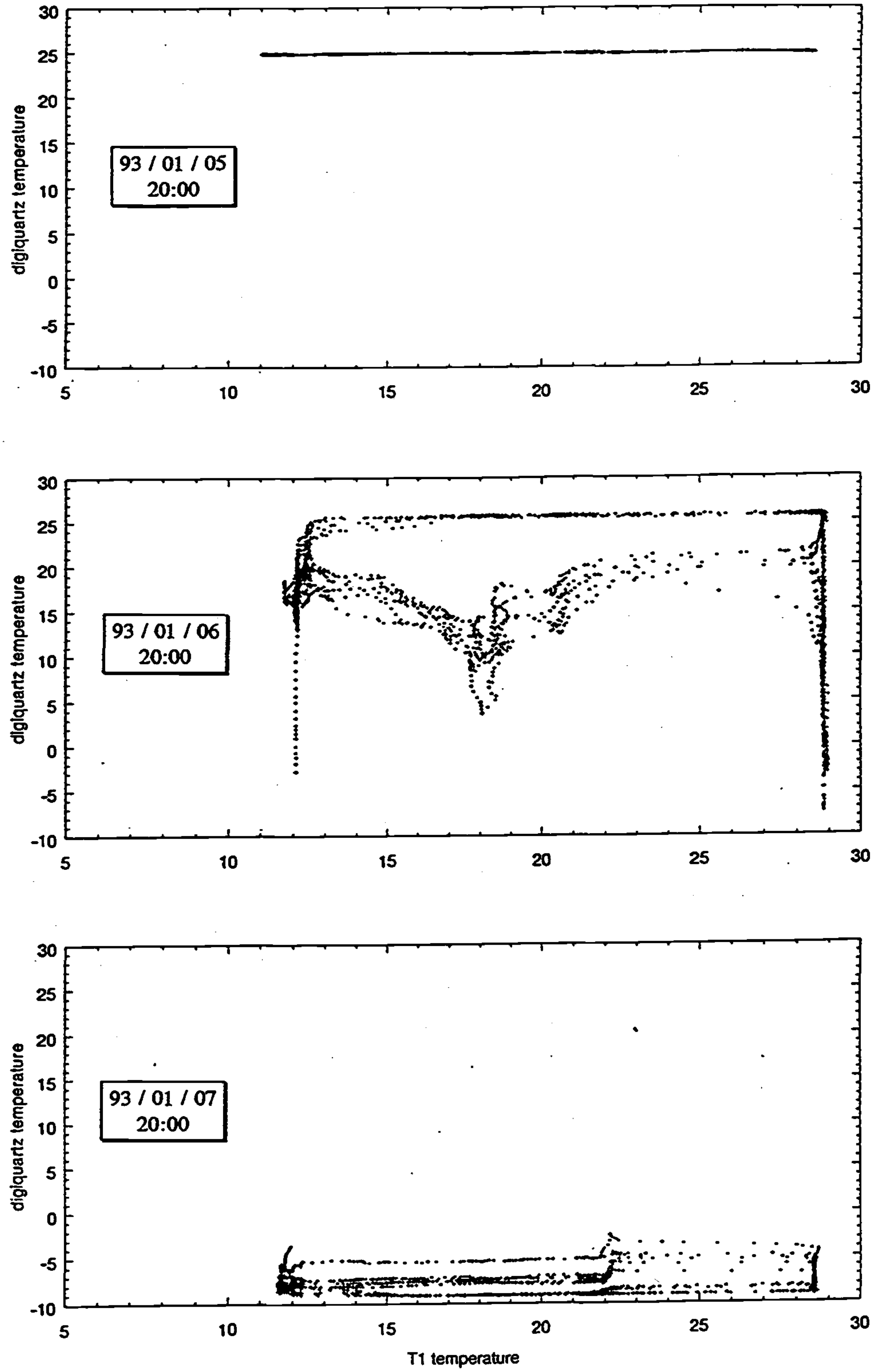

Figure 5. Hourly data plots of the pressure sensor's recorded internal temperature (digiquartz temperature) verses external water temperature (as measured by T1). The plot for 93/01/05 shows a typical hour prior to failure of the digiquartz sensor; 93/01/06 shows an hour with failure in progress; and 93/01/07 shows complete failure.

Seasoar was deployed for Tow 9 starting at about 0710 UTC, 09 January at 1° 50' S and 156° 42' E. We proceeded westward towards SBW until reaching the intersection of the north-to-south section at about 1315 UTC, and then headed northward (Table 12). We passed SBN at about 1800 UTC and continued northward, taking us out of the IFA. The tow continued along 156° 06' E until reaching 5° N, when the Seasoar was recovered at about 1950 UTC, 12 January. CTD Station 48 was completed immediately afterward. We then ceased operations and Wecoma proceeded to Guam, arriving there at approximately 1700 UTC, 16 January 1993.

In all, we completed nine Seasoar tows during W9211B, for a total towing time of 505 hours. The overall Seasoar sampling included 19 occupations of the N2S lines (12 complete; 7 partial) and 14 occupations of the W2E lines (12 complete; 2 partial) (Table 13) and 14 occupation of the S2W (13 complete; 1 partial) and E2N lines (11 complete; 3 partial) (Table 14), along with single W2N line and a 700 km cross-equatorial section.

Underway measurements were made continuously through most of the cruise. These include: Acoustic Doppler Current Profile measurements of water velocity relative to the ship and accompanying GPS position data (contact Eric Firing et al., Univ. of Hawaii); temperature and salinity of water at 5 m depth and 2 m depth (contact Clayton Paulson, Oregon State Univ.); near-surface salinity of water pumped from a buoyant hose (contact Gary Lagerloef, SAIC); and a broad spectrum of meteorological observations (contact Clayton Paulson, OSU) including sonic inertial dissipation (contact Jim Edson, WHOI).

Members of the scientific party included Brian Wendler, Mike Hill (both Wecoma Marine Technicians), Michael Kosro, Robert O'Malley, Fred Bahr, Pip Courbois, (all from Oregon State University), Roger Lukas, Craig Huhta, Rich Muller, Reka Domokos, Sophia Asghar (all from University of Hawaii), Alexander Soloview, Dimitri Khlebnikov (both from Moscow, Russia) and Anatoli Azjannikov (from St. Petersburg, Russia).

Table 13. Times (UTC) of meridional and zonal sections of the Standard Butterfly pattern. All N2S sections were southward along 156°06'E from SBN (1°14'S) to SBS (2°26'S), and all W2E sections were eastward along 1°50'S from SBW (155°30'E) to SBE (156°42'E). Number in parentheses indicates intake of preferred sensor T/C sensor pair was on port (1) or starboard (0) side of Seasoar)

N2S (SBN to SBS) along 156°06'E	W2E (SBW to SBE) along 1°50'S
0908, 19 Dec to 1355, 19 Dec (0)*	2019, 19 Dec to 0227, 20 Dec (0)*
1945, 20 Dec to 0516, 21 Dec (0)	1217, 21 Dec to 2048, 21 Dec (0)
0553, 22 Dec to 1653, 22 Dec (0)	0000, 23 Dec to 0827, 23 Dec (0)
0346, 24 Dec to 1323, 24 Dec[1] (1)	2026, 24 Dec to 0455, 25 Dec (1)
1138, 25 Dec to 2120, 25 Dec (1)	2017, 26 Dec to 0526, 27 Dec (1)
1238, 27 Dec to 2225, 27 Dec (1)	0532, 28 Dec to 1450, 28 Dec (1)
2209, 28 Dec to 0426, 29 Dec (1)*	
1415, 29 Dec to 1721, 29 Dec (1)*	0018, 30 Dec to 0846, 30 Dec (1)
1607, 30 Dec to 0124, 31 Dec (1)	0826, 31 Dec to 1715, 31 Dec (1)
2358, 31 Dec to 0922, 01 Jan (1)	1602, 01 Jan to 0007, 02 Jan (1)
1349, 02 Jan to 2316, 02 Jan (1)	
1224, 03 Jan, to 2343, 03 Jan (1)	
2343, 03 Jan to 0433, 04 Jan[2] (1)*	
1112, 04 Jan to 1532, 04 Jan (1)*	2230, 04 Jan to 0639, 05 Jan (1)
1336, 05 Jan to 2311, 05 Jan (1)	0603, 06 Jan to 1443, 06 Jan (1)
2123, 06 Jan to 0728, 07 Jan (1)	1354, 07 Jan to 2234, 07 Jan (1)
1017, 08 Jan to 2017, 08 Jan (1)	0250, 09 Jan to 1139, 09 Jan (1)
1842, 09 Jan to 2209, 09 Jan (1)*	0749, 10 Jan to 1316, 10 Jan[3] (1)*
1316, 10 Jan to 1756, 11 Jan[4] (1)*	
1746, 11 Jan to 1903, 12 Jan[5] (1)	

[1] Includes an 80 second data gap from 05:43:40 through 05:44:59 UTC, 24 December
[2] Section run northward from SBS to SBN, rather than SBN to SBS
[3] Section runs westward from SBE to SBW and turns at mid-point to begin transit to north
[4] Section starts at midpoint between SBS and SBN and runs northward to SBN
[5] Northward transit from SBN to 5° N latitude along 156° E longitude
* Indicates a partial section

Table 14. Times (UTC) of diagonal sections of the Standard Butterfly pattern: S2W between SBS (2°26'S, 156°06'E) and SBW (1°50'S, 155°30'E); and E2N between SBE (1°50'S, 156°42'E) and SBN (1°14'S, 156°06'E). During most E2N sections Seasoar was kept below a 30 meter depth for about 12 km.

S2W (SBS to SBW)	E2N (SBE to SBN)
1355, 19 Dec to 2019, 19 Dec (0)	1320, 20 Dec to 1945, 20 Dec (0)
0516, 21 Dec to 1217, 21 Dec (0)	2048, 21 Dec to 0417, 22 Dec (0)
1653, 22 Dec to 0000, 23 Dec (1)	0827, 23 Dec to 1405, 23 Dec (1)*
1323, 24 Dec to 2026, 24 Dec (1)	0455, 25 Dec to 1138, 25 Dec (1)
2120, 25 Dec to 0215, 26 Dec (1)*	0526, 27 Dec to 1238, 27 Dec (1)
2225, 27 Dec to 0532, 28 Dec (1)	1450, 28 Dec to 2209, 28 Dec (1)
1721, 29 Dec to 0018, 30 Dec (1)	0846, 30 Dec to 1607, 30 Dec (1)
0124, 31 Dec to 0826, 31 Dec (1)	1715, 31 Dec to 2358, 31 Dec (1)
0922, 01 Jan to 1602, 01 Jan (1)	0007, 02 Jan to 0230, 02 Jan (1)*
	0845, 02 Jan to 1349, 02 Jan (1)*
2316, 02 Jan to 0637, 03 Jan (1)	0637, 03 Jan to 1224, 03 Jan[1] (1)
1532, 04 Jan to 2230, 04 Jan (1)	0639, 05 Jan to 1336, 05 Jan (1)
2311, 05 Jan to 0603, 06 Jan (1)	1443, 06 Jan to 2123, 06 Jan (1)
0728, 07 Jan to 1354, 07 Jan (1)	0320, 08 Jan to 1017, 08 Jan (1)
2017, 08 Jan to 0250, 09 Jan (1)	1139, 09 Jan to 1842, 09 Jan (1)

[1] This section runs from SBW to SBN

* Indicates a partial section

CTD Data Acquisition, Calibration and Data Processing

All CTD/rosette casts were made with an SBE 9/11-plus CTD system equipped with dual ducted temperature and conductivity sensors. CTD casts were made to monitor the calibration of the Seasoar data, and were therefore generally made before and after each Seasoar tow, with as little delay as possible. CTD casts were also made to complete Seasoar sections which were stopped short, and to collect a cross-equatorial section from 5° N to 2° S during 16 - 19 December 1992 enroute to the IFA. Lastly, CTD casts were made near existing moorings to help cross-calibrate COARE's multiple data sets. Maximum sampling depth was 1500 meters on the cross-equatorial section, and minimum sampling depth was 250 meters near moorings. Table 1 summarizes the CTD casts, and Table 2 indicates the sensors used on the CTD/rosette system.

Raw 24 Hz CTD data were acquired on an IBM compatible PC using the SEASAVE module of SEASOFT version 4.015 (Anon., 1992); temperature and conductivity data were recorded from both pumped sensor ducts. At most stations salinity samples were collected for *in situ* calibration of the conductivity sensors; CTD values at the sample depth (calculated from the most recent manufacturer's pre-cruise calibration) were recorded both by pressing the F5 key at the time of rosette firing and manually on the station log sheets. All samples were analyzed at sea on a Guildline Autosal salinometer that was standardized with IAPSO Standard Water P-119 at the beginning and end of each batch of about 24 samples. Calibration of the conductivity cells were examined for CTD casts 1-31 for each set of sensor pairs, as well as for CTD casts 32-48 when a different set of conductivity and temperature sensors were present in the rosette. Preliminary calibration analysis was done at sea, and suggested a slope and offset correction needed for the conductivity sensors. Final analysis and processing of the CTD casts was performed by University of Hawaii, and is available from R. Lukas.

Seasoar Data Acquisition and Preliminary Processing

Raw 24 Hz CTD data from the Seasoar vehicle and GPS position and time data were acquired by an IBM compatible PC, which also set flags to mark the collection of salinity samples. The raw data were simultaneously recorded on optical disk by PC and on a Sun Sparc workstation. The PC displayed time series of subsampled temperature (both sensors), conductivity (both sensors) and pressure in real time; it also displayed accumulated temperature data for 6-8 hours as a vertical section (color raster). One-second averages of ship's position, CTD temperature (both sensors), conductivity (both sensors), salinity (both sensor pairs), and pressure were calculated on the Sparc workstation, using the most recent manufacturer's calibration (Table 2). Flags were also set to indicate missing positional GPS data. For each tow, the preliminary salinity for each sensor pair was calculated using a fixed offset between temperature and conductivity, and a fixed value for the amplitude and time constant of the thermal mass of the conductivity cell. These preliminary values were only used for at-sea quality control and initial examination of structure; post-processing is required to obtain final salinity values. Time-series and vertical profile plots of the one-second data were made at the end of each hour. The 1-second preliminary data were used to calculate the average temperature and salinity data in bins extending 3 km in the horizontal and 2 dbar in the vertical, and these gridded values were used to plot vertical sections for each leg of the Standard Butterfly pattern. Sections were made to show the entire depth range covered by the Seasoar, as well as sections which displayed only the upper 100 dbar and its finescale structure.

Seasoar Conductivity Calibration

Salinity samples were collected once per hour from a throughflow system in Wecoma's wetlab from 1600 UTC, 16 December 1992 until 2200 UTC, 12 January 1993. This system pumps water from the seachest at a depth of 5 m in the ship's hull, through a tank containing SBE temperature and conductivity sensors; samples are drawn from a point just beyond this tank. The 120 ml glass sample bottles were rinsed three times before filling, and closed with screw-on plastic caps with conical polyethylene liners. Samples were further sealed by wrapping parafilm around the base of the cap. Samples were analyzed at sea on an Autosal salinometer, usually within 2-3 days after collection; the salinometer was standardized with IAPSO Standard Water P-119 at the beginning and end of each batch of about 24 samples. Time series of these hourly salinity samples and time series of the preliminary Seasoar data from the 3-7 m depth range (Figure 6) show very similar variations. Also visible in Figure 6(d) is a period of large surficial stratification, starting near the end of Tow 6 and continuing through the first part of Tow 8, during a period of rain and low wind strength.

The quantitative comparison between the salinity samples and the Seasoar data would ideally have Seasoar measurements at the same location as the Wecoma when the water samples were collected from the throughflow system. Because the Seasoar is towed, its position lags the Wecoma's in time, and that lag is estimated by the time it takes to traverse 500 meters at eight knots (approximate towing cable length and ship speed respectively). We then select the nearest Seasoar value that is within +/- seven minutes of the lagged matchup time of the water samples and is also within a depth range of 3.0 to 5.5 m. For each salinity sample, we calculated a bottle conductivity at the measured temperature of each Seasoar sensor duct, and then compared this sample conductivity to the directly measured conductivity from the same sensor duct. During good conditions, only pairs with very large differences were eliminated from the comparison; during periods of surficial stratification, pairs were eliminated when there was low confidence in the quality of the matchup. Because of the

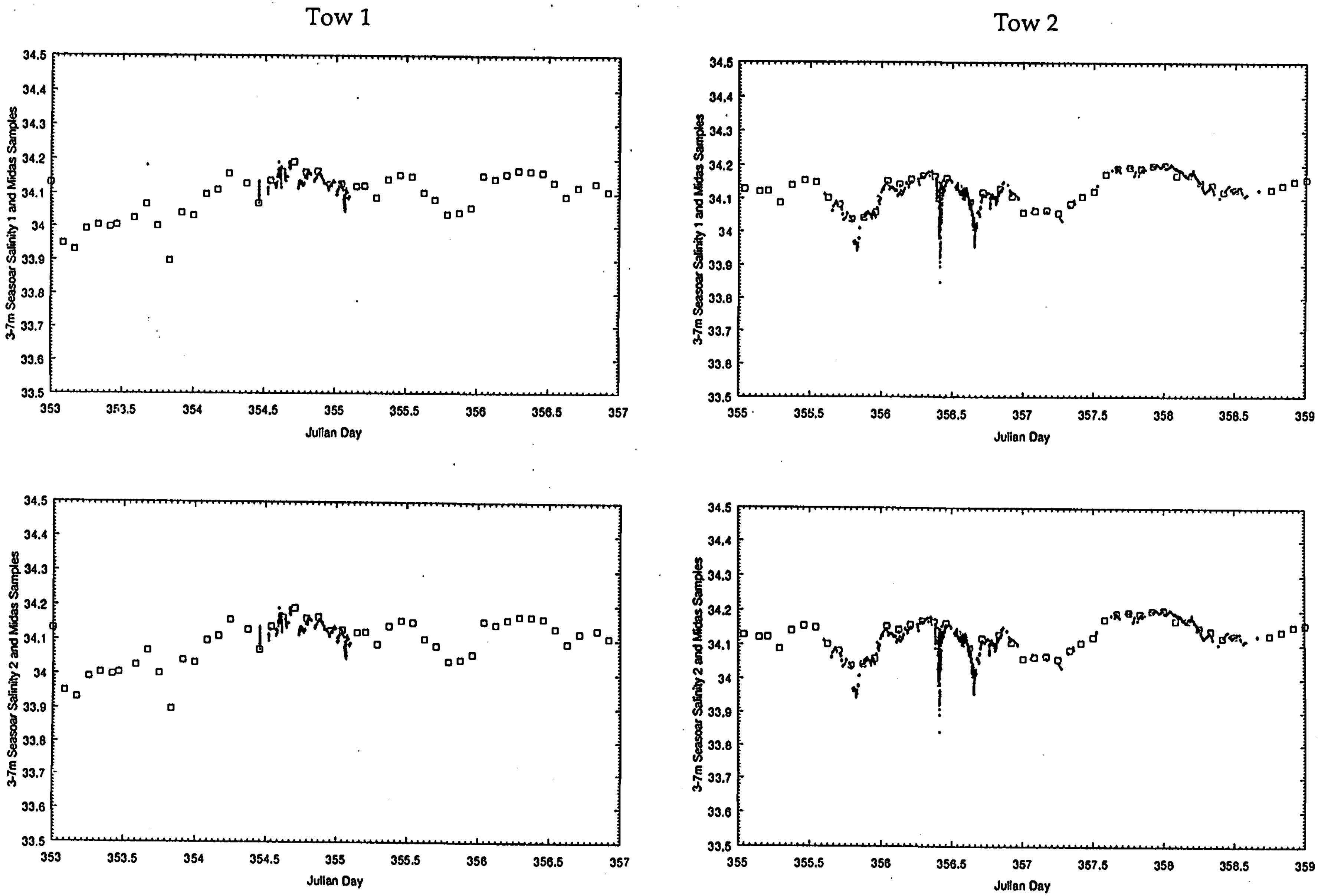

Figure 6(a). Time series of hourly salinity samples from the ship's intake at 5 m (squares), and of preliminary near-surface (3-7.99 m) Seasoar salinity data (dots) from both primary (upper panel) and secondary sensors (lower panel), for each Seasoar tow of W9211B: Tow 1 (left) and Tow 2 (right) of W9211B.

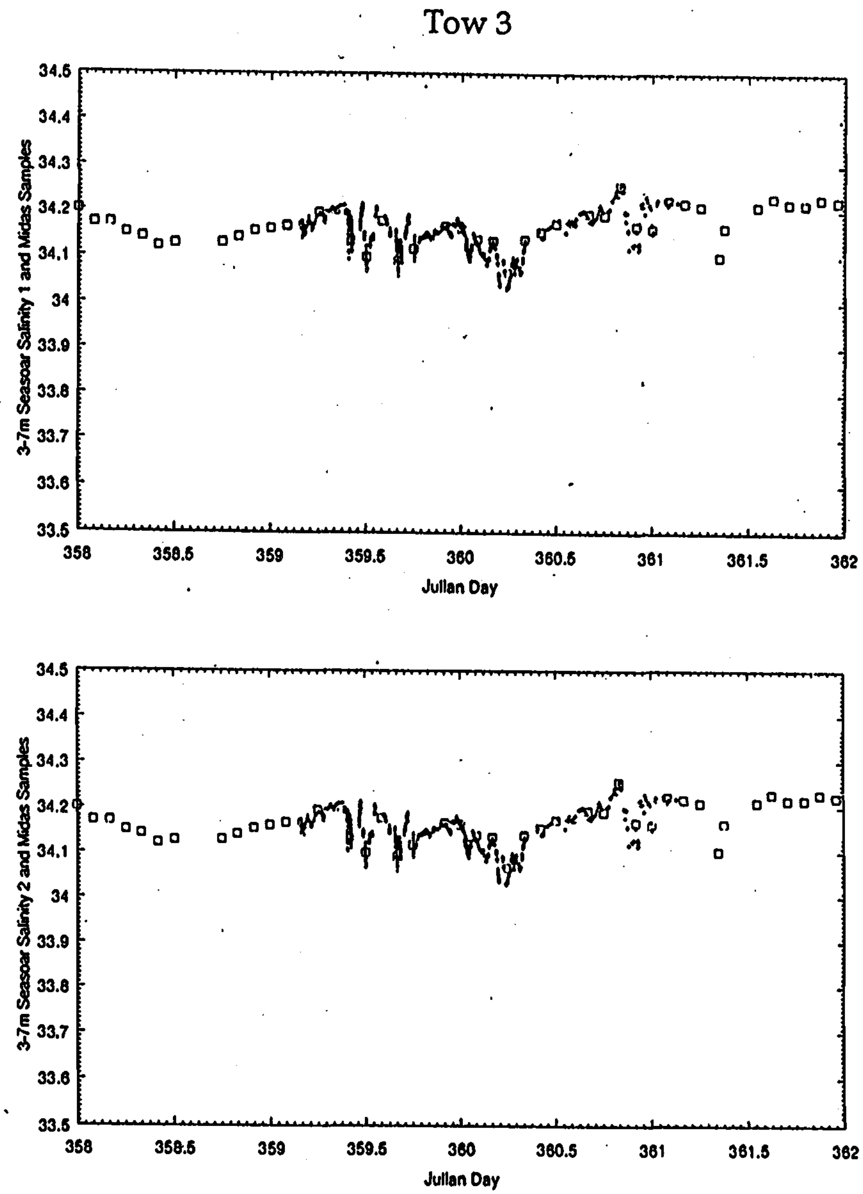

Figure 6(b). Time series of hourly salinity samples from the ship's intake at 5 m (squares), and of preliminary near-surface (3-7.99 m) Seasoar salinity data (dots) from both primary (upper panel) and secondary sensors (lower panel), during Tow 3 of W9211B.

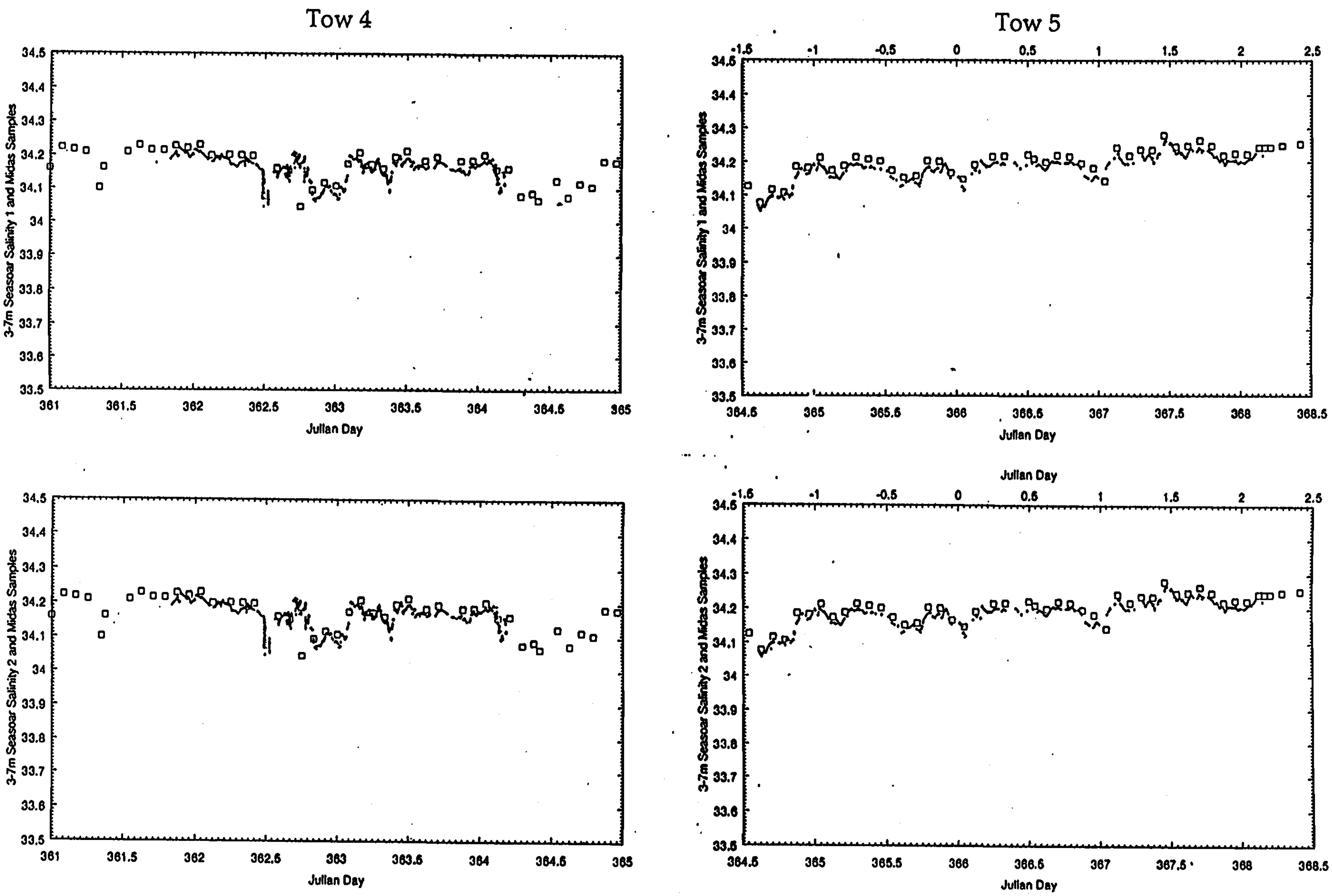

Figure 6(c). Time series of hourly salinity samples from the ship's intake at 5 m (squares), and of preliminary near-surface (3-7.99 m) Seasoar salinity data (dots) from both primary (upper panel) and secondary sensors (lower panel), during Tow 4 (left) and Tow 5 (right) of W9211B.

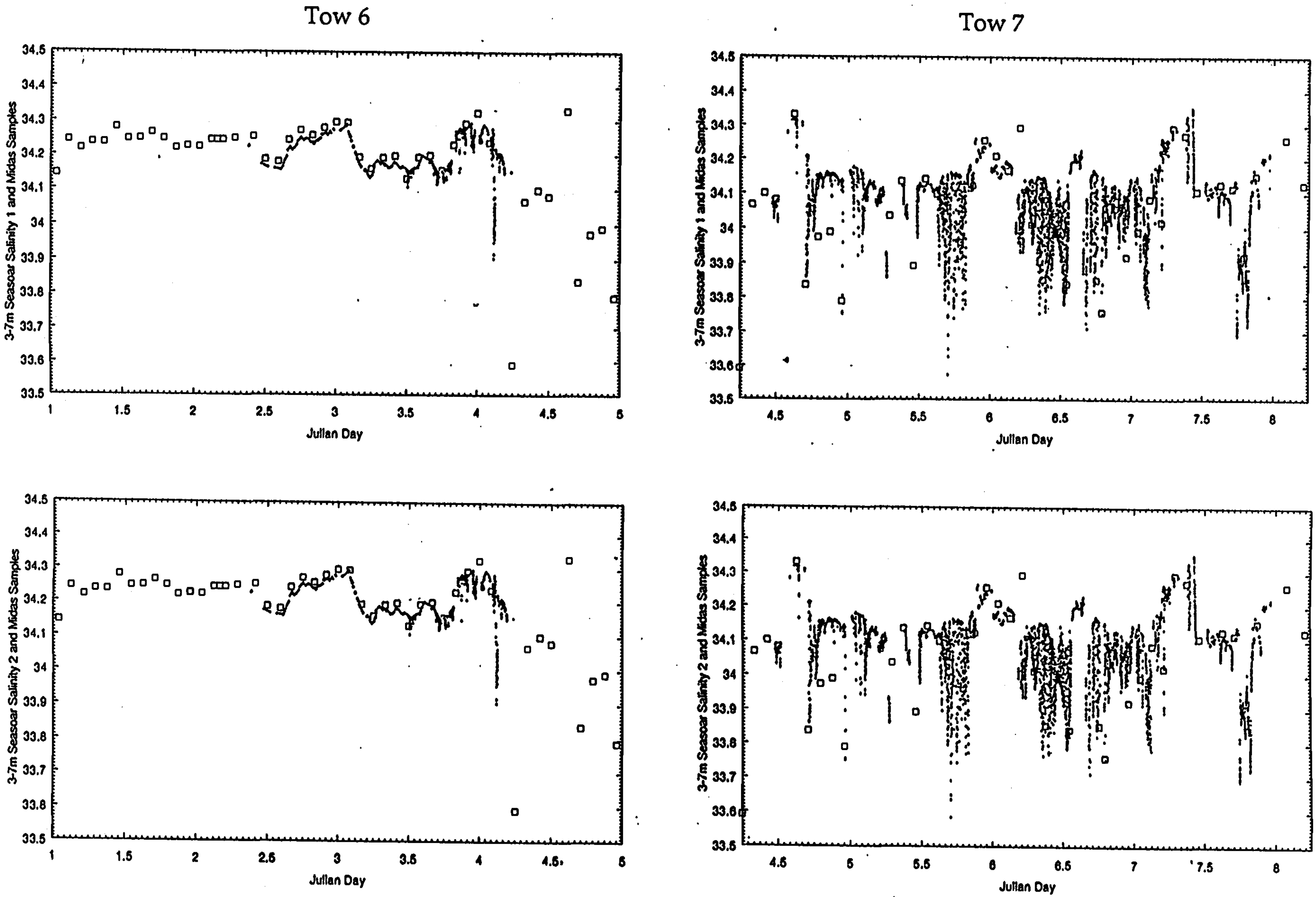

Figure 6(d): Time series of hourly salinity samples from the ship's intake at 5 m (squares), and of preliminary near-surface (3-7.99 m) Seasoar salinity data (dots) from both primary (upper panel) and secondary sensors (lower panel), during Tow 6 (left) and Tow 7 (right) of W9211B.

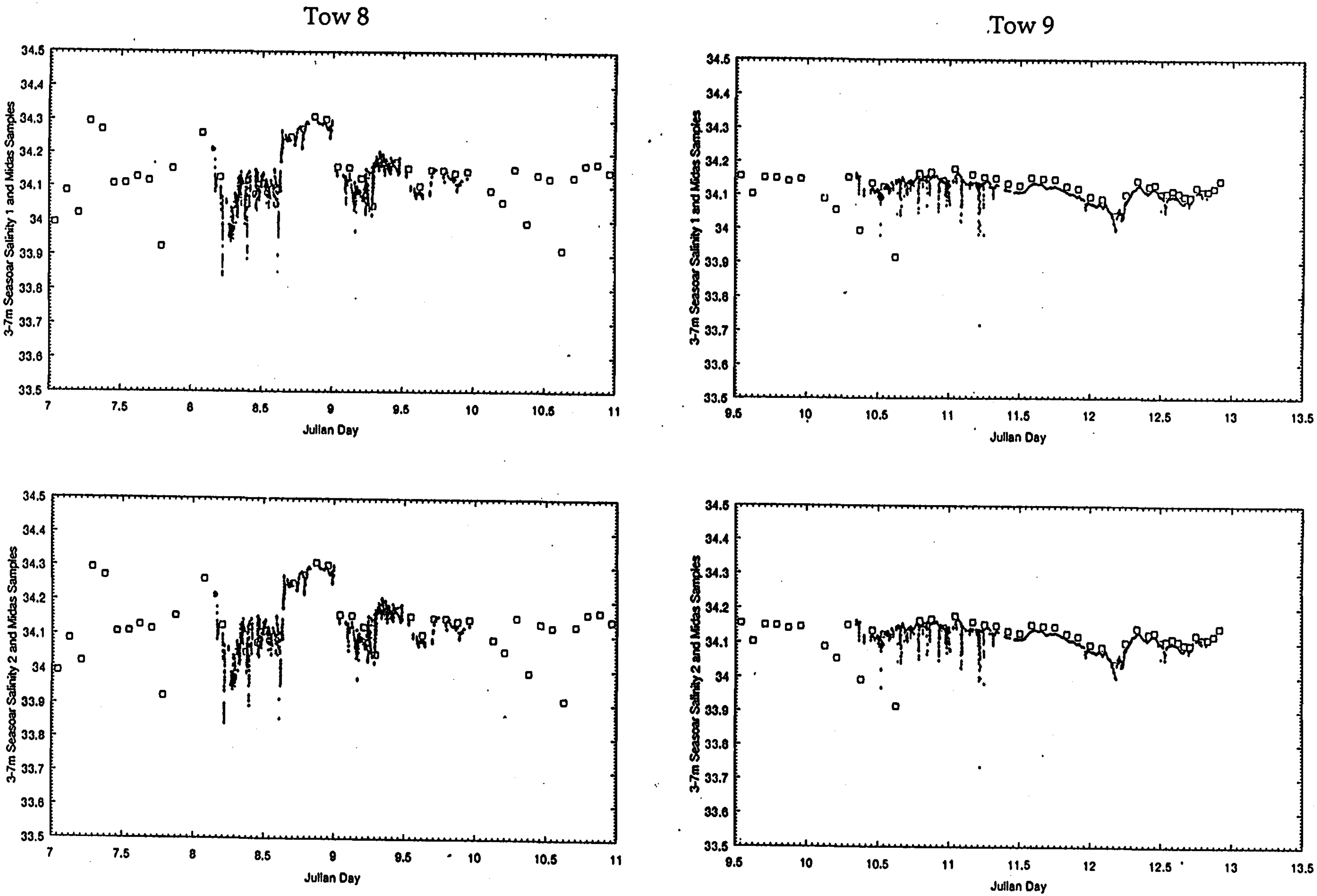

Figure 6(e). Time series of hourly salinity samples from the ship's intake at 5 m (squares), and of preliminary near-surface (3-7.99 m) Seasoar salinity data (dots) from both primary (upper panel) and secondary sensors (lower panel), during Tow 8 (left) and Tow 9 (right) of W9211B.

swapping of sensors from Seasoar and the CTD/rosette system, Tows 1 - 3 and Tows 4 - 9 were analyzed separately.

The sensors that had been in the Seasoar for Tows 1 - 3 were moved to the CTD for casts 32 -48. There was some chance that the sensors had been affected by the rough recovery at the end of Tow 3, which initiated the swapping of the sensors. If the sensors were fine, however, incorporating the CTD data would allow for calibrating the conductivity cells over the full range of the Seasoar flight path, instead of just having surface data. Analyzing the CTD data using only near-surface water samples (above 40 decibars) for casts 32 -48 yielded essentialy the same multiplication factor as that obtained from the Seasoar data in Tows 1 - 3, and so the two sets were merged. We also incorporated Seasoar data for the same sensor pairs from W9211A (tows 1 and 3). Using the surface Seasoar calibration data and the CTD calibration data, we calculated the best fit line to the bottle conductivity data from the sensor conductivity data (Figure 7). The resulting slope and offset values were used for reprocessing the data for Tows 1 - 3:

conductivity sensor 1	slope = 1.000513	offset = -0.00192
conductivity sensor 2	slope = 1.000617	offset = -0.00225

Use of the above slope and offsets resulted in standard deviations of 0.004 PSU for both sensors (sample size of 100 for sensor 1; sample size 130 for sensor 2).

Initial analysis of the shallow (3 to 7 m) Seasoar data for Tows 4 through 9, using pre-cruise calibrations of T1 and T2, showed an offset between T1 and T2 (Figure 8). We reprocessed the data with the post-cruise calibration values for T1, and we continued to use the pre-cruise calibration values for T2 because it had no post-cruise calibration due to subsequent sensor failure during the next leg of COARE (W9211C). There was a depth dependence in the temperature offset between the two sensors, obtained by examining the median difference between the two sensors at the top and bottom of the Seasoar flight path (Figure 9). Since T1 was processed with the most recent calibration, T1 was taken as the standard and we applied a slope and offset to T2 to match its values with T1. The slope and offset used in reprocessing T2 for Tows 4 - 9 were:

temperature sensor 2	slope = 1.000209	offset = 0.0034

The conductivity data for Tows 4 - 9 could now be analyzed using the post-cruise calibration of T1, and the pre-cruise calibration of T2 corrected using the slope and offset just described. Analysis assumed the conductivity could be corrected by multiplier alone, with no offset (Table 15). We found no significant difference between the slopes of the individual and the combined tows, and reprocessed Tows 4 through 9 with their combined slope shown

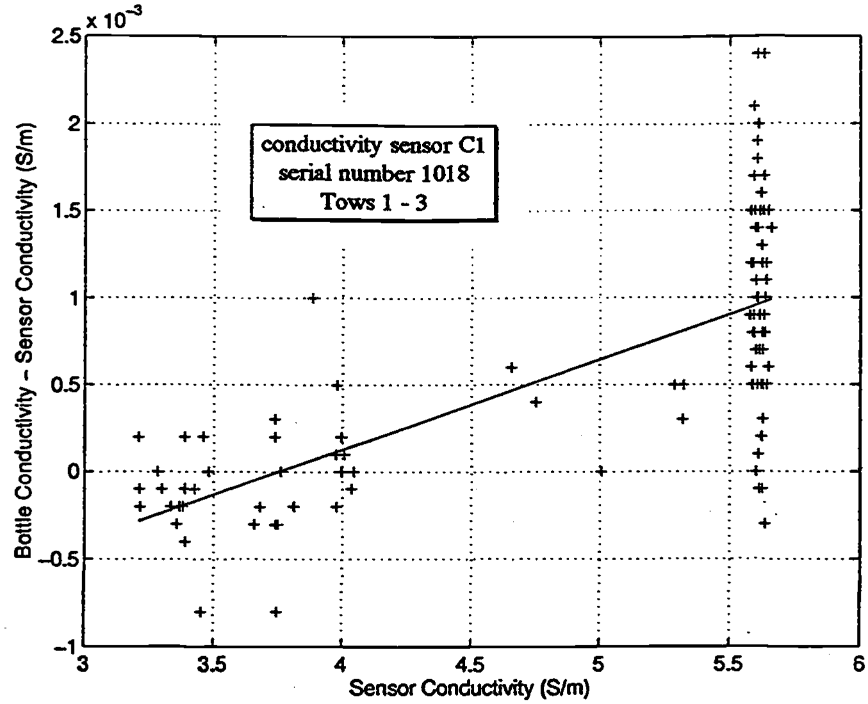

Figure 7(a). Plot of conductivity residuals for C1 calibration data and best fit line to the data.

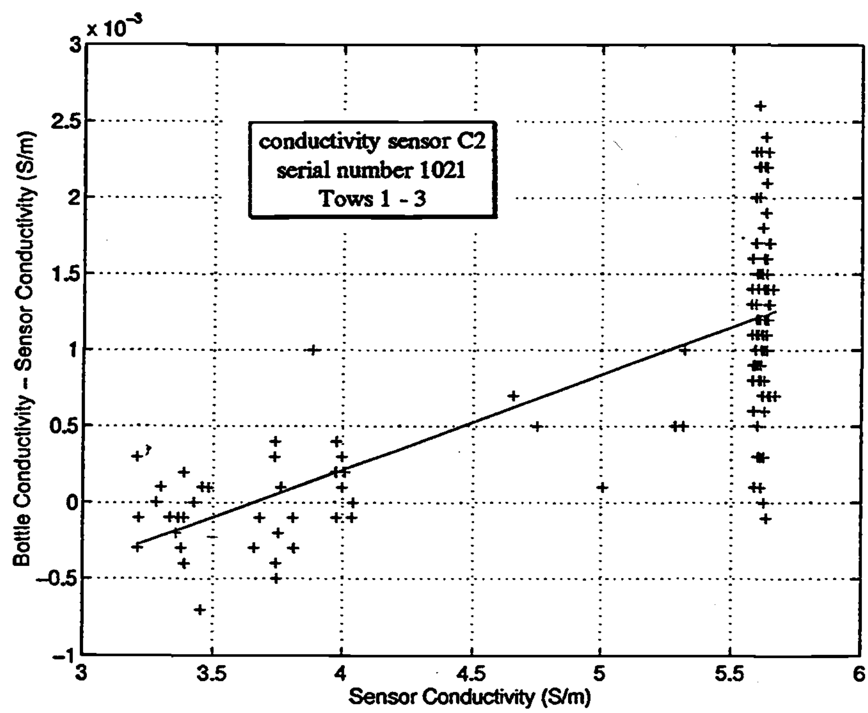

Figure 7(b). Plot of conductivity residuals for C2 calibration data and best fit line to the data. The best fit line illustrates the need for both a slope and offset correction. The zero intercept of the line was then used as the offset in the regression of the sensor data to the bottle data.

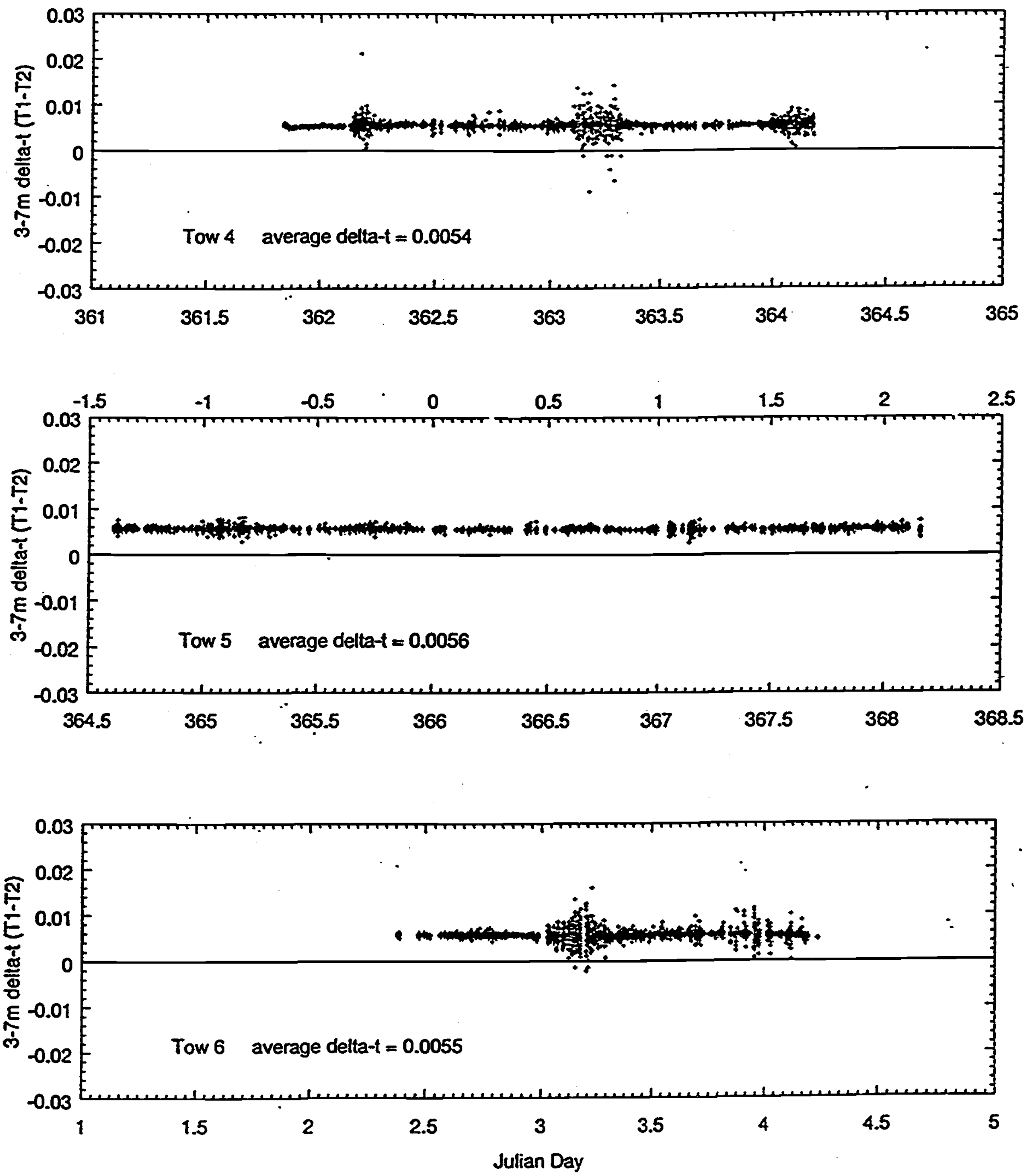

Figure 8 (a). Initial (near surface) temperature differences between T1 and T2 for Tows 4, 5, and 6.

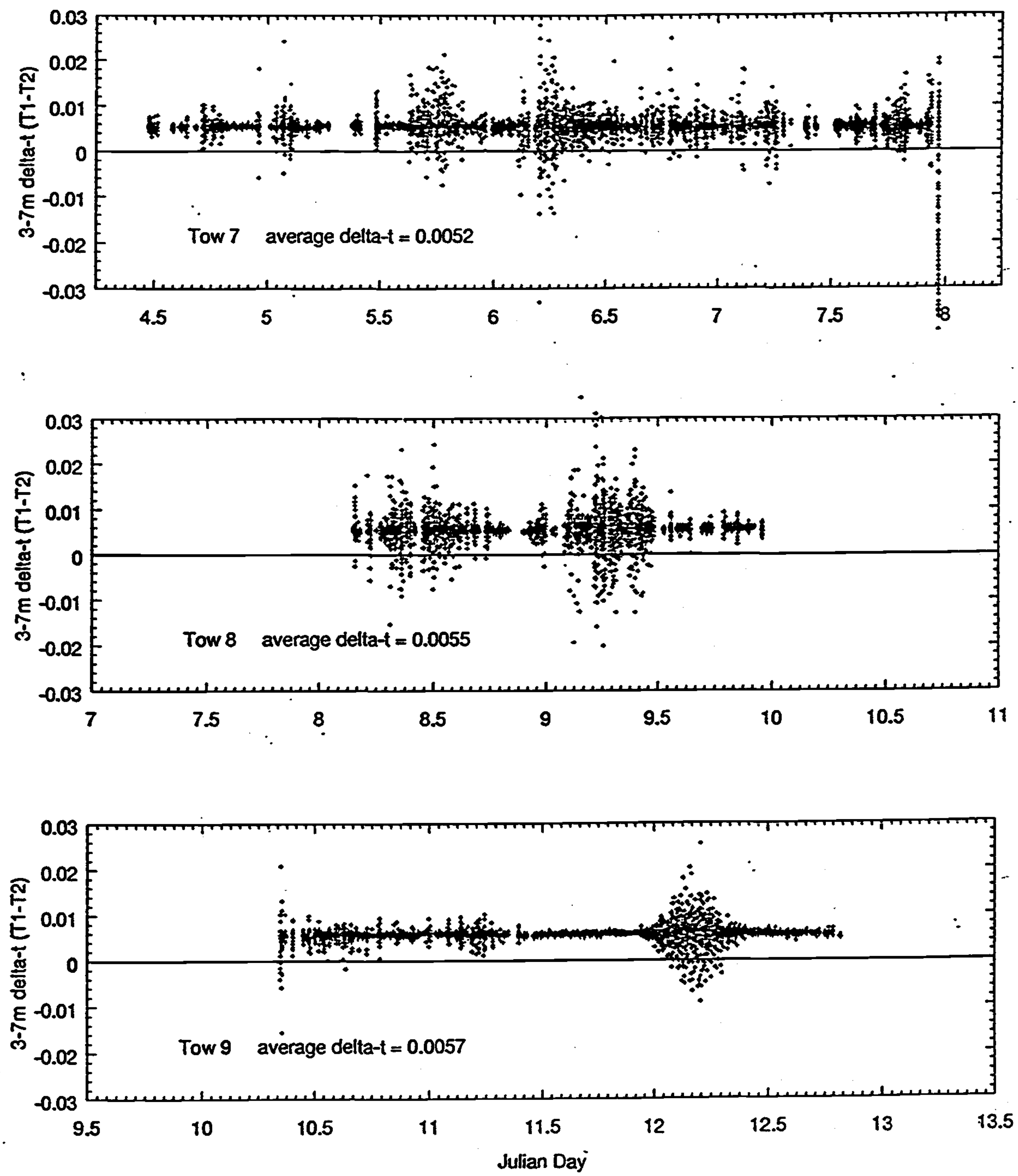

Figure 8 (b). Initial (near surface) temperature differences between T1 and T2 for Tows 7, 8, and 9.

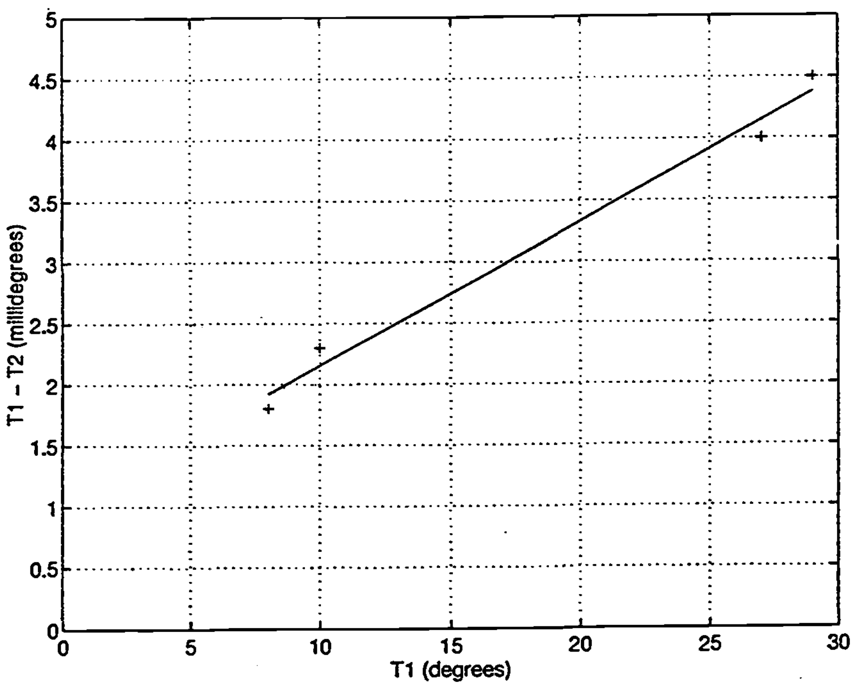

Figure 9. Median T1-T2 values for for the maximum and minimum one degree bins of T1 during Tow 4 and Tow 9. These temperature bins represent the shallowest and deepest Seasoar positions where the dive rate was near zero for extended periods. These end points indicate a consistant slope and offset correction required to match T1 and T2 together over the course of Tows 4 through 9.

in Table 15. Note that surface stratification was most extreme during Tow 7 (see Figure 6d) where only one calibration value was used from that entire tow.

The sensors that were in the Seasoar for Tows 4 - 9 came from the CTD when the sensor exchange took place, and had been used for Stations 1 - 31. The Seasoar and the CTD calibration data could not be merged because of the Seasoar's use of temperature calibrations described above. In order to verify that the temperature and conductivity calibrations applied to the Seasoar data were consistant with the CTD data, we recalculated the CTD calibration data using the Seasoar calibrations for sensor pair two. If the Seasoar temperature and conductivity calibrations were sufficient, then the CTD data should show no need for additional correction. After use of the Seasoar calibrations there is still a slope and offset present in the CTD data , but there is minimal impact over the range that the Seasoar samples (Figure 10). Correction of the remaining slope and offset would change the Seasoar salinity values by less than +/- 0.002 PSU and is considered within the tolerance of the data.

Applying these calibration factors to the Seasoar data before recalculating salinity allows us to compare the corrected Seasoar salinity values from both primary and secondary sensor ducts to the sample salinity. The time series of the differences (Figure 8) show reasonable agreement between sample and near-surface Seasoar data for both sensor pairs for the duration of Tows 1 through 9. In general, largest sample-Seasoar differences occur when the surface layer is stratified, so the standard deviations of the salinity differences (Table 15) primarily reflect sampling errors rather than instrumental noise.

Table 15. Conductivity multipliers (ml and m2) for primary and secondary sensors, determined from comparison of near-surface Seasoar data with 5-m intake samples. All entries were solved as multiplier-only corrections, and assumed no offset. The last entry shows the results of merging the data for Tows 4 - 9, and these correction factors were adopted for reprocessing the Seasoar conductivity data. Also shown are the average and standard deviations of the salinity differences between the sample values and the corrected Seasoar data.

		Slope		**Offset**		**Average**		**Std. Dev.**	
Tow	**N**	**m1**	**m2**	**b1**	**b2**	**S1**	**S2**	**S1**	**S2**
4	21	1.000517	1.000519	----	----	0.000	0.000	0.005	0.002
5	25	1.000547	1.000554	----	----	0.001	0.001	0.005	0.005
6	9	1.000547	1.000554	----	----	0.000	0.000	0.001	0.006
7	1	1.000550	1.000572	----	----	-0.001	0.000	----	----
8	5	1.000438	1.000474	----	----	-0.002	-0.001	0.003	0.004
9	19	1.000514	1.000528	----	----	-0.001	0.000	0.003	0.003
4 - 9	80	1.000526	1.000530	----	----	0.000	0.000	0.004	0.004

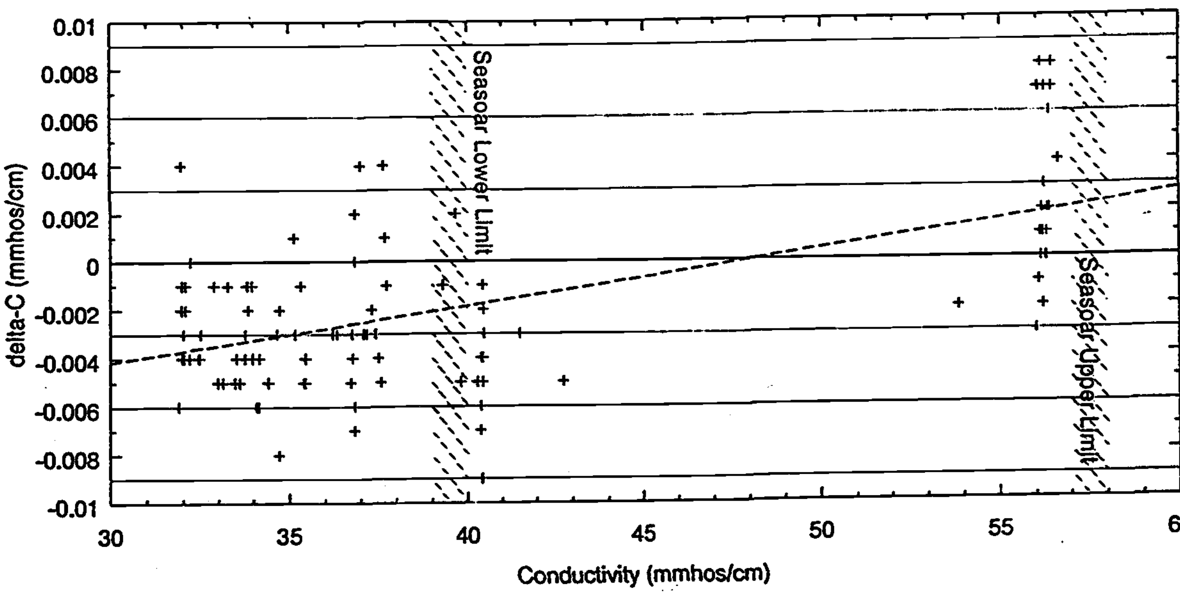

Figure 10. CTD residuals (casts 1-31) using Seasoar temperature and conductivity corrections for T2 and C2. Inside the range of Seasoar operation, correction according to the regression line would change the salinity values by no more than +/- 0.002 psu.

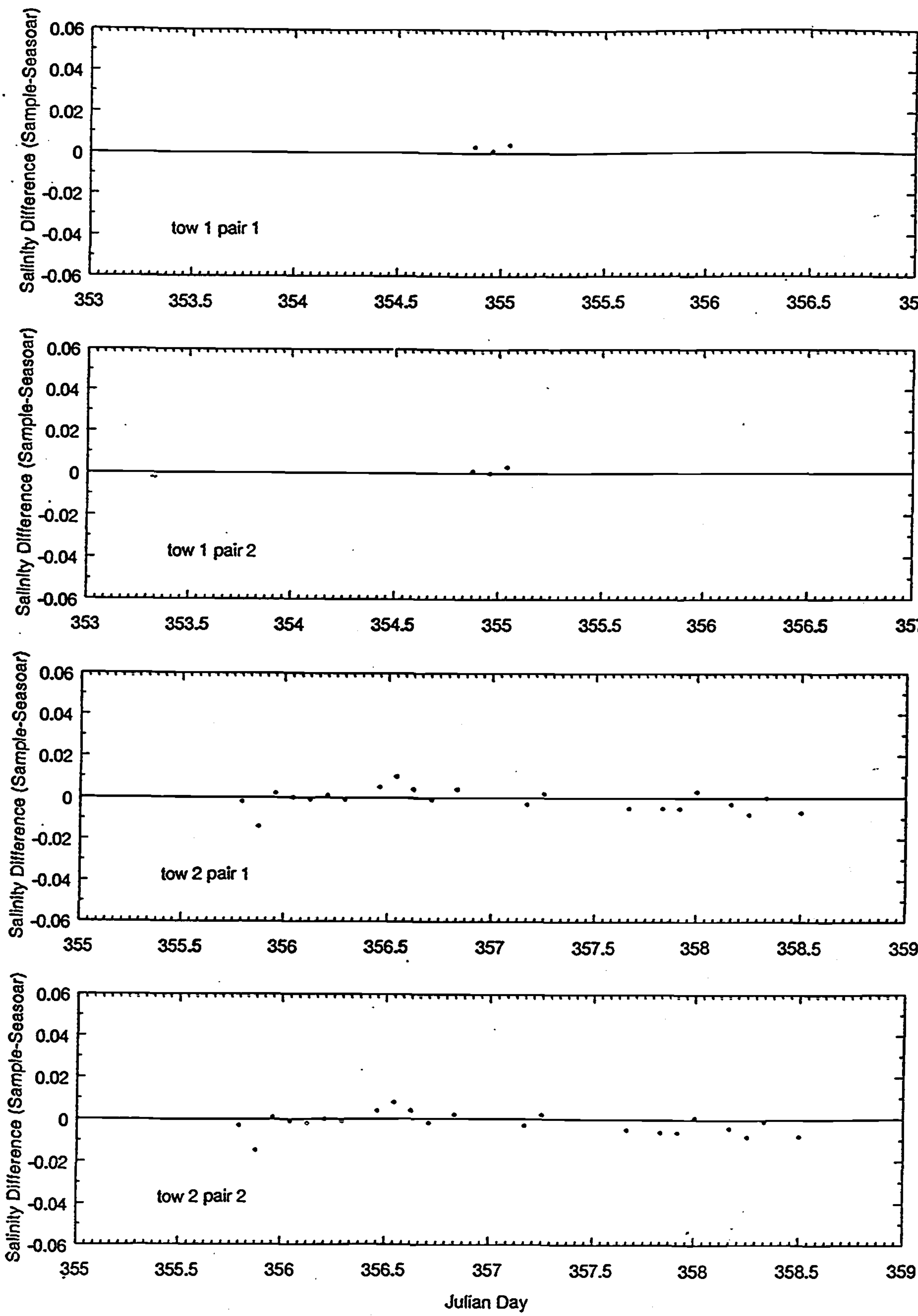

Figure 11 (a). Time series of salinity differences between the 5-m samples and the matching corrected Seasoar data, for both primary and secondary sensor pairs during Tows 1 and 2 of W9211B.

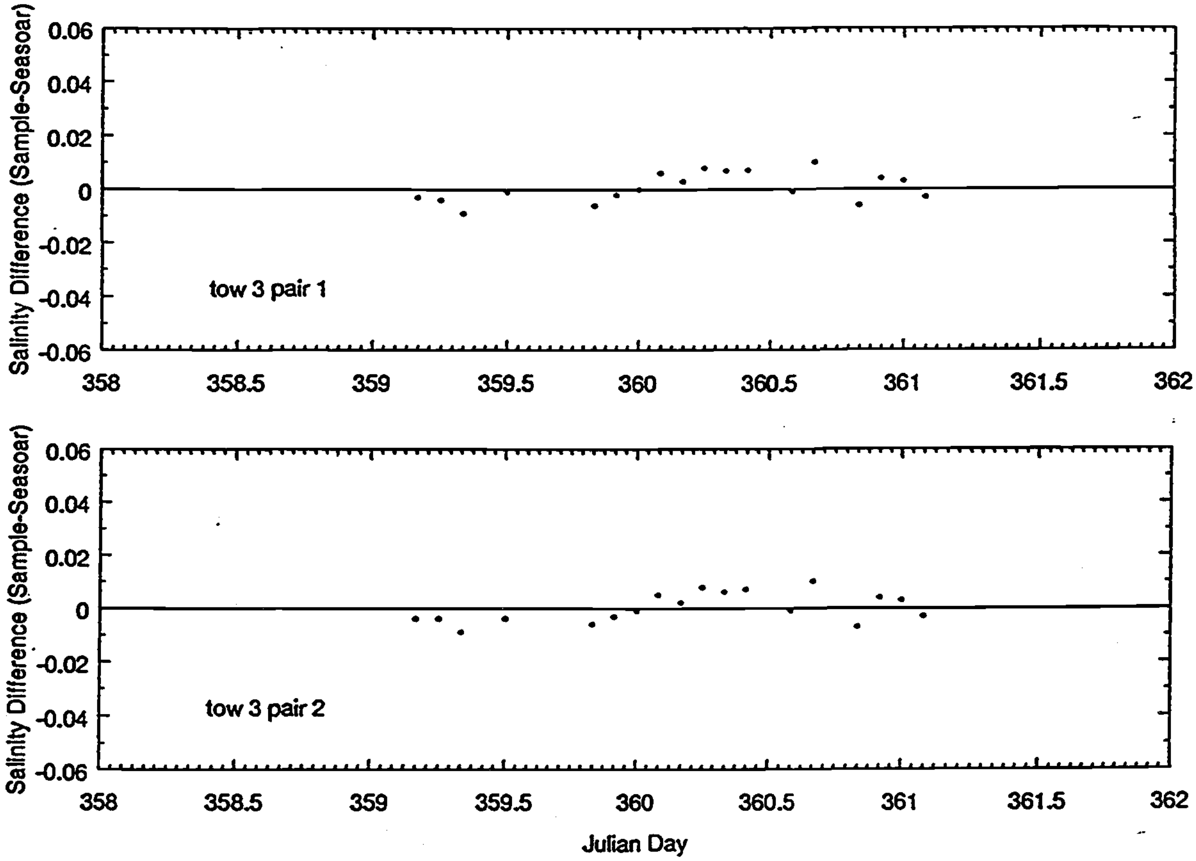

Figure 11 (b). Time series of salinity differences between the 5-m samples and the matching corrected Seasoar data, for both primary and secondary sensor pairs during Tow 3 of W9211B.

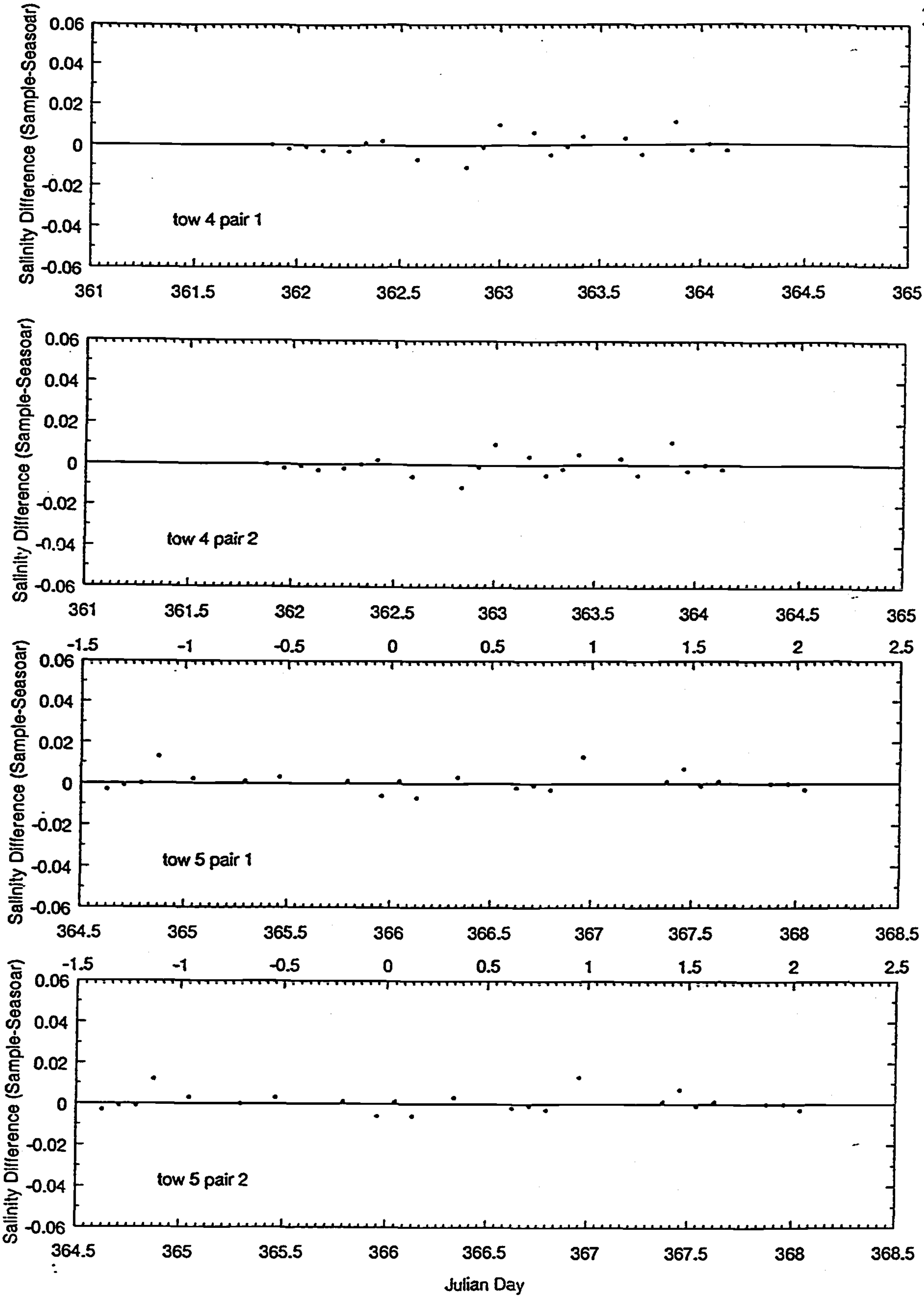

Figure 11 (c). Time series of salinity differences between the 5-m samples and the matching corrected Seasoar data, for both primary and secondary sensor pairs during Tows 4 and 5 of W9211B.

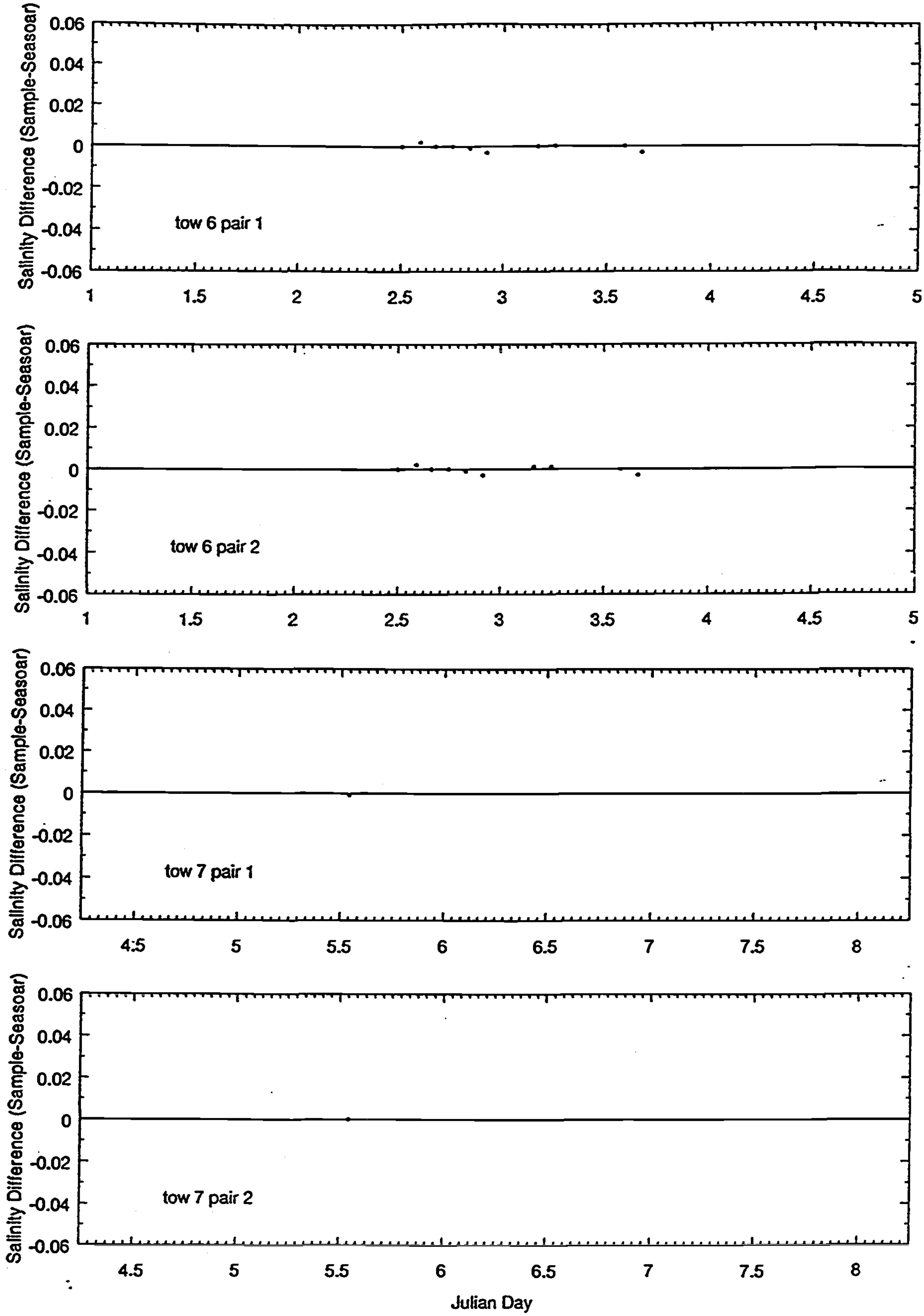

Figure 11 (d). Time series of salinity differences between the 5-m samples and the matching corrected Seasoar data, for both primary and secondary sensor pairs during Tows 6 and 7 of W9211B.

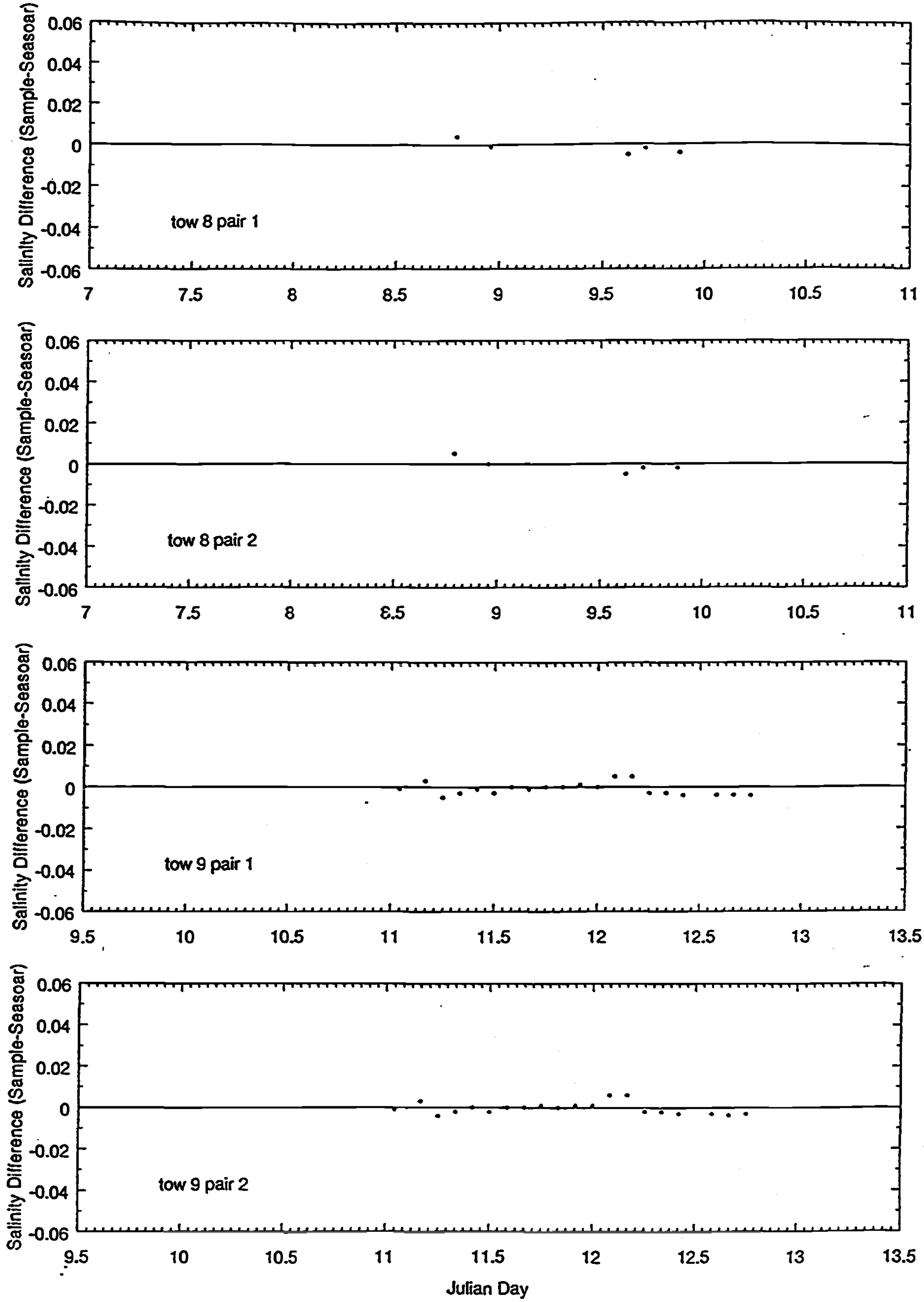

Figure 11 (e). Time series of salinity differences between the 5-m samples and the matching corrected Seasoar data, for both primary and secondary sensor pairs during Tows 8 and 9 of W9211B.

Post-processing of Seasoar Data

Salinity data derived from SeaBird ducted temperature and conductivity sensors are subject to errors from three separate sources (Larson, 1992). These sources are: offsets between the C and T values; heat transfer between the water flowing through the system and the mantle of the conductivity cell (a thermal mass adjustment); and accounting for the different response times of the temperature sensor and the conductivity cell. Corrections for these all improve the precision of the calculated values, and, of course, sensor calibration improves the accuracy. For ducted Seabird sensors, the simplest corrections involve a single offset to align the C and T values (typically 1.75 scans) and use of a recursive filter to adjust for the thermal mass of the conductivity cell (Lueck, 1990) where the recursive filter has an associated amplitude and time-constant. While this approach works well with CTD/rosette casts with a maximum descent rate of one meter per second from a stationary ship , it was not sufficient for a Seasoar towed at eight knots with climb and dive rates that sometimes reach three meters per second (or higher).

The primary difficulty appears to be that the water moves through the ducted system at a variable rate. This is explored in detail in the W9211C Data Report by Huyer, et. al. (1993). Where the simplest case has a single offset between T and C, the Seasoar data have different offsets between each ascending and descending profile, and the offsets vary within each individual ascent and descent. However, the amplitude value (used in the thermal mass correction) is proportional to flow rate (Lueck 1993) and is thus also proportional to the offsets. Variable T/C offsets and scaled amplitude values are the primary post-processing steps to our Seasoar data. While we have fixed the time constant in the thermal mass correction, it too is apparently proportional to flow rate (Morison et al., in press).

We incorporated our temperature and conductivity corrections determined from either *in situ* calibration or post-cruise calibration in a new configuration file for each tow. All sensors used the latest pre-cruise calibrations, except for temperature sensor 1 used in Tows 1 - 3, which used a post-cruise calibration. Temperature sensor 2 (Tows 1 - 3) also used *in situ* correction factors to match it to T1. The conductivity correction factors determined from the *in situ* calibration data (Table 15; Table 16) were also incorporated in the configuration files for each tow.

The next step is to compute lagged correlations between temperature and conductivity for each sensor pair, separately for ascending and descending profiles, and separately for three depth ranges: 50 to 120 dbar, 120 to 180 dbar, and 180 to 240 dbar, provided the segment contains at least 72 scans. Cross-correlations are calculated after detrending both temperature and conductivity by first-differencing the 24-Hz data. Correlations are calculated for conductivity lags of -12 scans to +12 scans; the maximum correlation is almost always ≥ 0.85. The fractional value of the lag at maximum correlation is determined by fitting a parabola to the cross-correlation values. The resulting time series of the optimum primary and secondary sensor pair alignment offsets (ξ_1 and ξ_2) for each tow are shown in Appendix A. Lag values greater than 12 and other outliers (obtained occasionally for data segments lasting <10 seconds) were not used in processing the data.

The edited values of the alignment offset were applied sequentially in reprocessing the 24-Hz T/C data. To reprocess data from depths shallower than 50 m, we used the ξ value determined from the associated (ascending or descending) 50 to 120 dbar layer; for data deeper than 240 m, we used the ξ value determined from the associated (ascending or descending) 180 to 240 dbar layer. Short segments with unreasonably large lags were processed with the lag obtained for the succeeding data segment.

To correct the 24 Hz conductivity data for the thermal mass of the conductivity cell, we used the standard algorithm with a fixed value for the thermal anomaly time constant (τ = 10 sec), and variable values for the thermal anomaly amplitude depending on the alignment offset:

$$
\begin{aligned}
\alpha_1 &= 0.03 && \text{if } \xi_1 \leq 0 \\
\alpha_1 &= 0.03 + 0.03(\xi_1/2.75) && \text{if } \xi_1 > 0 \\
\alpha_2 &= 0.03 && \text{if } \xi_2 \leq 1.75 \\
\alpha_2 &= 0.03 + 0.03((\xi_2\text{-}1.75)/2.75) && \text{if } \xi_2 > 1.75,
\end{aligned}
$$

where the subscripts denote primary or secondary sensors. Note that 1.75 scans was already removed from the data for the primary sensors by our deck-unit, but not for the secondary sensors. The corrected and realigned 24 Hz temperature and conductivity data are used to calculate 24-Hz salinity, and these are averaged to yield 1-second averages stored in hourly files.

One last post-processing adjustment was required for the end of Tow 7, when the digiquartz temperature sensor began to fail (Figure 5). Since the normal digiquartz signal is very close to constant, a substitute temperature value was inserted to replace the erratic digiquartz values. Starting at 23:00 UTC on 05 January 1993, a value of 25 degrees C was inserted for the internal temperature of the pressure sensor, and corrected about 48 hours of data to their proper pressure values.

The reprocessed data from both sensor pairs were plotted to determine which pair provided the better data for each Seasoar tow. The secondary sensor pair (sensors on the port side) were consistently better for the combined ascending and descending profiles for the majority of the tows. The secondary pair was chosen as the preferred sensors for Tows 3 through 9. However, the primary sensor pair (starboard side) gave the preferred sensors for Tow 1. Tow 2 was unusual in that the primary sensor pair gave better combined ascending and descending profiles at the start of the tow, but the secondary pair was doing better by the end of the tow. The primary sensor pair was eventually chosen as the preferred sensors for Tow 2.

Data Presentation

Successive hourly files of the reprocessed one-second average data were joined and clipped to yield a single data file for each section of the Standard Butterfly Pattern (Tables 13 and 14). Final processed data files contain unfiltered GPS latitude and longitude; pressure; temperature, salinity and sigma-t from the better sensor pair; date and time; and an integer representing flags (to indicate collection of a water sample from 5-m intake (thousands digit set to 1), missing GPS data filled by linear interpolation (tens digit set to 1), and to indicate port or starboard intake for the T/C sensor pair (ones digit set to 1 or 0, respectively)). We present consecutive figures of the Seasoar trajectory (time series of pressure, latitude and longitude) along each section. We also present summary figures of all of the 1-second data for each of the four standard sections as follows: ensembles of temperature profiles (both ascending and descending), salinity profiles (ascending profiles only), and T-S diagrams (for ascending profiles only). Vertical distributions of the temperature, salinity and sigma-t along each section were plotted using Don Denbo's PPlus program with a vertical grid spacing of 2 dbar and a horizontal spacing of 1 nm, and with a value of CAY= 5 for the smoothing parameter (combined spline and laplacian filter). For the temperature sections, we used both ascending and descending data for all tows. For the salinity and sigma-t sections, we used only ascending data for all tows.

Acknowledgments

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References

Anonymous, 1992. *CTD Data Acquisition Software, SEASOFT Version 4.015.* Sea-Bird Electronics, Inc., Bellevue, Washington, USA.

Huyer, A., Kosro, P.M., O'Malley, R., and Fleischbein, J. 1993. *SEASOAR and CTD Observations During a COARE Surveys Cruise, W9211C, 22 January to 22 February 1993.* Data Report 154, Reference 93-2, College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, Oregon, 325 pp.

Fofonoff, N. P., and R. C. Millard. 1983. *Algorithms for computation of fundamental properties of seawater.* Unesco Technical Papers in Marine Science, 44, 53 pp.

Larson, N. 1992. *Oceanographic CTD Sensors: Principles of Operation, Sources of Error, and Methods for Correcting Data.* Sea-Bird Electronics, Inc., Bellevue, Washington, USA.

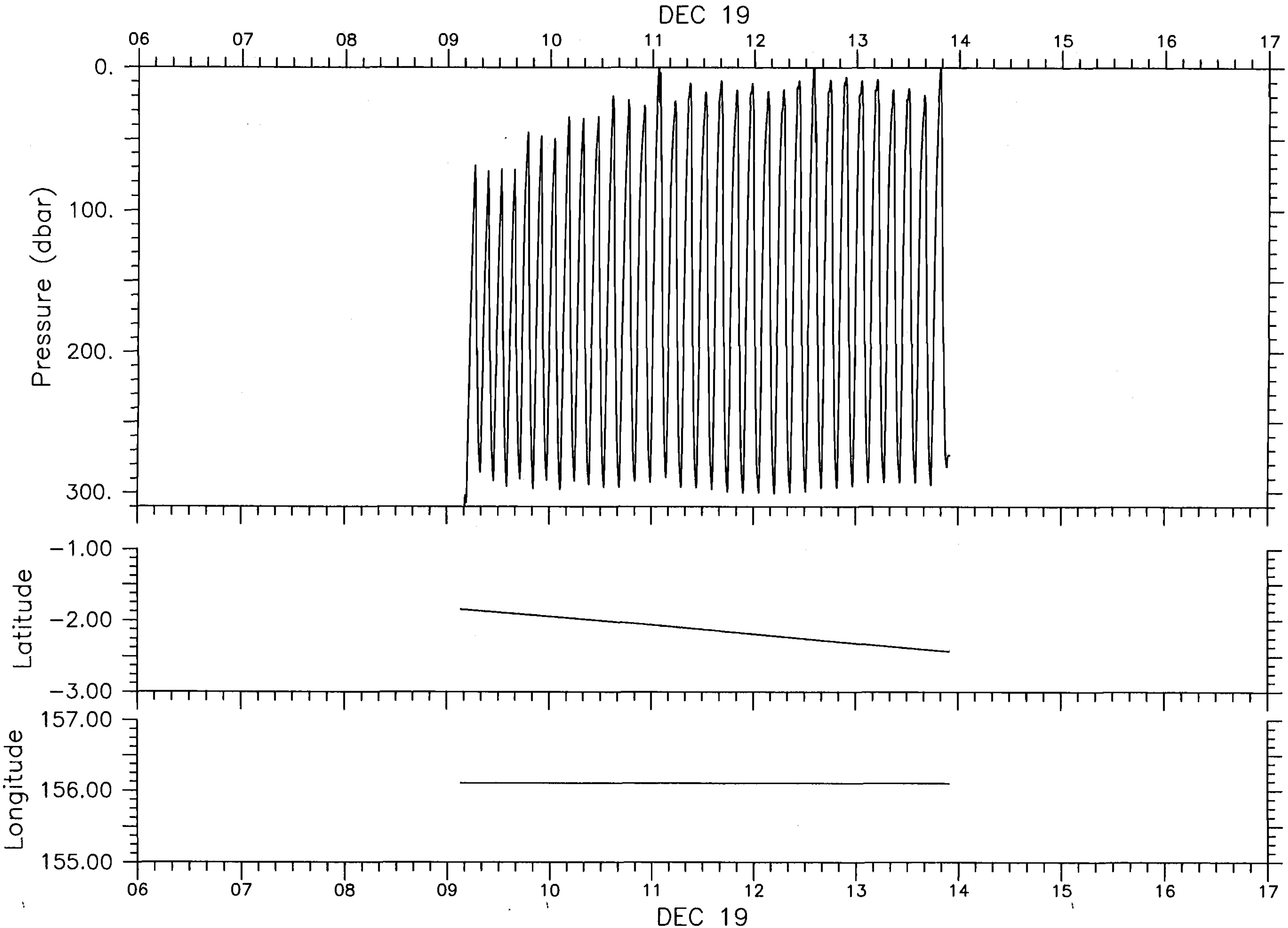
Lueck, R. 1990. Thermal inertia of conductivity cells: *Theory. J. Atmos. Oceanic Tech.*, **7**, 741-755.

Lueck, R., and J. J. Picklo. 1990. Thermal inertia of conductivity cells: Observations with a Sea-Bird cell. *J. Atmos. Oceanic Tech.*, **7**, 756-768.

Morrison, J., R. Andersen, N. Larson, E. D'Asaro, and T. Boyd. In Press. *J. Atmos. Oceanic Tech.*

Webster, P. J., and R. Lukas, 1992. TOGA COARE: The Coupled Ocean-Atmosphere Response Experiment. *Bull. Amer. Met. Soc.*, **73**, 1378-1416.

SEASOAR TRAJECTORIES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155.00
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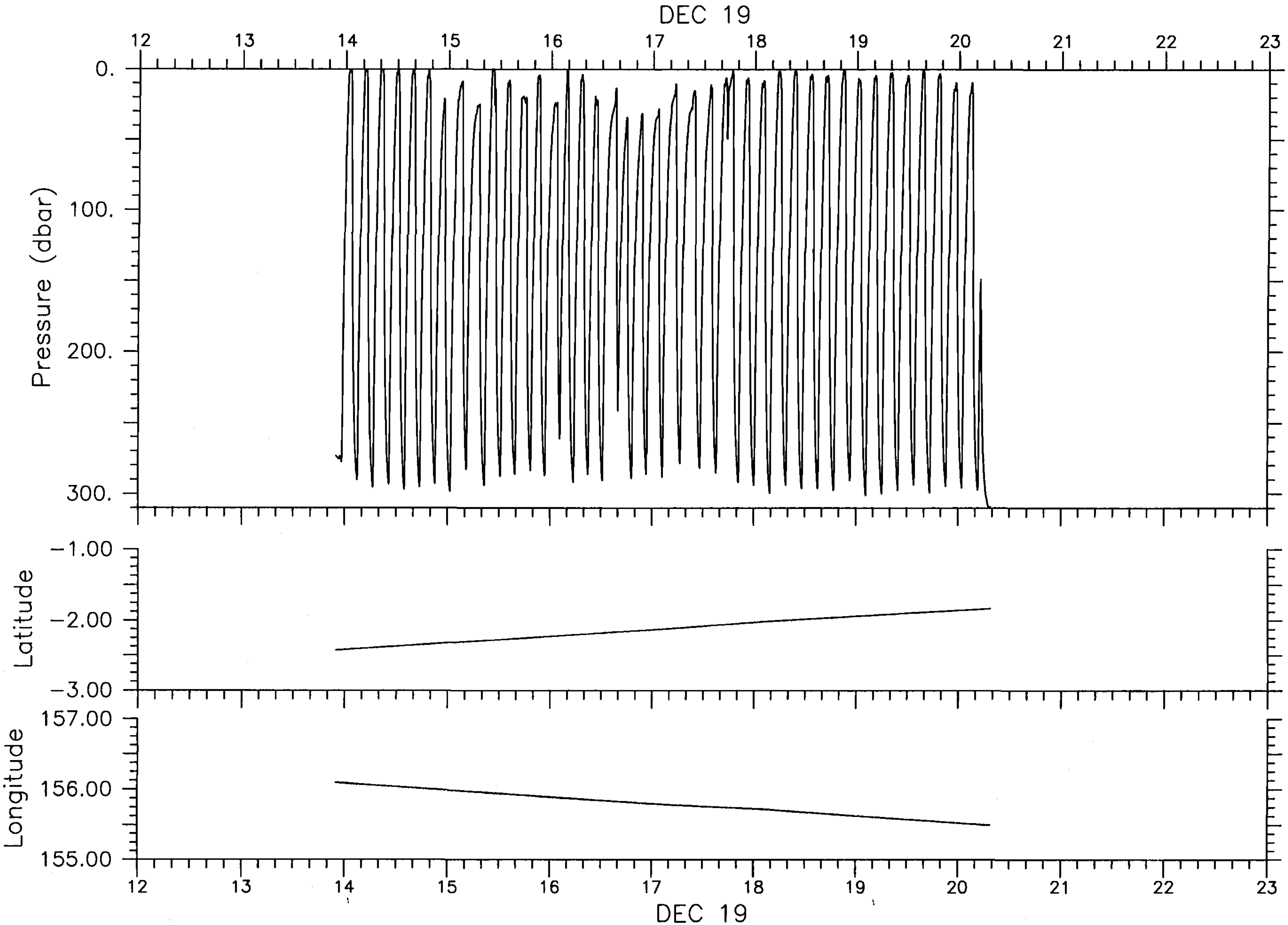
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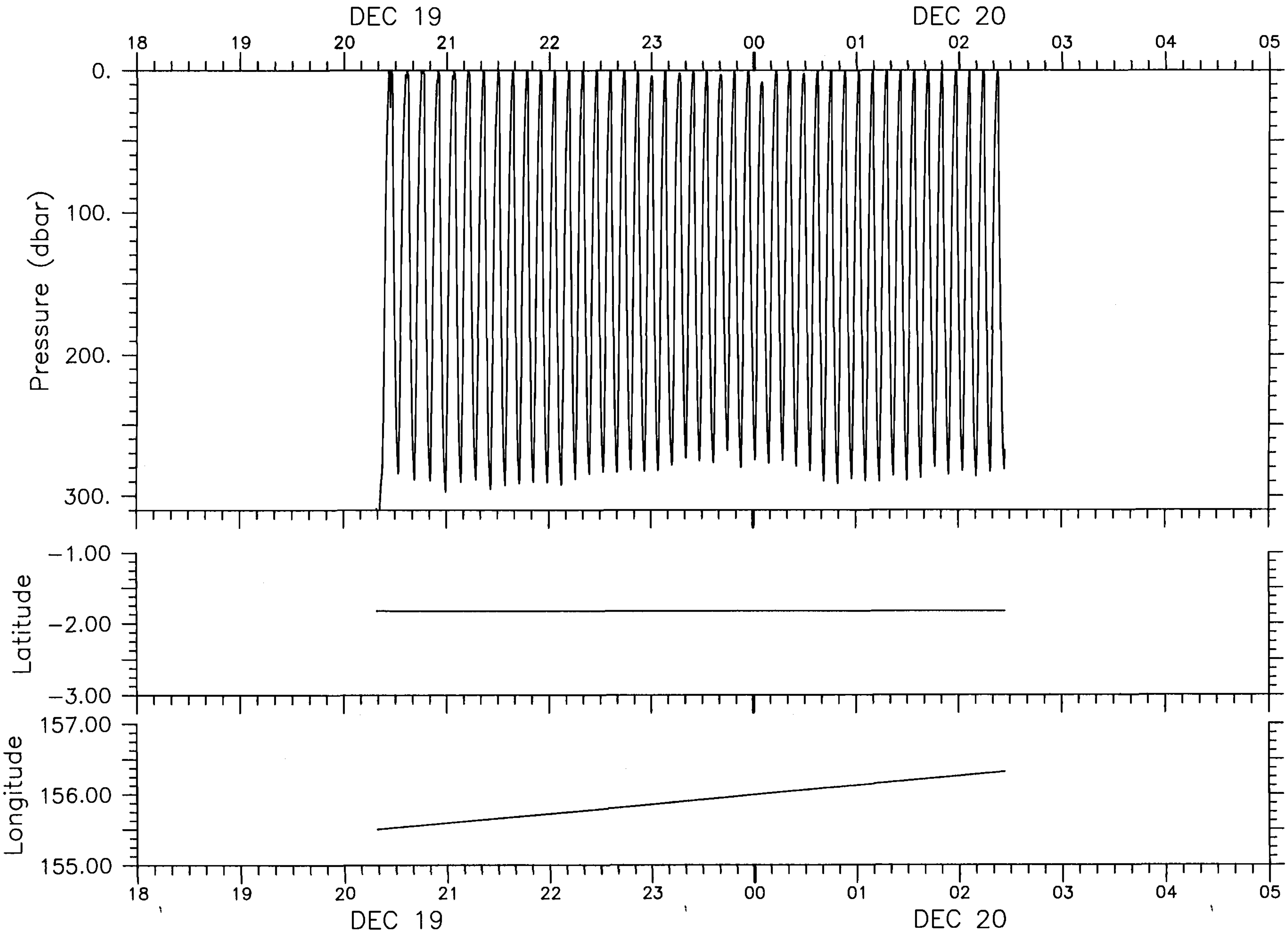
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Longitude
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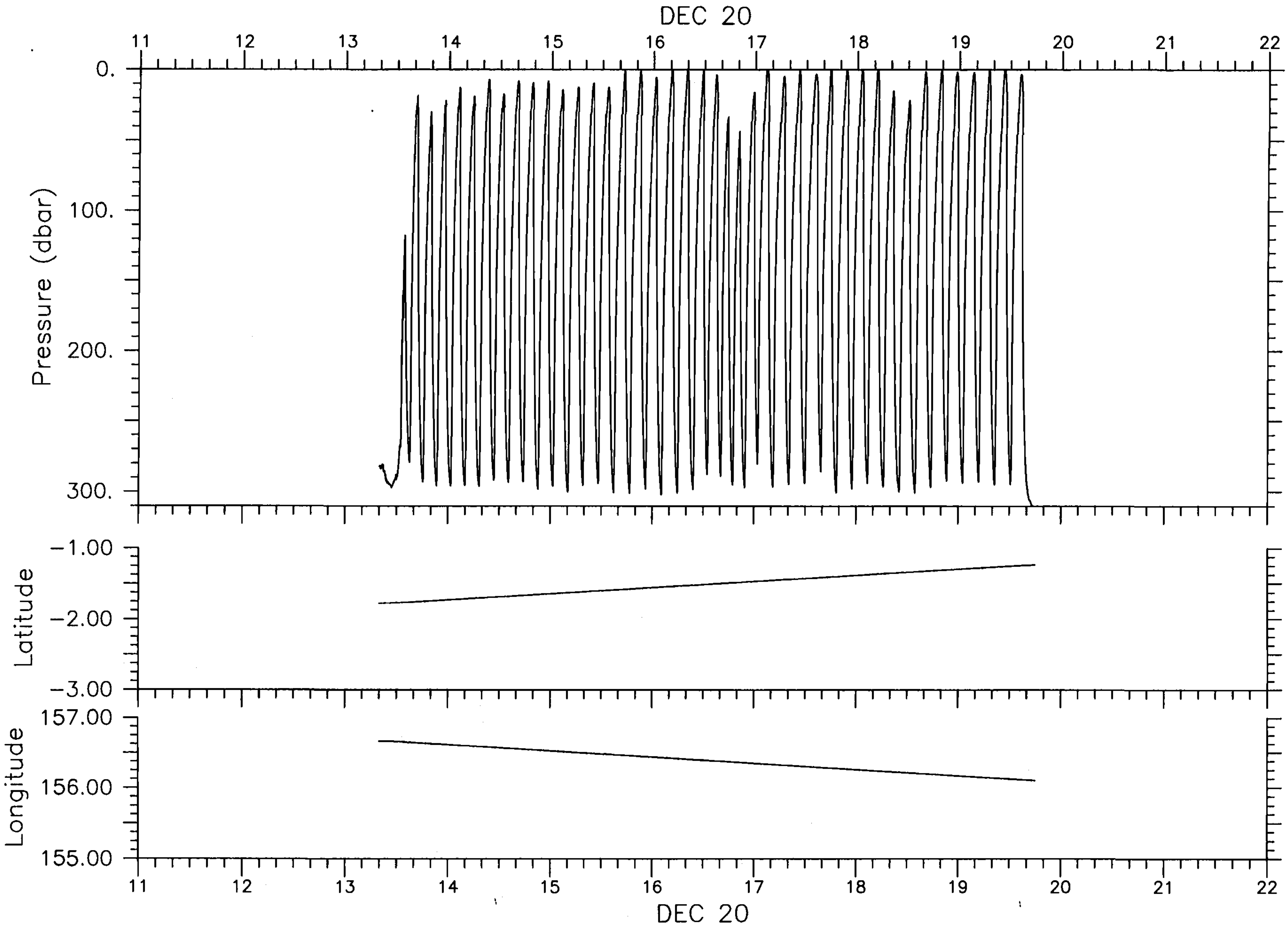
155.00

W2E



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Longitude
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155.00
DEC 20

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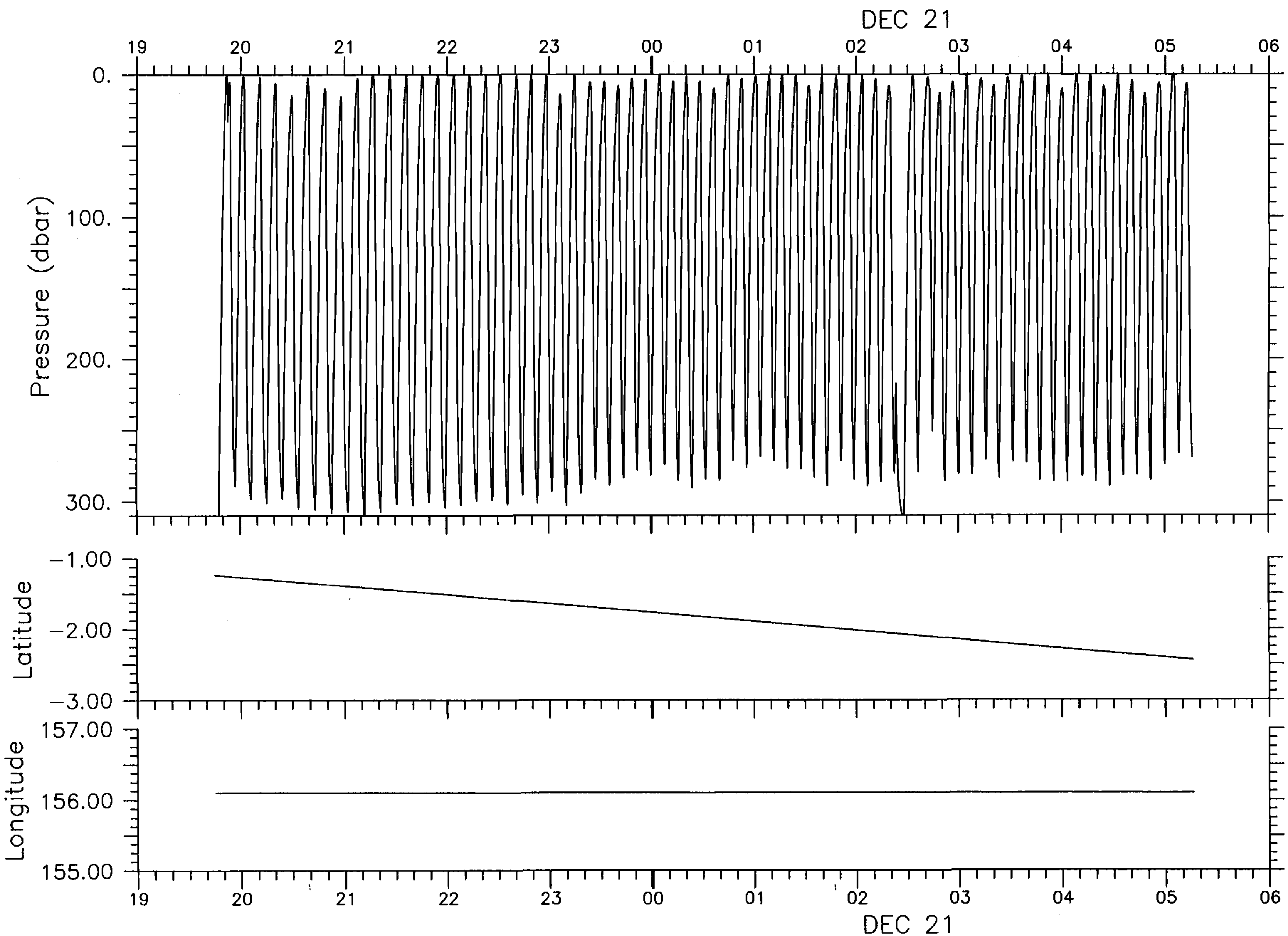
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Longitude
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155.00

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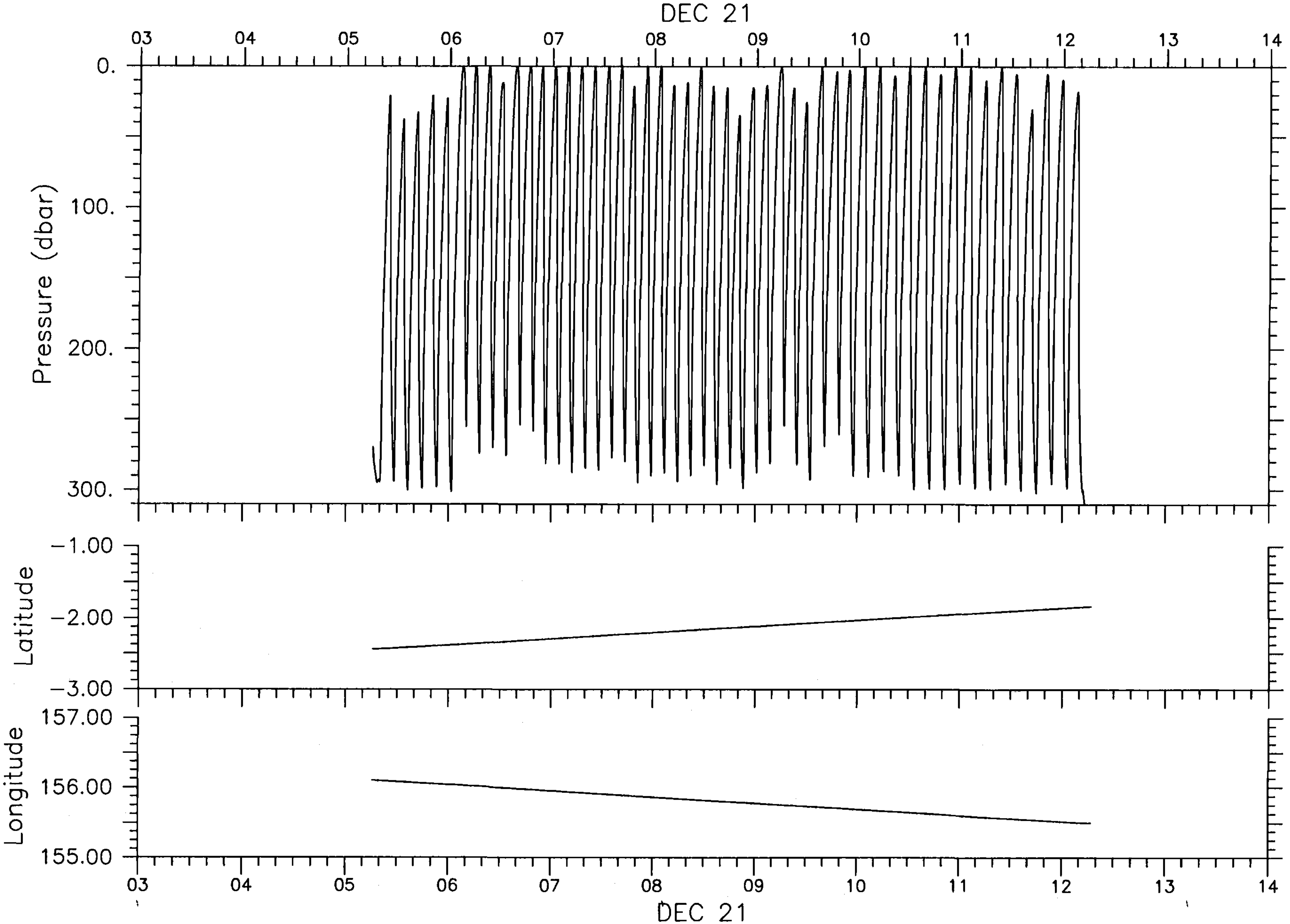
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155.00

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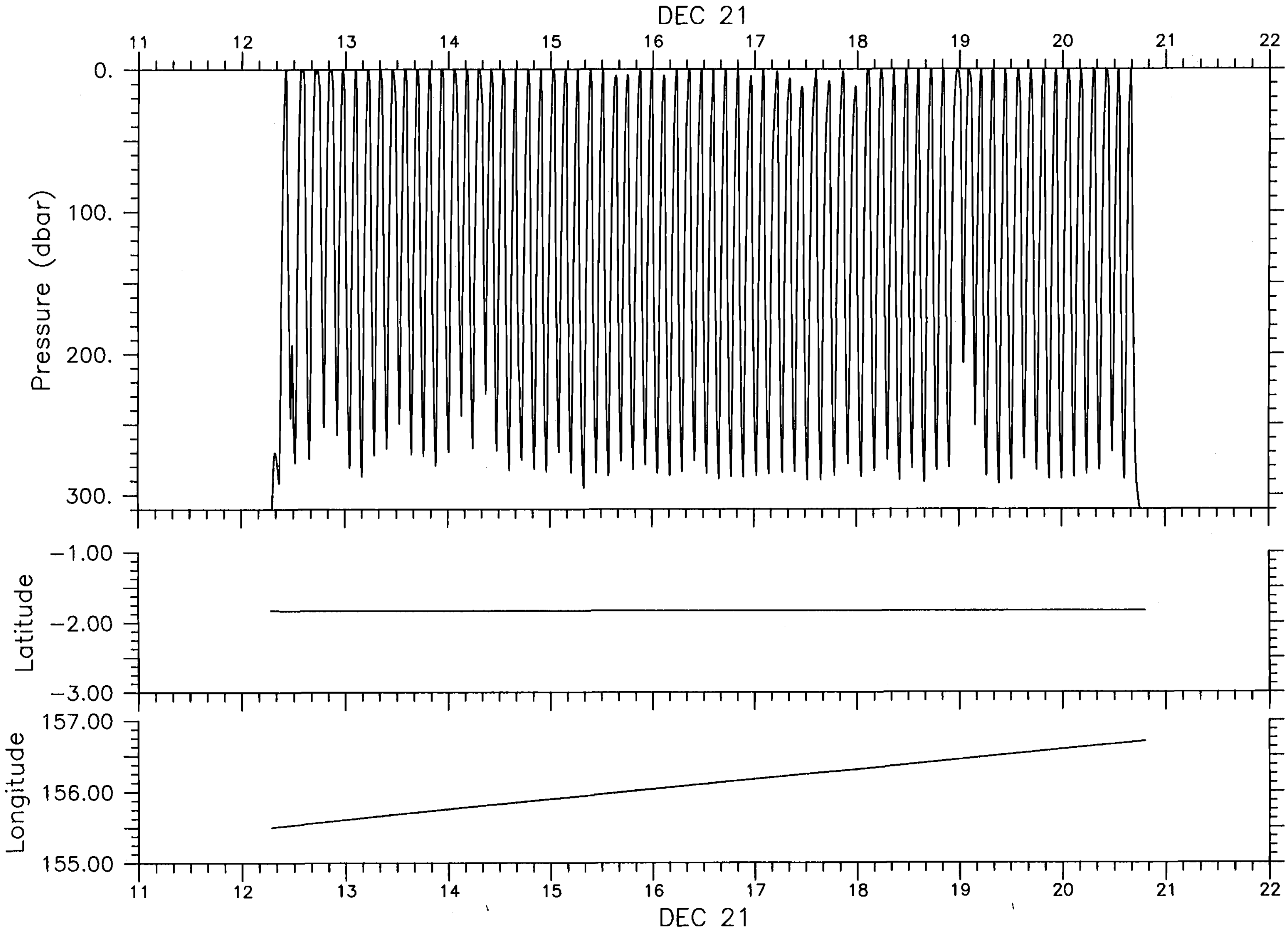
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Longitude
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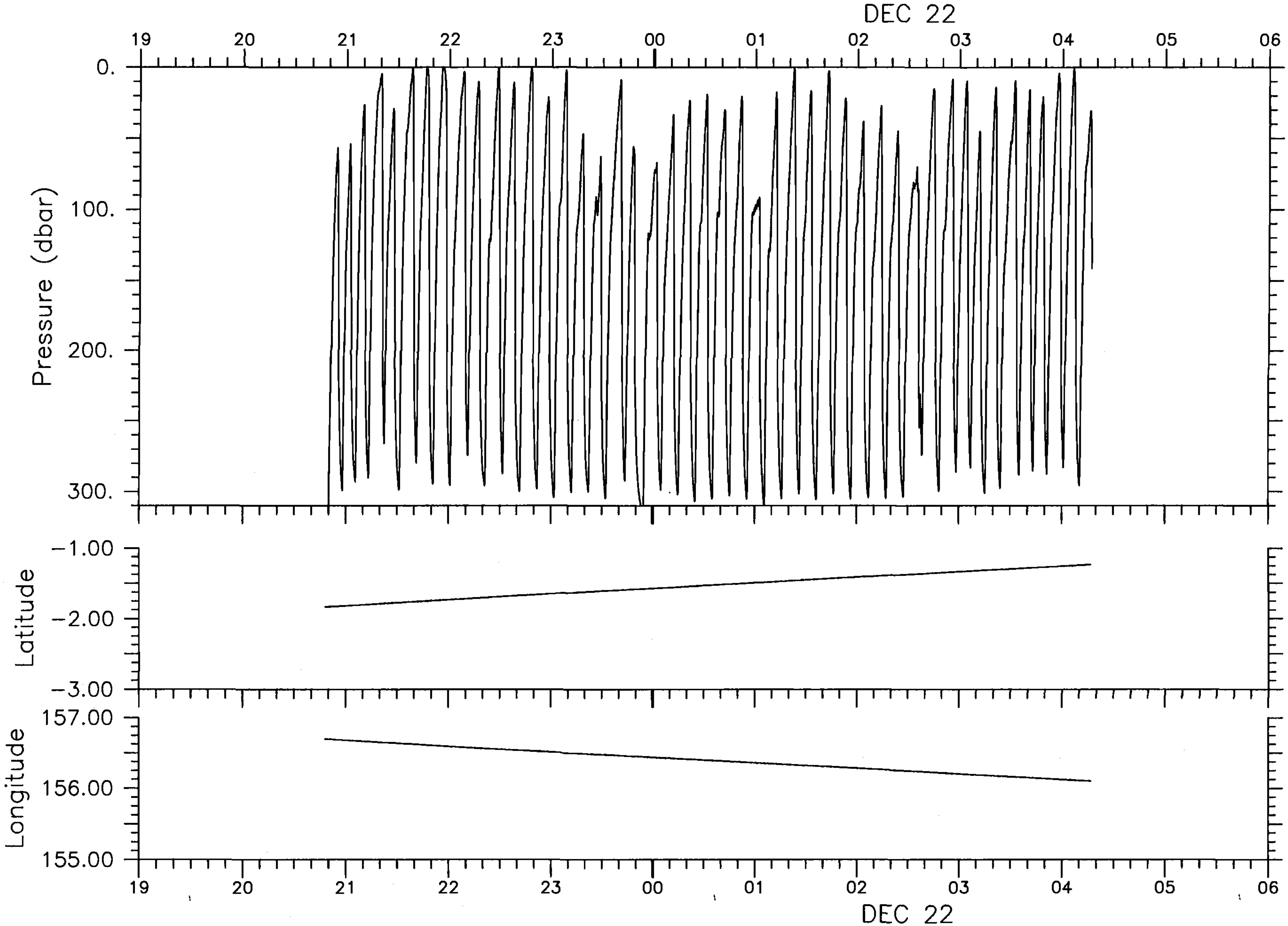
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Longitude
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22
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06
DEC 22

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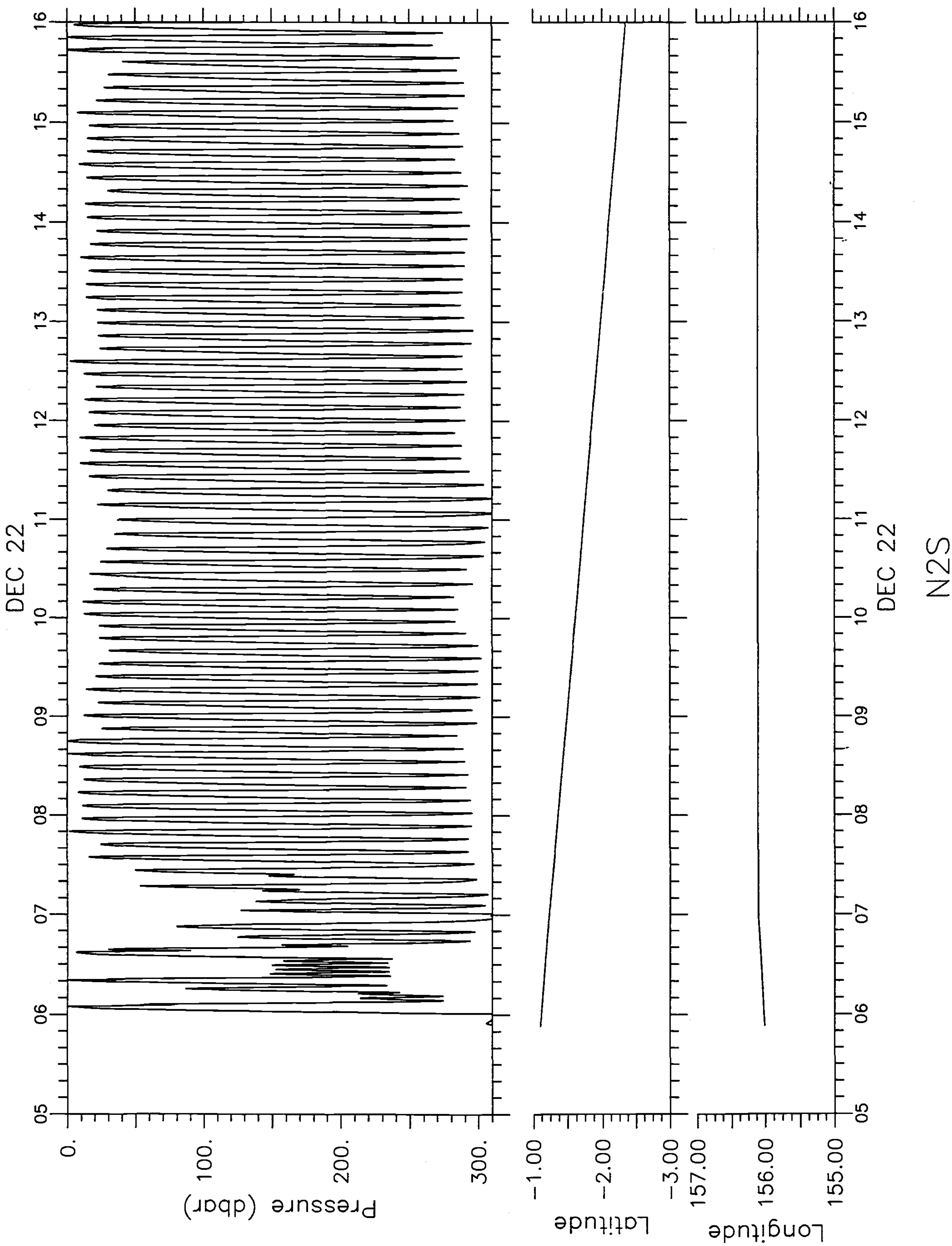
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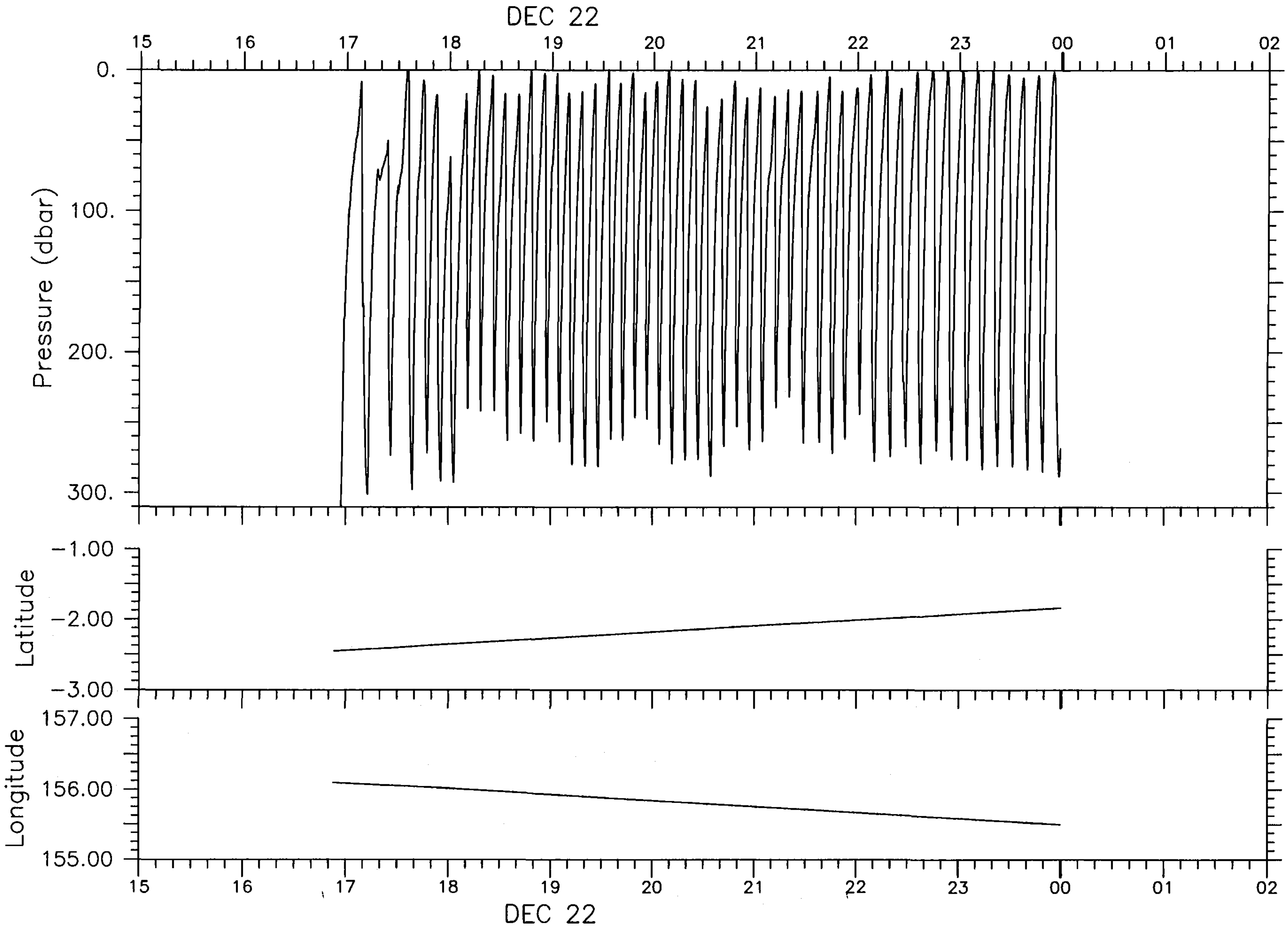
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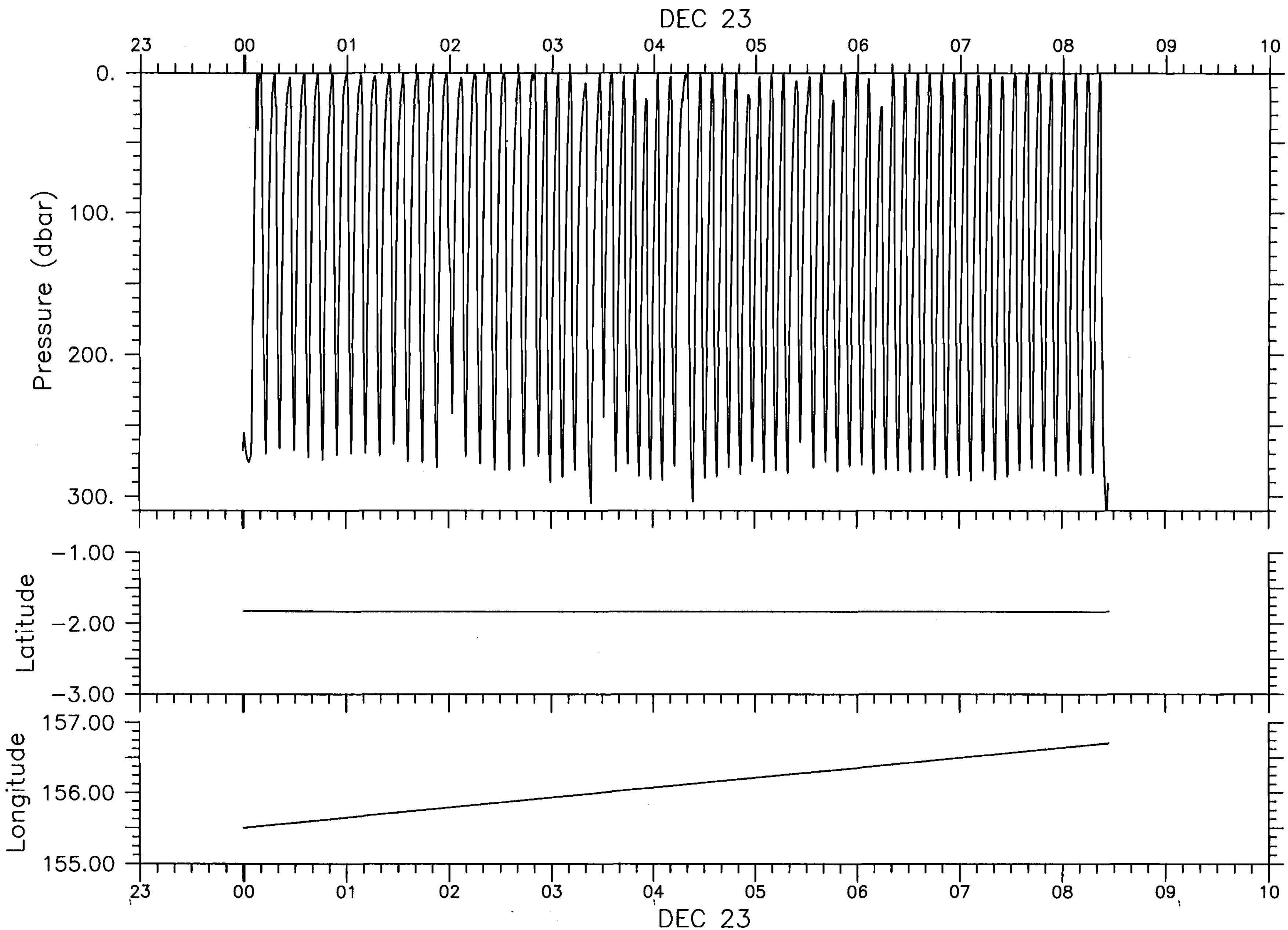

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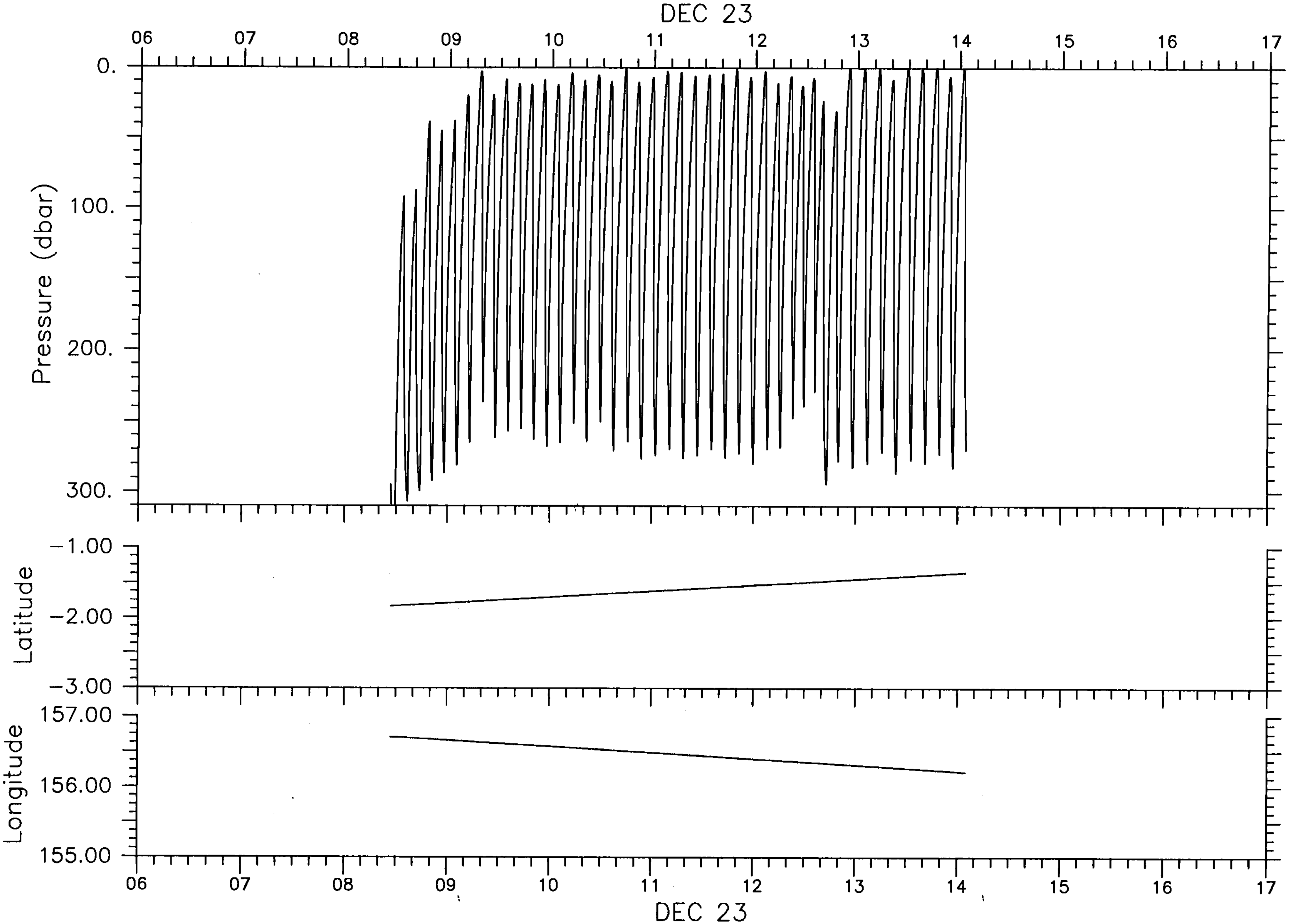
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Longitude

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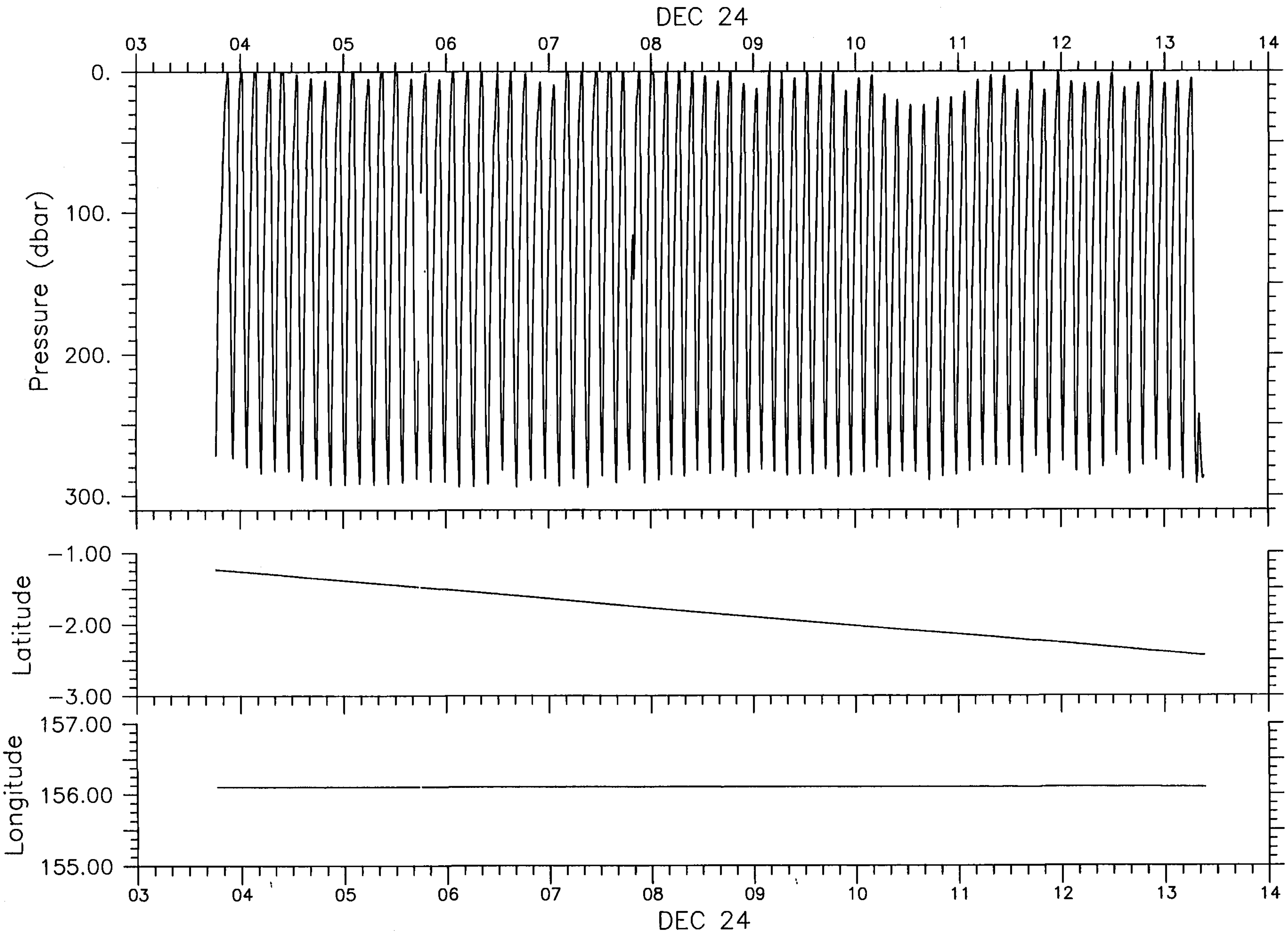
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Latitude
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14
DEC 24

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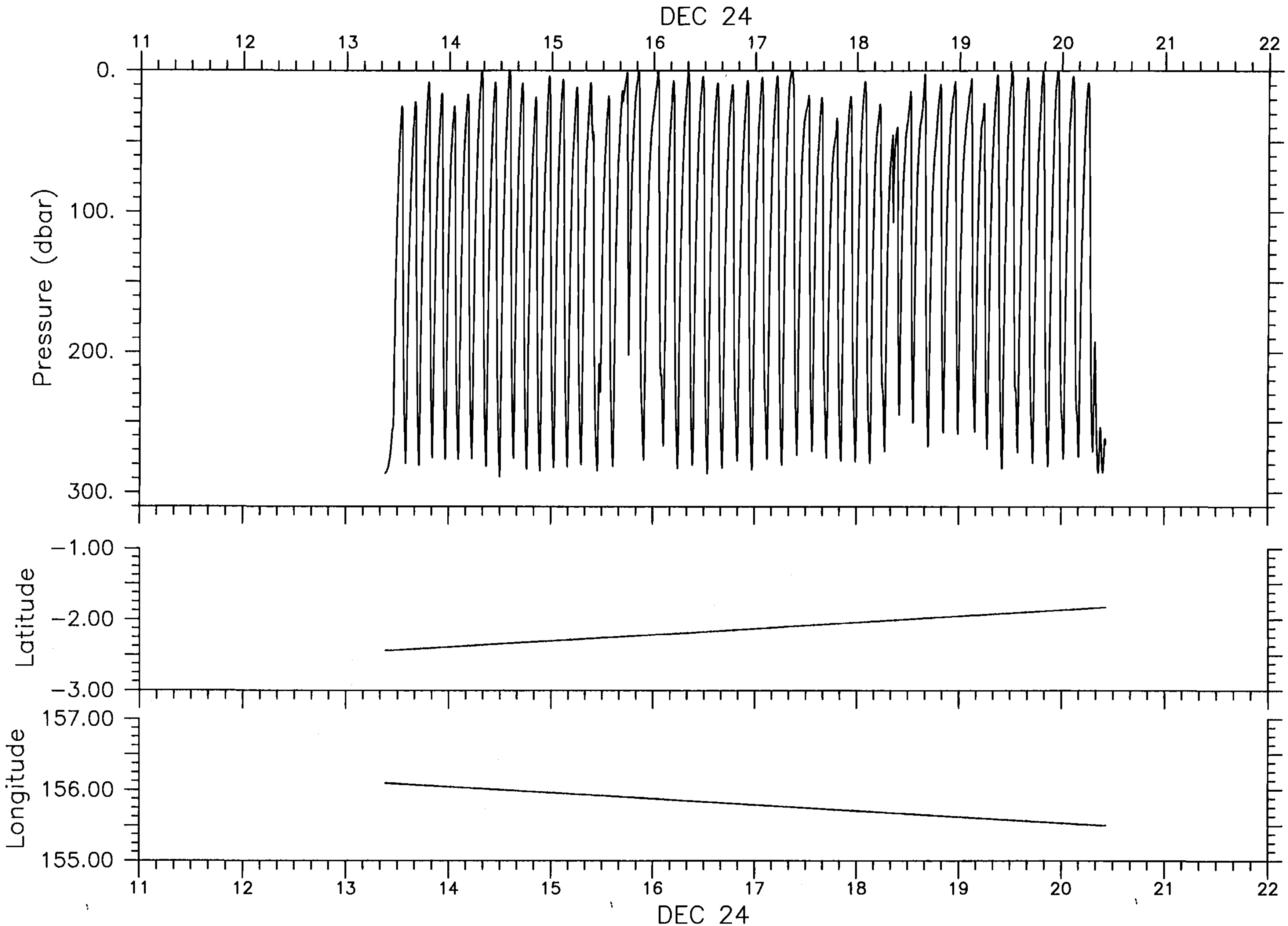
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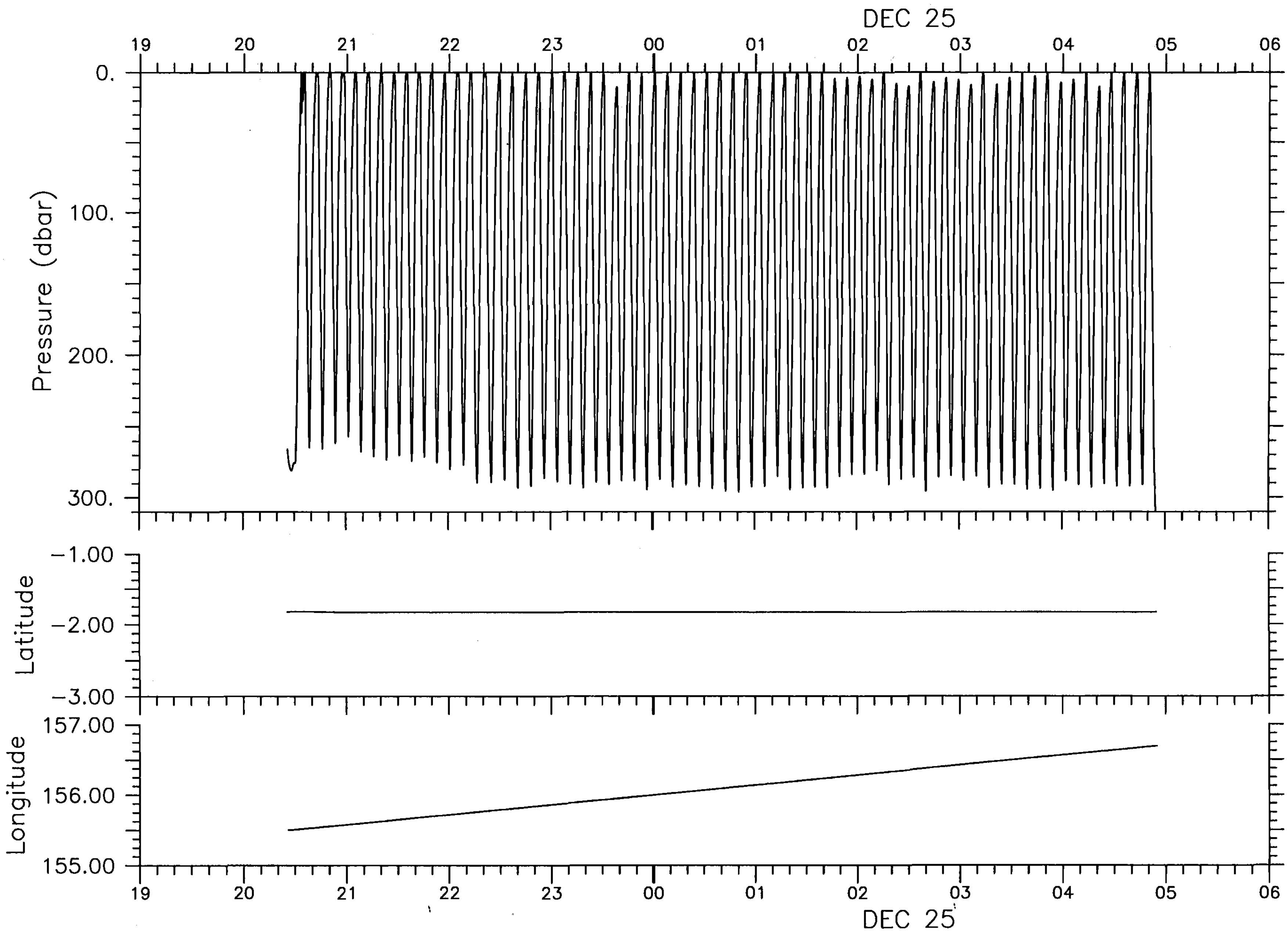
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DEC 25

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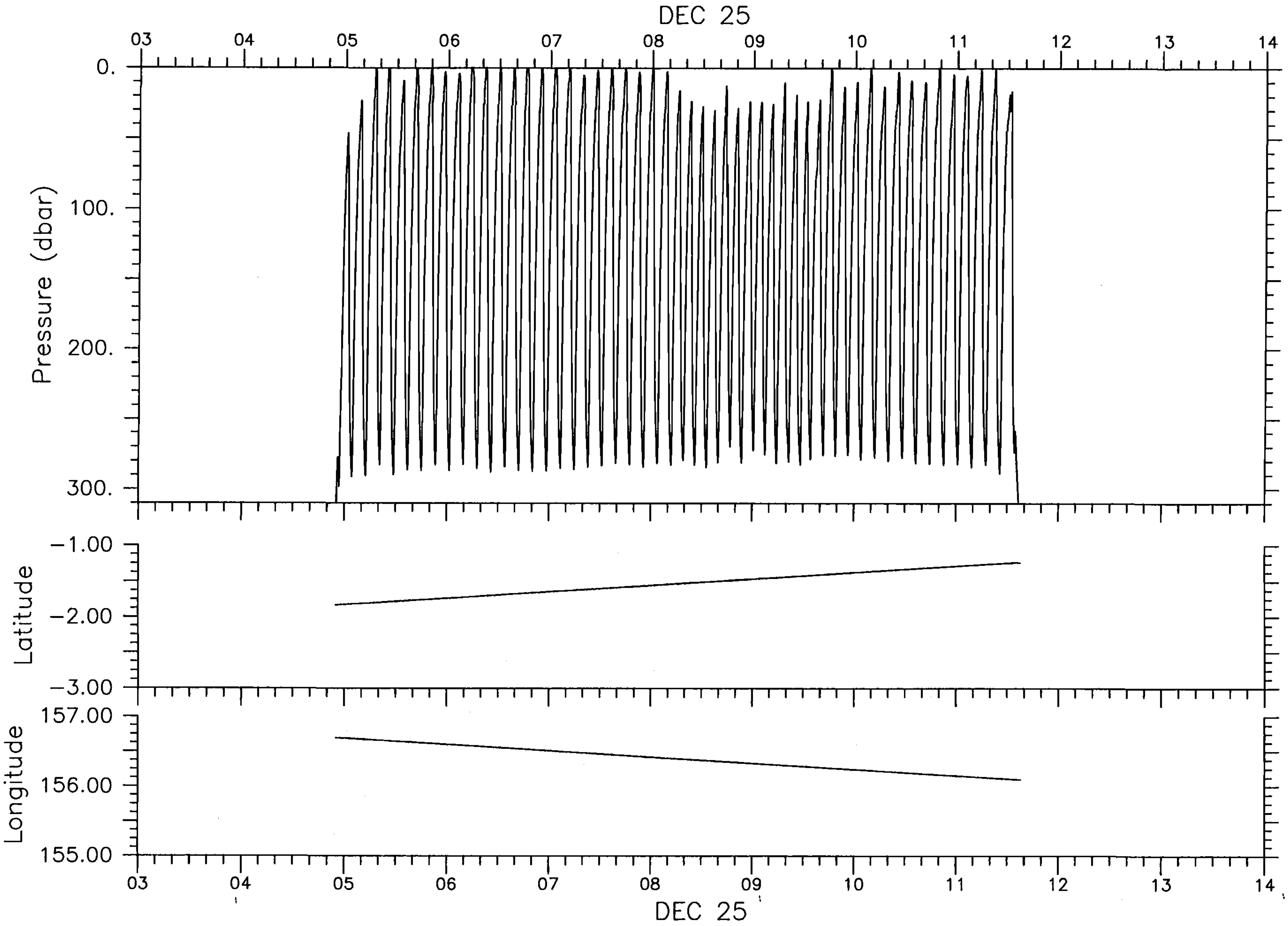
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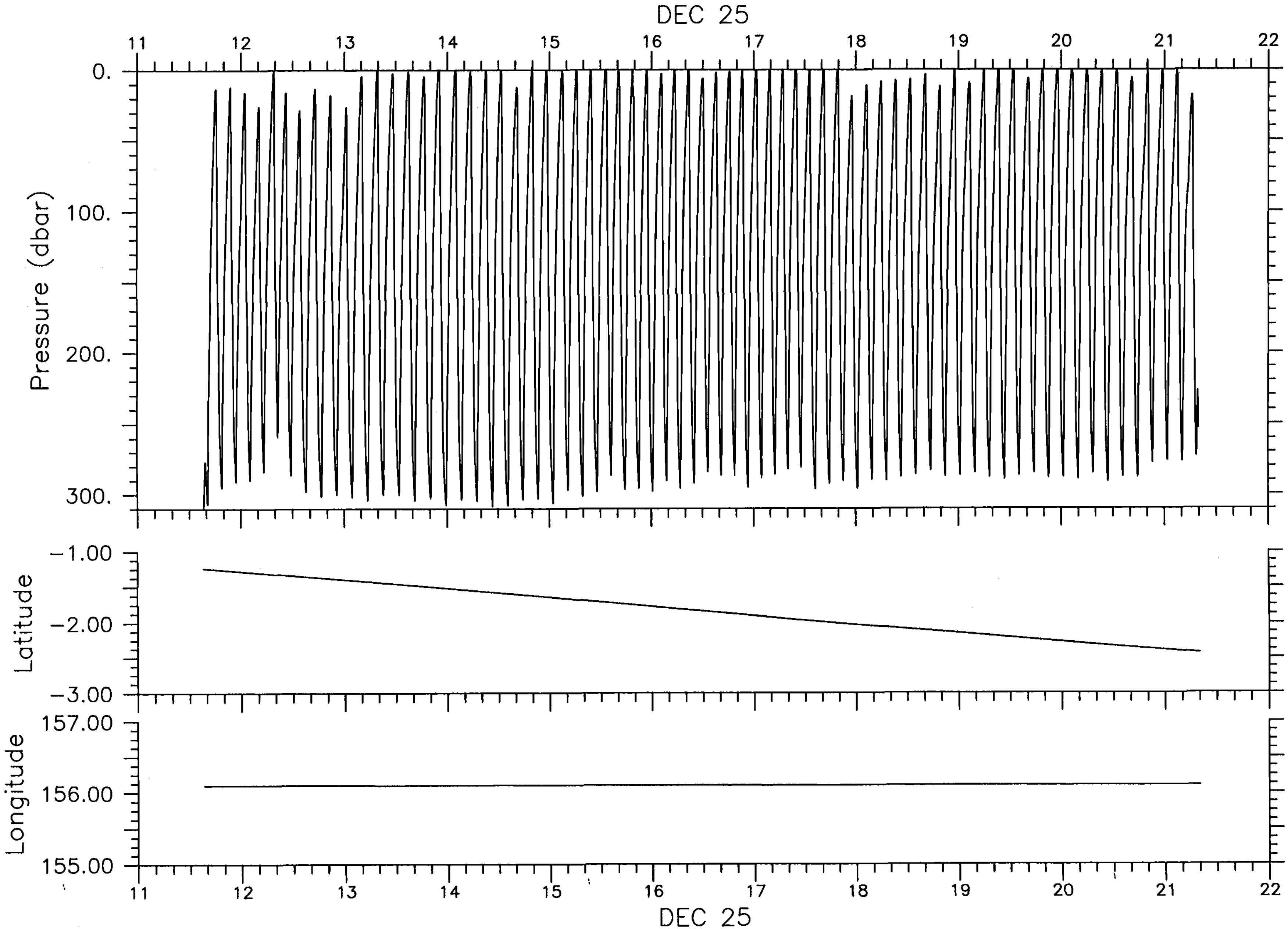

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Longitude
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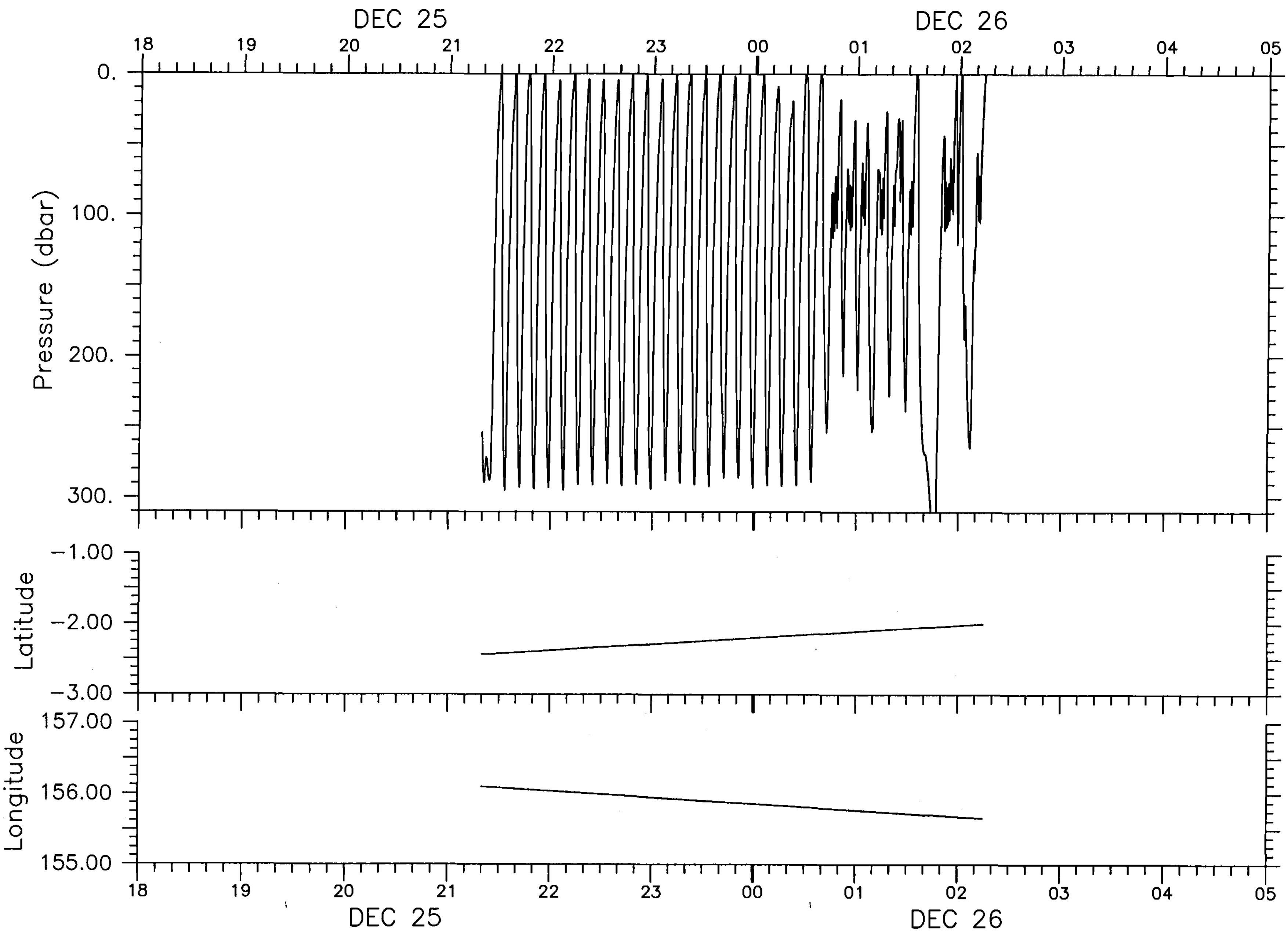
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Longitude
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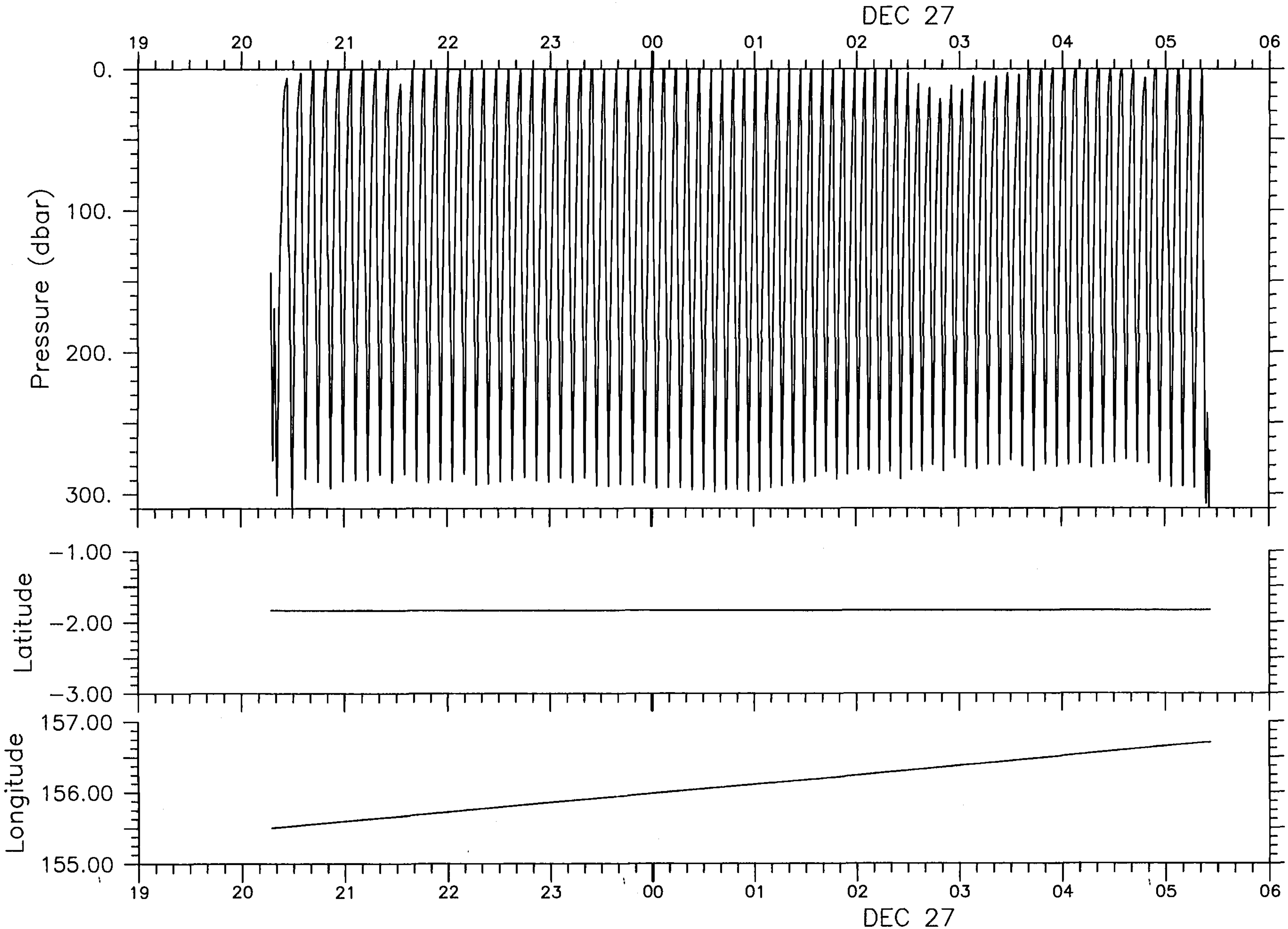
155.00

S2W



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Longitude
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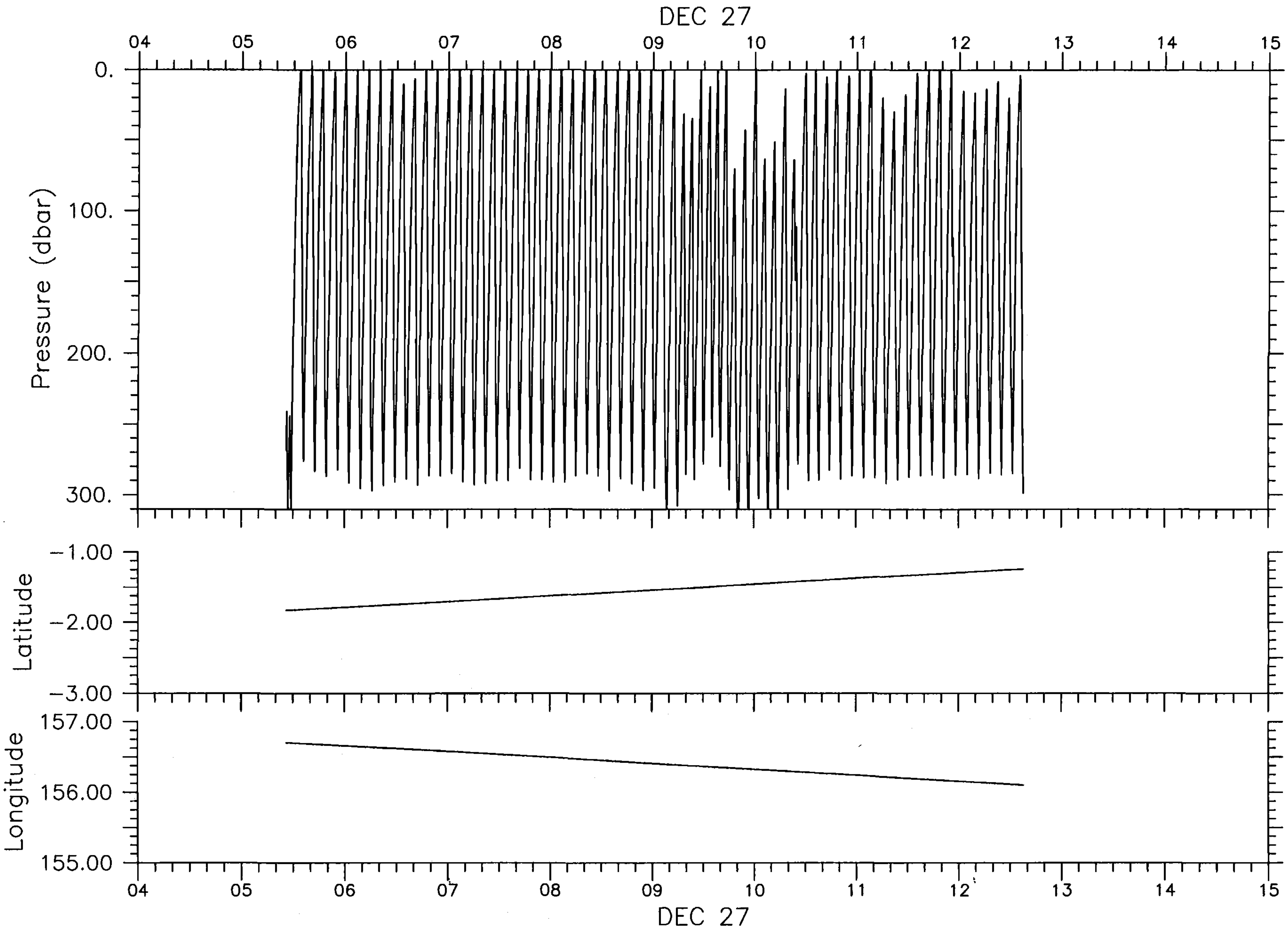
155.00

W2E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Latitude
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156.00
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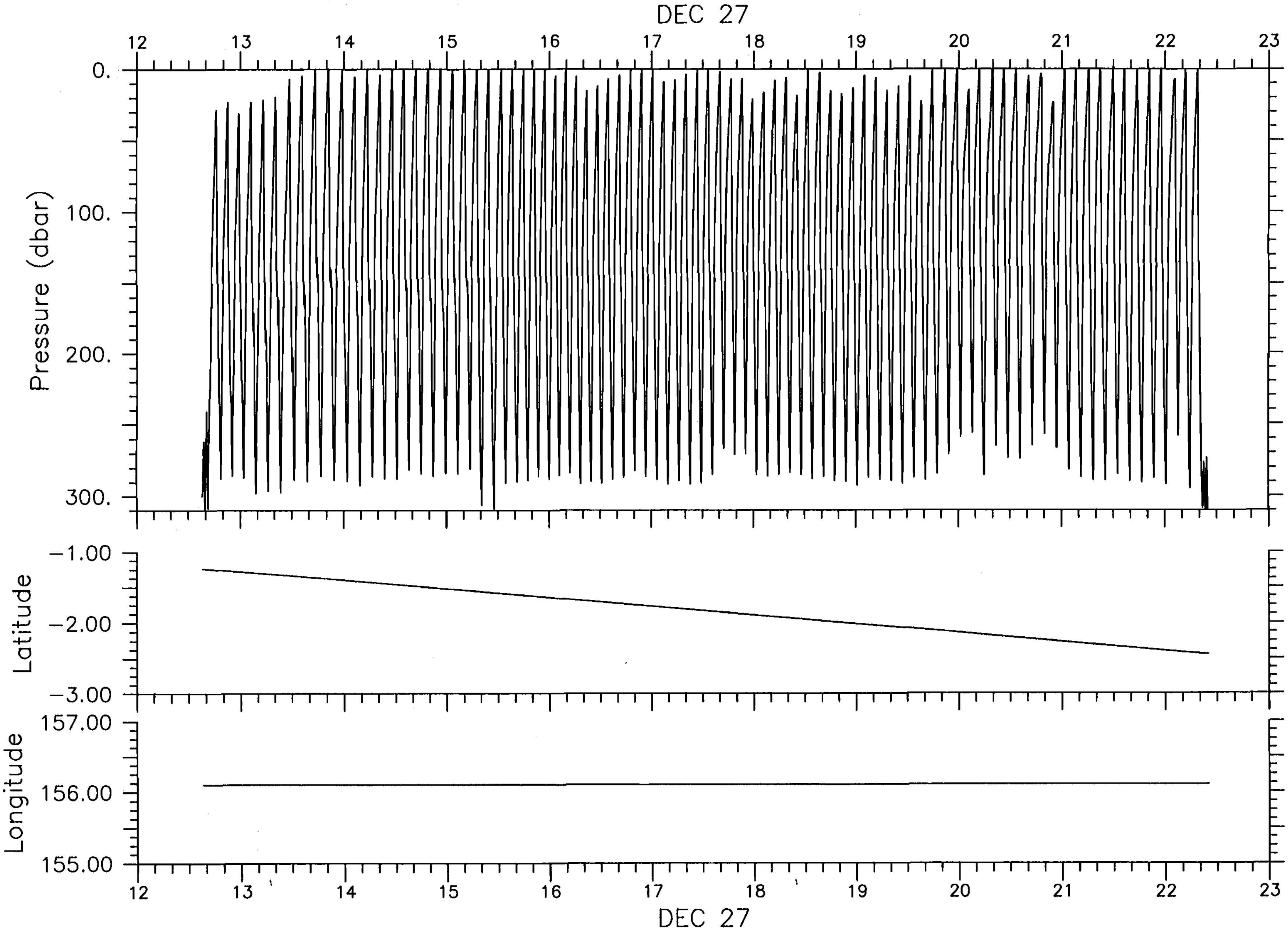
Longitude
DEC 27

E2N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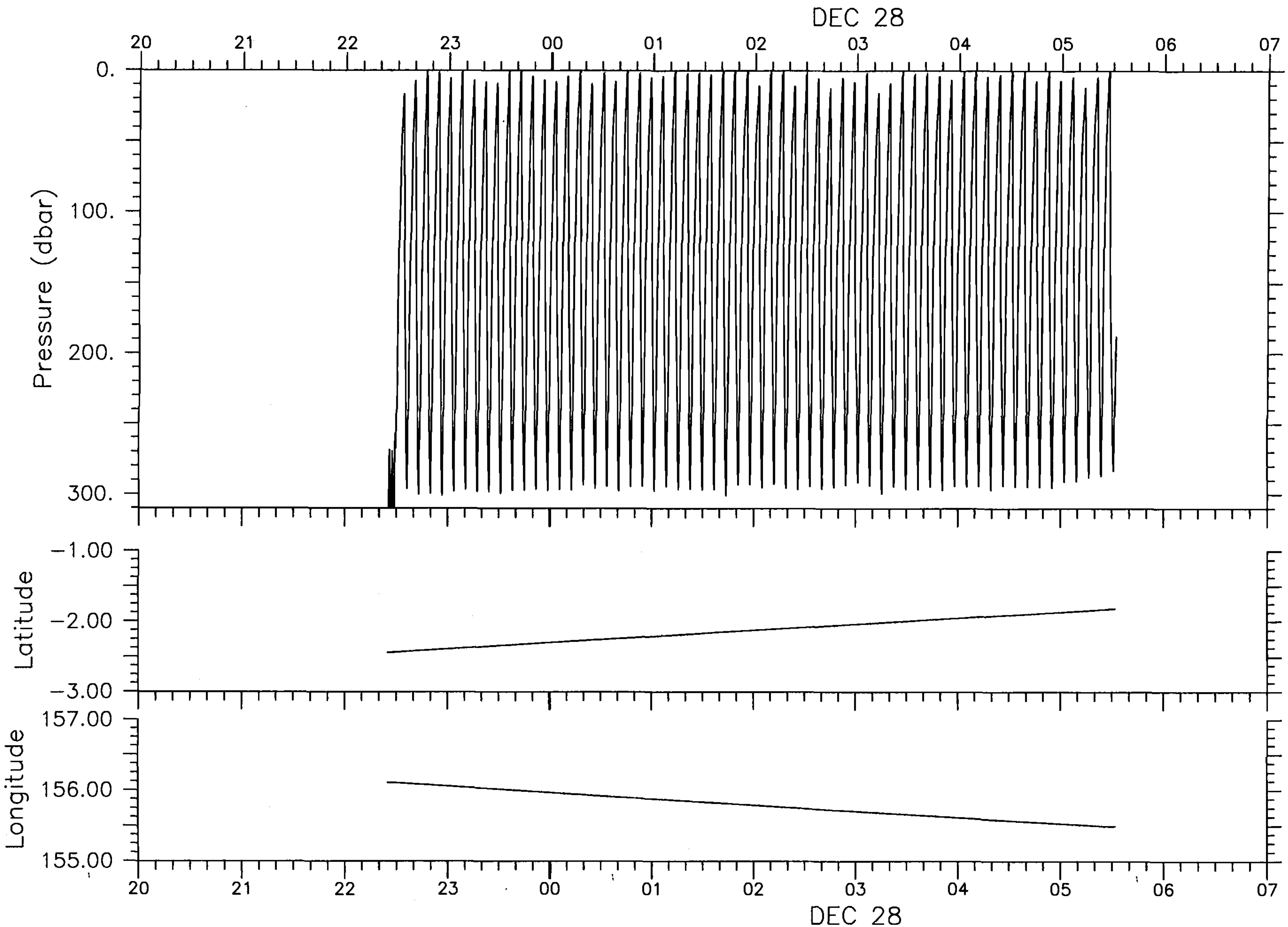

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-3.00
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Longitude
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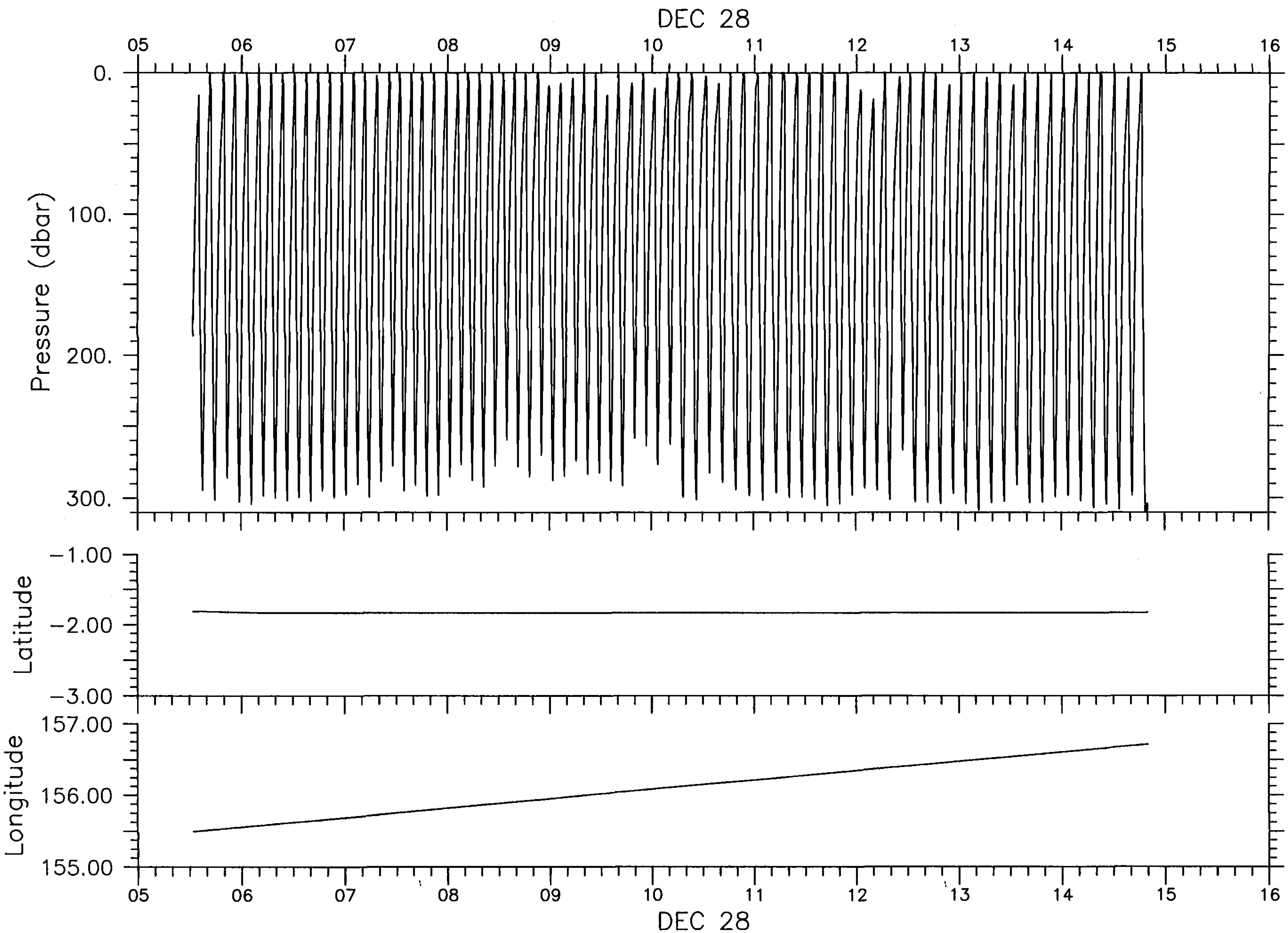
07
DEC 28

S2W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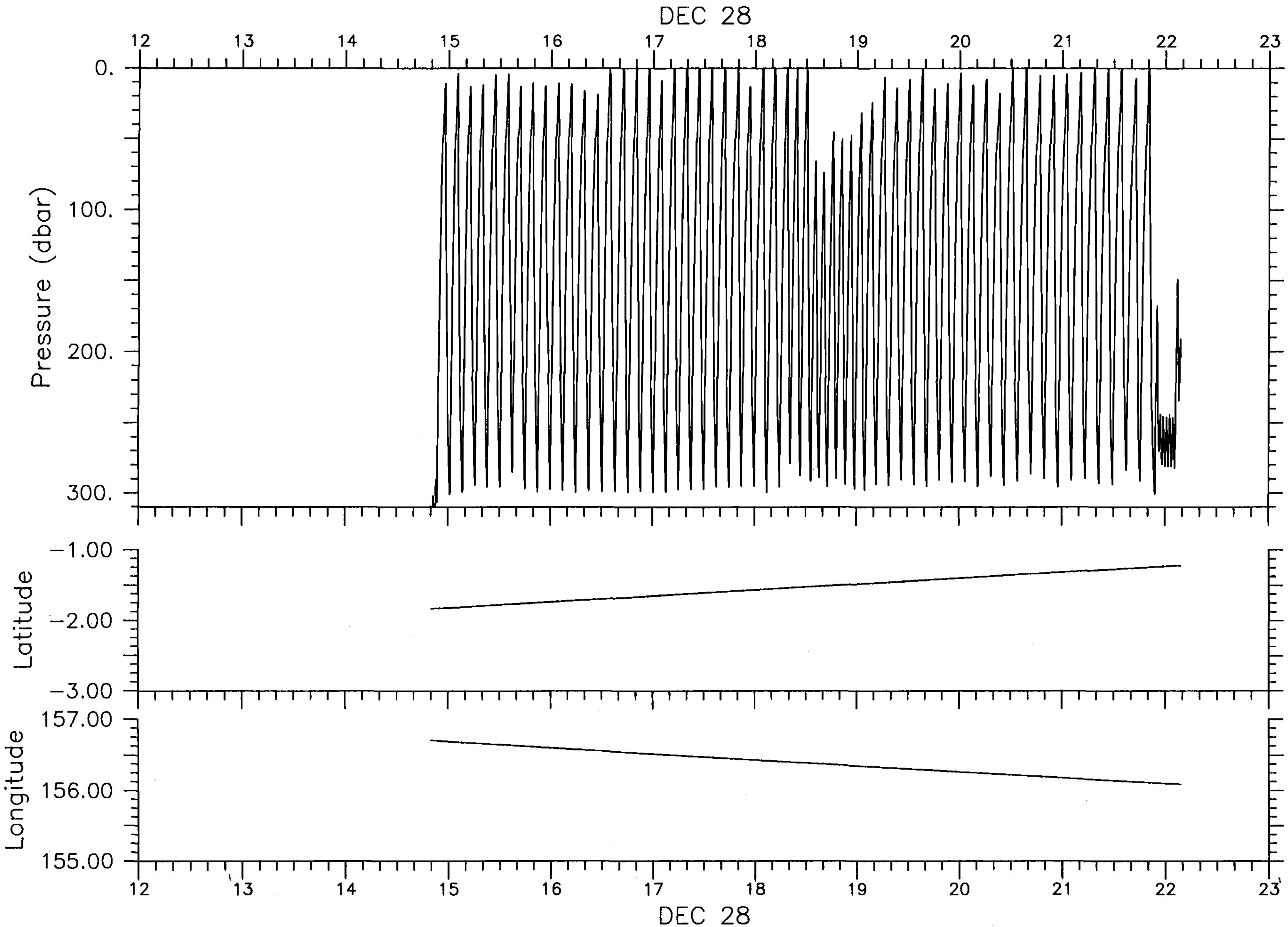
300.
Latitude
−1.00
−2.00
−3.00
Longitude
157.00
156.00
155.00
DEC 28

W2E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12
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19
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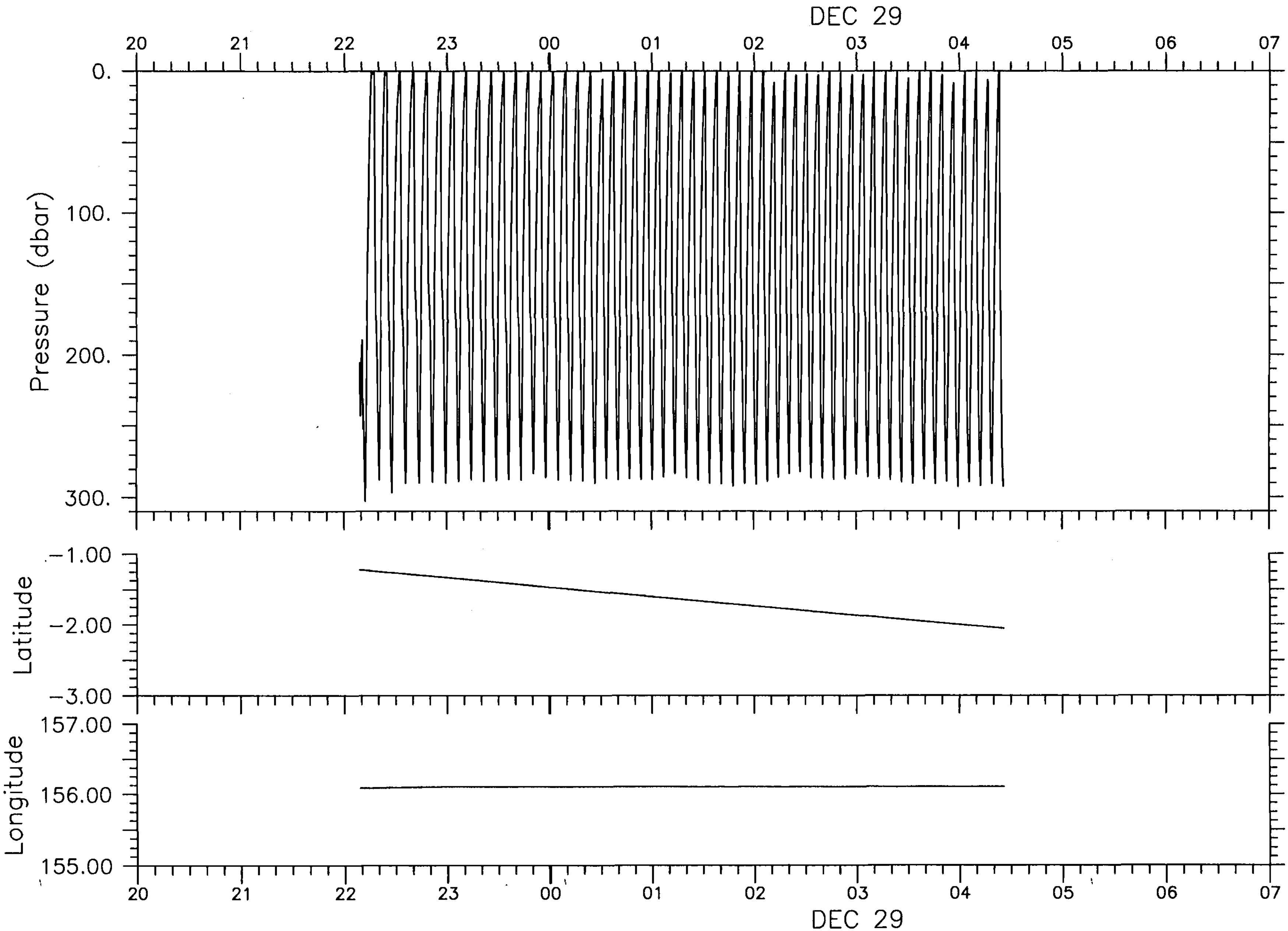
21
22
23
0.
100.
200.
300.
Pressure (dbar)
-1.00
-2.00
-3.00
Latitude
157.00
156.00
155.00
Longitude
DEC 28

E2N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03
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06
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0.
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Latitude
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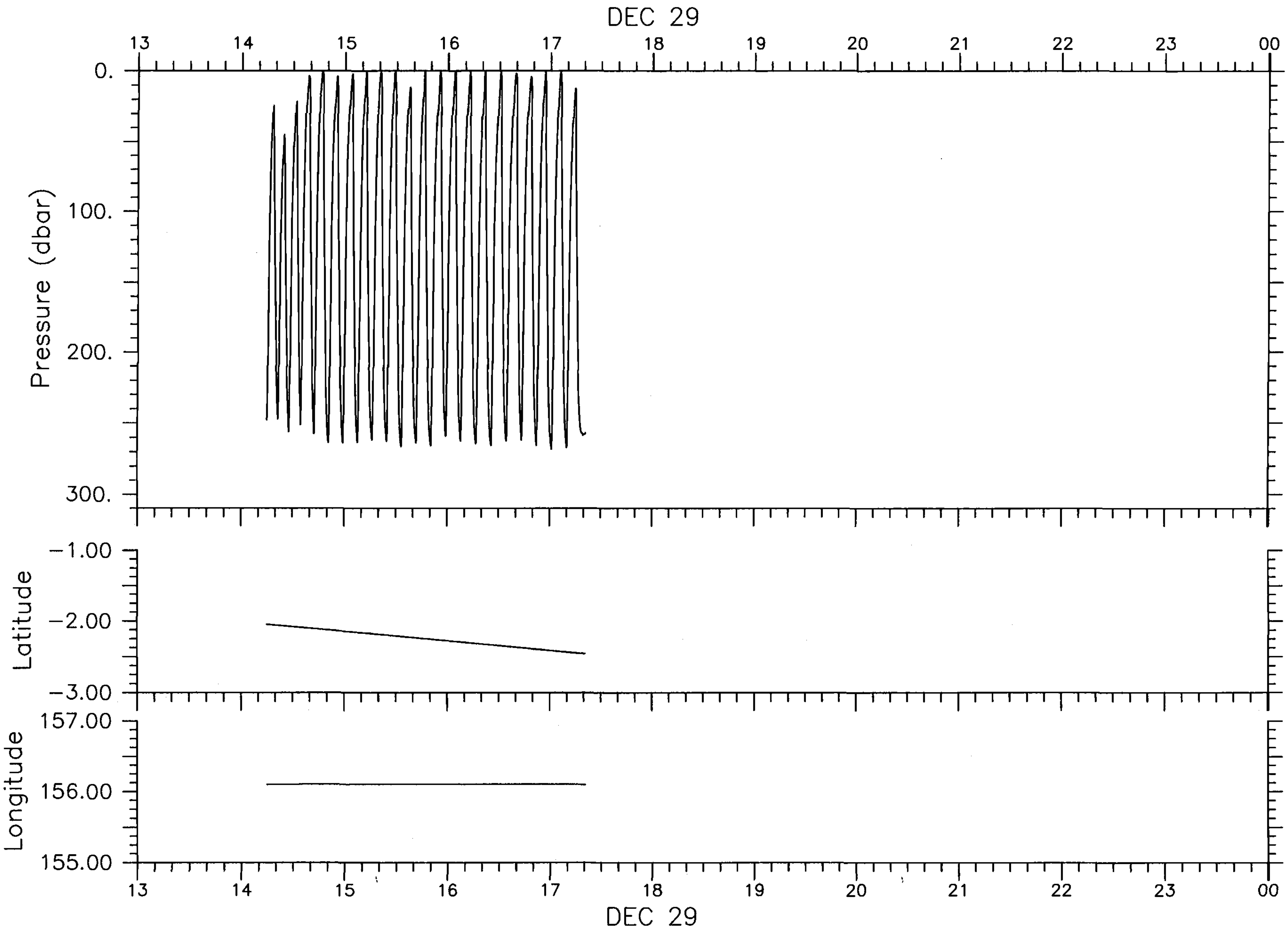
Longitude
157.00
156.00
155.00
DEC 29

N2S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Latitude
-1.00
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-3.00
Longitude
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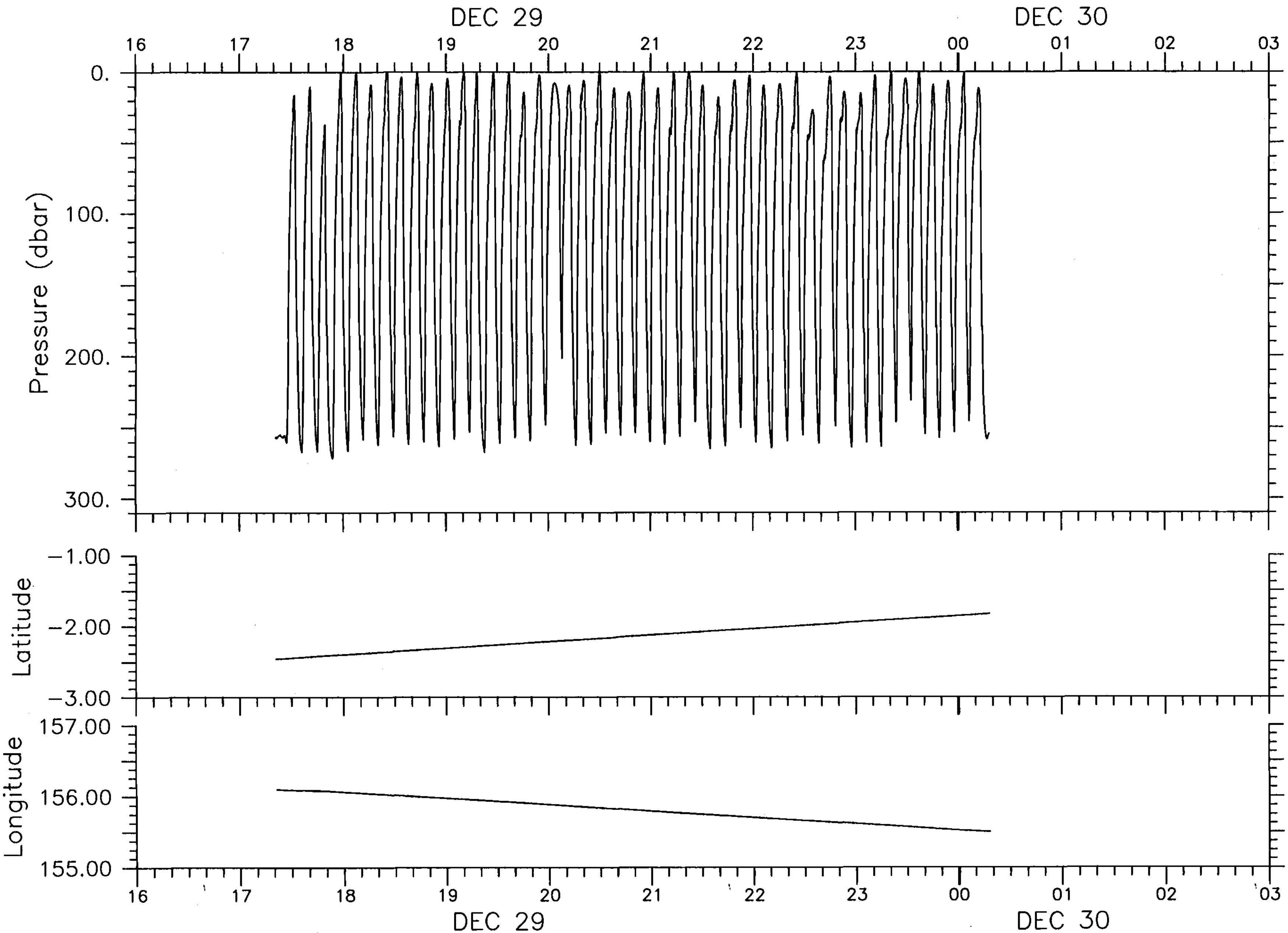
155.00

N2S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DEC 30
16 17 18 19 20 21 22 23 00 01 02 03
Pressure (dbar)
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100.
200.
300.
Latitude
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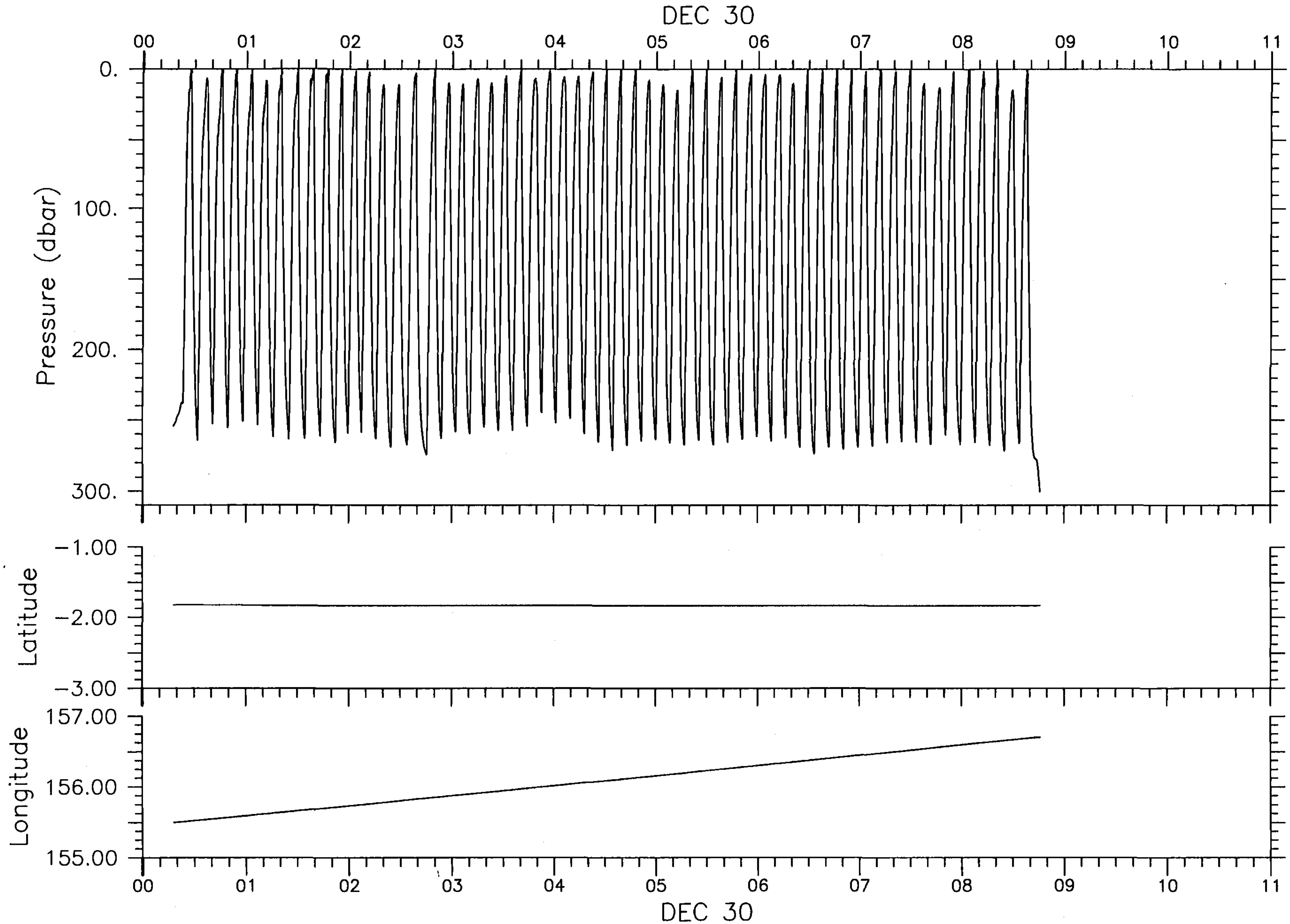
Longitude
157.00
156.00
155.00
16 17 18 19 20 21 22 23 00 01 02 03
DEC 29
DEC 30

S2W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00
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08
09
10
11
Pressure (dbar)
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300.
Latitude
-1.00
-2.00
-3.00
Longitude
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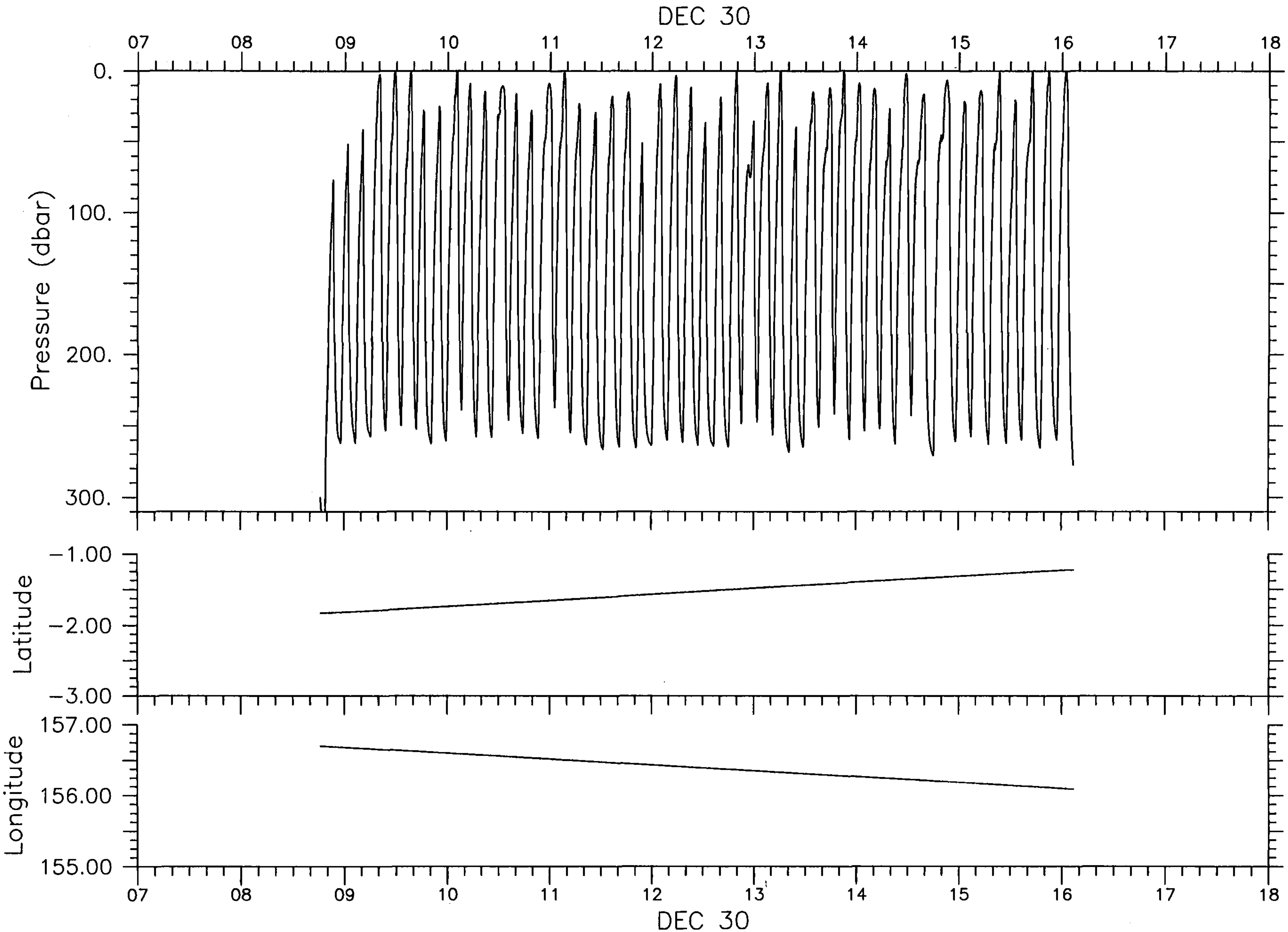
156.00
155.00

W2E


DEC 30
07 08 09 10 11 12 13 14 15 16 17 18
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0.
100.
200.
300.
Latitude
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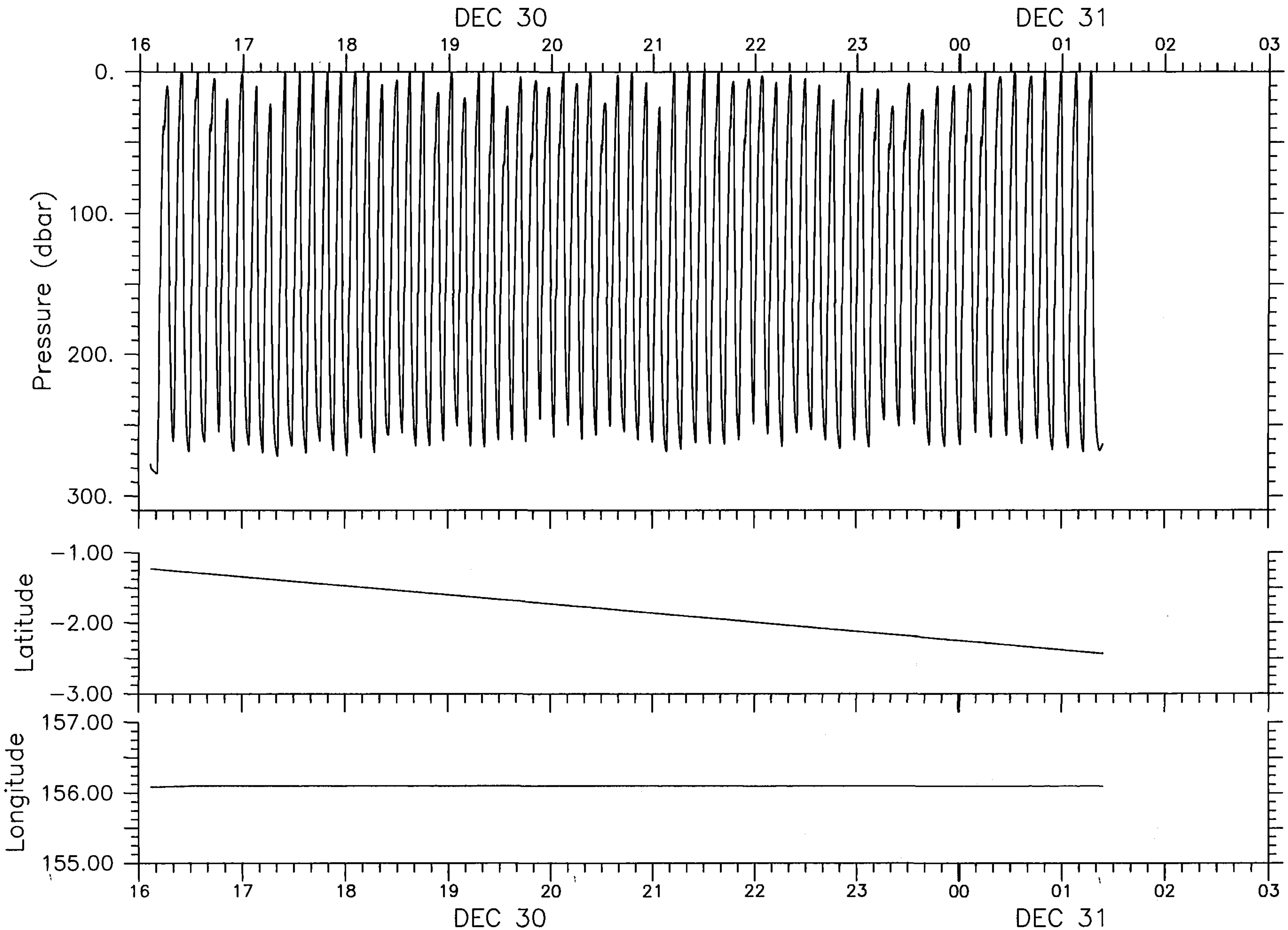
-3.00
Longitude
157.00
156.00
155.00
07 08 09 10 11 12 13 14 15 16 17 18
DEC 30

E2N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DEC 31
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100.
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-1.00
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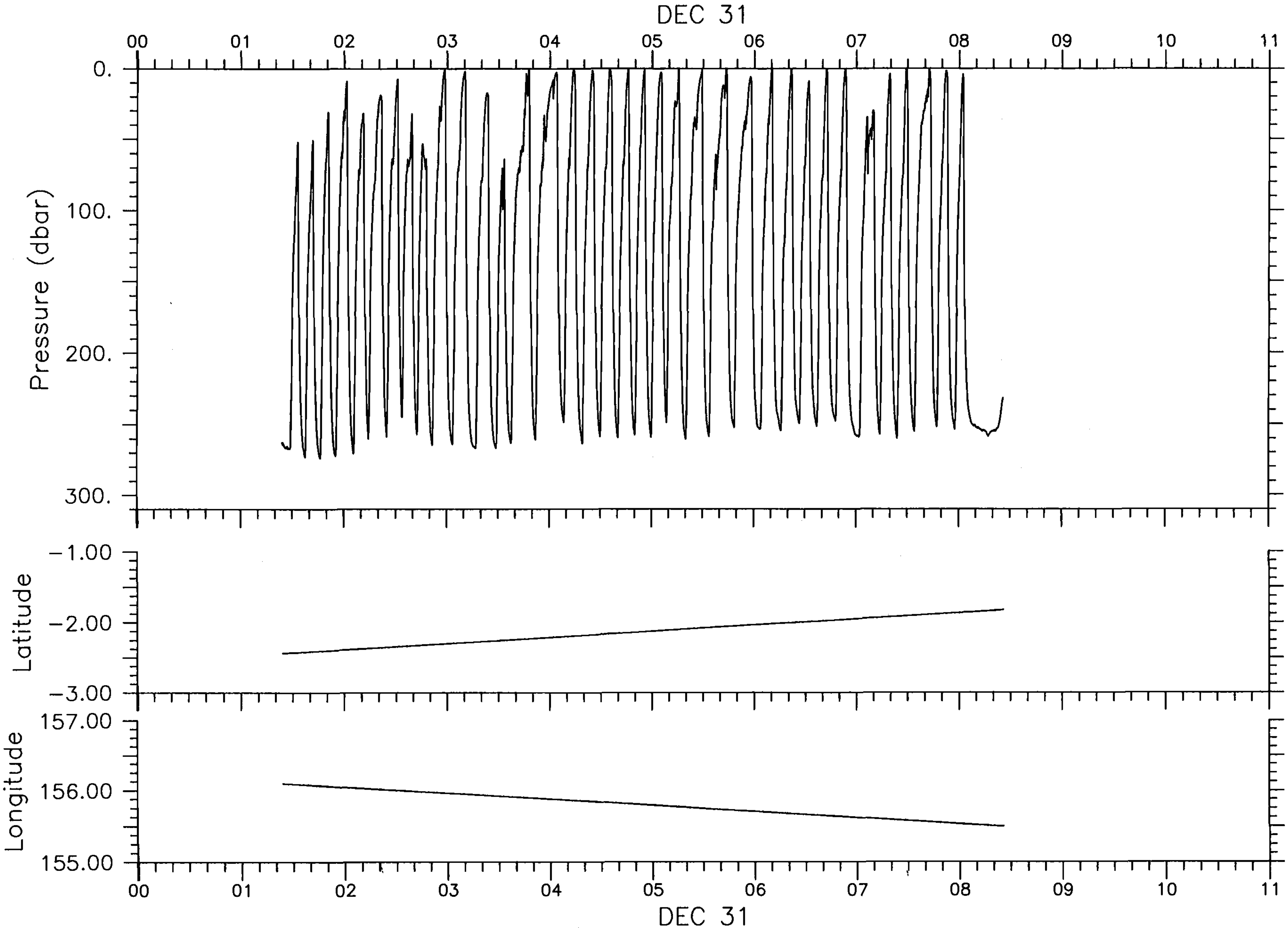
-3.00
Latitude
157.00
156.00
155.00
Longitude

N2S


DEC 31
00
01
02
03
04
05
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07
08
09
10
11
Pressure (dbar)
0.
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300.
Latitude
-1.00
-2.00
-3.00
Longitude
157.00
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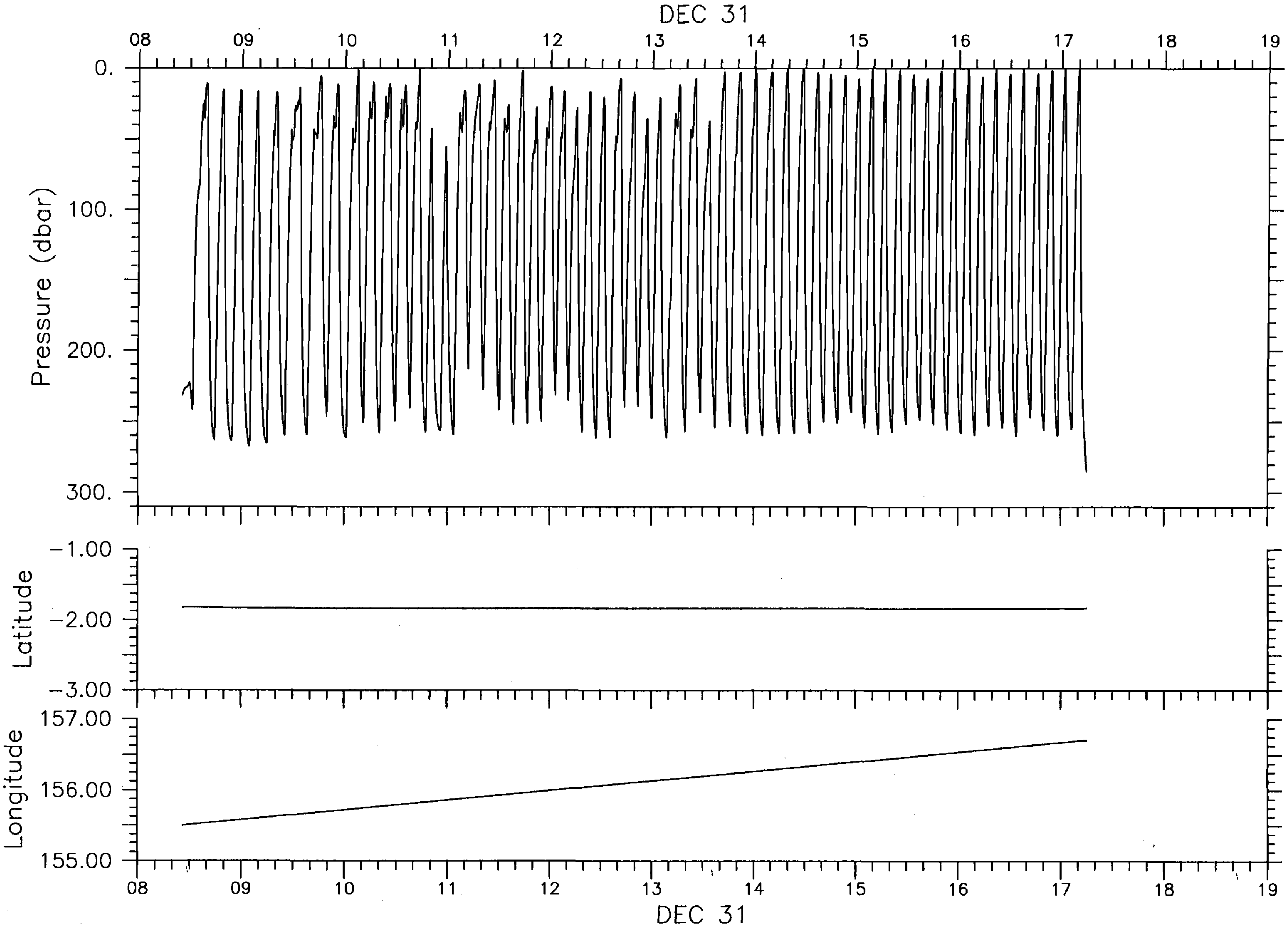
155.00
DEC 31

S2W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100.
200.
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-2.00
-3.00
Latitude
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156.00
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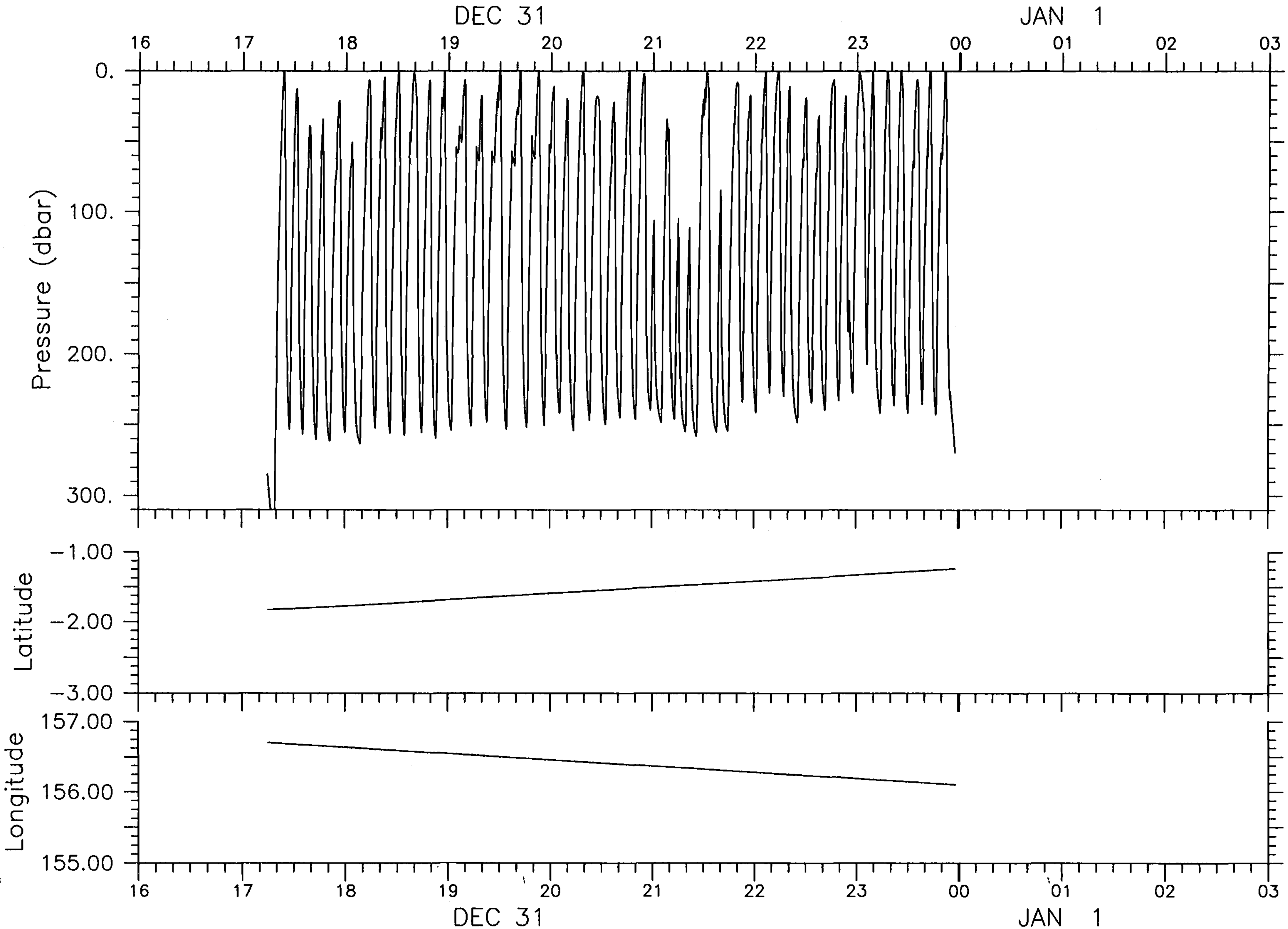
Longitude
DEC 31

W2E


DEC 31
JAN 1
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23
00
01
02
03
0.
100.
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300.
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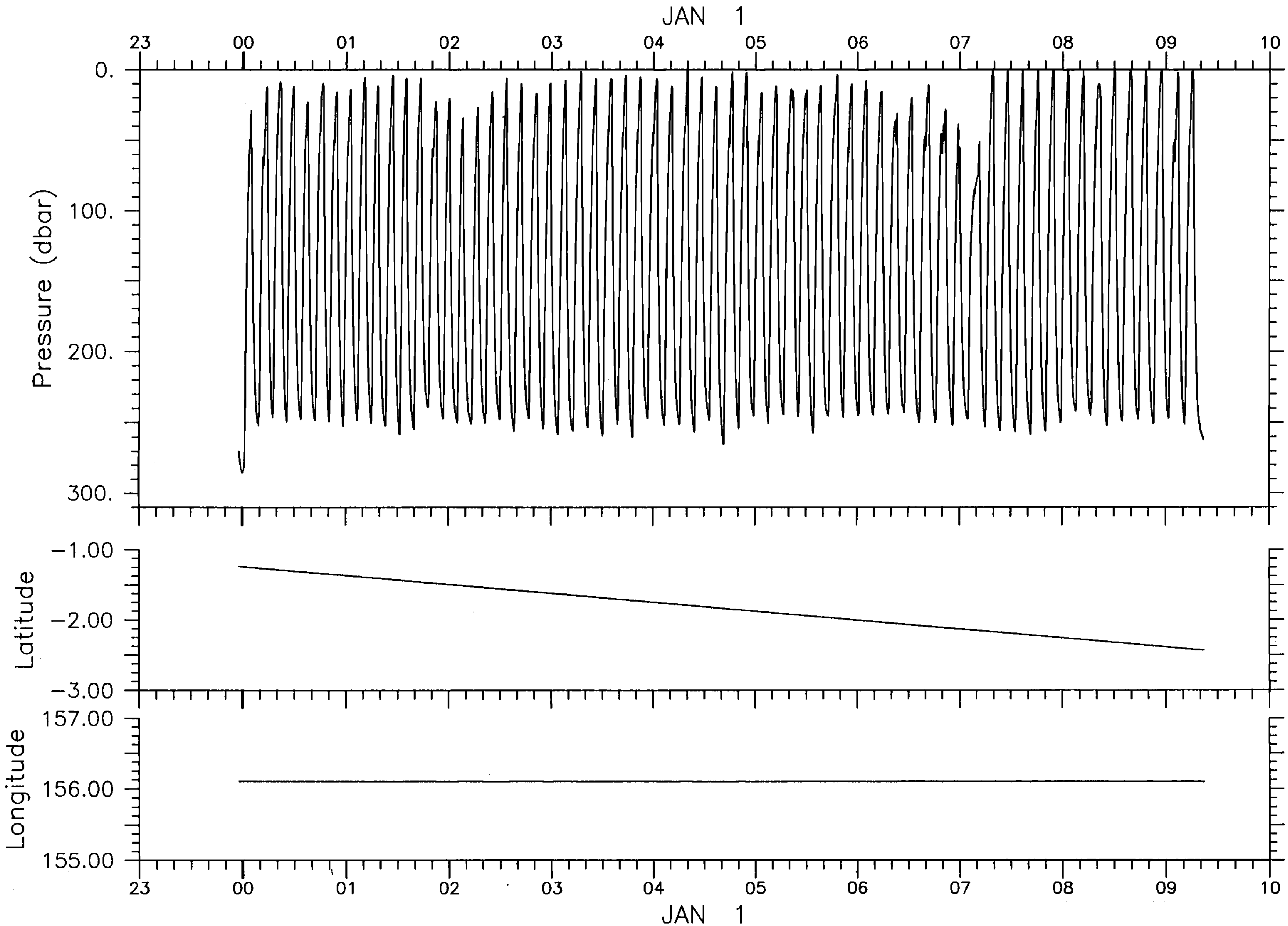
-1.00
-2.00
-3.00
Latitude
157.00
156.00
155.00
Longitude

E2N


JAN 1
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01
02
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04
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06
07
08
09
10
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300.
Latitude
-1.00
-2.00
-3.00
Longitude
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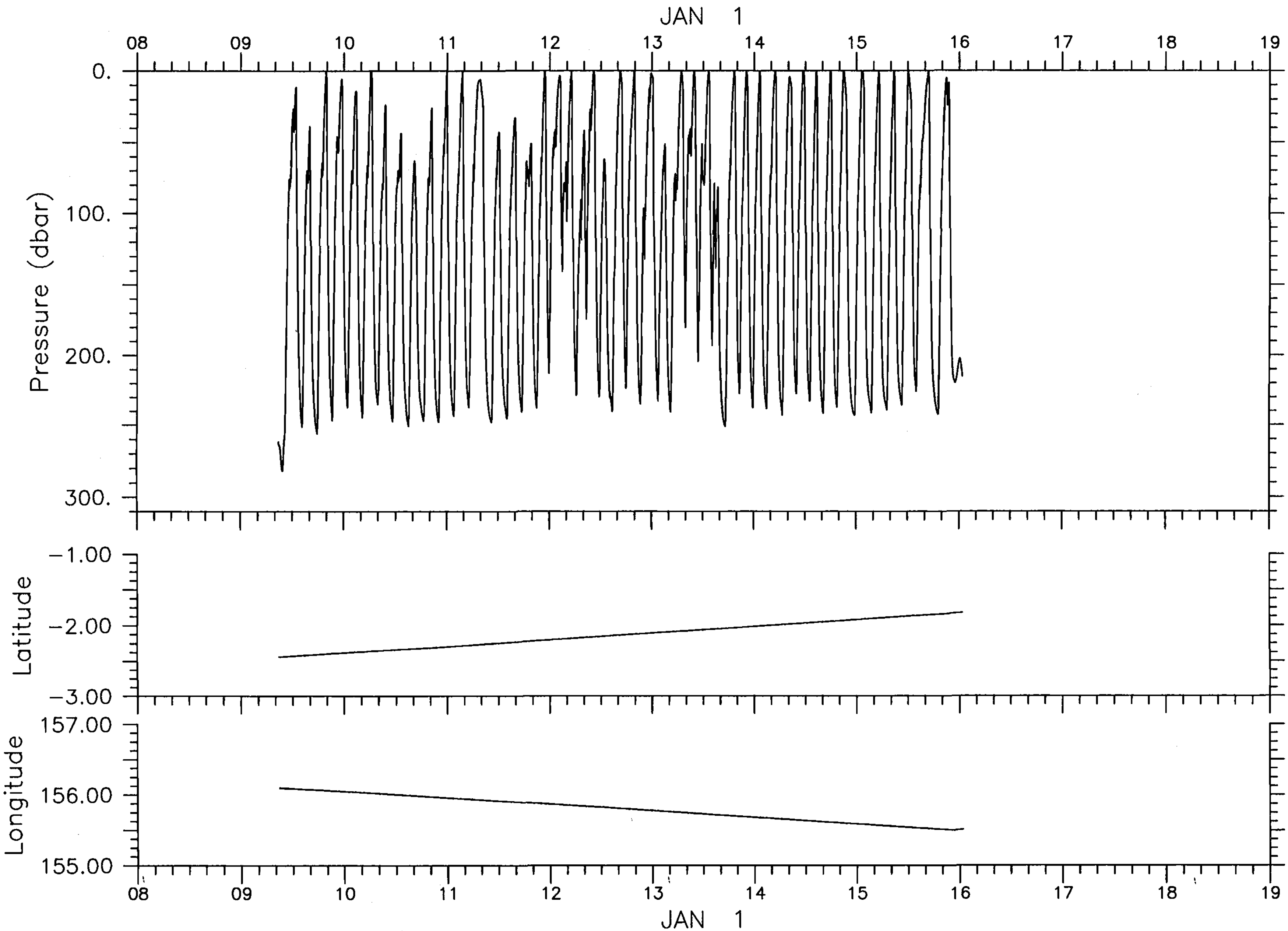
156.00
155.00

N2S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17
18
19
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0.
100.
200.
300.
Latitude
-1.00
-2.00
-3.00
Longitude
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156.00
155.00
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09
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12
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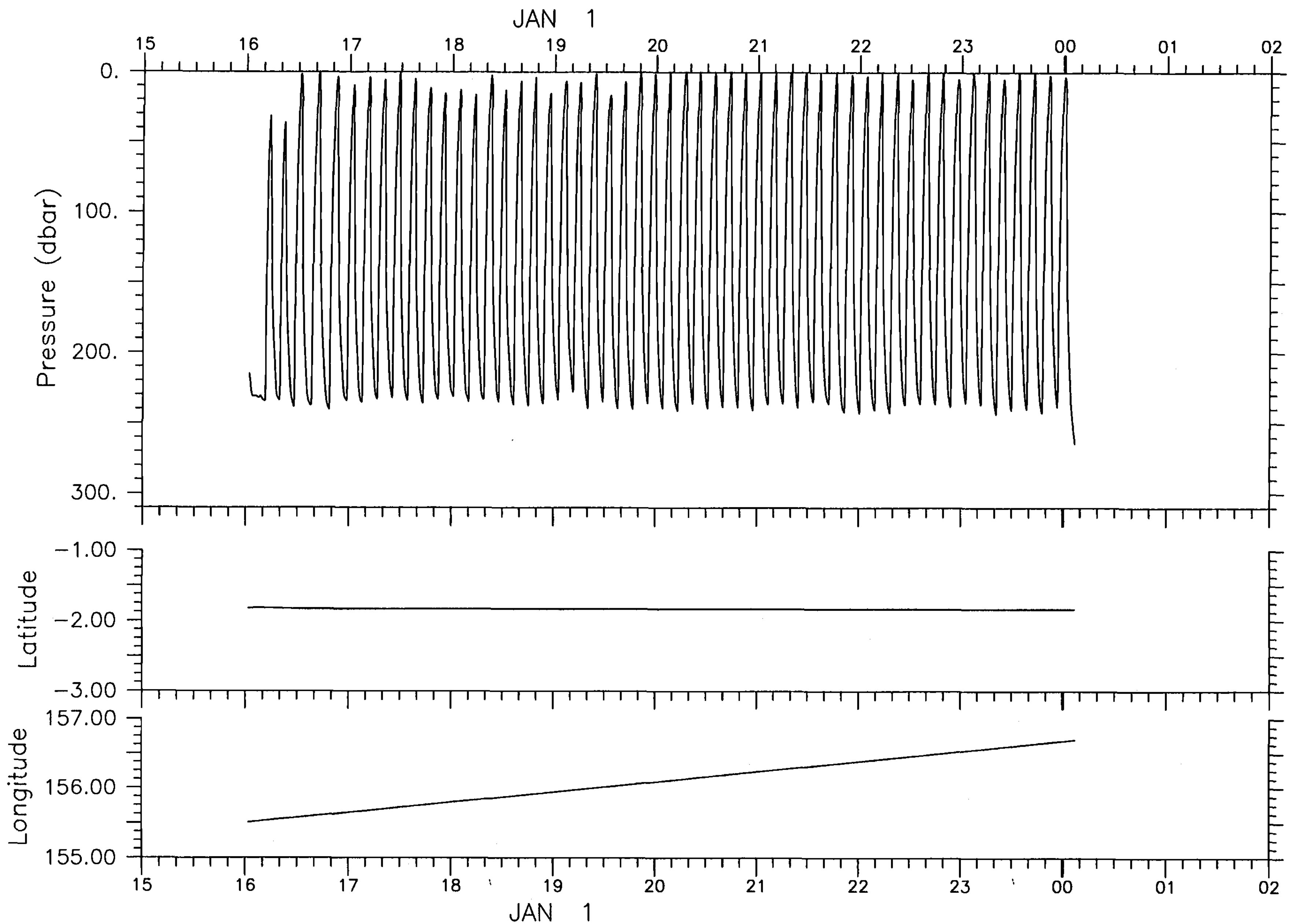
16
17
18
19
JAN 1

S2W


JAN 1
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18
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20
21
22
23
00
01
02
Pressure (dbar)
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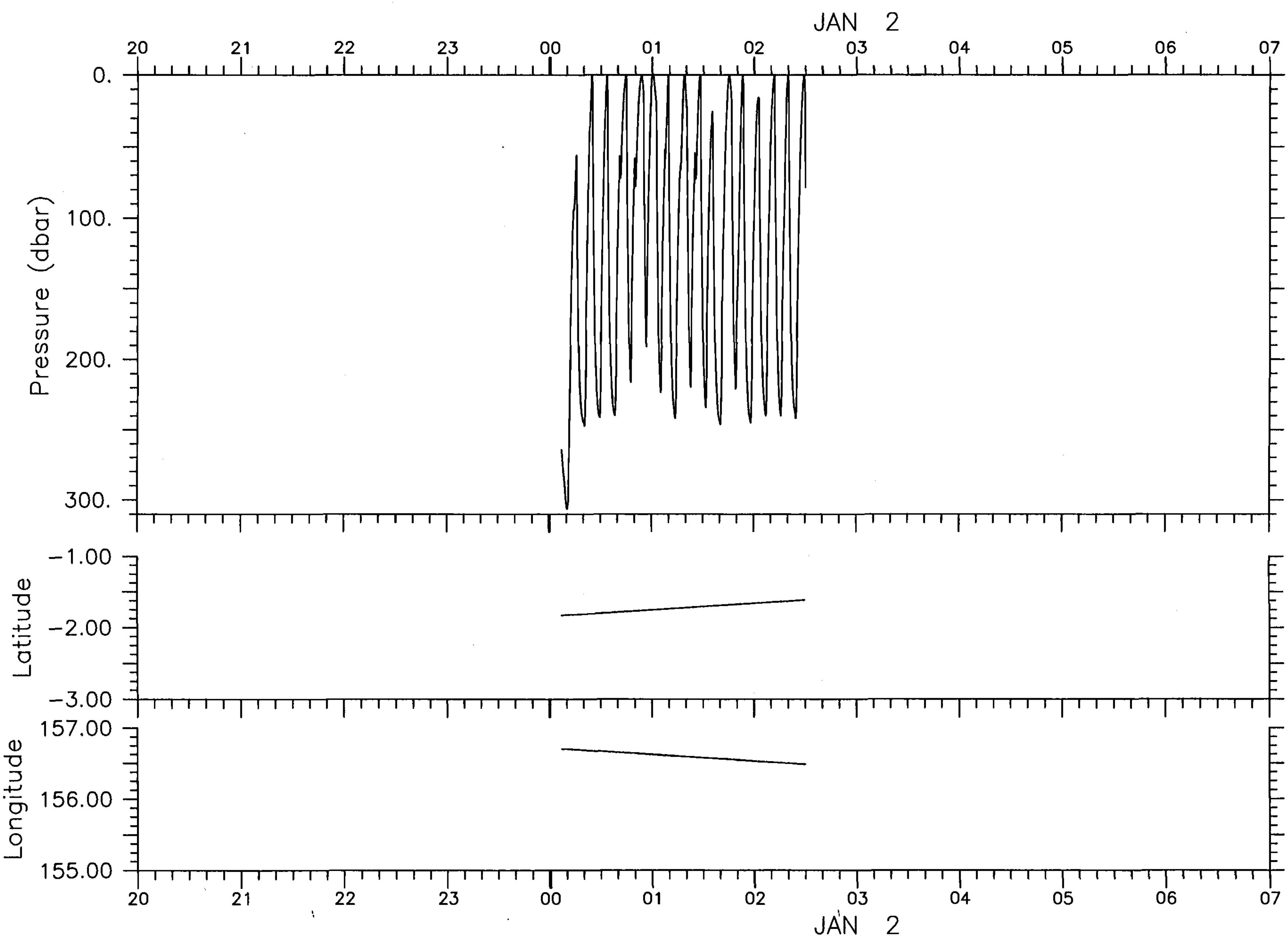
300.
Latitude
-1.00
-2.00
-3.00
Longitude
157.00
156.00
155.00

W2E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23
00
01
02
03
04
05
06
07
Pressure (dbar)
0.
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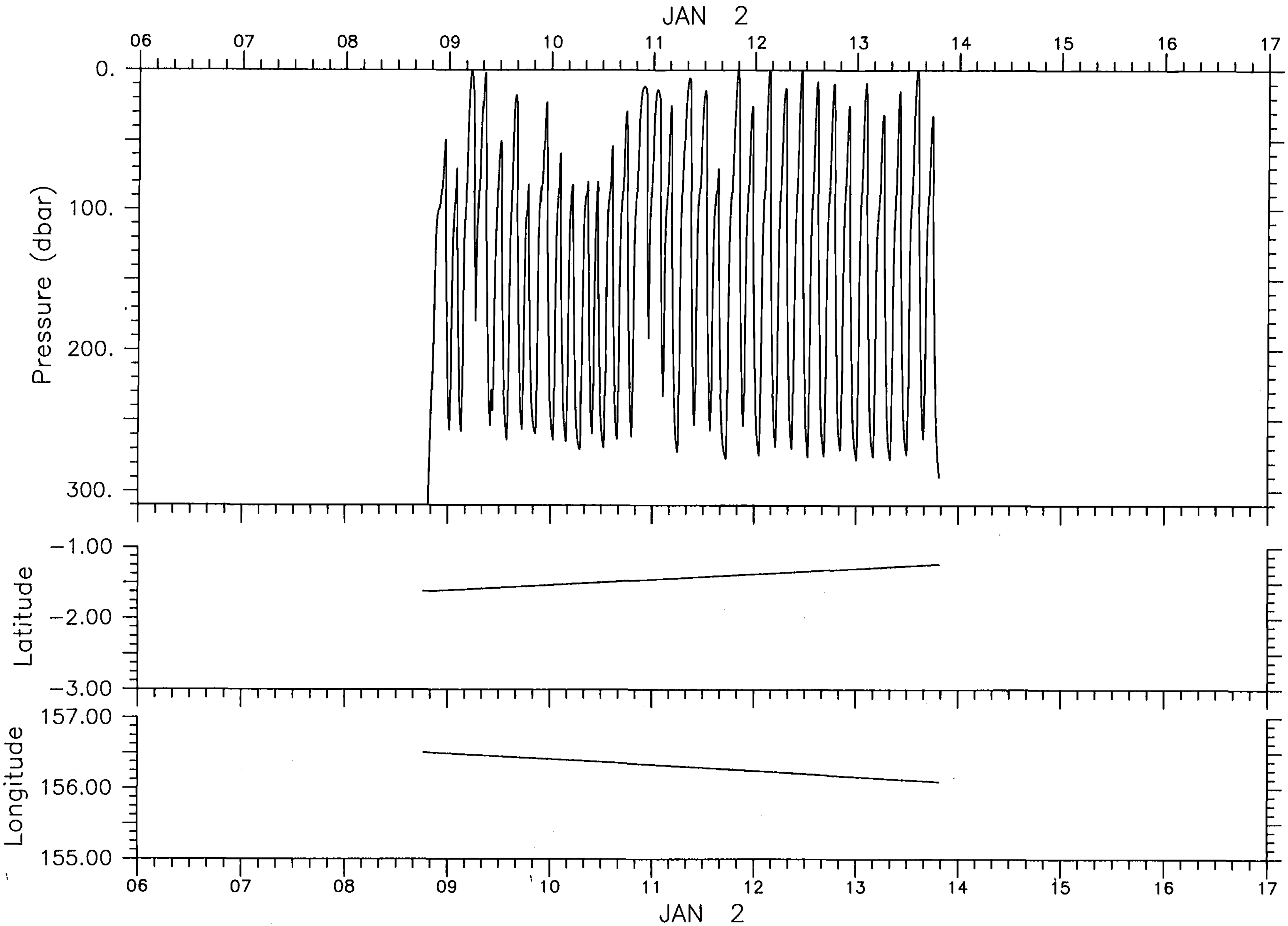
200.
300.
Latitude
-1.00
-2.00
-3.00
Longitude
157.00
156.00
155.00
JAN 2

E2N


JAN 2
06
07
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09
10
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14
15
16
17
0.
100.
200.
300.
Pressure (dbar)
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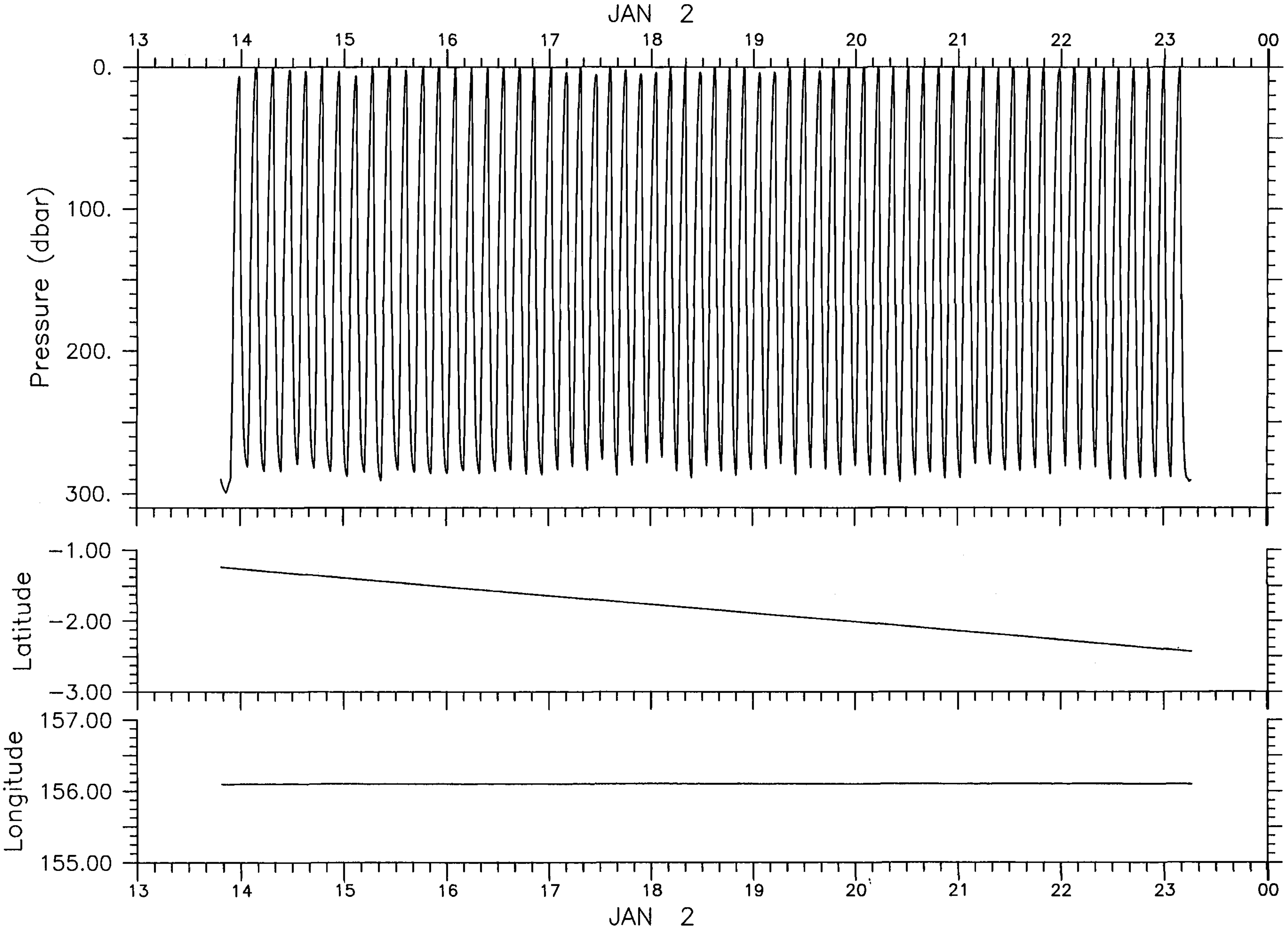
-2.00
-3.00
Latitude
157.00
156.00
155.00
Longitude
JAN 2

E2N


JAN 2
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20
21
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23
00
0.
100.
200.
300.
Pressure (dbar)
-1.00
-2.00
-3.00
Latitude
157.00
156.00
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Longitude
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16
17
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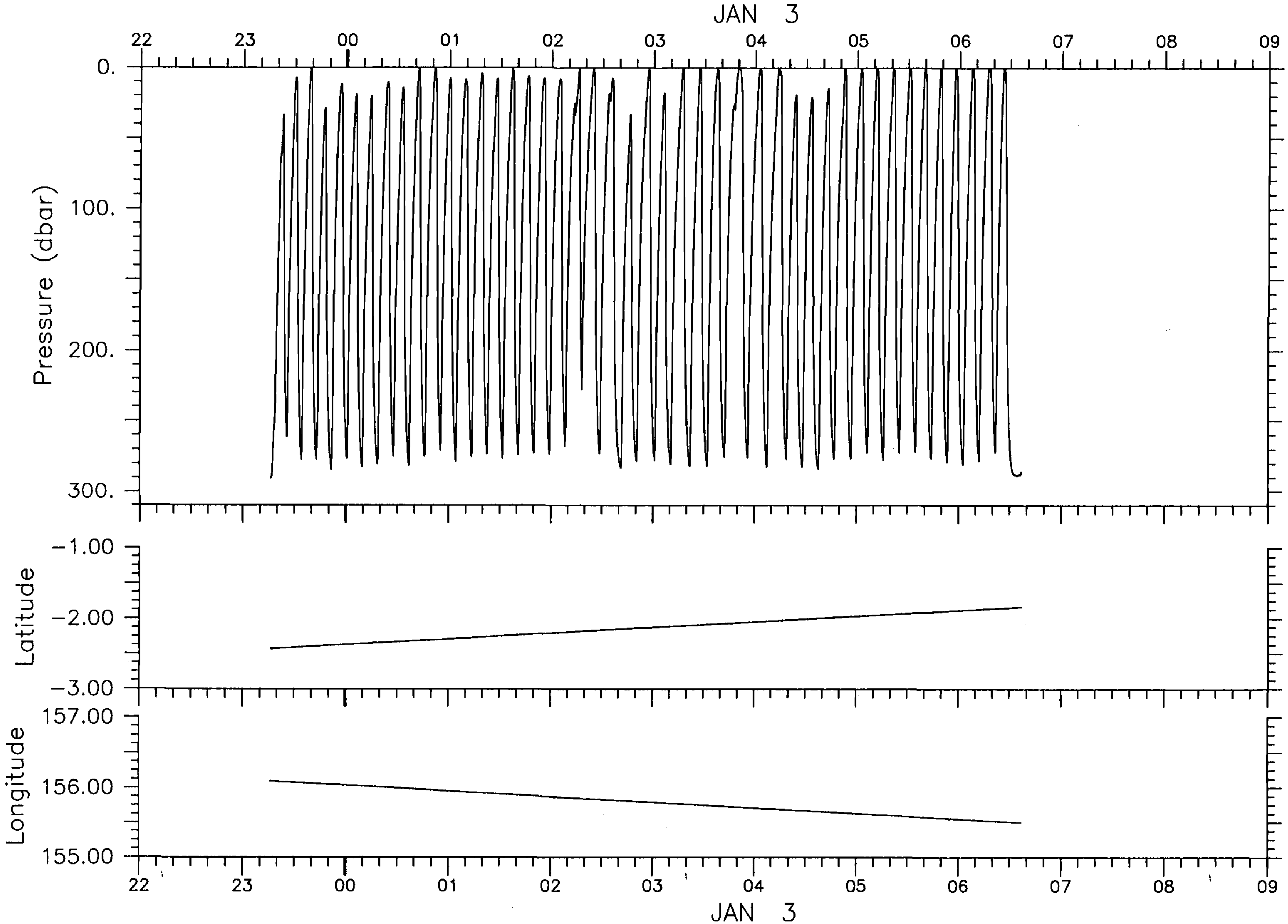
20
21
22
23
00
JAN 2

N2S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01
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07
08
09
Pressure (dbar)
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300.
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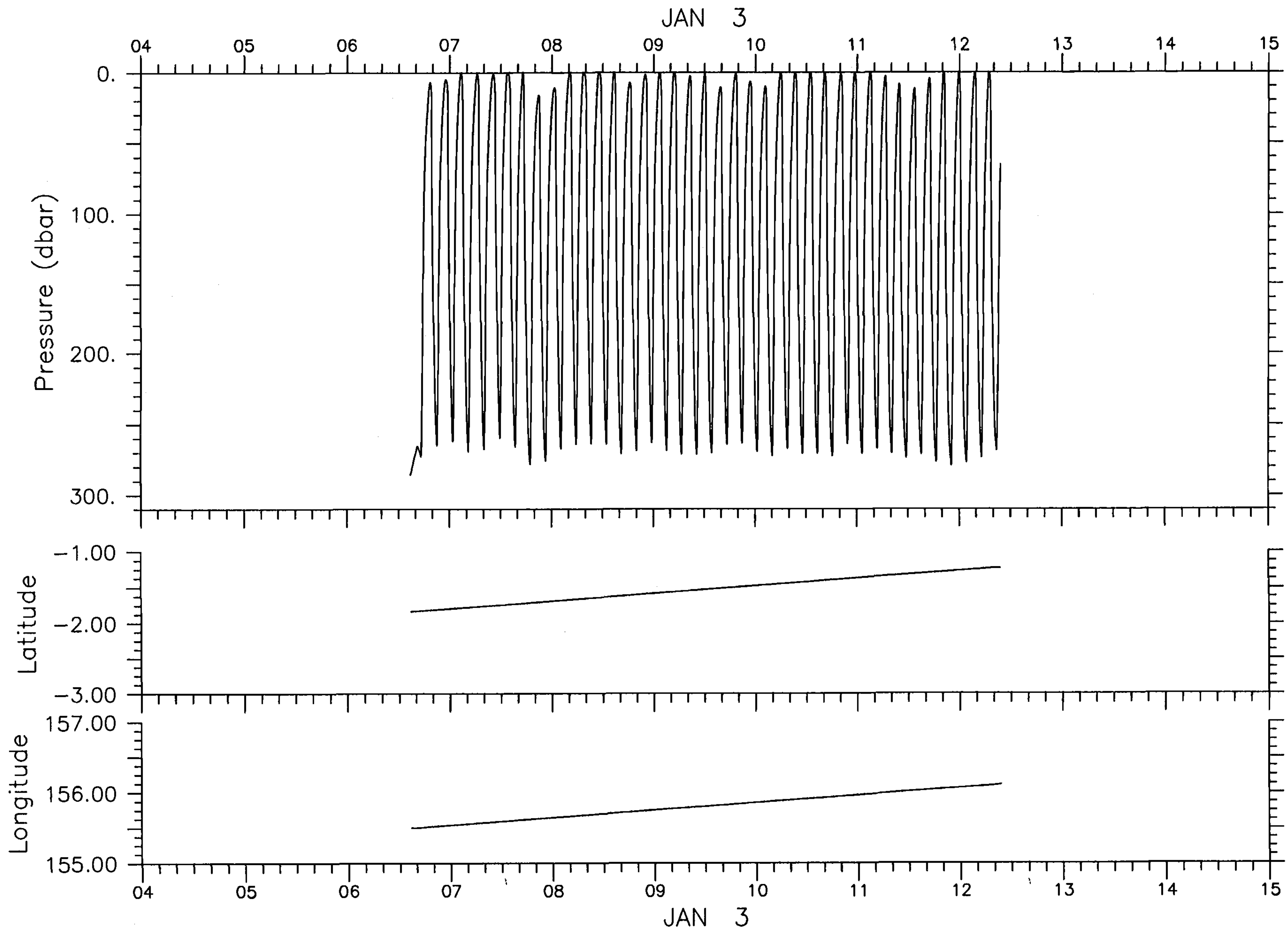
-1.00
-2.00
-3.00
Longitude
157.00
156.00
155.00
JAN 3

S2W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14
15
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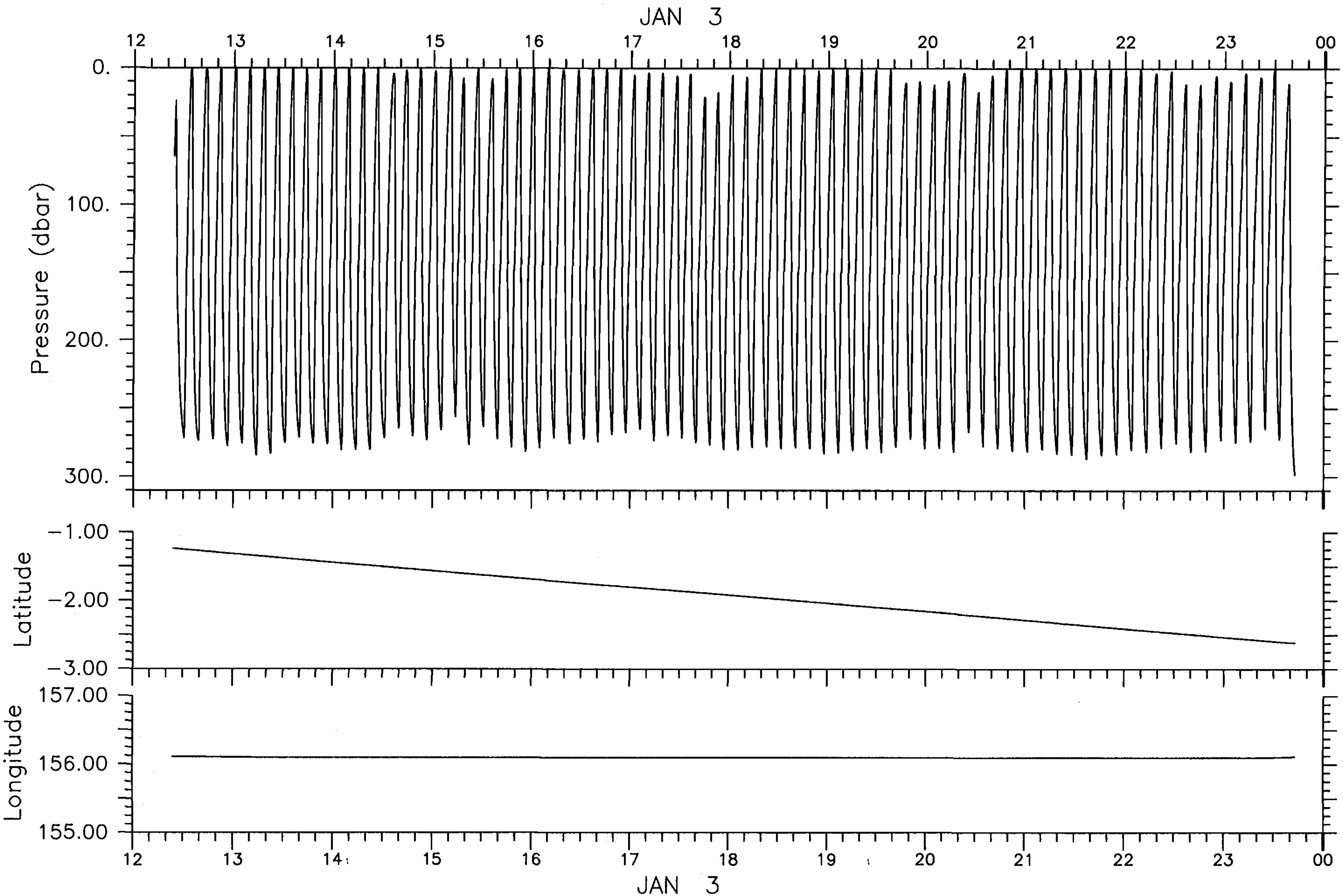
100.
200.
300.
Pressure (dbar)
-1.00
-2.00
-3.00
Latitude
157.00
156.00
155.00
Longitude
04
05
06
07
08
09
10
11
12
13
14
15
JAN 3

W2N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23
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Pressure (dbar)
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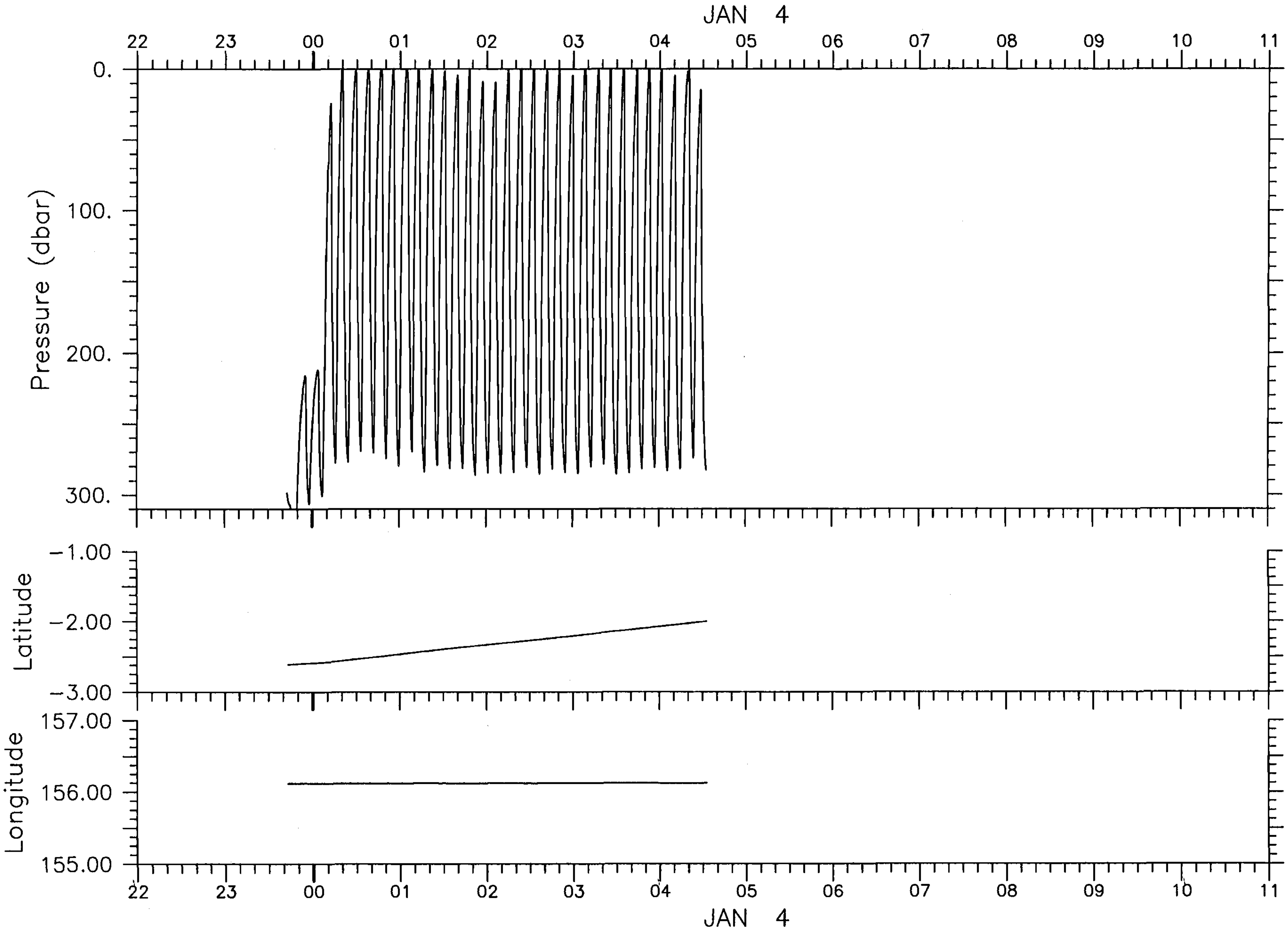
300.
Latitude
-1.00
-2.00
-3.00
Longitude
157.00
156.00
155.00

N2S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09
10
11
Pressure (dbar)
0.
100.
200.
300.
Latitude
-1.00
-2.00
-3.00
Longitude
157.00
156.00
155.00
22
23
00
01
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04
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07
08
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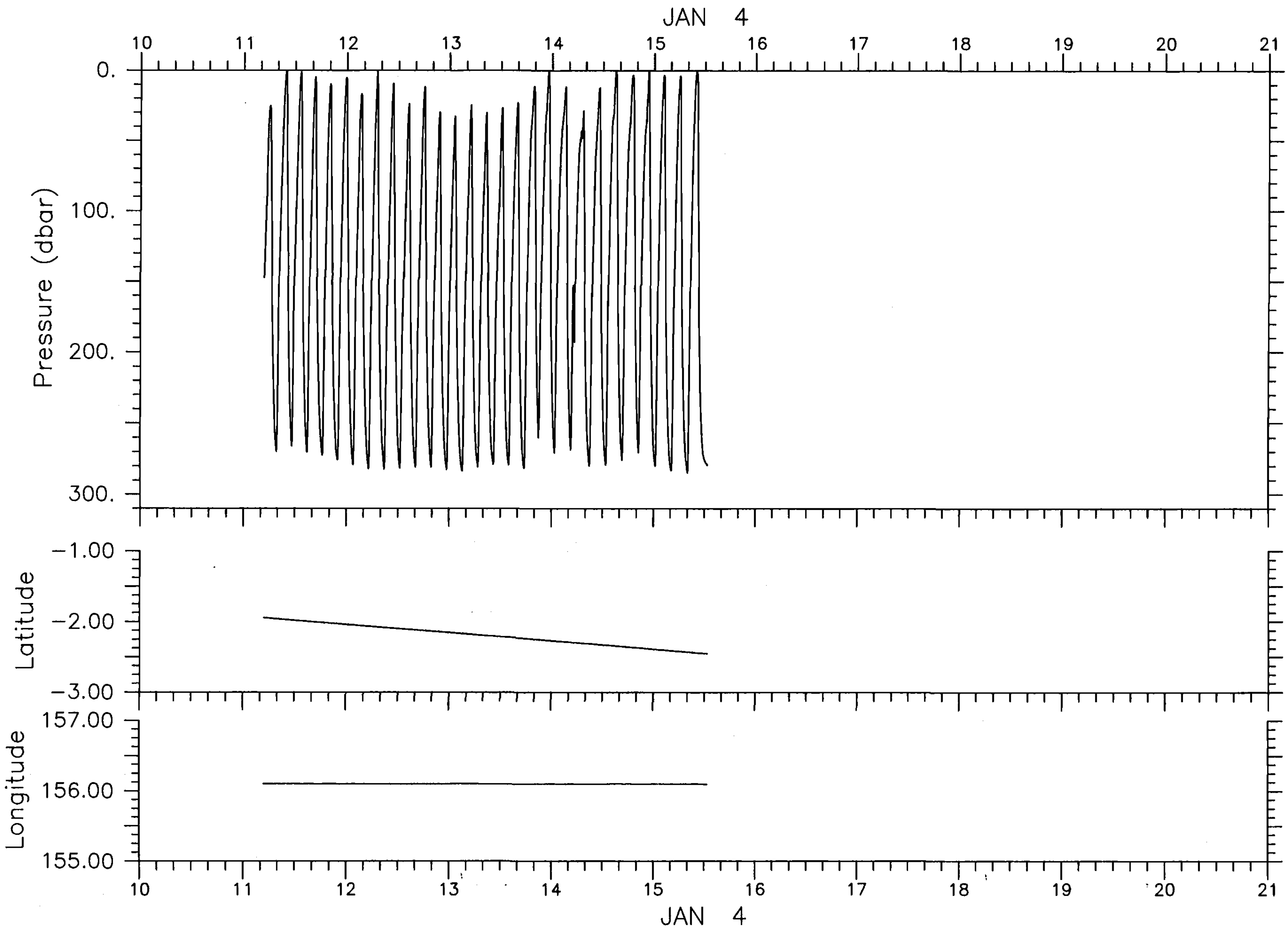
10
11
JAN 4

N2S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18
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20
21
0.
100.
200.
300.
Pressure (dbar)
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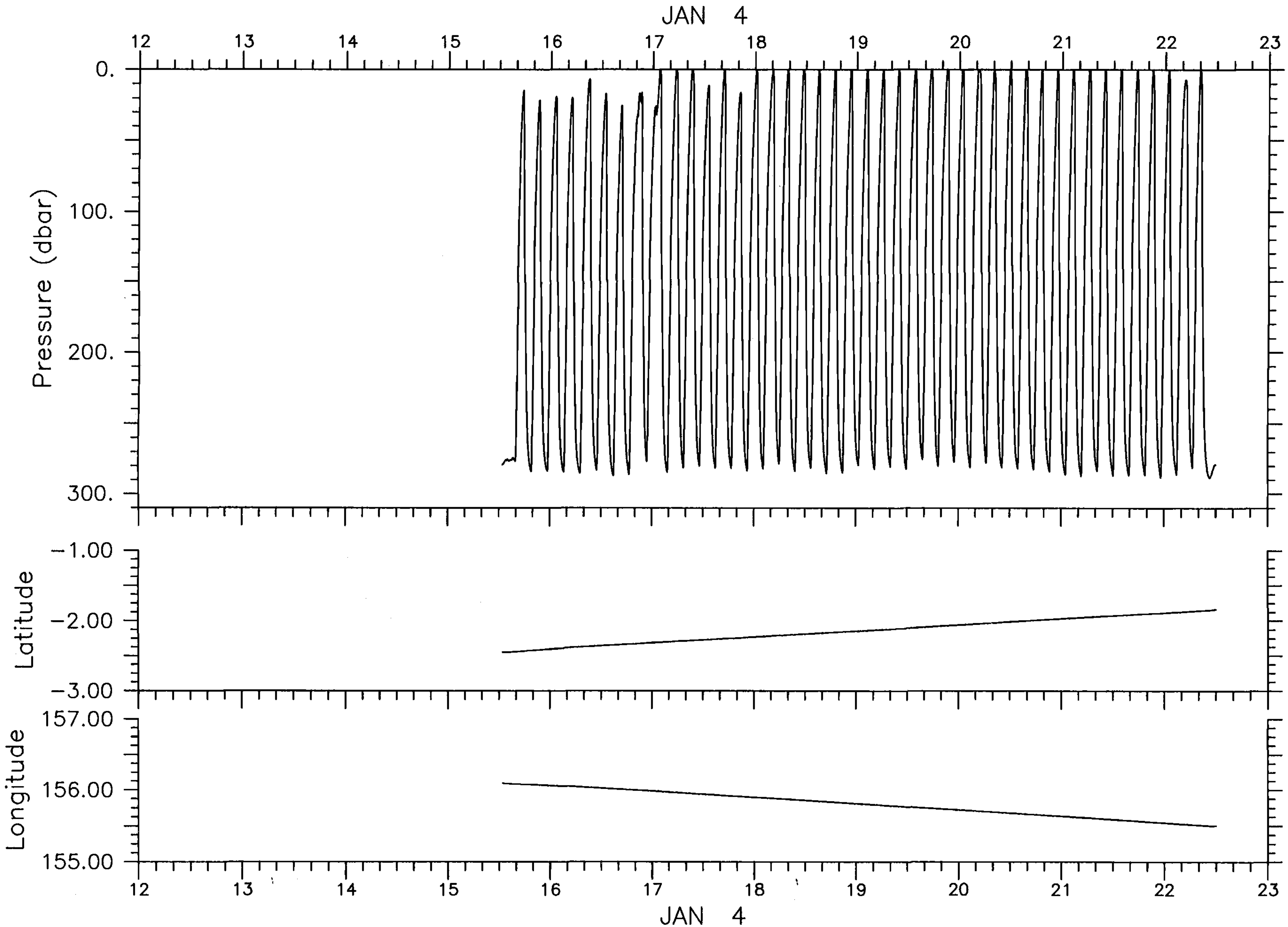
-2.00
-3.00
Latitude
157.00
156.00
155.00
Longitude
JAN 4

N2S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22
23
Pressure (dbar)
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Latitude
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-3.00
Longitude
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155.00
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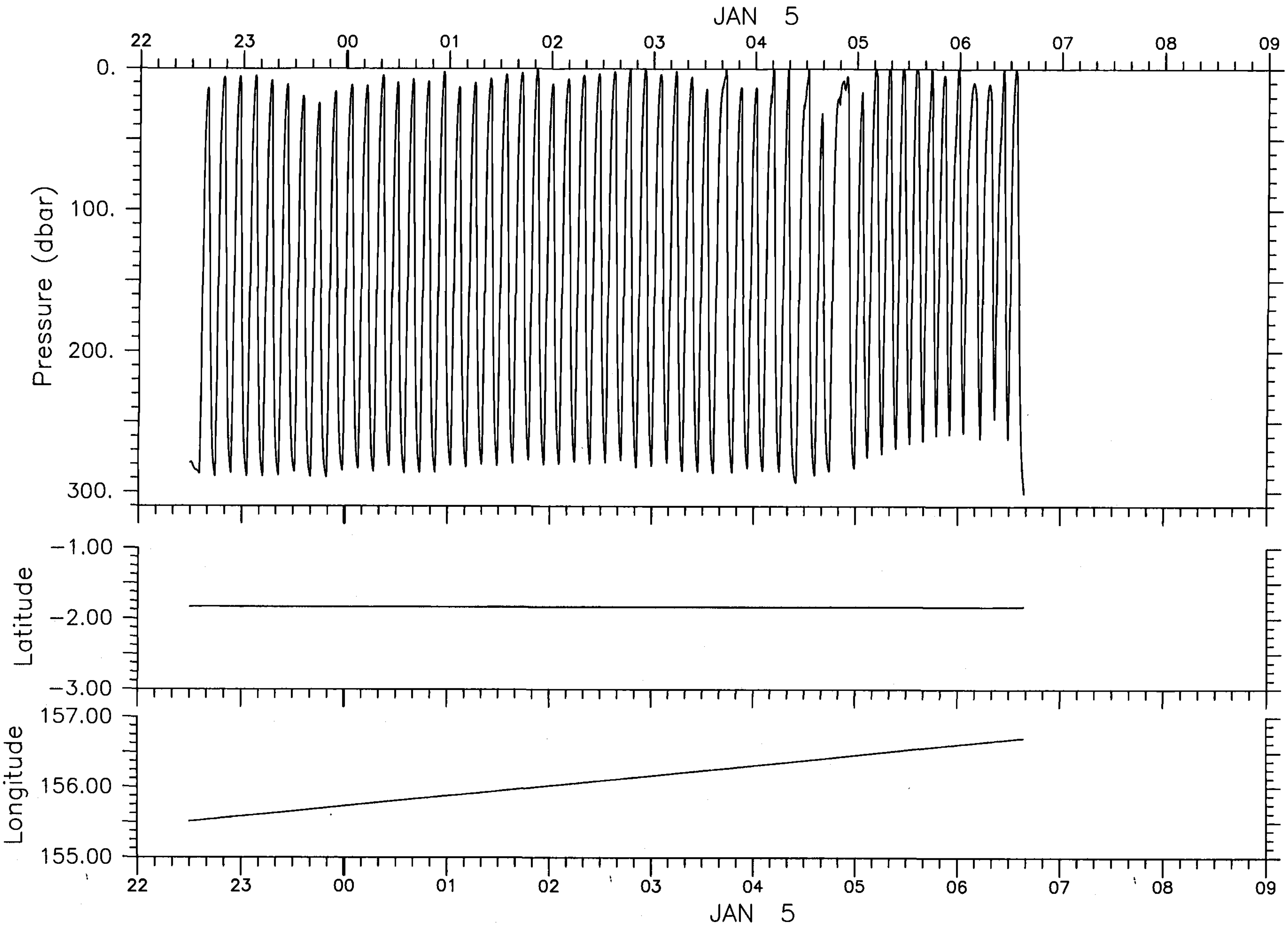
S2W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200.
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Latitude
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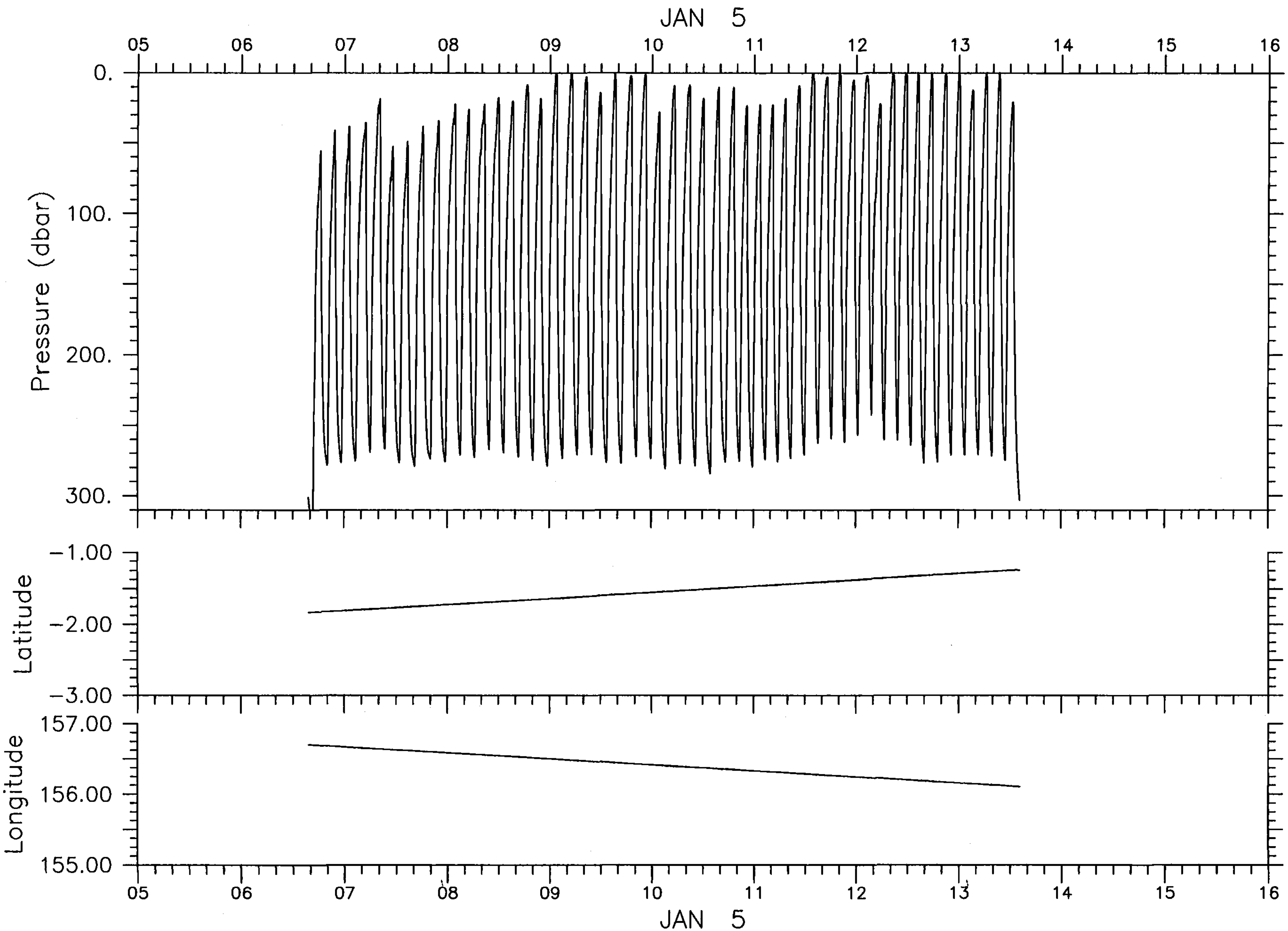
156.00
155.00
Longitude
JAN 5

W2E



JAN 5
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12
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15
16
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100.
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-3.00
Latitude
157.00
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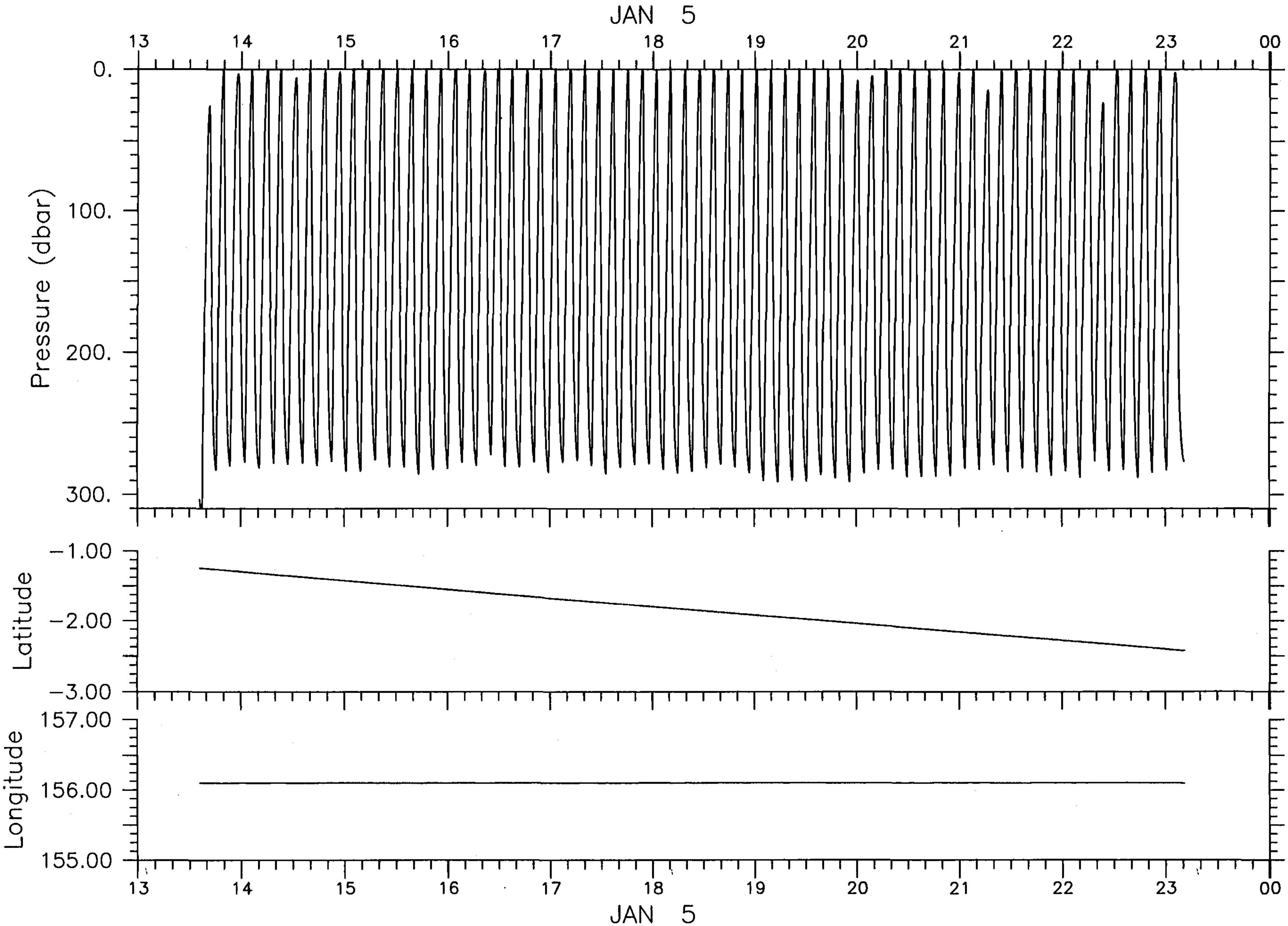
Longitude

E2N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300.
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-3.00
Longitude
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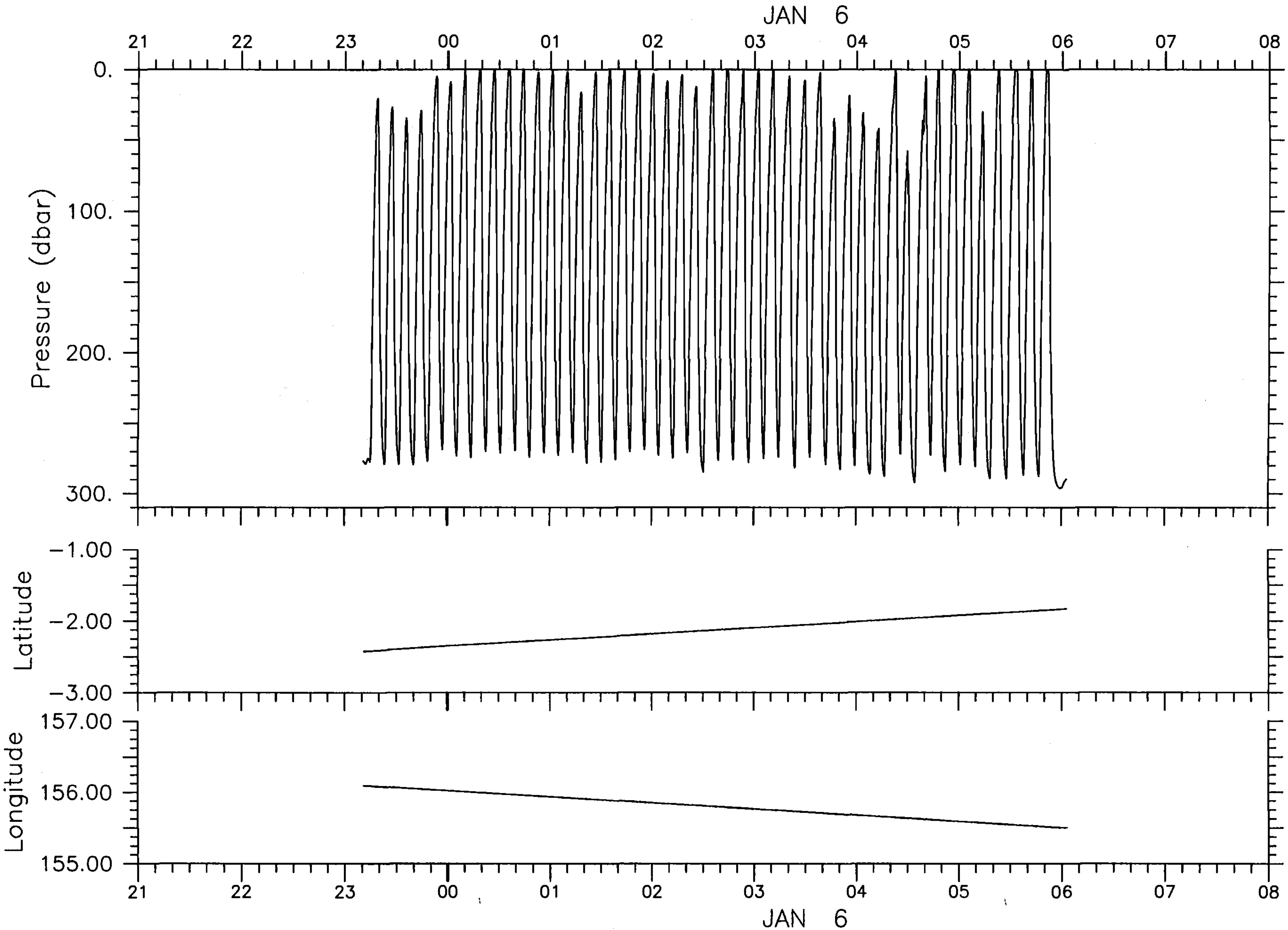
22
23
00
JAN 5

N2S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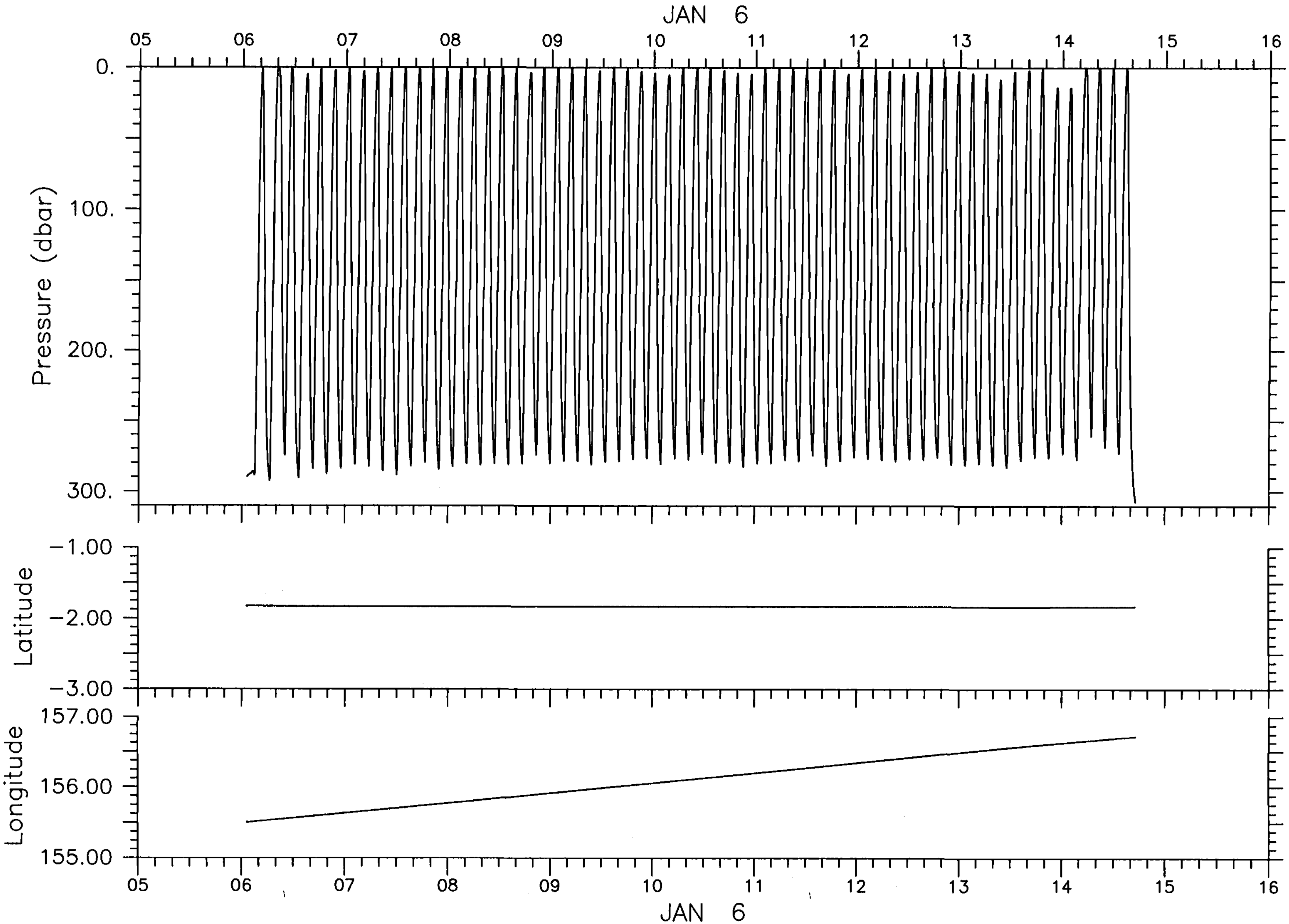
S2W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100.
200.
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Latitude
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156.00
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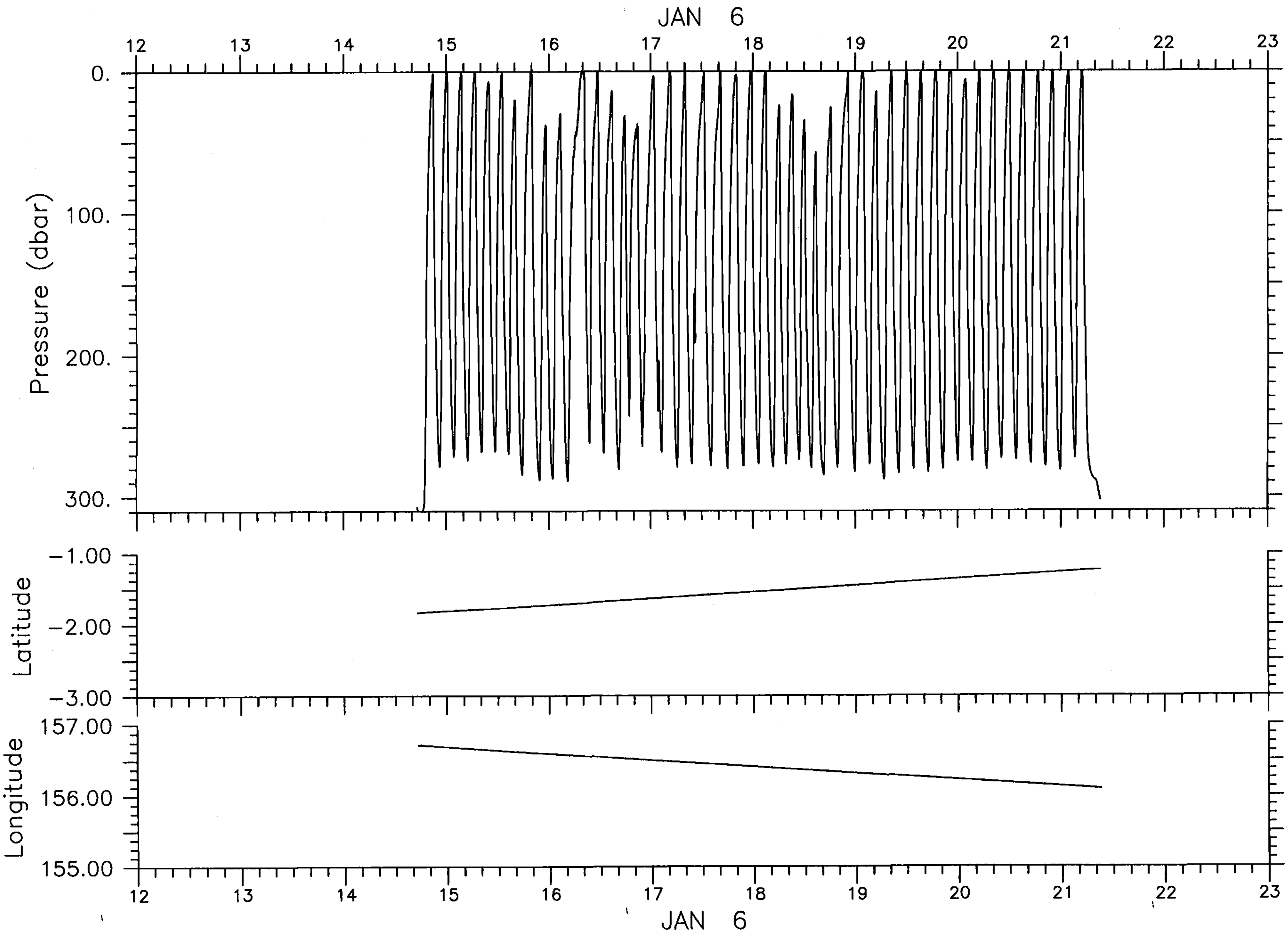
Longitude
JAN 6

W2E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100.
200.
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−2.00
−3.00
Latitude
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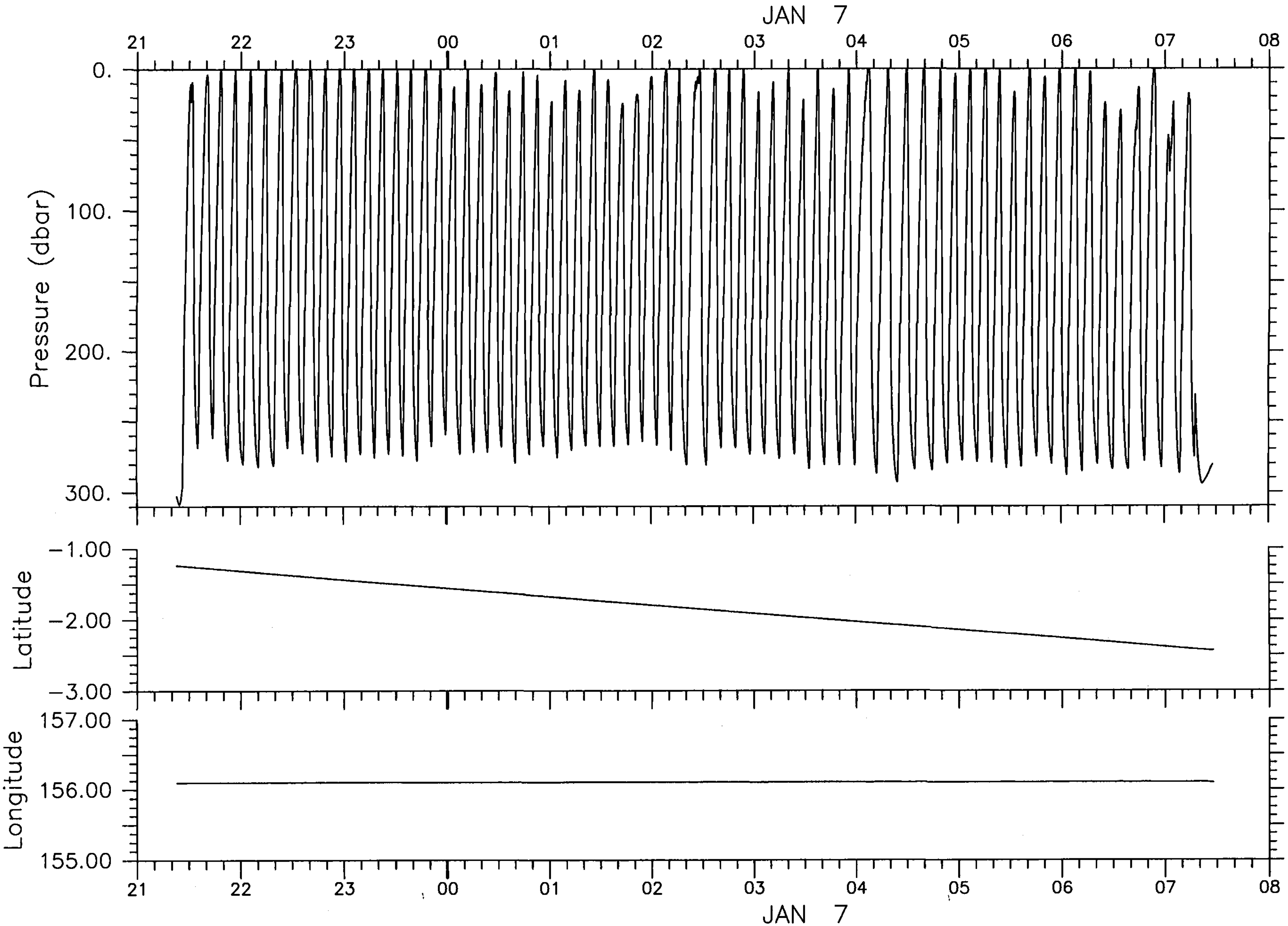
156.00
155.00
Longitude
JAN 6

E2N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Pressure (dbar)
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100.
200.
300.
Latitude
-1.00
-2.00
-3.00
Longitude
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06
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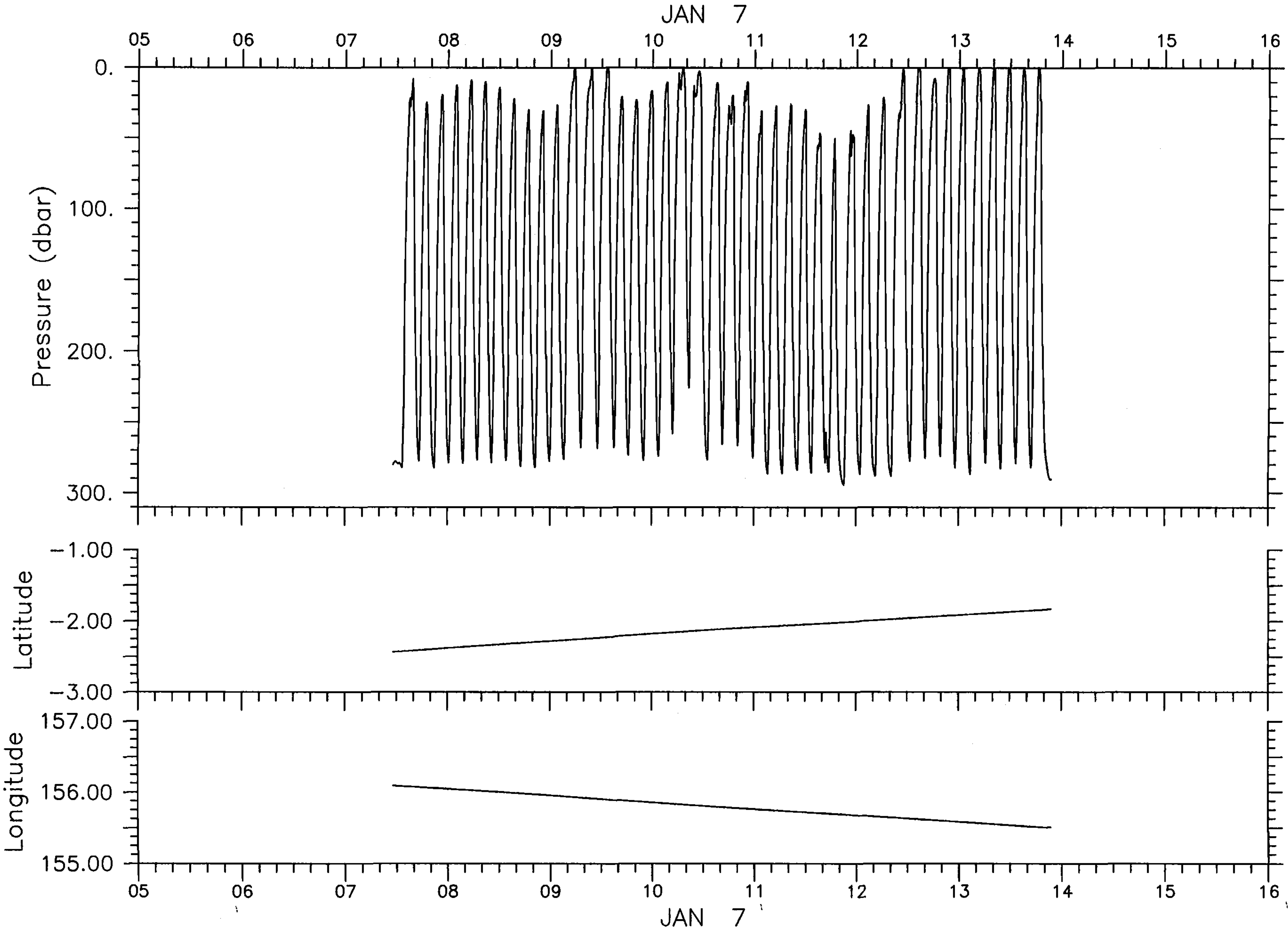
08
JAN 7

N2S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100.
200.
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−3.00
Latitude
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156.00
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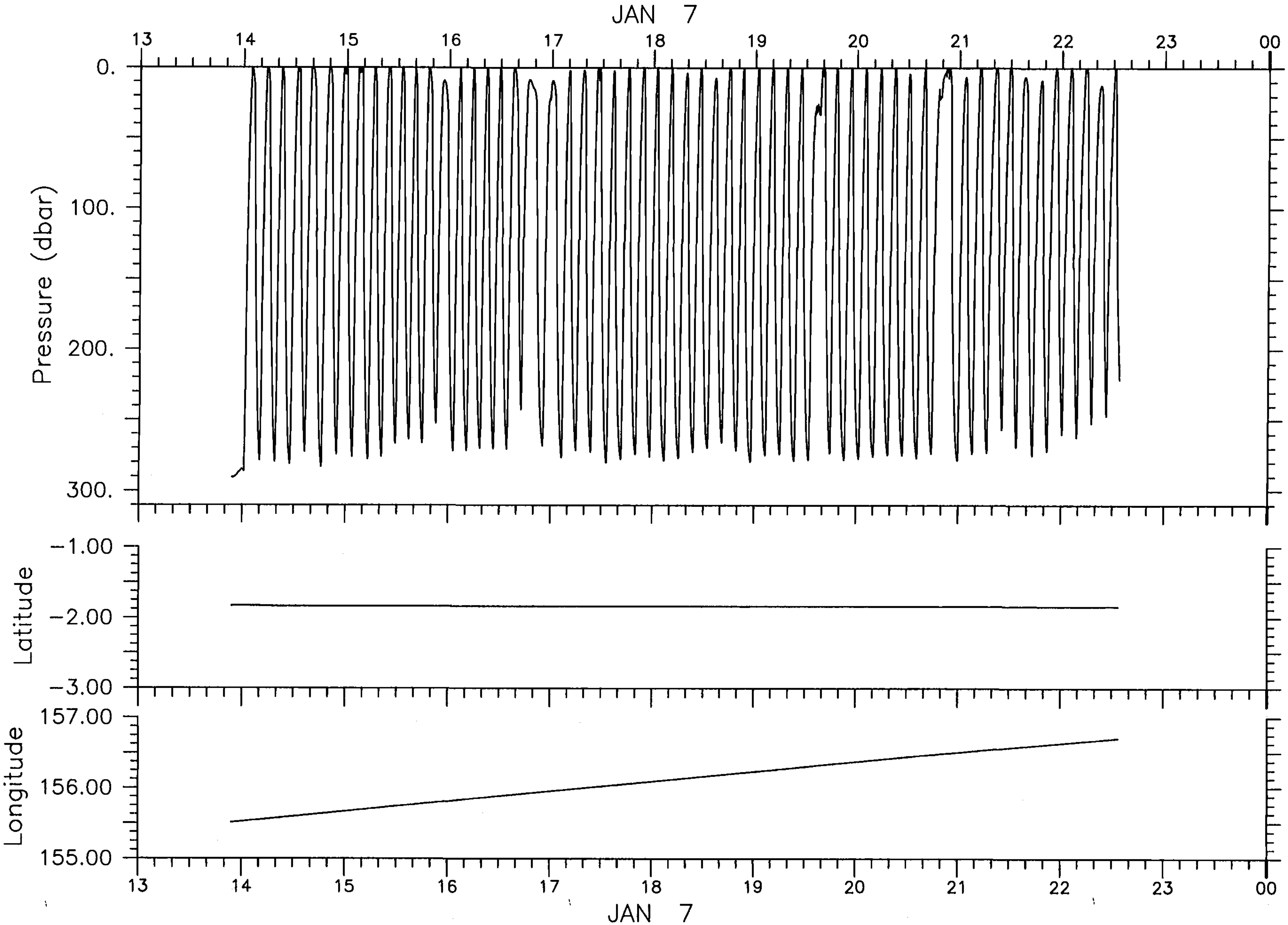
Longitude
JAN 7

S2W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Longitude
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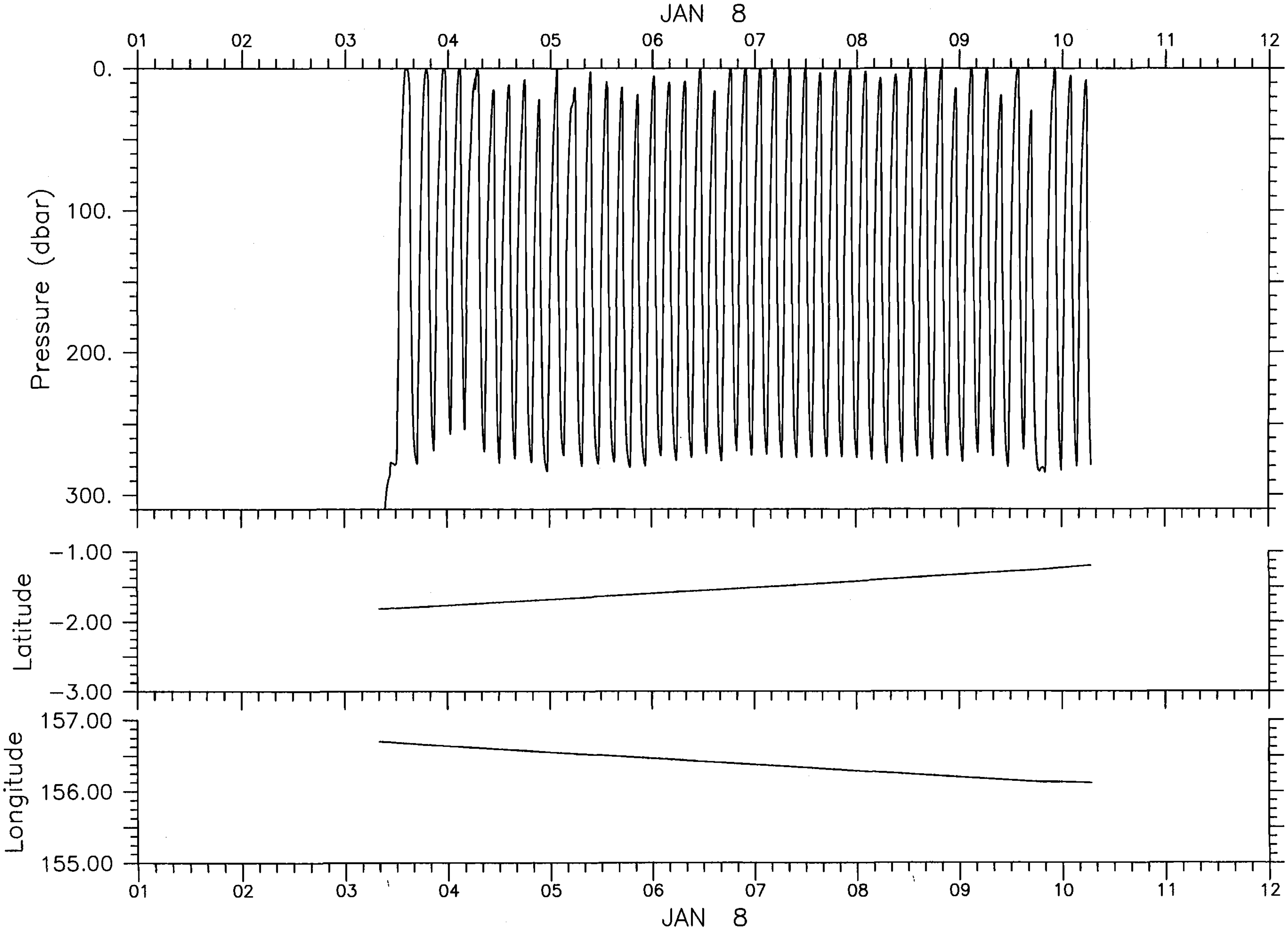
W2E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11
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Pressure (dbar)
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100.
200.
300.
Latitude
-1.00
-2.00
-3.00
Longitude
157.00
156.00
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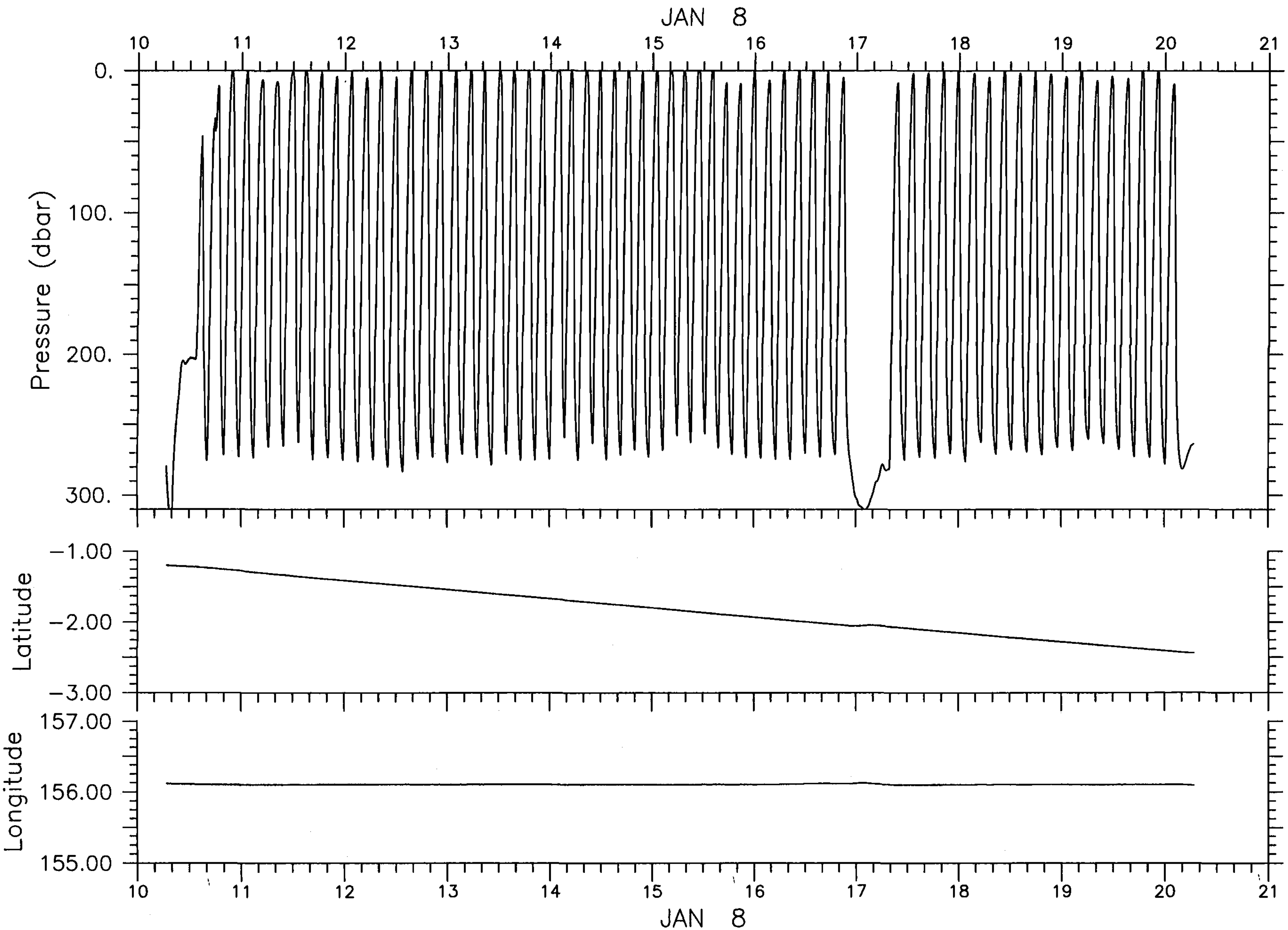
01
02
03
04
05
06
07
08
09
10
11
12
JAN 8

E2N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Pressure (dbar)
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100.
200.
300.
Latitude
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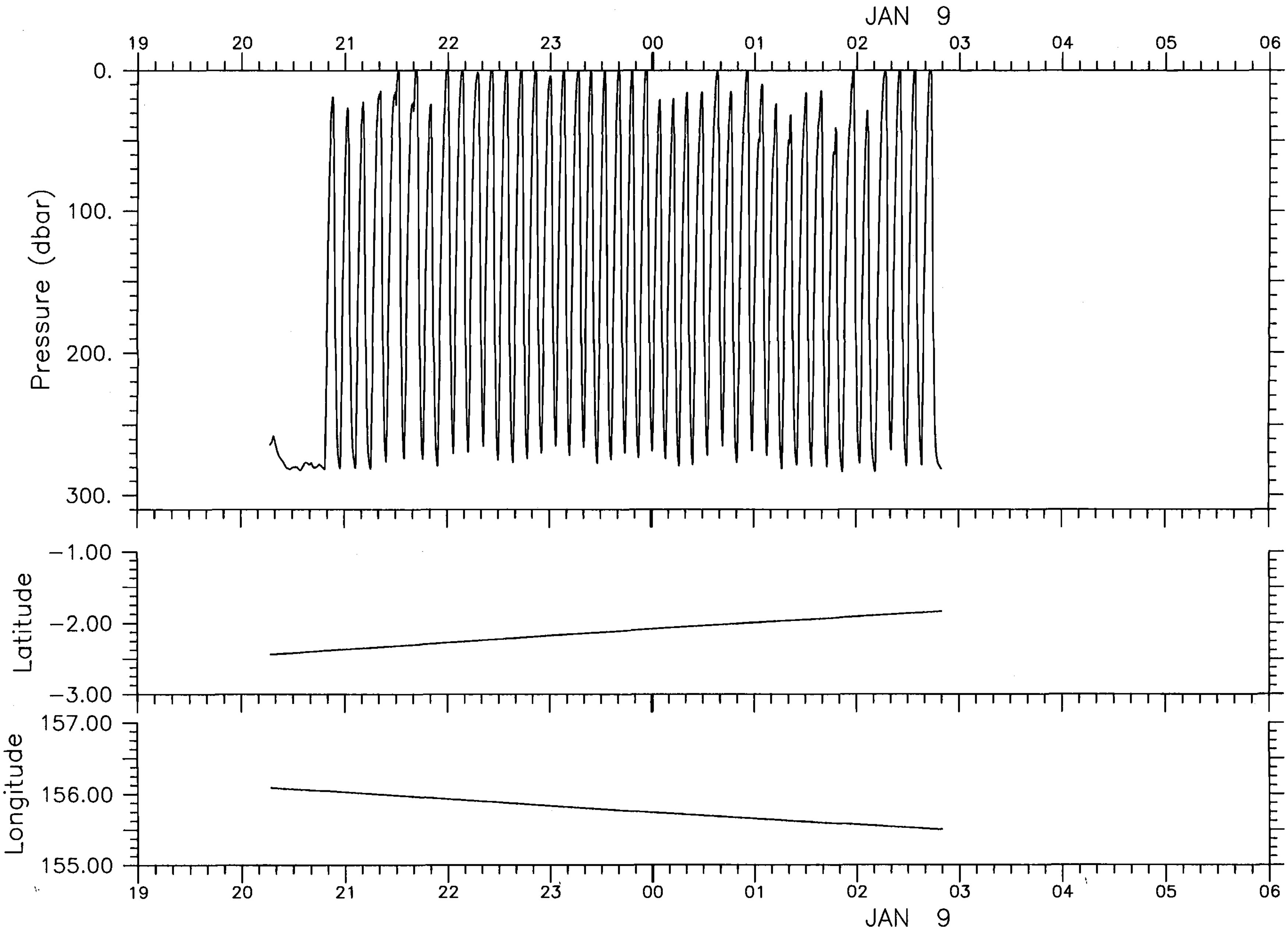
-3.00
Longitude
157.00
156.00
155.00
10 11 12 13 14 15 16 17 18 19 20 21
JAN 8

N2S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05
06
Pressure (dbar)
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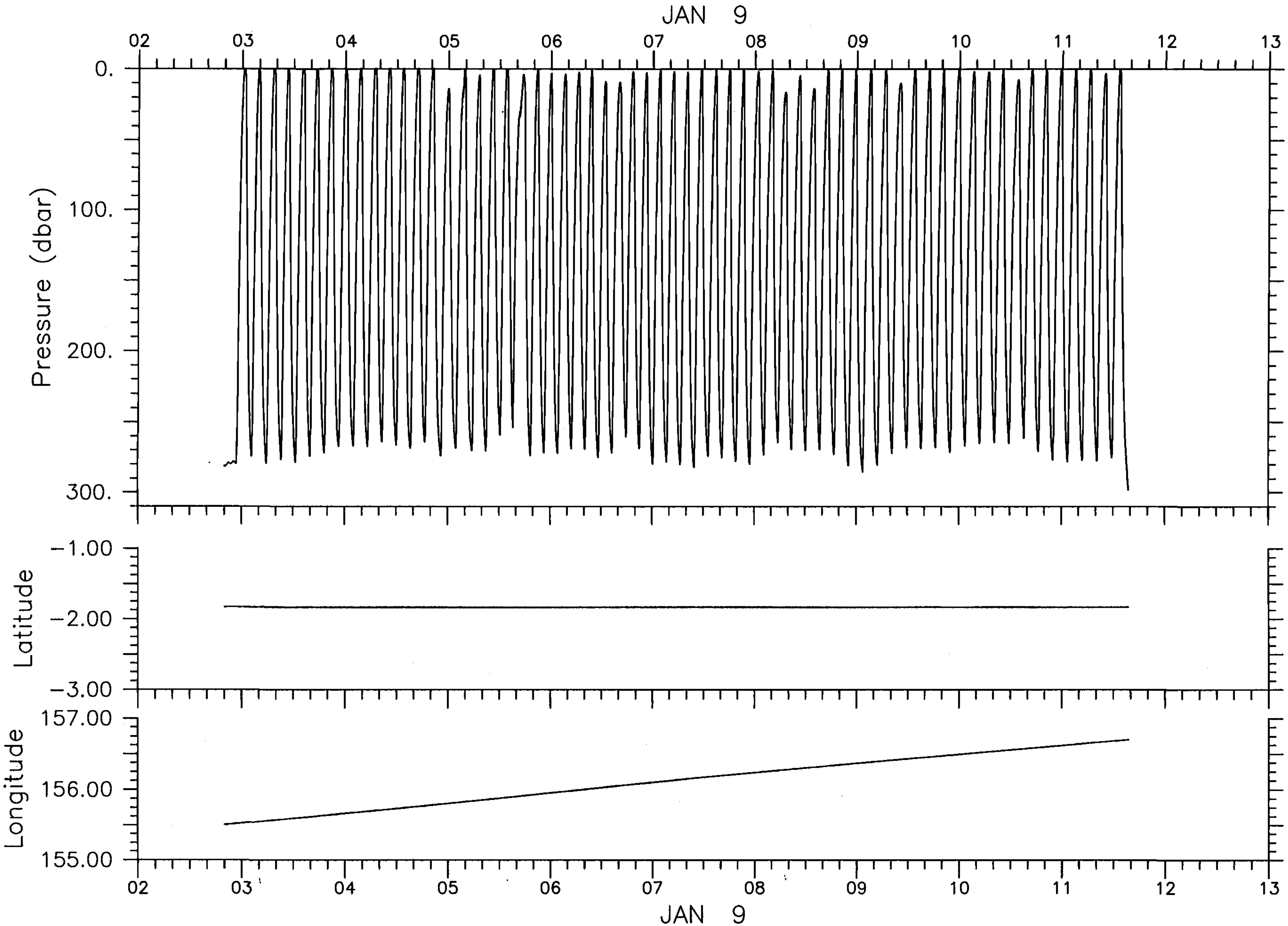
300.
Latitude
-1.00
-2.00
-3.00
Longitude
157.00
156.00
155.00

S2W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0.
100.
200.
300.
Pressure (dbar)
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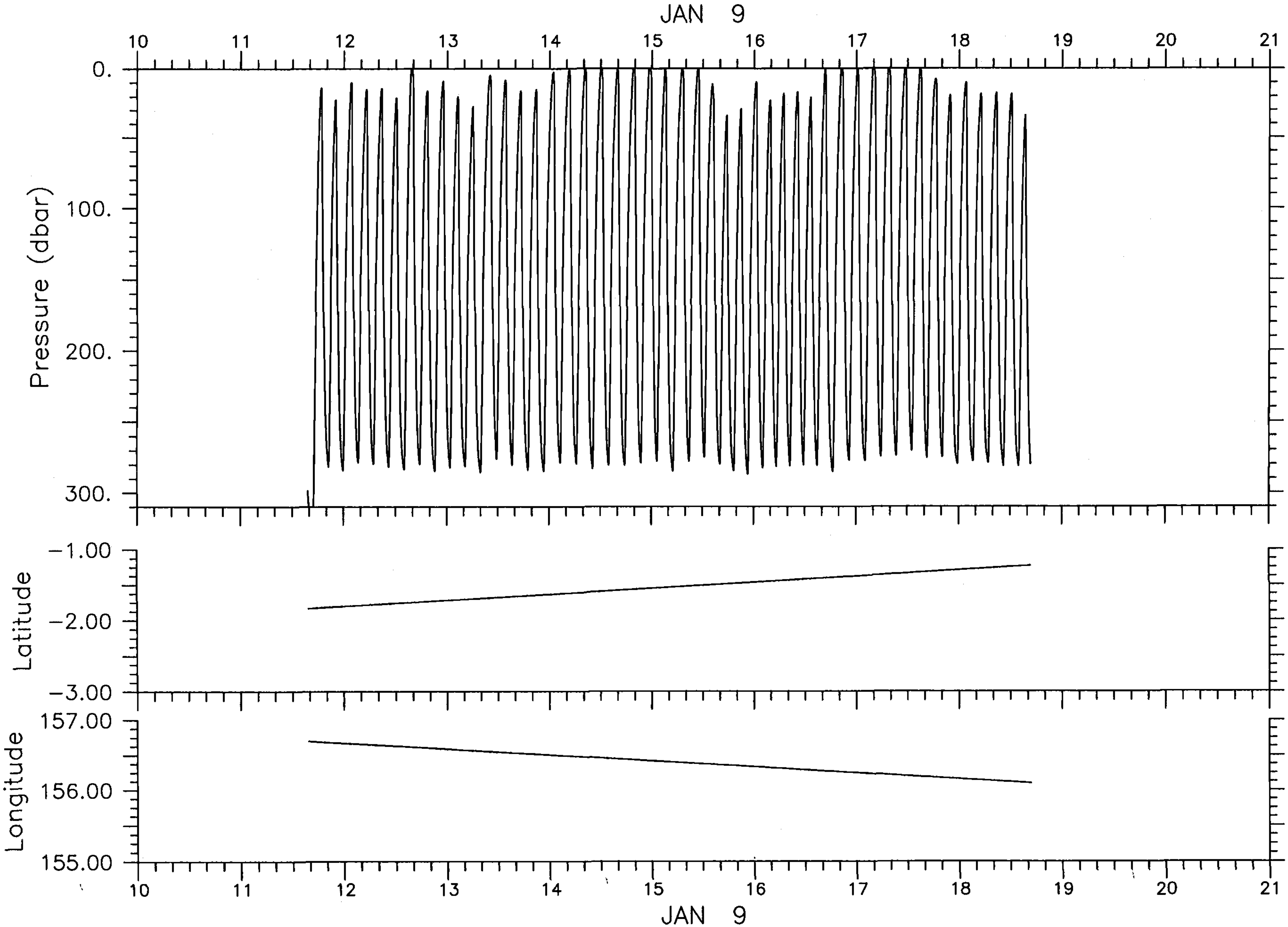
−2.00
−3.00
Latitude
157.00
156.00
155.00
Longitude
02 03 04 05 06 07 08 09 10 11 12 13
JAN 9

W2E



JAN 9
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0.
100.
200.
300.
Pressure (dbar)
-1.00
-2.00
-3.00
Latitude
157.00
156.00
155.00
Longitude
10
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12
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14
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16
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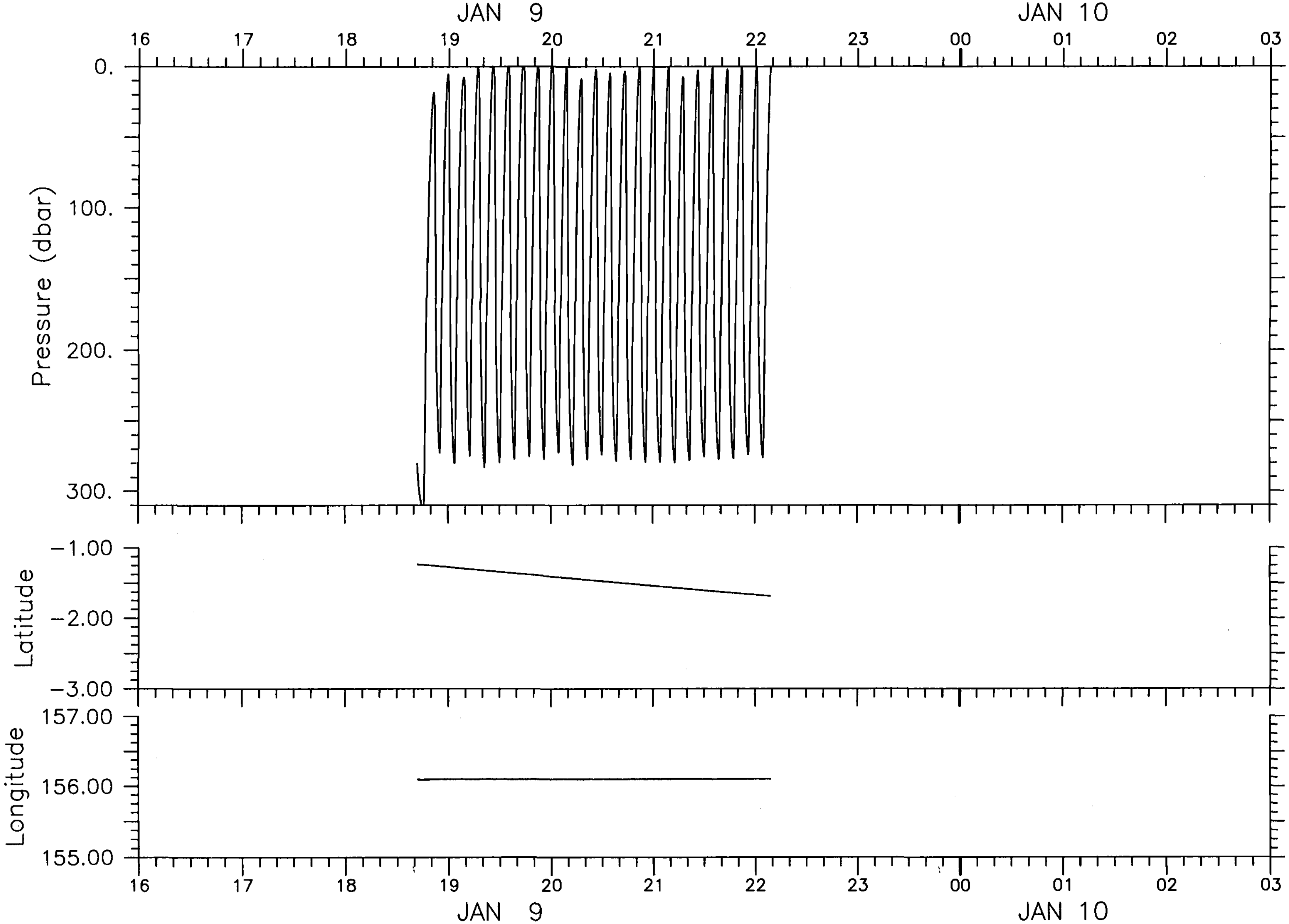
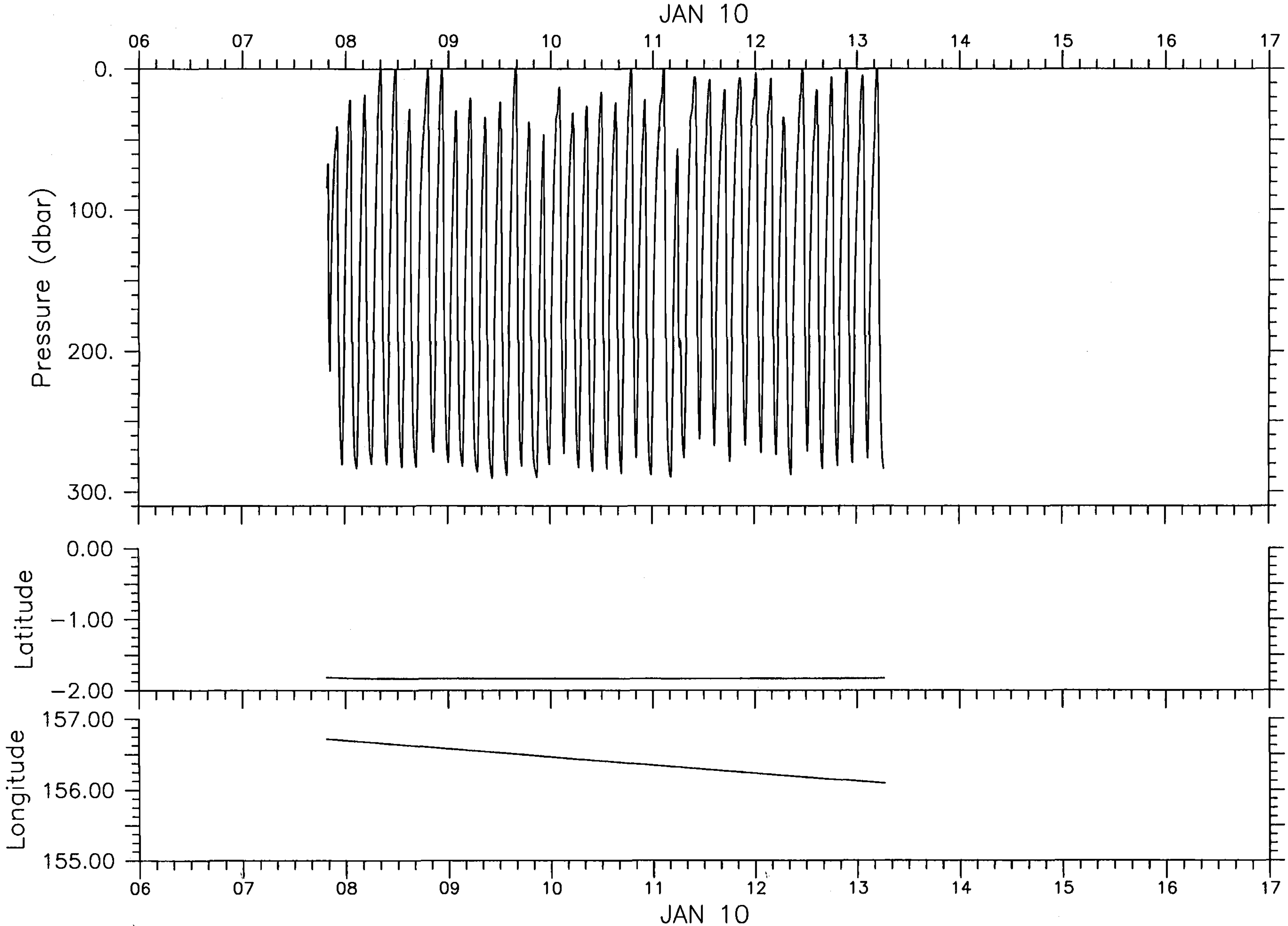
18
19
20
21
JAN 9

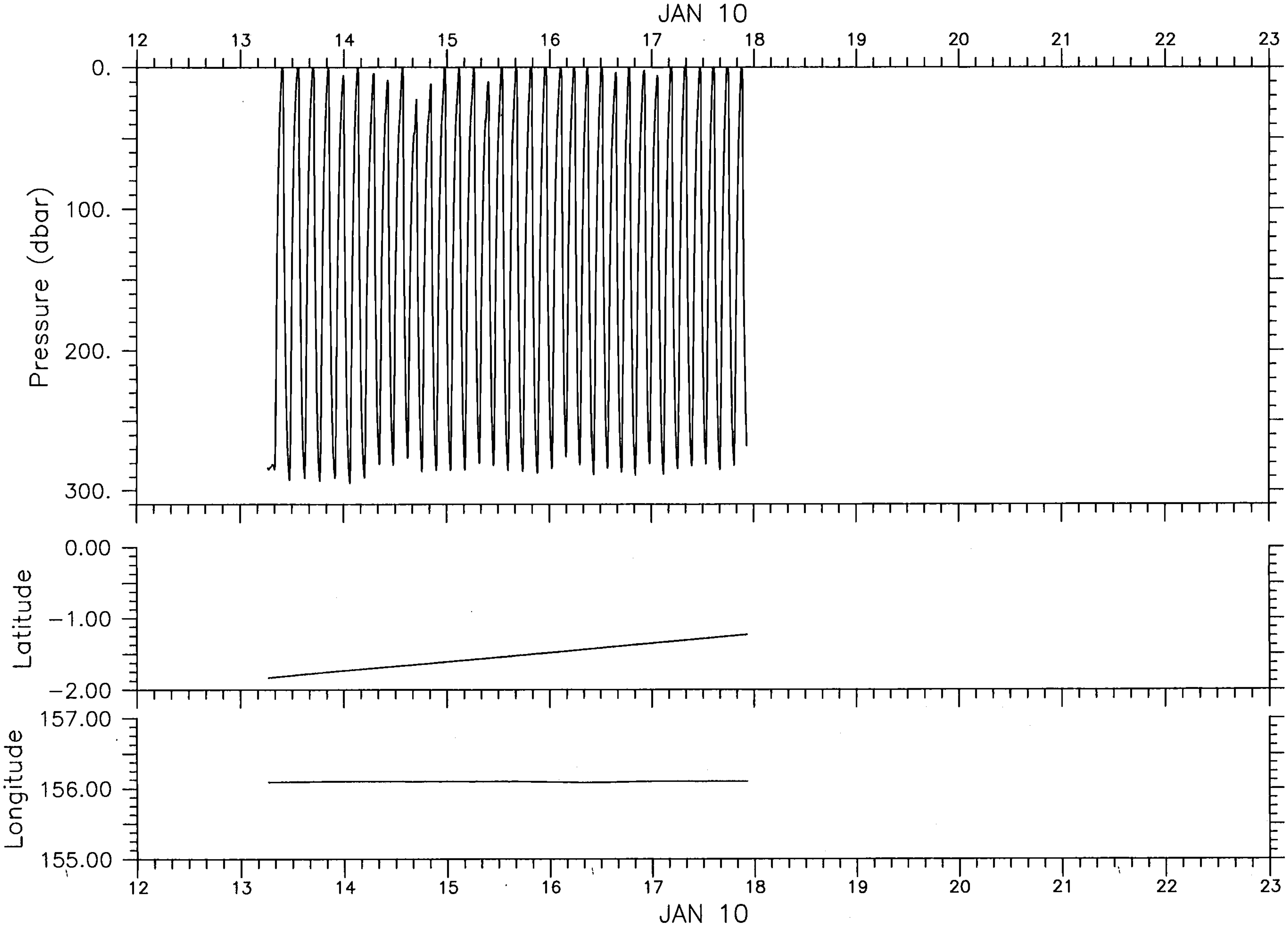
E2N


JAN 9
JAN 10
16
17
18
19
20
21
22
23
00
01
02
03
Pressure (dbar)
0.
100.
200.
300.
Latitude
-1.00
-2.00
-3.00
Longitude
157.00
156.00
155.00

N2S

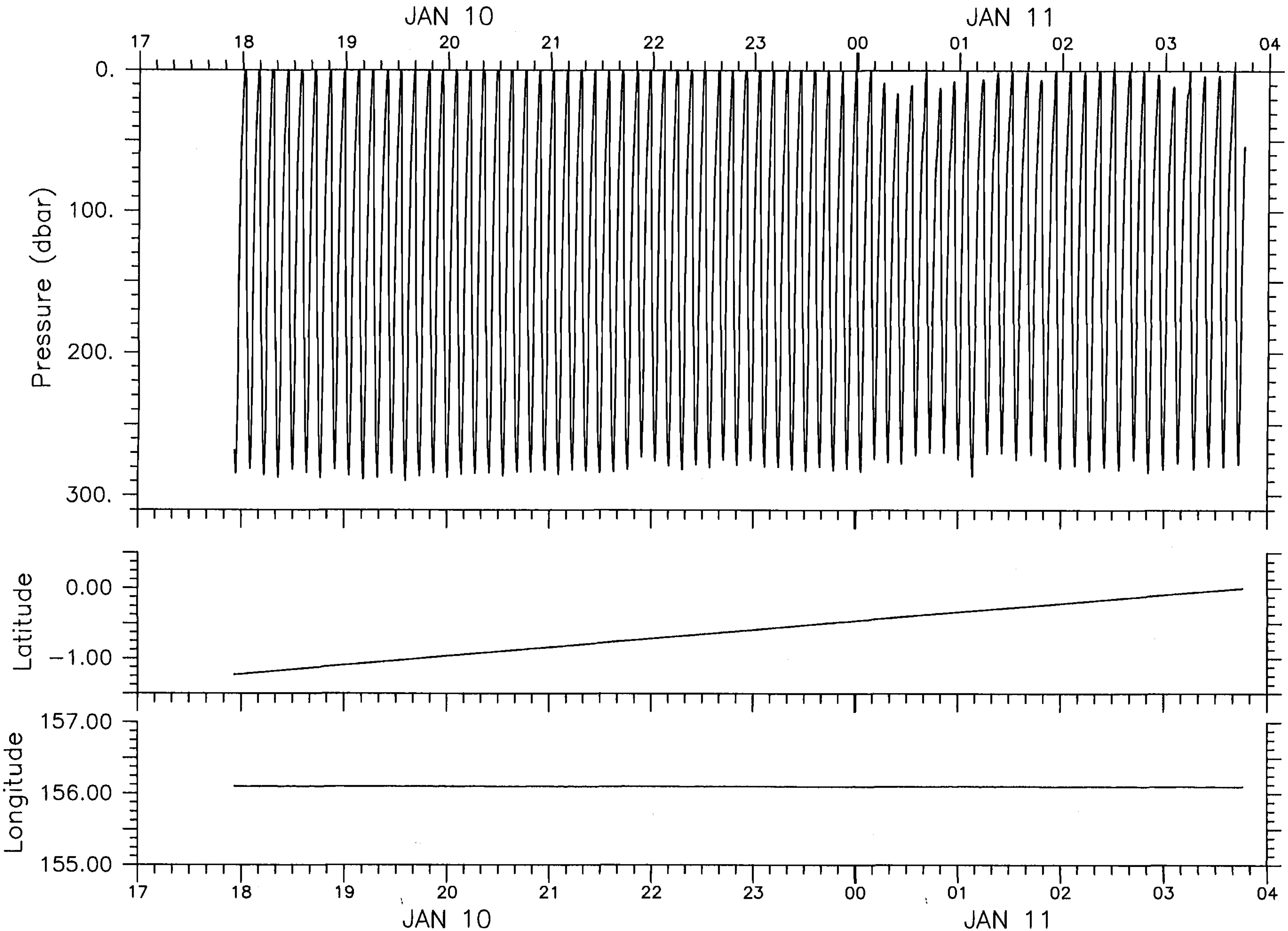

JAN 10
06 07 08 09 10 11 12 13 14 15 16 17
Pressure (dbar)
0.
100.
200.
300.
Latitude
0.00
−1.00
−2.00
Longitude
157.00
156.00
155.00
06 07 08 09 10 11 12 13 14 15 16 17
JAN 10

W2E

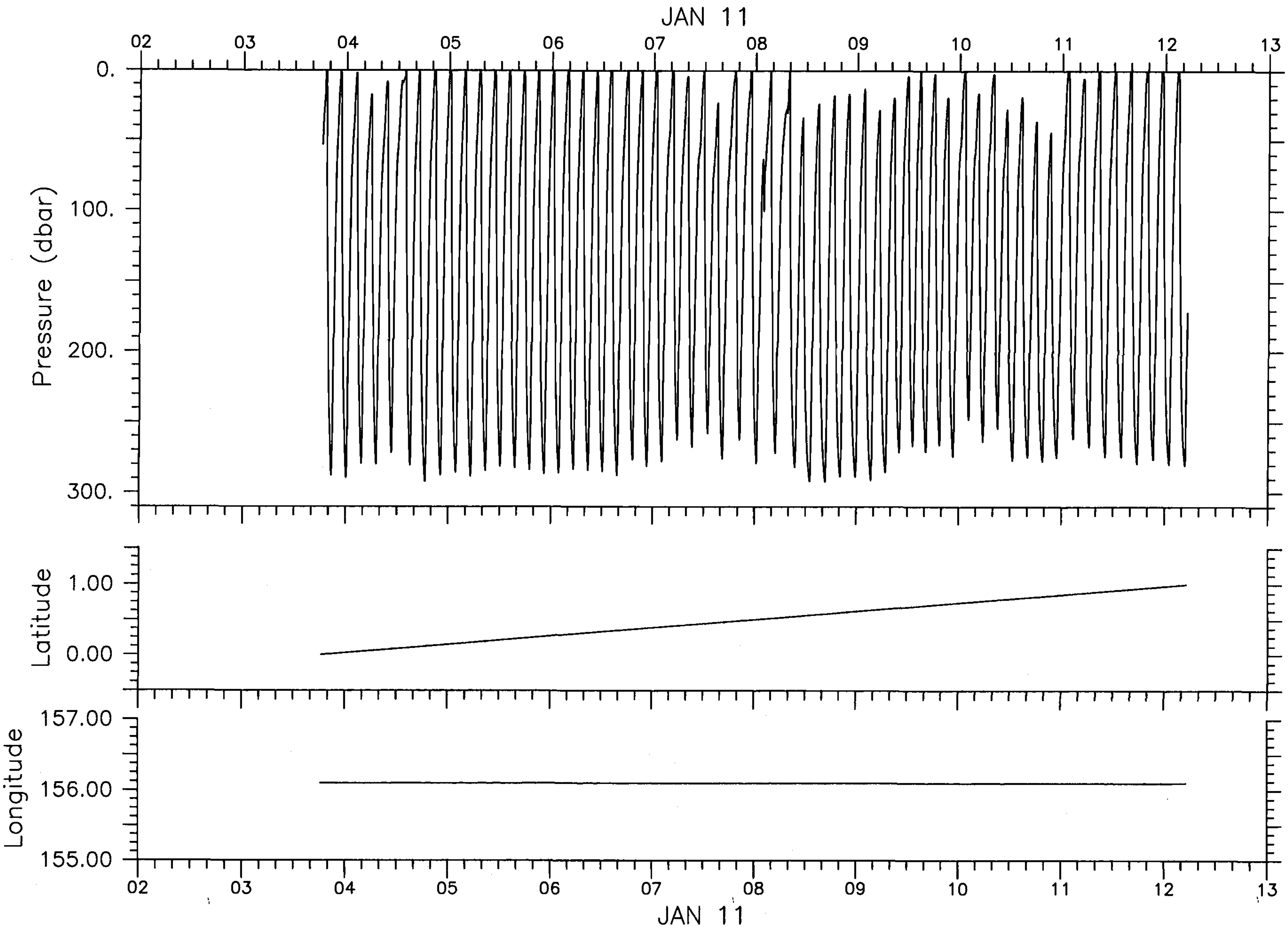


JAN 10
12
13
14
15
16
17
18
19
20
21
22
23
0.
100.
200.
300.
Pressure (dbar)
0.00
-1.00
-2.00
Latitude
157.00
156.00
155.00
Longitude
JAN 10

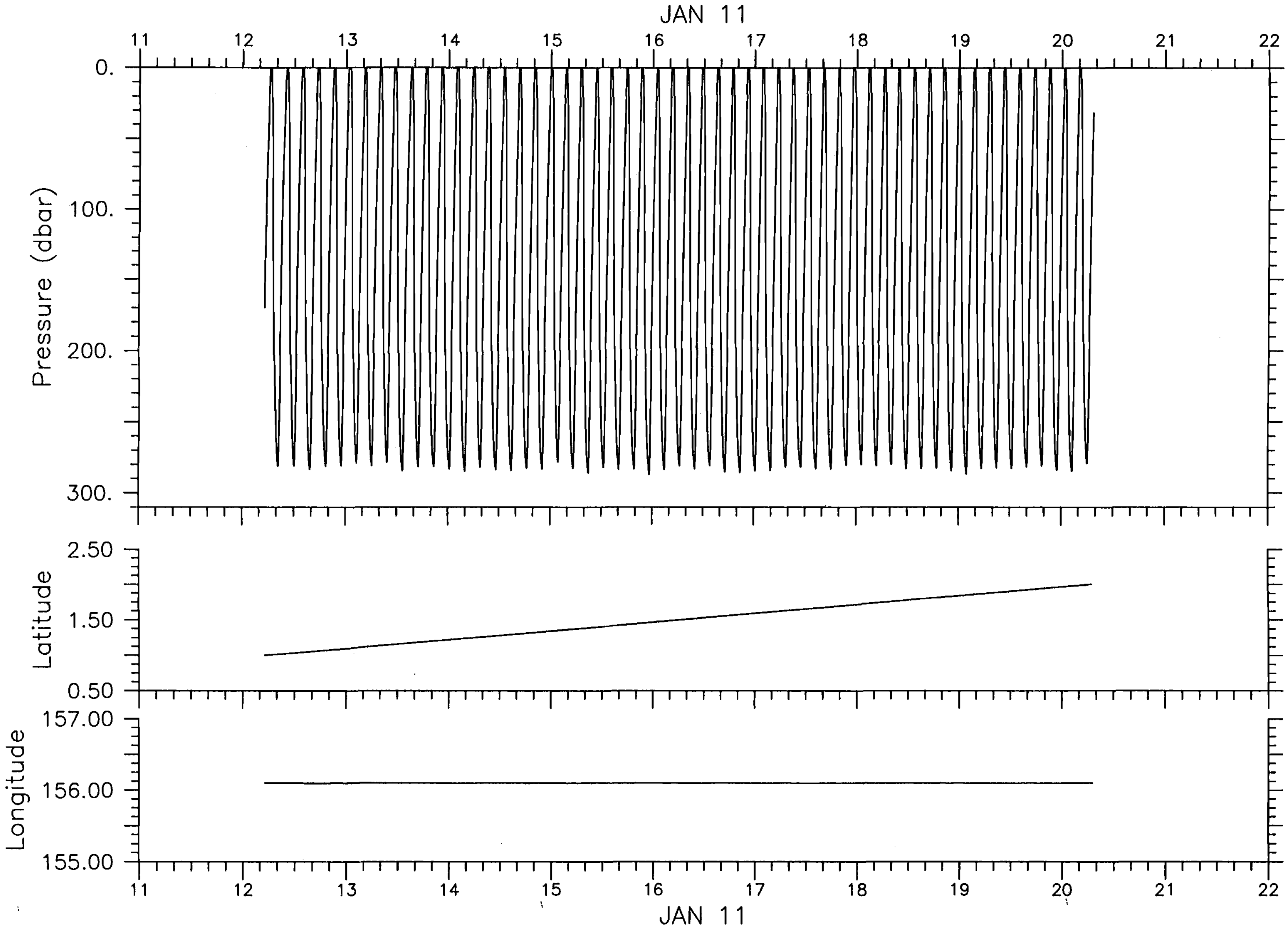
N2S


JAN 10
JAN 11
17
18
19
20
21
22
23
00
01
02
03
04
0.
100.
200.
300.
Pressure (dbar)
0.00
−1.00
Latitude
157.00
156.00
155.00
Longitude

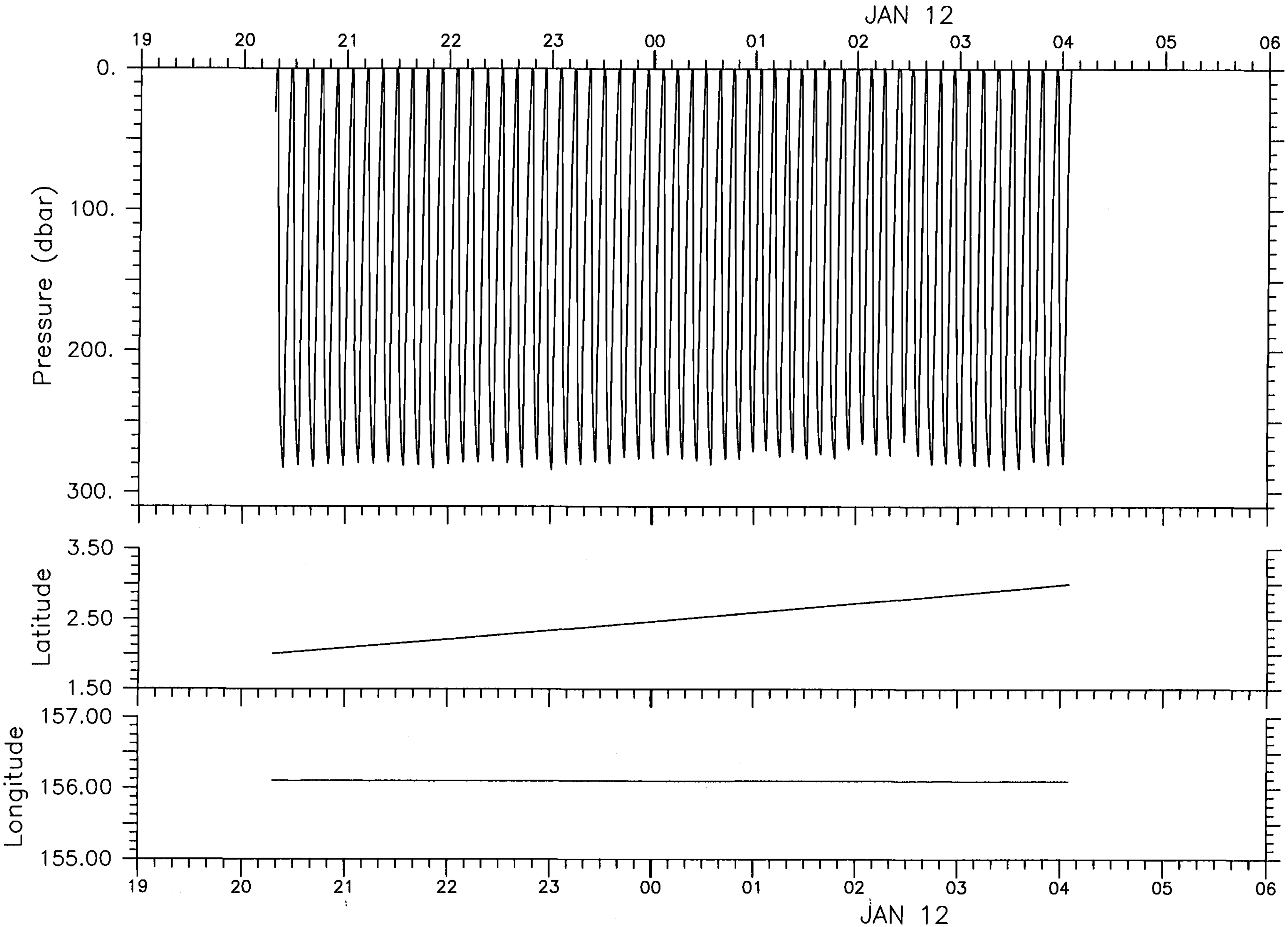
TRANSIT


JAN 11
02
03
04
05
06
07
08
09
10
11
12
13
0.
100.
200.
300.
Pressure (dbar)
1.00
0.00
Latitude
157.00
156.00
155.00
Longitude

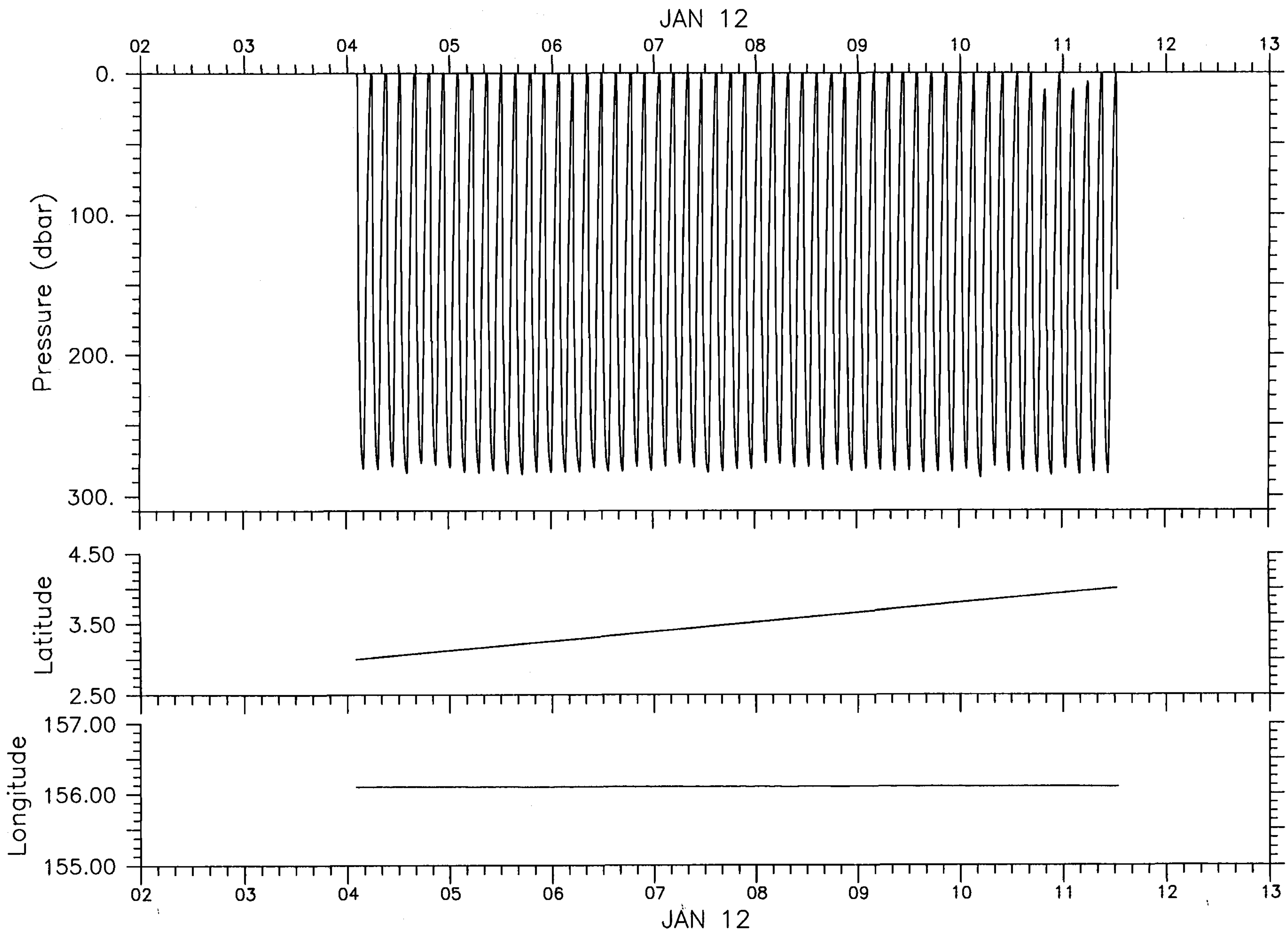
TRANSIT


JAN 11
11
12
13
14
15
16
17
18
19
20
21
22
0.
100.
200.
300.
Pressure (dbar)
2.50
1.50
0.50
Latitude
157.00
156.00
155.00
Longitude
JAN 11

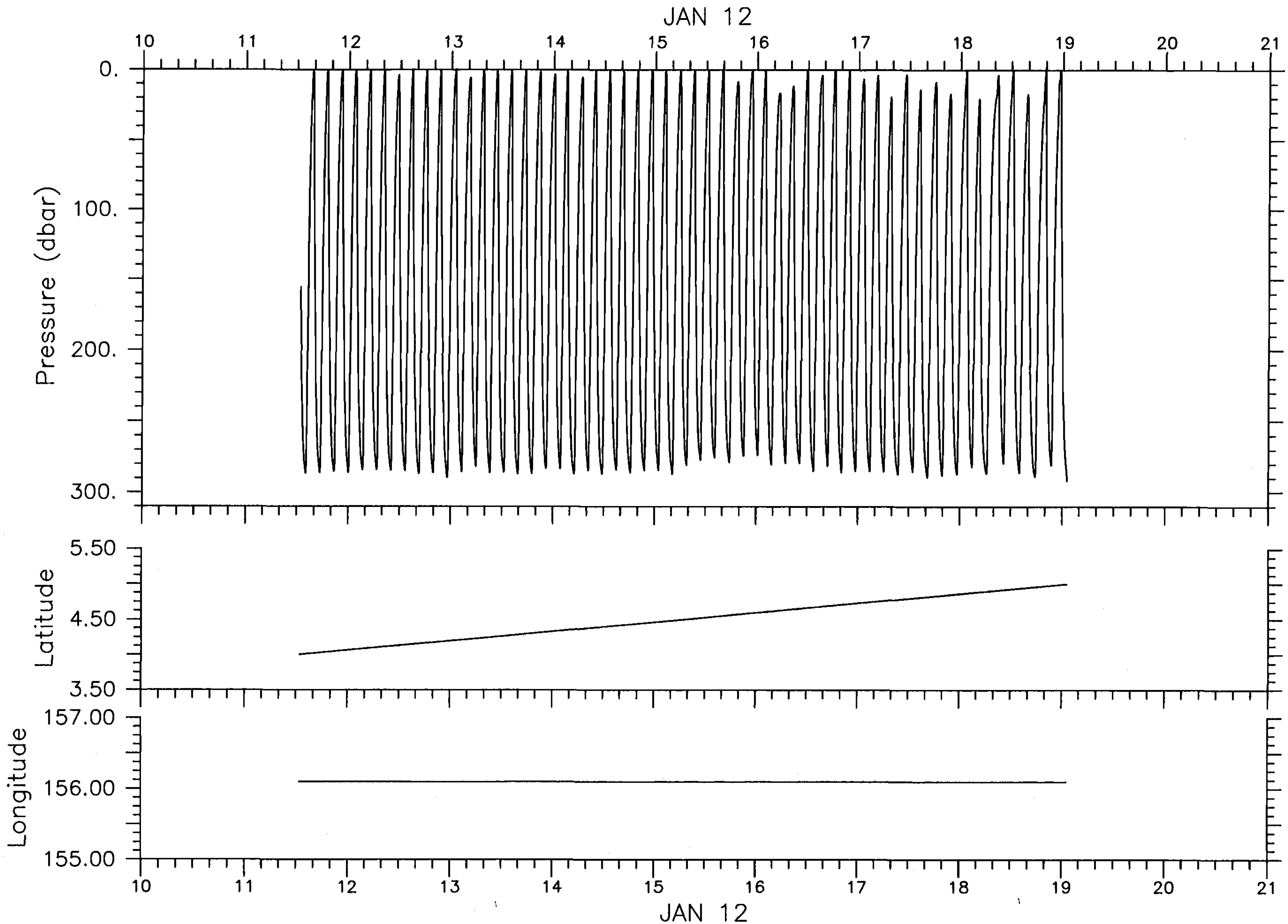
TRANSIT


JAN 12
19 20 21 22 23 00 01 02 03 04 05 06
Pressure (dbar)
0.
100.
200.
300.
Latitude
3.50
2.50
1.50
Longitude
157.00
156.00
155.00
19 20 21 22 23 00 01 02 03 04 05 06
JAN 12

TRANSIT


JAN 12
02
03
04
05
06
07
08
09
10
11
12
13
Pressure (dbar)
0.
100.
200.
300.
Latitude
4.50
3.50
2.50
Longitude
157.00
156.00
155.00
JAN 12

TRANSIT

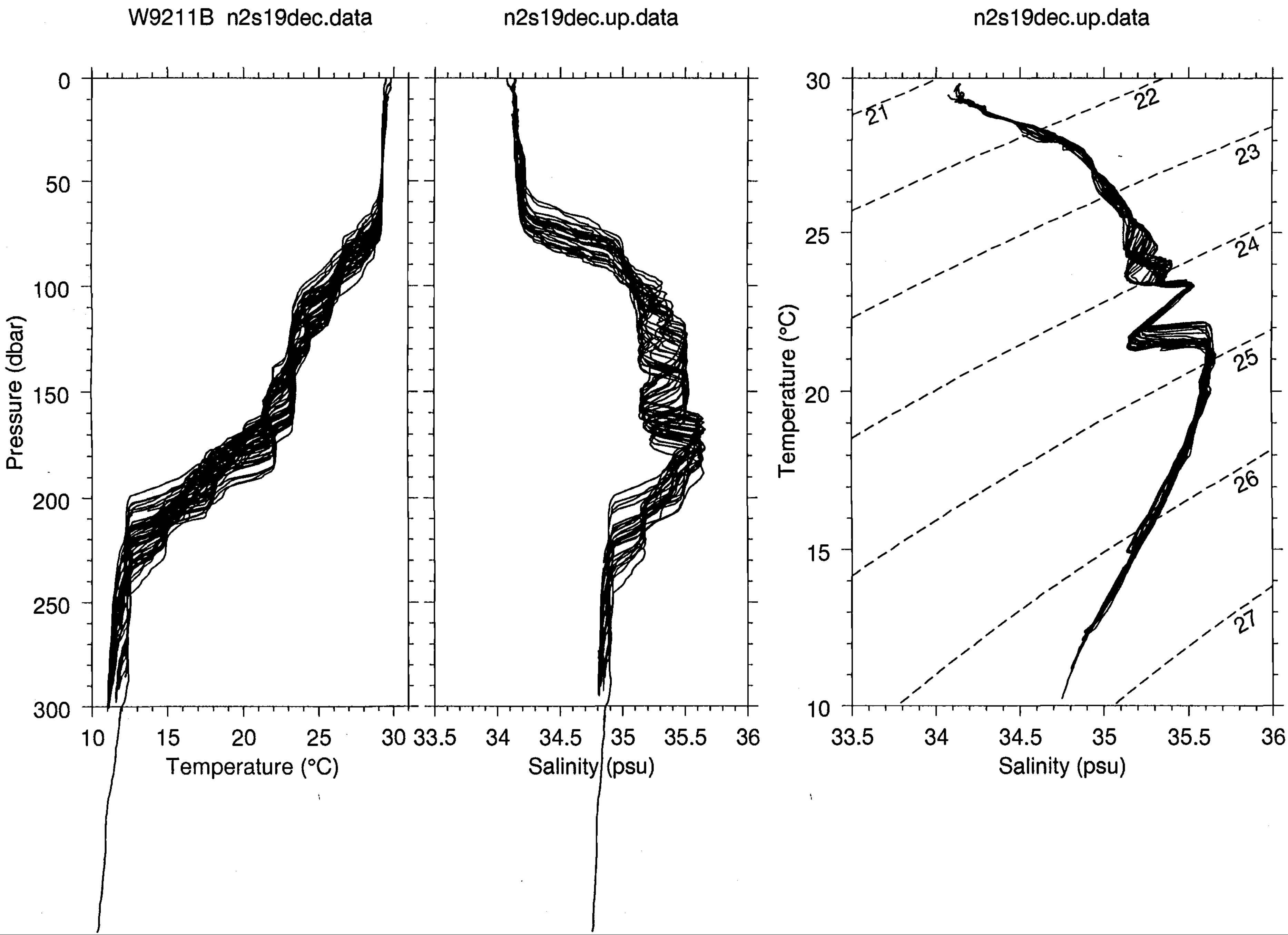

JAN 12
Pressure (dbar)
Latitude
Longitude
10
11
12
13
14
15
16
17
18
19
20
21
0.
100.
200.
300.
5.50
4.50
3.50
157.00
156.00
155.00

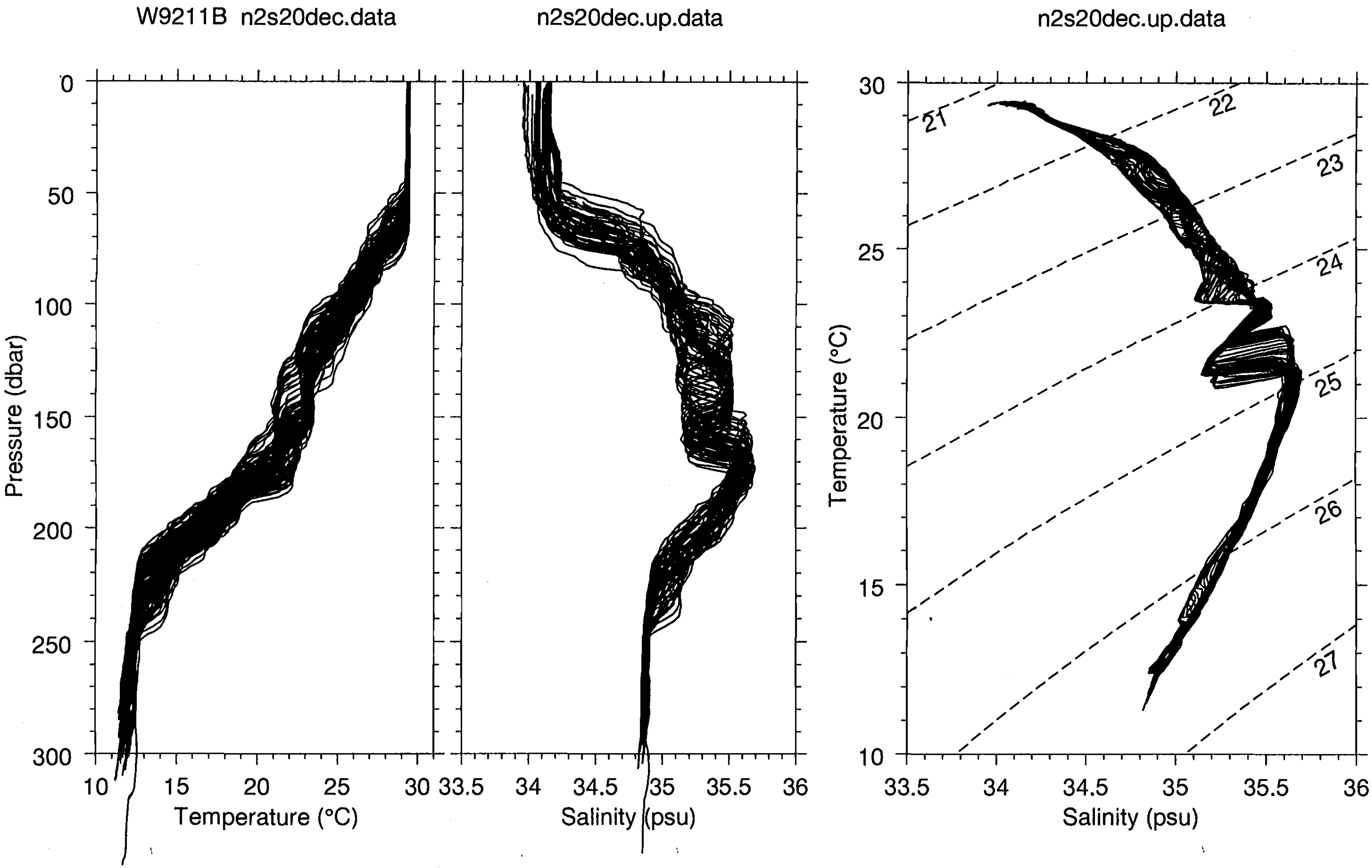
TRANSIT

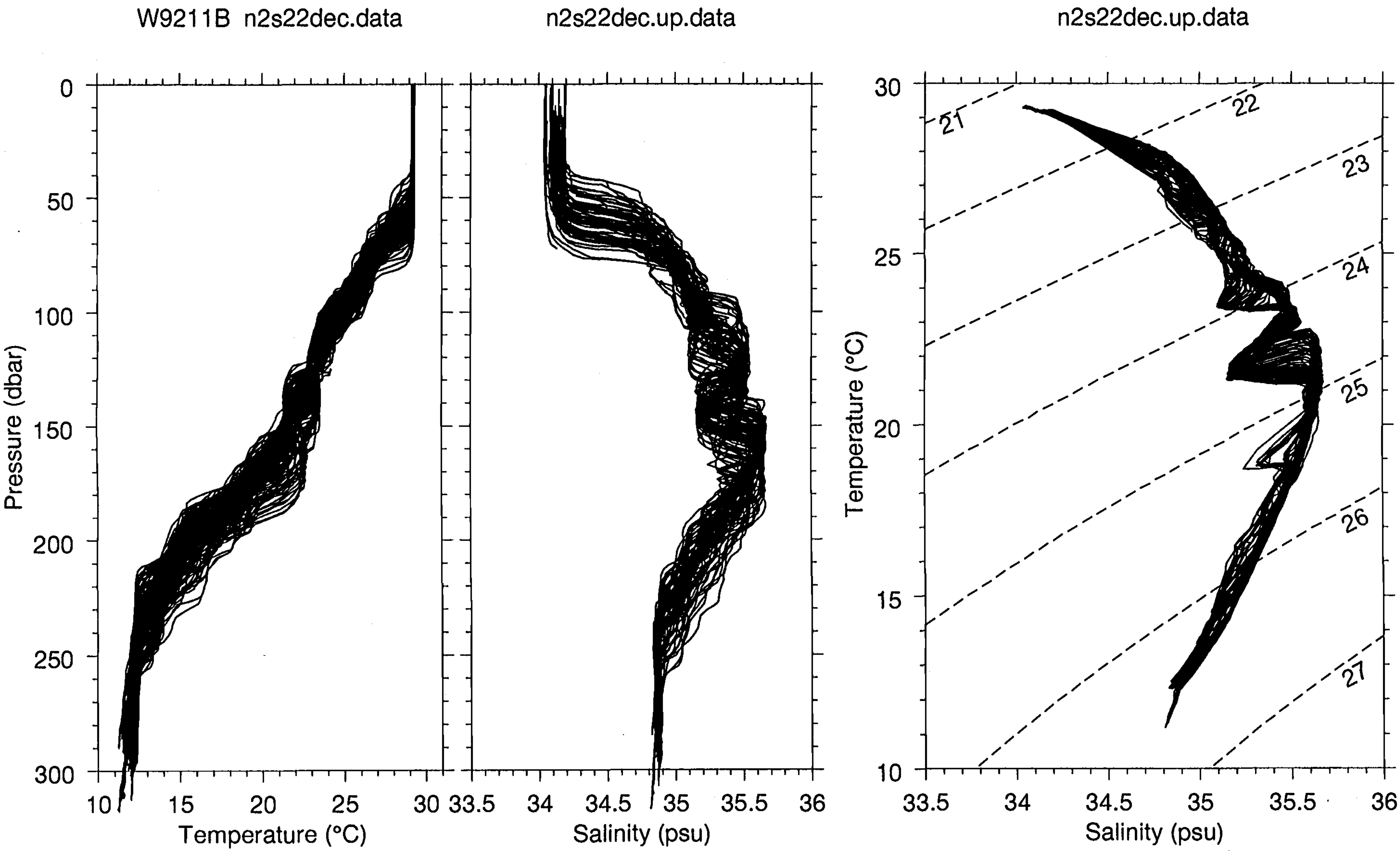
ENSEMBLE PROFILES

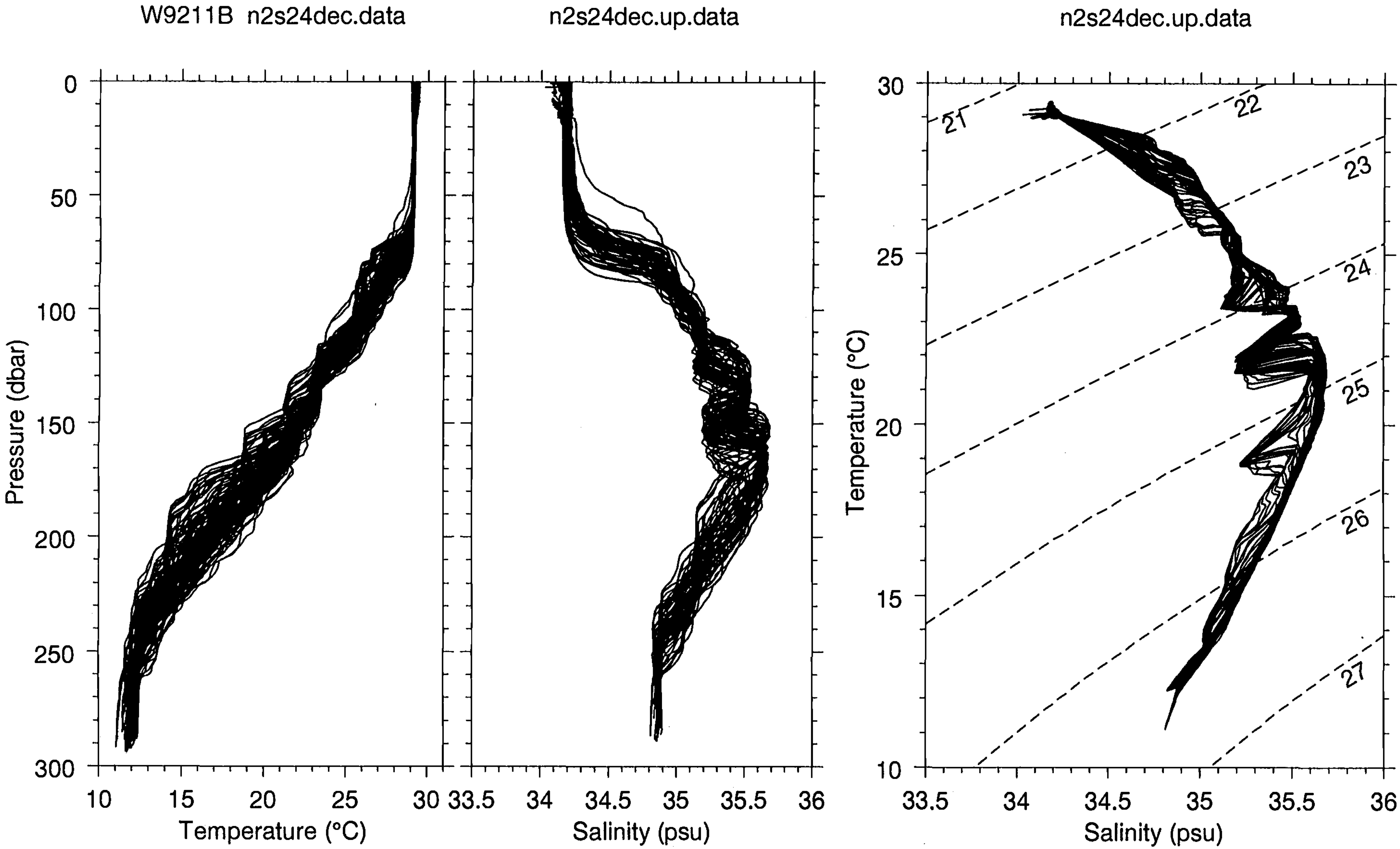
OF

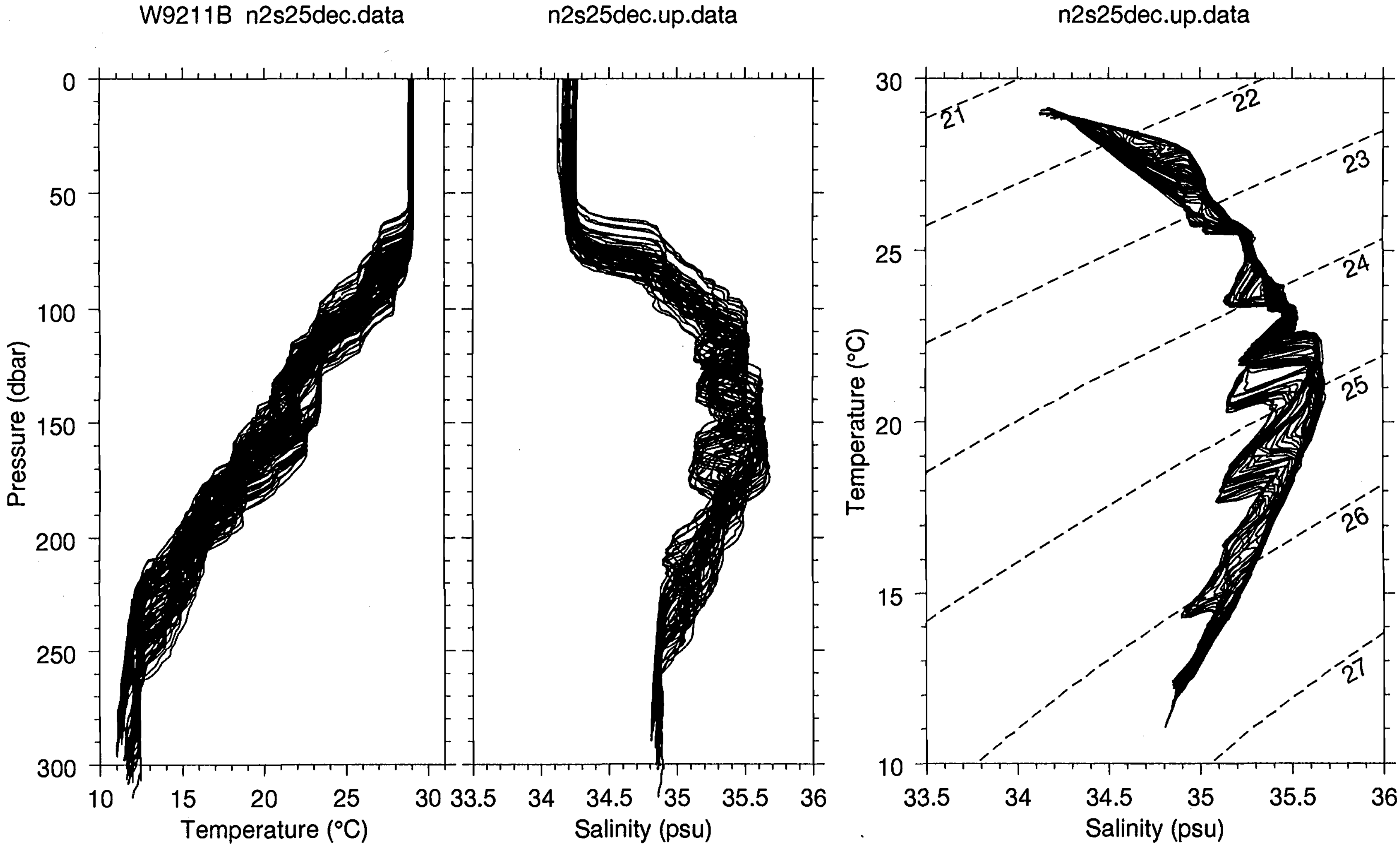
SEASOAR TEMPERATURE AND SALINITY


W9211B n2s19dec.data
n2s19dec.up.data
n2s19dec.up.data
Pressure (dbar)
Temperature (°C)
Salinity (psu)
Temperature (°C)
Salinity (psu)
21
22
23
24
25
26
27

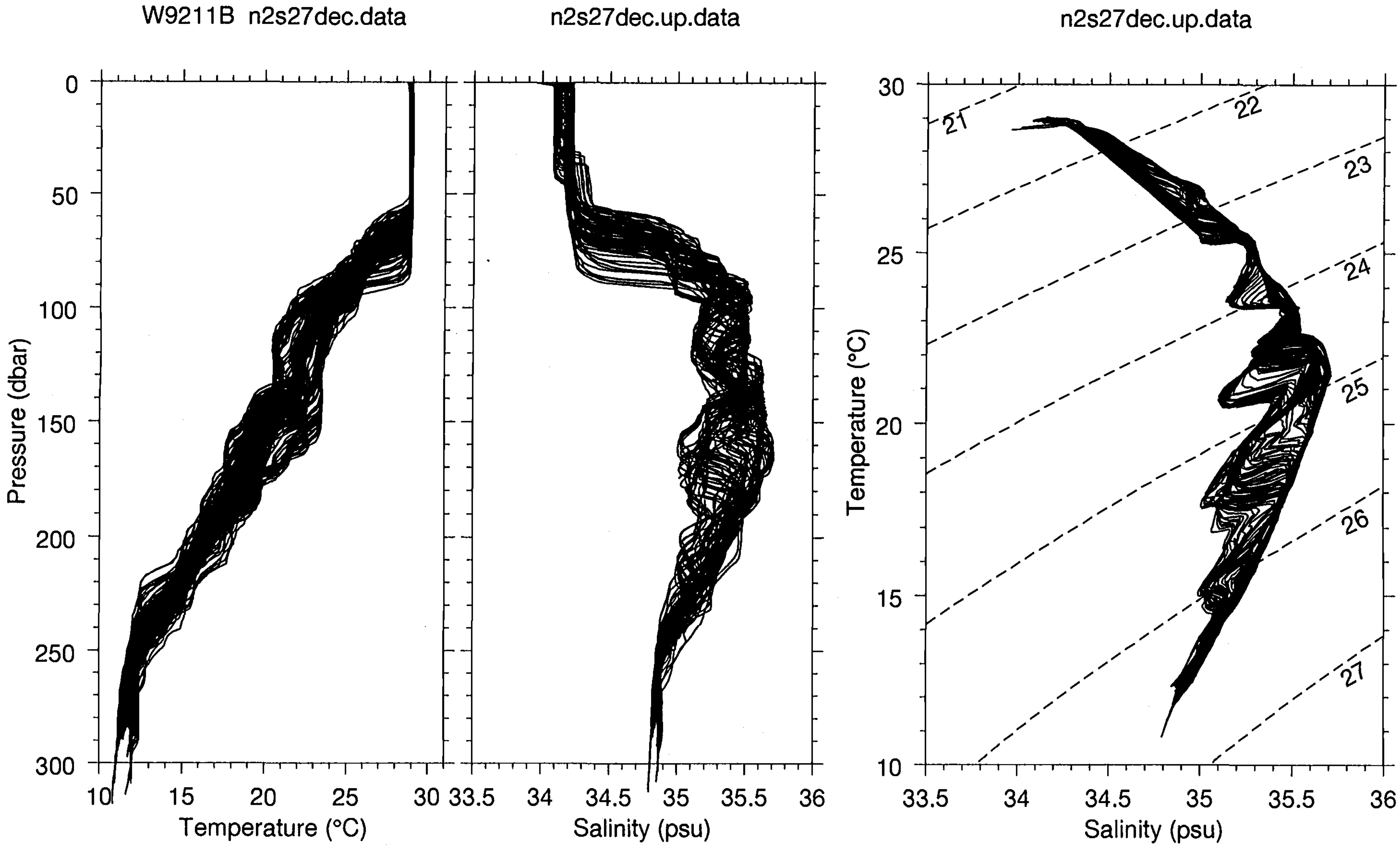

W9211B n2s20dec.data
n2s20dec.up.data
n2s20dec.up.data
Pressure (dbar)
Temperature (°C)
Salinity (psu)
Temperature (°C)
Salinity (psu)
21
22
23
24
25
26
27

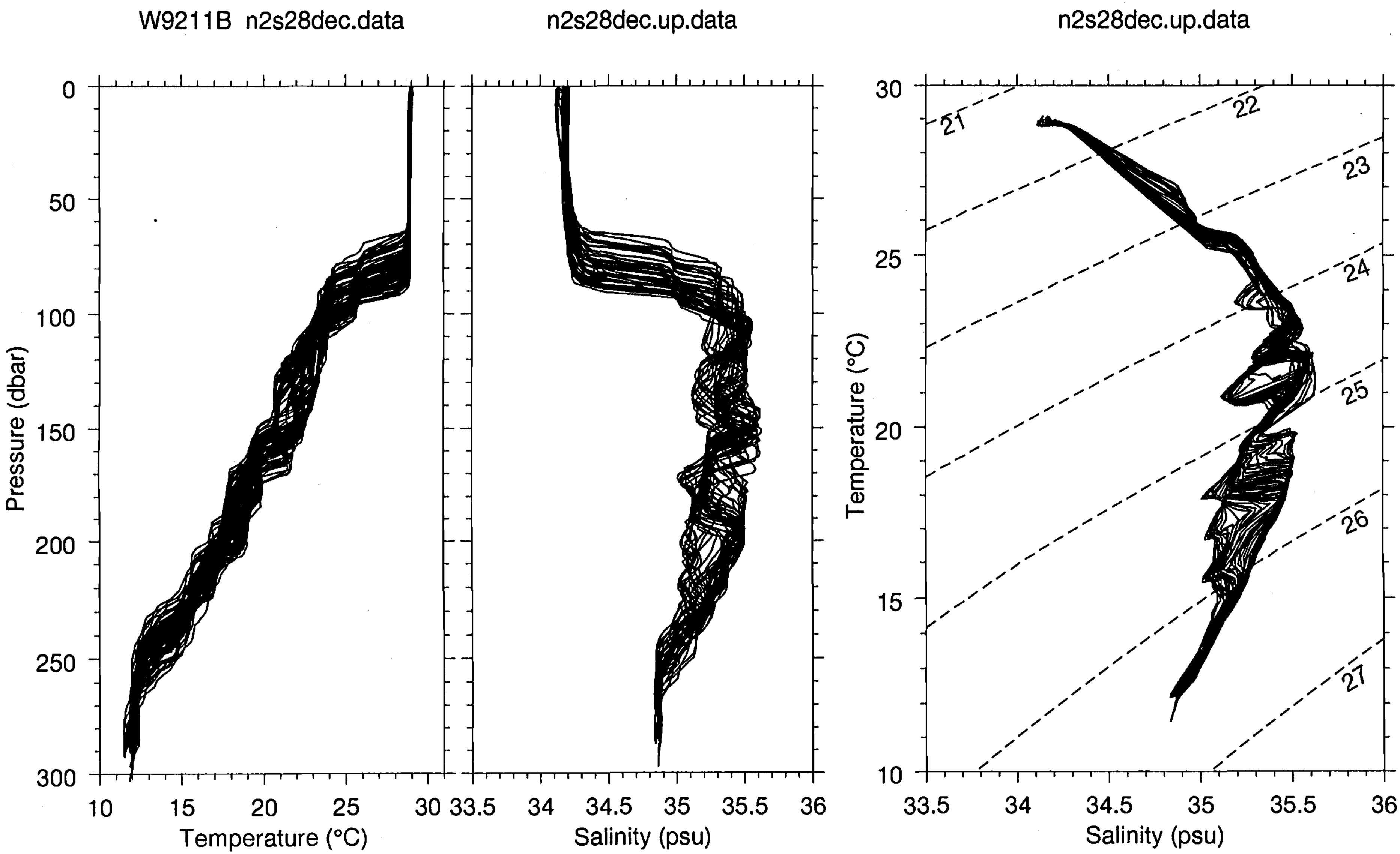

W9211B n2s22dec.data
n2s22dec.up.data
n2s22dec.up.data
Pressure (dbar)
Temperature (°C)
Salinity (psu)
Temperature (°C)
Salinity (psu)
0
50
100
150
200
250
300
10
15
20
25
30
33.5
34
34.5
35
35.5
36
21
22
23
24
25
26
27


W9211B n2s24dec.data
n2s24dec.up.data
n2s24dec.up.data
Pressure (dbar)
0
50
100
150
200
250
300
10
15
20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
Temperature (°C)
30
25
20
15
10
21
22
23
24
25
26
27
33.5
34
34.5
35
35.5
36
Salinity (psu)

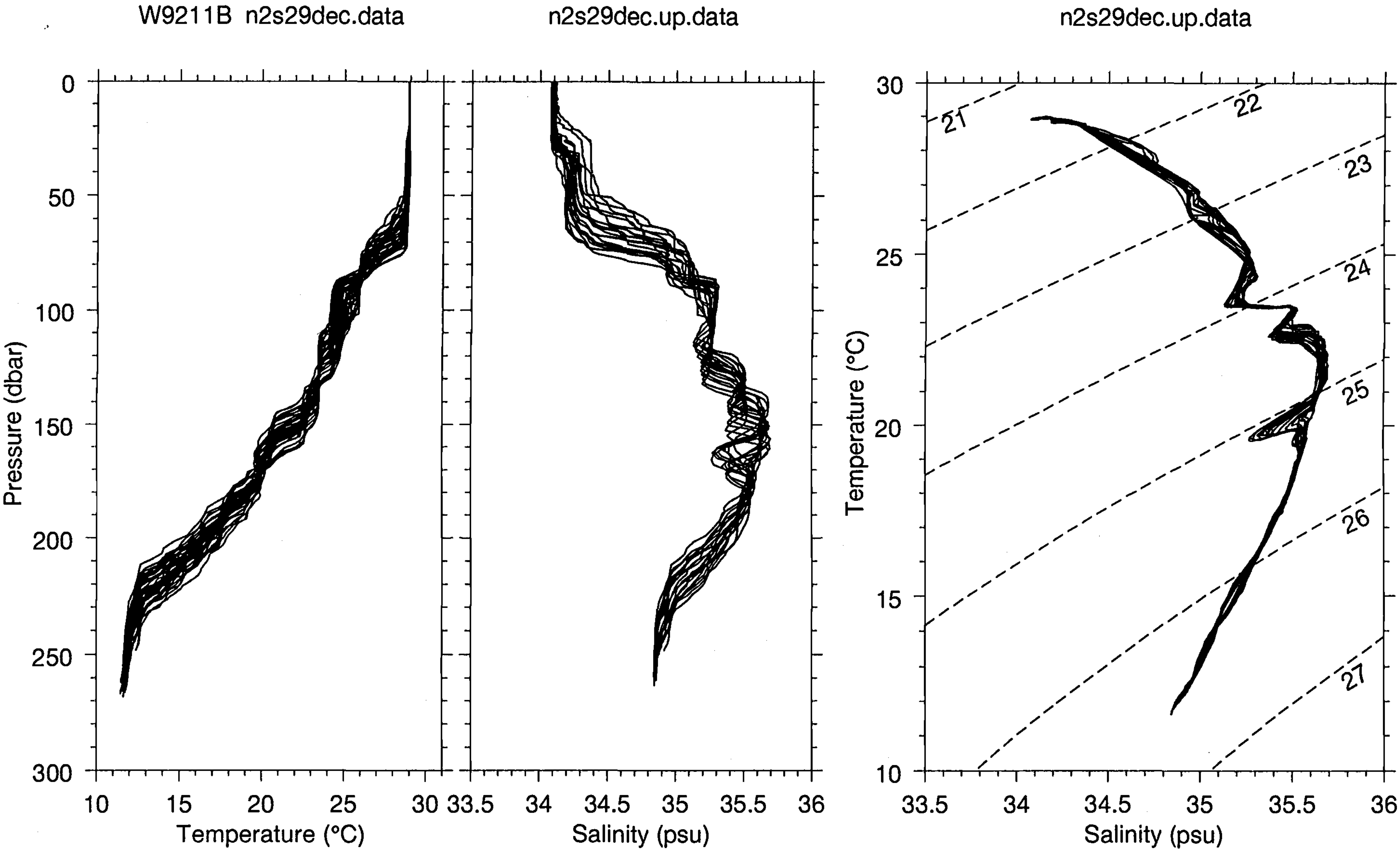


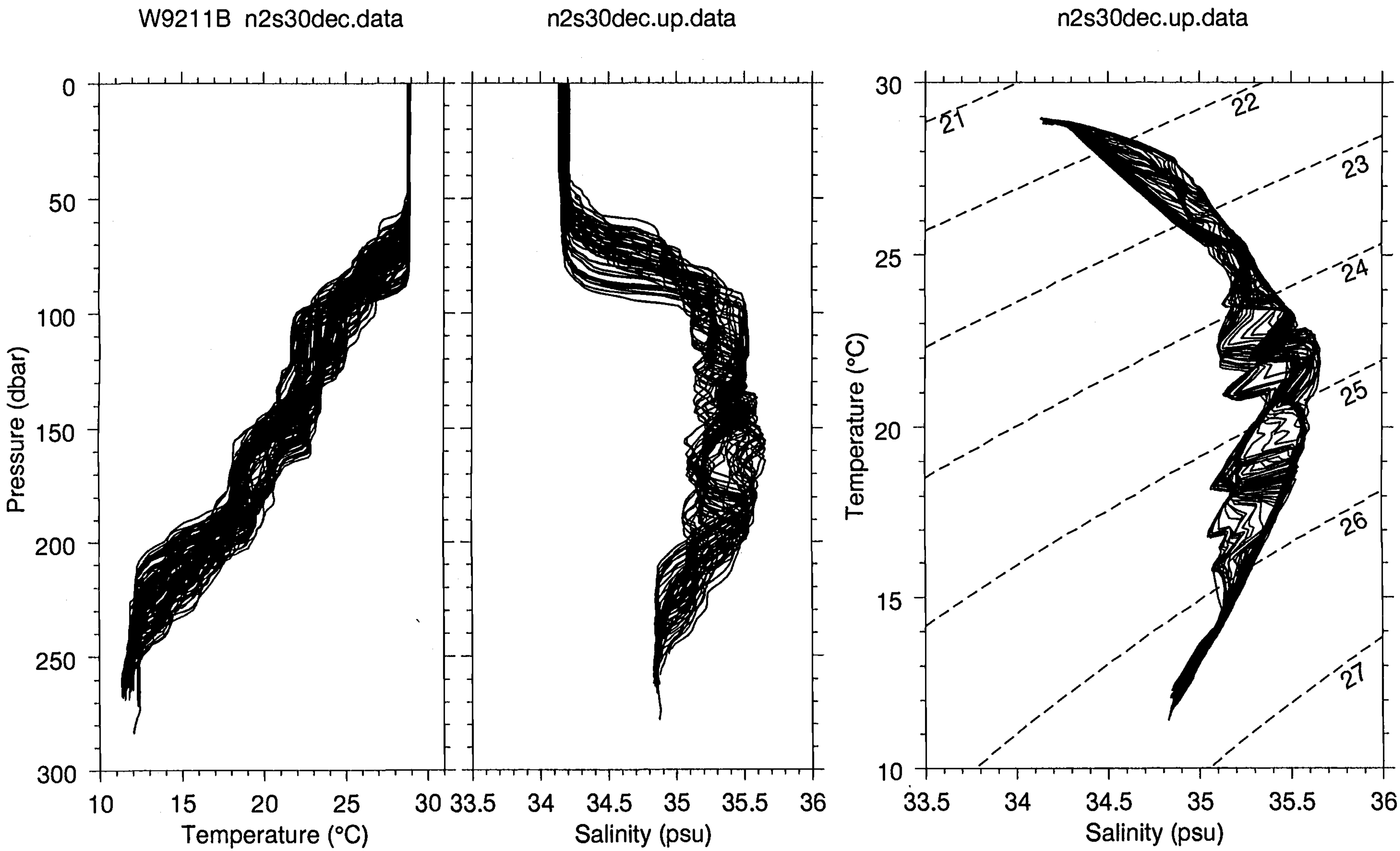
W9211B n2s25dec.data
n2s25dec.up.data
n2s25dec.up.data
Pressure (dbar)
0
50
100
150
200
250
300
10
15
20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
Temperature (°C)
30
25
20
15
10
33.5
34
34.5
35
35.5
36
Salinity (psu)
21
22
23
24
25
26
27

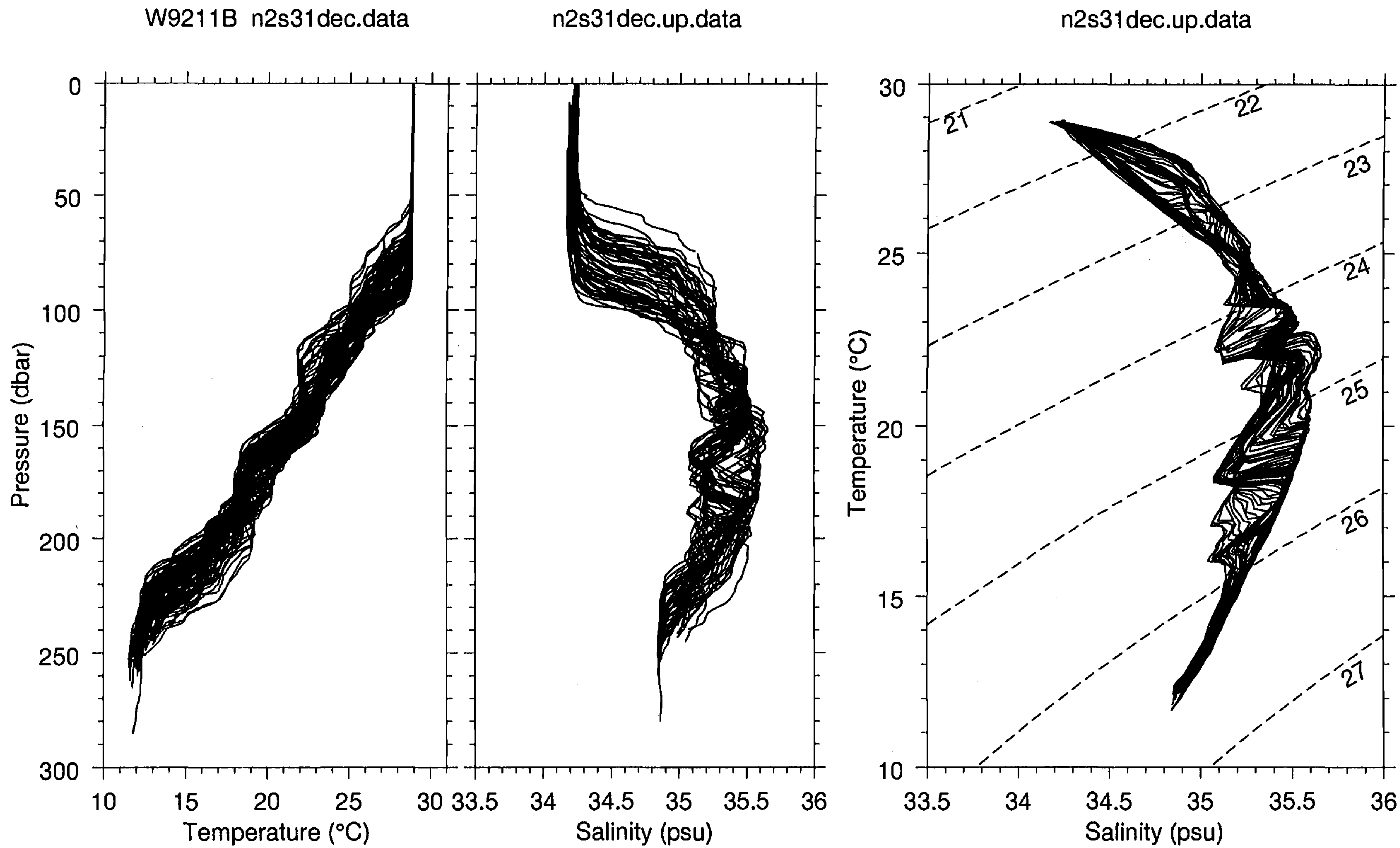

W9211B n2s27dec.data
n2s27dec.up.data
n2s27dec.up.data
Pressure (dbar)
Temperature (°C)
Salinity (psu)
Temperature (°C)
Salinity (psu)
21
22
23
24
25
26
27

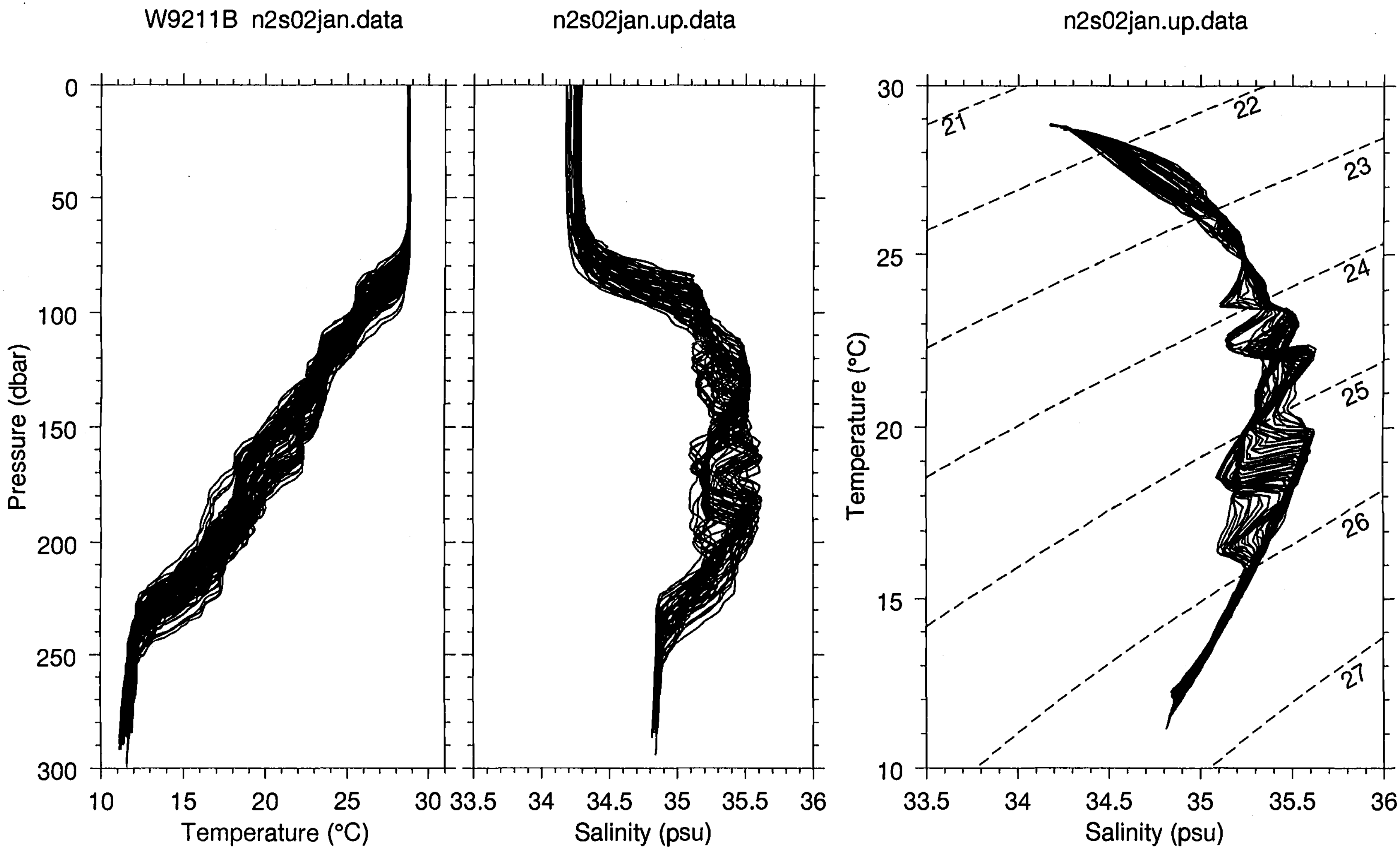


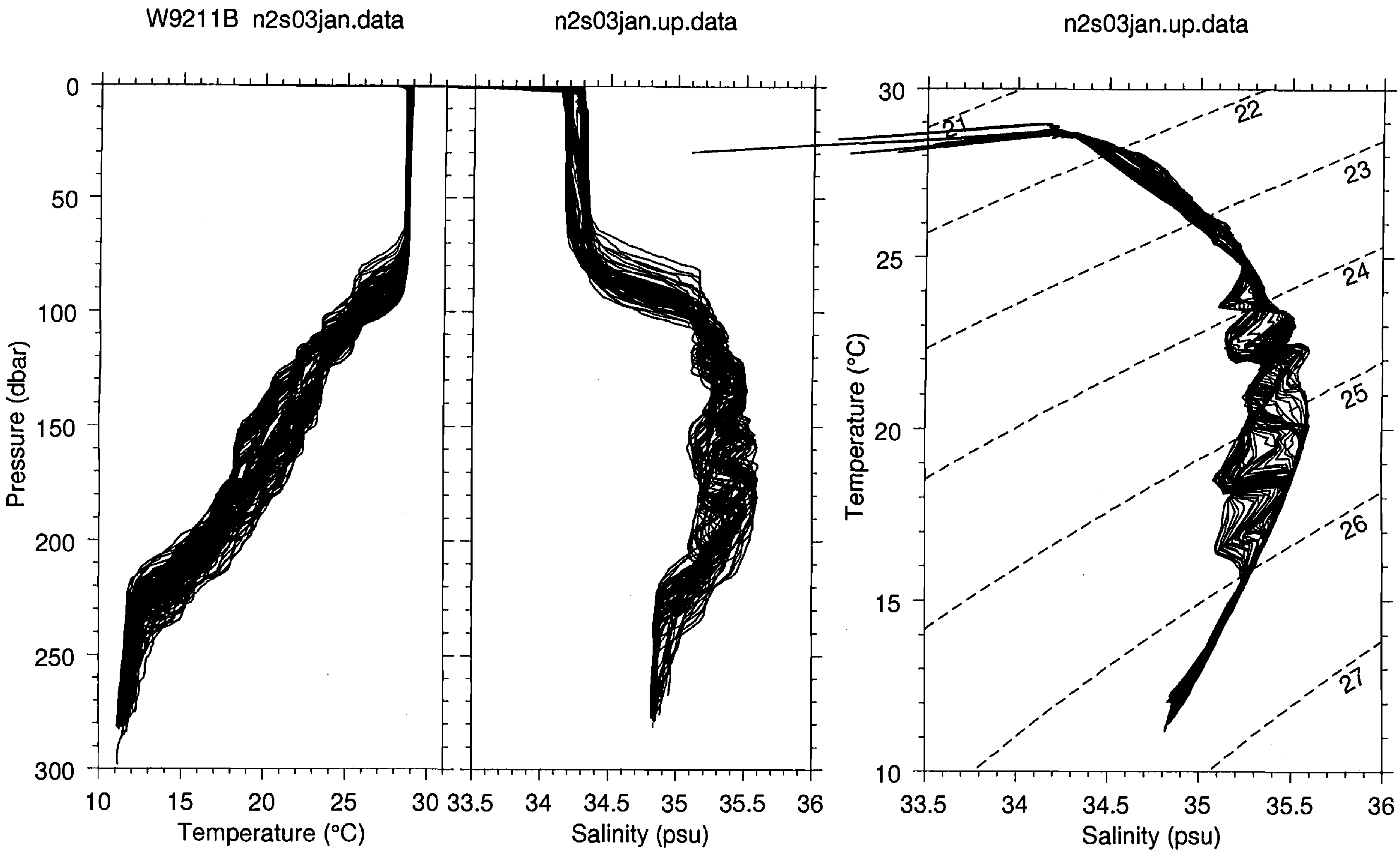
W9211B n2s28dec.data
n2s28dec.up.data
n2s28dec.up.data
Pressure (dbar)
0
50
100
150
200
250
300
10
15
20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
Temperature (°C)
30
25
20
15
10
21
22
23
24
25
26
27
33.5
34
34.5
35
35.5
36
Salinity (psu)

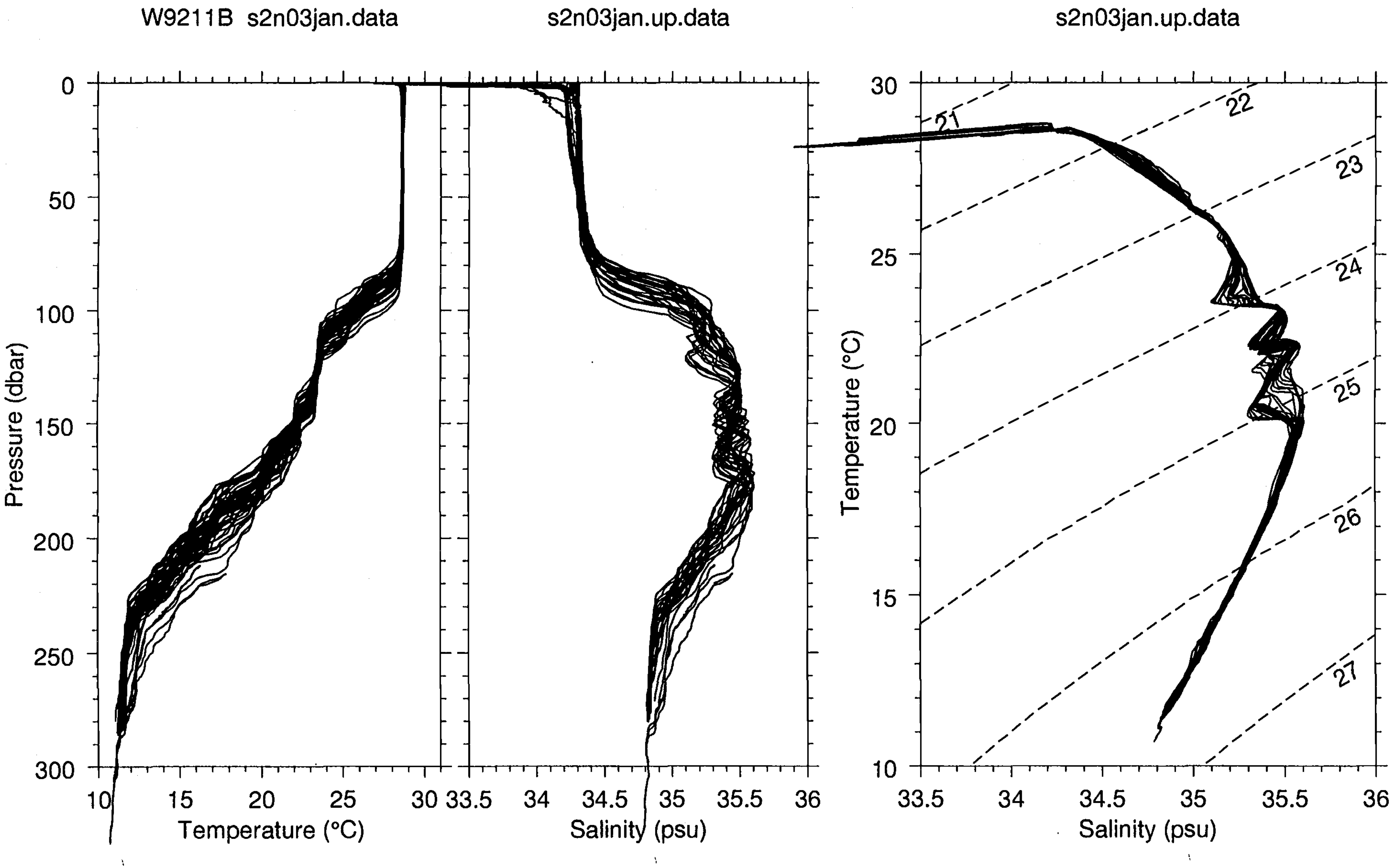

W9211B n2s29dec.data
n2s29dec.up.data
n2s29dec.up.data
Pressure (dbar)
0
50
100
150
200
250
300
10
15
20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
Temperature (°C)
30
25
20
15
10
33.5
34
34.5
35
35.5
36
Salinity (psu)
21
22
23
24
25
26
27


W9211B n2s30dec.data
n2s30dec.up.data
n2s30dec.up.data
Pressure (dbar)
0
50
100
150
200
250
300
10
15
20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
Temperature (°C)
30
25
20
15
10
33.5
34
34.5
35
35.5
36
Salinity (psu)
21
22
23
24
25
26
27


W9211B n2s31dec.data
n2s31dec.up.data
n2s31dec.up.data
Pressure (dbar)
0
50
100
150
200
250
300
10
15
20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
30
25
20
15
10
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
21
22
23
24
25
26
27


W9211B n2s02jan.data
n2s02jan.up.data
n2s02jan.up.data
Pressure (dbar)
0
50
100
150
200
250
300
10
15
20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
30
25
20
15
10
Temperature (°C)
21
22
23
24
25
26
27
33.5
34
34.5
35
35.5
36
Salinity (psu)


W9211B n2s03jan.data
n2s03jan.up.data
n2s03jan.up.data
Pressure (dbar)
0
50
100
150
200
250
300
10
15
20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
Temperature (°C)
30
25
20
15
10
33.5
34
34.5
35
35.5
36
Salinity (psu)
21
22
23
24
25
26
27


W9211B s2n03jan.data
s2n03jan.up.data
s2n03jan.up.data
Pressure (dbar)
Temperature (°C)
Salinity (psu)
Temperature (°C)
Salinity (psu)
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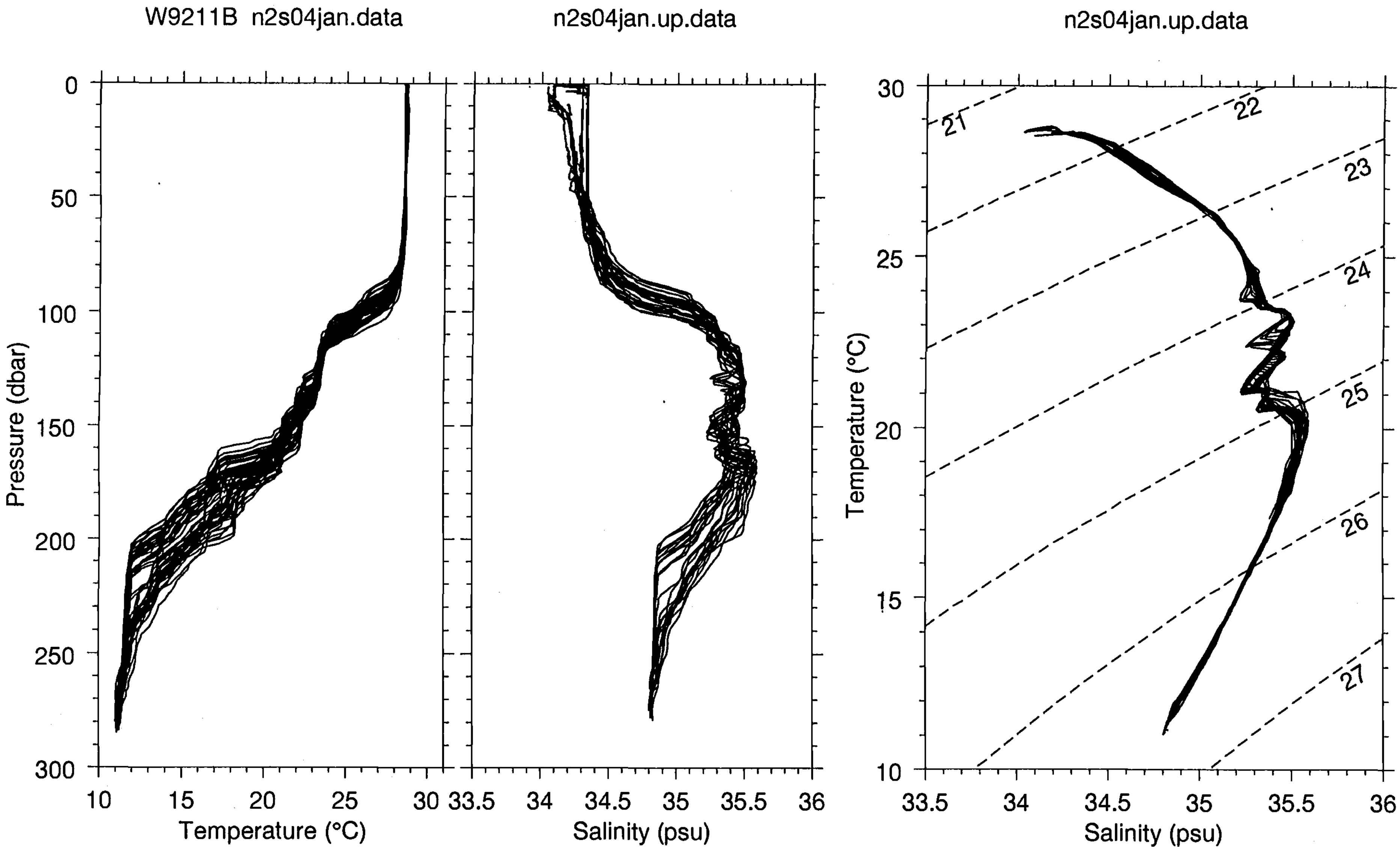
22
23
24
25
26
27


W9211B n2s04jan.data
n2s04jan.up.data
n2s04jan.up.data
Pressure (dbar)
0
50
100
150
200
250
300
10
15
20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
Temperature (°C)
30
25
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34.5
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35.5
36
Salinity (psu)
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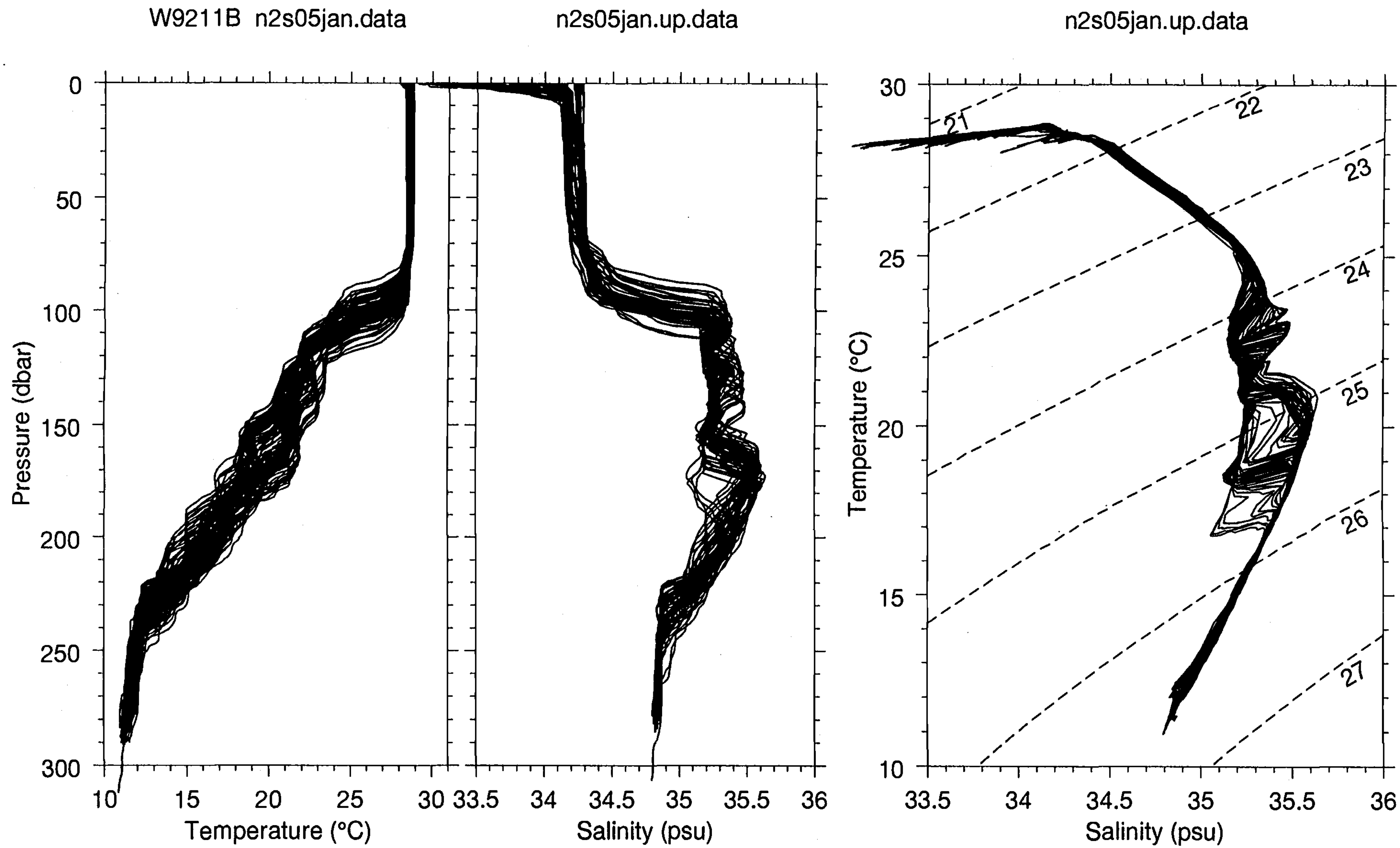
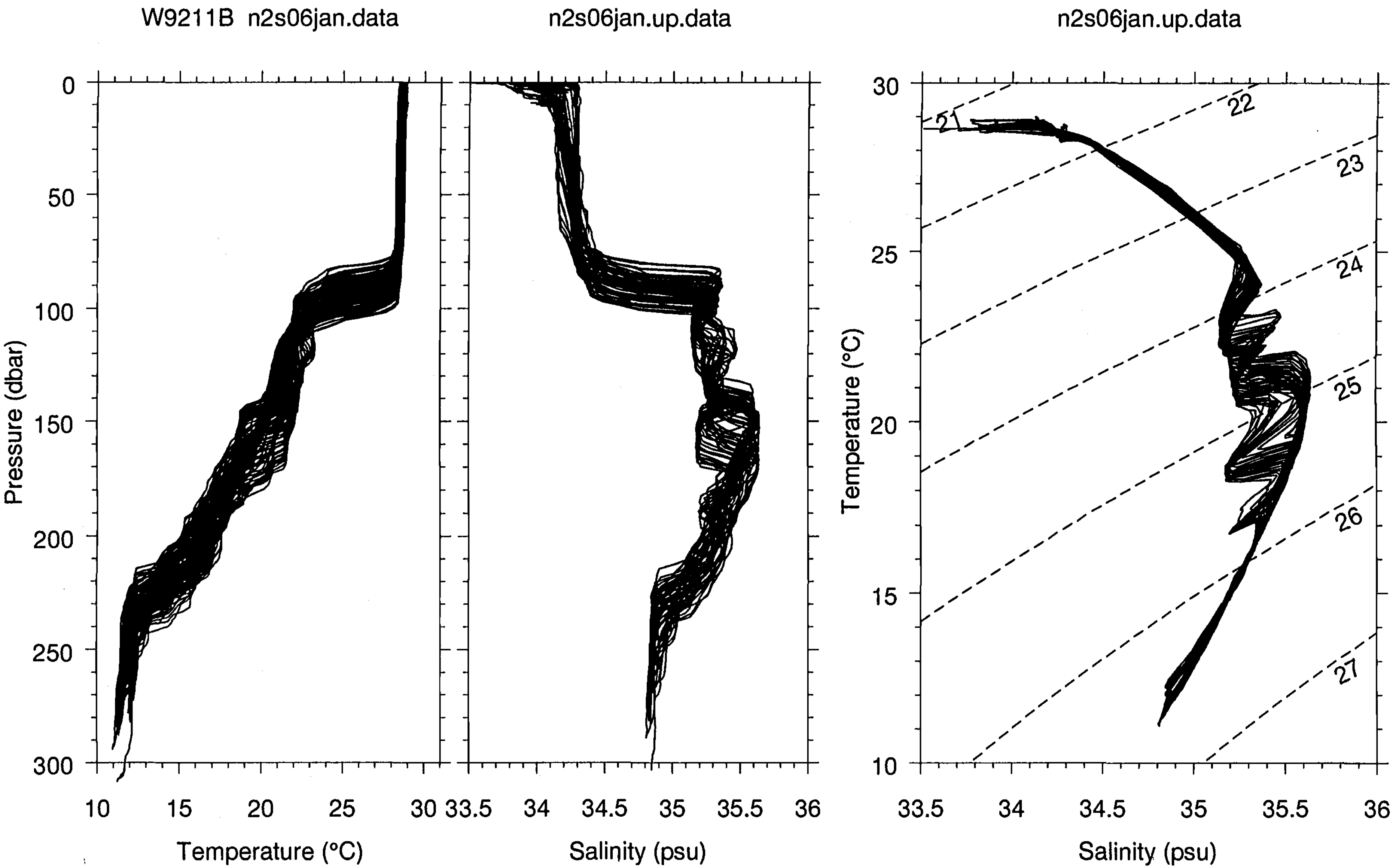
22
23
24
25
26
27


W9211B n2s05jan.data
n2s05jan.up.data
n2s05jan.up.data
Pressure (dbar)
0
50
100
150
200
250
300
10
15
20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
Temperature (°C)
30
25
20
15
10
21
22
23
24
25
26
27
33.5
34
34.5
35
35.5
36
Salinity (psu)


W9211B n2s06jan.data
n2s06jan.up.data
n2s06jan.up.data
Pressure (dbar)
Temperature (°C)
Salinity (psu)
Temperature (°C)
Salinity (psu)
0
50
100
150
200
250
300
10
15
20
25
30
33.5
34
34.5
35
35.5
36
30
25
20
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23
24
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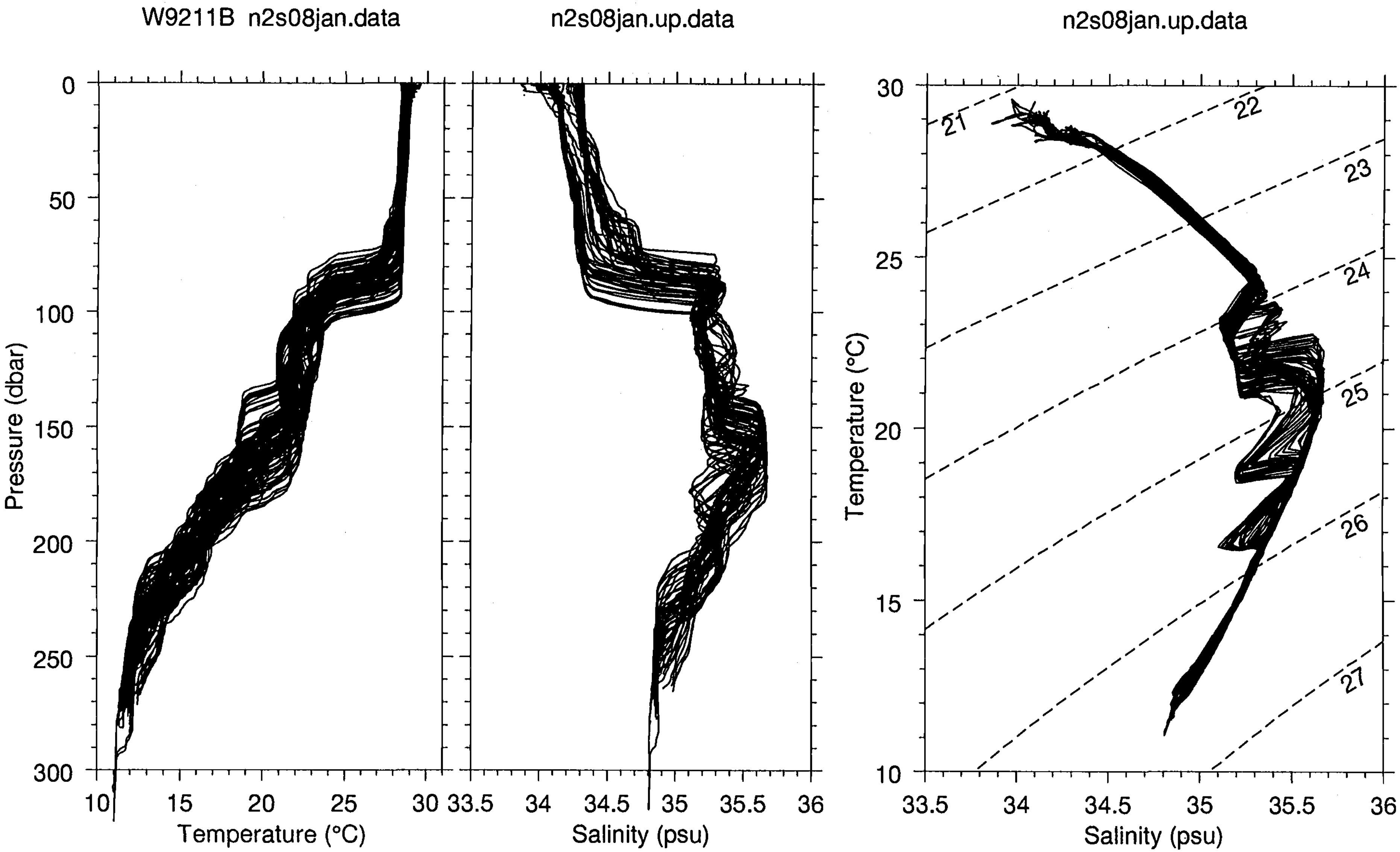
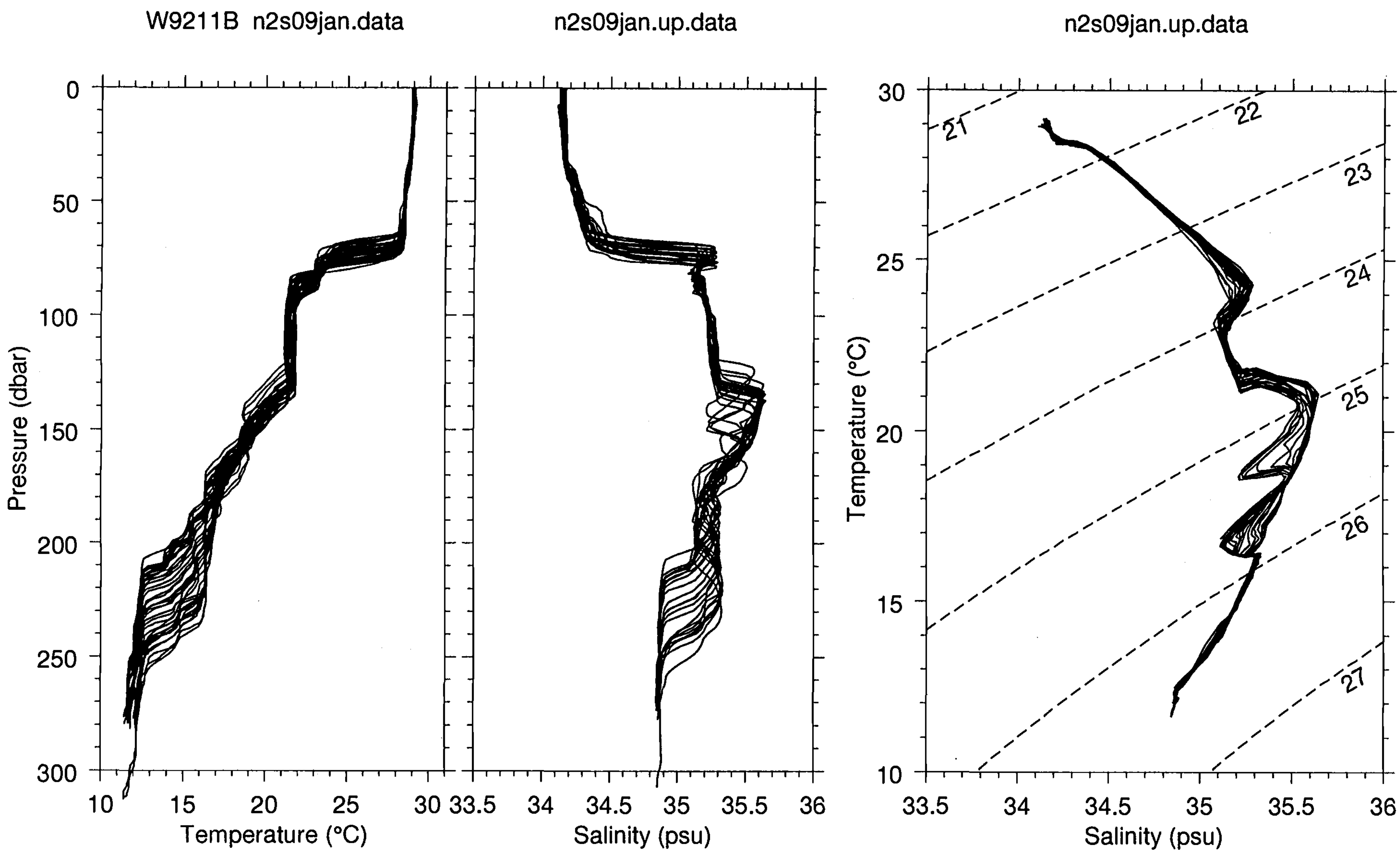
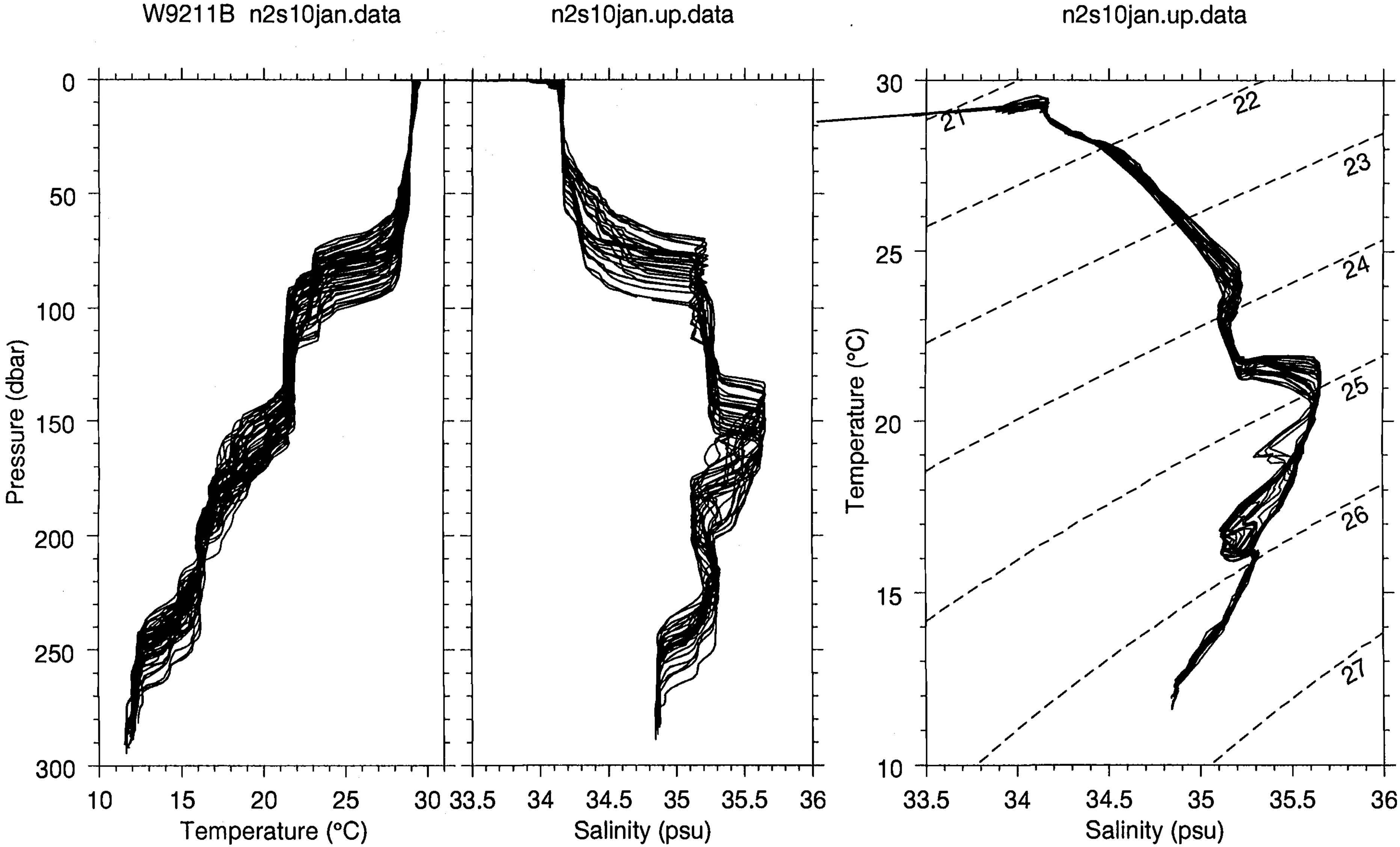
26
27


W9211B n2s08jan.data
n2s08jan.up.data
n2s08jan.up.data
Pressure (dbar)
Temperature (°C)
Salinity (psu)
Temperature (°C)
Salinity (psu)
21
22
23
24
25
26
27


W9211B n2s09jan.data
n2s09jan.up.data
n2s09jan.up.data
Pressure (dbar)
0
50
100
150
200
250
300
10
15
20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
Temperature (°C)
30
25
20
15
10
33.5
34
34.5
35
35.5
36
Salinity (psu)
21
22
23
24
25
26
27



W9211B n2s10jan.data
n2s10jan.up.data
n2s10jan.up.data
Pressure (dbar)
0
50
100
150
200
250
300
10
15
20
25
30
Temperature (°C)
33.5
34
34.5
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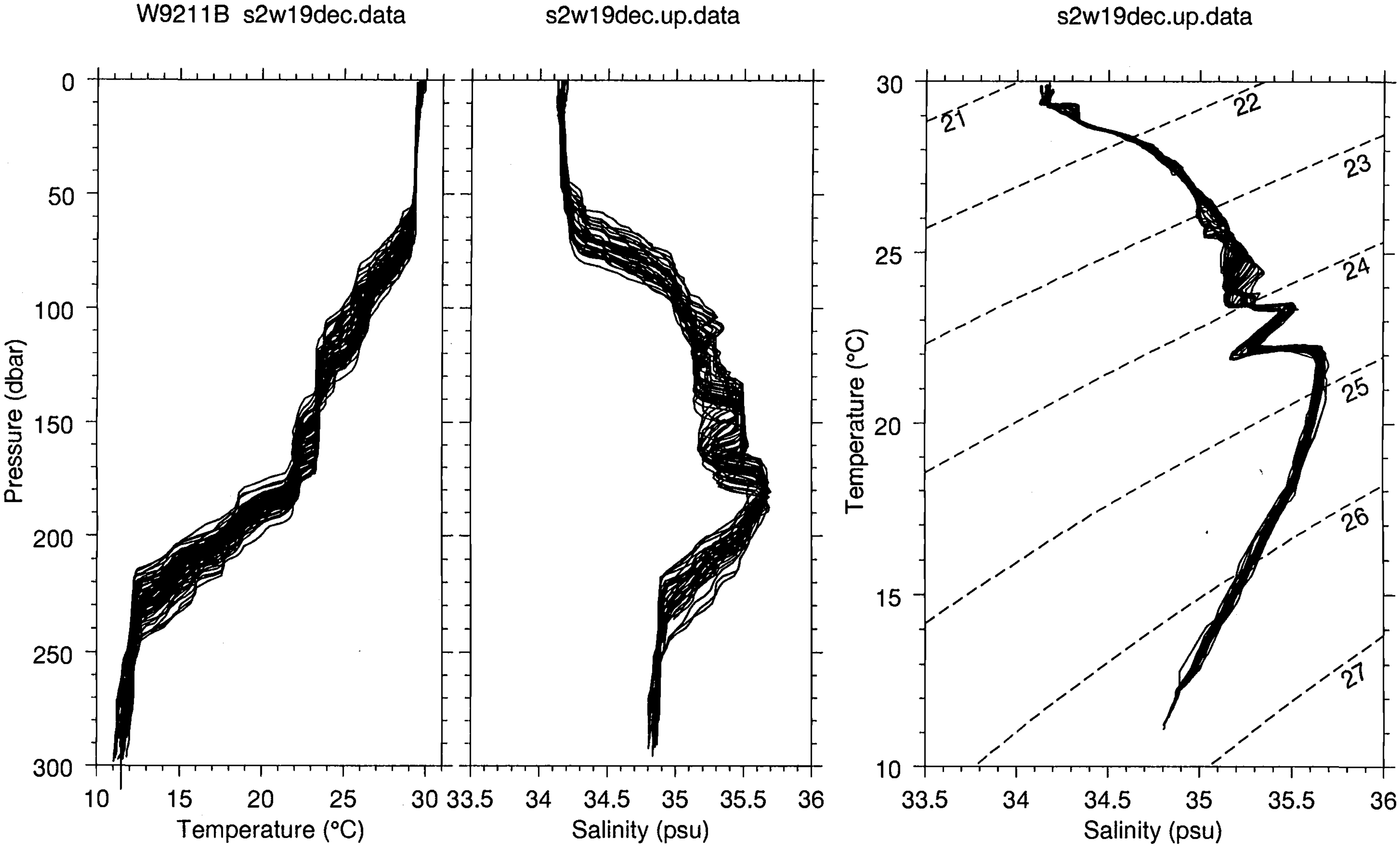
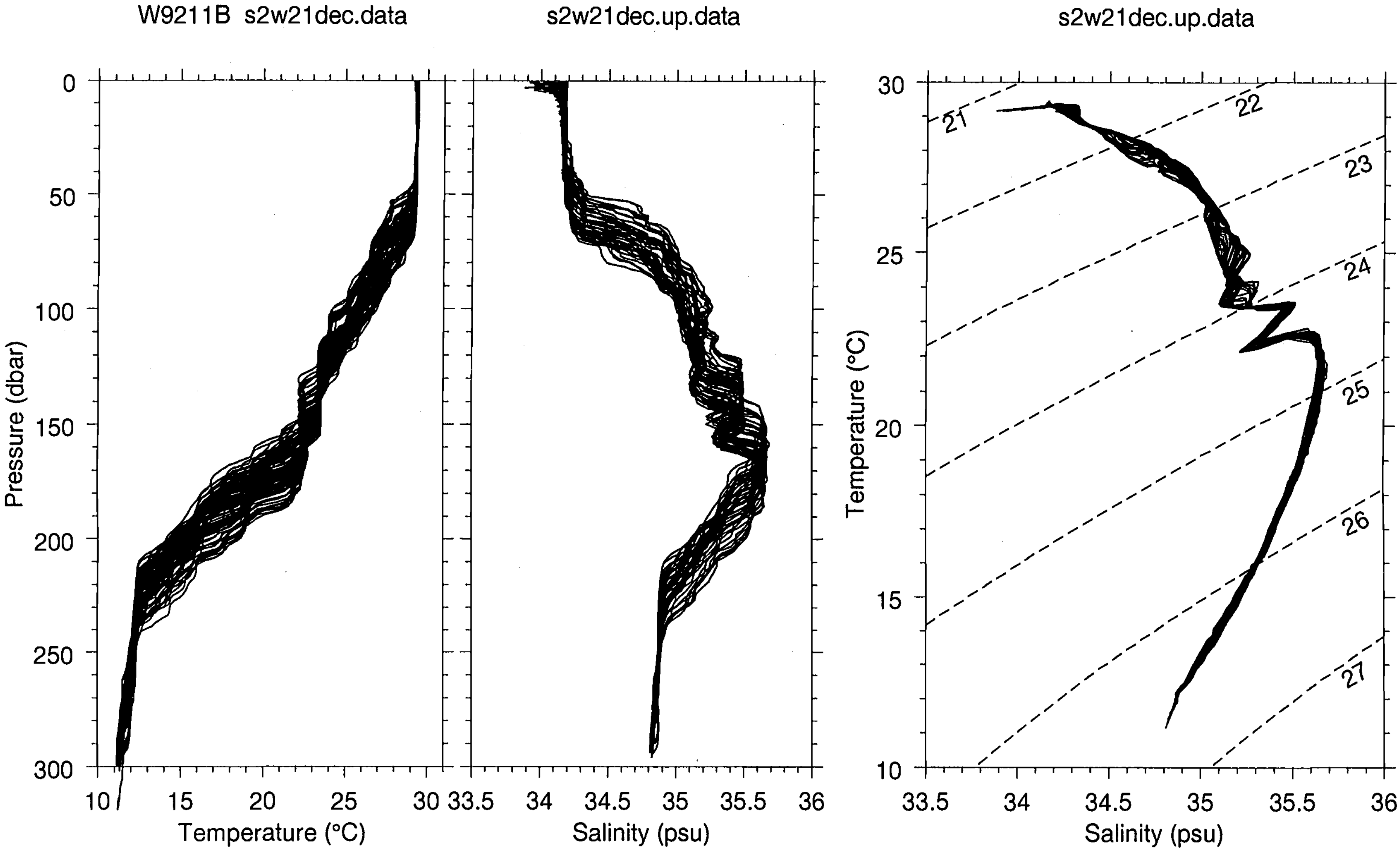
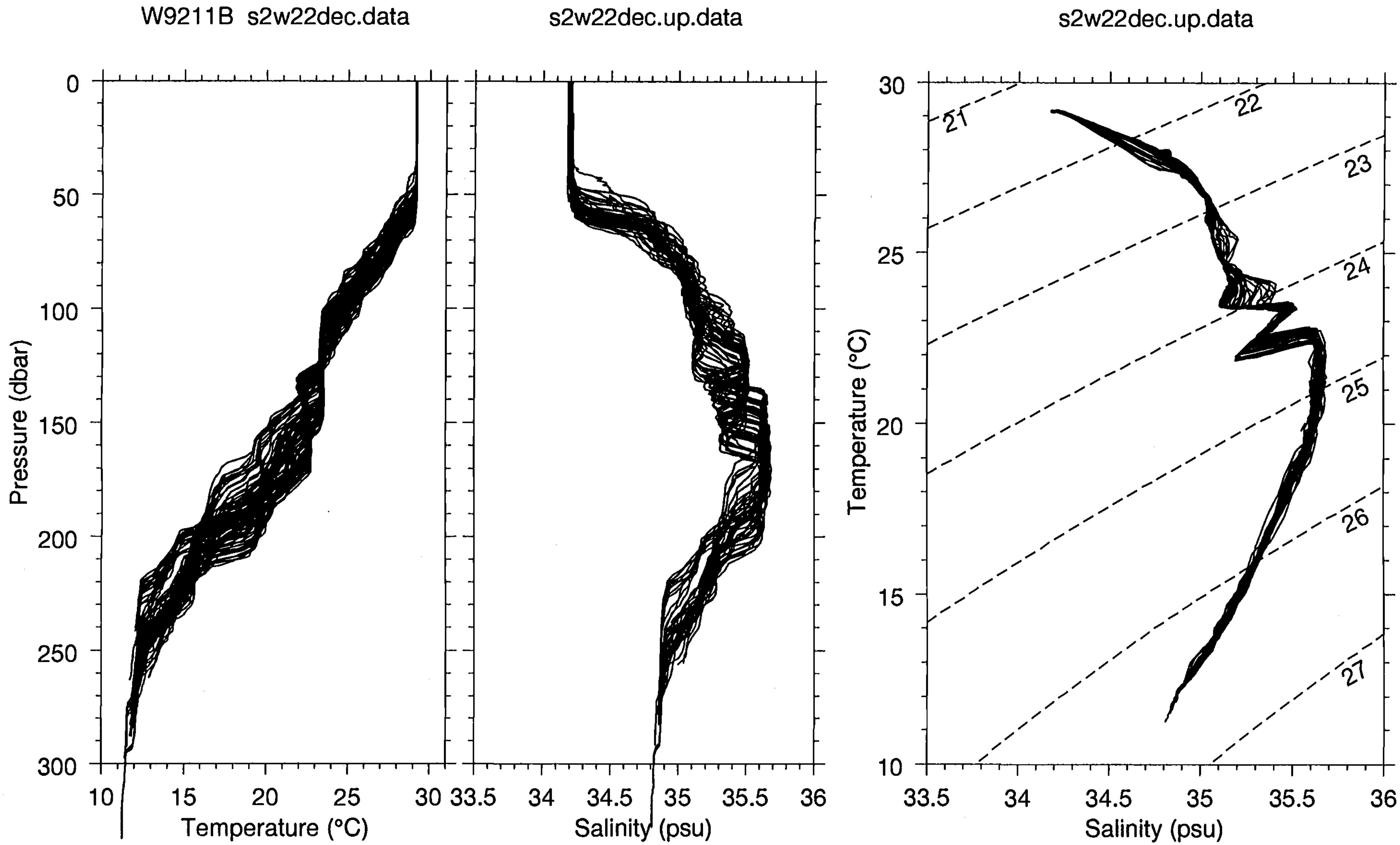
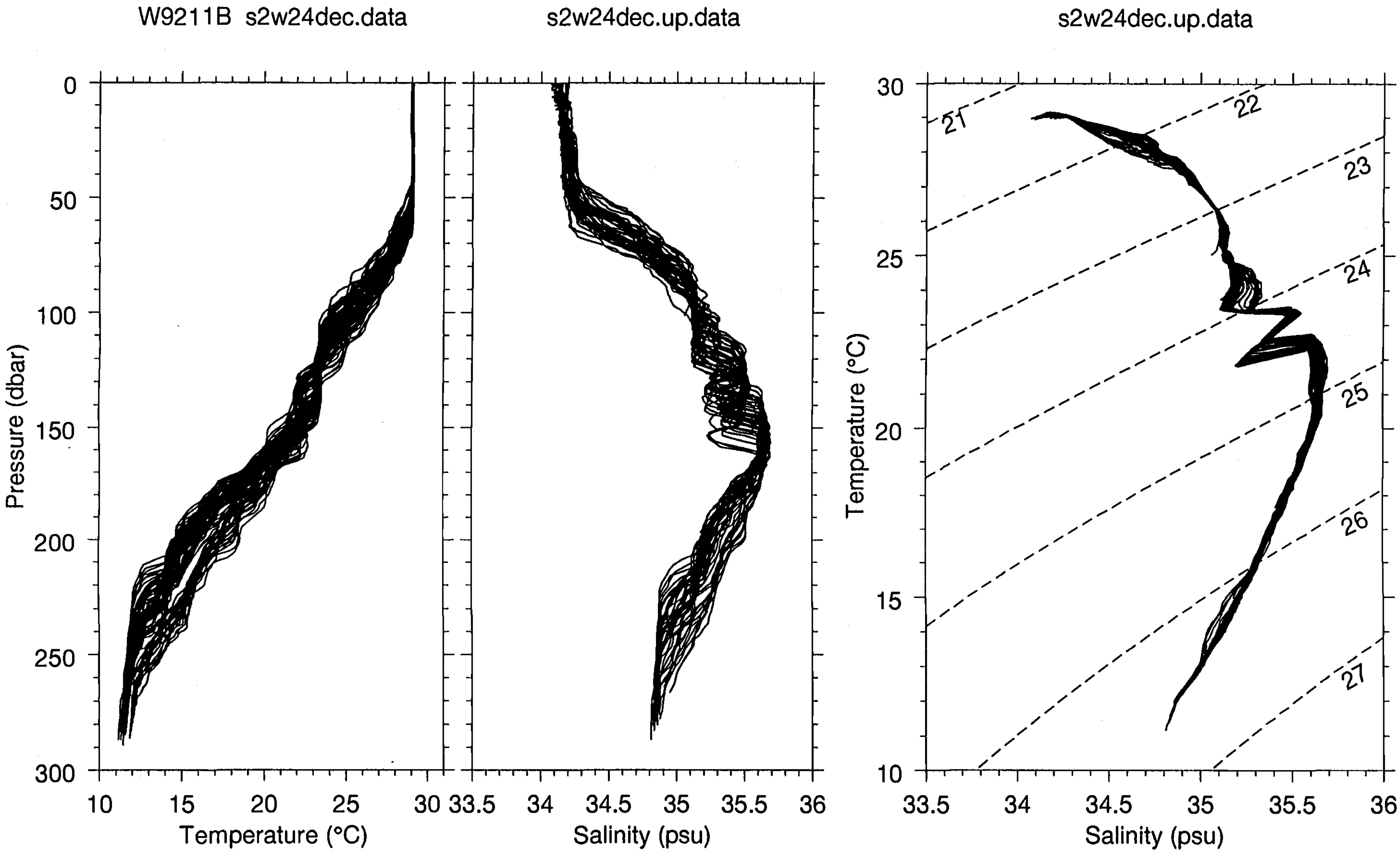
35.5
36
Salinity (psu)
Temperature (°C)
21
22
23
24
25
26
27


W9211B s2w19dec.data
s2w19dec.up.data
s2w19dec.up.data
Pressure (dbar)
0
50
100
150
200
250
300
10
15
20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
33.5
34
34.5
35
35.5
36
Salinity (psu)
30
25
20
15
10
Temperature (°C)
21
22
23
24
25
26
27



W9211B s2w21dec.data
s2w21dec.up.data
s2w21dec.up.data
Pressure (dbar)
0
50
100
150
200
250
300
10
15
20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
Temperature (°C)
30
25
20
15
10
21
22
23
24
25
26
27
33.5
34
34.5
35
35.5
36
Salinity (psu)


W9211B s2w22dec.data
s2w22dec.up.data
s2w22dec.up.data
Pressure (dbar)
0
50
100
150
200
250
300
10
15
20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
Temperature (°C)
30
25
20
15
10
33.5
34
34.5
35
35.5
36
Salinity (psu)
21
22
23
24
25
26
27


W9211B s2w24dec.data
s2w24dec.up.data
s2w24dec.up.data
Pressure (dbar)
0
50
100
150
200
250
300
10
15
20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
Temperature (°C)
10
15
20
25
30
33.5
34
34.5
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Salinity (psu)
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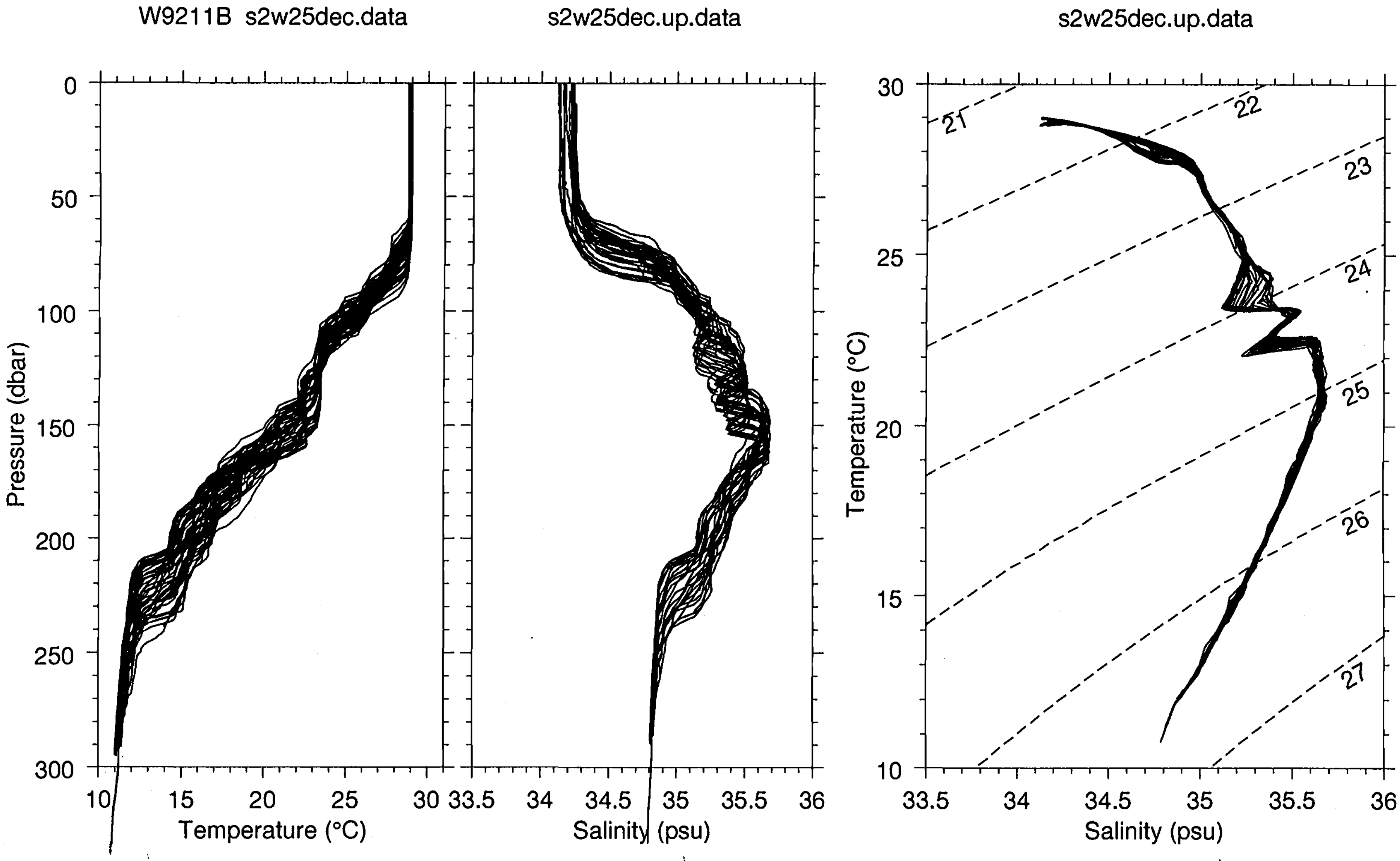
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s2w25dec.up.data
Pressure (dbar)
Temperature (°C)
Salinity (psu)
Temperature (°C)
Salinity (psu)
0
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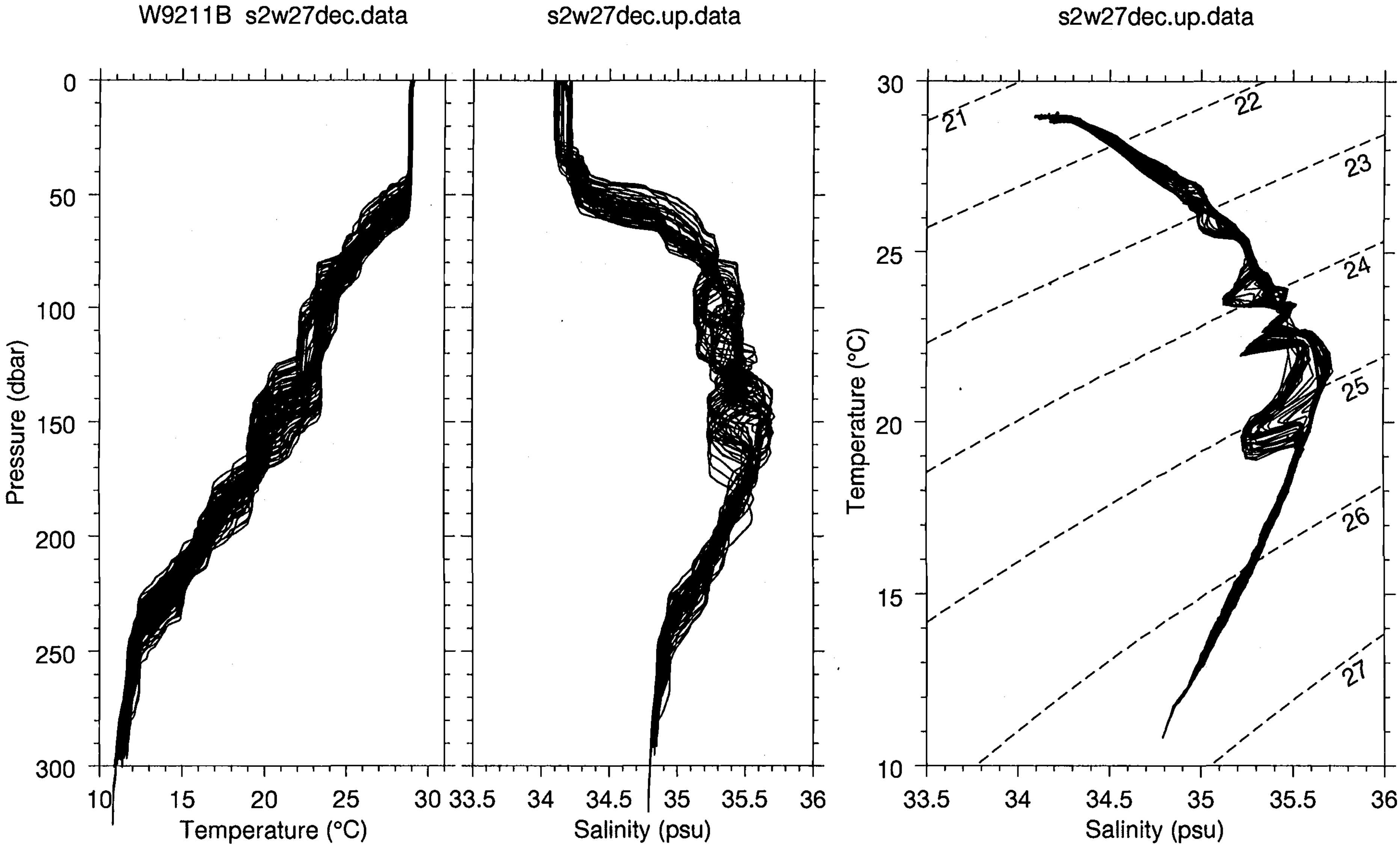
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Pressure (dbar)
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Temperature (°C)
33.5
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Salinity (psu)
Temperature (°C)
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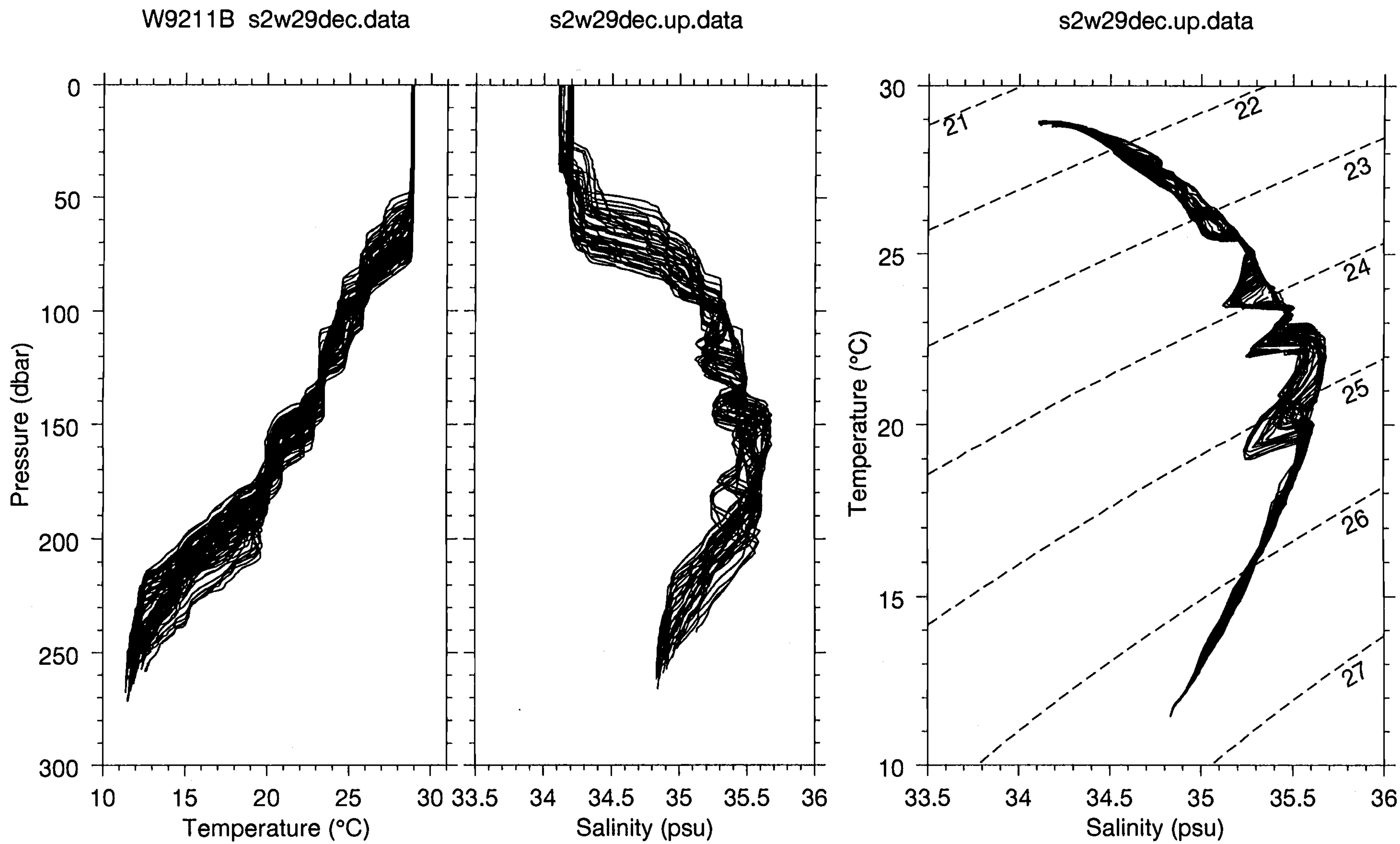
Salinity (psu)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Pressure (dbar)
Temperature (°C)
Salinity (psu)
Temperature (°C)
Salinity (psu)
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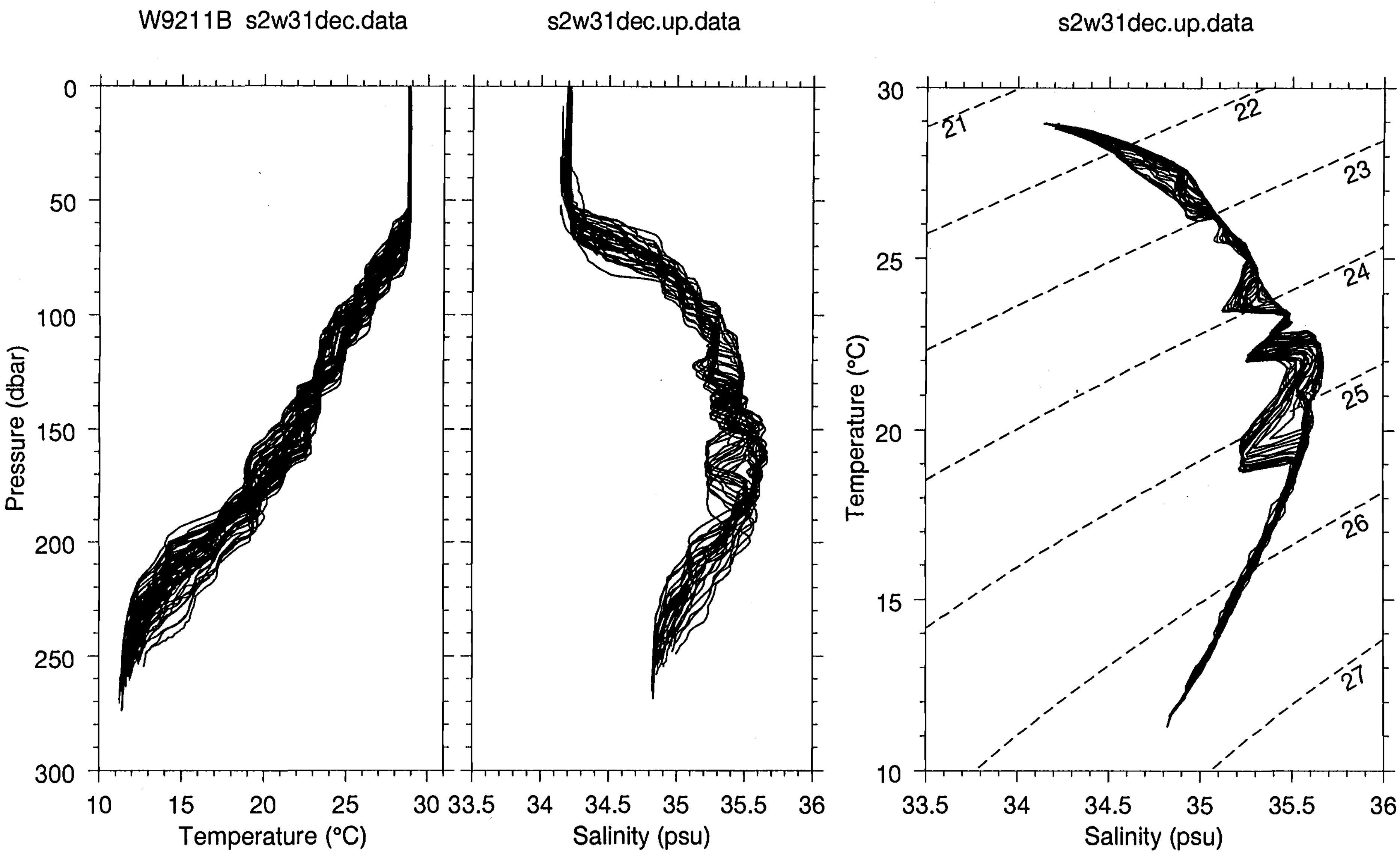
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Temperature (°C)
33.5
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34.5
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35.5
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Salinity (psu)
Temperature (°C)
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Salinity (psu)
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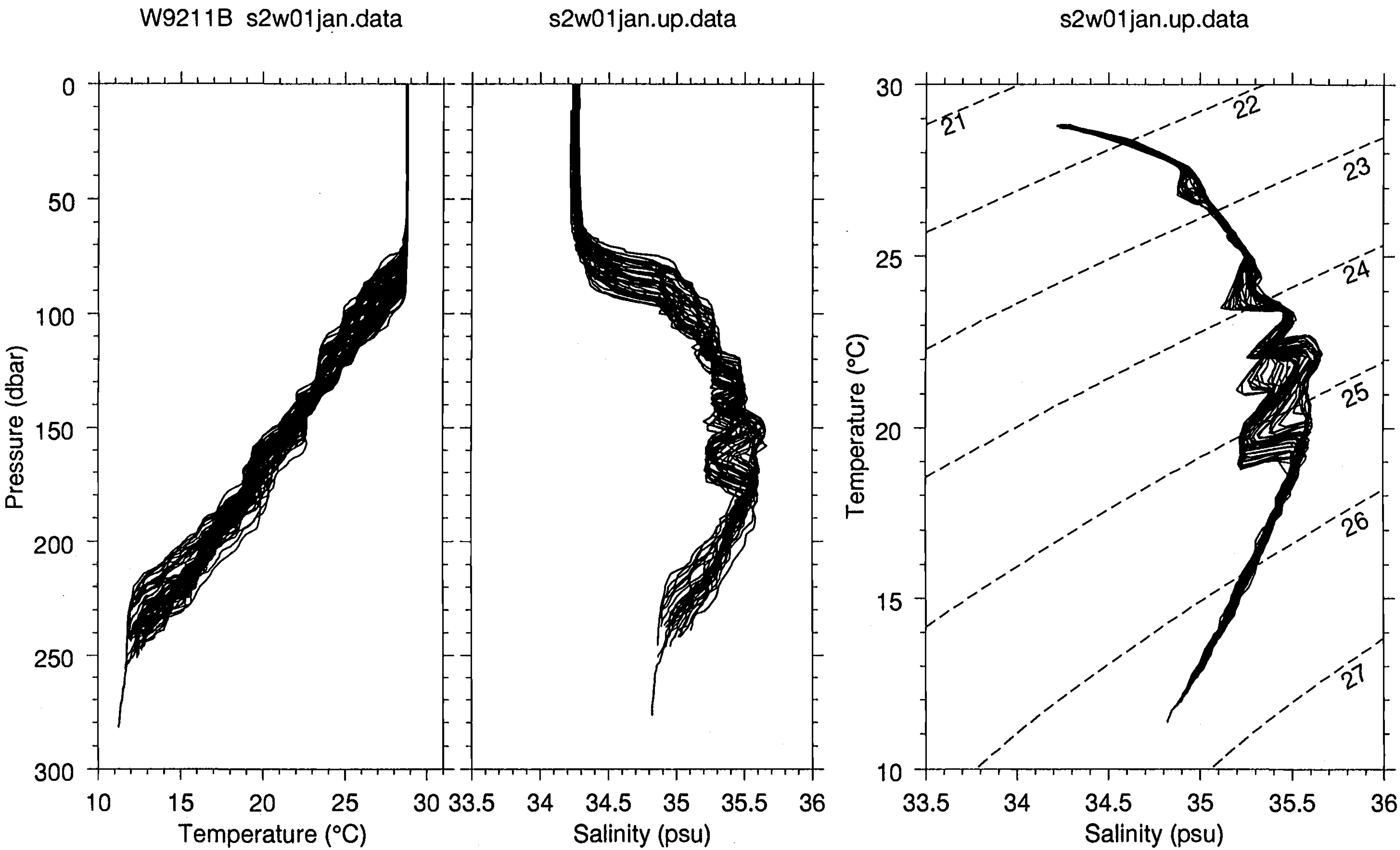
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Salinity (psu)
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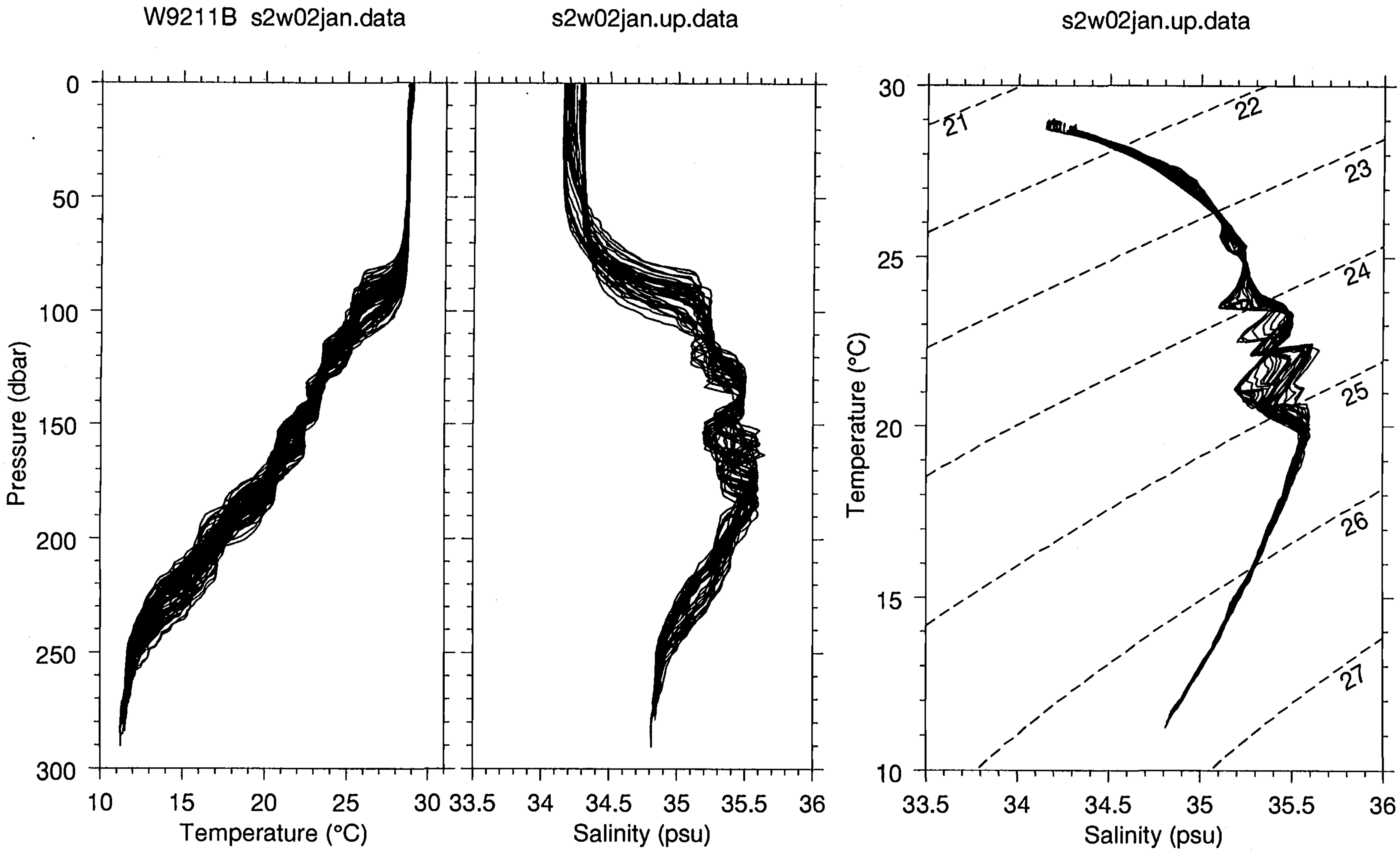
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Temperature (°C)
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Salinity (psu)
Temperature (°C)
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Salinity (psu)
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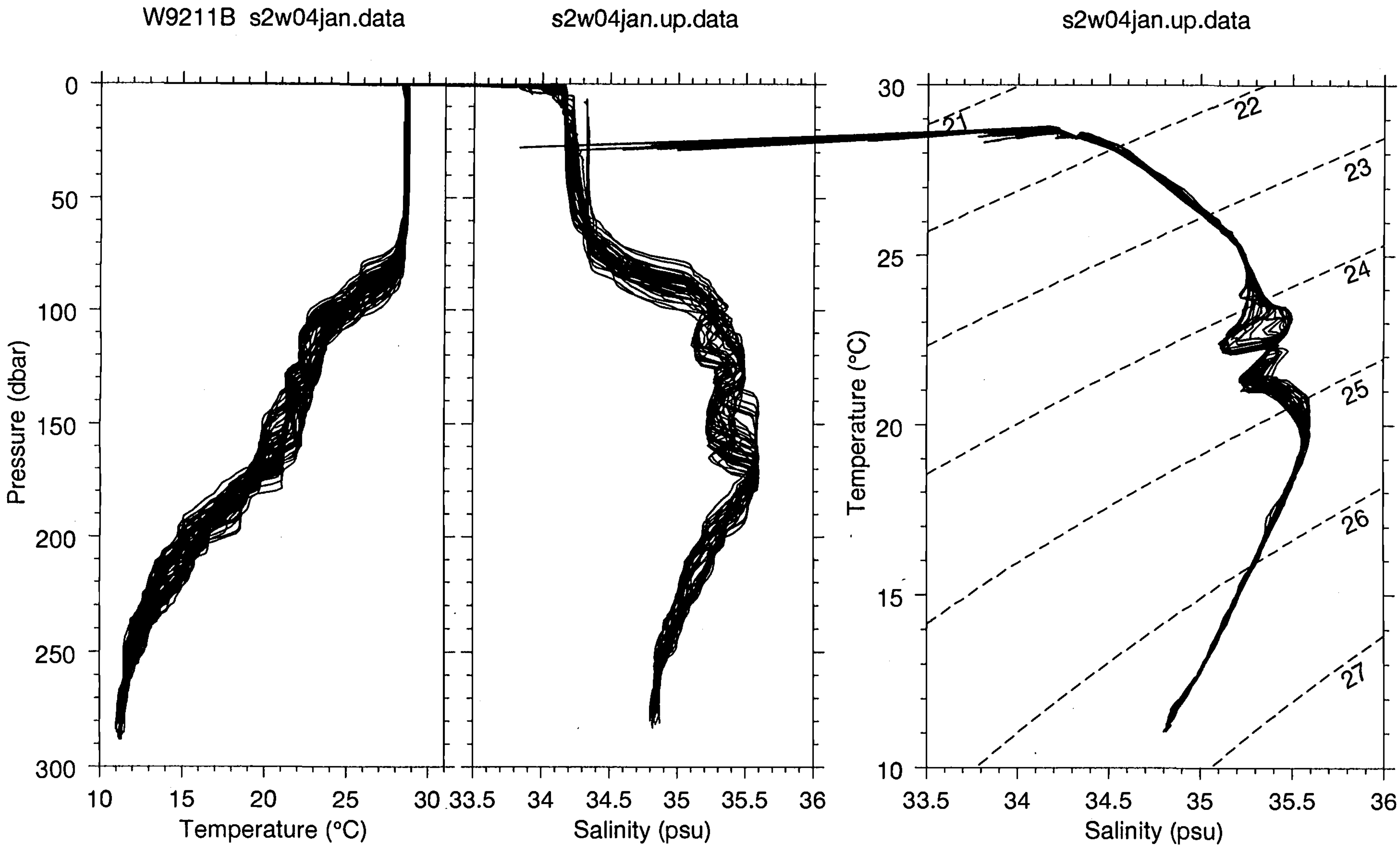

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Temperature (°C)
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34.5
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35.5
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Salinity (psu)
Temperature (°C)
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Salinity (psu)
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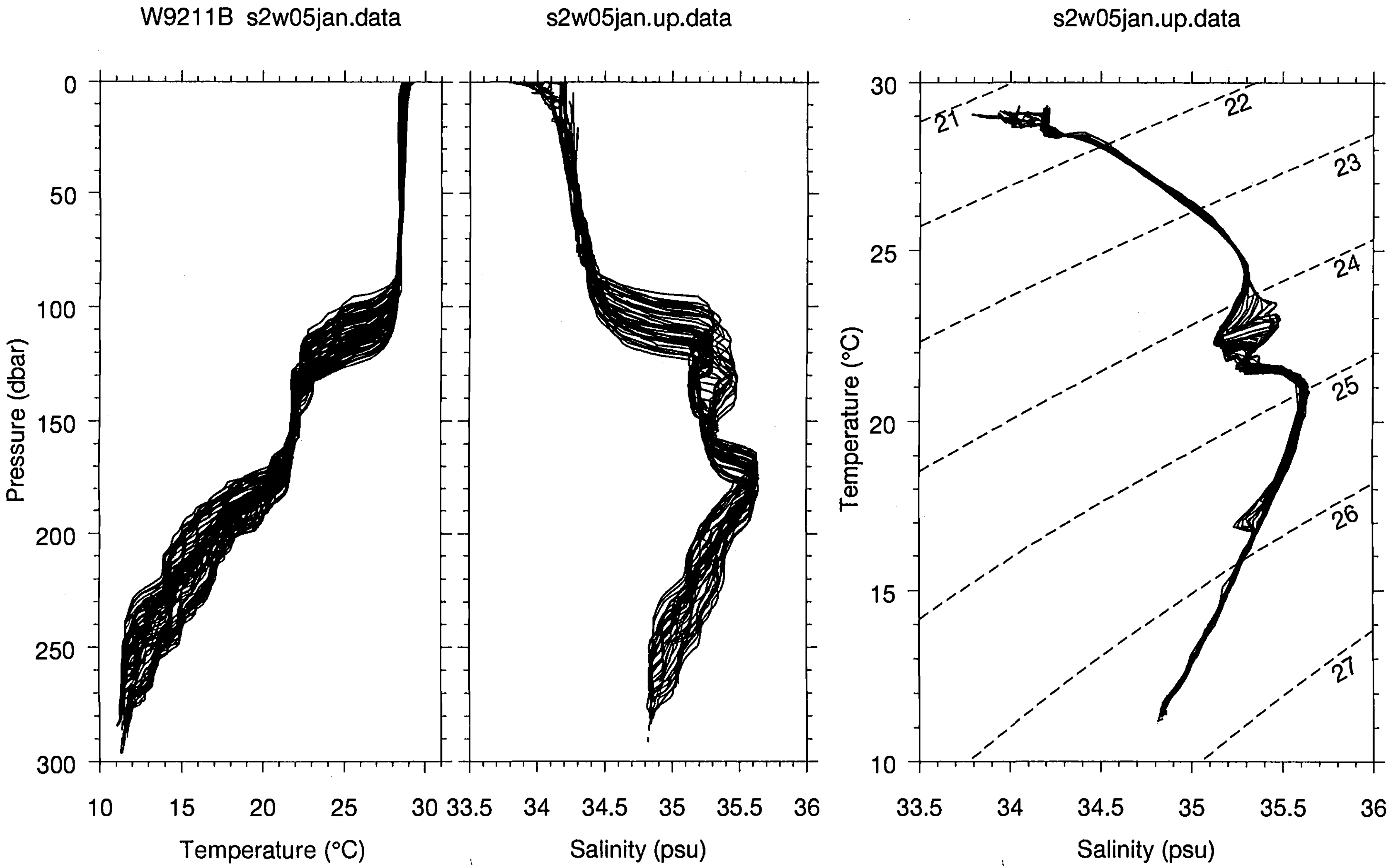
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Temperature (°C)
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Salinity (psu)
Temperature (°C)
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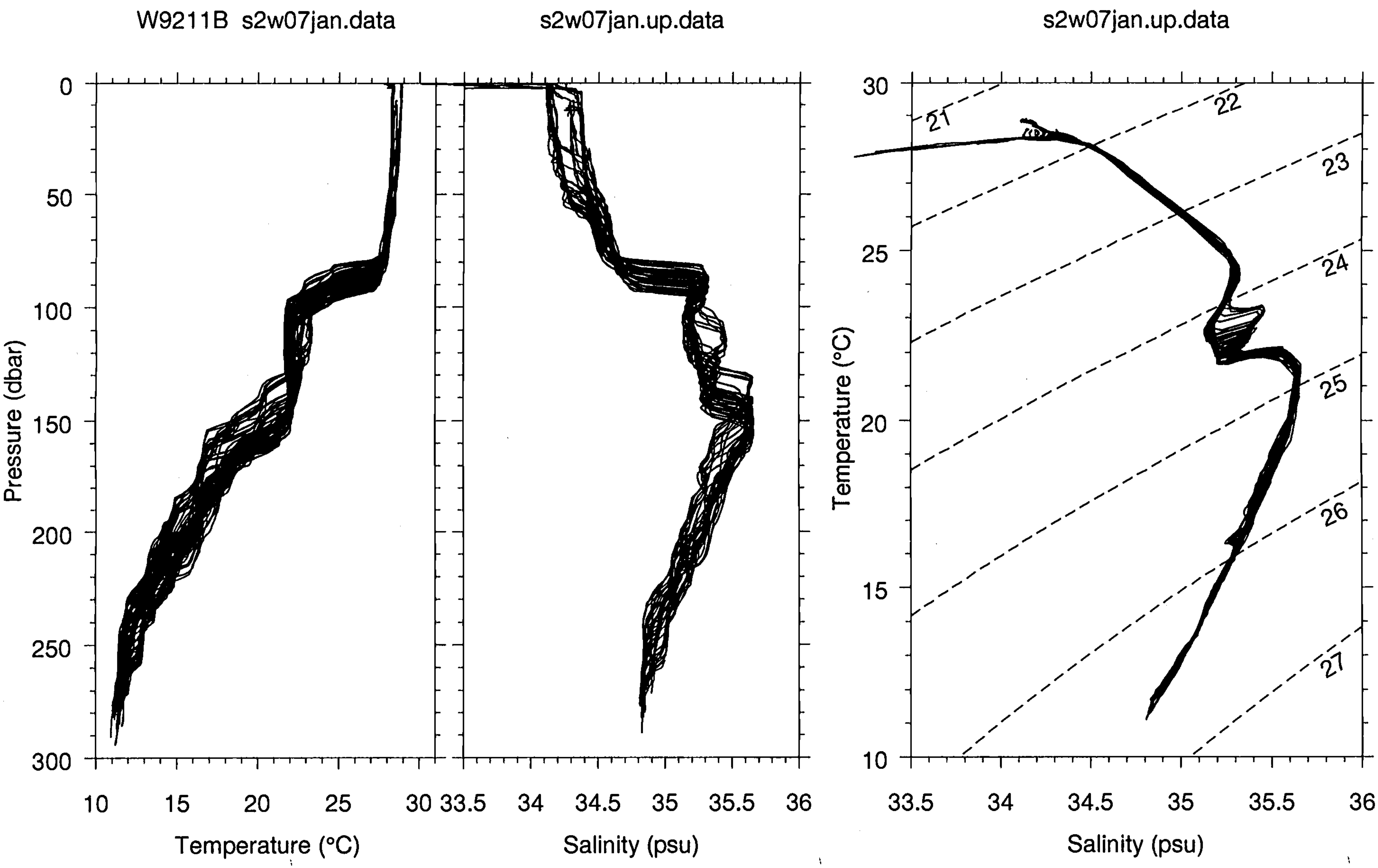
Salinity (psu)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Temperature (°C)
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Salinity (psu)
Temperature (°C)
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Salinity (psu)
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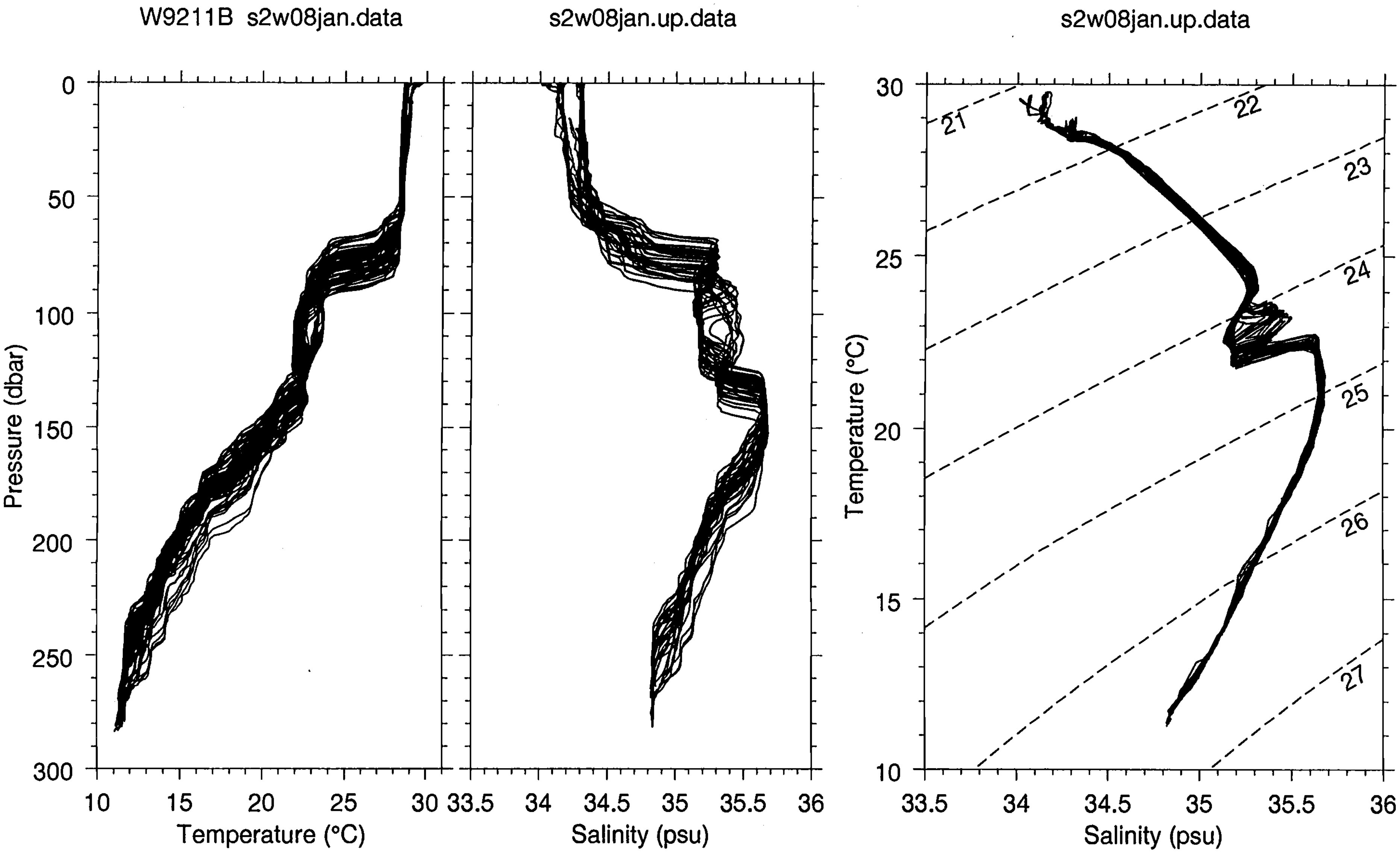
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Pressure (dbar)
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Temperature (°C)
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Salinity (psu)
Temperature (°C)
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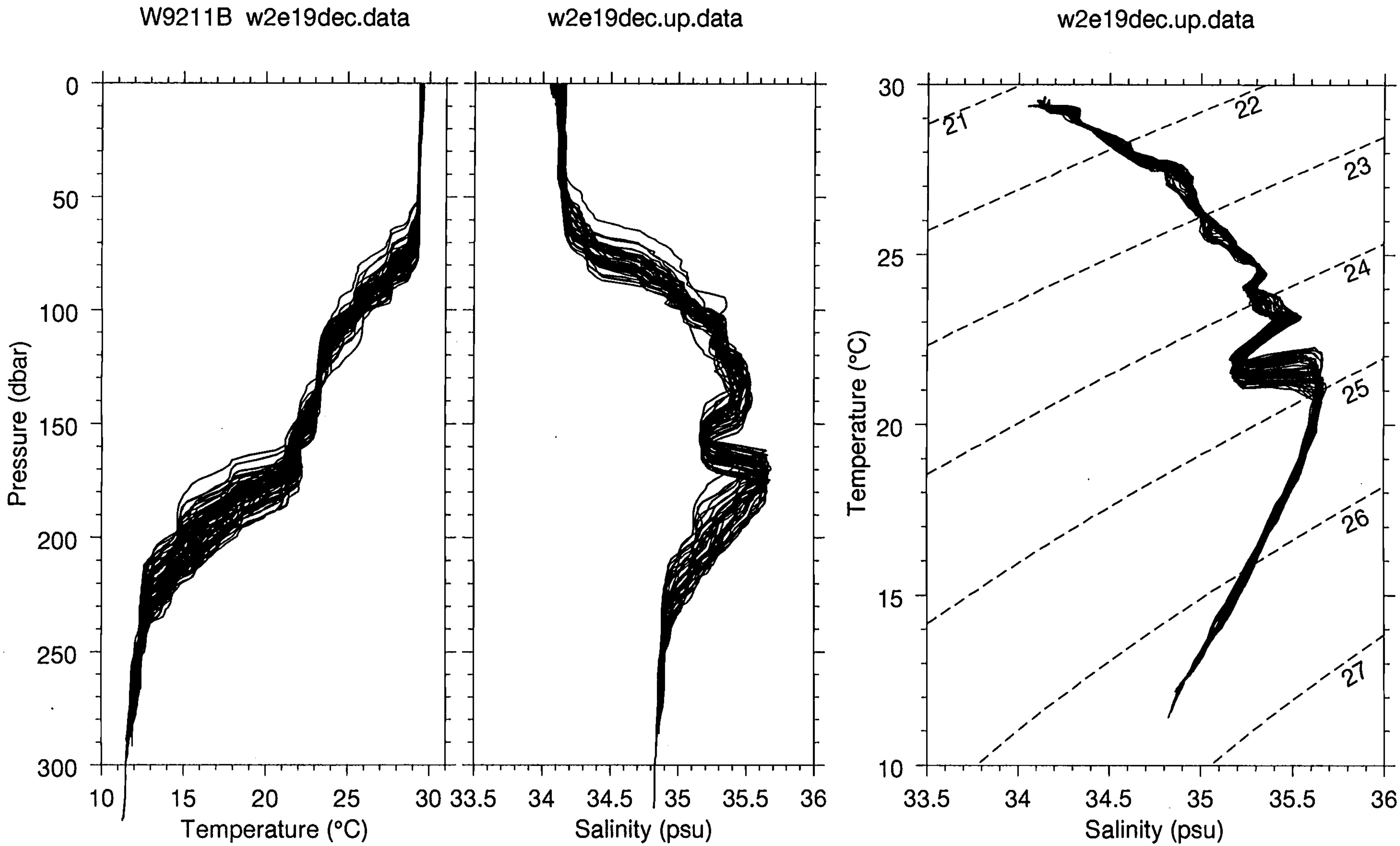
Salinity (psu)



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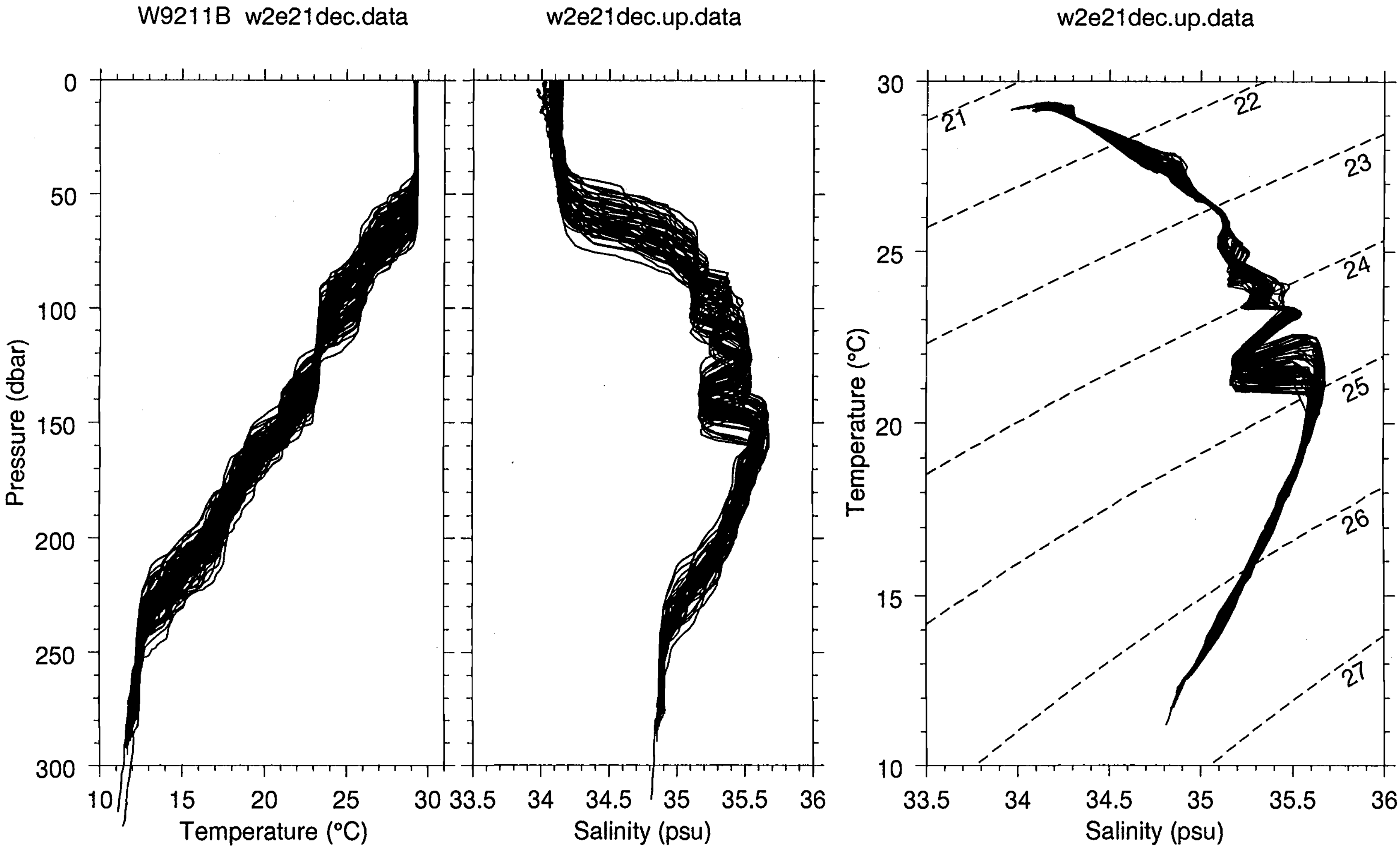
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Pressure (dbar)
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Temperature (°C)
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Salinity (psu)
Temperature (°C)
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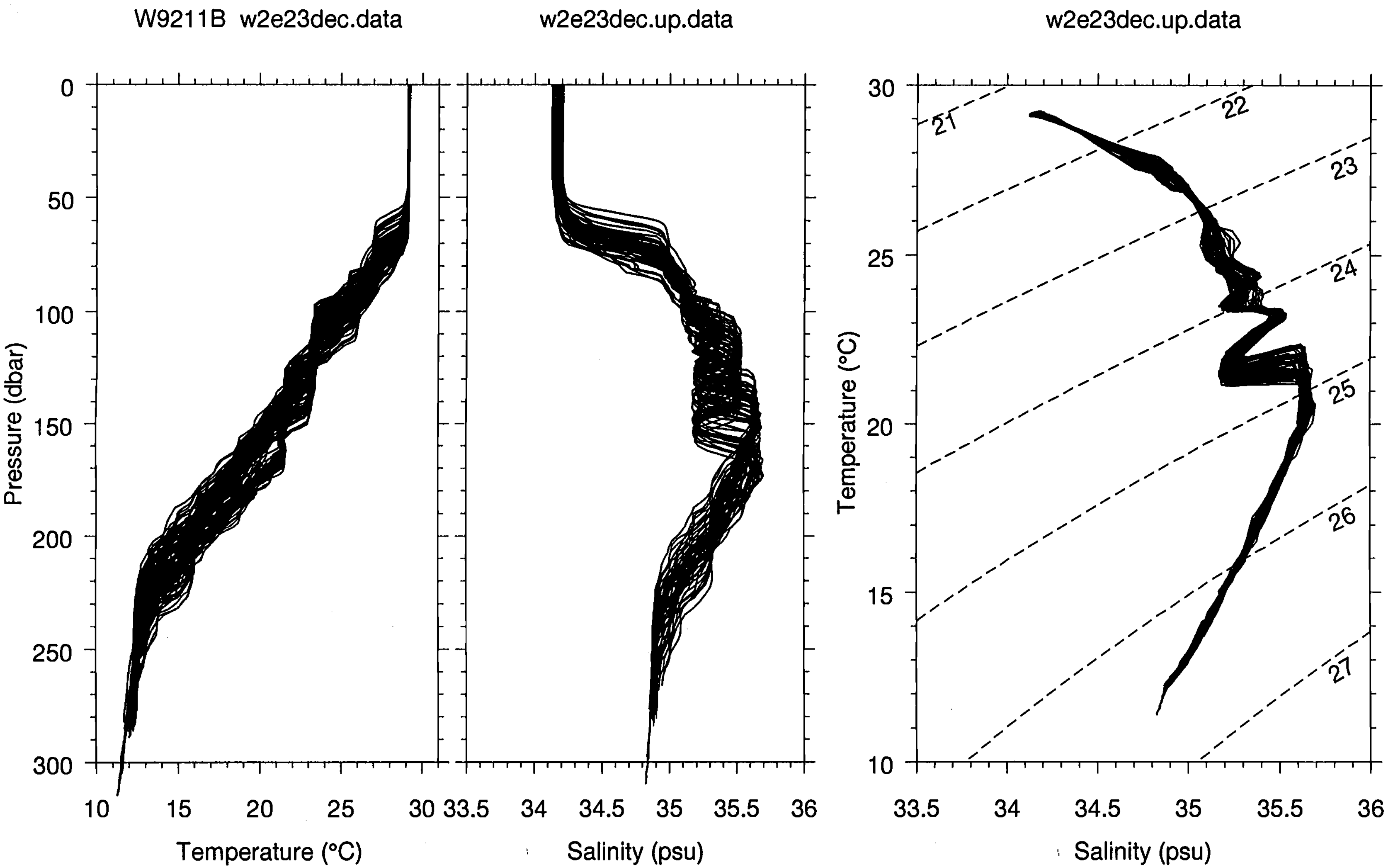
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Pressure (dbar)
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Salinity (psu)
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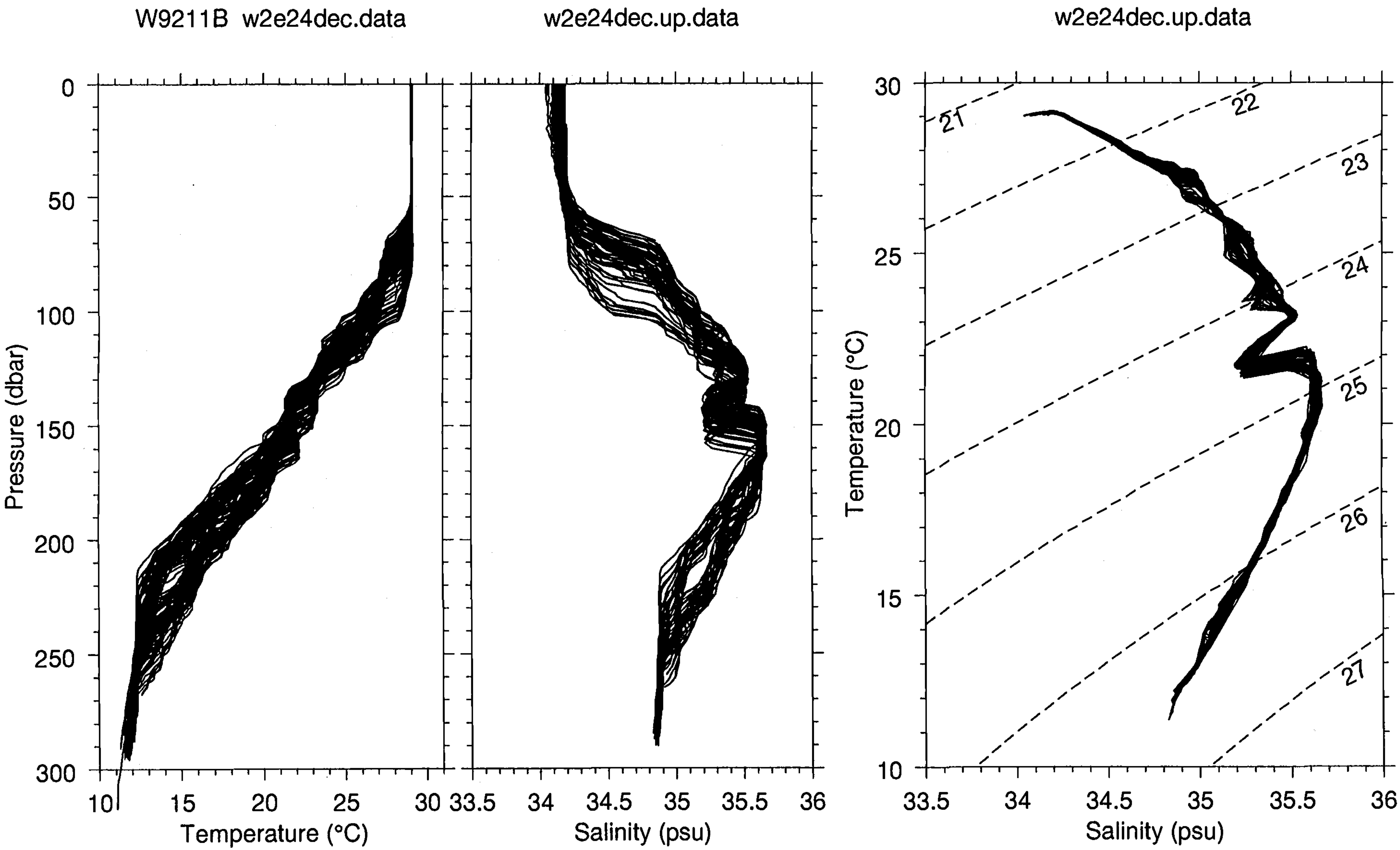
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Salinity (psu)
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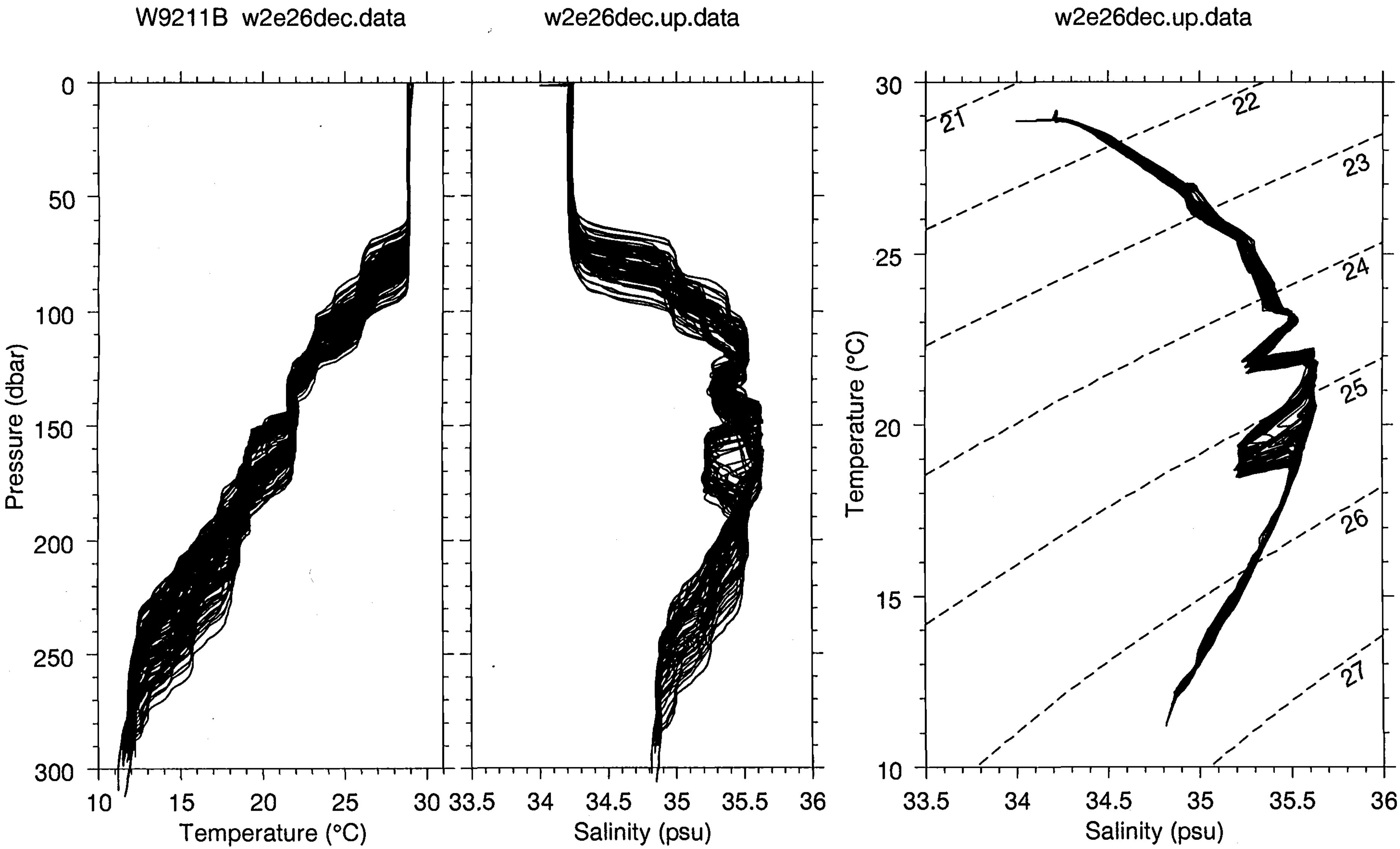
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Temperature (°C)
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Salinity (psu)
Temperature (°C)
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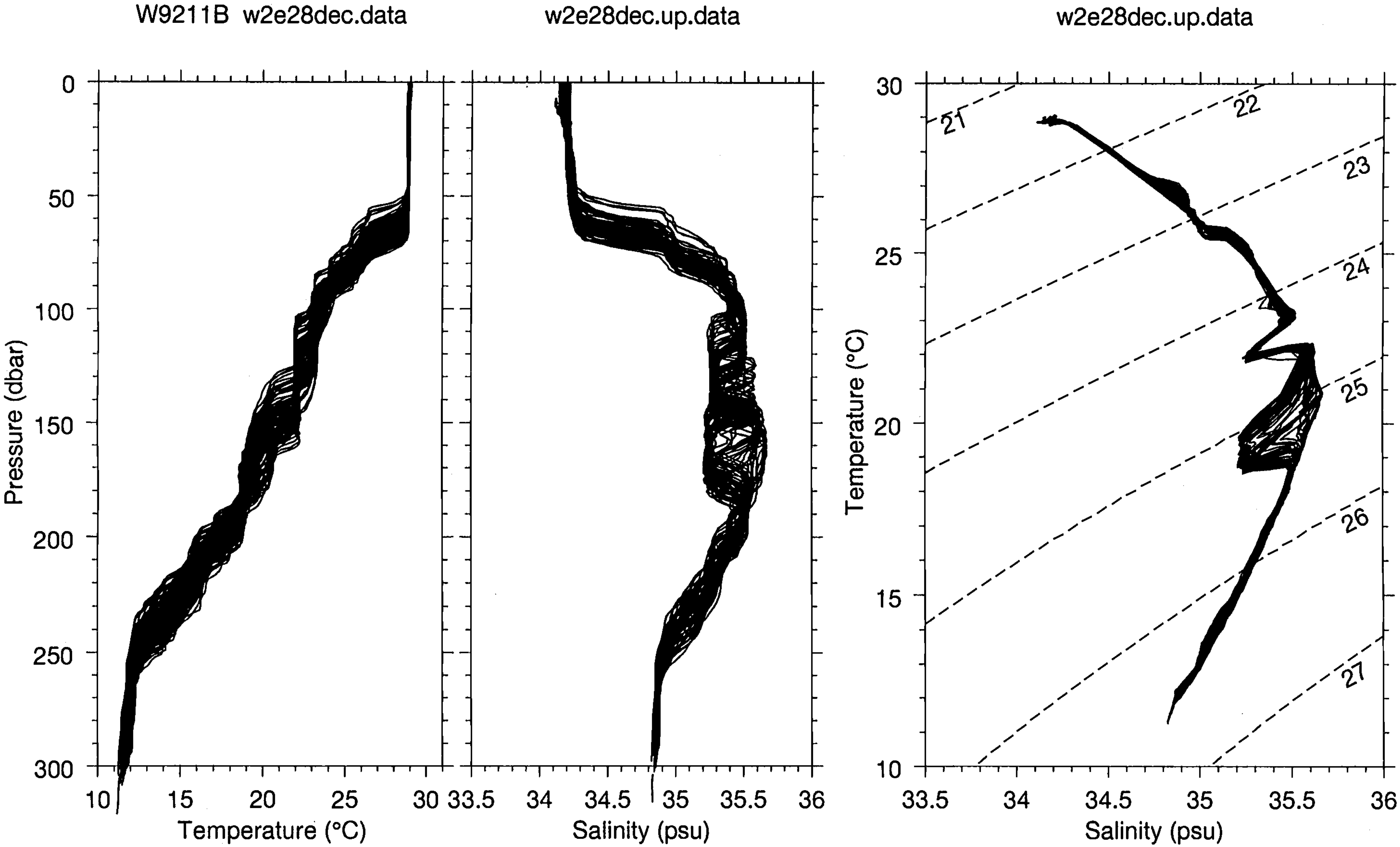
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Temperature (°C)
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Salinity (psu)
Temperature (°C)
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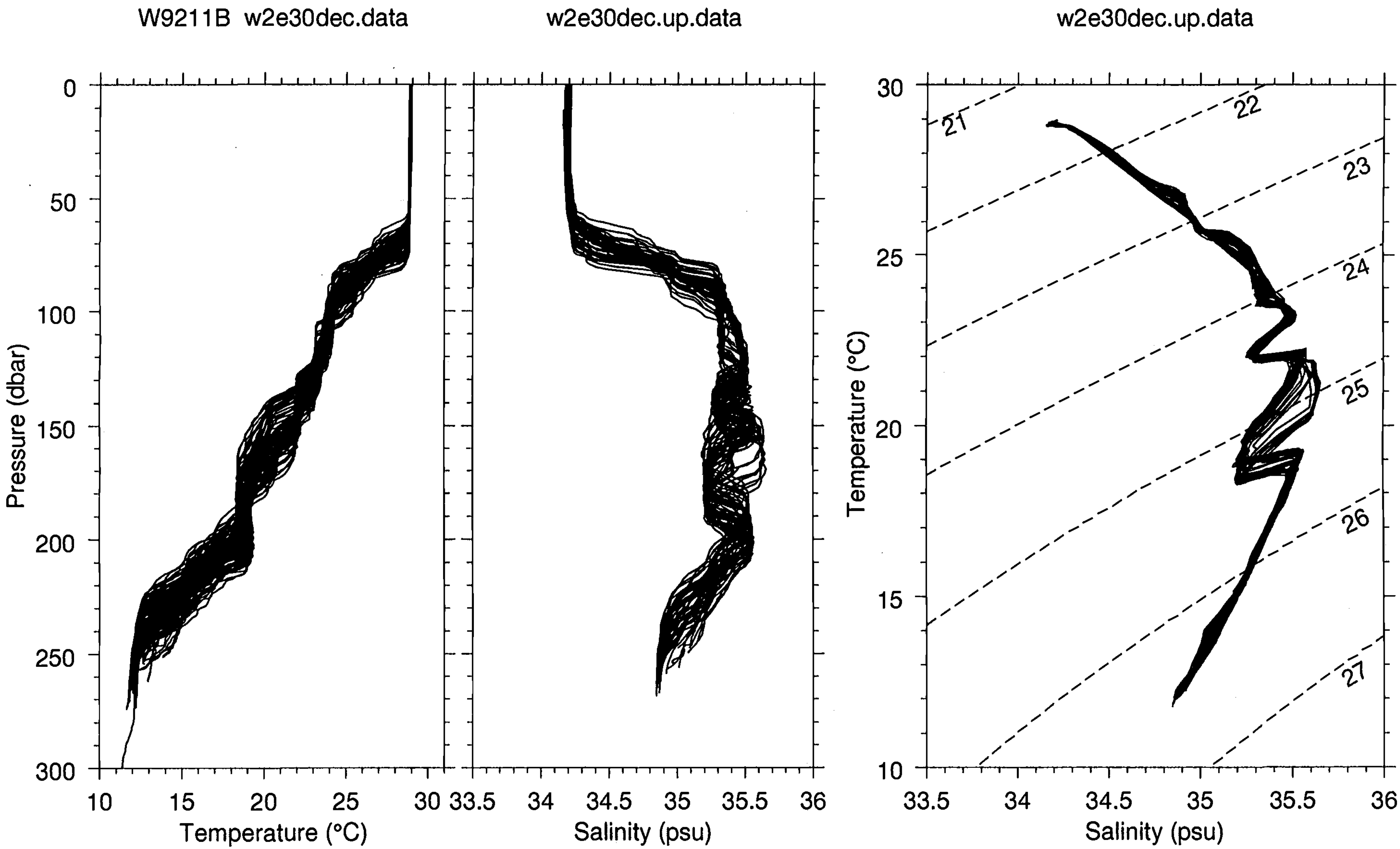
Salinity (psu)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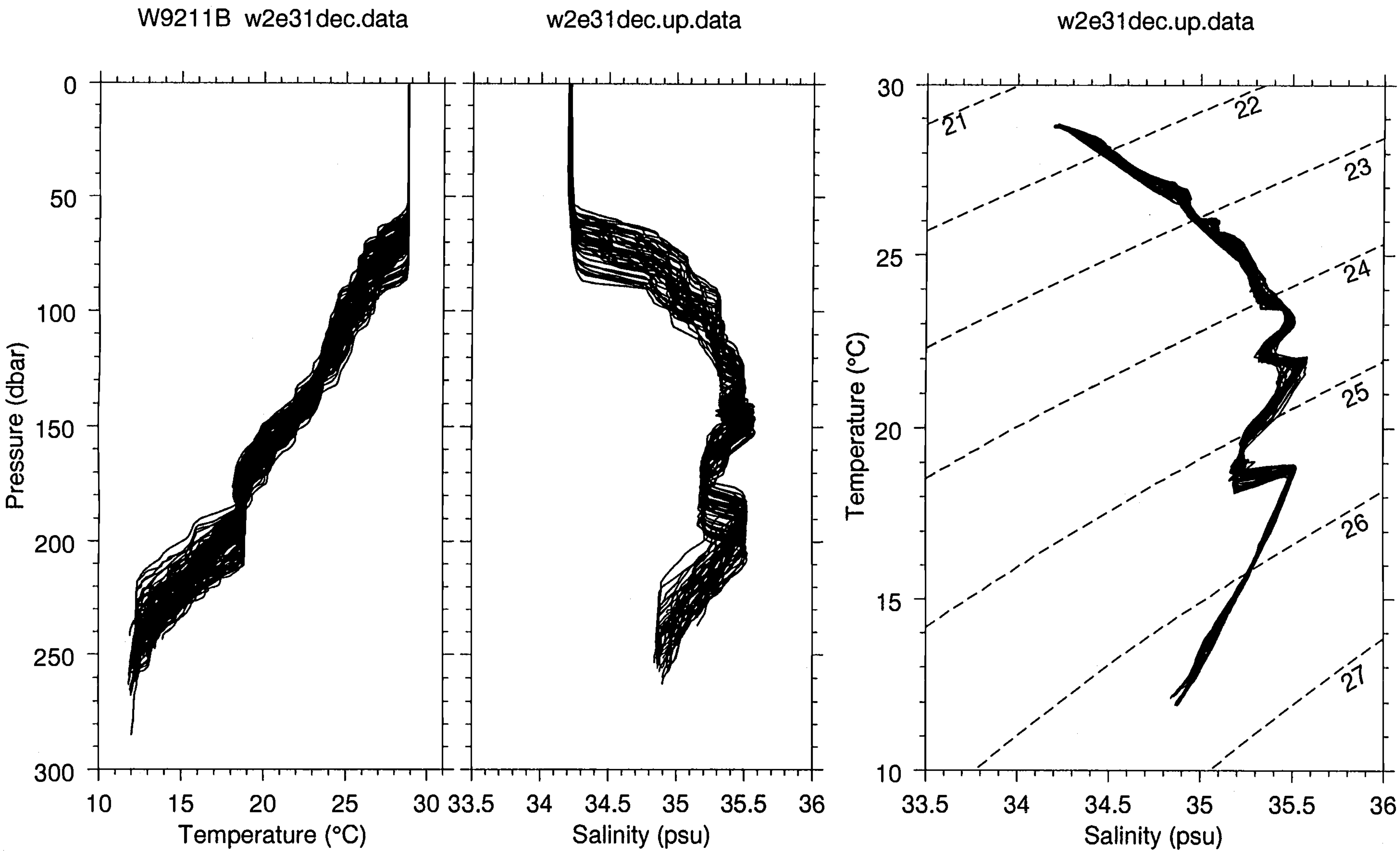

W9211B w2e31dec.data
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Salinity (psu)
Temperature (°C)
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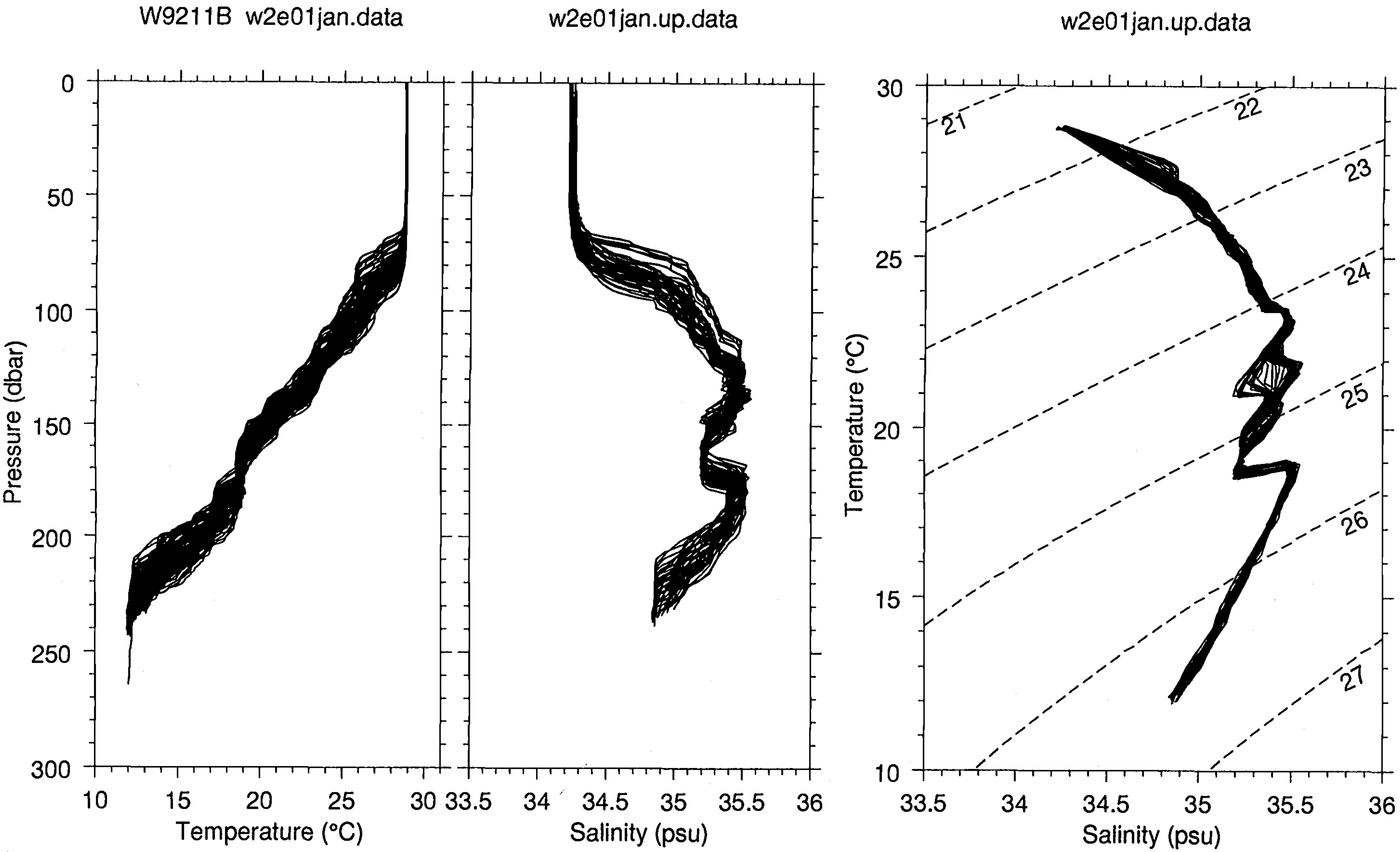
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Salinity (psu)
Temperature (°C)
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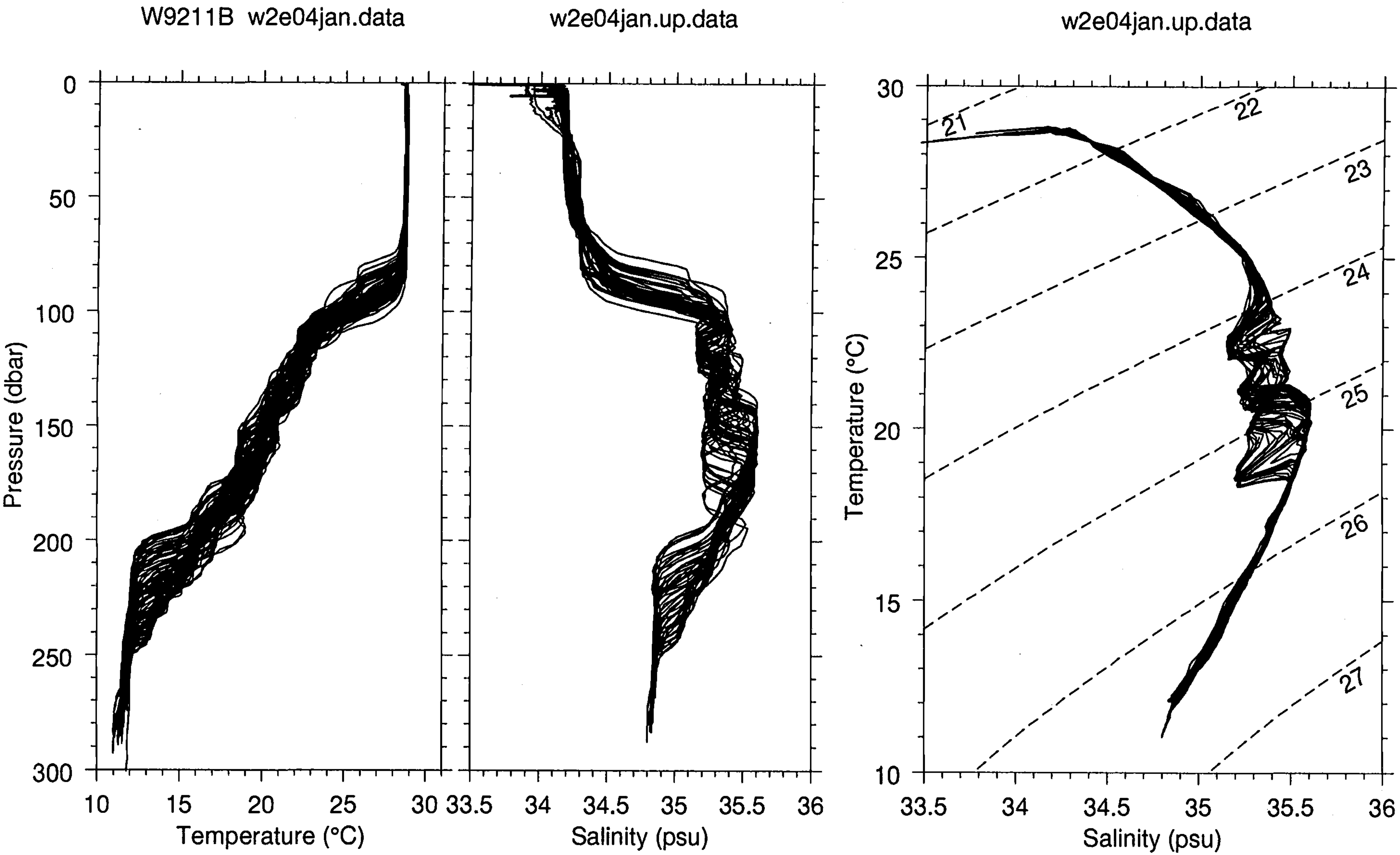
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Temperature (°C)
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Salinity (psu)
Temperature (°C)
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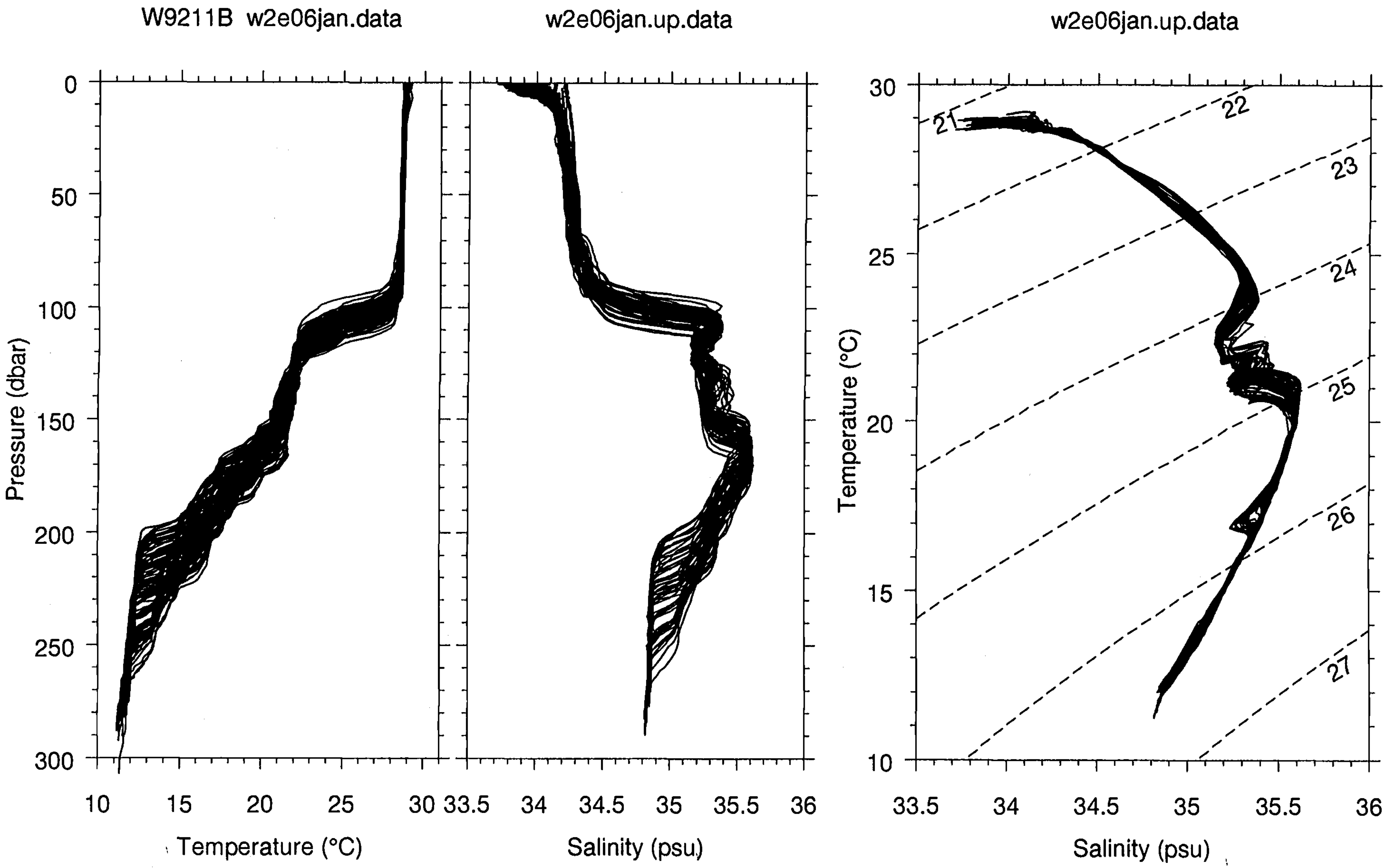
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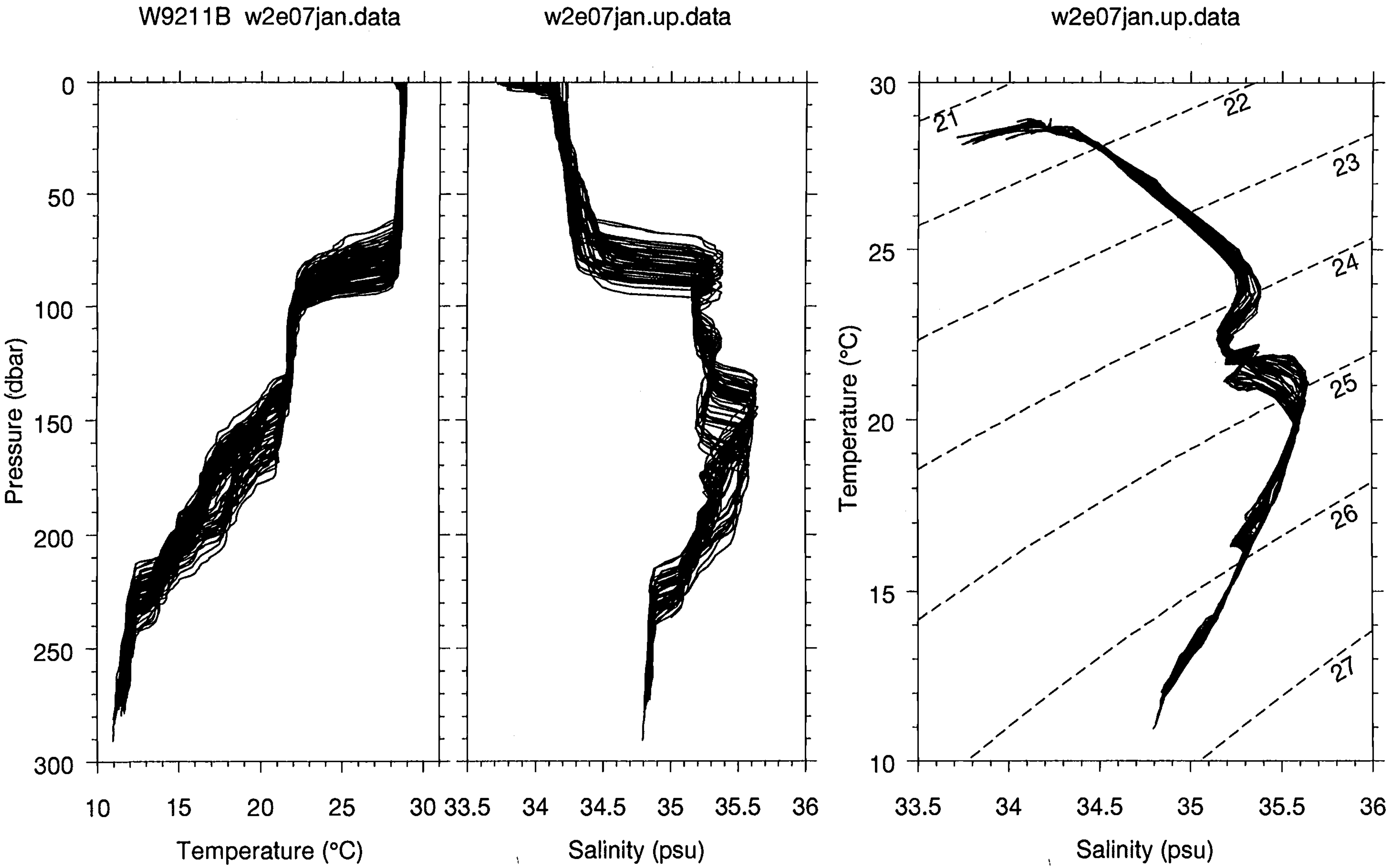
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Temperature (°C)
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Salinity (psu)
Temperature (°C)
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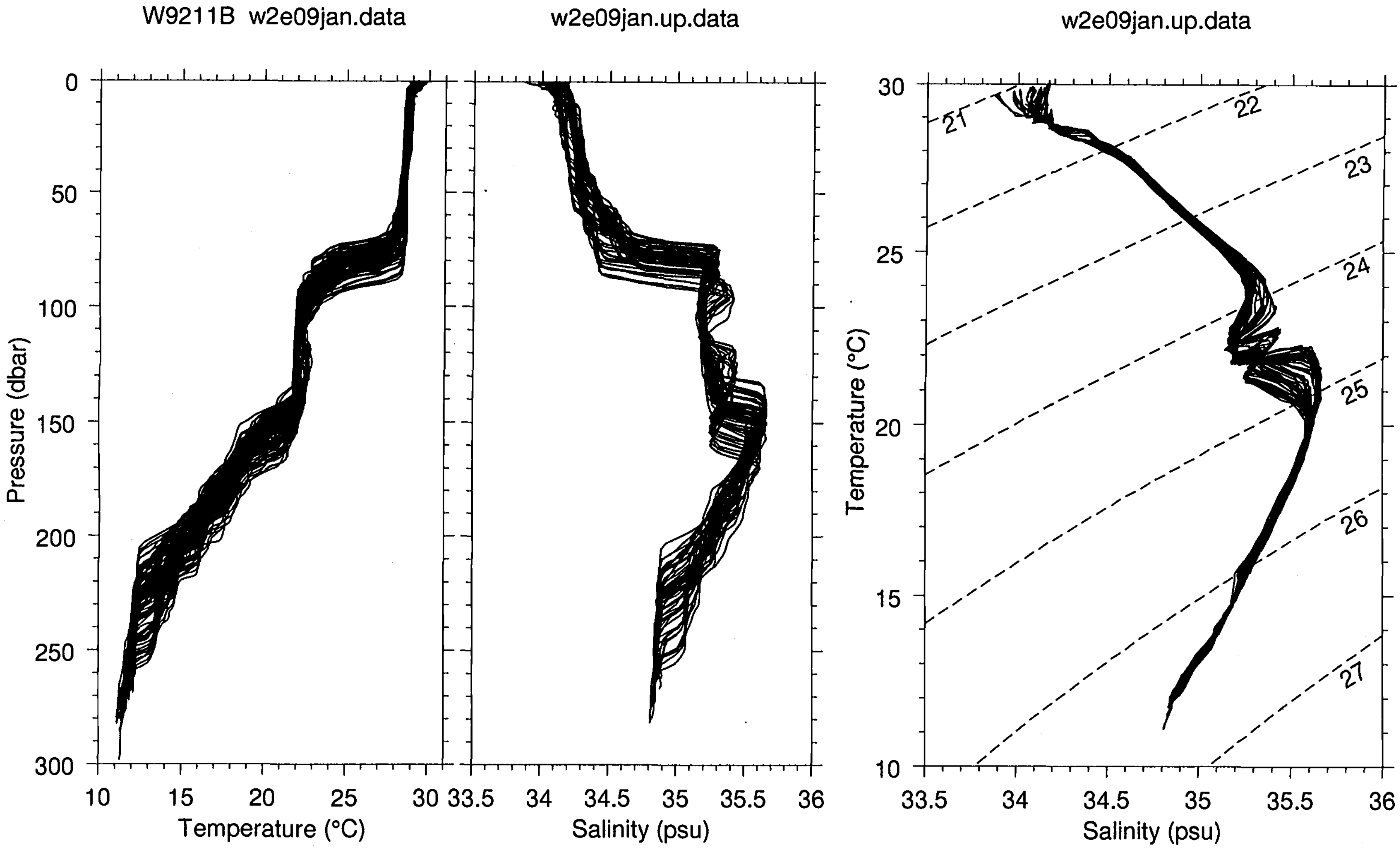
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Temperature (°C)
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Salinity (psu)
Temperature (°C)
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Salinity (psu)
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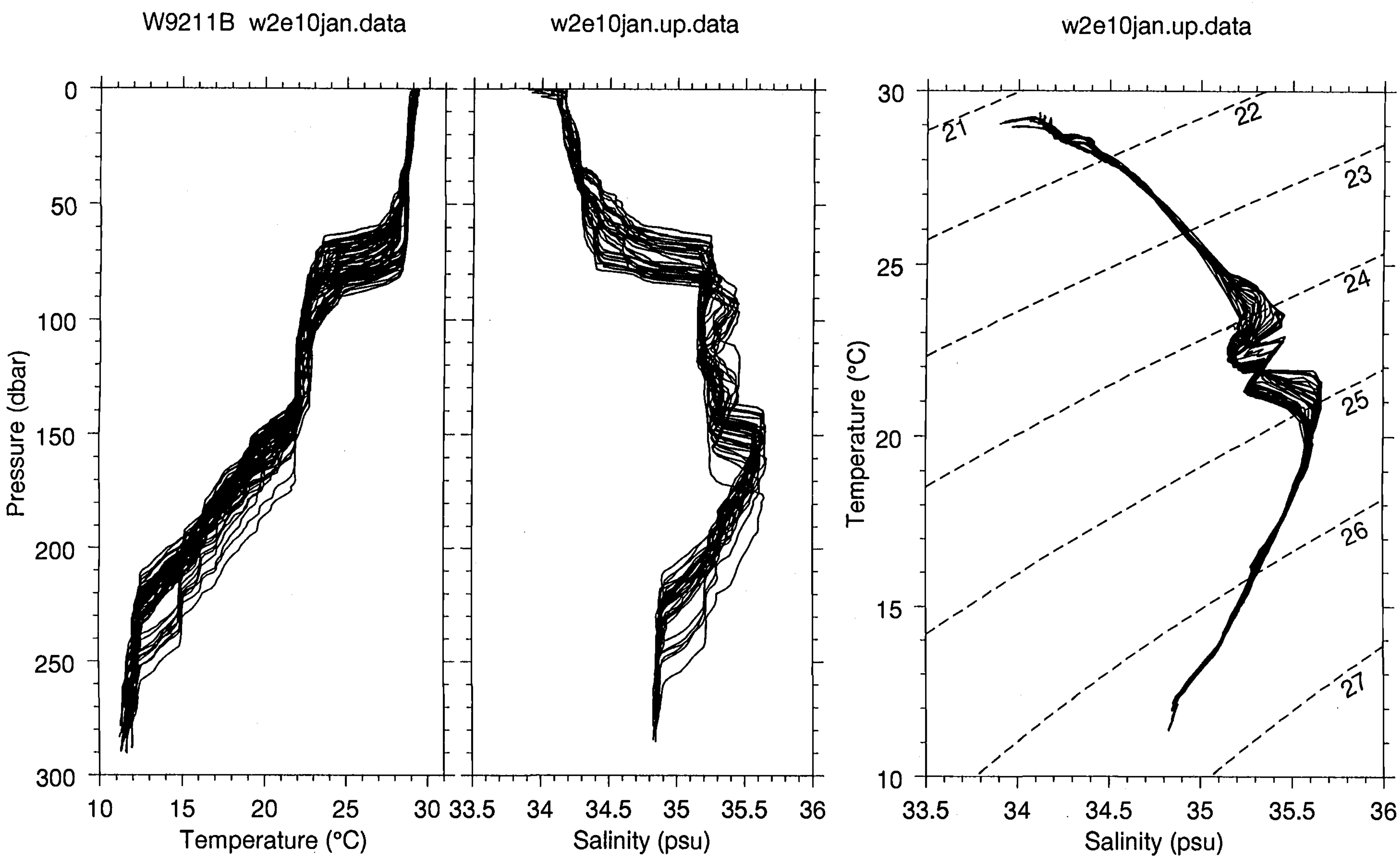
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Temperature (°C)
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Salinity (psu)
Temperature (°C)
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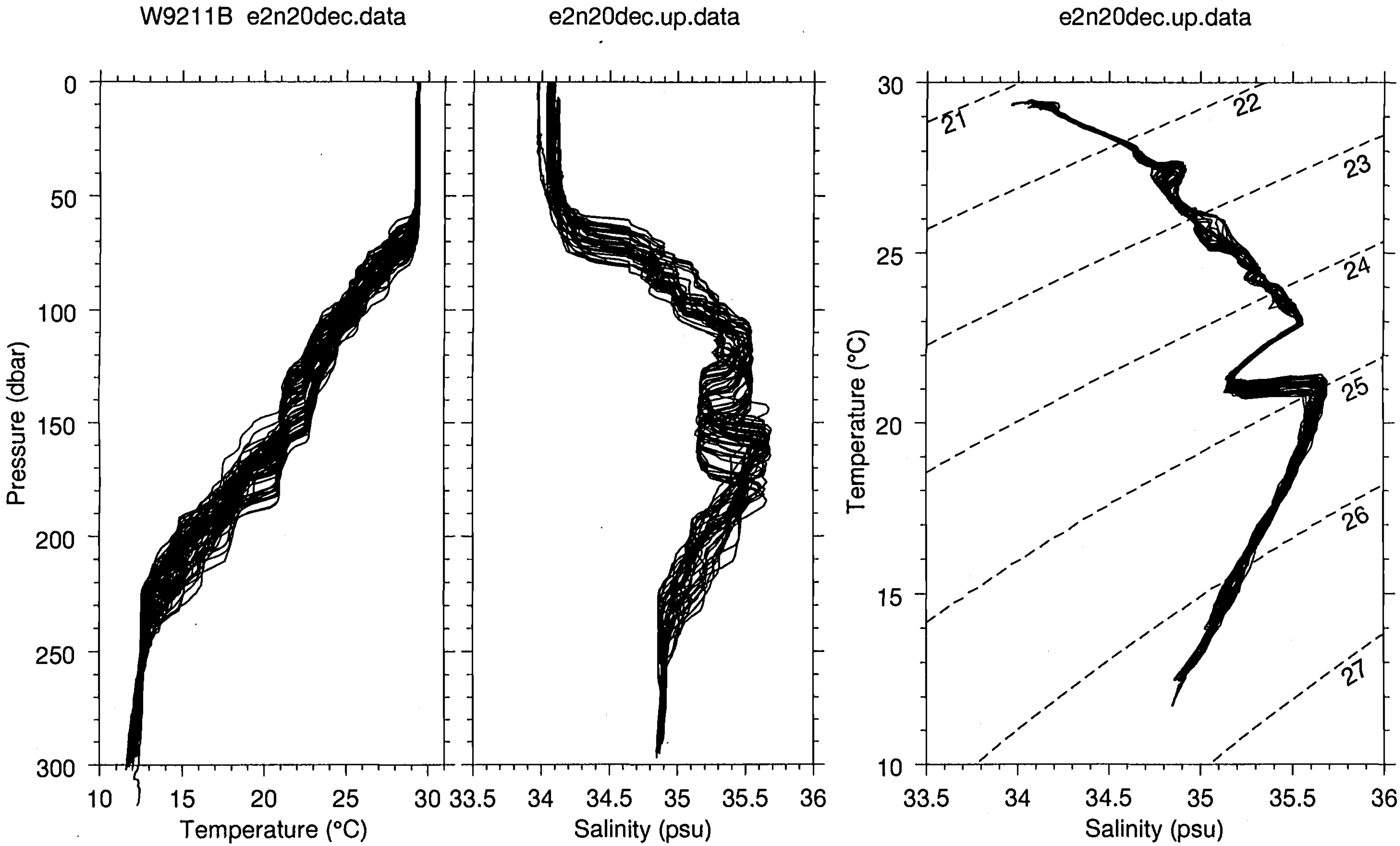
Salinity (psu)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Temperature (°C)
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Salinity (psu)
Temperature (°C)
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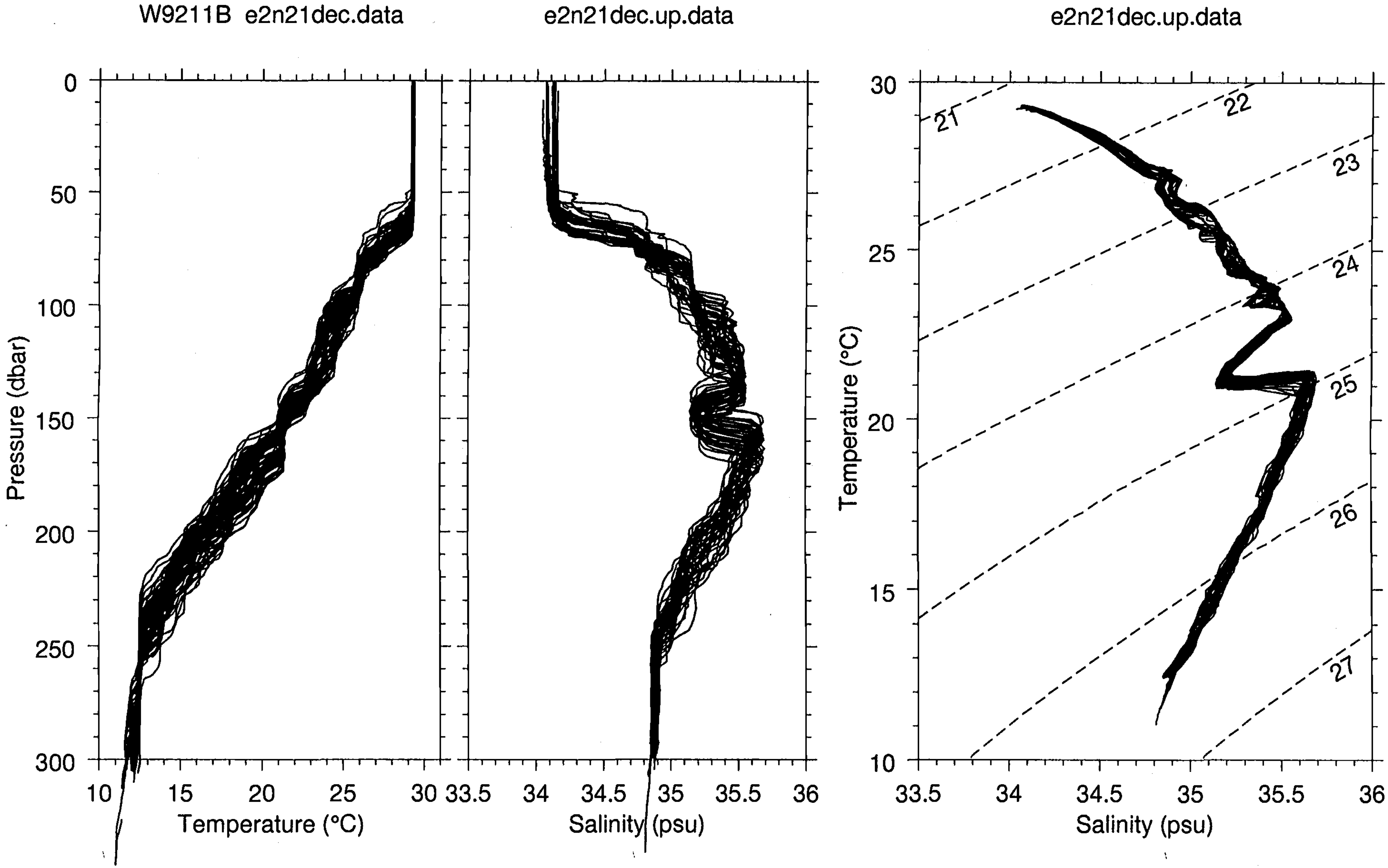
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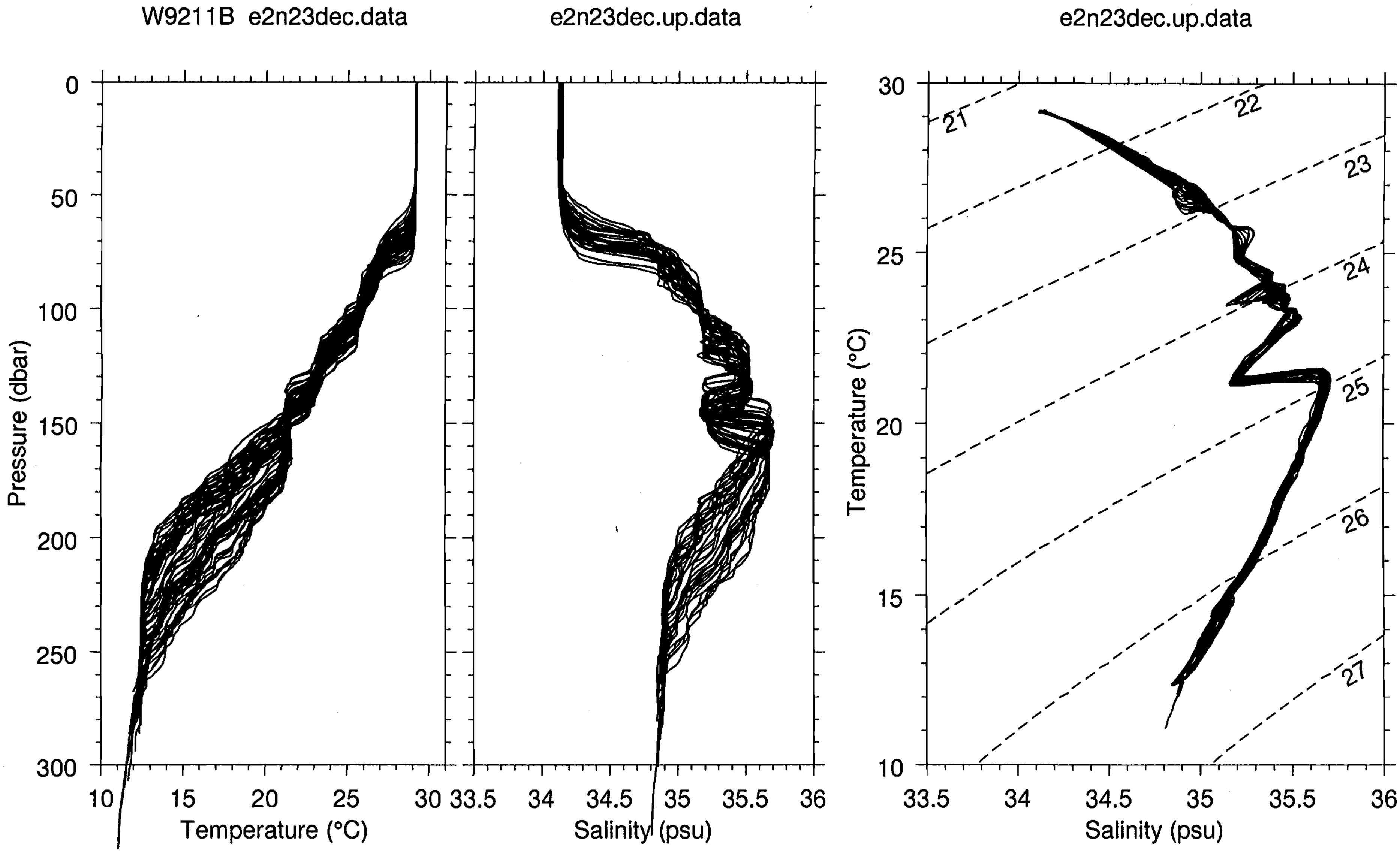
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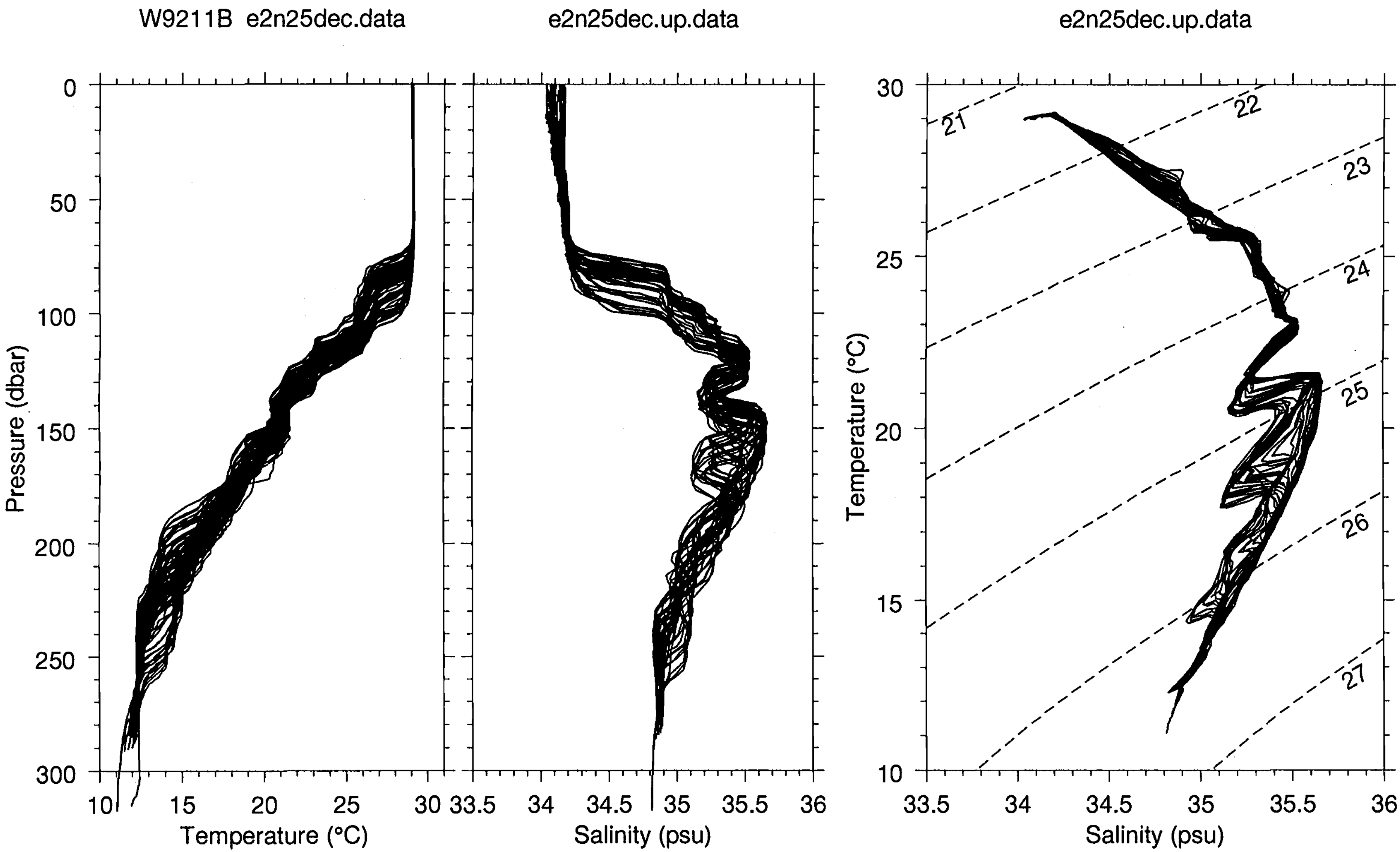
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Temperature (°C)
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Salinity (psu)
Temperature (°C)
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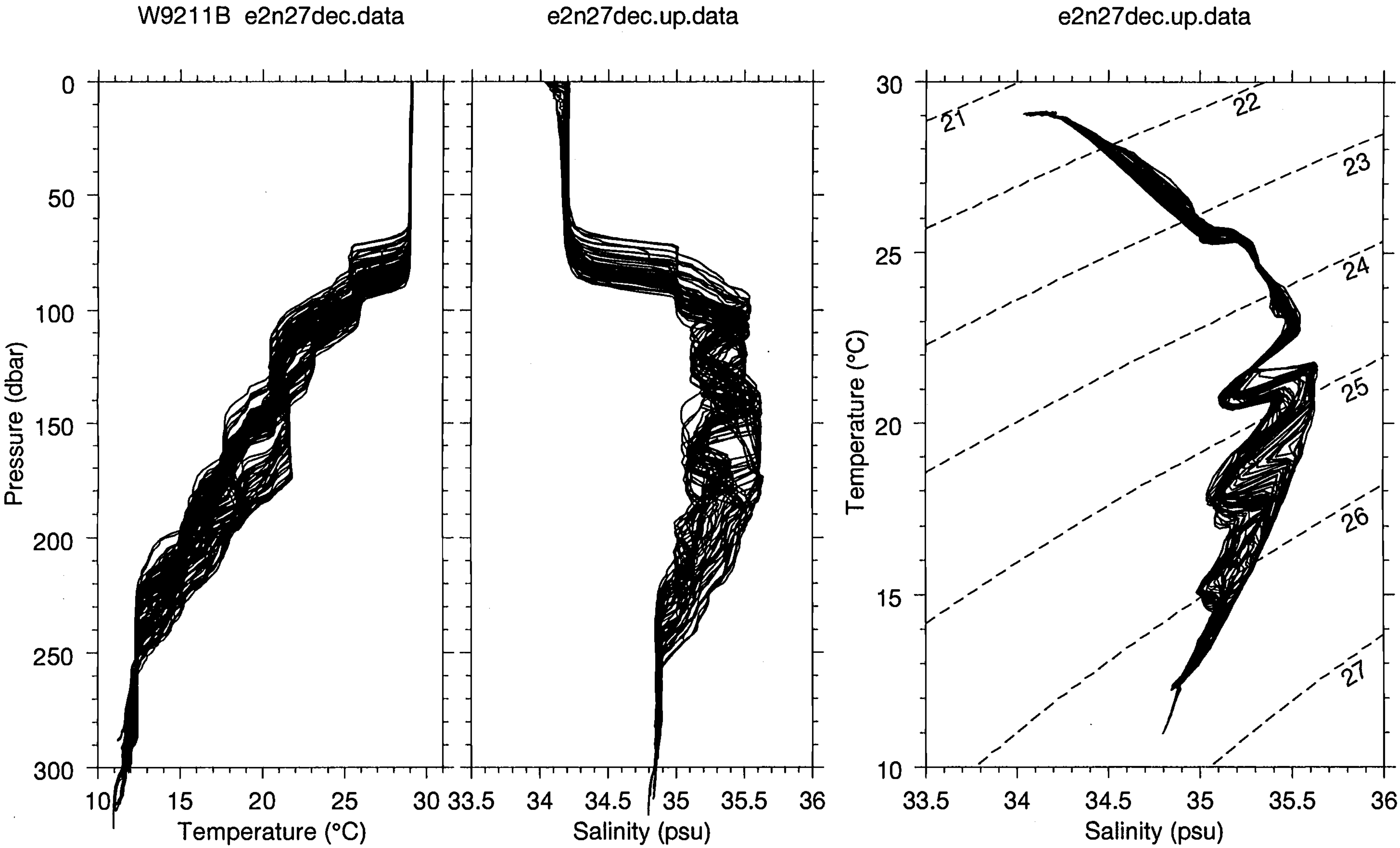
Salinity (psu)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Temperature (°C)
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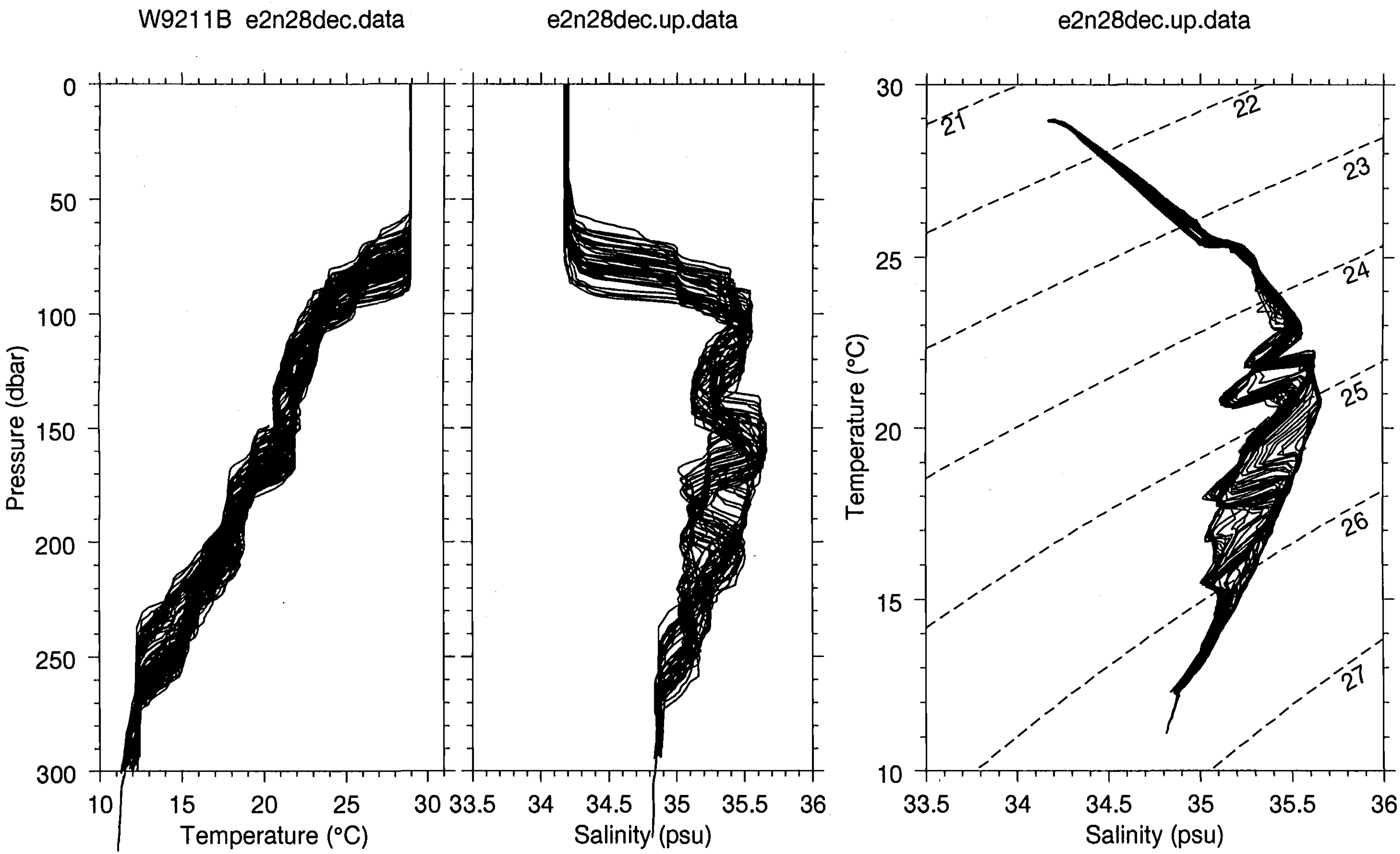
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Temperature (°C)
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Salinity (psu)
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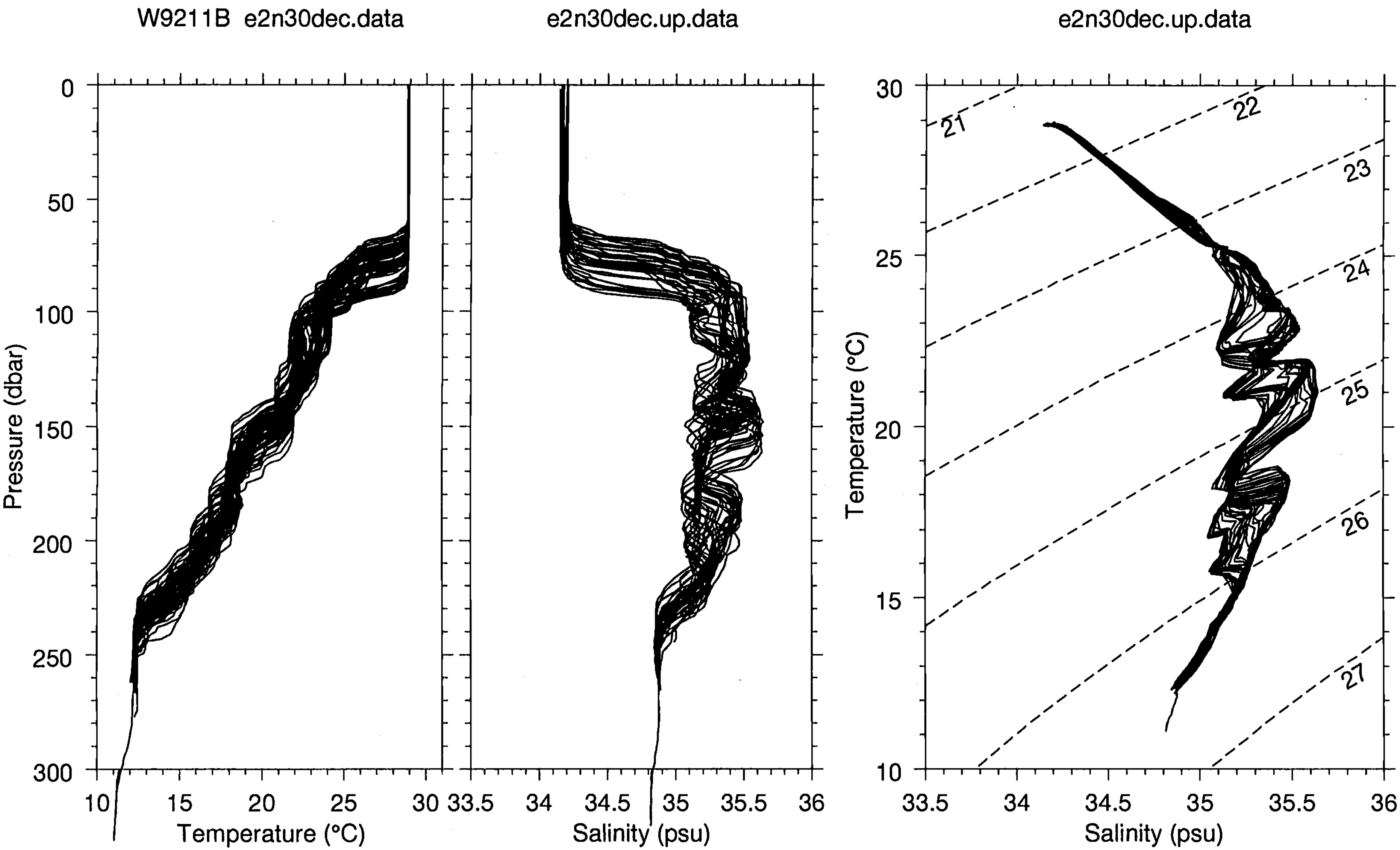
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e2n30dec.up.data
Pressure (dbar)
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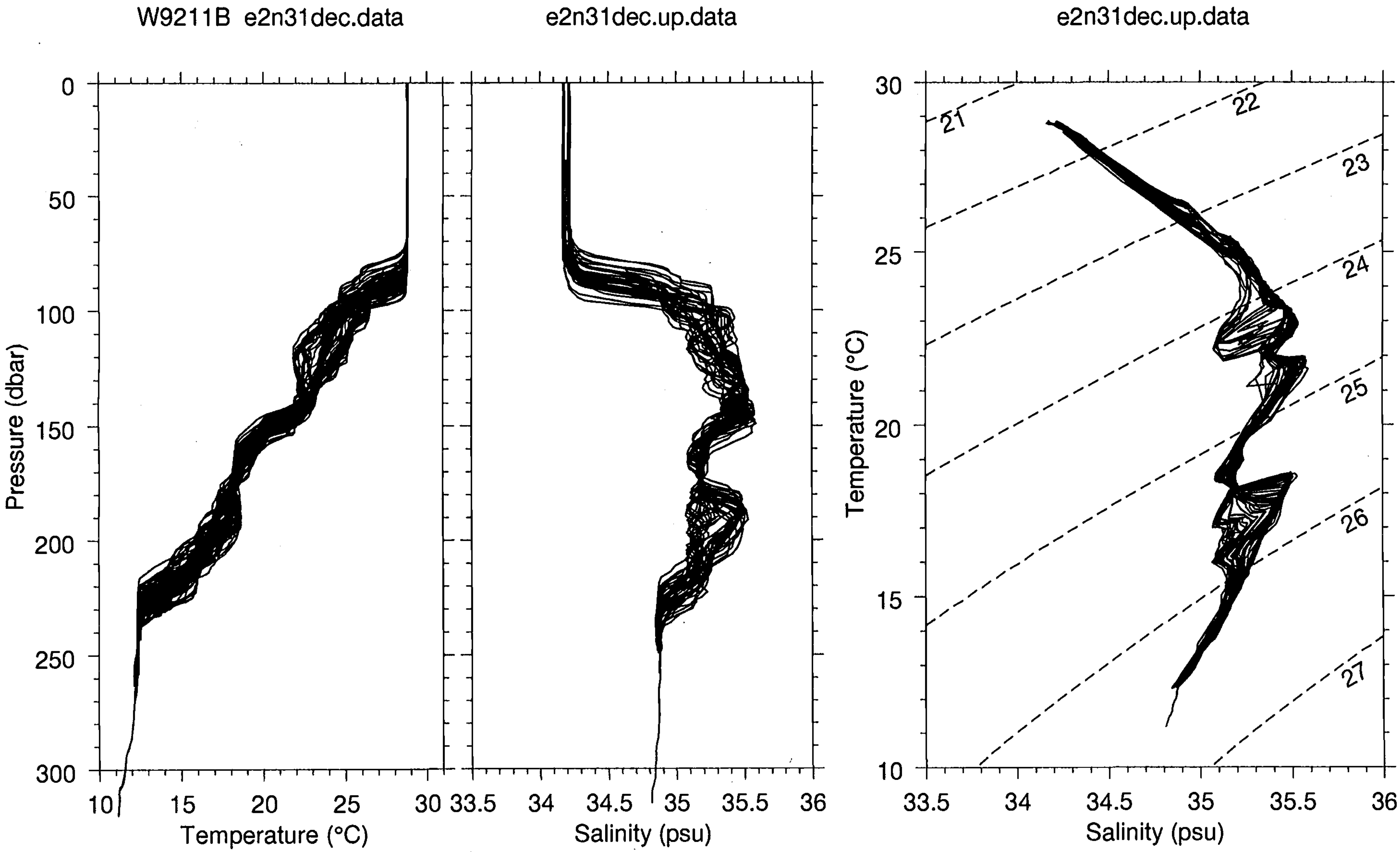
50
100
150
200
250
300
10
15
20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
Temperature (°C)
30
25
20
15
10
33.5
34
34.5
35
35.5
36
Salinity (psu)
21
22
23
24
25
26
27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20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
Temperature (°C)
30
25
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33.5
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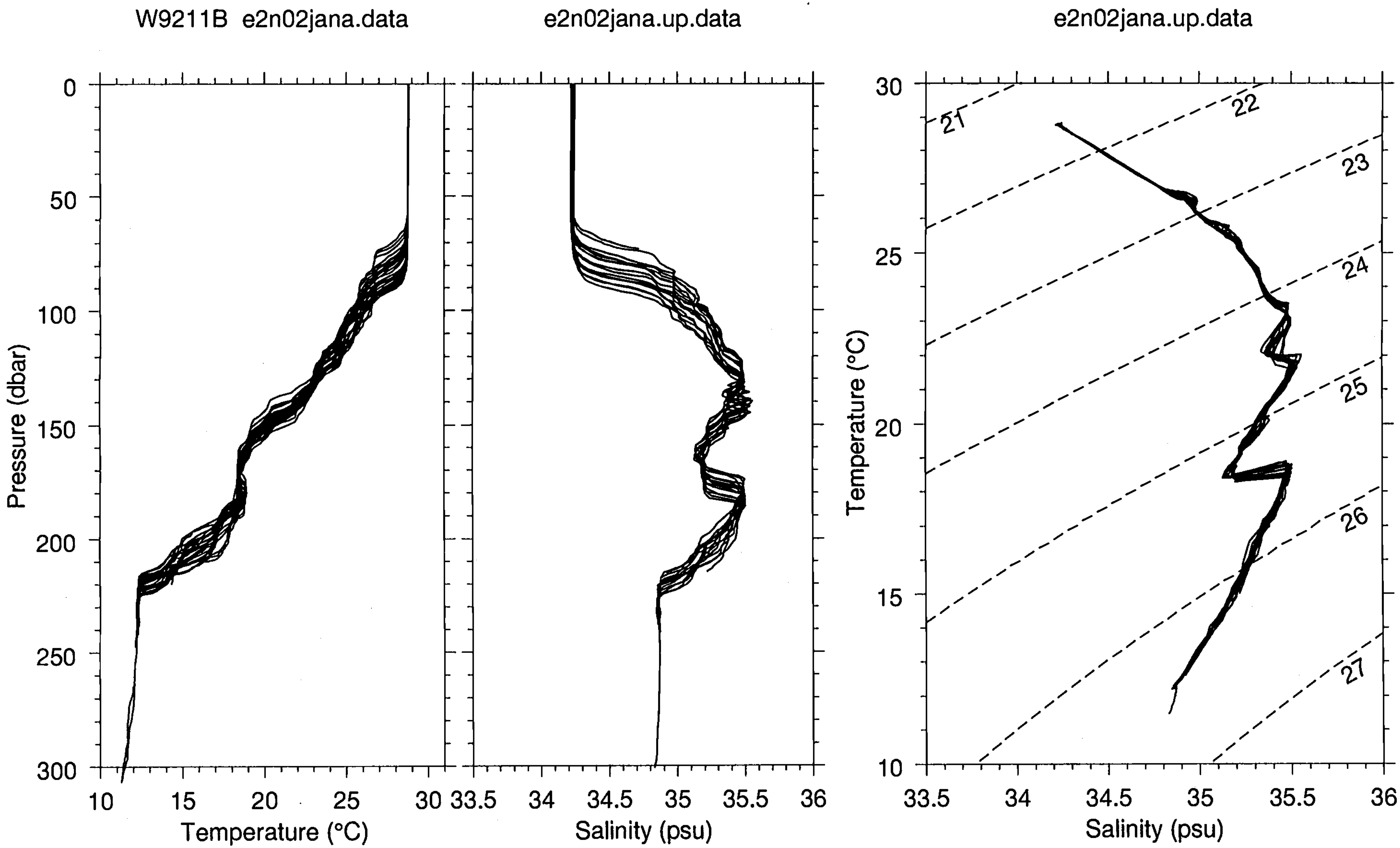
34.5
35
35.5
36
Salinity (psu)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20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
Temperature (°C)
30
25
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35.5
36
Salinity (psu)
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22
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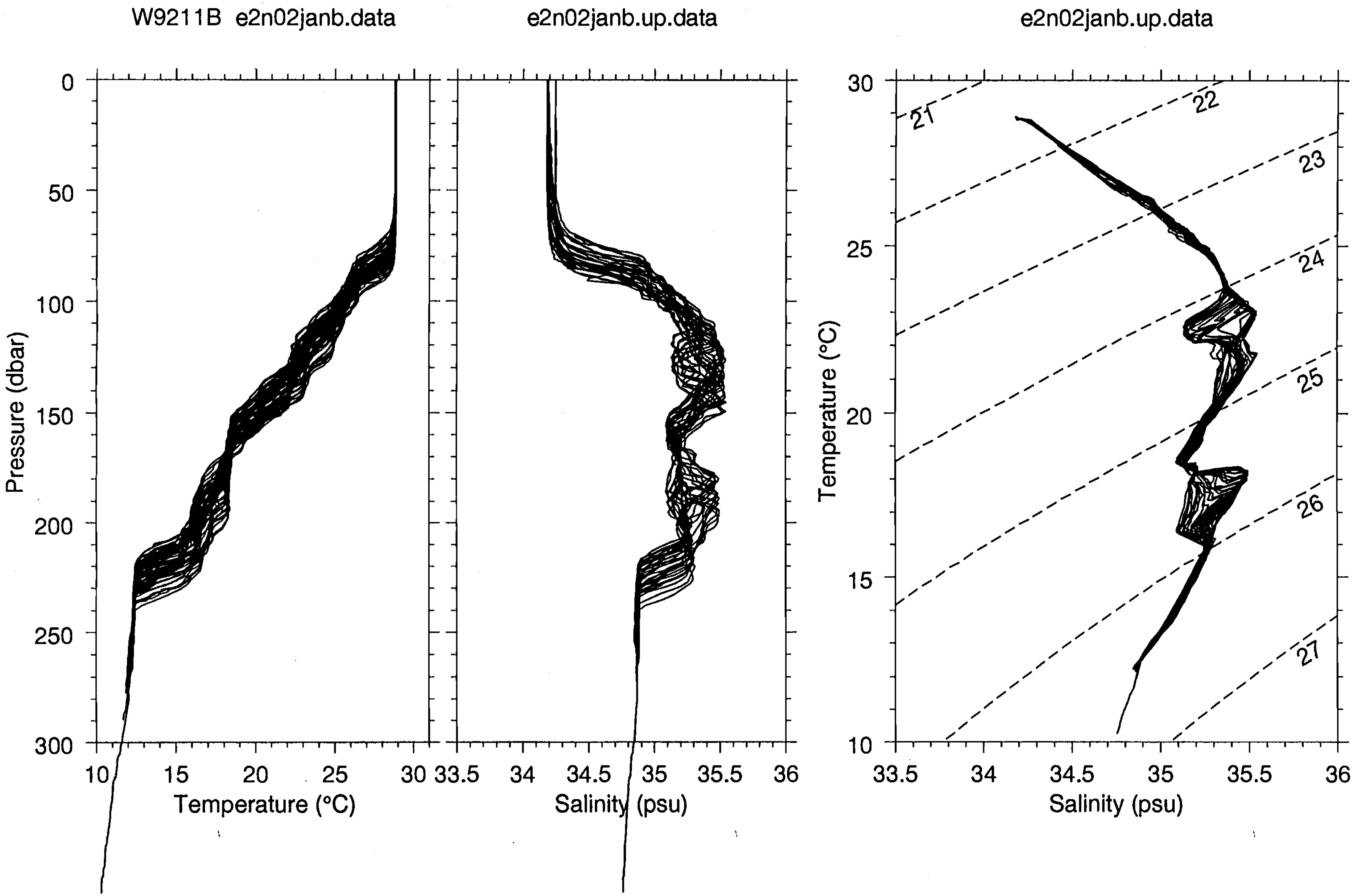
27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20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
Temperature (°C)
30
25
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34.5
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35.5
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Salinity (psu)
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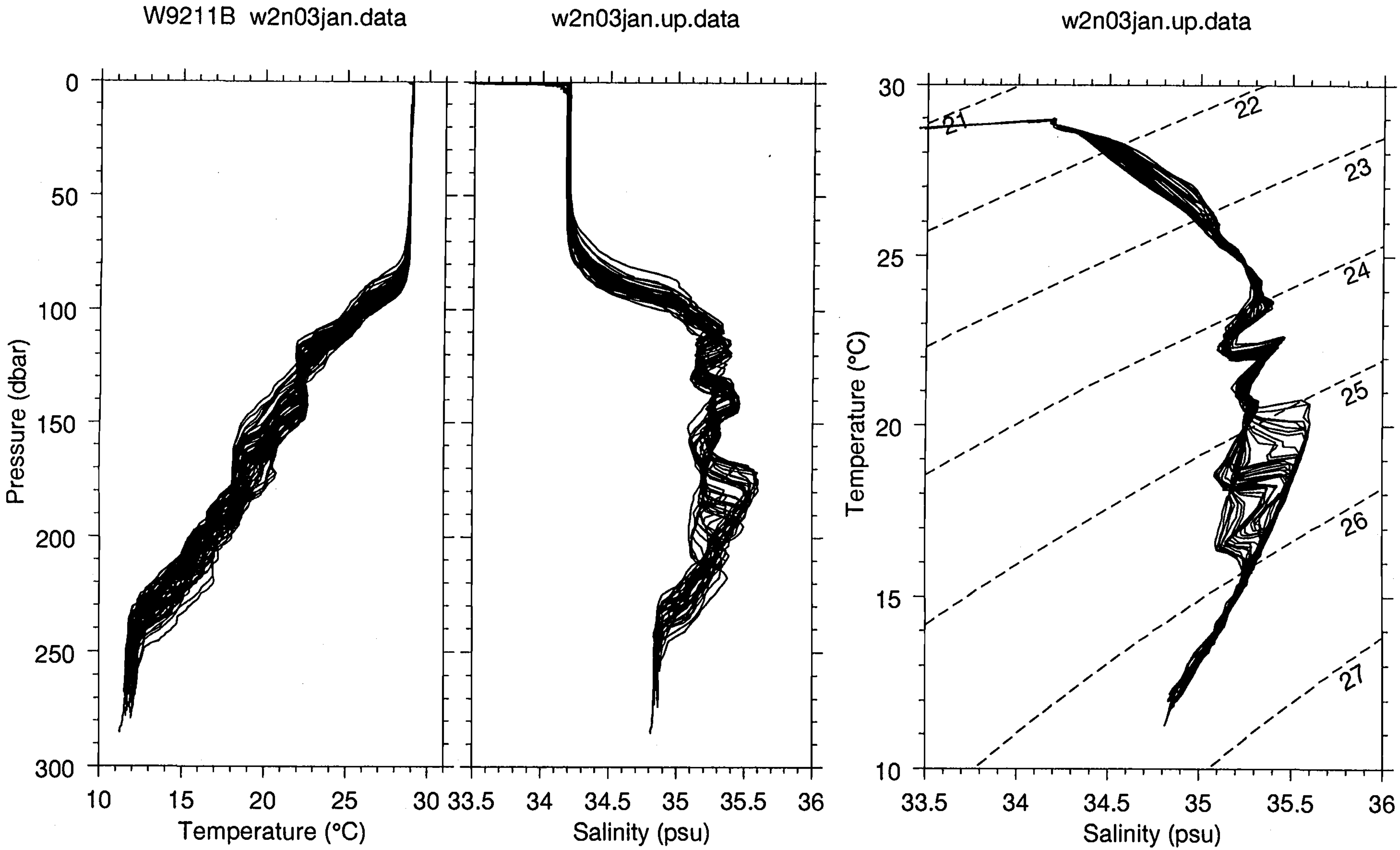
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200
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20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
Temperature (°C)
30
25
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34.5
35
35.5
36
Salinity (psu)
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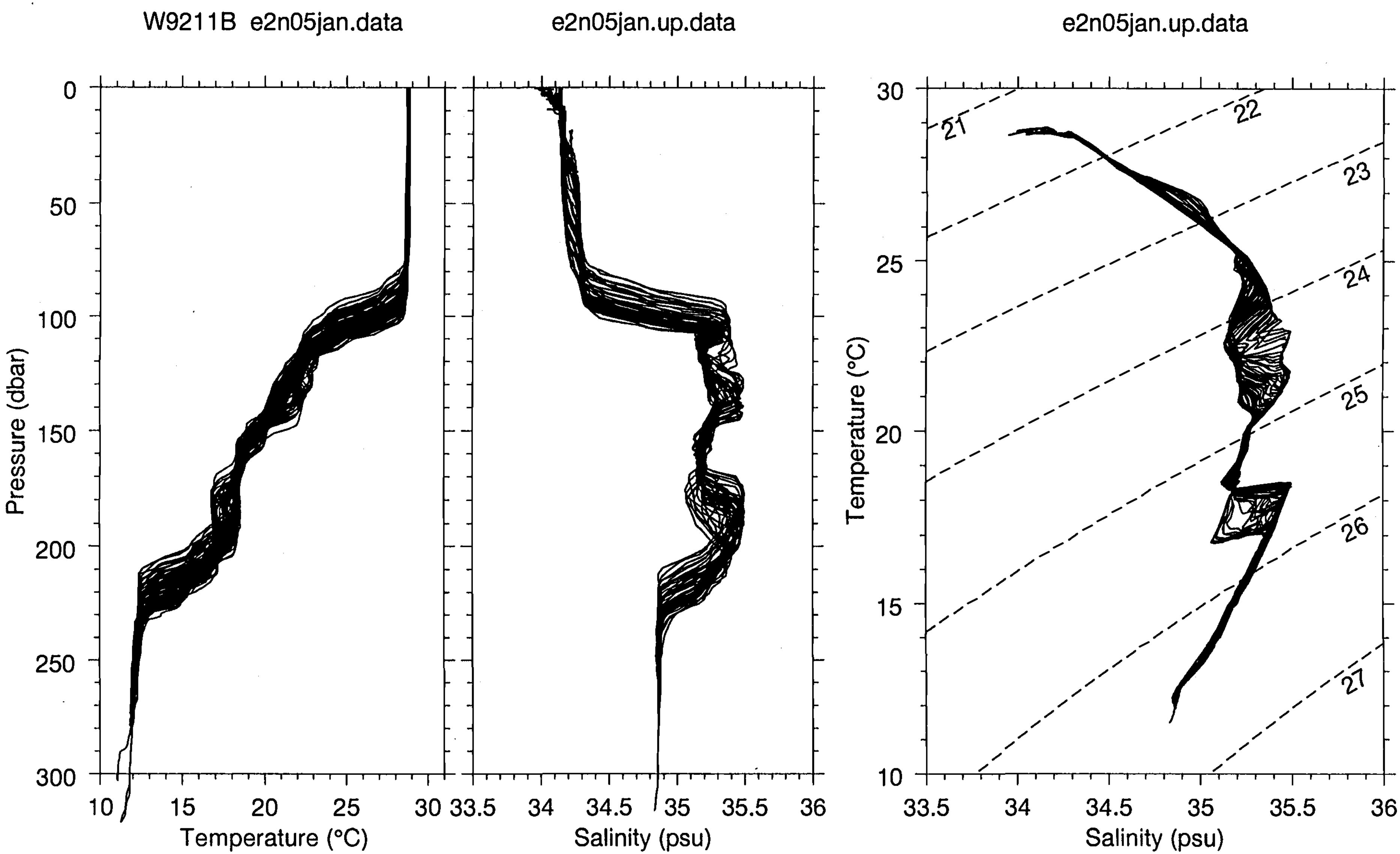
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200
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25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
Temperature (°C)
30
25
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35.5
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Salinity (psu)
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22
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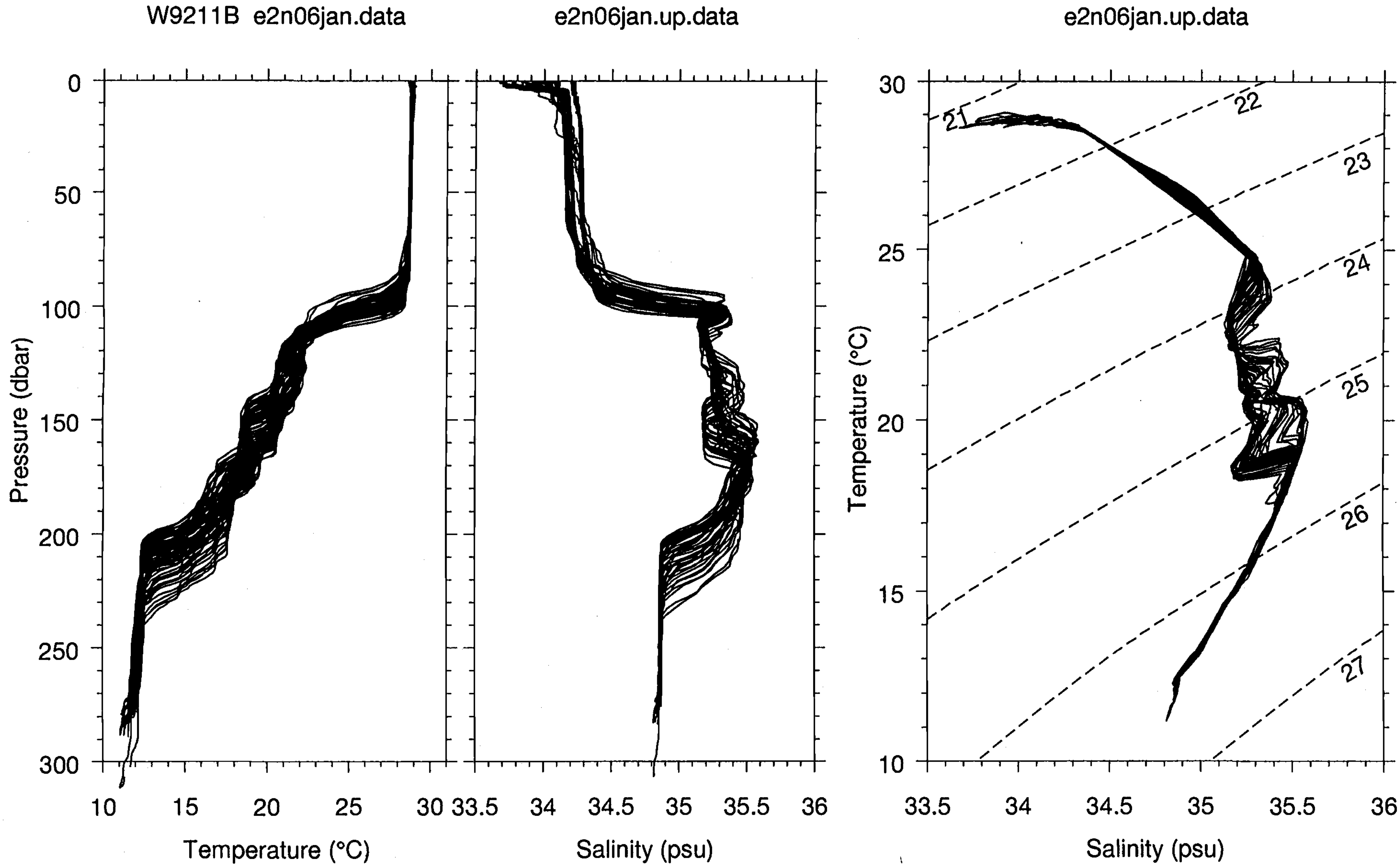
27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e2n06jan.up.data
Pressure (dbar)
Temperature (°C)
Salinity (psu)
Temperature (°C)
Salinity (psu)
0
50
100
150
200
250
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33.5
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34.5
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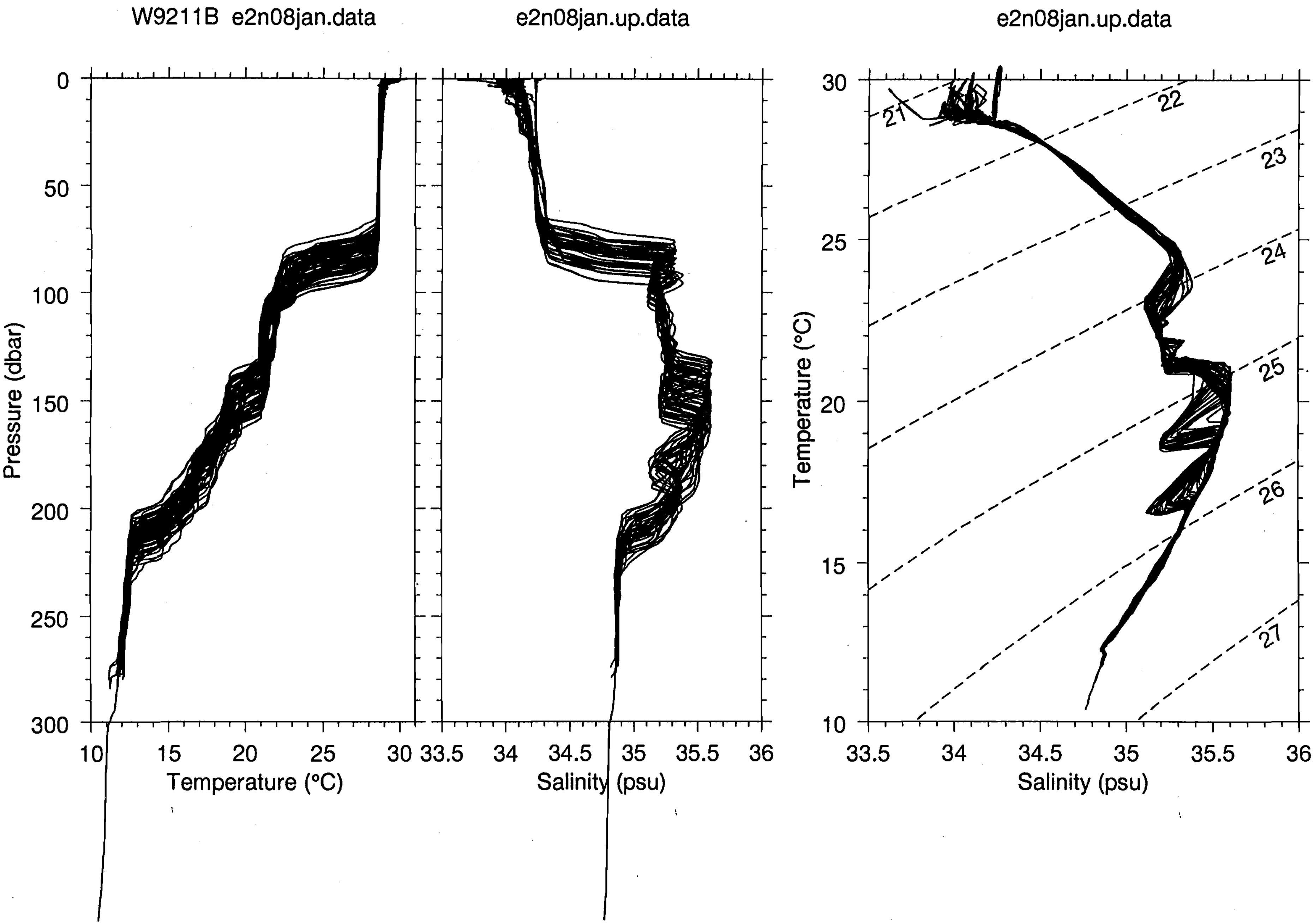
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20
25
30
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)
Temperature (°C)
30
25
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34.5
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35.5
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Salinity (psu)
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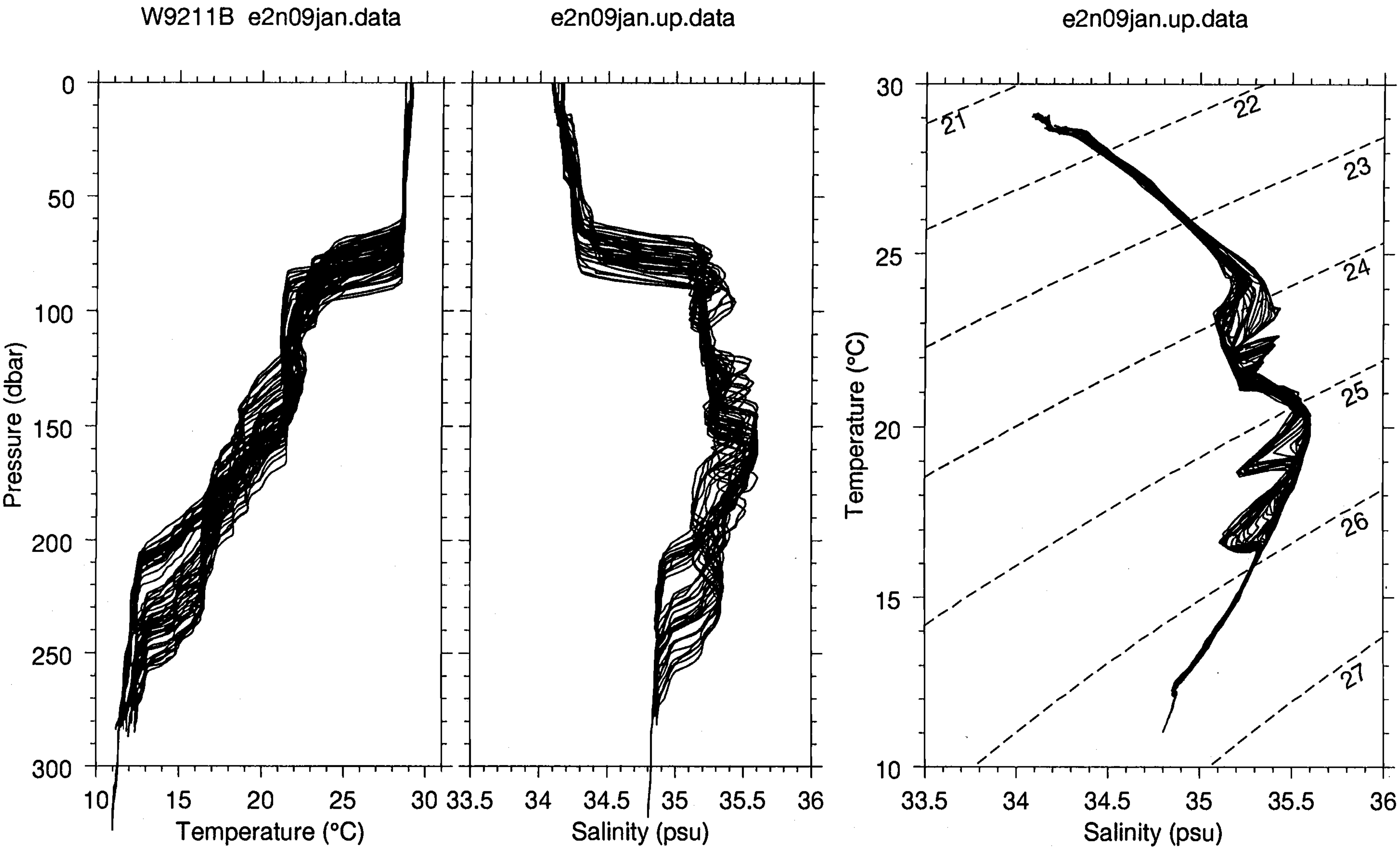
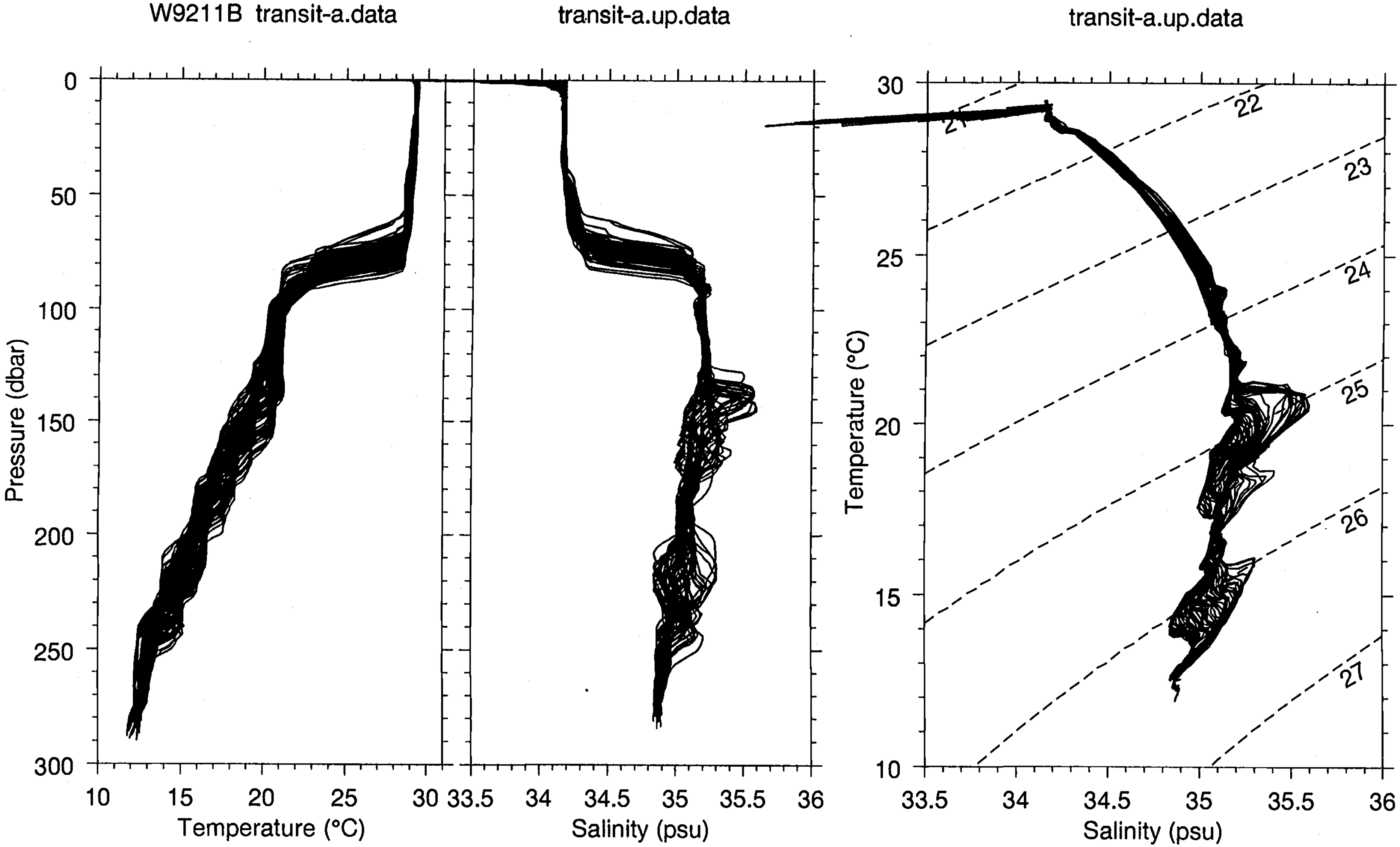
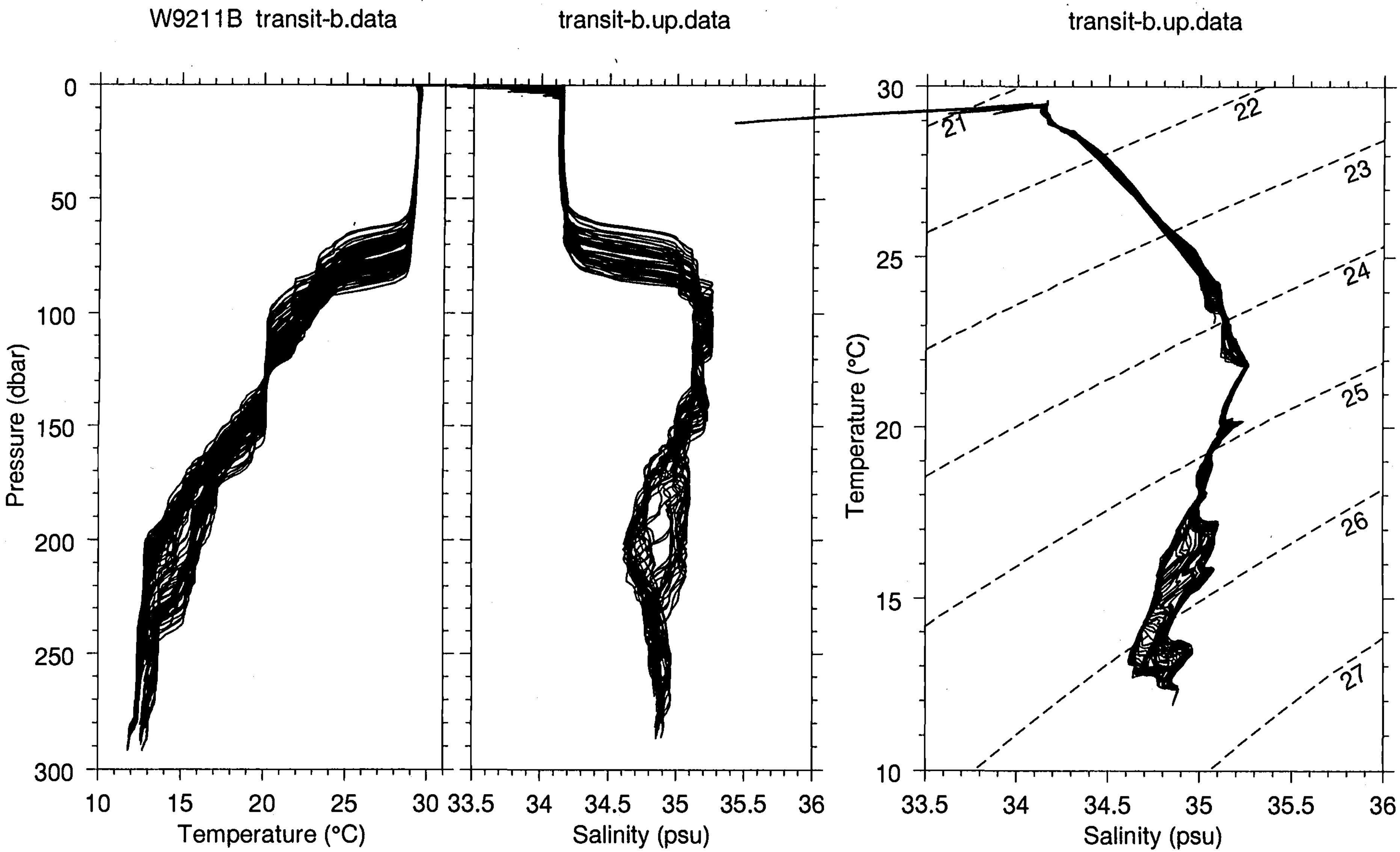

W9211B e2n09jan.data
e2n09jan.up.data
e2n09jan.up.data
Pressure (dbar)
Temperature (°C)
Salinity (psu)
Temperature (°C)
Salinity (psu)
21
22
23
24
25
26
27

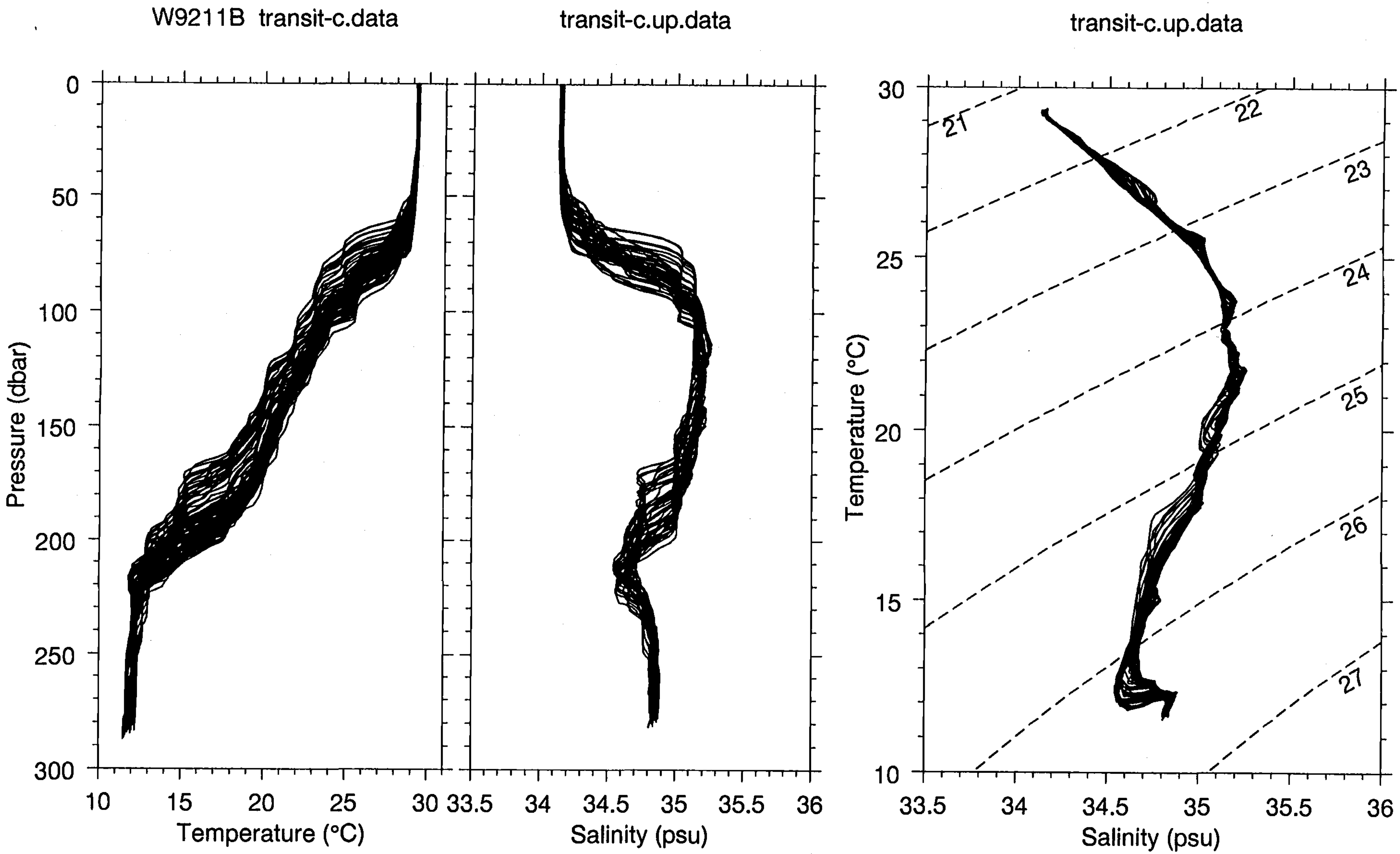
Transit from SBN to the equator along 156.1° East longitude



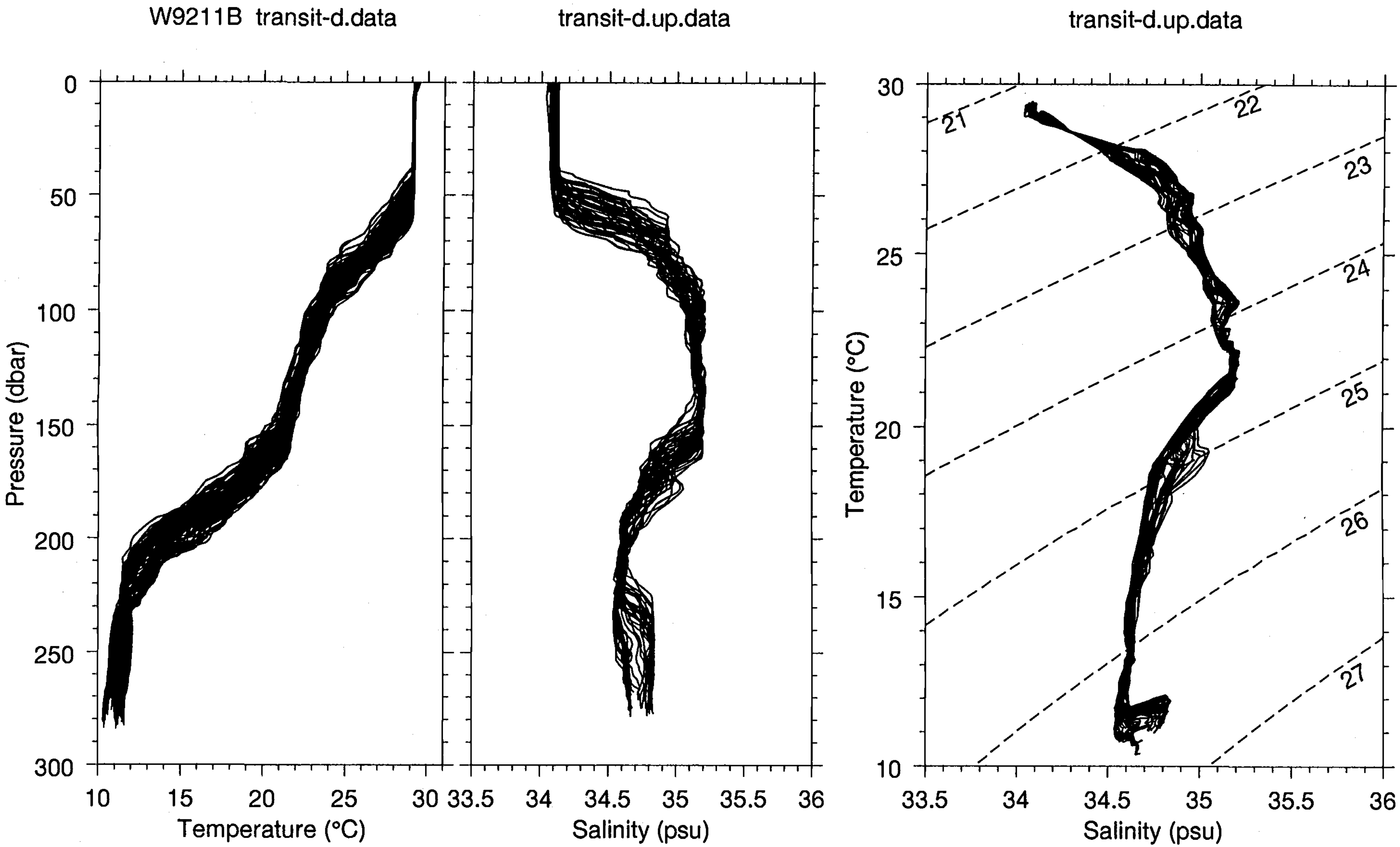
Transit from the equator to 1° North latitude along 156.1° East longitude



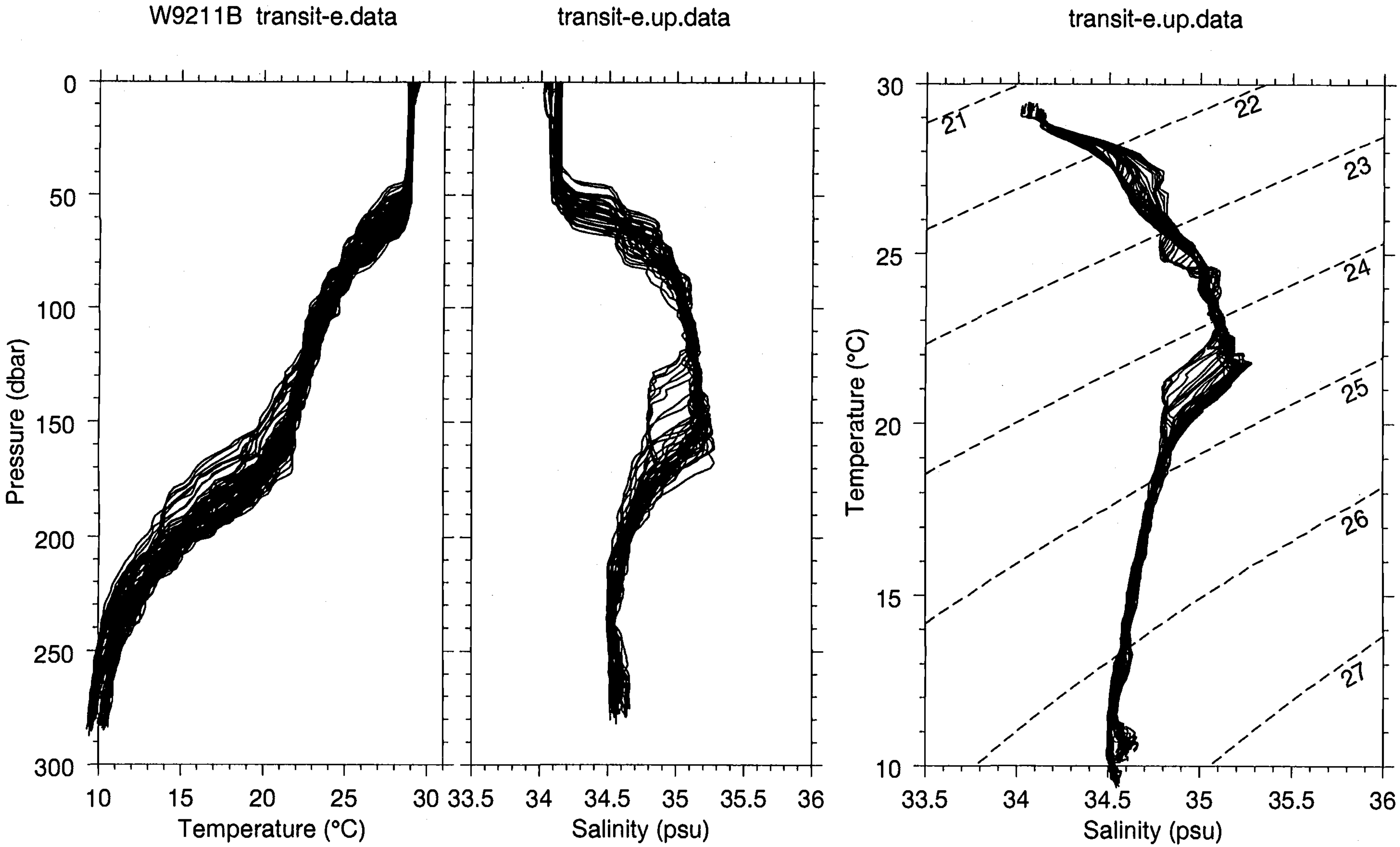
Transit from 1° North latitude to 2° North latitude along 156.1° East longitude



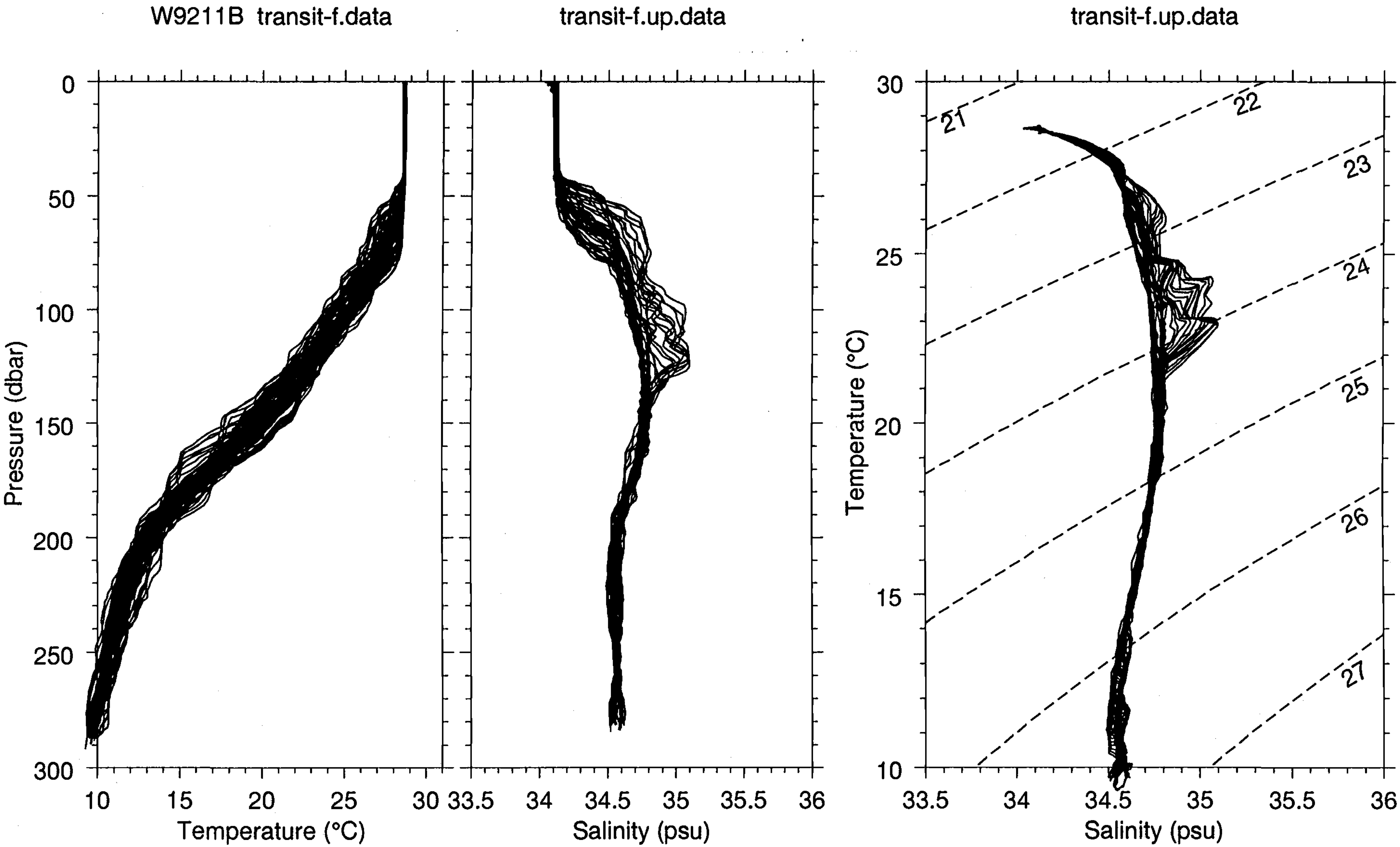
Transit from 2° North latitude to 3° North latitude along 156.1° East longitude



Transit from 3° North latitude to 4° North latitude along 156.1° East longitude



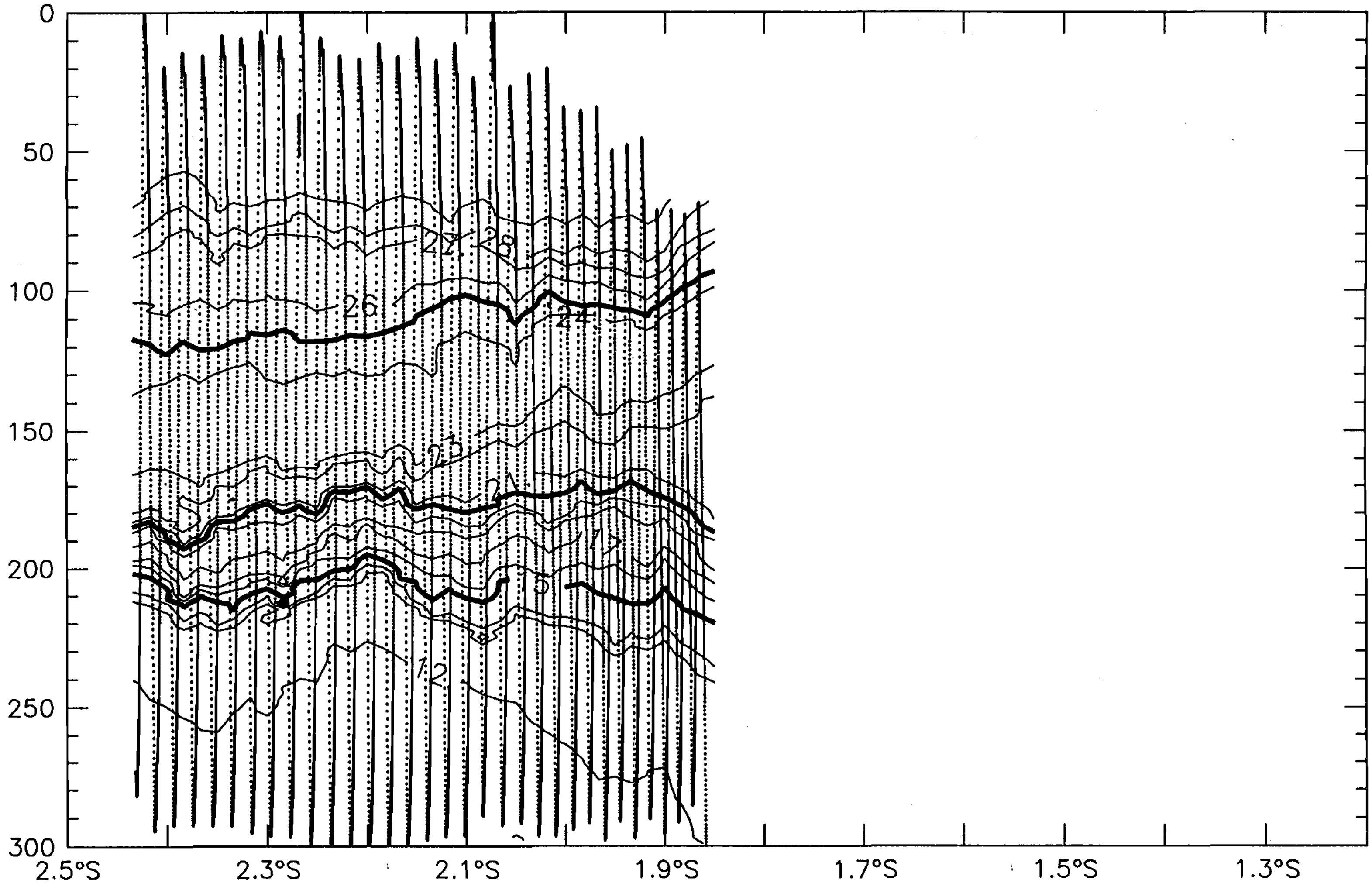
Transit from 4° North latitude to 5° North latitude along 156.1° East longitude



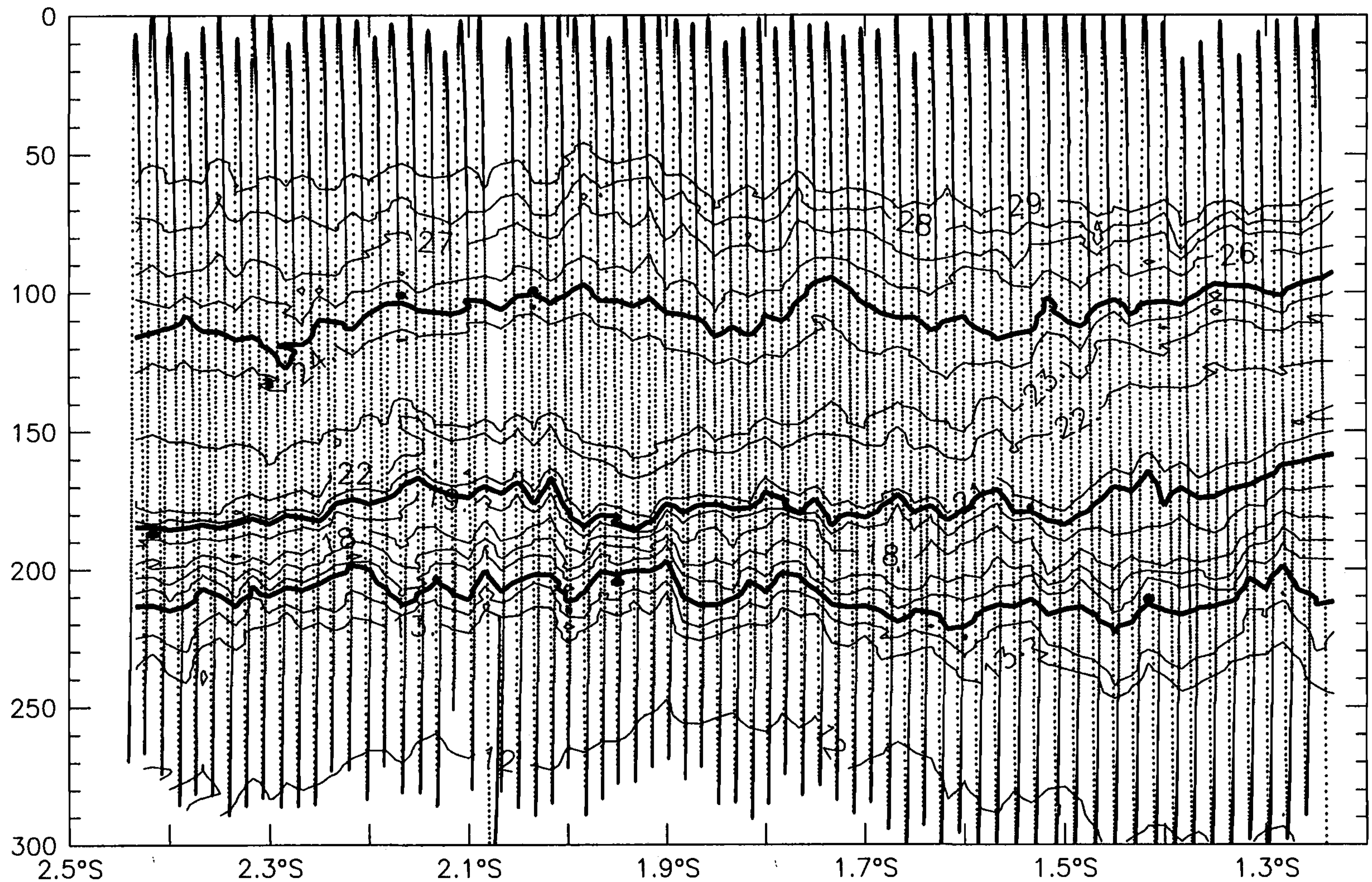
VERTICAL SECTIONS

OF

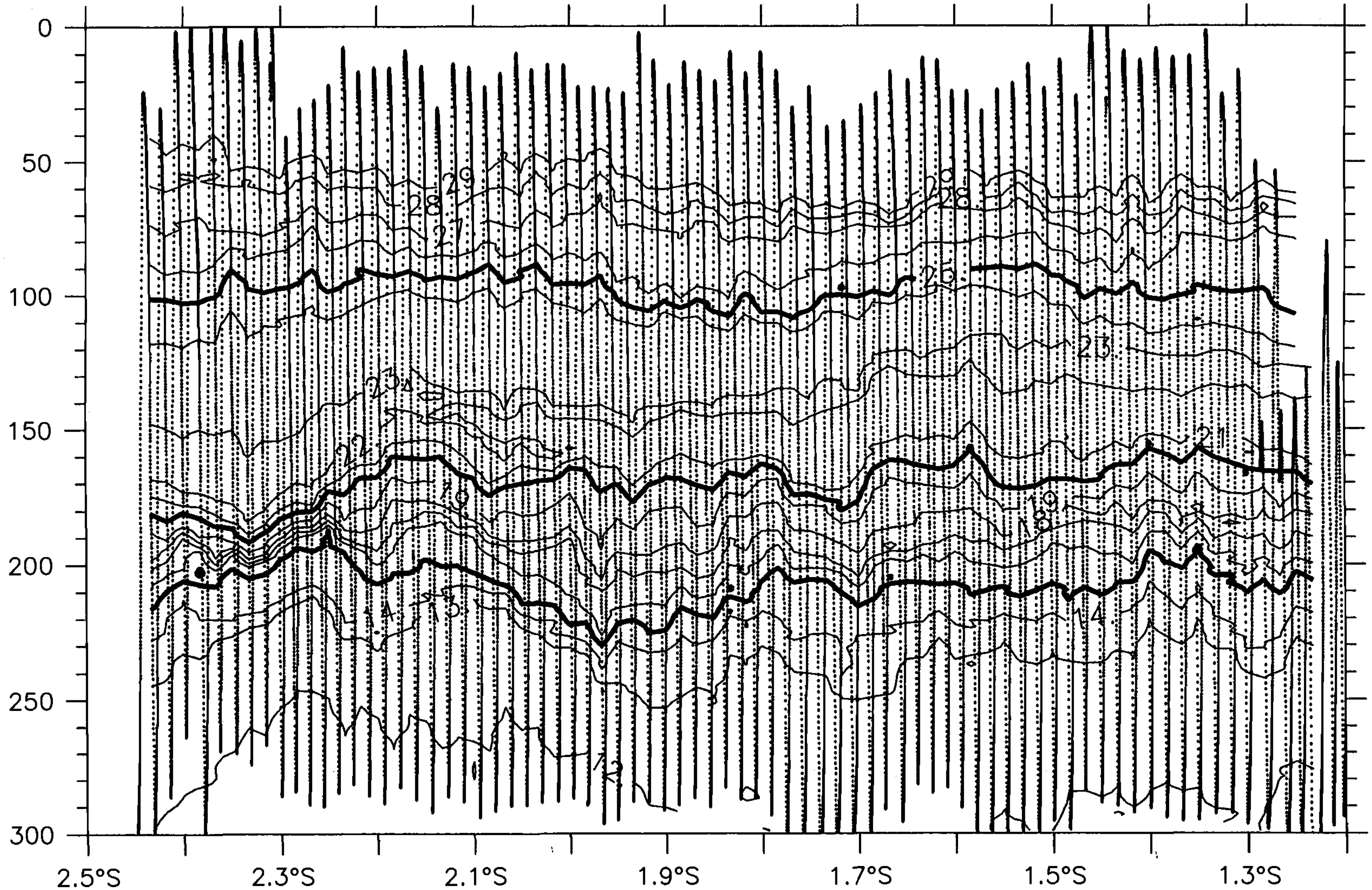
TEMPERATURE, SALINITY AND SIGMA-T



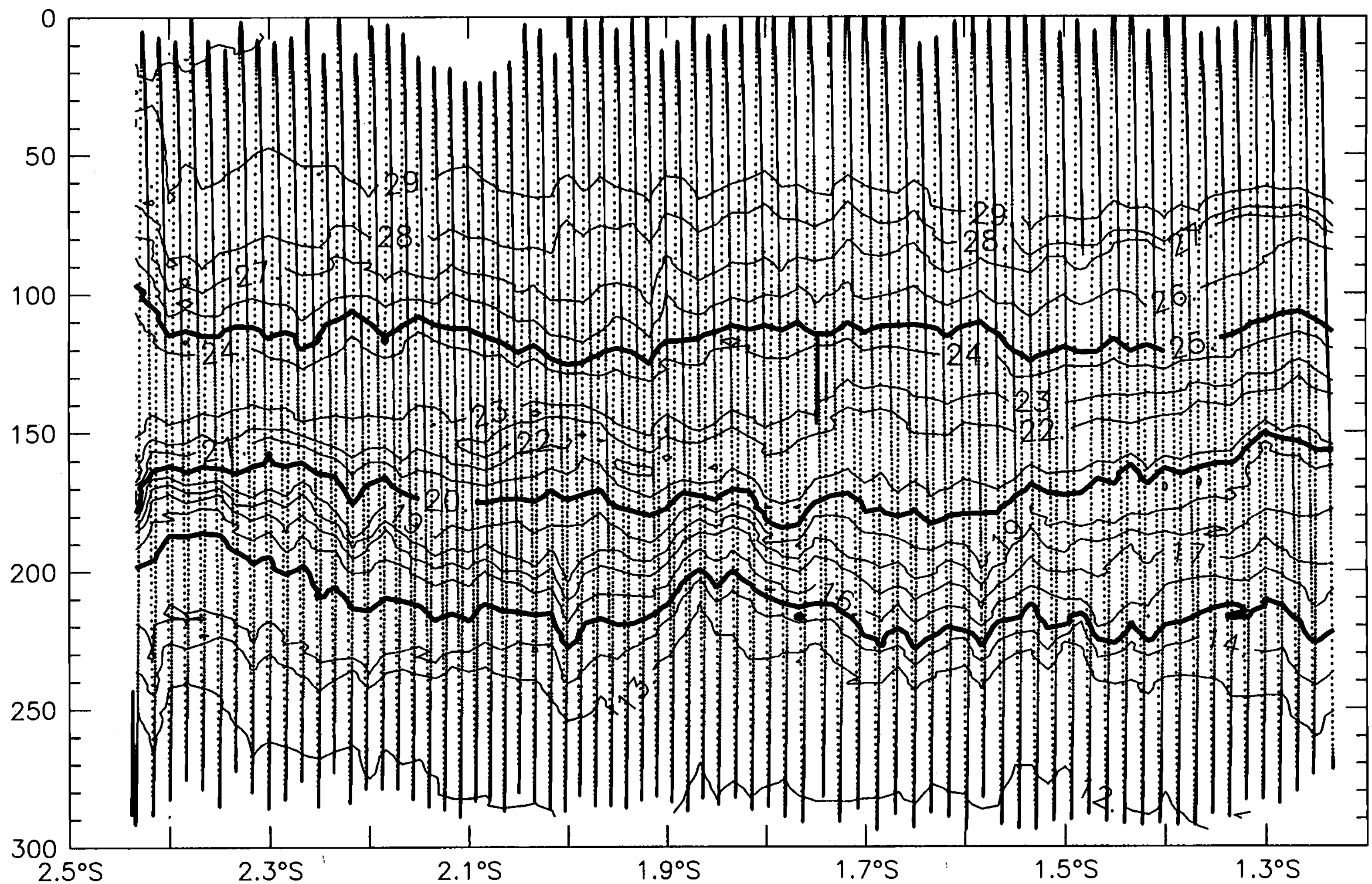
T(°C), N2S, 19 December 1992



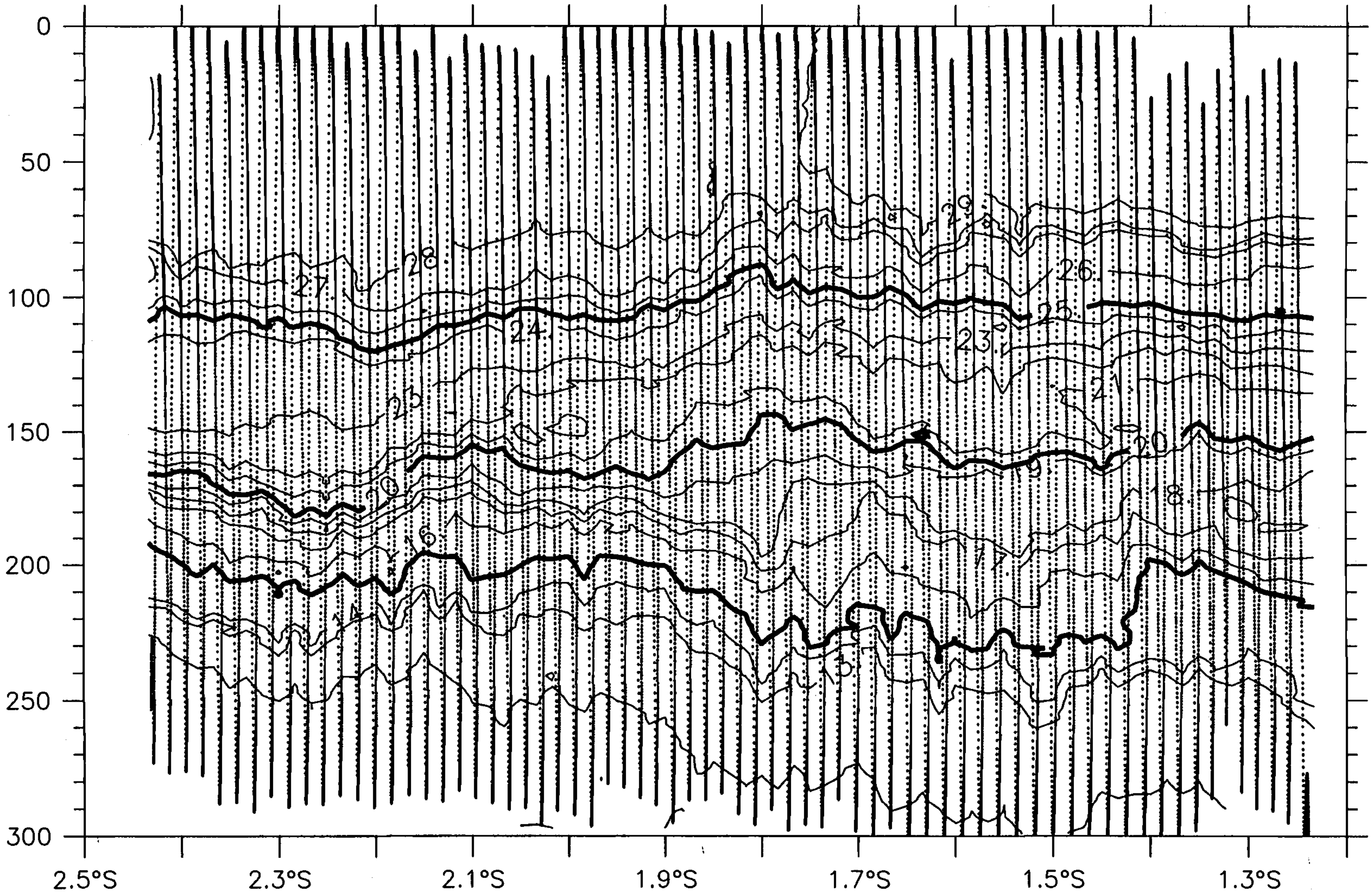
T(°C), N2S, 20 December 1992



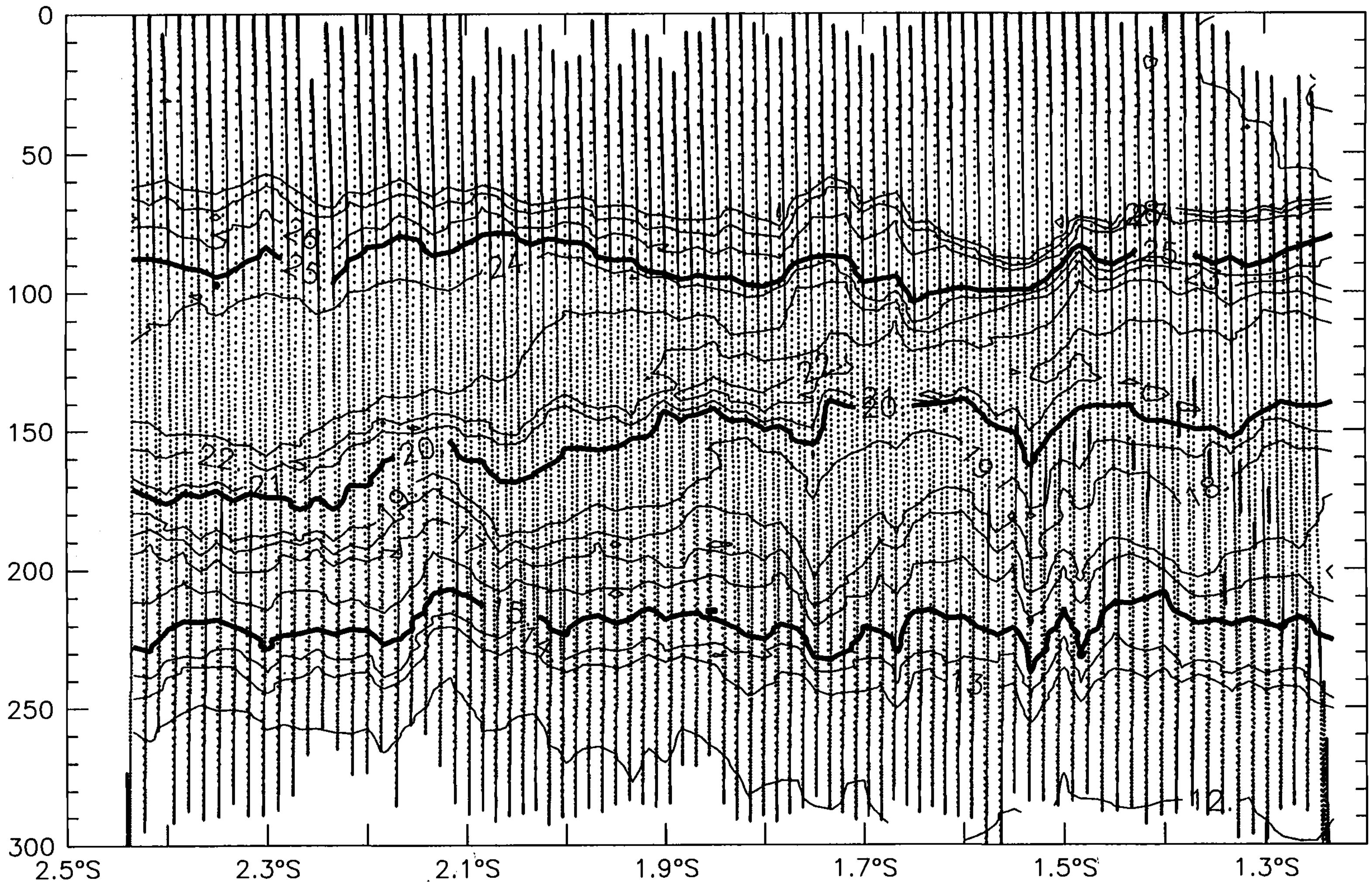
T(°C), N2S, 22 December 1992



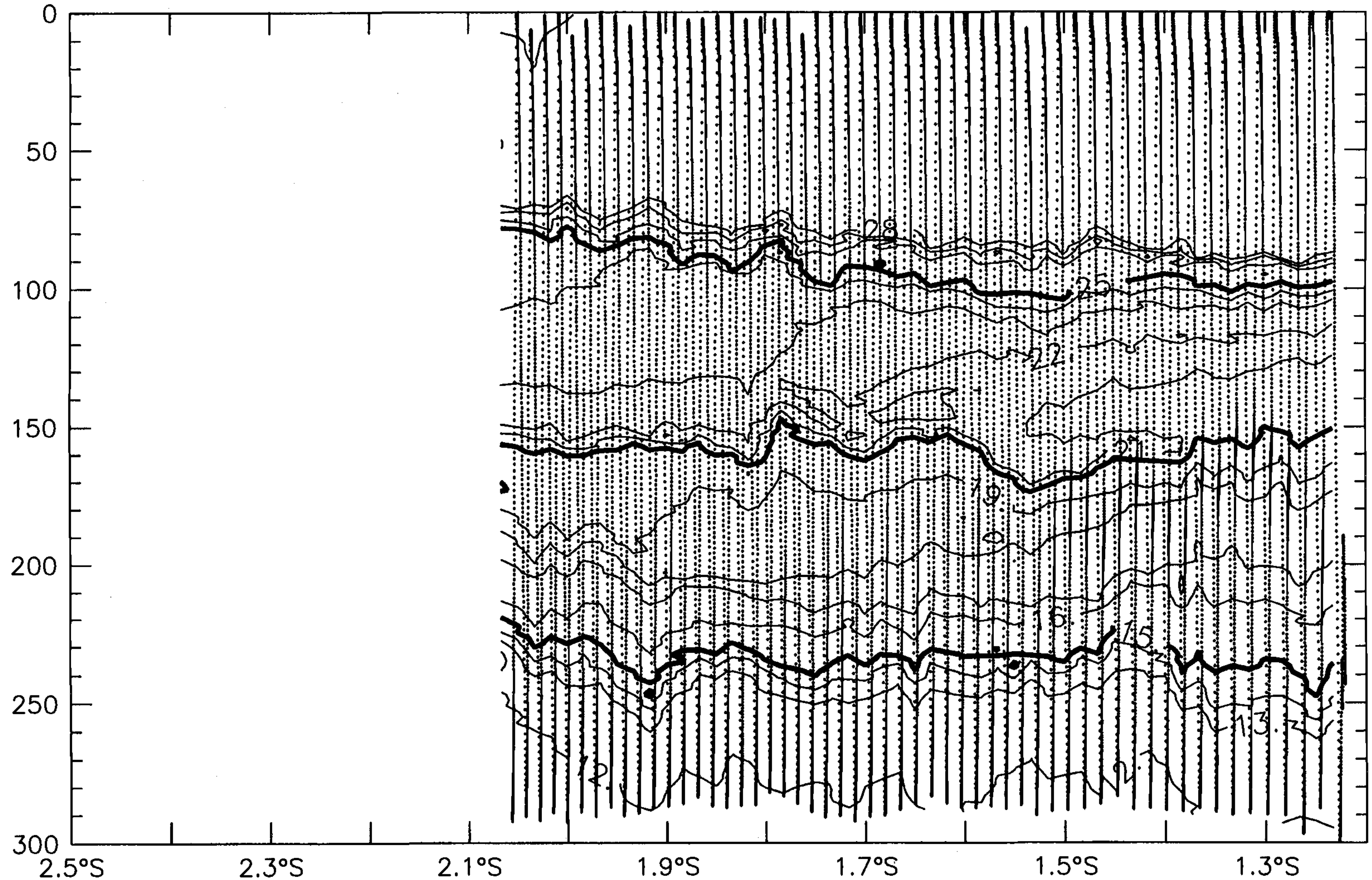
T(°C), N2S, 24 December 1992



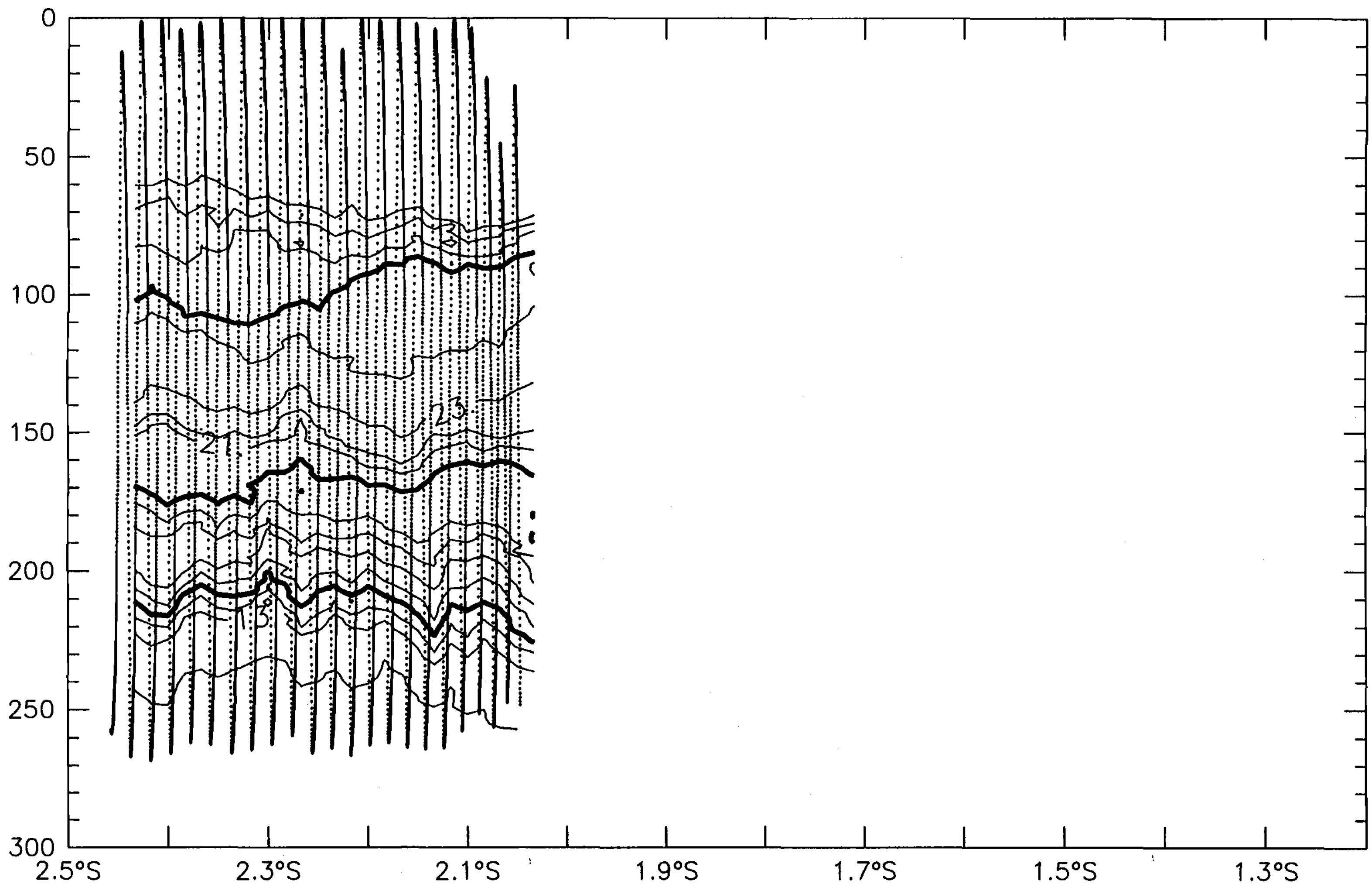
T(°C), N2S, 25 December 1992



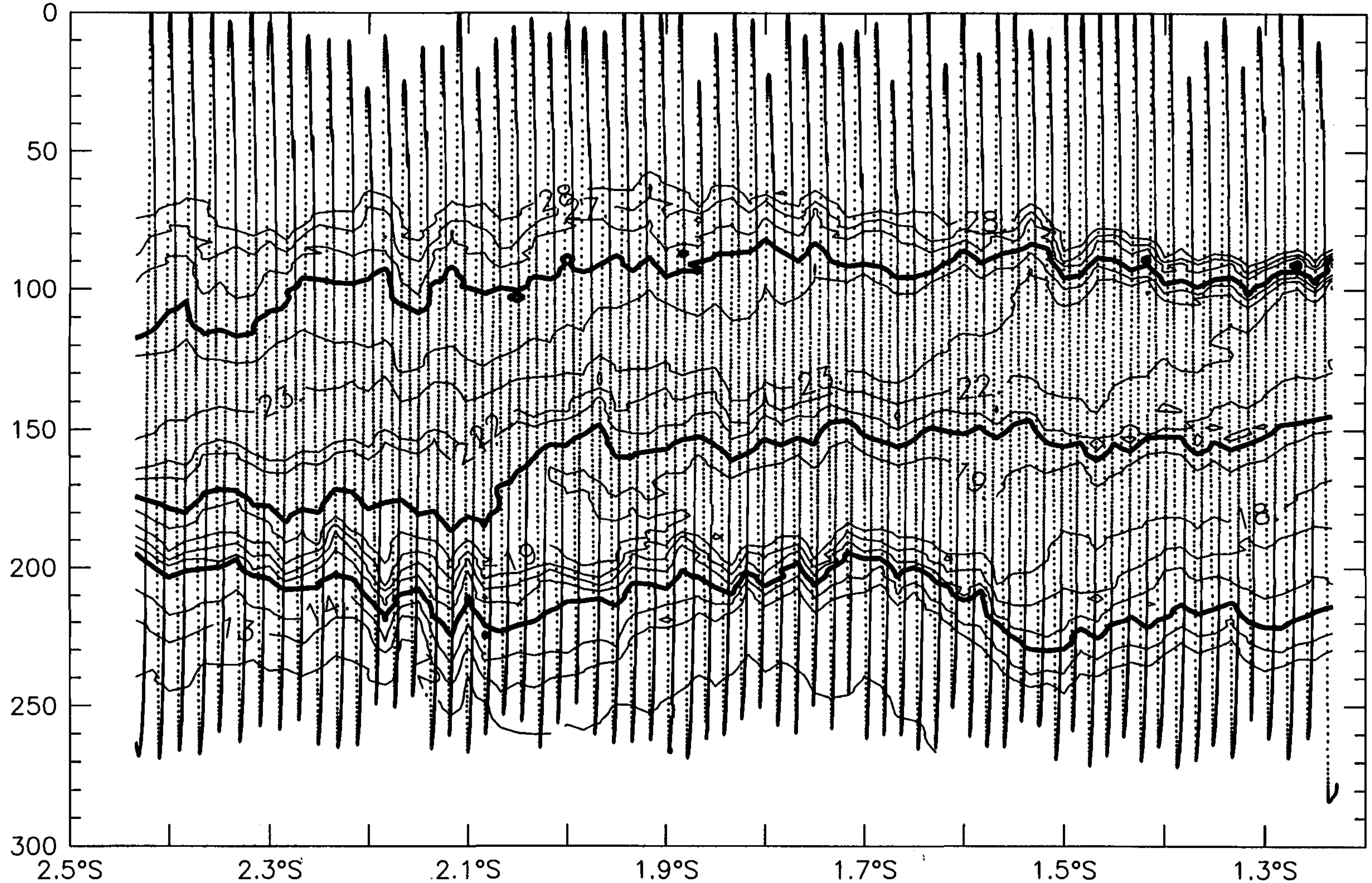
T(°C), N2S, 27 December 1992



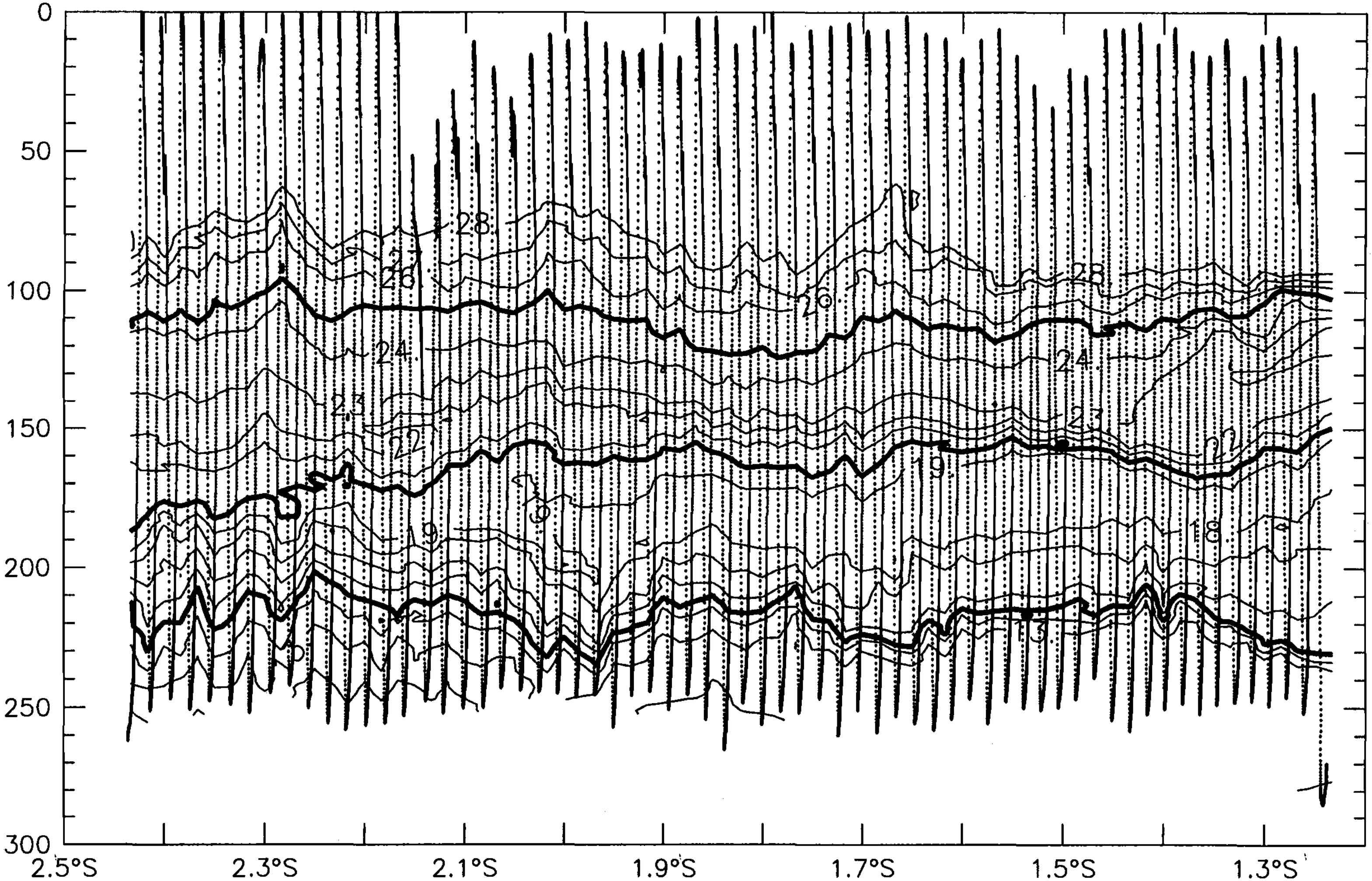
T(°C), N2S, 28 December 1992



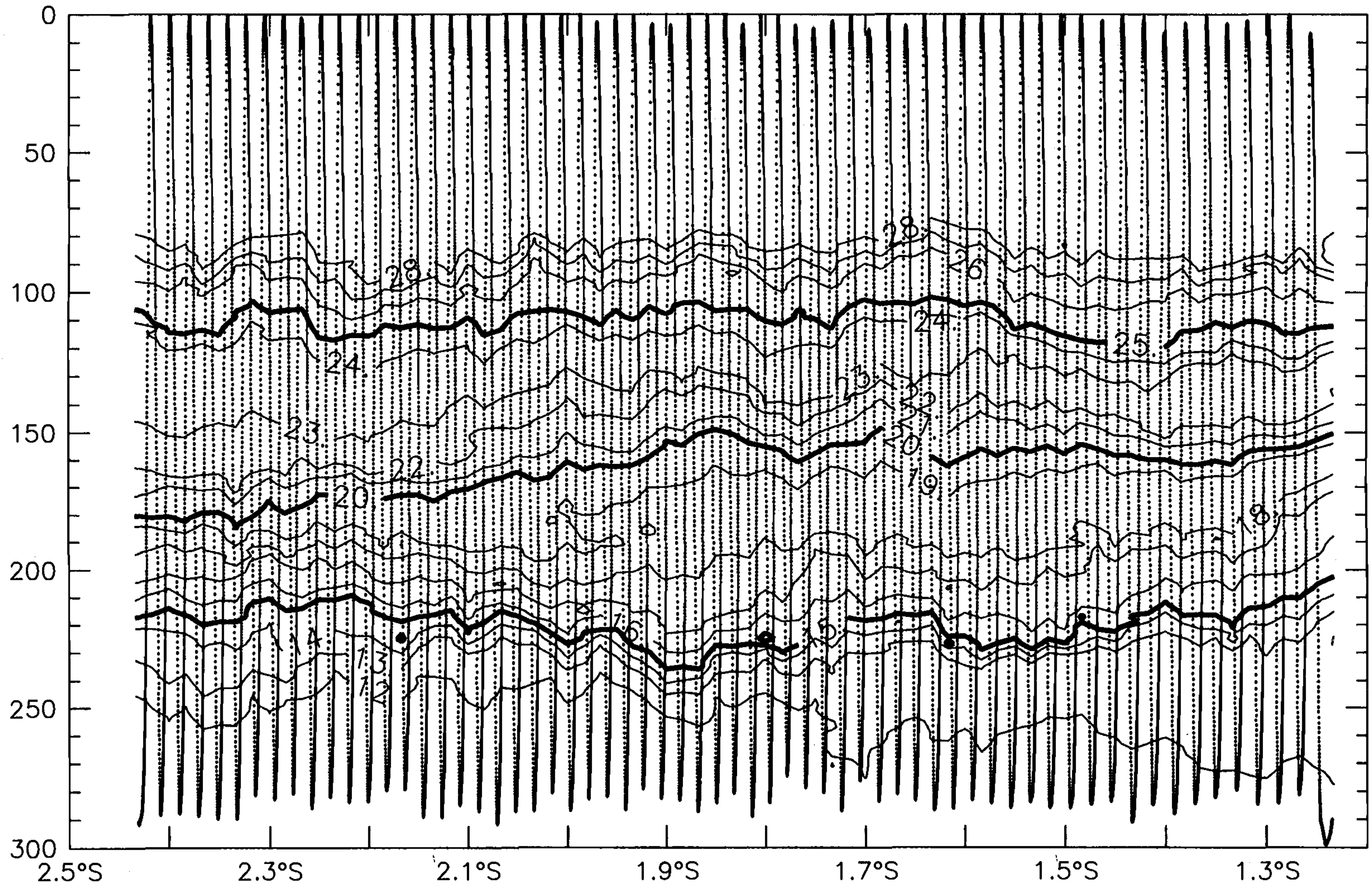
T(°C), N2S, 29 December 1992



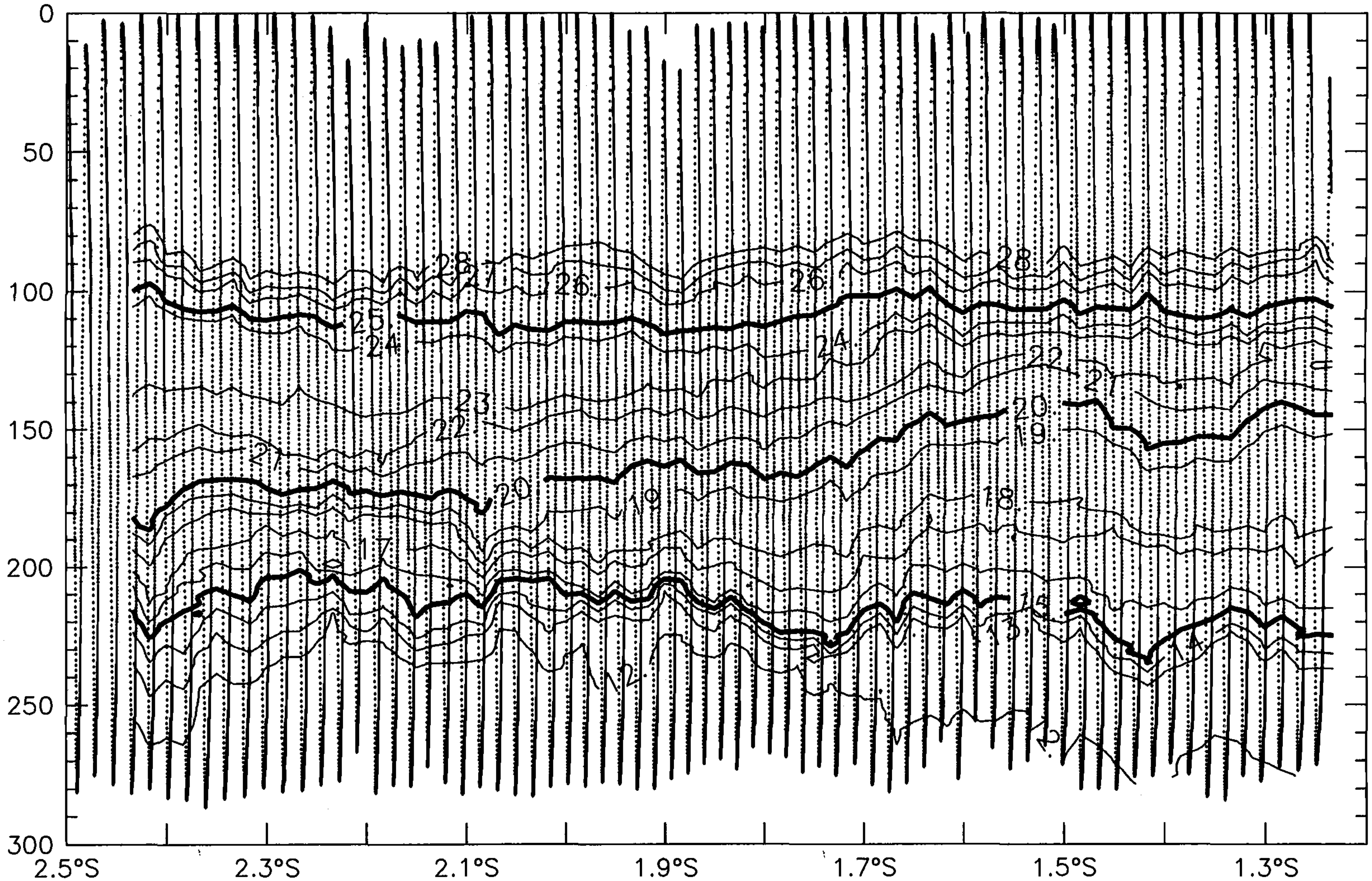
T(°C), N2S, 30 December 1992



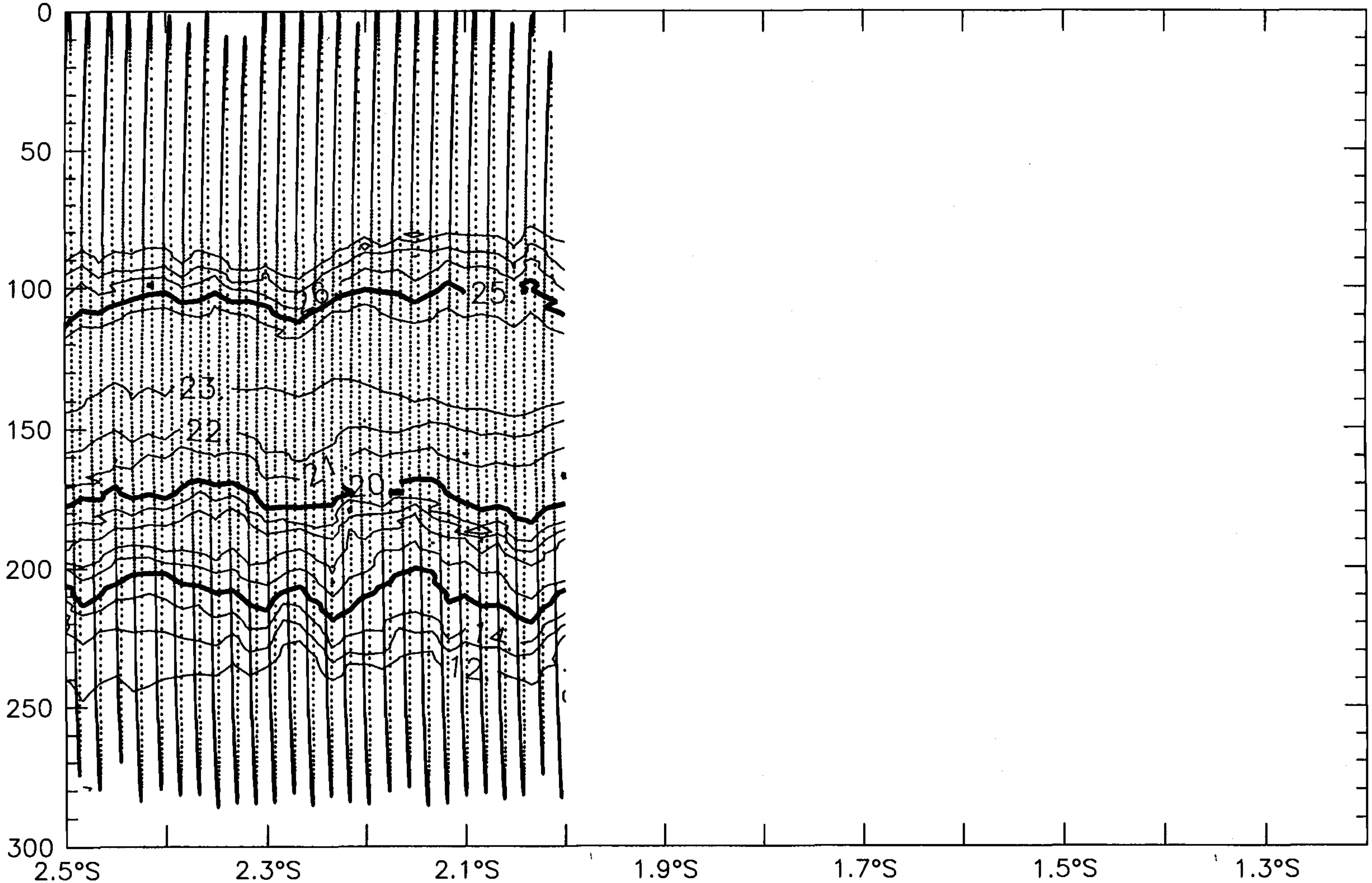
T(°C), N2S, 31 December 1992



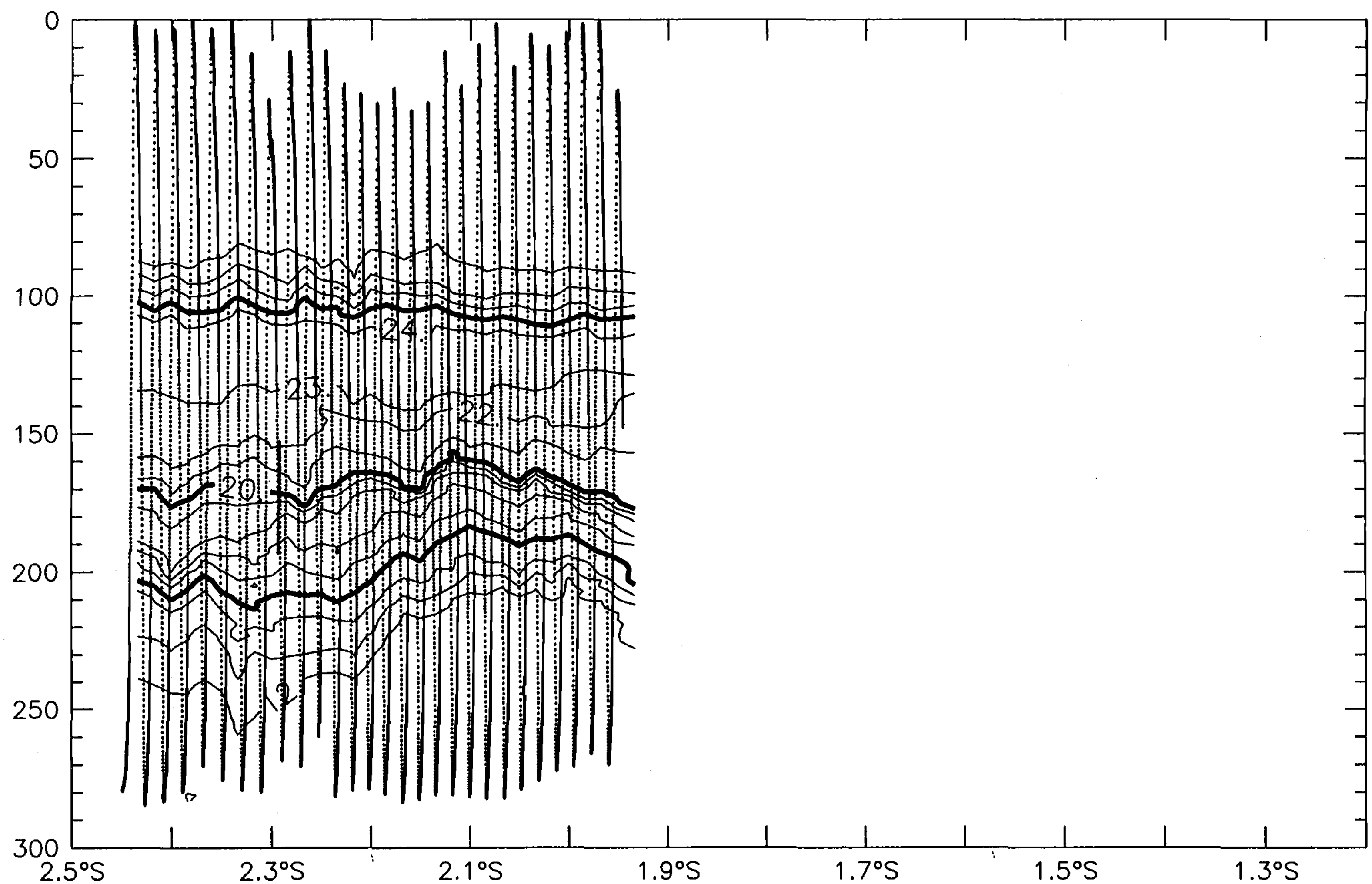
T(°C), N2S, 2 January 1993



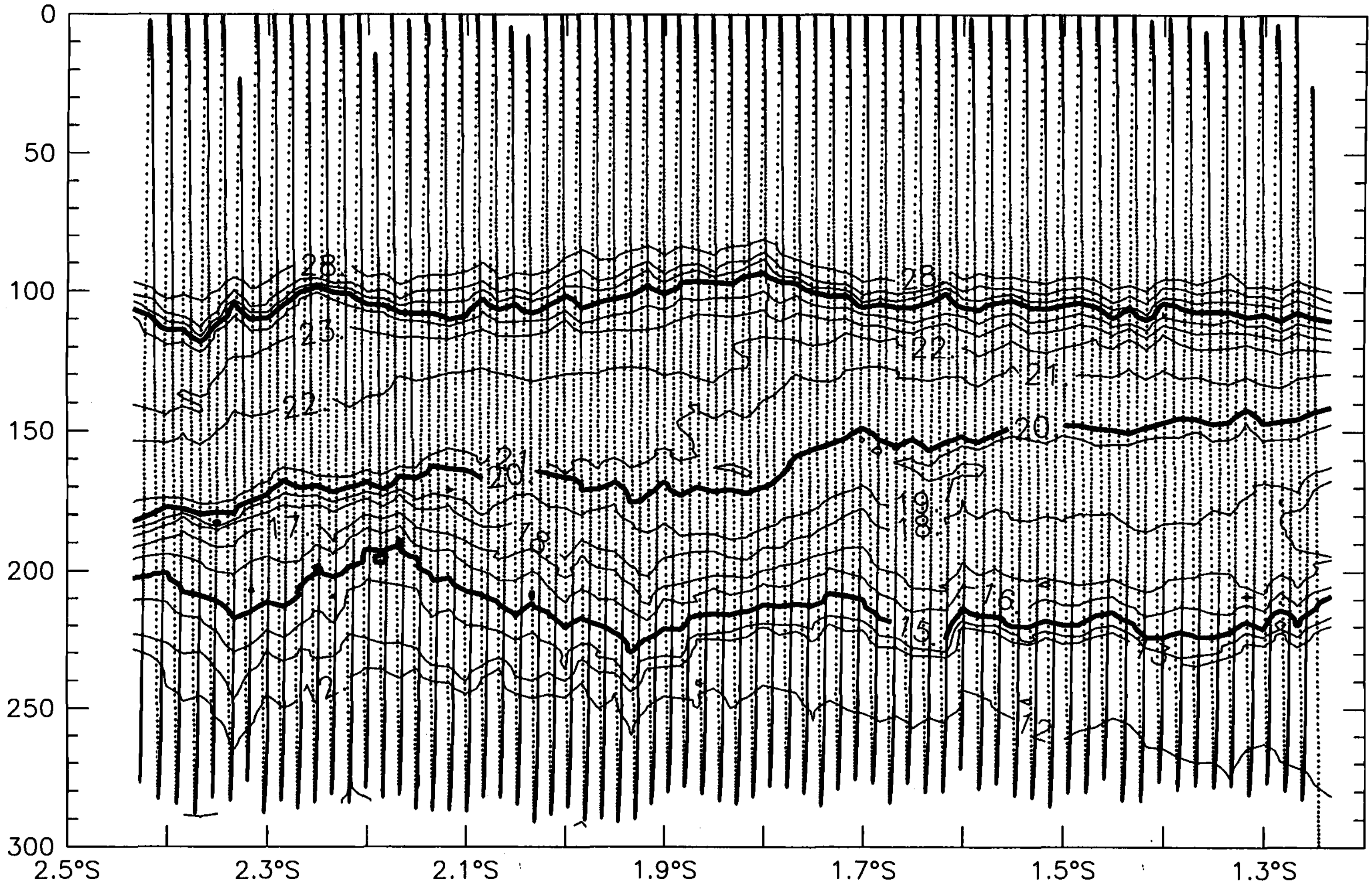
T(°C), N2S, 3 January 1993



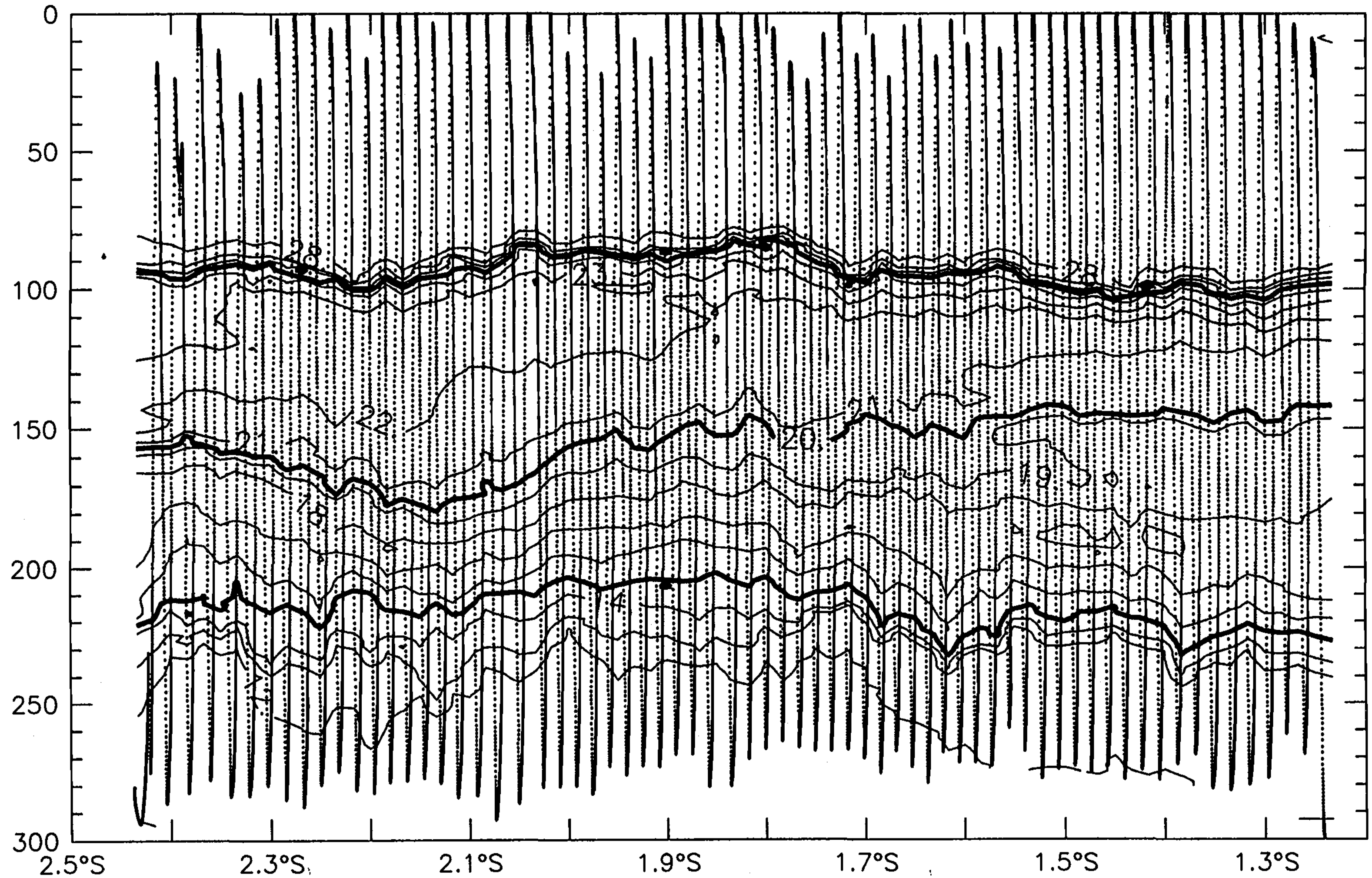
T(°C), S2N, 3 January 1993



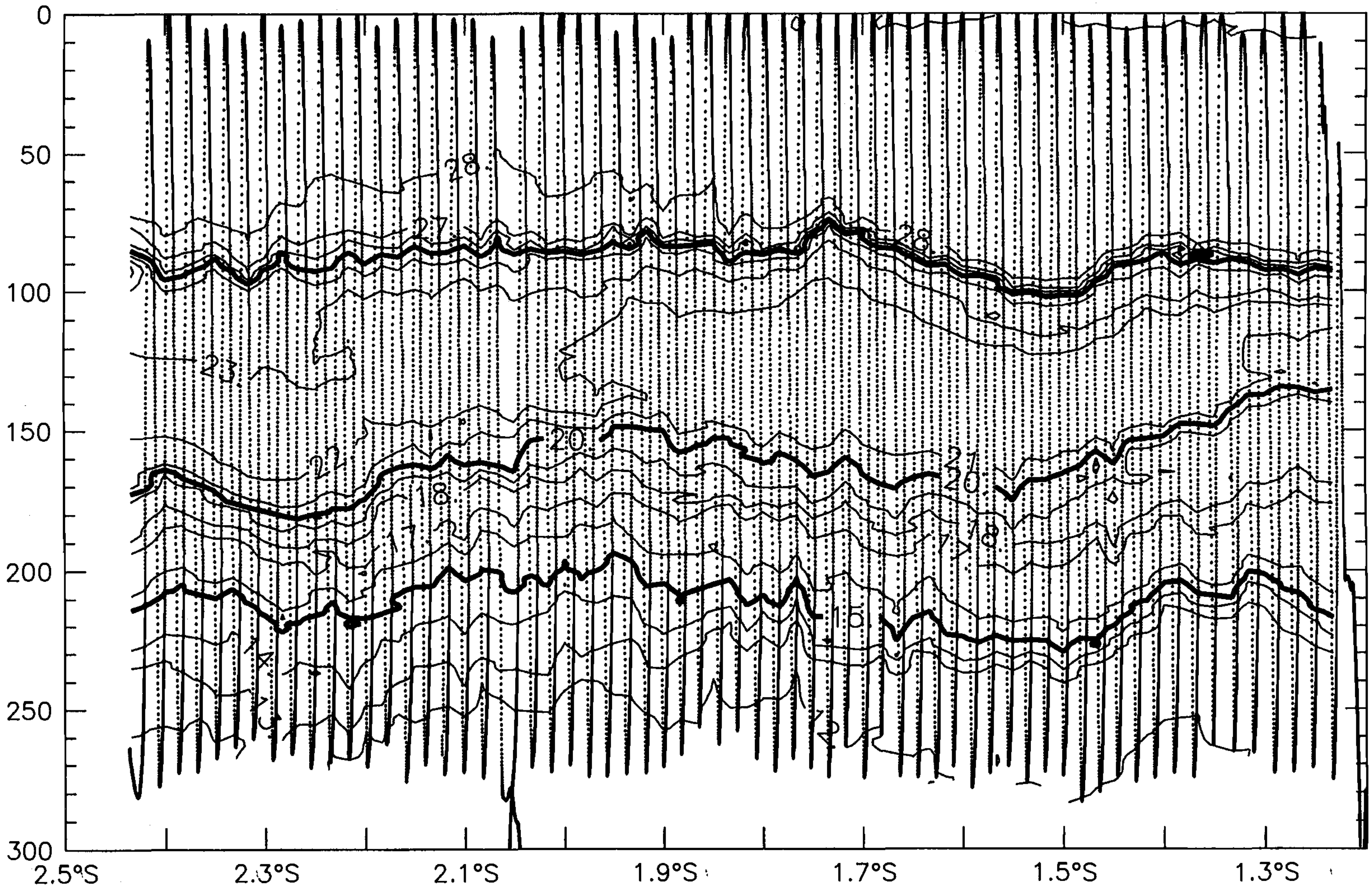
T(°C), N2S, 4 January 1993



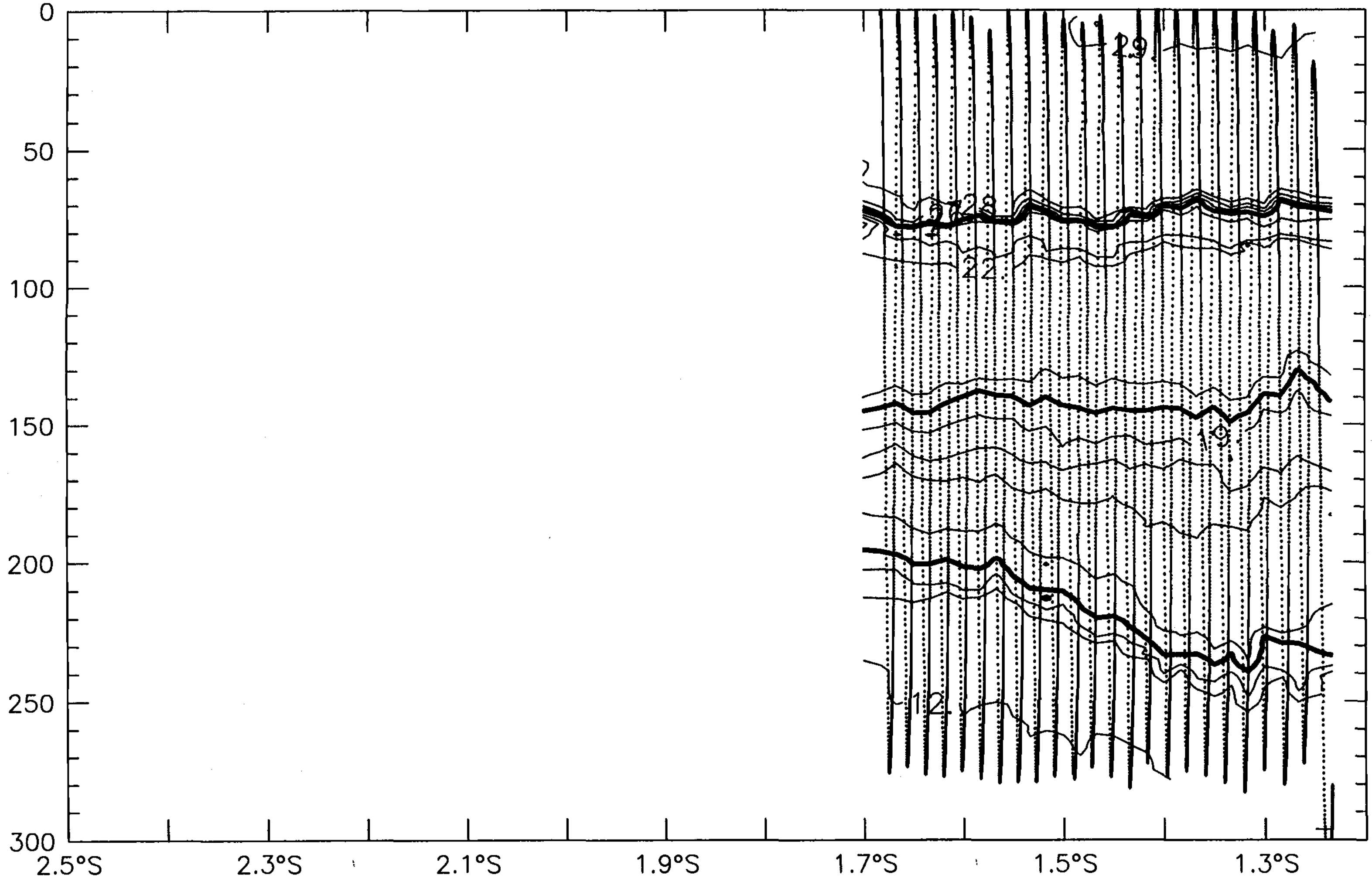
T(°C), N2S, 5 January 1993



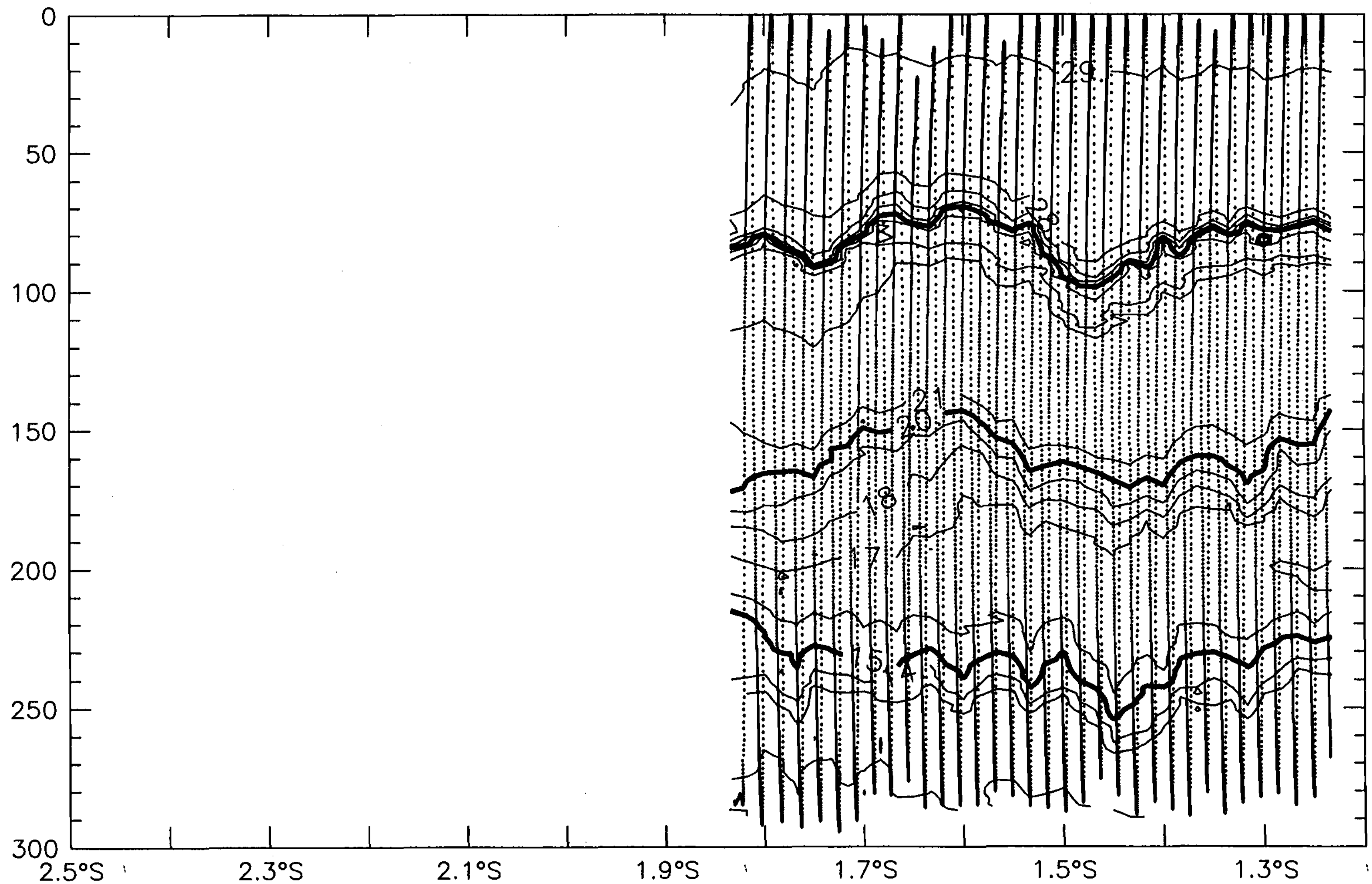
T(°C), N2S, 6 January 1993



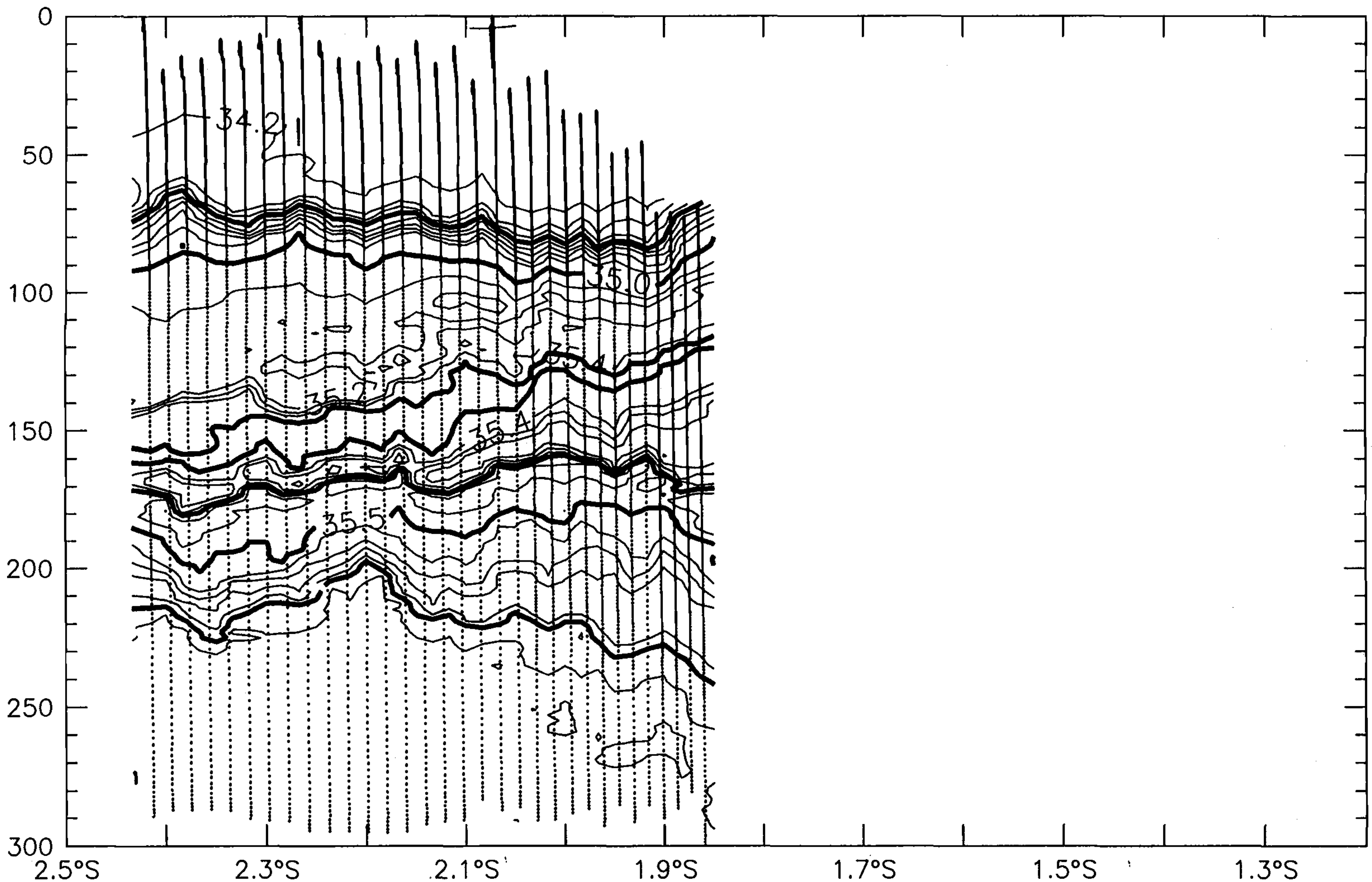
T(°C), N2S, 8 January 1993



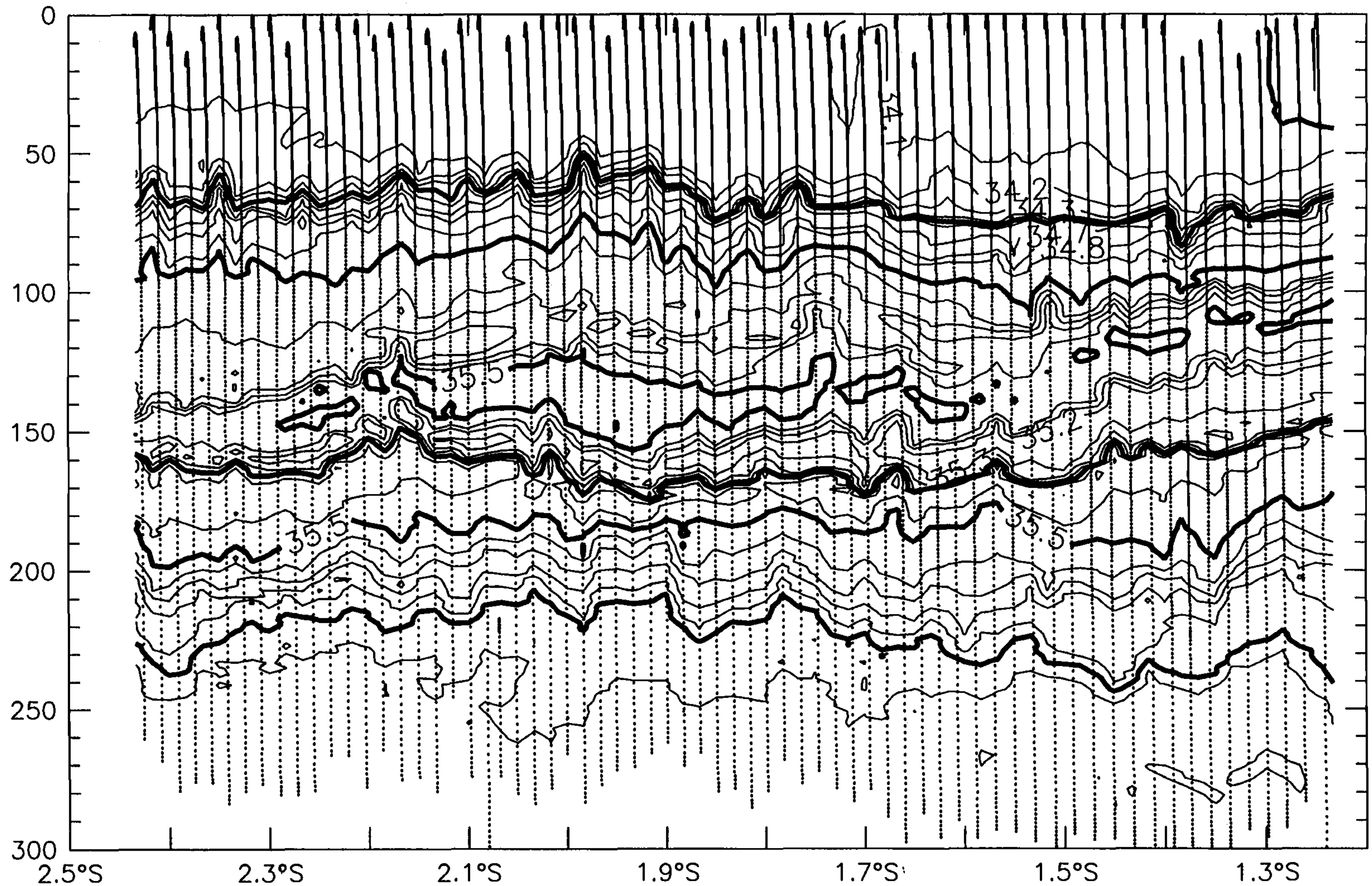
T(°C), N2S, 9 January 1993



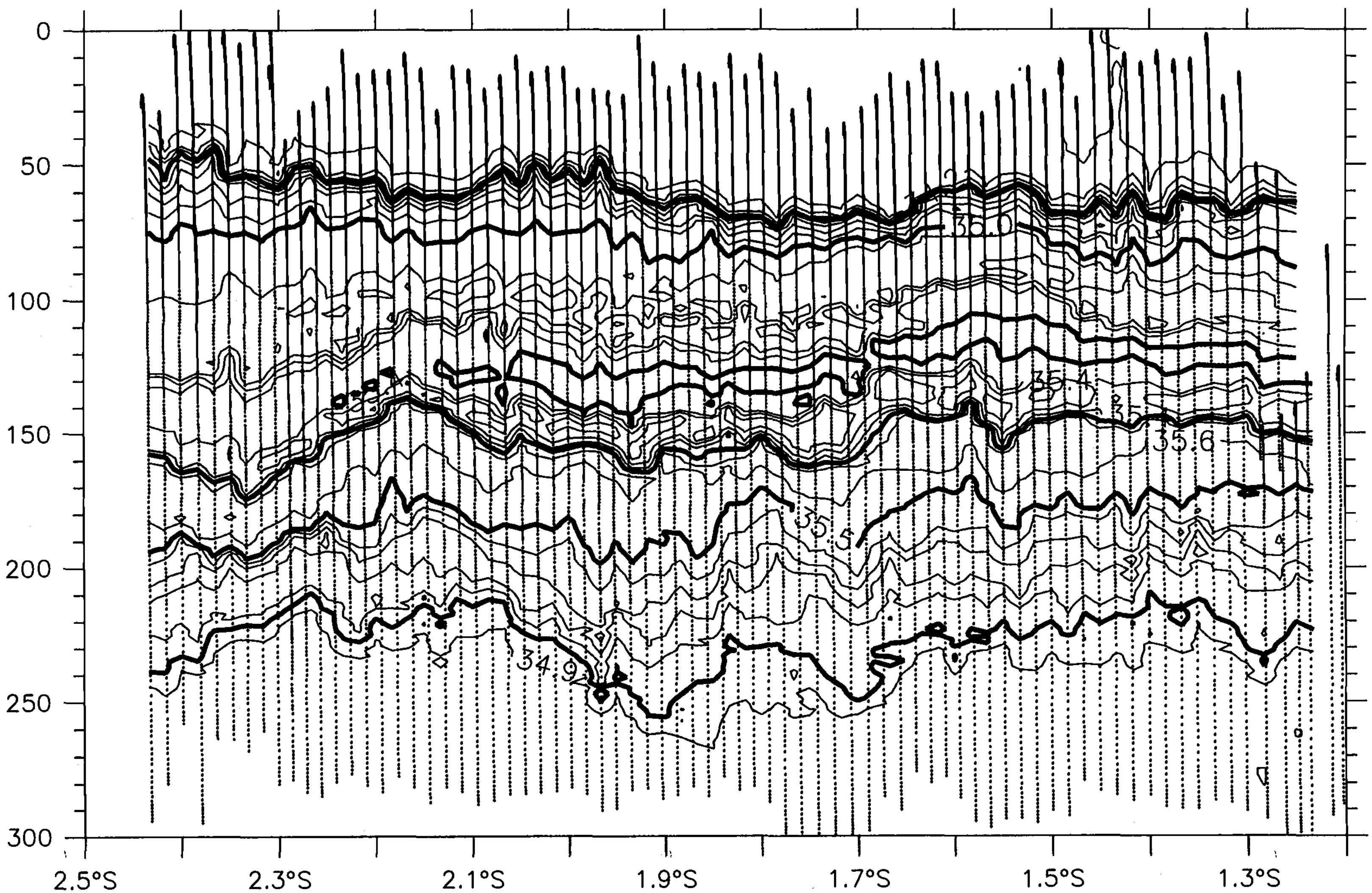
T(°C), N2S, 10 January 1993



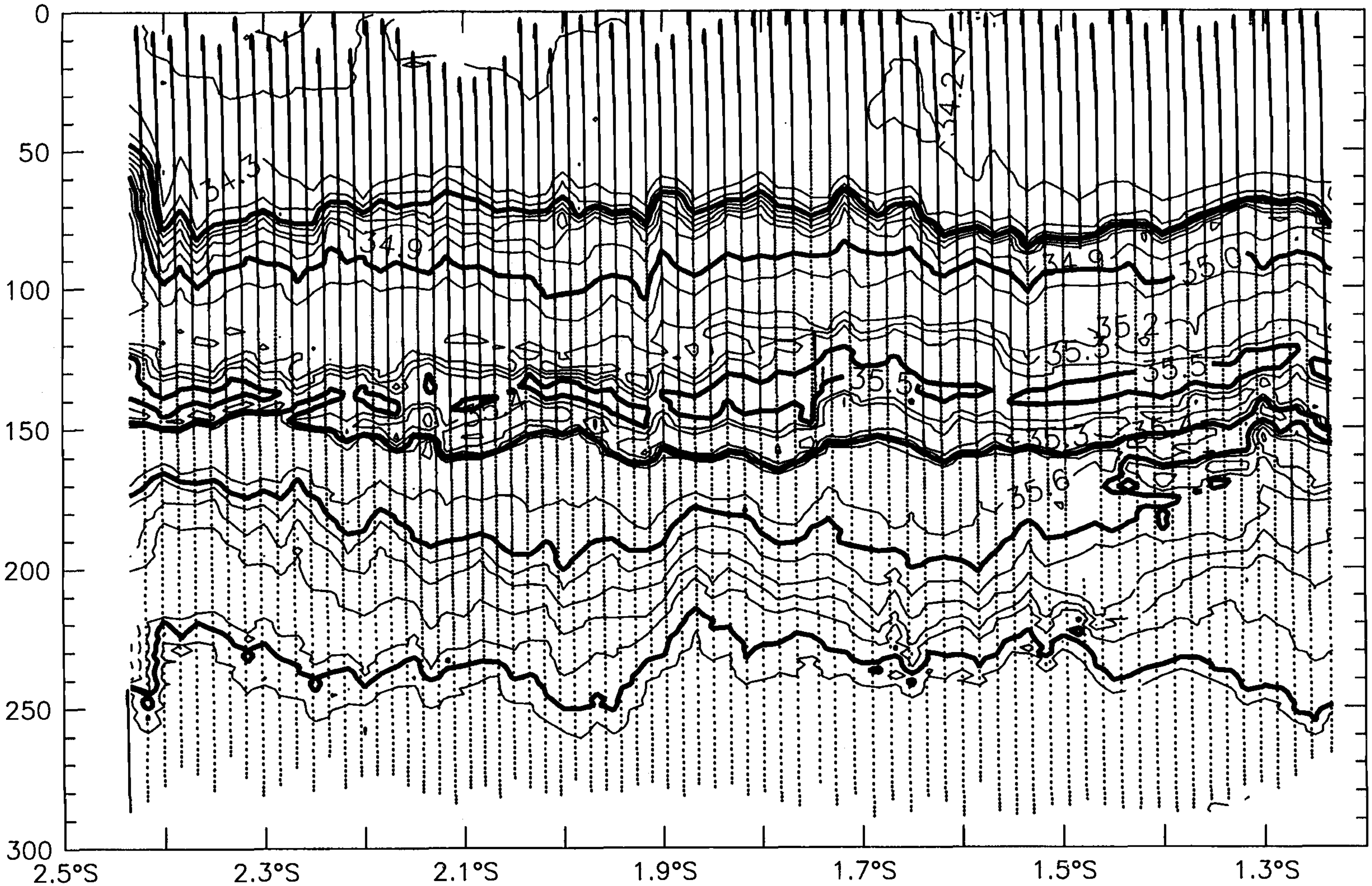
S(psu), N2S, 19 December 1992



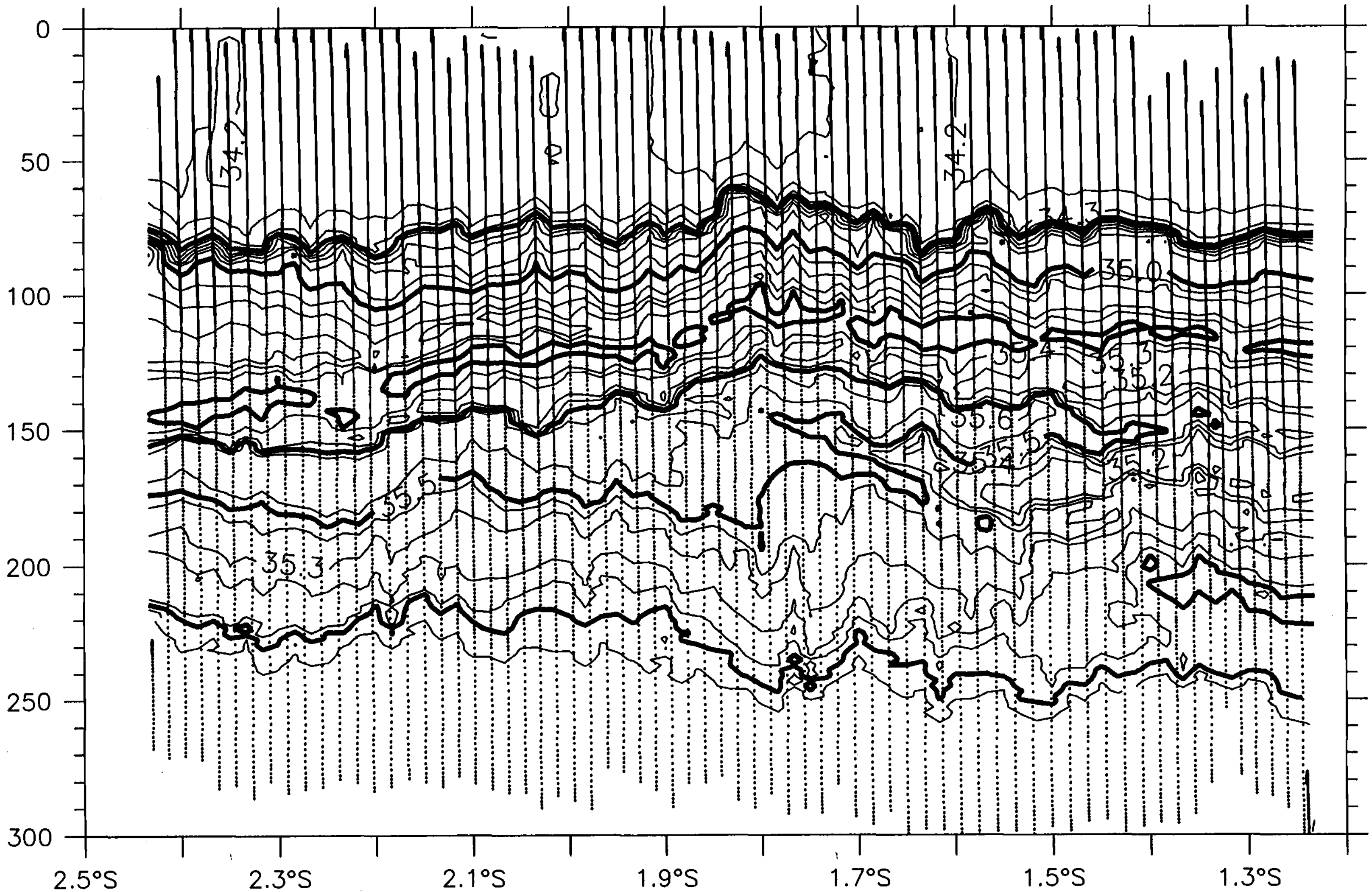
S(psu), N2S, 20 December 1992



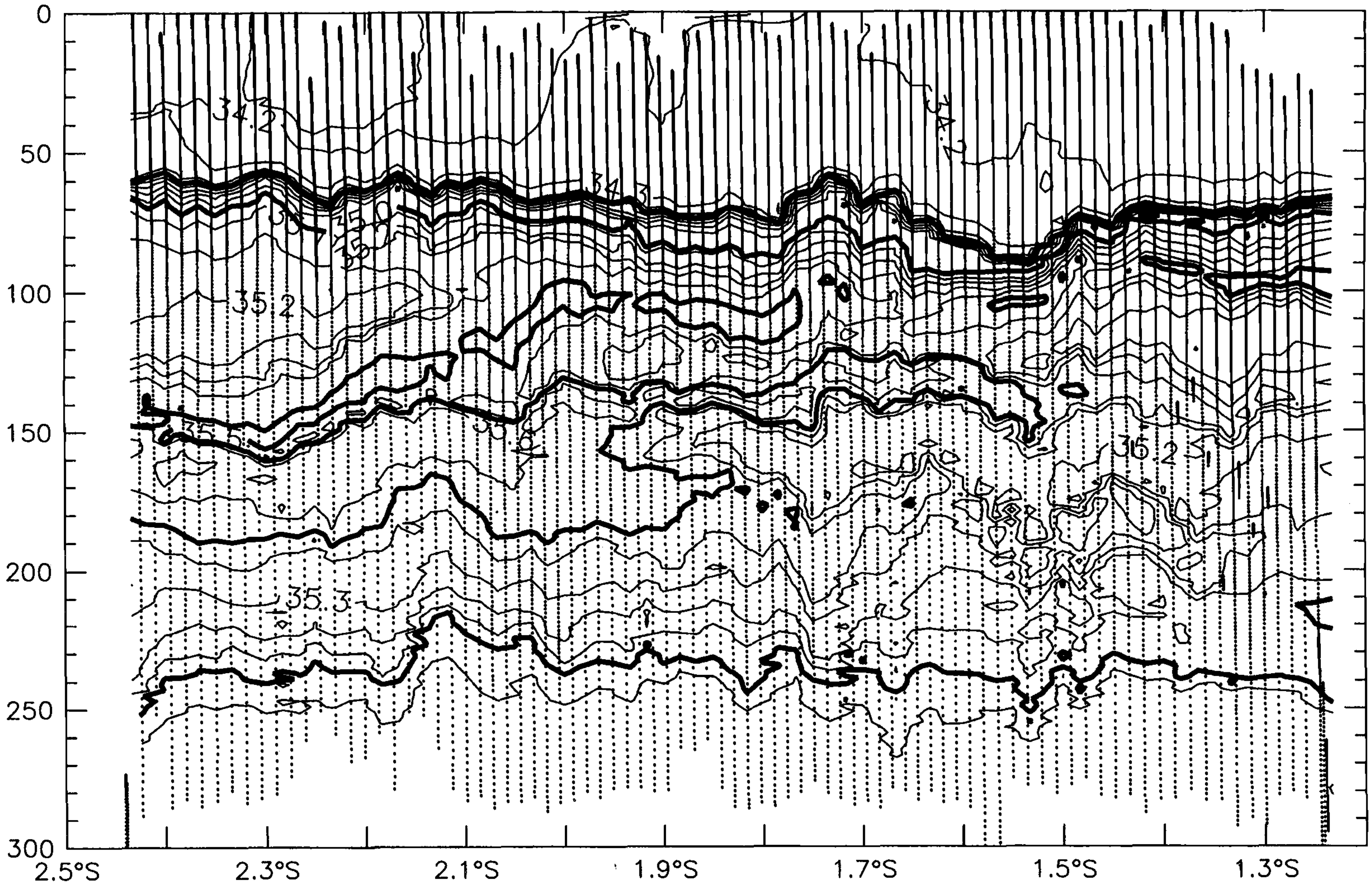
S(psu), N2S, 22 December 1992



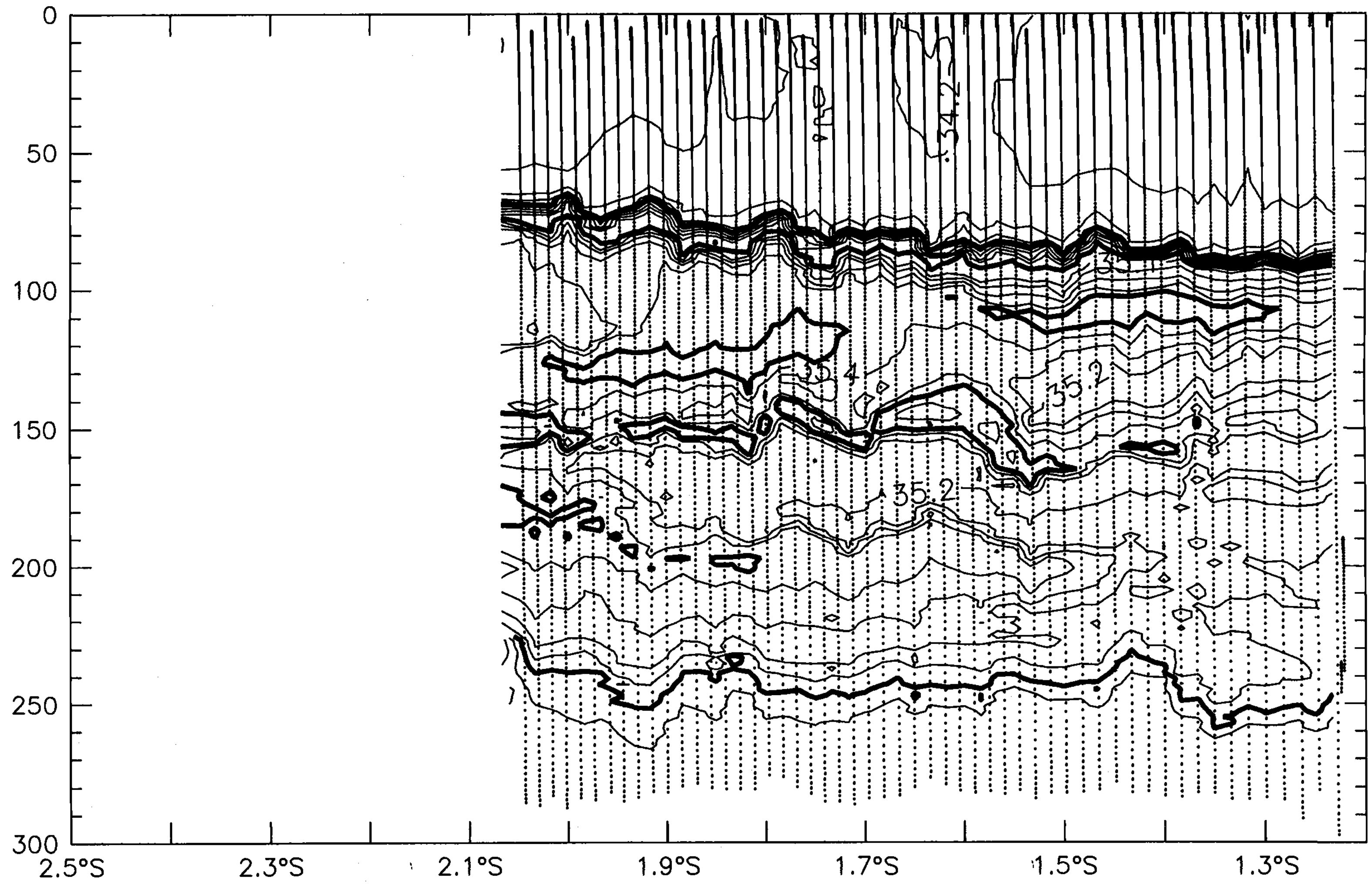
S(psu), N2S, 24 December 1992



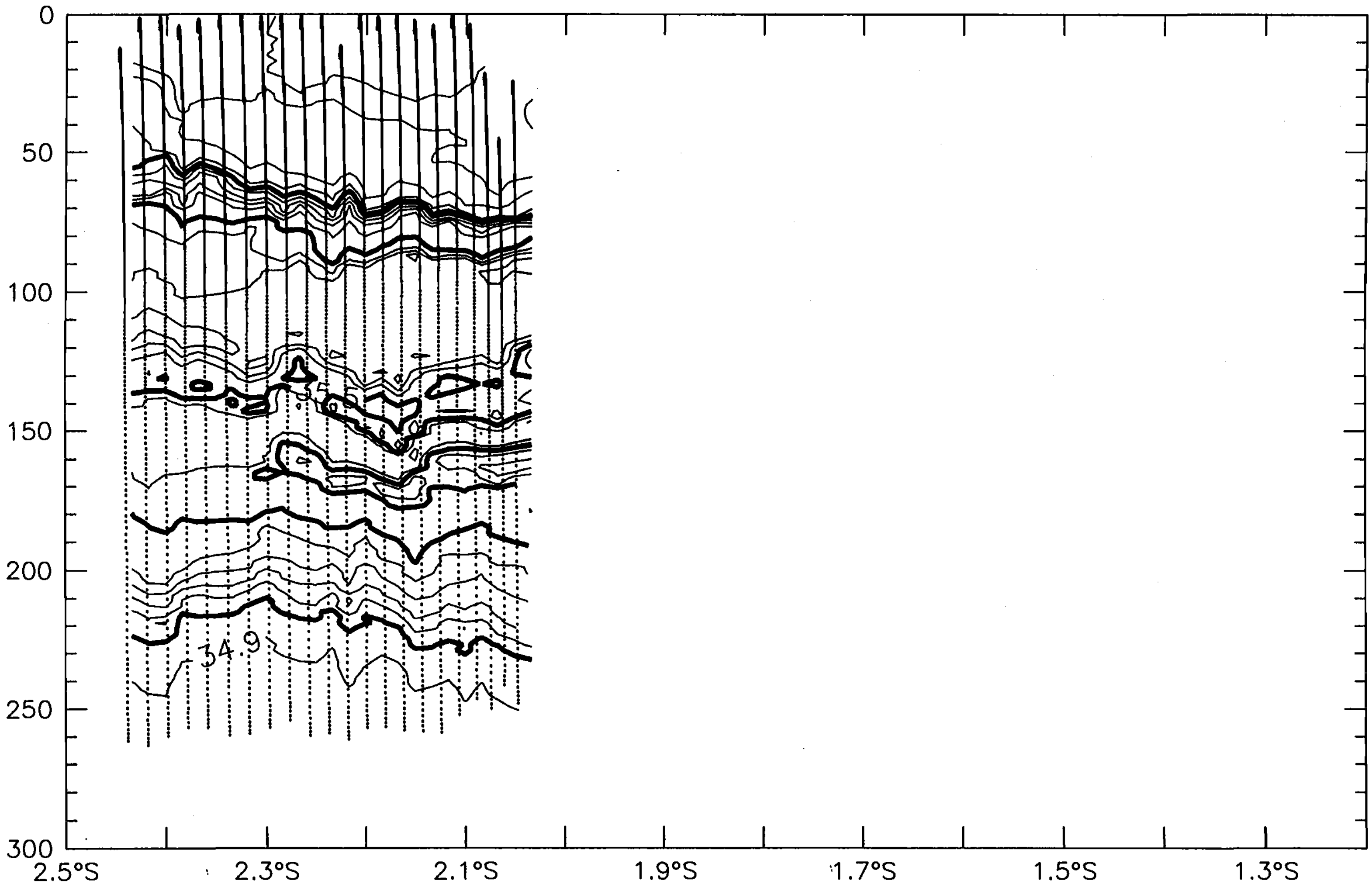
S(psu), N2S, 25 December 1992



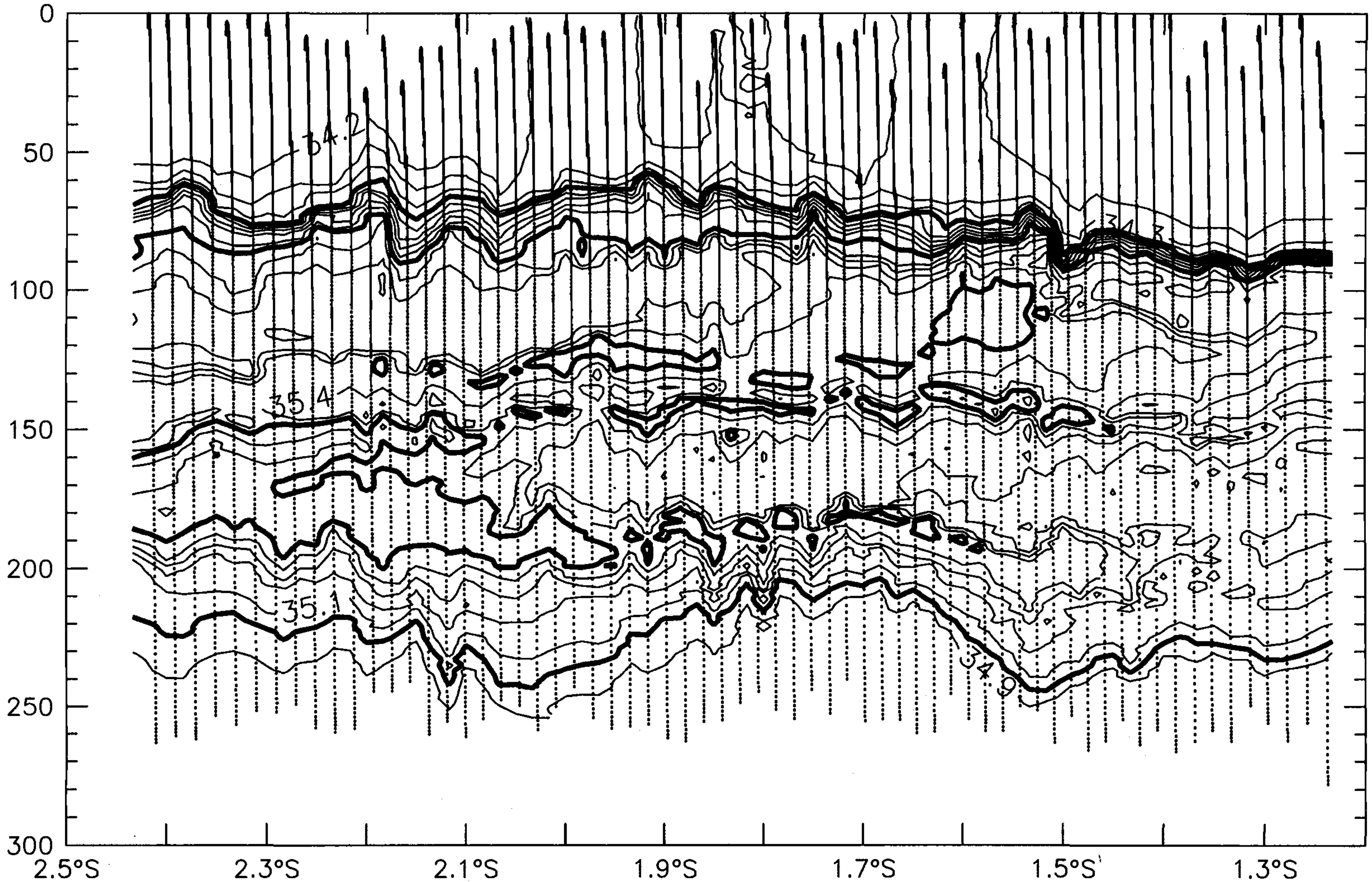
S(psu), N2S, 27 December 1992



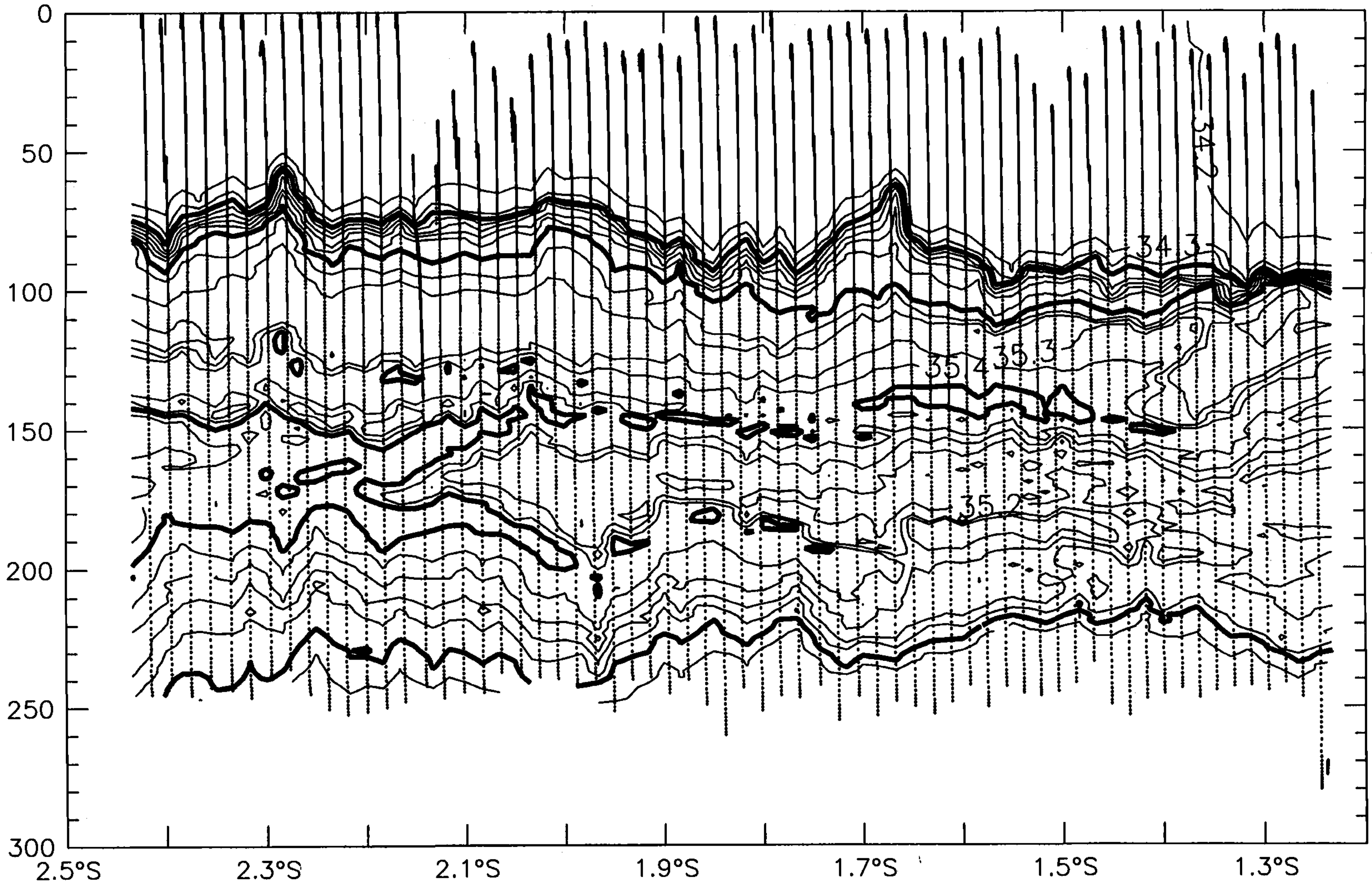
S(psu), N2S, 28 December 1992



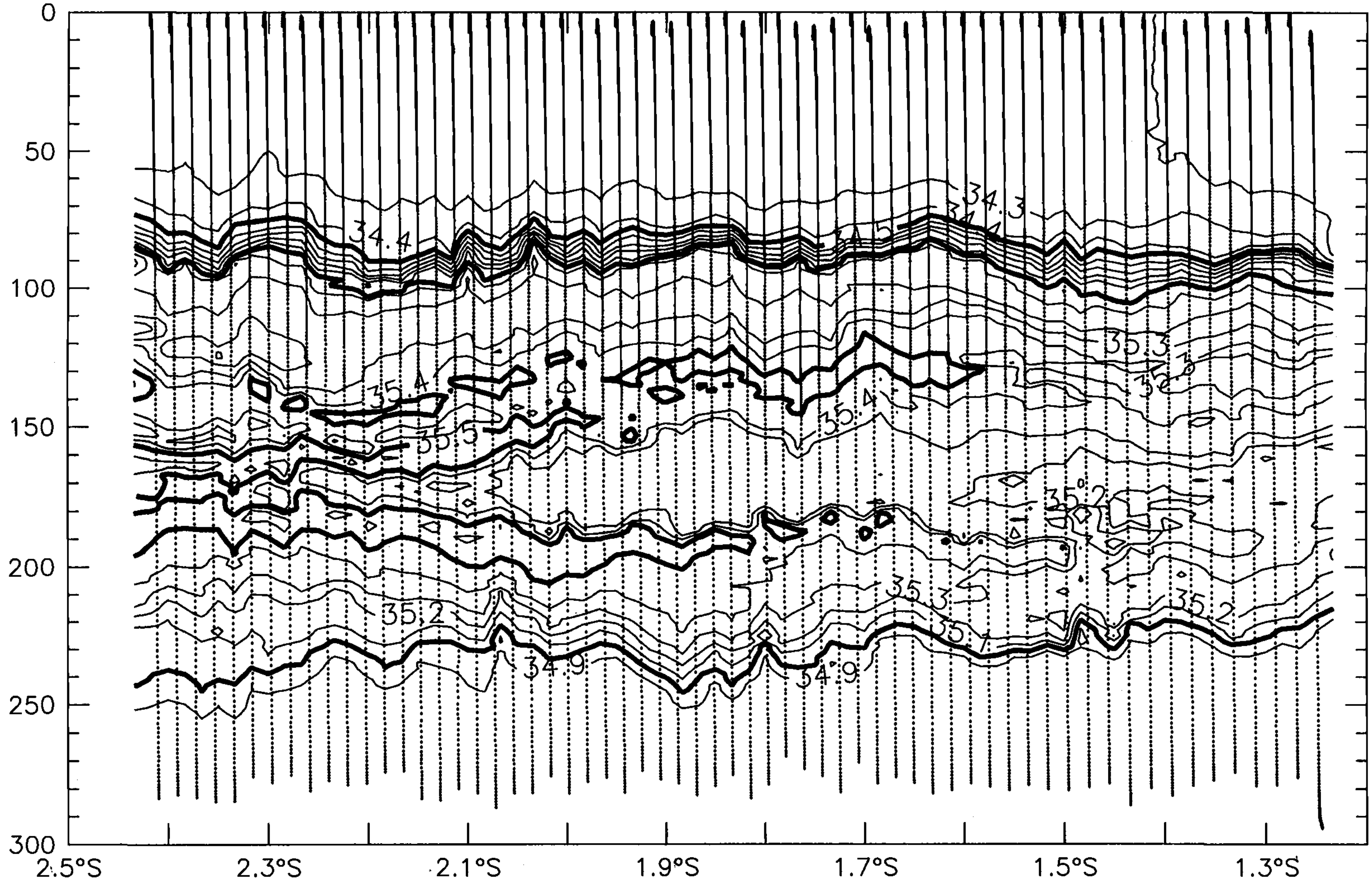
S(psu), N2S, 29 December 1992



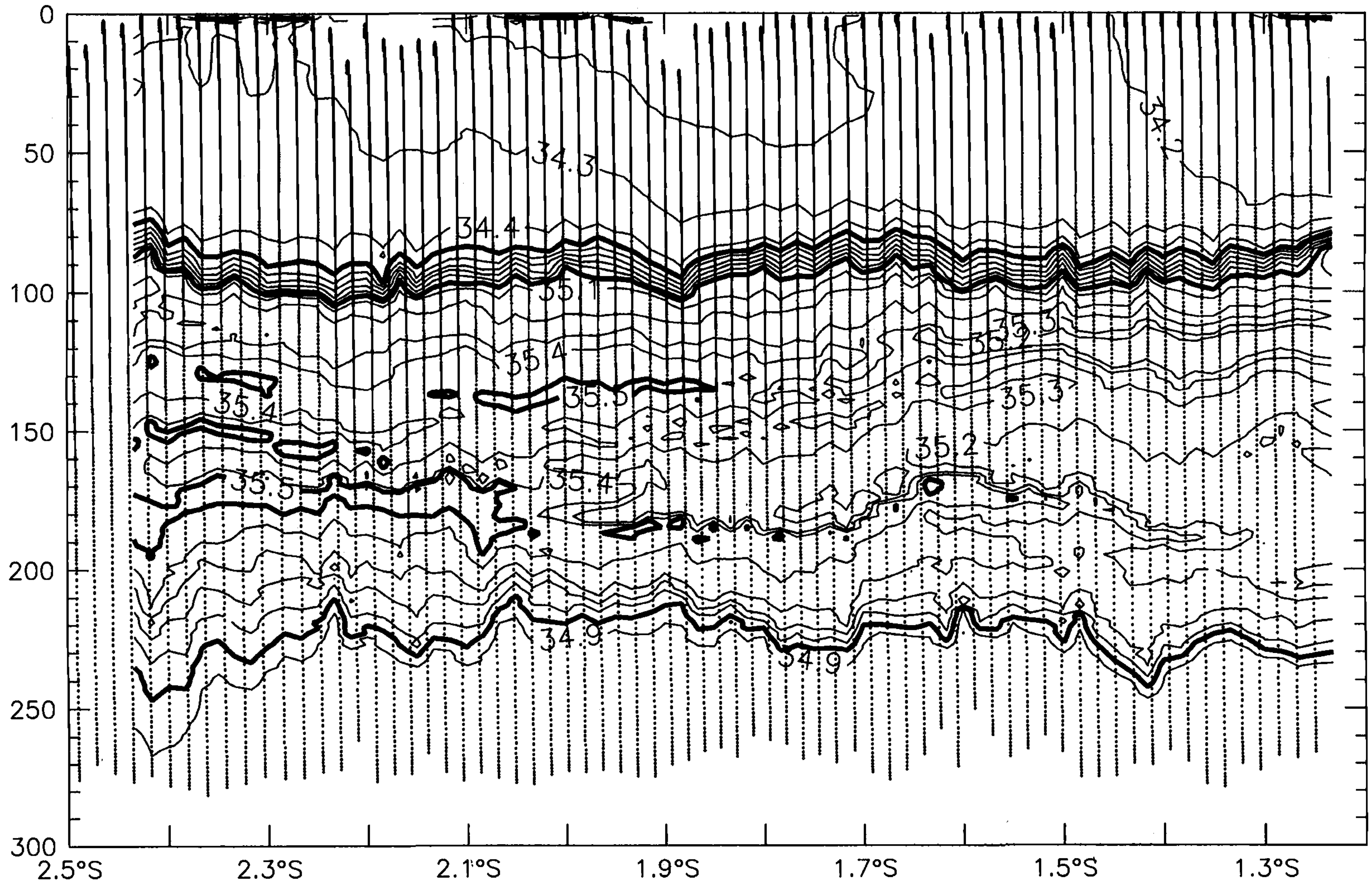
S(psu), N2S, 30 December 1992



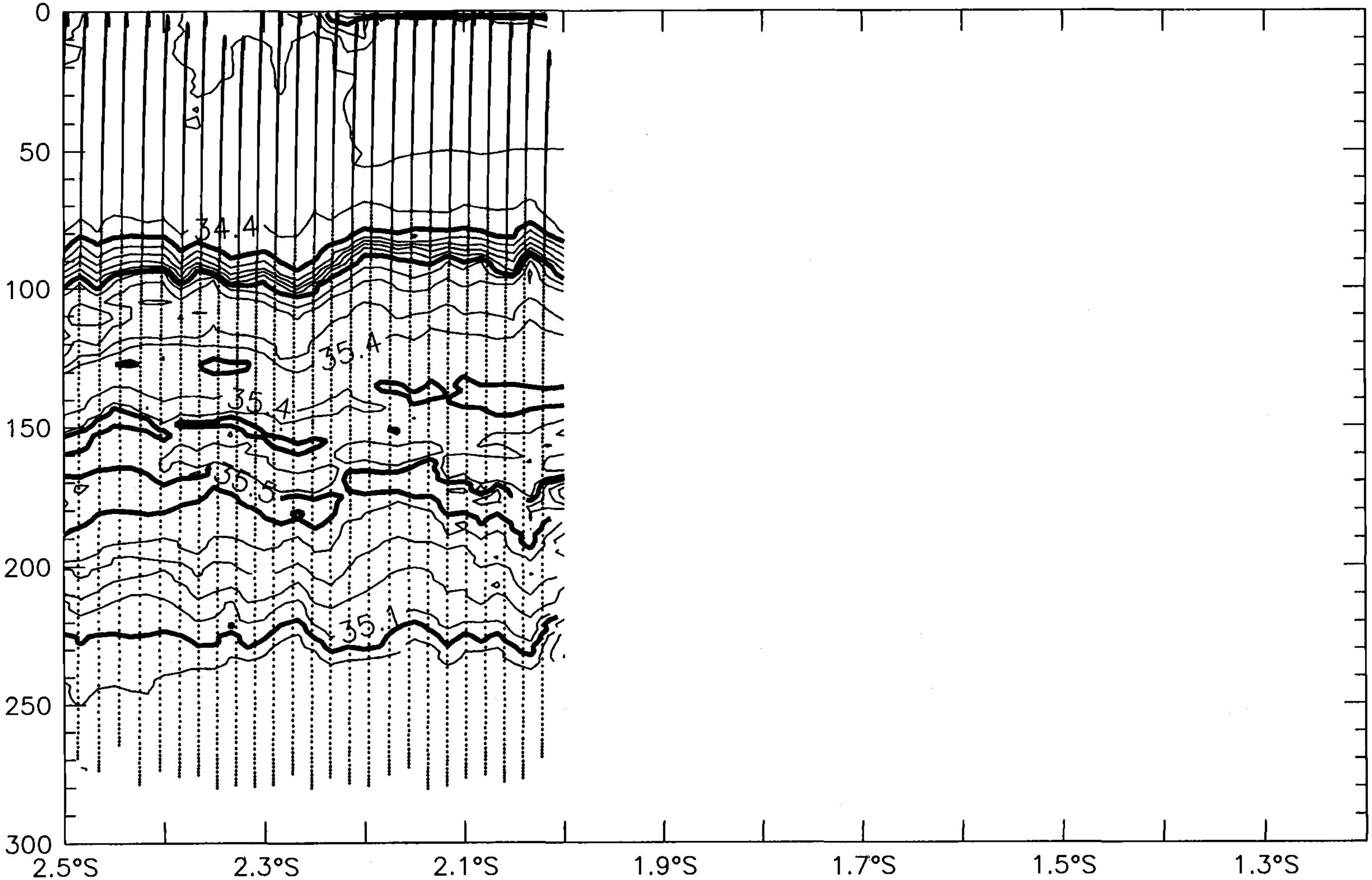
S(psu), N2S, 31 December 1992



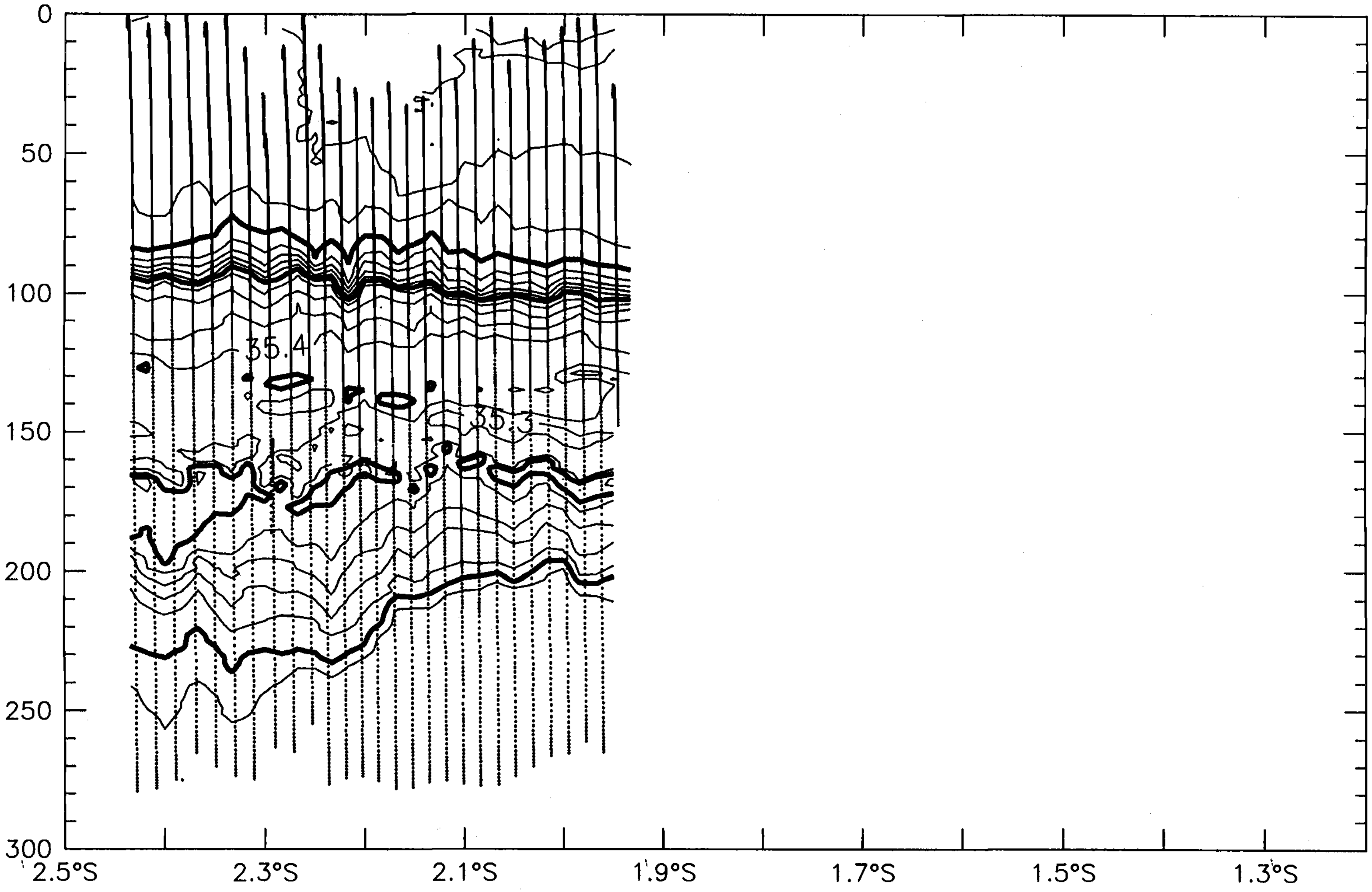
S(psu), N2S, 2 January 1993



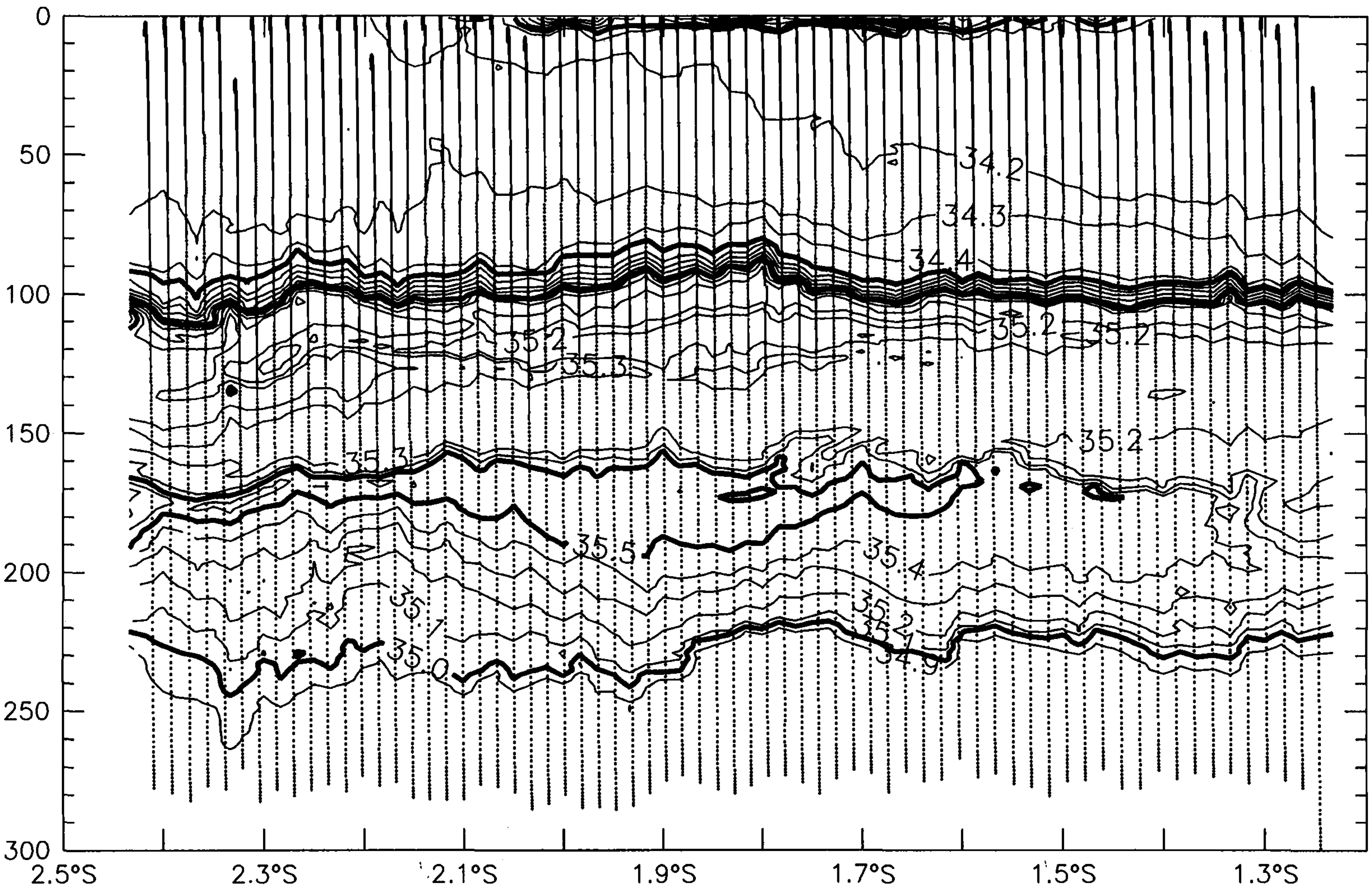
S(psu), N2S, 3 January 1993



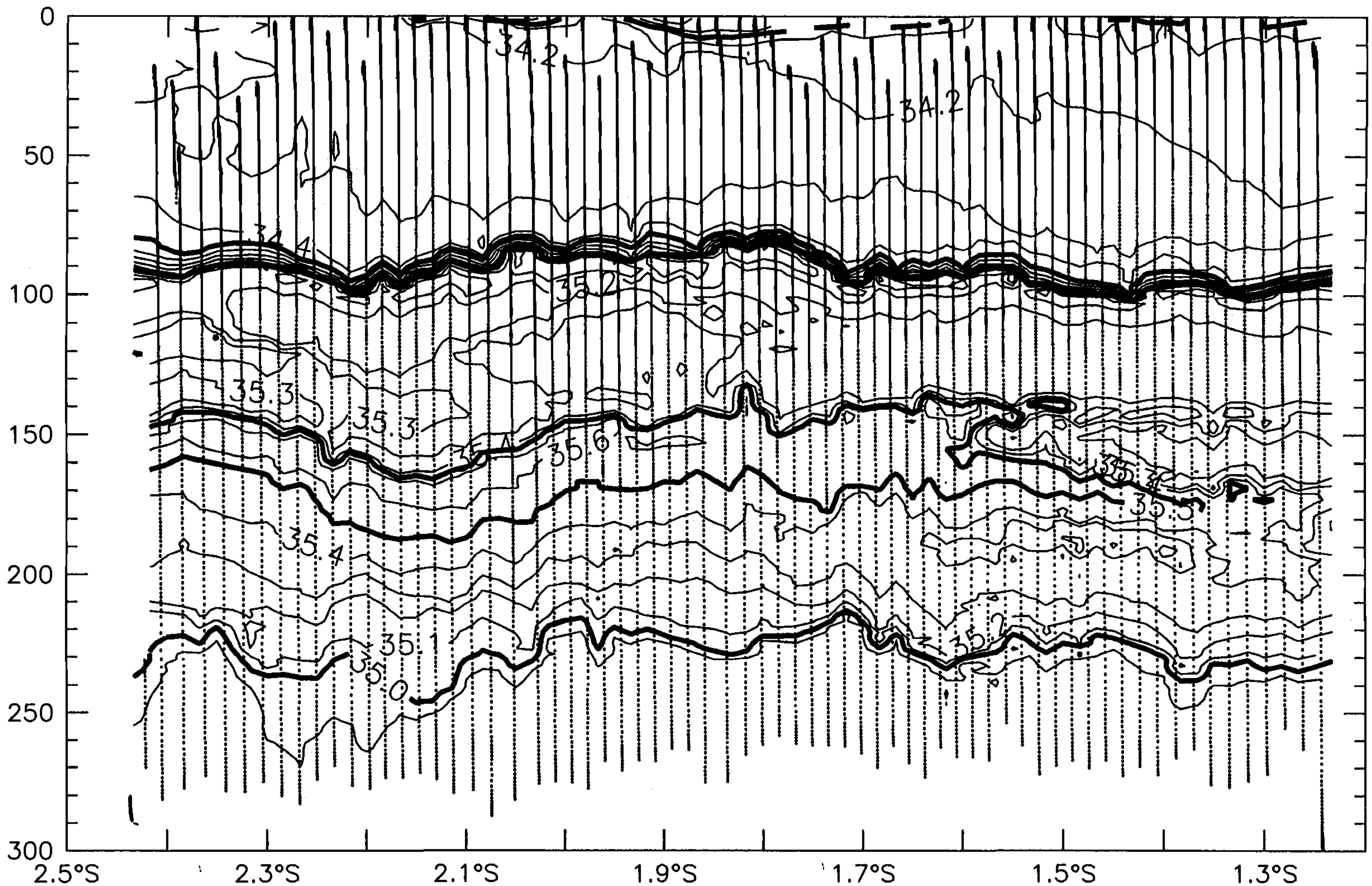
S(psu), S2N, 3 January 1993



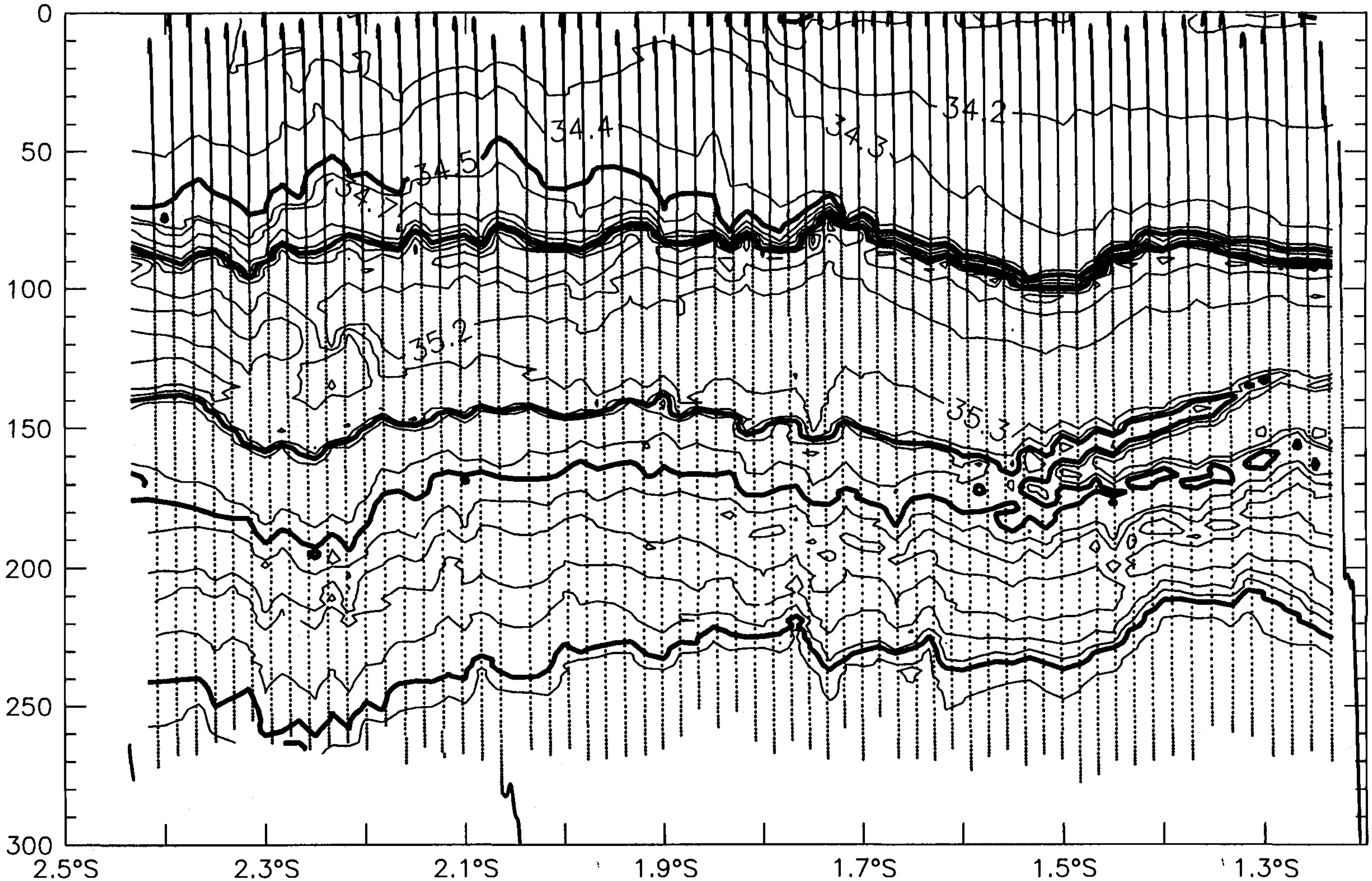
S(psu), N2S, 4 January 1993



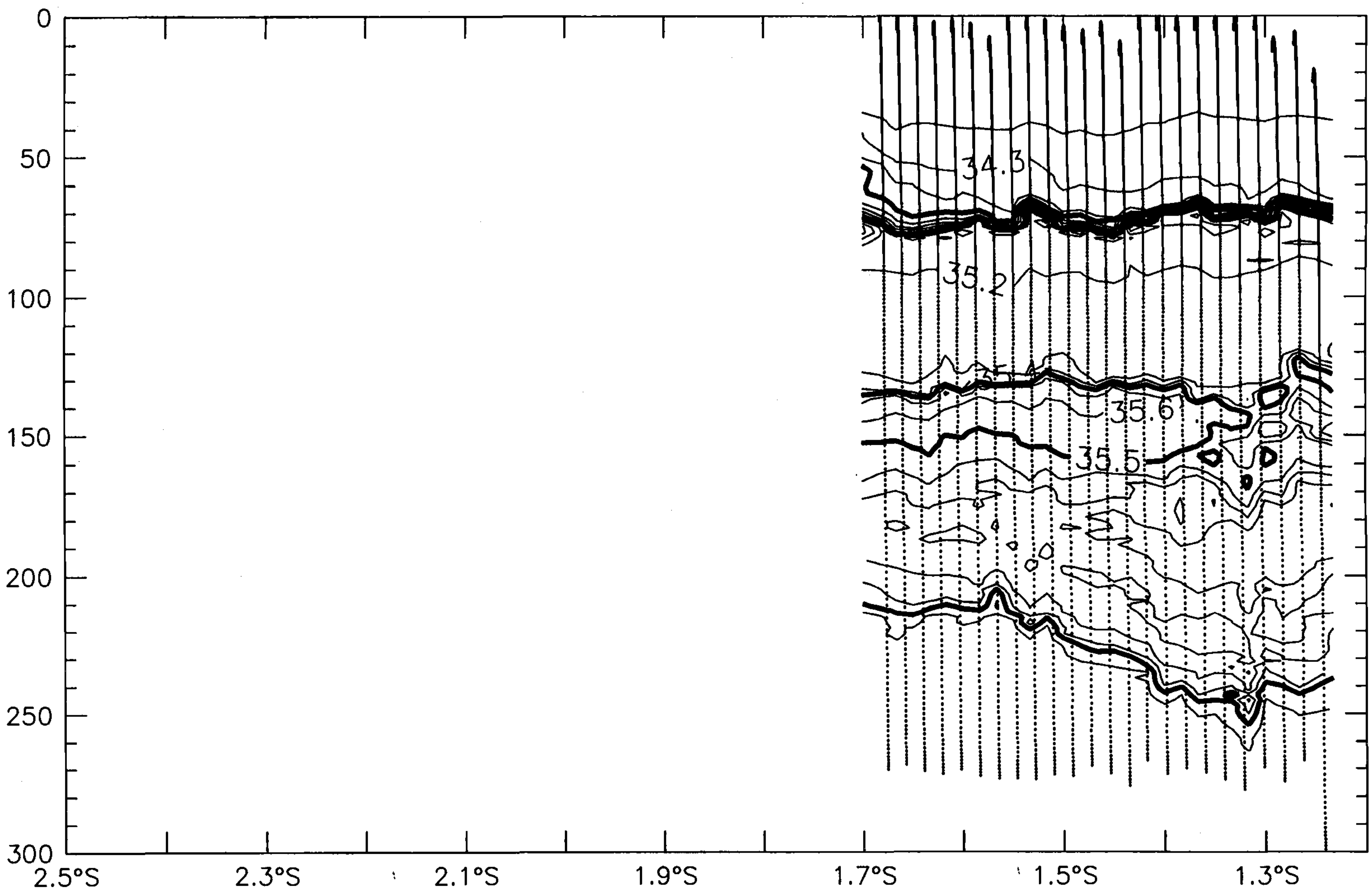
S(psu), N2S, 5 January 1993



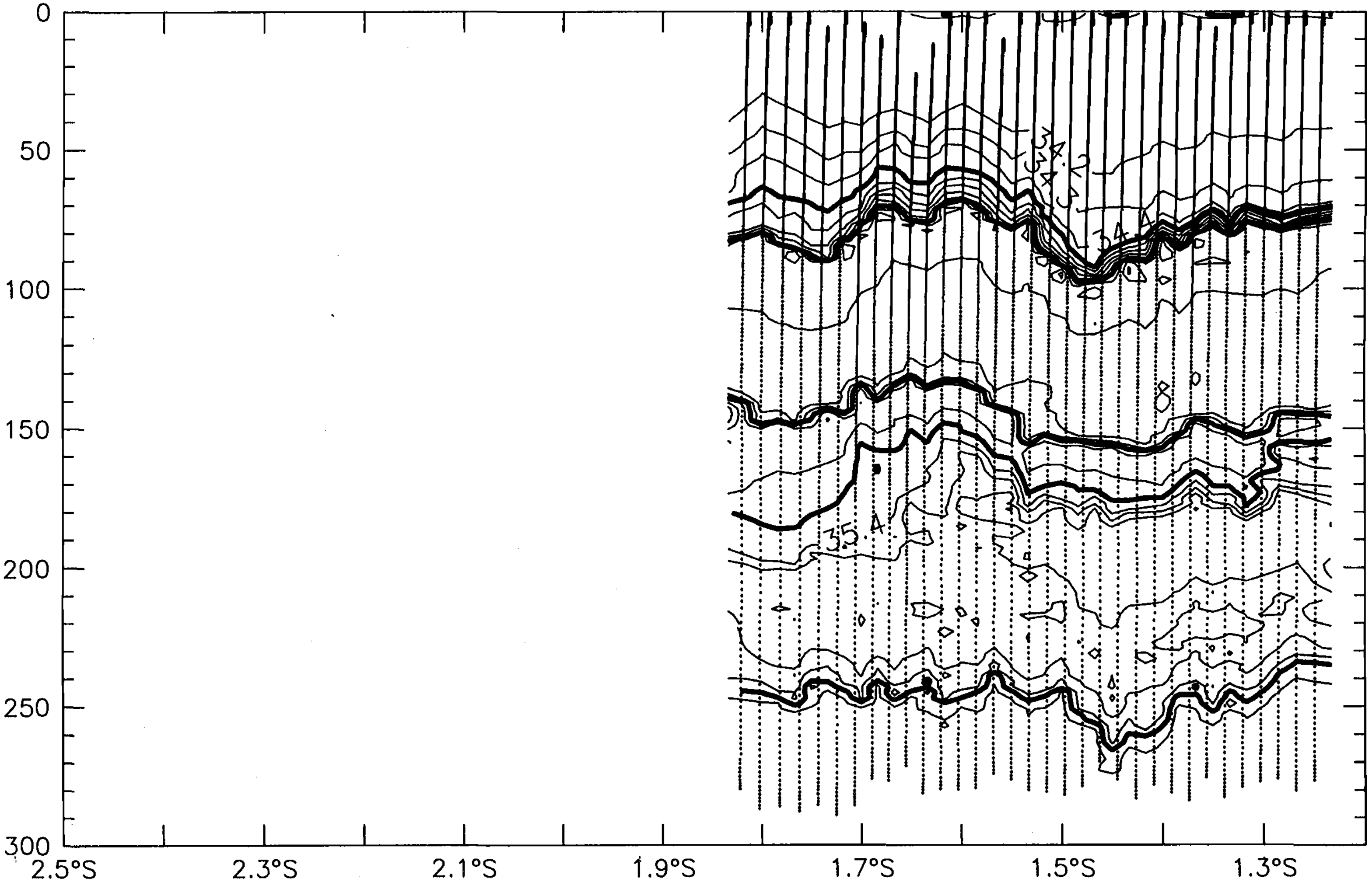
S(psu), N2S, 6 January 1993



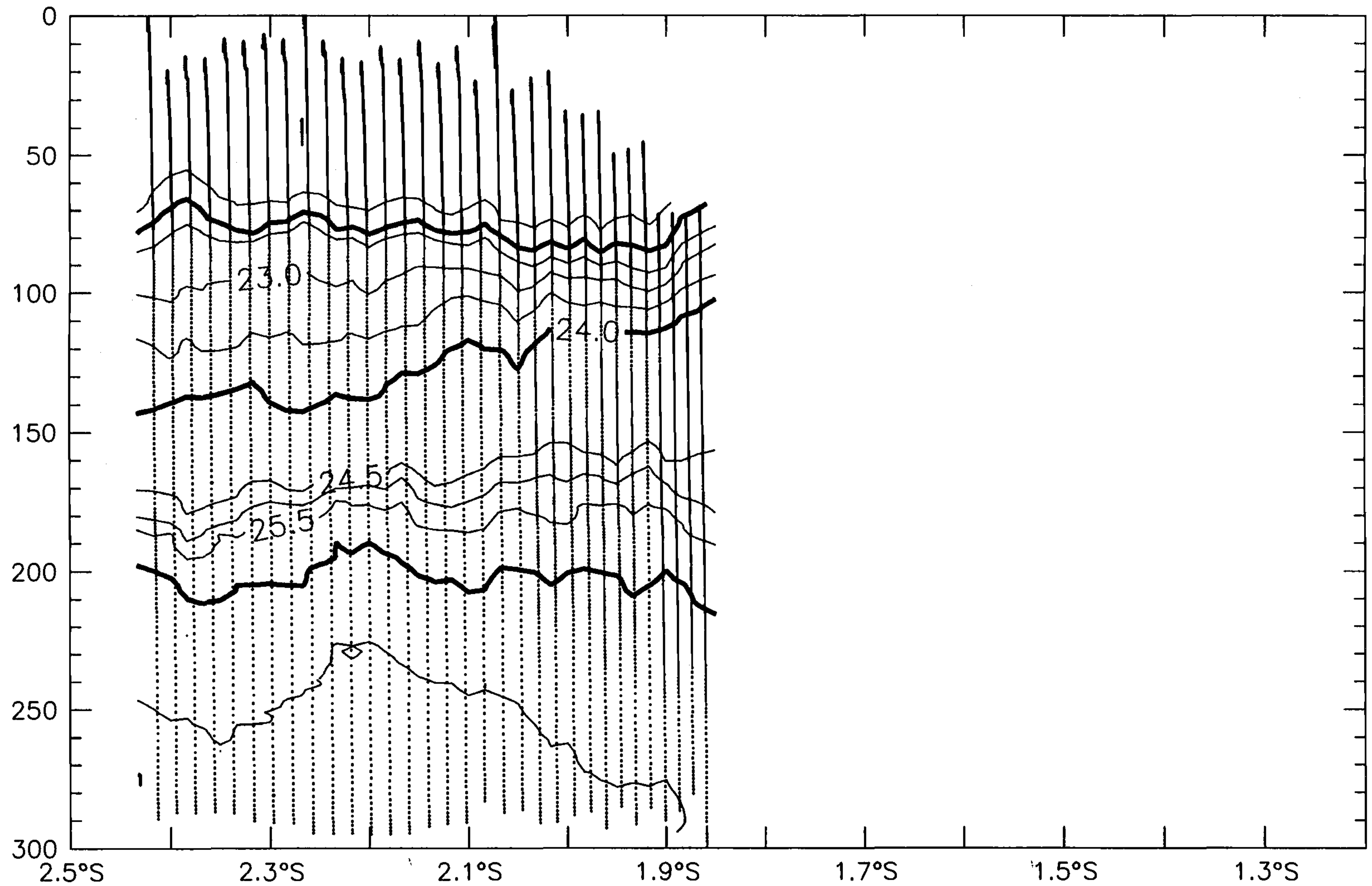
S(psu), N2S, 8 January 1993



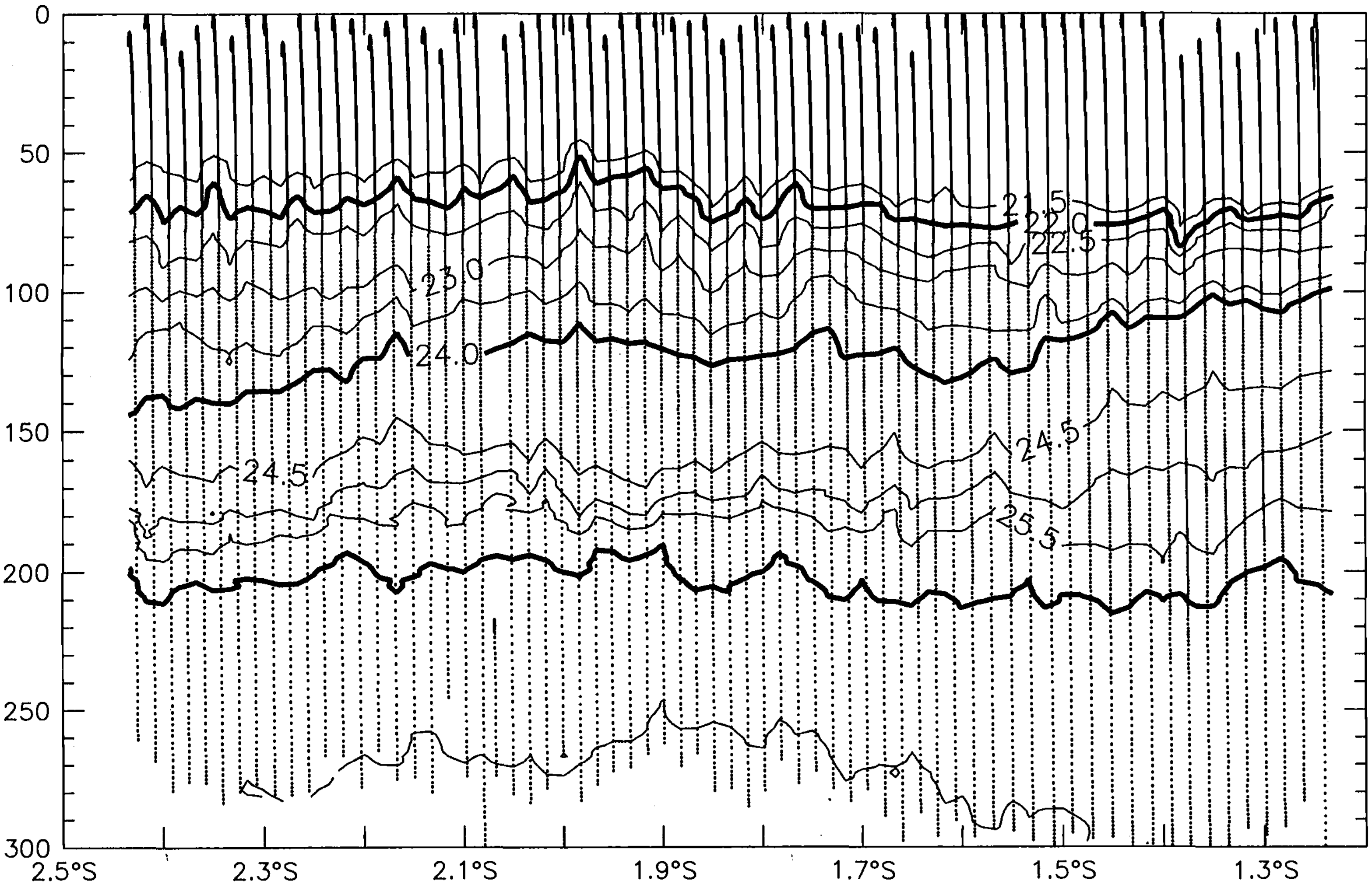
S(psu), N2S, 9 January 1993



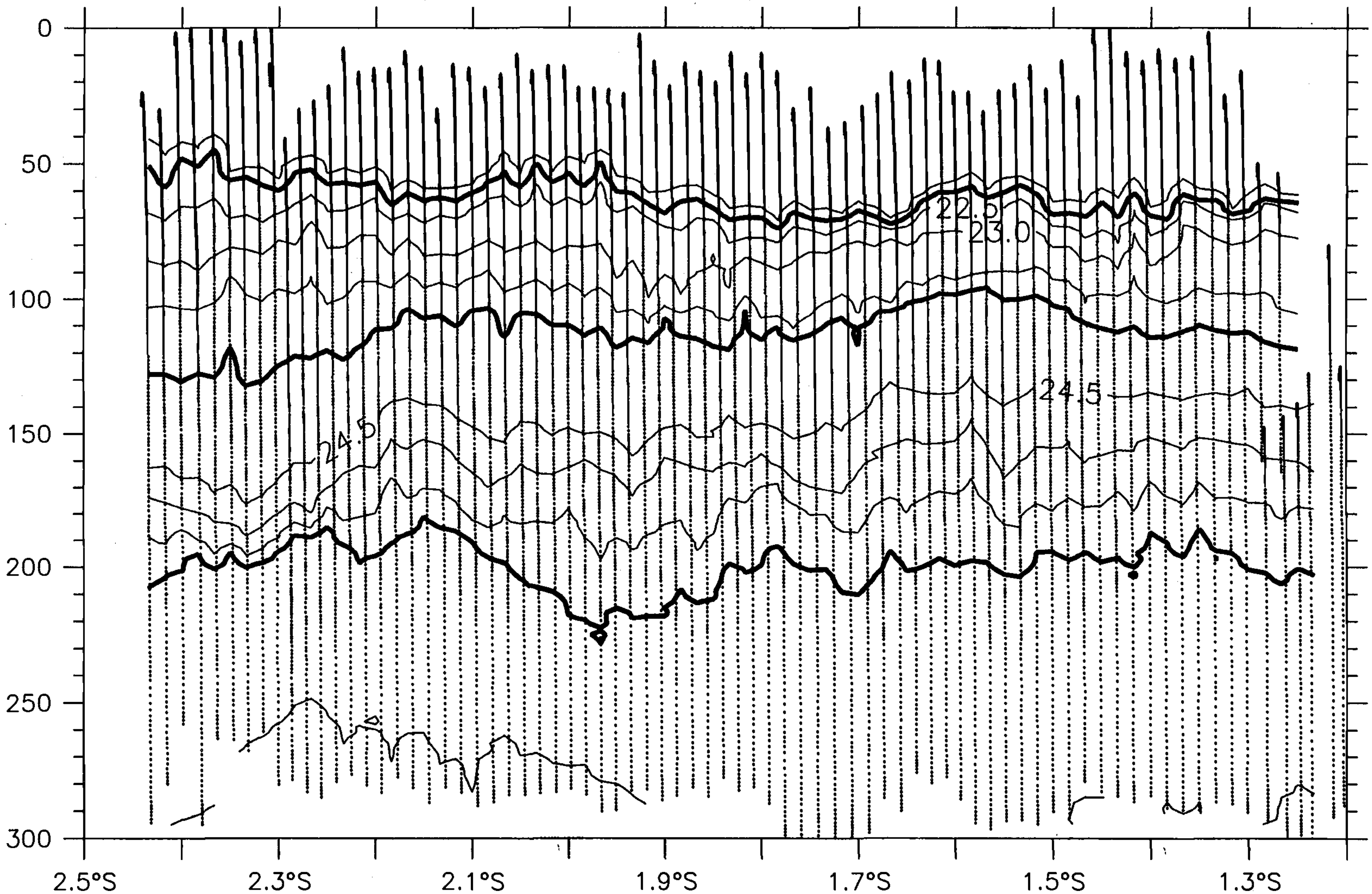
S(psu), N2S, 10 January 1993



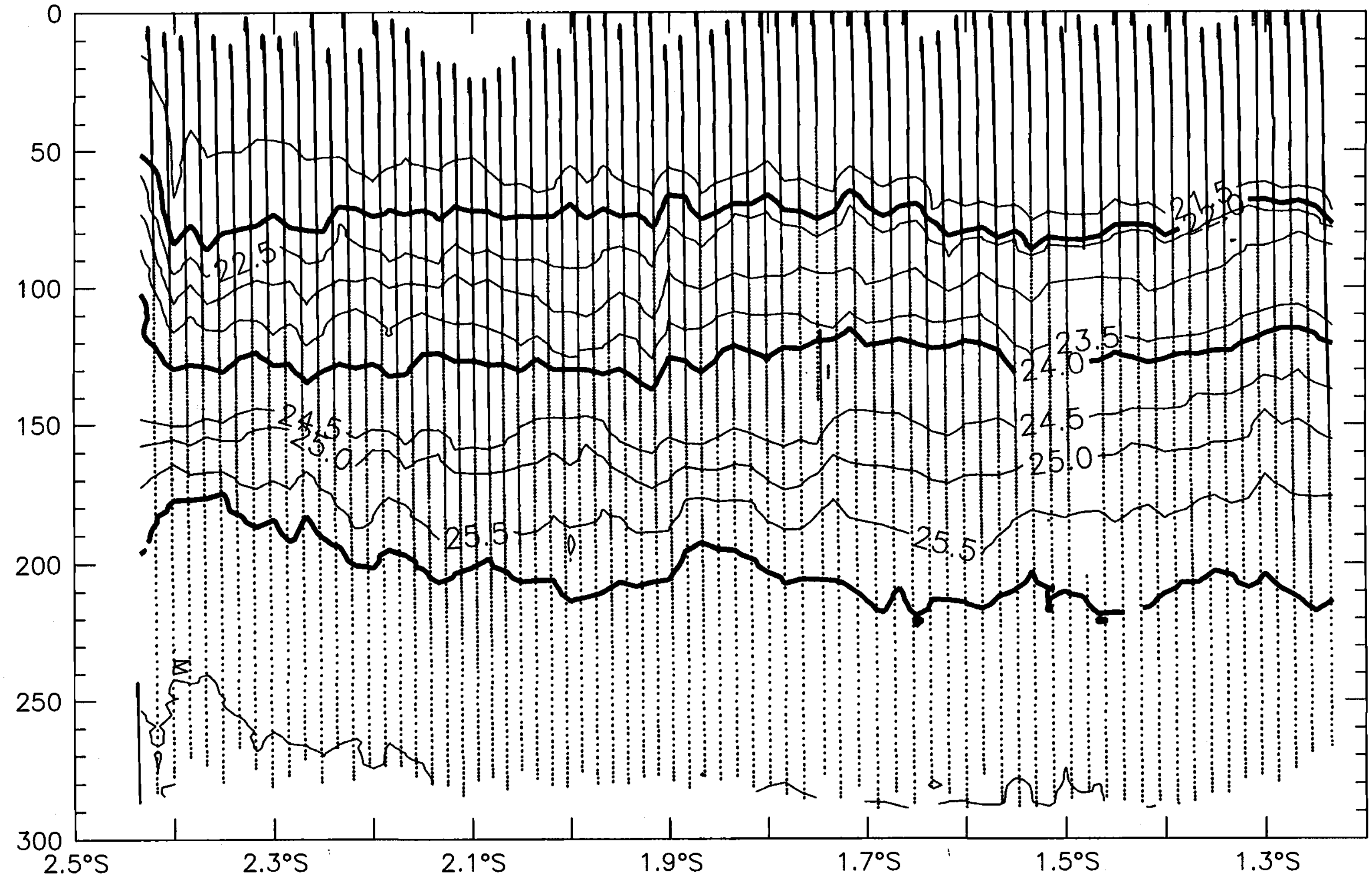
Sigma–t, N2S, 19 December 1992



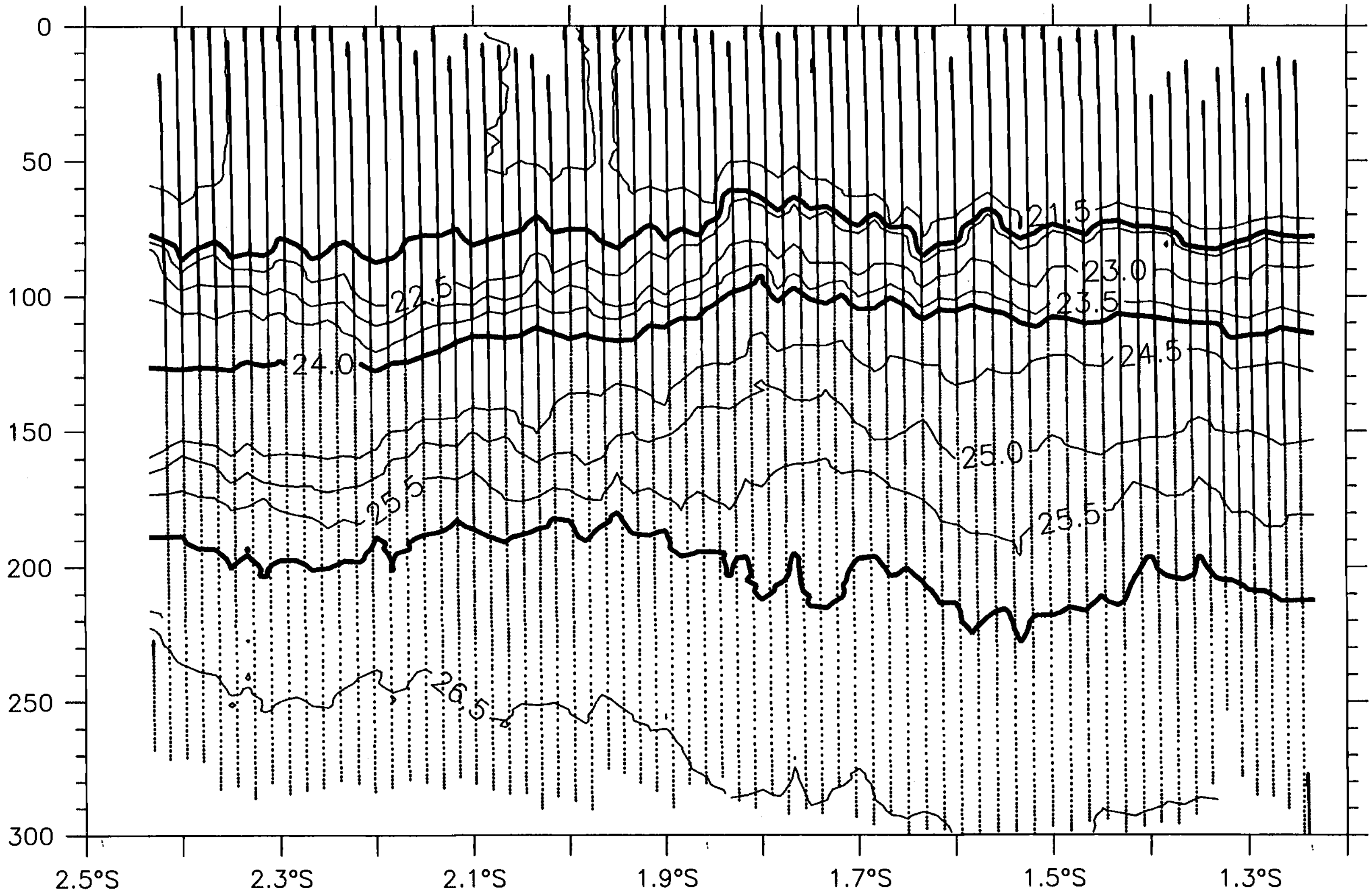
Sigma−t, N2S, 20 December 1992



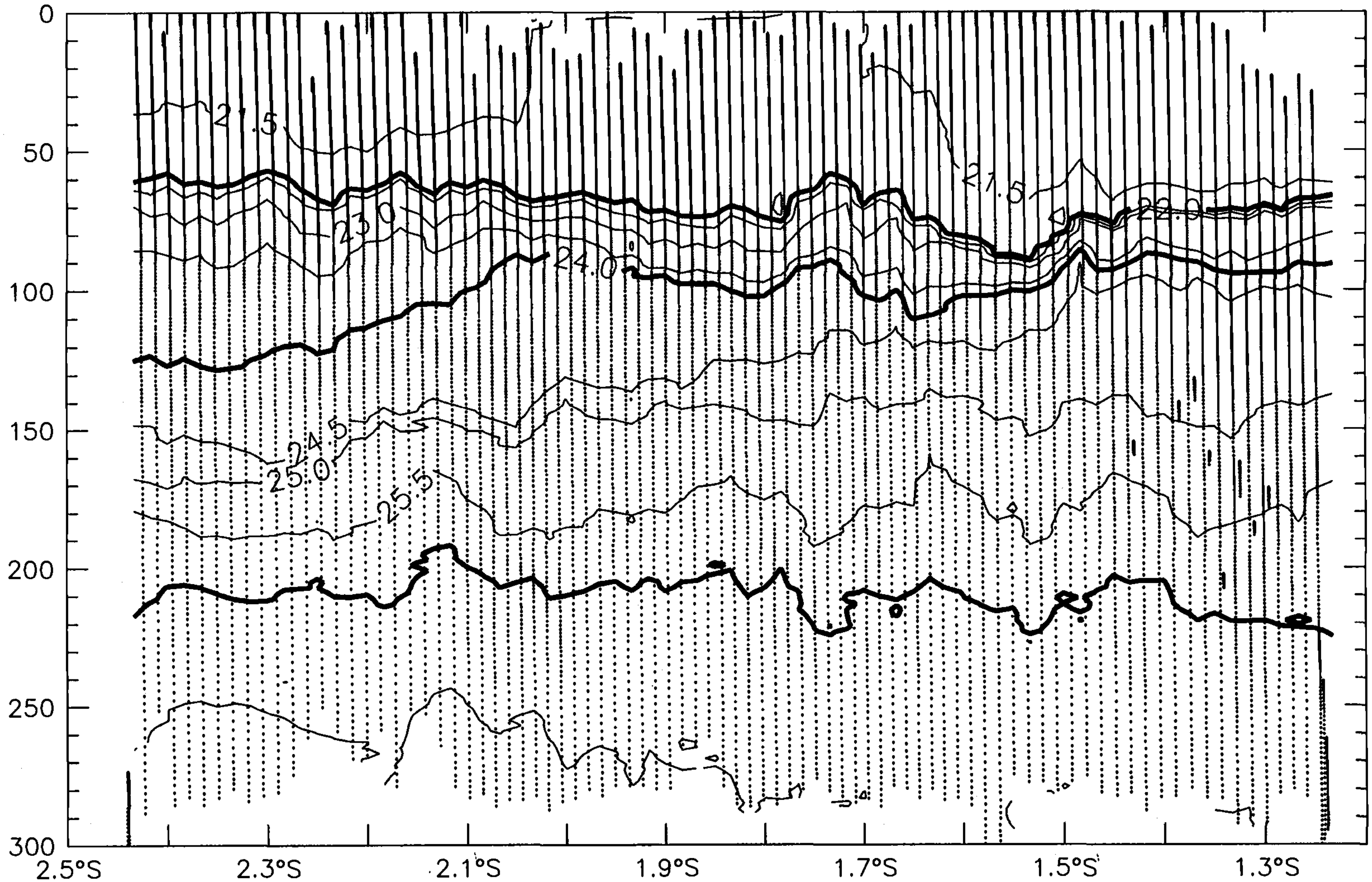
Sigma−t, N2S, 22 December 1992



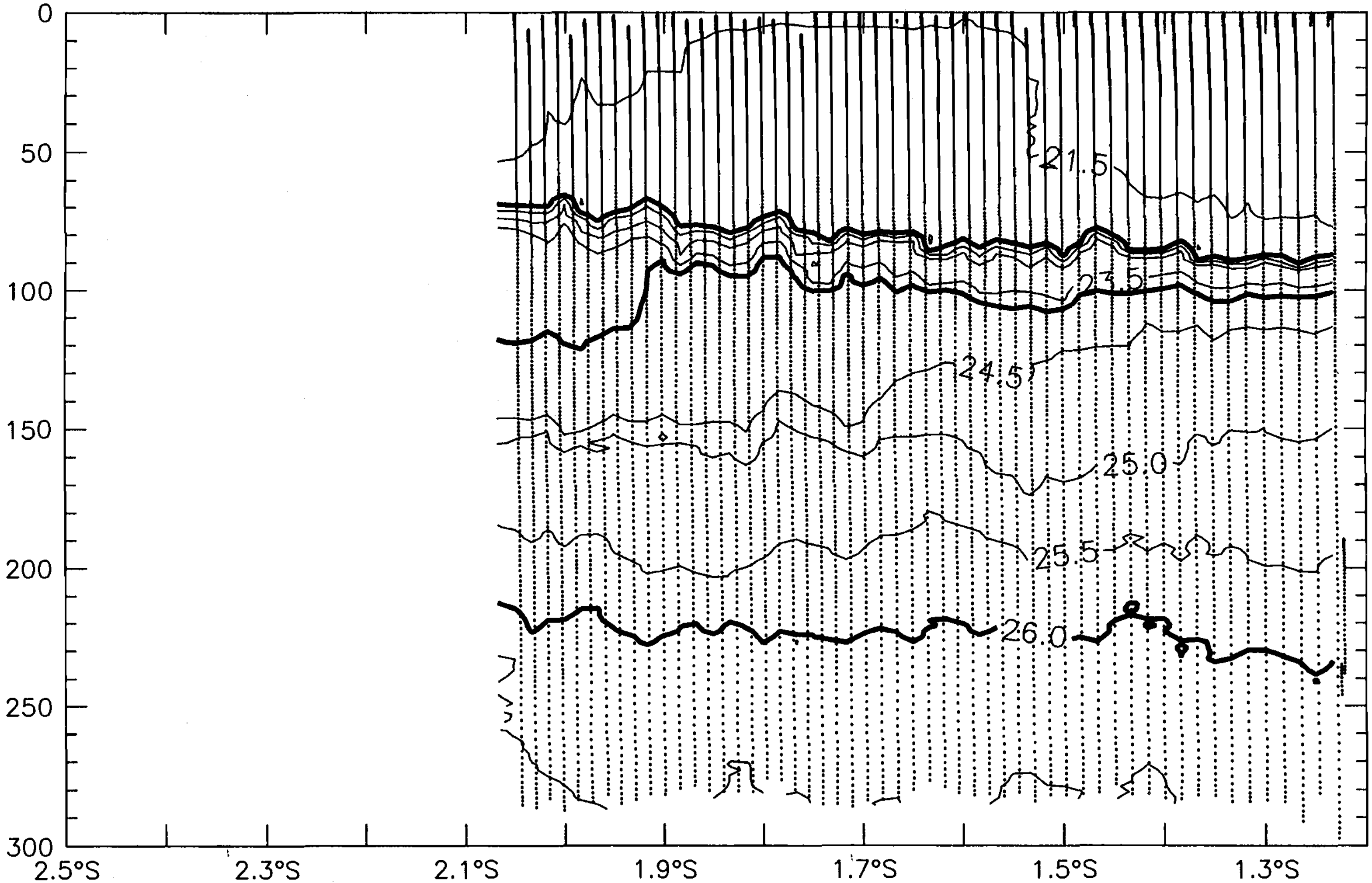
Sigma-t, N2S, 24 December 1992



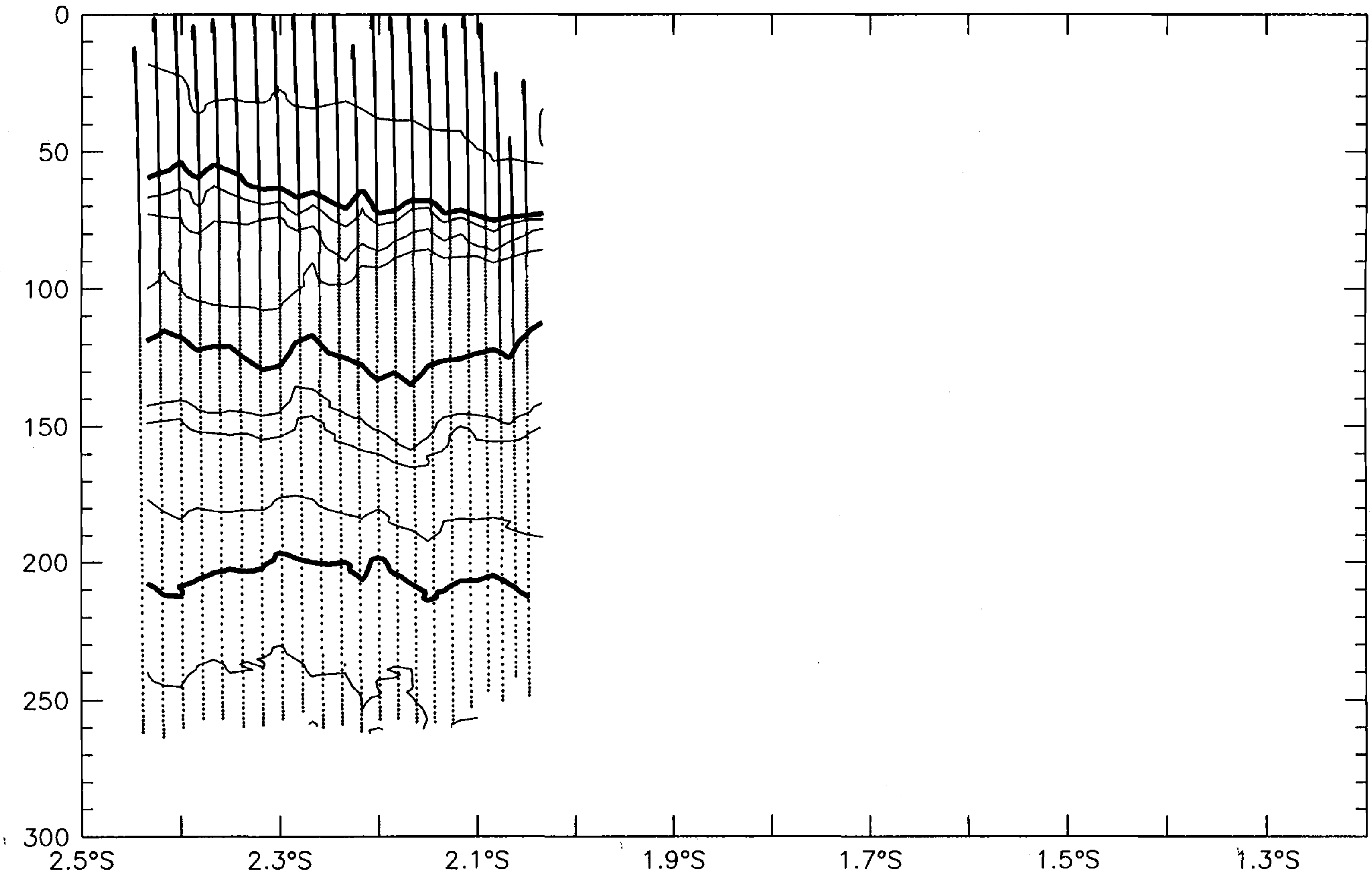
Sigma-t, N2S, 25 December 1992



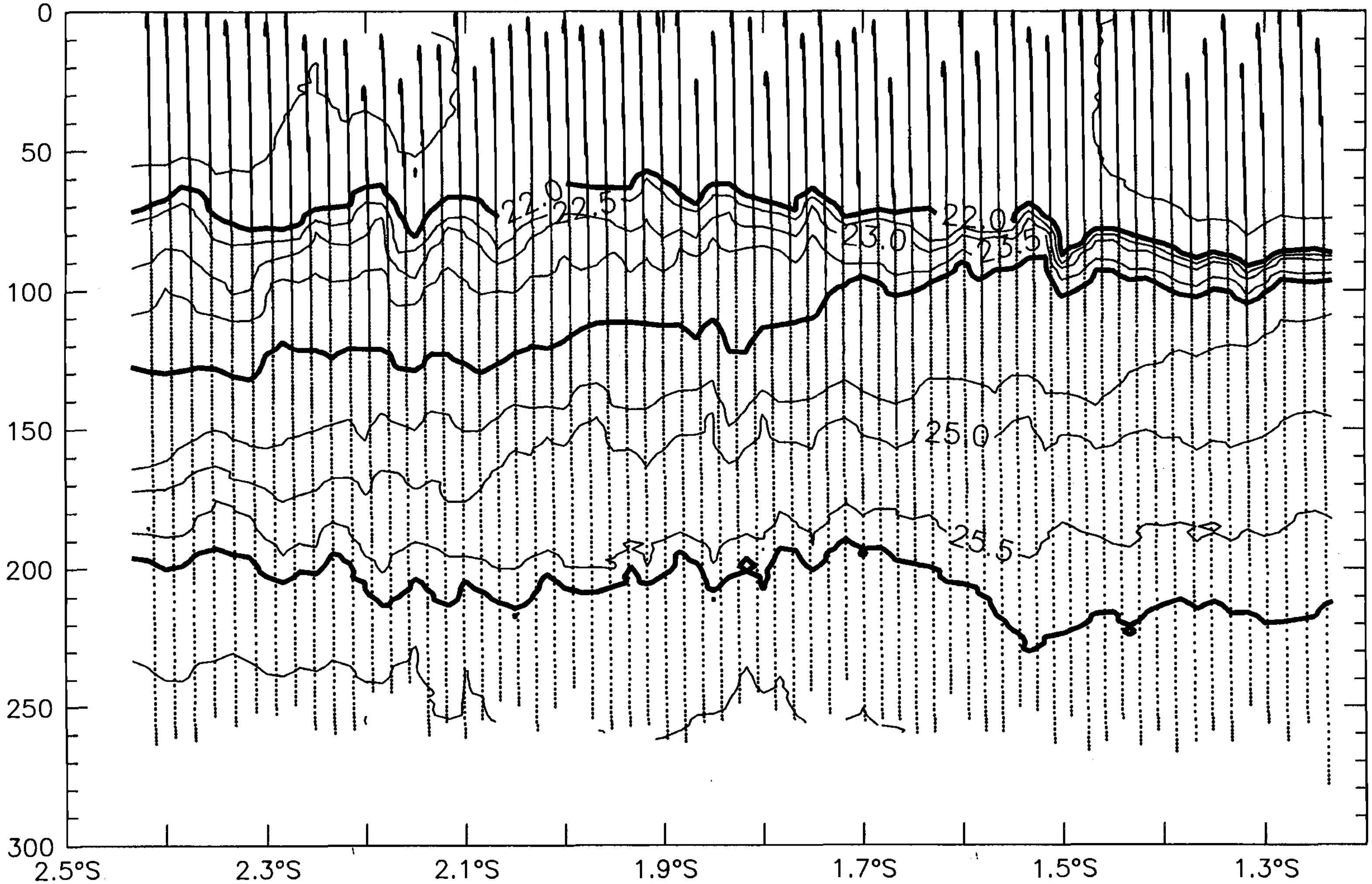
Sigma–t, N2S, 27 December 1992



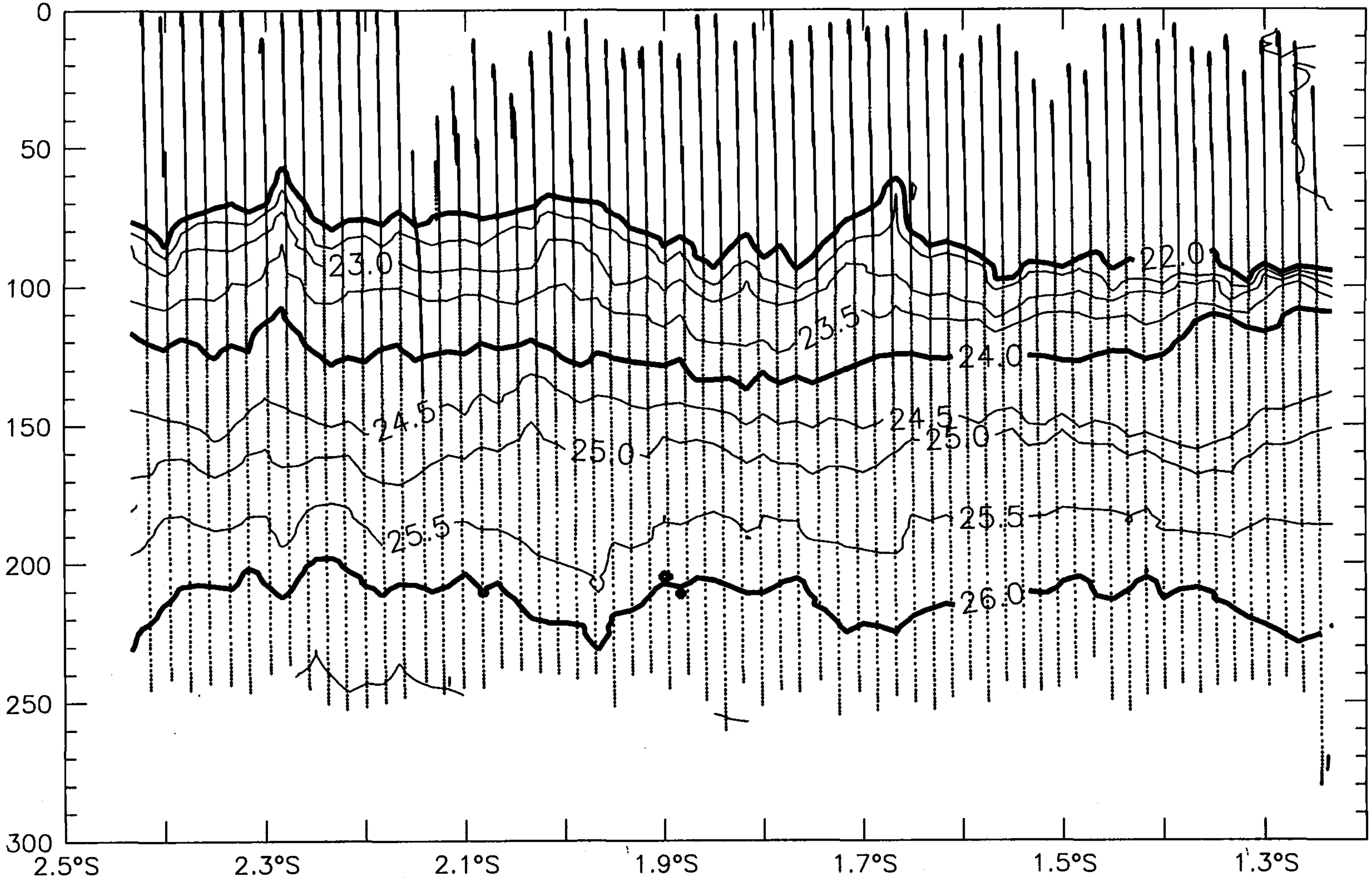
Sigma–t, N2S, 28 December 1992



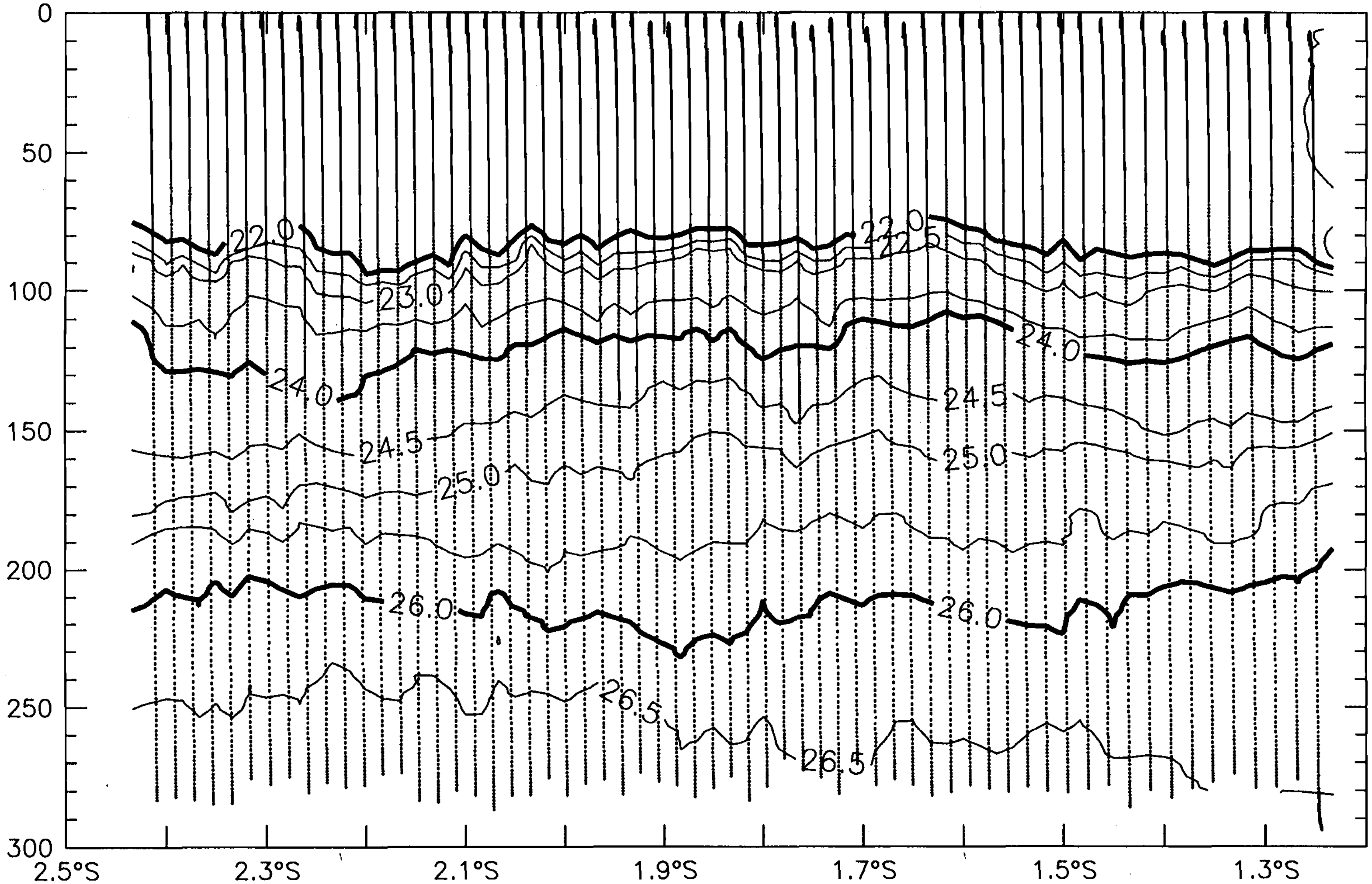
Sigma–t, N2S, 29 December 1992



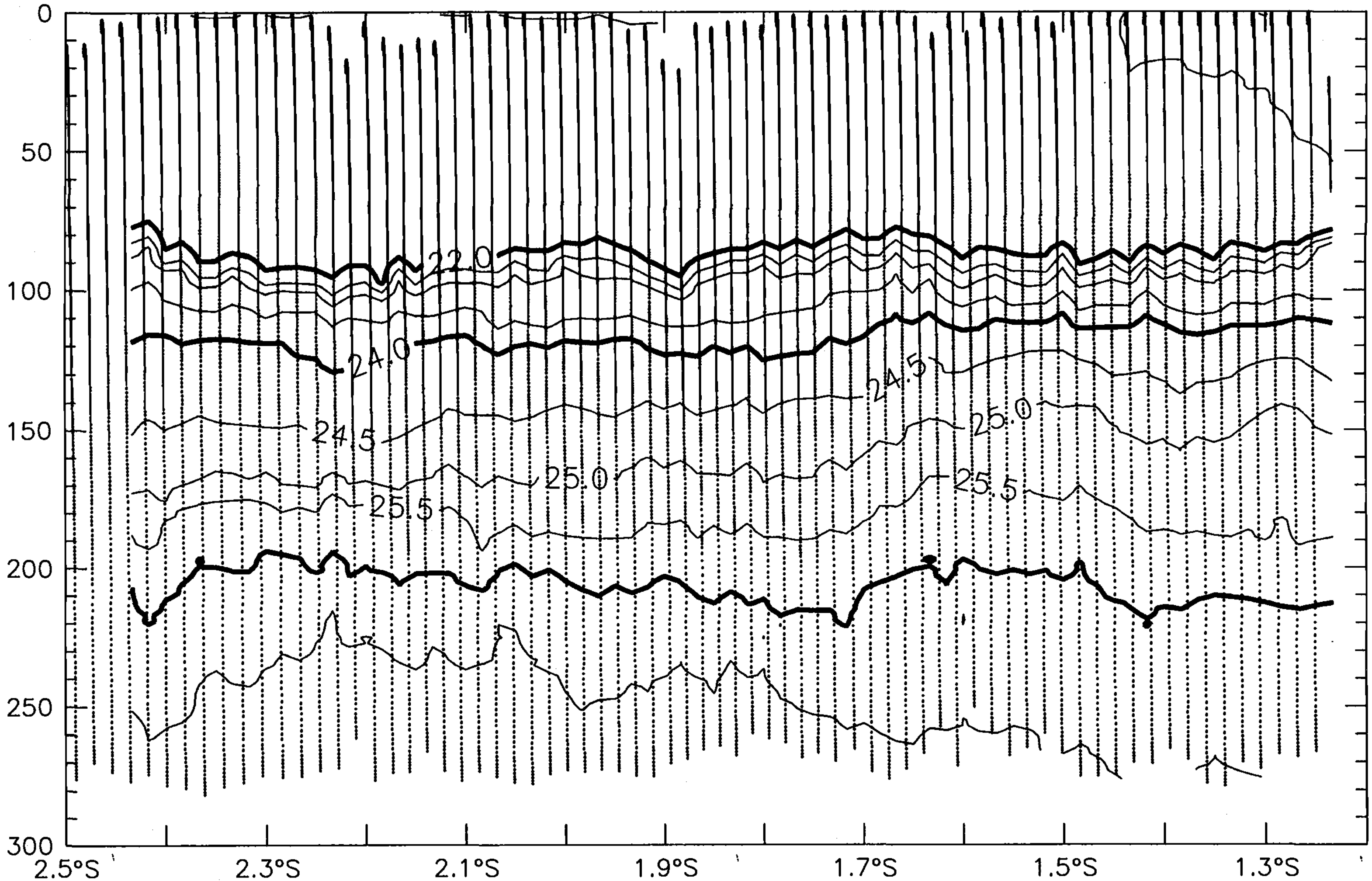
Sigma–t, N2S, 30 December 1992



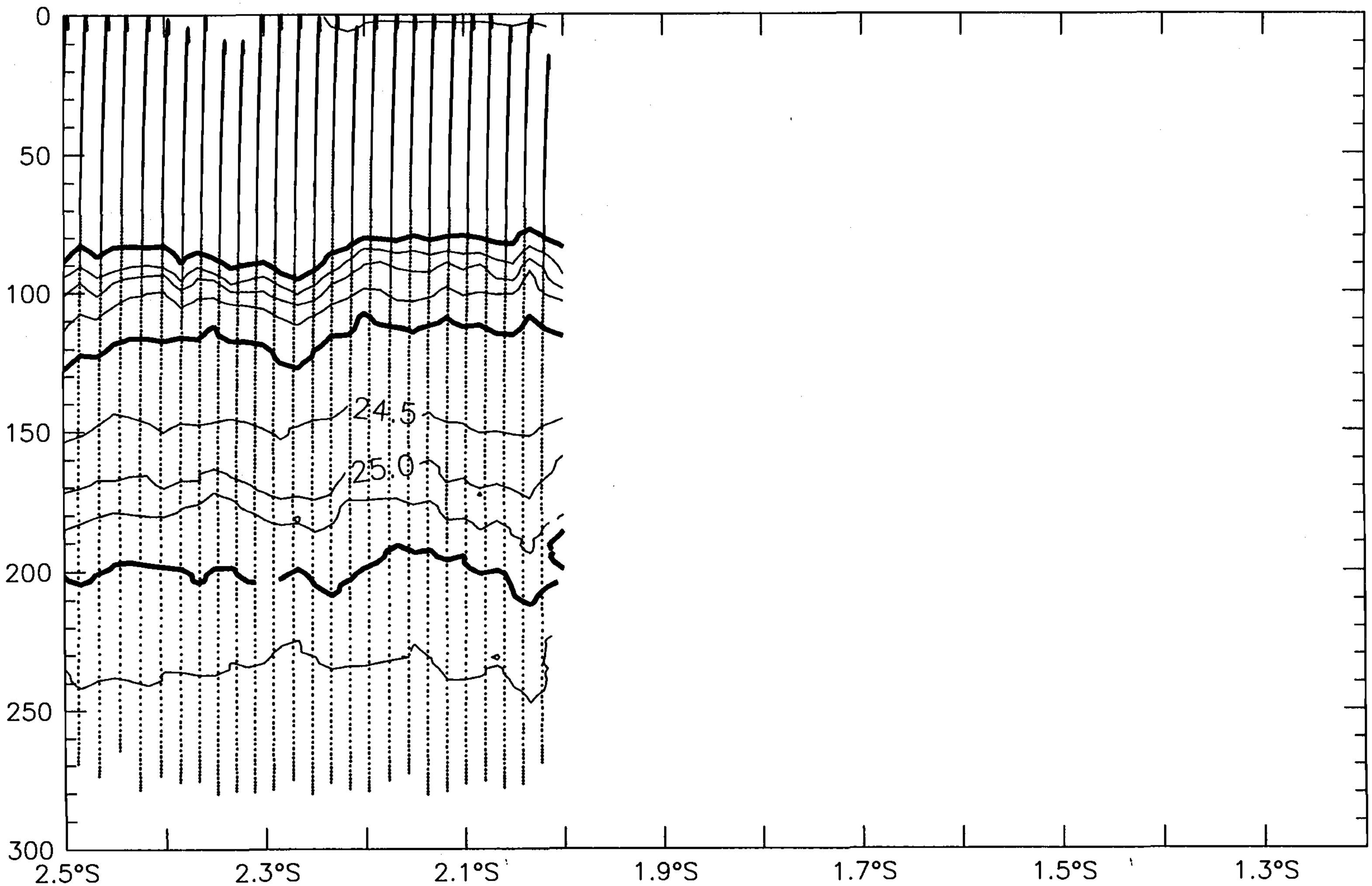
Sigma–t, N2S, 31 December 1992



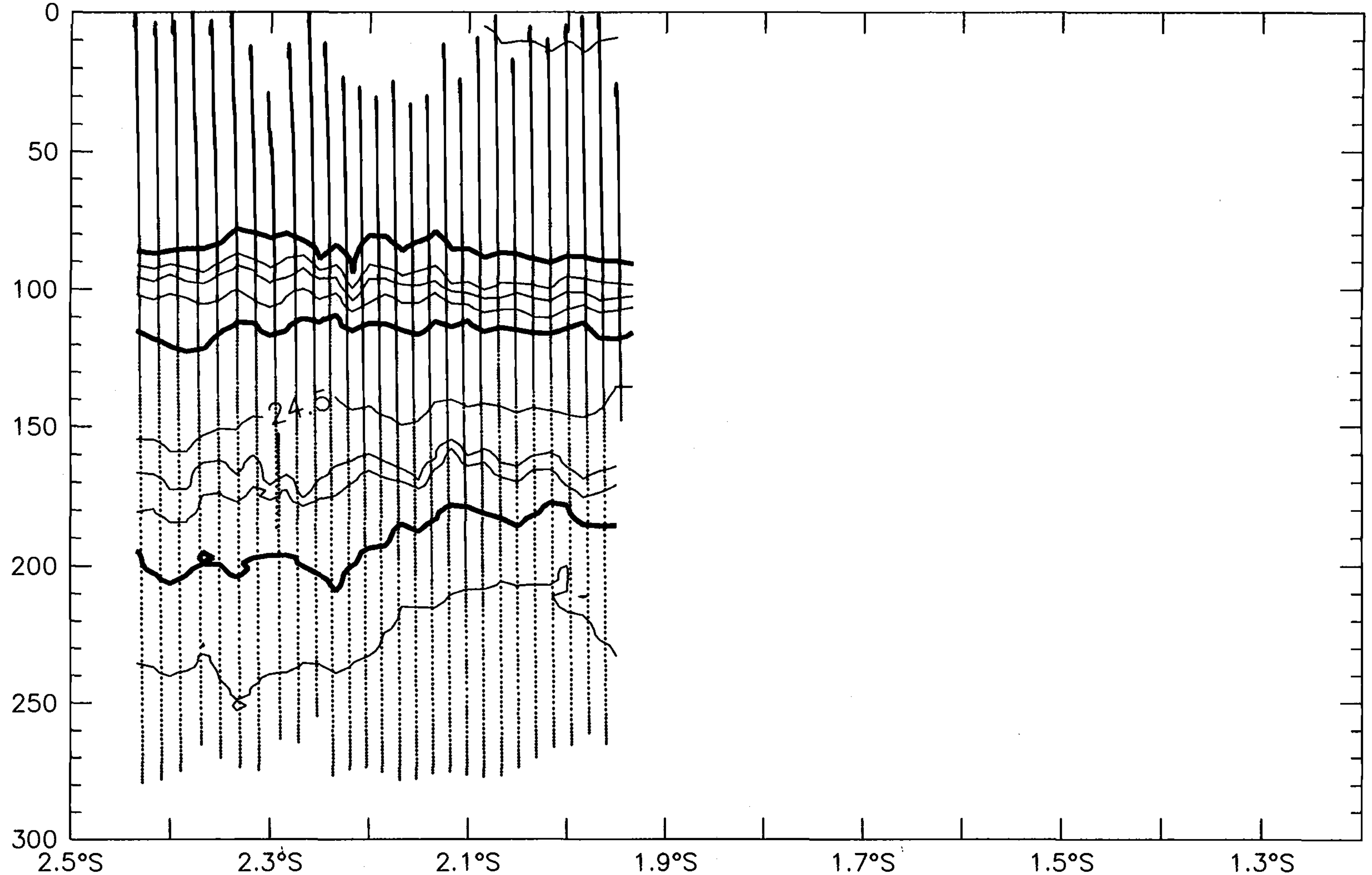
Sigma−t, N2S, 2 January 1993



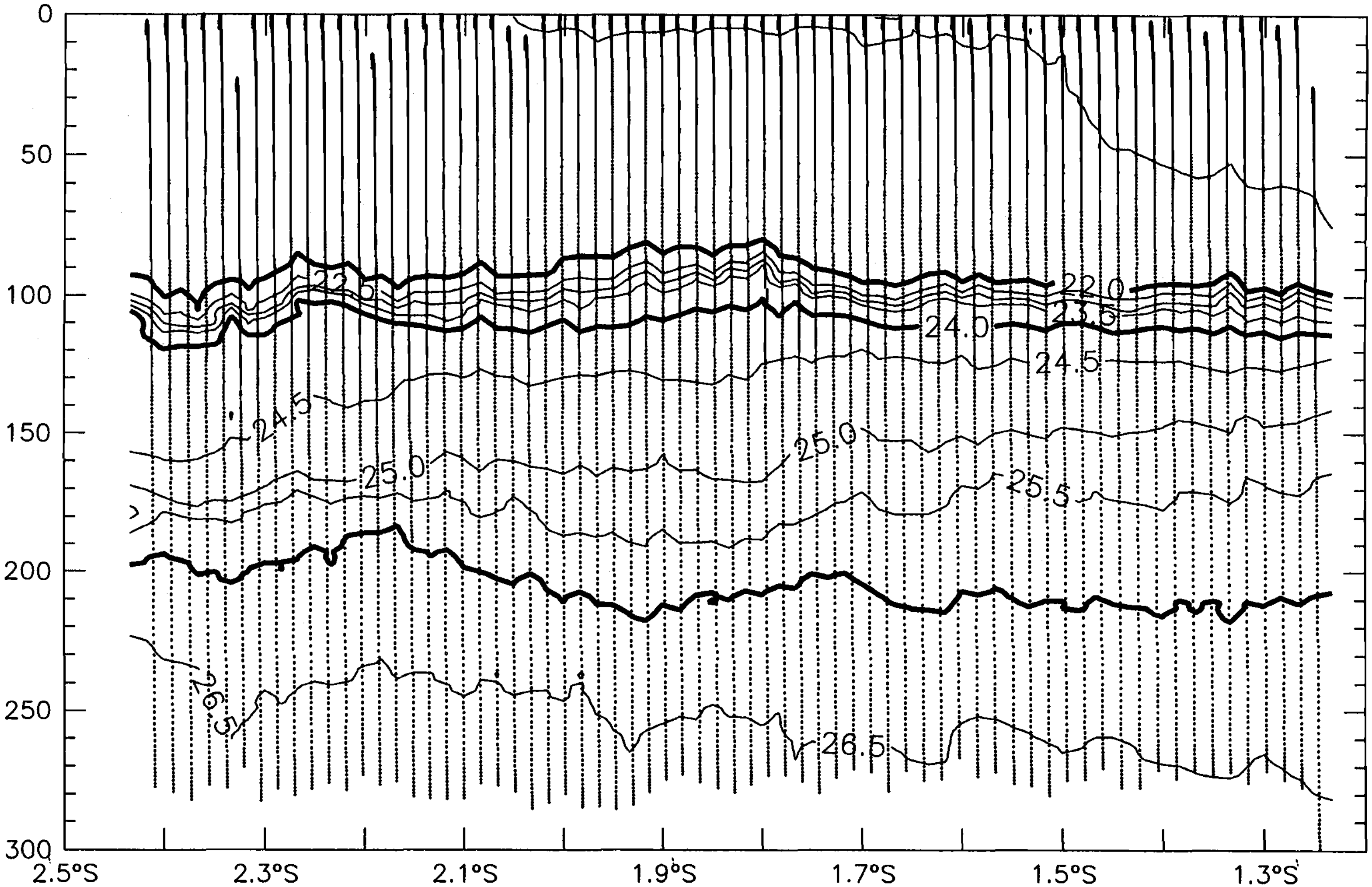
Sigma–t, N2S, 3 January 1993



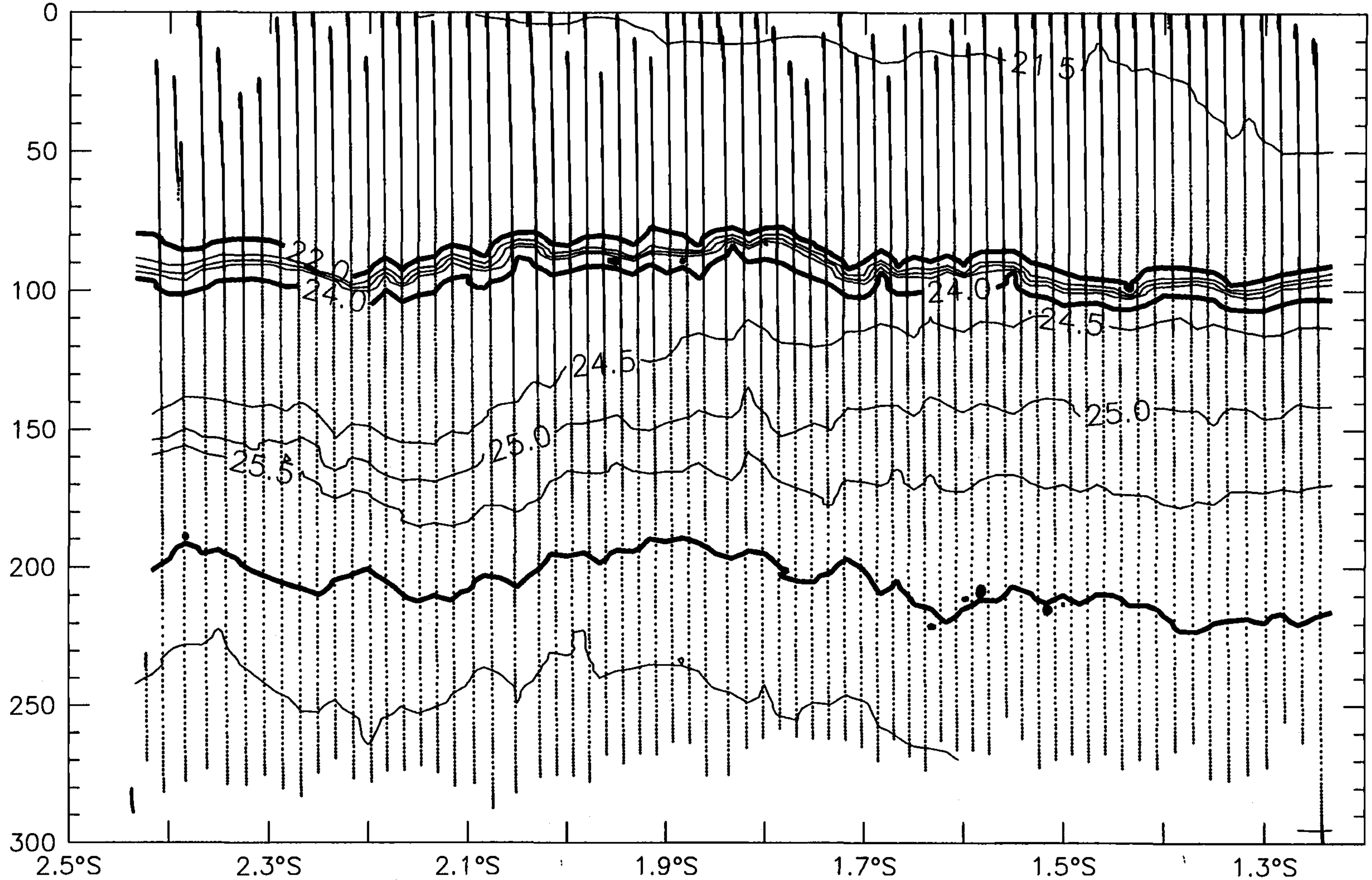
Sigma–t, S2N, 3 January 1993



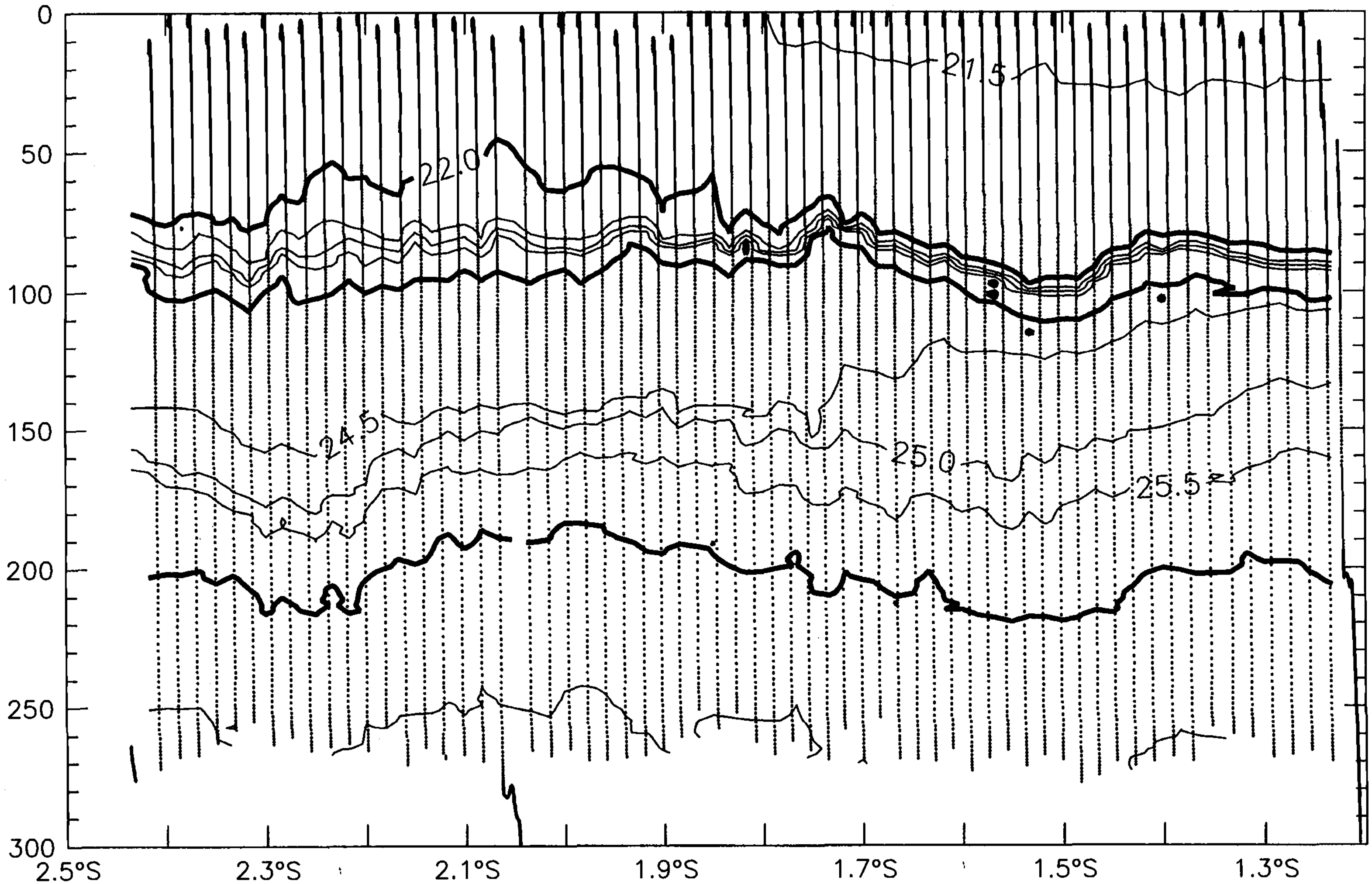
Sigma–t, N2S, 4 January 1993



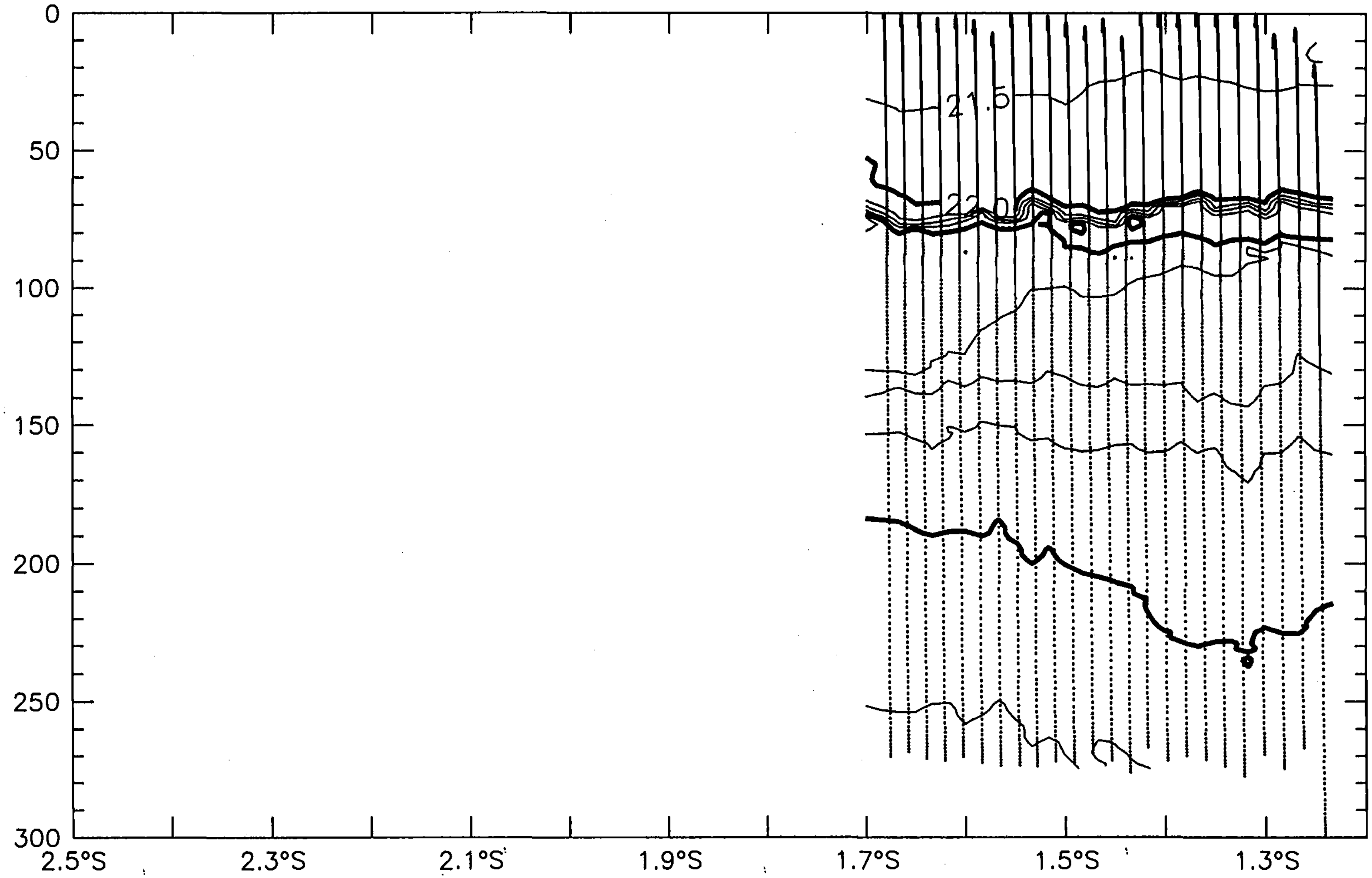
Sigma–t, N2S, 5 January 1993



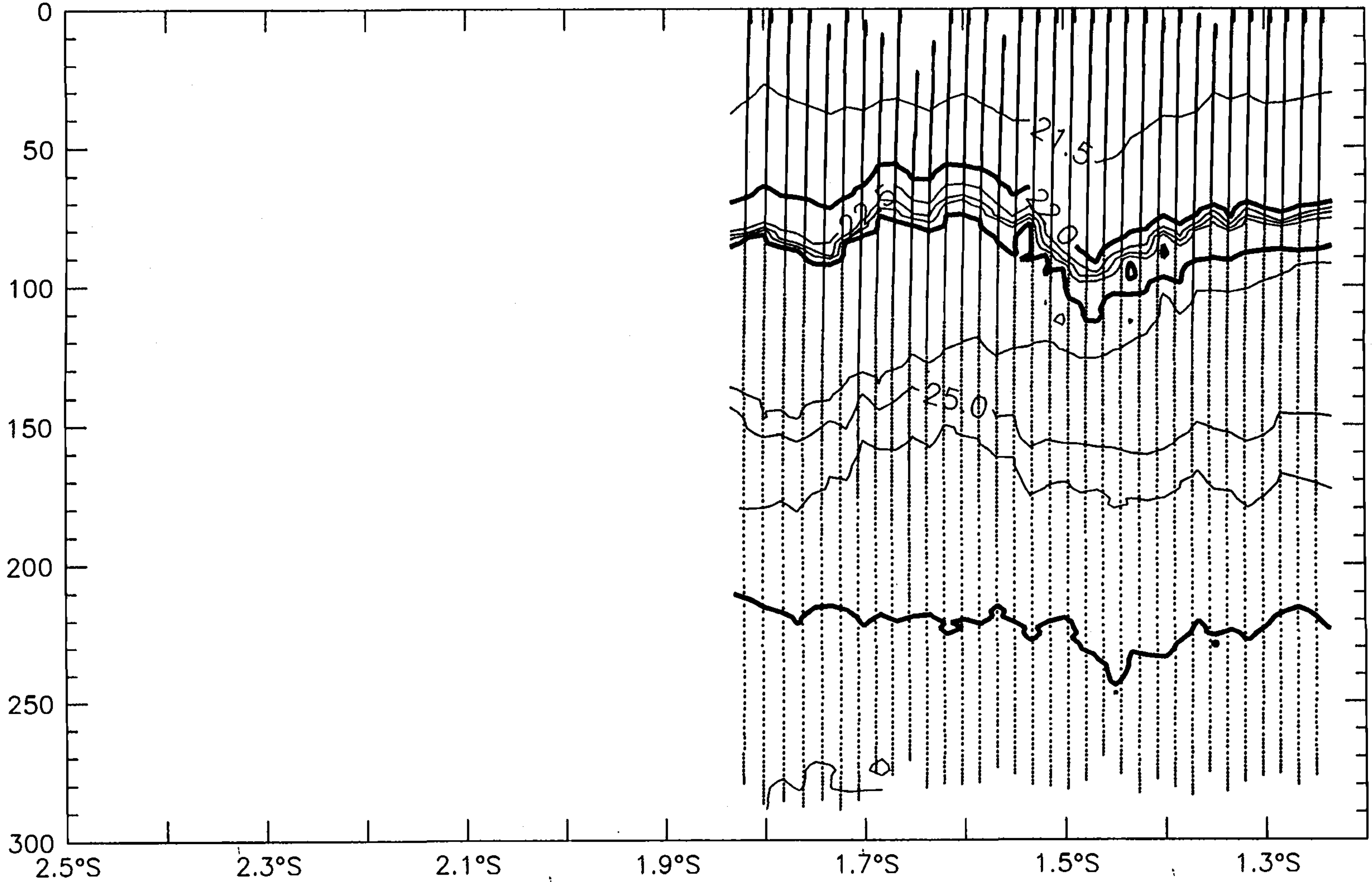
Sigma—t, N2S, 6 January 1993



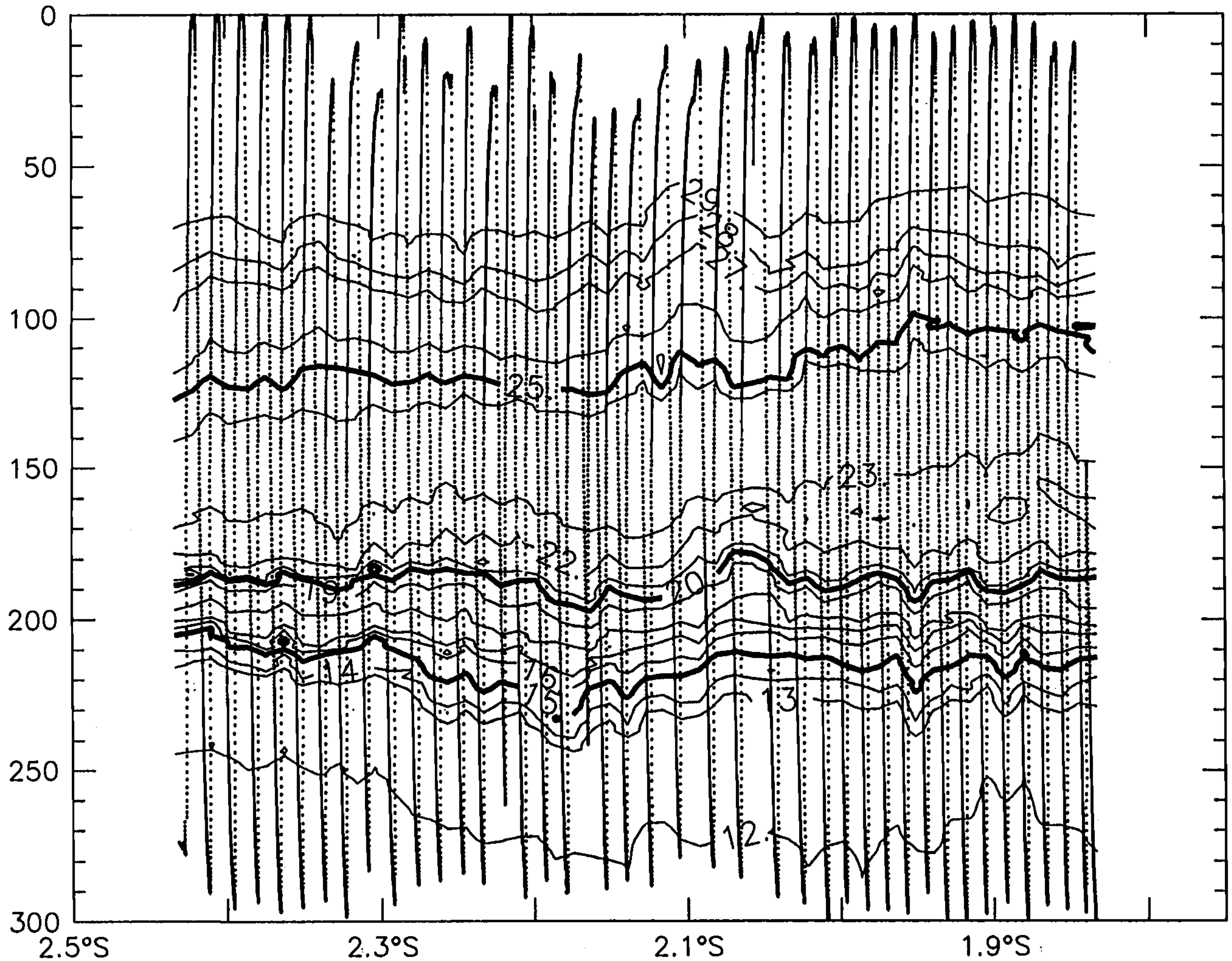
Sigma–t, N2S, 8 January 1993



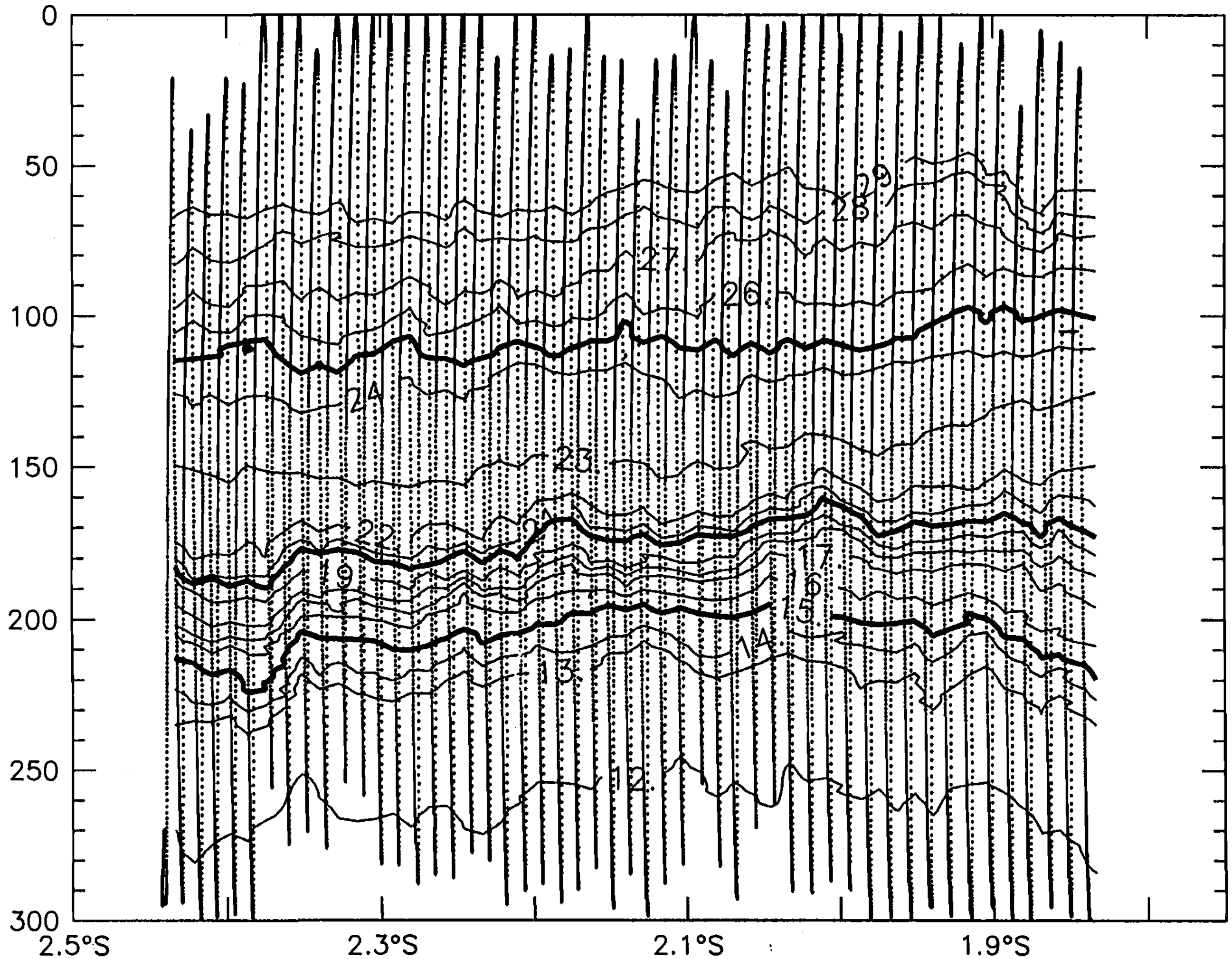
Sigma–t, N2S, 9 January 1993



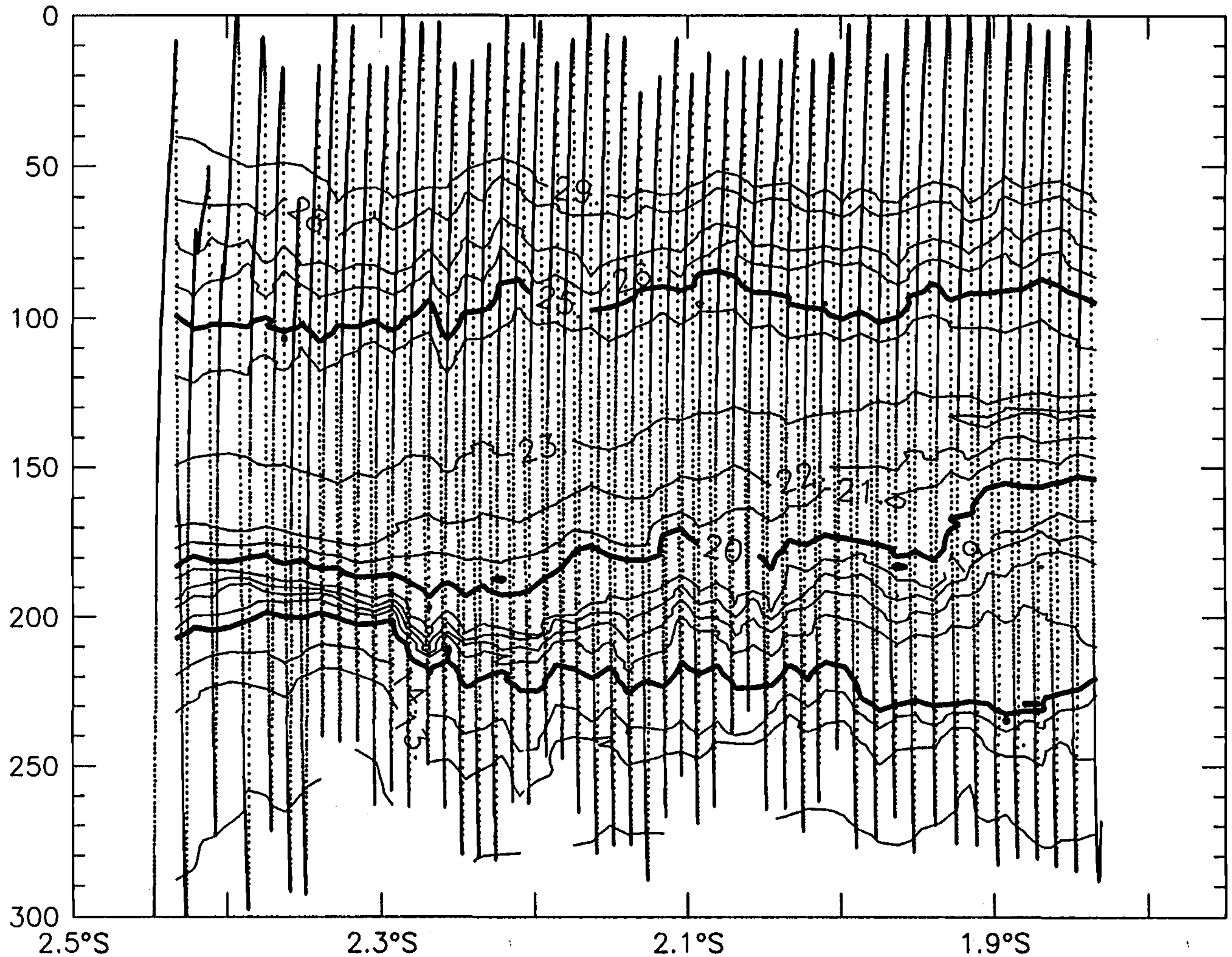
Sigma−t, N2S, 10 January 1993



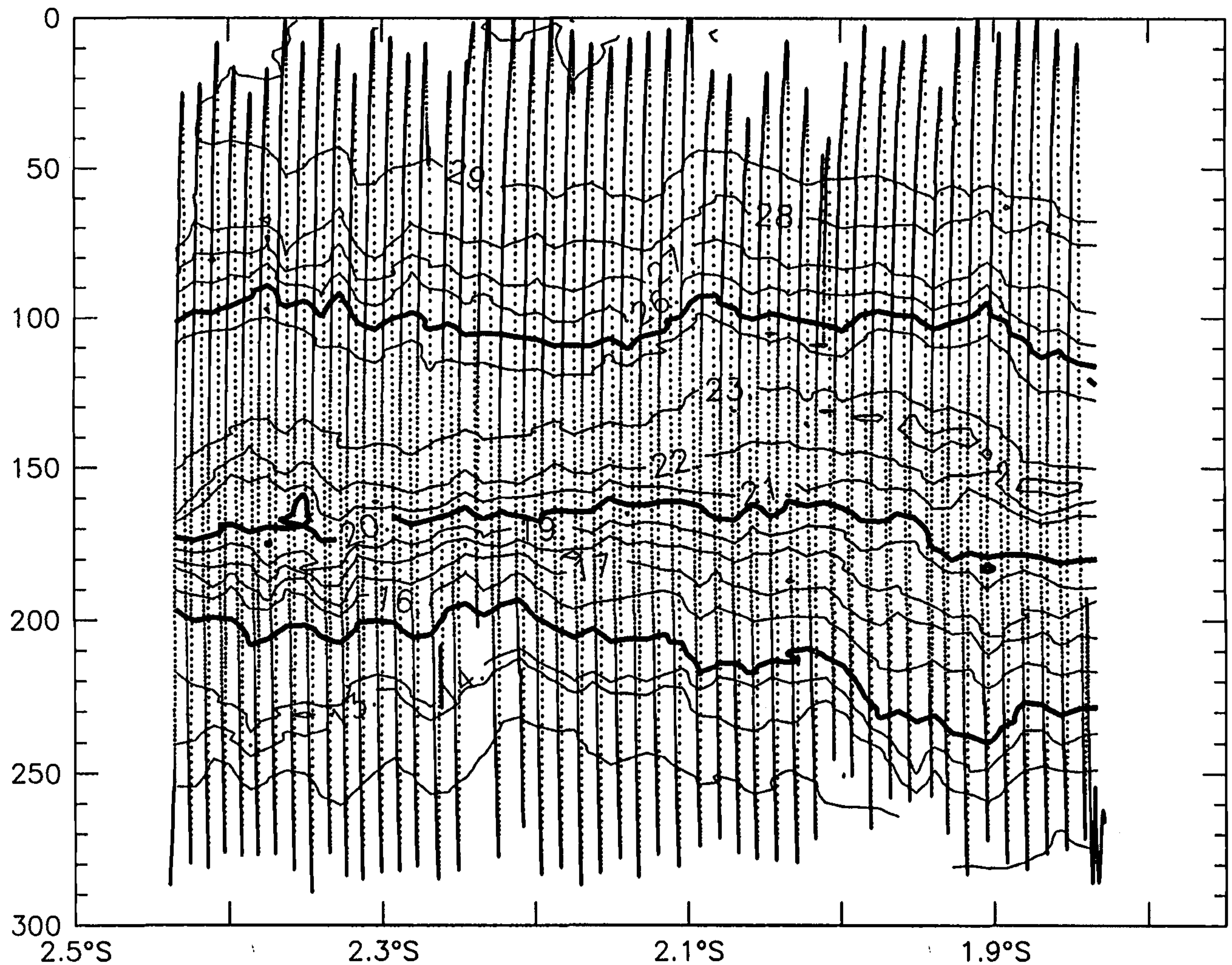
T(°C), S2W, 19 December 1992



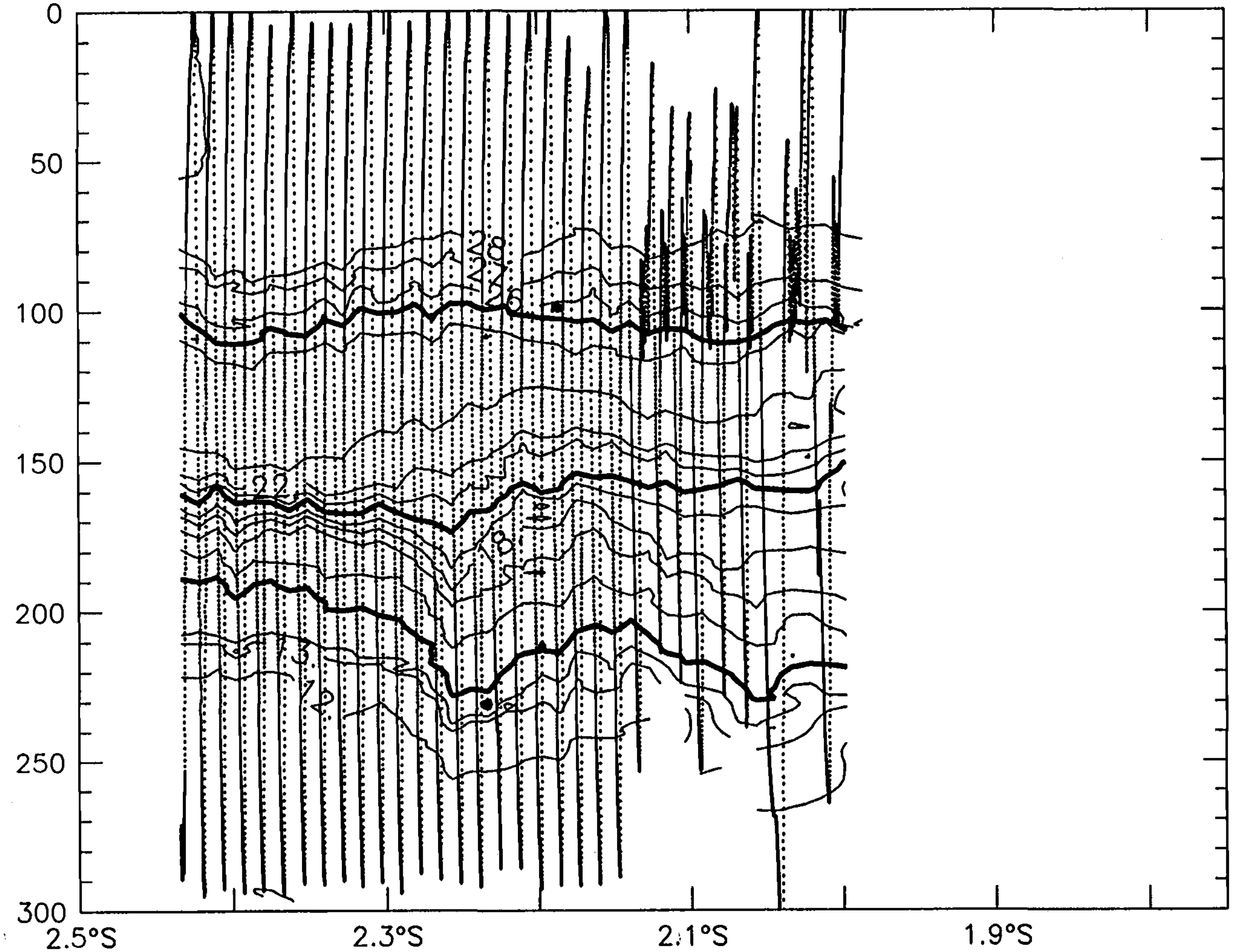
T(°C), S2W, 21 December 1992



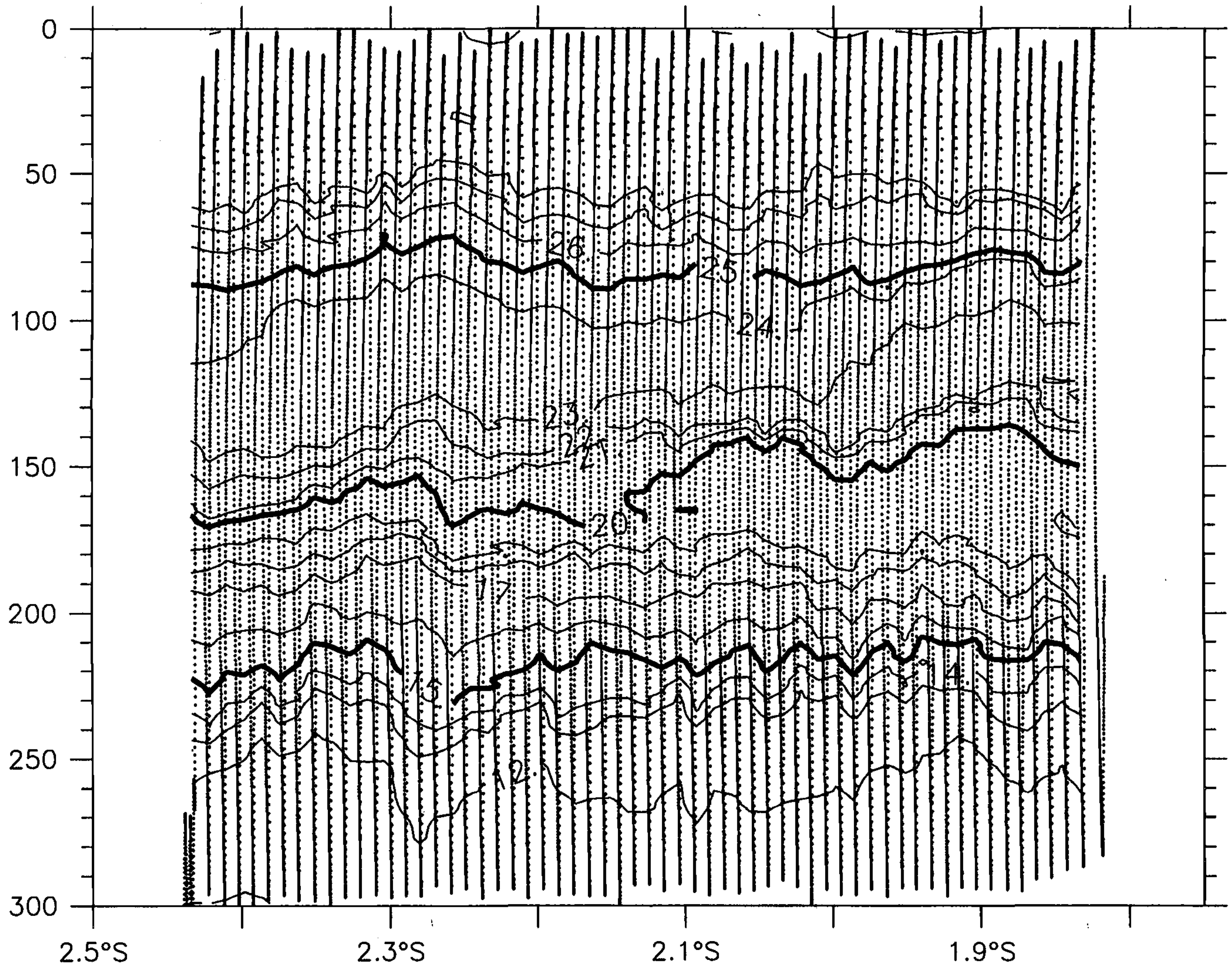
T(°C), S2W, 22 December 1992



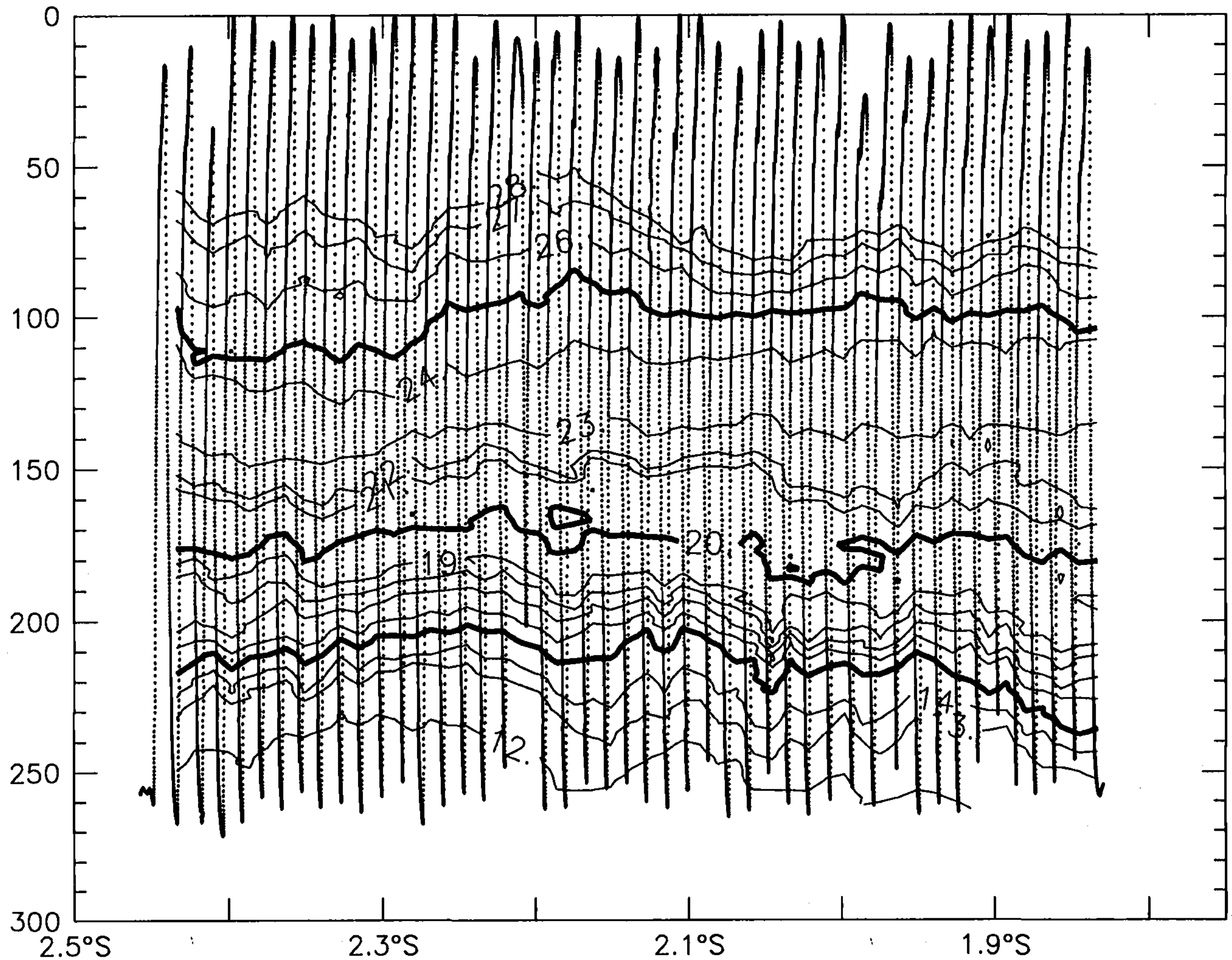
T(°C), S2W, 24 December 1992



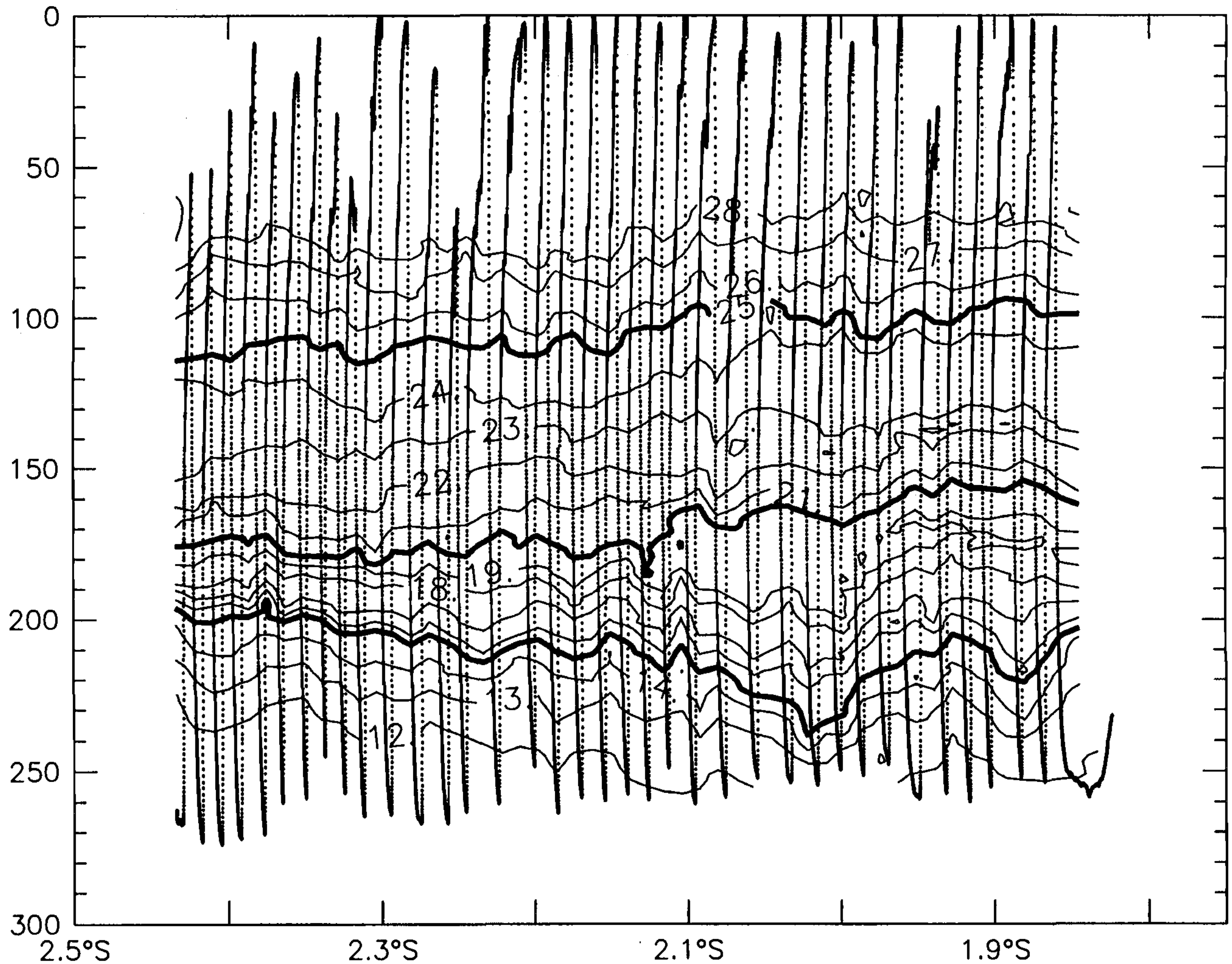
T(°C), S2W, 25 December 1992



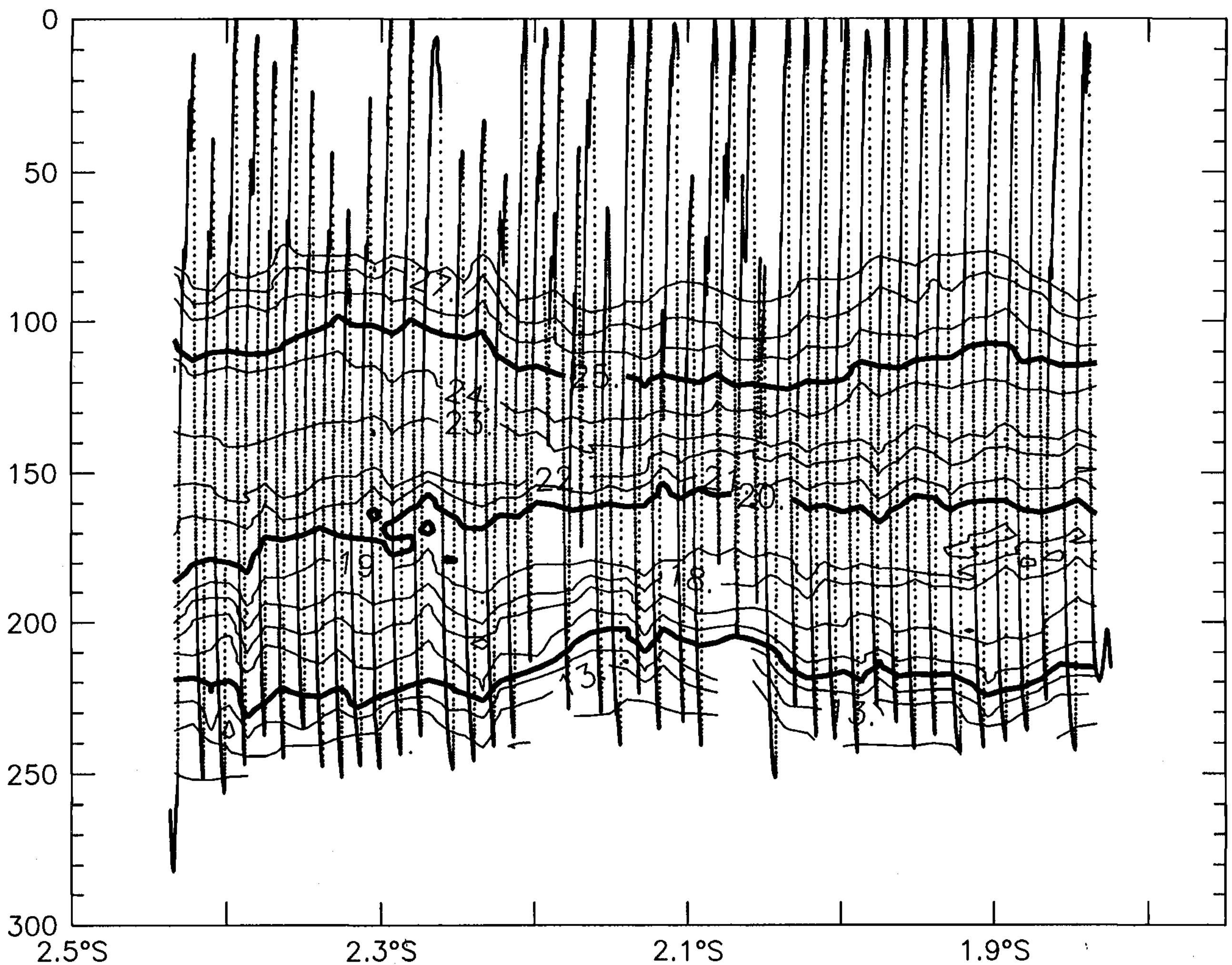
T(°C), S2W, 27 December 1992



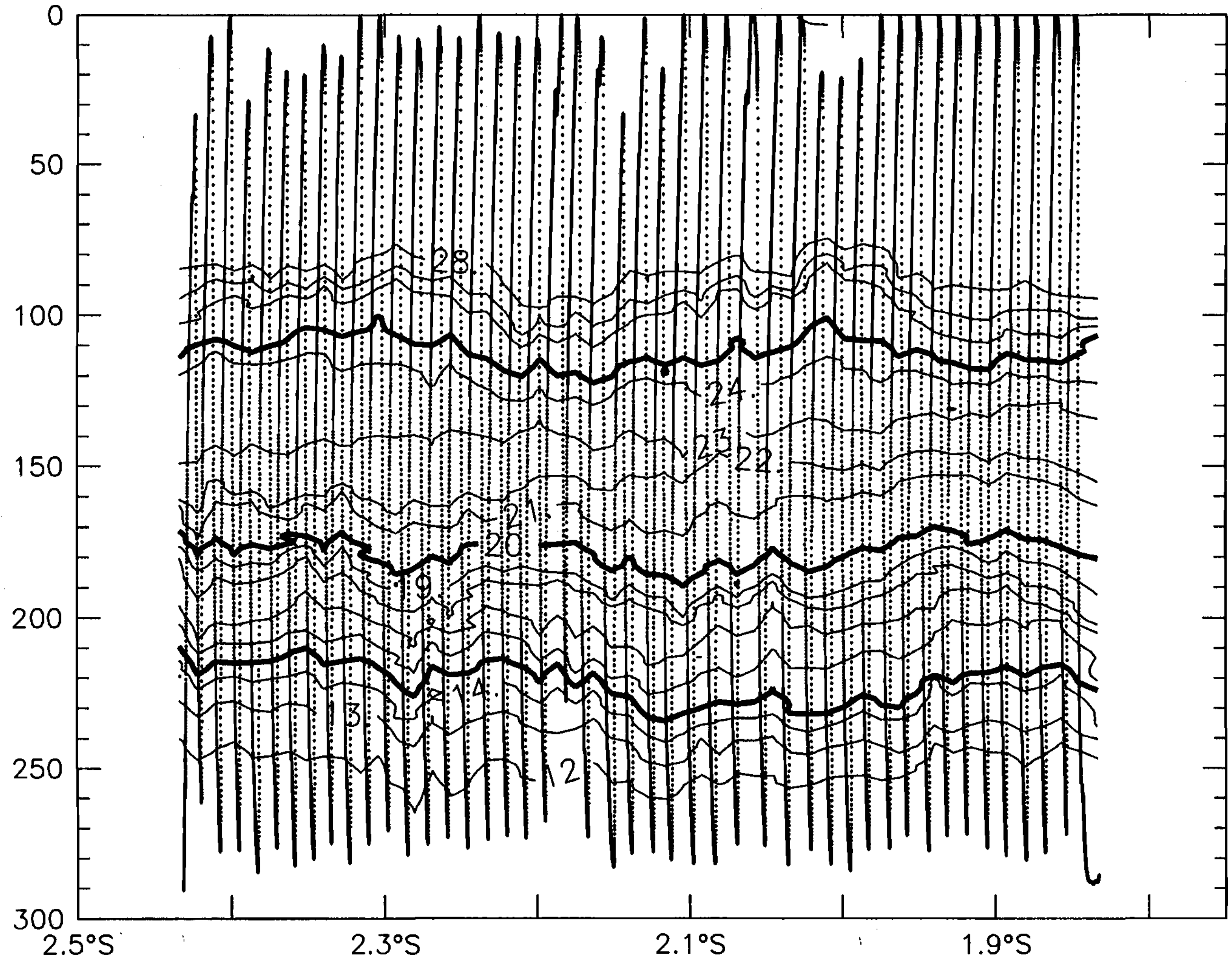
T(°C), S2W, 29 December 1992



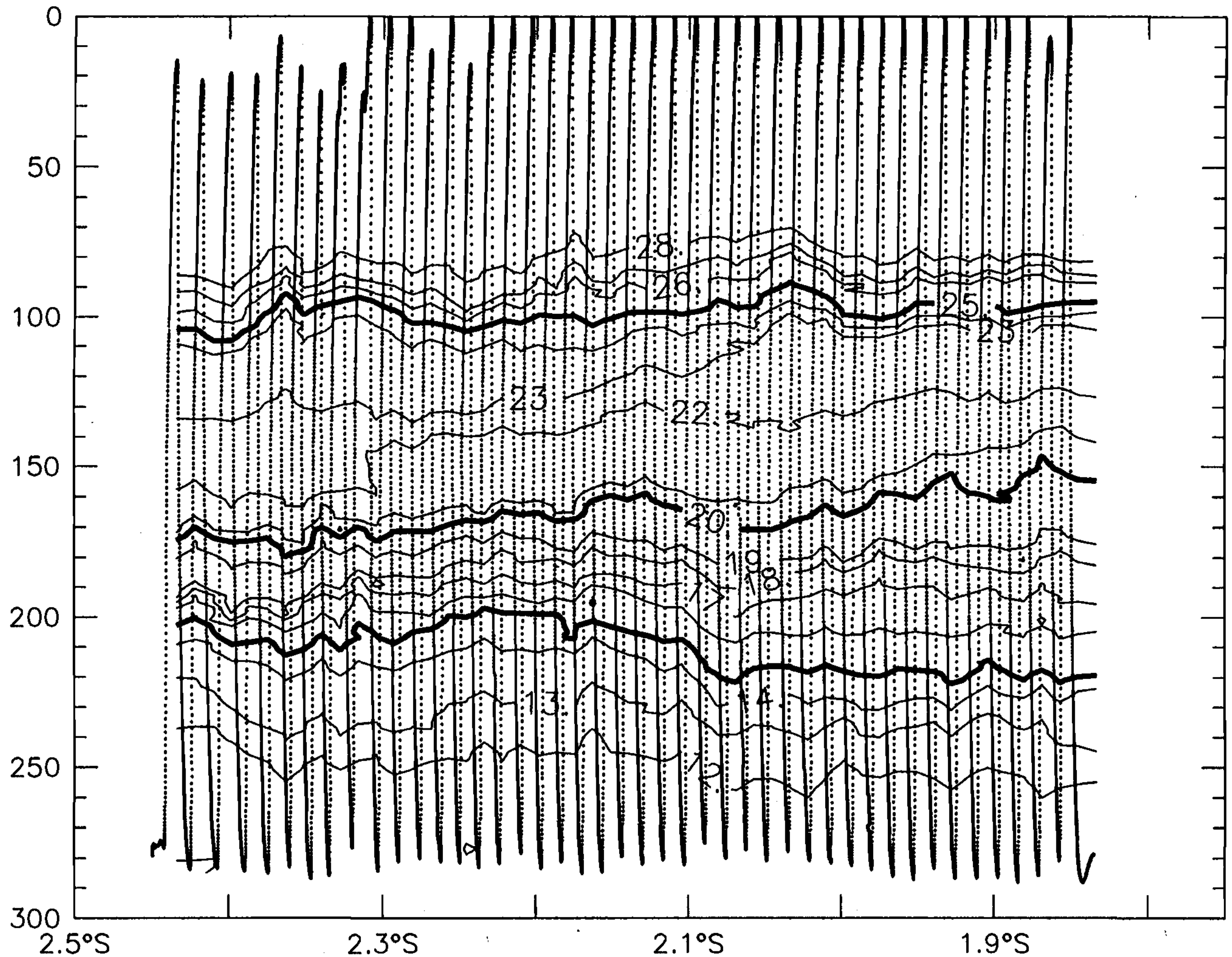
T(°C), S2W, 31 December 1992



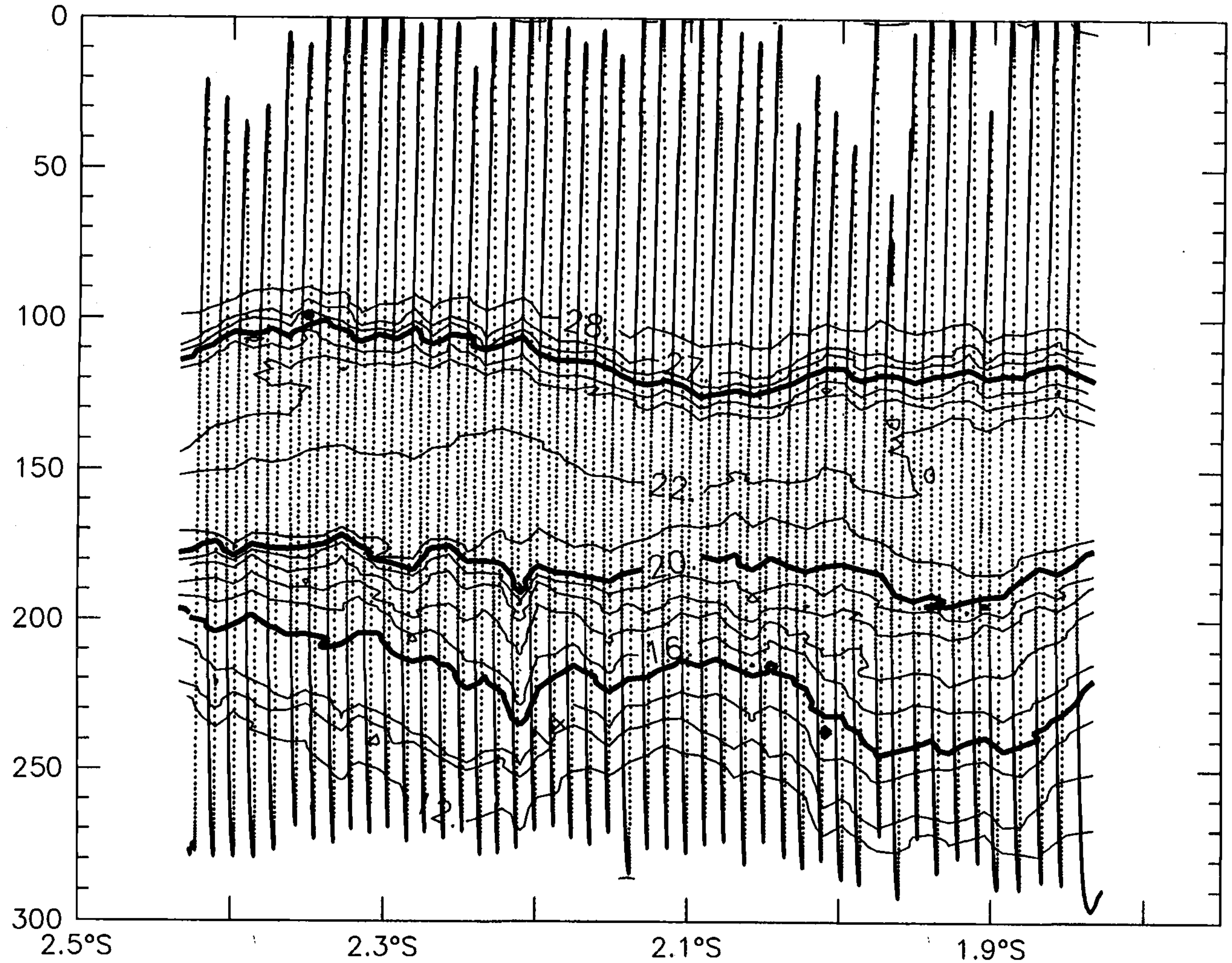
T(°C), S2W, 1 January 1993



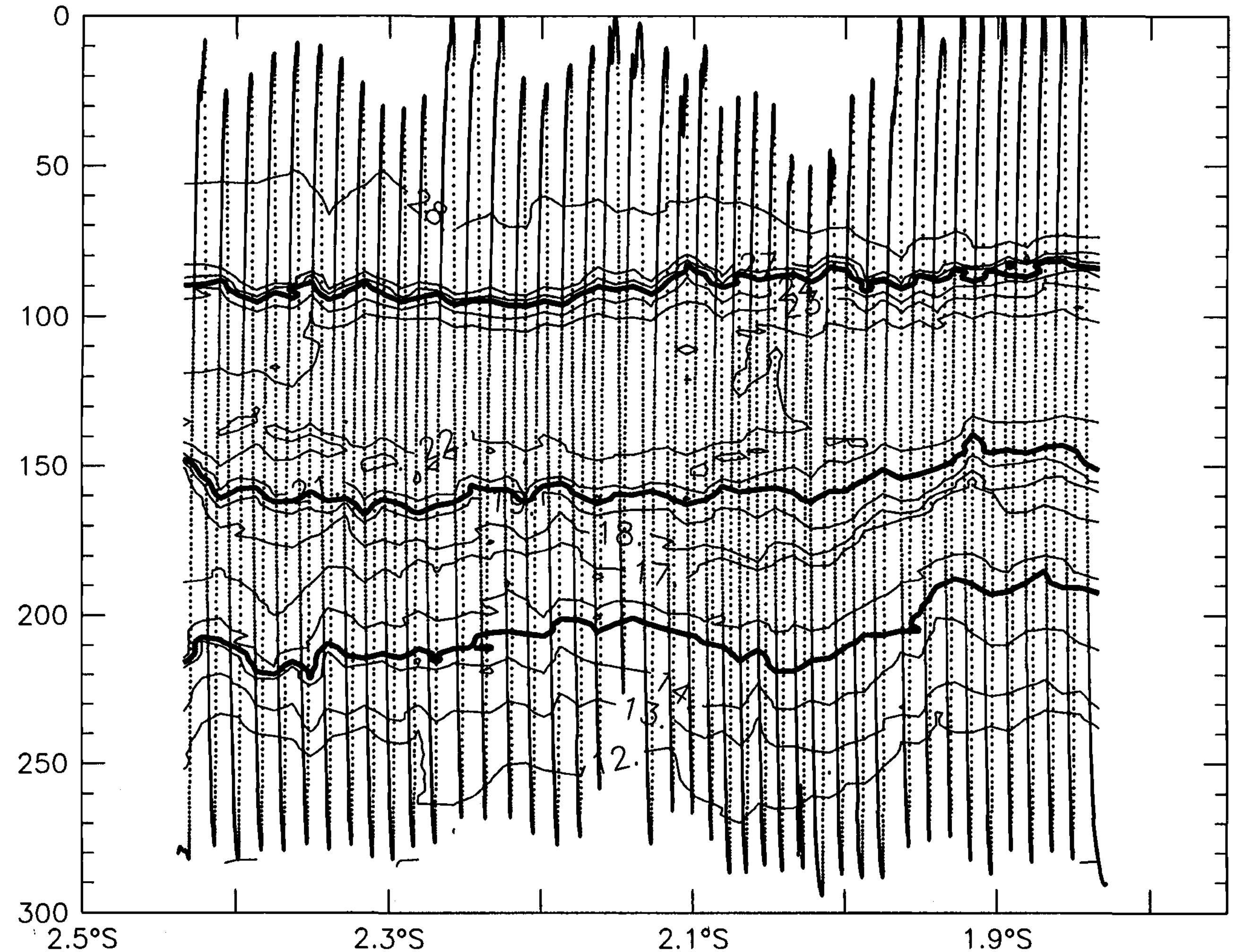
T(°C), S2W, 2 January 1993



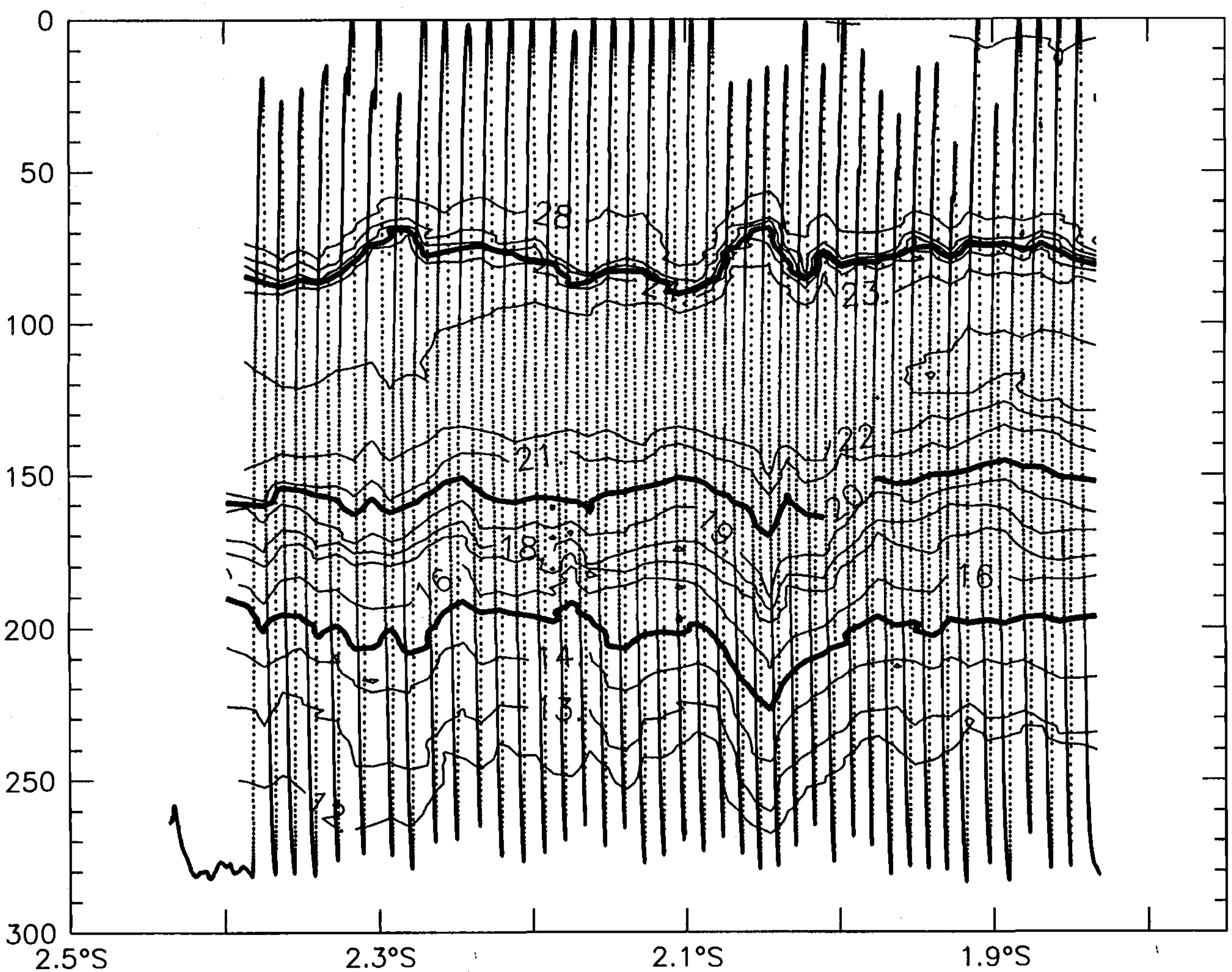
T(°C), S2W, 4 January 1993



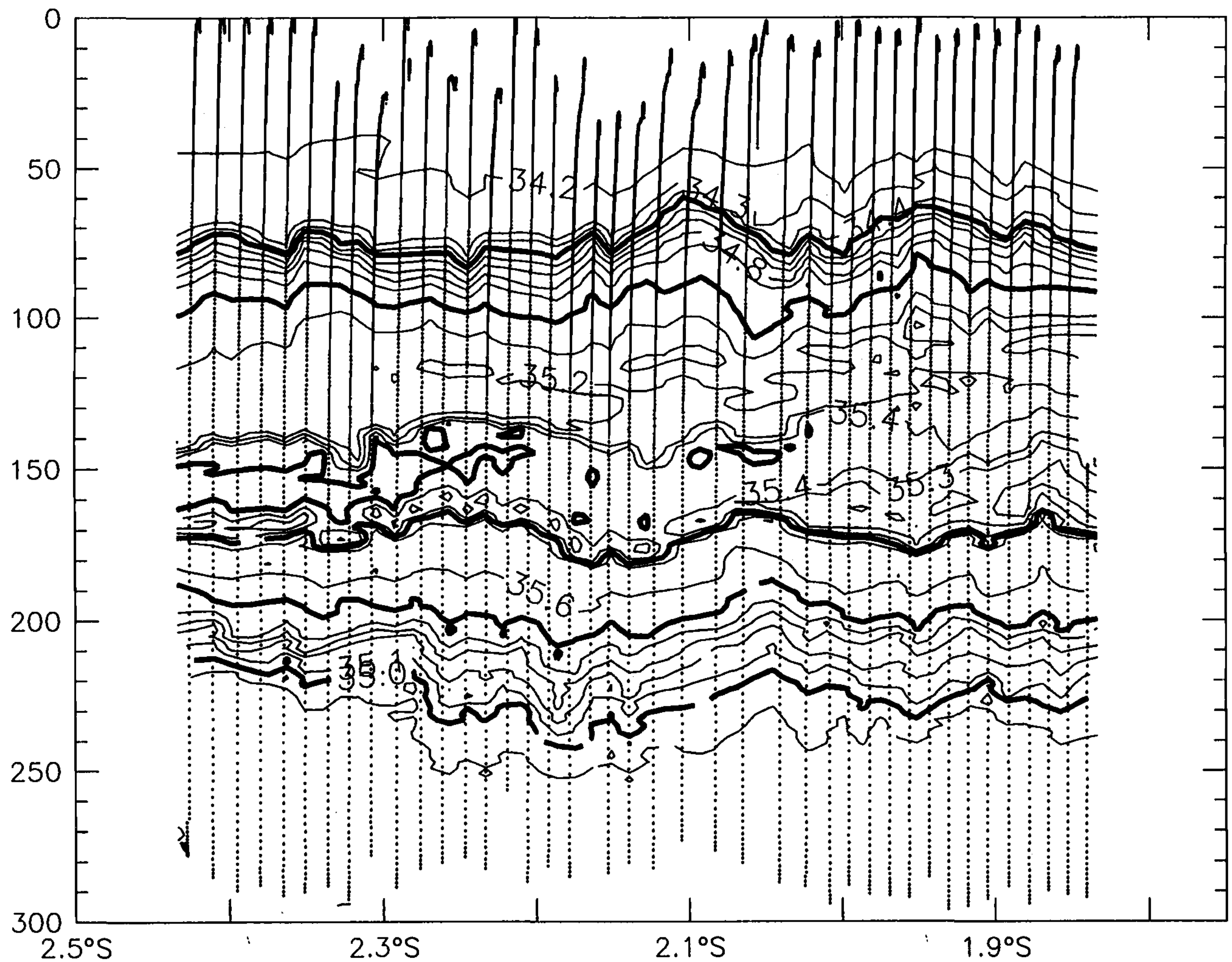
T(°C), S2W, 5 January 1993



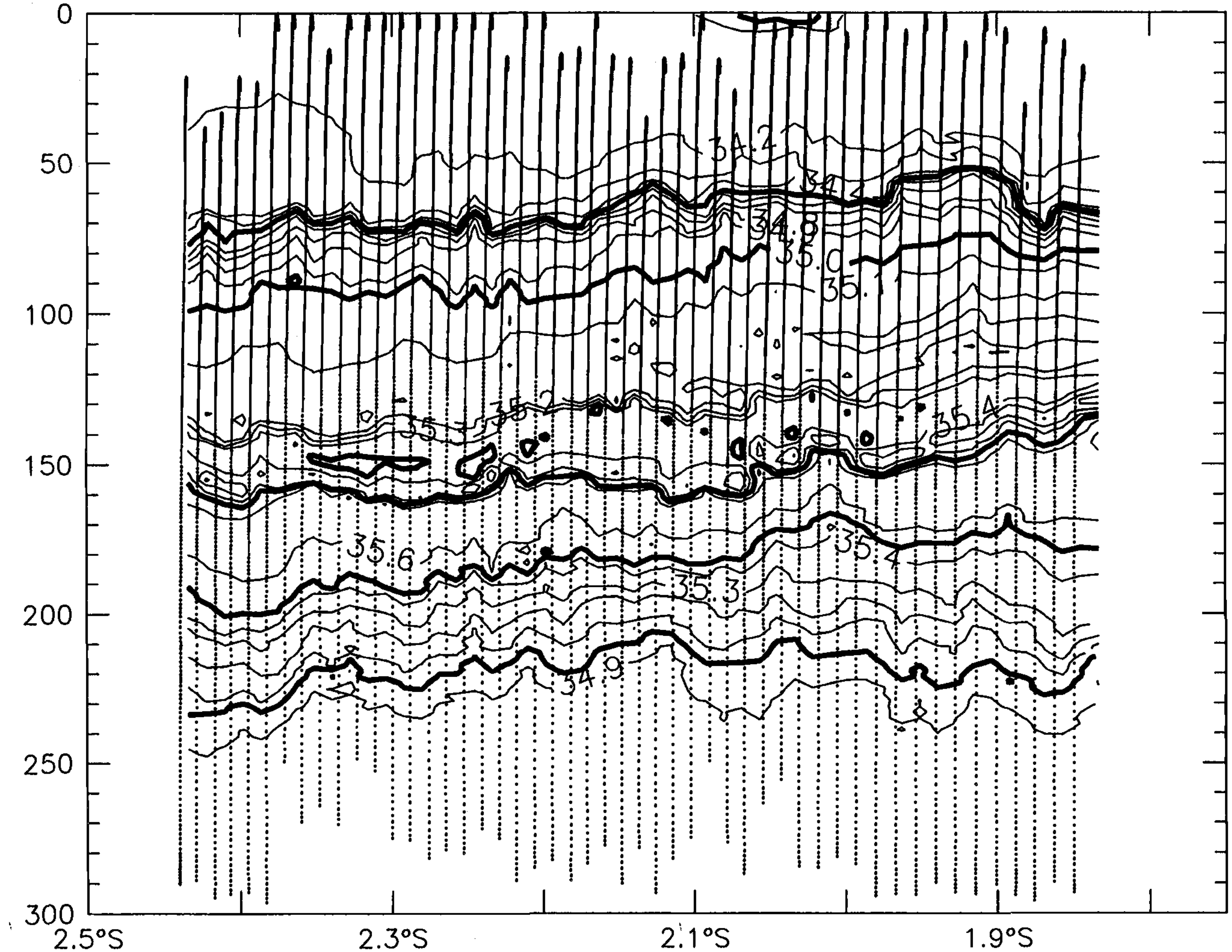
T(°C), S2W, 7 January 1993



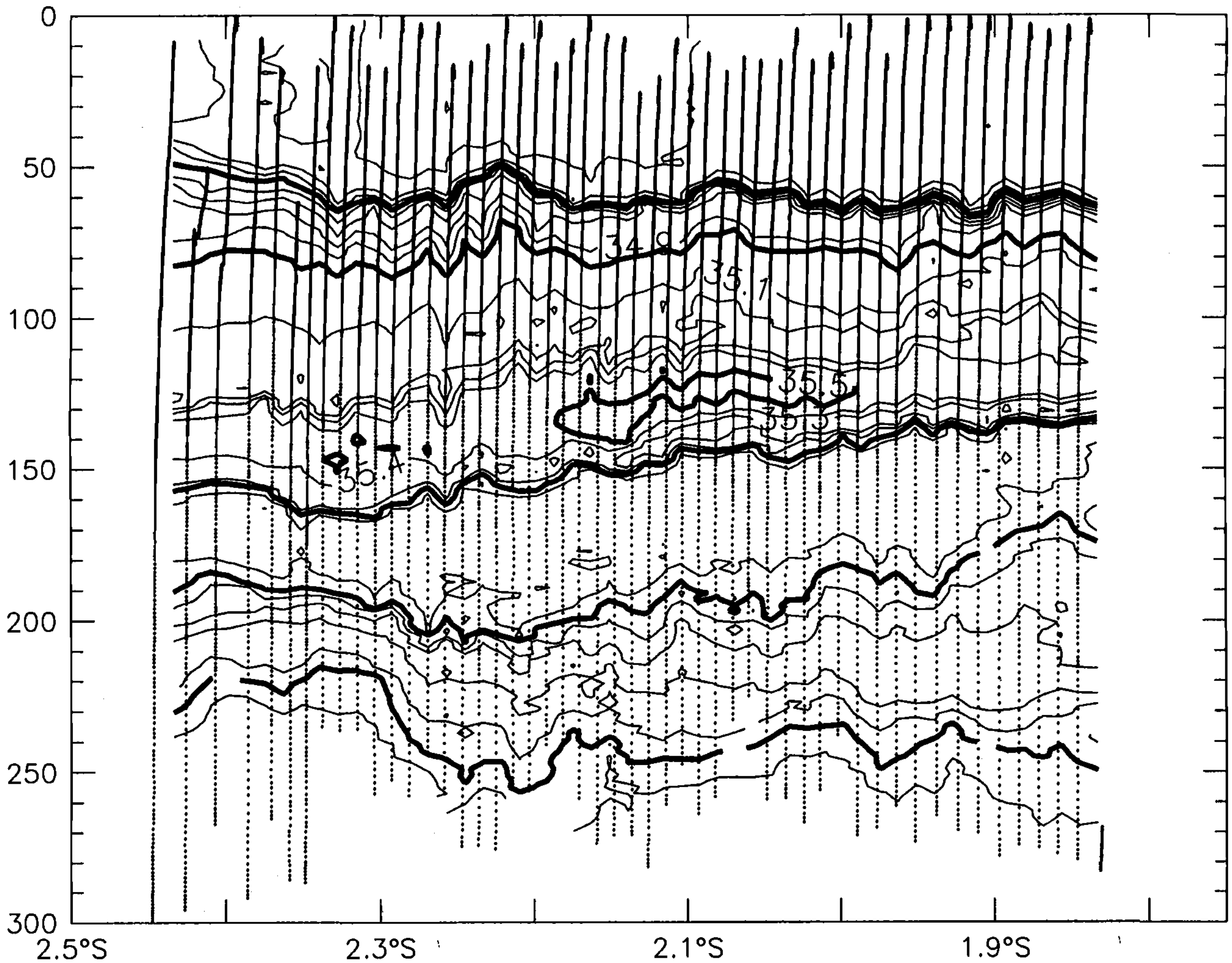
T(°C), S2W, 8 January 1993



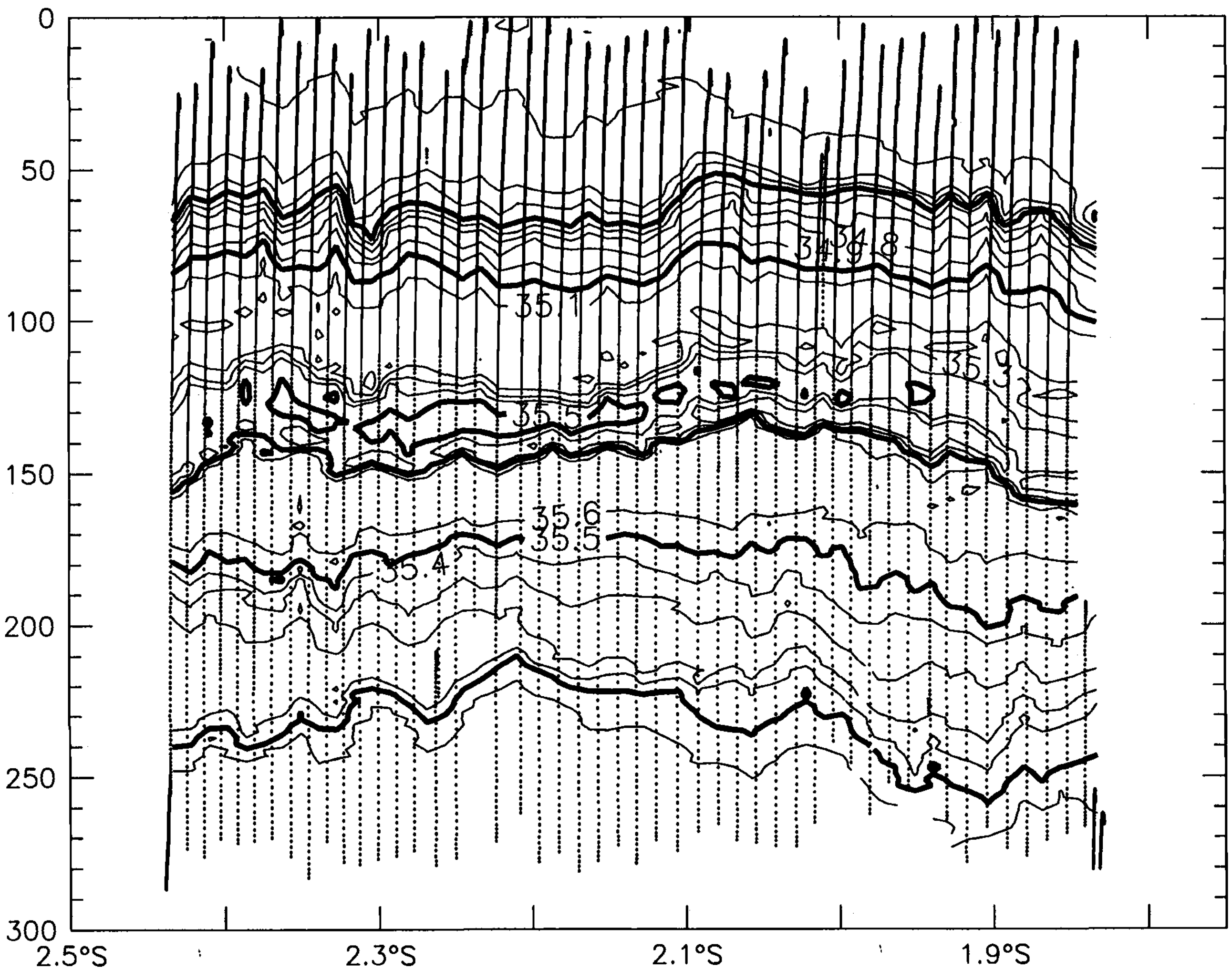
S(psu), S2W, 19 December 1992



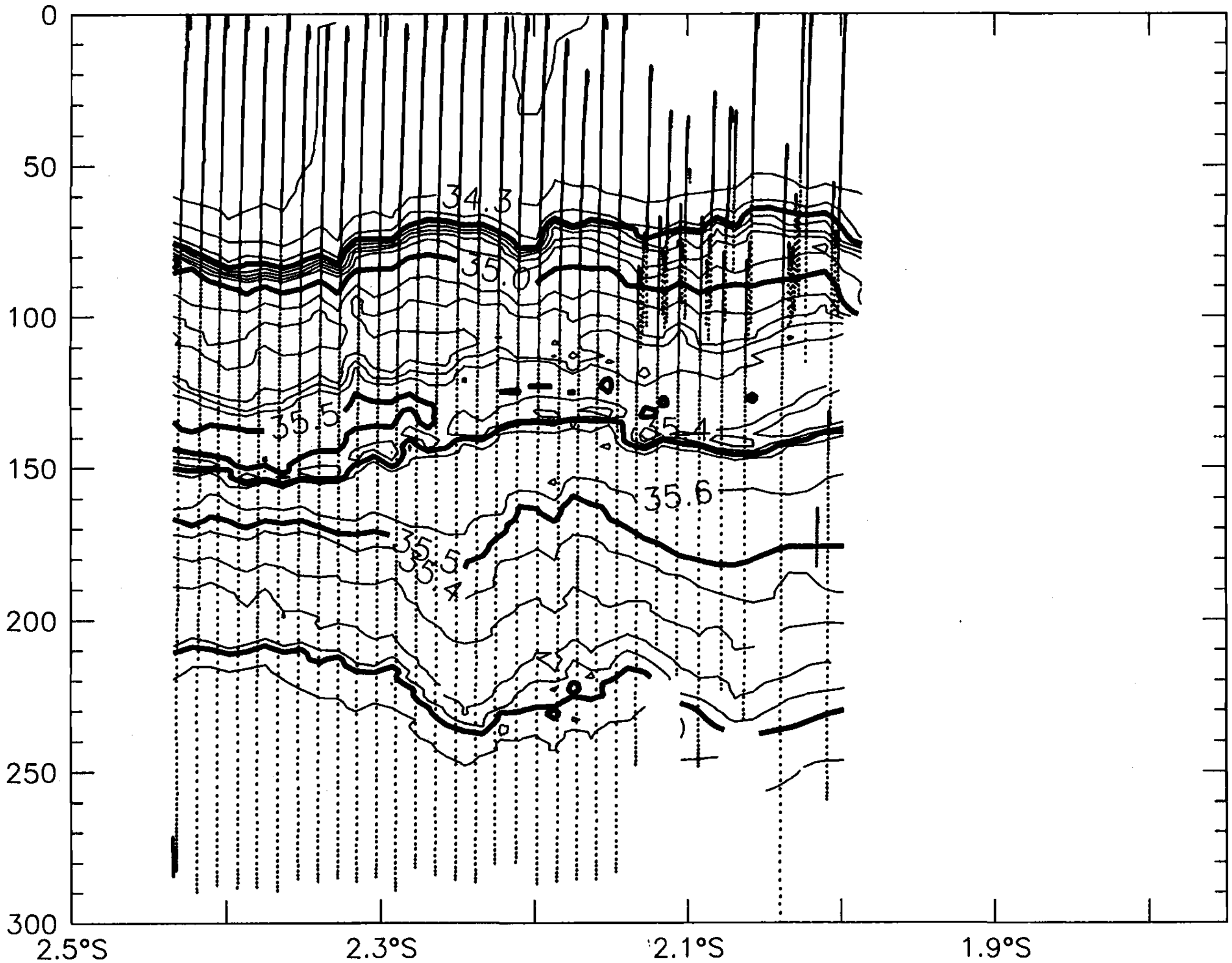
S(psu), S2W, 21 December 1992



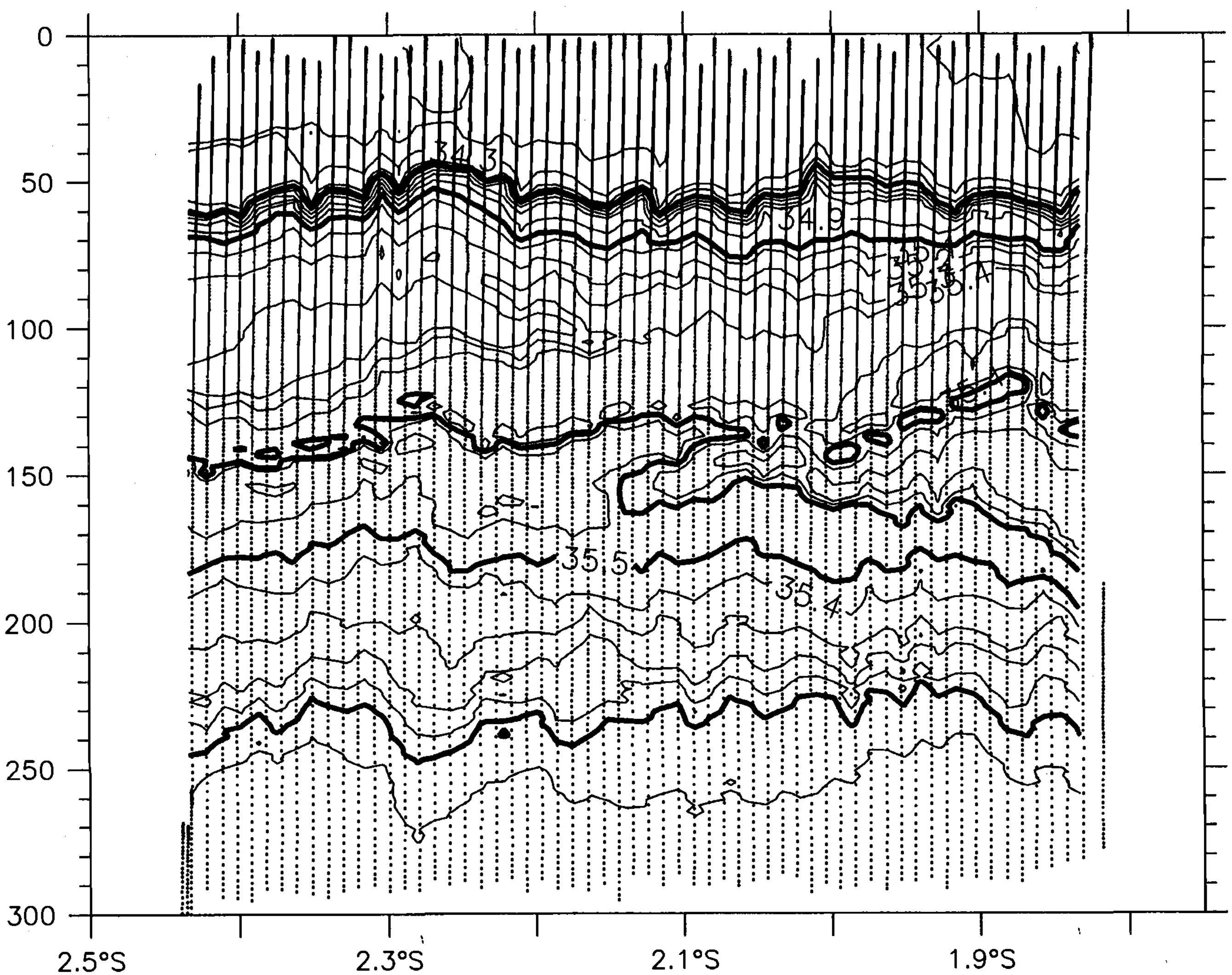
S(psu), S2W, 22 December 1992



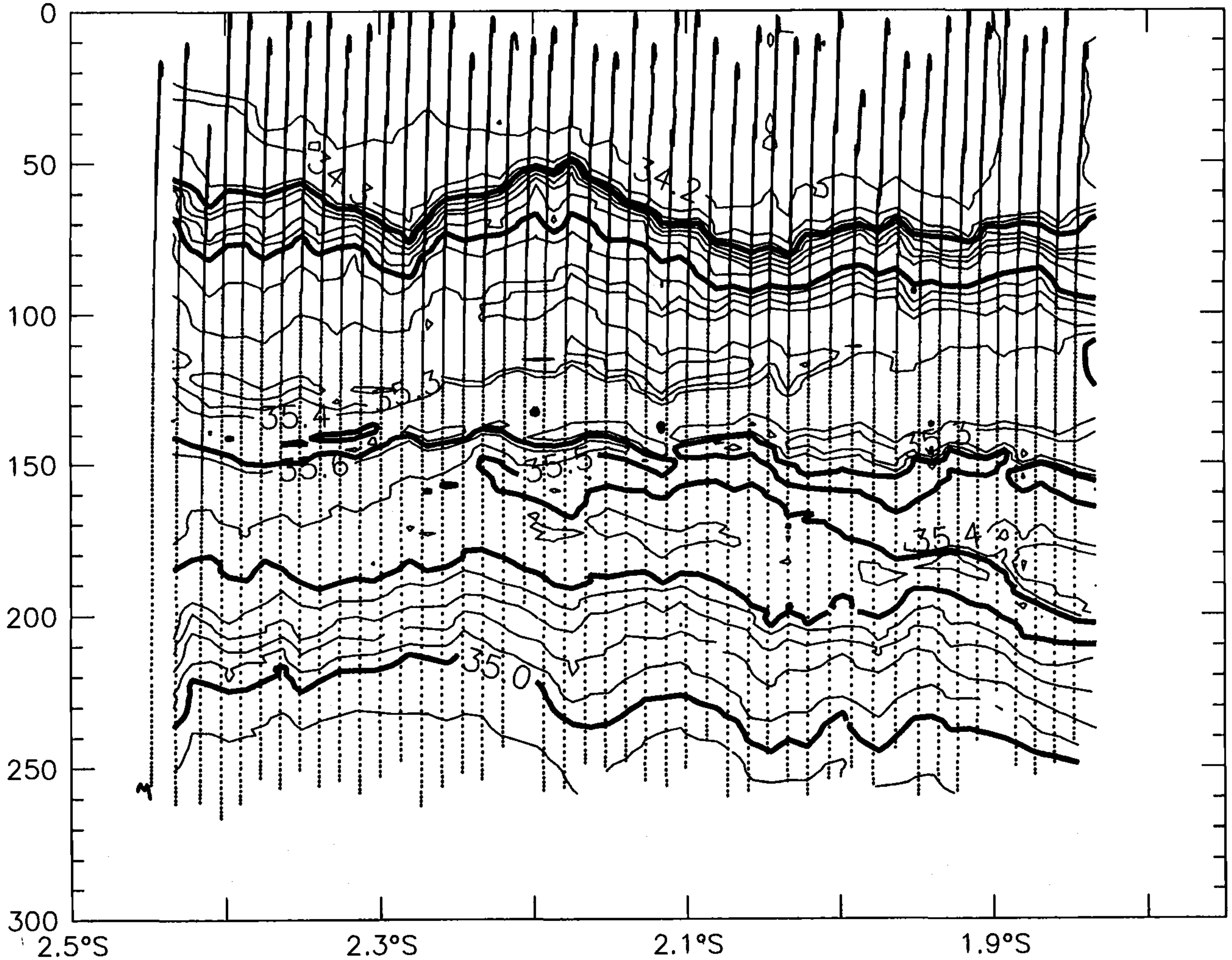
S(psu), S2W, 24 December 1992



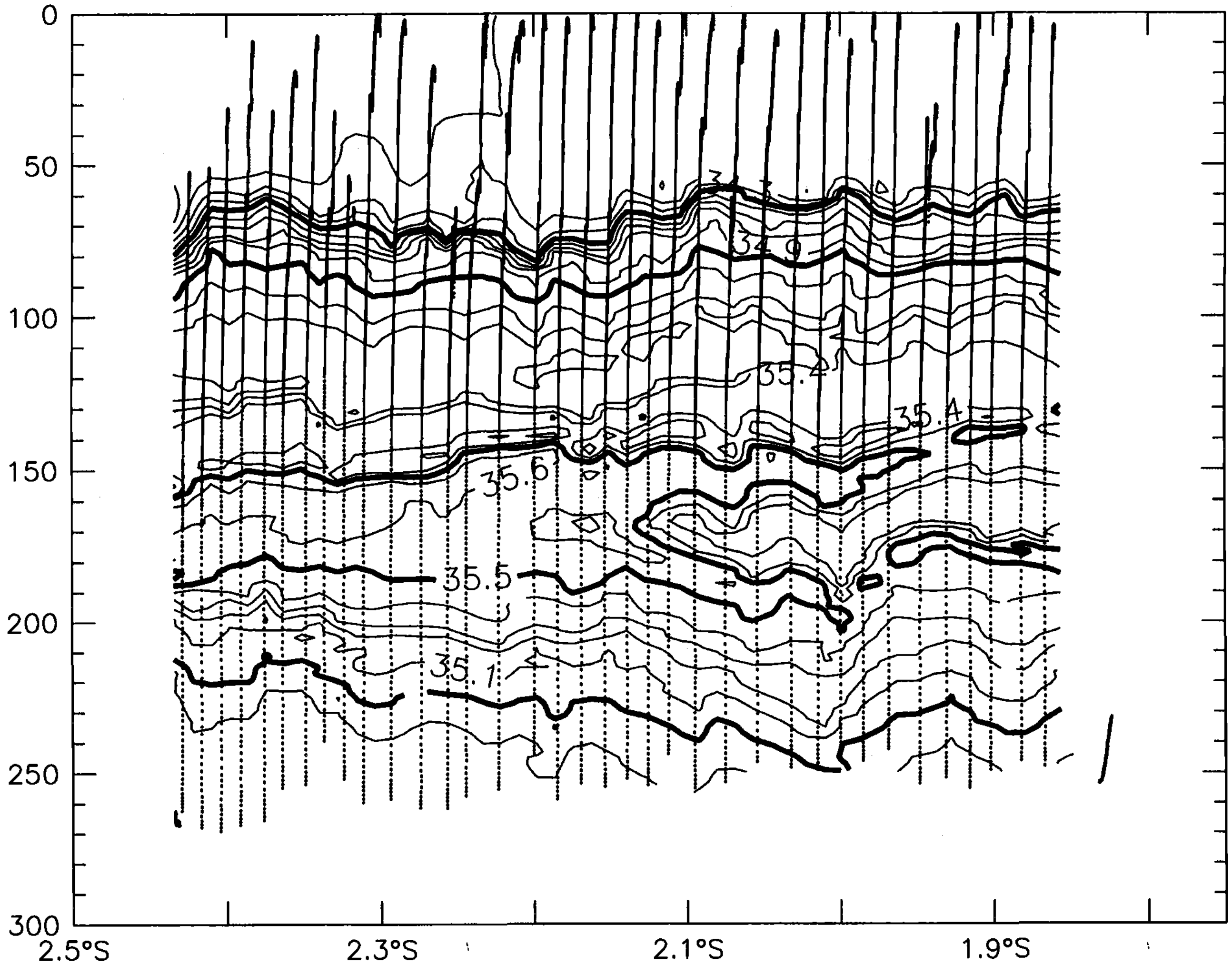
S(psu), S2W, 25 December 1992



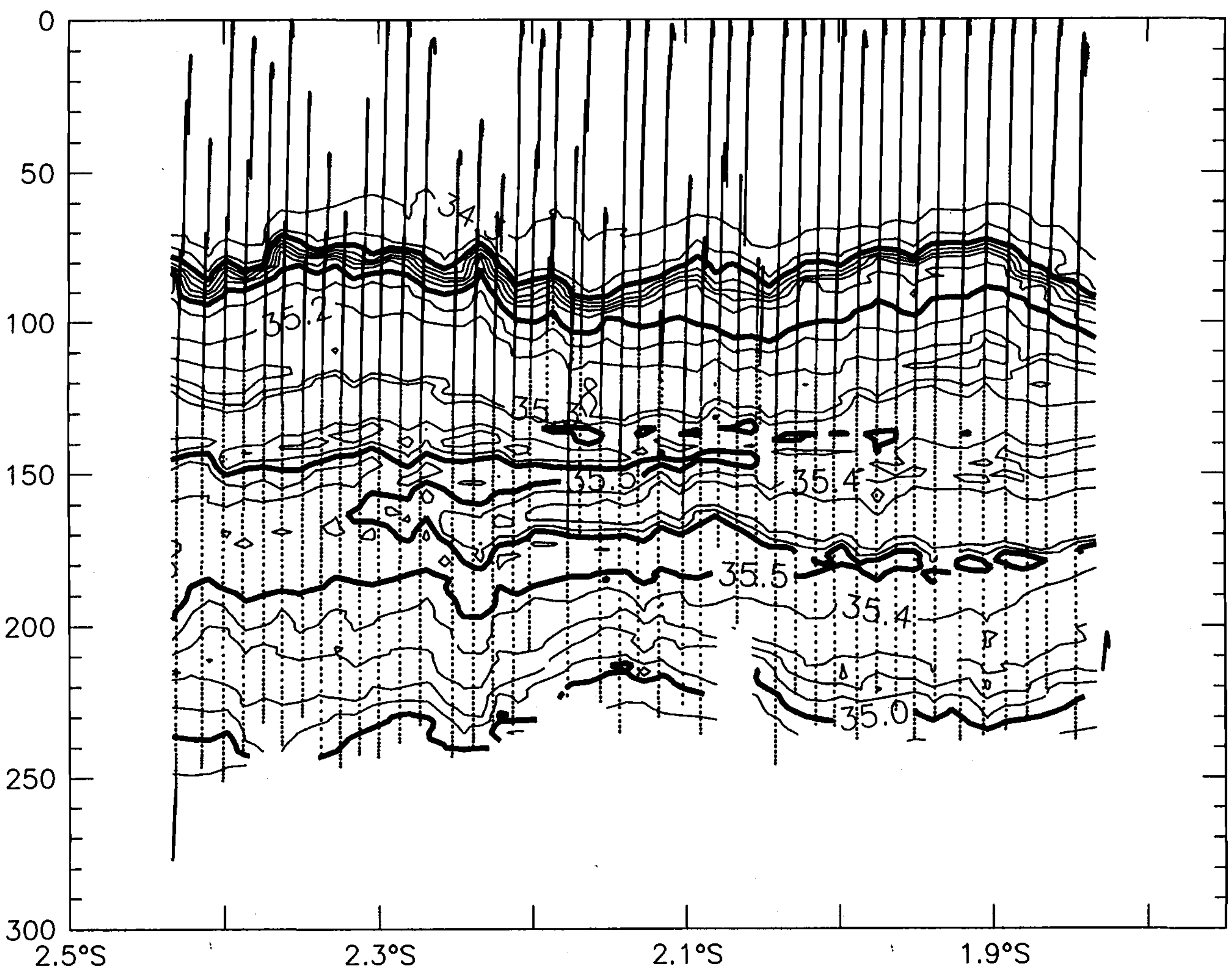
S(psu), S2W, 27 December 1992



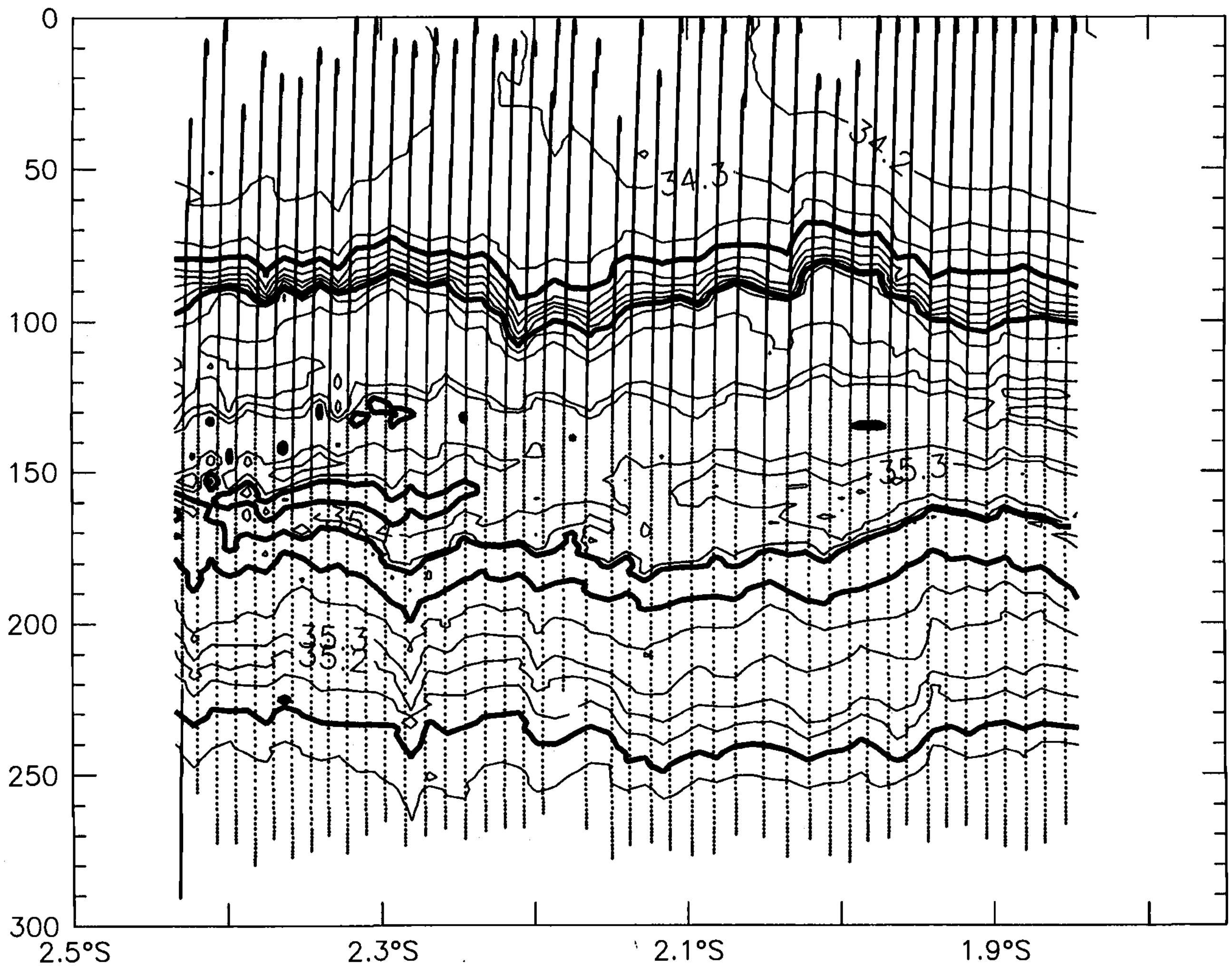
S(psu), S2W, 29 December 1992



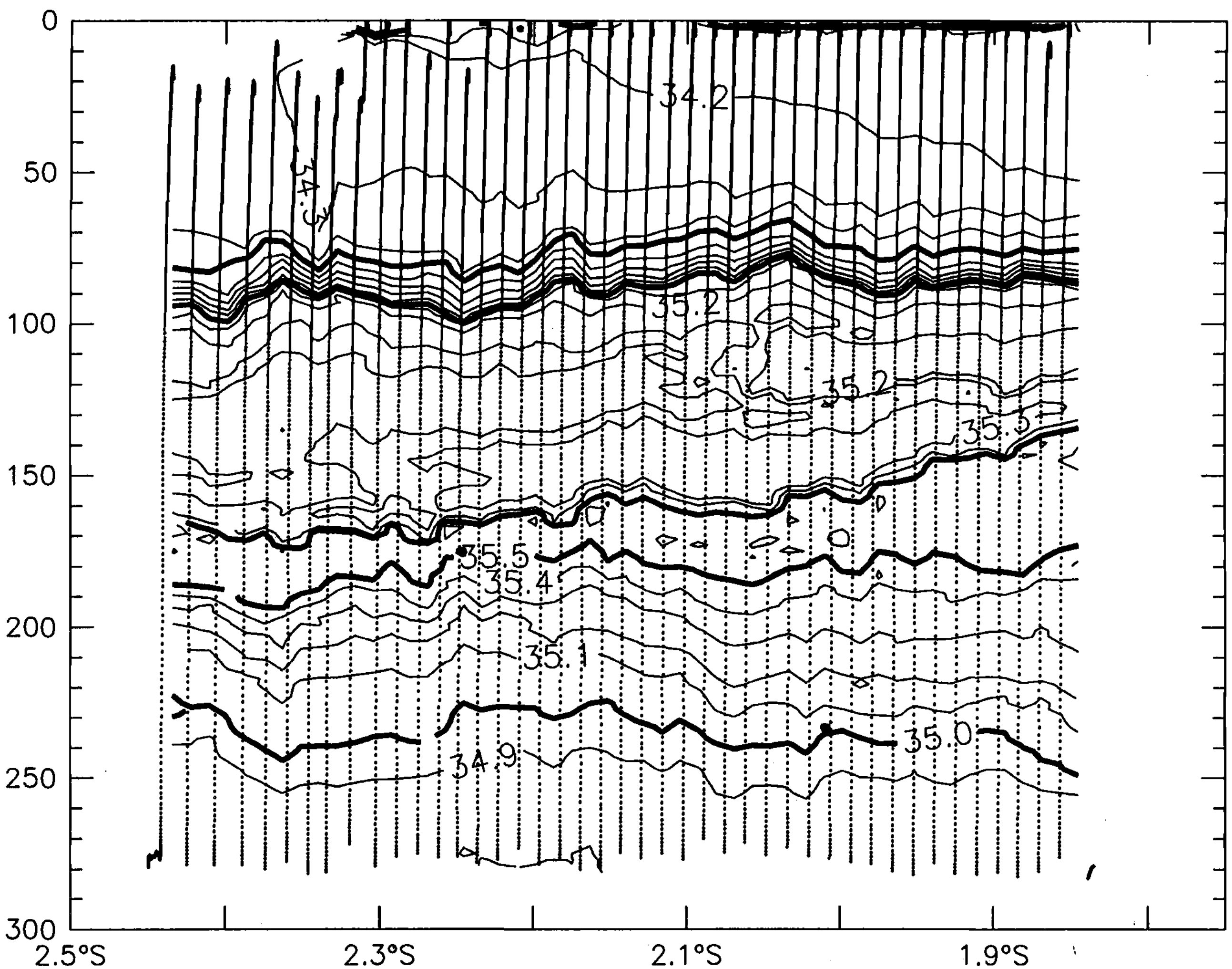
S(psu), S2W, 31 December 1992



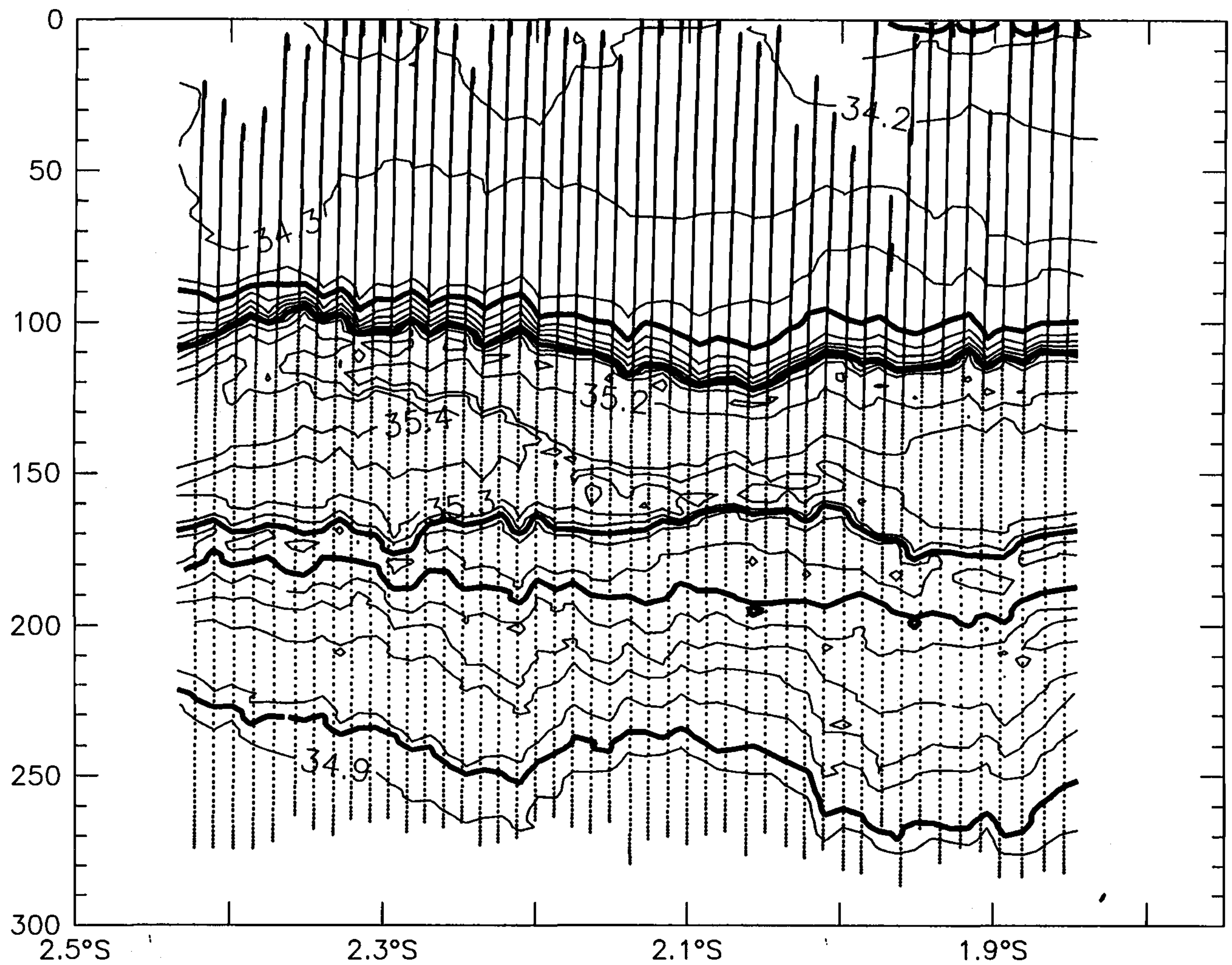
S(psu), S2W, 1 January 1993



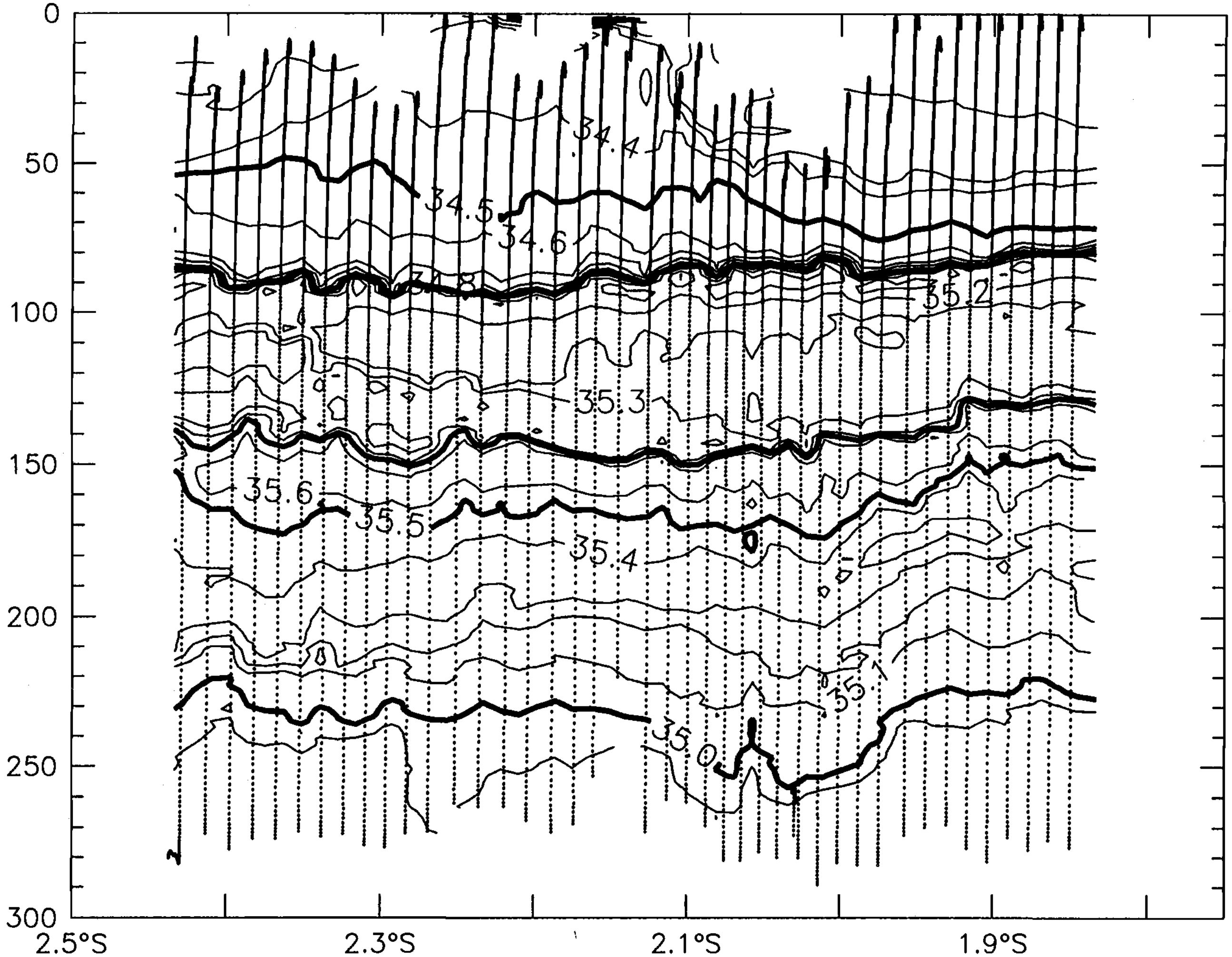
S(psu), S2W, 2 January 1993



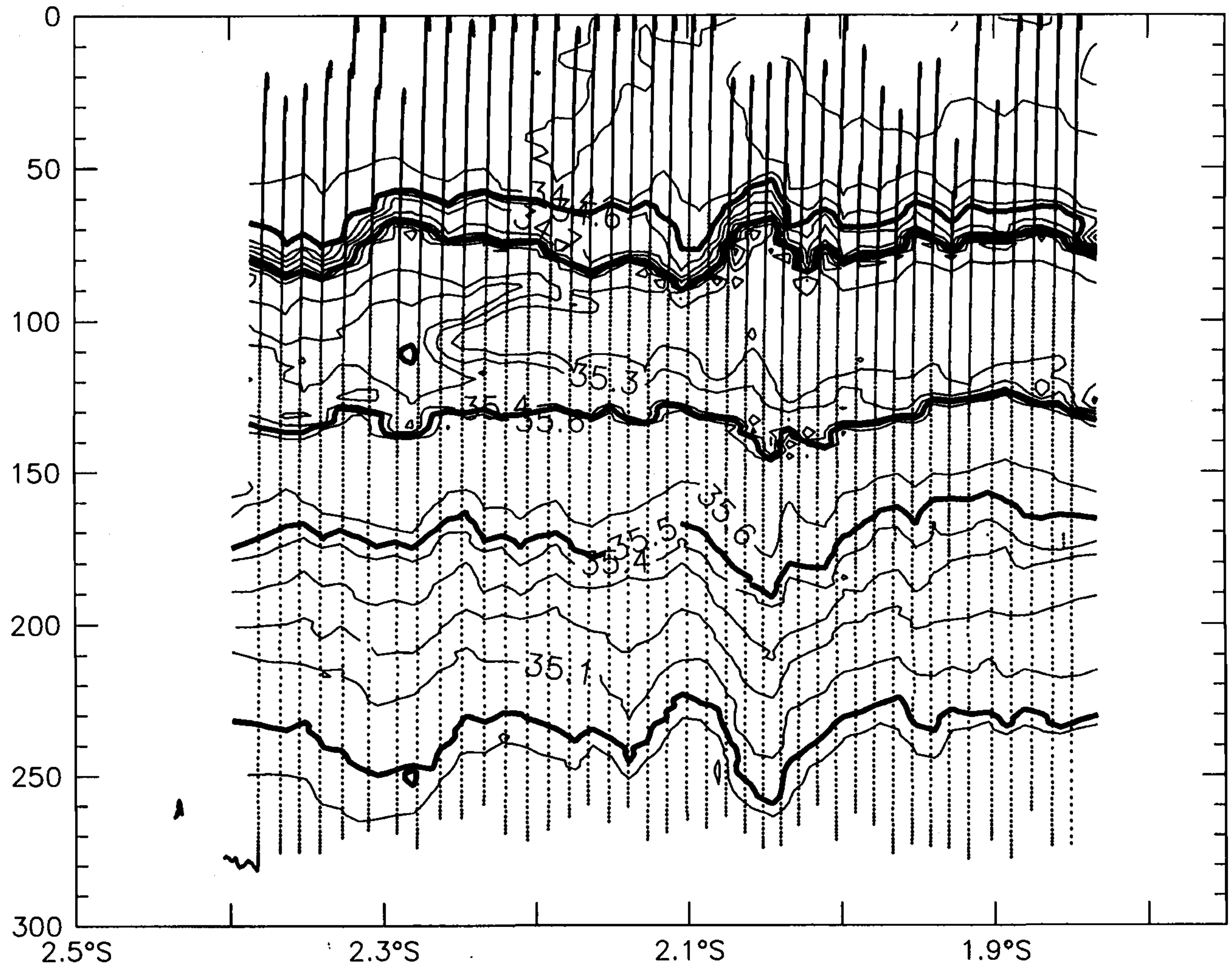
S(psu), S2W, 4 January 1993



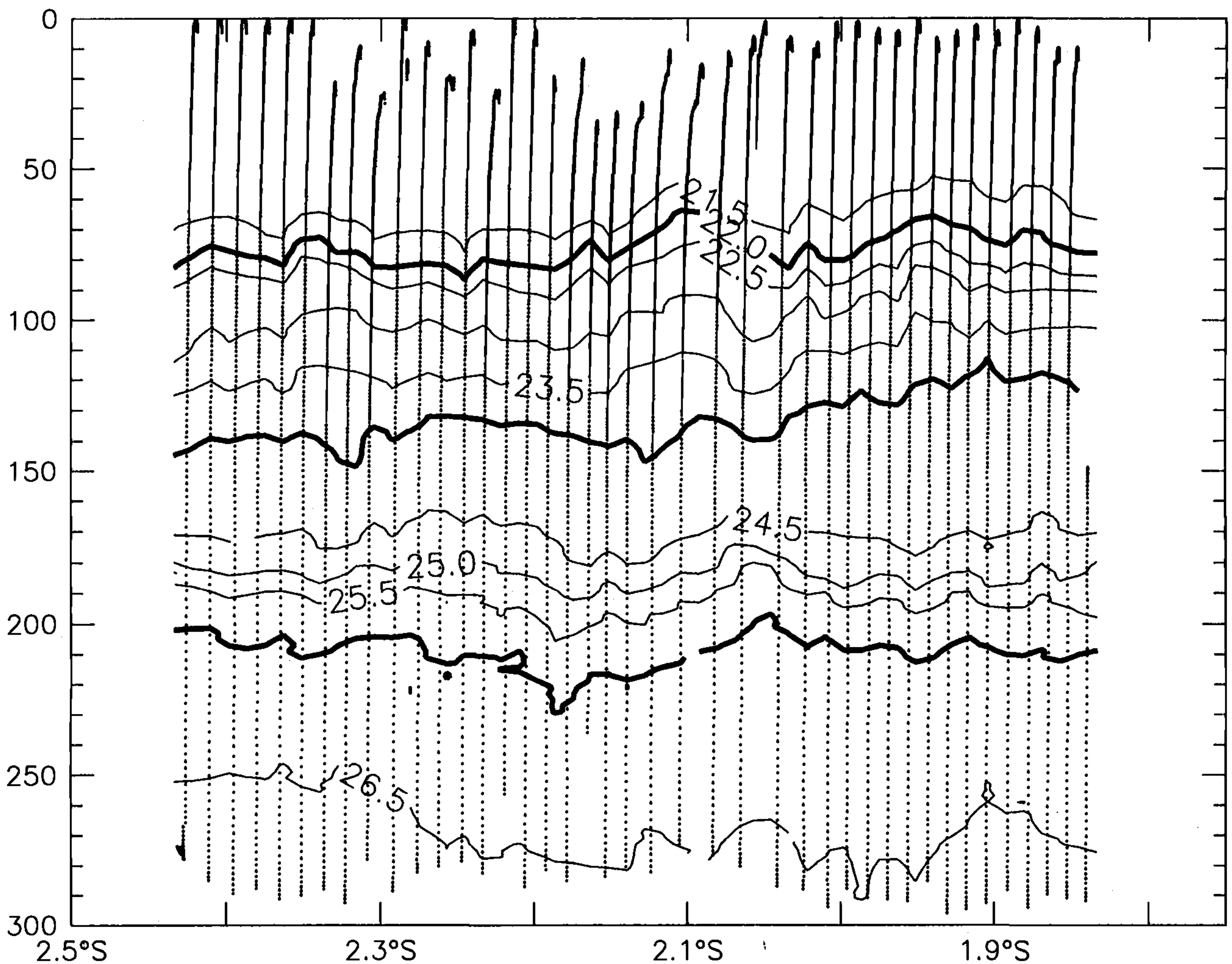
S(psu), S2W, 5 January 1993



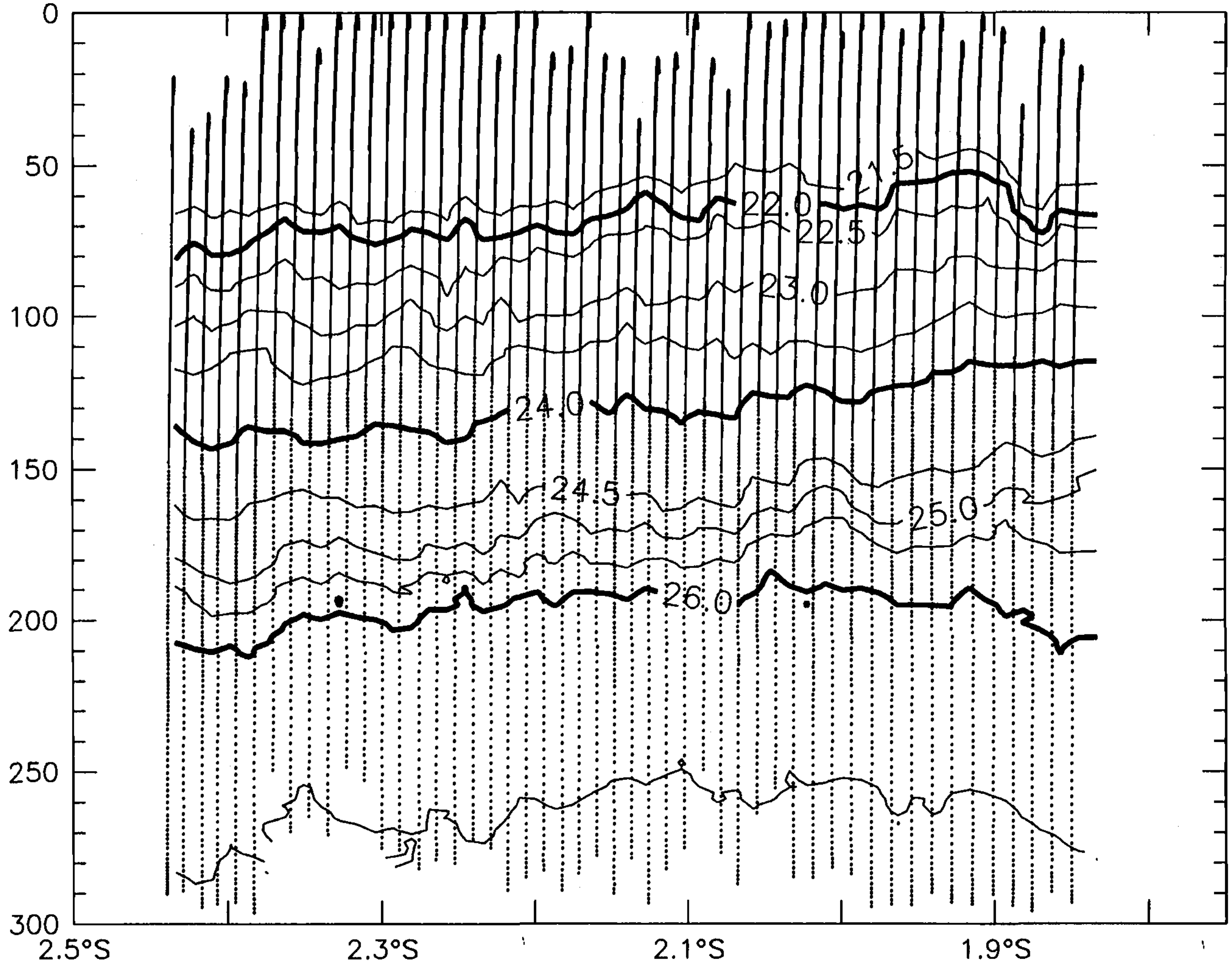
S(psu), S2W, 7 January 1993



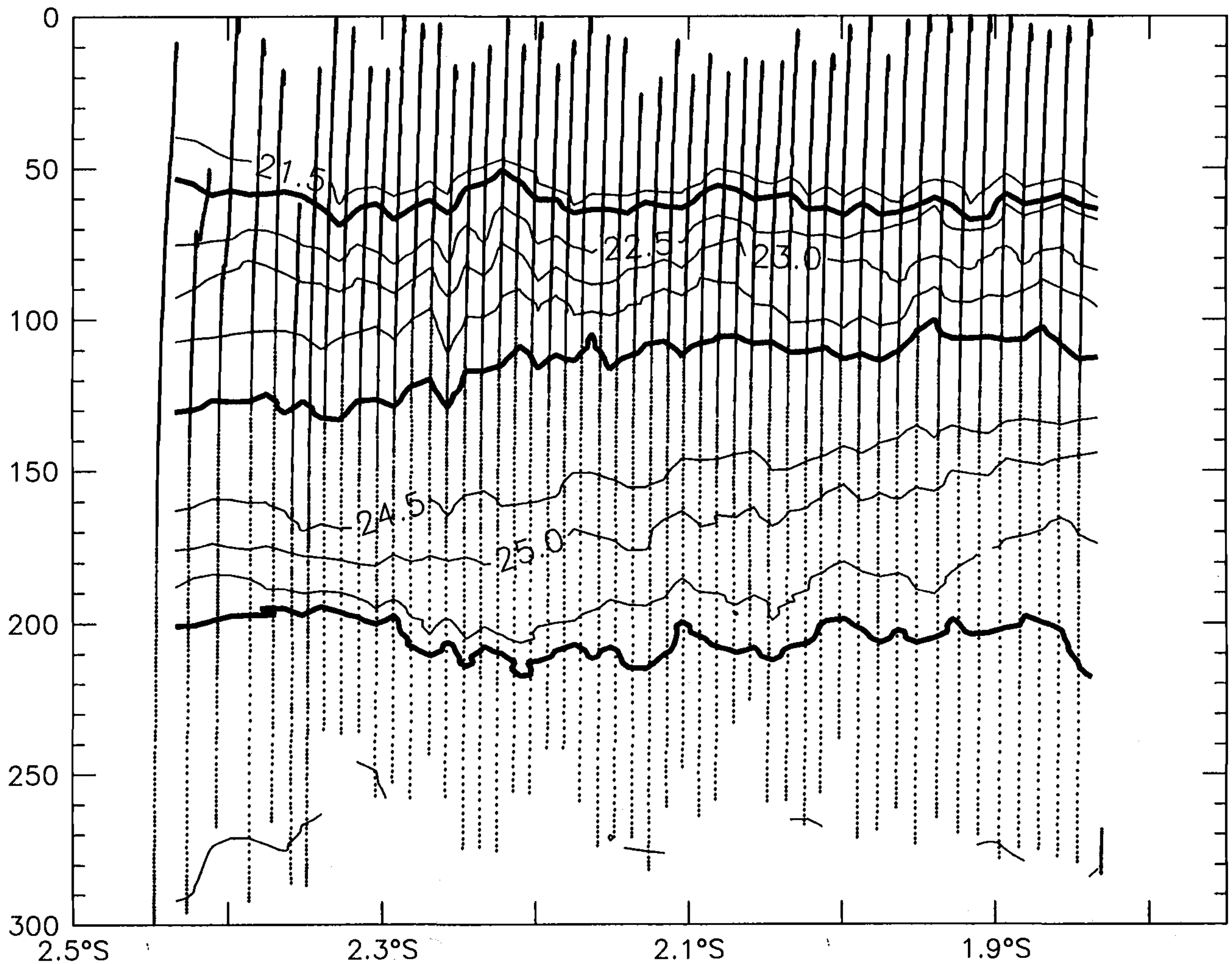
S(psu), S2W, 8 January 1993



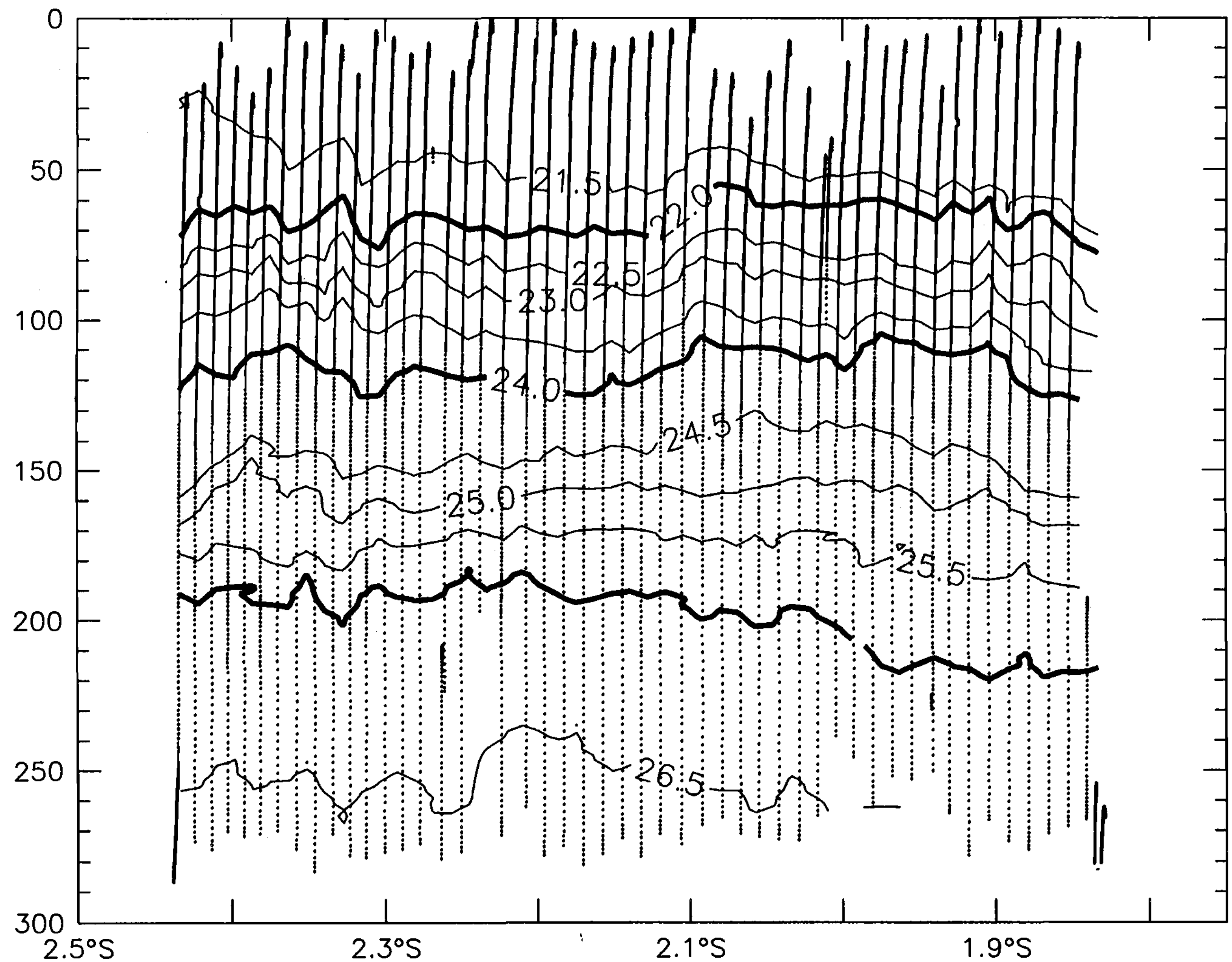
Sigma—t, S2W, 19 December 1992



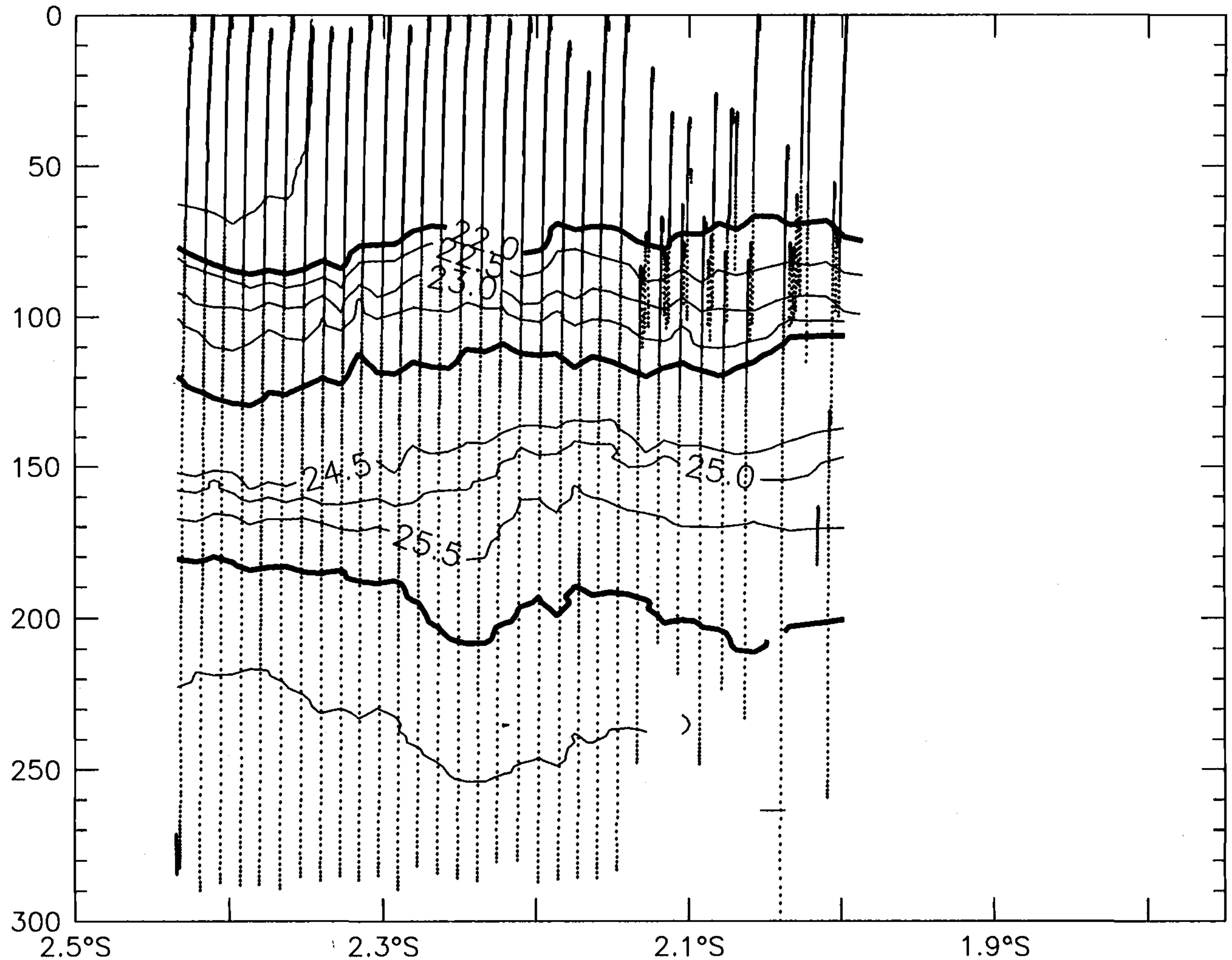
Sigma–t, S2W, 21 December 1992



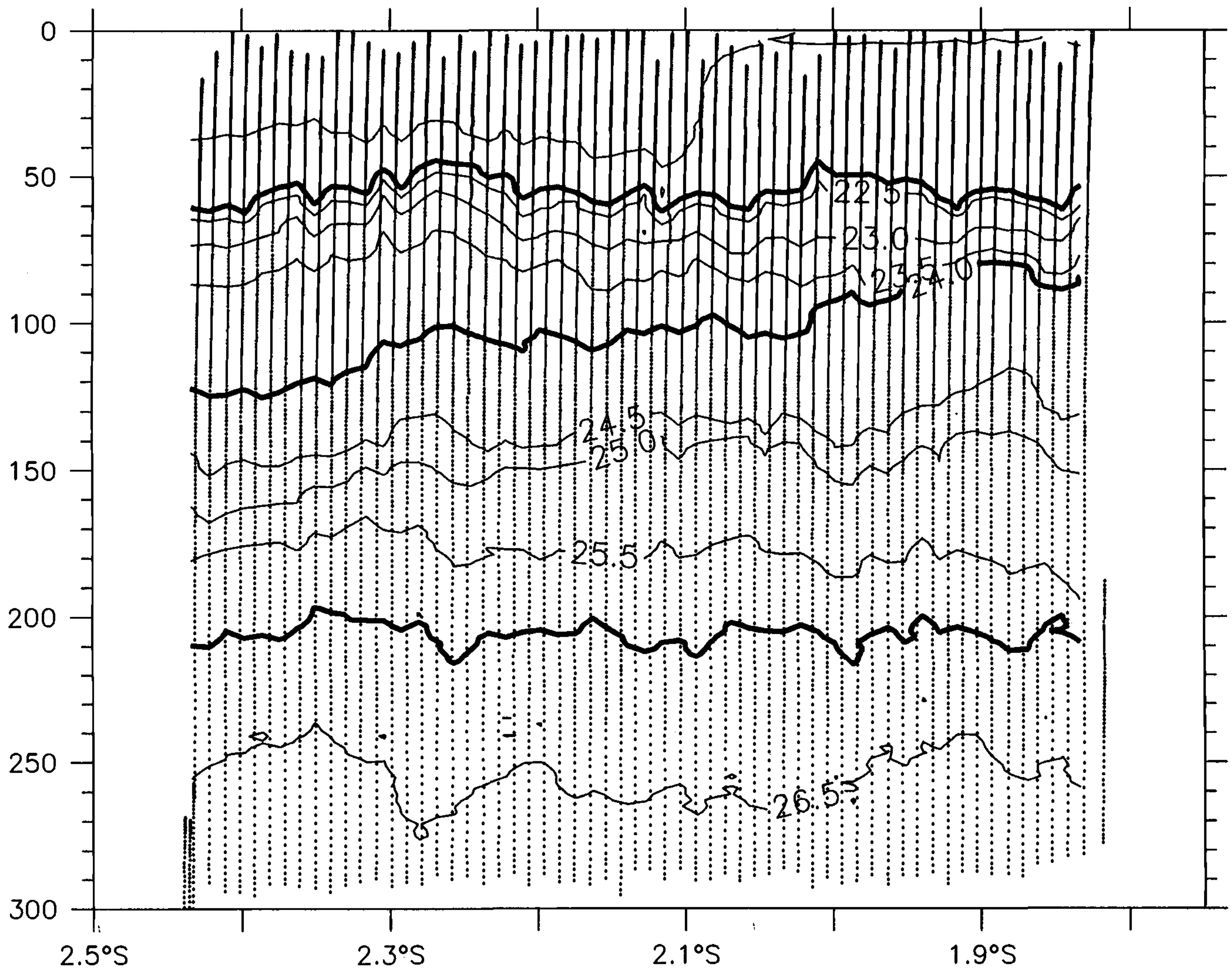
Sigma−t, S2W, 22 December 1992



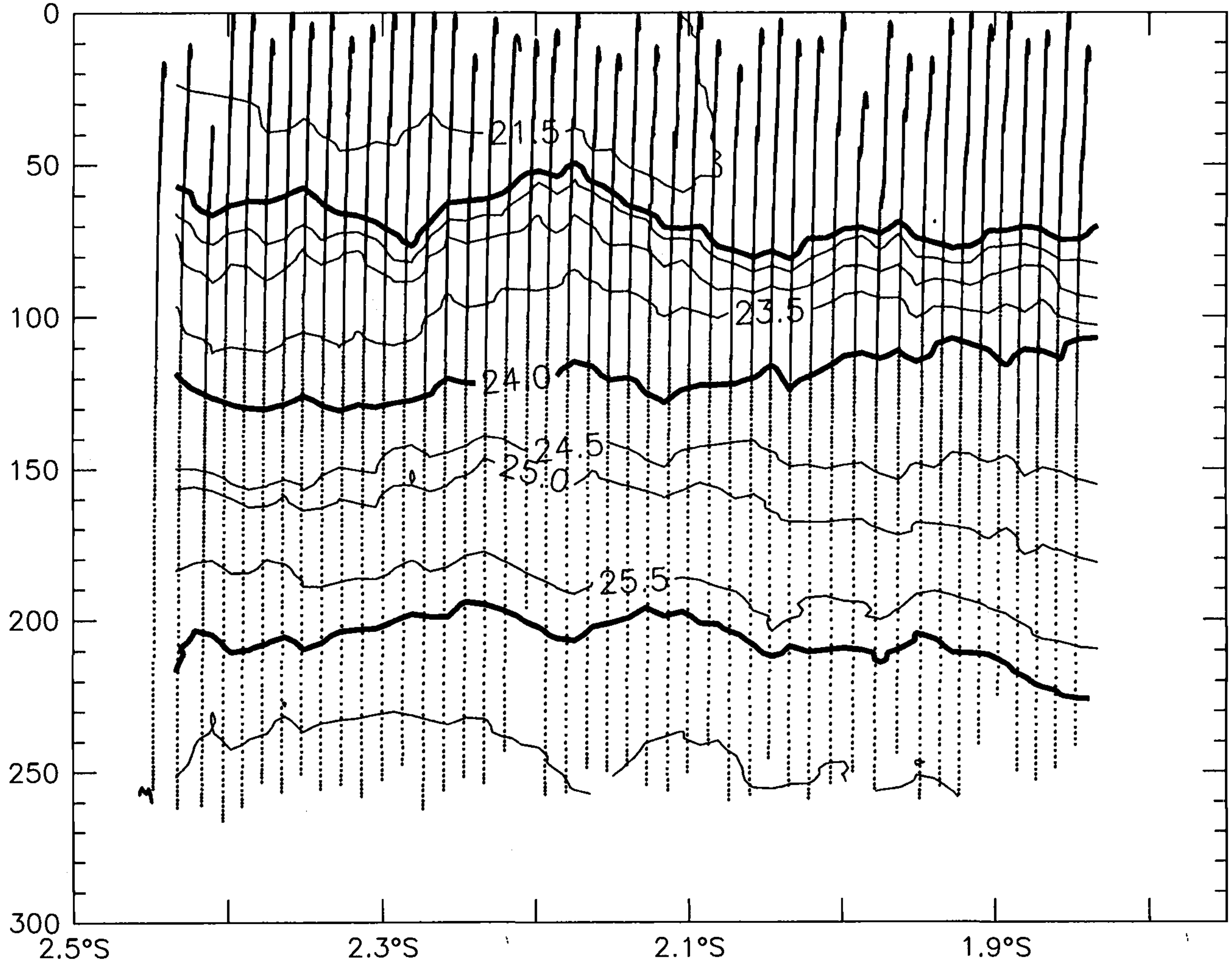
Sigma–t, S2W, 24 December 1992



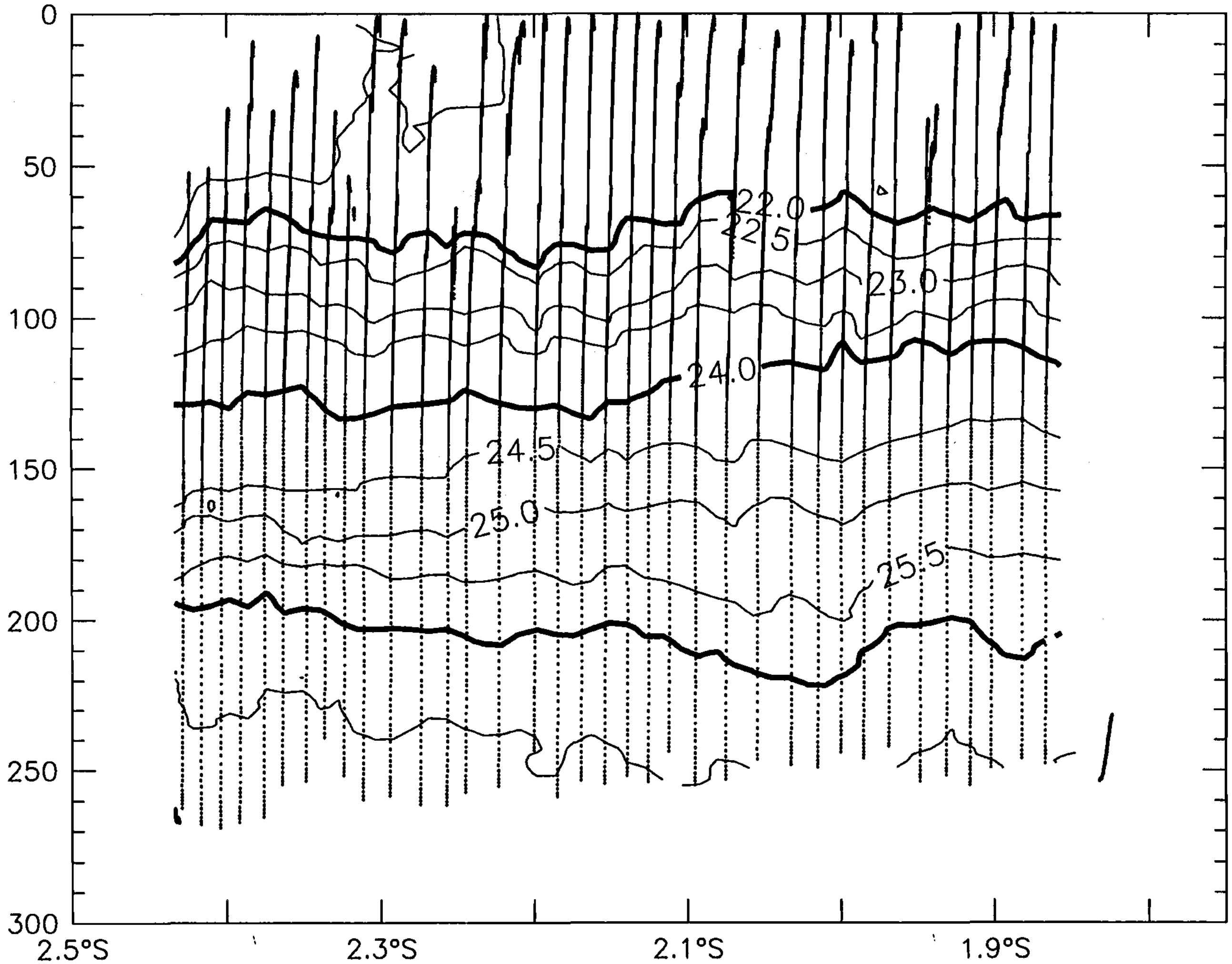
Sigma−t, S2W, 25 December 1992



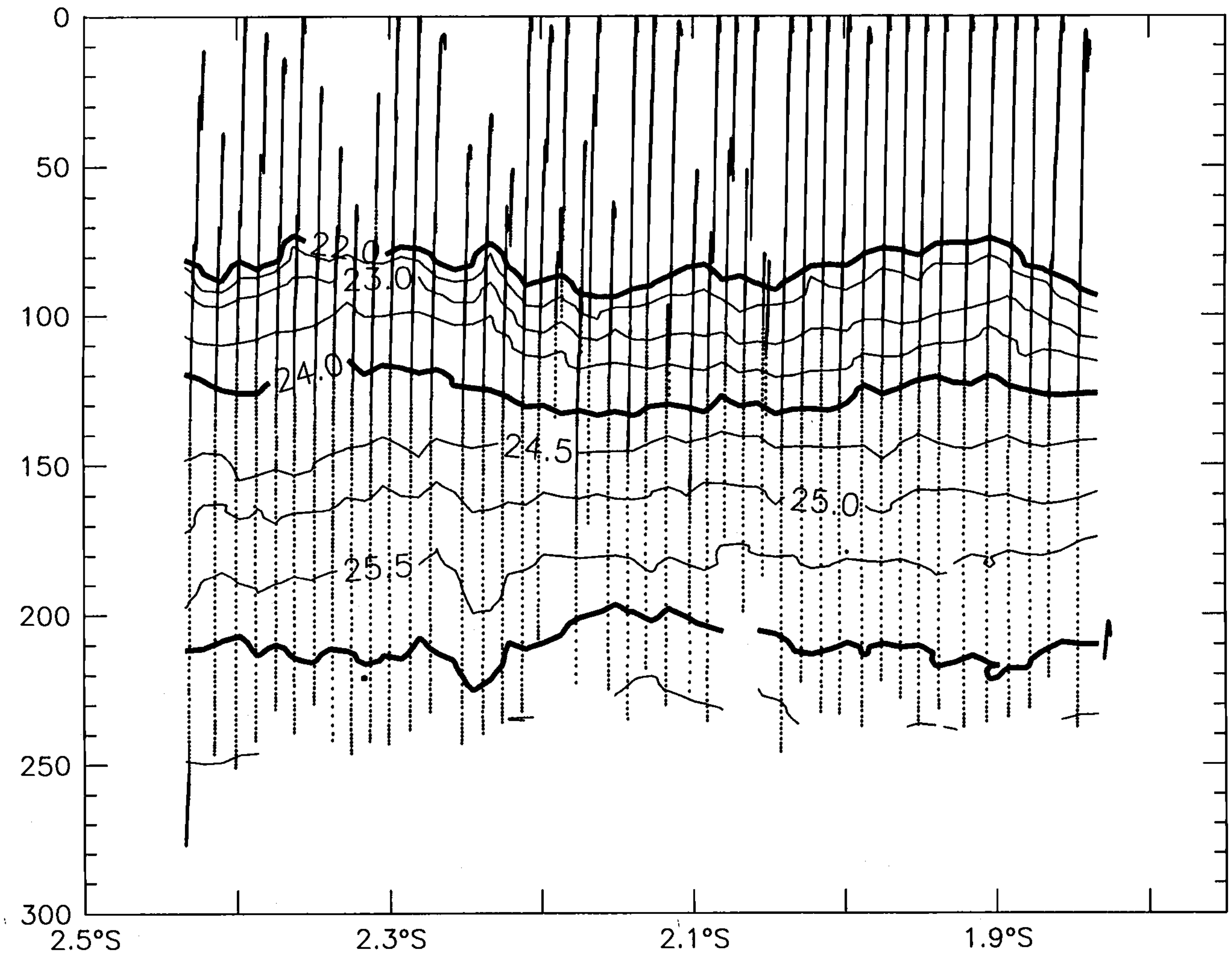
Sigma−t, S2W, 27 December 1992



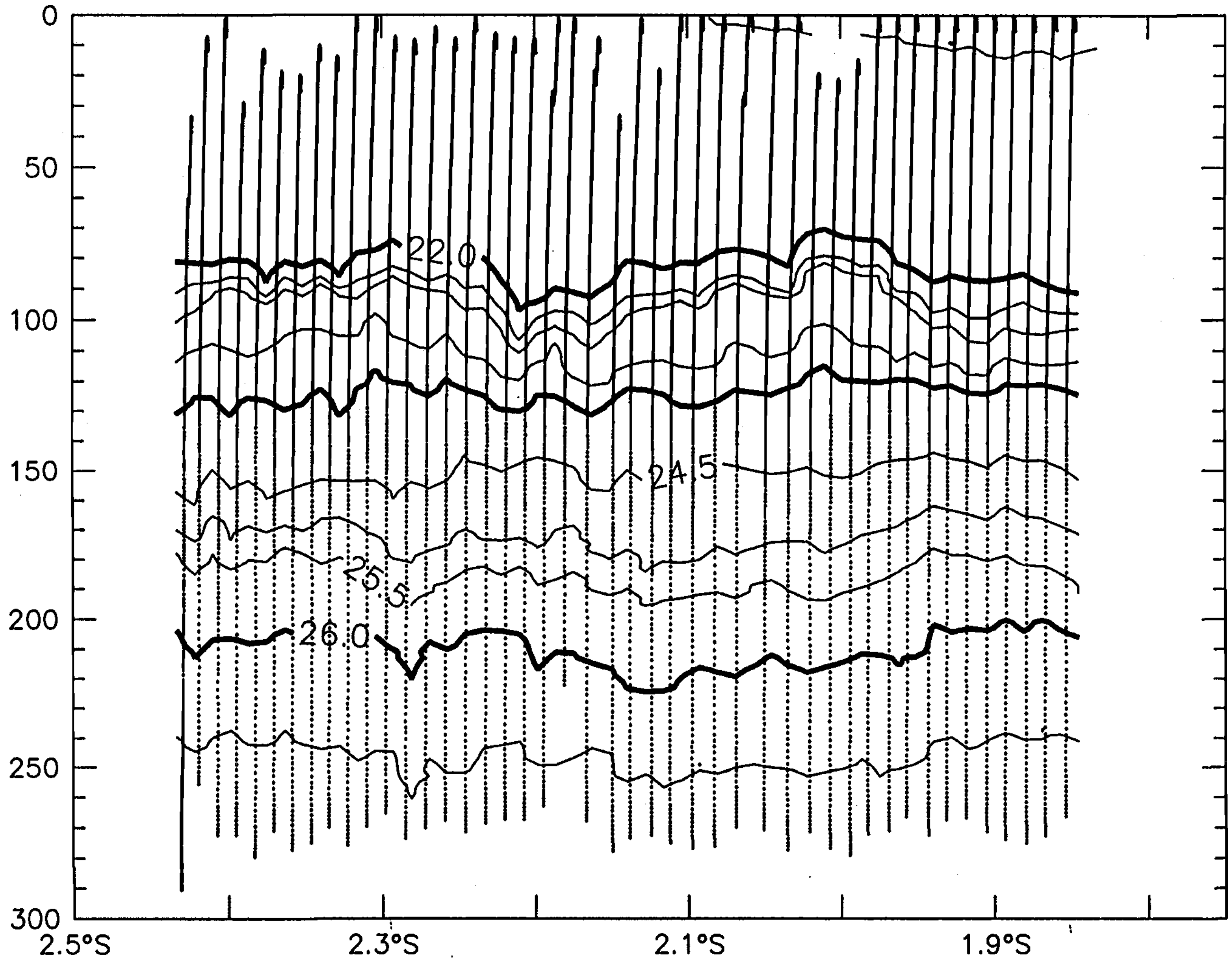
Sigma−t, S2W, 29 December 1992



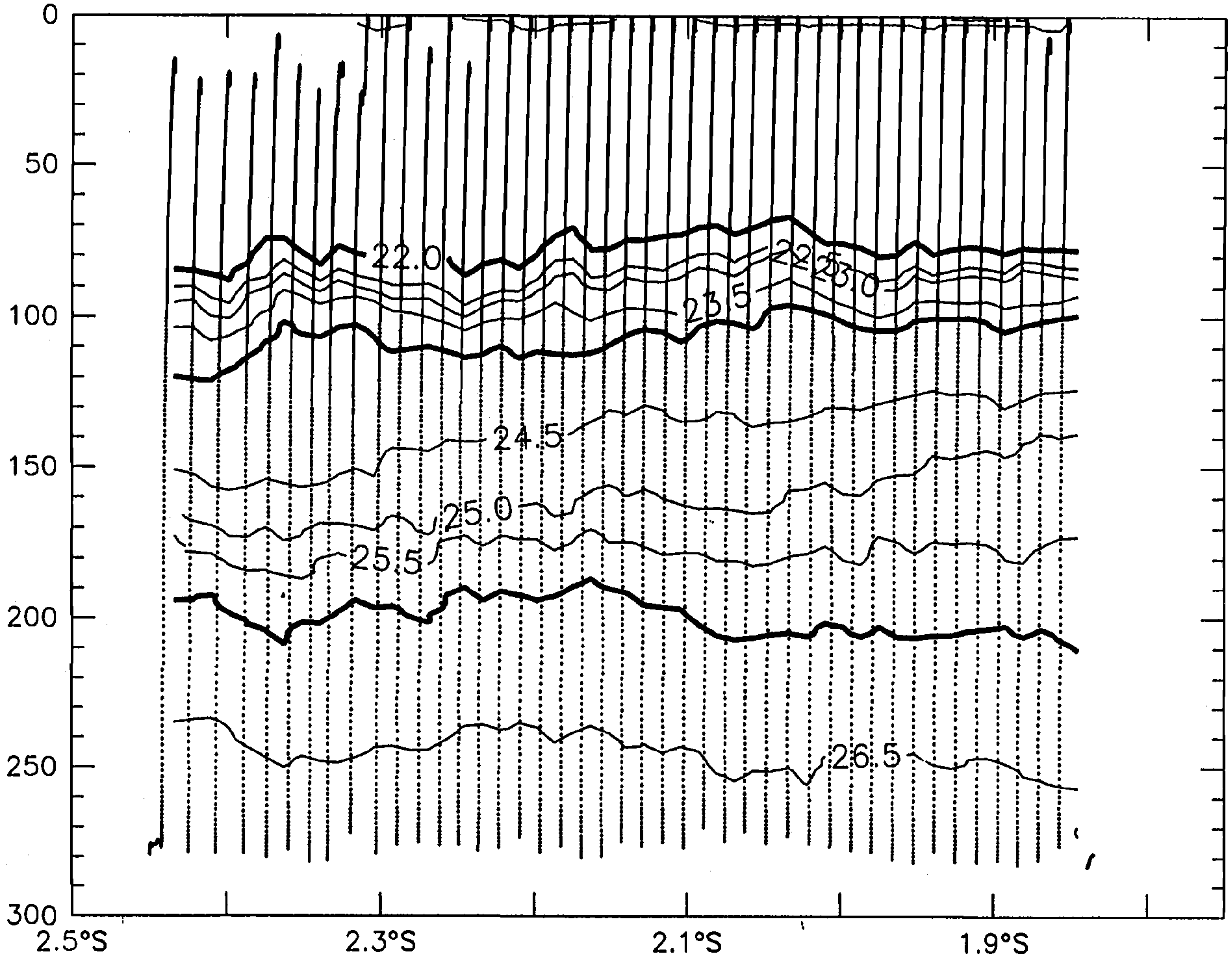
Sigma−t, S2W, 31 December 1992



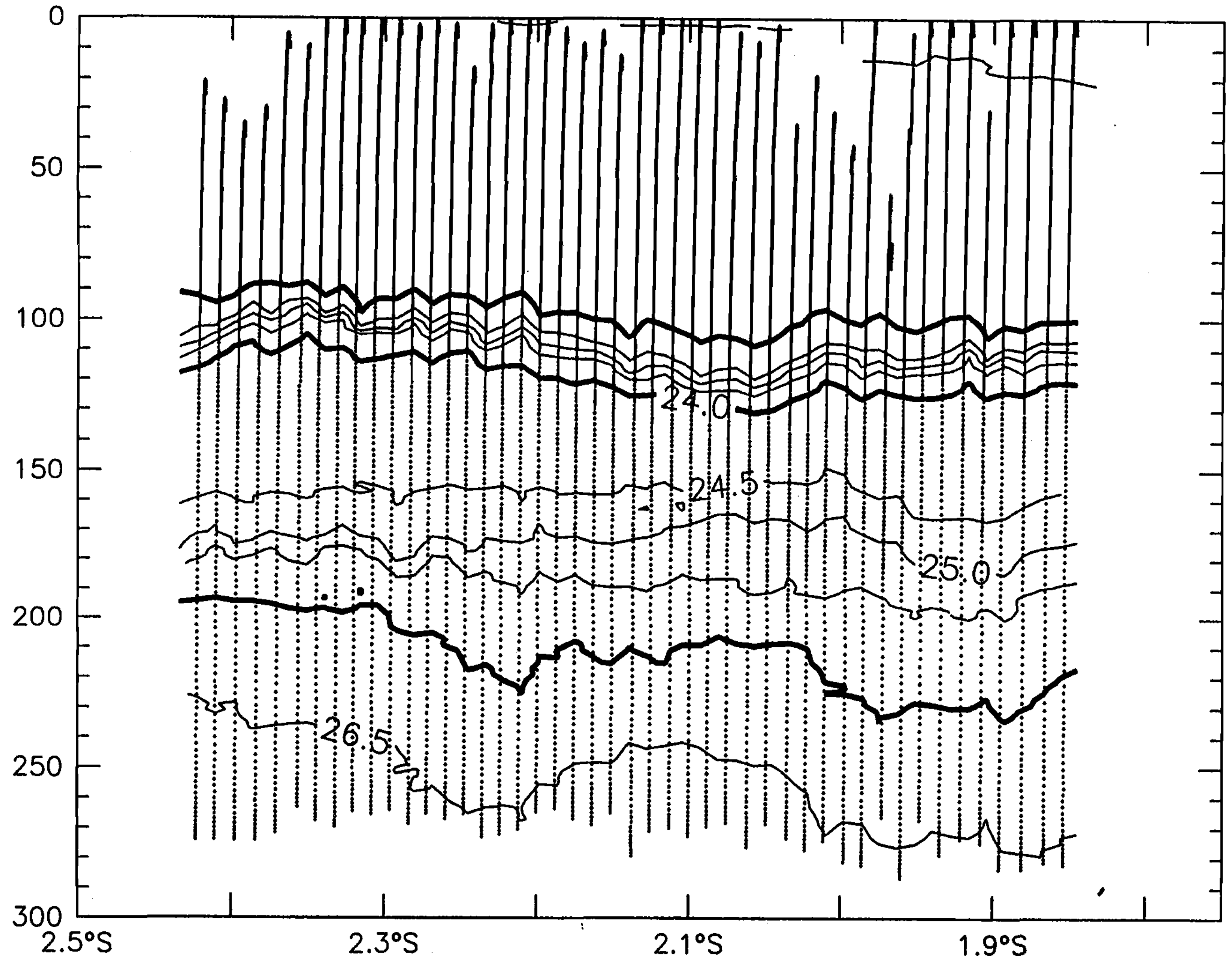
Sigma−t, S2W, 1 January 1993



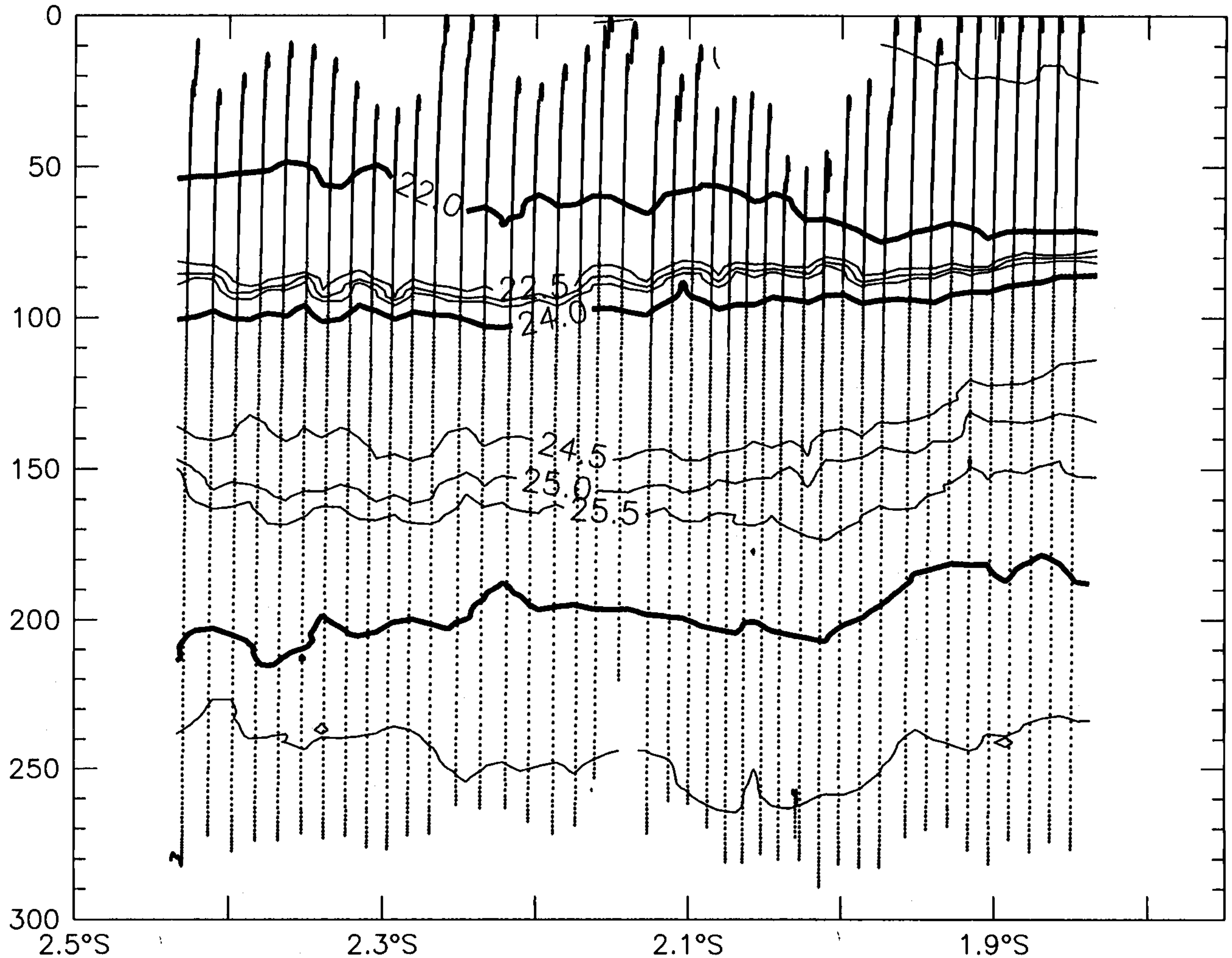
Sigma–t, S2W, 2 January 1993



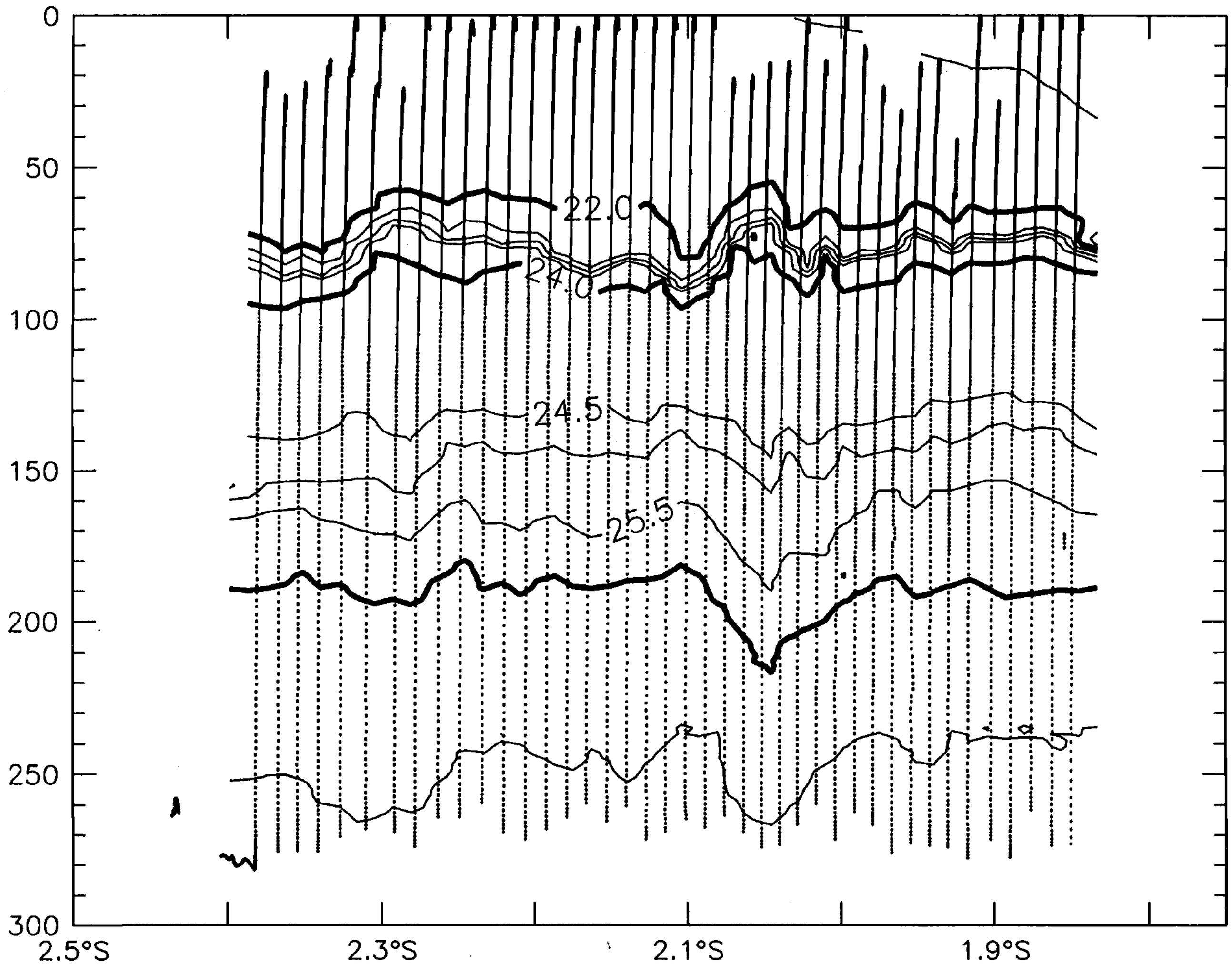
Sigma−t, S2W, 4 January 1993



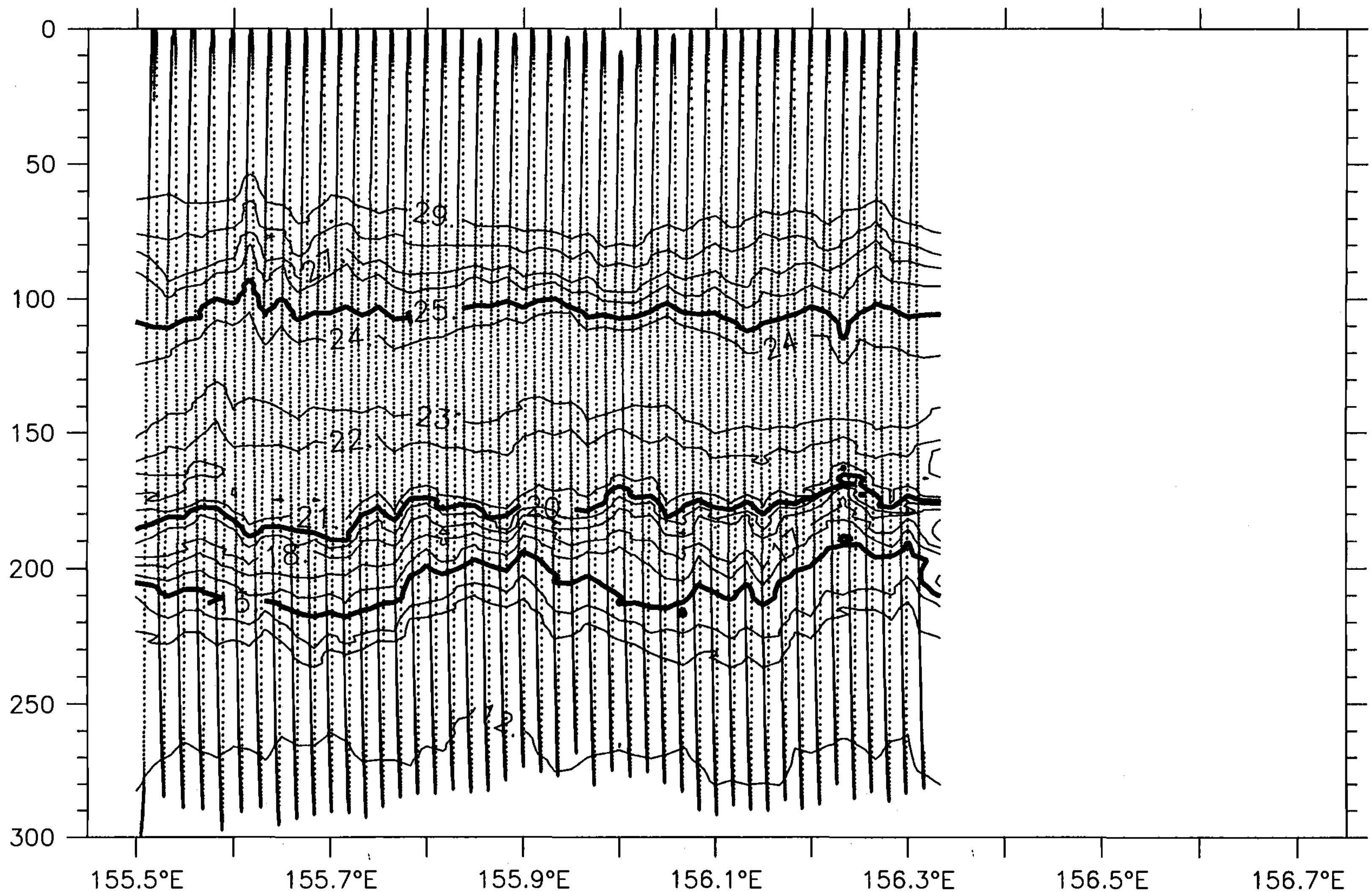
Sigma–t, S2W, 5 January 1993



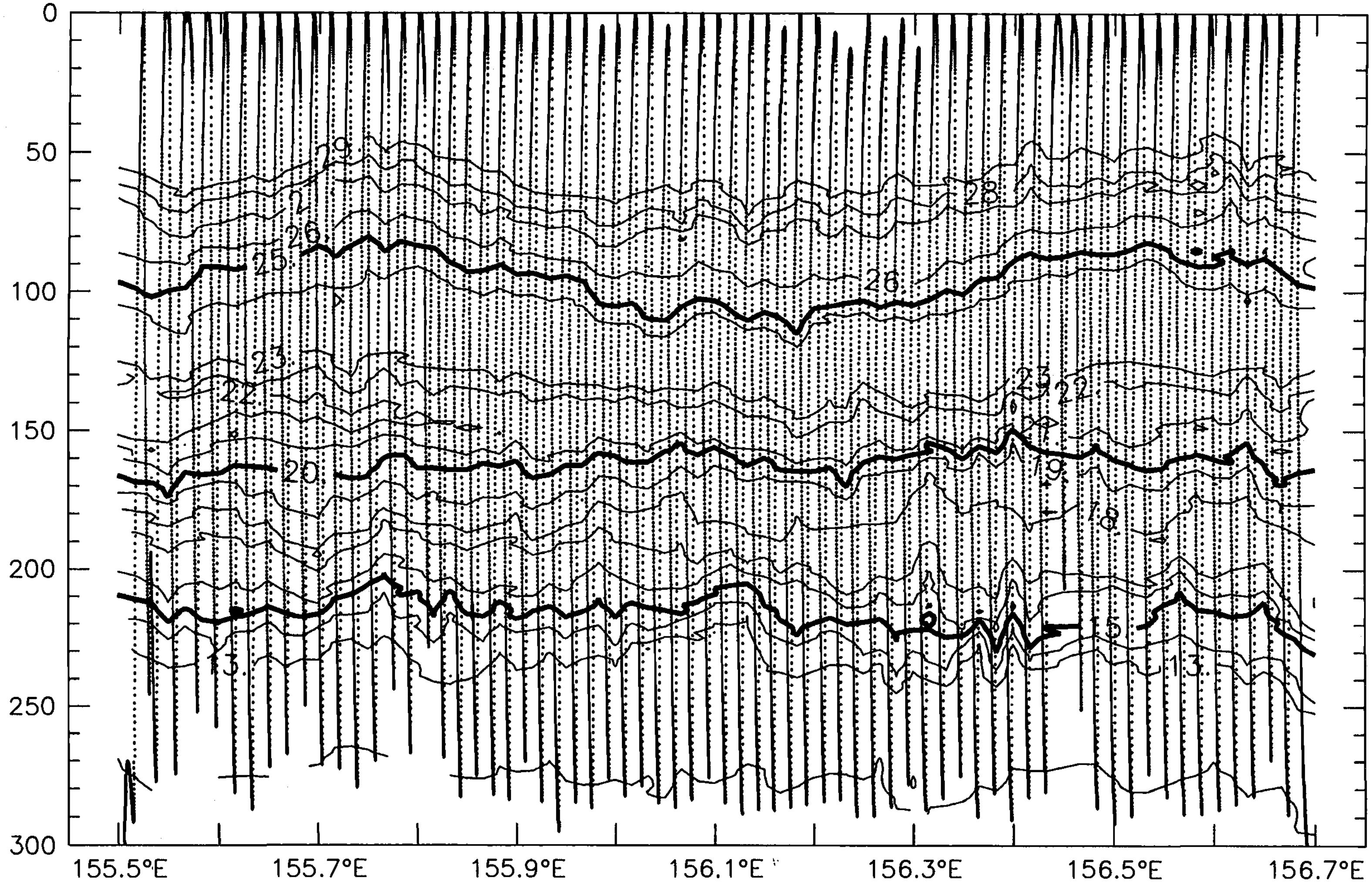
Sigma–t, S2W, 7 January 1993



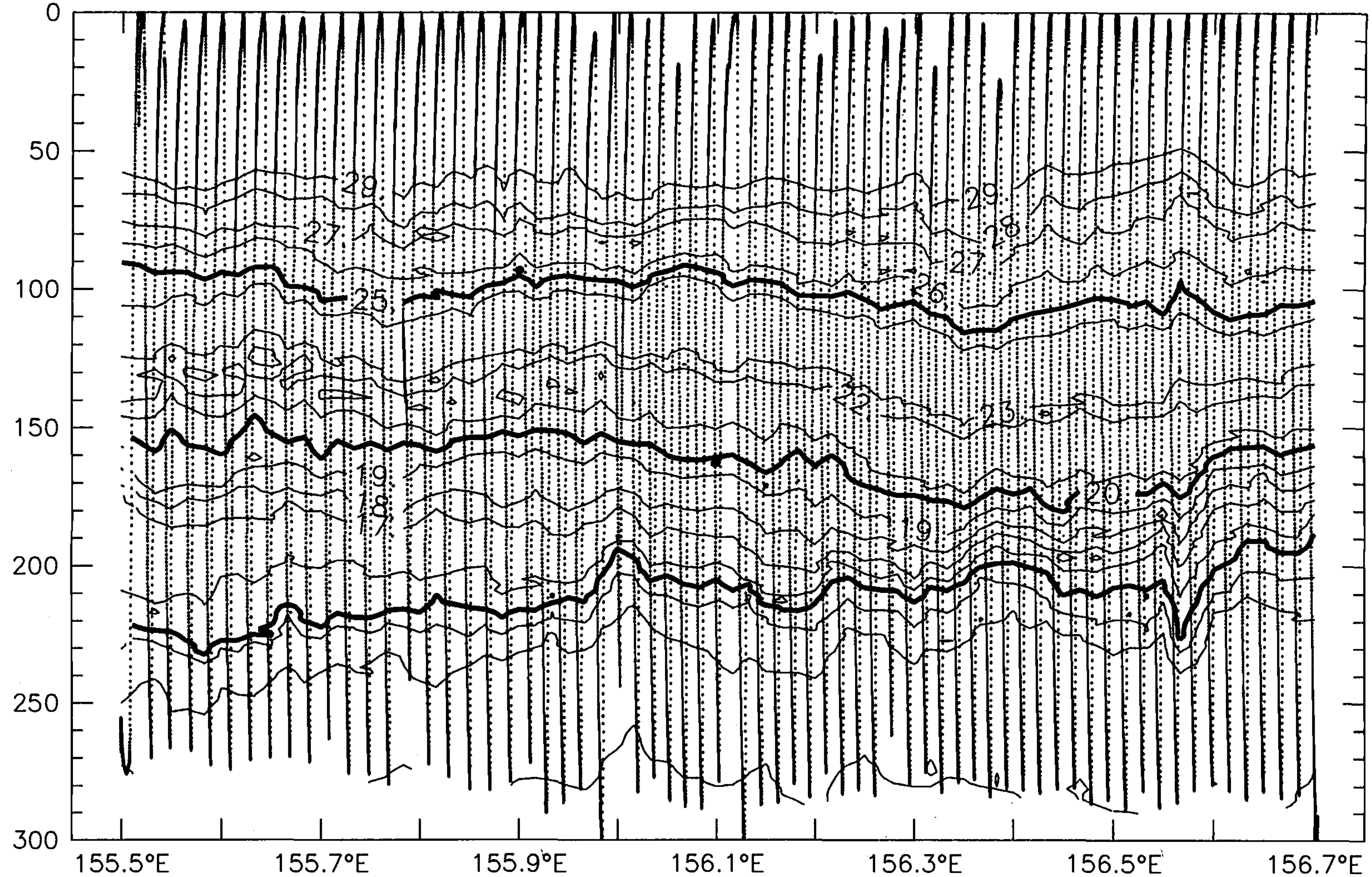
Sigma—t, S2W, 8 January 1993



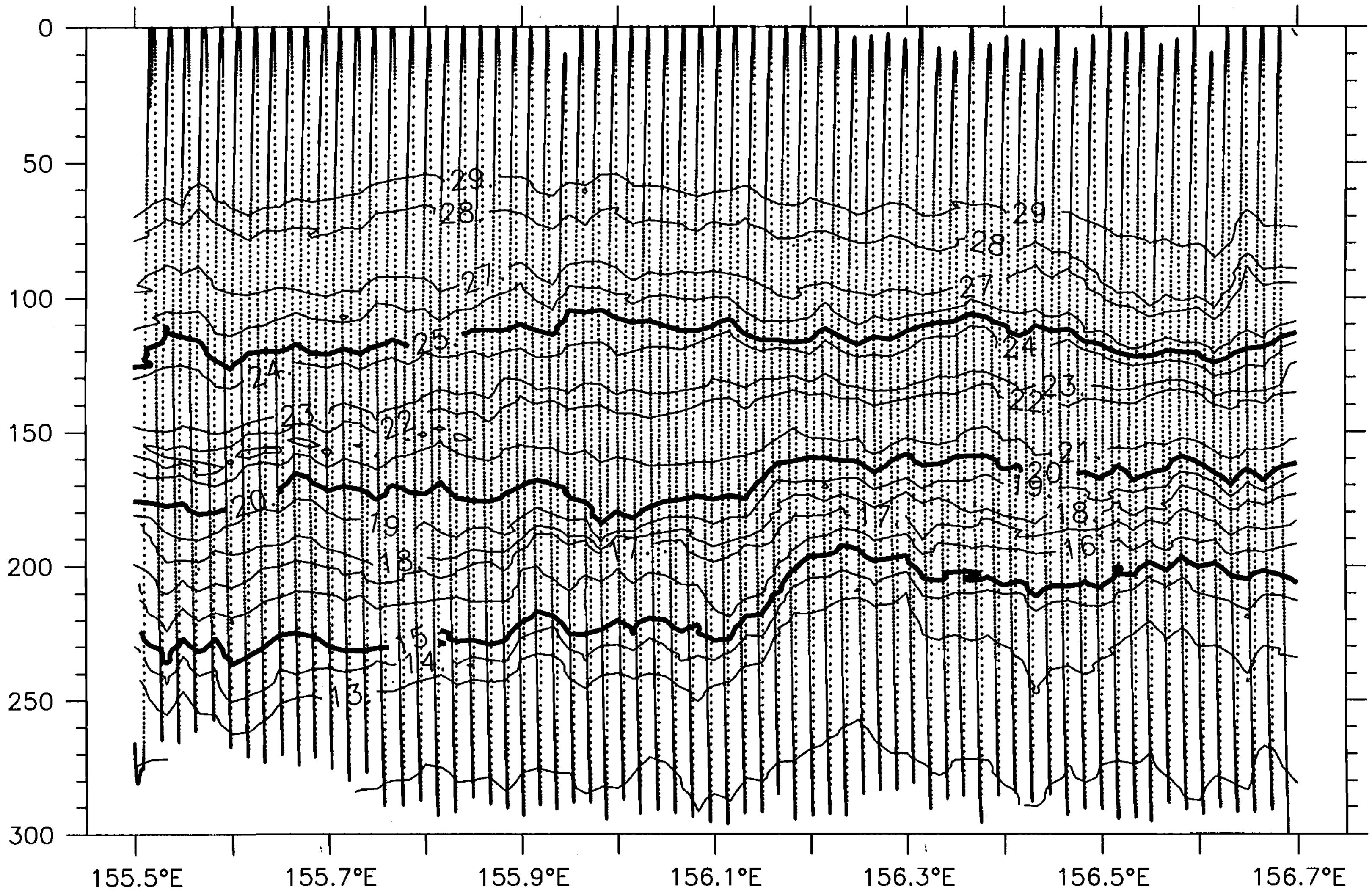
T(°C), W2E, 19 December 1992



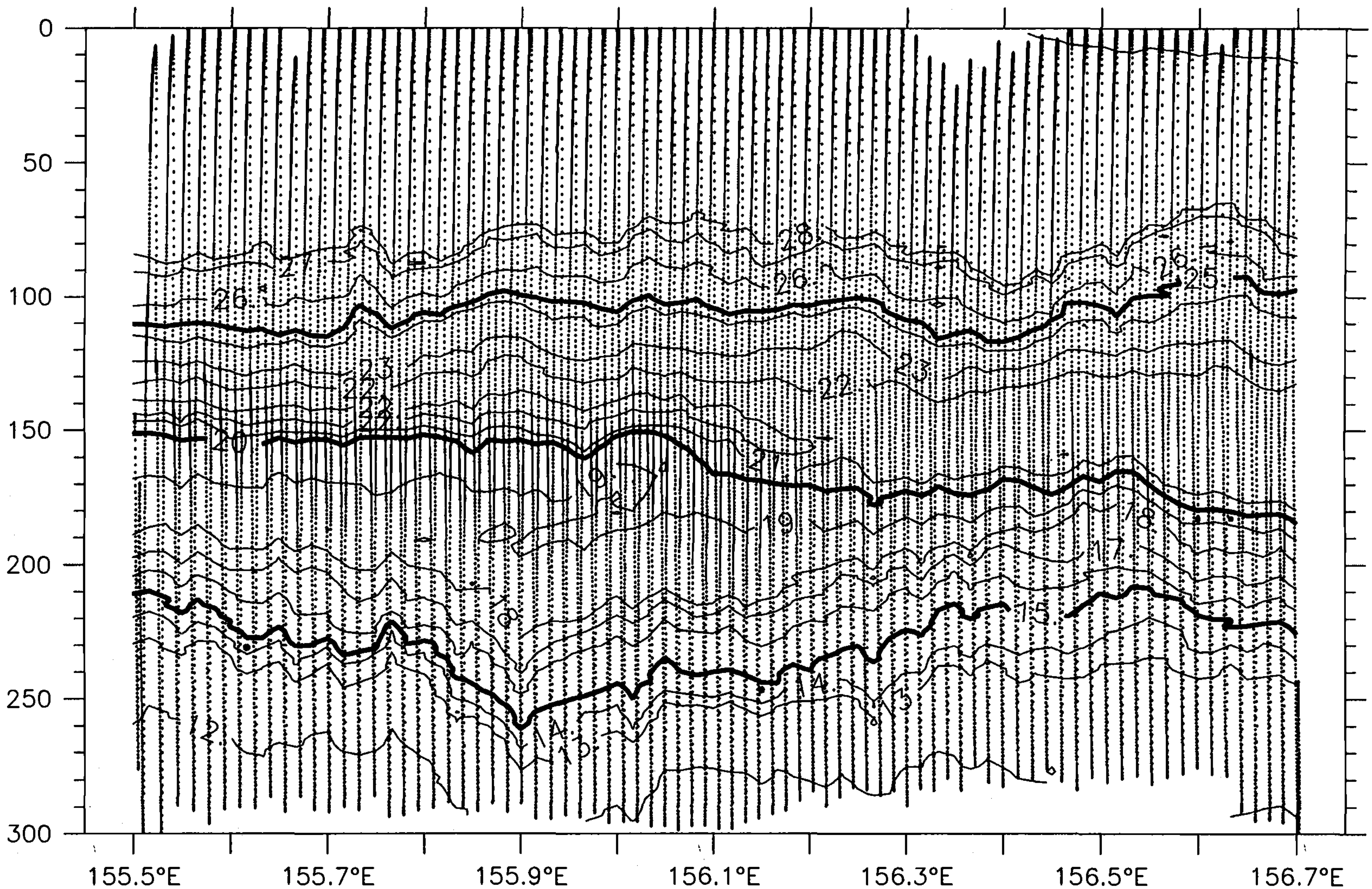
T(°C), W2E, 21 December 1992



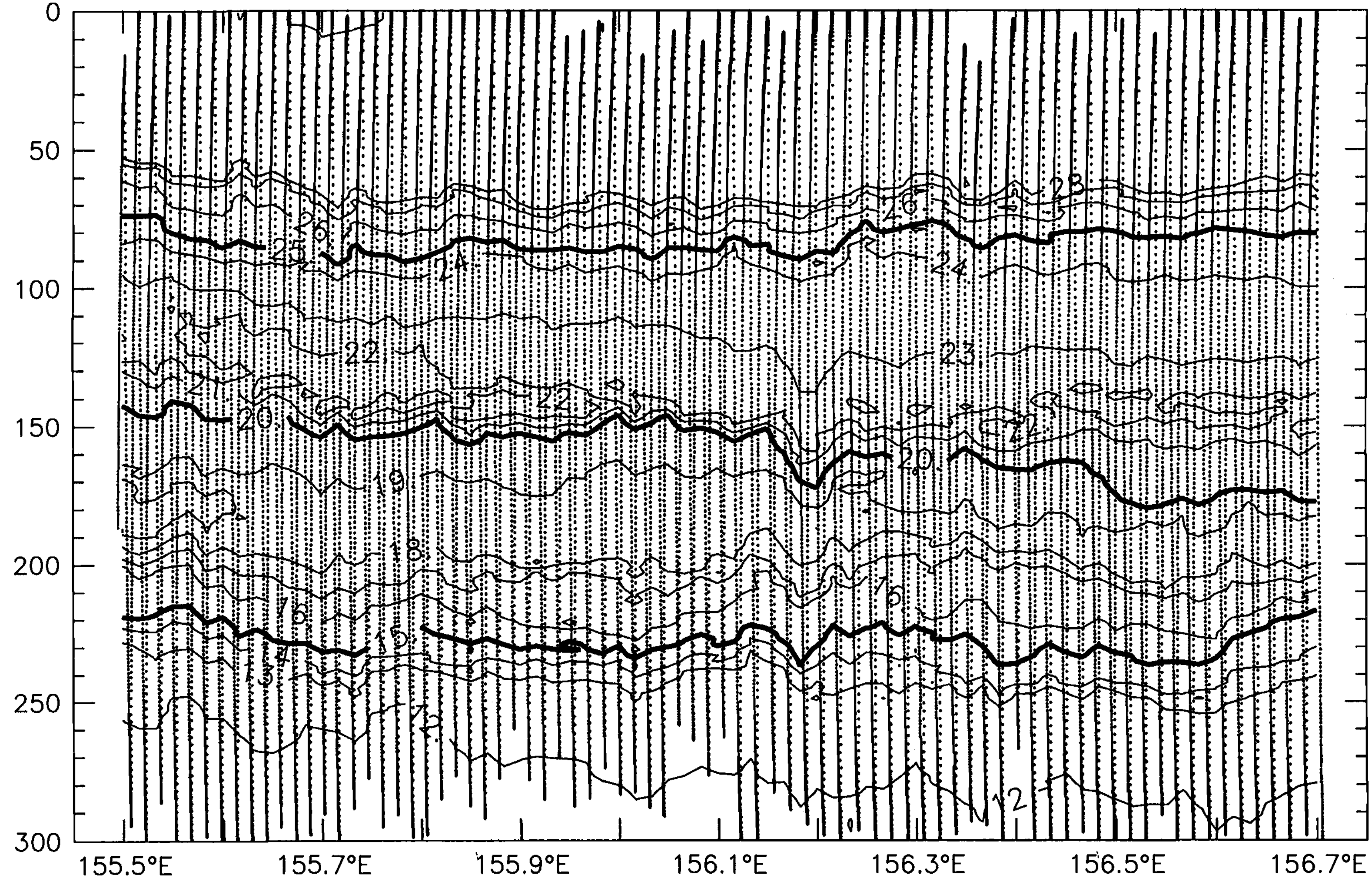
T(°C), W2E, 23 December 1992



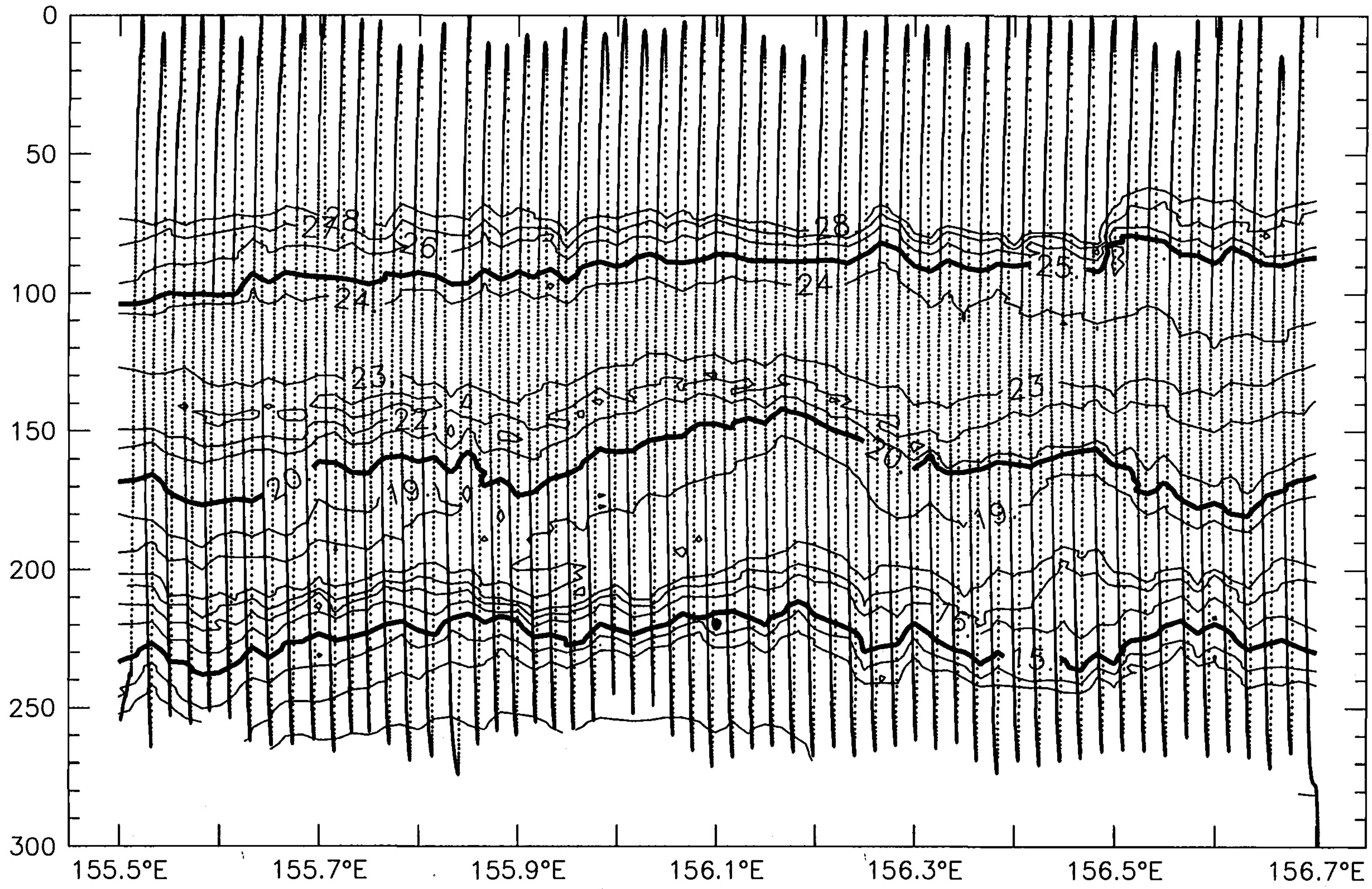
T(°C), W2E, 24 December 1992



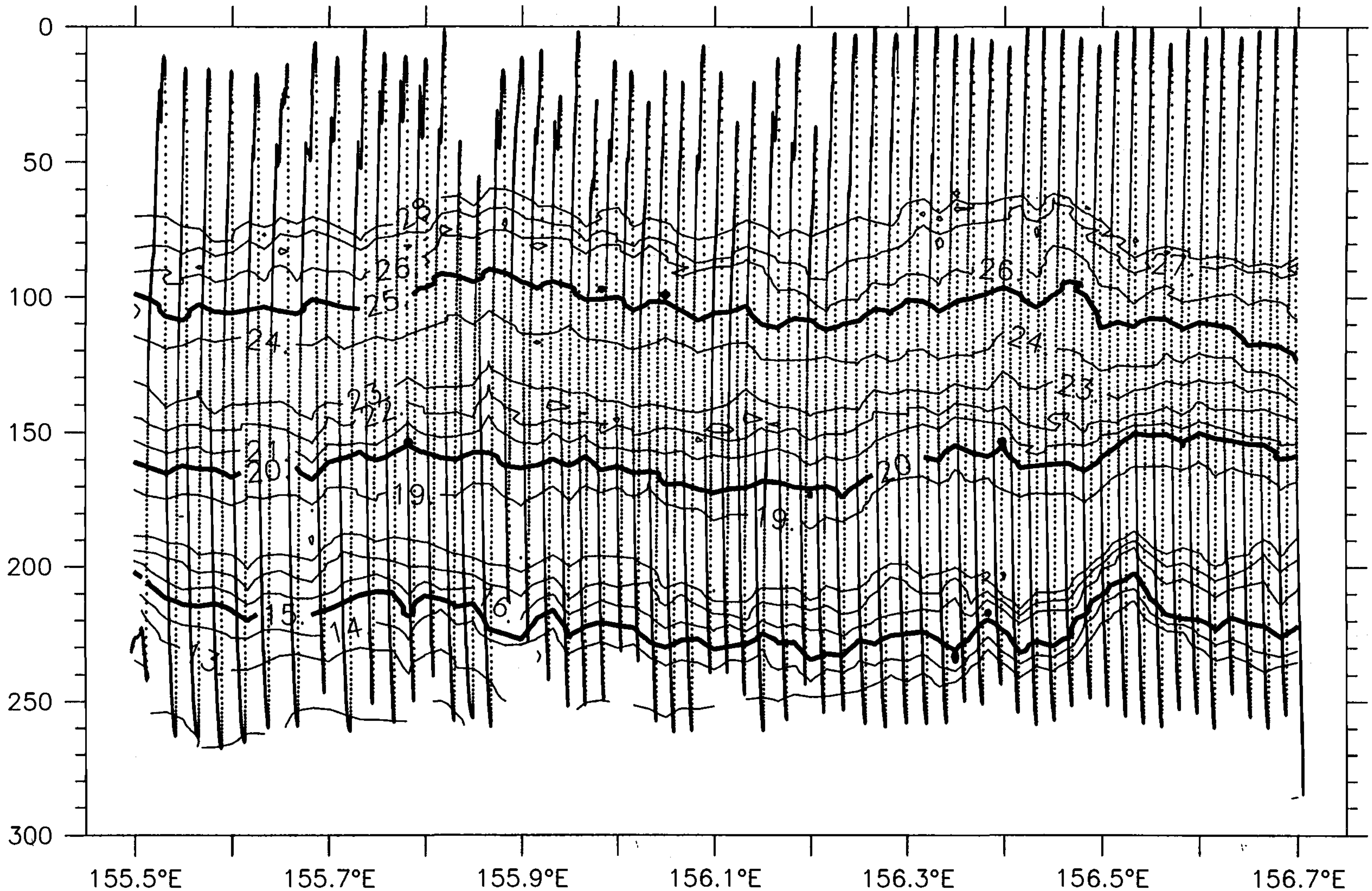
T(°C), W2E, 26 December 1992



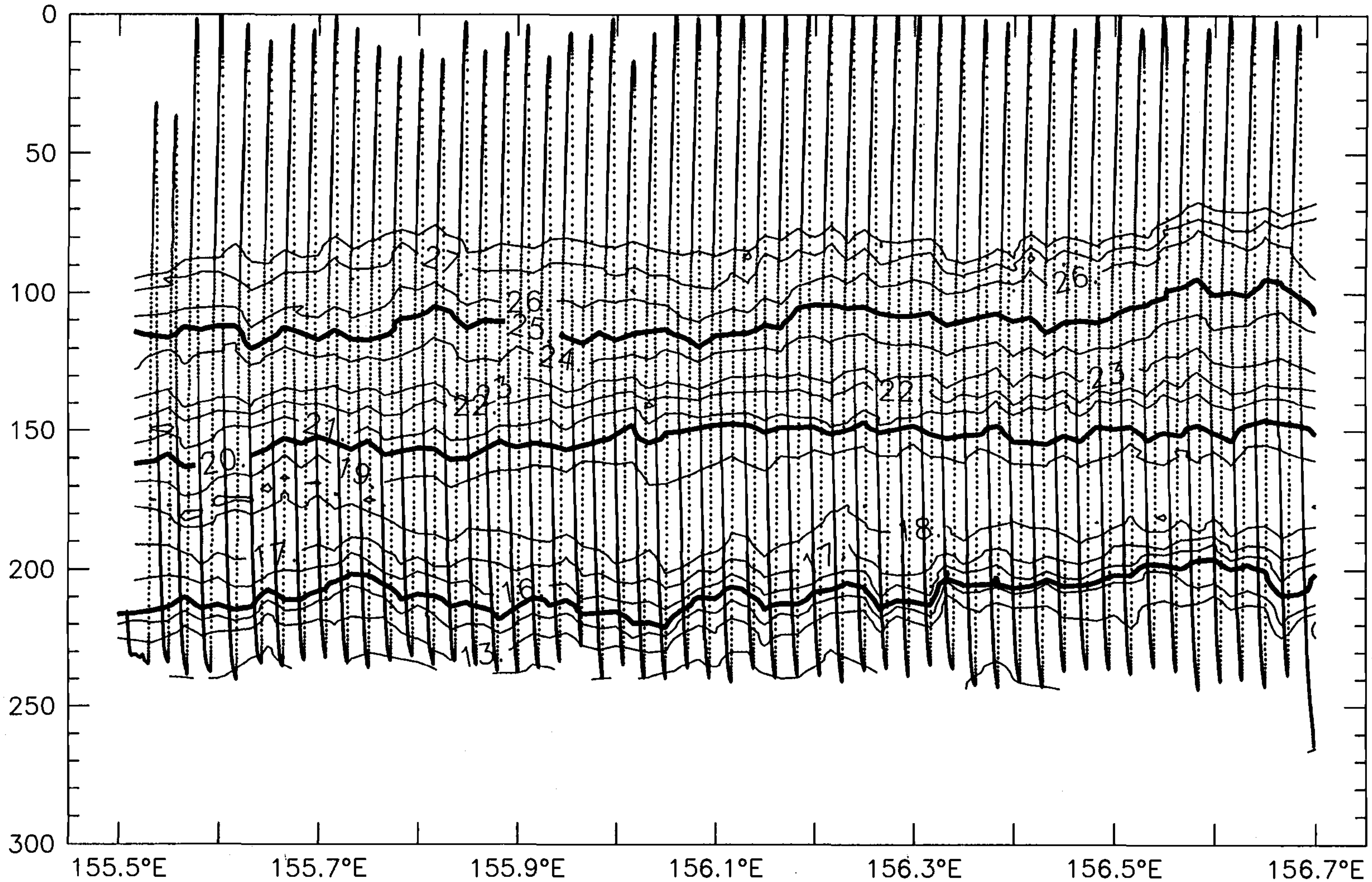
T(°C), W2E, 28 December 1992



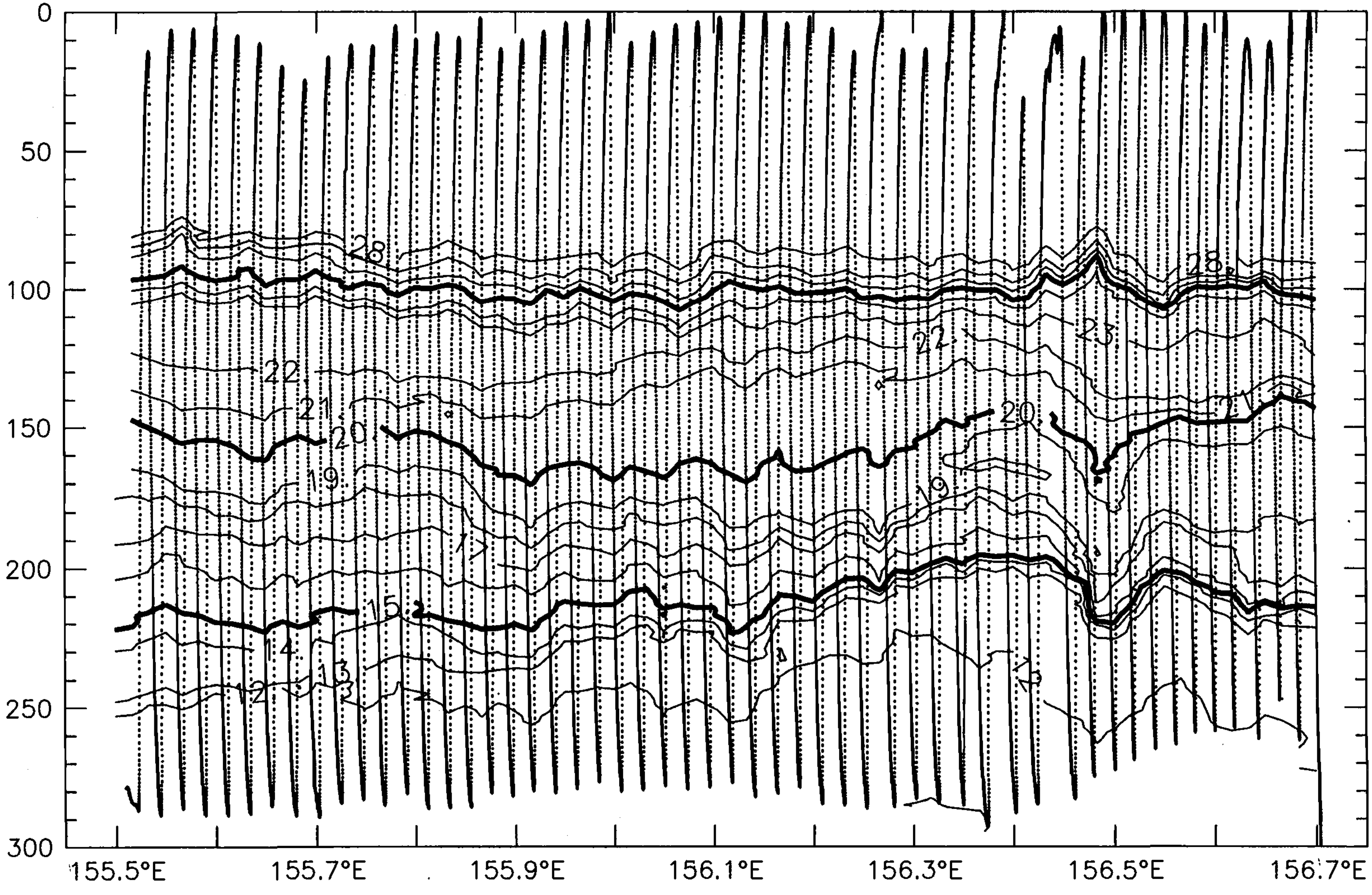
T(°C), W2E, 30 December 1992



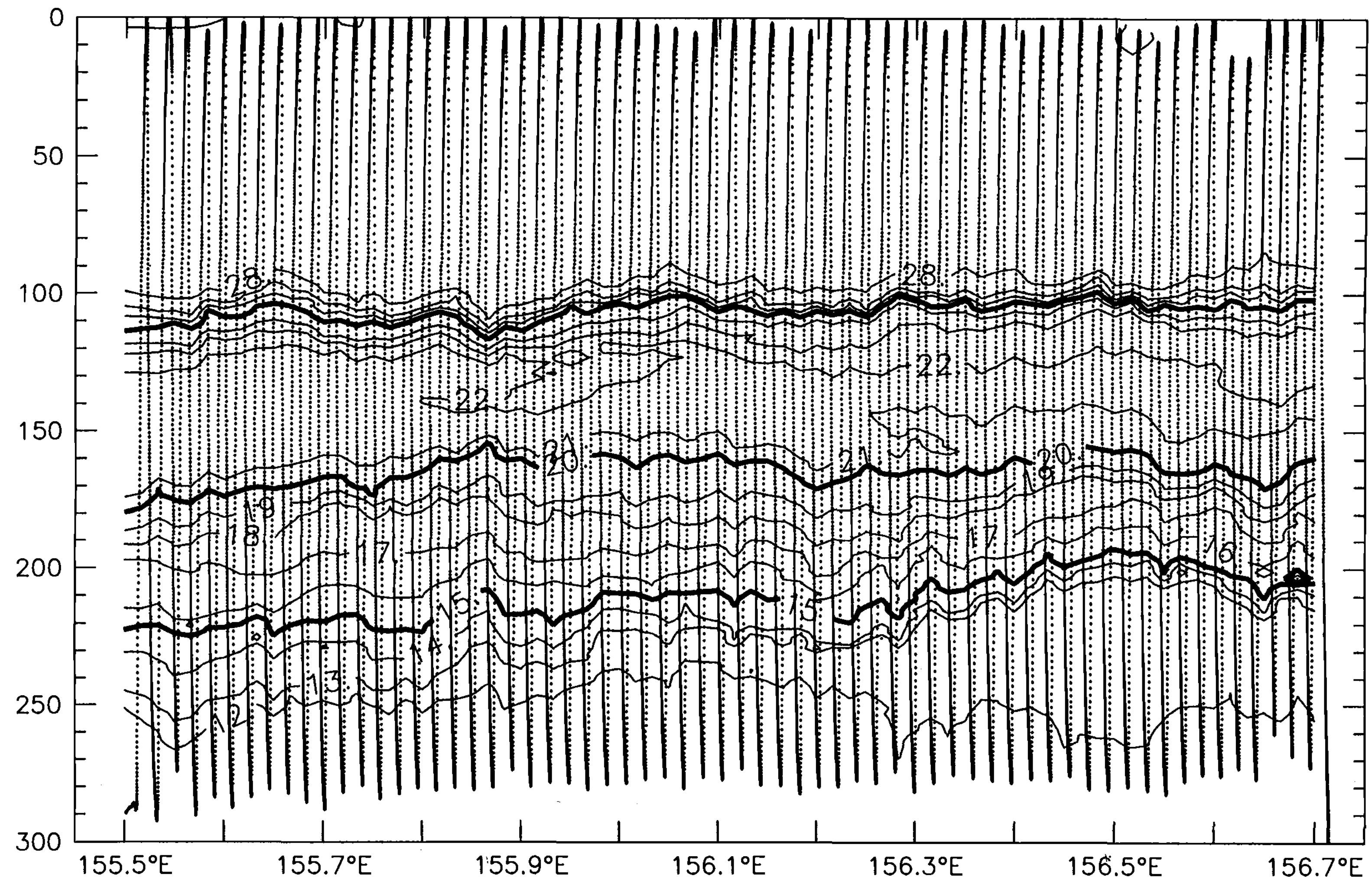
T(°C), W2E, 31 December 1992



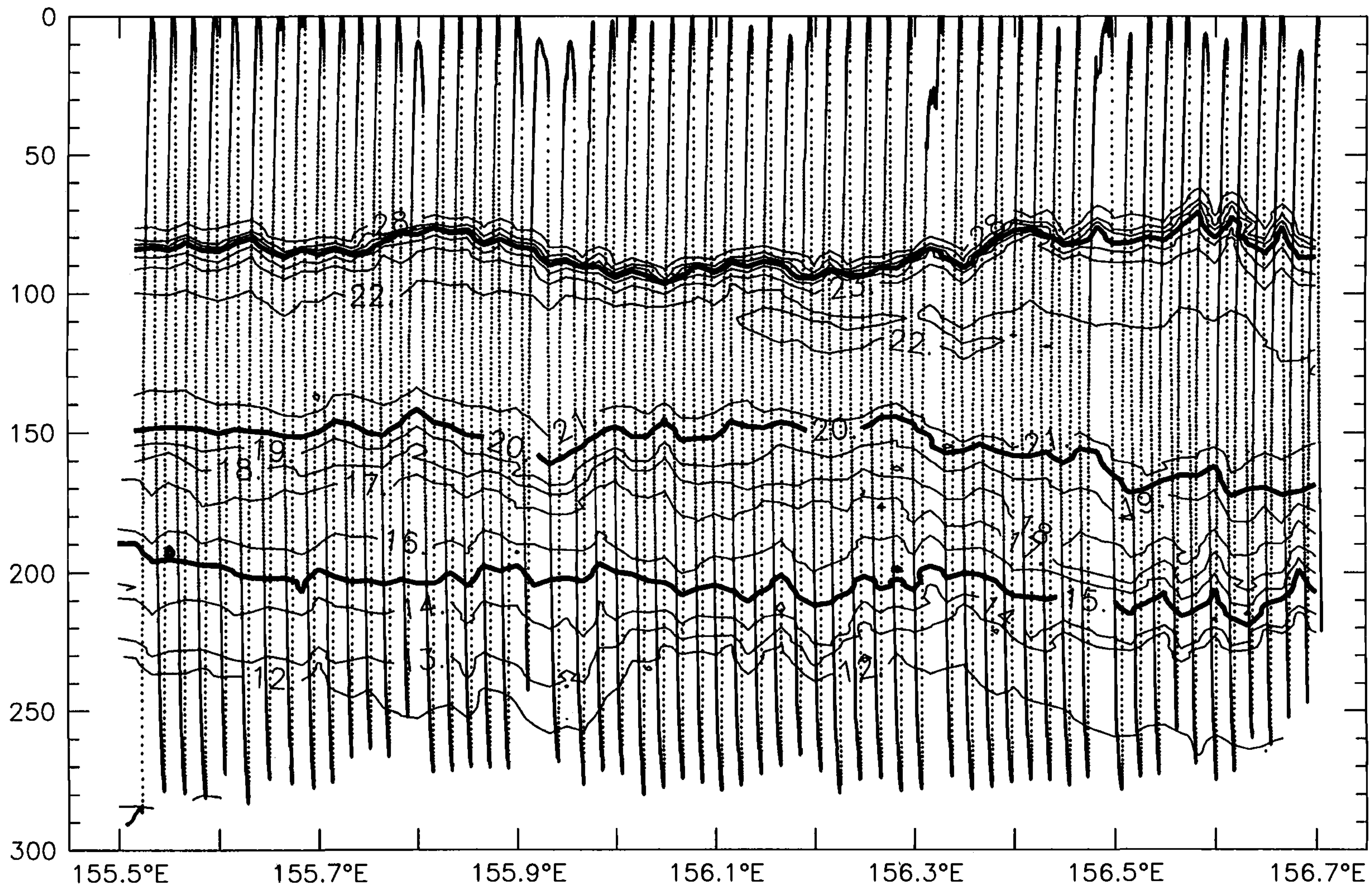
T(°C), W2E, 1 January 1993



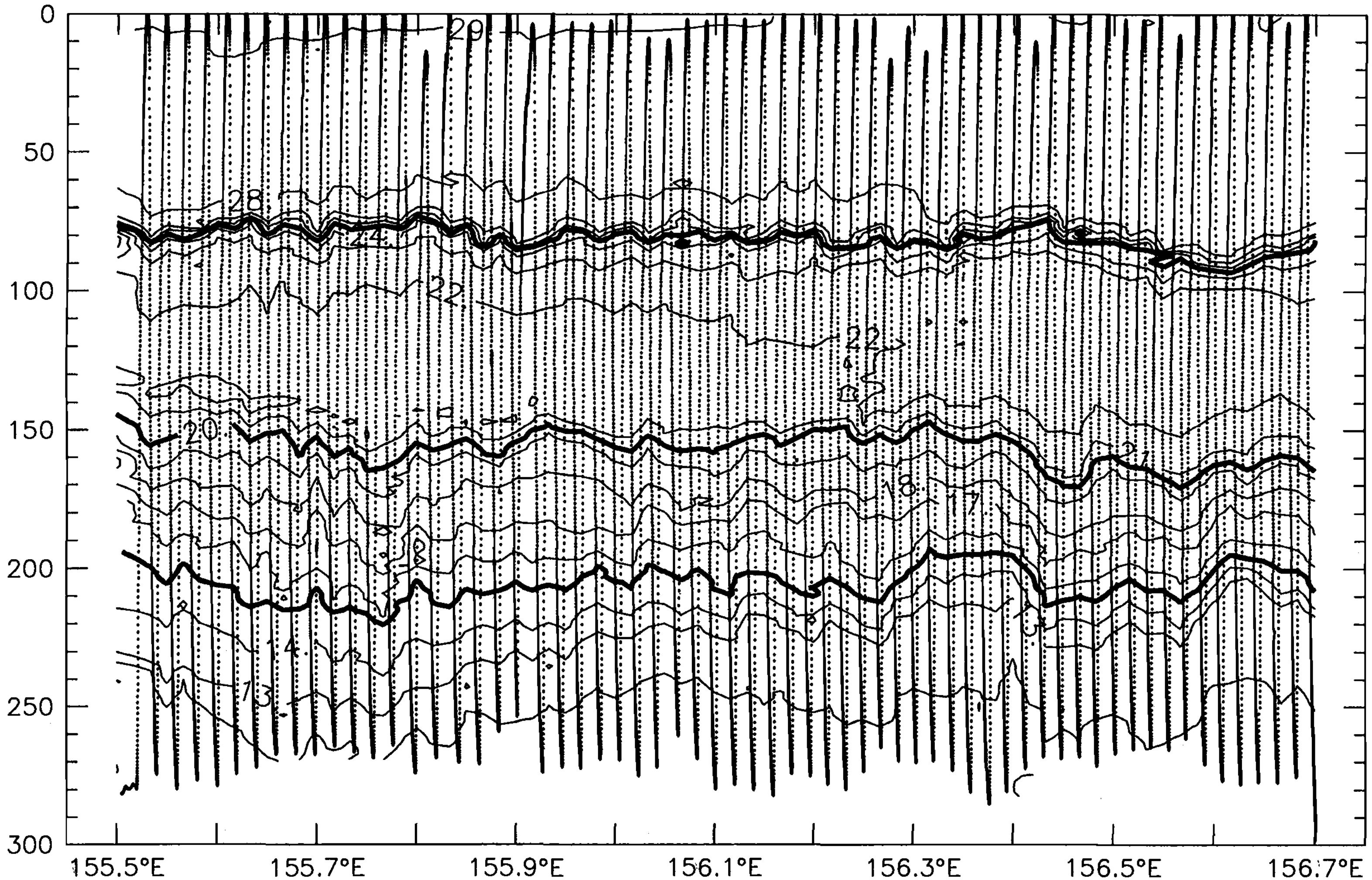
T(°C), W2E, 4 January 1993



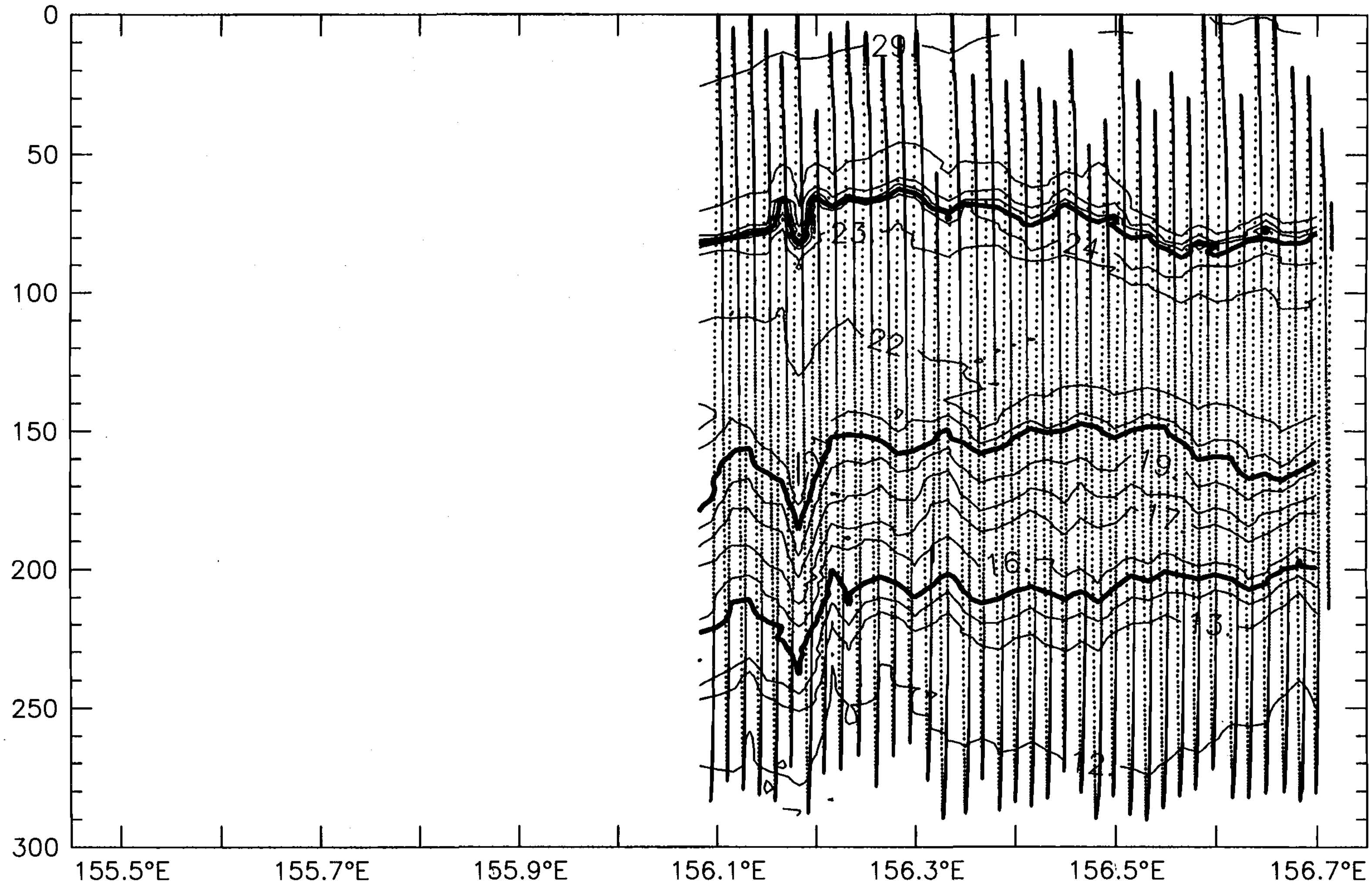
T(°C), W2E, 6 January 1993



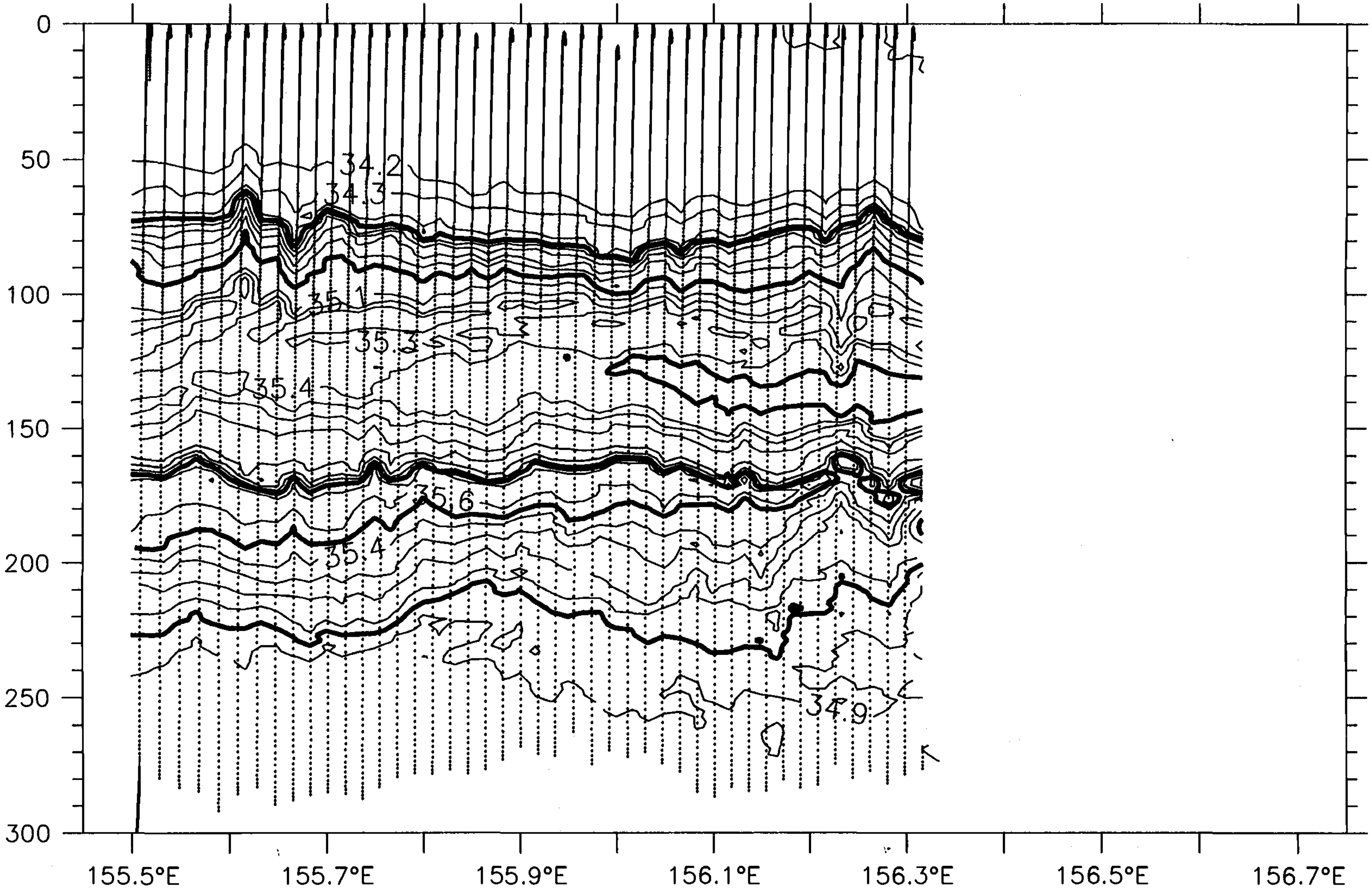
T(°C), W2E, 7 January 1993



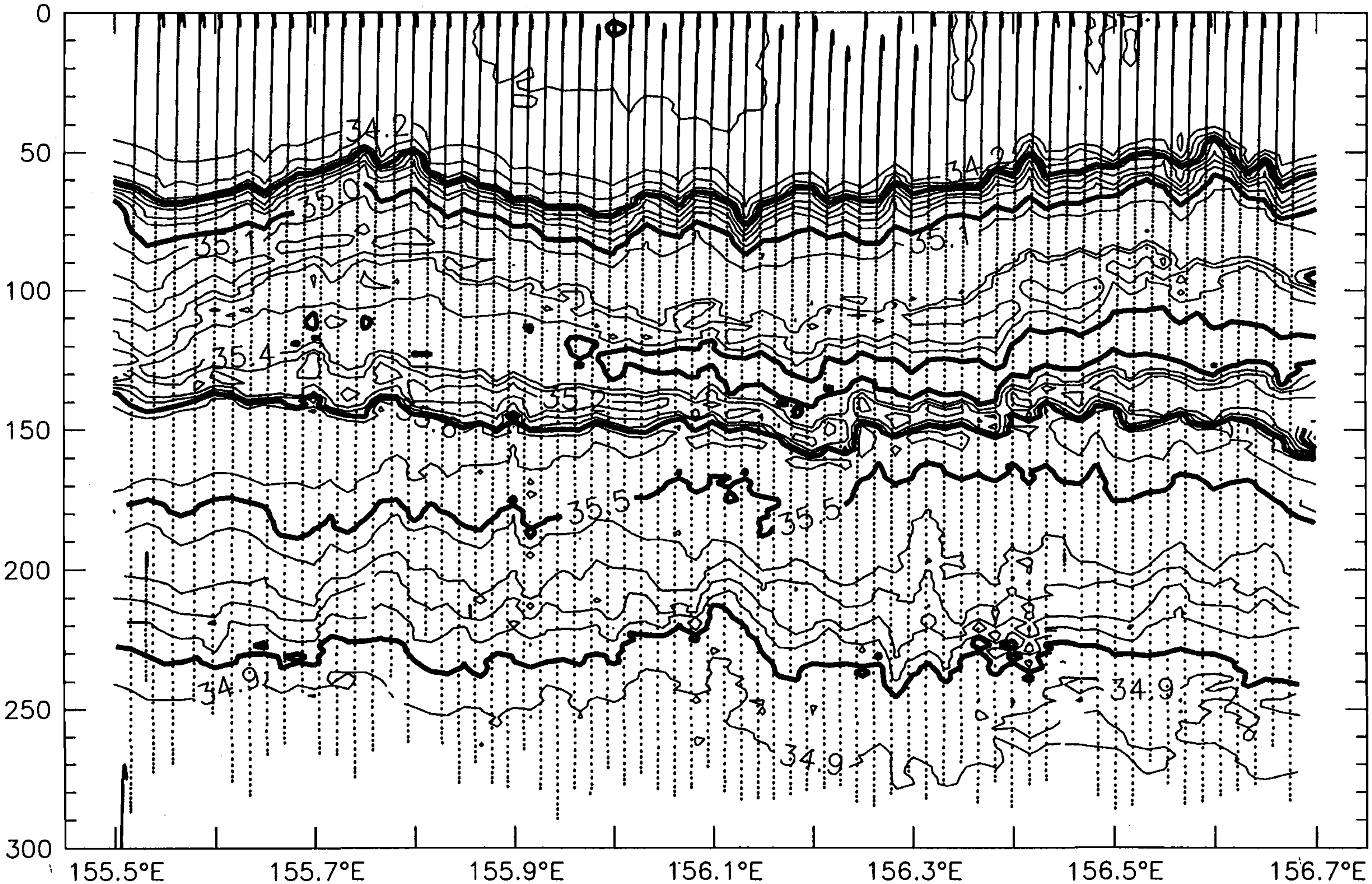
T(°C), W2E, 9 January 1993



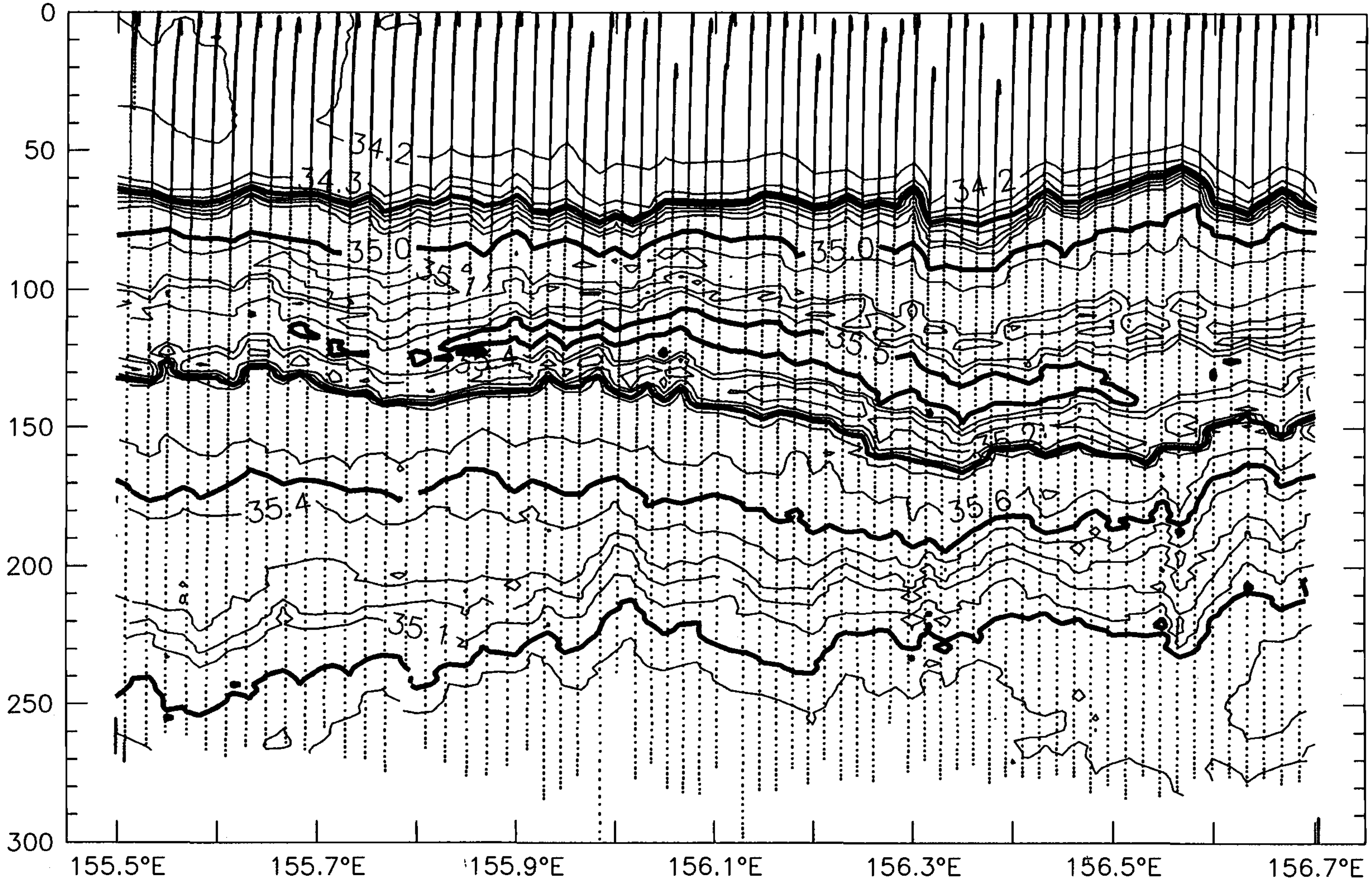
T(°C), W2E, 10 January 1993



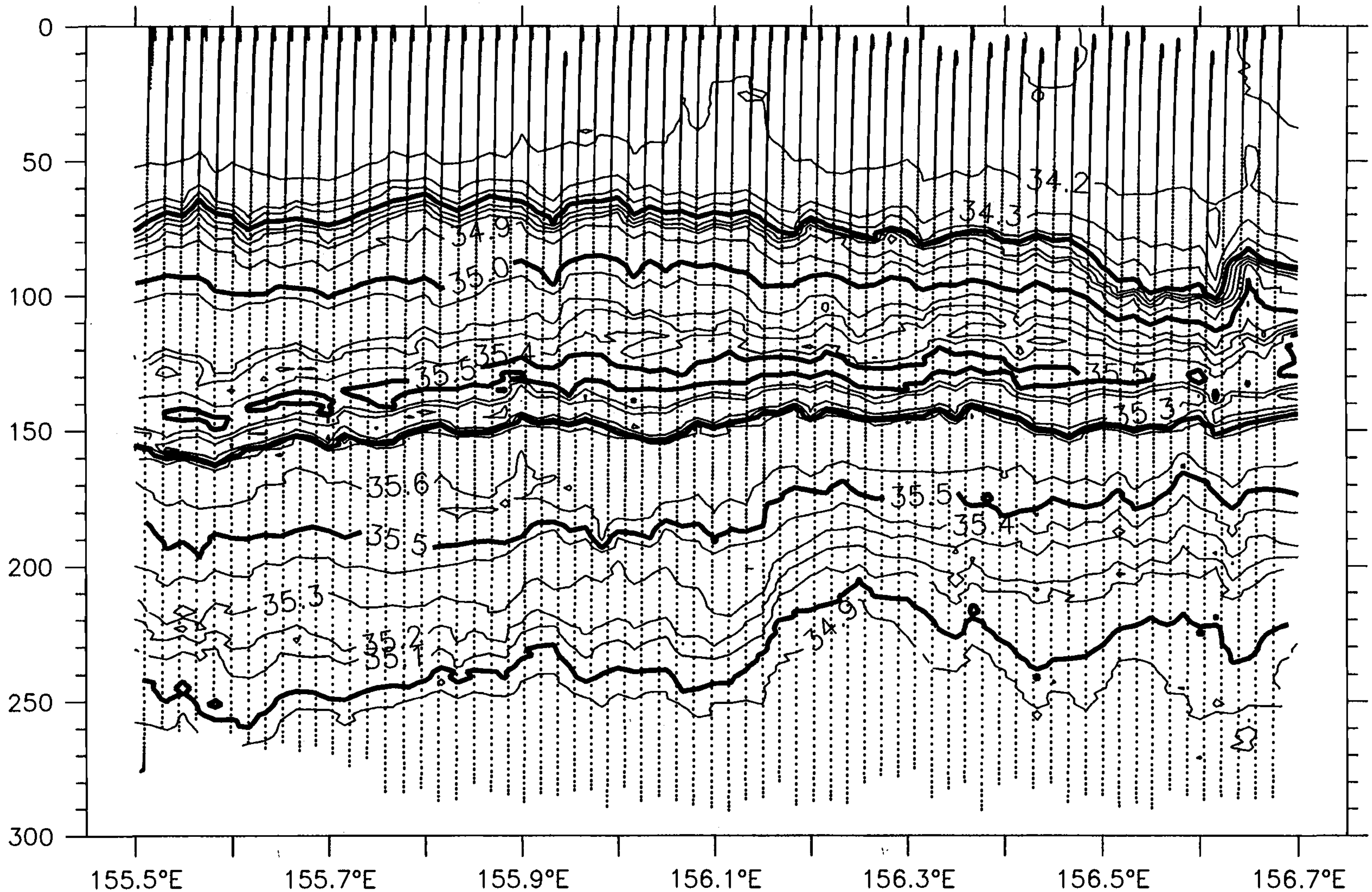
S(psu), W2E, 19 December 1992



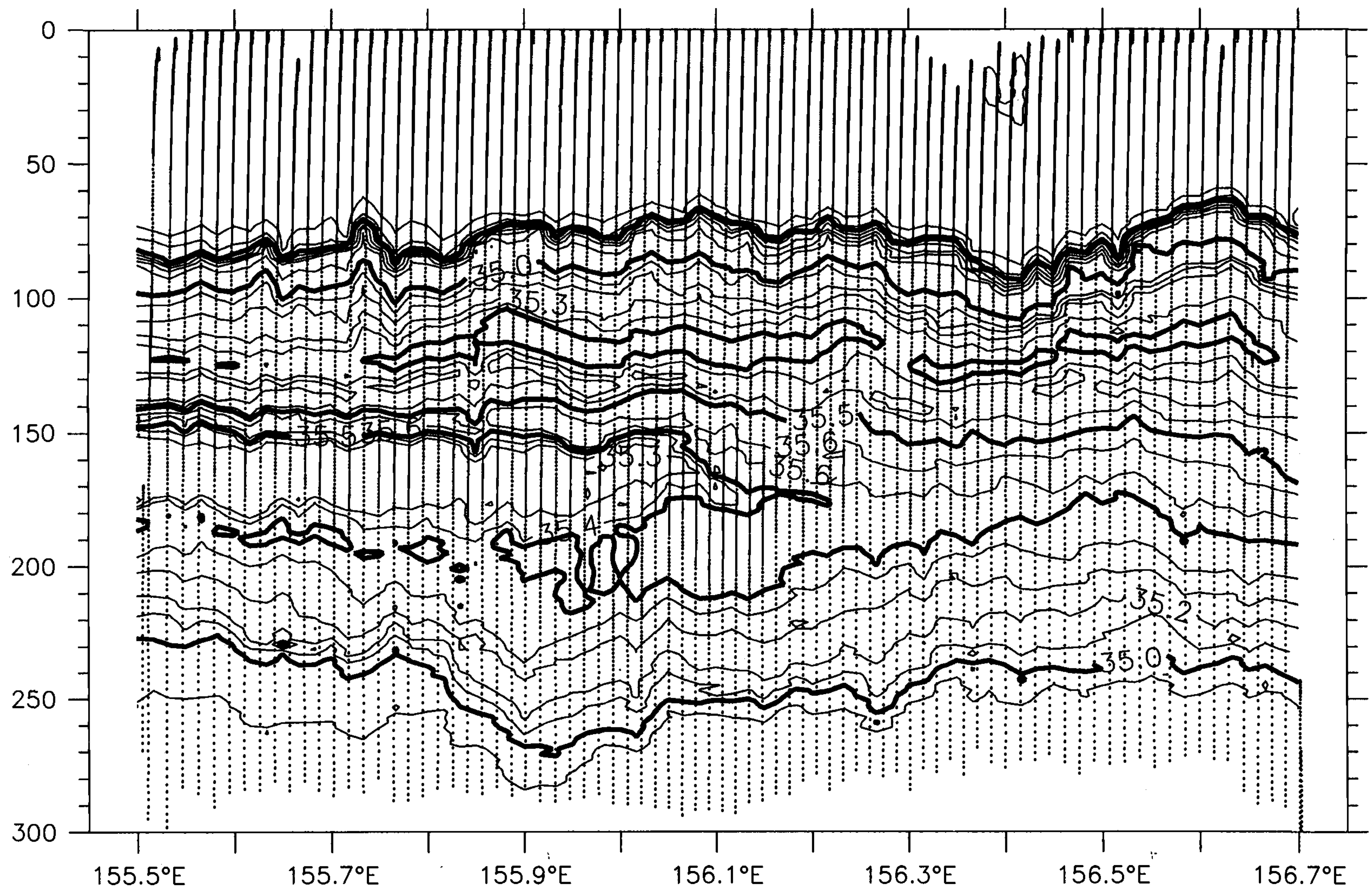
S(psu), W2E, 21 December 1992



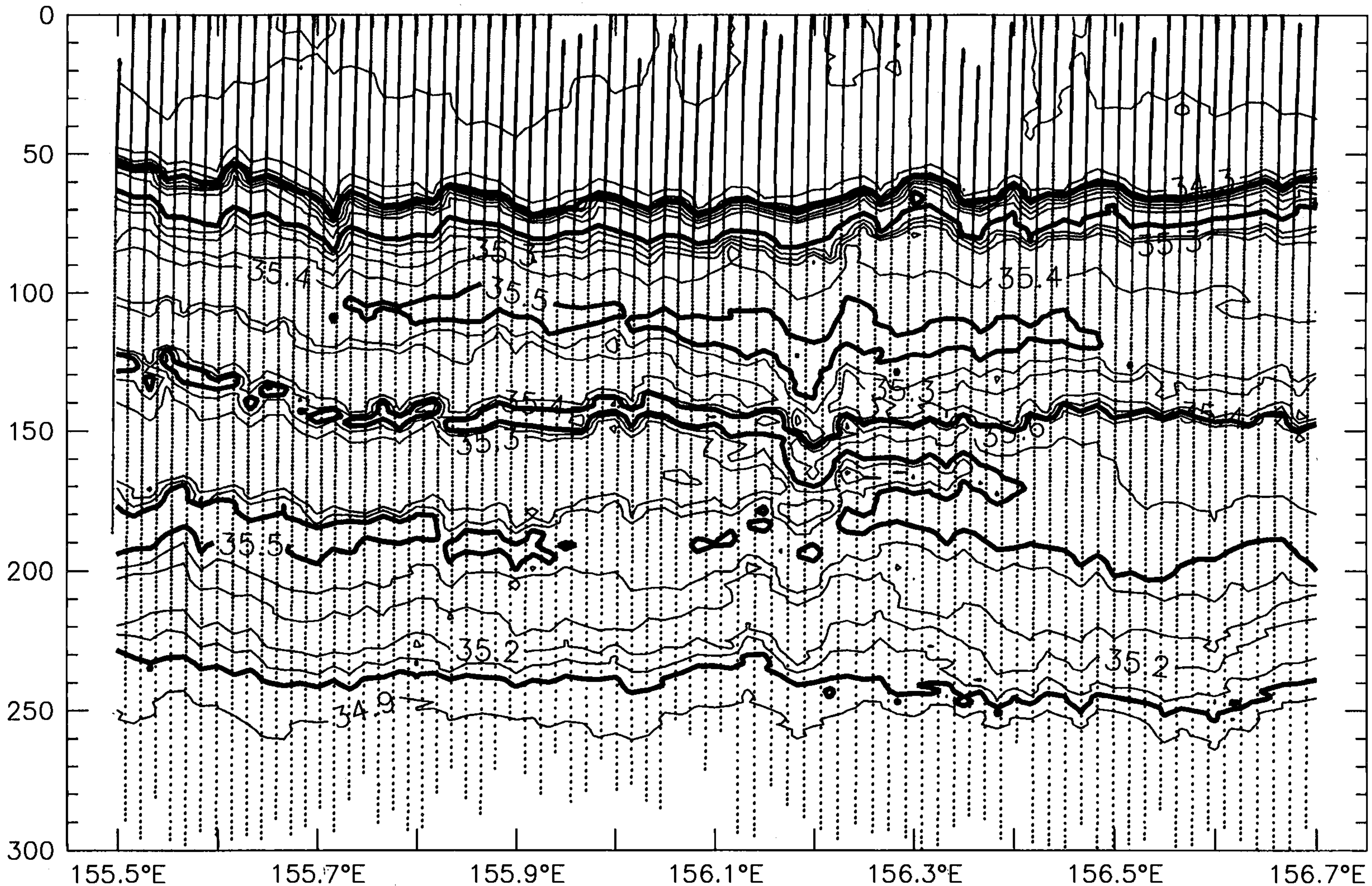
S(psu), W2E, 23 December 1992



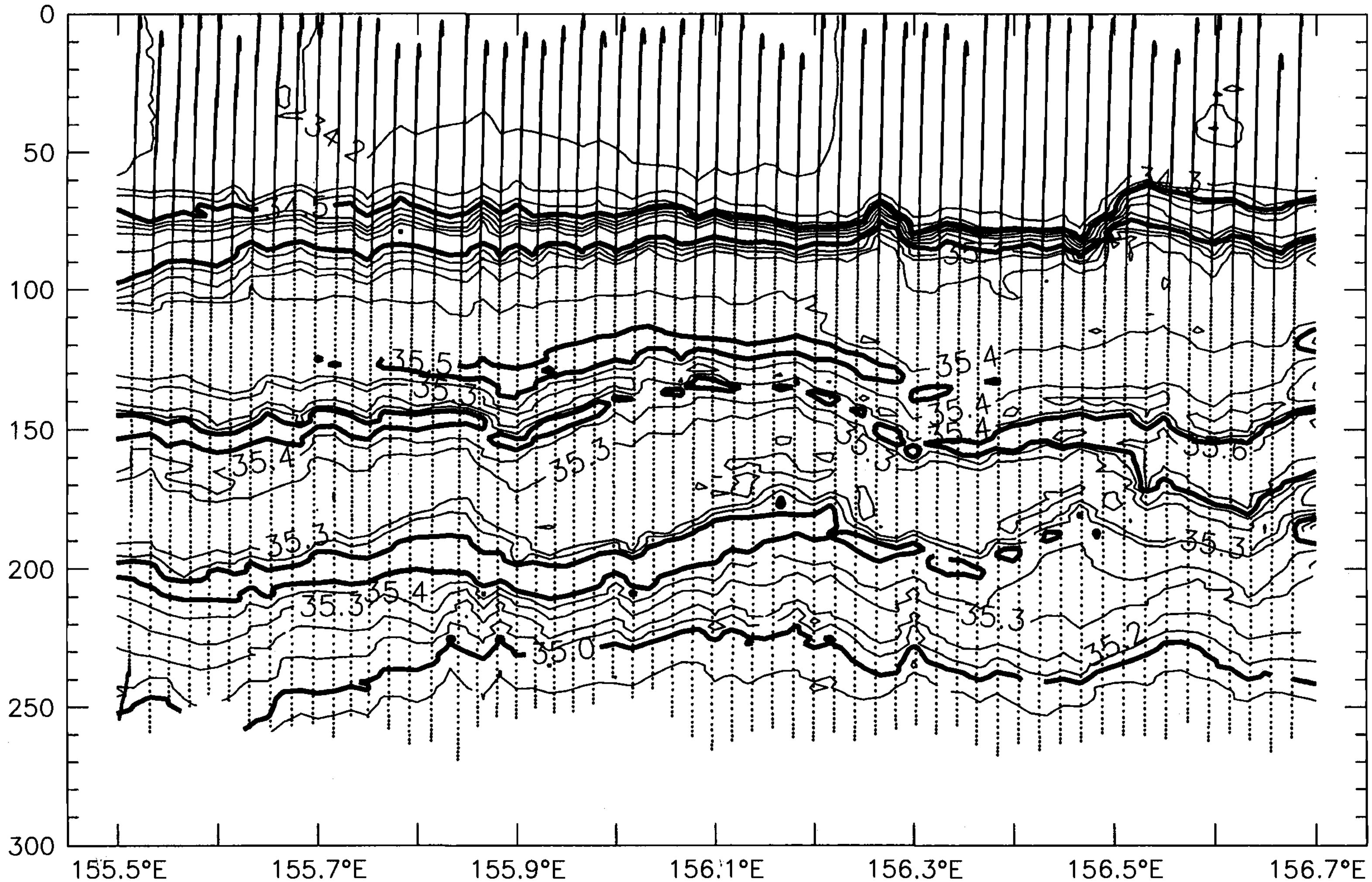
S(psu), W2E, 24 December 1992



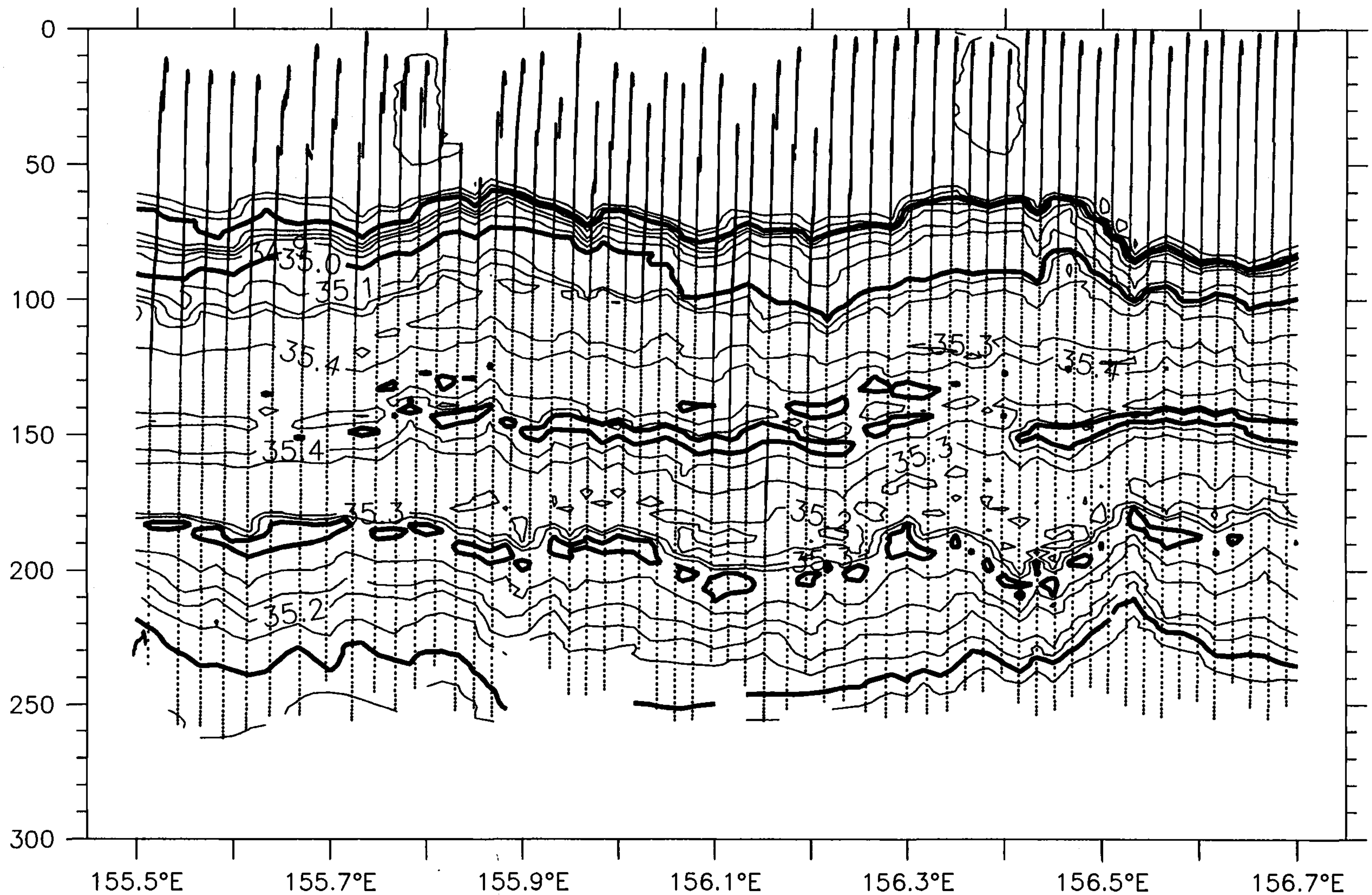
S(psu), W2E, 26 December 1992



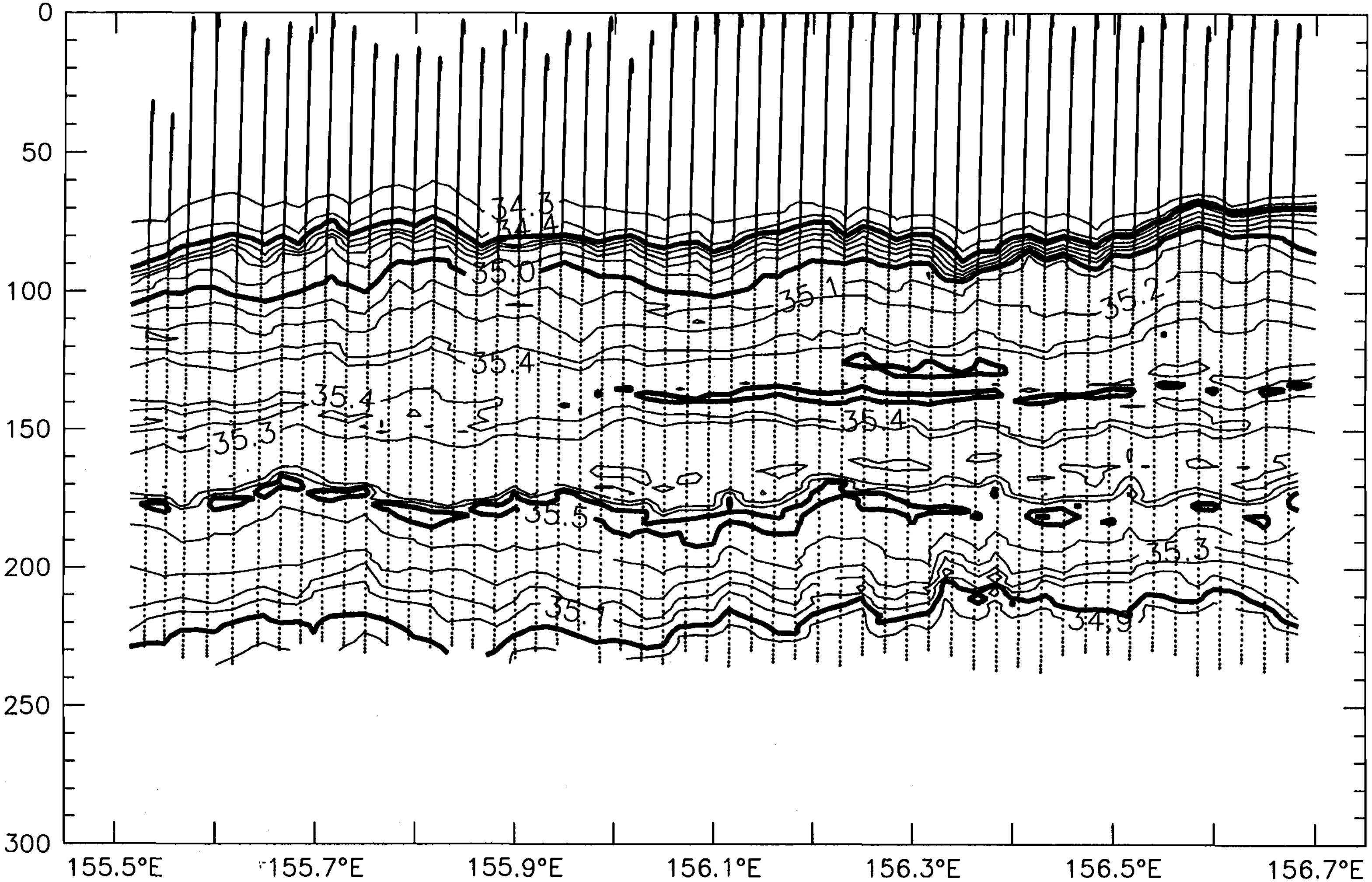
S(psu), W2E, 28 December 1992



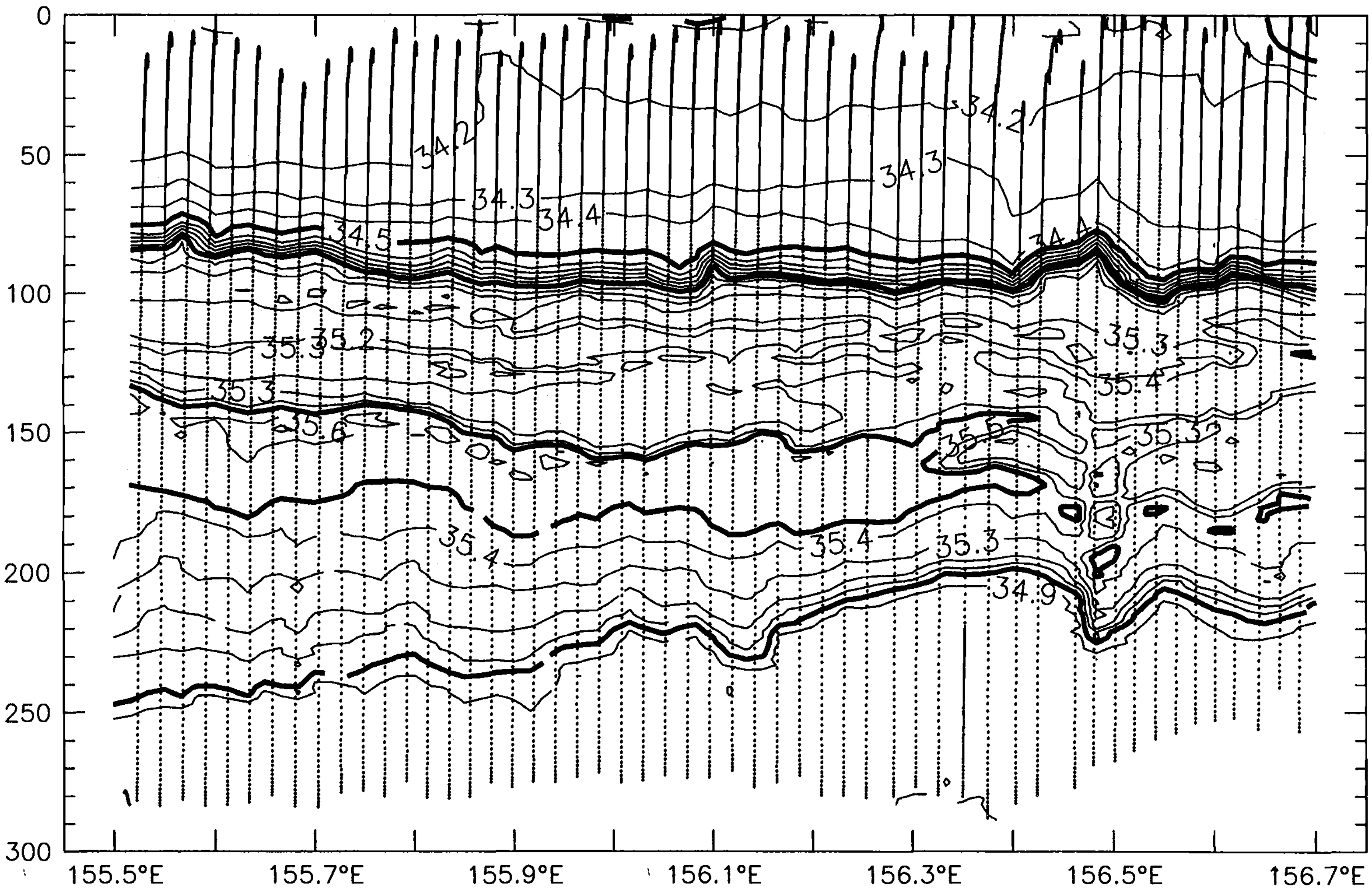
S(psu), W2E, 30 December 1992



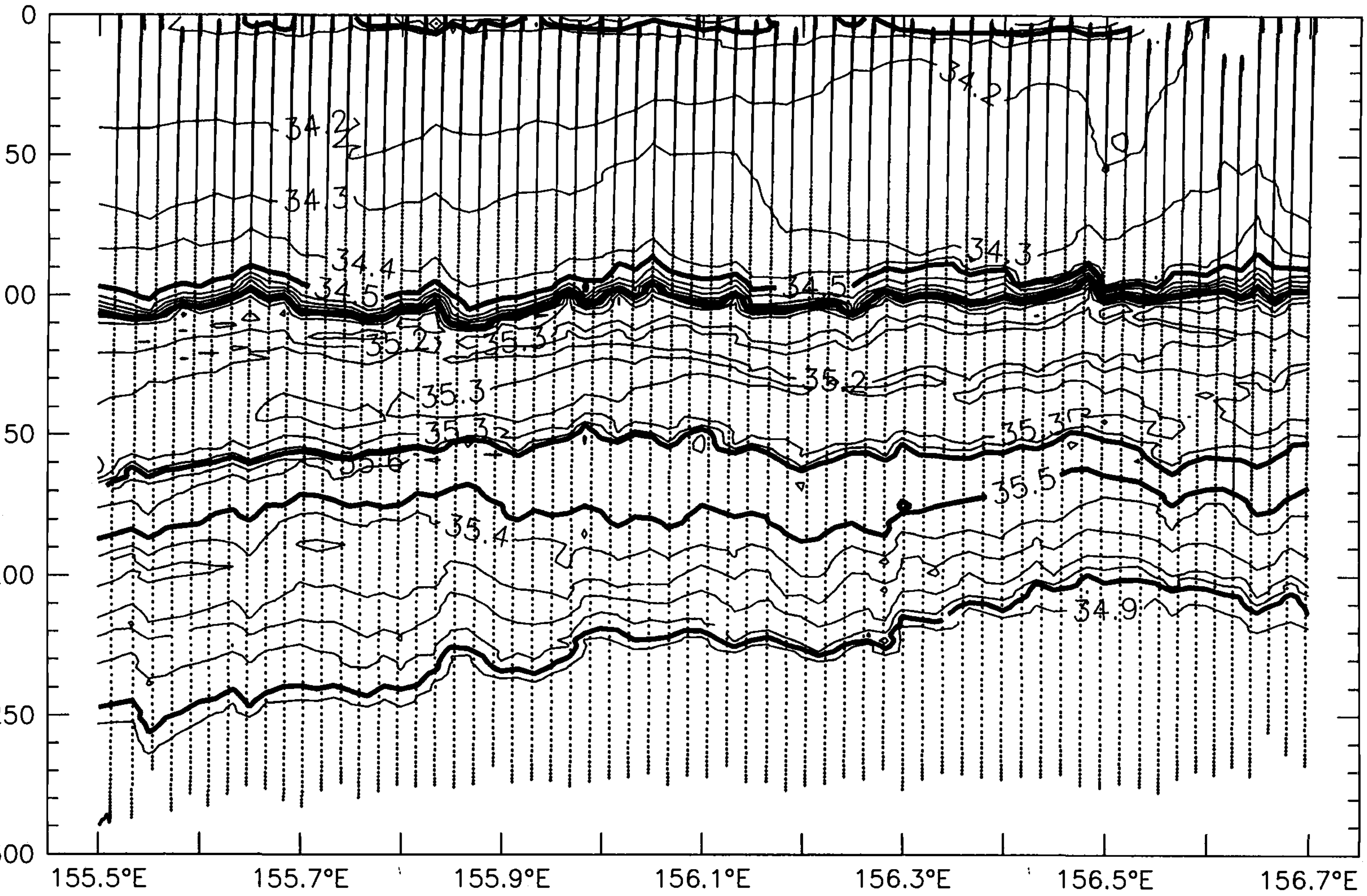
S(psu), W2E, 31 December 1992



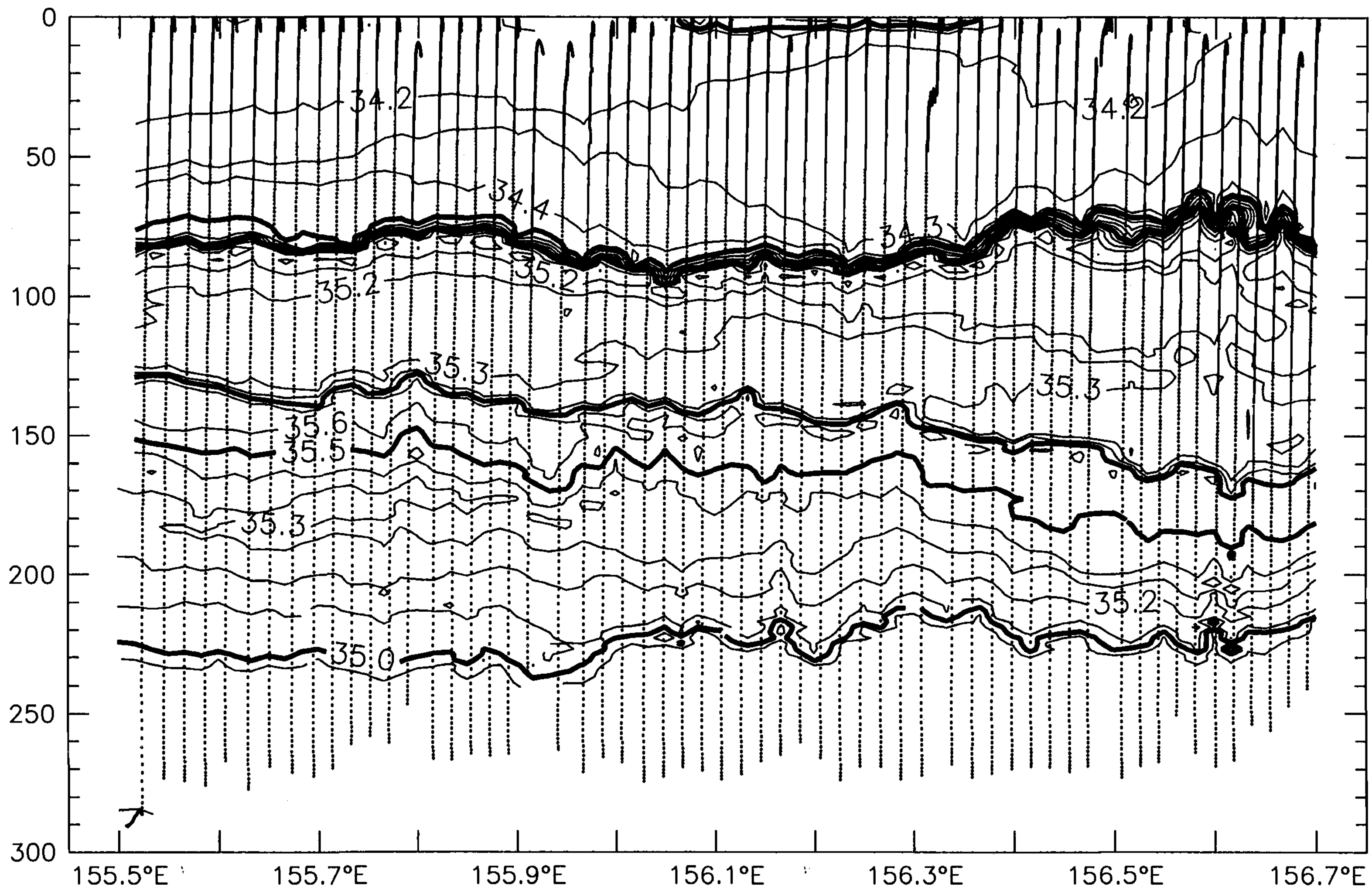
S(psu), W2E, 1 January 1993



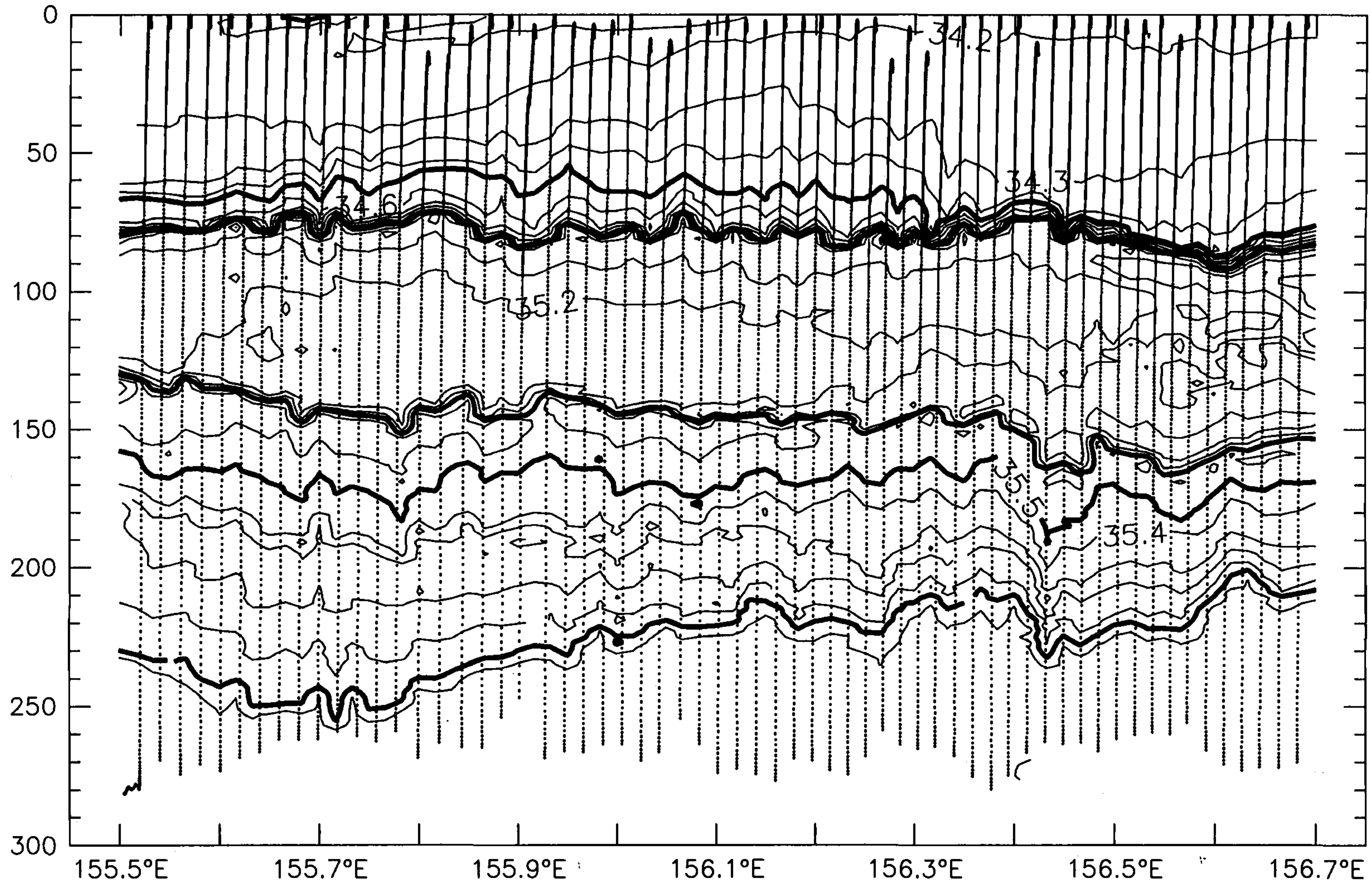
S(psu), W2E, 4 January 1993



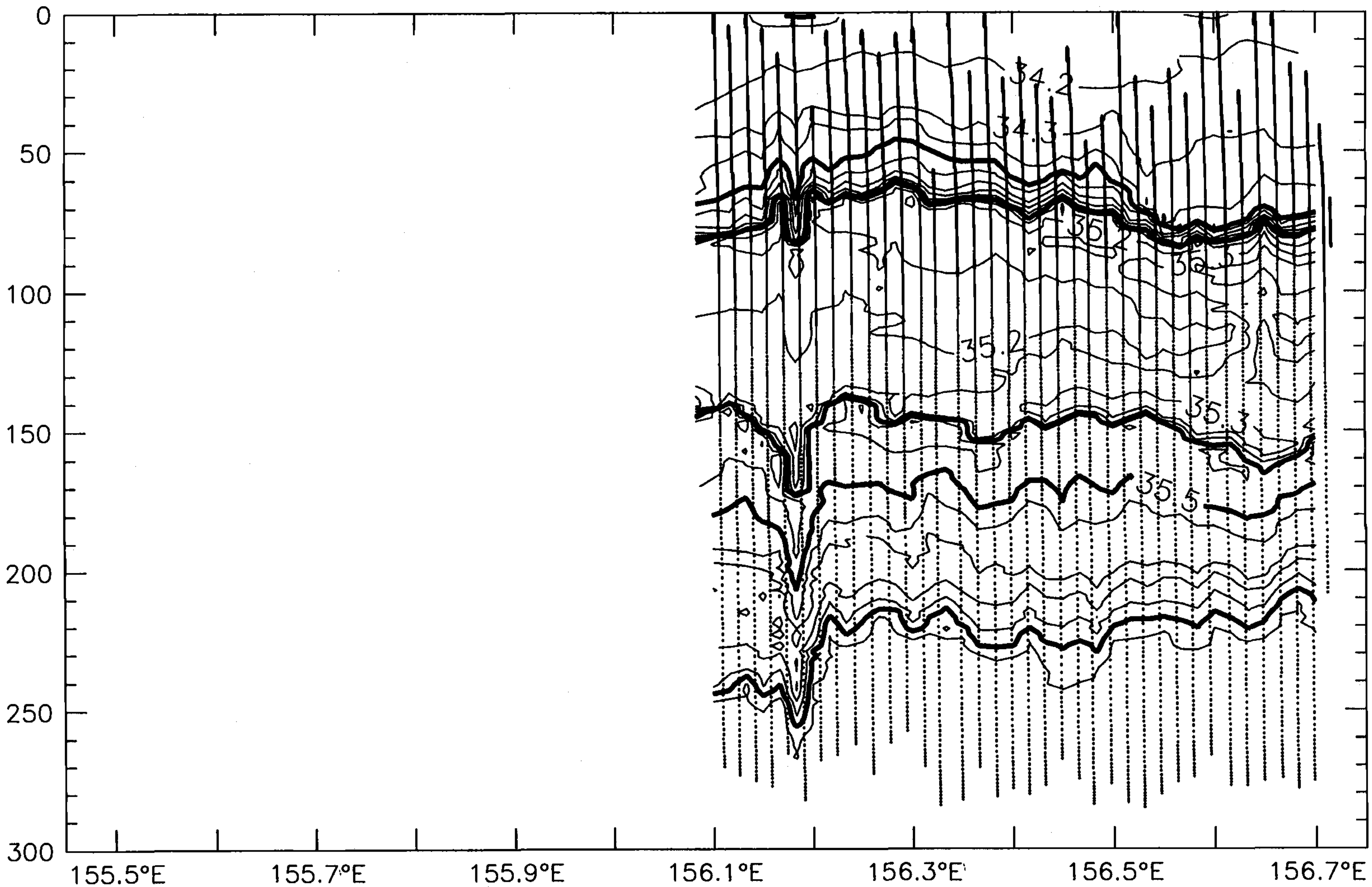
S(psu), W2E, 6 January 1993



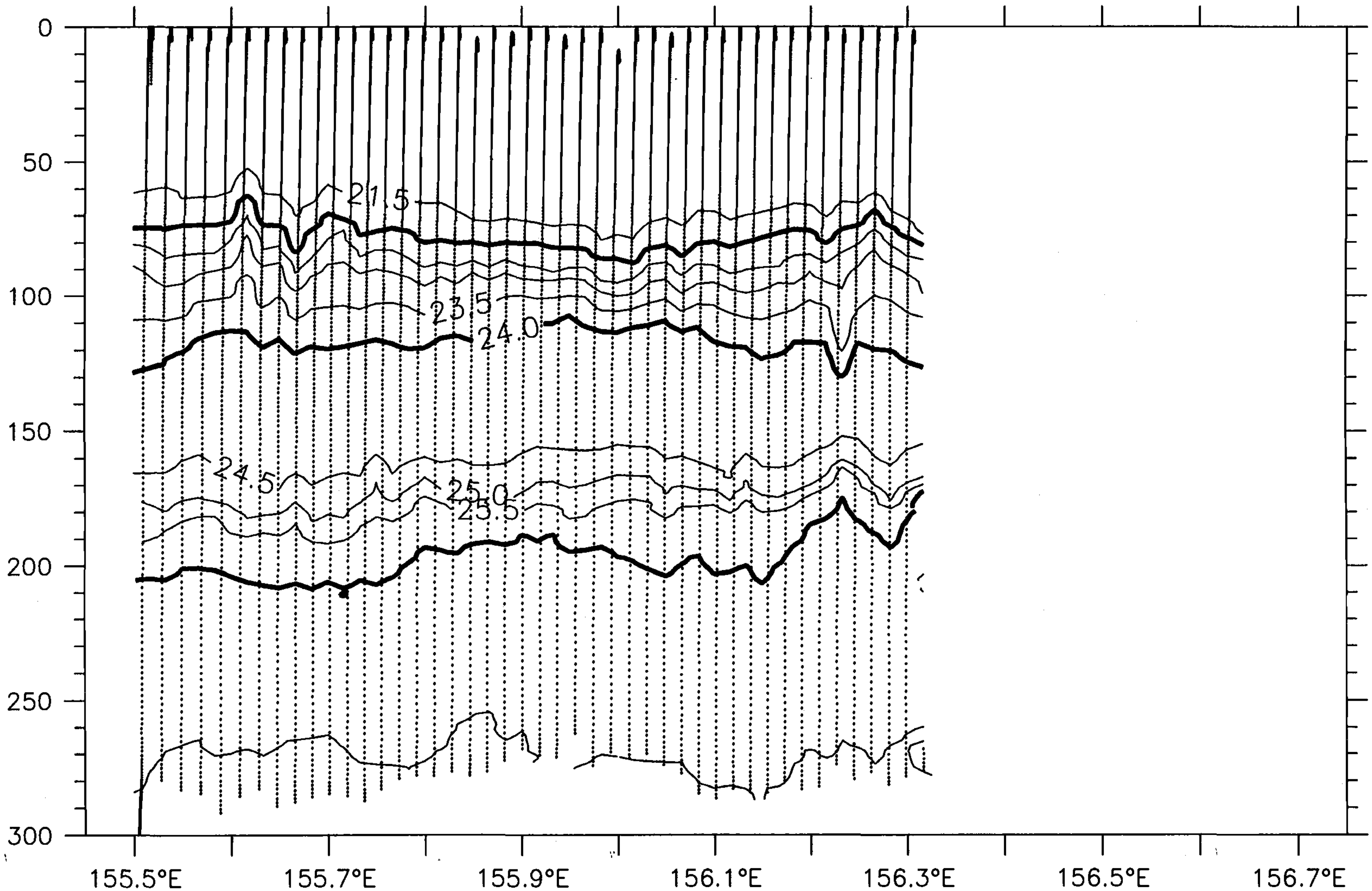
S(psu), W2E, 7 January 1993



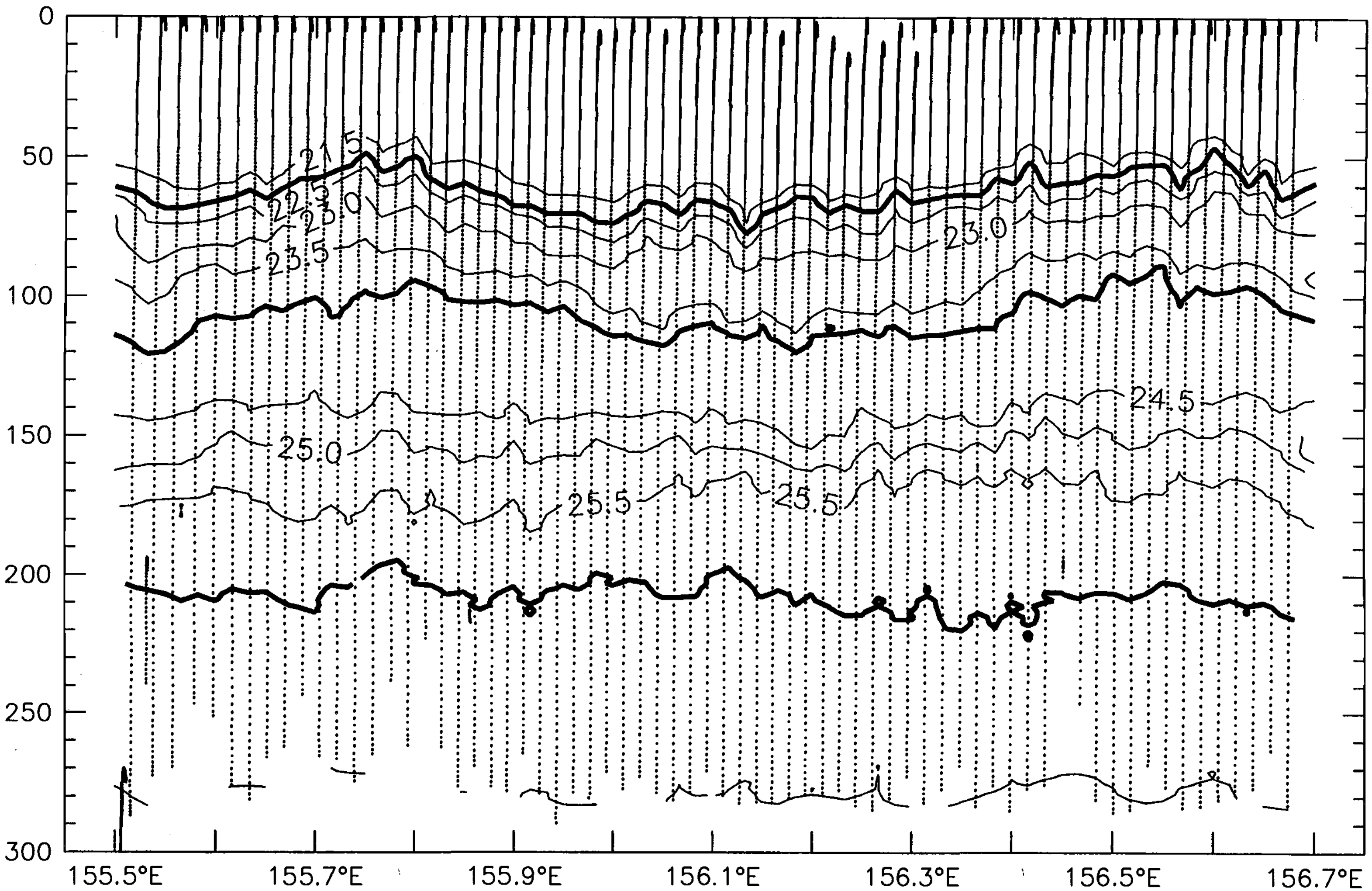
S(psu), W2E, 9 January 1993



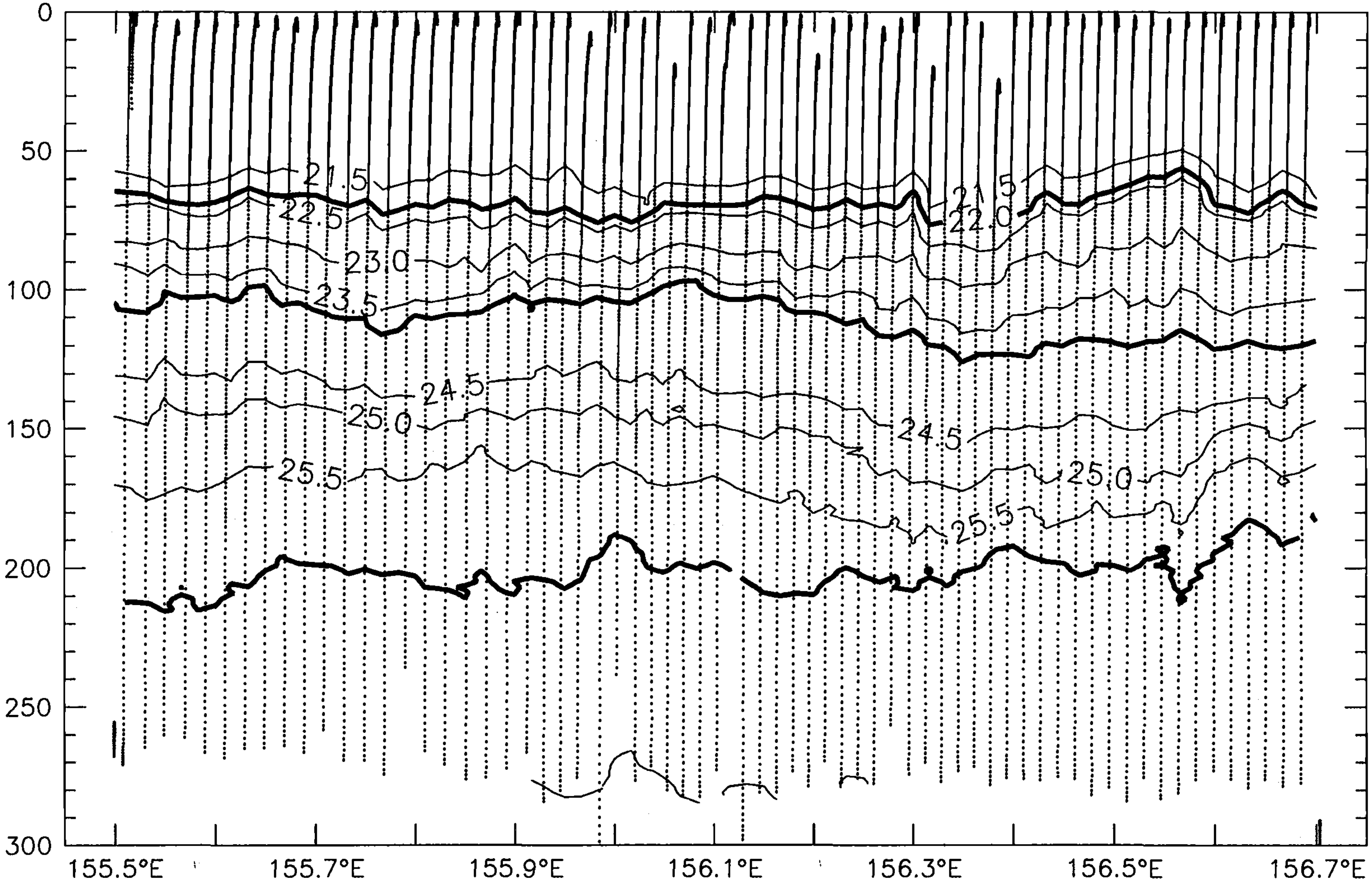
S(psu), W2E, 10 January 1993



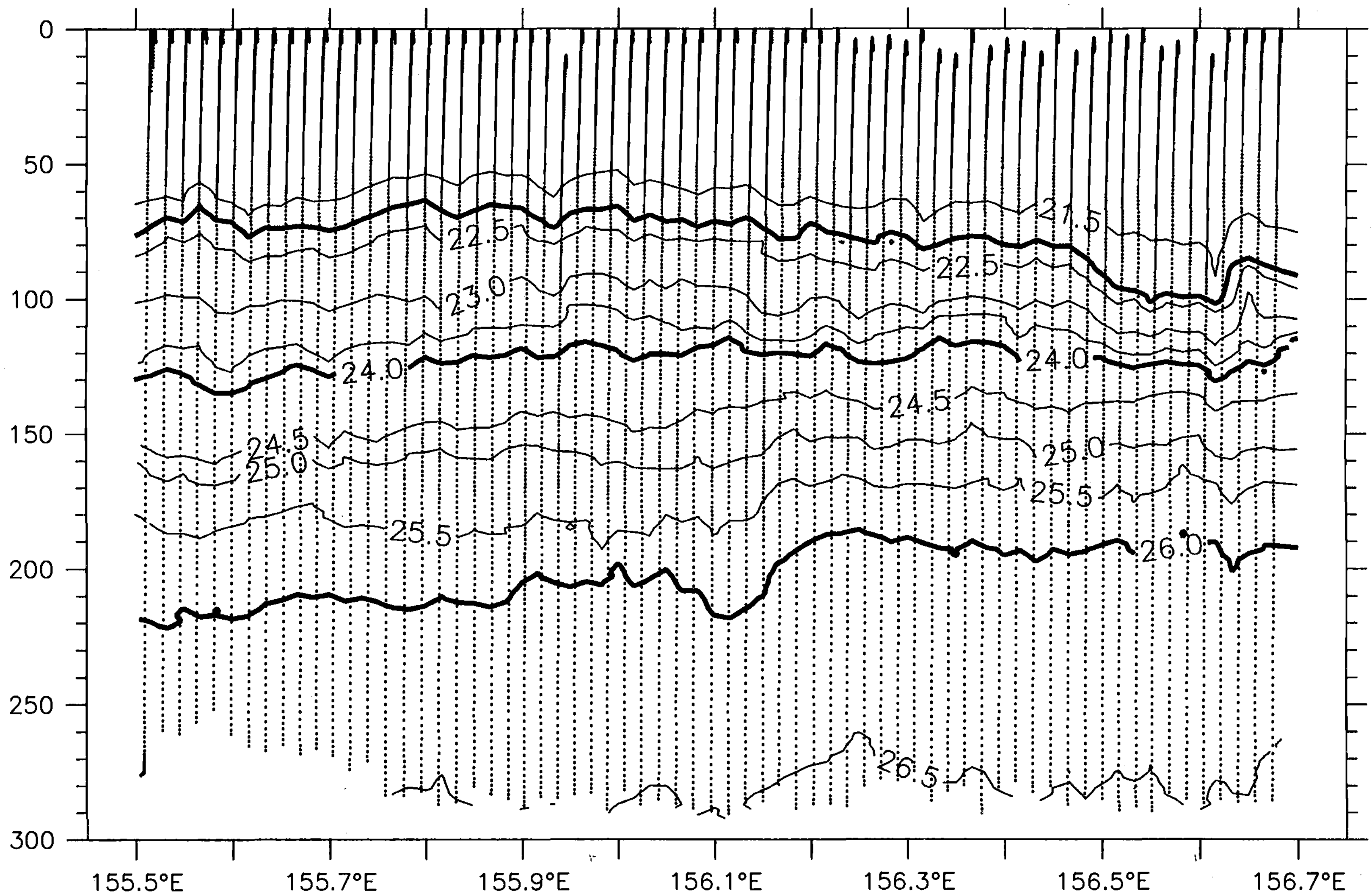
Sigma–t, W2E, 19 December 1992



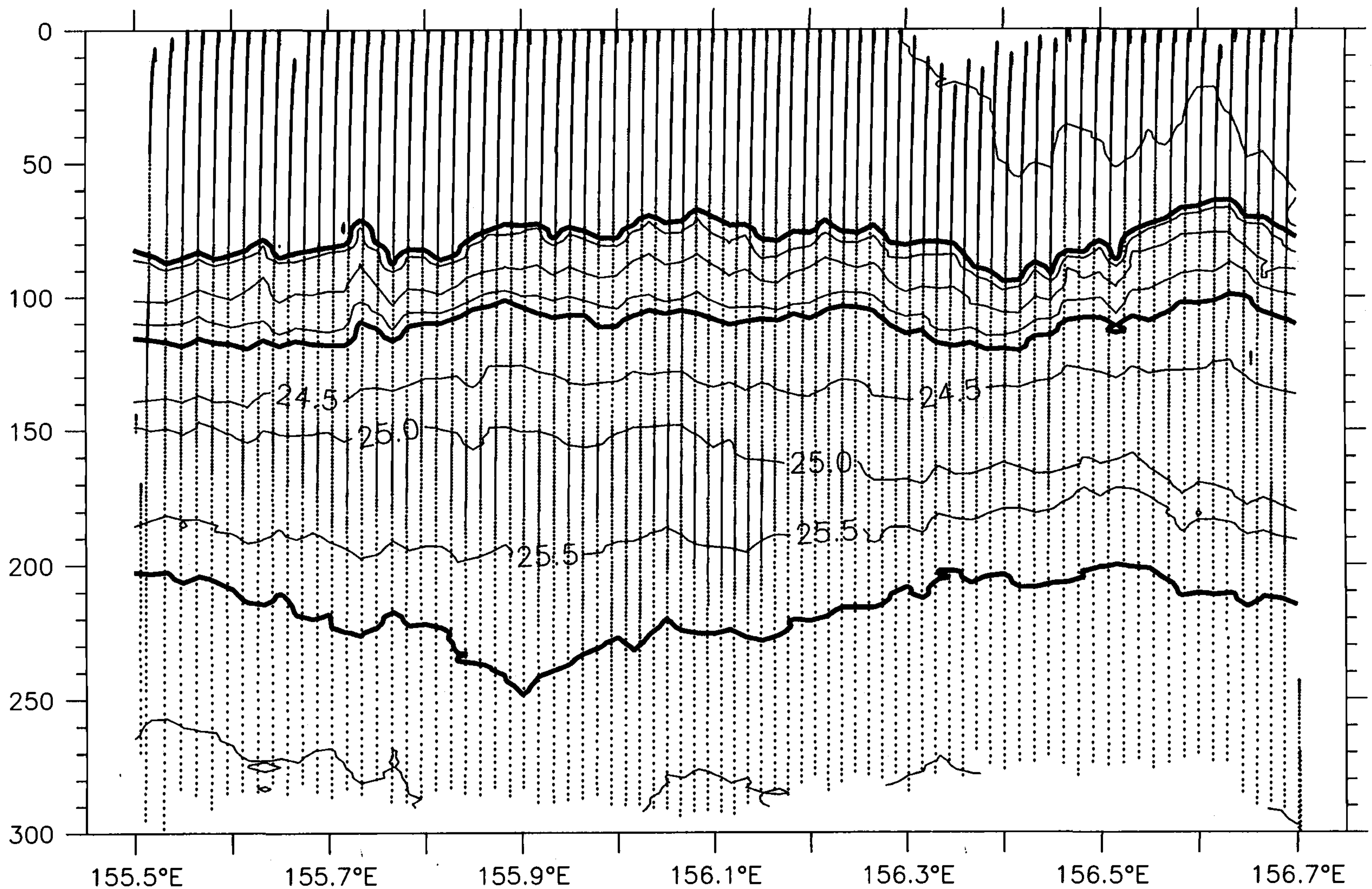
Sigma–t, W2E, 21 December 1992



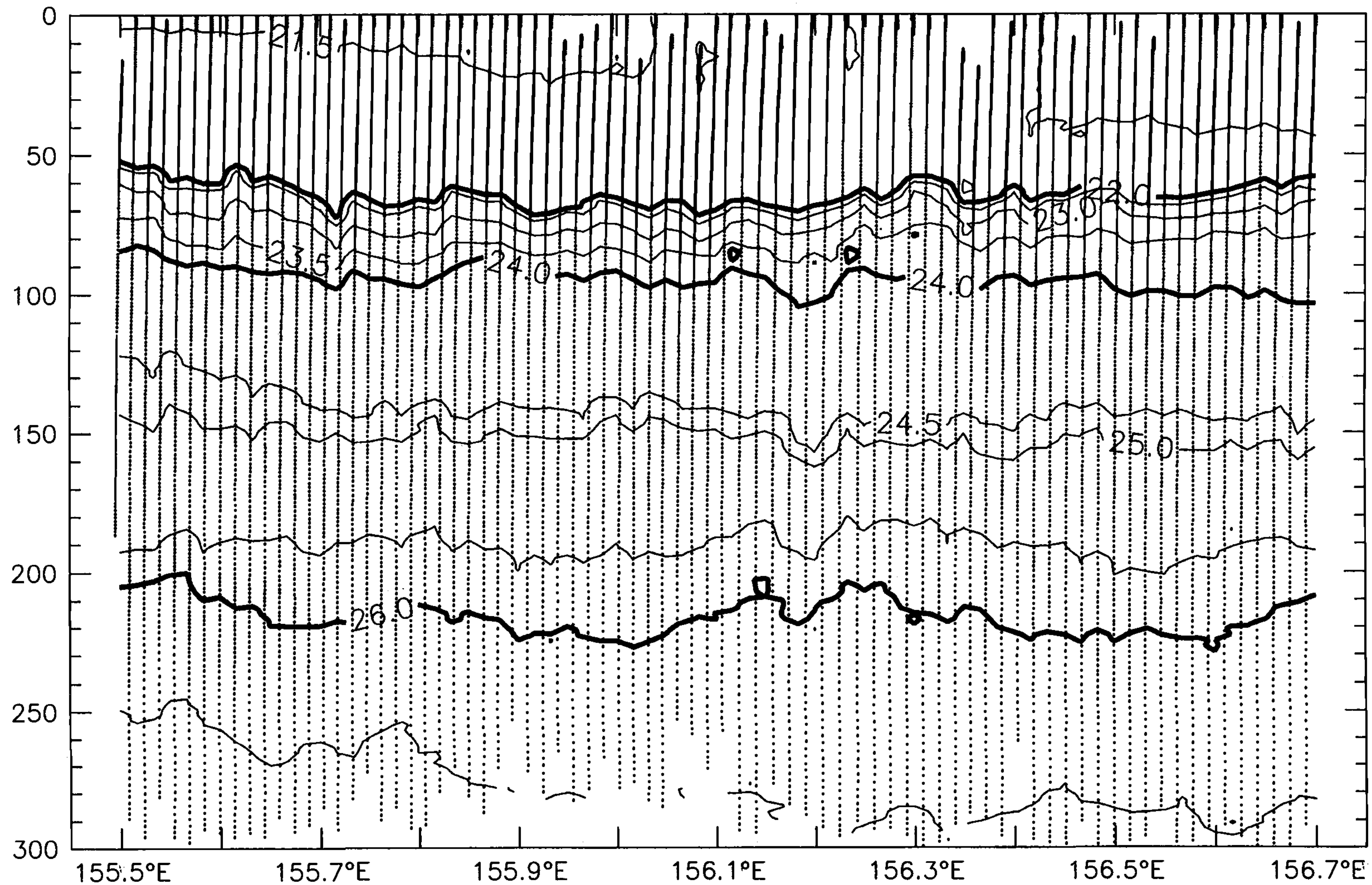
Sigma-t, W2E, 23 December 1992



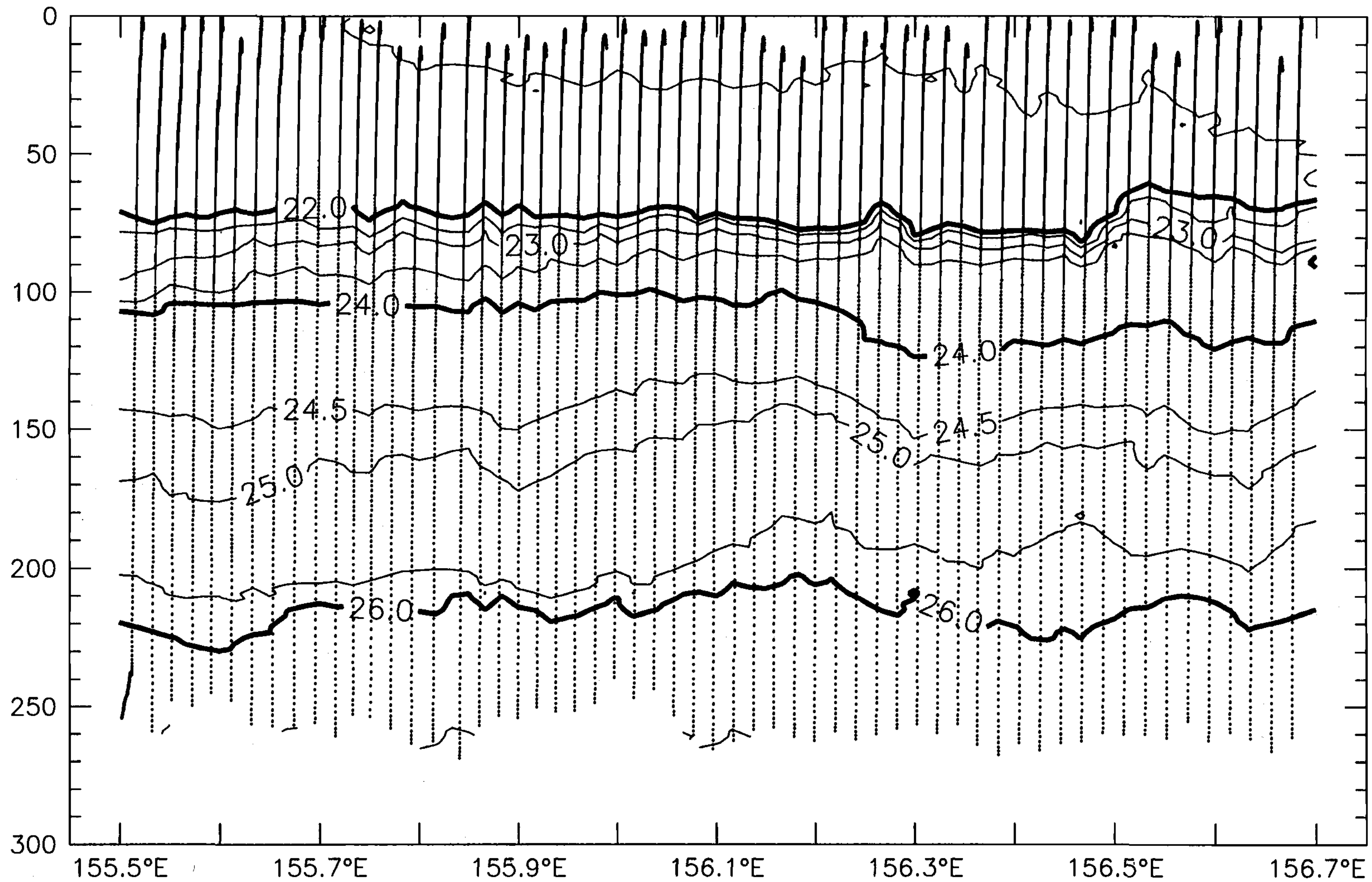
Sigma–t, W2E, 24 December 1992



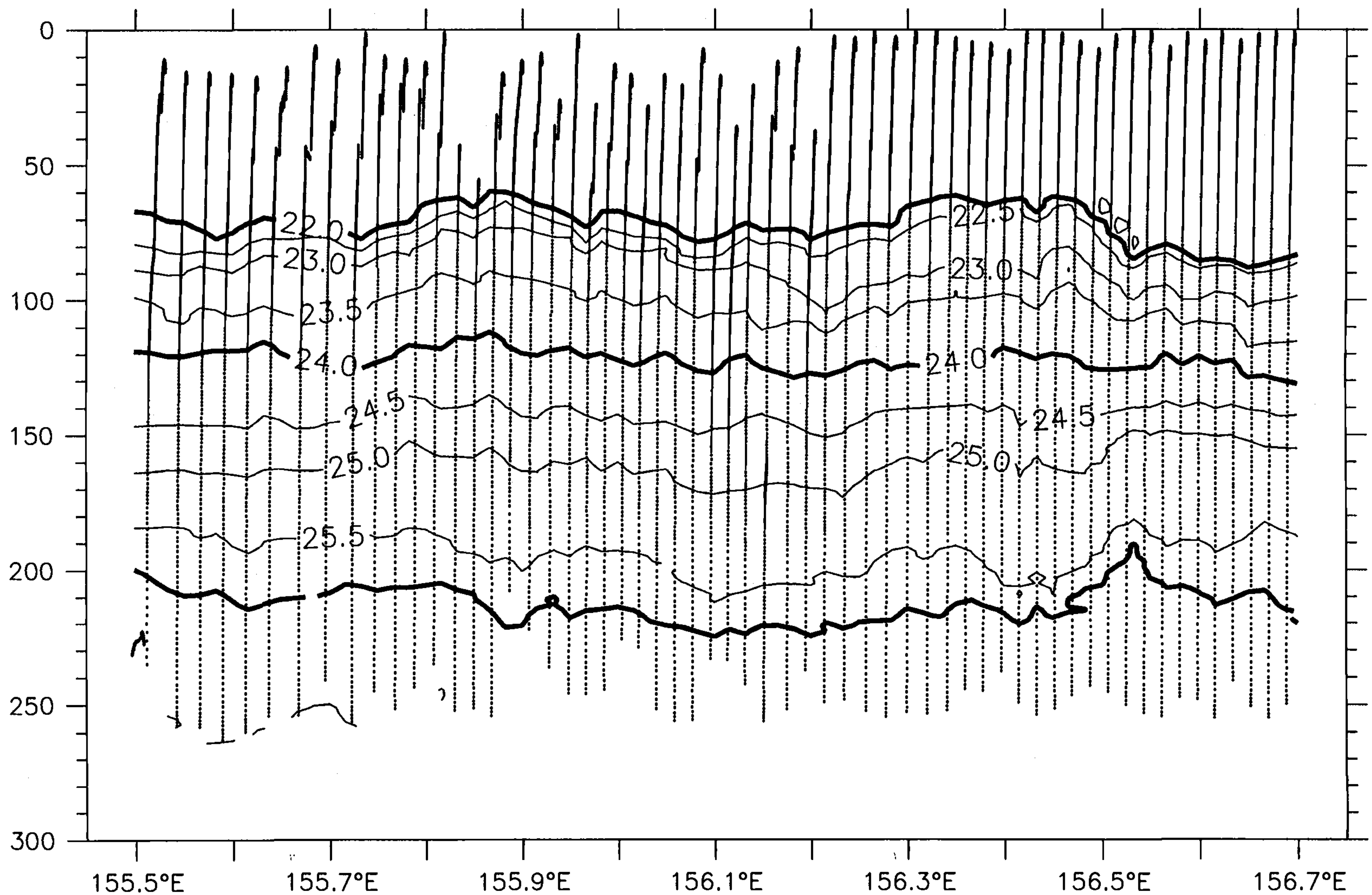
Sigma–t, W2E, 26 December 1992



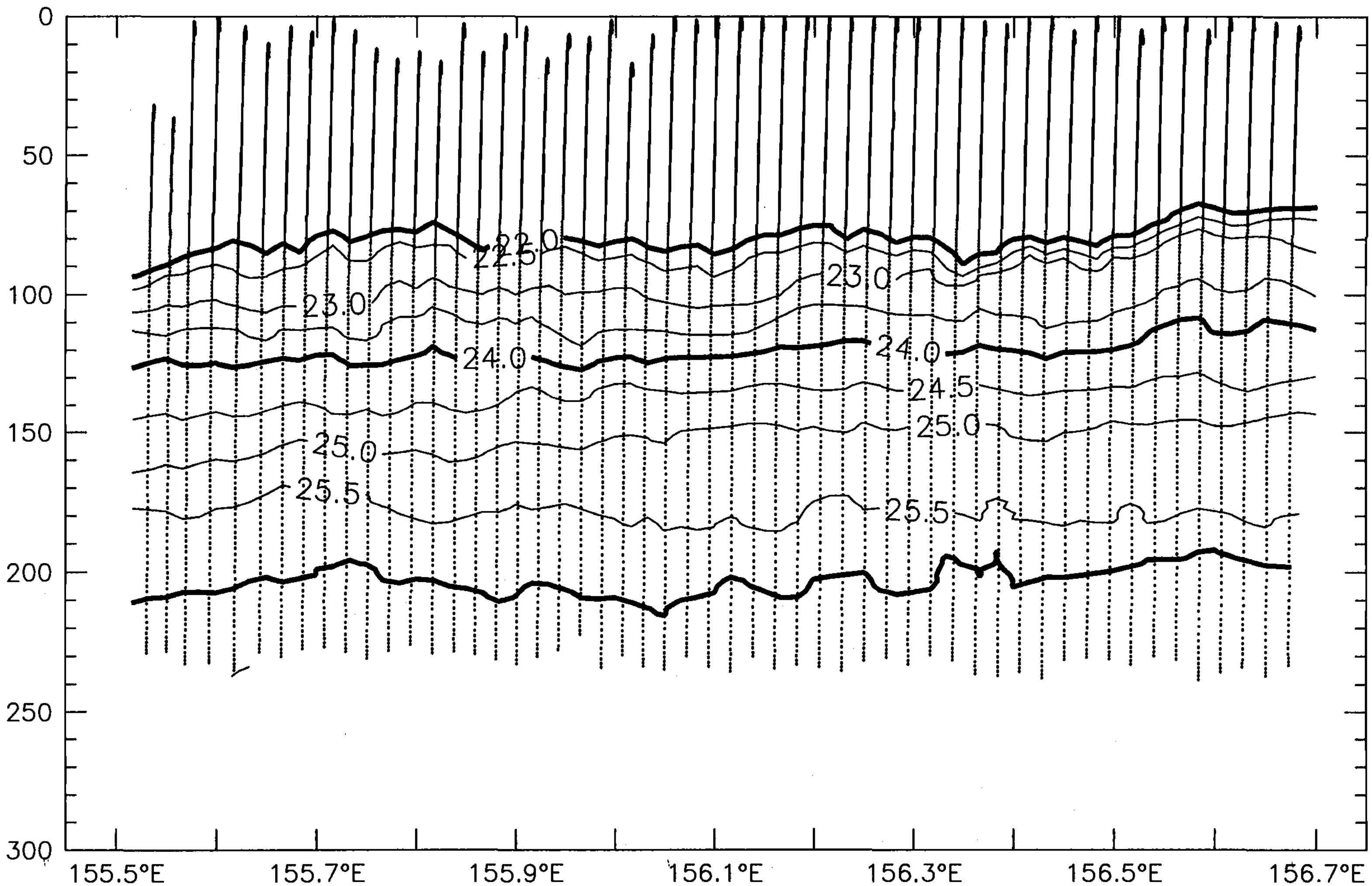
Sigma-t, W2E, 28 December 1992



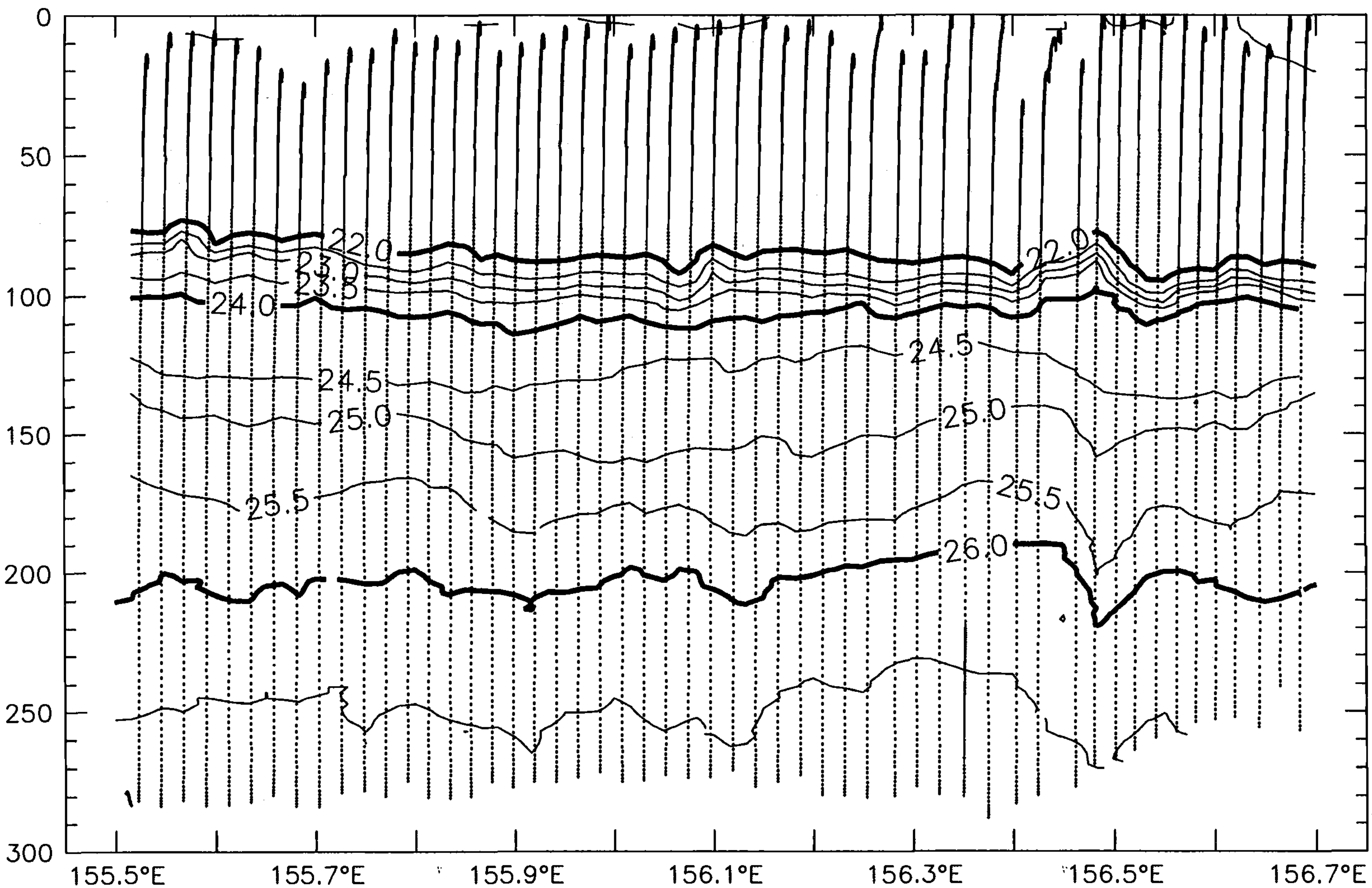
Sigma–t, W2E, 30 December 1992



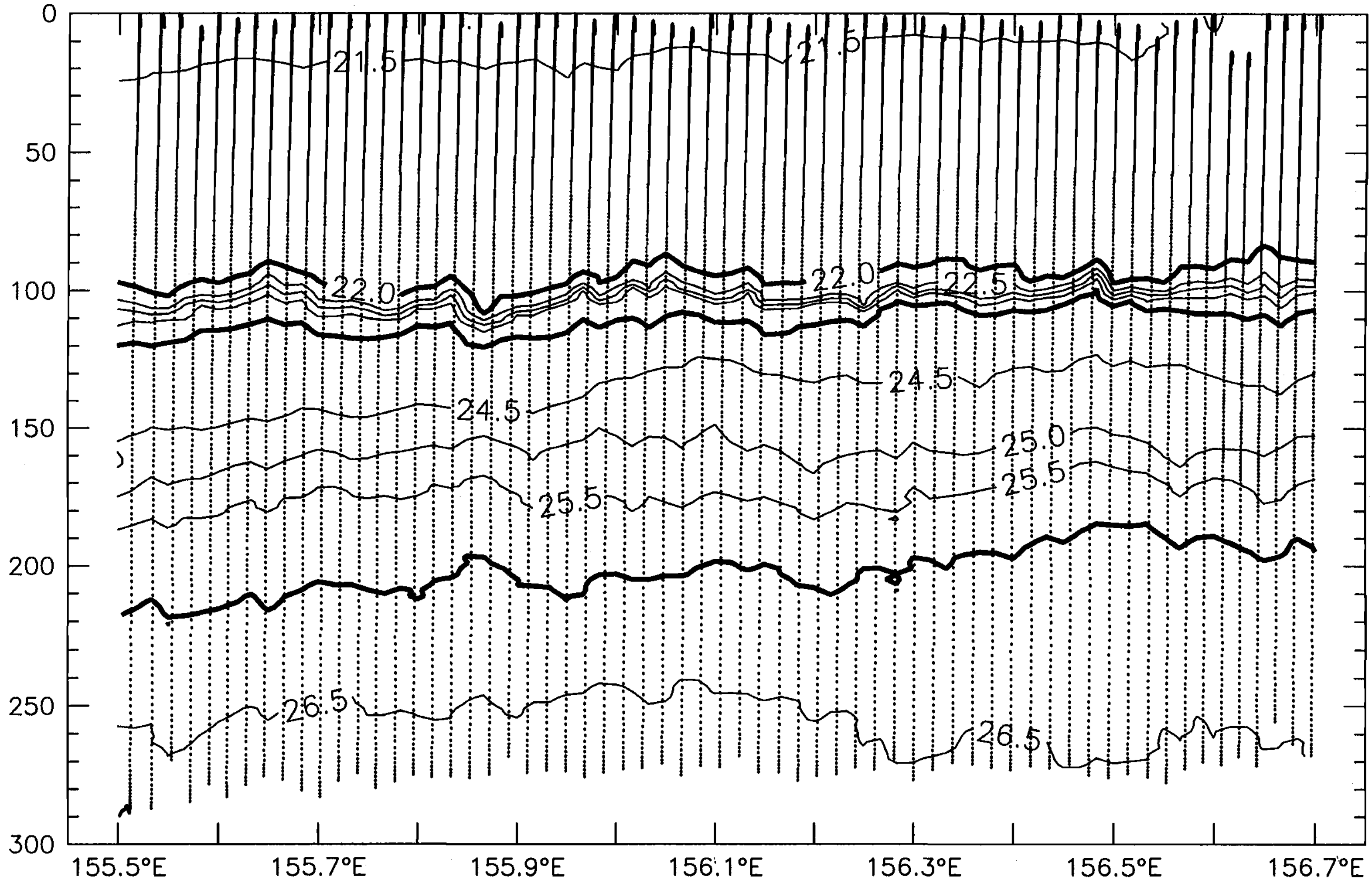
Sigma-t, W2E, 31 December 1992



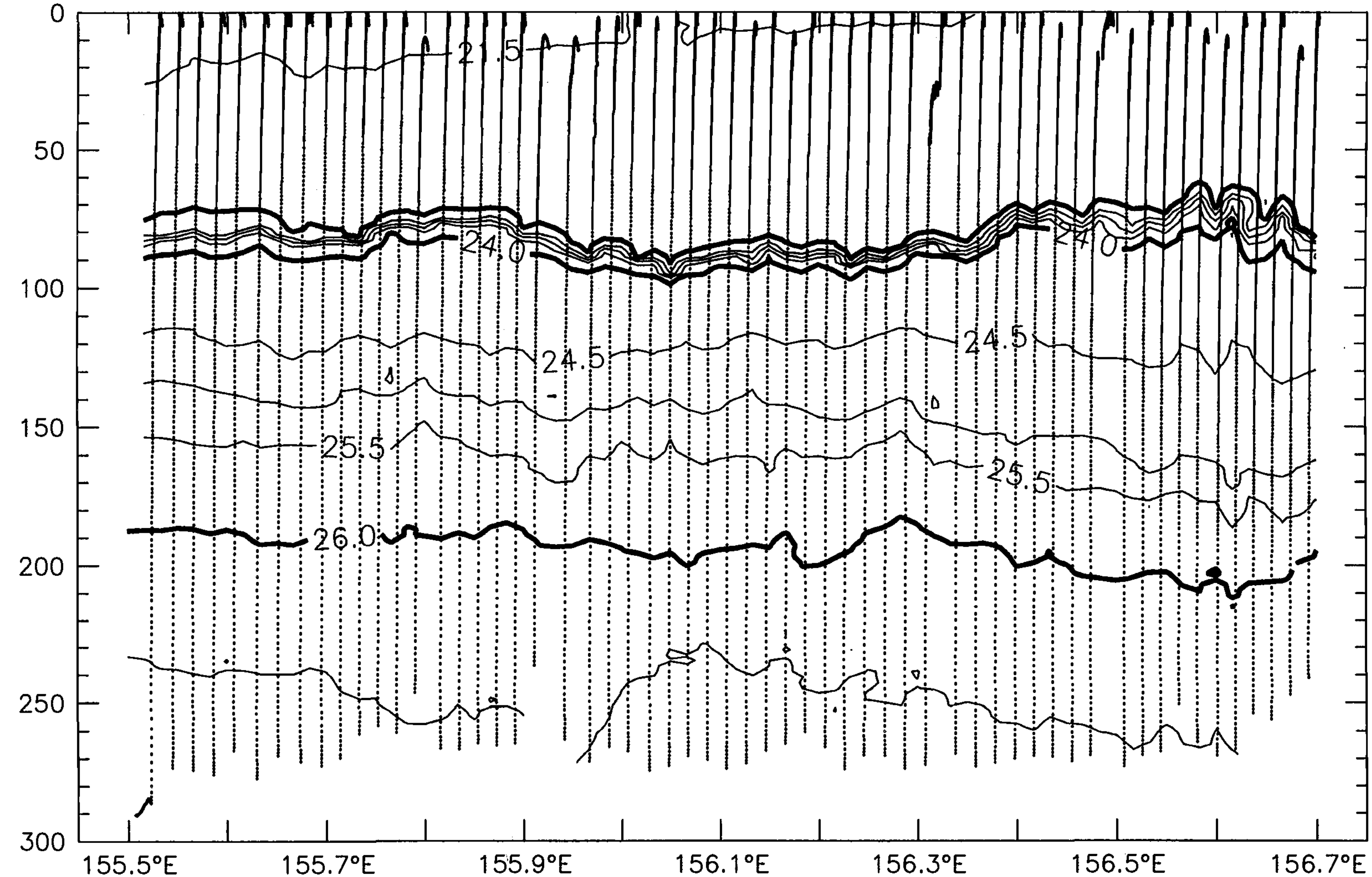
Sigma−t, W2E, 1 January 1993



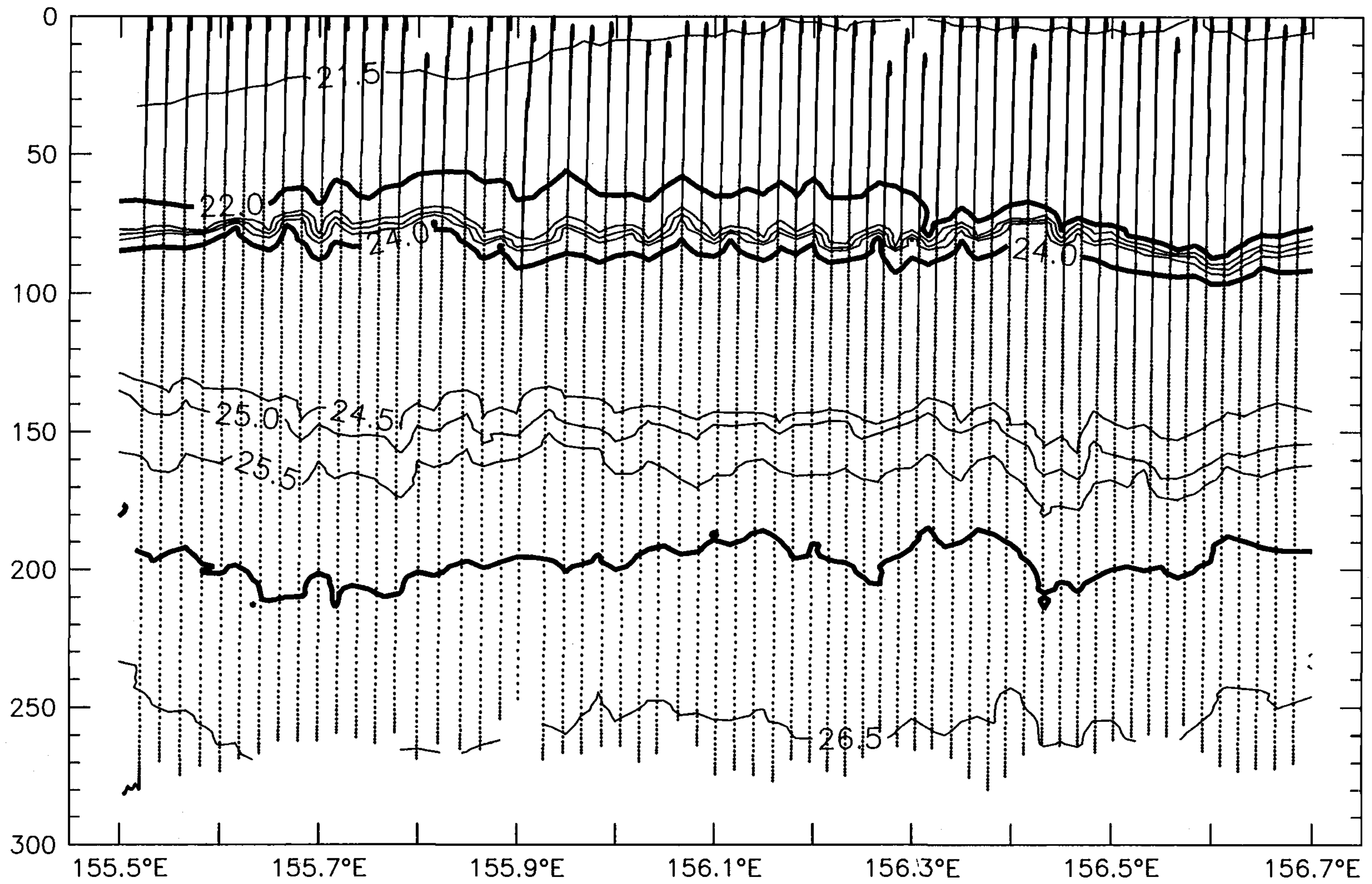
Sigma–t, W2E, 4 January 1993



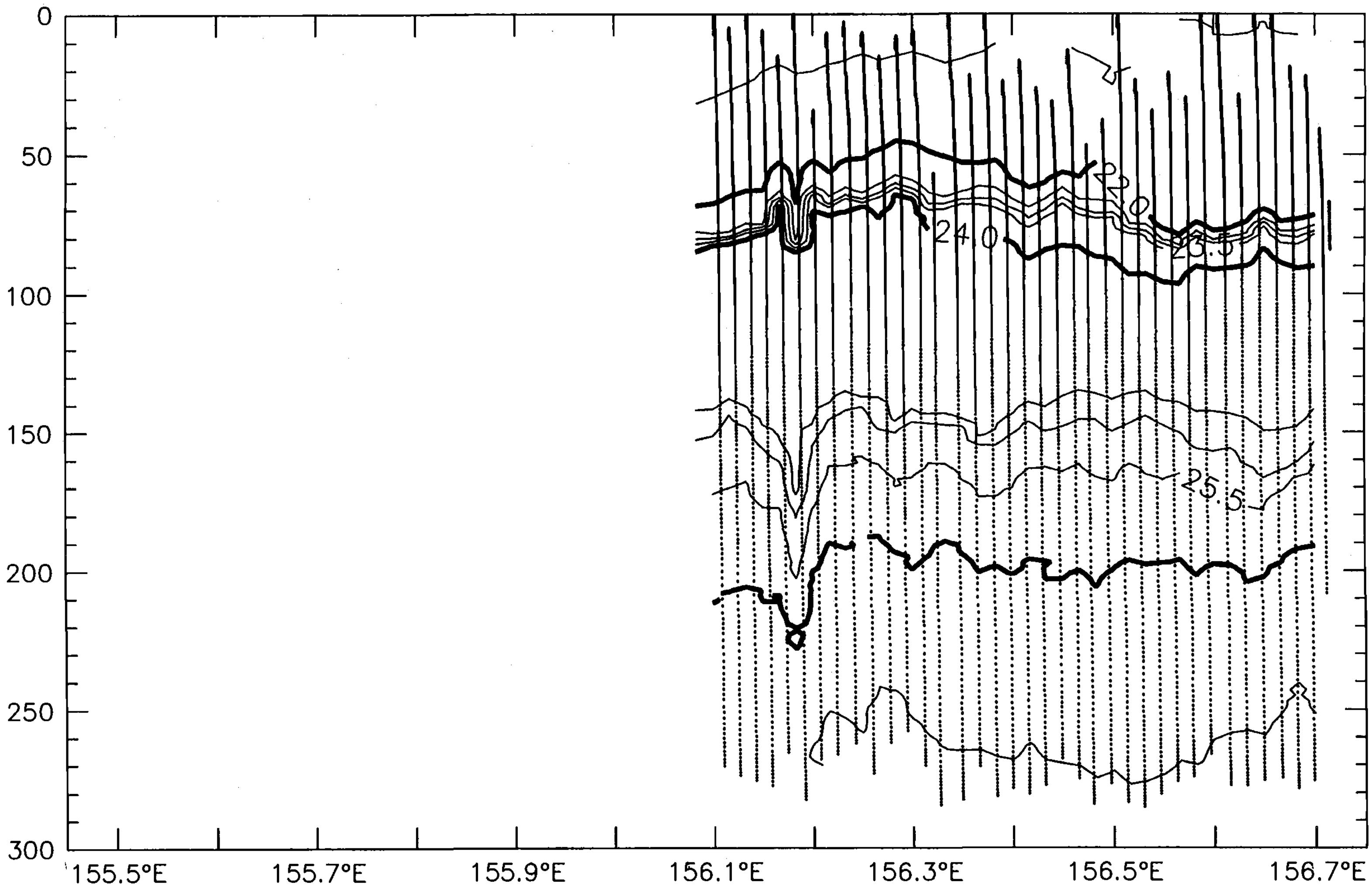
Sigma–t, W2E, 6 January 1993



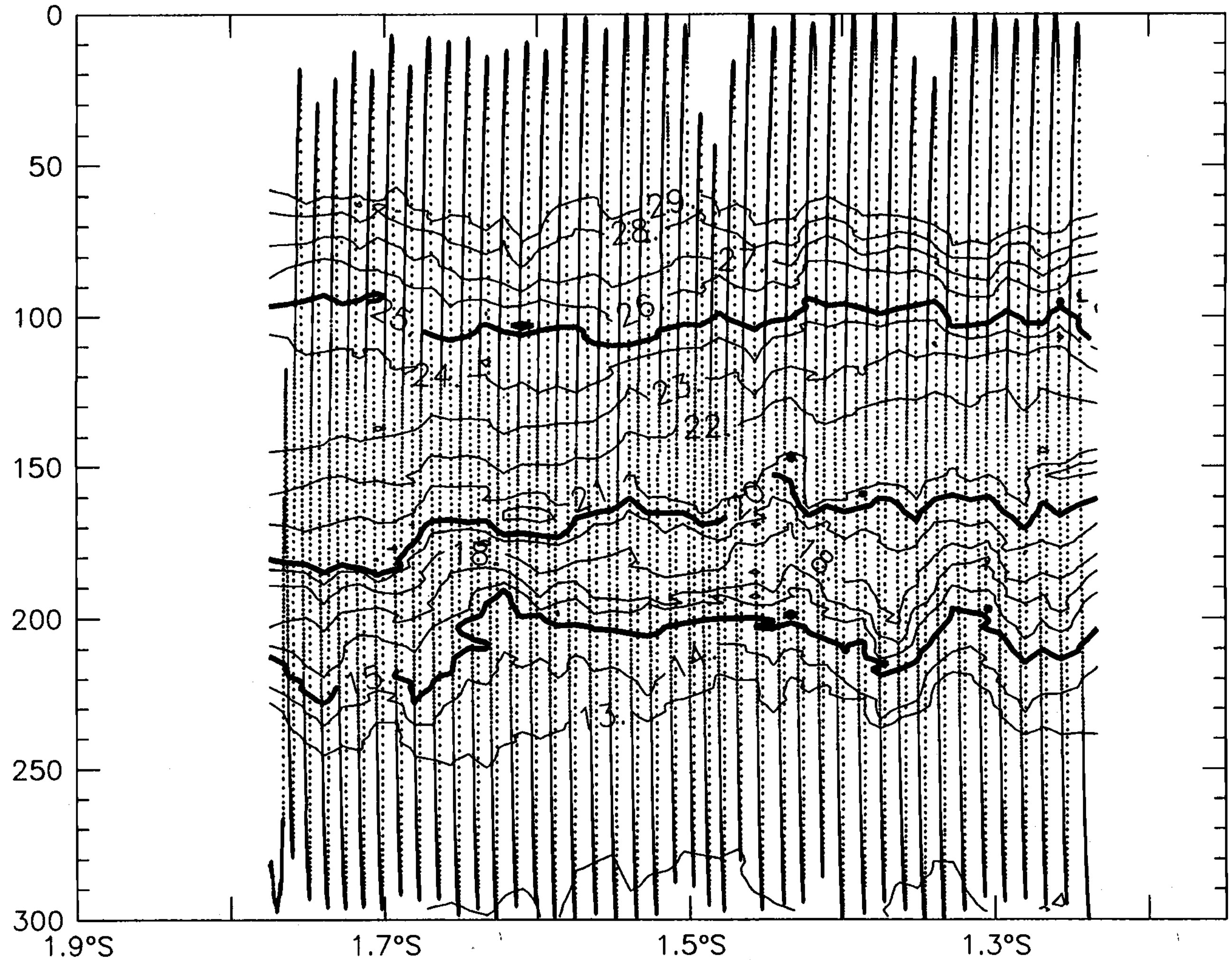
Sigma–t, W2E, 7 January 1993



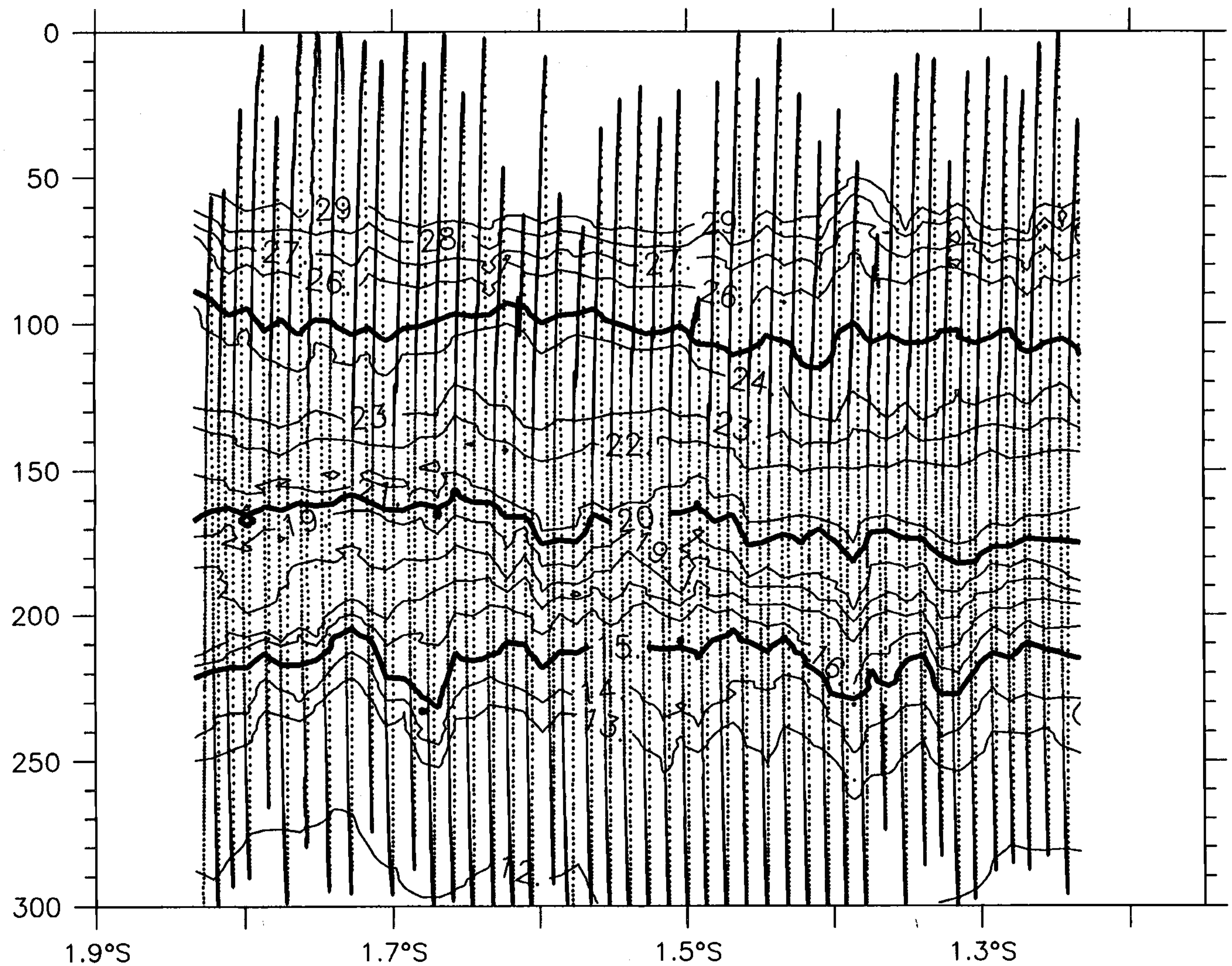
Sigma–t, W2E, 9 January 1993



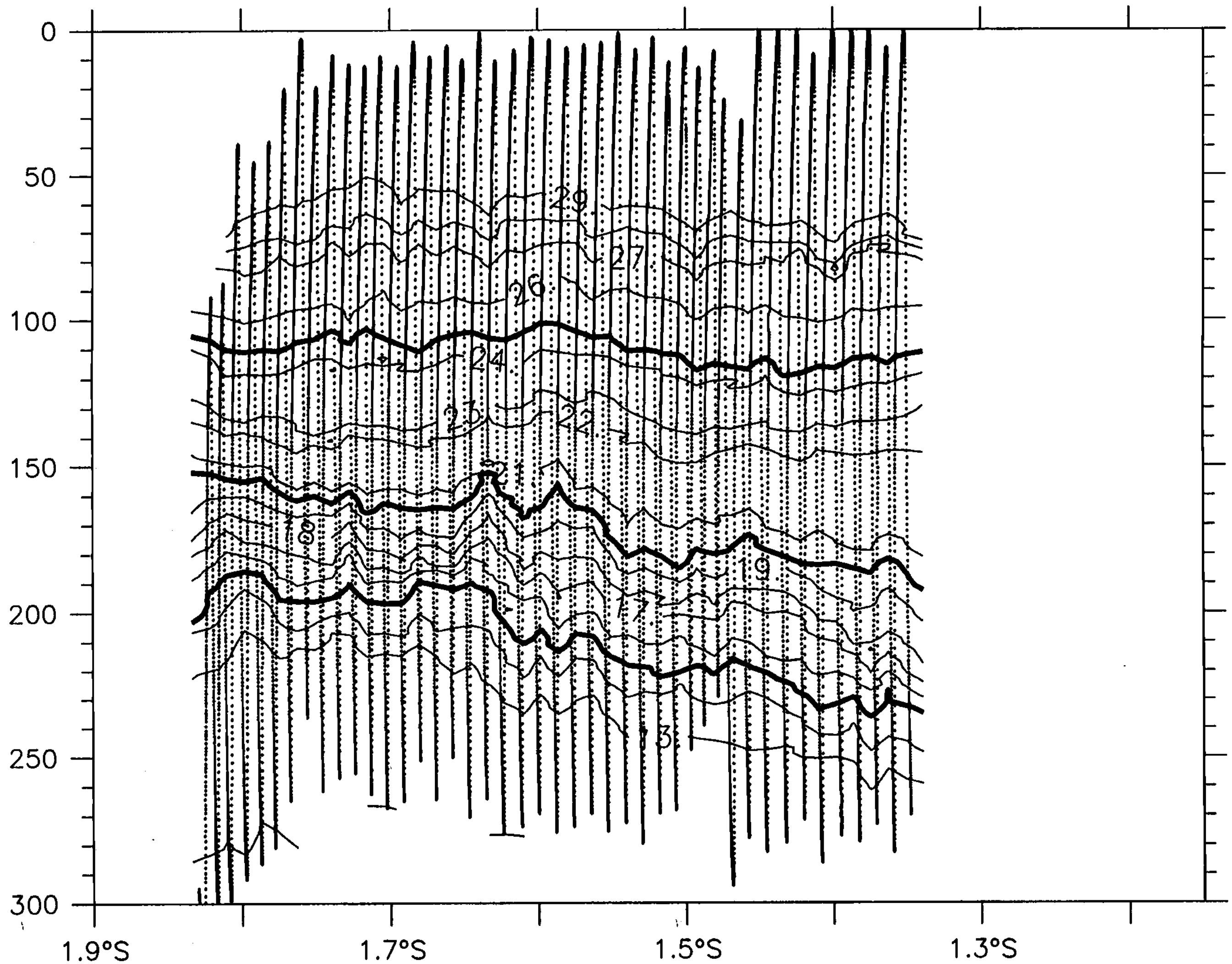
Sigma–t, W2E, 10 January 1993



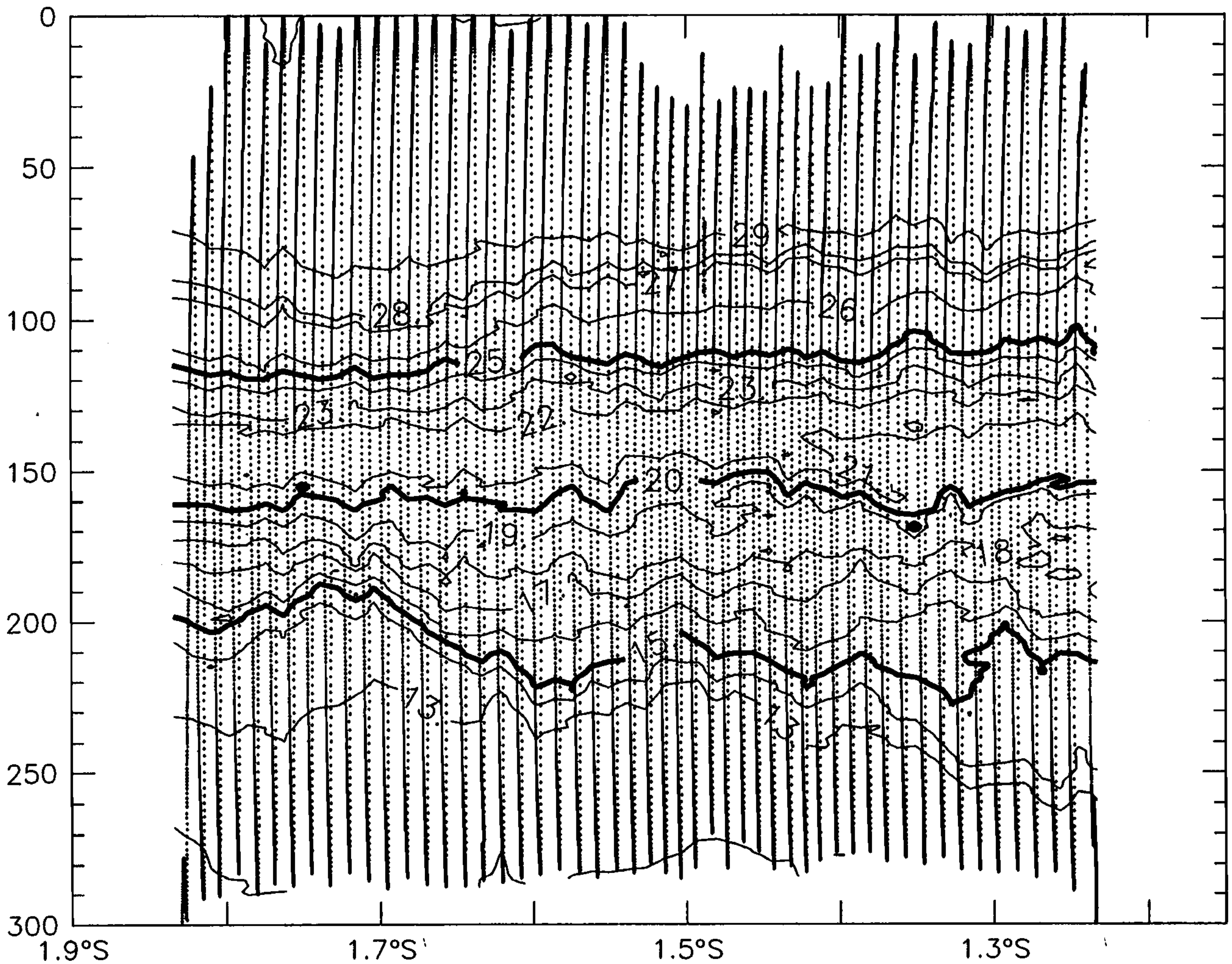
T(°C), E2N, 20 December 1992



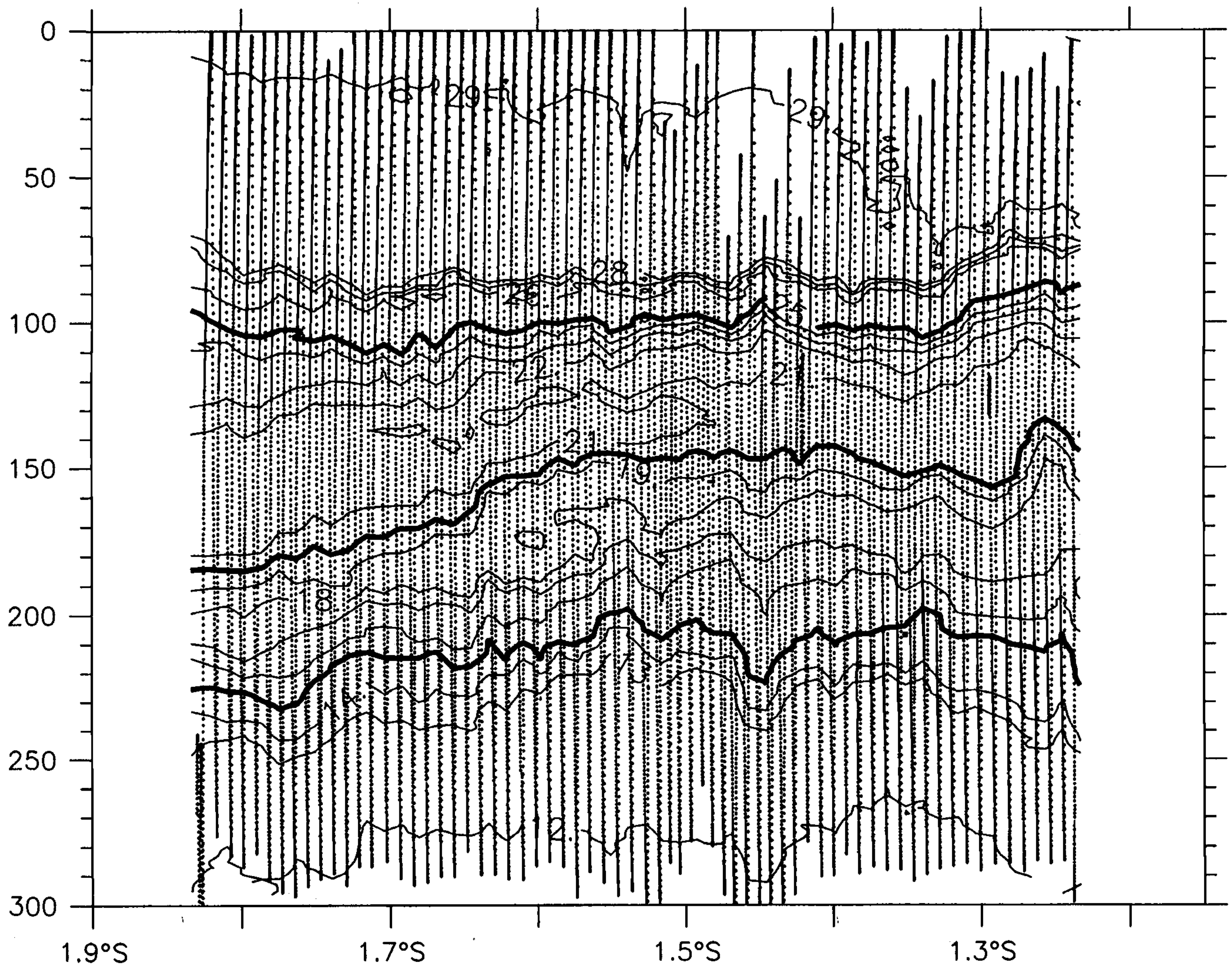
T(°C), E2N, 21 December 1992



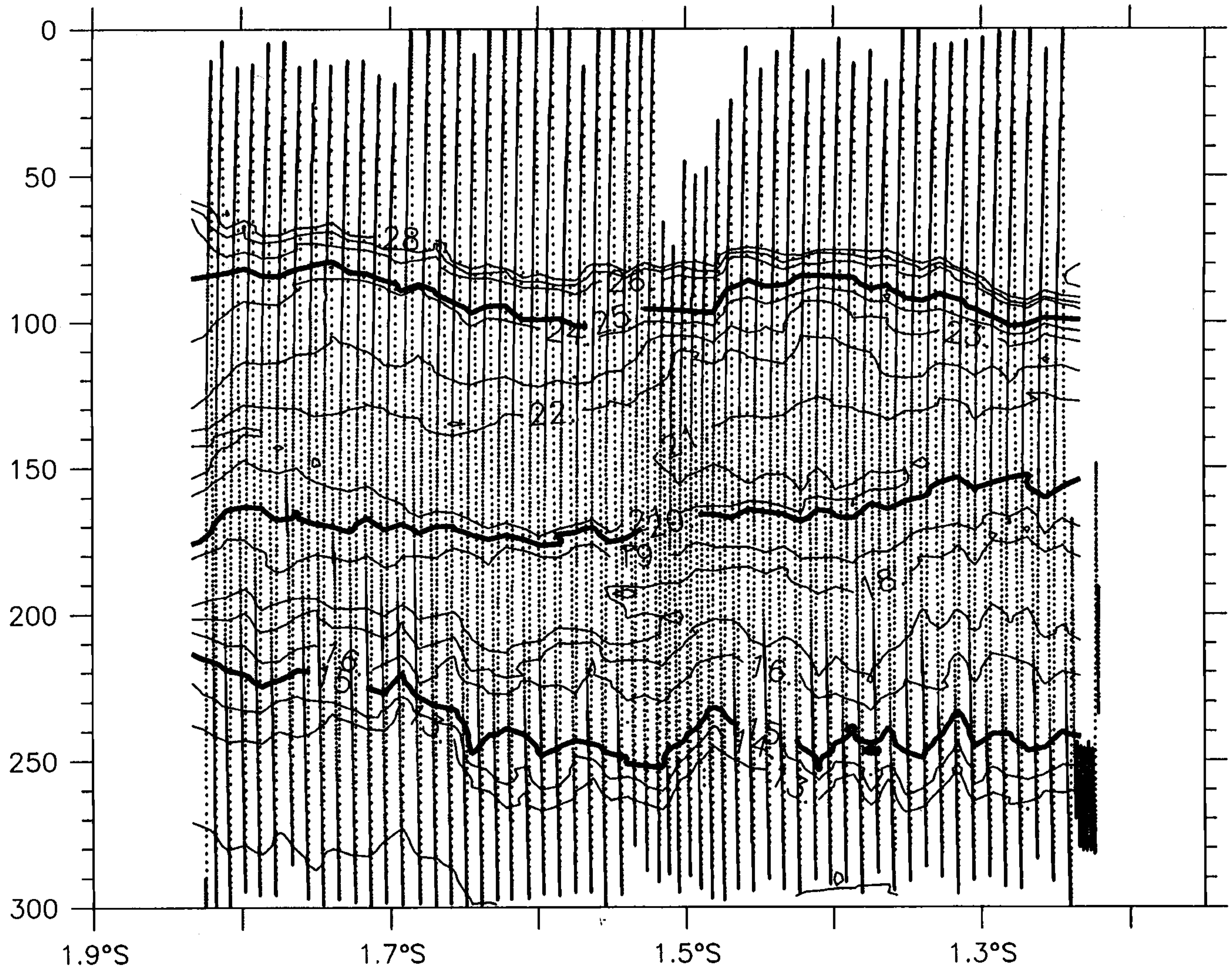
T(°C), E2N, 23 December 1992



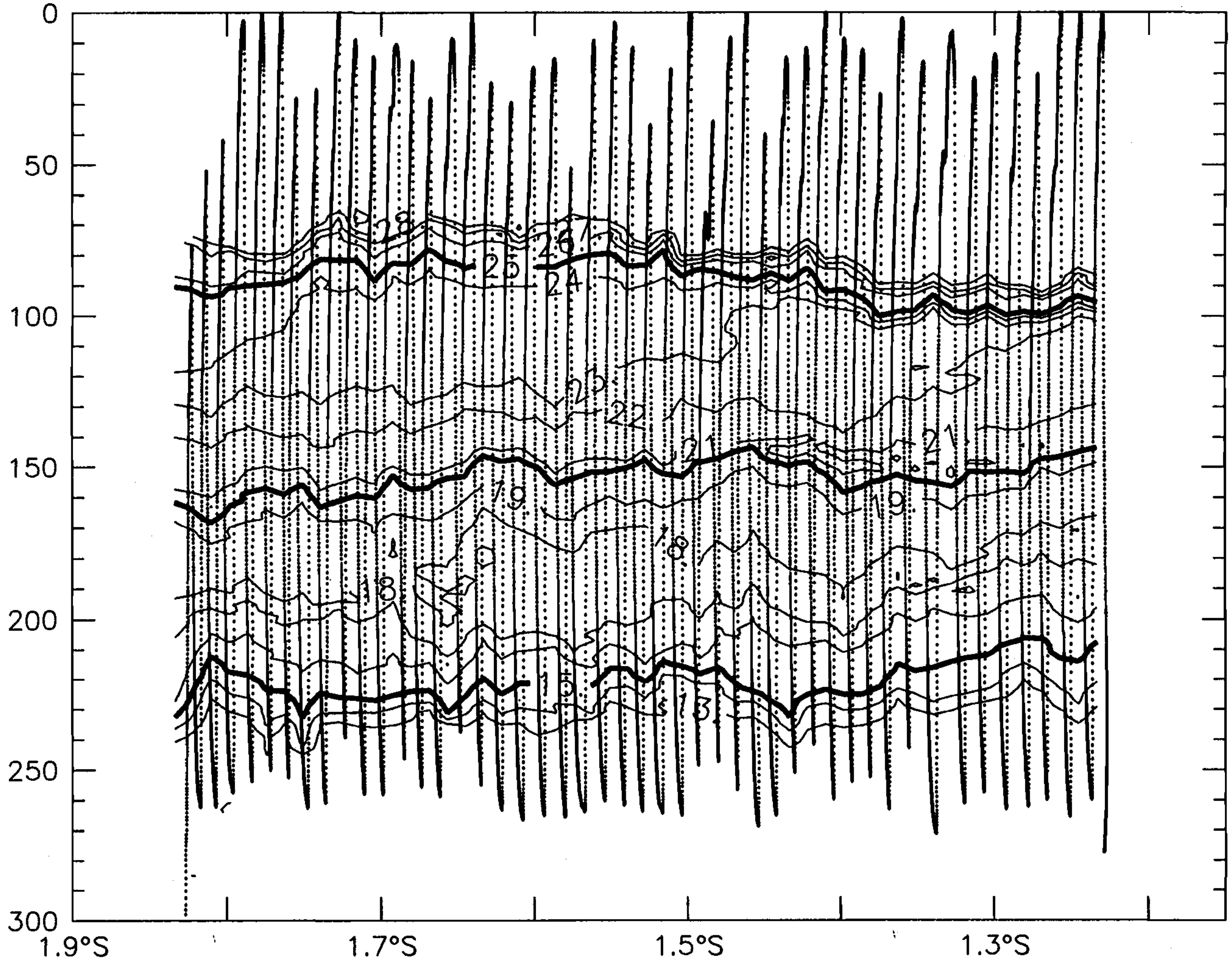
T(°C), E2N, 25 December 1992



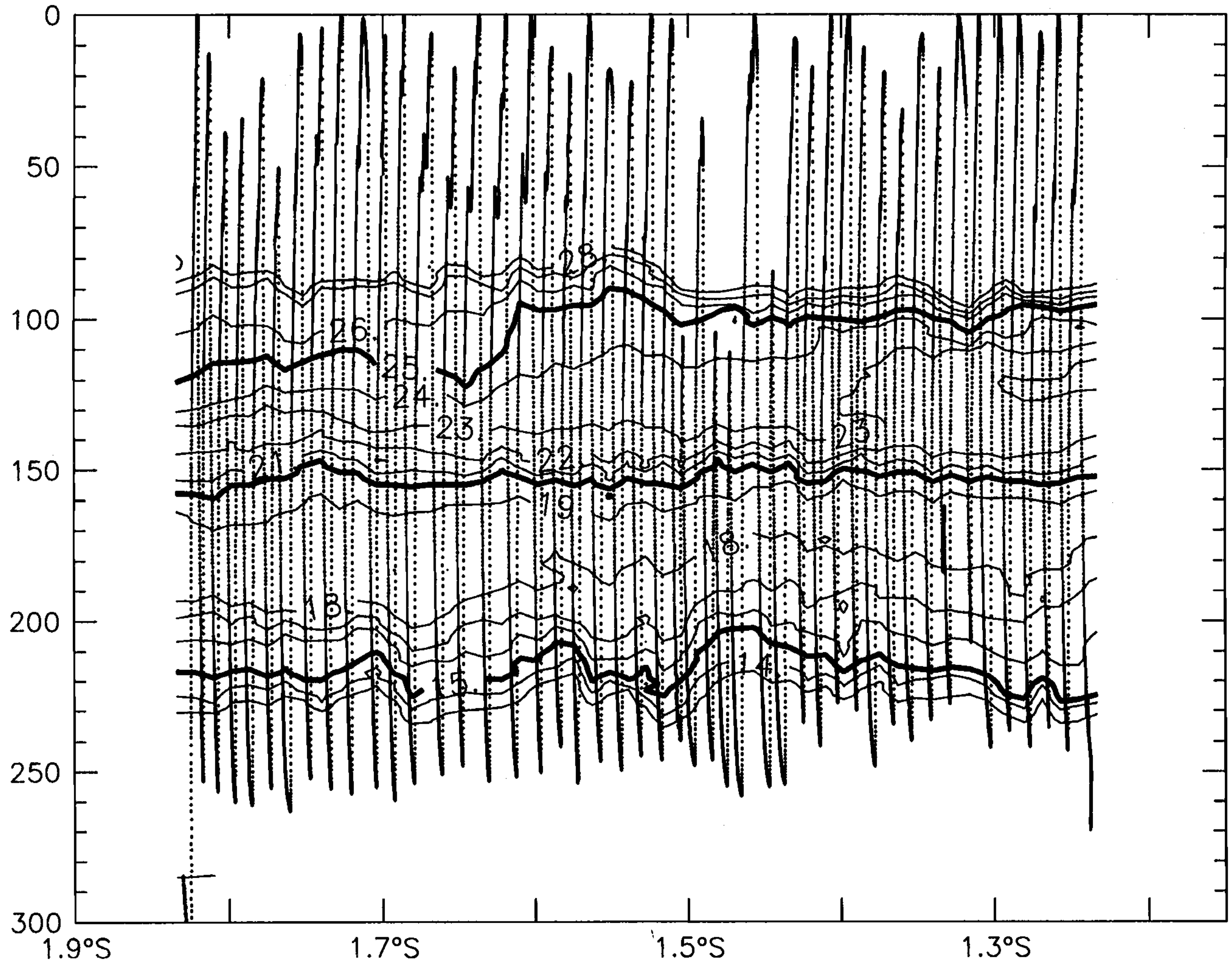
T(°C), E2N, 27 December 1992



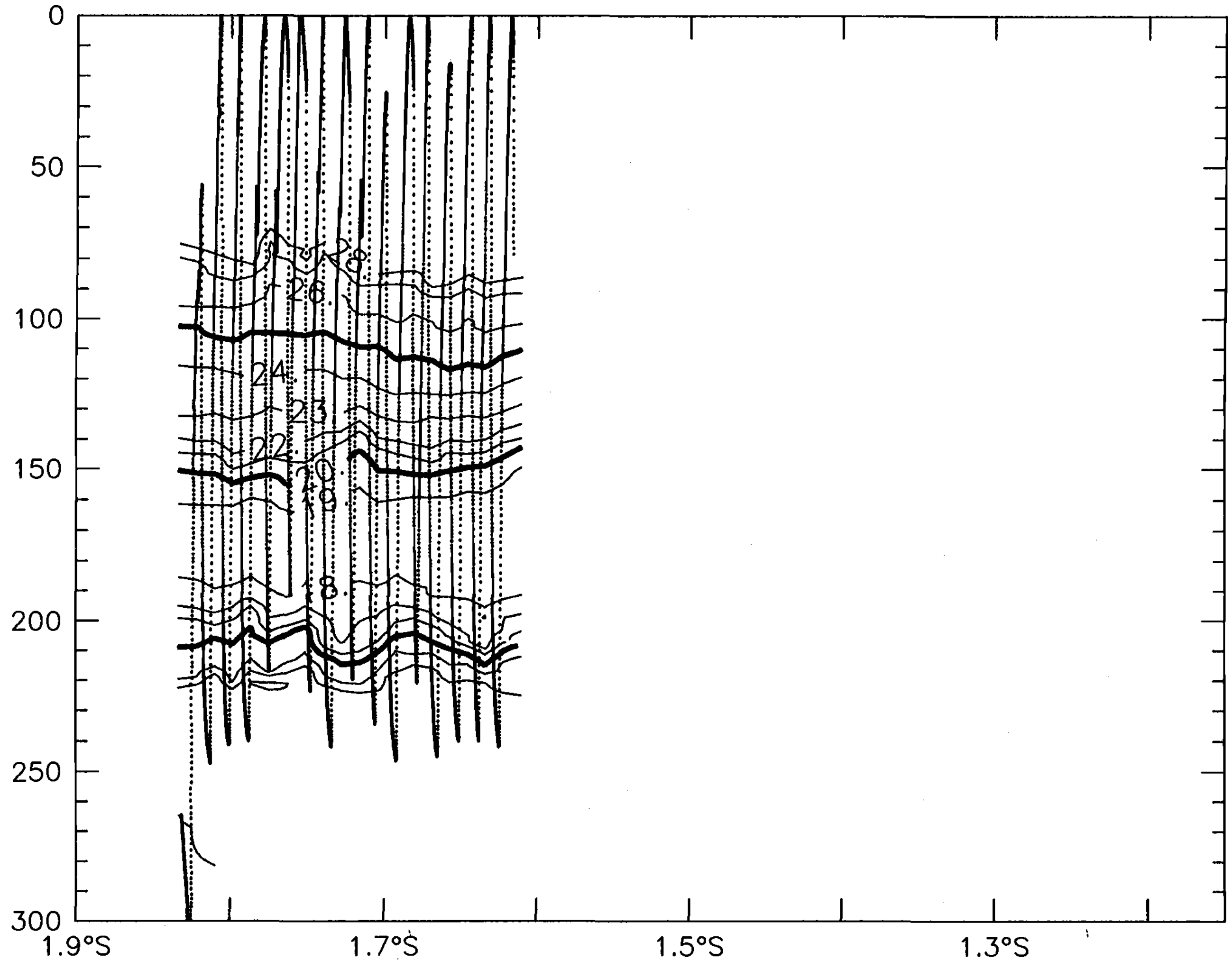
T(°C), E2N, 28 December 1992



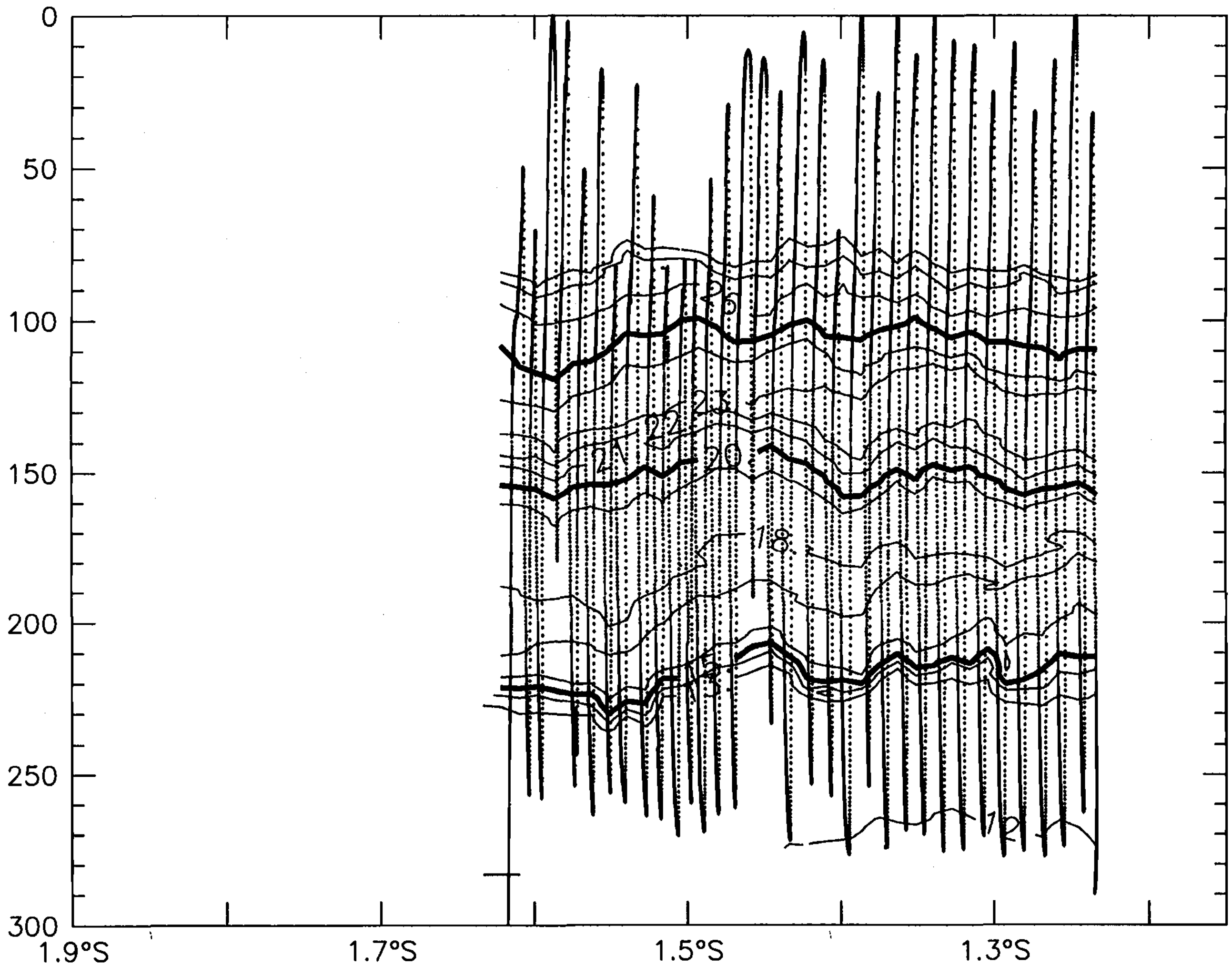
T(°C), E2N, 30 December 1992



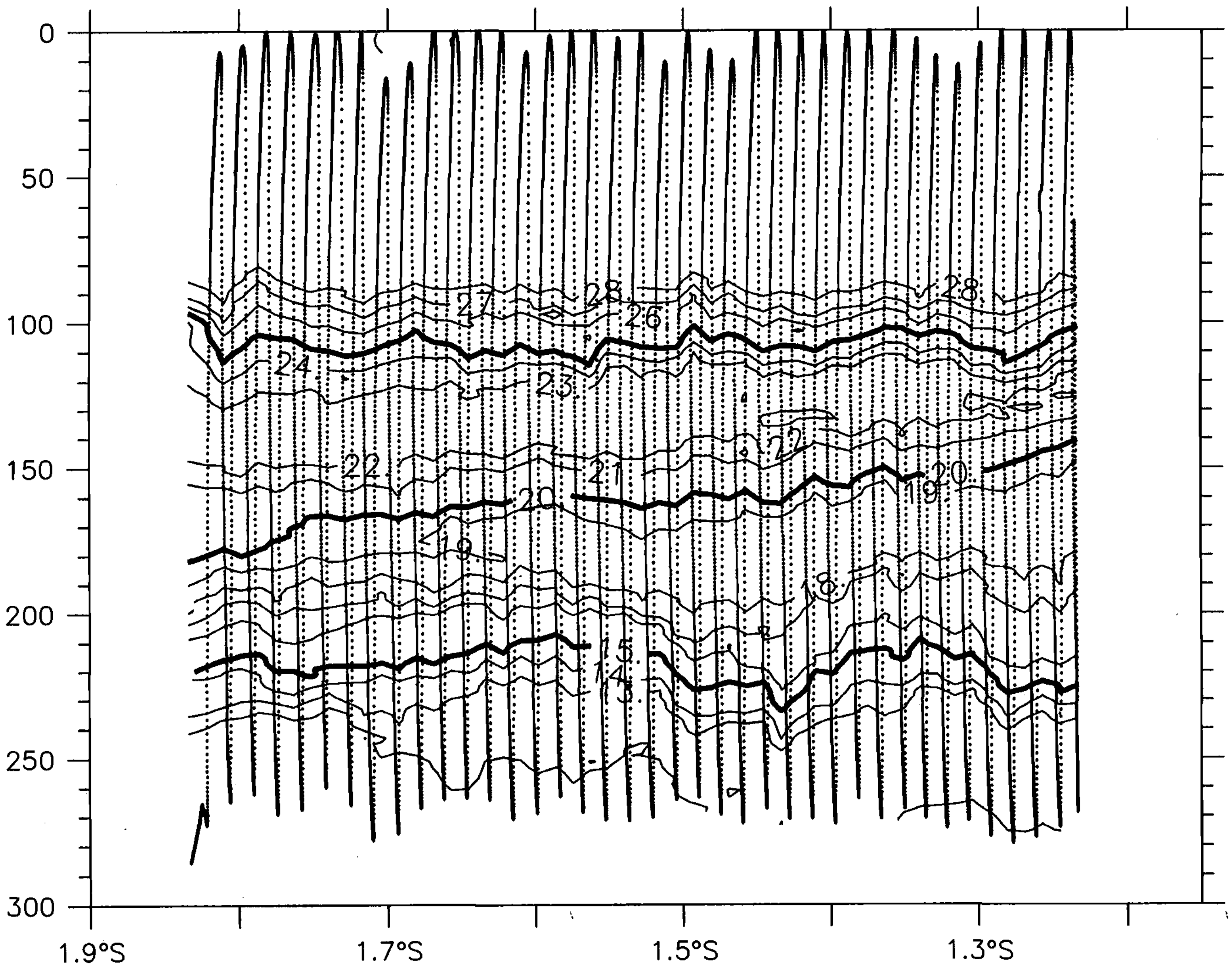
T(°C), E2N, 31 December 1992



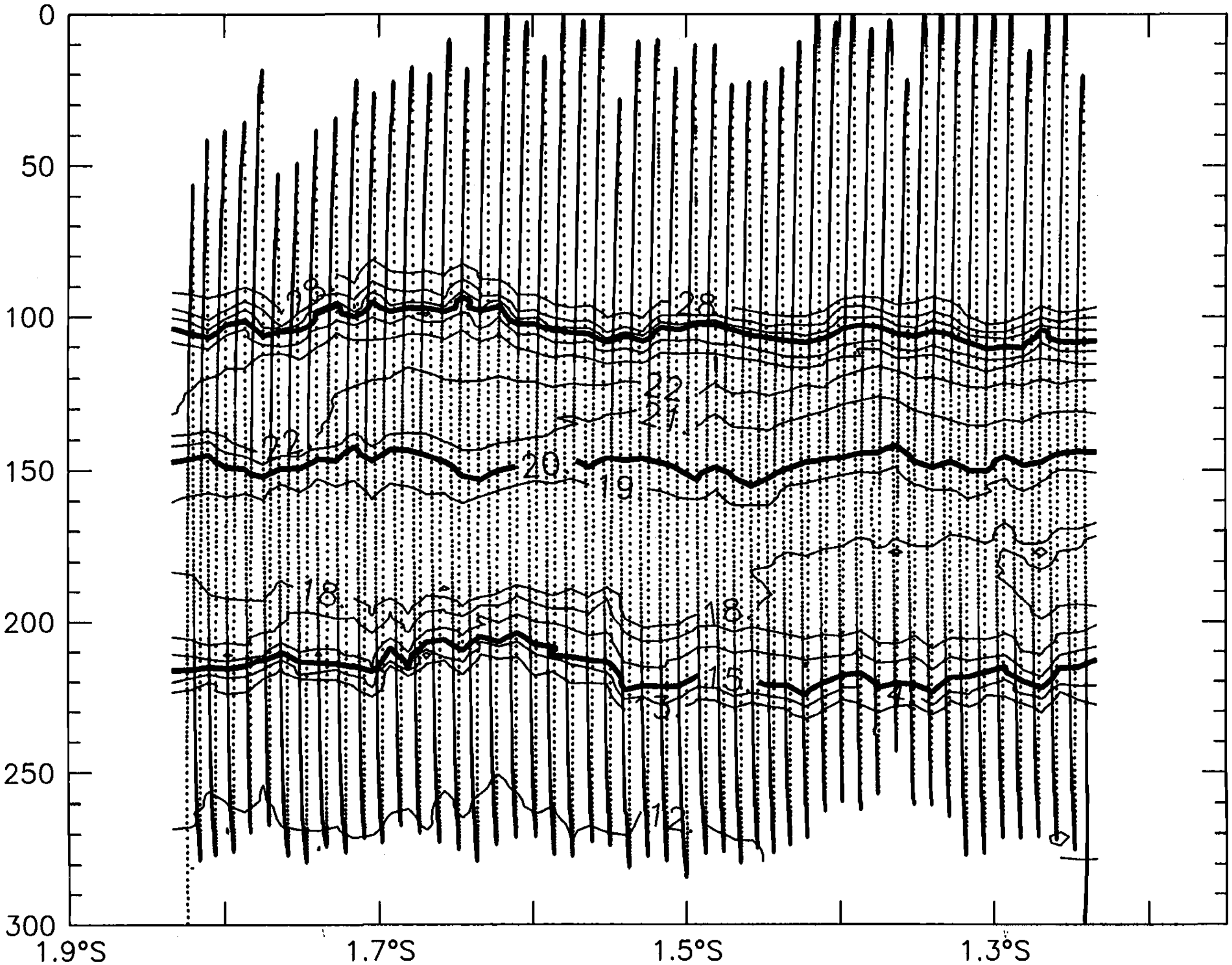
T(°C), E2N, 2 January 1993



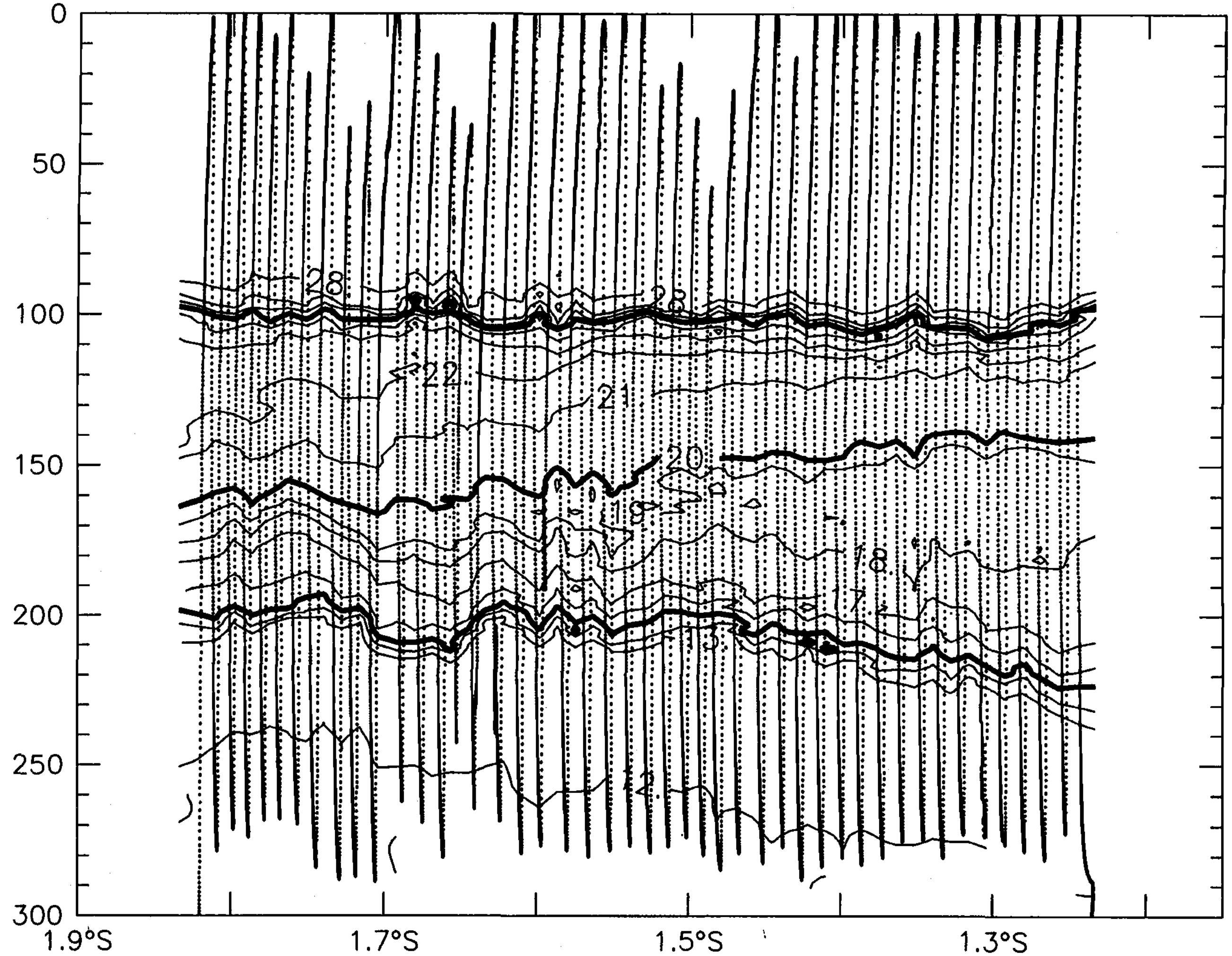
T(°C), E2N, 2 January 1993



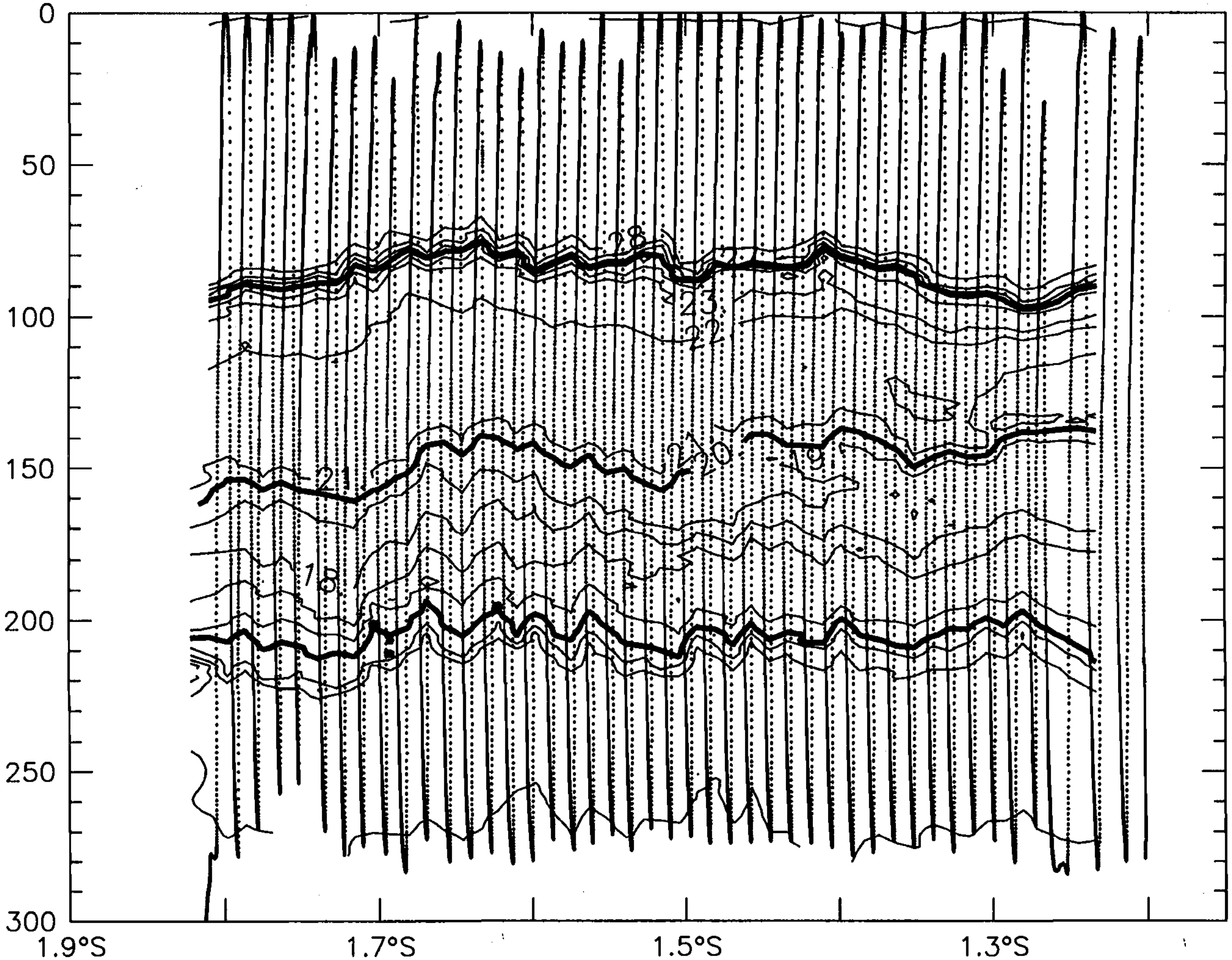
T(°C), W2N, 3 January 1993



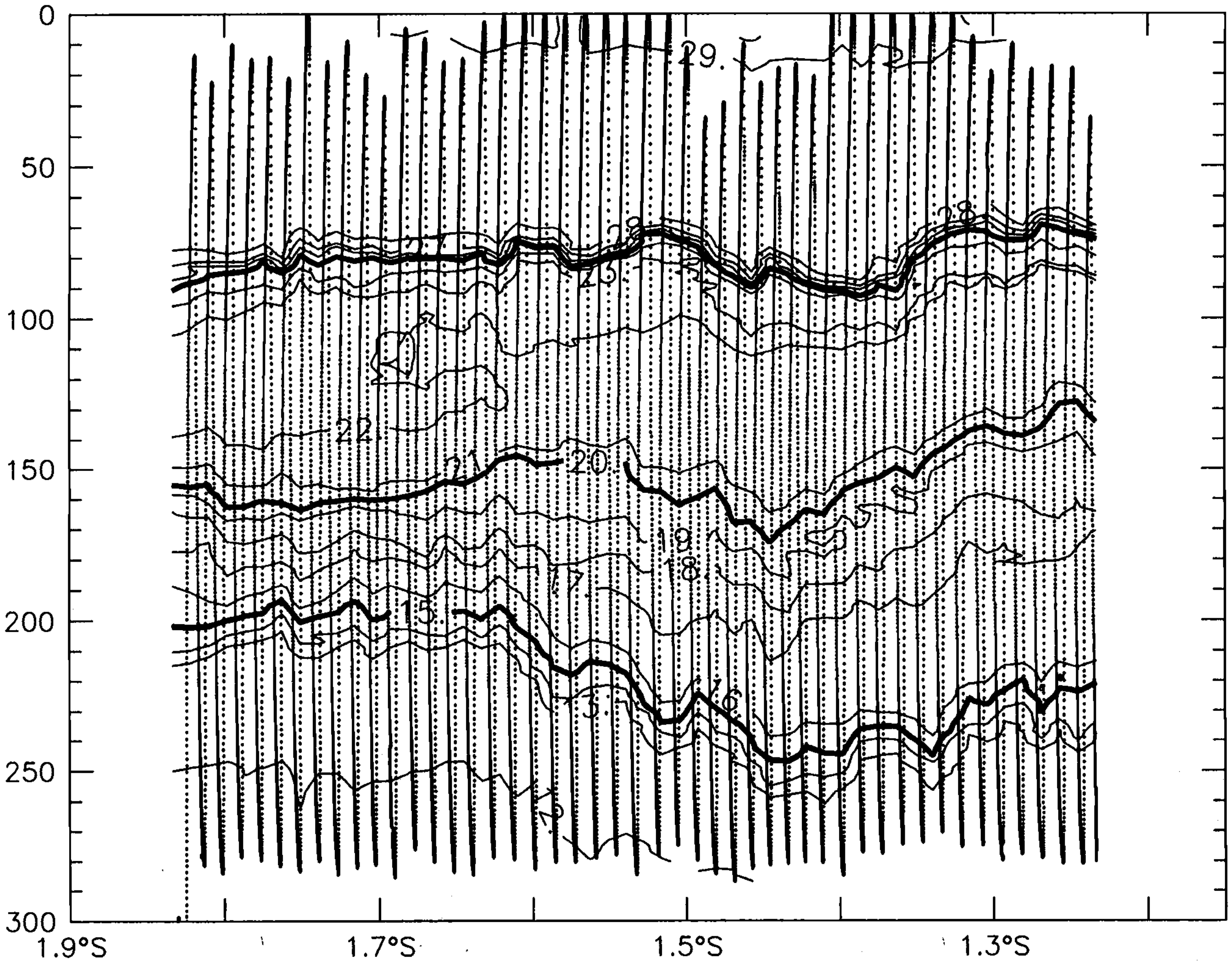
T(°C), E2N, 5 January 1993



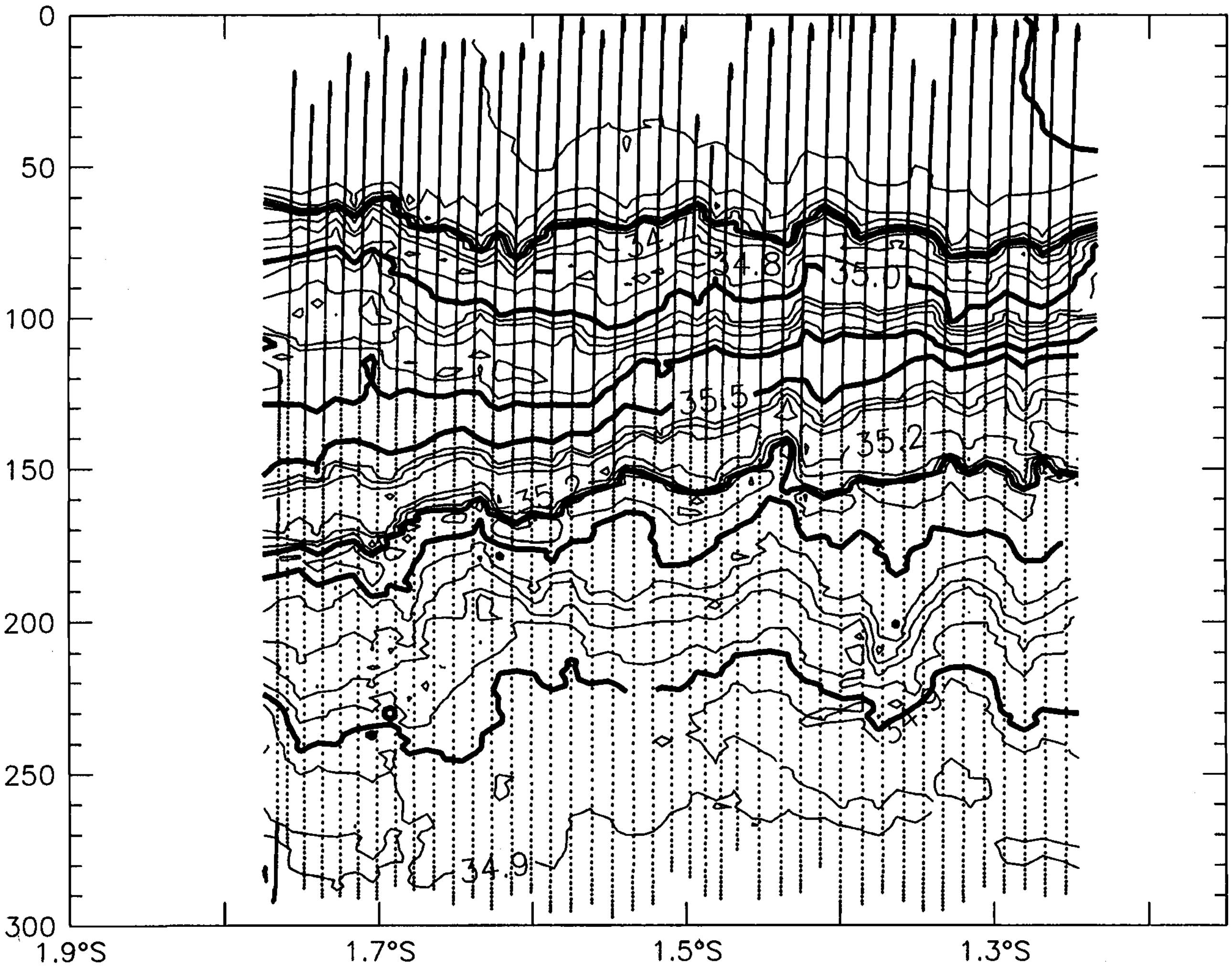
T(°C), E2N, 6 January 1992



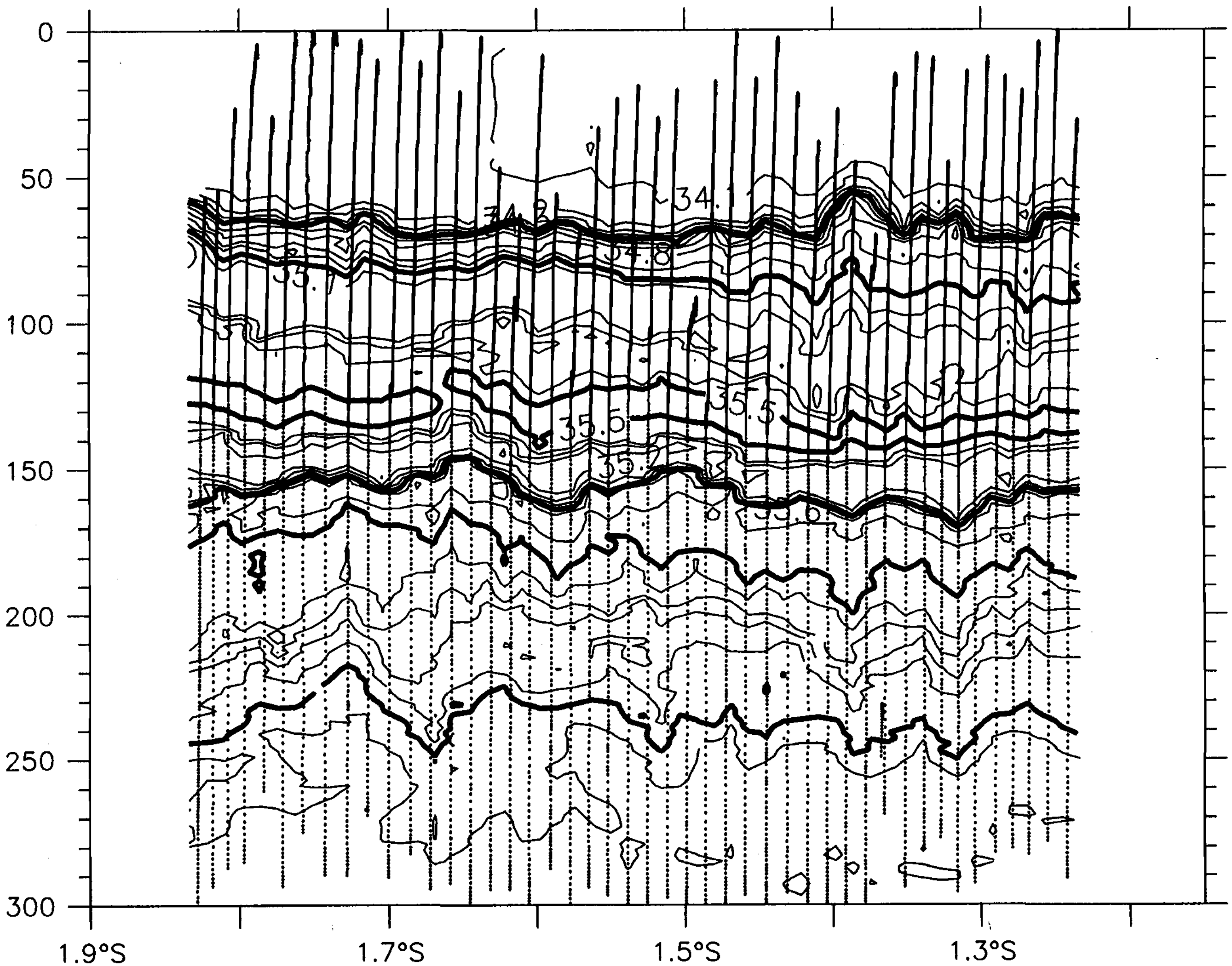
T(°C), E2N, 8 January 1993



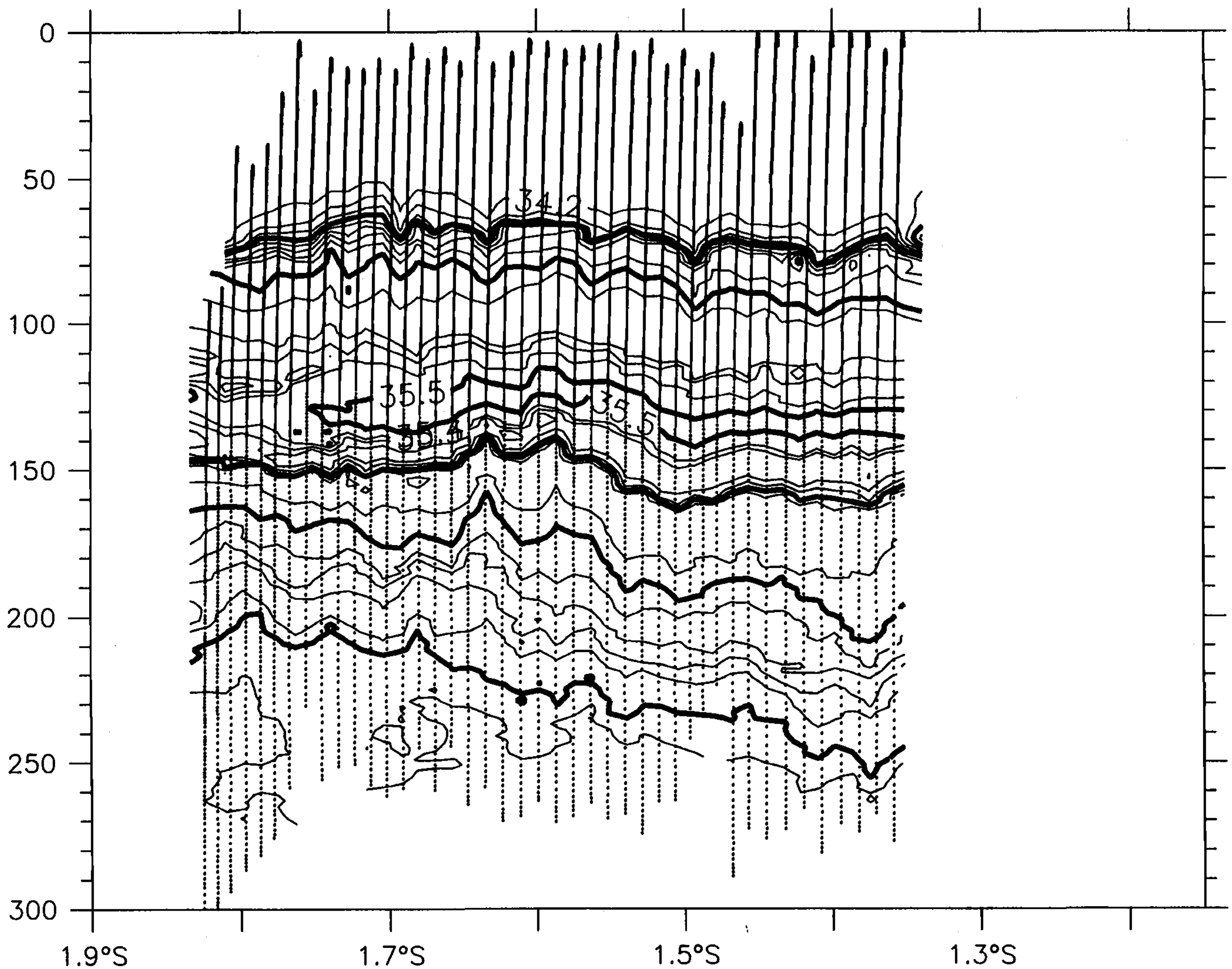
T(°C), E2N, 9 January 1993



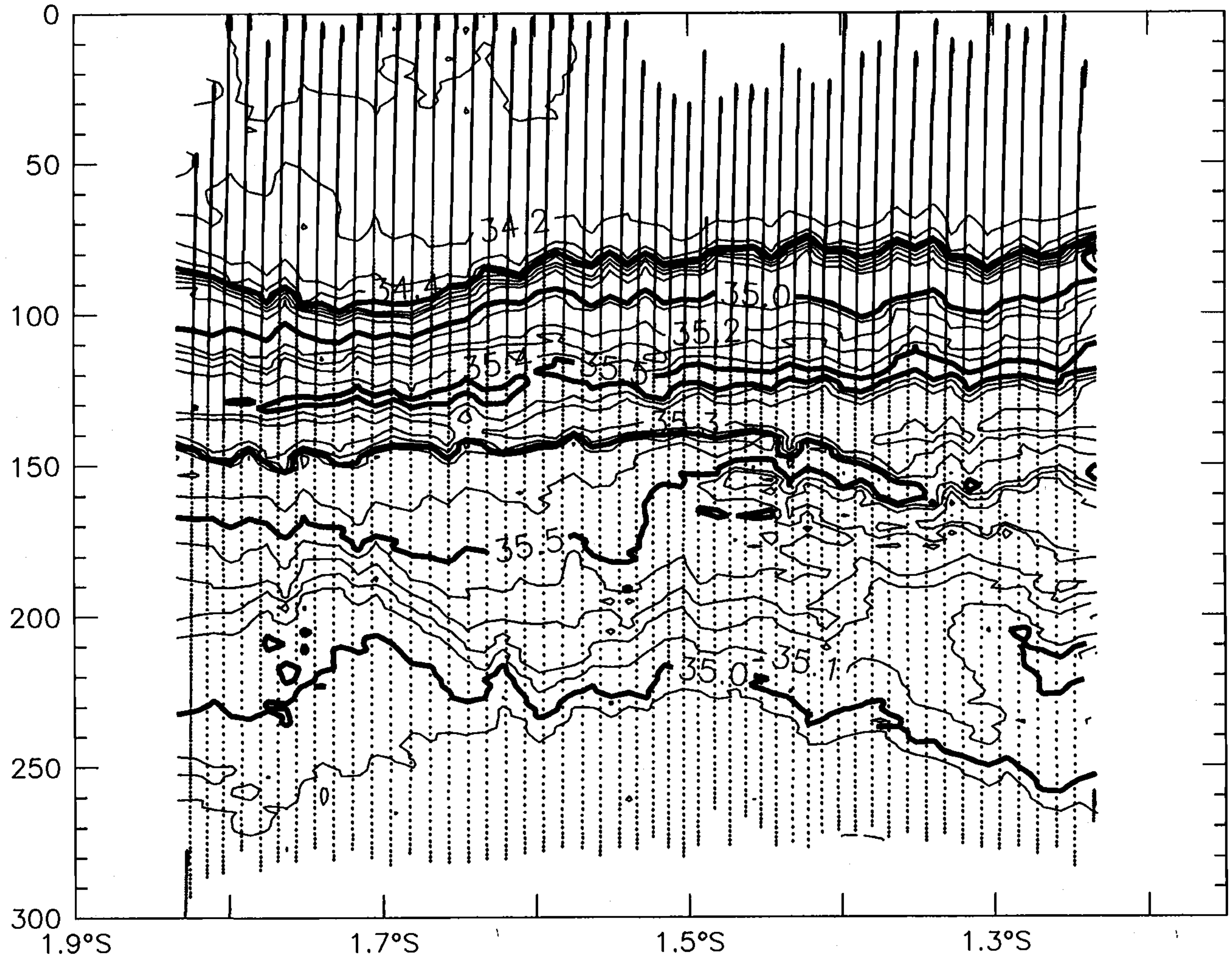
S(psu), E2N, 20 December 1992



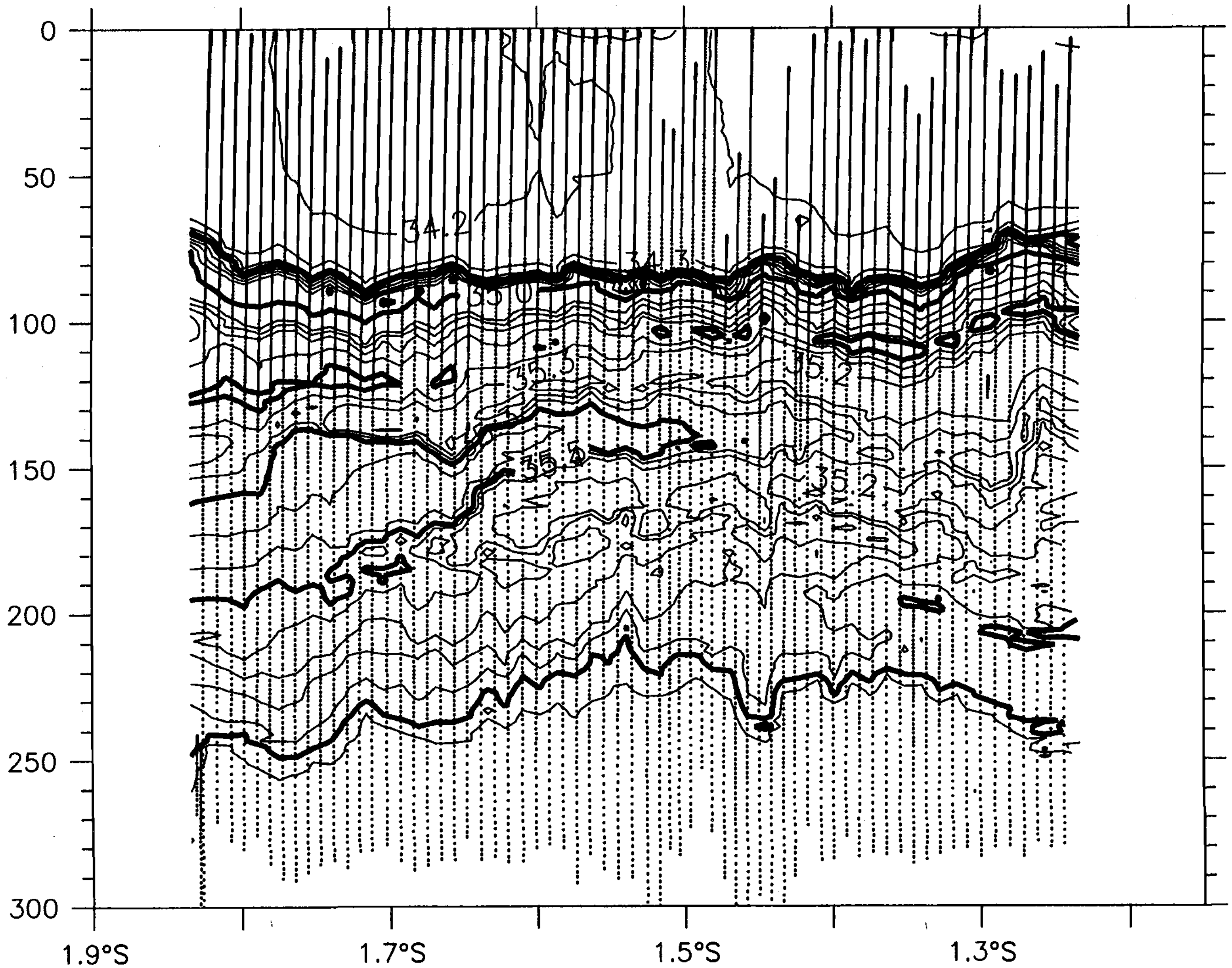
S(psu), E2N, 21 December 1992



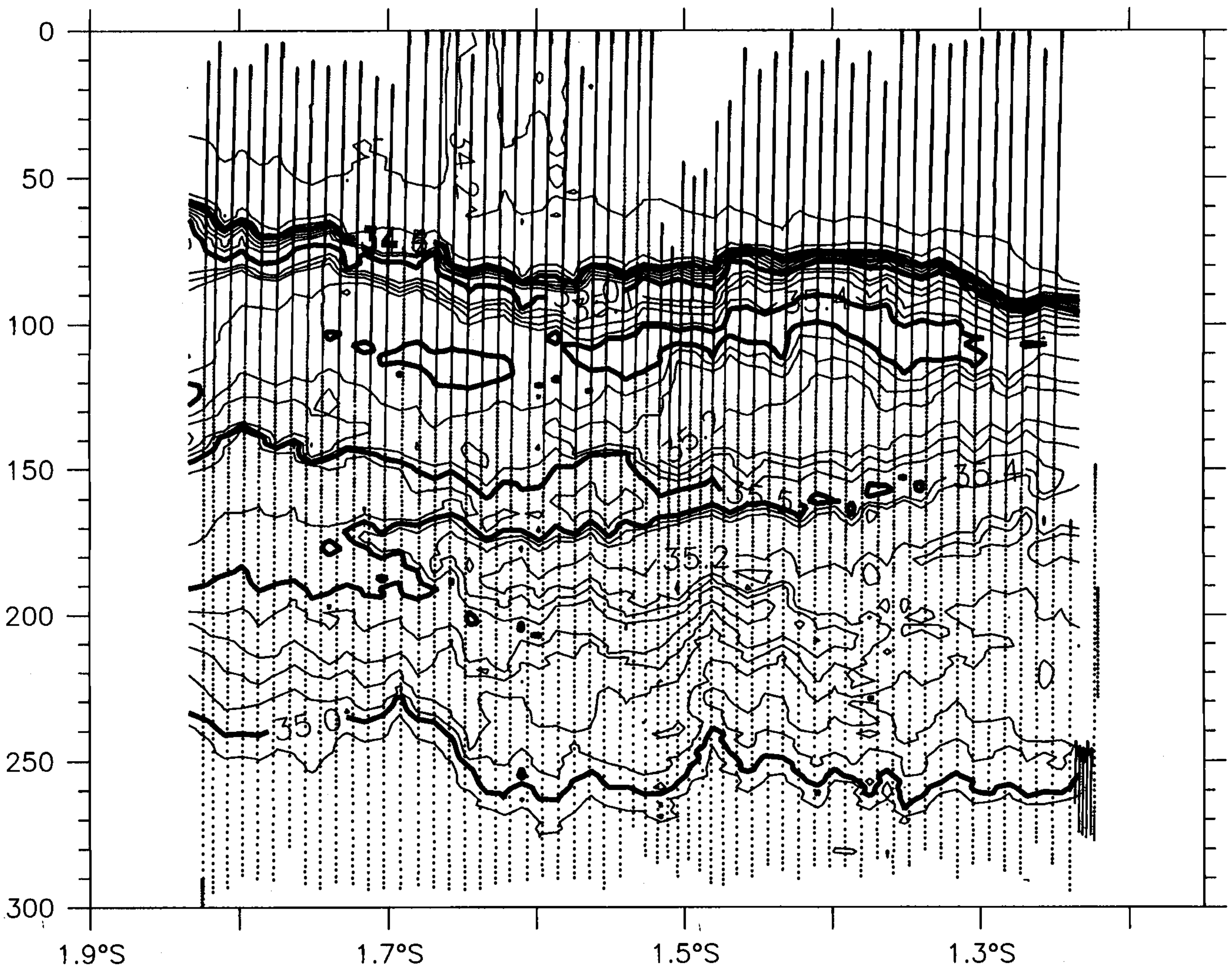
S(psu), E2N, 23 December 1992



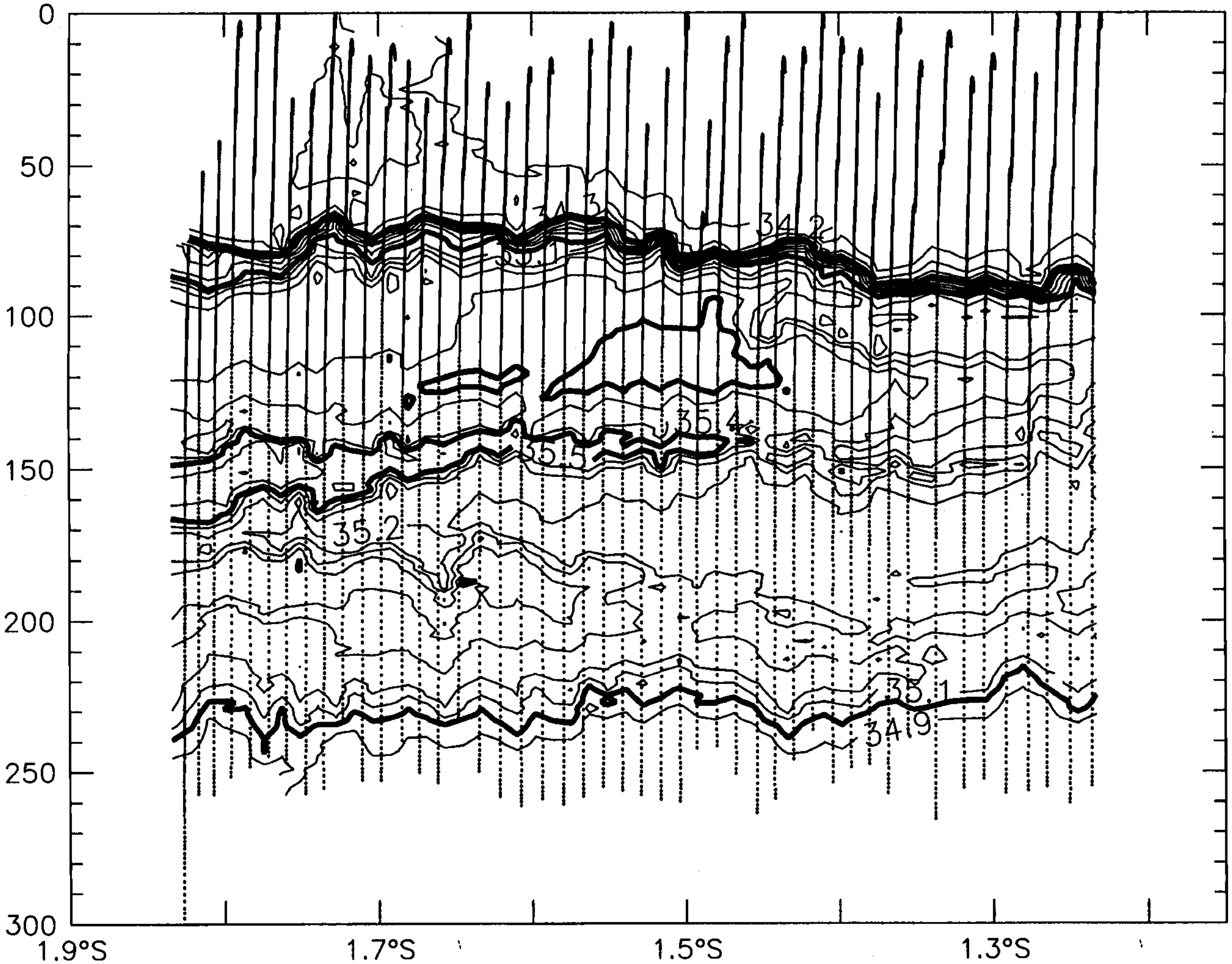
S(psu), E2N, 25 December 1992



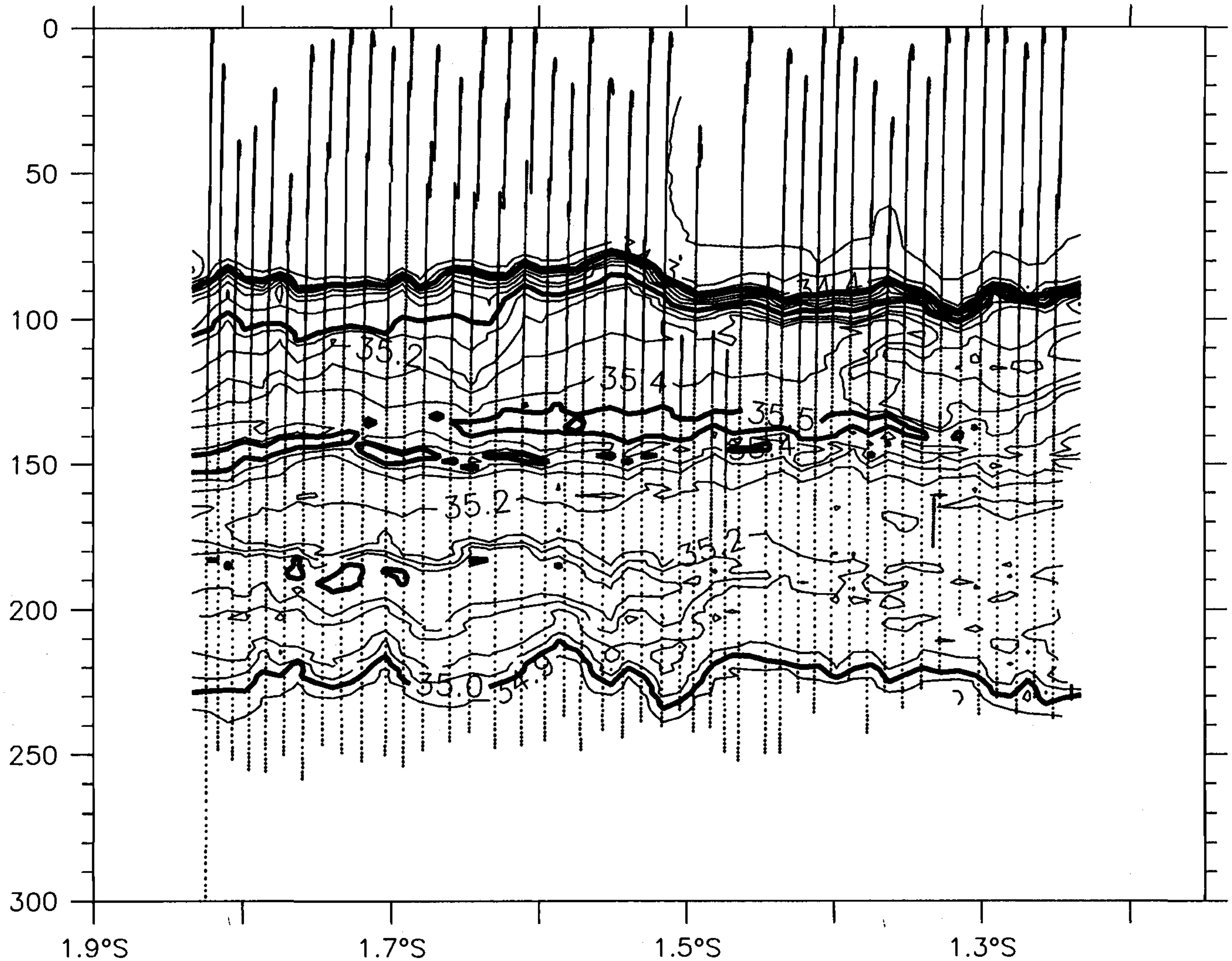
S(psu), E2N, 27 December 1992



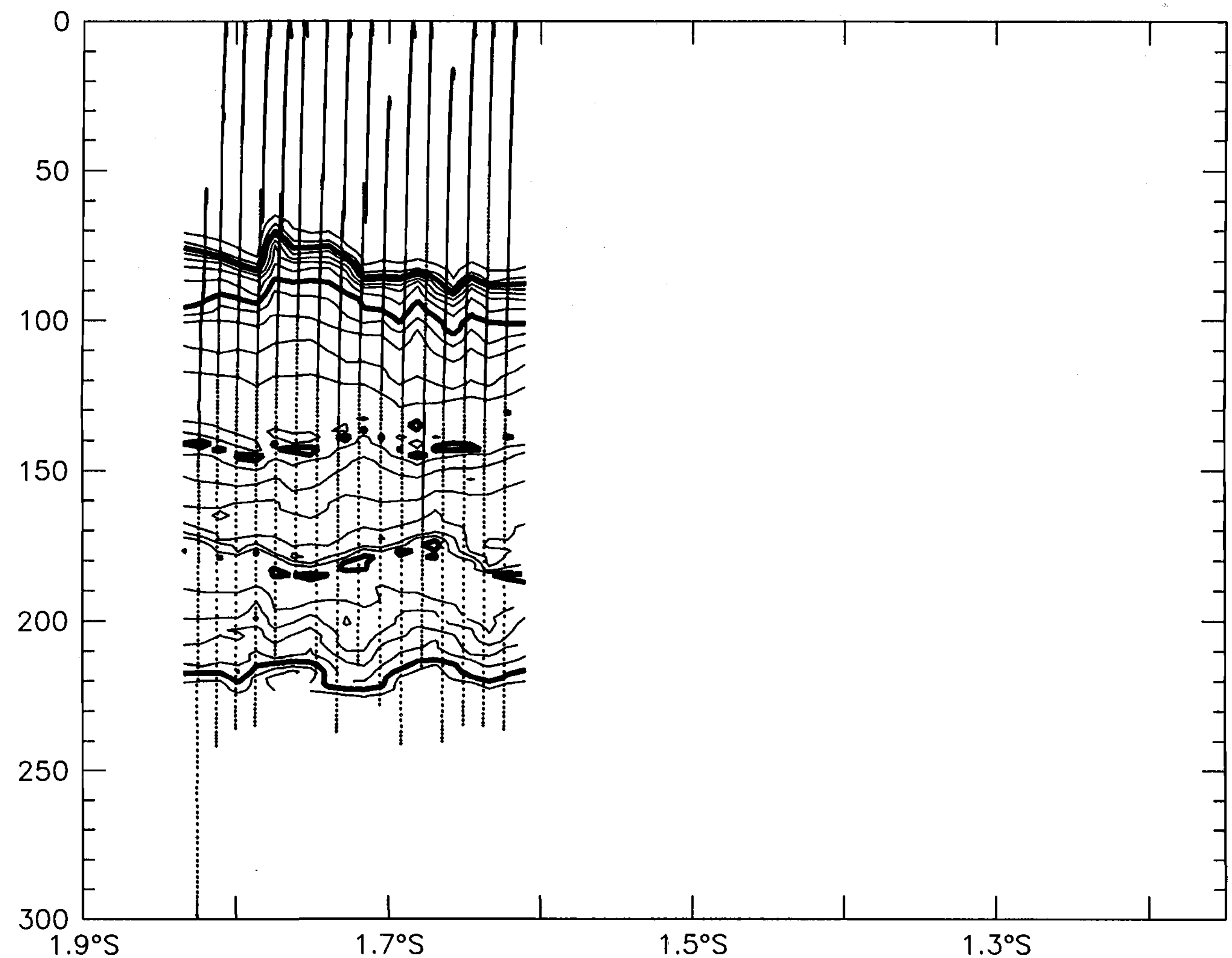
S(psu), E2N, 28 December 1992



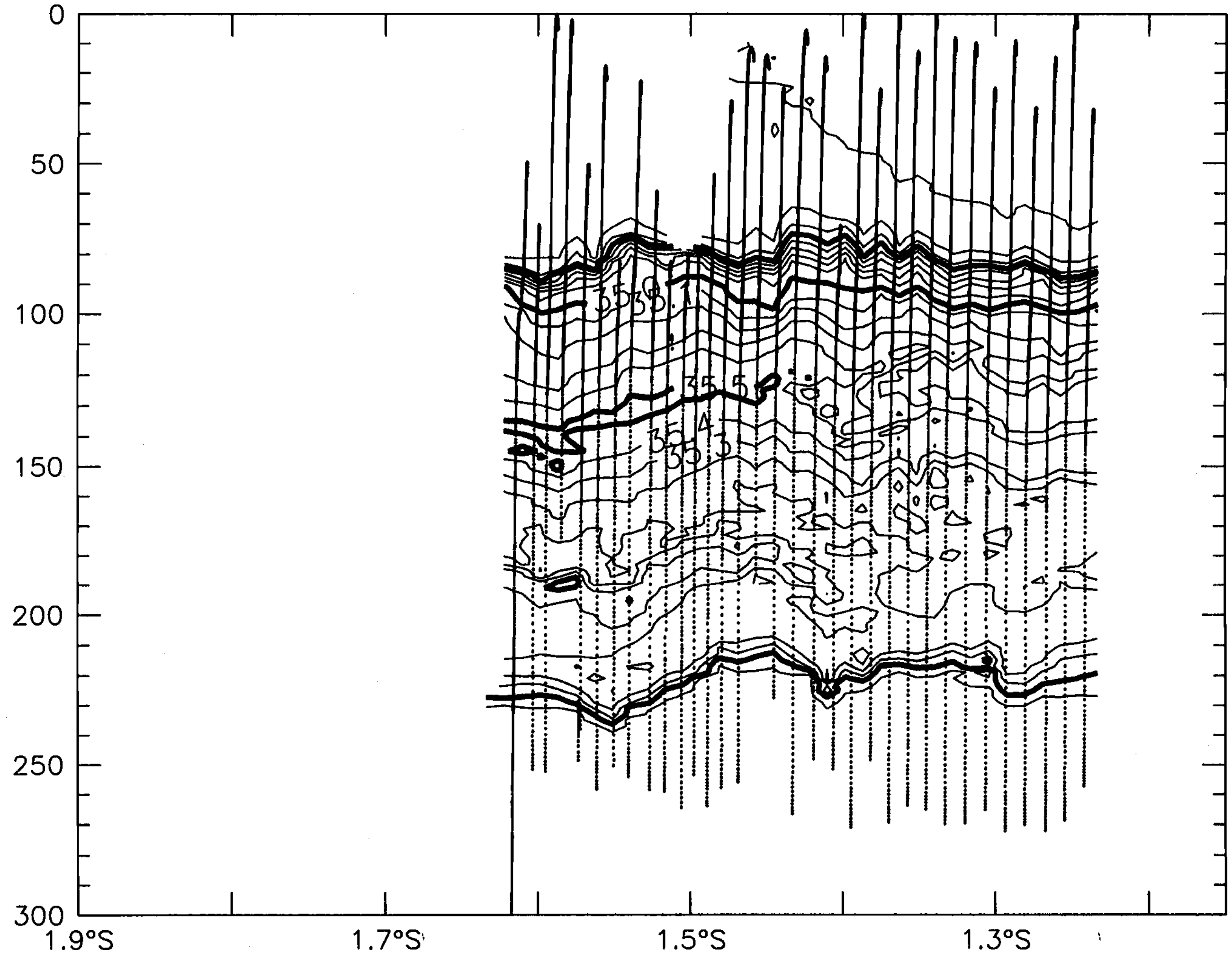
S(psu), E2N, 30 December 1992



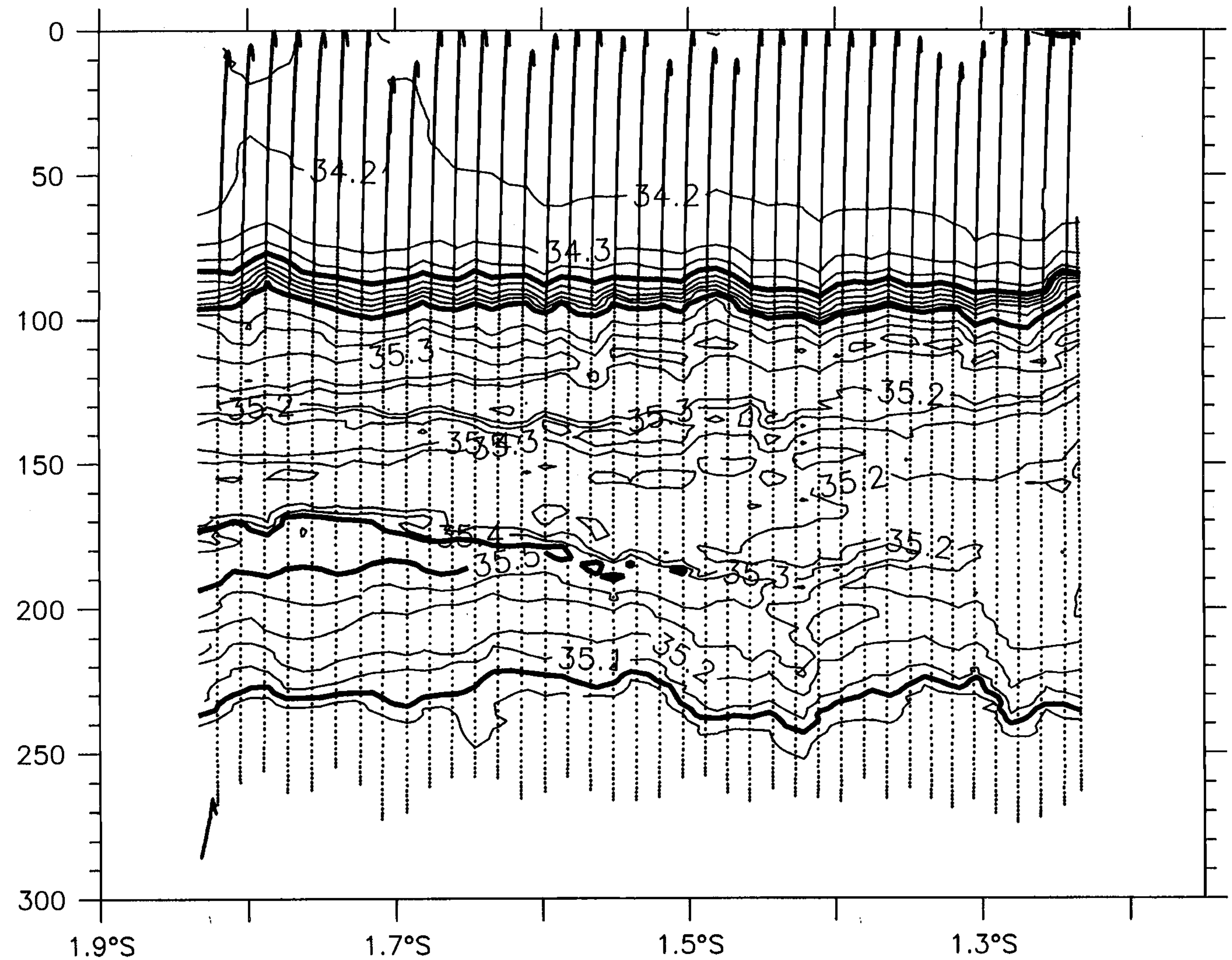
S(psu), E2N, 31 December 1992



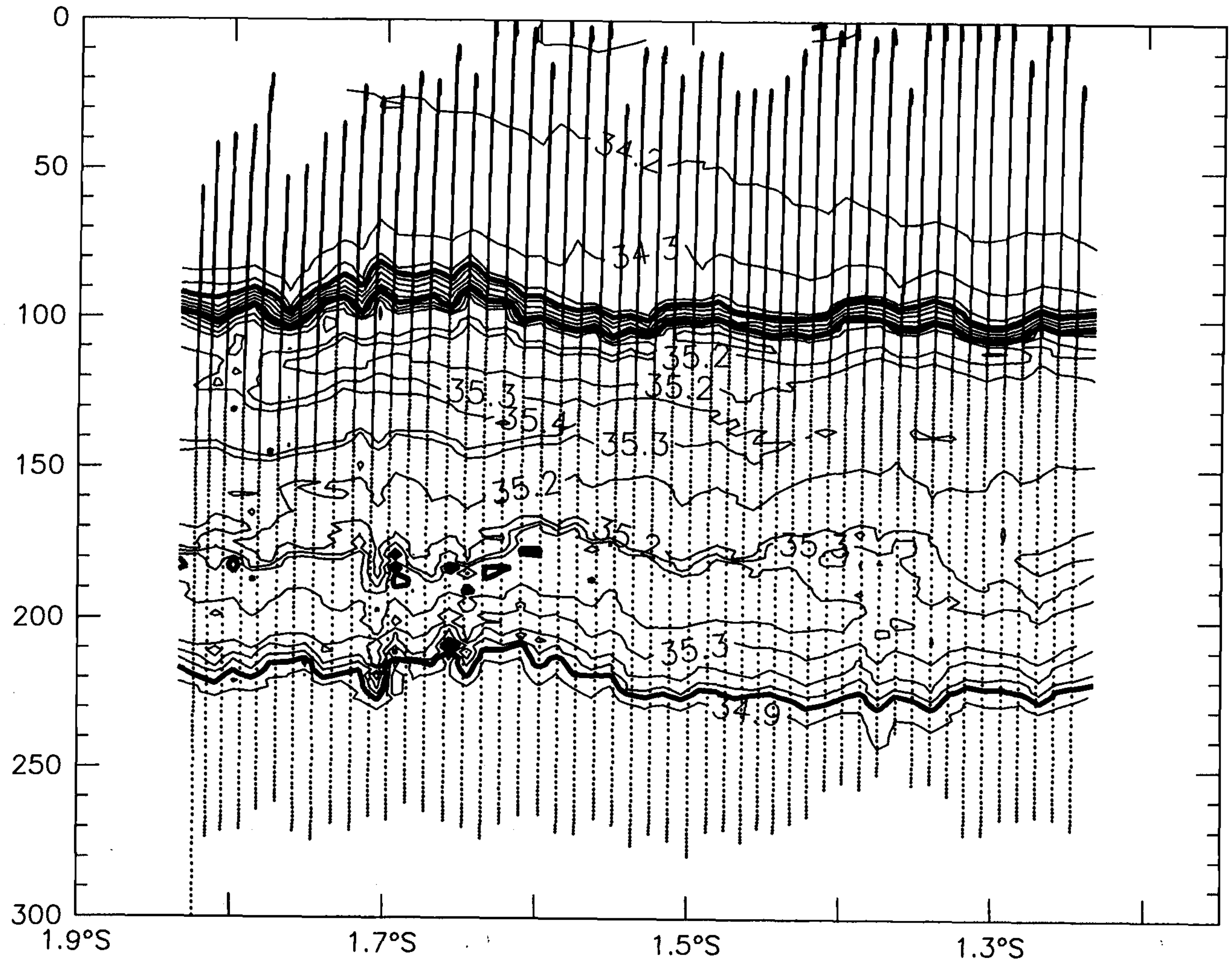
S(psu), E2N, 2 January 1993



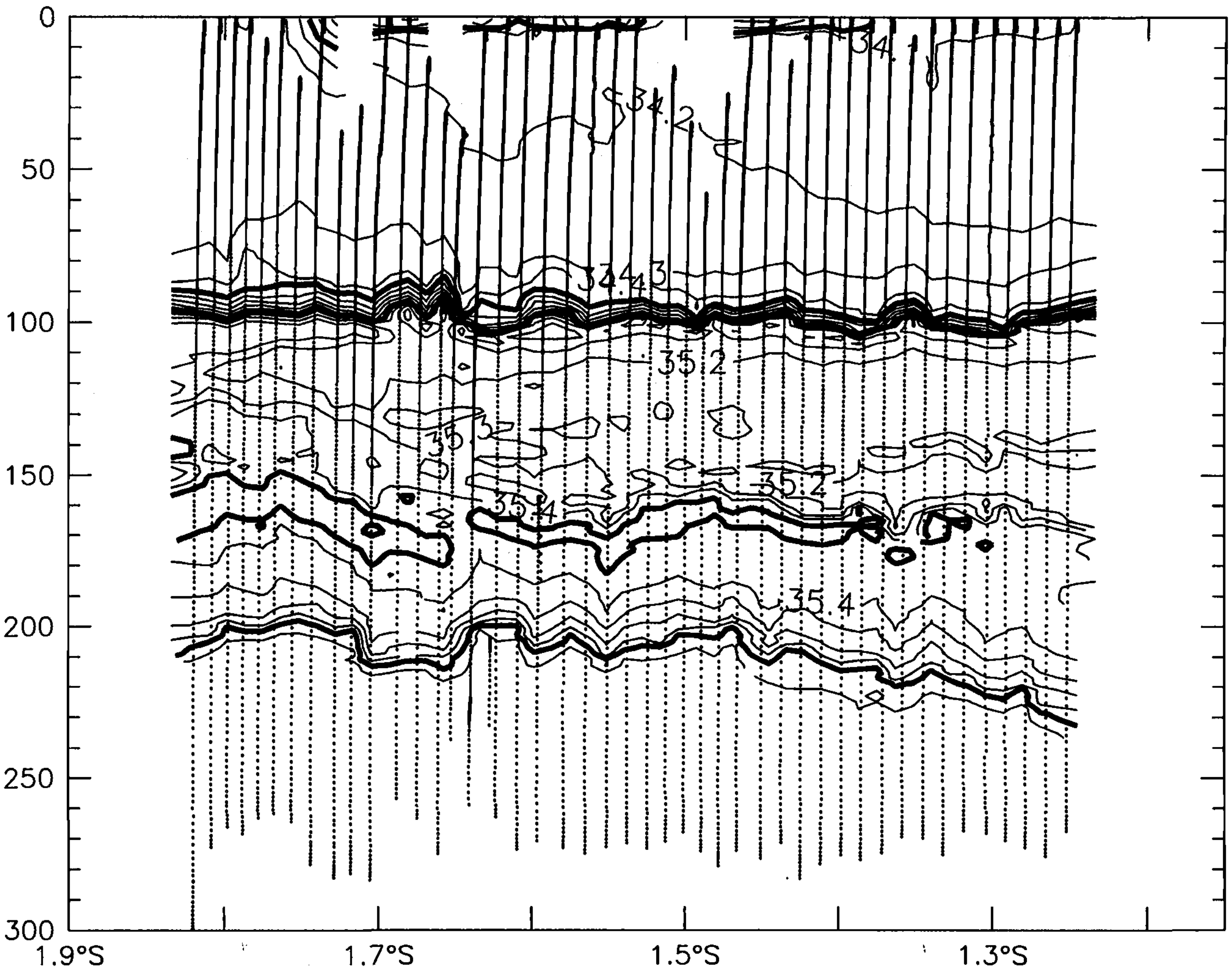
S(psu), E2N, 2 January 1993



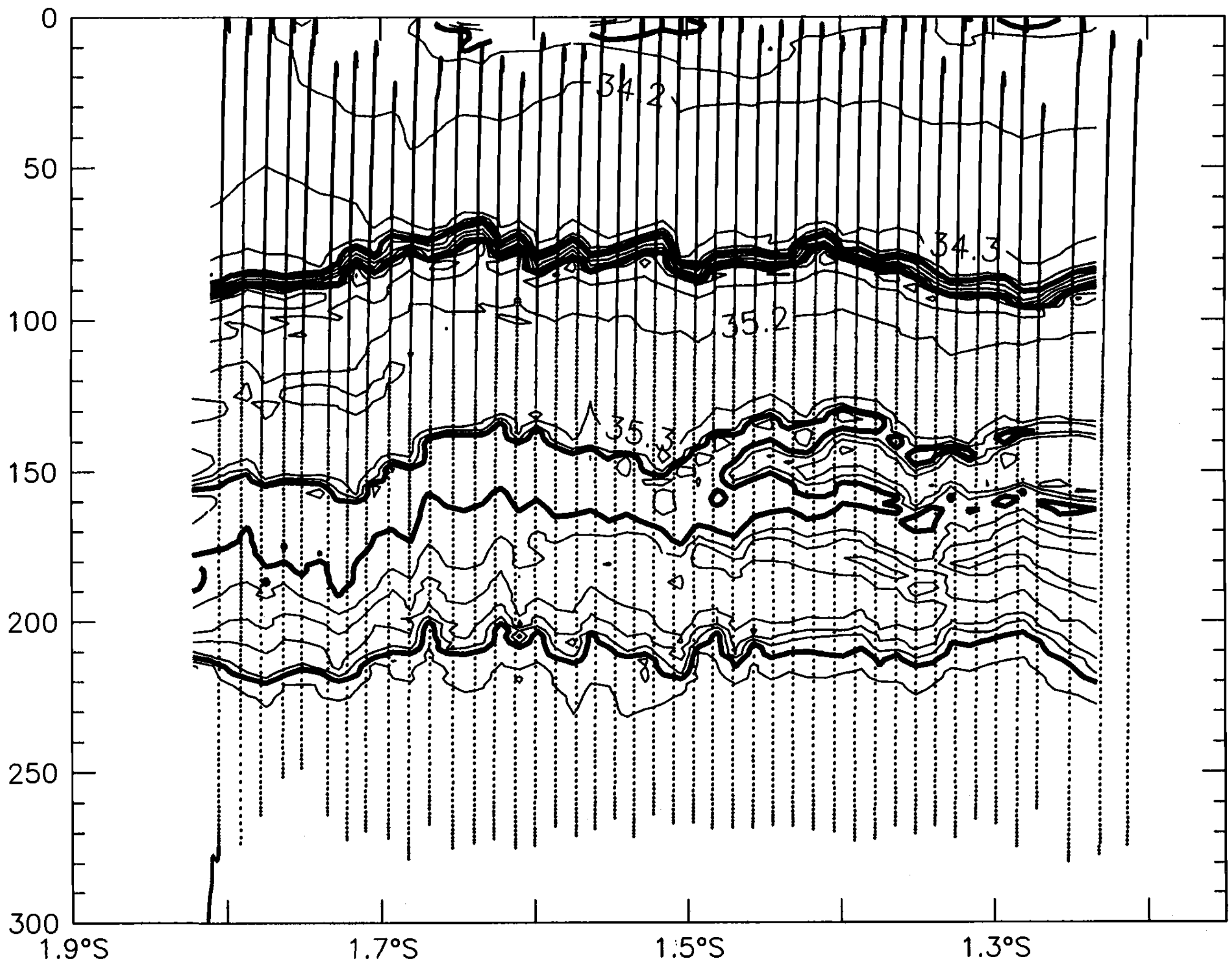
S(psu), W2N, 3 January 1993



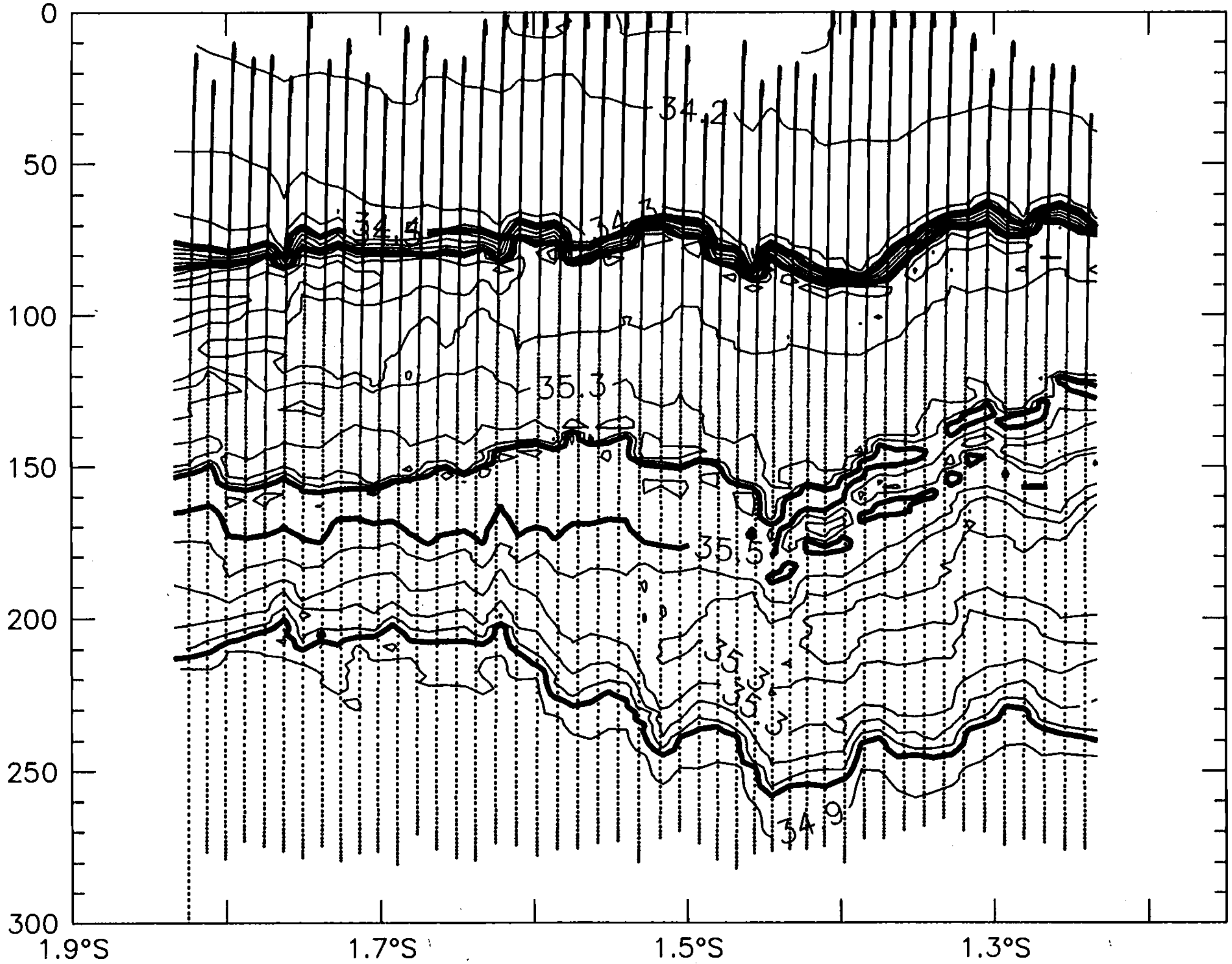
S(psu), E2N, 5 January 1993



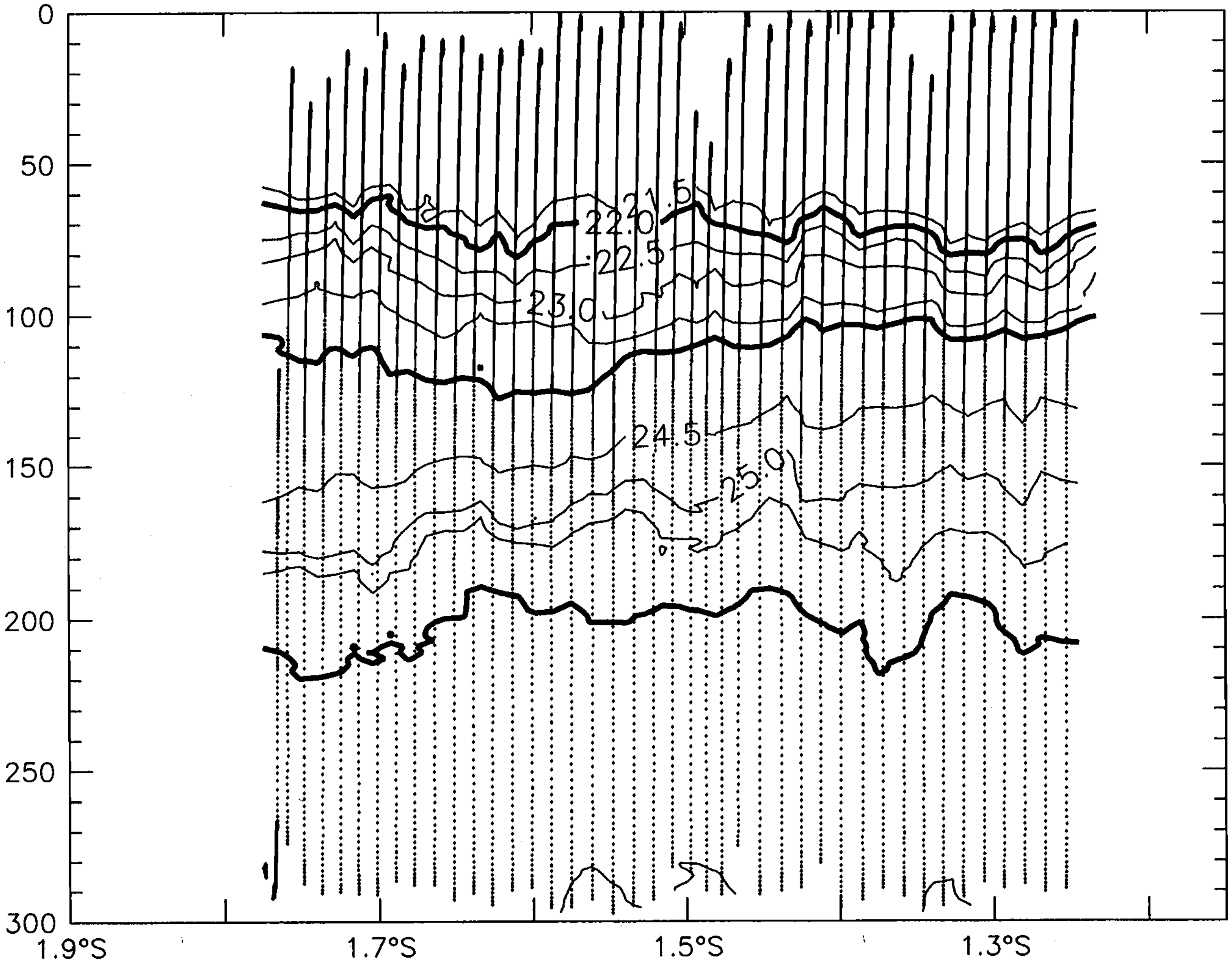
S(psu), E2N, 6 January 1992



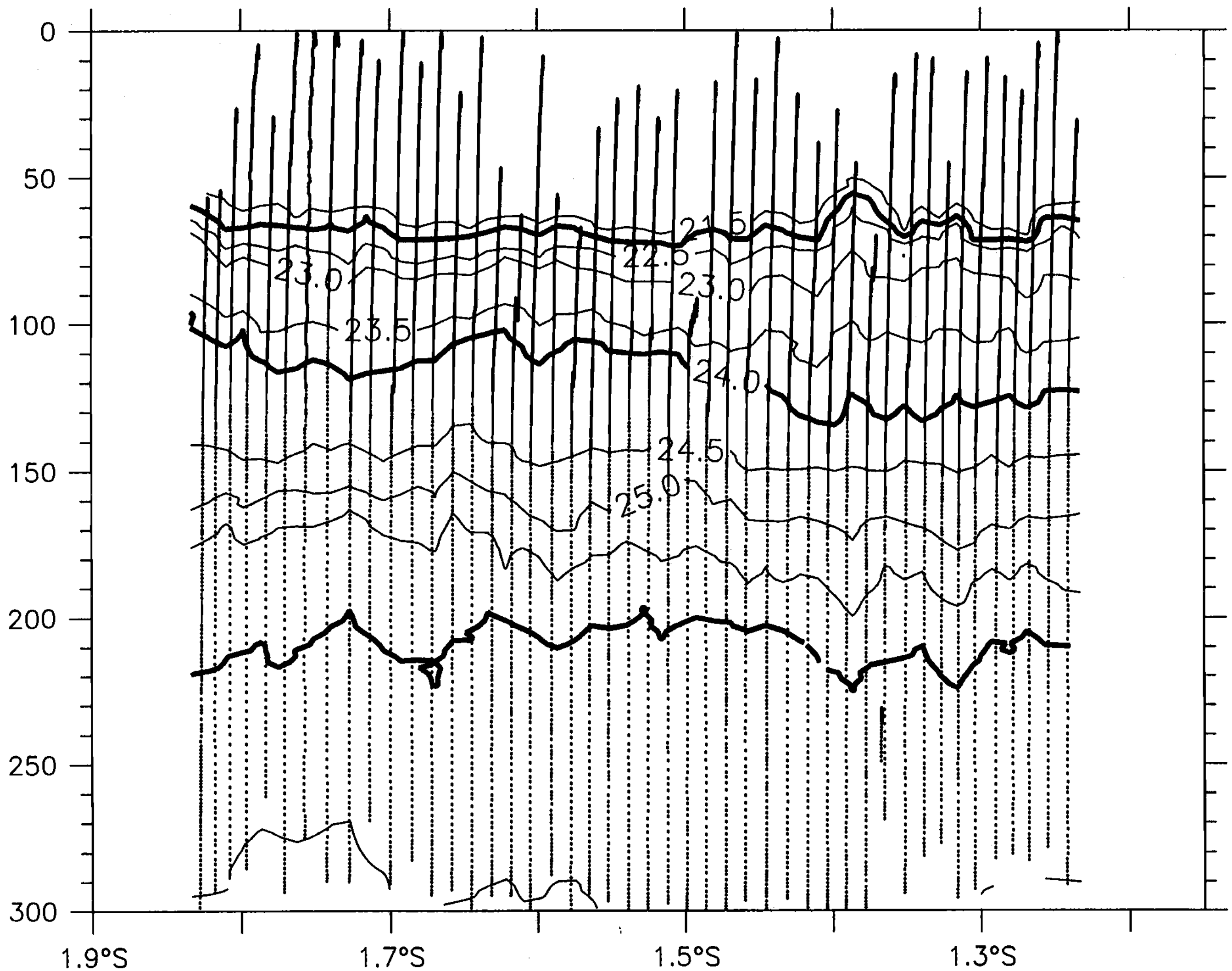
S(psu), E2N, 8 January 1993



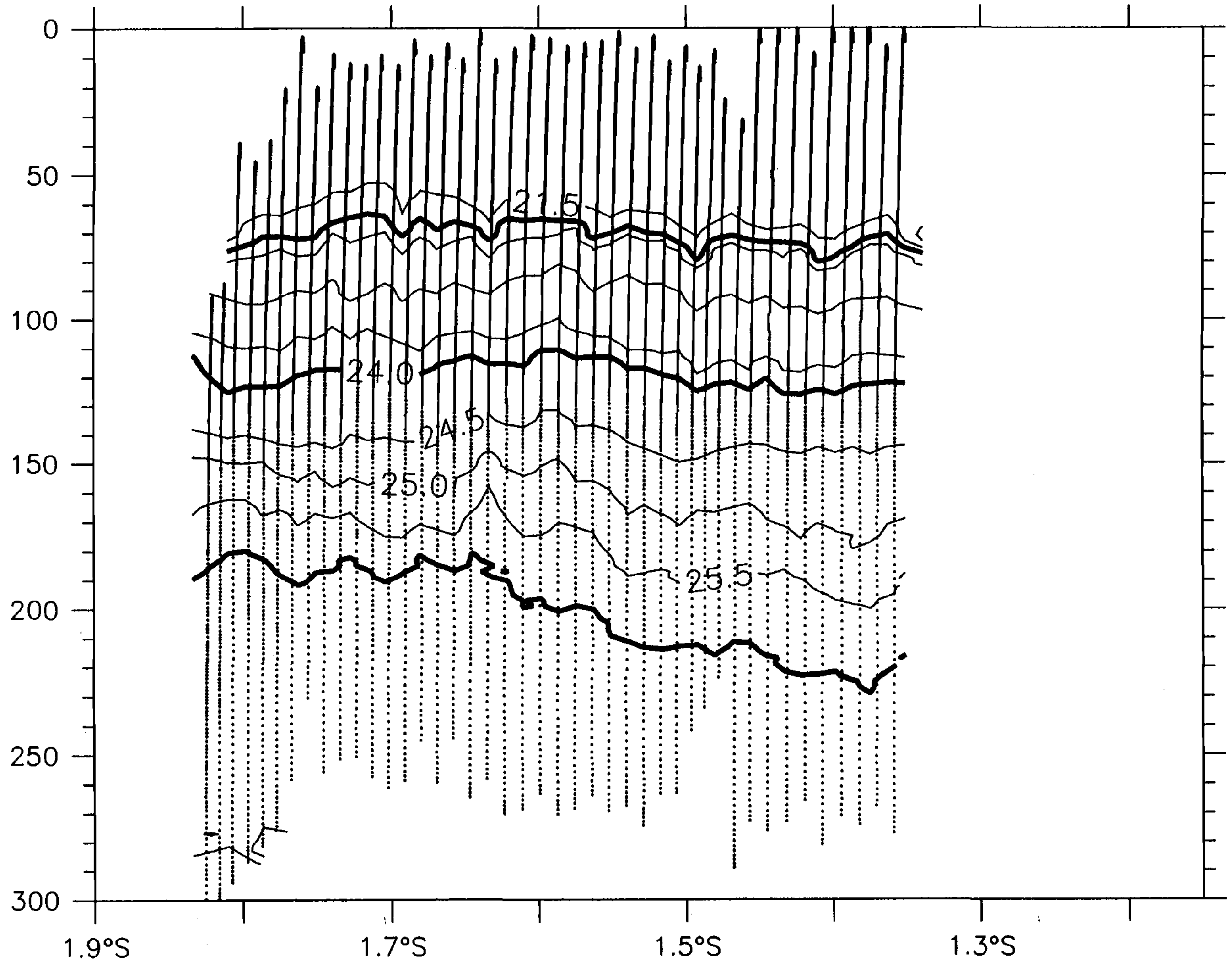
S(psu), E2N, 9 January 1993



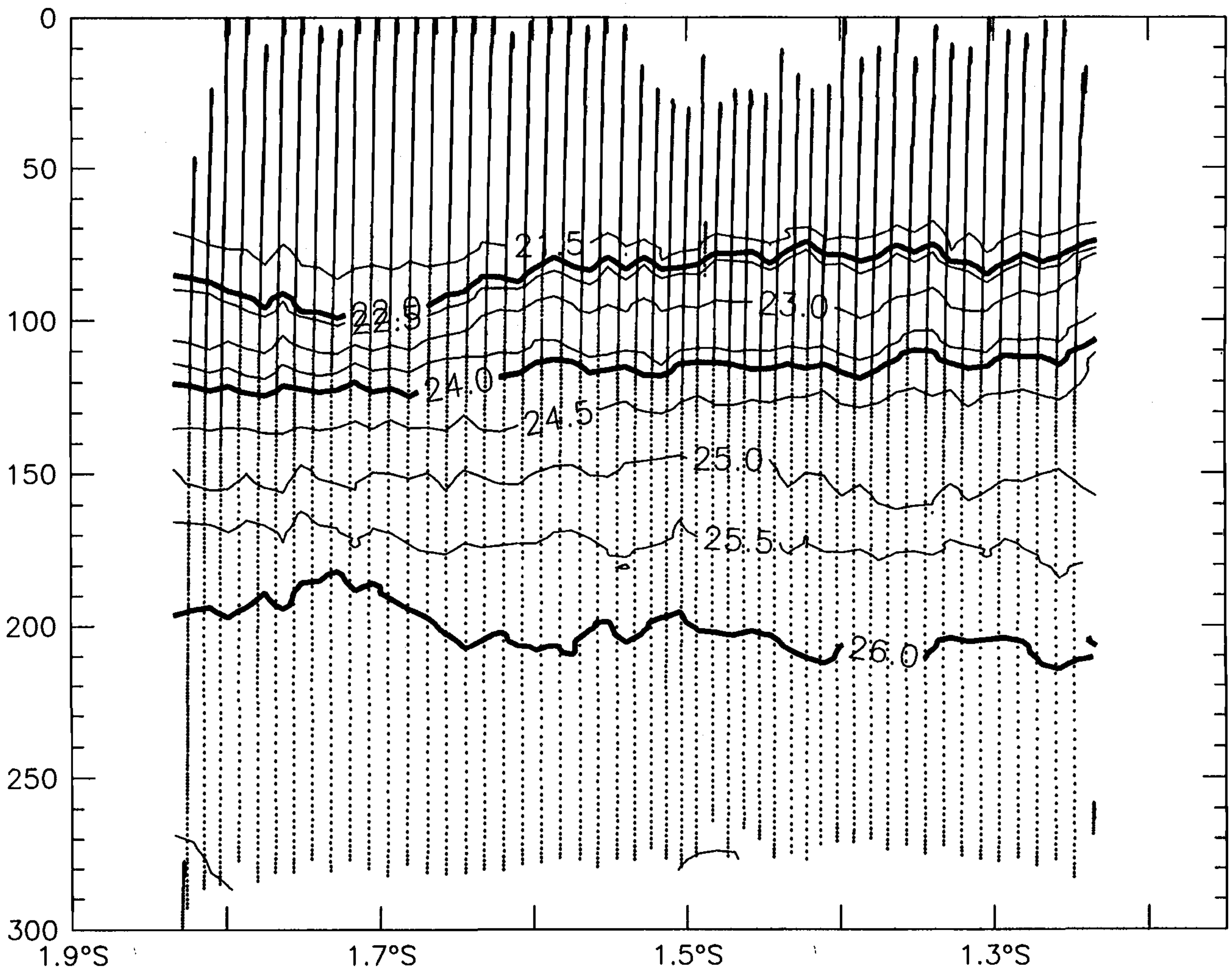
Sigma—t, E2N, 20 December 1992



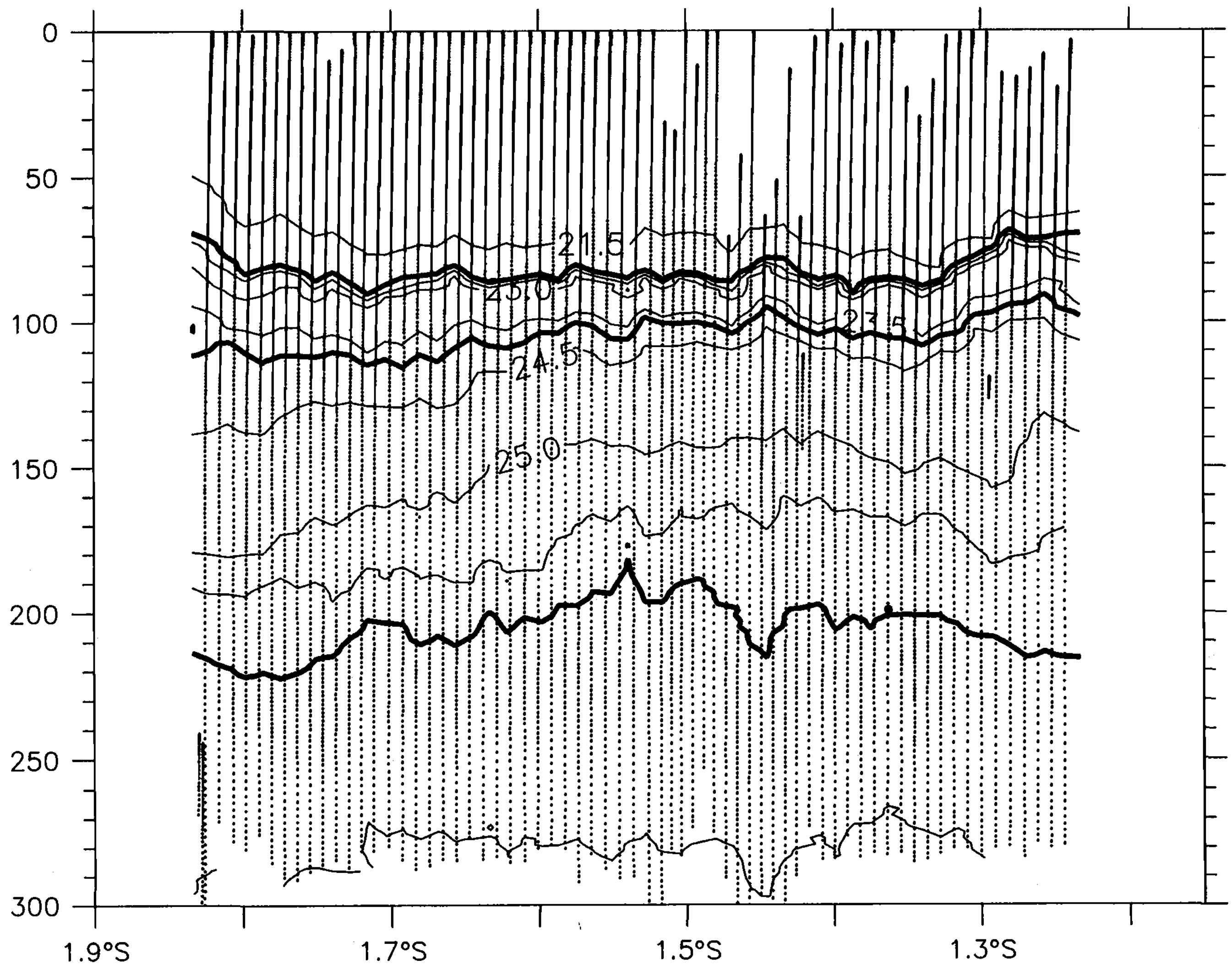
Sigma–t, E2N, 21 December 1992



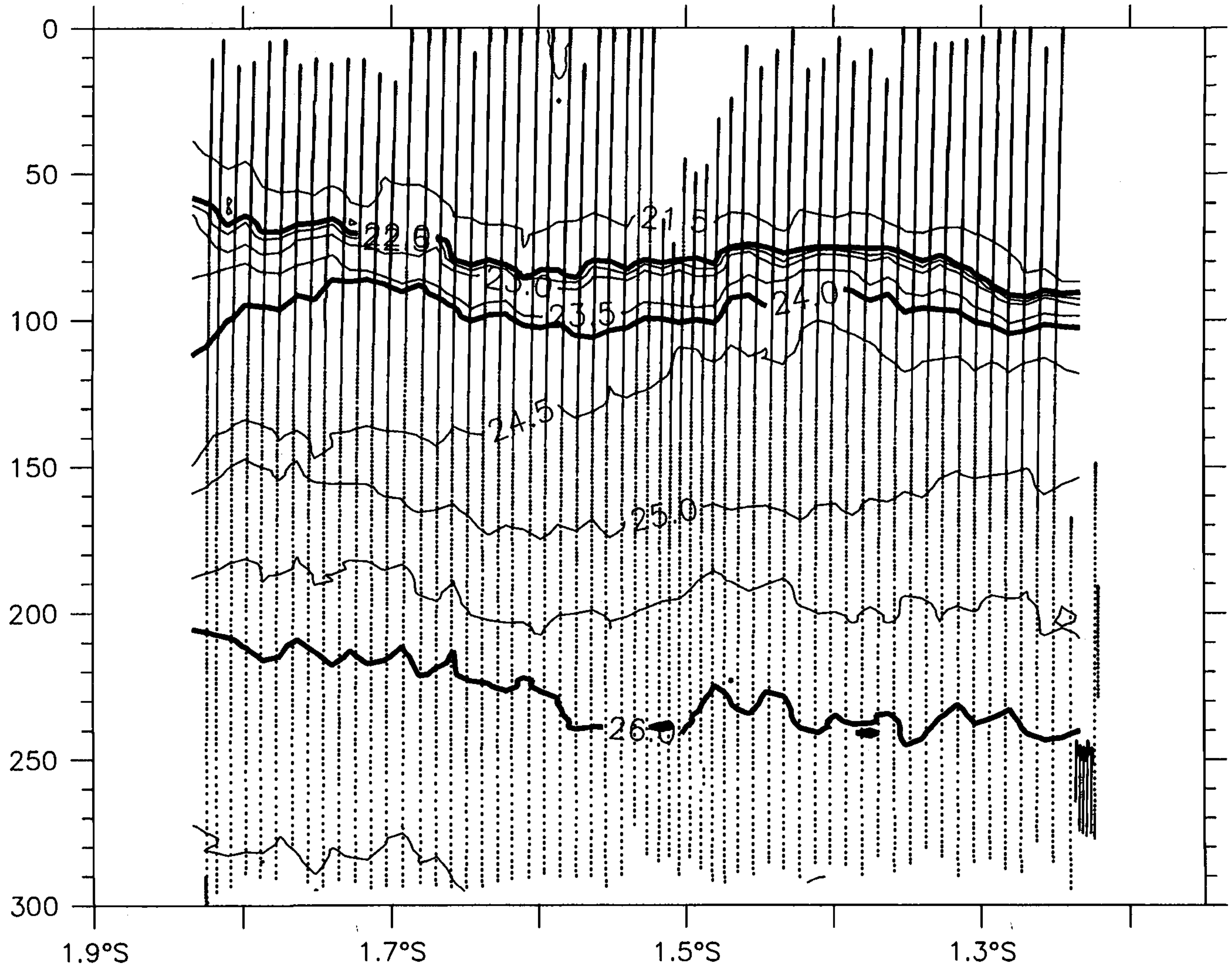
Sigma–t, E2N, 23 December 1992



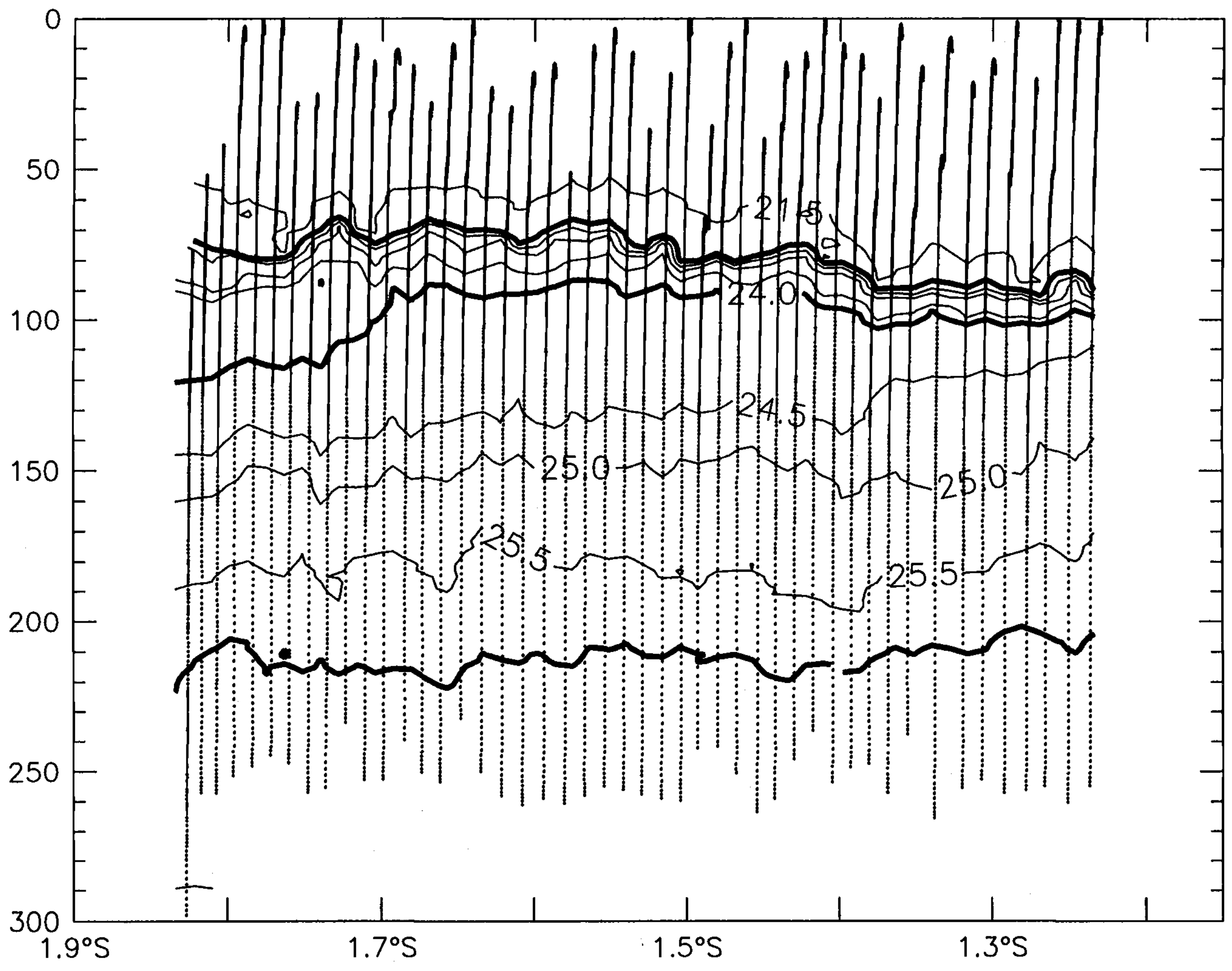
Sigma−t, E2N, 25 December 1992



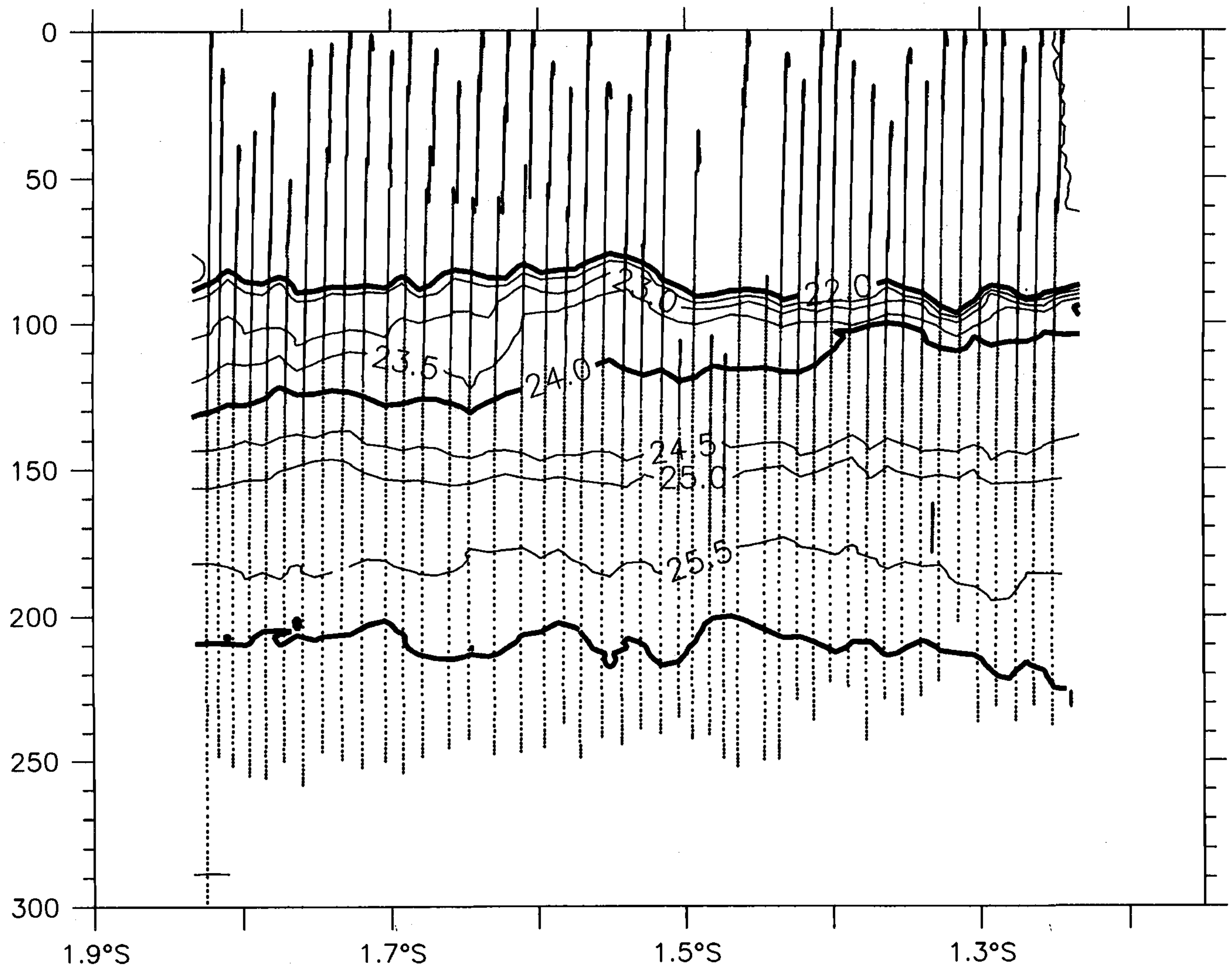
Sigma−t, E2N, 27 December 1992



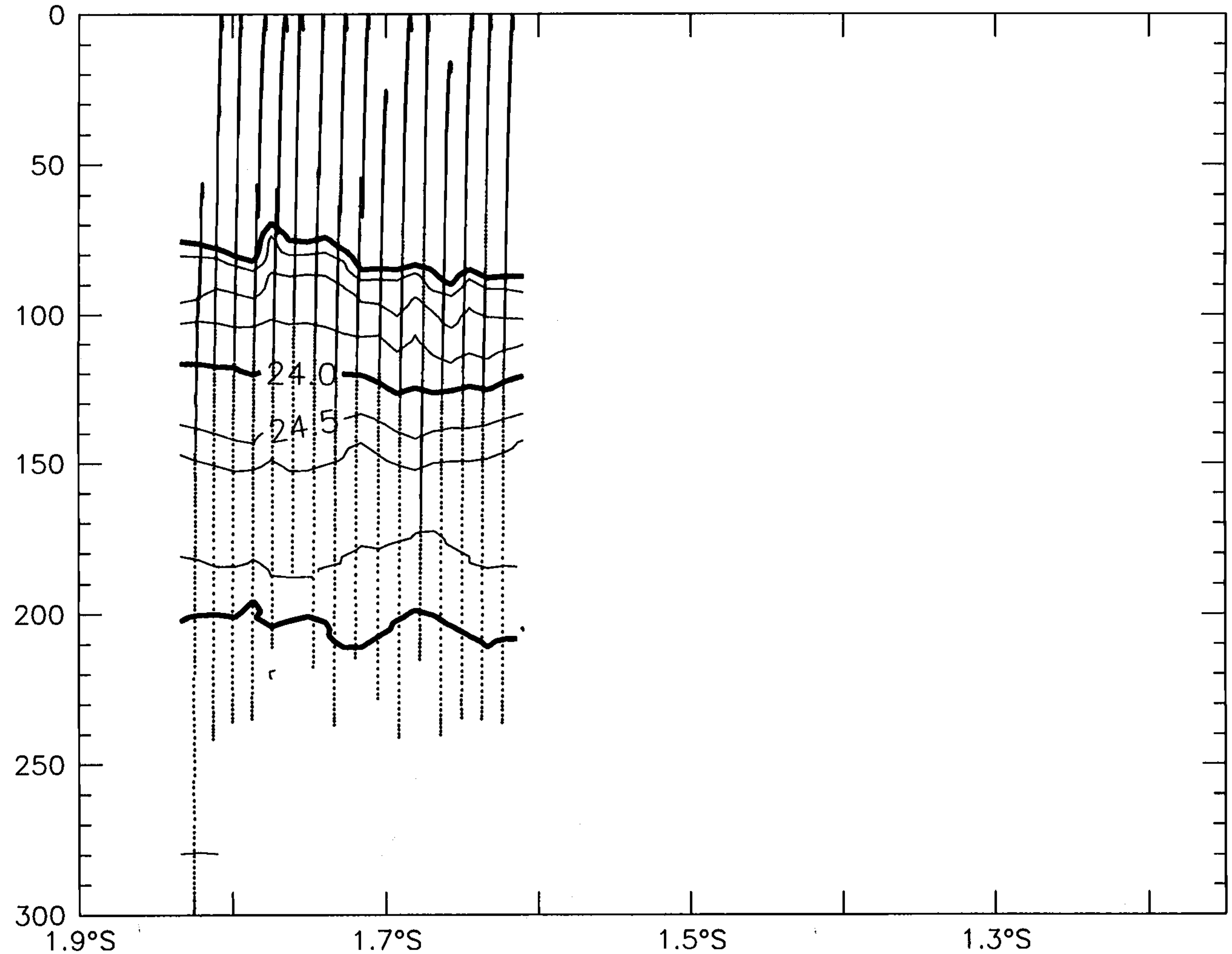
Sigma–t, E2N, 28 December 1992



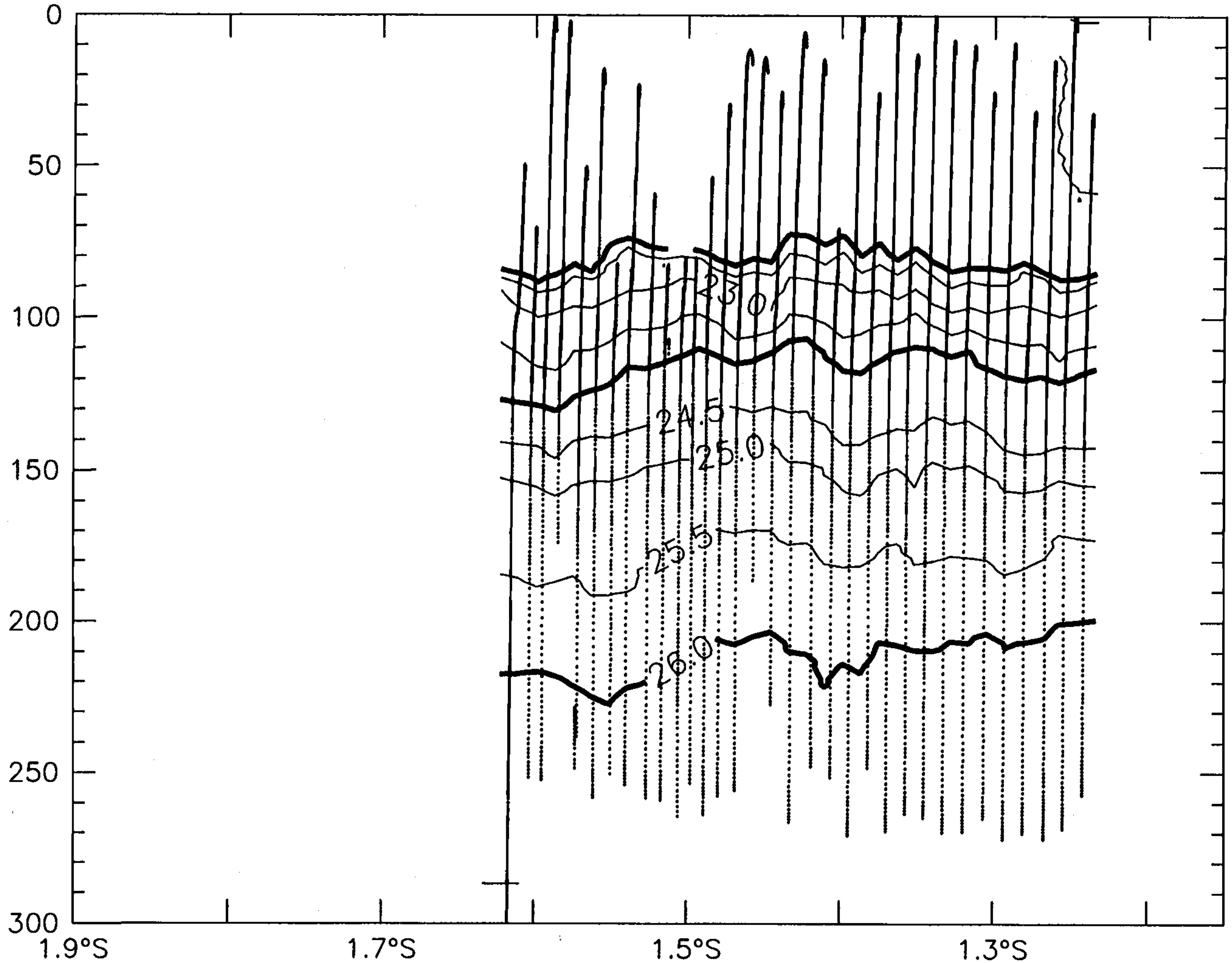
Sigma−t, E2N, 30 December 1992



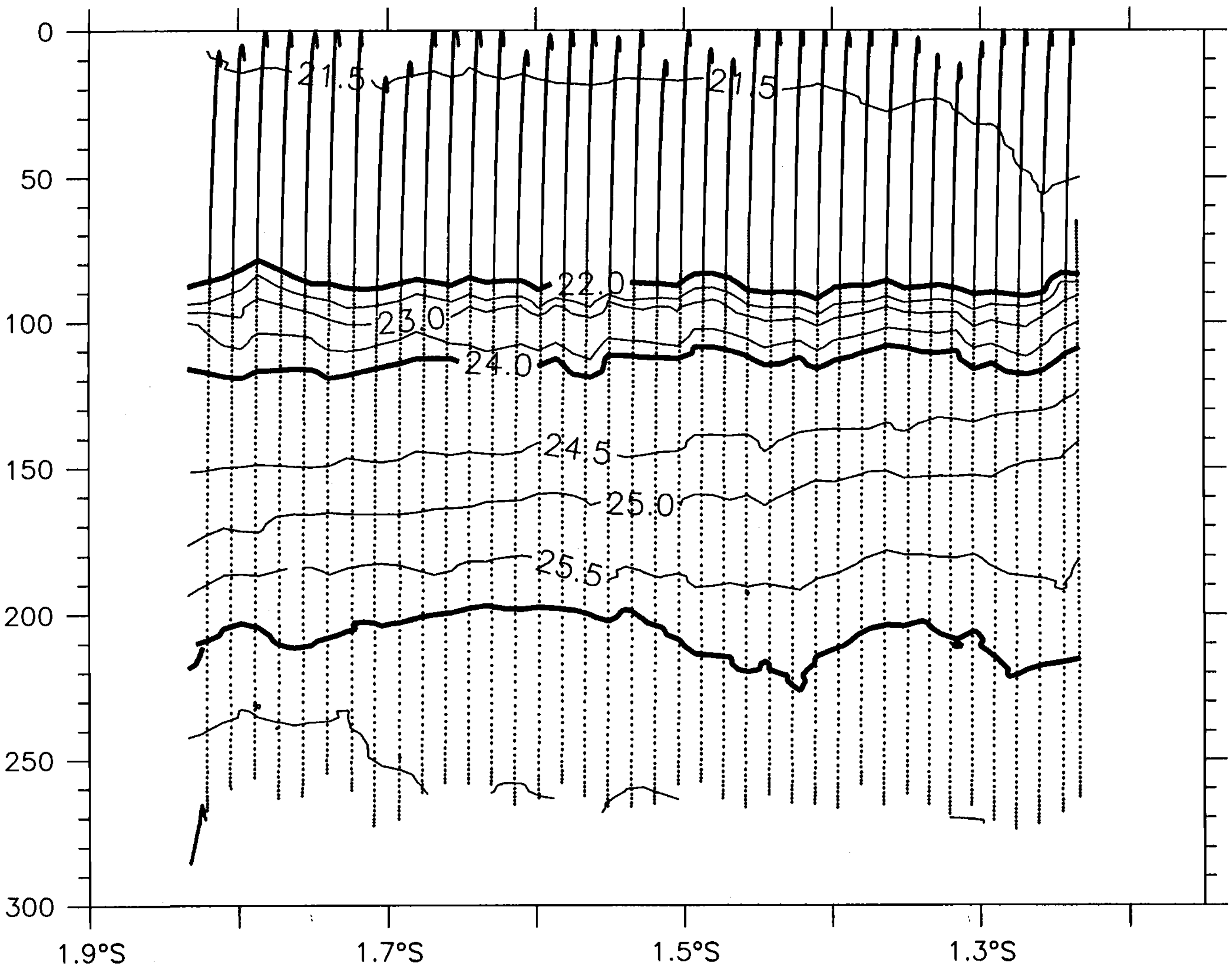
Sigma–t, E2N, 31 December 1992



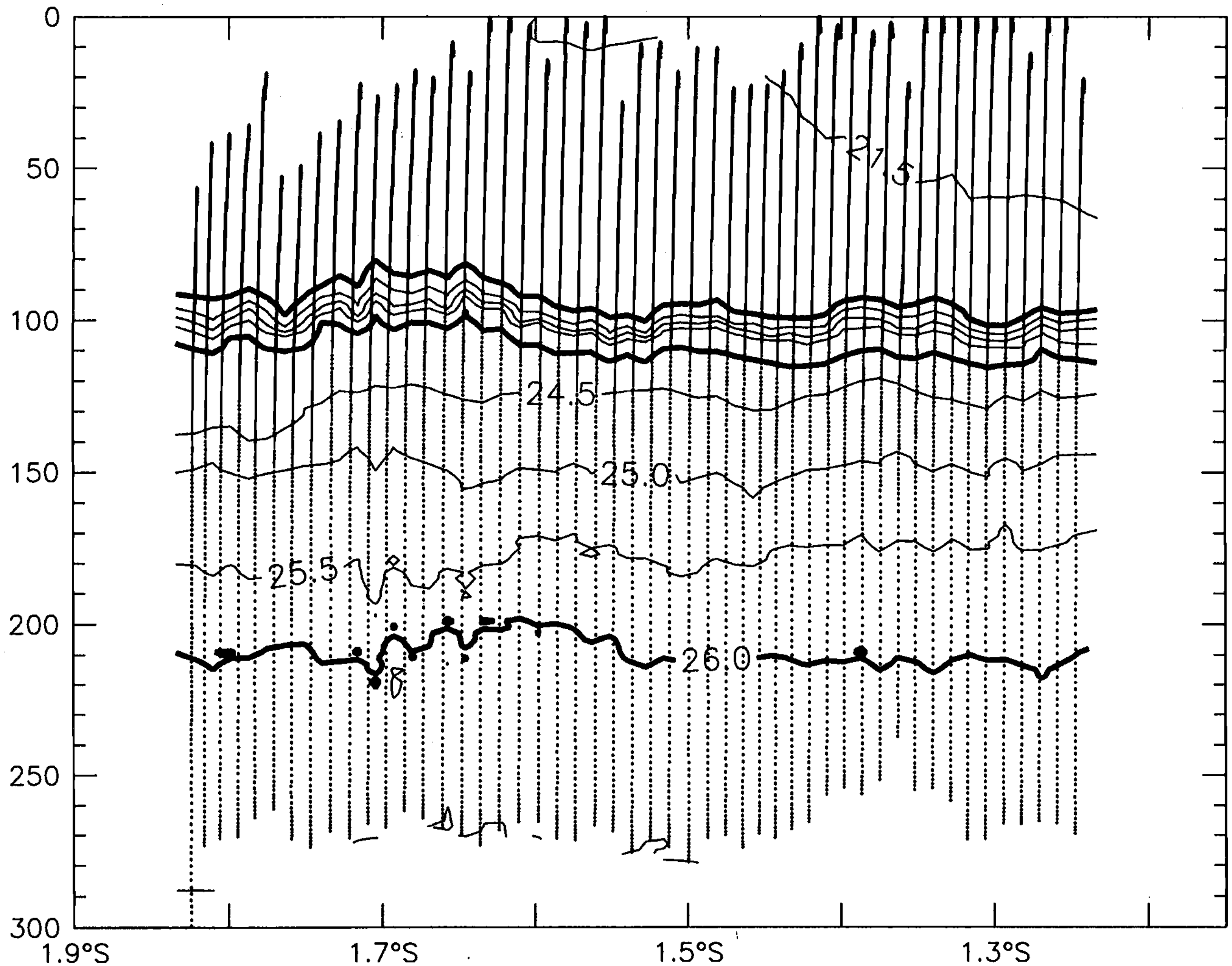
Sigma-t, E2N, 2 January 1993



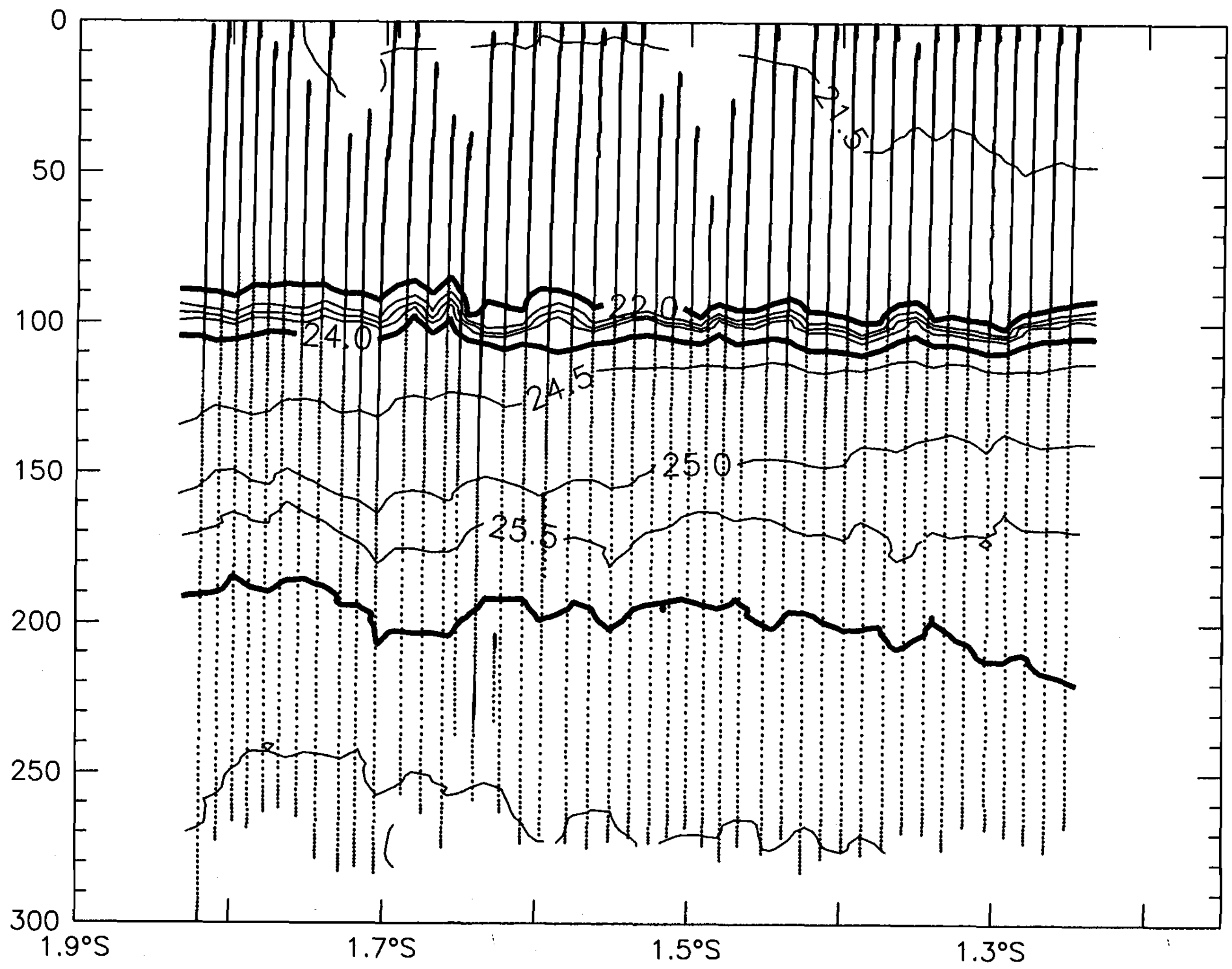
Sigma−t, E2N, 2 January 1993



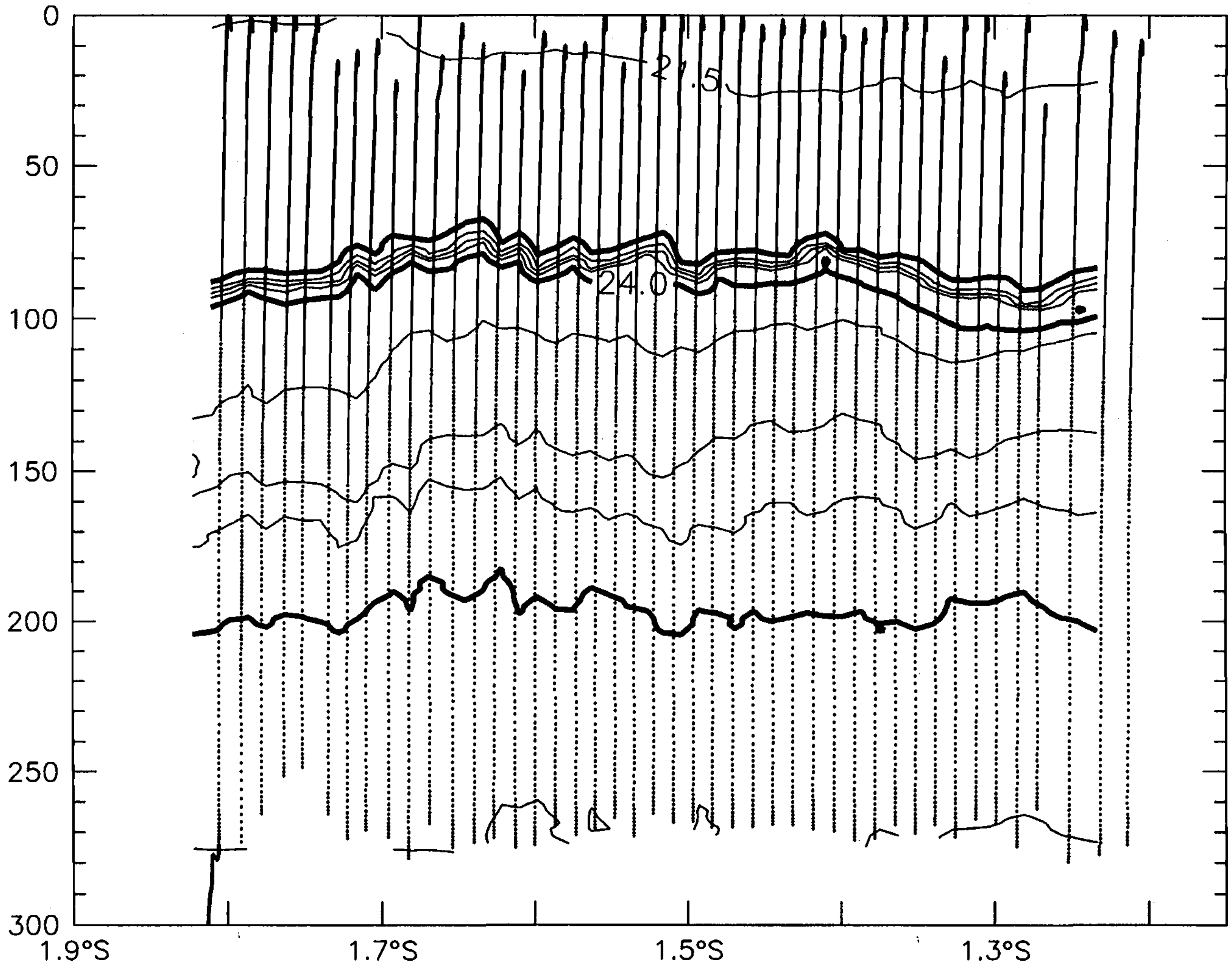
Sigma−t, W2N, 3 January 1993



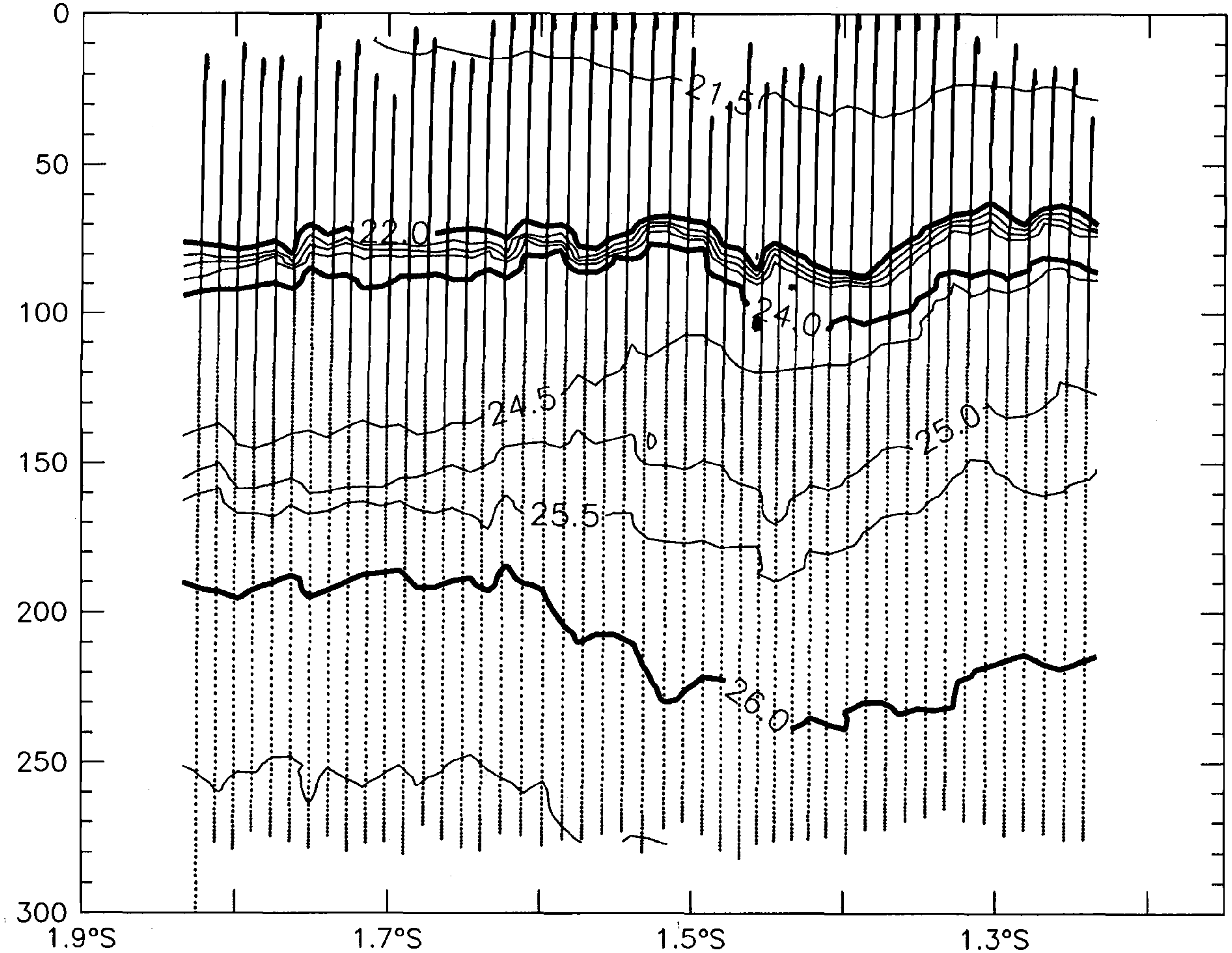
Sigma−t, E2N, 5 January 1993



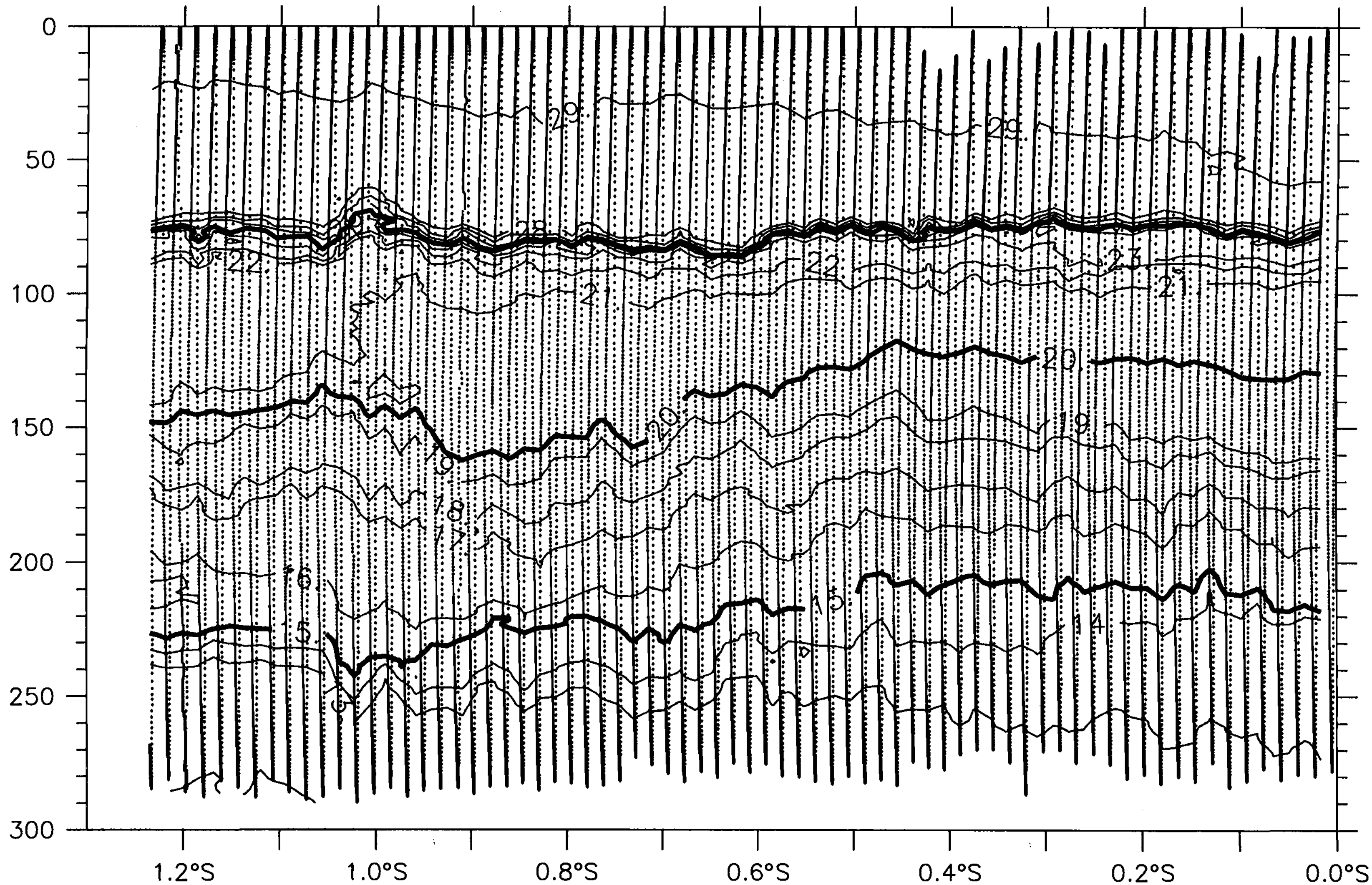
Sigma−t, E2N, 6 January 1992



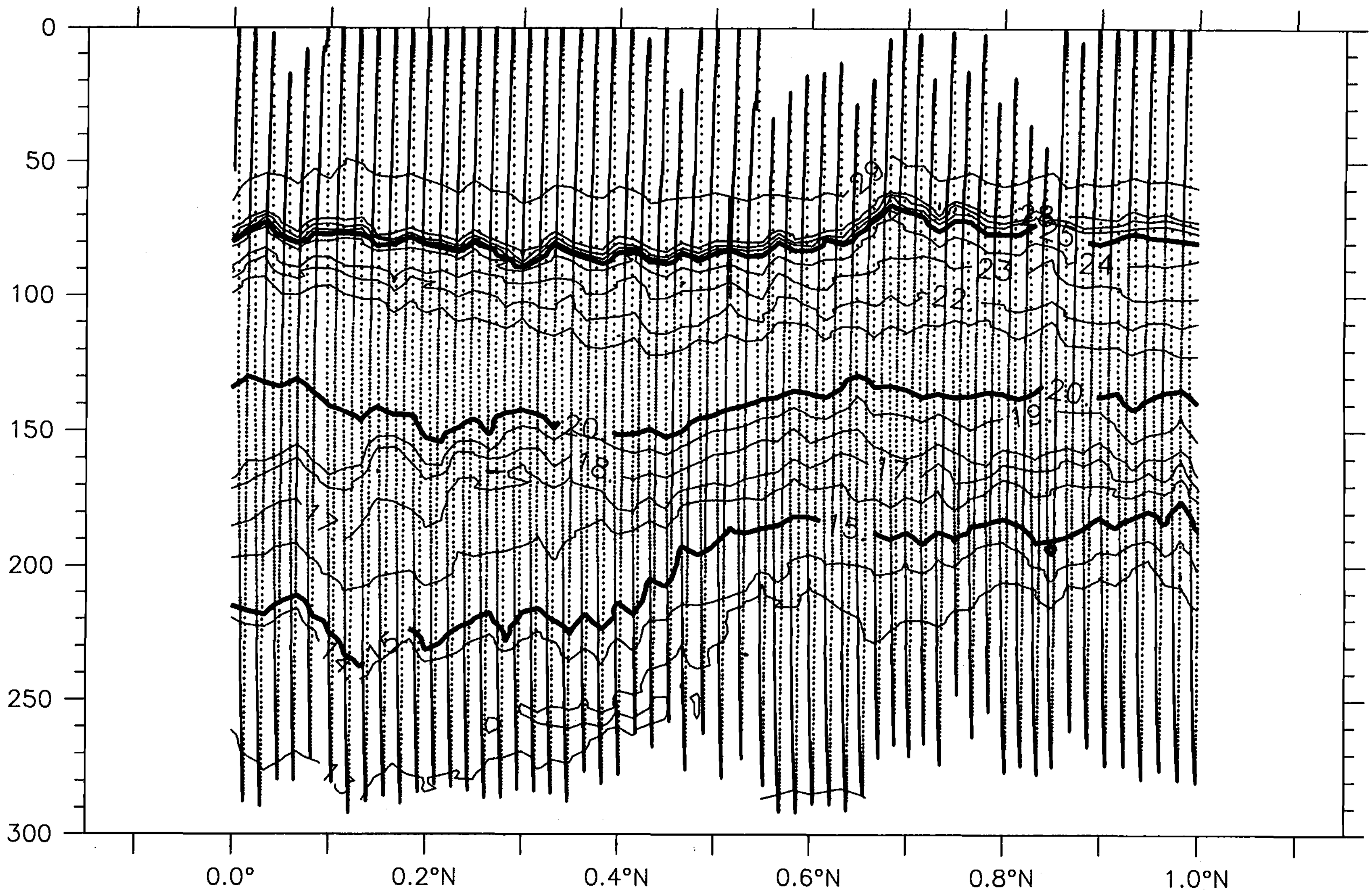
Sigma–t, E2N, 8 January 1993



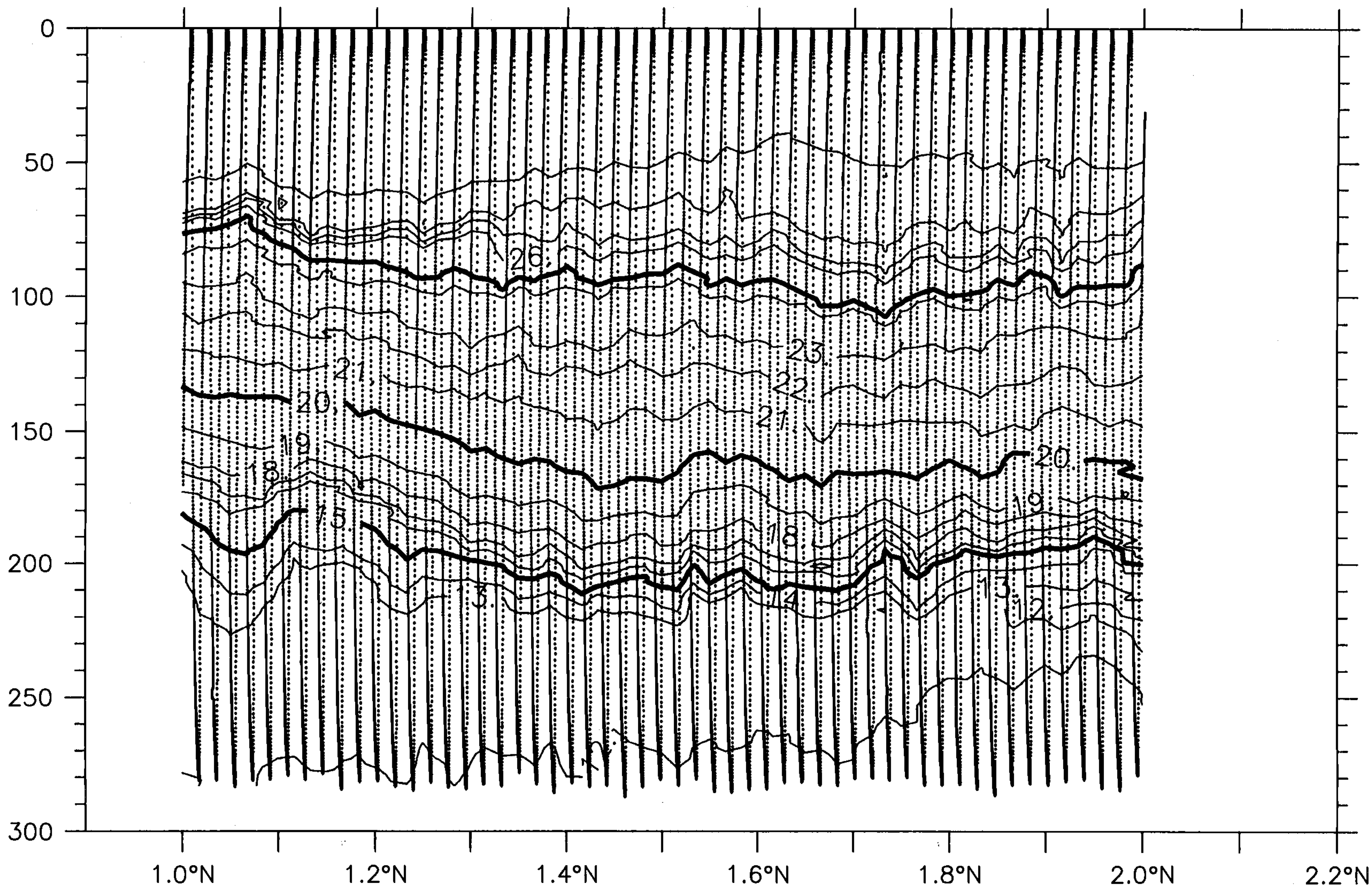
Sigma−t, E2N, 9 January 1993



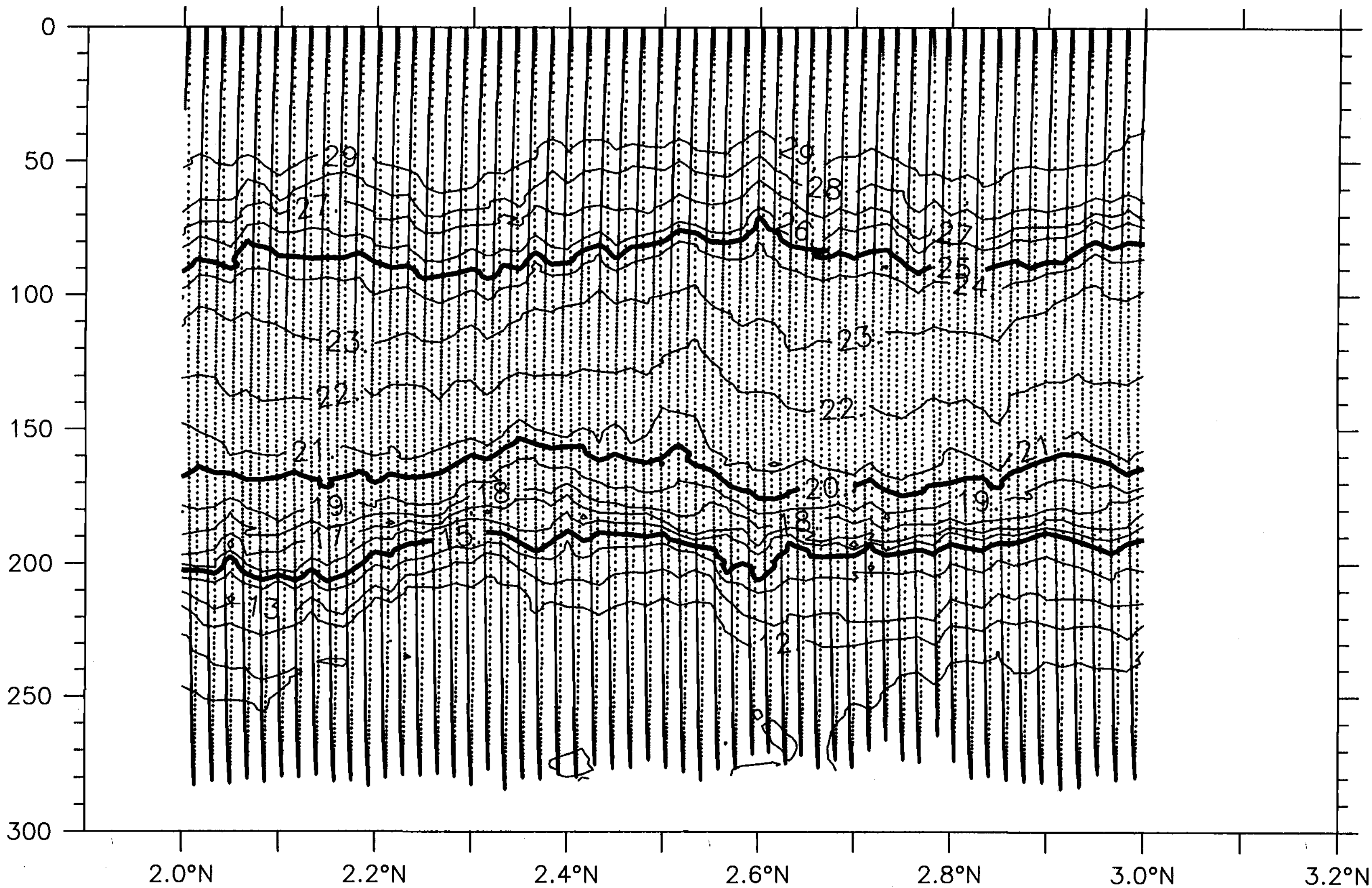
T(°C), Transit, 10–11 January 1993



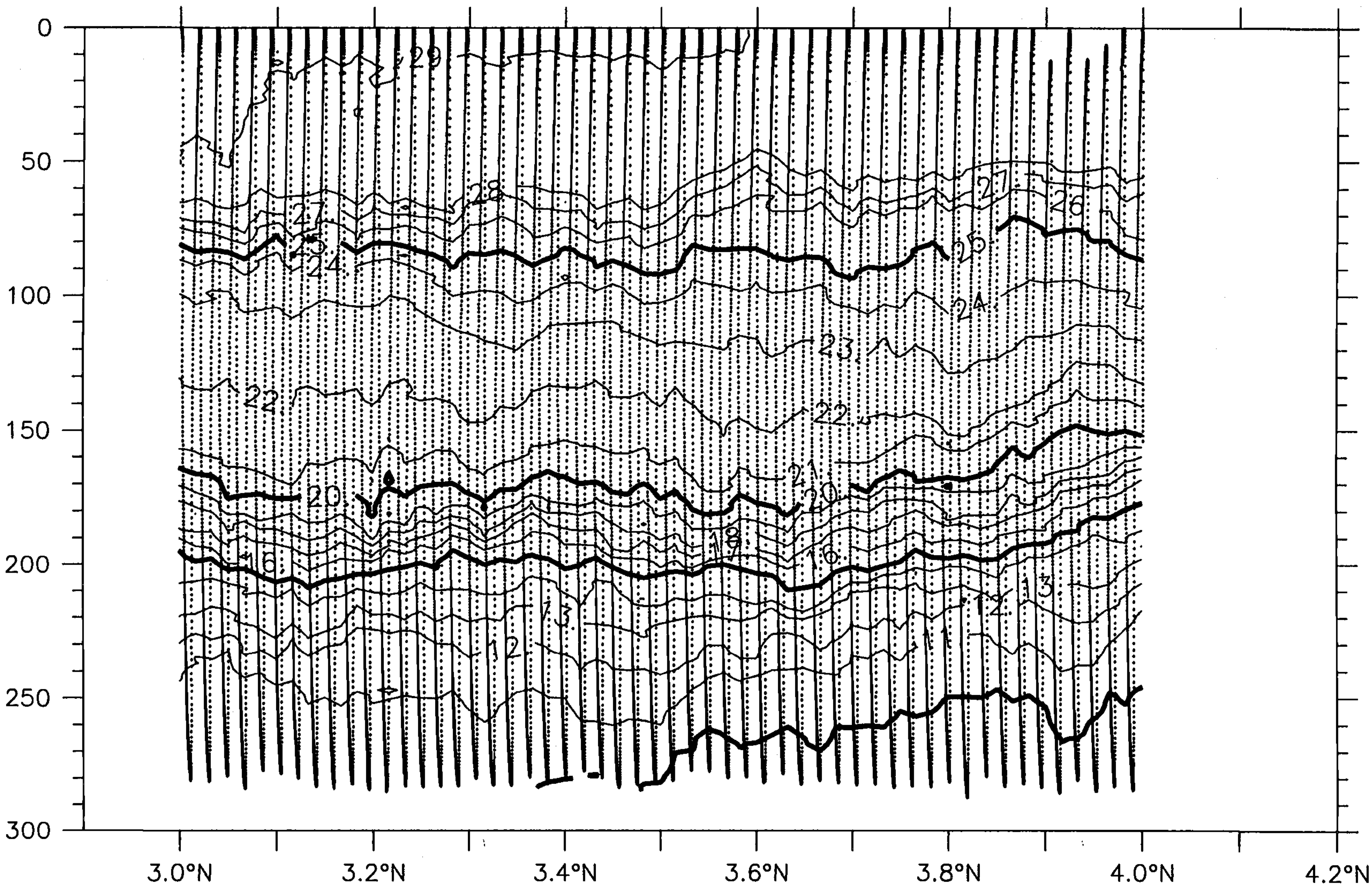
T(°C), Transit, 11 January 1993



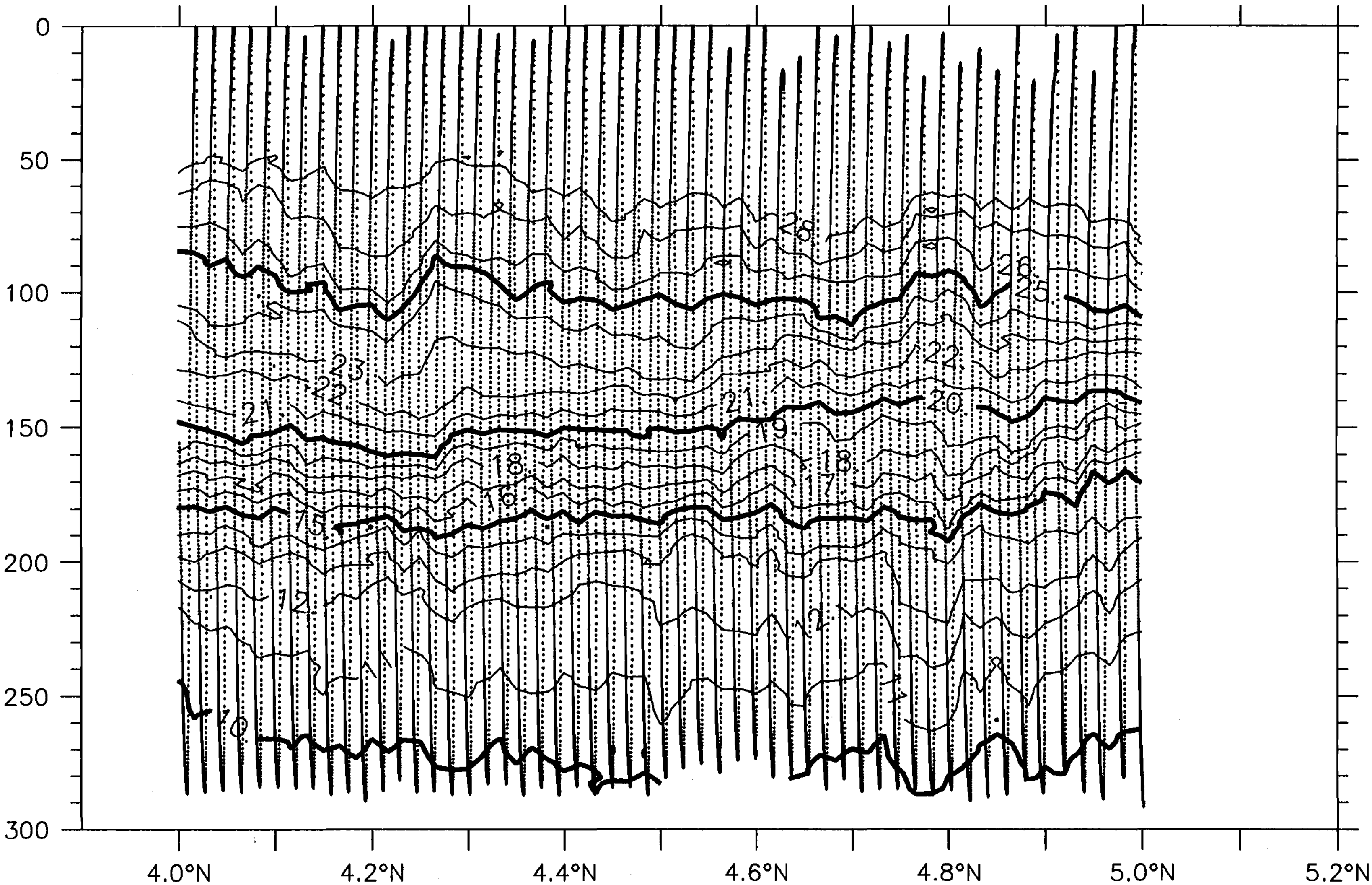
T(°C), Transit, 11 January 1993



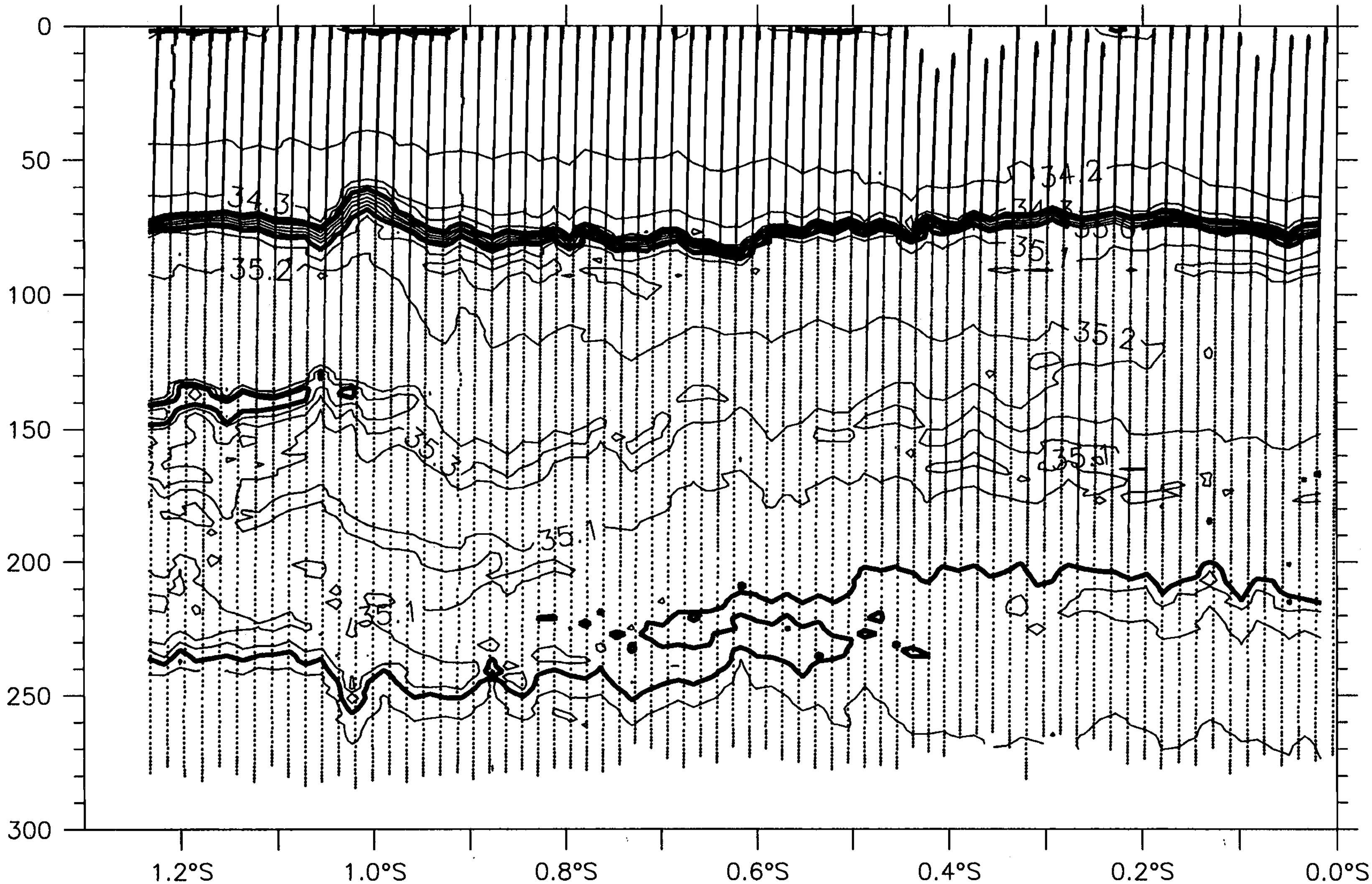
T(°C), Transit, 11–12 January 1993



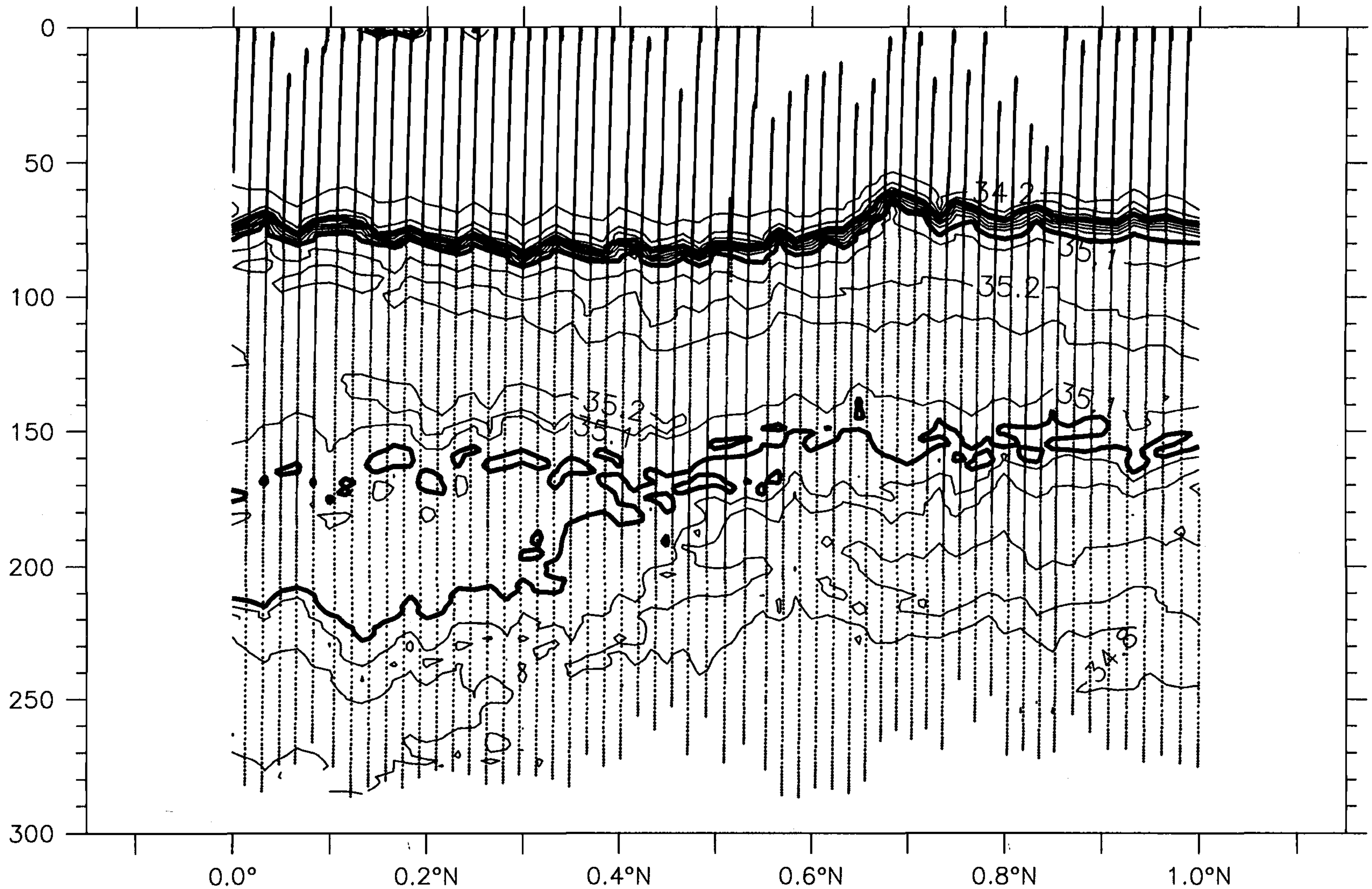
T(°C), Transit, 12 January 1993



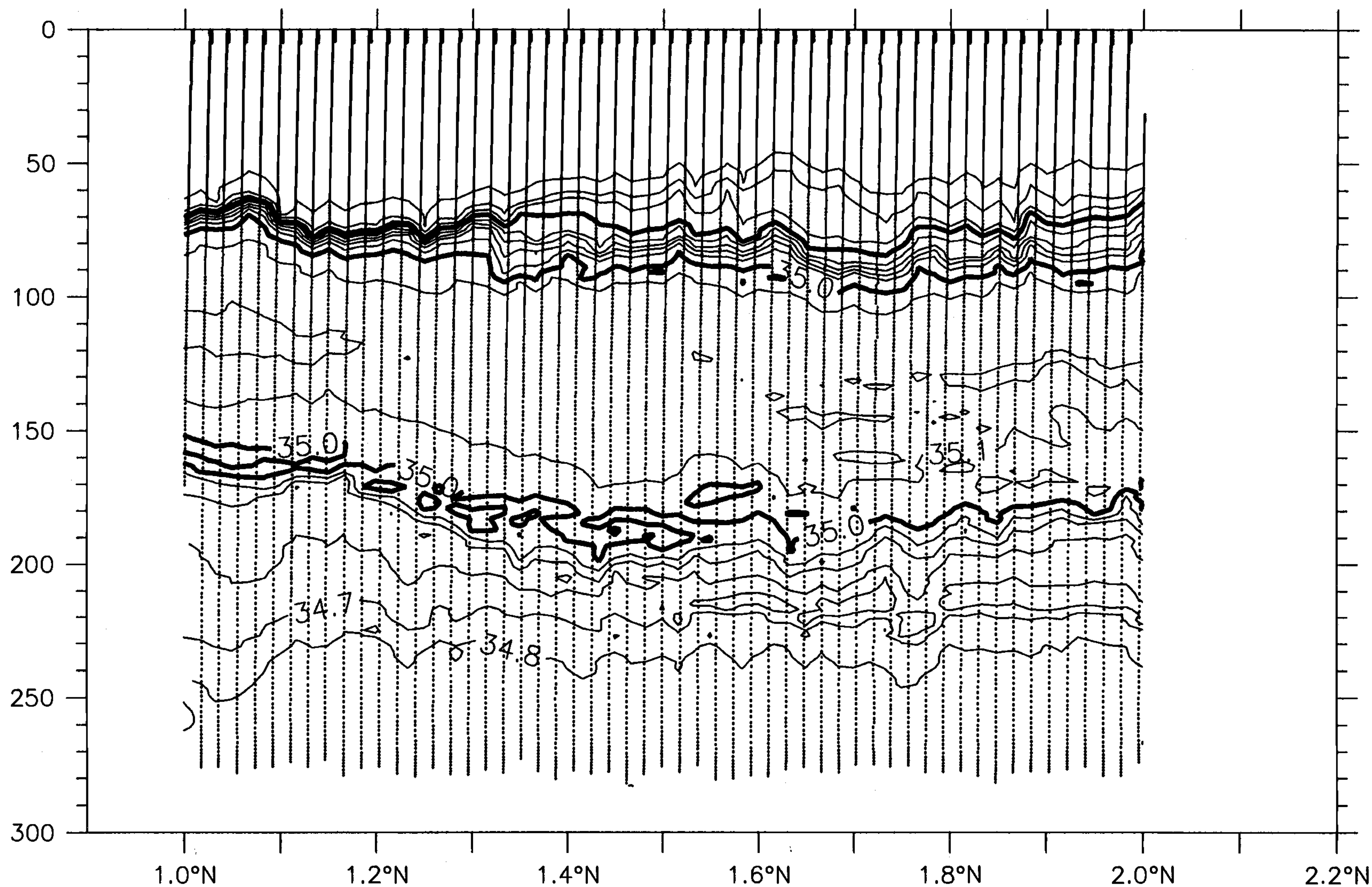
T(°C), Transit, 12 January 1993



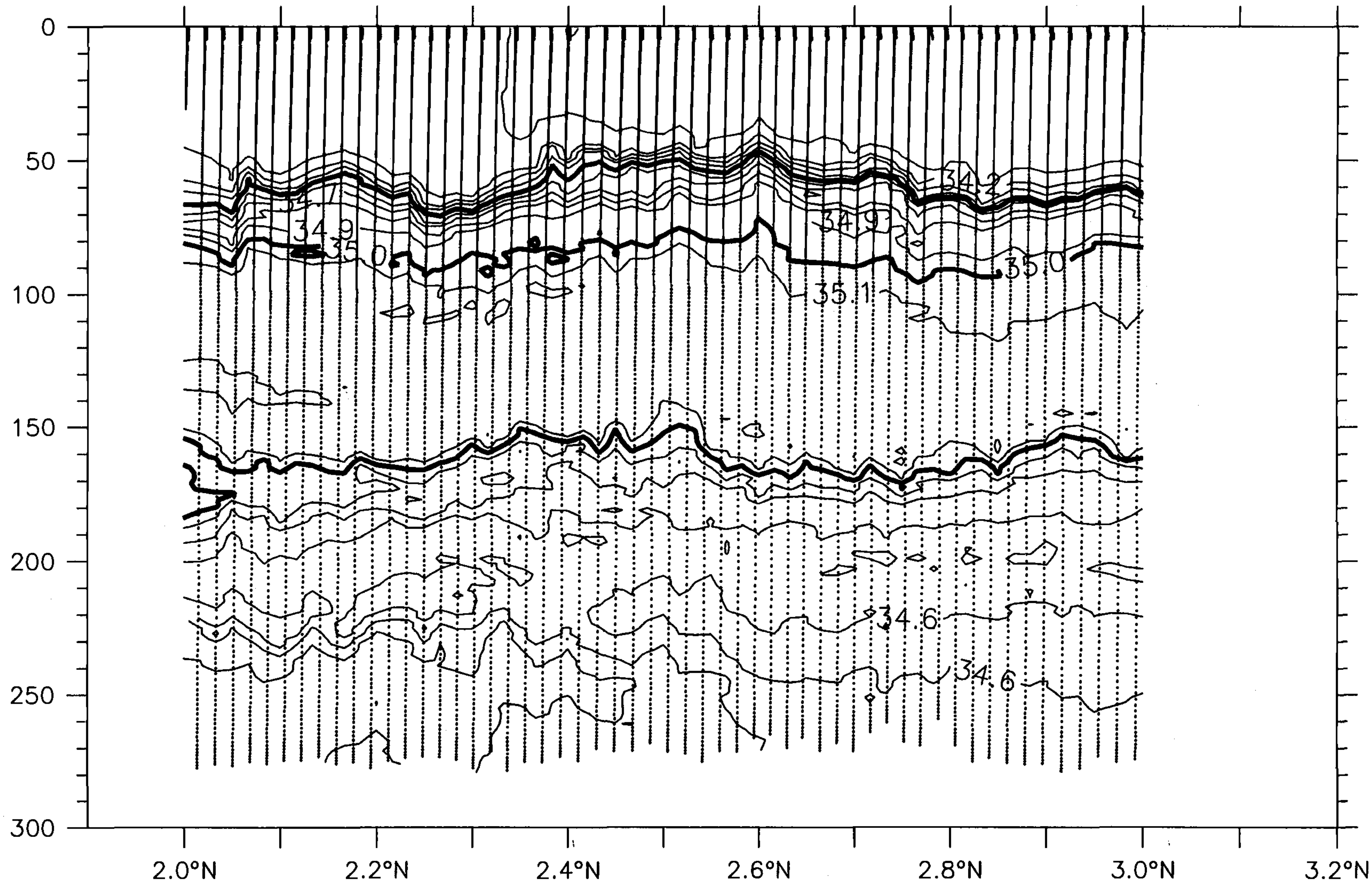
S(psu), Transit, 10–11 January 1993



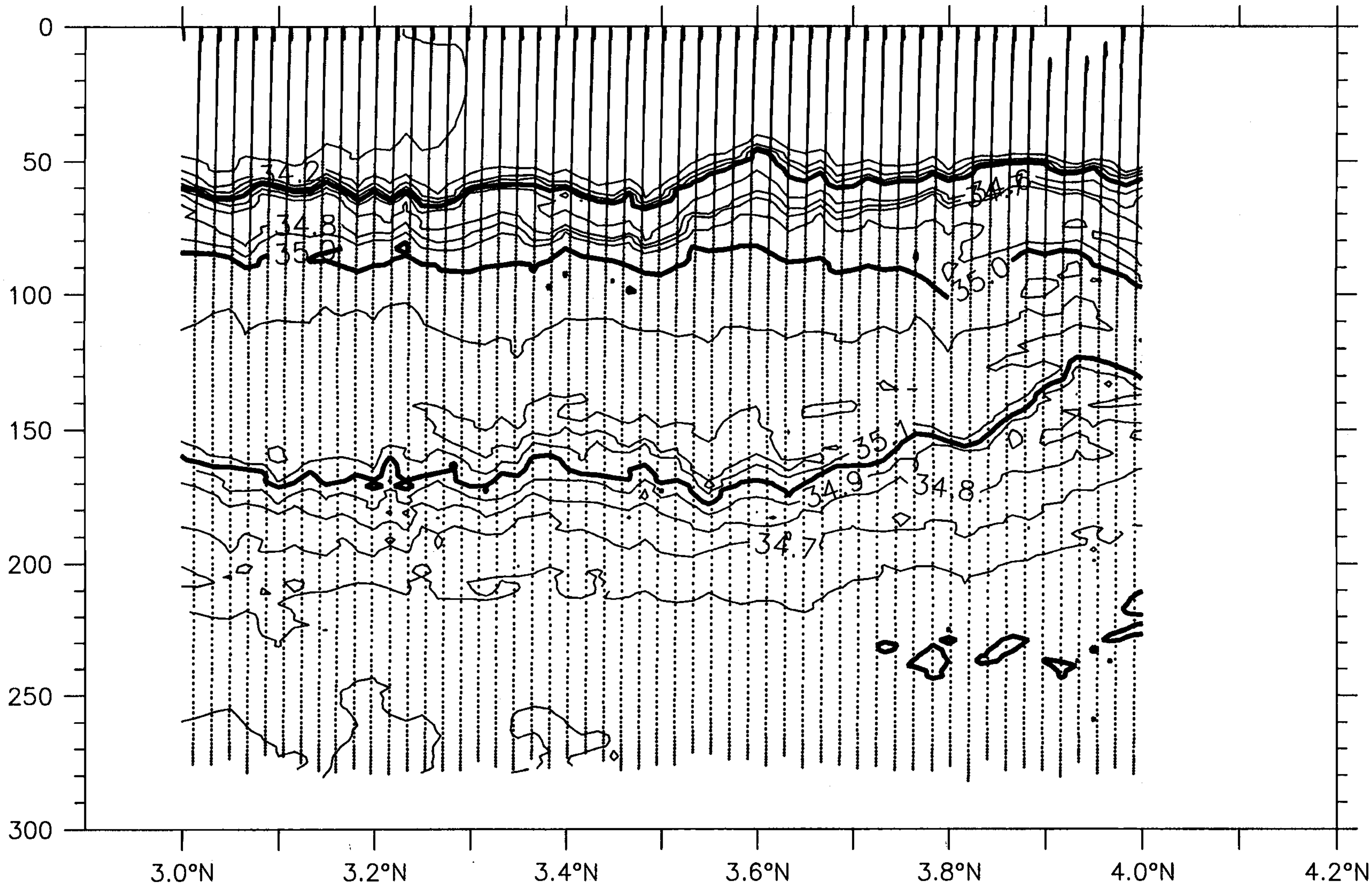
S(psu), Transit, 11 January 1993



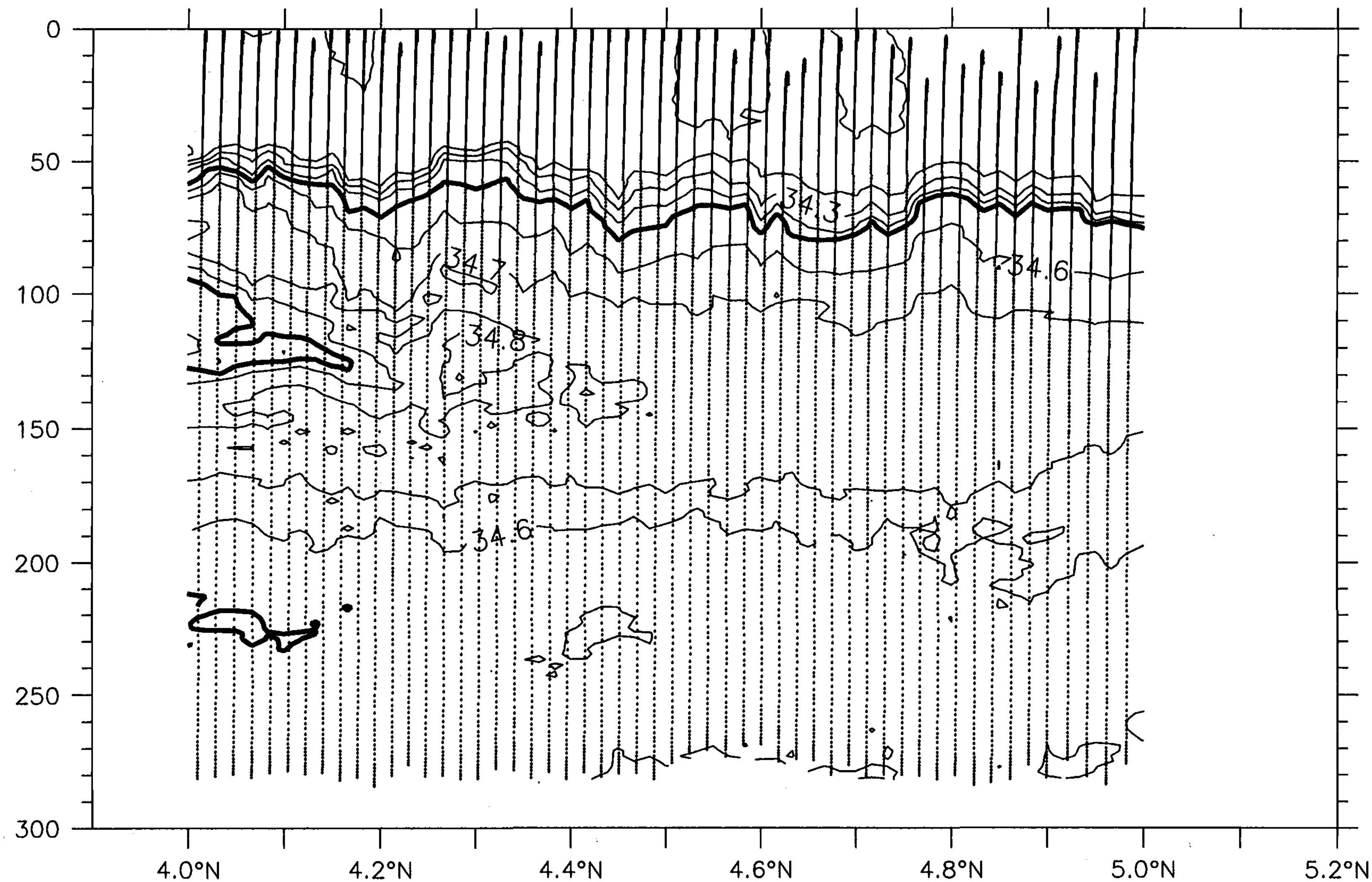
S(psu), Transit, 11 January 1993



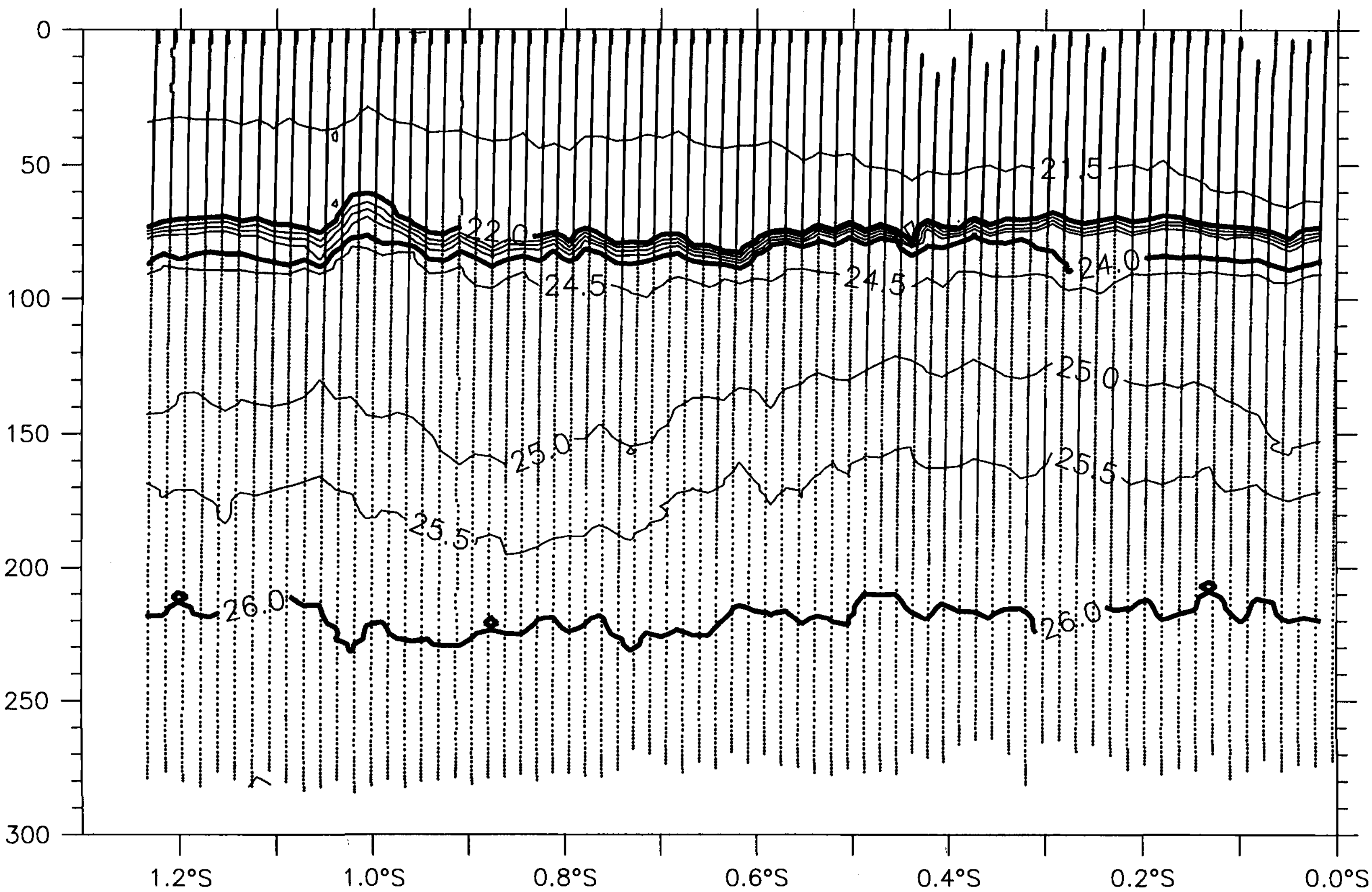
S(psu), Transit, 11–12 January 1993



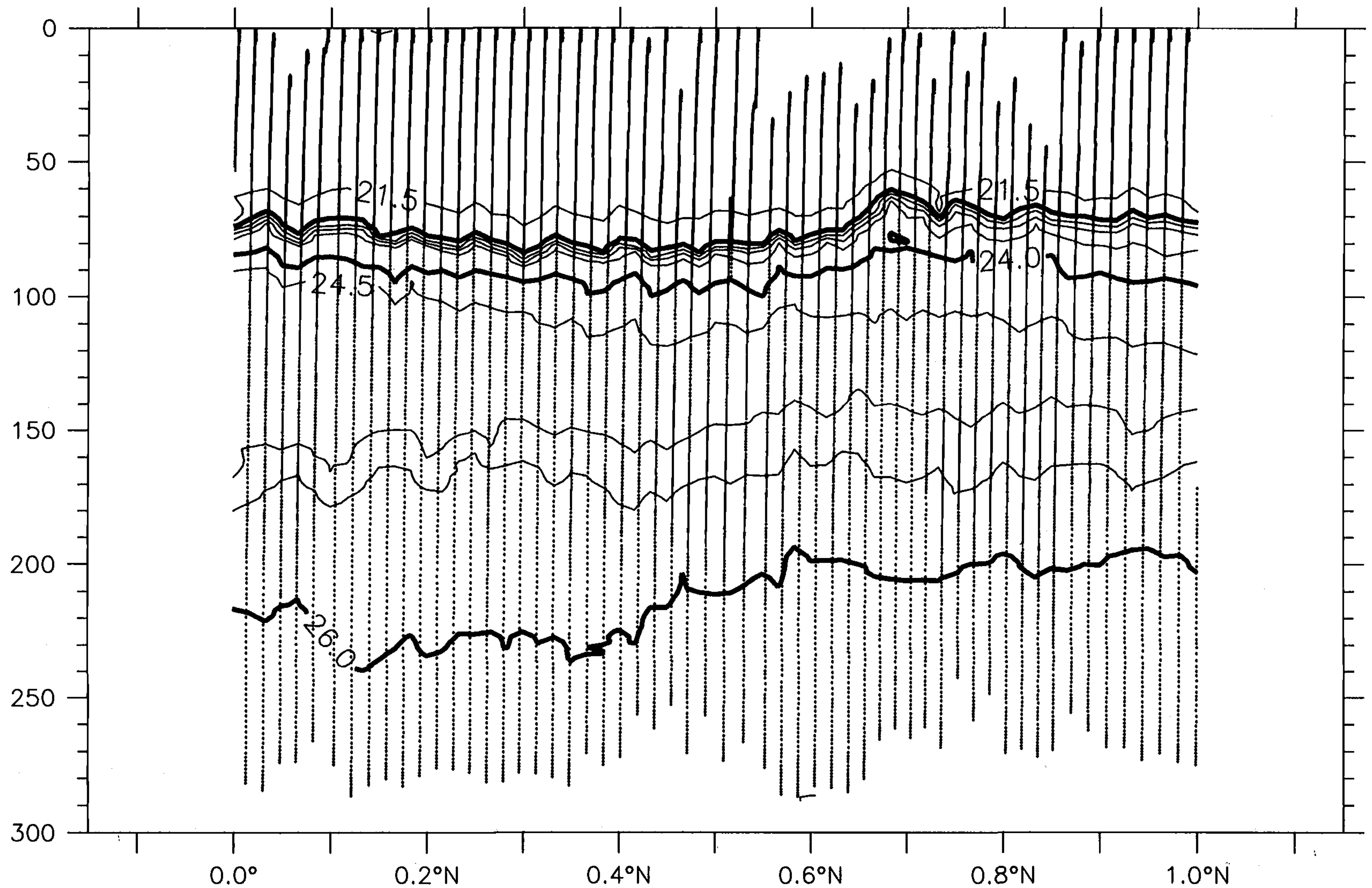
S(psu), Transit, 12 January 1993



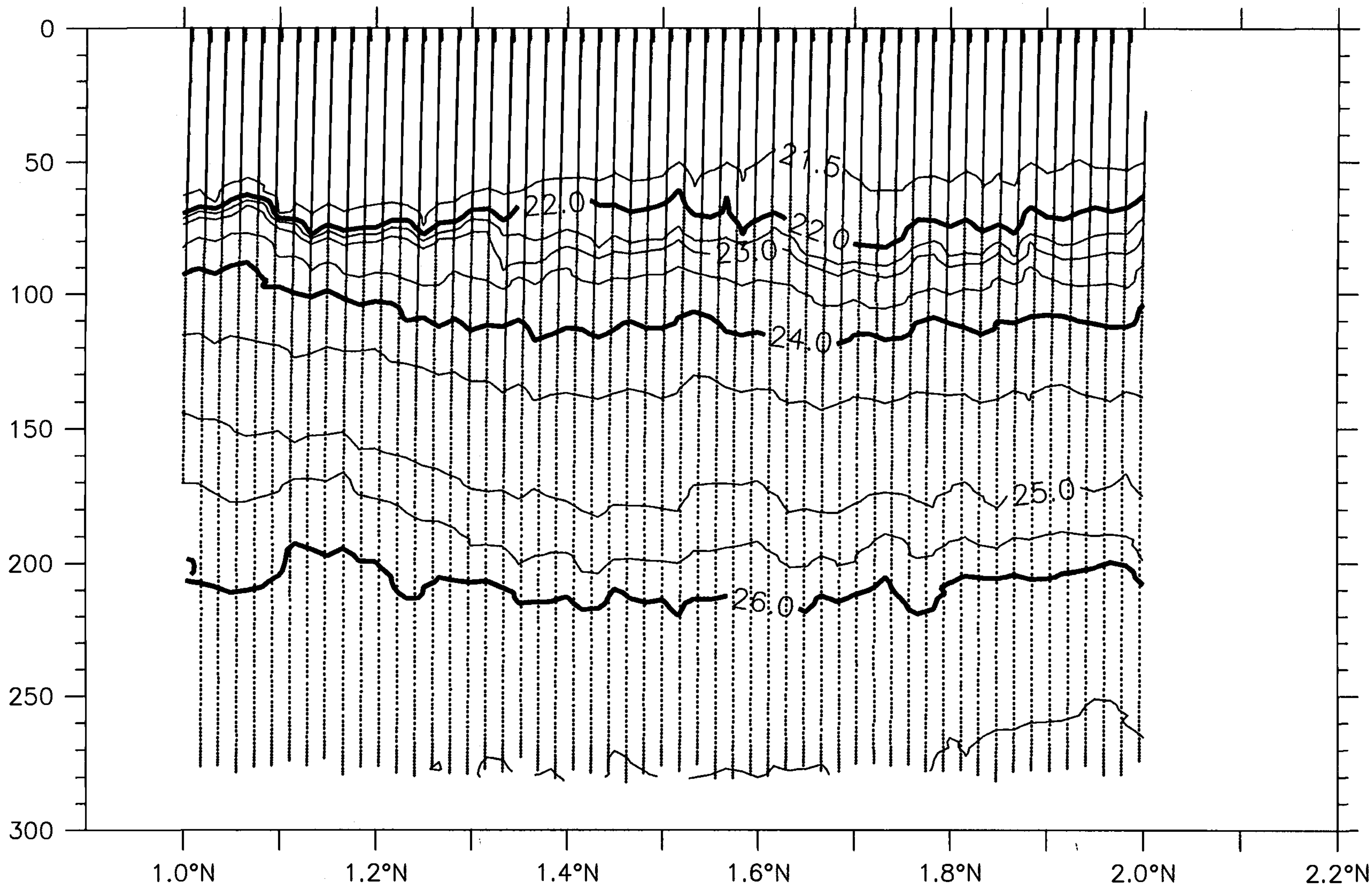
S(psu), Transit, 12 January 1993



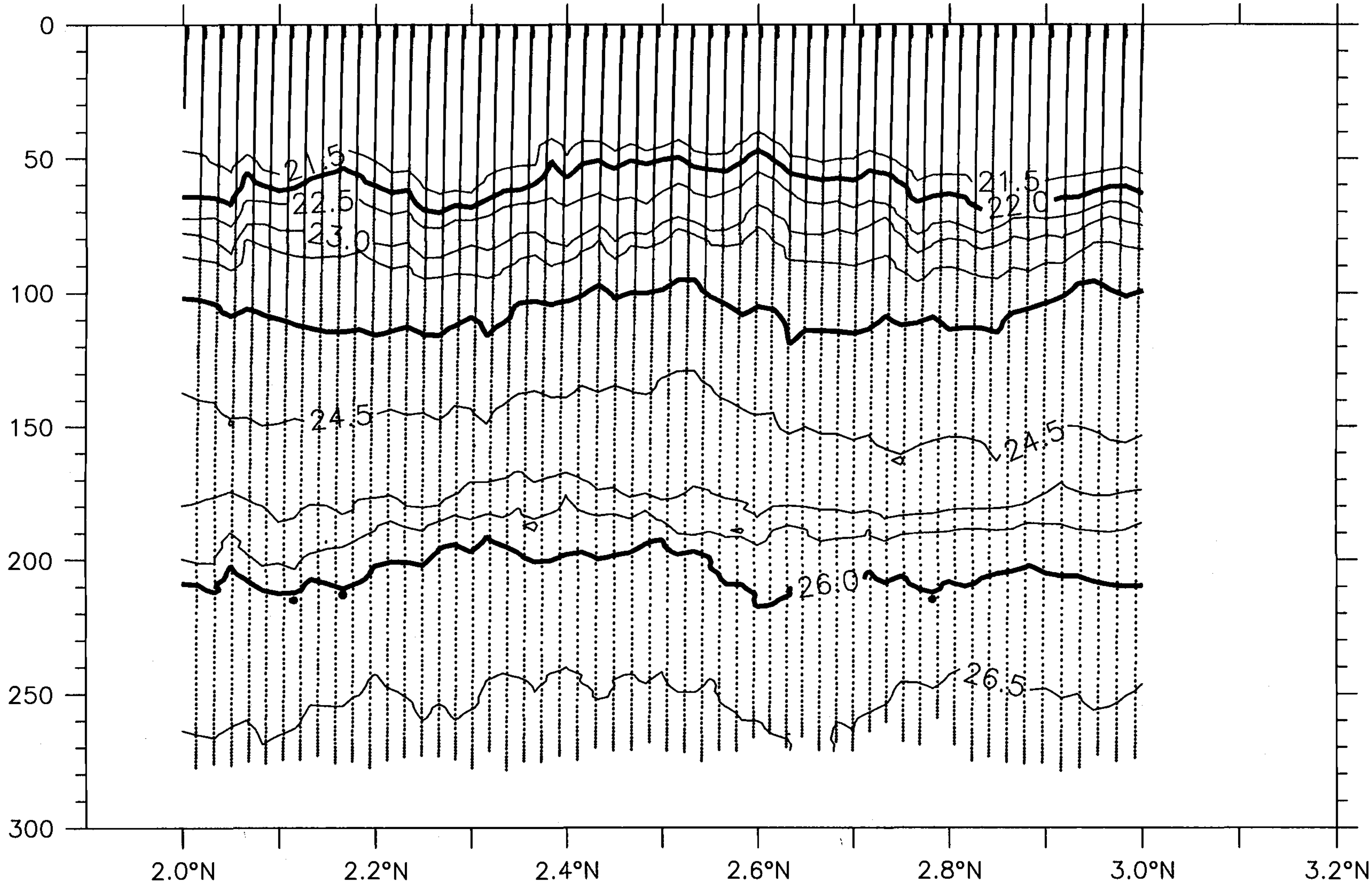
Sigma−t, Transit, 10−11 January 1993



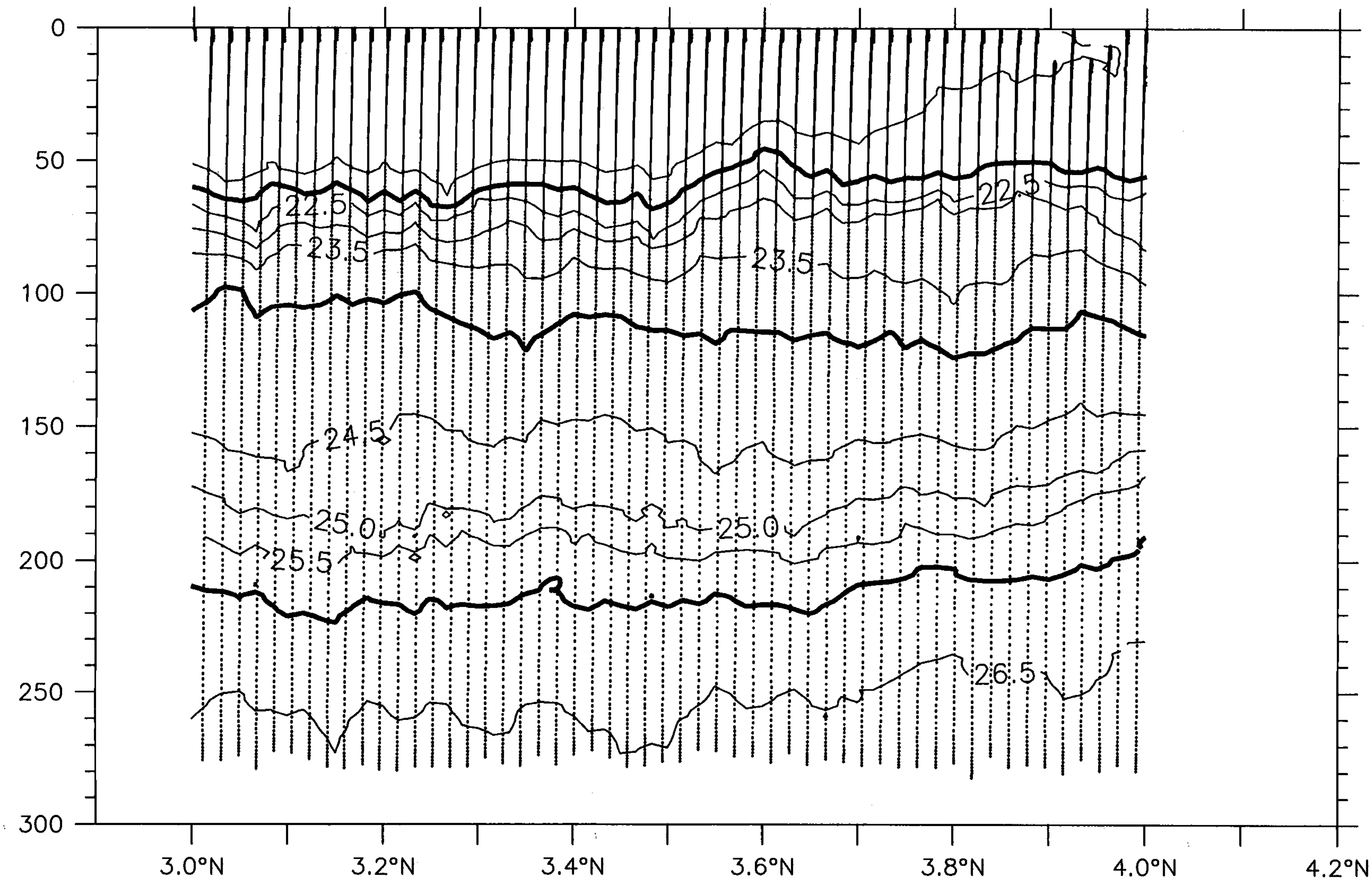
Sigma−t, Transit, 11 January 1993



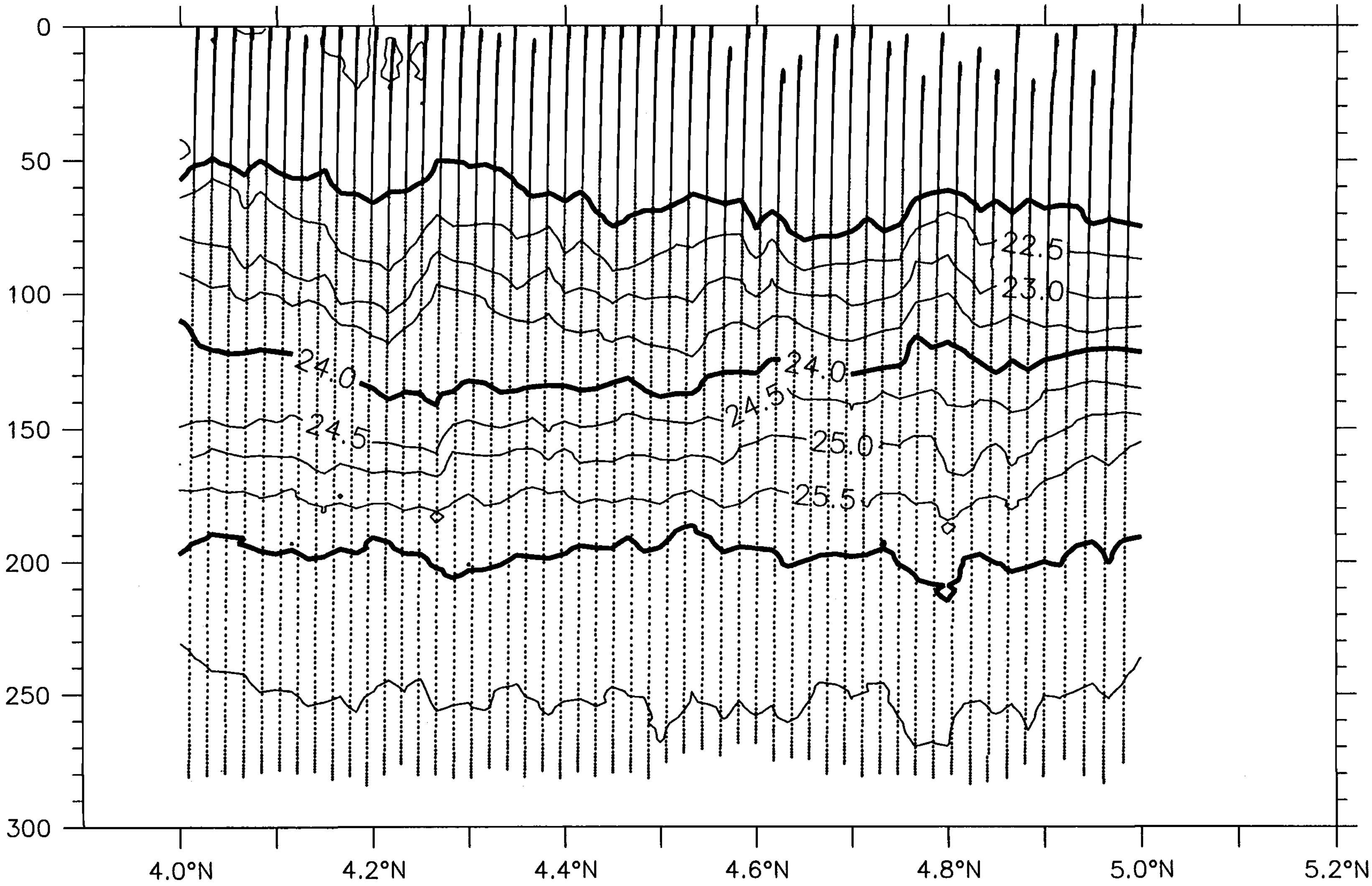
Sigma−t, Transit, 11 January 1993



Sigma−t, Transit, 11−12 January 1993



Sigma-t, Transit, 12 January 1993

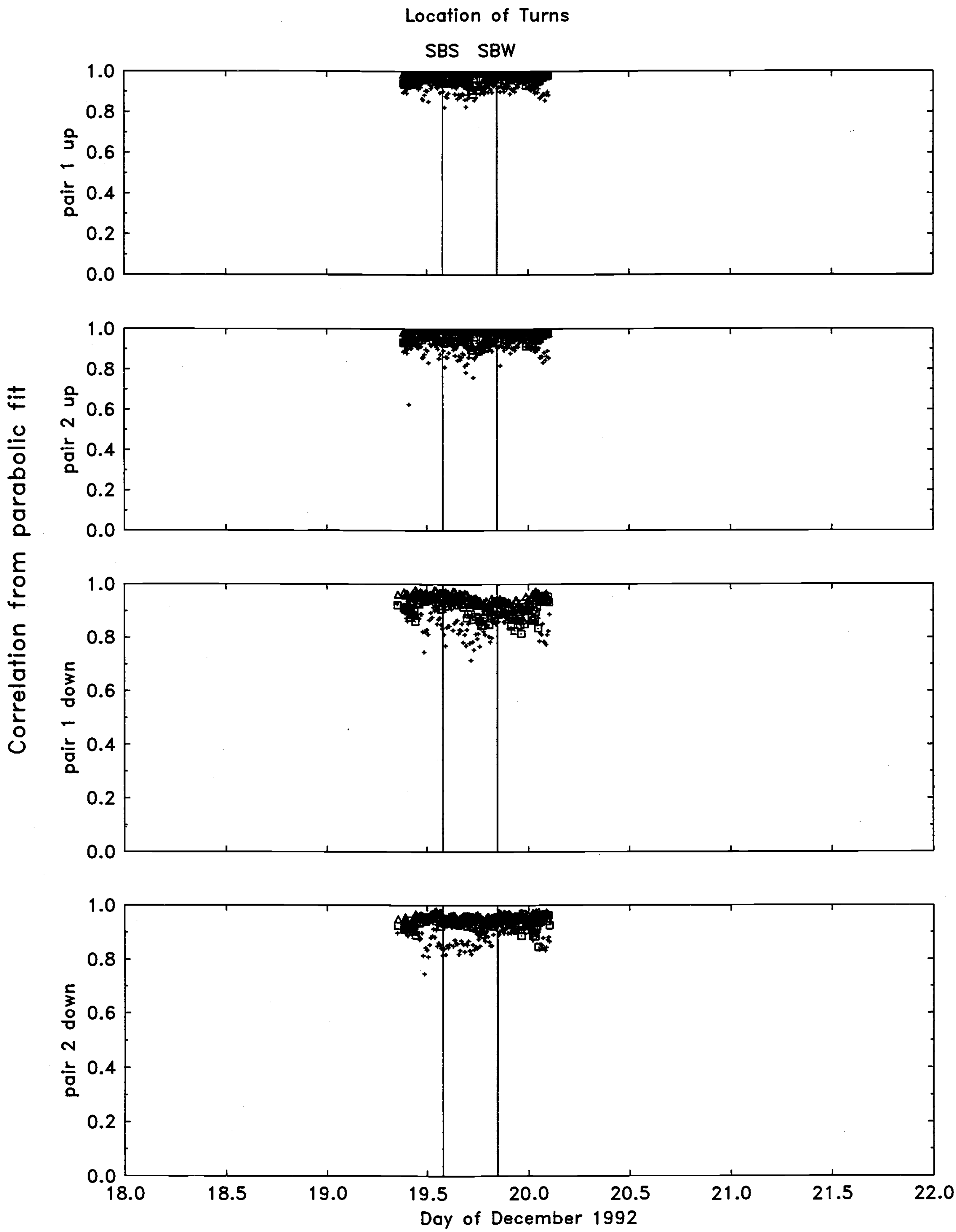


Sigma−t, Transit, 12 January 1993

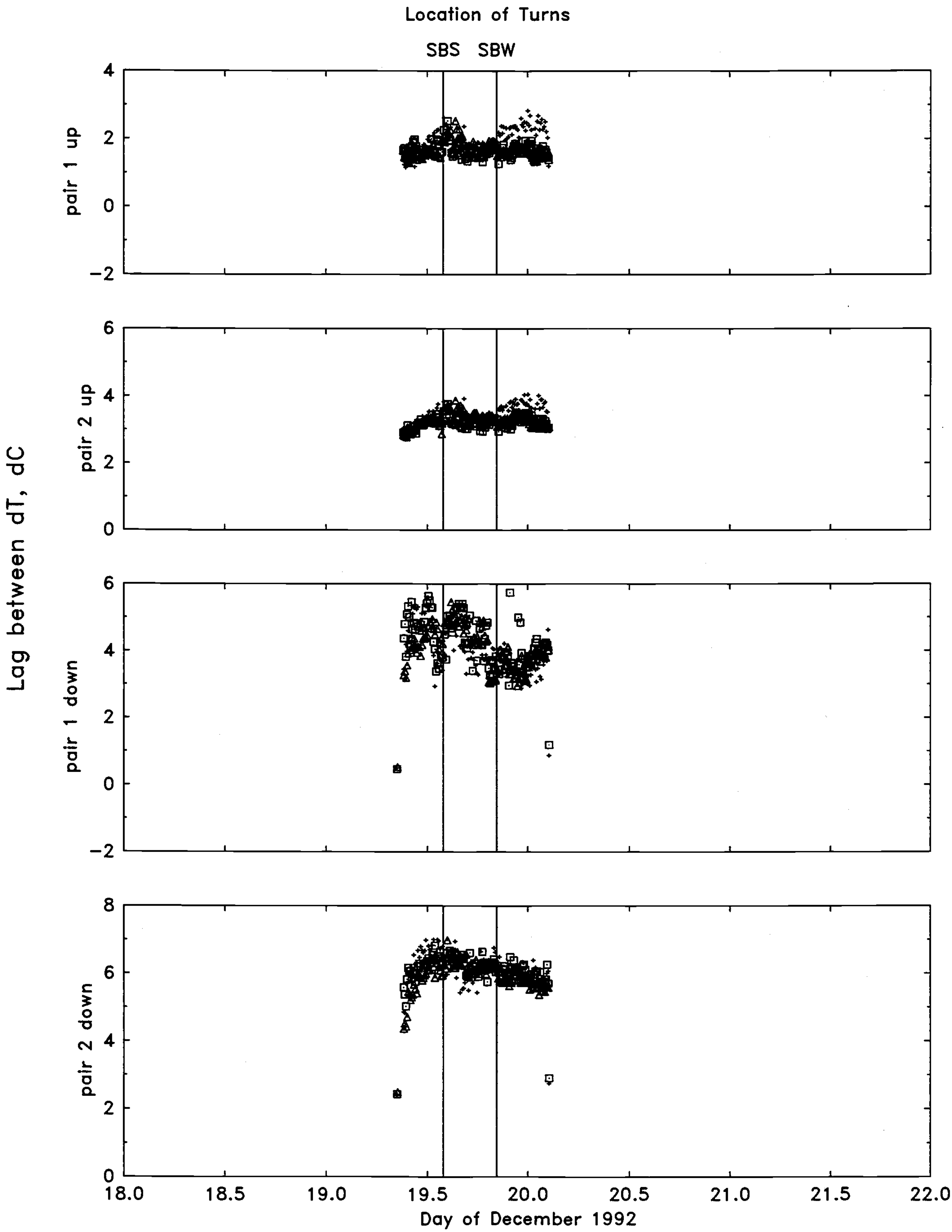
APPENDIX A:

Time Series of Lag of Maximum T/C Correlation

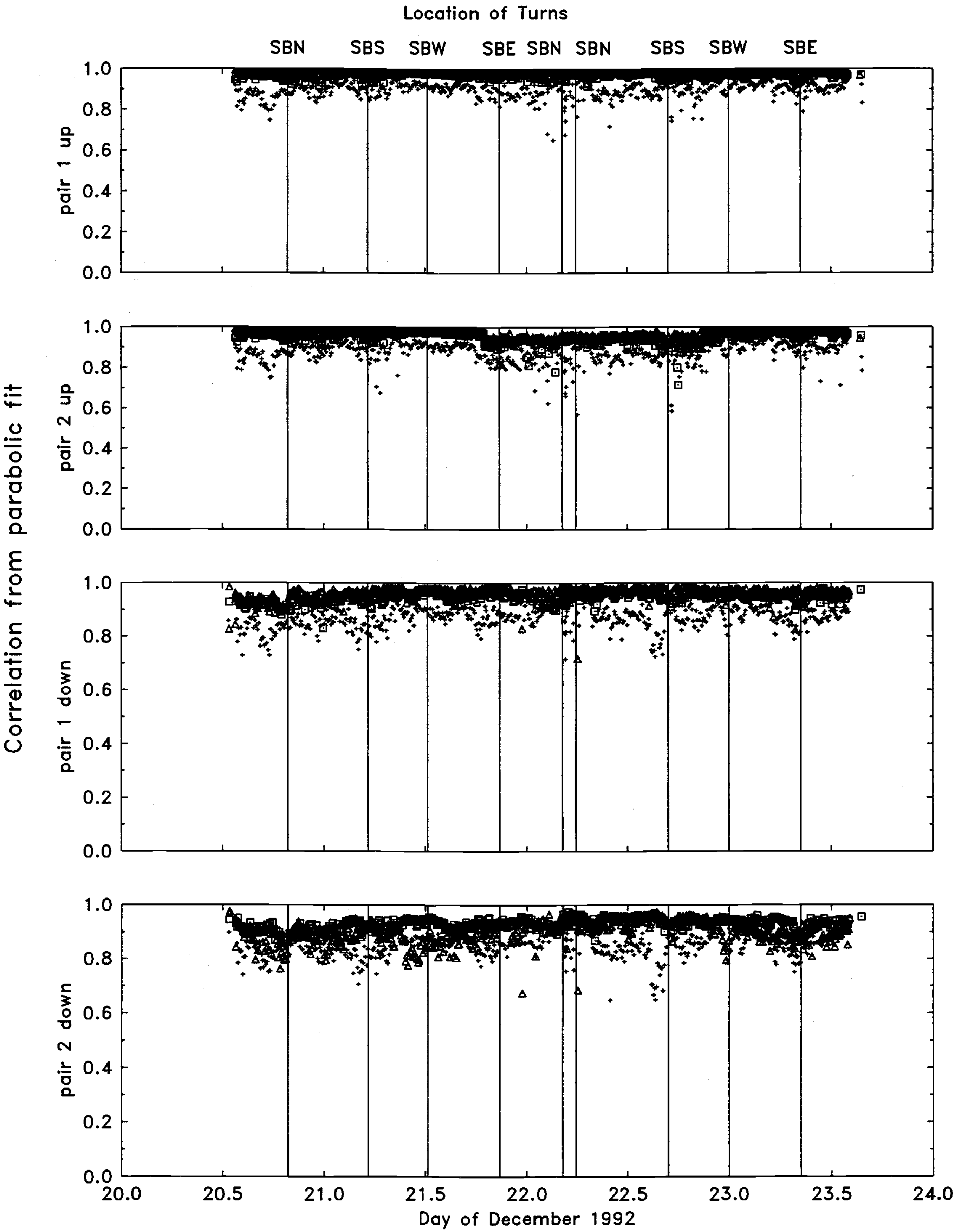
for Seasoar Tows 1 - 9



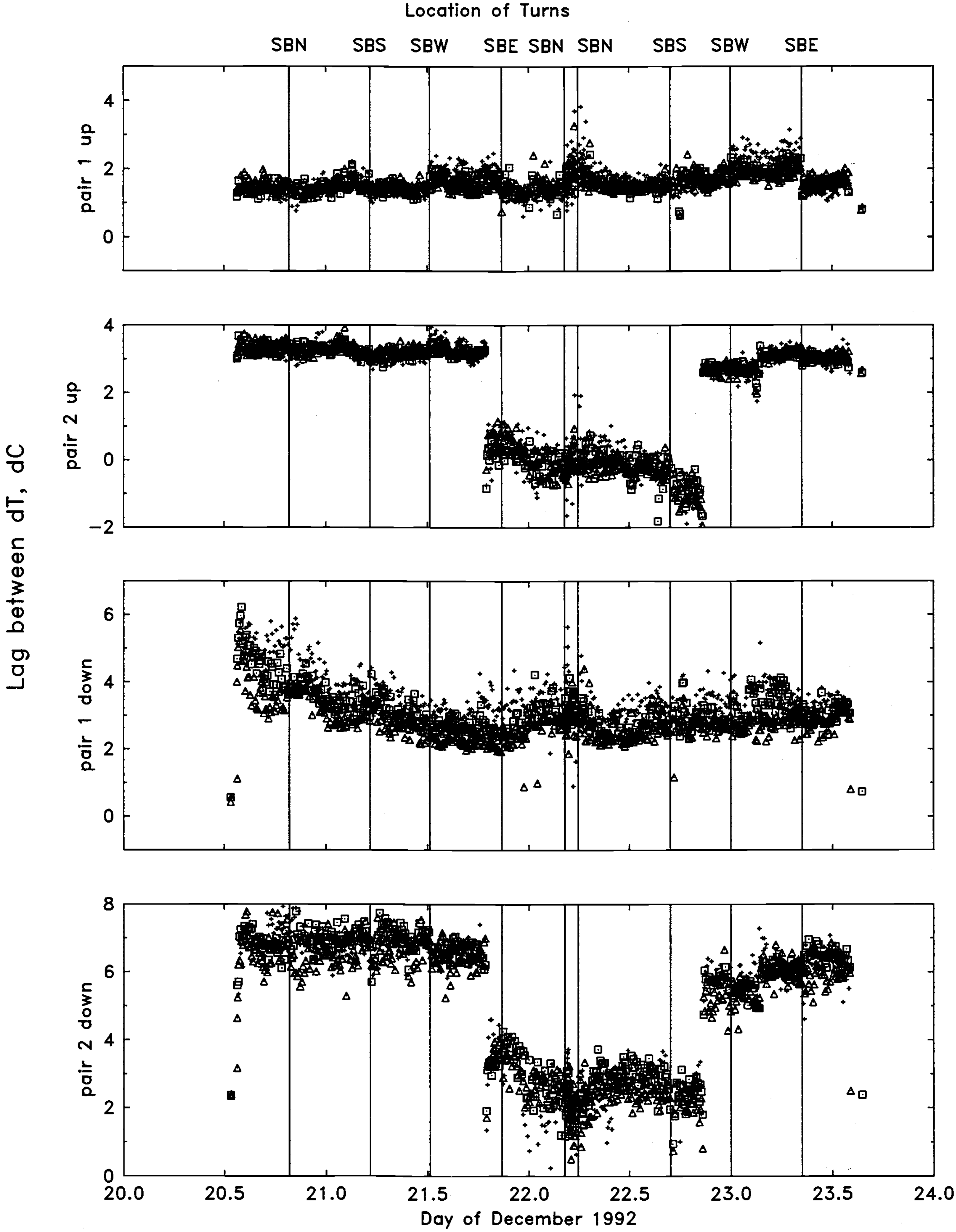
Leg 2 Tow 1, 50–120 db (plus) 120–180 db (square) 180–240 db (triangle)



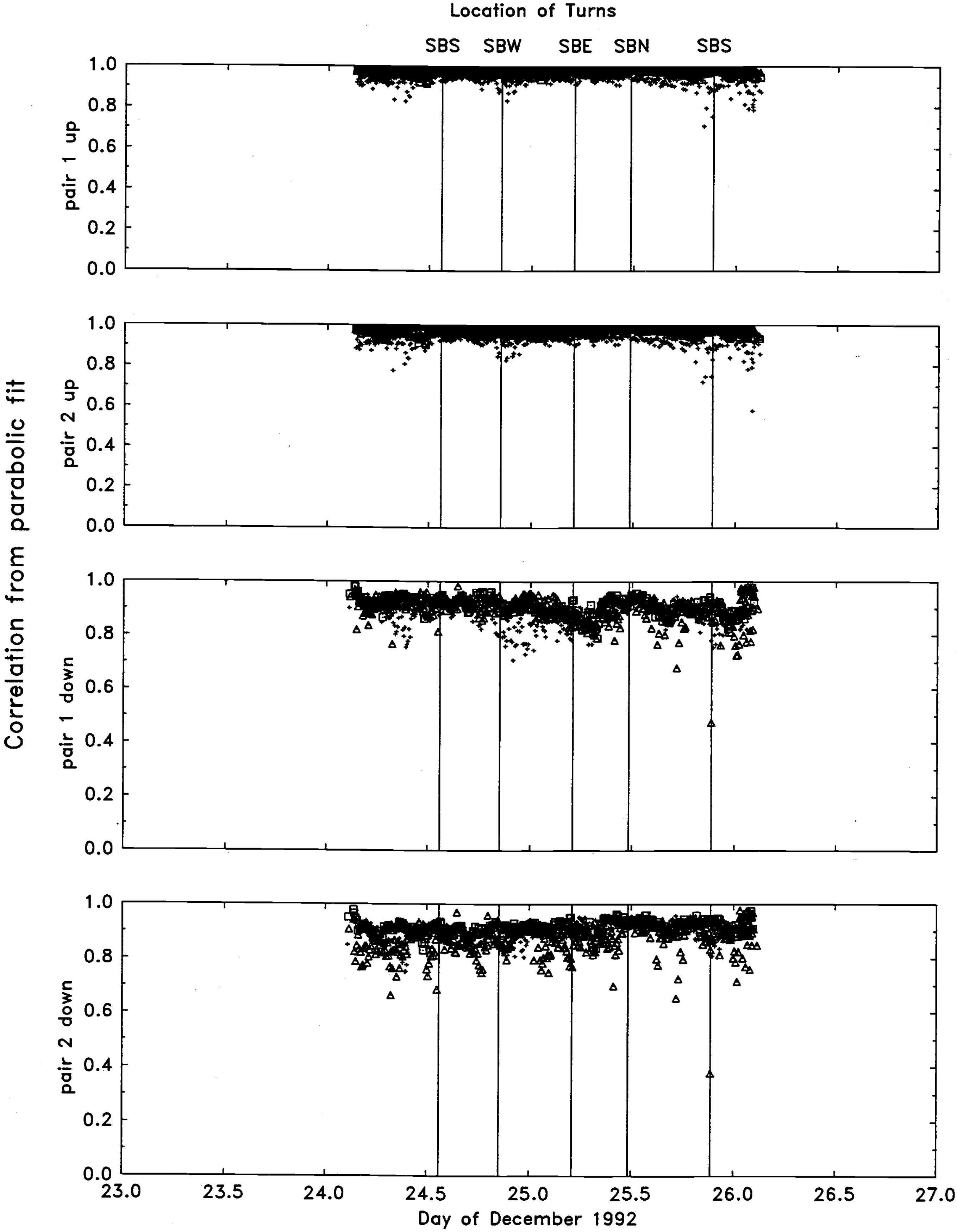
Leg 2 Tow 1, 50–120 db (plus) 120–180 db (square) 180–240 db (triangle)



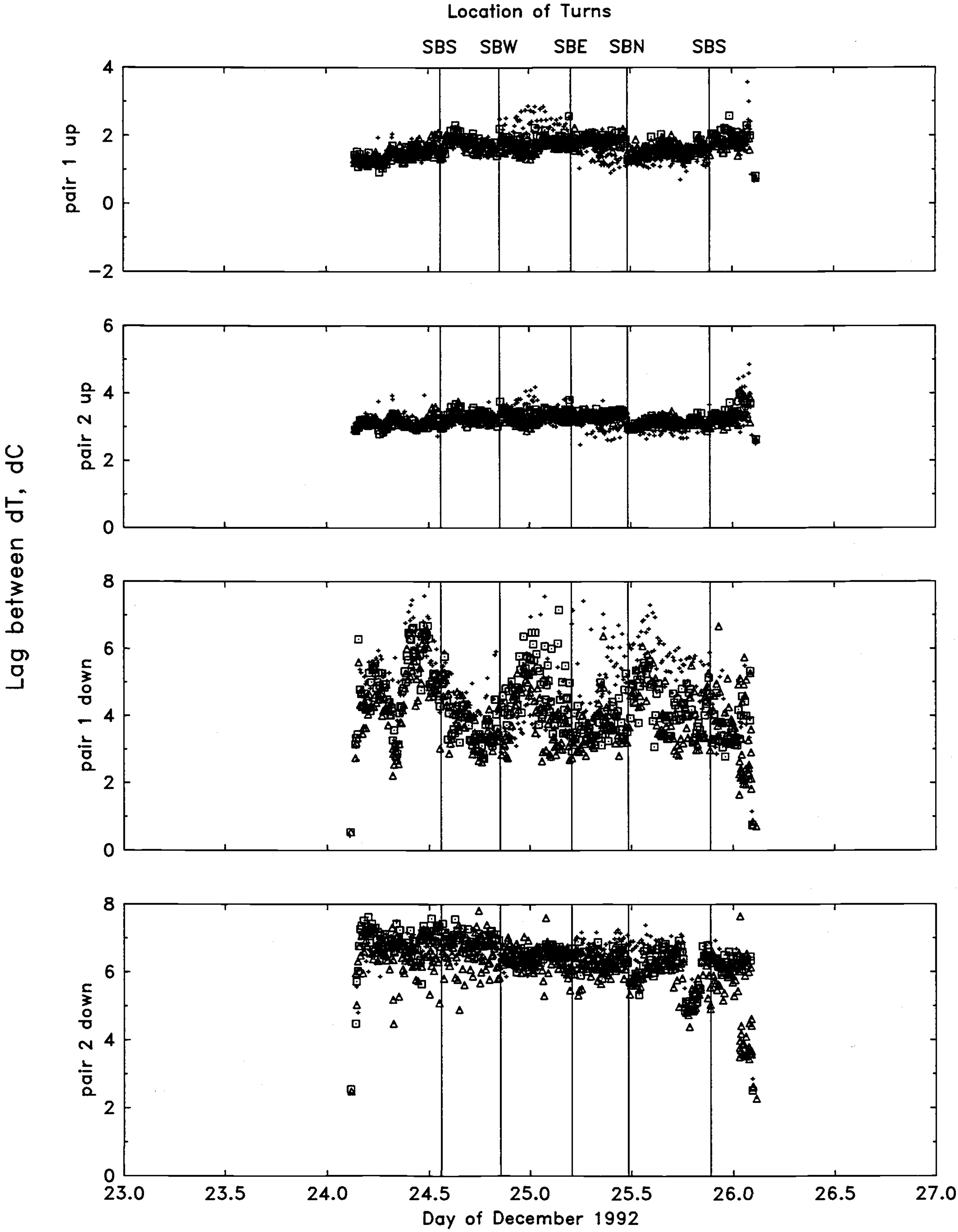
Leg 2 Tow 2, 50–120 db (plus) 120–180 db (square) 180–240 db (triangle)



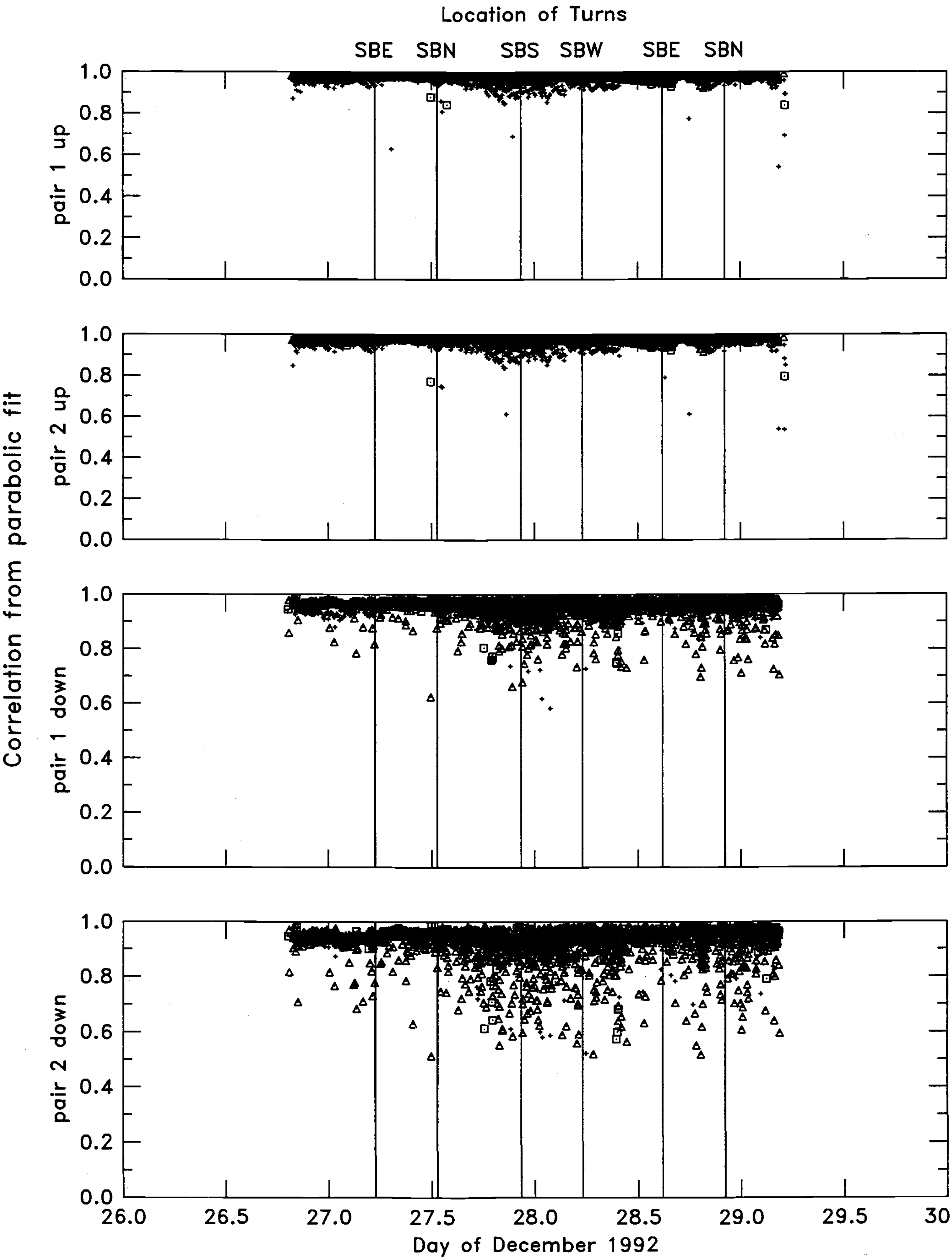
Leg 2 Tow 2, 50−120 db (plus) 120−180 db (square) 180−240 db (triangle)



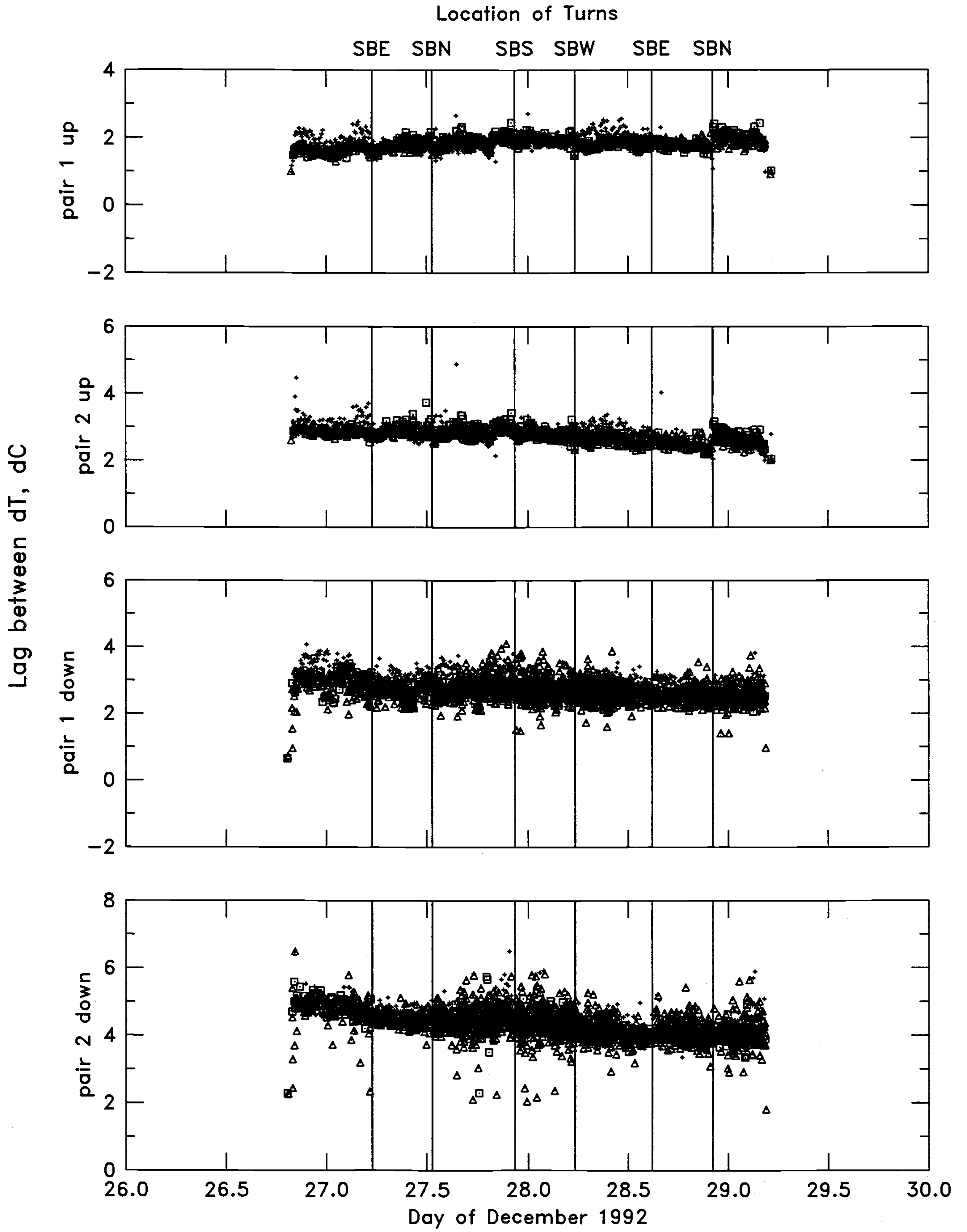
Leg 2 Tow 3, 50−120 db (plus) 120−180 db (square) 180−240 db (triangle)



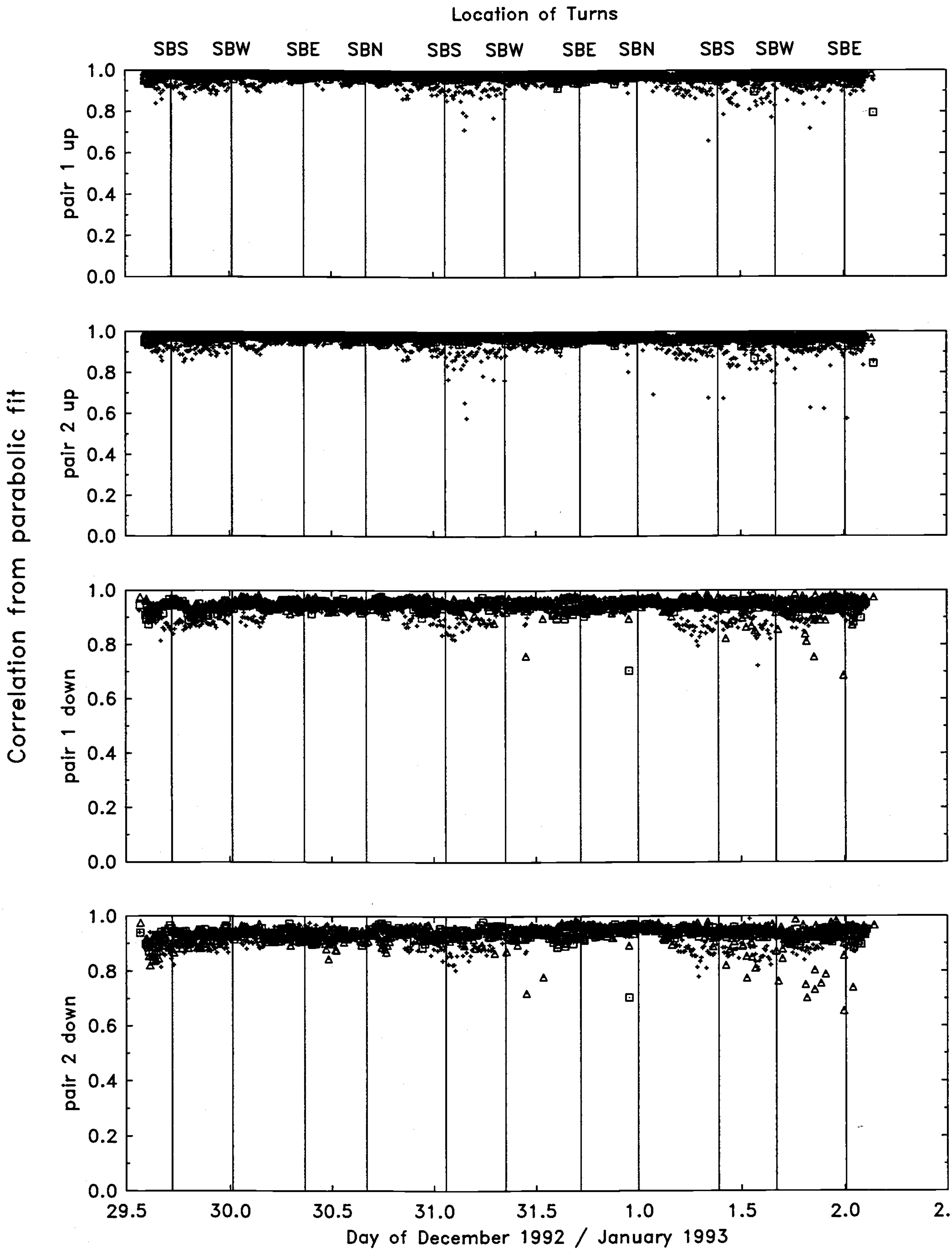
Leg 2 Tow 3, 50–120 db (plus) 120–180 db (square) 180–240 db (triangle)



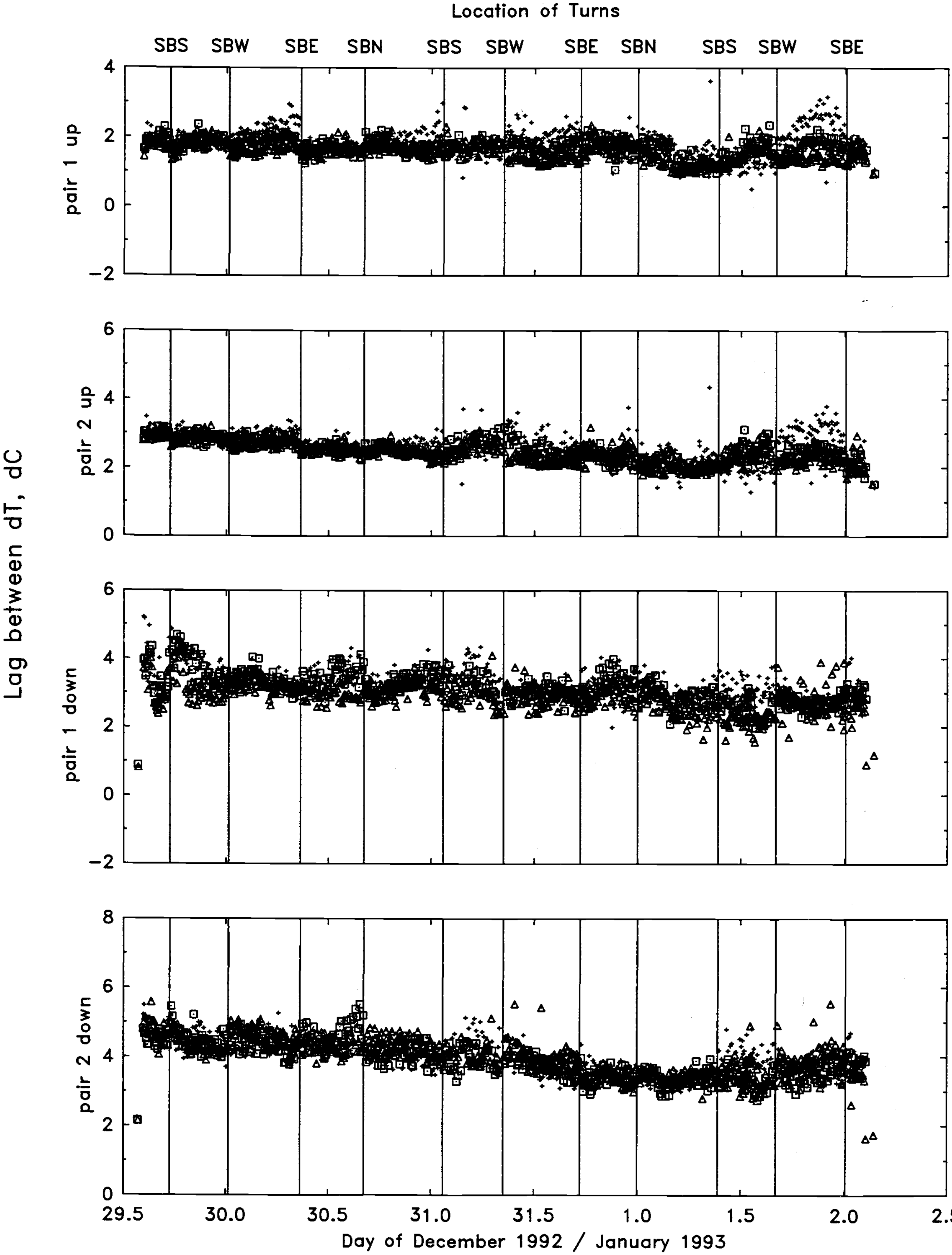
Leg 2 Tow 4, 50–120 db (plus) 120–180 db (square) 180–240 db (triangle)



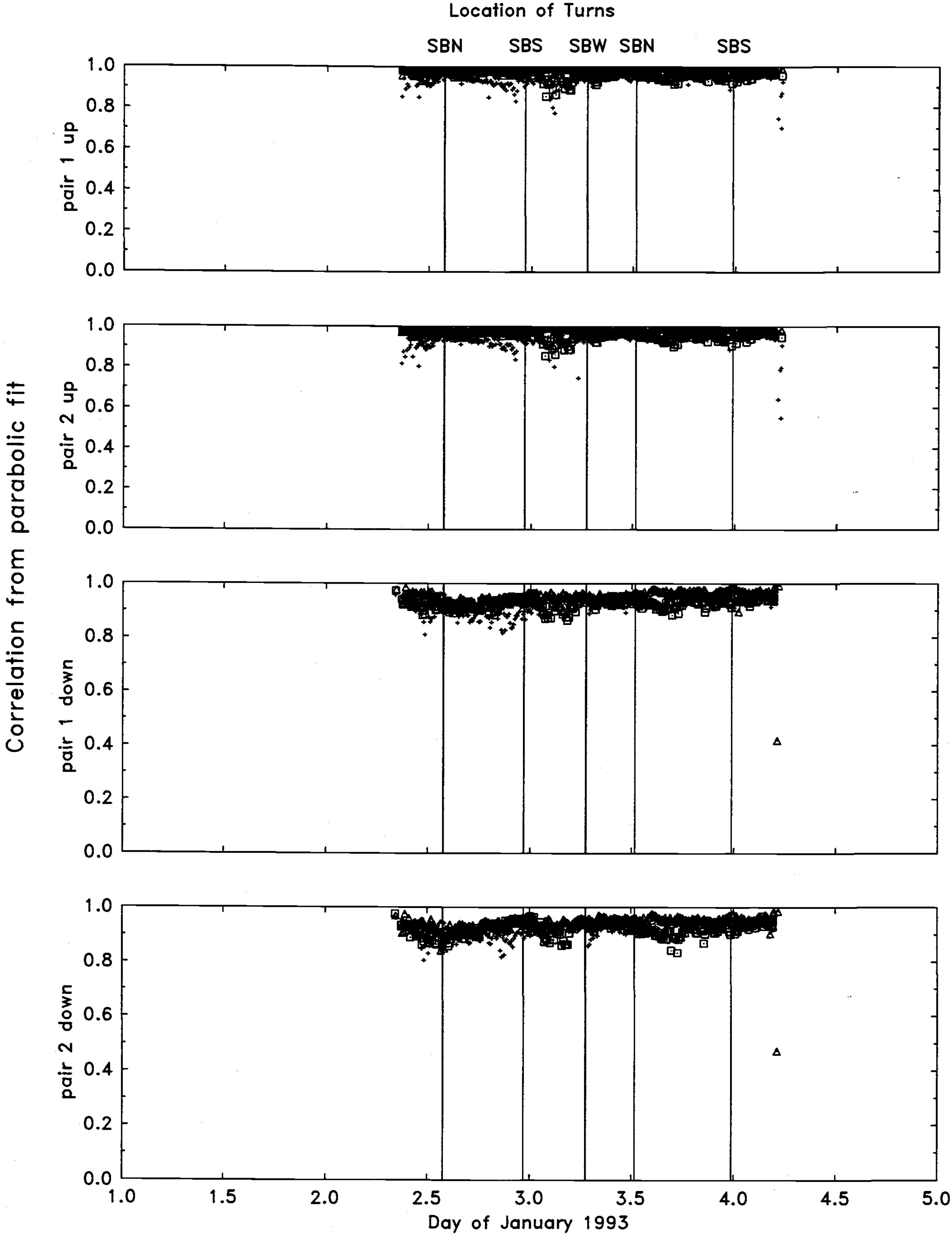
Leg 2 Tow 4, 50–120 db (plus) 120–180 db (square) 180–240 db (triangle)



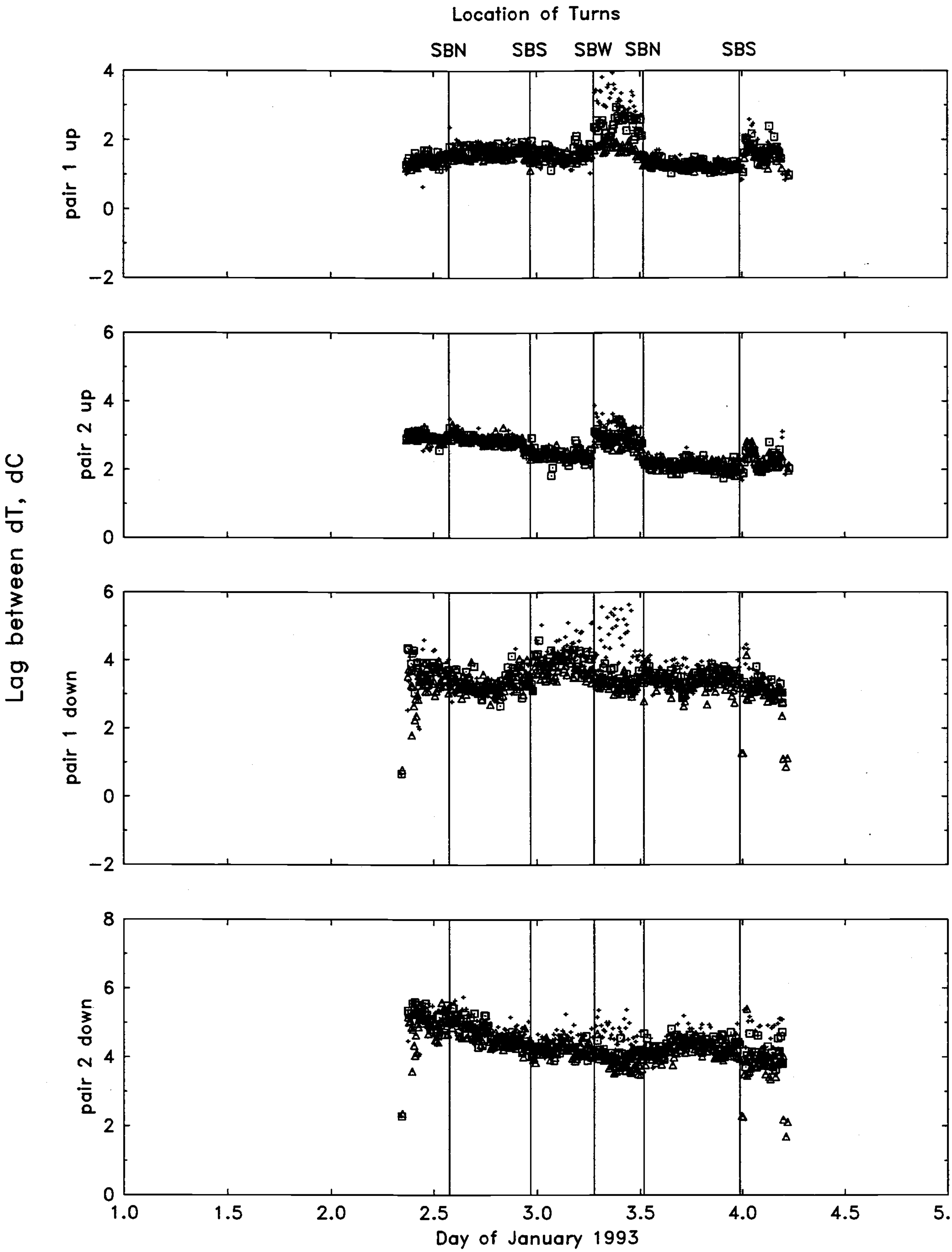
Leg 2 Tow 5, 50–120 db (plus) 120–180 db (square) 180–240 db (triangle)



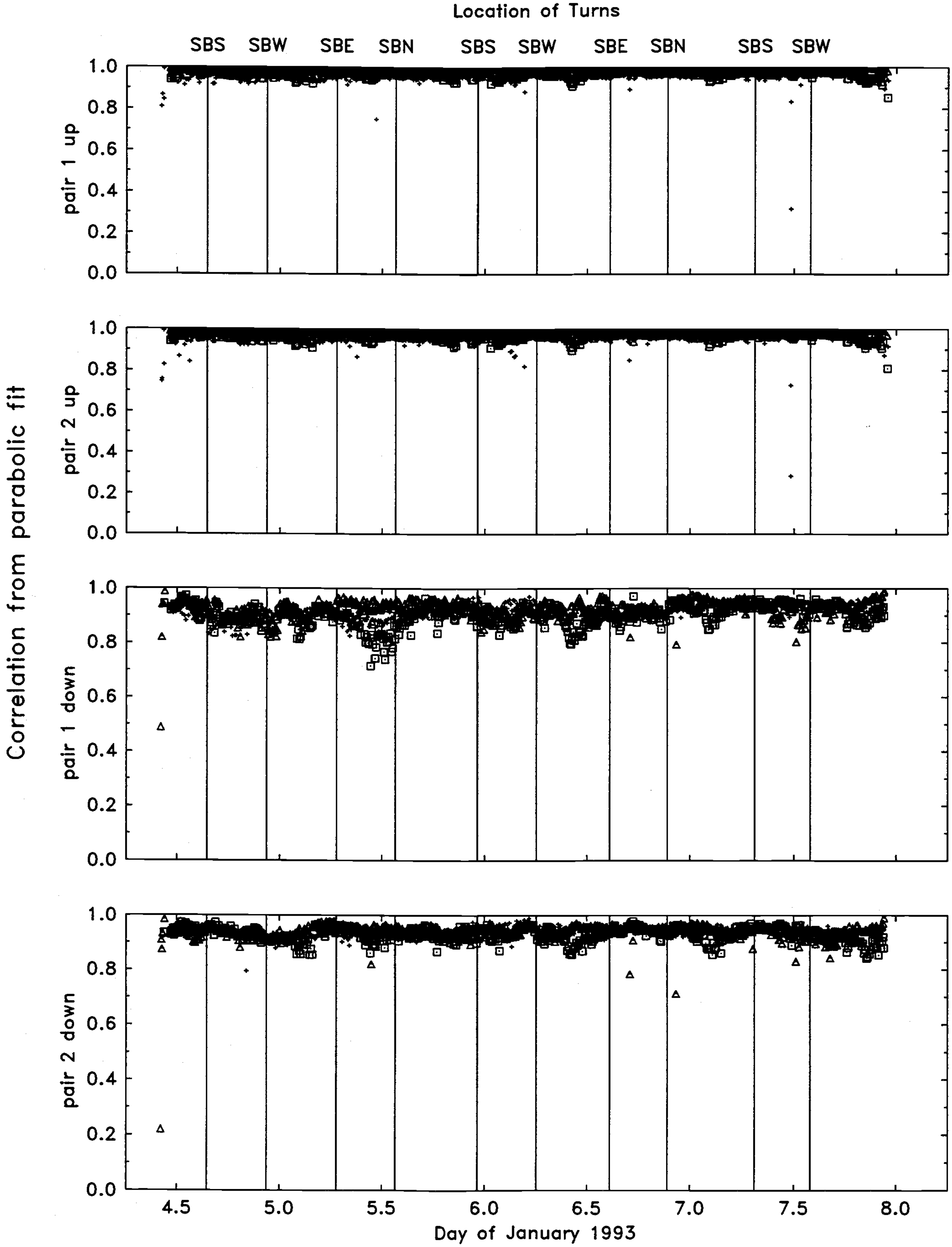
Leg 2 Tow 5, 50–120 db (plus) 120–180 db (square) 180–240 db (triangle)



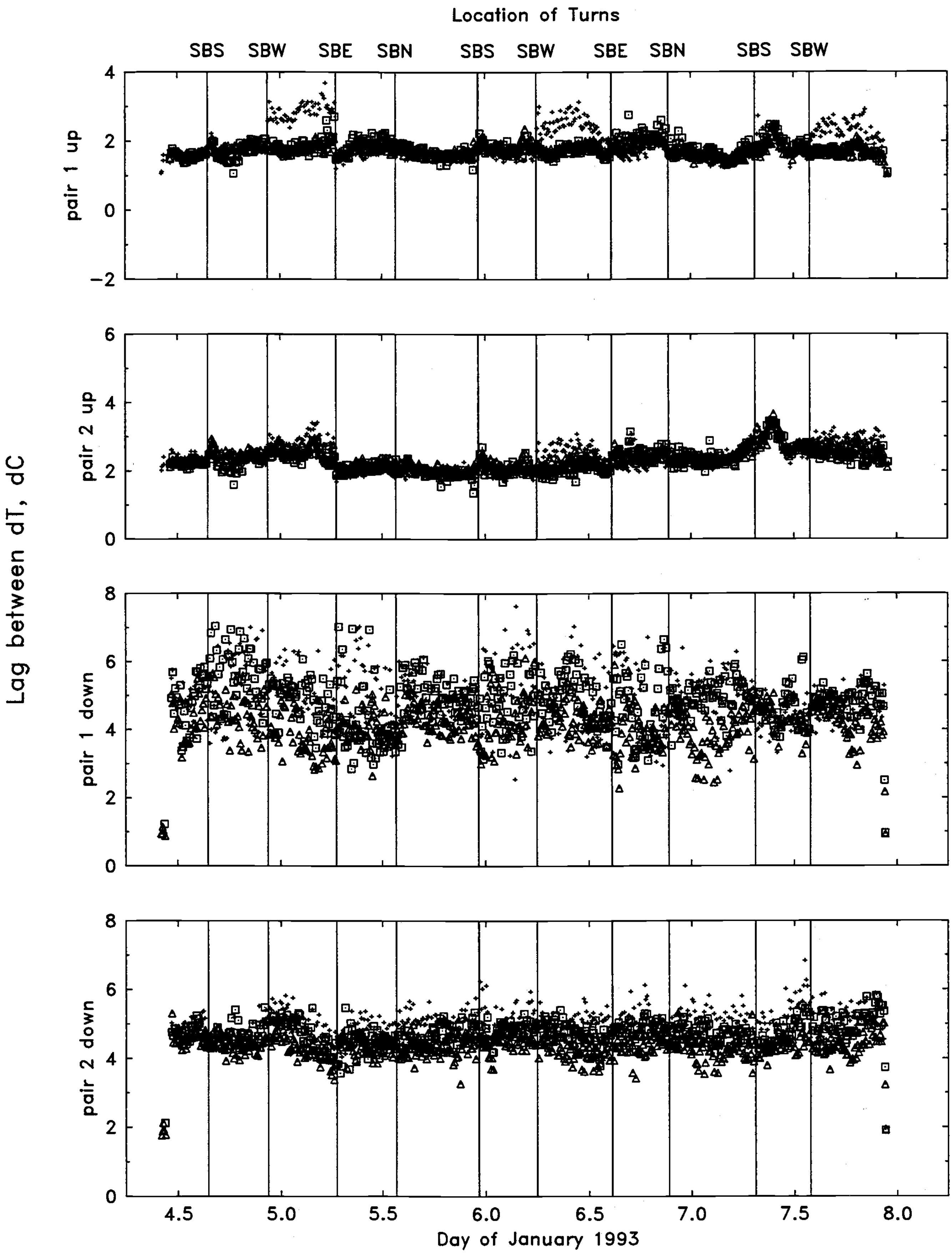
Leg 2 Tow 6, 50−120 db (plus) 120−180 db (square) 180−240 db (triangle)



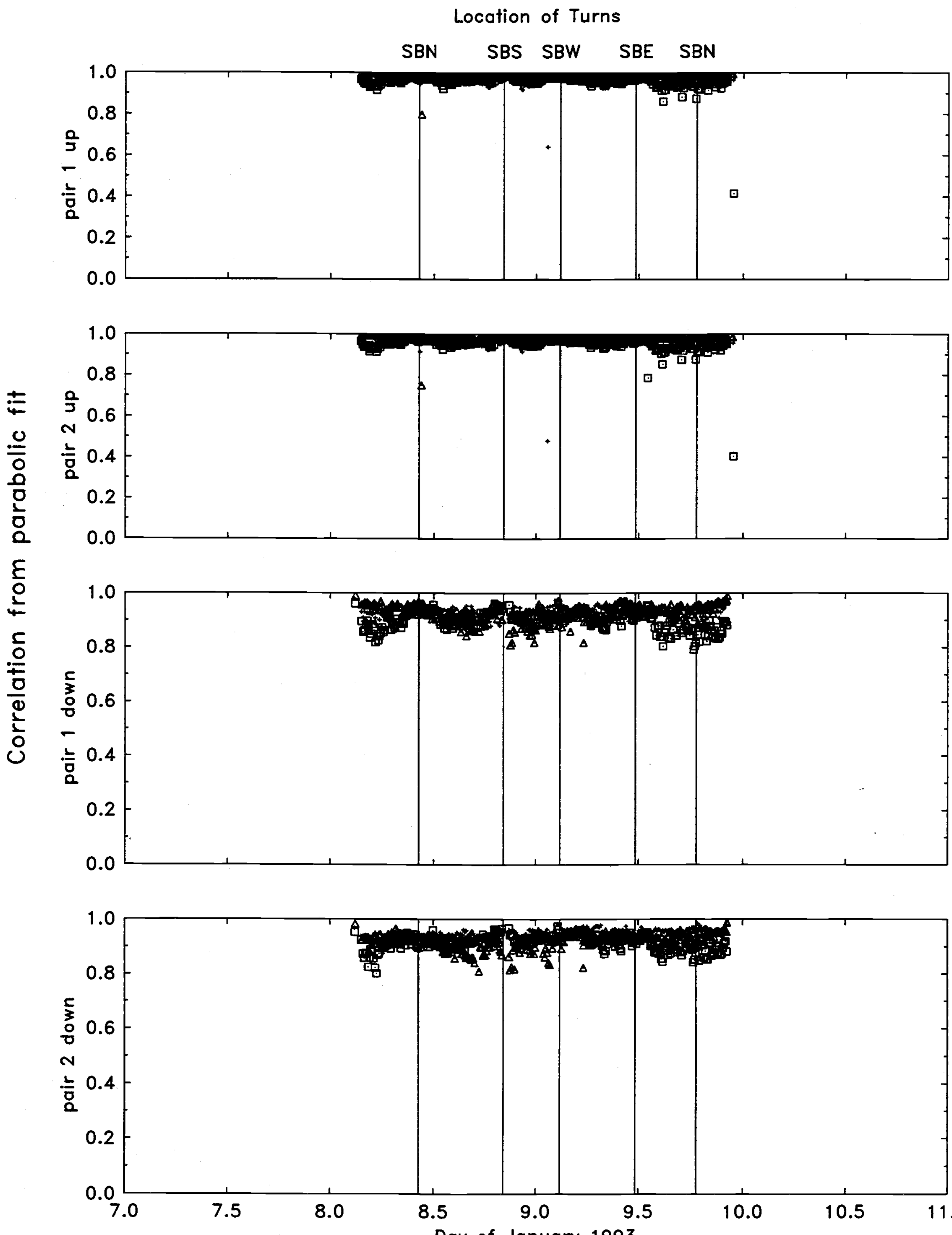
Leg 2 Tow 6, 50–120 db (plus) 120–180 db (square) 180–240 db (triangle)



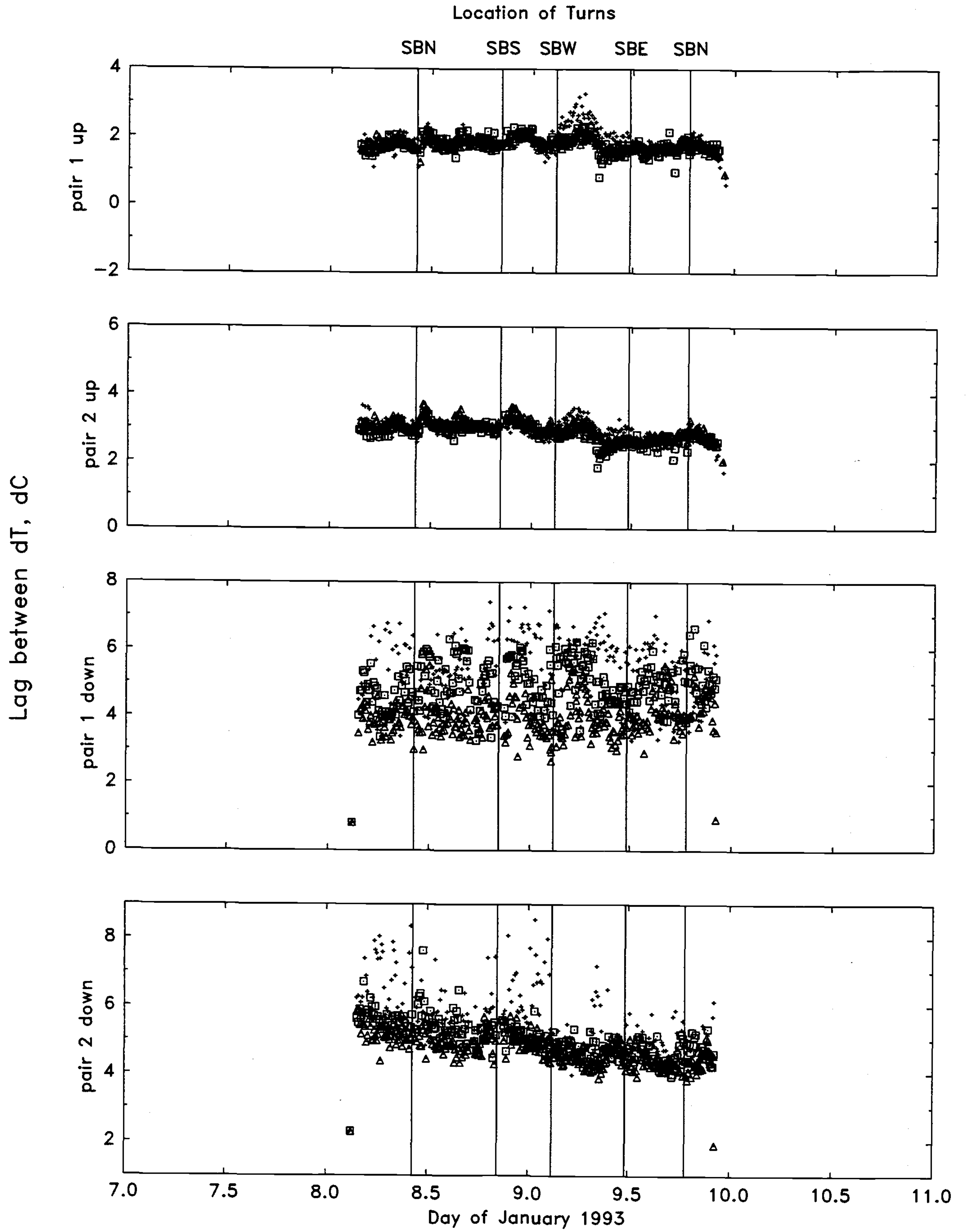
Leg 2 Tow 7, 50–120 db (plus) 120–180 db (square) 180–240 db (triangle)



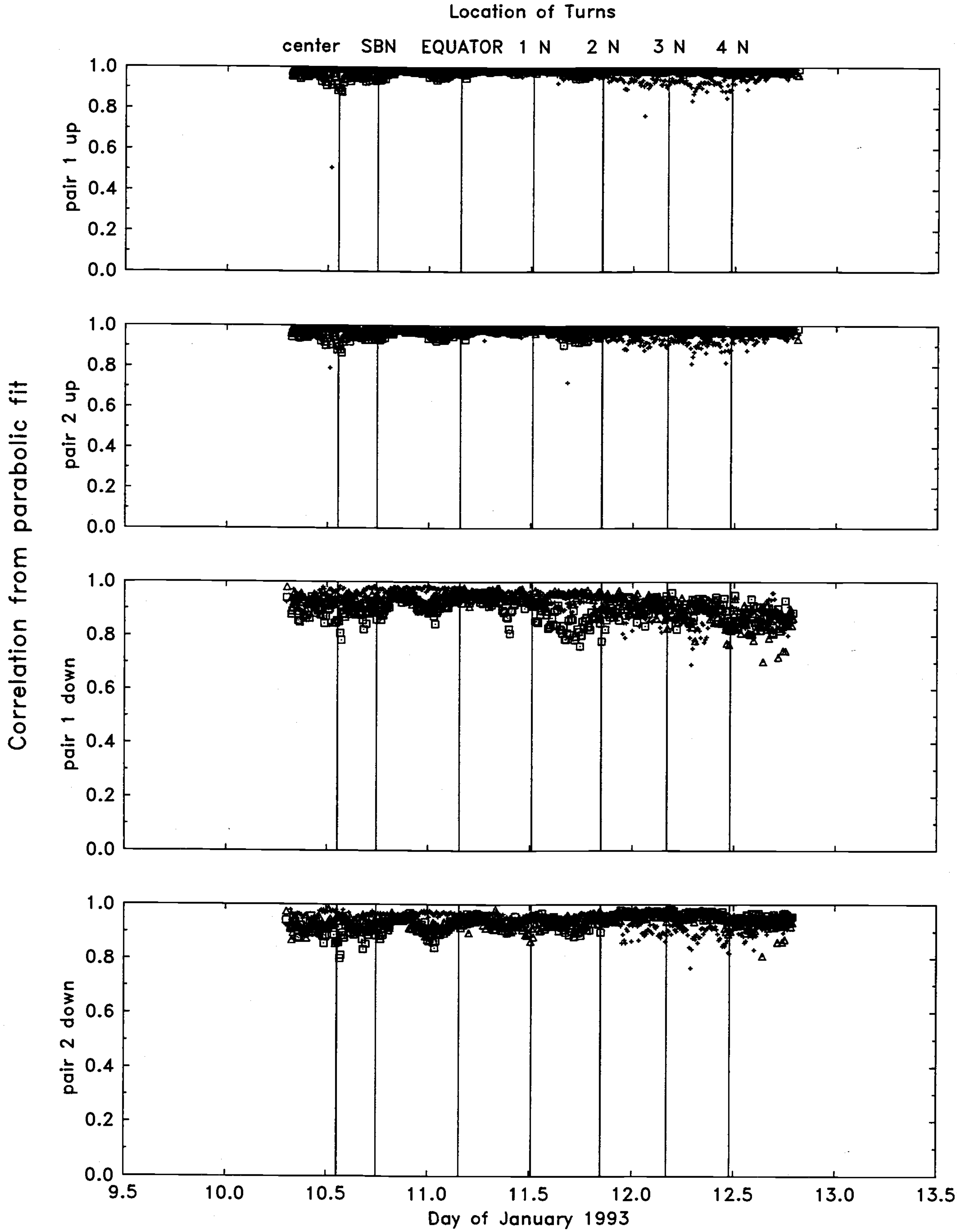
Leg 2 Tow 7, 50–120 db (plus) 120–180 db (square) 180–240 db (triangle)



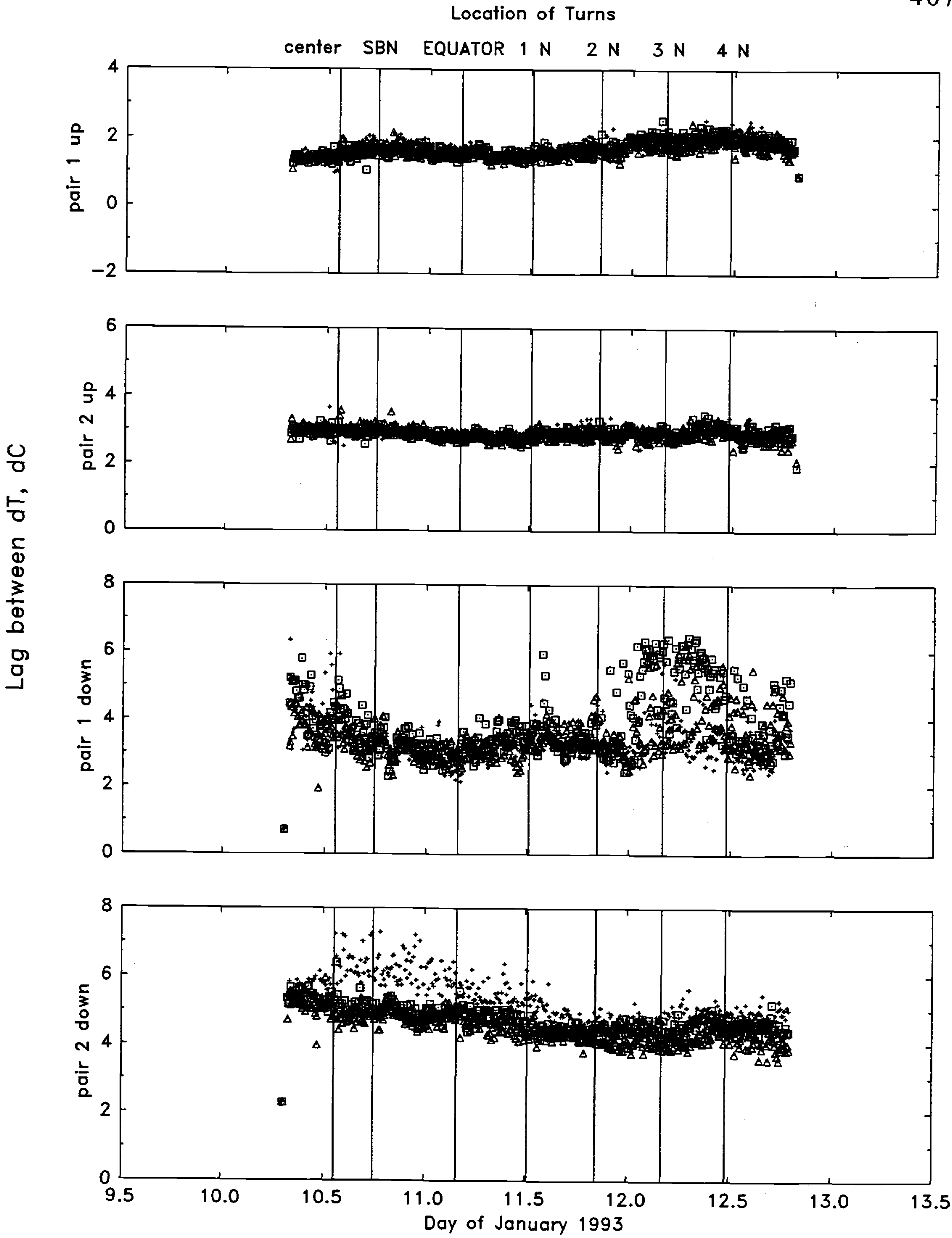
Leg 2 Tow 8, 50−120 db (plus) 120−180 db (square) 180−240 db (triangle)



Leg 2 Tow 8, 50−120 db (plus) 120−180 db (square) 180−240 db (triangle)



Leg 2 Tow 9, 50−120 db (plus) 120−180 db (square) 180−240 db (triangle)

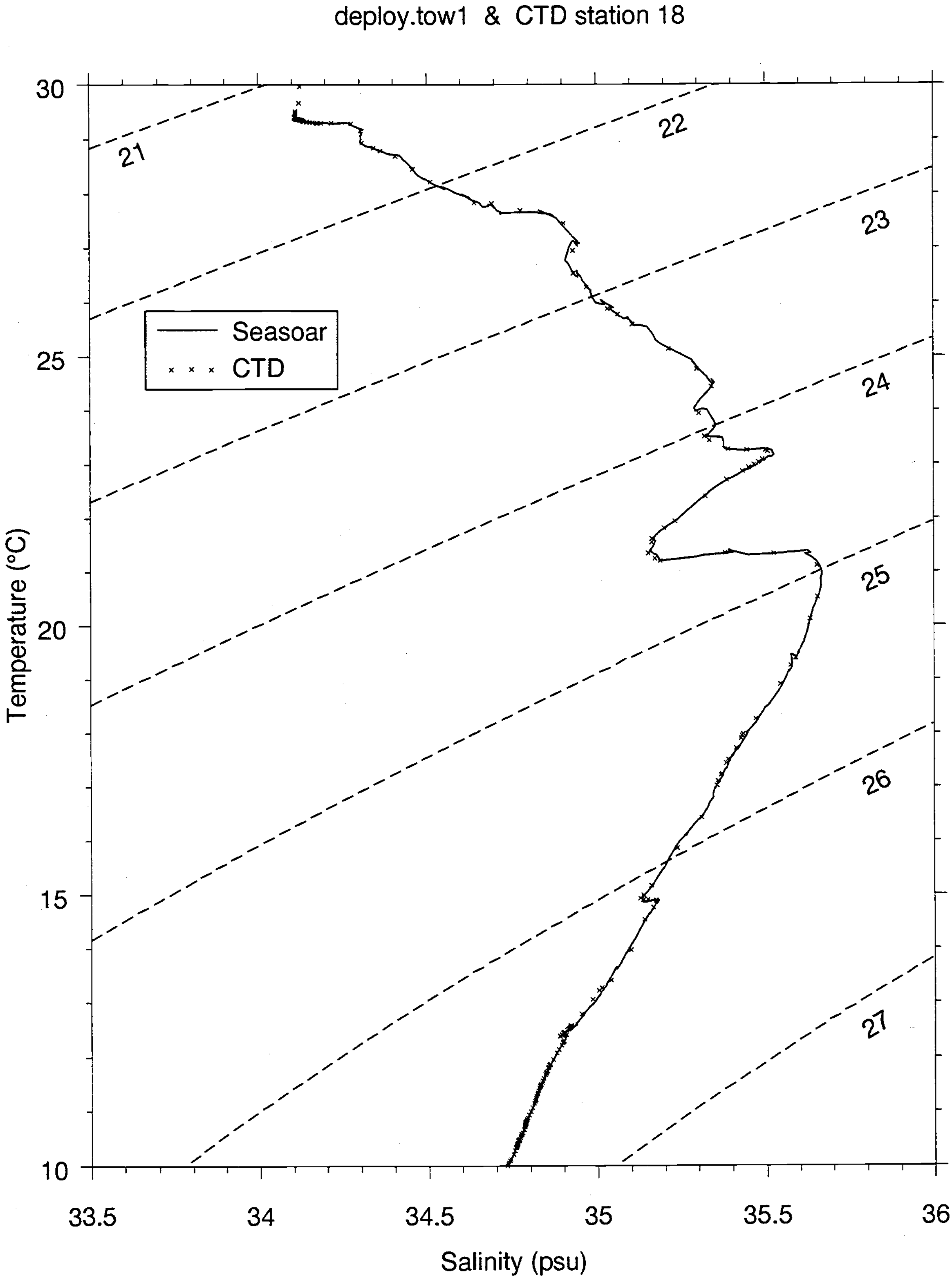


Leg 2 Tow 9, 50–120 db (plus) 120–180 db (square) 180–240 db (triangle)

APPENDIX B:

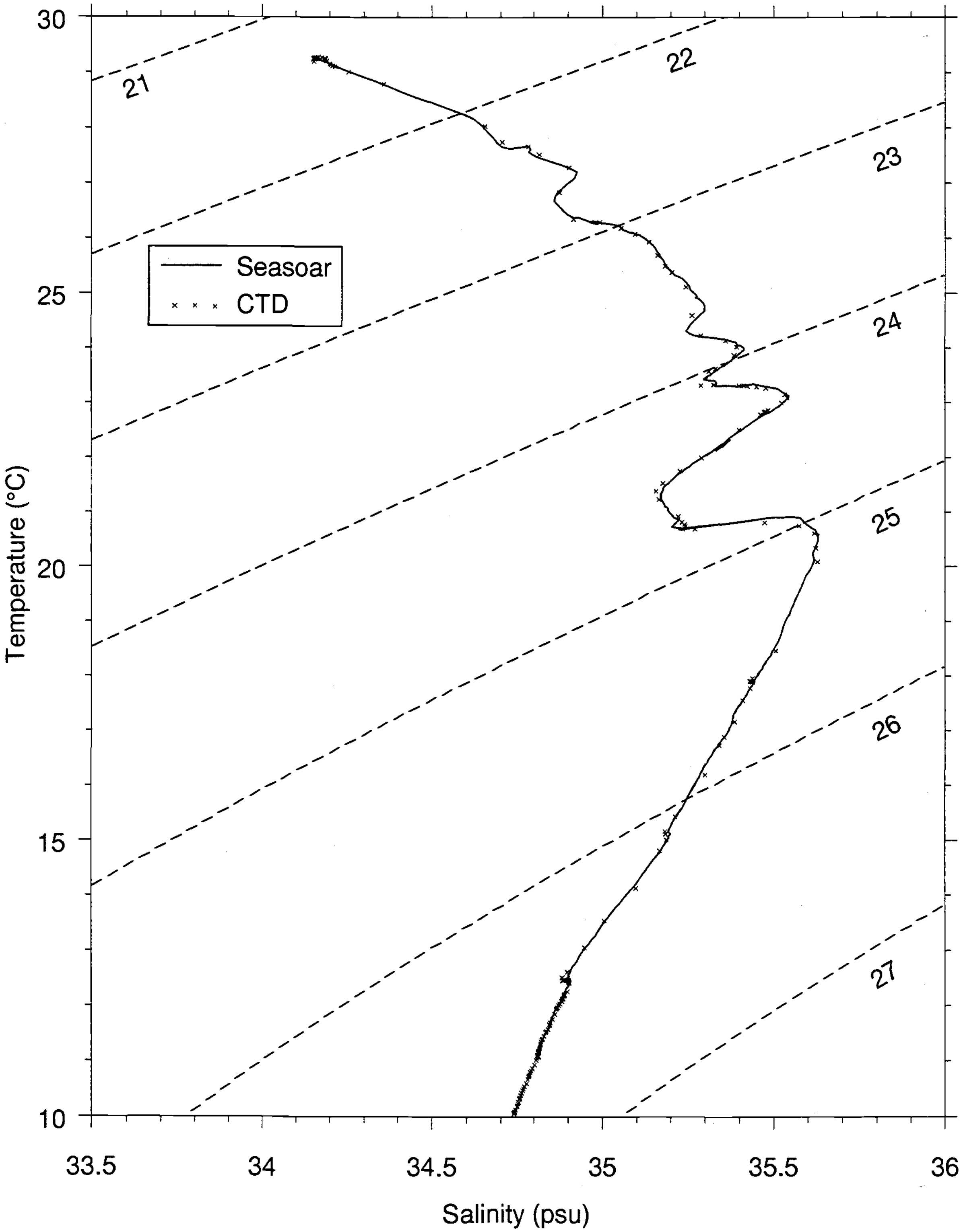
T-S Diagrams from CTD and Seasoar

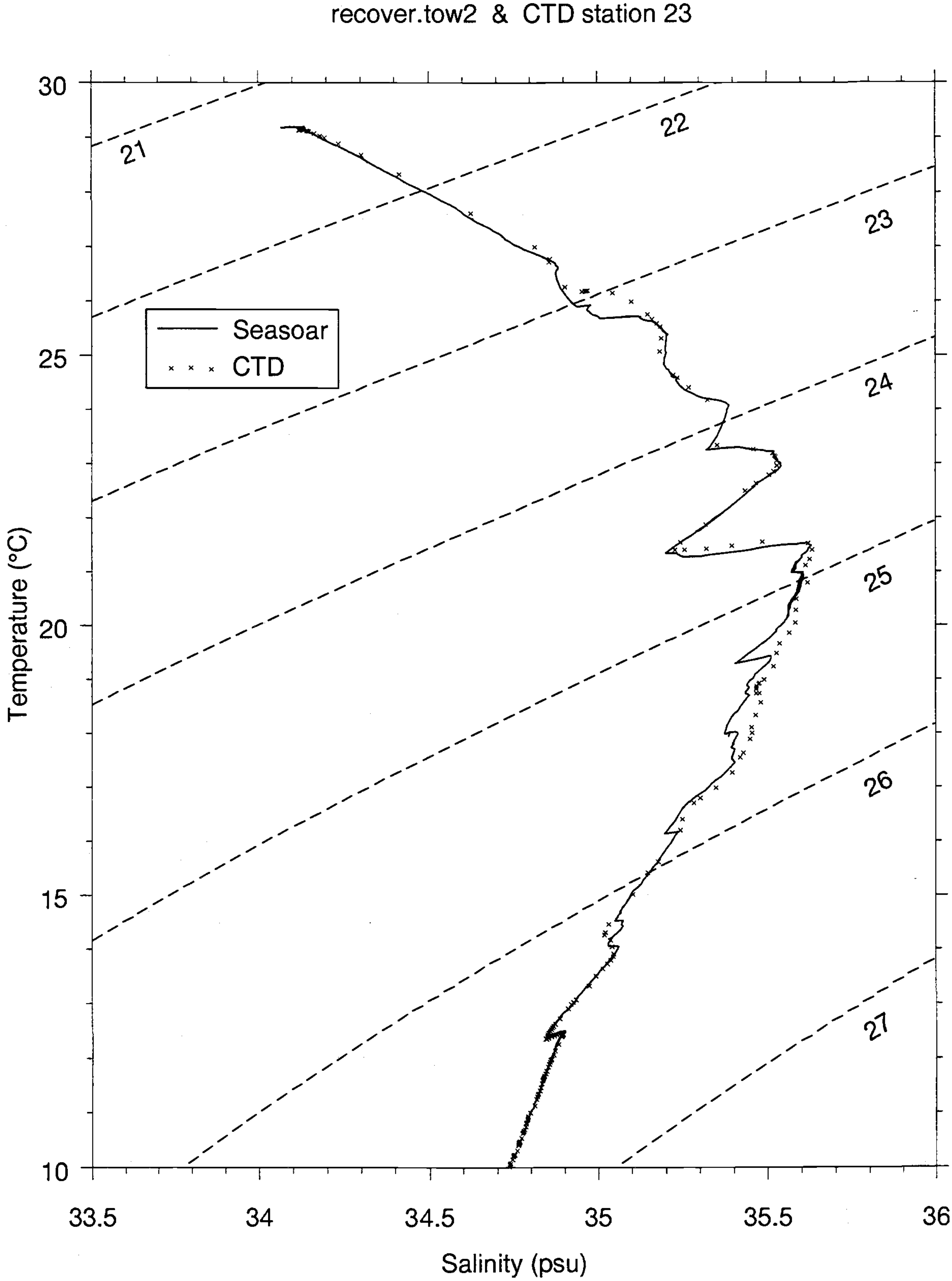
at Start and End of Tows 1 - 9

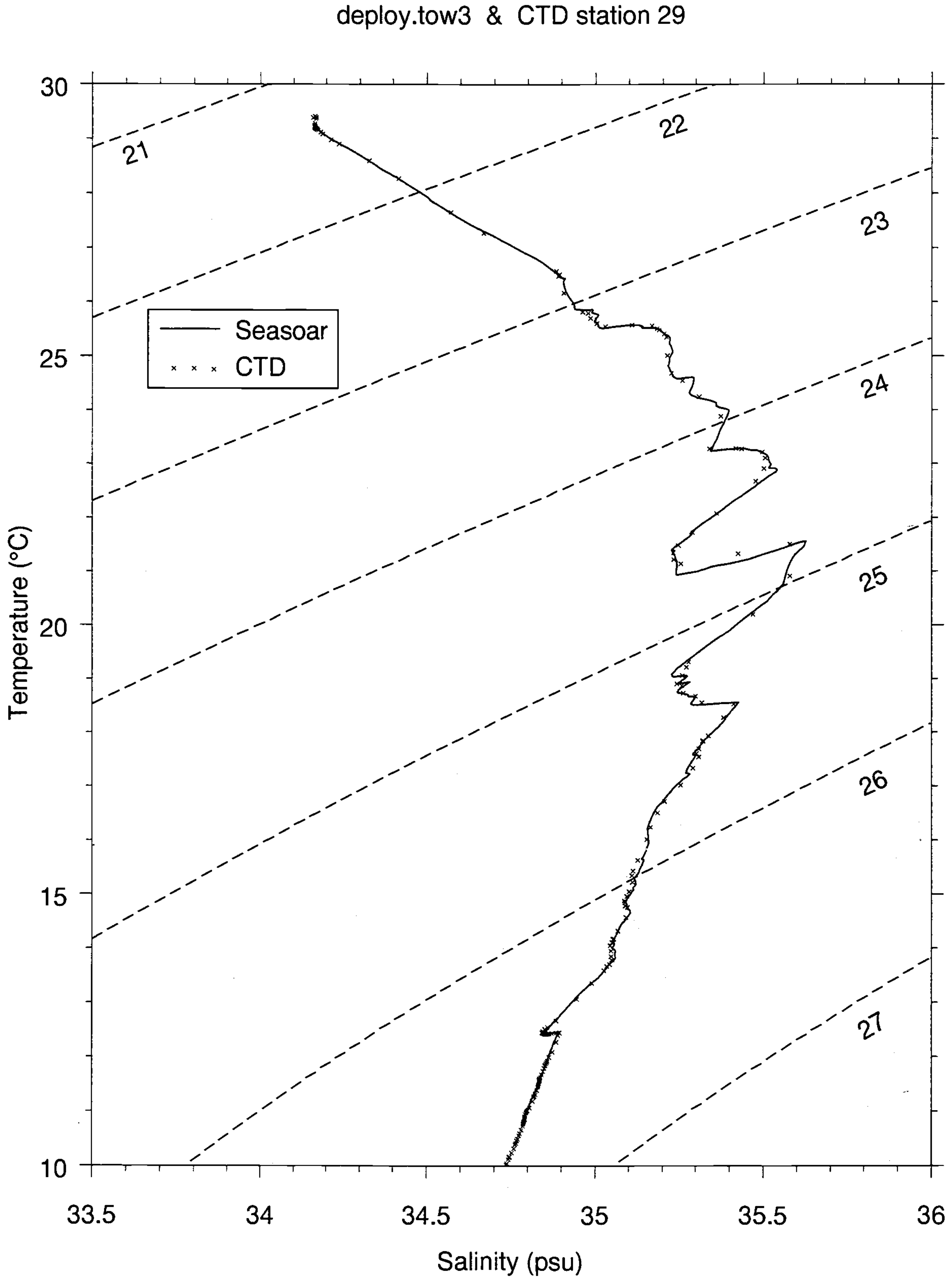


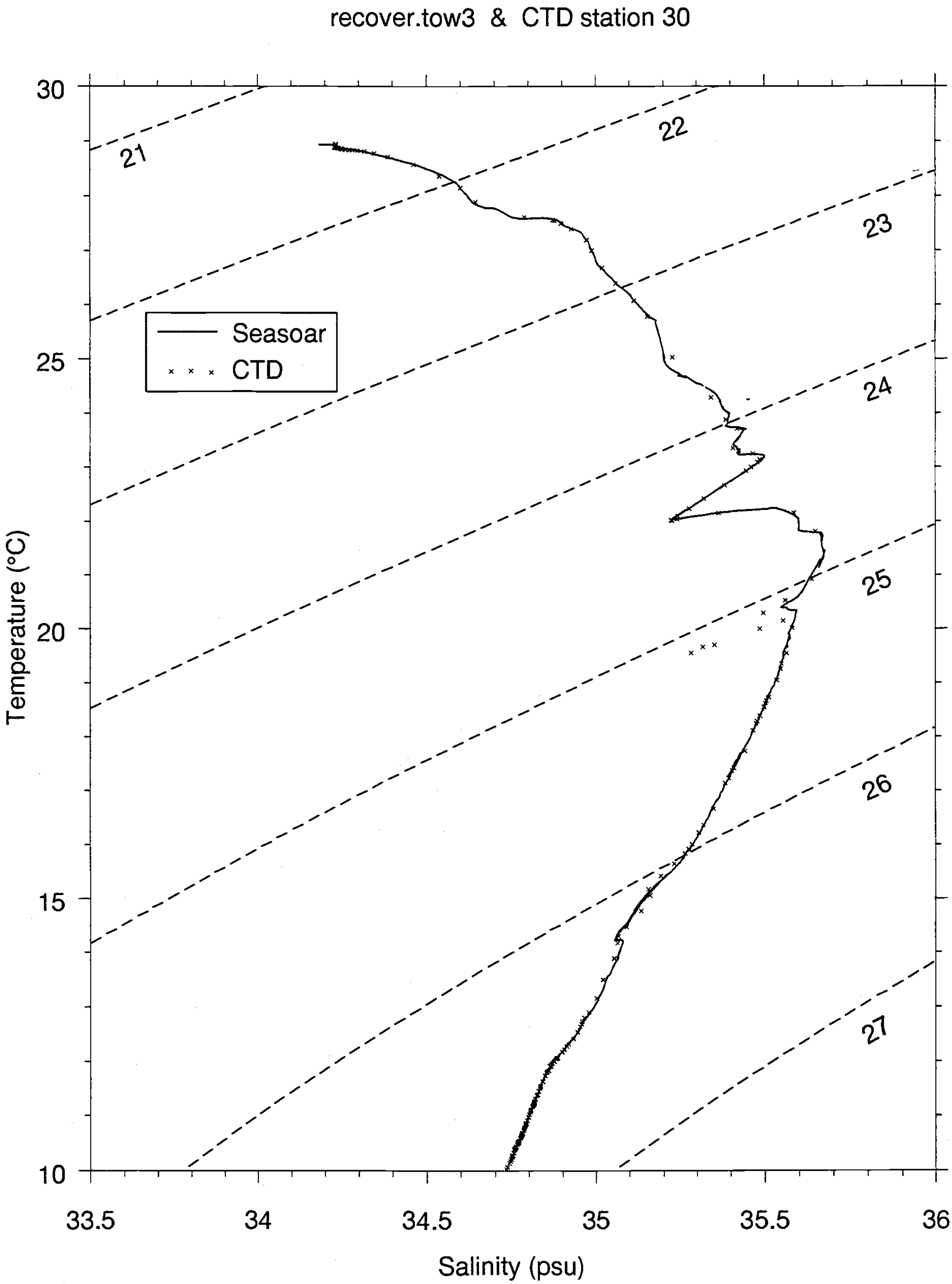
deploy.tow1 & CTD station 18
Seasoar
CTD
21
22
23
24
25
26
27
30
25
20
15
10
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)

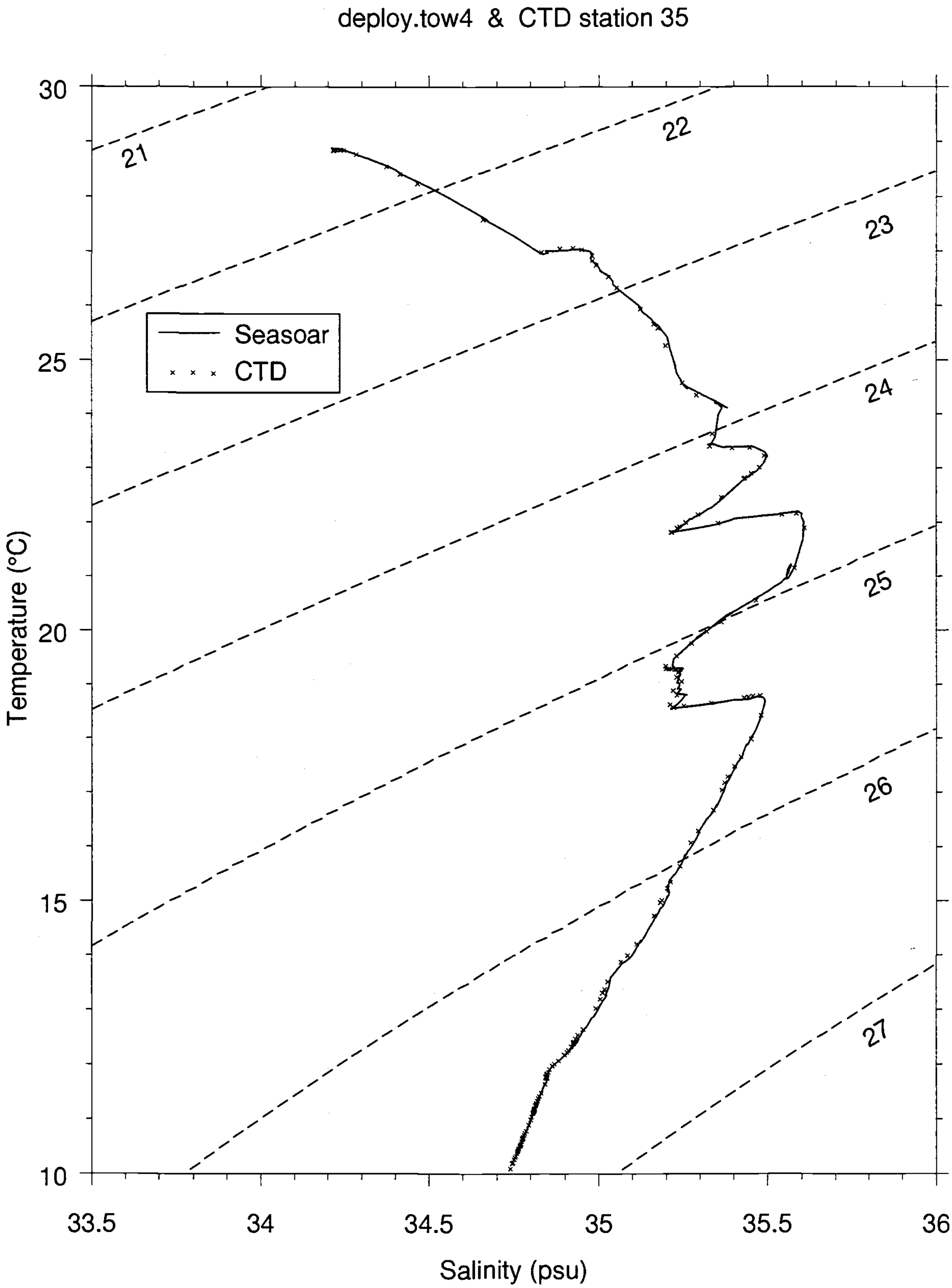
deploy.tow2 & CTD station 22

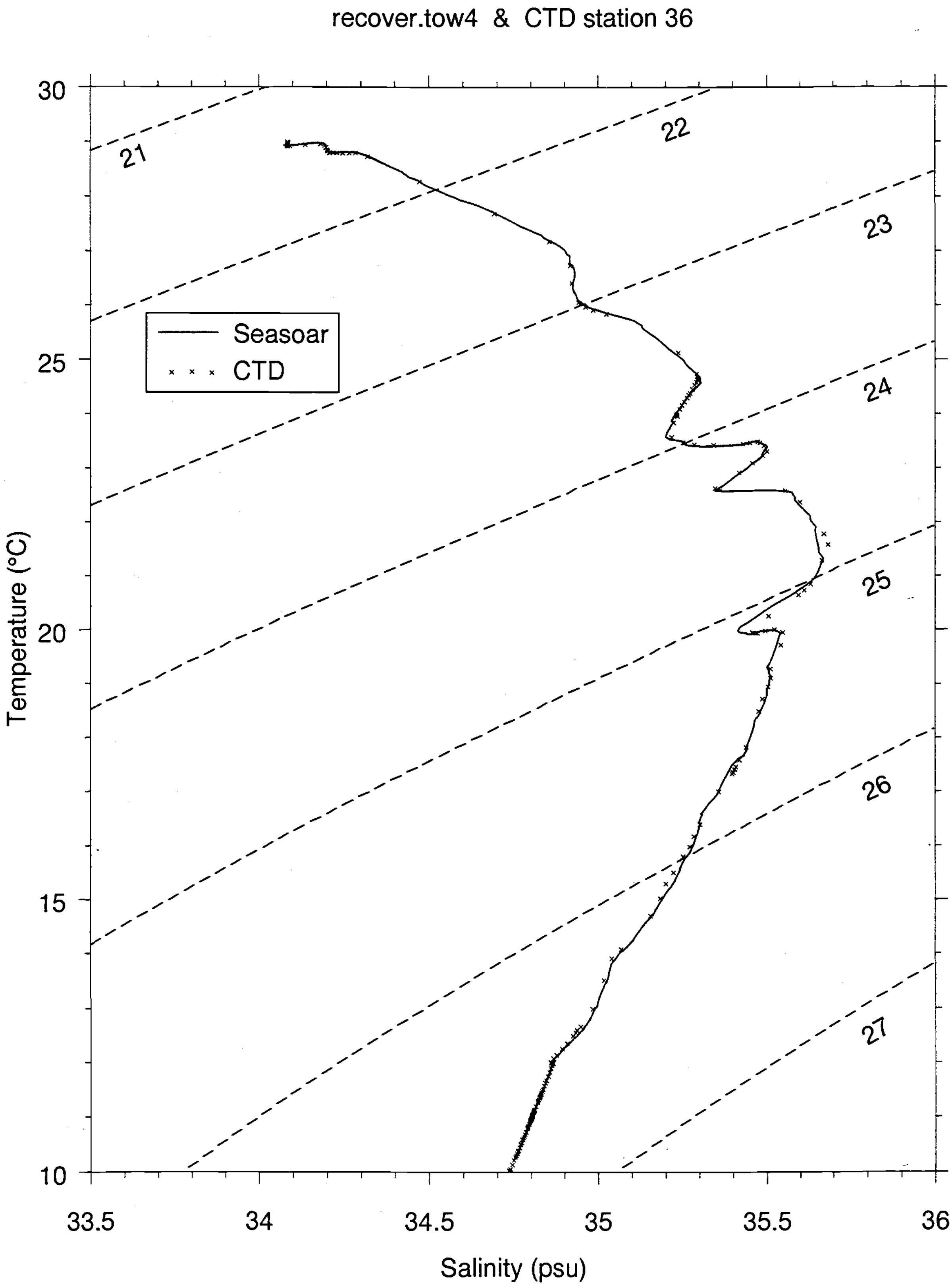



recover.tow2 & CTD station 23
Seasoar
CTD
21
22
23
24
25
26
27
30
25
20
15
10
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)

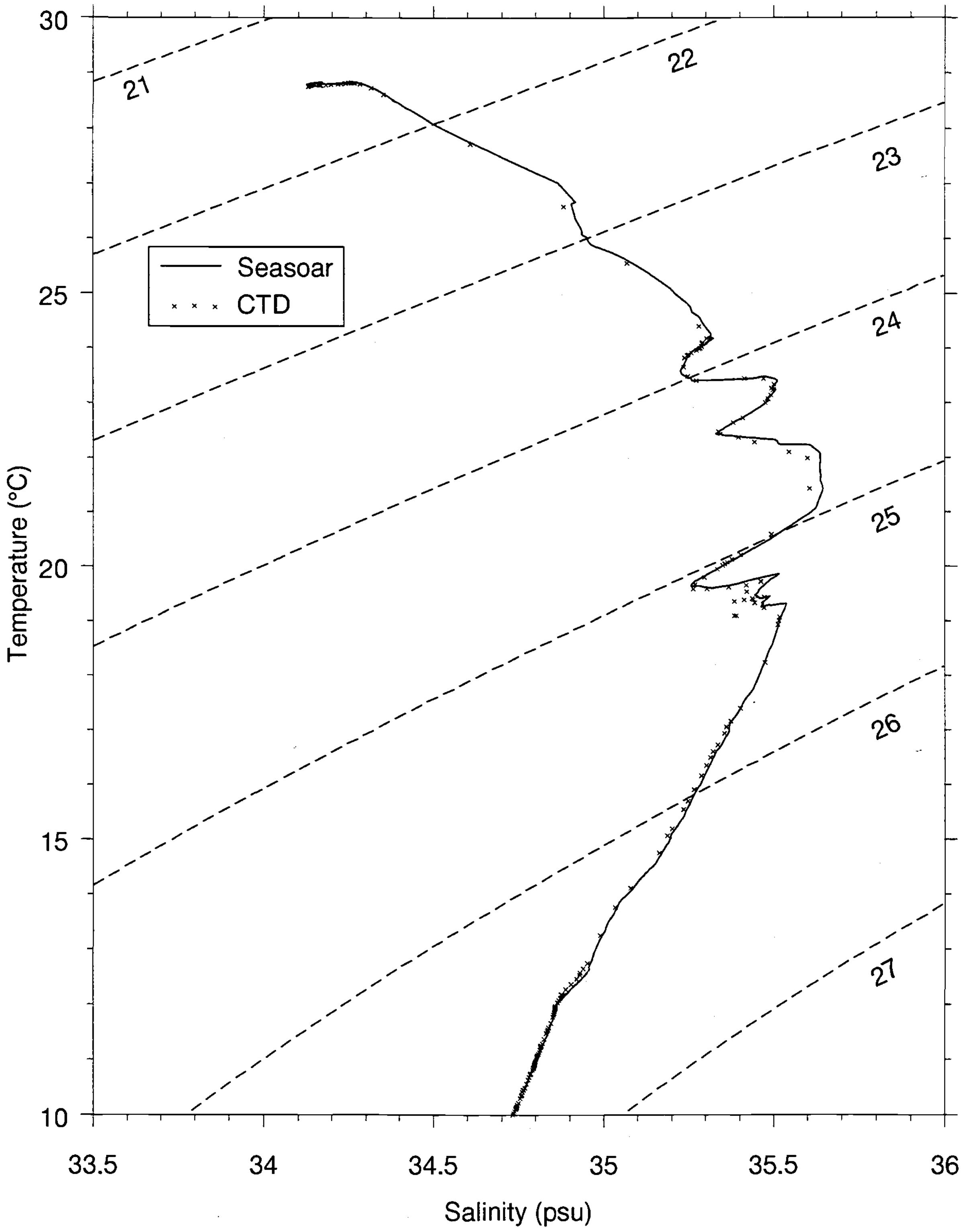

deploy.tow3 & CTD station 29
Seasoar
CTD
21
22
23
24
25
26
27
30
25
20
15
10
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)

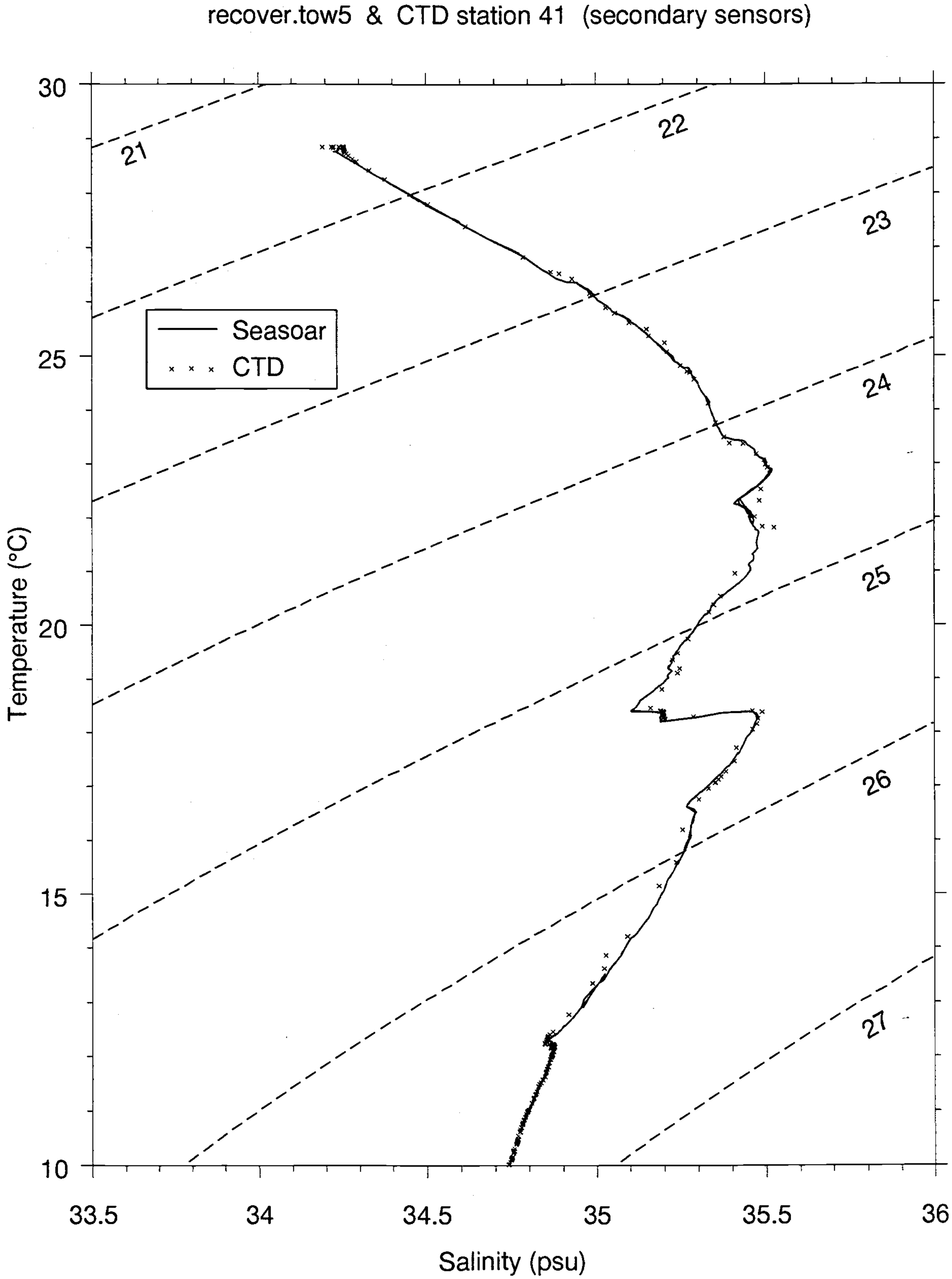

recover.tow3 & CTD station 30
Seasoar
CTD
Temperature (°C)
Salinity (psu)
30
25
20
15
10
33.5
34
34.5
35
35.5
36
21
22
23
24
25
26
27


deploy.tow4 & CTD station 35
Seasoar
CTD
21
22
23
24
25
26
27
30
25
20
15
10
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)

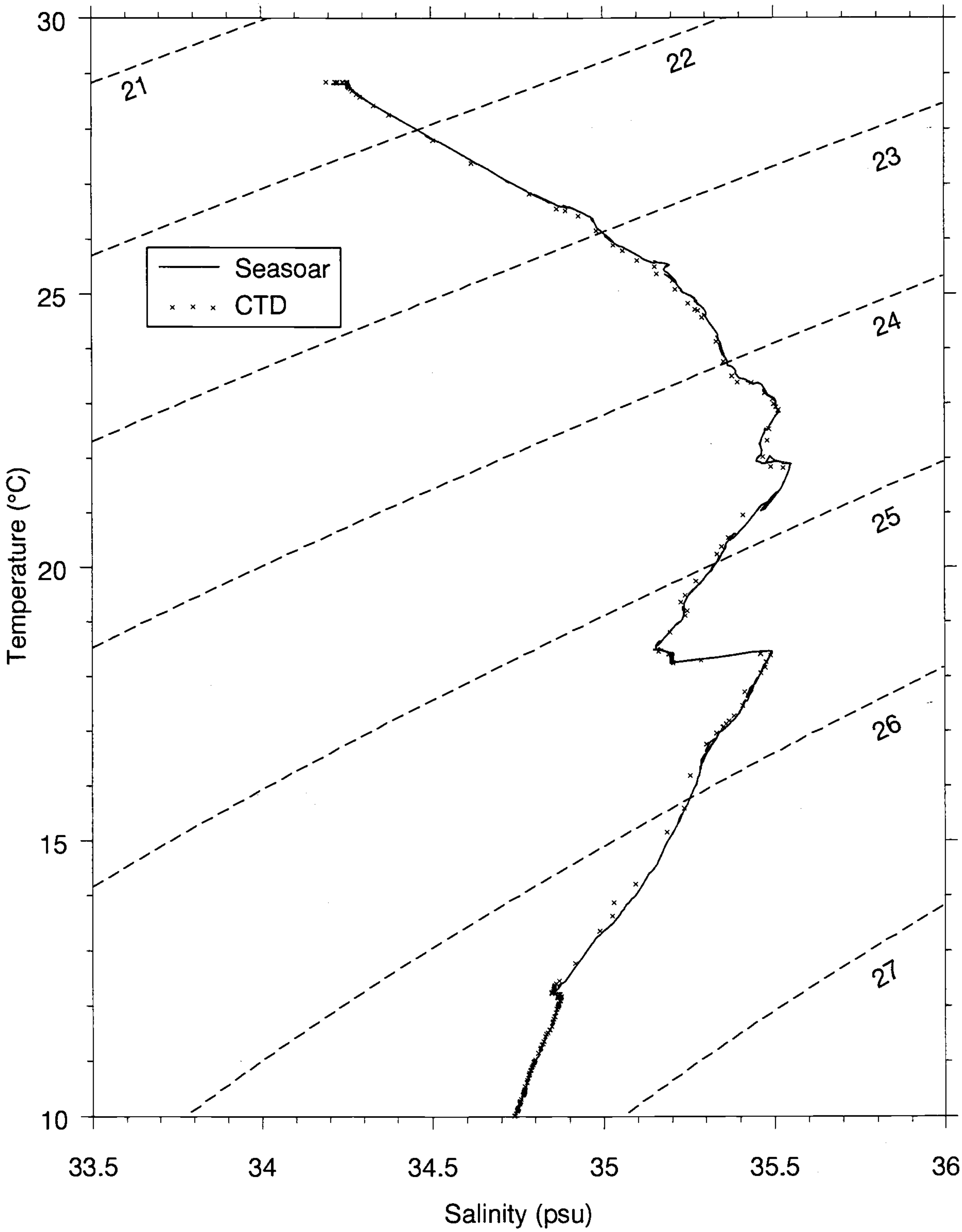

recover.tow4 & CTD station 36
Seasoar
CTD
Temperature (°C)
Salinity (psu)
30
25
20
15
10
33.5
34
34.5
35
35.5
36
21
22
23
24
25
26
27

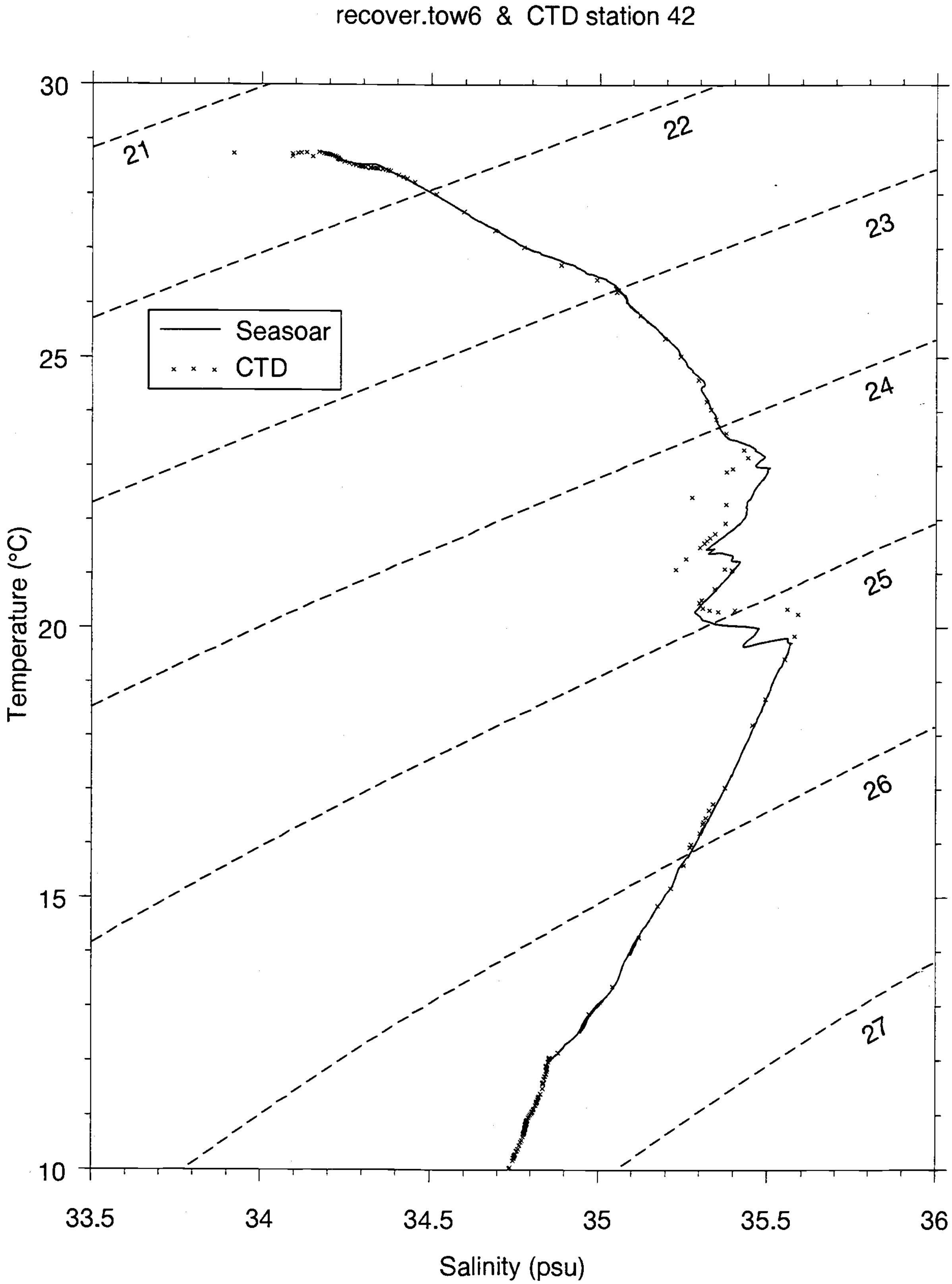
deploy.tow5 & CTD station 40




recover.tow5 & CTD station 41 (secondary sensors)
Temperature (°C)
Salinity (psu)
Seasoar
CTD
30
25
20
15
10
33.5
34
34.5
35
35.5
36
21
22
23
24
25
26
27

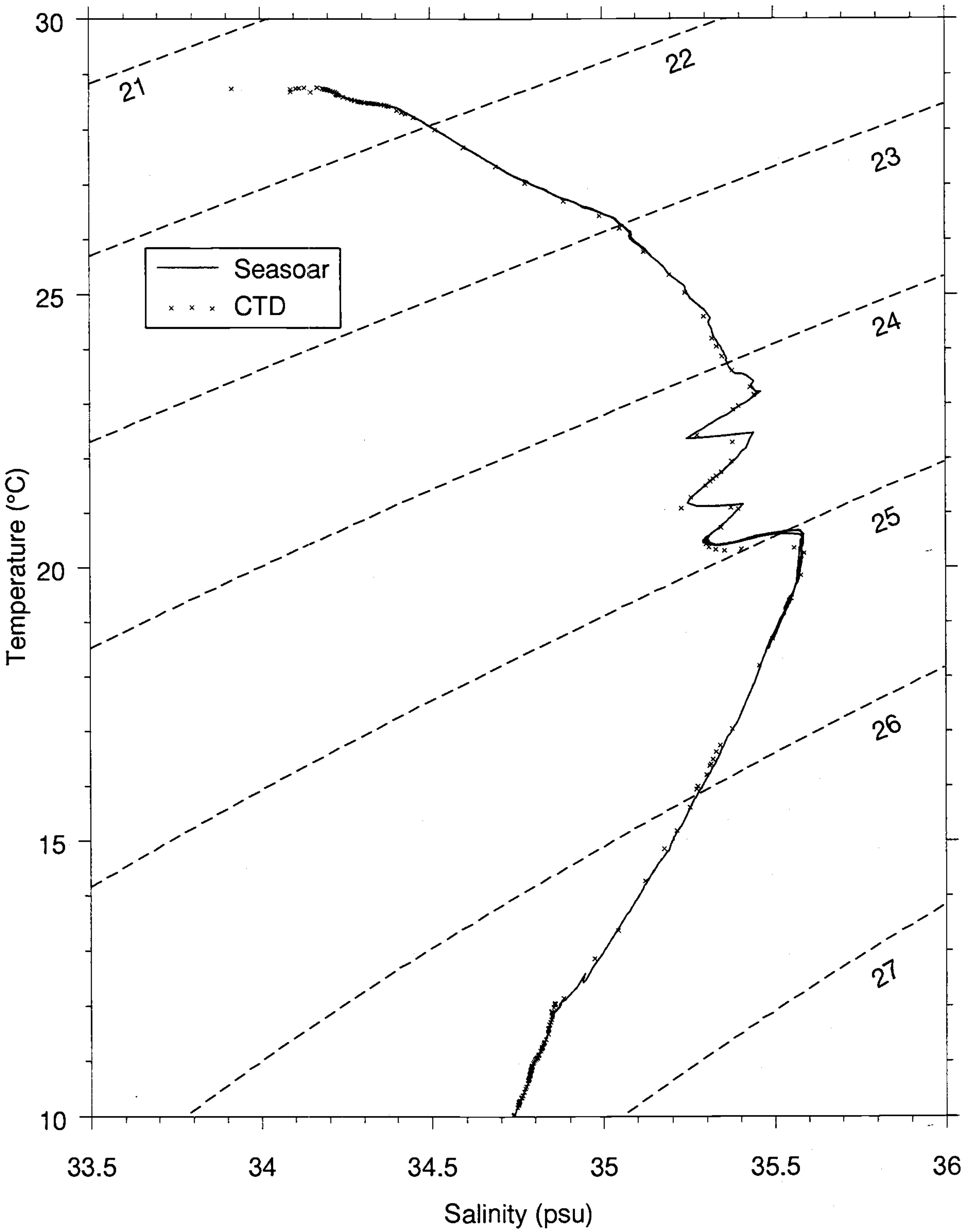
deploy.tow6 & CTD station 41 (secondary sensors)

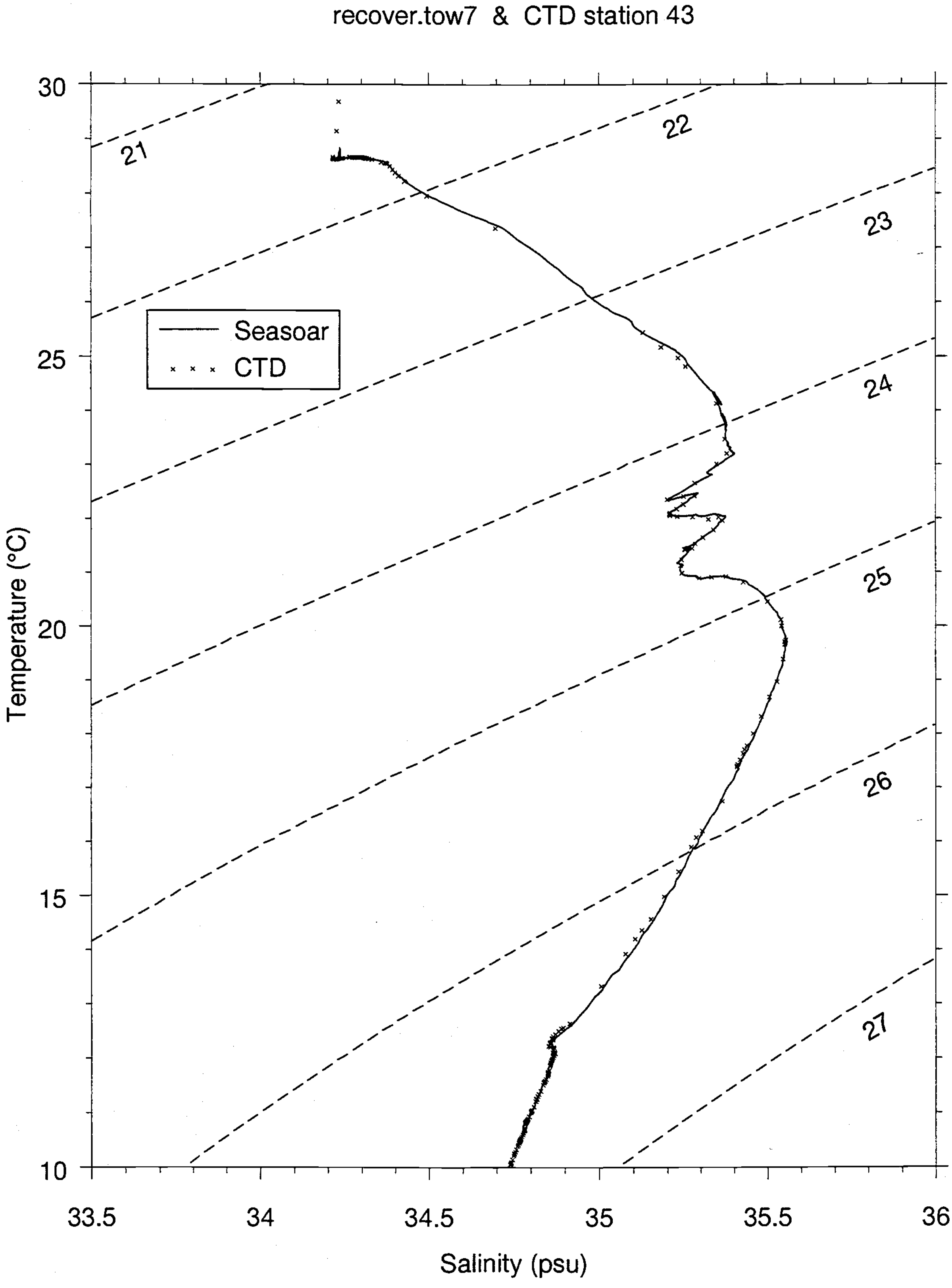




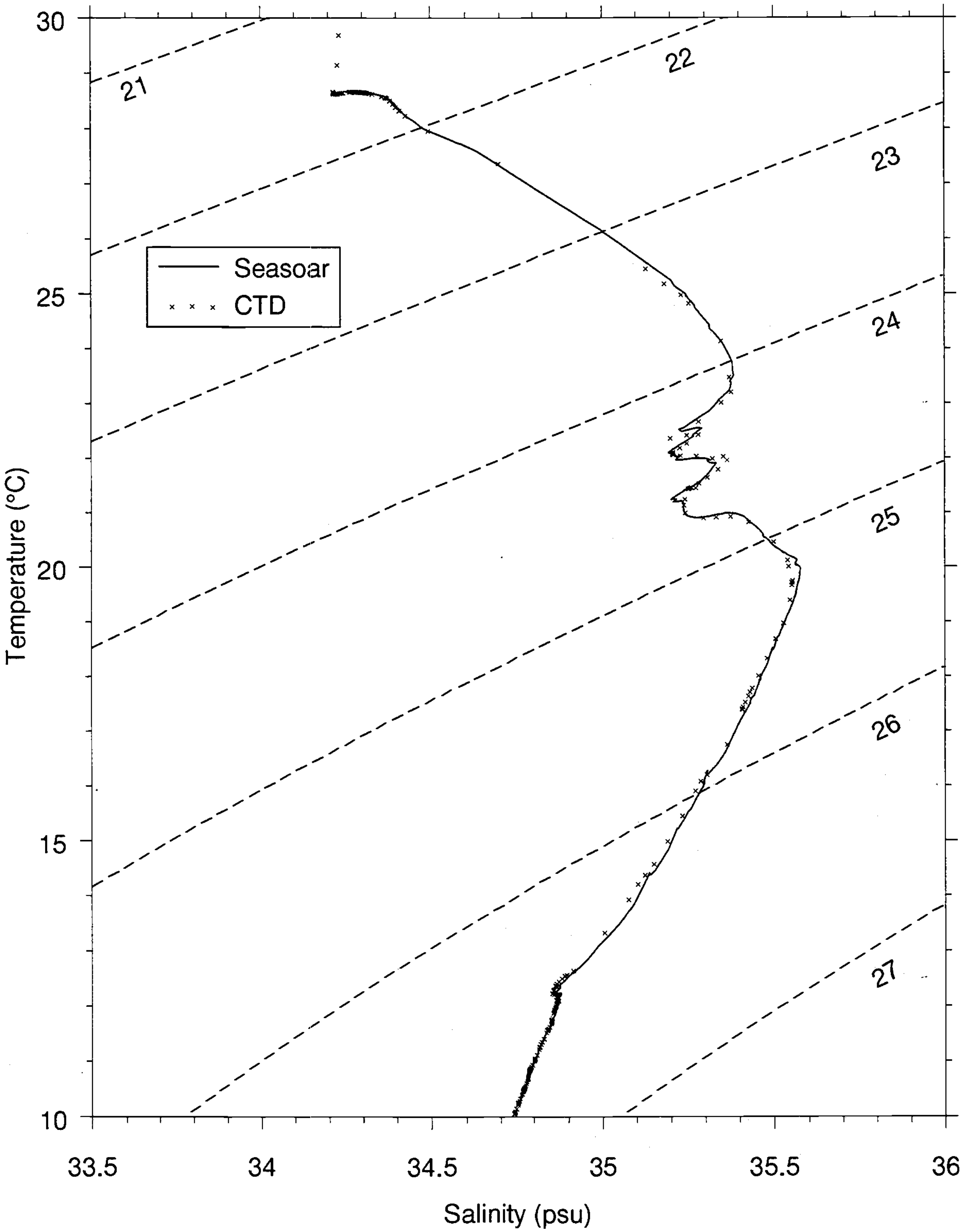
recover.tow6 & CTD station 42
Seasoar
CTD
21
22
23
24
25
26
27
30
25
20
15
10
Temperature (°C)
33.5
34
34.5
35
35.5
36
Salinity (psu)

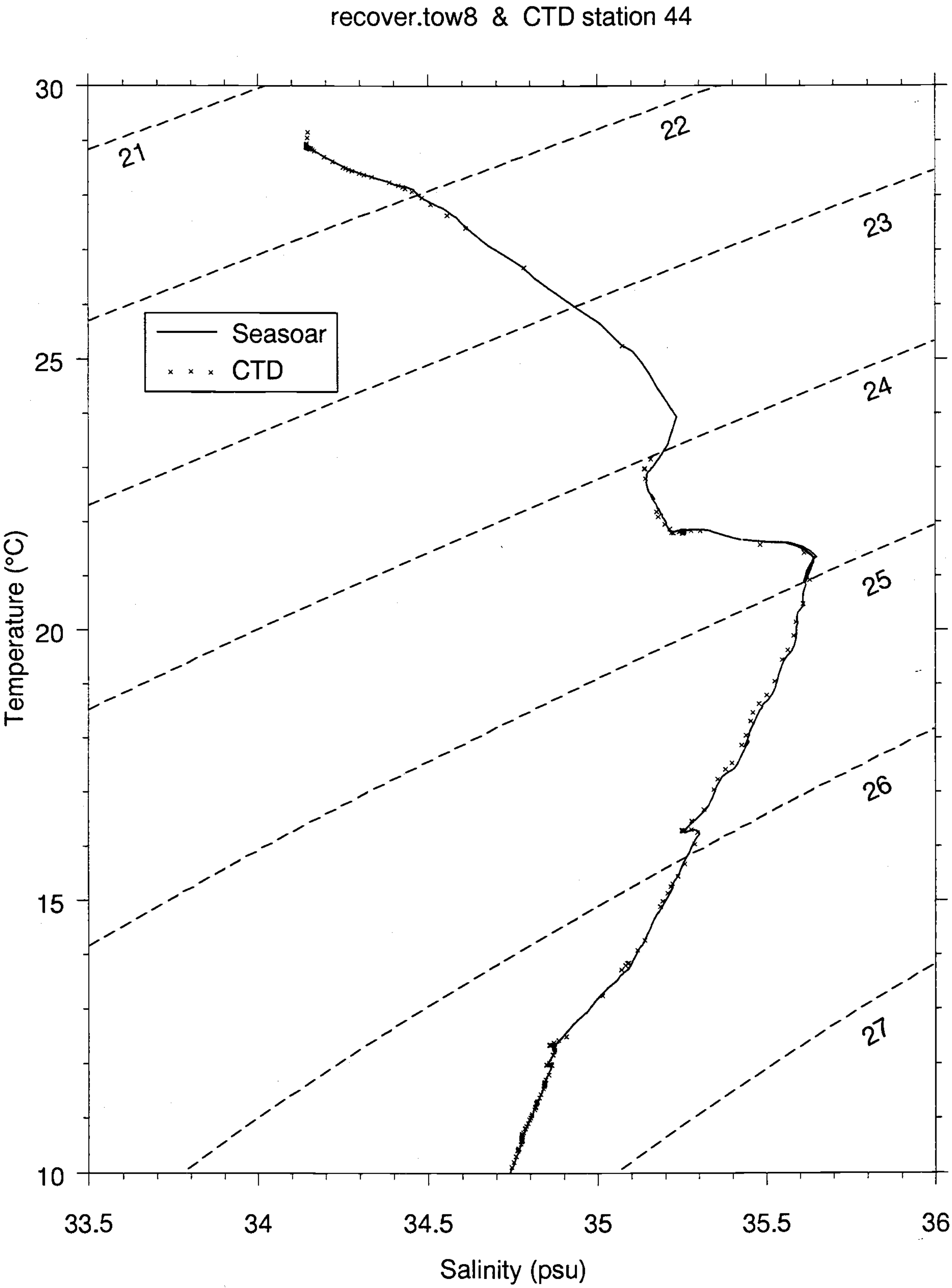
deploy.tow7 & CTD station 42



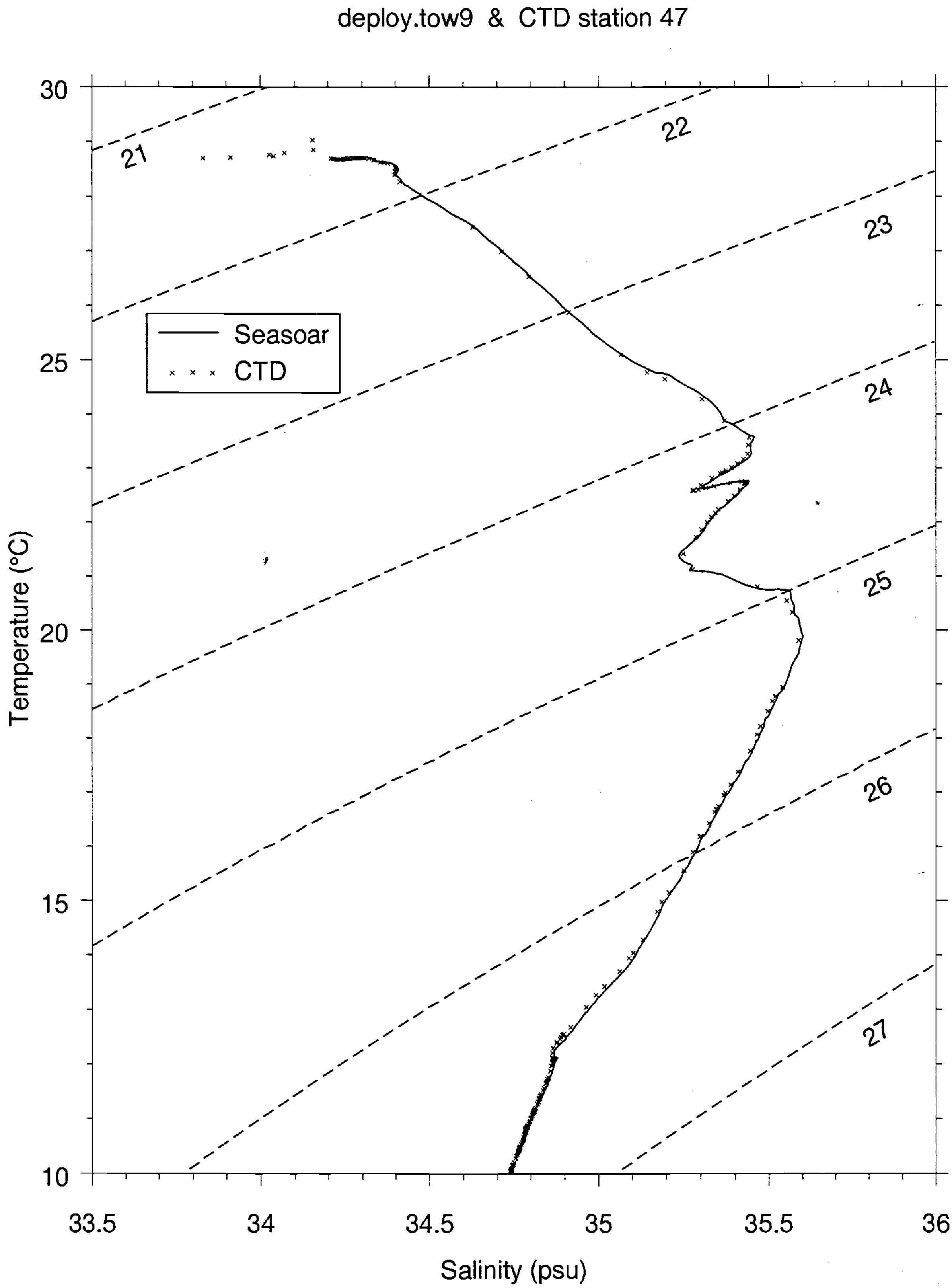

recover.tow7 & CTD station 43
Seasoar
CTD
21
22
23
24
25
26
27
Temperature (°C)
30
25
20
15
10
33.5
34
34.5
35
35.5
36
Salinity (psu)

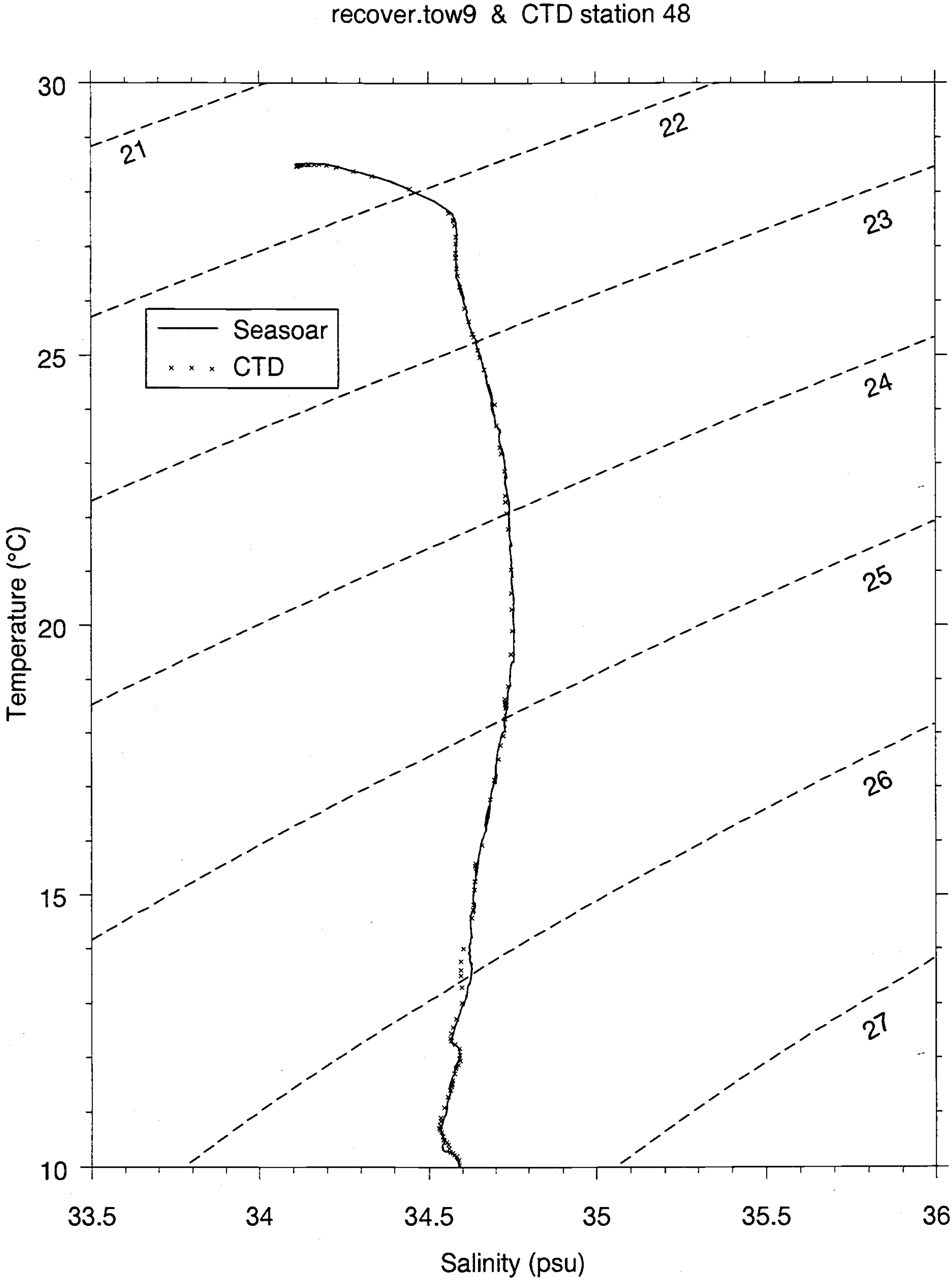
deploy.tow8 & CTD station 43





recover.tow8 & CTD station 44
Seasoar
CTD
Temperature (°C)
Salinity (psu)
30
25
20
15
10
33.5
34
34.5
35
35.5
36
21
22
23
24
25
26
27


deploy.tow9 & CTD station 47
Seasoar
CTD
Temperature (°C)
Salinity (psu)
30
25
20
15
10
33.5
34
34.5
35
35.5
36
21
22
23
24
25
26
27



recover.tow9 & CTD station 48
Temperature (°C)
Salinity (psu)
30
25
20
15
10
33.5
34
34.5
35
35.5
36
21
22
23
24
25
26
27
Seasoar
CTD