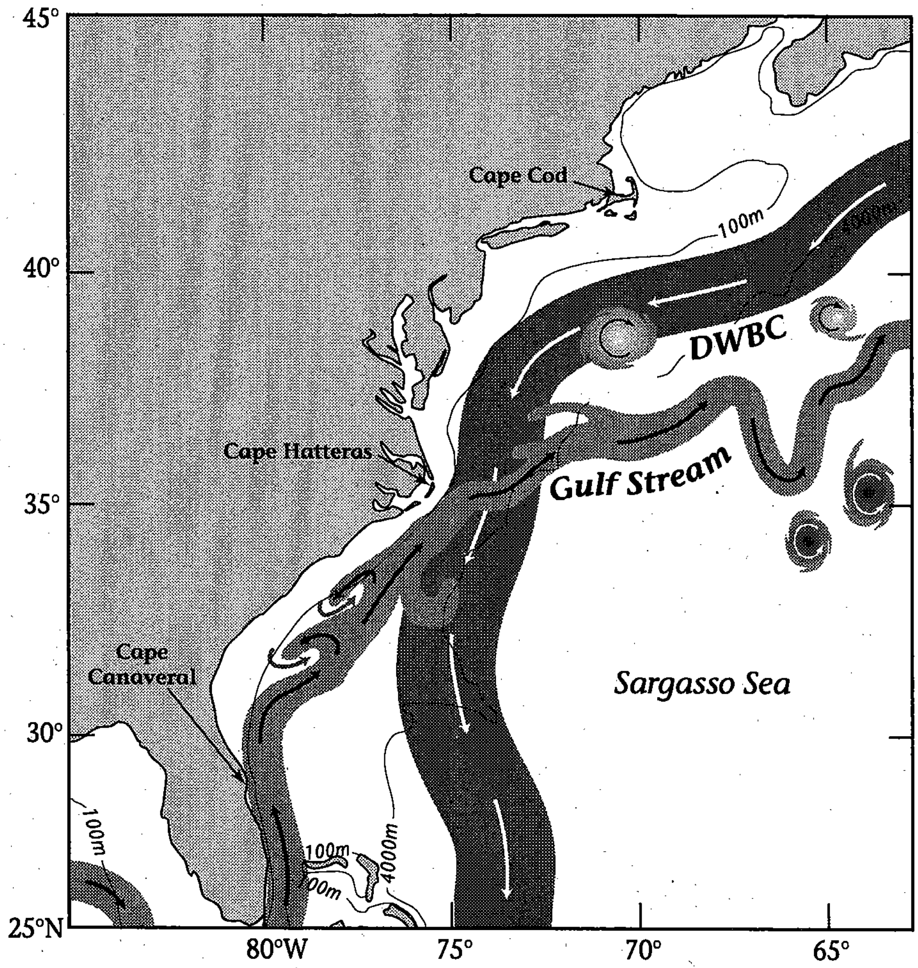
WHOI-98-06

Boundary Current Experiment I & II RAFOS Float Data Report 1994–1997

by

Heather D. Hunt and Amy S. Bower



March 1998

Technical Report

Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

Funding was provided by the National Science Foundation under Grant OCE-93-01448

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Approved for Distribution:

Philip L. Richardson, Chairman
Department of Physical Oceanography

Abstract

This is the final data report of all RAFOS (acoustically tracked) float data collected during the 1994-1997 Boundary Current Experiment (BOUNCE) study of the Deep Western Boundary Current (DWBC) in the North Atlantic Ocean. The overall objective of the program was to obtain the first comprehensive description of the North Atlantic DWBC's variability over a large path segment from Cape Hatteras to the Grand Banks. The experiment was comprised of CTD, tracer, and RAFOS float observations to achieve both Eulerian and Lagrangian descriptions of the DWBC. The three main objectives of the Lagrangian float study were 1) to determine fluid parcel pathways in the DWBC and identify regions of exchange with the interior, 2) to estimate the mean speed and variability of fluid parcels at two different levels in the DWBC, and 3) to study the kinematics and potential vorticity dynamics of fluid parcels in the DWBC at the Gulf Stream cross-over point near Cape Hatteras. Thirty floats were deployed: 15 were designed to be isopycnal floats, and 15 were isobaric floats. The isopycnal floats were ballasted for the $\sigma_t = 27.73$ density surface (approximately 800 decibars (db)) to seed the Upper Labrador Sea Water. The isobaric floats were ballasted for 3000 db to seed the Nordic Seas overflow water.

Front Cover Figure Caption: The major current features in the Boundary Current Experiment study region. One of the main objectives of the experiment was to study the interaction between the Deep Western Boundary Current (DWBC) and Gulf Stream. Depth contours are in meters. The figure is from On the World Ocean Circulation: Volume I by William J. Schmitz, Jr., and used with permission of the author.

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1. Introduction

This is the final data report of all acoustically tracked Ranging and Fixing of Sound (RAFOS) float data collected during the 1994-1997 Boundary Current Experiment (BOUNCE) study of the Deep Western Boundary Current (DWBC) in the North Atlantic Ocean. Principal investigators for the project were Amy Bower and Robert Pickart of the Woods Hole Oceanographic Institution (WHOI) and William Smethie of the Lamont-Doherty Earth Observatory (LDEO). The overall objective of the program, funded by the National Science Foundation, was to obtain the first comprehensive description of the North Atlantic DWBC's variability over a large path segment from Cape Hatteras to the Grand Banks. The experiment was comprised of CTD, tracer, and RAFOS float observations to achieve both Eulerian and Lagrangian descriptions of the DWBC. The three main objectives of the Lagrangian float study were 1) to determine fluid parcel pathways in the DWBC and identify regions of exchange with the interior, 2) to estimate the mean speed and variability of fluid parcels at two different levels in the DWBC, and 3) to study the kinematics and potential vorticity dynamics of fluid parcels in the DWBC at the Gulf Stream (GS) cross-over point near Cape Hatteras. Thirty floats were deployed: 15 were designed to be isopycnal floats, and 15 were isobaric floats. The isopycnal floats were ballasted for the σ_t = 27.73 density surface (approximately 800 decibars (db)), roughly the level of the upper chloro-fluorocarbon (CFC) maximum of the DWBC (associated with the Upper Labrador Sea Water). The isobaric floats were ballasted for 3000 db, the level of the deep CFC maximum in the DWBC (associated with the Nordic Seas overflow water). Two separate float deployments took place: November-December 1994 on the R/V Endeavor (EN257), and May-June 1995 on the R/V Oceanus (OC269). CTD casts were taken at nearly all float deployment locations. The float missions were set to be two years in length. The floats were tracked using seven moored sound sources, built by Webb Research, Inc. Four of the sources were deployed specifically for BOUNCE on EN255 in October 1994, and a single replacement source was deployed near Bermuda from R/V Weatherbird II in June 1996. The remaining two southern sources were originally set by Kevin Leaman (University of Miami) for a different experiment in April 1992. Only the replacement source near Bermuda has been recovered.

2. Description of the RAFOS Floats

The RAFOS float is an acoustically tracked subsurface Lagrangian drifter (see Rossby *et al.*, 1986, for a complete description of the RAFOS system), which is programmed to listen for signals from moored sound sources. The RAFOS floats determine the time-of-arrival (TOA) of these signals, from which, given the speed of sound in water, its position can be determined. The TOA of the acoustic signals, as well as temperature and pressure measurements are stored in the float's micro-processor memory. Also stored in the float's memory are confidence limits for each TOA, which indicate the quality of the TOA signal heard. The sound sources in this experiment were programmed to transmit an 80-second-long continuous wave tone, which linearly increases its frequency from 259.375 Hz to 260.898 Hz. The individual sound sources broadcast this tone twice a day, and broadcast at different times (beginning at 0030, 0100, and 0130 UTC, and then twelve hours later). The floats in this experiment listened for these signals once a day (beginning at 0000 UTC). The float temperature sensors were built by Yellow Springs Instrument Company and were calibrated to ±0.01°C. Float pressure sensors were built by Data Instruments and calibrated to ±1% at 2000 psi.

Two types of float, isopycnal and isobaric, were used in this experiment to seed the upper and lower cores of the DWBC. The WHOI float group (Jim Valdes, Bob Tavares, and Brian Guest) ballasted all the floats in the WHOI ballasting tanks. Isobaric floats are ballasted with a solid drop weight that forces the floats to be neutrally buoyant at a desired pressure surface, in this case 3000 db. More detail on the ballasting procedure can be found in Anderson-Fontana *et al.* (1996). Isopycnal floats are identical to the isobaric floats, but with the addition of a "compressee" attached with the weight package, outside the float body. The compressee is designed so that the entire float package has nearly the same compressibility as seawater (Rossby *et al.*, 1985), thus allowing the float to follow water parcels along σ_t surfaces. The isopycnal floats were placed in the upper DWBC to follow the $\sigma_t = 27.73$ density surface, which resides at about 800 db north of the Gulf Stream and about 1200 db south of the Gulf Stream. It would have been preferable to use isopycnal floats for the deep floats also, but due to the weak stratification at this depth, this was not technically feasible.

After the float completes its mission (in this case, two years), the float is programmed to drop its external ballast, rise to the ocean surface, and telemeter its data to Service Argos receivers aboard the NOAA Polar Orbiting Environmental Satellites. Through Service Argos, the data are relayed to a ground station and transferred to a Global Processing Center. At the Global Processing Center, the data are processed and then transferred via the Internet to WHOI. The float data, including temperature, pressure, TOAs and respective confidences, are converted from hexadecimal to decimal, and are then ready for editing and tracking.

3. Sound Source Deployment

Five sound sources were deployed for this experiment, shown in Figure 1 and listed in Table 1 as SS1-7. Standard sound sources manufactured by Webb Research, Inc. were used. Before the floats were launched, sound sources 1 through 4 were moored in the Sargasso Sea between Georges Bank and the Blake-Bahama Outer Ridge. Three of the sources were concentrated around the Cape Hatteras region, to ensure tracking where the DWBC passes under the Gulf Stream, a focal area of this experiment. The acoustic range of the sound source is maximal in the sound channel, at roughly 1200 m, and decreases above and below that depth. The shallow floats in this experiment were able to hear the sound sources at greater ranges (~1500 – 2000 km) than the deep floats (~1000 km) because they were closer to the sound sources and the sound velocity channel. The sources were placed in locations that ensured maximal range for the deep set of floats. A few of the deep floats made it south of the Blake-Bahama Outer Ridge, beyond the range

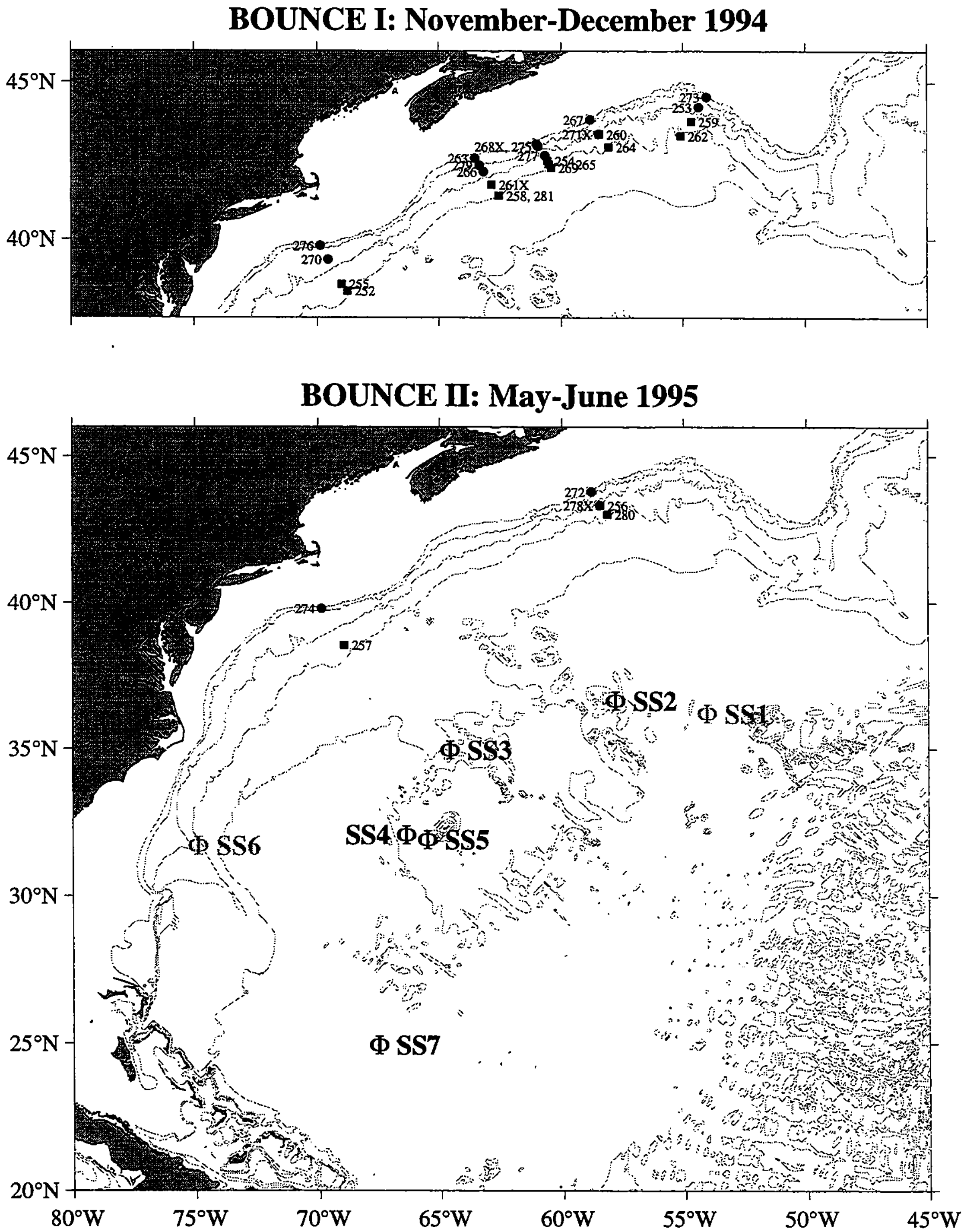

Figure 1. BOUNCE I and II float deployment and sound source locations. Shallow floats are marked as circles, with the float numbers to the left; deep floats are marked as squares, with the float numbers to the right. Floats that were not heard from after launch have an 'X' after their numbers. Sound sources are marked with the Φ symbol. The grayed sound source labels (SS1, SS6) indicate that these sound sources were not used to track the floats. Bathymetry is shown in 1000 meter contours.

Table 1: Sound Source Moorings

Mooring Number	*Source Depth (meters)*	*Deployment Date (yymmdd)*	*Source Died (yymmdd)*	*Latitude*	*Longitude*	*Transmission Time (GMT)*	*Initial Clock Offset (seconds)*	*Drift Rate (sec/day)*
SS1 (A-184/D1)	1560	941014		36.257 °N	54.477 °W	00:30, 12:30	0.000965	0*
SS2 (A-185/D2)	1500	941019		36.687 °N	58.263 °W	01:00, 13:00	0.005611	0.0113
SS3 (A-186/D3)	1500	941020		34.991 °N	65.023 °W	01:30, 13:30	-0.035715	0.0135
SS4 (A-187/D4)	1500	941206	950213	32.116 °N	65.964 °W	00:30, 12:30	0.00	0*
SS5 (S-200/D4)	1476	960604		31.947 °N	65.960 °W	00:30, 12:30	10.0	0*
SS6 (S-020/ ABACO Site A)	1000	920422		31.742 °N	75.329 °W	01:00, 09:00. 17:00	0.00	0*
SS7 (S-021/ ABACO Site B)	1000	920422		24.983 °N	68.001 °W	01:30, 09:30, 17:30	51.7	0*

*** The drift rates for these sources are unknown, and assumed to be zero for this experiment.**

of most of the sound sources placed in this experiment. It was fortunate that two sound sources (SS6 and SS7, Figure 1 and Table 1), moored by Kevin Leaman in 1992, continued to transmit long past their expected life span of 2 years and were still able to be heard.

Two of the five sound sources deployed as part of BOUNCE failed prematurely. SS1 was never heard from by any floats and presumably failed for unknown reasons immediately after deployment. SS4 failed in February 1995 (about 2.5 months after the floats were deployed) due either to mooring failure or to clock drift within the source. Some floats surfaced prematurely (see Figure 2), but the failure of SS4 was not confirmed until March 1996 because floats did not come within range of SS4 until they

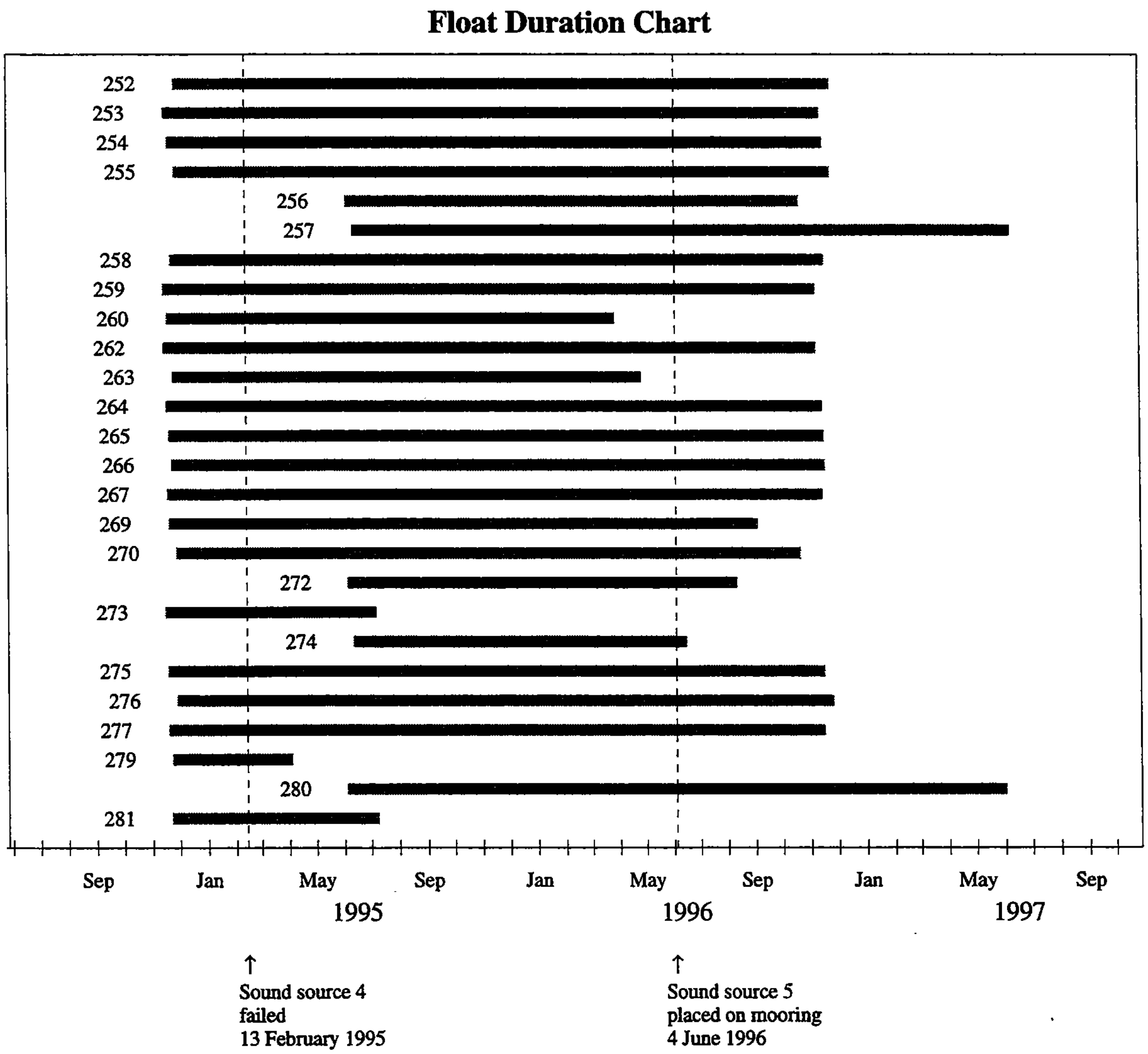

Figure 2. Float duration chart showing the periods the floats were in the water. Float numbers are marked on the left. The dashed lines indicate when sound source 4 was no longer usable, and when sound source 5 replaced sound source 4.

reached the Cape Hatteras region. Two months after the second set of floats surfaced (June 1996), a replacement sound source, SS5, was moored near where SS4 had been (Fig.1). This sound source was equipped with an acoustic release and was recovered in June 1997 by the R/V Atlantis.

4. Float Deployment

Initially, all 30 floats were to be deployed along eight of the nine planned CTD sections on the November 1994 R/V Endeavor cruise (BOUNCE I). The isopycnal floats were to seed the upper CFC core, and the isobaric floats the lower CFC core.

Due to unusually bad weather, and the subsequent reduction in the number of sections from nine to five, only 24 of the 30 floats were deployed along the sections during BOUNCE I. The remaining six floats were deployed during BOUNCE II in June 1995. Figure 1 shows the launch locations of the floats during the two BOUNCE cruises. A summary of BOUNCE I is as follows: four floats were deployed along the first, second, and fifth sections, and six floats were launched along sections three and four. (The first CTD section is the easternmost section; section numbers increase in order to the west.) All but one of the floats were set to their planned target pressure or density: deep floats to 3000 db, and shallow floats to $\sigma_t = 27.73$. To one deep float (b281) launched at the southern end of section 4 were added four 3/8" washers to increase the target depth to about 3320 m. There was not enough room on the eyebolt to accommodate all the weights, so some of the washers were attached to this float with an additional tie-wrap. Summaries of the float launch and surface times and locations are found in Table 2 for the shallow, isopycnal floats, and Table 3 for the deep, isobaric floats.

The strategy for choosing the launch sites in BOUNCE I was generally as follows. Real-time CFC data were not available before the floats had to be launched, so a combination of historical information and data from upstream sections (after section 1) was used to place the floats in the CFC maxima. Historically, the deep CFC maximum is found very close to the 3500 m isobath, so one deep float was launched at this isobath on each section. The second deep float was then launched up to 50 km offshore from the 3500 m isobath. This distance was decreased as the cruise progressed because it was observed in the first CFC section that a 50-km spacing put the float outside the CFC maximum. If three floats were deployed at one depth along the same section, the total distance spanned by the floats was in general less than 50 km. The deployment strategy for the shallow floats was to get one float as far inshore as possible. The 1500 m isobath was chosen as the site of the most inshore deployment, which leaves about 700 m under the float. The other shallow floats were deployed 25-50 km offshore from the float deployed at the 1500-m isobath.

During BOUNCE II, the remaining six floats were also deployed along hydrographic sections across the DWBC. In summary, four floats were launched along section 2 in a manner identical to BOUNCE I, with 2 floats ballasted for 3000 db and two

Table 2: Isopycnal Float Summary

		LAUNCH				*SURFACE*					
Float ID	*Target Density*	*Date (yymmdd)*	*Time (GMT)*	*Latitude*	*Longitude*	*Date (yymmdd)*	*Time (GMT)*	*ARGOS Fix-time (GMT)*	*Latitude*	*Longitude*	*Status Code*[1]
b253	27.73	941114	15:21	44.203 °N	54.329 °W	961113	02:30	11:31	40.544 °N	66.352 °W	00?[2]
b263	27.73	941122	18:54	42.560 °N	63.501 °W	960427	02:30	10:58	39.300 °N	67.020 °W	83
b266	27.73	941122	0418	42.136 °N	63.146 °W	961117	02:30	11:43	35.086 °N	67.802 °W	00
b267	27.73	941117	11:05	43.802 °N	58.796 °W	961115	02:30	10:45	39.609 °N	62.678 °W	00
b268	27.73	941118	05:58	42.939 °N	60.935 °W	961116	not heard				
b270	27.73	941127	09:30	39.349 °N	69.551 °W	961021	02:30	08:04	38.827 °N	64.939 °W	66
b271	27.73	941117	03:39	43.338 °N	58.448 °W	961115	not heard				
b272	27.73	950604	19:16	43.793 °N	58.774 °W	960812	02:30	05:41	41.956 °N	65.288 °W	66
b273	27.73	941114	21:55	44.531 °N	54.004 °W	950707	02:30	0612	44.473 °N	56.255 °W	83
b274	27.73	950610	22:30	39.786 °N	69.853 °W	960616	02:30	22:28	39.896 °N	56.881 °W	66
b275	27.73	941118	03:12	43.022 °N	60.995 °W	961116	02:30	23:25	37.526 °N	70.381 °W	00
b276	27.73	941127	21:07	39.787 °N	69.869 °W	961126	02:30	21:25	38.848 °N	69.360 °W	00
b277	27.73	941118	11:20	42.651 °N	60.655 °W	961116	02:30	05:01	40.483 °N	47.816 °W	00
b278	27.73	950604	13:26	43.331 °N	58.438 °W	970603	not heard				
b279	27.73	941122	08:45	42.344 °N	63.324 °W	950404	02:30	23:22	41.572 °N	64.960 °W	83

1. **Status codes at end of float mission. 00: normal mission, 66: low battery, 80: over pressure, 83: lost weight.**

2. **For float b253, the status code is unknown, and assumed normal (00) because float completed full mission length of 730 days.**

Table 3: Isobaric Float Summary

Float ID	*Target Pressure*	*LAUNCH* *Date (yymmdd)*	*Time (GMT)*	*Latitude*	*Longitude*	*SURFACE* *Date (yymmdd)*	*Time (GMT)*	*ARGOS Fix-time (GMT)*	*Latitude*	*Longitude*	*Status Code*[1]
b252	3000	941126	14:39	38.346 °N	68.783 °W	961124	02:30	05:16	34.662 °N	59.530 °W	00
b254	3000	941118	12:59	42.490 °N	60.558 °W	961116	02:30	10:26	34.586 °N	63.485 °W	00
b255	3000	941126	20:00	38.561 °N	69.013 °W	961124	02:30	12:31	27.091 °N	74.319 °W	00
b256	3000	950604	13:18	43.331 °N	58.438 °W	961021	02:30	08:06	36.482 °N	71.709 °W	83
b257	3000	950611	17:50	38.538 °N	68.954 °W	970609	02:30	17:42	41.326 °N	54.051 °W	00
b258	3000	941121	11:12	41.386 °N	62.542 °W	961117	02:30	10:03	35.419 °N	56.896 °W	00
b259	3000	941113	23:49	43.745 °N	54.646 °W	961108	02:30	11:40	35.525 °N	71.505 °W	00
b260	3000	941117	03:38	43.338 °N	58.447 °W	960328	02:30	16:48	38.161 °N	68.807 °W	83
b261	3000	941121	17:28	41.733 °N	62.829 °W	961117	not heard				
b262	3000	941113	13:57	43.291 °N	55.082 °W	961108	02:30	11:42	27.225 °N	75.848 °W	00
b264	3000	941116	16:25	42.933 °N	58.065 °W	961115	02:30	10:48	36.734 °N	64.953 °W	00
b265	3000	941118	16:40	42.385 °N	60.502 °W	961116	02:30	10:24	38.038 °N	53.185 °W	00
b269	3000	941118	18:00	42.269 °N	60.407 °W	960904	02:30	04:53	40.167 °N	52.503 °W	80
b280	3000	950603	17:05	43.031 °N	58.142 °W	970602	02:30	05:55	20.751 °N	68.499 °W	00
b281	3320	941121	11:22	41.398 °N	62.543 °W	950709	02:30	18:58	34.493 °N	74.037 °W	83

1. Status Code at end of mission. 00: normal mission, 66: low battery, 80: over pressure, 83: lost weight.

for σ_t = 27.73. This was done under the assumption that most of the floats launched during BOUNCE I had probably drifted west of 60°W, and the new floats would in essence extend the along-stream extent of the sampling. The two remaining floats, one deep and one shallow, were launched along section 5 at two locations also seeded during BOUNCE I (the 1500 and 3500 m isobaths), to increase the potential for some of the floats to reach the DWBC/GS cross-over.

All float launching was done by hand, with one person lying on the fantail and the other guiding the float down vertically. The launch tube was not used. The weather conditions at launch varied from flat calm to moderate seas.

5. Float Performance

The 30 RAFOS floats were deployed in the DWBC for 730-day missions. Out of the 30 floats deployed, 16 floats surfaced on time after two years (6 shallow and 10 deep). One of these 16 floats was 'deaf' (a shallow float), returning temperature and pressure records, but no TOAs to track the float. Of the remaining 14 floats, six (3 shallow, 3 deep) surfaced early, presumably due to lost weights. In most of these cases, there is evidence in the pressure records of bottom contact. Three shallow floats surfaced early due to a low battery. One deep float surfaced early due to the float sensing over-pressure. Four floats (3 shallow, 1 deep) failed to transmit entirely. Summaries of the float missions are described in Tables 2 and 3. The duration chart in Figure 2 describes visually the float missions in time. In total, 73% of the mission was accomplished: 84% of the deep missions, and 62% of the shallow missions.

From these results, it seems that contact with the bottom can lead to detachment of the drop weight or compressee from the float. In the case of the floats with compressees, it also seems that contact with the bottom leads to either leaking or attachment of sediments, because these floats tended to go too deep after they hit the bottom. Some shallow floats (e.g. b267 and b272) managed to hold on to their compressees for two years even after they hit the bottom, but either due to a leak or picking up sediments, these floats sank below their target depth.

In general, ballasting of both the deep and shallow floats was good. Table 4 shows the ballasting performance for each float. For the deep floats, the average difference between the actual and target pressure was 58 db too deep. One float (b262) was seriously misballasted 580 dbars too deep. If this float is removed from the statistics, the average difference is only 14 dbars too deep. For the shallow floats, the target density was σ_t = 27.73. The average σ_t at the depth of the float on the first record after launch (obtained from CTD data) was 27.7375, or only 0.0075 sigma units too heavy. This corresponds to a depth of about 75-100 meters.

Table 5 describes the performance of the floats that reached the surface and transmitted the data via ARGOS, including the number of days on surface, and the initial

Table 4: RAFOS Float Ballasting/Temperature Performance

Float ID	CTD Section	CTD Stations	Float target pressure (db)/ sigma-t	Float Initial Pressure (db)	Δ Pres. (initial - target) (db)	Float initial temp. (° C)	CTD in situ temp. (° C)	Δ Temp. (float – CTD) (° C)	CTD sigma-t	Δ Density (float – CTD) (kg/m^3)	# records: pres./ temp.[1]
Isopycnal Floats											
b253	1	8	27.73	939.1	n/a[2]	3.94	4.248	-0.31	27.7496	0.0196	81/35
b263	4	31-32	27.73	848.0	n/a	4.41	4.496	-0.09	27.7438	0.0138	0/0
b266	4	29-30	27.73	879.5	n/a	4.55	4.450	0.10	27.7218	-0.0082	0/0
b267[3]	2	16-17	27.73	942.0	n/a	4.17	4.090	0.08	27.7442	0.0142	0/0
b268	not heard										
b270	5	39	27.73	819.8	n/a	4.55	4.598	-0.05	27.7270	-0.0030	0/0
b271	not heard										
b272	2	16-17	27.73	846.6	n/a	4.18	4.271	-0.09	27.7332	0.0032	0/0
b273[3]	1	9-10	27.73	794.2	n/a	4.43	4.501	-0.07	27.7325	0.0025	0/0
b274	5	33-34	27.73	920.8	n/a	4.35	4.255	0.10	27.7418	0.0118	0/1
b275	3	18-19	27.73	902.0	n/a	4.19	4.132	0.06	27.7438	0.0138	0/0
b276[3]	5	41-42	27.73	1048.2	n/a	4.13	4.100	0.03	27.7495	0.0195	0/0
b277	3	20	27.73	926.6	n/a	4.38	4.265	0.12	27.7327	0.0027	0/0
b278	not heard				n/a						
b279	4	30-31	27.73	972.0	n/a	4.42	4.310	0.11	27.7418	0.0118	0/0
Isobaric Floats											
b252	5	35	3000	3017.6	17.6	2.67	2.595	0.08	n/a	n/a	0/0
b254	3	20-21	3000	3052.8	52.8	2.61	2.606	0.00	n/a	n/a	0/0
b255	5	36	3000	2985.6	-14.4	2.51	2.554	-0.04	n/a	n/a	0/0
b256	2	15	3000	3007.7	7.7	2.75	2.648	0.10	n/a	n/a	0/0
b257	5	38	3000	3041.1	41.1	2.63	2.508	0.12	n/a	n/a	40/40
b258	4	26-27	3000	3127.4	127.4	2.66	2.556	0.10	n/a	n/a	0/0
b259	1	6	3000	2992.8	-7.2	2.71	2.659	0.05	n/a	n/a	1/1

b260	2	15	3000	2998.4	-1.6	2.70	2.623	0.08	n/a	n/a	0/0
b261	not heard										
b262	1	4	3000	3585.0	585.0	2.48	2.421	0.06	n/a	n/a	0/0
b264	2	13-14	3000	3000.8	0.8	2.75	2.747	0.00	n/a	n/a	1/2
b265	3	21	3000	2998.0	-2.0	2.66	2.604	0.06	n/a	n/a	0/0
b269	3	21-22	3000	2989.0	-11.0	2.73	2.648	0.08	n/a	n/a	0/0
b280	2	13-14	3000	2998.9	-1.1	2.76	2.759	0.00	n/a	n/a	0/0
b281	4	26-27	3320	3338.8	18.8	2.43	2.393	0.04	n/a	n/a	0/0
Mean[4]					59.4 db[5]			0.04 °C		0.0075 kg/m^3	

1. Number of records before first good pressure/temperature record.

2. n/a: not applicable or not available.

3. These results are based on a single station because CTD stations 10, 17, and 42 were too shallow to use.

4. Data from floats b253 and b257 were not used when calculating the mean because there were too many records missing between launch and first data point.

5. The mean pressure difference between the float and CTD dropped to 14.4 db when data from float b262 was not used.

Table 5: Float Clock and ARGOS Information

Float ID	*Reset Date (yymmdd)*	*Initial Float Clock Offset (sec)*	*Launch Date (yymmdd)*	*Surface Due Date (yymmdd)*	*Actual Surface Date (yymmdd)*	*Final Float Clock Offset (sec)*	*Last Date Heard by ARGOS (yymmdd)*	*Days on Surface*	*Status[1] Code*
Isopycnal Floats									
b253	941109	-0.68	941114	961108	961113	-73.9	961114	1	00?[2]
b263	941122	-0.51	941123	961120	960427	-52.0	960605	39	83
b266	941118	0.58	941122	961117	961117	-67.1	970102	46	00
b267	941116	0.4	941117	961115	961115	-60.9	961228	43	00
b268	941117	0.42	941118	961116	not heard				
b270	941125	-0.51	941127	961124	961021	-65.5	961127	37	66
b271	941116	-0.83	941117	961115	not heard				
b272	950604	1	950604	970603	960812	-35.9	960929	48	66
b273	941109	-1.46	941114	961108	950707	-19.3	950905	60	83
b274	950610	2.5	950610	970609	960616	-81.5	960826	71	66
b275	941117	-0.54	941118	961116	961116	-76.6	970117	63	00
b276	941125	-2.58	941127	961124	961126	-161	970107	42	00
b277	941117	-0.55	941118	961116	961116	-70.3	961225	39	00
b278	950604	0.5	950604	970603	not heard				
b279	941118	1.13	941122	961117	950404	-8.7	950429	25	83
Isobaric Floats									
b252	941125	-2.67	941126	961124	961124	-188	970104	41	00
b254	941117	0.66	941118	961116	961116	-41.7	970114	60	00
b255	941125	0.14	941126	961124	961124	-79.0	961230	36	00
b256	950604	1.5	950604	970603	961021	-83.9	961205	45	83
b257	950610	1	950611	970609	970609	-12.8	970611	2	00
b258	941118	0.23	941121	961117	961117	-31.1	961228	41	00
b259	941109	-0.74	941113	961108	961108	24.3	961219	41	00
b260	941116	-1.14	941117	961115	960328	-29.4	960602	66	83

b261	941118	0.58	941121	961117	not heard				
b262	941109	-0.74	941113	961108	961108	-75.1	961209	31	00
b264	941116	0.58	941116	961115	961114	-66.8	961224	40	00
b265	941117	0.99	941118	961116	961116	-19.3	961224	38	00
b269	941118	-0.68	941118	961117	960904	-76.3	961014	40	80
b280	950603	0	950603	970602	970602	-84.3	970810	69	00
b281	941118	-0.51	941121	961117	950709	-20.2	950827	49[3]	83

1. **Status codes at end of float mission. 00: normal mission, 66: low battery, 80: over pressure, 83: lost weight.**

2. **For float b253, the status code was unknown and assumed normal (00) because float completed full mission length of 730 days.**

3. **The average number of days on surface was 43; without b253 and b257, this average increased to 46.**

and final float clock offsets. Two floats quit transmitting almost immediately after surfacing for unknown reasons. The remaining floats transmitted for 46 days on average, and one for as long as 71 days.

6. Float Tracking

The floats were tracked using ARTOA/ARTRK software, which originated at the University of Rhode Island, and is now primarily revised and maintained by Martin Menzel, at the Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER). ARTOA, which edits the temperature, pressure and TOA data, and ARTRK, which tracks the floats, are run on MATLAB. The programs can be found at http://www.ifremer.fr/lpo/eurofloat/. The TOAS were corrected for the Doppler shift and transmission time difference, then interpolated using 20-day cubic spline filter, before tracking. Tracking was done using the least-squares method.

The floats were able to hear signals from sound sources 2, 3, 4, 5, 6, and 7. Sound source 1 was never heard by any float. Sound source 6 was weak and not used for tracking because there were always suitable stronger sources that could be used during an interval that a float heard sound source 6. Therefore, only sound sources 2, 3, 4, 5 and 7 were used for tracking the floats. Overall, the TOA signals from sound sources 2, 3, 4, 5, and 7 were sufficient to track the floats. There were a few instances, however, where a float was unable to be tracked because the float passed through the base line of a sound source combination with which it was being tracked.

To determine when sound source 4 failed, and thus get back as many of the good TOAs as possible for tracking, a subset of deep floats was chosen that had clear TOAs from SS4 and other sound sources. By tracking the floats using the good TOAs, an accurate daily position could be found. The difference between the float position and the SS4 position yielded daily distances between SS4 and the float. Dividing the calculated distance to SS4 by the sound velocity resulted in an expected TOA for SS4. Where the actual TOA record diverged from the expected TOA record pinpointed the day SS4 failed. The TOA records from SS4 were used for tracking up until this day – 13 February 1995. Figure 2 shows the usable time segment of SS4 for this experiment.

While tracking the floats, it became apparent that sound sources 2 and 3 had clock drifts. These sound sources have not been recovered, so all that is known with certainty is the initial source clock offset. Calculating the sound velocity using the first and last TOAs from SS2 and SS3, and the distance between the float launch and surface positions, and the respective sound source, resulted in unrealistic sound velocities at the end of the mission. In contrast, reasonable sound velocities resulted from the same calculations with sound sources 4, 5, 6, and 7. The clocks of sources 2 and 3 apparently drifted over the two-year mission. The drift rate was calculated by adjusting the TOA times at the end of the mission until a satisfactory sound velocity resulted, and transforming the total offset into a linear drift rate.

Different sound velocities were used to track the deep and shallow floats. For the shallow floats, sound velocity was first calculated uniquely at each float's median temperature and pressure value, using the UNESCO sound velocity polynomial (Fofonoff and Millard, 1983). That value was then averaged with the mean sound velocity at the average sound source depth (1500 m) northwest and southeast of the Gulf Stream, calculated using the CTD data from EN257. Using this method for the deep floats resulted in sound velocities that were generally too high. In this case a sound velocity was estimated for each deep float using the first TOA after launch and the distance between the launch position (GPS) and the sound source positions. These estimates were averaged to obtain a value of 1.495 km/sec, with greater weights being given to estimates for which the elapsed time between float launch and the time of the first TOA was relatively short.

Appendix A contains launch to surface vector diagrams, spaghetti diagrams, and 100-day composites for the isopycnal and isobaric floats. Appendix B contains each float's track, as well as its temperature, pressure, u-velocity, v-velocity, and stick plot showing the direction and magnitude of the x-y component of the float's movement.

7. Acknowledgements

The authors thank the captains and crews of the R/V Endeavor, R/V Oceanus, and R/V Weatherbird II for their willing assistance and patience in the field phase of this program, which was plagued by bad weather. Jim Valdes, Brian Guest, and Bob Tavares are gratefully acknowledged for their invaluable expertise in the preparation and ballasting of the floats. Chris Wooding assisted with data processing, and Martin Menzel graciously allowed us to use his processing software. Sound sources deployed by Kevin Leaman for a separate experiment extended the tracking range in this experiment. BOUNCE was funded by the National Science Foundation under Grant No. OCE93-01448 to the Woods Hole Oceanographic Institution.

8. References

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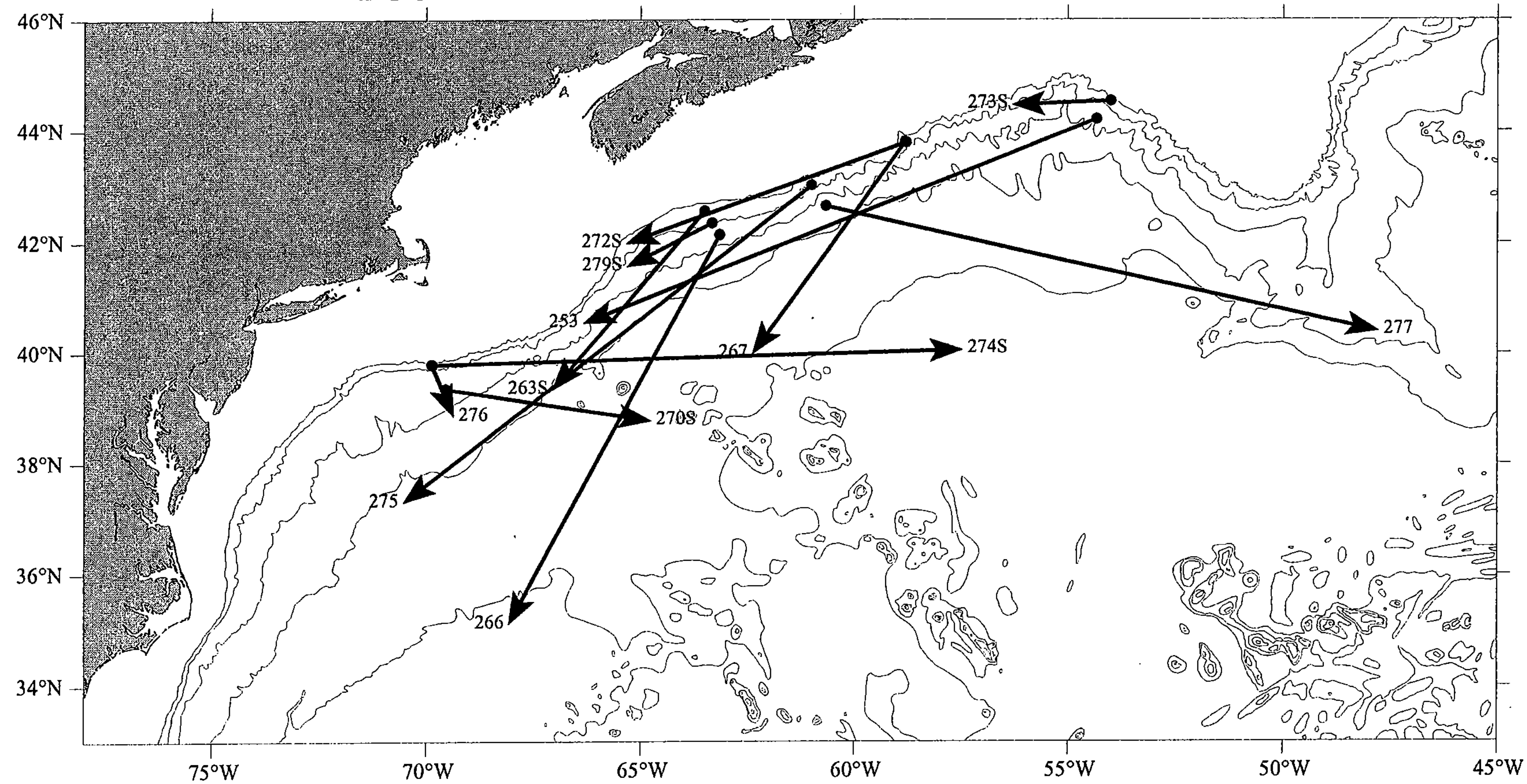
Appendix A

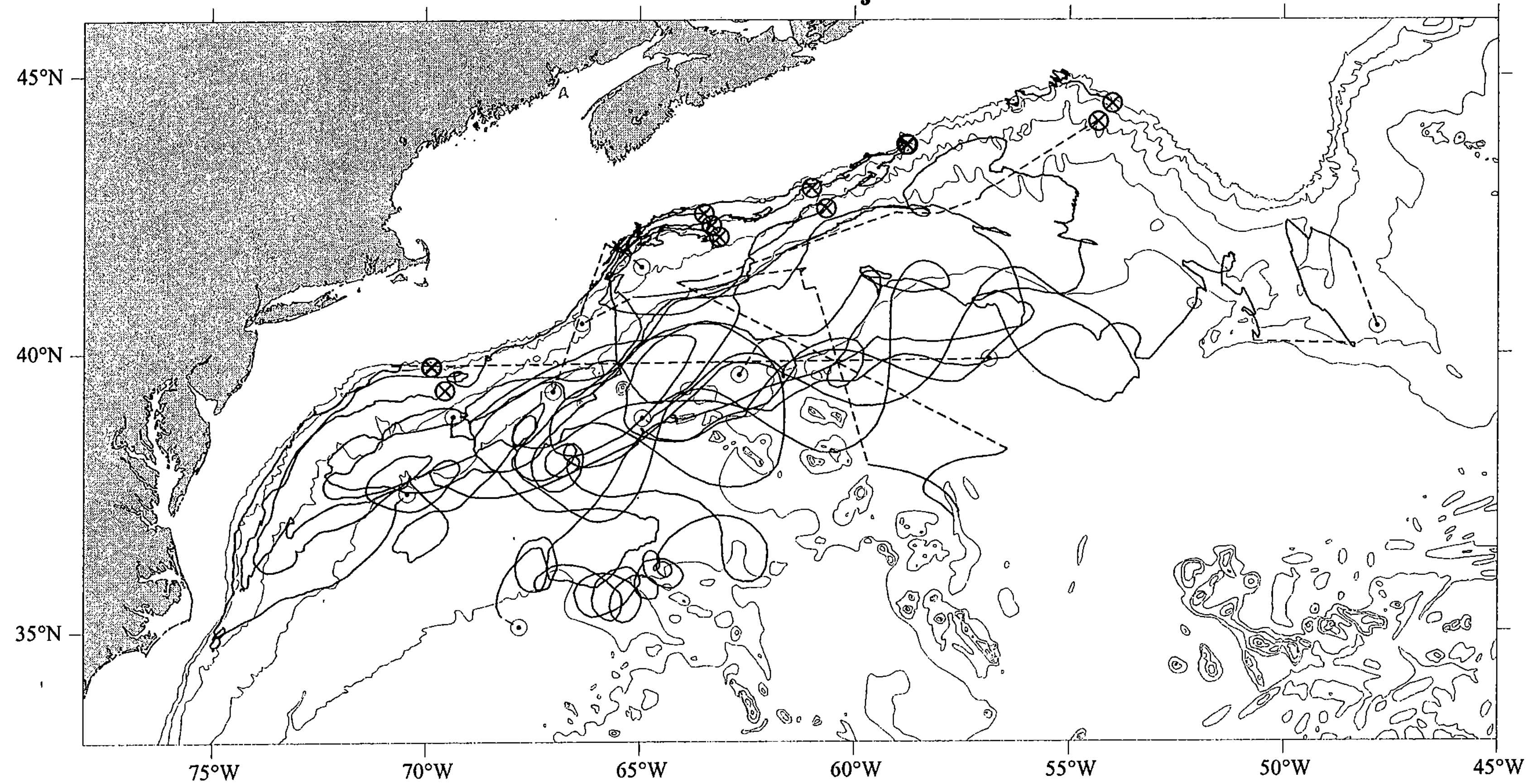
Contains launch-to-surface vector diagrams, "spaghetti" diagrams, and 100-day composite plots for the shallow and deep floats. In launch-to-surface vector diagrams launch positions are marked as dots, surface positions are marked as arrowheads. Float labels are at the surface point. An 'S' after a float label indicates a 'short' mission length (less than 730 days). Spaghetti diagrams show an 'into the page' symbol (circle-x) as the launch position, and an 'out of the page' symbol (circle-dot) as the surface position. Float tracks are the solid black lines, and untrackable segments are represented as dashed lines. Composite plots use similar symbols as the spaghetti diagrams, with a few additions. The 'into the page' and 'out of the page' symbols are used for the start and end of each 100-day segment. Launch and surface positions are marked with an additional concentric circle around the 'into' or 'out of the page' symbols. Float labels occur at the start of each float segment. Single day positions are black dots; 25-day positions are open circles. All bathymetric contour intervals are 1000 m from 1000 m to 5000 m.

Shallow Floats

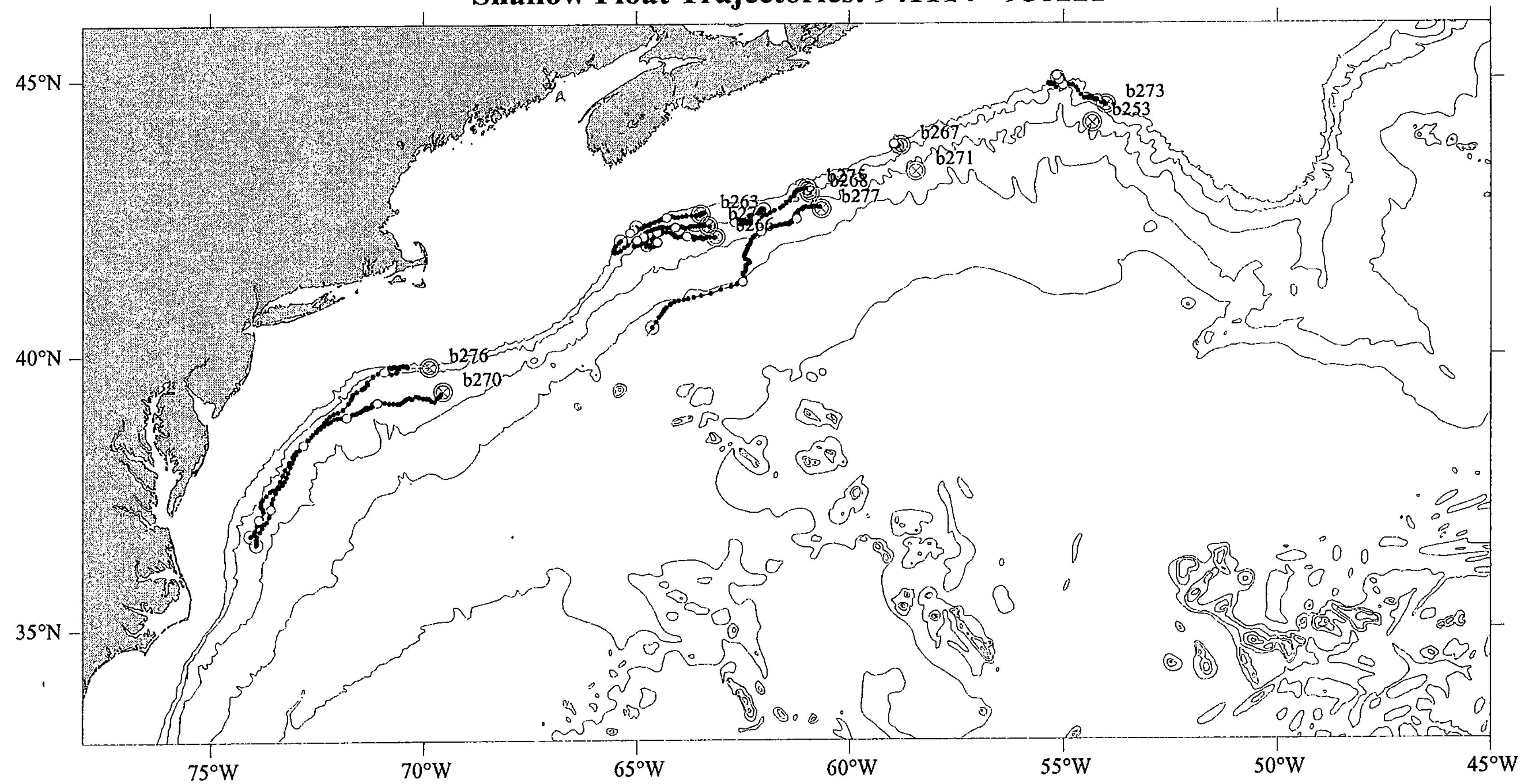
BOUNCE I & II: Launch-to-Surface Vectors: shallow floats



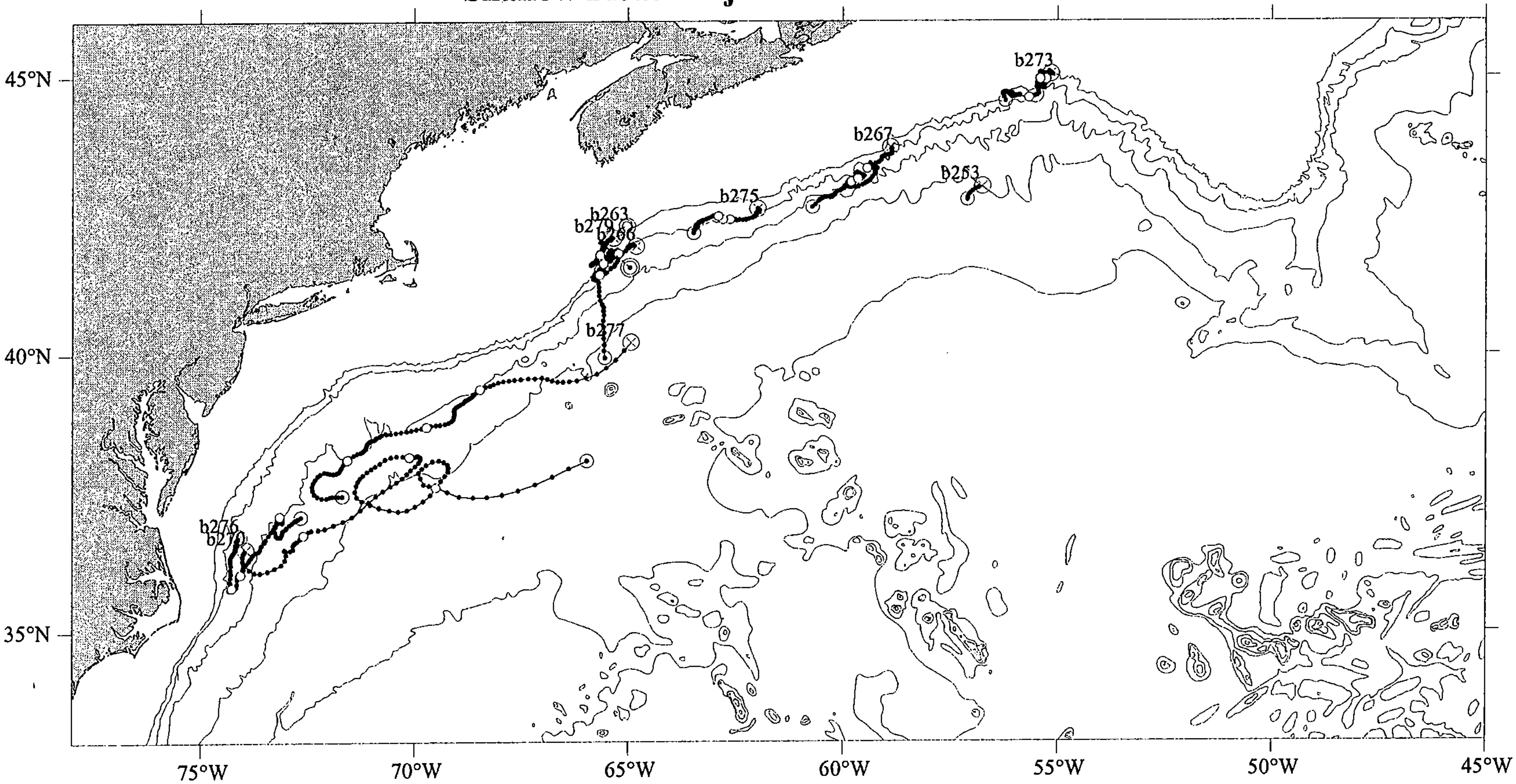
Shallow Float Trajectories



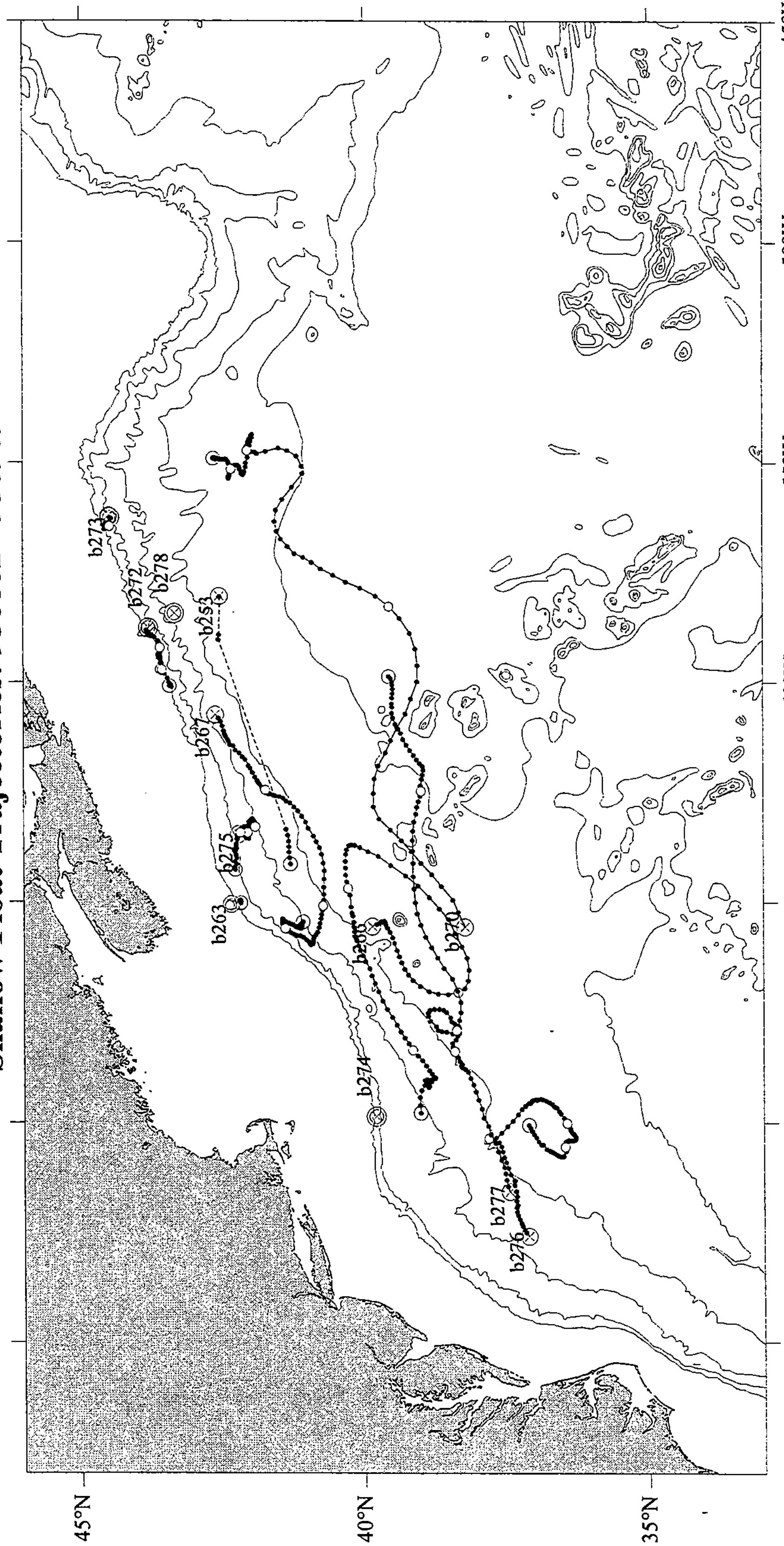
Shallow Float Trajectories: 941114 - 950221



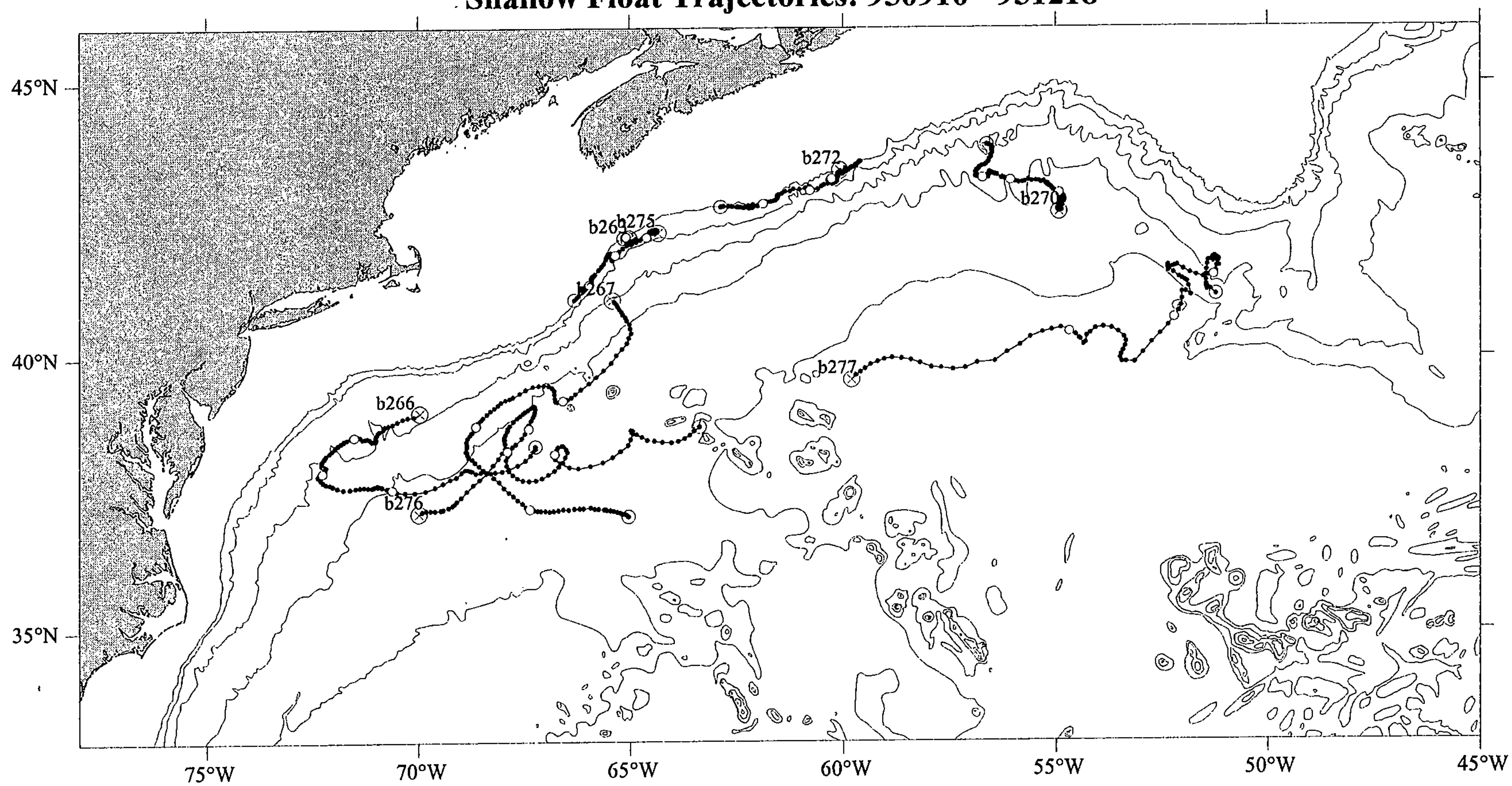
Shallow Float Trajectories: 950222 - 950601



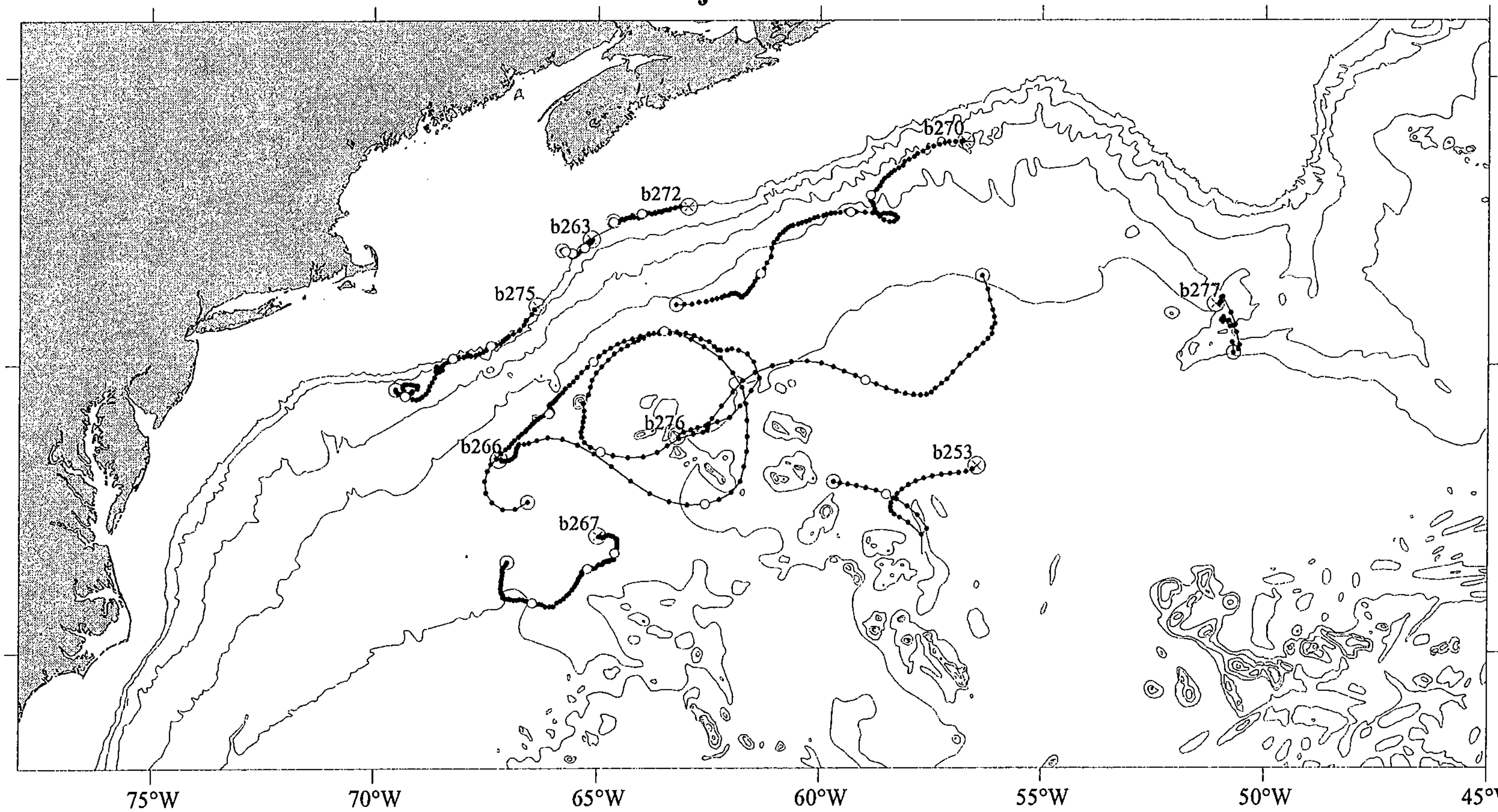
Shallow Float Trajectories: 950602 - 950909



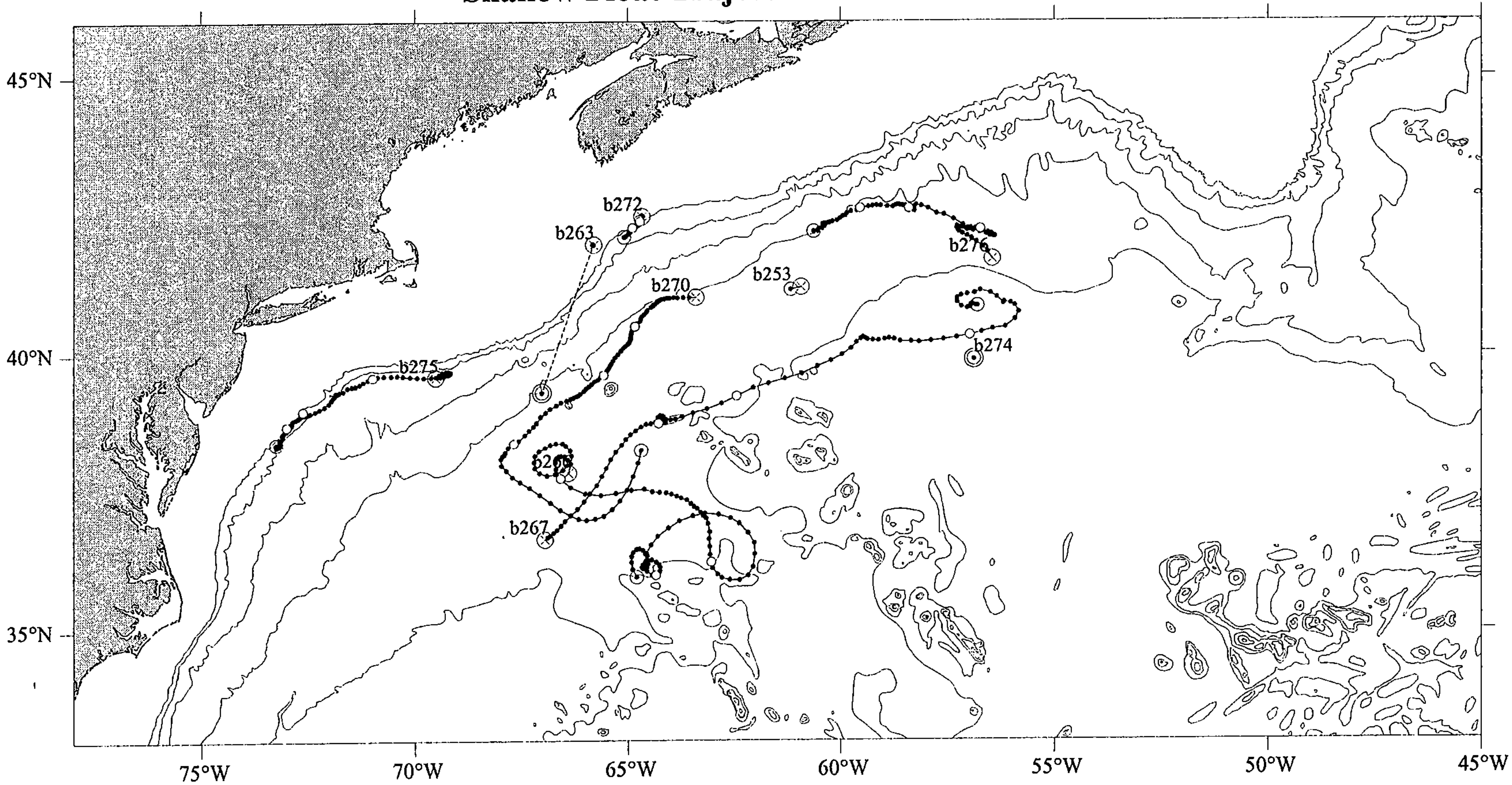
Shallow Float Trajectories: 950910 - 951218



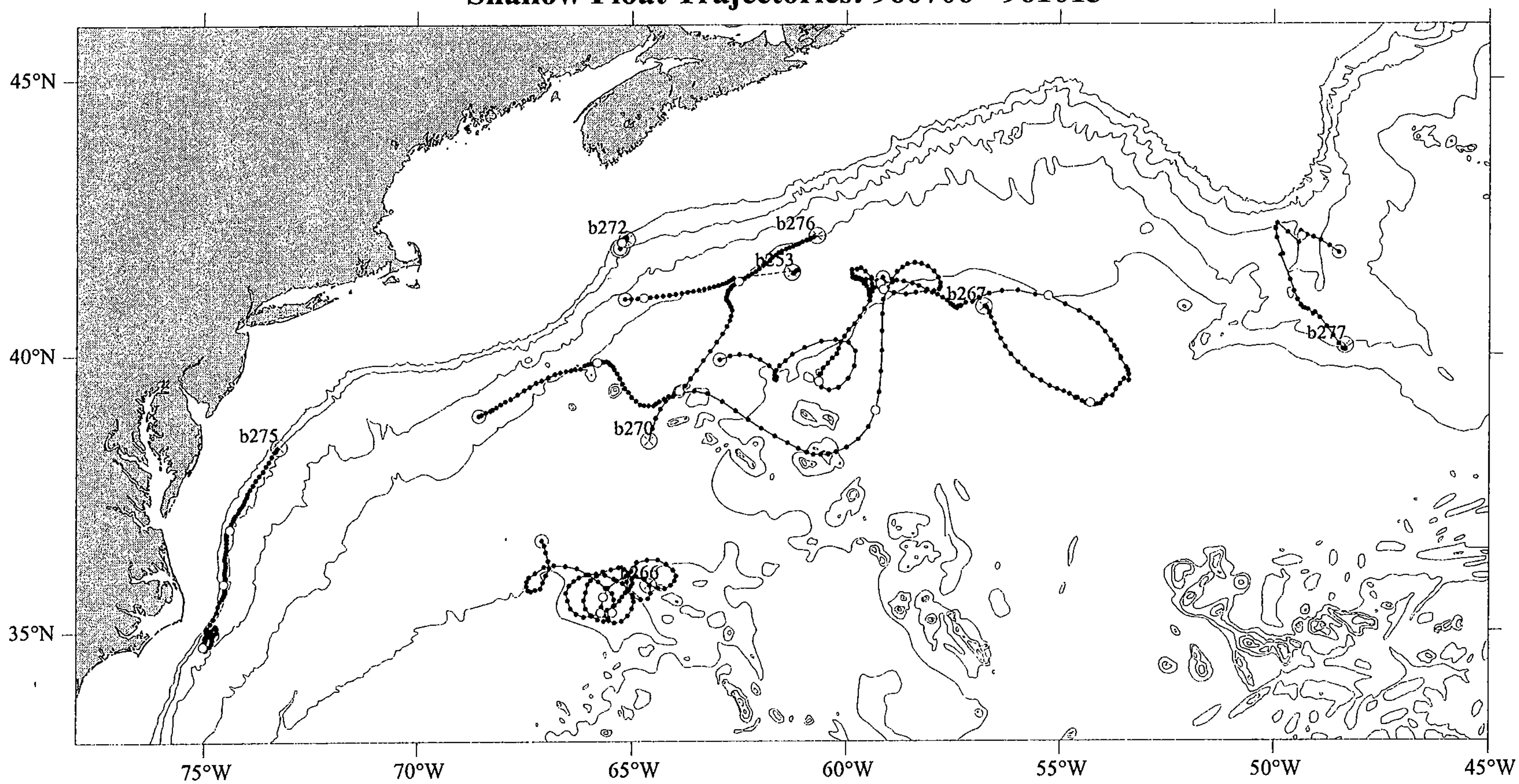
Shallow Float Trajectories: 951219 - 960327



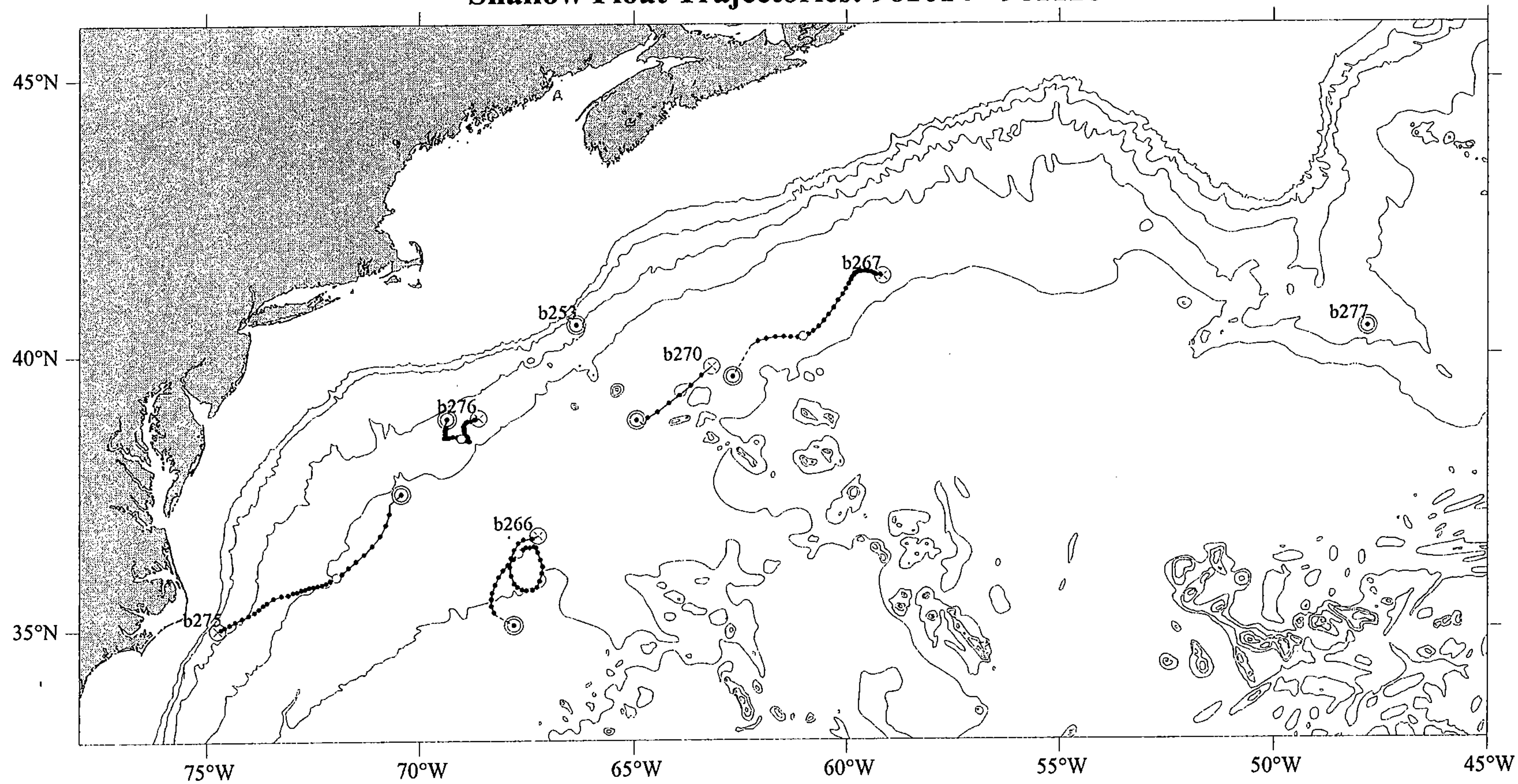
Shallow Float Trajectories: 960328 - 960705



Shallow Float Trajectories: 960706 - 961013

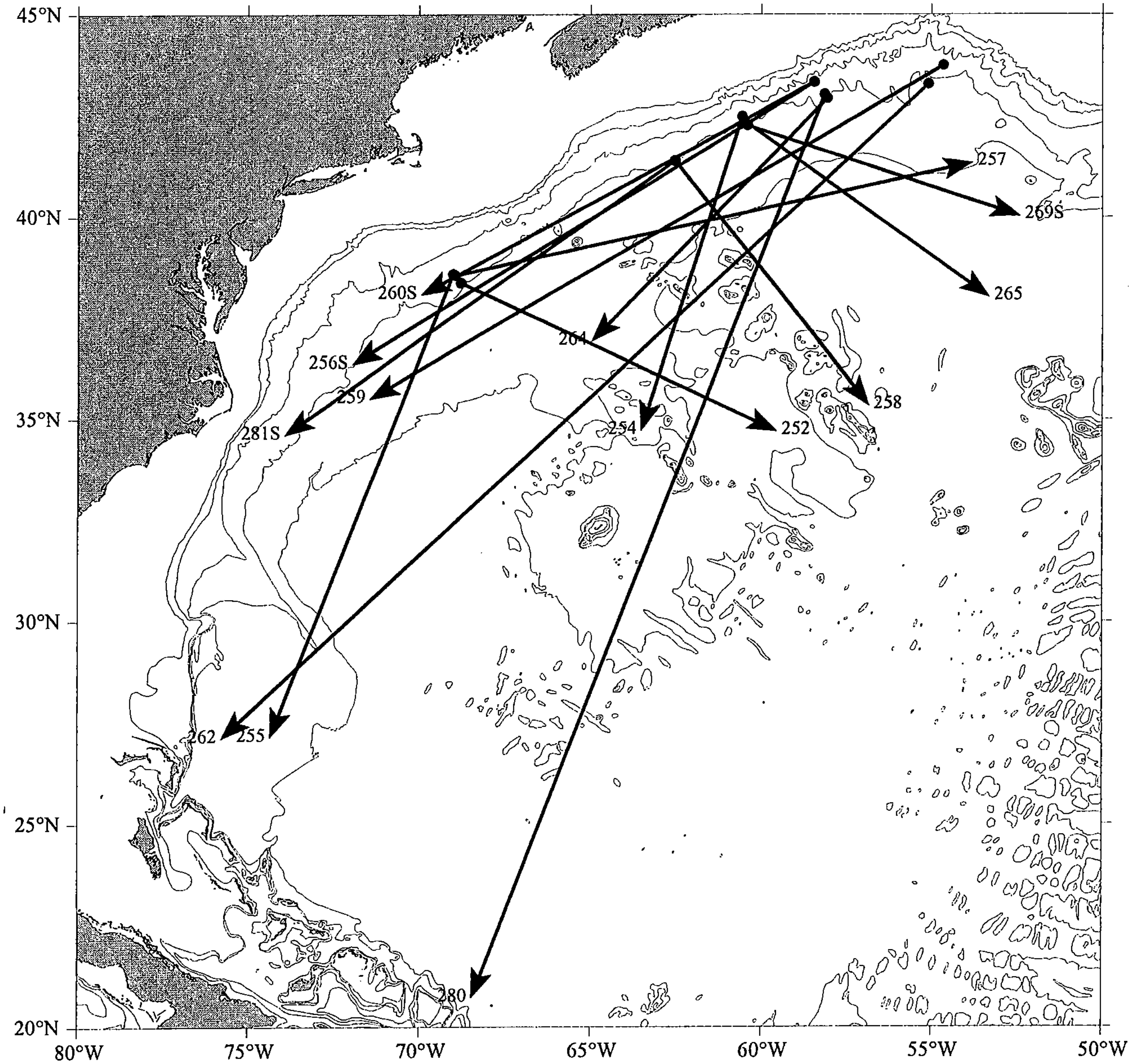


Shallow Float Trajectories: 961014 - 961126

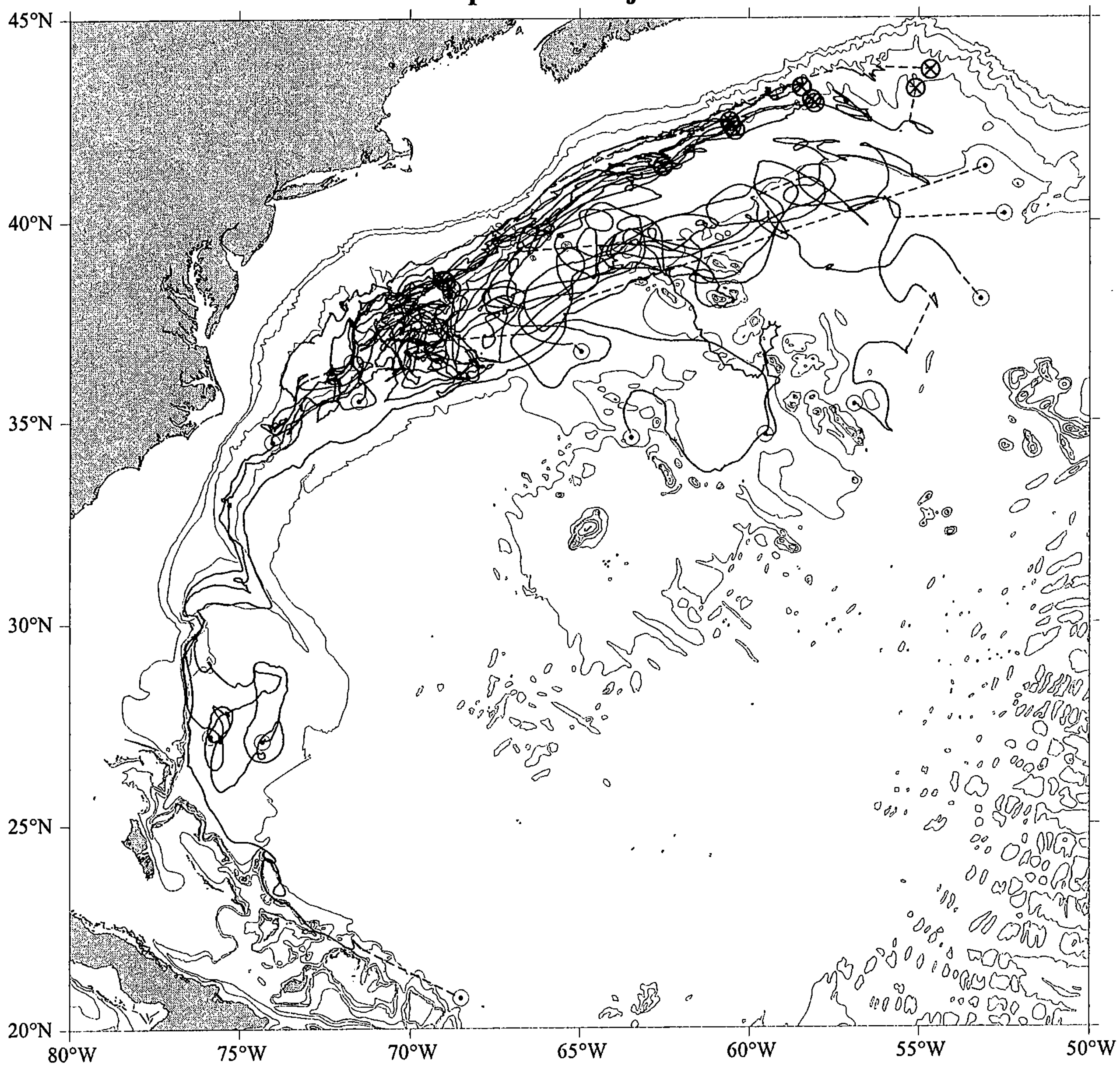


Deep Floats

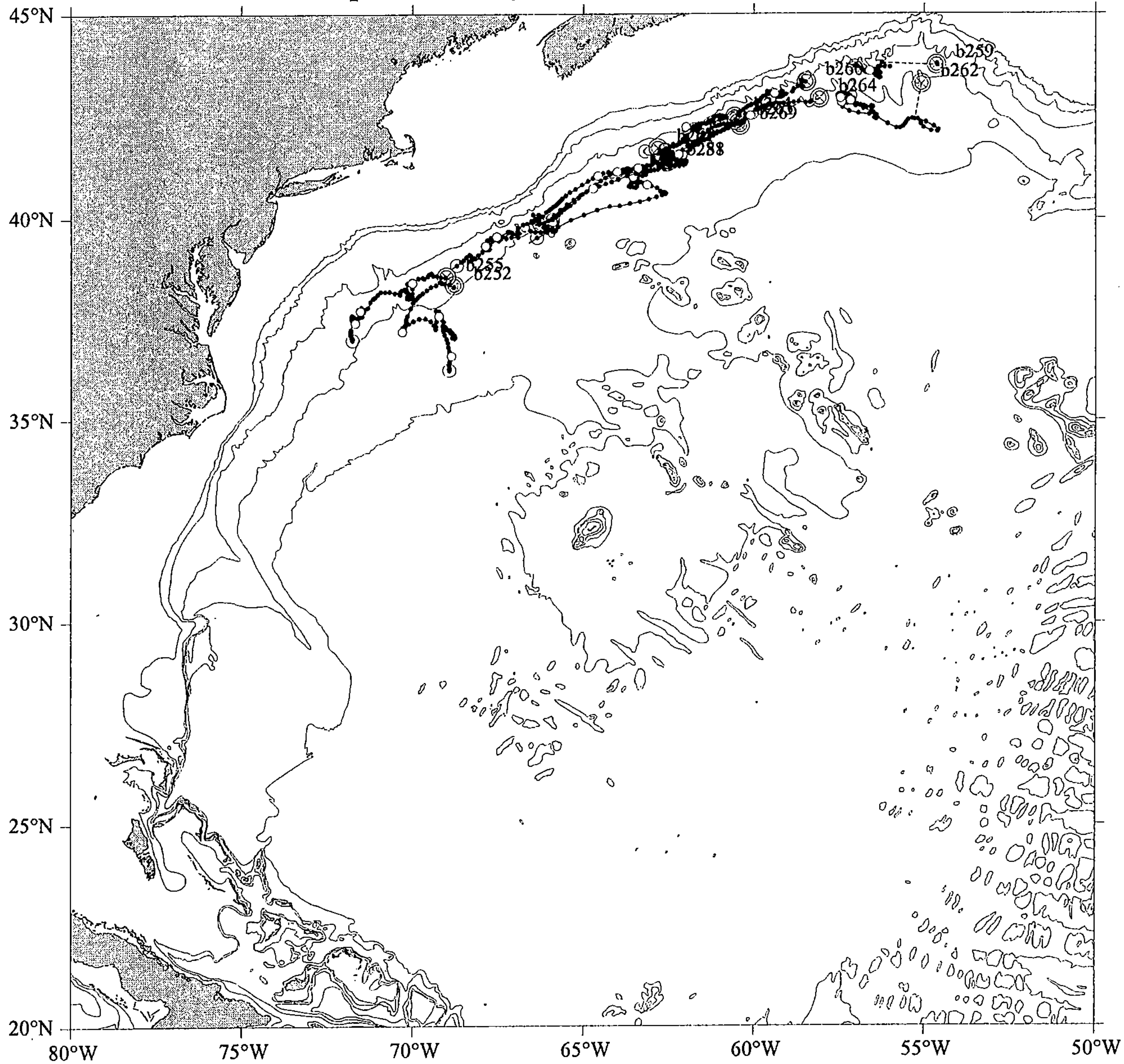
BOUNCE I & II: Launch-to-Surface Vectors: deep floats



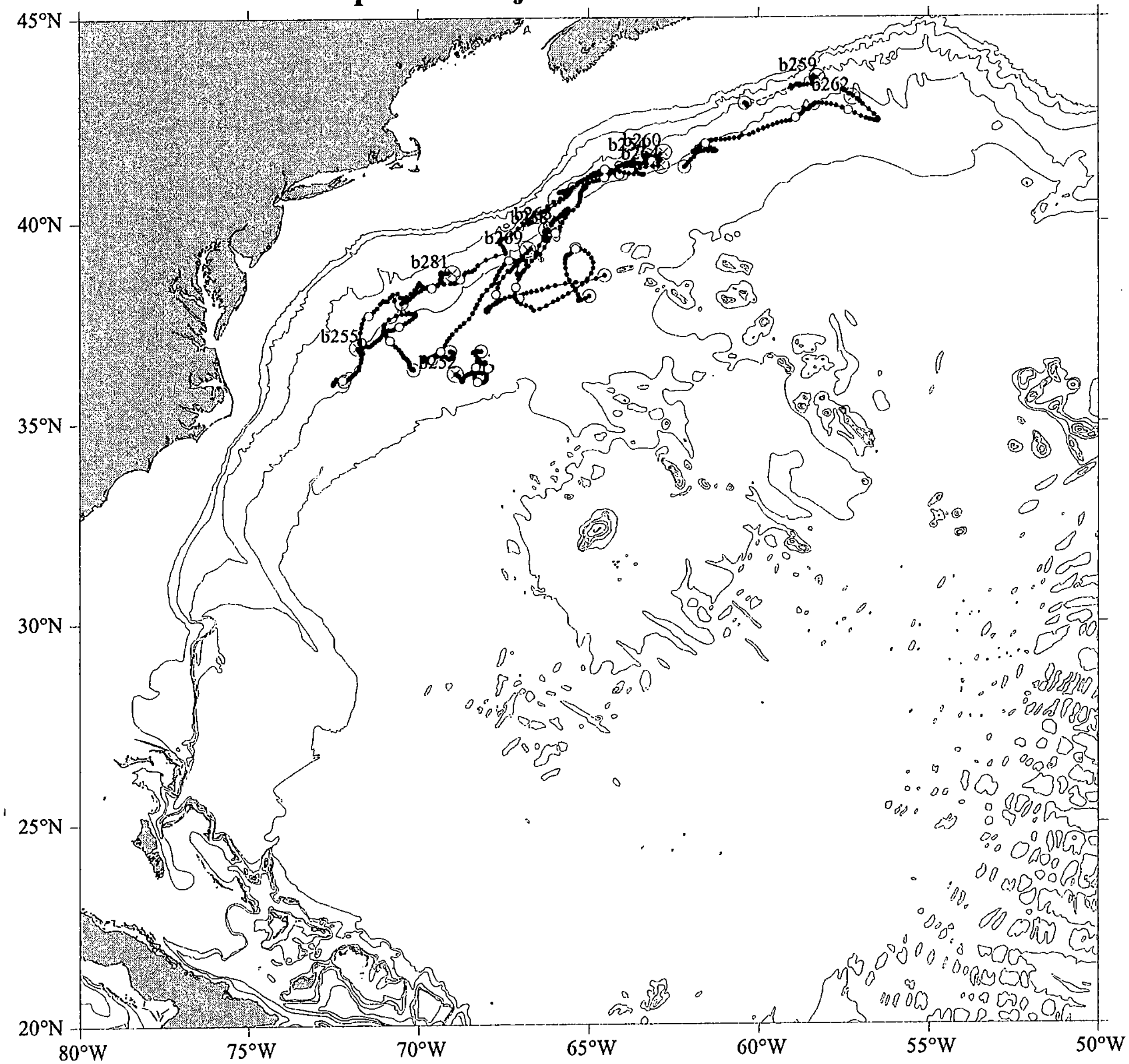
Deep Float Trajectories



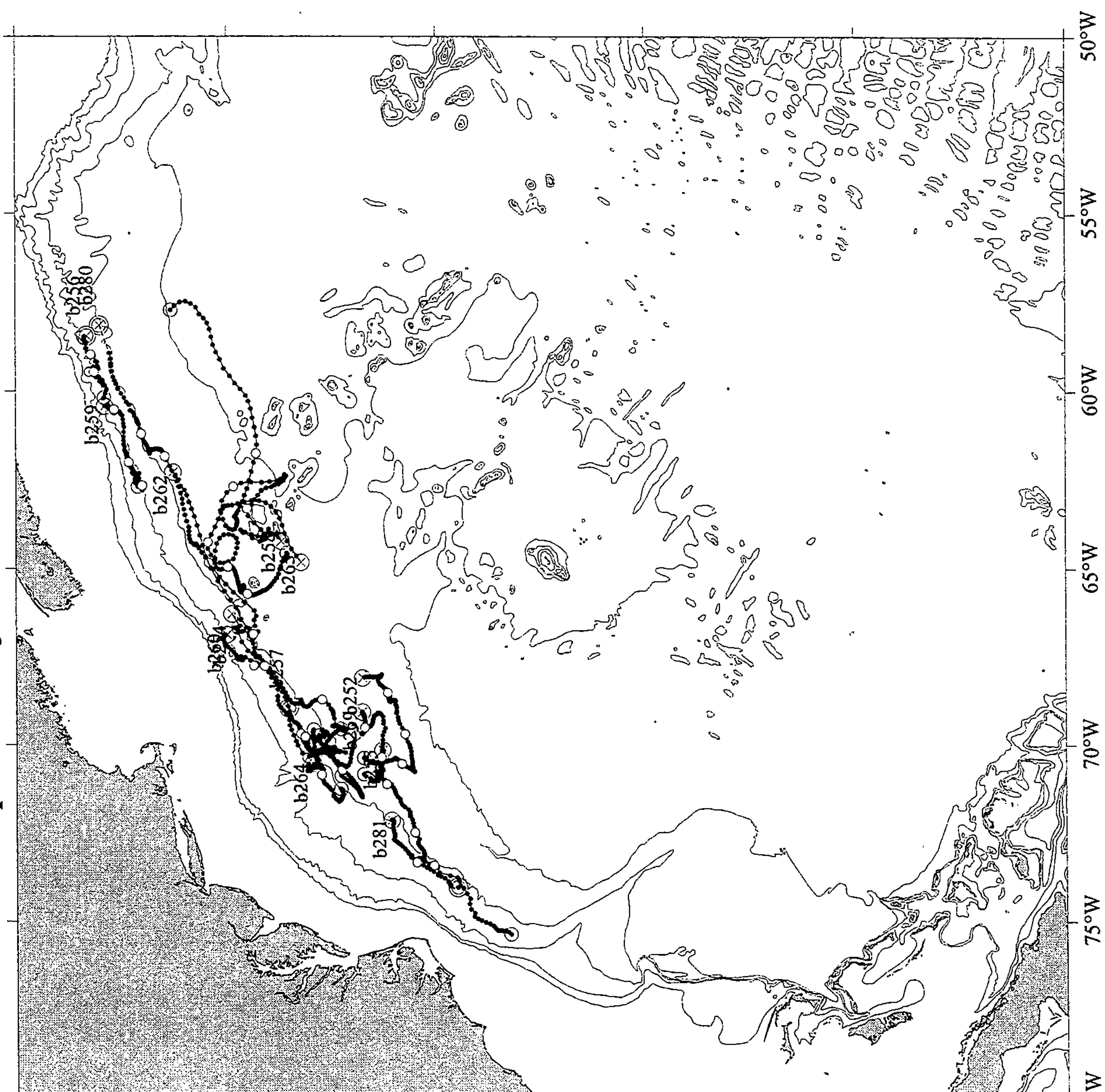
Deep Float Trajectories: 941113 - 950220



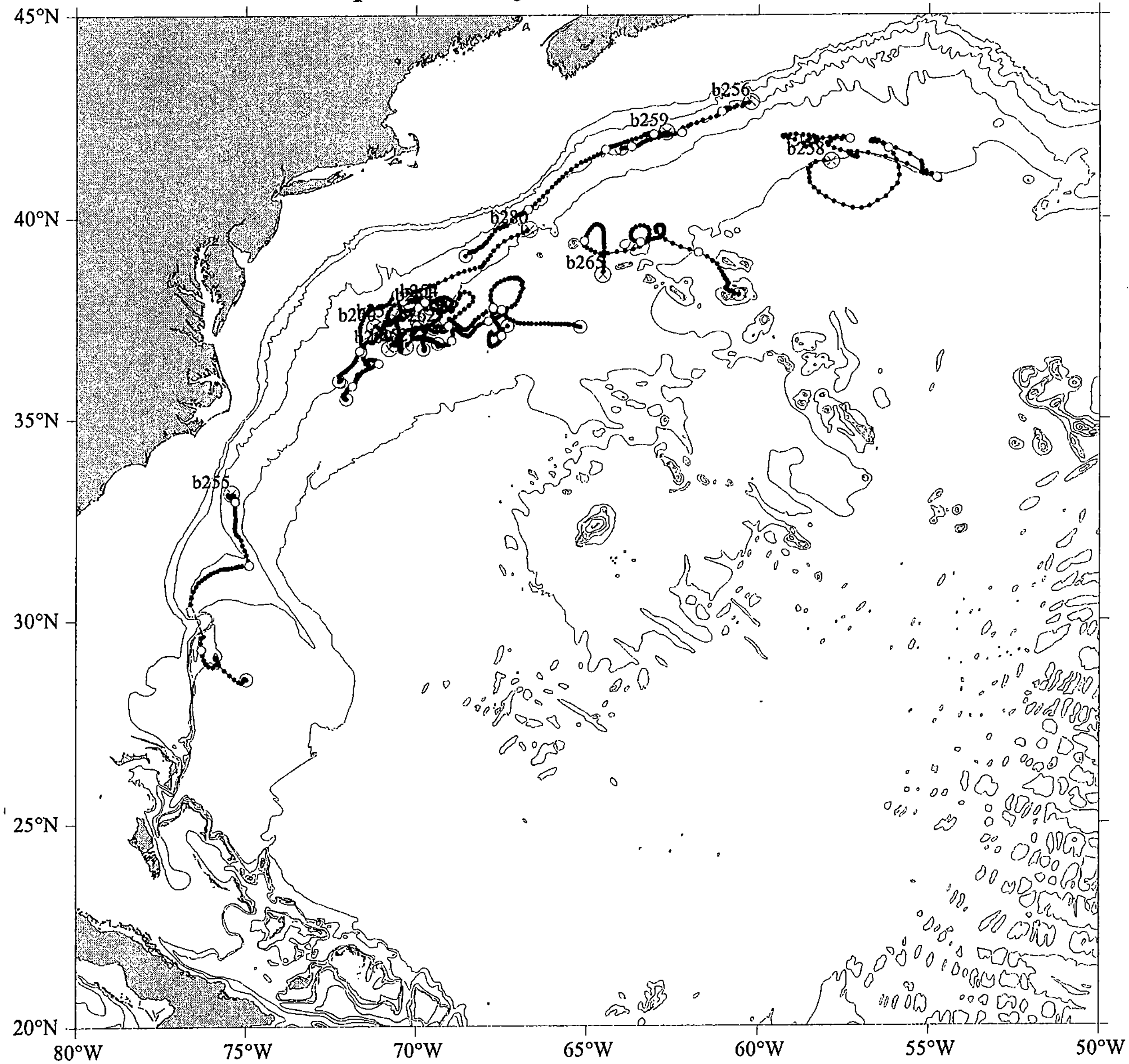
Deep Float Trajectories: 950221 - 950531



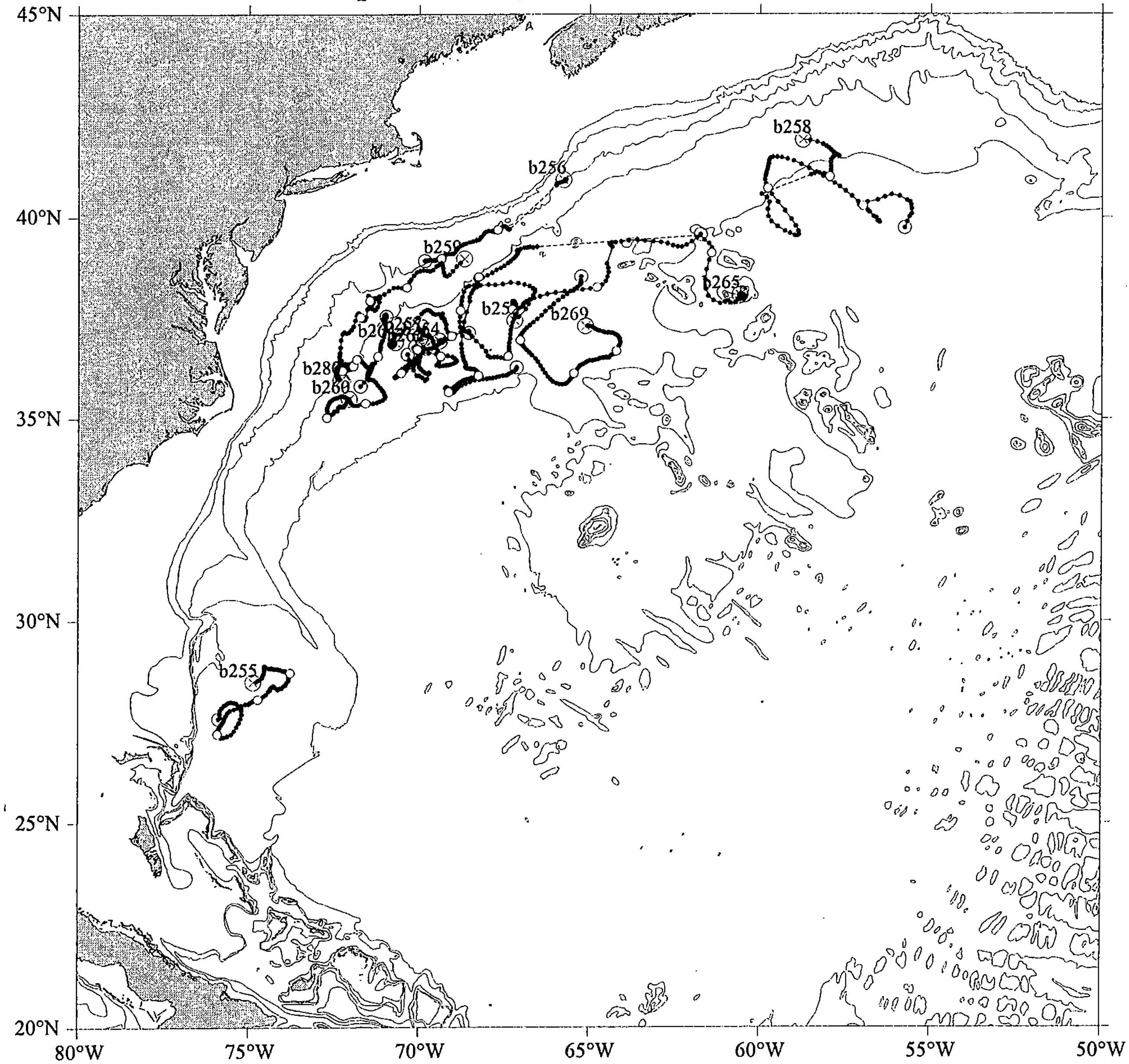
Deep Float Trajectories: 950601 - 950908



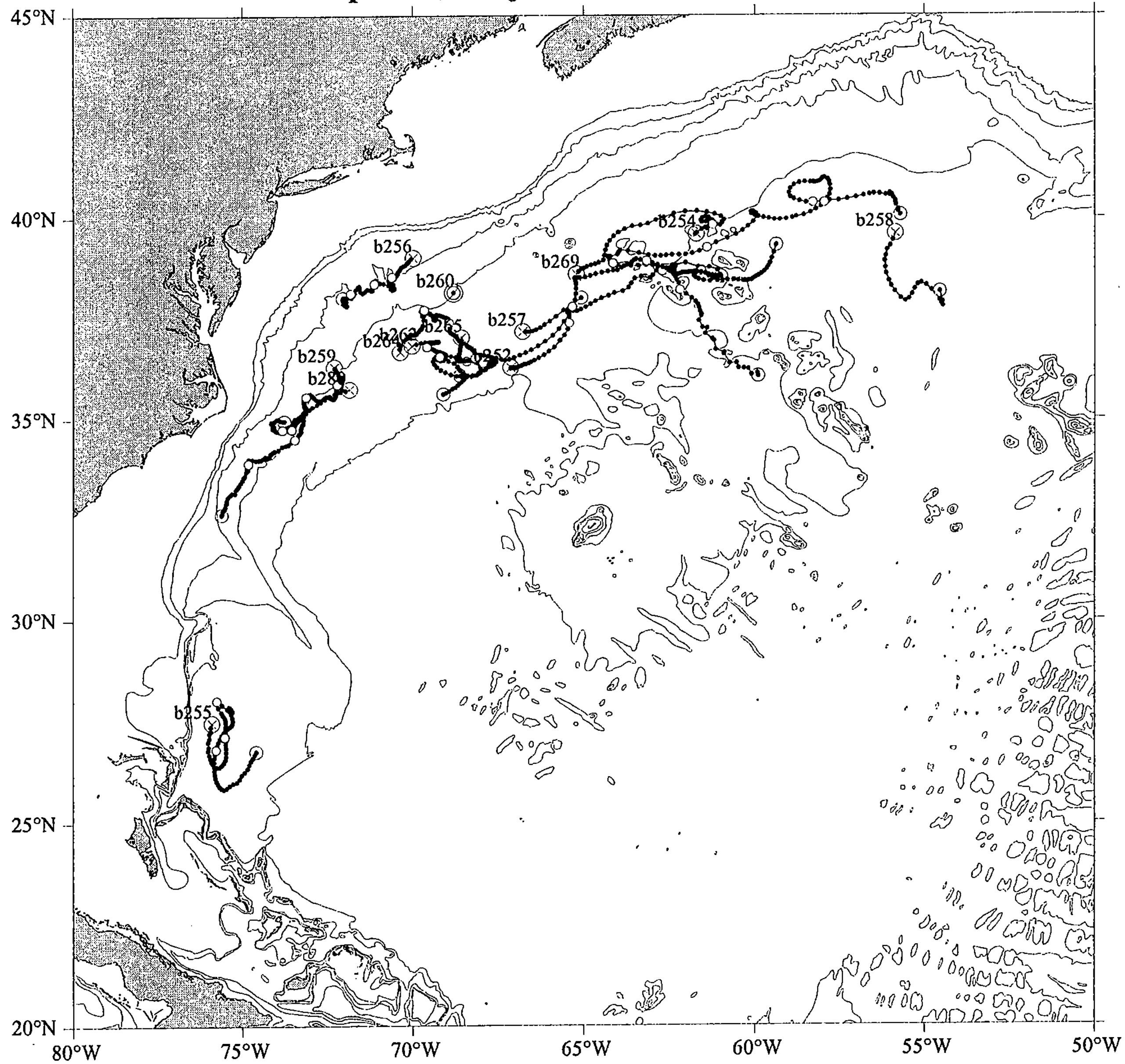
Deep Float Trajectories: 950909 - 951217



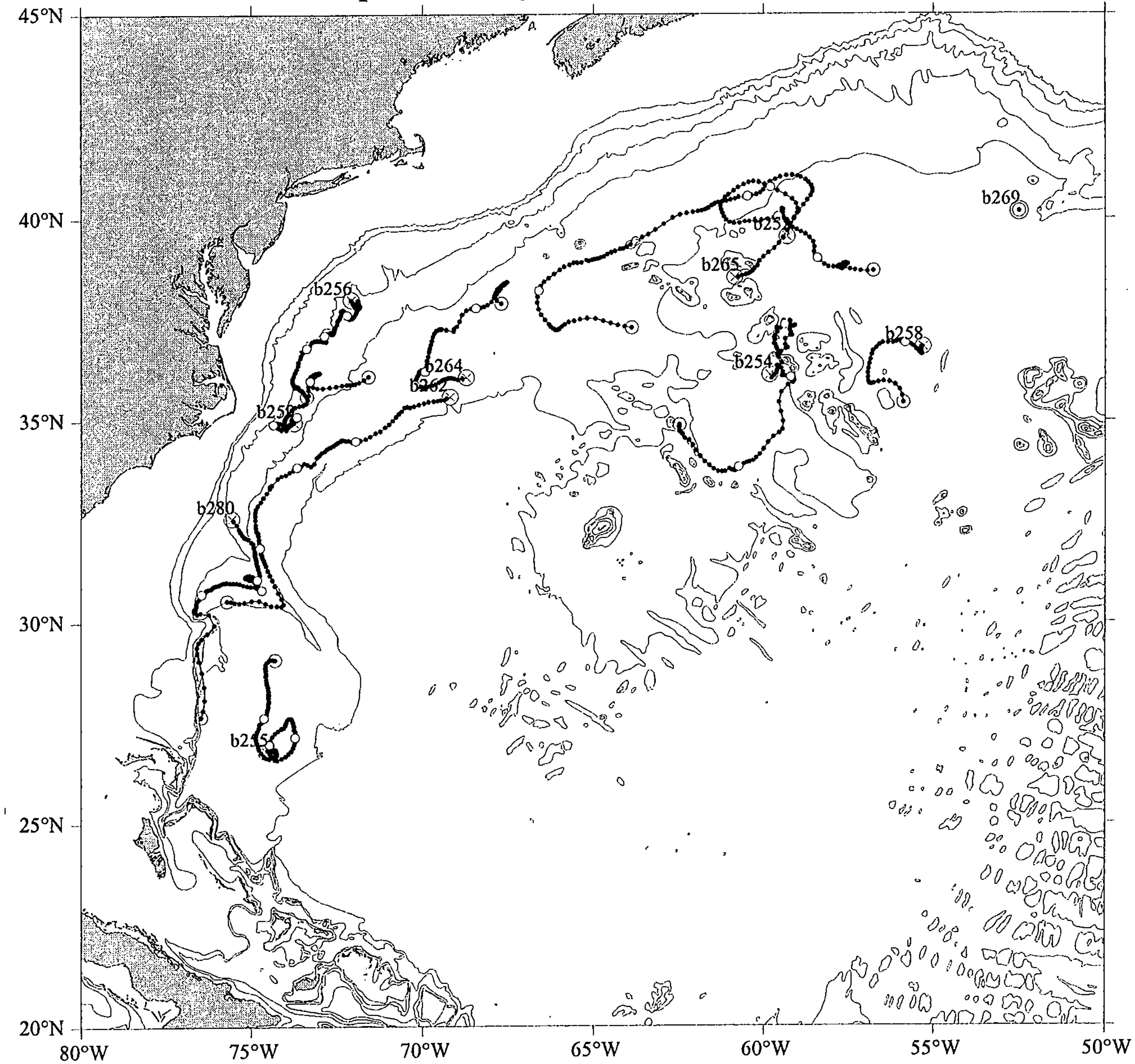
Deep Float Trajectories: 951218 - 960326



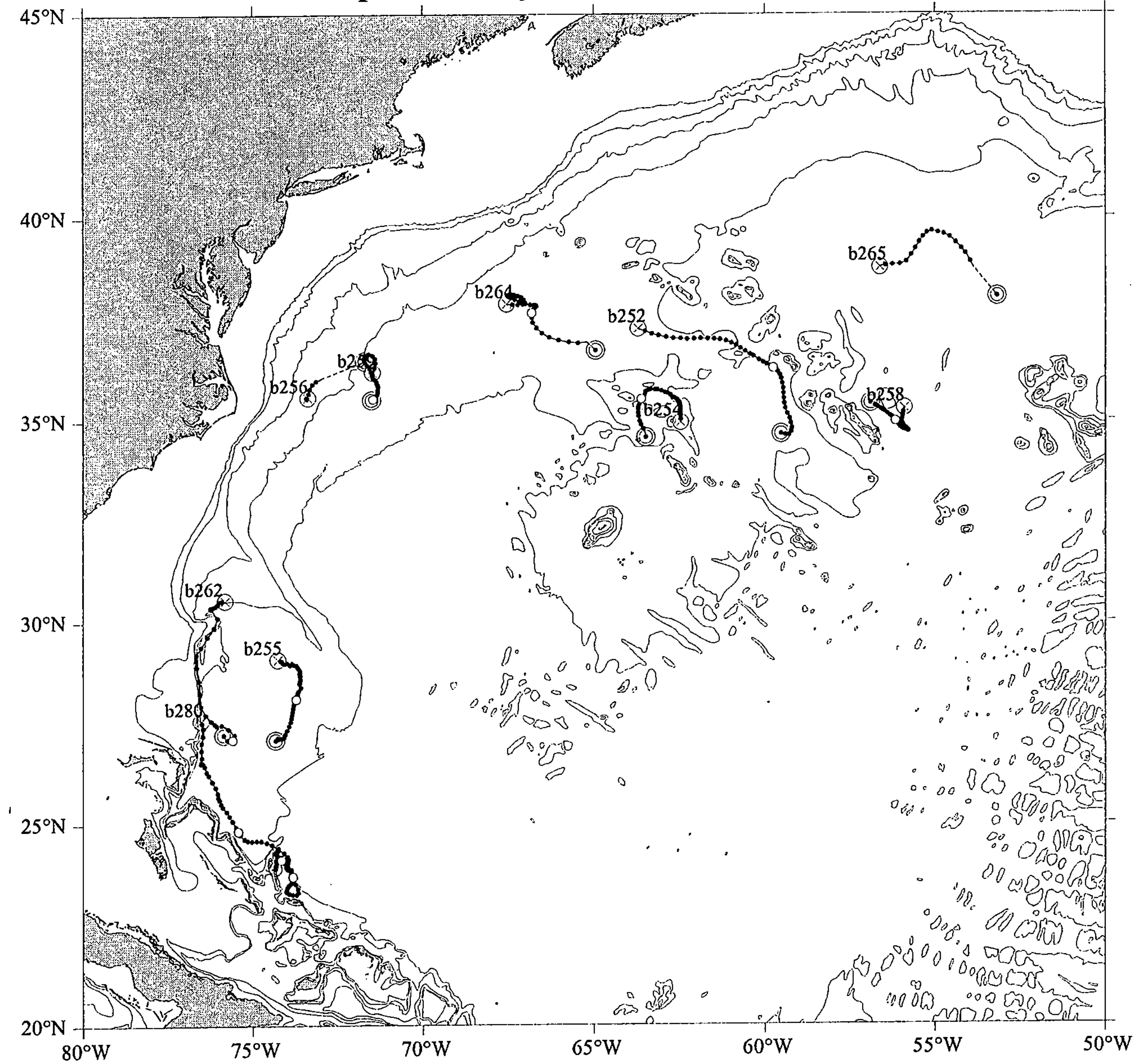
Deep Float Trajectories: 960327 - 960704



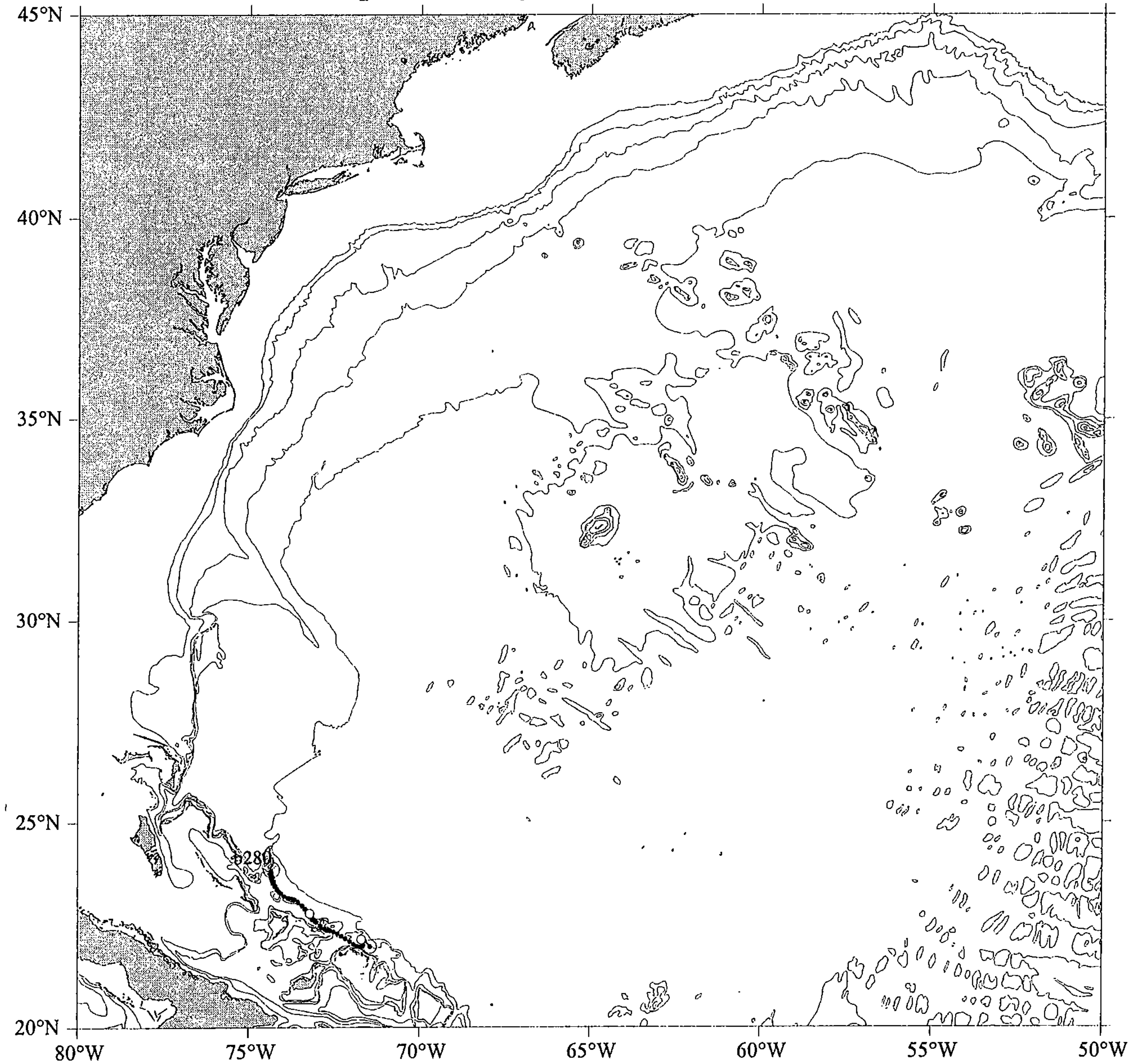
Deep Float Trajectories: 960705 - 961012



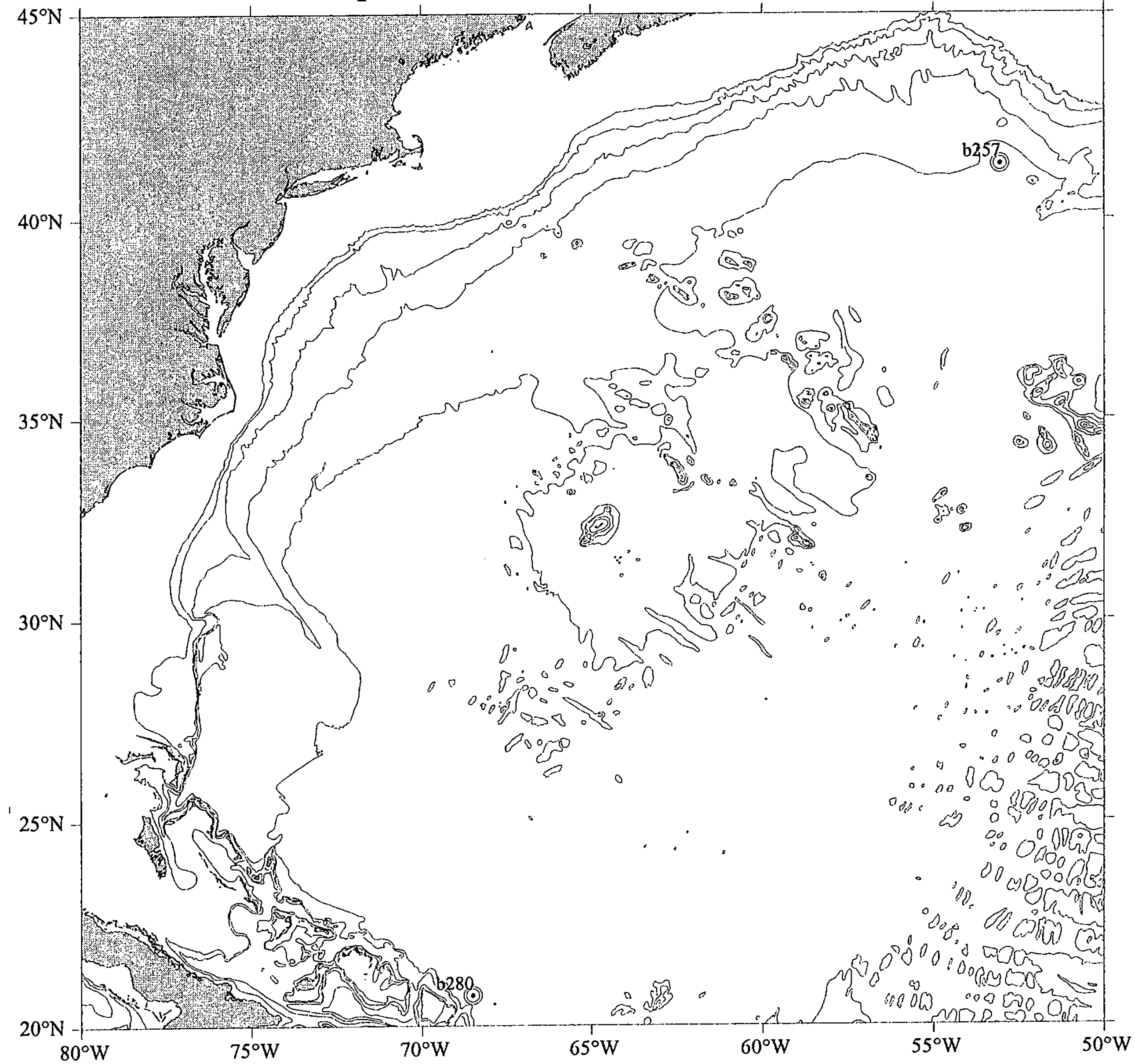
Deep Float Trajectories: 961013 - 970120



Deep Float Trajectories: 970121 - 970430



Deep Float Trajectories: 970501 - 970609

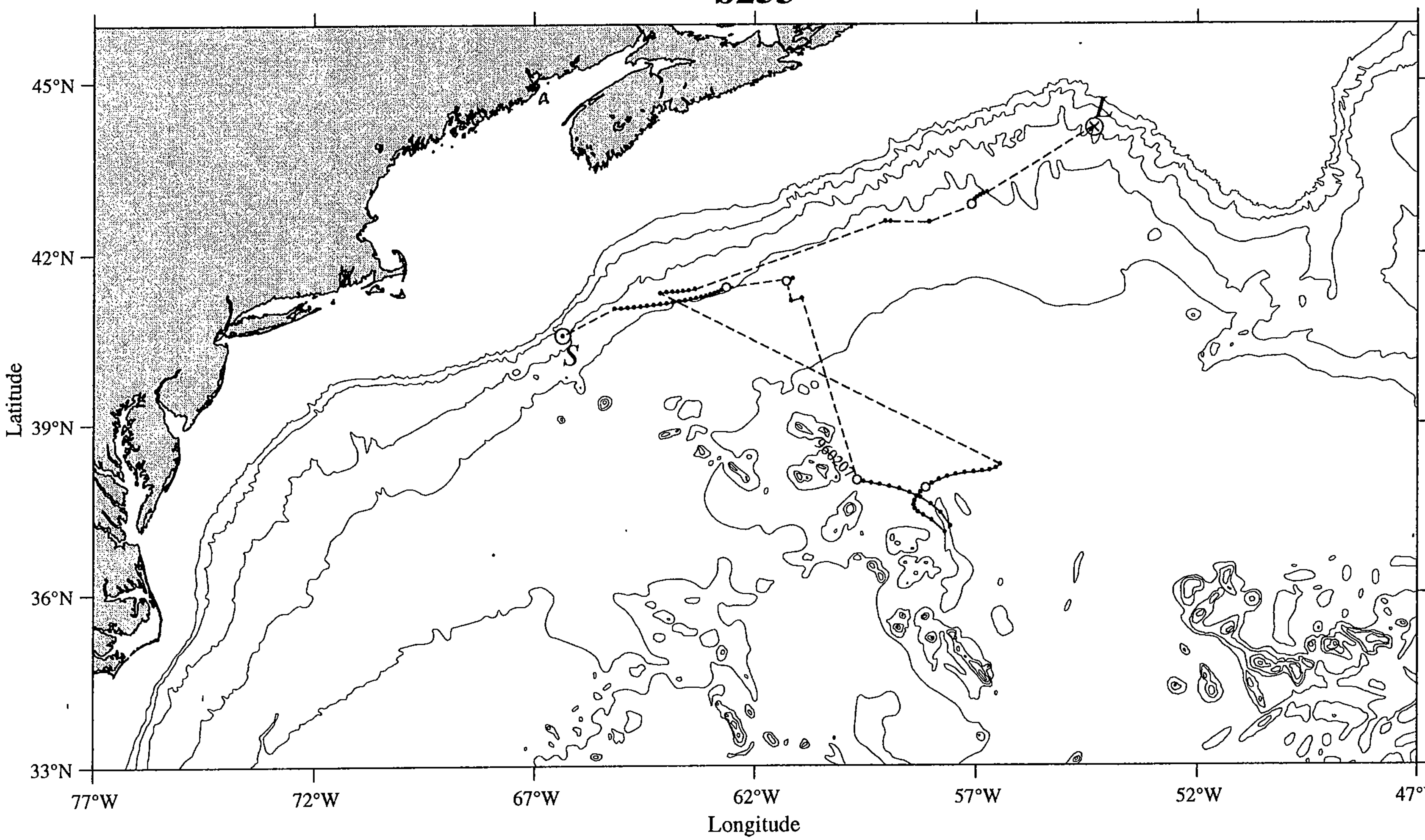


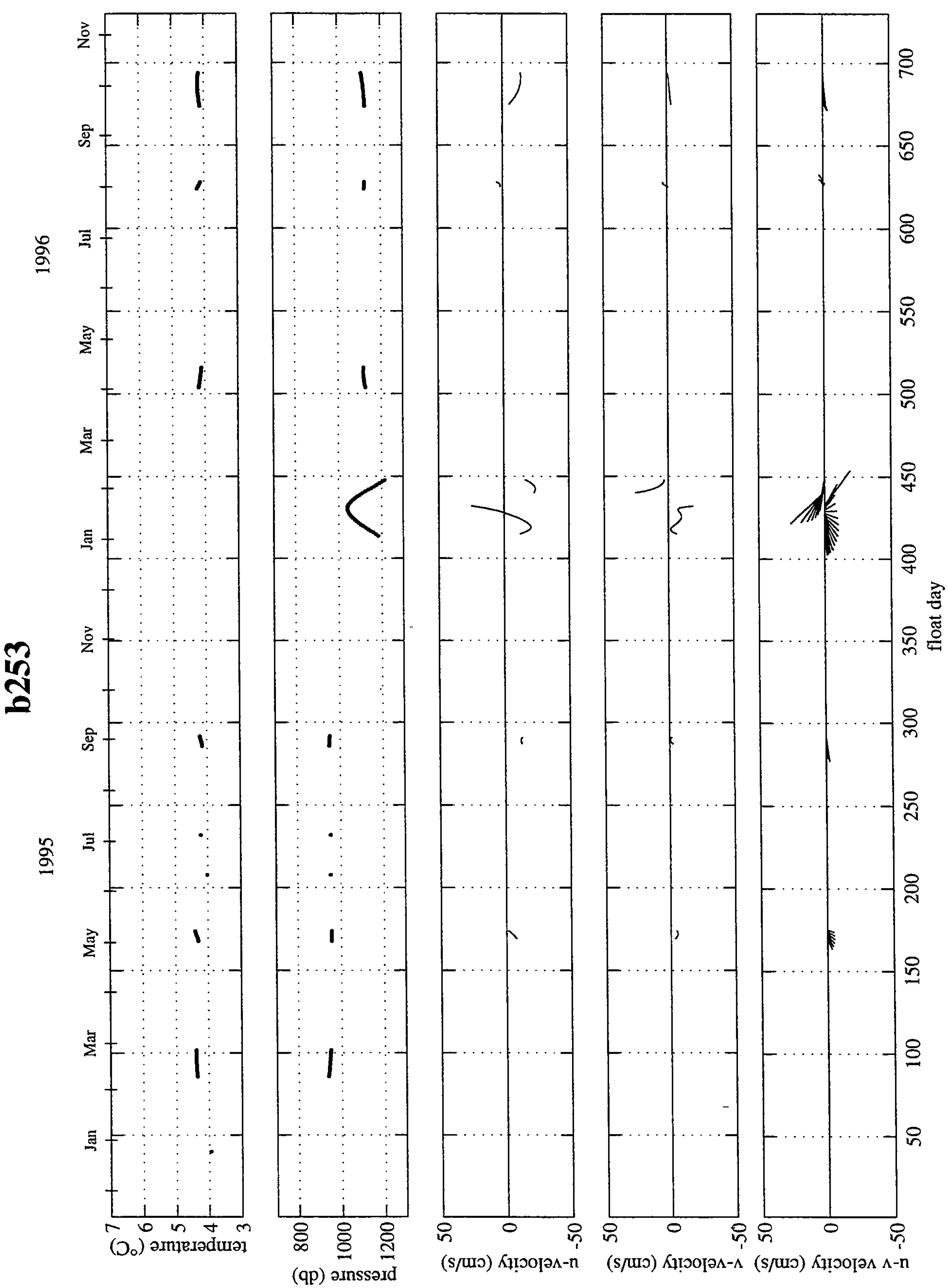
Appendix B

Contains individual float tracks and float property plots for the shallow and deep floats. Individual float plots have the same symbolism as the 100-day composite plots. In addition, every 50th day is marked with the date, represented as 'yymmdd', and launch and surface positions are marked with 'L' and 'S', respectively. Float property plots show temperature, pressure, u-velocity, v-velocity, and stick diagrams representing u-v velocity. All bathymetric contour intervals are 1000 m from 1000 m to 5000 m. Note: some floats became difficult to track after grounding (i.e. b273 and b279), resulting in erroneous position data.

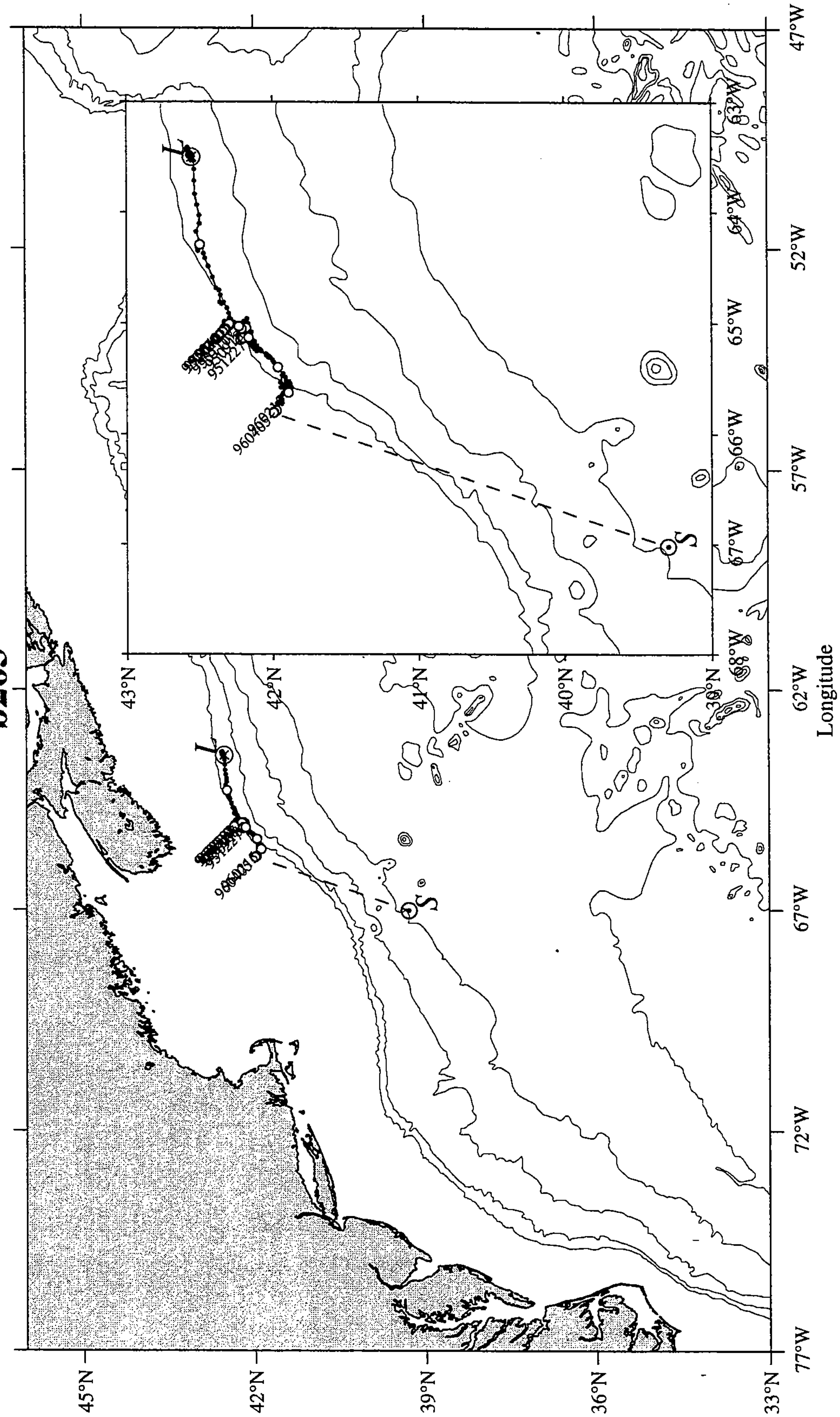
Shallow Floats

b253

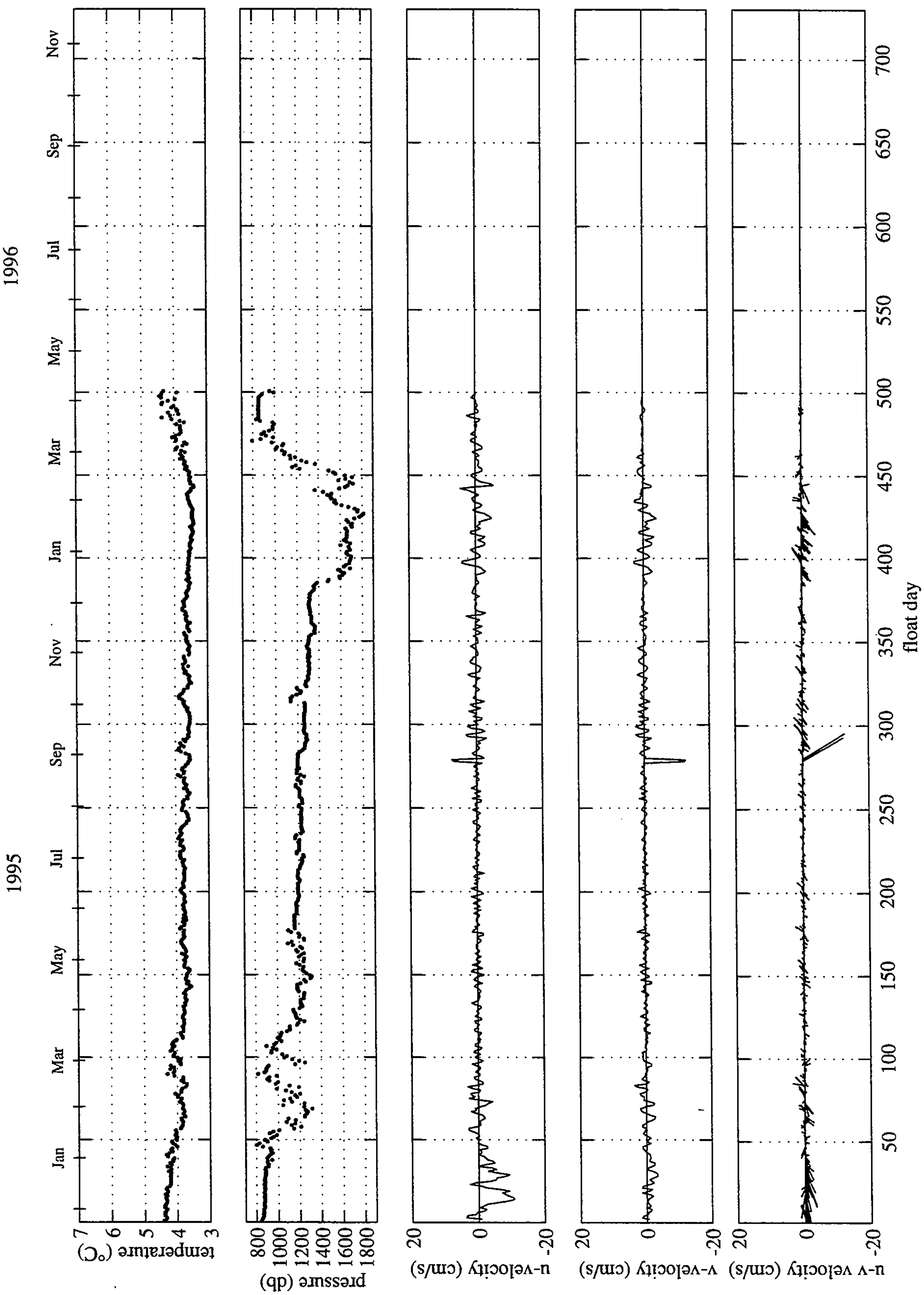

45°N
42°N
39°N
36°N
33°N
Latitude
77°W
72°W
67°W
62°W
57°W
52°W
47°W
Longitude
S
960201


b253
1995
1996
Jan
Mar
May
Jul
Sep
Nov
temperature (°C)
pressure (db)
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
float day
50
100
150
200
250
300
350
400
450
500
550
600
650
700
7
6
5
4
3
800
1000
1200
50
0
-50

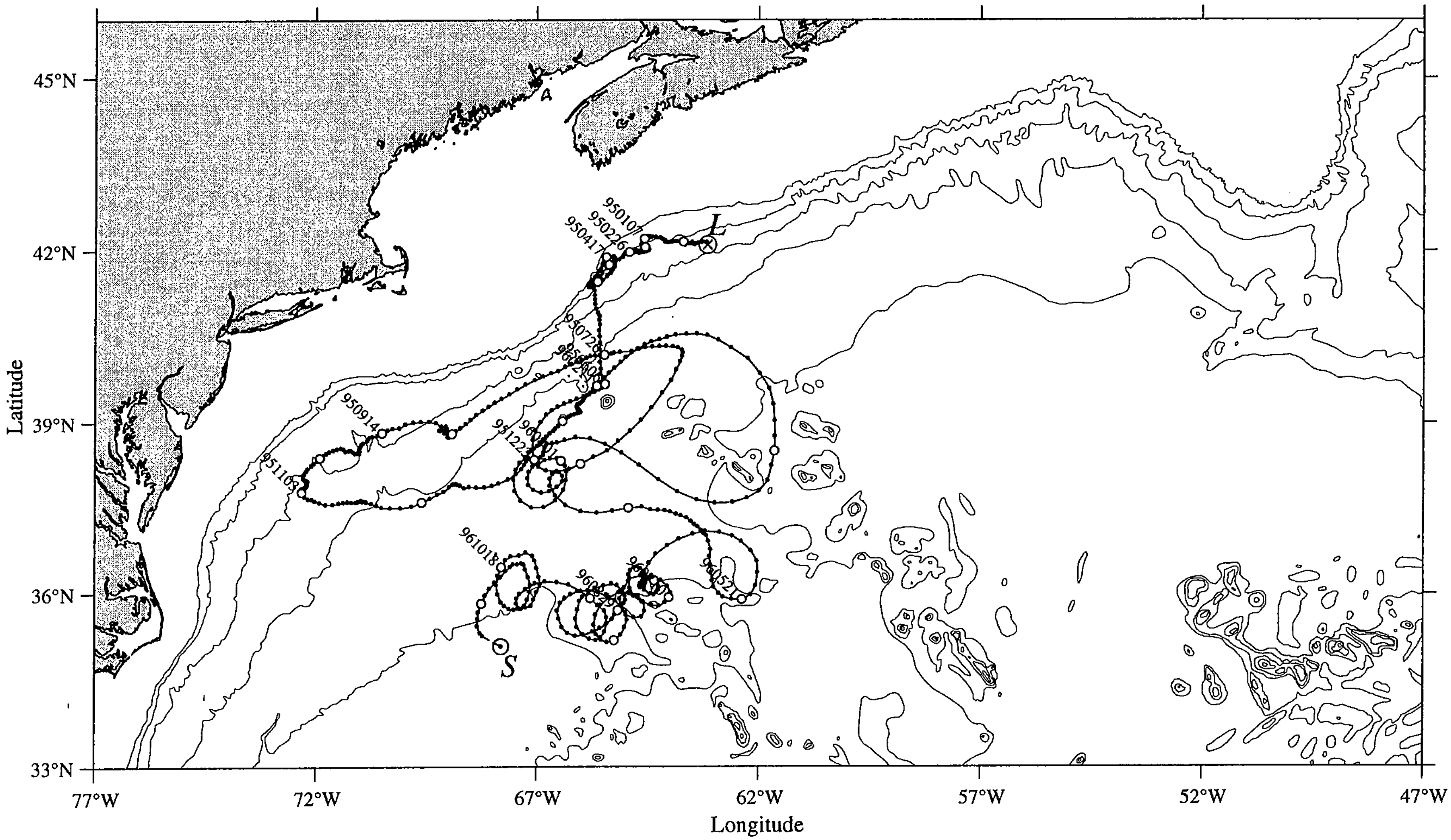
b263


45°N
42°N
39°N
36°N
33°N
Latitude
77°W
72°W
67°W
62°W
57°W
52°W
47°W
Longitude
43°N
42°N
41°N
40°N
39°N
68°W
67°W
66°W
65°W
64°W
63°W
S
I

b263

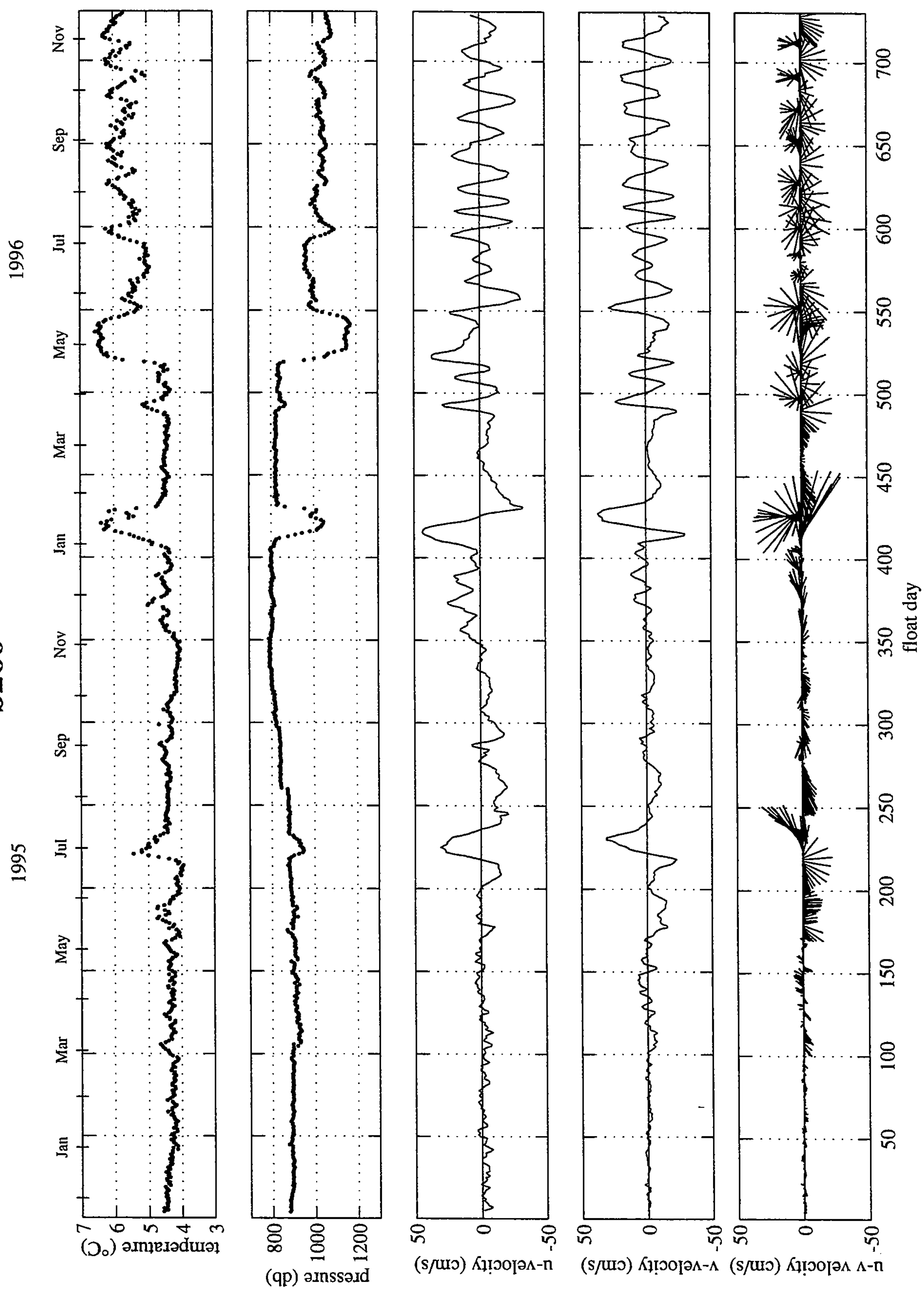

1995
1996
Jan
Mar
May
Jul
Sep
Nov
temperature (°C)
pressure (db)
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
float day
50
100
150
200
250
300
350
400
450
500
550
600
650
700

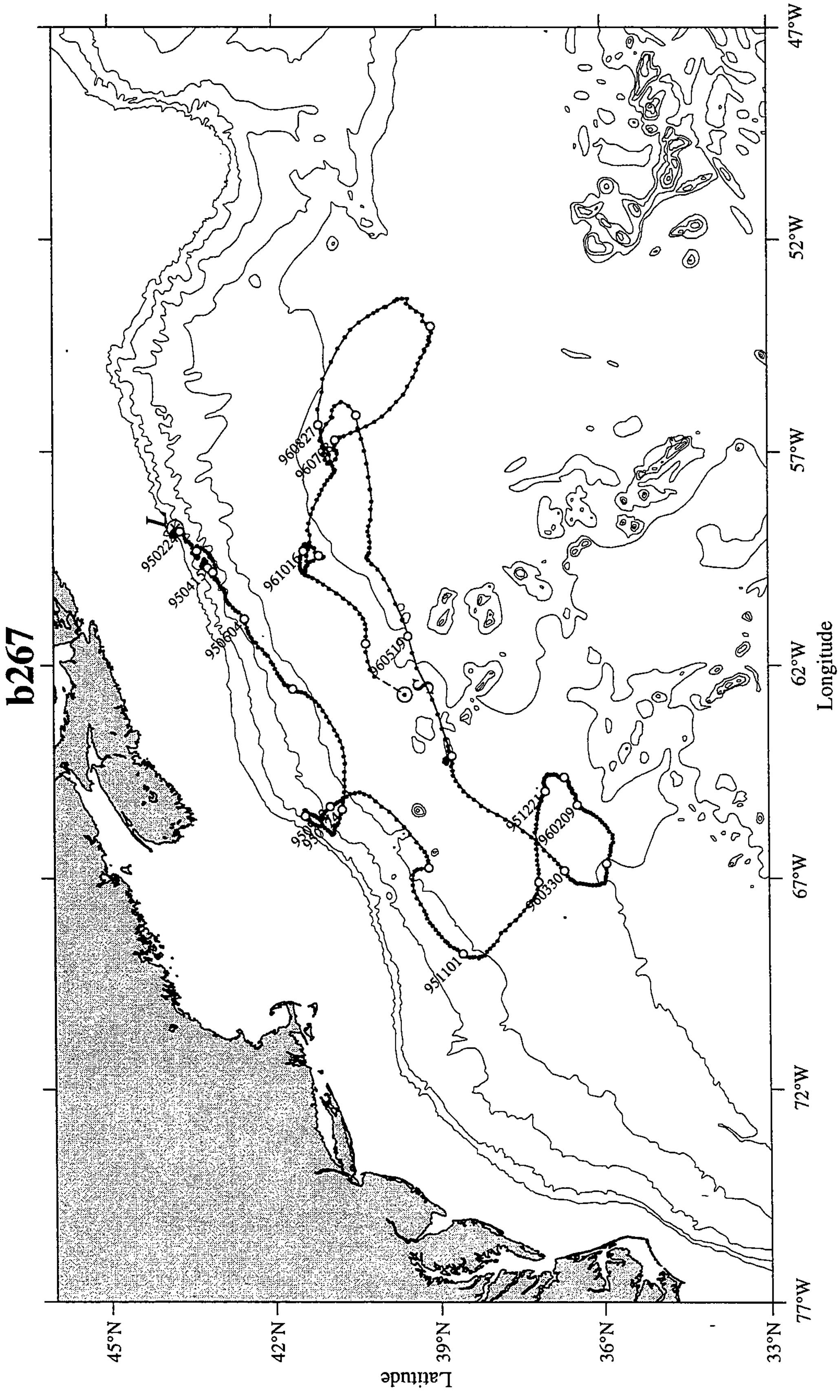
b266

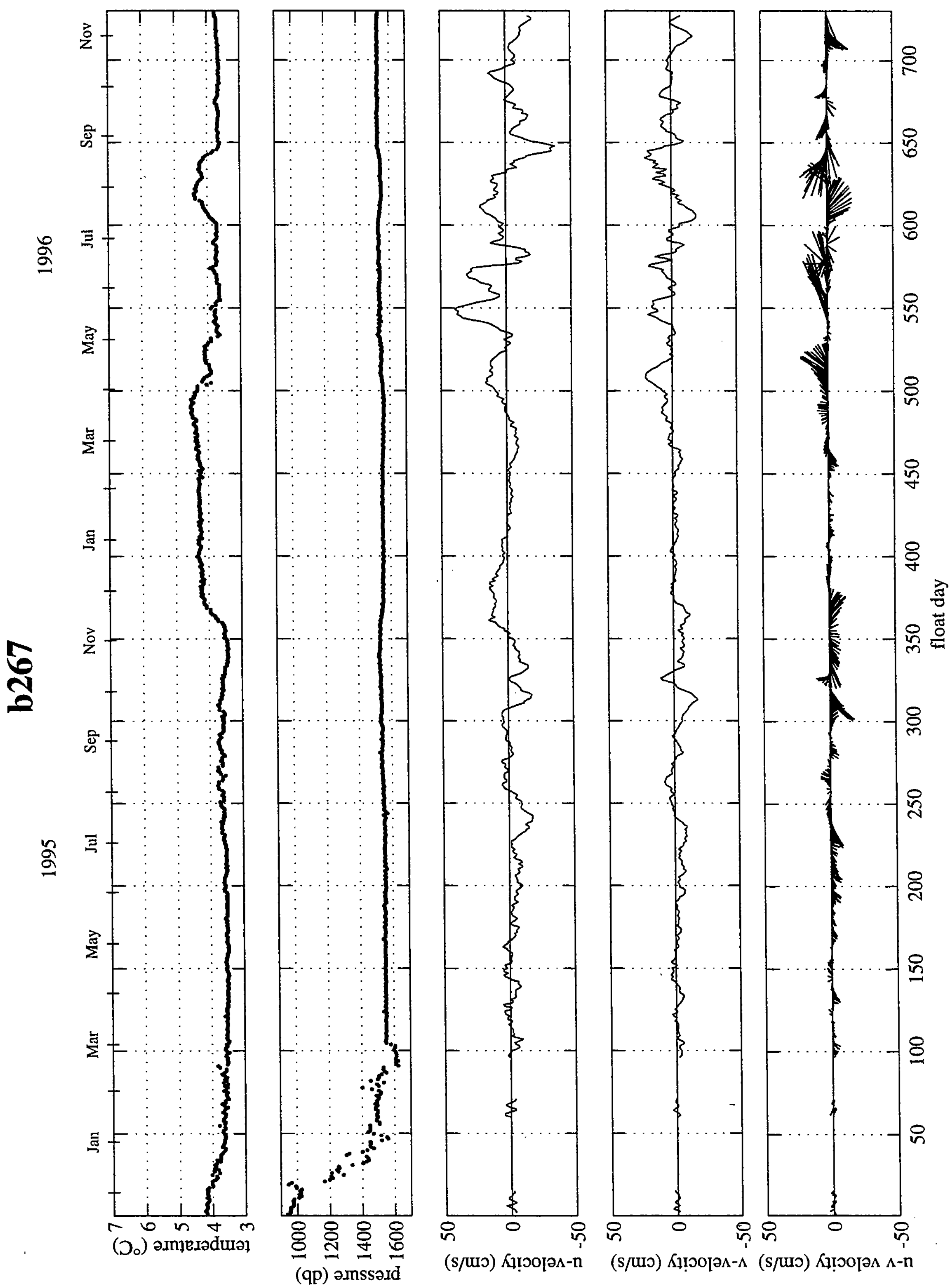


45°N
42°N
39°N
36°N
33°N
Latitude
77°W
72°W
67°W
62°W
57°W
52°W
47°W
Longitude
950107
950226
950417
950914
951108
961018
L
S

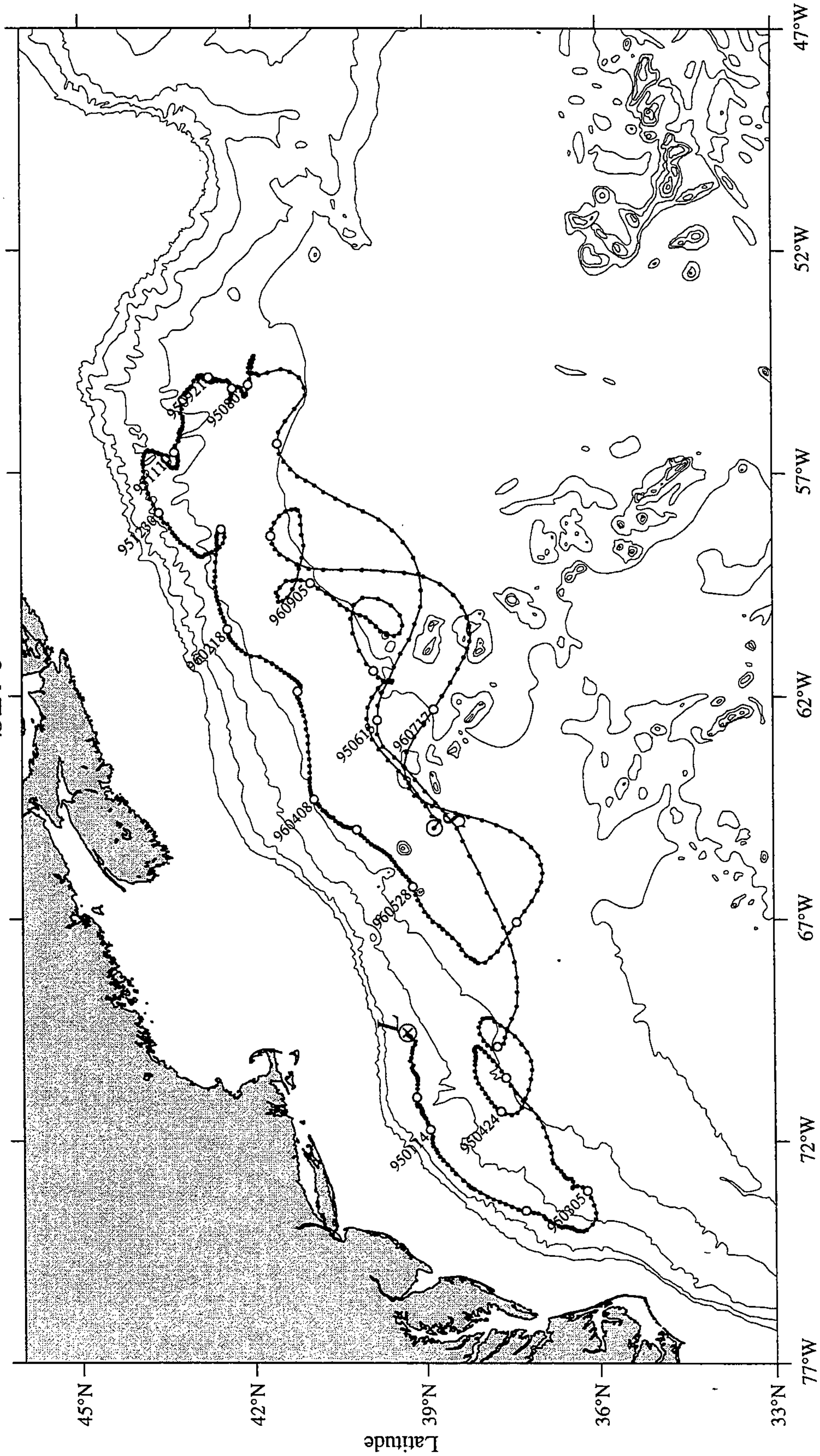
b266


1995
1996
Jan
Mar
May
Jul
Sep
Nov
temperature (°C)
pressure (db)
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
float day
50
100
150
200
250
300
350
400
450
500
550
600
650
700


b267
45°N
42°N
39°N
36°N
33°N
Latitude
77°W
72°W
67°W
62°W
57°W
52°W
47°W
Longitude
950222
950415
950604
960827
961016
960519
951221
960209
960330
951101

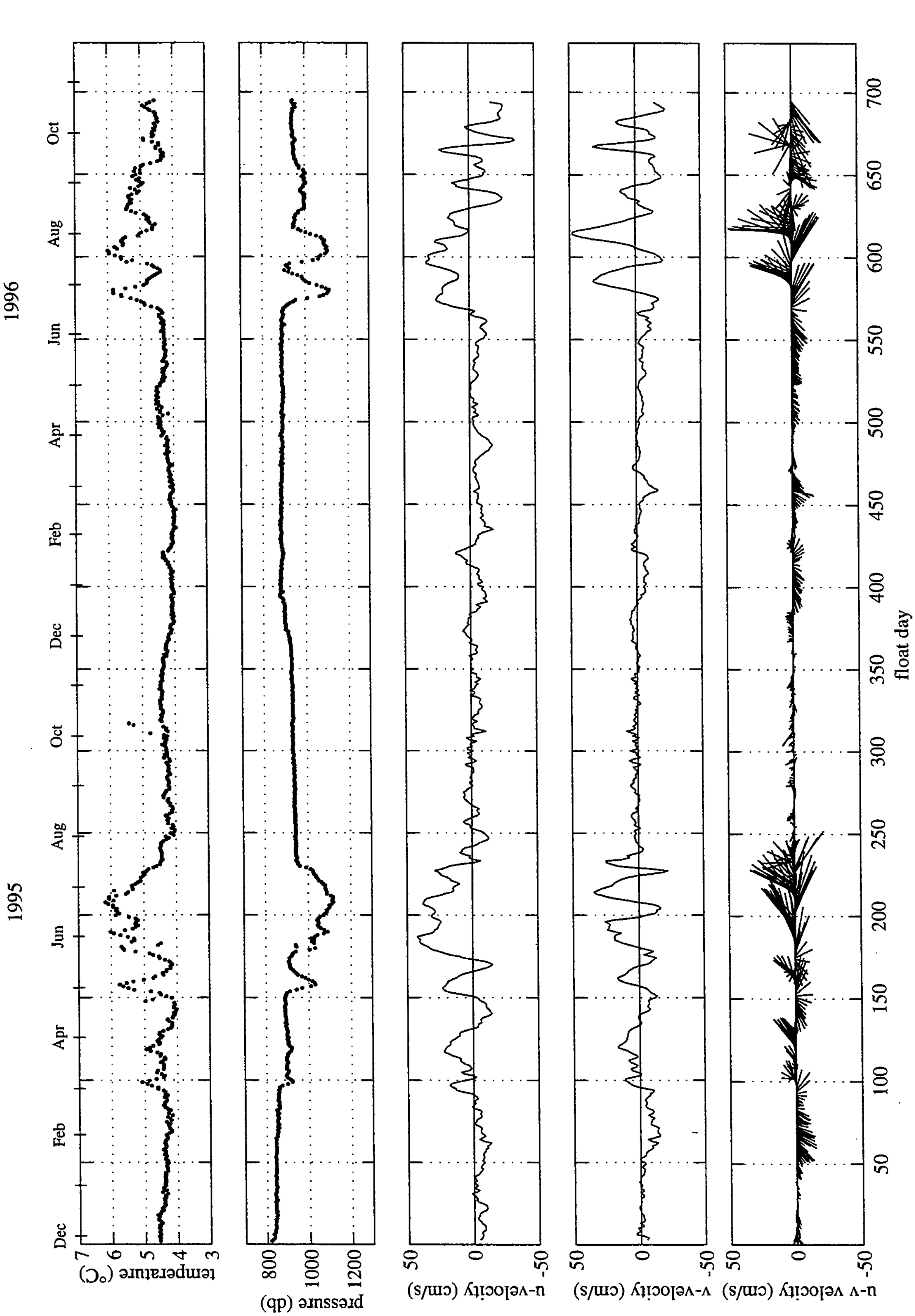

b267
1995
1996
Jan
Mar
May
Jul
Sep
Nov
temperature (°C)
pressure (db)
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
float day

b270

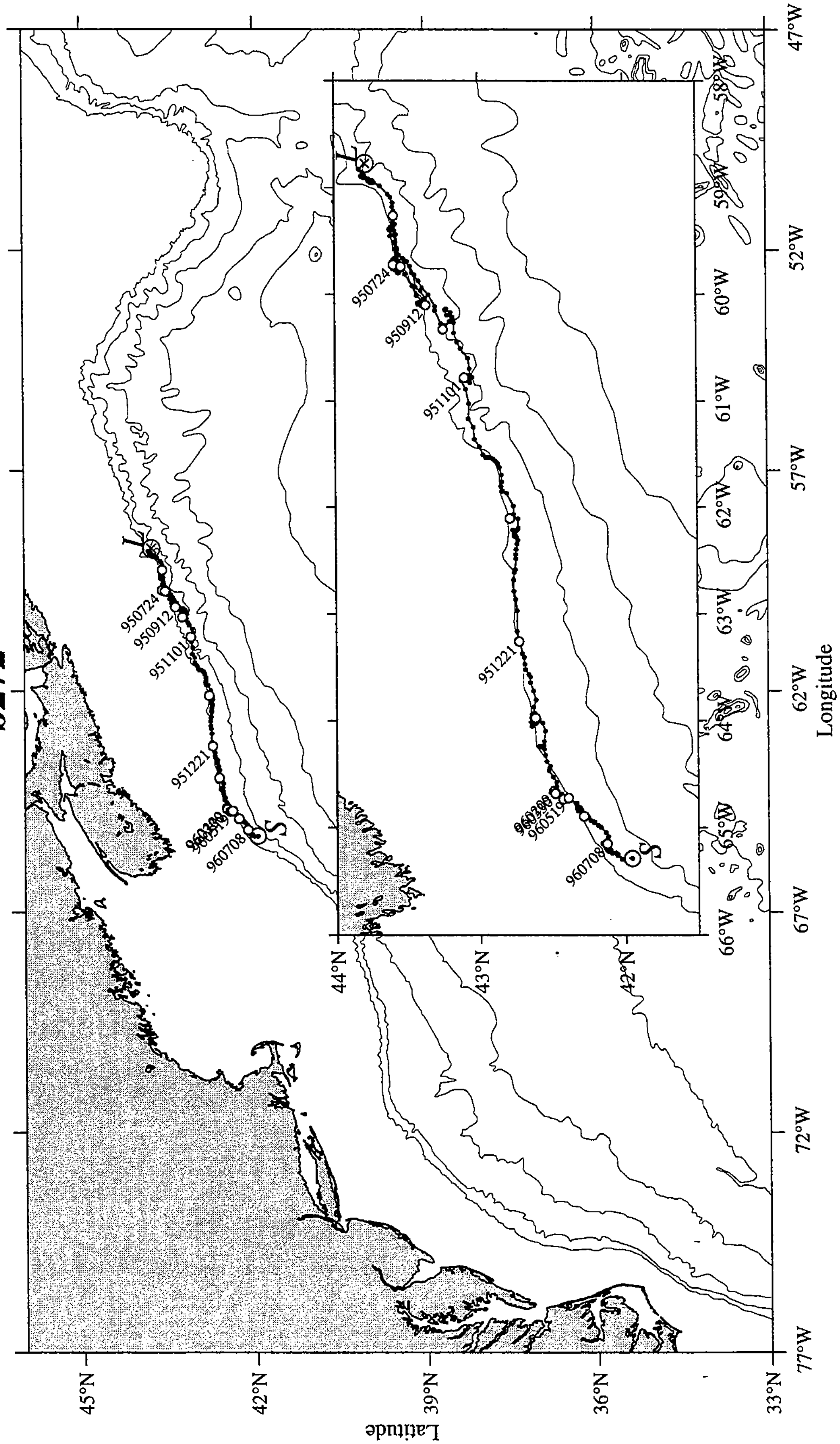


47°W
52°W
57°W
62°W
67°W
72°W
77°W
Longitude
45°N
42°N
39°N
36°N
33°N
Latitude
950921
950801
960218
960905
950618
960717
960408
960528
950424
950314
960305

b270


1995
1996
Dec
Feb
Apr
Jun
Aug
Oct
temperature (°C)
pressure (db)
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
float day
50
100
150
200
250
300
350
400
450
500
550
600
650
700
800
1000
1200
7
6
5
4
3
0
-50

b272



Latitude
Longitude
45°N
42°N
39°N
36°N
33°N
77°W
72°W
67°W
62°W
57°W
52°W
47°W
44°N
43°N
42°N
66°W
65°W
64°W
63°W
62°W
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59°W
58°W
950724
950912
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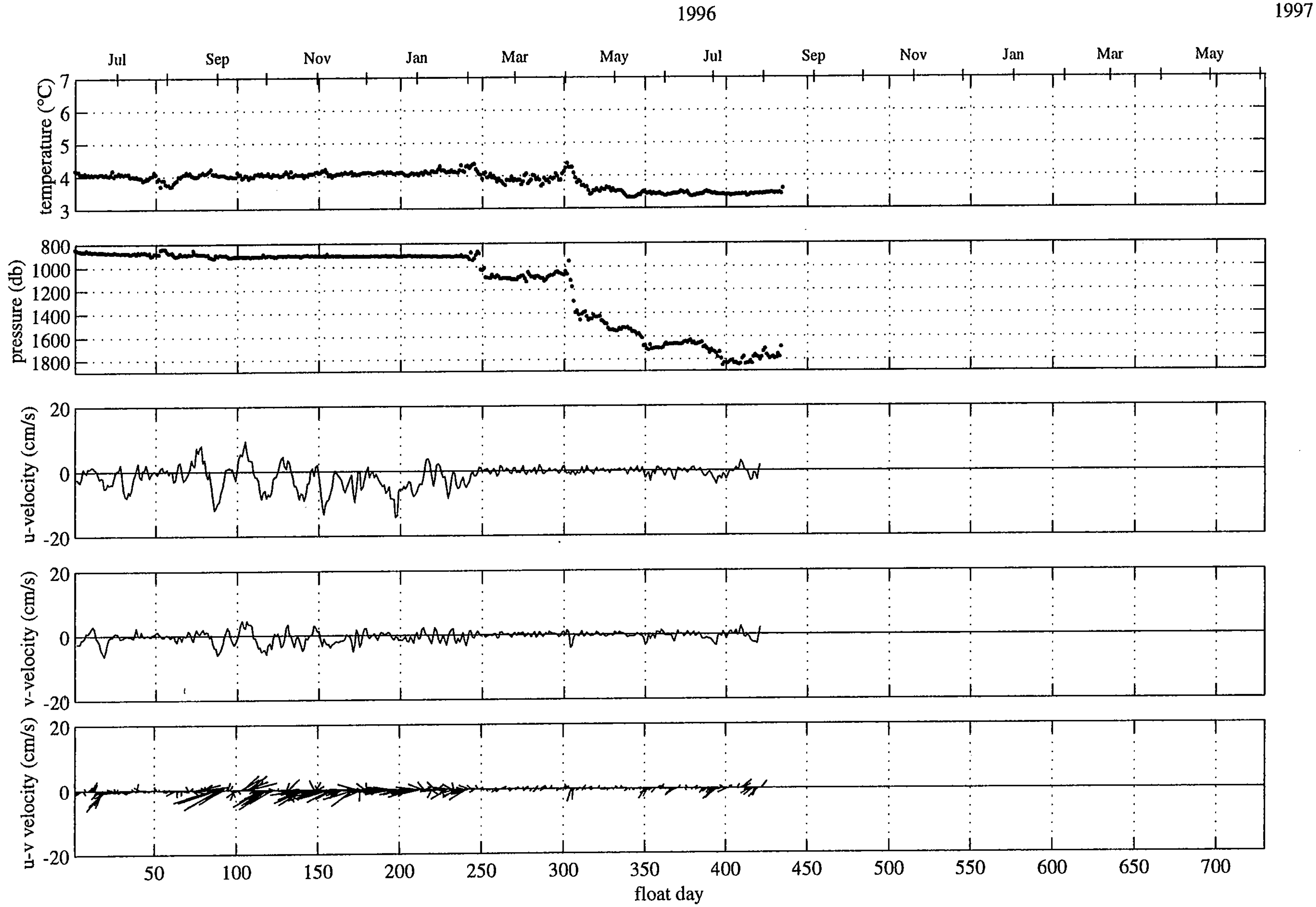
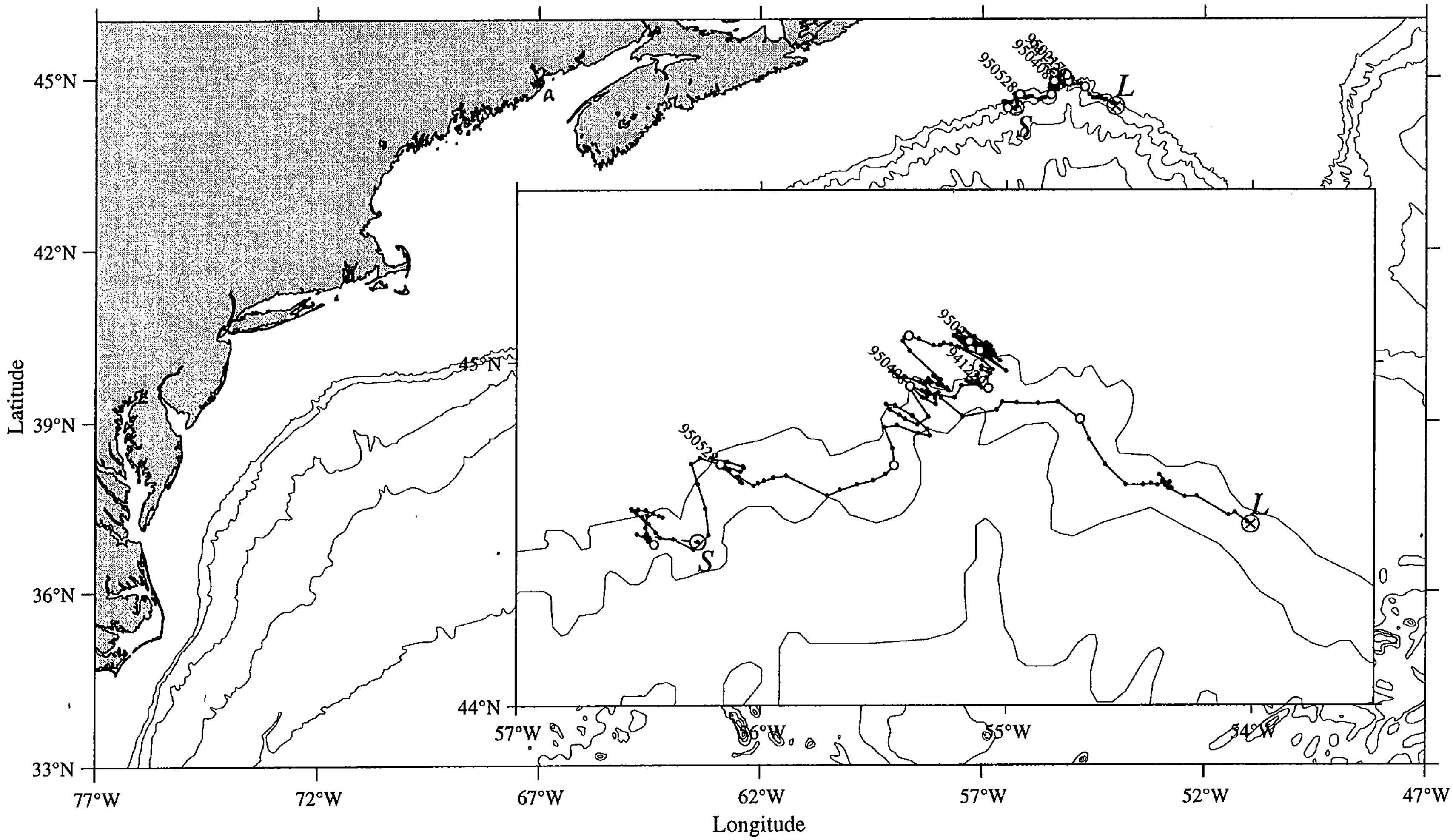
951221
960519
960708
T
S

b272

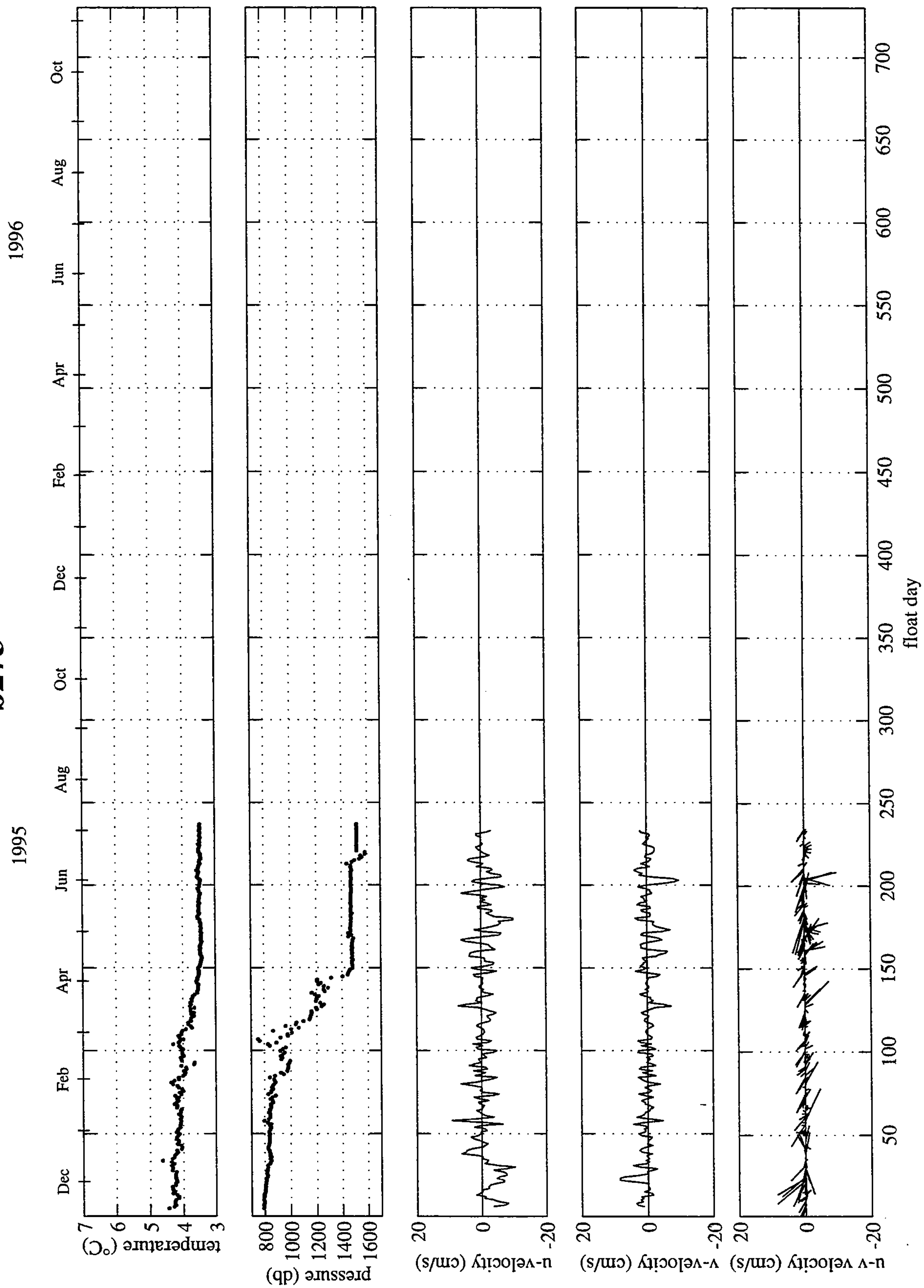


1996
1997
Jul
Sep
Nov
Jan
Mar
May
Jul
Sep
Nov
Jan
Mar
May
temperature (°C)
pressure (db)
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
float day

b273

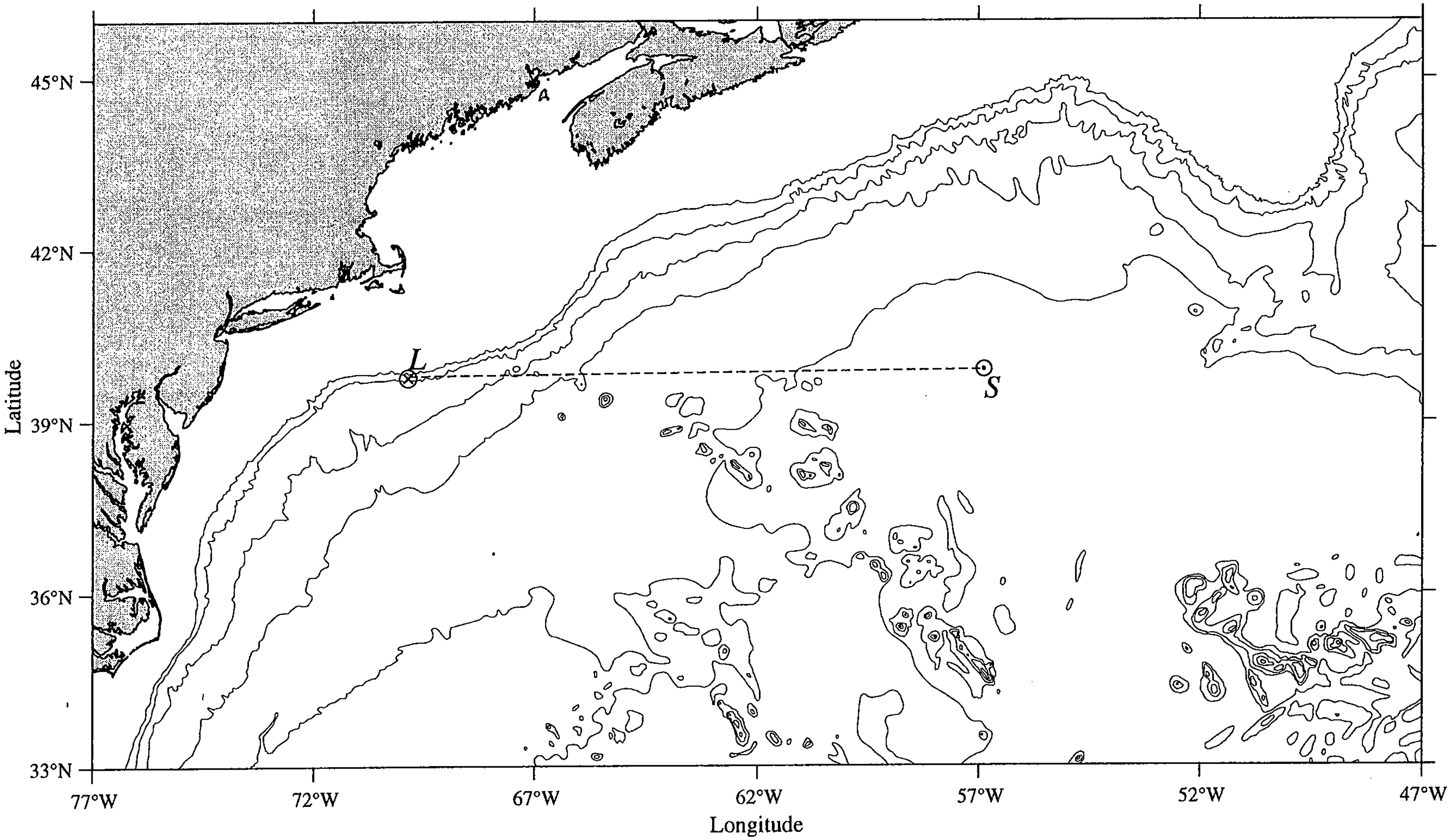

45°N
42°N
39°N
36°N
33°N
Latitude
77°W
72°W
67°W
62°W
57°W
52°W
47°W
Longitude
950528
950408
L
S
44°N
45°N
57°W
56°W
55°W
54°W

b273

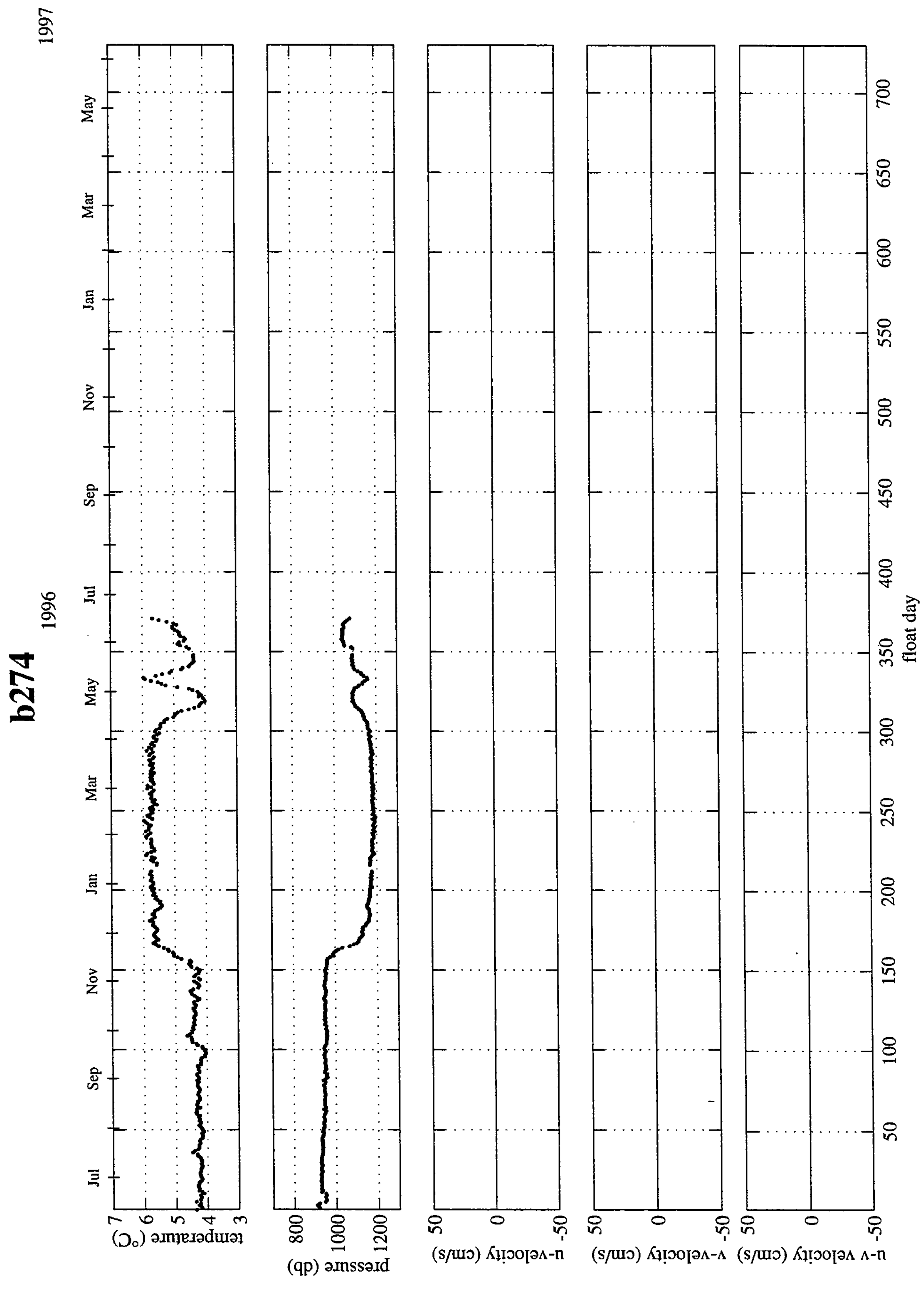


1995
1996
Dec
Feb
Apr
Jun
Aug
Oct
temperature (°C)
pressure (db)
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
float day

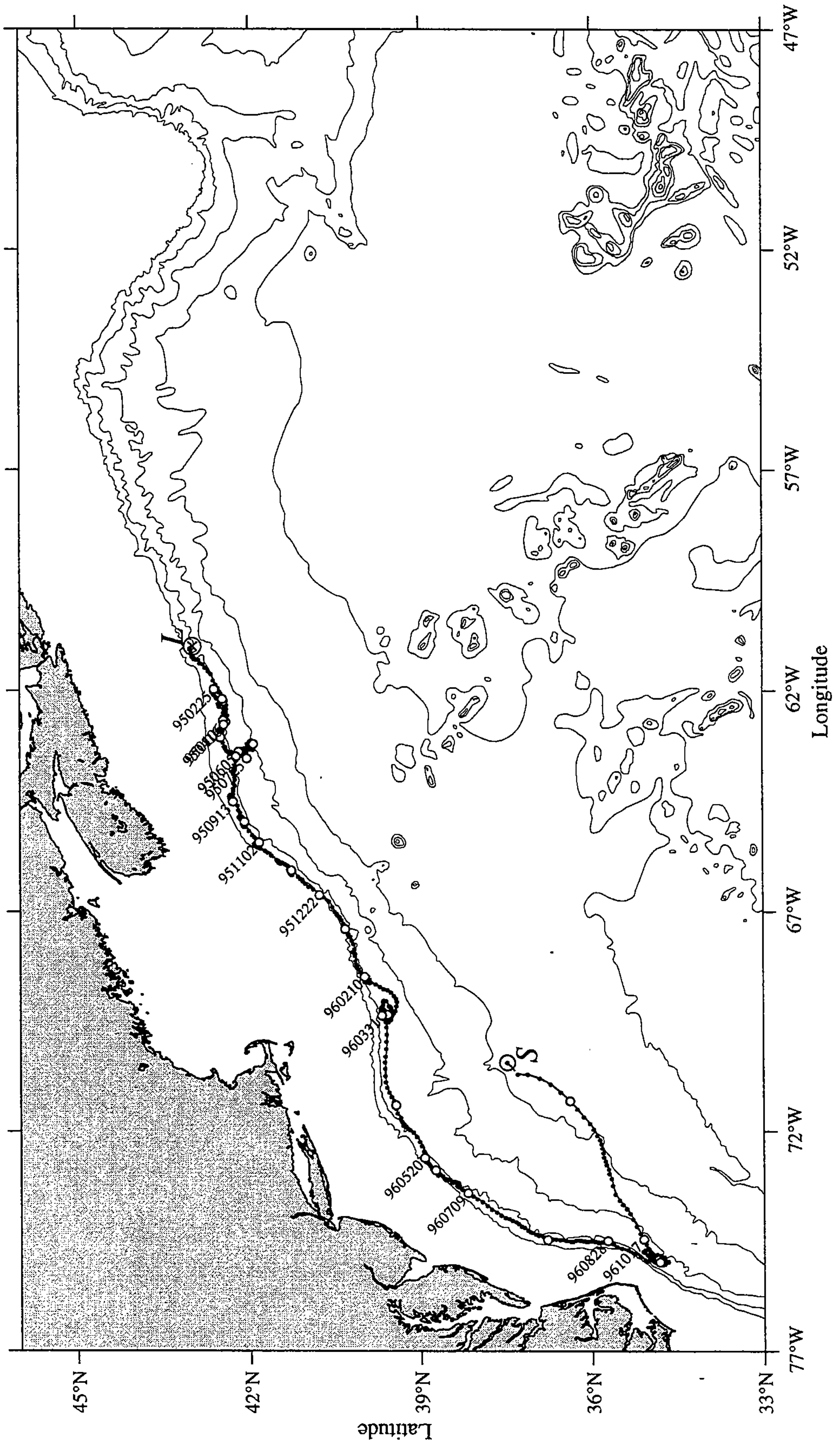
b274



L
S
45°N
42°N
39°N
36°N
33°N
Latitude
77°W
72°W
67°W
62°W
57°W
52°W
47°W
Longitude

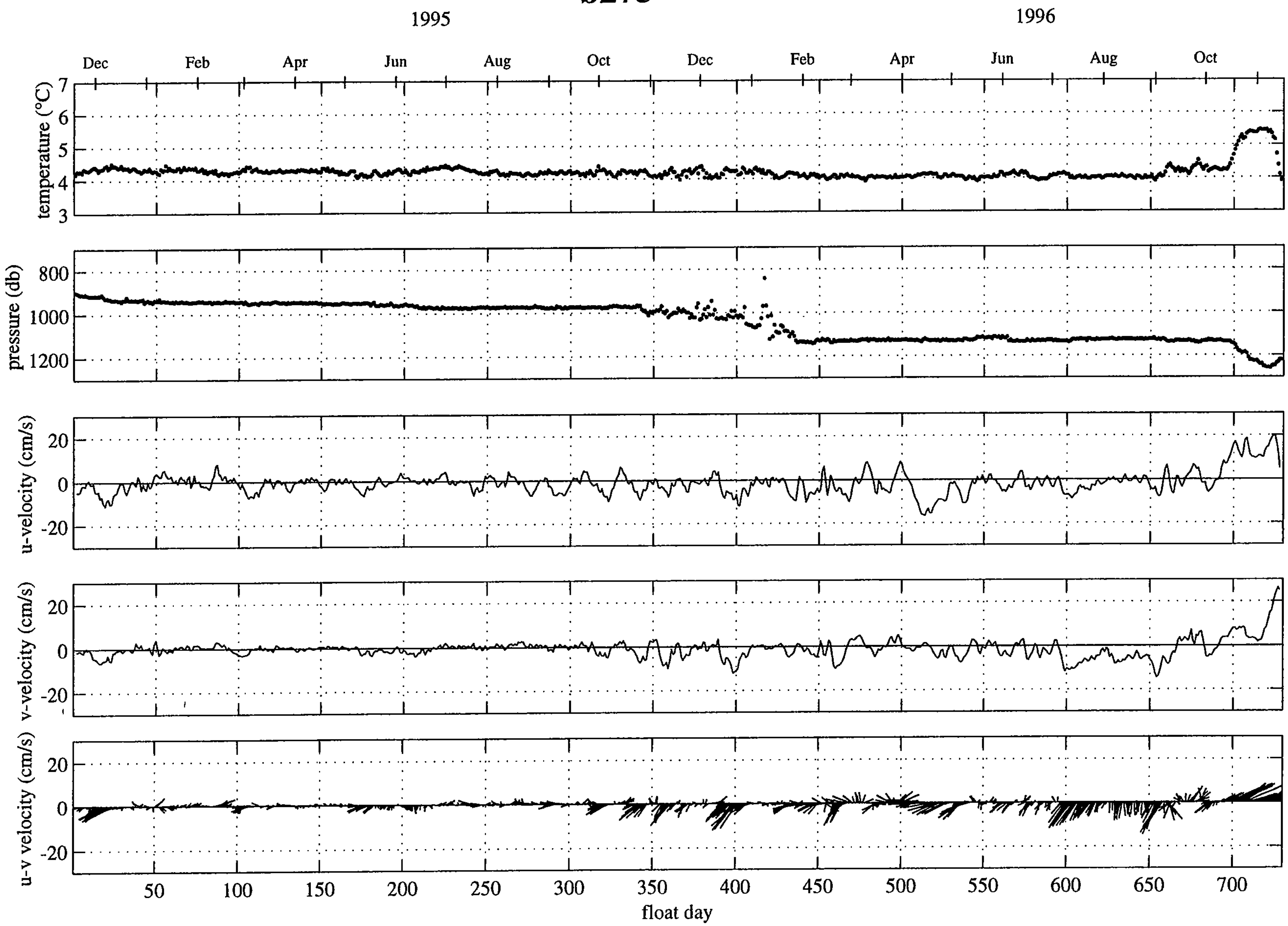

b274
1996
1997
Jul
Sep
Nov
Jan
Mar
May
Jul
Sep
Nov
Jan
Mar
May
temperature (°C)
7
6
5
4
3
pressure (db)
800
1000
1200
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
50
100
150
200
250
300
350
400
450
500
550
600
650
700
float day

b275

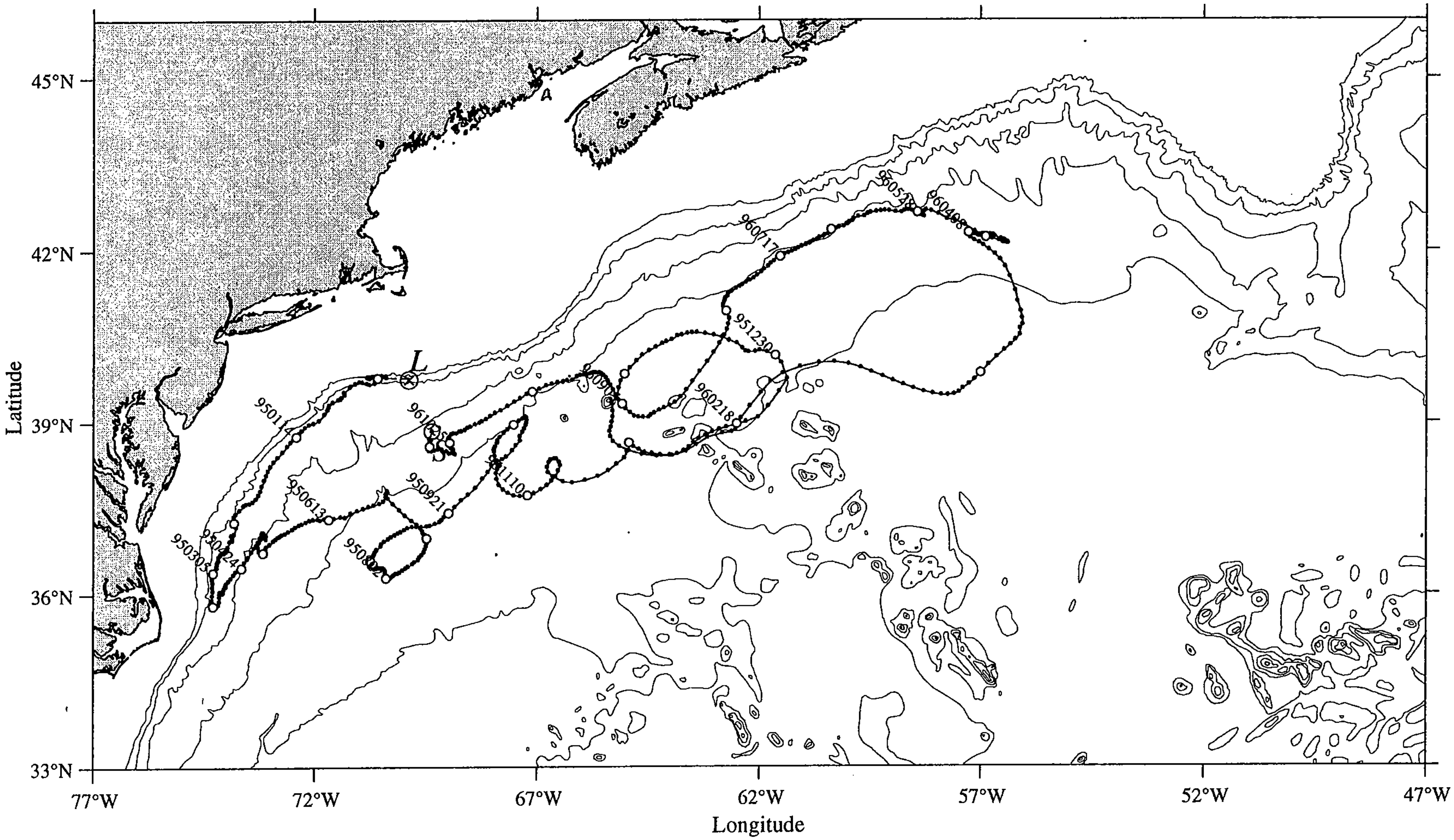


L
S
950225
950913
951102
951222
960210
960331
960520
960709
960828
961017
45°N
42°N
39°N
36°N
33°N
Latitude
77°W
72°W
67°W
62°W
57°W
52°W
47°W
Longitude

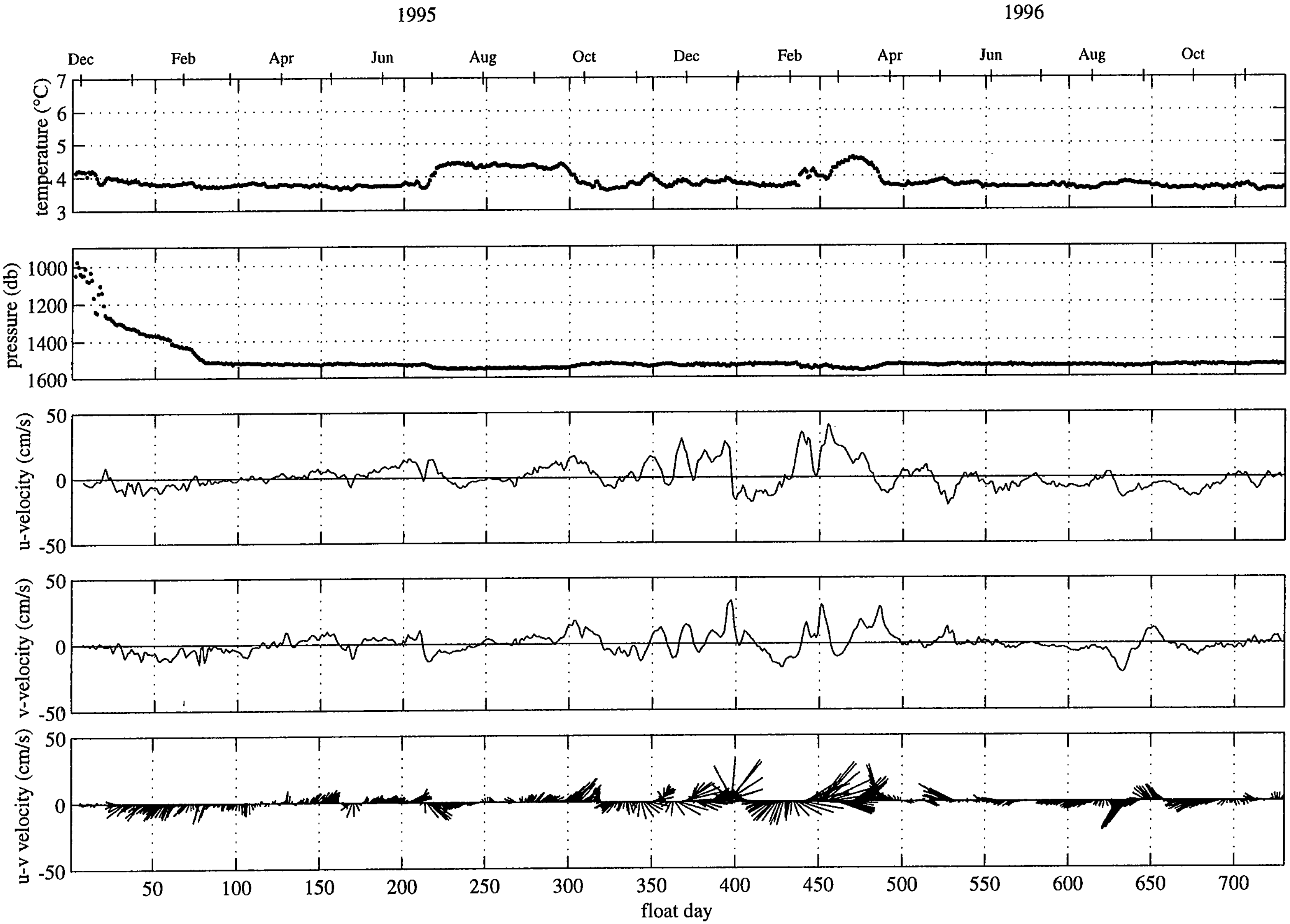
b275


1995
1996
Dec
Feb
Apr
Jun
Aug
Oct
Dec
Feb
Apr
Jun
Aug
Oct
temperature (°C)
pressure (db)
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
float day

b276

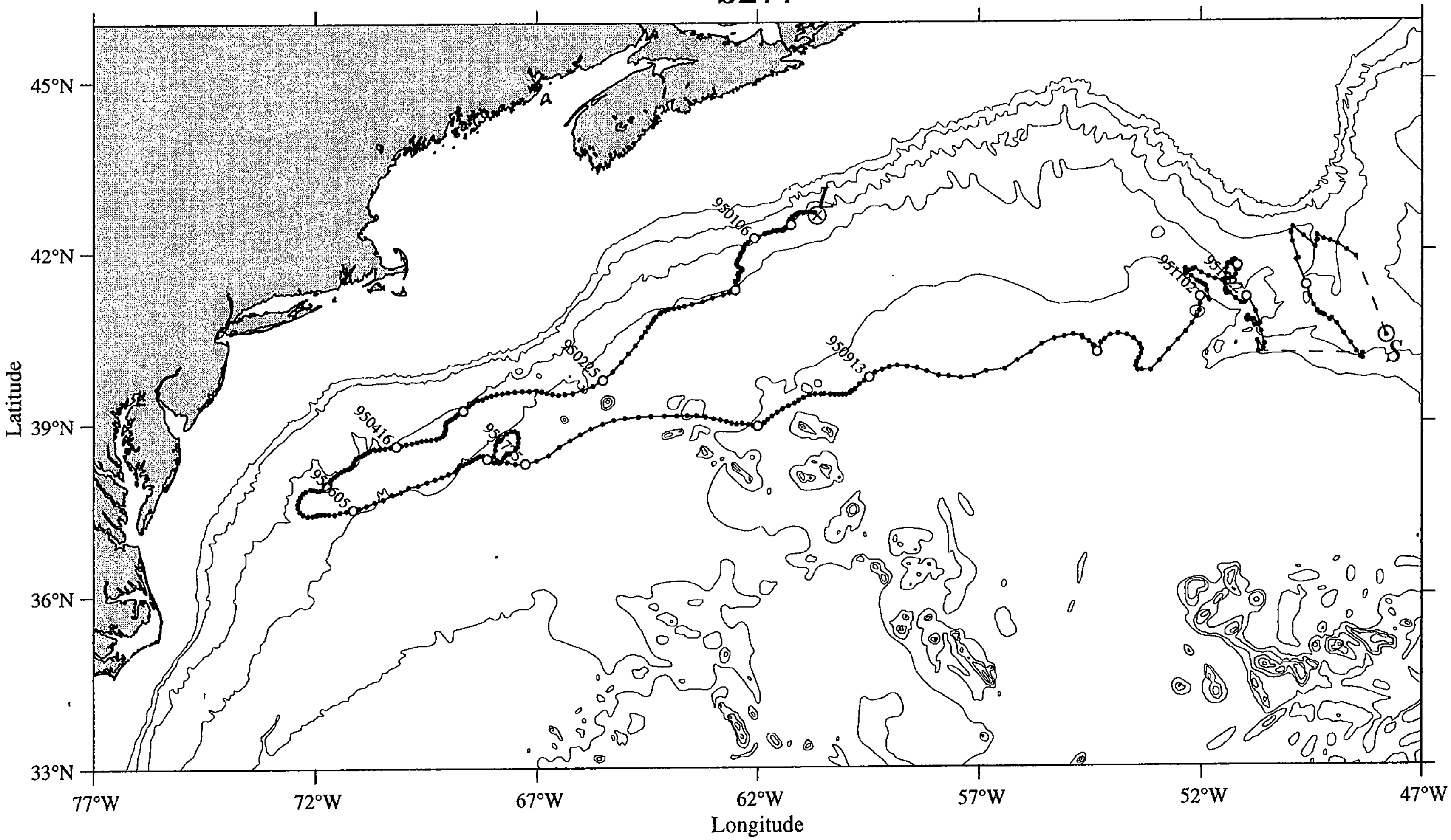

45°N
42°N
39°N
36°N
33°N
Latitude
77°W
72°W
67°W
62°W
57°W
52°W
47°W
Longitude
L
951230
960218
950613
950921

b276



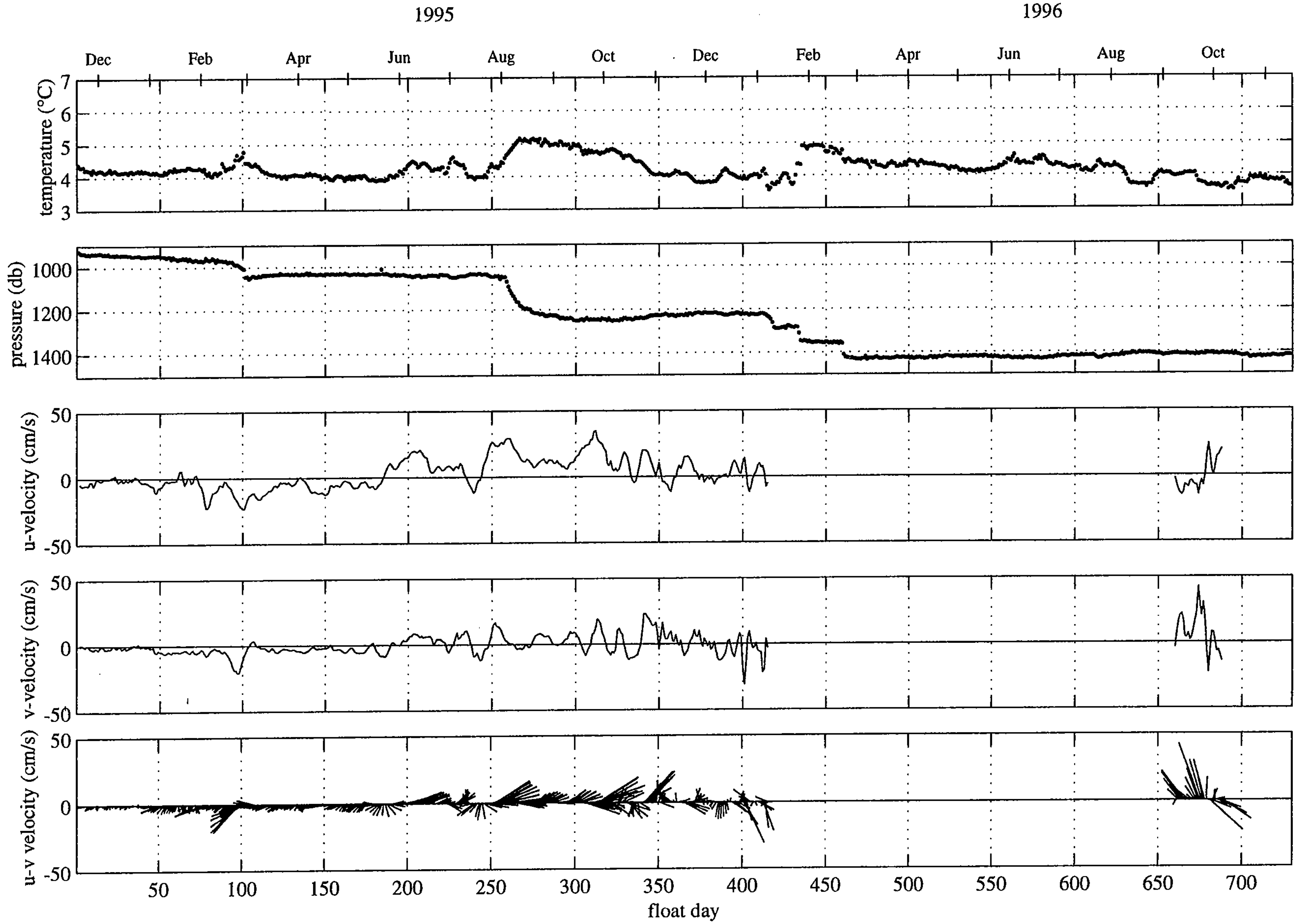
1995
1996
Dec
Feb
Apr
Jun
Aug
Oct
Dec
Feb
Apr
Jun
Aug
Oct
temperature (°C)
pressure (db)
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
float day

b277



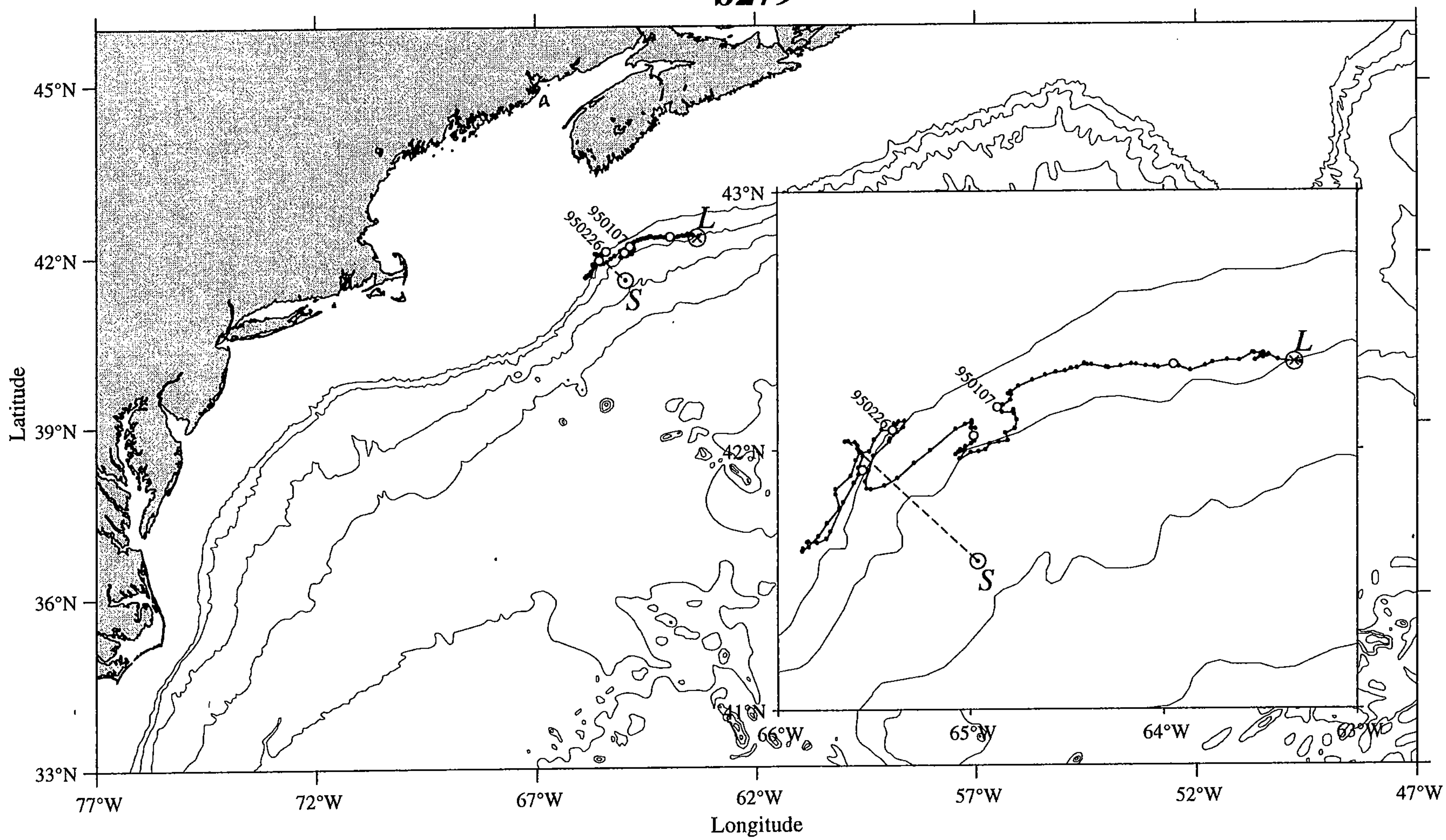
45°N
42°N
39°N
36°N
33°N
Latitude
77°W
72°W
67°W
62°W
57°W
52°W
47°W
Longitude
950106
950225
950416
950605
950913
951102

b277



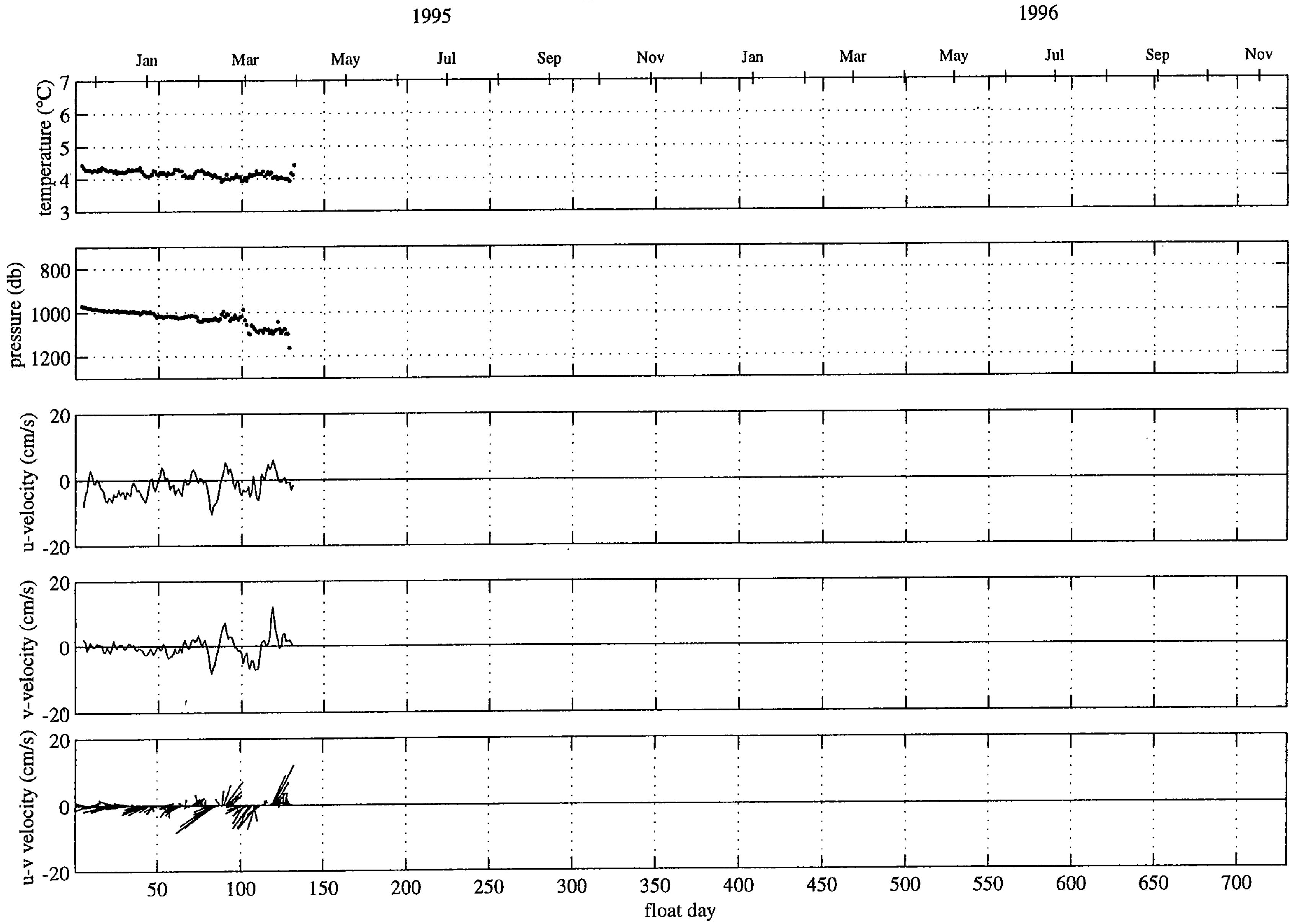
1995
1996
Dec
Feb
Apr
Jun
Aug
Oct
Dec
Feb
Apr
Jun
Aug
Oct
temperature (°C)
pressure (db)
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
float day

b279



45°N
42°N
39°N
36°N
33°N
Latitude
77°W
72°W
67°W
62°W
57°W
52°W
47°W
Longitude
950107
950226
L
S
43°N
42°N
41°N
66°W
65°W
64°W
63°W

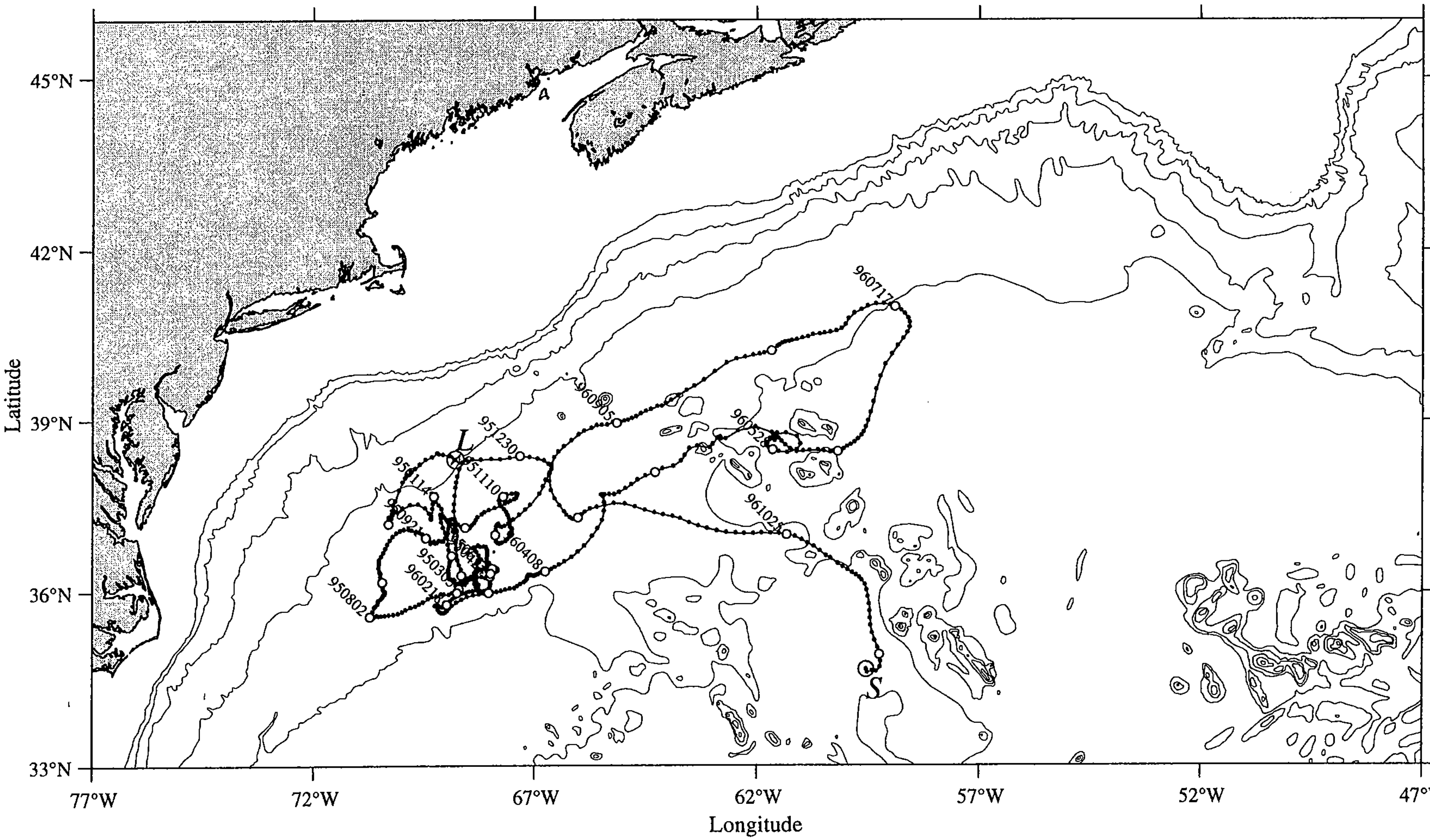
b279

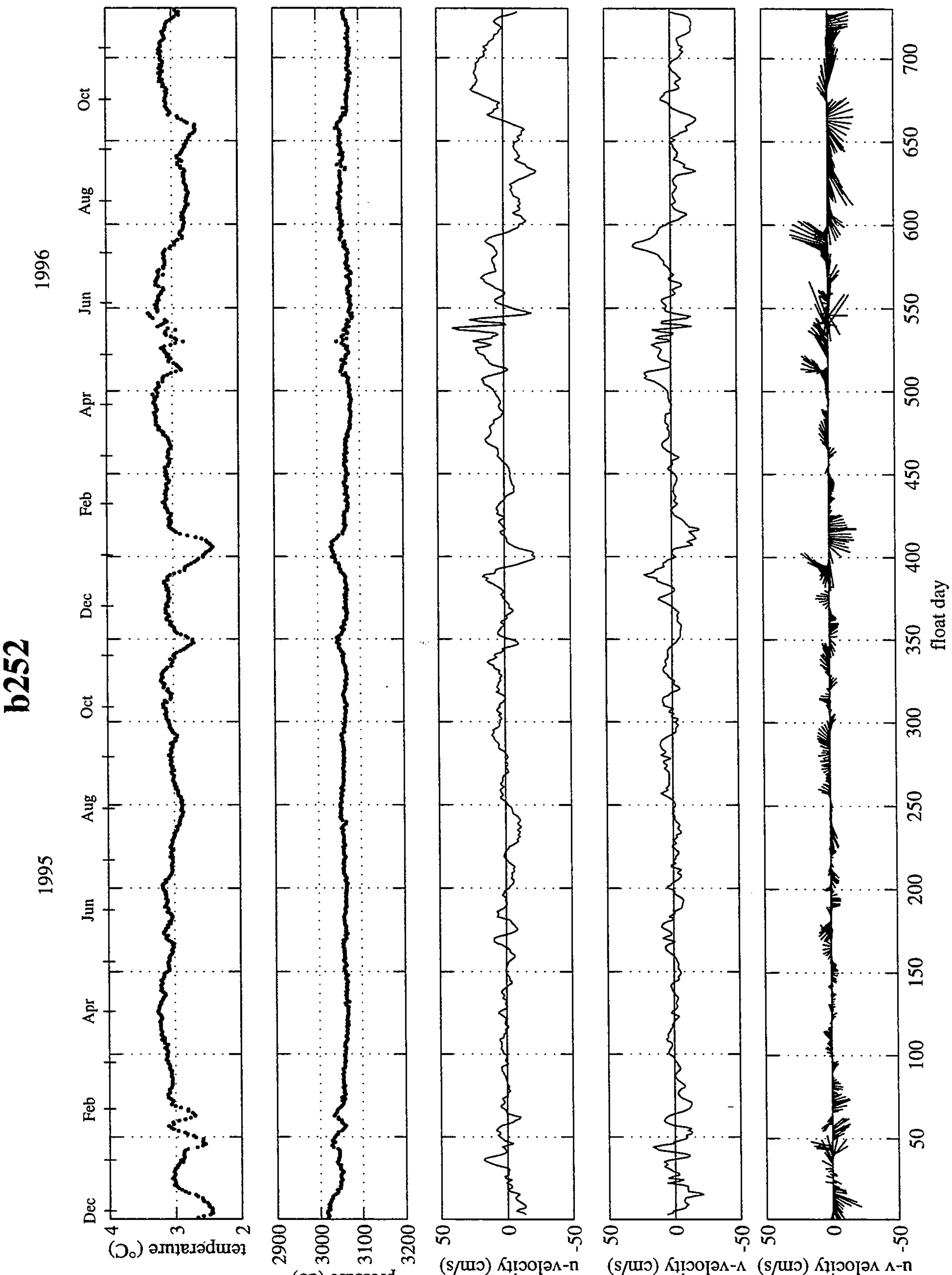


1995
1996
Jan
Mar
May
Jul
Sep
Nov
Jan
Mar
May
Jul
Sep
Nov
temperature (°C)
7
6
5
4
3
pressure (db)
800
1000
1200
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
50
100
150
200
250
300
350
400
450
500
550
600
650
700
float day

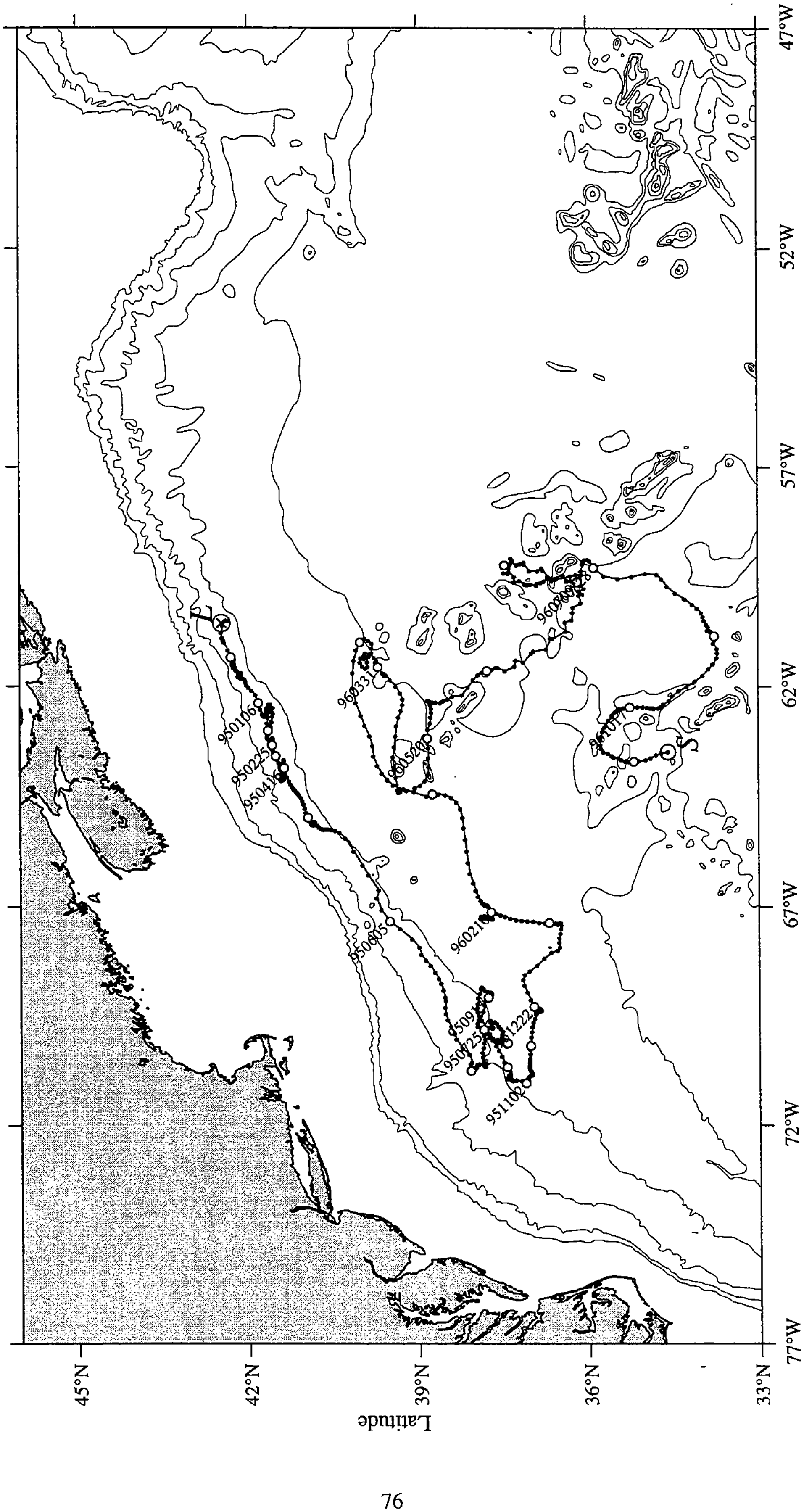
Deep Floats

b252

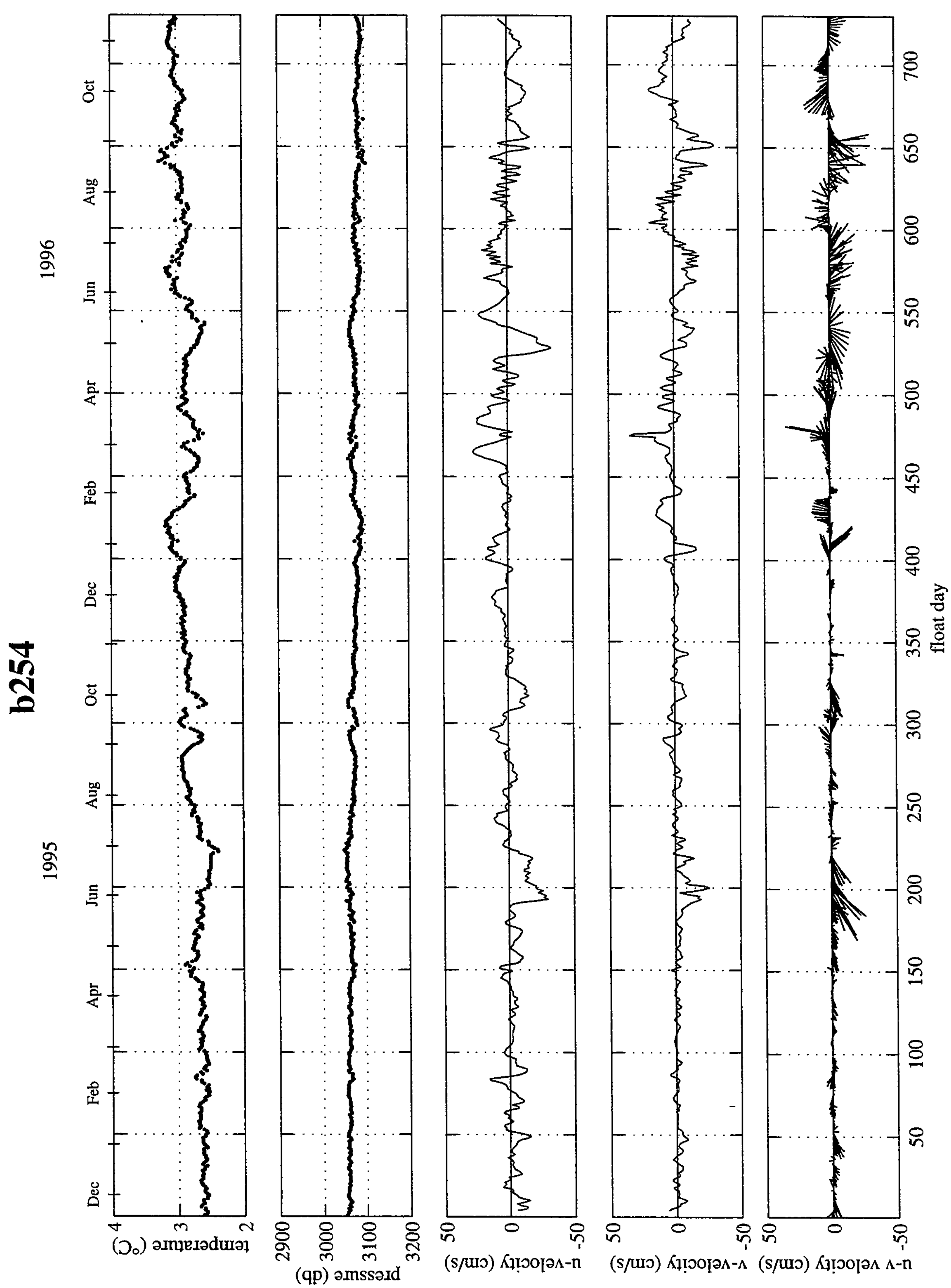

45°N
42°N
39°N
36°N
33°N
Latitude
77°W
72°W
67°W
62°W
57°W
52°W
47°W
Longitude
960717
960905
951230
951110
960408
950802
960528
961025
L
S


b252
1995
1996
Dec
Feb
Apr
Jun
Aug
Oct
Dec
Feb
Apr
Jun
Aug
Oct
temperature (°C)
4
3
2
pressure (db)
2900
3000
3100
3200
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
50
100
150
200
250
300
350
400
450
500
550
600
650
700
float day

b254

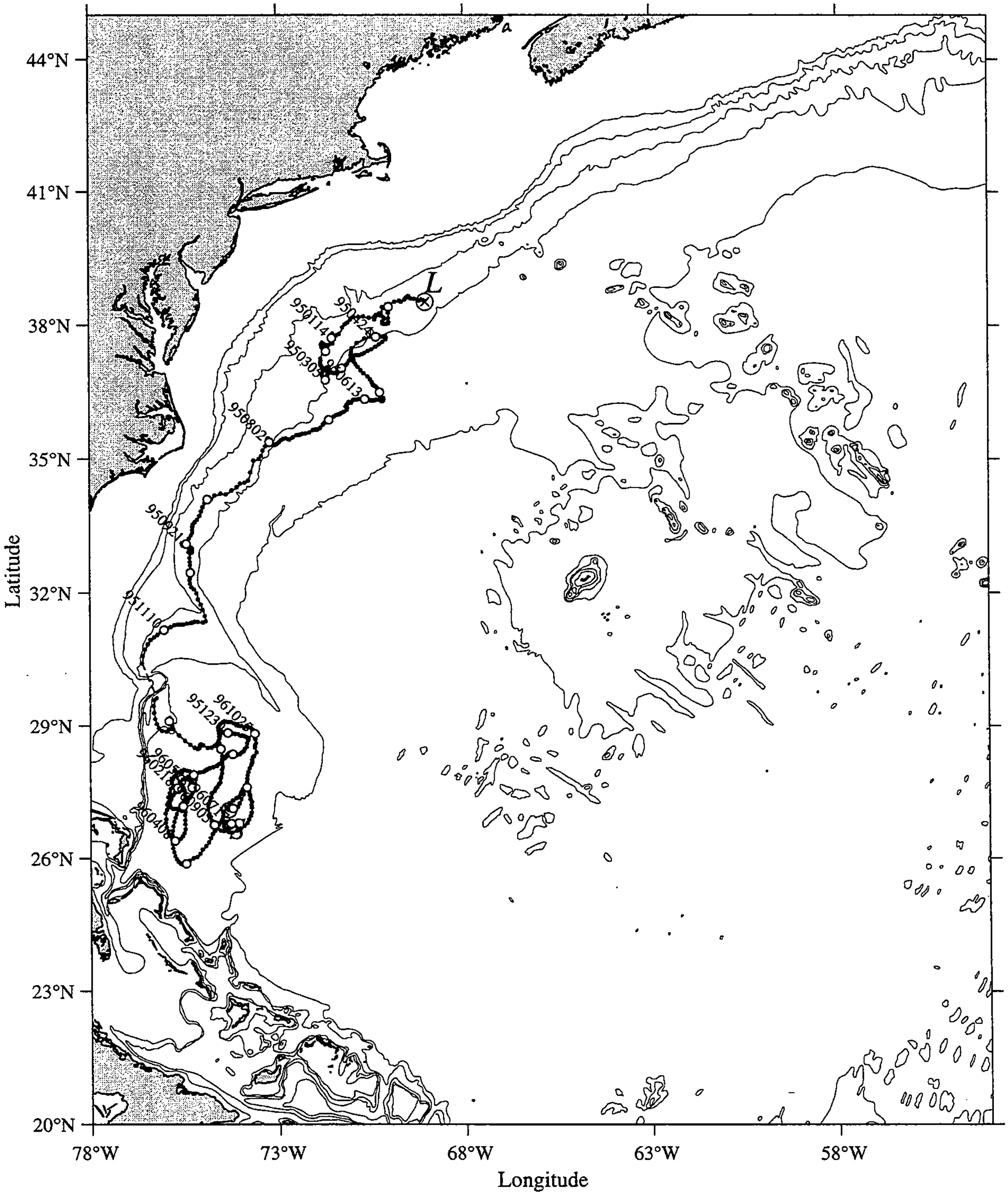


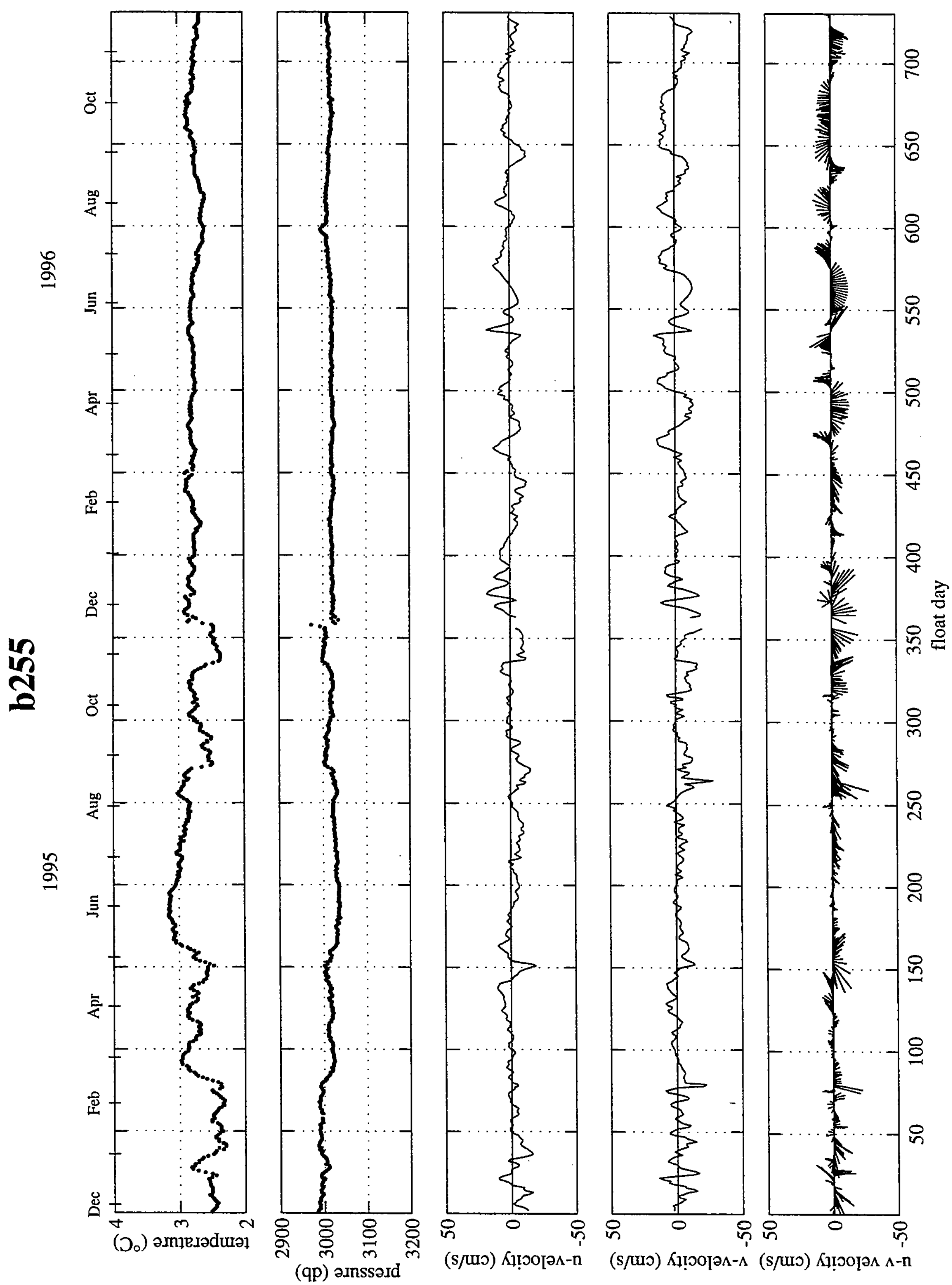
47°W
52°W
57°W
62°W
67°W
72°W
77°W
Longitude
45°N
42°N
39°N
36°N
33°N
Latitude
950106
950225
950410
950605
960331
960216
951102



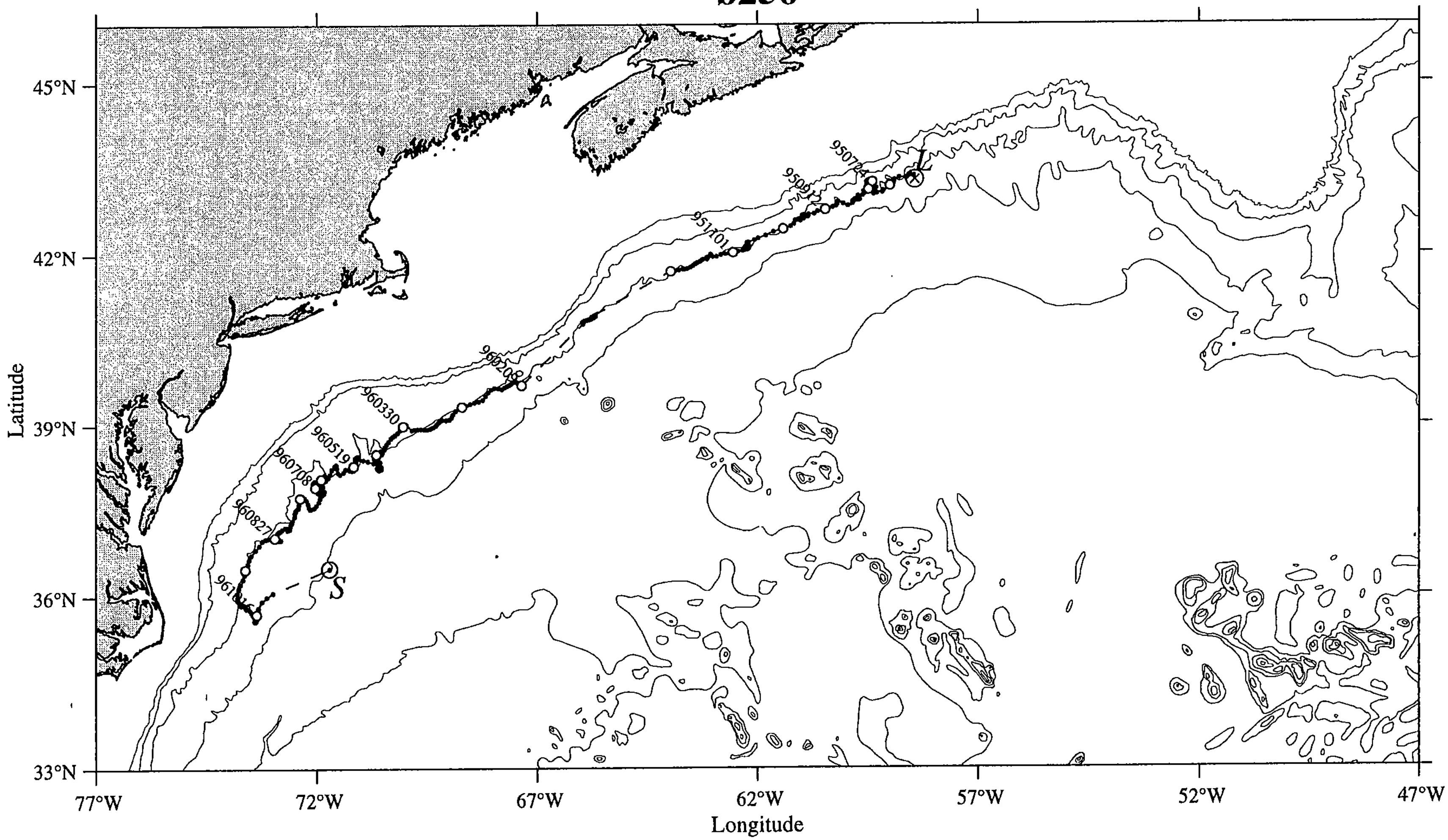
b254
1995
1996
Dec
Feb
Apr
Jun
Aug
Oct
temperature (°C)
4
3
2
pressure (db)
2900
3000
3100
3200
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
u-v velocity (cm/s)
50
100
150
200
250
300
350
400
450
500
550
600
650
700
float day

b255

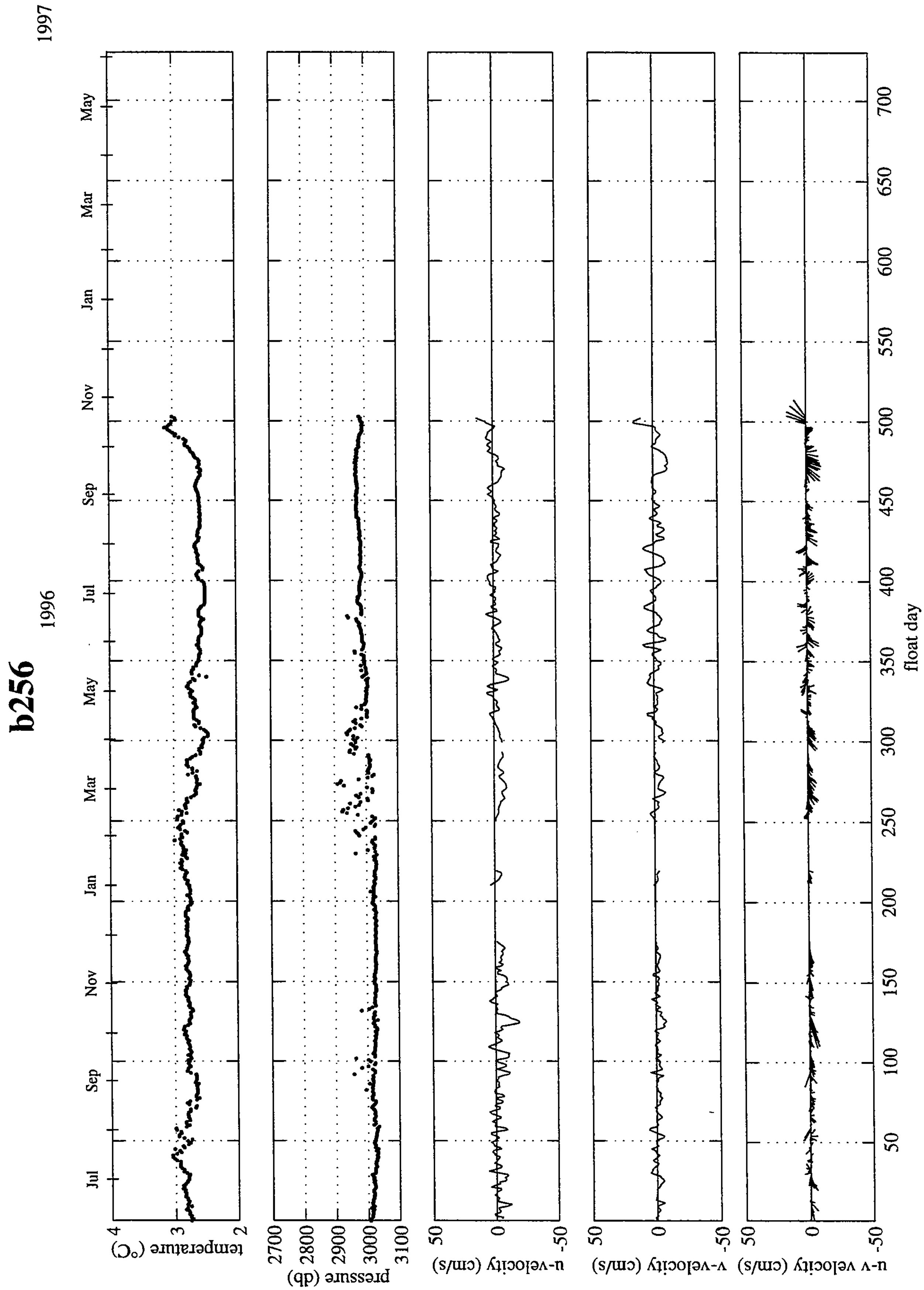

44°N
41°N
38°N
35°N
32°N
29°N
26°N
23°N
20°N
78°W
73°W
68°W
63°W
58°W
Latitude
Longitude
L


b255
1995
1996
Dec
Feb
Apr
Jun
Aug
Oct
temperature (°C)
pressure (db)
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
float day

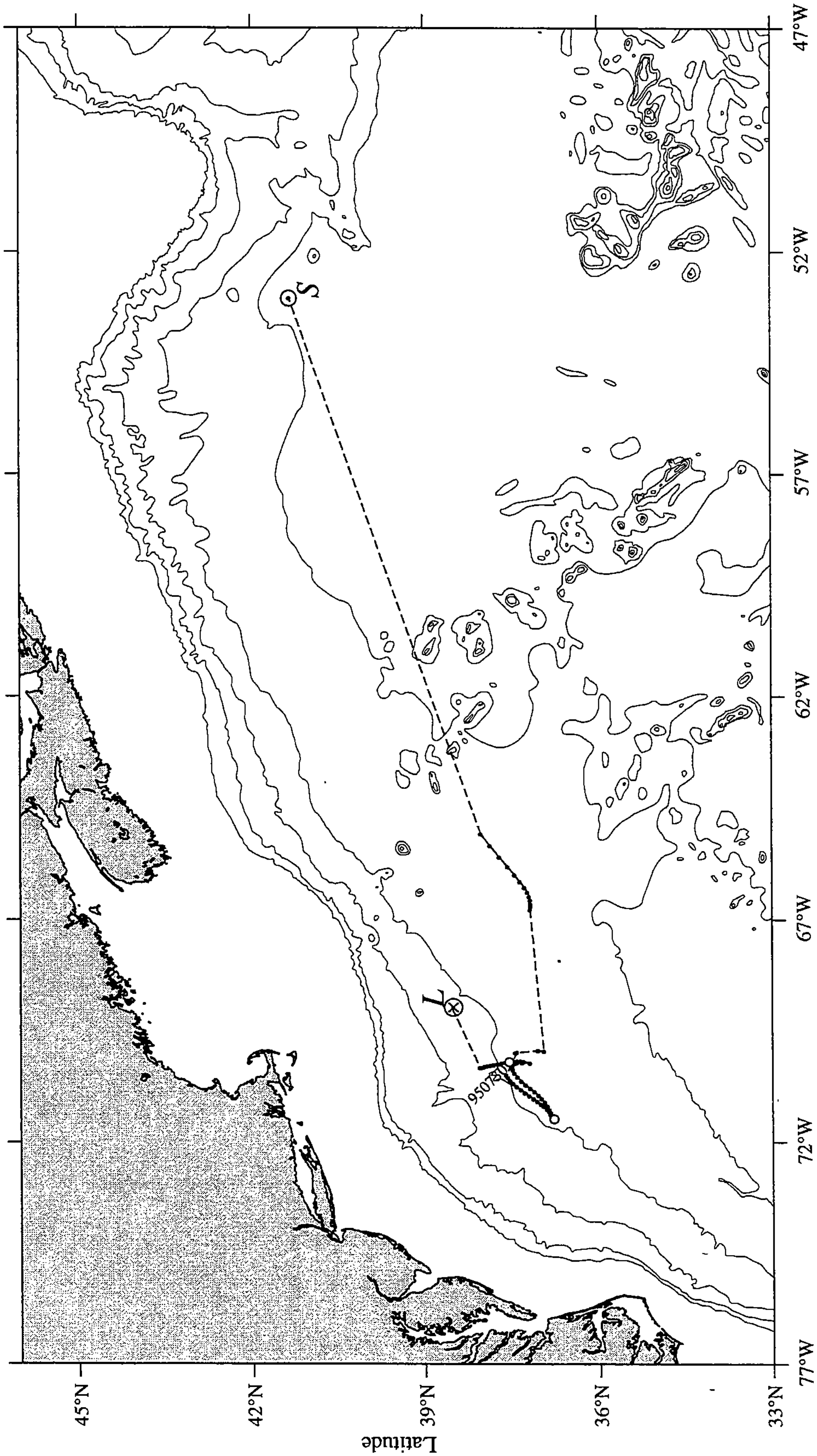
b256



45°N
42°N
39°N
36°N
33°N
Latitude
77°W
72°W
67°W
62°W
57°W
52°W
47°W
Longitude
950724
950911
951101
960208
960330
960519
960708
960827
S

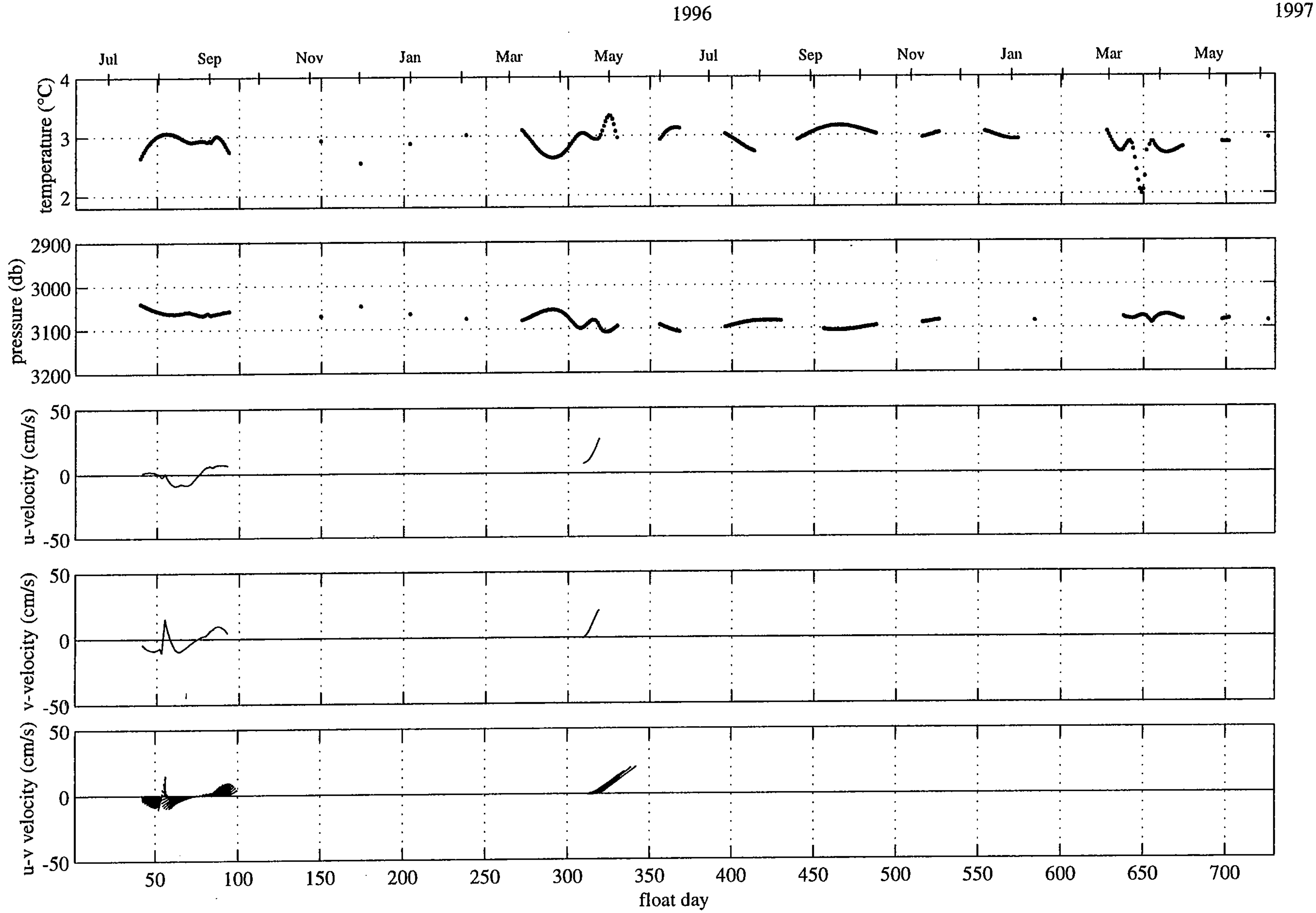

b256
1996
1997
Jul
Sep
Nov
Jan
Mar
May
temperature (°C)
pressure (db)
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
float day

b257



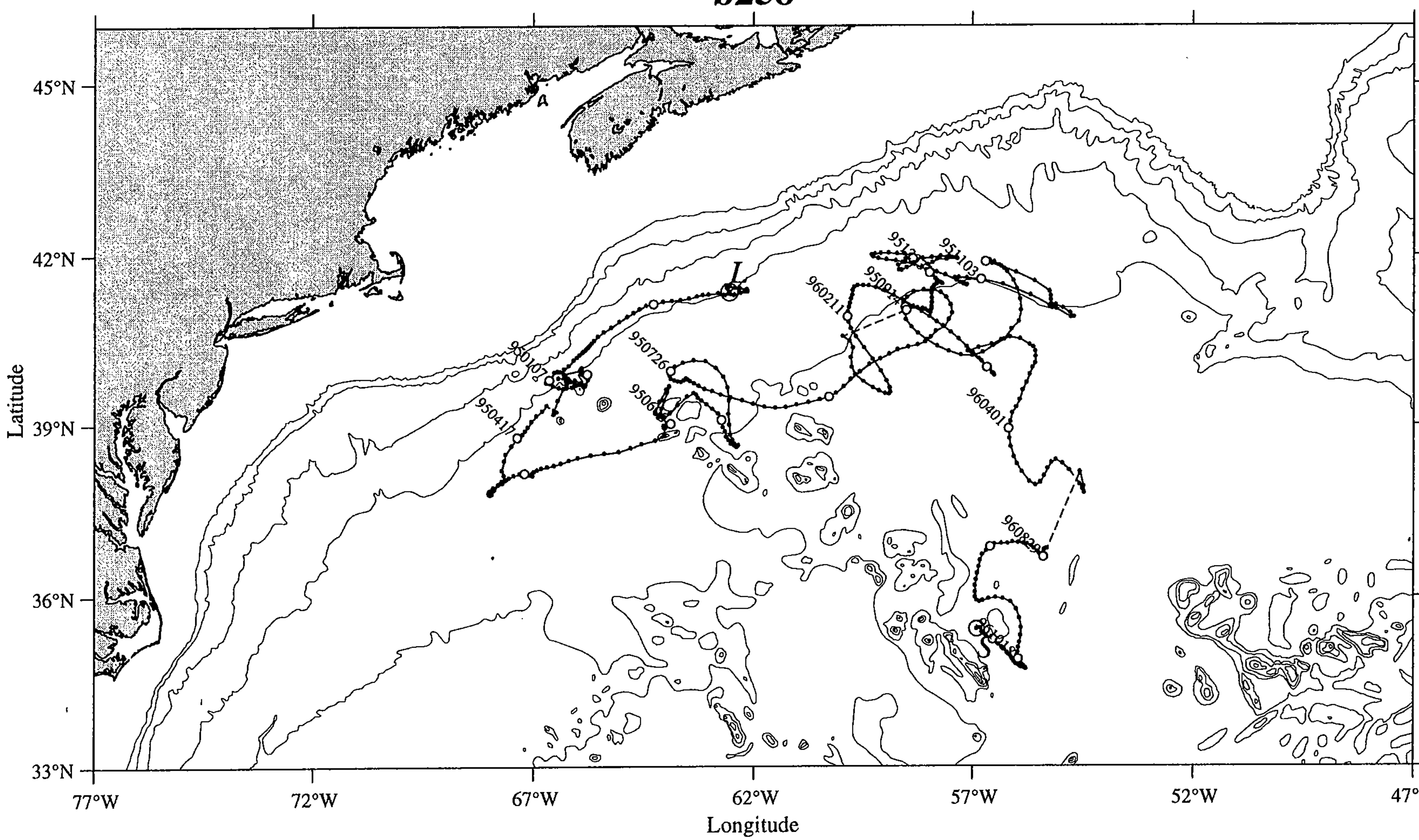
45°N
42°N
39°N
36°N
33°N
Latitude
77°W
72°W
67°W
62°W
57°W
52°W
47°W
Longitude
S
T
9507

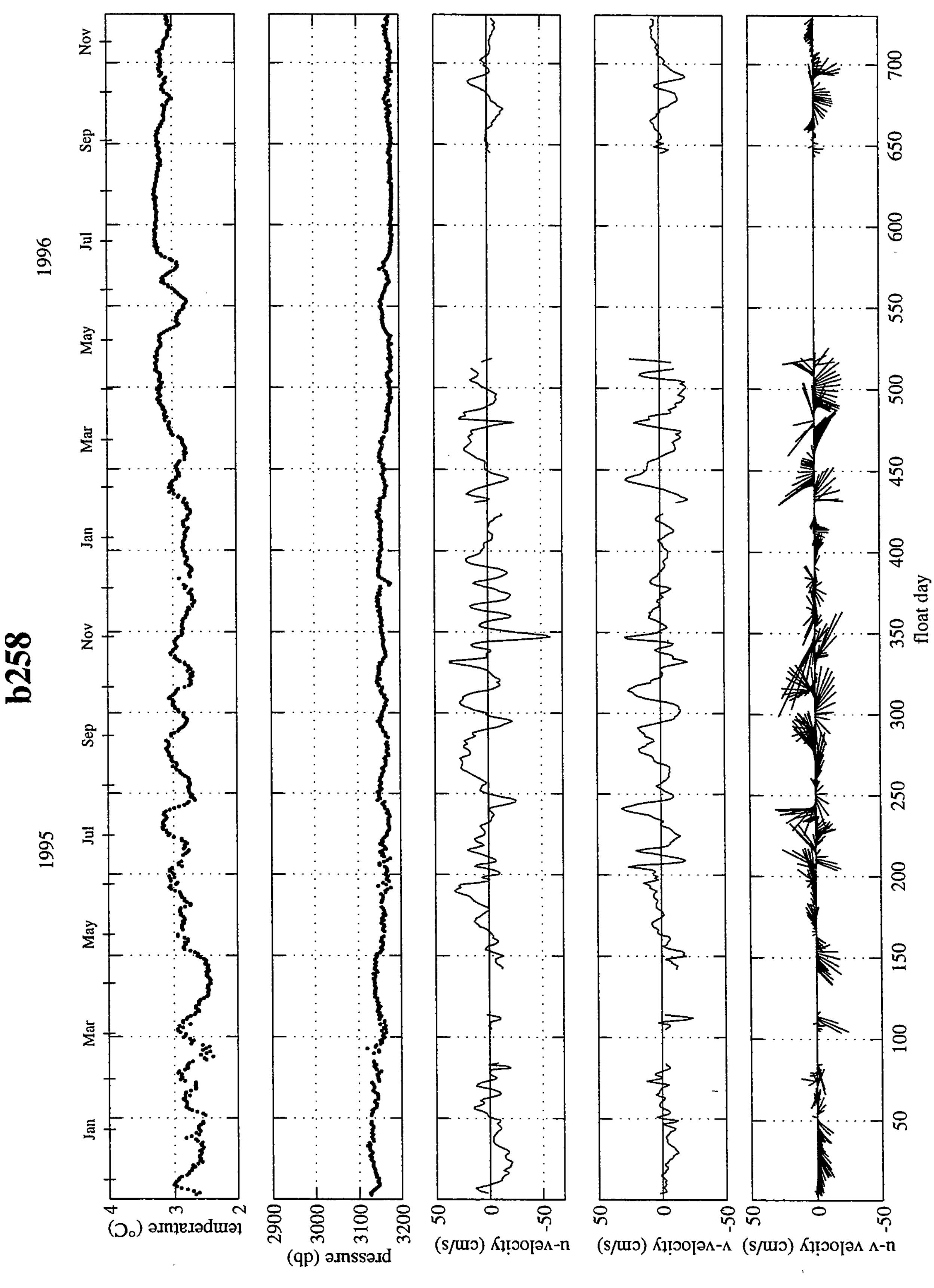
b257



1996
1997
Jul
Sep
Nov
Jan
Mar
May
Jul
Sep
Nov
Jan
Mar
May
temperature (°C)
4
3
2
pressure (db)
2900
3000
3100
3200
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
50
0
-50
50
100
150
200
250
300
350
400
450
500
550
600
650
700
float day

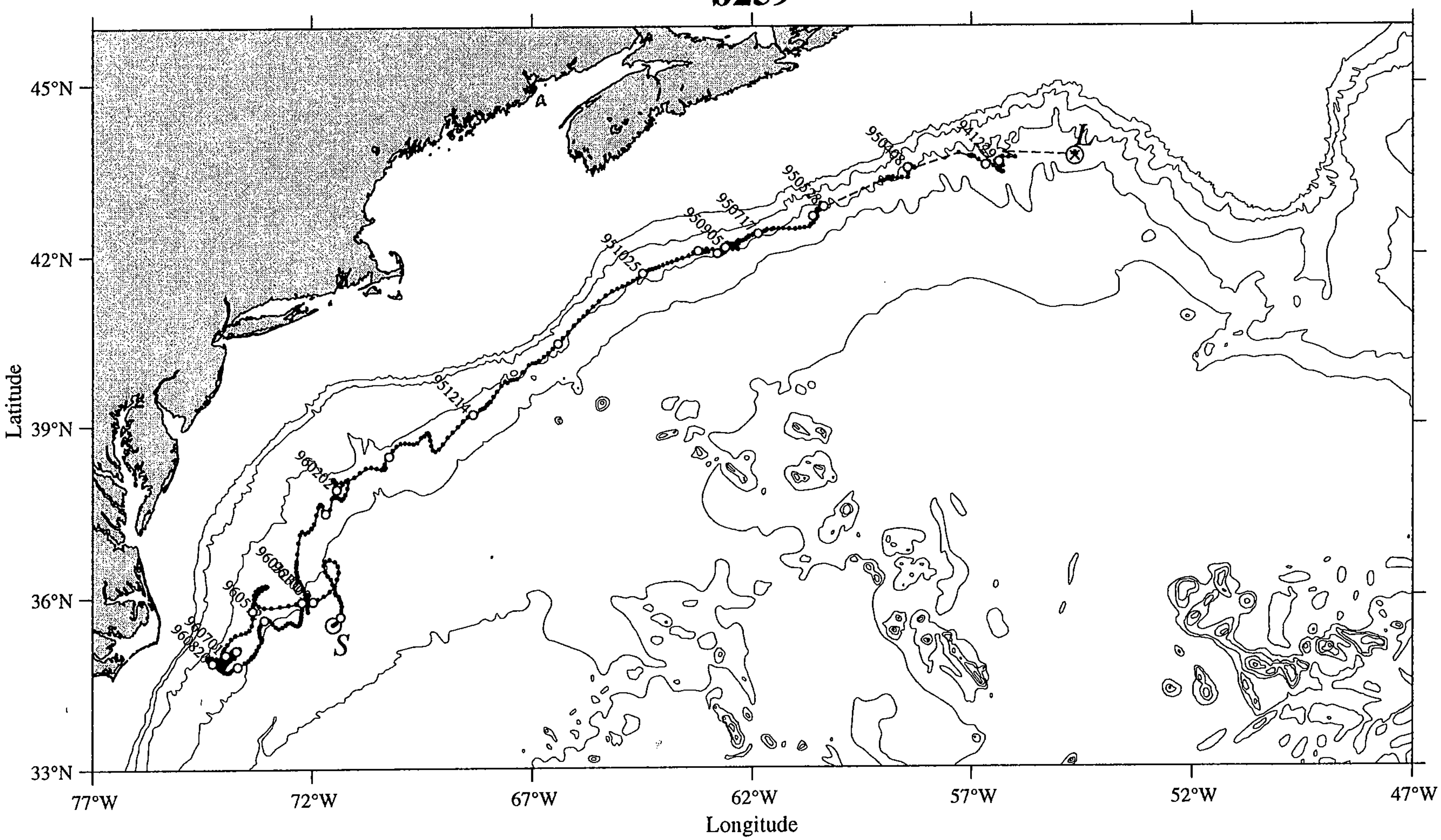
b258

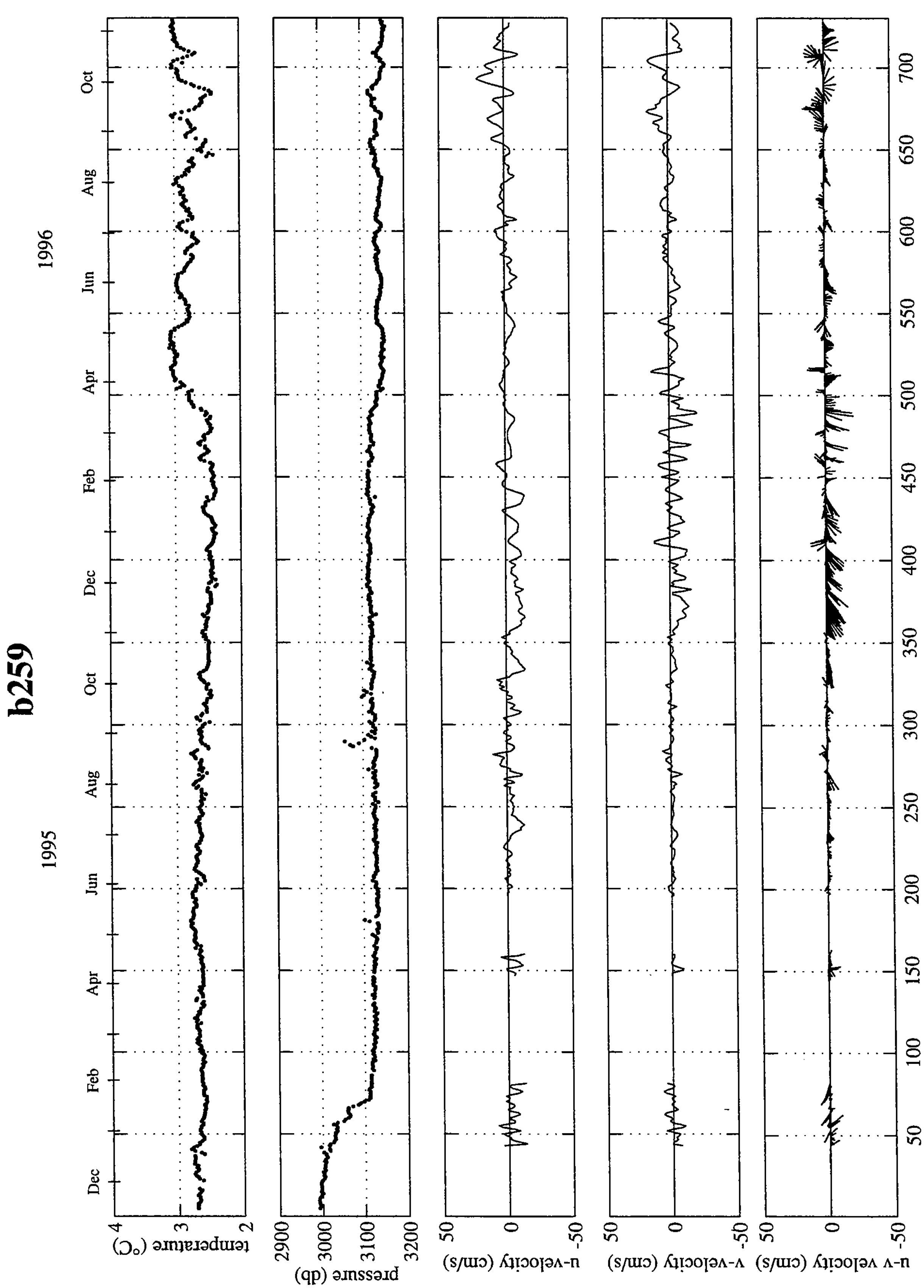

950107
950417
950726
960211
951103
960401
960829
45°N
42°N
39°N
36°N
33°N
Latitude
77°W
72°W
67°W
62°W
57°W
52°W
47°W
Longitude



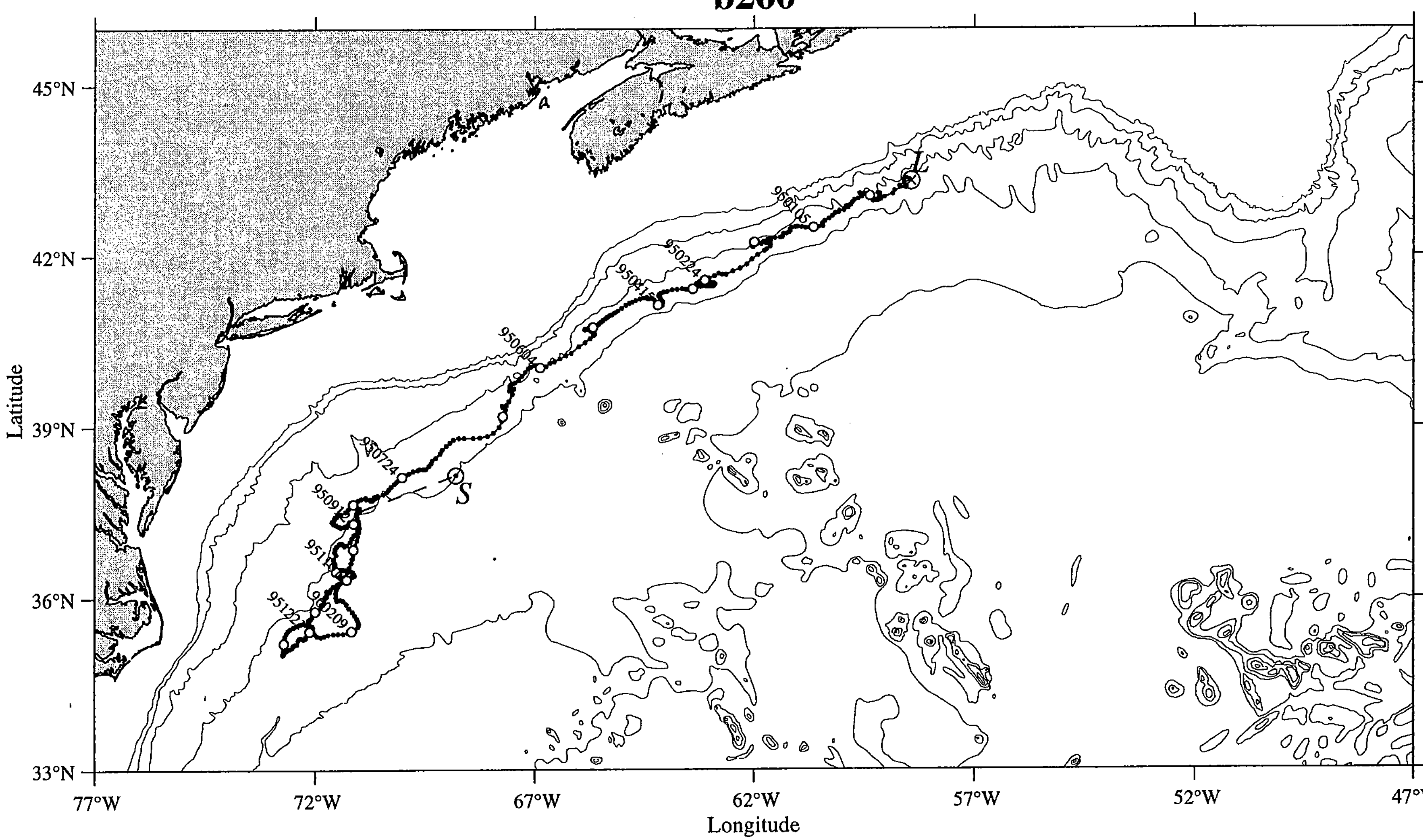
b258
1995
1996
Jan
Mar
May
Jul
Sep
Nov
temperature (°C)
pressure (db)
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
float day
4
3
2
2900
3000
3100
3200
50
0
-50
100
150
200
250
300
350
400
450
500
550
600
650
700

b259


45°N
42°N
39°N
36°N
33°N
Latitude
77°W
72°W
67°W
62°W
57°W
52°W
47°W
Longitude
950717
950905
951025
951214
960202
S
L

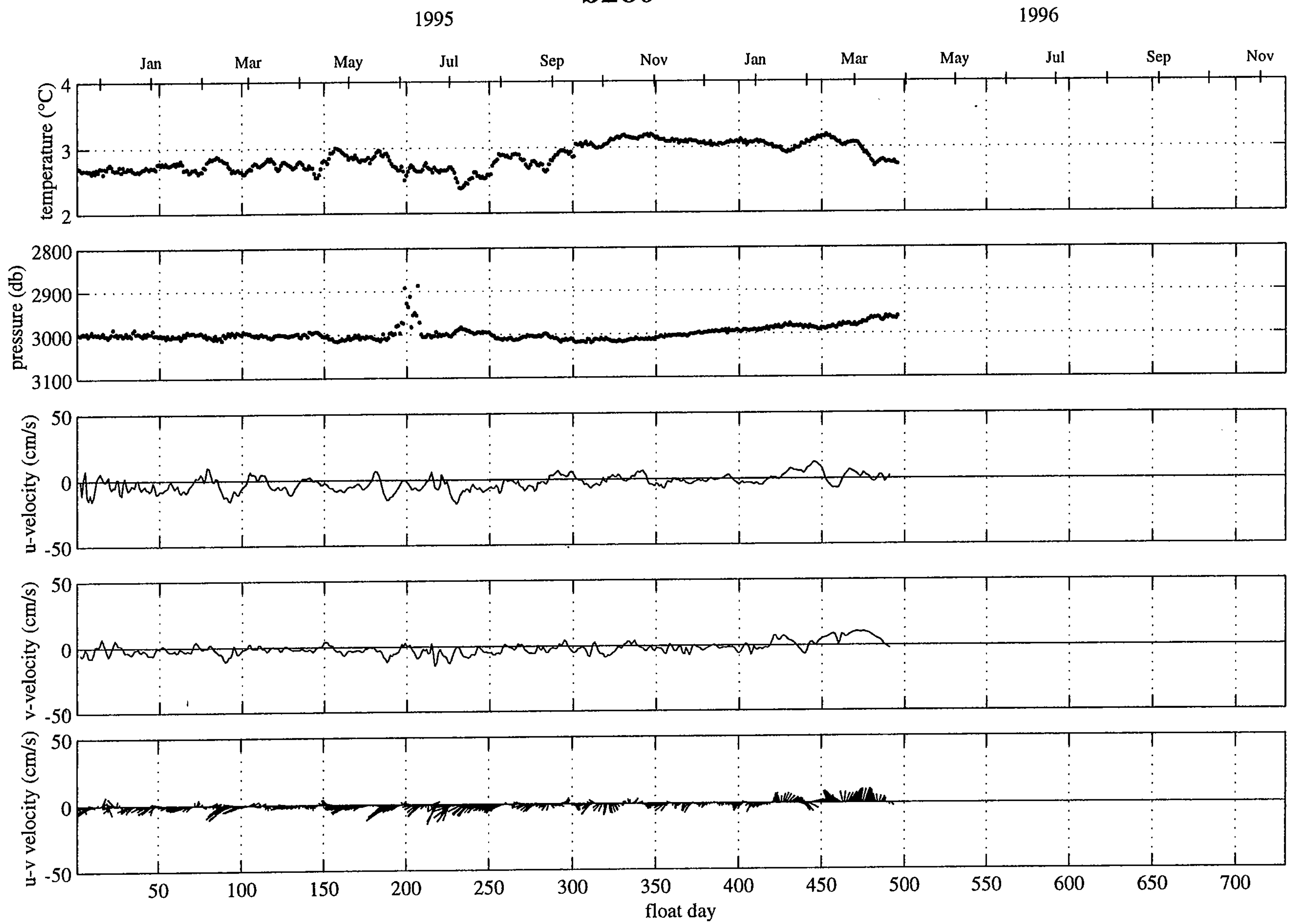

b259
1995
1996
Dec
Feb
Apr
Jun
Aug
Oct
temperature (°C)
pressure (db)
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
float day

b260



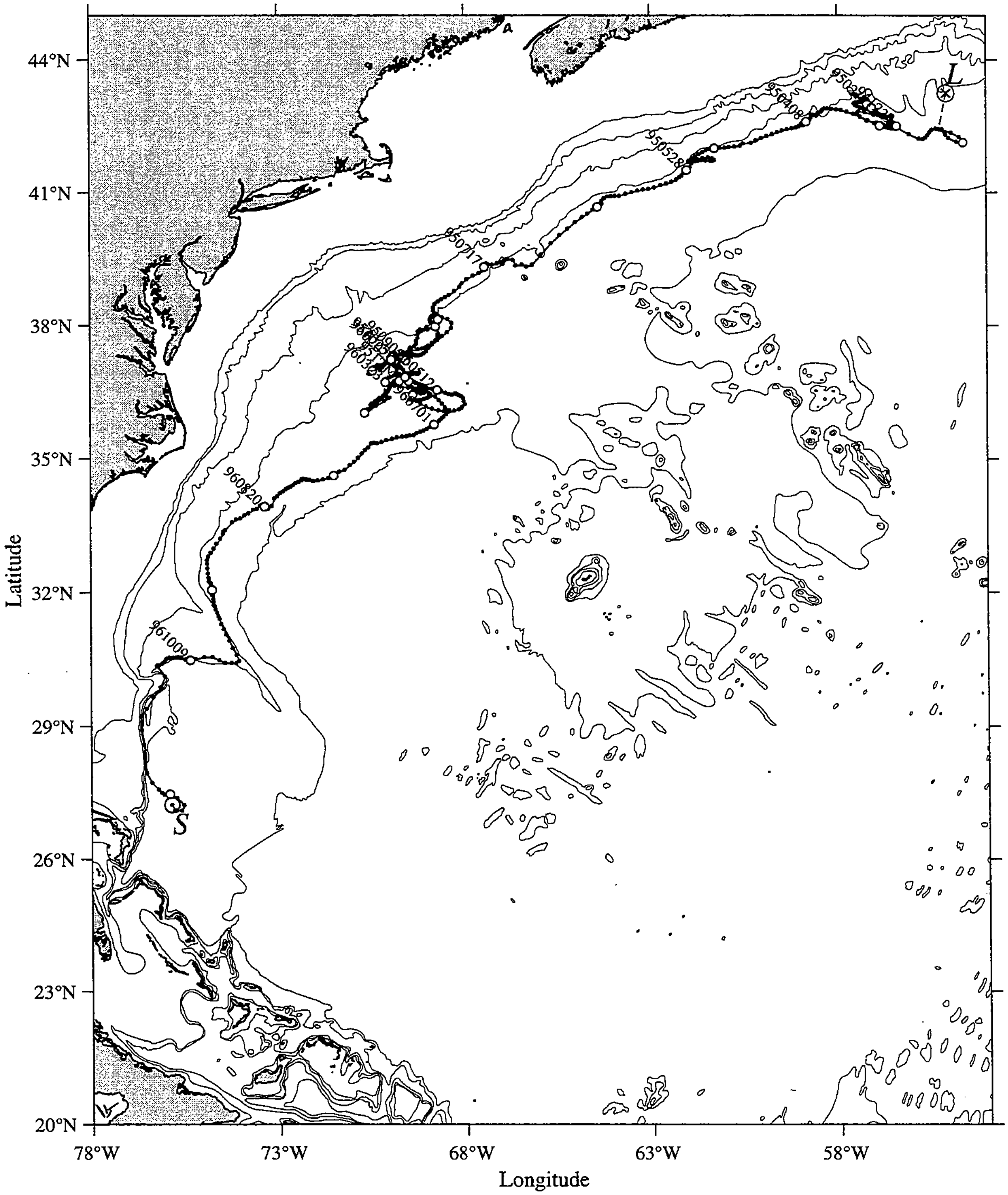
45°N
42°N
39°N
36°N
33°N
Latitude
77°W
72°W
67°W
62°W
57°W
52°W
47°W
Longitude
950105
950224
950415
950604
950724
950913
951102
951222
960209
S

b260

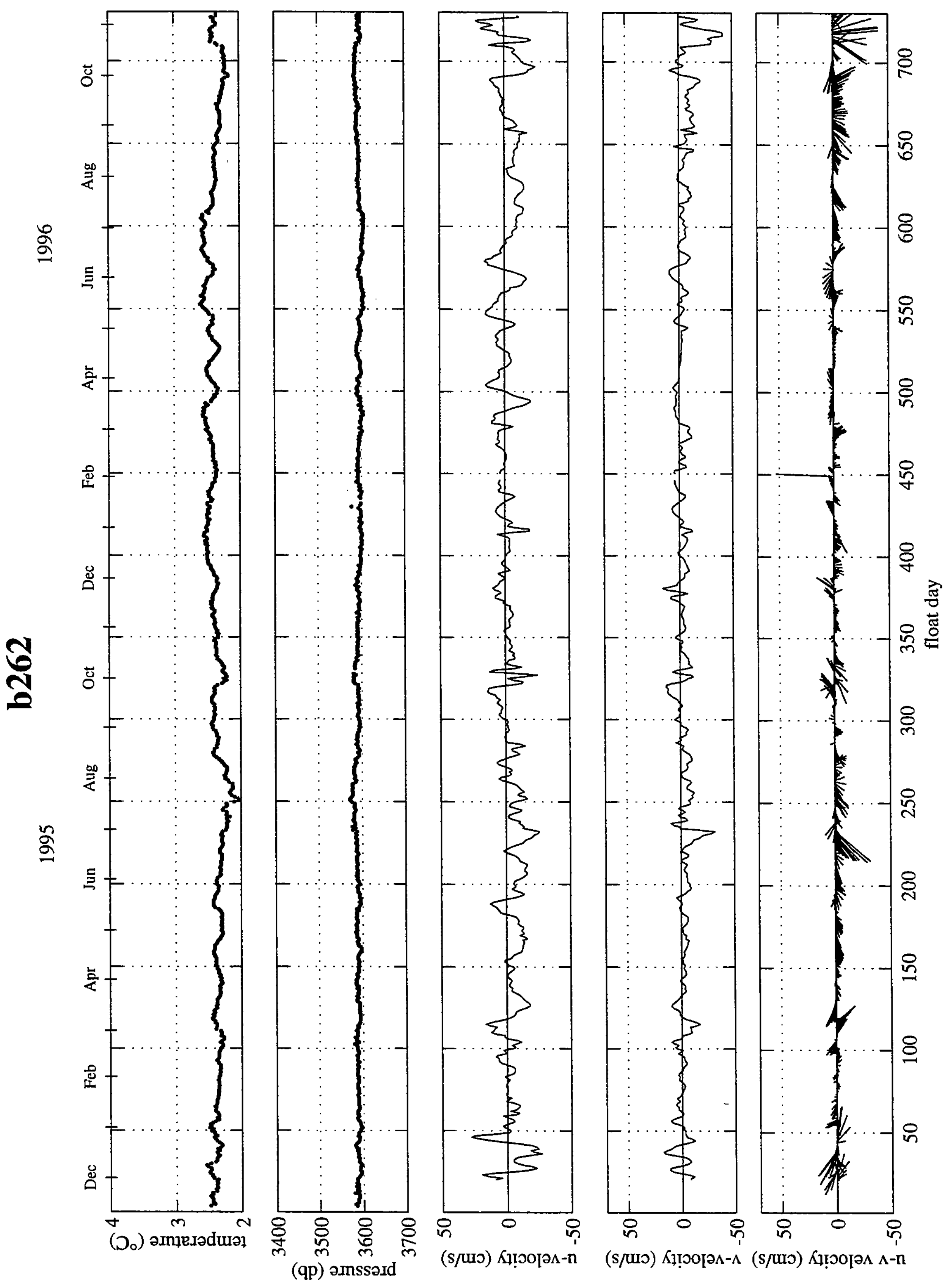


1995
1996
Jan
Mar
May
Jul
Sep
Nov
Jan
Mar
May
Jul
Sep
Nov
temperature (°C)
4
3
2
pressure (db)
2800
2900
3000
3100
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
50
100
150
200
250
300
350
400
450
500
550
600
650
700
float day

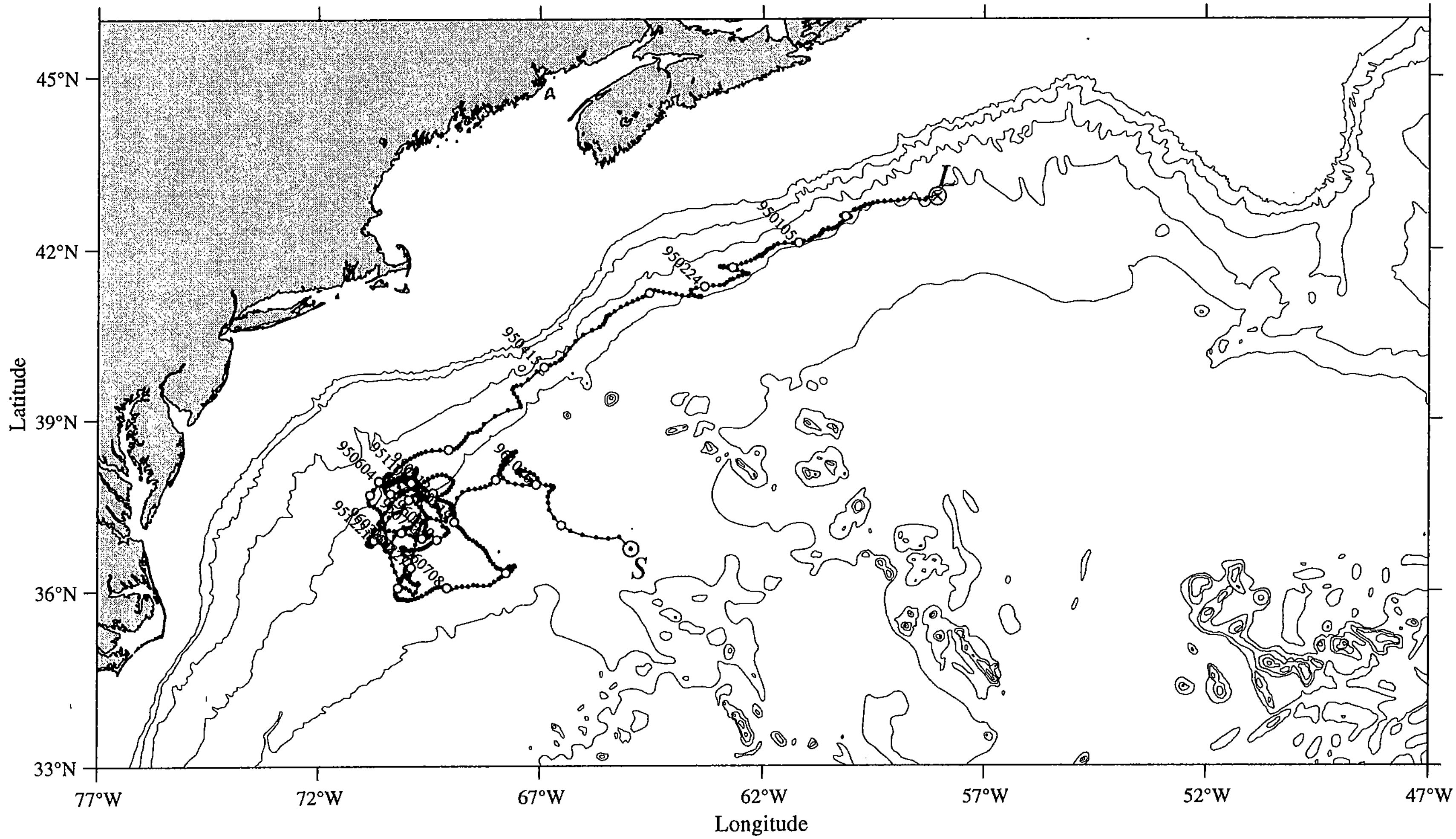
b262



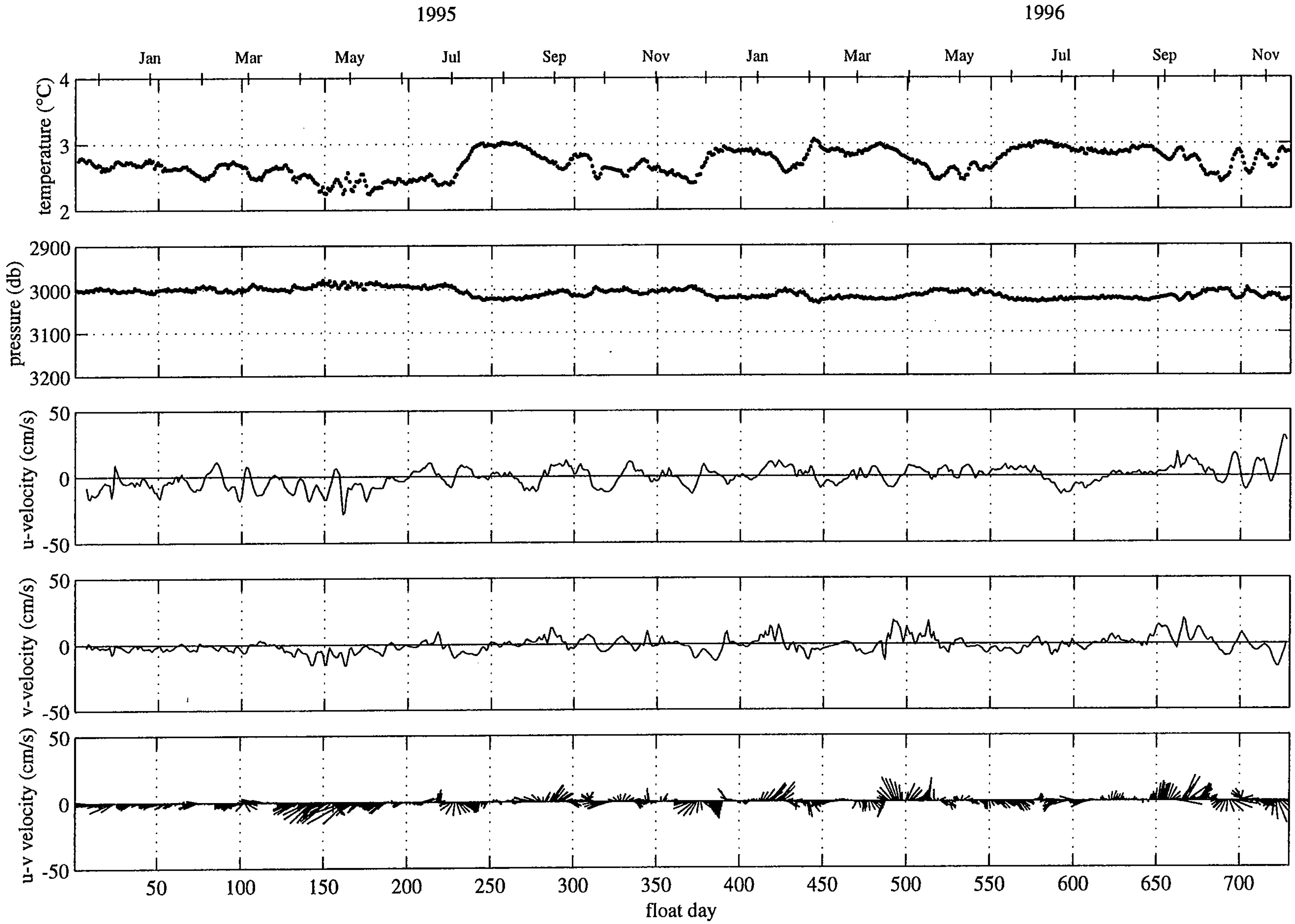
44°N
41°N
38°N
35°N
32°N
29°N
26°N
23°N
20°N
Latitude
78°W
73°W
68°W
63°W
58°W
Longitude
L
S
950408
950528
950717
960820
961009


b262
1995
1996
Dec
Feb
Apr
Jun
Aug
Oct
Dec
Feb
Apr
Jun
Aug
Oct
temperature (°C)
pressure (db)
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
float day
50
100
150
200
250
300
350
400
450
500
550
600
650
700

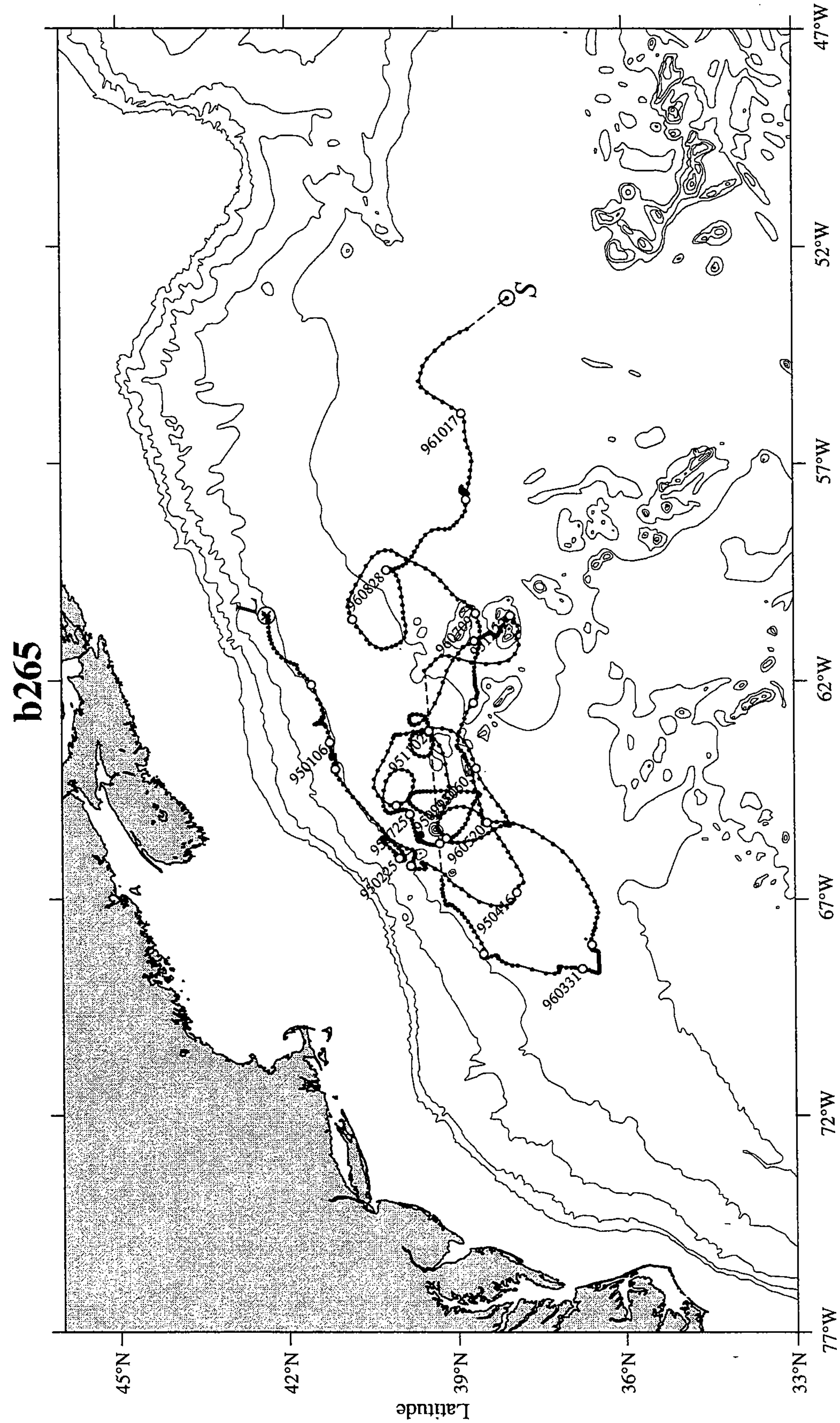
b264

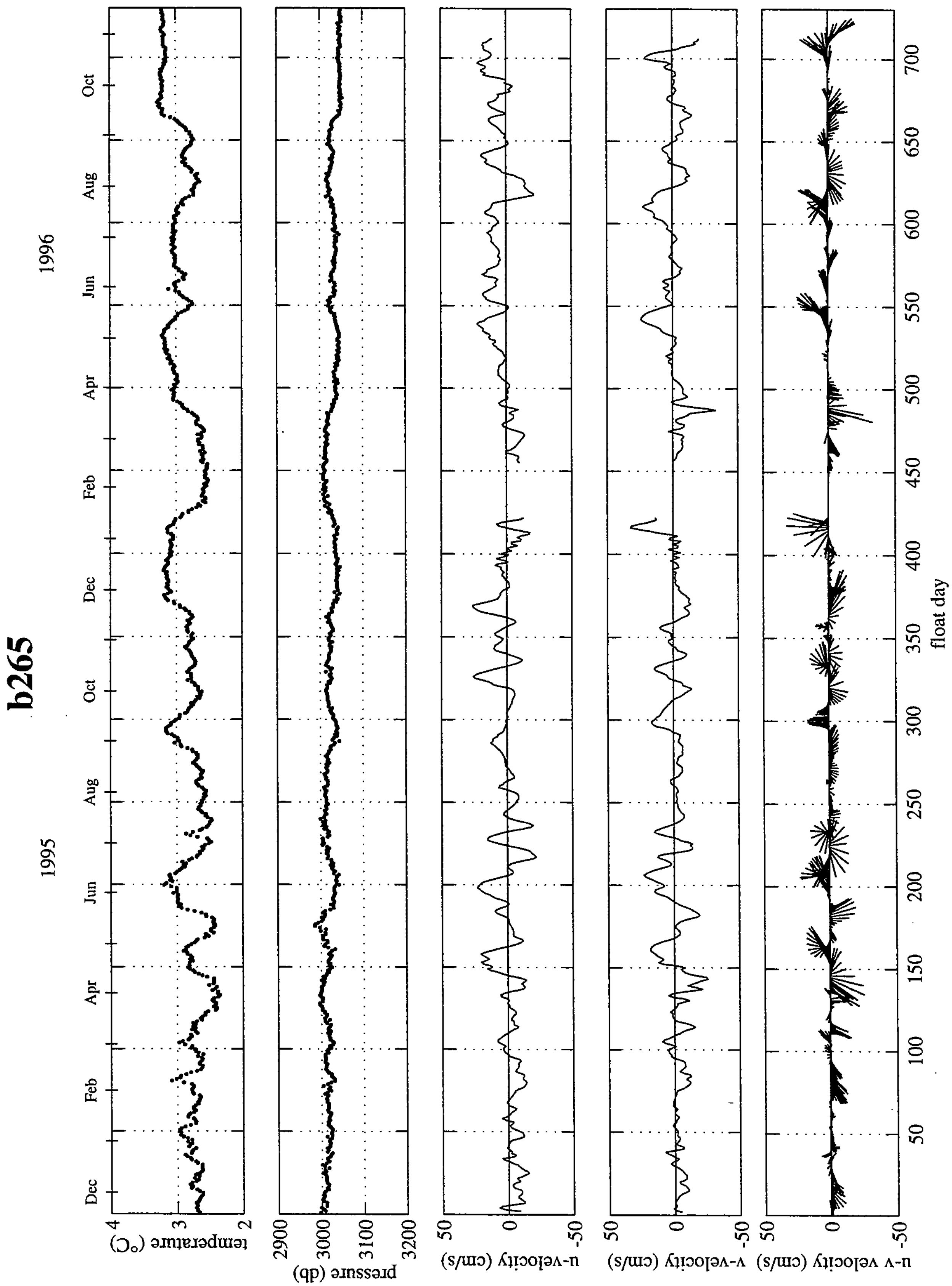

45°N
42°N
39°N
36°N
33°N
Latitude
77°W
72°W
67°W
62°W
57°W
52°W
47°W
Longitude
950105
950224
950415
950604
L
S

b264

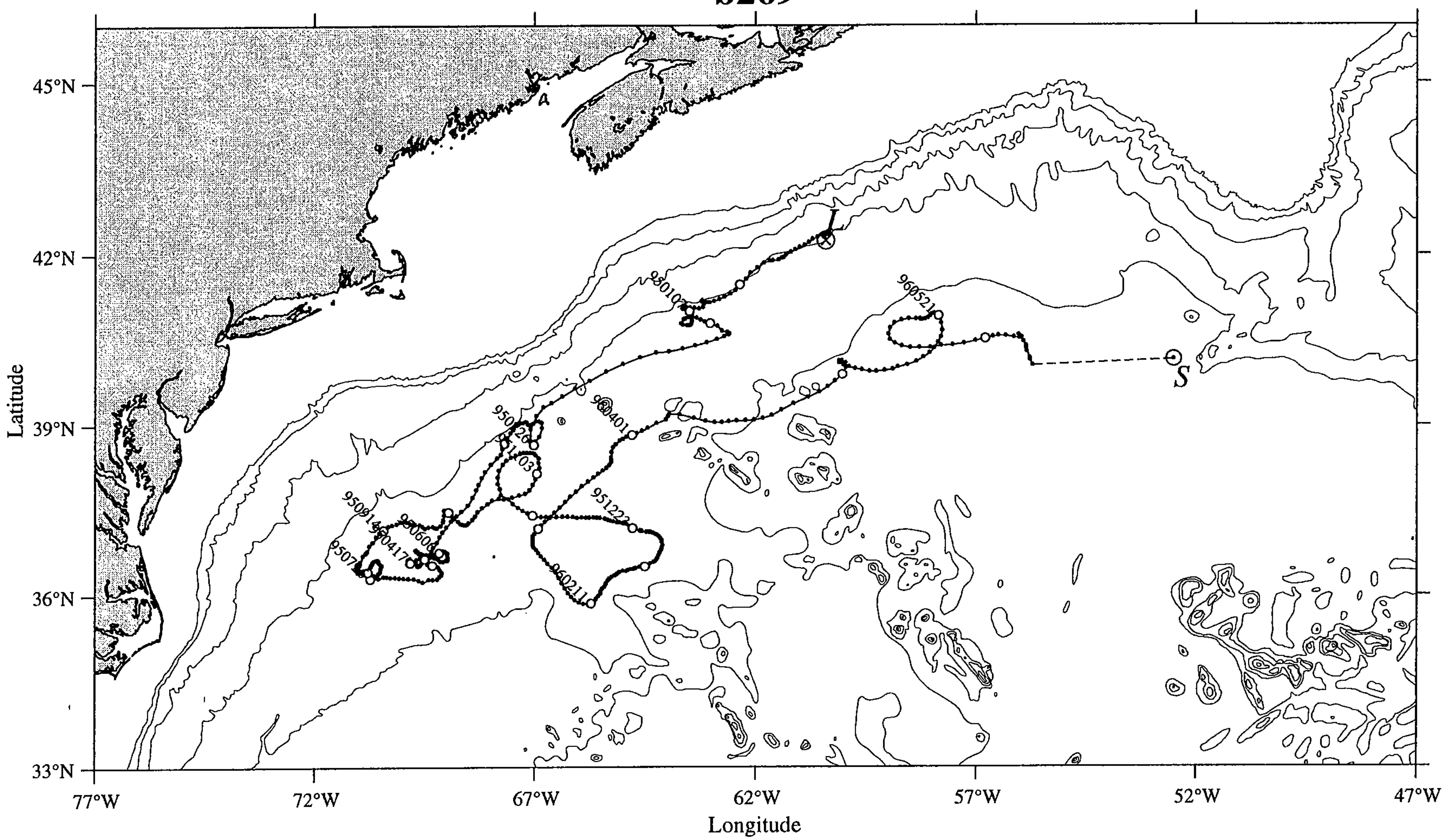


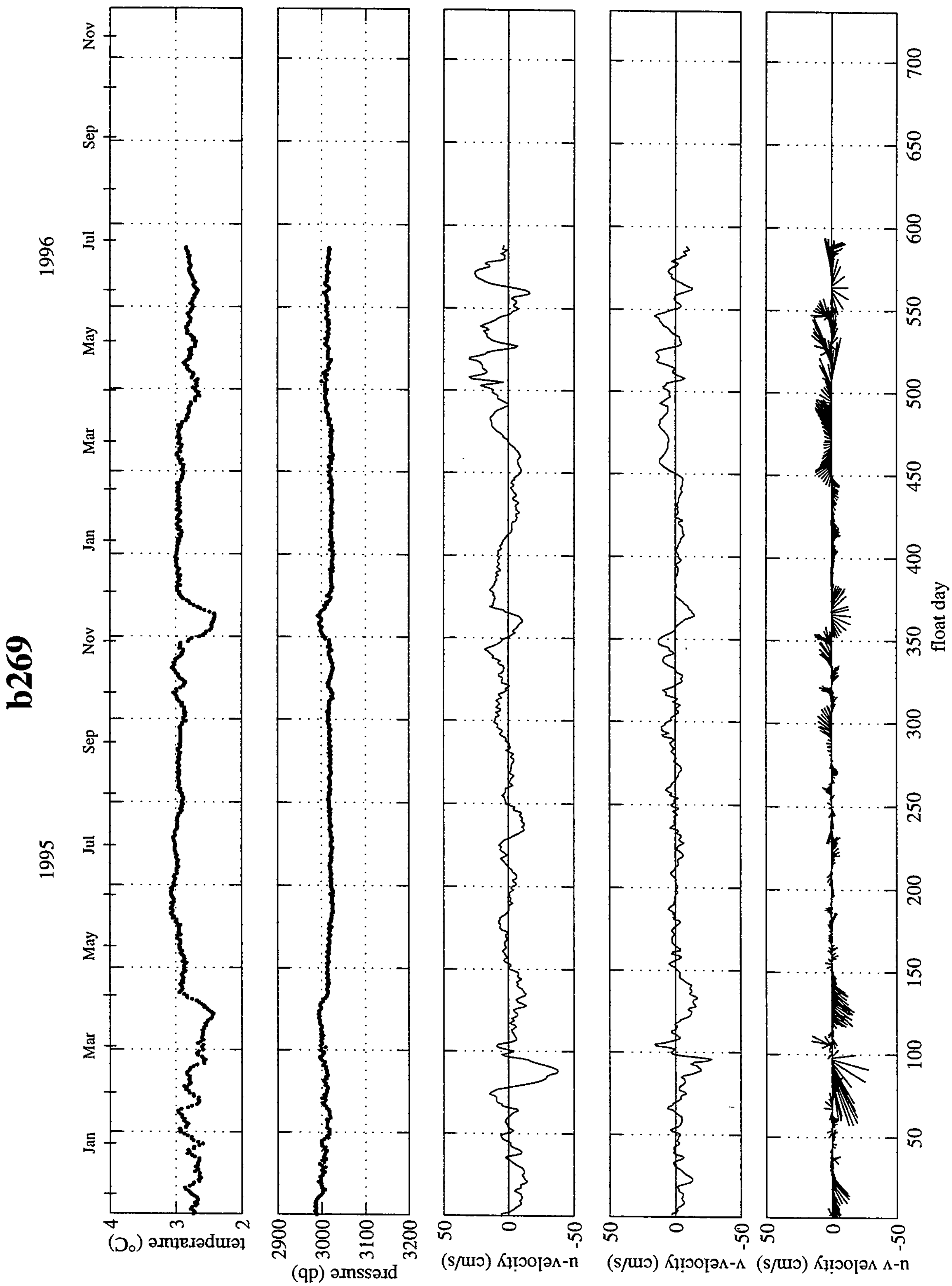
1995
1996
Jan
Mar
May
Jul
Sep
Nov
Jan
Mar
May
Jul
Sep
Nov
temperature (°C)
4
3
2
pressure (db)
2900
3000
3100
3200
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
50
100
150
200
250
300
350
400
450
500
550
600
650
700
float day


b265
Latitude
Longitude
45°N
42°N
39°N
36°N
33°N
77°W
72°W
67°W
62°W
57°W
52°W
47°W
S
961017
960828
950106
960331
960520
950225
950416


b265
1995
1996
Dec
Feb
Apr
Jun
Aug
Oct
Dec
Feb
Apr
Jun
Aug
Oct
temperature (°C)
pressure (db)
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
float day

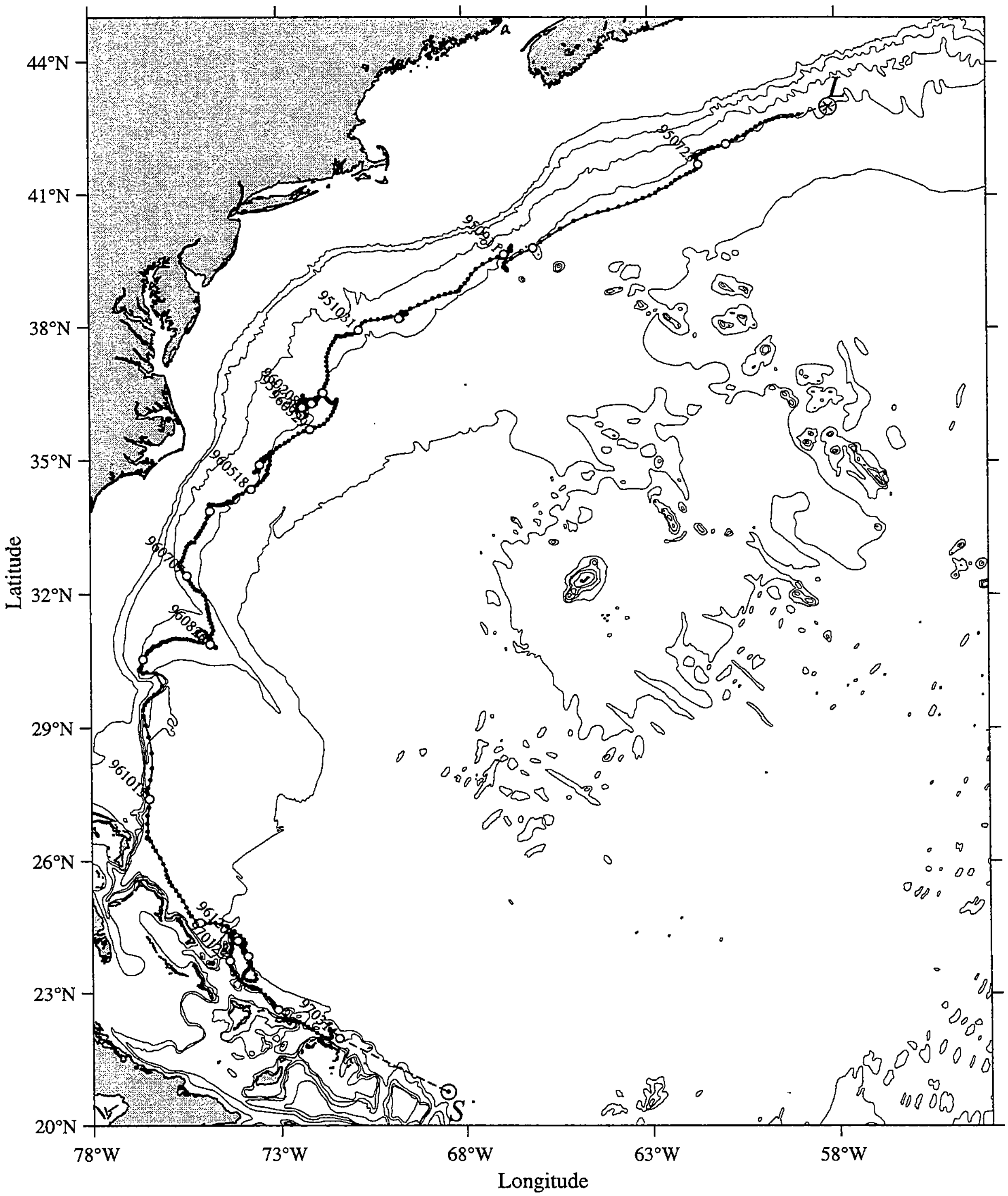
b269


45°N
42°N
39°N
36°N
33°N
Latitude
77°W
72°W
67°W
62°W
57°W
52°W
47°W
Longitude
960521
951222
960211
S

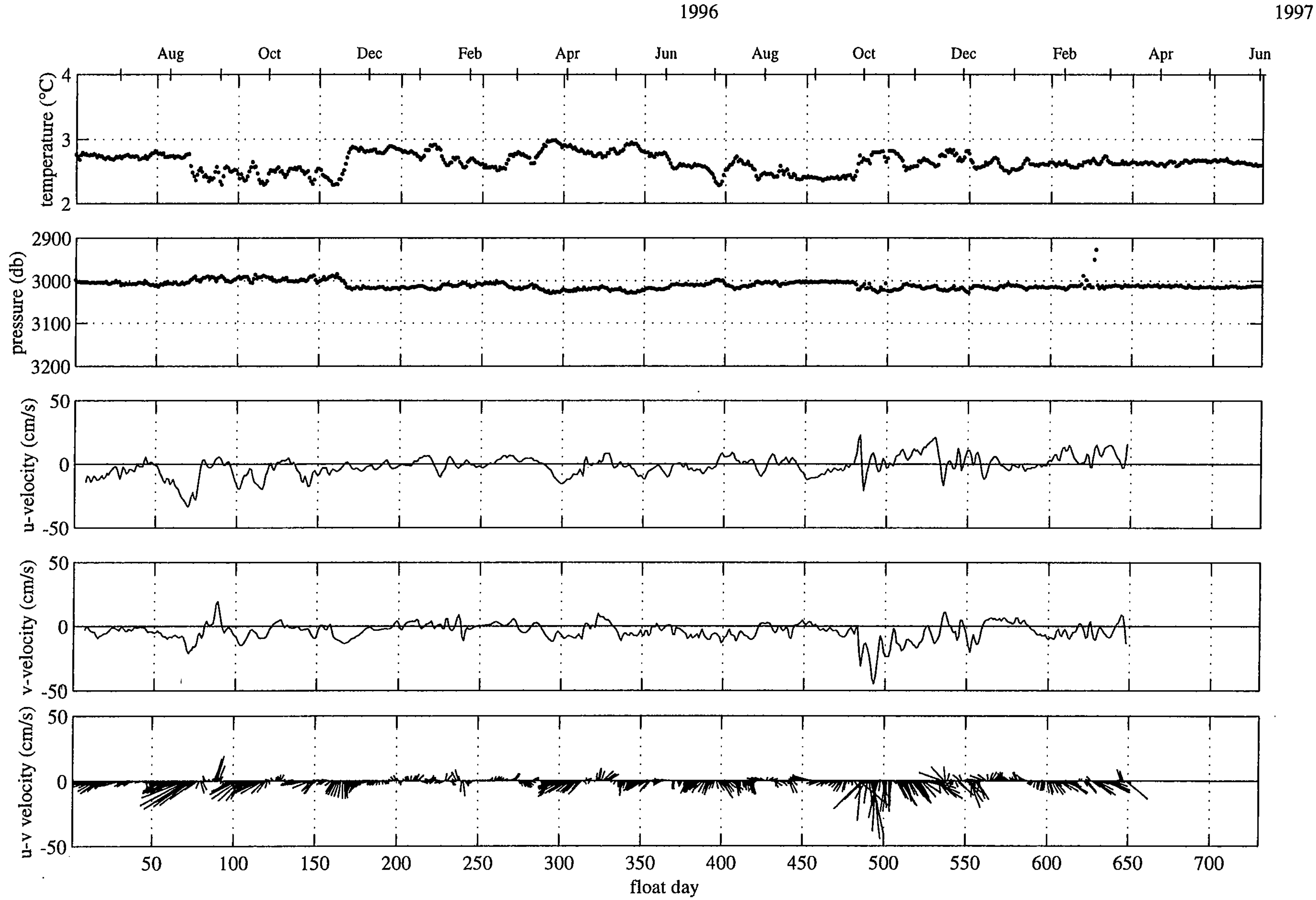


b269
1995
1996
Jan
Mar
May
Jul
Sep
Nov
temperature (°C)
pressure (db)
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
float day

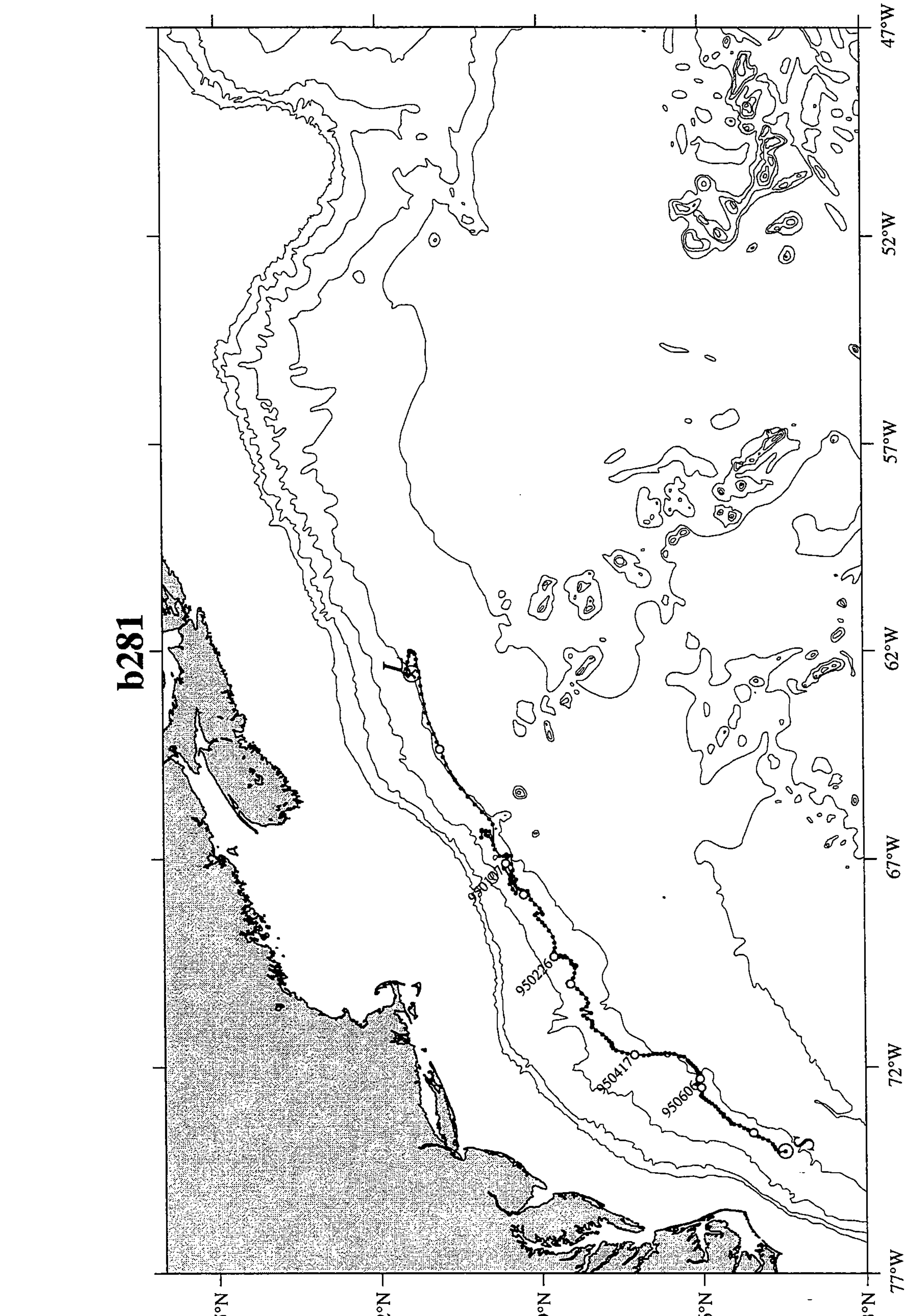
b280


44°N
41°N
38°N
35°N
32°N
29°N
26°N
23°N
20°N
Latitude
78°W
73°W
68°W
63°W
58°W
Longitude
L
S
960518

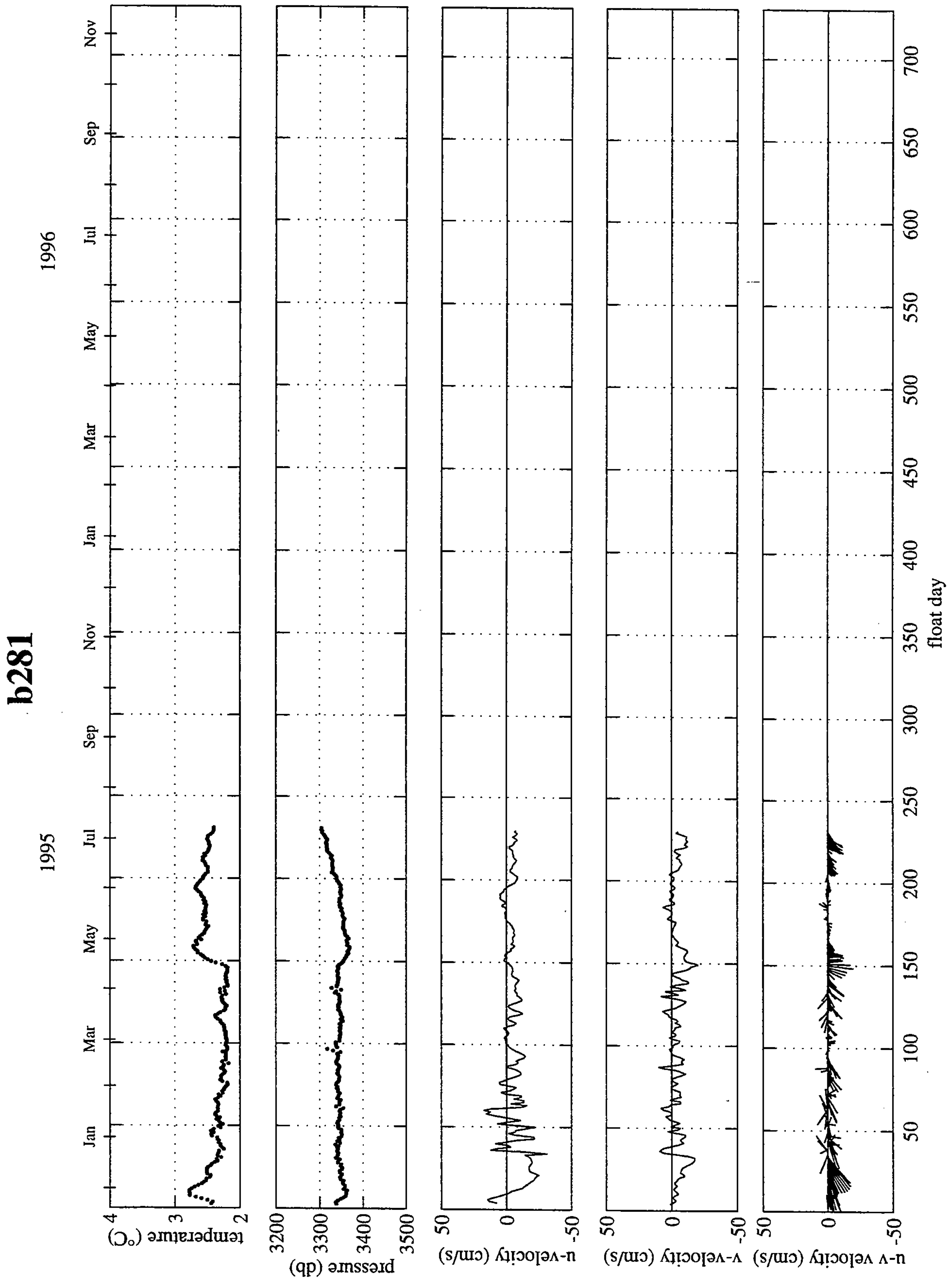
b280


1996
1997
Aug
Oct
Dec
Feb
Apr
Jun
Aug
Oct
Dec
Feb
Apr
Jun
temperature (°C)
4
3
2
pressure (db)
2900
3000
3100
3200
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
50
100
150
200
250
300
350
400
450
500
550
600
650
700
float day

b281



45°N
42°N
39°N
36°N
33°N
Latitude
77°W
72°W
67°W
62°W
57°W
52°W
47°W
Longitude
950226
950417


b281
1995
1996
Jan
Mar
May
Jul
Sep
Nov
temperature (°C)
pressure (db)
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
float day
50
100
150
200
250
300
350
400
450
500
550
600
650
700

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16. Abstract (Limit: 200 words)

This is the final data report of all RAFOS (acoustically tracked) float data collected during the 1994-1997 Boundary Current Experiment (BOUNCE) study of the Deep Western Boundary Current (DWBC) in the North Atlantic Ocean. The overall objective of the program was to obtain the first comprehensive description of the North Atlantic DWBC's variability over a large path segment from Cape Hatteras to the Grand Banks. The experiment was comprised of CTD, tracer, and RAFOS float observations to achieve both Eulerian and Lagrangian descriptions of the DWBC. The three main objectives of the Lagrangian float study were 1) to determine fluid parcel pathways in the DWBC and identify regions of exchange with the interior, 2) to estimate the mean speed and variability of fluid parcels at two different levels in the DWBC, and 3) to study the kinematics and potential vorticity dynamics of fluid parcels in the DWBC at the Gulf Stream cross-over point near Cape Hatteras. Thirty floats were deployed: 15 were designed to be isopycnal floats, and 15 were isobaric floats. The isopycnal floats were ballasted for the σ_t = 27.73 density surface (approximately 800 decibars (db)) to seed the Upper Labrador Sea Water. The isobaric floats were ballasted for 3000 db to seed the Nordic Seas overflow water.

17. Document Analysis a. Descriptors

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North Atlantic Circulation
Floats

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

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