NOAA Technical Memorandum NMFS

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THE PHYSICAL OCEANOGRAPHY OFF THE CENTRAL CALIFORNIA COAST DURING FEBRUARY-MARCH AND MAY-JUNE 1992: A SUMMARY OF CTD DATA FROM PELAGIC YOUNG-OF-THE-YEAR ROCKFISH SURVEYS

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Science Center

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ABSTRACT

Hydrographic conditions during a 12-day period from late February through early March 1992 in the area bounded by Cypress Pt. (36°35′N) and Bodega Bay (38°19′N), California, from the coast to approximately 315 km offshore are summarized in a series of horizontal maps and vertical transects. In addition, hydrographic conditions, during three periods of approximately 10 days each from mid-May through mid-June 1992 in the coastal ocean bounded by Cypress Pt. (36°35′N) and Pt. Reyes, California (38°10′N), and from the coast to about 75 km offshore, are also summarized. A total of 136 conductivity-temperature-depth (CTD) casts were obtained during the DAVID STARR JORDAN Cruise DSJ9203, while 277 standard casts plus 51 additional casts were taken during Cruise DSJ9206 over the course of three consecutive sweeps of the region. Data products contained in this report include (1) a master list of CTD stations during each cruise; (2) surface meteorological time series from the region's four National Data Buoy Center (NDBC) meteorological buoys; (3) horizontal maps of temperature, salinity, and density (sigma-theta [σ_θ]) at depths of 2 m, 10 m, 30 m, 100 m, 200 m, 300 m, and 500 m; (4) temperature, salinity and σ_θ along four cross-shelf vertical transects; and (5) dynamic height topography (0/500 m) in the survey region.

INTRODUCTION

In recent years, attempts have been made to integrate the studies of fisheries biologists investigating the recruitment problem (Sissenwine 1984; Rothschild 1986) with those of physical oceanographers studying coastal circulation patterns. This development is due to the widely held perception that spatial and temporal variations in hydrodynamics, on a wide range of scales, have a direct influence on the retention of young-of-the-year in areas favorable for their growth and survival (e.g., Sinclair 1988). This realization has fostered the development of interdisciplinary studies in the area of recruitment fisheries oceanography (Wooster 1988; Office of Oceanic and Atmospheric Research 1989[1]).

Along the central California coast, rockfishes of the genus *Sebastes* are a major component of the west coast groundfish fishery (Gunderson and Sample 1980), with annual landings from 1984-92 averaging 39,463 MT yr^{-1} (Pacific Fishery Management Council 1993). Current management of the rockfish fishery is based largely on analyses of catch-at-age data. Such models are usually poorly constrained in the absence of other information (Deriso et al. 1985). Auxiliary data, such as an independent recruitment index, have the potential to assist in the management of this fishery.

Research conducted at the Southwest Fisheries Science Center's (SWFSC) Tiburon Laboratory since 1983 has attempted to develop a recruitment index for rockfish. Data obtained during annual juvenile rockfish surveys have provided information regarding distributional and abundance patterns of young-of-the-year pelagic juveniles in the area between Monterey Bay and Pt. Reyes (latitude 36°30'-38°10'N) (Wyllie Echeverria et al. 1990). Results of this research show a complex pattern in the spatial distribution of pre-recruits of a variety of commercially significant species (e.g., widow rockfish, *S. entomelas;* chilipepper, *S. goodei;* yellowtail rockfish, *S. flavidus;* bocaccio, *S. paucispinis;* and shortbelly rockfish, *S. jordani*). Moreover, extreme interannual fluctuations in abundance have occurred, with combined stratified mean catches per haul ranging from 0.3-55.0 juvenile rockfish/tow (Adams 1992[2]).

Field studies have shown that the survey region is hydrodynamically complex. The California Current provides the backdrop for large-scale, seasonal circulation patterns (Hickey 1979). Coastal upwelling also occurs regionally for most of the year, especially from April to September (Huyer 1983). On the mesoscale (10-100 km), irregularities in the coastline interact with the wind stress field (Kelly 1985), resulting in turbulent jets, eddies and upwelling filaments, all of which are common features along the central California coast (Mooers and Robinson 1984; Flament et al. 1985; Njoku et al. 1985; Rosenfeld et al. 1994). Moreover, wind-driven fluctuations in coastal flow (Chelton et al. 1988) and freshwater discharge from San Francisco Bay (Applied Environmental Science Division[3]) add further complexity to the circulation regime.

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[1] Office of Oceanic and Atmospheric Research. 1989. Program Development Plan for the NOAA Recruitment Fisheries Oceanography Program. National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Washington, D.C., 28 p.

[2] Adams, P. B. (editor). 1992. Progress in rockfish recruitment studies. SWFSC Admin. Rep. T-92-01, 63 p., unpublished report.

[3] Applied Environmental Science Division. Final Report, California Seabird Ecology Study. Volume II, Satellite Data Analysis. Science Applications International Corporation, Monterey, California.

Realizing that a basic description of the physical environment is necessary to better understand the distribution and abundance of young-of-the-year rockfish, collection of conductivity-temperature-depth (CTD) data was initiated in 1987 as part of the Tiburon Laboratory's annual juvenile rockfish surveys. In the spirit of Wooster (1988), the staff of the Tiburon Laboratory along with the SWFSC Pacific Fisheries Environmental Group subsequently developed an interest in analyzing the CTD data as a part of the recruitment fisheries oceanography study. Ultimately, it is our goal to determine and forecast the manner in which rockfish year-class strength is affected by variations in the physical environment.

This report summarizes results obtained from the CTD data collected in 1992. Due to the large quantity of data analyzed and the extensive array of results presented herein, we make no attempt to provide detailed interpretations of our findings. Reports covering the juvenile rockfish surveys of 1988 (DSJ8804 and DSJ8806) and 1989 (DSJ8904) have been published (Schwing et al. 1990, Johnson et al. 1992). A companion volume (Schwing and Ralston 1990[4]) contains individual traces of temperature, salinity, and sigma-t (σ_t, a representation of water density) plotted against depth for each CTD cast conducted in 1989. Additional reports covering late larval and juvenile rockfish surveys during 1993 and 1994 are currently in preparation. Further scientific analysis of these data, and their linkages to fisheries recruitment, will be compiled in future peer-reviewed scientific publications (Schwing et al. 1991).

MATERIALS AND METHODS

Meteorological Data

Meteorological data were obtained for selected sites in the juvenile rockfish survey region. These sites include the region's four National Data Buoy Center (NDBC) moored buoys: 46013 (Bodega Bay; 38.2°N, 123.3°W), 46026 (Farallones; 37.8°N, 122.7°W), 46012 (Half Moon Bay; 37.4°N, 122.7°W) and 46042 (Monterey Bay; 36.8°N, 122.4°W) (Appendix 3). Daily averages of several surface meteorological parameters, including air and sea temperature, east and north wind components, and barometric pressure, were calculated for the time period that includes the 1992 late larval and juvenile rockfish surveys. Plots of several of these products are provided in this report to aid in the interpretation of results and to suggest possible atmospheric-oceanic interactions (Appendix 4).

Juvenile Rockfish Survey Design

Annual cruises aboard the NOAA Research Vessel (R/V) DAVID STARR JORDAN (DSJ) began in 1983 and have been conducted during late spring (April-June), a time when most pelagic-stage juvenile rockfishes are identifiable as to species, but prior to their settling to nearshore and benthic habitats. Throughout this time, a standard haul consisted of a 15-minute nighttime tow of a large midwater trawl set to a depth of 30 m. Additional tows were made at other depths (i.e., 10 and 100 m) as allowed by constraints imposed by time and bottom bathymetry.

In 1986, the sampling design was altered to permit three consecutive "sweeps" through a study area bounded by Cypress Pt. (36°35'N) and Pt. Reyes (38°10'N), California, and from the coast to about 75 km offshore. Trawls are now conducted at five or six stations along a transect each night; each sweep is composed of seven transects. Starting in 1987, a CTD cast was conducted at each trawl station occupied. In addition, daytime activities were restructured to permit sampling of a new grid of standard

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[4] Schwing, F. B., and S. Ralston. 1990. Individual cast data for CTD stations conducted during cruise DSJ8904 (May 14-June 13, 1989). SWFSC Admin. Rep. PFEG-91-01, 7 p. + figs., unpublished report.

CTD stations (Appendix 3)). Standard CTD stations were specific locations where CTD casts were scheduled and repeated for each sweep of each cruise. CTD cast locations that were only specific to a particular sweep during a cruise were considered as additional CTD stations. Although each sweep typically lasts approximately 10 days (7 nights of scheduled work plus 3 nights of additional discretionary sampling), adverse weather conditions can extend the completion date of a sweep. Logistical constraints can also restrict the number of casts completed. Discretionary sampling typically was focused on specific bathymetric features, such as Cordell Bank or Pioneer Canyon, or devoted to the intense study of oceanic features or processes that may be key to successful recruitment. CTD casts conducted during discretionary sampling were considered additional stations and not included in the grid of standard CTD stations. During DSJ9206, a series of additional CTD stations were done extending offshore from the standard CTD station transect lines off Pescadero during Sweep 1 and off Pt. Reyes and Pescadero during Sweep 3 (Appendix 7).

Late Larval Rockfish Survey Design

In late February to early March of 1992, a 5 m^2 Methot Isaacs Kidd (MIK) net (Methot 1986) was used to sample late larval stage rockfish in the area bounded by Cypress Pt. (36°35'N) and Bodega Bay (38°19'N) from the coast to approximately 315 km offshore (Appendix 3). Oblique tows were conducted at night to an average depth of 70 meters with a tow duration of approximately 25 minutes. Deeper tows were occasionally done to an average depth of 140 meters with a tow duration of approximately 40 minutes. At each tow station, a CTD cast was done with additional CTDs dropped during the day throughout the survey area (Appendix 3).

Collection of CTD Data at Sea

All CTD data from the 1992 rockfish surveys presented in this report were collected with a Sea-Bird Electronics, Inc., SEACAT-SBE-19 profiler[5]. This particular unit was rated to a depth of 600 m and contained 64K of memory. Four data channels were used to record pressure (0.05% of full scale range [50-5,000 psia]), temperature (0.01 °C from -5 to +35 °C), and conductivity (0.001 S/m from 0 to 7 S/m) at a baud rate of 9,600. The profiler has been recalibrated annually by Sea-Bird Electronics, Inc., since its purchase in 1987.

During deployment, the vessel was brought to a dead stop and the profiler was attached to a hydrographic winch cable. The profiler was then switched on and suspended underwater at the surface for a period of two minutes to allow the conductivity and temperature sensors to equilibrate. The rate of descent was 45 m/minute to a depth 10 m off the bottom if water depths were less than 500 m. Otherwise the profiler was lowered to a maximum depth of 500 m. Only data collected on the downcast were ultimately preserved for analysis. During the cast, certain collection information was recorded on data sheets, including (1) the date, (2) time, (3) a profiler-assigned cast number, (4) a cruise-specific consecutive index number, (5) the trawl station number (when appropriate), (6) latitude, (7) longitude, (8) bucket temperature (temperature [°C] of a bucket sample of surface water using a mercury thermometer; bucket temperatures were not taken during DSJ9203), and (9) bottom depth in meters. Position fixes were obtained using the Global Positioning System (GPS). All collection information recorded on the data sheets was eventually entered into a data file (####.LST where #### is the four-digit cruise number) on a personal computer.

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[5] Sea-Bird Electronics, Inc., 1808 - 136th Place NE, Bellevue, Washington 98005 USA. Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

Due to the limited storage capacity of the SEACAT-SBE-19 profiler (64K), data collected from a short series of casts (usually no more than 5-7) were periodically uploaded to a personal computer on board the vessel. During this step, each cast was stored as a separate file and named using the convention C####&&&.HEX, where #### is the four-digit cruise number and &&& is the three-digit consecutive index number. After uploading, the profiler was reinitialized and the *.HEX files on the personal computer were backed up on diskette.

An additional source of hydrographic data was the vessel's Sea-Bird Electronics, Inc., thermosalinometer (TS) unit, which provided a continuous data stream of surface temperature and salinity. These data were stored on diskette and transferred to a personal computer on board the vessel for further processing, analysis, and comparison with and verification of CTD observations. Position fixes for the TS unit were based on GPS.

Data Processing

The first step in data processing was to convert the uploaded CTD *.HEX files to ASCII files. This was accomplished using programs supplied by Sea-Bird Electronics, Inc., in SEASOFT menu-driven release version 4.011[6]. All *.HEX files were batch-processed through the SEASOFT modules DATCNV, FILTER, ALIGNCTD, LOOPEDIT, BINAVG, and DERIVE (see Appendix 1 for data settings) and output as ASCII files using SAS macros (SAS 1988[7]). All data were averaged into two-meter depth bins and subsequently transferred to a SUN file server.

Each CTD ASCII file was manually edited to remove large outliers (i.e., data spikes) in salinity and/or density, which sometimes occurred near the surface and at the thermocline. Comparisons were made between CTD temperature and salinity from the two-meter depth bin, TS temperature and salinity, and bucket temperature at each CTD station using a simple regression to check for data outliers and any blatant calibration problems (Appendix 5). Because bucket temperatures were not available for DSJ9203, only CTD and TS temperatures were compared.

Processed hydrographic data were summarized, by sweep, in a series of horizontal maps and vertical transects, and are presented in this report. Although additional CTD casts were completed during DSJ9206, only casts from the grid of standard CTD stations and only those casts which provided a relatively continuous sampling track within a specific sweep were included in the data summary for the horizontal maps (Appendix 6). This was done in an attempt to generate a relatively synoptic representation of each individual sweep and to spatially standardize hydrographic comparisons among sweeps. In generating the vertical profiles, however, additional CTD casts extending offshore of the standard stations were included during Sweep 1 off Pescadero and during Sweep 3 off Pt. Reyes and Pescadero. The offshore extent of these additional casts is shown in Appendix 7. In addition, vertical sections from the Farallones transect were less synoptic than those from the Pt. Reyes, Pescadero, and Davenport lines, because casts were combined over a 2- to 3-day time period instead of the more usual 24-hour period. All contouring of CTD data for horizontal maps and vertical transects was done using SURFER Version 4.0

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[6] CTD Data Acquisition software, SEASOFT Version 4.011, July 1992, Sea-Bird Electronics, Inc., 1808 - 1336th Place NE, Bellevue, Washington 98005, USA.

[7] Sas Institutes Inc., SAS Circle Box 8000, Cary, North Carolina 27512. Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

graphics software[8], which estimates values throughout a specified region based on the available data. Kriging was selected as the optimal interpolation method used for the algorithm grid (cf., Cressie 1991). Horizontal contours were post-processed using FREELANCE Version 4.0[9], while vertical contours were post-processed using CANVAS Version 3.5 graphics software[10].

The TS raw data were edited to provide a nearly continuous sampling track for DSJ9203 and for each sweep of DSJ9206. However, there appeared to be a consistent offset between salinity recorded by the TS and salinity recorded by the CTD at 2-m depth for each cruise (Appendix 5). Because the CTD was calibrated annually by the manufacturer, and because problems occurred with the TS unit during DSJ9203, TS salinity values were considered less reliable and, when necessary, were adjusted using the regression comparison with the CTD. That is, $TS' = C_0 + C_1(TS)$, where TS' is the adjusted thermosalinometer value (either temperature or salinity), TS is the unadjusted value, and C_0 and C_1 are the intercept and slope parameters of the regression of two-meter CTD data (temperature or salinity) on the corresponding TS value. The TS' data were then contoured using SURFER and post-processed with FREELANCE.

Dynamic height was calculated for stations occupied during DSJ9206. CTD casts that did not reach a maximum depth of 480 m were not included in this analysis. Of the remaining casts, many did not quite reach 500 m and the data were projected to this level. This was accomplished by a linear extrapolation of temperature and salinity values, based on the last 20 m of *in situ* data. For example, if the recorded data only went to 494 m, a line was fit to the data over the range 474-494 m. The fitted line was then used to extrapolate values to a depth of 500 m. All the data were then spline interpolated at 2-m intervals to remove any missing values, which were very few. Next, specific volume anomalies were calculated using the IES-80 density algorithm (UNESCO 1983). Finally, dynamic height anomalies were calculated by numerically integrating specific volumes over the appropriate depth range; for the 0 db surface this integration was over all depth levels. The dynamic height topography of the 0 db surface relative to the 500 db surface was contoured using SURFER for Windows, Version 5.01[11], after the data were gridded by Kriging. A 0.01 contour interval was chosen for all three sweeps.

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[8] SURFER Version 4, Golden Software, Inc., 809 14th Street, Golden, Colorado 80402. Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

[9] Lotus FREELANCE Graphics for DOS, Lotus Development Corporation, 55 Cambridge Parkway, Cambridge, Massachusetts 02142. Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

[10] CANVAS Version 3.5, Deneva Systems, Inc., 3305 NW 74th Avenue, Miami, Florida 33122. Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

[11] SURFER for Windows, Version 5.01, Golden Software, Inc., 809 14th St., Golden, Colorado 80401-1866. Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

To date, no attempt has been made to calculate vertical sections of geostrophic velocity because the large number of shallow stations during these surveys necessitates the extrapolation of isopycnals onto the shelf, a procedure that is subject to great uncertainty. In addition, recent studies (Berryman 1989; Tisch 1990) suggest that geostrophic velocities calculated for stations spaced closer than the internal Rossby radius often feature alternating current bands of reversed flow that are thought to be associated with inertial currents. The Rossby radius in the study area is about 10-20 km, which is similar to the typical station spacing in the surveys. We are investigating methods to determine geostrophic velocity from dynamic heights, based on closely spaced shallow water stations, before attempting to calculate the geostrophic velocity field during these surveys.

RESULTS

Data Products

Below are a few brief comments on each of the data products contained in this report in the order that they appear.

Appendix 1: Data Settings for SEASOFT Modules

Listed are the settings for the SEASOFT modules DATCNV, FILTER, ALIGNCTD, LOOPEDIT, BINAVG, and DERIVE used to process the CTD *.hex files.

Appendix 2: Lists of CTD Stations Summarized from Cruises DSJ9203 and DSJ9206

The station lists include, from left to right, CTD cast number (only acceptable casts included), date, local military time, latitude and longitude (degrees, minutes), and station bottom depth. Cruise DSJ9203 (February 23-March 6) includes 136 stations (casts 25-165). Cruise DSJ9206, Sweep 1 (May 11-May 18) includes 94 standard stations (casts 1-96) plus 11 additional stations for use in vertical transects (casts 98-110), Sweep 2 (May 19-May 26) includes 89 standard stations (casts 111-200) and Sweep 3 (June 4-13) includes 94 standard stations (casts 286-388) plus 40 additional stations (casts 395-434).

Appendix 3: CTD Stations and Bathymetric Maps of Survey Region with Locations of the NDBC Buoys

The locations of the CTD stations for DSJ9203 and the standard CTD stations for DSJ9206 along with the locations of the NDBC buoys, the place names, and the bottom bathymetry of the survey areas are shown.

Appendix 4: Meteorological Time Series

Meteorological time series are presented for the four NDBC buoys as described above. The first figure in this section summarizes the daily average wind speed (m/s) and direction (relative to true north) at these stations, in stick vector form, for the period January through June, 1992. Vectors point in the direction toward which the wind was blowing; an arrow pointing toward the top of the page represents a northward-directed wind.

The following figures show scalar time series of sea surface temperature, or SST (°C); air temperature (°C); the north-south component of wind speed (m/s), a crude indicator of upwelling-favorable wind; and barometric pressure (millibars) at each meteorological station for the first 180 calendar days of 1992. A positive wind value denotes a northward-directed wind component. The survey periods for DSJ9203 and DSJ9206 (divided by sweep) are shaded in all time series plots.

Appendix 5: Regression Comparisons of CTD, TS, and Bucket

The plots presented show comparisons between CTD, TS, and bucket temperatures and CTD and TS salinities. The solid lines represent the lines of equality in order to show how the different data varied from each other. The regression statistics for each comparison were as follows:

DSJ9203: CTD temperature versus TS temperature,
CTDtemp. = TStemp. x 0.9437 + 0.7114
$R^2 = 0.9817$
CTD salinity versus TS salinity,
CTDsal. = TSsal. x 0.9535 + 1.9322
$R^2 = 0.9820$

DSJ9206: CTD temperature versus TS temperature,
CTDtemp. = TStemp. x 0.9902 + 0.0516
$R^2 = 0.9904$
CTD temperature versus bucket temperature,
CTDtemp. = buckettemp. x 0.9713 + 0.3282
$R^2 = 0.9742$
TS temperature versus bucket temperature,
TStemp. = buckettemp. x 0.9866 + 0.2041
$R^2 = 0.9912$
CTD salinity versus TS salinity,
CTDsal. = TSsal. x 0.8435 + 5.9802
$R^2 = 0.7353$

Appendix 6: Horizontal Maps of CTD and TS

a) Maps of TS temperature and salinity

Maps of surface temperature (°C) and salinity (ppt) obtained from the vessel's TS continuous profiling unit are presented for DSJ9203 and for each sweep of DSJ9206. The TS maps are located in front of the corresponding horizontal map for the CTD at 2 m. The contour intervals are 0.2 °C for temperature and 0.1 ppt for salinity. They are included to provide some verification of hydrographic spatial patterns inferred from the CTD data. The 2-m CTD and surface TS maps display good quantitative agreement, despite the fact that the data used to generate each were collected by different instrument packages.

b) Maps of CTD temperature, salinity and density, by depth

Horizontal maps of temperature (°C), salinity (ppt) and density (sigma-theta [σ_θ]) (kg/m^3) are presented at depths of 2 m, 10 m, 30 m, 100 m, 200 m, 300 m, and 500 m. The locations of the CTD casts used in generating the horizontal contours are shown by a + symbol. The 2-m depth was selected to represent surface conditions. The 10-m depth was selected to represent near-surface conditions because (1) the quality of data in the first few meters below the surface was not acceptable at some stations, and (2) localized, ephemeral conditions, related to factors such as strong surface heating and low vertical mixing that did not reflect the realistic, longer-term conditions of the region, were generally confined to the upper 5 m (refer to footnote 4). The 30-m depth was contoured to coincide with the standard midwater trawl depth during the surveys. The contour intervals are 0.2 °C, 0.1 ppt and 0.1 kg/m^3, respectively for depths 2-100 m. For the 200-500 m depths, the contour intervals were lowered to 0.1 °C, 0.02 ppt, and 0.02 kg/m^3.

Appendix 7: Vertical Transects

Vertical transects of temperature, salinity and density are presented for four cross-shelf transects off Pt. Reyes, Half Moon Bay, Pescadero, and Davenport for DSJ9203 and off Pt. Reyes, the Farallones, Pescadero, and Davenport for DSJ9206. Station maps denote the location of each transect and the offshore extent of stations used to generate plots for each sweep. The contour intervals are 0.5 °C for temperature, 0.1 ppt for salinity, and 0.4 kg/m^3 for density. In some of the plots, the labels on the 8°C temperature contour, the 34 ppt salinity contour, and the 26 kg/m^3 density contour have been enlarged for use as reference points.

Appendix 8: Maps of Dynamic Height Topography

Horizontal maps of dynamic height (0/500 m) are presented for the three sweeps of DSJ9206 only. Locations of the CTD casts that were used in generating the contour plots are shown by a + symbol. All contour intervals are 0.01 dynamic meters.

Synopsis of Hydrographic Conditions

The most distinctive characteristic of the hydrographic conditions during the 1992 surveys was the anomalously warm and fresh water found throughout the water column. Compared to the mean for all May-June sweeps for the period 1987-92 (n=18), temperatures in 1992 were generally 1-4°C higher near-surface and 0.2-0.9°C higher at 200 m; salinities were generally 0.0-0.8 ppt lower near-surface and 0-0.1 ppt lower at 200 m. Vertical sections of temperature and salinity anomalies for DSJ9206, Sweep 1 off Davenport, relative to 1987-92, illustrate this (Figure 1). These anomalies are nearly all 1-3 standard deviations outside the means. They are reflected in a comparison of the temperature/salinity relationships from 1992 to the 1987-92 mean as well (Figure 2). Daily SST and salinity measurements at Farallon Island showed similar discrepancies relative to 1991, a year that featured above normal upwelling rates based on wind and ocean conditions (Table 1).

Table 1.--Means, by two month periods, of daily-averaged wind speed and wind stress components from NDBC Buoy 46042, and daily measurements of SST and salinity at Farallon Island, comparing 1991 and 1992. Alongshore stress is oriented positive toward 320°N; cross-shore stress is positive toward 50°N. A Lasker event is defined as a four-day period when the wind speed was less than 5 m/s (five days of wind < 5 m/s is two Lasker events, etc.) (Pauly 1989).

		JAN-FEB	MAR-APR	MAY-JUN
WIND SPEED (m/s)	1991	4.6336	7.3021	6.5384
	1992	5.7580	6.3343	5.1620
ALONGSHORE STRESS (Pa)	1991	-0.0215	-0.0456	-0.0653
	1992	0.0012	-0.0370	-0.0435
CROSS-SHORE STRESS (Pa)	1991	-0.0081	-0.0023	-0.0051
	1992	-0.0029	0.0001	0.0028
LASKER EVENTS	1991	8	0	3
	1992	6	0	10
FARALLONES SST (°C)	1991	11.5414	11.1474	10.2288
	1992	13.2356	13.9607	13.0661
FARALLONES SALINITY (ppt)	1991	33.4339	33.3667	33.8504
	1992	33.2580	33.1982	33.4716

The warm, fresh conditions observed throughout the survey were a continuation of those occurring off central California and the west coast for several months previous, a manifestation of the 1991-93 El Niño-Southern Oscillation (ENSO). A comparison to the CalCOFI spring climatology (Lynn 1967; Lynn et al. 1982) suggests the most likely mechanism for explaining the 1992 hydrography is the movement of California Current water toward the coast from the west. Simpson (1984, 1992) shows that a similar onshore transport occurred during the 1940-41 and 1982-83 ENSO events.

Anomalous regional meteorological forcing also may have contributed to the unusual hydrographic conditions. Averaged May-June 1992 wind stress at NDBC Buoy 46042, off Monterey Bay, was predominantly alongshore to the south, typical for this time of year, but 33% lower than during the identical period in 1991 (Table 1). The corresponding mean wind speed for May-June 1992 was 20% weaker than in 1991. There was a noticeable increase in Lasker events in 1992 as well, an indicator of weaker wind forcing. A Lasker event is defined as a four-day period when the wind speed was less than 5 m/s (five days of wind < 5 m/s is two Lasker events, etc.) (Pauly 1989). Despite these differences, the amplitude and timing of upwelling-favorable and relaxation wind events was quite similar in 1991 and 1992 (Figure 3).

Superimposed on the ENSO-like conditions of 1992 was the typical mesoscale variability seen in previous years. Upwelling centers off Pt. Reyes and Davenport were evident again, as defined by cooler, more saline water. However, the strength of the front separating upwelled and California Current water was weaker than usual, although the frontal position was similar to other years. The region was imbedded with eddy-like features as well. The repeated surveys display considerable temporal variability, presumably related to synoptic wind variations, consistent with non-ENSO years (Schwing et al. 1991).

A smaller base of historical CTD data from February and March makes it more difficult to compare the DSJ9203 results to conditions in previous years off central California. However, a comparison to CalCOFI February and March climatologies (1950-62) (Lynn 1967) suggests that early 1992 was warmer than normal, but similar in salinity to the long-term mean. One interesting difference between February-March and May-June was the presence of a strong temperature and salinity front in the upper 50 m, extending offshore at about 38°N then south along 124°W. The higher temperature and salinity inshore of this front is characteristic of the Davidson Current. The alongshore front in probably enhanced because of an onshore relocation of the California Current relative to the norm, a pattern noted in May-June 1992 as well. As discussed previously, wind during the early 1992 survey was very similar to 1991.

ACKNOWLEDGEMENTS

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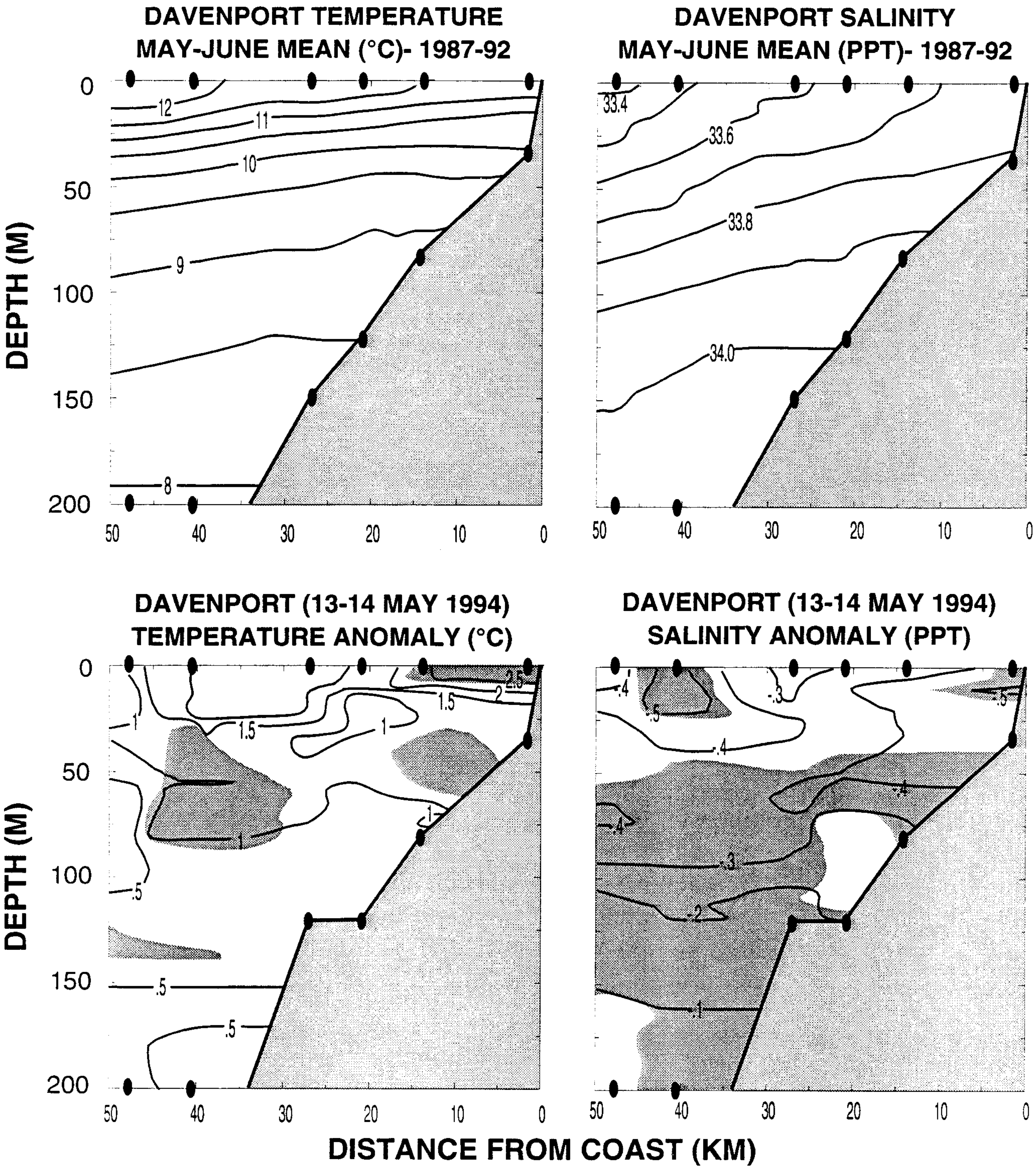


Figure 2. Vertical sections of temperature and salinity off Davenport. Upper figures show mean temperature and salinity fields from all May-June sweeps during 1987-92 (n=18). Lower figures show temperature and salinity anomalies during cruise DSJ-9206, sweep 1, relative to the 1987-92 means. Shaded areas denote locations where anomalies were greater than two standard deviations from mean.

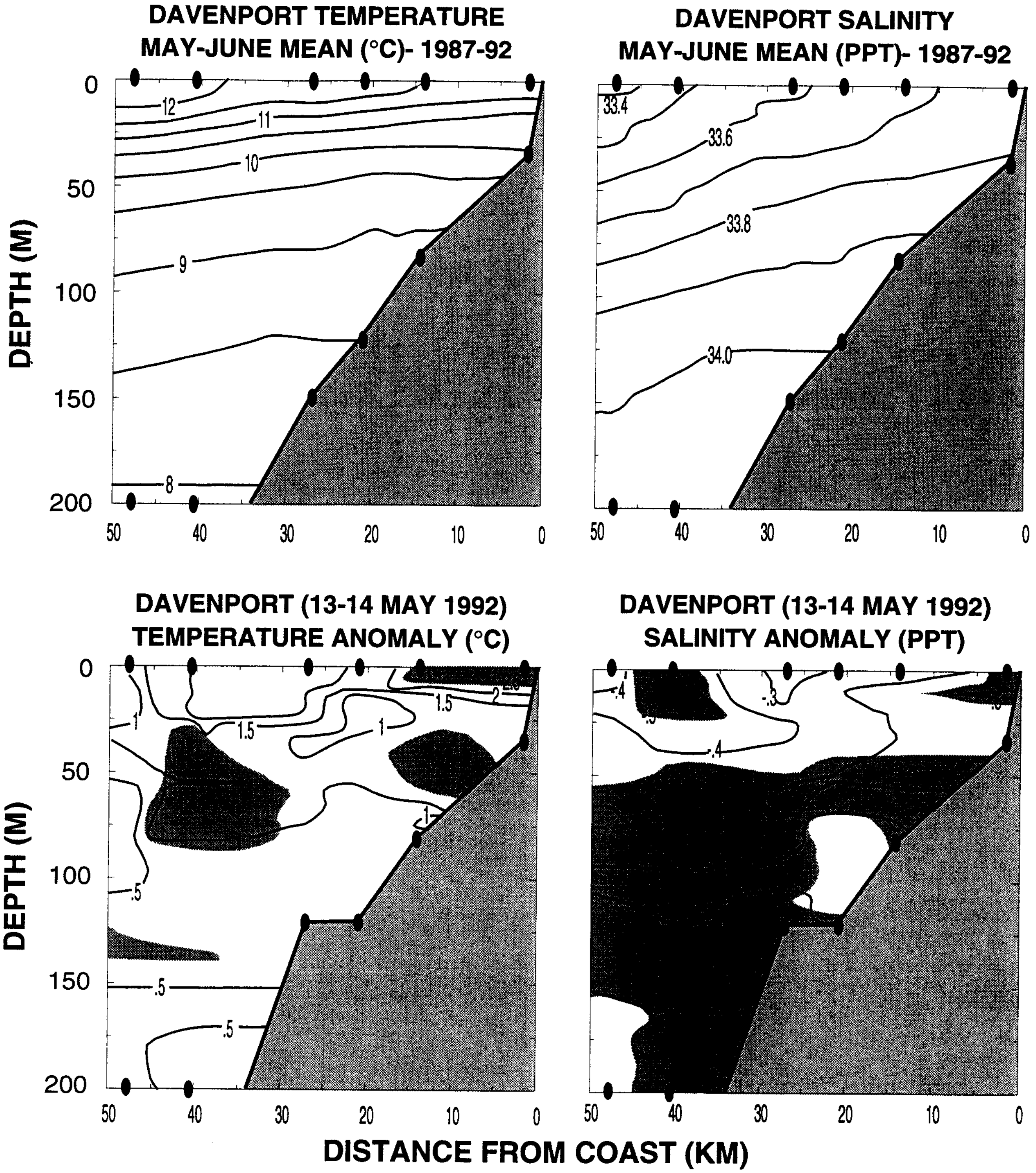


Figure 1. Vertical sections of temperature and salinity off Davenport. Upper figures show mean temperature and salinity fields from all May-June sweeps during 1987-92 (n=18). Lower figures show temperature and salinity anomalies during cruise DSJ-9206, sweep 1, relative to the 1987-92 means. Shaded areas denote locations where anomalies were greater than two standard deviations from mean.

CORRECTED VERSION OF PAGE 12

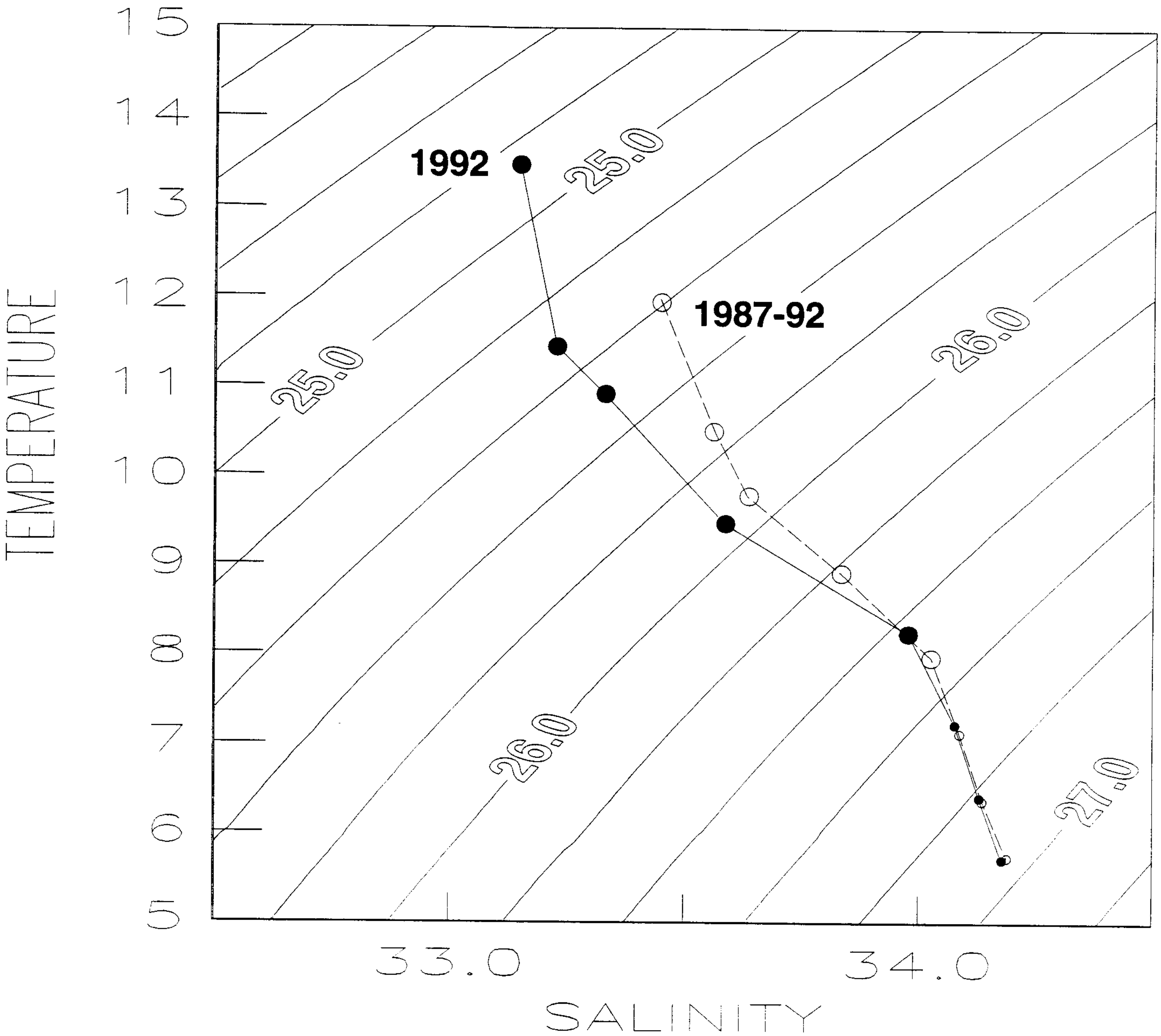


Figure 2. Temperature/salinity relationship at 5, 30, 50, 100, 200, 300, 400, and 500 m, comparing means from May-June 1987-92 surveys to the DSJ9206 survey. Means for depths greater than 200 m derived from 1991-92 data only.

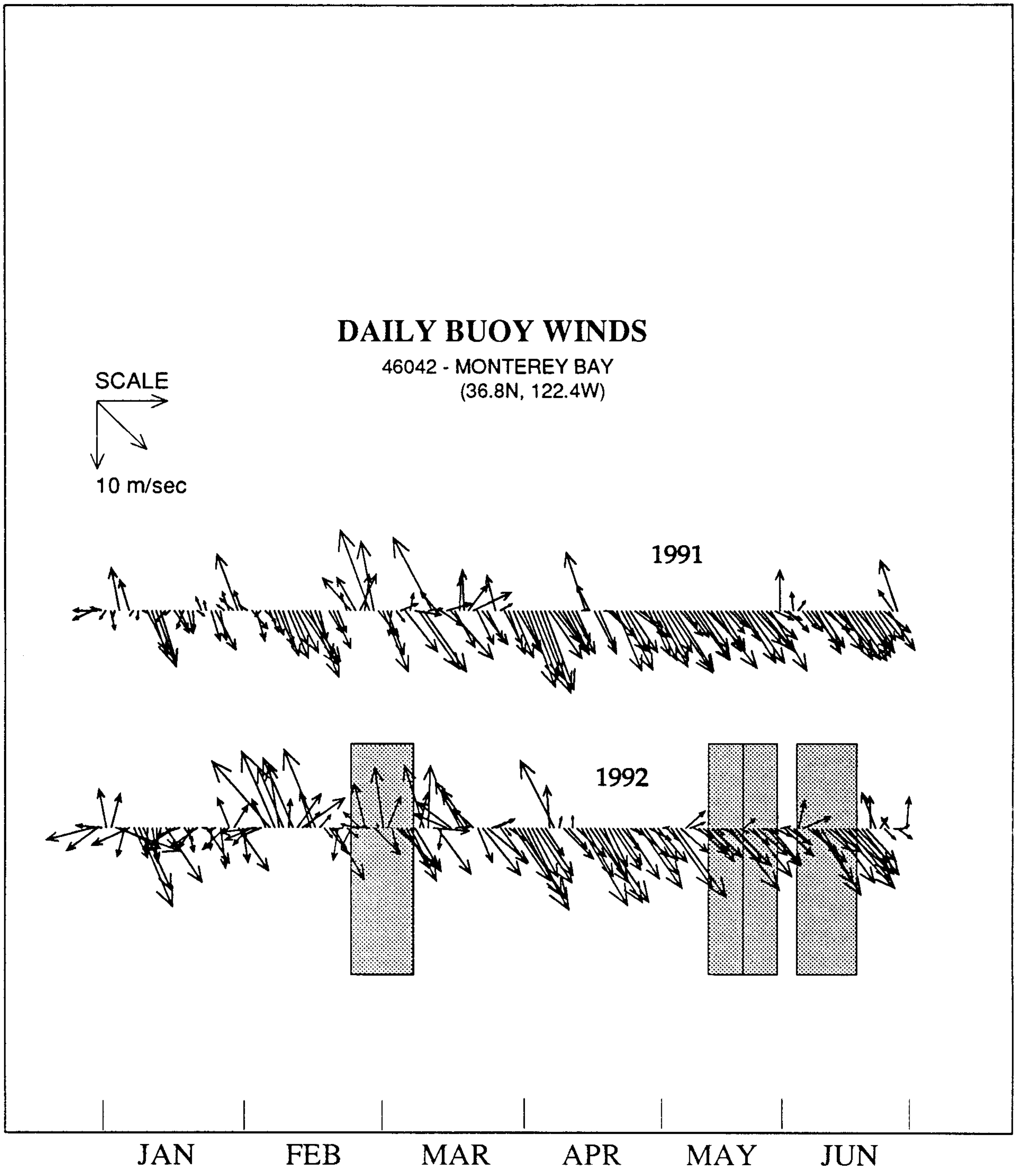


Figure 3. Comparison of daily-averaged wind vectors at NDBC buoy 46042 (Monterey Bay) from January-June 1991 and 1992. Northward-directed winds are denoted by vectors pointing to top of page. Shading denotes periods of groundfish surveys DSJ9203 and DSJ9206.

APPENDIX 1: DATA SETTINGS FOR SEASOFT MODULES

Module #1: DATCNV

```
Raw Data File =                                 depends on cast
Configuration File [.CON] =                     depends on cast
Input File [.CON, .DAT, .HEX] Path =          C:\SEASOFT\HEXDATA\
Output Data File Path =                       C:\SEASOFT\CNVDATA\
Data Conversion Format =                      ASCII
Data Conversion Variables =                   <Press Enter to Modify>
      Conversion Units                        Metric
      Column # 0 =                            scan number
      Column # 1 =                            pressure, decibars
      Column # 2 =                            depth, salt water, meters
      Column # 3 =                            temperature, deg C
      Column # 4 =                            conductivity, S/m
      Column # 5 =                            none
        etc.
Number of Scans to Skip Over =                0
```

Module #2: FILTER

```
Input Data File =                               depends on cast
Input File [.CNV] Path =                      C:\SEASOFT\CNVDATA\
Output Data File Path =                       C:\SEASOFT\CNVDATA\
Low Pass Filter A, Time Constant (sec) =            0.500000
Low Pass Filter B, Time Constant (sec) =            0.000000
Variables to Filter =                         <Press Enter to Modify>
      Filter Type, scan number =                          None
      Filter Type, pressure, decibars =                   None
      Filter Type, depth, salt water, meters =            None
      Filter Type, temperature, deg C =                   None
      Filter Type, conductivity, S/m =              Low Pass Filter A
      Filter Type, salinity, PSS-78 [PSU]                 None
      Filter Type, density, sigma-theta, kg^3 =           None
      Filter Type, =                                      None
```

Module #3: ALIGNCTD

```
Input Data File =                               depends on cast
Input File [.CNV] Path =                      C:\SEASOFT\CNVDATA\
Output Data File Path =                       C:\SEASOFT\CNVDATA\
Number of Seconds to Advance Cond Relative to Pres =    0.000000
Number of Seconds to Advance Temp Relative to Pres =    0.500000
Number of Seconds to Advance Oxygen Relative to Pres =  0.000000
```

Module #4: LOOPEDIT

```
Input Data File =                           depends on cast
Input File [.CNV] Path =                   C:\SEASOFT\CNVDATA\
Output Data File Path =                    C:\SEASOFT\CNVDATA\
Minimum CTD Velocity (m/s) =               0.200000
Exclude Scans Marked Bad in LOOPEDIT =     Yes
```

Module #5: BINAVG

```
Input Data File =                           depends on cast
Input File [.CNV] Path =                   C:\SEASOFT\CNVDATA\
Output Data File Path =                    C:\SEASOFT\CNVDATA\
Bin Type =                                 Depth Bins
Bin Size =                                 2.000000
Include Number of Scans Per Bin =          Yes
Exclude Scans Markded Bad in BINAVG =      Yes
Number of Scans to Skip Over =             0
Surface Bin Setup Parameters =             <Press Enter to Modify>
      Include Surface Bin =                No
      Surface Bin Minimum Value =          0.000000
      Surface Bin Maximum Value =          0.000000
```

Module #6: DERIVE

```
Input Data File =                           depends on cast
Input File [.CNV] Path =                   C:\SEASOFT\CNVDATA\
Output Data File Path =                    C:\SEASOFT\CNVDATA\
Input Variables =                          <Press Enter to Display>
      Name 0 =                             scan number
      Name 1 =                             pressure, decibars
      Name 2 =                             depth, salt water, meters
      Name 3 =                             temperature, deg C
      Name 4 =                             conductivity, S/m
      Name 5 =                             salinity, PSS-78 [PSU]
      Name 6 =                             density, sigma-theta, kg/m^3
Variables to be Derived =                  <Press Enter to Modify>
      Column # 0 =                         salinity, PSS-78 [PSU]
      Column # 1 =                         density, sigma-theta, kg/m^3
      Column # 2 =                         none
      Column # 3 =                         none
        etc.
Variable Coefficients =                    <Press Enter to Modify>
      Oxygen Coefficients =                <Press Enter to Modify>
            since there is no oxygen meter enter all zeros
      Time Window Size for doc/dt (seconds) =                    2.00000
      Time Window Size for Descent Rate and Accel (seconds) = 2.00000
```

 Directory of C:\SEASOFT

```
.            <DIR>        07-13-92   1:10p
..           <DIR>        07-13-92   1:10p
DSJ9206      <DIR>        07-13-92   1:10p
CNVDATA      <DIR>        09-22-92   7:59a
HEXDATA      <DIR>        09-29-92   9:35a
ASCIIDAT     <DIR>        10-01-92   9:53a
PROGRAMS     <DIR>        10-05-92  11:57a
LSTFILES     <DIR>        10-05-92   1:04p
CTD_CONV BAT         706  10-14-92   1:29p
ROSSUM   EXE       53984  07-09-92   3:06p
SINSTALL BAT         722  07-09-92   4:26p
OXFIT    EXE       21200  12-06-89  12:16p
ALIGNCTD EXE      279944  07-09-92   2:00p
ASCIIOUT EXE      273372  07-09-92   3:05p
BINAVG   EXE      283538  07-09-92   1:58p
CELLTM   EXE      274480  07-09-92   2:54p
CFGTOCON EXE       51440  07-08-92   5:01p
DATCNV   EXE      339876  07-09-92   1:49p
DERIVE   EXE      294598  07-09-92   1:54p
FILTER   EXE      284730  07-09-92   2:56p
LOOPEDIT EXE      274546  07-09-92   1:57p
SEACON   EXE      233414  07-09-92   1:46p
SEAPLOT  EXE      432438  07-09-92   2:48p
SEASAVE  EXE      440816  07-09-92   3:04p
SECTION  EXE      321240  07-09-92   1:51p
SPLIT    EXE      274862  07-09-92   1:55p
STRIP    EXE      276332  07-09-92   1:52p
TRANS    EXE      265132  07-09-92   1:50p
PHFIT    EXE       29834  06-11-92   3:08p
OXSAT    EXE       21086  11-18-85  12:33p
SEAPLOT  CFG          58  10-01-92   9:11a
SEAPLOT  PLT         564  10-01-92   9:11a
TERM19   EXE      281672  07-09-92   8:58a
TMODEM   EXE       30544  06-18-92   5:21p
WILDEDIT EXE      296056  07-09-92   1:56p
SBE$ERR  DAT        3118  03-09-92   4:46p
SBE$HELP DAT        3722  03-09-92   4:49p
SBE$MSG  DAT       12468  03-09-92   4:46p
SEACON   HLP        8719  07-08-92   4:25p
SEASAVE  HLP       18624  07-08-92   4:25p
TERM     HLP       24702  06-02-92   1:25p
GPIB     COM       35627  03-09-92   4:46p
MODE     COM        2345  03-09-92   4:46p
DATCNV   CFG         230  10-15-92   1:23p
FILTER   CFG         198  10-15-92   1:24p
BINAVG   CFG          97  10-15-92   1:24p
LOOPEDIT CFG          66  10-15-92   1:24p
ALIGNCTD CFG          77  10-15-92   1:24p
DERIVE   CFG         251  10-15-92   1:26p
DIRECT   LST           0  10-19-92   2:57p
MODULES  DOC       11098  10-19-92   2:57p
```

APPENDIX 2.1: LIST OF CTD STATIONS SUMMARIZED FROM CRUISE DSJ9203

DSJ9203

CAST	DATE	TIME	LATITUDE	LONGITUDE	DEPTH(M)
25	23FEB92	1857	36 42.6	121 55.2	92
26	23FEB92	2107	36 48.6	122 0.6	455
27	24FEB92	0042	36 48.0	122 10.8	228
28	24FEB92	0204	36 46.8	122 19.8	1600
29	24FEB92	0451	36 46.2	122 31.2	2200
30	24FEB92	0707	36 52.8	122 10.2	1000
31	24FEB92	1118	36 52.8	122 22.2	1150
32	24FEB92	1253	36 52.8	122 34.8	1650
33	24FEB92	1426	36 52.8	122 47.4	2600
34	24FEB92	1556	36 52.8	122 59.4	2745
35	24FEB92	1856	36 46.8	122 40.2	2070
36	24FEB92	2109	36 46.8	122 51.0	2800
37	24FEB92	2326	36 47.4	123 1.2	3050
38	25FEB92	0035	36 46.8	123 10.2	2745
39	25FEB92	0250	36 48.0	123 21.0	3200
40	25FEB92	0403	36 46.8	123 30.0	3515
41	25FEB92	0635	36 52.8	123 11.4	3111
42	25FEB92	0805	36 52.8	123 24.0	3200
43	25FEB92	0925	36 52.8	123 36.0	3600
44	25FEB92	0925	36 52.8	123 36.0	3600
46	25FEB92	1053	36 52.8	123 48.6	3650
47	25FEB92	1219	36 52.8	124 1.2	3660
48	25FEB92	1356	36 52.8	124 13.2	4034
49	25FEB92	1420	36 52.8	124 13.2	4034
50	25FEB92	1548	36 52.8	124 25.8	3960
51	25FEB92	1654	36 52.8	124 33.0	4200
53	25FEB92	2054	36 48.0	124 19.8	3500
54	25FEB92	2207	36 46.8	124 10.2	3400
55	26FEB92	0009	36 48.0	124 0.0	2300
56	26FEB92	0243	36 46.2	123 48.6	3660
57	26FEB92	0352	36 46.8	123 40.2	3660
58	26FEB92	0713	37 9.0	123 24.0	3200
59	26FEB92	0834	37 9.0	123 36.6	2800
60	26FEB92	0954	37 9.0	123 48.6	3200
61	26FEB92	1120	37 9.6	124 1.2	3700
62	26FEB92	1241	37 9.0	124 13.2	2750
64	26FEB92	1547	36 58.8	124 30.0	5300
65	26FEB92	1706	36 58.8	124 18.6	3600
66	26FEB92	1839	36 58.8	124 6.0	3650
67	26FEB92	2040	37 0.0	123 54.6	3700
68	26FEB92	2150	36 59.4	123 45.6	3700
69	26FEB92	2353	37 0.0	123 35.4	3100
70	27FEB92	0228	36 59.4	123 24.6	2550
71	27FEB92	0510	36 59.4	123 17.4	2250
73	27FEB92	0913	37 9.0	122 59.4	610
74	27FEB92	1040	37 9.0	122 47.4	400
75	27FEB92	1040	37 9.0	122 47.4	400
76	27FEB92	1210	37 9.0	122 34.8	102
77	27FEB92	1210	37 9.0	122 34.8	102
79	27FEB92	1334	37 8.4	122 23.4	32
80	27FEB92	1834	36 58.8	122 17.4	84
81	27FEB92	2031	36 58.8	122 27.0	200
82	27FEB92	2206	36 58.8	122 35.4	485
83	28FEB92	0009	36 58.8	122 46.8	915
84	28FEB92	0239	36 58.8	122 56.4	1800
85	28FEB92	0515	36 59.4	123 4.8	2745
86	28FEB92	1803	37 16.8	122 39.6	98
87	28FEB92	2024	37 16.8	122 50.4	220

CAST	DATE	TIME	LATITUDE	LONGITUDE	DEPTH(M)
88	28FEB92	2157	37 16.8	122 59.4	545
89	29FEB92	0005	37 16.2	123 10.2	2200
90	29FEB92	0221	37 16.8	123 19.8	2380
91	29FEB92	0456	37 17.4	123 30.6	2825
92	29FEB92	0746	37 22.2	123 42.6	3425
93	29FEB92	0918	37 22.8	123 54.6	3700
94	29FEB92	1042	37 22.2	124 7.2	3750
95	29FEB92	1204	37 22.2	124 19.8	4000
96	29FEB92	1335	37 19.8	124 31.2	4000
97	29FEB92	1454	37 22.8	124 42.0	4000
98	29FEB92	1620	37 22.2	124 54.0	4023
99	29FEB92	1820	37 16.8	124 39.0	4130
100	29FEB92	2021	37 16.2	124 49.2	4000
101	29FEB92	2133	37 16.8	124 58.8	4000
102	29FEB92	2336	37 16.2	125 10.2	4000
103	01MAR92	0051	37 16.8	125 19.2	3660
104	01MAR92	0254	37 16.2	125 30.6	3660
105	01MAR92	0413	37 16.8	125 39.0	4390
106	01MAR92	0610	37 16.2	125 51.6	4390
107	01MAR92	0755	37 22.2	125 45.0	4200
108	01MAR92	0925	37 22.2	125 32.4	3700
109	01MAR92	1049	37 22.2	125 20.4	4300
110	01MAR92	1234	37 22.2	125 7.8	4200
111	01MAR92	1820	37 16.8	124 28.8	4100
112	01MAR92	2017	37 17.4	124 18.6	4000
113	01MAR92	2132	37 16.8	124 9.0	3700
114	01MAR92	2338	37 16.8	123 58.2	3700
115	02MAR92	0152	37 16.2	123 48.0	3600
116	02MAR92	0327	37 16.8	123 22.2	3800
117	02MAR92	0609	37 22.2	123 30.0	2560
118	02MAR92	0803	37 22.8	123 18.0	1650
119	02MAR92	0933	37 22.8	123 5.4	820
120	02MAR92	1104	37 22.2	122 53.4	204
121	02MAR92	1228	37 22.8	122 42.0	87
122	02MAR92	1817	36 58.8	122 35.4	439
123	02MAR92	2032	37 6.0	122 41.4	295
124	02MAR92	2202	37 11.4	122 45.0	201
125	02MAR92	2349	37 16.2	122 50.4	210
126	03MAR92	0211	37 22.8	122 54.0	278
127	03MAR92	0344	37 28.2	122 58.2	290
128	03MAR92	1136	38 0.0	123 40.8	2600
129	03MAR92	1312	37 58.8	123 28.8	373
130	03MAR92	1441	38 0.0	123 16.8	113
131	03MAR92	1547	38 0.0	123 6.6	73
132	03MAR92	1702	38 0.0	123 4.2	73
133	03MAR92	1822	38 10.2	123 10.2	91
134	03MAR92	2044	38 10.8	123 21.6	182
135	03MAR92	2204	38 10.2	123 30.0	475
136	03MAR92	2357	38 10.2	123 41.4	1900
137	04MAR92	0206	38 10.2	123 51.6	3300
138	04MAR92	0341	38 10.2	124 18.0	3500
139	04MAR92	0650	38 0.0	123 54.6	3400
140	04MAR92	0755	38 0.0	124 54.0	3400
141	04MAR92	0922	38 0.0	124 18.0	3700
142	04MAR92	1047	38 0.0	124 30.6	3900
143	04MAR92	1220	37 59.4	124 43.2	5000
144	04MAR92	1351	38 0.0	124 55.2	4000
145	04MAR92	1351	38 0.0	124 55.2	4000
146	04MAR92	1530	38 0.0	125 7.8	4000
147	04MAR92	1530	38 0.0	125 7.8	4000
148	04MAR92	1705	38 10.2	125 10.2	3100
149	04MAR92	1825	38 10.2	125 0.0	3880

CAST	DATE	TIME	LATITUDE	LONGITUDE	DEPTH(M)
150	04MAR92	2051	38 9.0	124 50.4	3800
151	04MAR92	2208	38 10.2	124 40.2	3800
152	05MAR92	0015	38 9.0	124 30.6	3500
153	05MAR92	0139	38 10.2	124 20.4	3600
154	05MAR92	0352	38 9.0	124 10.2	3600
155	05MAR92	0728	37 49.8	124 37.2	4000
156	05MAR92	0851	37 51.0	124 25.2	4000
157	05MAR92	1020	37 49.8	124 12.6	3550
158	05MAR92	1145	37 49.8	124 0.0	3650
159	05MAR92	1315	37 49.8	123 48.0	3600
160	05MAR92	1443	37 49.8	123 35.4	2400
161	05MAR92	1830	37 52.8	123 30.0	1460
162	05MAR92	2109	37 50.4	123 21.6	140
163	05MAR92	2240	37 45.6	123 16.8	550
164	06MAR92	0025	37 44.4	123 7.8	76
165	06MAR92	0124	37 39.0	123 4.2	185

APPENDIX 2.2: LIST OF CTD STATIONS SUMMARIZED FROM CRUISE DSJ9206

DSJ9206 SWEEP 1

CAST	DATE	TIME	LATITUDE	LONGITUDE	DEPTH(M)
1	11MAY92	1504	36 44.4	122 2.6	MISSING
2	11MAY92	1623	36 49.0	122 5.0	106
3	11MAY92	1704	36 54.0	122 4.5	61
4	11MAY92	1756	36 53.0	121 56.0	77
5	11MAY92	2033	36 50.1	121 59.7	93
6	11MAY92	2334	36 45.8	121 51.6	62
7	12MAY92	0025	36 44.2	121 58.7	290
8	12MAY92	0235	36 41.9	121 53.3	78
9	12MAY92	0311	36 38.3	121 51.6	38
10	12MAY92	0500	36 38.5	121 58.5	80
11	12MAY92	0736	36 33.7	122 28.5	2745
12	12MAY92	0855	36 33.4	122 40.9	2800
13	12MAY92	1015	36 39.9	122 47.2	2800
14	12MAY92	1130	36 43.1	122 50.0	2500
15	12MAY92	1250	36 46.3	122 40.6	2070
16	12MAY92	1400	36 39.9	122 34.5	2377
17	12MAY92	1514	36 46.2	122 28.4	2195
18	12MAY92	1623	36 40.2	122 22.2	2000
19	12MAY92	1734	36 46.2	122 16.2	630
20	12MAY92	1847	36 40.2	122 10.2	1150
21	12MAY92	2014	36 35.4	122 10.2	1600
22	13MAY92	0045	36 35.0	122 4.3	800
23	13MAY92	0131	36 39.0	122 3.1	840
24	13MAY92	0327	36 43.0	122 8.5	1470
25	13MAY92	0417	36 46.0	122 9.1	1000
26	13MAY92	0550	36 52.7	122 10.2	100
27	13MAY92	0700	36 52.6	122 22.4	900
28	13MAY92	0820	36 52.7	122 34.6	1600
29	13MAY92	0940	36 52.7	122 47.0	2300
30	13MAY92	1047	36 59.0	122 53.2	1600
31	13MAY92	1157	36 52.6	122 59.3	2700
32	13MAY92	1315	36 58.9	123 5.3	2740
33	13MAY92	1422	37 5.0	122 59.3	950
34	13MAY92	1543	37 5.1	122 47.0	640
35	13MAY92	1703	37 4.8	122 34.5	116
36	13MAY92	1813	37 5.0	122 22.3	60
37	13MAY92	2016	36 58.9	122 12.3	44
38	13MAY92	2250	36 58.5	122 19.3	98
39	13MAY92	2320	36 59.0	122 22.5	120
40	14MAY92	0235	36 59.9	122 27.3	130
41	14MAY92	0328	36 59.0	122 35.9	410
42	14MAY92	0555	37 10.9	122 28.5	71
43	14MAY92	0702	37 10.9	122 40.9	116
44	14MAY92	0810	37 10.9	122 53.2	430
45	14MAY92	0927	37 10.8	123 5.3	860
46	14MAY92	1045	37 10.4	123 17.3	1900
47	14MAY92	1155	37 16.5	123 11.4	1200
48	14MAY92	1305	37 22.2	123 17.8	1800
49	14MAY92	1430	37 22.4	123 5.3	820
50	14MAY92	1554	37 22.4	122 52.9	193
51	14MAY92	1702	37 22.3	122 40.7	88
52	14MAY92	1810	37 22.4	122 28.3	32
53	14MAY92	2018	37 16.6	122 29.1	52
54	14MAY92	2240	37 16.4	122 36.0	94
55	14MAY92	2309	37 16.5	122 39.1	98
56	15MAY92	0230	37 16.5	122 51.7	278
57	15MAY92	0332	37 16.4	122 59.0	524
58	15MAY92	0615	37 30.8	122 48.5	81

CAST	DATE	TIME	LATITUDE	LONGITUDE	DEPTH(M)
59	15MAY92	0722	37 30.8	122 59.6	220
60	15MAY92	0838	37 31.1	123 11.9	1200
61	15MAY92	0955	37 30.8	123 24.1	2400
62	15MAY92	1110	37 30.7	123 36.4	3000
63	15MAY92	1235	37 38.3	123 42.4	3345
64	15MAY92	1355	37 46.2	123 48.4	3440
65	15MAY92	1510	37 46.2	123 36.2	2700
66	15MAY92	1630	37 46.2	123 24.0	1500
67	15MAY92	1750	37 46.3	123 11.5	113
68	15MAY92	2015	37 39.4	123 2.4	110
69	15MAY92	2305	37 38.8	123 12.2	1113
70	16MAY92	0015	37 44.5	123 8.5	92
71	16MAY92	0305	37 51.2	123 17.7	107
72	16MAY92	0538	37 51.2	123 30.5	1500
73	16MAY92	0705	38 1.7	123 30.2	145
74	16MAY92	0812	38 1.6	123 42.4	2400
75	16MAY92	0940	38 1.4	123 54.7	3400
76	16MAY92	1100	38 1.6	124 7.1	3600
79	16MAY92	1515	38 18.6	123 42.4	1460
80	16MAY92	1637	38 18.5	123 29.9	257
81	16MAY92	1747	38 18.5	123 17.7	110
82	16MAY92	2018	38 9.8	122 59.8	52
83	16MAY92	2205	38 5.3	123 1.9	72
84	16MAY92	2250	38 9.9	123 10.0	93
85	17MAY92	0100	38 9.0	123 16.6	120
86	17MAY92	0141	38 9.9	123 21.8	183
87	17MAY92	1340	38 1.5	123 17.8	121
88	17MAY92	1447	38 1.6	123 5.4	65
89	17MAY92	1546	37 53.0	123 4.9	92
90	17MAY92	1635	37 48.8	123 0.0	75
91	17MAY92	1743	37 55.6	122 50.0	43
92	17MAY92	1935	37 58.1	122 56.1	55
93	17MAY92	2044	37 50.9	122 46.0	41
94	17MAY92	2335	37 47.9	122 51.9	55
95	18MAY92	0023	37 42.0	122 54.7	59
96	18MAY92	0257	37 37.8	122 45.9	55

DSJ9206 SWEEP 1 ADDITIONAL STATIONS

CAST	DATE	TIME	LATITUDE	LONGITUDE	DEPTH(M)
97	18MAY92	0545	37 16.4	123 12.0	1500
98	18MAY92	0710	37 16.5	123 24.4	3000
99	18MAY92	0837	37 16.3	123 36.5	2800
100	18MAY92	1000	37 16.4	123 48.9	3300
101	18MAY92	1125	37 16.5	124 1.3	3800
102	18MAY92	1250	37 16.4	124 13.6	3930
103	18MAY92	1415	37 16.6	124 26.0	4030
104	18MAY92	1540	37 16.8	124 38.2	4130
105	18MAY92	1630	37 16.8	124 43.7	4100
106	18MAY92	2030	37 16.5	124 1.3	3900
110	19MAY92	0435	37 17.9	123 8.7	1400

DSJ9206 SWEEP 2

CAST	DATE	TIME	LATITUDE	LONGITUDE	DEPTH(M)
111	19MAY92	0805	36 46.1	122 53.0	2500
112	19MAY92	0910	36 40.0	122 46.7	2800
113	19MAY92	1030	36 46.1	122 40.6	2100
114	19MAY92	1135	36 40.0	122 34.6	2400
115	19MAY92	1245	36 46.3	122 28.3	2100
116	19MAY92	1355	36 40.1	122 22.2	1740
117	19MAY92	1557	36 43.3	122 15.9	600
118	19MAY92	1724	36 39.7	122 9.7	1170
119	19MAY92	1834	36 33.6	122 16.3	2520
120	19MAY92	2009	36 34.9	122 10.6	2300
121	20MAY92	0040	36 32.8	122 1.2	640
122	20MAY92	0145	36 38.7	122 3.1	840
123	20MAY92	0356	36 40.5	122 5.5	2100
124	20MAY92	0536	36 44.0	122 7.3	1000
125	20MAY92	0625	36 44.6	122 2.3	720
126	20MAY92	0720	36 49.2	122 5.1	105
127	20MAY92	0800	36 54.0	122 4.6	60
128	20MAY92	0845	36 53.0	121 56.1	37
129	20MAY92	2024	36 39.1	121 56.9	60
130	20MAY92	2230	36 38.6	121 51.5	32
131	20MAY92	2311	36 42.4	121 54.6	87
132	21MAY92	0117	36 43.4	121 57.7	105
133	21MAY92	0206	36 46.1	121 52.1	78
134	21MAY92	0430	36 49.6	122 0.5	98
135	21MAY92	0535	36 52.6	122 10.1	100
136	21MAY92	0650	36 52.6	122 22.4	900
137	21MAY92	0810	36 52.7	122 34.6	1600
138	21MAY92	0945	36 52.6	122 46.9	2300
139	21MAY92	1110	36 59.0	122 52.9	1400
140	21MAY92	1232	36 52.6	122 59.3	2700
141	21MAY92	1435	37 5.1	122 59.3	915
142	21MAY92	1557	37 5.1	122 47.0	800
143	21MAY92	1724	37 5.1	122 34.7	116
144	21MAY92	1837	37 5.0	122 22.3	60
145	21MAY92	2018	36 58.9	122 12.3	45
146	21MAY92	2256	36 57.5	122 16.4	93
147	21MAY92	2338	36 58.8	122 21.5	177
149	22MAY92	0510	36 57.5	122 34.4	800
150	22MAY92	0655	37 10.8	122 28.4	71
151	22MAY92	0810	37 10.7	122 40.5	114
152	22MAY92	0928	37 10.7	122 52.9	430
153	22MAY92	1055	37 10.8	123 5.2	885
154	22MAY92	1223	37 10.7	123 17.7	1870
155	22MAY92	1405	37 22.3	123 17.6	1645
156	22MAY92	1529	37 22.3	123 5.2	800
157	22MAY92	1709	37 22.4	122 52.9	190
158	22MAY92	1821	37 22.4	122 40.7	88
159	22MAY92	1926	37 22.4	122 28.4	32
160	22MAY92	2023	37 16.4	122 29.2	55
161	22MAY92	2249	37 15.1	122 33.7	87
162	22MAY92	2327	37 16.7	122 38.8	77
163	23MAY92	0328	37 16.3	122 47.3	146
164	23MAY92	0521	37 16.0	122 57.3	600
165	23MAY92	0725	37 31.0	122 47.0	83
166	23MAY92	0840	37 30.8	122 59.3	215
167	23MAY90	1007	37 30.8	123 11.5	1300
168	23MAY92	1132	37 30.8	123 23.9	2400
169	23MAY92	1255	37 30.8	123 36.2	2463

CAST	DATE	TIME	LATITUDE	LONGITUDE	DEPTH (M)
170	23MAY92	1420	37 38.4	123 42.4	3337
171	23MAY92	1543	37 46.2	123 36.4	2697
172	23MAY92	1705	37 46.3	123 24.1	1500
173	23MAY92	1824	37 46.3	123 11.5	115
174	23MAY92	2017	37 39.6	123 2.3	105
175	23MAY92	2324	37 39.0	123 10.9	1200
176	24MAY92	0025	37 44.6	123 8.3	78
177	24MAY92	0258	37 52.4	123 16.9	106
178	24MAY92	0530	37 53.2	123 29.5	1600
179	24MAY92	0645	38 1.8	123 30.1	138
180	24MAY92	0756	38 1.7	123 42.3	2600
181	24MAY92	0820	38 1.7	123 54.6	3500
182	24MAY92	1043	38 1.7	124 6.9	3700
183	24MAY92	1156	38 10.0	124 7.0	3700
184	24MAY92	1307	38 18.5	124 7.0	3700
185	24MAY92	1424	38 18.6	123 54.7	2835
186	24MAY92	1543	38 18.5	123 42.4	1460
187	24MAY92	1700	38 18.6	123 30.0	260
188	24MAY92	1813	38 18.5	123 17.7	110
189	24MAY92	2018	38 10.1	122 59.9	52
190	24MAY92	2053	38 9.5	123 4.9	76
191	24MAY92	2131	38 10.0	123 10.0	92
192	25MAY92	0445	38 8.4	123 16.0	118
193	25MAY92	1009	38 1.4	123 17.9	124
194	25MAY92	1122	38 1.6	123 5.5	64
195	25MAY92	1225	37 52.9	123 5.5	92
196	25MAY92	1311	37 48.7	123 0.1	77
197	25MAY92	1426	37 55.5	122 50.1	45
198	25MAY92	2136	37 58.1	122 56.2	58
199	25MAY92	2305	37 51.2	122 46.1	43
200	26MAY92	0448	37 40.3	122 53.6	60

DSJ9206 SWEEP 3

CAST	DATE	TIME	LATITUDE	LONGITUDE	DEPTH (M)
286	04JUN92	1804	36 53.9	122 04.6	62
287	04JUN92	1859	36 52.9	121 55.9	40
288	04JUN92	2020	36 50.6	121 59.0	90
289	04JUN92	2319	36 45.8	121 51.4	50
290	05JUN92	0007	36 44.4	121 58.6	300
291	05JUN92	0206	36 43.9	121 53.5	82
292	05JUN92	0252	36 38.5	121 51.4	39
293	05JUN92	0530	36 40.0	121 57.5	96
294	05JUN92	0650	36 40.0	122 10.3	1200
295	05JUN92	0759	36 46.4	122 16.3	850
296	05JUN92	0928	36 40.2	122 22.4	1800
297	05JUN92	1036	36 46.3	122 28.5	2800
298	05JUN92	1152	36 40.1	122 34.6	2400
299	05JUN92	1305	36 46.5	122 40.9	2050
300	05JUN92	1431	36 46.3	122 53.0	2560
301	05JUN92	1544	36 40.0	122 47.0	2750
302	05JUN92	1700	36 33.7	122 40.8	3000
303	05JUN92	1824	36 33.8	122 28.4	3000
304	05JUN92	1950	36 33.8	122 16.1	3000
305	05JUN92	2043	36 35.0	122 10.7	2300
306	06JUN92	0002	36 33.7	122 0.3	410

CAST	DATE	TIME	LATITUDE	LONGITUDE	DEPTH(M)
307	06JUN92	0057	36 38.8	122 3.0	800
308	06JUN92	0304	36 42.0	122 4.1	1700
309	06JUN92	0529	36 48.4	122 7.7	178
310	06JUN92	0617	36 52.7	122 10.2	102
311	06JUN92	0729	36 52.7	122 22.4	1200
312	06JUN92	0859	36 52.7	122 34.6	1600
313	06JUN92	1031	36 52.6	122 47.0	2400
314	06JUN92	1200	36 52.6	122 59.3	2700
315	06JUN92	1315	36 59.0	123 5.3	2750
316	06JUN92	1426	37 5.0	122 59.3	900
317	06JUN92	1554	37 5.1	122 47.0	648
318	06JUN92	1722	37 5.0	122 34.6	115
319	06JUN92	1836	37 5.2	122 22.3	60
320	06JUN92	2019	36 59.0	122 12.6	26
321	06JUN92	2255	36 58.1	122 15.8	85
322	06JUN92	2343	36 57.5	122 22.4	128
323	07JUN92	0310	36 57.9	122 24.0	200
324	07JUN92	0424	36 59.1	122 35.6	430
334	08JUN92	0655	37 10.9	122 28.7	72
335	08JUN92	0820	37 10.7	122 40.6	115
336	08JUN92	0931	37 10.7	122 52.9	425
337	08JUN92	1054	37 10.6	123 5.2	840
338	08JUN92	1215	37 10.7	123 17.6	1975
339	08JUN92	1325	37 16.6	123 11.4	1190
340	08JUN92	1436	37 22.3	123 17.6	1650
341	08JUN92	1614	37 22.4	123 5.2	800
342	08JUN92	1747	37 22.5	122 53.0	195
343	08JUN92	1855	37 22.4	122 40.7	88
344	08JUN92	2018	37 16.4	122 28.9	50
345	08JUN92	2308	37 15.3	122 32.8	84
346	08JUN92	2348	37 16.6	122 38.8	97
347	09JUN92	0310	37 14.8	122 48.8	200
348	09JUN92	0500	37 16.7	122 57.5	460
349	09JUN92	0701	37 30.9	122 47.1	83
350	09JUN92	0808	37 30.8	122 59.2	208
351	09JUN92	0921	37 30.8	123 11.6	1300
352	09JUN92	1045	37 30.8	123 23.9	2400
353	09JUN92	1211	37 30.8	123 36.2	2960
354	09JUN92	1334	37 38.4	123 42.4	3300
355	09JUN92	1456	37 46.2	123 48.7	3450
356	09JUN92	1625	37 46.3	123 36.3	2800
357	09JUN92	1746	37 46.3	123 24.0	1400
358	09JUN92	1905	37 46.3	123 11.6	115
359	09JUN92	2034	37 39.5	123 2.3	108
360	09JUN92	2330	37 38.8	123 11.2	1300
361	10JUN92	0035	37 44.6	123 8.3	80
362	10JUN92	0334	37 51.4	123 17.8	108
363	10JUN92	0531	37 52.2	123 29.0	1300
364	10JUN92	0652	38 1.6	123 30.2	150
365	10JUN92	0805	38 1.7	123 42.2	2900
366	10JUN92	0927	38 1.7	123 54.6	4000
367	10JUN92	1049	38 1.7	124 6.9	4000
368	10JUN92	1203	38 10.0	124 7.0	3350
369	10JUN92	1316	38 18.5	124 7.1	3540
370	10JUN92	1436	38 18.5	123 54.7	2800
371	10JUN92	1556	38 18.5	123 42.4	1500
372	10JUN92	1716	38 18.6	123 30.2	262
373	10JUN92	1827	38 18.7	123 17.7	110
374	10JUN92	2101	38 10.1	123 22.0	180
375	11JUN92	0029	38 9.2	123 15.2	114
376	11JUN92	0104	38 10.1	123 10.0	94
377	11JUN92	0309	38 8.9	123 3.3	70

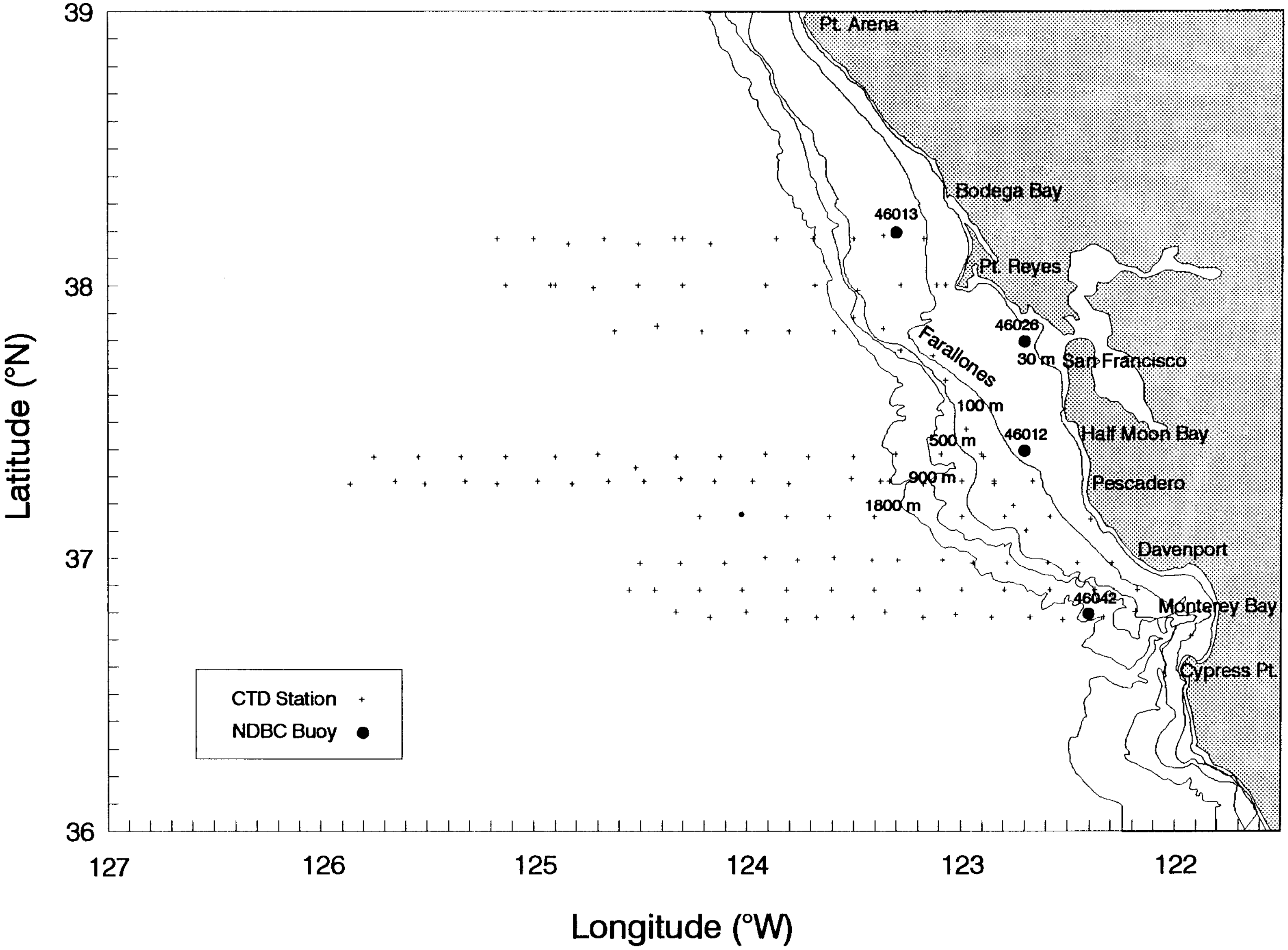
CAST	DATE	TIME	LATITUDE	LONGITUDE	DEPTH(M)
378	11JUN92	0410	38 9.4	122 59.2	34
379	12JUN92	1010	38 1.6	123 17.7	66
380	12JUN92	1111	38 1.5	123 5.7	36
381	12JUN92	1209	37 53.1	123 5.6	89
382	12JUN92	1256	37 48.8	122 59.9	73
383	12JUN92	1434	37 55.6	122 49.9	41
384	12JUN92	2039	37 38.0	122 45.7	52
385	12JUN92	2327	37 41.9	122 54.5	57
386	13JUN92	0014	37 47.5	122 52.0	55
387	13JUN92	0216	37 51.1	122 46.2	38
388	13JUN92	0345	37 58.1	122 56.1	51

DSJ9206 SWEEP 3 ADDITIONAL STATIONS

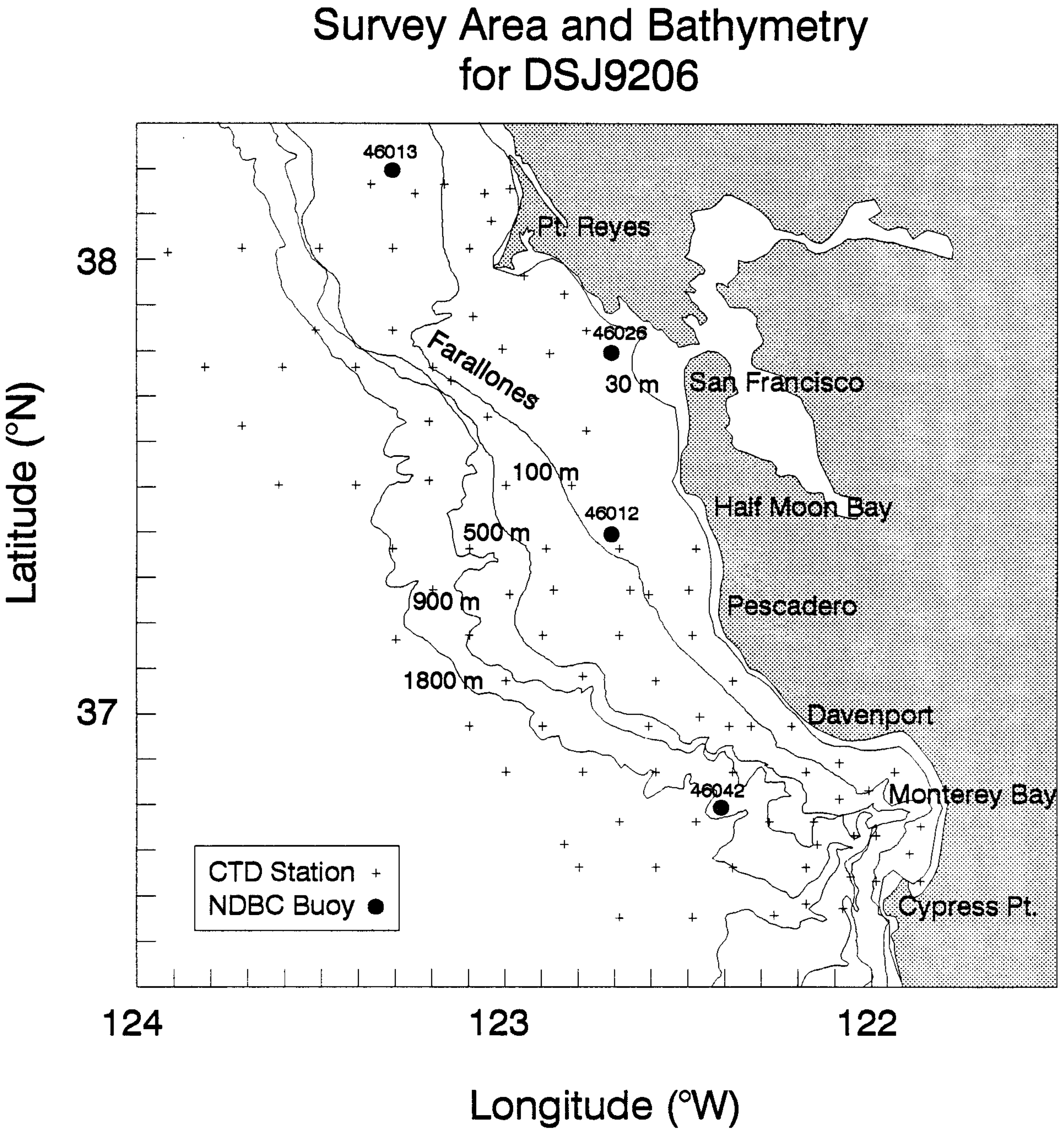
CAST	DATE	TIME	LATITUDE	LONGITUDE	DEPTH(M)
395	14JUN92	0528	37 16.5	122 30.1	60
396	14JUN92	0645	37 16.4	122 40.1	96
397	14JUN92	0747	37 16.5	122 50.0	207
398	14JUN92	0851	37 16.6	122 59.9	570
399	14JUN92	1011	37 16.6	123 10.0	1060
400	14JUN92	1128	37 16.6	123 20.0	2300
401	14JUN92	1249	37 16.6	123 30.1	2600
402	14JUN92	1405	37 16.5	123 40.0	3000
403	14JUN92	1526	37 16.5	123 49.9	3500
404	14JUN92	1647	37 16.4	124 0.0	3000
405	14JUN92	1807	37 16.4	124 10.0	4100
406	14JUN92	1925	37 16.5	124 20.0	3900
407	14JUN92	2045	37 16.6	124 29.9	4100
408	14JUN92	2311	37 16.6	124 39.9	4100
409	15JUN92	0040	37 16.6	124 51.2	4200
410	15JUN92	0240	37 16.5	124 59.9	3700
411	15JUN92	0402	37 16.6	125 10.0	4460
412	15JUN92	0610	37 16.5	125 20.0	4200
413	15JUN92	0724	37 16.6	125 30.1	4260
414	15JUN92	0835	37 16.7	125 40.1	4000
415	15JUN92	0946	37 16.5	125 49.9	4200
416	15JUN92	1059	37 16.6	126 0.0	4200
417	15JUN92	1728	38 10.0	126 0.1	4230
418	15JUN92	1837	38 10.0	125 50.0	4260
419	15JUN92	1947	38 10.0	125 39.8	4100
420	15JUN92	2058	38 10.0	125 30.1	3900
421	16JUN92	0019	38 7.0	125 18.6	4000
422	16JUN92	0131	38 9.8	125 10.0	3800
423	16JUN92	0355	38 9.7	125 0.2	3750
424	16JUN92	0625	38 9.9	124 50.2	3920
425	16JUN92	0738	38 10.0	124 40.0	3950
426	16JUN92	0846	38 10.3	124 29.9	3300
427	16JUN92	1007	38 10.1	124 20.1	3500
428	16JUN92	1117	38 10.0	124 10.1	3700
429	16JUN92	1226	38 10.0	123 59.9	3500
430	16JUN92	1338	38 10.0	123 50.0	3450
431	16JUN92	1450	38 10.1	123 40.0	1700
432	16JUN92	1602	38 10.0	123 29.8	470
433	16JUN92	1820	38 10.1	123 20.0	142
434	16JUN92	1915	38 10.1	123 10.0	90

APPENDIX 3.1: DSJ9203 CTD STATIONS AND BATHYMETRIC MAP OF SURVEY REGION WITH LOCATIONS OF THE NDBC BUOYS

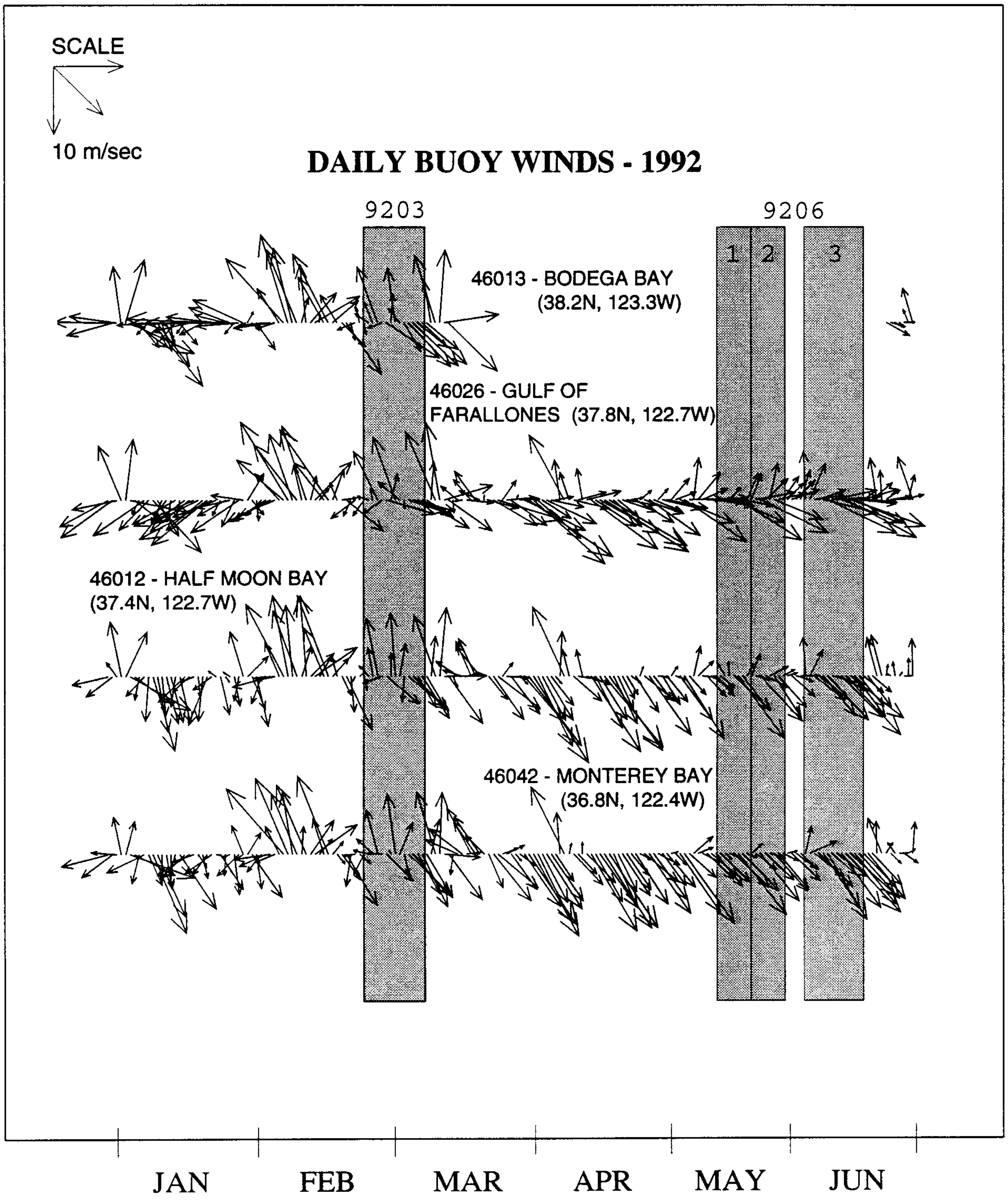
Survey Area and Bathymetry for DSJ9203



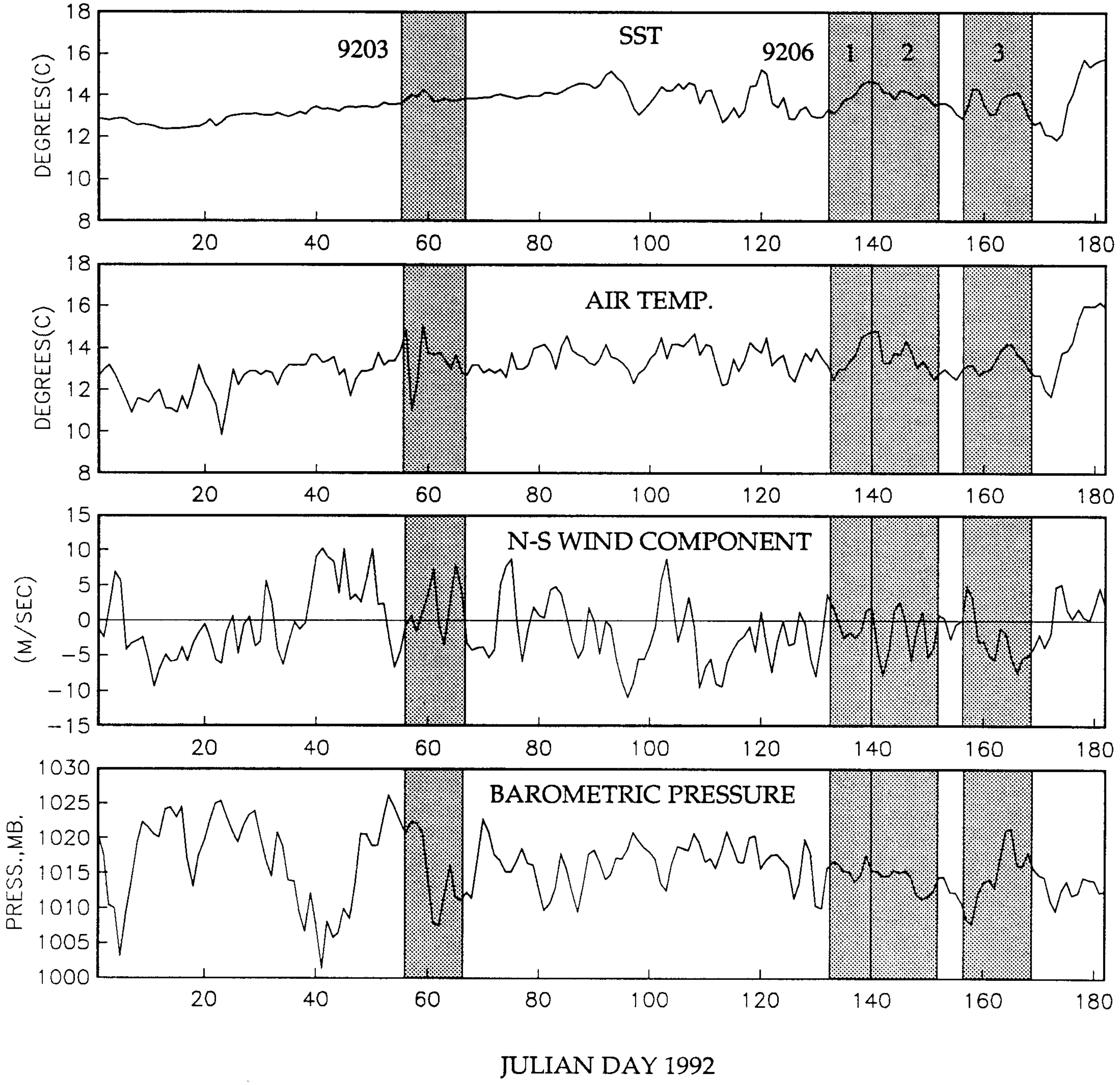
APPENDIX 3.2: DSJ9206 CTD STATIONS AND BATHYMETRIC MAP OF SURVEY REGION WITH LOCATIONS OF THE NDBC BUOYS

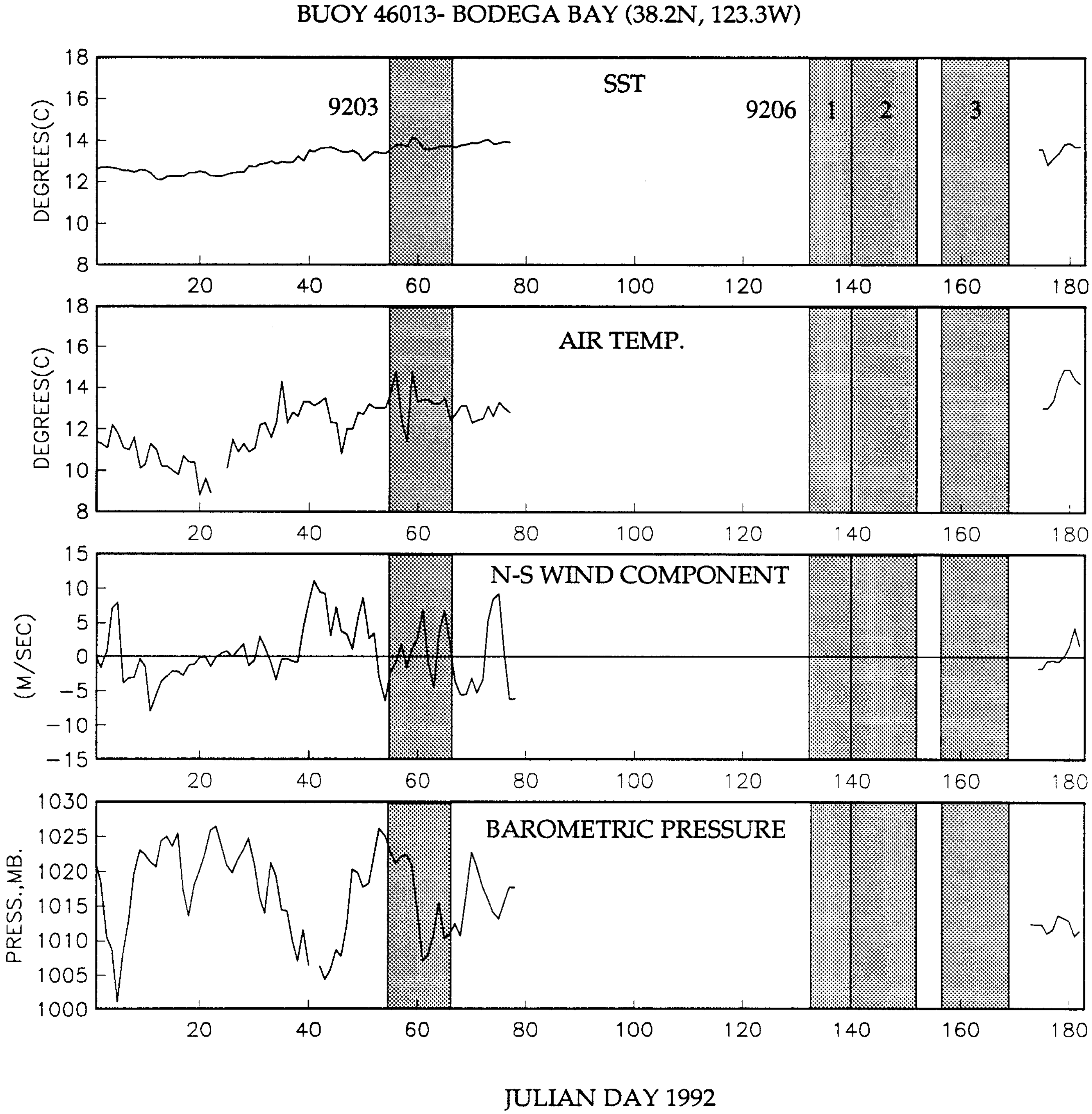

Survey Area and Bathymetry
for DSJ9206
Latitude (°N)
Longitude (°W)
38
37
124
123
122
46013
Pt. Reyes
46026
Farallones
30 m
San Francisco
100 m
46012
Half Moon Bay
500 m
900 m
Pescadero
1800 m
Davenport
46042
Monterey Bay
Cypress Pt.
CTD Station +
NDBC Buoy ●

APPENDIX 4: METEOROLOGICAL TIME SERIES

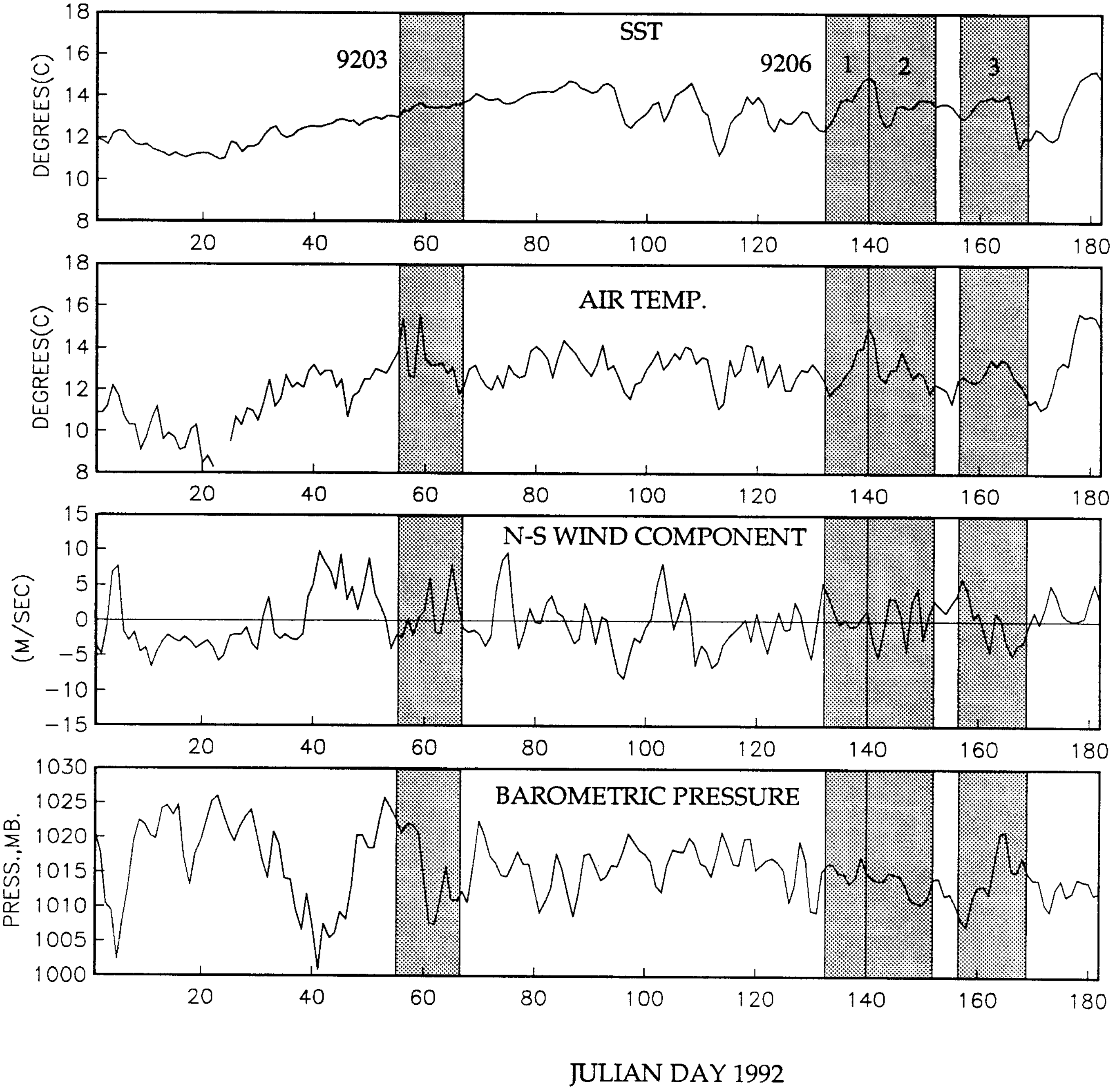

SCALE
10 m/sec
DAILY BUOY WINDS - 1992
9203
9206
1
2
3
46013 - BODEGA BAY
(38.2N, 123.3W)
46026 - GULF OF
FARALLONES (37.8N, 122.7W)
46012 - HALF MOON BAY
(37.4N, 122.7W)
46042 - MONTEREY BAY
(36.8N, 122.4W)
JAN
FEB
MAR
APR
MAY
JUN

BUOY 46012 - HALF MOON BAY (37.4N, 122.7W)

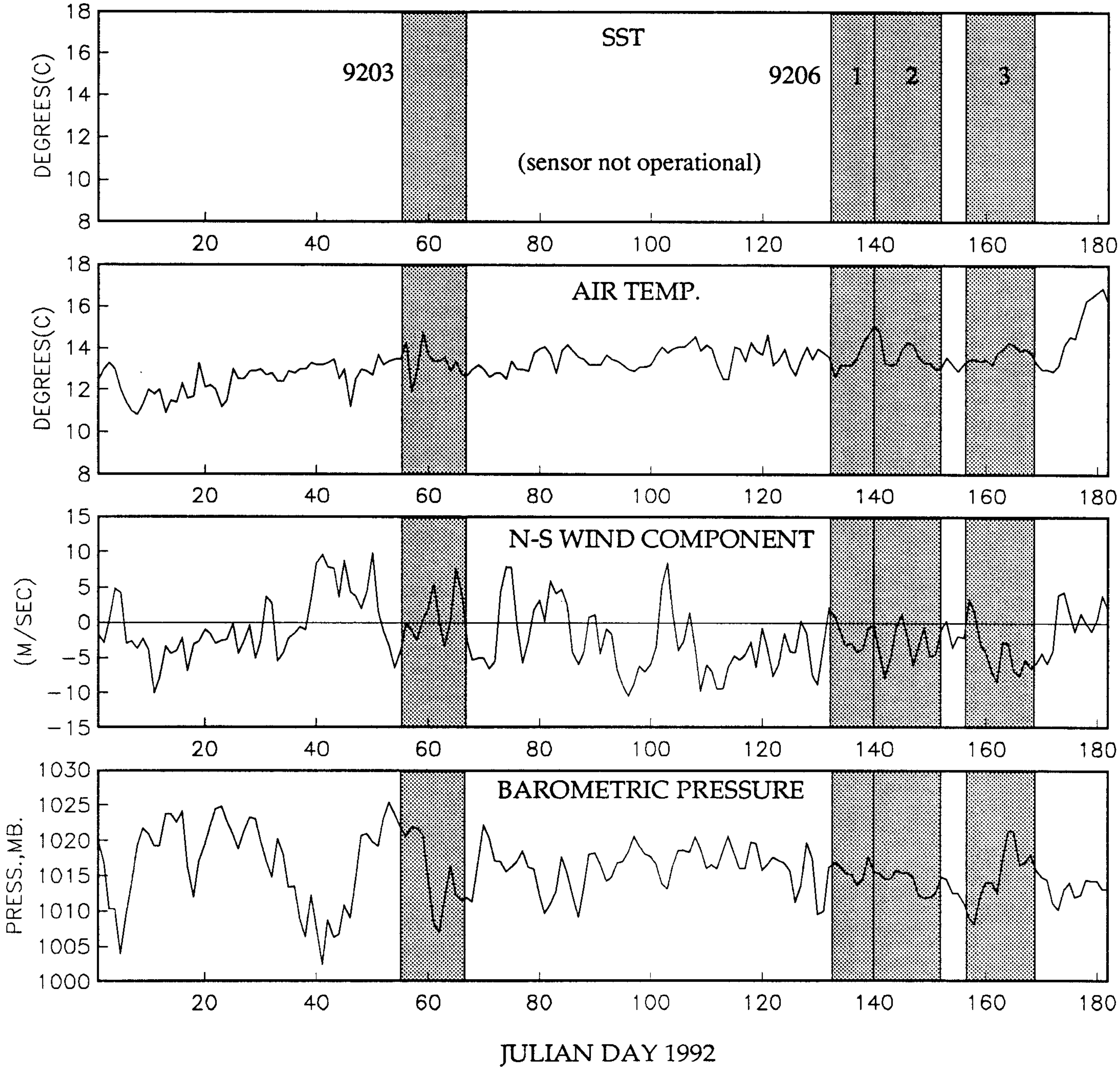



BUOY 46013- BODEGA BAY (38.2N, 123.3W)
SST
9203
9206
1
2
3
DEGREES(C)
18
16
14
12
10
8
20
40
60
80
100
120
140
160
180
AIR TEMP.
DEGREES(C)
N-S WIND COMPONENT
(M/SEC)
15
10
5
0
−5
−10
−15
BAROMETRIC PRESSURE
PRESS.,MB.
1030
1025
1020
1015
1010
1005
1000
JULIAN DAY 1992

BUOY 42026 - FARALLONES (37.8N, 122.7W)

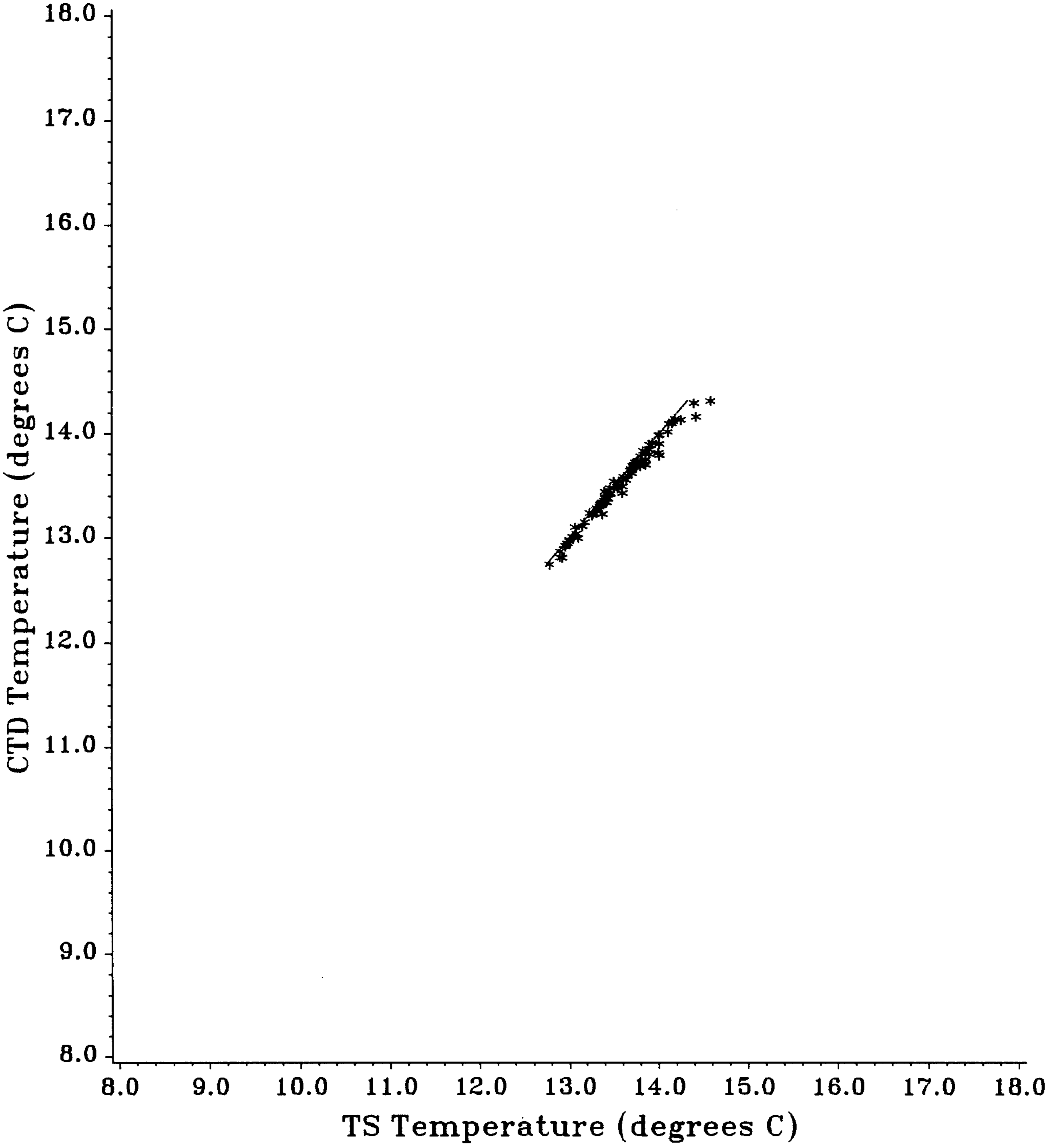


BUOY 46042- MONTEREY BAY (36.8N, 122.4W)

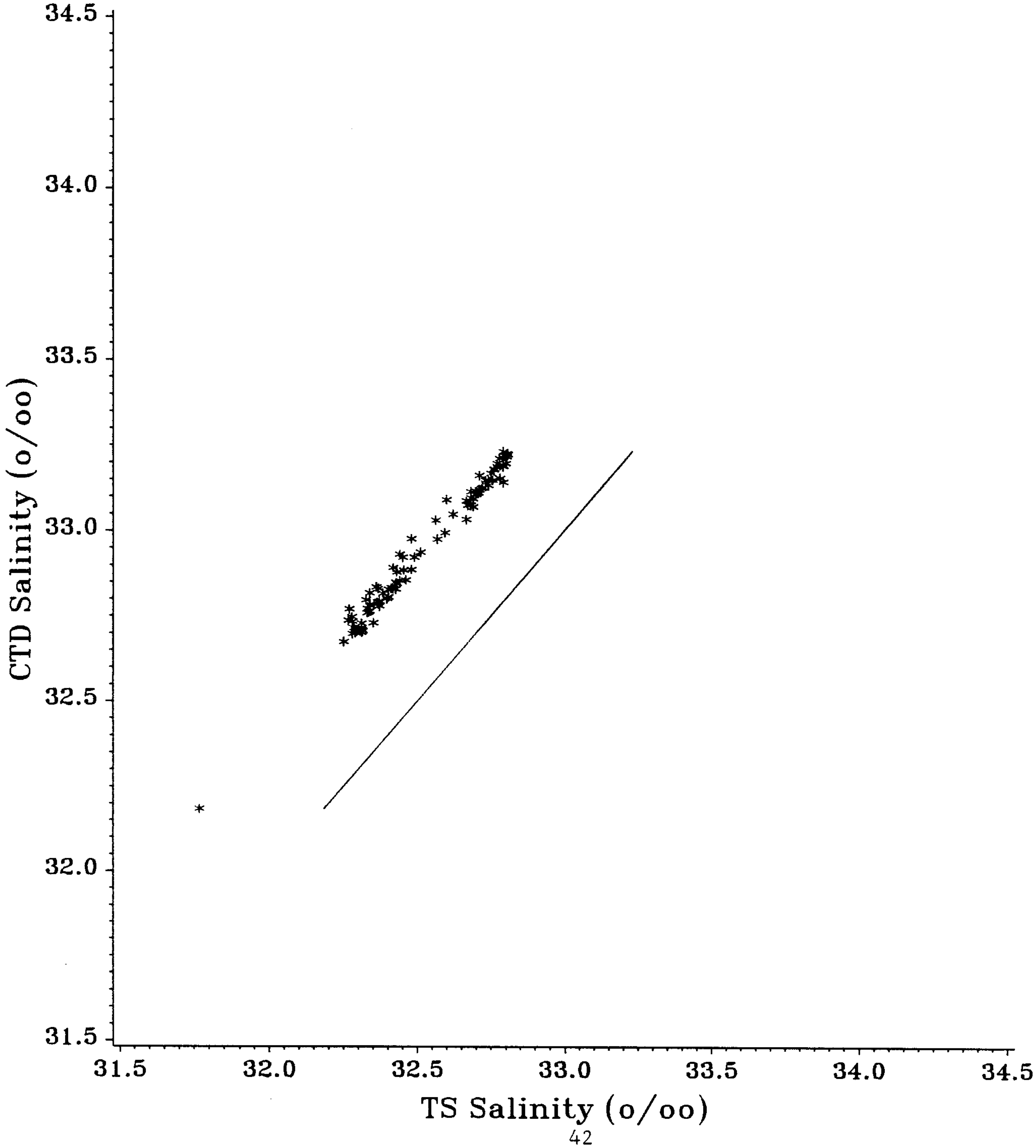


APPENDIX 5.1: REGRESSION COMPARISONS OF CTD, TS, AND BUCKET FOR DSJ9203

Surface Temperature CTD vs. TS for DSJ9203

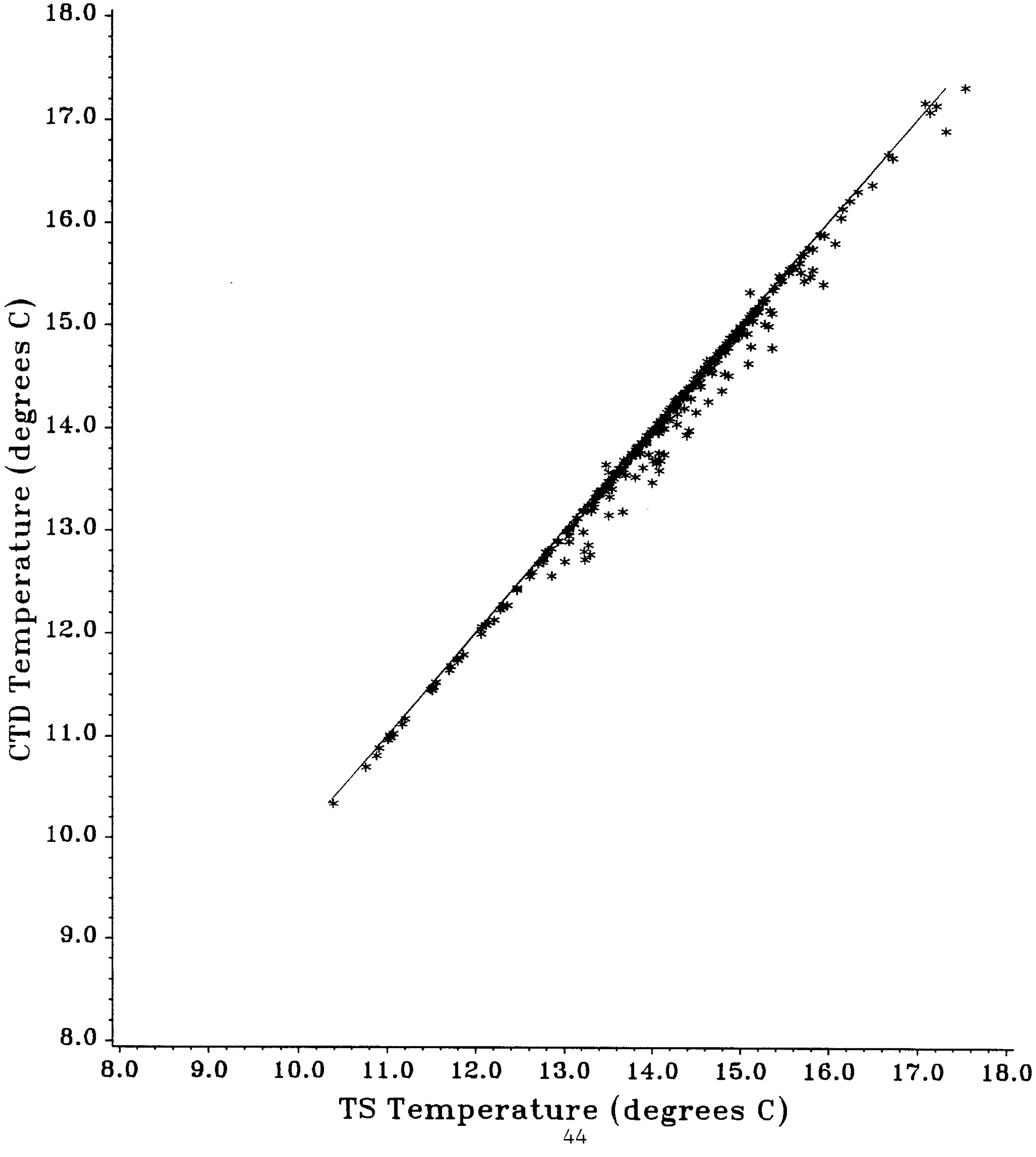


Surface Salinity CTD vs. TS for DSJ9203

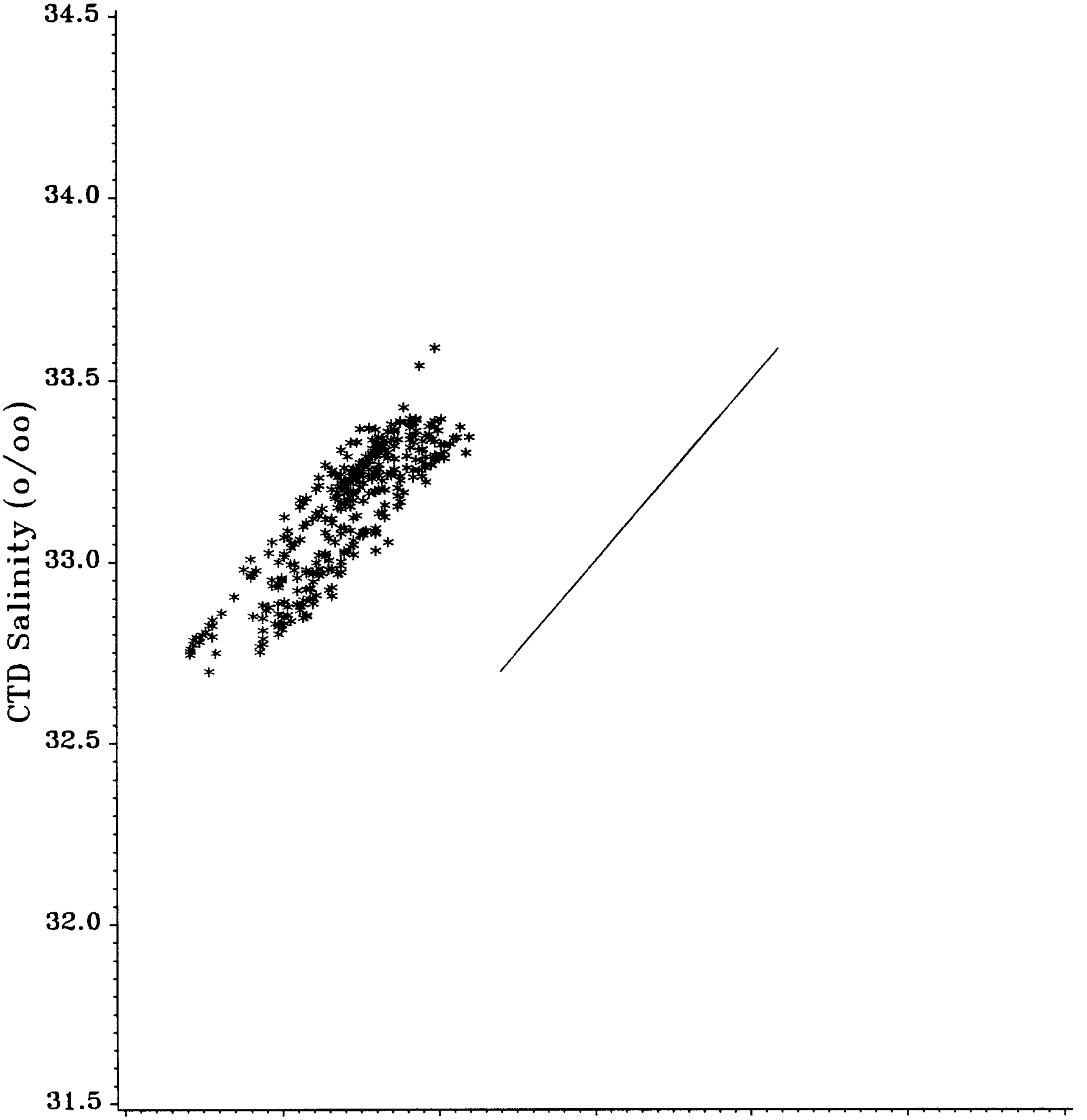


APPENDIX 5.2: REGRESSION COMPARISONS OF CTD, TS, AND BUCKET FOR DSJ9206

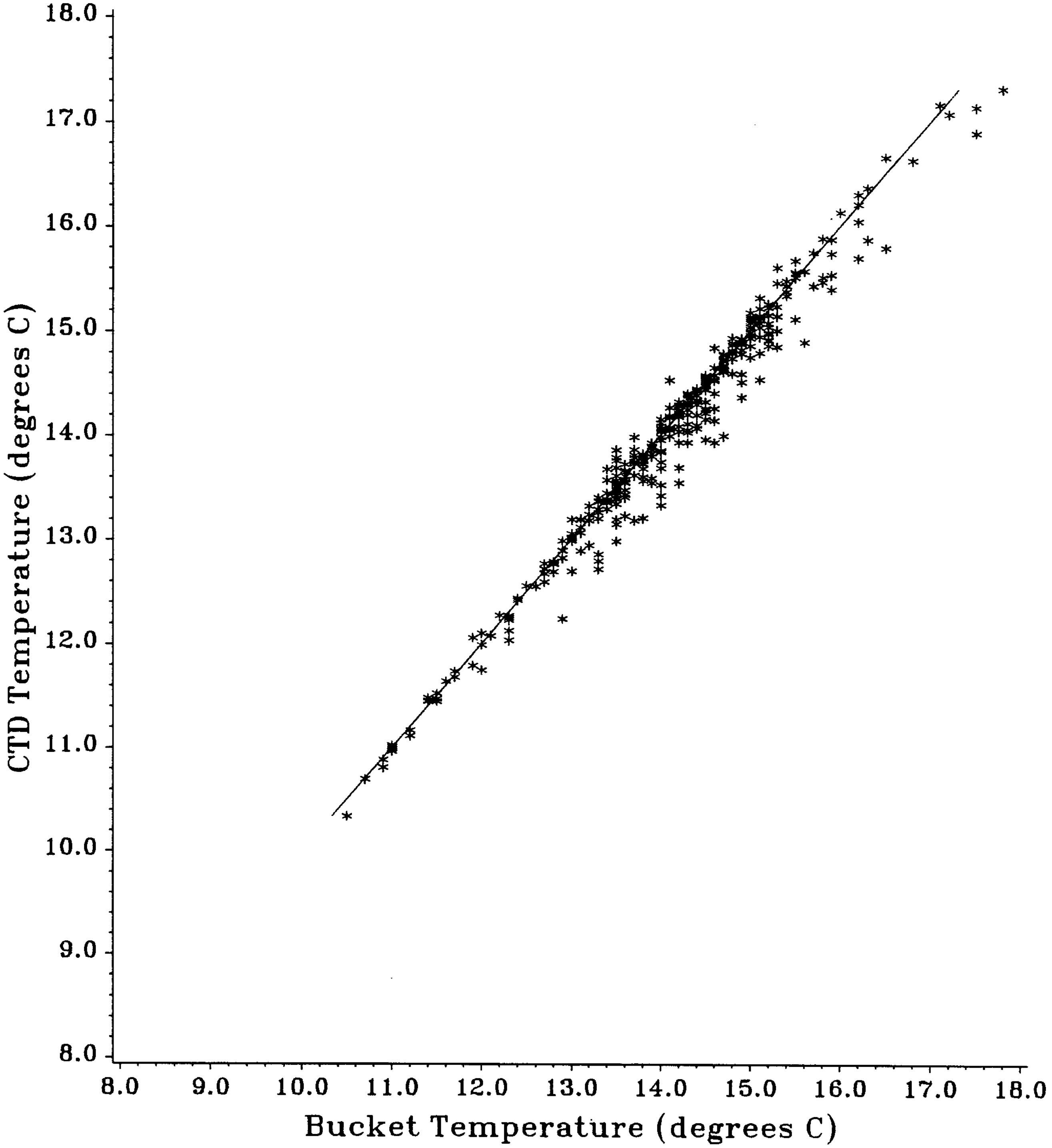
Surface Temperature CTD vs. TS for DSJ9206



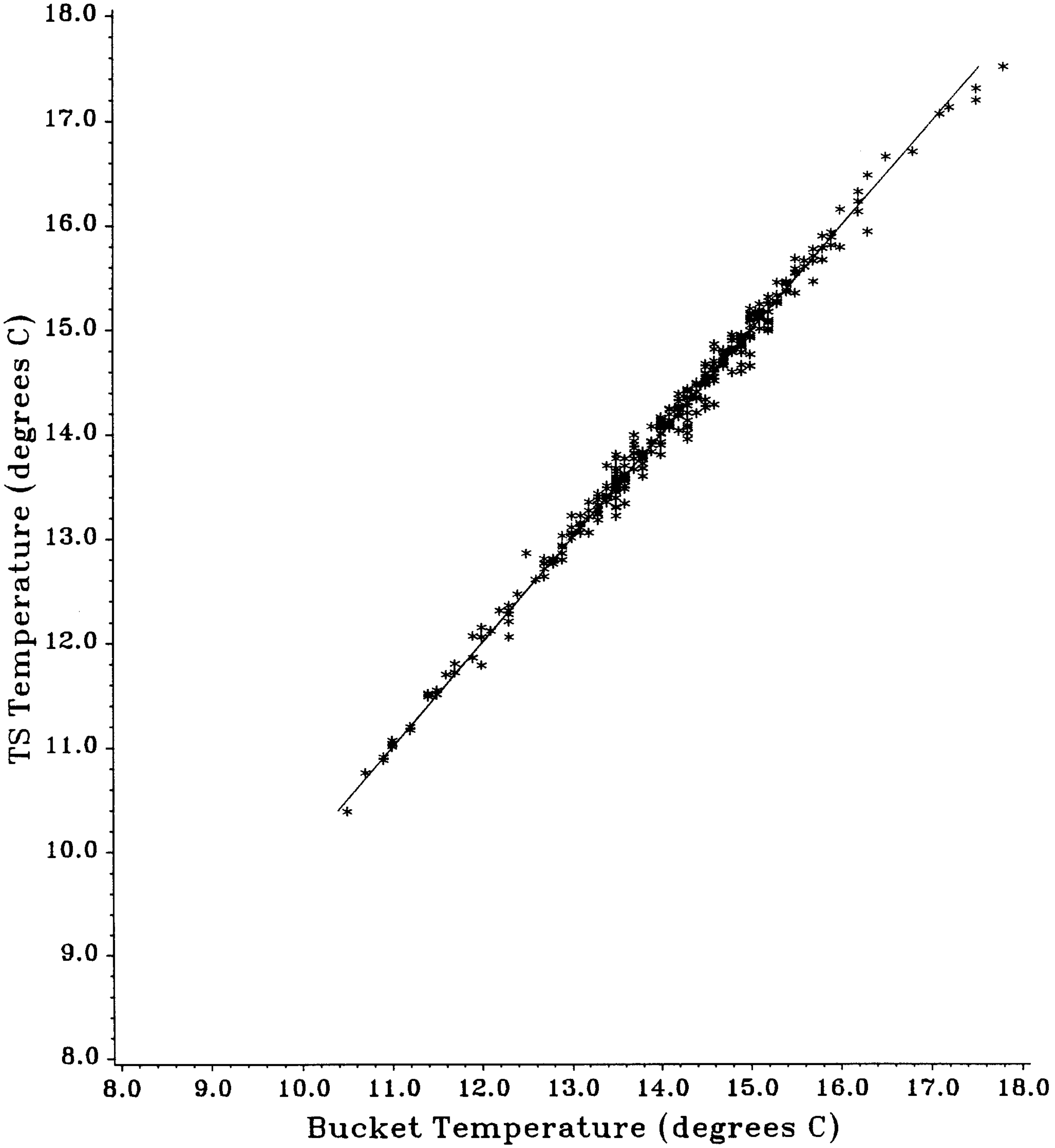
Surface Salinity CTD vs. TS for DSJ9206



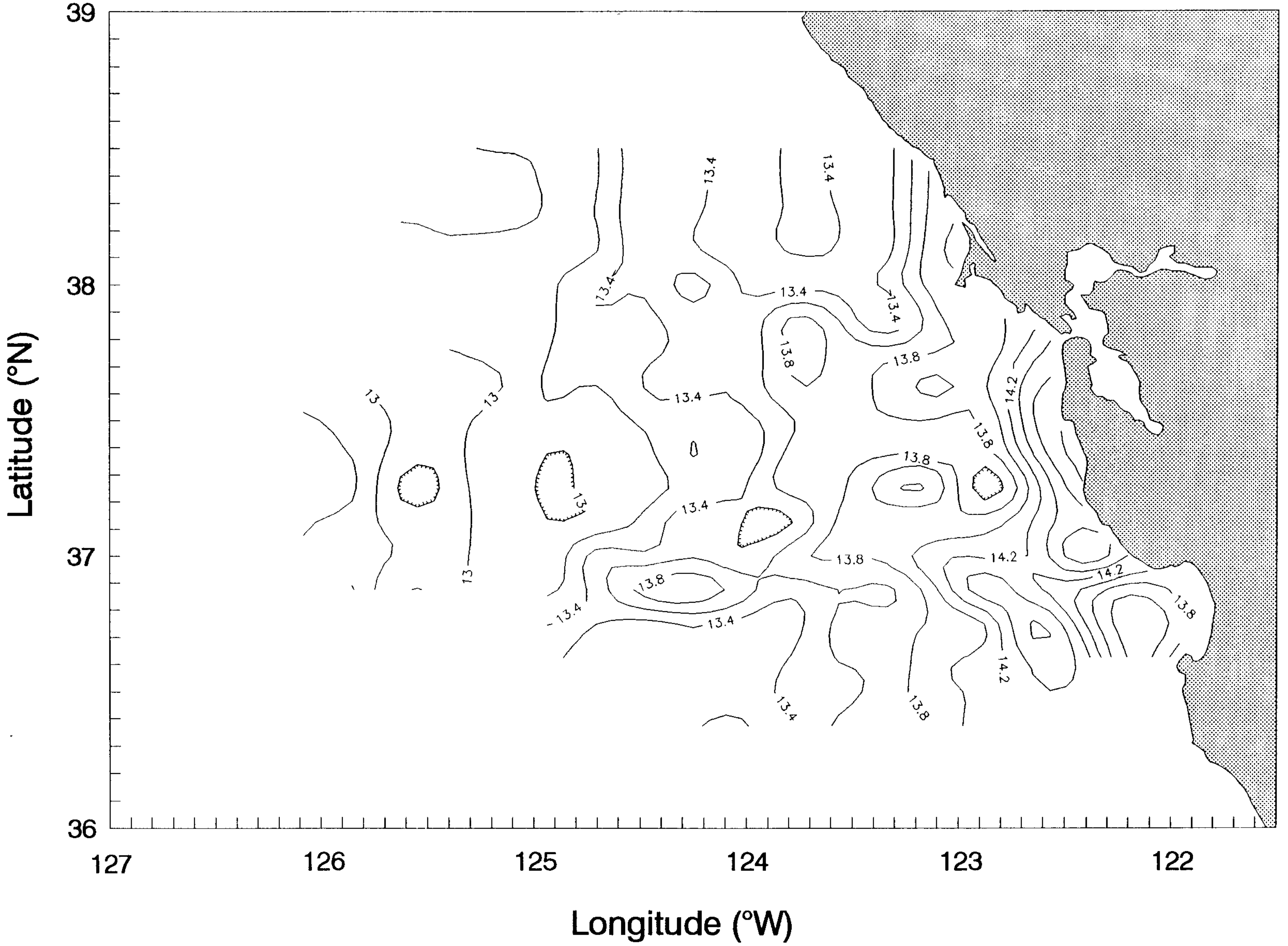
Surface Temperature CTD vs. Bucket for DSJ9206



Surface Temperature TS vs. Bucket for DSJ9206

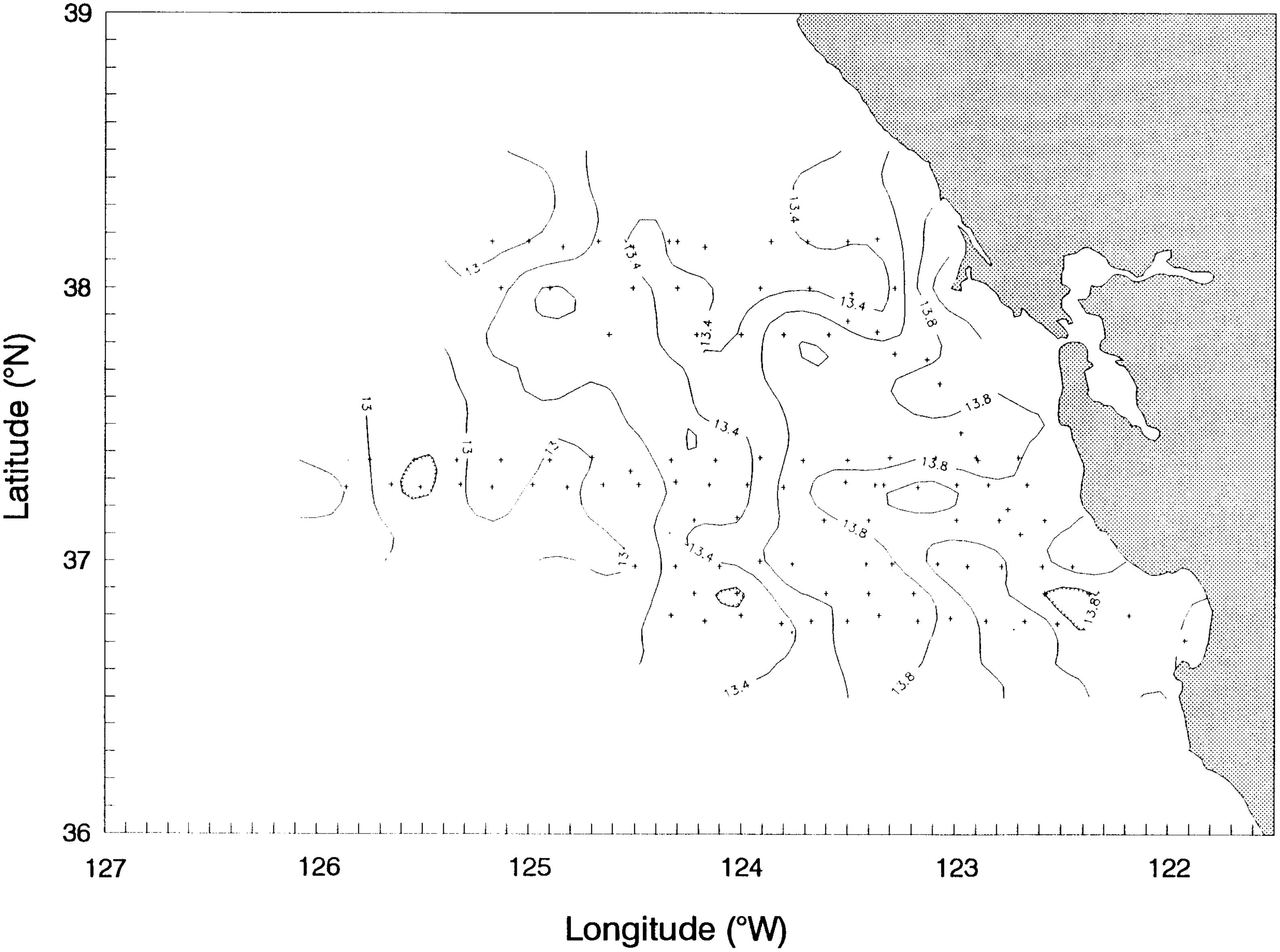


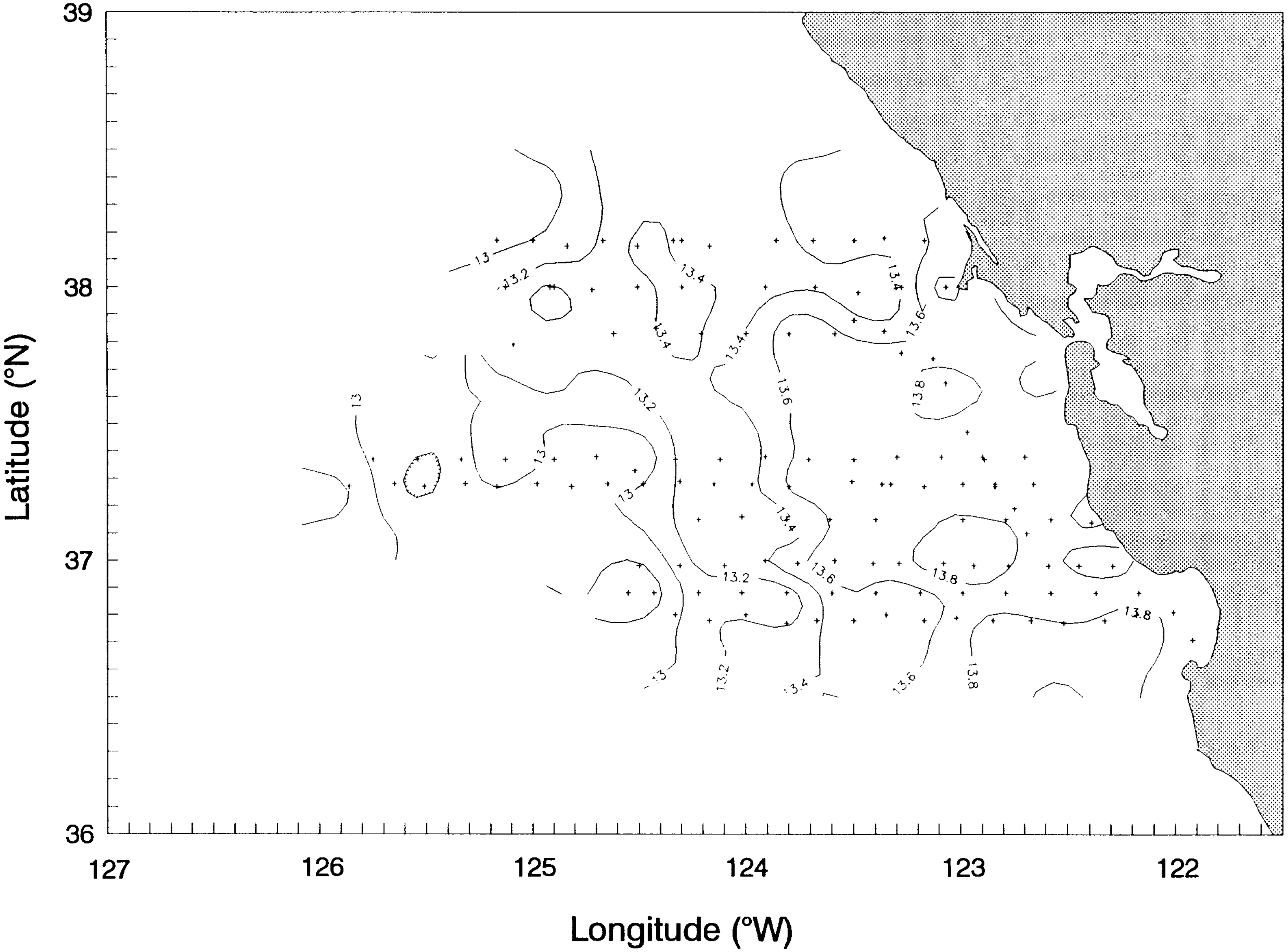
APPENDIX 6.1: HORIZONTAL MAPS OF CTD AND TS FOR DSJ9203



DSJ9203 TS Temperature (°C)

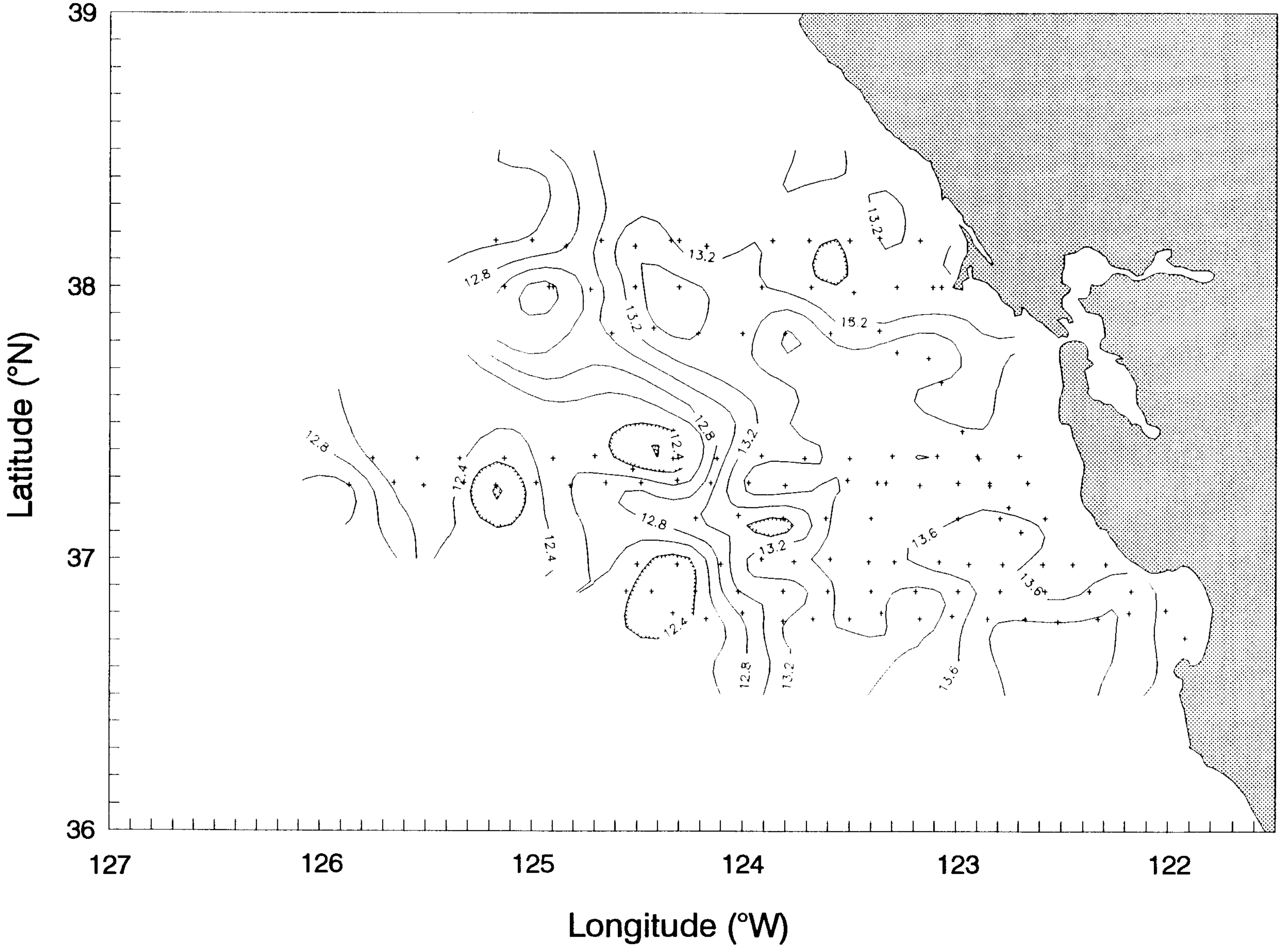
DSJ9203 Temperature (°C) at 2 m



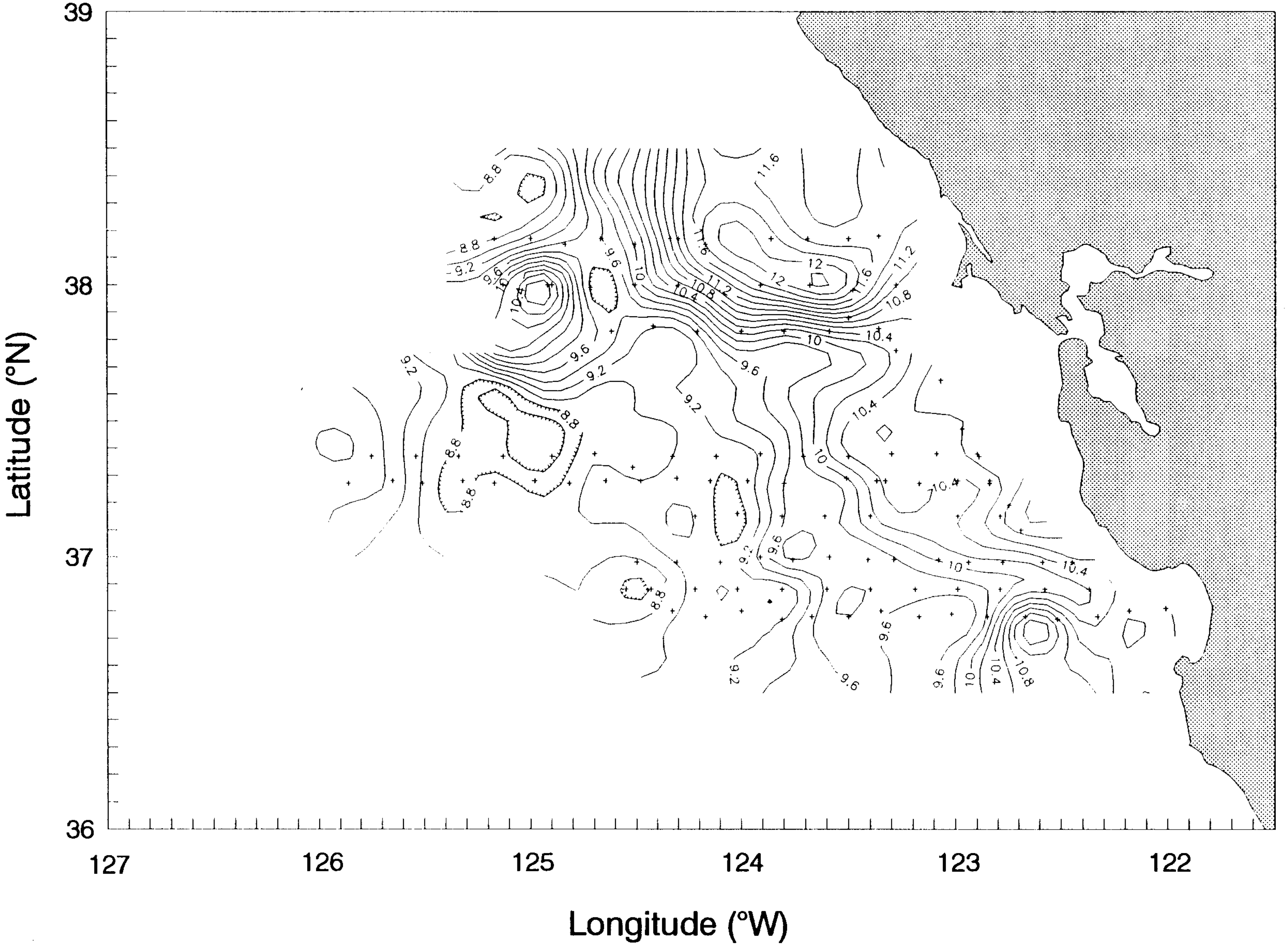


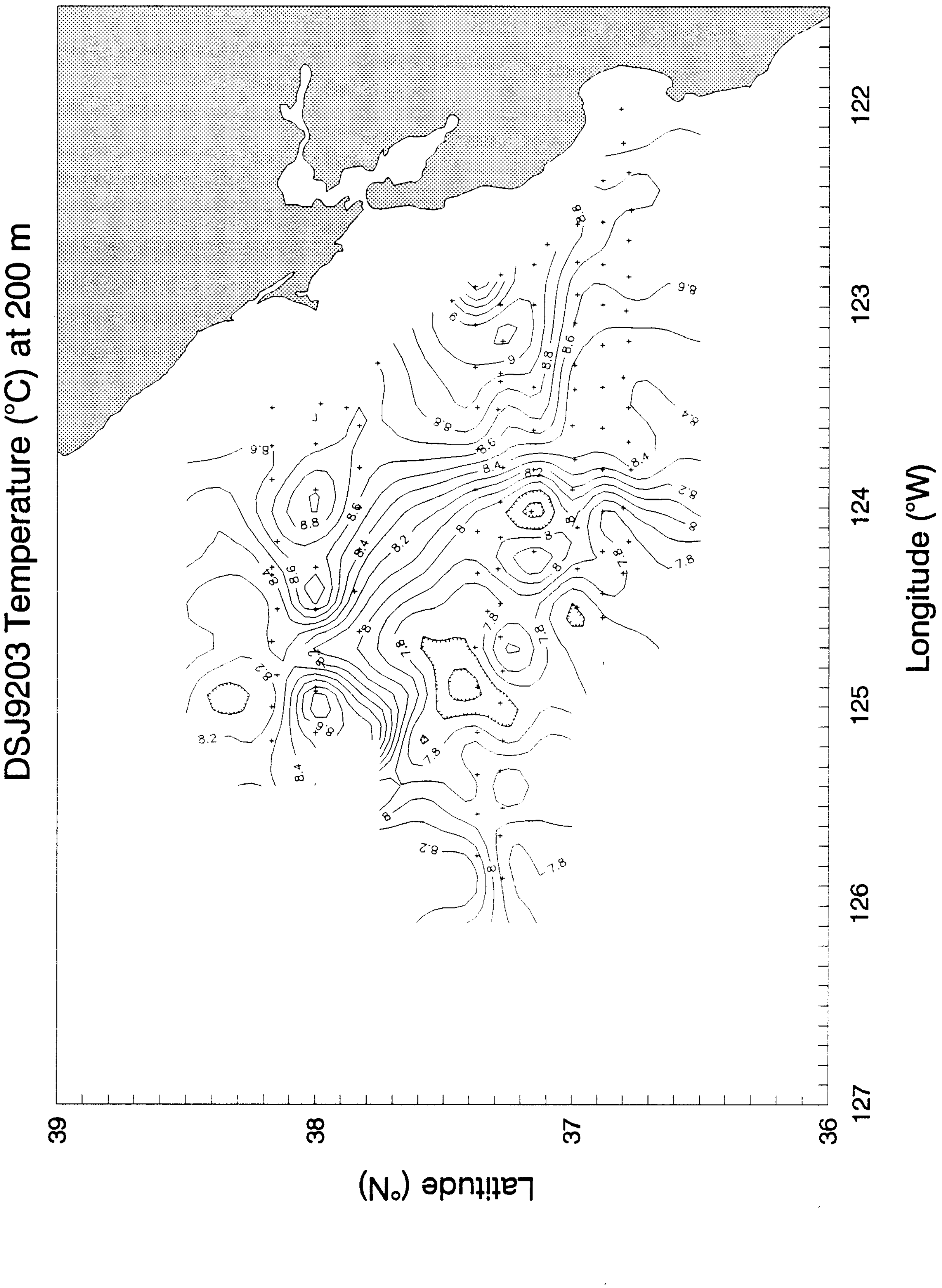
DSJ9203 Temperature (°C) at 10 m

DSJ9203 Temperature (°C) at 30 m

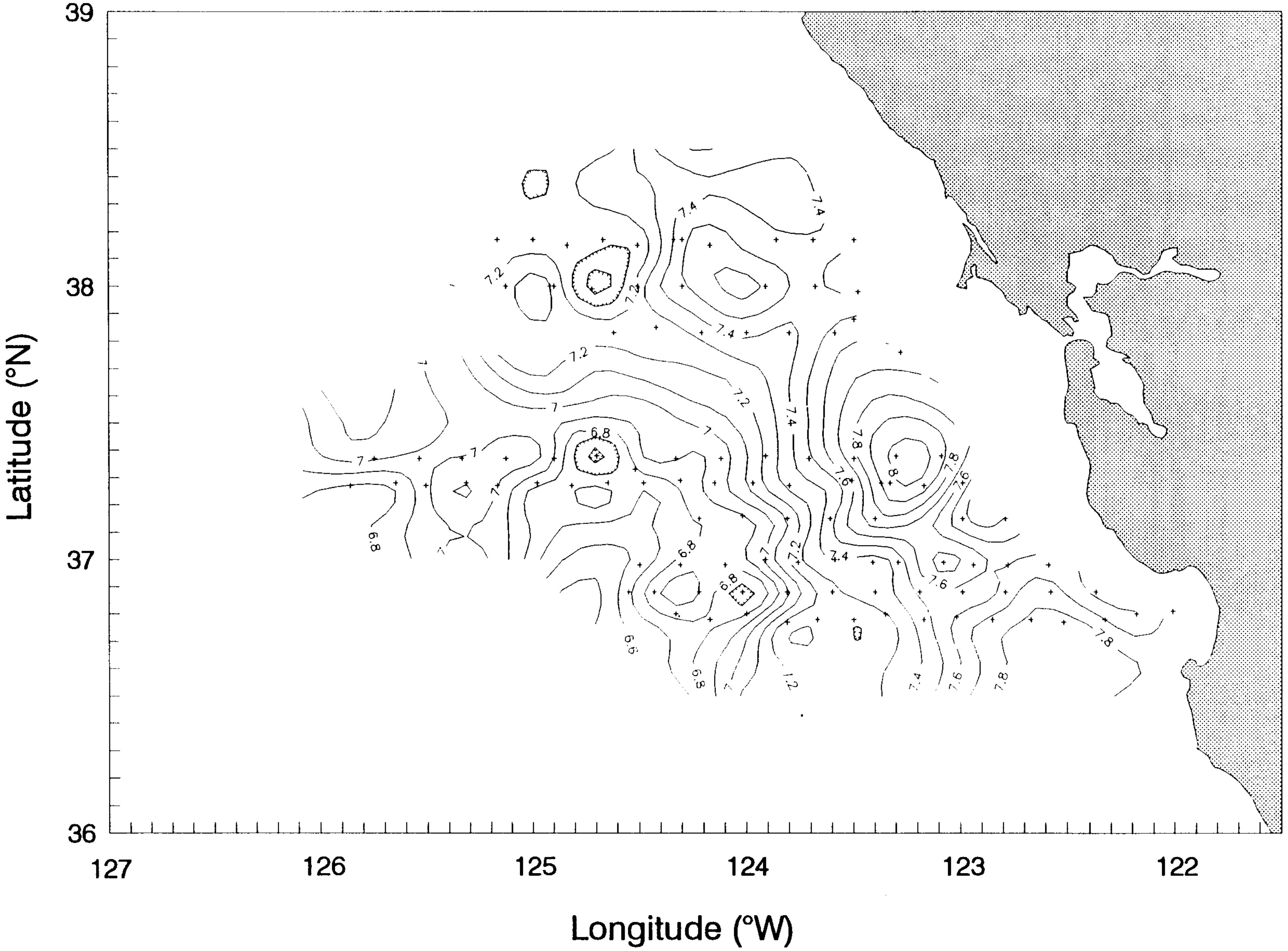


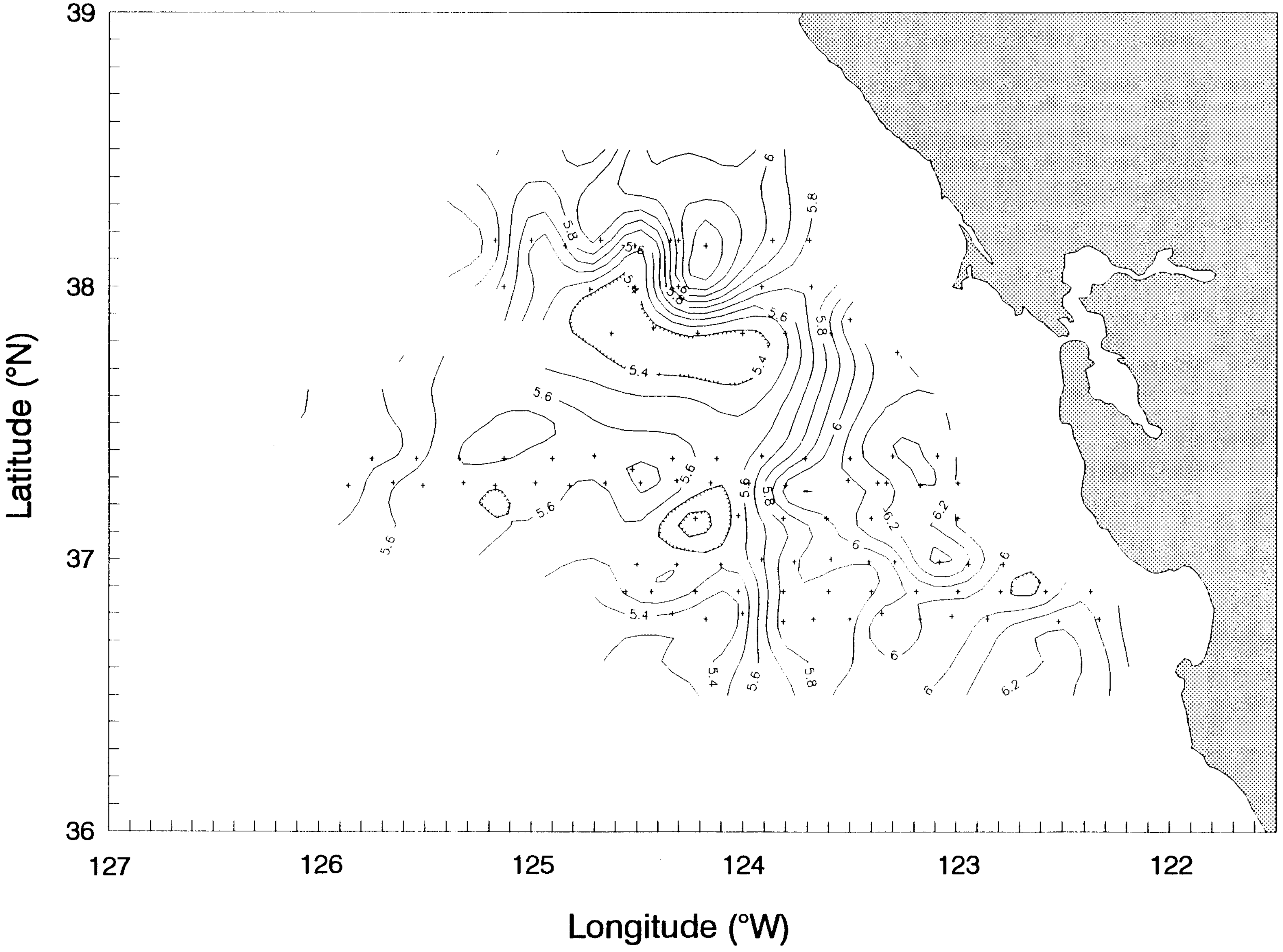
DSJ9203 Temperature (°C) at 100 m



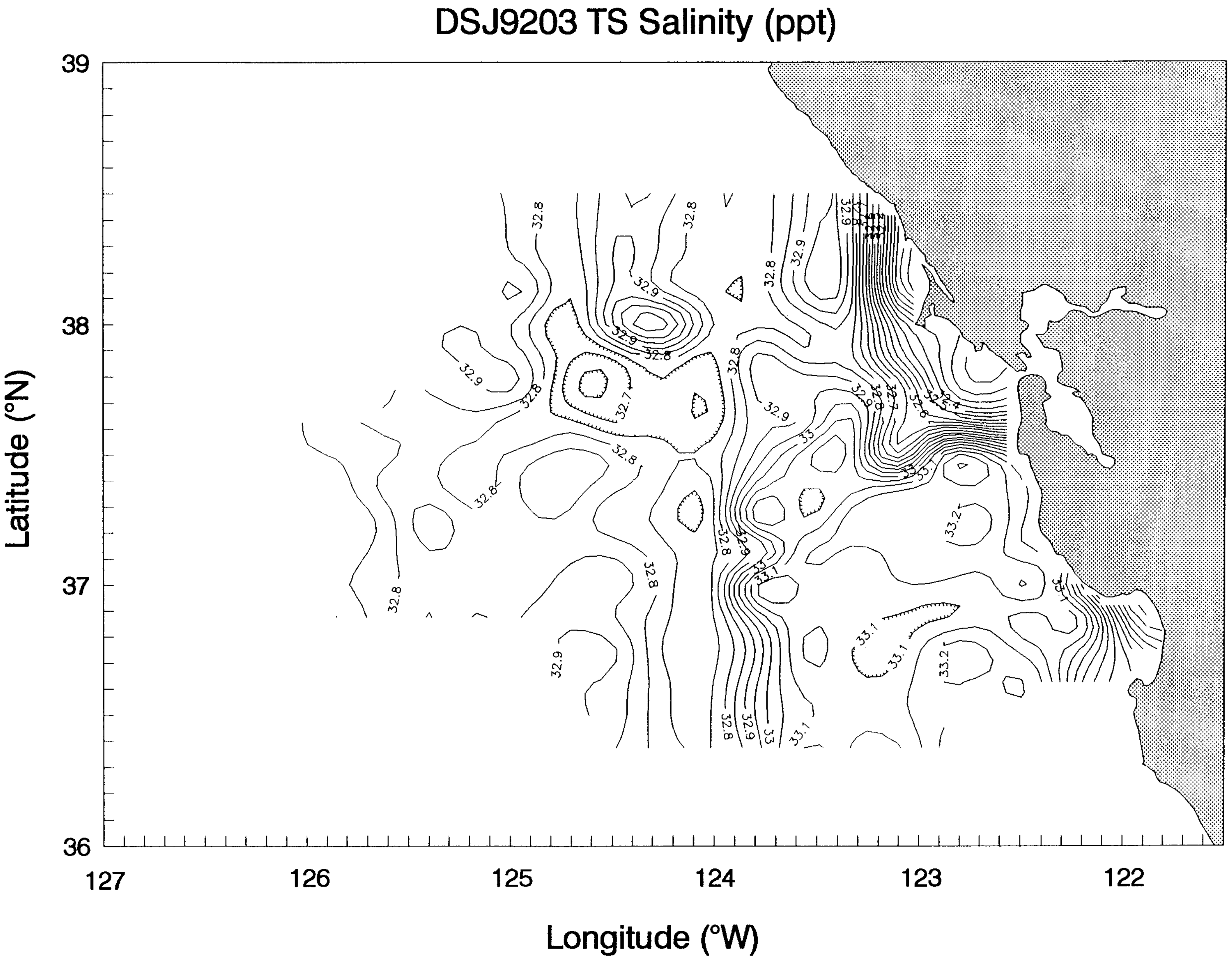

DSJ9203 Temperature (°C) at 200 m
Latitude (°N)
Longitude (°W)
39
38
37
36
127
126
125
124
123
122
7.8
8
8.2
8.4
8.6
8.8
9

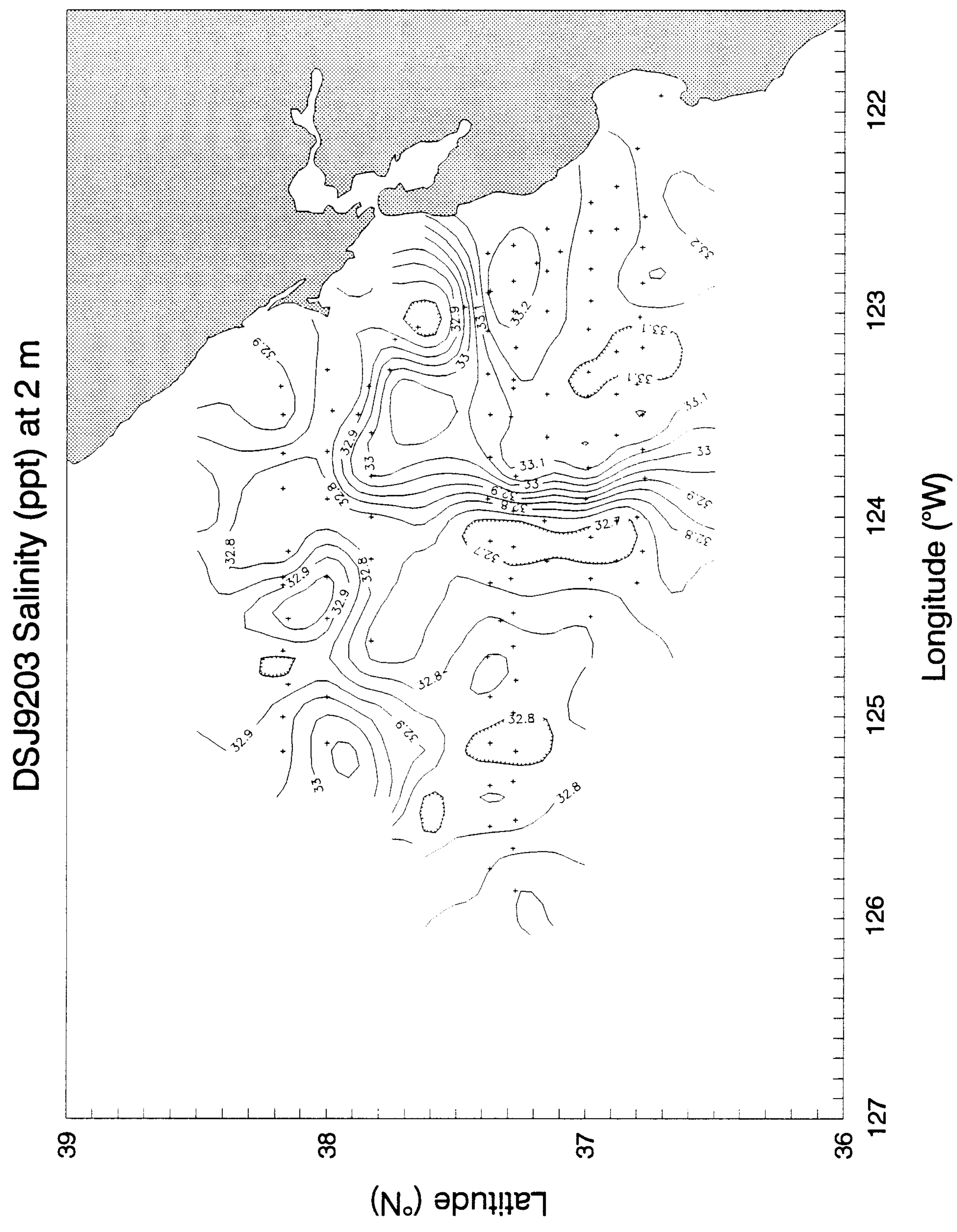
DSJ9203 Temperature (°C) at 300 m





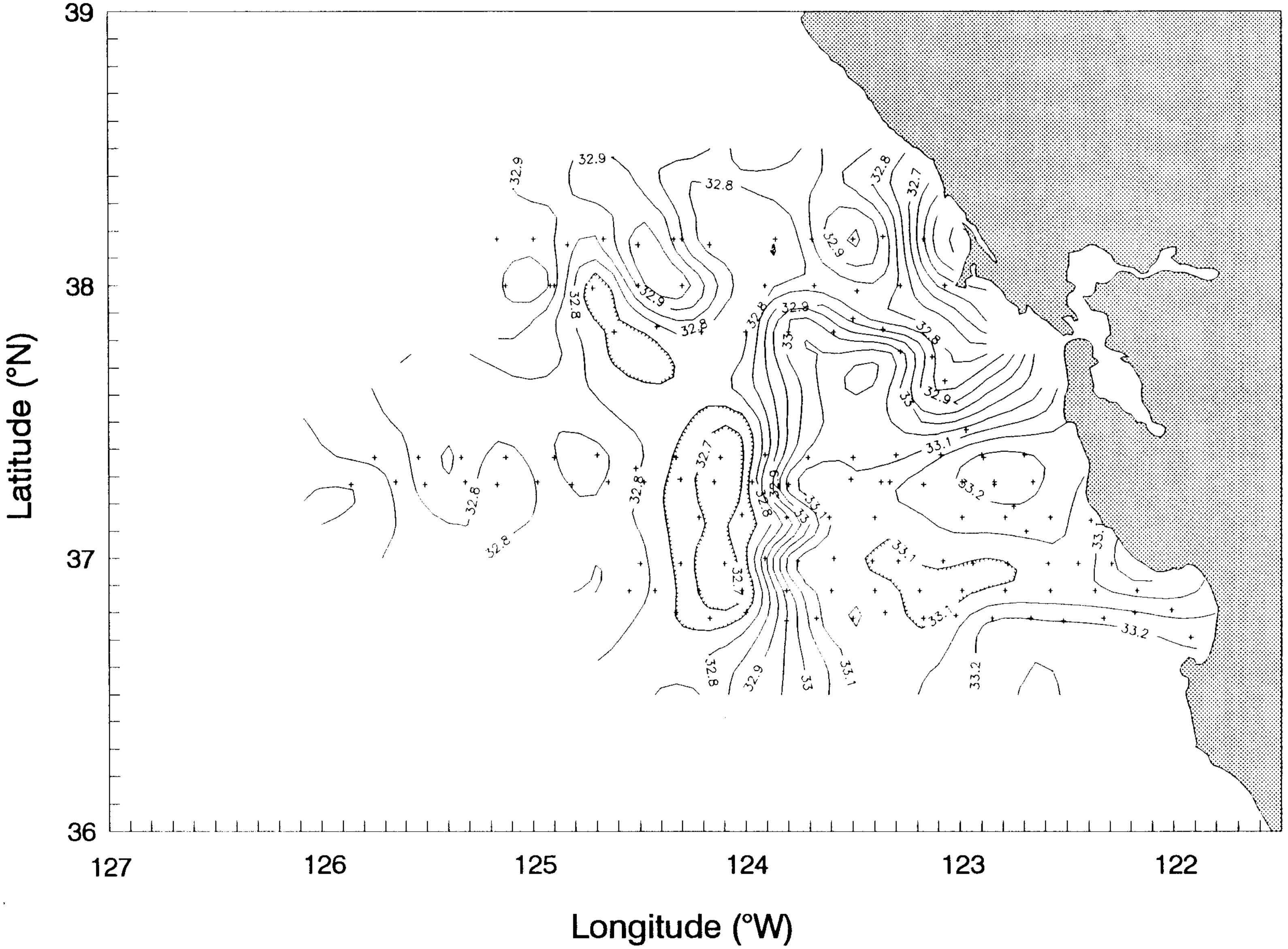
DSJ9203 Temperature (°C) at 500 m

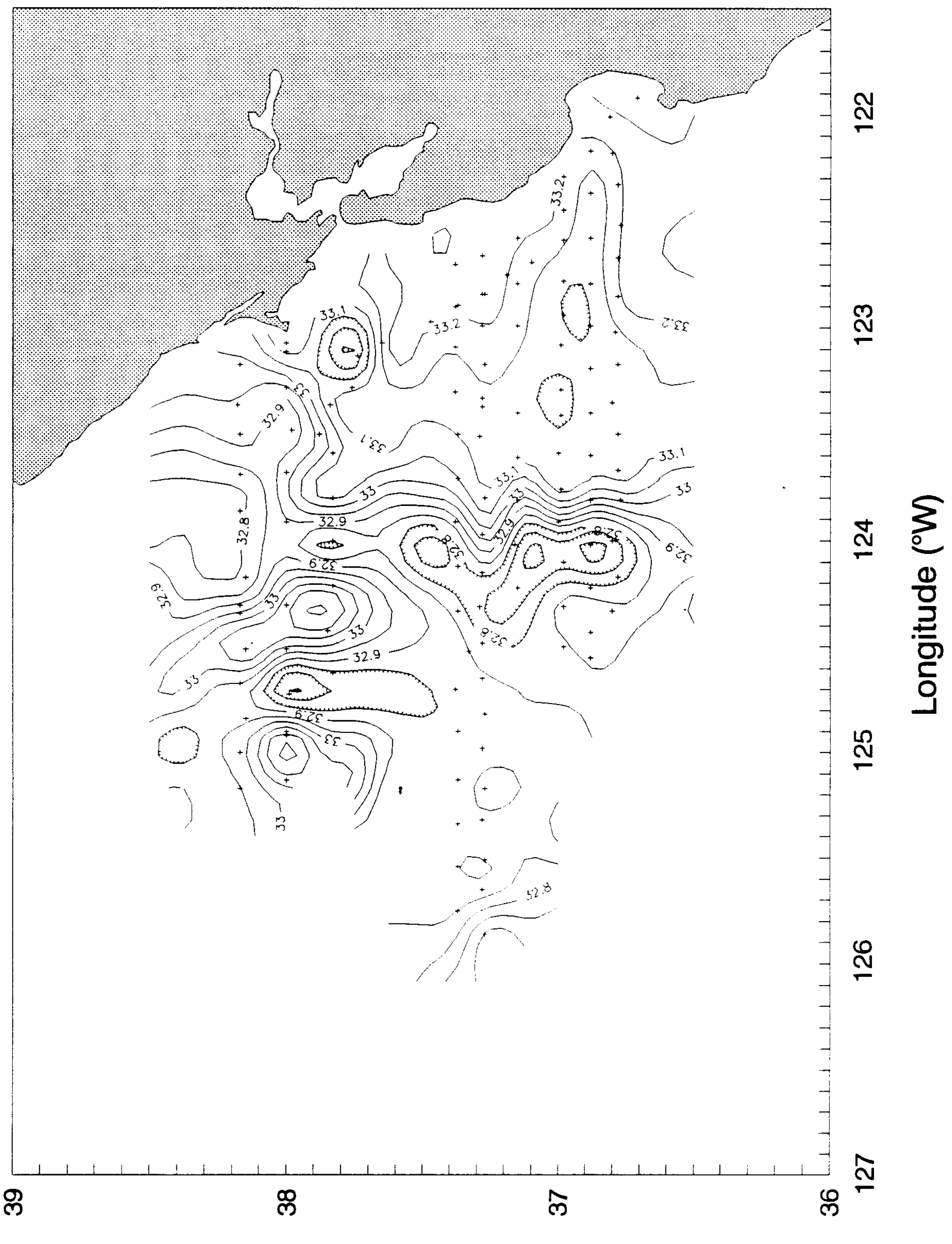

DSJ9203 TS Salinity (ppt)
Latitude (°N)
Longitude (°W)
39
38
37
36
127
126
125
124
123
122
32.7
32.8
32.9
33
33.1
33.2
32.4
32.5
32.6



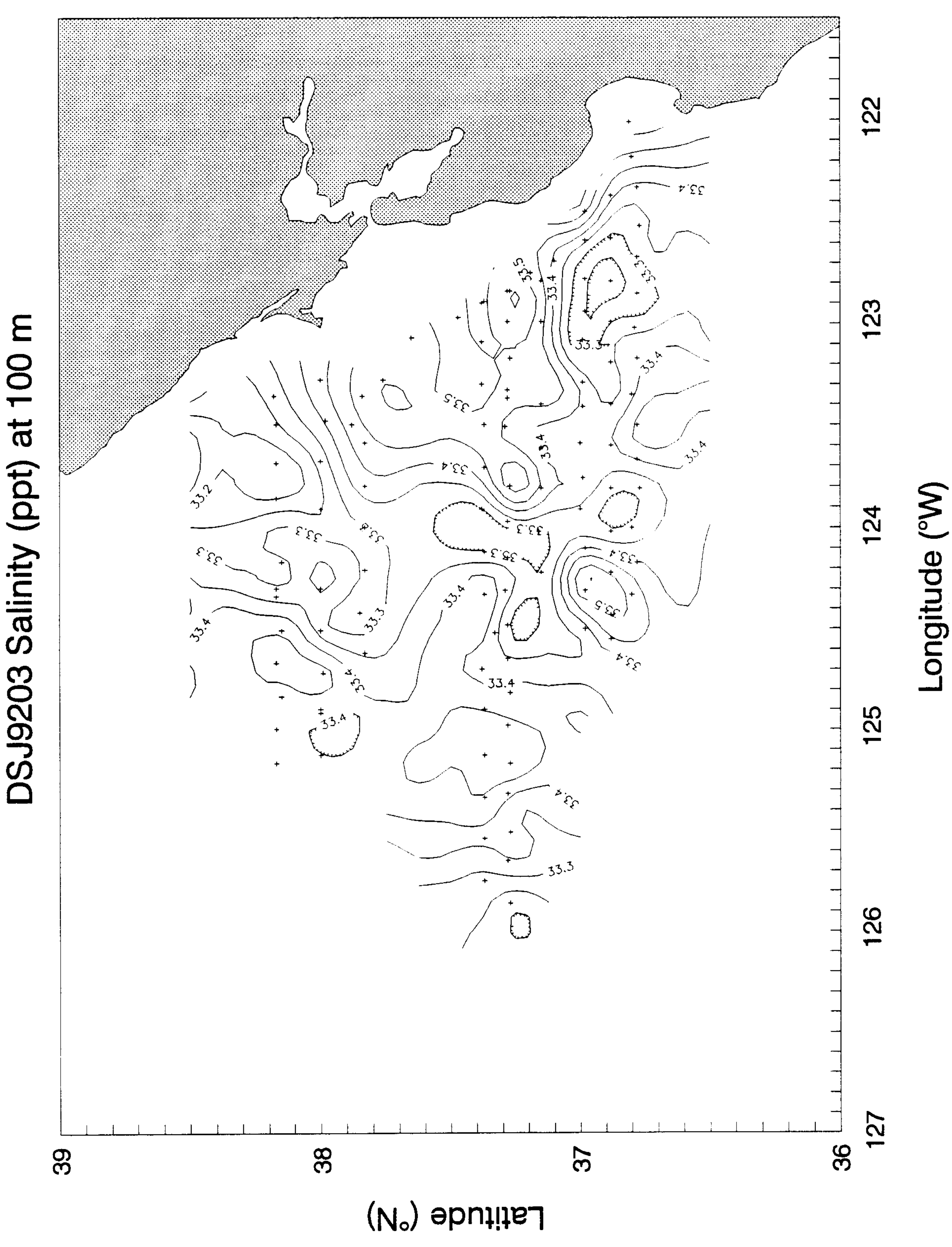
DSJ9203 Salinity (ppt) at 2 m

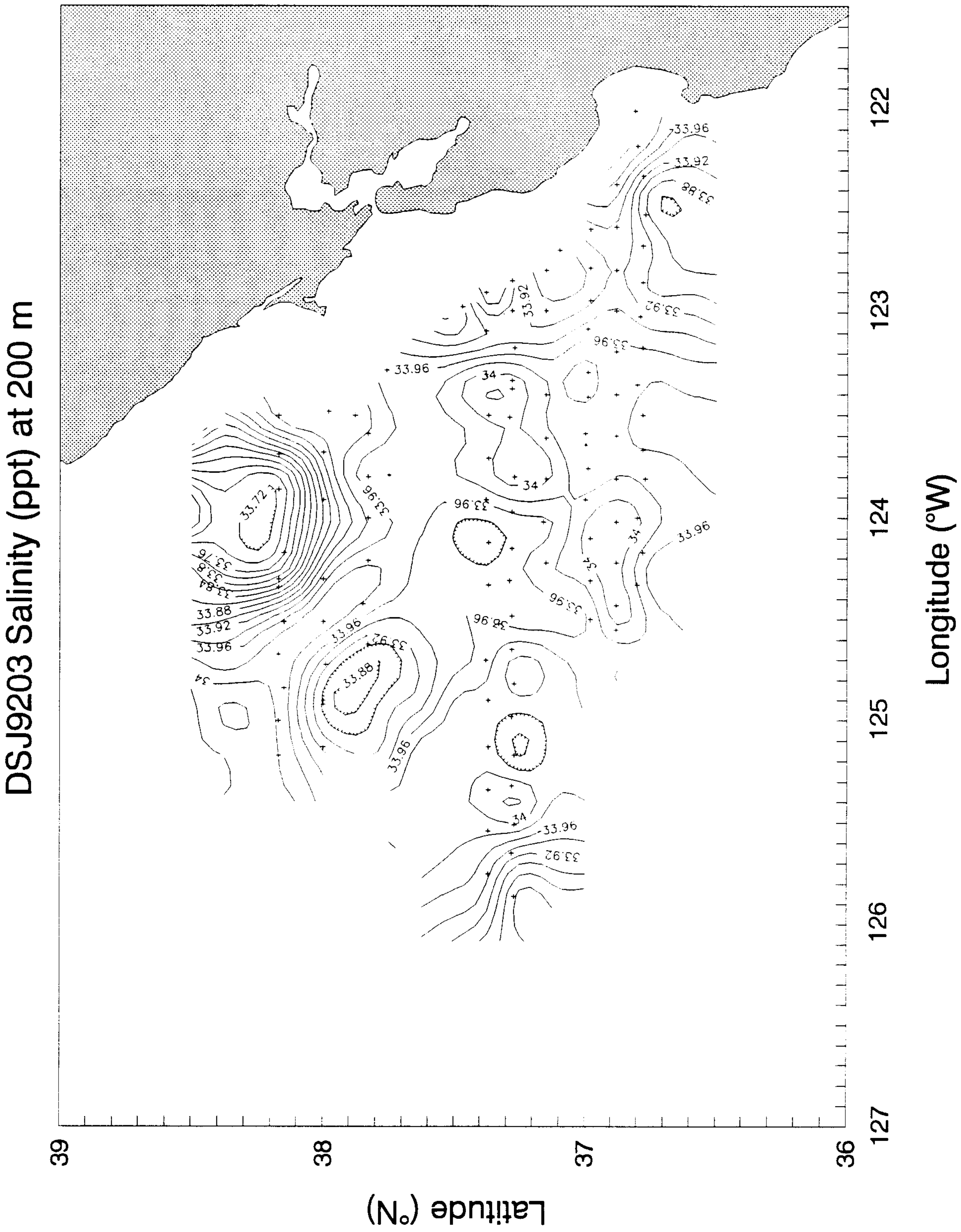
DSJ9203 Salinity (ppt) at 10 m

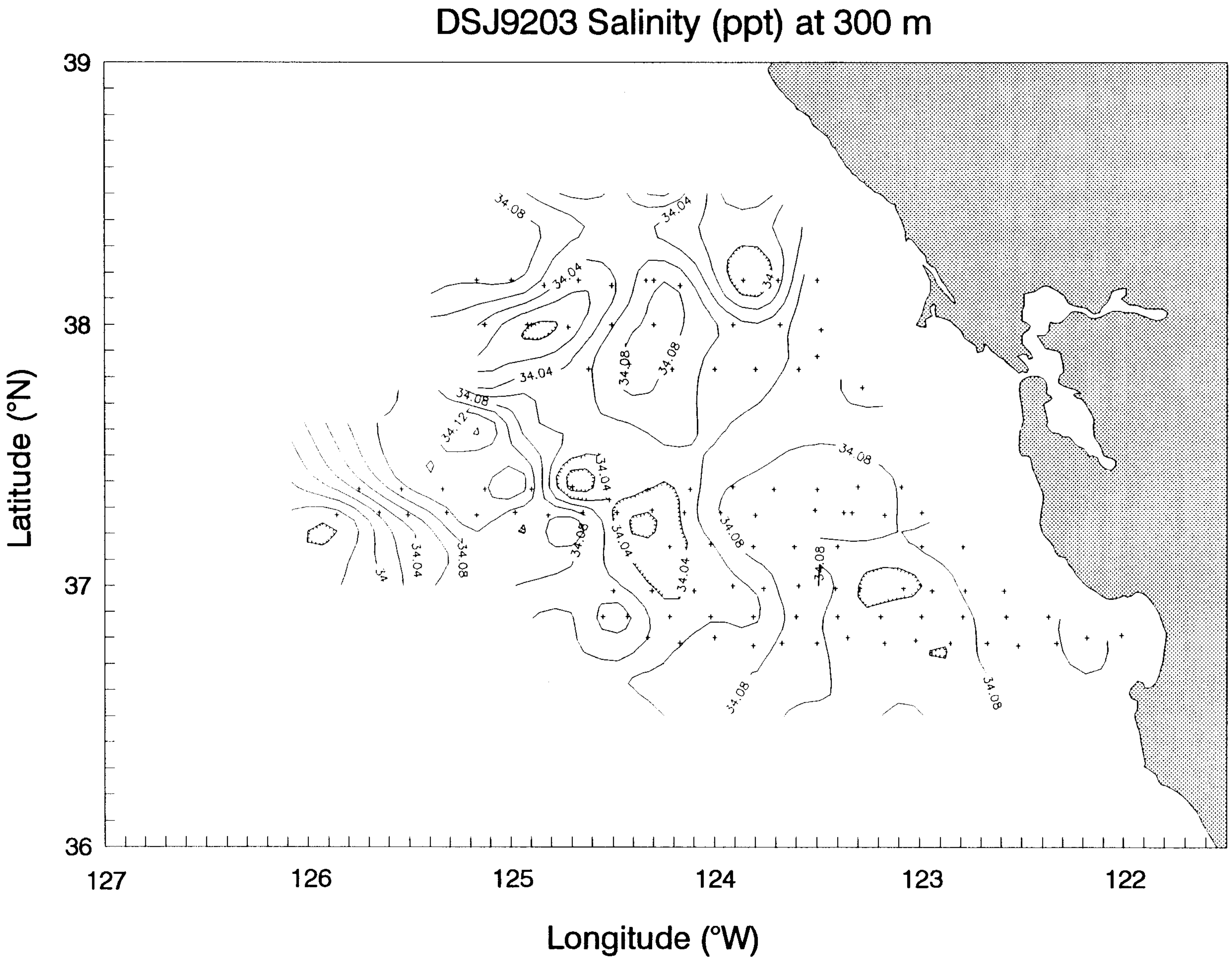




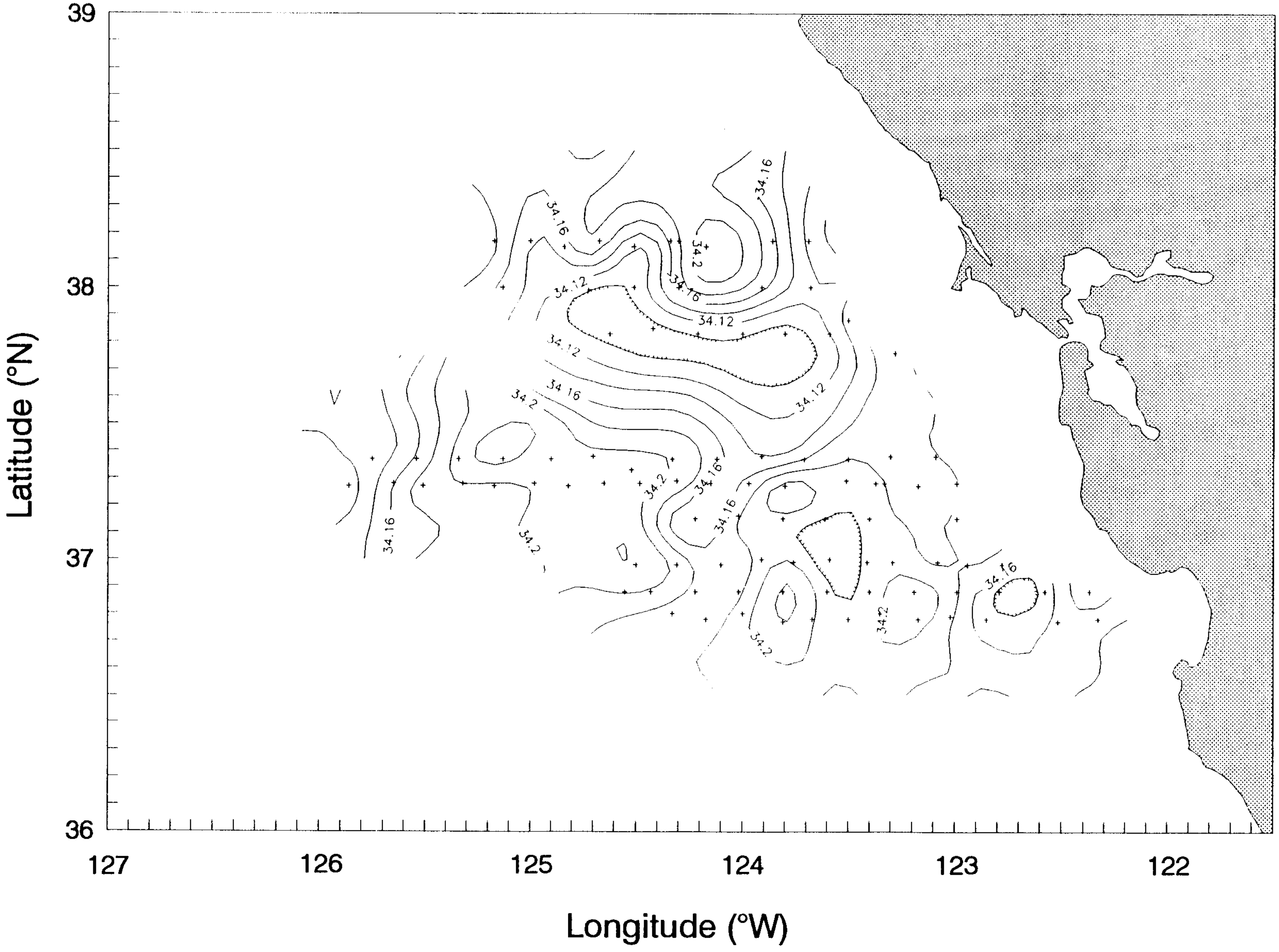
DSJ9203 Salinity (ppt) at 30 m

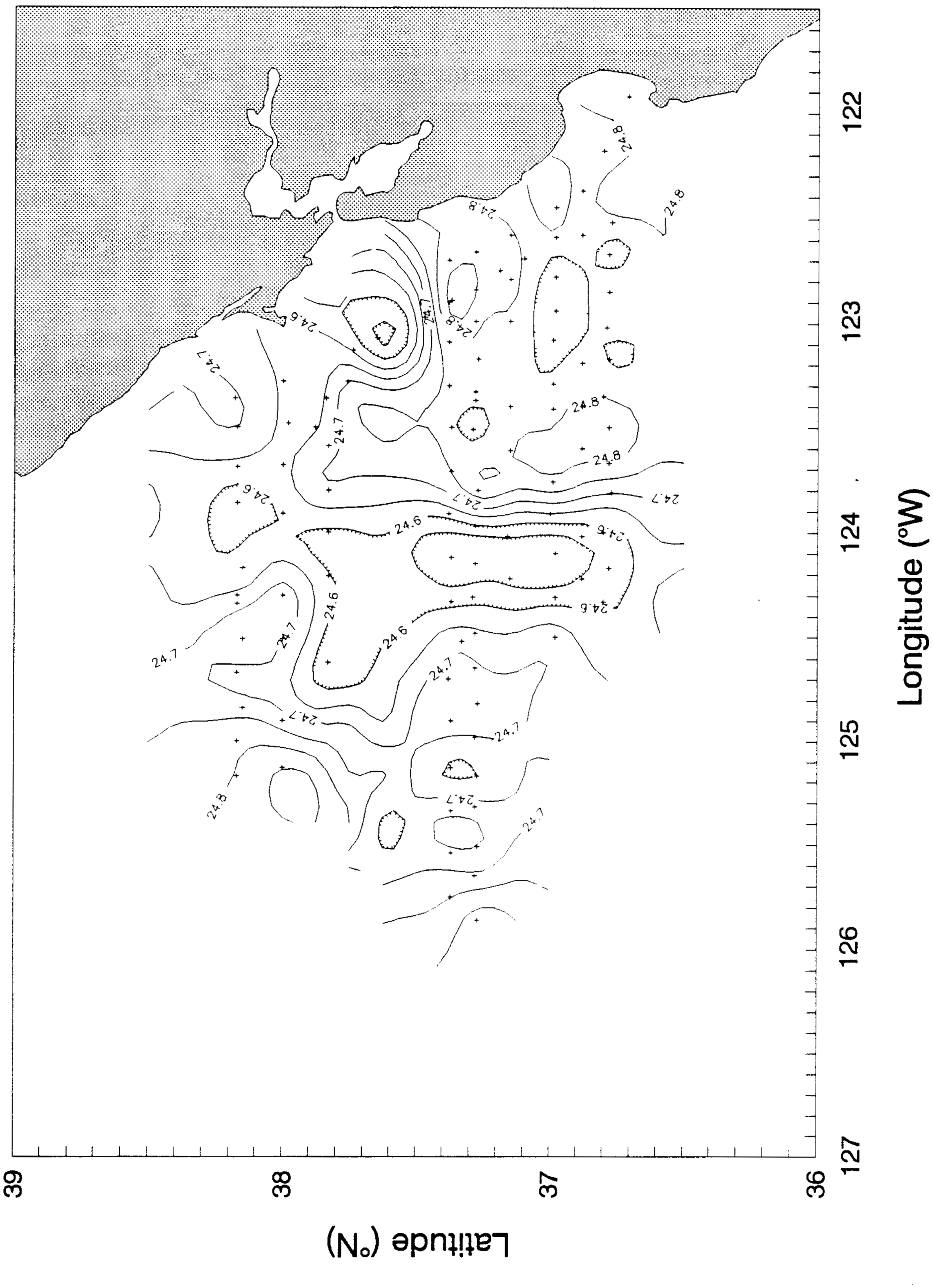

DSJ9203 Salinity (ppt) at 100 m
Latitude (°N)
Longitude (°W)
39
38
37
36
127
126
125
124
123
122
33.2
33.3
33.4
33.5


DSJ9203 Salinity (ppt) at 200 m

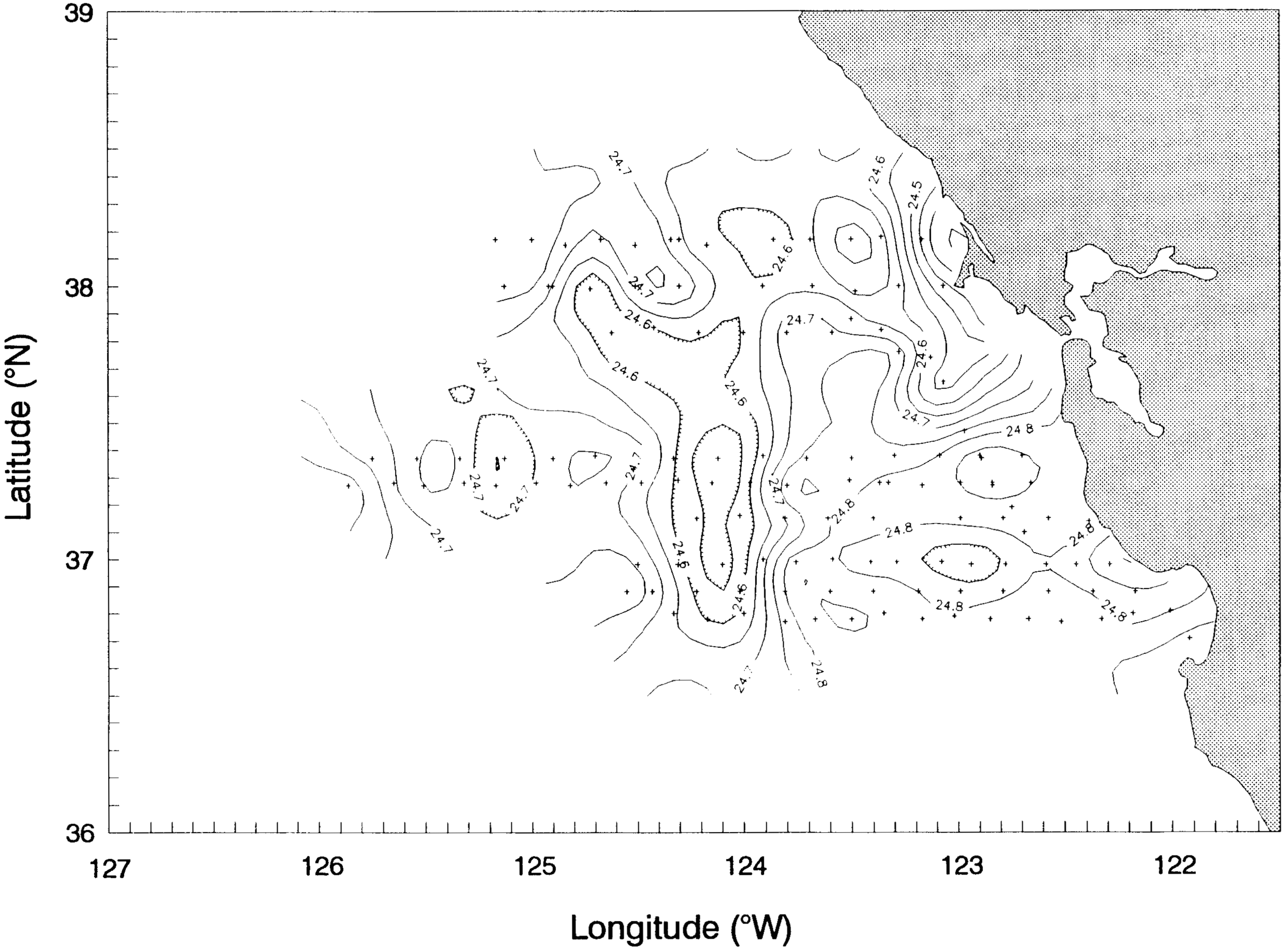

DSJ9203 Salinity (ppt) at 300 m
Latitude (°N)
39
38
37
36
Longitude (°W)
127
126
125
124
123
122
34.08
34.04
34
34.12

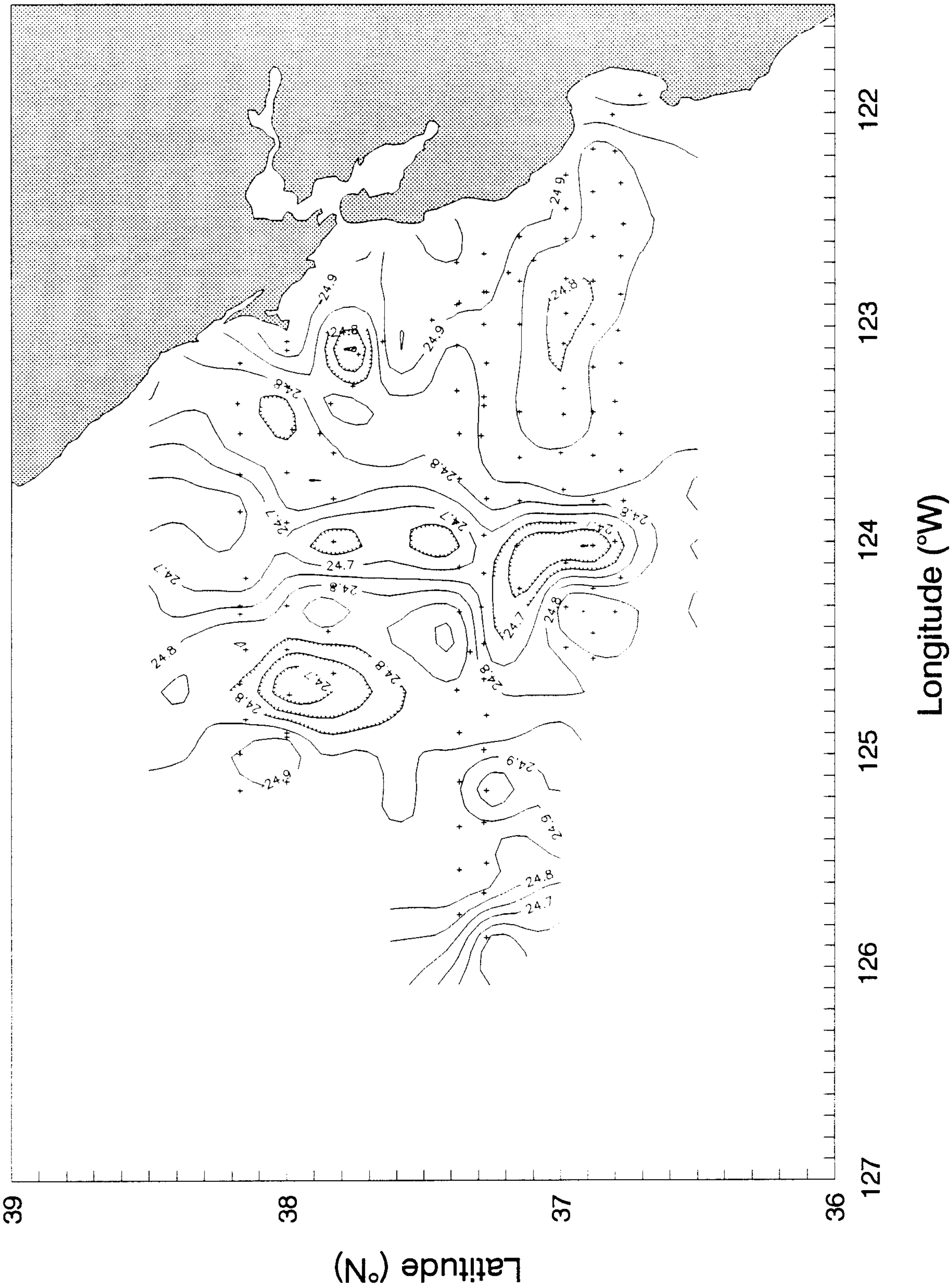
DSJ9203 Salinity (ppt) at 500 m




DSJ9203 Density (kg/m³) at 2 m

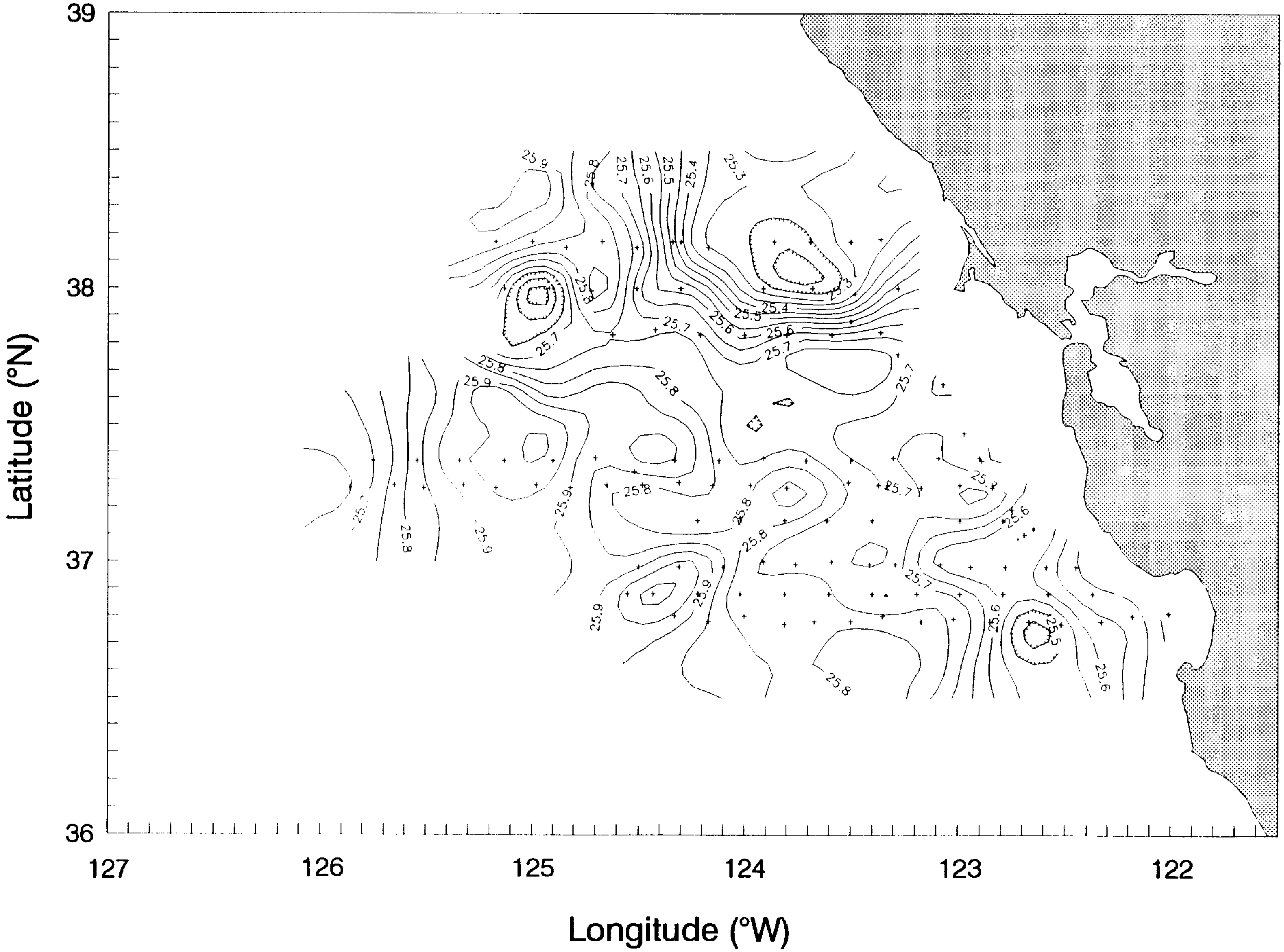
DSJ9203 Density (kg/m³) at 10 m



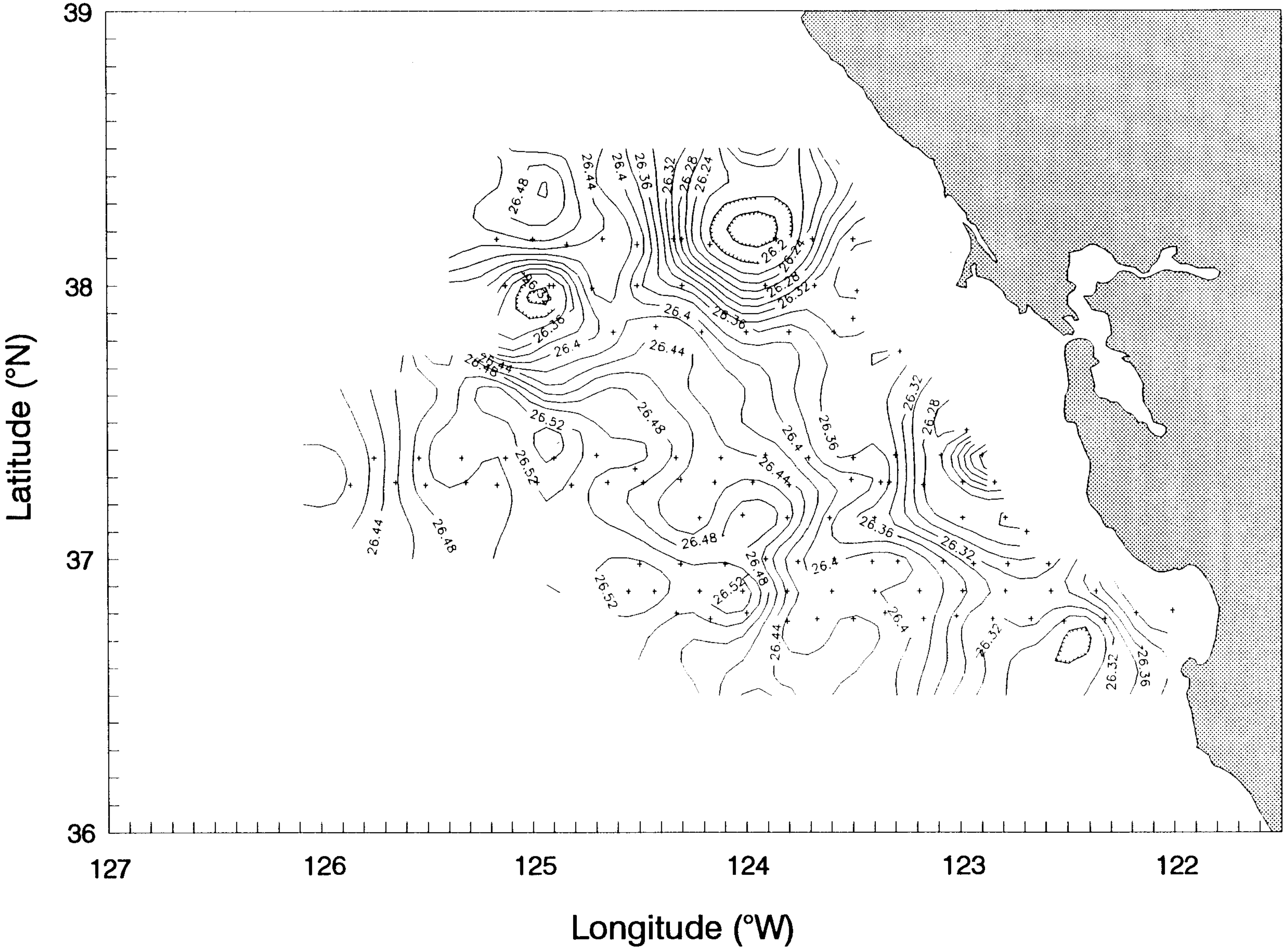


DSJ9203 Density (kg/m³) at 30 m

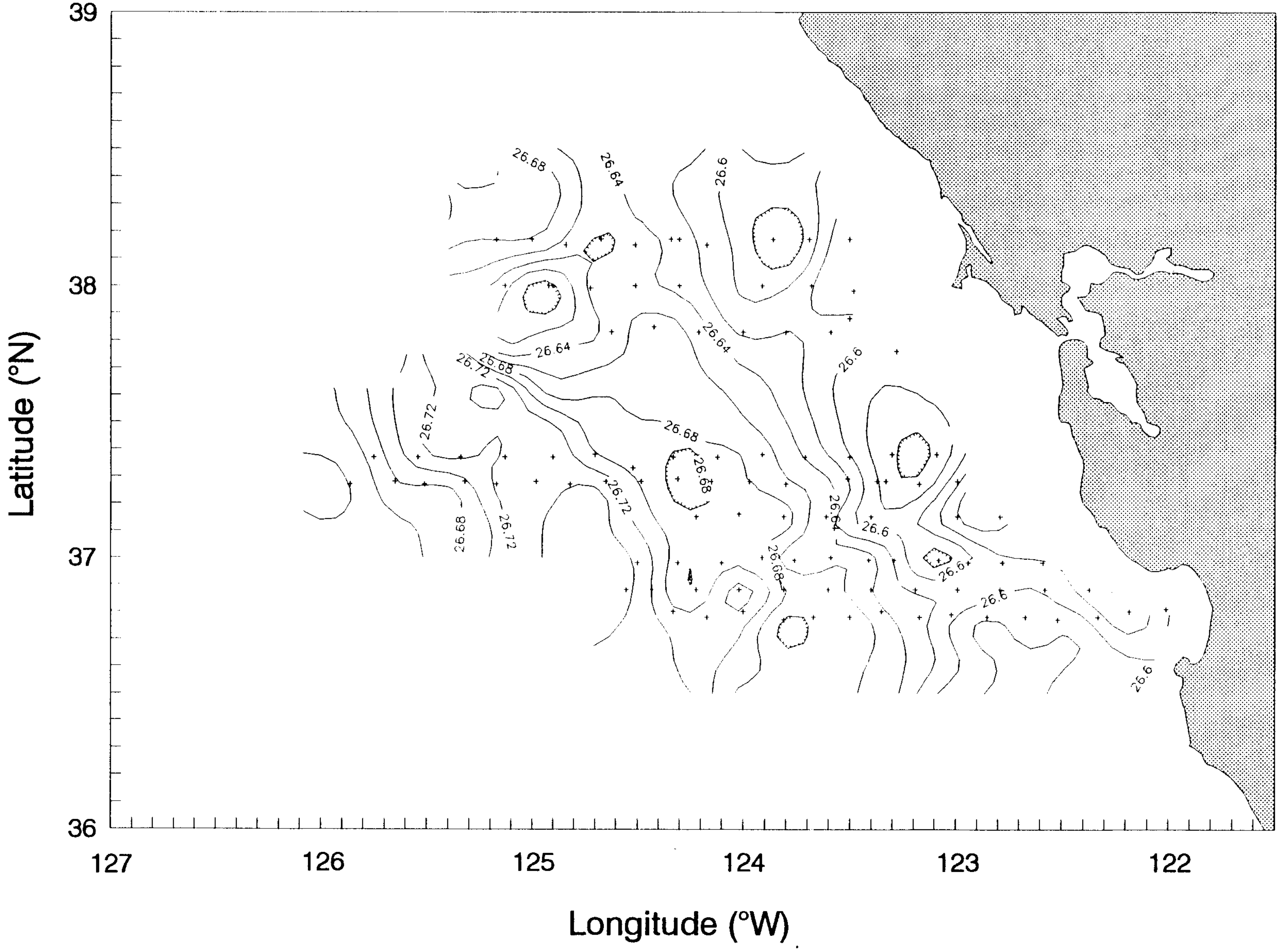
DSJ9203 Density (kg/m³) at 100 m

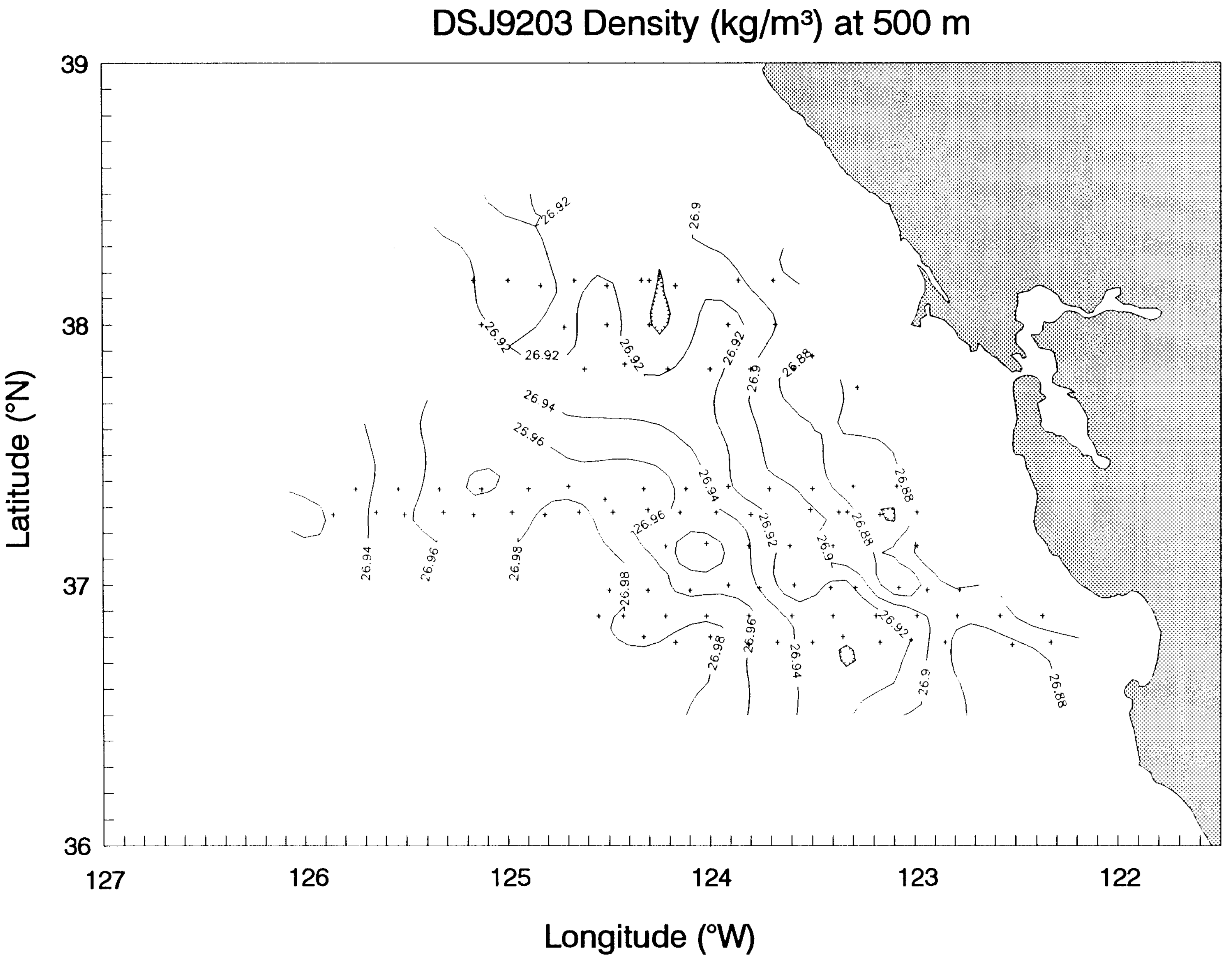


DSJ9203 Density (kg/m³) at 200 m

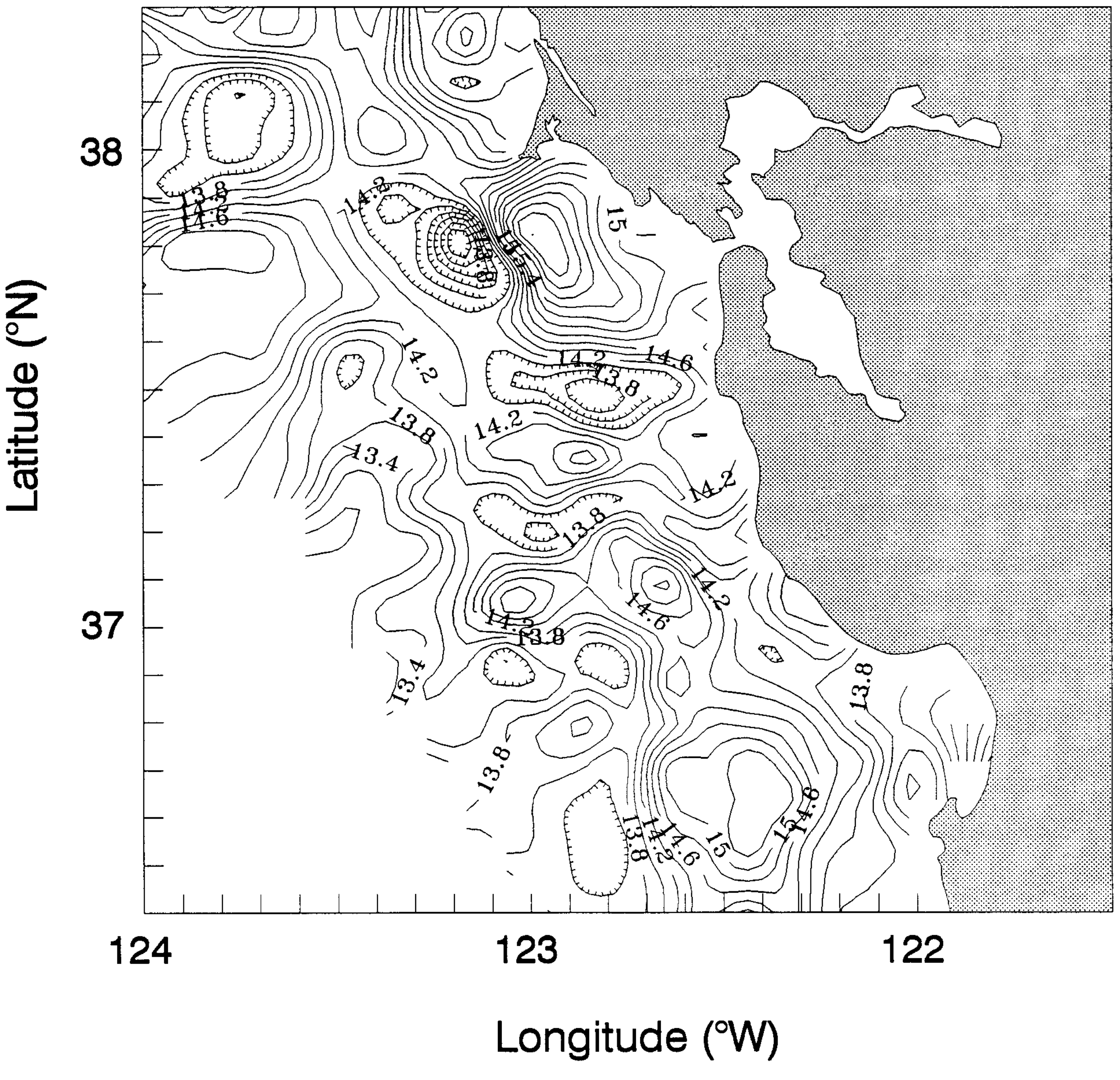


DSJ9203 Density (kg/m³) at 300 m



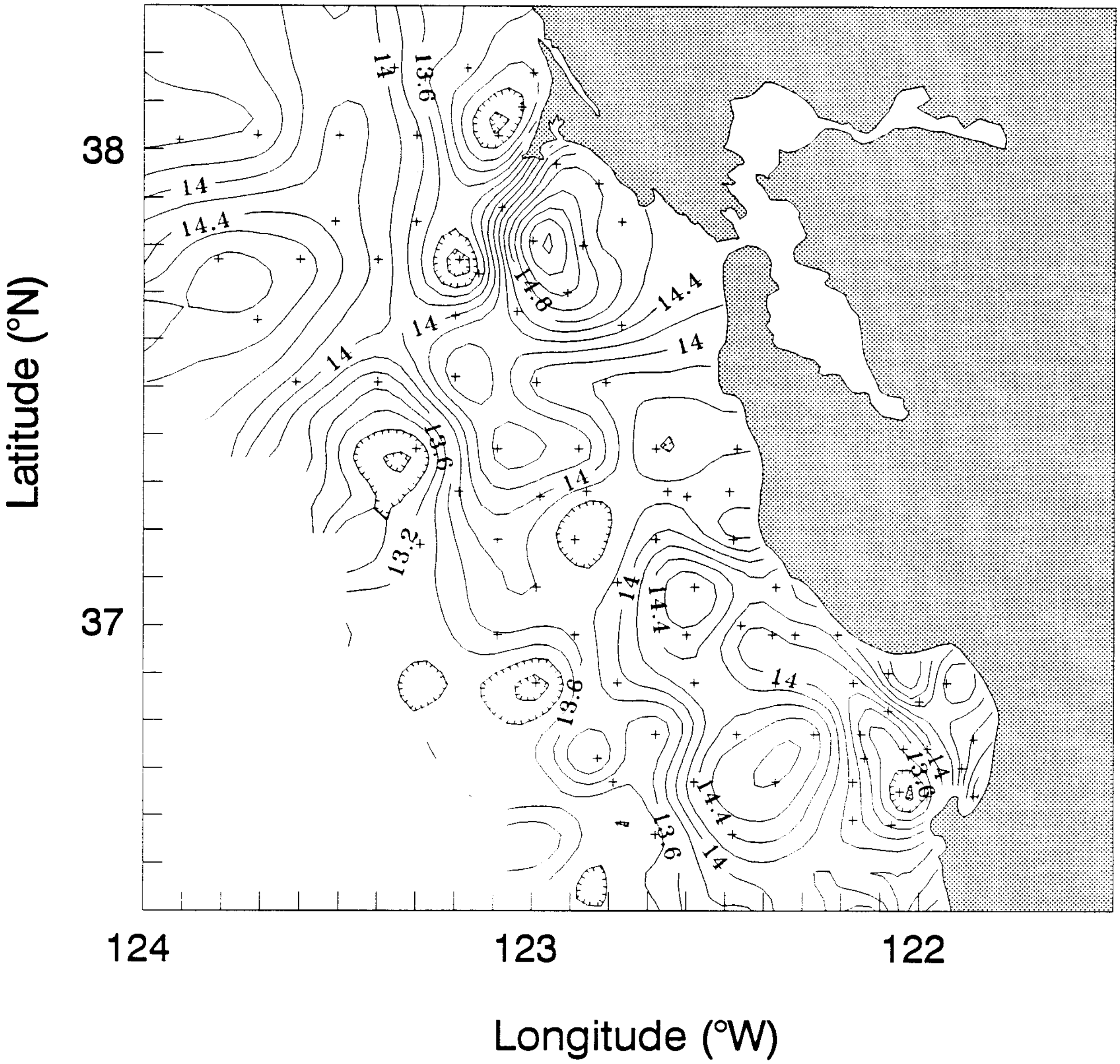

DSJ9203 Density (kg/m³) at 500 m
Latitude (°N)
Longitude (°W)
39
38
37
36
127
126
125
124
123
122
26.92
26.9
26.92
26.92
26.92
26.92
26.92
26.9
26.88
26.94
25.96
26.94
26.96
26.88
26.88
26.92
26.9
26.94
26.96
26.98
26.98
26.92
26.98
26.96
26.94
26.9
26.88

APPENDIX 6.2: HORIZONTAL MAPS OF CTD AND TS FOR DSJ9206, SWEEP 1

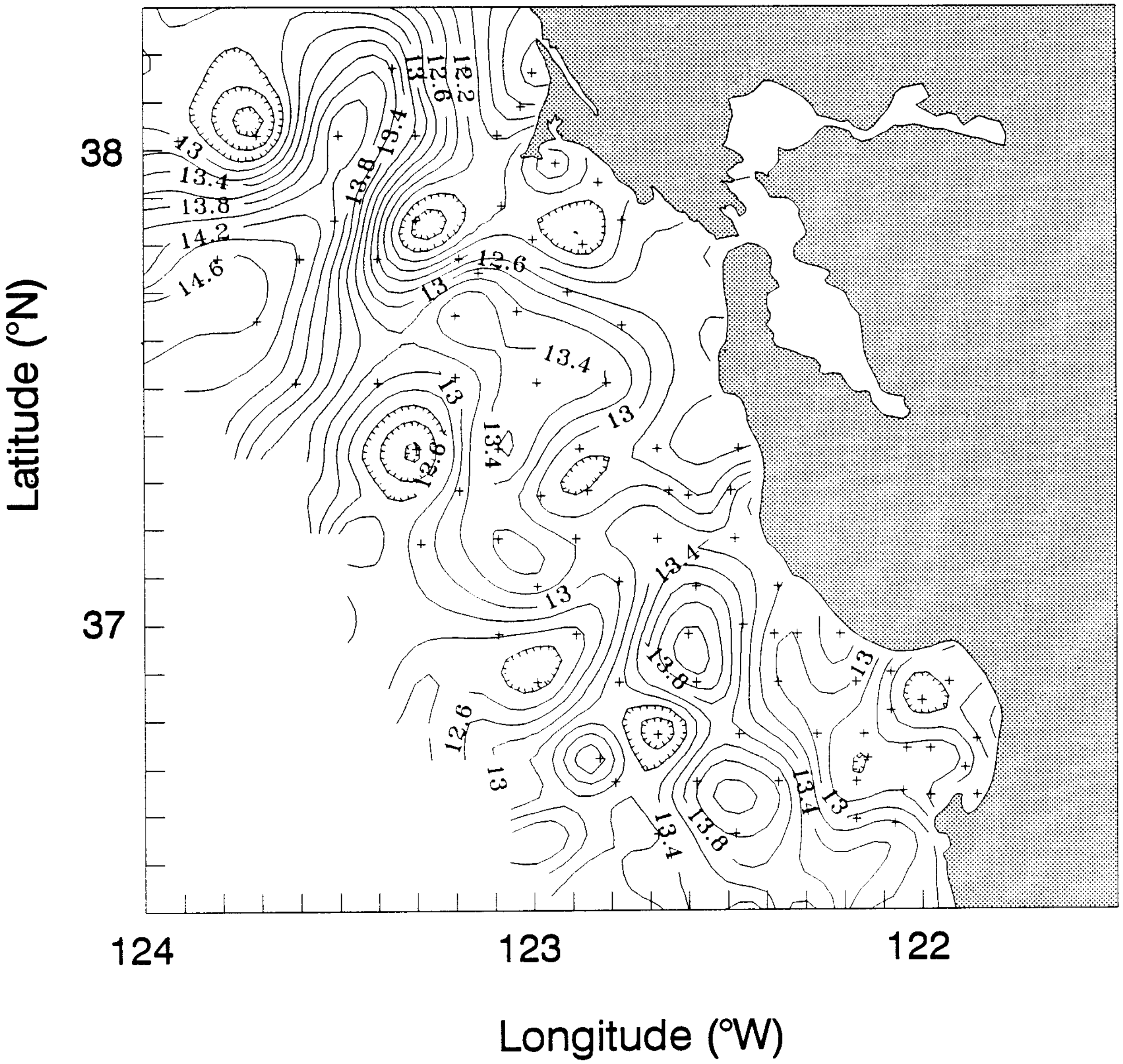


DSJ9206 Sweep 1
TS Temperature (°C)

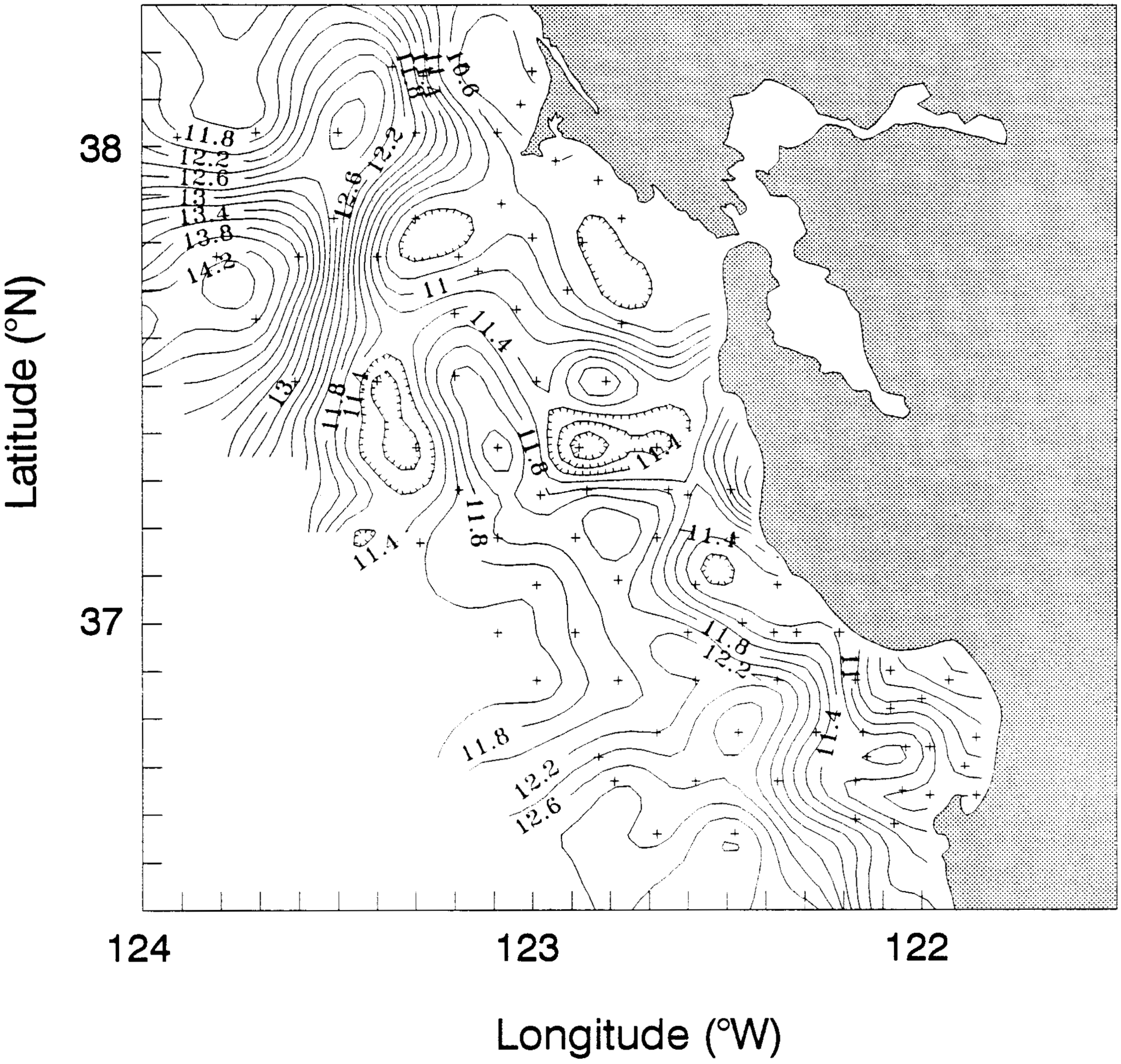
DSJ9206 Sweep 1
Temperature (°C) at 2 m

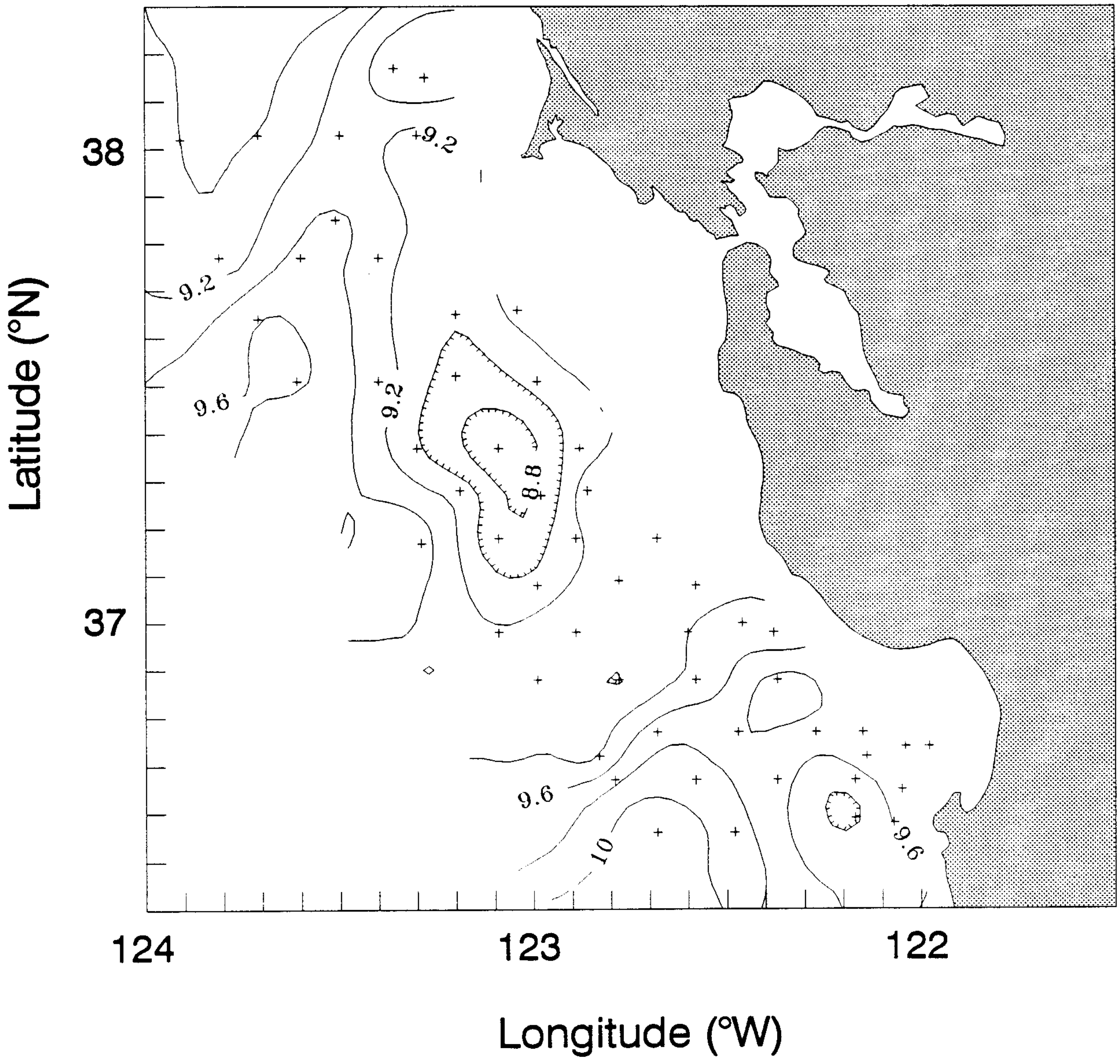


DSJ9206 Sweep 1
Temperature (°C) at 10 m



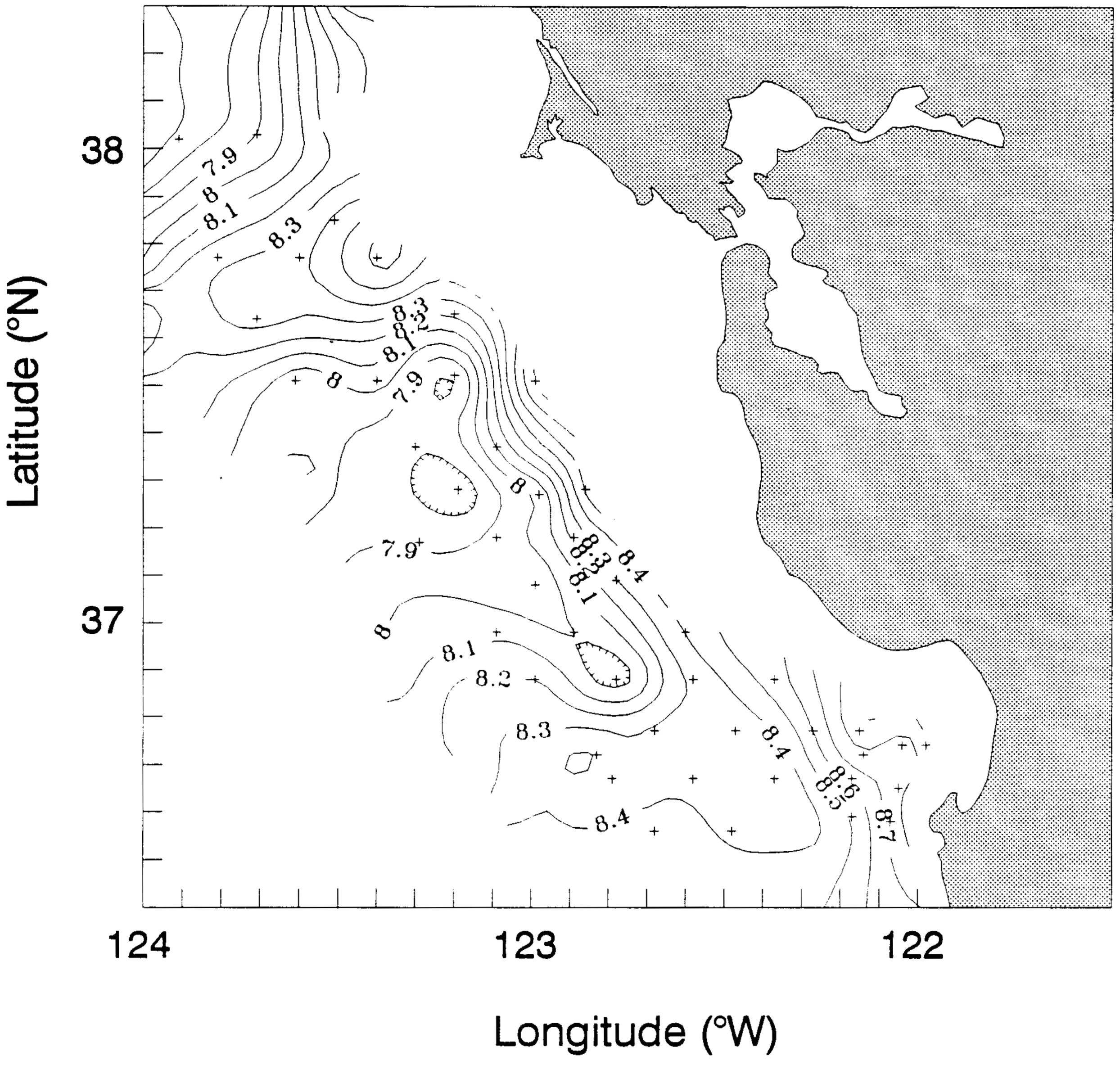
DSJ9206 Sweep 1
Temperature (°C) at 30 m

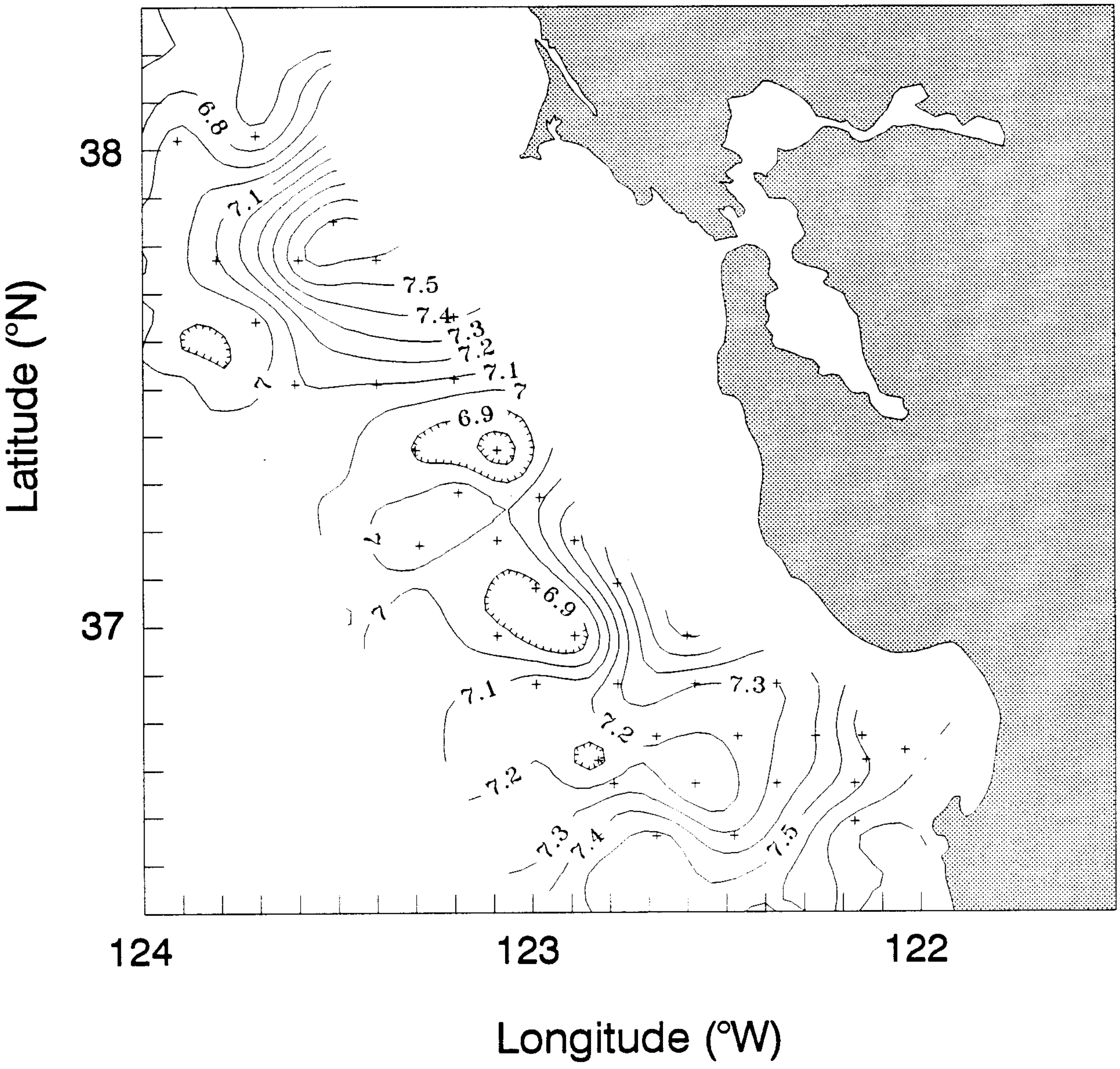




DSJ9206 Sweep 1
Temperature (°C) at 100 m

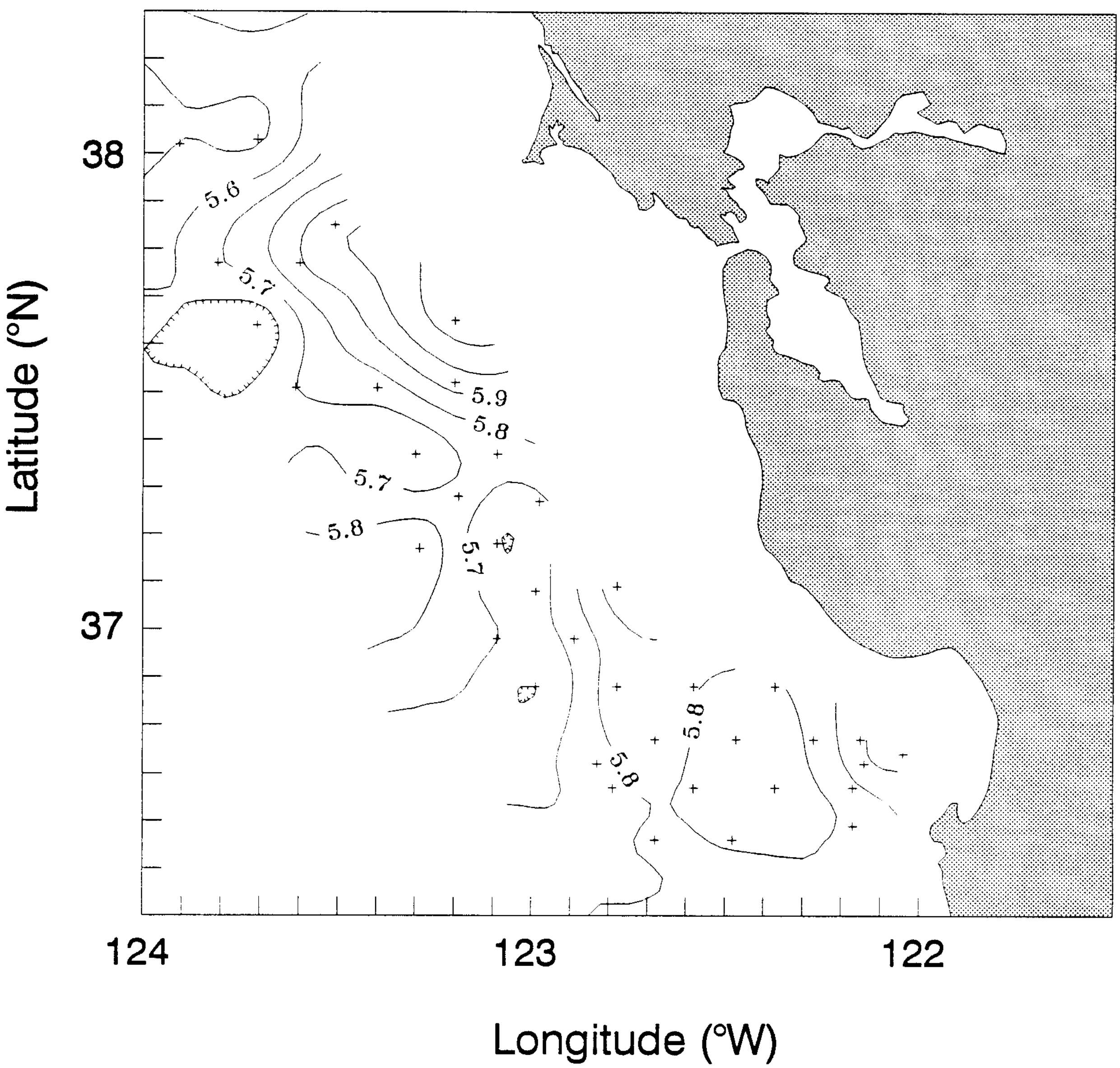
DSJ9206 Sweep 1
Temperature (°C) at 200 m



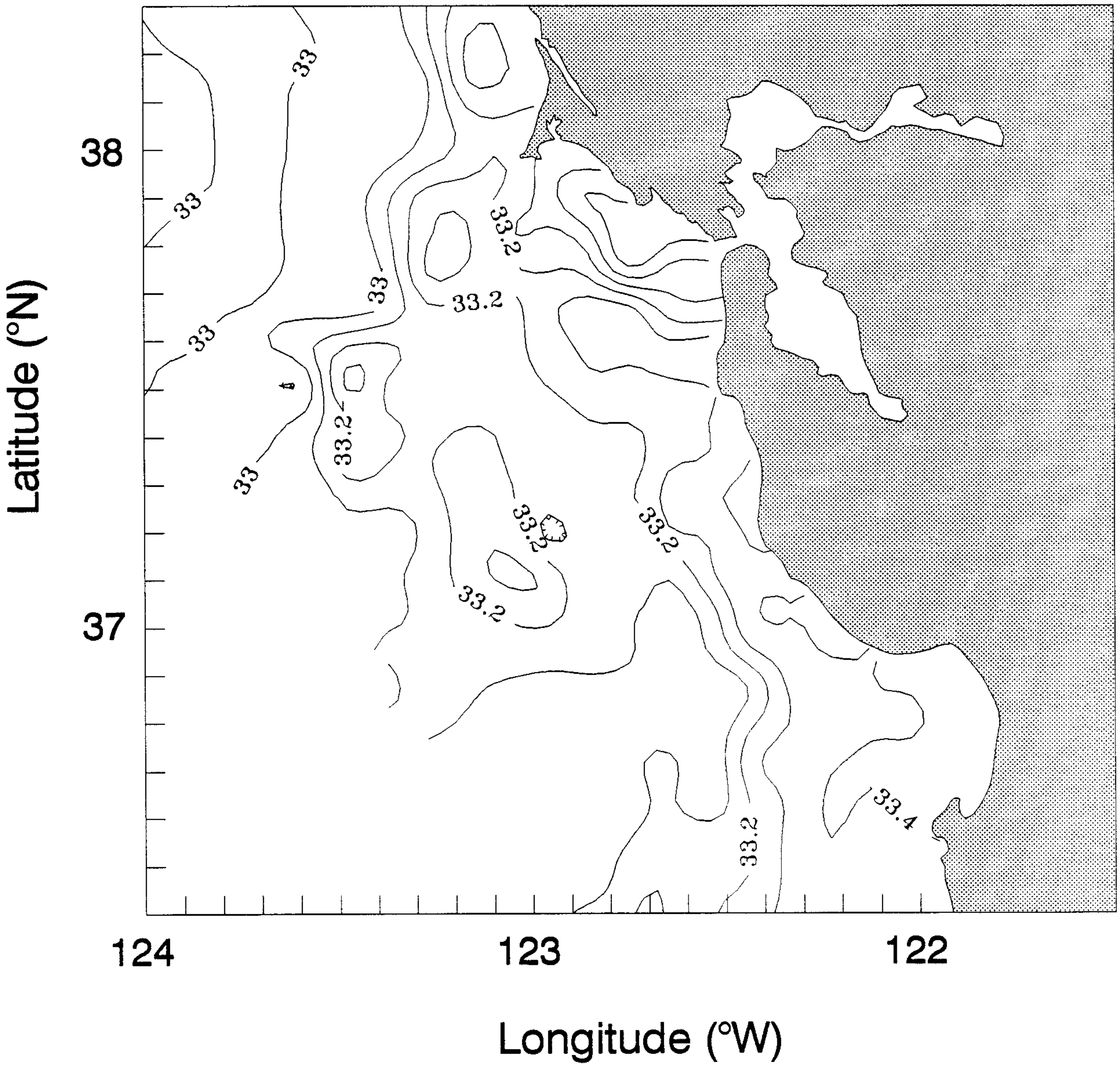


DSJ9206 Sweep 1
Temperature (°C) at 300 m

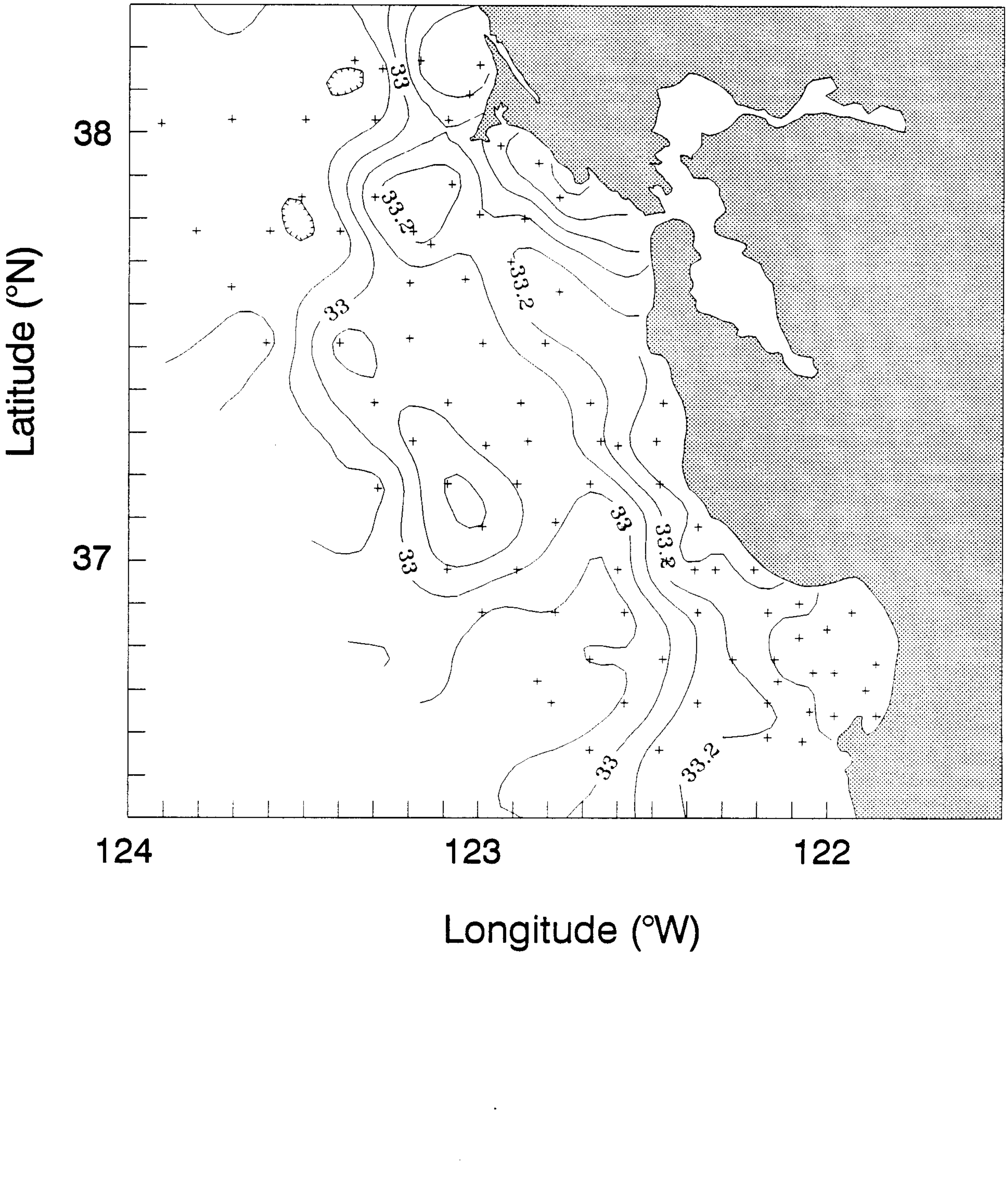
DSJ9206 Sweep 1
Temperature (°C) at 500 m



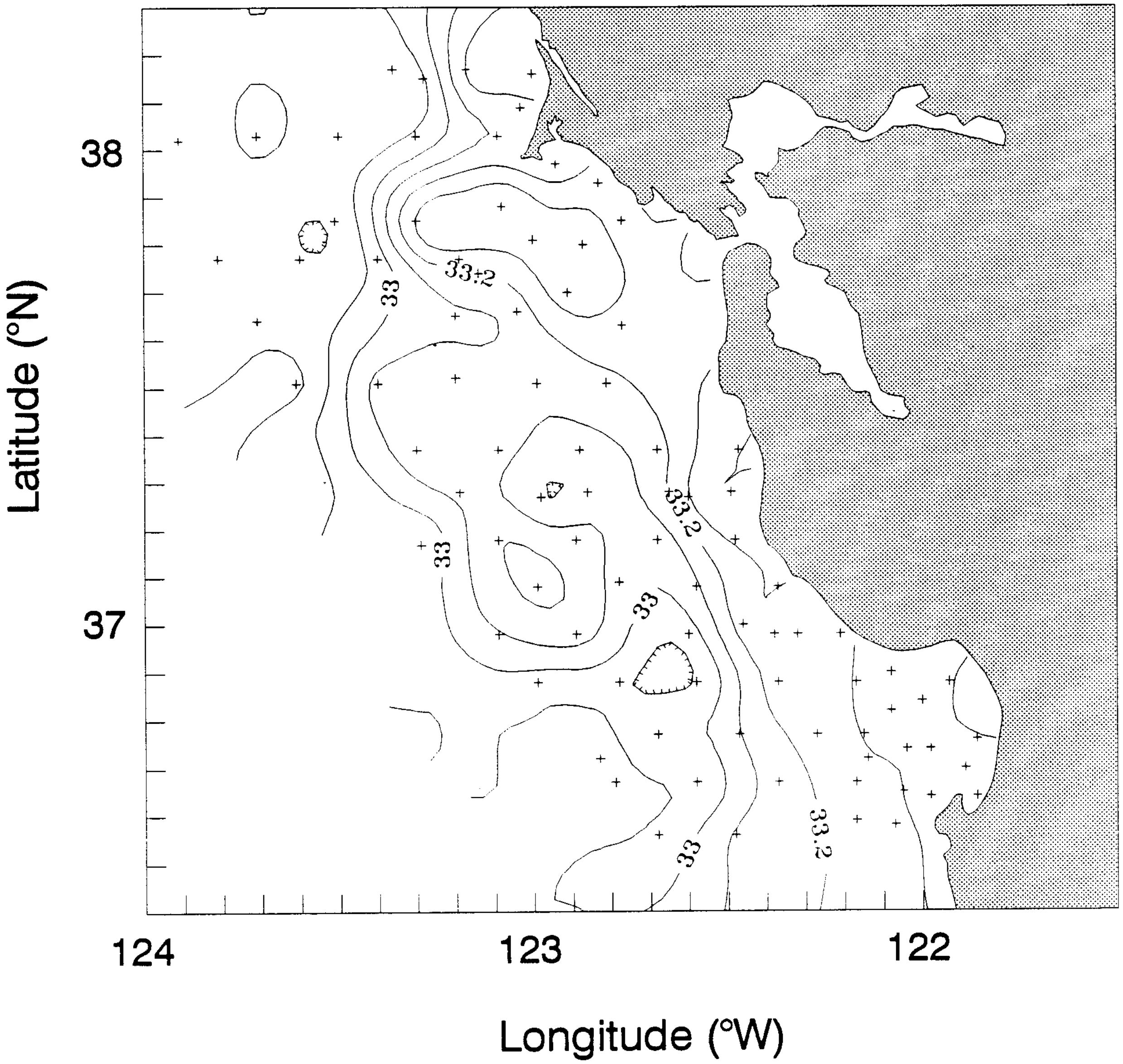
DSJ9206 Sweep 1
TS Salinity (ppt)



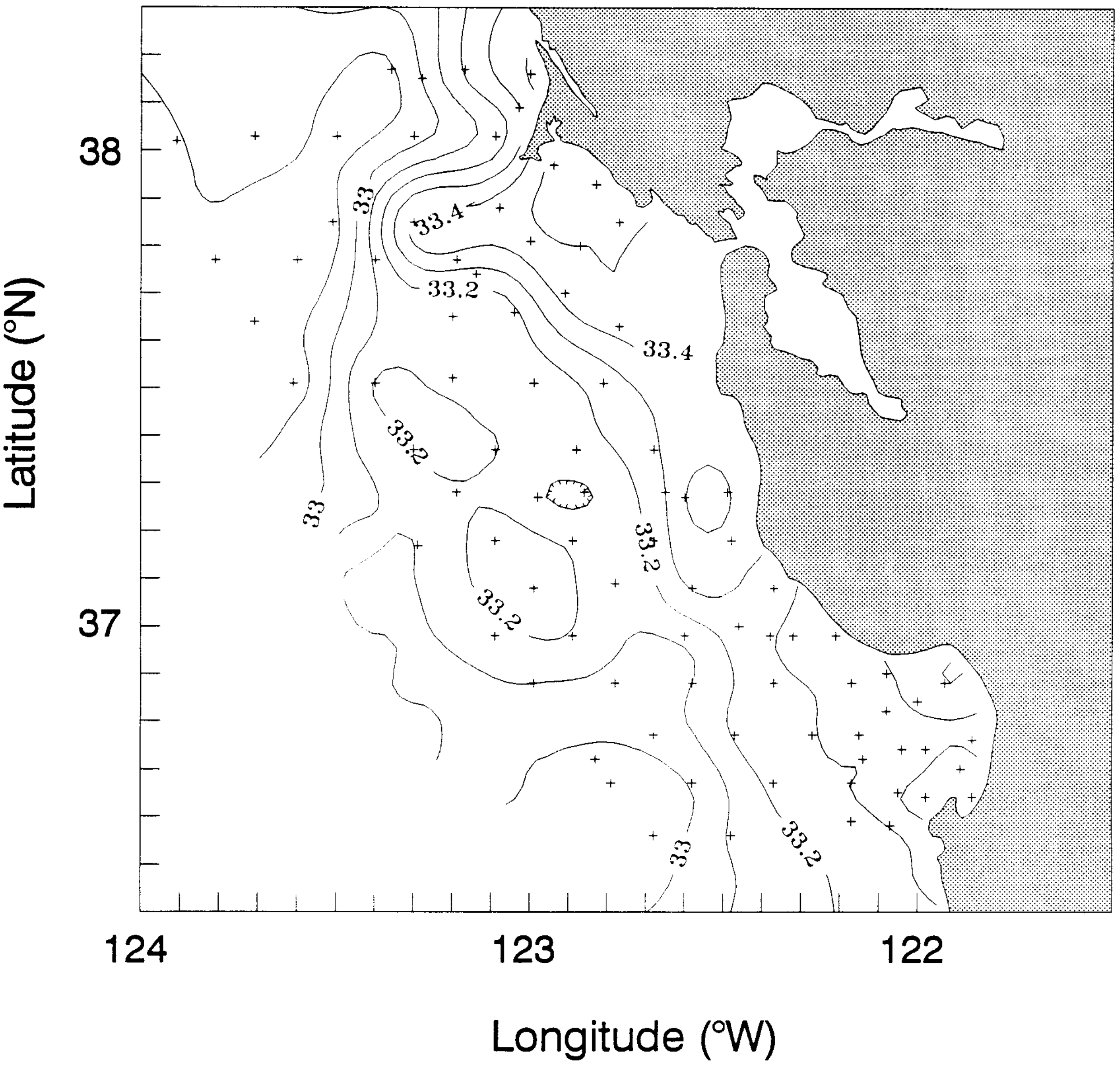
DSJ9206 Sweep 1
Salinity (ppt) at 2 m



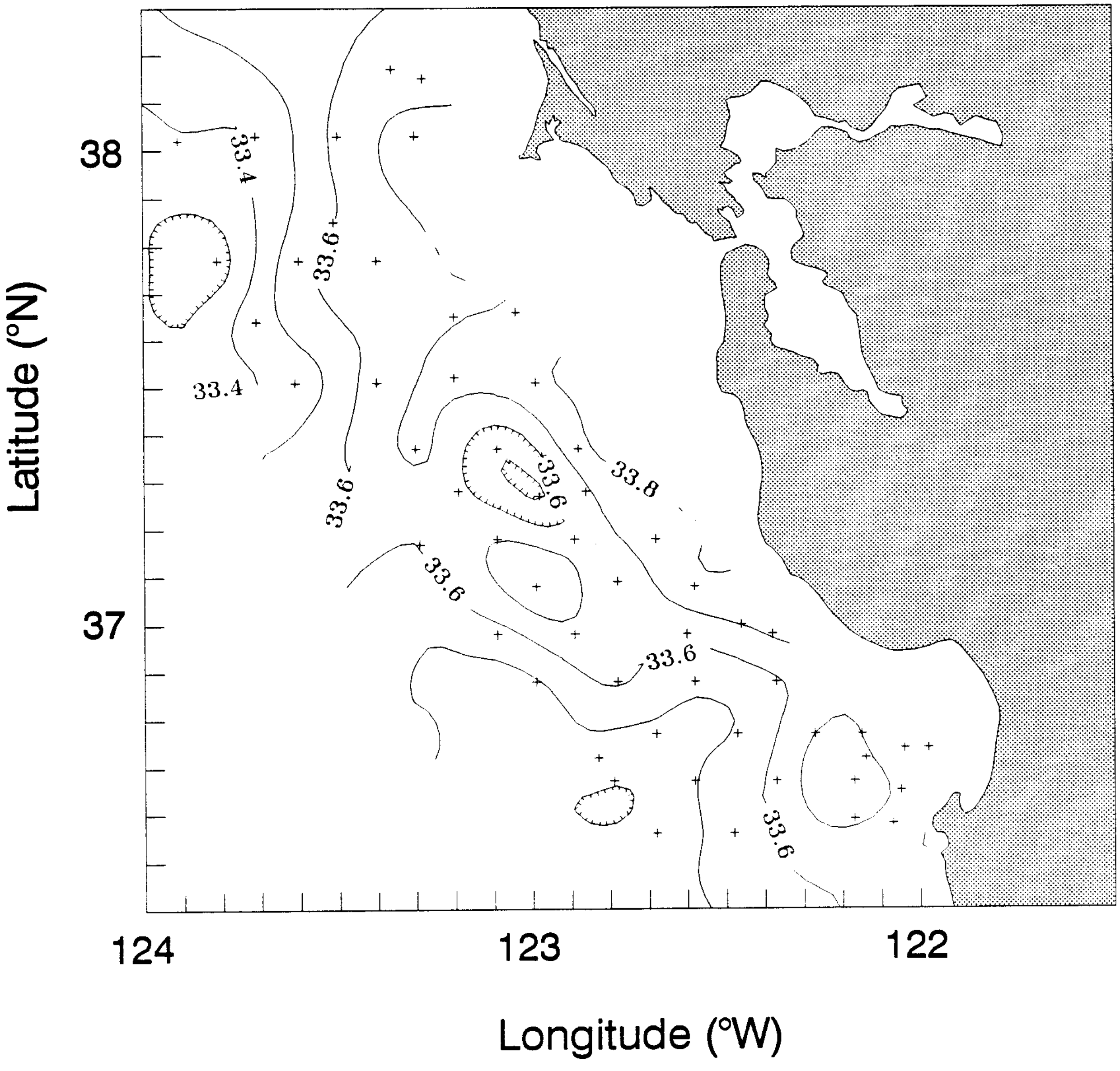
DSJ9206 Sweep 1
Salinity (ppt) at 10 m

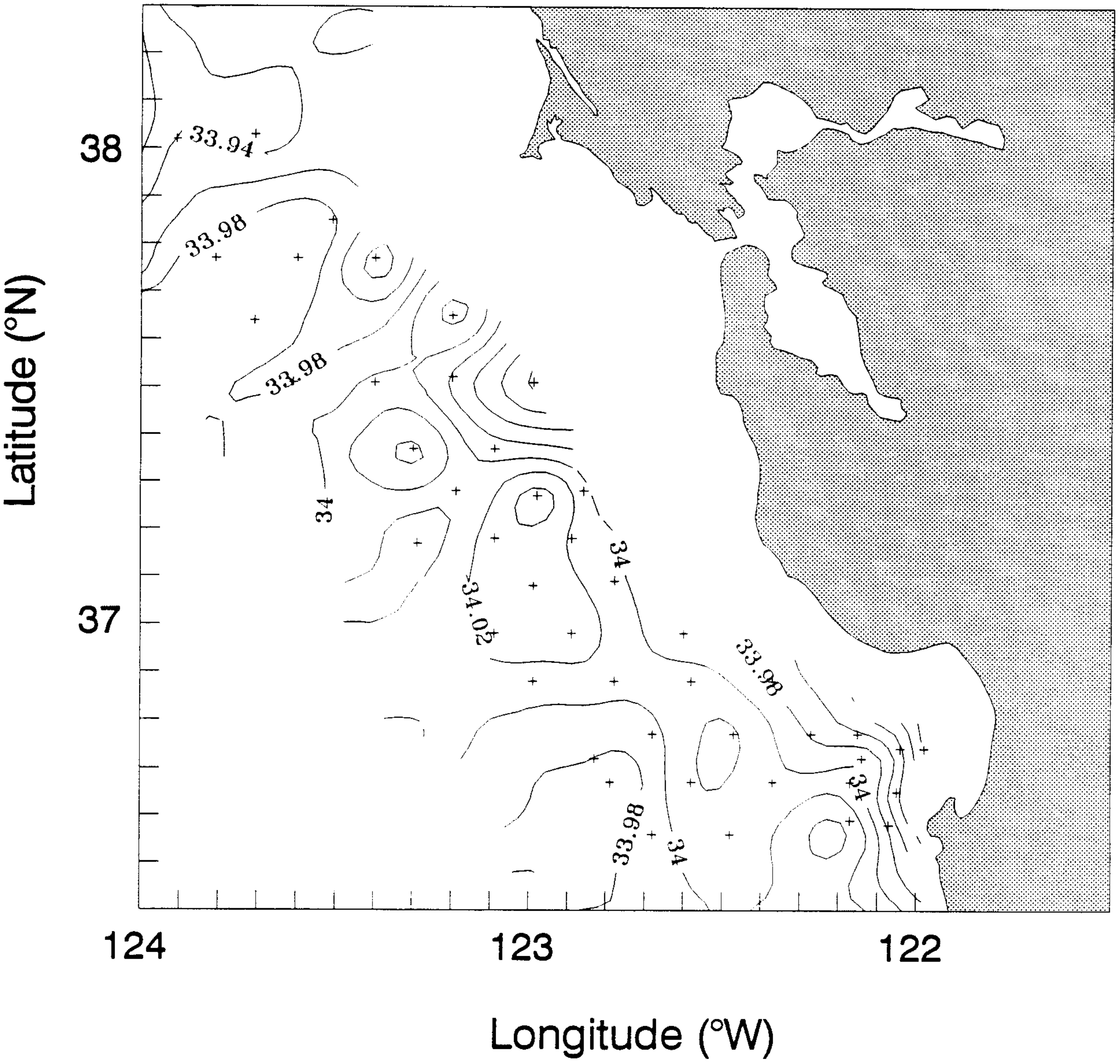


DSJ9206 Sweep 1
Salinity (ppt) at 30 m



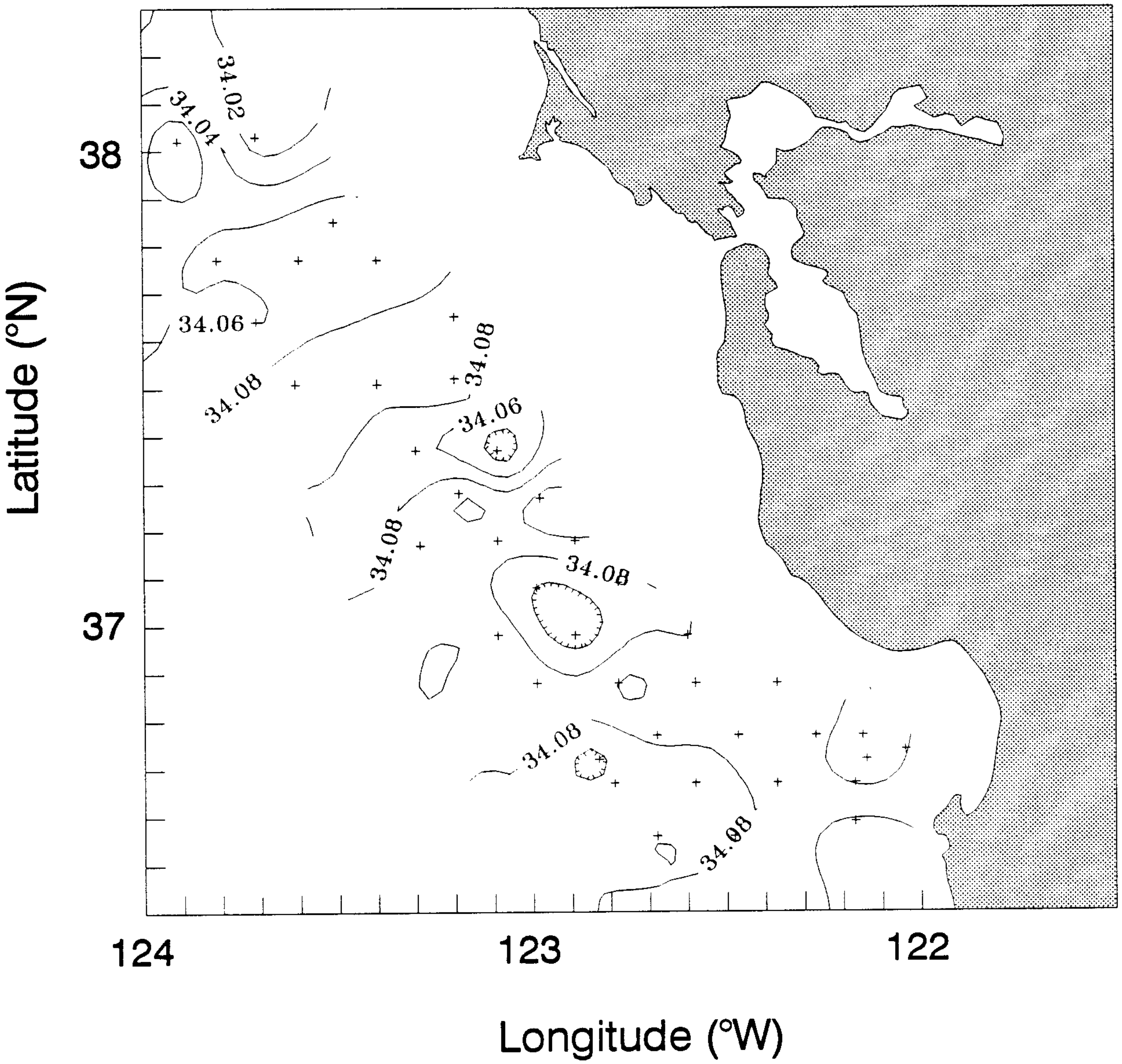
DSJ9206 Sweep 1
Salinity (ppt) at 100 m

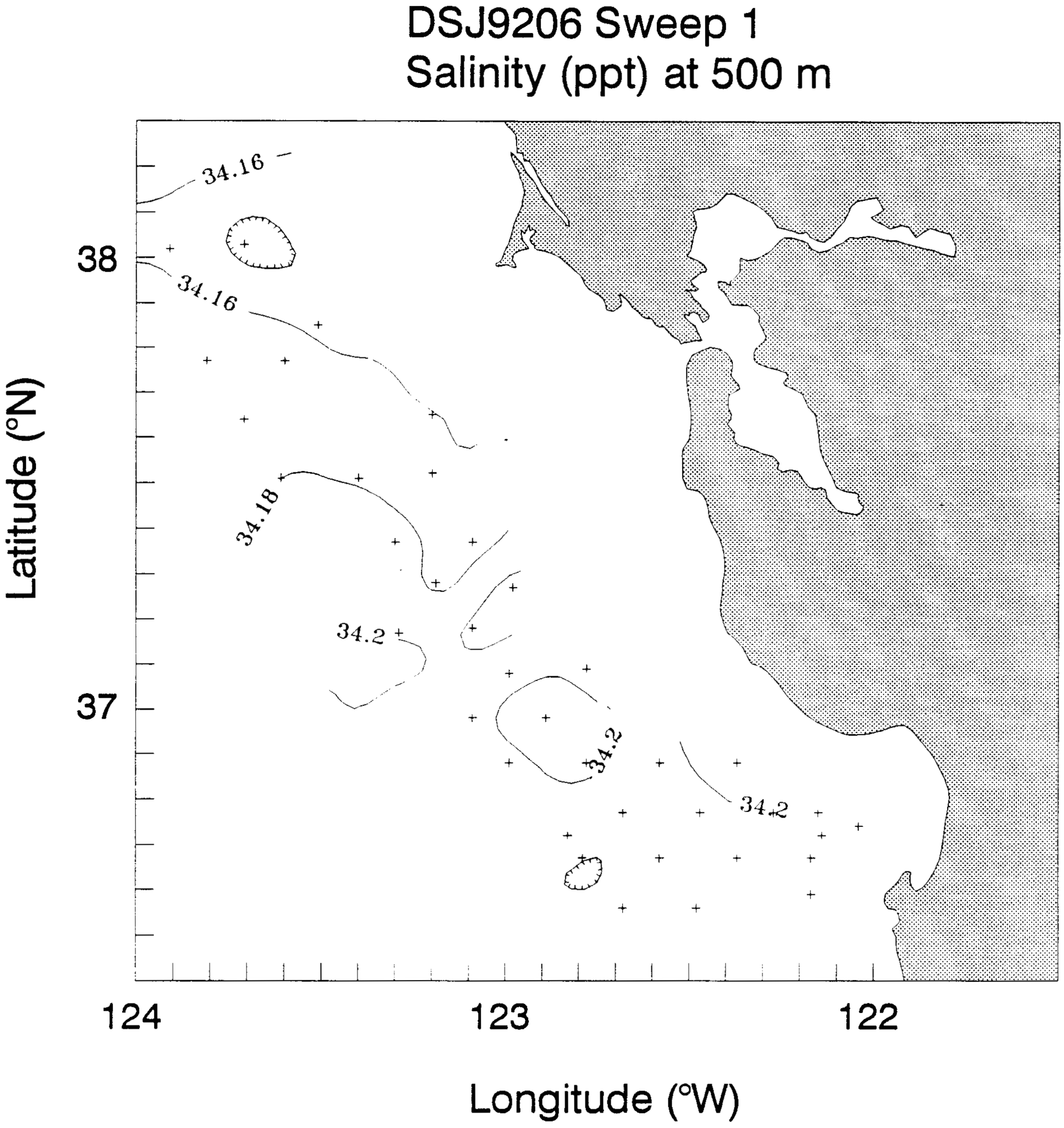




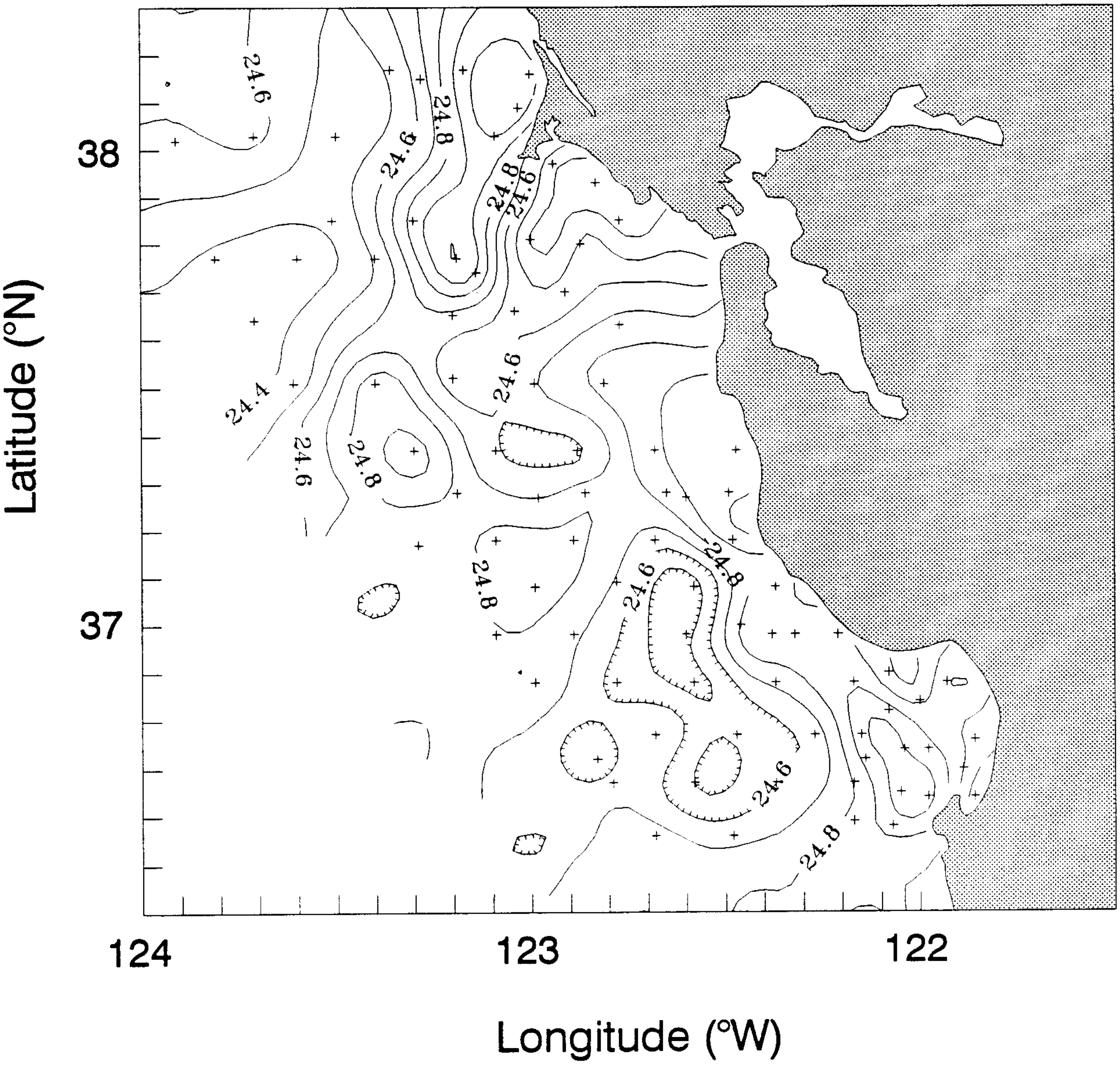
DSJ9206 Sweep 1
Salinity (ppt) at 200 m

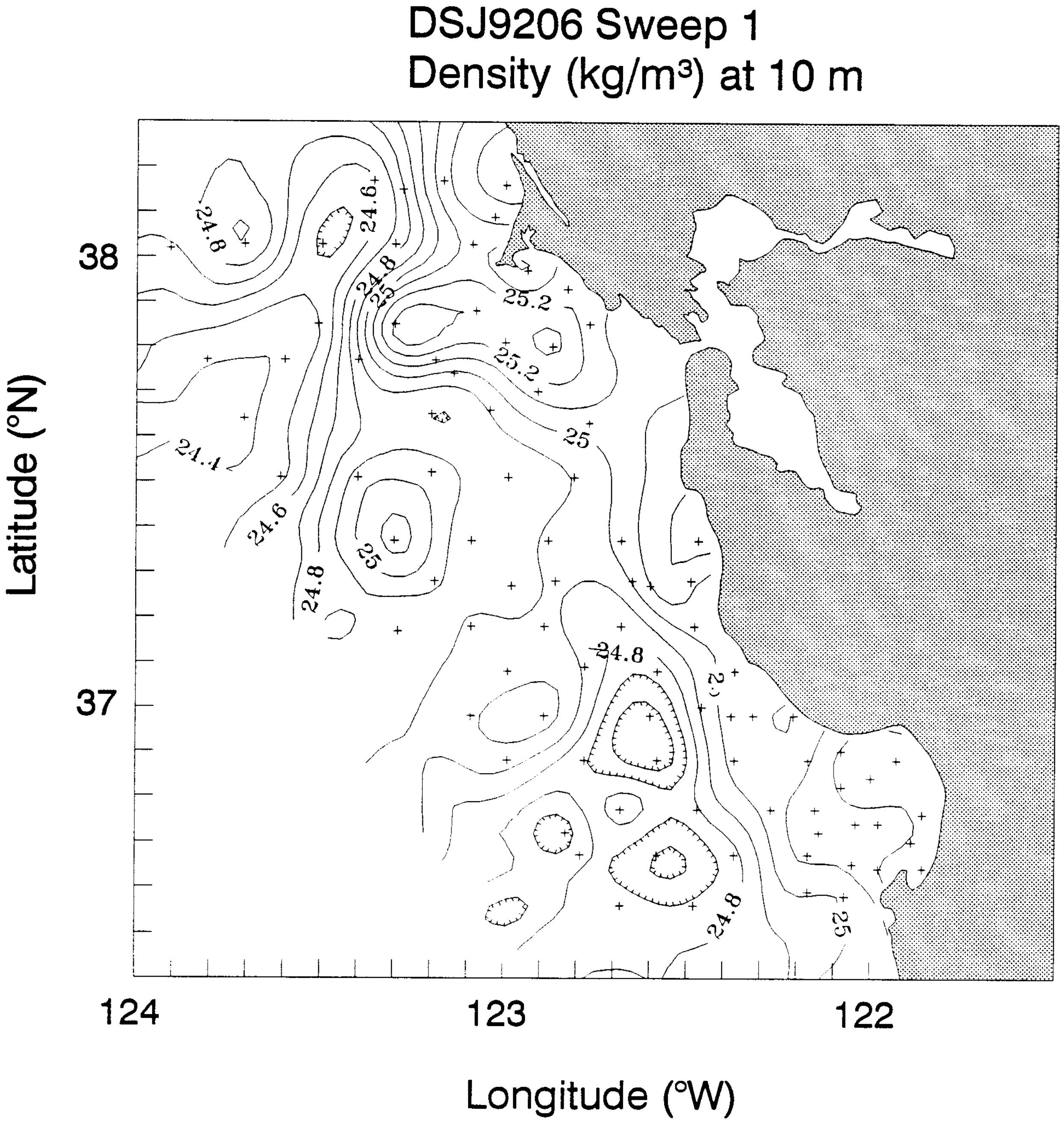
DSJ9206 Sweep 1
Salinity (ppt) at 300 m



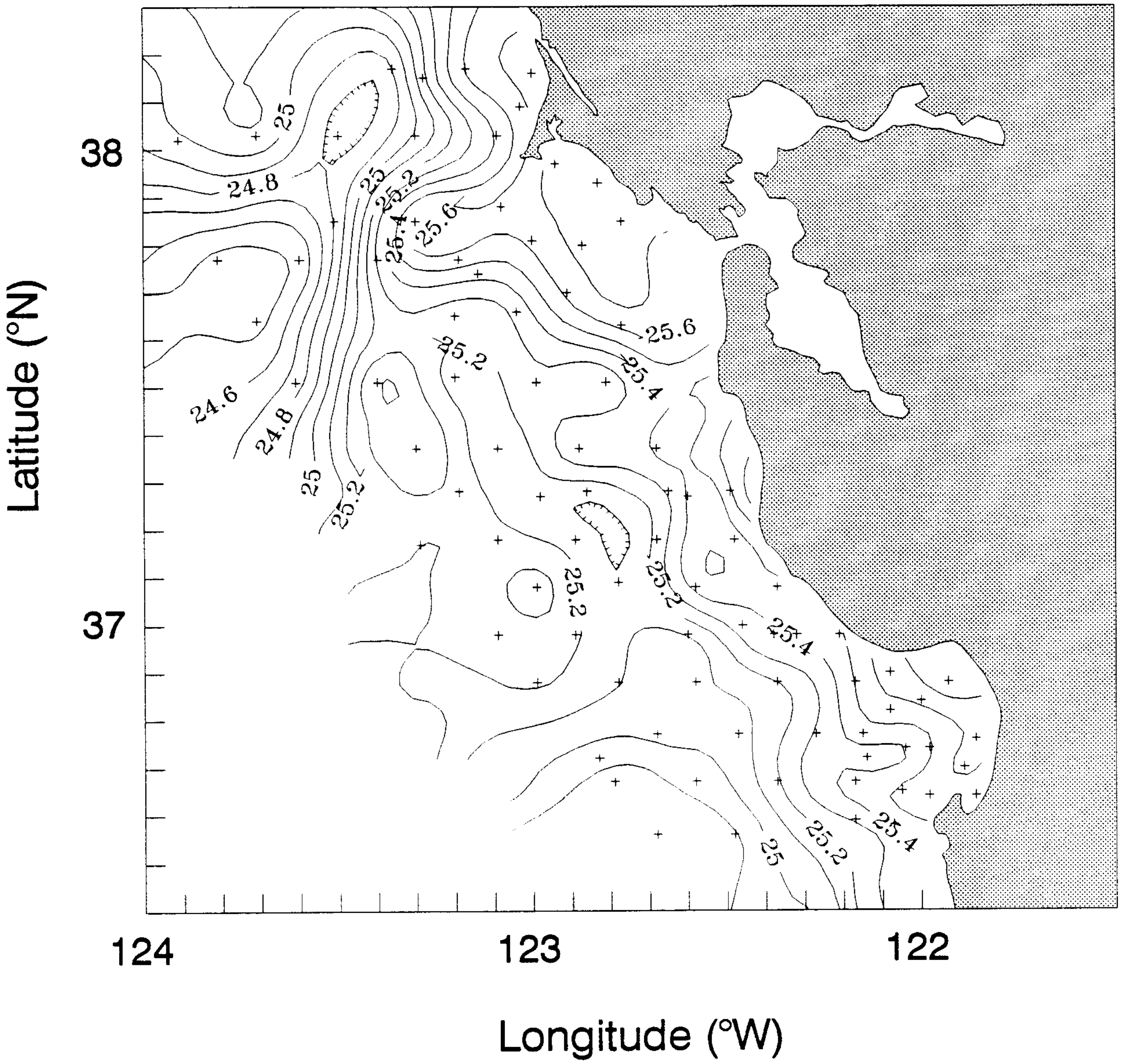

DSJ9206 Sweep 1
Salinity (ppt) at 500 m
34.16
34.16
34.18
34.2
34.2
34.2
38
37
124
123
122
Latitude (°N)
Longitude (°W)

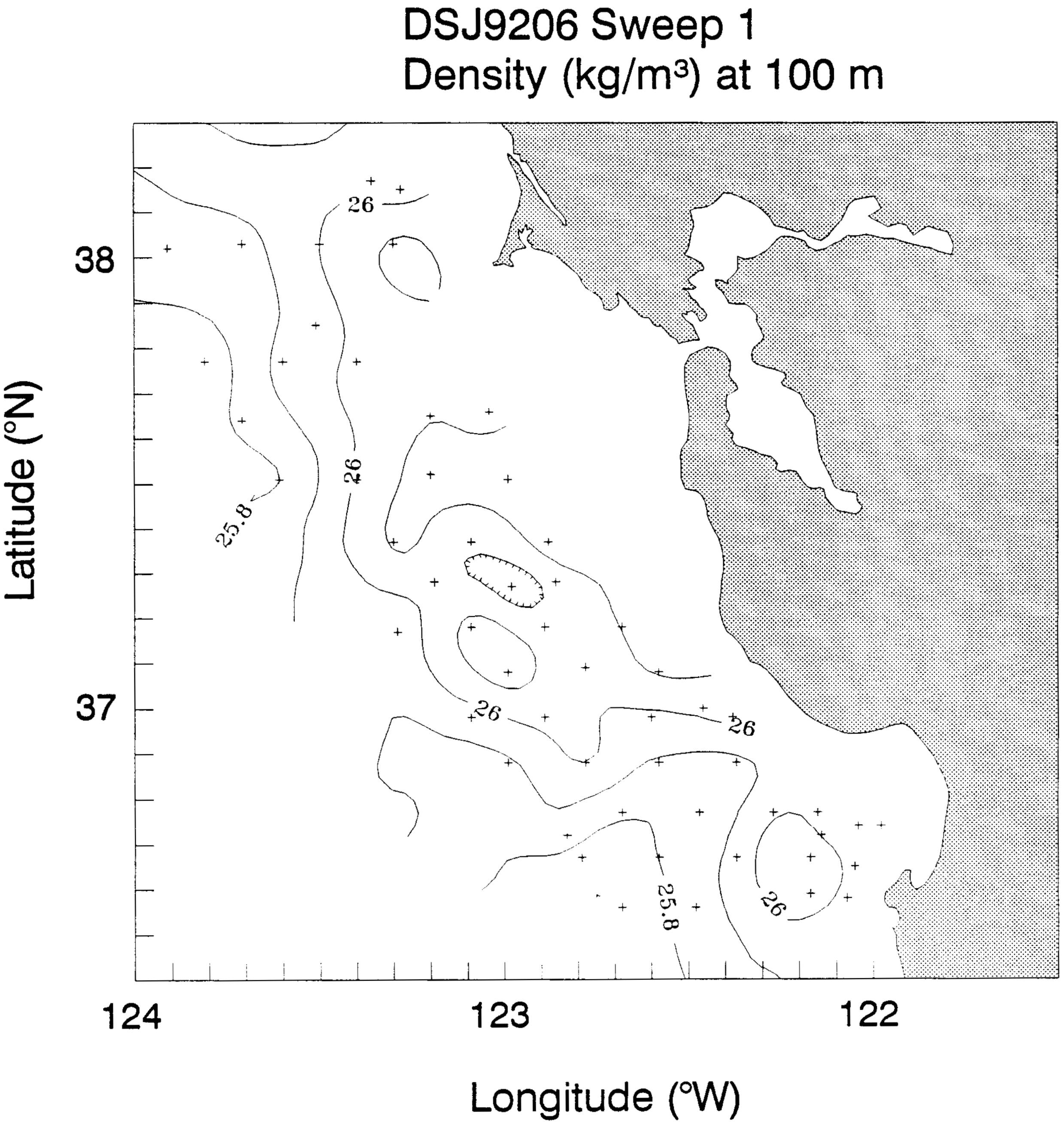
DSJ9206 Sweep 1
Density (kg/m^3) at 2 m



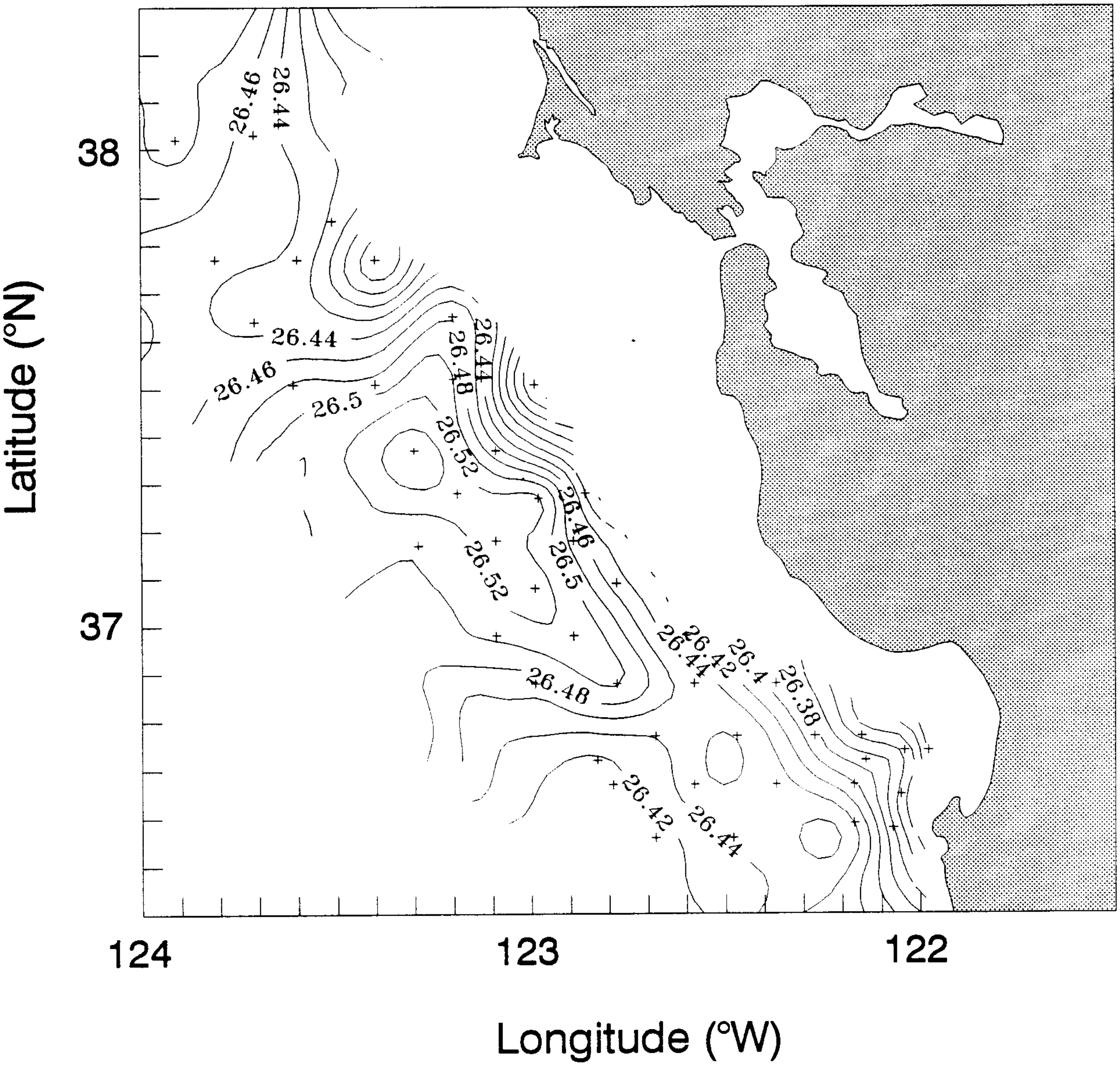

DSJ9206 Sweep 1
Density (kg/m^3) at 10 m
Latitude (°N)
Longitude (°W)
38
37
124
123
122
24.8
24.6
24.8
25
25.2
25.2
25
24.4
24.6
24.8
25
24.8
25
24.8
25

DSJ9206 Sweep 1
Density (kg/m^3) at 30 m

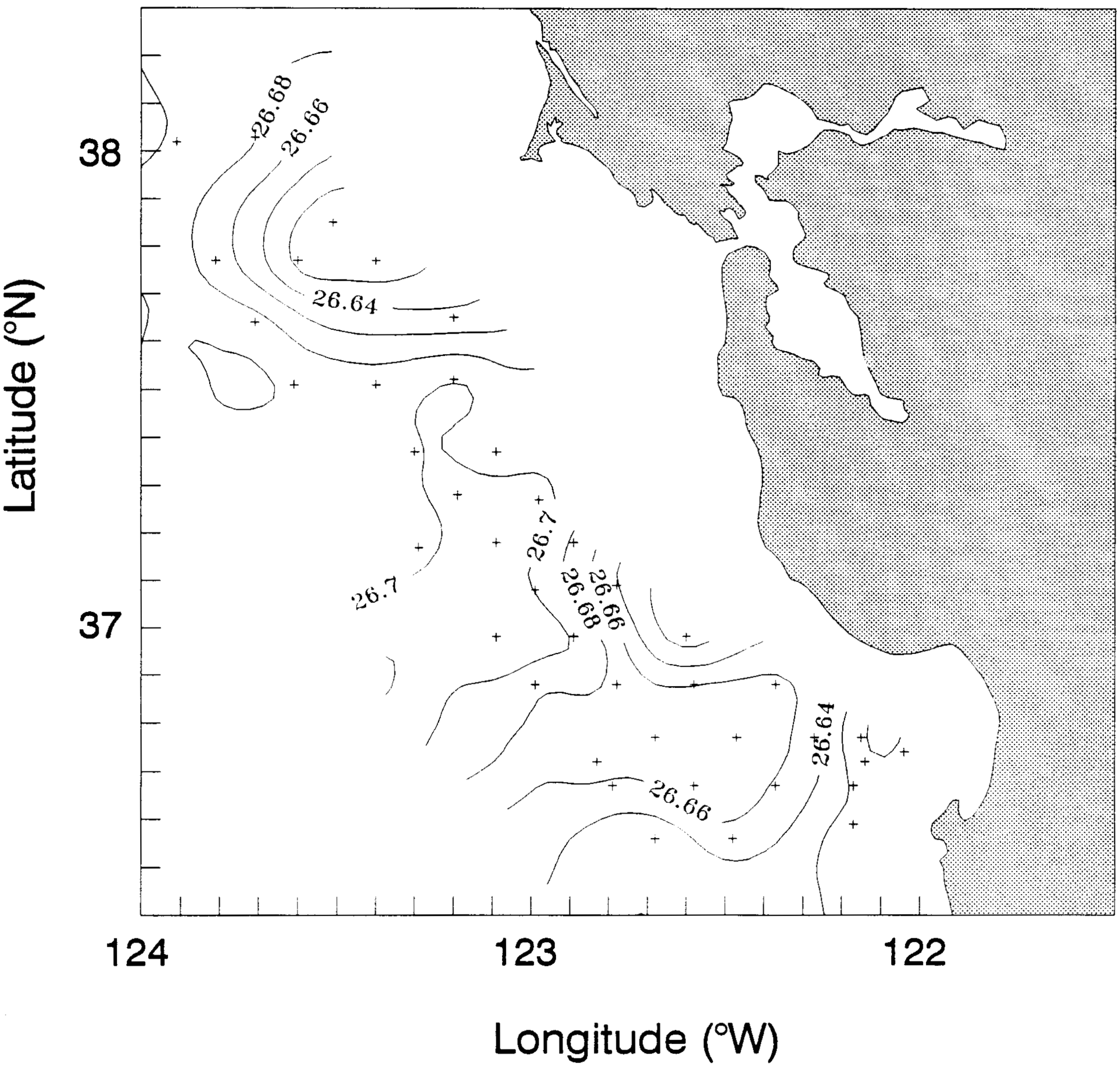



DSJ9206 Sweep 1
Density (kg/m³) at 100 m
Latitude (°N)
38
37
Longitude (°W)
124
123
122
26
25.8
26
26
26
25.8
26

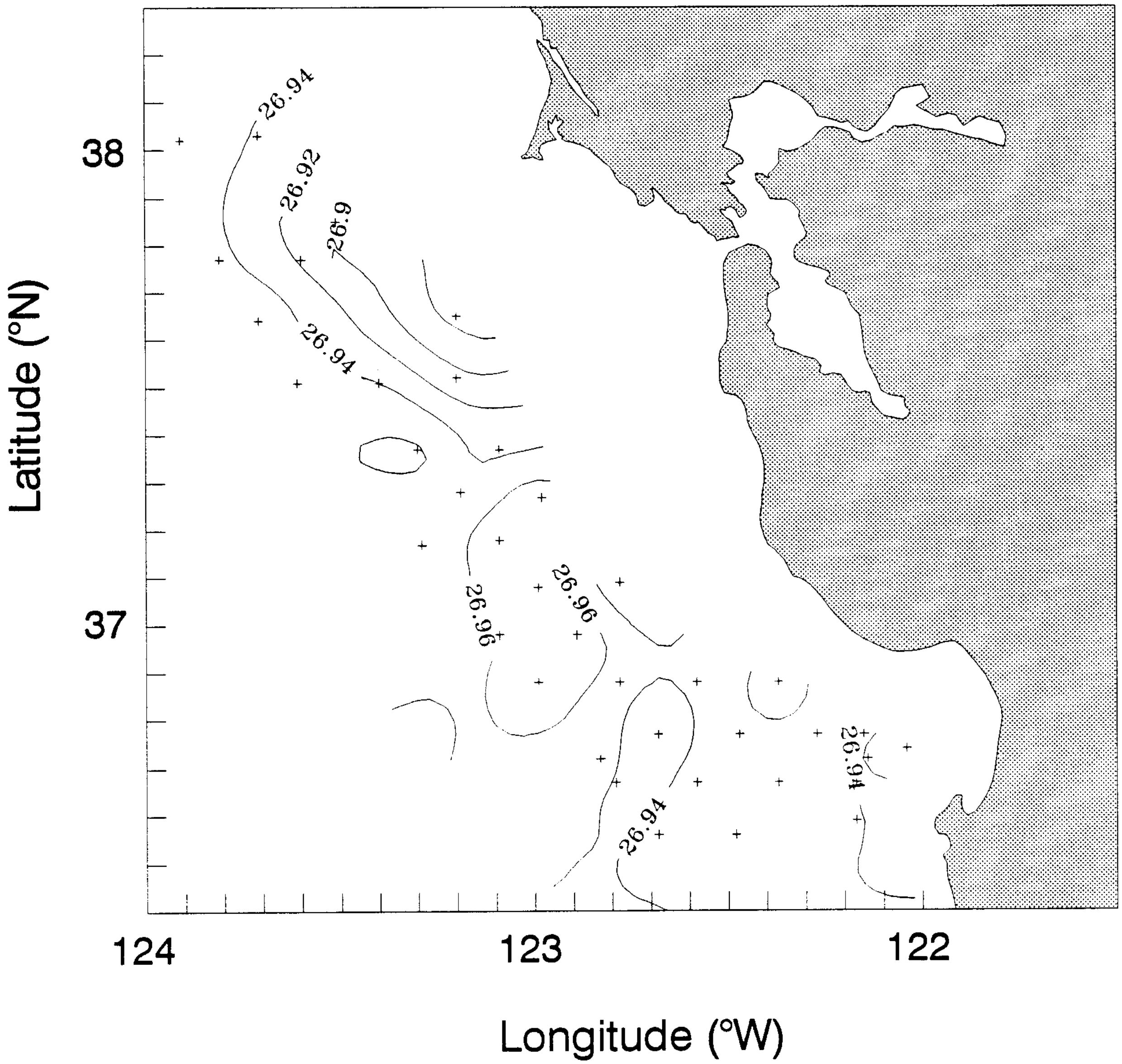
DSJ9206 Sweep 1
Density (kg/m³) at 200 m



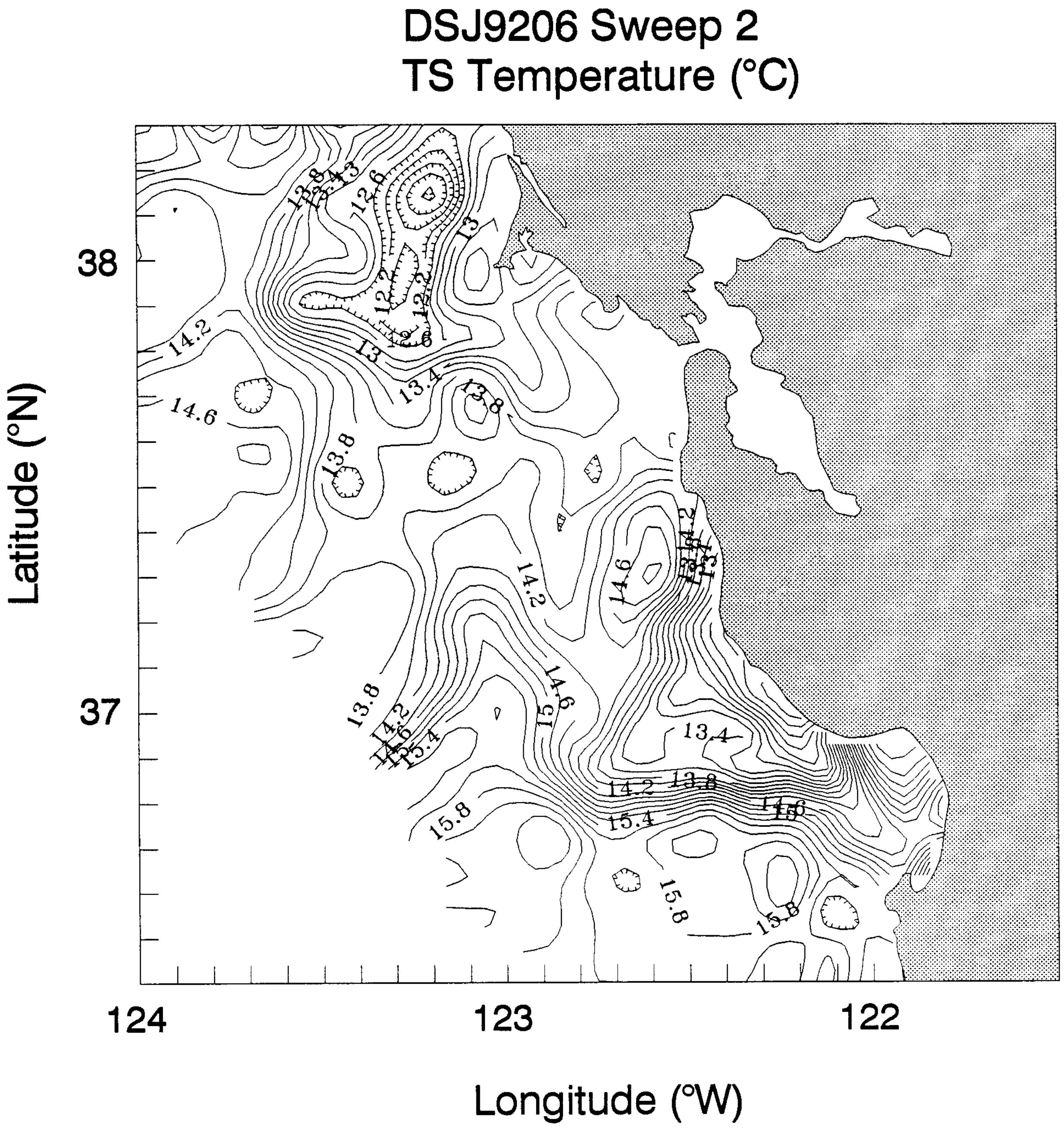
DSJ9206 Sweep 1
Density (kg/m³) at 300 m



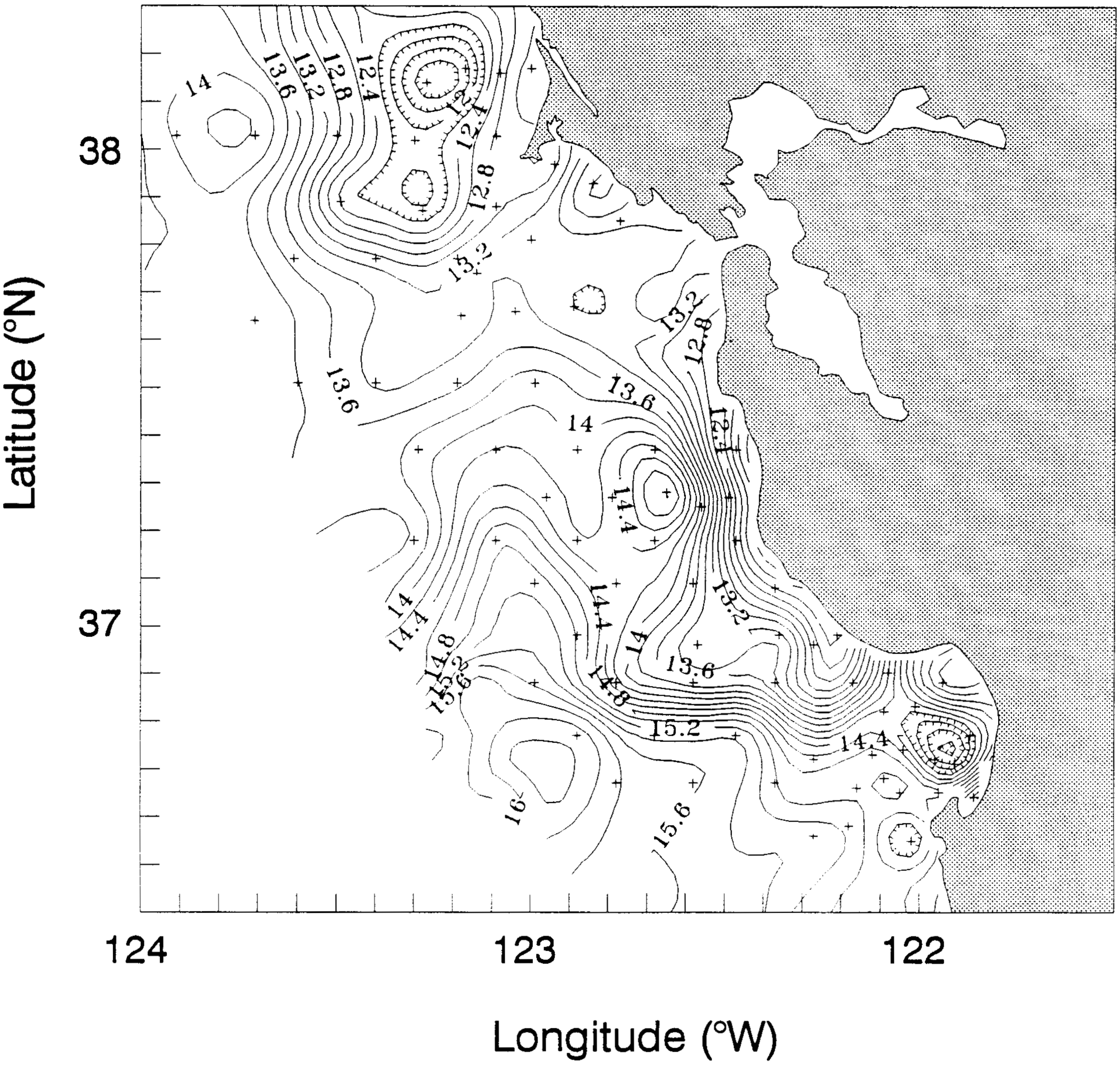
DSJ9206 Sweep 1
Density (kg/m^3) at 500 m

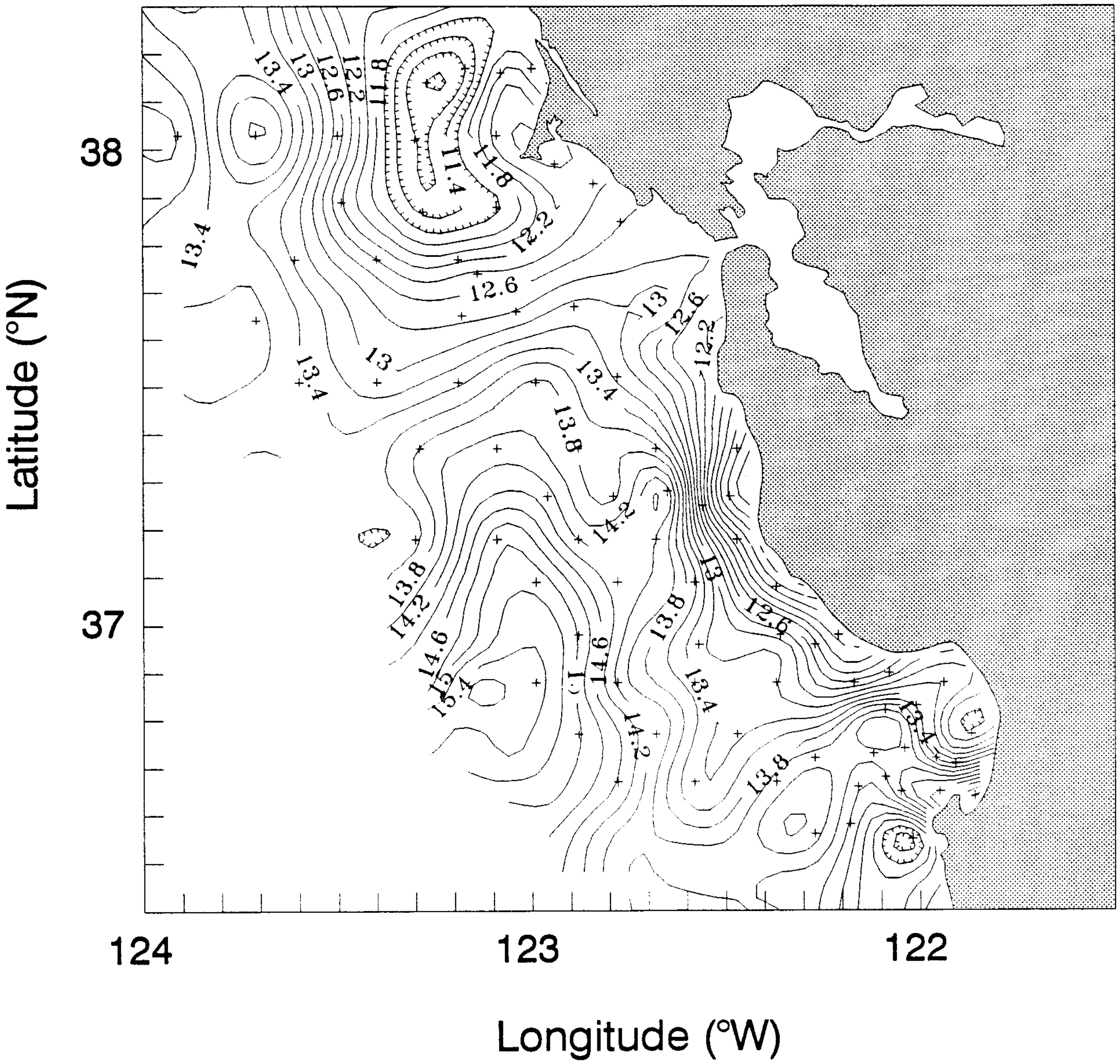


APPENDIX 6.3: HORIZONTAL MAPS OF CTD AND TS FOR DSJ9206, SWEEP 2


DSJ9206 Sweep 2
TS Temperature (°C)
Latitude (°N)
38
37
Longitude (°W)
124
123
122
13.8
13.4
12.6
12.2
13
14.2
14.6
15
15.4
15.8

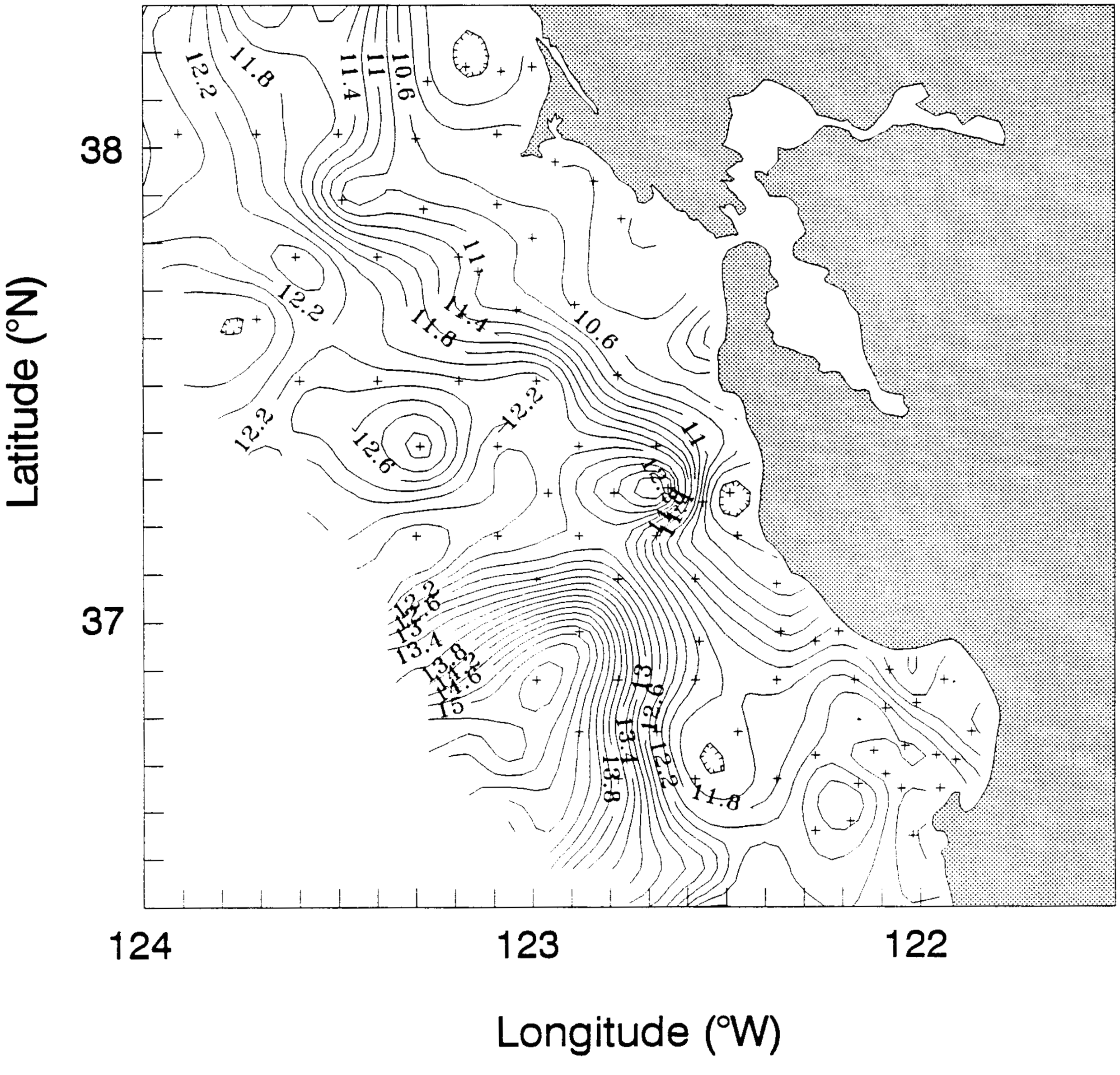
DSJ9206 Sweep 2
Temperature (°C) at 2 m



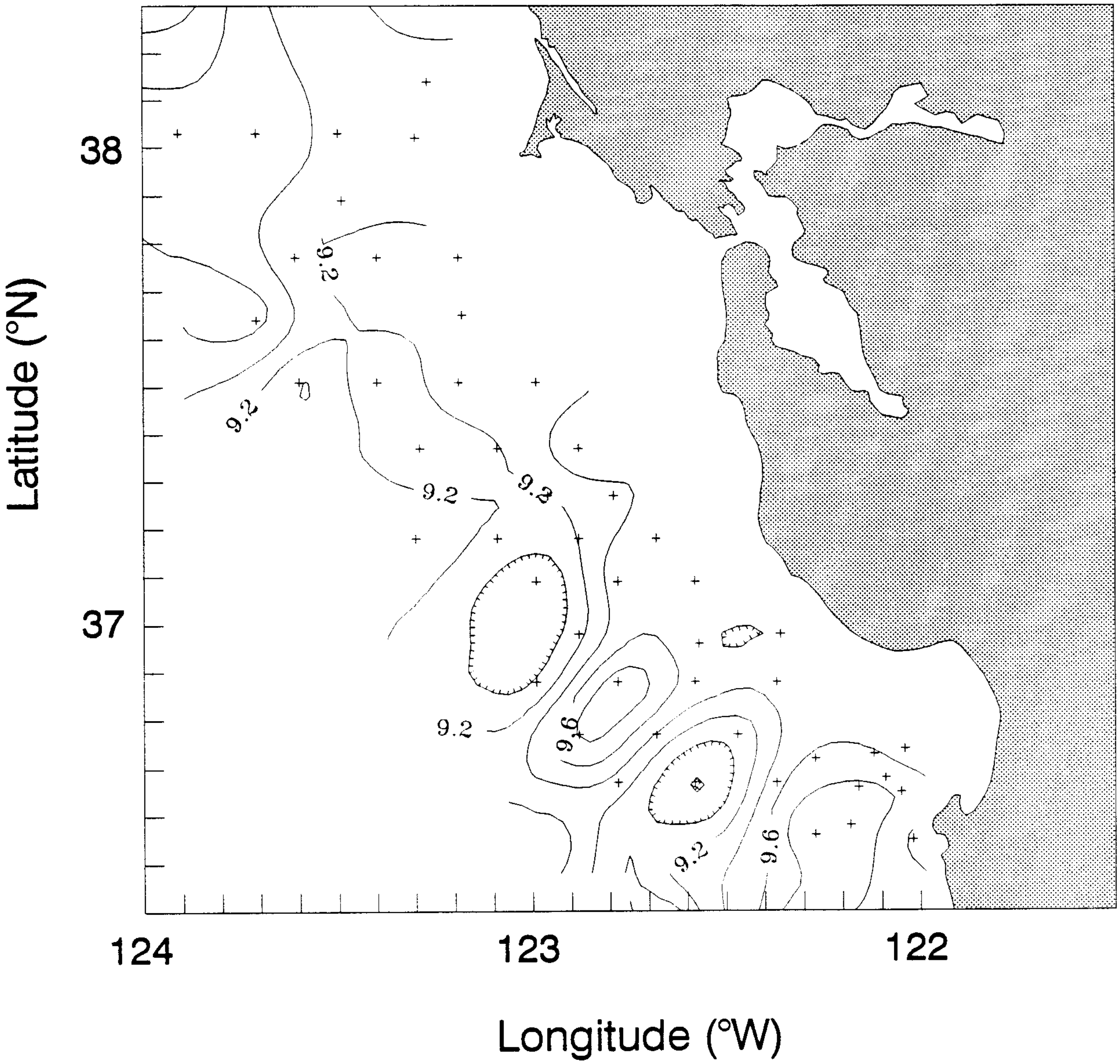


DSJ9206 Sweep 2
Temperature (°C) at 10 m

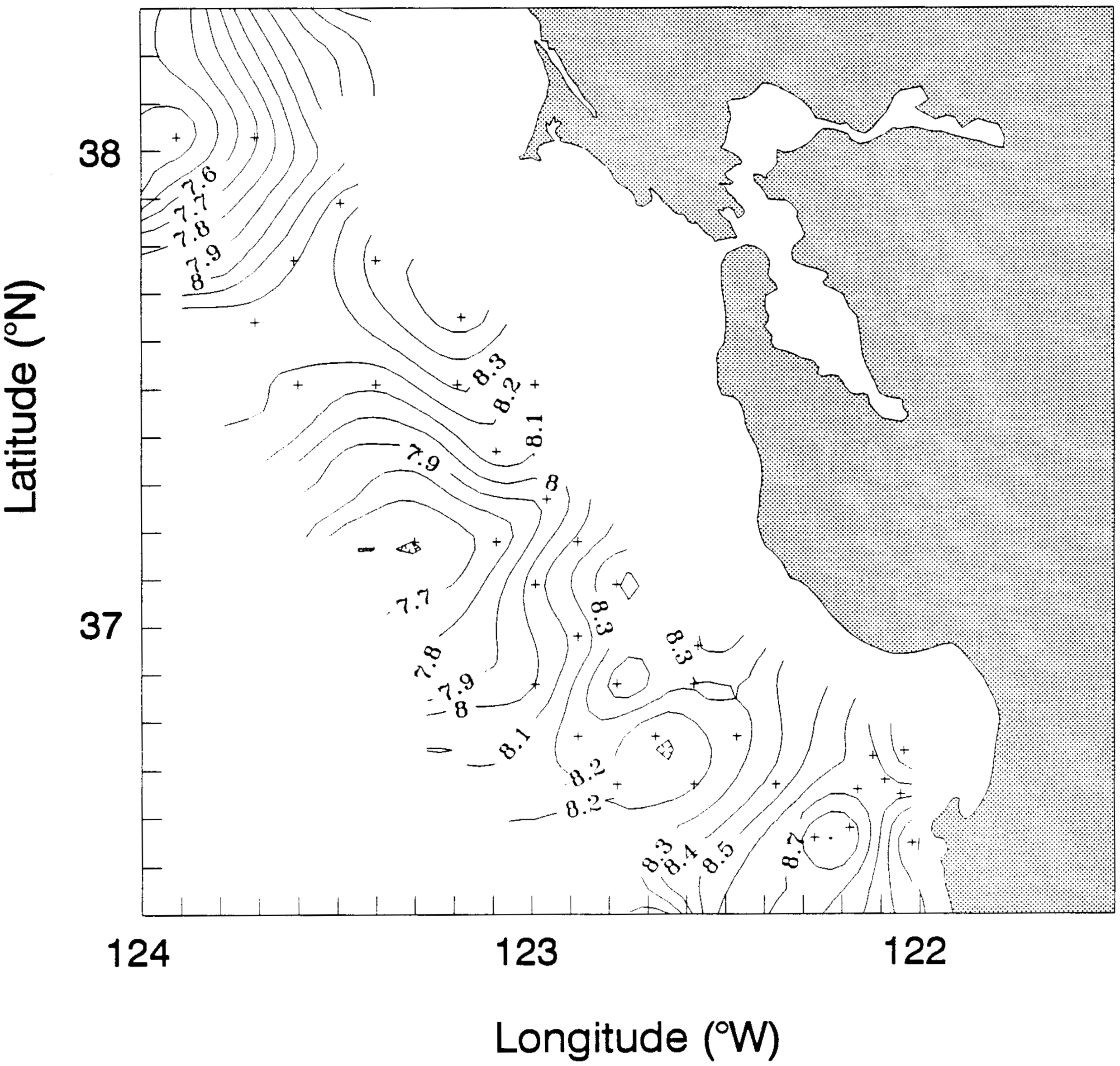
DSJ9206 Sweep 2
Temperature (°C) at 30 m



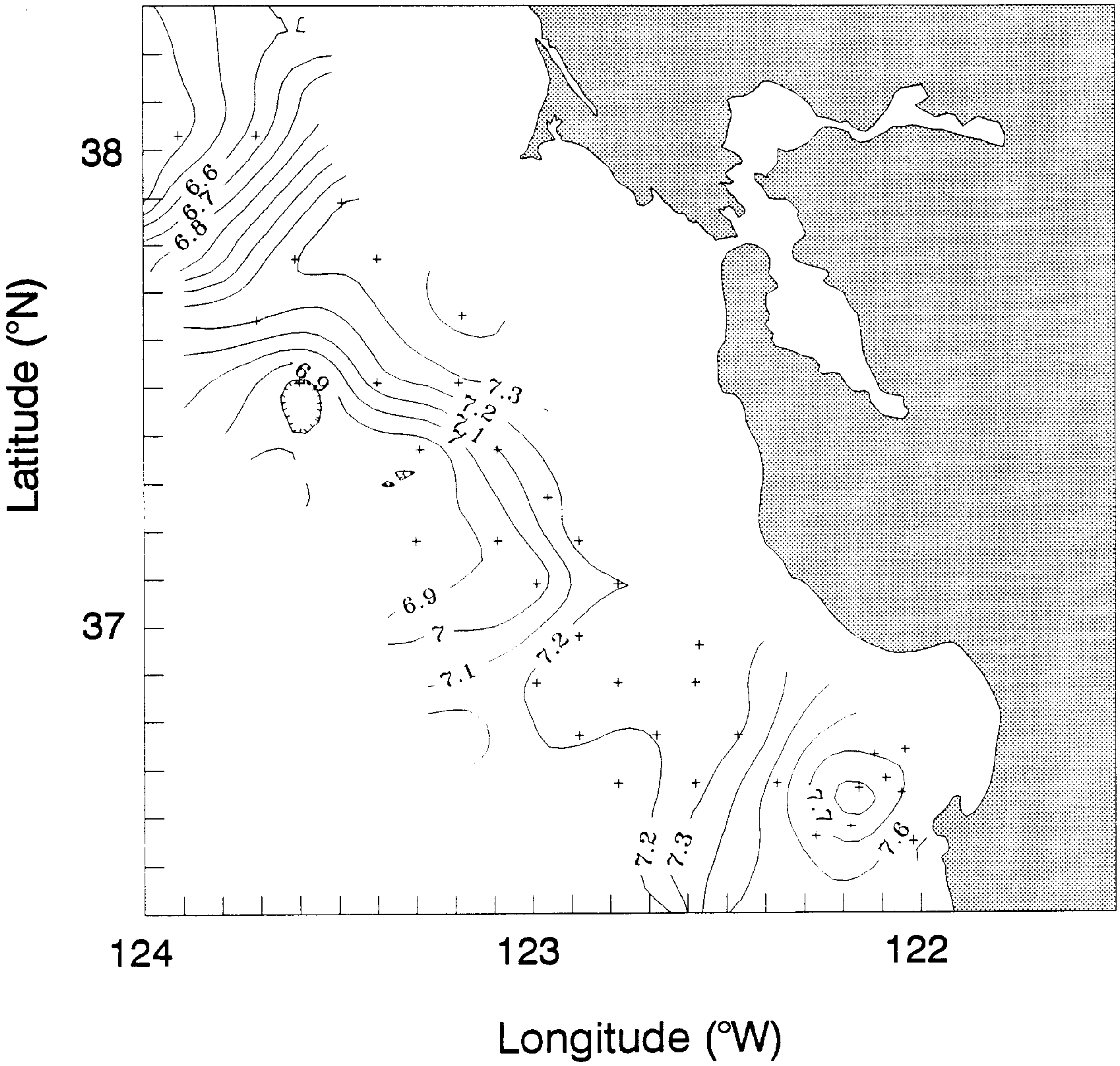
DSJ9206 Sweep 2
Temperature (°C) at 100 m

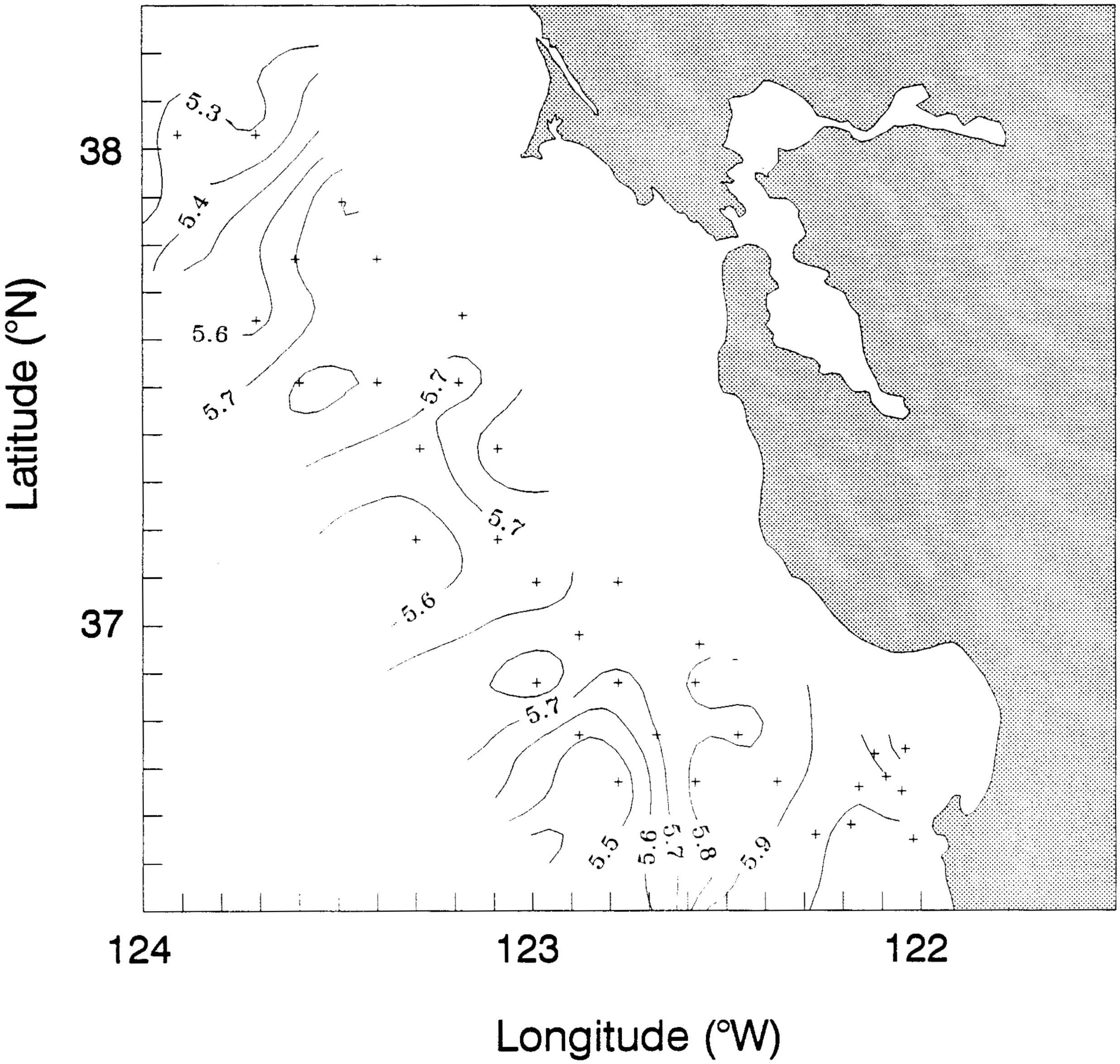


DSJ9206 Sweep 2
Temperature (°C) at 200 m



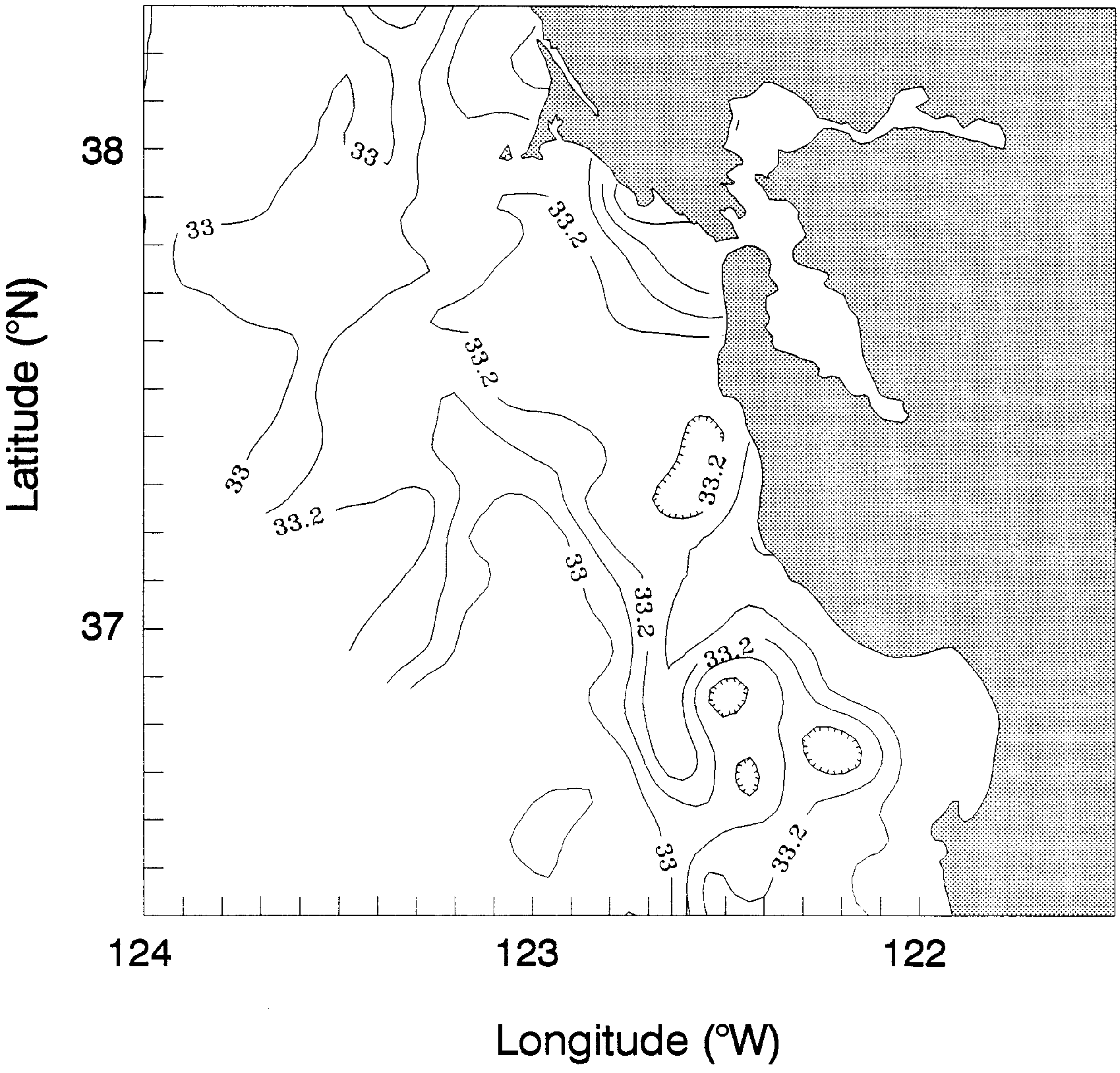
DSJ9206 Sweep 2
Temperature (°C) at 300 m



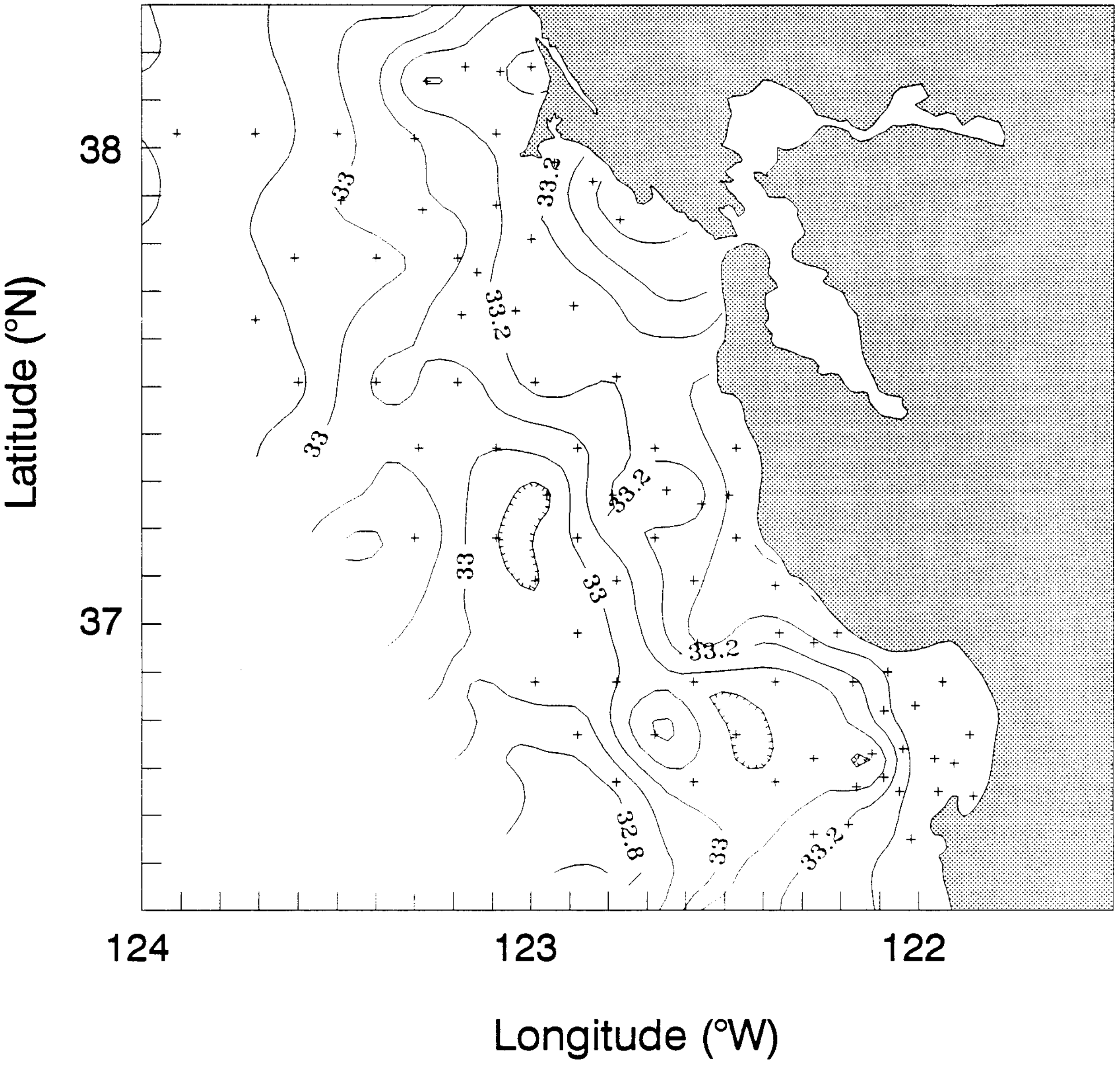


DSJ9206 Sweep 2
Temperature (°C) at 500 m

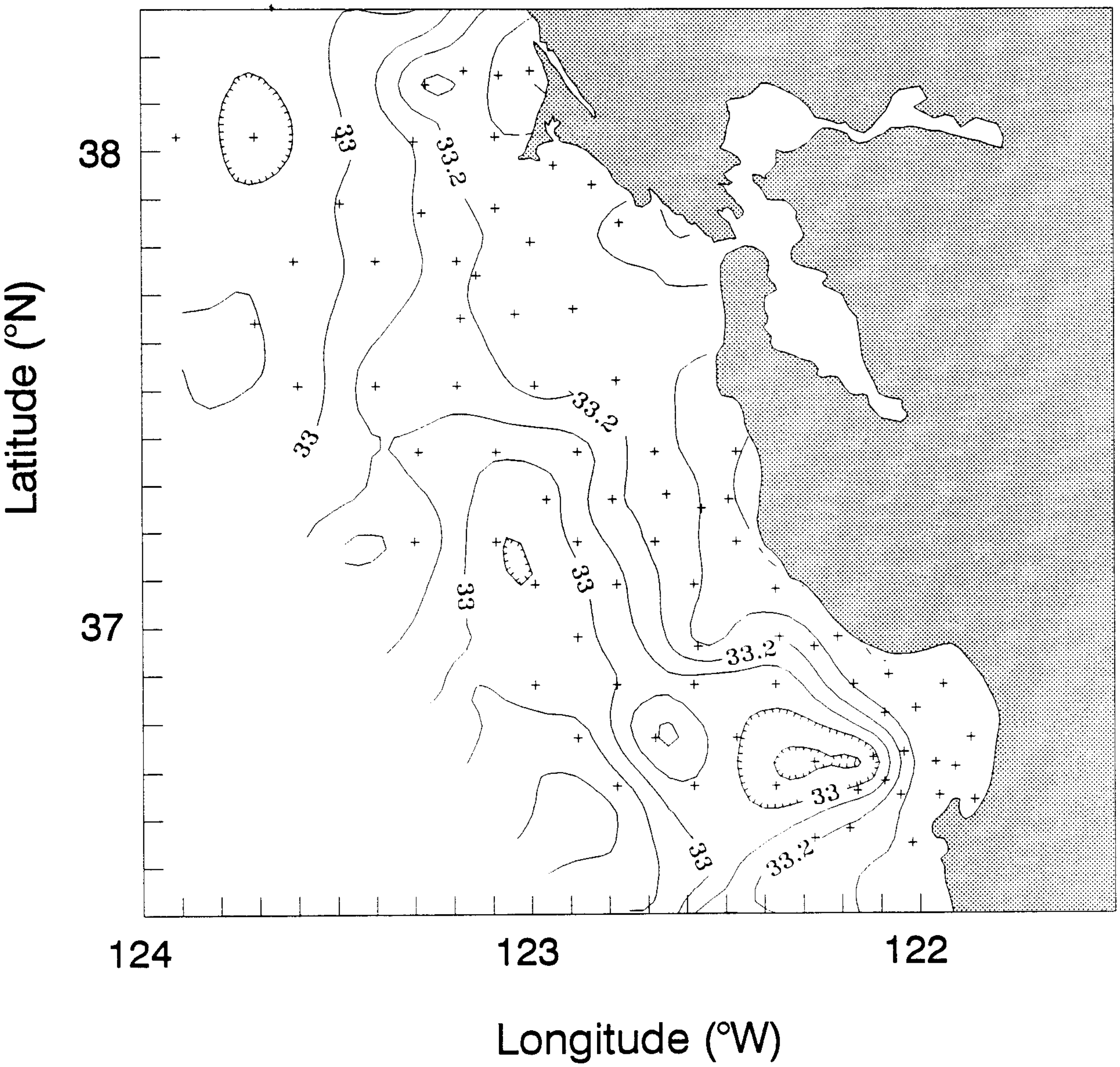
DSJ9206 Sweep 2
TS Salinity (ppt)



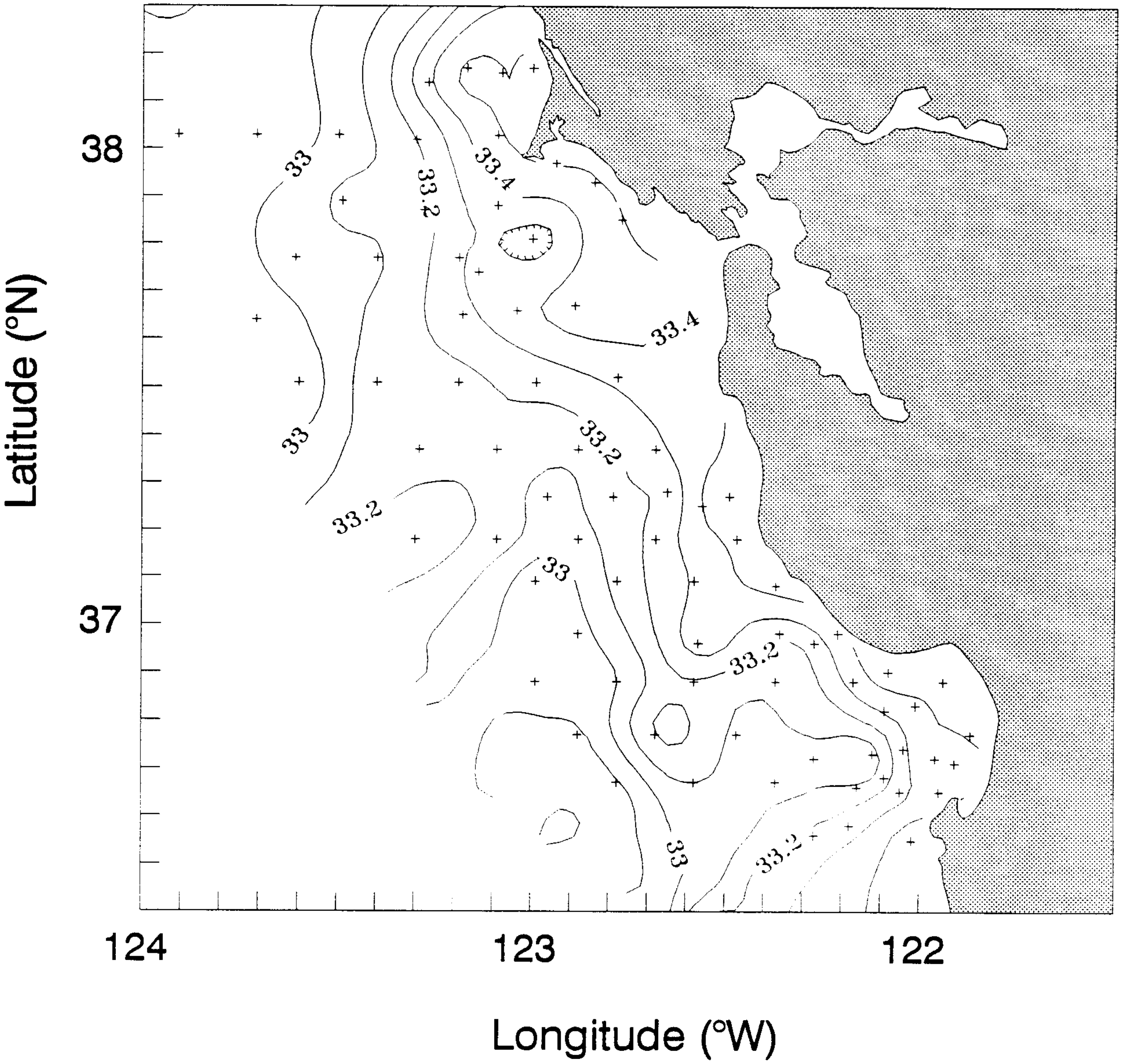
DSJ9206 Sweep 2
Salinity (ppt) at 2 m



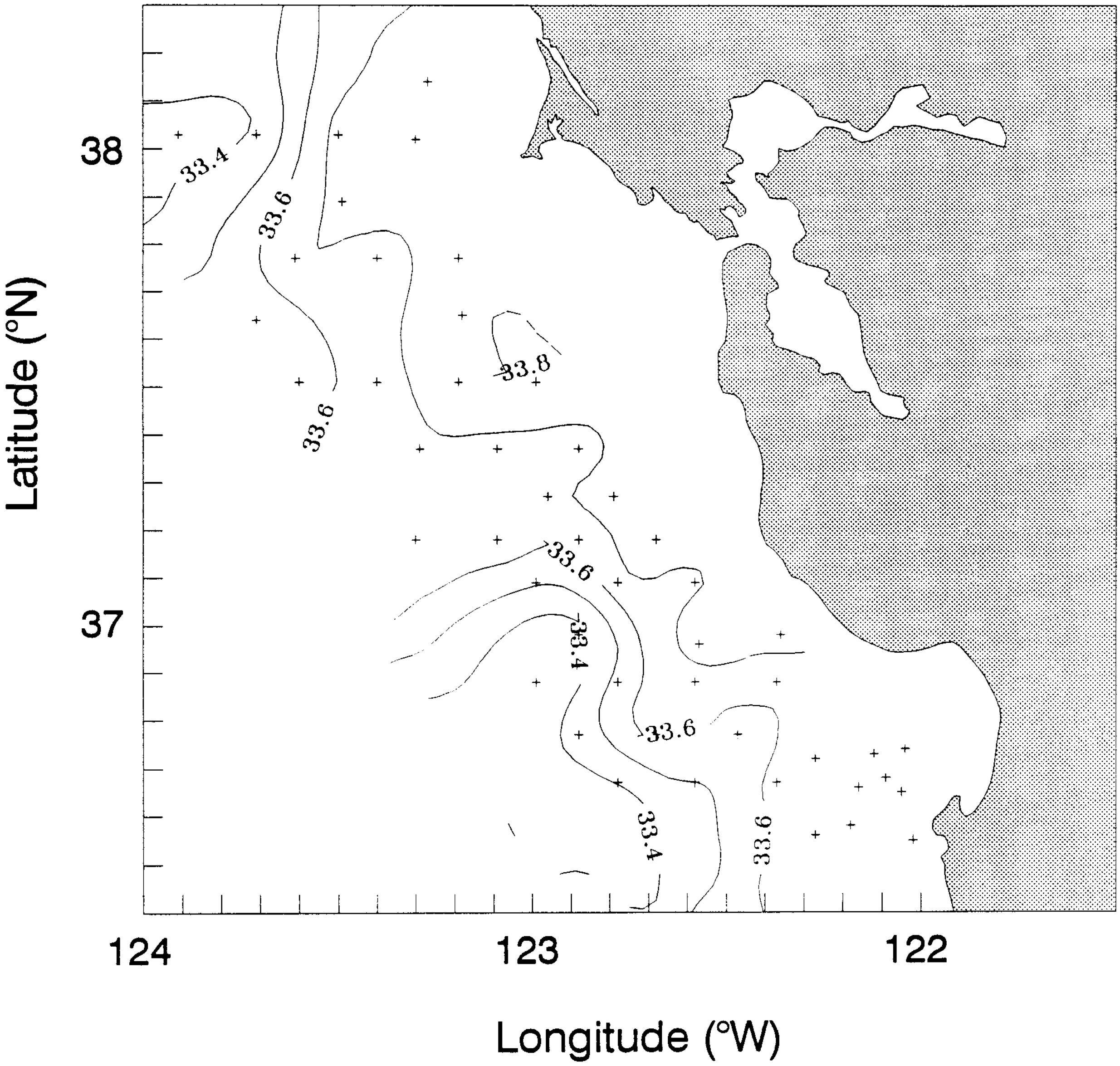
DSJ9206 Sweep 2
Salinity (ppt) at 10 m

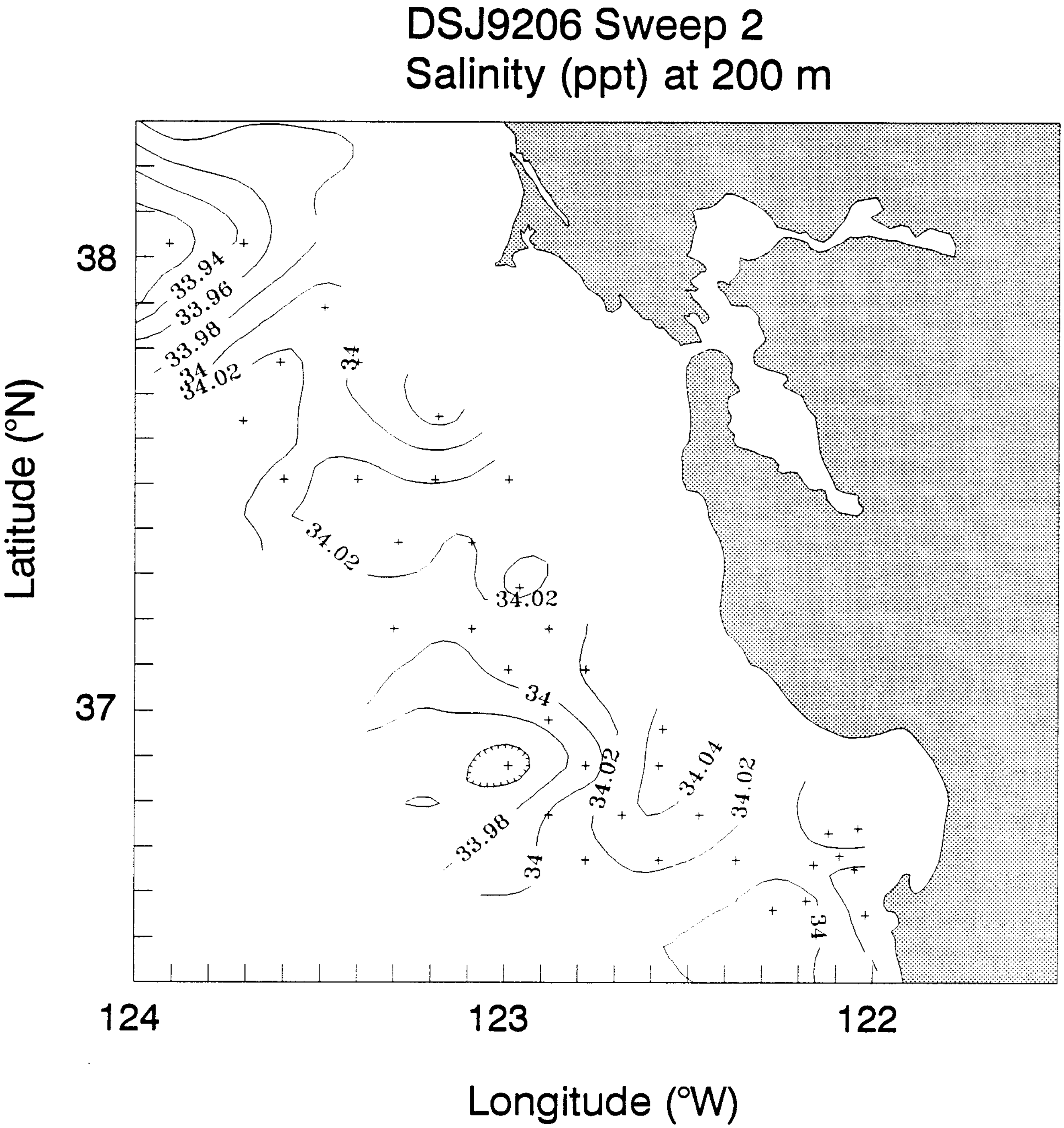


DSJ9206 Sweep 2
Salinity (ppt) at 30 m

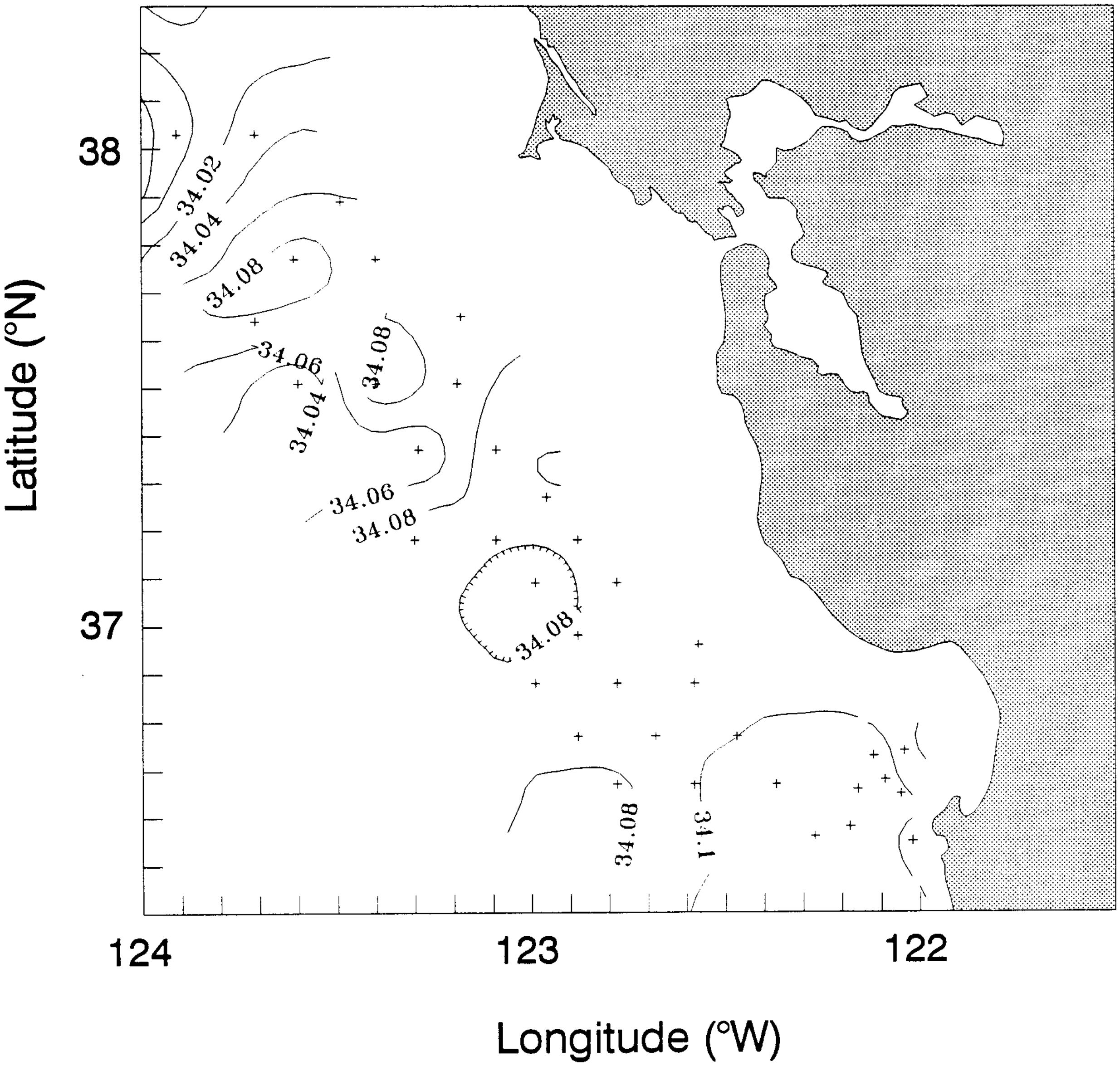


DSJ9206 Sweep 2
Salinity (ppt) at 100 m

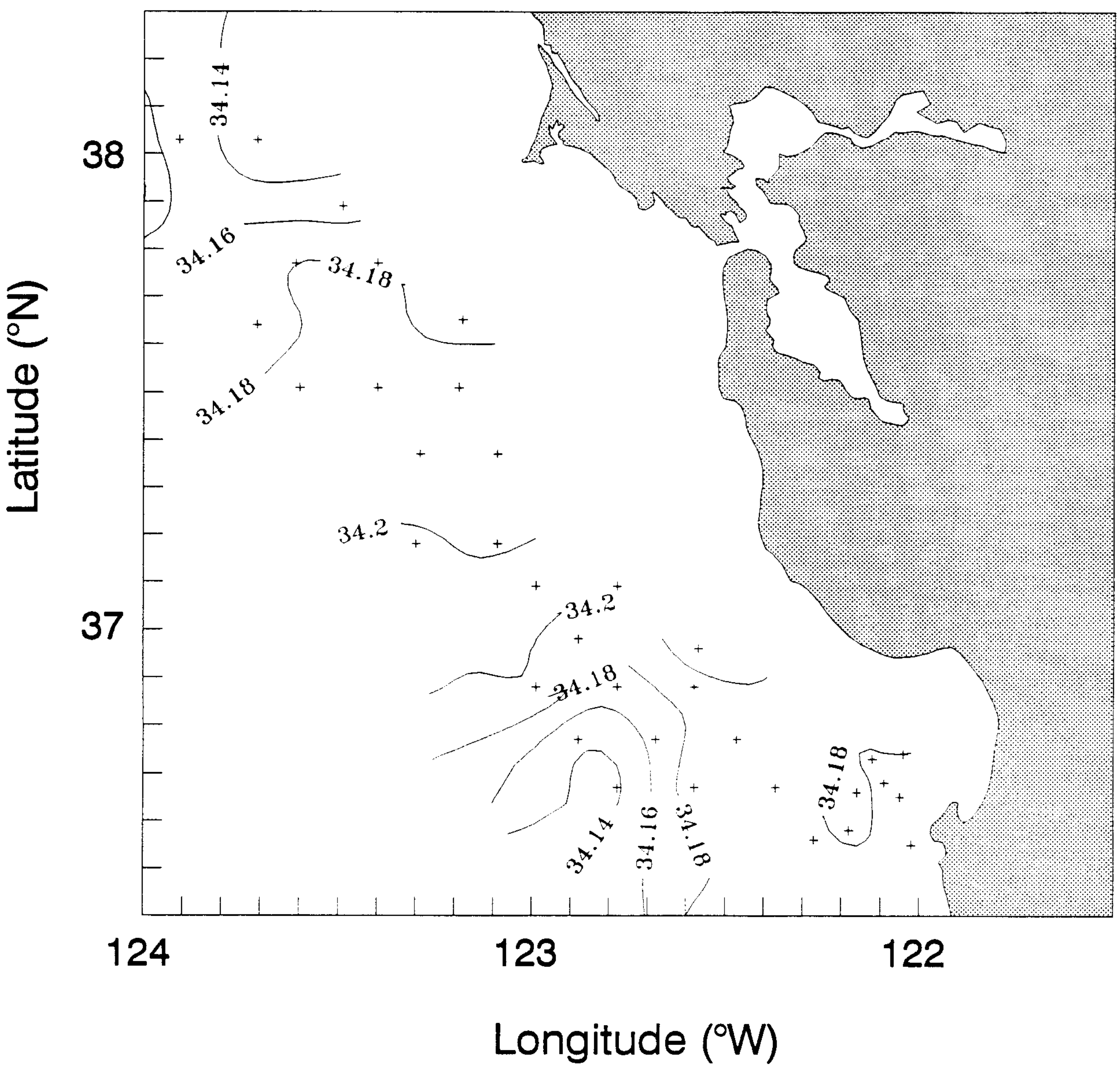



DSJ9206 Sweep 2
Salinity (ppt) at 200 m
33.94
33.96
33.98
34
34.02
34
34.02
34.02
34
34.02
34.04
34.02
33.98
34
34
38
37
Latitude (°N)
124
123
122
Longitude (°W)

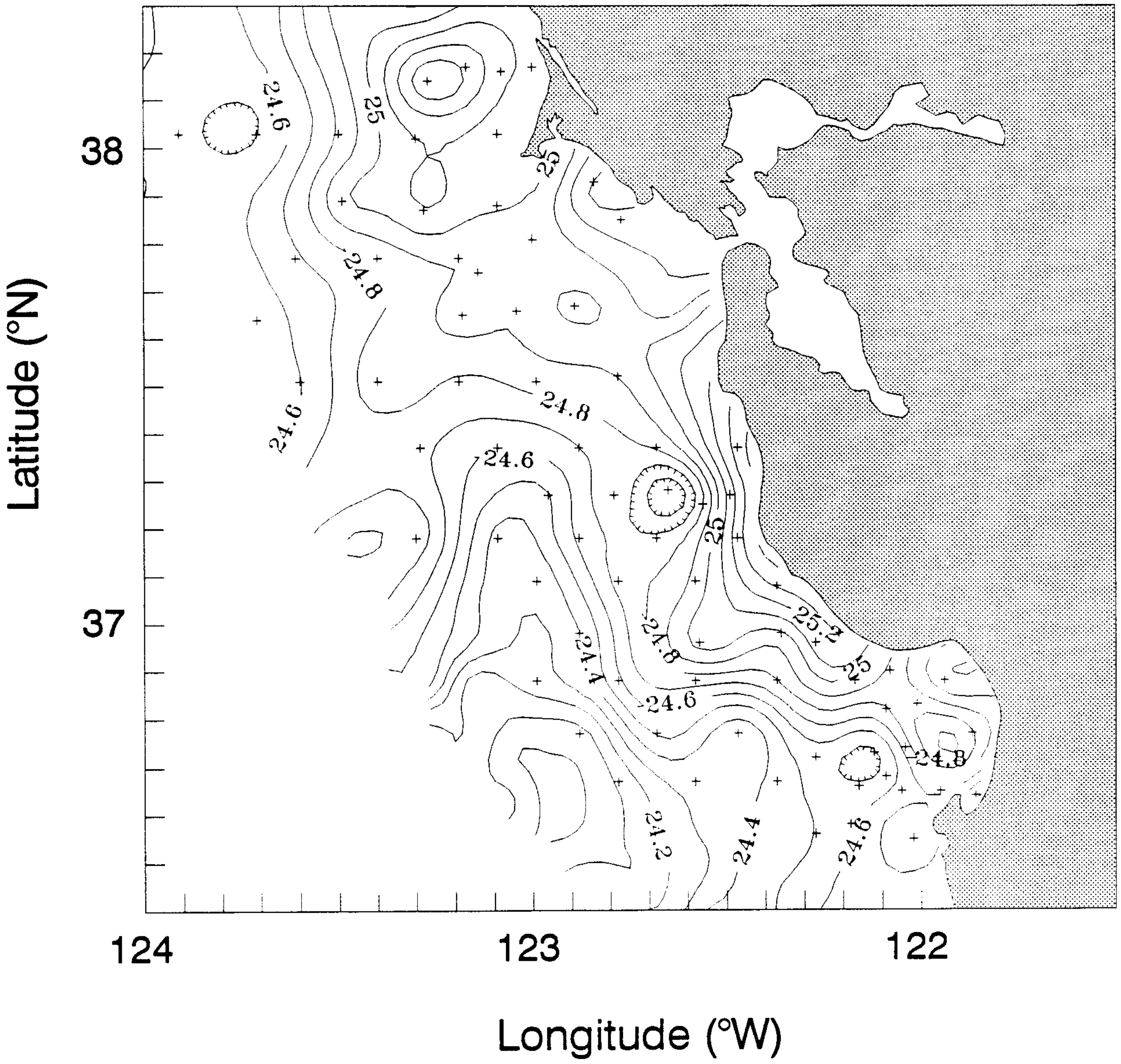
DSJ9206 Sweep 2
Salinity (ppt) at 300 m



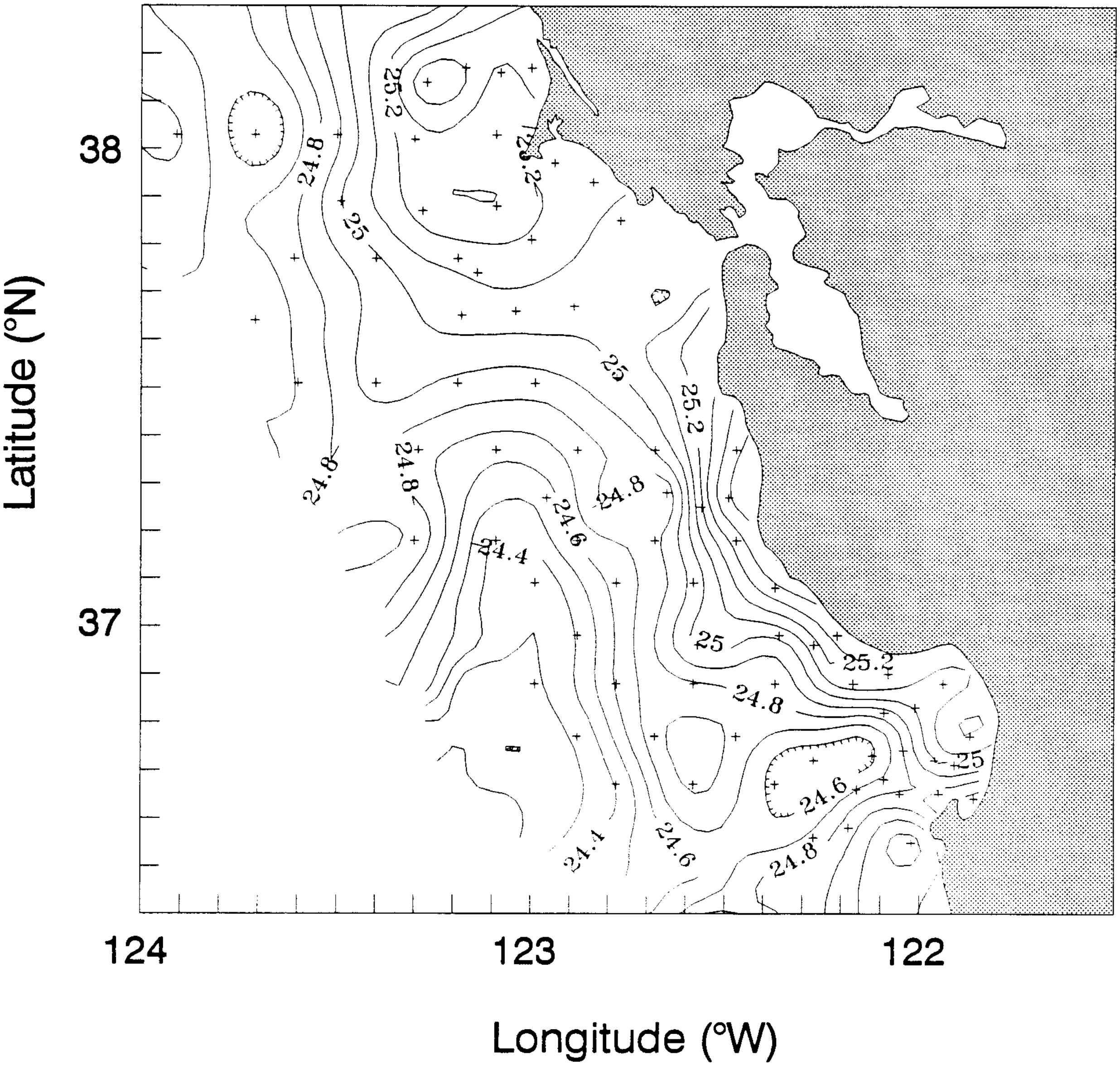
DSJ9206 Sweep 2
Salinity (ppt) at 500 m



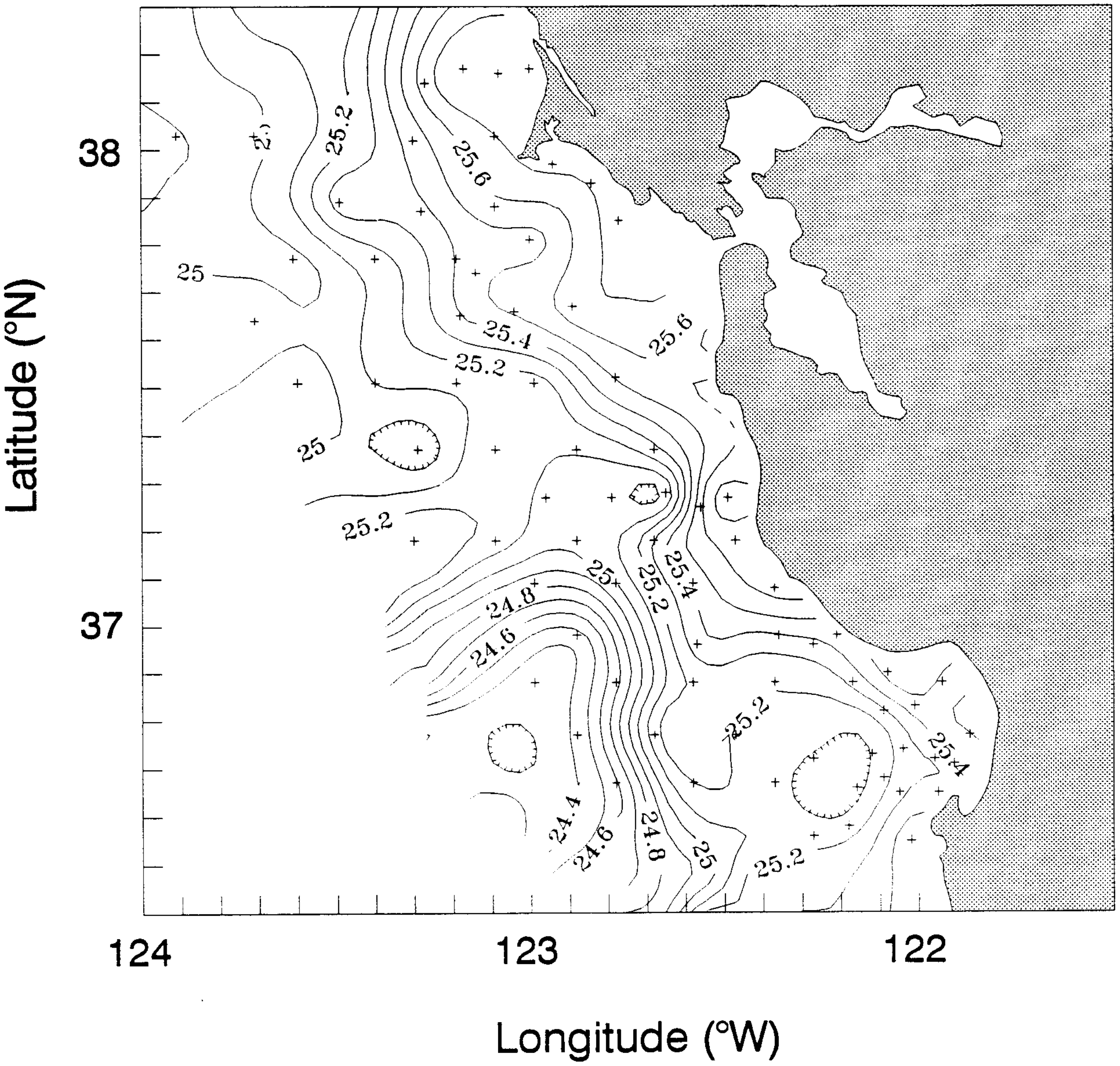
DSJ9206 Sweep 2
Density (kg/m^3) at 2 m



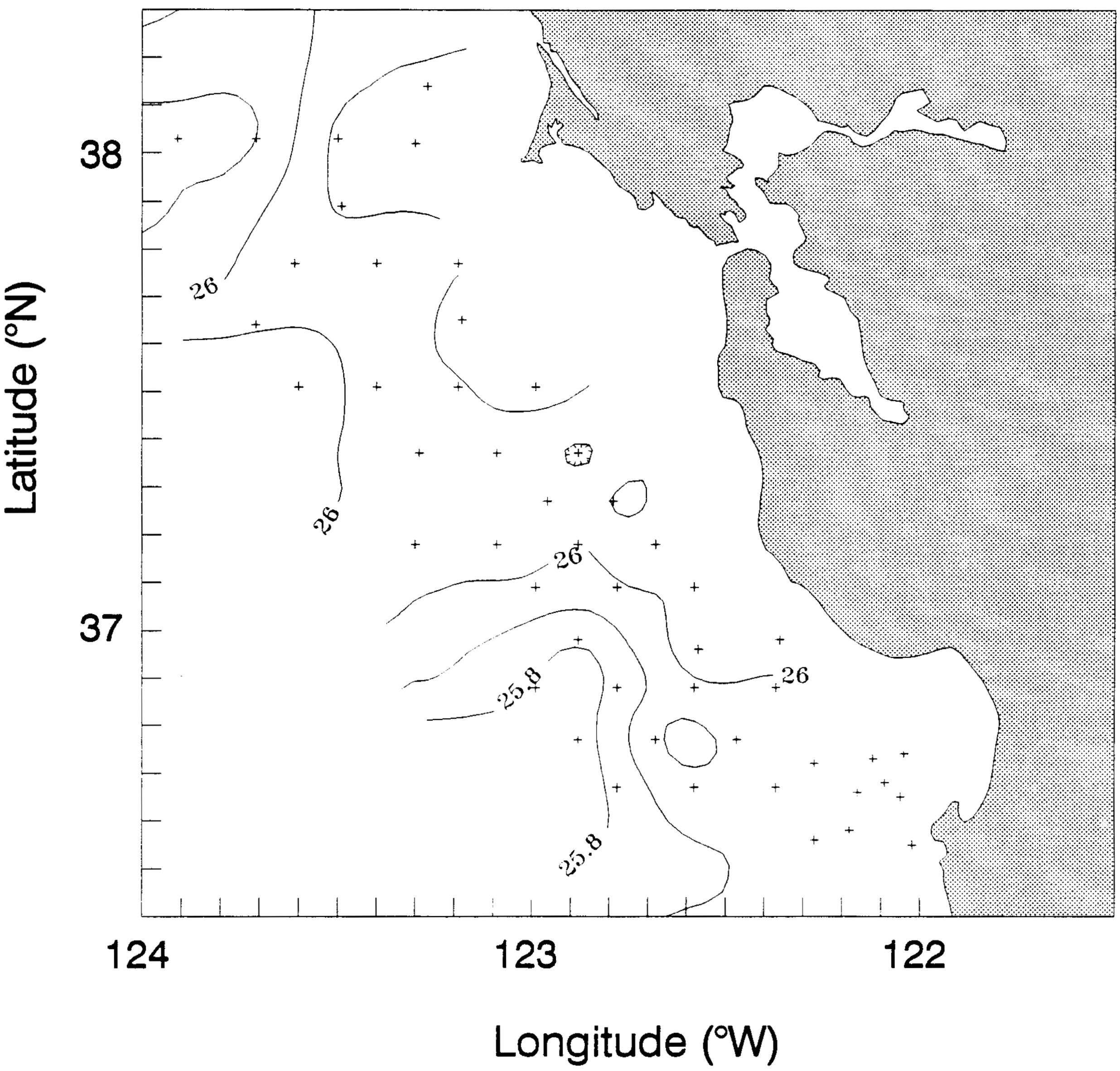
DSJ9206 Sweep 2
Density (kg/m^3) at 10 m



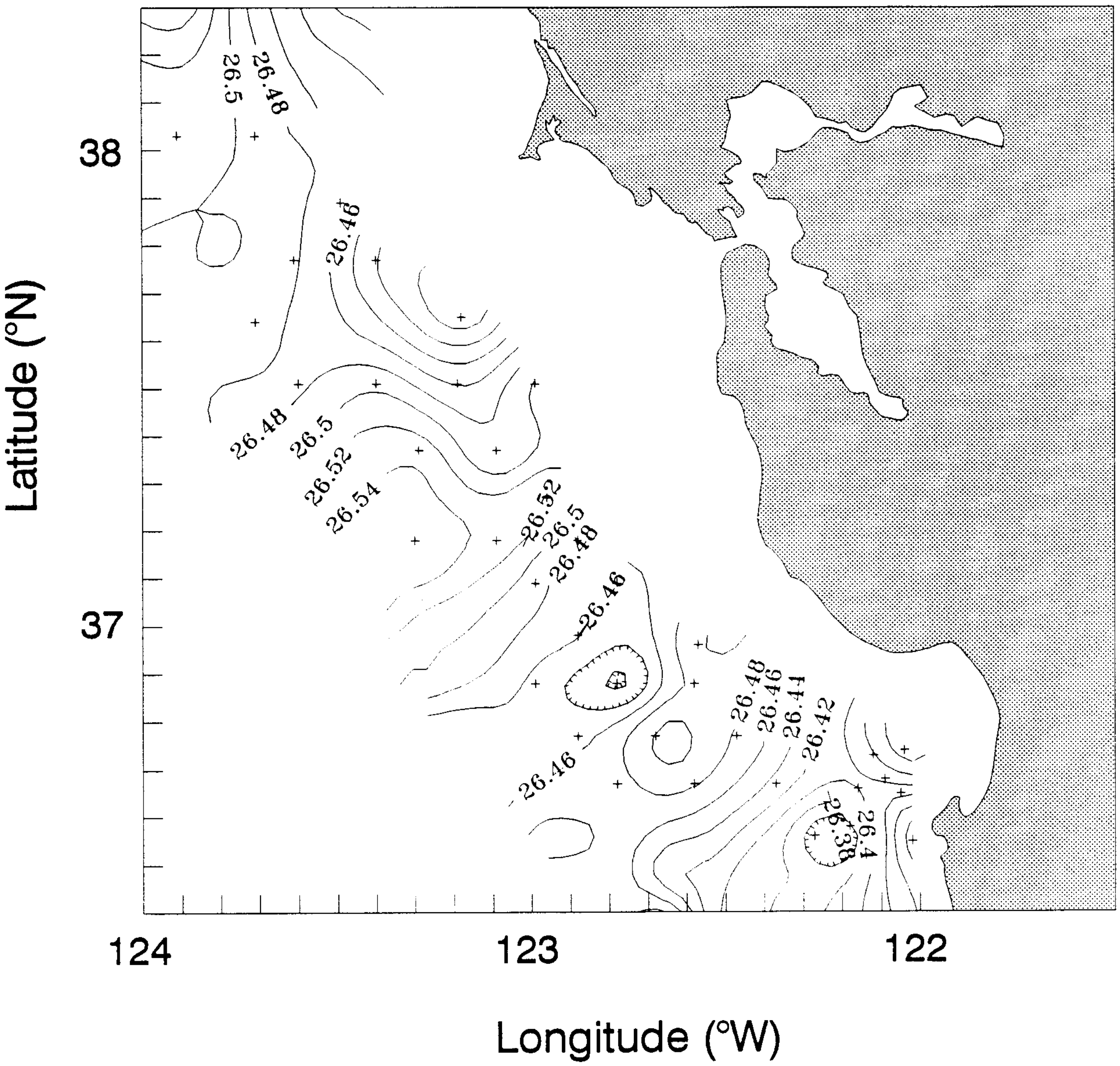
DSJ9206 Sweep 2
Density (kg/m³) at 30 m



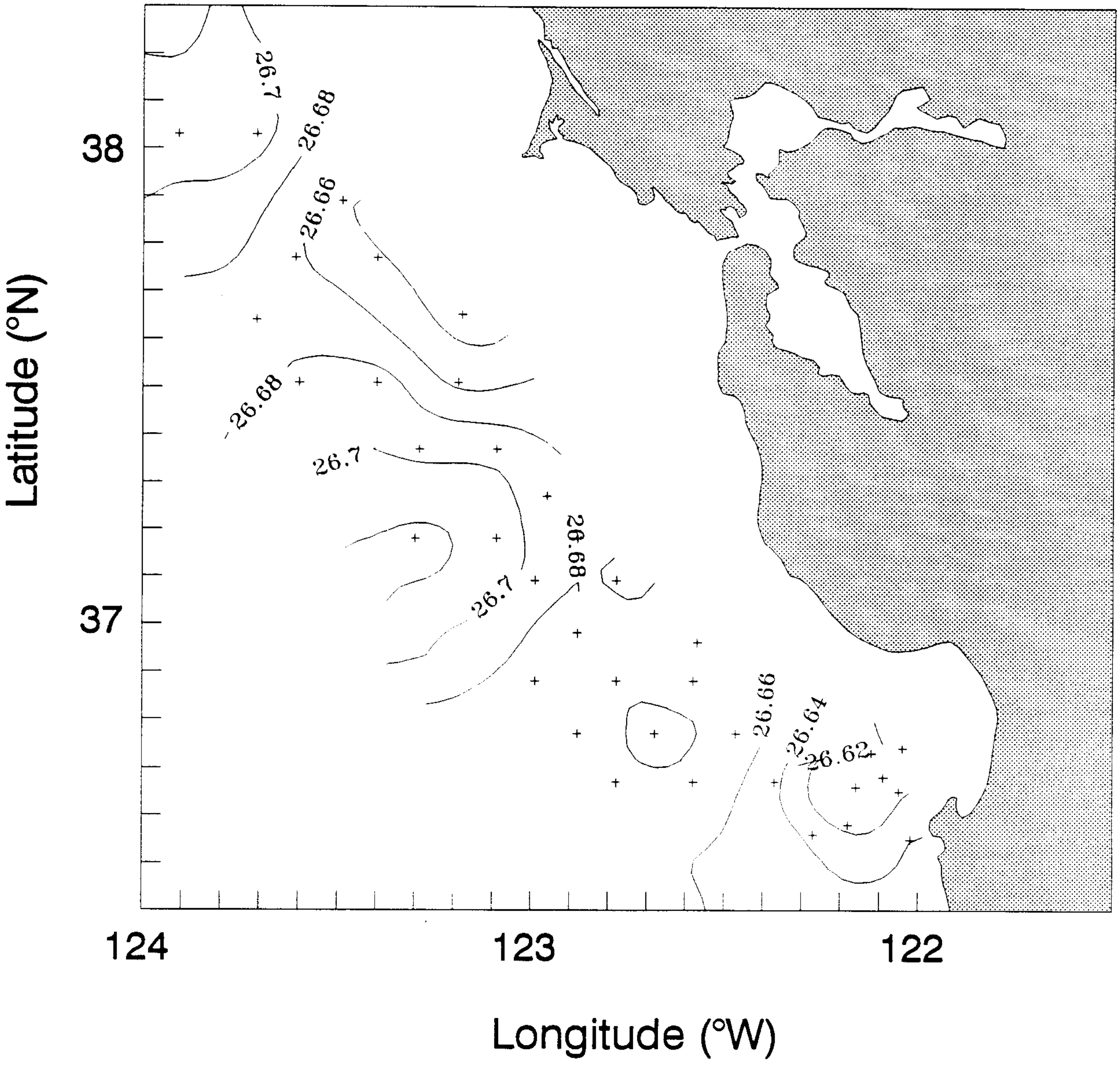
DSJ9206 Sweep 2
Density (kg/m³) at 100 m



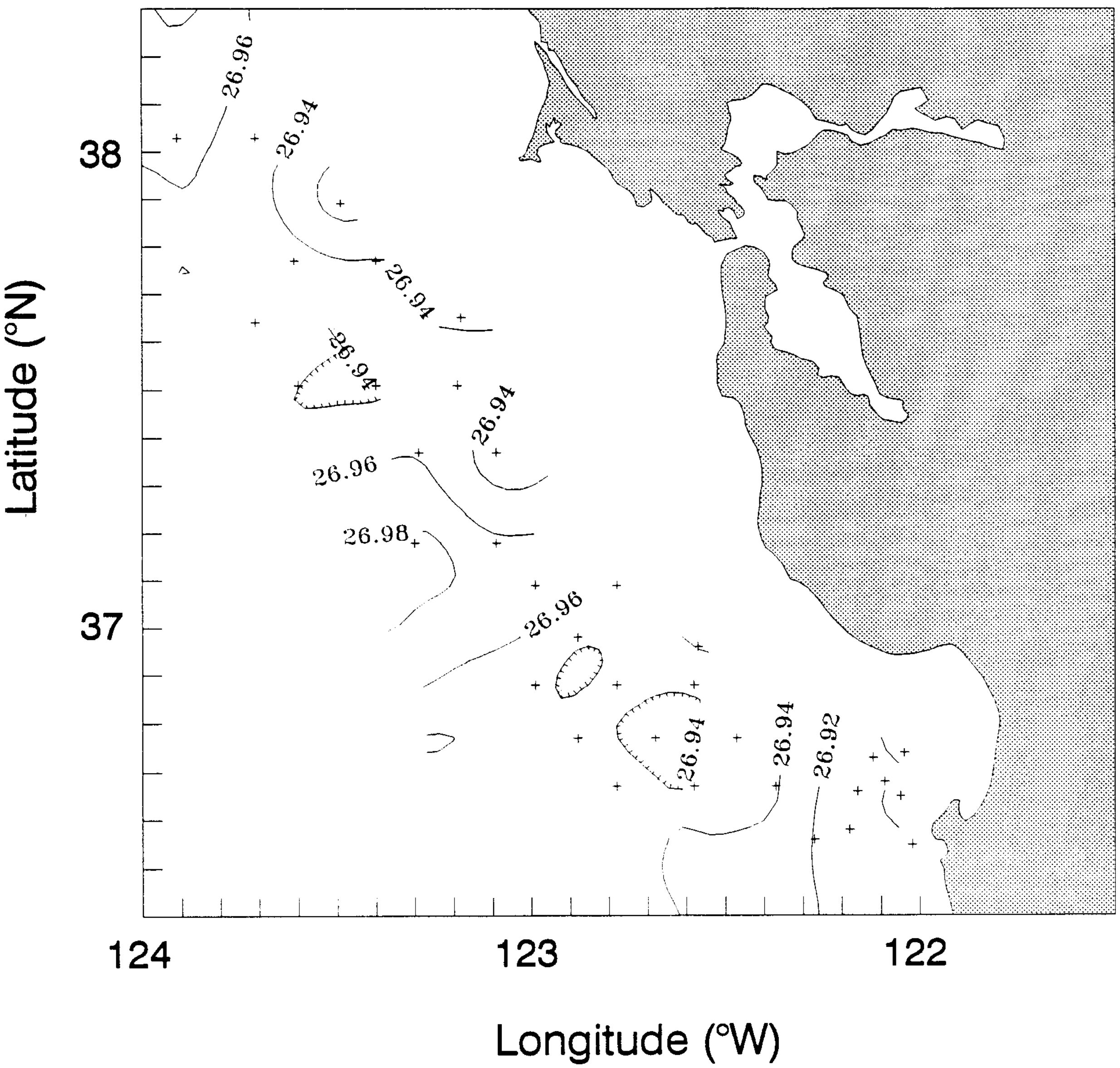
DSJ9206 Sweep 2
Density (kg/m³) at 200 m



DSJ9206 Sweep 2
Density (kg/m³) at 300 m

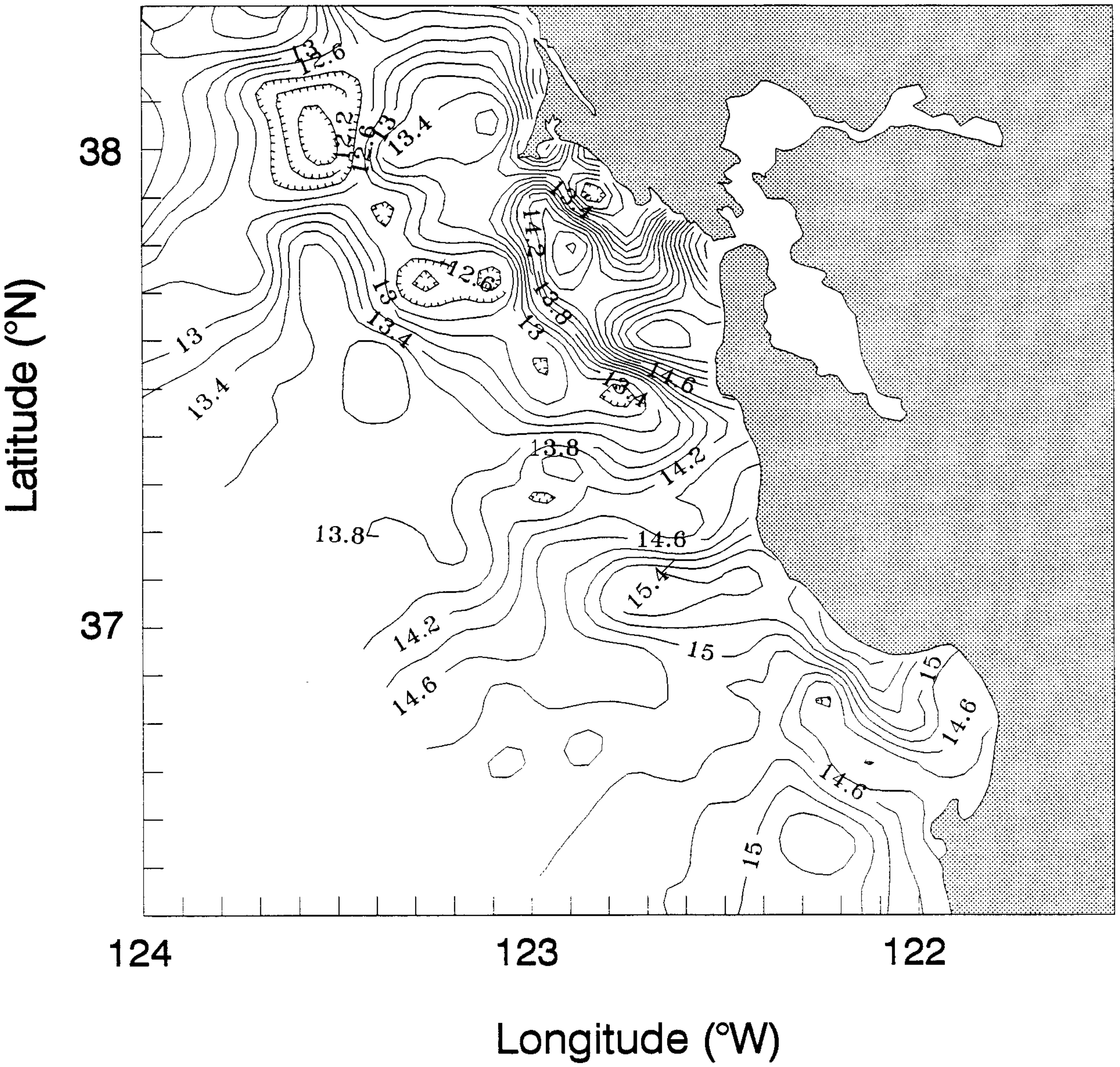


DSJ9206 Sweep 2
Density (kg/m³) at 500 m

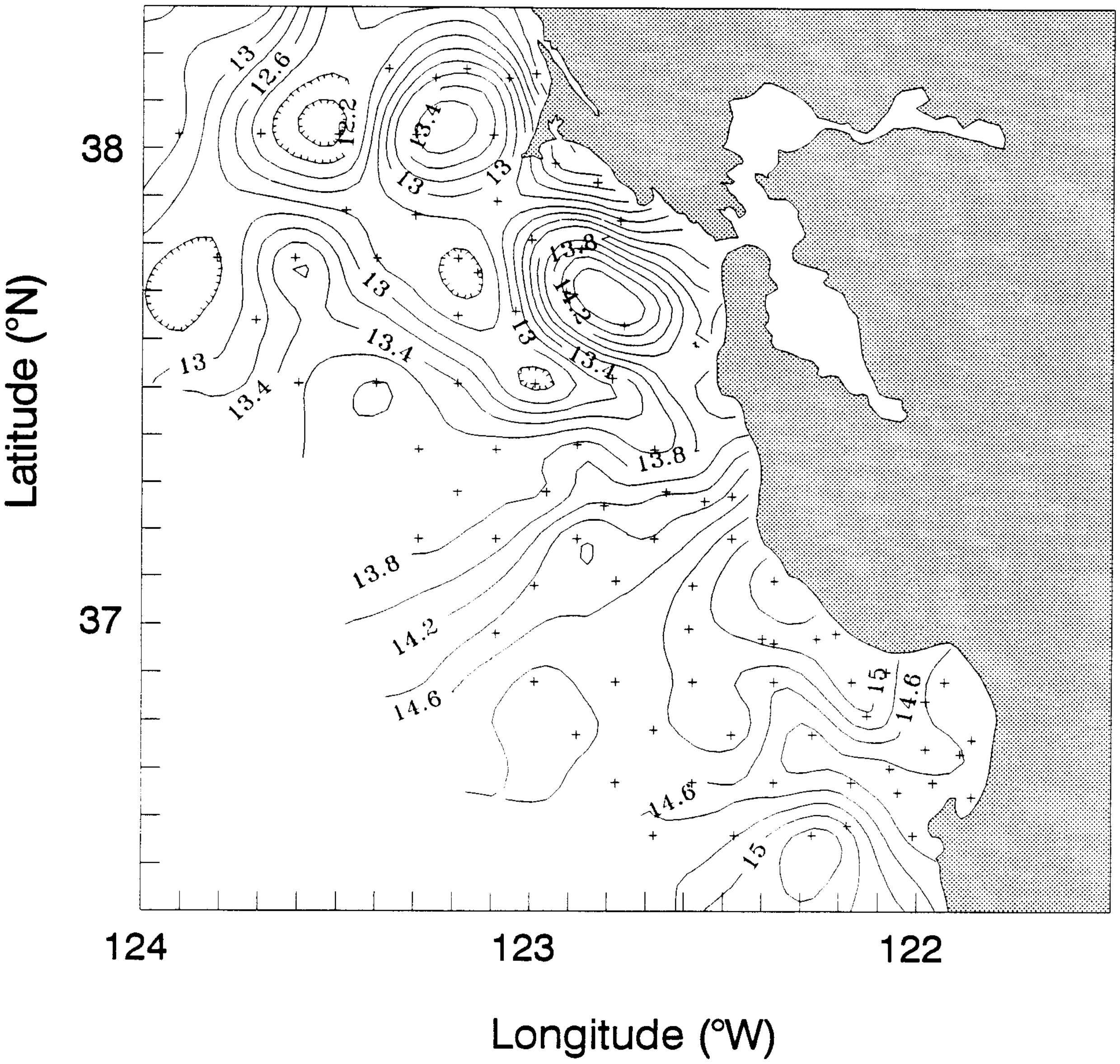


APPENDIX 6.4: HORIZONTAL MAPS OF CTD AND TS FOR DSJ9206, SWEEP 3

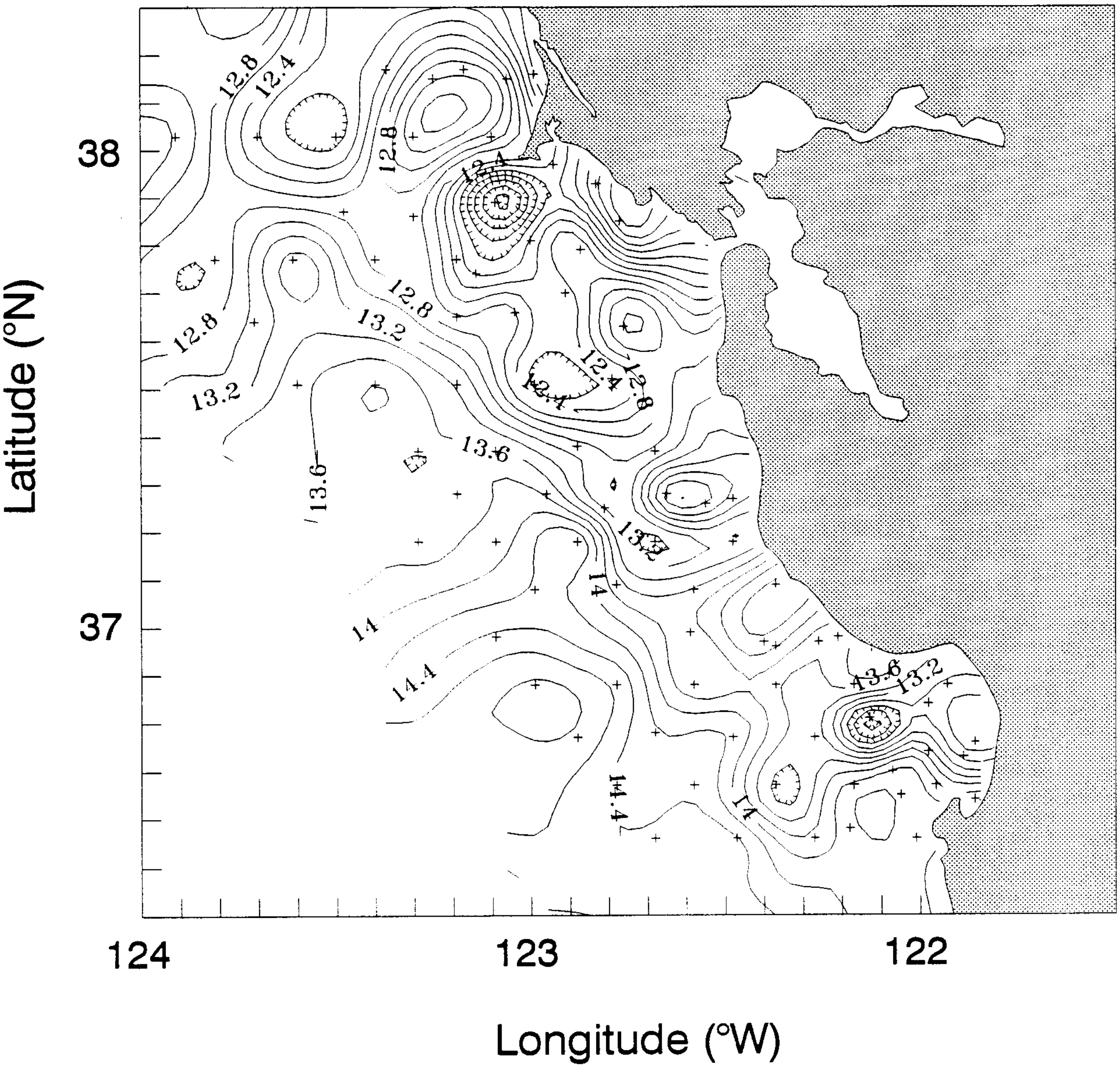
DSJ9206 Sweep 3
TS Temperature (°C)



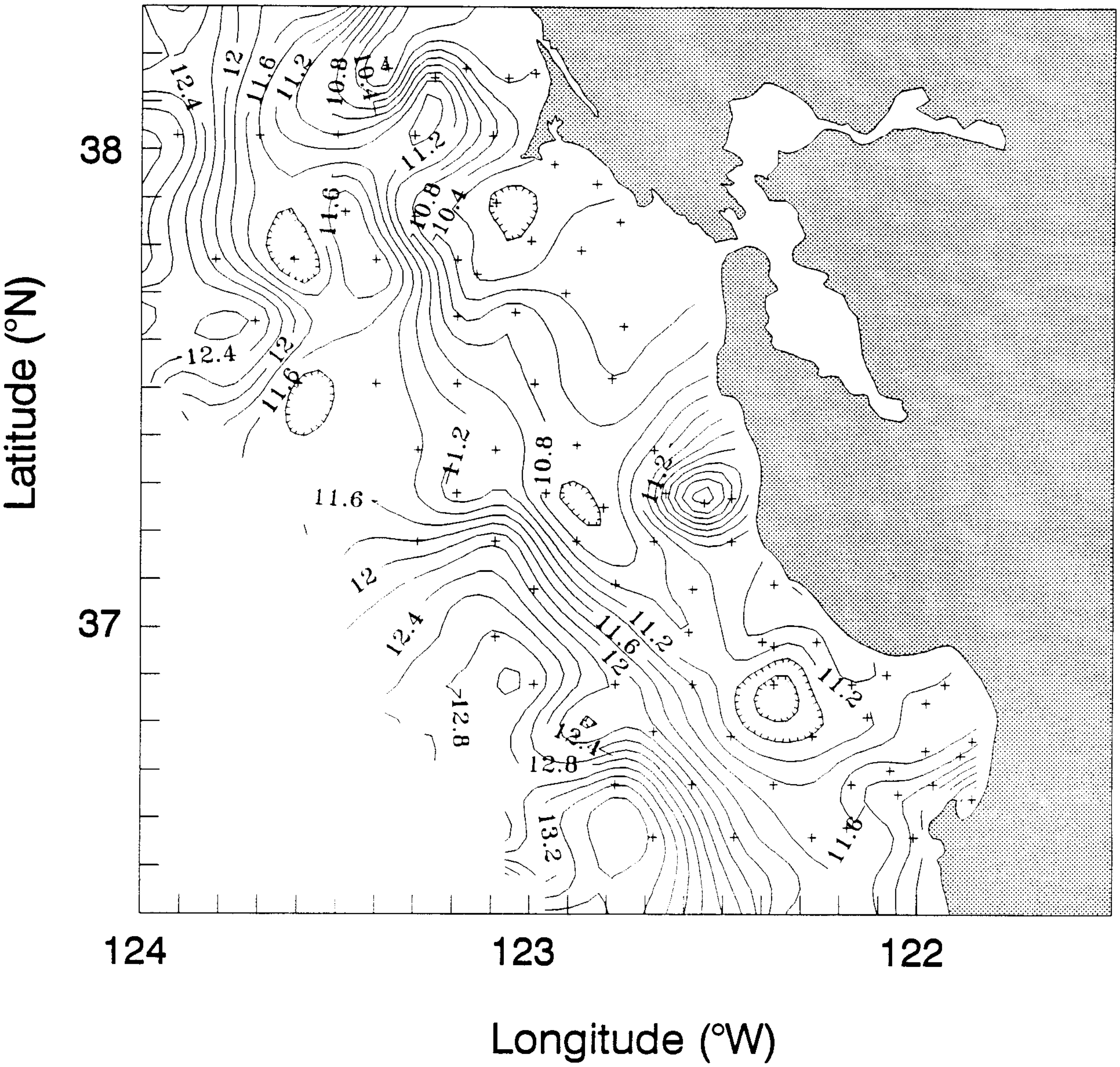
DSJ9206 Sweep 3
Temperature (°C) at 2 m



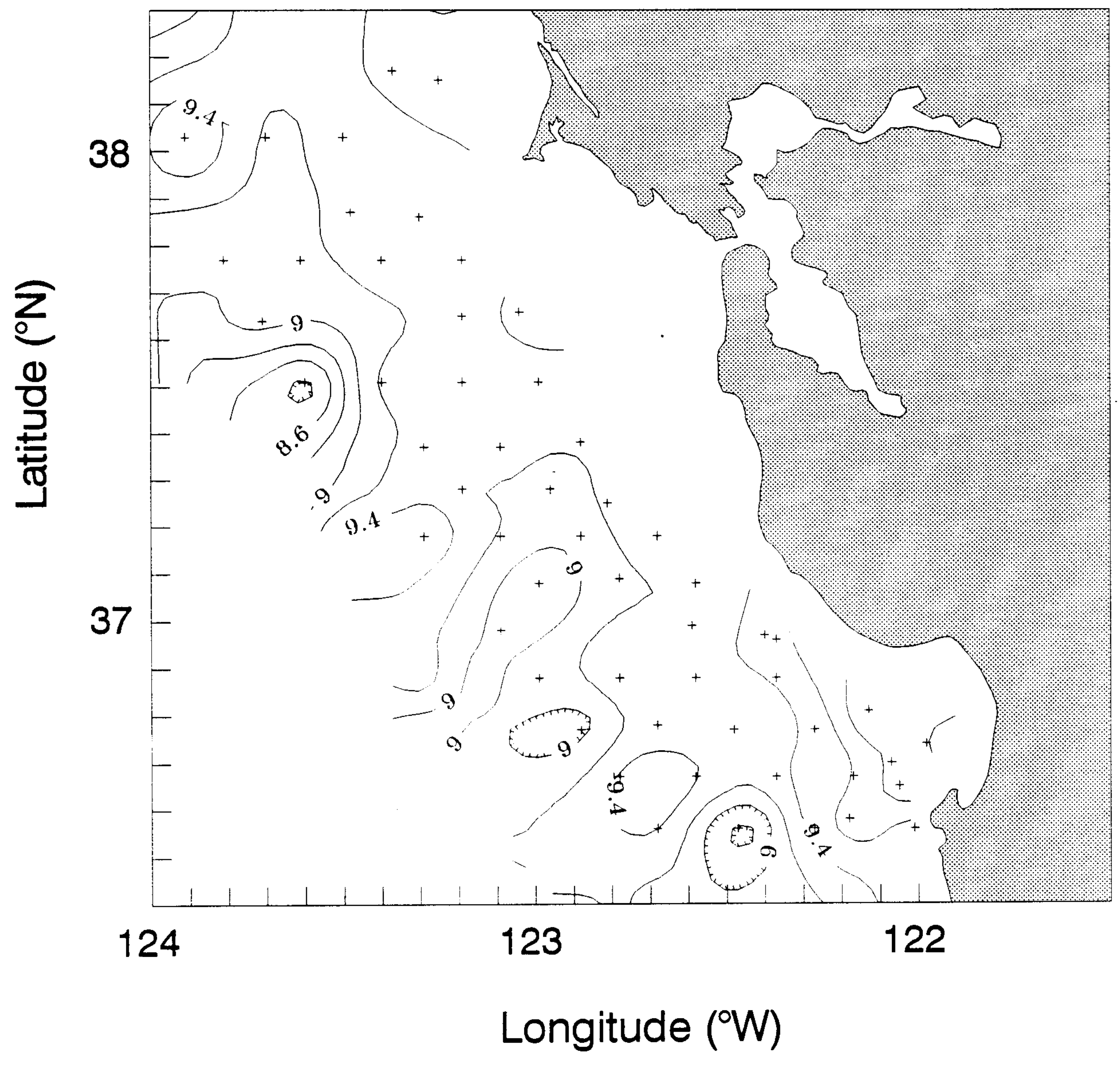
DSJ9206 Sweep 3
Temperature (°C) at 10 m

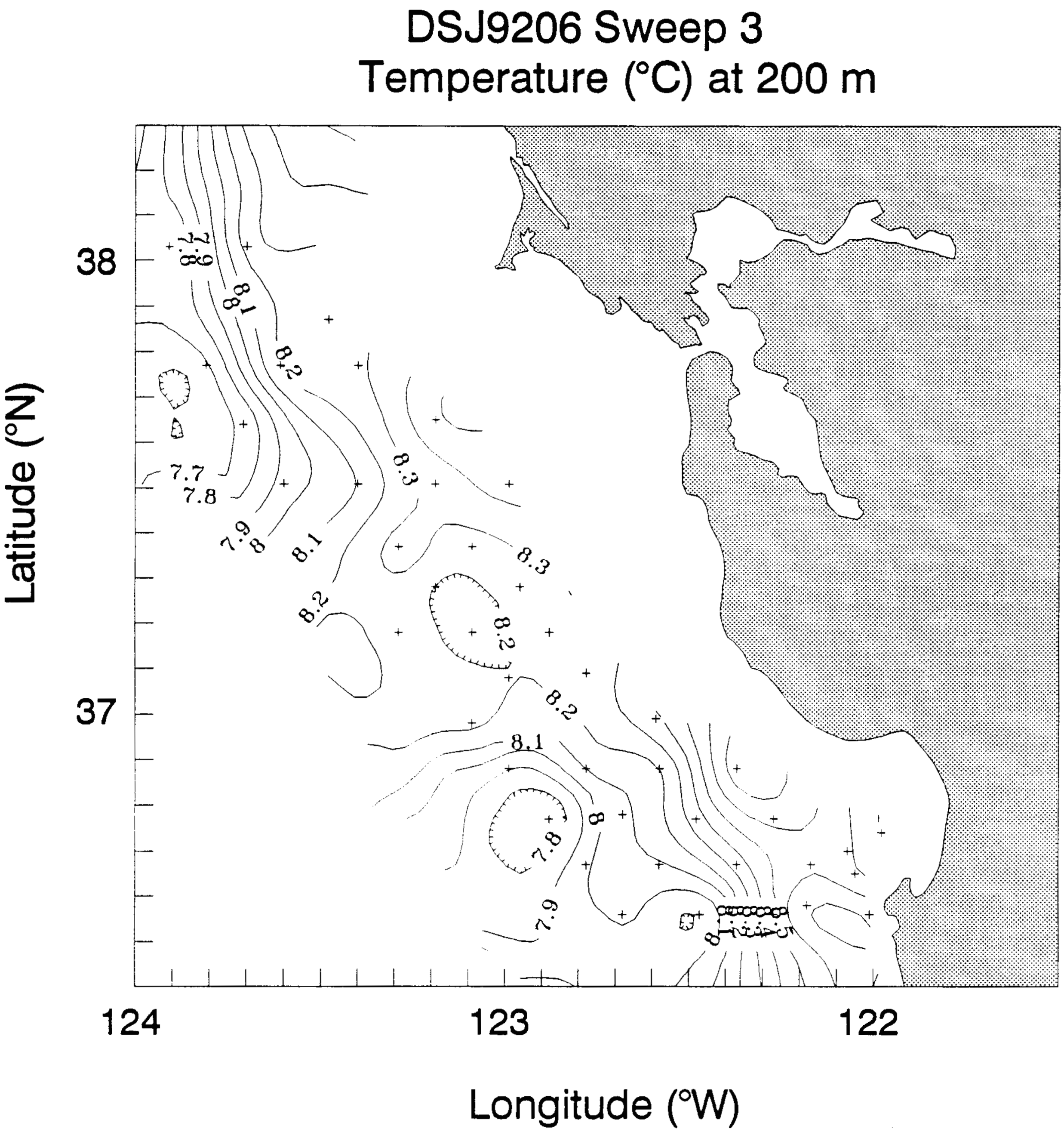


DSJ9206 Sweep 3
Temperature (°C) at 30 m



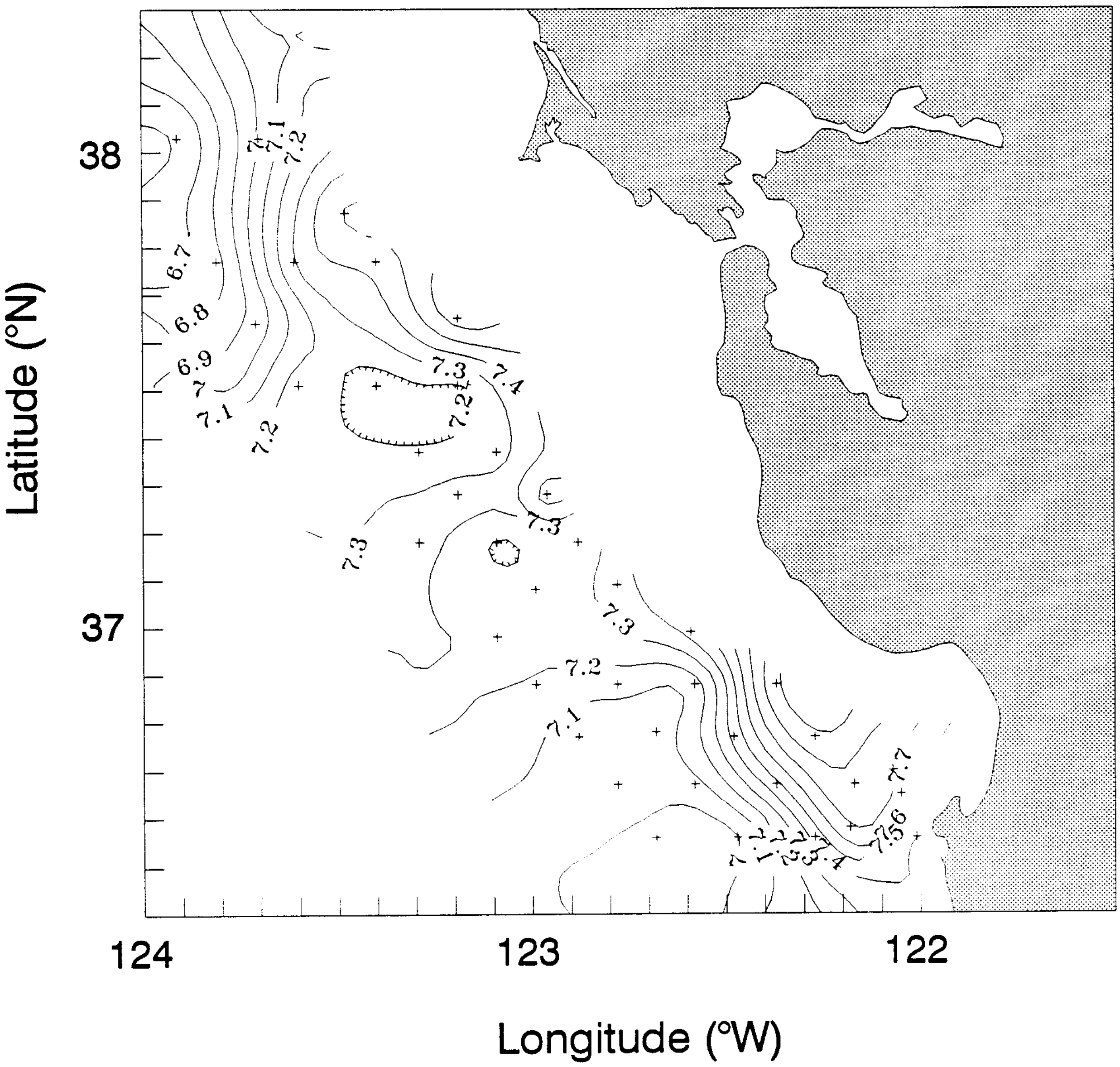
DSJ9206 Sweep 3
Temperature (°C) at 100 m



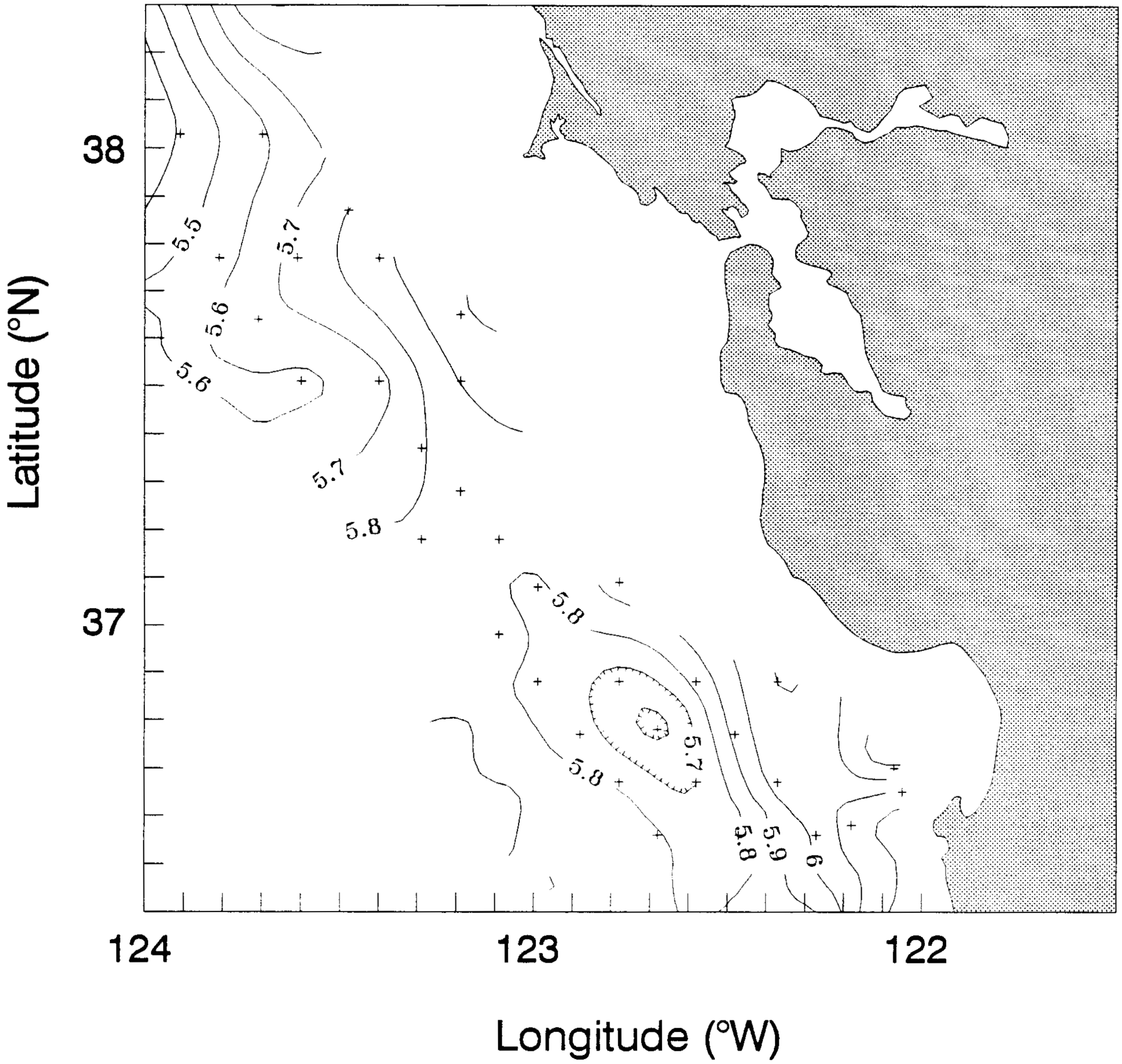


DSJ9206 Sweep 3
Temperature (°C) at 200 m

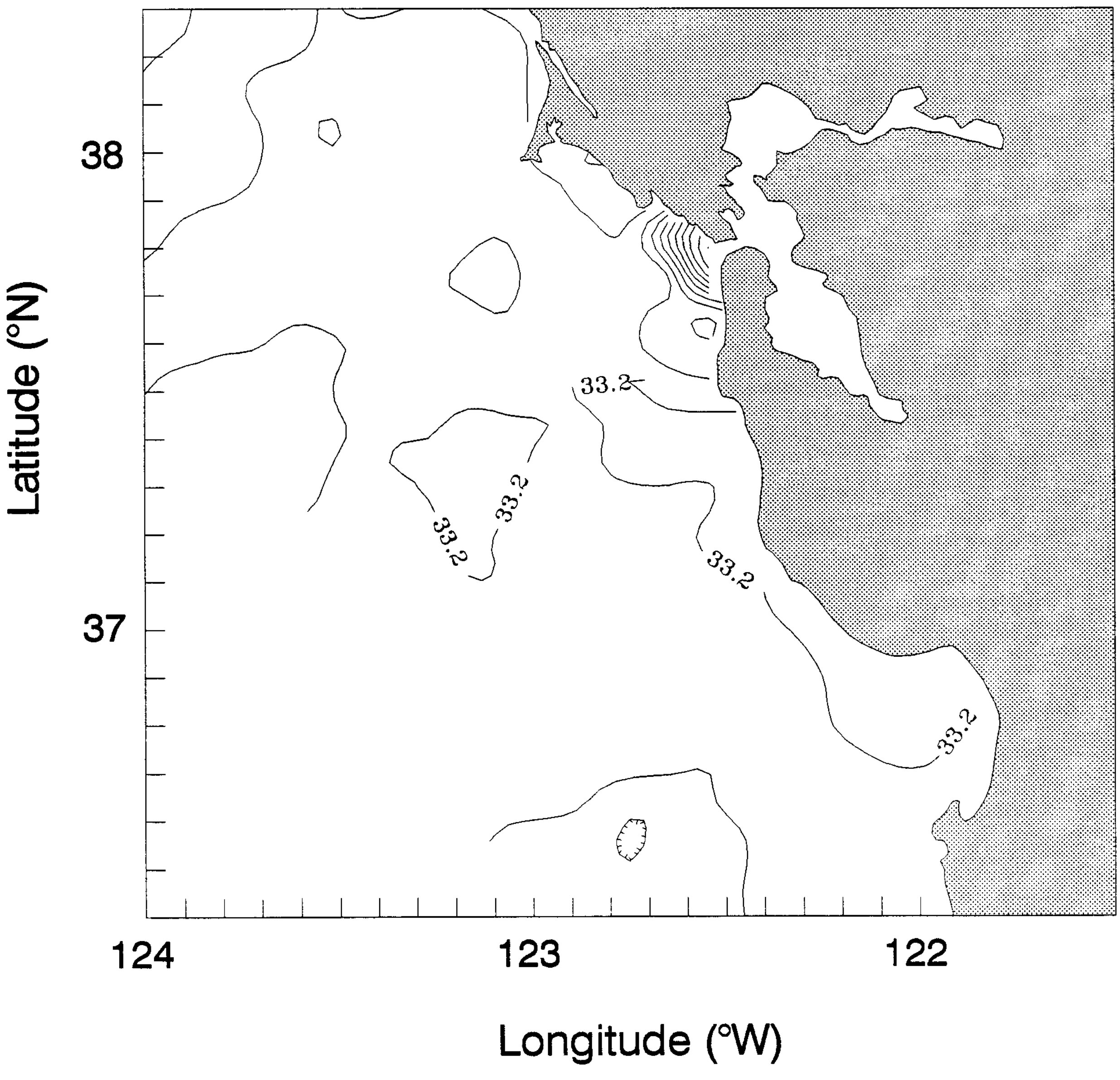
DSJ9206 Sweep 3
Temperature (°C) at 300 m



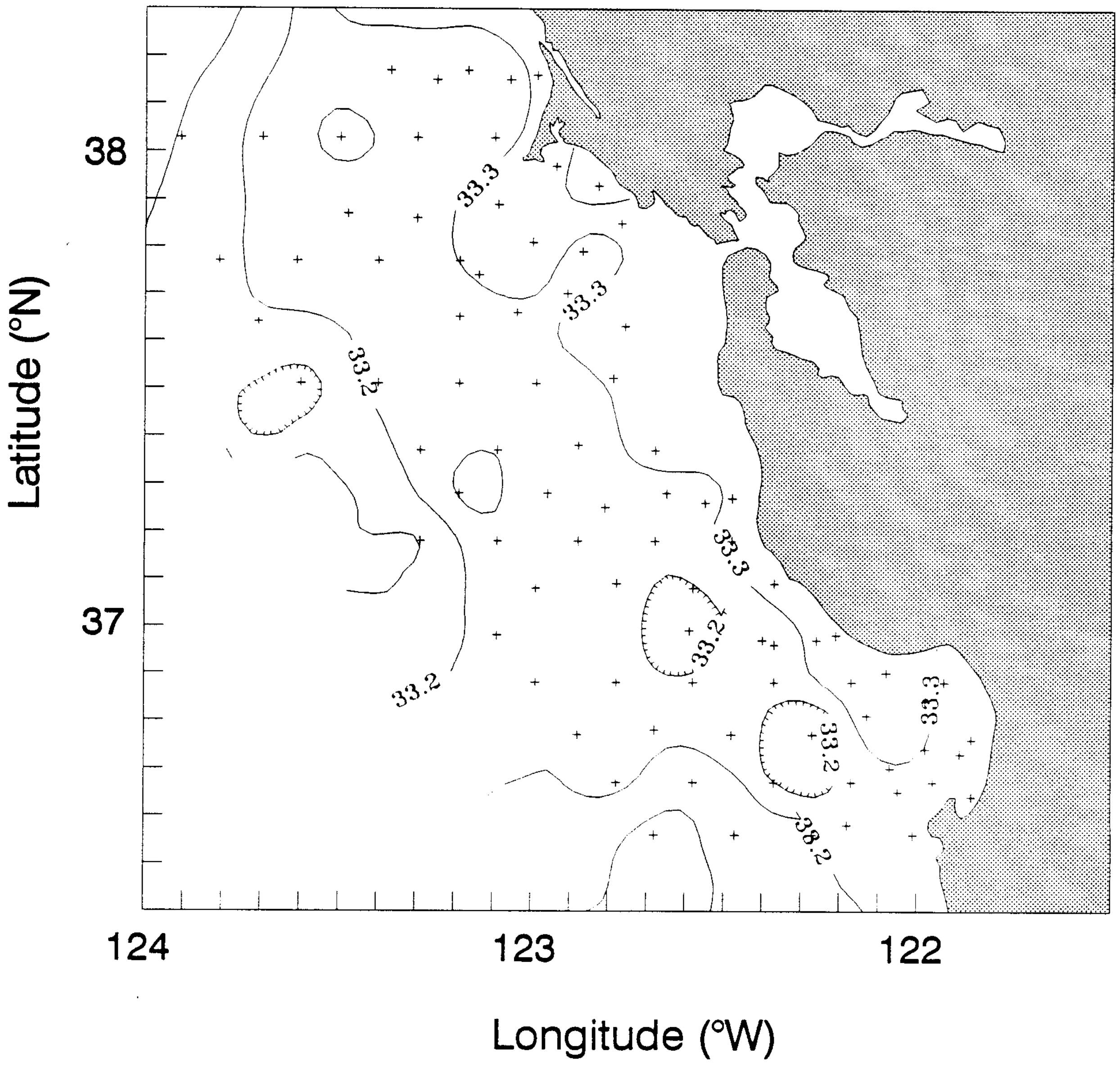
DSJ9206 Sweep 3
Temperature (°C) at 500 m



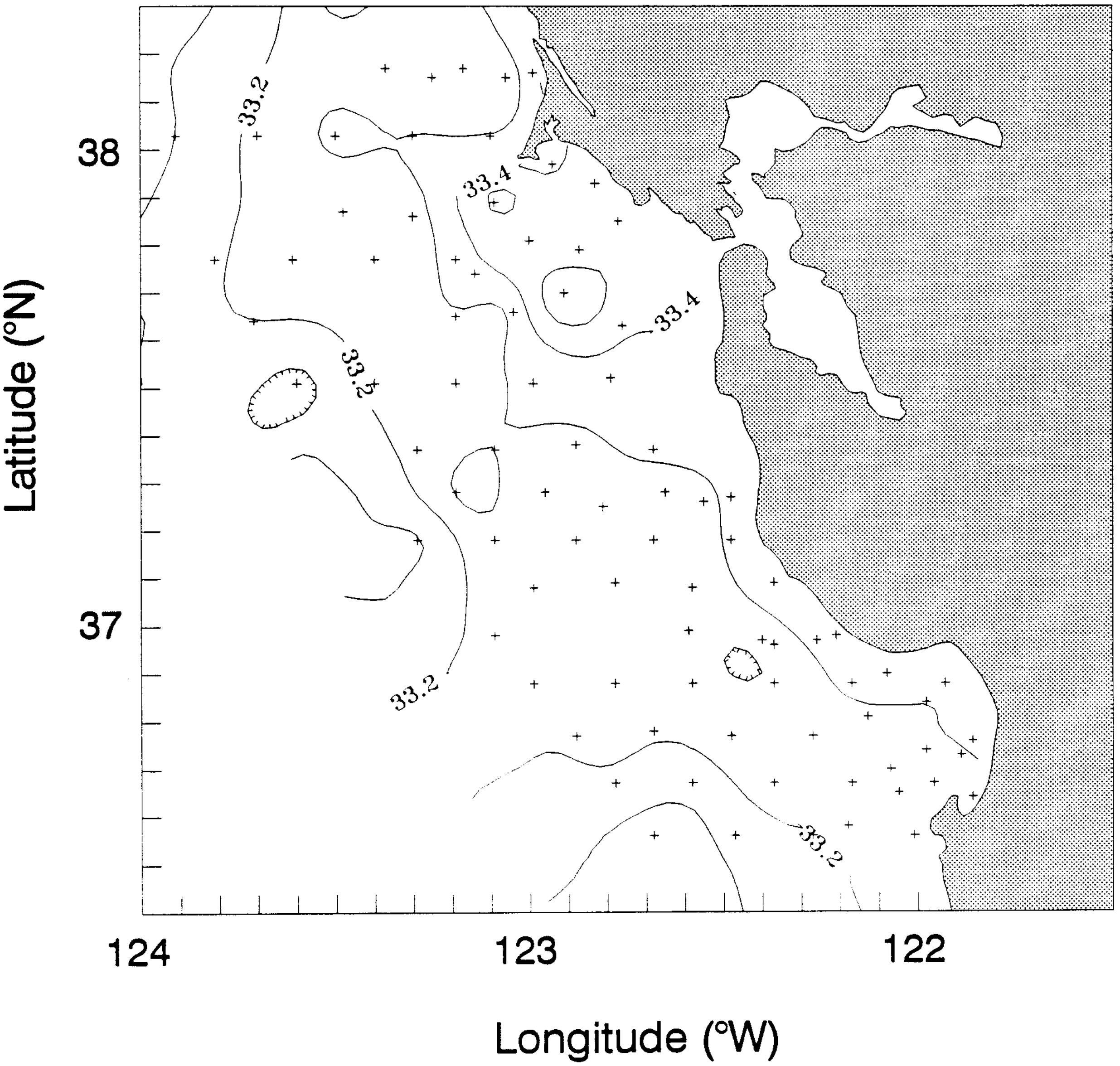
DSJ9206 Sweep 3
TS Salinity (ppt)



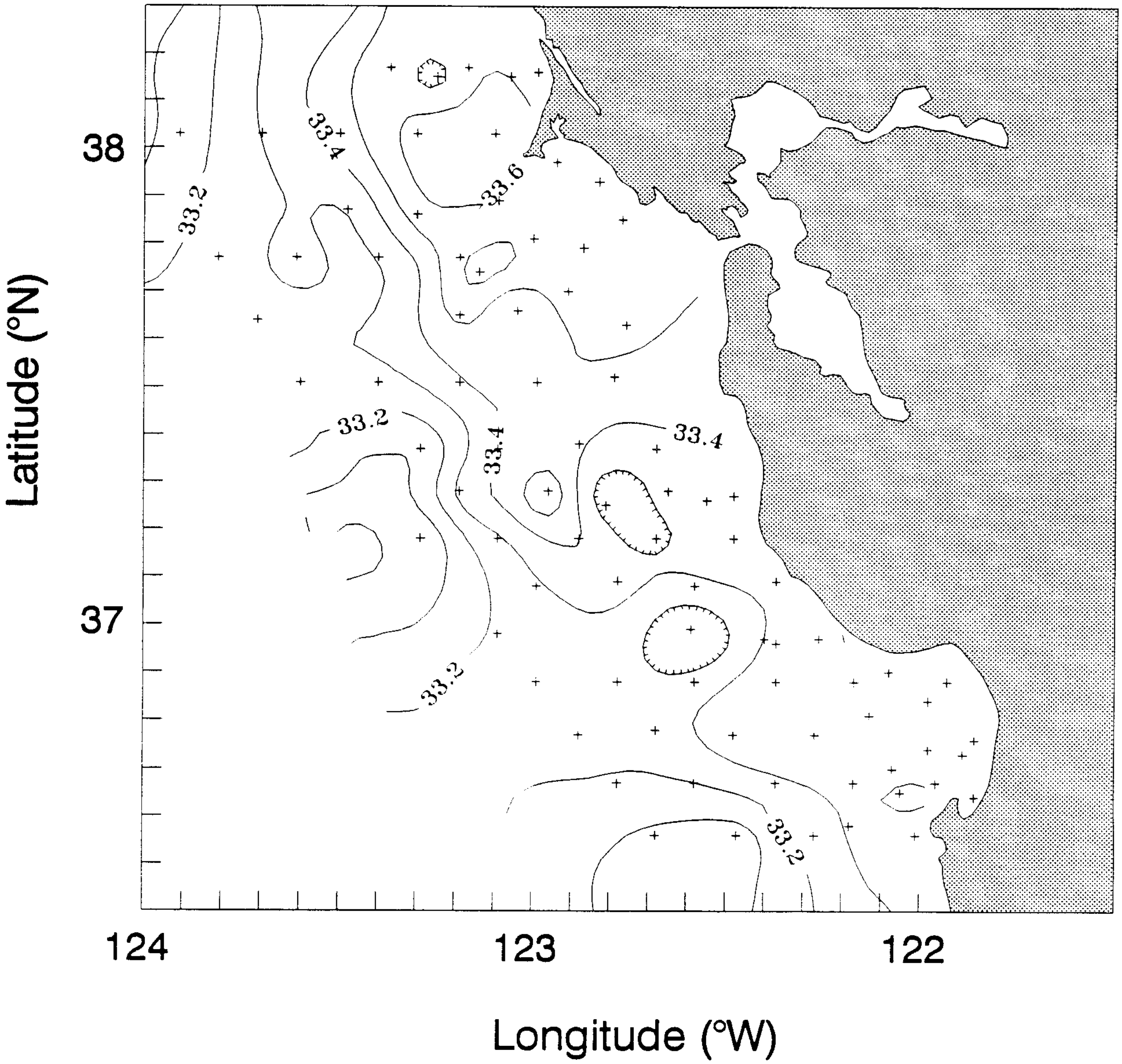
DSJ9206 Sweep 3
Salinity (ppt) at 2 m

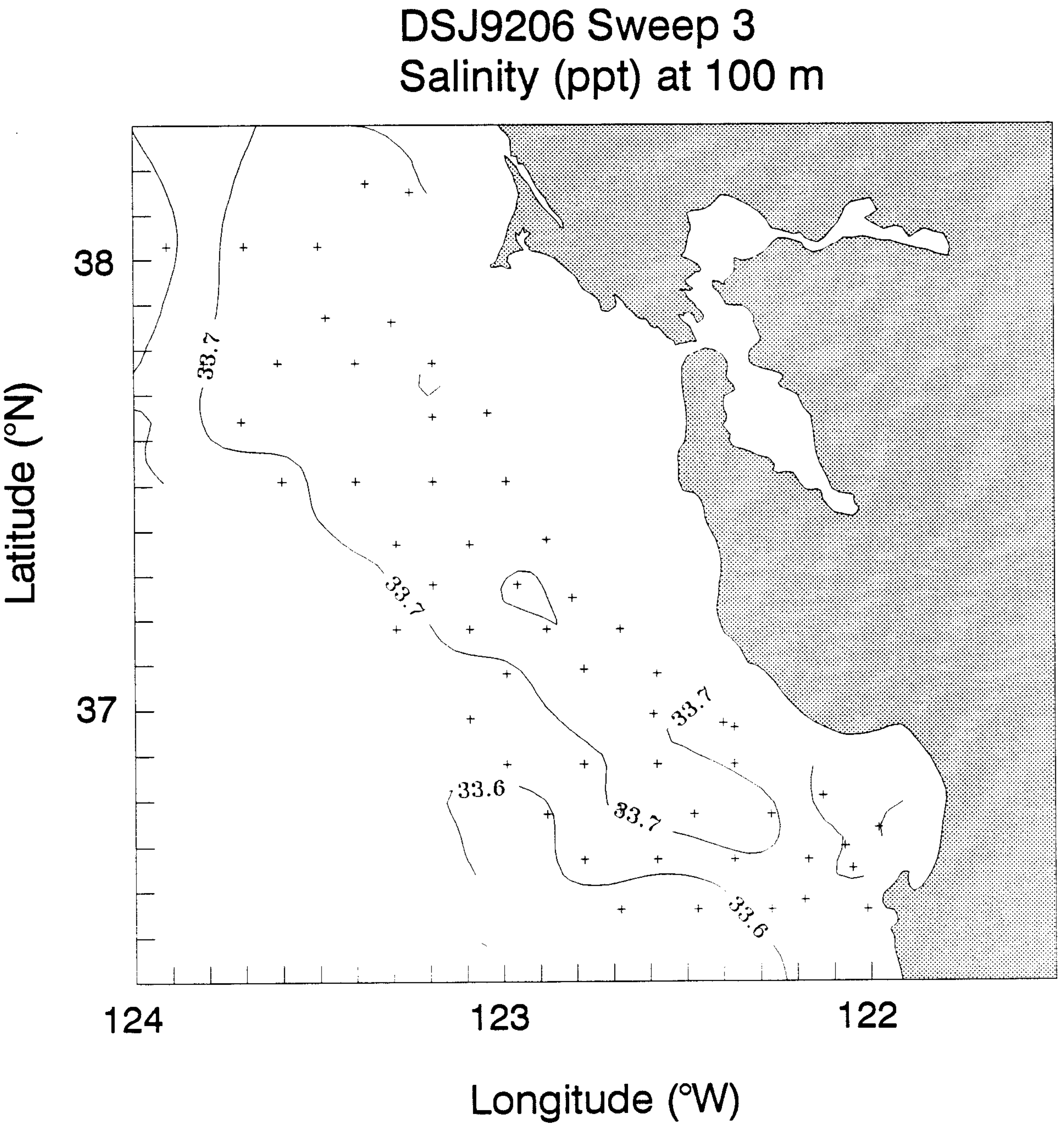


DSJ9206 Sweep 3
Salinity (ppt) at 10 m

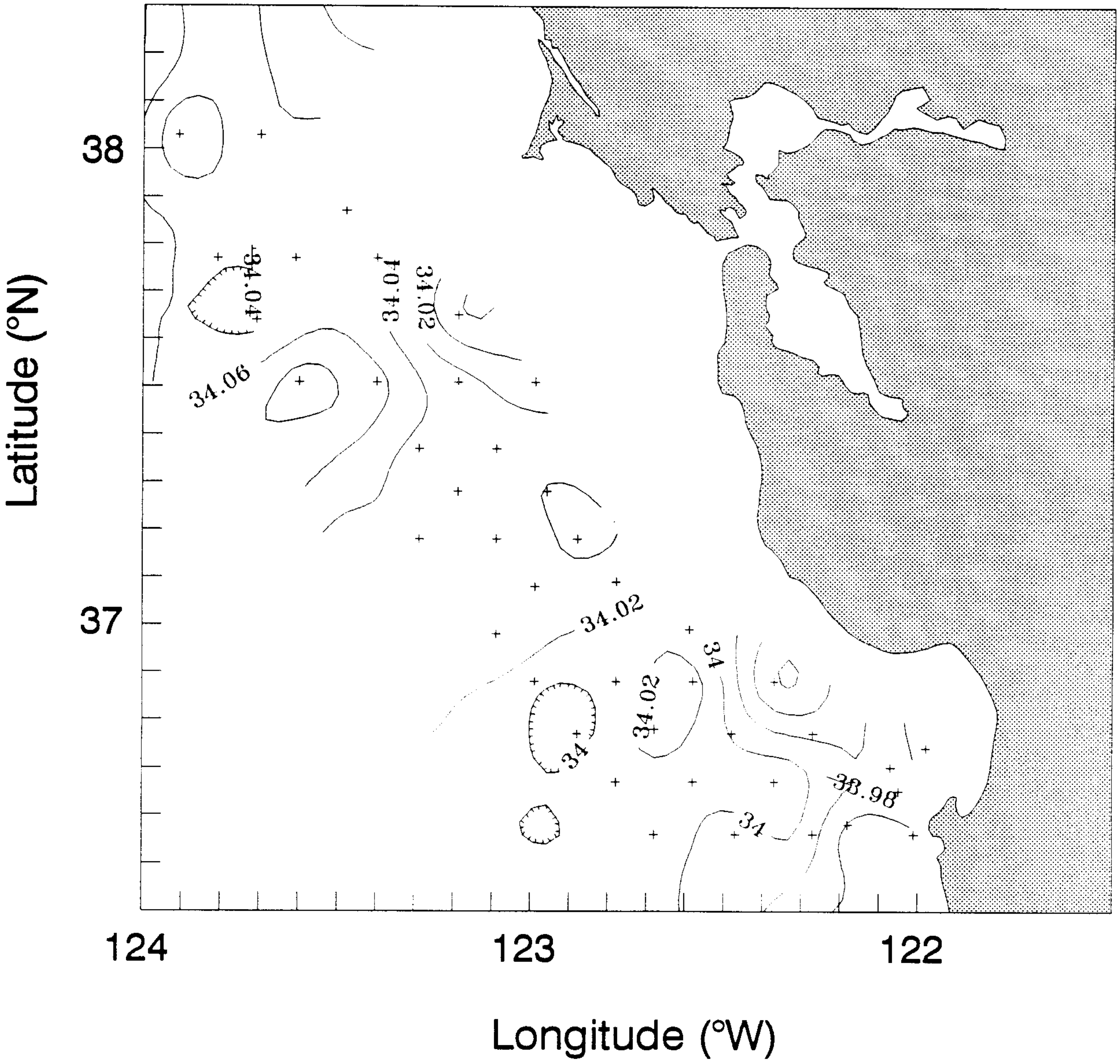


DSJ9206 Sweep 3
Salinity (ppt) at 30 m

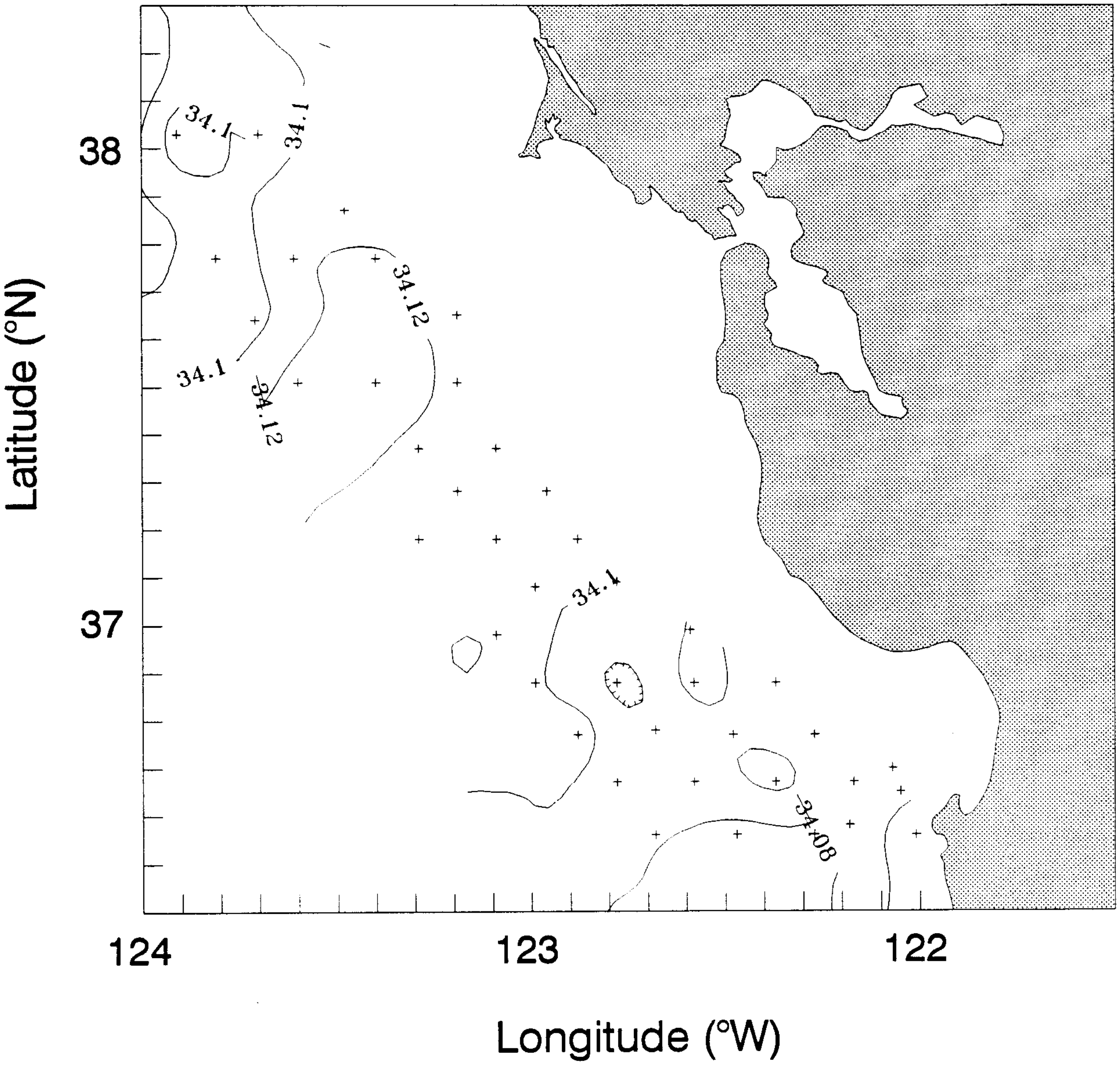


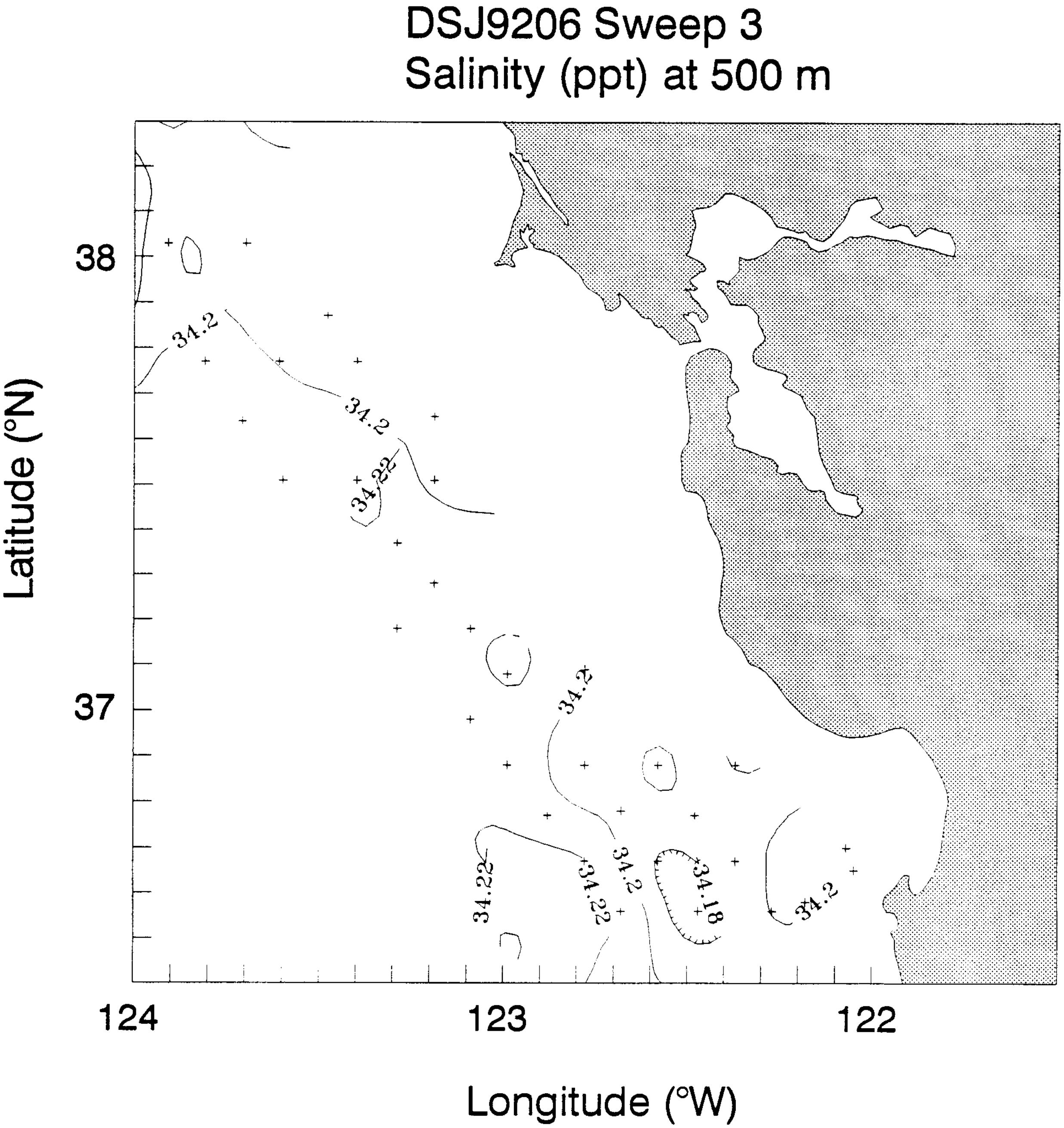
DSJ9206 Sweep 3
Salinity (ppt) at 100 m
Latitude (°N)
38
37
124
123
122
Longitude (°W)
33.7
33.7
33.7
33.7
33.6
33.6

DSJ9206 Sweep 3
Salinity (ppt) at 200 m

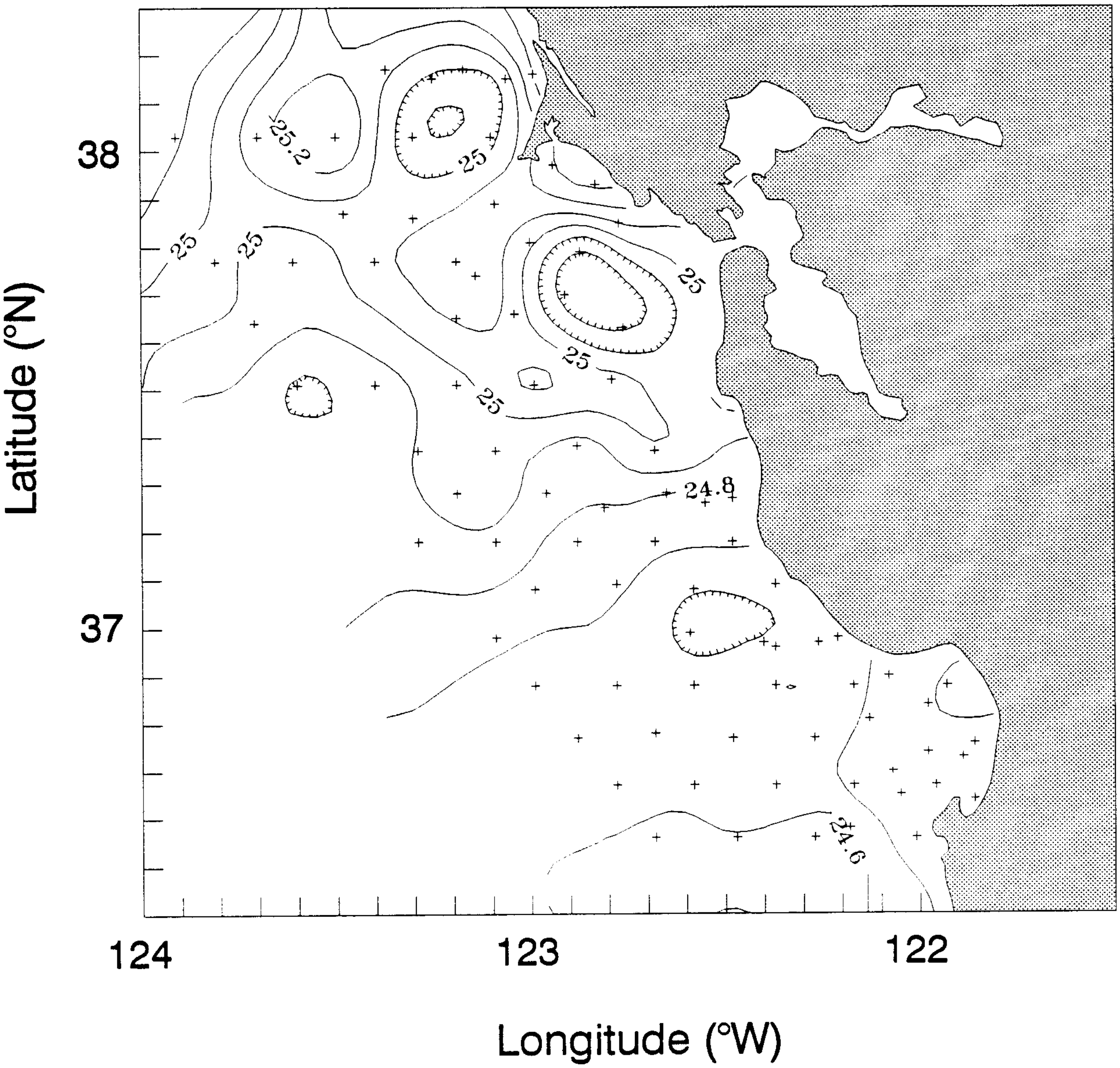


DSJ9206 Sweep 3
Salinity (ppt) at 300 m

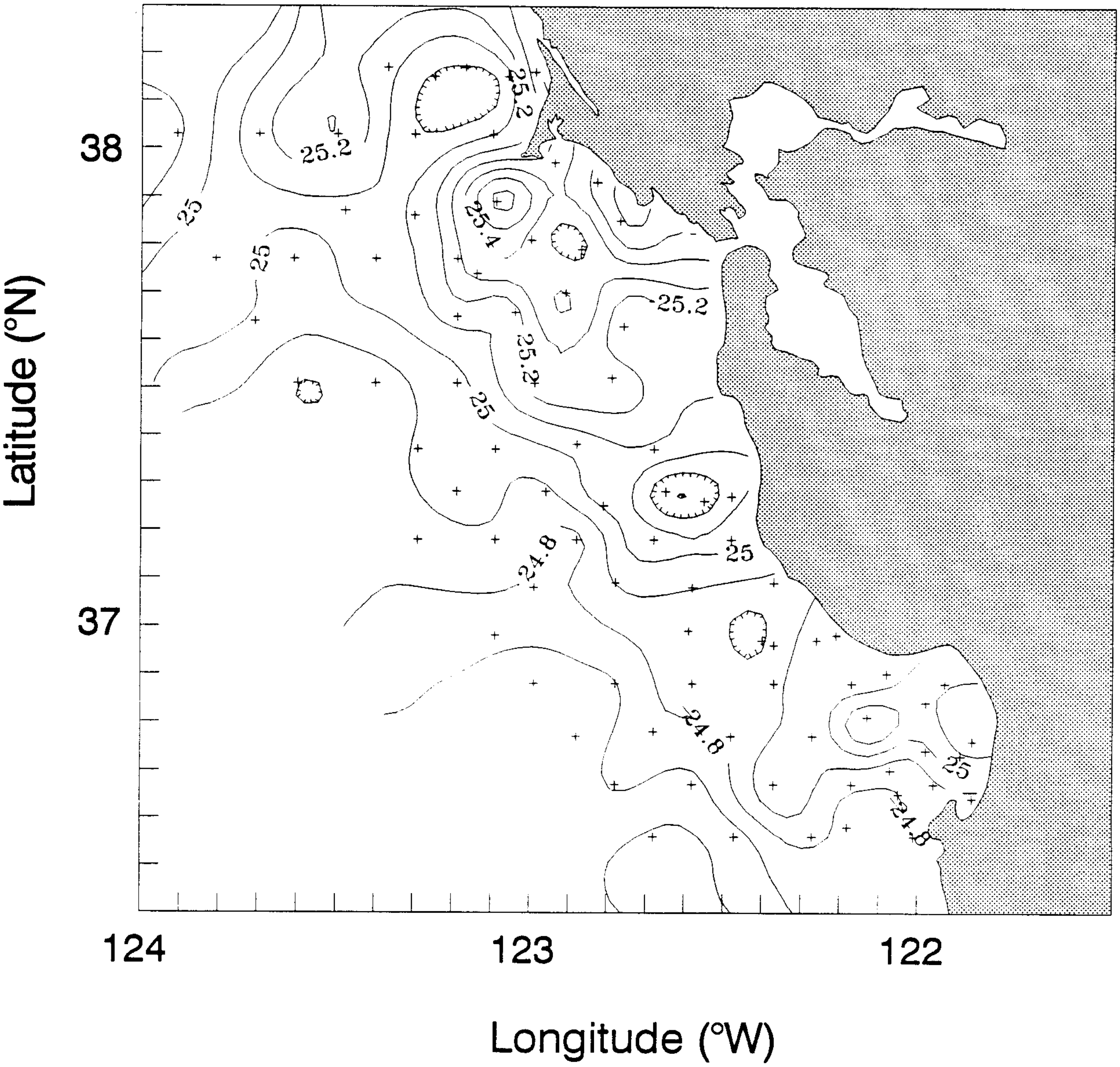



DSJ9206 Sweep 3
Salinity (ppt) at 500 m
Latitude (°N)
38
37
Longitude (°W)
124
123
122
34.2
34.2
34.22
34.2
34.22
34.22
34.2
34.18
34.2

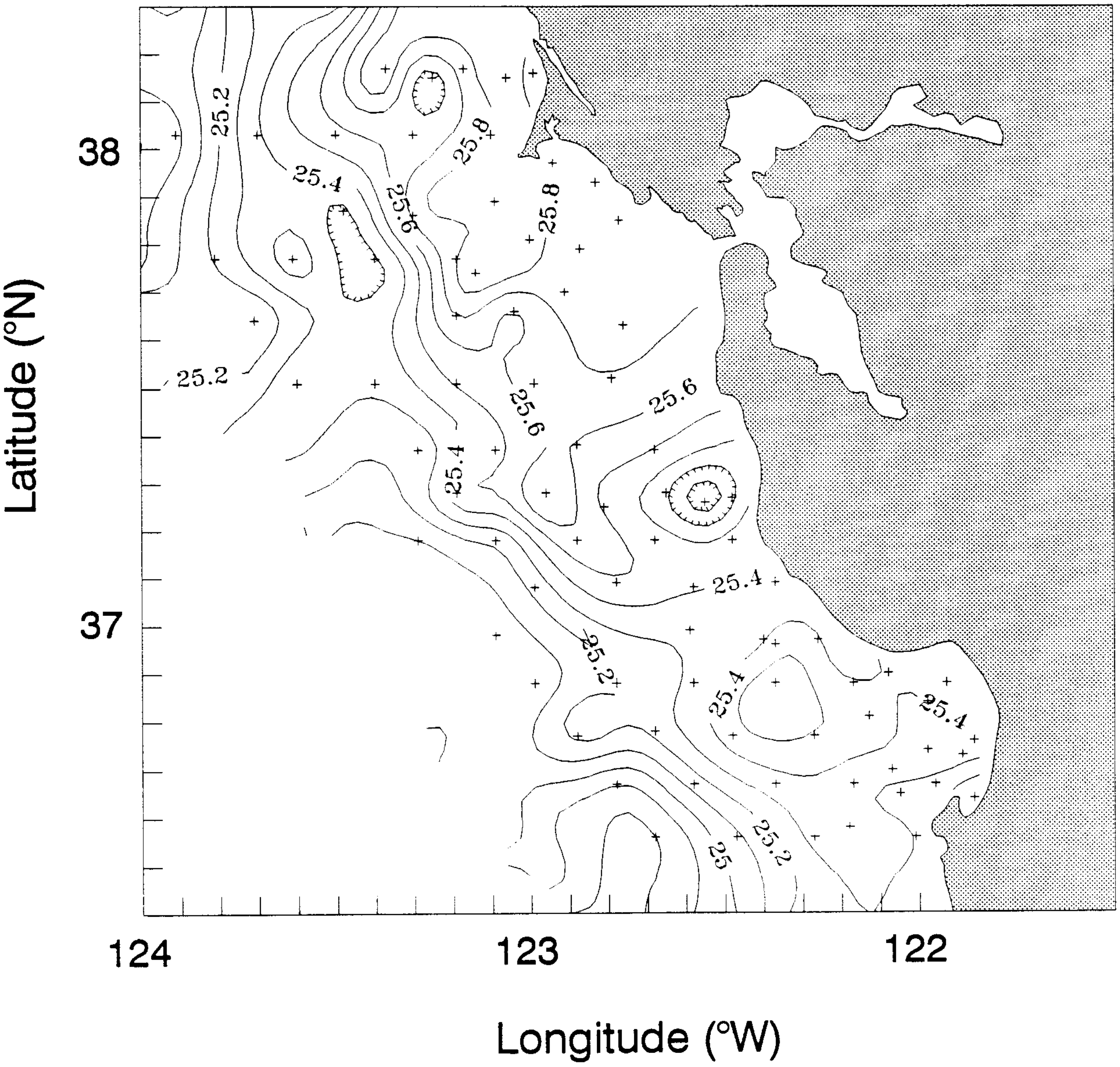
DSJ9206 Sweep 3
Density (kg/m³) at 2 m

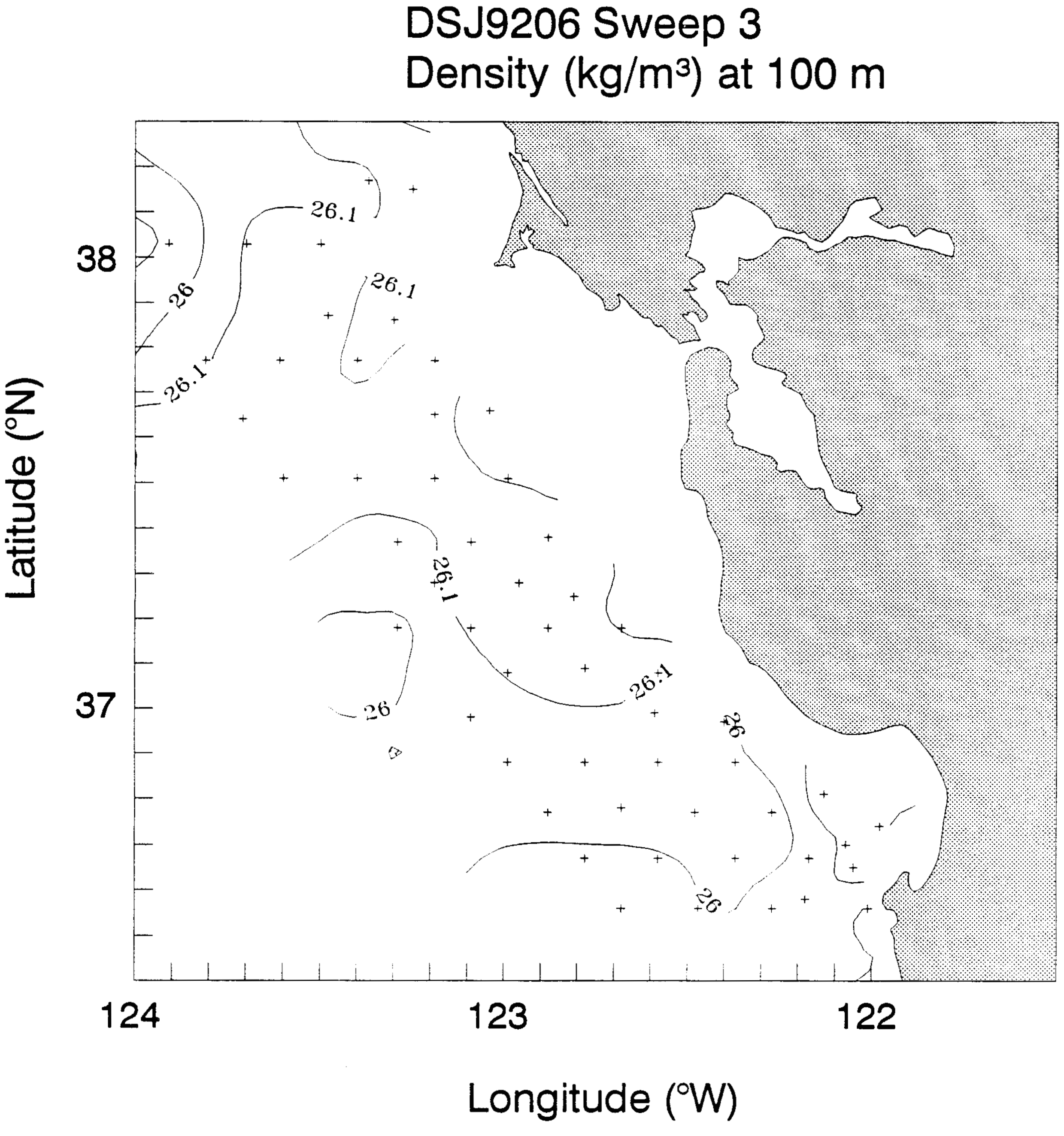


DSJ9206 Sweep 3
Density (kg/m³) at 10 m

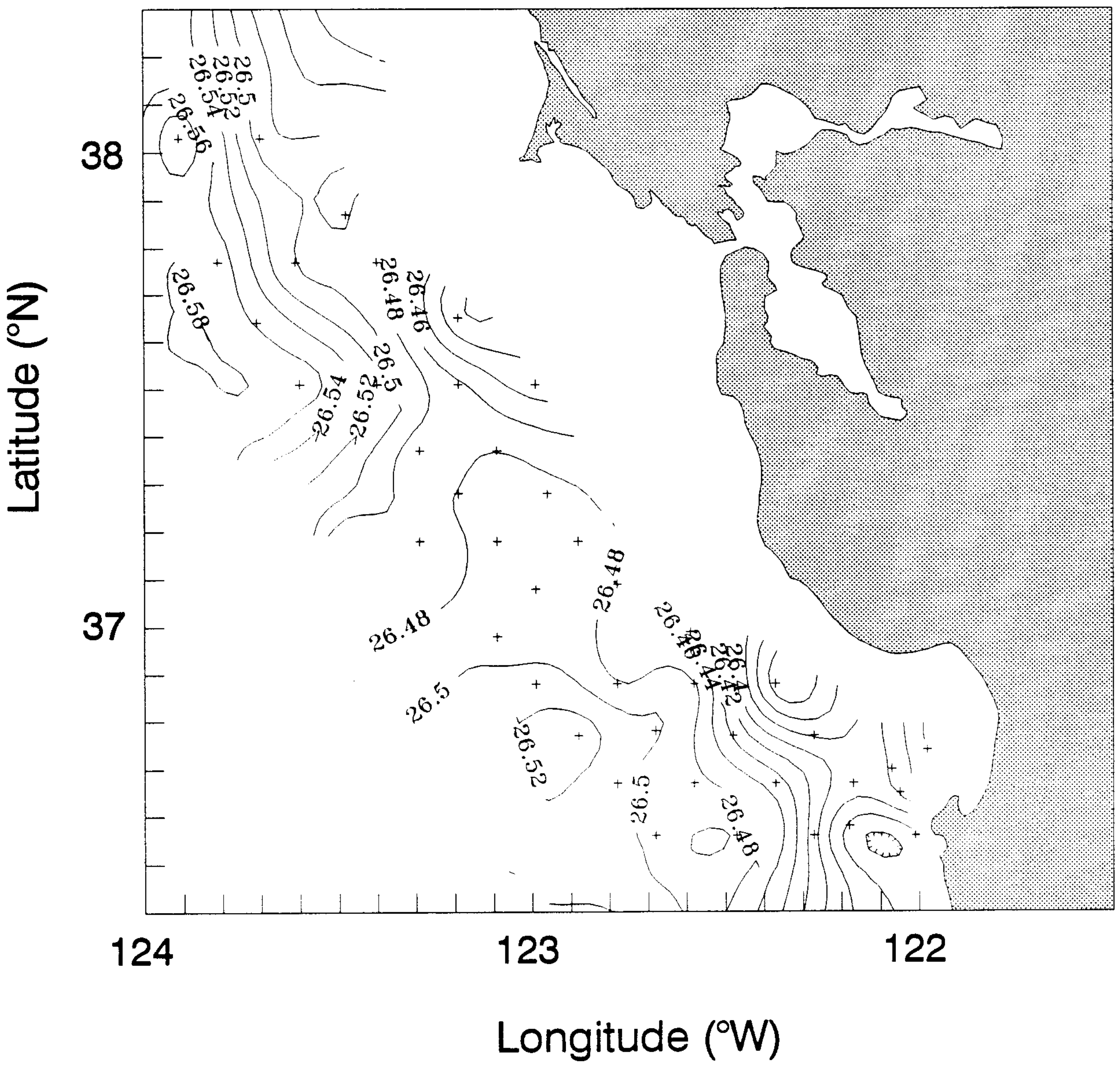


DSJ9206 Sweep 3
Density (kg/m³) at 30 m

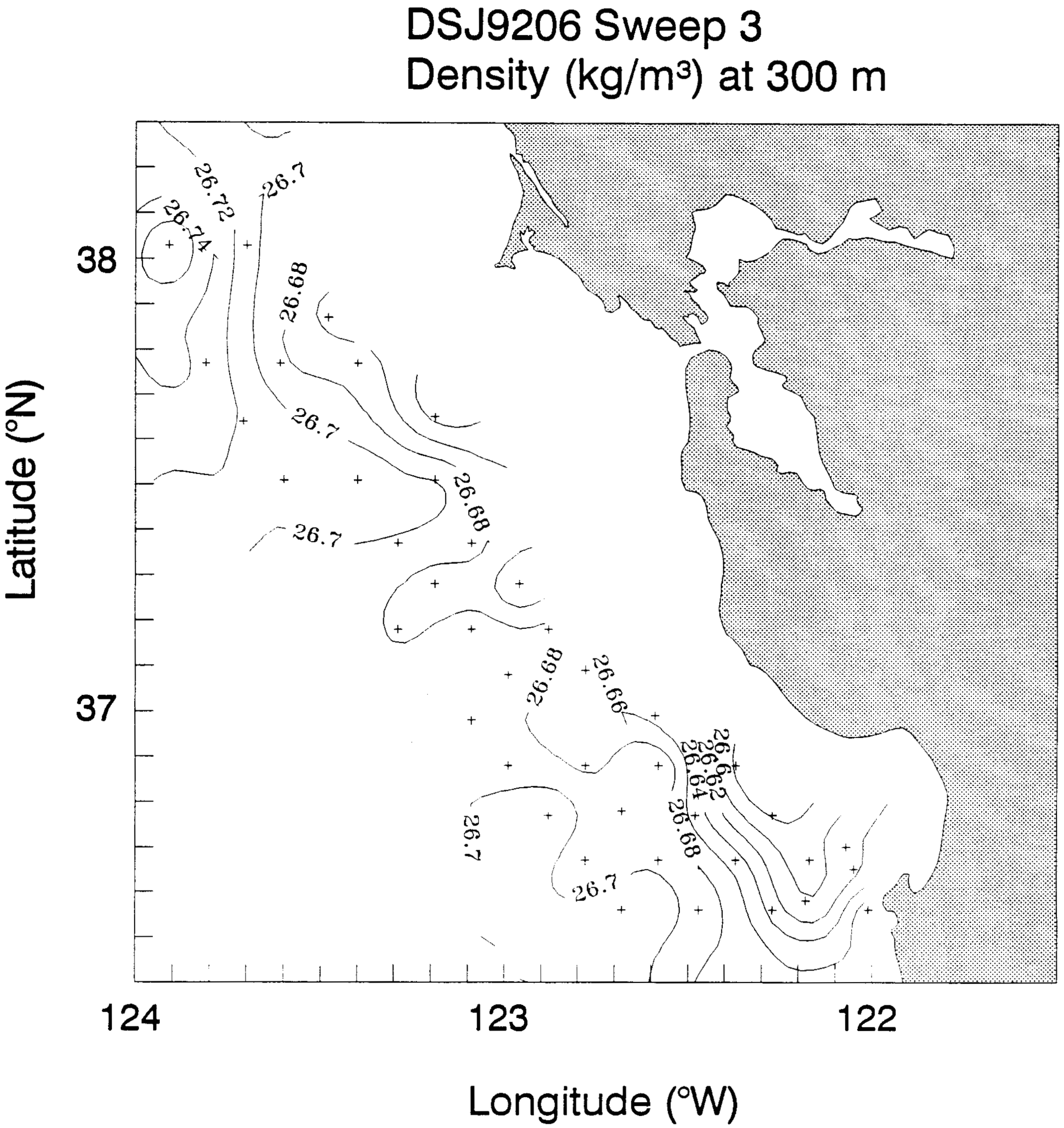




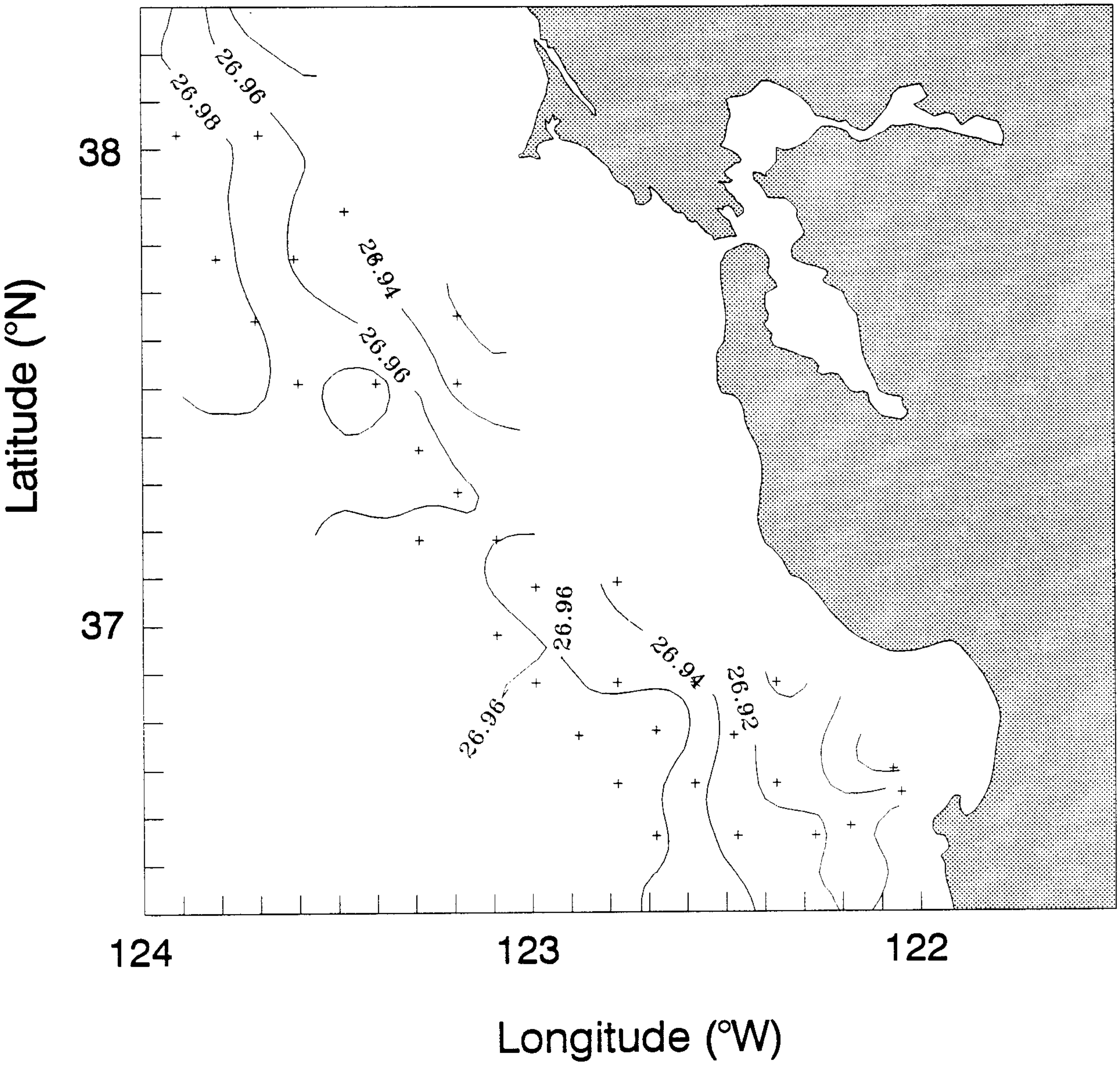
DSJ9206 Sweep 3
Density (kg/m³) at 100 m



DSJ9206 Sweep 3
Density (kg/m³) at 200 m

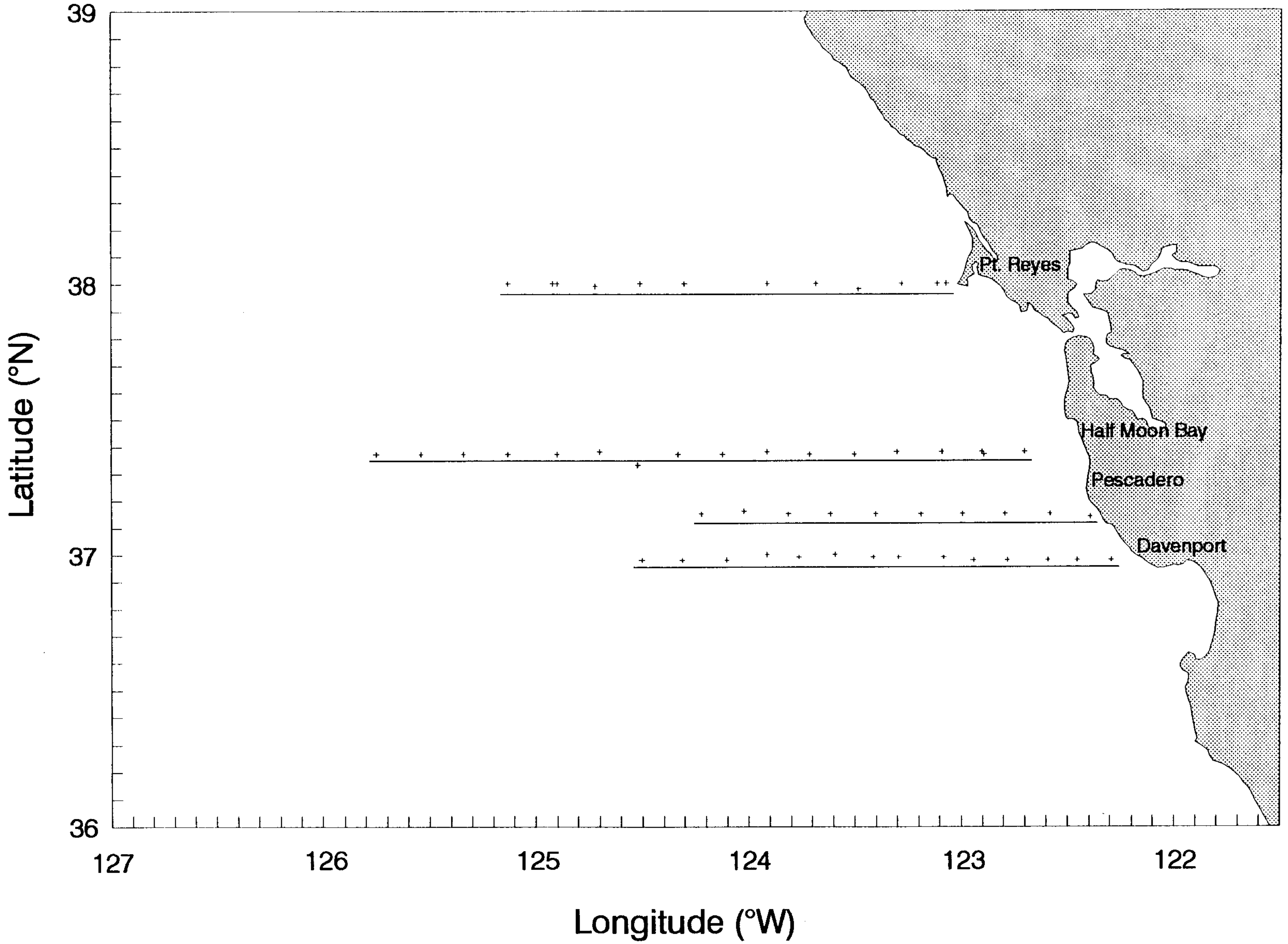

DSJ9206 Sweep 3
Density (kg/m³) at 300 m
26.72
26.7
26.74
26.68
26.7
26.68
26.7
26.68
26.66
26.6
26.62
26.64
26.68
26.7
26.7
38
37
Latitude (°N)
124
123
122
Longitude (°W)

DSJ9206 Sweep 3
Density (kg/m^3) at 500 m

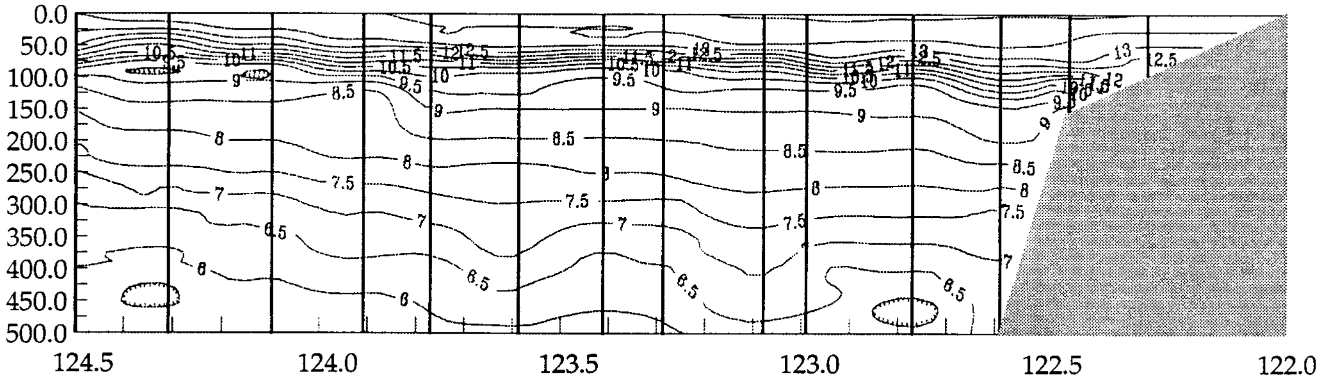


APPENDIX 7.1: VERTICAL TRANSECTS FOR DSJ9203

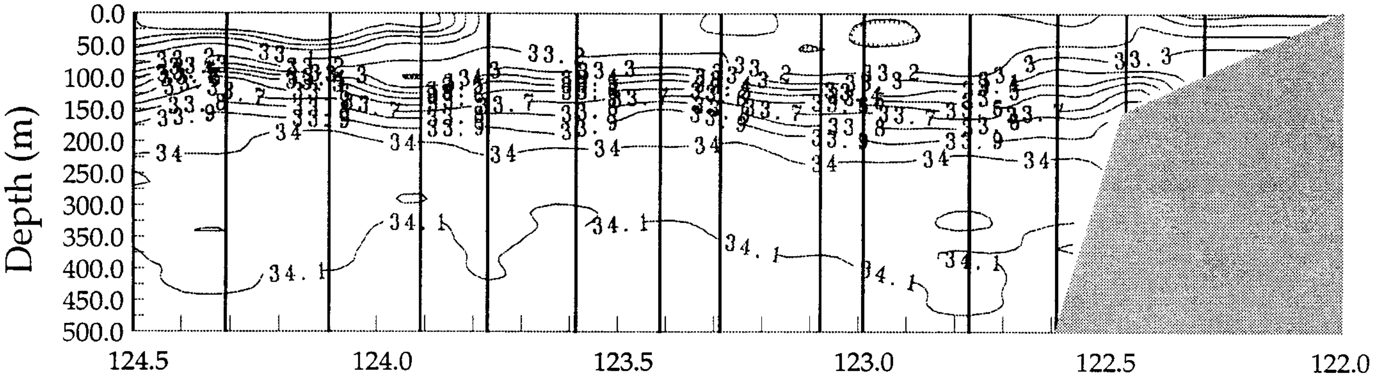
DSJ9203 Vertical Transect CTD Stations



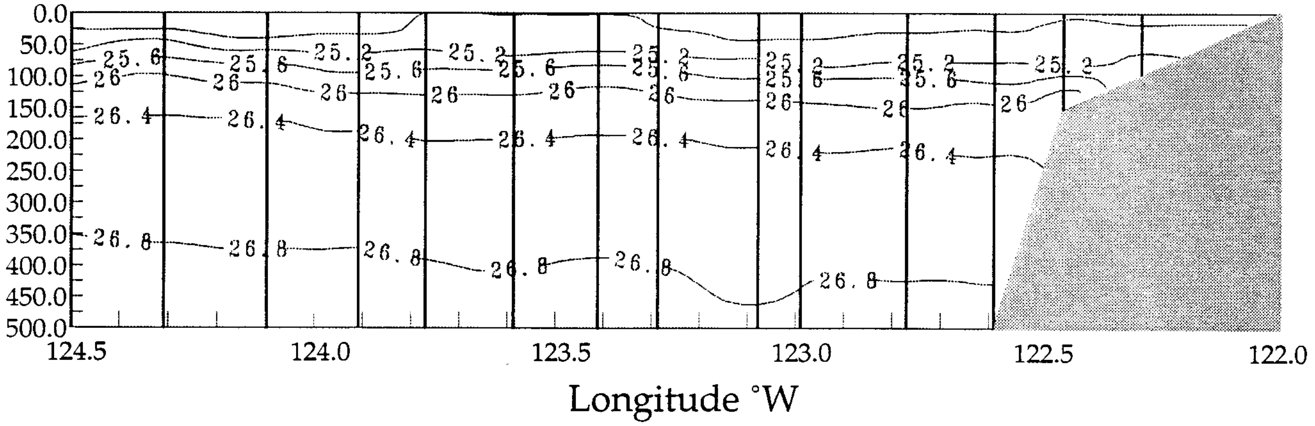
9203 Davenport Temperature



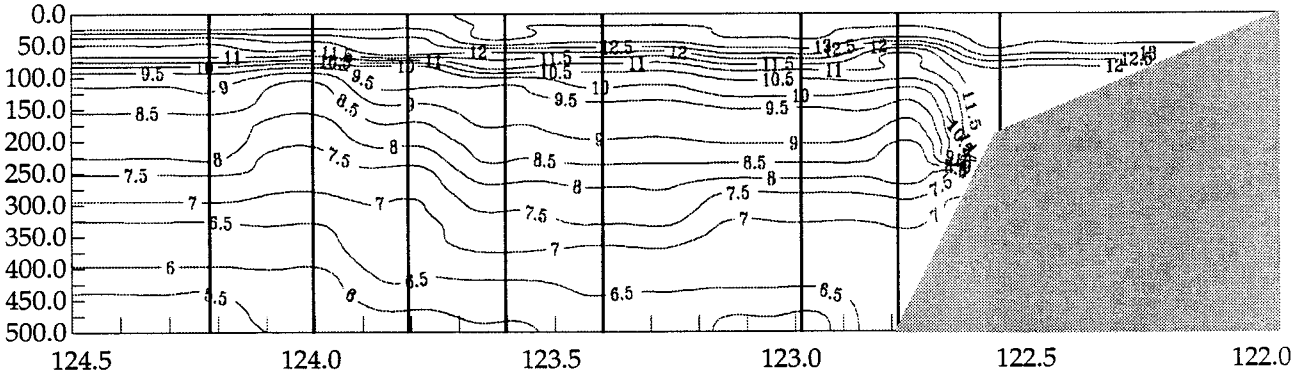
Salinity



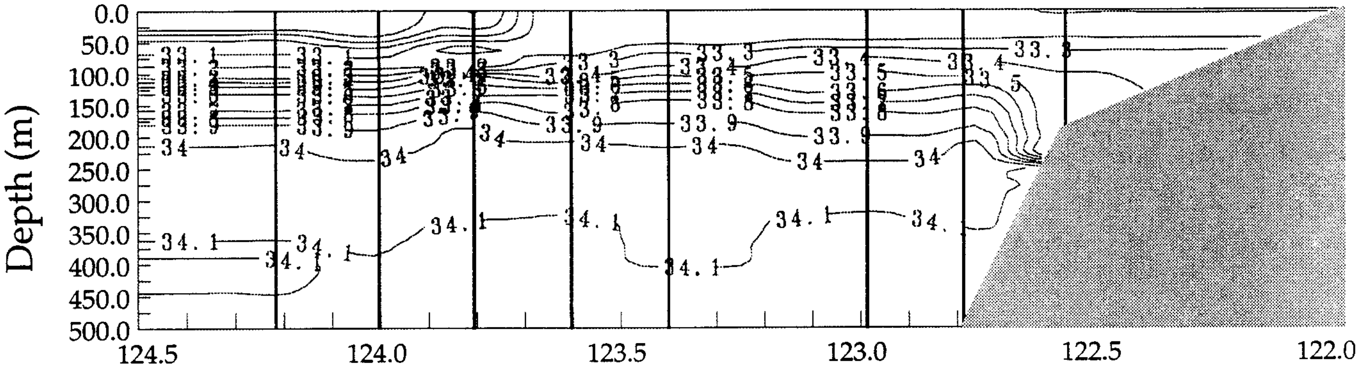
Density



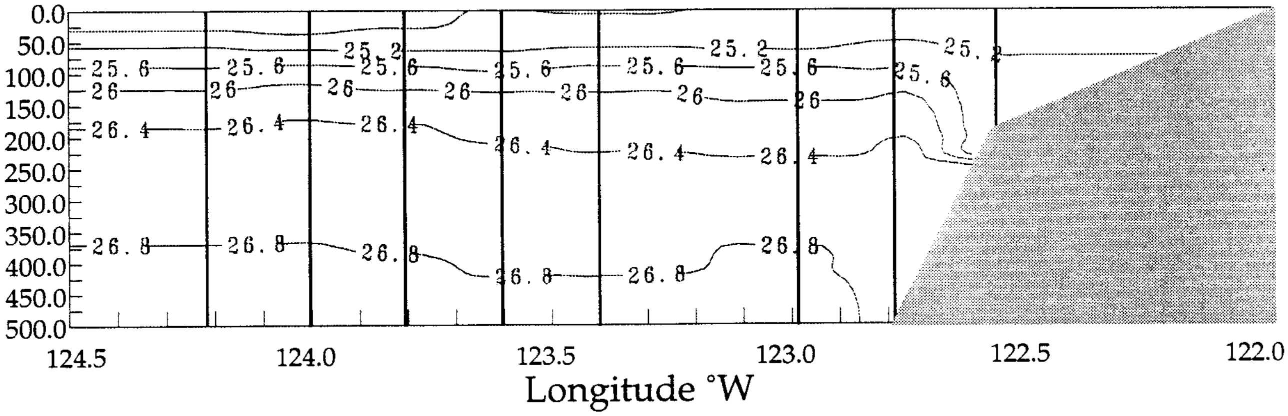
9203 Pescadero Temperature

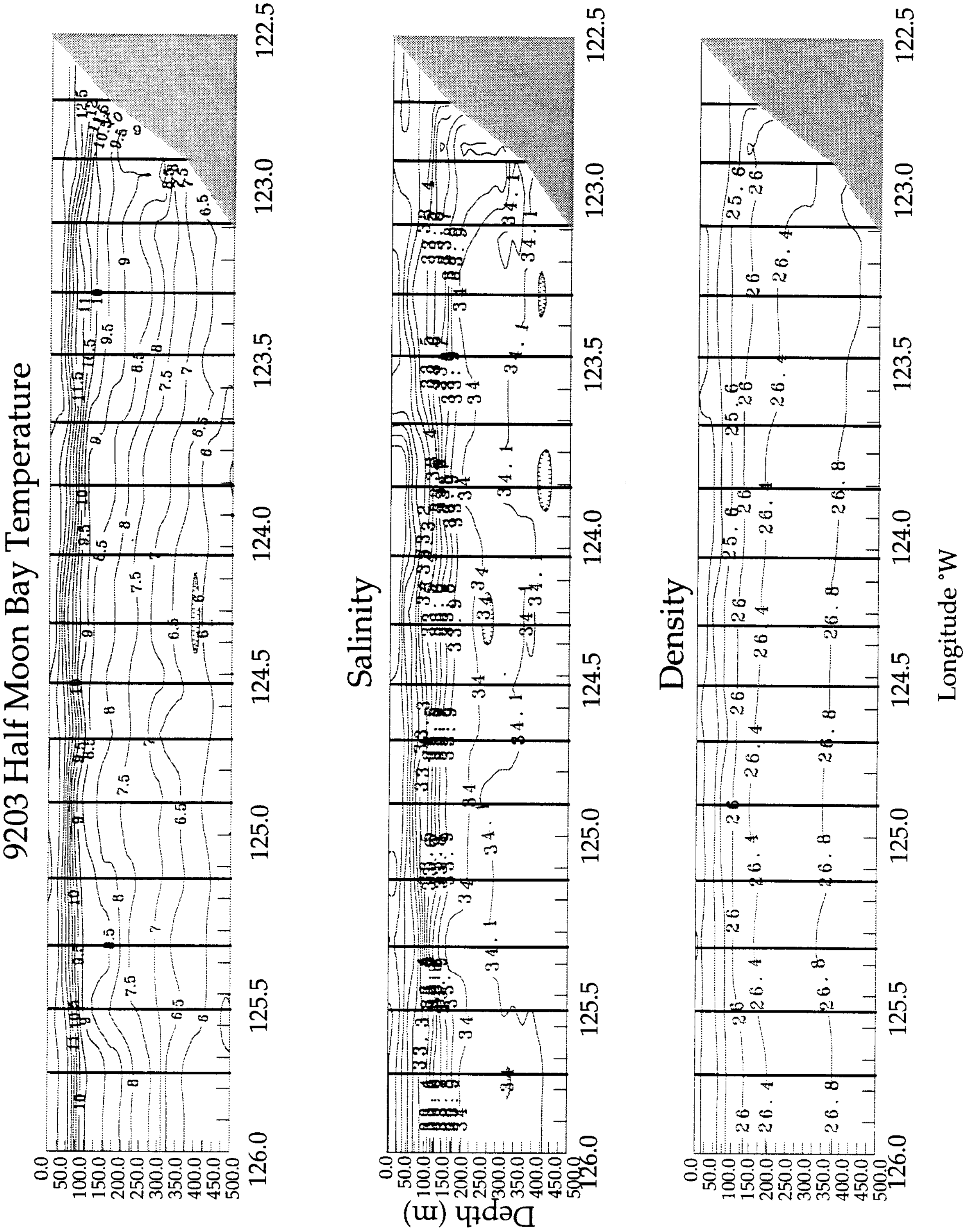


Salinity



Density

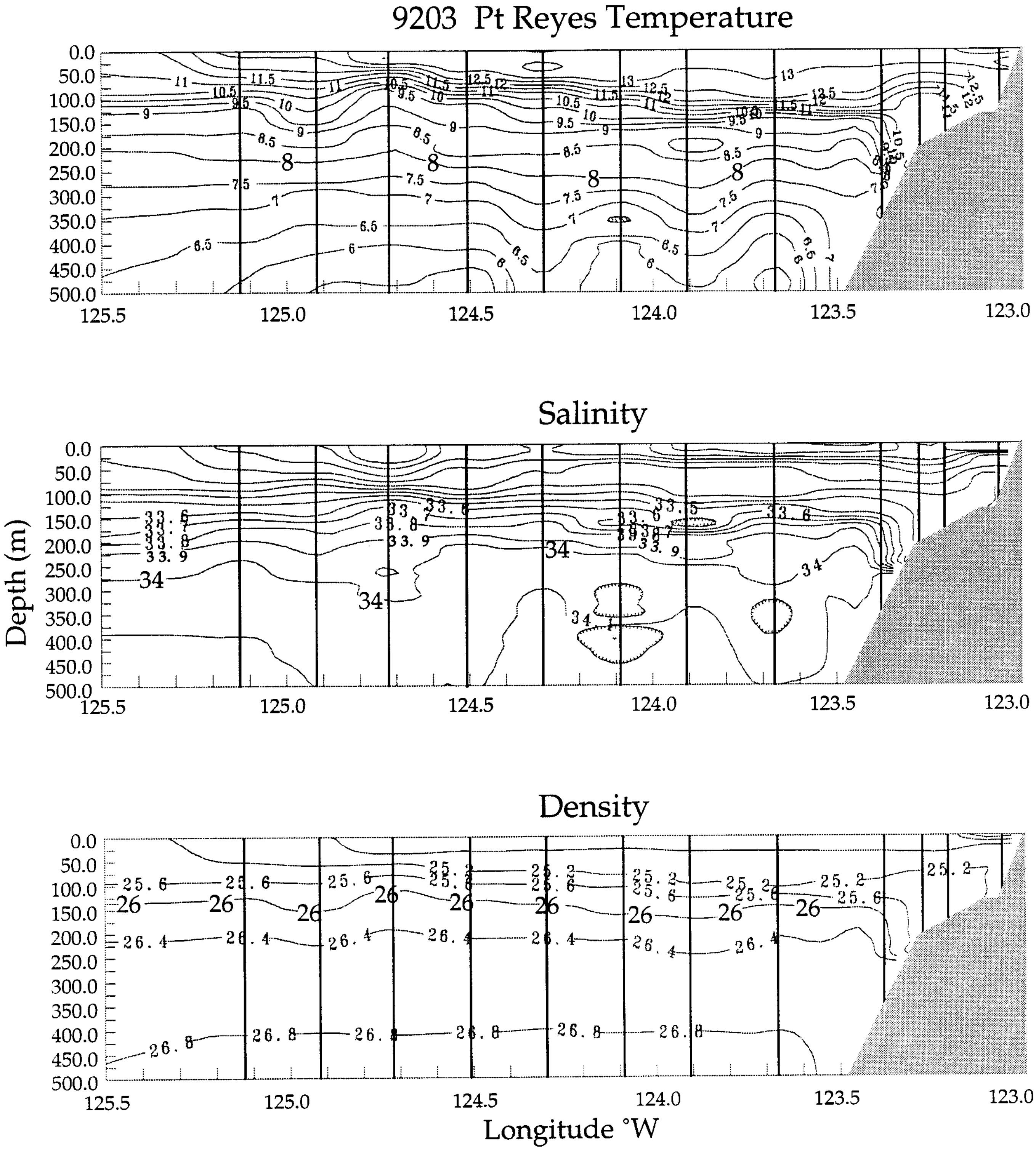




9203 Half Moon Bay Temperature

Salinity

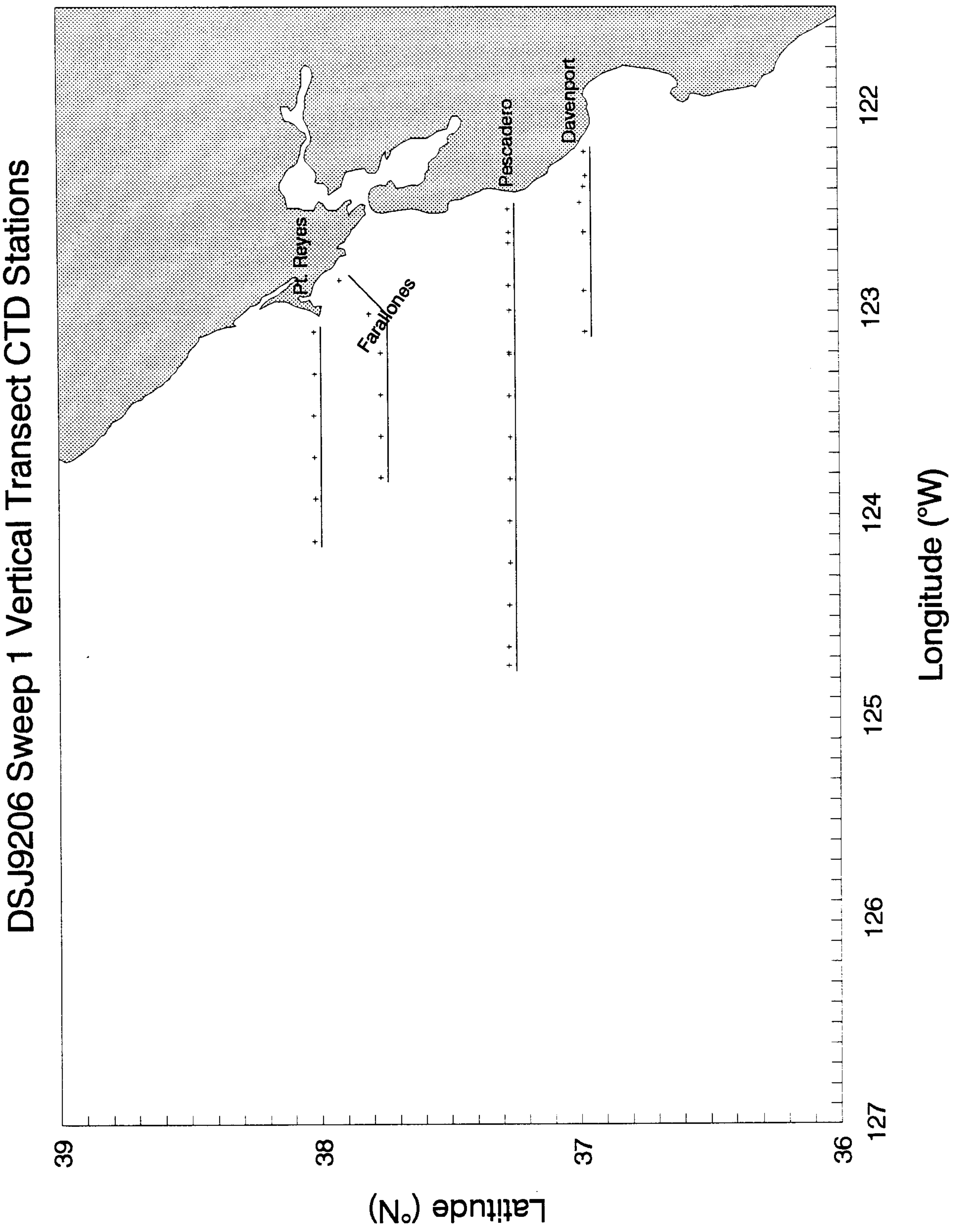
Density


9203 Pt Reyes Temperature

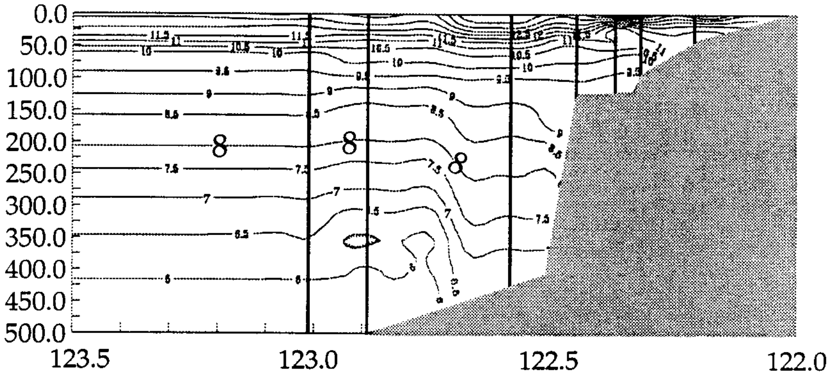
Salinity

Density

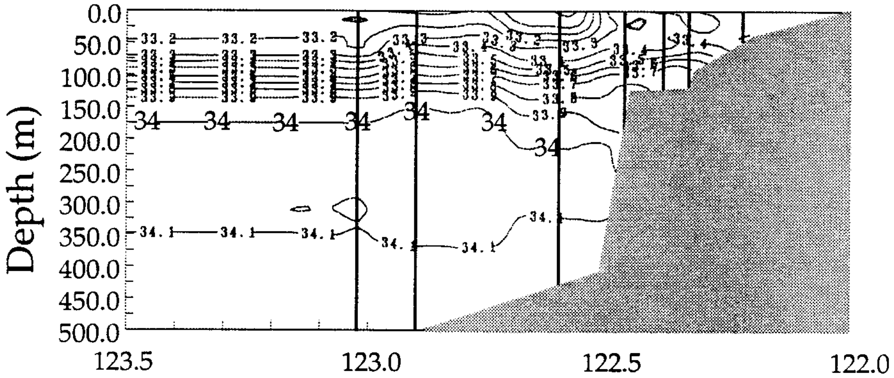
APPENDIX 7.2: VERTICAL TRANSECTS FOR DSJ9206


DSJ9206 Sweep 1 Vertical Transect CTD Stations
Latitude (°N)
39
38
37
36
Longitude (°W)
127
126
125
124
123
122
Pt. Reyes
Farallones
Pescadero
Davenport

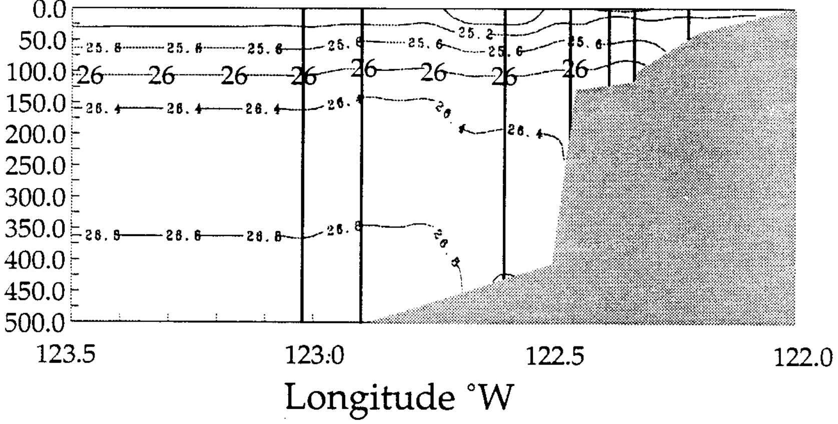
9206.1 Davenport Temperature



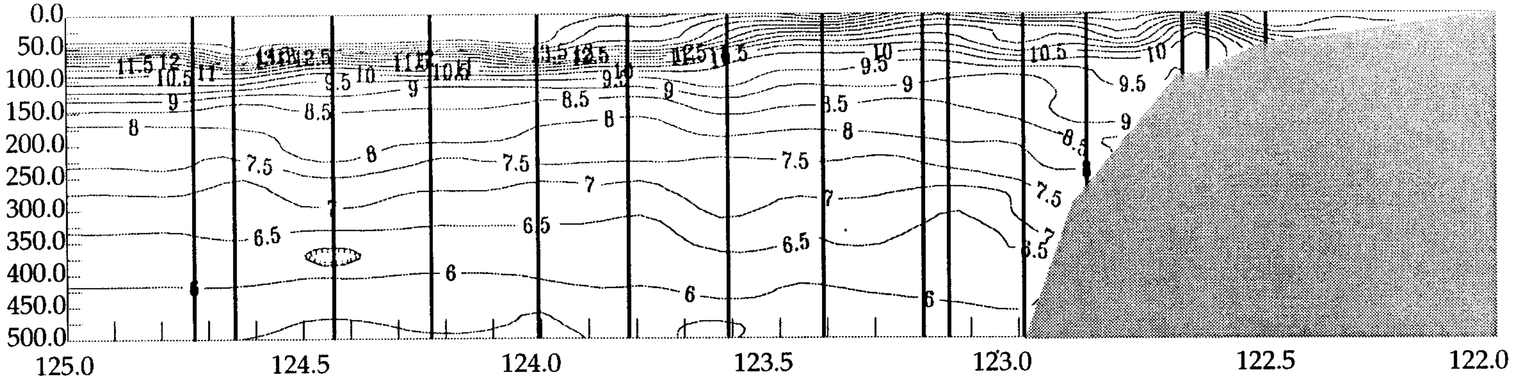
Salinity



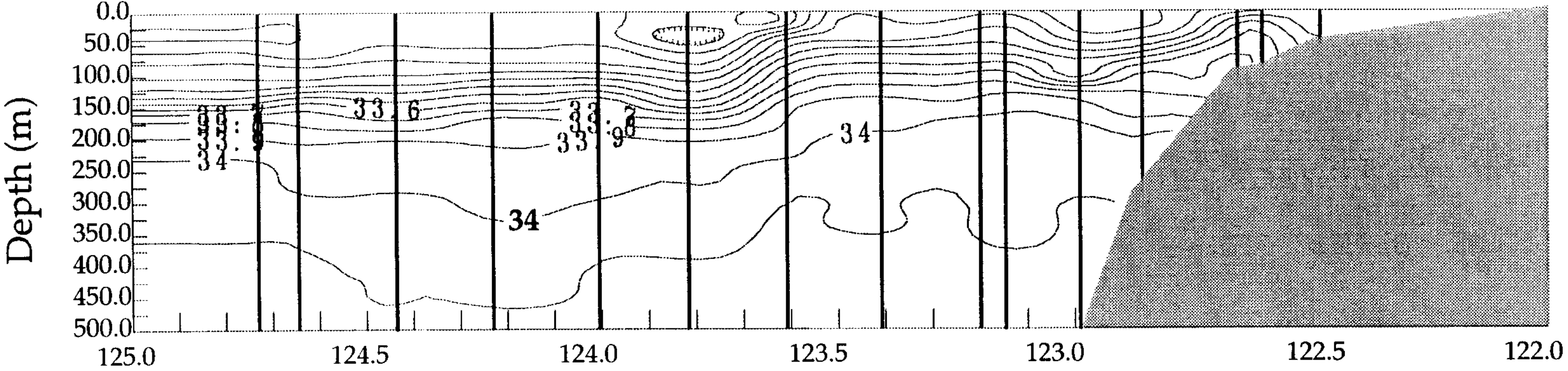
Density



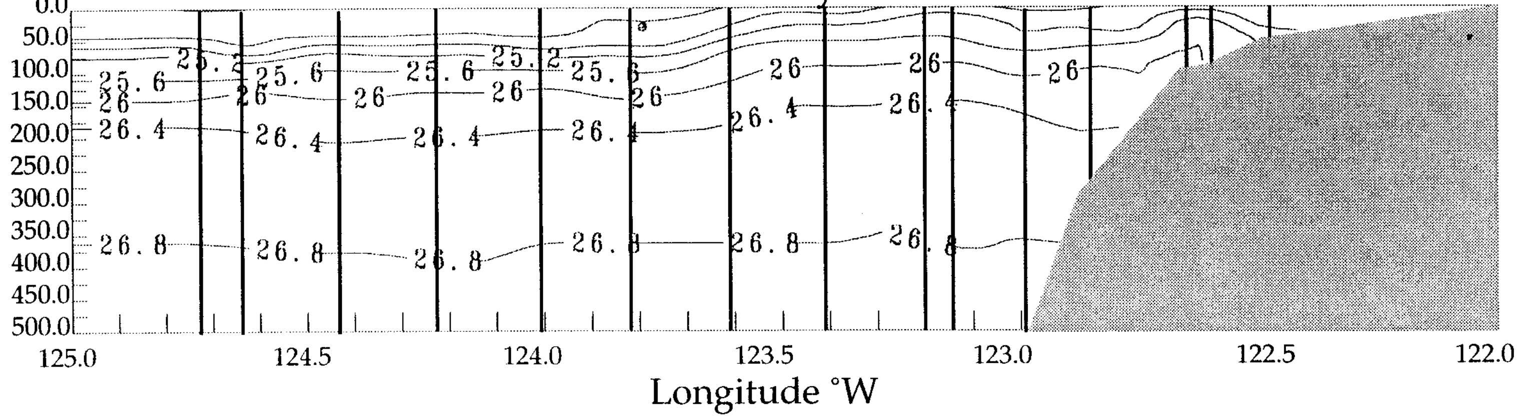
9206.1 Pescadero Temperature

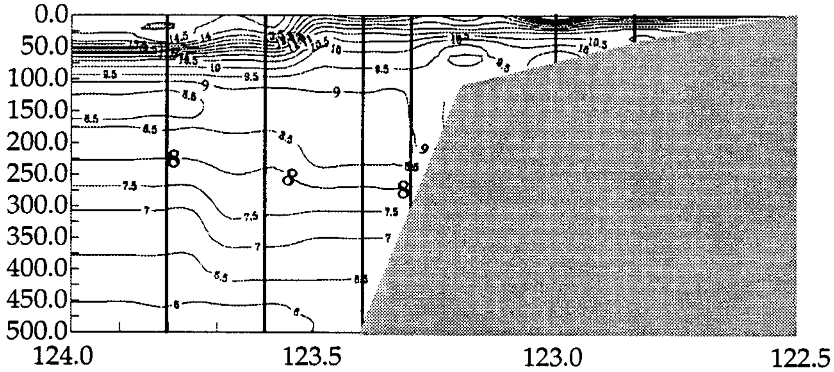


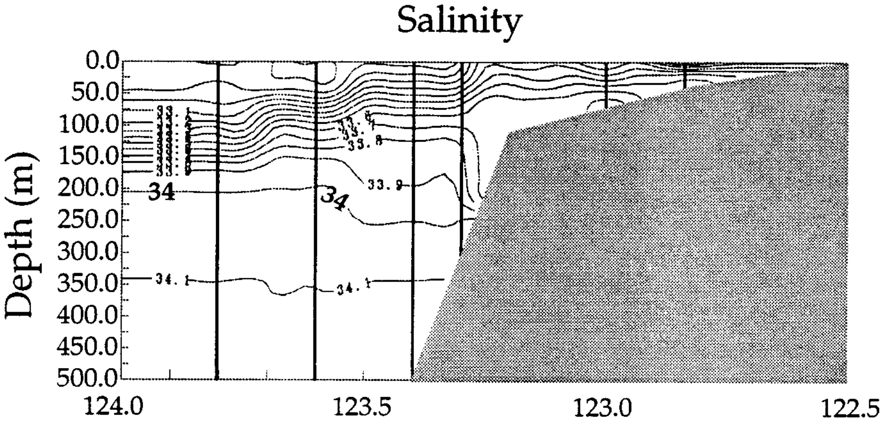
Salinity

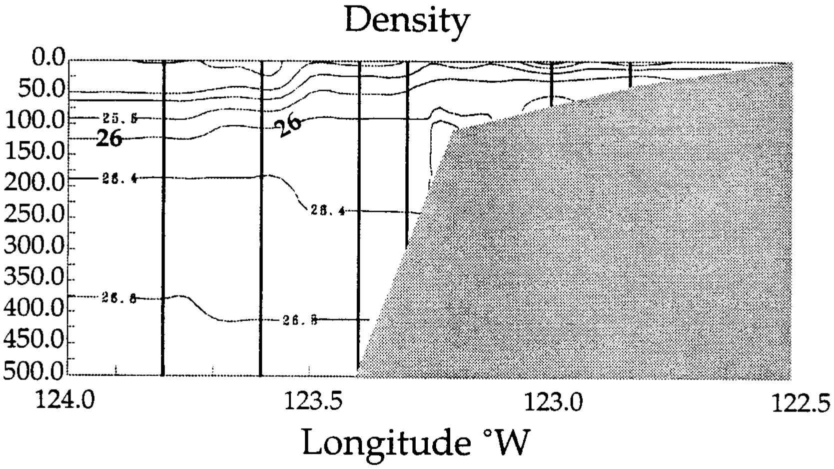


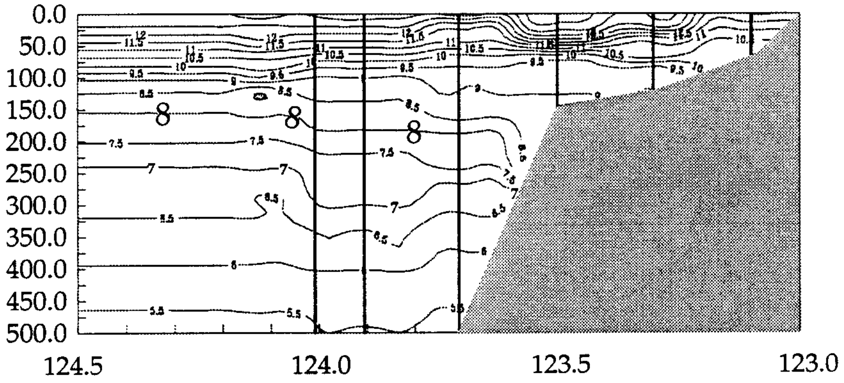
Density

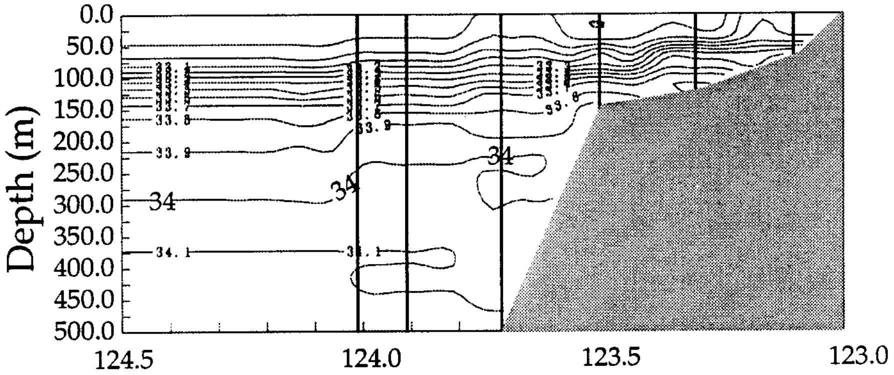


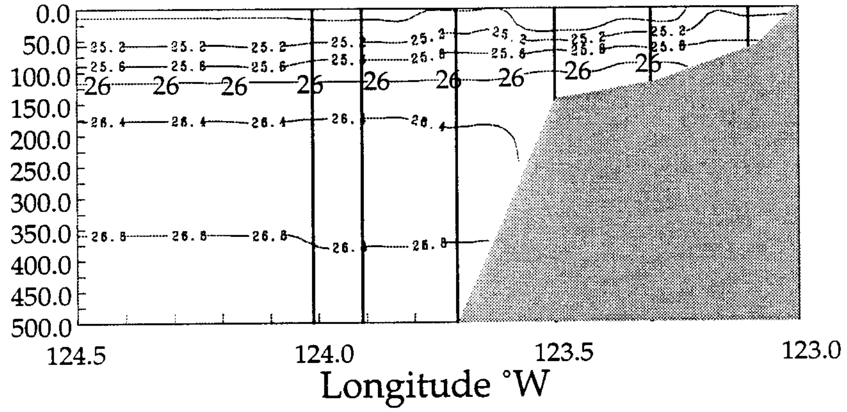

9206.1 Farallones Temperature


Salinity

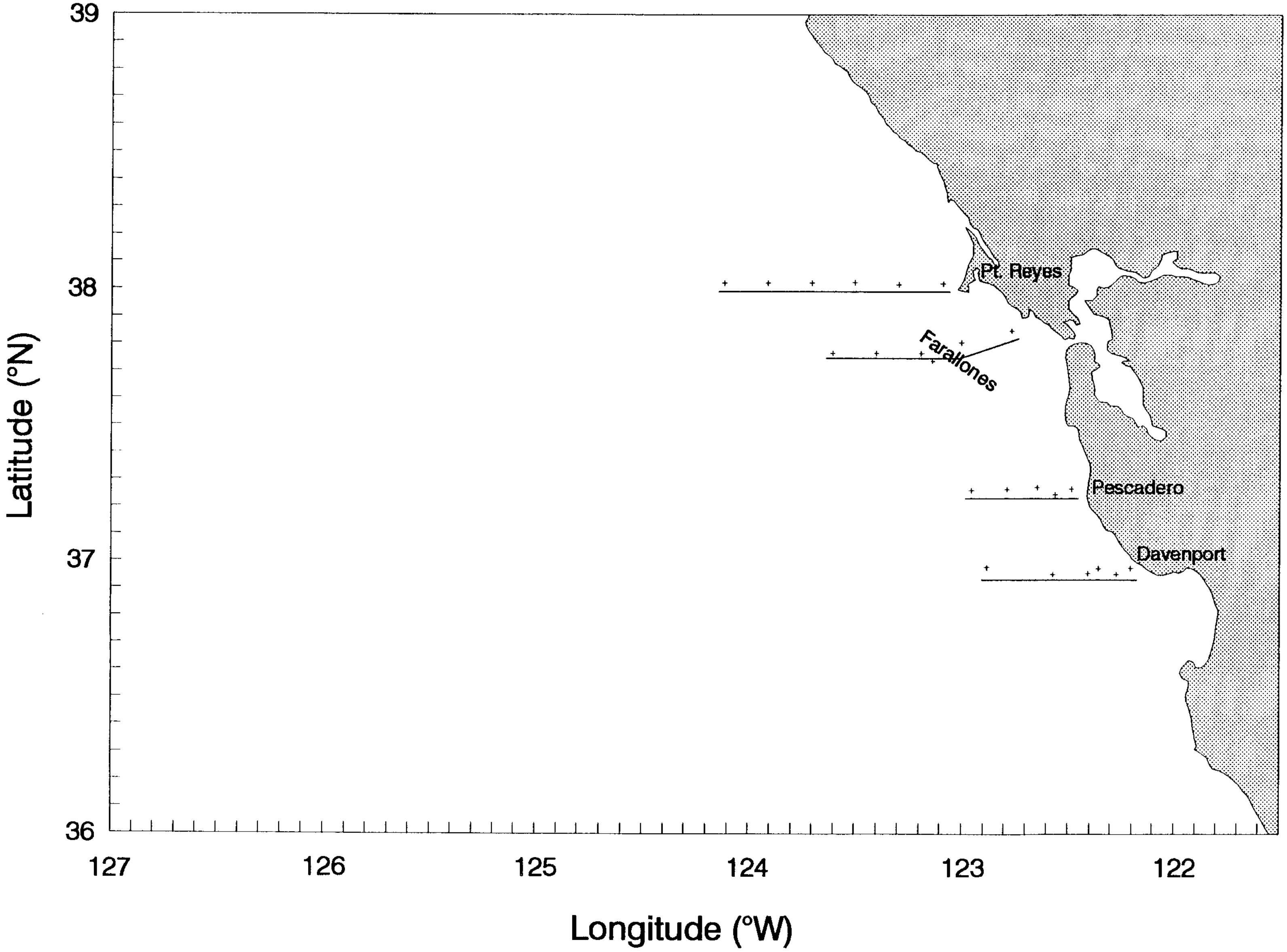

Density

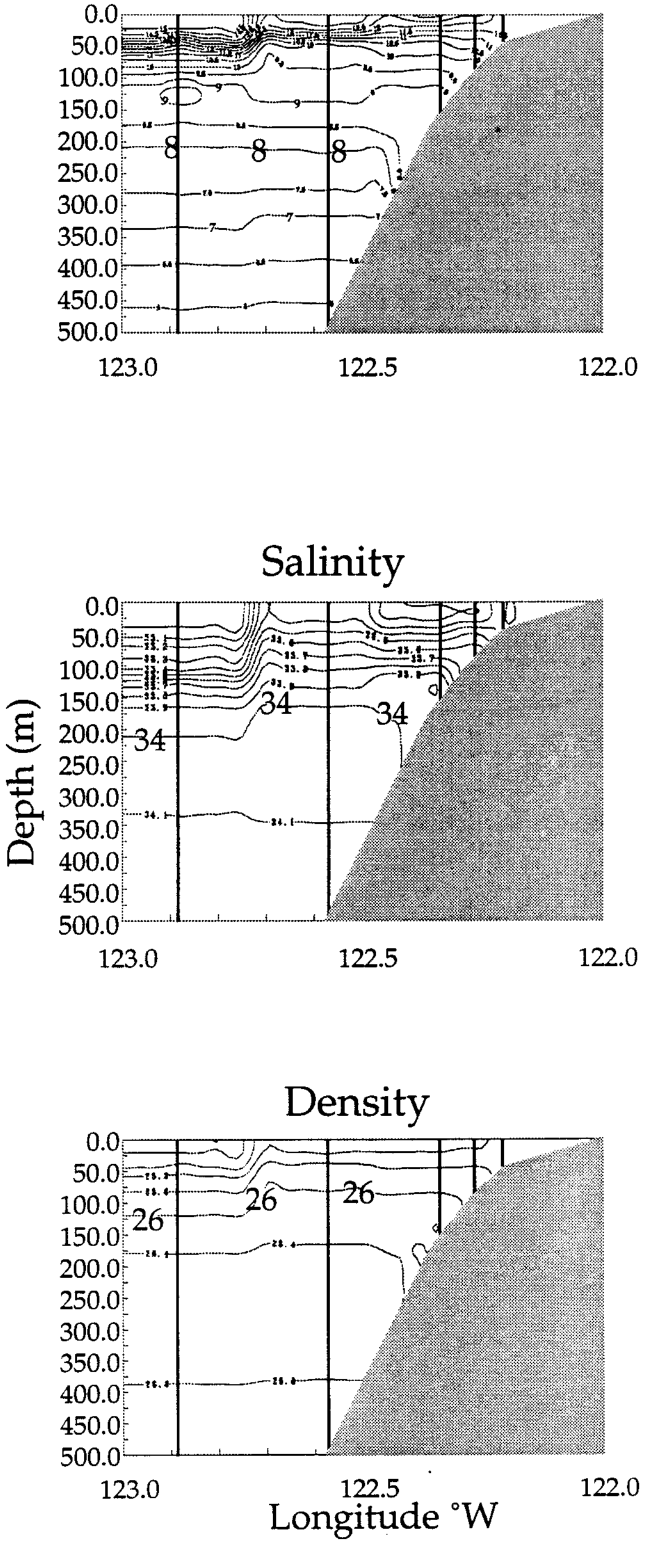

9206.1 Pt Reyes Temperature


Salinity


Density

DSJ9206 Sweep 2 Vertical Transect CTD Stations



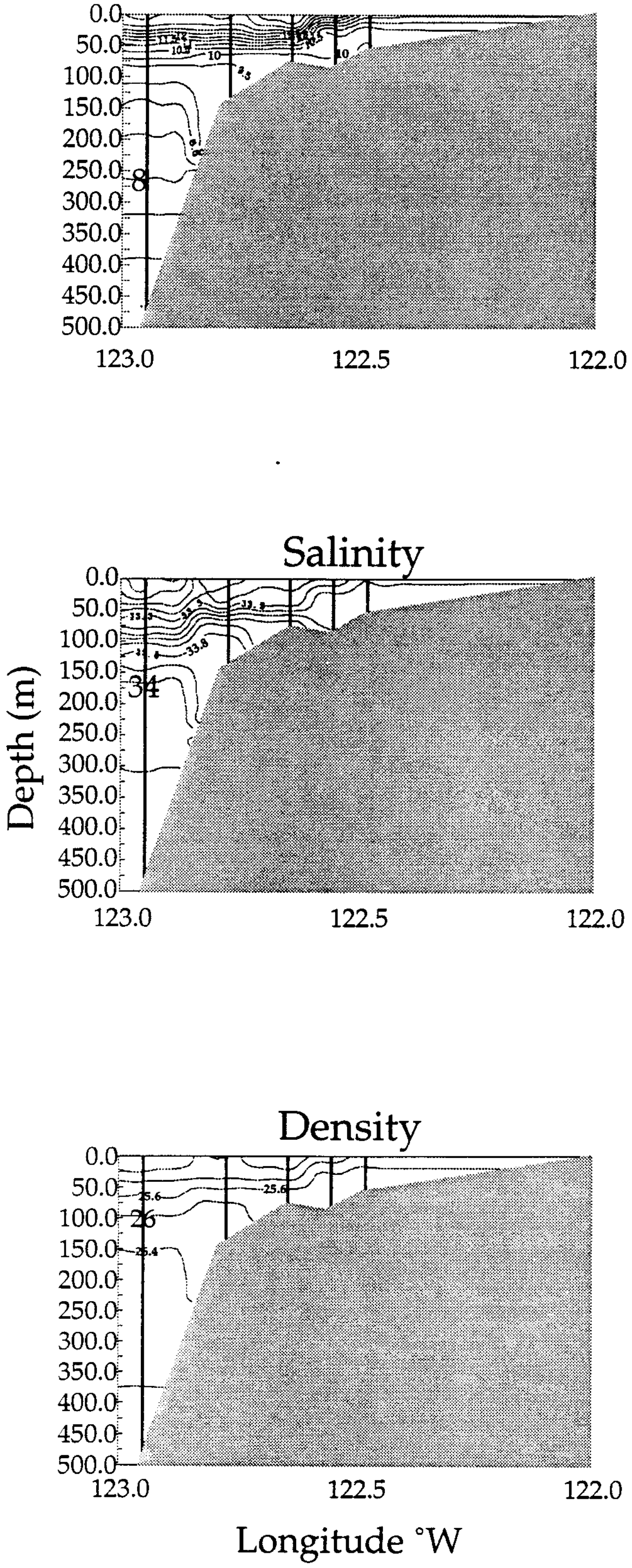


9206.2 Davenport Temperature

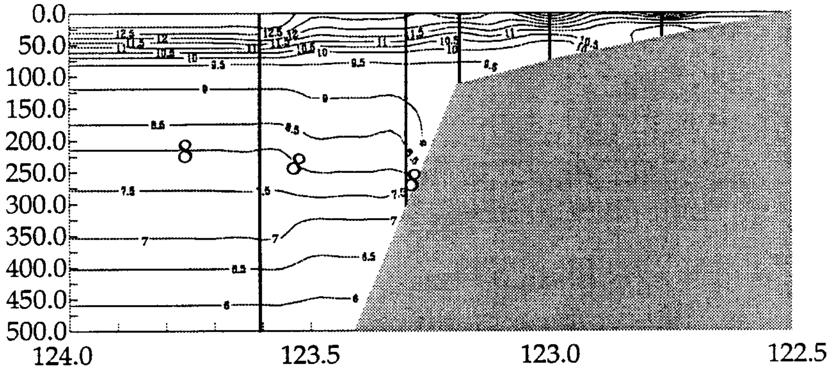
Salinity

Density

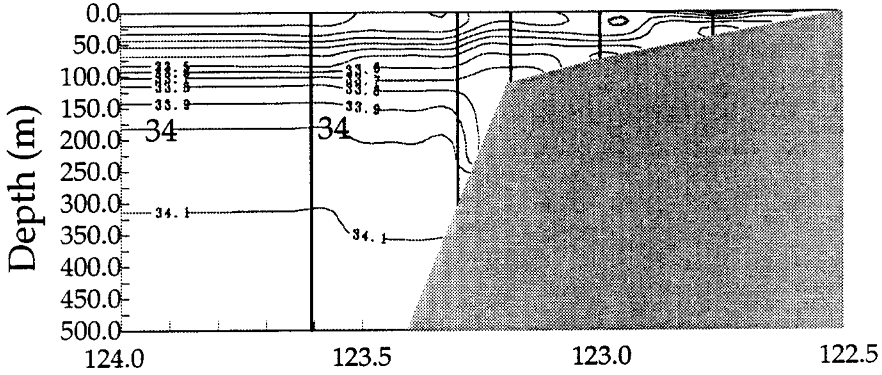
9206.2 Pescadero Pt. Temperature



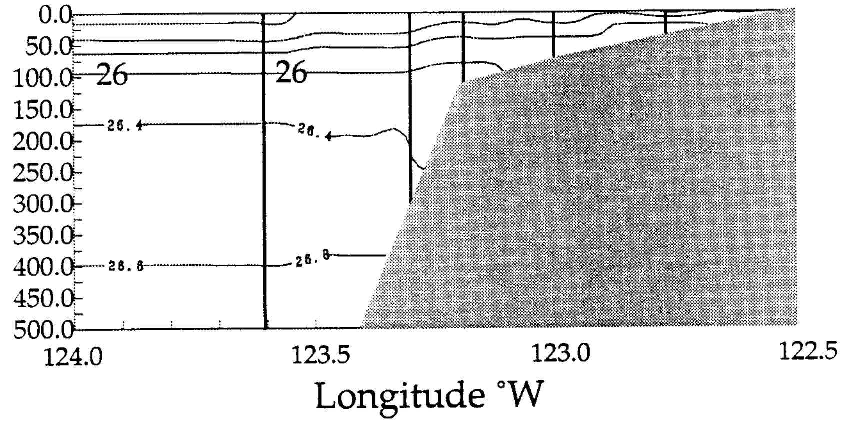
9206.2 Farallones Temperature



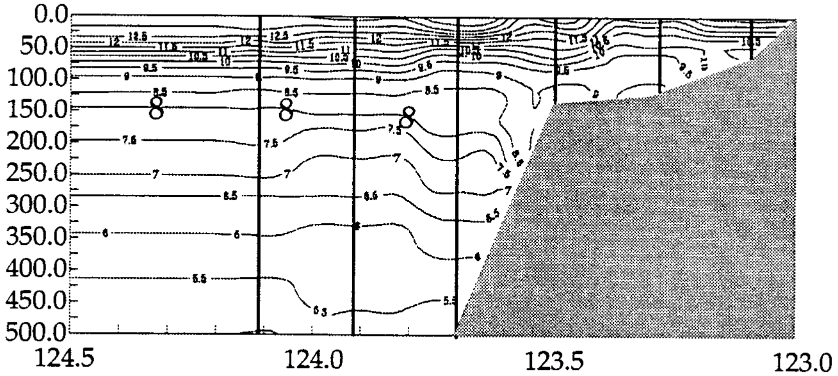
Salinity



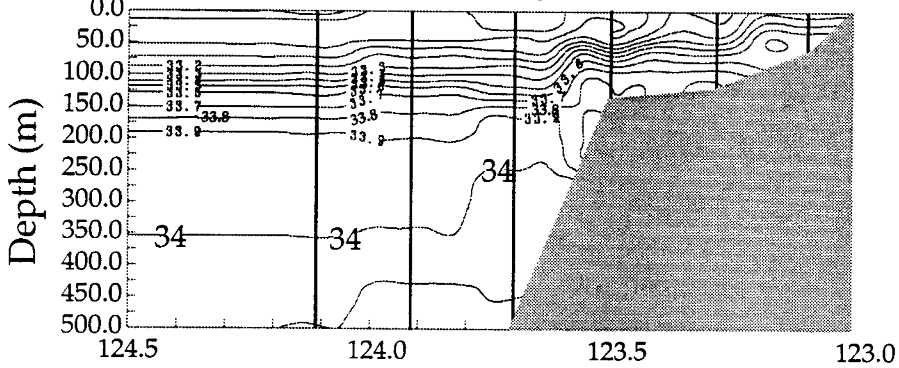
Density



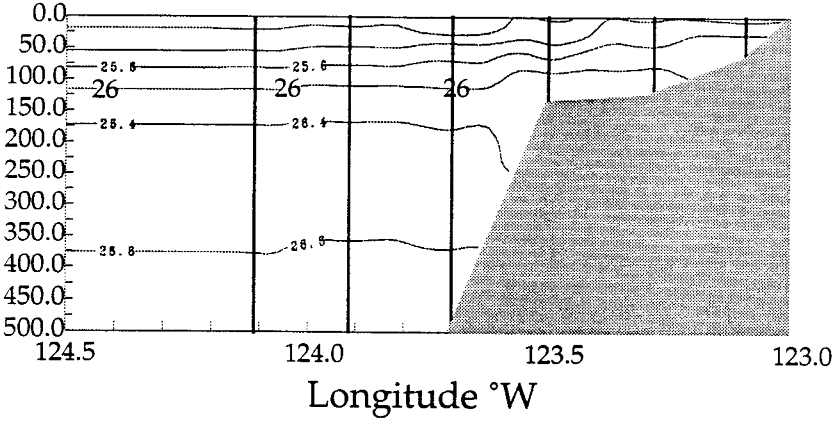
9206.2 Pt Reyes Temperature



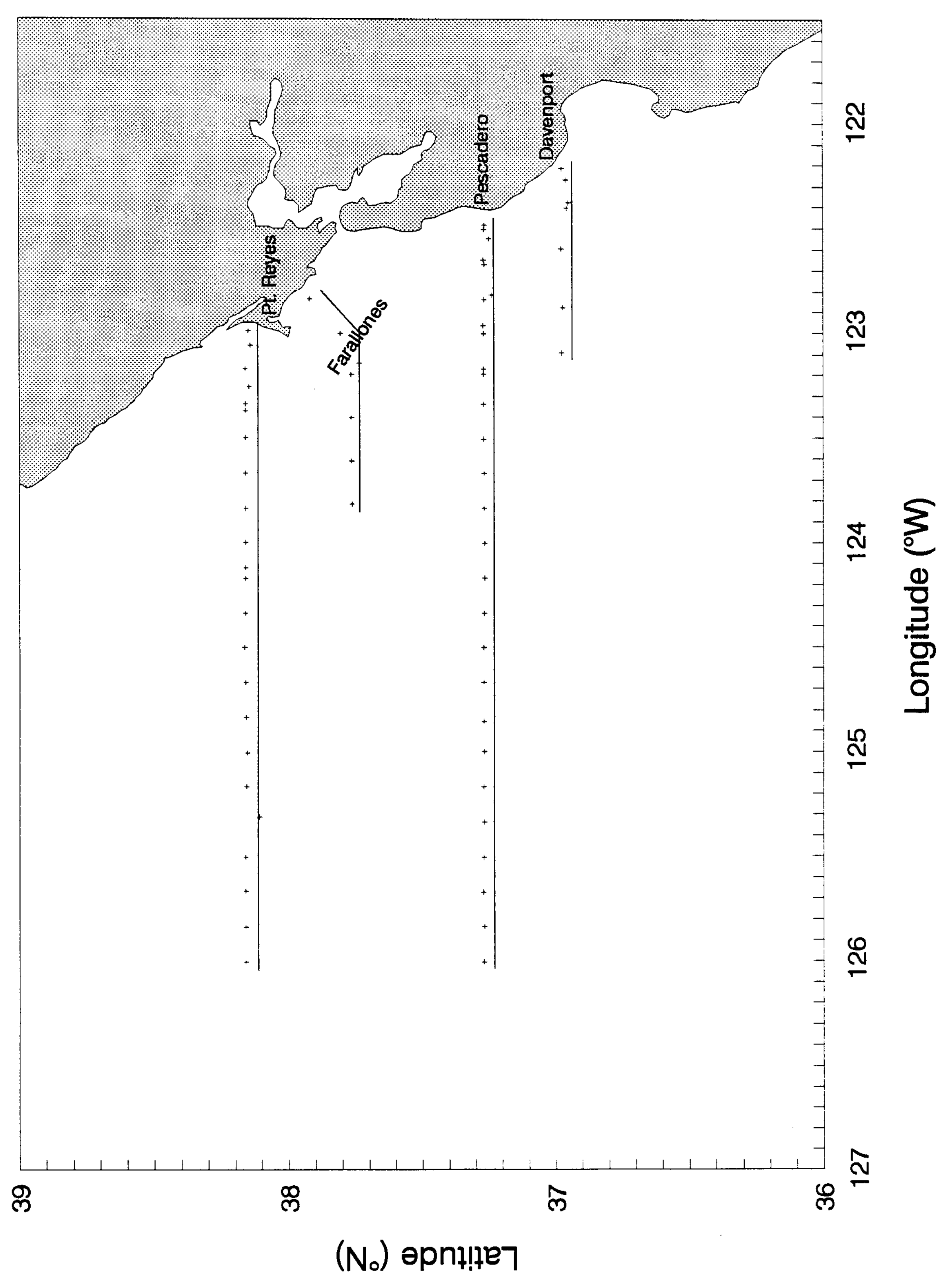
Salinity

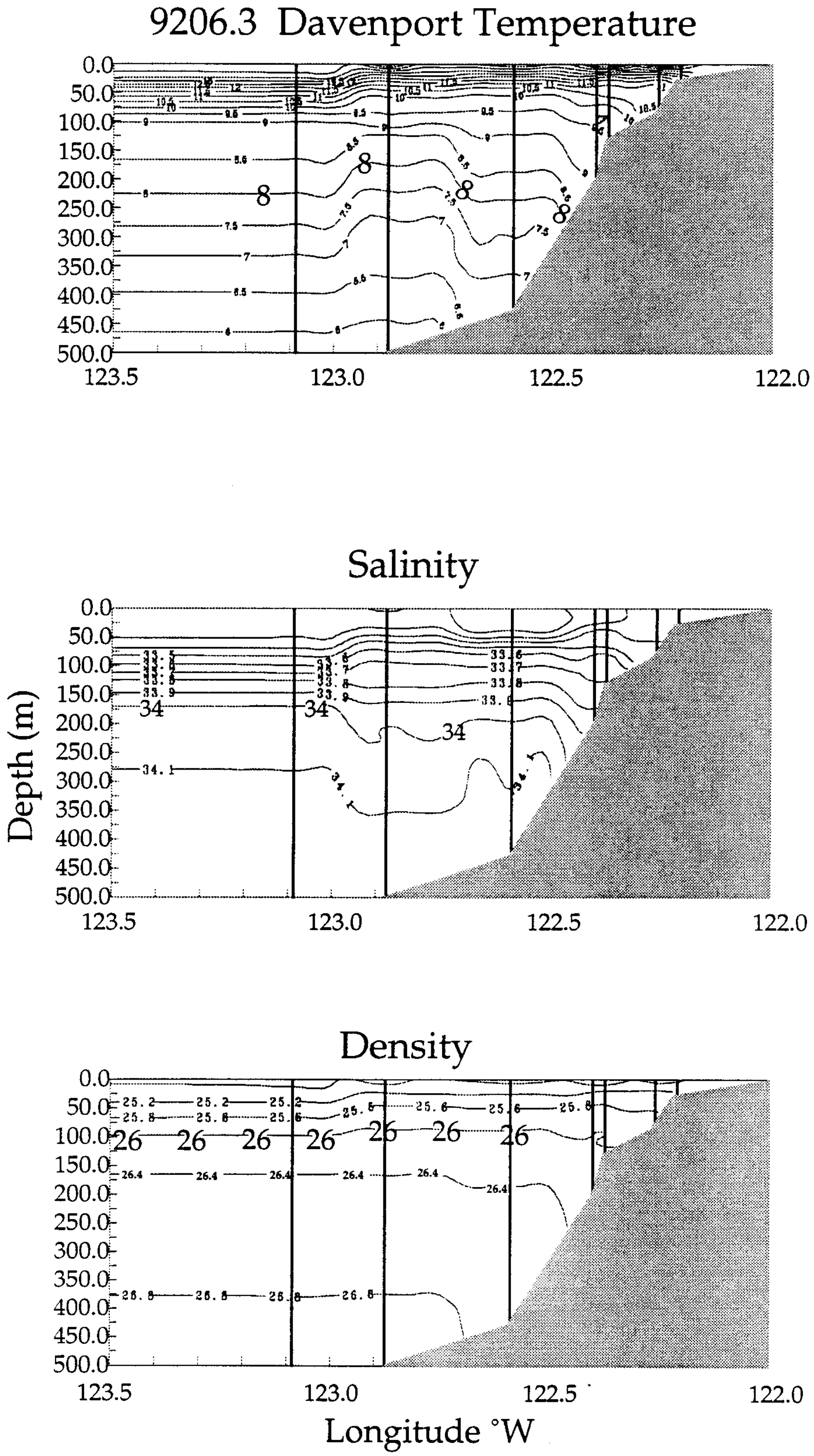


Density



DSJ9206 Sweep 3 Vertical Trasect CTD Stations

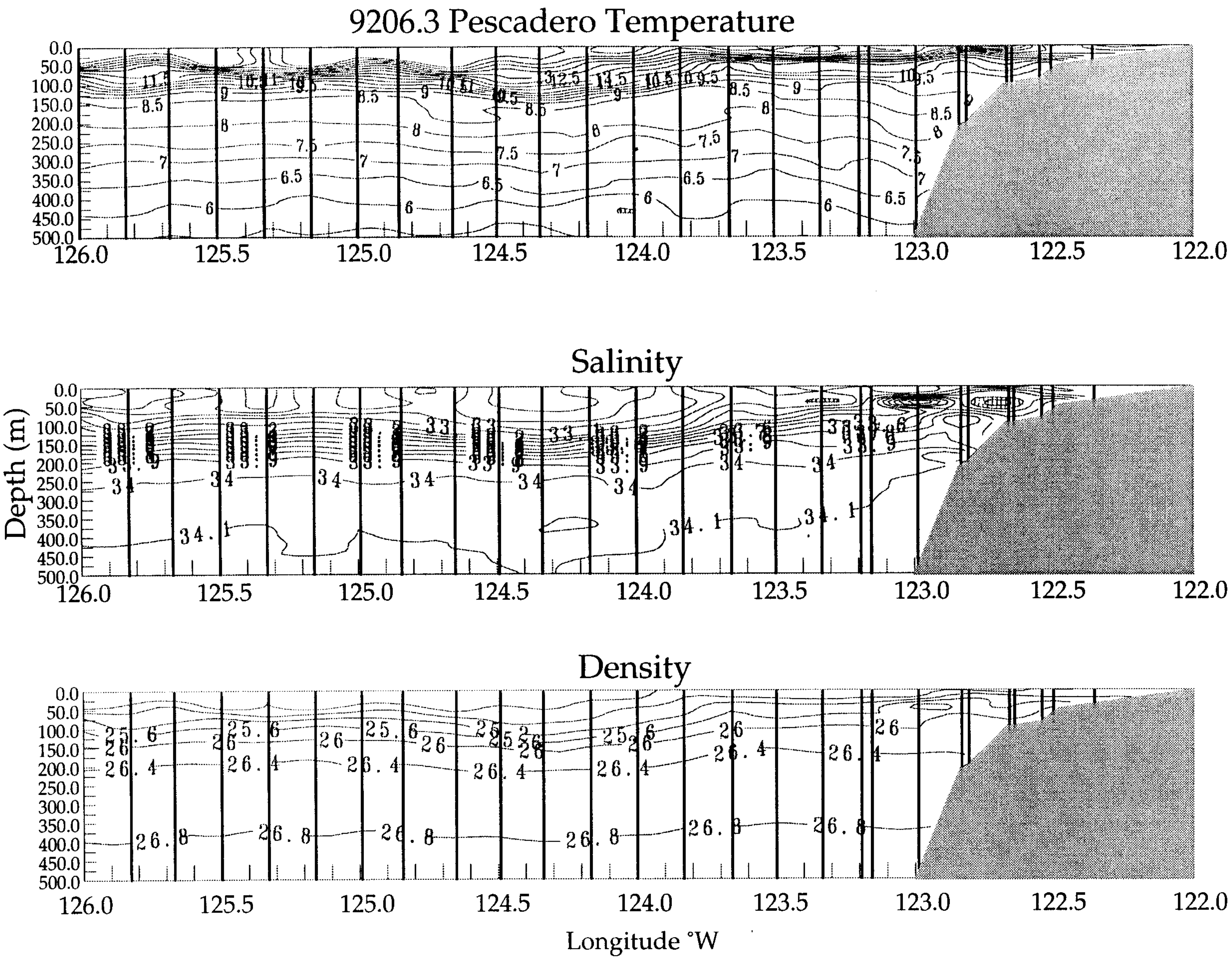




9206.3 Davenport Temperature

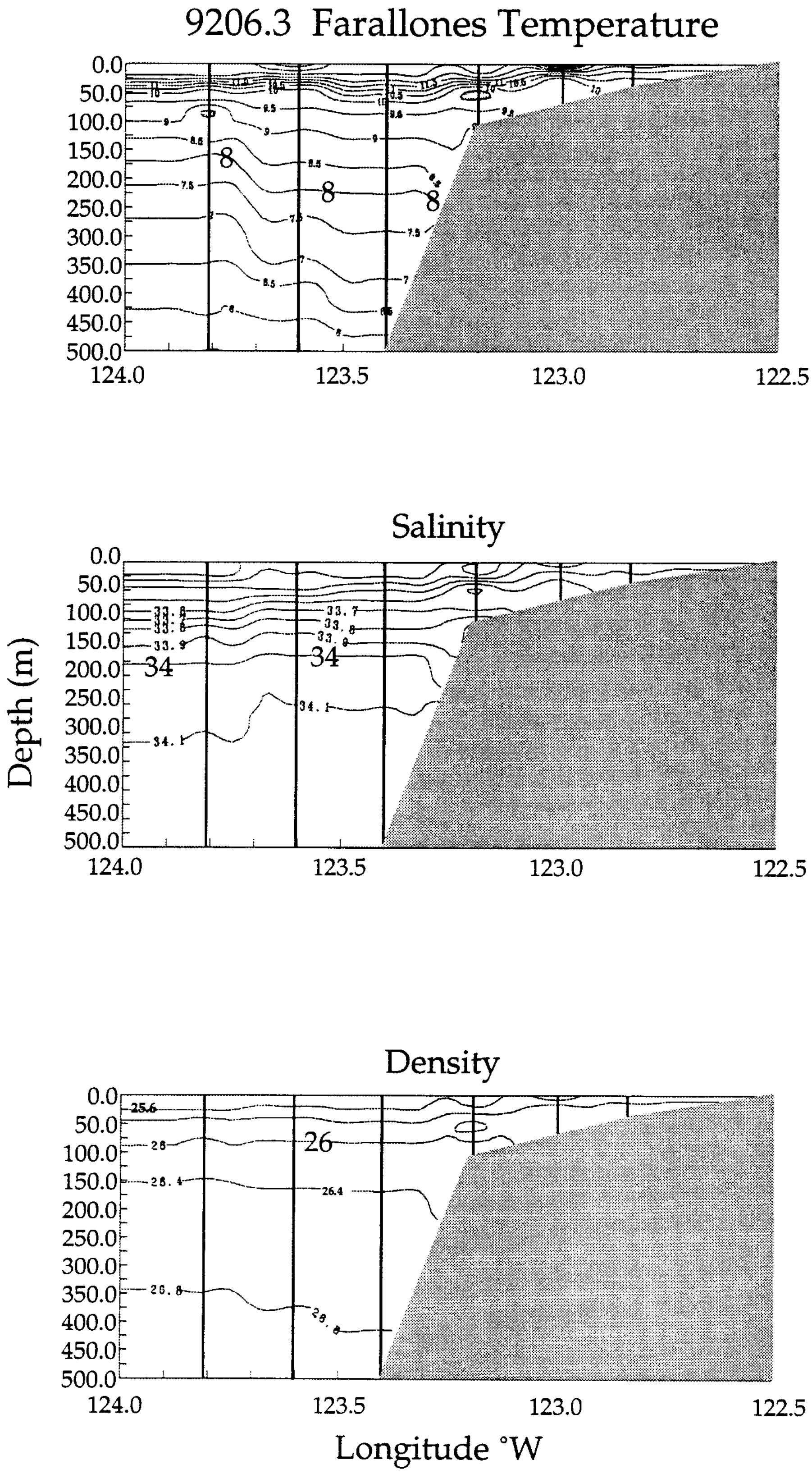
Salinity

Density

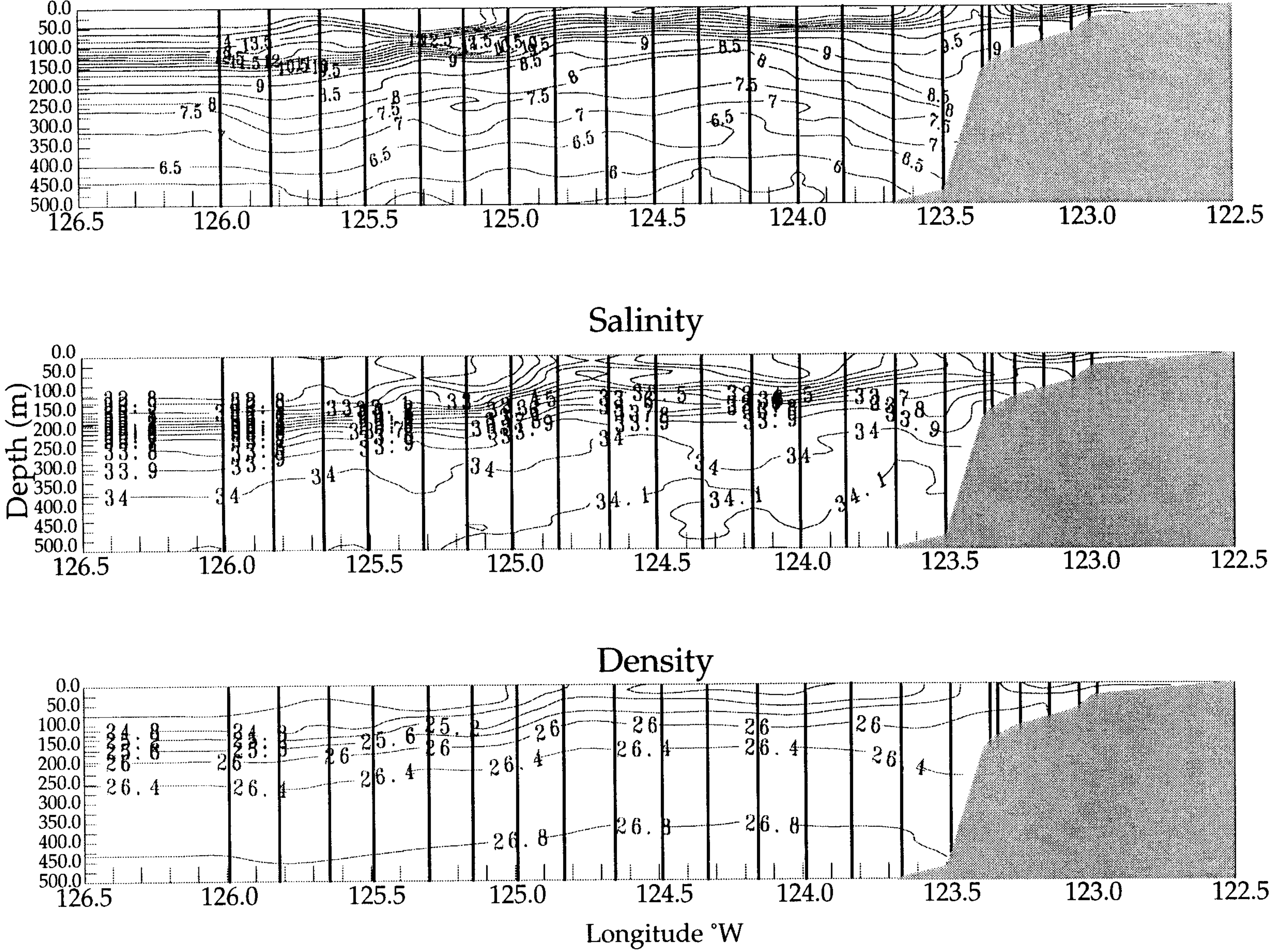

9206.3 Pescadero Temperature

Salinity

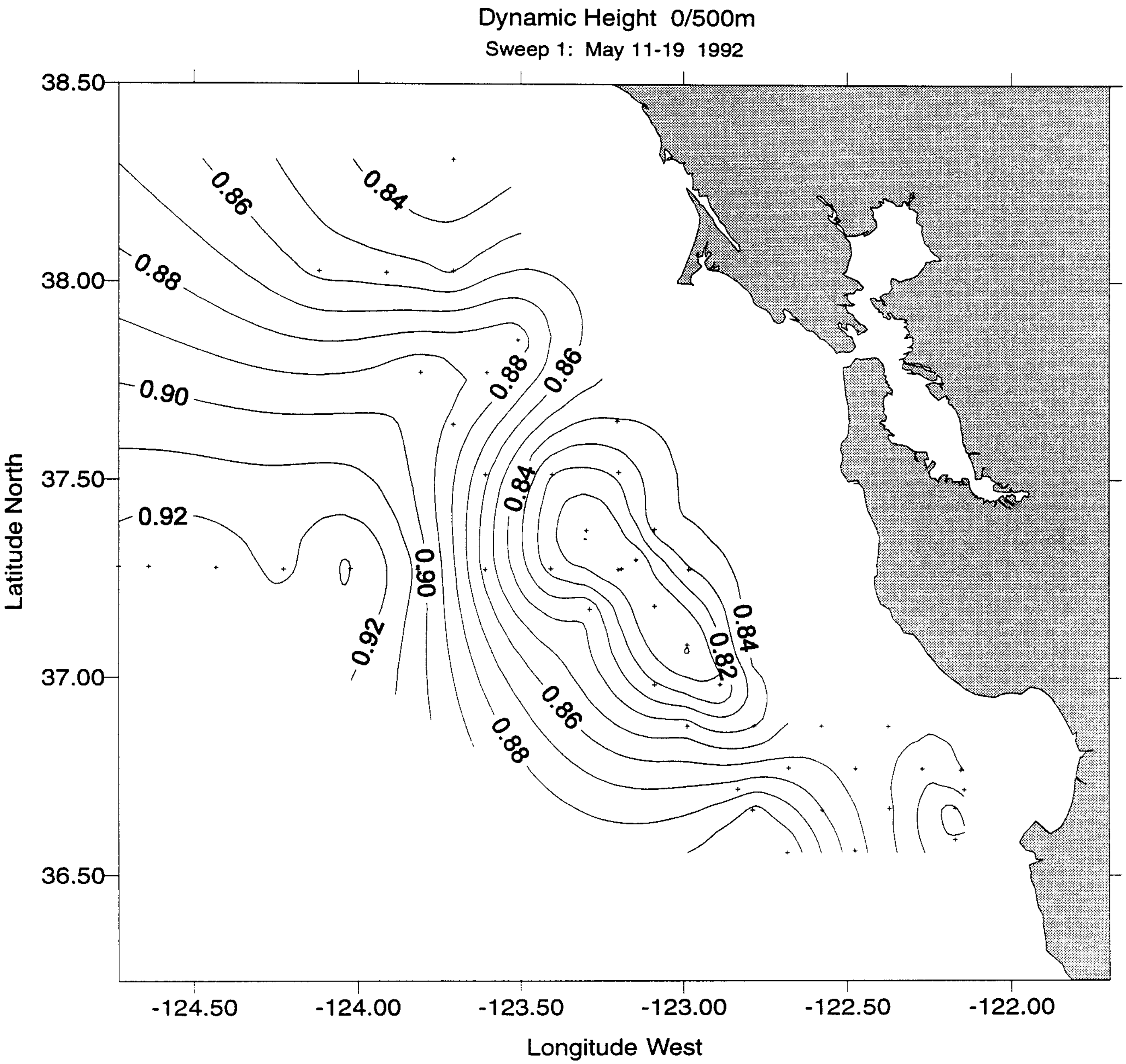
Density

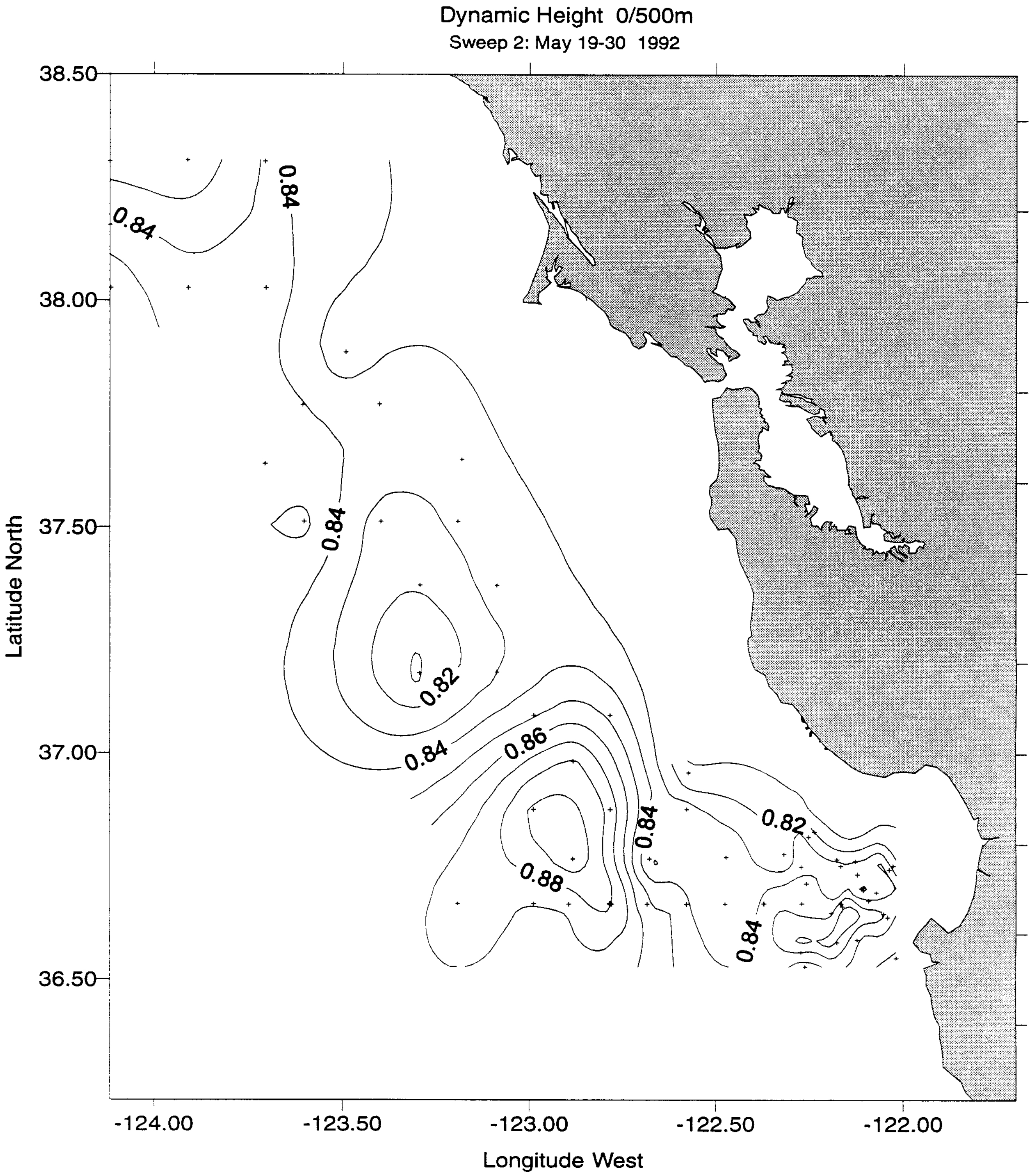

9206.3 Farallones Temperature
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
124.0
123.5
123.0
122.5
8
8
8
9
8.5
7.5
7
6.5
6
Salinity
33.8
33.9
34
34
33.7
34.1
34.1
Density
25.6
26
26
26.4
26.4
26.8
26.8
Depth (m)
Longitude °W

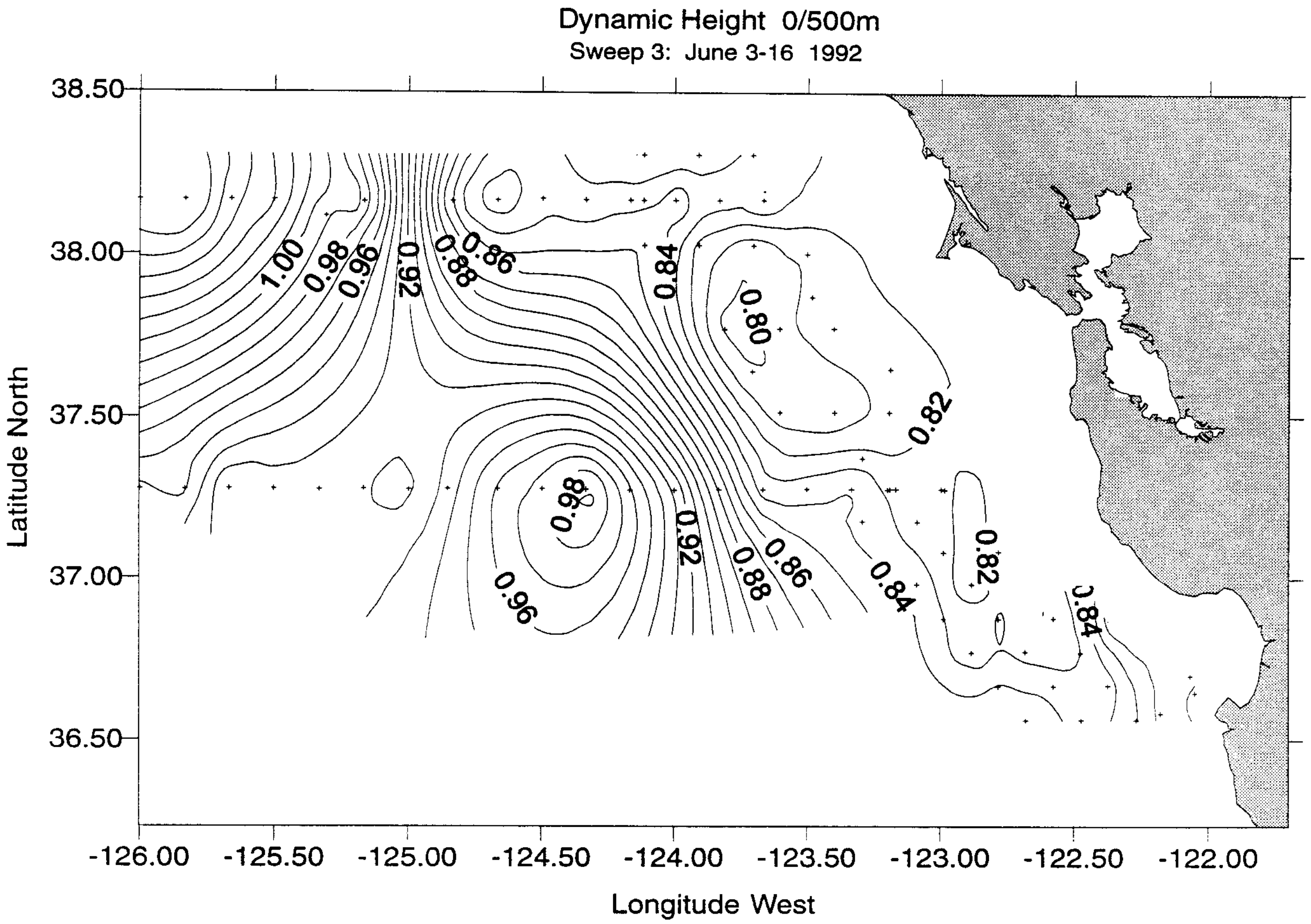
9206.3 Pt. Reyes Temperature



APPENDIX 8: MAPS OF DYNAMIC HEIGHT TOPOGRAPHY FOR DSJ9206


Dynamic Height 0/500m
Sweep 1: May 11-19 1992
38.50
38.00
37.50
37.00
36.50
Latitude North
-124.50
-124.00
-123.50
-123.00
-122.50
-122.00
Longitude West
0.84
0.86
0.88
0.90
0.92
0.88
0.86
0.84
0.82
0.84
0.86
0.88
0.90
0.92


Dynamic Height 0/500m
Sweep 2: May 19-30 1992
38.50
38.00
37.50
37.00
36.50
Latitude North
-124.00
-123.50
-123.00
-122.50
-122.00
Longitude West
0.84
0.84
0.84
0.82
0.84
0.86
0.88
0.84
0.82
0.84


Dynamic Height 0/500m
Sweep 3: June 3-16 1992
Latitude North
38.50
38.00
37.50
37.00
36.50
Longitude West
-126.00
-125.50
-125.00
-124.50
-124.00
-123.50
-123.00
-122.50
-122.00
1.00
0.98
0.96
0.92
0.88
0.86
0.84
0.80
0.82
0.98
0.96
0.92
0.88
0.86
0.84
0.82
0.84

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