

data report

PHYSICAL, CHEMICAL AND BIOLOGICAL DATA

CalCOFI Cruise 9007
25 July – 9 August 1990

CalCOFI Cruise 9011
5 – 20 November 1990

SIO Reference 91-18
31 July 1991

UNIVERSITY OF CALIFORNIA, SANDIEGO
SCRIPPS INSTITUTION OF OCEANOGRAPHY
LA JOLLA, CALIFORNIA 92093-0227

PHYSICAL, CHEMICAL AND BIOLOGICAL DATA

CalCOFI Cruise 9007
25 July - 9 August 1990

CalCOFI Cruise 9011
5 - 20 November 1990

SIO Reference 91-18
31 July 1991

Approved for distribution:



Edward A. Frieman, Director

CONTENTS

Introduction.....	3
Literature Cited.....	6
CalCOFI Cruise 9007	
Personnel.....	7
List of Figures.....	8
Tabulated Hydrographic Cast Data.....	19
Tabulated Primary Productivity Cast Data.....	48
Tabulated Macrozooplankton Data.....	51
CalCOFI Cruise 9011	
List of Figures.....	52
Personnel.....	63
Tabulated Hydrographic Cast Data.....	64
Tabulated Primary Productivity Data.....	93
Tabulated Macrozooplankton Data.....	96

INTRODUCTION

The data in this report were collected during Cruises 9007* and 9011 of the California Cooperative Oceanic Fisheries Investigations (CalCOFI) program aboard the RV *New Horizon* of the Scripps Institution of Oceanography, University of California, San Diego. The CalCOFI program was organized in the late 1940s to study the causes of variations in population size of fishes of importance to the State of California. It is carried out by NOAA's National Marine Fisheries Service Southwest Fisheries Science Center, the California Department of Fish and Game, and the Marine Life Research Group (MLRG) at Scripps Institution of Oceanography (SIO). MLRG contributes to this program by investigations of the physical, chemical and biological structure of the California Current. Data from CalCOFI Cruises 9007 and 9011 were collected and processed by personnel of the Marine Life Research Group and the Southwest Fisheries Science Center. Volunteers and other SIO staff members also assisted in the collection of data and chemical analyses at sea.

In addition to the usual horizontal maps of characteristics at the surface and at 200 m, vertical sections of various properties measured on CalCOFI line 90 appear in this report.

STANDARD PROCEDURES

Hydrographic Cast Data

The hydrographic casts usually consisted of 20 three-liter plastic (PVC) bottles lowered to a maximum sampling depth of 500 meters, bottom depth permitting. Temperature, salinity, oxygen and nutrients were determined at sea for all depths sampled. Chlorophyll-*a* and phaeopigments were usually determined at sea from the top 14 depths. A special near-bottom cast was done in the Santa Barbara Basin on each cruise.

Paired protected reversing thermometers read by two observers were used to determine temperatures which were then recorded to hundredths of a degree Celsius. The temperatures are reported relative to the International Practical Temperature Scale of 1968 (IPTS-68). The new International Temperature Scale of 1990 (ITS-90) differs from the IPTS-68 by less than 0.01° C over oceanic temperature ranges, so the distinction between the two scales is of marginal significance for temperatures listed to the nearest hundredth of a degree. Most sampling bottles used below a depth of about 75 meters were equipped with unprotected thermometers for determination of the depth of sampling, using the Saunders (1981) pressure-to-depth conversion technique.

Salinity samples were analyzed at sea using inductive-type salinometers standardized with substandard seawater. Periodic checks on the concentration of the substandard were made by comparison with IAPSO Standard Seawater batch P-78. Salinity values have been calculated from the algorithms for the Practical Salinity Scale, 1978 (UNESCO, 1981a) and were reported to three decimal places, provided that accepted standards were met. If only one determination per sample was obtained, or there was doubt concerning the accuracy of the analytical results, the salinities were reported to two decimal places.

Dissolved oxygen was determined by the Winkler method, as modified by Carpenter (1965), using the equipment and procedure outlined by Anderson (1971). Percent oxygen saturation was calculated from the equations of Weiss (1970).

Silicate, phosphate, nitrate and nitrite nutrients were determined at sea using an automated analyzer. The procedures used are similar to those described in Atlas *et al.* (1971).

Chlorophyll-*a* and phaeopigments were measured with a fluorometric technique (Yentsch and Menzel, 1963; Holm-Hansen *et al.*, 1965) from subsamples filtered onto GF/F filters. The pigments were extracted with a cold extraction technique in 90% acetone (Venrick and Hayward, 1984) and the fluorescence determined before and after acidification with a fluorometer.

Evaluation of the data involved comparisons with adjacent stations and consideration of the variation of a property as a function of density or depth and the relationships with other properties (Klein, 1973). Estimates of precision of the standard techniques are given in SIO, 1991.

*The first two digits represent the year and the last digits the month of the cruise.

Primary Production

Primary productivity casts were taken each day shortly before local apparent noon (LAN). Primary production was estimated from C uptake using a simulated *in situ* technique. Light penetration was estimated from the Secchi depth (assuming that the 1% light level is three times the Secchi depth). The depths with ambient light intensities corresponding to light levels simulated by the on-deck incubators were identified and sampled with 5-liter Niskin bottles attached to the hydrowire. The Niskin bottles were equipped with epoxy-coated springs and silicone-rubber O-rings. Where the productivity casts occurred at non-standard CalCOFI sampling locations, additional hydrographic bottles were added to extend the observations to 200 m. Triplicate samples (two light and one dark control) were drawn from each productivity sample (depth into 250 ml polycarbonate incubation bottles. Samples were inoculated with 10 pCi of C^{14} as $NaHCO_3$ (200 (J of 50 pCi/ml stock) prepared in a 0.3g/liter solution of sodium carbonate (Fitzwater *et al.*, 1982). Samples were incubated from LAN to civil twilight in seawater-cooled incubators with neutral-density screens which simulate *in-situ* light levels. At the end of the incubation, the samples were filtered onto HA millipore filters and placed in scintillation vials. One half ml of 10% HCl was added to each sample. The sample was then allowed to sit, without a cap, at room temperature for 12 hours (after Lean and Burnison, 1979). Following this, 10 ml of scintillation fluor were added to each sample and the samples were returned to SIO where the radioactivity was determined with a scintillation counter. Temperature, salinity, oxygen, nutrients, chlorophyll-a, and phaeopigments were determined for all depths.

Macrozooplankton Net Tows

Macrozooplankton was sampled with a 71-cm mouth diameter paired net (bongo net) equipped with 0.505-mm plankton mesh. Bottom depth permitting, the nets were towed obliquely from 210 m to the surface. The tow time for a standard tow was 21.5 minutes. Volumes filtered were determined from flowmeter readings and the mouth area of the net. Only one sample of each pair was retained and preserved. The biomass, as wet displacement volume, after removal of large (>5-ml) organisms, was determined in the laboratory ashore. These procedures are summarized in greater detail in Kramer *et al.* (1972).

TABULATED DATA

Hydrographic Cast Data

The reported hydrographic cast time is the Coordinated Universal Time (UTC) of the messenger release. Bottom depths, determined acoustically have been corrected using British Admiralty Tables (Carter, 1980) and are reported in meters. Weather conditions have been coded using WMO code 4501. Secchi depths, taken on most daylight stations, are also reported.

Observed and interpolated standard depth data from hydrographic casts have been interspersed and are presented together sequentially by depth. Interpolated or extrapolated standard level data are noted by the footnote "ISL" printed after the depth. Density-related parameters have been calculated from the International Equation of State of Seawater 1980 (UNESCO, 1981, b). Computed values of potential temperature, sigma-theta, specific volume anomaly (SVA), dynamic height or geopotential anomaly, and pressure are included with both observed and interpolated standard depth levels.

Primary Production

In addition to the normal hydrographic data, the tabulated data include: the *in situ* light levels at which the samples were collected, the uptake from each of the replicate light bottles (uptake 1 and uptake 2) which have been corrected for dark uptake by subtracting the dark value, the mean of the two uptake values, the dark uptake, chlorophyll-a and phaeopigments. The uptake values are totals for the incubation period. Also shown are the times of LAN, civil twilight, and the value of the mean uptake integrated from the surface to the deepest sample, assuming that the shallowest value continues to the surface and that negative values (when dark uptake exceeds light uptake) are zero. The uptake data have been presented to two significant digits (values <1.00) or one decimal (values >1.00). The higher production values may not vibrant all of the digits presented. Incubation time, LAN, and civil twilight are given in local Pacific Standard Time (JST); to convert to UTC, add eight hours to the PST time. Incubation light intensities are listed in a footnote at the bottom of each page.

Macrozooplankton Data

Macrozooplankton biomass volumes are tabulated as total biomass volume (cm /1000 m³ strained) and as the total volume minus the volume of larger organisms under the heading "Small." Tow times are given in local PST (+8) time.

FOOTNOTES

In addition to footnotes, special notations are used without footnotes because the meaning is always the same.

ISL: After depth values indicates interpolated or extrapolated standard level.

U: Uncertain value. Values which are not used in interpolation because they seem to be in error without apparent reason.

LITERATURE CITED

- Anderson, G. C., compiler, 1971 "Oxygen Analysis," fieldarine Technician's Handbook, SIO Ref. No. 71-8, Sea Grant Pub. No. 9.
- Atlas, E. L., J. C. Callaway, R. D. Tomlinson, L. I. Gordon, L. Barstow, and P. K. Park, 1971. *A Practical Manual for Use of the Technicon AutoAnalyzer in Sea Water Nutrient Analysis*, Revised. Oregon State University Technical Report 215, Reference No. 71-22.
- Carpenter, J. H., 1965. The Chesapeake Bay Institute technique for the Winkler dissolved oxygen method. *Limnol. Oceanogr.*, 10:141-143.
- Carter, D. J. T., 1980. Echo-sounding correction tables. Third Edition. Hydrographic Department, Ministry of Defence, Taunton, U. K., NP139:150 pp.
- Fitzwater, S. E., G. A. Knauer, and J. H. Martin. 1982. Metal contamination and its effect on primary production measurements. *Limnol. Oceanogr.*, 27:544-551.
- Holm-Hansen, O., C. J. Lorenzen, R. W. Holmes, and J. D. H. Strickland,, 1965. Fluorometric determination of chlorophyll. *J. Cons. perm. int. Explor. Mer.*, 30:3-15.
- Klein, Hans T., 1973. A new technique for processing physical Oceanographic data. SIO Ref. No. 73-14.
- Kramer, D., M. J. Kalin, E. G. Stevens, J. R. Thraillkill, and J. R. Zweifel, 1972. Collecting and processing data on fish eggs and larvae in the California Current region. *NOAA Technical Report NMFS CIRC-370*: 38 pp.
- Lean, D. R. S., and B. K. Bumispn, 1979. An evaluation of errors in the C method of primary production measurement. *Limnol. Oceanogr.*, 24:917-928.
- Reid, J. L., and A. W. Mantyla, 1976. The effect of the geostrophic flow upon coastal sea elevations in the northern North Pacific Oceli. *J. Geophys. Res.*, 81:3100-3110.
- Saunders, P. M., 1981. Practical conversion of pressure to depth. *J. Phys. Oceanogr.*, 11:573-574.
- Scripps Institution of Oceanography, University of California, 1991. Physical, Chemical and Biological Data, CalCOFI Cruises 9003 and 9004. SIO Ref. 91-4,95 pp. 93 pp.
- UNESCO, 1981, a. Background papers and supporting data on the Practical Salinity Scale, 1978. *UNESCO Tech. Pap. in Mar. Sci.*, No. 37.
- UNESCO, 1981, b. Background papers and supporting data on the International Equation of State 1980. *UNESCO Tech. Pap. in Mar. Sci.*, No. 38.
- Venrick, E. L., and T. L. Hayward, 1984. Determining chlorophyll on the 1984 CalCOFI surveys. *CalCOFI Rep.*, Vol. XXV:74-79.
- Weiss, R. F. 1970. The solubility of nitrogen, oxygen and argon in water and seawater. *Deep-Sea Res.*, 17: 721-735.
- Yentsch, C. S., and D. W. Menzel, 1963. A method for the determination of phytoplankton, chlorophyll and phaeophytin by fluorescence. *Deep-Sea Res.*, 10:221-231.

PERSONNEL

CaLCOFI Cruise 9007

SHIP'S CAPTAIN

Eric C. Buck, *RV New Horizon*

PERSONNEL PARTICIPATING IN THE COLLECTION OF DATA

Mullin, Michael M. (Chief Scientist)	Professor, Director, M L R G , S I O
Abramenkoff, Dimitry N.	Fishery Biologist, N M F S
Bos, David L.	Staff Research Associate, S I O
Griffith, David A.	Fishery Biologist, N M F S
Gripp, Sherry L.	Staff Research Associate, S I O
Gruber, Dennis W.	Marine Technician, S I O
Lippsmeyer, Michael J.	Volunteer, U C I
Maggert, Keith	Student, U C S D
Molina, Kathy C.	Preparator, Los Angeles County Museum of Natural History
Renger, Edward H.	Staff Research Associate, S I O
Swanson, Willie J	Student, U C S D
Wilkinson, James R.	Staff Research Associate, S I O

FIGURES

Cruise 9007

1. CalCOFI Cruise 9007, track and station positions.
2. Horizontal distribution of dynamic height anomaly (0 over 500 m). In areas shallower than 500 m, the dynamic heights were extrapolated on the basis of the offshore deeper steric height as described in Reid and Mantyla (1976).
3. Horizontal distributions at 10 meters: A) chlorophyll-a; B) potential density; C) temperature; and D) salinity.
4. Horizontal distributions at 200 meters: A) dynamic height anomaly (200 over 500 m); B) potential density; C) temperature; and D) salinity.
5. Sections along CalCOFI Line 90 (vertical exaggeration, 1000): A) potential density; B) temperature; C) salinity; D) silicate; E) nitrite; F) phosphate; G) chlorophyll-a; H) oxygen saturation; I) oxygen; J) nitrite; and K) phaeopigments.

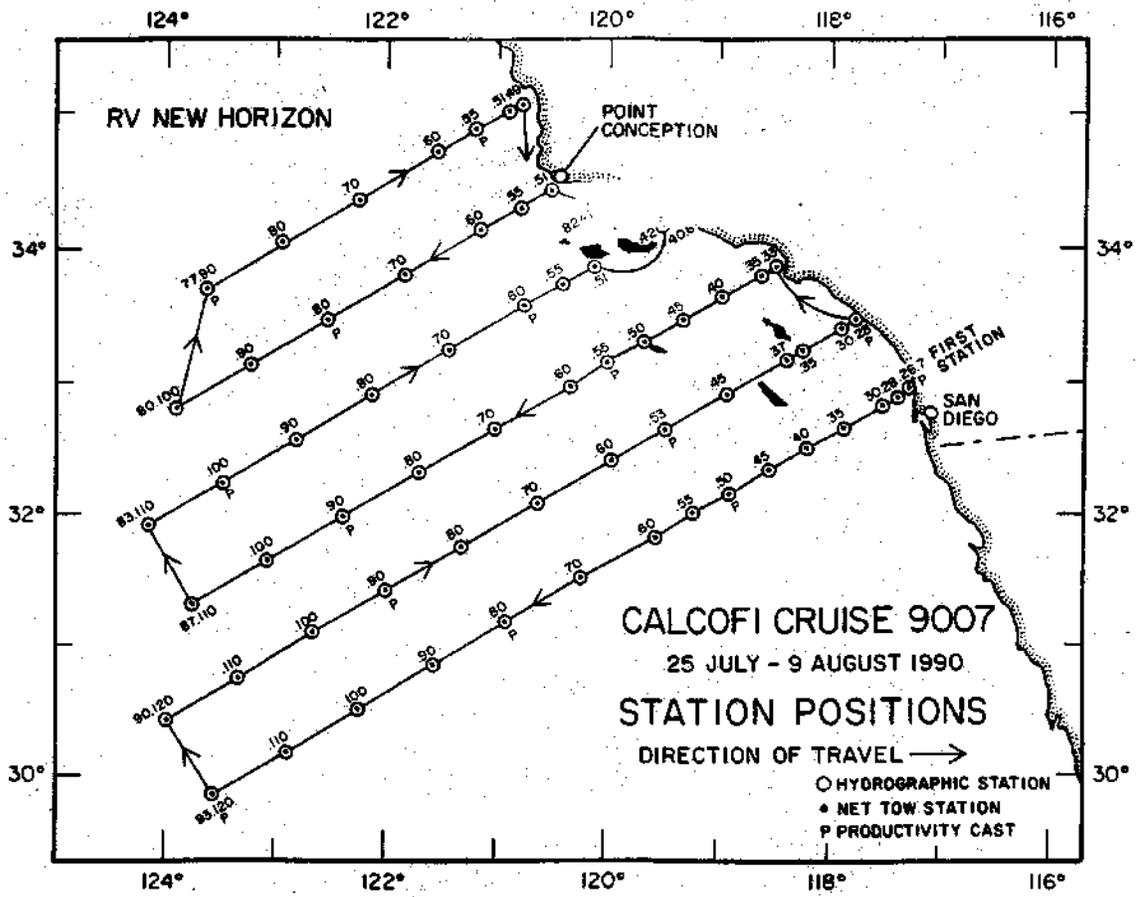


FIGURE 1

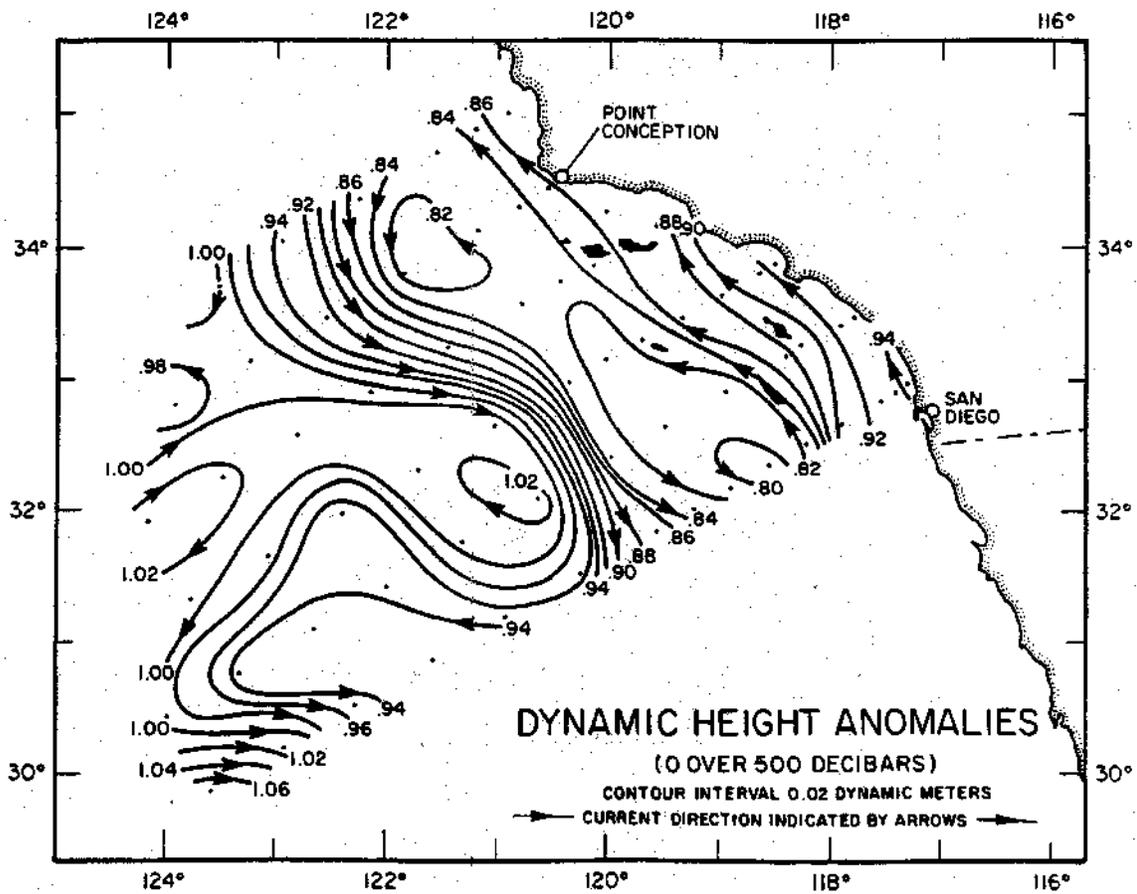


FIGURE 2

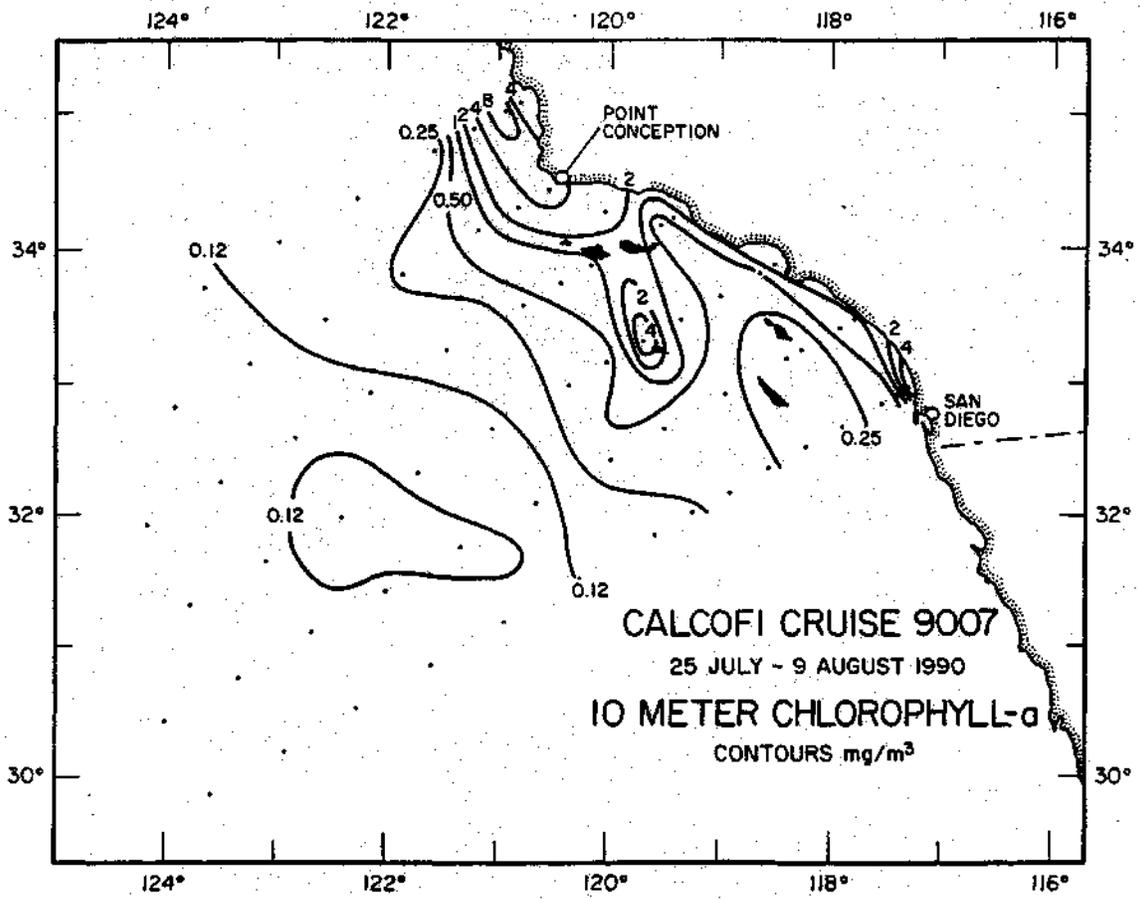


FIGURE 3A

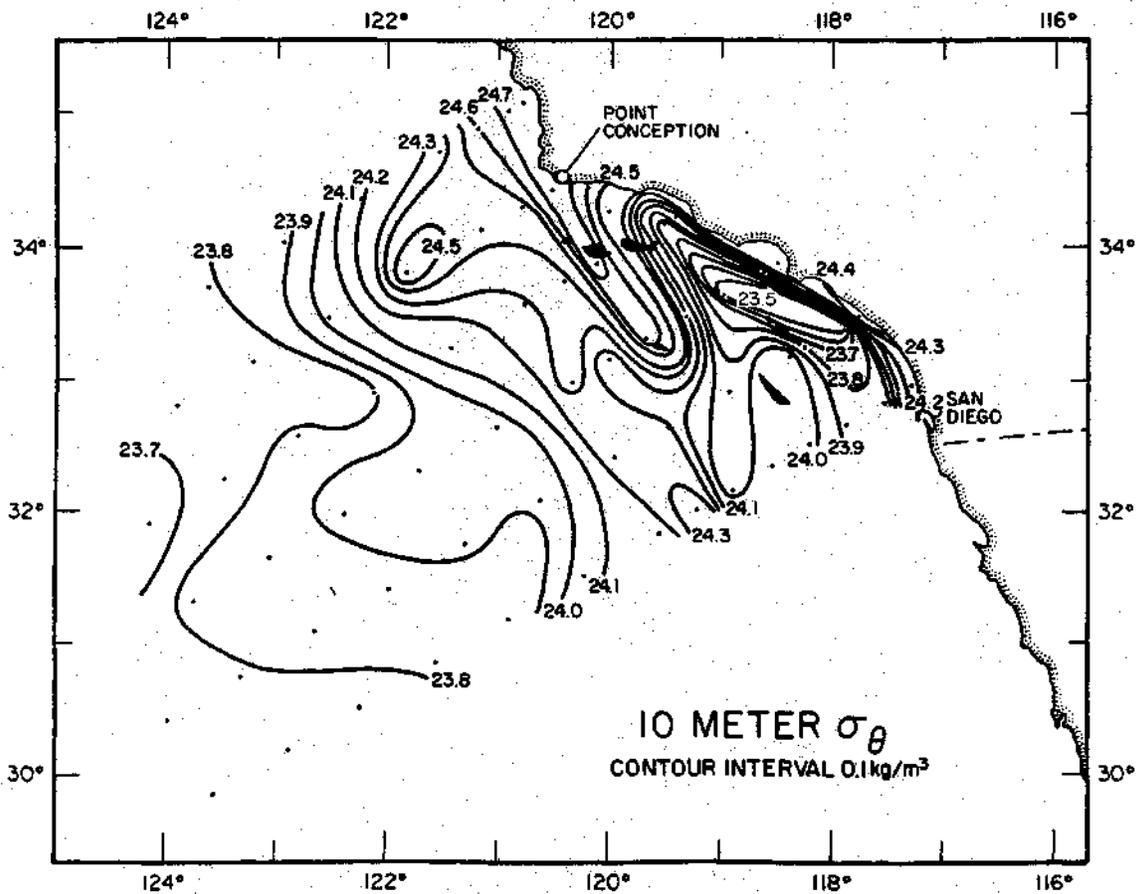


FIGURE 3B

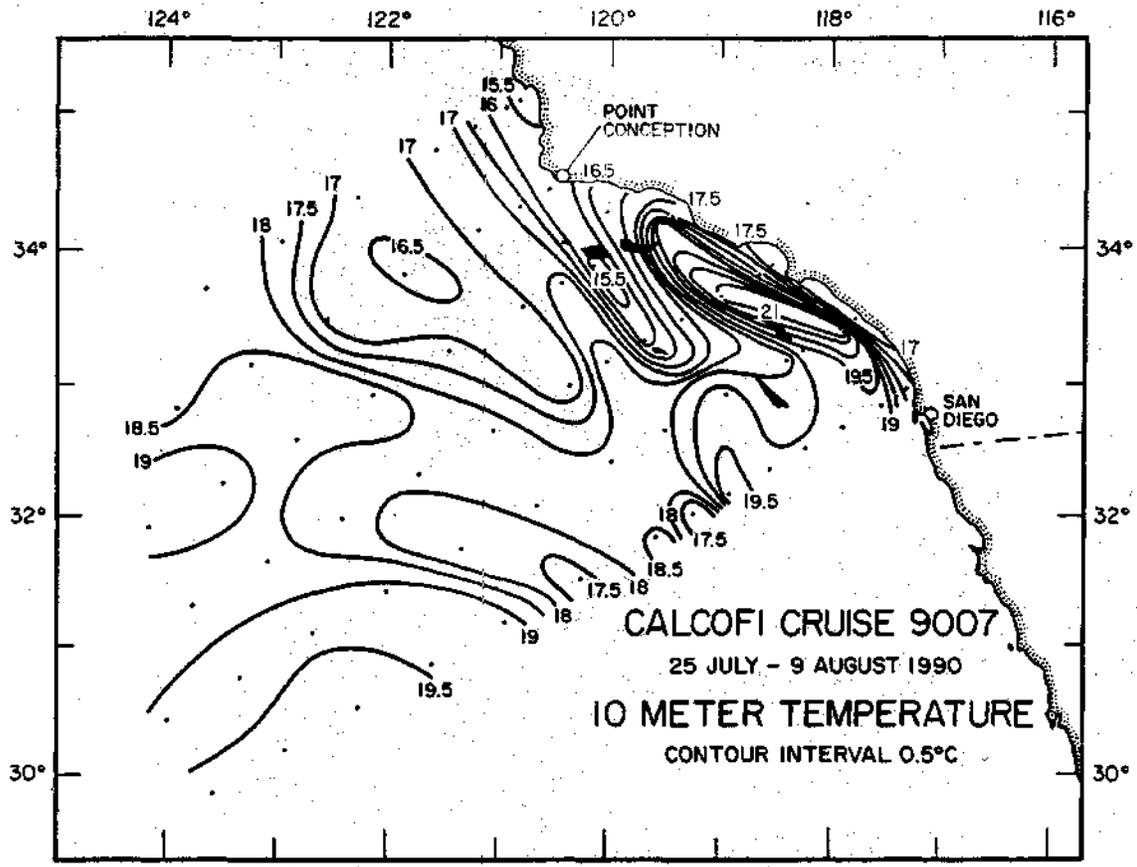


FIGURE 3C

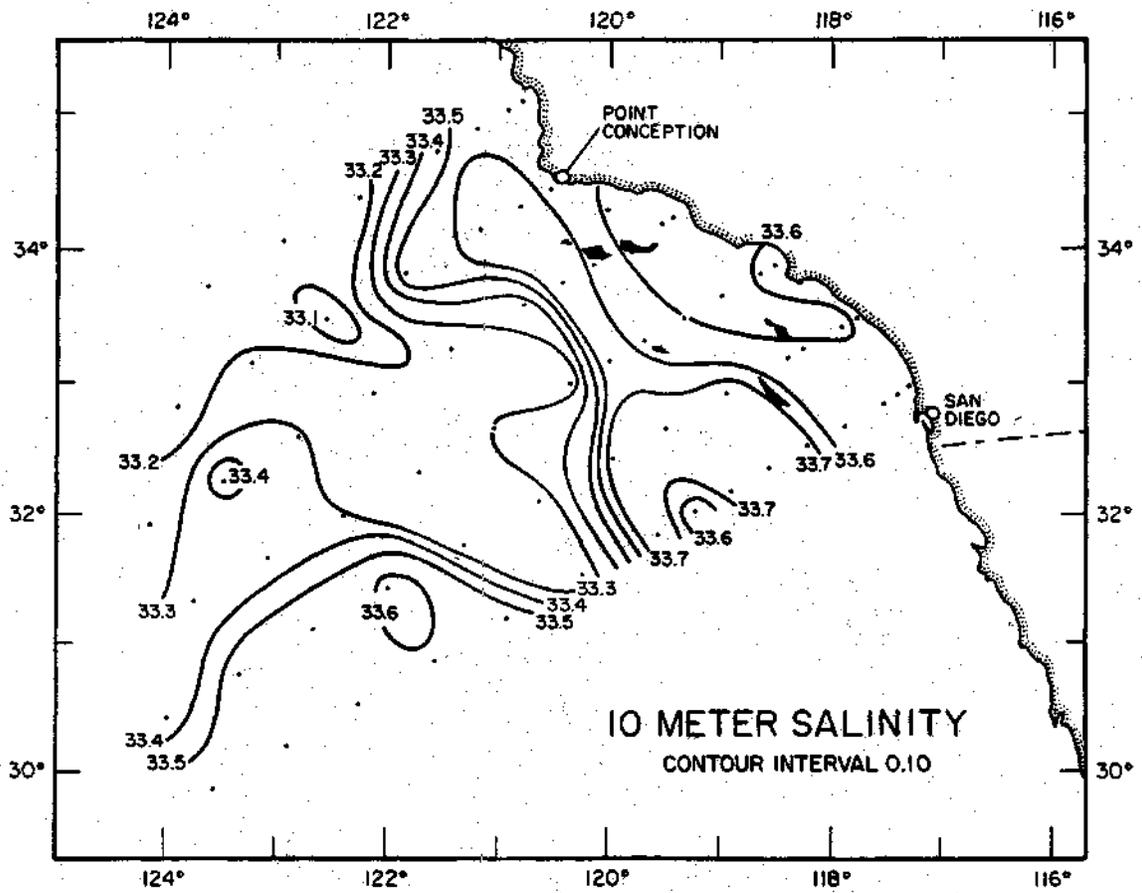


FIGURE 3D

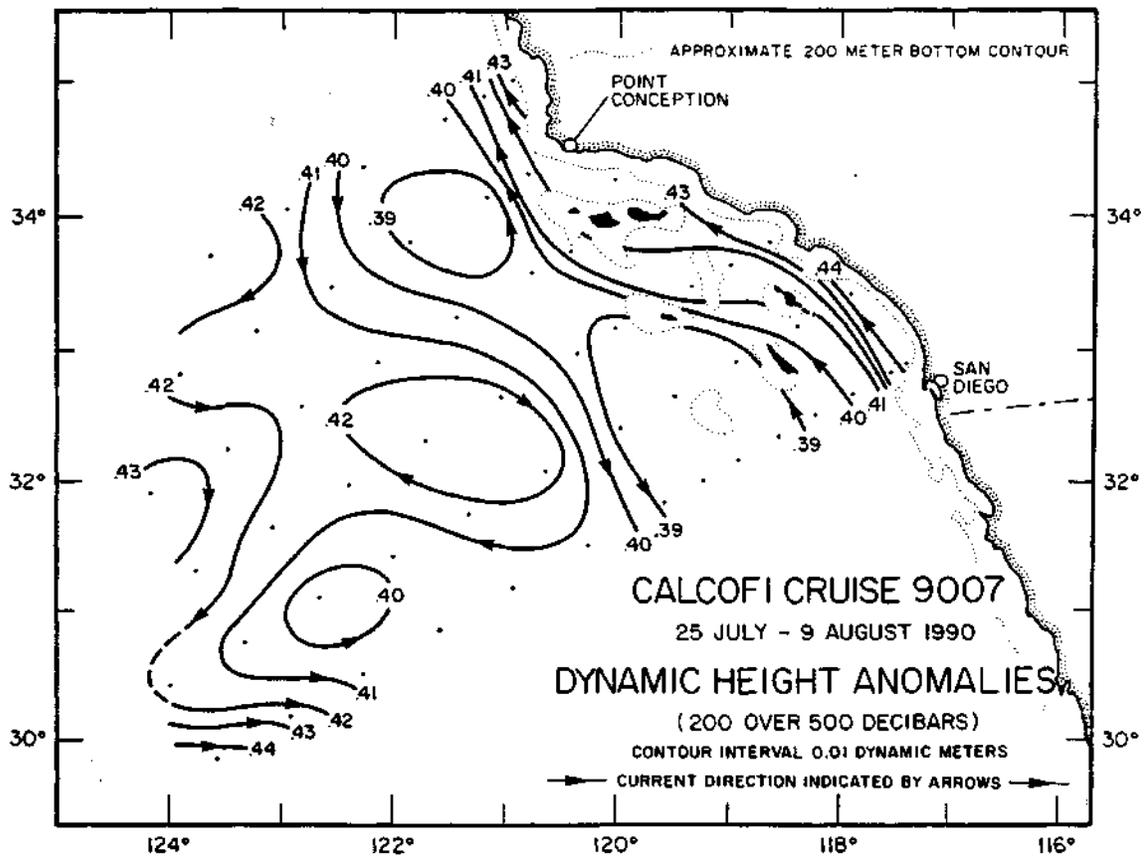


FIGURE 4A

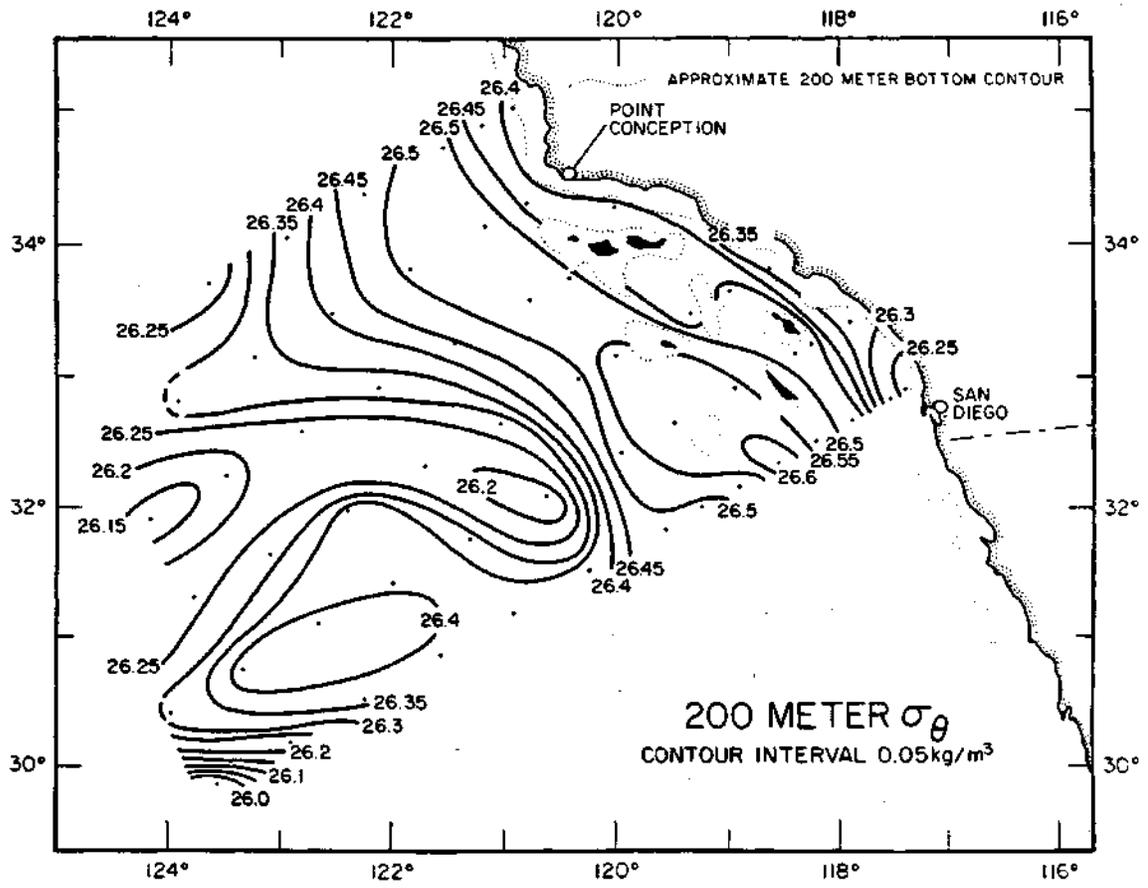


FIGURE 4B

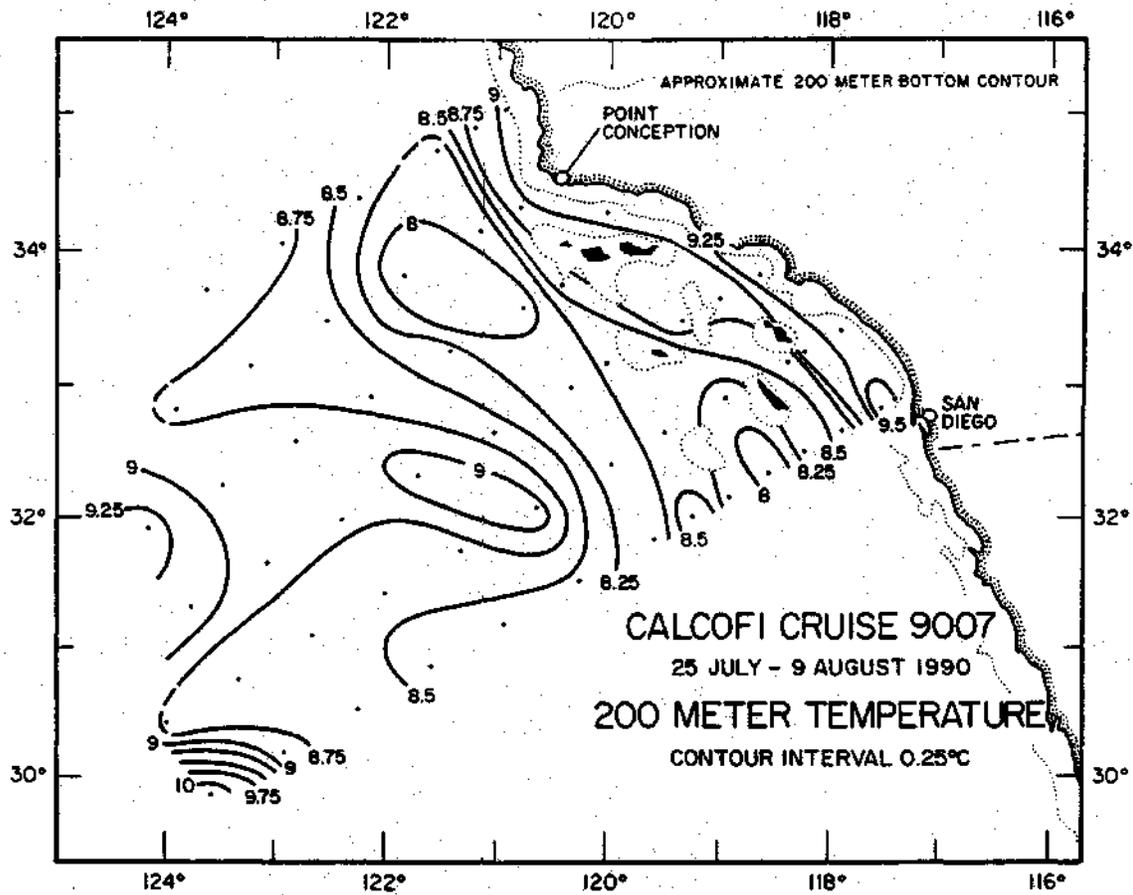


FIGURE 4C

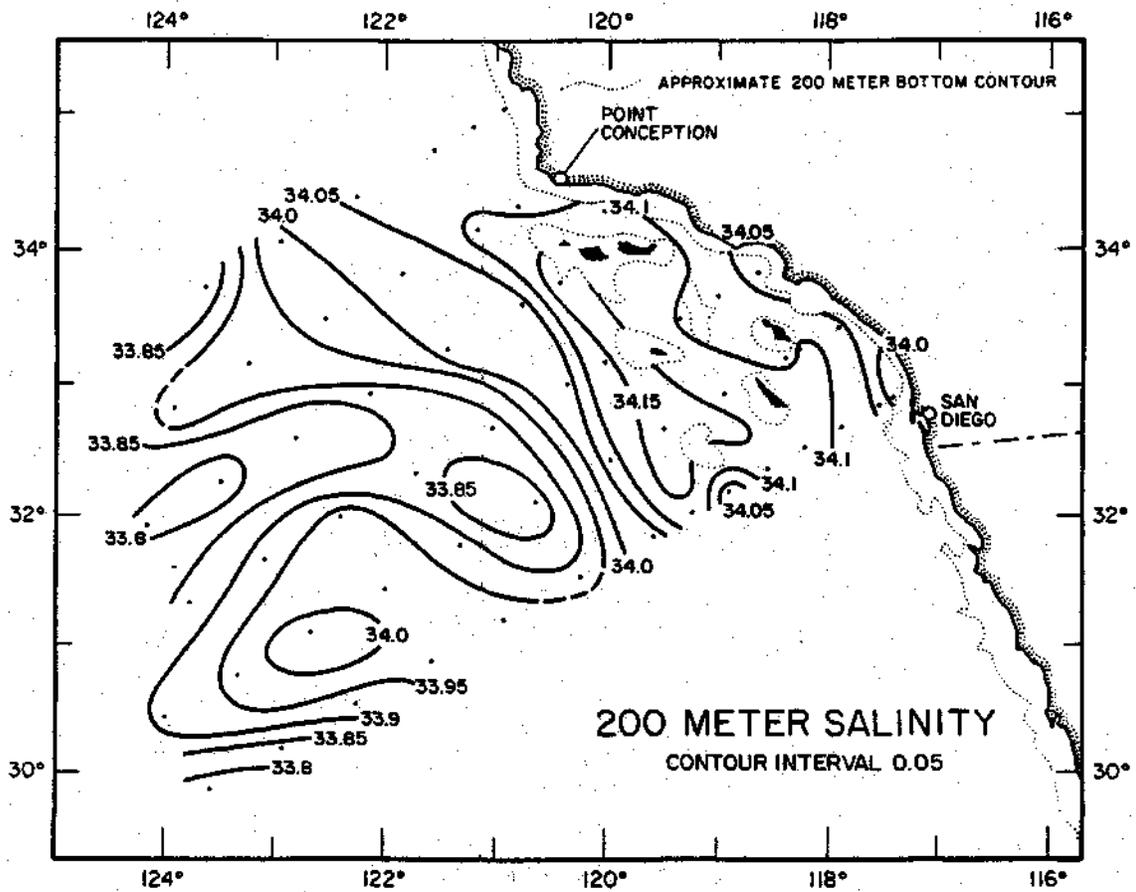


FIGURE 4D

CALCOFI CRUISE 9007

28-31 JULY 1990

POTENTIAL DENSITY (σ_θ) ALONG CALCOFI LINE 90

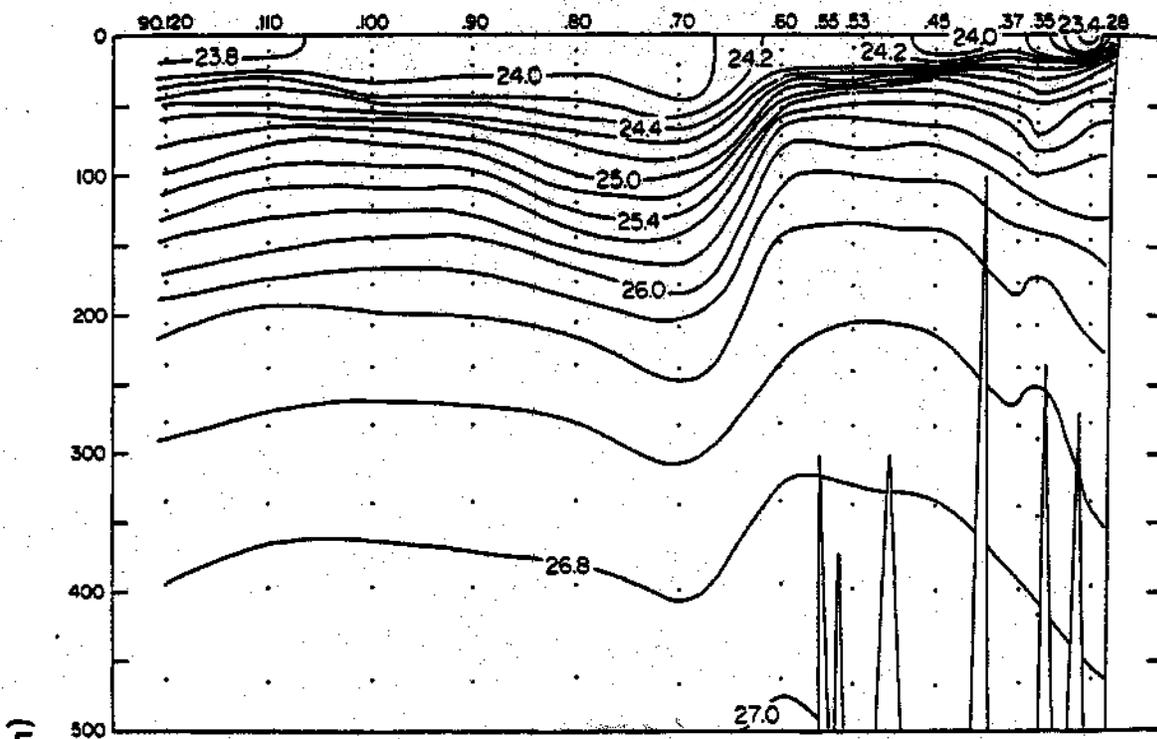


FIGURE 5A

DEPTH (m)

TEMPERATURE ($^{\circ}$ C) ALONG CALCOFI LINE 90

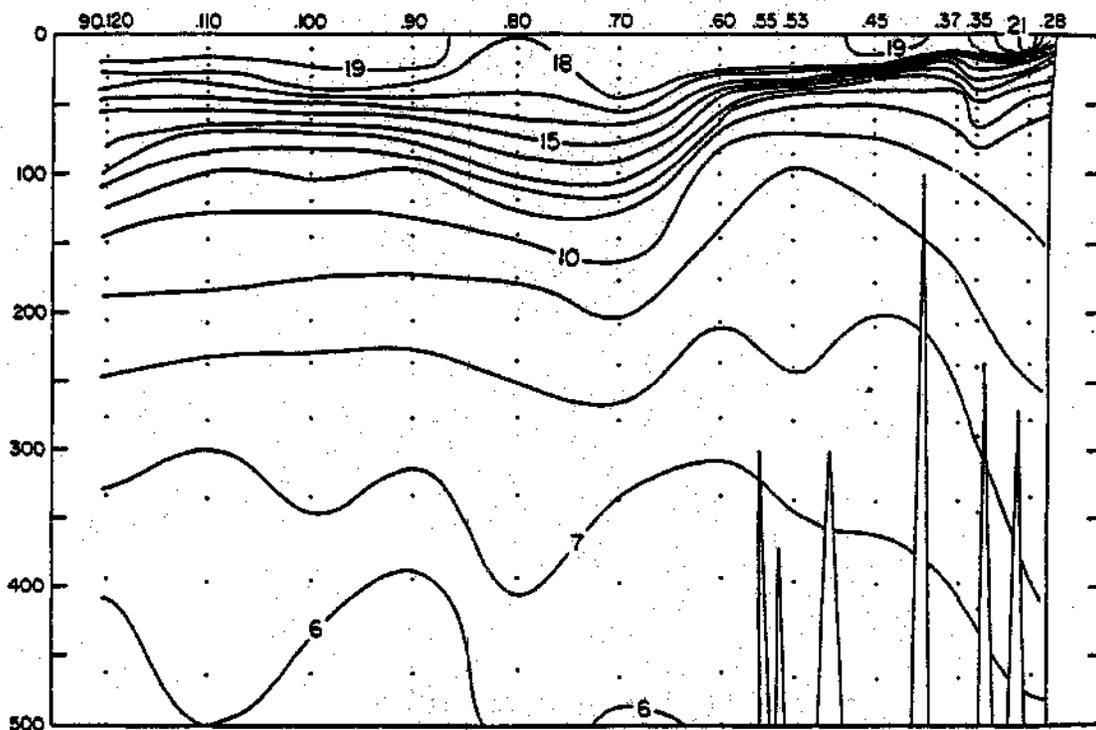


FIGURE 5B

CALCOFI CRUISE 9007

28-31 JULY 1990

SALINITY ALONG CALCOFI LINE 90

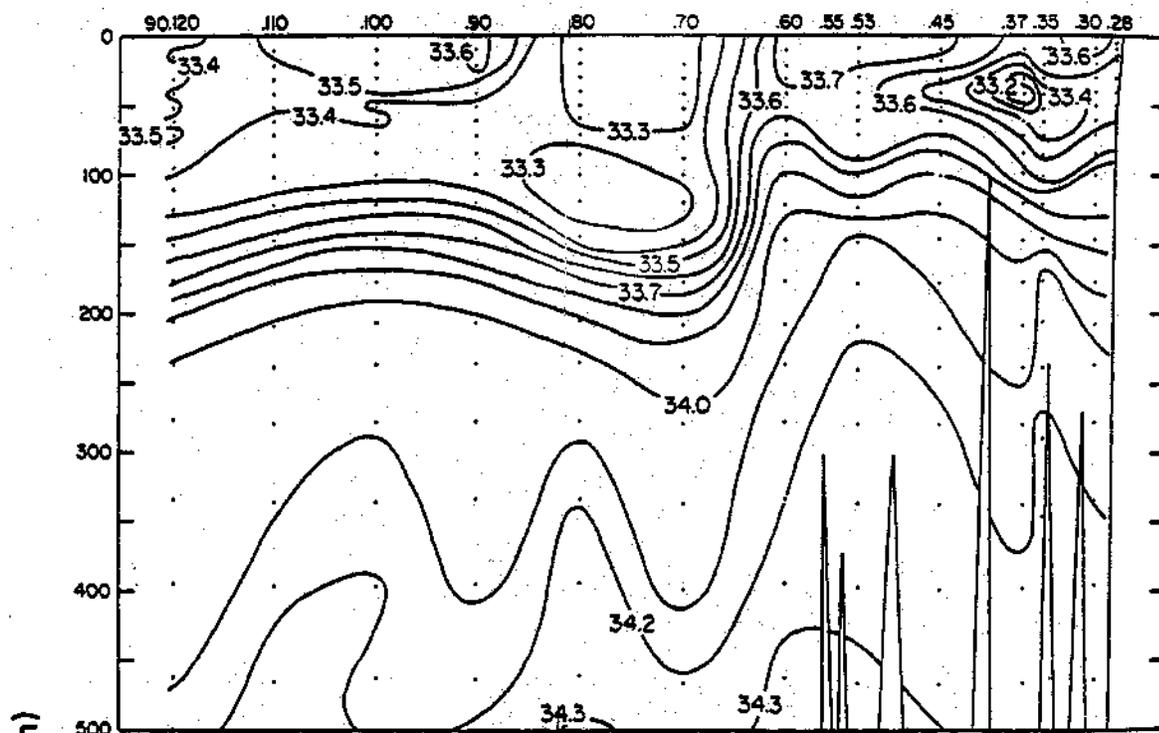


FIGURE 5C

SILICATE ($\mu\text{M}/\text{l}$) ALONG CALCOFI LINE 90

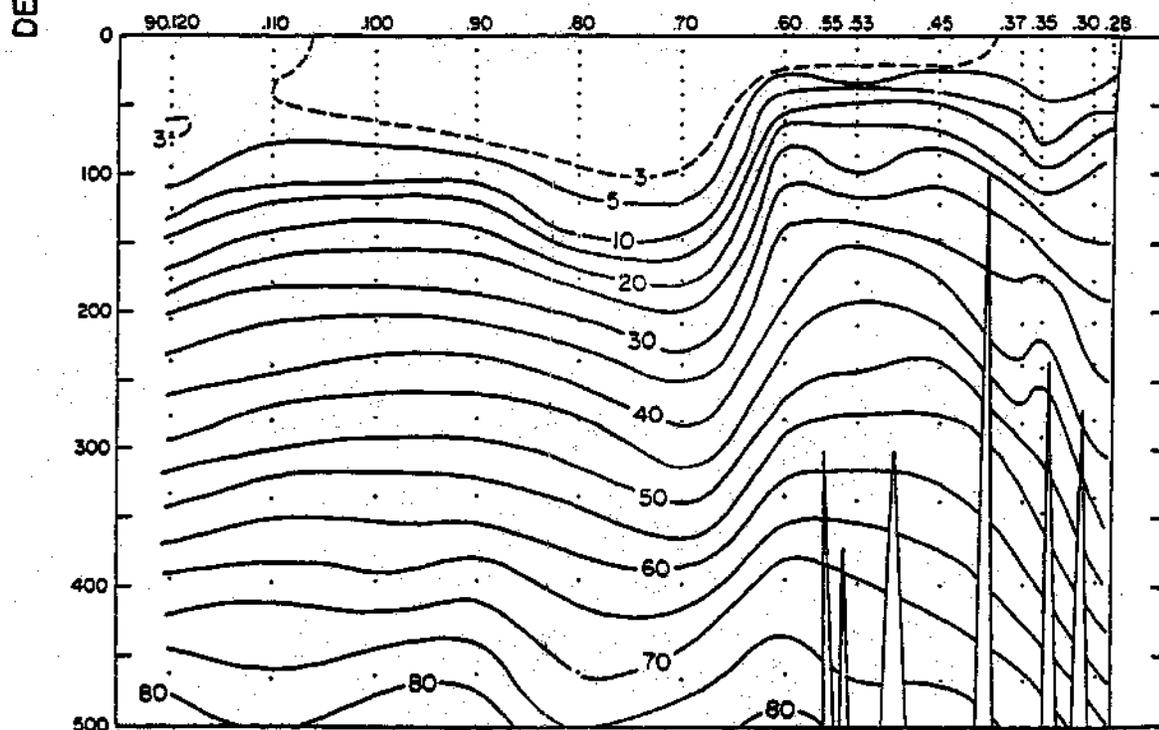


FIGURE 5D

CALCOFI CRUISE 9007

28-31 JULY 1990

NITRATE ($\mu\text{M}/\text{l}$) ALONG CALCOFI LINE 90

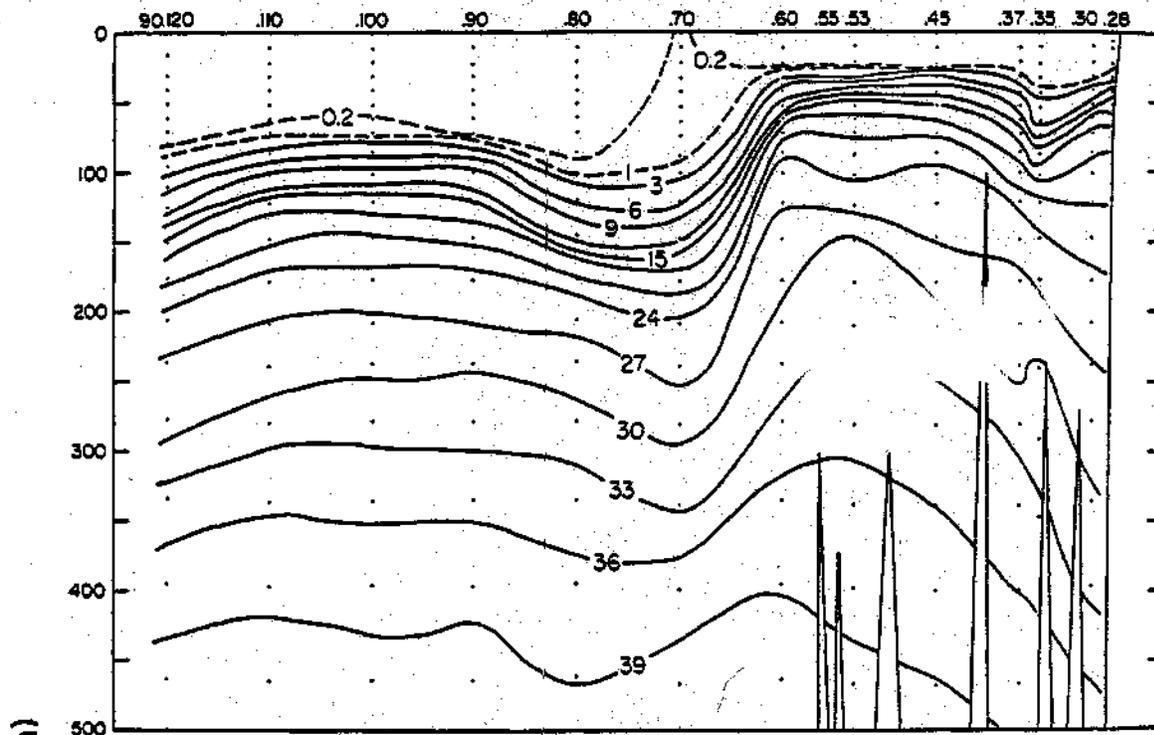


FIGURE 5E

PHOSPHATE ($\mu\text{M}/\text{l}$) ALONG CALCOFI LINE 90

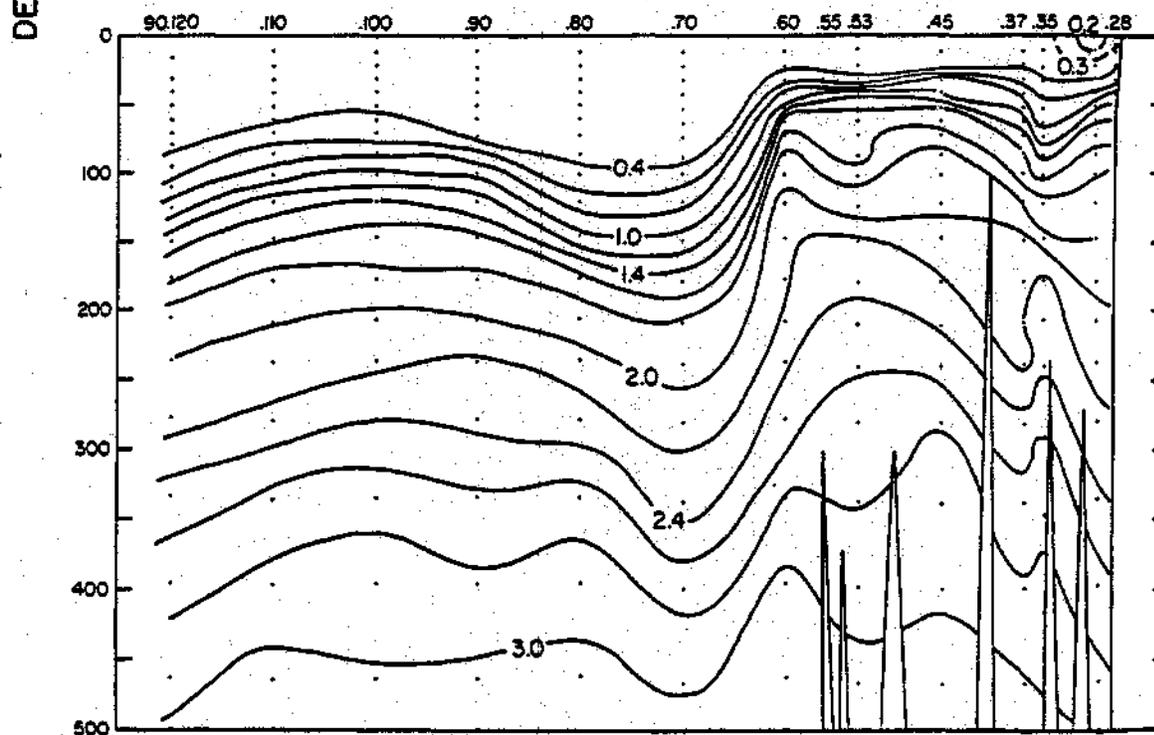


FIGURE 5F

CALCOFI CRUISE 9007

28-31 JULY 1990

CHLOROPHYLL-a ($\mu\text{g/l}$) ALONG CALCOFI LINE 90

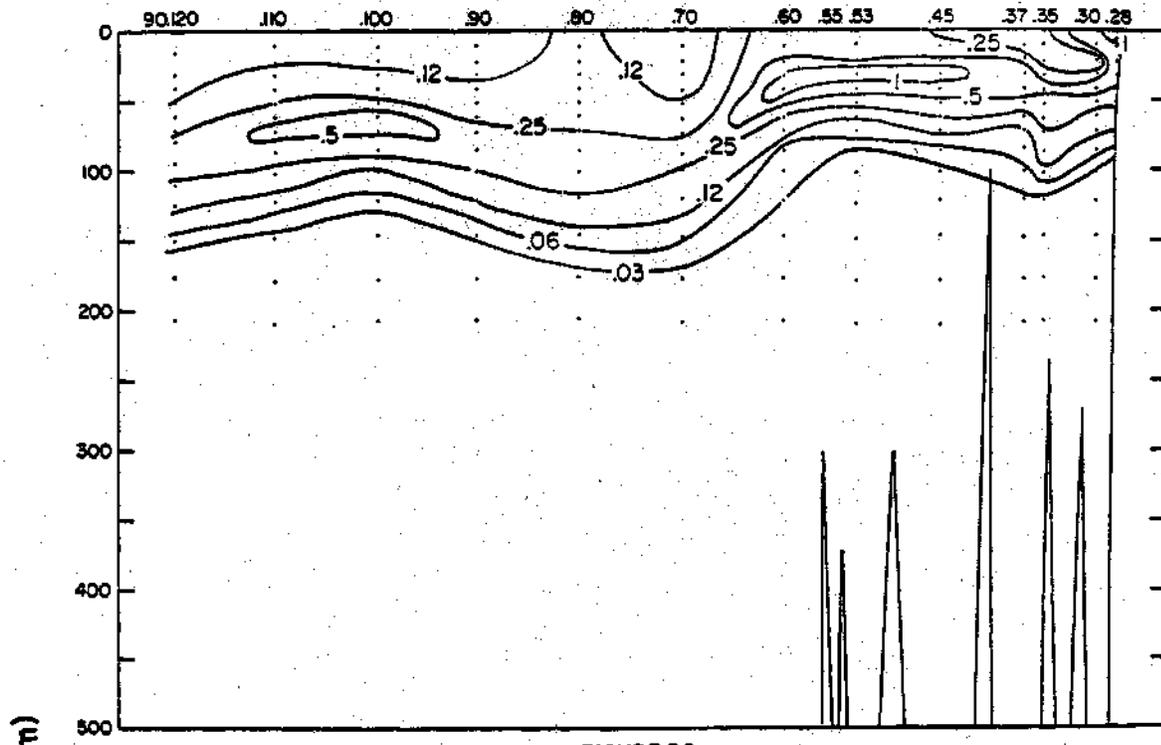


FIGURE 5G

OXYGEN SATURATION (%) ALONG CALCOFI LINE 90

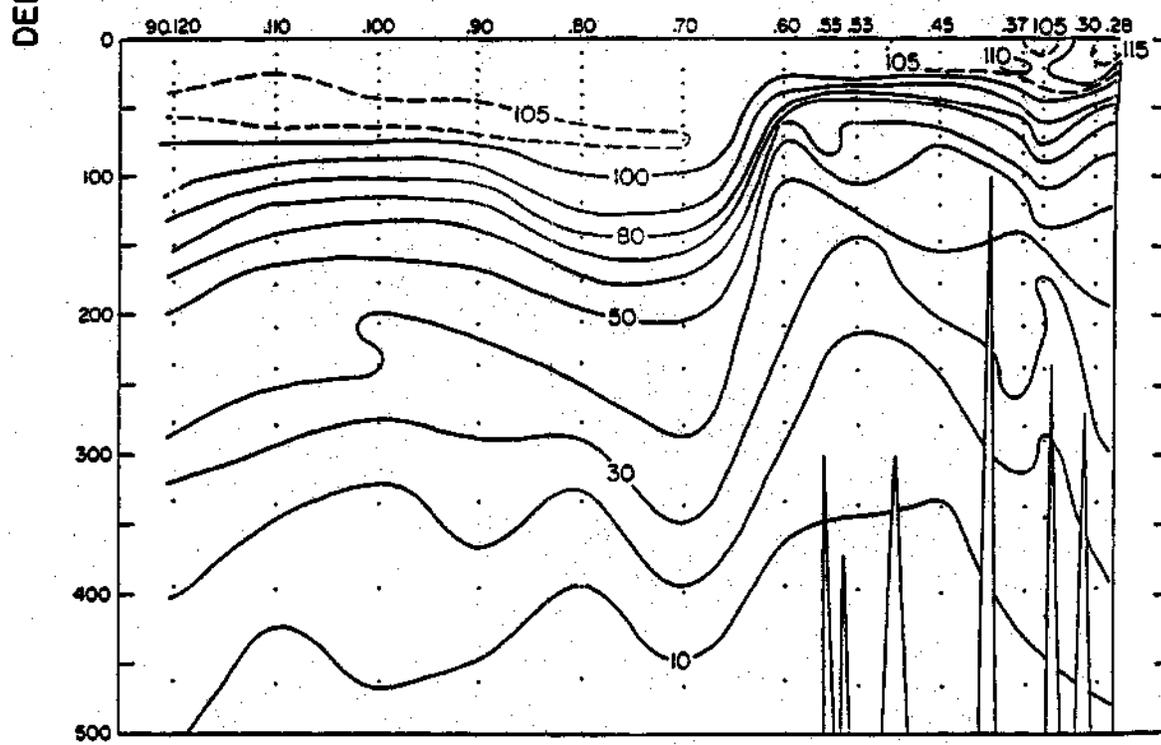


FIGURE 5H

CALCOFI CRUISE 9007

28-31 JULY 1990

OXYGEN (ml/l) ALONG CALCOFI LINE 90

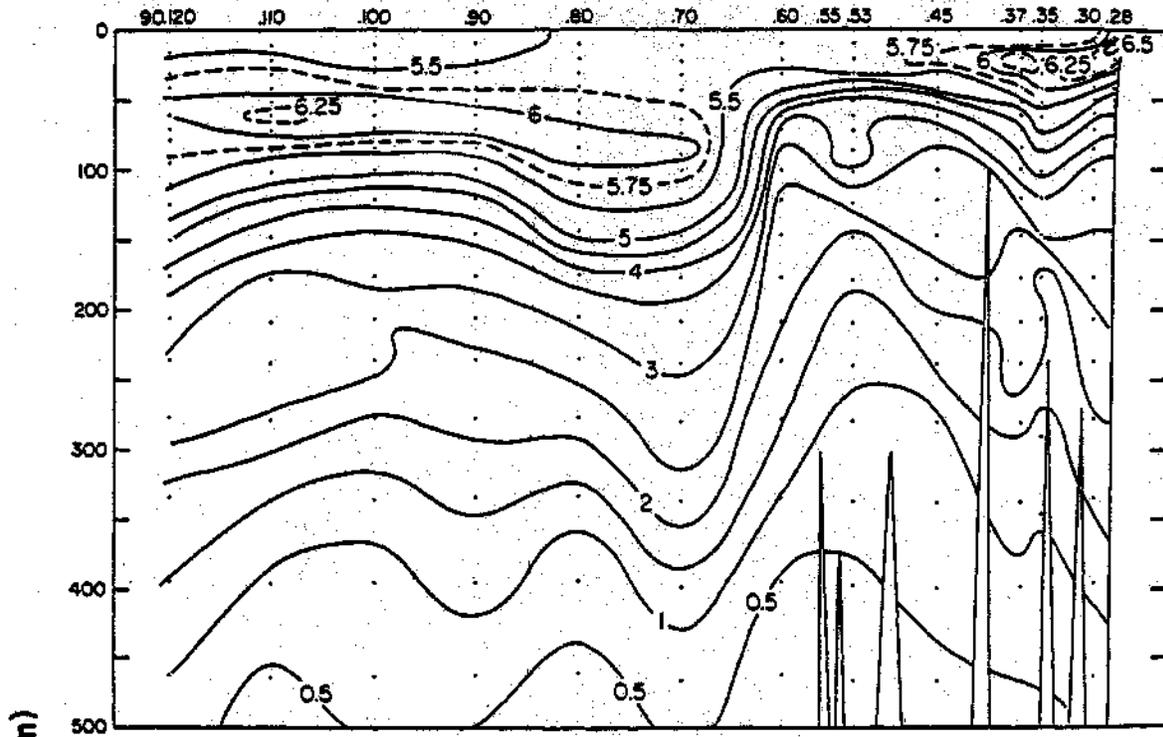


FIGURE 5I

NITRITE ($\mu\text{M/l}$) ALONG CALCOFI LINE 90

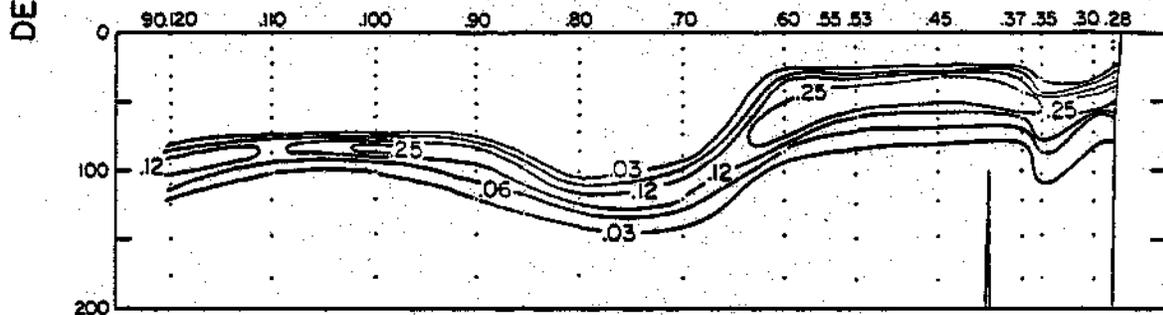


FIGURE 5J

PHAEOPIGMENTS ($\mu\text{g/l}$) ALONG CALCOFI LINE 90

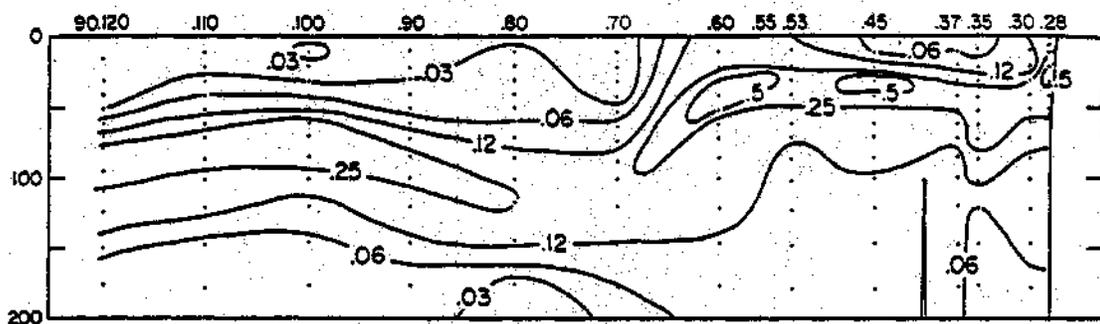


FIGURE 5K

RV NEW HORIZON

CALCOFI CRUISE 9007

STATION 80 51

Table with 18 columns: LATITUDE, LONGITUDE, DAY/MO/YR, MESSENGER, BOTTOM, WIND SPEED, WAVES, WEA, BAROMETER, DRY, WET, SECCHI/FOREL, CLD AMT, TYPE. Data for station 80 51 showing depth profiles from 2m to 62m.

RV NEW HORIZON

CALCOFI CRUISE 9007

STATION 80 55

Table with 18 columns: LATITUDE, LONGITUDE, DAY/MO/YR, MESSENGER, BOTTOM, WIND SPEED, WAVES, WEA, BAROMETER, DRY, WET, SECCHI/FOREL, CLD AMT, TYPE. Data for station 80 55 showing depth profiles from 1m to 533m.

RV NEW HORIZON

CALCOFI CRUISE 9007

STATION 80 60

Table with 18 columns: LATITUDE, LONGITUDE, DAY/MO/YR, MESSENGER, BOTTOM, WIND SPEED, WAVES, WEA, BAROMETER, DRY, WET, SECCHI/FOREL, CLD AMT, TYPE. Data for station 80 60 showing depth profiles from 1m to 534m.

RV NEW HORIZON

CALCOFI CRUISE 9007

STATION 80 90

Table with columns: LATITUDE, LONGITUDE, DAY/MO/YR, MESSENGER, BOTTOM, WIND SPEED, WAVES, WEA, BAROMETER, DRY, WET, SECCHI/FOREL, CLD AMT, TYPE. Includes a detailed data table for station 80 90 with sub-headers for CAST DEPTH, TEMP, POT TEMP, SALINITY, SIGMA, SVA, DYN HT, OXYGEN, OXY, SI03, P04, N03, N02, CHL-A, PHAE0, and PRESS.

RV NEW HORIZON

CALCOFI CRUISE 9007

STATION 80 100

Table with columns: LATITUDE, LONGITUDE, DAY/MO/YR, MESSENGER, BOTTOM, WIND SPEED, WAVES, WEA, BAROMETER, DRY, WET, SECCHI/FOREL, CLD AMT, TYPE. Includes a detailed data table for station 80 100 with sub-headers for CAST DEPTH, TEMP, POT TEMP, SALINITY, SIGMA, SVA, DYN HT, OXYGEN, OXY, SI03, P04, N03, N02, CHL-A, PHAE0, and PRESS.

Table with 18 columns: LATITUDE, LONGITUDE, DAY/MO/YR, MESSEKGER, BOTTOM, WIND SPEED, WAVES, WEA, BAROMETER, DRY, WET, SECCHI/FOREL, CLD AMT, TYPE. Includes a detailed 18-column data section for depth measurements from 0 to 533 meters.

Table with 18 columns: LATITUDE, LONGITUDE, DAY/MO/YR, MESSENGER, BOTTOM, WIND SPEED, WAVES, WEA, BAROMETER, DRY, WET, SECCHI/FOREL, CLD AMT, TYPE. Includes a detailed 18-column data section for depth measurements from 0 to 531 meters.

Table with 18 columns: LATITUDE, LONGITUDE, DAY/MO/YR, MESSENGER, BOTTOM, WIND SPEED, WAVES, WEA, BAROMETER, DRY, WET, SECCHI/FOREL, CLD AMT, TYPE. Includes a detailed 18-column data section for depth measurements from 0 to 52 meters.

RV NEK HORIZON

CALCOFI CRUISE 9007

STATION 87 IIO

Table with columns: LATITUDE, LONGITUDE, DAY/MO/YR, MESSENGER, BOTTOM, WIND SPEED, WAVES, WEA, BAROMETER, DRY, WET, SECCHI/FOREL, CLD AMT TYPE, CAST DEPTH, TEMP, POT TEMP, SALINITY, SIGMA, SVA, DYN HT, OXYGEN, OXY, SI03, P04, N03, N02, CHL-A, PHAE0, PRESS. Rows include depth from 0 to 536 meters.

RV NEW HORIZON

CALCOFI CRUISE 9007

STATION 90 28

Table with columns: LATITUDE, LONGITUDE, DAY/MO/YR, MESSENGER, BOTTOM, WIND SPEED, WAVES, WEA, BAROMETER, DRY, WET, SECCHI/FOREL, CLD AMT TYPE, CAST DEPTH, TEMP, POT TEMP, SALINITY, SIGMA, SVA, DYN HT, OXYGEN, OXY, SI03, P04, N03, N02, CHL-A, PHAE0, PRESS. Rows include depth from 0 to 55 meters.

RV NEW HORIZON

CALCOFI CRUISE 9007

STATION 90 30

Table with columns: LATITUDE, LONGITUDE, DAY/MO/YR, MESSENGER, BOTTOM, WIND SPEED, WAVES, WEA, BAROMETER, DRY, WET, SECCHI/FOREL, CLD AMT TYPE, CAST DEPTH, TEMP, POT TEMP, SALINITY, SIGMA, SVA, DYN HT, OXYGEN, OXY, SI03, P04, N03, N02, CHL-A, PHAE0, PRESS. Rows include depth from 0 to 534 meters.

RV NEW HORIZON

CALCOFI CRUISE 9007

STATION 90 120

Table with 18 columns: LATITUDE, LONGITUDE, DAY/MO/YR, MESSENGER, BOTTOM, WIND SPEED, WAVES, WEA, BAROMETER, DRY, WET, SECCHI/FOREL, CLD AMT, TYPE. Contains depth profile data from 0 to 533 meters.

RV NEW HORIZON

CALCOFI CRUISE 9007

STATION 93 26.7

Table with 18 columns: LATITUDE, LONGITUDE, DAY/MO/YR, MESSENGER, BOTTOM, WIND SPEED, WAVES, WEA, BAROMETER, DRY, WET, SECCHI/FOREL, CLD AMT, TYPE. Contains depth profile data from 0 to 64 meters.

RV NEW HORIZON

CALCOFI CRUISE 9007

STATION 93 28

Table with 18 columns: LATITUDE, LONGITUDE, DAY/MO/YR, MESSENGER, BOTTOM, WIND SPEED, WAVES, WEA, BAROMETER, DRY, WET, SECCHI/FOREL, CLD AMT, TYPE. Contains depth profile data from 0 to 538 meters.

FIGURES

Cruise 9011

1. CalCOFI Cruise 9011, track and station positions.
2. Horizontal distribution of dynamic height anomaly (0 over 500 m). In areas shallower than 500 m, the dynamic heights were extrapolated on the basis of the offshore deeper steric height as described in Reid and Mantyla (1976).
3. Horizontal distributions at 10 meters: A) chlorophyll-a; B) potential density; C) temperature; and D) salinity.
4. Horizontal distributions at 200 meters: A) dynamic height anomaly (200 over 500 m); B) potential density; C) temperature; and D) salinity.
5. Sections along CalCOFI line 90 (vertical exaggeration, 1000): A) potential density; B) temperature; C) salinity; D) silicate; E) nitrate; F) phosphate; G) chlorophyll-a; H) oxygen saturation; I) oxygen; J) nitrite; and K) phaeopigments.

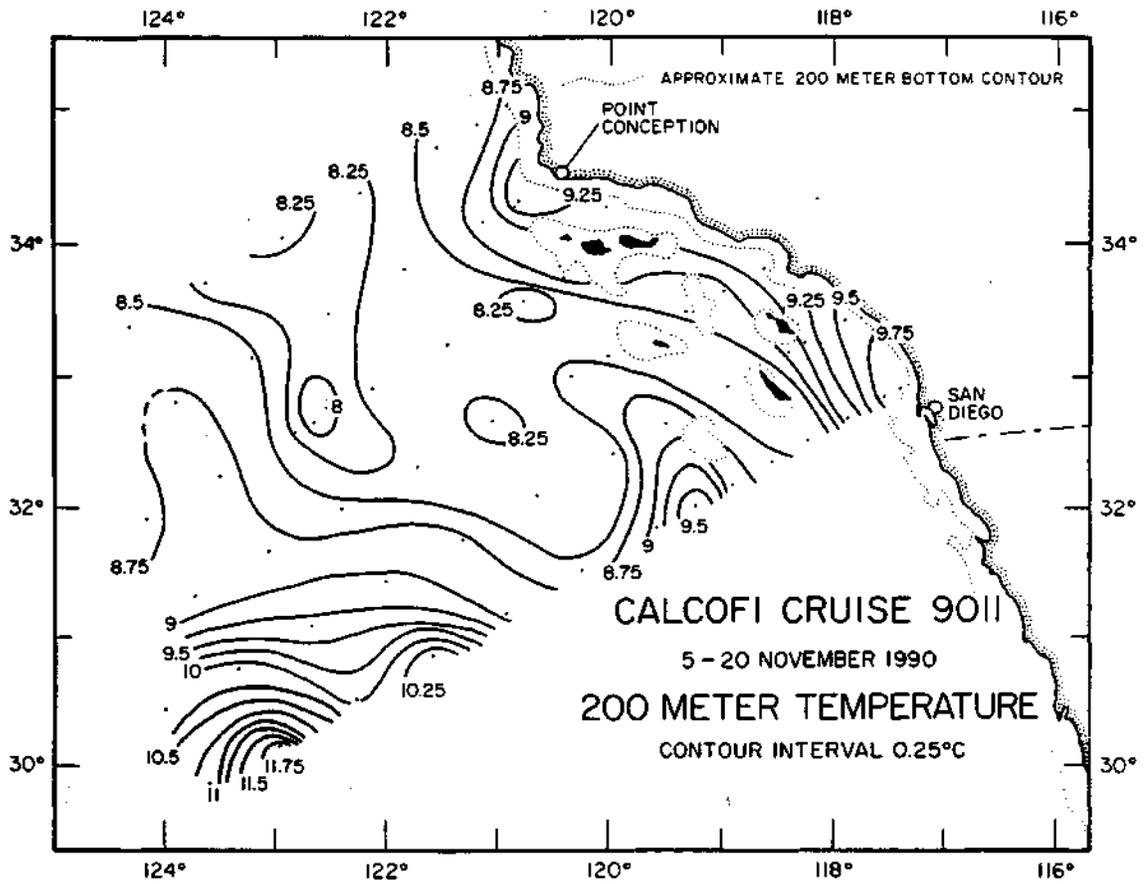


FIGURE 4C

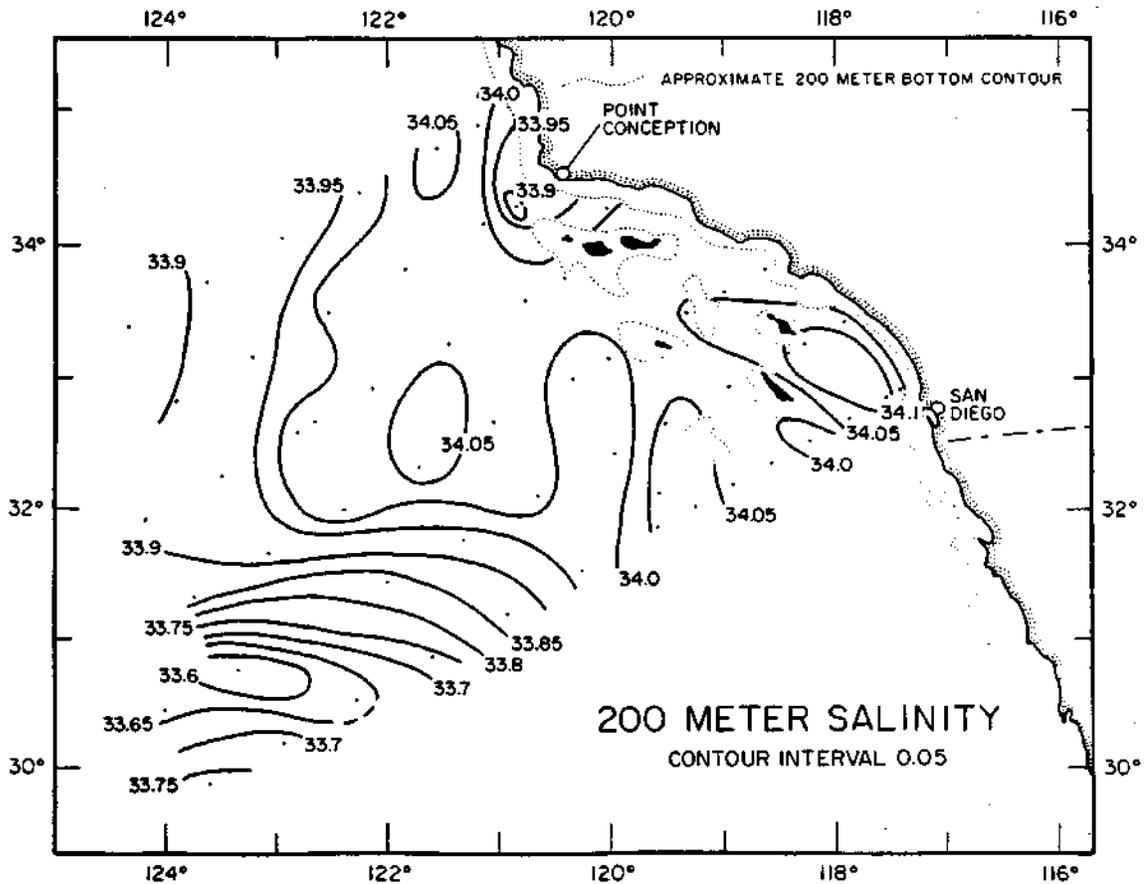


FIGURE 4D

CALCOFI CRUISE 9011

8 - 11 NOVEMBER 1990

POTENTIAL DENSITY (σ_θ) ALONG CALCOFI LINE 90

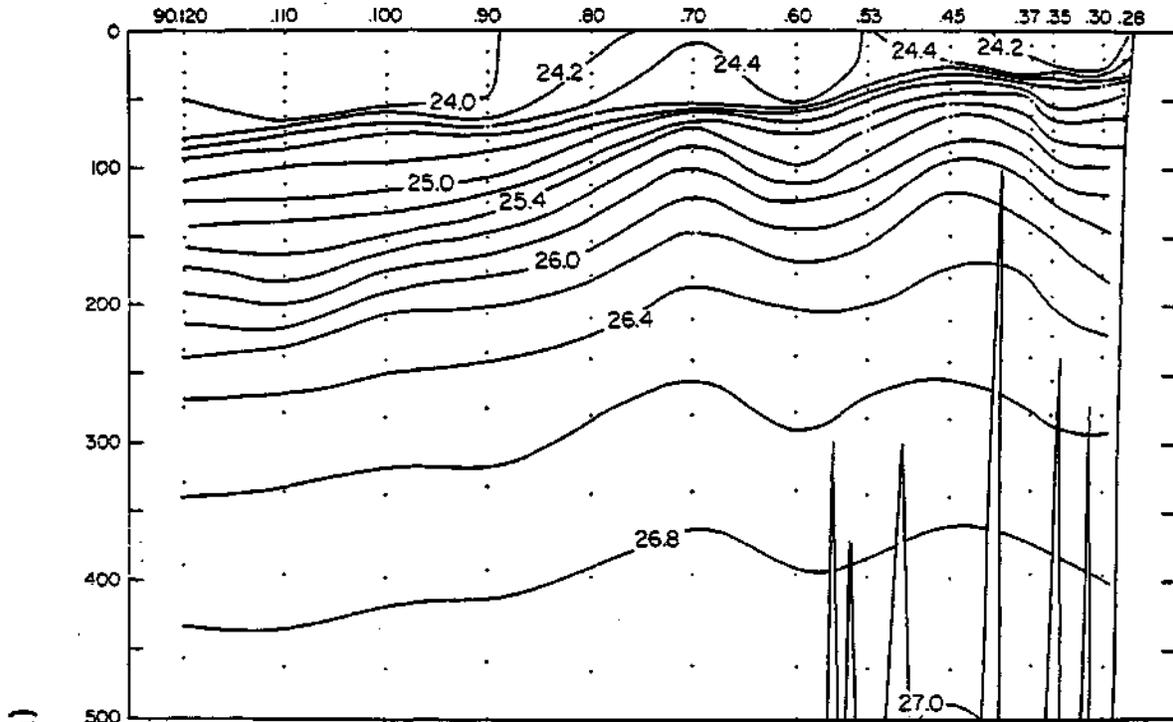


FIGURE 5A

TEMPERATURE (°C) ALONG CALCOFI LINE 90

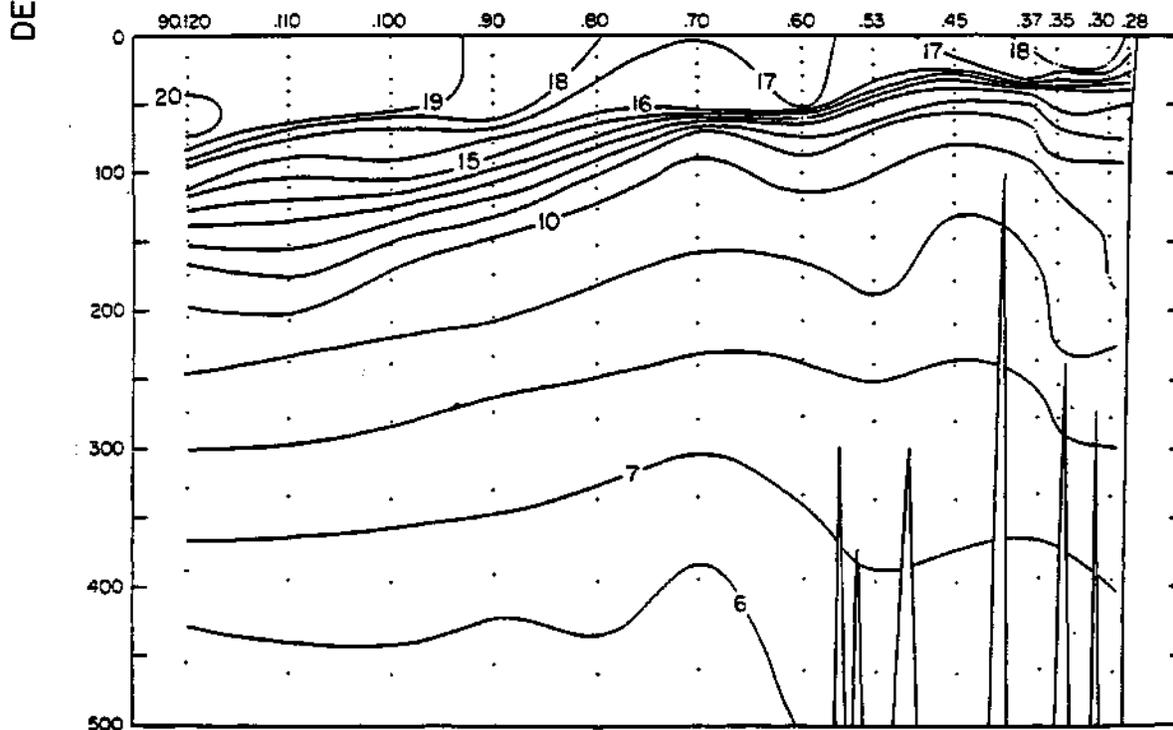


FIGURE 5B

CALCOFI CRUISE 9011

8-11 NOVEMBER 1990

SALINITY ALONG CALCOFI LINE 90

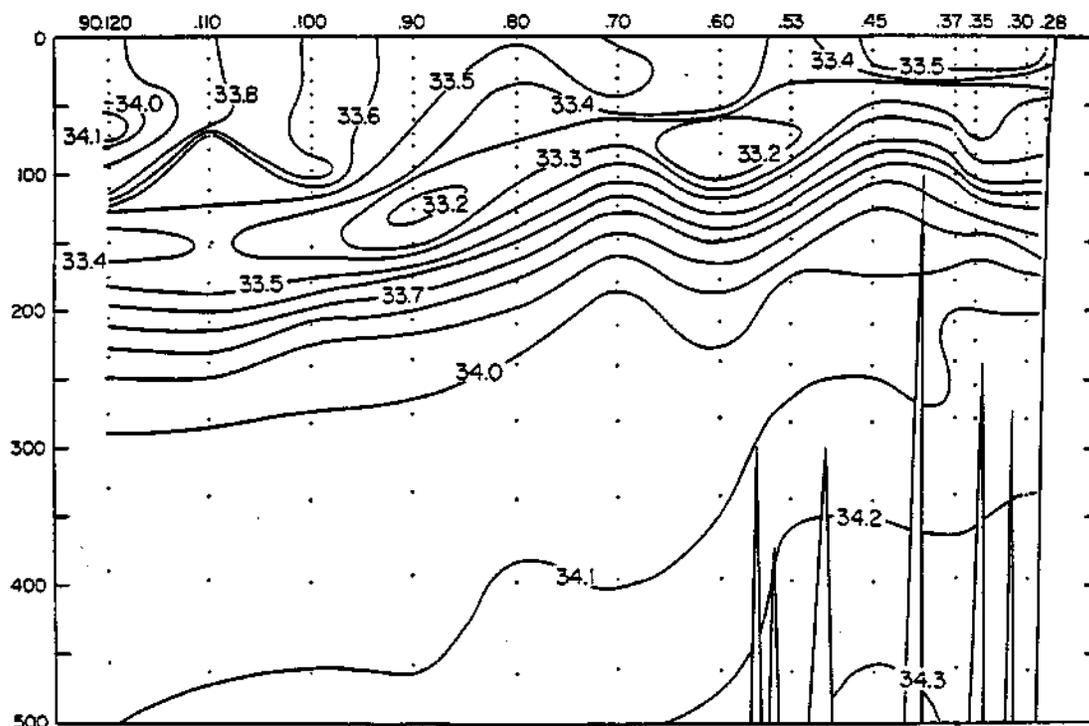


FIGURE 5C

SILICATE ($\mu\text{M/l}$) ALONG CALCOFI LINE 90

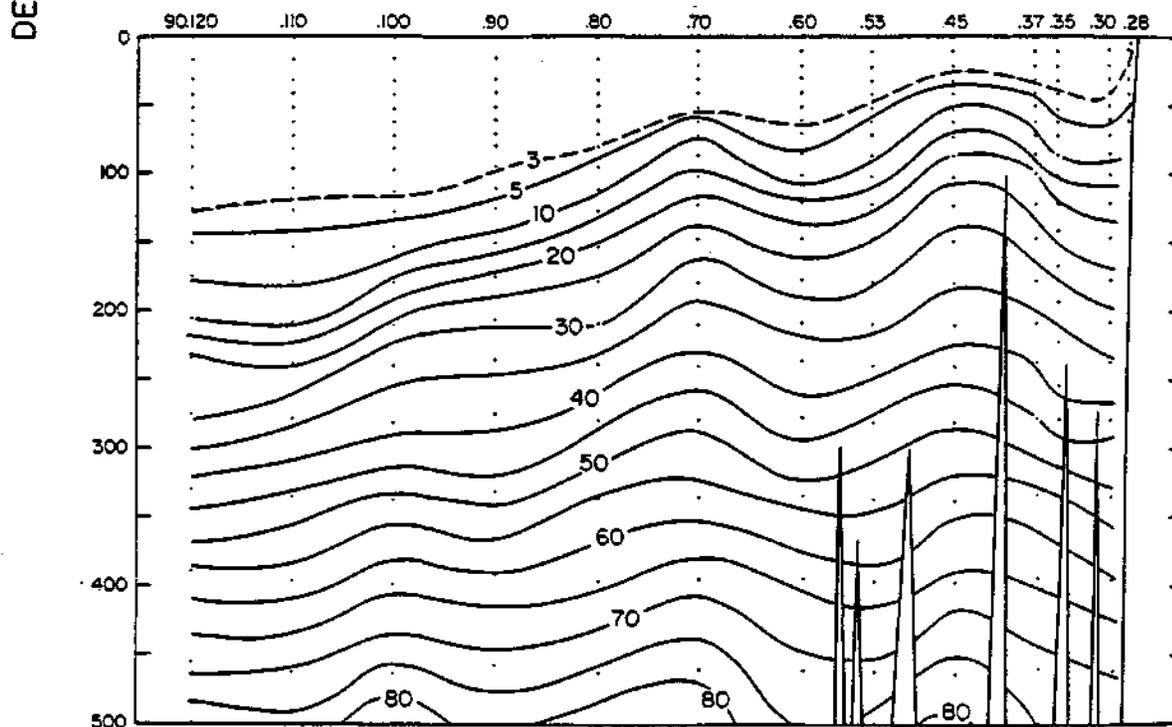


FIGURE 5D

CALCOFI CRUISE 9011
8-11 NOVEMBER 1990

NITRATE ($\mu\text{M/l}$) ALONG CALCOFI LINE 90

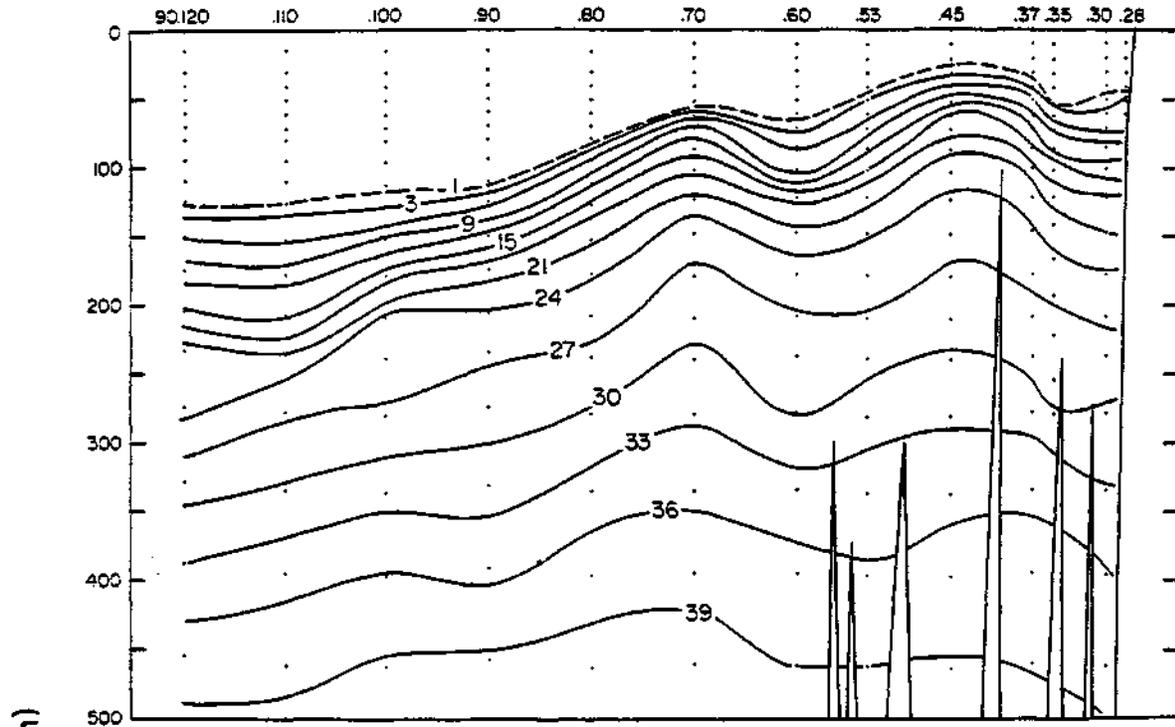


FIGURE 5E

PHOSPHATE ($\mu\text{M/l}$) ALONG CALCOFI LINE 90

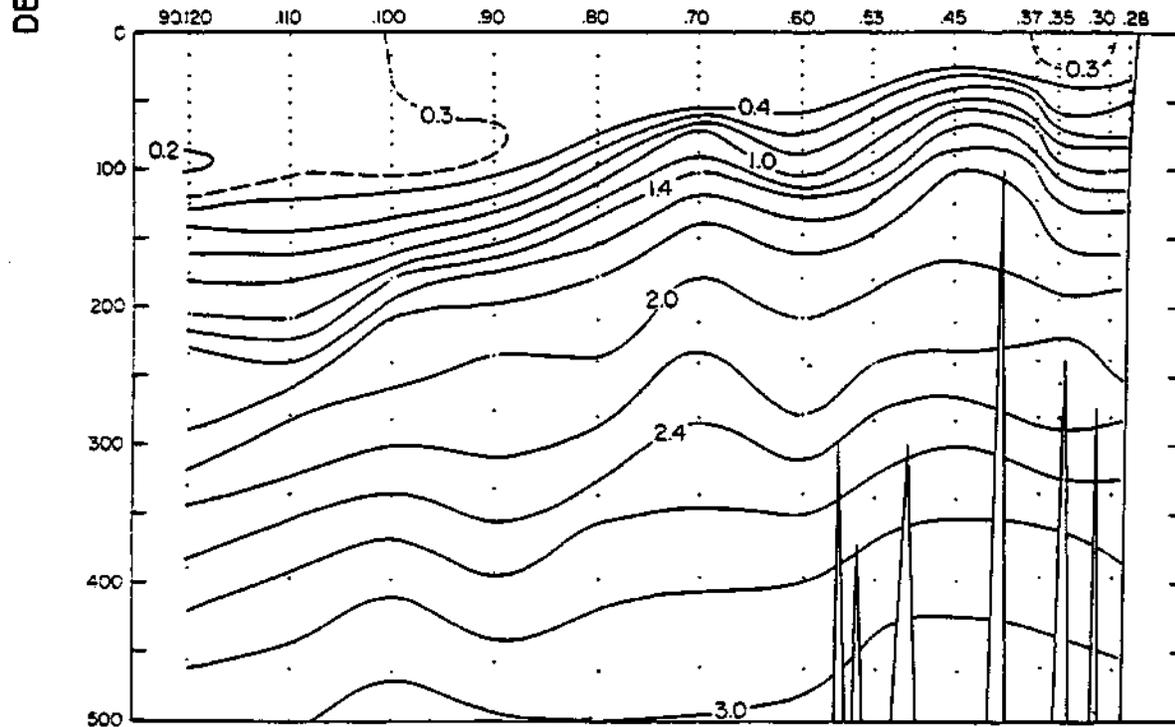


FIGURE 5F

CALCOFI CRUISE 9011
8-11 NOVEMBER 1990

CHLOROPHYLL-a ($\mu\text{g/l}$) ALONG CALCOFI LINE 90

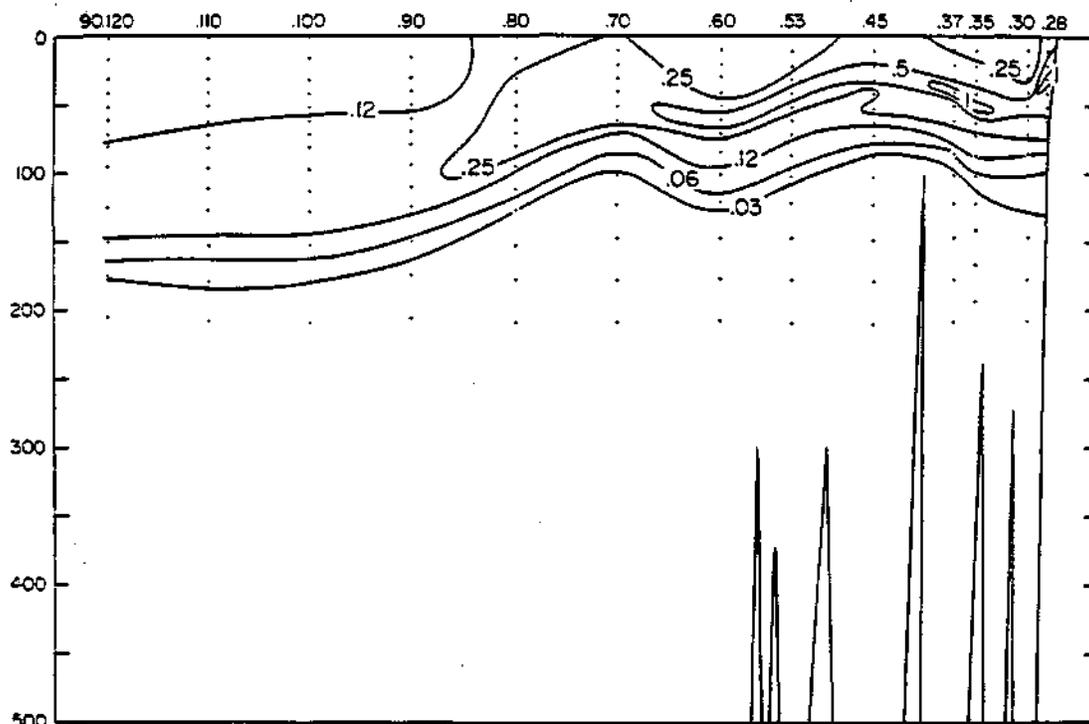


FIGURE 5G

DEPTH (m)

OXYGEN SATURATION (%) ALONG CALCOFI LINE 90

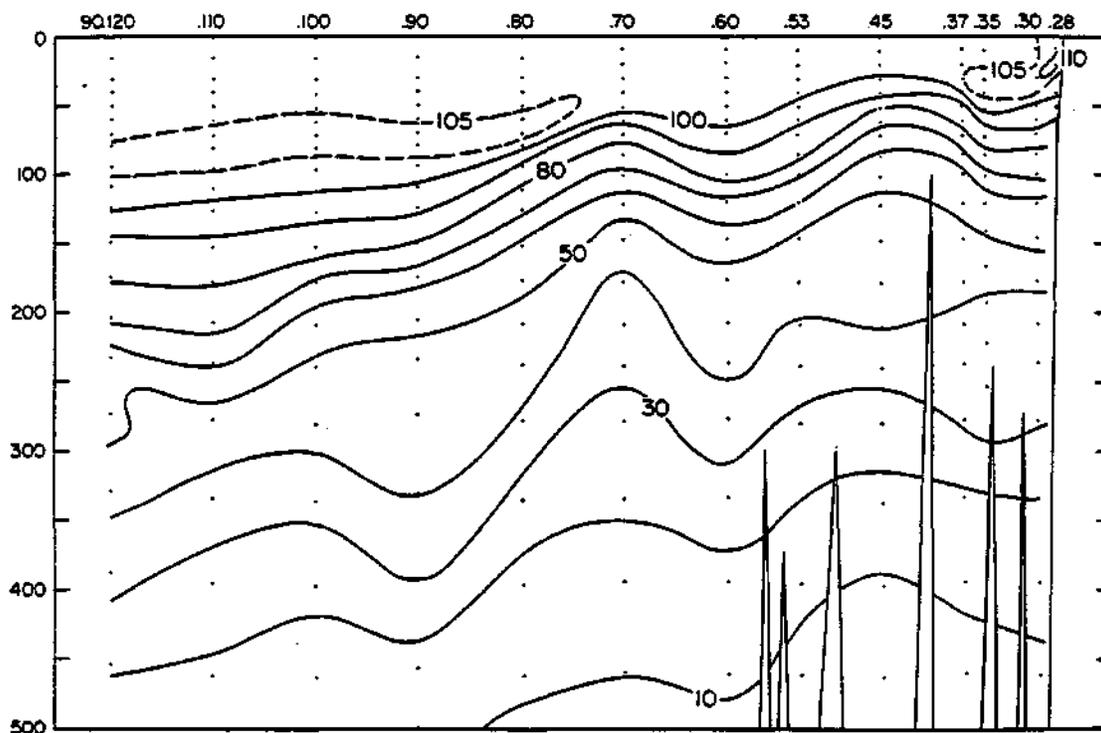


FIGURE 5H

PERSONNEL

CaLCOFI Cruise 9011

SHIP'S CAPTAIN

Eric C. Buck, *RV New Horizon*

PERSONNEL PARTICIPATING IN THE COLLECTION OF DATA

Venrick, Elizabeth L. (Chief Scientist)	Research Oceanographer, SIO
Abramenkoff, Dimitry N.	Fishery Biologist, N M F S
Casal, Elizabeth H.	Staff Volunteer, SIO
Costello, James P.	Staff Research Associate, SIO
Cynar, Skip J.	Graduate Student, SIO
Dunn, Jon L.	Tour Director, WINGS, Inc.
Gripp, Sherry L.	Staff Research Associate, SIO
Gruber, Dennis W.	Marine Technician, SIO
Manion, Susan M.	Fishery Biologist, N M F S
Muus, David A.	Staff Research Associate, SIO
Renger, Edward H.	Staff Research Associate, SIO
Schweizer, Dominik P.	Staff Volunteer, SIO
Wilkinson, James R.	Staff Research Associate, SIO

Table with 14 columns: LATITUDE, LONGITUDE, DAY/MO/YR, MESSENGER, BOTTOM, WIND SPEED, WAVES, WEA, BAROMETER, DRY, WET, SECCHI/FOREL, CLD, AMT, TYPE. Contains 57 data rows for Station 83 60.

Table with 14 columns: LATITUDE, LONGITUDE, DAY/MO/YR, MESSENGER, BOTTOM, WIND SPEED, WAVES, WEA, BAROMETER, DRY, WET, SECCHI/FOREL, CLD, AMT, TYPE. Contains 57 data rows for Station 83 70.

