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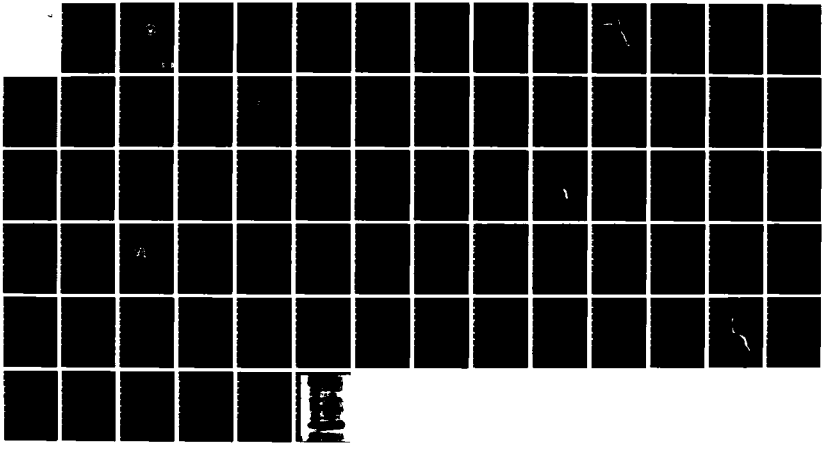

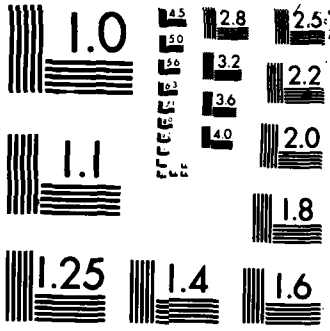

NPS68-84-002

# NAVAL POSTGRADUATE SCHOOL

## Monterey, California

HYDROGRAPHIC DATA FROM THE OPTOMA PROGRAM
OPTOMA2, LEGS I AND II
31 JULY - 14 AUGUST, 1982.

by

Michele M. Rienecker
Christopher N.K. Mooers
Marie C. Colton
Paul A. Wittmann

March 1984



Prepared for:
Office of Naval Research
Environmental Sciences Directorate (Code 420)
Arlington, VA 22217.

NAVAL POSTGRADUATE SCHOOL

Monterey, California 93943

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This report is for the research project "Ocean Prediction Through Observations, Modeling and Analysis" sponsored by the Physical Oceanography Program of the Office of Naval Research under Program Element 61153N.


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Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

| REPORT DOCUMENTATION PAGE | | READ INSTRUCTIONS BEFORE COMPLETING FORM |
|---|---|---|
| 1. REPORT NUMBER<br>NPS68-84-002 | 2. GOVT ACCESSION NO.<br>AD-A141547 | 3. RECIPIENT'S CATALOG NUMBER |
| 4. TITLE (and Subtitle)<br>HYDROGRAPHIC DATA FROM THE OPTOMA PROGRAM. OPTOMA2, LEGS I AND II, 31 JULY - 14 AUGUST, 1982 | | 5. TYPE OF REPORT & PERIOD COVERED<br>Report for October 1982 to March 1984.<br>6. PERFORMING ORG. REPORT NUMBER |
| 7. AUTHOR(s)<br>Michele M. Rienecker, Christopher N.K. Mooers<br>Marie C. Colton, Paul A. Wittmann | | 8. CONTRACT OR GRANT NUMBER(s) |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS<br>Naval Postgraduate School<br>Monterey, CA 93943. | | 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS<br>61153N<br>N0001484WR24051 |
| 11. CONTROLLING OFFICE NAME AND ADDRESS<br>Office of Naval Research (Code 420)<br>Arlington VA 22217. | | 12. REPORT DATE<br>March 1984.<br>13. NUMBER OF PAGES<br>65 |
| 14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) | | 15. SECURITY CLASS. (of this report)<br>Unclassified<br>15a. DECLASSIFICATION/DOWNGRADING SCHEDULE |

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

California Current System
Physical oceanography
Dynamic oceanography

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The cruise OPTOMA2 was undertaken in August, 1982 to sample a subdomain of the California Current System. This report presents the hydrographic data, acquired by XBT and CTD casts, from the cruise.

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S/N 0102-LF-014-6601

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

# *Hydrographic Data from the* **OPTOMA** *Program: OPTOMA2, Legs I and II*

***31 July - 14 August, 1982***





*by*

*Michele M. Rienecker*
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**The OPTOMA Program is a joint program of**

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TABLE OF CONTENTS


| | PAGE |
|---|---|
| LIST OF FIGURES | ii |
| INTRODUCTION | 2 |
| DATA ACQUISITION | 2 |
| DATA PROCESSING | 3 |
| DATA PRESENTATION | 4 |
| SECTION 1: LEG I | 6 |
| SECTION 2: LEG II | 32 |
| ACKNOWLEDGEMENTS | 63 |
| REFERENCES | 63 |
| INITIAL DISTRIBUTION LIST | 64 |

LIST OF FIGURES


| Figure No. | Caption | Page |
|---|---|---|
| 1. | The NOCAL and CENCAL subdomains of the OPTOMA Program. Isobaths are shown in meters. | 1 |
| 2. | Cruise track for OPTOMA2, Leg I with transect extremes identified by letter. | 7 |
| 3. | XBT and CTD locations for OPTOMA2, Leg I. | 8 |
| 4. | Station numbers for OPTOMA2, Leg I. | 9 |
| 5 (a)-(f). | Staggered temperature profiles from the XBT's. Profiles are staggered by a multiple of 5C. (OPTOMA2, Leg I). | 13 |
| 6 (a)-(c). | Temperature profiles, staggered by multiples of 5C, and salinity profiles staggered by multiples of 4 ppt. (OPTOMA2, Leg I). | 19 |
| 7 (a)-(d). | Isotherms from XBT's and CTD's. Tick marks along the horizontal axis show station positions. Some station numbers are shown. Arrows indicate the positions where the cruise track changed direction. (OPTOMA2, Leg I). | 22 |
| 8 (a)-(b). | Isopleths of temperature, salinity and sigma-t from the CTD's. (OPTOMA2, Leg I). | 26 |
| 9. | T-S pairs from the CTD casts for OPTOMA2, Leg I. | 28 |
| 10. | Profiles of $\overline{T(z)}$ with + and - the standard deviation from (a) XBT's and CTD's and (b) CTD's only. (OPTOMA2, Leg I). | 29 |
| 11. | Profiles of (a) mean salinity and (b) mean sigma-t, with + and - the standard deviations, from the CTD's. (OPTOMA2, Leg I). | 30 |
| 12. | Profiles of $\overline{N^2(z)}$ (——), with + and - the standard deviation (----) and the profile of $N^2$ from $\overline{T(z)}$ and $\overline{S(z)}$ (.....). (OPTOMA2, Leg I). | 31 |
| 13. | Cruise track for OPTOMA2, Leg II with transect extremes identified by letter. | 33 |

| Figure No. | Caption | Page |
|---|---|---|
| 14. | XBT and CTD locations for OPTOMA2, Leg II. | 34 |
| 15. | Station numbers for OPTOMA2, Leg II. | 35 |
| 16 (a)-(g). | Staggered temperature profiles from the XBT's. Profiles are staggered by a multiple of 5C. (OPTOMA2, Leg II). | 40 |
| 17 (a)-(e). | Temperature profiles, staggered by multiples of 5C, and salinity profiles staggered by multiples of 4 ppt. (OPTOMA2, Leg II). | 47 |
| 18 (a)-(d). | Isotherms from XBT's and CTD's. Tick marks along the horizontal axis show station positions. Some station numbers are shown. Arrows indicate the positions where the cruise track changed direction. (OPTOMA2, Leg II). | 52 |
| 19 (a)-(c). | Isopleths of temperature, salinity and sigma-t from the CTD's. (OPTOMA2, Leg II). | 56 |
| 20. | T-S pairs from the CTD casts for OPTOMA2, Leg II. | 59 |
| 21. | Profiles of $\overline{T(z)}$ with + and - the standard deviation from (a) XBT's and CTD's and (b) CTD's only. (OPTOMA2, Leg II). | 60 |
| 22. | Profiles of (a) mean salinity and (b) mean sigma-t, with + and - the standard deviations, from the CTD's. (OPTOMA2, Leg II). | 61 |
| 23. | Profiles of $\overline{N^2(z)}$ (———), with + and - the standard deviation (-----), and the profile of $N^2$ from $\overline{T(z)}$ and $\overline{S(z)}$ (.....). (OPTOMA2, Leg II). | 62 |

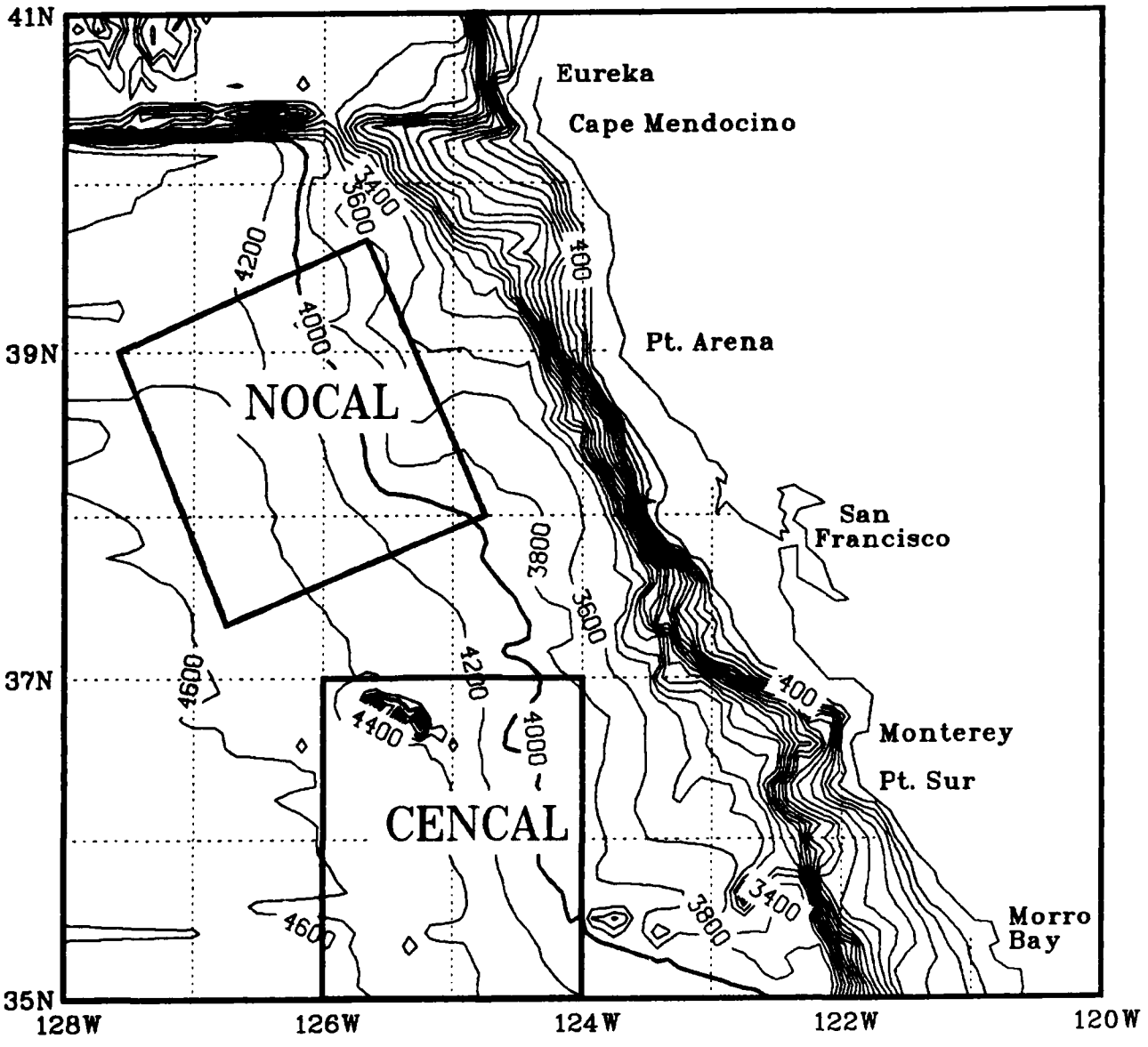



Figure 1: The NOCAL and CENCAL subdomains of the OPTOMA Program. Isobaths are shown in meters.

## INTRODUCTION

The OPTOMA (Ocean Prediction Through Observations, Modeling and Analysis) Program, a joint NPS/Harvard program sponsored by ONR, seeks to understand the mesoscale (fronts, eddies, and jets) variability and dynamics of the California Current System and to determine the scientific limits to practical mesoscale ocean forecasting. To help carry out the aims of this project, a series of cruises has been planned in two subdomains, NOCAL and CENCAL, shown in Figure 1.

The cruise OPTOMA2 was undertaken, in the R/V ACANIA, for two weeks in August, 1982 and covered part of the NOCAL domain which is roughly 200 km square centered 150 km off the California coast.

Hydrographic data were acquired during two legs: Leg I was carried out during the period 31 July to 5 August and sampled an area 130 km cross-shore by 190 km alongshore with additional transects to and from the domain as shown in Figure 2. The transect extremes are identified by letter to aid in the cross-referencing of data presented in subsequent figures. Leg II was carried out during the period 8 to 14 August and sampled an area roughly 150 km cross-shore by 100 km alongshore as shown in Figure 13. Each leg consisted of a series of parallel transects directed alongshore, separated by roughly 45 km and along which hydrographic stations were occupied every 8.8 km. In addition, there were diagonal transects and tracks to and from the domain.

## DATA ACQUISITION

Data acquired during OPTOMA2 include XBT and CTD profiles and continuous 2 m thermalsalinograph measurements. Bucket surface temperature and water samples for salinity were taken at every CTD station. These surface values and those at 2 m were used for calibration purposes as well as contributions to the data base. Continuous meteorological data such as atmospheric pressure at a height of 2 m and wind speed and direction at a height of 20 m were also recorded. The XBT, CTD and continuous "underway" data were digitized using an

HP 5328 frequency counter and a 40 channel digital voltmeter. The continuous data were averaged over one-minute intervals. All data were recorded, using an HP 9835 computer, on data cassettes and transferred ashore to the IBM 3033 mainframe computer for editing and processing.

Station positions were determined by Loran C fixes and are claimed to be accurate to within about 0.1 km. The probe on the Sippican Expendable Bathythermograph (XBT) has an accuracy of ±0.2C in temperature and ±2% or 4.6 m (whichever is greater) in depth. The Neil Brown Instrument Mark IIIb conductivity - temperature - depth (CTD) sensors have an accuracy of ±0.005 mmho, ±0.005C, and ±1.6db, respectively. The 2 m underway sensors are from SEA-BIRD Electronics. The temperature sensor, a glass coated thermistor bead, has an accuracy of ±0.003C; the conductivity sensor, a two-terminal flow-through electrode cell, has an accuracy of of ±0.003 mmho/cm. The bottle surface salinity samples were determined ashore by a Guildline Model 8400 "Autosal" salinometer with an accuracy of ±0.003 ppt. The Table on page 6 summarizes the various sensors available on the R/V ACANIA and their accuracy.

## DATA PROCESSING

Data processing, such as estimating depth profiles for the XBT temperature profiles based on the XBT's descent speed, and conversion of CTD conductivity to salinity using the algorithm given in Lewis and Perkin (1981), was carried out on the IBM 3033 at the Naval Postgraduate School. The data were then edited by removing obvious salinity spikes and eliminating cast failures that were not identified during the cruise. Approximately 91% of casts were retained in the data set. The CTD salinity profiles were corrected by reference to the 2 m salinity and surface salinity measurements. The surface salinities from the CTD casts up to Station 110 were too high on average by 0.17 ppt; hence they were adjusted accordingly. Thereafter, the offset was random and the average difference between sensors was only 0.02 ppt; hence, no correction was made. The CTD data were interpolated to 5 m intervals and then up and down casts were averaged.

The data have been transferred on digital tape to the National Oceanographic Data Center in Washington, DC.

## DATA PRESENTATION

The cruise track, station locations (with XBT's and CTD's identified) and station numbers are shown in the first three figures of each of the next two sections, which present the data from Leg I and Leg II, respectively. These figures are followed by a listing of the stations, with their coordinates, the date and time at which the station was occupied, and the surface information obtained at the station.

Vertical profiles of temperature from the XBT casts are shown in staggered fashion. The location of these profiles may be found by reference to the various maps of the cruise track. Transect extremes are identified as nearly as possible. The first profile on each plot is shown with its temperature unchanged; to each subsequent profile an appropriate multiple of 5C has been added. Vertical profiles from the CTD's follow. Profiles of temperature are staggered by 5C and those of salinity by 4 ppt.

Isotherms for each transect are shown in the next pages, followed by isopleths of temperature, salinity and sigma-t from the CTD's. Based on instrument accuracy and the vertical temperature gradient, it is estimated that the depth of isotherms in the main thermocline are uncertain to $\pm$20m. The tick marks identify station positions and, again, the transect extremes are shown on these plots. In each section, the data presentation concludes with a scatter diagram of T-S pairs, plots of mean and $\pm$ standard deviation on profiles of temperature from XBT's and CTD's and temperature, salinity and sigma-t from the CTD's, and a plot of the mean and $\pm$ standard deviation profiles of $N^2$ (Brunt-Vaisala frequency squared). On the sigma-t and $N^2$ plots, the appropriate profiles derived from the mean temperature and mean salinity profiles are also shown, but these are barely distinguishable from the mean profiles themselves.

## SCIENTIFIC INSTRUMENTS ABOARD THE R/V ACANIA

| Instrument | Variable | Sensor | Accuracy | Resolution |
|---|---|---|---|---|
| Neil Brown CTD Mark IIIb | pressure | strain gage | 1.6 db | 0.025 db |
| | temperature | thermistor | 0.005 C | 0.0005 C |
| | conductivity | electrode cell | 0.005 mmho | 0.001 mmho |
| Sippican BT | temperature | thermistor | 0.2 C | |
| | depth | descent speed | max. of 4.6 m and 2% of depth | |
| Guildline Autosal | conductivity | electrode cell | 0.003 ppt | 0.0002 ppt |
| *Amatek Straza ADVP | velocity profiles to 100m | 4 beam sonar | 3 cm/sec relative to ship speed | 3 cm/sec |
| *Rosemount Sensor | sea surface temperature | platinum thermometer | 0.05 C | 0.005 C |
| Sea-Bird Sensors | temperature | thermistor | 0.003 C | 0.0005 C |
| | conductivity at 2 meters | electrode cell | 0.003 mmho | 0.0005 mmho |
| Rosemount Sensor | air temperature | thermometer | 0.01 C | |
| Kavolico Barometer | atmospheric pressure | pressure transducer | 1.5 mb | 0.1 mb |
| *1200 EPS Hygrometer | dew point | condensation temp. sensor | 0.2 C | 0.02 C |
| Meteorology Res. Inc. | wind speed | anemometer | 0.15 mph or 1% | |
| Meteorology Res. Inc. | wind direction | vane | 2.5 degrees | |
| Internav LC408 LORAN C | position | two chain LORAN receiver | 100 meters | 10 meters |
| Motorola Miniranger | position | microwave transponders | 4 meters | 2 meters |

* Not operating on the OPTOMA2 cruise.

# SECTION 1

## OPTOMA2 - LEG I

## 31 JULY to 5 AUGUST 1982

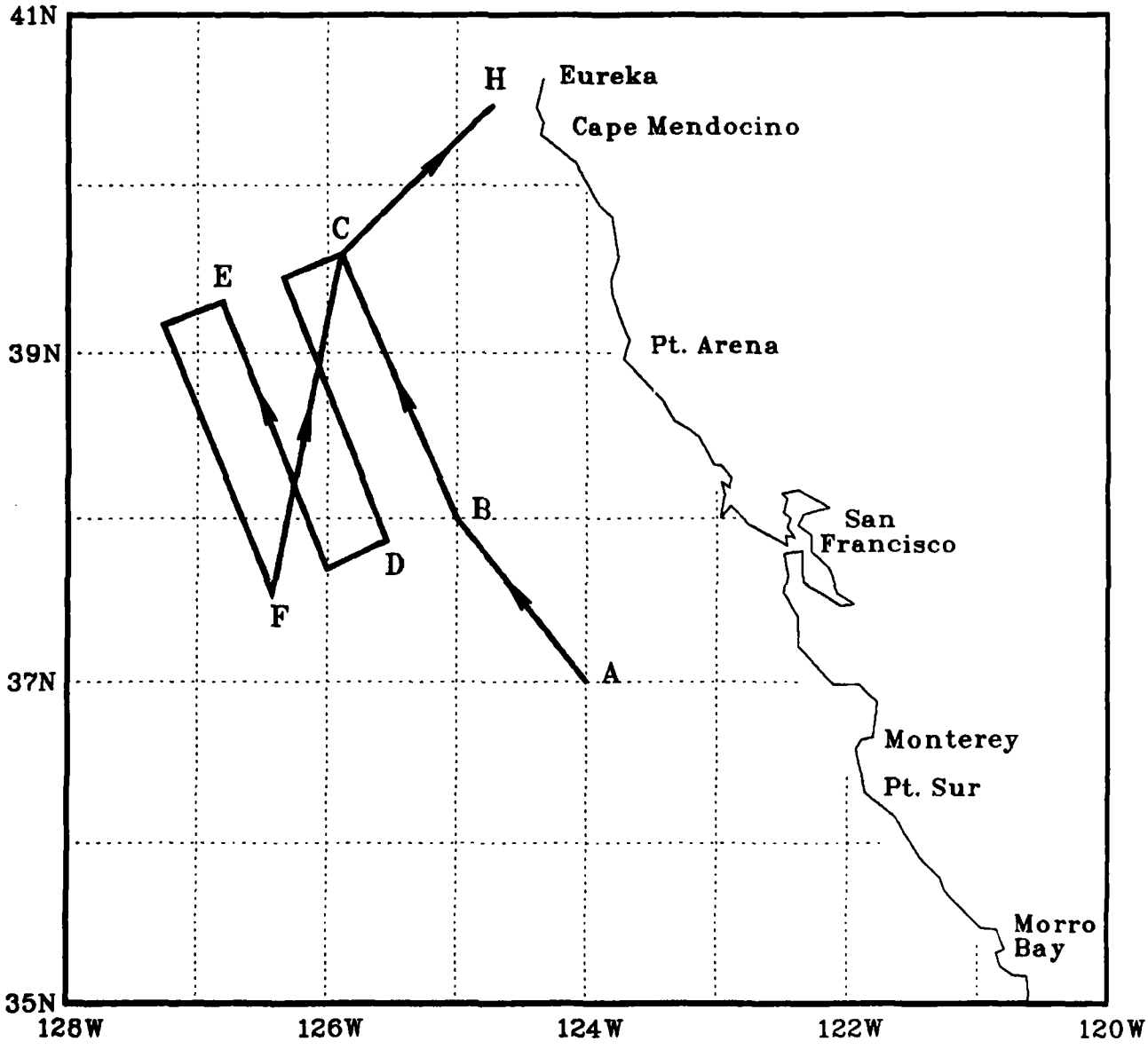



Figure 2: Cruise track for OPTOMA2, Leg I with transect extremes identified by letter.

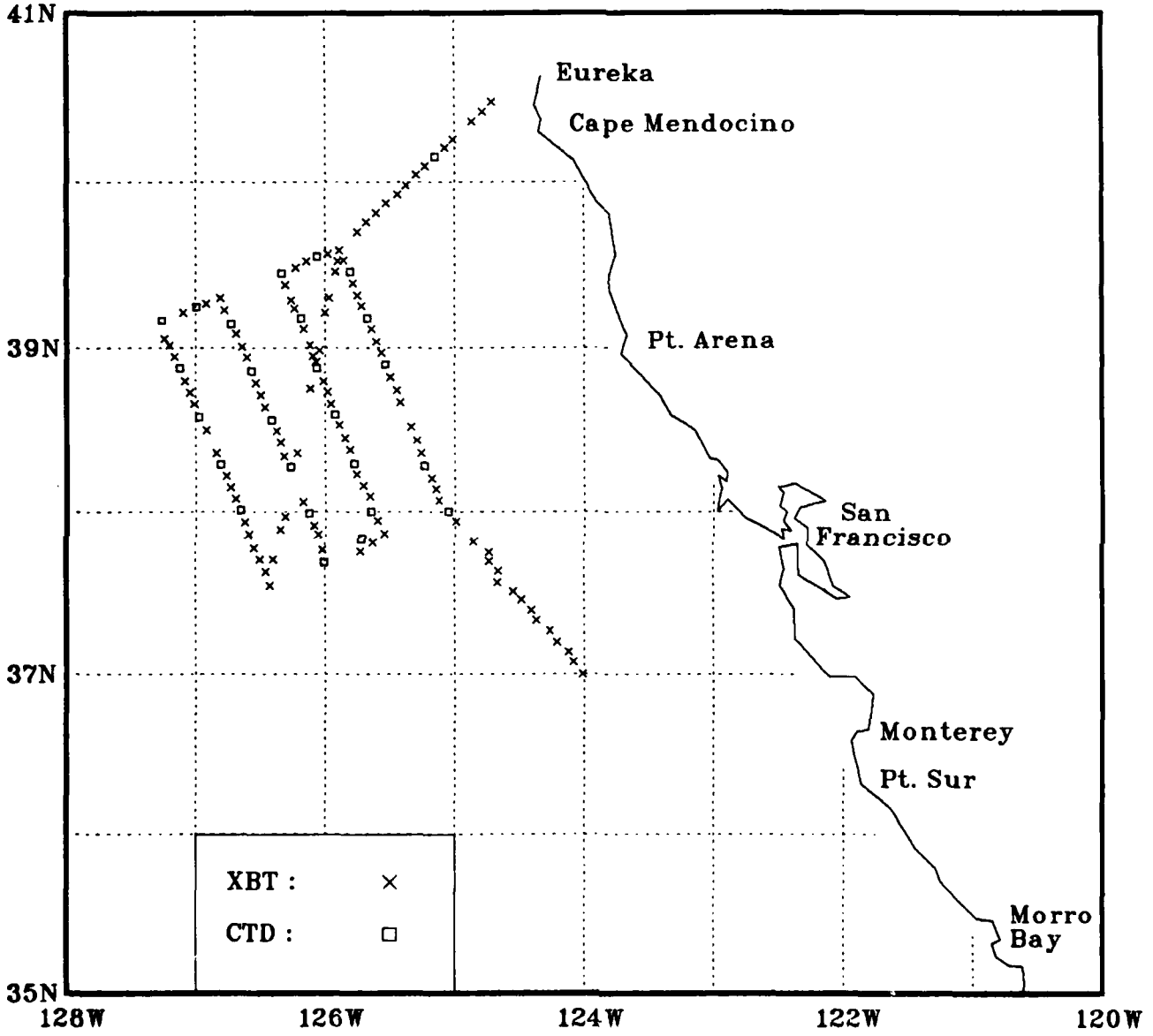



Figure 3: XBT and CTD locations for OPTOMA2, Leg I.

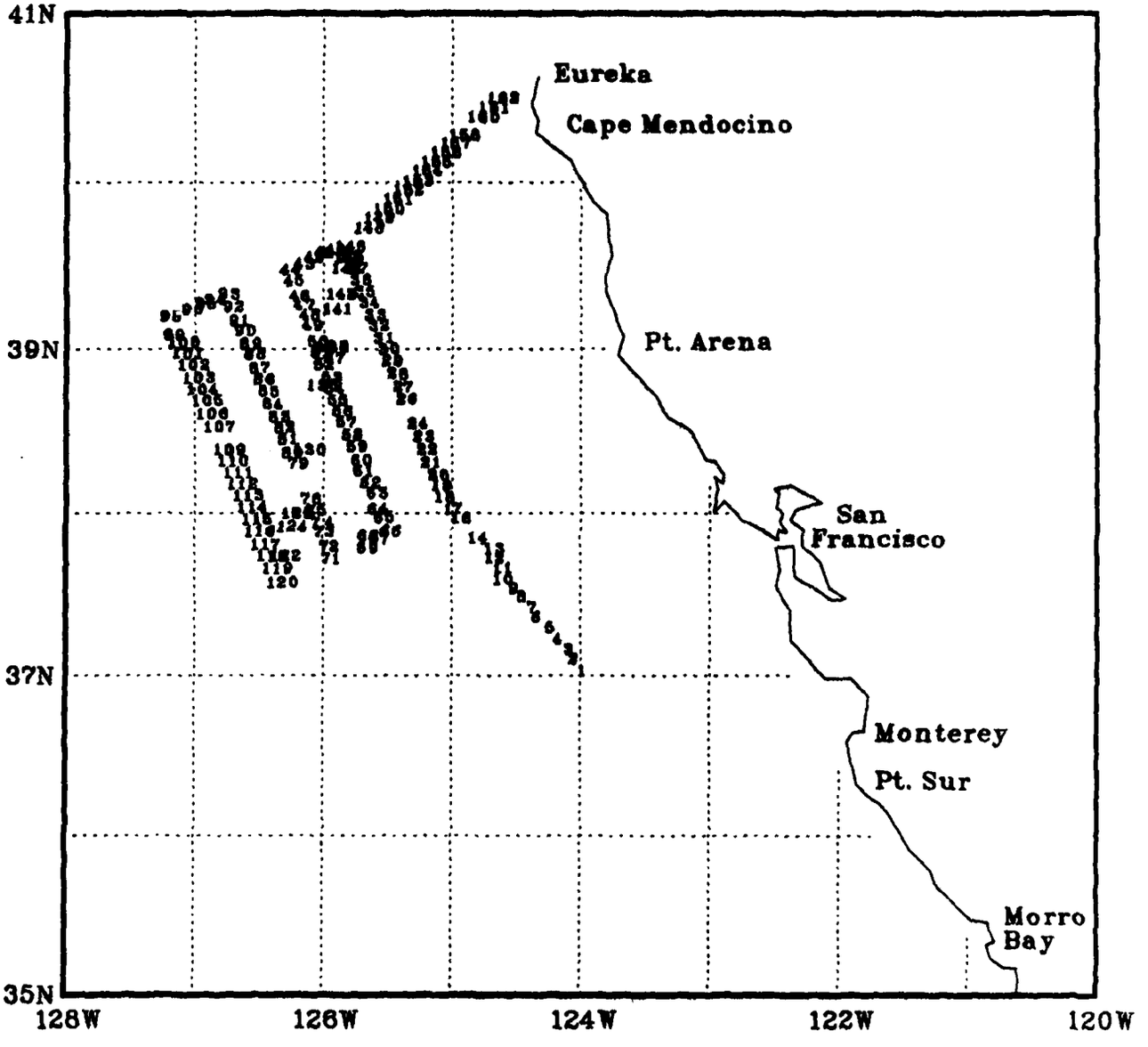



Figure 4: Station numbers for OPTOMA2, Leg I.

## XBT - CTD STATION LISTING

| STN | TYPE | YR/DAY | GMT | LAT (NORTH) | LONG (WEST) | SURFACE TEMP (DEG C) | SURFACE SALINITY (PPT) | BUCKET TEMP (DEG C) | BOTTLE SALINTIY (PPT) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | XBT | 82212 | 1526 | 37.00 | 124.01 | 13.9 | | | |
| 2 | XBT | 82212 | 1733 | 37.05 | 124.05 | 15.0 | | | |
| 3 | XBT | 82212 | 1844 | 37.08 | 124.07 | 15.1 | | | |
| 4 | XBT | 82212 | 2016 | 37.12 | 124.13 | 15.1 | | | |
| 5 | XBT | 82212 | 2132 | 37.16 | 124.16 | 14.8 | | | |
| 6 | XBT | 82212 | 2314 | 37.20 | 124.22 | 14.0 | | | |
| 7 | XBT | 82213 | 19 | 37.24 | 124.24 | 13.6 | | | |
| 8 | XBT | 82213 | 140 | 37.28 | 124.29 | 13.3 | | | |
| 9 | XBT | 82213 | 242 | 37.31 | 124.33 | 13.0 | | | |
| 10 | XBT | 82213 | 402 | 37.34 | 124.40 | 13.2 | | | |
| 11 | XBT | 82213 | 515 | 37.38 | 124.40 | 13.3 | | | |
| 12 | XBT | 82213 | 625 | 37.42 | 124.44 | 13.6 | | | |
| 13 | XBT | 82213 | 746 | 37.45 | 124.44 | 14.2 | | | |
| 14 | XBT | 82213 | 910 | 37.49 | 124.51 | 14.1 | | | |
| 16 | XBT | 82213 | 1154 | 37.56 | 124.60 | 15.4 | | | |
| 17 | CTD | 82213 | 1252 | 38.00 | 125.03 | 15.1 | 33.06 | 15.2 | 33.15 |
| 18 | XBT | 82213 | 1609 | 38.04 | 125.07 | 14.4 | | | |
| 19 | XBT | 82213 | 1649 | 38.08 | 125.09 | 14.6 | | | |
| 20 | XBT | 82213 | 1726 | 38.12 | 125.11 | 14.9 | | | |
| 21 | CTD | 82213 | 1828 | 38.17 | 125.14 | 14.1 | 33.14 | 15.0 | 33.11 |
| 22 | XBT | 82213 | 1919 | 38.22 | 125.16 | 12.9 | | | |
| 23 | XBT | 82213 | 1958 | 38.26 | 125.17 | 13.5 | | | |
| 24 | XBT | 82213 | 2035 | 38.31 | 125.20 | 14.2 | | | |
| 26 | XBT | 82213 | 2231 | 38.40 | 125.25 | 15.1 | | | |
| 27 | XBT | 82213 | 2306 | 38.45 | 125.27 | 15.5 | | | |
| 28 | XBT | 82213 | 2346 | 38.49 | 125.30 | 15.4 | | | |
| 29 | CTD | 82214 | 44 | 38.54 | 125.32 | 15.2 | 32.75 | 15.2 | 32.84 |
| 30 | XBT | 82214 | 134 | 38.58 | 125.34 | 15.6 | | | |
| 31 | XBT | 82214 | 217 | 39.02 | 125.36 | 15.6 | | | |
| 32 | XBT | 82214 | 318 | 39.07 | 125.38 | 15.4 | | | |
| 33 | CTD | 82214 | 432 | 39.11 | 125.40 | 15.3 | 32.70 | 15.3 | 32.65 |
| 34 | XBT | 82214 | 555 | 39.15 | 125.43 | 15.2 | | | |
| 35 | XBT | 82214 | 647 | 39.19 | 125.45 | 15.4 | | | |
| 36 | XBT | 82214 | 743 | 39.23 | 125.47 | 15.7 | | | |
| 37 | CTD | 82214 | 857 | 39.28 | 125.48 | 15.3 | 32.62 | 15.5 | 32.68 |
| 38 | XBT | 82214 | 1014 | 39.32 | 125.52 | 15.6 | | | |
| 40 | XBT | 82214 | 1150 | 39.34 | 125.59 | 15.7 | | | |
| 41 | CTD | 82214 | 1303 | 39.33 | 126.04 | 15.6 | 32.48 | 15.7 | 32.58 |
| 42 | XBT | 82214 | 1422 | 39.32 | 126.09 | 15.7 | | | |
| 43 | XBT | 82214 | 1453 | 39.29 | 126.14 | 16.1 | | | |
| 44 | CTD | 82214 | 1550 | 39.27 | 126.20 | 15.6 | 32.62 | 15.8 | 32.57 |
| 45 | XBT | 82214 | 1628 | 39.23 | 126.18 | 15.4 | | | |
| 46 | XBT | 82214 | 1709 | 39.17 | 126.16 | 15.5 | | | |
| 47 | XBT | 82214 | 1730 | 39.14 | 126.14 | 15.8 | | | |
| 48 | CTD | 82214 | 1813 | 39.11 | 126.11 | 15.2 | 32.69 | 15.4 | 32.62 |
| 49 | XBT | 82214 | 1850 | 39.07 | 126.10 | 16.1 | | | |
| 50 | XBT | 82214 | 1934 | 39.01 | 126.07 | 15.7 | | | |
| 51 | XBT | 82214 | 2001 | 38.57 | 126.06 | 15.5 | | | |

| STN | TYPE | YR/DAY | GMT | LAT (NORTH) | LONG (WEST) | SURFACE TEMP (DEG C) | SURFACE SALINITY (PPT) | BUCKET TEMP (DEG C) | BOTTLE SALINITY (PPT) |
|---|---|---|---|---|---|---|---|---|---|
| 52 | CTD | 82214 | 2046 | 38.53 | 126.04 | 14.9 | 32.70 | 14.9 | 32.64 |
| 53 | XBT | 82214 | 2135 | 38.48 | 126.01 | 15.2 | | | |
| 54 | XBT | 82214 | 2206 | 38.44 | 125.59 | 14.6 | | | |
| 55 | XBT | 82214 | 2301 | 38.40 | 125.57 | 14.7 | | | |
| 56 | CTD | 82214 | 2349 | 38.36 | 125.55 | 14.1 | 32.70 | 14.3 | 32.79 |
| 57 | XBT | 82215 | 32 | 38.32 | 125.54 | 14.2 | | | |
| 58 | XBT | 82215 | 108 | 38.27 | 125.51 | 14.0 | | | |
| 59 | XBT | 82215 | 145 | 38.23 | 125.49 | 16.2 | | | |
| 60 | CTD | 82215 | 238 | 38.18 | 125.47 | 16.5 | 32.82 | 16.5 | 32.76 |
| 61 | XBT | 82215 | 315 | 38.14 | 125.46 | 16.9 | | | |
| 62 | XBT | 82215 | 348 | 38.10 | 125.42 | 16.4 | | | |
| 63 | XBT | 82215 | 416 | 38.06 | 125.39 | 15.9 | | | |
| 64 | CTD | 82215 | 503 | 38.00 | 125.39 | 15.7 | 32.99 | 15.9 | 32.82 |
| 65 | XBT | 82215 | 557 | 37.57 | 125.36 | 15.8 | | | |
| 66 | XBT | 82215 | 637 | 37.52 | 125.33 | 15.6 | | | |
| 67 | XBT | 82215 | 711 | 37.49 | 125.38 | 15.8 | | | |
| 68 | CTD | 82215 | 757 | 37.50 | 125.43 | 15.4 | 32.87 | 15.9 | 32.96 |
| 69 | XBT | 82215 | 836 | 37.46 | 125.44 | 15.5 | | | |
| 71 | CTD | 82215 | 1000 | 37.42 | 126.00 | 15.5 | 32.86 | 15.7 | 32.87 |
| 72 | XBT | 82215 | 1126 | 37.46 | 126.01 | 15.7 | | | |
| 73 | XBT | 82215 | 1205 | 37.52 | 126.04 | 15.7 | | | |
| 74 | XBT | 82215 | 1231 | 37.55 | 126.05 | 15.7 | | | |
| 75 | CTD | 82215 | 1316 | 37.59 | 126.08 | 15.6 | 32.86 | 15.7 | 32.87 |
| 76 | XBT | 82215 | 1402 | 38.04 | 126.10 | 15.8 | | | |
| 79 | CTD | 82215 | 1612 | 38.17 | 126.16 | 16.4 | 32.85 | 16.5 | 32.87 |
| 80 | XBT | 82215 | 1658 | 38.20 | 126.19 | 15.8 | | | |
| 81 | XBT | 82215 | 1733 | 38.25 | 126.21 | 15.6 | | | |
| 82 | XBT | 82215 | 1803 | 38.30 | 126.22 | 15.5 | | | |
| 83 | CTD | 82215 | 1907 | 38.34 | 126.25 | 15.2 | 32.97 | 15.4 | 32.92 |
| 84 | XBT | 82215 | 2014 | 38.38 | 126.28 | 15.7 | | | |
| 85 | XBT | 82215 | 2047 | 38.43 | 126.30 | 14.7 | | | |
| 86 | XBT | 82215 | 2119 | 38.47 | 126.32 | 14.8 | | | |
| 87 | CTD | 82215 | 2200 | 38.51 | 126.34 | 15.5 | 32.60 | 15.5 | ----- |
| 88 | XBT | 82215 | 2249 | 38.57 | 126.36 | 16.0 | | | |
| 89 | XBT | 82215 | 2317 | 39.00 | 126.39 | 16.3 | | | |
| 90 | XBT | 82215 | 2351 | 39.05 | 126.41 | 16.4 | | | |
| 91 | CTD | 82216 | 36 | 39.09 | 126.44 | 16.1 | 32.76 | 16.3 | ----- |
| 92 | XBT | 82216 | 124 | 39.14 | 126.46 | 16.2 | | | |
| 93 | XBT | 82216 | 156 | 39.18 | 126.48 | 16.8 | | | |
| 94 | XBT | 82216 | 235 | 39.16 | 126.55 | 16.6 | | | |
| 95 | CTD | 82216 | 317 | 39.15 | 126.59 | 16.3 | 32.73 | 16.3 | 32.65 |
| 96 | XBT | 82216 | 405 | 39.13 | 127.06 | 17.0 | | | |
| 98 | CTD | 82216 | 539 | 39.10 | 127.16 | 16.9 | 32.72 | 17.0 | 32.64 |
| 99 | XBT | 82216 | 649 | 39.03 | 127.14 | 16.7 | | | |
| 100 | XBT | 82216 | 722 | 39.01 | 127.12 | 16.6 | | | |
| 101 | XBT | 82216 | 754 | 38.57 | 127.10 | 16.3 | | | |
| 102 | CTD | 82216 | 839 | 38.53 | 127.07 | 15.6 | 32.69 | 15.7 | 32.82 |
| 103 | XBT | 82216 | 927 | 38.48 | 127.05 | 15.6 | | | |
| 104 | XBT | 82216 | 958 | 38.44 | 127.03 | 15.7 | | | |
| 105 | XBT | 82216 | 1026 | 38.40 | 127.01 | 15.3 | | | |
| 106 | CTD | 82216 | 1108 | 38.35 | 126.58 | 15.2 | 32.72 | 15.3 | 32.84 |

| STN | TYPE | YR/DAY | GMT | LAT (NORTH) | LONG (WEST) | SURFACE TEMP (DEG C) | SURFACE SALINITY (PPT) | BUCKET TEMP (DEG C) | BOTTLE SALINITY (PPT) |
|---|---|---|---|---|---|---|---|---|---|
| 107 | XBT | 82216 | 1151 | 38.30 | 126.55 | 15.3 | | | |
| 109 | XBT | 82216 | 1243 | 38.22 | 126.50 | 15.4 | | | |
| 110 | CTD | 82216 | 1321 | 38.18 | 126.49 | 15.7 | 33.00 | 15.7 | 32.91 |
| 111 | XBT | 82216 | 1403 | 38.13 | 126.46 | 15.7 | | | |
| 112 | XBT | 82216 | 1432 | 38.09 | 126.44 | 15.7 | | | |
| 113 | XBT | 82216 | 1503 | 38.05 | 126.41 | 16.0 | | | |
| 114 | CTD | 82216 | 1550 | 38.01 | 126.39 | 16.6 | 32.95 | 16.7 | 33.00 |
| 115 | XBT | 82216 | 1637 | 37.56 | 126.37 | 16.2 | | | |
| 116 | XBT | 82216 | 1709 | 37.52 | 126.35 | 16.4 | | | |
| 117 | XBT | 82216 | 1744 | 37.47 | 126.33 | 16.2 | | | |
| 118 | XBT | 82216 | 1818 | 37.43 | 126.30 | 16.4 | | | |
| 119 | XBT | 82216 | 1852 | 37.38 | 126.28 | 16.6 | | | |
| 120 | XBT | 82216 | 2023 | 37.33 | 126.25 | 16.8 | | | |
| 122 | XBT | 82216 | 2138 | 37.43 | 126.24 | 16.6 | | | |
| 124 | XBT | 82216 | 2248 | 37.53 | 126.21 | 16.4 | | | |
| 125 | XBT | 82216 | 2323 | 37.58 | 126.19 | 16.5 | | | |
| 130 | XBT | 82217 | 158 | 38.22 | 126.13 | 16.9 | | | |
| 135 | XBT | 82217 | 435 | 38.45 | 126.07 | 15.7 | | | |
| 137 | XBT | 82217 | 540 | 38.55 | 126.04 | 15.5 | | | |
| 138 | XBT | 82217 | 609 | 38.59 | 126.03 | 16.0 | | | |
| 141 | XBT | 82217 | 745 | 39.13 | 125.60 | 16.7 | | | |
| 142 | XBT | 82217 | 819 | 39.18 | 125.58 | 16.7 | | | |
| 144 | XBT | 82217 | 924 | 39.28 | 125.55 | 16.8 | | | |
| 145 | XBT | 82217 | 953 | 39.32 | 125.54 | 16.9 | | | |
| 146 | XBT | 82217 | 1031 | 39.35 | 125.54 | 16.9 | | | |
| 148 | XBT | 82217 | 1135 | 39.42 | 125.45 | 16.7 | | | |
| 149 | XBT | 82217 | 1205 | 39.46 | 125.41 | 16.8 | | | |
| 150 | XBT | 82217 | 1238 | 39.49 | 125.36 | 16.4 | | | |
| 151 | XBT | 82217 | 1311 | 39.52 | 125.32 | 16.2 | | | |
| 152 | XBT | 82217 | 1343 | 39.56 | 125.26 | 15.8 | | | |
| 153 | XBT | 82217 | 1415 | 39.59 | 125.23 | 15.6 | | | |
| 154 | XBT | 82217 | 1446 | 40.02 | 125.18 | 15.5 | | | |
| 155 | XBT | 82217 | 1515 | 40.06 | 125.14 | 14.9 | | | |
| 156 | CTD | 82217 | 1600 | 40.09 | 125.09 | 15.2 | 32.87 | 15.3 | 33.00 |
| 157 | XBT | 82217 | 1642 | 40.12 | 125.05 | 14.9 | | | |
| 158 | XBT | 82217 | 1707 | 40.15 | 125.01 | 14.0 | | | |
| 160 | XBT | 82217 | 1806 | 40.22 | 124.52 | 12.8 | | | |
| 161 | XBT | 82217 | 1840 | 40.25 | 124.47 | 12.1 | | | |
| 162 | XBT | 82217 | 1909 | 40.28 | 124.43 | 12.1 | | | |

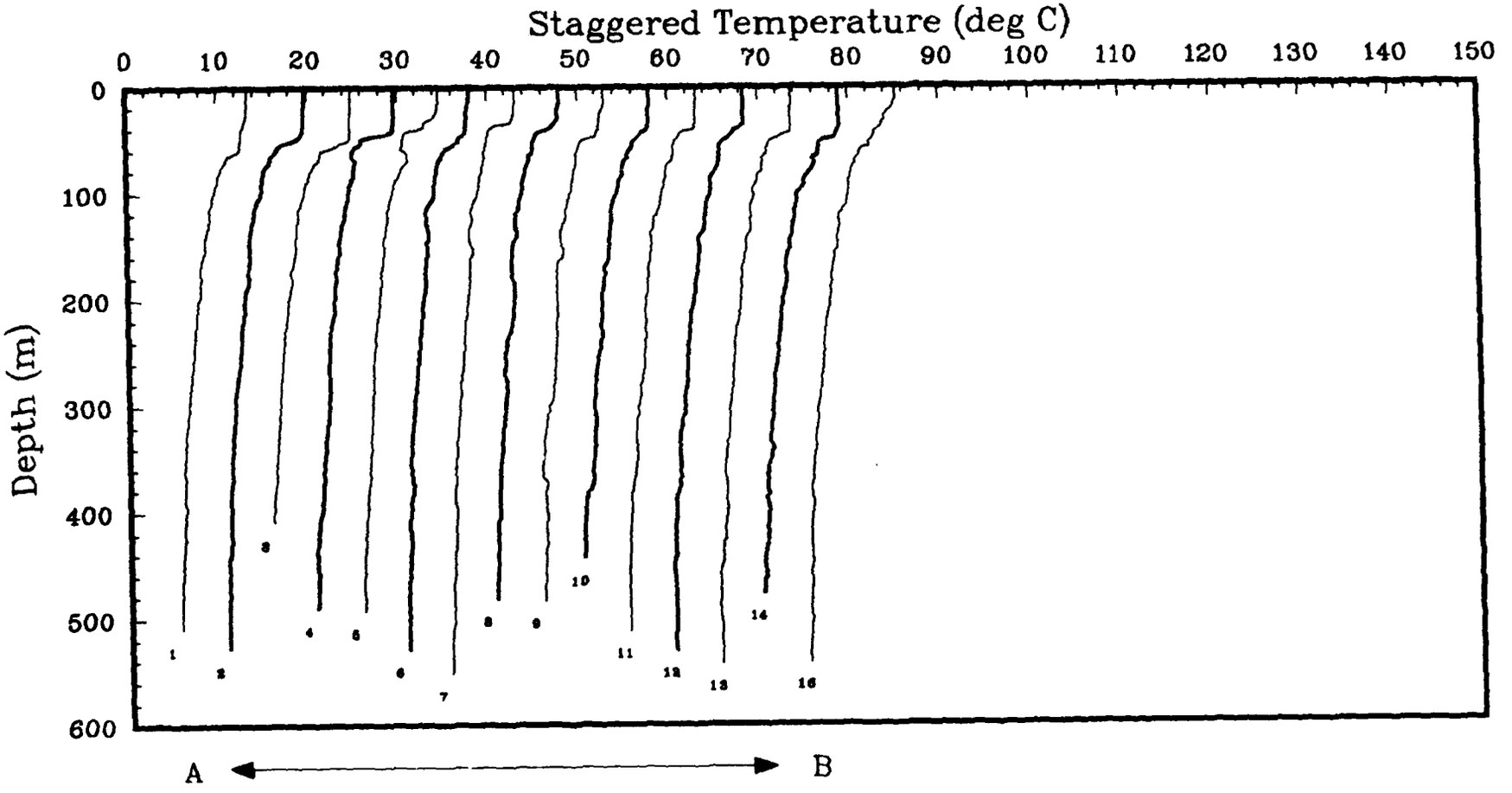



Figure 5(a): Staggered temperature profiles from the XBT's. Profiles are staggered by a multiple of 5C.

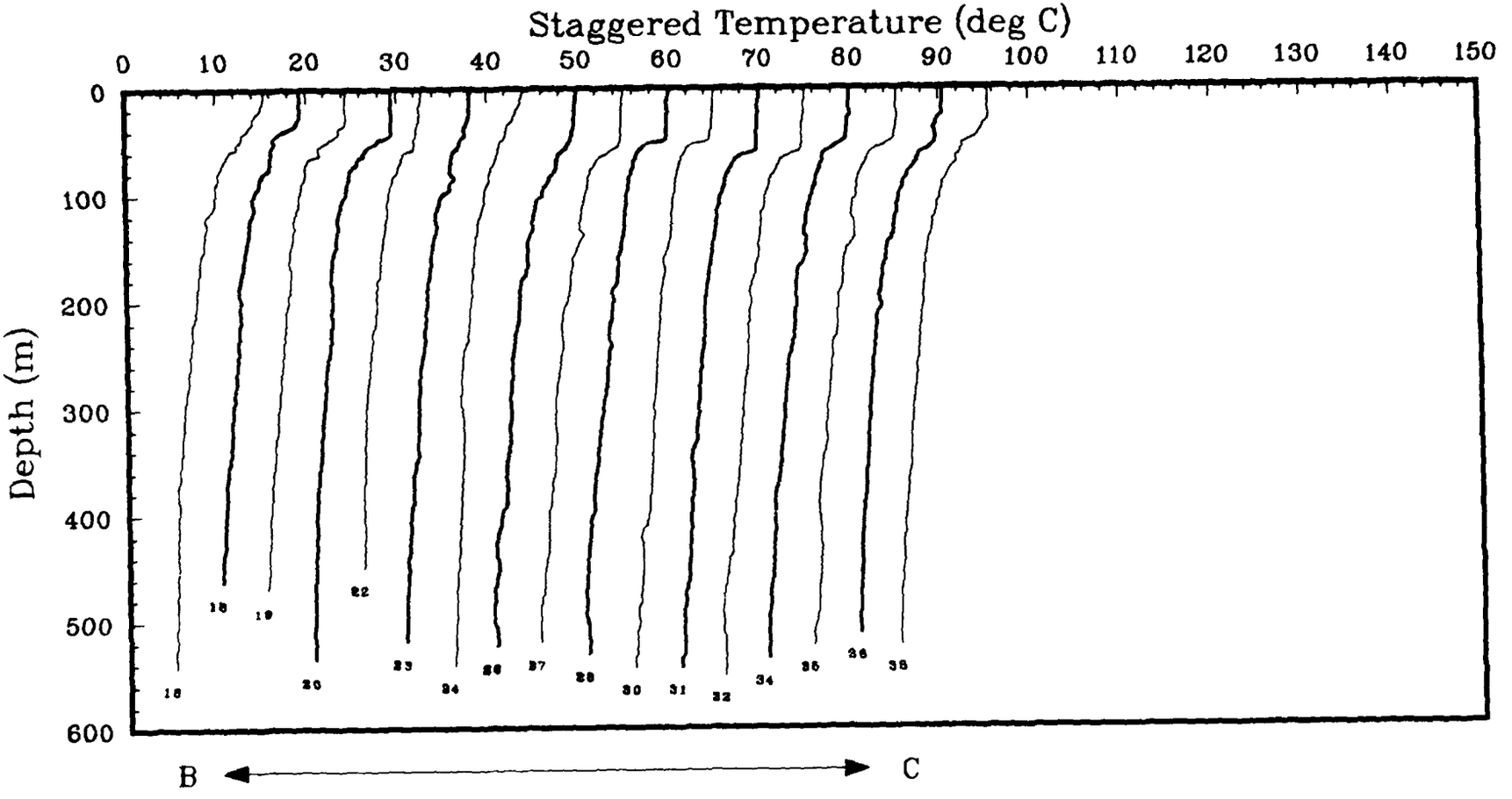

Staggered Temperature (deg C)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
Depth (m)
0 100 200 300 400 500 600
18 19 20 22 23 24 26 27 28 30 31 32 34 35 36 38
B
C

Figure 5(b).

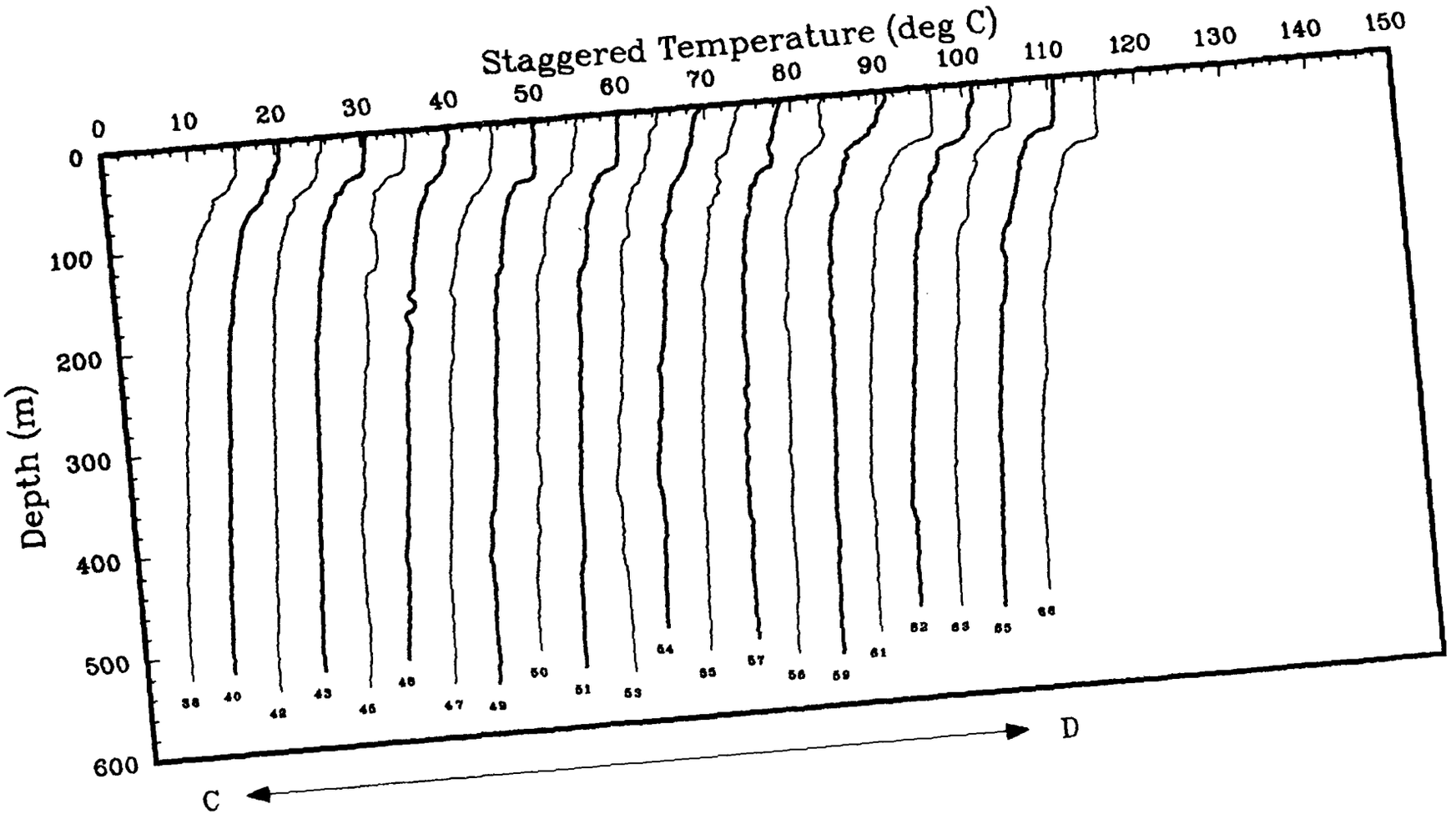

Staggered Temperature (deg C)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Depth (m)
0
100
200
300
400
500
600
C
D
36
40
42
43
45
46
47
49
50
51
53
54
55
57
58
59
61
62
63
65
66

Figure 5(c).

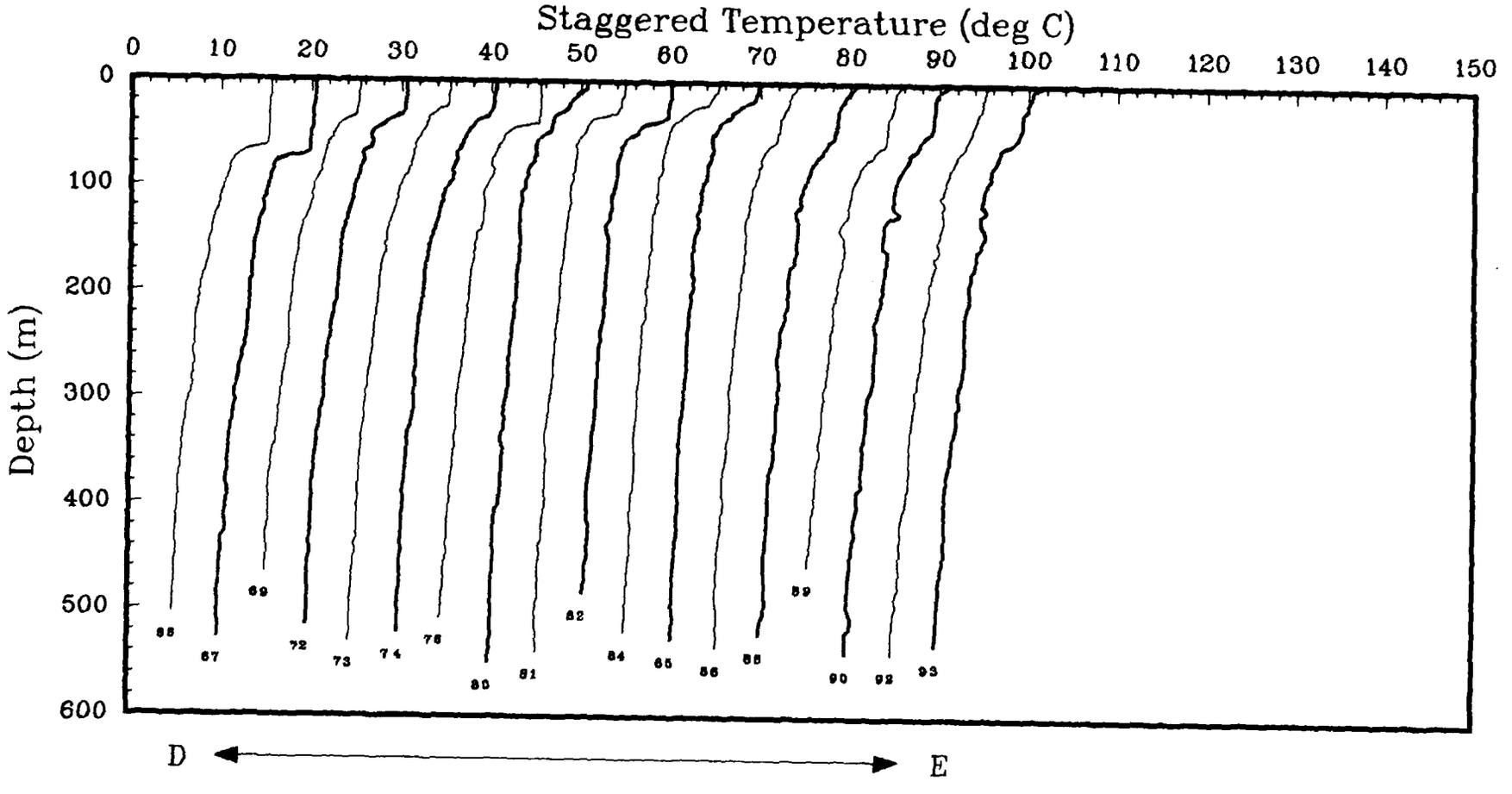
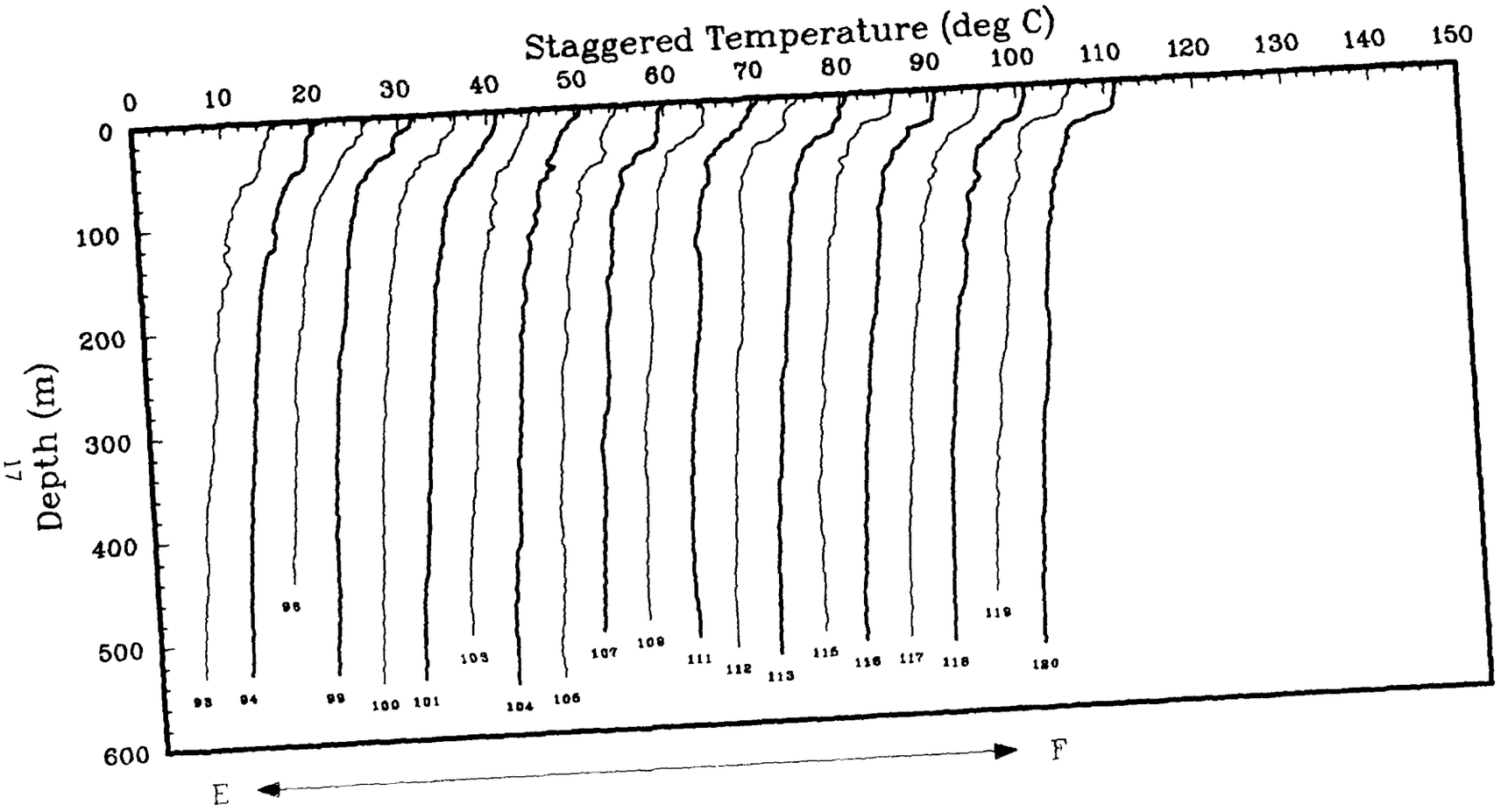

Staggered Temperature (deg C)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Depth (m)
0
100
200
300
400
500
600
65
67
69
72
73
74
76
80
81
82
84
85
86
88
89
90
92
93
D
E

Figure 5(d).


Staggered Temperature (deg C)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Depth (m)
0
100
200
300
400
500
600
93
94
96
99
100
101
103
104
106
107
109
111
112
113
115
116
117
118
119
120
E
F

(Figure 5(e)).

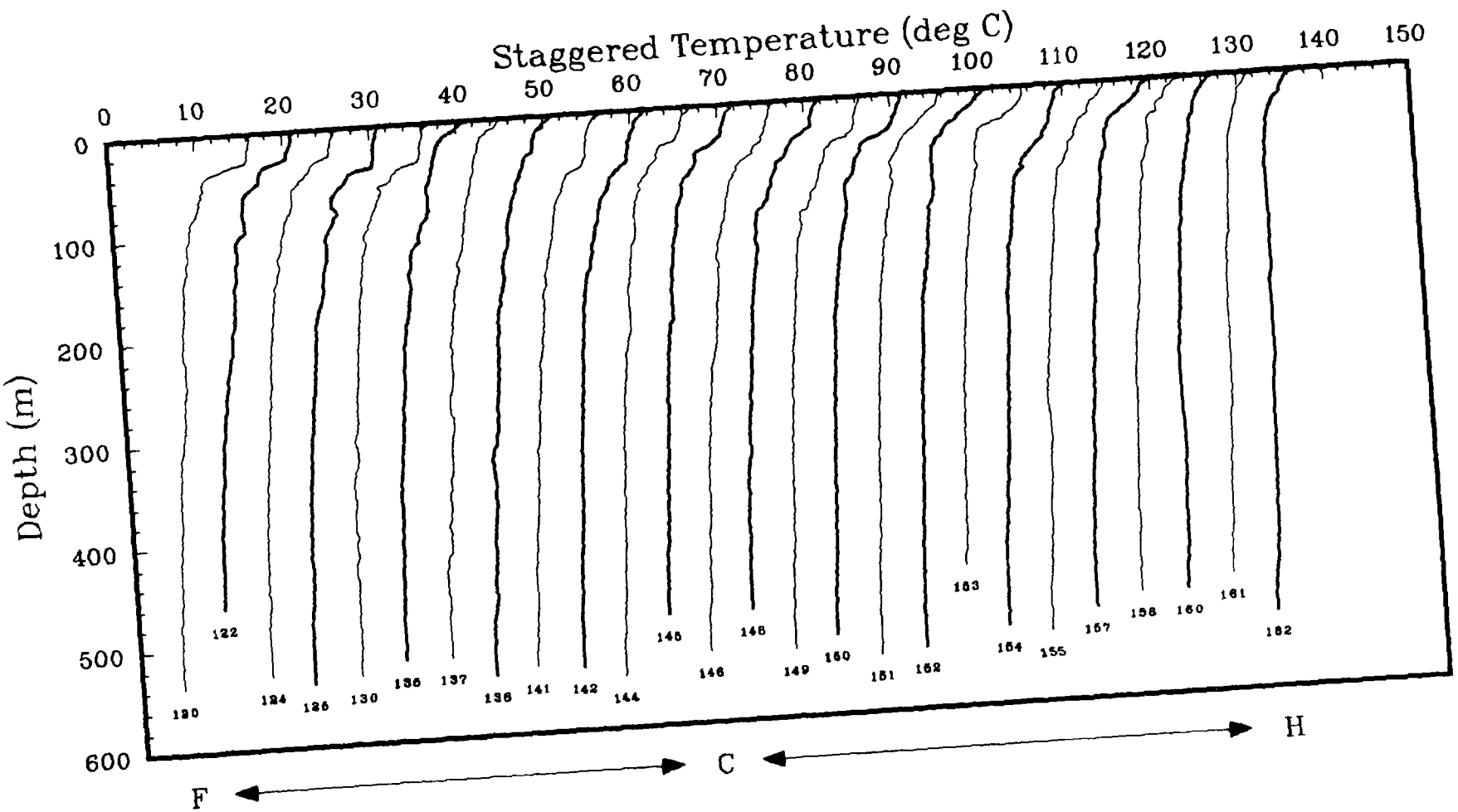

Staggered Temperature (deg C)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
Depth (m)
0 100 200 300 400 500 600
120 122 124 126 130 136 137 138 141 142 144 145 146 148 149 150 151 152 153 154 155 157 158 160 161 162
F
C
H

Figure 5(f).

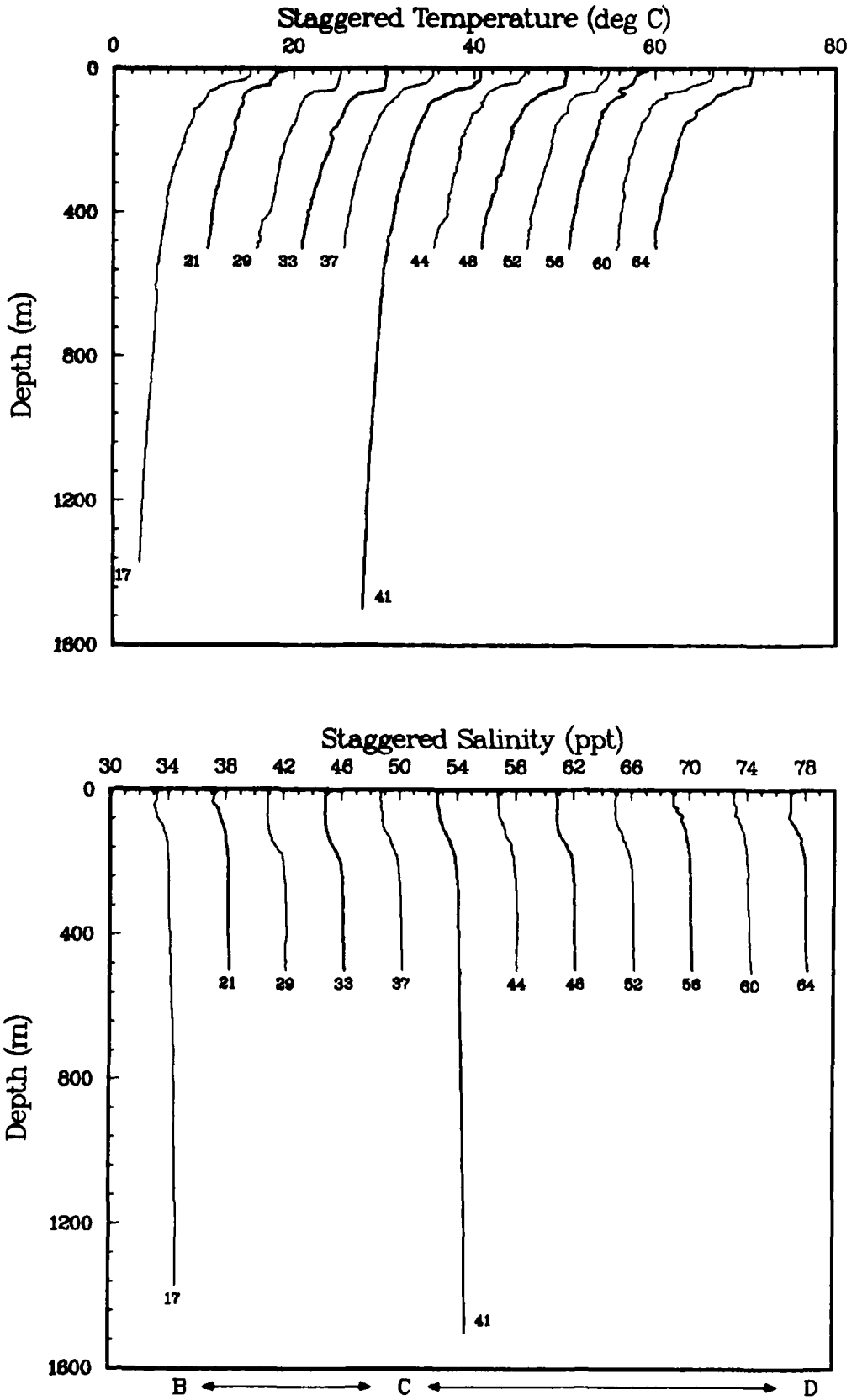



Figure 6(a): Temperature profiles, staggered by multiples of 5C, and salinity profiles, staggered by multiples of 4 ppt.

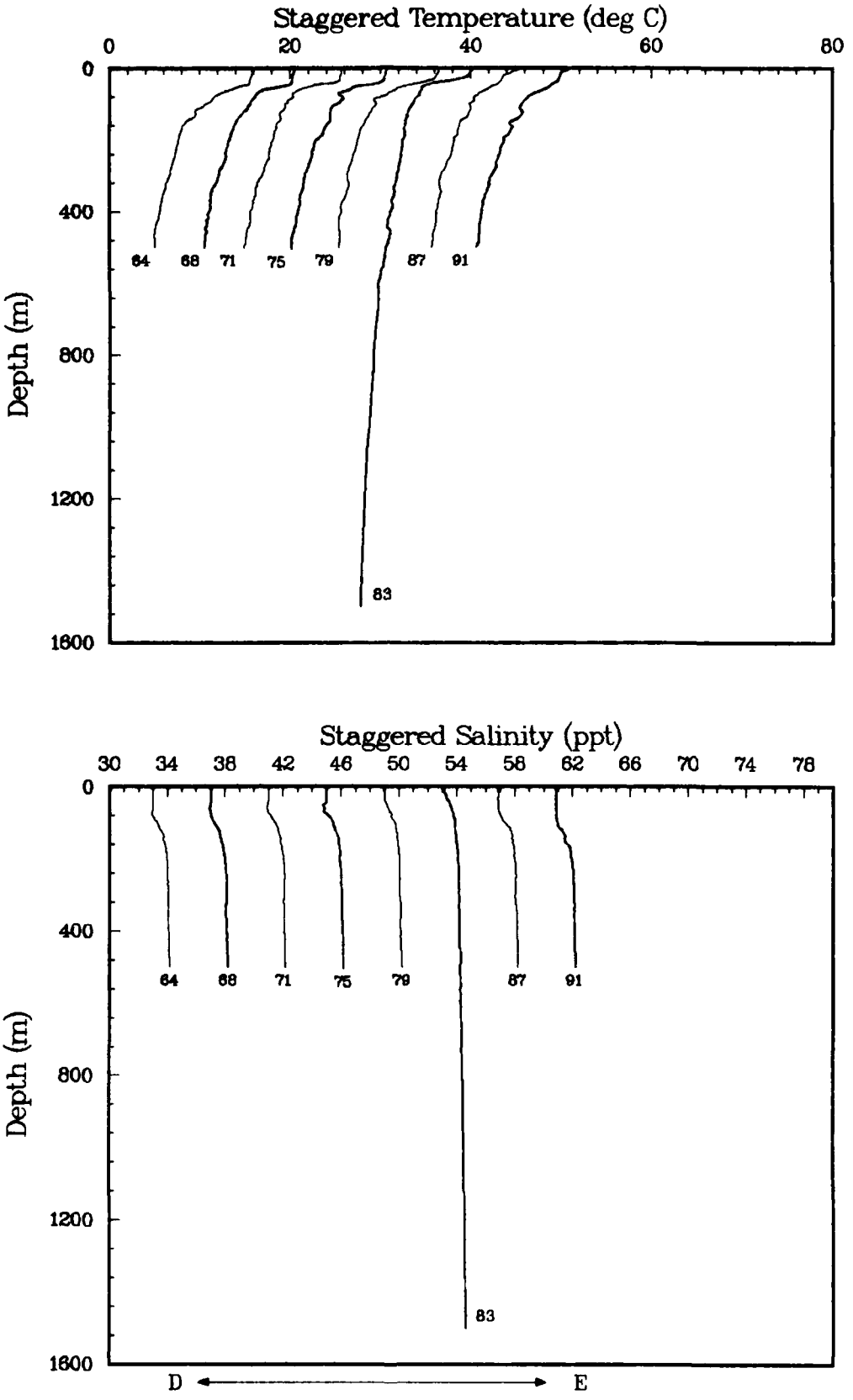

Staggered Temperature (deg C)
0
20
40
60
80
0
400
800
1200
1600
Depth (m)
64
68
71
75
79
87
91
83
Staggered Salinity (ppt)
30
34
38
42
46
50
54
58
62
66
70
74
78
0
400
800
1200
1600
Depth (m)
64
68
71
75
79
87
91
83
D
E

Figure 6(b).

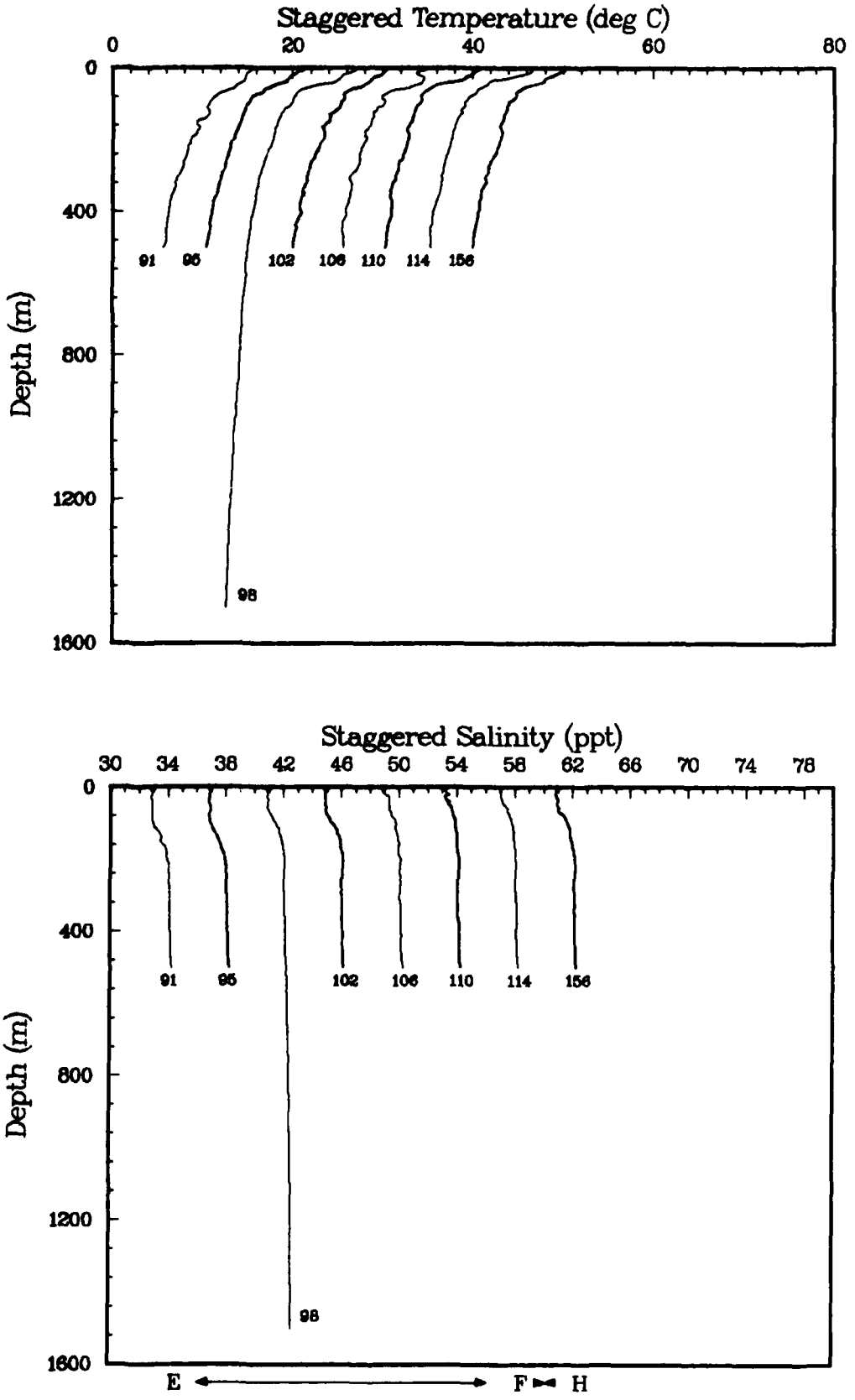

Staggered Temperature (deg C)
0
20
40
60
80
0
400
800
1200
1600
Depth (m)
91
95
102
106
110
114
156
98
Staggered Salinity (ppt)
30
34
38
42
46
50
54
58
62
66
70
74
78
0
400
800
1200
1600
Depth (m)
91
95
102
106
110
114
156
98
E
F
H

Figure 6(c).

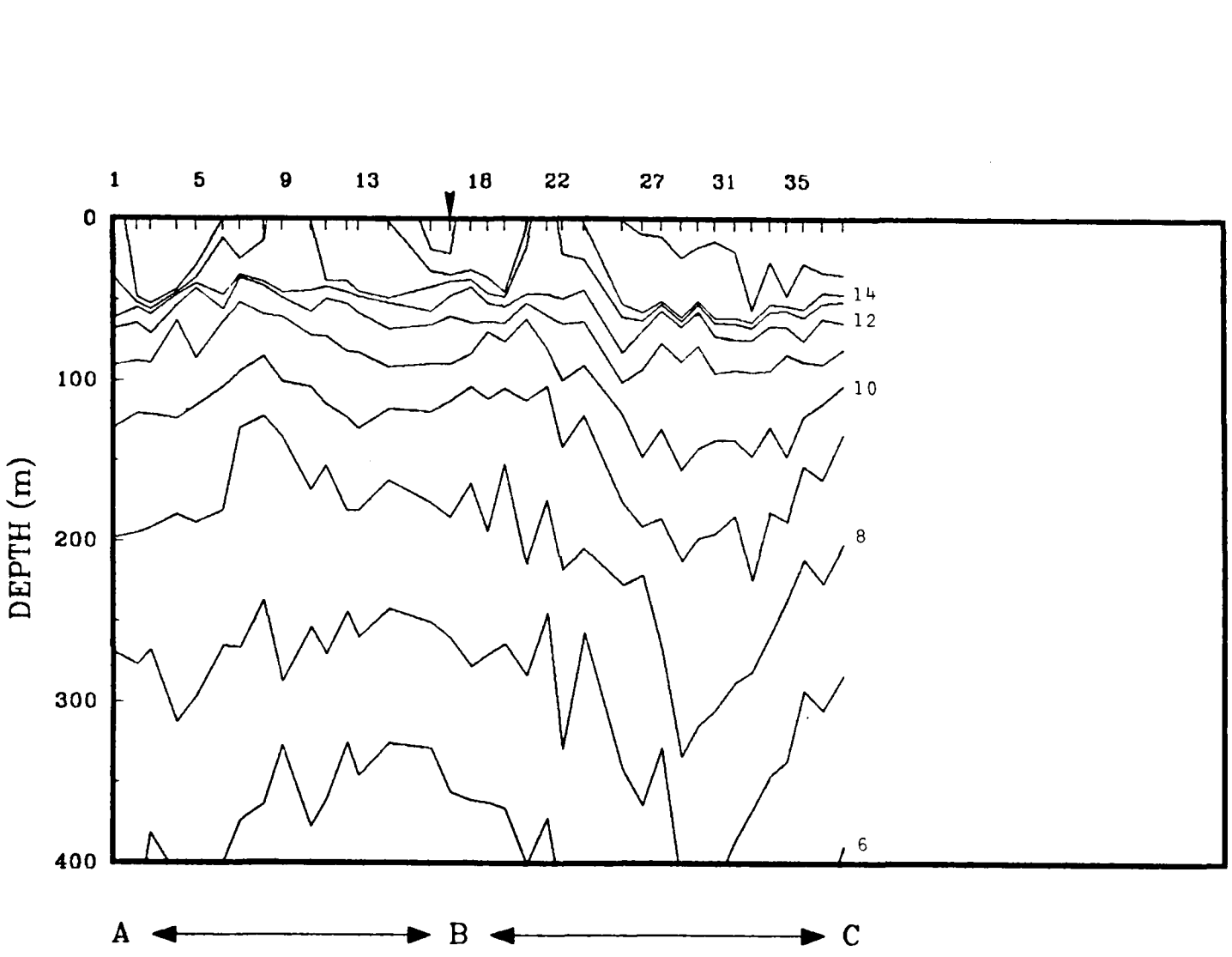



Figure 7(a): Isotherms from XBT's and CTD's. Tick marks along the horizontal axis show station positions. Some station numbers are shown. Arrows indicate the positions where the cruise track changed direction.

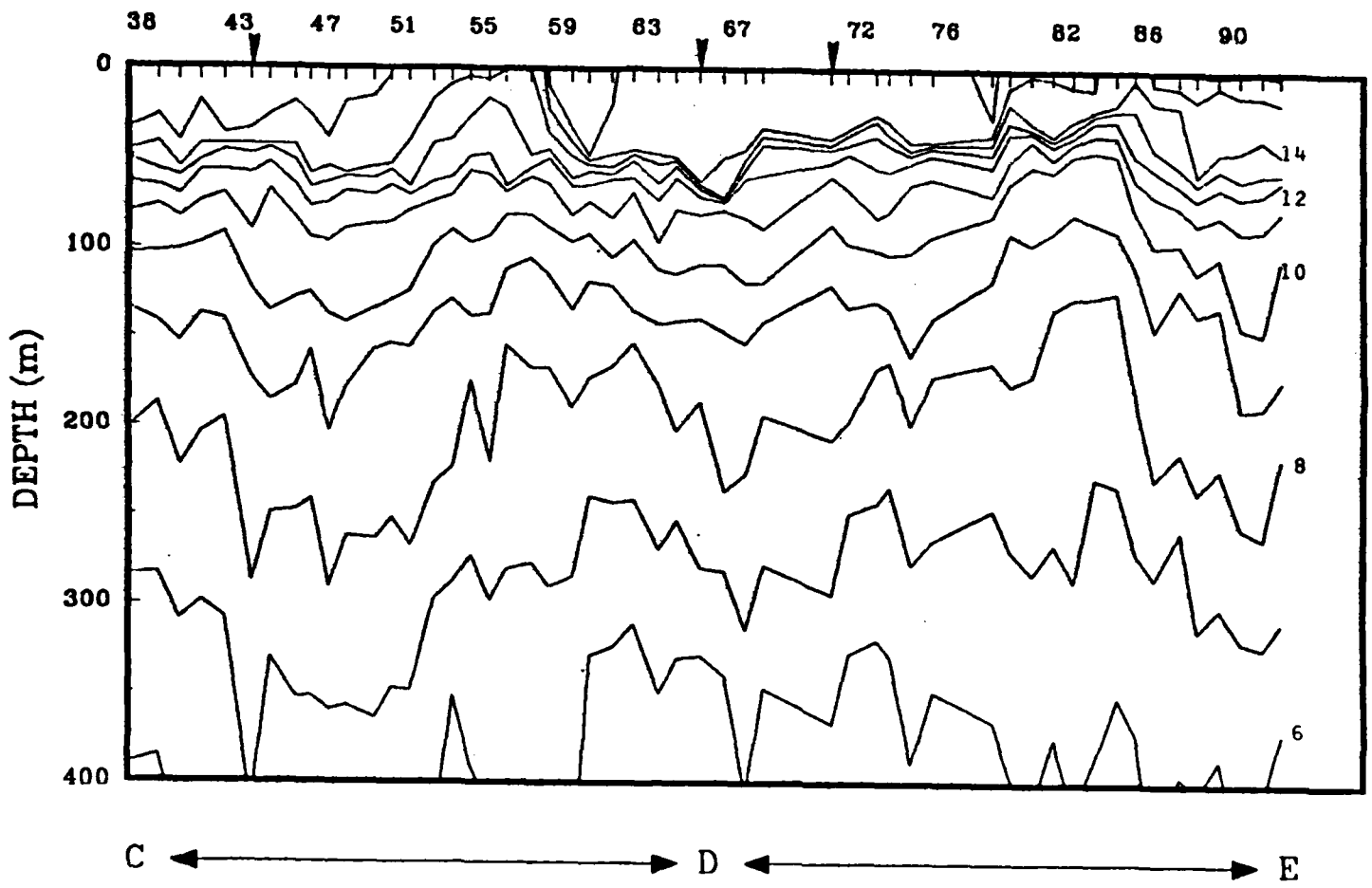

38
43
47
51
55
59
63
67
72
76
82
86
90
0
100
200
300
400
DEPTH (m)
14
12
10
8
6
C
D
E

Figure 7(b).

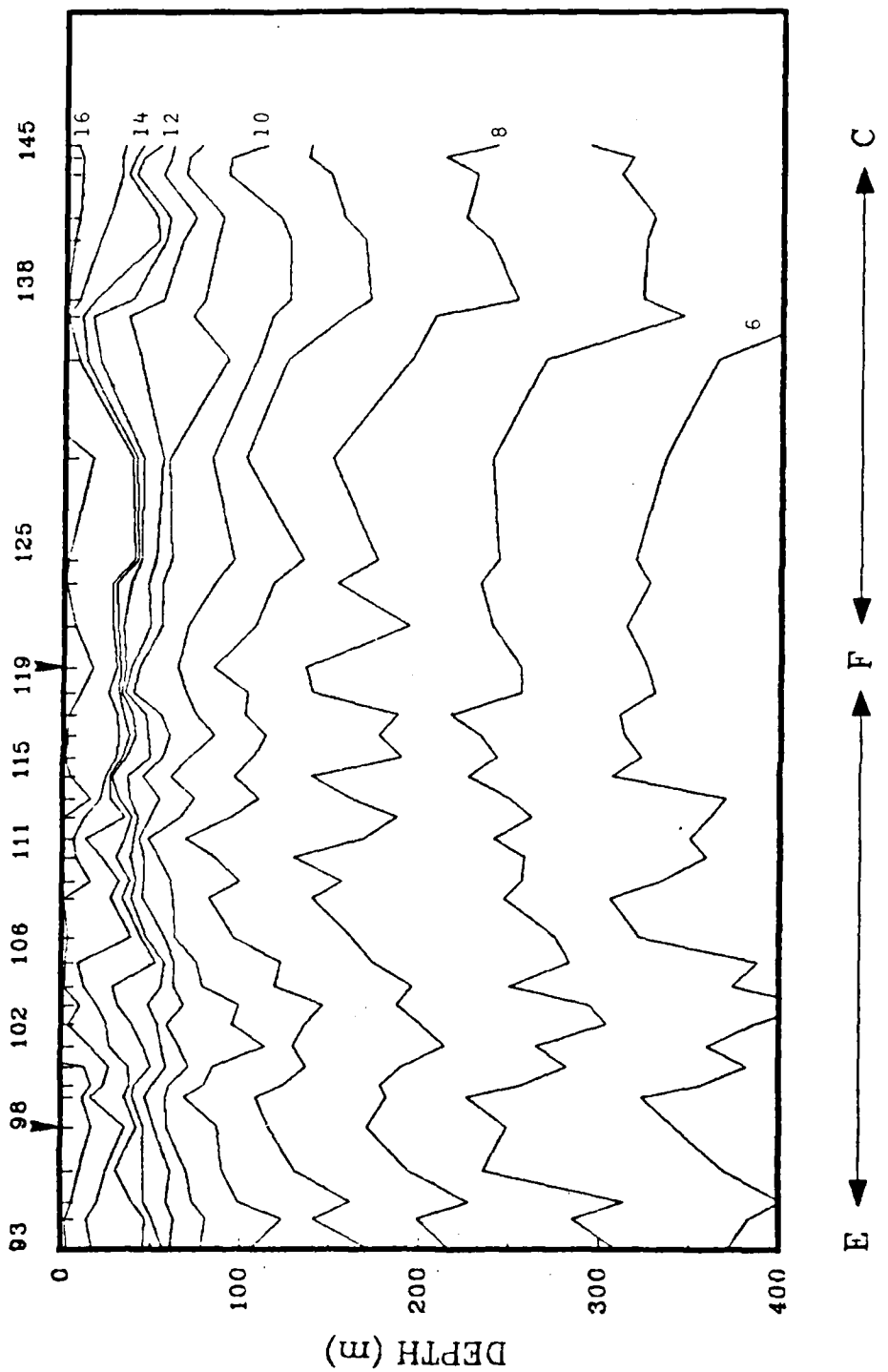

DEPTH (m)
0
100
200
300
400
93
98
102
106
111
115
119
125
138
145
16
14
12
10
8
6
E
F
C

Figure 7(c).

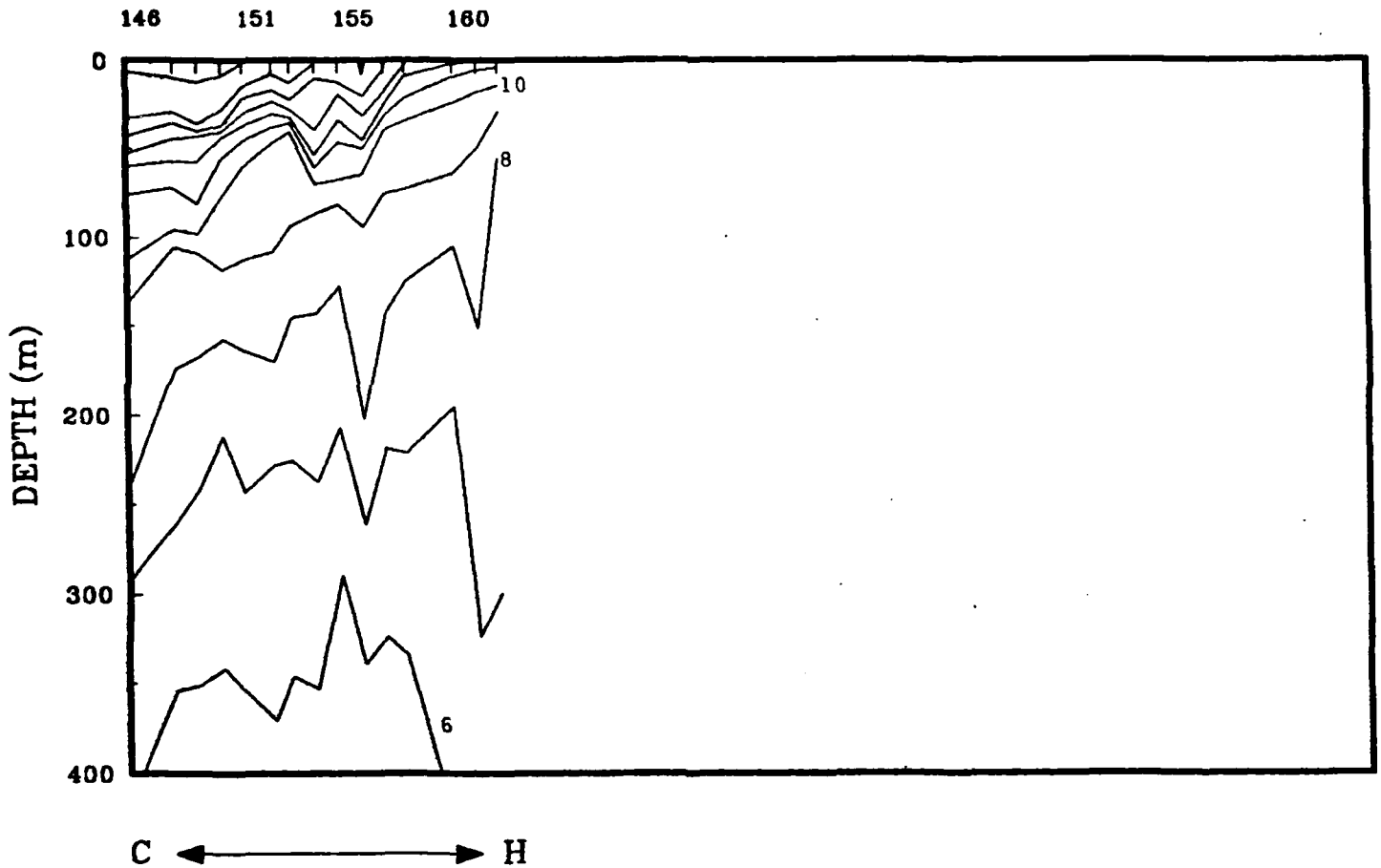



Figure 7(d).

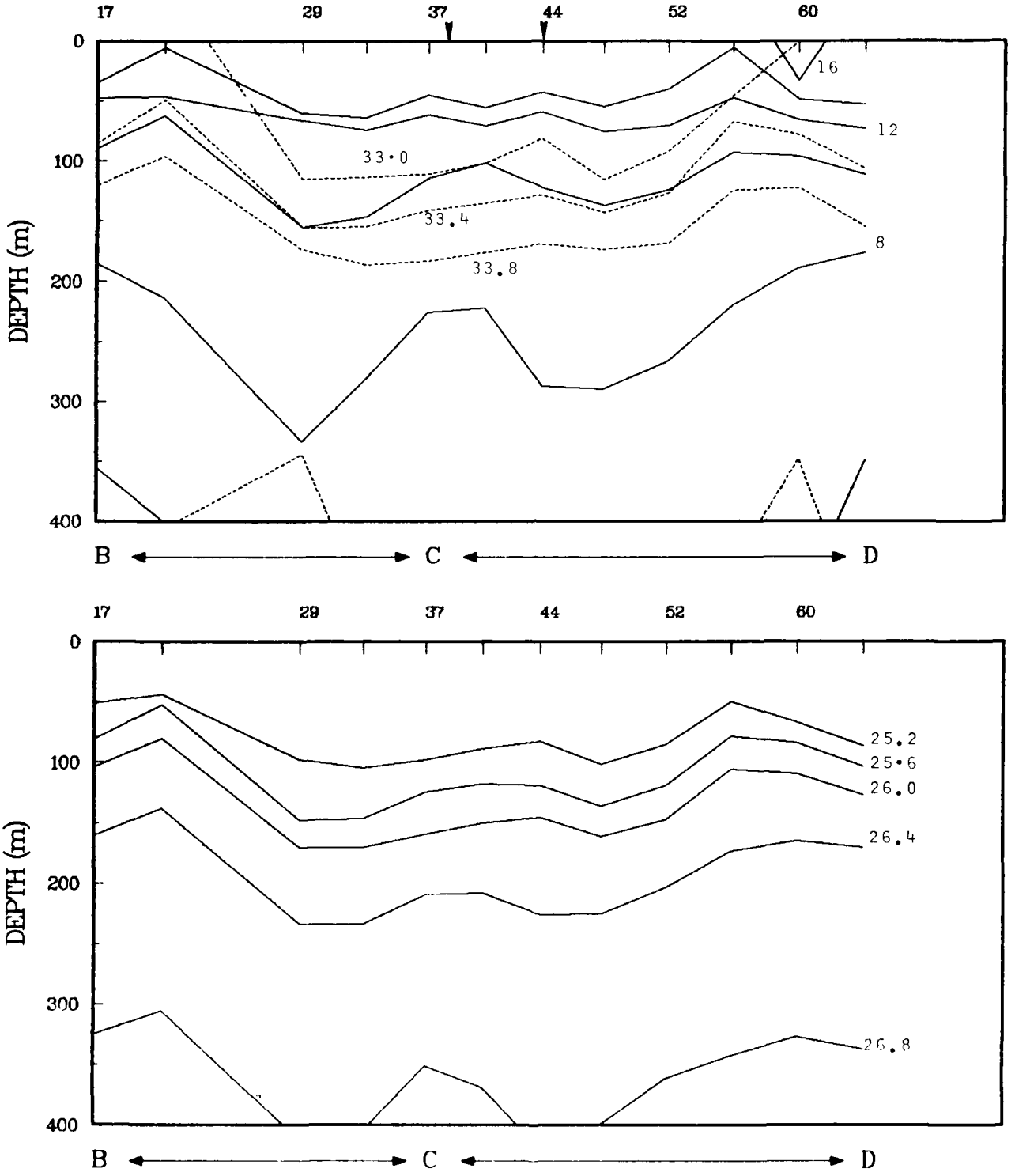



Figure 8(a): Isopleths of temperature, salinity and sigma-t, from the CTD's.

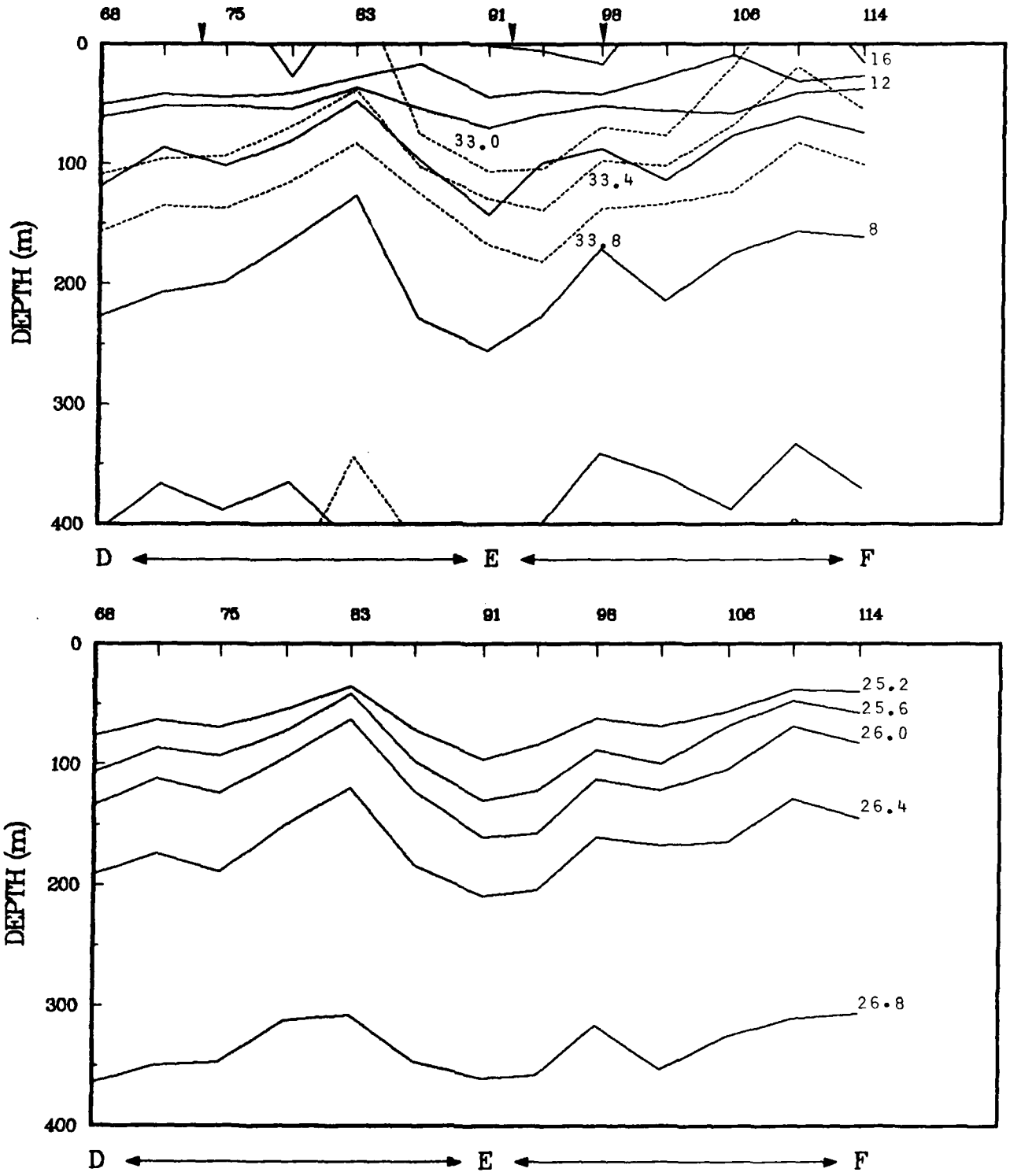

68
75
83
91
98
106
114
0
100
200
300
400
DEPTH (m)
16
12
33.0
33.4
33.8
8
D
E
F
25.2
25.6
26.0
26.4
26.8

Figure 8(b).

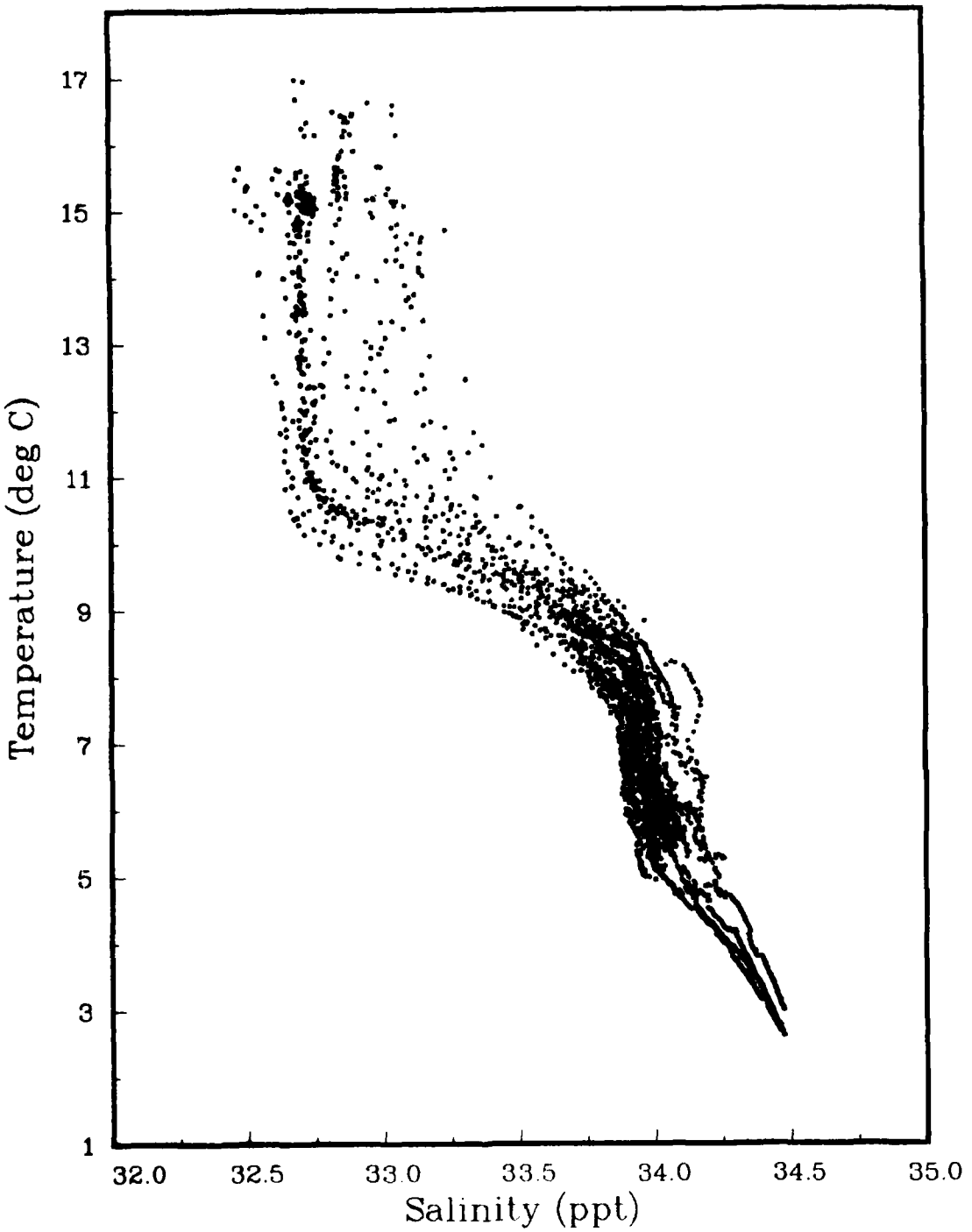



Figure 9: T-S pairs from the CTD casts for OPTOMA2, Leg 1.

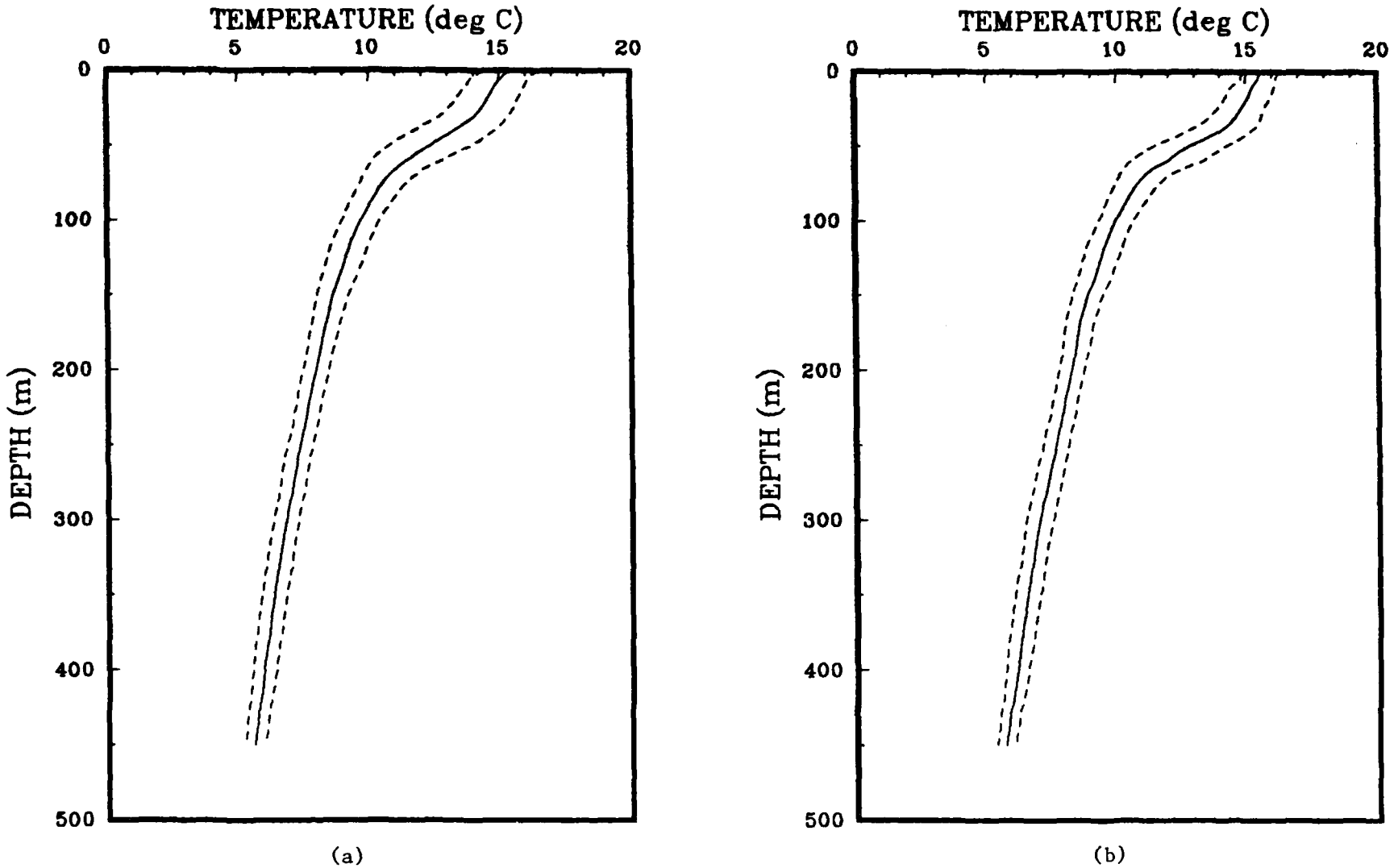



Figure 10: Profiles of $\overline{T(z)}$ with + and - the standard deviation from (a) XBT's and CTD's and (b) CTD's only.

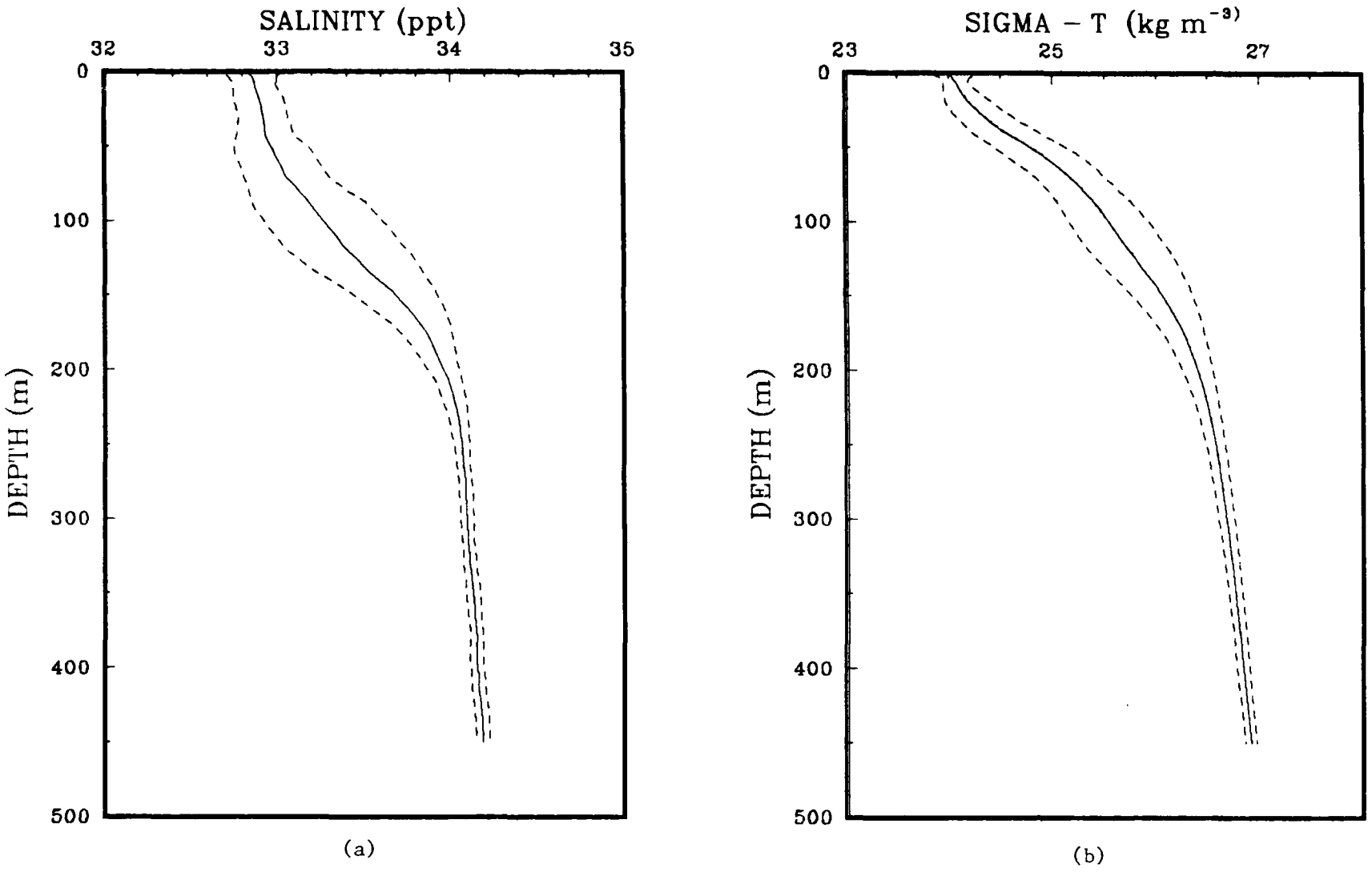



Figure 11: Profiles of (a) mean salinity and (b) mean sigma-t, with + and - the standard deviations, from the CTD's.

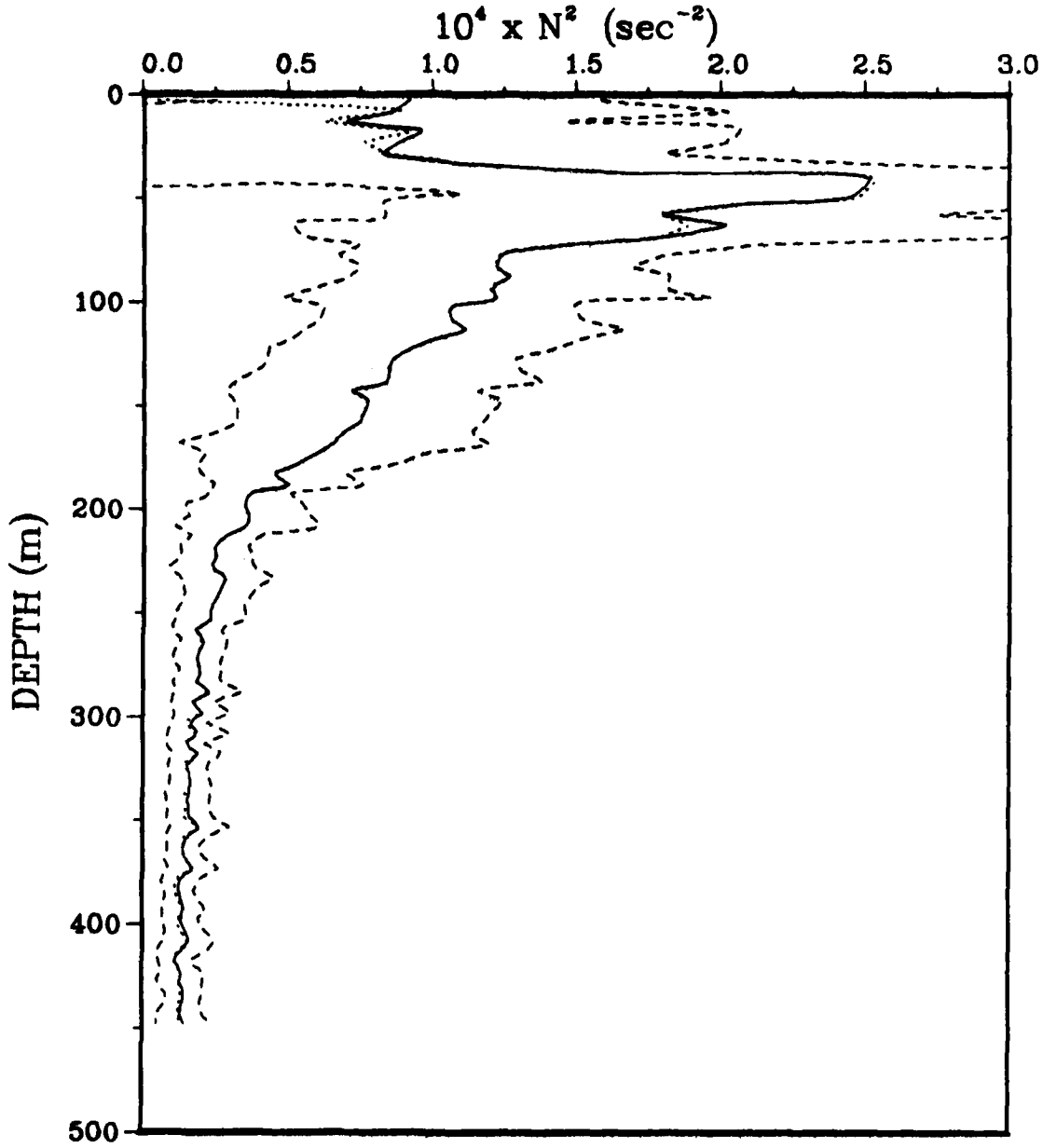



Figure 12: Profiles of $\overline{N^2(z)}$ (——), with + and - the standard deviation (----), and the profile of $N^2$ from $\overline{T(z)}$ and $\overline{S(z)}$ (.....).

SECTION 2

OPTOMA2 - LEG II

8 AUGUST to 14 AUGUST 1982

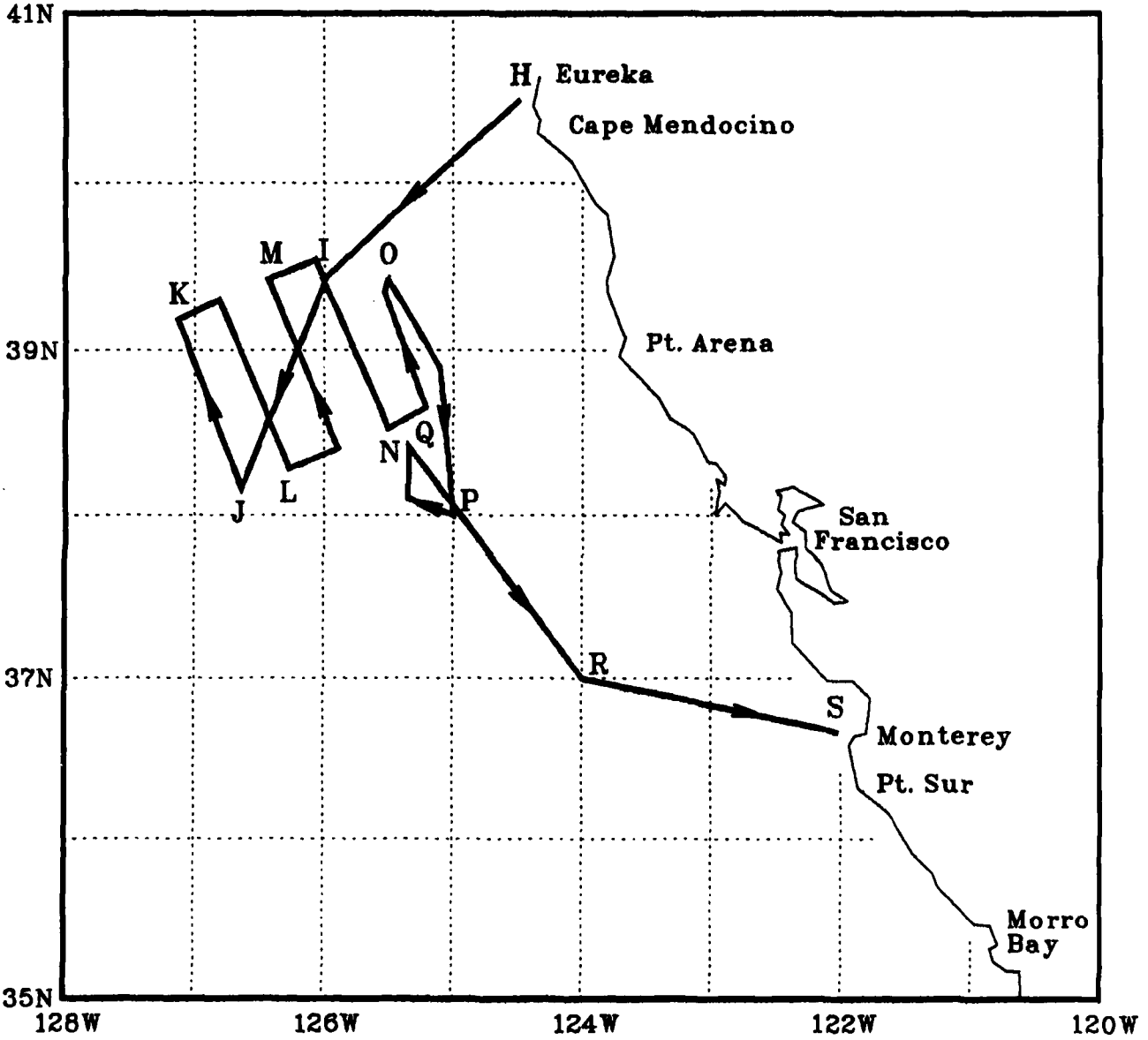



Figure 13: Cruise track for OPTOMA2, Leg II with transect extremes identified by letter.

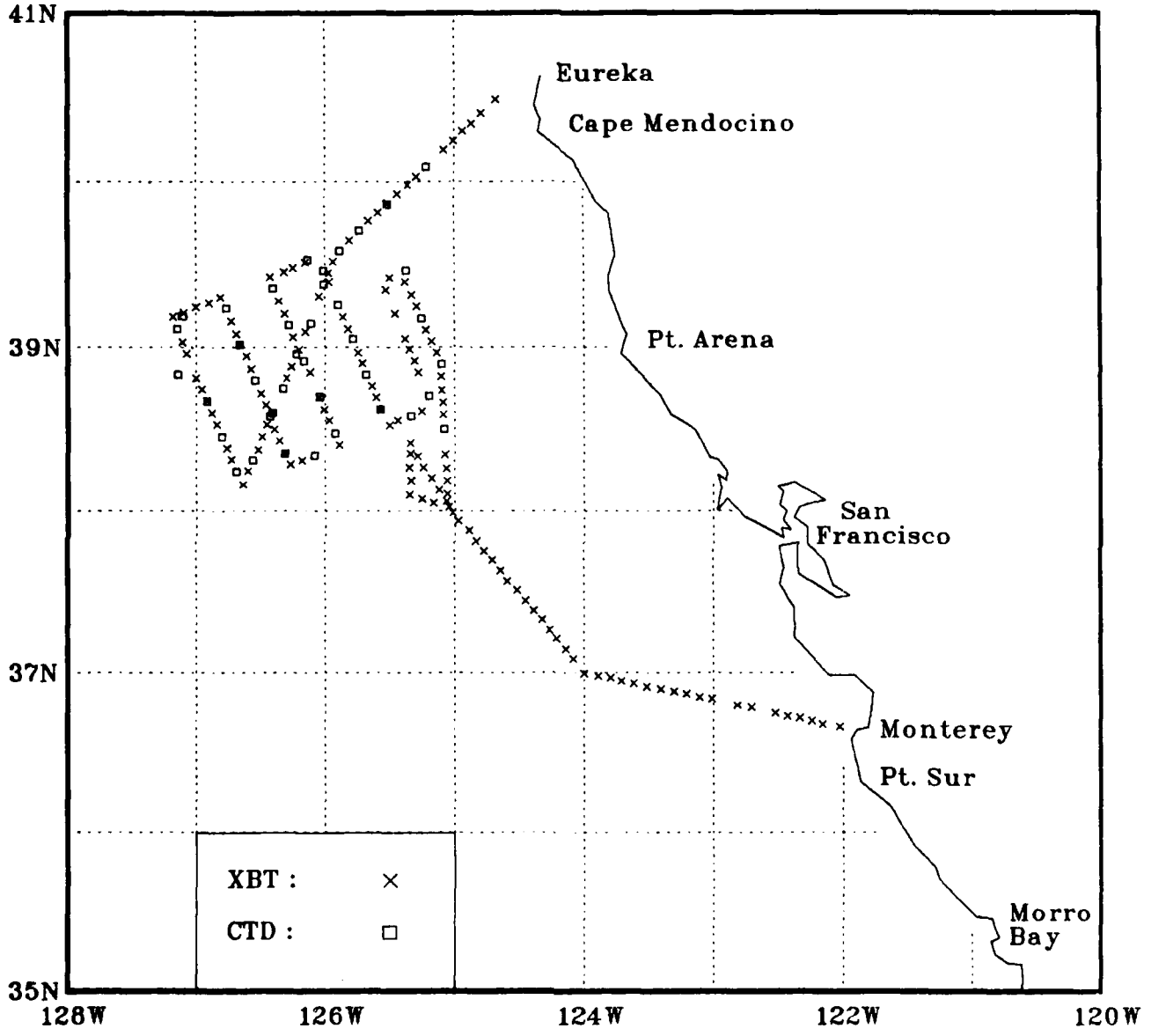



Figure 14: XBT and CTD locations for OPTOMA2, Leg II.

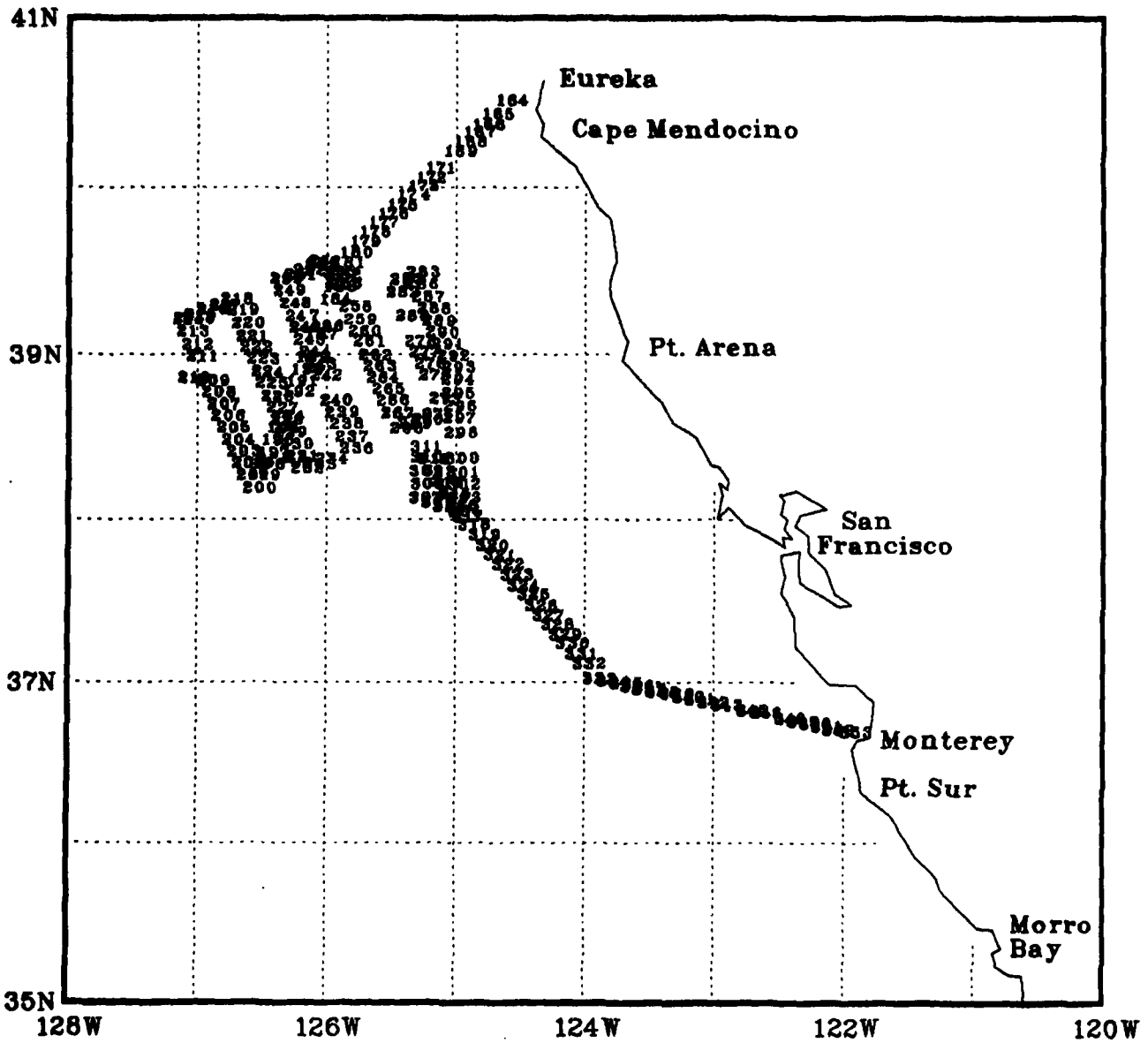



Figure 15: Station numbers for OPTOMA2, Leg II.

## XBT - CTD STATION LISTING

| STN | TYPE | YR/DAY | GMT | LAT (NORTH) | LONG (WEST) | SURFACE TEMP (DEG C) | SURFACE SALINITY (PPT) | BUCKET TEMP (DEG C) | BOTTLE SALINITY (PPT) |
|---|---|---|---|---|---|---|---|---|---|
| 164 | XBT | 82220 | 1958 | 40.29 | 124.41 | 10.0 | | | |
| 165 | XBT | 82220 | 2043 | 40.24 | 124.47 | 11.8 | | | |
| 166 | XBT | 82220 | 2116 | 40.21 | 124.52 | 13.9 | | | |
| 167 | XBT | 82220 | 2143 | 40.18 | 124.56 | 14.2 | | | |
| 168 | XBT | 82220 | 2213 | 40.15 | 125.00 | 14.6 | | | |
| 169 | XBT | 82220 | 2242 | 40.11 | 125.05 | 14.4 | | | |
| 171 | CTD | 82220 | 2354 | 40.05 | 125.13 | 15.1 | 32.79 | ---- | ----- |
| 172 | XBT | 82221 | 37 | 40.02 | 125.18 | 14.3 | | | |
| 173 | XBT | 82221 | 105 | 39.59 | 125.22 | 14.3 | | | |
| 174 | XBT | 82221 | 140 | 39.56 | 125.26 | 15.5 | | | |
| 175 | XBT | 82221 | 215 | 39.52 | 125.31 | 14.8 | | | |
| 175 | CTD | 82221 | 216 | 39.52 | 125.31 | 15.3 | 32.00 | ---- | ----- |
| 176 | XBT | 82221 | 314 | 39.49 | 125.35 | 15.8 | | | |
| 177 | XBT | 82221 | 344 | 39.46 | 125.40 | 16.0 | | | |
| 178 | CTD | 82221 | 447 | 39.43 | 125.44 | 16.3 | 32.76 | 16.3 | 32.67 |
| 179 | XBT | 82221 | 529 | 39.39 | 125.48 | 16.5 | | | |
| 180 | CTD | 82221 | 638 | 39.35 | 125.53 | 16.6 | 32.77 | 16.6 | 32.70 |
| 181 | XBT | 82221 | 744 | 39.31 | 125.56 | 16.6 | | | |
| 182 | XBT | 82221 | 823 | 39.27 | 125.58 | 16.4 | | | |
| 183 | CTD | 82221 | 905 | 39.23 | 126.01 | 16.3 | 32.86 | 16.4 | 32.66 |
| 184 | XBT | 82221 | 947 | 39.18 | 126.02 | 16.1 | | | |
| 186 | CTD | 82221 | 1127 | 39.09 | 126.07 | 15.8 | 32.87 | 15.8 | 32.81 |
| 187 | XBT | 82221 | 1226 | 39.06 | 126.09 | 15.7 | | | |
| 189 | CTD | 82221 | 1342 | 38.58 | 126.14 | 15.6 | 32.77 | 15.7 | 32.94 |
| 190 | XBT | 82221 | 1432 | 38.53 | 126.16 | 15.2 | | | |
| 191 | XBT | 82221 | 1507 | 38.49 | 126.18 | 16.2 | | | |
| 192 | CTD | 82221 | 1608 | 38.45 | 126.19 | 16.5 | 33.03 | ---- | 32.98 |
| 194 | XBT | 82221 | 1832 | 38.36 | 126.24 | 16.8 | | | |
| 194 | CTD | 82221 | 1808 | 38.36 | 126.25 | 16.6 | 33.04 | ---- | 32.99 |
| 195 | XBT | 82221 | 1906 | 38.32 | 126.27 | 16.8 | | | |
| 196 | XBT | 82221 | 1939 | 38.27 | 126.29 | 16.7 | | | |
| 197 | XBT | 82221 | 2015 | 38.23 | 126.31 | 16.8 | | | |
| 198 | CTD | 82221 | 2116 | 38.19 | 126.34 | 25.6 | 0.0 | 16.6 | 32.98 |
| 199 | XBT | 82221 | 2217 | 38.15 | 126.36 | 16.7 | | | |
| 200 | XBT | 82221 | 2252 | 38.10 | 126.38 | 16.7 | | | |
| 201 | CTD | 82221 | 2342 | 38.14 | 126.41 | 16.9 | 33.07 | 17.0 | 33.01 |
| 202 | XBT | 82222 | 30 | 38.19 | 126.43 | 16.8 | | | |
| 203 | XBT | 82222 | 101 | 38.23 | 126.46 | 16.7 | | | |
| 204 | CTD | 82222 | 134 | 38.27 | 126.48 | 16.2 | 33.23 | 16.5 | 33.07 |
| 205 | XBT | 82222 | 239 | 38.32 | 126.51 | 16.8 | | | |
| 206 | XBT | 82222 | 314 | 38.36 | 126.53 | 16.9 | | | |
| 207 | XBT | 82222 | 349 | 38.40 | 126.55 | 16.2 | | | |
| 207 | CTD | 82222 | 404 | 38.40 | 126.55 | 16.3 | 33.14 | 16.4 | 33.12 |
| 208 | XBT | 82222 | 457 | 38.45 | 126.57 | 16.6 | | | |
| 209 | XBT | 82222 | 533 | 38.49 | 126.60 | 16.8 | | | |
| 210 | CTD | 82222 | 618 | 38.50 | 127.08 | 16.4 | 33.18 | 16.5 | 33.19 |
| 211 | XBT | 82222 | 707 | 38.58 | 127.04 | 16.8 | | | |
| 212 | XBT | 82222 | 737 | 39.02 | 127.07 | 16.8 | | | |

| STN | TYPE | YR/DAY | GMT | LAT (NORTH) | LONG (WEST) | SURFACE TEMP (DEG C) | SURFACE SALINITY (PPT) | BUCKET TEMP (DEG C) | BOTTLE SALINITY (PPT) |
|---|---|---|---|---|---|---|---|---|---|
| 213 | CTD | 82222 | 823 | 39.07 | 127.09 | 16.0 | 32.83 | 16.1 | 32.61 |
| 214 | XBT | 82222 | 910 | 39.11 | 127.11 | 15.9 | | | |
| 215 | XBT | 82222 | 942 | 39.13 | 127.06 | 14.9 | | | |
| 216 | XBT | 82222 | 1016 | 39.15 | 127.00 | 16.2 | | | |
| 216 | CTD | 82222 | 1018 | 39.11 | 127.06 | 15.5 | 32.84 | 15.6 | ----- |
| 217 | XBT | 82222 | 1204 | 39.16 | 126.54 | 15.8 | | | |
| 218 | XBT | 82222 | 1237 | 39.18 | 126.49 | 15.7 | | | |
| 219 | CTD | 82222 | 1322 | 39.14 | 126.46 | 15.6 | 32.78 | 16.6 | 32.80 |
| 220 | XBT | 82222 | 1408 | 39.10 | 126.43 | 16.4 | | | |
| 221 | XBT | 82222 | 1443 | 39.05 | 126.41 | 16.7 | | | |
| 222 | XBT | 82222 | 1515 | 39.01 | 126.40 | 16.7 | | | |
| 222 | CTD | 82222 | 1530 | 39.01 | 126.40 | 16.5 | 33.04 | 16.5 | 32.98 |
| 223 | XBT | 82222 | 1615 | 38.57 | 126.37 | 16.4 | | | |
| 224 | XBT | 82222 | 1652 | 38.52 | 126.35 | 16.9 | | | |
| 225 | CTD | 82222 | 1740 | 38.48 | 126.32 | 16.7 | 33.02 | 16.8 | 33.00 |
| 226 | XBT | 82222 | 1829 | 38.43 | 126.30 | 16.6 | | | |
| 227 | XBT | 82222 | 1859 | 38.39 | 126.27 | 15.8 | | | |
| 228 | CTD | 82222 | 1941 | 38.35 | 126.25 | 15.5 | 32.75 | 15.8 | 32.71 |
| 229 | XBT | 82222 | 2023 | 38.30 | 126.24 | 16.1 | | | |
| 230 | XBT | 82222 | 2054 | 38.26 | 126.21 | 16.0 | | | |
| 231 | XBT | 82222 | 2123 | 38.21 | 126.19 | 16.0 | | | |
| 231 | CTD | 82222 | 2137 | 38.21 | 126.19 | 15.7 | 32.77 | 15.7 | 32.79 |
| 232 | XBT | 82222 | 2220 | 38.17 | 126.16 | 16.4 | | | |
| 233 | XBT | 82222 | 2251 | 38.19 | 126.11 | 16.0 | | | |
| 234 | CTD | 82222 | 2340 | 38.21 | 126.05 | 15.8 | 32.81 | 15.9 | 32.78 |
| 236 | XBT | 82223 | 100 | 38.24 | 125.53 | 16.0 | | | |
| 237 | CTD | 82223 | 145 | 38.29 | 125.56 | 16.3 | 32.73 | 16.4 | 32.71 |
| 238 | XBT | 82223 | 230 | 38.33 | 125.58 | 16.4 | | | |
| 239 | XBT | 82223 | 300 | 38.37 | 126.00 | 16.5 | | | |
| 240 | XBT | 82223 | 333 | 38.42 | 126.02 | 16.2 | | | |
| 240 | CTD | 82223 | 348 | 38.42 | 126.02 | 16.2 | 32.77 | 16.7 | 32.73 |
| 242 | XBT | 82223 | 504 | 38.51 | 126.07 | 16.7 | | | |
| 243 | CTD | 82223 | 549 | 38.55 | 126.10 | 16.5 | 32.62 | 16.4 | 32.75 |
| 244 | XBT | 82223 | 635 | 38.59 | 126.12 | 16.6 | | | |
| 245 | XBT | 82223 | 708 | 39.04 | 126.15 | 16.2 | | | |
| 246 | CTD | 82223 | 753 | 39.08 | 126.17 | 16.2 | 32.67 | 16.3 | ----- |
| 247 | XBT | 82223 | 834 | 39.12 | 126.19 | 16.2 | | | |
| 248 | XBT | 82223 | 906 | 39.17 | 126.21 | 16.1 | | | |
| 249 | CTD | 82223 | 952 | 39.21 | 126.24 | 16.1 | 32.72 | 16.2 | 32.68 |
| 250 | XBT | 82223 | 1031 | 39.26 | 126.26 | 16.3 | | | |
| 251 | XBT | 82223 | 1104 | 39.27 | 126.19 | 16.5 | | | |
| 252 | XBT | 82223 | 1137 | 39.29 | 126.15 | 16.5 | | | |
| 252 | CTD | 82223 | 1149 | 39.32 | 126.08 | 16.4 | 32.84 | 16.4 | 32.80 |
| 253 | XBT | 82223 | 1232 | 39.31 | 126.09 | 16.5 | | | |
| 255 | CTD | 82223 | 1347 | 39.28 | 126.01 | 16.5 | 32.82 | 16.5 | 32.78 |
| 256 | XBT | 82223 | 1428 | 39.24 | 125.58 | 16.5 | | | |
| 258 | CTD | 82223 | 1538 | 39.16 | 125.54 | 16.2 | 32.64 | 16.2 | ----- |
| 259 | XBT | 82223 | 1622 | 39.11 | 125.52 | 16.3 | | | |
| 260 | XBT | 82223 | 1652 | 39.07 | 125.49 | 16.3 | | | |

| STN | TYPE | YR/DAY | GMT | LAT (NORTH) | LONG (WEST) | SURFACE TEMP (DEG C) | SURFACE SALINITY (PPT) | BUCKET TEMP (DEG C) | BOTTLE SALINITY (PPT) |
|---|---|---|---|---|---|---|---|---|---|
| 261 | CTD | 82223 | 1731 | 39.03 | 125.47 | 16.2 | 32.79 | 16.3 | 32.76 |
| 262 | XBT | 82223 | 1820 | 38.58 | 125.45 | 16.9 | | | |
| 263 | XBT | 82223 | 1848 | 38.54 | 125.43 | 16.7 | | | |
| 264 | CTD | 82223 | 1929 | 38.50 | 125.41 | 16.2 | 32.87 | 16.4 | 32.87 |
| 265 | XBT | 82223 | 2012 | 38.46 | 125.38 | 16.5 | | | |
| 266 | XBT | 82223 | 2042 | 38.42 | 125.36 | 16.9 | | | |
| 267 | XBT | 82223 | 2117 | 38.37 | 125.34 | 16.8 | | | |
| 267 | CTD | 82223 | 2146 | 38.37 | 125.34 | 16.7 | 32.79 | 16.8 | 32.88 |
| 268 | XBT | 82223 | 2308 | 38.32 | 125.30 | 16.2 | | | |
| 269 | XBT | 82223 | 2339 | 38.33 | 125.26 | 16.9 | | | |
| 270 | CTD | 82224 | 26 | 38.35 | 125.20 | 16.8 | 32.76 | 16.9 | 32.71 |
| 271 | XBT | 82224 | 117 | 38.37 | 125.15 | 16.8 | | | |
| 273 | CTD | 82224 | 252 | 38.42 | 125.12 | 16.7 | 32.85 | 16.8 | 32.78 |
| 275 | XBT | 82224 | 505 | 38.51 | 125.17 | 16.2 | | | |
| 276 | XBT | 82224 | 558 | 38.55 | 125.19 | 16.2 | | | |
| 277 | XBT | 82224 | 708 | 38.59 | 125.21 | 16.9 | | | |
| 278 | XBT | 82224 | 815 | 39.03 | 125.23 | 16.6 | | | |
| 280 | XBT | 82224 | 1101 | 39.12 | 125.28 | 16.9 | | | |
| 282 | XBT | 82224 | 1428 | 39.21 | 125.32 | 16.5 | | | |
| 283 | XBT | 82224 | 1601 | 39.25 | 125.30 | 16.5 | | | |
| 283 | CTD | 82224 | 1805 | 39.28 | 125.22 | 16.8 | 32.84 | ---- | ----- |
| 286 | XBT | 82224 | 1839 | 39.24 | 125.23 | 16.8 | | | |
| 287 | XBT | 82224 | 1909 | 39.19 | 125.20 | 16.7 | | | |
| 288 | XBT | 82224 | 1941 | 39.15 | 125.17 | 17.0 | | | |
| 289 | CTD | 82224 | 2023 | 39.11 | 125.15 | 16.5 | 32.86 | 16.6 | 32.82 |
| 290 | XBT | 82224 | 2101 | 39.06 | 125.13 | 16.5 | | | |
| 291 | XBT | 82224 | 2128 | 39.02 | 125.11 | 16.6 | | | |
| 292 | XBT | 82224 | 2155 | 38.58 | 125.08 | 16.6 | | | |
| 293 | CTD | 82224 | 2244 | 38.54 | 125.06 | 16.7 | 32.84 | 16.8 | 32.77 |
| 294 | XBT | 82224 | 2328 | 38.50 | 125.06 | 16.6 | | | |
| 295 | XBT | 82225 | 5 | 38.45 | 125.06 | 16.8 | | | |
| 296 | XBT | 82225 | 40 | 38.40 | 125.05 | 16.6 | | | |
| 297 | XBT | 82225 | 111 | 38.35 | 125.05 | 16.4 | | | |
| 300 | XBT | 82225 | 322 | 38.21 | 125.04 | 16.3 | | | |
| 301 | XBT | 82225 | 400 | 38.16 | 125.04 | 13.9 | | | |
| 302 | XBT | 82225 | 459 | 38.11 | 125.03 | 14.1 | | | |
| 303 | XBT | 82225 | 533 | 38.06 | 125.03 | 15.5 | | | |
| 304 | XBT | 82225 | 606 | 38.01 | 125.03 | 15.5 | | | |
| 305 | XBT | 82225 | 659 | 38.03 | 125.10 | 15.0 | | | |
| 306 | XBT | 82225 | 742 | 38.05 | 125.15 | 14.9 | | | |
| 307 | XBT | 82225 | 822 | 38.06 | 125.21 | 14.9 | | | |
| 308 | XBT | 82225 | 908 | 38.11 | 125.20 | 14.5 | | | |
| 309 | XBT | 82225 | 1004 | 38.16 | 125.21 | 15.1 | | | |
| 310 | XBT | 82225 | 1109 | 38.21 | 125.21 | 16.2 | | | |
| 311 | XBT | 82225 | 1204 | 38.25 | 125.21 | 16.3 | | | |
| 312 | XBT | 82225 | 1251 | 38.20 | 125.17 | 16.0 | | | |
| 313 | XBT | 82225 | 1336 | 38.16 | 125.15 | 14.8 | | | |
| 314 | XBT | 82225 | 1419 | 38.12 | 125.11 | 14.0 | | | |
| 315 | XBT | 82225 | 1501 | 38.08 | 125.07 | 14.5 | | | |

| STN | TYPE | YR/DAY | GMT | LAT (NORTH) | LONG (WEST) | SURFACE TEMP (DEG C) | SURFACE SALINITY (PPT) | BUCKET TEMP (DEG C) | BOTTLE SALINITY (PPT) |
|---|---|---|---|---|---|---|---|---|---|
| 316 | XBT | 82225 | 1531 | 38.04 | 125.04 | 14.8 | | | |
| 317 | XBT | 82225 | 1601 | 37.60 | 125.01 | 15.8 | | | |
| 318 | XBT | 82225 | 1624 | 37.57 | 124.58 | 16.4 | | | |
| 319 | XBT | 82225 | 1658 | 37.53 | 124.54 | 16.1 | | | |
| 320 | XBT | 82225 | 1728 | 37.49 | 124.50 | 15.4 | | | |
| 321 | XBT | 82225 | 1758 | 37.45 | 124.46 | 14.7 | | | |
| 322 | XBT | 82225 | 1827 | 37.42 | 124.42 | 13.9 | | | |
| 323 | XBT | 82225 | 1857 | 37.38 | 124.38 | 15.4 | | | |
| 324 | XBT | 82225 | 1928 | 37.34 | 124.35 | 16.4 | | | |
| 325 | XBT | 82225 | 2000 | 37.31 | 124.31 | 15.8 | | | |
| 326 | XBT | 82225 | 2034 | 37.27 | 124.27 | 15.9 | | | |
| 327 | XBT | 82225 | 2106 | 37.23 | 124.23 | 15.9 | | | |
| 328 | XBT | 82225 | 2136 | 37.20 | 124.19 | 16.0 | | | |
| 329 | XBT | 82225 | 2205 | 37.16 | 124.16 | 15.0 | | | |
| 330 | XBT | 82225 | 2239 | 37.13 | 124.13 | 15.0 | | | |
| 331 | XBT | 82225 | 2313 | 37.09 | 124.09 | 15.0 | | | |
| 332 | XBT | 82225 | 2343 | 37.05 | 124.05 | 14.5 | | | |
| 333 | XBT | 82226 | 26 | 36.60 | 124.00 | 15.1 | | | |
| 334 | XBT | 82226 | 59 | 36.59 | 123.54 | 15.5 | | | |
| 335 | XBT | 82226 | 131 | 36.58 | 123.48 | 15.3 | | | |
| 336 | XBT | 82226 | 200 | 36.57 | 123.43 | 15.1 | | | |
| 337 | XBT | 82226 | 227 | 36.56 | 123.37 | 15.2 | | | |
| 338 | XBT | 82226 | 258 | 36.55 | 123.31 | 15.6 | | | |
| 339 | XBT | 82226 | 332 | 36.54 | 123.24 | 15.4 | | | |
| 340 | XBT | 82226 | 402 | 36.53 | 123.18 | 15.5 | | | |
| 341 | XBT | 82226 | 431 | 36.52 | 123.13 | 15.4 | | | |
| 342 | XBT | 82226 | 503 | 36.51 | 123.07 | 15.3 | | | |
| 343 | XBT | 82226 | 534 | 36.50 | 123.01 | 14.9 | | | |
| 345 | XBT | 82226 | 638 | 36.48 | 122.49 | 14.9 | | | |
| 346 | XBT | 82226 | 711 | 36.47 | 122.43 | 14.3 | | | |
| 348 | XBT | 82226 | 813 | 36.45 | 122.32 | 13.6 | | | |
| 349 | XBT | 82226 | 846 | 36.44 | 122.26 | 13.3 | | | |
| 350 | XBT | 82226 | 916 | 36.43 | 122.20 | 13.1 | | | |
| 351 | XBT | 82226 | 948 | 36.42 | 122.14 | 13.6 | | | |
| 352 | XBT | 82226 | 1019 | 36.41 | 122.09 | 13.9 | | | |
| 353 | XBT | 82226 | 1104 | 36.40 | 122.01 | 12.9 | | | |

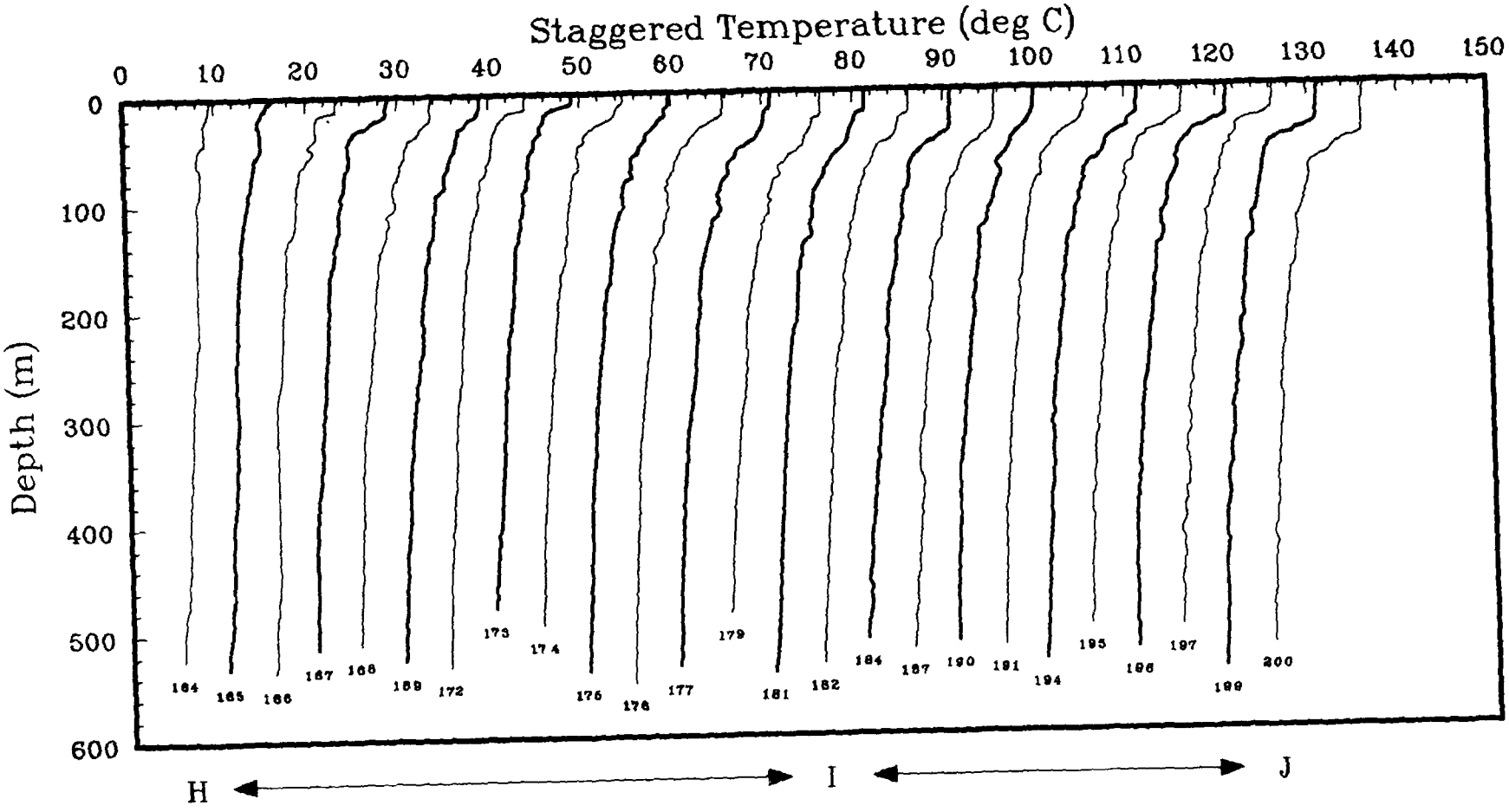



Figure 16(a): Staggered temperature profiles from the XBT's. Profiles are staggered by a multiple of 5C.

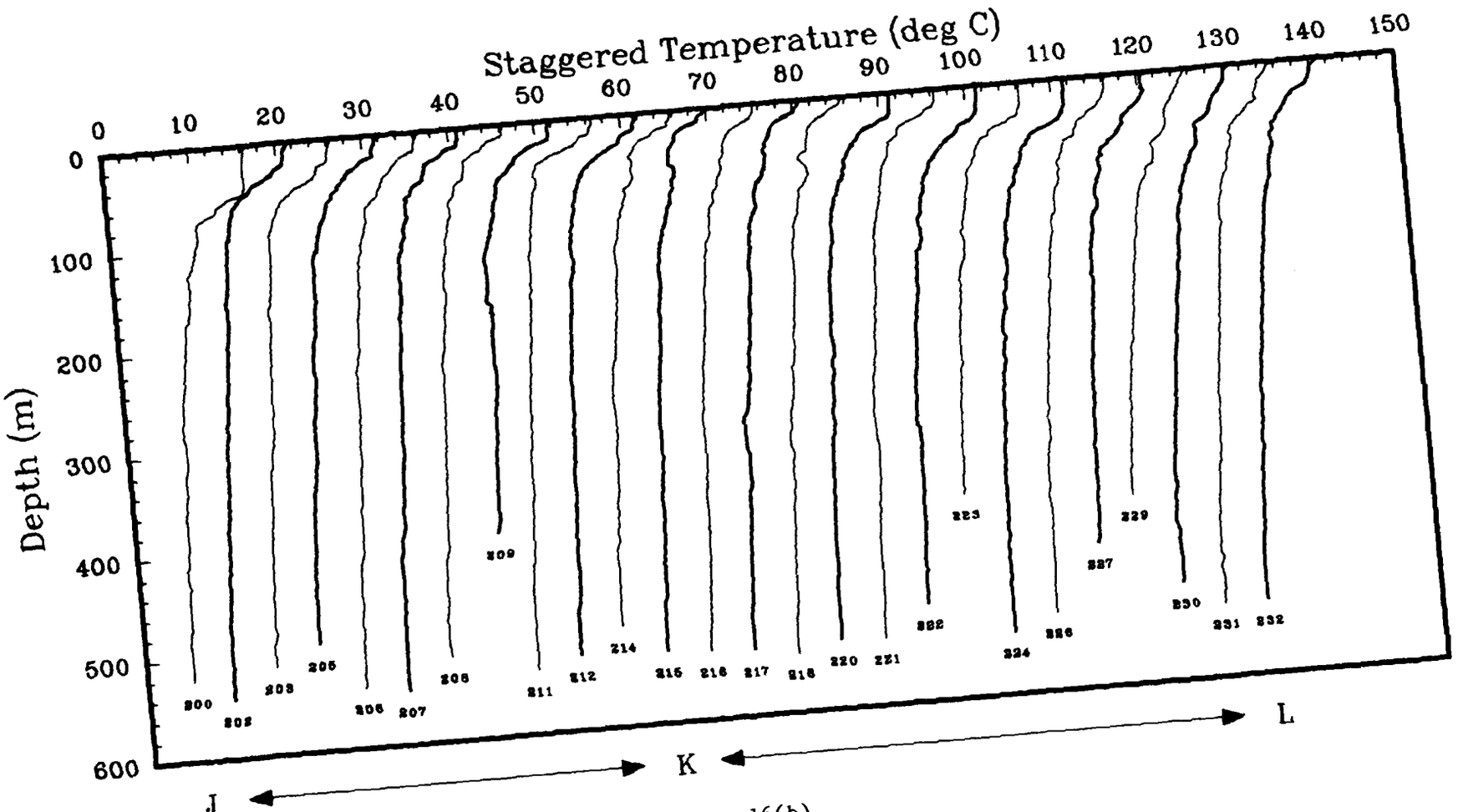

Staggered Temperature (deg C)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Depth (m)
0
100
200
300
400
500
600
200
202
203
205
206
207
208
209
211
212
214
215
216
217
218
220
221
222
223
224
226
227
229
230
231
232
J
K
L

Figure 16(b).

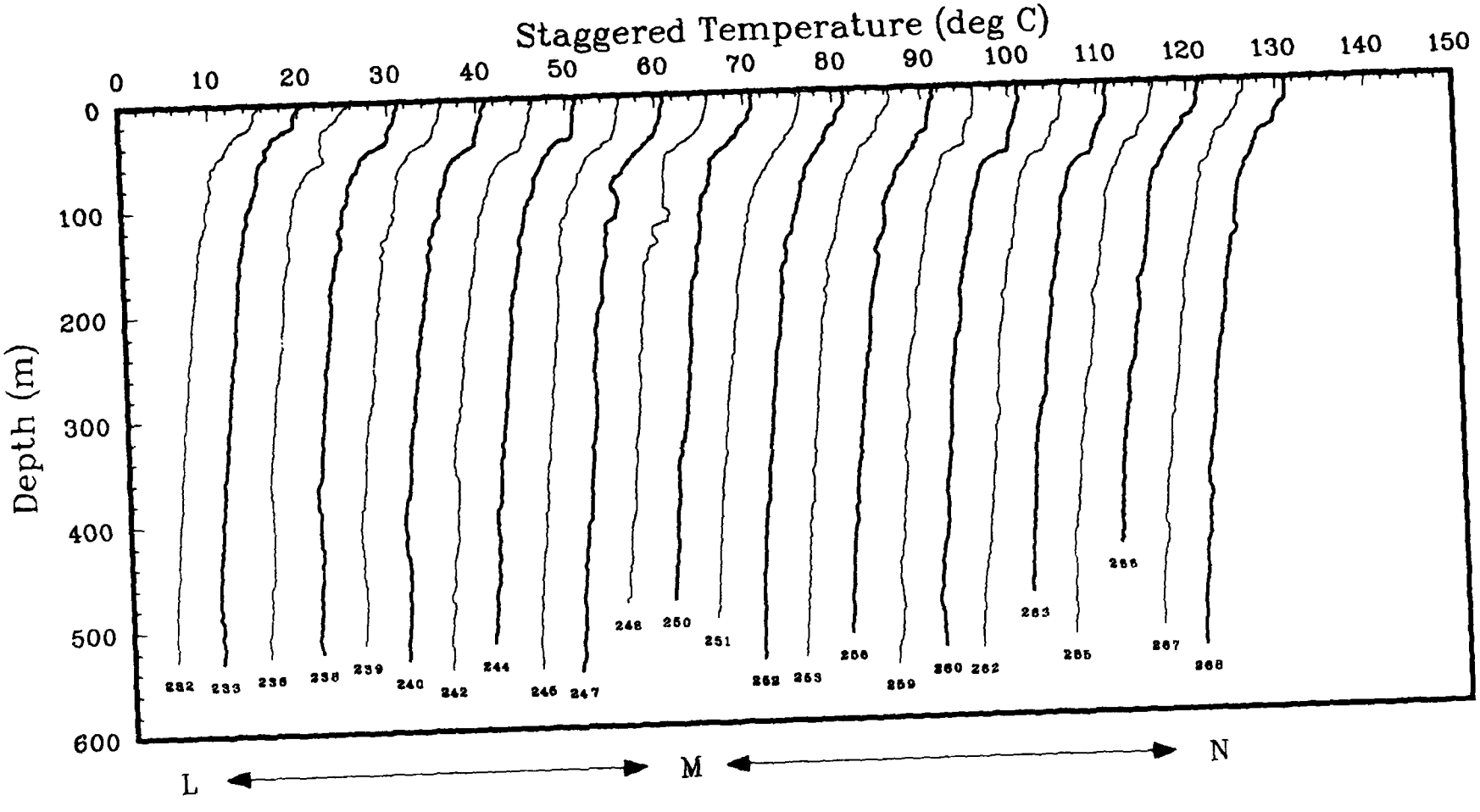

Staggered Temperature (deg C)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Depth (m)
0
100
200
300
400
500
600
232
233
236
238
239
240
242
244
246
247
248
250
251
252
253
256
259
260
262
263
265
266
267
268
L
M
N

Figure 16(c).

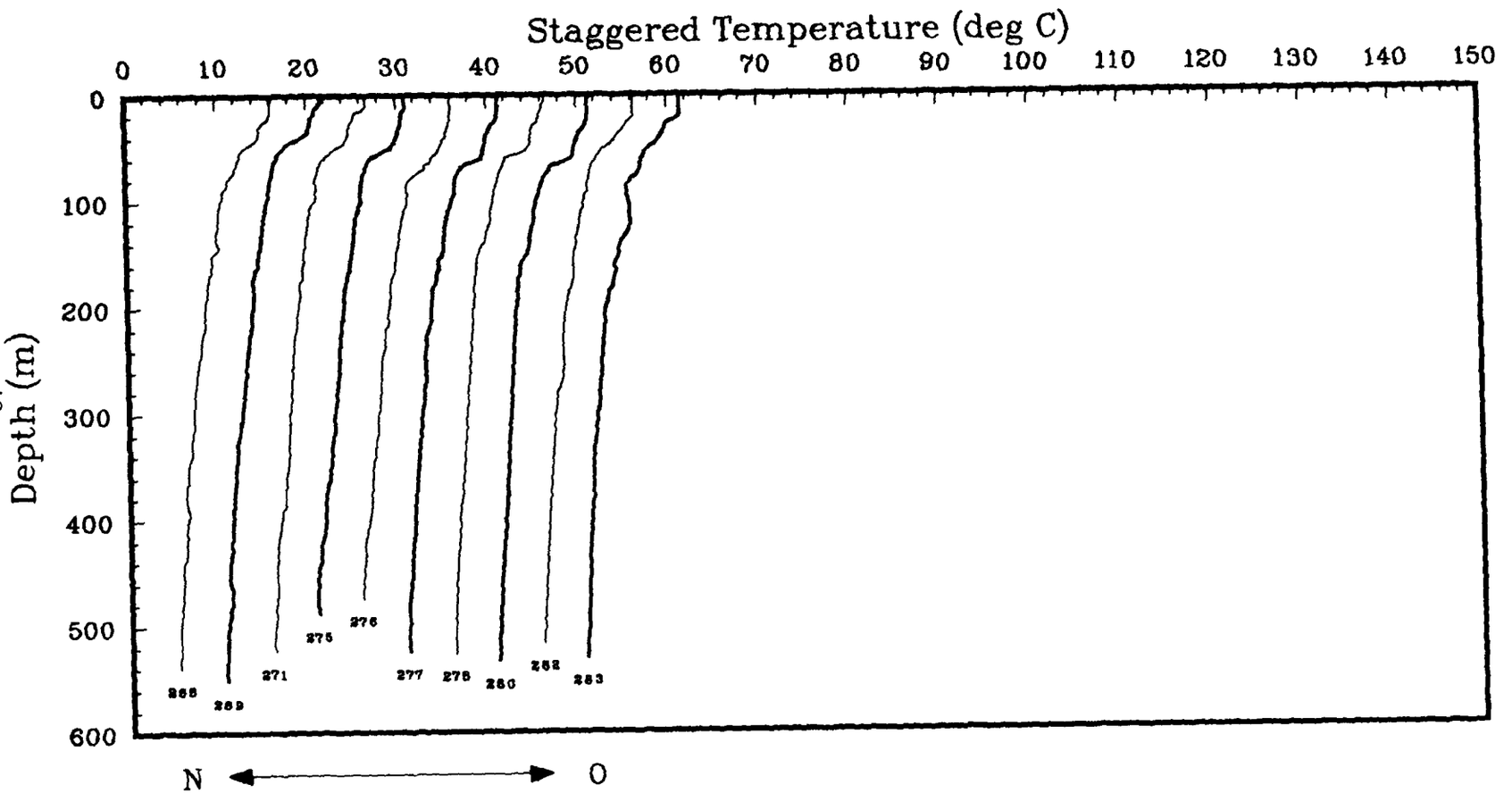

Staggered Temperature (deg C)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Depth (m)
0
100
200
300
400
500
600
268
269
271
275
276
277
278
280
282
283
N
O

Figure 16(d).

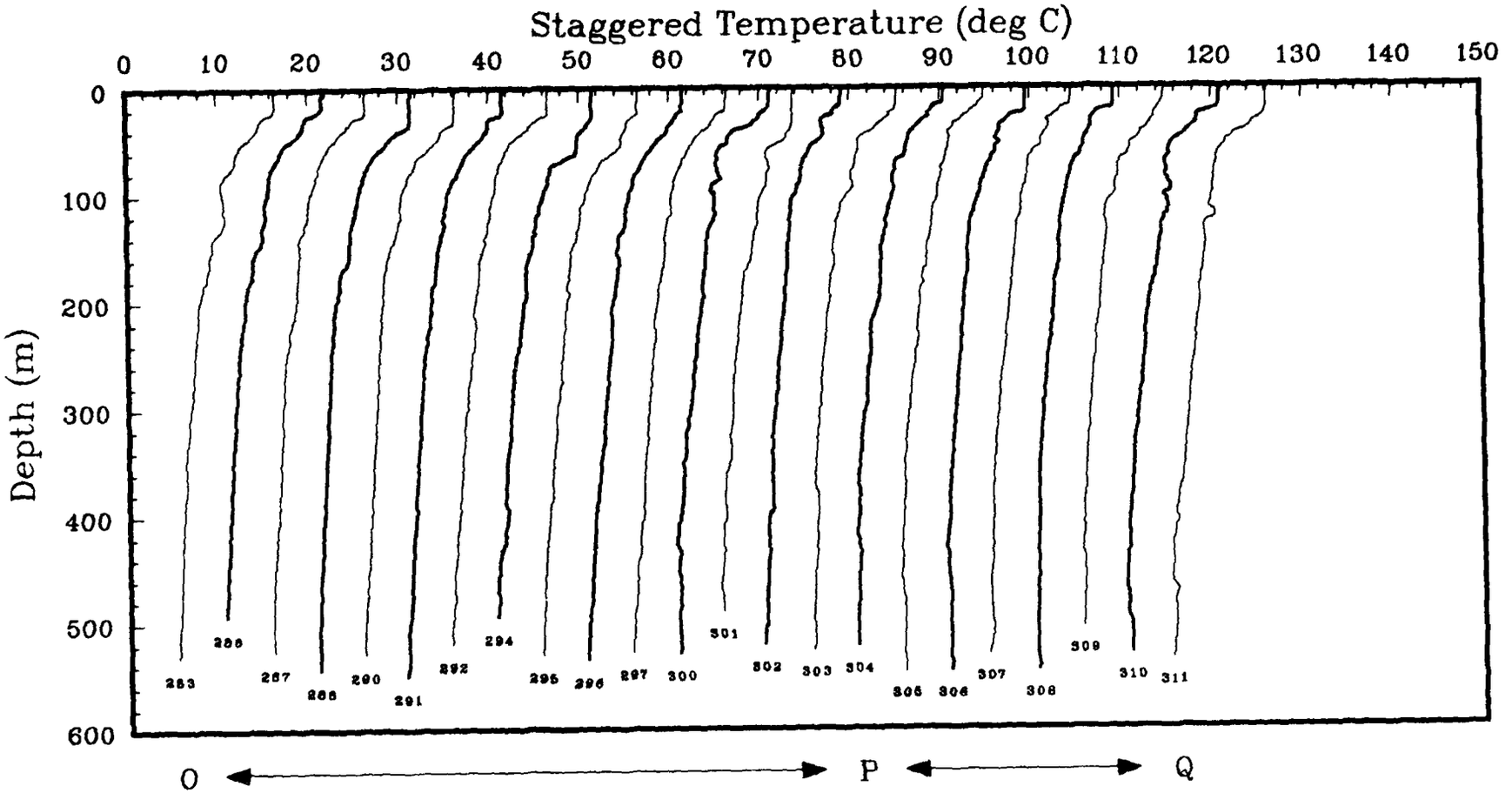

Staggered Temperature (deg C)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
Depth (m)
0 100 200 300 400 500 600
283 286 287 288 290 291 292 294 295 296 297 300 301 302 303 304 305 306 307 308 309 310 311
O
P
Q

Figure 16(e).

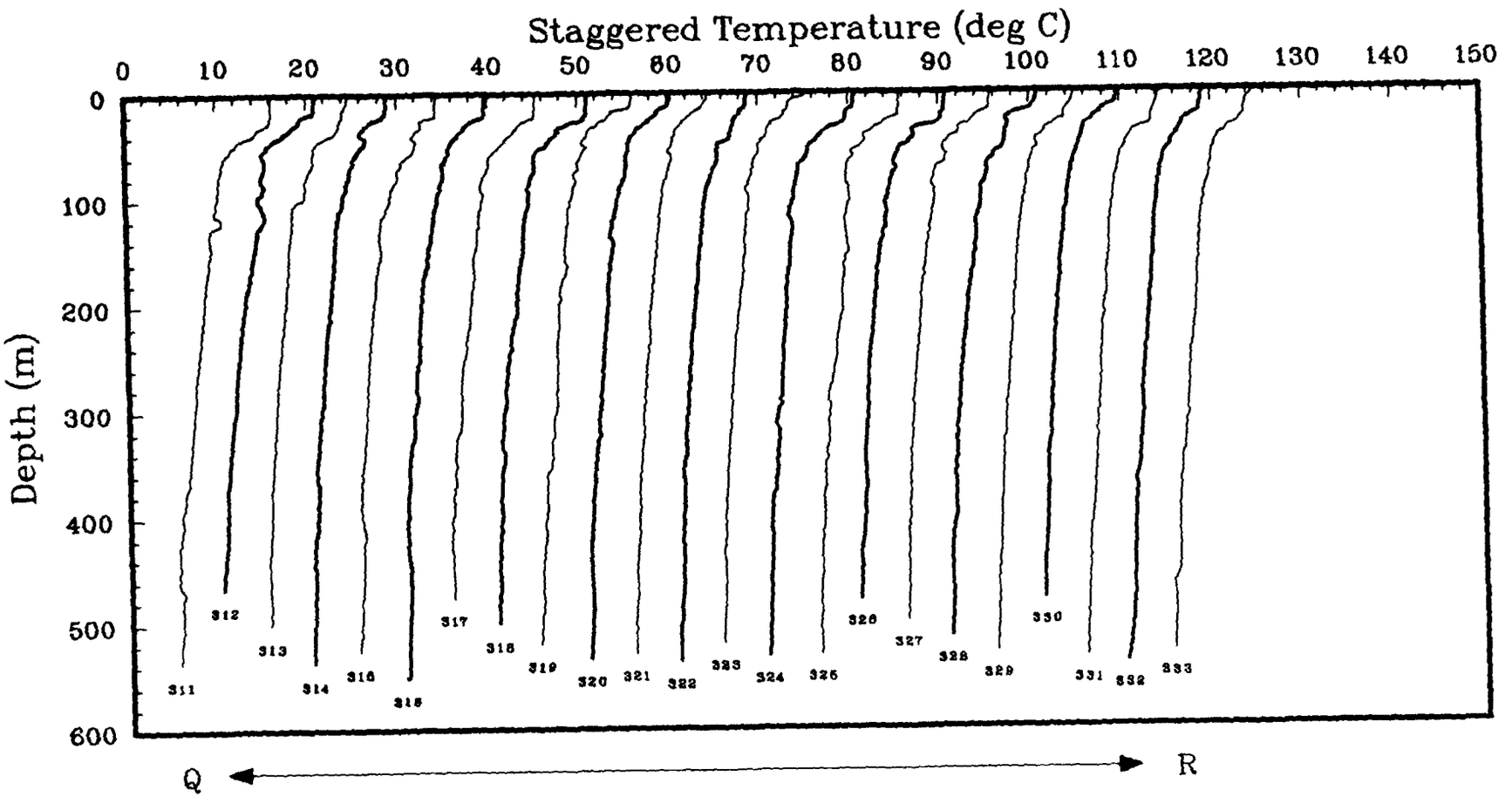

Staggered Temperature (deg C)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Depth (m)
0
100
200
300
400
500
600
311
312
313
314
315
316
317
318
319
320
321
322
323
324
325
326
327
328
329
330
331
332
333
Q
R

Figure 16(f).

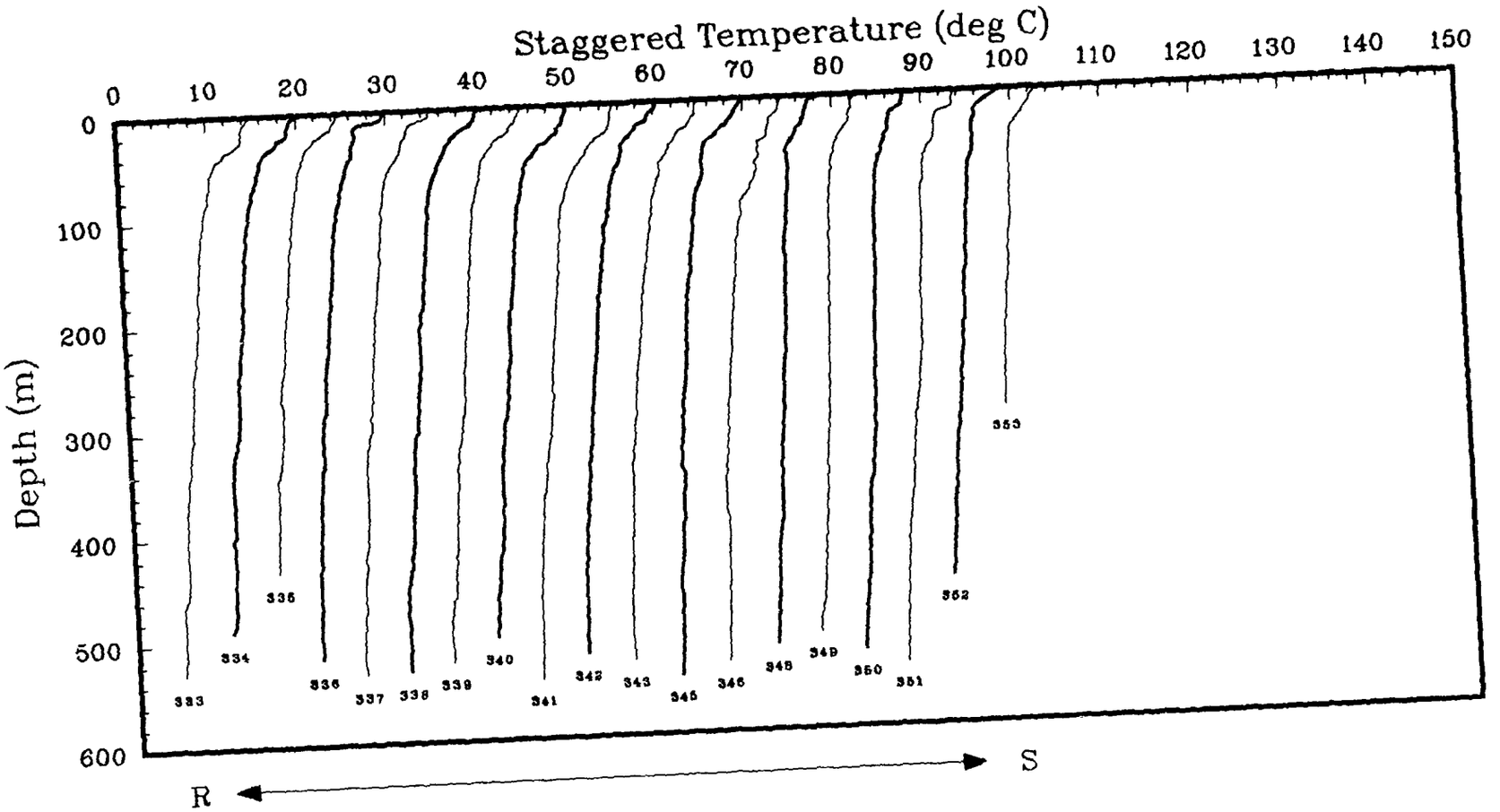

Staggered Temperature (deg C)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Depth (m)
0
100
200
300
400
500
600
333
334
335
336
337
338
339
340
341
342
343
345
346
348
349
350
351
352
353
R
S

Figure 16(g).

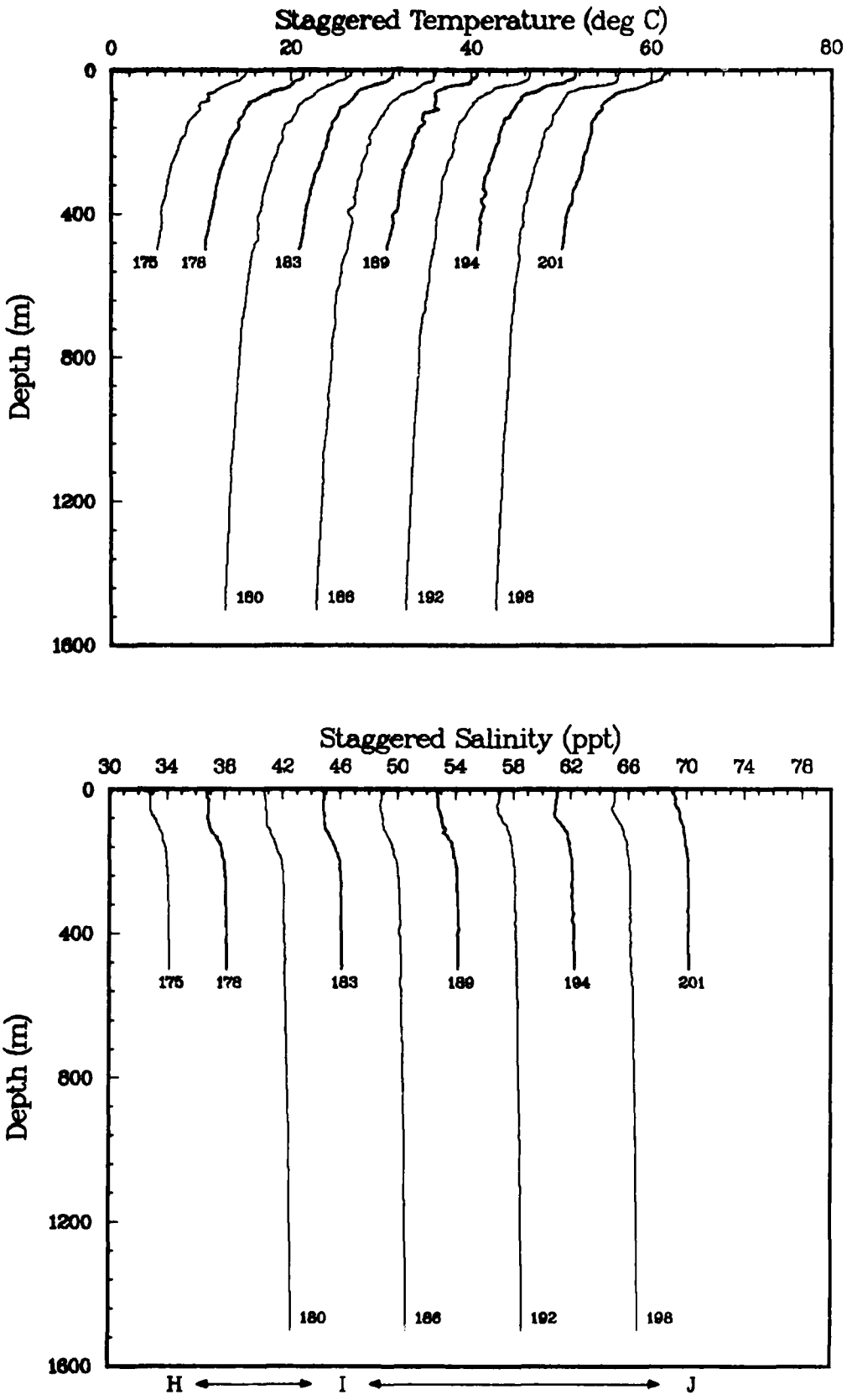



Figure 17(a): Temperature profiles, staggered by multiples of 5C, and salinity profiles, staggered by multiples of 4 ppt.

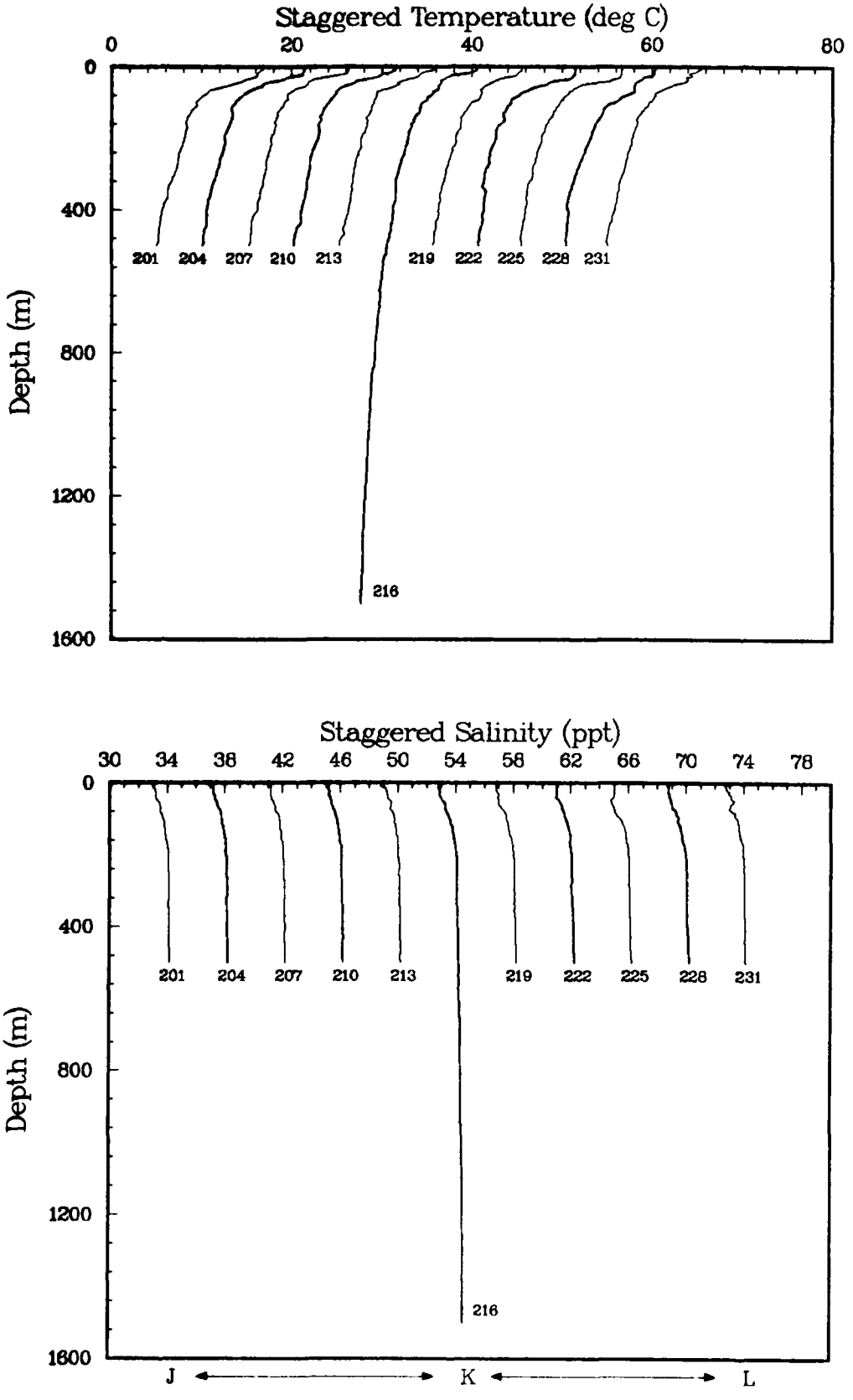

Staggered Temperature (deg C)
0
20
40
60
80
0
400
800
1200
1600
Depth (m)
201
204
207
210
213
219
222
225
228
231
216
Staggered Salinity (ppt)
30
34
38
42
46
50
54
58
62
66
70
74
78
0
400
800
1200
1600
Depth (m)
201
204
207
210
213
219
222
225
228
231
216
J
K
L

Figure 17(b).

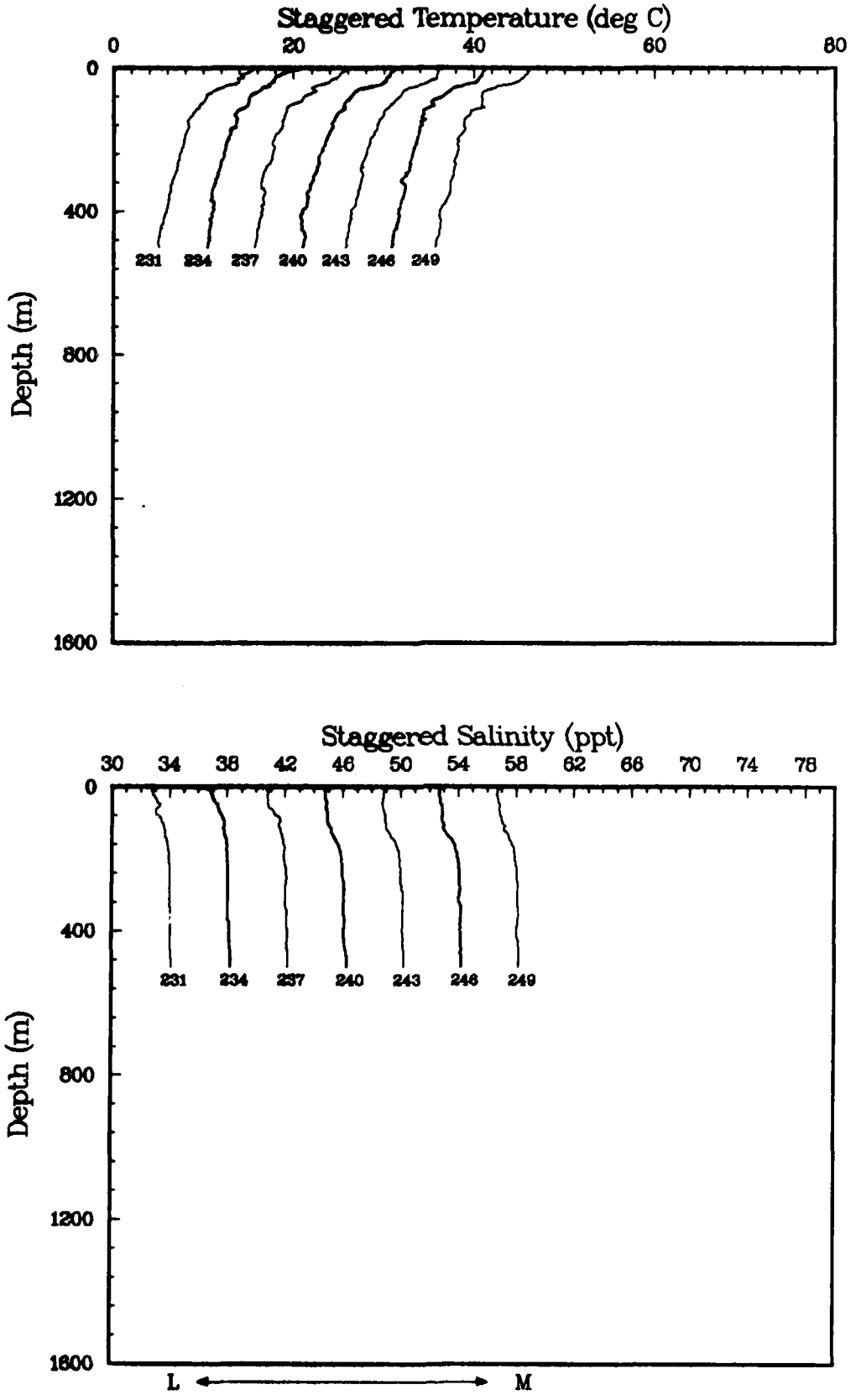

Staggered Temperature (deg C)
0
20
40
60
80
0
400
800
1200
1600
Depth (m)
231
234
237
240
243
246
249
Staggered Salinity (ppt)
30
34
38
42
46
50
54
58
62
66
70
74
78
0
400
800
1200
1600
Depth (m)
231
234
237
240
243
246
249
L
M

Figure 17(c).

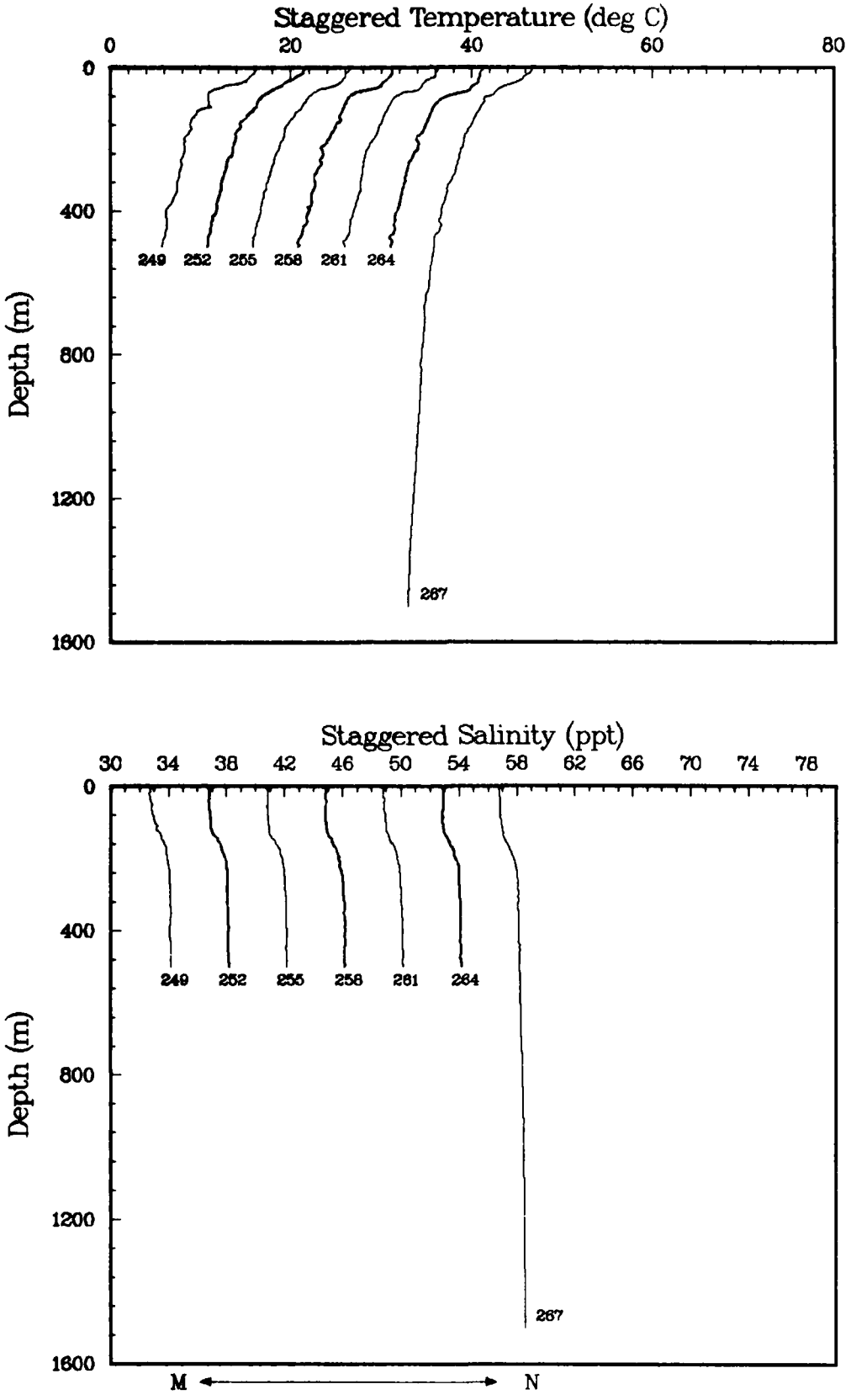

Staggered Temperature (deg C)
0
20
40
60
80
0
400
800
1200
1600
Depth (m)
249
252
255
258
261
264
267
Staggered Salinity (ppt)
30
34
38
42
46
50
54
58
62
66
70
74
78
0
400
800
1200
1600
Depth (m)
249
252
255
258
261
264
267
M
N

Figure 17(d).

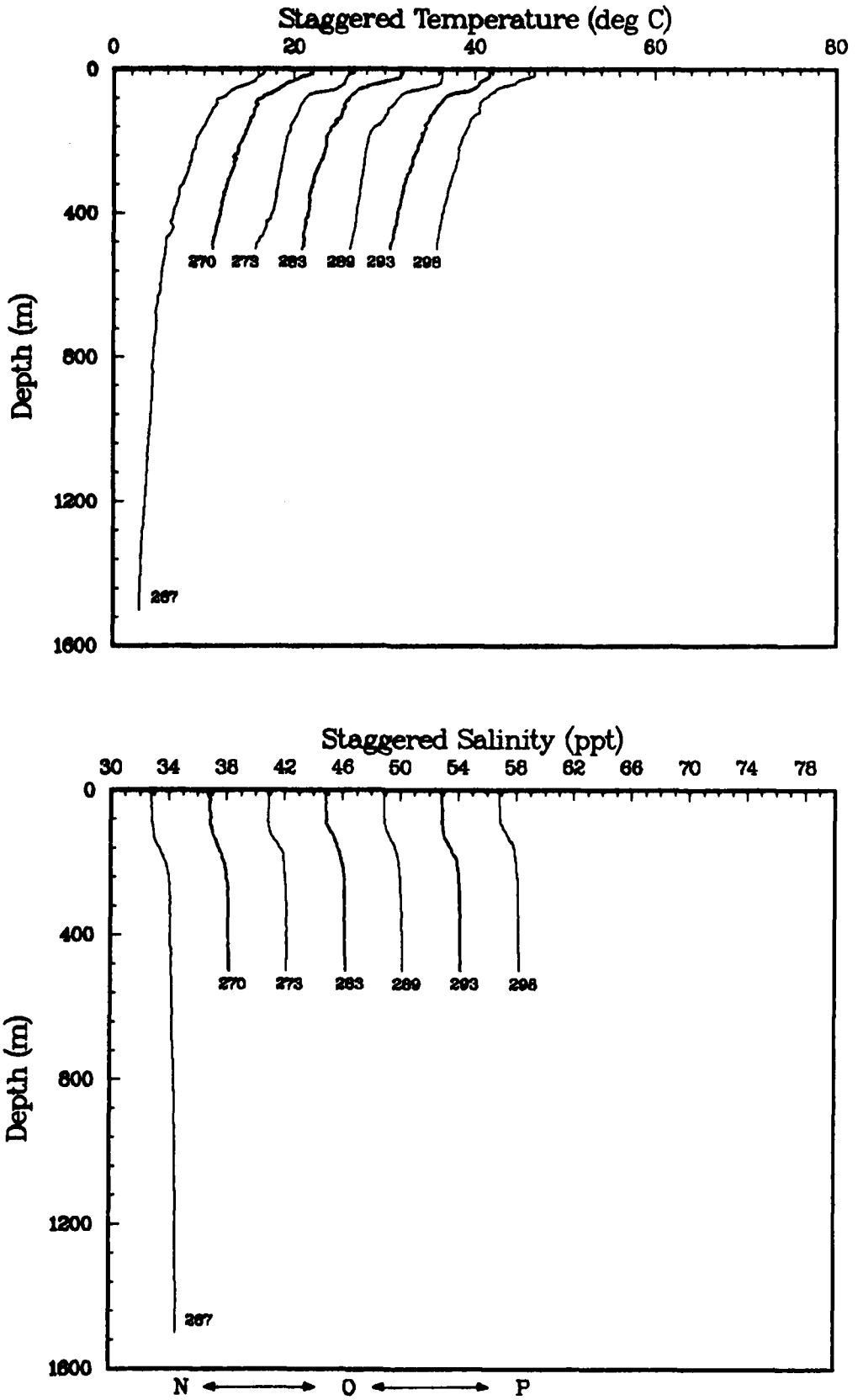

Staggered Temperature (deg C)
0
20
40
60
80
0
400
800
1200
1600
Depth (m)
270
273
283
289
293
298
267
Staggered Salinity (ppt)
30
34
38
42
46
50
54
58
62
66
70
74
78
0
400
800
1200
1600
Depth (m)
270
273
283
289
293
298
267
N
O
P

Figure 17(e).

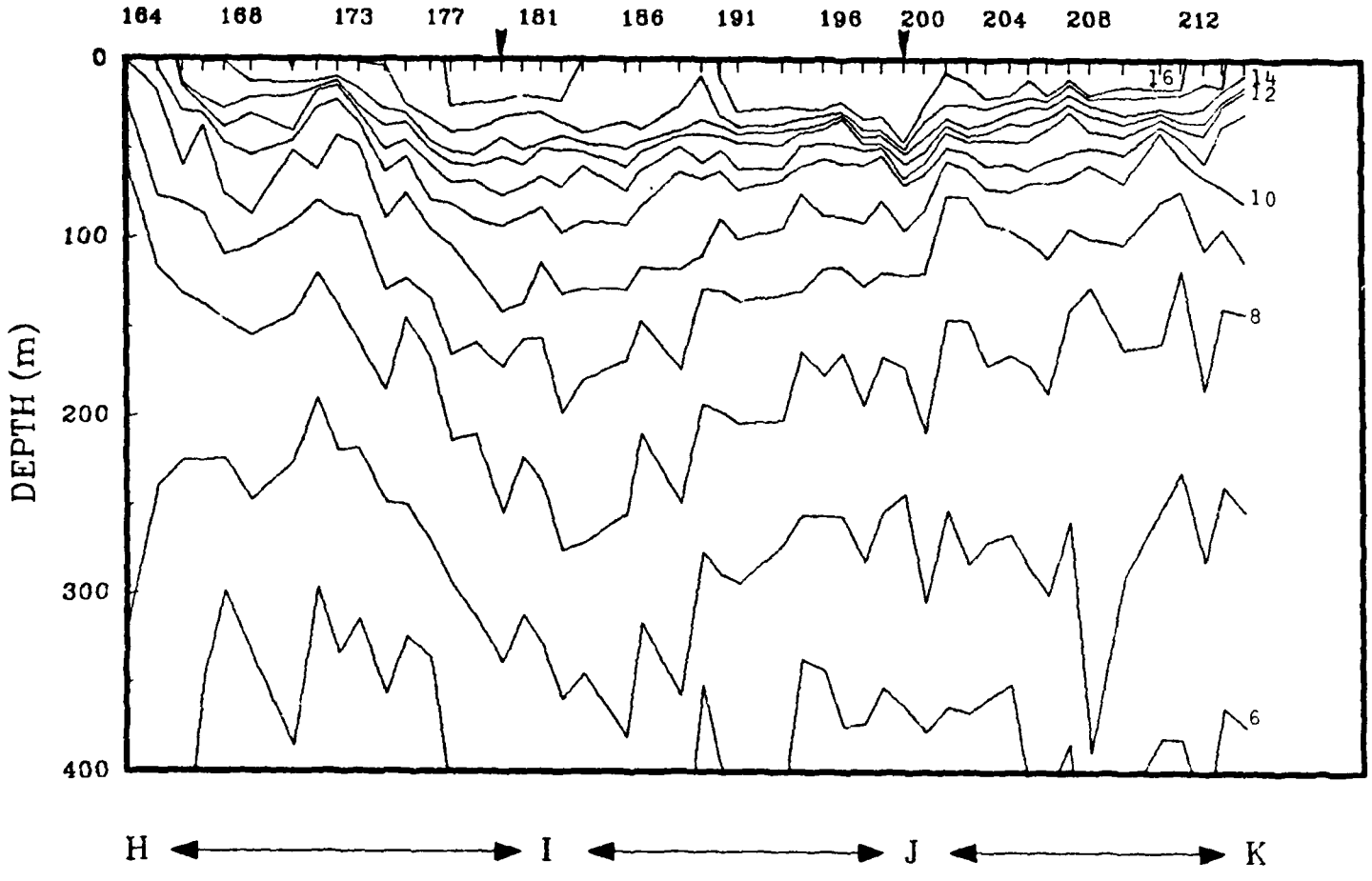



Figure 18(a): Isotherms from XBT's and CTD's. Tick marks along the horizontal axis show station positions. Some station numbers are shown. Arrows indicate the positions where the cruise track changed direction.

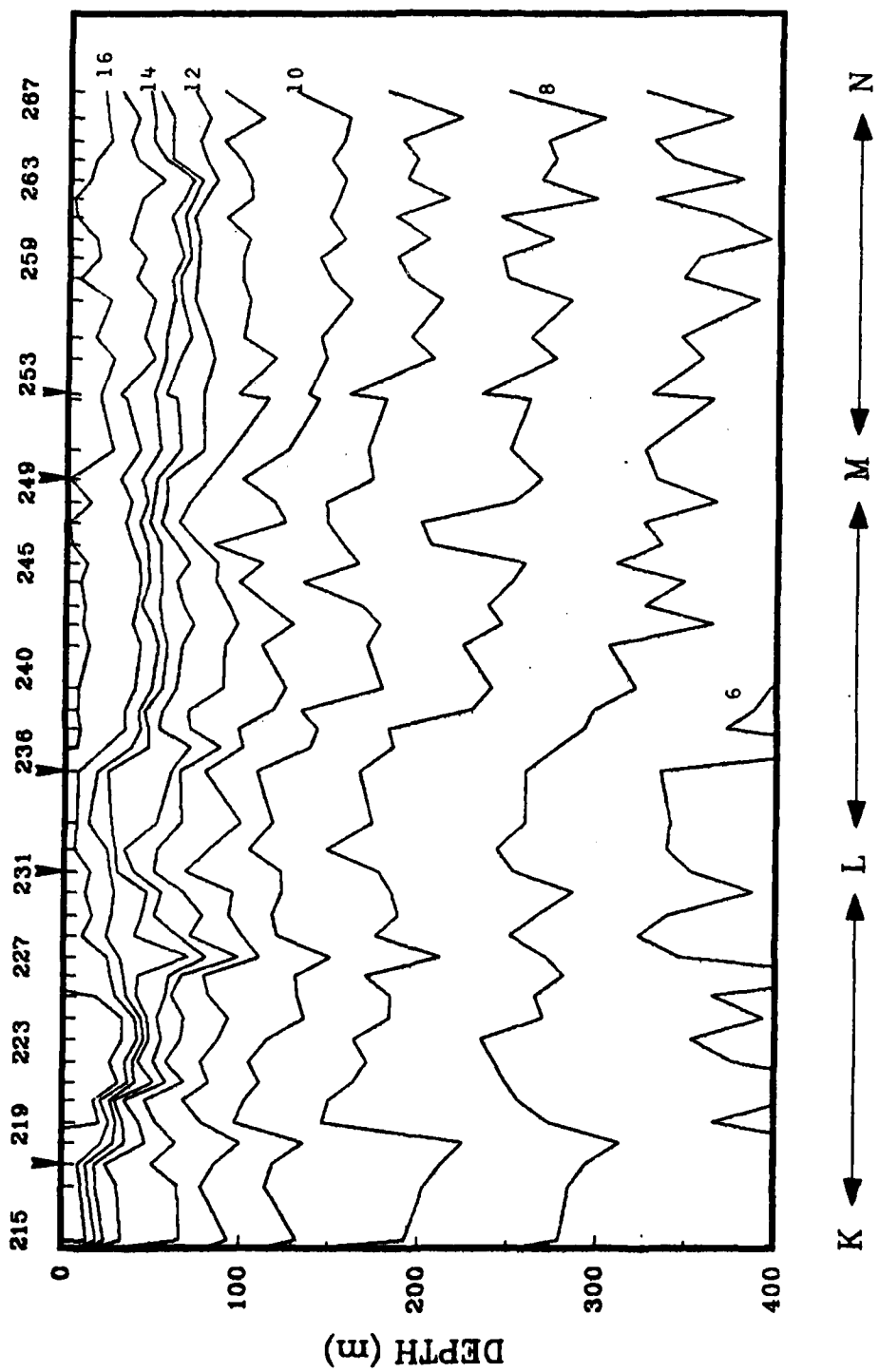

DEPTH (m)
0
100
200
300
400
215
219
223
227
231
236
240
245
249
253
259
263
267
16
14
12
10
8
6
K
L
M
N

Figure 18(b).

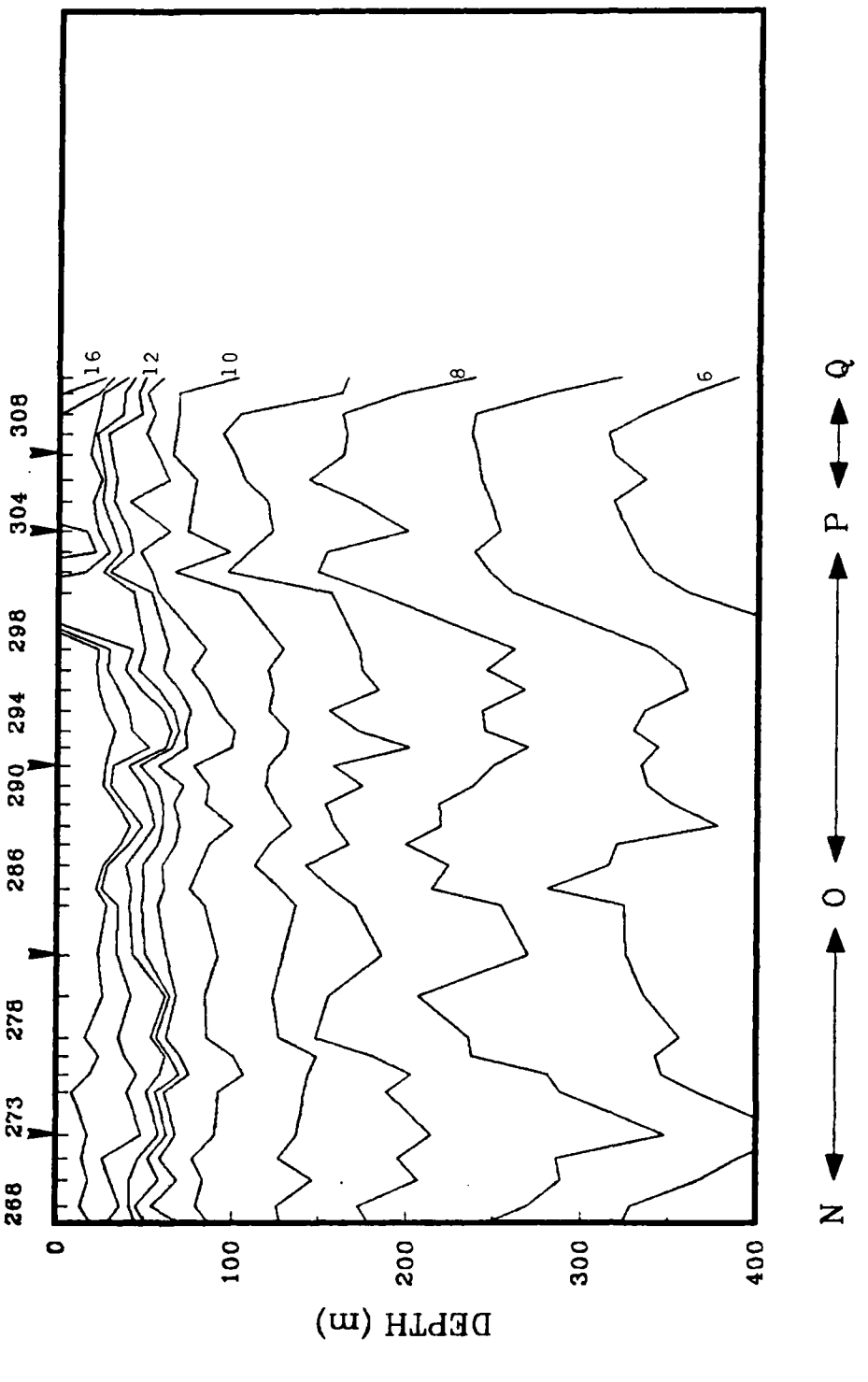

DEPTH (m)
0
100
200
300
400
268
273
278
286
290
294
298
304
308
16
12
10
8
6
N
O
P
Q

Figure 18(c).

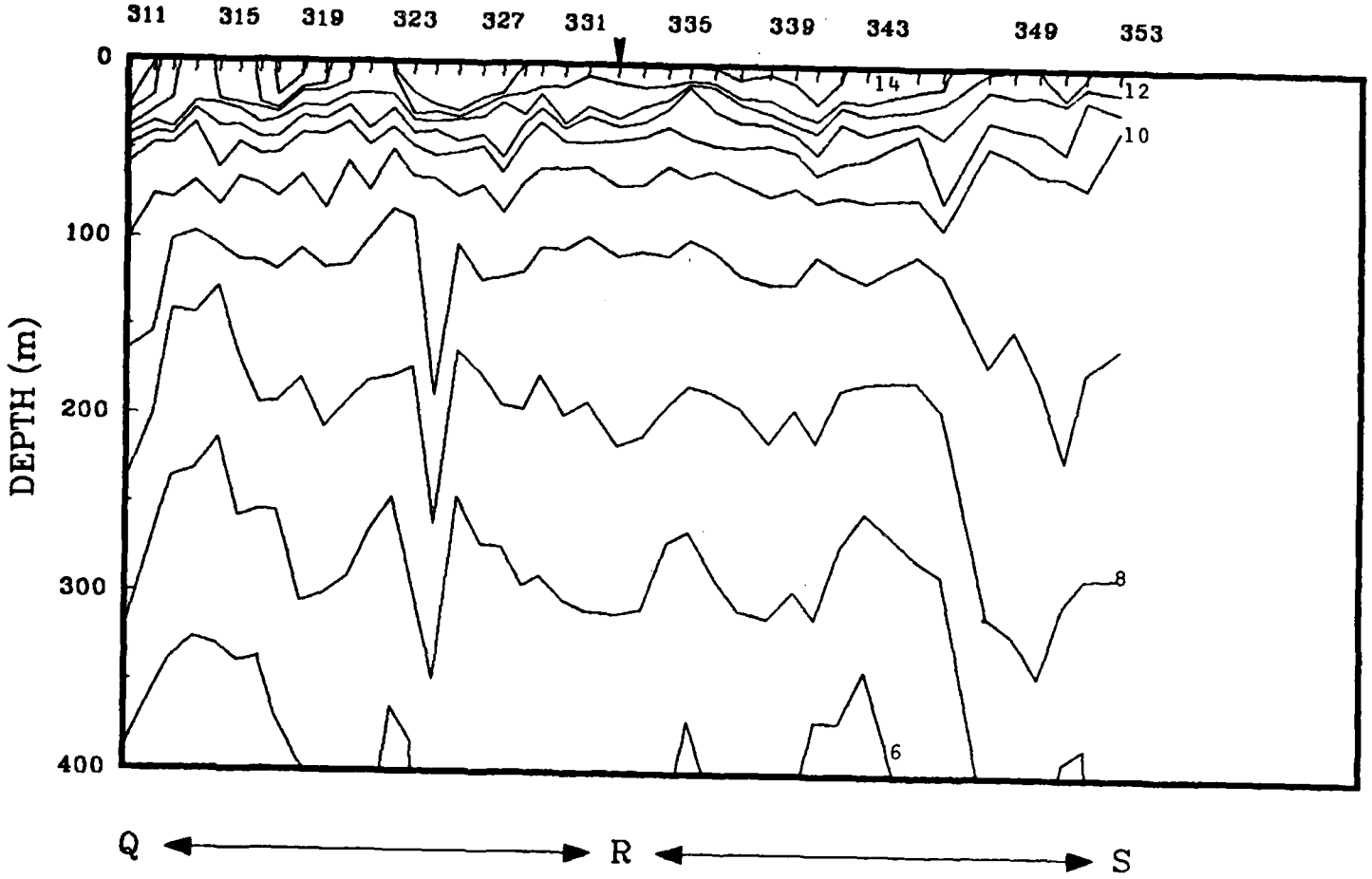

311
315
319
323
327
331
335
339
343
349
353
0
100
200
300
400
DEPTH (m)
14
12
10
8
6
Q
R
S

Figure 18(d).

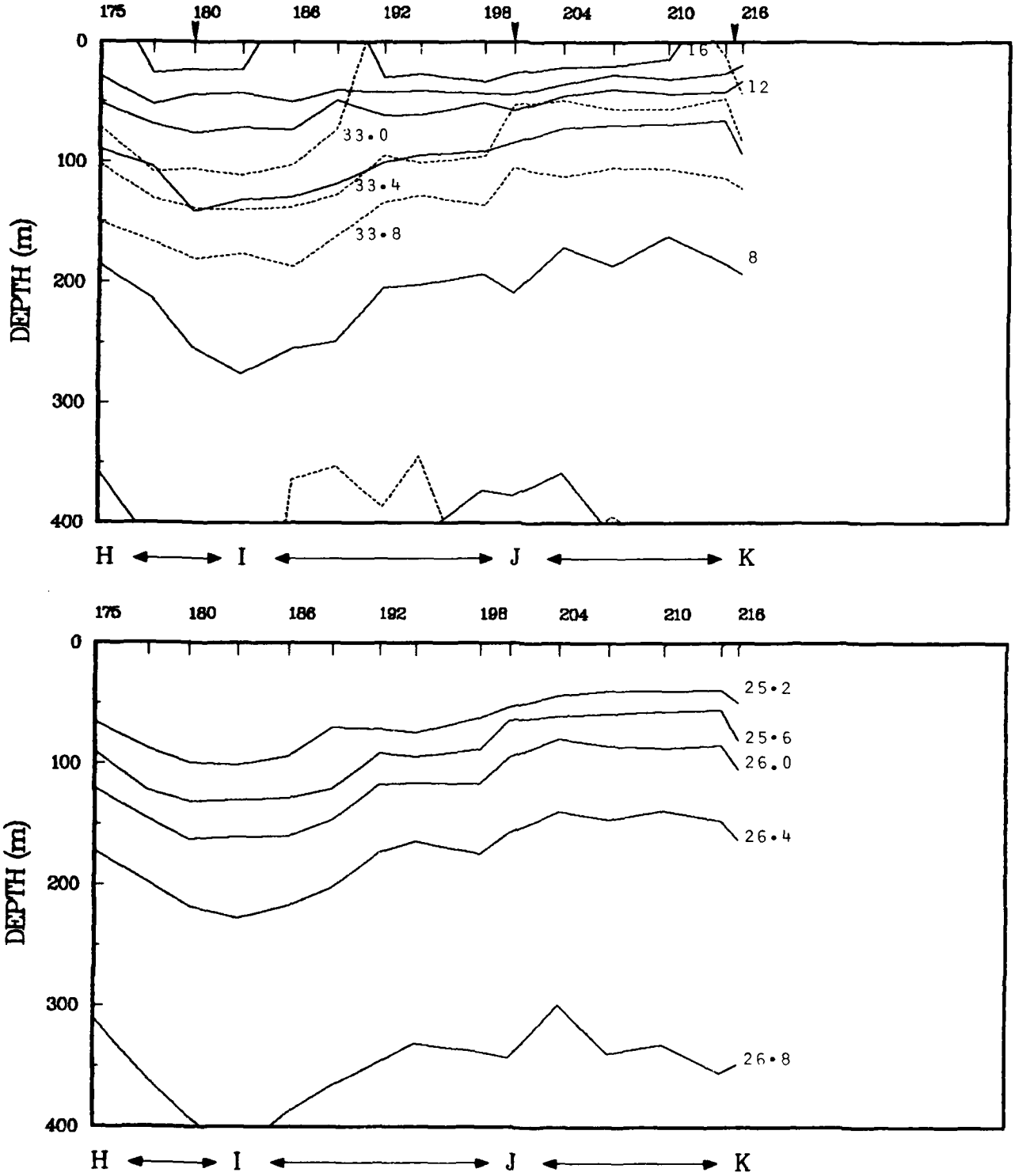



Figure 19(a): Isopleths of temperature, salinity and sigma-t from the CTD's.

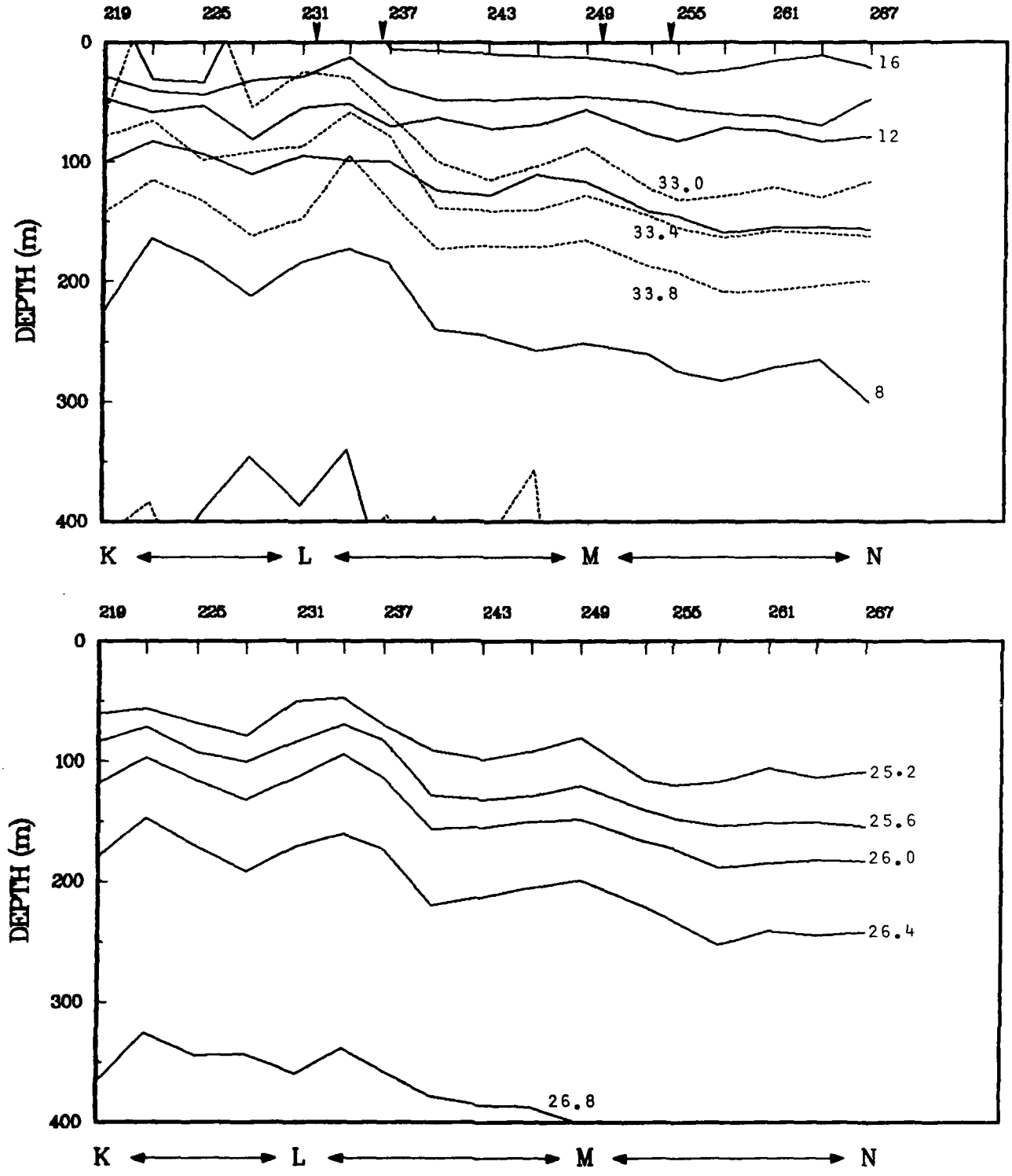

219
225
231
237
243
249
255
261
267
0
100
200
300
400
DEPTH (m)
16
12
33.0
33.4
33.8
8
K
L
M
N
25.2
25.6
26.0
26.4
26.8

Figure 19(b).

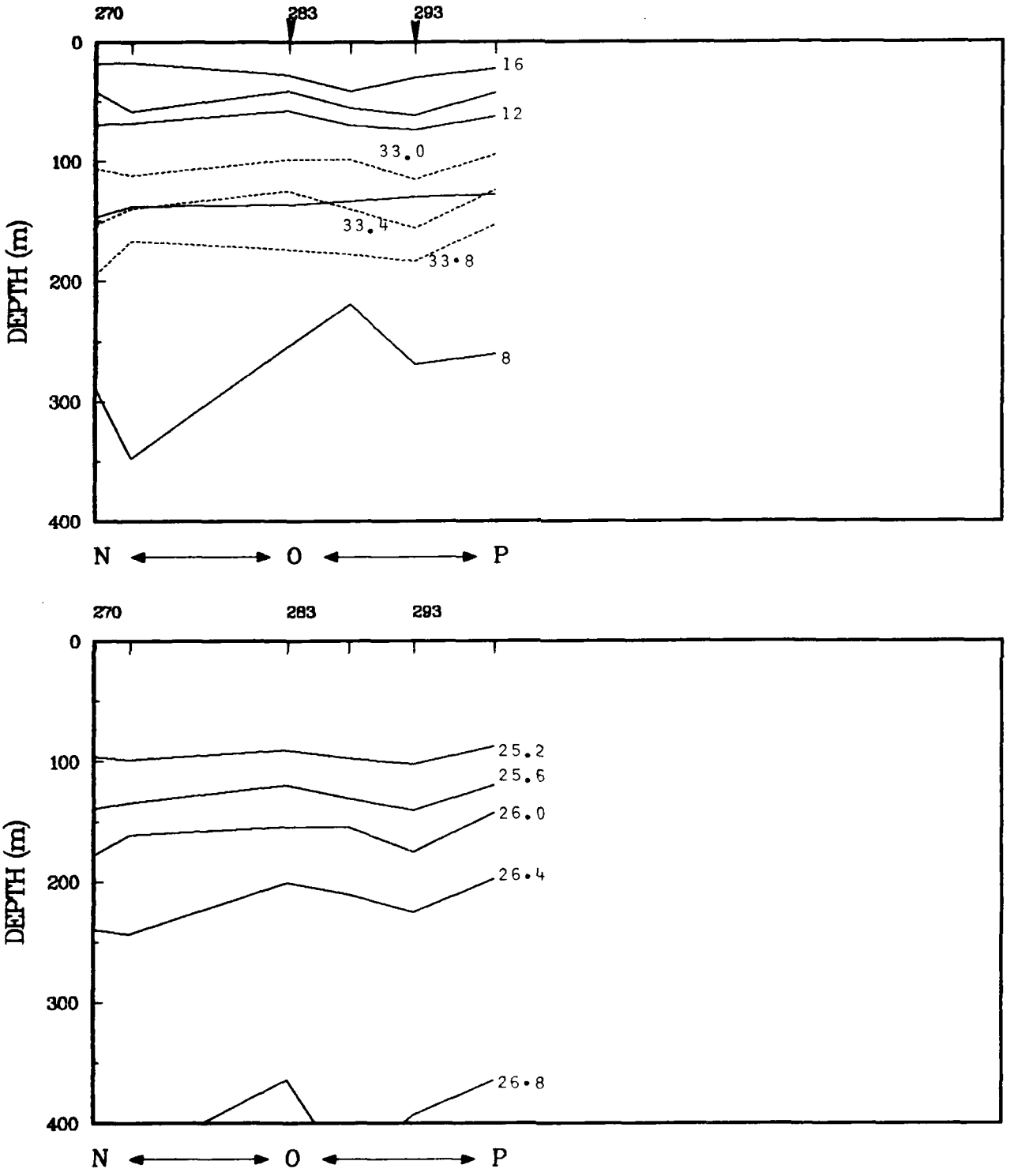

270
283
293
0
100
200
300
400
DEPTH (m)
16
12
33.0
33.4
33.8
8
N
O
P
270
283
293
0
100
200
300
400
DEPTH (m)
25.2
25.6
26.0
26.4
26.8
N
O
P

Figure 19(c).

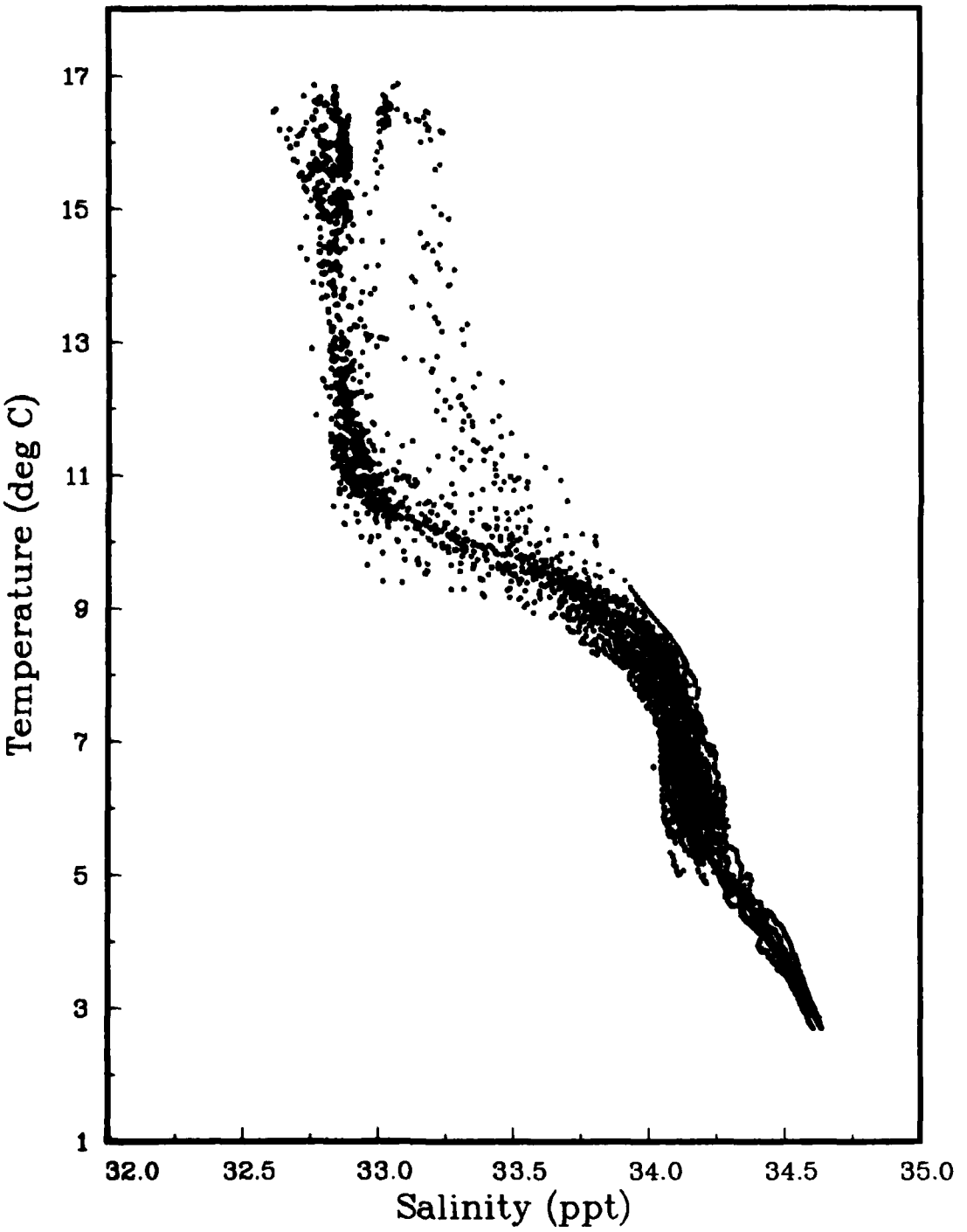



Figure 20: T-S pairs from the CTD casts for OPTOMA2, Leg II.

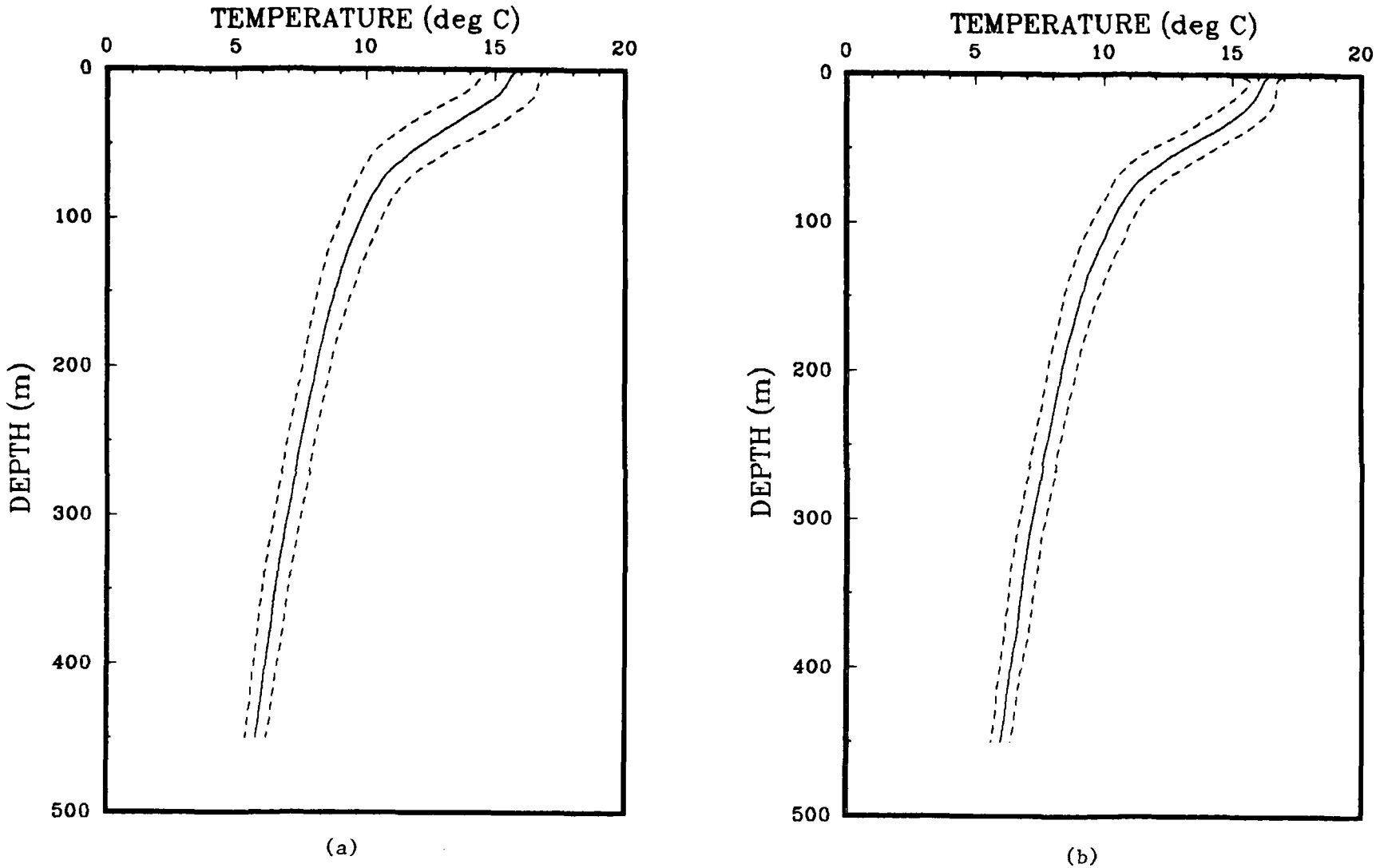



Figure 21: Profiles of $\overline{T(z)}$ with + and - the standard deviation from (a) XBT's and CTD's and (b) CTD's only.

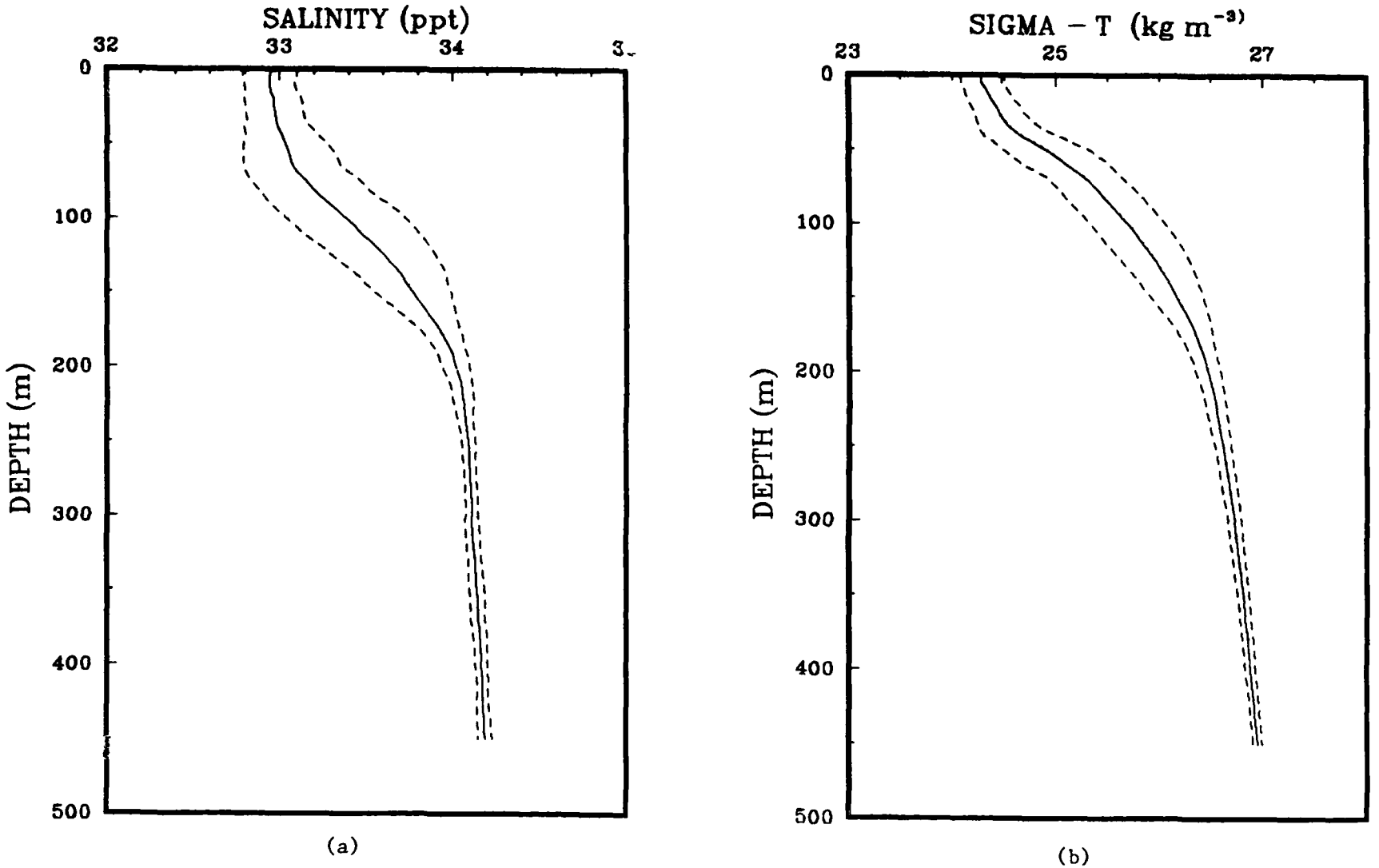



Figure 22: Profiles of (a) mean salinity and (b) mean sigma-t, with + and - the standard deviations, from the CTD's.

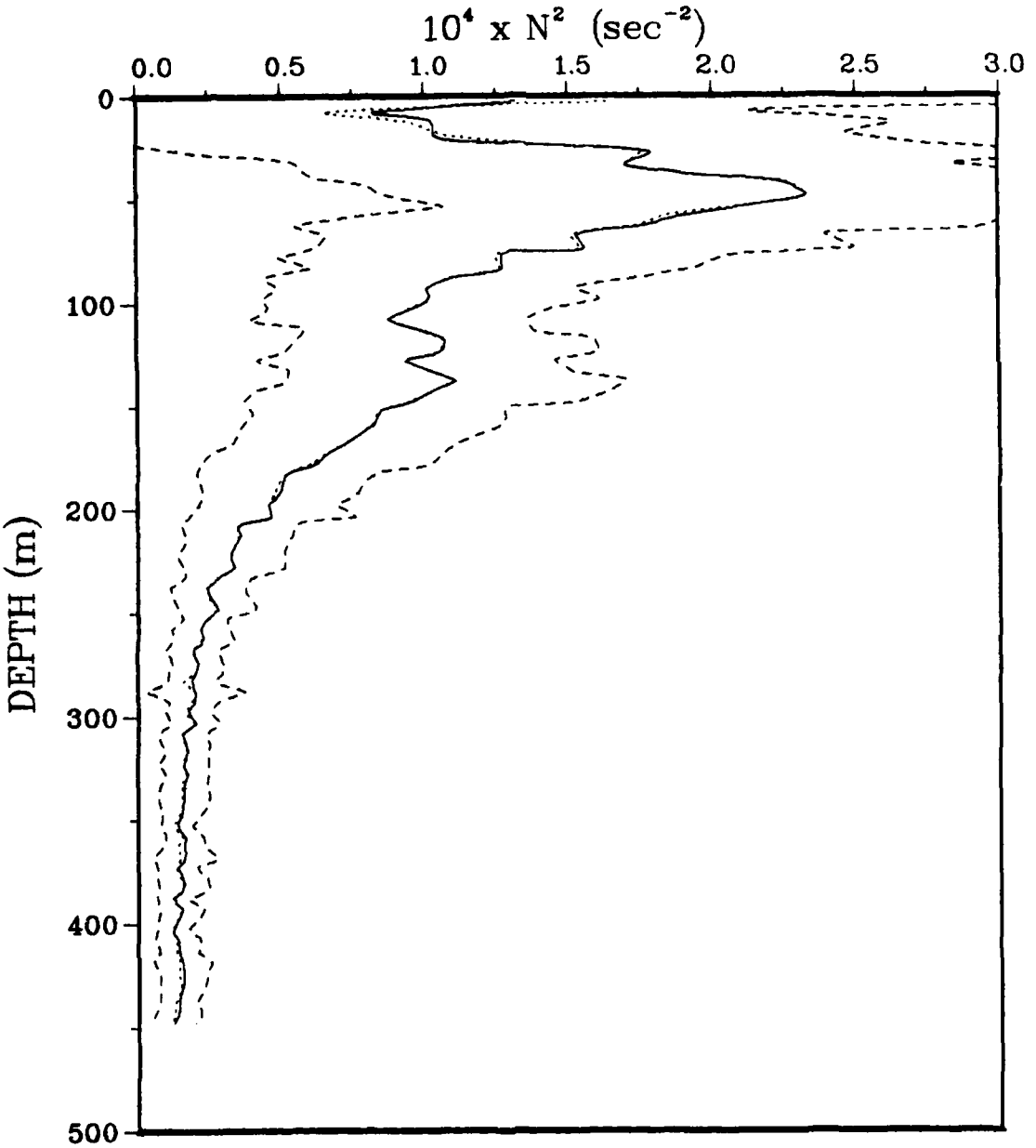



Figure 23: Profiles of $\overline{N^2(z)}$ (——), with + and - the standard deviation (----), and the profile of $N^2$ from $\overline{T(z)}$ and $\overline{S(z)}$ (....).

## ACKNOWLEDGEMENTS

This research was sponsored by the ONR Physical Oceanography Program. The success of the fieldwork was strongly dependent on the competent, willing support of CAPT Woodrow Reynolds, Chief Engineer Bobby Winton, and other crew members of the R/V ACANIA. Members of the scientific cruise party were:

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Dr. Jerome A. Smith, NPS, Party Chief
Dr. Robert Miller, Harvard
Mr. Everett (Skip) Carter, Harvard
Ms. Nadia Pinardi, Harvard
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The help of Mr. Stephan Lamont, from the W.R. Chruch Computer Center at the Naval Postgraduate School, in producing some of this report and comments from Dr. Adriana Huyer, Oregon State University, are also gratefully acknowledged.

## REFERENCE

Lewis, E.L. and R.G. Perkin, 1981: The Practical Salinity Scale 1978: conversion of existing data. Deep Sea Res. 28A, 307-328.

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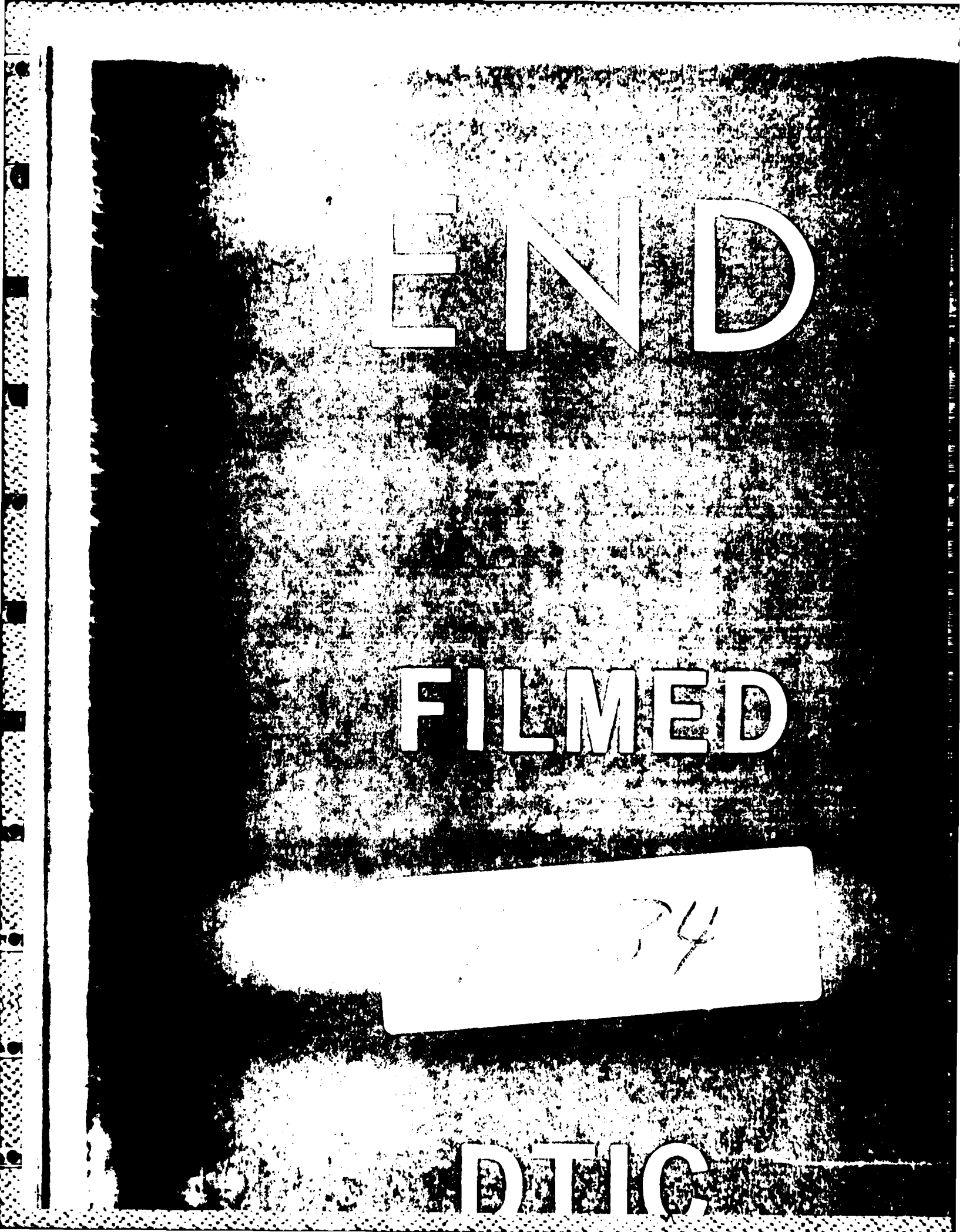
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