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Monterey, California

HYDROGRAPHIC DATA FROM THE OPTOMA PROGRAM
OPTOMA19
8 - 13 February 1986

by

Paul A. Wittmann
Christopher N.K. Mooers

May 1986

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The cruise OPTOMA19 was undertaken from the period 8 to 13 February 1986 to sample a subdomain of the California Current System. This report presents the hydrographic data from the cruise.

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Hydrographic Data from the **OPTOMA** *Program:*

OPTOMA19

8 - 13 February, 1986

by

Paul A. Wittmann
Christopher N. K. Mooers

Chief Scientist:
Gordon W. Groves

The **OPTOMA** Program is a joint program of

Department of Oceanography
Naval Postgraduate School
Monterey, CA 93943.

Center for Earth and Planetary Physics
Harvard University
Cambridge, MA 02138.

TABLE OF CONTENTS

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LIST OF TABLES

LIST OF FIGURES

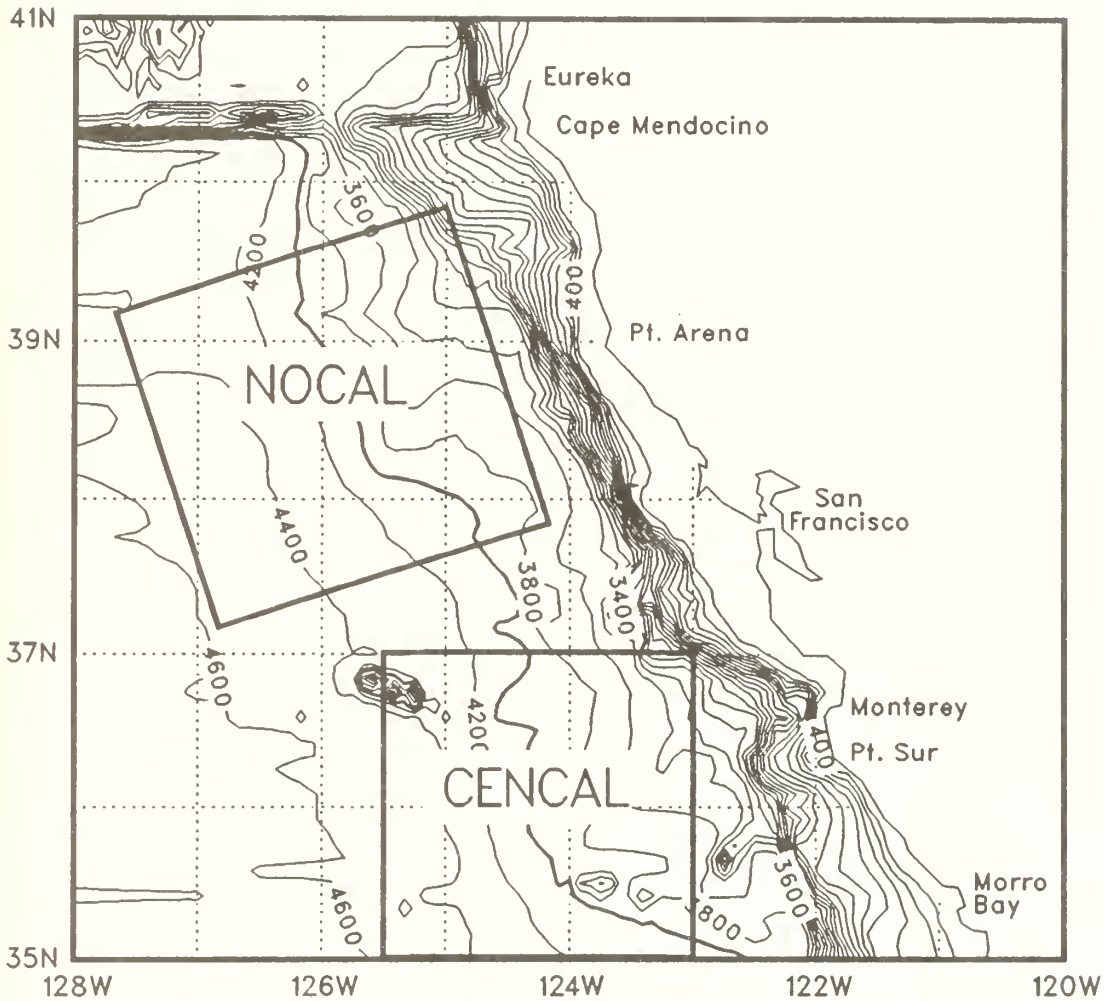

Figure 1: The NOCAL and CENCAL subdomains of the OPTOMA Program. Isobaths are shown in meters.

INTRODUCTION

The OPTOMA (Ocean Prediction Through Observation, 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 OPTOMA19 was undertaken, in the USNS DE STEIGUER, in February, 1986 and covered a domain 240 km square centered 190 km off the coast from Pt. Arena.

Hydrographic data were acquired during the period 8 to 13 February. The cruise track consisted of alongshore transects shown in Figure 2. Transect extremes are identified by letter to aid in cross-referencing the data presented in subsequent figures. Hydrographic stations were occupied at approximately 19km along the track.

DATA ACQUISITION

Data acquired during OPTOMA19 include XBT and CTD profiles. Wind velocity, air temperature, dew point, and 2 meter thermalsalinograph measurements were recorded every 2 minutes using a Serial ASCII Interface Loop (SAIL) data acquisition system. CTD data were digitized using a Neil Brown MK3 unit and the XBT data were digitized using a Sippican MK9 unit. All data were recorded on data disks using HP200 series computers, and transferred ashore to the IBM 3033 mainframe computer at the Naval Postgraduate School for editing and processing.

Station positions were determined by Loran C fixes and are claimed to be accurate to within about 0.1km. A NAVOCEANO Neil Brown CTD was used on the cruises. Table 1 on page 6 summarizes the various sensors used on the USNS DE STEIGUER and their accuracy.

DATA PROCESSING

The data processing, such as estimating depth profiles for the XBT temperature profiles based on 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. The data were then edited by removing obvious salinity spikes and eliminating cast failures that were not identified during the cruise. Approximately 97% of casts were retained. The CTD data were interpolated to 5m intervals. 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 Figures 2, 3, and 4, 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 in Figure 5. 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 depths of isotherms in the main thermocline are uncertain to $\pm$20m. The tick marks identify station positions and, again, the transect extremes are shown in these plots.

Mean profiles of temperature from the XBT's and temperature, salinity and sigma-t from the CTD's are given in Figures 9 and 10, followed by a scatter diagram of the T-S pairs and the mean S(T) curve with the $\pm$ standard deviation envelope. The data presentation concludes with a plot of the mean N^2 (Brunt-Vaisala frequency squared) profile with $\pm$ the standard deviation. On the sigma-t and N^2 plots, the appropriate profiles derived from the mean temperature and mean salinity profiles are also shown.

Table 1: Scientific instruments aboard the USNS DE STEIGUER

Instrument	Variable	Sensor	Accuracy	Resolution
Neil Brown CTD Mark IIIb	pressure	strain gauge	1.6 db	0.025 db
	temperature	thermistor	0.005 C	0.0005 C
	conductivity	electrode cell	0.005 mmbo	0.001mmbo
Sippican MK9 XBT	temperature	thermistor	0.2C	
	depth	descent speed	greater of 4.6 m and 2% of depth	
Sea-Bird Sensors	temperature	thermistor	0.003 C	0.0005 C
	conductivity at 2 meters	electrode cell	0.003 mmho	0.0005 mmho
General Eastern Temperature Sensors	air temperature	thermometer	0.01C	
	dew point temperature	condensation temp. sensor	0.2C	
R.M. Young Wind Sensors	wind speed	anemometer	0.15mph	
	wind direction	vane	2.5 degrees	
Internav LC 408 LORAN C	position	two chain LORAN receiver	100 meters	10 meters

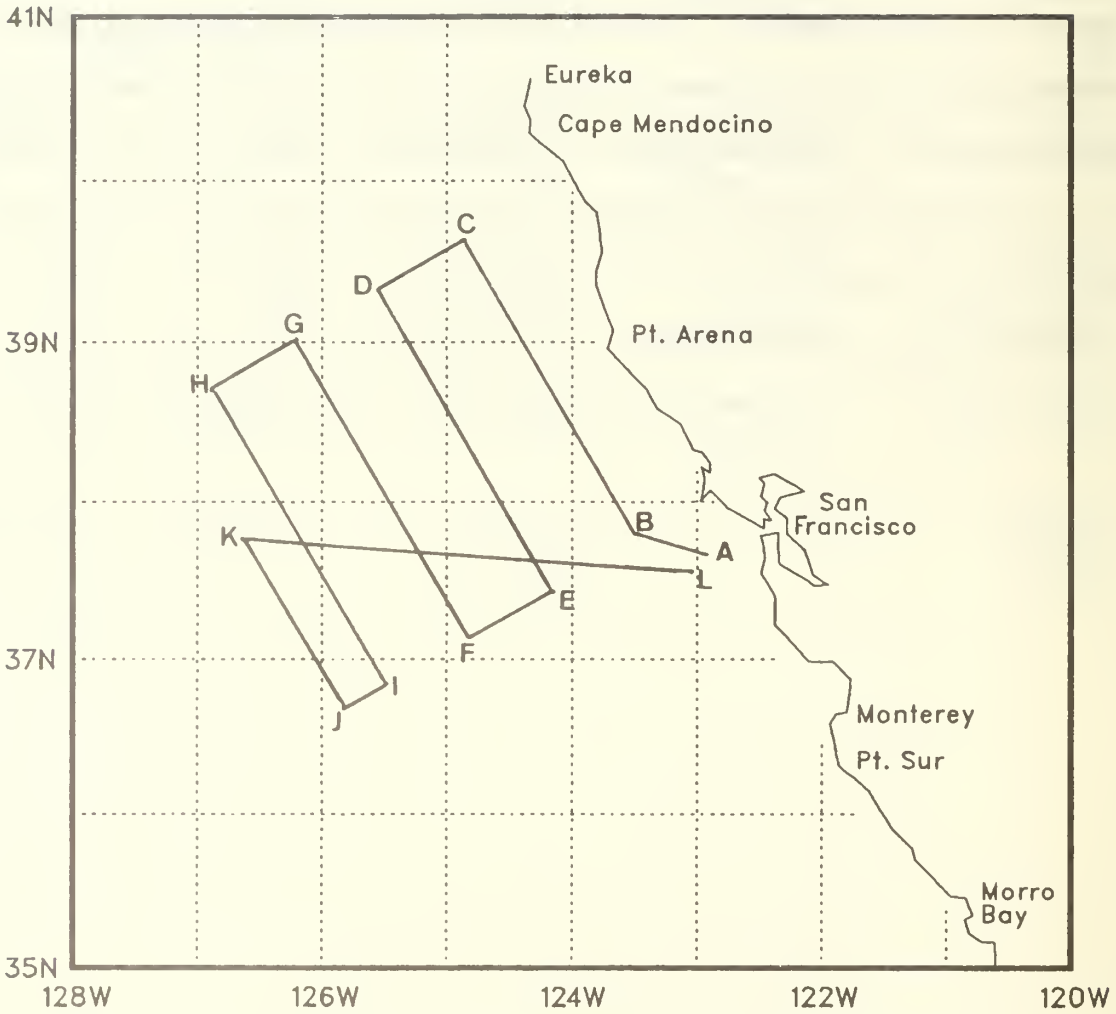

Figure 2: Cruise track for OPTOMA19 with transect extremes identified by letter.

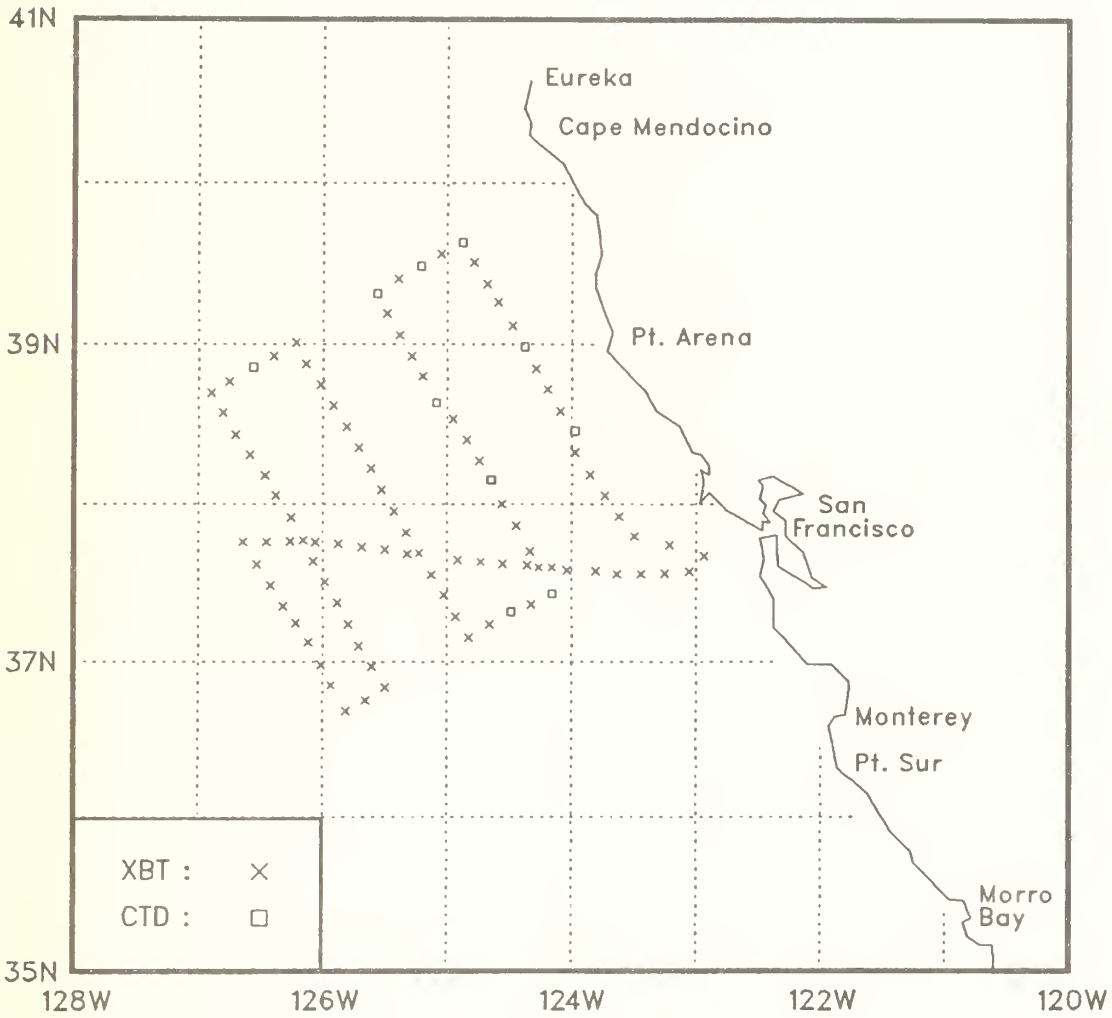

Figure 3: XBT and CTD locations for OPTOMA19.

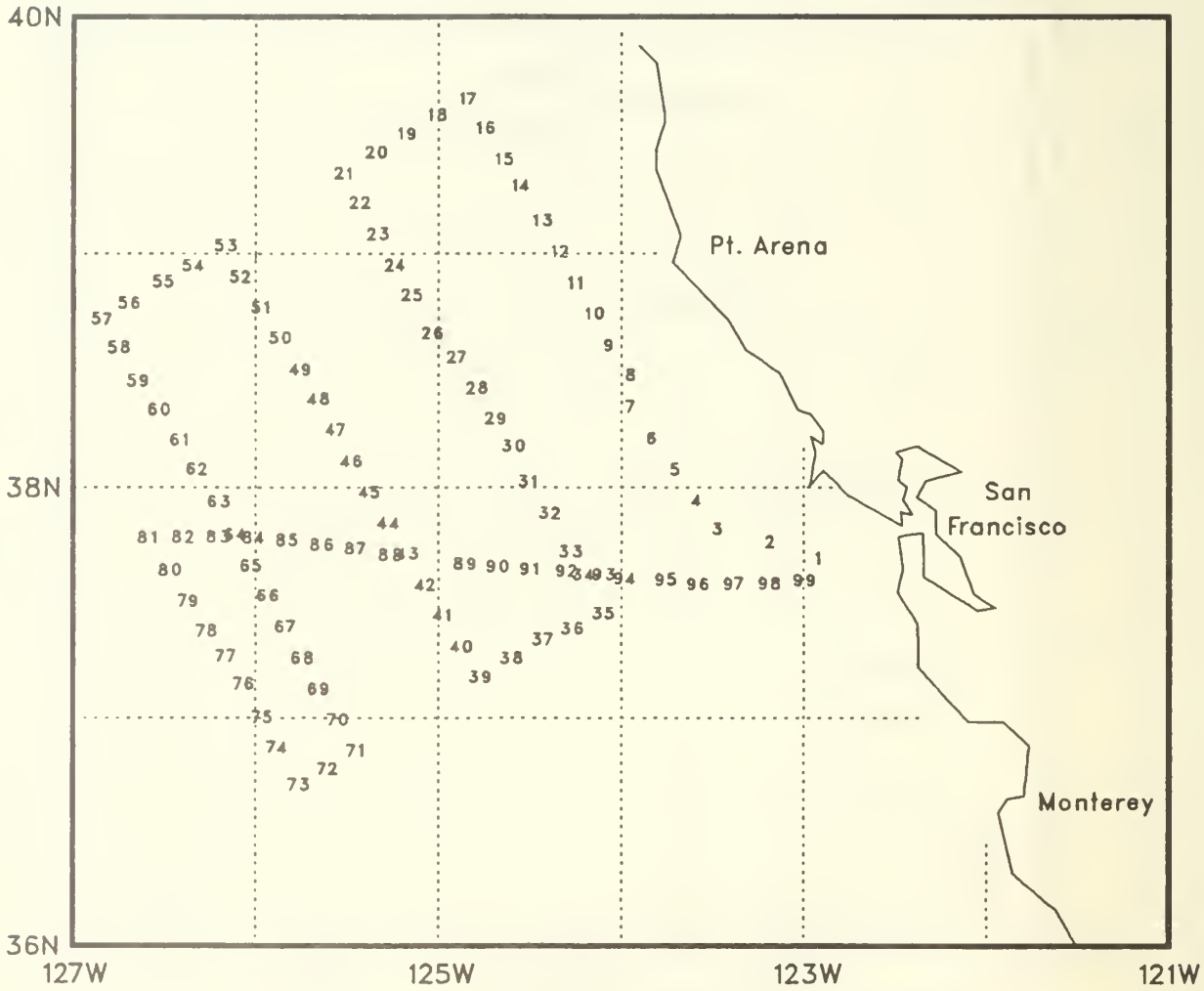

Figure 4: Station numbers for OPTOMA19.

Table 2 : Station Listing

STN	TYPE	YR/DAY	GMT	LAT (NORTH) (DD.MM)	LONG (WEST) (DDD.MM)	SURFACE TEMP (DEG C)	SURFACE SALINITY (PPT)
1	XBT	86039	2000	37.40	122.56	12.7	
2	XBT	86039	2122	37.45	123.12	13.0	
3	XBT	86039	2326	37.48	123.30	13.4	
4	XBT	86040	30	37.55	123.37	13.4	
5	XBT	86040	125	38.03	123.44	13.2	
6	XBT	86040	216	38.11	123.51	13.1	
7	XBT	86040	311	38.19	123.58	12.6	
8	CTD	86040	424	38.28	123.58	12.5	33.10
9	XBT	86040	547	38.35	124.05	12.1	
10	XBT	86040	651	38.43	124.11	11.8	
11	XBT	86040	736	38.51	124.17	11.9	
12	CTD	86040	854	38.59	124.22	11.7	32.75
13	XBT	86040	1028	39.07	124.28	11.9	
14	XBT	86040	1143	39.16	124.35	11.8	
15	XBT	86040	1208	39.23	124.41	12.1	
16	XBT	86040	1307	39.31	124.47	11.6	
17	CTD	86040	1417	39.38	124.53	12.1	33.20
18	XBT	86040	1537	39.34	125.03	12.0	
19	CTD	86040	1751	39.29	125.13	11.8	32.63
20	XBT	86040	1933	39.24	125.24	12.6	
21	CTD	86040	2115	39.19	125.34	12.6	32.70
22	XBT	86040	2225	39.12	125.29	13.1	
23	XBT	86040	2314	39.04	125.23	12.9	
24	XBT	86041	3	38.56	125.17	12.9	
25	XBT	86041	51	38.48	125.12	12.7	
26	CTD	86041	217	38.38	125.05	11.9	32.64
27	XBT	86041	328	38.32	124.57	12.9	
28	XBT	86041	418	38.24	124.51	12.8	
29	XBT	86041	509	38.16	124.44	12.5	
30	CTD	86041	617	38.09	124.39	12.4	33.09
31	XBT	86041	743	38.00	124.33	12.8	
32	XBT	86041	828	37.52	124.27	13.2	
33	XBT	86041	922	37.42	124.20	13.0	
34	XBT	86041	1009	37.36	124.16	13.1	
35	CTD	86041	1139	37.26	124.09	13.0	32.88
36	XBT	86041	1300	37.22	124.19	13.3	
37	CTD	86041	1445	37.19	124.29	13.0	32.91
38	XBT	86041	1628	37.14	124.39	13.4	
39	XBT	86041	1730	37.09	124.50	13.2	
40	XBT	86041	1824	37.17	124.56	12.2	
41	XBT	86041	1915	37.26	125.02	12.3	
42	XBT	86041	2005	37.33	125.08	12.3	
43	XBT	86041	2059	37.41	125.14	12.3	
44	XBT	86041	2153	37.49	125.20	12.3	
45	XBT	86041	2247	37.57	125.26	12.7	

STN	TYPE	YR/DAY	GMT	LAT (NORTH) DD.MM	LONG (WEST) DDD.MM	SURFACE TEMP (DEG C)	SURFACE SALINITY (PPT)
46	XBT	86041	2341	38.05	125.32	12.6	
47	XBT	86042	32	38.13	125.37	12.6	
48	XBT	86042	124	38.21	125.43	12.3	
49	XBT	86042	221	38.29	125.49	12.6	
50	XBT	86042	312	38.37	125.55	12.8	
51	XBT	86042	403	38.45	126.01	12.5	
52	XBT	86042	456	38.53	126.08	12.6	
53	XBT	86042	545	39.01	126.13	11.8	
54	XBT	86042	640	38.56	126.24	11.9	
55	CTD	86042	846	38.51	126.34	11.3	32.68
56	XBT	86042	1040	38.46	126.45	11.7	
57	XBT	86042	1127	38.42	126.54	11.6	
58	XBT	86042	1218	38.35	126.48	11.7	
59	XBT	86042	1310	38.26	126.42	11.7	
60	XBT	86042	1408	38.19	126.35	12.8	
61	XBT	86042	1503	38.11	126.28	13.0	
62	XBT	86042	1555	38.03	126.22	13.3	
63	XBT	86042	1656	37.55	126.15	13.0	
64	XBT	86042	1756	37.46	126.10	13.4	
65	XBT	86042	1845	37.38	126.05	13.4	
66	XBT	86042	1944	37.31	125.59	13.4	
67	XBT	86042	2038	37.22	125.53	13.0	
68	XBT	86042	2136	37.14	125.48	13.5	
69	XBT	86042	2237	37.06	125.42	13.0	
70	XBT	86042	2344	36.58	125.36	12.5	
71	XBT	86043	125	36.50	125.30	12.7	
72	XBT	86043	241	36.45	125.39	12.8	
73	XBT	86043	426	36.41	125.49	13.0	
74	XBT	86043	624	36.51	125.56	13.4	
75	XBT	86043	756	36.59	126.01	13.4	
76	XBT	86043	954	37.08	126.07	14.0	
77	XBT	86043	1138	37.15	126.13	14.0	
78	XBT	86043	1312	37.21	126.19	13.3	
79	XBT	86043	1448	37.29	126.25	13.7	
80	XBT	86043	1629	37.37	126.32	13.5	
81	XBT	86043	1812	37.46	126.38	13.6	
82	XBT	86043	1932	37.46	126.27	13.7	
83	XBT	86043	2056	37.46	126.16	13.1	
84	XBT	86043	2219	37.46	126.04	13.0	
85	XBT	86043	2339	37.45	125.53	13.5	
86	XBT	86044	59	37.44	125.41	12.6	
87	XBT	86044	214	37.43	125.30	12.6	
88	XBT	86044	327	37.41	125.19	12.5	
89	XBT	86044	553	37.39	124.55	12.3	
90	XBT	86044	701	37.38	124.44	12.5	

STN	TYPE	YR/DAY	GMT	LAT (NORTH) DD.MM	LONG (WEST) DDD.MM	SURFACE TEMP (DEG C)	SURFACE SALINITY (PPT)
91	XBT	86044	810	37.38	124.33	13.1	
92	XBT	86044	914	37.37	124.21	13.1	
93	XBT	86044	1020	37.36	124.09	13.4	
94	XBT	86044	1137	37.35	124.02	13.1	
95	XBT	86044	1243	37.35	123.48	12.9	
96	XBT	86044	1353	37.34	123.38	12.8	
97	XBT	86044	1502	37.34	123.26	13.1	
98	XBT	86044	1615	37.34	123.15	13.0	
99	XBT	86044	1740	37.35	123.03	13.1	

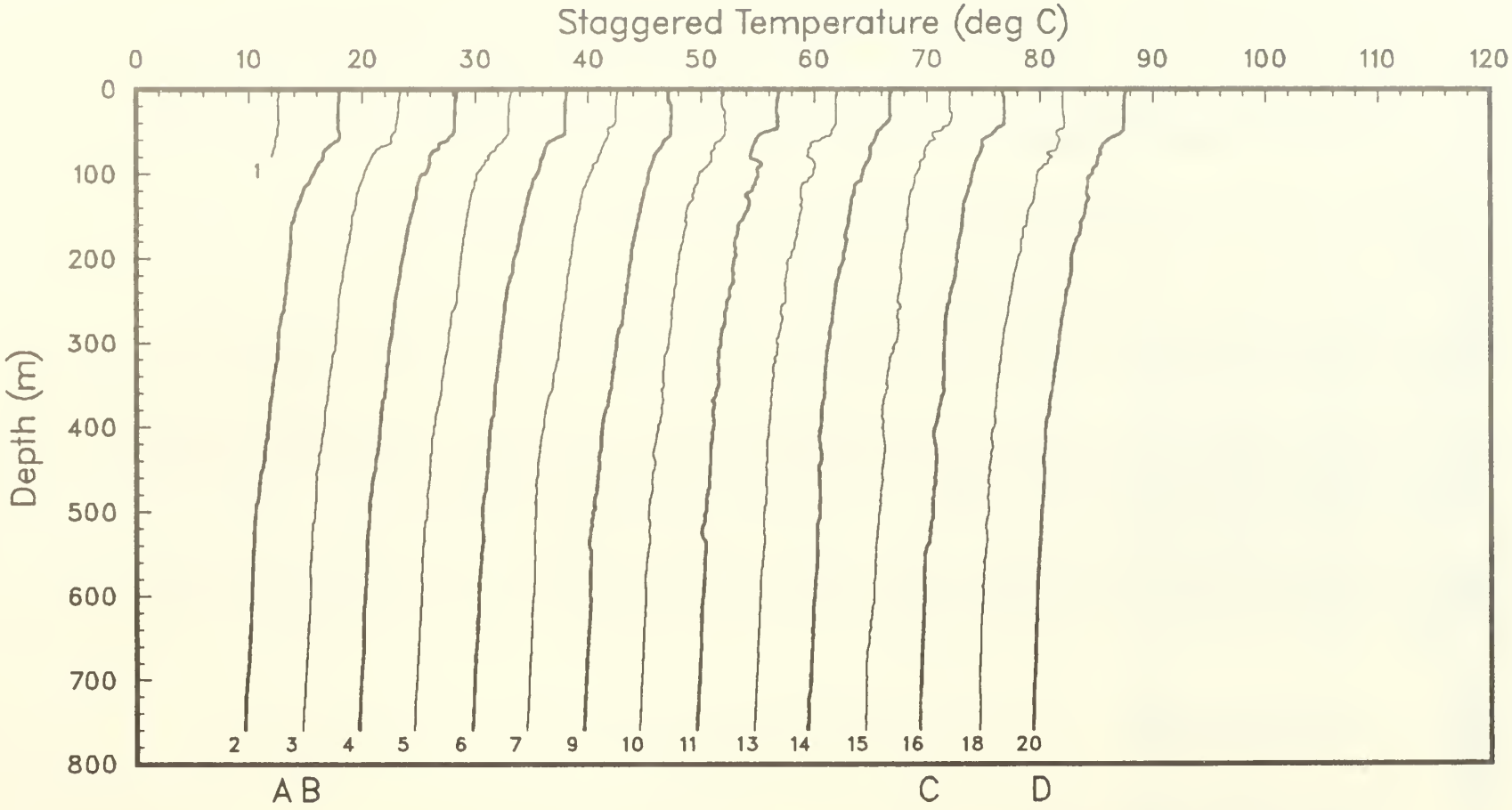

Figure 5(a): Staggered temperature profiles from the XBT's. Profiles are staggered by a multiple of 5C (OPTOMA19).

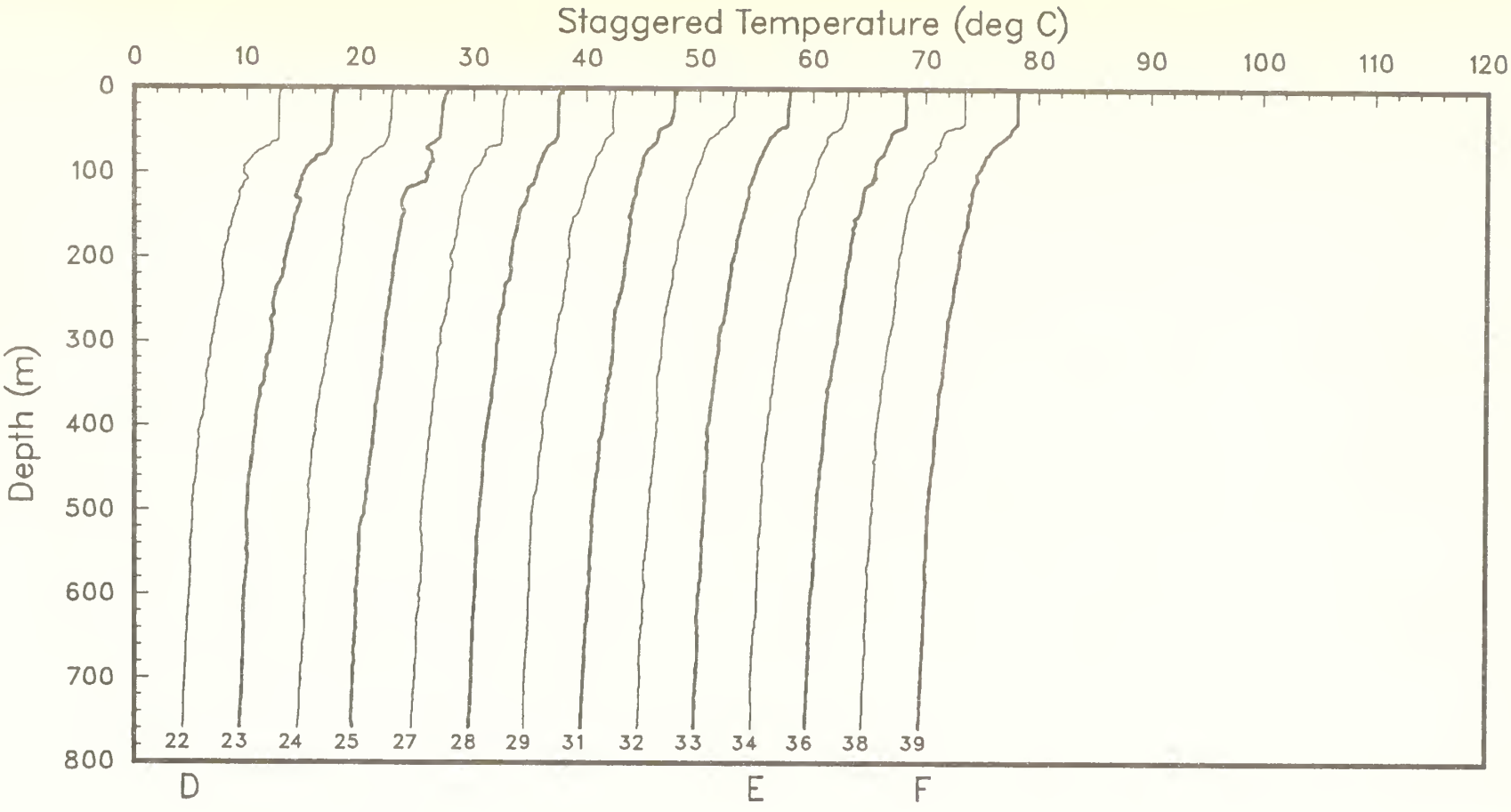
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Figure 5(b)

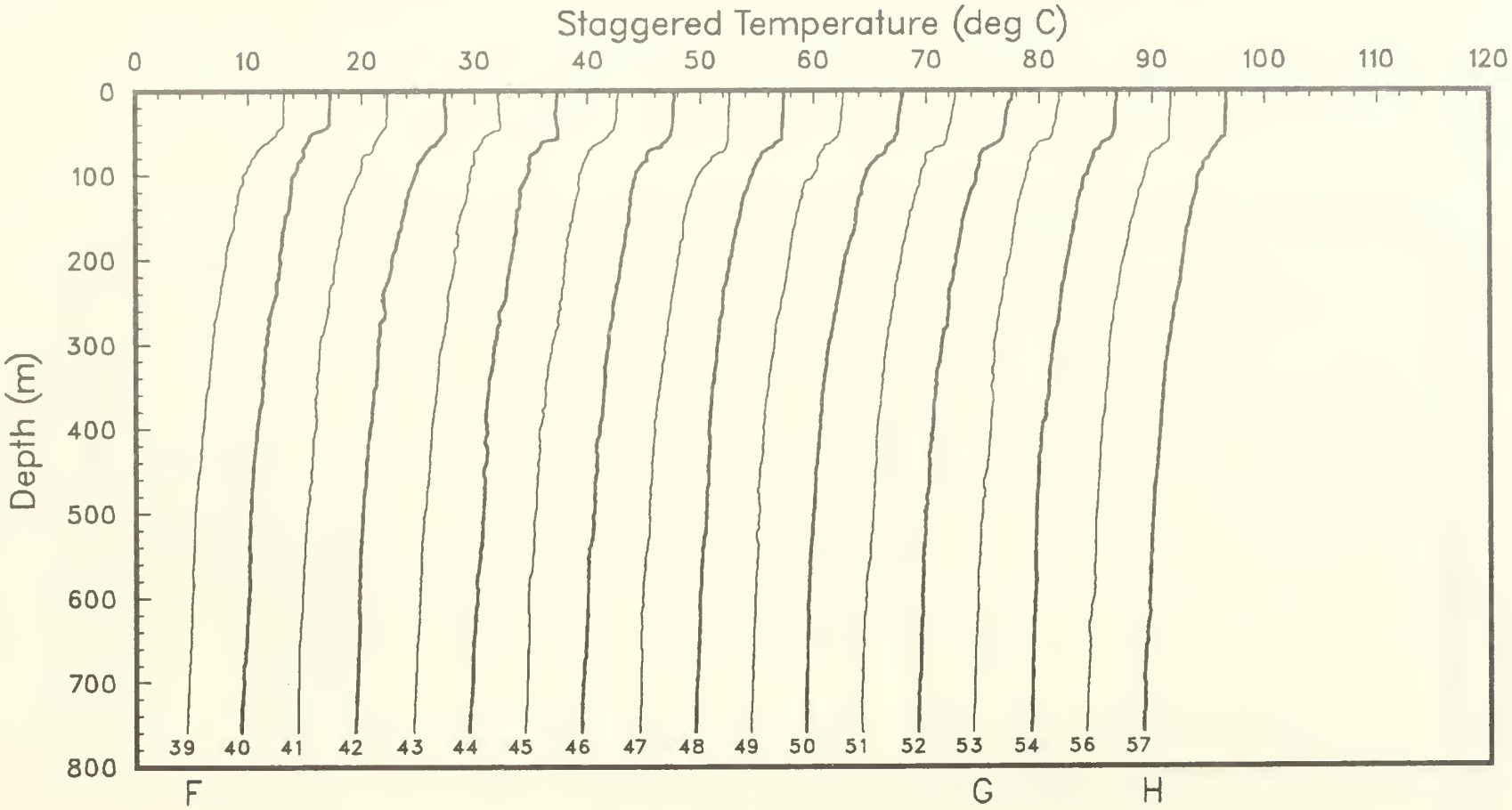
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Figure 5(c)

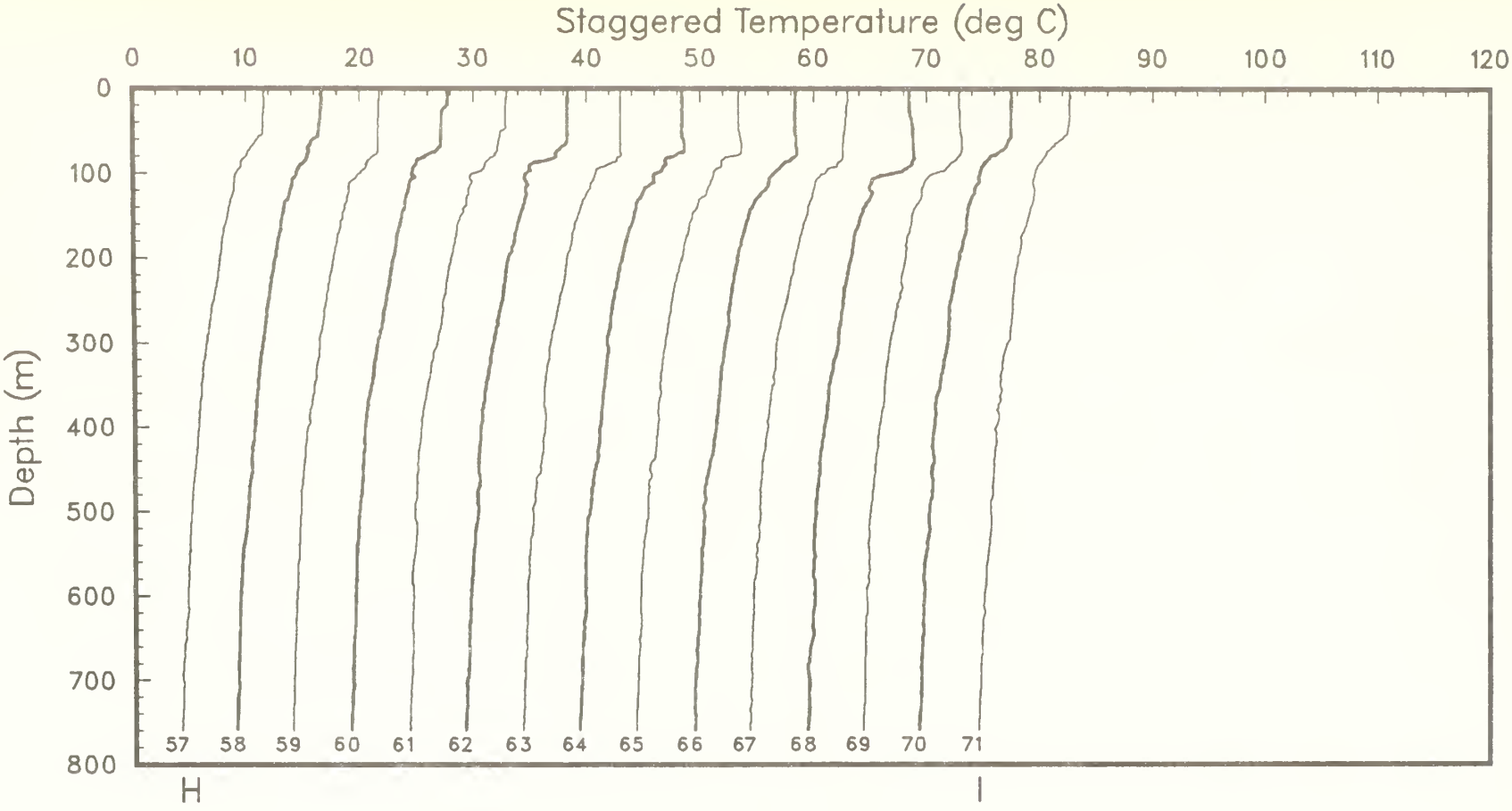
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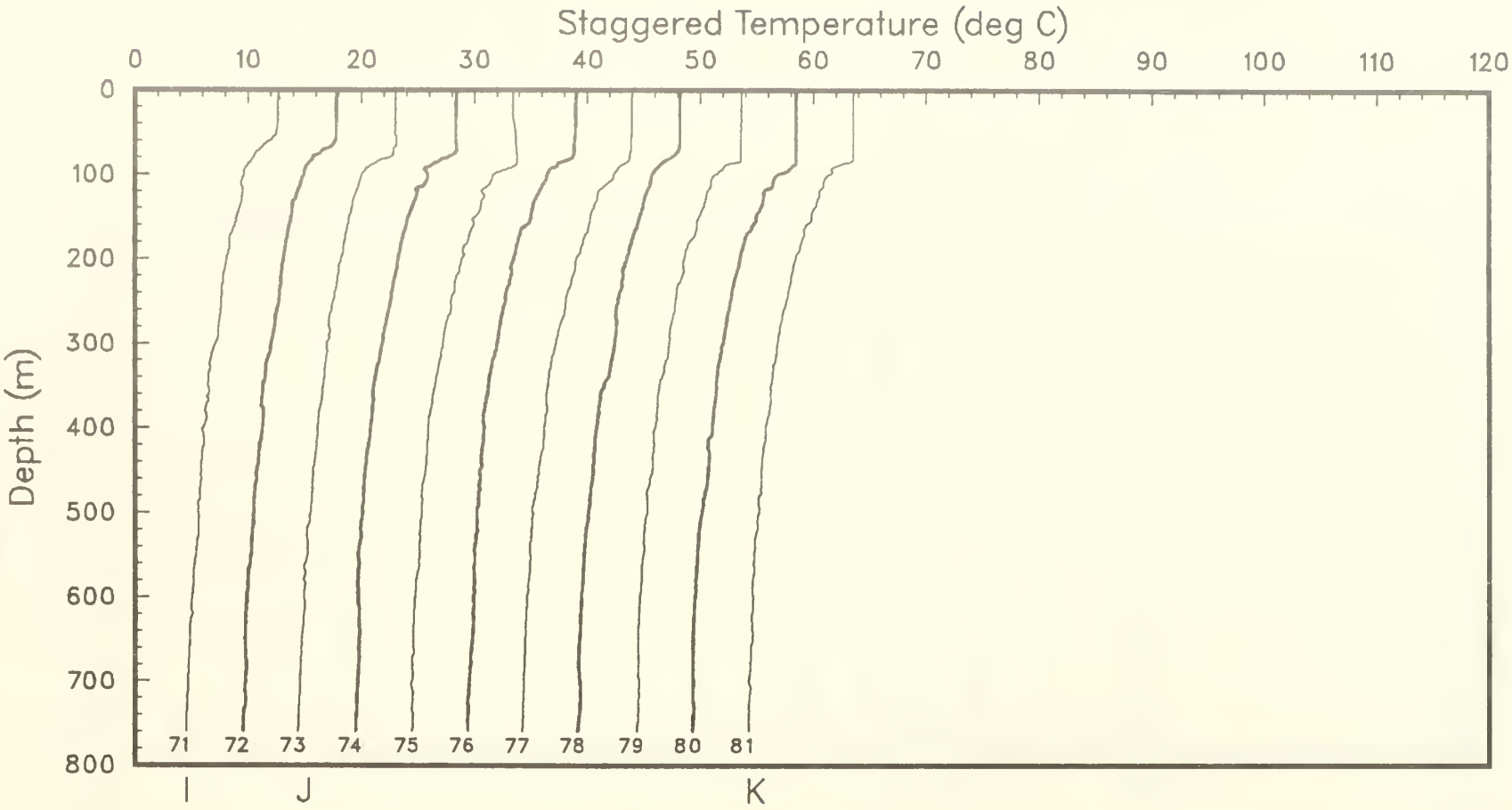
Figure 5(d)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Depth (m)
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Figure 5(e)

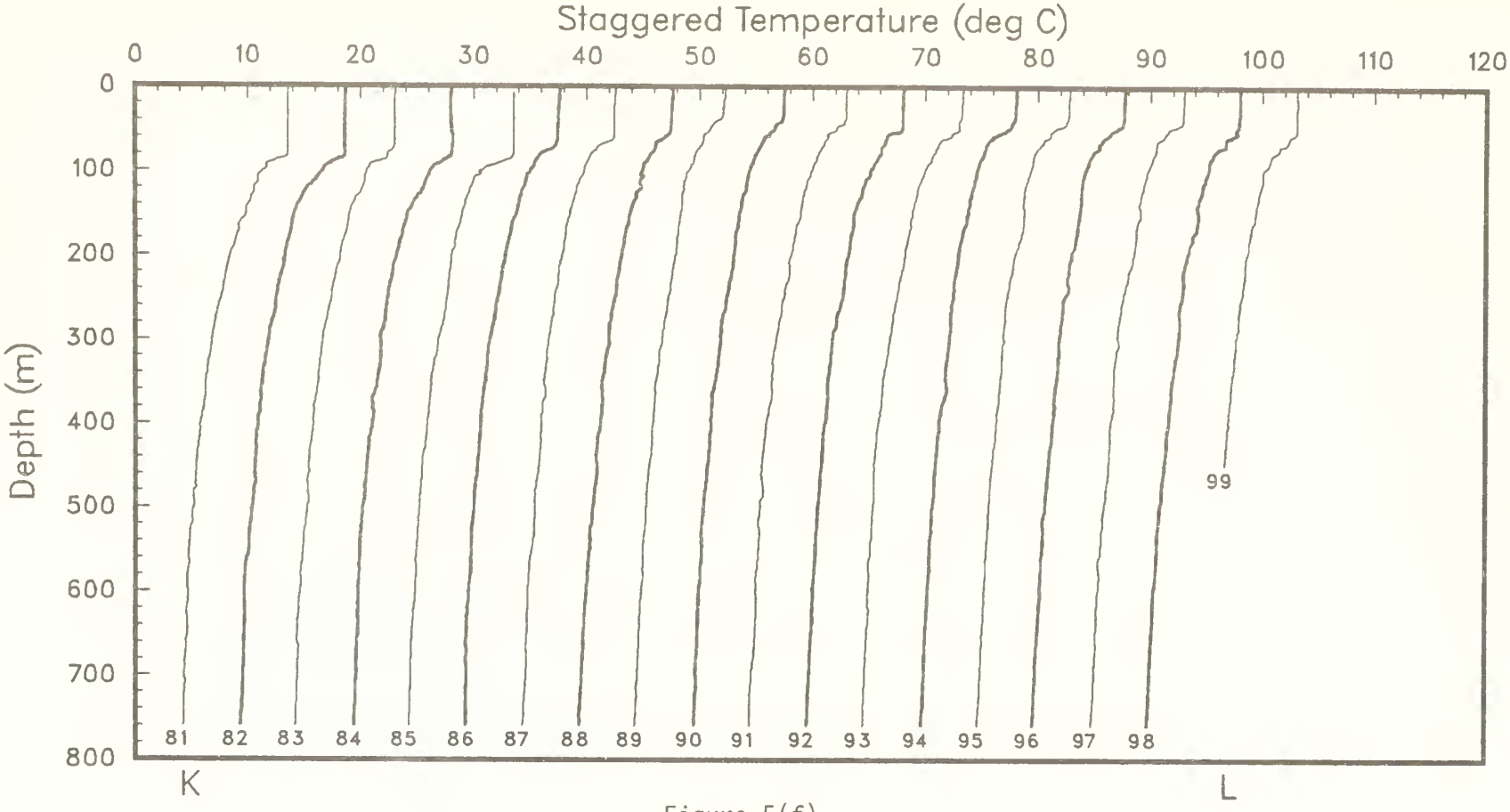
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Figure 5(f)

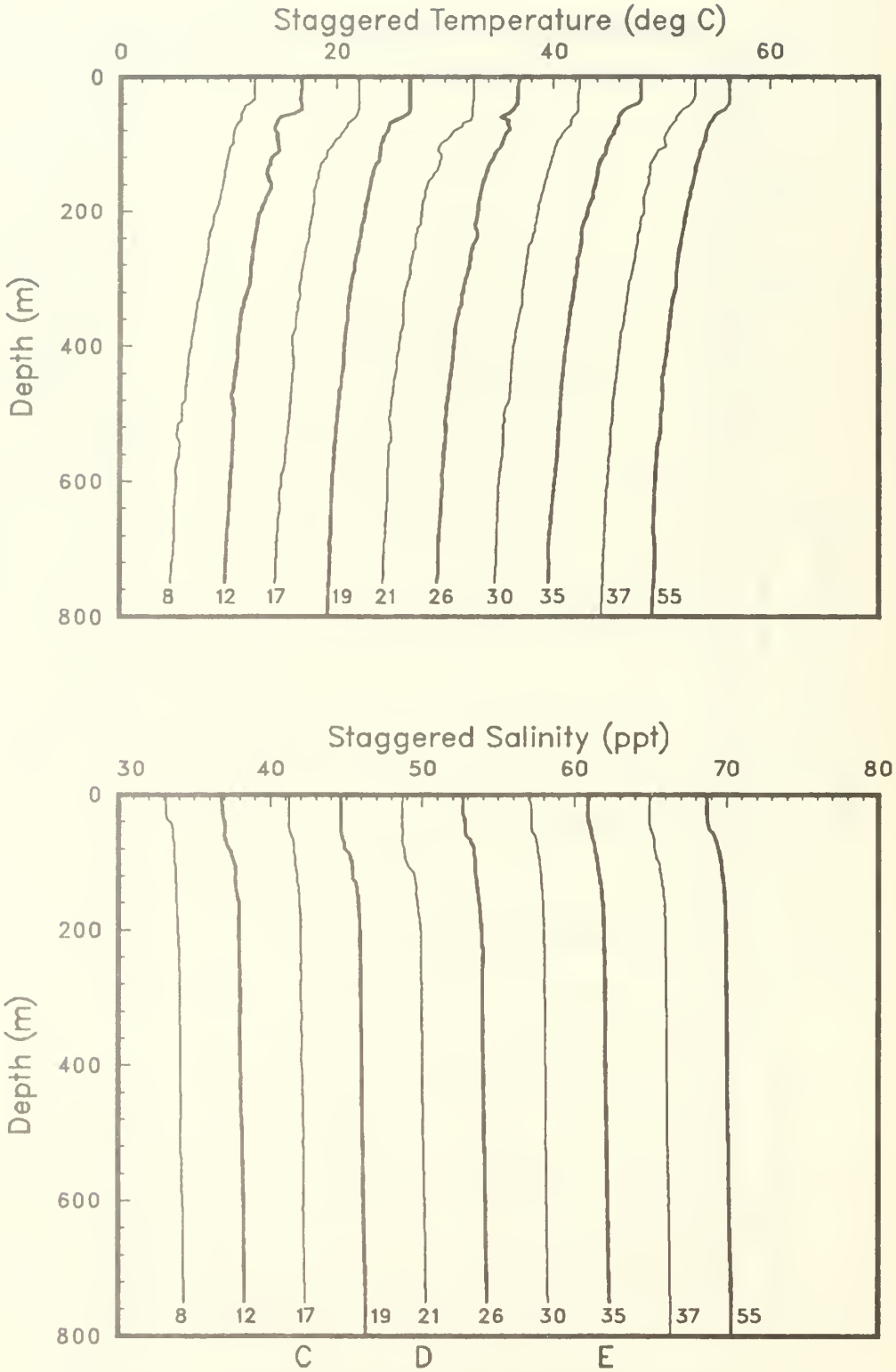
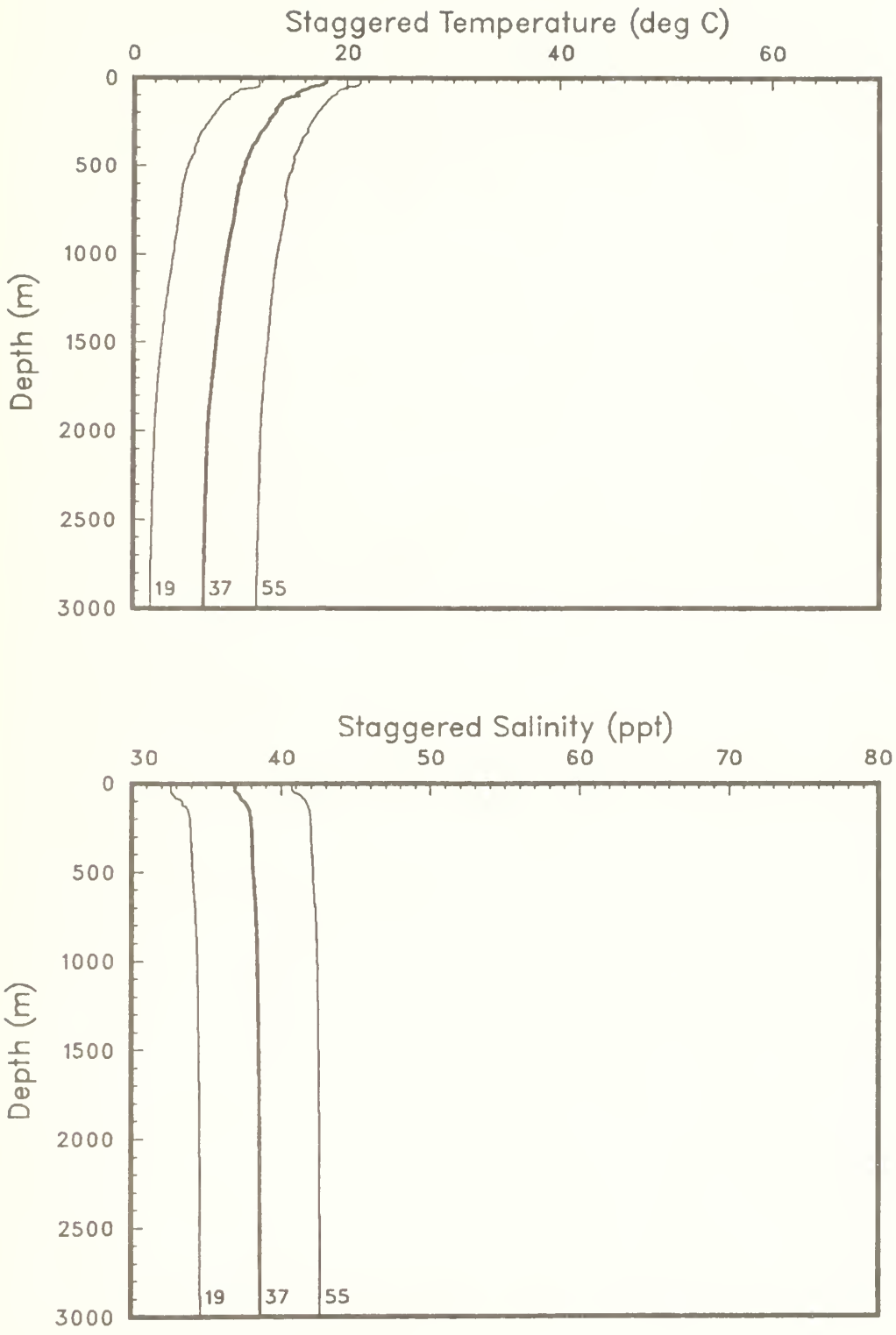


Figure 6(a): CTD temperature profiles, staggered by multiples of 5C, and salinity profiles staggered by multiples of 4 ppt (OPTOMA19).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3000
Depth (m)
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37
55
Staggered Salinity (ppt)
30
40
50
60
70
80
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500
1000
1500
2000
2500
3000
Depth (m)
19
37
55

Figure 6(b)

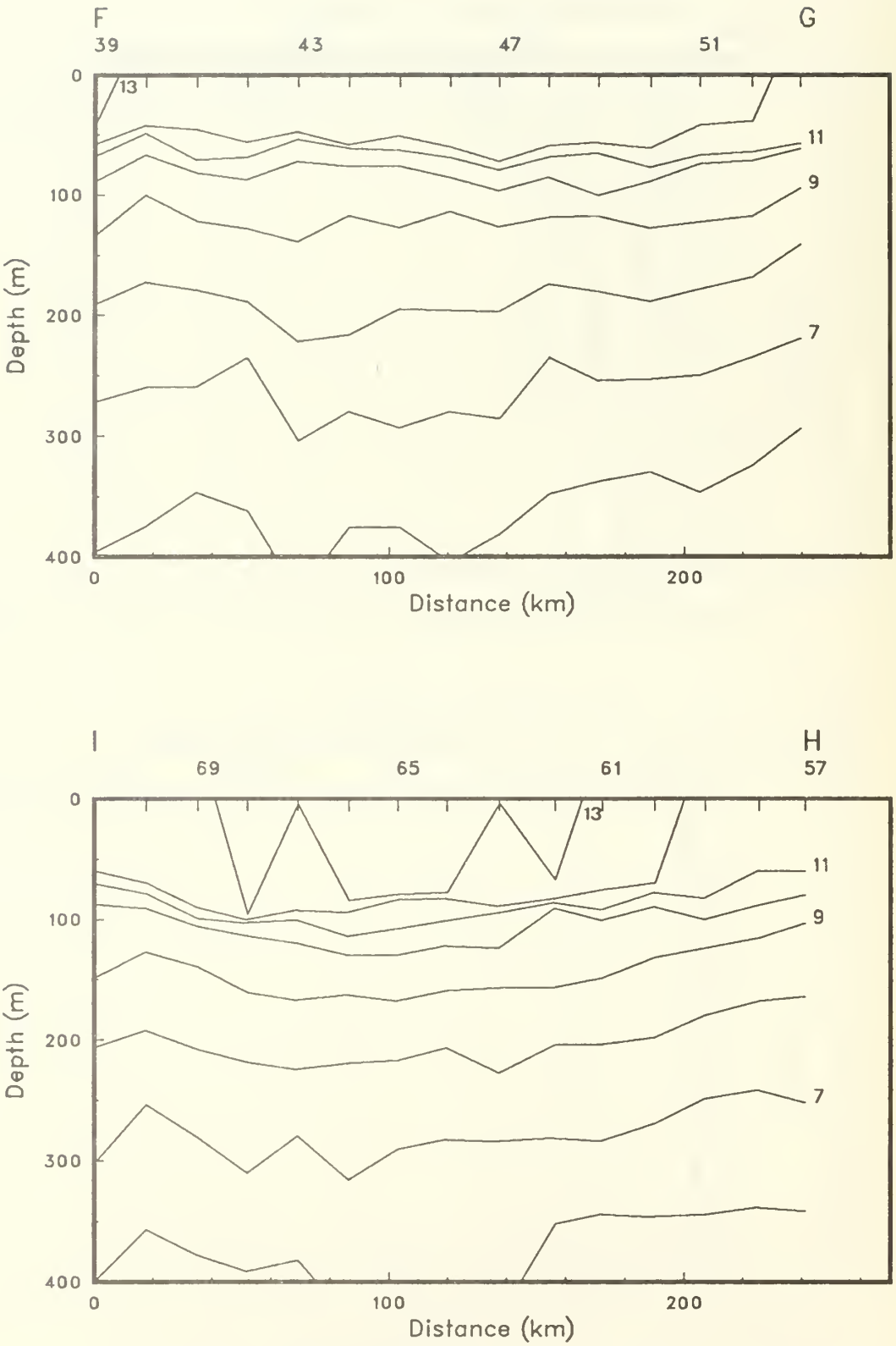
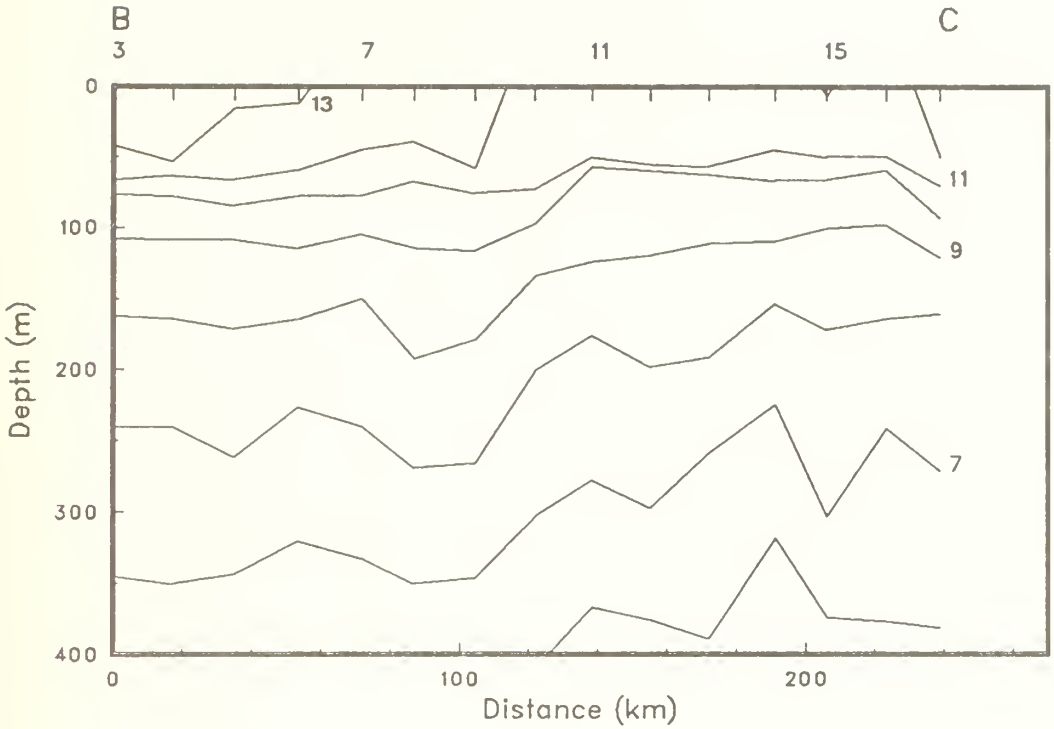


Figure 7(a): Isotherms from XBT's and CTD's. Tick marks along the upper horizontal axis show station positions. Some station numbers are given. (OPTOMA19).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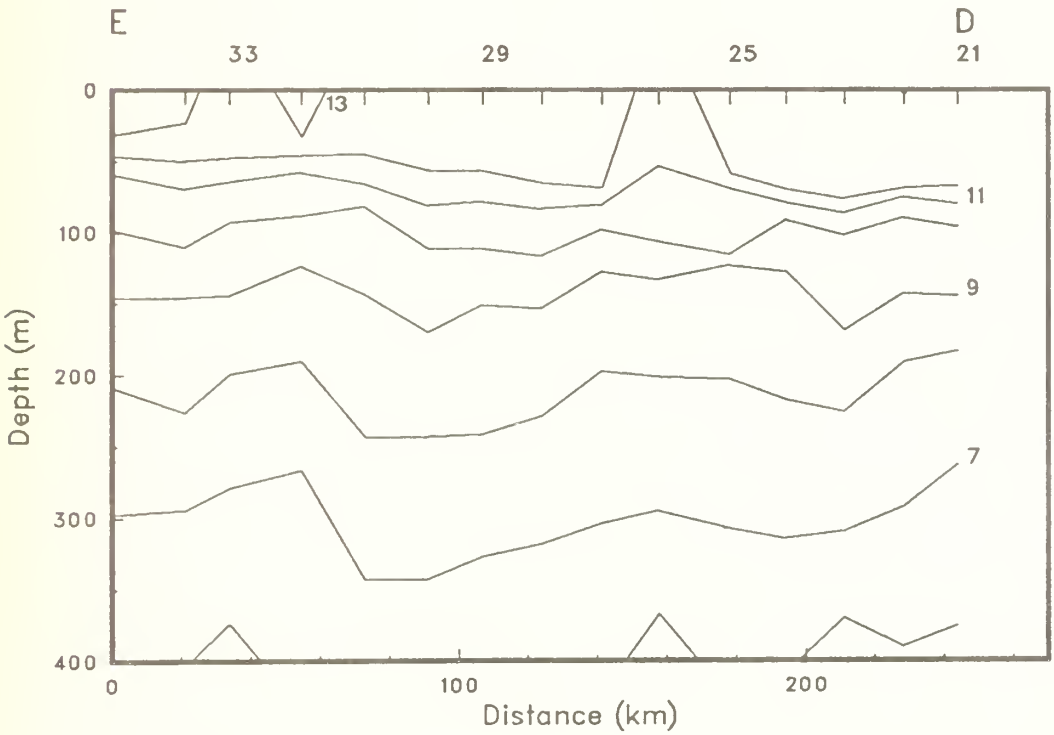
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Depth (m)
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100
200
Distance (km)

Figure 7(b)

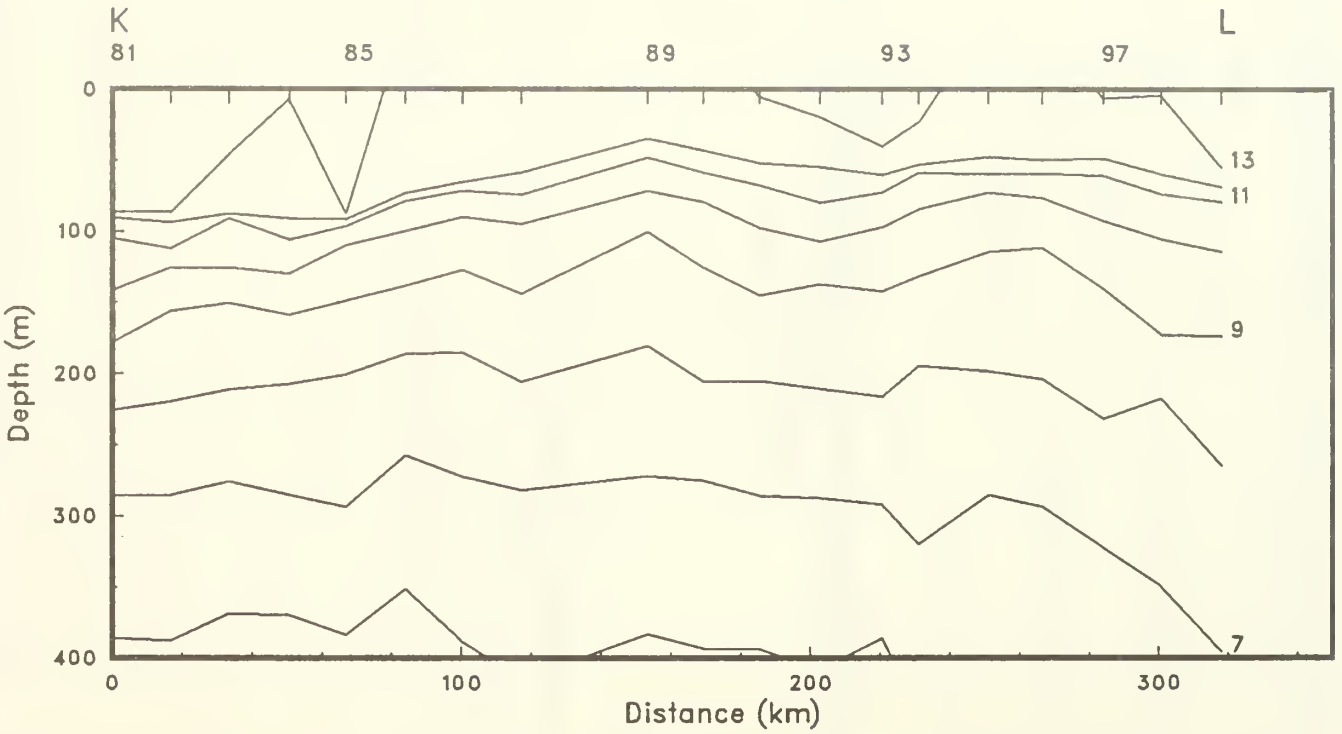
K
L
81
85
89
93
97
0
100
200
300
400
Depth (m)
13
11
9
7
0
100
200
300
Distance (km)

Figure 7(c)

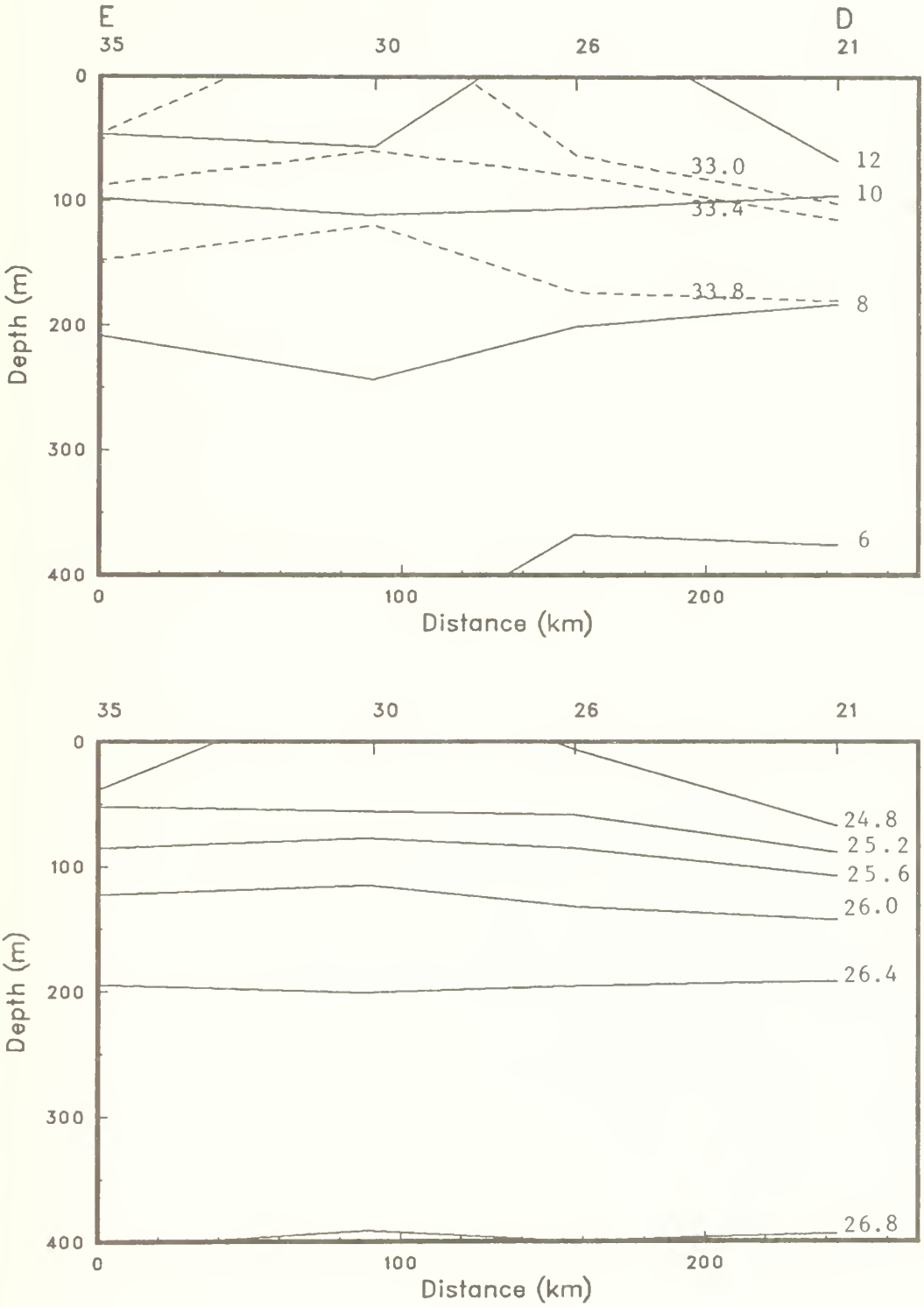

Figure 8: Isopleths of (1) temperature and salinity and (2) sigma-t from the CTD's. (OPTOMA19).

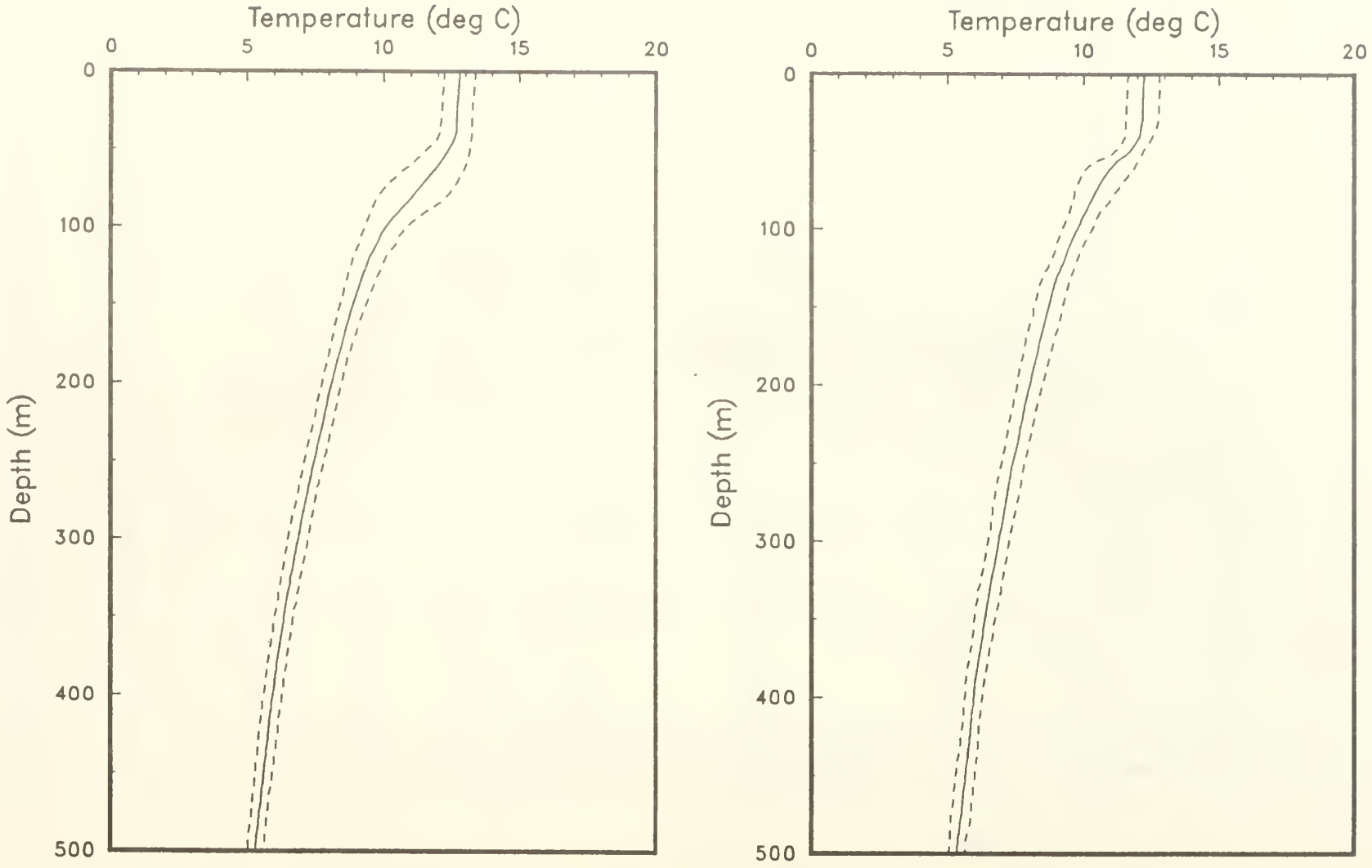

Figure 9: Profiles of $\overline{T(z)}$ with + and - the standard deviation from (a) XBT's and (b) CTD's. (OPTOMA19).

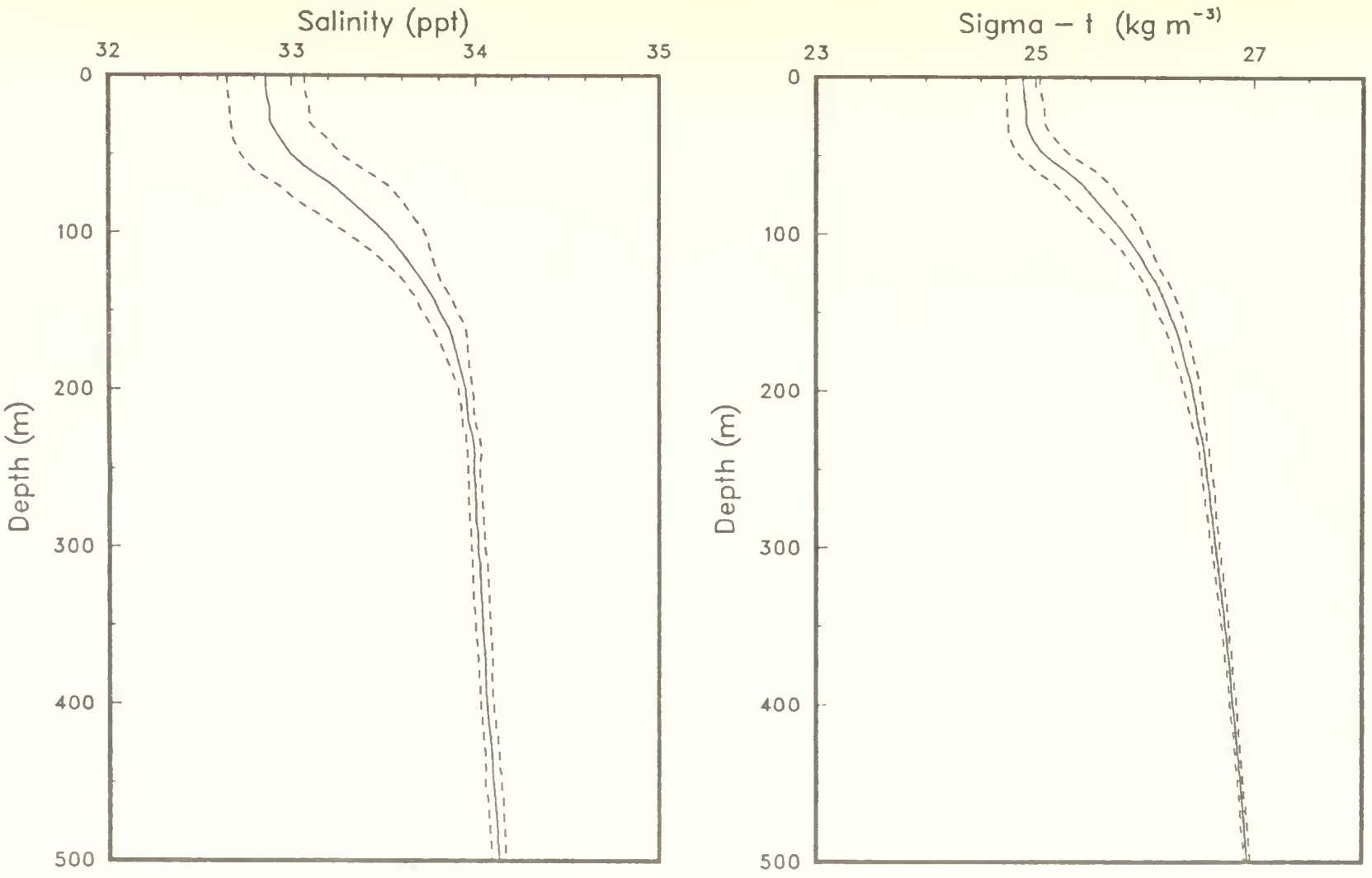

Figure 10: Profiles of (a) mean salinity and (b) mean sigma-t, with + and - the standard deviations, from the CTD's (OPTOMA19).

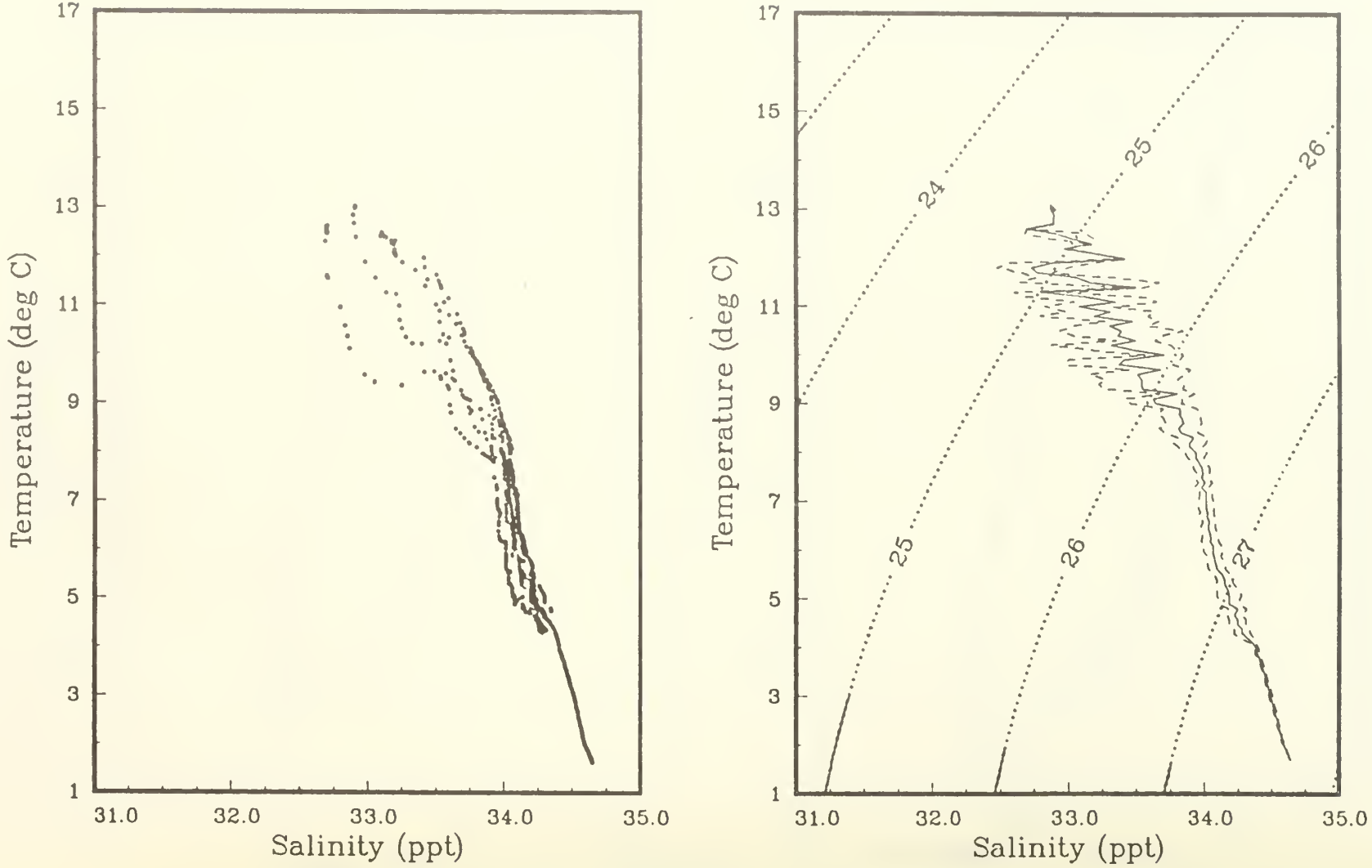

Figure 11: (a) T-S pairs and (b) mean T-S relationship with + and - the standard deviation, and selected sigma-t contours, from the CTD casts (OPTOMA19).

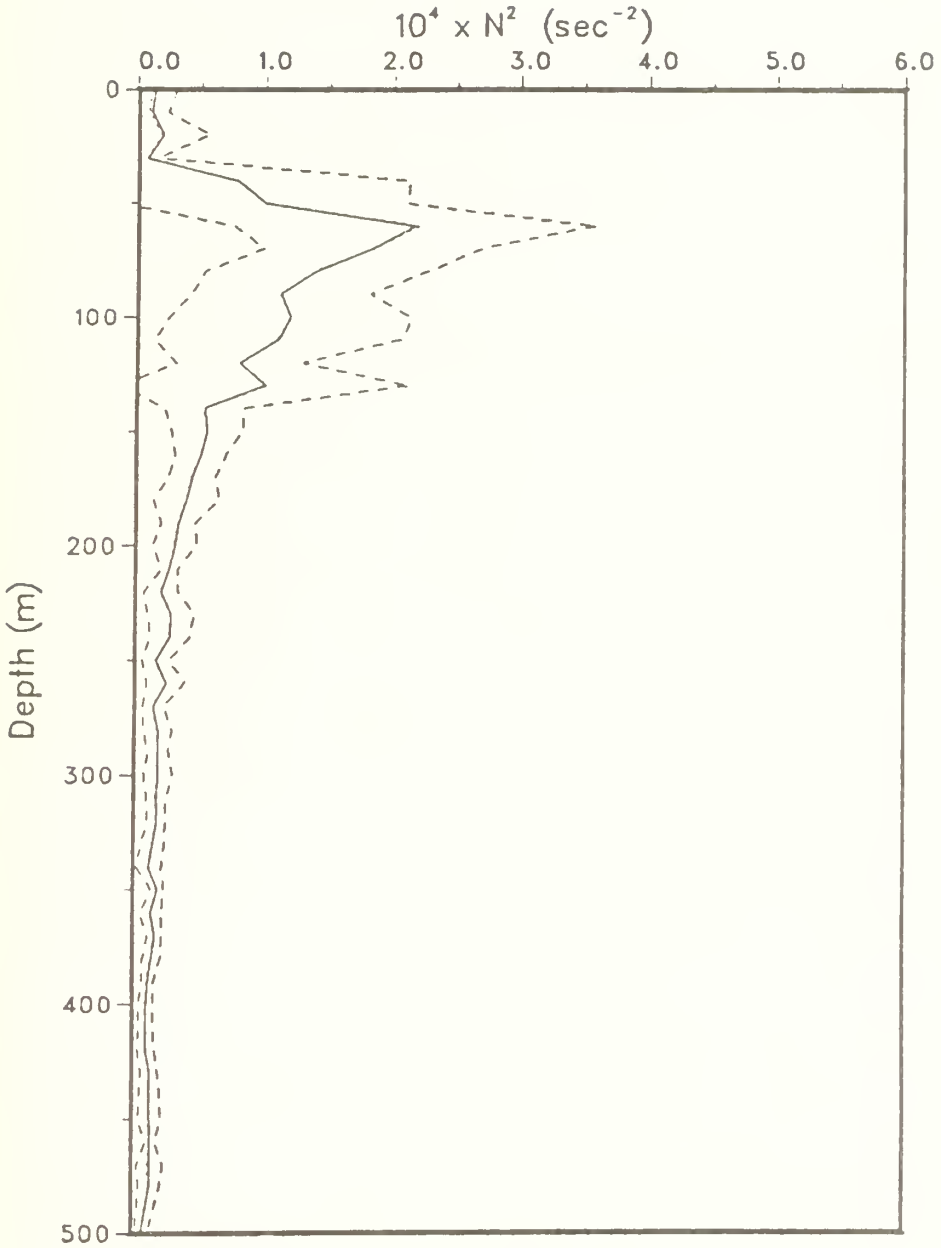

Figure 12: Profile of $N^2(z)$ (——), with + and - the standard deviation (---), and the profile of N^2 from $\overline{T(z)}$ and $\overline{S}(z)$ (...) (OPTOMA19).

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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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