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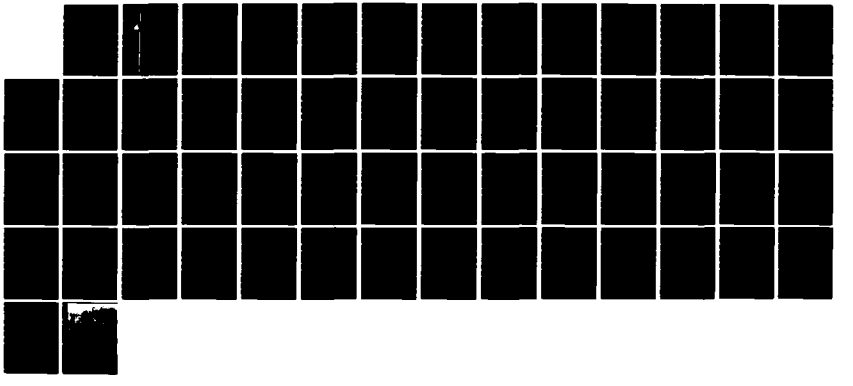

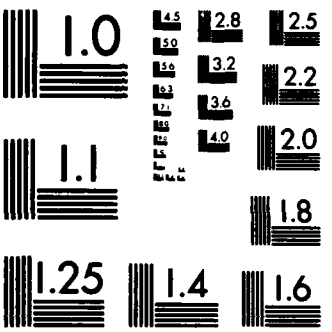

WHOI-83-29

Woods Hole Oceanographic Institution

THE LONG TERM UPPER OCEAN STUDY (LOTUS) CRUISE SUMMARY AND HYDROGRAPHIC DATA REPORT - OCEANUS 129 - OCTOBER 1982

by

Richard P. Trask and Melbourne G. Briscoe

August 1983

TECHNICAL REPORT

Prepared for the Office of Naval Research under Contract N00014-76-C-0197; NR 083-400.

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OCEANUS cruise number 129 (28 October - 4 November, 1982) was the eighth in a series of cruises to the Long Term Upper Ocean Study (LOTUS) area centered at 34°N, 70°W. In the LOTUS area seven SOFAR floats were launched, two moorings were recovered (a LOTUS surface mooring and a C. S. Draper Labs profiling current meter mooring), and a surface mooring which replaced the one recovered was set. Seven CTD stations were also completed in the LOTUS area. Outside the LOTUS area a subsurface mooring was set in the Gulf Stream in cooperation with H. Bryden's (WHOI)

Gulf Stream Observations project, and a WHOI engineering mooring at Site D was recovered, examined and redeployed. In addition, several XBT sections were made, one along 70°W between 40°N and 34°N, a second surveyed a cold core ring discovered during the trip to the LOTUS area and a third was made in the vicinity of the Gulf Stream Observations mooring.

Part I of this report is a summary of the major cruise activities and part II presents the hydrographic data (CTD and XBT) collected during the cruise.

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(LOTUS)
CRUISE SUMMARY AND HYDROGRAPHIC DATA REPORT
OCEANUS 129 - OCTOBER 1982

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Approved for Distribution:

N. P. Fofonoff

N. P. Fofonoff, Chairman
Department of Physical Oceanography

The Long Term Upper Ocean Study
(LOTUS)

Cruise Summary and Hydrographic Data Report
OCEANUS 129
October 1982

Richard P. Trask and Melbourne G. Briscoe

Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

ABSTRACT

OCEANUS cruise number 129 (28 October-4 November, 1982) was the eighth in a series of cruises to the Long Term Upper Ocean Study (LOTUS) area centered at 34°N, 70°W. In the LOTUS area seven SOFAR floats were launched, two moorings were recovered (a LOTUS surface mooring and a C. S. Draper Labs profiling current meter mooring), and a surface mooring which replaced the one recovered was set. Seven CTD stations were also completed in the LOTUS area. Outside the LOTUS area a subsurface mooring was set in the Gulf Stream in cooperation with H. Bryden's (WHOI) Gulf Stream Observations project, and a WHOI engineering mooring at Site D was recovered, examined and redeployed. In addition several XBT sections were made, one along 70°W between 40°N and 34°N, a second surveyed a cold core ring discovered during the trip to the LOTUS area and a third was made in the vicinity of the Gulf Stream Observations mooring.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES
(Continued)

LIST OF TABLES

ACKNOWLEDGEMENTS

The moorings set during OCEANUS cruise number 129 were designed, prepared and deployed by the WHOI Buoy Group, composed of personnel from the Physical Oceanography Department and the Ocean Structures and Moorings Section of the Ocean Engineering Department.

We are grateful for the skill of Captain Paul Howland and the personnel of the R/V OCEANUS. We also wish to thank Nancy Pennington for her assistance in organizing the graphics displayed in this report.

This work was supported by the Office of Naval Research under Contract No. N00014-76-C-0197, NR083-400.

INTRODUCTION

The main purpose of OCEANUS Cruise 129 was to recover the Long Term Upper Ocean Study (LOTUS) surface mooring deployed six months earlier near 34°N, 70°W and to replace it with a nearly identical surface mooring as a continuation of the two year long LOTUS field program (Briscoe and Trask, 1983).

Figure 1 shows the LOTUS area (33°-35°N, 69°-71°W) relative to the Gulf Stream, the east coast of the United States, and Bermuda. The site is in the mid-ocean away from the direct influences of topography and the Gulf Stream, in the path of hurricanes and Gulf Stream rings and at the edge of the region of eighteen degree water formation and high eddy kinetic energy.

The deployment of the surface mooring during OCEANUS 129 was the second of a series of four science deployments planned for the LOTUS experiment. The first science deployment, designated LOTUS 3, occurred in May 1982 and consisted of a surface mooring, a near-surface mooring and two subsurface moorings. Details of that deployment can be found in Trask and Briscoe (1983). The LOTUS surface moorings are replaced every six months whereas the near-surface and subsurface moorings are replaced once a year.

Part I of this report summarizes the major cruise events including the mooring work and SOFAR float deployments. Part II presents the CTD stations and XBT sections made during the cruise.

Following each LOTUS cruise a report of similar content to this will be issued. Upon recovery of the entire moored array, annual data reports presenting the moored current meter and thermistor chain data, and meteorological data will be available. Table 1 gives the nominal contents and publication dates of the LOTUS report series.

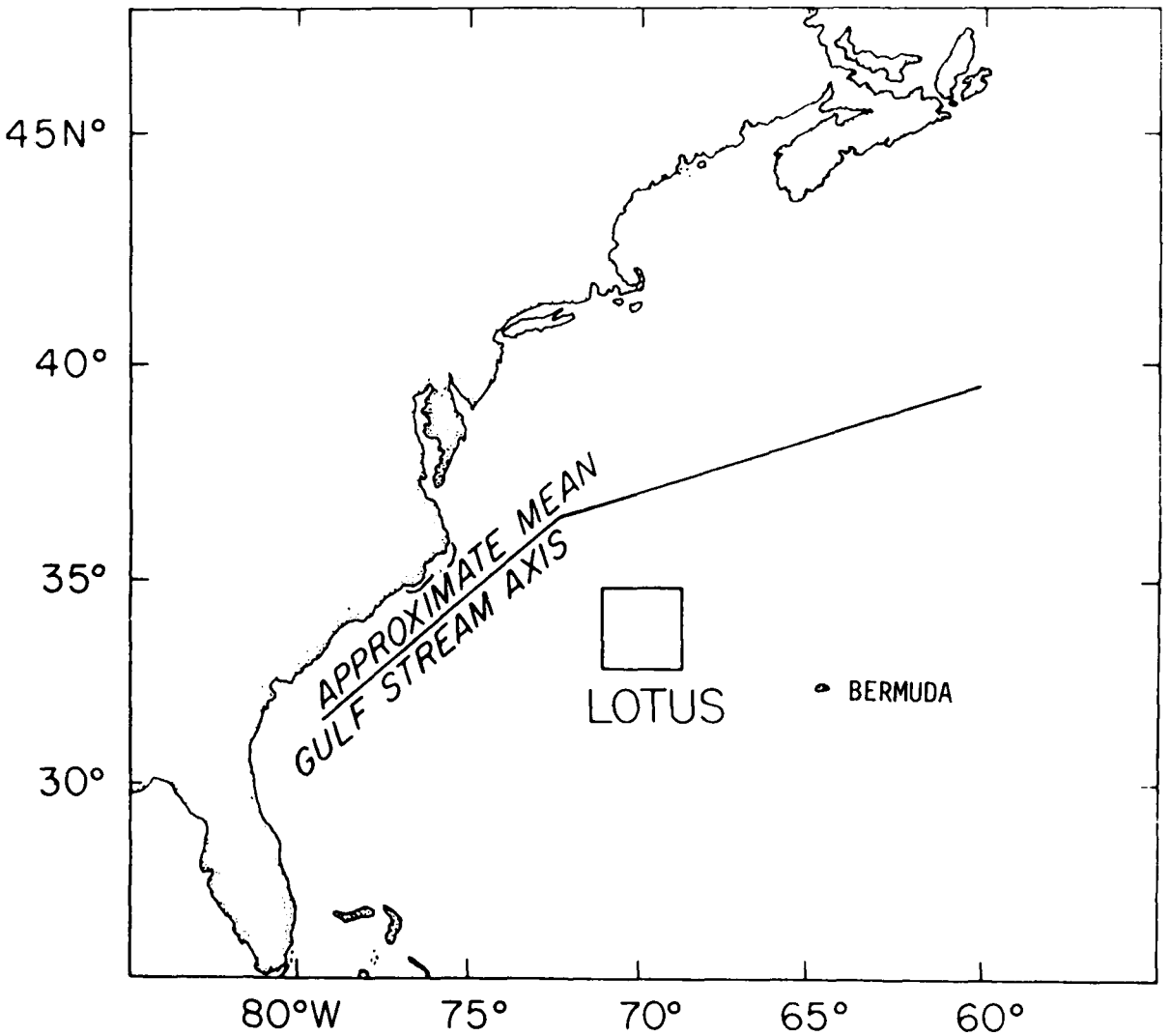

Figure 1. The location of the Long Term Upper-Ocean Study area.

Table 1. LOTUS-related WHOI Technical Reports.

PRESENTLY AVAILABLE REPORTS

Title	WHOI No.	Date
Long Term Upper Ocean Study (LOTUS) A Summary of the Historical Data and Engineering Test Data.	82-53	Dec 82
The Long Term Upper Ocean Study (LOTUS) Cruise Summary and Hydrographic Data Report, OCEANUS 119 - May 1982.	83-7	Feb 83
*The Long Term Upper Ocean Study (LOTUS) Cruise Summary and Hydrographic Data Report, OCEANUS 129 - October 1982.		

PLANNED FUTURE REPORTS

Subject	Expected Availability
An introduction to the experiment and its instrumentation.	Sept 83
Meteorological Sensors, Data, and Heat Fluxes for May-October 1982 (LOTUS-3 and LOTUS-4).	Sept 83
Cruise summary and hydrographic data report, April 83.	Oct 83
Current meter data report, LOTUS-3 and 4.	Oct 83
Cruise summary and hydrographic data report, October 83.	Apr 84
Meteorological data report, LOTUS-5.	Apr 84
Cruise summary and hydrographic data report, April 84.	Oct 84
Meteorological data report, LOTUS-6.	Oct 84
Current meter data report, LOTUS-5 and 6.	Oct 84
A summary of the LOTUS experiment.	Jan 85

* This report.

Navigation

All navigation on OCEANUS 129 and all positions shown in this report are based on LORAN C and the geographical calculation performed by the Northstar 7000 LORAN C unit. The Northstar algorithm provides a geographical position that is southeast of the true (satellite based) position.

From numerous simultaneous LORAN and satellite position fixes in the LOTUS area we have determined an average offset of the LORAN-based calculation. Table 2 shows the offsets and standard deviations for the Northstar 7000. Positions listed in Tables and Figures in this report are all the LORAN-7000 positions; to convert to absolute geographical positions the offsets shown for the Northstar 7000 in Table 2 should be added.

Table 2. Offsets (and standard deviations) from LORAN position to geographical position, based on simultaneous LORAN and satellite position fixes (GEOG = LORAN + OFFSET).

	OFFSET (S.D.)		OFFSET (S.D.)	
UNIT	NORTH	WEST	RANGE [km]*	BEARING
Northstar 7000	1.07'(.15)	1.24'(.16)	2.76 (.32)	316° (4)

* 1 km = .54 nautical miles

PART I

Cruise Summary

OCEANUS 129

October-November 1982

Cruise number 129 of the R/V OCEANUS left Woods Hole on 28 October 1982 bound for the LOTUS area, i.e. the vicinity of 34°N, 70°W. The trip was the eighth in a series of cruises planned for the LOTUS experiment. The cruise was eight days long with the R/V OCEANUS returning to Woods Hole on 4 November.

A total of three moorings were recovered and three moorings were set during the cruise. While in the LOTUS area the LOTUS-3 surface mooring and a C. S. Draper Lab-MIT profiling current meter (PCM) mooring were recovered. The only mooring set in the LOTUS area was a nearly identical replacement for the LOTUS-3 surface mooring. It has been designated as LOTUS-4. Mooring work outside the LOTUS area consisted of setting a subsurface mooring in the Gulf Stream for H. Bryden's (WHOI) Gulf Stream Observations (GUSTO) project and the recovery and redeployment of an engineering mooring in the vicinity of WHOI site D (39°30'N, 70°W).

Non-mooring work included the deployment of seven SOFAR floats in the LOTUS area in cooperation with J. Price and B. Owens of WHOI, nine CTD stations, seven of which were in the LOTUS area and an XBT section along 70°W between 40°N and 34°N. During the northbound trip an XBT survey was made of a cold core ring that had been observed during the trip south. An additional survey was made to locate the north wall of the Gulf Stream with respect to the GUSTO mooring.

Upon arriving in the LOTUS area seven SOFAR floats were deployed in the pattern shown in Figure 2. This operation cleared the deck of the floats and made way for the mooring work that followed. A visual inspection of the LOTUS-3 surface buoy and its near surface mooring components revealed that the Vector Measuring Current Meter (VMCM) at 5 m depth was missing a pair of propellors from the lower hub. No other problems were visible. The LOTUS-3 surface mooring (WHOI mooring number 767) was then recovered. The following morning three scuba divers made a 30 minute dive in order to observe and collect gelatinous zooplankton as part of a cooperative effort with L. Madin

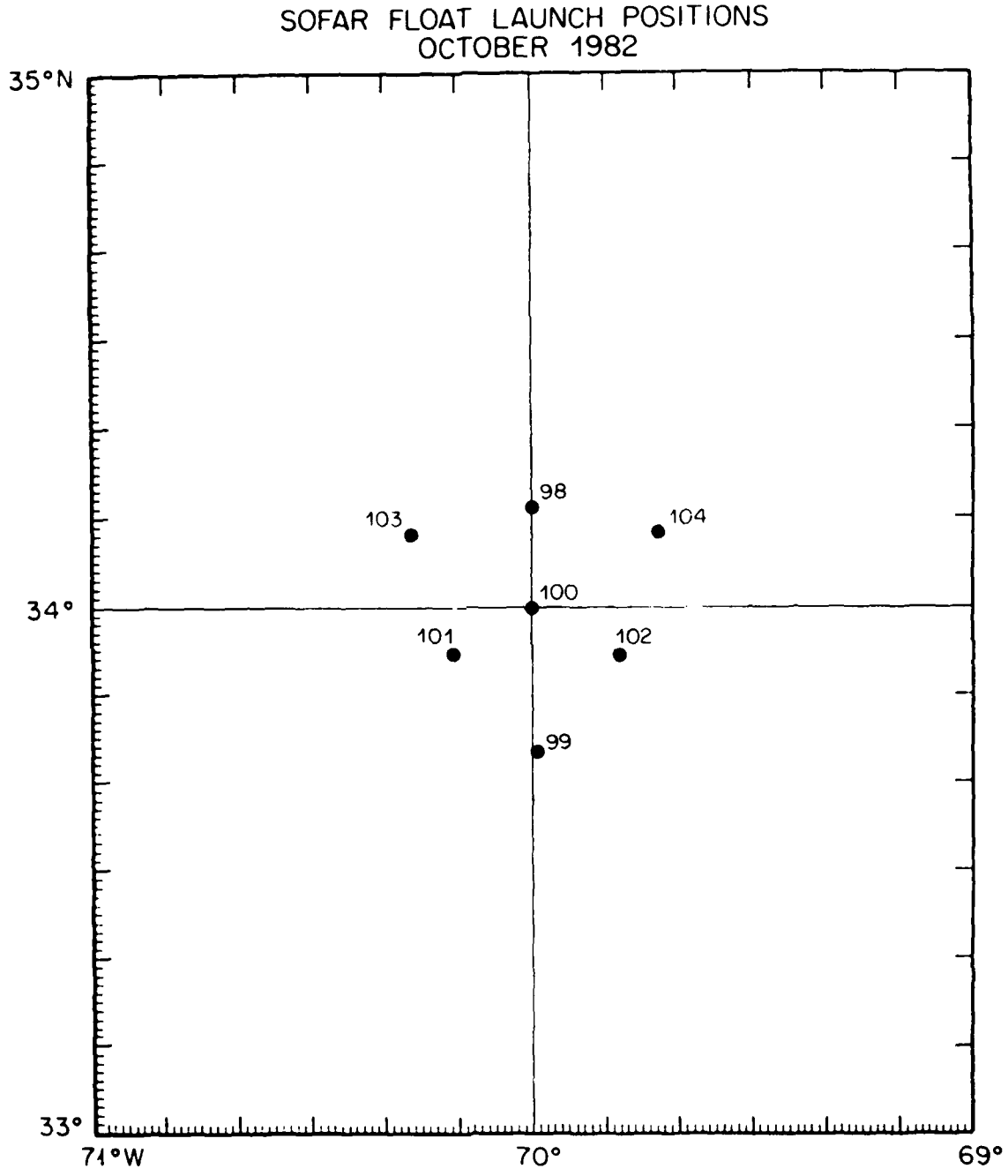

Figure 2. The launch positions of the seven SOFAR floats deployed during OCEANUS cruise 129.

(WHOI). Following the dive the LOTUS-4 surface mooring was launched (WHOI mooring 770). The PCM mooring was recovered the following day. Figure 3 is a chart of a section of the LOTUS area showing the location of the four LOTUS moorings following OCEANUS Cruise 129. Mooring diagrams of the LOTUS moorings appear in Figure 4. The instrument depths shown in Figure 4 for moorings 764, 765 and 766 differ from those reported in Trask and Briscoe (1983) because it has since been determined that the mooring lines were cut shorter than specified in the mooring design. The cause of the problem has been attributed to the application of an incorrect calibration factor to the length counter used to measure the mooring components. The instrument depths shown in Figure 4 were obtained using the correct calibration factors, actual depths may vary slightly. Table 3 summarizes the mooring deployment times and positions.

Following the work in the LOTUS area OCEANUS proceeded to the proposed GUSTO mooring site. While enroute to the GUSTO site the ship stopped and a second dive for collecting gelatinous zooplankton was made. At the GUSTO site a bathymetry survey was conducted and the mooring was set (WHOI mooring 771). An acoustic survey of the release indicated the anchor position to be 37°36.96'N, 68°00.08'W. Following the GUSTO mooring work an engineering test mooring (WHOI mooring 763) was recovered near 39°11.29'N, 69°59.73'W. Particular components of the mooring line were removed for testing at WHOI. The mooring was then redeployed (WHOI mooring 772). The anchor position as determined by an acoustic survey of the release was 39°11.42'N, 69°59.75'W. Details of the CTD and XBT work conducted during the cruise are presented in Part II of this report. A chronological log of OCEANUS Cruise 129 along with a plot of the cruise track appears in the Appendix.

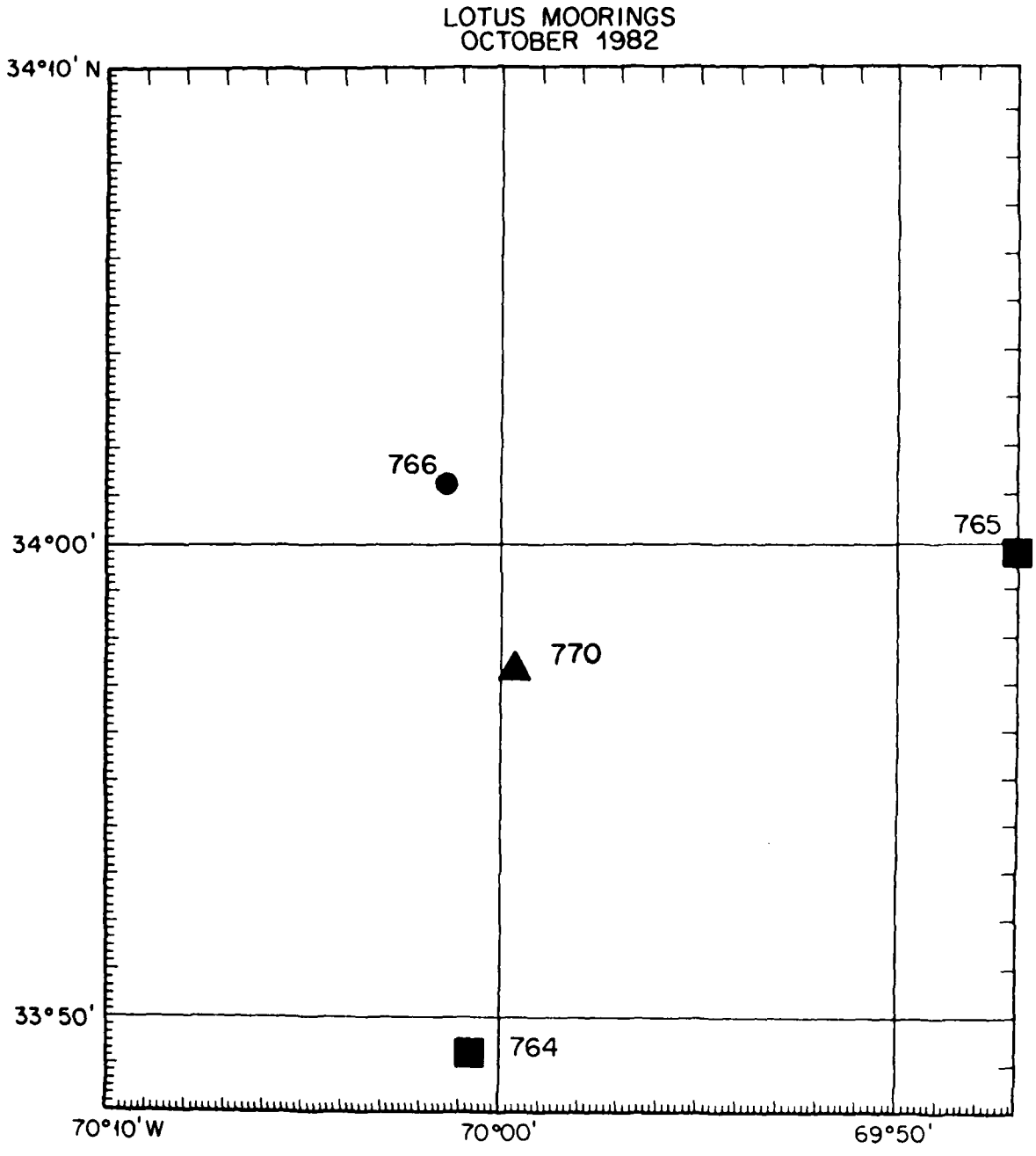

Figure 3. A chart of a section of the LOTUS area showing the location of the LOTUS surface mooring (▲), near-surface mooring (●), and subsurface moorings (■) following OCEANUS cruise 129.

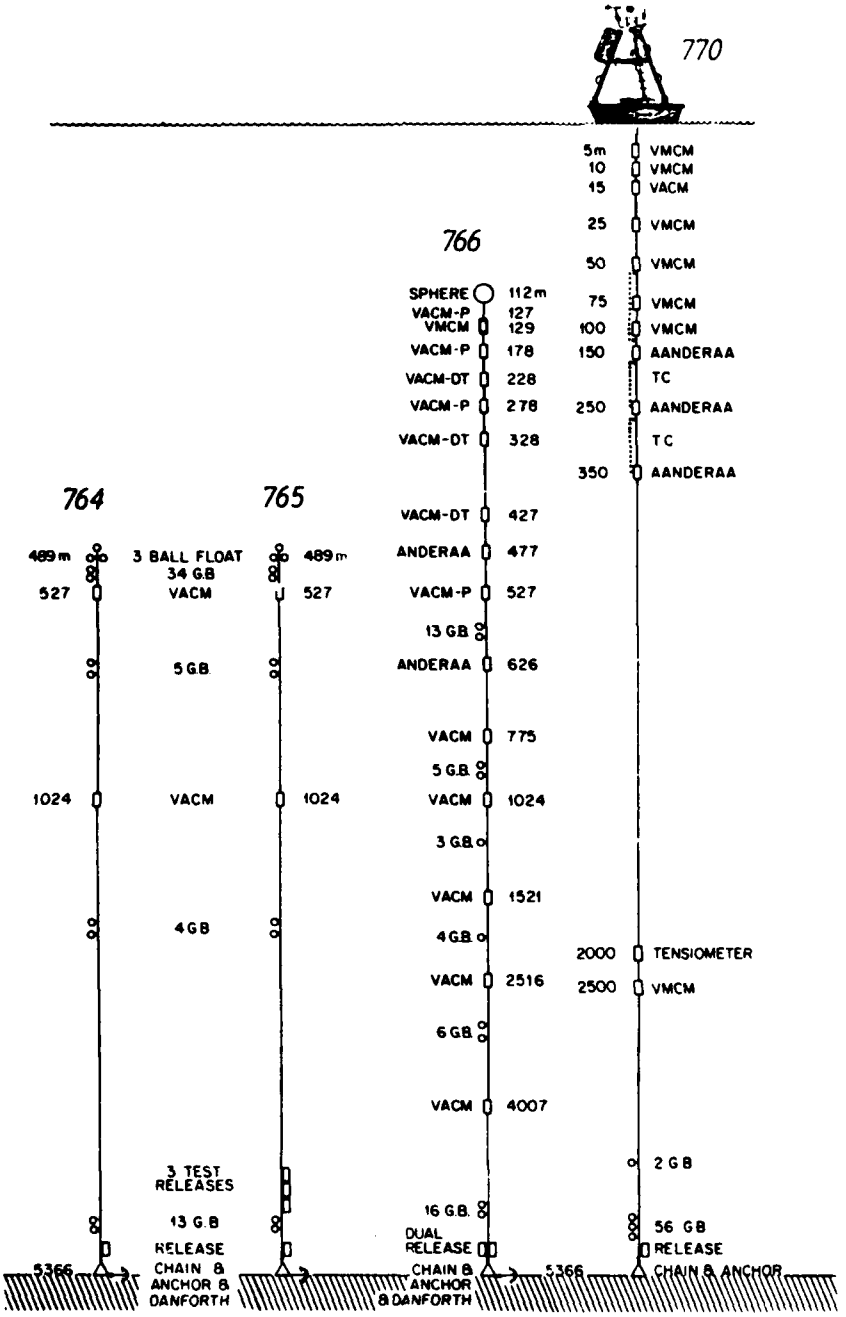

Figure 4. Mooring diagrams of the four LOTUS moorings. The only change to the moored array was a new surface mooring set during OCEANUS cruise 129. The instrument depths shown are design depths, actual depths may vary slightly.

Table 3. A summary of the moorings remaining in the water following OCEANUS cruise 129.

Mooring ID	Date/Time Set	LORAN-C Anchor Position
764 LOTUS-3 South subsurface	8 May 82 1935 Z	33°49.23'N 70°00.73'W
765 LOTUS-3 East subsurface	9 May 82 0507 Z	33°59.80'N 69°47.16'W
766 LOTUS-3 near-surface	10 May 82 1608 Z	34°01.16'N 70°01.37'W
770 LOTUS-4 surface mooring	31 October 82 2352 Z	33°57.22'N 69°59.66'W

PART II

Hydrographic Data

a. CTD Data

Seven CTD stations were made during OCEANUS Cruise 129 in the vicinity of the LOTUS area (Figure 5). The CTD measurements were made by a Neil Brown Instrument Systems internal recording conductivity-temperature-depth profiler (CTD/IR). Mechanical and operational details of the LOTUS CTD/IR are found in Trask (1981).

CTD/IR stations 1, 2 and 3 are all nearly full depth profiles. The start locations of the three stations correspond to the launch positions of SOFAR floats 99, 100 and 104, respectively. In addition station 2 is in close proximity to the LOTUS surface and near-surface moorings. During CTD/IR station number 4 the CTD failed early (discontinued operating) in the cast due to an exhausted battery pack. No usable data were obtained from that station. CTD/IR stations 5 and 6 were both full depth profiles made near the LOTUS south and east intermediate moorings respectively. Station 7 is a shallow 198 m cast made near the C. S. Draper Labs PCM mooring prior to its recovery.

CTD/IR stations 8 and 9 were made outside the LOTUS area. During both stations the CTD failed early in the station due to a second exhausted battery pack. Station 8 was located near the center of a cold core ring that had been detected by XBTs during the trip south. At station 8 the CTD recorded data to a depth of 1274 dbars; however at station 9, made near the GUSTO mooring, the CTD failed on deck. In both cases the problem went undetected until the cassette tape was removed from the instrument and read. A summary of the CTD/IR stations taken during OCEANUS Cruise 129 appears in Table 4.

Examination of the CTD/IR battery packs at WHOI revealed that both of the rechargeable nickel cadmium batteries were not accepting a full charge and were therefore not capable of powering the CTD/IR for the normal period of operation. The post cruise installation of new battery packs eliminated the failure experienced during OCEANUS 129.

Calibration and preliminary data processing procedures are found in Briscoe and Trask (1983); a brief summary follows.

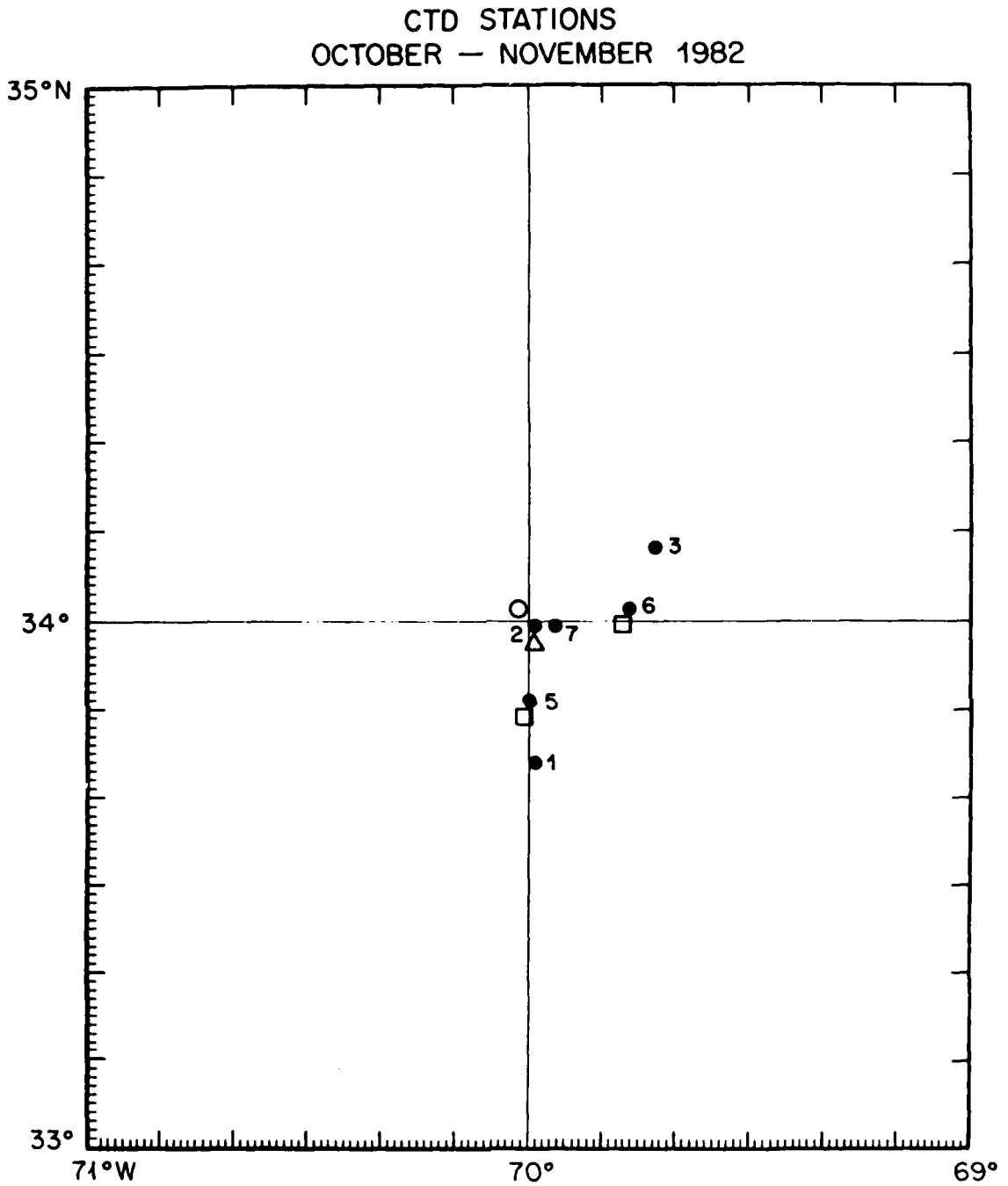

Figure 5. Chart of the LOTUS area showing the locations of the CTD/IR stations (●) made during OCEANUS 129 and their proximity to the LOTUS surface mooring (△), near-surface mooring (○), and subsurface moorings (□). CTD/IR station 4 is not shown because the CTD malfunctioned during that cast.

Table 4: A summary of the CTD/IR work conducted on OCEANUS cruise 129.

CTD Station	Date (year day)	Start Time (UTC)	Deployed Position Lat. (N)	Long. (W)	Pressure Range (dbar)
1	30 October 82 (303)	0140	33°43.64'	69°59.35'	0-5200
2	31 October 82 (304)	0016	33°59.61'	69°59.15'	0-5216
3	31 October 82 (304)	0430	34°08.08'	69°42.96'	0-5298
5	1 November 82 (305)	0406	33°51.05'	70°00.01'	0-5252
6	1 November 82 (305)	0840	34°01.51'	69°46.46'	0-5256
7	1 November 82 (305)	1300	33°59.67'	69°56.40'	0-198
8	2 November 82 (306)	0714	35°25.41'	69°48.11'	0-1274

Stations 4 and 9 yielded unusable data.

Data Presentation

The CTD/IR data are presented in two forms, tabular listings and graphical profiles. The profiles are reproductions of the original computer plots. Included here are profiles of potential temperature, salinity, Brunt Väisälä frequency, and potential density referenced to the surface (Figures 6-12). Full depth profiles as well as profiles of the upper 750 meters are presented. In addition a potential temperature-salinity diagram is presented for each station. The listings of data (Tables 5-11) include the above parameters plus sigma-t, potential temperature gradient, dynamic height, and sound speed, all at standard pressures as well as at the design depths of the instrumentation on the moorings.

The heading of the tabular listing includes the ship name (OC = OCEANUS) and cruise number, CTD number, year, year day, time, the latitude and longitude (LORAN-7000 position) of the CTD station when it started and the water depth at that station. Abbreviations used in the listings include PRESS for pressure, TEMP for temperature, SALIN for salinity, POTEMP for potential temperature, POTGRD for potential temperature gradient, POTDEN for potential density, BR-V for Brunt Väisälä frequency, SSPEED for sound speed and DYNHGT for dynamic height.

Summary of Calibration and Data Processing Procedures

The CTD/IR routinely undergoes pre-cruise laboratory calibrations at WHOI. The laboratory calibration of the temperature and pressure sensors is relied on totally for adjusting the calibration coefficients of those sensors. The conductivity sensor is calibrated using water samples collected at the bottom of each cast. Based on a comparison of the water sample salinities and the CTD/IR conductivity readings a conductivity cell factor is computed for each station. The cell factor is the scaling factor by which the measured conductivity must be multiplied to obtain the "true" conductivity. The conductivity values of the entire cast are then multiplied by the appropriate cell factor to obtain the "true" conductivities.

The preliminary CTD/IR data processing is accomplished with a SEA DATA 12A cassette reader and Asynchronous Reader Interface in conjunction with a Hewlett Packard (HP) 85 desk top computer and HP 5.25 inch flexible disc

drive, printer and 7225B plotter. The preliminary processing presently takes the raw down cast data from cassette and applies the appropriate calibration coefficients, edits wild points, applies a pressure and conductivity sensor time lag correction, pressure averages the data (2 dbar pressure range) and stores the data on flexible disc.

All salinity computations are based on the 1978 Practical Salinity Scale (Lewis and Perkin, 1981) as recommended by the Joint Panel on Oceanographic Tables and Standards. Further processing incorporates the new equation of state for sea water (Millero, et al., 1980) for computing density and its related parameters such as specific volume and specific volume anomaly. Potential temperature at a reference pressure is computed using a fourth order Runge Kutta integration algorithm (Fofonoff, 1977) which uses the Bryden (1973) polynomial for adiabatic lapse rate. Sound speed calculations are based on the algorithms of Chen and Millero (1977). These algorithms are the basis of further computations which yield quantities of sigma-t, sigma-theta, dynamic height, potential temperature gradients and Brunt-Väisälä frequency. The Brunt-Väisälä frequency calculation incorporates a sliding least squares fit to the potential density data over user specified smoothing windows. Four windows were chosen for this calculation. A smoothing interval of 10 dbars was used between 0 and 150 dbars, a 30 dbar interval between 150 and 1500 dbars, 62 dbar interval between 1500 and 3500 dbars and a 90 dbar smoothing interval between 3500 dbars and the bottom.

Table 5: Listing of CTD data and derived quantities for station 1.

DC129	CTD 001		1982 303 01207		33 43.64N	69 59.35W		corrD: 5375m	
PRESS dbar	TEMP °C	SALIN psu	POTEMP °C	POTGRD m°C/db	SIGMA-t kg/m**3	POTDEN kg/m**3	BRV cph	SSPEED m/s	DYNHGT dyn m
2.	24.146	36.233	24.146	0.00	24.551	24.534	0.00	1533.7	0.0000
6.	24.182	36.286	24.181	-2.35	24.580	24.563	3.03	1533.9	.0126
10.	24.192	36.290	24.190	-4.46	24.580	24.563	1.13	1534.0	.0274
16.	24.196	36.298	24.193	-.39	24.585	24.568	1.13	1534.1	.0467
20.	24.196	36.298	24.192	.04	24.585	24.569	.39	1534.2	.0611
26.	24.198	36.298	24.193	-.30	24.584	24.568	.51	1534.3	.0808
30.	24.197	36.298	24.190	1.23	24.585	24.569	.81	1534.3	.0946
36.	24.195	36.298	24.188	.39	24.585	24.570	.90	1534.4	.1141
50.	24.191	36.301	24.180	1.28	24.589	24.575	1.52	1534.7	.1618
66.	24.173	36.306	24.159	1.56	24.598	24.585	1.21	1534.9	.2156
76.	24.166	36.312	24.150	.31	24.604	24.592	1.57	1535.1	.2497
100.	22.894	36.621	22.874	53.95	25.213	25.202	7.44	1532.6	.3255
126.	21.142	36.641	21.117	88.77	25.722	25.713	6.98	1528.5	.3921
150.	20.205	36.600	20.177	33.31	25.945	25.937	4.87	1526.3	.4458
200.	19.112	36.573	19.076	21.45	26.212	26.206	3.65	1524.1	.5455
250.	18.479	36.535	18.435	8.21	26.344	26.341	2.47	1523.1	.6360
300.	18.189	36.521	18.136	8.36	26.407	26.405	2.01	1523.0	.7236
350.	17.970	36.504	17.909	2.25	26.448	26.448	1.58	1523.2	.8094
400.	17.786	36.482	17.717	4.45	26.477	26.479	1.25	1523.5	.8945
450.	17.592	36.456	17.515	4.45	26.505	26.509	1.47	1523.7	.9788
500.	17.384	36.423	17.299	3.54	26.530	26.536	1.42	1523.9	1.0628
550.	17.117	36.387	17.025	1.40	26.567	26.574	1.49	1523.9	1.1455
600.	16.802	36.329	16.701	8.16	26.598	26.607	1.66	1523.7	1.2279
650.	16.112	36.194	16.007	11.04	26.657	26.666	2.56	1522.3	1.3086
700.	15.177	36.031	15.068	23.32	26.744	26.753	2.47	1520.0	1.3863
750.	14.141	35.861	14.029	21.84	26.840	26.847	2.72	1517.3	1.4597
800.	12.984	35.685	12.871	31.56	26.945	26.951	2.84	1514.2	1.5290
900.	10.757	35.383	10.643	21.33	27.136	27.138	2.97	1507.8	1.6532
1000.	8.834	35.196	8.721	11.31	27.318	27.317	2.59	1502.3	1.7580
1100.	7.047	35.084	6.937	16.24	27.499	27.494	2.74	1497.1	1.8456
1200.	5.997	35.062	5.885	12.98	27.623	27.616	2.07	1494.6	1.9158
1300.	5.367	35.054	5.251	3.85	27.696	27.689	1.36	1493.7	1.9758
1400.	4.981	35.042	4.859	7.08	27.732	27.725	1.27	1493.8	2.0311
1500.	4.741	35.035	4.612	2.84	27.755	27.748	.88	1494.5	2.0838
1600.	4.516	35.020	4.381	1.34	27.767	27.761	.88	1495.2	2.1351
1800.	4.132	34.991	3.982	.99	27.786	27.781	.70	1496.9	2.2358
2000.	3.992	34.995	3.825	1.23	27.804	27.800	.65	1499.7	2.3350
2200.	3.833	34.996	3.649	1.71	27.822	27.819	.62	1502.4	2.4324
2400.	3.604	34.982	3.403	.80	27.834	27.832	.67	1504.8	2.5289
2500.	3.500	34.976	3.291	.76	27.839	27.838	.67	1506.1	2.5766
2600.	3.377	34.969	3.160	.98	27.846	27.845	.73	1507.2	2.6237
2800.	3.184	34.960	2.950	.42	27.858	27.858	.66	1509.8	2.7166
3000.	2.999	34.949	2.748	1.74	27.866	27.867	.67	1512.4	2.8080
3200.	2.847	34.939	2.579	.45	27.872	27.875	.60	1515.1	2.8981
3400.	2.706	34.932	2.419	.50	27.879	27.882	.62	1517.9	2.9875
3600.	2.579	34.923	2.273	.07	27.883	27.887	.53	1520.8	3.0754
3800.	2.482	34.917	2.157	.30	27.887	27.893	.48	1523.8	3.1632
4000.	2.413	34.912	2.067	.28	27.888	27.896	.43	1527.0	3.2509
4200.	2.367	34.907	1.999	.14	27.889	27.898	.34	1530.2	3.3393
4400.	2.341	34.903	1.951	.02	27.888	27.898	.30	1533.6	3.4289
4600.	2.327	34.900	1.913	.36	27.886	27.898	.24	1537.0	3.5202
4800.	2.318	34.897	1.879	.33	27.884	27.898	.23	1540.4	3.6134
5000.	2.313	34.890	1.850	.18	27.880	27.896	.21	1543.8	3.7084
5200.	2.299	34.885	1.811	.27	27.877	27.895	0.00	1547.3	3.8056

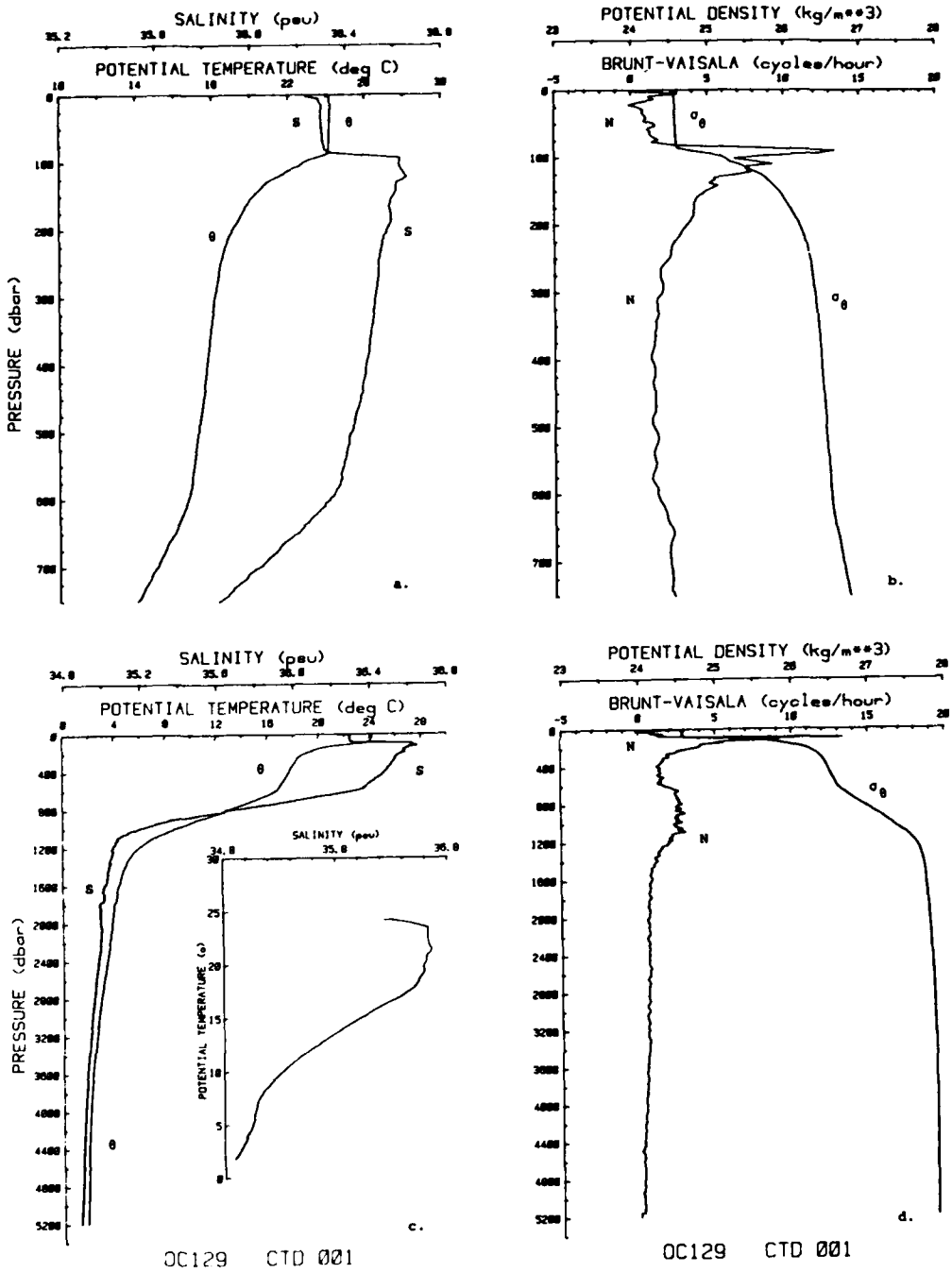

Figure 6. CTD station 1. Profiles of potential temperature (θ) and salinity (S), and Brunt-Väisälä frequency (N) and potential density (σ_θ) for the upper 750 m (a and b respectively) and for the entire cast (c and d respectively). θ-S diagram included in c.

Table 6: Listing of CTD data and derived quantities for station 2.

OC129	CTD 002		1982 307 00127		33 59.61N	69 59.15W		corrD: 5363m	
PRESS dbar	TEMP °C	SALIN psu	POTEMP °C	POTGRD m°C/db	SIGMA-t kg/m**3	POTDEN kg/m**3	BR-V cph	SSPEED m/s	DYNHGT dyn m
2.	23.741	36.360	23.741	0.00	24.767	24.750	0.00	1532.8	0.0000
6.	23.753	36.354	23.752	1.41	24.759	24.743	-1.16	1532.9	.0118
10.	23.749	36.355	23.747	.10	24.761	24.744	-.54	1533.0	.0255
16.	23.750	36.349	23.746	-2.55	24.756	24.740	-.87	1533.1	.0450
20.	23.748	36.349	23.744	.57	24.756	24.741	.99	1533.1	.0569
26.	23.731	36.350	23.725	5.28	24.762	24.747	2.39	1533.2	.0768
30.	23.713	36.353	23.707	1.81	24.770	24.755	2.23	1533.2	.0898
36.	23.694	36.356	23.686	6.28	24.778	24.763	2.18	1533.3	.1081
50.	23.665	36.360	23.654	.58	24.790	24.776	1.24	1533.4	.1539
66.	23.661	36.365	23.648	-.31	24.794	24.781	1.24	1533.7	.2041
76.	23.027	36.520	23.011	266.80	25.098	25.086	15.22	1532.4	.2358
100.	21.436	36.608	21.416	78.70	25.616	25.605	8.22	1528.8	.2981
126.	20.265	36.596	20.241	17.32	25.926	25.917	5.44	1526.1	.3564
150.	19.723	36.603	19.695	6.15	26.075	26.067	4.04	1525.0	.4057
200.	18.862	36.568	18.827	16.01	26.272	26.266	2.75	1523.4	.4999
250.	18.448	36.544	18.404	3.50	26.359	26.355	1.86	1523.0	.5895
300.	18.258	36.534	18.205	4.01	26.399	26.397	1.63	1523.3	.6761
350.	18.050	36.519	17.989	3.82	26.440	26.440	1.53	1523.5	.7626
400.	17.902	36.504	17.832	3.31	26.465	26.468	1.30	1523.8	.8481
450.	17.717	36.478	17.639	3.45	26.490	26.495	1.24	1524.1	.9329
500.	17.531	36.449	17.445	5.01	26.515	26.521	1.44	1524.4	1.0180
550.	17.268	36.403	17.175	3.44	26.543	26.551	1.48	1524.4	1.1028
600.	16.758	36.305	16.658	19.56	26.591	26.599	2.11	1523.5	1.1852
650.	15.977	36.165	15.872	15.88	26.665	26.674	2.21	1521.8	1.2658
700.	15.144	36.023	15.035	23.63	26.746	26.754	2.24	1519.9	1.3432
750.	14.261	35.879	14.148	20.39	26.828	26.836	2.59	1517.8	1.4172
800.	13.300	35.737	13.186	28.27	26.920	26.927	2.60	1515.3	1.4872
900.	11.007	35.430	10.892	38.39	27.128	27.131	2.98	1508.8	1.6136
1000.	8.969	35.187	8.856	32.37	27.289	27.289	2.70	1502.8	1.7207
1100.	6.959	35.075	6.849	20.02	27.504	27.499	2.87	1496.7	1.8089
1200.	5.876	35.058	5.765	.01	27.635	27.628	1.88	1494.1	1.8773
1300.	5.350	35.058	5.234	2.55	27.701	27.694	1.28	1493.7	1.9367
1400.	5.046	35.050	4.923	1.62	27.731	27.724	1.13	1494.1	1.9918
1500.	4.759	35.039	4.630	1.99	27.756	27.749	.93	1494.6	2.0446
1600.	4.525	35.022	4.390	1.00	27.768	27.762	.83	1495.3	2.0960
1800.	4.174	34.997	4.023	1.59	27.787	27.781	.71	1497.1	2.1964
2000.	3.963	34.991	3.796	.25	27.804	27.800	.70	1499.6	2.2952
2200.	3.836	34.998	3.651	1.85	27.823	27.820	.68	1502.4	2.3926
2400.	3.612	34.985	3.411	1.34	27.836	27.834	.65	1504.9	2.4888
2500.	3.506	34.978	3.297	.86	27.841	27.840	.65	1506.1	2.5362
2600.	3.427	34.975	3.209	.70	27.846	27.845	.66	1507.4	2.5835
2800.	3.249	34.964	3.014	1.12	27.854	27.855	.61	1510.1	2.6777
3000.	3.086	34.953	2.833	1.08	27.862	27.863	.58	1512.8	2.7708
3200.	2.940	34.943	2.669	.12	27.867	27.870	.61	1515.5	2.8630
3400.	2.802	34.935	2.513	.45	27.873	27.877	.54	1518.4	2.9547
3600.	2.670	34.927	2.363	.19	27.879	27.884	.55	1521.2	3.0454
3800.	2.548	34.920	2.221	.45	27.884	27.890	.54	1524.1	3.1353
4000.	2.463	34.914	2.115	.63	27.886	27.893	.44	1527.2	3.2245
4200.	2.396	34.908	2.027	.01	27.887	27.896	.42	1530.3	3.3140
4400.	2.359	34.903	1.968	.24	27.886	27.897	.33	1533.6	3.4043
4600.	2.333	34.898	1.919	.16	27.884	27.897	.29	1537.0	3.4962
4800.	2.324	34.895	1.885	.08	27.883	27.897	.18	1540.4	3.5895
5000.	2.321	34.892	1.857	.02	27.881	27.897	.22	1543.9	3.6849
5200.	2.317	34.888	1.829	.48	27.878	27.896	0.00	1547.3	3.7821

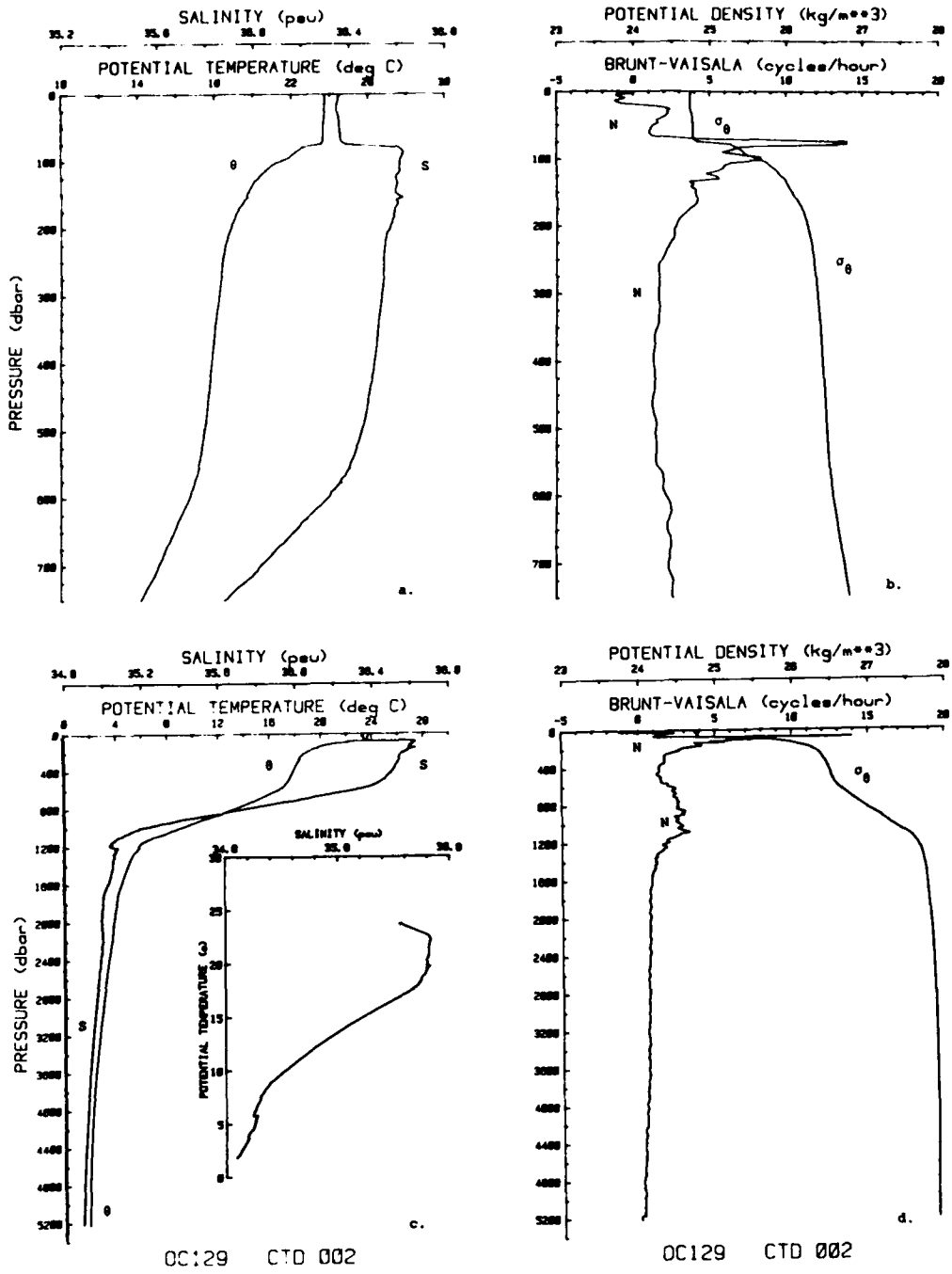

Figure 7. CTD station 2. Profiles of potential temperature (θ) and salinity (S), and Brunt-Väisälä frequency (N) and potential density (σ_θ) for the upper 750 m (a and b respectively) and for the entire cast (c and d respectively). θ-S diagram included in c.

Table 7: Listing of CTD data and derived quantities for station 3.

OC129	CTD 003	1982 304 04:27		34 08.08N	69 42.96W		corrD: 5353m	
PRESS dbar	TEMP °C	SALIN psu	POTEMP °C	POTGRD m°C/db	SIGMA-t kg/m**3	POTDEN kg/m**3	BRV cph	SSPEED m/s	DYNHGT dyn m
2.	23.841	36.345	23.840	0.00	24.727	24.719	0.00	1533.1	0.0000
6.	23.861	36.342	23.860	-.93	24.718	24.701	-1.85	1533.2	.0122
10.	23.865	36.341	23.863	-.35	24.716	24.700	-1.13	1533.2	.0245
16.	23.866	36.338	23.863	.18	24.714	24.698	-.80	1533.3	.0458
20.	23.868	36.339	23.864	-.22	24.713	24.698	-.08	1533.4	.0566
26.	23.869	36.338	23.863	.14	24.713	24.697	.19	1533.5	.0774
30.	23.868	36.338	23.862	.43	24.713	24.698	.72	1533.6	.0903
36.	23.862	36.338	23.855	1.97	24.715	24.700	1.86	1533.7	.1101
50.	23.806	36.353	23.795	2.92	24.742	24.728	1.57	1533.8	.1547
66.	23.739	36.360	23.725	10.45	24.768	24.755	2.70	1533.9	.2064
76.	23.693	36.374	23.677	14.57	24.792	24.780	12.06	1534.0	.2386
100.	21.308	36.638	21.288	47.80	25.674	25.663	6.45	1528.5	.3015
126.	20.289	36.605	20.266	21.10	25.926	25.917	4.53	1526.2	.3595
150.	19.630	36.585	19.602	16.70	26.085	26.077	3.86	1524.7	.4086
200.	18.884	36.560	18.848	9.47	26.260	26.255	2.66	1523.4	.5041
250.	18.519	36.548	18.474	4.48	26.344	26.340	2.10	1523.2	.5943
300.	18.273	36.534	18.220	3.51	26.395	26.394	1.57	1523.3	.6818
350.	18.075	36.519	18.014	2.47	26.434	26.434	1.49	1523.5	.7681
400.	17.914	36.502	17.844	3.91	26.461	26.463	1.39	1523.9	.8534
450.	17.747	36.482	17.669	3.17	26.486	26.491	1.32	1524.2	.9391
500.	17.511	36.445	17.425	2.28	26.516	26.522	1.30	1524.3	1.0237
550.	17.231	36.398	17.137	9.08	26.548	26.556	1.66	1524.2	1.1076
600.	16.856	36.332	16.756	10.25	26.587	26.596	1.94	1523.9	1.1907
650.	16.168	36.205	16.062	17.76	26.652	26.662	2.36	1522.5	1.2722
700.	15.290	36.053	15.180	13.02	26.736	26.745	2.79	1520.4	1.3501
750.	14.202	35.877	14.090	26.55	26.839	26.847	2.61	1517.6	1.4239
800.	13.294	35.735	13.179	22.51	26.919	26.927	2.49	1515.3	1.4936
900.	11.126	35.433	11.011	14.45	27.108	27.111	2.59	1509.2	1.6201
1000.	8.899	35.194	8.785	13.50	27.306	27.305	2.89	1502.6	1.7270
1100.	6.926	35.085	6.817	25.24	27.516	27.511	2.51	1496.6	1.8124
1200.	5.724	35.040	5.615	9.56	27.641	27.633	1.80	1493.5	1.8797
1300.	5.114	35.021	5.001	5.67	27.700	27.692	1.20	1492.7	1.9383
1400.	4.733	35.003	4.614	.61	27.730	27.722	1.00	1492.8	1.9928
1500.	4.511	34.997	4.385	4.91	27.750	27.743	.85	1493.5	2.0449
1600.	4.330	34.988	4.196	1.91	27.763	27.756	.74	1494.4	2.0959
1800.	4.187	34.995	4.037	1.20	27.783	27.778	.62	1497.2	2.1967
2000.	4.060	35.004	3.891	.62	27.804	27.801	.67	1500.0	2.2965
2200.	3.894	35.001	3.709	2.58	27.819	27.817	.68	1502.7	2.3951
2400.	3.686	34.988	3.483	1.52	27.831	27.830	.73	1505.2	2.4925
2500.	3.590	34.986	3.379	.11	27.838	27.838	.58	1506.5	2.5409
2600.	3.495	34.980	3.276	.63	27.844	27.844	.63	1507.7	2.5887
2800.	3.292	34.967	3.056	.46	27.853	27.854	.59	1510.2	2.6835
3000.	3.123	34.956	2.869	.74	27.860	27.862	.57	1512.9	2.7775
3200.	2.962	34.945	2.690	2.12	27.866	27.869	.58	1515.6	2.8703
3400.	2.823	34.937	2.533	.44	27.872	27.876	.61	1518.4	2.9624
3600.	2.672	34.927	2.364	.34	27.878	27.883	.57	1521.2	3.0536
3800.	2.548	34.919	2.221	-.03	27.883	27.889	.53	1524.1	3.1433
4000.	2.452	34.913	2.105	.20	27.886	27.893	.51	1527.1	3.2327
4200.	2.391	34.907	2.022	.58	27.887	27.896	.42	1530.3	3.3222
4400.	2.349	34.903	1.958	-.01	27.887	27.897	.33	1533.6	3.4124
4600.	2.335	34.899	1.920	.26	27.885	27.897	.31	1537.0	3.5040
4800.	2.322	34.896	1.883	.57	27.883	27.897	.24	1540.4	3.5974
5000.	2.323	34.893	1.859	.08	27.881	27.897	.24	1543.9	3.6927
5200.	2.321	34.889	1.832	-.02	27.878	27.896	.23	1547.4	3.7900

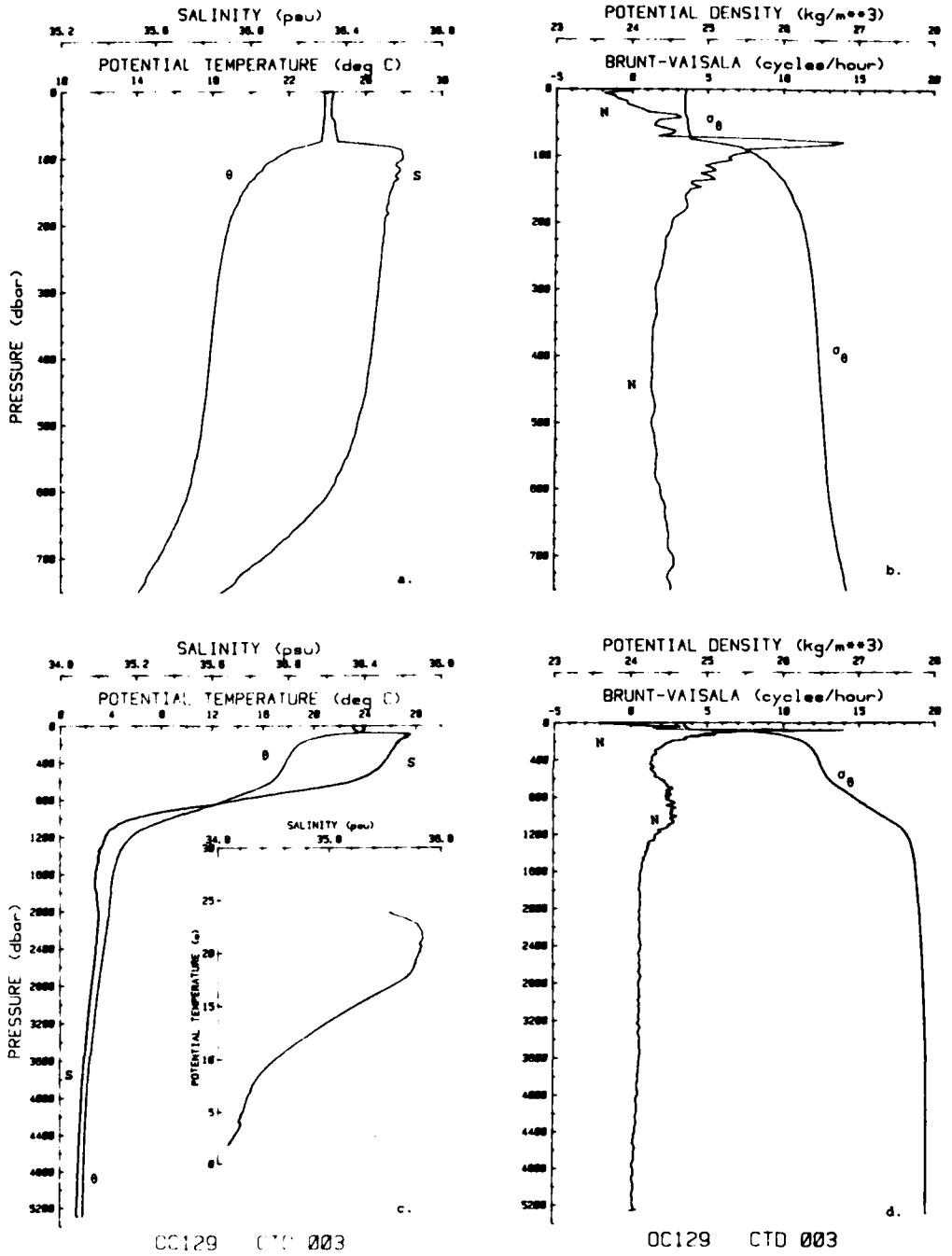

Figure 8. CTD station 3. Profiles of potential temperature (θ) and salinity (S), and Brunt-Väisälä frequency (N) and potential density (σ_θ) for the upper 750 m (a and b respectively) and for the entire cast (c and d respectively). θ-S diagram included in c.

Table 8: Listing of CTD data and derived quantities for station 5.

OC129	CTD 005	1982 304 04107		33 51.05N	70 00.01W	corrD: 5368m		
PRESS	TEMP	SALIN	POTEMP	POTGRD	SIGMA-t	POTDEN	RR-V	SSPEED	DYNHGT
dbar	°C	psu	°C	m°C/db	kg/m**3	kg/m**3	cph	m/s	dyn m
2.	24.093	36.242	24.093	0.00	24.573	24.556	0.00	1533.6	0.0000
6.	24.116	36.263	24.115	-4.94	24.583	24.566	2.66	1533.7	.0119
10.	24.121	36.277	24.119	-2.11	24.592	24.575	2.55	1533.8	.0275
16.	24.125	36.288	24.122	1.82	24.599	24.582	1.06	1533.9	.0467
20.	24.126	36.289	24.122	-.10	24.599	24.583	-.46	1534.0	.0601
26.	24.129	36.288	24.123	-.23	24.598	24.582	.55	1534.1	.0808
30.	24.130	36.289	24.123	.19	24.598	24.583	1.14	1534.2	.0935
36.	24.131	36.295	24.123	-.59	24.603	24.588	1.58	1534.3	.1139
50.	24.097	36.302	24.087	10.92	24.617	24.603	2.26	1534.4	.1607
66.	24.033	36.300	24.019	2.14	24.635	24.622	1.96	1534.5	.2146
76.	24.020	36.310	24.003	.82	24.647	24.634	2.00	1534.7	.2480
100.	22.197	36.621	22.177	52.29	25.412	25.401	8.00	1530.8	.3217
126.	20.532	36.608	20.508	46.97	25.863	25.854	6.40	1526.8	.3834
150.	19.790	36.581	19.762	25.98	26.040	26.032	4.51	1525.1	.4333
200.	18.940	36.566	18.904	8.13	26.251	26.245	2.87	1523.6	.5302
250.	18.486	36.543	18.442	5.37	26.348	26.344	2.06	1523.1	.6195
300.	18.211	36.528	18.158	4.82	26.406	26.404	1.79	1523.1	.7067
350.	18.036	36.517	17.975	5.53	26.442	26.442	1.45	1523.4	.7929
400.	17.915	36.505	17.845	2.30	26.462	26.465	1.33	1523.9	.8782
450.	17.699	36.475	17.621	6.85	26.493	26.497	1.54	1524.0	.9631
500.	17.436	36.433	17.351	5.93	26.525	26.531	1.48	1524.1	1.0478
550.	17.114	36.374	17.021	9.44	26.558	26.565	1.80	1523.9	1.1311
600.	16.586	36.276	16.486	19.04	26.609	26.617	1.99	1523.0	1.2137
650.	16.055	36.182	15.950	16.97	26.661	26.670	2.35	1522.1	1.2939
700.	15.187	36.032	15.078	23.04	26.743	26.751	2.70	1520.1	1.3717
750.	14.099	35.856	13.988	14.71	26.844	26.852	2.73	1517.2	1.4452
800.	13.146	35.711	13.032	25.11	26.932	26.938	2.66	1514.7	1.5143
900.	10.851	35.400	10.737	28.25	27.132	27.135	2.94	1508.2	1.6395
1000.	8.632	35.179	8.521	18.25	27.336	27.335	2.50	1501.6	1.7444
1100.	6.929	35.091	6.820	26.27	27.521	27.516	2.34	1496.6	1.8275
1200.	5.967	35.069	5.856	6.35	27.633	27.626	1.62	1494.5	1.8956
1300.	5.404	35.062	5.288	3.06	27.697	27.690	1.45	1493.9	1.9557
1400.	5.013	35.050	4.891	3.47	27.734	27.727	1.16	1494.0	2.0108
1500.	4.764	35.040	4.635	.65	27.756	27.749	.92	1494.6	2.0635
1600.	4.511	35.024	4.375	1.90	27.771	27.765	.81	1495.2	2.1146
1800.	4.223	35.010	4.072	1.71	27.792	27.787	.72	1497.3	2.2147
2000.	4.008	35.002	3.840	2.43	27.808	27.804	.70	1499.8	2.3131
2200.	3.797	34.991	3.612	.49	27.822	27.819	.70	1502.3	2.4105
2400.	3.599	34.986	3.398	2.86	27.838	27.836	.68	1504.8	2.5063
2500.	3.493	34.980	3.284	1.59	27.843	27.842	.65	1506.0	2.5536
2600.	3.377	34.973	3.160	1.42	27.849	27.848	.68	1507.2	2.6003
2800.	3.200	34.961	2.966	.49	27.857	27.858	.60	1509.9	2.6930
3000.	3.050	34.952	2.798	.55	27.864	27.865	.54	1512.6	2.7849
3200.	2.925	34.943	2.654	.11	27.868	27.871	.53	1515.5	2.8764
3400.	2.777	34.935	2.488	1.01	27.875	27.879	.59	1518.2	2.9675
3600.	2.647	34.928	2.340	-.00	27.881	27.886	.53	1521.1	3.0577
3800.	2.523	34.919	2.196	.31	27.885	27.891	.52	1524.0	3.1467
4000.	2.441	34.914	2.094	.32	27.888	27.895	.43	1527.1	3.2353
4200.	2.384	34.909	2.016	.26	27.889	27.898	.36	1530.3	3.3243
4400.	2.345	34.904	1.954	.12	27.888	27.899	.34	1533.6	3.4143
4600.	2.327	34.898	1.913	.03	27.885	27.897	.26	1537.0	3.5057
4800.	2.316	34.895	1.878	-.12	27.883	27.897	.23	1540.4	3.5989
5000.	2.315	34.893	1.851	.59	27.881	27.897	.23	1543.9	3.6940
5200.	2.310	34.888	1.822	.23	27.878	27.896	.28	1547.3	3.7911

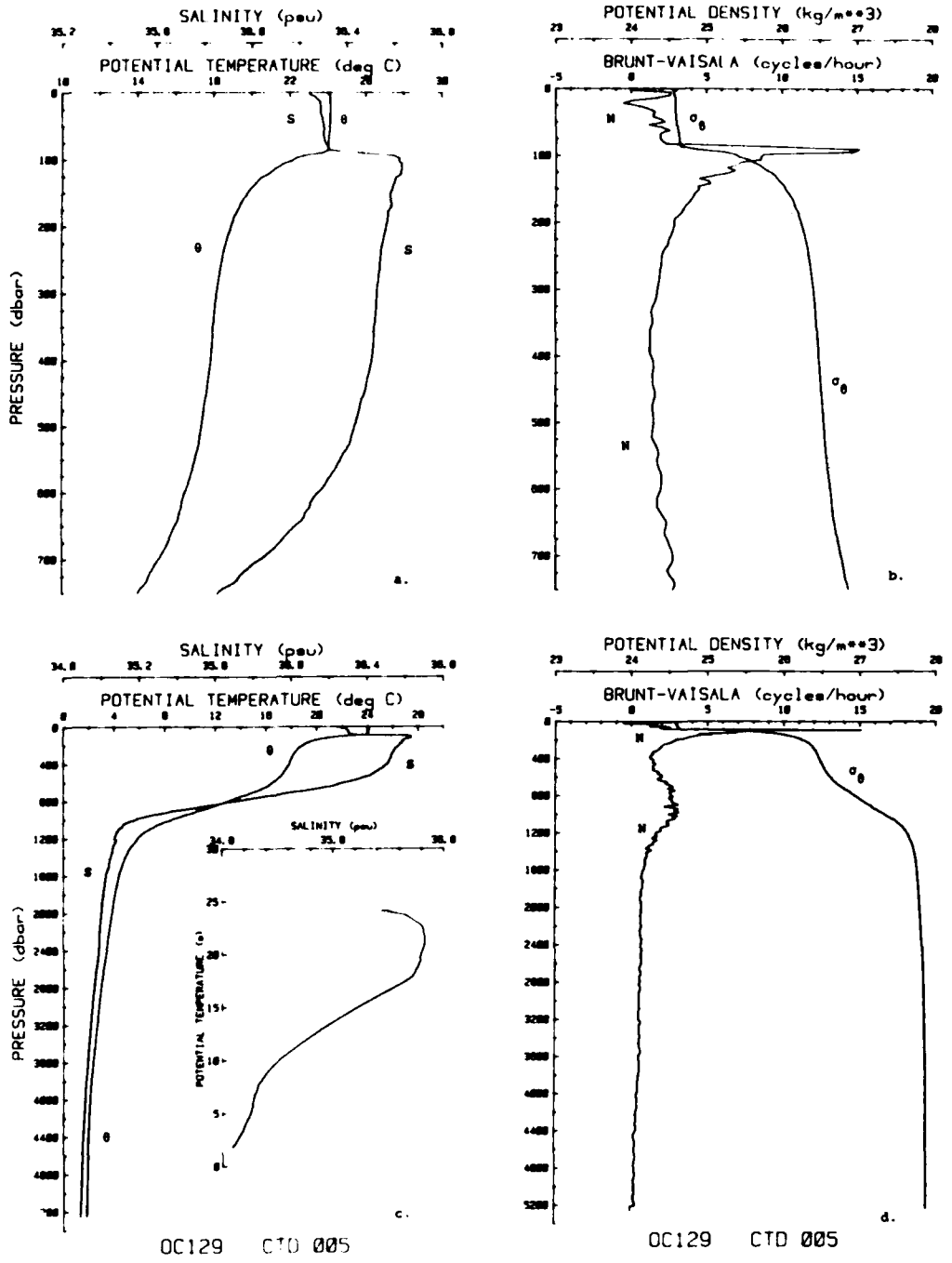

Figure 9. CTD station 5. Profiles of potential temperature (θ) and salinity (S), and Brunt-Väisälä frequency (N) and potential density (σ_θ) for the upper 750 m (a and b respectively) and for the entire cast (c and d respectively). θ-S diagram included in c.

Table 9: Listing of CTD data and derived quantities for station 6.

00129	CTD 006	1982 305 08447	34 01.51N	69 46.46W	corrD: 5263m				
PRESS dbar	TEMP °C	SALIN psu	POTEMP °C	POTGRD m°C/db	SIGMA-t kg/m**3	POTDEN kg/m**3	BR-V cph	SSPEED m/s	DYNHGT dyn m
2.	23.934	36.334	23.933	0.00	24.690	24.673	0.00	1533.5	0.0000
6.	23.944	36.332	23.943	.27	24.685	24.668	-1.97	1533.4	.0119
10.	23.949	36.330	23.947	.32	24.683	24.666	-1.33	1533.4	.0253
16.	23.951	36.327	23.948	-.01	24.680	24.664	-.66	1533.5	.0450
20.	23.952	36.327	23.948	.14	24.680	24.664	-.65	1533.6	.0583
26.	23.952	36.326	23.947	.30	24.679	24.663	.38	1533.7	.0786
30.	23.953	36.326	23.947	-.02	24.679	24.663	-.36	1533.8	.0912
36.	23.954	36.326	23.947	-.01	24.678	24.663	.38	1533.9	.1101
50.	23.942	36.327	23.932	6.64	24.682	24.668	3.67	1534.1	.1573
66.	23.760	36.366	23.747	19.31	24.766	24.753	4.00	1533.9	.2083
76.	23.681	36.361	23.665	6.82	24.786	24.774	2.72	1533.9	.2409
100.	21.669	36.624	21.649	65.92	25.563	25.552	7.36	1529.4	.3084
126.	20.463	36.616	20.439	15.93	25.888	25.879	4.02	1526.6	.3681
150.	19.794	36.594	19.767	20.97	26.049	26.041	4.30	1525.2	.4184
200.	18.982	36.571	18.946	10.90	26.244	26.238	2.76	1523.7	.5146
250.	18.534	36.549	18.490	7.61	26.341	26.337	2.48	1523.2	.6055
300.	18.253	36.535	18.201	6.27	26.401	26.399	1.55	1523.2	.6929
350.	18.088	36.523	18.027	3.36	26.434	26.434	1.52	1523.6	.7792
400.	17.931	36.508	17.861	1.69	26.461	26.464	1.19	1523.9	.8650
450.	17.759	36.486	17.681	4.80	26.486	26.490	1.31	1524.2	.9501
500.	17.555	36.454	17.469	7.64	26.512	26.518	1.49	1524.4	1.0347
550.	17.244	36.396	17.150	9.30	26.544	26.551	1.68	1524.3	1.1188
600.	16.782	36.309	16.682	6.32	26.588	26.597	1.86	1523.6	1.2026
650.	16.075	36.189	15.970	7.79	26.661	26.670	2.29	1522.2	1.2831
700.	15.084	36.014	14.975	32.88	26.752	26.760	2.54	1519.7	1.3607
750.	14.183	35.871	14.070	36.37	26.838	26.846	2.55	1517.5	1.4342
800.	13.251	35.730	13.136	16.86	26.925	26.932	2.55	1515.1	1.5034
900.	11.105	35.439	10.990	37.84	27.116	27.120	3.12	1509.1	1.6296
1000.	8.796	35.175	8.684	11.83	27.308	27.306	2.55	1502.2	1.7360
1100.	7.074	35.084	6.964	16.58	27.495	27.490	3.13	1497.2	1.8235
1200.	5.902	35.074	5.791	14.61	27.644	27.638	1.63	1494.2	1.8916
1300.	5.296	35.055	5.181	4.78	27.705	27.698	1.21	1493.4	1.9501
1400.	4.979	35.046	4.858	.25	27.735	27.729	1.06	1493.8	2.0046
1500.	4.749	35.042	4.621	2.68	27.759	27.752	.88	1494.5	2.0572
1600.	4.528	35.025	4.392	4.24	27.770	27.764	.82	1495.3	2.1083
1800.	4.203	35.003	4.052	2.47	27.788	27.783	.76	1497.2	2.2086
2000.	3.982	34.996	3.814	-2.01	27.806	27.802	.70	1499.7	2.3072
2200.	3.820	34.997	3.636	1.37	27.824	27.822	.59	1502.4	2.4043
2400.	3.642	34.988	3.440	1.26	27.835	27.834	.65	1505.0	2.5004
2500.	3.552	34.984	3.342	1.33	27.841	27.840	.63	1506.3	2.5482
2600.	3.424	34.975	3.206	2.02	27.846	27.846	.68	1507.4	2.5956
2800.	3.236	34.963	3.001	.89	27.855	27.856	.53	1510.0	2.6891
3000.	3.086	34.953	2.833	.93	27.861	27.863	.63	1512.8	2.7821
3200.	2.930	34.945	2.659	1.04	27.869	27.872	.59	1515.5	2.8741
3400.	2.775	34.933	2.487	1.16	27.874	27.878	.61	1518.2	2.9652
3600.	2.645	34.927	2.338	1.47	27.881	27.886	.56	1521.1	3.0551
3800.	2.533	34.921	2.206	.69	27.885	27.891	.55	1524.0	3.1441
4000.	2.443	34.912	2.096	.21	27.886	27.894	.48	1527.1	3.2329
4200.	2.387	34.909	2.019	.30	27.888	27.897	.36	1530.3	3.3219
4400.	2.349	34.904	1.958	.12	27.888	27.898	.26	1533.6	3.4119
4600.	2.325	34.898	1.911	.06	27.885	27.898	.21	1537.0	3.5034
4800.	2.317	34.895	1.878	.03	27.884	27.898	.26	1540.4	3.5966
5000.	2.317	34.893	1.854	-.03	27.881	27.897	.22	1543.9	3.6917
5200.	2.309	34.888	1.820	.64	27.878	27.896	.23	1547.3	3.7889

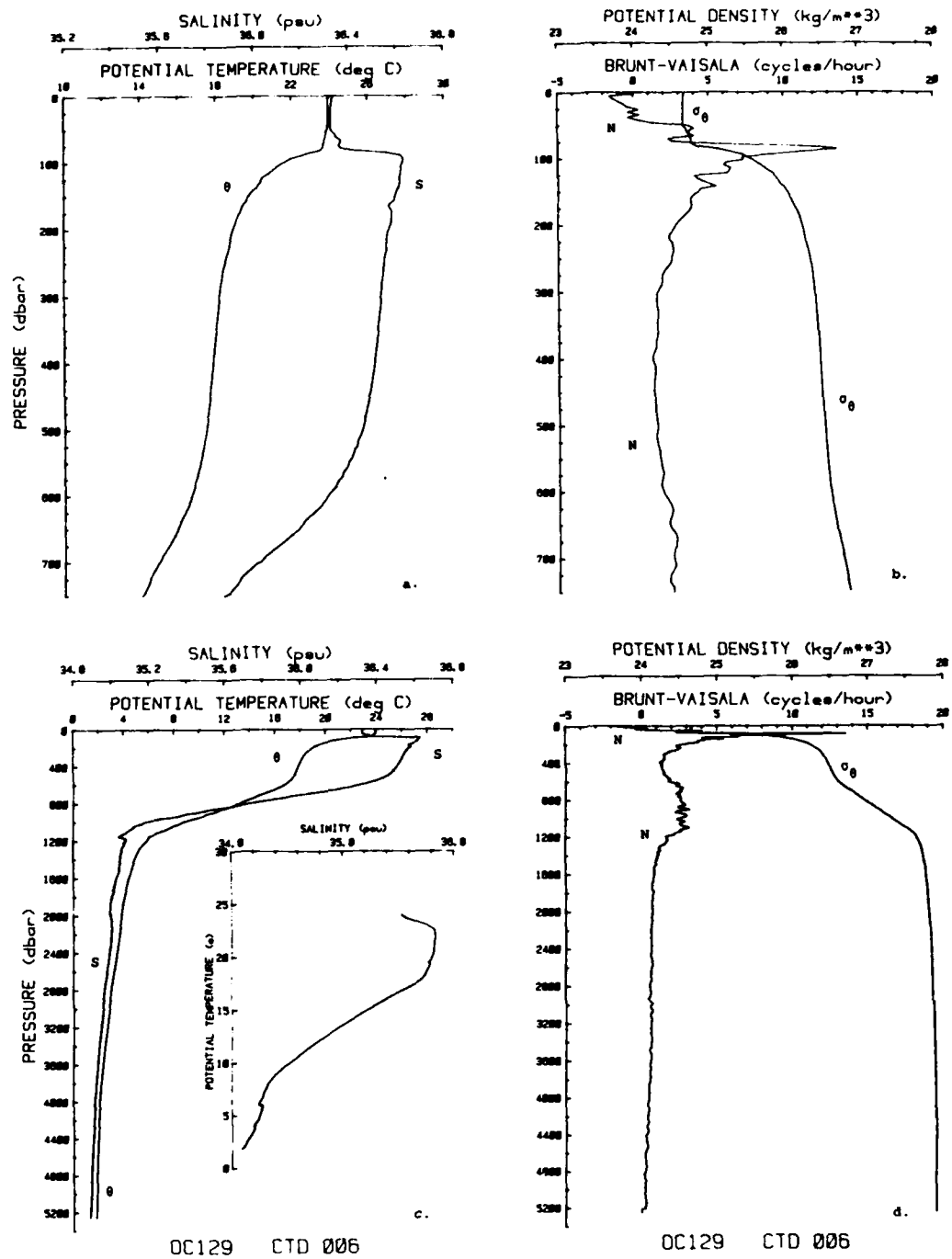

Figure 10. CTD station 6. Profiles of potential temperature (θ) and salinity (S), and Brunt-Väisälä frequency (N) and potential density (σ_θ) for the upper 750 m (a and b respectively) and for the entire cast (c and d respectively). θ -S diagram included in c.

Table 10: Listing of CTD data and derived quantities for station 7.

OC129	CTD 007	1982 305 1	33 59.67N	69 56.40W	corrD: 538.3m				
PRESS dbar	TEMP °C	SALIN psu	POTEMP °C	POTGRD m°C/db	SIGMA-t kg/m##3	POTDEN kg/m##3	BR-V cph	SSPEED m/s	DYNHGT dyn m
2.	23.690	36.351	23.690	0.00	24.776	24.759	0.00	1532.7	0.0000
6.	23.690	36.352	23.689	-.41	24.776	24.759	.50	1532.8	.0124
10.	23.691	36.352	23.688	-.02	24.776	24.759	.54	1532.8	.0249
16.	23.688	36.352	23.685	1.33	24.777	24.761	1.40	1532.9	.0439
20.	23.682	36.355	23.678	1.15	24.780	24.764	1.78	1533.0	.0570
26.	23.663	36.356	23.657	3.98	24.787	24.772	1.69	1533.0	.0758
30.	23.658	36.357	23.651	.51	24.789	24.774	1.24	1533.1	.0892
36.	23.650	36.357	23.643	1.51	24.791	24.777	1.05	1533.2	.1075
50.	23.647	36.358	23.637	.21	24.793	24.779	.70	1533.4	.1520
66.	23.647	36.365	23.633	-.44	24.799	24.786	2.77	1533.7	.2035
76.	23.632	36.389	23.617	2.04	24.821	24.809	1.78	1533.8	.2352
100.	21.839	36.636	21.820	114.67	25.524	25.514	9.07	1529.9	.3043
126.	20.571	36.612	20.547	17.32	25.855	25.846	4.58	1526.9	.3645
150.	19.720	36.590	19.692	20.94	26.065	26.058	4.60	1525.0	.4146

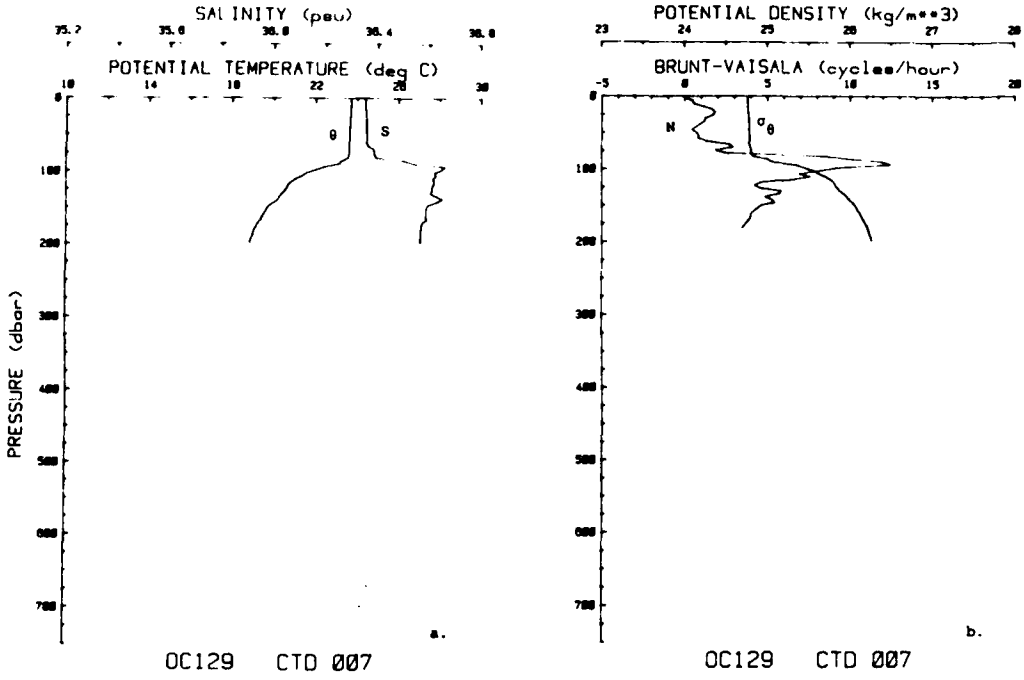

Figure 11. CTD station 7. Profiles of potential temperature (θ) and salinity (S), and Brunt-Väisälä frequency (N) and potential density (σ_θ) for the upper 198 m.

Table 11: Listing of CTD data and derived quantities for station 8.

OC129	CTD 008		1982 306 07:47		35 25.41N	69 48.11W		corrD: 4768m	
PRESS dbar	TEMP °C	SALIN psu	POTEMP °C	POTGRD m°C/db	SIGMA-t kg/m**3	POTDEN kg/m**3	BRV cph	SSPEED m/s	DYNHGT dyn m
2.	23.578	35.947	23.577	0.00	24.502	24.485	0.00	1532.0	0.0000
6.	23.587	35.945	23.586	-2.20	24.499	24.481	-1.27	1532.0	.0140
10.	23.588	35.945	23.586	.40	24.498	24.481	-.65	1532.1	.0281
16.	23.589	35.943	23.586	.52	24.497	24.480	-.44	1532.2	.0488
20.	23.588	35.943	23.584	.73	24.496	24.480	-.59	1532.3	.0623
26.	23.593	35.942	23.587	-.38	24.495	24.479	-.86	1532.4	.0835
30.	23.593	35.941	23.587	-.03	24.493	24.478	-.84	1532.5	.0980
36.	23.588	35.938	23.580	2.36	24.493	24.477	.25	1532.5	.1189
50.	23.590	35.937	23.579	.08	24.492	24.477	.49	1532.8	.1669
66.	23.571	35.930	23.558	.02	24.491	24.478	.19	1533.0	.2220
76.	23.565	35.928	23.549	1.29	24.492	24.479	.70	1533.1	.2569
100.	23.566	35.928	23.545	.10	24.491	24.480	.51	1533.6	.3402
126.	22.720	35.951	22.694	166.61	24.755	24.745	14.84	1531.9	.4303
150.	18.504	35.918	18.477	158.31	25.866	25.857	9.28	1520.8	.4933
200.	15.065	35.711	15.034	62.64	26.523	26.514	5.34	1511.0	.5853
250.	13.654	35.681	13.619	26.18	26.803	26.794	3.27	1507.3	.6566
300.	13.128	35.685	13.086	14.08	26.915	26.907	2.52	1506.4	.7199
350.	12.019	35.540	11.973	21.98	27.022	27.014	2.84	1503.3	.7790
400.	10.680	35.374	10.631	12.34	27.143	27.134	2.60	1499.3	.8325
450.	9.795	35.273	9.742	15.94	27.219	27.209	2.23	1496.8	.8816
500.	9.016	35.197	8.961	3.96	27.289	27.279	2.17	1494.7	.9280
550.	8.270	35.124	8.212	.76	27.350	27.339	1.99	1492.7	.9713
600.	7.569	35.104	7.508	8.95	27.439	27.428	2.58	1490.8	1.0107
650.	6.851	35.078	6.789	18.89	27.521	27.509	2.42	1488.9	1.0460
700.	6.220	35.053	6.156	20.36	27.586	27.574	2.08	1487.2	1.0782
750.	5.730	35.039	5.664	5.07	27.639	27.627	1.87	1486.1	1.1077
800.	5.501	35.032	5.432	6.04	27.662	27.650	1.47	1486.0	1.1354
900.	5.049	35.023	4.973	2.32	27.709	27.697	1.15	1485.8	1.1876
1000.	4.881	35.035	4.798	8.40	27.738	27.727	.96	1486.8	1.2368
1100.	4.537	35.007	4.447	.92	27.755	27.744	.61	1487.0	1.2842
1200.	4.597	35.039	4.498	-1.21	27.774	27.764	.68	1488.9	1.3311

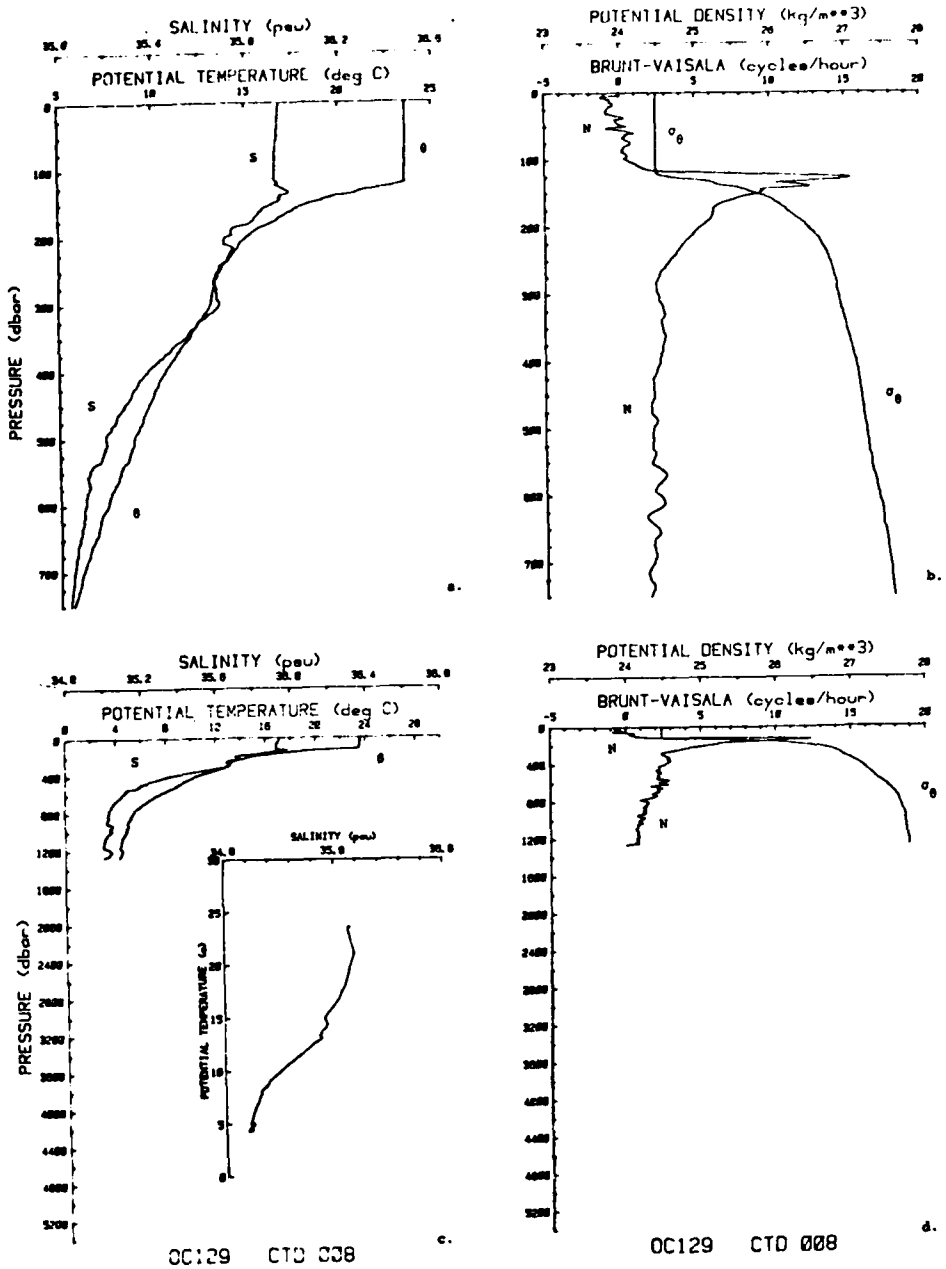

Figure 12. CTD station 8. Profiles of potential temperature (θ) and salinity (S), and Brunt-Väisälä frequency (N) and potential density (σ_θ) for the upper 750 m (a and b respectively) and for the upper 1274 m (c and d respectively. θ-S diagram included in c. Note the change in the potential temperature and salinity scales in Figure 12a from other CTD station plots. The influence of a cold core ring necessitated the shift in the plot scales.

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b. XBT Data

Expendable bathythermograph data were collected approximately every 20 km (i.e., hourly) along 70°W between 40° and 34°N during the trip to the LOTUS area. This XBT section indicated the presence of a cold core ring to the north of the LOTUS area. The closest point of approach occurred at 35°25'N, 70°W, at which time the ship was being set to the South, which implies the ring center was east of 70°W. The XBT section made during the northbound trip was made along 70°10'W in order to position the ship clearly to the west of the ring center. Upon passing the closest point of approach the ship changed course and made a short section to the east, then a short section to the southeast and then a section to the northeast while leaving the area for the GUSTO mooring site. Following the deployment of the GUSTO mooring a short XBT section was made from the GUSTO mooring site to the Gulf Stream. XBTs were taken more frequently (1/2 hourly) during the ring survey and as the Gulf Stream was approached.

A description of the instrumentation and preliminary data processing procedures associated with the XBTs appears in Briscoe and Trask (1983).

The depths of the whole degree isotherms were transcribed from the strip chart records and plotted. Figure 13 is a chart showing the location of individual XBTs taken during the trip south and Figure 14 shows the XBT section from the southbound trip. Figure 15 is a chart showing the location of individual XBTs taken during the northbound trip, the ring survey and those taken to and from the GUSTO mooring site. Figure 16 is a composite XBT section showing all the XBTs taken during the short legs shown in Figure 15. Vertical exaggeration of the XBT sections is 1:463. Figure 16 is an overplot of all the XBTs made in the LOTUS area during OC129 (numbers 30-47). This presentation shows the range of temperatures observed due to the combined effects of the temporal and spatial variations.

All LOTUS XBT traces are supplied to the National Oceanographic Data Center for inclusion in the National files for general access and usage.

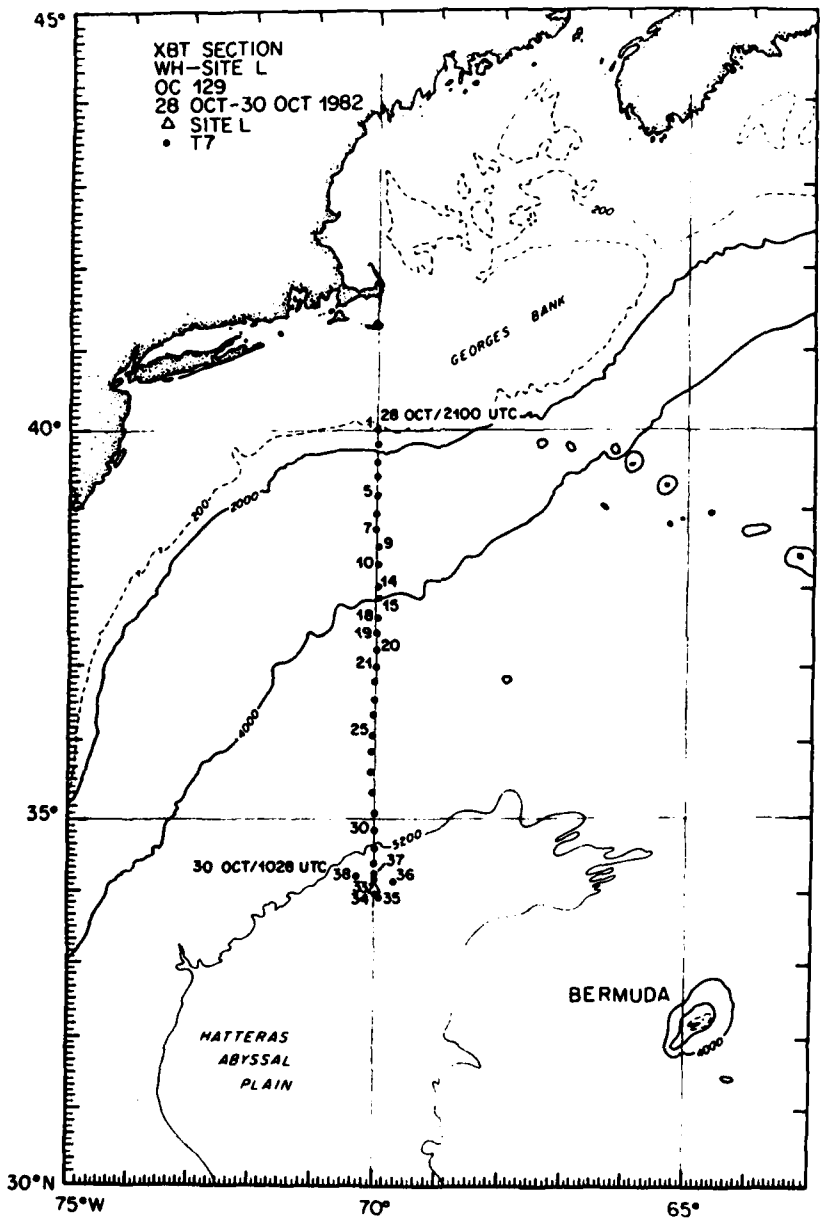

Figure 13. Chart showing the location of individual XBT's taken during the trip south and while launching the SOFAR floats.

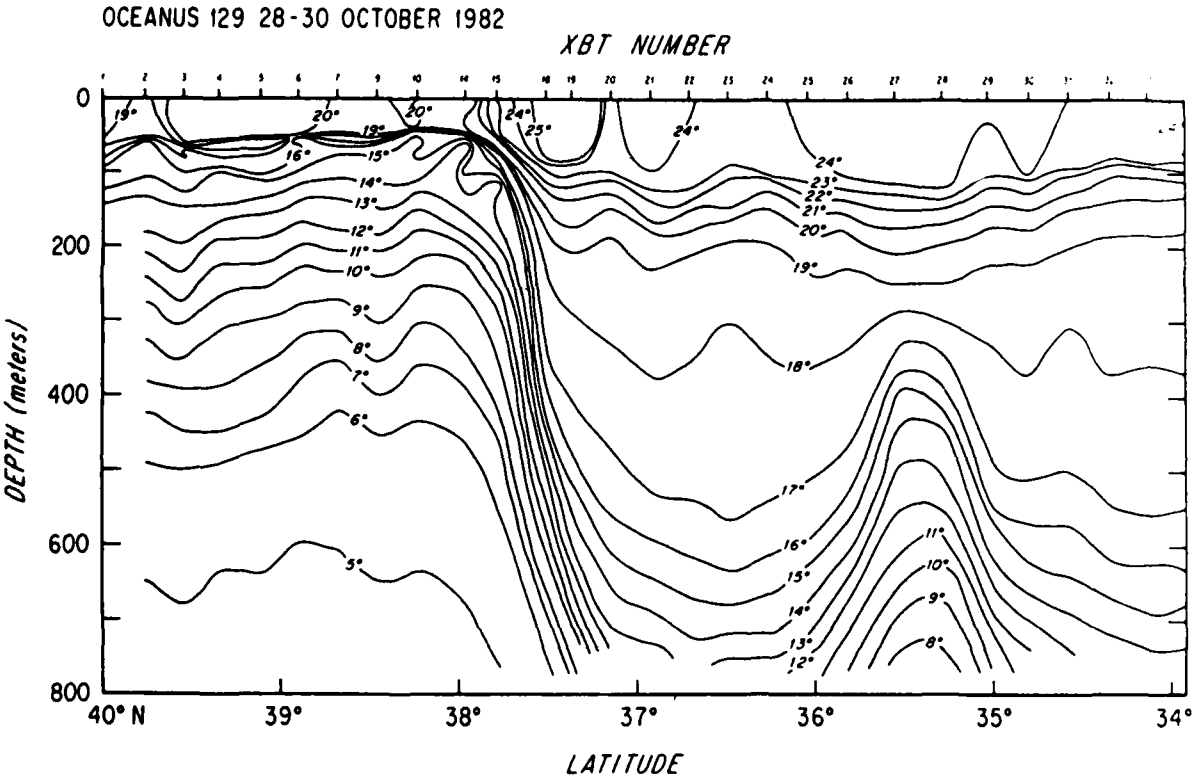

Figure 14. XBT section from the southbound trip along 70°W between 40°N and 34°N.

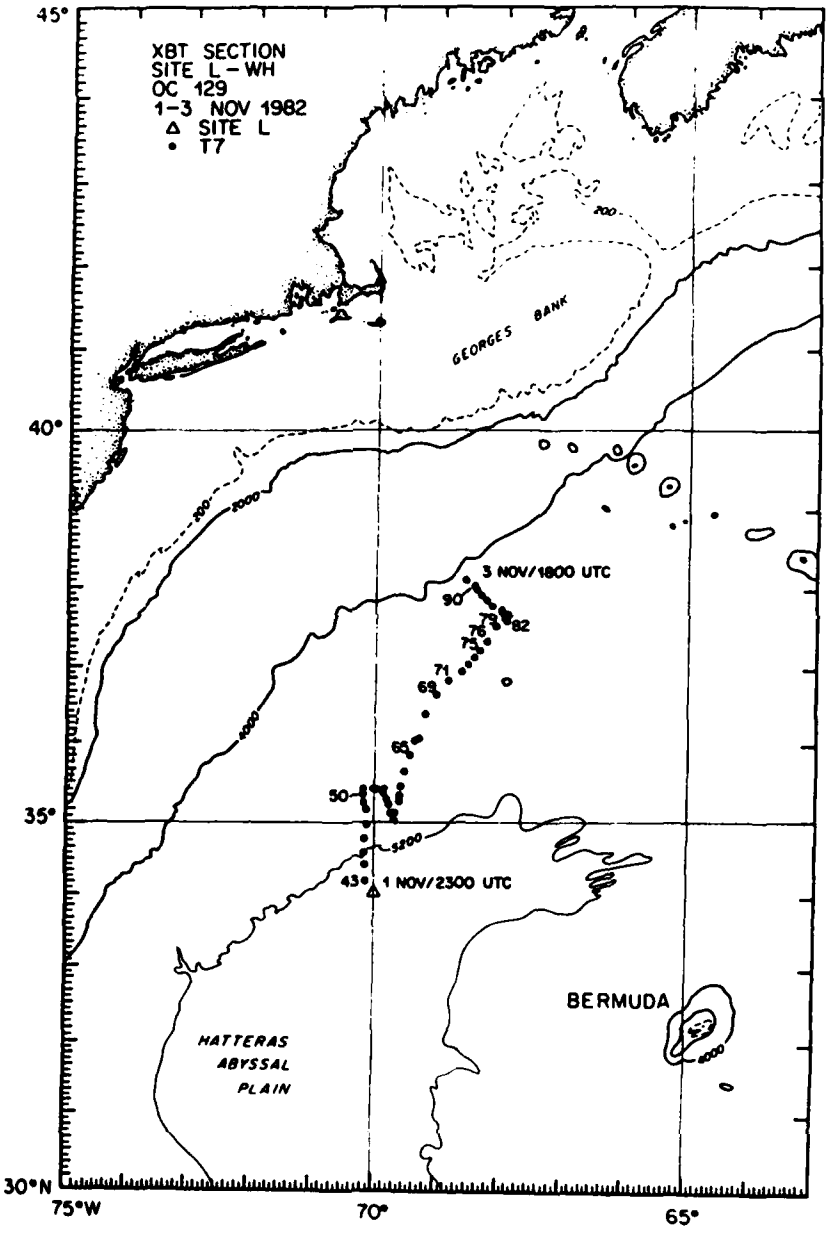

Figure 15. Chart showing the location of individual XBT's taken during the northbound trip, the ring survey and those taken to and from the GUSTO mooring site.

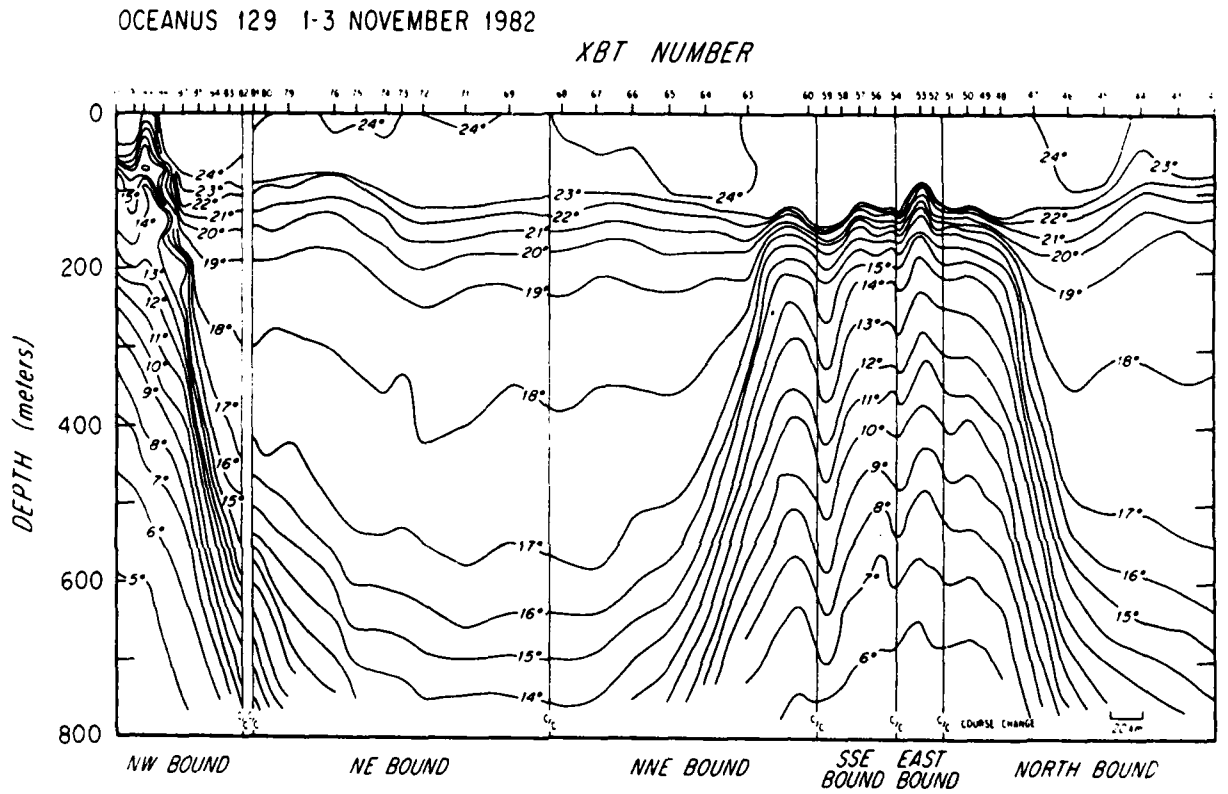

Figure 16. A composite XBT section showing all the XBT's taken during the short legs shown in Figure 15. The horizontal scale is shown in the lower right hand corner.

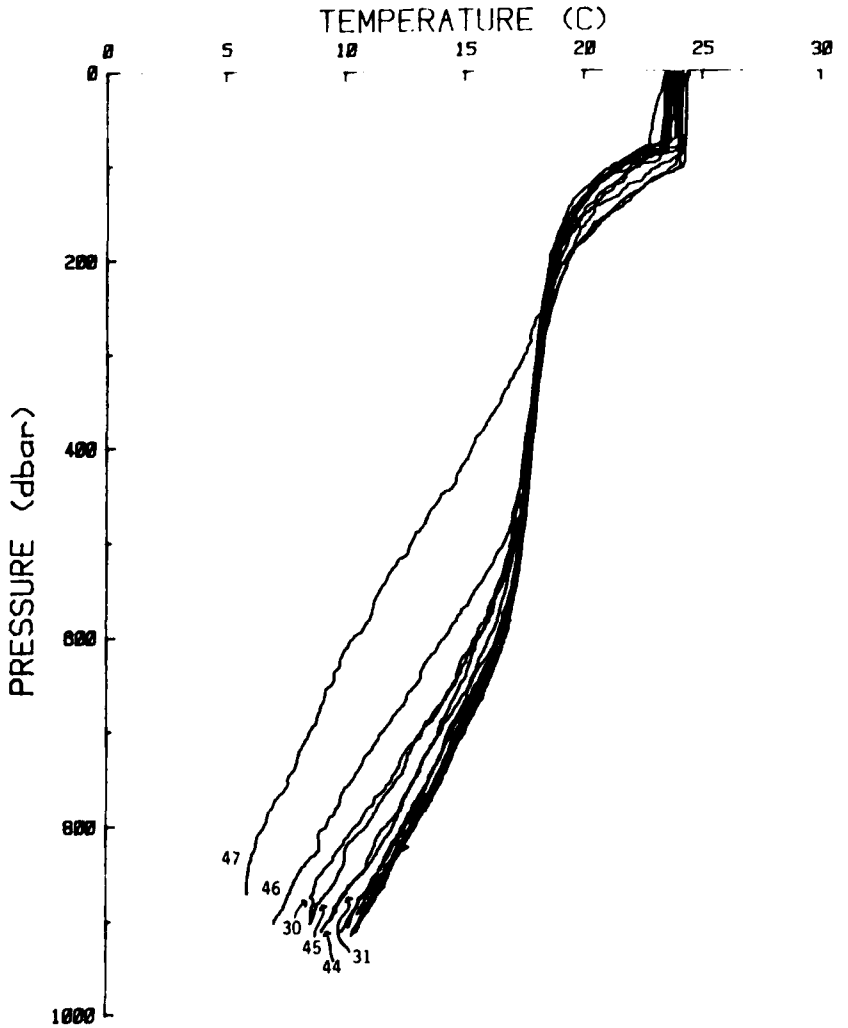

Figure 17. An overplot of all the XBTs taken in the LOTUS area during OCEANUS cruise 129. The numbers at the bottom of the traces identify particular XBT traces. (Note: XBTs 30 and 31 show the colder temperatures of the cold core ring to the north of the LOTUS area and XBTs 44 to 47 show the progressively decreasing temperatures as the ship approached the ring during the northbound trip.)

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APPENDIX

OCEANUS 129: Cruise Narrative

[all time Zulu]

28 October 1982 (Day 301) (Time Zone + 4)

1301 Away from dock in Woods Hole. Bound for vicinity of 34°N, 70°W.

2100 Course change to South along 70°W; first XBT.

29 October (Day 302)

0000 Watch now taking wet and dry bulb temperatures hourly with the XBTs.

1130 Three whales sighted, possibly sperm. Position approximately 36°50'N, 70°00'W.

30 October (Day 303)

0107 SOFAR Float No. 99 in water at Position F.

0140 CTD Station No. 1 begun at 60m/min.

0305 Double ping detected; rehaul begun at 80m/min.

0435 CTD on board and secure.

0559 SOFAR Float No. 102 in water at Position C. Simultaneous XBT (No. 35) taken.

0724 SOFAR Float No. 104 in water at Position G, with XBT No.36.

0854 SOFAR Float No. 98 in water at Position D, with XBT No. 37.

1027 SOFAR Float No. 103 in water at Position E, with XBT No. 38.

1204 SOFAR Float No. 101 in water at Position B, with XBT No. 40.

1307 SOFAR Float No. 100 in water at Position A (Site L).

1330 Close by LOTUS-3 buoy for observation; lots of animal life in water.

1336 Meteorological observations from bridge: pressure 1032 mb; wind 17 kts from 109T. (Bridge barometer reads 7 mb too high, according to R. Payne calibration 27 October 82; pressure is therefore 1025 mb corrected.)

1405 Zodiac to LOTUS-3 with Briscoe, Trask, Cetta (divers), Gould, and A/B. Numerous medium-sized sharks sighted (possibly browns or blues; 4-6 feet) co-mingled with dolphin and trigger fish. Dive cancelled, but underwater photos taken of mooring by holding Nikonos in water from Zodiac; visual observation of VMCM's showed missing pair of propellors on lower hub of 5m instrument. No other problems visible.

1453 Wind from East and current from Southwest will make LOTUS-3 recovery difficult; mooring could drift toward 766 and PCM after release. Will rig tow bridle and haul surface discus to WNW after release, and stretch the mooring out along the surface until it is clear of the other two moorings.

1505 Ready to tow LOTUS-3; release fired (WHOI Mooring No. 767).

1555 Reserve buoyancy sighted on port quarter at one-quarter mile. Tow begun.

1644 Seawater collection for Madin, Mlodzinski. Biological collection for Caron.

1748 Starboard quarter bulwark removed. Ready to terminate tow of LOTUS-3 discus.

1832 Glass balls grapnelled in reserve cluster.

1903 Balls aboard.

2310 Buoy and all instruments aboard and secured.

31 October (Day 304) (Time Zone +5)

0016 CTD Station No. 2 begun at Site L (SOFAR Position A).

0430 CTD Station No. 3 begun at SOFAR Position G.

0909 Wire rope from LOTUS-3 dumped.

0948 CTD Station No. 4 begun at SOFAR Position E.

1233 CTD aboard; steaming to biological dive site.

1335 Zodiac away with Briscoe, Trask, Cetta (divers) and A/B. Thirty minute bottom time at 80 feet maximum depth, for observation and collection of gelatinous zooplankton.

1452 Zodiac aboard.

1512 Acoustic release tests on hydrowire.

1722 Tests completed. Niskin bottle sample from 20m to go with morning dive.

1842 LOTUS-4 surface buoy launch commenced (WHOI Mooring No. 770).

2352 Anchor over.

1 November (Day 305)

0141 Ranging on the LOTUS-4 (770) acoustic release.

0244 End of acoustic survey.

0255 Net tow for plankton.

0329 Tow completed.

0406 CTD Station No. 5 at Mooring 764 (Southern intermediate mooring).

0648 CTD station completed. Move to Mooring 765.

0840 CTD Station No. 6 at Mooring 765 (Eastern intermediate mooring).

1128 CTD station completed. Commence testing of releases on 765.

1210 Moving to position one-quarter mile East of PCM for 200m CTD Station No. 7.

1459 PCM primary release (lower) fired; no release confirmation heard. Various attempts to enable/disable, transpond, and fire; no success with the release command. R. Reid decides to try backup (upper) release.

1634 PCM backup release fired.

1637 Top buoyancy on surface (approximate time).

1646 Commence hauling PCM.

1950 Complete PCM recovery. Tried again to fire the primary release; no success.

2037 Close by LOTUS-4.

Satellite MX1105: 33°58.70, 69°59.77

LORAN-C 7000: 33°57.54, 69°58.84

offset: 1.16°S, 0.93°E

LORAN TD's: 25865.5, 40859.8

2052 Depart area for Gulf Stream (Bryden GUSTO Mooring). Hourly XBTs during a zig-zag through a cold core ring NE of Site L; switch to half-hourly XBTs as Gulf Stream is neared.

2 November (Day 306)

0714 Stopping to do CTD Station No. 8 in the estimated center of the cold core ring.

0949 Commence transit to Gulf Stream site.

1913 Zodiac away with Briscoe, Trask, Cetta (divers) and A/B. Thirty-five minute bottom time at 80 feet maximum depth, for observation and collection of gelatinous zooplankton.

2022 Zodiac aboard.

3 November (Day 307)

0240 Commence bottom survey for GUSTO mooring site: 37°37'N, 68°00'W.

0338 Estimate corrected depth at site as 4688m, using Area 12 Matthews correction of 33m and 5m transducer depth.

0505 Hove to for ship drift estimate; wind 13 kts from 190T.

0610 Moving to mooring start location of 37°39'N, 68°08.7'W; based on observed set of about 3 kts at 060T, which yields an estimated Gulf Stream of 2.7 kts at 072T. We will set into the wind at about 1.5 kts through the water, and try for a course and speed over the bottom of 2.4 kts at 105T to move toward the target.

0710 Deployment commenced for Mooring 771.

1022 Anchor in water at 37°36.65, 68°00.36, southwest of target to allow for fall-back and set by Gulf Stream.

1040 CTD in water for Station No. 9.

1325 CTD aboard; begin acoustic survey of anchor position on 771.

1438 Steam for Site D; houlry XBTs until Gulf Stream edge is crossed.

1836 Stopped for net tow at 100m.

1911 Underway for Site D.

4 November (Day 308)

0348 Release fired on Engineering Mooring 763 at Site D.

0428 Back-up buoyancy aboard.

0614 Top buoyancy aboard.

0718 Tear-drop float in water for re-setting of Engineering Mooring; new number 772.

0823 Anchor over.

0844 Anchor on bottom; commence acoustic survey.

0919 Survey completed; release disabled. Steam for Woods Hole.

1952 Arrive Southwest Shoals buoy.

2148 Abeam buoys 1 and 2, Woods Hole.

2200 At dock.

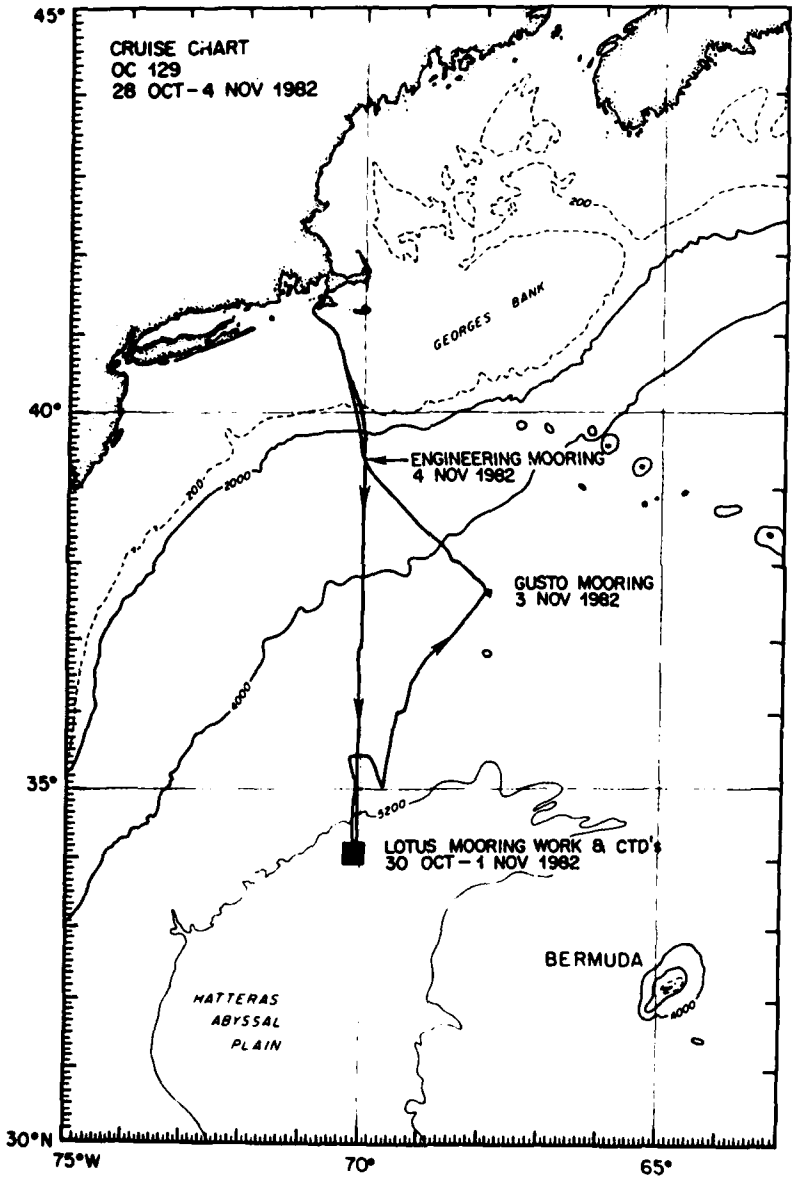

Figure A-1. Cruise track of OCEANUS cruise 129.

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