# CRUISE REPORT

CC-102

SCIENTIFIC ACTIVITIES

WOODS HOLE - ANTIGUA - GRENADA -

CARRIACOU - ST. THOMAS

14 OCTOBER 1988 - 22 DECEMBER 1988

SSV <u>CORWITH</u> <u>CRAMER</u>

SEA EDUCATION ASSOCIATION - WOODS HOLE, MA

# PREFACE

This cruise report presents a basic outline of the academic program and scientific research conducted on board the SSV Corwith Cramer during the fall of 1988. It consists of a brief cruise narrative describing operations during our six weeks at sea as well as tabulated information on the location and type of samples taken. Some raw data are included; detailed cruise logs and full student reports are available through Sea Education Association and the Chief Scientist.

CC-102 was a highly successful cruise blessed by fine weather, enthusiastic students and an excellent professional crew. I am very grateful to our Captain, Peg Brandon and the Mates, Doug Nemeth, Jim Holm and Chuck Holloway for their efforts throughout this cruise. The nautical staff provided excellent instruction in seamanship and established a pleasant and efficient ambiance for all operations on CC-102. I would also like to thank our Steward, Rick Jones for his culinary and social contribution and our Engineer, Dan Lehman for all his efforts - especially in the repair and maintenance of sampling gear.

The three assistant scientists of CC-102 were Gretchen Rollwagen, Tim Kenna and Shana Smith. They were excellent throughout the trip in all aspects; on-watch instruction, over the side sampling and the compilation and analysis of our data. I am particularly grateful to these three for all their efforts. The data generated on CC-102 were both interesting and of very high quality. This is most directly a result of the assistant scientists efforts through out the cruise.

As with any Sea Semester cruise the results are most reflective of the students' effort during the trip. The students of CC-102 exhibited enthusiasm, competence and stamina throughout our voyage. Above all else the Captain and I found the students of CC-102 to be extremely good shipmates. As Chief Scientist it was a pleasure teaching and working alongside this group of "new-comers" to oceanography. On behalf of all the staff, I salute and thank the students of CC-102 for an extremely pleasant, productive and highly memorable cruise.

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## Introduction

This cruise report presents a summary of the academic program and scientific research conducted during cruise CC-102 of the SSV Corwith Cramer. The cruise track (Figs. 1A, B) was designed to permit collection of physical, chemical, biological and geological data from a broad area of the western North Atlantic ocean and eastern Caribbean. A diverse program of sampling and analysis was conducted over the course of CC-102 and much of the basic information related to this effort is included in the appendices of this report. The ship's itinerary, including ports-of-call, is included as Table 1. Cruise participants are listed in Table 2.

## Academic Program

Throughout the six week period covered by SSV Corwith Cramer cruise CC-102, a 24-hour science watch was maintained by teams of three students and one member of the science staff. During science watch, students were instructed in the use of gear and scientific procedures spanning many aspects of physical, chemical, geological and biological oceanography. The essence of on-watch learning was the hands-on experience gained by the students in carrying out the sampling and analysis necessary to complete the research objectives. As the cruise progressed, each student was given increasing responsibility in laboratory activities. During the last two weeks, the students were sufficiently familiar with scientific procedures to conduct research operations without significant help from staff scientists.

Every oceanographic station was made for the purpose of actual research, and no sample was taken solely for demonstration. In this way students were given the opportunity to learn from meaningful participation in actual research activities.

Formal instruction on a daily basis was also provided in the form of lectures given by the oceanography staff. Lecture topics, designed to cover aspects of marine science not readily gained from laboratory experience, are listed in Table 3. Normally two class periods were conducted each week day with oceanography in the morning and nautical science and seamanship in the afternoon.

In addition to instruction in oceanography and the research projects, teams of students investigated and reported on the taxonomy, biology and ecology of selected marine organisms encountered during our trip. These presentations were known as "creature features" and occurred on a daily basis starting at mid-cruise.

At sea, CC-102 was academically structured as two, three-week courses in oceanography offered by Boston University through SEA. The on-board experience was preceded by a rigorous six-week introductory course on shore. Successful completion of the entire program includes eleven credit hours in oceanography. Letter grades for each of the two shipboard cruises were determined on the basis of on-watch evaluations, project research and final report, and a written examination.

## Research Program

The research program conducted on CC-102 was centered around the individual student research projects prepared during the six-week shore component prior to sailing. These projects were designed to focus on a specific topic in oceanography, in some cases related to long-term research efforts conducted by SEA staff scientists. During CC-102 investigations were carried out in a broad range of topics which included physical, biological chemical and geological oceanography. A list of the titles of individual student research projects completed during CC-102 are listed in Table 4.

All original data and the full student reports are on file at SEA in Woods Hole. Data generated on CC-102 are incorporated into long-term research programs and data sets under the direction of the staff scientists at SEA. Materials reported herein should not be excerpted or cited without permission of the Chief Scientist.

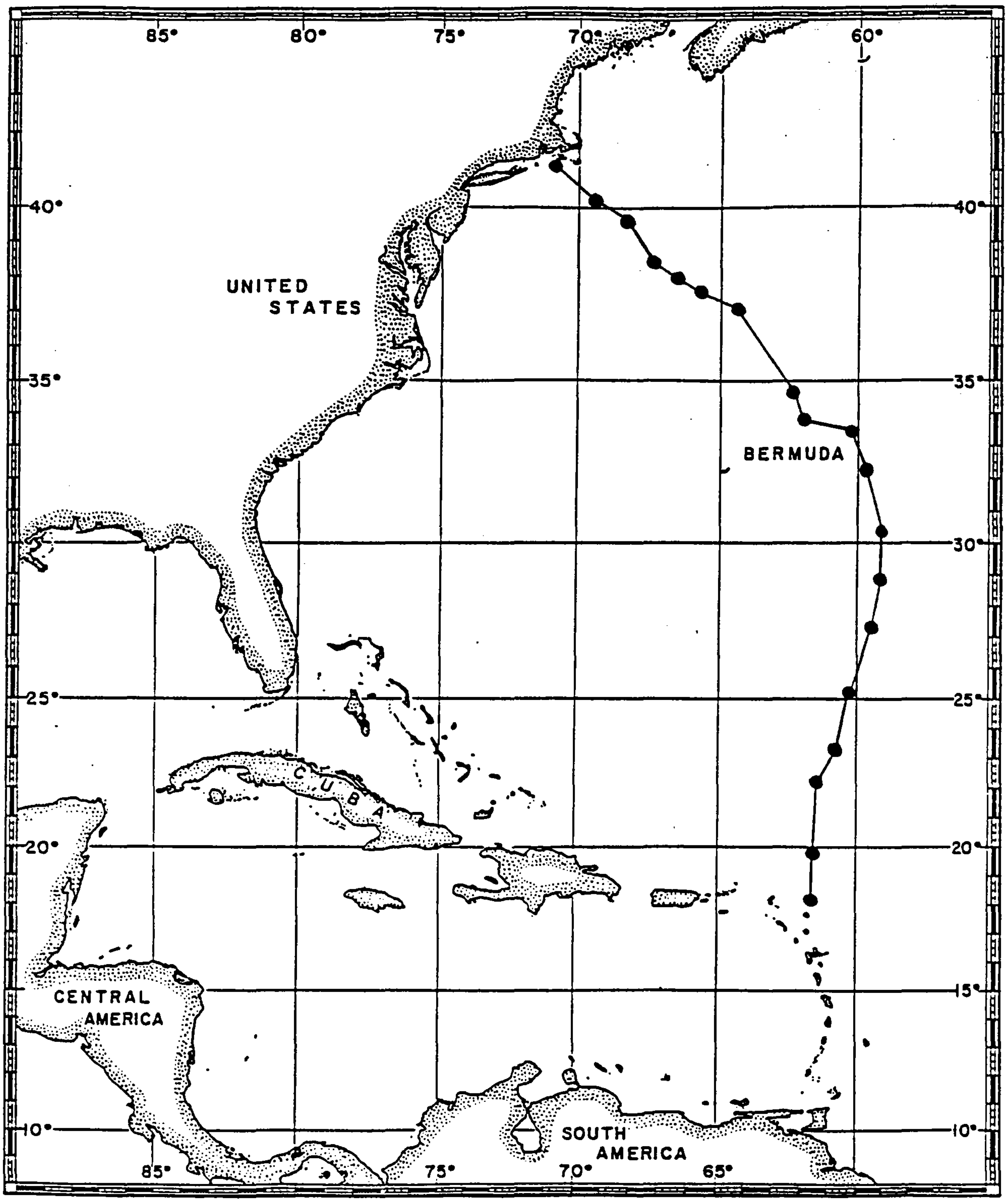
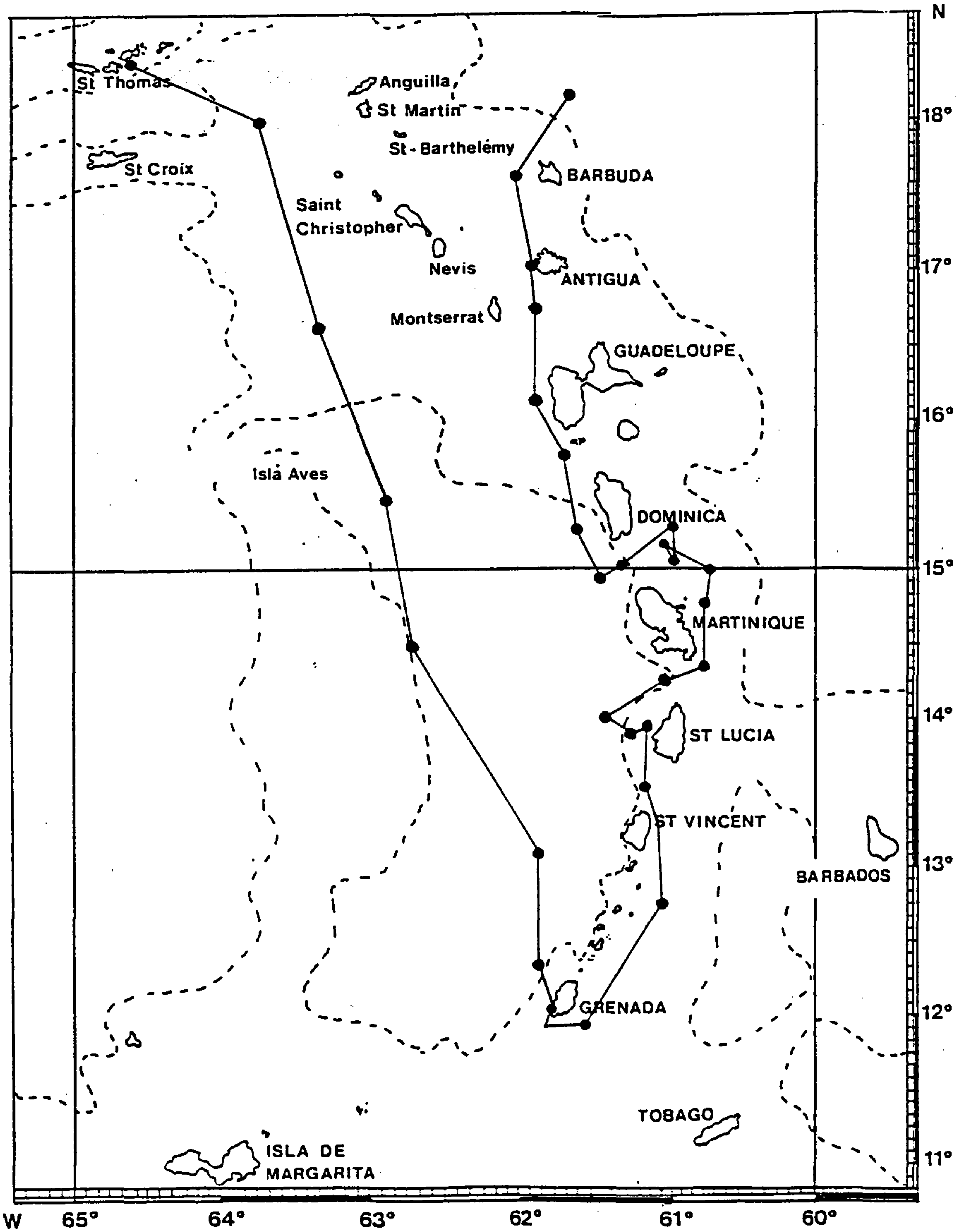



FIGURE 1A Cruise Track of Leg 1 of CC-102 from Woods Hole, MA to Barbuda platform. Friday, October 14th, 1988 to Monday, October 31st, 1988. Plotted from positions in Table 1.




<u>FIGURE 1B</u> Cruise Track of Legs 2 and 3 of CC-102 from Barbuda platform to St. Thomas, USVI. Monday, October 31st, 1988 to Tuesday, November 22nd, 1988. Plotted from data in Table 1.

## TABLE 1

DAILY POSITIONS FOR CC-102

| Day | Date | Time | Log(nm) | Latitude(N) | Longitude(W) |
|---|---|---|---|---|---|
| Friday | 10-14/88 | 1400 | 13 | 41°24' | 70°51' |
| Friday | 10-14/88 | 1800 | 41 | 41°05' | 70°48' |
| Saturday | 10-15/88 | 0000 | 84 | 40°41' | 70°05' |
| Saturday | 10-15/88 | 0600 | 110 | 40°23' | 69°37' |
| Saturday | 10-15/88 | 1200 | 134 | 40°09' | 69°19' |
| Saturday | 10-15/88 | 1800 | 139 | 40°09' | 69°08' |
| Sunday | 10-16/88 | 0000 | 139 | 40°08' | 69°08' |
| Sunday | 10-16/88 | 0600 | 177 | 39°50' | 68°32' |
| Sunday | 10-16/88 | 1200 | 193 | 39°41' | 68°04' |
| Sunday | 10-16/88 | 1800 | 212 | 39°21' | 68°02' |
| Monday | 10-17/88 | 0000 | 232 | 38°58' | 67°54' |
| Monday | 10-17/88 | 0600 | 253 | 38°41' | 67°42' |
| Monday | 10-17/88 | 1200 | 284 | 38°24' | 67°17' |
| Monday | 10-17/88 | 1800 | 301 | 38°26' | 67°06' |
| Tuesday | 10-18/88 | 0000 | 329 | 38°11' | 66°42' |
| Tuesday | 10-18/88 | 0600 | 341 | 38°03' | 66°31' |
| Tuesday | 10-18/88 | 1200 | 356 | 37°51' | 66°27' |
| Tuesday | 10-18/88 | 1800 | 375 | 37°48' | 66°41' |
| Wednesday | 10-19/88 | 0000 | 385 | 37°53' | 66°23' |
| Wednesday | 10-19/88 | 0600 | 404 | 37°48' | 66°05' |
| Wednesday | 10-19/88 | 1200 | 425 | 37°40' | 65°34' |
| Wednesday | 10-19/88 | 1800 | 440 | 37°40' | 65°20' |
| Thursday | 10-20/88 | 0000 | 463 | 37°34' | 65°02' |
| Thursday | 10-20/88 | 0600 | 485 | 37°19' | 64°38' |
| Thursday | 10-20/88 | 1200 | 505 | 37°02' | 64°20' |
| Thursday | 10-20/88 | 1800 | 549 | 36°28' | 63°48' |
| Friday | 10-21/88 | 0000 | 580 | 36°00' | 63°31' |
| Friday | 10-21/88 | 0600 | 617 | 35°27' | 63°01' |
| Friday | 10-21/88 | 1200 | 666 | 34°46' | 62°25' |
| Friday | 10-21/88 | 1800 | 697 | 34°19' | 62°13' |
| Saturday | 10-22/88 | 0000 | 726 | 33°57' | 62°10' |
| Saturday | 10-22/88 | 0600 | 743 | 33°52' | 62°26' |
| Saturday | 10-22/88 | 1200 | 769 | 33°49' | 61°55' |
| Saturday | 10-22/88 | 1800 | 790 | 33°47' | 61°39' |
| Sunday | 10-23/88 | 0000 | 822 | 33°45' | 61°06' |
| Sunday | 10-23/88 | 0600 | 863 | 33°38' | 60°27' |
| Sunday | 10-23/88 | 1200 | 895 | 33°34' | 60°06' |
| Sunday | 10-23/88 | 1800 | 901 | 33°38' | 60°05' |
| Monday | 10-24/88 | 0000 | 922 | 33°10' | 59°58' |
| Monday | 10-24/88 | 0600 | 955 | 32°38' | 59°50' |
| Monday | 10-24/88 | 1200 | 983 | 32°13' | 59°44' |
| Monday | 10-24/88 | 1800 | 992 | 32°06' | 59°41' |

| Day | Date | Time | Log(nm) | Latitude(N) | Longitude(W) |
|---|---|---|---|---|---|
| Tuesday | 10-25/88 | 0000 | 1017 | 31°47' | 59°20' |
| Tuesday | 10-25/88 | 0600 | 1053 | 31°05' | 59°10' |
| Tuesday | 10-25/88 | 1200 | 1101 | 30°24' | 59°00' |
| Tuesday | 10-25/88 | 1800 | 1125 | 29°59' | 58°57' |
| Wednesday | 10-26/88 | 0000 | 1139 | 29°39' | 59°12' |
| Wednesday | 10-26/88 | 0600 | 1175 | 29°03' | 59°08' |
| Wednesday | 10-26/88 | 1200 | 1206 | 28°41' | 59°11' |
| Wednesday | 10-26/88 | 1800 | 1229 | 28°22' | 59°21' |
| Thursday | 10-27/88 | 0000 | 1248 | 28°10' | 59°25' |
| Thursday | 10-27/88 | 0600 | 1274 | 27°39' | 59°34' |
| Thursday | 10-27/88 | 1200 | 1297 | 27°13' | 59°45' |
| Thursday | 10-27/88 | 1800 | 1325 | 26°45' | 59°54' |
| Friday | 10-28/88 | 0000 | 1366 | 26°06' | 60°01' |
| Friday | 10-28/88 | 0600 | 1394 | 25°41' | 60°19' |
| Friday | 10-28/88 | 1200 | 1429 | 25°07' | 60°26' |
| Friday | 10-28/88 | 1800 | 1457 | 24°38' | 60°36' |
| Saturday | 10-29/88 | 0000 | 1481 | 24°14' | 60°38' |
| Saturday | 10-29/88 | 0600 | 1508 | 23°47' | 60°41' |
| Saturday | 10-29/88 | 1200 | 1540 | 23°17' | 60°48' |
| Saturday | 10-29/88 | 1800 | 1566 | 23°03' | 61°07' |
| Sunday | 10-30/88 | 0000 | 1585 | 22°47' | 61°13' |
| Sunday | 10-30/88 | 0600 | 1607 | 22°28' | 61°24' |
| Sunday | 10-30/88 | 1200 | 1622 | 22°14' | 61°20' |
| Sunday | 10-30/88 | 1800 | 1655 | 21°46' | 61°19' |
| Monday | 10-31/88 | 0000 | 1677 | 21°24' | 61°18' |
| Monday | 10-31/88 | 0600 | 1721 | 20°40' | 61°20' |
| Monday | 10-31/88 | 1200 | 1767 | 19°56' | 61°32' |
| Monday | 10-31/88 | 1800 | 1788 | 19°30' | 61°32' |
| Tuesday | 11-01/88 | 0000 | 1807 | 19°11' | 61°33' |
| Tuesday | 11-01/88 | 0600 | 1837 | 18°42' | 61°38' |
| Tuesday | 11-01/88 | 1200 | 1871 | 18°08' | 61°36' |
| Tuesday | 11-01/88 | 1800 | 1887 | 18°02' | 61°56' |
| Wednesday | 11-02/88 | 0000 | 1916 | 17°32' | 62°00' |
| Wednesday | 11-02/88 | 0600 | 1929 | 17°17' | 62°00' |
| Wednesday | 11-02/88 | 1200 | alongside St. John's, Antigua | | |
| Wednesday | 11-02/88 | 1800 | alongside St. John's, Antigua | | |
| Thursday | 11-03/88 | 0000 | alongside St. John's, Antigua | | |
| Thursday | 11-03/88 | 0600 | alongside St. John's, Antigua | | |
| Thursday | 11-03/88 | 1200 | at anchor St. John's, Antigua | | |
| Thursday | 11-03/88 | 1800 | at anchor St. John's, Antigua | | |
| Friday | 11-04/88 | 0000 | at anchor St. John's, Antigua | | |
| Friday | 11-04/88 | 0600 | at anchor St. John's, Antigua | | |
| Friday | 11-04/88 | 1200 | at anchor St. John's, Antigua | | |
| Friday | 11-04/88 | 1800 | at anchor St. John's, Antigua | | |
| Saturday | 11-05/88 | 0000 | at anchor St. John's, Antigua | | |
| Saturday | 11-05/88 | 0600 | at anchor St. John's, Antigua | | |
| Saturday | 11-05/88 | 1200 | 1967 | 16°42' | 61°58' |
| Saturday | 11-05/88 | 1800 | 1986(HT) | 16°25' | 62°00' |

| Day | Date | Time | Log(nm) | Latitude(N) | Longitude(W) |
|---|---|---|---|---|---|
| Sunday | 11-06/88 | 0000 | 2007 | 16°06' | 61°54' |
| Sunday | 11-06/88 | 0600 | 2011 | 16°02' | 61°51' |
| Sunday | 11-06/88 | 1200 | 2048(HT) | 15°43' | 61°46' |
| Sunday | 11-06/88 | 1800 | 2065 | 15°23' | 61°45' |
| Monday | 11-07/88 | 0000 | 2074 | 15°14' | 61°37' |
| Monday | 11-07/88 | 0600 | 2097 | 15°02' | 61°30' |
| Monday | 11-07/88 | 1200 | 2126 | 14°57' | 61°23' |
| Monday | 11-07/88 | 1800 | 2152 | 15°05' | 61°23' |
| Tuesday | 11-08/88 | 0000 | 2177 | 15°01' | 61°18' |
| Tuesday | 11-08/88 | 0600 | 2196 | 15°12' | 61°13' |
| Tuesday | 11-08/88 | 1200 | 2229 | 15°18' | 60°53' |
| Tuesday | 11-08/88 | 1800 | 2233 | 15°12' | 61°00' |
| Wednesday | 11-09/88 | 0000 | 2253 | 15°04' | 60°55' |
| Wednesday | 11-09/88 | 0600 | 2266 | 15°13' | 60°58' |
| Wednesday | 11-09/88 | 1200 | 2283 | 15°11' | 61°00' |
| Wednesday | 11-09/88 | 1800 | 2287 | 15°10' | 61°02' |
| Thursday | 11-10/88 | 0000 | 2307(HT) | 15°00' | 60°45' |
| Thursday | 11-10/88 | 0600 | 2308(HT) | 15°02' | 60°53' |
| Thursday | 11-10/88 | 1200 | 2332 | 14°44' | 60°47' |
| Thursday | 11-10/88 | 1800 | 2366 | 14°09' | 60°45' |
| Friday | 11-11/88 | 0000 | 2387 | 14°15' | 61°03' |
| Friday | 11-11/88 | 0600 | 2398 | 14°09' | 61°11' |
| Friday | 11-11/88 | 1200 | 2425 | 14°00' | 61°26' |
| Friday | 11-11/88 | 1800 | 2449 | 14°02' | 61°24' |
| Saturday | 11-12/88 | 0000 | 2471 | 13°53' | 61°16' |
| Saturday | 11-12/88 | 0600 | 2482 | 13°41' | 61°14' |
| Saturday | 11-12/88 | 1200 | 2502 | 13°55' | 61°09' |
| Saturday | 11-12/88 | 1800 | 2526 | 13°30' | 61°12' |
| Sunday | 11-13/88 | 0000 | 2550 | 13°31' | 61°09' |
| Sunday | 11-13/88 | 0600 | 2574 | 13°11' | 61°00' |
| Sunday | 11-13/88 | 1200 | 2602 | 12°45' | 61°06' |
| Sunday | 11-13/88 | 1800 | 2638 | 12°06' | 61°17' |
| Monday | 11-14/88 | 0000 | 2657 | 11°57' | 61°31' |
| Monday | 11-14/88 | 0600 | 2677 | 11°58' | 61°45' |
| Monday | 11-14/88 | 1200 | alongside St. Georges, Grenada | | |
| Monday | 11-14/88 | 1800 | alongside St. Georges, Grenada | | |
| Tuesday | 11-15/88 | 0000 | alongside St. Georges, Grenada | | |
| Tuesday | 11-15/88 | 0600 | alongside St. Georges, Grenada | | |
| Tuesday | 11-15/88 | 1200 | alongside St. Georges, Grenada | | |
| Tuesday | 11-15/88 | 1800 | alongside St. Georges, Grenada | | |
| Wednesday | 11-16/88 | 0000 | alongside St. Georges, Grenada | | |
| Wednesday | 11-16/88 | 0600 | alongside St. Georges, Grenada | | |
| Wednesday | 11-16/88 | 1200 | alongside St. Georges, Grenada | | |
| Wednesday | 11-16/88 | 1800 | alongside St. Georges, Grenada | | |
| Thursday | 11-17/88 | 0000 | 2690 | 12°19' | 61°49' |
| Thursday | 11-17/88 | 0600 | 2730 | 12°27' | 61°38' |
| Thursday | 11-17/88 | 1200 | at anchor Hillsboro Bay, Carricou | | |
| Thursday | 11-17/88 | 1800 | 2754 | 12°45' | 61°38' |

| Day | Date | Time | Log(nm) | Latitude(N) | Longitude(W) |
|---|---|---|---|---|---|
| Friday | 11-18/88 | 0000 | 2775 | 13°03' | 61°51' |
| Friday | 11-18/88 | 0600 | 2812 | 13°37' | 62°06' |
| Friday | 11-18/88 | 1200 | 2858 | 14°27' | 62°45' |
| Friday | 11-18/88 | 1800 | 2877 | 14°43' | 62°52' |
| Saturday | 11-19/88 | 0000 | 2916 | 15°24' | 62°56' |
| Saturday | 11-19/88 | 0600 | 2947 | 16°02' | 63°13' |
| Saturday | 11-19/88 | 1200 | 2980 | 16°36' | 63°21' |
| Saturday | 11-19/88 | 1800 | 3021 | 17°19' | 63°34' |
| Sunday | 11-20/88 | 0000 | 3054 | 17°57' | 63°42' |
| Sunday | 11-20/88 | 0600 | 3098 | 18°28' | 63°46' |
| Sunday | 11-20/88 | 1200 | 3144 | 18°23' | 64°35' |
| Sunday | 11-20/88 | 1800 | 3170 | 18°01' | 64°28' |
| Monday | 11-21/88 | 0000 | 3195 | 18°11' | 64°50' |
| Monday | 11-21/88 | 0600 | 3222 | 18°08' | 64°45' |
| Monday | 11-21/88 | 1200 | 3237 | 18°25' | 64°45' |
| Monday | 11-21/88 | 1800 | at anchor Hurricane Hole, St. John's | | |
| Tuesday | 11-22/88 | 0000 | at anchor Hurricane Hole, St. John's | | |
| Tuesday | 11-22/88 | 0800 | 3245 | 18°13' | 64°44' |
| Tuesday | 11-22/88 | 1200 | alongside Charlotte Amalie, St. Thomas | | |

TABLE 2. Ship's Complement for SSV *Corwith Cramer* Cruise CC-102

| | |
|---|---|
| **Scientific Staff** | |
| R. Jude Wilber | Chief Scientist |
| Gretchen Rollwagen | First Scientist |
| Shana Smith | Second Scientist |
| Tim Kenna | Third Scientist |
| **Nautical Staff** | |
| Margaret Brandon | Captain |
| Doug Nemeth | First Mate |
| Jim Holm | Second Mate |
| Chuck Holloway | Third Mate |
| Ricky Lee Jones | Steward |
| Dan Lehman | Engineer |
| **Students** | |
| Suzanne Amaducci | Vanderbilt University |
| Beverly Auburn | Smith College |
| Douglas Belkin | Colby College |
| Peter Bream | Davidson College |
| Johanna Capps | Corpus Christi State |
| Nancy Curran | Wesleyan College |
| Holly Davis | Stanford University |
| Joanne Ducey | Trinity College |
| Jonathan Dupont | Colorado College |
| Malcolm Hill | Colby College |
| Jane Klassen | Carleton College |
| Nelson Lebo | Bowdoin Colleg |
| Johanna Martins | Clark University |
| Paul Mirel | Oberlin College |
| Sarah Pedersen | Wellesley College |
| Craig Peters | University of California, Berkeley |
| John Piechocki | Hampden-Sydney College |
| Danniel Polidoro | Connecticut College |
| Alicia Robinson | Williams College |
| William Russell | Boston College |
| Stuart Slattery | Cornell University |
| Nadine Slavinsky | Cornell University |
| James Spencer | Cornell University |
| Eric Swergold | University of Pennsylvania |
| Amy Lee Young | Connecticut College |

TABLE 3. Oceanography Lectures at Sea During CC-102

Oceanography I

| Day | Date | Speaker | Topic |
|---|---|---|---|
| Sa | 10-15 | Wilber | Introduction; SST Data from Satellite; Regional oceanographic boundaries. |
| Mo | 10-17 | Wilber | Principles of operation of EBT, MBT, CTD; Gulf Stream structure: Temperature in the ocean. |
| Tu | 10-18 | Wilber | Oceanography from space: methods, advantages and data. |
| We | 10-19 | Wilber | Oceanography from space (cont.); Hydrowinch set-up and operation. |
| Th | 10-20 | Wilber | Continental Lo pressures and associated weather patterns; Sea level history and implications. |
| Fr | 10-21 | Wilber | Sea level history and implications (cont.). |
| Mo | 10-24 | Wilber | Windrow formation and patterns; Operation of Niskin bottles and deep sea reversing thermometers. |
| Tu | 10-25 | Wilber | Crustacea made easy: Ostracoda, Cirripedia, Copepoda. |
| We | 10-26 | Wilber | Crustacea made easy (cont.): Malacostraca. |
| Th | 10-27 | Wilber | Chemosynthesis in deep sea environments. |
| Fr | 10-28 | Wilber | Chemosynthesis in deep sea environments (cont.). |
| Mo | 10-31 | Rollwagen | Marine fish physiology. |

Oceanography II

| | | | |
|---|---|---|---|
| Tu | 11-1 | Wilber | Overview of the Geology of the Caribbean. |
| We | 11-2 | Wilber | A brief history of the Caribbean and the island of Antigua. |
| Th | 11-3 | Wilber | Field Trip: Geology of Antigua. |
| Fr | 11-4 | Wilber | Field Trip: Geology of Antigua. |
| Mo | 11-7 | Staff | Exam I |
| Tu | 11-8 | Wilber | Atolls, banks and other things: tropical marine carbonate environments. |
| We | 11-9 | Kenna | Biology and Ecology of Coral Reefs. |
| Th | 11-10 | Kenna, Wilber | Coral Reefs (cont.); Outline for student presentation of data. |
| Fr | 11-11 | Smith | Osmoregulation in marine organisms. |
| Sa | 11-12 | Lehman | Commercial fishing techniques in the North Atlantic. |
| Su | 11-13 | Student research project presentations. | |
| Fr | 11-18 | Student research project presentations. | |
| Sa | 11-19 | Student research project presentations. | |
| Su | 11-20 | Exam II | |

TABLE 4. Student Research Projects Completed During CC-102

PHYSICAL OCEANOGRAPHY

Thermal Structure and Water Masses of the Western North Atlantic during Fall of 1988.................Peter Bream and Craig Peters

Antarctic Intermediate Water Distribution in the Area of the St. Lucia Passage .................................. Beverly Auburn

A Cross Section of the Subtropical Underwater of the Sargasso Sea ...................................................... Holly Davis

Tangential Shear of Water as a Source of Both Cyclonic and Anticyclonic Gyres on the Leeward Side of St. Vincent and St. Lucia Island ..................................... James Spencer

Amazon and Orinoco River Water in the Caribbean Sea ........... ................................................ Nana Slavinsky

NEUSTON STUDIES

Biological

The Significance of *Oscillatoria* in the Caribbean and Sargasso Sea, with Regard to Chlorophyll Contribution and the Effects of Day vs. Night on the Relative Abundance ........ John Piechocki

A Study of Chlorophyll *a* in the Open Ocean and Coastal Waters ...................................................... Joey Ducey

Pelagic *Sargassum*: Interesting Answers to Questions on Quantity, Distribution and Speciation .................... Sarah Pedersen

Diversity of Motile Macrofaunal Associates of *Sargassum* in the Sargasso Sea .................... Dan Polidoro and Nancy Curran

Zooplankton Boundaries Between Woods Hole and Antigua: Density and Diversity in the Neuston Layer ............ Stuart Slattery

A Study of Factors Affecting Distribution and Size Distribution of *Physalia physalis*, *Velella velella*, and *Porpita porpita* in the Western North Atlantic Ocean .................. Amy Lee Young

The Distribution of Phyllosoma, Stomatopod larvae and Leptocephali in the Western North Atlantic Ocean .... Alicia Robinson

A Study of the Distributional Patterns of *Halobates micans* in the Atlantic Ocean ................................ Johanna Martins

Pollution



BENTHIC ECOLOGY AND SEDIMENTOLOGY

## CRUISE NARRATIVE

Cruise CC-102 left Dyers Dock in Woods Hole late in the afternoon of October 13, 1988. The vessel moved offshore to an anchorage at Tarpaulin Cove, Naushon Island where first night orientation and safety drills were carried out. We got underway on our long first leg at 1200 on the 14th and sailed south and east past Martha's Vineyard and Nantucket - our last glimpse of land for the next three weeks.

Our passage from Woods Hole to Antigua was characterized by very fair weather conditions. We experienced a calm and relatively normal passage through the Bermuda-Azores high pressure ridge which made for very light winds. Sailing a little slower than optimal but,to our advantage, the sea state remained low. We lost no station time to weather during the entire first leg of this trip.

Oceanographic work during this leg was focused in part on the physical oceanography and water mass characteristics of the western North Atlantic and in particular on trends and boundaries in surface characteristics along our cruise track. Our route on this first leg crossed over twenty full degrees of latitude taking us from the cold, subpolar waters of the Labrador Current to the warm, low-salinity conditions of Tropical Surface Water.

After an initial southeasterly slant (out and past the island of Bermuda) the cruise followed a true longitudinal track along the 60th meridian. This cruise track allowed us to investigate major trends in biological and chemical factors as well as pollutants across most of the major oceanographic regions of the western North Atlantic.

Sampling for surface trends related to physical oceanography included hourly temperature measurements by bucket thermometer and surface salinity measurements every 20 nm. These data served to define our location with regard to major water types as we passed from Shelf Water through a Warm Core Eddy into Slope Water and then across the Gulf Stream. South of the Stream these data were critical in defining our location in the Northern vs Southern Sargasso Sea and our eventual passage in to tropical surface water to the south. A total of 640 Ts measurements and 83 SS values were used in defining major water types during this leg. (Bream and Peters, Figs. 2, 3A, 3B). In combination with surface sampling for these factors bathythermograph profiles were obtained every 20 nm and CTD and/or Niskin bottle hydrocasts were completed on a 60 nm spacing. These data were used in assessing the thickness and southward extension of the 18° Water (North Atlantic Mode Water) and in particular the characteristics of Salinity Maximum Water (Subtropical Underwater; Davis, Fig. 4). These data, in combination with the surface measurements, provided the solid physical oceanographic reference critical for the interpretation of other data trends.

Our studies of the neuston layer were of two types: biological and pollution-related. Biological sampling included measurement of surface chlorophyll and phosphate concentrations every 20 nm for regional productivity trends (Ducey), with a particular emphasis on the relative importance of Oscillatoria in the productivity of the near surface waters (Piechocki).

A series of studies focused on data obtained with the neuston net. We completed replicate (back-to-back) tows every day at 0000 and 1200 hrs. From these nets we measured total zooplankton biomass and diversity (Slattery), the biomass and species of Sargassum (Pedersen, Fig. 5), the diversity of Sargassum associates (Polidoro and Curran), the abundance, sex and age of Halobates micans and regional trends in surface dwelling gelatinous organisms (Physalia, Velella, Porpita; Young). In addition, the neuston tows provided data (in combination with less frequent meter net tows) on the distribution and abundance of "scotch-tape larvae" of the Sargasso Sea (phyllosomes, leptocephali, and stomatopod larvae; Robinson), chaetognaths (Mirel), juvenile fish (Belkin) and myctophid fish (Capps and Dupont).

In addition to these biological studies of the neuston layer, the amounts of plastic debris (Amaducci and Swergold) and tar (Hill) were quantified from each tow (Fig. 6). Our studies of tar included an investigation into the abundance and distribution of microtar which was sampled by filtration every 20 nm and from hydrocast samples (Russell).

This leg also saw the first performance of the much-heralded "Lab Man" series and the first ever performance of the "Yo Baby Rap" - reproduced here in its entirety (Appendix 7).

The first leg ended with a well-earned and highly enjoyable three-day rest on the island of Antigua. In addition to independent explorations and adventure two field trips over the island demonstrated the geologic history of this northern representative of the "limestone" Antilles. A perilous climb to an overview at Boggy Peak was followed by a closing look at the "volcanic" Antilles to the west as seen from the beach at Clydes.

Our second leg began on November 5th as we left Antigua and headed for Grenada. Investigations on this leg were more site-specific representing a significant change from the surface trend and sectional work completed during Leg I. The first focus was the carbonate banks lying to the east of Dominica and Martinique in the central Antilles. Here, we combined extensive 3.5kHz seismic profiling with a program of rock dredging in an effort to assess the benthic community and sedimentological framework of these features (Klassen and Lebo). An intense two days of sampling in this area was highly successful and provided enough rhodoliths for a lifetime.

On leaving these banks we turned to our last major sampling efforts in the southern Antilles. Here concentrated sampling by CTD and hydrocasts were focused on the intrusion of Antarctic Intermediate Water through the St Lucia passage (Auburn). The presence of quasi-permanent eddies in the lee of St. Lucia and St. Vincent was assessed through concentrated surface sampling and BT´s in this area (Spencer). In the extreme southernmost part of our study area the northward penetration of Amazon/Orinoco River water into the Caribbean was studied through close-spaced assessment of surface salinity and silicate values (Slavinsky).

In addition to these project efforts sampling continued for many of the regional trend projects initiated in Leg I. The final sampling effort of this leg represented a close to our major research efforts of the cruise.

Our stop at St. Georges, Grenada, which was initially planned to be a single day layover, was extended as we engaged in a favorite Caribbean pastime - waiting for the mail... Nevertheless this afforded us all an opportunity to explore the "Spice Island" and such exotic treats as the "road kill" specials at Mama´s.

Following a brief day stop at Carriacou we headed north (!) for our final destination in the US Virgin Islands. After days of anticipation and maneuvering the "stealth" Cramer surprised its doppleganger Westward early in the morning of November 19th. Our morning of sailing together provided a fitting climax to the long hours of work at sea.

After clearing customs in St. John a final swizzle and schooner races occupied our final night at anchor in Cruz Bay. We completed CC-102 as the lines went on the dock at Charlotte Amalie, St. Thomas at 0800 hrs on the 22nd.

The final tallies of the samples taken and analyses done on CC-102 are reflective of the hard work and stamina of all involved:

| | |
|---|---|
| Surface Temperatures | ~1000 |
| Surface Salinity Values | 144 |

| | |
|---|---|
| Surface Nutrients (PO4, SiO2) | 125 |
| Surface Chlorophyll | 93 |
| Surface Microtar | 93 |
| Neuston Tows | 78 |
| Meter Net Tows | 6 |
| Hydrocasts | 7 |
| CTD's | 22 |
| Bathythermographs | 119 |
| Rock Dredges | 25 |
| 3.5 kHz (line km) | 1000+ |
| Weather Transmissions | 22 |

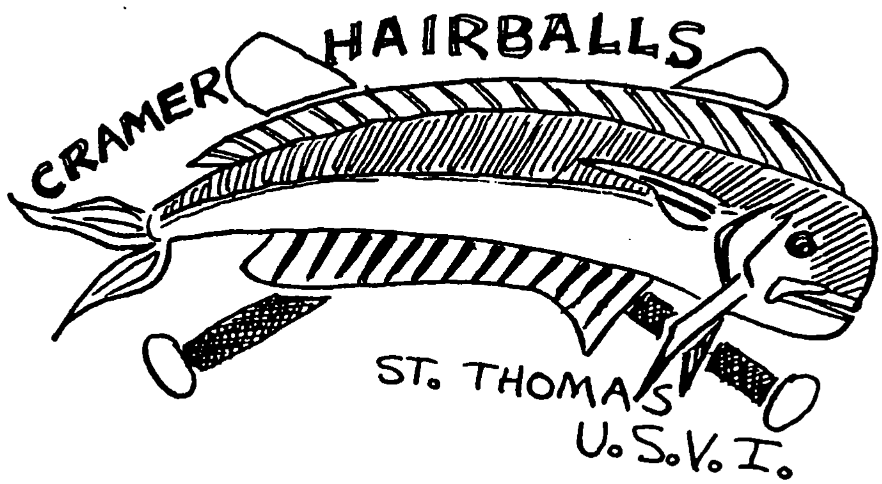
The final entry in the Oceanography Running Log:

Now's the time when the A-Watch crew
Must grab the buckets, its nothing new
For us to clean while the sun rises
Then four hours later there's no surprises
Because Field Day's here and the heads look clean
But scrub them again, it ain't no thing.
But A-Watch is here and ready to sing
This'll be the fastest dawn clean up you have ever seen.

Love, Pete

And oh yes, the final score of the First Annual Great

Caribbean Softball Game between the crews of Cramer-102 and Westward-102 was Cramer: 28-5 !!



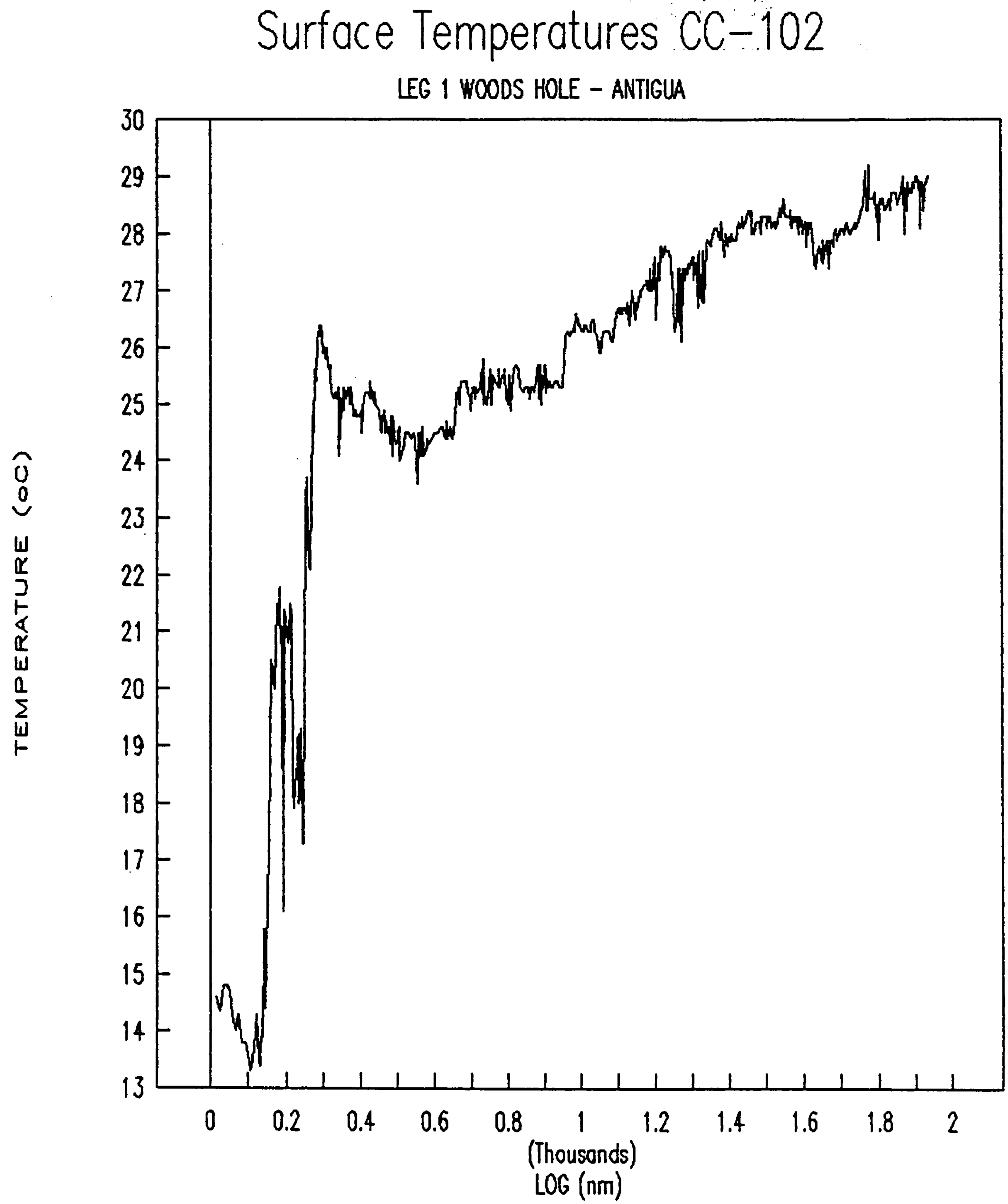
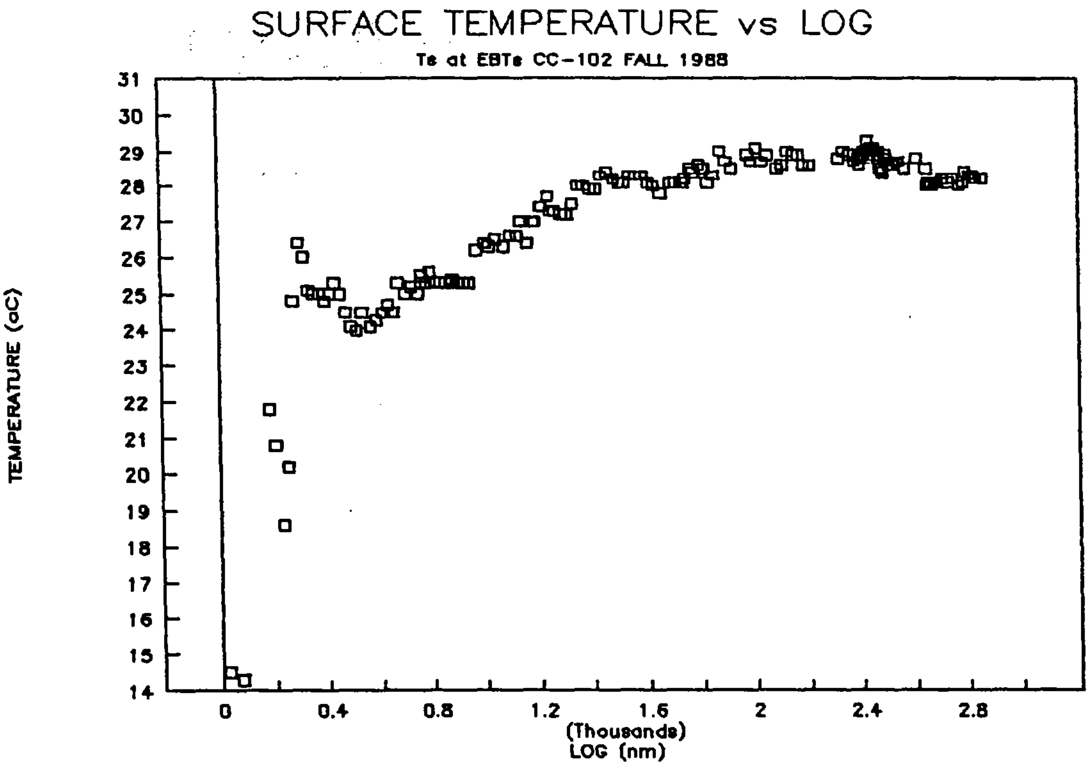
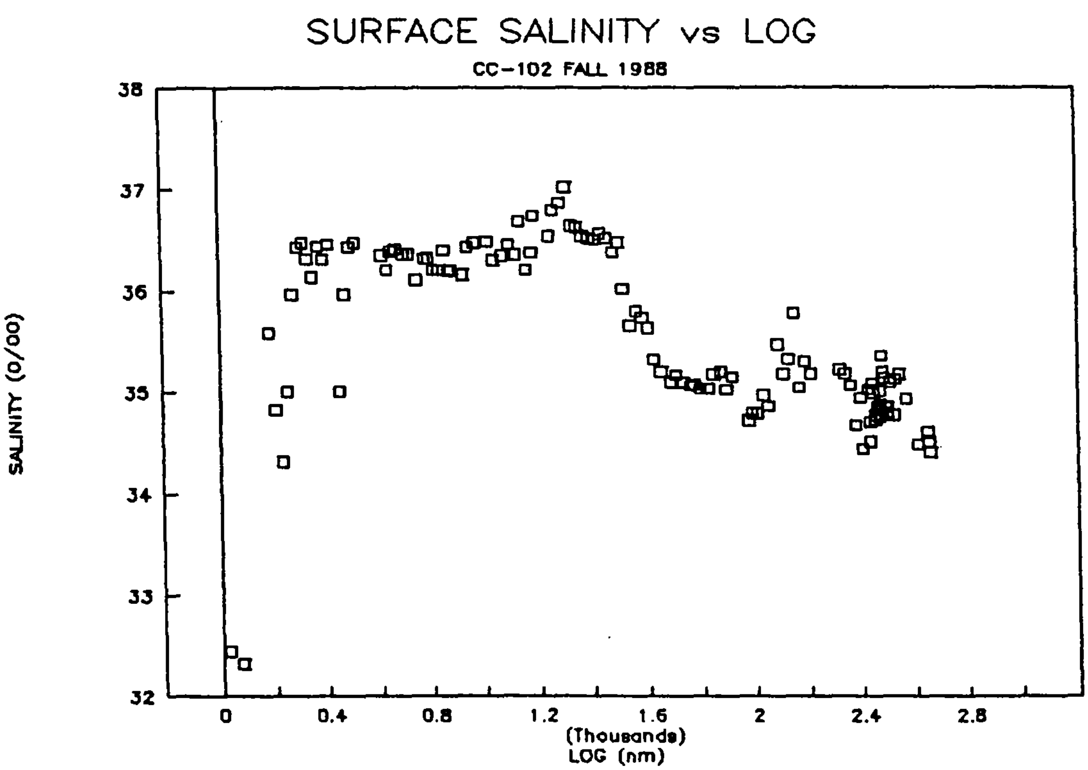



FIGURE 2 Line Graph of Surface Temperature vs Taffrail Log distance for Leg 1 of CC-102. Woods Hole - Antigua. Graph based on over 600 hourly surface temperature readings obtained during this interval.




<u>FIGURE 3A</u> Scatter plot of Surface Temperature vs Taffrail Log distance for all of CC-102. Woods Hole - St. Thomas. Graph based on surface temperatures obtained at Surface Salinity stations.




<u>FIGURE 3B</u> Scatter plot of Surface Salinity vs Taffrail Log distance for all of CC-102. Woods Hole - St. Thomas. Surface salinity maxima occurs between 29N and 24N (1200-1500 nm). Strong surface halocline occurs between 24N and 22 30 N (1500-1600nm). Low salinity tropical surface waters are found below 22N.

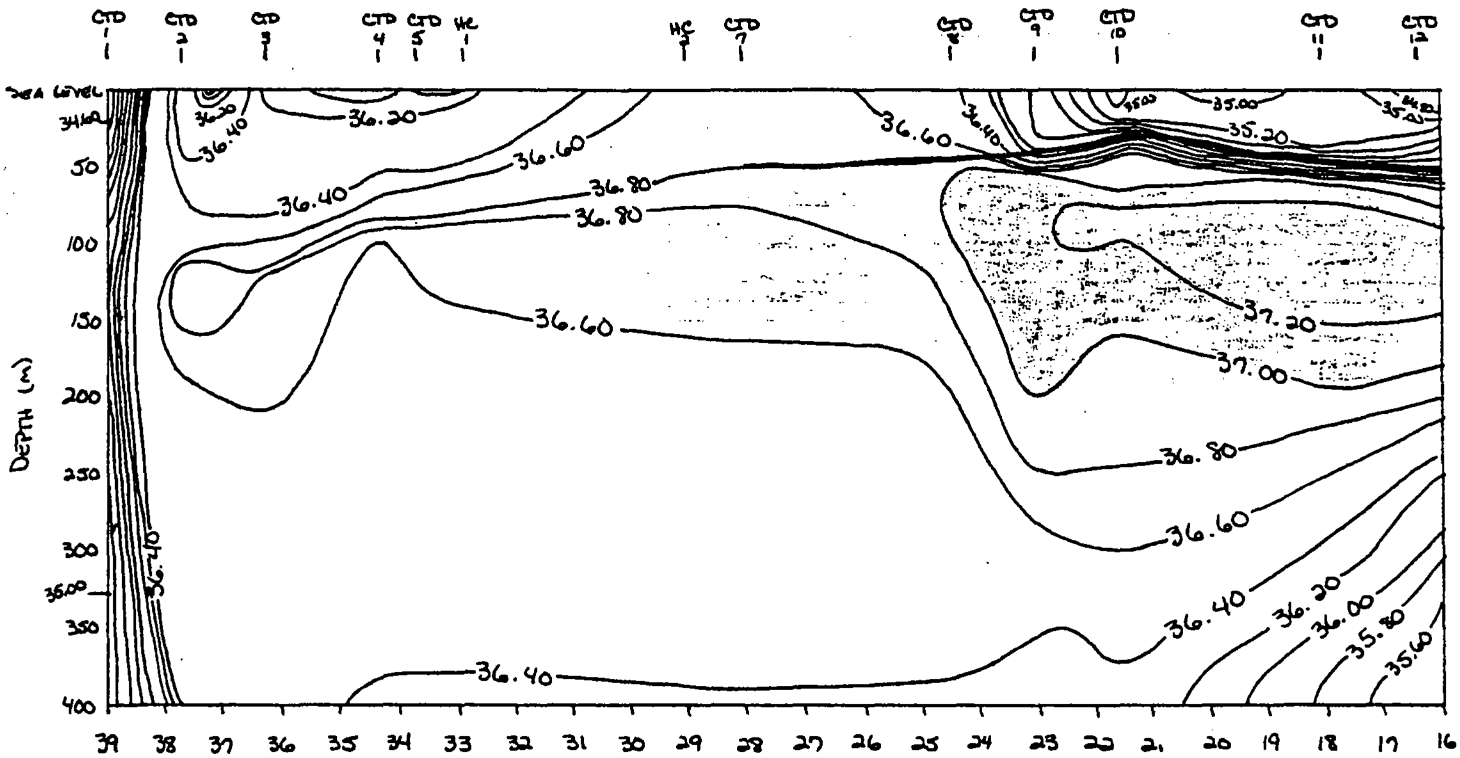



FIGURE 6a. CONTOURED SALINITY PROFILE OF THE SARGASSO SEA DURING OCTOBER AND NOVEMBER, 1988.

(SALINITY IN PARTS PER THOUSAND
CONTOUR INTERVAL = .2‰)

**— 28°C TEMPERATURE INVERSION**

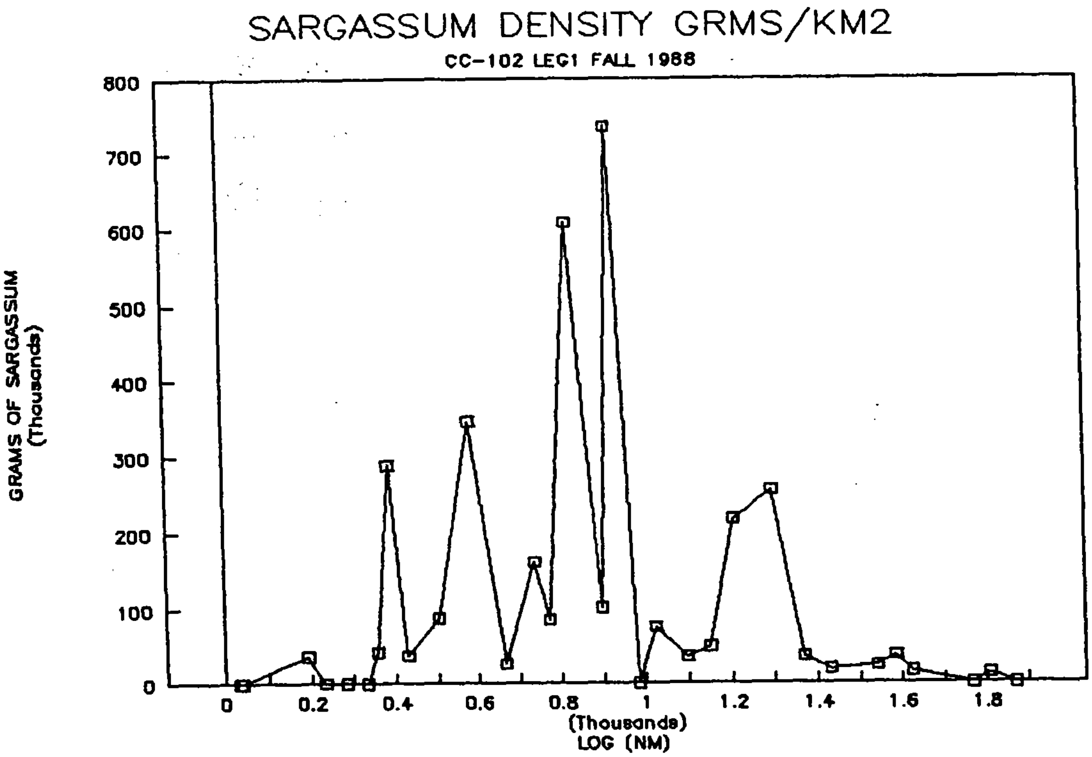
KEY

LOW SALINITY POD (≤ 36.20‰)

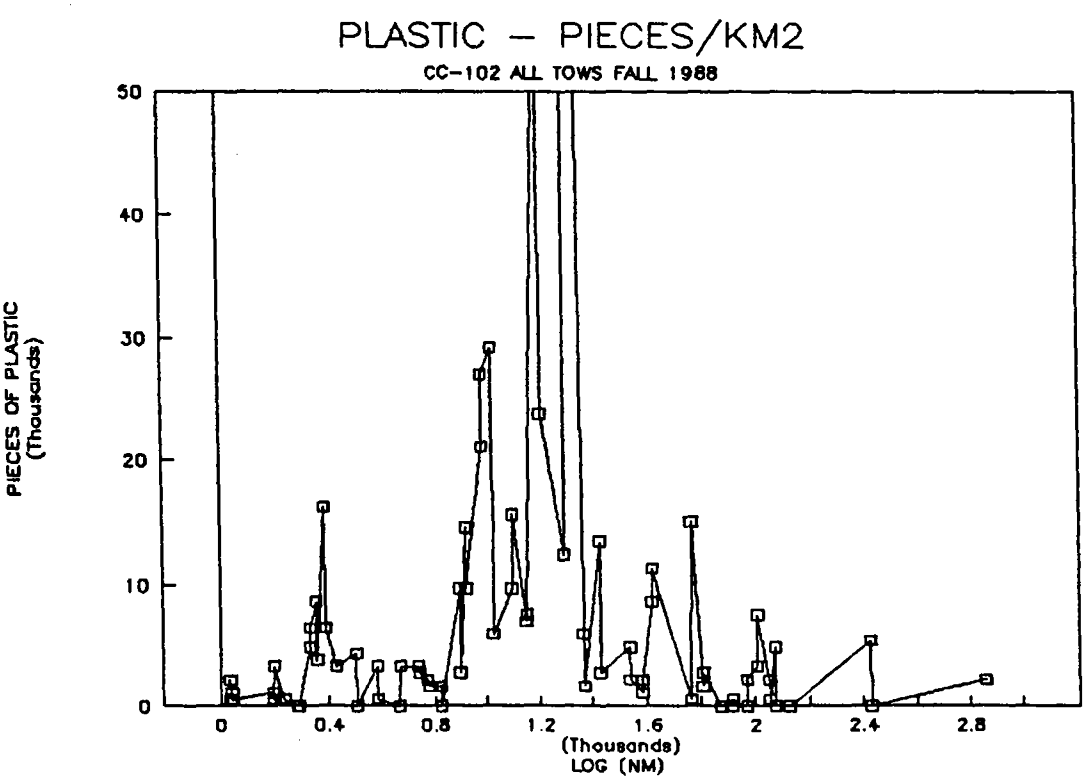
SALINITY MAXIMA WATER (≥ 36.60‰)

SUPER SALINE CORE (≥ 37.00‰)

<u>FIGURE 4</u> Contour plot of Salinity Maximum Water along CC-102 cruise track. Data based on 12 CTD and 2 Hydrocasts. Contour plot by Holly Davis.




<u>FIGURE 5</u> Line graph of <u>Sargassum</u> density along CC-102 cruise track. Graph based on mean values from paired neuston tows. Highest concentration of <u>Sargassum</u> is found in Northern Sargasso Sea between 38N and 31N (400-1000nm).




<u>FIGURE 6</u> Line Graph of plastic concentration along CC-102 cruise track. Graph based on all neuston tows. Highest concentration of plastic is found in between 33N and 24N (800-1500 nm).

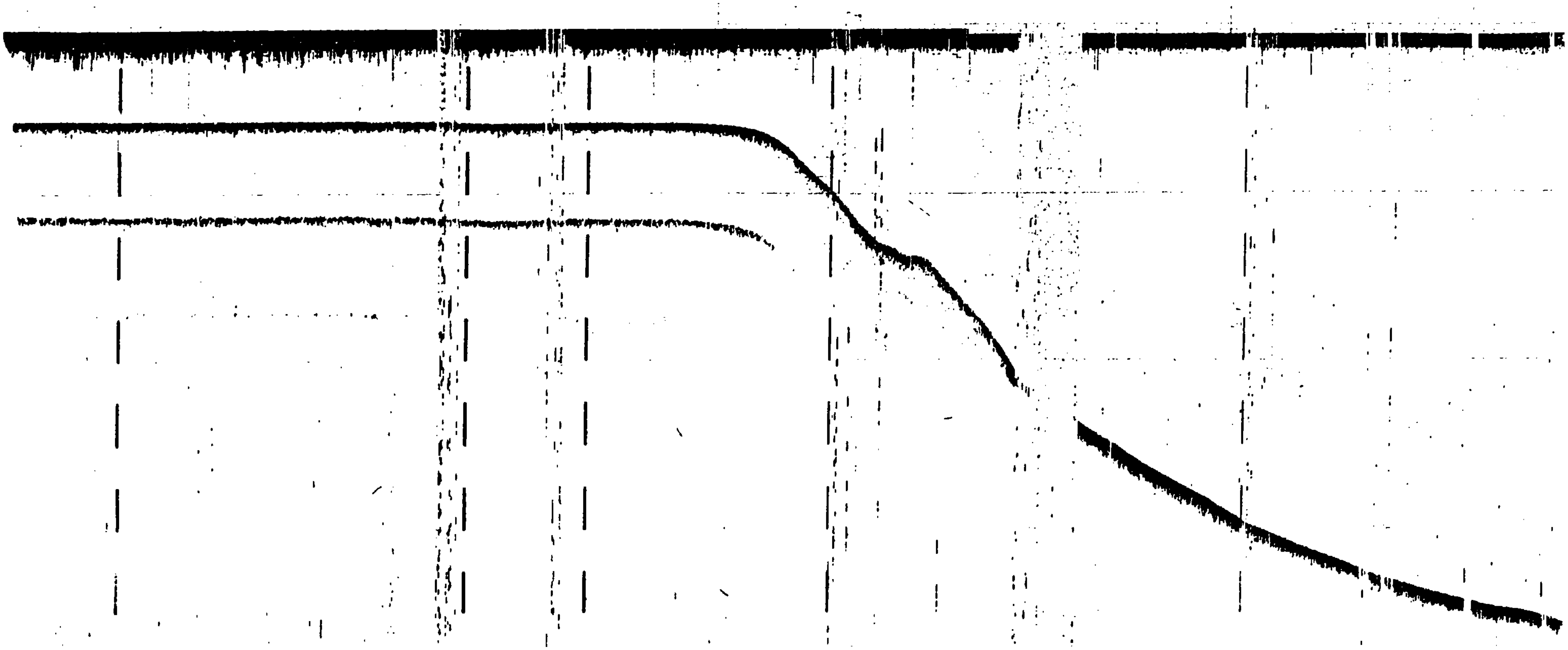
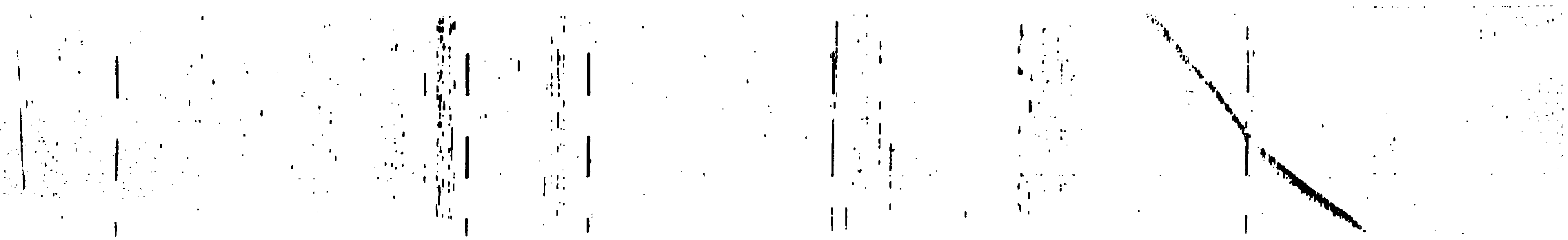


FIGURE 7A  3.5 kHz seismic profile of the leeward (western) margin and upper slope of Dominica Bank. Profile is run at 2 sec sweep with each scale line equal to 150 m. Figure shows flat bank top at approx 90 m with concave slope to the right. Dredging of this slope recovered bank top sediment (including rhodoliths) as deep as 400 m.



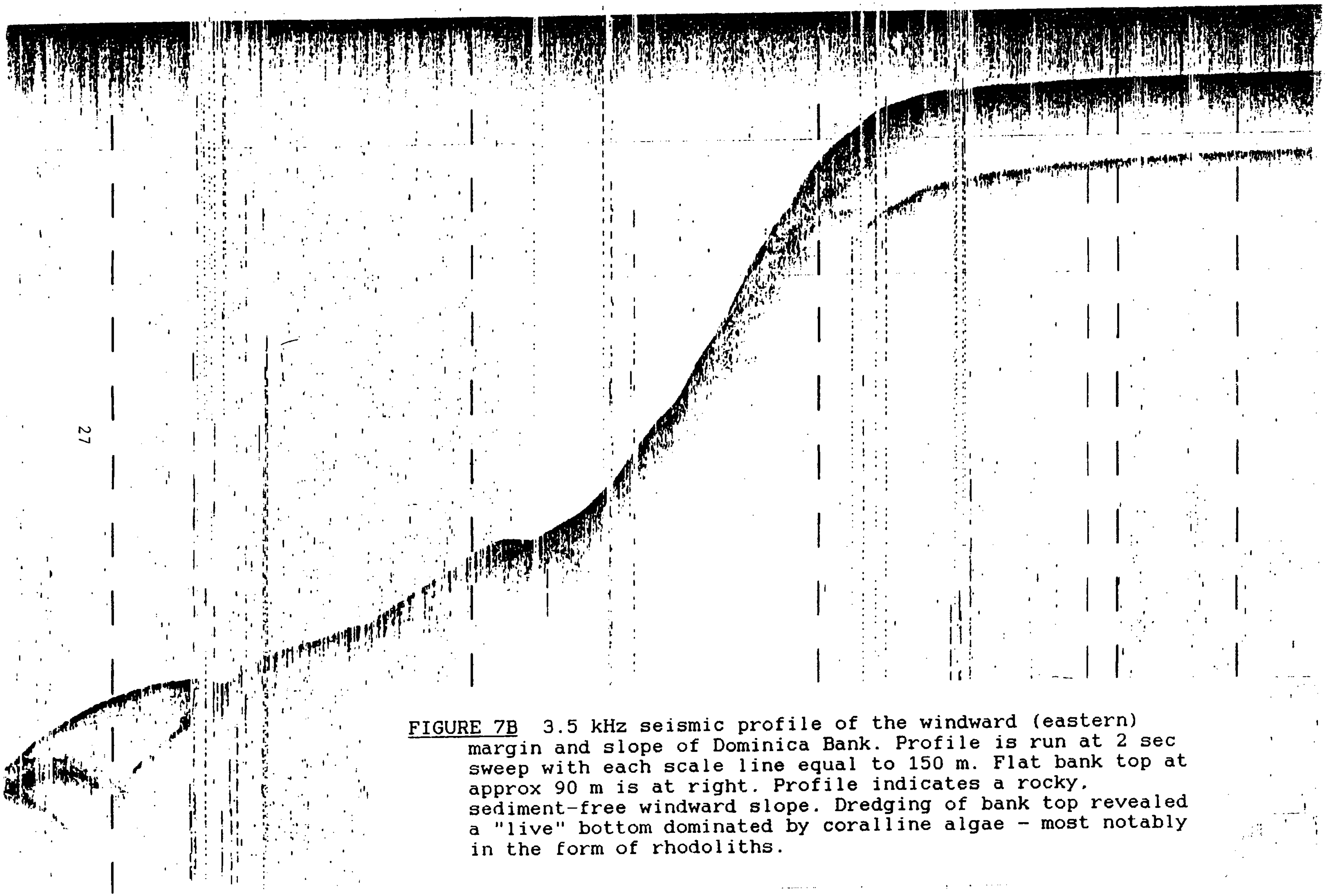
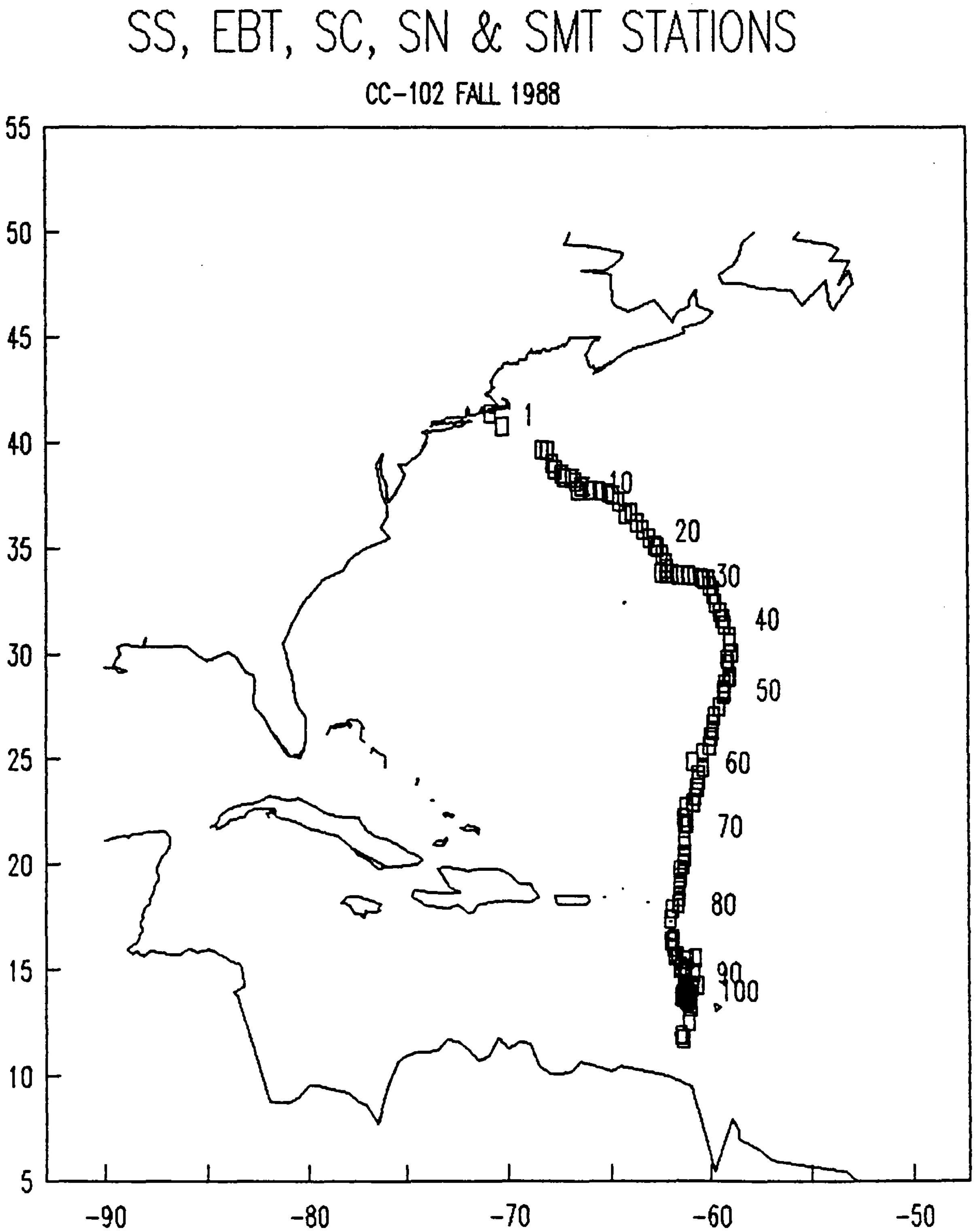


FIGURE 7B 3.5 kHz seismic profile of the windward (eastern) margin and slope of Dominica Bank. Profile is run at 2 sec sweep with each scale line equal to 150 m. Flat bank top at approx 90 m is at right. Profile indicates a rocky, sediment-free windward slope. Dredging of bank top revealed a "live" bottom dominated by coralline algae - most notably in the form of rhodoliths.



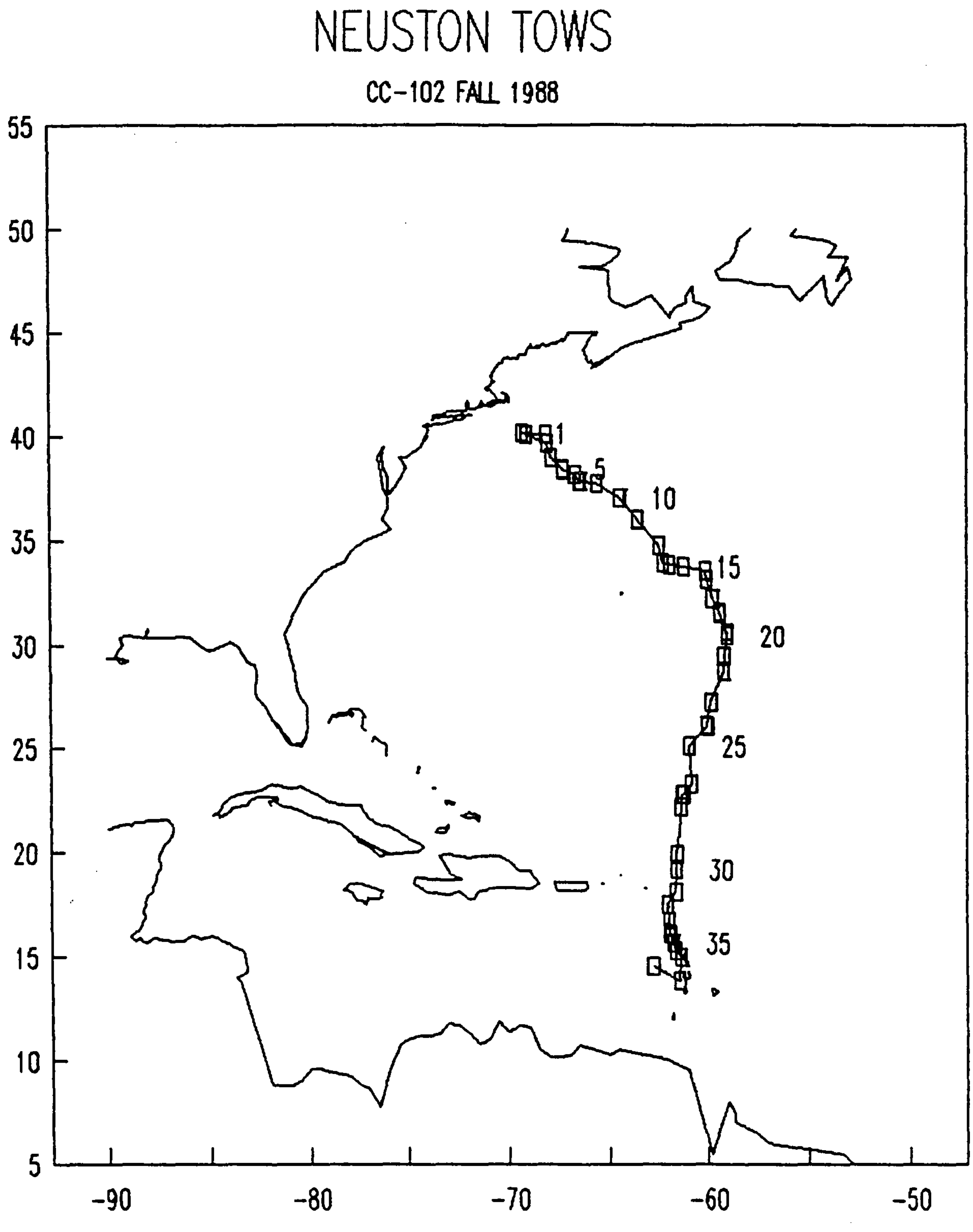

APPENDIX 1 Reference Chart and tabulated data on Electronic Bathythermographs (EBT), Surface Salinity (SS), Chlorophyll (SC), Nutrients (SN) and Microtar (SMT) stations. Chart depicts SS stations plotted from data in folowing table.

| SS # | 0/00 | SC # | SN # | SMT # | BT # | Ts (C) | LOG (NM) | LATITUDE (DEG.MIN) | LONGITUDE (DEG.MIN) |
|---|---|---|---|---|---|---|---|---|---|
| SS-1 | 32.45 | | | | | 14.5 | 21 | 41.24 | 70.54 |
| SS-2 | 32.33 | | | | | 14.3 | 71 | 40.48 | 70.17 |
| SS-3 | 35.59 | SC-1 | SN-1 | | | 21.8 | 182 | 39.43 | 68.21 |
| SS-4 | 34.82 | | SN-2 | SMT-1 | BT-2 | 20.8 | 203 | 39.38 | 68.06 |
| SS-5 | 34.31 | SC-2 | SN-3 | SMT-2 | | 18.6 | 229 | 39.03 | 67.54 |
| SS-6 | 35.00 | SC-3 | SN-4 | | BT-3 | 20.2 | 249 | 38.45 | 67.43 |
| SS-7 | 35.97 | SC-4 | SN-5 | SMT-4 | BT-4 | 24.8 | 271 | 38.31 | 67.26 |
| SS-8 | 36.43 | SC-5 | SN-6 | SMT-5 | | 26.4 | 292 | 38.23 | 67.16 |
| SS-9 | 36.47 | SC-6 | SN-7 | | BT-5 | 26.0 | 313 | 38.20 | 66.55 |
| SS-10 | 36.31 | SC-7 | SN-8 | SMT-6 | BT-6 | 25.1 | 329 | 38.11 | 66.43 |
| SS-11 | 36.14 | SC-8 | SN-9 | SMT-7 | BT-7 | 25.0 | 347 | 37.57 | 66.26 |
| SS-12 | 36.44 | SC-9 | SN-10 | SMT-8 | BT-8 | 25.0 | 370 | 37.45 | 66.38 |
| SS-13 | 36.31 | SC-10 | SN-11 | SMT-9 | BT-9 | 24.8 | 390 | 37.54 | 66.26 |
| SS-14 | 36.46 | SC-11 | SN-12 | SMT-10 | BT-10 | 25.0 | 408 | 37.45 | 65.57 |
| SS-15 | NA | SC-12 | SN-13 | SMT-11 | | 25.3 | 426 | 37.41 | 65.34 |
| SS-16 | 35.00 | SC-13 | SN-14 | SMT-12 | BT-11 | 25.0 | 449 | 37.36 | 65.07 |
| SS-17 | 35.97 | SC-14 | SN-15 | SMT-13 | BT-12 | 24.5 | 469 | 37.30 | 64.54 |
| SS-18 | 36.43 | SC-15 | SN-16 | SMT-14 | BT-13 | 24.1 | 489 | 37.12 | 64.35 |
| SS-19 | 36.47 | SC-16 | SN-17 | | BT-14 | 24.0 | 510 | 36.42 | 63.58 |
| SS-18A | NA | | | | BT-15 | 24.5 | 532 | 36.39 | 64.14 |
| SS-19B | NA | SC-17 | SN-18 | SMT-15 | CTD-3 | 24.1 | 564 | 36.14 | 63.40 |
| SS-20 | NA | SC-18 | SN-19 | SMT-16 | BT-17 | 24.3 | 587 | 35.52 | 63.22 |
| SS-21 | 36.35 | SC-19 | SN-20 | SMT-17 | BT-18 | 24.5 | 614 | 35.30 | 63.03 |
| SS-22 | 36.21 | SC-20 | SN-21 | SMT-18 | | 24.7 | 632 | 35.10 | 62.45 |
| SS-23 | 36.39 | SC-21 | SN-22 | SMT-19 | BT-19 | 24.5 | 647 | 35.01 | 62.37 |
| SS-24 | 36.41 | SC-22 | SN-23 | SMT-20 | BT-20 | 25.3 | 667 | 34.45 | 62.25 |
| SS-25 | 36.36 | SC-23 | SN-24 | SMT-21 | CTD-4 | 25.0 | 697 | 34.19 | 62.12 |
| SS-26 | 36.36 | SC-24 | SN-25 | SMT-22 | BT-21 | 25.2 | 716 | 34.04 | 62.11 |
| SS-27 | 36.11 | SC-25 | SN-26 | SMT-23 | | 25.0 | 745 | 33.52 | 62.29 |
| | NA | | | | BT-22 | 25.3 | 755 | 33.50 | 62.13 |
| | NA | | | | BT-23 | 25.5 | 758 | 33.49 | 62.08 |
| SS-28 | 36.31 | SC-26 | SN-27 | SMT-24 | BT-24 | 25.3 | 777 | 33.50 | 61.52 |
| SS-29 | 36.32 | | SN-28 | SMT-25 | CTD-5 | 25.6 | 790 | 33.46 | 61.39 |
| SS-30 | 36.21 | SC-27 | SN-29 | SMT-26 | BT-25 | 25.3 | 809 | 33.45 | 61.20 |
| SS-31 | 36.21 | SC-28 | SN-30 | SMT-27 | BT-26 | 25.3 | 830 | 33.46 | 61.03 |
| SS-32 | 36.40 | SC-29 | SN-31 | | BT-27 | 25.3 | 851 | 33.44 | 61.05 |
| SS-33 | 36.20 | SC-30 | SN-32 | SMT-28 | | 25.3 | 867 | 33.38 | 60.27 |
| SS-34 | 36.21 | SC-31 | SN-33 | SMT-29 | BT-28 | 25.4 | 874 | 33.36 | 60.19 |
| SS-35 | NA | SC-32 | SN-34 | SMT-30 | BT-29 | 25.3 | 897 | 33.33 | 60.05 |
| SS-36 | 36.16 | SC-33 | SN-35 | SMT-31 | BT-30 | 25.3 | 920 | 33.15 | 60.03 |
| SS-37 | 36.43 | SC-34 | SN-36 | SMT-32 | BT-31 | 25.3 | 940 | 32.52 | 59.55 |
| SS-38 | 36.47 | SC-35 | SN-37 | SMT-33 | BT-32 | 26.2 | 967 | 32.25 | 59.45 |
| SS-39 | NA | SC-36 | SN-38 | SMT-34 | BT-33 | 26.4 | 996 | 32.00 | 59.32 |
| SS-40 | 36.48 | SC-40 | SN-40 | SMT-40 | BT-34 | 26.3 | 1015 | 31.42 | 59.25 |
| SS-41 | 36.30 | SC-41 | SN-41 | SMT-41 | BT-35 | 26.5 | 1035 | 31.27 | 59.19 |
| SS-42 | 36.35 | SC-42 | SN-42 | SMT-42 | BT-36 | 26.3 | 1069 | 30.51 | 59.04 |
| SS-43 | 36.46 | SC-43 | SN-43 | SMT-43 | BT-37 | 26.6 | 1094 | 30.34 | 59.02 |
| SS-44 | 36.36 | SC-44 | SN-44 | SMT-44 | BT-38 | 26.6 | 1119 | 30.07 | 58.58 |
| SS-45 | 36.68 | SC-45 | SN-45 | SMT-45 | BT-39 | 27.0 | 1133 | 29.47 | 59.12 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SS-46 | 36.21 | SC-46 | SN-46 | SMT-46 | BT-40 | 26.4 | 1156 | 29.34 | 59.07 |
| SS-47 | 36.38 | SC-47 | SN-47 | SMT-47 | BT-41 | 27.0 | 1178 | 28.58 | 59.03 |
| SS-48 | 36.73 | SC-48 | SN-48 | SMT-48 | BT-42 | 27.0 | 1187 | 28.53 | 59.07 |
| SS-49 | NA | SC-49 | SN-49 | SMT-49 | BT-43 | 27.4 | 1208 | 28.36 | 59.18 |
| | NA | | | | BT-44 | 27.4 | 1209 | 28.36 | 59.18 |
| SS-50 | NA | SC-50 | SN-50 | SMT-50 | BT-45 | 27.7 | 1233 | 28.22 | 59.21 |
| SS-51 | 36.54 | SC-51 | SN-51 | SMT-51 | CTD-7 | 27.3 | 1243 | 28.10 | 59.18 |
| SS-52 | 36.78 | SC-52 | SN-52 | SMT-52 | BT-46 | 27.3 | 1259 | 28.05 | 59.24 |
| SS-53 | 36.86 | SC-53 | SN-53 | SMT-53 | BT-47 | 27.2 | 1284 | 27.31 | 59.35 |
| SS-54 | 37.02 | SC-54 | SN-54 | SMT-54 | BT-48 | 27.2 | 1304 | 27.05 | 59.50 |
| SS-55 | 36.63 | SC-55 | SN-55 | SMT-55 | BT-49 | 27.5 | 1324 | 26.45 | 59.54 |
| SS-56 | 36.62 | SC-56 | SN-56 | SMT-56 | BT-50 | 28.0 | 1345 | 26.25 | 59.55 |
| SS-57 | 36.54 | SC-57 | SN-57 | SMT-57 | BT-51 | 28.0 | 1368 | 26.06 | 60.00 |
| SS-58 | 36.51 | SC-58 | SN-58 | SMT-58 | BT-52 | 27.9 | 1392 | 25.43 | 60.03 |
| SS-59 | 36.50 | SC-59 | SN-59 | SMT-59 | BT-53 | 27.9 | 1413 | 25.21 | 60.24 |
| SS-60 | 36.56 | SC-60 | SN-60 | SMT-60 | BT-54 | 28.3 | 1433 | 24.56 | 60.55 |
| SS-61 | 36.51 | SC-61 | SN-61 | SMT-61 | BT-55 | 28.4 | 1456 | 24.38 | 60.26 |
| SS-62 | 36.38 | SC-62 | SN-62 | SMT-62 | BT-56 | 28.2 | 1480 | 24.20 | 60.37 |
| SS-63 | 36.47 | SC-63 | SN-63 | SMT-63 | BT-57 | 28.1 | 1498 | 24.05 | 60.39 |
| SS-64 | 36.02 | SC-64 | SN-64 | SMT-64 | BT-58 | 28.1 | 1518 | 23.42 | 60.42 |
| SS-65 | 35.66 | SC-65 | SN-65 | SMT-65 | BT-59 | 28.3 | 1541 | 23.16 | 60.48 |
| SS-66 | 35.80 | SC-66 | SN-66 | SMT-66 | BT-60 | 28.3 | 1563 | 23.00 | 60.54 |
| SS-67 | 35.74 | SC-67 | SN-67 | SMT-67 | BT-61 | 28.3 | 1584 | 22.47 | 61.13 |
| SS-68 | 35.64 | SC-68 | SN-68 | SMT-68 | BT-62 | 28.1 | 1606 | 22.00 | 61.12 |
| SS-69 | 35.32 | SC-69 | SN-69 | SMT-69 | BT-63 | 28.0 | 1626 | 22.16 | 61.21 |
| SS-70 | 35.20 | SC-70 | SN-70 | SMT-70 | BT-64 | 27.8 | 1653 | 21.55 | 61.19 |
| SS-71 | 35.09 | SC-71 | SN-71 | SMT-71 | BT-65 | 28.1 | 1688 | 21.12 | 61.18 |
| SS-72 | 35.16 | SC-72 | SN-72 | SMT-72 | BT-66 | 28.1 | 1707 | 20.55 | 61.19 |
| SS-73 | 35.09 | SC-73 | | SMT-73 | BT-67 | 28.1 | 1731 | 20.32 | 61.20 |
| | NA | | | | BT-68 | 28.2 | 1741 | 20.26 | 61.20 |
| SS-74 | 35.06 | SC-74 | | SMT-74 | BT-69 | 28.5 | 1762 | 20.03 | 61.21 |
| SS-75 | 35.07 | | | | BT-70 | 28.4 | 1773 | 19.48 | 61.32 |
| SS-76 | 35.03 | SC-75 | | SMT-75 | BT-71 | 28.6 | 1793 | 19.25 | 61.32 |
| SS-77 | NA | SC-76 | | SMT-76 | BT-72 | 28.5 | 1807 | 19.11 | 61.33 |
| | NA | | | | BT-73 | 28.5 | 1813 | 19.04 | 61.34 |
| SS-78 | 35.03 | SC-77 | | SMT-77 | BT-74 | 28.1 | 1826 | 18.52 | 61.34 |
| SS-79 | 35.17 | SC-78 | | SMT-78 | BT-75 | 28.3 | 1846 | 18.32 | 61.34 |
| SS-80 | 35.20 | SC-79 | | SMT-79 | BT-76 | 29.0 | 1871 | 18.12 | 61.37 |
| SS-81 | 35.02 | SC-80 | | SMT-80 | BT-77 | 28.7 | 1894 | 17.59 | 61.56 |
| SS-82 | 35.14 | SC-81 | | SMT-81 | | 28.5 | 1916 | 17.30 | 62.00 |
| SS-83 | 34.71 | SC-82 | | SMT-82 | BT-78 | 28.9 | 1975 | 16.32 | 61.54 |
| SS-84 | 34.78 | SC-83 | | SMT-83 | CTD-1 | 28.7 | 1986 | 16.25 | 62.00 |
| SS-85 | 34.78 | SC-84 | | SMT-84 | BT-79 | 29.1 | 2006 | 16.07 | 61.54 |
| SS-86 | 34.96 | SC-85 | | SMT-85 | BT-80 | 28.7 | 2029 | 15.42 | 61.47 |
| SS-87 | 34.85 | SC-86 | | SMT-86 | CTD-1 | 28.9 | 2048 | 15.44 | 61.41 |
| SS-88 | 35.47 | SC-87 | SN-73 | SMT-87 | BT-81 | 28.5 | 2086 | 15.06 | 61.32 |
| SS-89 | 35.18 | SC-88 | SN-74 | SMT-88 | BT-82 | 28.6 | 2106 | 15.12 | 61.30 |
| SS-90 | 35.32 | SC-89 | SN-75 | SMT-89 | BT-83 | 29.0 | 2125 | 14.57 | 61.23 |
| SS-91 | 35.78 | SC-90 | SN-76 | SMT-90 | BT-84 | 28.9 | 2145 | 14.53 | 61.22 |
| SS-92 | 35.04 | SC-91 | SN-77 | SMT-91 | BT-85 | 28.9 | 2166 | 15.01 | 61.18 |
| SS-93 | 35.30 | SC-92 | SN-78 | SMT-92 | BT-86 | 28.6 | 2185 | 15.07 | 61.15 |
| SS-94 | 35.18 | SC-93 | SN-79 | SMT-93 | BT-87 | 28.6 | 2208 | 15.29 | 61.11 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SS-95 | 35.22 | SN-93 | SMT-94 | 28.8 | 2318 | 14.54 | 60.52 |
| SS-96 | 35.18 | SN-94 | | 29.0 | 2338 | 15.38 | 60.47 |
| SS-97 | 35.06 | SN-95 | | 28.9 | 2358 | 14.18 | 60.42 |
| SS-98 | 34.66 | SN-96 | BT-88 | 28.7 | 2379 | 14.14 | 60.55 |
| SS-99 | 34.93 | SN-97 | CTD-1 | 28.8 | 2396 | 14.14 | 61.16 |
| | NA | | BT-89 | 28.6 | 2397 | 14.09 | 61.11 |
| SS-100 | 34.43 | | BT-90 | 28.8 | 2403 | 14.04 | 61.10 |
| | NA | | BT-91 | 28.9 | 2407 | 14.04 | 61.12 |
| | NA | | BT-92 | 29.0 | 2413 | 14.02 | 61.15 |
| | NA | | BT-93 | 29.0 | 2415 | 14.00 | 61.19 |
| | NA | | BT-94 | 29.0 | 2418 | 13.58 | 61.23 |
| SS-101 | 35.02 | SN-98 | BT-95 | 29.0 | 2425 | 13.49 | 61.26 |
| | NA | | BT-96 | 29.3 | 2427 | 13.47 | 61.27 |
| SS-102 | 34.50 | SN-99 | | 28.8 | 2431 | 13.45 | 61.28 |
| SS-103 | 34.69 | SN-100 | BT-97 | 28.9 | 2434 | 13.44 | 61.25 |
| SS-104 | 35.08 | SN-101 | BT-98 | 29.0 | 2440 | 13.52 | 61.25 |
| SS-105 | 34.98 | SN-102 | BT-99 | 29.1 | 2444 | 13.54 | 61.25 |
| SS-106 | 34.76 | SN-103 | BT-10 | 29.1 | 2449 | 14.02 | 61.23 |
| SS-107 | 34.72 | SN-104 | BT-10 | 28.9 | 2453 | 14.03 | 61.22 |
| SS-108 | 34.85 | SN-105 | BT-10 | 29.0 | 2460 | 14.00 | 61.20 |
| SS-109 | 34.83 | SN-106 | | 29.0 | 2464 | 13.55 | 61.13 |
| SS-110 | 34.87 | SN-107 | CTD-1 | 29.0 | 2470 | 13.52 | 61.13 |
| SS-111 | 34.82 | SN-108 | | 28.9 | 2470 | 13.53 | 61.16 |
| SS-112 | 34.74 | SN-109 | | 28.8 | 2470 | 13.52 | 61.17 |
| SS-113 | 34.81 | SN-110 | | 28.9 | 2470 | 13.51 | 61.17 |
| SS-114 | 35.00 | SN-111 | | 28.8 | 2471 | 13.51 | 61.17 |
| SS-115 | 35.35 | SN-112 | BT-10 | 28.5 | 2476 | 13.45 | 61.20 |
| SS-116 | 35.19 | SN-113 | BT-10 | 28.5 | 2482 | 13.41 | 61.14 |
| SS-117 | 35.13 | SN-114 | | 28.4 | 2485 | 13.46 | 61.14 |
| SS-118 | 34.85 | SN-115 | | 28.9 | 2494 | 13.50 | 61.14 |
| SS-119 | 34.84 | SN-116 | | 28.8 | 2496 | 13.52 | 61.02 |
| SS-120 | 34.78 | SN-117 | BT-10 | 28.7 | 2499 | 13.55 | 61.08 |
| SS-121 | 35.09 | SN-118 | | 28.6 | 2509 | 13.49 | 61.08 |
| SS-122 | 34.76 | SN-119 | BT-10 | 28.6 | 2521 | 13.34 | 61.13 |
| SS-123 | 35.12 | SN-120 | | 28.7 | 2526 | 13.30 | 61.12 |
| SS-124 | 35.17 | SN-121 | BT-10 | 28.7 | 2542 | 13.34 | 61.09 |
| SS-125 | 34.92 | SN-122 | BT-10 | 28.5 | 2568 | 13.16 | 61.01 |
| SS-126 | 34.47 | SN-123 | BT-10 | 28.8 | 2610 | 12.37 | 61.08 |
| SS-127 | 34.59 | SN-124 | | 28.5 | 2647 | 11.47 | 61.25 |
| SS-128 | 34.51 | SN-125 | BT-11 | 28.0 | 2652 | 11.56 | 61.29 |
| SS-129 | 34.40 | SN-126 | | 28.1 | 2657 | 11.57 | 61.31 |
| SS-130 | NA | SN-127 | | 28.0 | 2662 | 11.58 | 61.35 |
| SS-131 | NA | SN-128 | | 28.0 | 2667 | 11.57 | 61.38 |
| SS-132 | NA | SN-129 | | 28.1 | 2679 | 12.00 | 61.50 |
| SS-133 | NA | SN-130 | BT-11 | 28.1 | 2687 | 12.07 | 61.47 |
| SS-134 | NA | SN-131 | BT-11 | 28.2 | 2707 | 12.30 | 61.45 |
| SS-135 | NA | SN-132 | BT-11 | 28.1 | 2728 | 12.27 | 61.38 |
| SS-136 | NA | | BT-11 | 28.2 | 2746 | 12.38 | 61.34 |
| SS-137 | NA | | BT-11 | 28.0 | 2771 | 13.01 | 61.50 |
| SS-138 | NA | SN-134 | | 28.1 | 2786 | 13.14 | 61.52 |
| SS-139 | NA | SN-135 | BT-11 | 28.4 | 2792 | 13.14 | 61.58 |
| SS-140 | NA | SN-136 | | 28.3 | 2808 | 13.30 | 62.05 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SS-141 | NA | SN-137 | BT-11 | 28.3 | 2813 | 13.37 | 62.06 |
| SS-142 | NA | SN-138 | | 28.3 | 2825 | 14.05 | 62.38 |
| SS-143 | NA | SN-139 | BT-11 | 28.2 | 2834 | 14.02 | 62.25 |
| SS-144 | NA | SN-140 | BT-11 | 28.2 | 2858 | 14.27 | 62.45 |



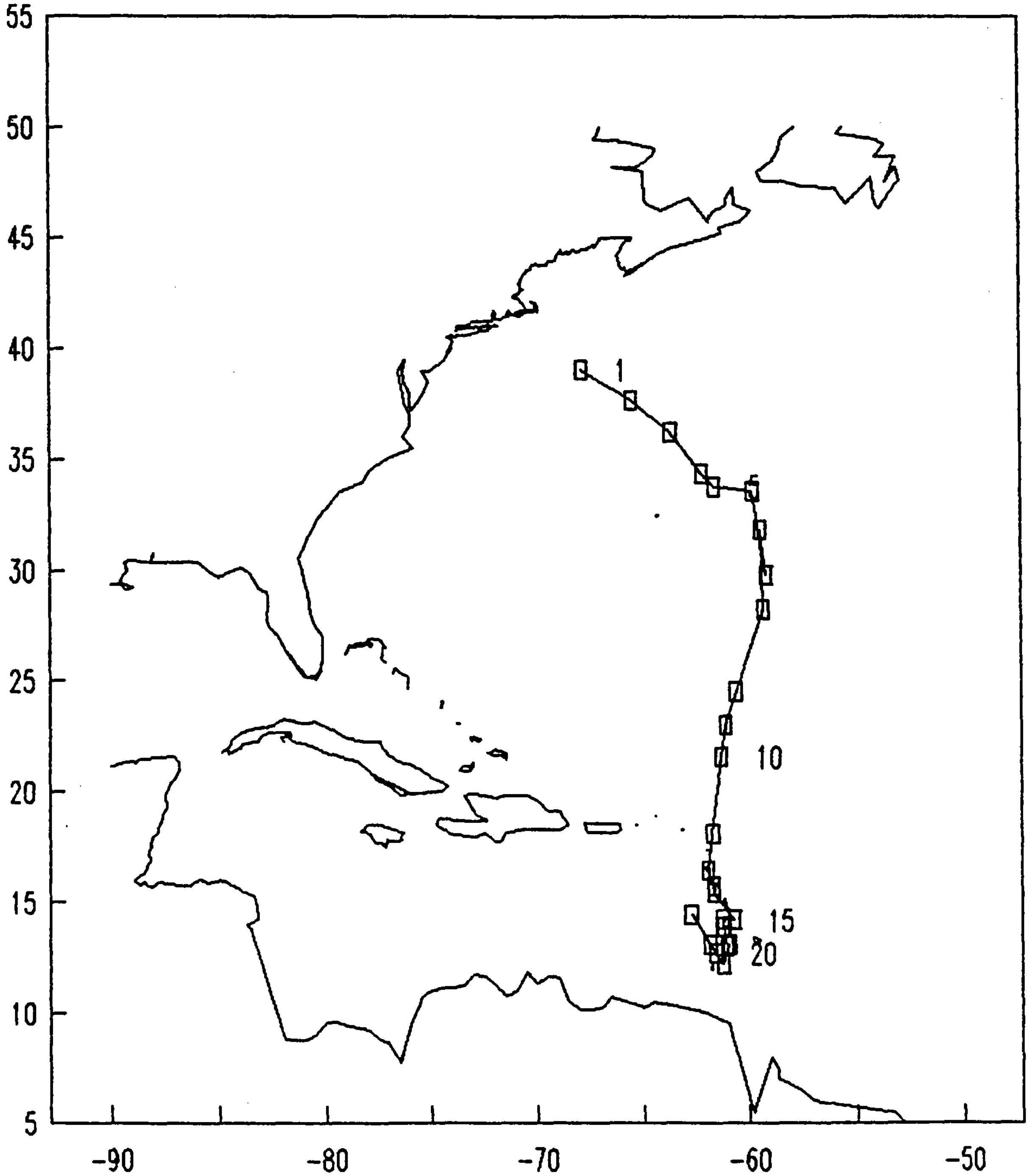

APPENDIX 2 Reference Chart and tabulated data on Neuston Tow locations. NT sites plotted from data in following table.

| NT # | DATE | TIME | LOG (NM) | LATITUDE (DEG.MIN) | LONGITUDE (DEG.MIN) | LENGTH (Meters) |
|---|---|---|---|---|---|---|
| NT-1A | 10-15/88 | 1200 | 34 | 40.09 | 69.18 | 1850 |
| NT-1B | 10-15/88 | 1300 | 35 | 40.12 | 69.17 | 1850 |
| NT-2A | 10-16/88 | 0015 | 39 | 40.08 | 68.08 | 1850 |
| NT-2B | 10-16/88 | 0115 | 41 | 40.08 | 69.06 | 1850 |
| NT-3A | 10-16/88 | 1200 | 192 | 39.40 | 68.04 | 1850 |
| NT-3B | 10-16/88 | 1345 | 193 | 39.40 | 68.04 | 1850 |
| NT-3C | 10-16/88 | 1430 | 195 | 39.40 | 68.04 | 1850 |
| NT-4 | 10-17/88 | 0000 | 232 | 38.58 | 67.54 | 1850 |
| NT-5A | 10-17/88 | 1200 | 284 | 38.25 | 67.17 | 1850 |
| NT-5B | 10-17/88 | 1300 | 288 | 38.24 | 67.17 | 1850 |
| NT-6A | 10-18/88 | 0030 | 331 | 38.10 | 66.41 | 1850 |
| NT-6B | 10-18/88 | 0100 | 332 | 38.09 | 66.40 | 1850 |
| NT-7A | 10-18/88 | 1200 | 356 | 37.49 | 66.28 | 1850 |
| NT-7B | 10-18/88 | 1230 | 357 | 37.49 | 66.28 | 1850 |
| NT-8A | 10-19/88 | 0000 | 385 | 37.53 | 66.23 | 1850 |
| NT-8B | 10-19/88 | 0100 | 388 | 37.51 | 66.23 | 1850 |
| NT-9 | 10-19/88 | 1430 | 428 | 37.41 | 65.34 | 1850 |
| NT-10A | 10-20/88 | 1000 | 502 | 37.02 | 64.25 | 1850 |
| NT-10B | 10-20/88 | 1100 | 504 | 37.02 | 64.23 | 1850 |
| NT-11A | 10-21/88 | 0000 | 581 | 36.00 | 63.30 | 1850 |
| NT-11B | 10-21/88 | 0100 | 581 | 35.59 | 63.29 | 1850 |
| NT-12A | 10-21/88 | 1200 | 666 | 34.43 | 62.24 | 1850 |
| NT-12B | 10-21/88 | 1230 | 668 | 34.43 | 62.24 | 1850 |
| NT-13A | 10-22/88 | 0030 | 737 | 33.57 | 62.12 | 1850 |
| NT-13B | 10-22/88 | 0130 | 740 | 33.57 | 62.12 | 1850 |
| NT-14A | 10-22/88 | 1300 | 772 | 33.49 | 61.52 | 1850 |
| NT-14B | 10-22/88 | 1330 | 774 | 33.49 | 61.52 | 1850 |
| NT-15A | 10-23/88 | 0000 | 823 | 33.46 | 61.11 | 1850 |
| NT-15B | 10-23/88 | 0100 | 825 | 33.46 | 61.11 | 1850 |
| NT-16A | 10-23/88 | 1230 | 898 | 33.34 | 60.06 | 1850 |
| NT-16B | 10-23/88 | 1300 | 899 | 33.34 | 60.06 | 1850 |
| NT-17A | 10-24/88 | 0015 | 922 | 33.09 | 60.02 | 1850 |
| NT-17B | 10-24/88 | 0100 | 923 | 33.09 | 60.02 | 1850 |
| NT-18A | 10-24/88 | 1215 | 983 | 32.13 | 59.44 | 1850 |
| NT-18B | 10-24/88 | 1300 | 984 | 32.13 | 59.44 | 1850 |
| NT-19A | 10-25/88 | 0000 | 1023 | 31.34 | 59.23 | 1850 |
| NT-19B | 10-25/88 | 0030 | 1025 | 31.32 | 59.22 | 1850 |
| NT-20A | 10-25/88 | 1200 | 1097 | 30.28 | 59.00 | 1850 |
| NT-20B | 10-25/88 | 1230 | 1099 | 30.38 | 59.00 | 1850 |
| NT-21A | 10-26/88 | 0145 | 1151 | 29.27 | 59.09 | 1850 |
| NT-21B | 10-26/88 | 0230 | 1152 | 29.27 | 59.09 | 1850 |
| NT-22A | 10-26/88 | 1215 | 1207 | 28.41 | 59.11 | 1850 |
| NT-22B | 10-26/88 | 1300 | 1208 | 28.41 | 59.11 | 1850 |
| NT-23A | 10-27/88 | 1200 | 1297 | 27.14 | 59.48 | 1850 |
| NT-23B | 10-27/88 | 1300 | 1298 | 27.14 | 59.48 | 1850 |
| NT-24B | 10-28/88 | 0015 | 1368 | 26.06 | 60.01 | 1850 |
| NT-24B | 10-28/88 | 0100 | 1369 | 26.03 | 60.00 | 1850 |
| NT-25A | 10-28/88 | 1230 | 1430 | 25.08 | 60.56 | 1850 |
| NT-25B | 10-28/88 | 1300 | 1431 | 25.08 | 60.56 | 1850 |

| | | | | | | |
|---|---|---|---|---|---|---|
| NT-26A | 10-29/88 | 1200 | 1540 | 23.17 | 60.49 | 1850 |
| NT-26B | 10-29/88 | 1230 | 1541 | 23.17 | 60.49 | 1850 |
| NT-27A | 10-30/88 | 0000 | 1584 | 22.47 | 61.13 | 1850 |
| NT-27B | 10-30/88 | 0100 | 1586 | 22.46 | 61.18 | 1850 |
| NT-28A | 10-30/88 | 1215 | 1623 | 22.14 | 61.20 | 1850 |
| NT-28B | 10-30/88 | 1245 | 1624 | 22.14 | 61.20 | 1850 |
| NT-29A | 10-31/88 | 1200 | 1767 | 19.54 | 61.32 | 1850 |
| NT-29B | 10-31/88 | 1245 | 1768 | 19.54 | 61.32 | 1850 |
| NT-30A | 11-1/88 | 0000 | 1807 | 19.11 | 61.33 | 1850 |
| NT-30B | 11-1/88 | 0045 | 1808 | 19.11 | 61.33 | 1850 |
| NT-31A | 11-1/88 | 1200 | 1871 | 18.08 | 61.36 | 1850 |
| NT-31B | 11-1/88 | 1230 | 1872 | 18.08 | 61.36 | 1850 |
| NT-32A | 11-2/88 | 0000 | 1916 | 17.30 | 62.01 | 1850 |
| NT-32B | 11-2/88 | 0100 | 1917 | 17.30 | 62.01 | 1850 |
| NT-33A | 11-4/88 | 1200 | 1967 | 16.42 | 61.58 | 1850 |
| NT-33B | 11-4/88 | 1230 | 1968 | 16.42 | 61.58 | 1850 |
| NT-34A | 11-6/88 | 0130 | 2007 | 16.06 | 61.57 | 1850 |
| NT-34B | 11-6/88 | 0200 | 2009 | 16.03 | 61.52 | 1850 |
| NT-35A | 11-6/88 | 1330 | 2050 | 15.38 | 61.46 | 1850 |
| NT-35B | 11-6/88 | 1430 | 2053 | 15.38 | 61.46 | 1850 |
| NT-36A | 11-7/88 | 0030 | 2075 | 15.14 | 61.37 | 1850 |
| NT-36B | 11-7/88 | 0130 | 2076 | 15.14 | 61.37 | 1850 |
| NT-37A | 11-7/88 | 1230 | 2125 | 14.57 | 61.23 | 1850 |
| NT-37B | 11-7/88 | 1315 | 2126 | 14.57 | 61.23 | 1850 |
| NT-38A | 11-11/88 | 1230 | 2427 | 13.47 | 61.27 | 1850 |
| NT-38B | 11-11/88 | 1330 | 2429 | 13.47 | 61.27 | 1850 |
| NT-39A | 11-18/88 | 1200 | 2857 | 14.29 | 62.45 | 1850 |
| NT-39B | 11-18/88 | 1230 | 2859 | 14.29 | 62.45 | 1850 |

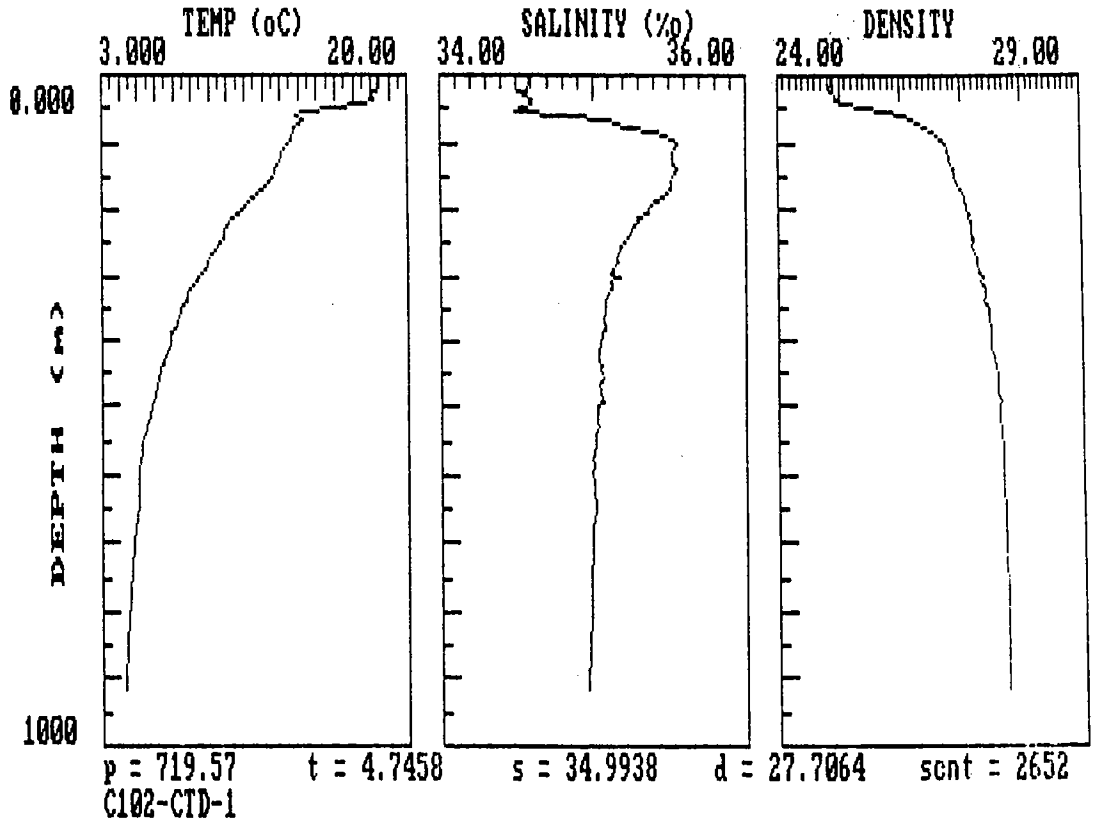
# CTD AND HYDROCAST STATIONS

CC-102 FALL 1988

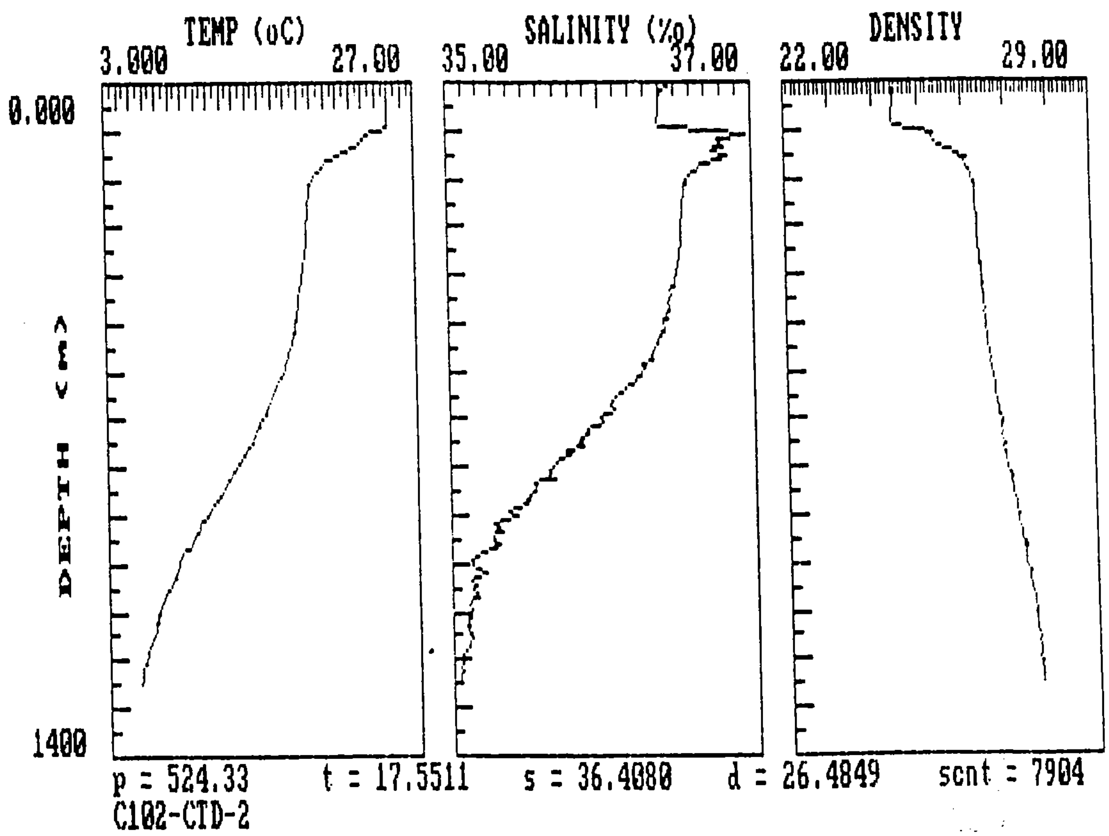


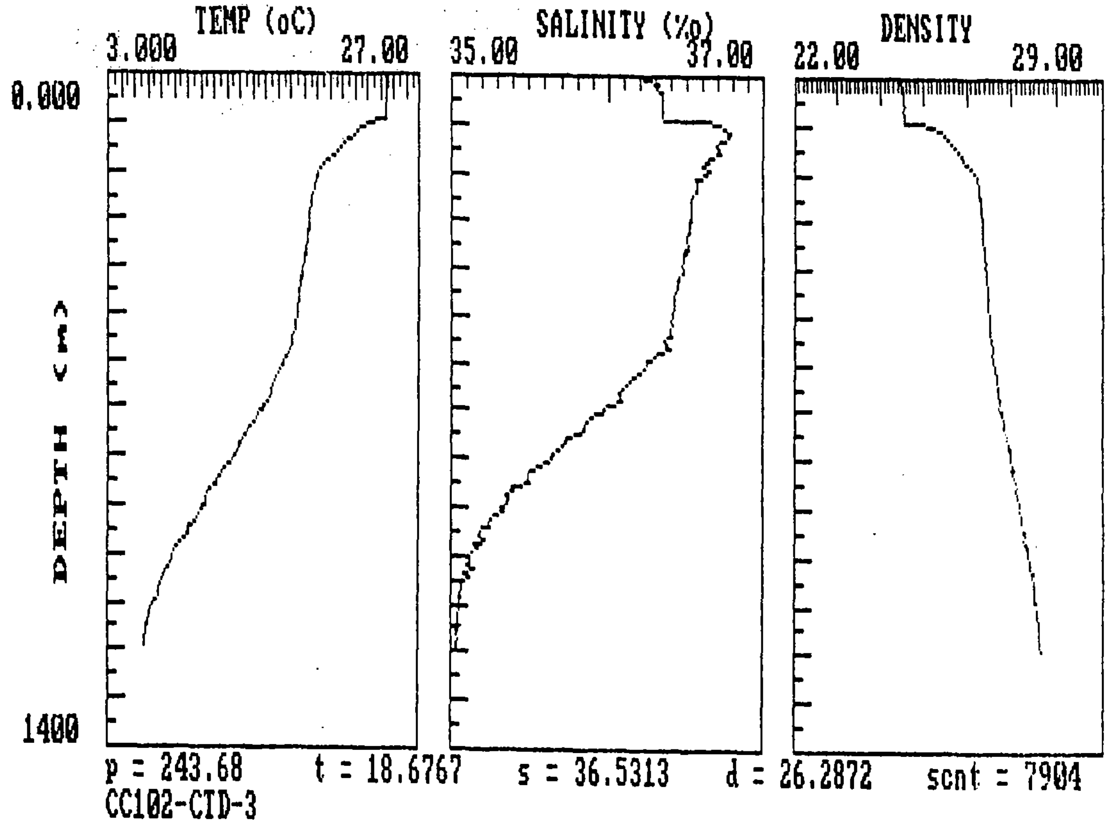

APPENDIX 3 Reference Chart and tabulated data on CTD and Hydrocast stations. Chart depicts CTD stations plotted from data in following table.

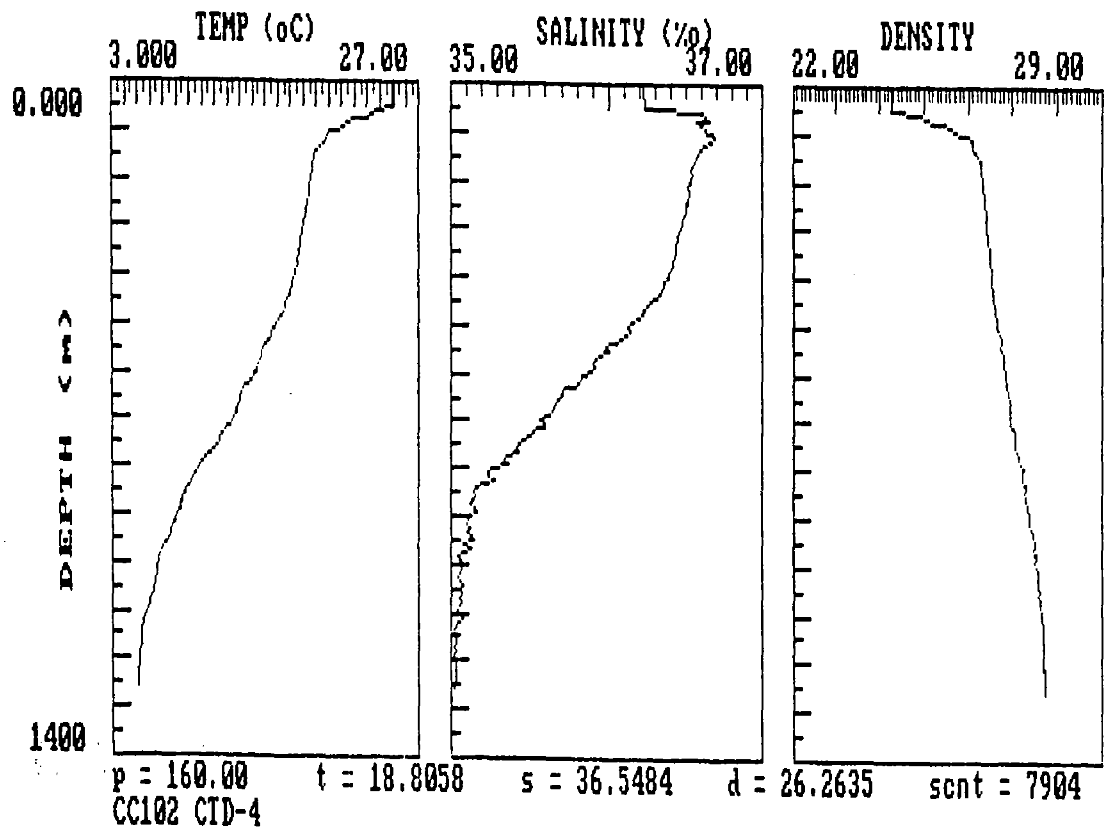
| CTD/HC # | DATE | TIME | LOG (NM) | LATITUDE (DEG.MIN) | LONGITUDE (DEG.MIN) |
|---|---|---|---|---|---|
| CTD-1 | 10-16/88 | 2100 | 229 | 39.03 | 67.54 |
| CTD-2 | 10-19/88 | 1200 | 426 | 37.40 | 65.33 |
| CTD-3 | 10-20/88 | 2045 | 565 | 36.14 | 63.40 |
| CTD-4 | 10-21/88 | 1700 | 697 | 34.19 | 62.12 |
| CTD-5 | 10-22/88 | 1745 | 790 | 33.46 | 61.39 |
| HC-1 | 10-23/88 | 1530 | 901 | 33.34 | 59.48 |
| HC-2 | 10-23/88 | 2050 | 1135 | 29.47 | 59.12 |
| CTD-6 | 10-24/88 | 2000 | 1008 | 31.50 | 59.28 |
| CTD-7 | 10-26/88 | 2050 | 1243 | 28.10 | 59.18 |
| CTD-8 | 10-28/88 | 1900 | 1460 | 24.30 | 60.37 |
| CTD-9 | 10-29/88 | 1900 | 1567 | 23.03 | 61.07 |
| CTD-10 | 10-30/88 | 2000 | 1666 | 21.35 | 61.18 |
| HC-3 | 10-30/88 | 2005 | 1666 | 21.37 | 61.19 |
| CTD-11 | 11-1/88 | 1400 | 1874 | 18.08 | 61.44 |
| CTD-12 | 11-5/88 | 1630 | 1986 | 16.25 | 61.58 |
| CTD-13 | 11-6/88 | 1100 | 2048 | 15.44 | 61.41 |
| CTD-14 | 11-6/88 | 1730 | 2065 | 15.25 | 61.43 |
| HC-4 | 11-6/88 | 1730 | 2065 | 15.25 | 61.43 |
| CTD-15 | 11-10/88 | 1800 | 2367 | 14.09 | 60.45 |
| CTD-16 | 11-11/88 | 0230 | 2396 | 14.14 | 61.16 |
| CTD-17 | 11-11/88 | 2200 | 2471 | 13.52 | 61.13 |
| HC-5 | 11-11/88 | 2200 | 2471 | 13.53 | 61.16 |
| CTD-18 | 11-13/88 | 1000 | 2588 | 13.00 | 61.02 |
| HC-6 | 11-13/88 | 0800 | 2588 | 13.02 | 60.58 |
| CTD-19 | 11-13/88 | 1600 | 2638 | 12.10 | 61.15 |
| HC-7 | 11-13 | 1630 | 2638 | 12.10 | 61.15 |
| CTD-20 | 11-17/88 | 1730 | 2751 | 12.42 | 61.36 |
| CTD-21 | 11-17/88 | 2200 | 2775 | 13.02 | 61.51 |
| CTD-22 | 11-18/88 | 2860 | 2860 | 14.26 | 62.45 |

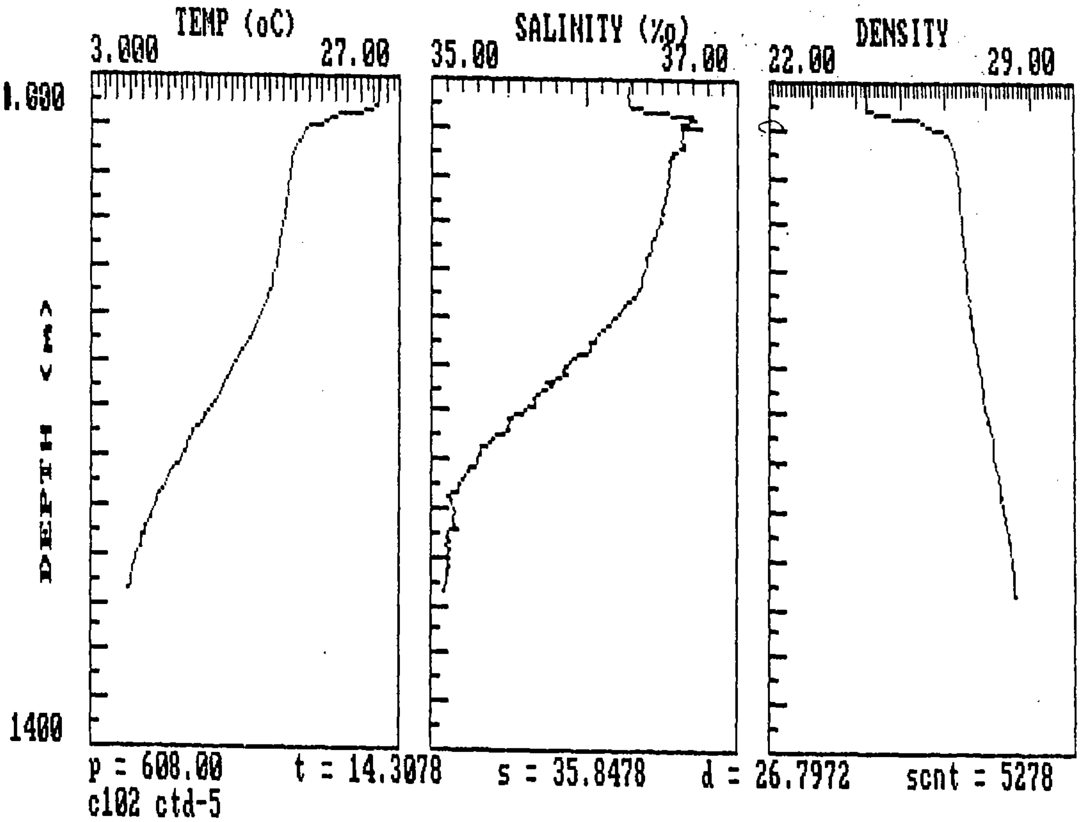


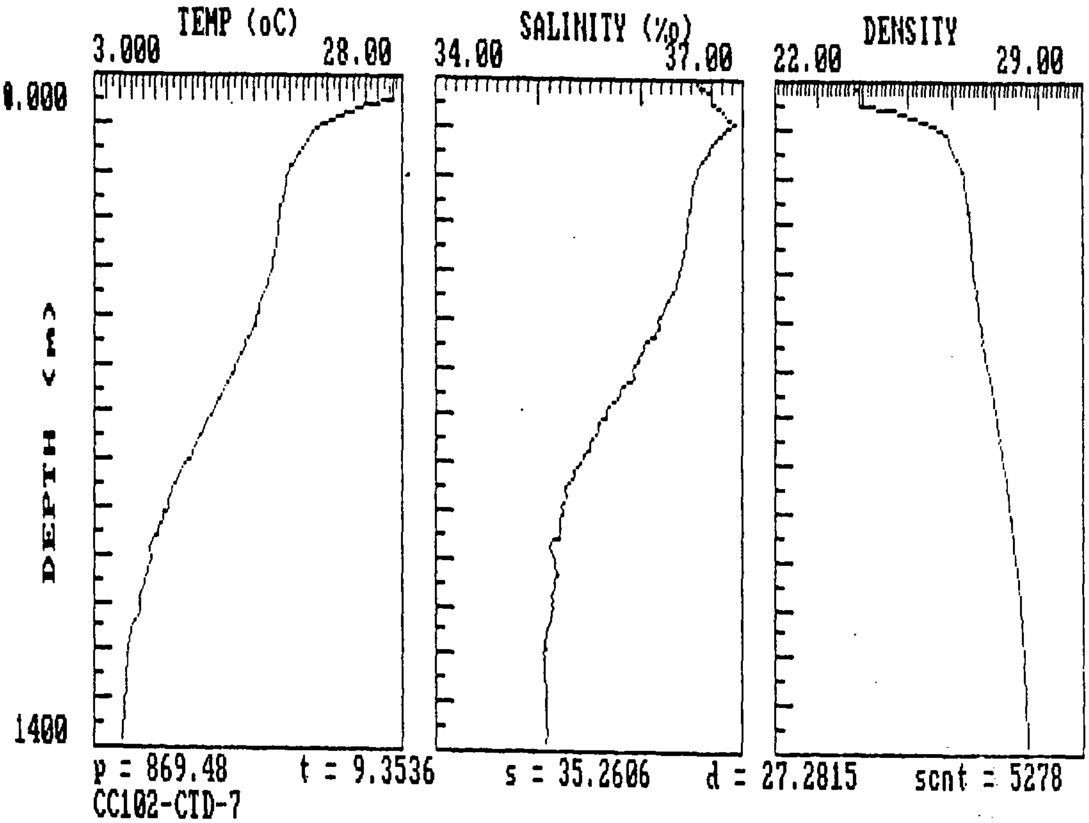

APPENDIX 4 Line graphs of Temperature, Salinity and Density (Sigma t) vs Depth from CTDs obtained on CC-102. CTD # is in lower left corner of graphs. See previous chart and table for location of casts.

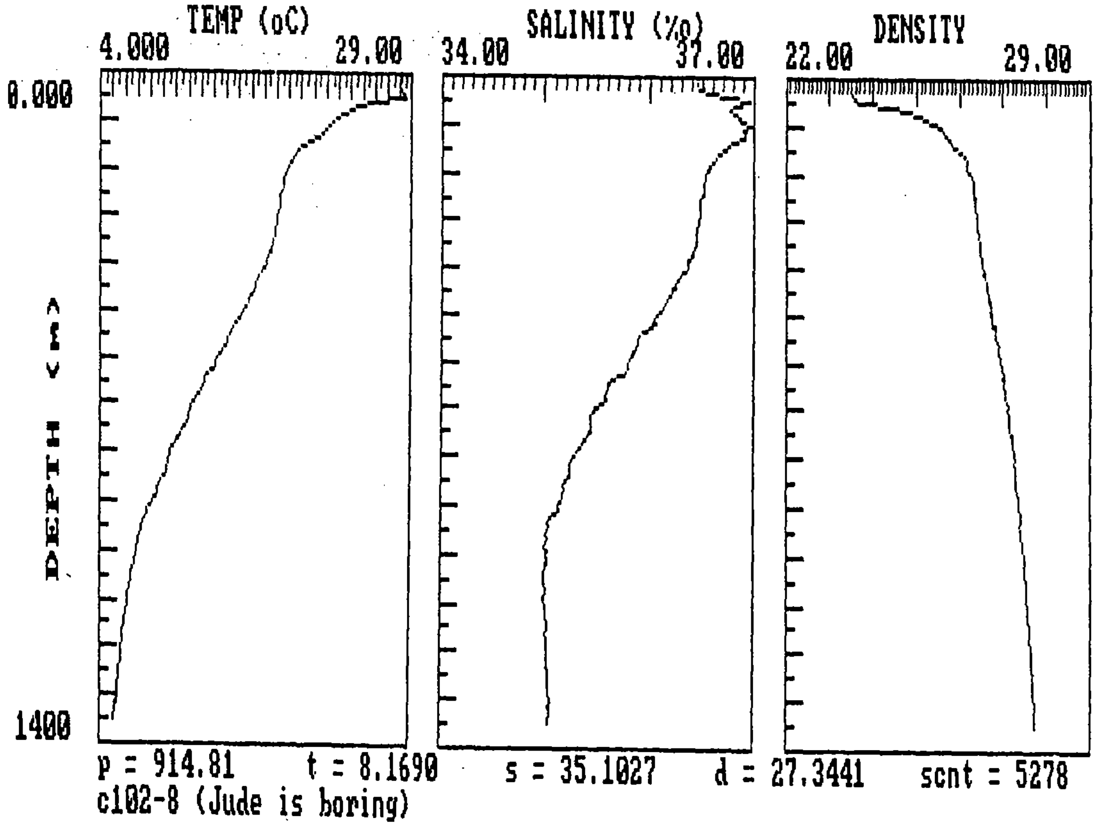


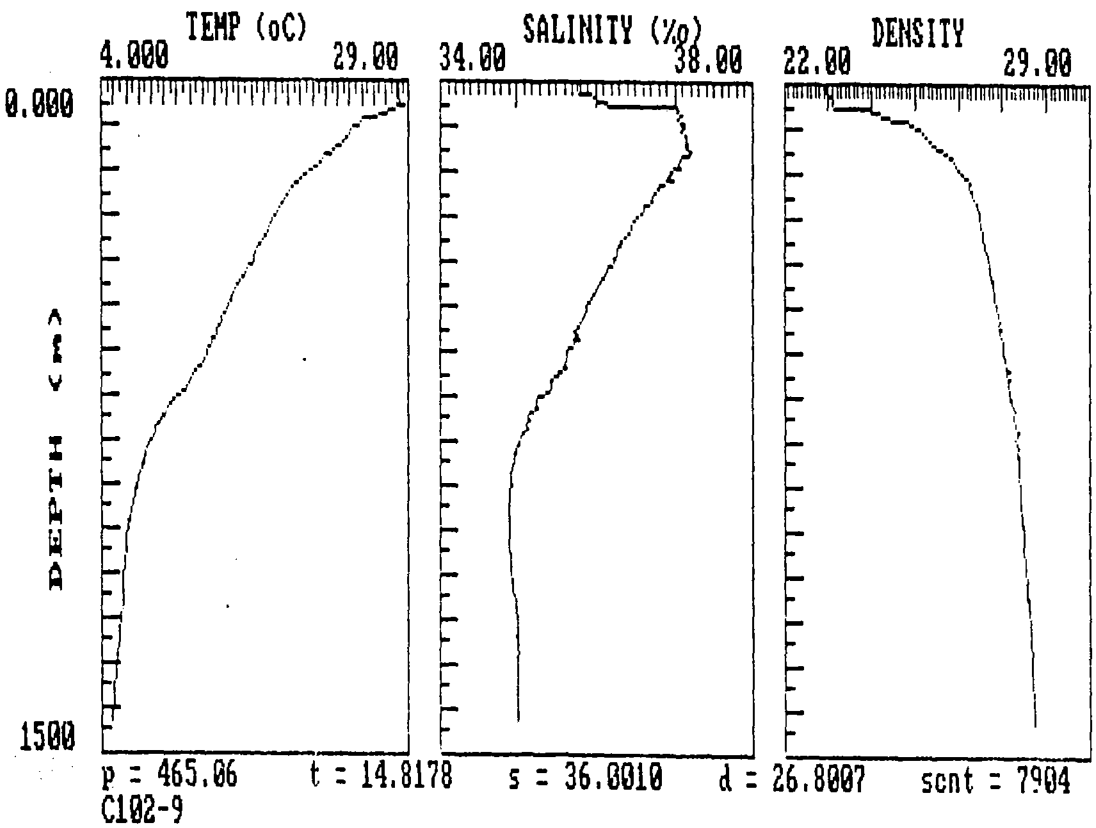

TEMP (oC)
3.000
27.00
SALINITY (‰)
35.00
37.00
DENSITY
22.00
29.00
0.000
1400
DEPTH <m>
p = 243.68
t = 18.6767
s = 36.5313
d = 26.2872
scnt = 7904
CC102-CTD-3

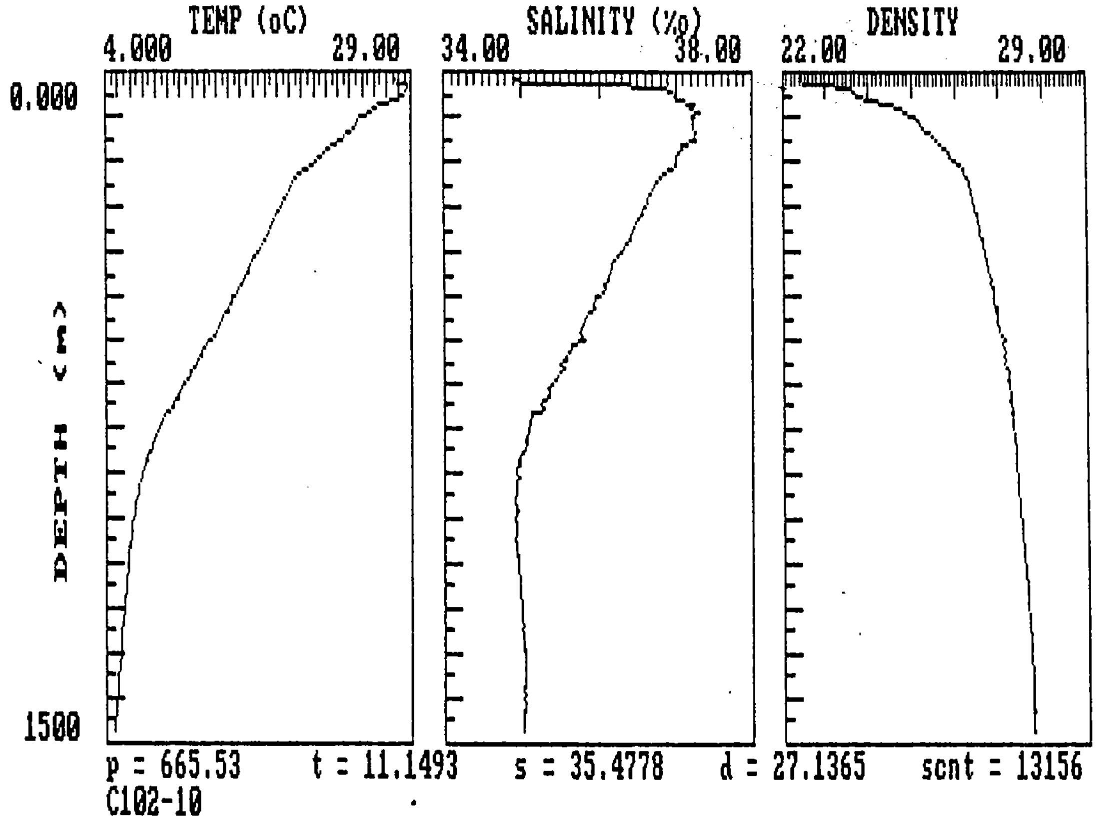

TEMP (oC)
3.000
27.00
SALINITY (‰)
35.00
37.00
DENSITY
22.00
29.00
0.000
1400
DEPTH <m>
p = 160.00
t = 18.8058
s = 36.5484
d = 26.2635
scnt = 7904
CC102 CTD-4

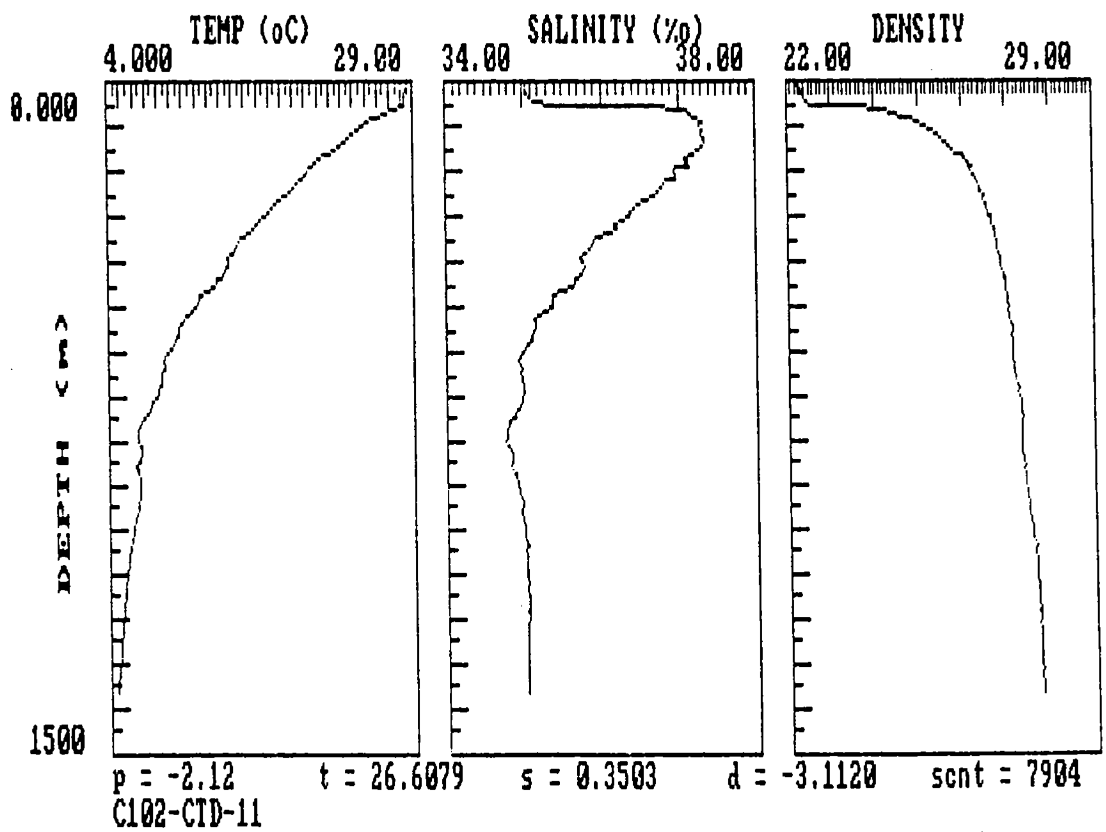

TEMP (oC)
3.000
27.00
SALINITY (%o)
35.00
37.00
DENSITY
22.00
29.00
0.000
1400
DEPTH <m>
p = 608.00
t = 14.3078
s = 35.8478
d = 26.7972
scnt = 5278
c102 ctd-5

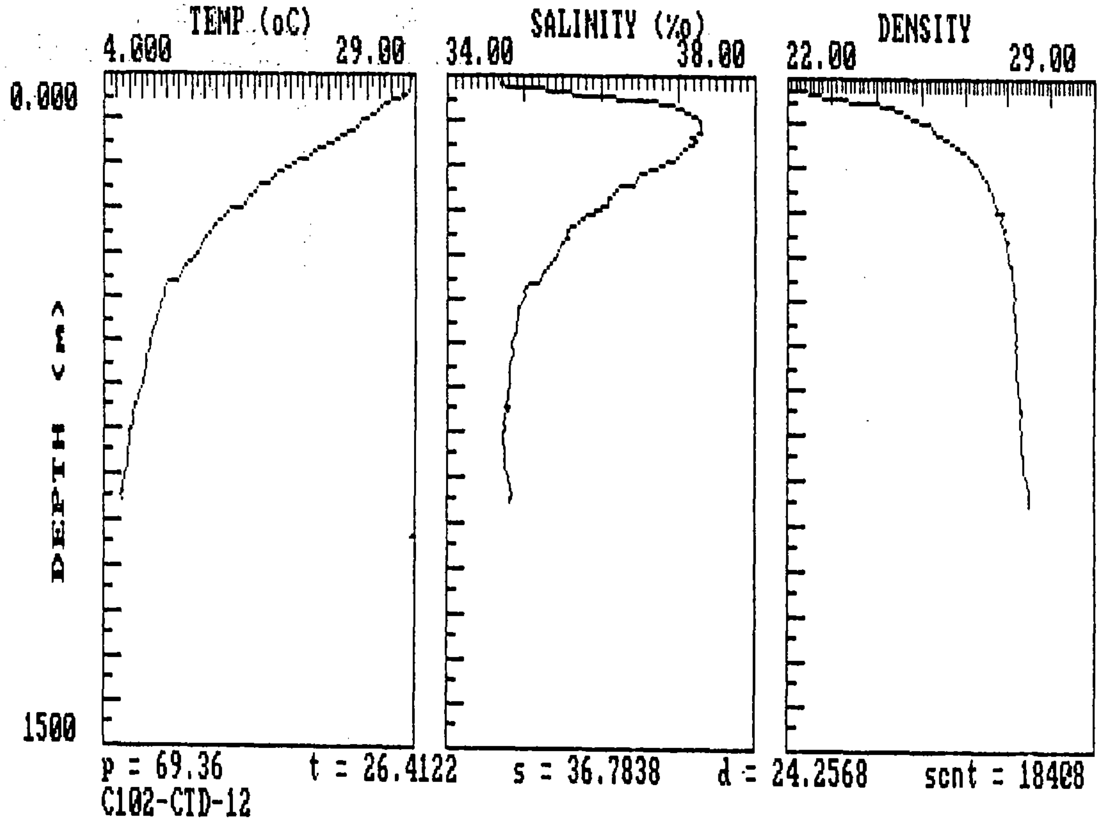

TEMP (oC)
3.000
28.00
SALINITY (%o)
34.00
37.00
DENSITY
22.00
29.00
0.000
1400
DEPTH <m>
p = 869.48
t = 9.3536
s = 35.2606
d = 27.2815
scnt = 5278
CC102-CTD-7

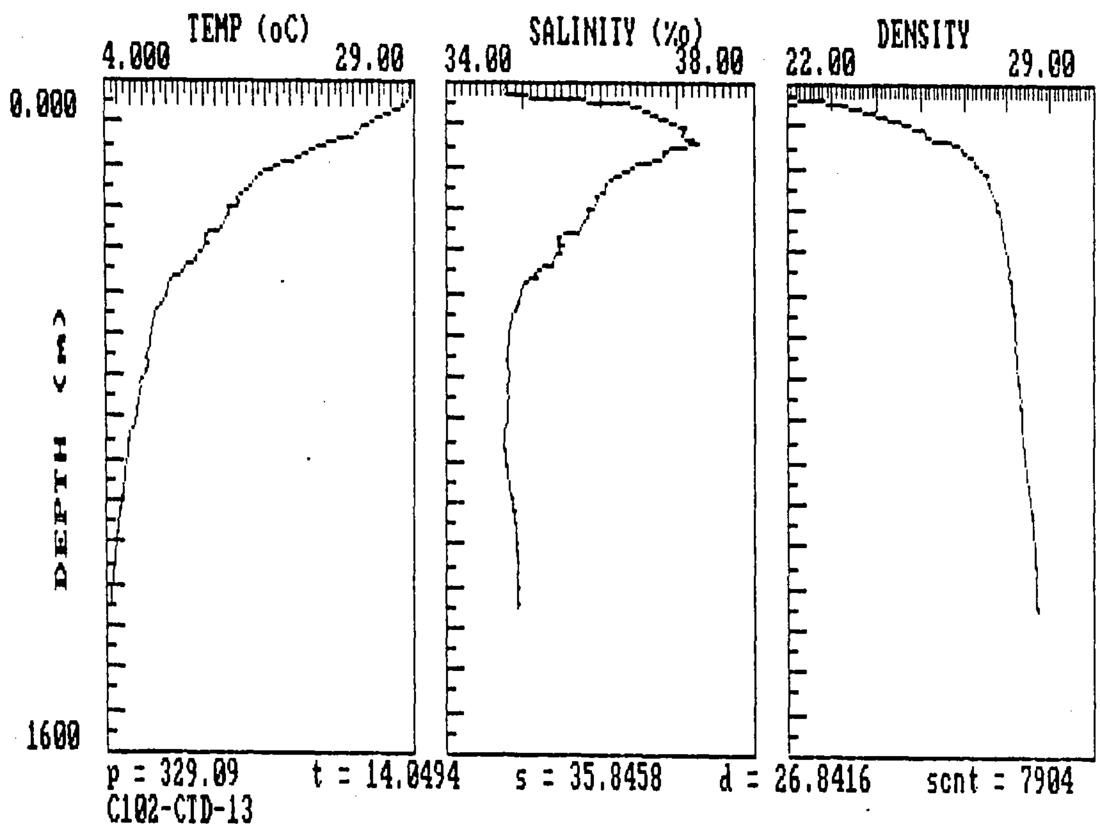

TEMP (oC)
4.000
29.00
SALINITY (‰)
34.00
37.00
DENSITY
22.00
29.00
0.000
1400
DEPTH (m)
p = 914.81
t = 8.1690
s = 35.1027
d = 27.3441
scnt = 5278
c102-8 (Jude is boring)

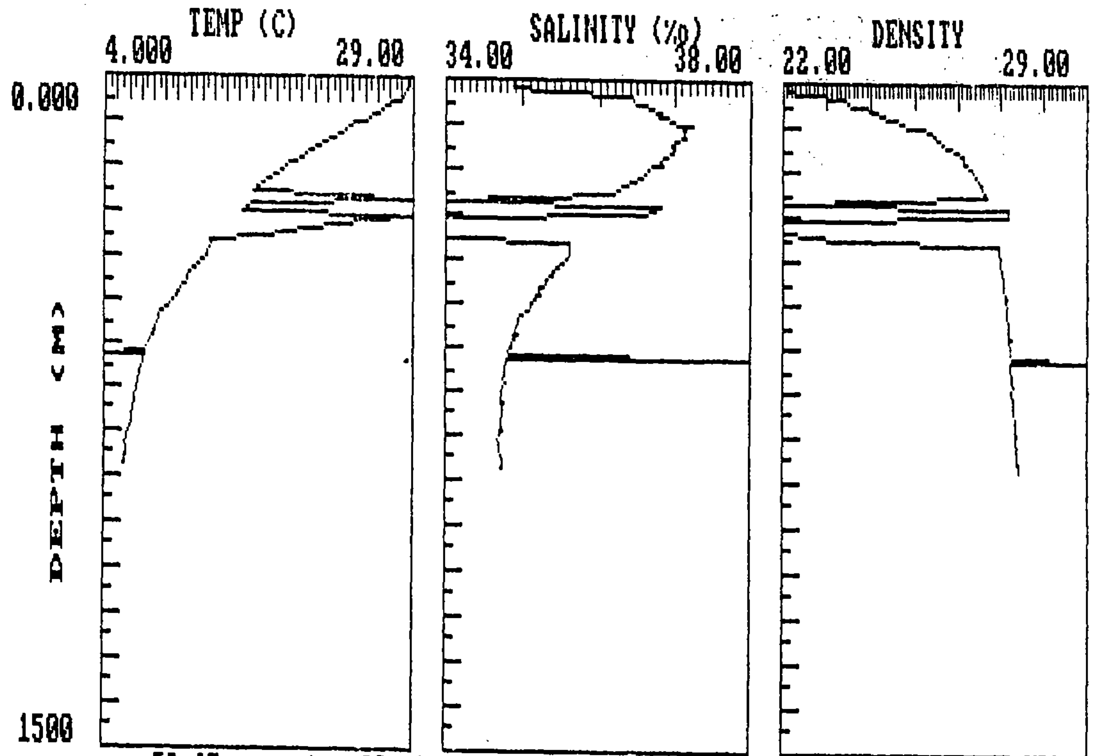

TEMP (oC)
4.000
29.00
SALINITY (‰)
34.00
38.00
DENSITY
22.00
29.00
0.000
1500
DEPTH (m)
p = 465.06
t = 14.8178
s = 36.0010
d = 26.8007
scnt = 7904
C102-9


TEMP (oC)
4.000
29.00
SALINITY (‰)
34.00
38.00
DENSITY
22.00
29.00
0.000
DEPTH (m)
1500
p = 665.53
t = 11.1493
s = 35.4778
d = 27.1365
scnt = 13156
C102-10

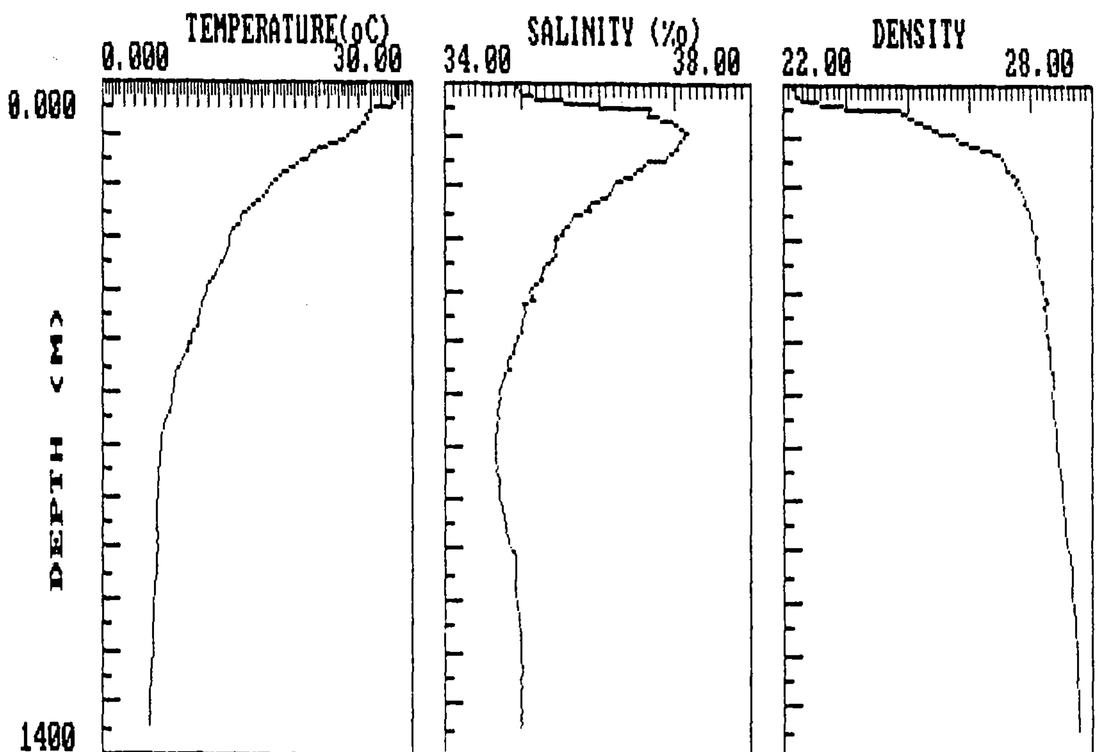

TEMP (oC)
4.000
29.00
SALINITY (‰)
34.00
38.00
DENSITY
22.00
29.00
0.000
DEPTH (m)
1500
p = -2.12
t = 26.6079
s = 0.3503
d = -3.1120
scnt = 7904
C102-CTD-11


TEMP (oC)
4.000
29.00
SALINITY (‰)
34.00
38.00
DENSITY
22.00
29.00
0.000
1500
DEPTH (m)
p = 69.36
t = 26.4122
s = 36.7838
d = 24.2568
scnt = 18408
C102-CTD-12

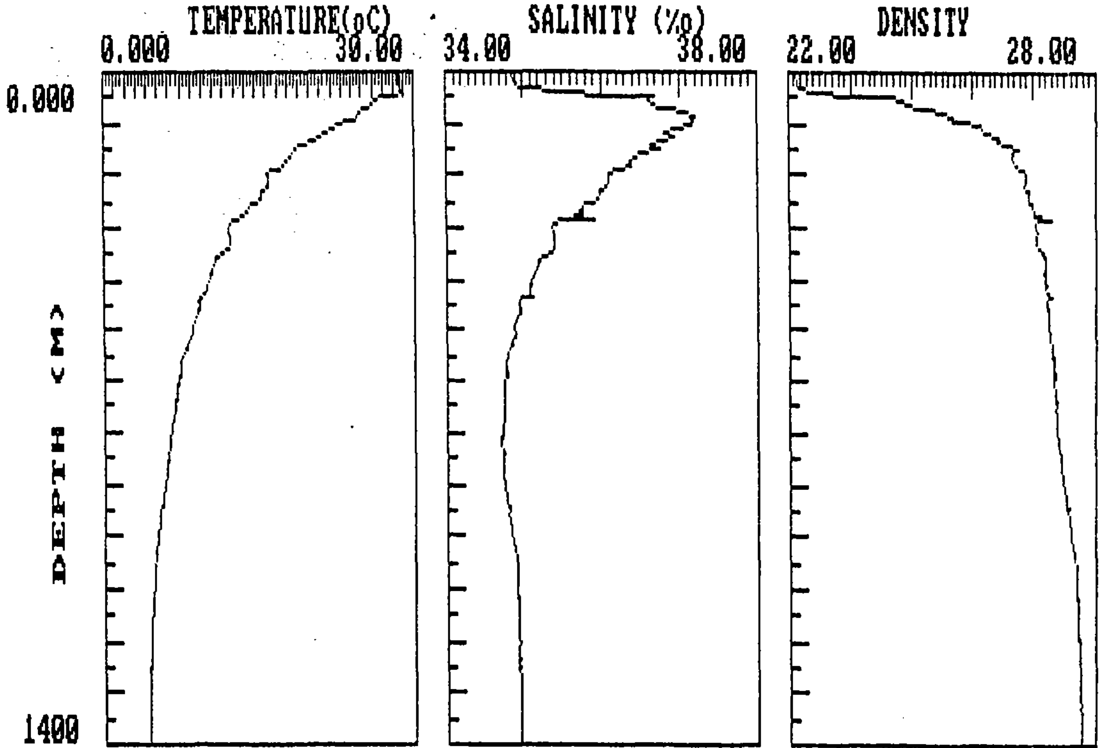

TEMP (oC)
4.000
29.00
SALINITY (‰)
34.00
38.00
DENSITY
22.00
29.00
0.000
1600
DEPTH (m)
p = 329.09
t = 14.0494
s = 35.8458
d = 26.8416
scnt = 7904
C102-CTD-13



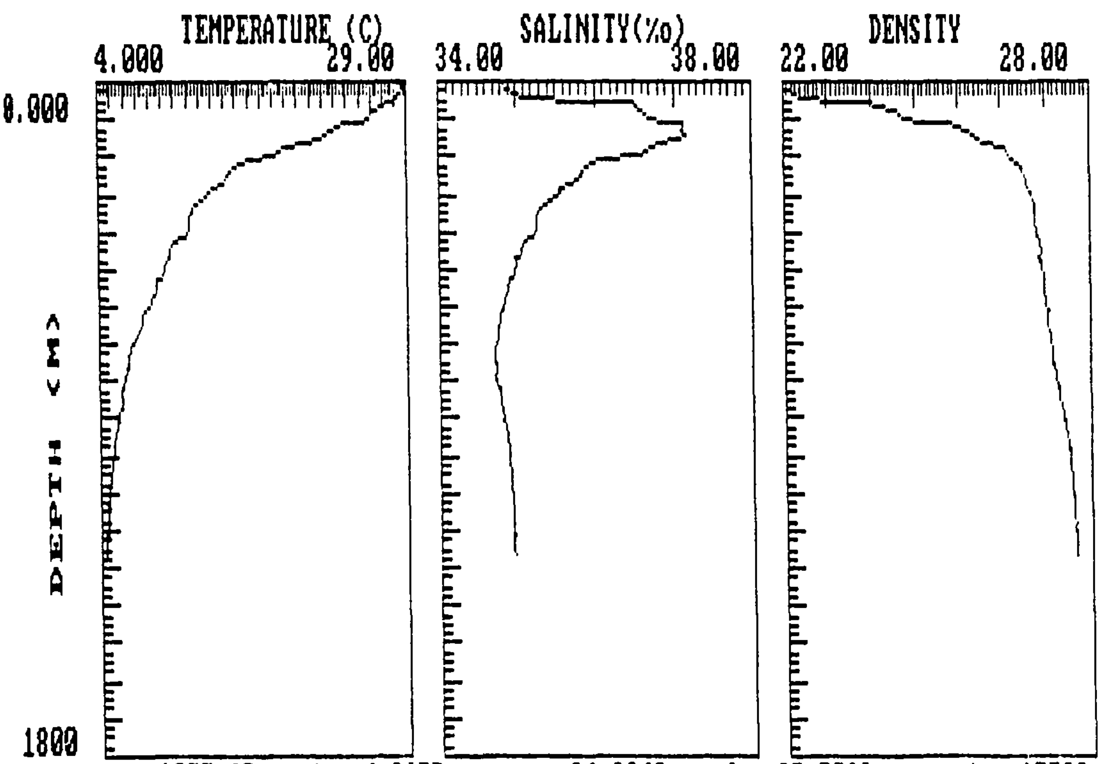

p = 53.67 t = 28.4992 s = 37.3387 d = 23.9957 scnt = 15782
C102-CTD-14




p = 78.07 t = 25.4295 s = 36.5491 d = 24.3875 scnt = 7904
C102-15

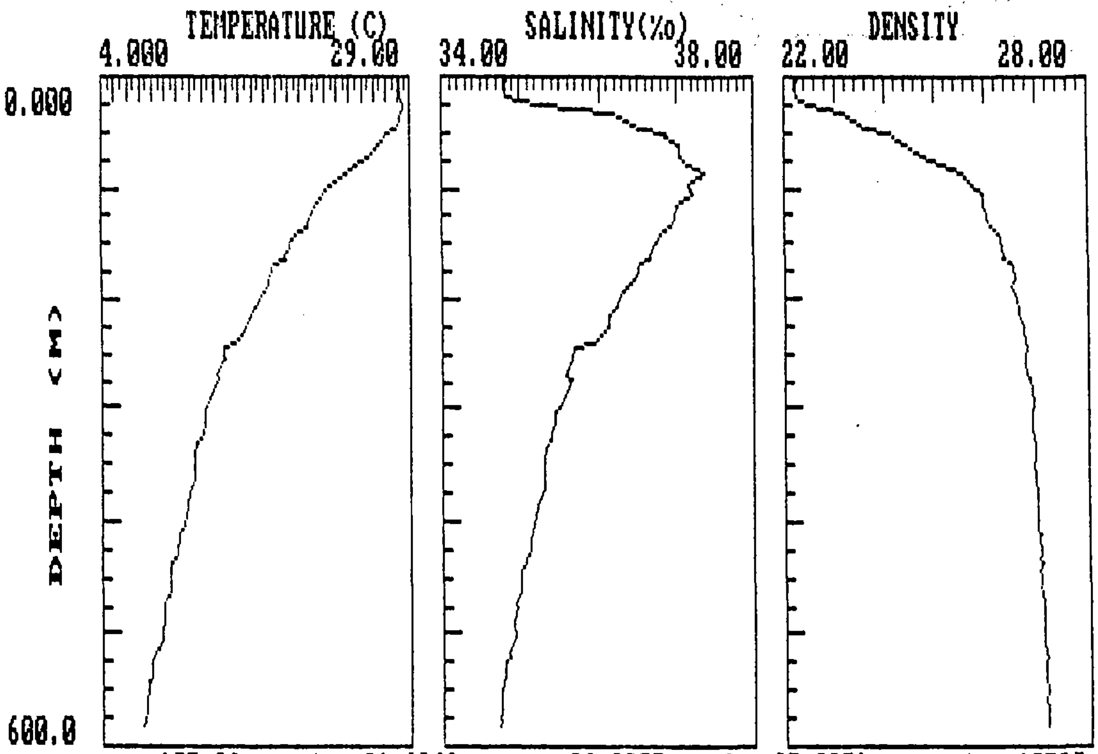



p = 1375.01 t = 4.2754 s = 34.9384 d = 27.7200 scnt = 5278
c102-16

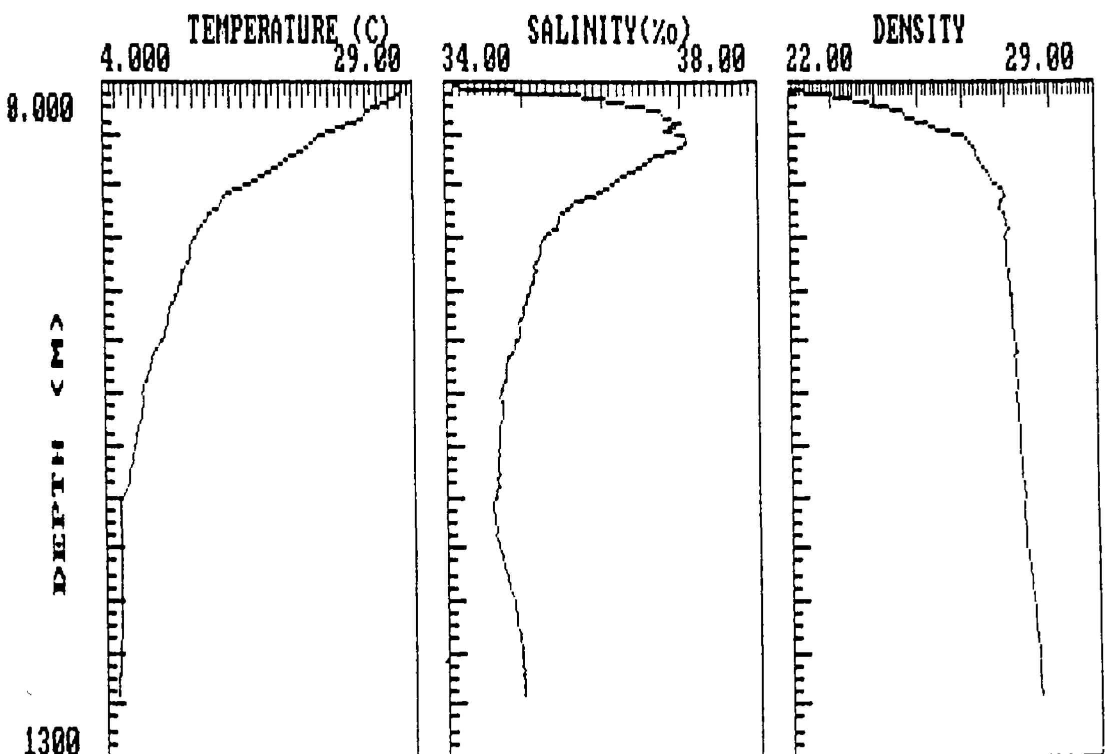



p = 1275.65 t = 4.3677 s = 34.9348 d = 27.7063 scnt = 15782

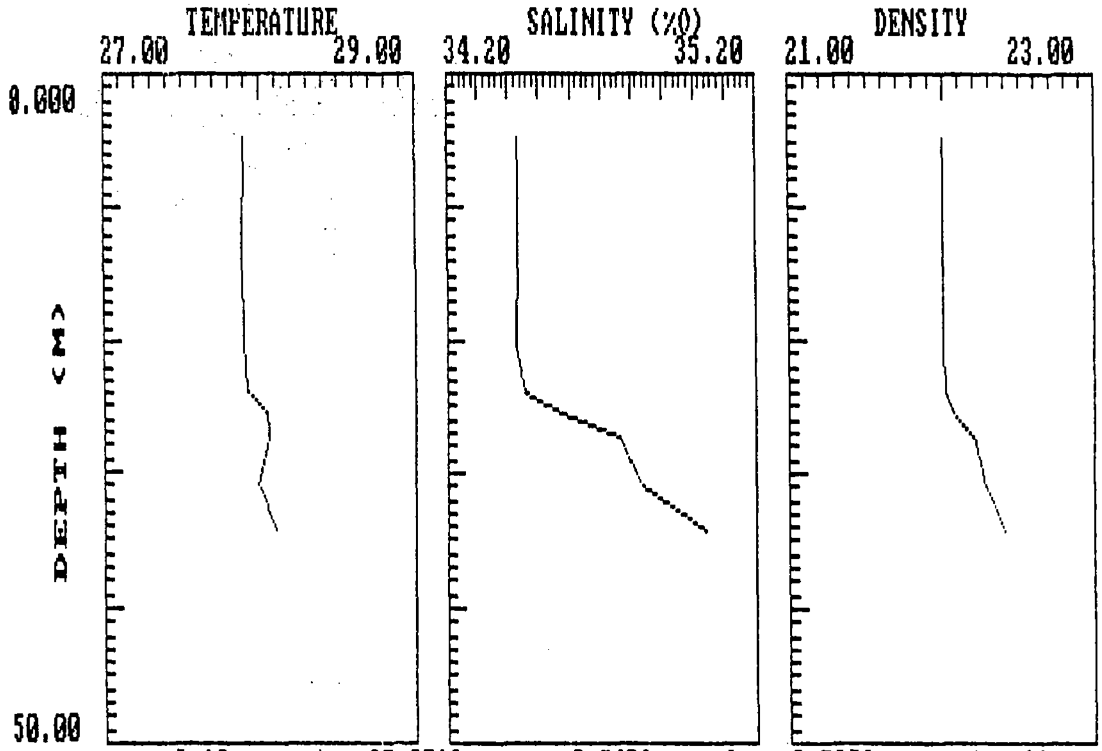
C102-17



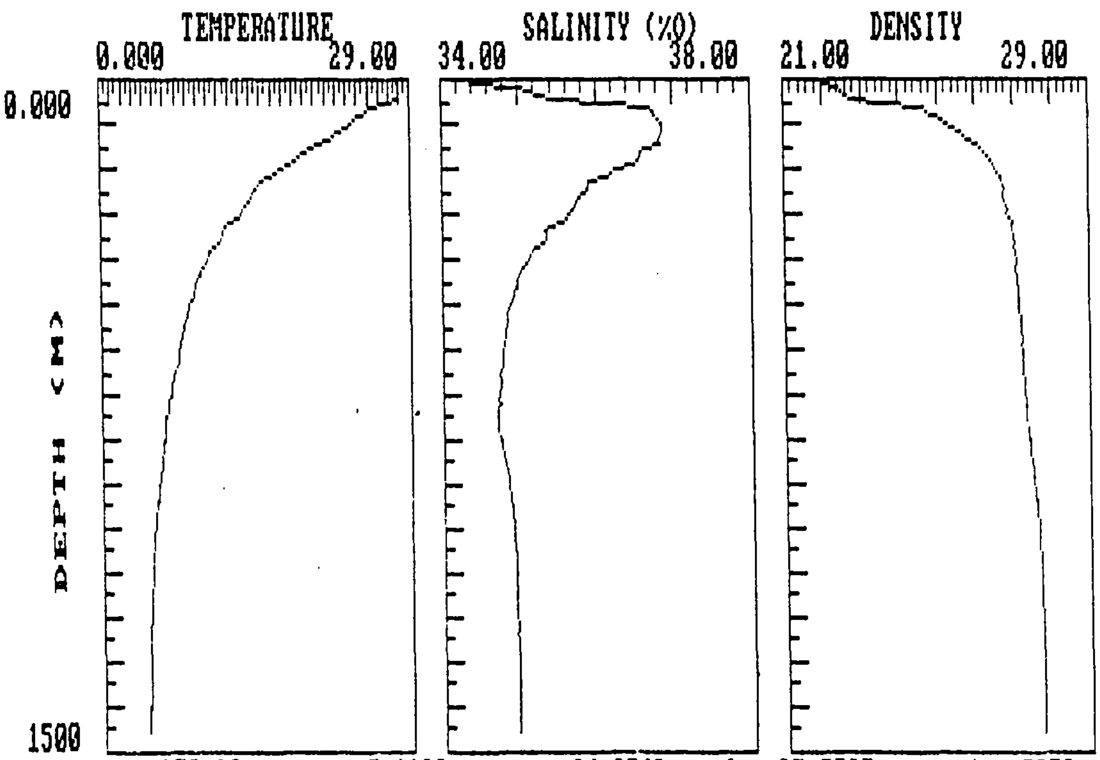

p = 105.96 t = 21.6846 s = 36.9875 d = 25.8251 scnt = 10530
C102-19 (same as C102-18)



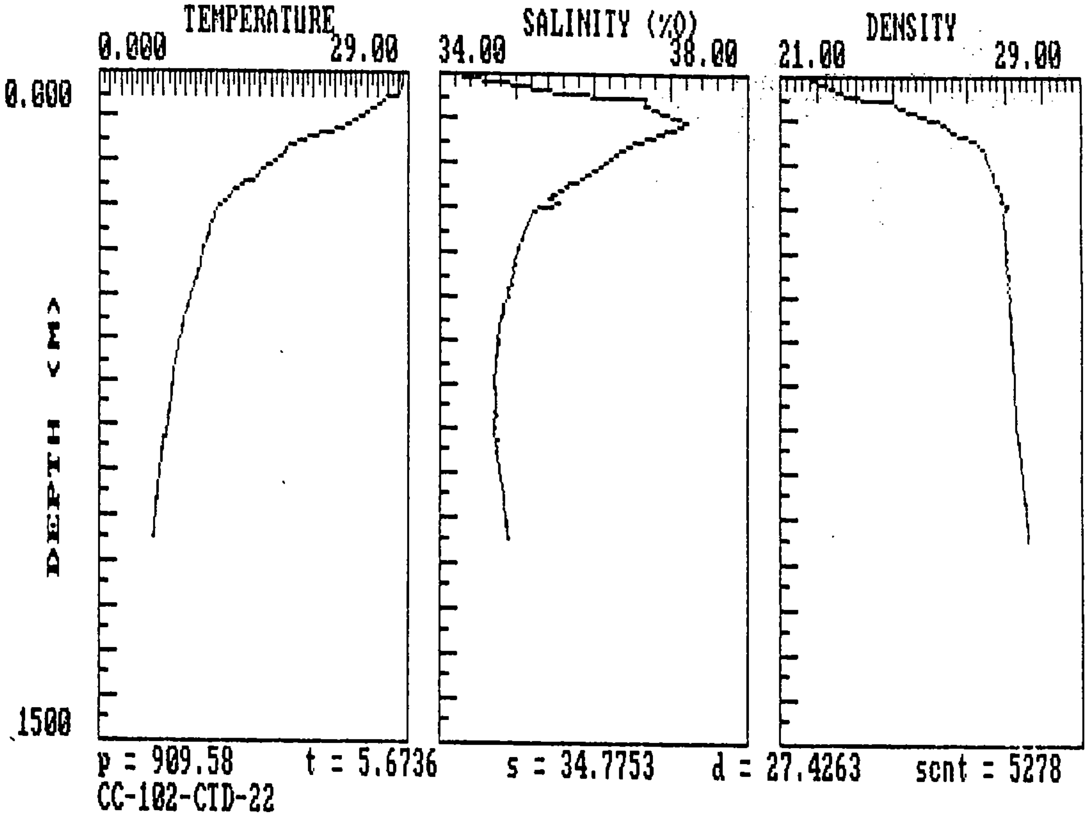

p = 261.11 t = 13.2871 s = 35.6089 d = 26.8146 scnt = 13156
C102-19a

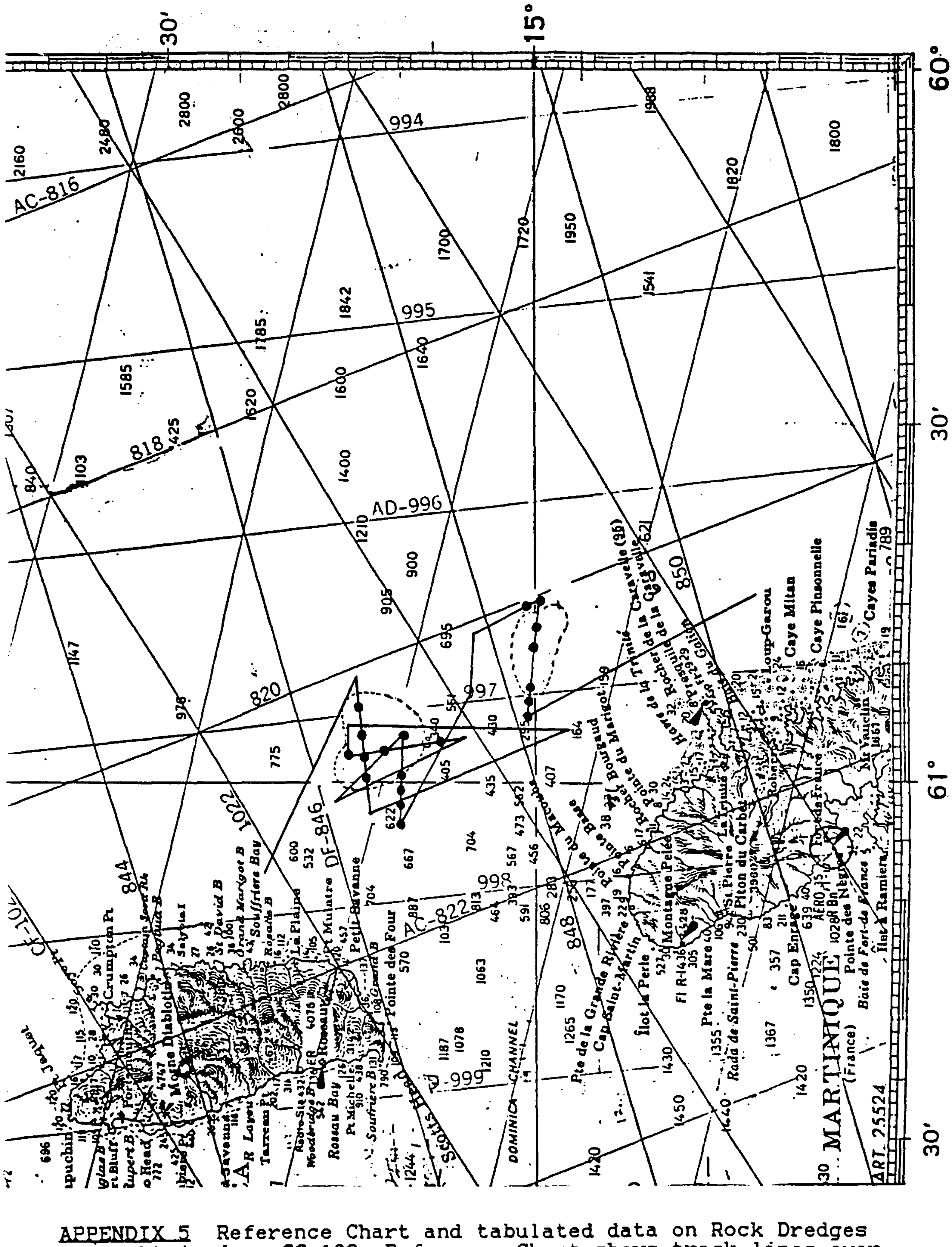



p = -2.12 t = 27.9719 s = 0.0456 d = -3.7206 scnt = 11
C102-20bt (done off of BT winch)




p = 958.39 t = 5.1123 s = 34.8748 d = 27.5725 scnt = 5278
C102-21


TEMPERATURE
0.000
29.00
SALINITY (%0)
34.00
38.00
DENSITY
21.00
29.00
0.000
DEPTH <M>
1500
p = 909.58
t = 5.6736
s = 34.7753
d = 27.4263
scnt = 5278
CC-102-CTD-22




APPENDIX 5 Reference Chart and tabulated data on Rock Dredges obtained on CC-102. Reference Chart shows track lines over Dominica and Martinique Bank along which 3.5 kHz seismic data was obtained. Dots mark approx positions of rock dredge sites listed in follwing table.

| ROCK DREDGE # | DATE | TIME | LOG (NM) | LATITUDE (DEG.MIN) | LONGITUDE (DEG.MIN) | DEPTH (M) |
|---|---|---|---|---|---|---|
| DOMINICA BANK | | | | | | |
| RD-1 | 11-8/88 | 1400 | 2230 | 15.15 | 60.56 | 120 |
| RD-2A | 11-8/88 | 1430 | 2230 | 15.15 | 60.57 | 94 |
| RD-2B | 11-8/88 | 1500 | 2230 | 15.14 | 60.57 | 88 |
| RD-3A | 11-8/88 | 1620 | 2230 | 15.13 | 60.59 | 85 |
| RD-4 | 11-8/88 | 1800 | 2231 | 15.12 | 61.02 | 600 |
| RD-5B | 11-9/88 | 0430 | 2265 | 15.16 | 60.56 | 110 |
| RD-6A | 11-9/88 | 0850 | 2273 | 15.06 | 60.57 | 840 |
| RD-7A | 11-9/88 | 1320 | 2237 | 15.10 | 60.56 | 90 |
| RD-7B | 11-9/88 | 1335 | 2237 | 15.10 | 60.56 | 90 |
| RD-8A | 11-9/88 | 1450 | 2287 | 15.10 | 60.57 | 90 |
| RD-9 | 11-9/88 | 1510 | 2287 | 15.10 | 60.57 | 150 |
| RD-10 | 11-9/88 | 1540 | 2287 | 15.10 | 60.58 | 435 |
| RD-11 | 11-9/88 | 1615 | 2287 | 15.09 | 60.59 | 600 |
| RD-12 | 11-9/88 | 1720 | 2287 | 15.09 | 61.01 | 800 |
| MARTINIQUE BANK | | | | | | |
| RD-13A | 11-9/88 | 2300 | 2307 | 15.01 | 60.45 | 560 |
| RD-13B | 11-9/88 | 2345 | 2307 | 15.00 | 60.45 | 300 |
| RD-14A | 11-10/88 | 0100 | 2307 | 15.00 | 60.45 | 130 |
| RD-15A | 11-10/88 | 0200 | 2307 | 15.00 | 60.48 | 82 |
| RD-15B | 11-10/88 | 0230 | 2307 | 15.00 | 60.48 | 82 |
| RD-16A | 11-10/88 | 0520 | 2311 | 15.01 | 60.53 | 85 |
| RD-17 | 11-10/88 | 0545 | 2311 | 15.01 | 60.53 | 250 |
| RD-18 | 11-10/88 | 0625 | 2311 | 15.01 | 60.54 | 410 |

APPENDIX 6 Tabulated data for Meter Net Tows during CC-102.

| METER NET # | DATE | TIME | LOG (NM) | LATITUDE (DEG.MIN) | LONGITUDE (DEG.MIN) | LENGTH (M) |
|---|---|---|---|---|---|---|
| MN-1 | 10-18/88 | 1730 | 374 | 37.49 | 66.40 | 4000 |
| MN-2 | 10-19/88 | 2200 | 460 | 37.34 | 65.00 | 3880 |
| MN-3 | 10-24/88 | 0600 | 955 | 32.38 | 59.50 | 2941 |
| MN-4 | 10-29/88 | 0100 | 1485 | 24.08 | 60.38 | 2763 |
| MN-5 | 11-13/88 | 2000 | 2642 | 12.02 | 61.19 | 2672 |
| MN-6 | 11-14/88 | 0250 | 2667 | 11.57 | 61.39 | 2492 |

APPENDIX 7 In its original form, by the authors (and performers) D (Doug) and P (Peter), here is The YO BABY RAP (also known as the Horse Shoe Rap).

D:
YO BABY YO BABY YO BABY YO
ME AND MY BOY PETE GOT SOMETHING YOU OUGHT TO KNOW
WE GOT HERE A CREATURE YOU AIN'T SEEN IN THE LAB
YO, CHECK IT OUT, ITS THE HORSE SHOE CRAB
(PICTURE OF CRAB)

P:
THIS HERE BEAST IS CALLED THE LI-MU-LUS
DON'T SWEAT THE NAME, YOU WON'T REMEMBER THIS STUFF
JUST THE SAME, ITS PHYLUM'S CHELICERATA
HERE'S ONE MORE NAME, ITS CLASS IS MEROSTOMATA

D:
THERE ARE FOUR SPECIES, ONLY ONE OF WHICH RATES,
THATS THE ONE FOUND HERE, IN THESE UNITED STATES,
THIS DUDE HANGS OUT, FROM MAINE TO MEXICO,
CATCHING RAYS NEAR THE SHORE, IN THE SUBTIDAL ZONE.

P:
THE HORESHOE CRAB HAS CHANGED LITTLE FROM THE START,
HE'S REMAINED THE SAME, DOWN TO EACH AND EVERY PART,
HE HAS SURVIVED, DESPITE THE LOSS OF OTHERS,
INCLUDING THE EXTINCTION OF ALL HIS LITTLE BROTHERS.

D:
THIS SUCKER GOES BACK FIVE HUNDRED MILLION YEARS,
AND THATS BECAUSE, THERE AIN'T NOTHING THAT HE FEARS
NO ONE MESSES, WITH THE HORSE SHOE CRAB
YOU KNOW ITS BECAUSE, HE LOOKS SO DAMN BAD
(PICTURE OF SUNGLASSED CRAB)

P:
THE THING ON ITS BACK IS CALLED A CARAPACE,
THIS HERE SHIELD, PROTECTS HIS FACE
ITS OTHERWISE KNOWN, AS THE PROSOMA
IT FITS REAL NICE, INTO THE OPITHOSOMA
(DIAGRAM, DORSAL, EXTERNAL)

D:
ATTACHED BEHIND THIS LIES THE MIGHTY TELSON,
IT LOOKS SO SHARP, JUST LIKE OUR OWN NELSON,
IT SERVES NO FUNCTION, UNLESS HE'S ON HIS BACK,
AND THEN HE RIGHTS HIMSELF, YOU CAN COUNT ON THAT JACK

P:
THESE THREE PIECES GROW TO 60 CM,
THE BIGGER OF THE SPECIES, ARE THE WOMEN,
AFTER THREE YEARS, HE'S SEXUALLY BOLD,
HE'S BEEN KNOWN TO REACH, TWENTY YEARS OLD.

D:
HE'S GOT FIVE PAIRS OF LEGS TO GET HIMSELF AROUND,
THE LAST PAIR ARE USED, TO BURROW IN THE GROUND,
HIS LEGS HAVE GOT CLAWS, THEY ARE CALLED CHE-LATE,
WITH THESE HE GATHERS FOOD, AND MOUNTS HIS MATE.

P:
HE'S GOT SOME SPECIAL TOOLS CALLED THE GNATHOBASE, (PICTURE)
THESE SMELL THE FOOD, WITH WHICH HE STUFFS HIS FACE,
HE EATS POLYCHAETES, AND SMALL MOLLUSCS,
HE FINDS THEM IN THE GROUND, BURIED 'NEATH THE CRUST.

D:
THIS HERE FOOD IS PASSED INTO THE MOUTH,
IF THE GIZZARD CAN'T CHEW IT, THEN IT SPITS IT OUT,
THE REST GOES TO THE STOMACH, WHERE IT IS DIGESTED
THEN OUT THROUGH THE ANUS, WHERE IT IS SENT TO WESTWARD

P:
YO BABY YO BABY YO BABY YO BABY YO,
WE DOIN THE HORSESHOE CRAB, AND YOUVE GOT TO KNOW,
THIS SUCKER BE COOL, IT STOOD THE TEST OF TIME,
ITS EARNED THIS RAP, ITS EARNED THIS RHYME

D:
THIS HERE BEAST GOT A LONG TUBULAR HEART,
MADE UP OF SEVEN ARTERIES, IN PART,
THE BLOOD IS COLLECTED, IN THE SINUSES ON THE SIDE
AND TRANSFERRED TO THE GILLS, BENEATH ITS BACK HIDE

P:
THE BLOOD OF THE CRAB IS USED LOTS BY MAN,
WE STUDY HIS BLOOD PROTEIN, THE BEST WE CAN,
YOU MAY HAVE SEEN TUBS OF HIM, IN WOODS HOLE
GIVING UP HIS BLOOD, IS HIS MAIN ROLE

D:
THE HORSE SHOE CRAB IS OLD BUT IT CERTAINLY HAS A BRAIN,
IT FINDS ITS HOME LOOPING, ROUND ITS MAIN DRAIN,
ENCIRCLING THE ESOPHAGUS, IS WHERE ITS AT,
YEA, ITS A STRANGE PLACE, BUT ITS A STRANGE CAT

P:
SPEAKING OF STRANGE HAVE YOU HEARD ABOUT HIS EYES?
HES GOT TWO PAIRS, TO LOOK AT THE SKY,
THE BIG ONES ARE COMPOUND, AND HOOK RIGHT TO ITS BRAIN,
THE OTHERS DON'T DO MUCH, EXCEPT REMOVE SOME OF THE STRAIN

D:
THESE EYES DON'T SEE MUCH BUT ARE SENSITIVE TO MOTION,
AND THATS ONLY WHEN, THERE IS A BIG COMMOTION,
THESE EYES TOO, ARE CURIOUS TO PEOPLE,
EVEN THOUGH TO US, THEY SEEM REAL FEEBLE

P:
THE FEMALE HORSE SHOE CRAB LAYS A COUPLE HUNDRED EGGS,
THE MALE CHECKS HER OUT, AND TO FERTILIZE HE BEGS,
FOLLOWING THIS ACT, OF MUTUAL EXPRESSION,
THE EGGS ARE LEFT TO HATCH, IN A SANDY DEPRESSION

D:
IN HIS FAMILY ARE THE TICKS AND MITES,
AND WHEN THE BABIES HATCH, THEY LOOK LIKE TRILOBITES,
THIS IS BECAUSE, THEY USED TO BE RELATED,
BUT THIS OLD COUSIN, IS NOW OUTDATED.

YO BABY YO BABY YO BABY YO,
IS THERE ANYTHING ELSE, THAT YOU WOULD LIKE TO KNOW
NOWS THE TIME , FOR YOUR INTELLIGENT QUERIES,
COME ON, RELAX, DON'T YOU HAVE ANY WORRIES,

YO BABY YO BABY YO BABY YO
THIS HERE CONCLUDES THE REST OF OUR SHOW,