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Bottom Temperatures on the Continental Shelf and Slope South of New England during 1983

by

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Annual summaries of bottom temperauture have been prepared since 1974 from expendable bathythermograph (XBT) data collected along transects across the continental shelf and slope south of New England on or near 71°00'W Longitude (Fig. 1). This report summarizes the data collected during 1983, especially the seasonal and non-seasonal changes in bottom temperature, and compares it to data collected from the same area since 1974 and to bottom temperatures averaged for 1976-1982.

During 1983, 23 XBT transects were collected (Table 1). For each transect a contoured vertical temperature section was drawn. To construct the annual summary diagram of bottom temperatures (Fig. 2), the bottom temperatures recorded by the XBTs and intersects of isotherms with the bottom, determined from the contoured vertical sections, were plotted by depth and date, and contoured at 1°C intervals. To complete the bottom temperature diagram to shore, temperatures were determined for every tenth day through the year from the following two records: daily observations acquired from the NOAA National Ocean Survey of tide station temperature (0 m depth) at Newport, Rhode Island (41°30'N, 71°20'W); and data collected from a recording thermograph placed on the bottom at Brenton Tower (20 m depth) in the mouth of Narragansett Bay (41°25'N, 71°25'W).

Passages of warm core Gulf Stream rings through slope water south of New England are noted as lines of duration along the bottom of Figure 2. Each duration line starts when the western edge of a ring crosses

the transect line and ends when the ring's northern or northeastern edge passes south of 39°30'N. The ring durations are determined from AVHRR satellite imagery and from the ring analysis for 1983 by Price and Celone (MS 1984).

Shelf water south of New England generally covers the bottom inshore of the 80-120 m isobath. At the surface near the 200-m isobath, a thermal gradient (front), separating the shelf water from the warmer offshore slope water, is usually visible in infrared satellite imagery except in the warmest part of the year. On the bottom, offshore and below shelf water and above cooler deep slope water, there is a slope water thermostad layer of relatively uniform, warm (10-12°C) water. The thermostad layer is present at depths ranging from about 100 to 200 m.

Shelf Water

During winter, vertically homogeneous shelf water progressively cools from nearshore to offshore along the bottom to beyond the 100-m isobath, accompanied by deepening of the shelf-slope front and intensification of the frontal gradient. Mid-winter shelf bottom temperatures typically range from near 0°C nearshore to 10°C at the shelf-slope front.

In 1983 the wintertime decline in shelf water temperatures and deepening of the shelf-slope front was interrupted by intrusions along the bottom of warmer waters of apparent offshore origin in late March (Fig.2). The warm water intrusion coincided with the passage of warm core ring 82-I. In late March, bottom temperatures between 60 and 100 m were from 1° to 2°C warmer than the average conditions recorded there since 1976. Minimum temperatures across the shelf were similar to those reported in 1980 (Crist and Chamberlin, 1983) cooling to less than 2°C at the coast in mid-February and to about 3.5°C at 40 m in early March. These minimums were about 1°C warmer than was reported in 1982 (Crist and Armstrong, MS 1983).

Thermal stratification was apparent in the water column by early April and bottom temperatures began rising over the inner shelf from vernal warming. Between the shelf-slope front and nearshore bottom water, the cold pool is found. From spring into autumn, the coolest water on the bottom across the shelf is found in the cold pool. From

mid-April to mid-July 1983, nearshore waters along the bottom (0-20 m) increased 4° to 5°C per month as the thermocline deepened and intensified, whereas, along the axis of the cold pool (60 - 80 m), bottom temperatures increased at a rate of about 1°C per month.

From mid-April until late September, the shelf-slope front retreated shoreward along the bottom from a depth of about 110 m in April to near the 80-m isobath in September. As the retreating shelf water was replaced by slope water, bottom temperatures at 100 m increased from about 7°C to about 11.5°C. During summer, and with the deepening of the thermocline and the shoreward retreat of the shelf-slope front, the cold pool diminished in size, and bottom temperatures were typical for those observed there in the 1976-1982 average.

As surface water began cooling and mixing downward during fall, bottom temperatures between 40 and 100 m increased to their annual maximum. During the fall when shelf water along the bottom became warmer than 12°C, the thermal gradient separating shelf and slope water was indistinct.

Following the occurrence of the annual maximum bottom temperatures, the cooling and mixing during December produced vertically homogeneous shelf water which cooled rapidly from nearshore to offshore.

Slope Water

Maximum bottom temperatures in the upper slope water warm band between about 120 and 170 m were above 12°C for all of 1983, except during late February and early March when cooler conditions prevailed. Highest temperatures (> 13°C) in the warm band occurred during January. Temperatures in excess of 11°C were present in the upper slope water throughout the year, as is typical for the data since 1974.

Three warm core Gulf Stream rings passed through the slope water south of New England and close to the shelf in 1983 with a cumulative duration of about 2 months. A fourth ring, 83-E moved past the area during June but remained well offshore. The slight warming of bottom waters in early June at depths greater than 280 m may have been associated with the passage of ring 83-E. Three or four rings have passed the transect every year since 1974, except in 1977, when seven rings were recorded with a cumulative duration of over six months.

Bottom temperatures in the deeper slope water (> 200 m) were within the typical range during 1983, as compared to the 1974-1982 conditions, except from late February to early March. During the late February-early March period of 1983, the bottom temperature at 400 m was greater than 8°C, which was about 2°C warmer than normal. Of the 1974-1982 data, only in 1976 and 1982 have bottom temperatures in excess of 8°C been recorded at 400 m depth. The warming of bottom waters in late February and the subsequent, large fluctuations in bottom temperatures at depths greater than 200 m during March and into April coincided with the passage of ring 82-I. An increase in bottom temperatures at depths greater than 280 m accompanied the passage of ring 82-J in August.

References

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CRIST, R. W., and J. L. CHAMBERLIN. 1983. Bottom temperatures on the continental shelf and slope south of New England during 1980. ICES Annls. Biol., 37: 18-20.

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Table 1. Temperature sections collected south of New England during 1983.

Section Number	Date	Vessel and Cruise Number	Coordinates Inshore	Coordinates Offshore
1	22 Jan	RV "Endeaver" 83-01	41°10'N 71°00'W	39°50'N 71°00'W
2	26 Jan	CGC "Vigilant" 83-01	40°50'N 71°00'W	39°50'N 71°00'W
3	22 Feb	CGC "Vigorous" 83-01	41°11'N 71°00'W	39°50'N 71°00'W
4	30 Mar	RV "Iselin" 83-01	41°11'N 71°00'W	39°50'N 71°00'W
5	2 Apr	CGC "Vigilant" 83-02	41°10'N 71°00'W	39°50'N 71°00'W
6	12 Apr	RV "Cape Henlopen" 83-01	41°10'N 71°00'W	39°50'N 70°57'W
7	1 May	RV "Knorr" 83-01	41°10'N 71°00'W	39°50'N 71°00'W
8	25 May	RV "Endeavor" 83-02	41°10'N 71°00'W	39°50'N 71°00'W
9	31 May	RV "Knorr" 83-02	41°00'N 71°00'W	39°50'N 71°00'W
10	2 Jun	RV "Cape Henlopen" 83-02	41°10'N 70°59'W	39°47'N 70°58'W
11	9 Jun	RV "Albatross IV" 83-04	41°10'N 70°59'W	39°59'N 70°41'W
12	18 Jul	RV "Cape Florida" 10 A	40°27'N 71°00'W	39°48'N 71°00'W
13	29 Jul	RV "Cape Florida" 10 B	40°41'N 71°00'W	39°48'N 71°00'W
14	1 Aug	RV "Cape Henlopen" 83-03	41°10'N 71°00'W	39°50'N 70°59'W
15	4 Aug	RV "Albatross IV" 83-07	40°30'N 70°59'W	40°16'N 71°13'W
16	13 Aug	RV "Endeavor" 83-03	40°30'N 71°00'W	39°50'N 71°00'W
17	1 Sep	RV "Delaware II" 83-07	41°07'N 71°02'W	40°38'N 71°43'W
18	7 Sep	RV "Gyre" 83-01	41°10'N 71°00'W	39°50'N 71°00'W
19	16 Sep	RV "Gyre" 83-02	41°10'N 70°53'W	39°52'N 70°56'W
20	18 Sep	RV "Mt. Mitchell" 83-01	41°05'N 70°59'W	39°48'N 71°01'W
21	6 Oct	RV "Albatross IV" 83-08	41°06'N 71°29'W	40°02'N 71°02'W
22	1 Dec	RV "Delaware II" 83-09	41°20'N 71°21'W	40°21'N 70°51'W
23	2 Dec	CGC "Vigilant" 83-03	41°10'N 71°00'W	39°50'N 71°00'W

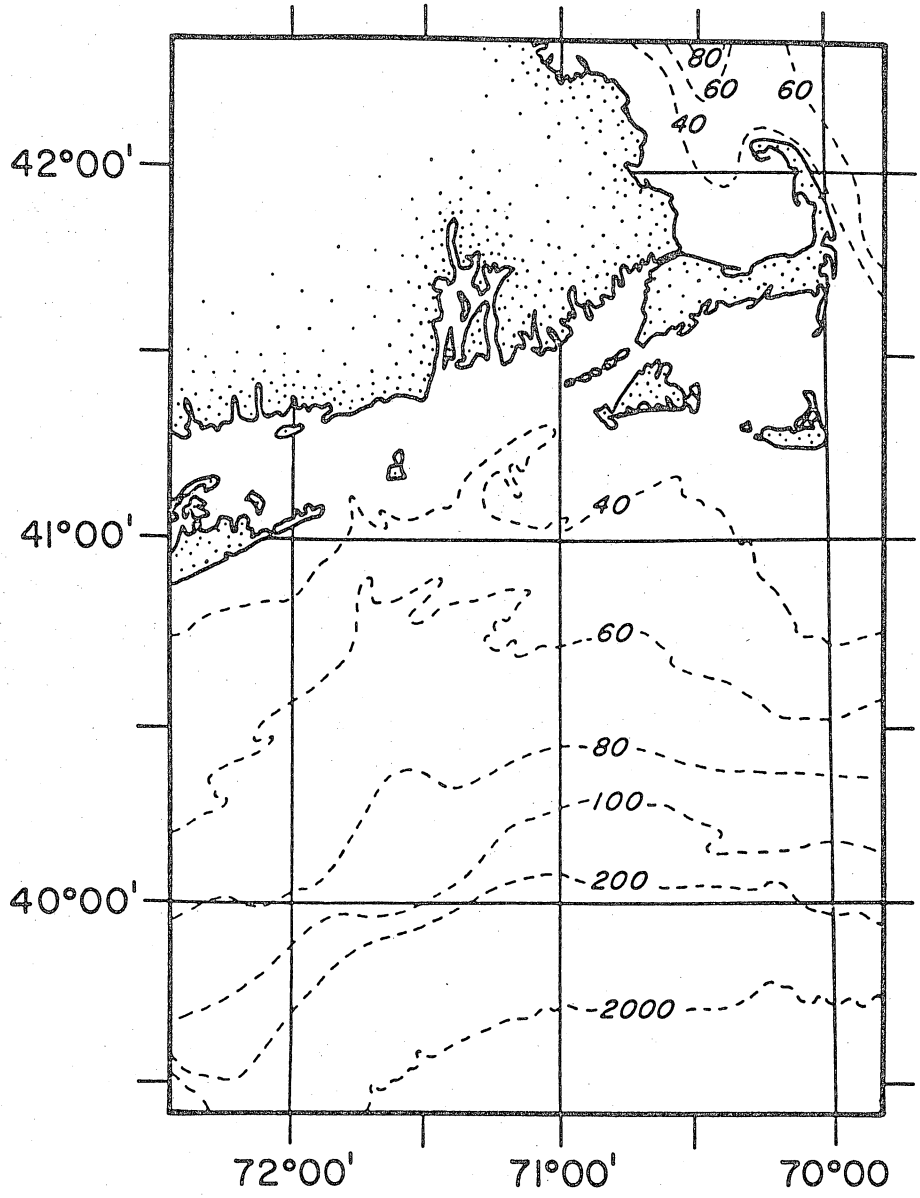

Figure 1. Location of 71°00'W transect south of New England.

Depth contours in meters.

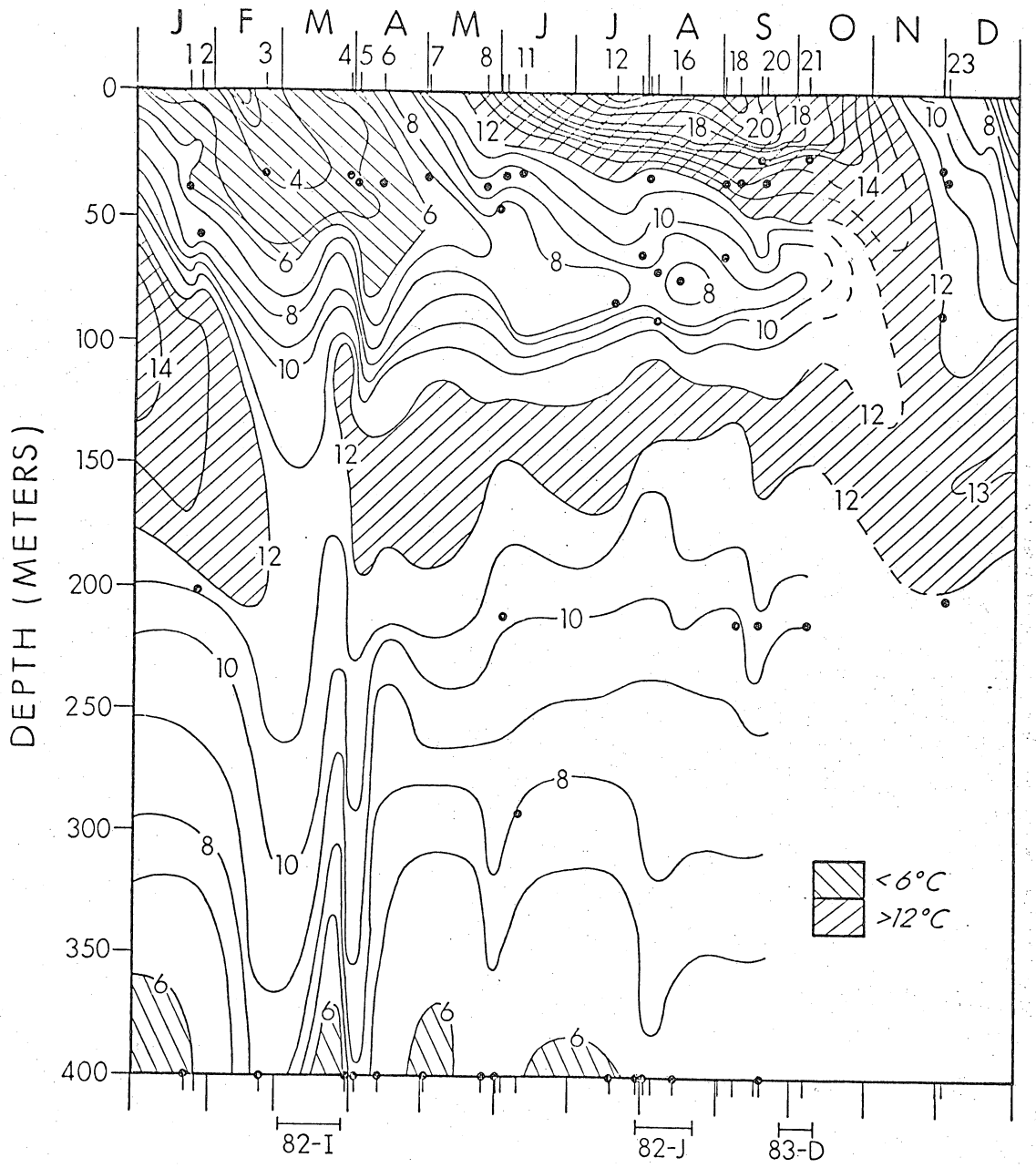

Figure 2. Bottom temperatures on the continental shelf and slope south of New England during 1983. Vertical sections are numbered along the top (see Table 1). Heavy dots mark inshore and offshore limits for each section. Horizontal lines at the bottom indicate duration of warm core ring passages south of New England.