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Bottom Temperatures on the Continental Shelf and Slope
South of New England During 1980

by

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Annual summaries of bottom temperature have been prepared since 1974 from expendable bathythermograph data collected across the continental shelf and slope along transects south of New England on or near $71^{\circ}00'W$ longitude (Fig. 1). This report summarizes the data collected during 1980, especially the seasonal and non-seasonal changes in bottom temperature and compares it to data collected in the same area since 1974.

During 1980, 15 temperature transects were collected (Table 1). For each transect a vertical temperature section was drawn. To construct the annual summary diagram of bottom temperatures (Fig. 2), the intersects of isotherms with the bottom, determined from the contoured vertical sections, were plotted by depth and date, and contoured at $1^{\circ}C$ intervals. Passages of warm core Gulf Stream rings through the 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 a cruise track and ends when the ring's northern or northeastern edge passes south of $39^{\circ}30'N$. The line durations are based on the ring analysis for 1980 by Fitzgerald and Chamberlin (MS 1981).

Shelf water south of New England generally occurs on the bottom inshore of the 80-120 m isobath. At the surface a thermal front is often visible in infrared satellite imagery separating shelf and slope water near the location of the 200 m isobath. Offshore of and below shelf water and above cooler, deep slope water, there is an upper slope water thermostat.

The thermostat appears in figure 2 as a band of relatively uniform, warm (11-12°C) water on the bottom at depths ranging from about 100 to 170 m.

Shelf Water Events

On the shelf vertically homogeneous winter water cooled rapidly from nearshore to offshore through February of 1980. The shelf-slope water front position deepened along the bottom to about 90-100 m in late February, and the frontal gradient intensified. The lowest mid-shelf bottom temperature recorded during 1980 was 2.5°C near 60 m in early March. The mid-shelf annual minimum occurred at about the same time in other years, but was 1-2°C cooler during the winters since 1977.

Bottom cooling on the shelf was interrupted briefly in mid-March as warmer offshore waters migrated shoreward. The shelf-slope front remained remarkably sharp along the bottom. At the end of March bottom temperatures across the shelf again decreased. The temperature briefly fell below 3°C at depths <60 m. In late March the shelf-slope front abruptly shifted offshore along the bottom. The 10°C isotherm deepened to 130 m, which was its furthest offshore position for the year. During this episode the frontal gradient began to relax.

The offshore extension of the shelf-slope front is an annual event which typically occurs between mid-February and mid-April. The shelf water excursion this year was unusual in that only in 1979 was the event so brief. The 10°C isotherm, in the cold winters of 1977 and 1978, extended to bottom depths >120 m for 2-3 months, and reached depths as great as 150 m.

Weak thermal stratification was observed in the water column in mid-April and bottom temperatures began to warm more rapidly nearshore than at mid-shelf. The shelf-slope front abruptly shifted shoreward on the bottom in the beginning of April. Between the shelf-slope front and surface warmed, nearshore bottom water, the cold core or cool pool is found, where warming along the bottom is gradual. Coolest temperatures persist on the bottom in the cold core through the summer. In May 1980 the 10°C isotherm shifted offshore to 110 m bottom depth. (Shelf water does not often reach depths beyond 100 m after the winter-spring offshore frontal migration.) The front shifted shoreward on the bottom in June and was found at more normal depths (80 - 100 m) through September.

Summer warming in 1980 inshore of the 40 m isobath occurred at a familiar rate. However, the warming of bottom waters in the cold core through July 1980 was more rapid than had been observed in other years. Typically, cold core bottom temperatures $<8^{\circ}\text{C}$ persist until mid to late August. In 1980, $<8^{\circ}\text{C}$ bottom temperatures were not measured after mid-July.

The rate of warming on the bottom across the shelf increased in September 1980 as surface waters cooled, became more dense, and mixed downward. Stratification of the water column broke down and maximum bottom temperatures were recorded between 30 m and 100 m during October. The maximum bottom temperature recorded on the shelf in 1980 was 17.4°C during late October. Maximum bottom temperatures observed during fall overturn have averaged between 14° and 15°C for the period 1974-1979. Only in 1977 was an overturn maximum $>17^{\circ}\text{C}$ recorded at similar depths. During the fall when shelf water becomes warmer than 10°C and reaches an annual maximum it becomes thermally indistinct from adjacent slope water.

Vertically homogeneous shelf water cooled rapidly from nearshore to offshore during November and December 1980. The rate of cooling observed during the early winter of 1980 was similar to that found in 1976-1978. In other years since 1974 maximum bottom temperatures were observed in November, and winter cooling did not begin until December.

Slope Water Events

Maximum temperatures in the upper slope water warm band between 100 m and 170 m were $>12^{\circ}\text{C}$ for most of the year. The warmest temperature recorded in the area of warm slope water bottom contact in 1980 was 14°C in February (Fig. 2), and appeared to be a remnant of the previous year's warming and vertical mixing. Upper slope water bottom temperatures never fell below 11°C during 1980. In 1977 maximum slope water bottom temperature was below 11°C for about two months and in 1978 the temperature was below 11°C for four months.

Four warm core rings passed south of New England in 1980. In early June warm core ring 80-A approached from the east, and was observed in satellite imagery entraining Gulf Stream water along its western, leading edge. When the leading edge of the ring intersected the transect, water of 13°C was recorded at the bottom in depths of 180-250 m. For the 7 years

of records (1974-1980), this was the greatest depth that water this warm had been observed on the bottom.

The deep intrusion of unusually warm water on the bottom was brief, and it appears to coincide with entrainment of Gulf Stream water as warm core ring 80-A approached the area.

REFERENCES

Fitzgerald, J. L., and J. L. Chamberlin. MS 1981. Anticyclonic warm core Gulf Stream rings off the northeastern United States during 1980. NAFO SCR Doc. 81/IX/90, Serial No. N388.

Table 1. Temperature sections collected south of New England during 1980.

Section Number	Date	Vessel and Cruise Number	Inshore Coordinates	Offshore Coordinates
1	4 Feb	"Albatross IV" 8001	41°09'N, 71°00'W	39°50'N, 71°00'W
2	8 Mar	"Wieczno" 8002	41°10'N, 71°10'W	39°59'N, 71°40'W
3	13 Mar	"Wieczno" 8003	41°10'N, 71°00'W	40°00'N, 71°00'W
4	30 Mar	"Wieczno" 8003	41°10'N, 70°57'W	40°00'N, 71°20'W
5	15 Apr	"Delaware II" 8002	41°10'N, 71°00'W	39°54'W, 71°00'W
6	5 Jun	"Delaware II" 8003	41°20'N, 71°21'W	39°50'W, 70°40'W
7	16 Jun	"Oceanus" OC-82	41°09'N, 71°00'W	39°48'N, 71°00'W
8	12 Jul	"Oceanus" OC-83	41°10'N, 71°00'W	39°50'N, 71°00'W
9	26 Jul	"Evrika" 8006	41°19'N, 71°19'W	39°47'N, 70°34'W
10	15 Aug	"Endeavor" EN-53	41°10'N, 71°24'W	39°49'N, 71°31'W
11	13 Sep	"Endeavor" EN-54	41°10'N, 71°24'W	39°50'N, 71°24'W
12	3 Oct	"Endeavor" EN-56	41°10'N, 71°00'W	39°50'N, 71°00'W
13	8 Oct	"Albatross IV" 8010	41°20'N, 71°21'W	39°59'N, 70°40'W
14	22 Oct	"Endeavor" EN-57	40°00'N, 71°00'W	39°50'N, 71°00'W
15	12 Dec	"Vigilant" 8001	41°10'N, 71°00'W	39°50'N, 71°00'W

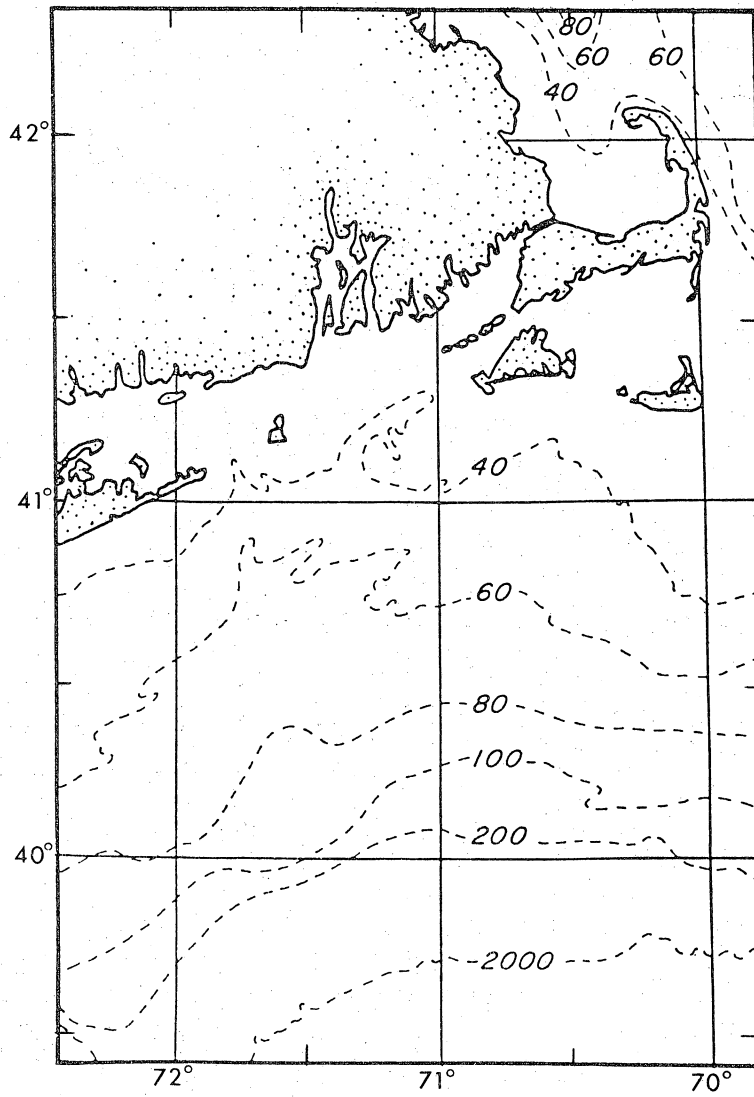


Figure 1. Location of transects along 71°00'W longitude south of New England. Depth contours in meters.

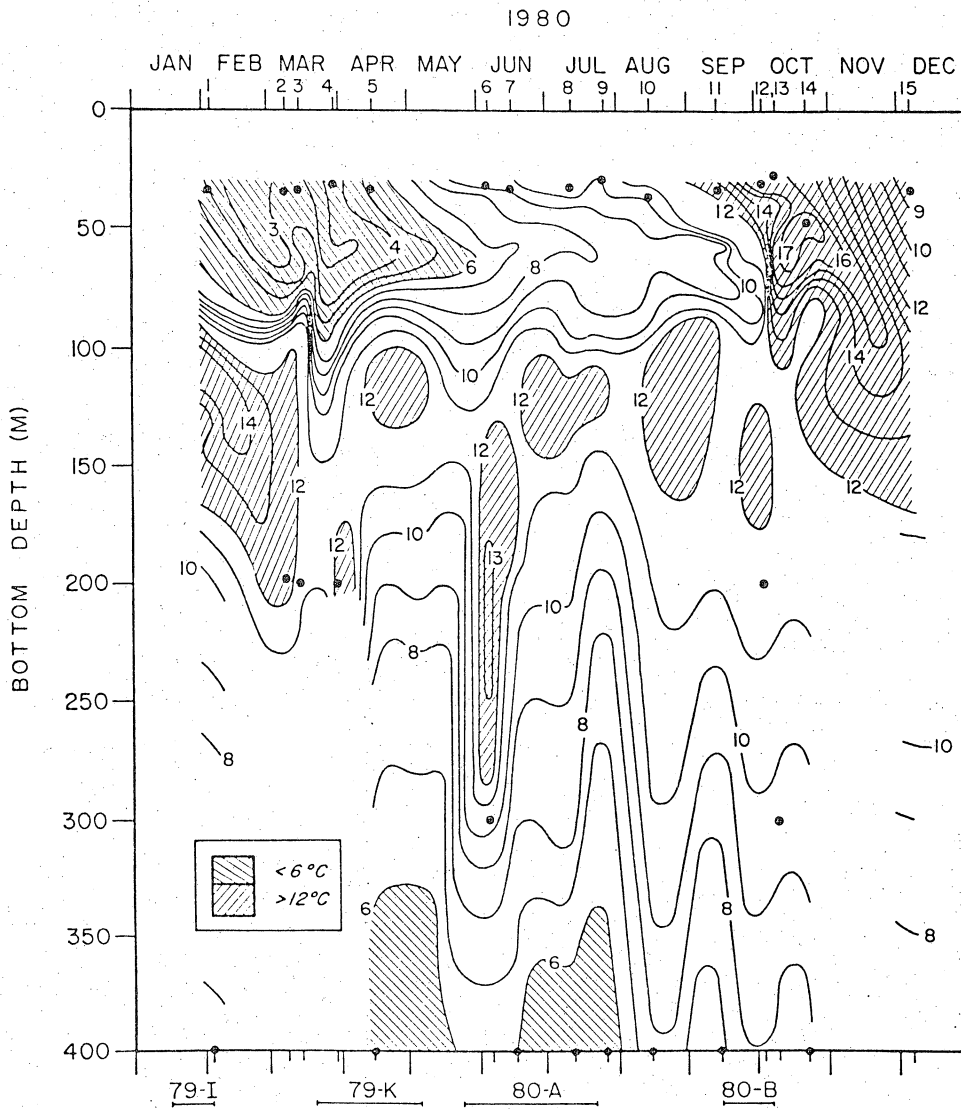


Figure 2. Bottom temperature on the continental shelf and slope south of New England during 1980. Vertical sections are numbered along the top (see Table 1). Heavy dots mark inshore and offshore depth limits for each section. Horizontal lines at the bottom indicate duration of warm core ring passages south of New England.