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Water Column Thermal Structure Across the Shelf and Slope Southeast of Sandy Hook, New Jersey in 1986

by

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Introduction

Monitoring of water temperatures across the continental shelf and upper slope in the New York Bight continued in 1986 for the eleventh year. Temperature-depth profiles were constructed from 14 expendable bathythermograph (XBT) transects extending from the entrance of New York Harbor through the 106-mile Dumpsite (Fig. 1). Information on the XBT cruises conducted and the oceanic features monitored in the New York Bight is presented in Table 1.

Methods

A "station-through-time" diagram (Fig. 2) and a bottom temperature diagram (Fig. 3) depict the major oceanographic/climatological events occurring in this portion of the New York Bight in 1986. The "station-through-time" diagram was constructed by plotting the temperatures in the water column above the 65-m isobath from each cruise at the date of the cruise and contouring the temperatures, at 1°C intervals, through time for the year. The 65-m isobath was selected for its mid-shelf location, a position in the cold pool not influenced by the Hudson Canyon. The bottom temperature diagram was constructed following the method of Chamberlin (1977) by deriving bottom water temperatures from each contoured section, plotting the temperatures against depth and date, and contouring at 1°C intervals. To complete the bottom temperature diagram to shore, the record of daily observations of water temperature was acquired from the NOAA National Ocean Service of tide station temperature at Long Branch, New Jersey.

Two distinct water masses, shelf water and slope water, reside in the New York Bight. A thermal transition zone, the shelf/slope front (SSF) separates the inshore shelf water from the offshore slope water and is visible at the surface on satellite imagery for most of the year. The surface position of

the SSF usually is over the 200-m isobath, while the bottom indicator, the intersection of the 10°C isotherm with the bottom, occurs between 80-120 m depths (Wright, 1976). Based on the analyses of Gulf Stream warm core rings in 1986 by Price and Barton (MS 1986), three rings were present along this transect during the year. For the years 1977-1983 and in 1985, an average of four rings were present each year with a maximum of five in 1982 and minimum of three in 1978 and 1981. The year 1984 was unusual in that no warm core rings migrated far enough to the south and west to enter the transect envelope (Fig. 1).

Shelf Water Events

In 1986, sea surface temperatures nearshore (top of Fig. 3) ranged from a minimum of about 2°C in late February to a maximum of over 23°C in August. Sea surface temperatures at mid-shelf ranged from less than 6°C in mid-February to greater than 24°C in mid-August (Fig. 2), reflecting the normal timing lag and temperature increase from nearshore to offshore.

Thermocline development began in April, as usual, and reached maximum intensity of about 1°C per meter of depth through the thermocline in mid-August. In general, normal deepening of the thermocline took place through the summer until fall overturn was completed in early November.

In early May, an intrusion of slope water brought warm water (>10°C) to mid-shelf along the bottom (Fig. 2).

Bottom Temperature Events

In 1986 cold pool water (water < 10°C) lasted on the bottom until late September, as is typical (Fig. 3). The extent of water on the bottom cooler than 5°C (a subjective way of estimating winter intensity) was greater than normal as compared to previous years. In 1986 5°C water lasted on the bottom until the beginning of April, which is typical, but its extent to greater than 50-m bottom depth was slightly greater than normal.

With fall overturn, temperatures on the bottom exceeded 15°C in November at mid- to outer shelf depths (50 - 100 m). The November bottom temperatures were about 1-2°C warmer than normal, compared with the compilations by Cook (1985), but were cooler than temperatures encountered in 1984 and 1985. On the upper slope, at depths of 100 m to 200 m, water temperatures exceeding 12°C persisted throughout the year. Since 1977, water warmer than 12°C has remained on the upper slope for the entire year only twice, in 1985 and 1986.

Although three warm core rings moved through the slope water along the transect line in 1986, none seemed to come close enough to the shelf and upper slope to have any persisting influence on bottom temperatures.

Summary

In 1986, cold pool temperatures on the bottom at mid-shelf during summer were warmer than observed in 1985 and were about 2°C warmer than normal. At mid- to outer- shelf depths, bottom temperatures during fall overturn were 1 - 2°C warmer than normal. For the second consecutive year, bottom temperatures along the upper slope remained above 12°C for the entire year, which seems to follow a pattern of steady warming of upper slope bottom water through the period since 1977.

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Table 1. Water Column Thermal Structure in 1986

Vessel	Cruise No.	Date	Depth range of the cold pool Minimum/Maximum depth (m)	Bottom depth (m) of 10°C isotherm SSF indicator	Rings present along transect
Oleander	86-01	Jan 10-11	Isothermal	70	
Oleander	86-02	Feb 07	Isothermal	104	
Oleander	86-03	Mar 07	Isothermal	98	
Oleander	86-05	Apr 04	Transitional	100	
Oleander	86-06	May 02	00-64	64	
Oleander	86-07	Jun 05-07	10-69	69	
Oleander	86-08	Jul 04	19-65	65	86-A
Oleander	86-09	Aug 08-09	19-65	65	86-A
Oleander	86-10	Sep 19	35-60	60	
Oleander	86-11	Oct 10	Transitional	-	86-E
Oleander	86-12	Oct 15-16	Transitional	-	86-E
Oleander	86-13	Nov 07	Transitional	-	86-E
Oleander	86-14	Nov 12-13	Isothermal	-	86-E
Oleander	86-16	Dec 10-11	Isothermal	-	86-F

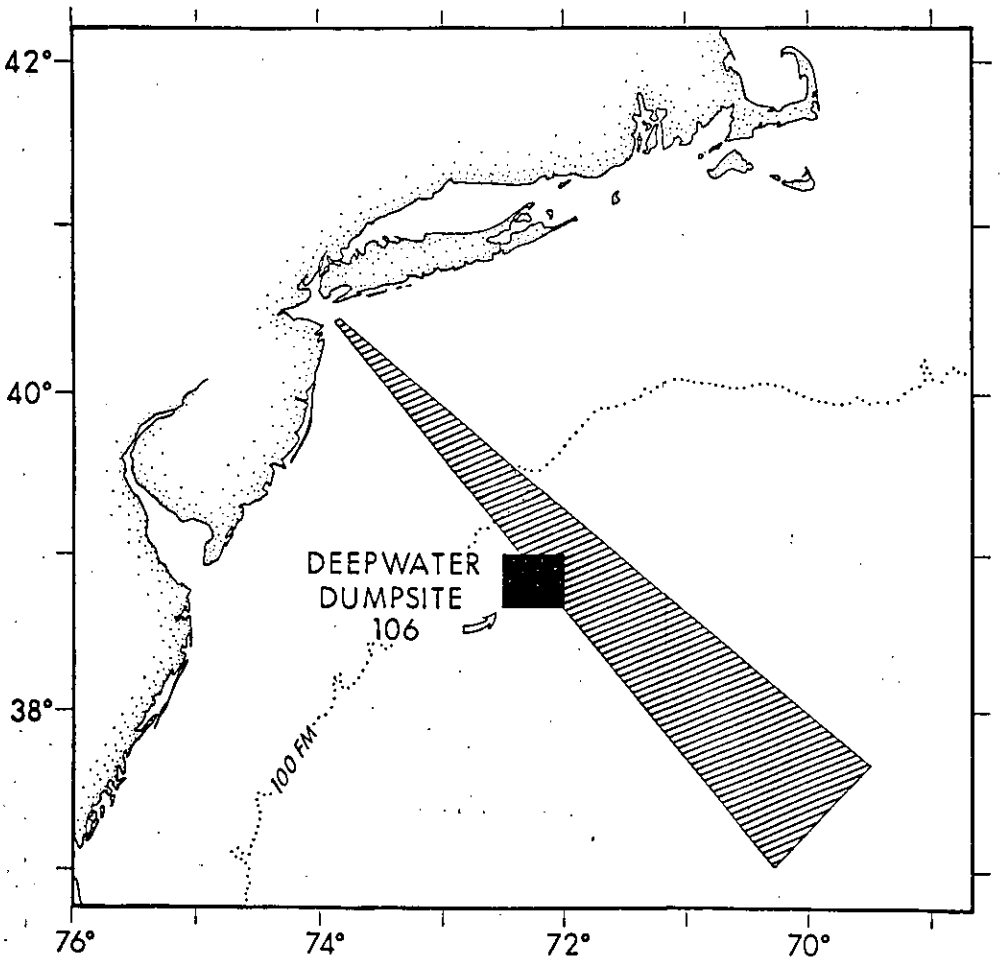

Figure 1. Envelope of 1986 transects in the New York Bight from the entance of New York Harbor to beyond the 106 Dumpsite.

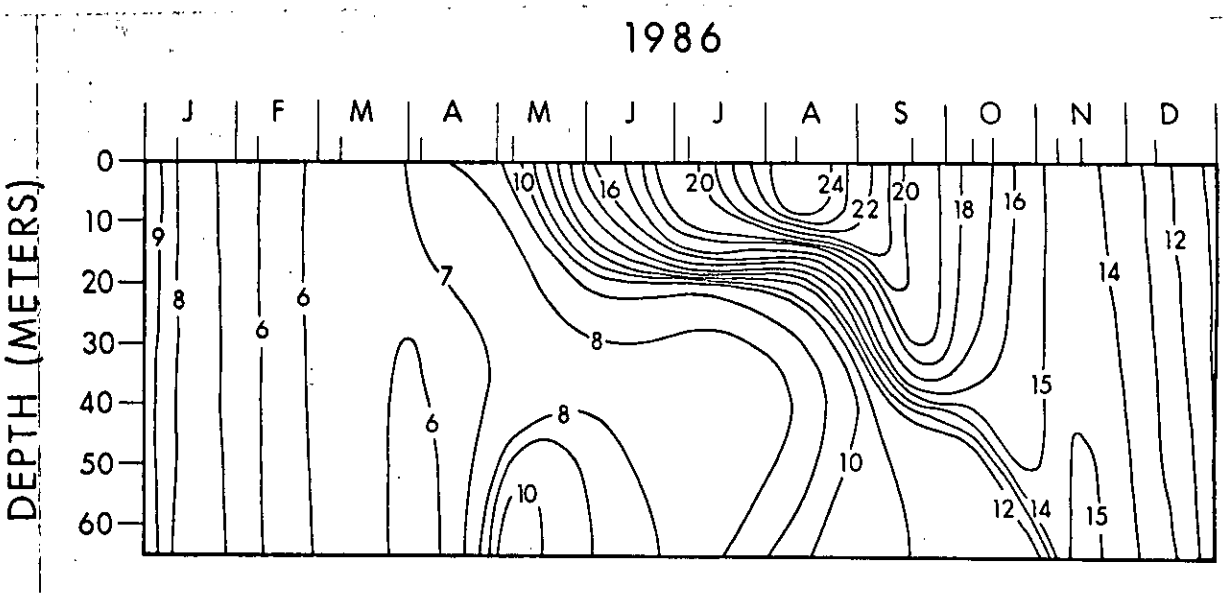

Figure 2. Station through time depicting seasonal water column temperatures at 65 m.

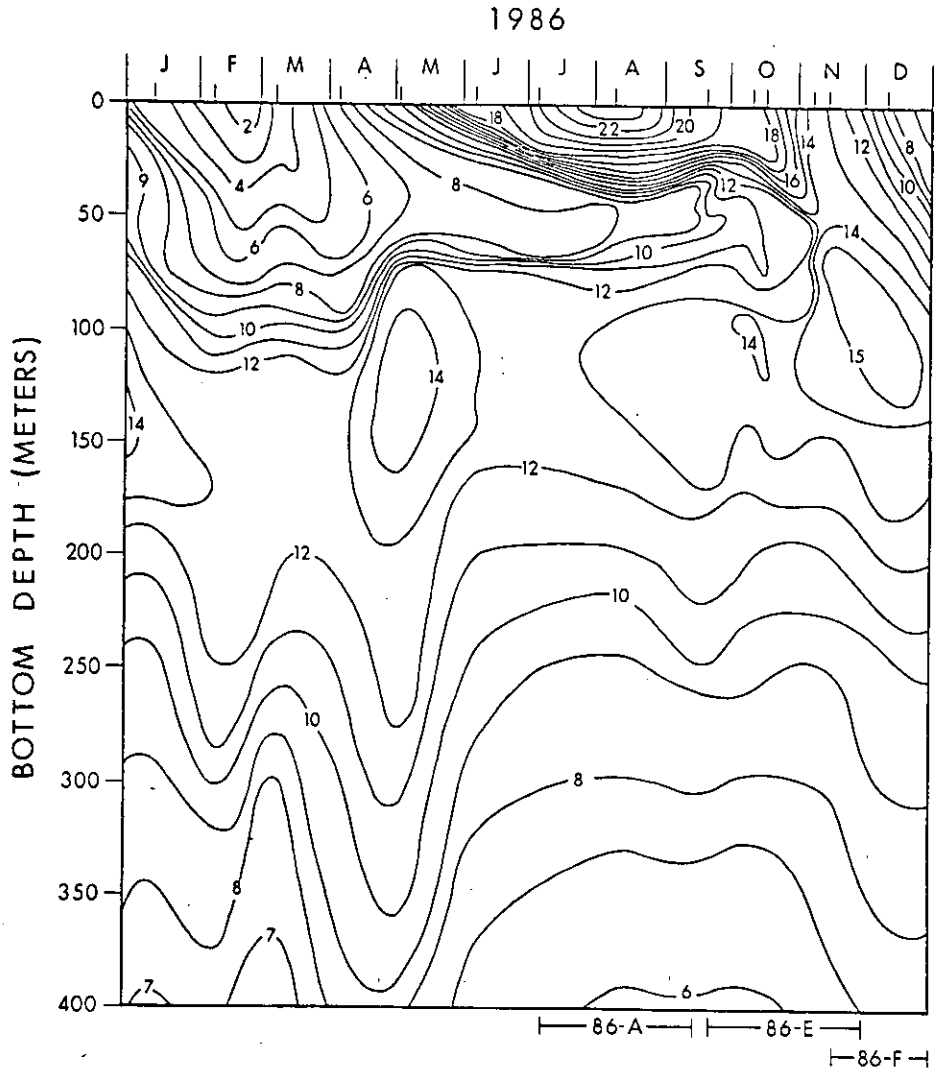

Figure 3. Bottom temperature diagram of the continental shelf and slope waters from New York Harbor to the 106 Dumpsite. Lines at the bottom of the diagram indicate the duration of Gulf Stream warm core rings in the New York Bight area.