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Water Column Thermal Structure Across the Shelf and Slope Southeast of Sandy Hook, New Jersey in 1982

by

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Monitoring of the shelf water and upper continental slope water events in the New York Bight continued in 1982 for the seventh year. Temperature-depth profiles were constructed from 26 expendable bathythermograph (XBT) transects, extending from the entrance of New York Harbor through the 106-Mile Dumpsite (Fig. 1). The transects collected and the oceanic features monitored in the New York Bight are presented in Table 1.

A "station through time" diagram (fig. 2) and a bottom temperature diagram (Fig. 3) depict the major oceanographic/climatological events occurring in the New York Bight in 1982. The "station through time" diagram was constructed by plotting through time the temperatures in the water column above the 65 m isobath, using 1°C contour intervals. The 65 m isobath was selected for its mid-shelf location, a position in the cold cell and not influenced by the Hudson Canyon. The bottom temperature diagram was constructed following Chamberlin's (1977) method, by deriving bottom water temperatures from each contoured section, plotting these temperatures against depth and date and contouring at 1°C intervals.

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 shelf water inshore from the slope water offshore. The surface trace of the SSF usually occurs near the 200 m isobath, while the bottom indicator, the intersection of the 10°C isotherm with the bottom, occurs between 80 and 120 m depths (Wright, 1976).

Shelf Water Events

The sea surface temperatures near shore ranged from a minimum of 1.3°C in January to a maximum of 21.7°C in August. Sea surface temperatures at mid-shelf ranged from 4.9°C in March to 23.4°C in August, reflecting the normal time lag and temperature increase from the beach to offshore. Shore station data (temperatures at 0 meters on Figure 3) show a slight cooling event occurring in early March and again, to a larger degree in early April. These cooling events occurring at the start of spring warming created more 5°C water than usual, which persisted almost to mid-May (Fig. 3), nearly one month longer than in 1981 and 1980.

An unusual warming of bottom water occurred from early to mid-March between 80 and 130 meters depth. Warm water (almost 12°C) was injected onto the shelf, apparently from the offshore activity of a warm core Gulf Stream ring (81-F). We've seen these warm water intrusions in the past. In 1980, there was water of greater than 13°C temperatures injected onto the shelf to depths as shallow as 70 meters. These occurrences are almost always associated with rings in close proximity at the edge of the continental shelf.

Another warming event in mid-November, that is reflected in both Figures 2 and 3, show water warmer than 17°C at bottom depths as shallow as 55 meters. Water this warm and in this location had to come from offshore, although, in this case, the warming event occurred "between" rings.

Thermocline development began as usual in late April to early May and reached maximum intensity of about 1°C in mid-August. Normal deepening and thermocline erosion occurred throughout the late summer early fall until early November, when overturn was complete (Fig. 2).

Bottom Temperature Events

This year cold pool water (water <10°C) lasted only until the end of September, compared to 1981 when it lasted beyond mid-October and 1980 when it lasted until early October. Apparently, early fall overturn along with ring interruptions (warm water being advected onto the shelf in the cold pool area) was the cause of the shorter-than-usual life of the 1982 cold pool The presence of 5°C water lasting longer than usual early in the season did not represent enough cold mass to prevent ring interaction. (later in the season) from attenuating the cold pool and shortening its life span.

The average position of the cold pool shifted slightly shoreward in 1982. The shoreward edge of the cold pool extended into depths of less than 30 meters, about 5 meters shallower than past years. The average center position of the cold pool subsequently, was moved shoreward to about 55 meters depth. The cause of the shoreward movement is unknown and could possibly be accounted for by inaccuracies in the measuring techniques used in this study.

Summary

Cold pool temperatures were colder than usual earlier in the year but didn't last as long as in 1981 or 1980.

Two warming events from offshore due to ring activity impacted on the continental shelf to depths as shallow as 55 meter.

Cold pool shifted shoreward about 15 km (8 Nmi).

Fall overturn was about two weeks earlier than last year and significantly warmer (≈2°C) higher than last year.

REFERENCES

Chamberlin, J. L. 1977. Temperature structure on the continental shelf and slope south of New England during 1975. Ocean variability - 1975. Effects on the Marine Fisheries Resources of The United States. J. R. Goulet and E. D. Haynes (Eds.) Section 16, MARMAP Contrib. No. 130, Nat. Mar. Fish. Ser., Washington, D.C.

Wright, W. R. 1976. The limits of shelf water south of Cape Cod, 1941 to 1972. J. Mar. Res., 34:1-14.

Table 1. Water Column Thermal Structure in 1982

Vessel	Cruise no.	Date	Cold cell weighted avg. temp. (°C)	Depth range of cold cell minimum/maximum depth (m)	Bottom depth (m) of 10°C isotherm	Distance (km) of shelf/slope front shoreward (-) or seaward (+) of 200 m isobath	Rings present along transect
"Oleander"	82-01	15-16 Jan	Isothermal (4.2-10.0)	-	80	+11 Nmi/+20 km	-
"Oleander"	82-02	20-21 Jan	Isothermal (2.7-10.0)	-	66	+34 Nmi/+63	-
"Oleander"	82-03	19-20 Feb	Isothermal (1.6-10.0)	-	121	-7 Nmi/-13 km	-
"Oleander"	82-04	24-25 Feb	Isothermal (2.0-10.0)	-	114	-8 Nmi/-15 km	81-F
"Oleander"	82-05	11-12 Mar	Isothermal (0.5-9.0)	-	134	+10 Nmi/+19 km	81-F
"Oleander"	82-06	17-18 Mar	Isothermal (2.1-11.0)	-	78	+49 Nmi/+91 km	81-F
"Albatross"	82-02	17-18 Mar	Isothermal (2.0-7.1)	-	91	-	-
"Oleander"	82-07	17-18 Apr	Isothermal (5.7-11.4)	-	62	+4 Nmi/ +7 km	82-B
"Oleander"	82-08	21-22 Apr	Isothermal (5.8-10.0)	-	76	+3 Nmi/ +6 km	82-B
"Oleander"	82-09	14 May	7.0	20-77	98	+110 Nmi/+204 km	82-B
"Oleander"	82-10	19-20 May	6.4	21-71	146	+5 Nmi/ +9 km	82-B
"Oleander"	82-11	11-12 Jun	6.9	44-120	138	-14 Nmi/-26 km	-
"Oleander"	82-12	16-17 Jun	7.0	31-83	83	+1 Nmi/ +2 km	-
"Oleander"	82-13	16 Jul	7.5	36-81	91	+17 Nmi/+32 km	-
"Oleander"	82-14	21 Jul	8.1	31-69	70	+32 Nmi/+59 km	-
"Oleander"	82-16	13-14 Aug	8.6	31-75	68	+17 Nmi/+32 km	-
"Oleander"	82-17	18-19 Aug	9.4	32-69	66	+23 Nmi/+43 km	-
"Oleander"	82-18	11-12 Sep	9.1	39-73	72	+31 Nmi/+57 km	82-D
"Oleander"	82-19	16 Dep	10.2	27-85	70	+32 Nmi/+59 km	-
"Oleander"	82-20	15 Oct	Isothermal (15.6-17.4)	-	-	-23 Nmi/-43 km	-
"Oleander"	82-21	20-21 Oct	Isothermal (16.5-17.4)	-	-	-14 Nmi/-26 km	-
"Oleander"	82-22	12 Nov	Isothermal (13.0-15.7)	-	-	+1 Nmi/ +2 km	82-G
"Oleander"	82-23	17-18 Nov	Isothermal (11.6-15.7)	-	-	+4 Nmi/ +7 km	-
"Oleander"	82-24	10-11 Dec	Isothermal (10.1-14.7)	-	-	-18 Nmi/-33 km	-
"Delaware II"	82-09	15-16 Dec	Isothermal (10.0-12.8)	-	-	-	-
"Oleander"	82-25	16 Dec	Isothermal (10.4-12.6)	-	-	-19 Nmi/-35 km	82-H

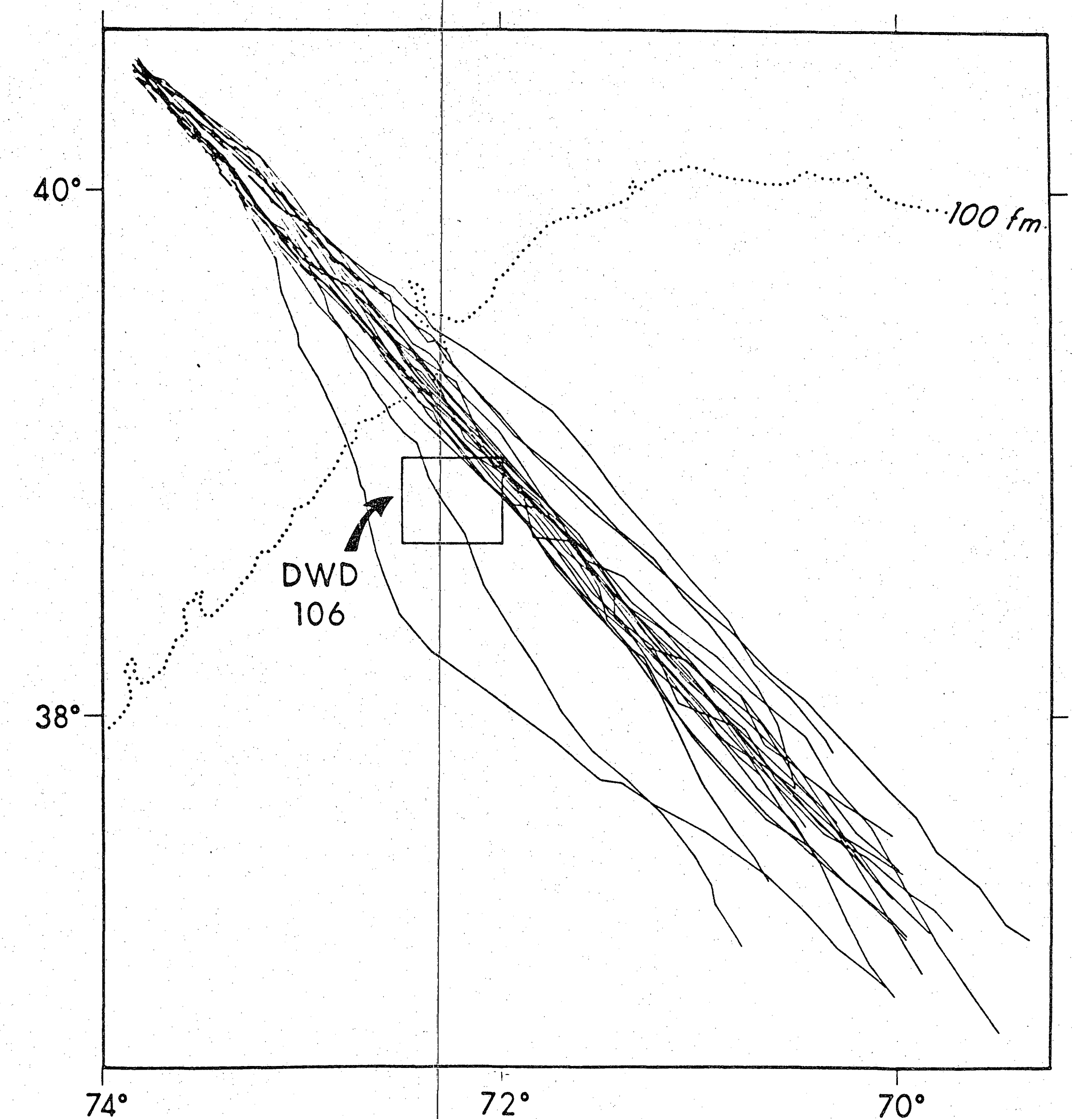

Figure 1. Envelope of 1982 transects in the New York Bight from the entrance of New York Harbor to the 106 Dumpsite.

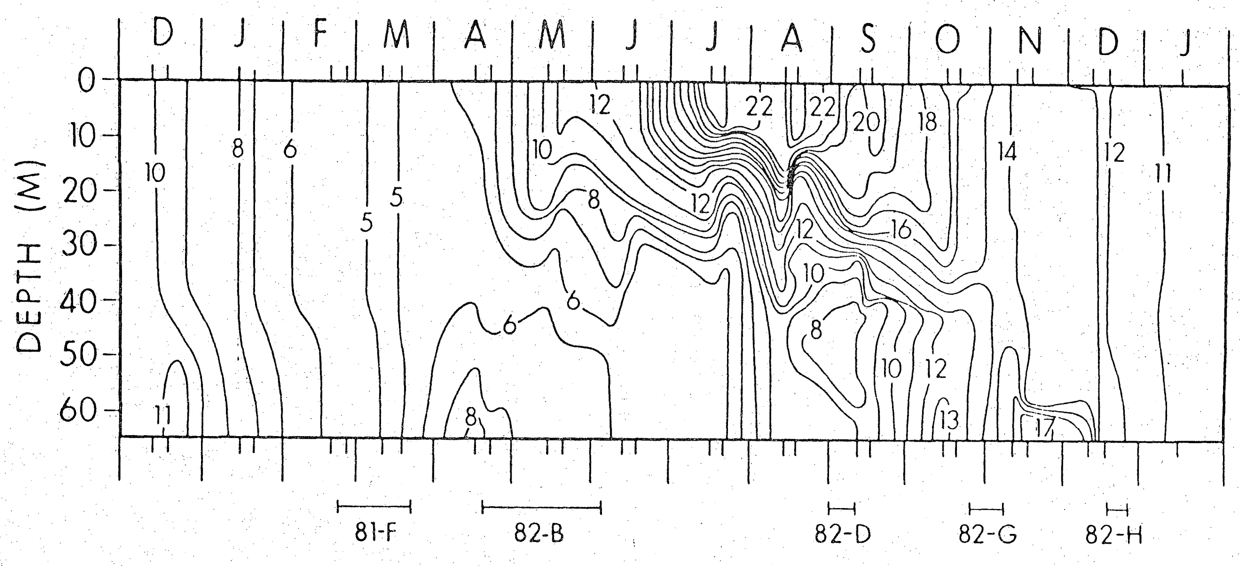

Figure 2. Station through time depicting seasonal water column temperatures at 65 meters. Lines at the bottom of the diagram indicate the duration of warm core Gulf Stream rings along the transect.

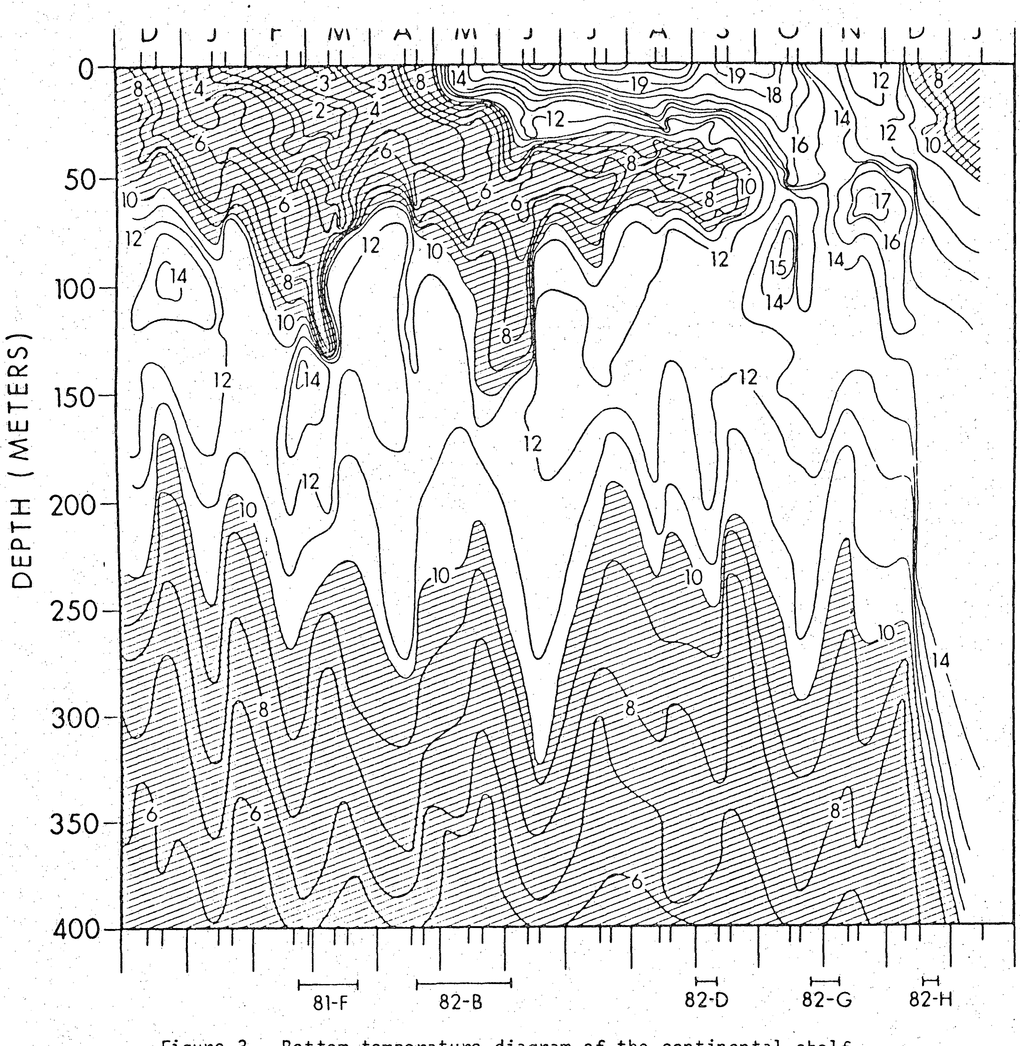

Figure 3. Bottom temperature diagram of the continental shelf and slope waters from New York Harbor out to the 400 meter isobath. Lines at the bottom of the diagram indicate the duration of warm core Gulf Stream rings along the transect.