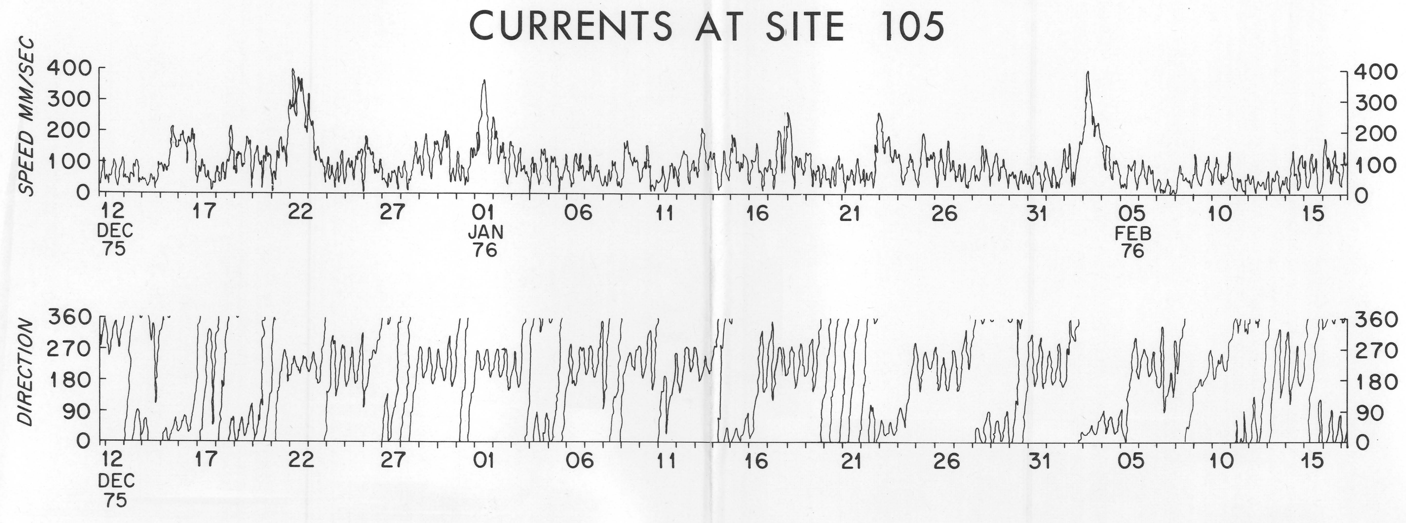
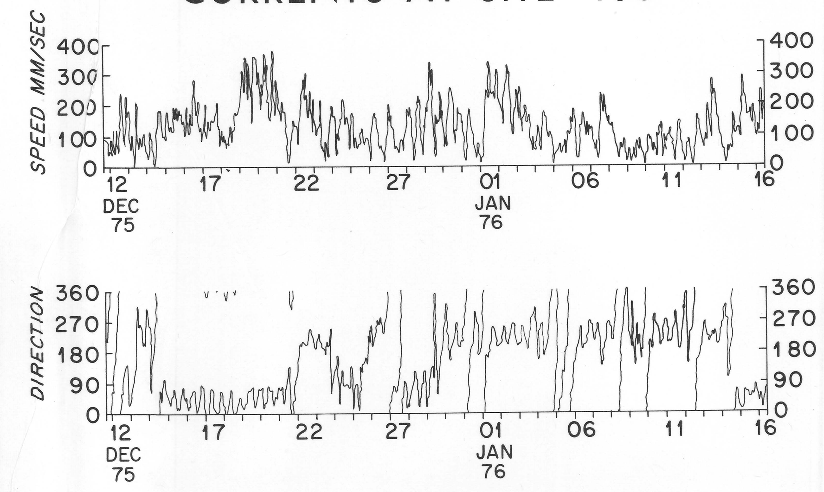
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

BOTTOM CURRENT DATA

CURRENTS AT SITE 105

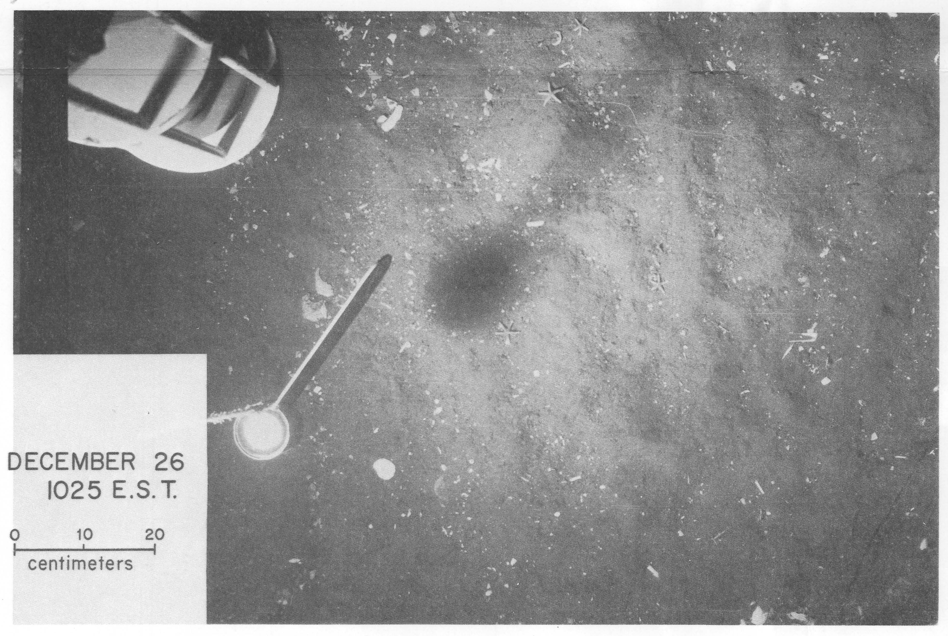


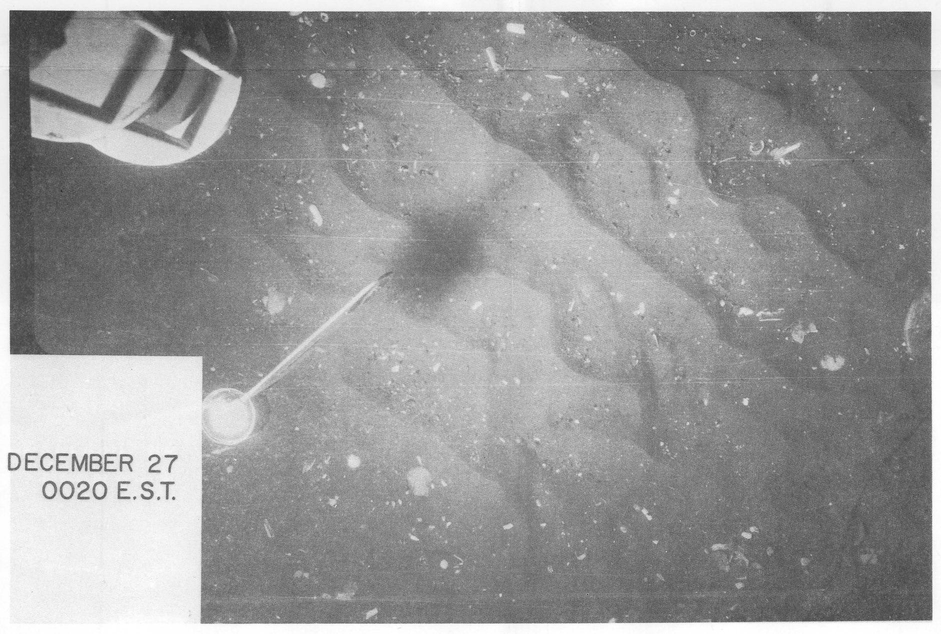
CURRENTS AT SITE 106

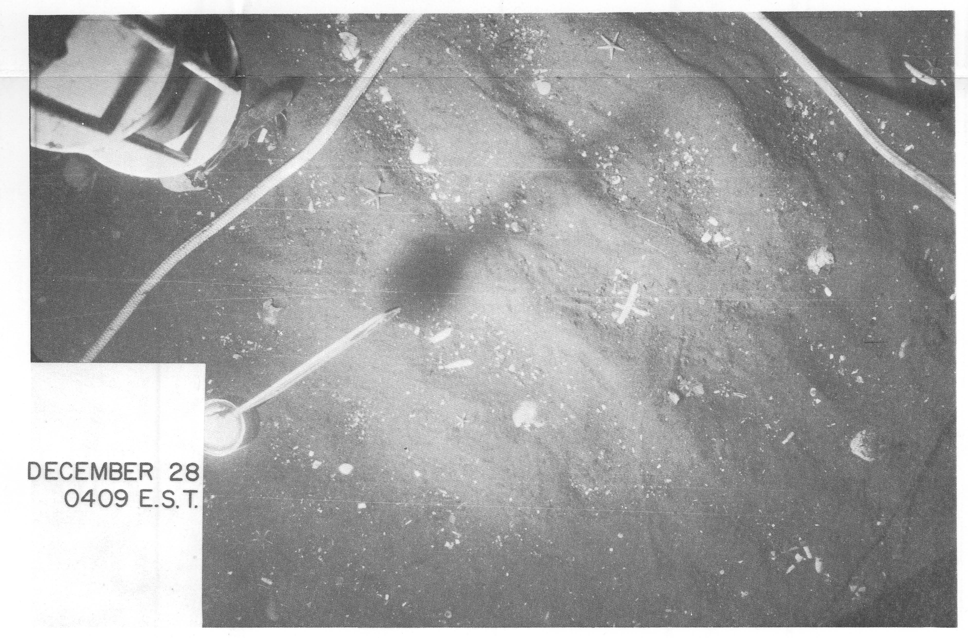


BOTTOM PHOTOGRAPHS

SITE 104







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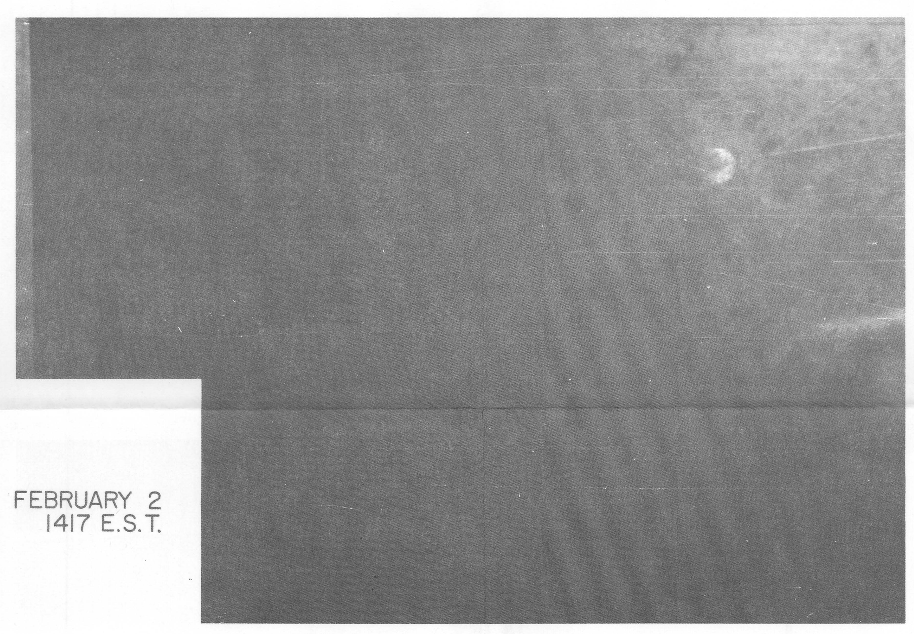
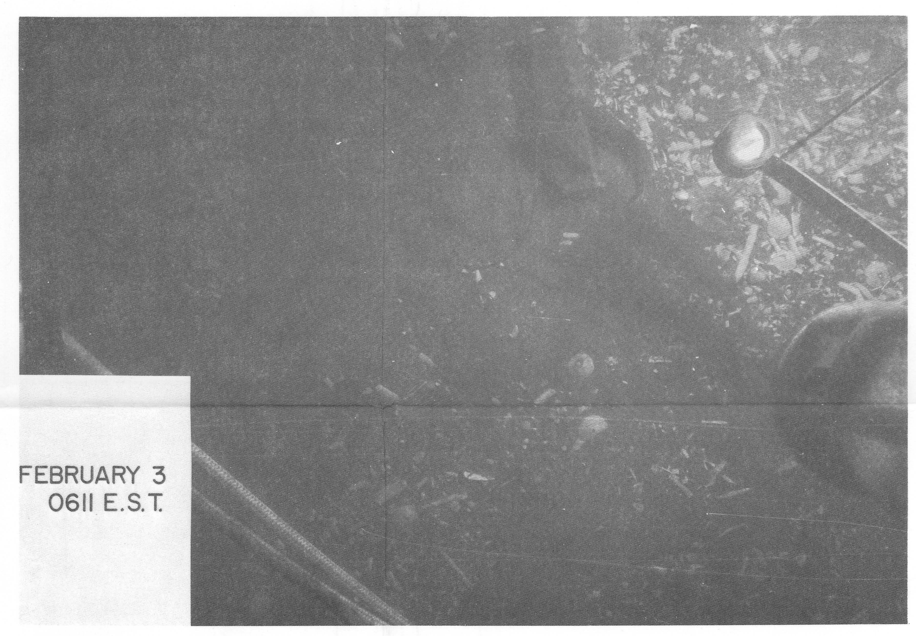
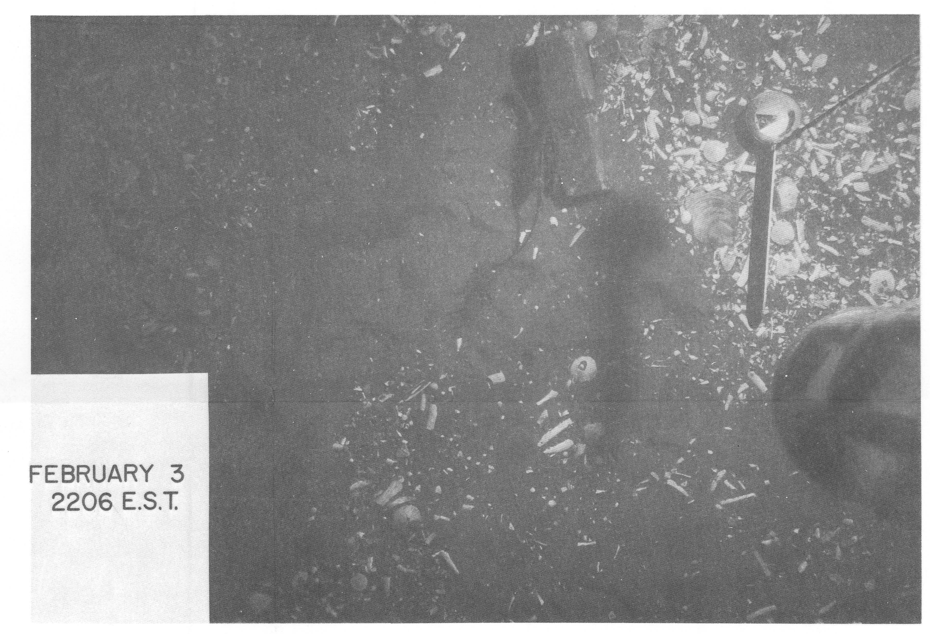
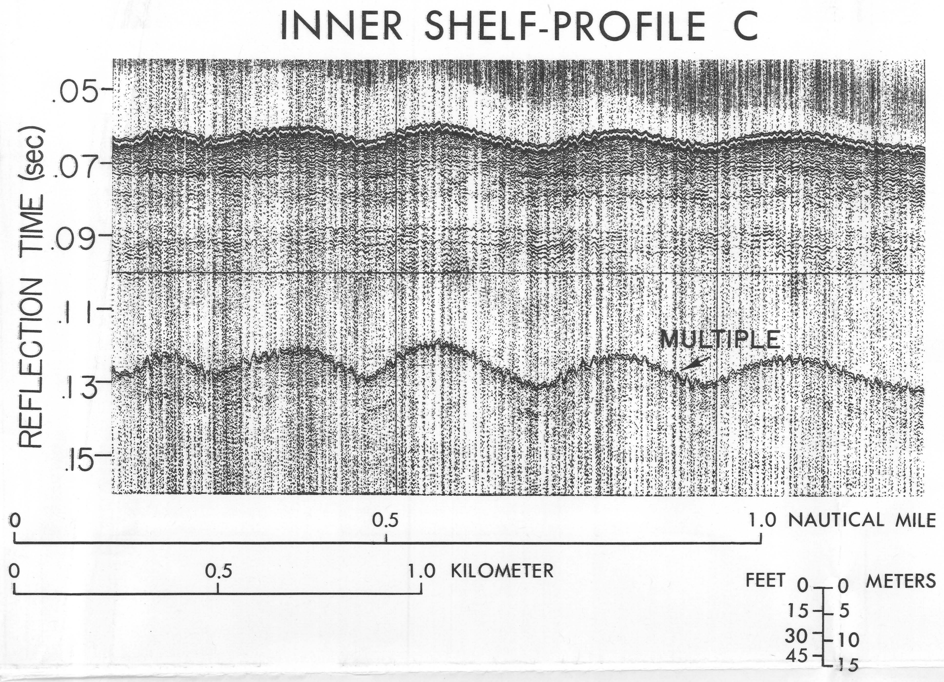




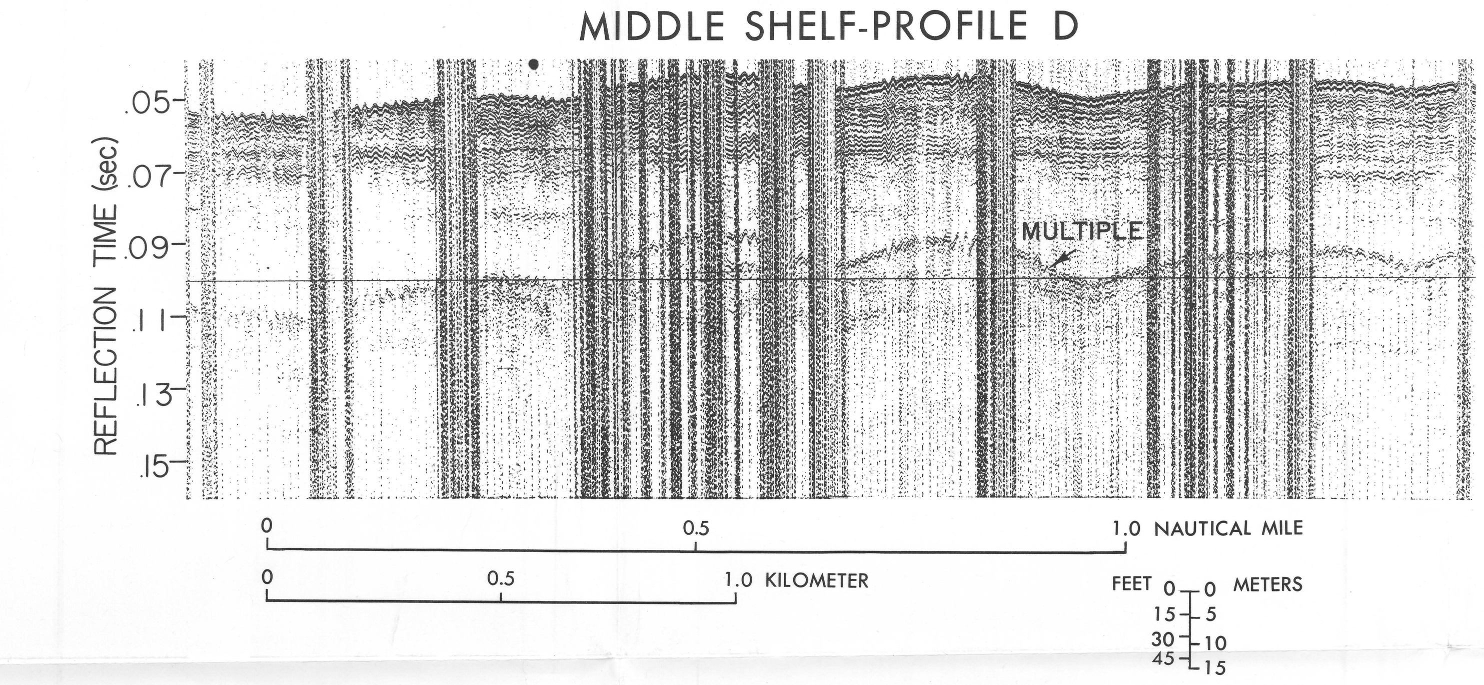


SAND WAVES

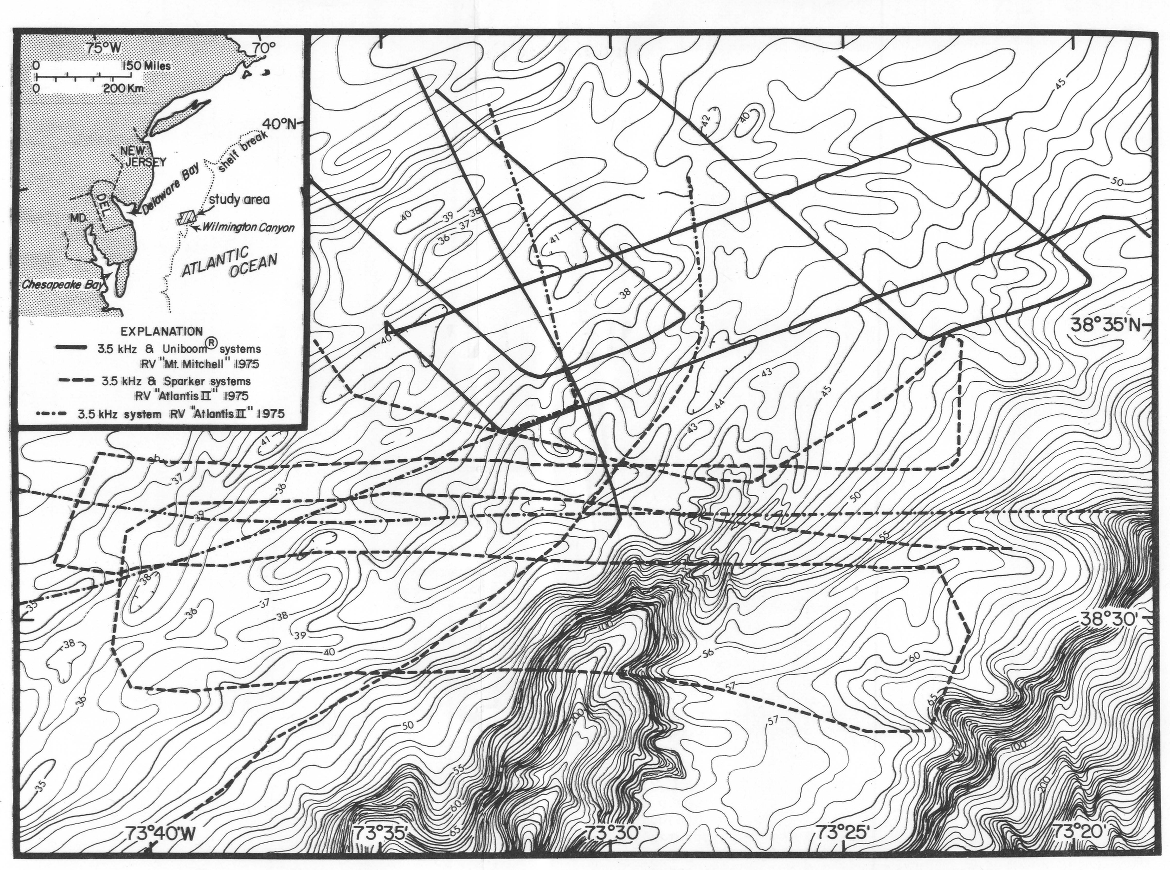
INNER SHELF-PROFILE C

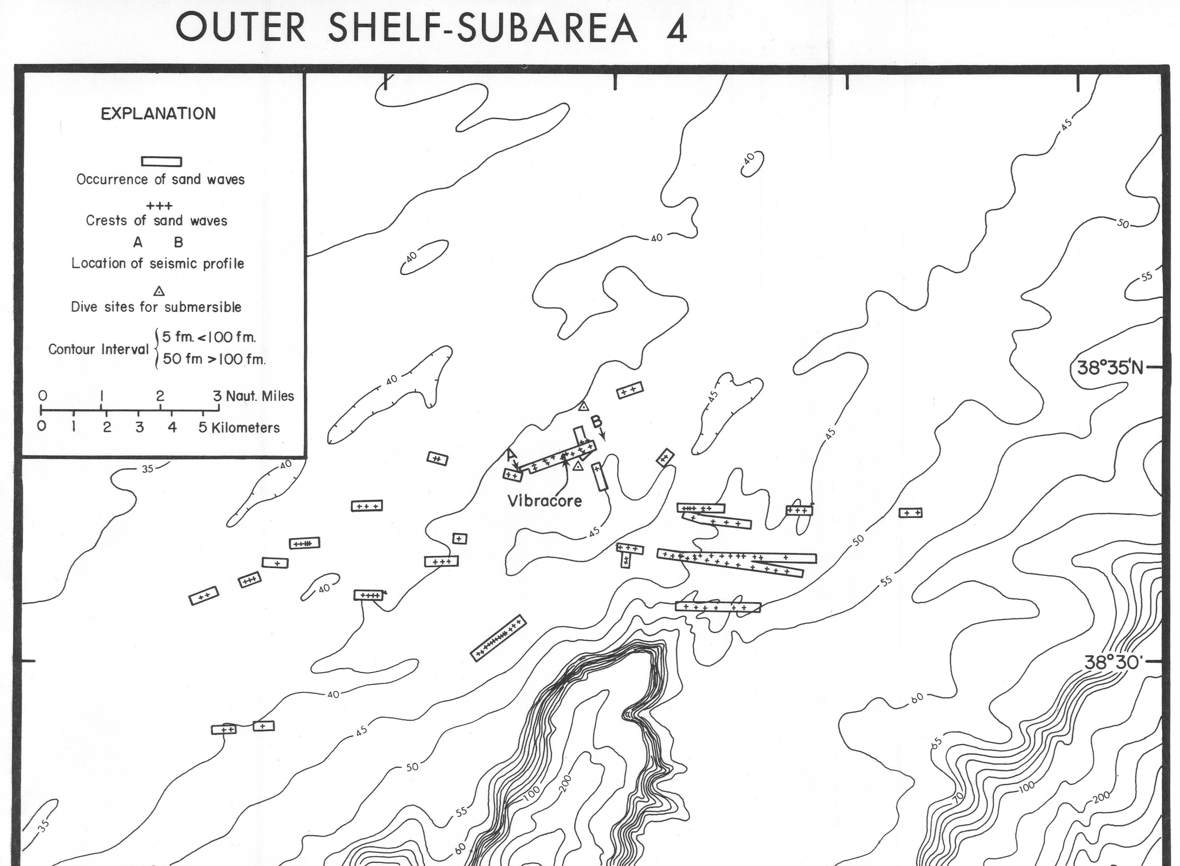


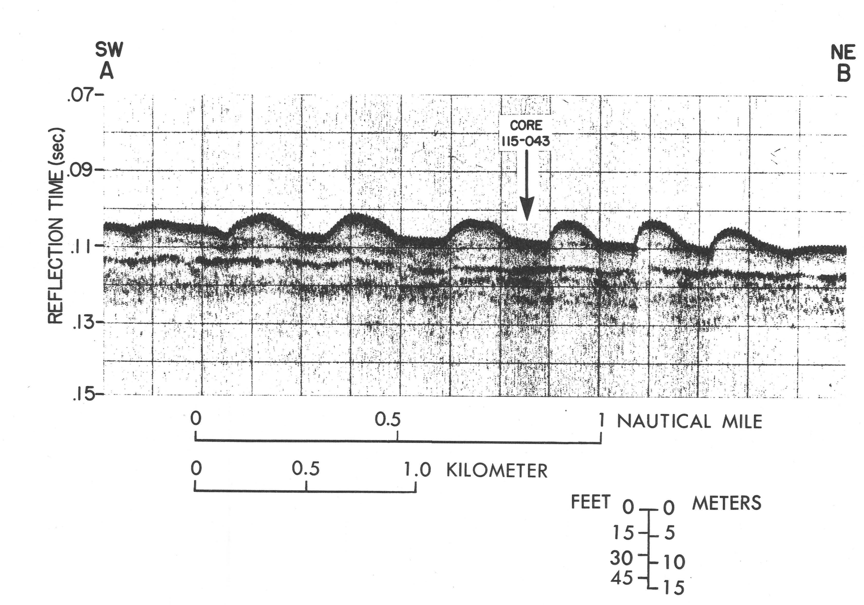
MIDDLE SHELF-PROFILE D



OUTER SHELF-SUBAREA 4







SEDIMENT TRANSPORT

Sheet 2 presents observations that relate to sediment transport in the Baltimore Canyon Trough area. The observations show: (1) the magnitude and direction of bottom currents that were monitored at two stations during the winter of 1975-6 (sites 105 and 106); (2) changes in the bottom sediment distribution that are due to bottom water flow (sites 104 and 105); and (3) the magnitude, distribution, and characteristics of sand waves which were found during regional and local seismic-reflection surveys. Inset 1 shows the locations of the profiles and the subarea that are discussed on this sheet.

Bottom Currents and Sediment Motion

The data on bottom currents and sediment motion are of two types: (1) graphs (by time) of current speed and direction; and (2) bottom photographs which show sediment movement. Currents were measured at sites 105 and 106 using Savonius rotor current meters (Geodyne Model 102) which generate a one-minute average of current speed and direction every 10 minutes. The plotted values are one-hour averages of the one-minute samples. At both sites the current meters were suspended from epibenthic tripod frames; the rotors were about 60 cm above the sea floor. The bottom current measurements were made between December 12, 1975 and February 17, 1976. On the graphs, each day refers to the interval between two time marks; each mark corresponds to midnight.

The current observations illustrate the temporal and spatial variability of the bottom flow, especially that due to strong winter storms. During the measurement period, at least four intense low-pressure systems passed over the current-meter sites (December 18, December 21-22, January 1, and February 2). Maximum current speeds associated with these events were between 30-40 cm/sec, with the net flow generally to the northeast or southwest, parallel to the isobaths. During nonstorm conditions the current was 10-15 cm/sec and dominated by the semidiurnal tide.

The bottom photographs at sites 104 and 105 were taken with underwater cameras (Benthos model 372) that were mounted on the tripod (current-meter) frames. The cameras, which were about 2 m above the bottom, took photographs every 2 hours during the periods of deployment. Manmade objects that are shown in the photographs include: (1) the rotors of the current meters; (2) a directional vane and compass (33 cm long); (3) a lead brick (23 cm long); and (4) two strands of synthetic line (5/8 inch diameter).

The photographs show that bottom sediment in the Baltimore Canyon Trough area often are moved for short periods of time during the winter. The sequence of photographs that was taken at site 104 shows how the bottom changed during three 14-hour periods. During the first period (from 1025 December 26 to 0020 December 27), the bottom microtopography was characterized by features produced by burrowing organisms; these features were rapidly obscured as ripples with sharp crests developed. During the next period (from 0020 to 1414 December 27), the ripples that had been formed remained sharp, but they were moved and modified. Over the third period (1414 December 27 to 0409 December 28), the ripples were degraded, and the bottom began to return to its original character. The mean currents at site 105 (approximately 80 km from site 104) were weak (less than 20 cm/sec) during this period. However, relatively large waves were observed at site 105 during this period, suggesting that the sharp ripples at site 104 may have been formed by wave-induced oscillatory bottom flow.

The sequence of photographs from site 105 shows the effects of the February storm. At 2222 February 1, 1976, prior to the onset of the storm, the water was remarkably clear. Over the next 16 hours (to 1417 February 2), the water became turbid, and the bottom was completely obscured. By 0611 February 3, the water clarity had improved, but the bottom appeared hazy in the photographs. By 2206 February 3, the water transparency had returned to its prestorm state. During the storm, the sediments were scoured around the large lead brick which sat atop the bottom. Flat, asymmetric ripples were formed by the large mean flow, in contrast to the symmetric ripples that were observed at site 104 in December.

Sand Waves

Sand waves were found at five locations during the regional, seismic-reflection survey of the Continental Shelf from south of Long Island, New York to east of Cape Henry, Virginia (see sheet 1). As examples, Uniboom records from two of these locations (inner and middle shelf; Inset 1) are shown in profiles C and D. In profile C, the sand waves have wavelengths of 300-400 m and wave heights of 2-5 m. In profile D, the spacing is 500-700 m, and the relief is 2-4 m. At both locations, the sand waves are symmetrical.

Another field of sand waves occurs within subarea 4 on the Outer Continental Shelf near the head of Wilmington Canyon. The areal distribution and characteristics of the sand waves there have been outlined by a detailed seismic-reflection survey that utilized the 3.5 kHz, Uniboom (400-4,000 Hz band pass; 300 j) and Sparker (150-450 Hz band pass; 1,000 j) acoustic systems. Sub-bottom sediments in the sand-wave field were sampled with a vibracorer (core 115-043). Visual observations of the sea floor near or within the sand-wave field were made during two dives of a submersible.

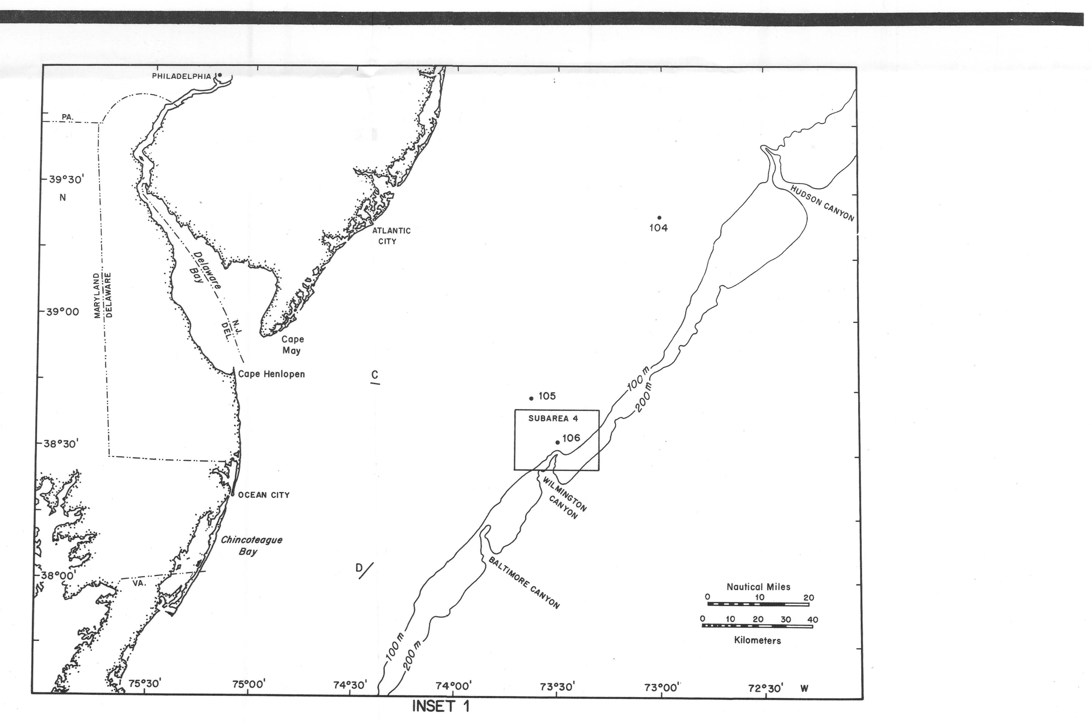
Three diagrams relate to the sand waves within subarea 4. These include: (1) a map which shows the tracklines of the local seismic-reflection survey; (2) a map of the distribution of the sand waves which also shows the locations of the profile AB, the vibracore, and the dive sites of the submersible; and (3) a photograph of an original Uniboom profile (AB) across some representative sand waves in the subarea. The bathymetry (in fathoms) that is shown on the diagrams was taken from U.S. Coast and Geodetic Survey and U.S. Bureau of Commercial Fisheries (1967).

Within subarea 4, sand waves were found north and west of the head of Wilmington Canyon in distinct "patches" composed of 1-14 individual bedforms. None was observed east of the canyon. Most groups of sand waves occur within 11 km of the canyon in water depths of 70-100 m and extend laterally for 0.3 to 5.0 km. The bedforms have a spacing of 100-650 m, a relief of 2-9 m, trend northwest, and are asymmetrical with the steeper slopes being toward the south or west. Vibracore sediments indicate that the sand waves apparently have formed on a substrate of relict near-shore sediments. The submersible dives, which were made during August, revealed weak bottom currents, sediment bioturbation, un-rippled microtopography, and lack of scour. These observations suggest that the asymmetry of the sand waves may be maintained by periodic water motion, possibly associated with storms or perhaps with flow in the canyon head. A more complete discussion of the sand waves within subarea 4 can be found in Knebel and Folger (1976).

REFERENCES CITED

Knebel, H.J., and Folger, D.W., 1976, Large sand waves on the Atlantic Outer Continental Shelf around Wilmington Canyon, off eastern United States: Marine Geology, v. 22, p. M7-M15.

U.S. Coast and Geodetic Survey and U.S. Bureau of Commercial Fisheries, 1967, Bathymetric map, Baltimore and Wilmington Canyons (0807N-56): Washington, D.C., U.S. Coast and Geodetic Survey, scale 1:125,000.



MAPS AND GRAPHIC DATA RELATED TO GEOLOGIC HAZARDS IN THE BALTIMORE CANYON TROUGH AREA

By

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Paul W. Cousins, and Robert R. McGirr

1976