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KEY WORDS: Mid-Atlantic; New Jersey; Delaware; Maryland; Virginia; baseline; biology; infauna; benthos; shelf; slope; canyon; epifauna; histopathology; sediment; hydrography; hydrocarbons; plankton; grain size; nutrients; bacteria; geology; community; suspended matter; trace metals.

BACKGROUND: In 1975, the U.S. Department of the Interior included development of a chemical-biological benchmark program in the Middle Atlantic Bight Outer Continental Shelf (OCS) area as part of the OCS Environmental Studies Program. This report represents information from the first full sampling year (four seasons) completed mid-September 1976.

OBJECTIVES: (1) To provide chemical and biological data to serve as a baseline for assessment of possible changes resulting from oil and gas exploration, development, and production activities; and (2) To provide data and information to enhance the quality of OCS management decisions.

DESCRIPTION: The study region covers about 45,000 km^2, extending off New Jersey, Delaware, Maryland, and Virginia over the broad continental shelf and upper slope. To provide both the extensive area coverage required for leasing consideration and the intensive coverage desired in the lease area portion of most interest to industry, 51 benthic stations were established as follows: (1) 24 stations (A through F), grouped in 6-4 station clusters primarily concentrated in the outer shelf but extending into central and inner shelf areas, were located in a corridor bounded roughly by 33.5°N Lat and 39.5°N Lat; (2) a 7 station transect (G series) positioned near the northern lease area border (40°N Lat); (3) a 6 station transect (K series) positioned along the southern lease area borders (38°N Lat); (4) a 6 station transect (L series) positioned off Chincoteague, Virginia between 37°N Lat and 37.5°N Lat, south of the lease area; and (5) 8 stations assigned to continental slope and submarine canyons in the central area. The 24 cluster stations were sampled quarterly. The remaining 27 stations were sampled twice yearly. Nine stations in the central area were for dredge and trawl collection of large organisms (megabenthos) that would be used for histopathological and chemical studies. Wherever possible, these stations

corresponded with stations sampled for macrobenthos and sediments. These stations were sampled quarterly. Six water column stations were located on a cross-shelf transect extending from C1 off Atlantic City, New Jersey to J1 on the slope edge. Sampling methodology included: standard meteorological parameters; oceanographic parameters [water temperature, conductivity, dissolved oxygen (DO), light transmission, and light scattering] taken at several levels in the water column; and water samples processed for laboratory analysis of salinity, DO, nitrites, nitrates, total dissolved organic phosphates (micronutrients), particulate and dissolved organic carbon (POC-DOC), and suspended sediments. Biological samples were collected including zooplankton with 60-cm opening-closing bongo systems, neuston with towed nets, macrobenthos with a Smith-McIntyre grab, megabenthos with a small biological trawl and a modified anchor dredge, and foraminifera in sediment cores. Sediment samples were collected and analyzed for grain size, organic carbon, and nitrogen. Trace metals were analyzed in zooplankton, neuston, sediment, megabenthos, and particulate matter. Hydrocarbons were analyzed in sediment, benthic organisms, water samples, surface film samples, zooplankton, neuston, and onboard fuels and lubricants. Histopathological studies were conducted on representative megabenthos. Bacteria was sampled and analyzed in the surface microlayer, surface water (1 m), and sediments.

SIGNIFICANT CONCLUSIONS: Within the study area, cross shelf trends seem to be more distinct than latitudinal trends. The study area waters were characterized by two vertical frontal zones, subdividing essentially three water mass types--the coastal boundary layer, shelf water, and slope water. Cross-shelf patterns in the benthic realm are driven by bottom type and temperature. The ridge and swale topography found on areas of the shelf can cause significant localized differences in parameters.

STUDY RESULTS: Data were interpreted as properties and processes in the pelagic realm (i.e., in the water column) and in the benthic realm (i.e., on or in the bottom). Study area cross-shelf trends in both realms seem to be more distinct than latitudinal trends. Dominant trends seem to be related to water depth or distance from shore, but often environmental factors covary with these parameters. The pelagic realm was characterized by two vertical frontal zones, subdividing three water mass types--the coastal boundary layer, shelf water, and slope water. Frontal zones may be sharp or diffuse and may shift depending on hydrographic conditions. The shelf-slope front is generally more distinct than the coastal boundary layer. Water masses were distinguished by salinity, temperature, and variation in vertical thermohaline structure. Generally, parameters were variable nearshore becoming less variable offshore. The water column on the shelf and slope was vertically stratified. Water temperature below the thermocline was constant and calm most of the year, influenced by a "cold pool" water mass present on the central and outer shelf until fall overturn.
Stratification is maintained by density differences created by generally higher salinity and lower temperature bottom water. Density stratification of slope water was seasonally persistent. Water column seston concentrations were locally variable. Surface water seston showed a clear trend of decreasing offshore. Seston in outer shelf and slope water were primarily phytoplankton (bioseston) whereas mineral particles (abioseston) were dominant nearshore. Trace metals and hydrocarbons in seston showed no clear trends. Heterotrophic bacteria, coincident with higher nutrient and dissolved organic carbon levels, were more concentrated in the coastal boundary layer. A secondary peak occurred at the shelf break due possibly to observed nutrient enrichment in this area. Zooplankton density was variable but generally decreased towards offshore. Meroplankton abundance showed sharp attenuation away from the inner shelf. Neuston and subsurface zooplankton generally increased greatly offshore. Certain zooplankton species were indicators of coastal boundary layer or oceanic (slope) water and their numbers declined markedly across frontal zones.

Substrate characteristics and temperature were important features effecting cross-shelf trends in the benthic realm. A dominant shelf bottom feature was the ridge and swale topography running obliquely to the shoreline and extending nearly to the shelf break. These features and others (e.g., terraces and valleys) were formed during the Holocene shoreface transgression across the shelf and contemporary modification by hydraulic processes. This topography has a strong influence on sediment and benthic organism distribution. Study area sediments are characteristically sandy. Hydraulic grading of sediments on the shelf result in medium to coarse sands on the inner shelf and slightly muddy, fine sands on the outermost shelf and break. Sediment distribution and benthic communities are influenced

by frequency and severity of sediment movement by waves and current which is related to depth. Sediment movement on the inner shelf is frequent, but on the outer shelf, sediment movement is episodic. Trace metals and hydrocarbons tend to associate with fine sediment and concentrate on the shelf break and slope. Trace metals in megabenthos were variable. High concentrations of heterotrophic bacteria occurred at the shelf break and nearshore due to silt-clay content of sediments and proximity to shore. Foraminifera abundance was variable and affected by local topography. Macrobenthos was most dense on the outer shelf and least dense on the continental slope. Macrobenthos species diversity and richness showed an offshore increase. Shelf break communities had greatest areal richness but continental slope communities had numerical richness.

STUDY PRODUCT(S): Lynch, M. P. and D. W. Folger. 1977. Middle Atlantic Outer Continental Shelf Environmental Studies. Vol. I, Executive Summary. A final report for the U.S. Department of the Interior, Bureau of Land Management Atlantic OCS Office, New York, NY. NTIS No. PB281296. Contract No. 14-12-0001-29125. 122 pp.

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