ACCESS NUMBER: **30064**

STUDY TITLE: Biological Processes on the U.S. Atlantic Continental Slope and Rise: Part A, and Studies of the North and Mid-Atlantic Slope and Rise: Part B.

REPORT TITLE: Study of Biological Processes on the U.S. South Atlantic Slope and Rise, Phase 2. Vol. 1, Executive Summary; Vol. 2, Final Report.

CONTRACT NUMBER(S): MMS: 14-12-0001-30064.

SPONSORING OCS REGION: Atlantic.

APPLICABLE PLANNING AREA(S): South Atlantic.

FISCAL YEAR(S) OF PROJECT FUNDING: 1983; 1984; 1985; 1986.

COMPLETION DATE OF REPORT: March 1987.

COST(S): FY 1983: $3,059,462; FY 1984: $803,181; FY 1985: $3,050,196; FY 1986: $867,396; CUMULATIVE PROJECT COST: $7,780,235.

PROJECT MANAGER(S): J. Blake.

AFFILIATION: Battelle Ocean Sciences.

ADDRESS: 397 Washington Street, Duxbury, Massachusetts 02332.

PRINCIPAL INVESTIGATOR(S)*: E. Baptiste, J. Blake, P. Boehm, B. Dade, J. Grassle, R. Petrecca.

KEY WORDS: South Atlantic; North Carolina; South Carolina; Charleston Bump; Blake Plateau; Cape Hatteras; Cape Lookout; Cape Fear; biology; slope; rise; geology; chemistry; benthos; trace metals; hydrocarbons; sediment; grain size; survey; photographs; infauna; epifauna; hydrography; gas chromatography; spectroscopy; abundance; diversity; multivariate statistics; Atlantic Region.

BACKGROUND: With the lack of success in exploratory drilling on the Outer Continental Shelf off the U.S. Atlantic coast, oil companies have been looking to the slope and rise for resources. Therefore, the need to acquire baseline data for deep sea areas of resource interest was identified. Consequently, the U.S. Department of the Interior sponsored a series of studies to characterize the slope and rise environment as a basis for an evaluation of the impacts of drilling. The study of the continental slope and rise of the U.S. South Atlantic Ocean was conducted in two phases. The report summarized herein describes the data collected during Phase 2.

OBJECTIVES: (1) To characterize biological, geological, and chemical properties of benthic environments at a limited number of stations within areas of potential oil and gas development on the U.S. South Atlantic slope and rise; (2) To monitor potential changes in these properties over time in order to determine the extent of natural temporal variations; and (3) To determine the background distribution of trace metals and hydrocarbons that may accumulate due to future drilling activities.

DESCRIPTION: The field program for Phase 2 included nine primary sampling stations located off the North and South Carolina coasts. Two stations were located in the vicinity of Lease Block 510 off Cape Hatteras, North Carolina in water depths of 800 and 2,000 m. Another station, Station 4, was located in 2,000-m depths off Cape Lookout, North Carolina. A cross slope transect composed of three stations was established off Cape Fear, North Carolina in depths of 800, 2,000, and 3,000 m. Another transect was established on the northern Blake Plateau, located off Charleston, South Carolina, in depths of 800, 2,000, and 3,000 m. An additional station in 600 m water depths was sampled during the second cruise of Phase 2. Replicate box core samples were taken at each station using a 0.25 m2 box corer. Each sample was divided into subcores of 0.01 m2. Subcores were partitioned for various analyses including organics determinations, sediment grain size, trace metal chemistry, hydrocarbon chemistry, and meiofauna. Samples for biological analyses were sieved through 0.03 mm screens, preserved in 10% buffered formalin, and transferred to 70% alcohol. Samples for chemical, sediment grain size, and CHN determinations were frozen until analyzed.

Towed camera sleds equipped with 35-mm survey cameras were used to photograph and characterize the epifauna of the study area. Camera transects were made in proximity to Lease Block 510 off Cape Hatteras, on the Cape Fear transect, and more fully along the Charleston transect. A total of eleven camera-sled tows were made. Epifaunal samples were collected with a Day dredge and a 40-ft otter trawl equipped with steel doors.

At each station, hydrocasts were made using a Niskin bottle equipped with three reversing thermometers. Samples of near-bottom water were collected for measurements of temperature, salinity, and dissolved oxygen. In the laboratory, biological samples were sorted and organisms identified to the lowest possible taxon. Photographic samples were analyzed for surficial geology, topography, faunal associations, species occurrence, and abundance. Sediment hydrocarbon levels were determined using synchronous scanning ultraviolet/fluorescence spectrophotometry and gas chromatography/mass spectroscopy. Sediment grain size was determined with pipette procedures for silt and clay fractions while larger fractions were sieved on a shaker. Brittle star and sea urchin tissues were analyzed for trace metals and hydrocarbons using atomic absorption spectroscopy and gas chromatography/mass spectroscopy, respectively. Statistical analyses of biological community data included the calculation of Shannon-Wiener diversity index, rarefaction curves, and species accumulation curves. Also, community analyses were performed using normal and inverse cluster analyses and reciprocal averaging ordination. Mean abundances of 18 common species were subjected to the analysis of variance to examine differences among stations and sampling times.

SIGNIFICANT CONCLUSIONS: The biological communities of the U.S. South Atlantic slope and rise differ from those recorded from the U.S. North and Mid-Atlantic deep sea programs. Communities differ in terms of faunal composition and their associated sediment characteristics. Collections from the South Atlantic slope and rise revealed more species and individuals than the Mid- or North Atlantic regions. In the northern regions, diversity increased with increasing water depth, while in the South Atlantic the most diverse stations were scattered over a range of depths. Apparently the distribution of substrates and currents in the southern region are responsible for the observed heterogeneity. Many of the infaunal species collected were new to science. Stations exhibiting the highest diversities were along the Cape Hatteras transect and the Charleston transect. Sediments and organisms were found to be uncontaminated by hydrocarbons or trace metals.

STUDY RESULTS: Analysis of the deep-sea benthic and infaunal communities off North and South Carolina has revealed one of the richest and most diverse on the U.S. Atlantic slope and rise. Infaunal samples collected during this survey yielded a total of 1,202 species, including 40% of which were new to science. The highest diversity was recorded at off Charleston, South Carolina in 800 m water depths. Annelids, mostly polychaetes, numerically dominated the collections. Arthropods were second in abundance, followed by molluscs. Cluster analysis revealed community differences in depth and along depth contours. Differences occurred along the contours from Cape Hatteras, North Carolina to Charleston, South Carolina confirming the presence of a zoogeographic barrier. Wet weight analysis of infauna suggested a general decrease in infaunal biomass with increasing depth.

Epifaunal camera tows were completed on the continental slope north of Blake Plateau. The epifauna found on the northeastern slope of Cape Hatteras and Cape Fear were similar to other slope areas. Epifaunal patterns found off Charleston differed substantially. Total megafaunal densities were highest along the lower slope, particularly where the brittle star Ophiomusium lymani was present. A hard coral, Bathypsammia tintinnabulum, was very abundant on the middle slope off Charleston. This species was not found on any other South Atlantic transect. The Blake Plateau environment was entirely different from the slope environment. The seafloor of the Blake Plateau consisted of a hard pavement of cemented sediments and manganese encrusted outcrops, occasionally with layers of coarse-grained material. The Charleston Bump, a topographic high, supports a unique epifauna composed of filter feeding corals and sponges. The fauna on the upstream side of the Bump consists mostly of gorgonians. Stylasterid corals predominated on the downstream portion of the Bump.

No indication of hydrocarbon contamination of the sediments was found. The distribution of polycyclic aromatic hydrocarbons found in the study area was what would be expected for the slope and rise of the South Atlantic. Hydrocarbon levels did not correlate with the sediment grain size or percent carbon in the sediment.

Hydrocarbon levels in the tissues of brittle stars and sea urchins ranged from 5.2 to 322 µg/g wet weight. In most samples, saturated hydrocarbon components were higher than unsaturated/aromatic compounds. Regardless of species, aluminum and iron showed the highest levels in the tissue samples. The lowest concentrations were found for chromium, lead, and mercury.

Sediment texture and composition varied with depth and latitude. The upper slope stations had high percentages of sand (mostly foramaniferan tests). Some deeper stations had relatively coarse sediments owing to the effect of the Western Boundary Undercurrent. In general, most sediments were poorly sorted.

STUDY PRODUCT(S): Blake, J. A., B. Hecker, J. F. Grassle, B. Brown, M. Wade, P. D. Boehm, E. Baptiste, B. Hilbig, N. Maciolek, R. Petrecca, R. E. Ruff, V. Starczak, and L. Watling. 1987. Study of Biological Processes on the U.S. South Atlantic Slope and Rise, Phase 2. Vol. 1, Executive Summary; Vol. 2, Final Report. A final report by Battelle Ocean Sciences, Woods Hole Oceanographic Institution, Lamont-Doherty Geological Observatory of Columbia University, and the Ira C. Darling Center, University of Maine for the U. S. Department of the Interior, Minerals Management Service Atlantic OCS Region, Vienna, VA. Vol. 1 - NTIS No. PB87-214342; Vol. 2 - NTIS No. PB87-214359. MMS Report 86-0096. Contract No. 14-12-0001-30064. vii + 58 pp. (Vol. 1); 414 pp. + app. (Vol. 2).

*P.I.'s affiliation may be different than that listed for Project Manager(s).