STUDY TITLE: South Texas OCS Baseline Study, Geology, FY 1975

REPORT TITLE: Environmental Studies, South Texas Outer Continental Shelf, 1975: Geology, Part I: Geologic Description and Interpretation and Part II: Inventory of Data Archived and Analyzed

CONTRACT NUMBER: BLM: 08550-MU5-20

SPONSORING OCS REGION: Gulf of Mexico

APPLICABLE PLANNING AREA: Western Gulf of Mexico

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COSTS: FY 1975: $567,946; CUMULATIVE PROJECT COST: $567,946

PROJECT MANAGERS: H. Berryhill, Jr.

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KEY WORDS: Western Gulf; Texas; baseline; geology; shelf; hydrography; physical oceanography; biology; chemistry; trace metals; particulate matter; water column; sediment; mineralogy; currents; seasonality; wind forcing; infauna; epifauna; faunal zones; benthic photographs; hazards pollutants; survey; shipboard observations

BACKGROUND: These geologic investigations were one element of a coordinated interdisciplinary environmental assessment which also included chemistry, biology, and physical oceanography. The overall environmental assessment was part of a national program to provide the Bureau of Land Management with the scientific information necessary to make sound management decisions regarding the development of mineral resources on the Outer Continental Shelf (OCS) and to provide the basis for predicting the impact of oil and gas exploration and development on the marine environment.

OBJECTIVES: (1) To investigate the subsurface geologic framework of the continental terrace; (2) To study the nature and physical sedimentology of surficial and shallow subsurface seafloor sediments; (3) To describe the biogeologic and animal-sediment relationships in surficial and shallow subsurface sediments; (4) To investigate the geochemistry of surficial seafloor sediments, including the trace metals and organic carbon content; (5) To determine the amount and mineralogy of sediments suspended in the water column; (6) To determine the trace metals content of sediments suspended in the water column; and (7) To investigate seafloor stability.

DESCRIPTION: The South Texas OCS study area extended northward from the U.S.-Mexico International Boundary to the northern end of Matagorda Island, Texas and seaward from the Federal-State territorial boundary 16.6 km to the approximate position of the 200-m isobath or outer edge of the continental shelf. A sampling net of 275 bottom stations spaced along 27 transects was established. A series of shipboard sampling cruises included bottom grab samples for geological, chemical, and biological analyses; water samples from various depths for suspended sediments; core samples for lithologic stratification and biogenic structures; bottom photographs; expendable bathythermograph profiles for temperature and depth trends; and surface drifters for circulation trends. Geophysical data used for compiling the geologic framework included extensive high resolution seismic reflection analog profiles and side-scan profiles.

SIGNIFICANT CONCLUSIONS: The seafloor of the South Texas OCS is predominantly a mud province which might have a greater tendency for retention of industrial pollutants than a more permeable and aerated sandy province. Areas of pronounced textural variability, such as the northern and southern delta sectors, would be more prone to differential compaction and subsidence, which could produce instability hazards associated with platform and pipeline construction. The central OCS sector functions as a mud depocenter, and could function as a receptacle for the long-term concentration of pollutants toward the southern sector of the OCS region. The most dense and diverse macrobenthic infaunal assemblages occurred in shallow water within the general area of the ancestral deltas of the Brazos-Colorado and Rio Grande Rivers (to the north and south of the OCS area). Impact on infaunal populations would be greatest in those areas. Bioturbation in these regions would also tend to work pollutants into deep sediments, increasing the probability of long-term retention and higher concentration of the pollutant. Trace metals in estuarine sediments adjacent to the continental shelf were relatively higher than in sediments on the OCS. Cadmium and manganese concentrations were significantly high in suspected gas seep areas on the outer edge of the northeastern part of the OCS. Average levels of trace metals within the study area were comparable to the overall northern Gulf of Mexico.

STUDY RESULTS: The primary structural features within the continental terrace are a series of anticlinal folds with a northeastward regional trend. Extensive secondary structures associated with the folds include numerous faults that tend to converge downward from above the anticlinal crests. A localized syncline of broad closure that trends southeastward across the southern third of the OCS is a cross structure imposed on the northeastward trend of the older and deeper lying folds.

Quantitatively, the highly dominant mud component of the seafloor was silt which appeared to be effectively trapped hydraulically within the OCS environment. The subordinate clay fraction appeared to reflect a more open dispersal system, with substantial clay detritus escaping into deep Gulf environments. The majority of the OCS region was classified as a clayey silt province, with sand quantitatively dominant only along the shoreface sector and within portions of the ancestral Brazos-Colorado and Rio Grande River deltas. The gravel fraction was minor and composed almost entirely of biogenic materials. The rate of sediment deposition during all of Holocene

time appears to have been relatively high, exceeding a meter per thousand years locally.

Distribution of biological components in the study area was not homogeneous. Biomass and diversity decreased with increasing depth and was lower within the central sector when compared to the north and south ancestral delta sector. Five macrobenthic infaunal assemblages in the study area were defined relative to species distribution and density, diversity-equitability, and biogenic sedimentary structures. The most dense and diverse assemblage was located in the southwestern corner of the study are, while assemblages near the shelf edge in the central sector showed relatively low density and diversity. Polychaeta, Arthropoda, and Mollusca were the dominat infaunal taxa. In general, density and diversity of macrobenthic infauna have increased over the study area over time. Biological-geological-hydrological relationships were identified as important factors controlling macrobenthic infaunal zonations. In contrast, interspecific relationships seemed to be insignificant.

The organic carbon content for the central sector was higher than the extreme north and south sectors probably die to finer sediment size encountered in this area. Carbonates were higher in the northeast and far southern areas. Trace metals were in higher concentrations along the outer edge of the shelf in the northeastern part of the OCS.

Folds and associated faults within the continental terrace indicated relatively low-level, long-term, and progressive movements, probably related to sediment accumulation and diapirism. Disturbance of seafloor sediments by slumping was restricted to the outer periphery of the ancestral Rio Grande River delta.

STUDY PRODUCTS: Berryhill, H.L., Jr. (ed.). 1976. Environmental Studies, South Texas Outer Continental Shelf, 1975: Geology. Part I, Geologic Description; Part II, Inventory of Data Archived and Analyzed. A final report by the U.S. Geological Survey for the U.S. Department of the Interior, Bureau of Land Management Gulf of Mexico OCS Office, New Orleans, LA. NTIS No. PB-251341. Contract No. 08550-MU5-20. 335 pp.

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