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

REPORT TITLE: Environmental Studies, South Texas Outer Continental Shelf, 1975: An Atlas and Integrated Summary

CONTRACT NUMBER: BLM: MU5-20

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APPLICABLE PLANNING AREAS: Western Gulf of Mexico

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KEY WORDS: Western Gulf; Texas; baseline; geology; shelf; hydrography; physical oceanography; biology; chemistry; trace metals; hydrocarbons; particulate matter; sediment; mineralogy; currents; seasonality; wind forcing; infauna; epifauna; ichthyoplankton; fish; survey; shipboard observations

BACKGROUND: In 1974, the Bureau of Land Management (BLM) was authorized to initiate a National Outer Continental Shelf (OCS) Environmental Studies Program to include all OCS areas considered for future petroleum leasing and development. To accomplish this goal, the BLM developed an operational plan that included four phases of effort in those segments of the OCS that yielded oil and gas. The phases were (1) summary of existing knowledge; (2) baseline sampling and gathering of supportive descriptive and predictive data based on consideration of data gaps indicated by review of existing data; (3) special topical and additional descriptive and predictive studies as directed by the initial studies; and (4) environmental monitoring of oil and gas exploration and development.

OBJECTIVES: (1) To provide information about the OCS environment that will enable sound management decisions regarding the development of mineral resources; (2) to provide a basis for predicting the impact of oil and gas exploration and development on the marine environment; (3) to establish a basis for predicting the impact of OCS oil and gas activities in frontier areas; and (4) to provide impact data that might result in modification of leasing regulations, operating regulations, or operating orders.

DESCRIPTION: The South Texas OCS study area covered approximately 19,250 km^2 and extended northward from the U.S.-Mexico International Boundary to the midpoint of Matagorda Island, Texas and seaward from the Federal-State territorial boundary 16.6 km to the outer edge of the continental shelf (200-m isobath). This project was multidisciplinary in nature, and involved sampling of both water mass and sediment. Water mass studies included hydrography and physical oceanography (water mass structure, movement and variations, severe conditions); biology (planktonic populations, biomass, productivity levels, macrofauna, taxonomy); and chemistry (trace metals and hydrocarbons in particulates and in organisms, hydrocarbons in solution, micronutrients, dissolved oxygen, salinity). Sediment studies included biology (identification of benthic communities, total biomass, species diversity, extent of bioturbation); chemistry (trace metals, hydrocarbons, organic carbon, carbonate); and geology (texture and mineralogy of unconsolidated sediments, structural features with emphasis on faults and chronology of faulting, seeps, slumps). As a supplement to the field sampling and acquisition of new data, pertinent historical data of two types were used: sample material previously collected but not analyzed; and analytical data available but not extensively published.

SIGNIFICANT CONCLUSIONS: Directions of movement for surficial water on the inner shelf were reasonably well known; directions of movement at depth were progressively less known seaward. Seasonal changes in hydrographic conditions were reasonably well established. Nutrient patterns in the study area were predictable, allowing for yearly differences in amounts due to variations in continental runoff. Biologically, the inner shelf region was the most critical part of the study area relative to monitoring future petroleum development. Further work was needed over a several year period to establish meaningful regional patterns in trace metals and hydrocarbons. Due to evidence of slumping in some areas, detailed site-specific surveys should be conducted prior to placement of structures and pipelines. The general incoherence of shallow sediment in areas susceptible to hurricanes suggests the need for burying any pipelines laid across the shelf.

STUDY RESULTS: Water movement was seasonally influenced by relative winds, with net flow southward in winter, northward in summer, and multidirectional in spring/fall. The study area was influenced by two regimes of water mass movement/influx of continental runoff on the inner shelf, and movement of open Gulf water onto the outer shelf. The inner shelf region displayed marked variability in hydrography with respect to season, as compared to the more stable outer shelf region.

Amounts of the nutrients phosphate, nitrate, and silicate showed strong geographic zonation, with each showing distinctly different seasonal patterns. Nutrients on the

inner shelf were strictly seasonal, and were related to continental runoff in spring and subsequent utilization by plankton.

Numerical abundance of marine organisms showed strong geographic zonation, with plankton most abundant along the inner shelf. Their distributions were seasonally similar to nutrient patterns. Epifaunal, infaunal, and ichthyoplanktonic organisms were more numerous along the inner shelf, and clustered in the northern and southern parts. Larger and more motile organisms (e.g., pelagic fish) showed less obvious geographic patterns.

Trace metal concentrations in biota and sediments from present studies were found to be similar to amounts found in previous studies. No amounts significantly larger than normal were measured. Concentrations were regionally higher along the inner shelf, due to continental runoff, and within the fine-grained sediments along the outer shelf, which were enriched with pelagic organic remains.

Abnormally high concentrations of methane were found at mid and near-bottom water depths, both at the mid shelf and along the edge of the shelf. It was not determined whether the source was biogenic or petrogenic, nor was it determined that the high concentrations found were normal or an anomaly for the region. Both low molecular weight and heavy hydrocarbons showed inconsistent patterns.

Patterns of sediment (grain size) distribution were predictable, based on energy levels of moving water relative to water depth. Sand-sized sediments were predominant on the inner shelf and decreased in abundance seaward. Net long-term movement of sediment along the shelf appeared to be southward. Surficial and near-surface bottom sediments were relatively soft and not suitable for bearing heavy structures at shallow depths. Some slumping of seafloor sediments occurred along the periphery of the ancestral Rio Grande River delta at the edge of the continental shelf. Over much of the ancestral Rio Grande River delta, where firm relict sand and soft mud were locally adjacent, sea floor stability was highly variable over short distances. Faulting of Holocene sediments all along the outer part of the continental terrace was indicated by geophysical data. Movements have been progressive along the faults, with evidence of recent activity. Seepage of natural gas along a number of faults was suggested by seismic profiles. Diapiric salt has penetrated almost to the sea floor in two places along the faults of the outer shelf, producing domal structures. The nature of the faulting associated with the salt domes suggested that future movement can be expected.

STUDY PRODUCT: Berryhill, H. L., Jr. (ed.). 1977. Environmental Studies, South Texas Outer Continental Shelf, 1975: An Atlas and Integrated Summary. A final report by the University of Texas, Texas A&M University, Rice University, National Marine Fisheries Service, National Ocean Survey, and the U.S. Geological Survey for the U.S. Department of the Interior, Bureau of Land Management Gulf of Mexico Office, New Orleans, LA. NTIS No. PB80-217763. Contract No. 08550-MU5-20. 303 pp.

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