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KEY WORDS: Western Gulf; Matagorda Bay; Texas; geology; particulate matter; water column; benthos; stratigraphy; sediment; deposition; trace metals; geochemistry; mineralogy; shelf; transport; shipboard observations; plankton; currents; resuspension; grain size; seasonality

BACKGROUND: This study was designed to provide qualitative data relative to defining the environmental character of the South Texas Outer Continental Shelf (OCS) as it related to the mission of the Bureau of Land Management. These studies were a continuation of studies begun in 1974 as part of the National OCS Environmental Studies Program. The study was designed to provide seasonal data as further details and quantification of sedimentary processes operative on the South Texas OCS.

OBJECTIVES: (1) To determine amounts, composition, sources, and dispersal patterns for inorganic particulate matter suspended in the water column; (2) to identify textural stratigraphy and sedimentary structures and shallow subbottom sediments; and (3) to investigate the geochemistry of benthic sediments along the 27° N Lat anomaly.

DESCRIPTION: Four cruises were made to the South Texas OCS study area in October-November 1976 and March, May, and May-June 1977. On these cruises, cores were taken for benthic sediment analyses as well as water samples at near

surface, mid depth, and near bottom. In investigating suspended sediments, subsampling was completed for textural analysis, transmissivity/temperature profiles, trace metal content, clay mineralogy, and surface drifters. Twenty-two benthic sediment cores were analyzed for trace metals and 251 samples were studied for clay mineralogy.

SIGNIFICANT CONCLUSIONS: The results of these studies, designed to determine the distribution of trace metals in suspended sediments by seasons and the relationship between total particulates, total carbon, and clay minerals, led to the conclusion that two water masses interact over the south Texas OCS: an inner shelf water mass and an outer shelf water mass. Total particulates and montmorillonitic clay signify a terrigenous input on the inner shelf as opposed to a strong organic input on the outer shelf. Bottom waters apparently flow from the outer to the inner shelf. Trace metals seem to be associated with microorganisms of the outer shelf, although some contribution may be due to seeping natural gas. Trace metals are most abundant over the outer shelf, whereas particulates are most abundant on the inner shelf. The higher trace metal concentrations encountered on the outer shelf seem to be correlated with the finer grained, highly organic sediments characteristic of this region.

STUDY RESULTS: Textural gradients of suspended sediments in surface and bottom waters were highly variable. Very fine silt tended to be the most dominant sediment type. Hydraulic fractionation within the water column or differences in surface and bottom dispersal mechanisms may explain the observed differences in surface and bottom grain size patterns. Regionally, sediment coarseness increased seaward, possibly due to an increase in large biogenic particulates.

Surface and bottom water sediments were poorly to very poorly sorted. This may reflect the complex nature (i.e., multiple components) of the suspended particulate system which included phytoplankton, zooplankton, and inorganic fractions. Sediment uniformity was reduced seaward possibly due to a size difference between organic and inorganic fractions.

Cadmium, lead, nickel, copper, and zinc in surface waters increased in a seaward direction. This pattern was similar to that evident for total carbon, yet was directly inverse of the pattern noted for total particulates. The data seem to suggest that trace metals in suspended sediments were influenced by planktonic activity. In addition, manganese, iron, and vanadium were generally more concentrated in bottom than near surface waters. This was also true for total particulates. Other elements did not show clear patterns but did indicate an association with carbon. The seasonal variability evident appeared to be associated with biological activity. An overall pattern indicated an increase in percent carbon or a decrease in total suspended sediment.

The highest concentrations of suspended sediments were noted for the inner shelf near the mouths of estuarine systems. High energy coupled with internal waves and tidal forces may have contributed to significant increases in sediment concentrations in bottom waters along the shelf edge in fall and early spring. Organic carbon was higher in surface than bottom waters. Organic carbon was also higher in the late spring when

energy conditions needed to transport inorganic constituents and contributions from land sources would be at a minimum.

Three major clay types were identified in the suspended sediments. These three types were also present in the fine clay fraction, comprising 34-70% of the clay substances present. Illite dominated the suspended material, whereas montmorillonite dominated bottom sediments. The data indicated that material in the water column on the shelf is derived from detrital materials flushed from bays. Smaller suspended sediment fractions also indicated the contribution of seafloor-derived sediment.

Seafloor sediment texture was seasonally variable which appeared to be random and with no consistent seasonal trend. Generally, grain size decreased and sorting improved seaward.

Moving bottom water capable of transporting sediments for long distances is a characteristic of the South Texas OCS. Two possible sources of these currents included: (1) internal waves from the deeper Gulf that feel bottom along the 90 m isobath; or (2) a loop current that swings frequently onto the outer shelf. Bioturbation on the inner shelf possibly enhances the susceptibility of the bottom sediments to resuspension and transport. Hurricanes are believed to deposit sand during and immediately after their passage from sources along shorelines. The currents generated by the hurricanes can transport the sediments for long distances.

In examining seasonal variability in trace metal content of surface sediments, no apparent differences were evident in the seasonal and areal values for zinc, cadmium, iron, and copper. By comparison, seasonal variability was greater than areal variability for barium, chromium, manganese, nickel, lead, and vanadium. This variability appeared to be greater at the innermost stations on the shelf and seasonal variations affected some elements more than others. However, average trace metal content on a yearly basis did not change significantly in spite of the fact that seasonal variation was evident.

Trace metal content in the upper 10 cm of the sediment column revealed an apparent geochemical discontinuity roughly at 27° N Lat. Sediments to the north contained less manganese, nickel, and copper than those south of the parallel. This anomaly was attributed to two distinct processes. South of Matagorda Bay, a region of fine sediment deposition and increased manganese content was noted. The manganese content appeared to be related to rapid deposition of detrital substances coated by a manganese film. Further south, the increased manganese content has been caused by an upward migration of manganese through the sediment coupled with slow sedimentation. East of Corpus Christi, the manganese concentration at the edge of the shelf has been attributed to the deposition of clay-sized sediments plus upward migration.

STUDY PRODUCT: Berryhill, H. L., Jr. (ed.). 1978. Environmental Studies, South Texas Outer Continental Shelf, 1977: Geology. 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-289144. Contract No. AA550-MU7-27. 306 pp.

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