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STUDY TITLE: Environmental and Geologic Atlas of the Texas Coastal Zone

REPORT TITLE: Submerged Lands of Texas, Galveston-Houston Area: Sediments, Geochemistry, Benthic Macroinvertebrates, and Associated Wetlands

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KEY WORDS: Western Gulf; Texas; fates and effects; coastal zone; estuarine; lagoons; wetlands; shelf; sediment; geochemistry; erosion; deposition; benthos; macrofauna; invertebrates; trace metals; satellite imagery; maps; Galveston Bay; diversity; faunal zones; floral zones; spectrometry

BACKGROUND: State-owned submerged lands of Texas encompass almost 15,540 km^2. These lands lie below waters of the bay-estuary-lagoon system and below waters of the Gulf of Mexico. Their importance is reflected in the flora and fauna they support as well as in the one-third of the state's population that lives within the coastal zone. Man's interactions with these submerged lands demand a comprehensive understanding of the potential short-term and long-term impacts of these interactions. This understanding can be gained in part through a detailed inventory of the basic components of these lands. This project was designed to accomplish such an objective.

OBJECTIVES: (1) To identify, map, and characterize sediment texture, sediment geochemistry, benthic macroinvertebrates, and associated wetlands of the submerged

lands of Texas.

DESCRIPTION: Surficial sediment samples were taken with grab samplers at sites approximately 1.6 km apart in the bay-estuary-lagoon system and to a distance of 18 km seaward of the Gulf shoreline. Textural analysis of sediments included quantitative determinations of gravel, sand, and mud fractions. More than 6,500 samples were analyzed for total organic carbon content. Approximately 3,800 samples were analyzed using an inductively coupled plasma-atomic emission spectrometer for as many as 65 trace and major element components. A total of 1,050 samples from bays and estuaries and 550 samples from the inner shelf were examined for benthic organisms. Wetlands were mapped using NASA color infrared satellite imagery taken in 1979. This report provided the results of data collected for the Galveston Bay area.

SIGNIFICANT CONCLUSIONS: Muds and sandy muds were the dominant sediment types in bay-estuary-lagoon and inner shelf areas identified during this study. Shell represented only a minor fraction of shelf sediments. Sediment type distributions reflected different levels of wave and current energy controlled mostly by water depth. Concentrations of chemical elements correlated with sediment texture (i.e., highest concentrations in fine grained sediments, lowest in sandy sediments). Higher than normal concentrations in some sediments were attributed to anthropogenic sources. Polychaetes, bivalves, gastropods, and crustaceans dominated benthic assemblages. Differences existed in distribution patterns and diversity between inner shelf and bay samples. Marshes in the area included fresh, brackish, and salt water types, with brackish and salt water marshes noted as being the most extensive. Occurrence of swamps in the area was notable because of the scarcity of such features in other parts of the coast. Compactional subsidence due to natural and human induced causes, sea level rise, and faulting have contributed to changes such as submergence of marshes and woodlands in many areas.

STUDY RESULTS: Sediments in the Galveston-Houston coastal area have been derived from a number of sources including river deposition, shoreline erosion, redistribution and transport of sediments, eolian transport, biological organisms, and spoil materials. Mud, sandy mud, and muddy sand were the dominant sediment types noted in the bay-estuary-lagoon system. Mud and sand also dominated the shelf sediments. The average trace metal concentrations in muds tended to be comparable or lower than baseline levels of all elements. However, barium, chromium, copper, lead, manganese, nickel, and zinc were generally higher than the expected baseline concentrations. These high levels have typically been found near industrial developments such as the Houston Ship Channel and Texas City. The Trinity River may also contribute to high concentrations noted in Trinity Bay.

Polychaetes were the dominant macrobenthic organisms in both the bays and on the inner shelf. The highest number of species within the bays occurred at stations near San Luis Pass and Bolivar Roads. On the inner shelf, species numbers tended to be higher in a depth range of 3.7 to 11 m. High species numbers also occurred south of Bolivar Roads and 1.6 to 4.8 km offshore. Species numbers directly correlated with

percent sand at the inner shelf stations. In the bay, stations with a shell content greater than 10% had high numbers of species. Diversity was generally low in the bays, although parts of West Bay and lower Galveston Bay exhibited high to very high diversity. West Bay had the highest median diversity is the study area. On the inner shelf, diversity was generally high to very high. Macrobenthic assemblages included a nearshore, transitional, and outer zone on the inner shelf. In bays, six assemblages were noted and included river influenced, inlet influenced, bay margin, oyster reef, open bay center, and grassflat.

Nineteen wetland environments were identified within the Galveston-Houston area. These wetland units were defined on the basis of vegetation communities which reflect soil moisture and salinity, frequency of flooding or elevation, and hydrodynamic processes which form and maintain the wetlands. Wetland changes that have occurred in the Galveston-Houston area include the expansion of open water or shallow subaqueous flats into areas previously occupied by marshes, woodlands, and uplands. Marshes have expanded along the bayward side of the modern barriers into areas previously characterized by wind tidal flats. Wetlands have also formed farther up the valleys of bayous and creeks. In addition, several existing marshes have expanded landward and wetter conditions have developed on the downthrown sides of faults especially in areas periodically flooded by tides. In some cases, marine grasses have been reduced or eliminated along the bayward margins of barrier islands. Human activities have also reduced or modified wetlands in some areas. Many of these changes have been brought about by human-induced subsidence, natural compactional subsidence, and an accompanying rise in sea level.

STUDY PRODUCT: White, W. A., T. R. Calnan, R. A. Morton, R. S. Kimble, T. G. Littleton, J. H. McGowen, H. S. Nance, and K. E. Schmedes. 1985. Submerged Lands of Texas, Galveston-Houston Area: Sediments, Geochemistry, Benthic Macroinvertebrates, and Associated Wetlands. A final report by the University of Texas at Austin for the U.S. Department of the Interior, Minerals Management Service Gulf of Mexico OCS Region, Metairie, LA. Contract No. 14-12-0001-30070. 145 pp. + map packet enclosing 6 plates (scale 1:250,000).

*P.I.'s affiliation may be different than that listed for Project Managers.