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BACKGROUND: This study was part of a three-year evaluation of suspended sediments within the South Texas Outer Continental Shelf (OCS) region. Physical properties of the suspended particulate system studied were the turbidity of the water and the texture of the suspended particulates.

OBJECTIVE: To determine the spatial and temporal variability in the distribution of suspended sediments in order to gain insight into the regional sediment transport system.

DESCRIPTION: Suspended sediments were monitored over a three-year period in the South Texas OCS. During the first two years, measurements of turbidity, sediment texture, and hydrography were made at 26 stations on 6 cruises conducted over an 18-month period. Information on summer and winter turbidity patterns was also collected in the third year from an analysis of satellite (i.e., LANDSAT) imagery.

The 26 monitoring stations were located to give optimum coverage of the region and to provide concentrated coverage of inlets at Matagorda Bay, Aransas Pass, and Rio

Grande-Brazos Santiago Channel. These inlets were selected because they serve as major sources of sediment for the nearshore zone of the study region. Water samples collected in the field were analyzed in the laboratory for texture and total particulate concentrations. Satellite imagery was qualitatively analyzed for turbidity patterns and flow directions. Composite maps for each of 10 overpass dates were prepared. Wind and tidal information for each overpass period were plotted on the maps to relate imagery patterns to possible forcing agents. Imagery data were then integrated with field observations.

SIGNIFICANT CONCLUSIONS: The sediment dispersal system over the South Texas OCS was characterized by substantial temporal and spatial variability. The system involved the interaction of relatively turbid, inner shelf waters that moved alongshore and gulfward and nonturbid open-Gulf waters that moved shoreward onto the outer shelf. Winds appeared to drive waters along the inner shelf; deep Gulf circulation mechanisms forced outer shelf water movements. The degree of interchange between the opposing water masses appeared to determine regional turbidity patterns. Temporal and spatial sediment dispersal patterns were probably due to ambient wind conditions, runoff volume from adjacent fluvial systems, and the degree of incursion by open Gulf waters.

Subsurface turbidity structure and thermostructure were both spatially and temporally variable. The study detected the widespread occurrence of a benthic nepheloid layer which was also highly variable in time and space. This layer tended to increase in thickness seaward and had a complex relationship to thermostructure. Most suspended sediment transport within the South Texas OCS probably occurs within this nepheloid layer.

STUDY RESULTS: Inner shelf waters were highly turbid, with increasing turbidity towards shore. The turbidity structure followed coastline orientation and bathymetry. This probably reflected a diffusive and advective offshore transport from a coastal line source as well as a progressive shoreward increase in wave surge intensity that maintained sediment in suspension. Local gradients were also evident at the major coastal inlets which served as point sources and dispersal centers of sediment introduced onto the shelf via ebb tide discharge. Flushing of lagoonal-estuarine waters was most effective during periods of strong northerly storm winds which were associated with the passing of cold fronts. An alongshore sediment transport component appeared to be the result of wind-driven currents.

Outer shelf waters were relatively non-turbid and had low shoreward increasing gradients. This gradient was not consistent with coastline orientation and bathymetry, reflecting the incursion of adjacent deeper Gulf waters onto the shelf. The shelfward incursion of open ocean waters also appeared to be supported by previously conducted microzooplankton studies.

Turbidity patterns varied both seasonally and annually. Turbidity was highest in fall and lowest in early spring. Higher turbidity in the region during the second year of the study was attributed to generally higher discharge from adjacent rivers. Secondarily, this pattern probably also reflected variations in deep Gulf circulation which resulted in a lower degree of shelfward incursion by non-turbid, open ocean waters.

Satellite imagery corroborated observations on regional turbidity patterns obtained from surface water measurements. These data indicated that regional surface-sediment dispersal patterns along the inner shelf were controlled by coastline curvature and ambient wind conditions. Winds with strong northerly components resulted in alongshore transport to the south-southwest; southerly winds produced north-northeast transport.

The zone of turbid nearshore waters was of maximum width east of Galveston Bay where the shelf widened substantially. The turbid zone was generally narrowest in the central sector between Corpus Christi Bay and Baffin Bay where the coast exhibited maximum curvature.

A benthic nepheloid layer was detected using a time sequence of transmissivity/temperature gradients at each observation station. These measurements detected an average bottom water sediment concentration over 2.5 times greater than surface concentrations. This nepheloid layer was repeatedly observed during the study.

Turbidity structure and thermostructure near inlets appeared to be controlled by short-term diurnal variations in ambient hydrographic conditions which control the degree of interaction between inlet tidal waters and coastal waters. Hydrographic variables included tidal current strength, longshore currents which control the dispersal direction of ebb-tide sediment plumes, and wave-surge intensity which controls the degree of benthic sediment resuspension and water homogenization. Three water layers were commonly observed: (1) a turbid layer reflecting the seaward dispersal of an ebb-tidal sediment plume; (2) a turbid bottom layer reflective of resuspension of benthic sediments by wave surge; and (3) an intermediate depth layer of relatively low turbidity.

The inner shelf included those waters less than 45 m deep. Spatial and temporal variability was attributed to the shallow waters and associated hydrographic variability. No systematic seasonal trends were apparent. Turbidity structures within the water column at individual stations ranged from isoturbid to well stratified, two and three layer structures. An intermittent nepheloid layer at the inner shelf stations was best developed in the presence of thermoclines and negative temperature gradients. The nepheloid layer was minimal or nonexistent in isothermal waters.

The outer shelf waters included those areas where water depths were greater than 45 m. Turbidity structure and thermostructure within the outer shelf sector of this zone had substantial spatial and temporal variability but was less variable within the inner shelf sector. The most prevalent turbidity structure consisted of a stratified, two or three layer water column with a well defined benthic nepheloid layer. Thickness of the nepheloid layer was seasonally variable. The greatest thickness occurred along the southern shelf edge.

Although regional textural patterns of suspended sediments were highly variable within the OCS, some general relationships were evident. Very fine silt was the predominant size of suspended sediment. There was a seaward increase in sediment coarseness and a seaward reduction in uniformity or sorting, indicating a seaward increase in the proportion of relatively large biogenic components incorporated in the particulate system. Bottom sediments were better sorted than surface sediments, suggesting a lower concentration of size variable organic constituents. Average sorting was best during fall, possibly reflecting a relatively low proportion of size divergent organic particulates. The average sediment was coarser during the first-year program whereas sorting was not significantly different between the two years.

STUDY PRODUCT: Shideler, G. L. 1978. Physical Characteristics of Suspended Sediments, South Texas Continental Shelf. 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. PB80-164130. Contract No. AA551-MU8-11. 68 pp.