DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-901
SHIDELER AND BERRYHILL—SEA-FLOOR
SEDIMENTS, SOUTH TEXAS INNER CONTINENTAL
SHELF, CORPUS CHRISTI BAY AREA

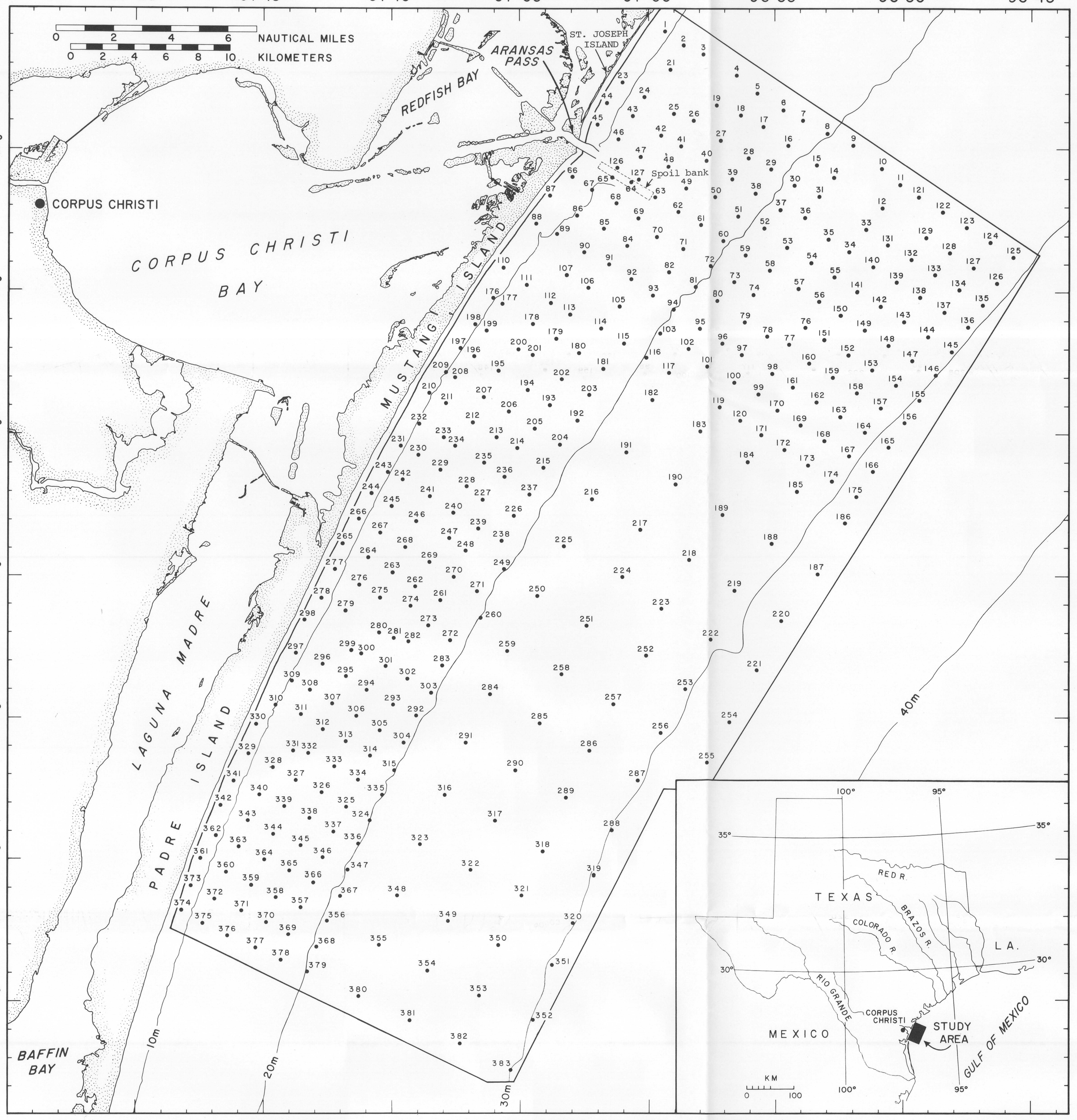

Figure 1. Map showing locations of surficial sea-floor sampling in the study area.

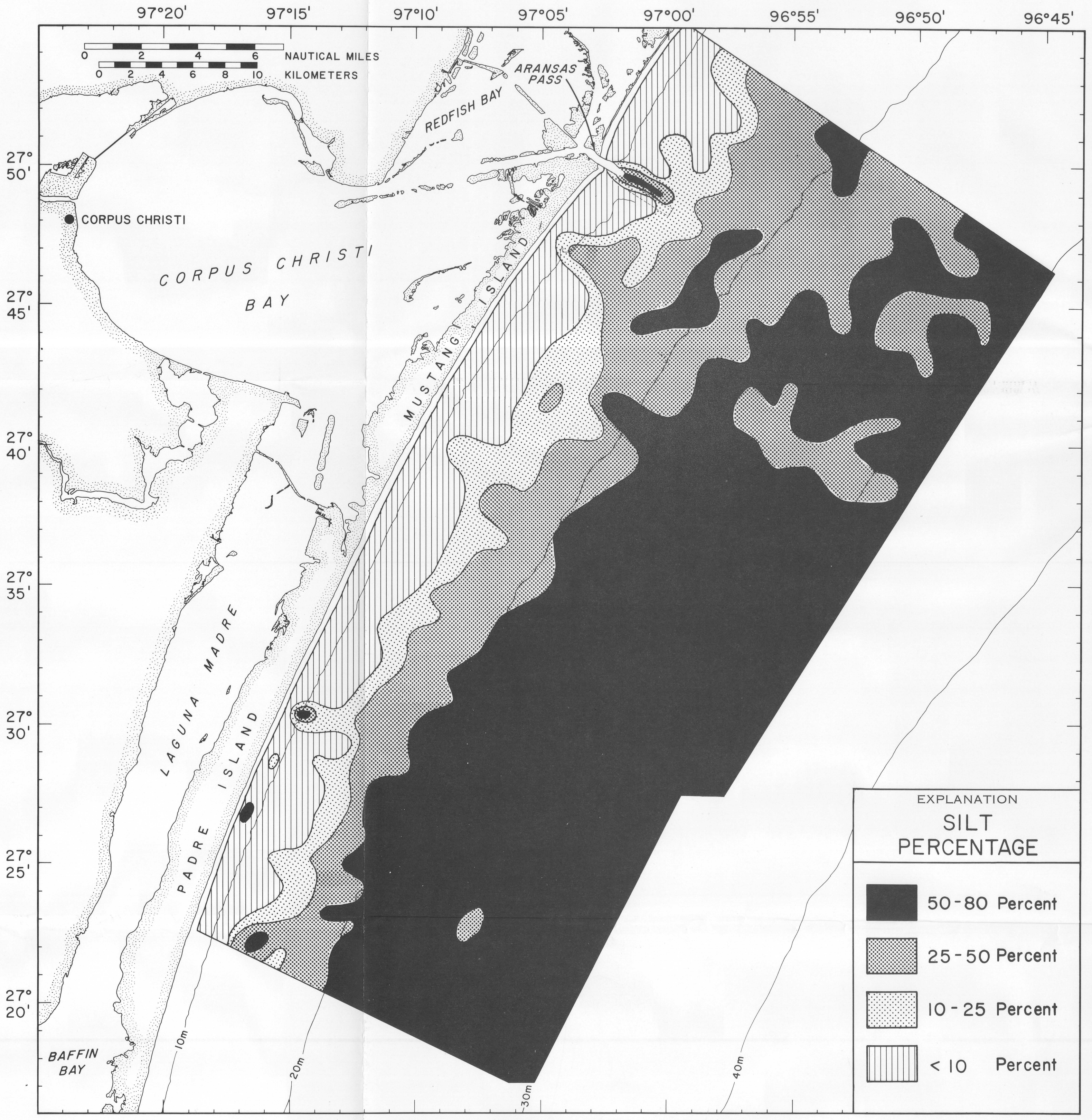

Figure 3. Map showing distribution of silt-size constituents in surficial sea-floor sediments from the study area.

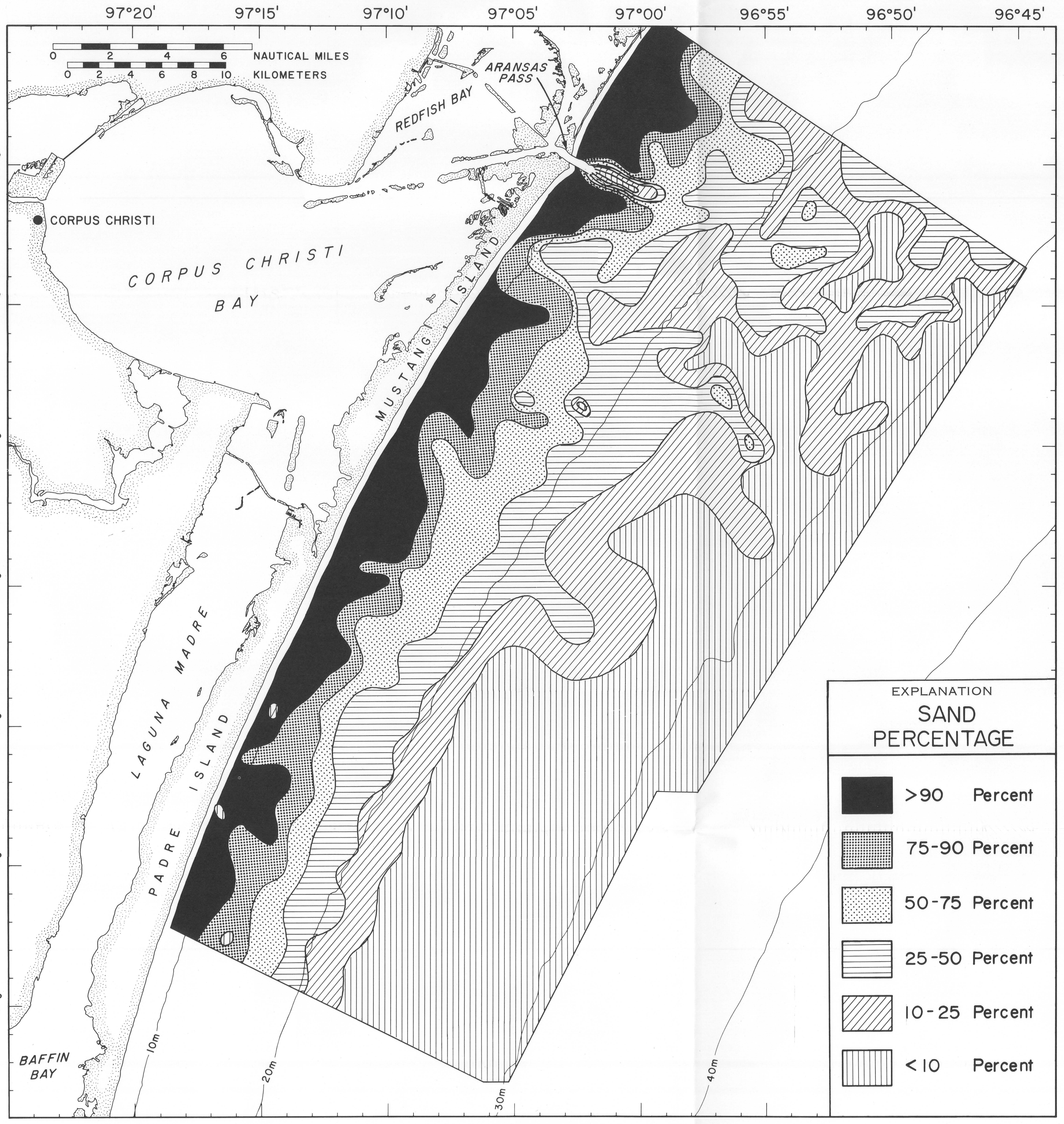

Figure 2. Map showing distribution of sand-size constituents in surficial sea-floor sediments from the study area.

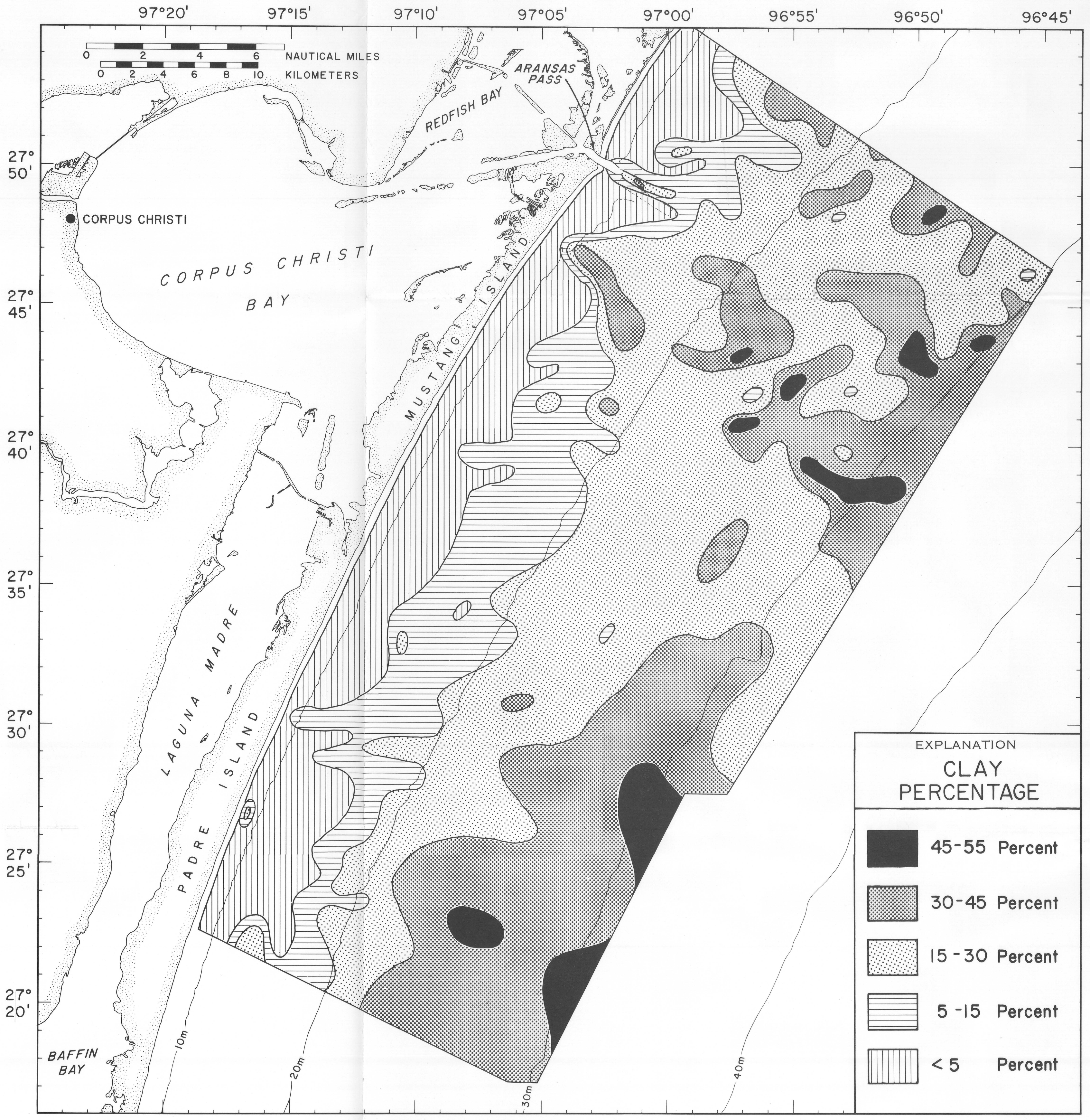

Figure 4. Map showing distribution of clay-size constituents in surficial sea-floor sediments from the study area.

INTRODUCTION

Effective coastal-zone management programs require a thorough knowledge of the nature of adjacent nearshore sea-floor sediments. The purpose of this report is to describe the general textural composition of surficial sea-floor sediments within a sector of the inner continental shelf along the south-central Texas coast between Corpus Christi Bay and Baffin Bay. This knowledge can be utilized in studies of local nearshore natural resources, of benthic ecosystems, or of sedimentary processes within the highly dynamic and complex nearshore environment. This study is an extension of an earlier local investigation of inner-shelf sediments within the Aransas Pass (Corpus Christi Bay Inlet) area by Berryhill and others (1975). In addition, sea-floor sediment texture on the adjacent South Texas outer continental shelf has been described earlier (Shideler, 1976a).

The study area is in the northwest Gulf of Mexico, extending from lat 27°17' to 27°55' N., and from long 96°45' to 97°19' W. (fig. 1). Seaward, it extends from near the shoreline to a maximum depth of 32 meters. The sea floor is relatively smooth; it has an average seaward gradient of approximately 1.8 m/km in the shallower shoreface sector (<20-m depth), and 0.7 m/km within the deeper sector. The adjacent coast is characterized by a well-developed barrier-island structure and an extensive back-barrier lagoonal-estuarine system; the main tidal inlet within the area studied is Aransas Pass, which is maintained for navigation by periodic dredging operations.

METHODS

A total of 374 surficial-sediment samples were obtained over a one-year field period (1973-74), using a Shipek[1/] grab sampler with a 0.1 m^3 capacity and a 10-cm penetration depth. A rectangular 1-sq-mi sample grid was used along the shallower shoreface sector and within the northern sector near Aransas Pass where pronounced textural variations were anticipated; whereas, the remainder of the area was sampled along a 2-sq-mi grid. Shipboard navigation was accomplished by a combination of radar, Loran C, and a precision trisponder system.

In the laboratory, the sediment samples were analyzed texturally. Representative work samples were digested in a hydrogen peroxide solution (30 percent) to oxidize carbonaceous organic matter; the samples were then washed to remove soluble salts and were dispersed in a standard sodium hexametaphosphate solution (5 g/l). Following dispersion, the samples were fractionated by wet-sieving into gravel (>2 mm), sand (2 mm-63 μm), and mud (<63 μm) fractions. The mud fraction was subjected to further size analysis by Coulter Counter (Model TA) to determine the relative proportions of silt (63 μm-3.9 μm) and clay (<3.9 μm), using techniques described elsewhere (Shideler, 1976b). The weight percentage of each grain-size component was then determined. Gravel percentages are quantitatively minor and are based on the total sample. In contrast, the sand, silt, and clay percentages are based on the nongravel fraction.

DISCUSSION

Gravel

The sediments of gravel size (>2 mm) are essentially biogenic detritus. Except for an occasional carbonate-lithic clast, the gravel is mainly molluscan shell fragments; pelecypod shells are highly dominant. Quantitatively, gravel is minor, constituting less than 1 percent of the sediment weight throughout most of the study area; consequently, its distribution was not mapped. Gravel contents exceed 1 percent at only 21 stations and reach a maximum of 6.7 percent at station 278. With a single exception (station 53), all stations with gravel contents in excess of 1 percent are at depths of less than 20 m. These stations are mainly along the shoreface south of Corpus Christi Bay within the lat 27°31'-27°40' N. interval. Some gravel also tends to be localized near the spoil bank south of the Aransas Pass jetties; this may represent dredged shelly material from the back-barrier navigation channels.

Sand

The sediments of sand size (2 mm-63 μm) are mainly terrigenous detritus. Using Folk's (1954) system, Curray (1960) has classified the light-mineral fraction as ranging from orthoquartzitic in the northernmost sector to subarkosic throughout the remainder of the area. A study of the heavy-mineral assemblage by van Andel and Poole (1960) indicated a mixed provenance for sands of the study area; they were derived from a combination of the Rio Grande, Colorado River, and coastal Pleistocene sources. In terms of grain size, the sand fraction is mainly very fine grained (63-125 μm) detritus and highly subordinate quantities of fine-grained (125-250 μm) detritus.

Sand contents at individual stations range from near zero to a maximum of 98.7 percent (station 210). The areas of highest sand concentration (>90 percent) are along a linear zone adjacent to the shoreline within water depths shallower than 15 m (fig. 2). Sand is the dominant component (>50 percent) in areas that are largely localized shoreward of the 20-m isobath, except for a few isolated deeper localities within the northern sector. The smallest amounts of sand (<10 percent) generally are localized in water depths greater than 20 m, except for a few small local sand-deficient areas on the southern shoreface and adjacent to the Aransas Pass jetties. The regional pattern of sand distribution indicates that the southern two-thirds of the area exhibits a well-defined gradient of decreasing sand seaward. The isopleths indicating relative sand content are largely parallel to isobaths, probably reflecting a regional seaward reduction in ambient wave-surge intensity. Curray (1960) noted that the frequency of fine-sand movement by significant wave surge (bottom-surge velocities $\geq$ 35 cm/sec) decreases seaward-trending salients of increased sand content probably reflect seaward transport during storms. After passage of Hurricane Carla along the Texas coast in 1961, a study by Hayes (1967) suggested that coastally derived sands were deposited over a muddy sea floor to depths exceeding 18 m.

In contrast to the southern two-thirds of the area, the northern one-third has a more complex pattern of sand variability that is attributed to the influence of Aransas Pass. Sand content, as indicated by the isopleths, does not exhibit a systematic relationship to bathymetry; the isopleths tend to be subparallel to the isobaths within the nearshore sector (<15-m depth), but they are highly discordant to the isobaths in deeper water. The sand distribution probably largely reflects a dispersal pattern resulting from the complex interaction of longshore currents with the tidal current regime of Aransas Pass. It is feasible that the nearshore pattern could partially reflect rudiments of an inlet ebb-tidal delta, possibly constructed largely by sand deposition during storms. Effluent from the inlet during normal fair weather appears to be sand-deficient. However, ebbing storm-surge waters from the inlet, as well as waters overtopping the narrow barrier (St. Joseph Island) just north of the inlet, could transport substantial sand seaward. This mechanism may have produced the seaward-trending sand salient outlined by the 50-percent isopleth just north of the inlet; a more detailed bathymetric map of this area shows that the sand salient is also a slight topographic shoal (Berryhill and others, 1975). Deeper water sands within this northern sector may similarly have had a storm-transport origin. The distribution of sand in close proximity to the inlet may also partially reflect effects from inlet dredging and spoil-disposal activities.

Silt

The sediments of silt size (63 μm-3.9 μm) at individual stations range from near zero (fig. 3) to a maximum of 78 percent (station 342). Silt is the most widely distributed detritus, constituting the dominant (>50 percent) size fraction throughout at least half of the study area. Relative to water depth, silt is dominant in areas largely seaward of the 20-m isobath. The lowest concentrations of silt (<10 percent) are in a linear zone adjacent to the shoreline. The regional silt trend within the southern two-thirds of the area is inversely related to the sand trend; the amount of silt progressively increases seaward. The isopleths indicating silt content are largely parallel to isobaths, apparently reflecting a seaward reduction in ambient wave-surge intensity. In contrast, the northern part of the area has a more complex pattern of silt variability, apparently attributable to the interaction of longshore currents with the tidal-current regime of Aransas Pass. The local pattern at the mouth of Aransas Pass suggests that silt is the dominant inlet effluent, an inference supported by ongoing suspended-sediment studies.

Clay

The sediments of clay size (<3.9 μm) at individual stations range from near zero (fig. 4) to a maximum of 55 percent (stations 121, 349). Except for gravel, clay is the least abundant detrital fraction. Clay is the dominant component (>50 percent) at only four isolated localities (stations 98, 121, 166, 349), which are restricted to depths greater than 20 m. The areas of lowest clay content (<5 percent) are in a linear zone adjacent to the shoreline. The regional day trend within the southern two-thirds of the area is much like the silt-distribution pattern; clay content increases seaward. Once again, the concentration isopleths are largely parallel to isobaths, apparently reflecting a seaward reduction in wave-surge intensity. Similar to both the sand and silt patterns, the clay pattern of the northern third of the area is more complex. This variable northern pattern also is apparently related to the influence of Aransas Pass, probably a significant source of clay-size detritus.

An X-ray diffraction study of outer shelf sea-floor sediments (2.0-0.45 μm fraction) in areas adjacent to, and partially encompassing, the present study area indicates that the predominant clay mineral is the expandable variety, probably Ca-montmorillonite (Berryhill and others, 1976). Illite is the second most common clay mineral, whereas a third "chlorite-type" mineral was identified only in trace proportions.

1/ Any trade names in this publication are used for descriptive purposes only and do not constitute endorsement by the U.S. Geological Survey.

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MAPS SHOWING SEA-FLOOR SEDIMENT TEXTURE ON THE SOUTH TEXAS INNER CONTINENTAL SHELF, CORPUS CHRISTI BAY TO BAFFIN BAY

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