DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

TO ACCOMPANY MAP MF-1530

MAPS SHOWING TIME-SEQUENCE SURFACE PATTERNS OF ESTUARINE HYDROGRAPHY AND SUSPENDED SEDIMENTS IN CORPUS CHRISTI BAY, TEXAS GULF COAST

By

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INTRODUCTION

This report presents time-sequence surface patterns of hydrographic and suspended-sediment characteristics within the Corpus Christi Bay estuarine system of the Texas Gulf Coast. The patterns are based on field measurements obtained by eight surveys conducted during a 25-month observational period from March 1978 to April 1980. The purpose of these time-sequence measurements was to provide a data base for investigating estuarine sedimentation processes within Corpus Christi Bay. The need for these measurements was indicated by an earlier reconnaissance study of the bay's turbidity structure (Shideler, 1980), a study that indicated high variability of bay conditions in both time and space.

Corpus Christi Bay is a restricted "bar-built" variety of estuary (Schubel, 1981), which is typical of the Texas Gulf Coast (fig. 1). The bay is separated from the Gulf of Mexico by the Mustang Island barrier, and the bay's main tidal inlet (Aransas Pass) is near the city of Port Aransas, Tex. The main fluvial input into the estuarine system is from the Nueces River, which discharges into shallow (<2 m deep) Nueces Bay. In turn, Nueces Bay has water exchange with Corpus Christi Bay through a causeway-connected inlet. Minor stream discharge enters Corpus Christi Bay along its south shore from the shallow (<3 m deep) Oso Bay tributary. Corpus Christi Bay also has water exchange with Redfish Bay to the north and with Laguna Madre to the south. The depth of Corpus Christi Bay is generally less than 5 m, except along the ship channel, which is dredged to a depth of approximately 14 m. The bottom sediment of both Corpus Christi Bay and Nueces Bay is mainly mud within the interiors and sand along the marginal areas (Shideler and others, 1981).

ACKNOWLEDGMENTS

The authors acknowledge their gratitude to personnel of the U.S. Coast Guard Station in Corpus Christi for providing helicopter support. Gratitude is also expressed to the several U.S. Geological Survey staff members of the Corpus Christi office who provided assistance in fieldwork and laboratory analyses.

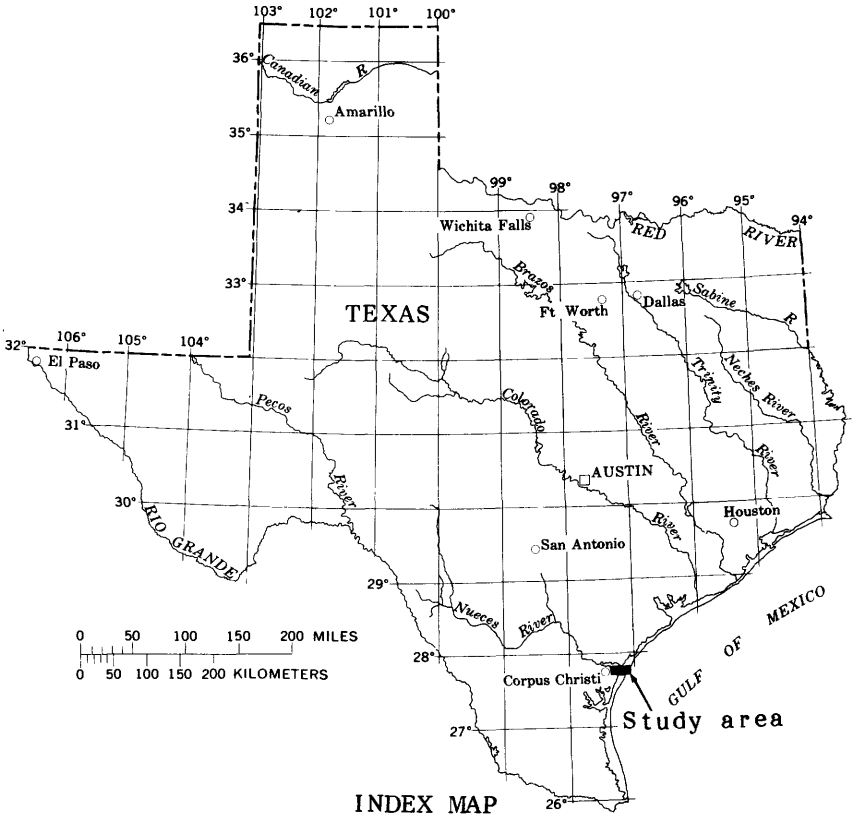
METHODS

Field measurements of surface hydrographic and suspended-sediment parameters were made at 15 monitoring stations (designated A through O), which were positioned to provide complete geographic coverage of the estuarine system (fig. 1). The measurements were made during eight separate surveys that encompassed all seasons. The surveys were conducted on the following dates: March 8, 1978; July 19, 1978; November 29, 1978; January 24, 1979; May 31, 1979; August 8, 1979; October 3, 1979; and April 23, 1980. All surveys utilized a U.S. Coast Guard amphibious helicopter, thus permitting the acquisition of quasi-synoptic field measurements. The sampling time required for individual surveys ranged from 2.5 to 5.5 hours (h), and the mean time was 4.3 h. The sequence of station sampling for individual surveys was arranged so that the inlet station (O) was consistently sampled during a flood time. The sample stations were located using TACAN navigation. During each survey, *in situ* water transmissivity and temperature measurements were obtained at each monitoring station by use of a light-beam transmissometer (25-cm optical path) system. A surface-water sample also was obtained with a 3-l Van Dorn[1] bottle at each station. From each bulk water sample, a 1-l laboratory subsample was immediately transferred to a particle-free amber polypropylene bottle containing sufficient particle-free formaldehyde to result in a 5 percent (by volume) formaldehyde solution; the formaldehyde was added to inhibit organic growth prior to the laboratory analyses for suspended-sediment texture and concentration. A 250-ml untreated subsample also was transferred to a particle-free polyethylene bottle for salinity measurements in the laboratory. Several ballasted surface-drifter bottles were released at each station during sampling to obtain information on surface-drift patterns for each survey. The surface-drifter data are recorded in two groups: those bottles recovered 0-2 days from release and those recovered 3-5 days from release.

In the laboratory, the untreated water subsamples were analyzed for salinity in parts per thousand (ppt) using an induction salinometer and a Copenhagen seawater standard. The formaldehyde-treated subsamples were analyzed for suspended-sediment concentrations and textures. Sediment concentrations were determined by gravimetric analysis. The mass (mg/l) of the total suspended particulate matter was determined by filtration through a pre-washed 0.45 micrometer (μ m) millipore filter; salt was removed from the sediment residue by the filtration of deionized water. The textures of suspended sediment were determined by means of model TA Coulter[1] counter, using procedures outlined in detail elsewhere (Shideler and Stelting, 1982). The textural analyses were conducted using a combination of 200-μm- and 30-μm-tube apertures, thus providing analyses of particles within the 0.63- to 81-μm size range. Statistical grain size parameters of the particulate matter were then derived by computer. Derived grain-size parameters include silt/clay ratios, and the moment measures of particle mean diameter and standard deviation. The moment measures are expressed in terms of Krumbein's (1934) phi scale ($\phi = -\log_2 D$, where D = particle diameter in millimeters).

The field and laboratory measurements provided the basis for the construction of time-sequence maps illustrating the bay's hydrographic and suspended-sediment characteristics during the eight surveys, as illustrated by surveys 1-4 on sheet 1 and surveys 5-8 on sheet 2. The basic measurement data are presented in tabular form elsewhere (Shideler and Stelting, 1982). For each survey, hydrographic conditions are illustrated by the surface-drifter pattern, and by contour maps of water temperature degrees (C) and salinity (ppt). Turbidity conditions are illustrated by

[1]Use of trade names is for descriptive purposes only and does not constitute endorsement by the U.S. Geological Survey.



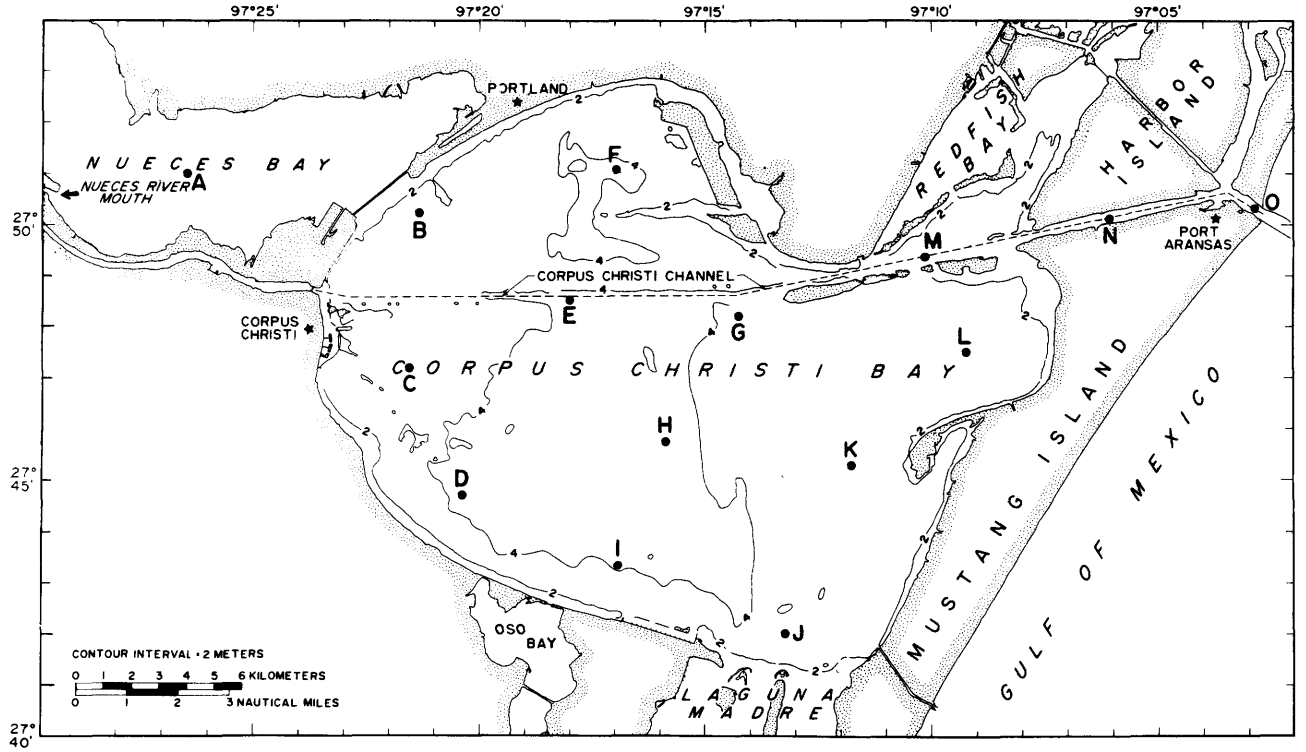


Figure 1.—Corpus Christi Bay bathymetry and locations of monitoring stations (A–O).

complementary contour maps of both water transmissivity (T), expressed as %T/0.25 m, and the total mass (mg/l) of suspended sediment. The textural characteristics of suspended sediment are illustrated by contour maps of the following parameters: 1) silt/clay ratios that show the proportions of the two highly dominant components of the suspensate; 2) mean diameters (ϕ) that show the average grain size of the total suspensate, which consists of a sand-silt-clay mixture; and 3) standard-deviation ($\sigma\phi$) values that show the sorting characteristics of the particulate matter. In order to relate the hydrographic and suspended-sediment characteristics to forcing agents, the wind and tidal conditions associated with each survey were determined. Wind speed and directional data for the Corpus Christi area were obtained from the U.S. National Weather Service; local tidal data were obtained from the U.S. Army Corps of Engineers tide gauge stations at the Nueces Bay causeway and at Port Aransas.

DISCUSSION OF RESULTS

March 8, 1978, Survey

The initial survey (CCHS-1) was conducted over a 6-h period. During the survey, the tide was flooding at Aransas Pass inlet and ebbing from Nueces Bay inlet. The daily resultant wind vector on the survey date was toward the south (180°) and had a speed of 24.5 km/h. The surface-drifter pattern indicates predominantly southward water movement for the early drifter returns (days 0-2), reflecting wind-driven currents generated by northerly winds during March 7-9. The later drifter returns (days 3-5) indicate predominantly westward movement, apparently reflecting a shift to mainly southeasterly and easterly winds during March 10-12. Surface-water temperatures of the estuarine system ranged from 13.5 to 16.0°C, and had a mean value of 13.8°C. Water salinities ranged from 26.6 to 32.2 ppt, and had a mean value of 30.6 ppt. The temperature and salinity gradients indicate the movement of a relatively warmer and higher-salinity water mass that was ebbing from Nueces Bay into Corpus Christi Bay, which was characterized by a general absence of lateral temperature and salinity gradients.

The turbidity of surface waters during the survey is illustrated by both water transmissivity and suspended-sediment concentrations. Surface-water transmissivity ranged from 0 to 21 percent, and had a mean value of 7 percent. The transmissivity gradients indicate relatively higher turbidity within Nueces Bay and in the southern half of Corpus Christi Bay. A plume of less-turbid tidal waters was flooding into the bay from Aransas Pass inlet. Further indications of estuarine turbidity are illustrated by the sediment-concentration gradients, which are inversely related to the water-transmissivity gradients. Sediment concentrations ranged from 17 to 176 mg/l, and had a mean value of 41 mg/l. Highest concentations occurred in Nueces Bay, from which an ebb-tidal plume of relatively turbid water flowed into Corpus Christi Bay. Concentrations also were higher within the southern half of Corpus Christi Bay relative to the northern part; this is attributed to the northerly winds, which appear to have caused more intense wave action and bottom-sediment resuspension in a down-fetch direction.

Texturally, the silt/clay ratios of suspended particulate matter during the survey ranged from 0.43 to 0.89 and had a mean value of 0.66, thus indicating that clay-size (<3.9 μm) detritus was the dominant component of the suspensate by volume. The ratio gradients illustrate increasing silt content (increasing coarseness) toward the southern and eastern shores of Corpus Christi Bay, possibly reflecting higher wave energy. The gradients also indicate ebb-tidal discharge of clay-rich sediment from Nueces Bay into Corpus Christi Bay. The mean diameters of suspended particles ranged from 8.00 to 8.63 ϕ; a grand mean value of 8.26 ϕ indicates that clay also was the average grain size of the suspensate. The mean-diameter gradients are in general agreement with silt/clay-ratio gradients; they illustrate a tongue of relatively finer sediment along the longitudinal axis of Corpus Christi Bay, with the finest sediment occurring within Nueces Bay. The sediment standard-deviation values range from 1.23 to 1.65$\sigma\phi$and have a mean vaue of 1.38 $\sigma\phi$, illustrating that the suspended particulate matter was poorly sorted. The sorting gradients show a general correlation with grain-size gradients; the coarser sediments tend to be more poorly sorted.

July 19, 1978 Survey

The second survey (CCHS-2) was conducted over a 5.5-h period during which the tide was flooding at both Aransas Pass and Nueces Bay inlet. The daily resultant wind vector was toward the northwest (320°) with a speed of 18.7 km/h. The surface-water circulation pattern indicated by drifters shows northwestward movement for both the early and the later drifter returns, apparently reflecting wind-driven currents generated by persistent southeasterly winds during the entire July 14-24 period. Water temperatures ranged from 27.0 to 34.0°C, and had a mean value of 31.8°C. Temperature gradients indicate the bayward movement of relatively cool flood-tide waters from Aransas Pass. Water salinities ranged from 27.1 to 36.9 ppt, and had a mean value of 34.1 ppt. The salinity gradients are pronounced throughout the estuary, and indicate the northward flushing of higher-salinity waters from northern Laguna Madre into Corpus Christi Bay; this is attributed to wind-driven currents generated by the persistent southeasterly winds, in agreement with the drifter pattern.

The surface-water transmissivity during the survey ranged from 3 to 63 percent, and had a mean value of 17 percent. The transmissivity gradients indicate relatively higher turbidity within the bayhead sector; they also indicate plumes of less turbid water entering Corpus Christi Bay from both Aransas Pass and northern Laguna Madre. Sediment concentrations throughout the estuarine system ranged from 5 to 111 mg/l, and had a mean value of 21 mg/l. The concentration gradients, in agreement with transmissivity gradients, show increasing turbidity toward the bayhead sector, with highest turbidity occurring within Nueces Bay. The concentration gradients also show the bayward influx of less-turbid waters from Aransas Pass and Laguna Madre. The turbidity pattern appears to be largely the result of the persistent southeasterly onshore winds. The winds resulted in more intense wave action and bottom-sediment resuspension in a down-fetch direction, generating greater turbidity within the bayhead sector. Additionally, the southeasterly winds effectively flushed less-turbid waters from Laguna Madre northward into Corpus Christi Bay.

The silt/clay ratios of suspended sediment during the survey ranged from 0.42 to 1.39 and had a mean value of 0.74, indicating that clay-size detritus was dominant over silt-size detritus. The ratio gradients indicate a pronounced plume of relatively silty sediment coming into the bay with the flood-tidal waters through Aransas Pass, as well as an influx of clay-rich sediment transported from Laguna Madre by wind-driven currents. The mean diameters of suspended sediments ranged from 7.34 to 8.54 ϕ; a grand mean value of 8.14 ϕ indicates that clay was the average grain size of the suspensate. In agreement with silt/clay ratios, the mean-diameter gradients illustrate the bayward influx of relatively coarse sediment from Aransas Pass and fine sediment from northern Laguna Madre. Sediment standard-deviation values ranged from 1.14 to 1.75 $\sigma\phi$, and had a mean value of 1.49$\sigma\phi$, indicating that the suspended matter was poorly sorted. The sorting gradients correlate with grain-size gradients, whereby the coarser sediments tend to be more poorly sorted.

November 29, 1978 Survey

The third survey (CCHS-3) was conducted over a 4.5-h period. Tidal conditions during the survey consisted of flooding at Aransas Pass and ebbing at the Nueces Bay inlet. The daily resultant wind vector was toward the southeast (140°) with a speed of 1.9 km/h. The surface-water

movement indicated by drifters was predominantly to the north and northeast. This movement does not appear to reflect currents generated by the weak northeasterly winds during the survey, but was probably a result of stronger southerly winds during the post-survey period (November 30-December 3). Surface-water temperatures ranged from 15.6 to 18.3°C, and had a mean value of 17.7°C. Water salinities ranged from 22.5 to 29.9 ppt, and had a mean value of 28.4 ppt. The temperature-salinity gradients indicate the ebb-tidal movement of a relatively cooler and lower-salinity water mass from Nueces Bay into Corpus Christi Bay. Relatively cool and lower-salinity waters also entered the bay from Aransas Pass. The bay was characterized by lateral-salinity gradients that indicate decreasing salinities northward, apparently reflecting dilution effects from the two inlets.

Surface-water transmissivity ranged from 5 to 33 percent, and had a mean value of 18 percent. The transmissivity gradients indicate increasing turbidity toward the southern shore of Corpus Christi Bay. Sediment concentrations ranged from 5 to 16 mg/l, and had a mean value of 9 mg/l. In agreement with transmissivity, the concentration gradients also show a general southward increase in turbidity.

During the survey, the silt/clay ratios of suspended matter ranged from 0.41 to 1.15 and had a mean value of 0.73, indicating a dominance of clay-size detritus. The ratio gradients indicate a progressive coarsening toward the bay's interior. Sediment mean diameters ranged from 7.77 to 8.51 ϕ ; the grand mean value was 8.16 ϕ , indicating that clay was the average grain size of the suspensate. The mean-diameter gradients illustrate a coarsening toward the bay's interior, similar to the silt/clay-ratio gradients. Particle standard deviations ranged from 1.18 to 1.54$\sigma\phi$ and had a mean value of 1.39$\sigma\phi$, indicating that the suspended matter was poorly sorted. The sorting gradients show a correlation with grain-size gradients, with the coarser sediments in the bay's interior having poorer sorting.

January 24, 1979 Survey

The fourth survey (CCHS-4) was conducted over a 5-h period while the tide was flooding at both Aransas Pass and Nueces Bay inlet. The daily resultant wind vector was toward the southwest (220°) with a speed of 6.0 km/h. The surface-drifter pattern shows mainly westward water movement for the early drifter returns, probably reflecting resultant currents generated by alternating northeasterly and southeasterly winds during January 24-26. The later drifter returns show a greater southwestward component, apparently reflecting the persistent northeasterly winds during Janury 26-29. Surface-water temperatures ranged from 9.5 to 12.0°C and had a mean value of 11.4°C. Water salinities ranged from 23.3 to 28.7 ppt, and had a mean value of 27.6 ppt. The temperature and salinity gradients indicate the bayward influx of relatively warm and lower-salinity flood-tide waters from Aransas Pass. Throughout the remainder of the estuarine system, gradients were subdued but did show a slight reduction in both temperature and salinity toward the bayhead sector.

Surface-water transmissivity ranged from 2 to 16 percent, and had a mean value of 5 percent. Transmissivity gradients were not well developed regionally, but they do indicate areas of less-turbid water in proximity to the two inlets. Sediment concentrations throughout the estuarine system ranged from 11 to 83 mg/l, and had a mean value of 37 mg/l. The concentration gradients show a general reduction in turbidity along the longitudinal axis of Corpus Christi Bay, with highest turbidity occurring along the bay's northern margin. The gradients suggest the westward movement of relatively less-turbid waters along the axis of the bay; this may represent the bayward migration of flood-tidal waters from Aransas Pass, possibly enhanced by currents driven by northeasterly winds.

The silt/clay ratios of suspended sediments ranged from 0.31 to 1.19 and had a mean value of 0.88, indicating the dominance of clay-size detritus. The ratio gradients illustrate a well-defined bayward reduction in silt content away from Aransas Pass toward Nueces Bay; a reduction in silt toward northern Laguna Madre is also evident. The mean diameters of suspended sediments ranged from 7.70 to 8.57 ϕ ; a grand mean value of 8.00 ϕ indicates that particles at the silt/clay size boundary (3.9 μm) constituted the average grain-size component of the suspensate. The mean-diameter gradients illustrate a pattern similar to the silt/clay-ratio pattern, both of which indicate the tidal influx and bayward migration of relatively coarser sediment from Aransas Pass. The particle standard-deviation values ranged from 1.00 to 1.72$\sigma\phi$ and had a mean value of 1.41$\sigma\phi$, indicating that the suspended matter was poorly sorted.

May 31, 1979 Survey

The fifth survey (CCHS-5) was conducted over a 4-h period during which the tide was flooding at both Aransas Pass and Nueces Bay inlet. The daily resultant wind vector was toward the northwest (300°) with a speed of 22.4 km/h. Surface-water movement indicated by the drifter pattern was toward the west for both early and later drifter returns. This pattern appears to reflect wind-driven currents generated by persistent southeasterly onshore winds during the survey and most of the post-survey period. Surface-water temperatures ranged from 26.0 to 28.0°C, and had a mean value of 27.0°C. The temperature gradients indicate relatively cooler flood-tide waters coming from Aransas Pass, with only minor temperature variations throughout the bay itself. Water salinities illustrate a substantial range (15.5 to 29.8 ppt) and had a mean value of 25.1 ppt. Pronounced baywide salinity gradients indicate that plumes of relatively higher-salinity waters were moving bayward from both Aransas Pass and Laguna Madre. The Laguna Madre plume was apparently the result of wind-driven currents generated by persistent southeasterly winds, which also probably enhanced the influx of a higher-salinity flood-tidal plume from Aransas Pass. The introduction of the two plumes resulted in highly pronounced lateral salinity gradients throughout the entire estuarine system.

Surface-water transmissivity during the survey ranged from 1 to 17 percent, and had a mean value of 5 percent. Transmissivity gradients indicate plumes of relatively less-turbid water influxing bayward from both Aransas Pass and northern Laguna Madre. Sediment concentrations throughout the estuarine system ranged from 4 to 74 mg/l, and had a mean value of 28 mg/l. The concentration gradients agree with the transmissivity gradients, indicating less-turbid waters influxing from Aransas Pass and Laguna Madre. The gradients show increasing turbidity toward the bayhead sector, with the greatest tubidity occurring within Nueces Bay. The turbidity pattern is primarily the result of the persistent southeasterly onshore winds.

Suspended-sediment silt/clay ratios ranged from 0.13 to 1.07 and had a mean value of 0.60, indicating that clay-size detritus was dominant over silt. The ratio gradients show a bayward influx of relatively silty sediment from both Aransas Pass and Laguna Madre. The gradients also show a general reduction in silt content toward the bayhead, with Nueces Bay being a clay-rich area. Particle mean diameters ranged from 7.77 to 9.24 ϕ ; a grand mean value of 8.31 ϕ indicates that clay was the average grain size. The mean-diameter gradients are in general agreement with the silt/clay-ratio gradients, indicating coarser sediment coming from Aransas Pass and Laguna Madre with a reduction in grain size toward the bayhead. Particle standard-deviation values ranged from 1.12 to 1.90$\sigma\phi$ and had a mean value of 1.54 $\sigma\phi$, indicating that the suspended sediments were poorly sorted. The sorting gradients correlate with grain-size gradients, with coarser sediment being more poorly sorted.

August 8, 1979 Survey

The sixth survey (CCHS-6) was conducted over a 3-h period. During the survey, the tide was flooding at Aransas

Pass and was weakly ebbing or near slack water at Nueces Bay inlet. The daily resultant wind vector was toward the northwest (300°), with a speed of 11.9 km/h. The drifter pattern indicates that surface-water movement was toward the northwest for both the early and later drifter returns, apparently reflecting wind-driven currents generated by persistent southeasterly onshore winds during the survey and post-survey period. Surface-water temperatures ranged from 30.0 to 31.5°C, and had a mean value of 30.7°C. The temperature gradients were not pronounced, but do indicate slightly warmer waters along the relatively shallow southern and eastern margins of Corpus Christi Bay. Water salinities displayed a wide range, from 13.6 to 32.8 ppt, and had a mean value of 26.2 ppt. Salinity gradients were very pronounced throughout the estuarine system, and indicate a flood-tidal plume of relatively high-salinity water entering the bay from Aransas Pass. The gradients also show a progressive reduction in salinity toward the bayhead sector, with lowest salinities occurring within Nueces Bay. The pronounced salinity gradients probably reflect strong flood-tidal currents through Aransas Pass which were enhanced by the persistent southeasterly onshore winds; the onshore winds probably also retarded lower-salinity waters from leaving Nueces Bay.

Surface-water transmissivity ranged from 1 to 74 percent, and had a mean value of 15 percent. The transmissivity gradients indicate a flood-tidal plume of less-turbid water entering the bay from Aransas Pass; they also show increasing turbidity toward the bayhead sector. The transmissivity pattern also suggests some outflow of less-turbid water from Laguna Madre into the bay. Sediment concentration throughout the estuarine system ranged from 0.4 to 42 mg/l, and had a mean value of 13 mg/l. The concentration gradients are in agreement with transmissivity gradients, showing increasing turbidity toward the bayhead sector; highest sediment concentrations are present within Nueces Bay. The turbidity pattern illustrates the dominant influence of the persistent southeasterly winds.

The silt/clay ratios of suspended sediment ranged from 0.26 to 1.82 and had a mean value of 0.87, indicating that clay-size detritus was dominant over silt. The ratio gradients show the bayward influx of relatively coarser, silt-rich sediment plumes from both Aransas Pass and Laguna Madre. The gradients also show increasing clay content toward the bayhead, with Nueces Bay being a clay-rich area. The mean diameters of suspended particles ranged from 6.59 to 8.77 ϕ ; a grand mean value of 7.92 ϕ indicates that very fine silt was the average grain size of the suspensate. The mean-diameter gradients agree with the silt/clay gradients and show coarser sediment coming into the bay from Aransas Pass. The gradients also show a decrease in grain size toward the bayhead, with Nueces Bay containing the finest sediment. The standard-deviation values of suspended particles ranged from 1.04 to 2.28$\sigma\phi$ and had a mean value of 1.33$\sigma\phi$, indicating that the sediment was poorly sorted. The sorting gradients correlate with grain-size gradients, with the coarser sediments being more poorly sorted.

October 3, 1979, Survey

The seventh survey (CCHS-7) was conducted over a 4.5-h period. Tidal conditions during the survey consisted of flooding at Aransas Pass and ebbing at Nueces Bay inlet. The daily resultant wind vector was toward the north (010°) with a speed of 16.9 km/h. The surface-water movement indicated by drifters was predominantly toward the northwest. Some early drifter returns also show northeasterly and southwesterly drift components, apparently reflecting the shift from southerly to northeasterly winds during October 3-4. Most of the later returns show northwestward movement, in response to the southeasterly winds during the October 5-8 post-survey period. Surface-water temperatures ranged from 26.5 to 27.5°C, and had a mean value of 26.8°C. The temperature gradients show slightly warmer waters in the bay's shallower southern and western marginal areas, as well as slightly warmer flood-tidal waters influxing through Aransas Pass. Water salinities ranged from 18.0 to 26.5 ppt, and had mean value of 22.7 ppt. The salinity gradients are well developed; they indicate the bayward influx of higher-salinity flood-tidal waters from Aransas Pass, and wind-driven higher-salinity waters from northern Laguna Madre. The gradients show a general reduction in salinity toward the bayhead, with lowest salinities occurring in Nueces Bay.

Surface-water transmissivity during the survey ranged from 1 to 32 percent, and had a mean value of 8 percent. The transmissivity gradients indicate increasing turbidity toward the marginal areas of the bay. The gradients also suggest the possible bayward influx of more-turbid waters from Laguna Madre, and the influx of less-turbid waters through Aransas Pass. Sediment concentrations ranged from 11 to 78 mg/l, and had a mean value of 31 mg/l. Concentration gradients show generally higher turbidity toward the northern margin of Corpus Christi Bay, with the most turbid waters occurring within Nueces Bay. Higher turbidity in the northern half of the bay is attributed to greater wave-resuspension of bottom sediments in a down-fetch direction by the southerly winds.

During the survey, the silt/clay ratios of suspended sediments ranged from 0.45 to 2.03 and had a mean value of 1.21, indicating that silt was dominant over clay. The ratio gradients show the bayward influx of a plume of relatively coarse, silt-rich sediment from Aransas Pass. With the exception of an isolated silt-rich area near Nueces Bay inlet, the gradients show a general increase in clay content toward the bayhead and show Nueces Bay to be a clay-rich area. Particle mean diameters ranged from 6.82 to 8.50 ϕ ; a grand mean value of 7.70ϕ indicates that very fine silt was the average size of suspended particles. The mean-diameter gradients are in agreement with the silt/clay-ratio gradients, showing a bayward influx of coarser sediments from Aransas Pass, and a general reduction in grain size toward the bayhead; Nueces Bay contains the finest-grained sediment. Particle standard-deviation values ranged from 1.26 to 1.96$\sigma\phi$ and had a mean value of 1.59$\sigma\phi$, indicating that suspended matter was poorly sorted. The sorting gradients correlate with grain-size gradients, with the coarser sediments being more poorly sorted.

April 23, 1980, Survey

The last survey (CCHS-8) was conducted over a 5-h period. During the survey, the tide was flooding at Aransas Pass, and was near slack water or initial flooding at Nueces Bay inlet. The daily resultant wind vector was toward the northwest (330°) with a speed of 27.2 km/h. The drifter pattern indicates that surface-water movement was essentially toward the northwest, both for early and later drifter returns. This apparently reflects wind-driven currents resulting from relatively strong southeasterly onshore winds during April 23-24. The lack of response by the late drifters to the northerly winds during April 25-27 suggests that they also had probably beached during the early period April 23-24 but were not found until later. Water temperatures ranged from 20.0 to 21.0°, and had a mean value of 20.5°C. The temperature gradients show some slightly cooler waters was moving bayward through Aransas Pass, and a slight general reduction in temperature toward the bayhead sector. Water salinities ranged from 29.3 to 34.6 ppt, and had a mean value of 30.9 ppt. The salinity gradients show a plume of relatively high-salinity flood-tidal waters was moving bayward from Aransas Pass. The gradients also suggest some bayward influx of lower-salinity waters from northern Laguna Madre driven by the southeasterly onshore winds.

The transmissivity of surface waters during the survey ranged from 0 to 17 percent, and had a mean value of 5 percent. The transmissivity gradients show a plume of less-turbid flood-tidal waters entering the bay from Aransas Pass. The gradients also indicate a general increase in turbidity toward the bayhead sector and show Nueces Bay to be the most turbid. Sediment concentrations throughout the estuarine system ranged widely from 11 to 333 mg/l, and had a mean value of 54 mg/l. The concentration gradients show a well-defined increase in turbidity toward the bayhead, in agreement with the transmissivity gradients; highest

sediment concentrations occur within Nueces Bay. The concentration gradients also suggest the outflow of less-turbid waters from Laguna Madre into Corpus Christi Bay. The turbidity pattern reflects the dominant influence of the southeasterly onshore winds.

The silt/clay ratios of suspended sediment ranged from 0.39 to 1.50 and had a mean value of 1.00, indicating that the suspensate consisted of silt and clay-size detritus in essentially equal proportions. The ratio gradients are well-developed and show a general increase in clay content toward the northern bayhead sector, with Nueces Bay being a clay-rich area. The pattern also suggests the bayward influx of silt-rich sediment from Aransas Pass, and possibly from Laguna Madre. The mean diameters of suspended particles ranged from 7.51 to 8.48 ϕ ; a grand mean value of 7.93 ϕ indicates that very fine silt was the average size of particulate matter. The mean-diameter gradients agree with the silt/clay-ratio gradients and show a general decrease in grain size toward the northern bayhead sector; the finest sediments occurred in Nueces Bay. The standard-deviation values of suspended particles ranged from 1.19 to 1.60 $\sigma\phi$, and had a mean value of 1.36 $\sigma\phi$, indicating that suspended matter was poorly sorted. No strong correlation between sorting gradients and grain-size gradients is apparent.

SUMMARY

The time-sequence measurements of Corpus Christi Bay's hydrographic and suspended-sediment characteristics illustrate a high degree of variability in both time and space. Mean baywide values of water temperature during the eight individual surveys ranged from 11.4 to 31.8° C, and mean values of water salinity ranged from 22.7 to 34.1 ppt. Bay waters were highly turbid. Mean baywide values of water transmissivity ranged from 5 to 18 percent T/0.25 m during individual surveys, and mean concentrations of suspended matter ranged from 9 to 54 mg/l. Texturally, the suspended matter consisted mainly of a poorly sorted mixture of silt and clay particles, with clay being dominant during most of the surveys. The synoptic patterns of hydrography, turbidity, and sediment texture indicate that the bay's sediment-dispersal system is regulated by both wind and tide, with wind direction being a major influential factor.

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