Physical and Environmental Assessment of Sand Resources
Sabine and Heald Banks
Second Phase 1994–1995

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Final Report

Prepared for the U.S. Department of Interior
Minerals Management Service
Office of International Activities and Marine Minerals

Cooperative Agreement No. 14-35-0001-30635

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December 1995

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SUMMARY

Sand deposits on the continental shelf of the western Gulf of Mexico are potential sources of fill material to nourish recreational beaches in Texas. Demand for beach nourishment sand is increasing as the combined effects of relative sea-level rise and reduced sediment supply cause rapid erosion and accelerated loss of recreational beaches. Particularly promising for leasing and commercialization in the near term are offshore deposits of sand that form shoals on the inner continental shelf. Preliminary geological and engineering analyses indicate that these sand deposits are suitable for beach replenishment because sediment textures of the shoals are generally compatible with those of native beach sand. Also, offshore sand extraction may be economically feasible if onshore or nearshore sources of beach-quality sand are volumetrically limited.

In Texas, Sabine and Heald Banks are two offshore sand deposits that have the greatest economic potential for near-term exploitation because they are (1) suitable for beach replenishment, (2) the largest sand deposits located offshore of some of the most rapidly eroding developed shores, (3) relatively close to potential markets in both southeastern Texas and western Louisiana, and (4) relatively close to major ports that can support offshore mining activities.

A prior geological investigation demonstrated that large volumes of sand-rich sediments are associated with Sabine Bank and Heald Bank (Morton and Gibeaut, 1993). The total volume of sandy sediments, estimated at more than 1.8 billion m^3, constitutes a large hard-mineral resource. Most of that material would be suitable for beach replenishment and other construction activities that can use well-sorted fine sand with some shell and some sediments finer than sand. The previous study also showed that the offshore sand deposits are located in water depths ranging from 4.5 m to about 16 m and the greatest thicknesses of beach-quality sand generally coincide with the shallowest water depths.

The second phase of this study was directed principally toward assessing the quality and volume of Sabine and Heald Bank sediments. To accomplish this, the banks were cored, sediment textures and mineralogy were determined, and sand volumes were estimated using bathymetry and lithologic information. Geographic locations and attributes of all the pertinent offshore data sources were incorporated into ARC/INFO, a widely used Geographic Information System (GIS). An additional task of the second phase evaluated the potential environmental impact of mining the sand deposits by examining the potential changes in wave refraction patterns if large volumes of sand were removed from Sabine and Heald Banks. Another task analyzed the wave heights and wind patterns near the Banks to estimate the maximum number of working days for shallow-draft dredges working in the Gulf, and we also conducted a preliminary investigation of dredging costs based on experience with the 1995 Galveston Beach replenishment project and two other beach nourishment projects planned for the western Gulf of Mexico.

INTRODUCTION

Regional Overview

Potentially economic concentrations of sand and shell have been identified in the western Gulf of Mexico during decades of exploration and research on the continental shelf. On the Texas portion of the continental shelf, significant sand accumulations at or near the seafloor occur as shore-aligned sand bodies and patchy accumulations of transgressive sands that were deposited during the most recent rise in sea level (Paine et al., 1988). Fluvial sand and gravel occur within late Wisconsin stream courses that extend across the continental shelf, but these valley-fill deposits are typically covered by tens of meters of overburden and are not exploitable considering the current economic constraints.

There are potential markets for offshore sand along the western Gulf of Mexico. Sand contained in submerged shoreline and nearshore deposits has the greatest near-term economic potential because it can be used for beach replenishment projects. Beach replenishment can be justified where large recreational, residential, and industrial investments would be damaged or destroyed by continued coastal erosion and storm impacts.

Long-term erosion of beaches and heavy beach use near population centers in the western Gulf make beach replenishment an attractive alternative to other methods of shoreline stabilization. The City of Galveston recently (spring 1995) completed a beach nourishment project using offshore sand dredged from a borrow area on the adjacent shoreface. The Town of South Padre Island is also planning for a beach nourishment project in the near future, and a feasibility plan and environmental impact statement are being prepared for mining Ship Shoal in coastal Louisiana. The history of coastal development in Texas and widespread beach erosion suggest that other beach communities such as North Padre Island and Freeport will likely need beach nourishment in the near future.

Objectives of the Study

The assessment study of Sabine and Heald Banks (Figure 1) accomplished several objectives. First, it provided information that could stimulate interest in offshore sand resources, thus bringing closer the time when leasing and commercial utilization in the western Gulf of Mexico are a reality. Second, the study quantified the sediment textures of Heald Bank, which contains the largest sand deposits that are closest to Galveston Island, a primary site for future beach replenishment. Third, the study characterized the wave conditions that offshore mining equipment might encounter.

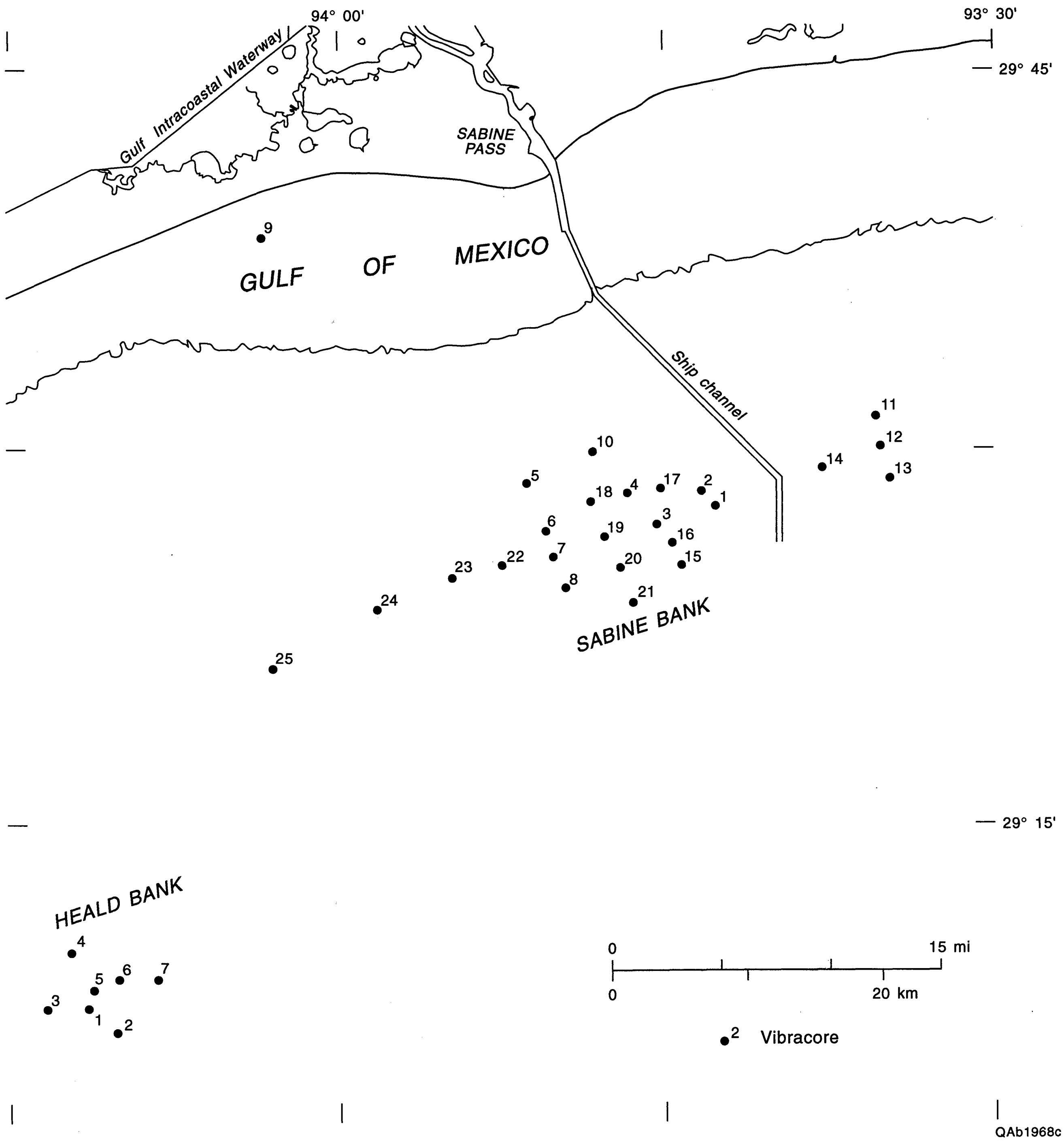


Figure 1. Locations of vibracores collected from Sabine Bank and Heald Bank.

Fourth, the study examined if sand extraction will significantly alter wave propagation and thus possibly accelerate erosion of beaches along the southeastern Texas coast. Finally, the study provided a preliminary cost analysis of mining sand from Heald and Sabine Banks.

One of the primary objectives was to determine the suitability of offshore sand for replenishment of beaches along the southeastern Texas coast. To reach this objective, the following physical attributes were determined for Sabine and Heald Banks: (1) the three-dimensional geometry of the deposits and their approximate volumes; (2) the textural characteristics of the deposits, including composition, grain size, sorting, and lateral and vertical variations; and (3) the degree to which the compositional and textural characteristics of the banks match characteristics of nearby beaches. The detailed sedimentological data provided a basis for calculating sand volume, determining its suitability for beach replenishment, and providing a basis for evaluating the costs of extracting sand from these deposits.

The second phase of the study was designed and organized to (1) obtain vibracores on Heald Bank and to quantify textures of sediments associated with that poorly defined sand deposit, (2) acquire meteorological and oceanographic data near the proposed mining sites as they relate to the physical climate of mining activities and the potential problems that might be encountered because of bad weather, high waves, or strong currents, (3) determine if sand extraction at Sabine and Heald Banks might alter wave refraction patterns and possibly exacerbate erosion of nearby beaches, and (4) estimate the cost of mining and transporting the sand to nearby beaches.

ADDITIONAL INVESTIGATION OF SABINE AND HEALD BANKS

Sources of Data

Vibracores

In addition to the eight vibracores collected during the first phase of study, 24 vibracores (Figure 1) were collected to determine the quality and suitability of the bank deposits for beach replenishment or other construction uses. Coring sites were selected by analyzing and integrating the bathymetric, seismic, and lithologic data that were available from the first phase of the project. Core site criteria included anticipated thicknesses of the sand deposits, seismic characteristics of the sand bodies and underlying reflections, water depth, potential variable mining characteristics (presence or absence of hardgrounds), and any limitations imposed by the vibracoring equipment.

Vibracores were collected using standard aluminum irrigation tubes, which are 6 m long and 7.6 cm in diameter. Each tube is fitted with a brass core catcher and is attached to a pneumatic vibrator head that is part of a rigid steel frame. The frame is lowered by cable to the seafloor where it rests on four pads. Compressed air rapidly vibrates the head, which drives the core tube into the unconsolidated sediments. A track on the frame guides the vibrator head and keeps the core tube vertical as it penetrates the sediments and is recovered. After the core is retrieved, it is sealed and marked for later processing. Geographic coordinates of the vibracores (Appendix A) were provided by a dual-channel GPS navigation receiver.

Considering both phases of the investigation, a total of 25 vibracores were collected from Sabine Bank and 7 vibracores were taken from Heald Bank (Figure 1). Penetration depths of the vibracores were controlled primarily by sediment composition. Soft mud with only a few scattered and broken shells allowed complete penetration of an entire 6 m core tube. In contrast, well-sorted sand or shelly sand was the most difficult sediment to penetrate. Core tubes encountering these sediments penetrated less than 2 m below the seafloor.

The vibracores were transported to the Core Research Center of the Bureau of Economic Geology in Austin, Texas, where they were inventoried, split into equal halves, trimmed with an osmotic knife, and physically described using standard core description sheets (Appendices B and C). Information recorded on the sheets included core depth, sediment color, sediment type, nature of contacts, textural trends, sedimentary structures, and presence of accessories (organic material, shells). The cores were then photographed (large format color prints and 35 mm slides) and sampled for textural and compositional analyses. The photographed half and sampled half of the core were wrapped in plastic and placed in separate core boxes and are stored in a climate-controlled room. The archived core half serves as a permanent record of the sediment types encountered and the types of material sampled.

Sediment Textures

To assess textural characteristics of the sand deposits and their compatibility with native beach sediments, 120 sediment samples from 32 vibracores were analyzed for gravel, sand, silt, and clay content. Because shell dominates the gravel fraction, the two classifications (size and composition) are used interchangeably in the discussion.

Textural analyses of the cores collected in 1994 were conducted at the Soils and Physical Geography Laboratory at the University of Wisconsin, Milwaukee. A set of standard sieves were used to analyze the sand and gravel fractions, and hydrometer techniques were used to analyze the clay and silt fractions. Numerical and graphical results of the textural analyses are presented in Appendix D.

Data Management

Data generated in conjunction with the sand assessment project are being manipulated and stored in a geographic information system (ARC/INFO) so that archiving and future retrieval will be facilitated. Most Federal and State agencies use a GIS to store locational information and to create maps that superimpose several layers of information. The GIS component of this study anticipates the need for a digital data base so that information can be readily transferred to other users.

Major components of the sand assessment GIS include a digital base map with shoreline features and bathymetry, locations of seismic lines and shotpoints, values for the thickness between the seafloor and ravinement surface, locations of pipelines and platforms, and locations of subsurface lithologic information including foundation borings, cores, and rotary borings, which were compiled from several sources (unpublished data; Nelson and Bray, 1970; Thomas, 1990; this study). Maps showing the locations of seismic profiles, offshore petroleum facilities, and other subsurface data for the Sabine Bank Heald Bank area were presented by Morton and Gibeaut (1993).

SAND RESOURCE ASSESSMENT OF SABINE AND HEALD BANKS

Bank Morphologies

Sabine Bank is delineated by the 10 m isobath. The Bank extends 50 km in a northeast-southwest orientation and is about 7.5 km wide (Figure 1). A few small shoals detached from Sabine Bank exist to the east but are not considered in this study. The shallowest portions of Sabine Bank are on the eastern end between the spoil areas and west of the ship channel. This shoal area is marked by the Sabine Bank lighthouse. Depths are as shallow as 4.5 m but deepen to more than 9 m to the southwest.

The bathymetric map (Morton and Gibeaut, 1993) shows that the 10 m and 8 m isobaths are smooth on the landward side of Sabine Bank relative to the seaward side, and on the eastern part of the bank, the landward side is steeper than the seaward side. On the seaward side, however, the 10 m and especially the 8 m isobaths display a digitate configuration oriented southeast-northwest, which is normal to the alignment of the long axis of the Bank. The 6 m isobath outlines small shoals, which are aligned normal to the axis of the Bank, on top of the eastern half of the Bank.

On the Louisiana inner shelf, near the filled former incised valley of the Calcasieu River, the eastern extension of Sabine Bank trends almost 90° to the main axis of sand body. This abrupt change in orientation is easy to explain in terms of former shoreline deposits when sea level was lower, but it is difficult to explain using only alongshelf currents and a depositional model that requires complete subtidal deposition.

Heald Bank (Figure 1) is 27 km southwest of Sabine Bank and 55 km southeast of the Entrance to Galveston Harbor. Heald Bank is not as well defined as Sabine Bank and has a relatively small area that is shallower than 10 m. The 14-m isobath encloses a much larger area extending 30 km to the southwest from the eastern shallow areas. The 10 m isobath encloses two irregularly shaped areas with no particular orientation.

Scour Depths

To understand sand bank evolution and the history of the bank deposits, it is necessary to distinguish between sedimentary features that are related to modern processes and bank reworking as compared to paleo sedimentary features that originated when the banks first formed. Many of the cores from Sabine and Heald Banks exhibit upward-fining textures in the upper few meters (Appendices B, C, and D). The upward-fining patterns are characterized by distinct erosional bases overlain by gravel-size clasts of whole and broken shell that grade into shelly sand and sand with only minor amounts of finely broken shell. These cyclical textural patterns are interpreted as shelf storm deposits and the products of modern shelf processes.

The depth to the base of scour depends partly on water depth (Figure 2) and partly on lithology of the underlying sediments. Position on the bank surface (crest or margins) is less important than water depth in controlling scour depth. Wave and current scour greater than 1.5 m is observed where the upper part of the bank is composed of sand, and water depths are less than 10 m. These relatively shallow water depths also coincide with the bank crest. Where water depths exceed 11 m and the sediments are muddy, scour is minimized and essentially no storm deposits are preserved.

Primary Bank Lithofacies

Our initial study (Morton and Gibeaut, 1993) identified six lithofacies that characterize sediments within and around Sabine and Heald Banks (Appendices B and C). The lithofacies, which were identified from detailed descriptions of the vibracores, are fine sand (A), shelly sand and gravel (B), slightly muddy sand (C), muddy sand (D), sandy mud (E), and organic clay (F). Each lithofacies exhibits different sediment compositions, sediment textures, and preserved fauna. Also each lithofacies occupies a predictable stratigraphic position within the vertical succession of lithofacies. The superposition of lithofacies describes an overall upward-coarsening facies

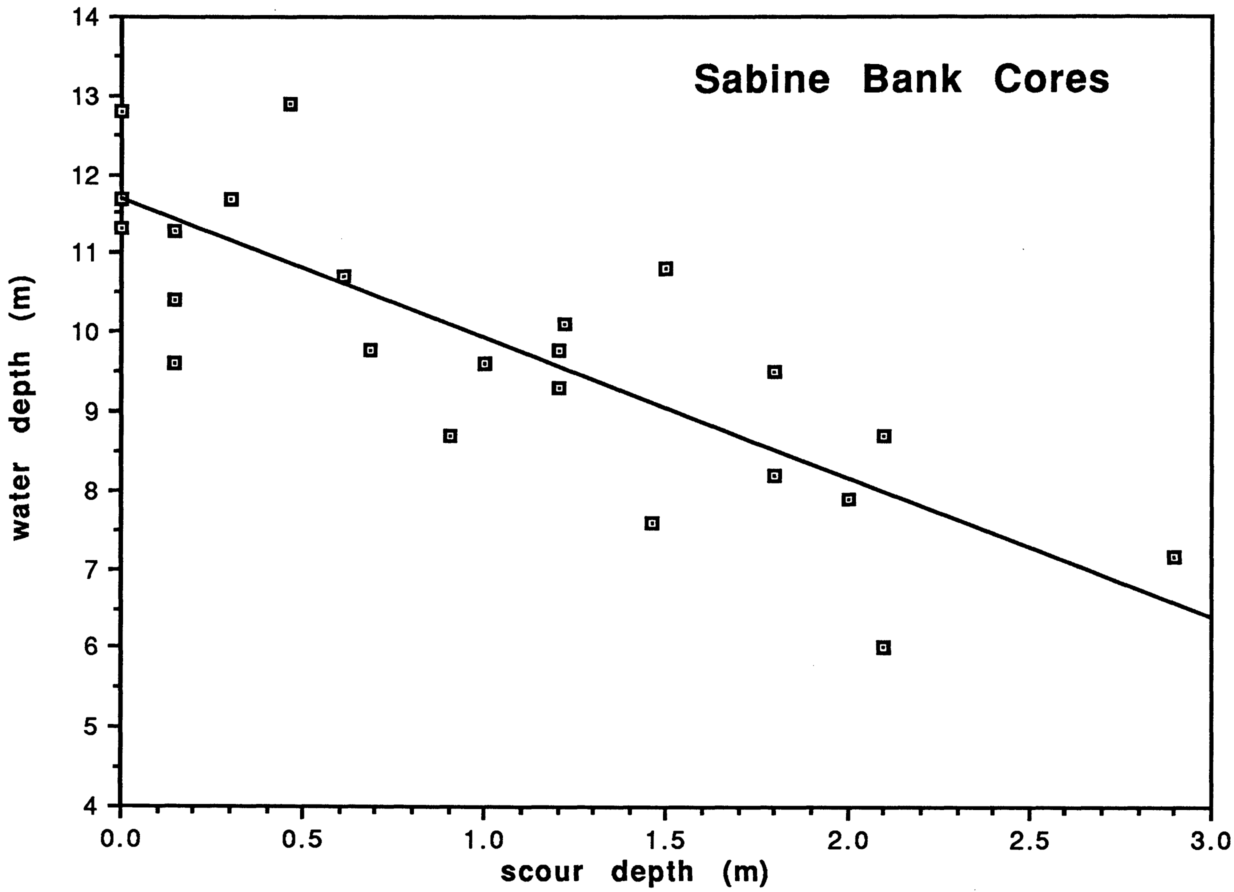


Figure 2. Relationship between water depth and depth of storm wave scour in sediments of Sabine Bank.

architecture with progressively more sand and less mud from bottom to top. The attributes of each lithofacies are described in detail by Morton and Gibeaut (1993).

Overview of Sand Quality

Sand quality of the banks was evaluated using two methods that differed in detail and scale of the analysis. The large-scale method considered the relationship between sedimentary facies of the banks determined from the core descriptions and sediment textures derived from the grain-size analyses. Quantitative textural analyses (Appendix D) were performed on 120 samples taken from the 32 vibracores obtained for this study. There is good correspondence between the textural data and the qualitative facies descriptions (Morton and Gibeaut, 1993). This agreement provided a mechanism for extrapolating the textural data to sections of the cores that lacked textural analyses. However, qualitative (visual) estimates of shell content based on core descriptions do not agree closely with quantitative measurements from sieve analyses. In fact, the visual estimates of shell content are consistently higher than the actual measurements. This discrepancy did not interfere with evaluations of sand quality. The second method of evaluating sand quality relied just on textural analyses from the upper 2 m of core. This small-scale, more detailed evaluation of sand quality considered the depth of dredging that would likely occur on the banks in order to optimize sand content in the dredged material.

The fine sand, shelly sand and gravel, and slightly muddy sand facies (facies A, B, and C) generally contain less than 15% mud and range in mean grain size from 0.75 ø to 2.98 ø (0.13 mm to 0.59 mm). The fine sand and slightly muddy sand facies are moderately well to poorly sorted, whereas the shelly sand and gravel is poorly to very poorly sorted. These are the coarsest facies in the Sabine Bank area, and mean grain size within and between these facies is primarily a function of the relative amounts of coarse shell material and mud.

The muddy sand and sandy mud facies (facies D and E) contain considerably more mud than overlying facies. The muddy sand averages 23% mud and ranges from 14 to 34% mud, whereas the sandy mud facies averages 48% mud and ranges from 24 to 71% mud. The mud fraction in both facies is dominated by clay-size material. The average mean grain sizes of the muddy sand and sandy mud are 4.29 ø (0.05 mm) and 5.70 ø (0.02 mm), respectively. Both facies are very poorly sorted partly because the sediments are highly bioturbated.

The finest grained facies is the organic clay (facies F), which occurs at the bottom of the sedimentary sequence. Four samples from different cores (3 Sabine Bank, 1 Heald Bank) analyzed for this facies yielded very similar textural values with 91 to 95% mud.

The available compositional and textural data indicate that the sand deposits associated with Sabine Bank and Heald Bank are compatible with the beach sediments of the southeastern Texas coast (Morton et al., 1995). Beach replenishment using the fine sand, shelly sand, slightly muddy sand, and muddy sand facies (facies A, B, C, and D) would require only moderate overfill ratios. The sandy mud and organic clay facies (facies E and F), however, are not appropriate for beach replenishment.

Overview of Sand Quantity

Revised estimates of sand volume in Sabine and Heald Banks used the three-dimensional geometry of the sand deposits as determined by nearsurface lithology and bathymetry. Nearsurface lithology, provided primarily by the vibracores, delineated the lateral extent of sand as well as the thickness of sand and any overburden (Table 1). Bathymetry also was used to help define the lateral extent of sand in those areas where core control was not available.

Both Sabine and Heald Banks are lenticular sand bodies that cover large areas (Figures 3-10). Revised estimates of sand volume based on all vibracores indicate that together the banks contain about 1.8 billion m^3 of sand, shelly sand, and muddy sand. Within the overall trends of sand deposits are elongate lenses where sand and muddy sand deposits more than 3 m thick are concentrated (Table 1). These elongate lenses would be the optimum sites for sand extraction because sand concentrations are relatively high. The distribution of sand associated with Heald Bank is not well defined, and it does not coincide just with the bathymetric highs but extends far beyond the small irregular shoals defined by the 10-m isobath (Morton and Gibeaut, 1993).

Sediments of Sabine Bank

Sand Quality

Most of the vibracores collected for this study, and consequently most of the textural analyses, are from Sabine Bank (Figure 1, Appendix D). Examination of sediment textures in the upper 2 m of core from Sabine Bank shows that sediments generally are composed of more than 91% sand. Shallow shelf sediments containing low concentrations of sand (high concentrations of mud) are located in relatively deep water and around the margins of the banks at sites such as vibracore locations 5, 10, 11, 13, and 15 (Figure 1).

Locally high concentrations of shell found in vibracores 2, 7, 12, 14, 16, 20, 21, and 25 range from 26 to 71% of the sediment sample. These sites of high shell concentration also generally coincide with physical settings that are subjected to relatively high wave energy such as the crest or seaward flank of Sabine Bank. The shelly sand facies in Sabine Bank probably consists of lenses representing less than 12 percent of the total sand facies (Table 1); therefore, locally high shell concentrations should not limit the use of the sand resource for beach nourishment.

Table 1. Thickness of sand facies in each vibracore from Heald Bank (HB) and Sabine Bank (SB).

Core	Sand (m)	Shelly Sand (m)	Muddy Sand (m)	Total (m)
SBV - 1	1.6	0.3	0.8	2.7
SBV - 2	1.3	1.4	0.0	2.7
SBV - 3	1.6	0.2	0.3	2.1
SBV - 4	1.7	0.2	1.6	3.5
SBV - 5	0.0	0.0	2.9	2.9
SBV - 6	1.7	0.3	2.6	4.6
SBV - 7	0.7	0.3	3.4	4.4
SBV - 8	0.9	0.2	3.4	4.5
SBV - 9	0.0	0.0	0.0	0.0
SBV - 10	0.0	0.0	2.1	2.1
SBV - 11	0.3	0.0	1.4	1.7
SBV - 12	2.8	0.8	1.2	4.8
SBV - 13	0.3	0.0	3.2	3.5
SBV - 14	1.1	0.0	1.5	2.6
SBV - 15	0.3	0.0	0.8	1.1
SBV - 16	0.4	0.8	1.5	2.7
SBV - 17	3.4	1.1	0.0	4.5
SBV - 18	3.0	0.0	2.6	5.6
SBV - 19	1.3	0.0	1.1	2.4
SBV - 20	1.4	0.2	0.0	1.6
SBV - 21	0.0	0.4	0.3	0.7
SBV - 22	1.3	0.1	3.5	4.9
SBV - 23	0.5	0.5	4.8	5.8
SBV - 24	0.0	0.5	2.4	2.9
SBV - 25	0.6	0.3	4.1	5.0
HBV - 1	1.5	1.3	0.0	2.8
HBV - 2	1.5	0.1	0.6	2.2
HBV - 3	2.2	0.0	1.8	4.0
HBV - 4	0.8	0.0	0.9	1.7
HBV - 5	4.3	1.8	0.0	6.1
HBV - 6	3.1	0.2	0.0	3.3
HBV - 7	1.5	0.3	0.6	2.4

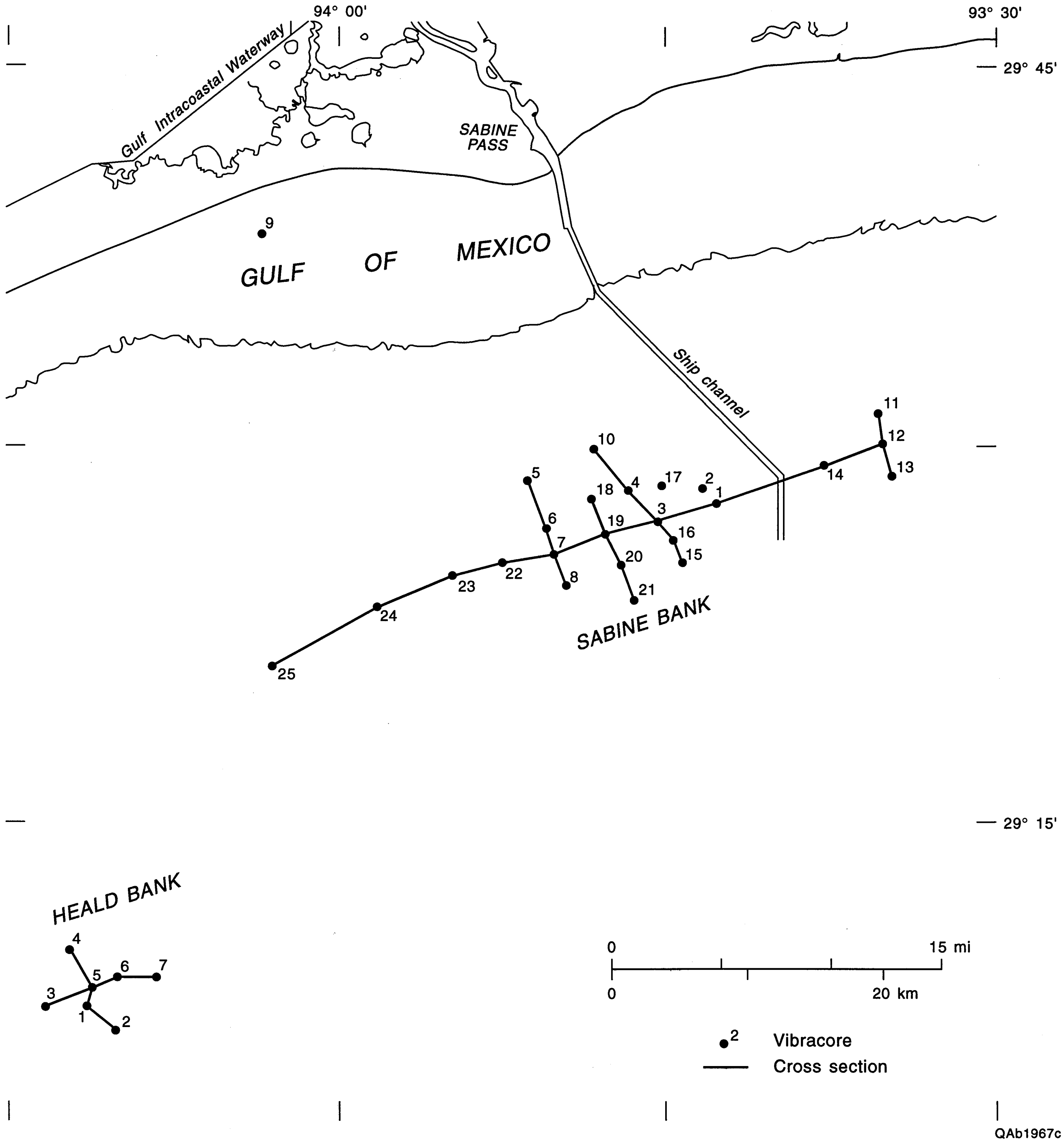


Figure 3. Locations of stratigraphic cross sections illustrating lithofacies associated with Sabine and Heald Banks.

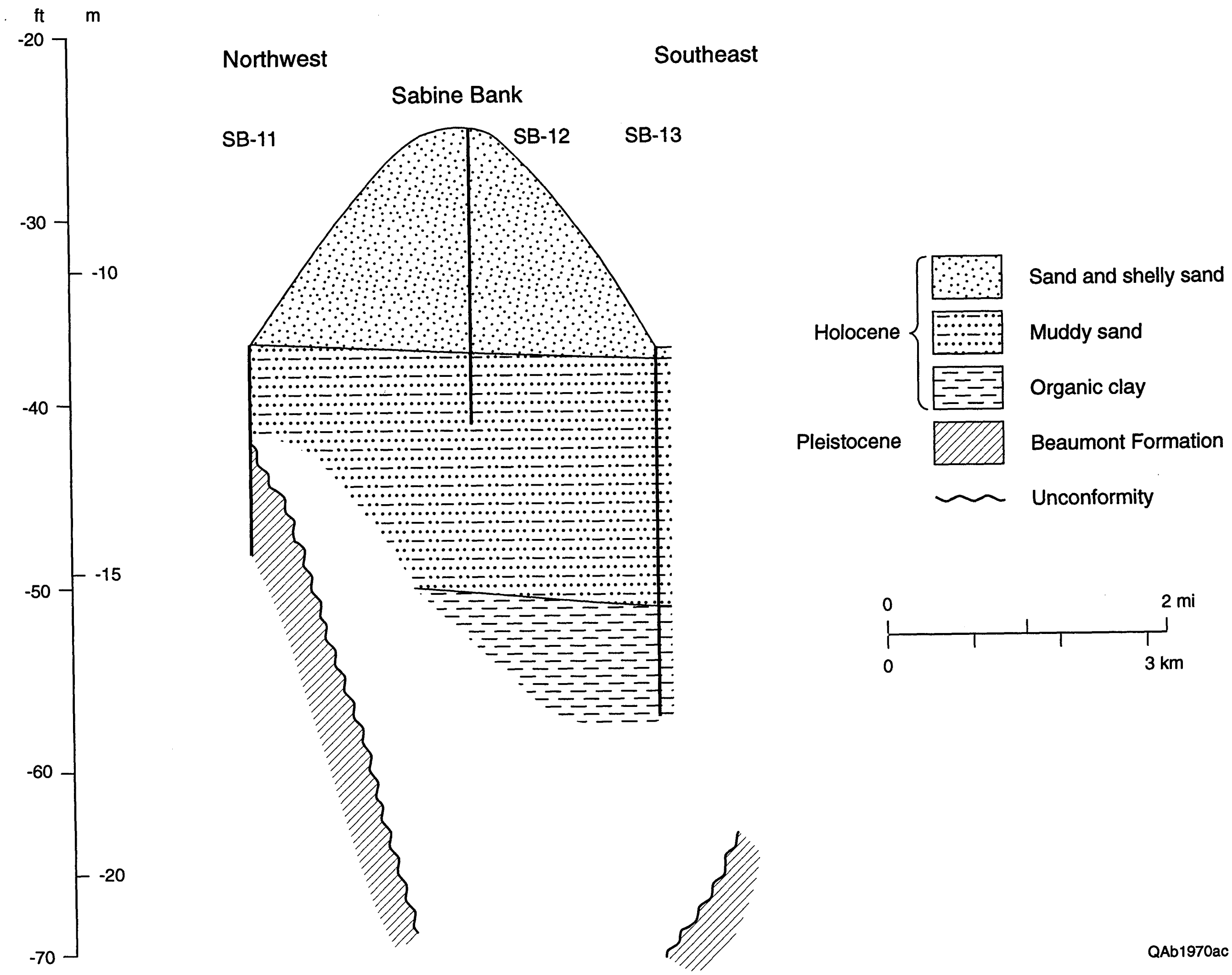


Figure 4. Stratigraphic dip section across eastern end of Sabine Bank.

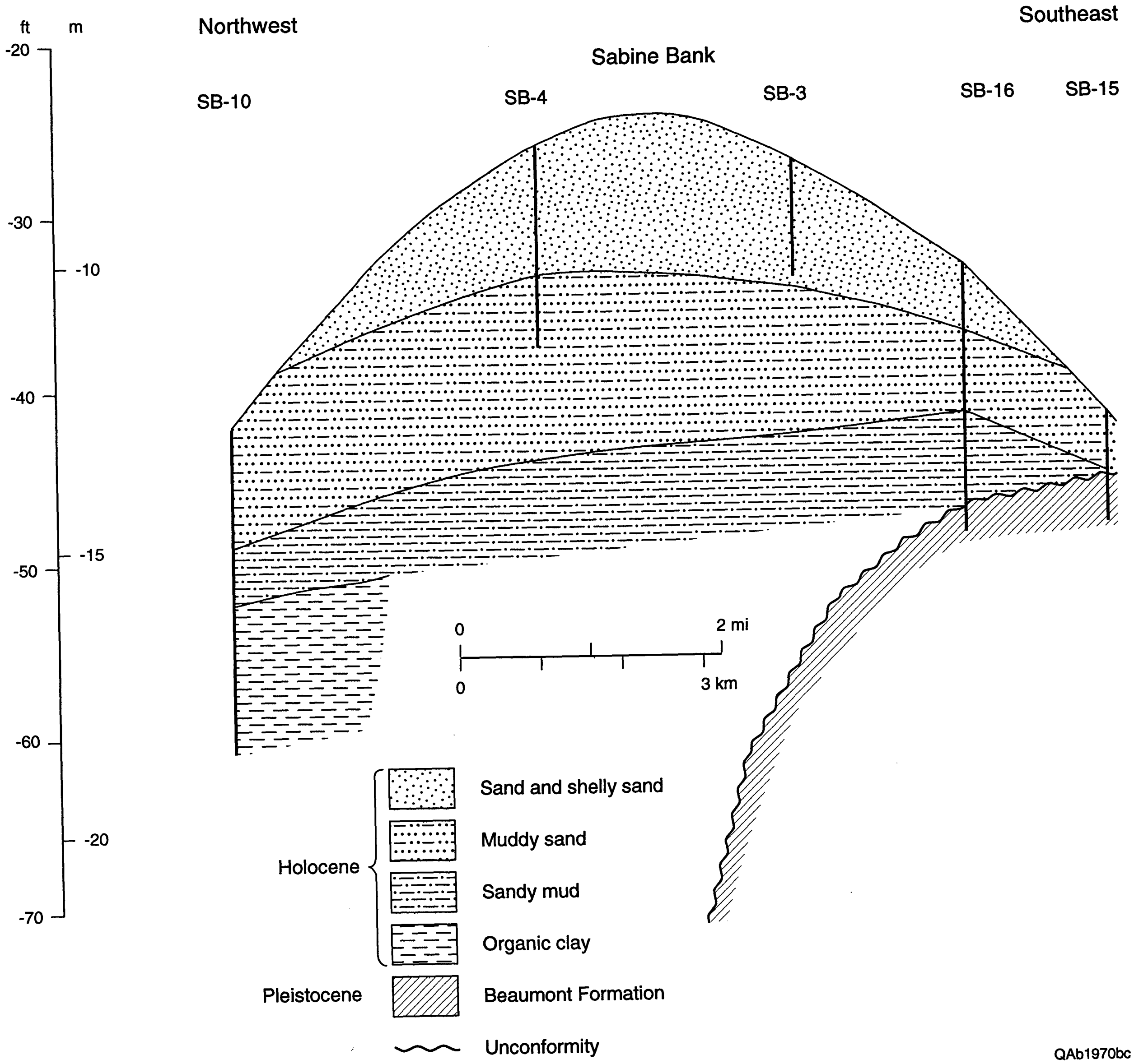


Figure 5. Stratigraphic dip section across middle of Sabine Bank.

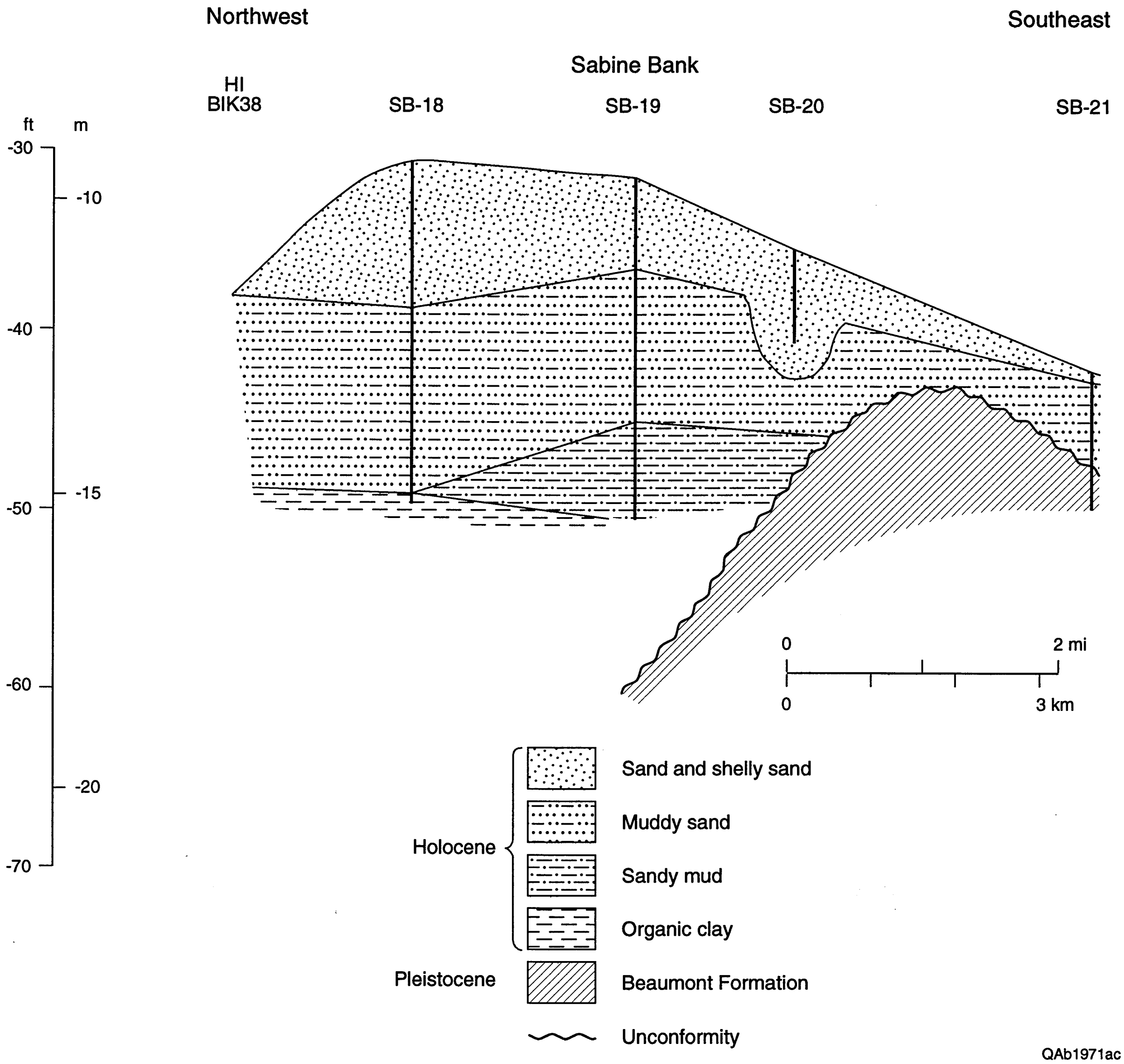


Figure 6. Stratigraphic dip section across middle of Sabine Bank.

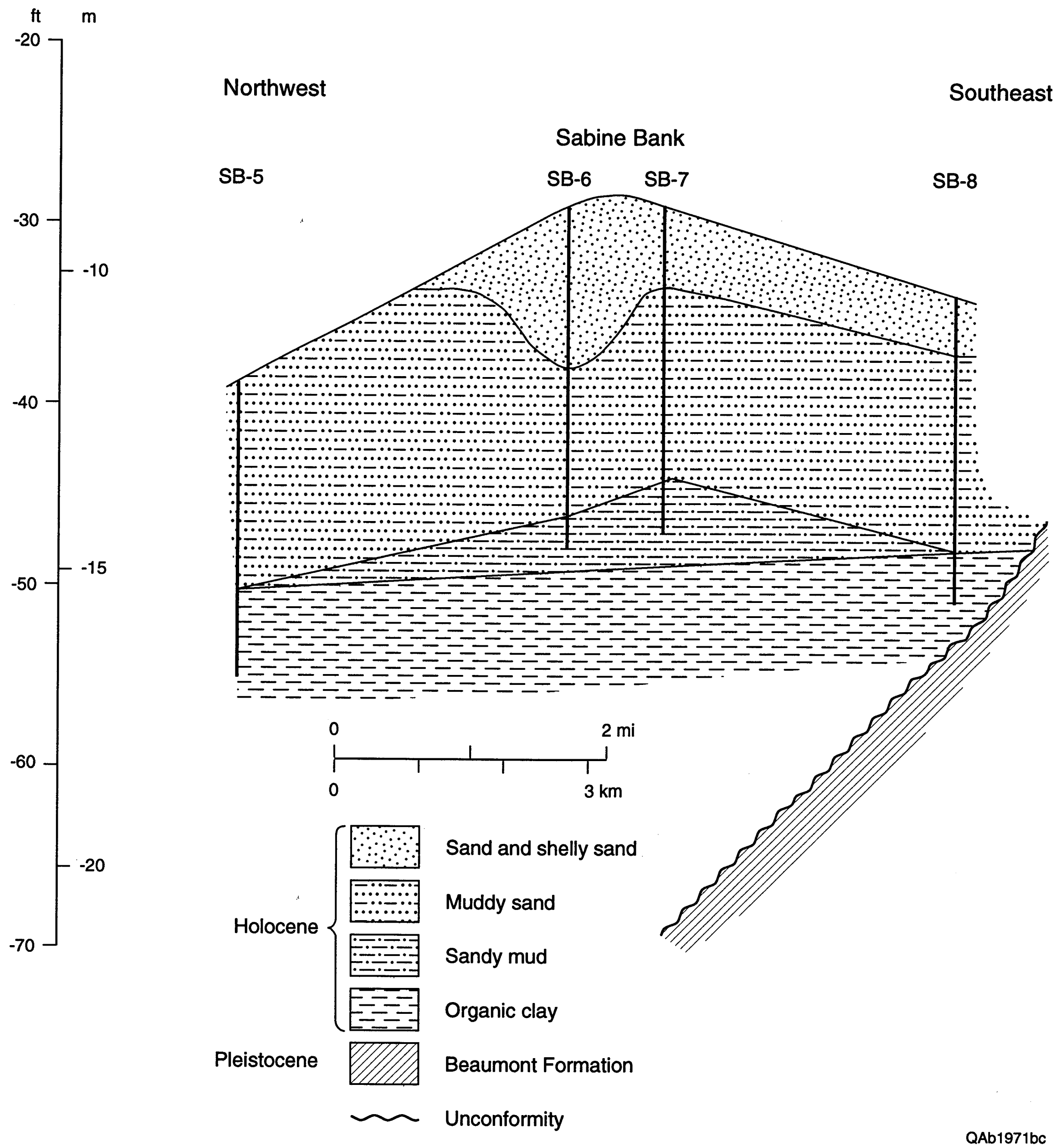


Figure 7. Stratigraphic dip section across middle of Sabine Bank.

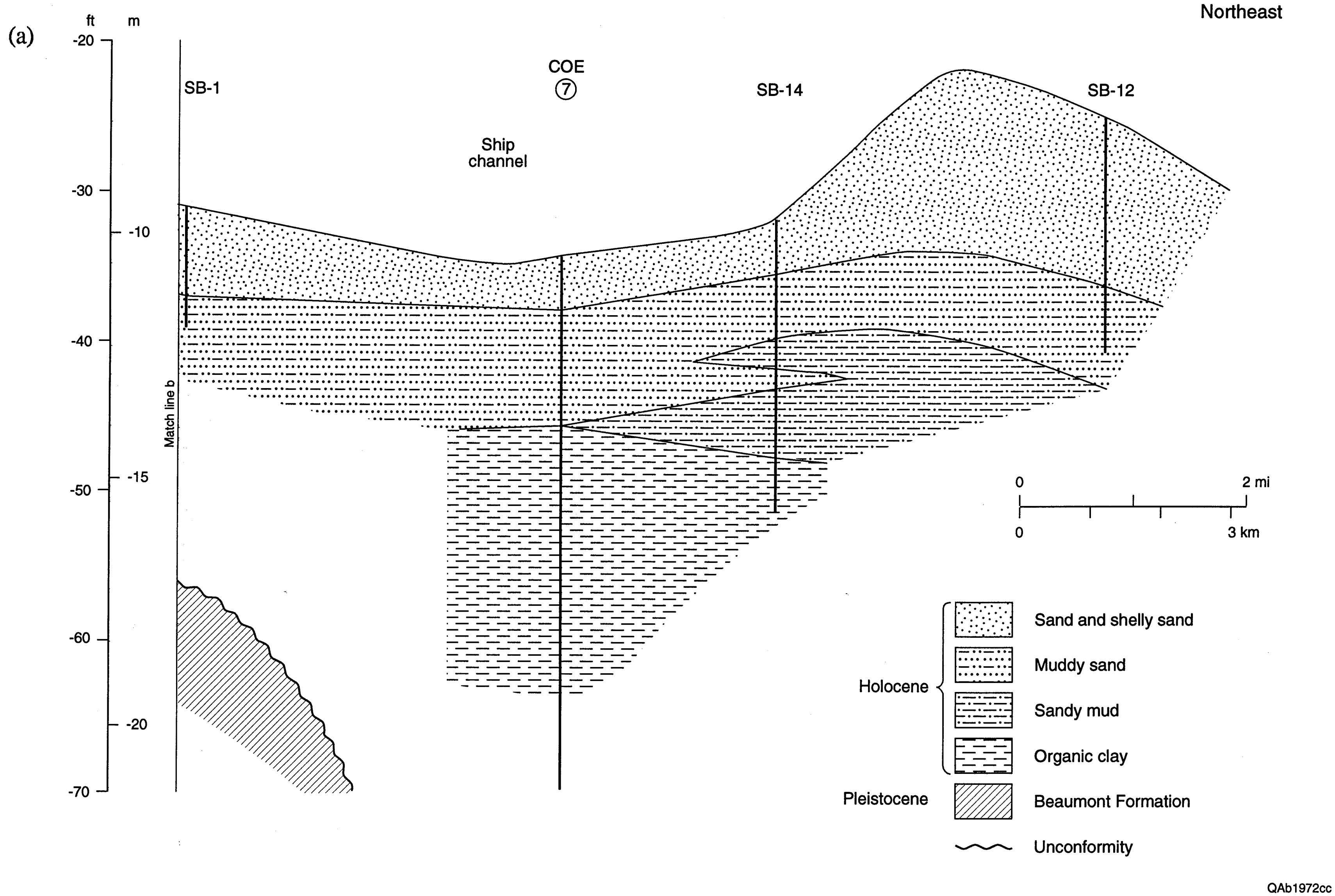


Figure 8. Stratigraphic strike section along middle of Sabine Bank, (a) eastern, (b) central, and (c) western sections.

(b)

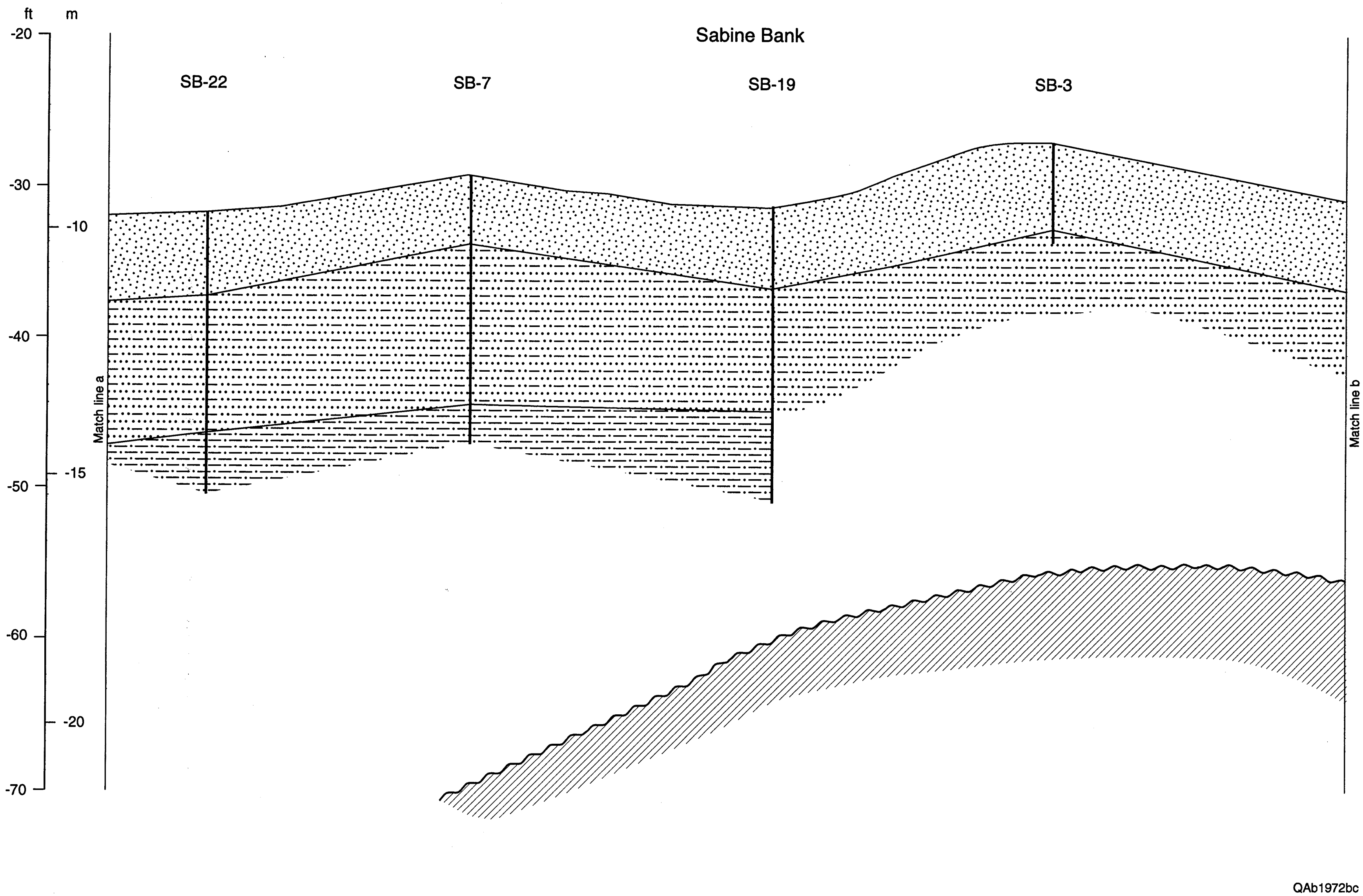


Figure 8. (cont.)

(c)

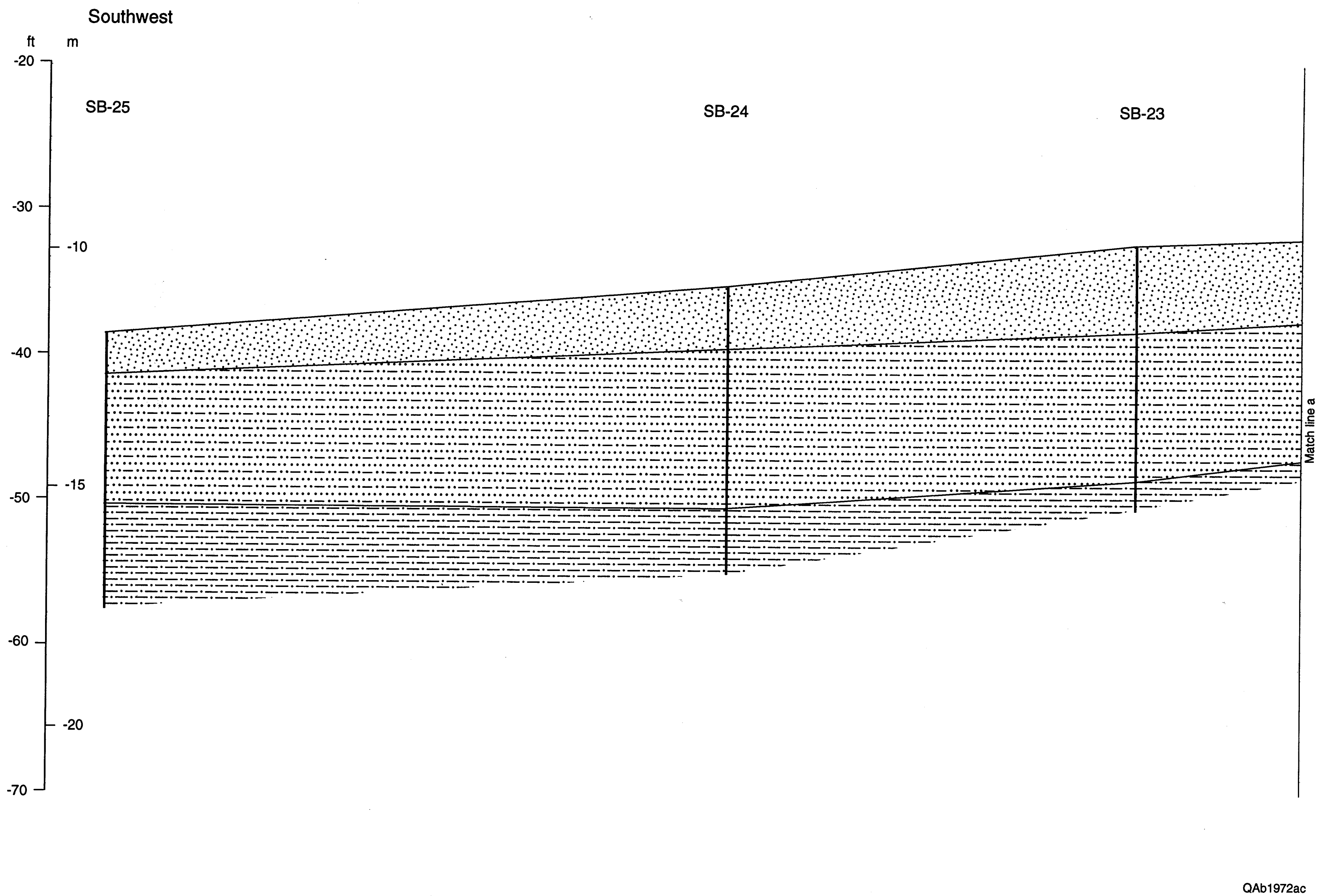


Figure 8. (cont.)

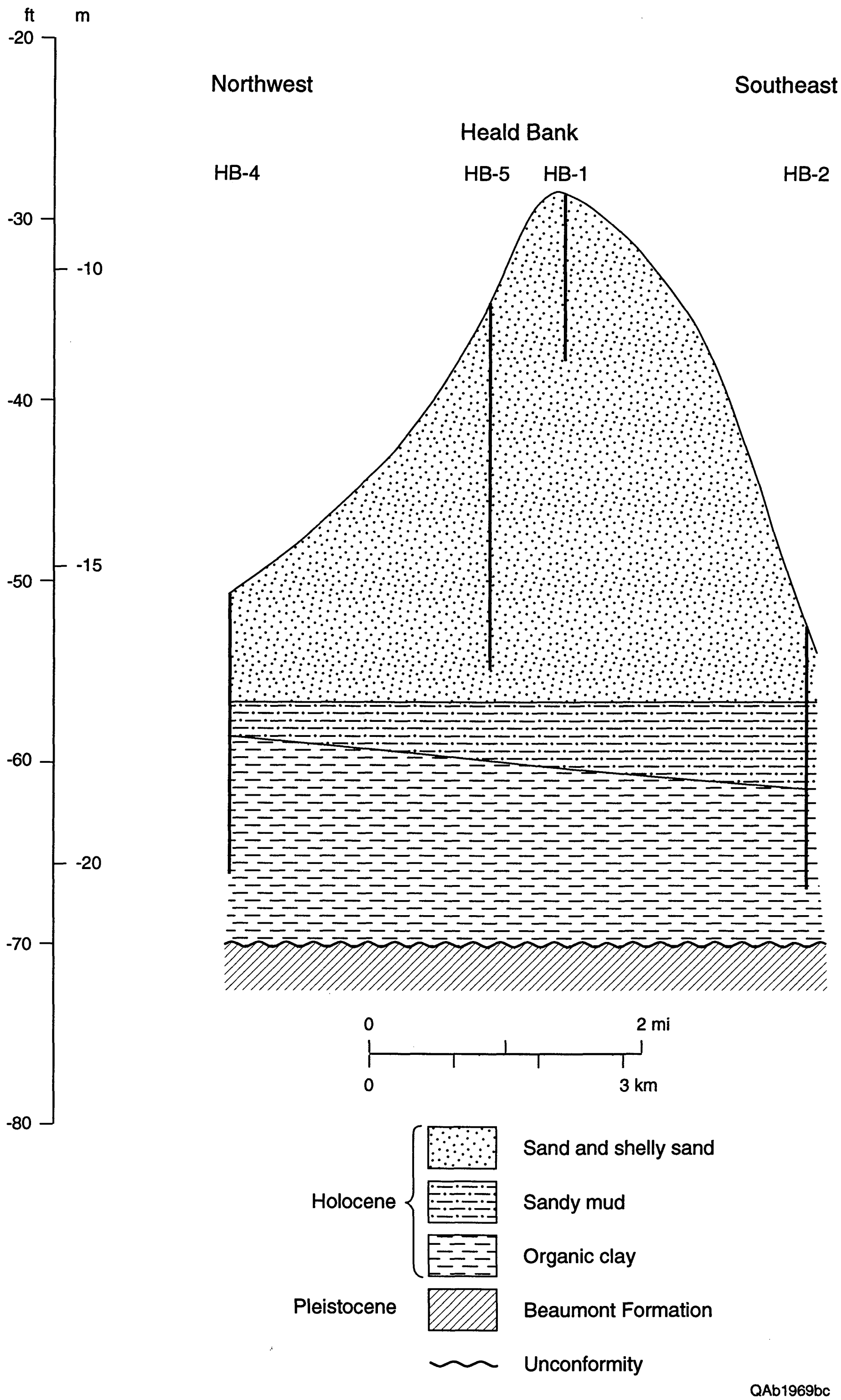


Figure 9. Stratigraphic dip section along middle of Heald Bank.

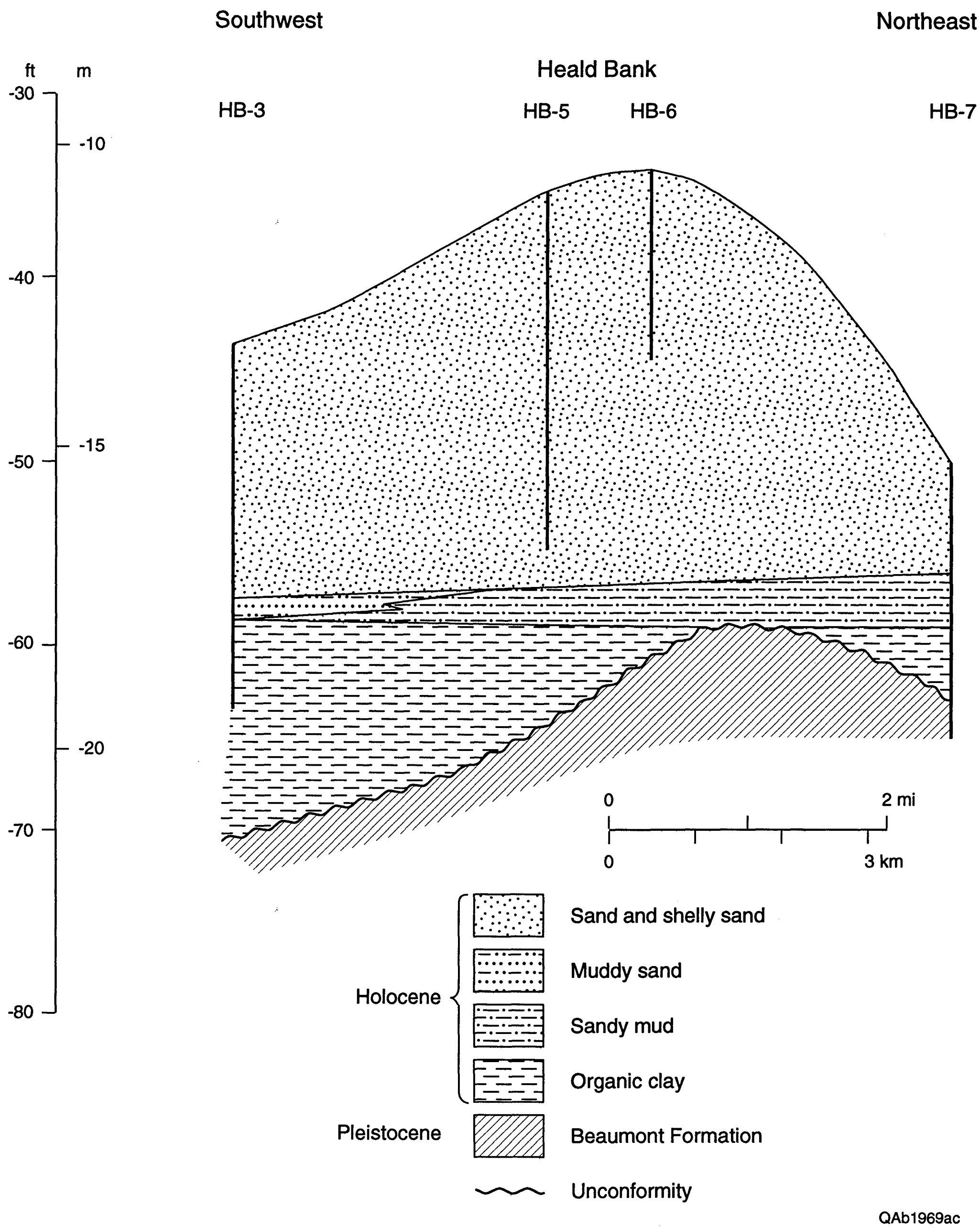


Figure 10. Stratigraphic strike section along middle of Heald Bank.

Sand Quantity

The total volume of sand, shelly sand, and muddy sand estimated for Sabine Bank in Texas is about 1.2 billion m^3. This estimate is based on an average sand-body length of 50 km, an average sand-body width of 7.5 km, and an average sand thickness of 3.3 m. Of this total sand facies that makes up Sabine Bank, about 562 million m^3 is sand and shelly sand with an average thickness of about 1.5 m (Table 1).

Sediments of Heald Bank

Sand Quality

Textural analyses of sediment samples from Heald Bank (Appendix D) indicate uniformly good sand quality. Nearly all samples from the upper 2 m of the Bank contain more than 95% sand. Most sediment samples contain less than 5% shell, and only one sample contained 11% shell. When the thicknesses of sand facies (Table 1) are used to estimate shell concentrations in the Bank deposits, the shelly sand facies represents from 0 to 46% of the total sand facies in Heald Bank sediments. However, most of the vibracores from Heald Bank contain less than 12% shelly sand facies compared to the total sand facies. Considering that the shell material is generally dispersed in Heald Bank and not in thick concentrations (Appendix E), the shell content should not limit the use of the sand resource for beach nourishment.

Sand Quantity

The total volume of sand, shelly sand, and muddy sand estimated for Heald Bank is approximately 585 million m^3. This estimate is based on an average sand-body length of 13.5 km, an average sand-body width of 13.5 km, and an average sand thickness of 3.2 m. Of this total sand facies that makes up Heald Bank, more than 458 million m^3 is sand and shelly sand with an average thickness of about 2.5 m (Table 1).

WAVE REFRACTION ANALYSIS, SABINE AND HEALD BANKS

A preliminary analysis was conducted of potential wave transformation that might occur if large volumes of sand were dredged from the crest of Sabine and Heald Banks. Results of these analyses were compared with extant wave conditions to determine if wave energy would be significantly altered as a result of sand mining. Nine cases of wave refraction were considered (Table 2). Each case evaluated the differences in wave height between existing water depths and altered water depths over Sabine Bank. The first seven cases analyzed average conditions for waves propagating from easterly to southwesterly directions, the eighth case analyzed average conditions for all onshore waves, and the ninth case was a special case that considered storm waves generated by Hurricane Alicia.

Model Parameters and Input

The wave refraction analysis was designed to address environmental concerns regarding possible increased erosion of beaches adjacent to the proposed mining sites. To accomplish this, the Regional Coastal Processes Wave (RCPWAVE) Propagation Model (Ebersole et al., 1986) was applied to the region offshore of the southeastern Texas coast (Figures 11-23). This is the same model that was used by Byrnes and Patnaik (1991) to investigate potential wave transformation over Ship Shoal. The Waterways Experiment Station of the U.S. Army Corps of Engineers developed RCPWAVE to predict natural and human-induced coastal change across an extensive length of shoreline. RCPWAVE can predict linear, plane wave propagation over a coastal region with varying bathymetry. The model does not include nonlinear effects, and wave input is monochromatic. RCPWAVE was modified to run on a SUN 1000 workstation. It was also modified to provide output suitable for input into the CPS-3 mapping and contouring program (Schlumberger GeoQuest 1994) for graphical display of the results.

RCPWAVE is well suited to measure the effects that mining Sabine and Heald Banks may have on wave patterns. Because these banks are up to 50 km offshore, a large area must be considered in the wave model. This analysis includes the southeastern Texas coast between the Calcasieu River (Louisiana) on the east and Matagorda Peninsula on the west. Using CPS-3 mapping software, we developed a rectilinear bathymetric grid covering this area that is 300 km in the alongshore direction and 100 km in the offshore direction out to depths of 30 m. The grid is not smoothed, and cells measure 500 m alongshore and 125 m normal to shore forming a grid with 600 by 800 cells.

Two types of data are required for the wave transformation analysis: wave climate and bathymetry. Digital bathymetric data used to construct the grid were obtained from the National Geophysical Data Center through the U.S. Geological Survey in St. Petersburg, Florida. Bathymetry data were compiled from a combination of surveys dating from the 1930's to the 1970's. Care was taken to use the latest data available from the National Oceanographic and Atmospheric Administration for a particular area.

Table 2. Wave parameters used in model runs displayed in figures 1 through 9. Hs= significant wave height, WIS= Wave Information Study. Frequency is percent occurrence of all waves approaching from 78.75 to 236.25 degrees.

Case	Height (m)	Period (s)	True direction	Frequency	Comments
1	1.2	5.4	90.0	12.1%	Mean Hs and mean period for wave directions in a 22.5 degree arc centered around 90 degrees; WIS station #12
2	1.1	5.6	112.5	17.4%	Mean Hs and mean period for wave directions in a 22.5 degree arc centered around 112.5 degrees; WIS station #12
3	1.2	6.1	135.0	35.5%	Mean Hs and mean period for wave directions in a 22.5 degree arc centered around 135 degrees; WIS station #12
4	1.4	6.1	157.5	23.5%	Mean Hs and mean period for wave directions in a 22.5 degree arc centered around 157.5 degrees; WIS station #12
5	1.2	5.7	180.0	8.1%	Mean Hs and mean period for wave directions in a 22.5 degree arc centered around 180.0 degrees; WIS station #12
6	1.1	5.3	202.5	2.4%	Mean Hs and mean period for wave directions in a 22.5 degree arc centered around 202.5 degrees; WIS station #12
7	1.0	5.1	225.0	1.1%	Mean Hs and mean period for wave directions in a 22.5 degree arc centered around 225 degrees; WIS station #12
8	1.2	5.8	131.0	N/A	Mean Hs and mean period for wave directions between 33.75 and 259.75 degrees true; WIS station #12
9	2.0	8.5	135.0	N/A	Estimated Hurricane Alicia conditions from CERC-84-6 Tech. Rpt. Data from Shell Oil platform (Vermillion 22, 25 ft deep). Hs and period are measured but directions are absent other than statement of predominantly southeast waves, therefore used southeast compass direction for model.

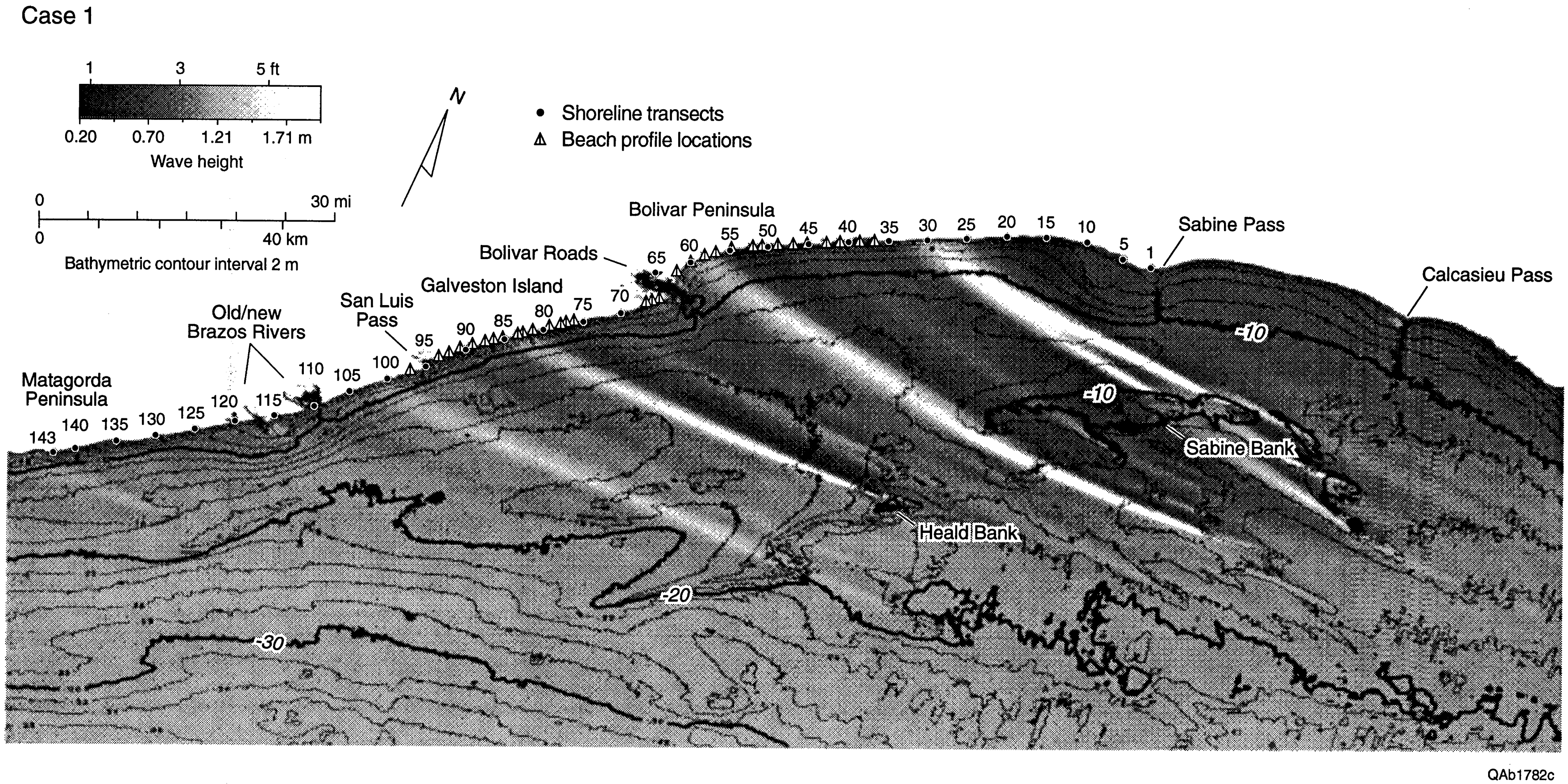


Figure 11. Bathymetry and wave heights for case 1 wave conditions: height= 1.2 m; period= 5.4 s; direction= 90°.

Case 2

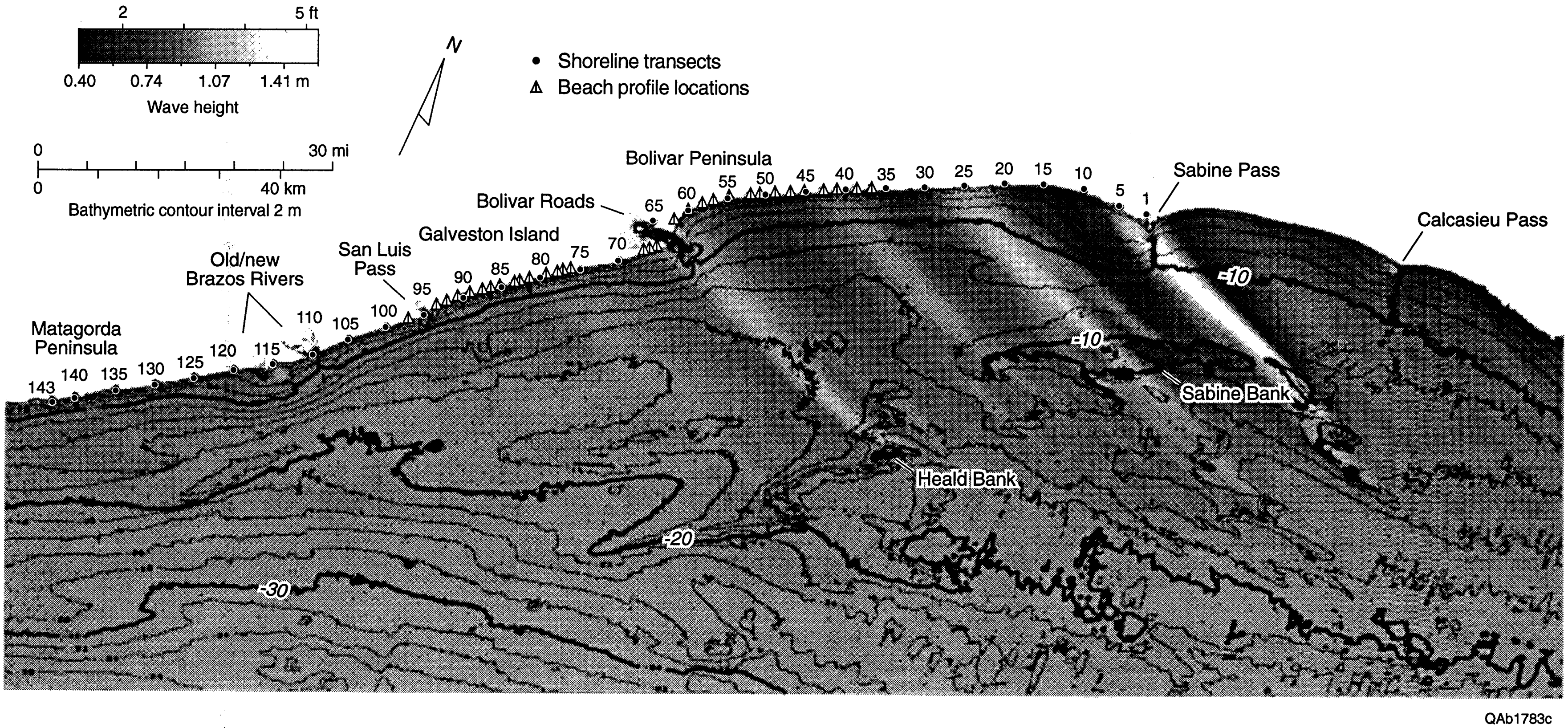


Figure 12. Bathymetry and wave heights for case 2 wave conditions: height= 1.1 m; period= 5.6 s; direction= 112.5°.

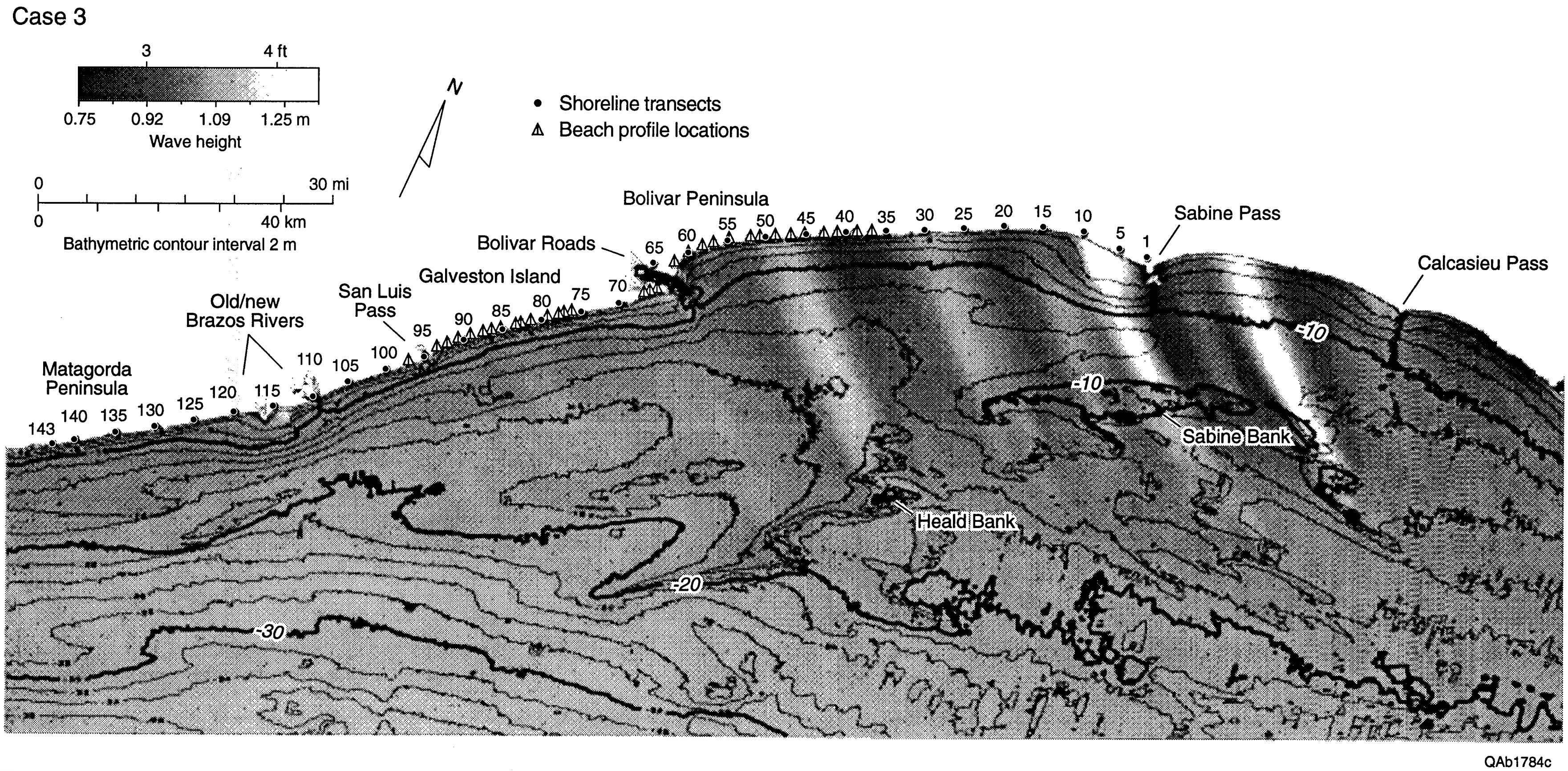


Figure 13. Bathymetry and wave heights for case 3 wave conditions: height= 1.2 m; period= 6.1 s; direction= 135°.

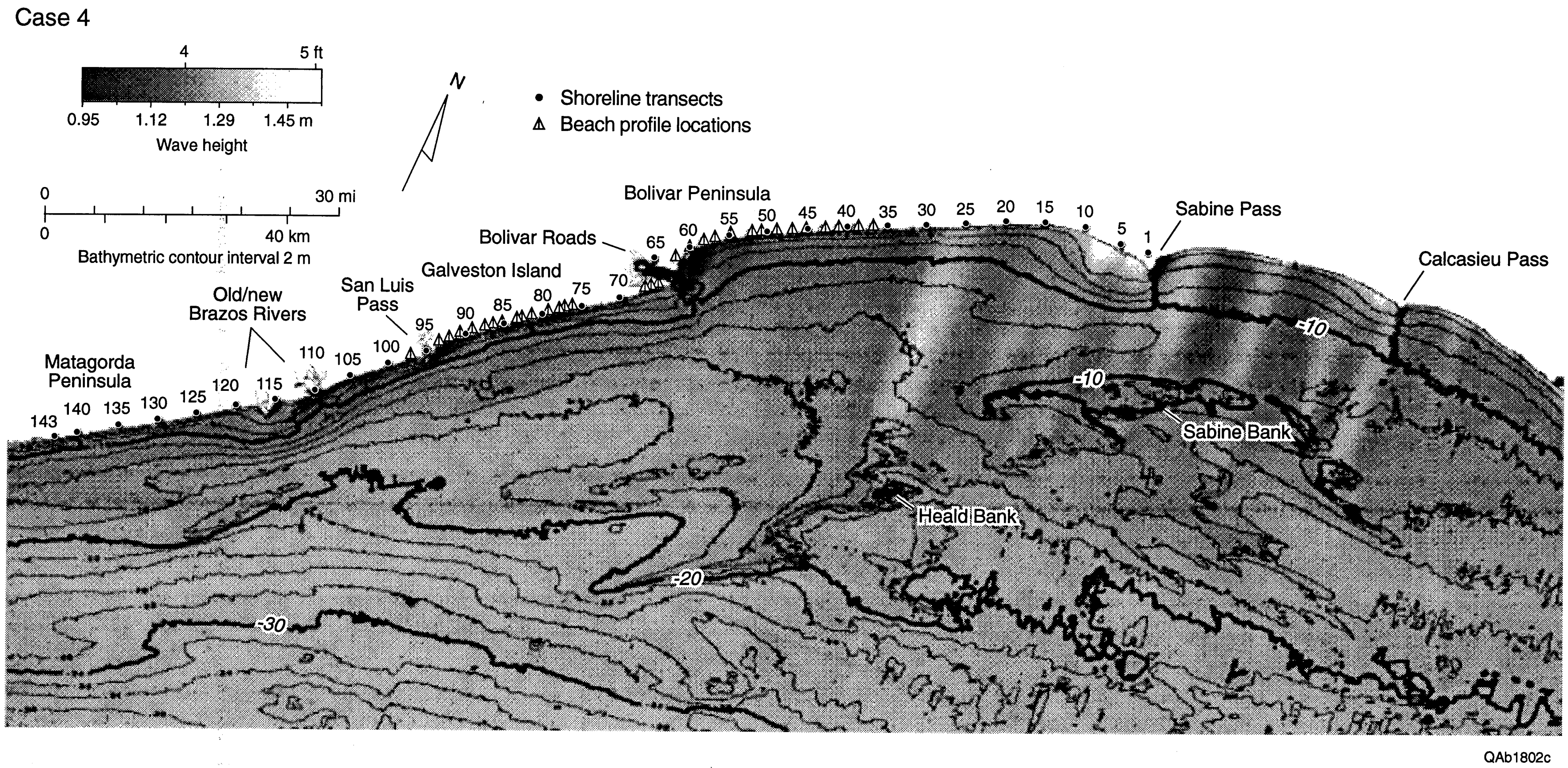


Figure 14. Bathymetry and wave heights for case 4 wave conditions: height= 1.4 m; period= 6.1 s; direction= 157.5°.

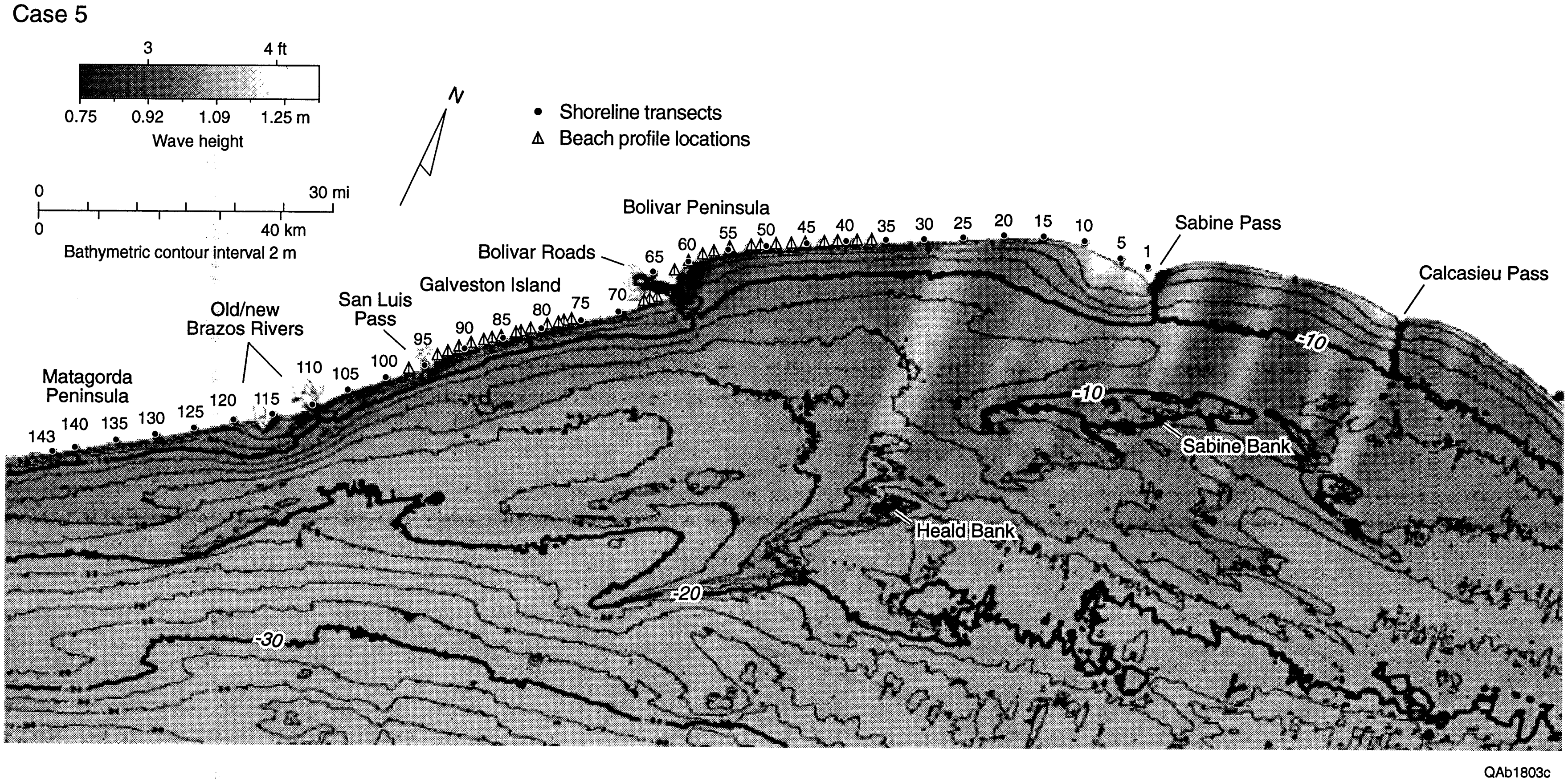


Figure 15. Bathymetry and wave heights for case 5 wave conditions: height= 1.2 m; period= 5.7 s; direction= 180°.

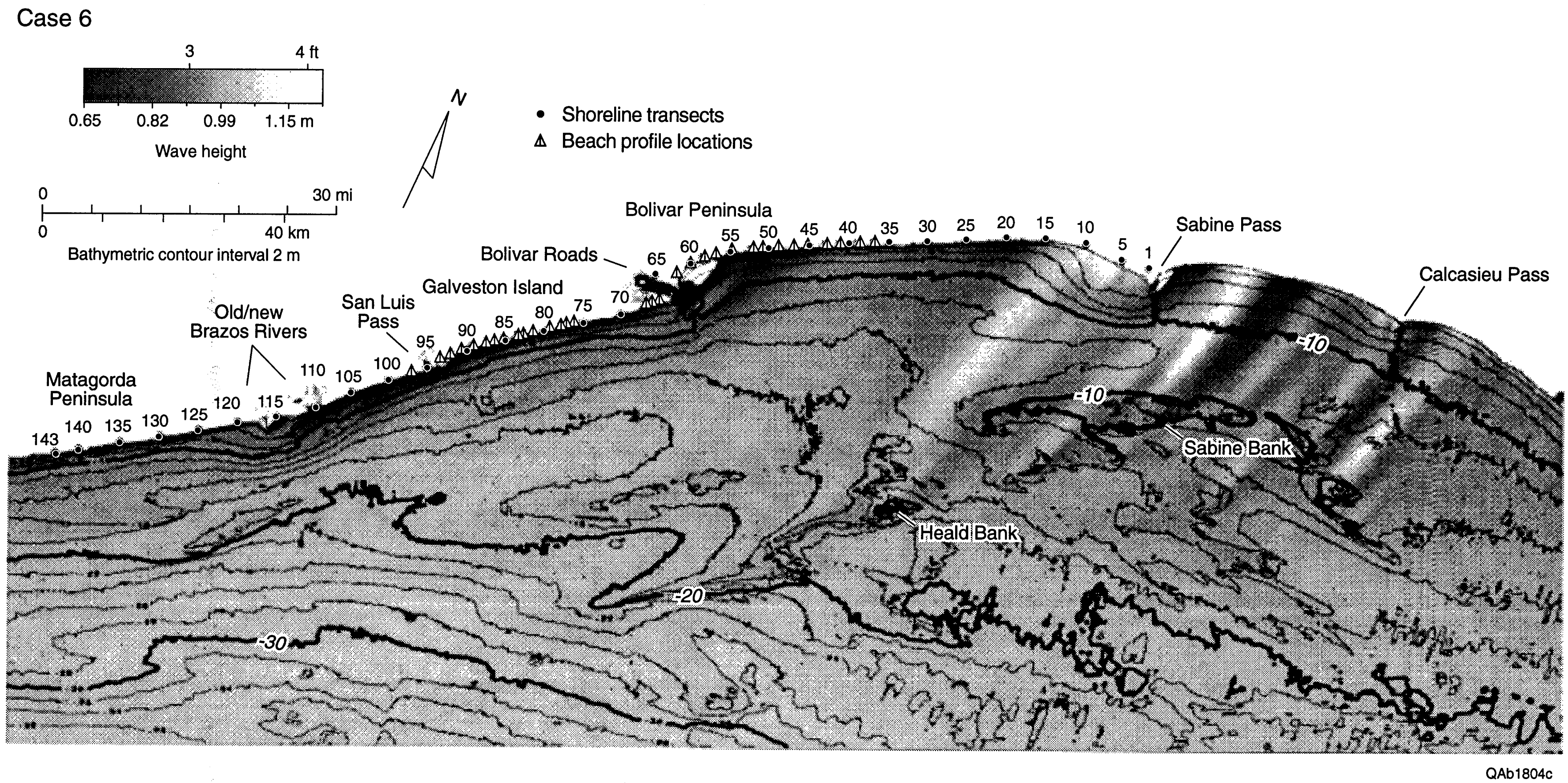


Figure 16. Bathymetry and wave heights for case 6 wave conditions: height= 1.1 m; period= 5.3 s; direction= 202.5°.

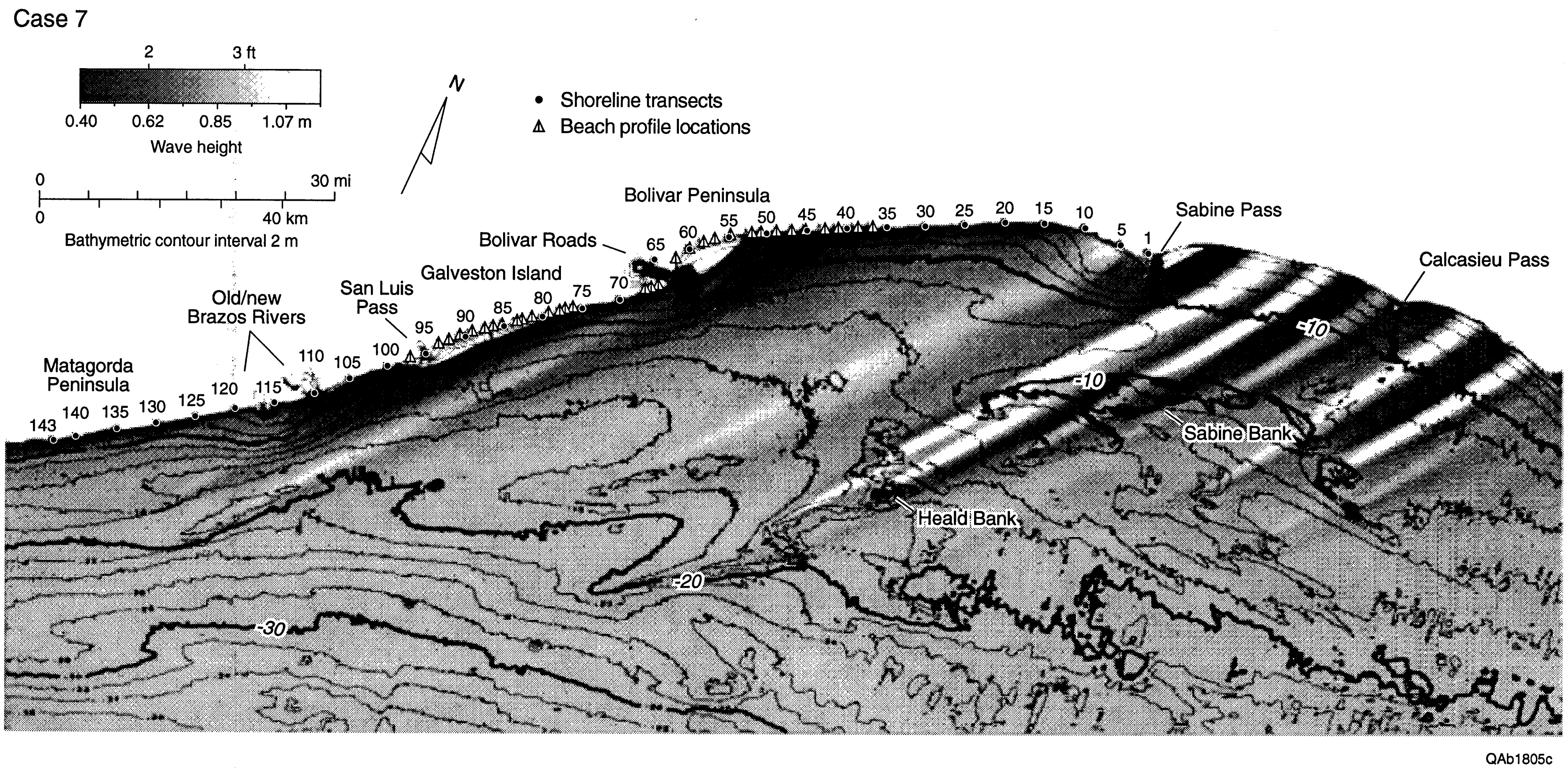


Figure 17. Bathymetry and wave heights for case 7 wave conditions: height= 1.0 m; period= 5.1 s; direction= 225°.

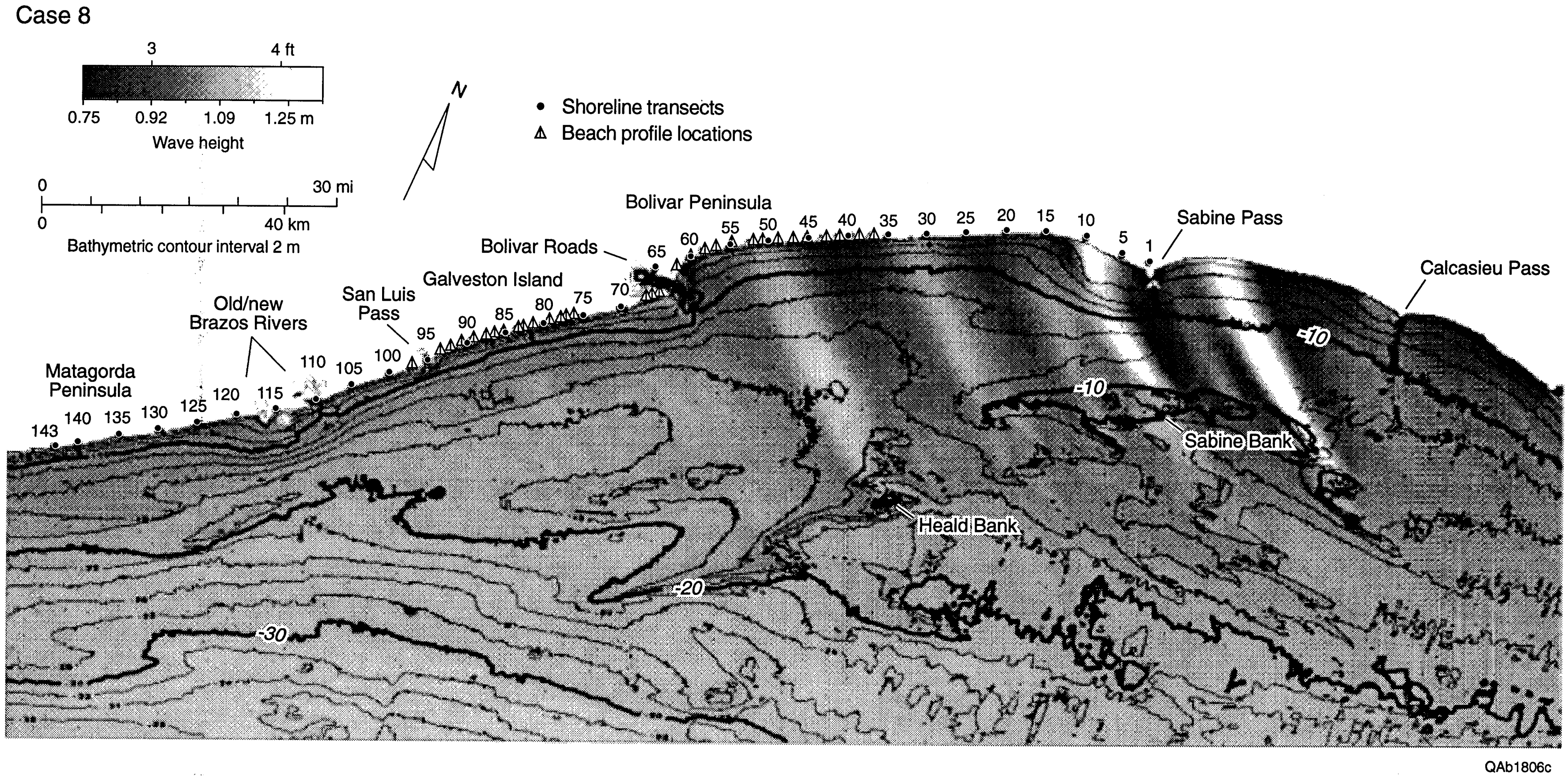


Figure 18. Bathymetry and wave heights for case 8 wave conditions: height= 1.2 m; period= 5.8 s; direction= 131°.

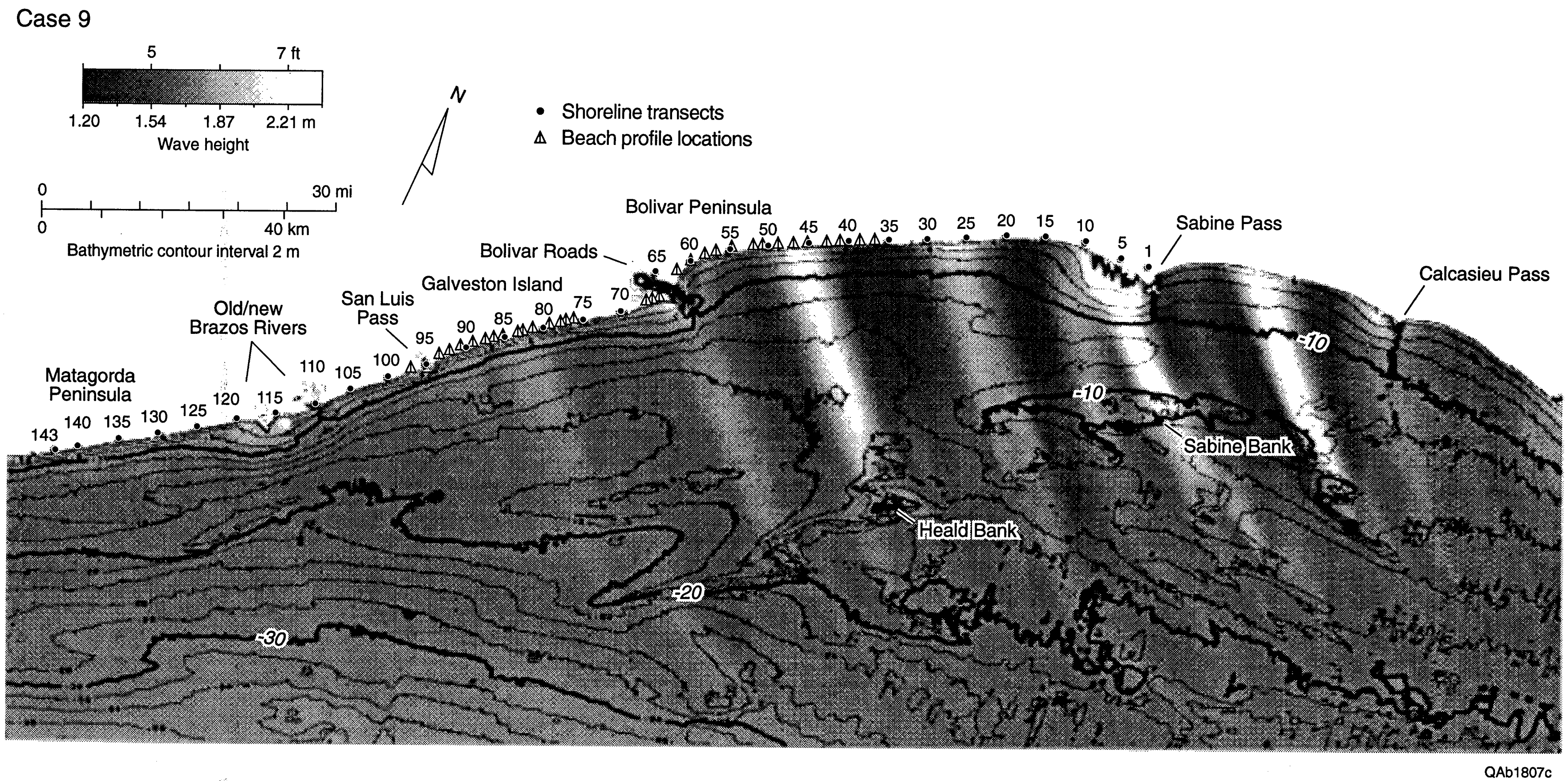


Figure 19. Bathymetry and wave heights for case 9 wave conditions: height= 2.0 m; period= 8.5 s; direction= 135°.

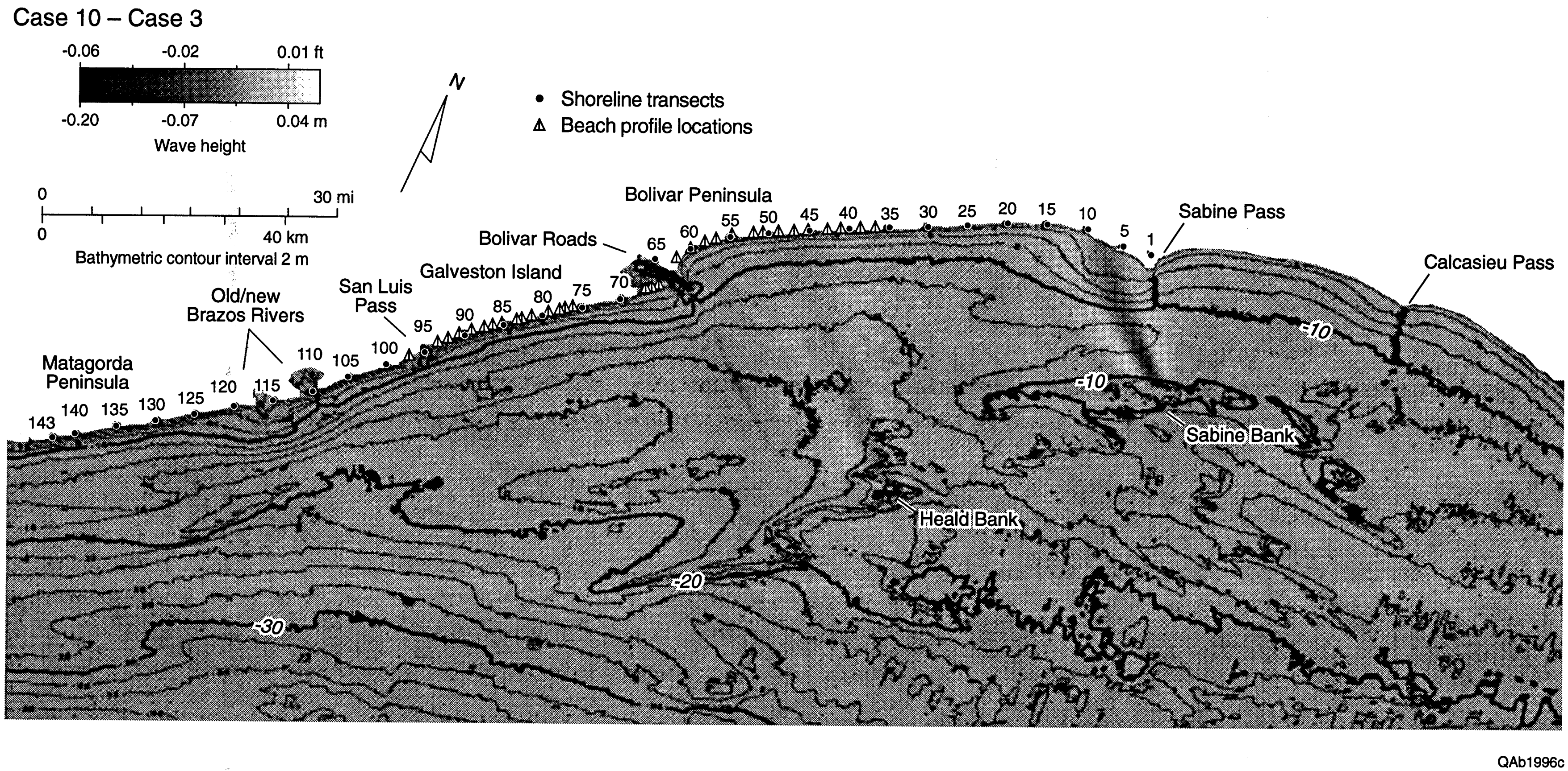


Figure 20. Wave-height difference map for excavated and nonexcavated conditions for modal wave conditions of case 3: height= 1.2 m; period= 6.1 s; direction= 135°. Lighter shades indicate where higher wave heights are predicted for excavated condition relative to nonexcavated condition. Darker shades indicate the opposite.

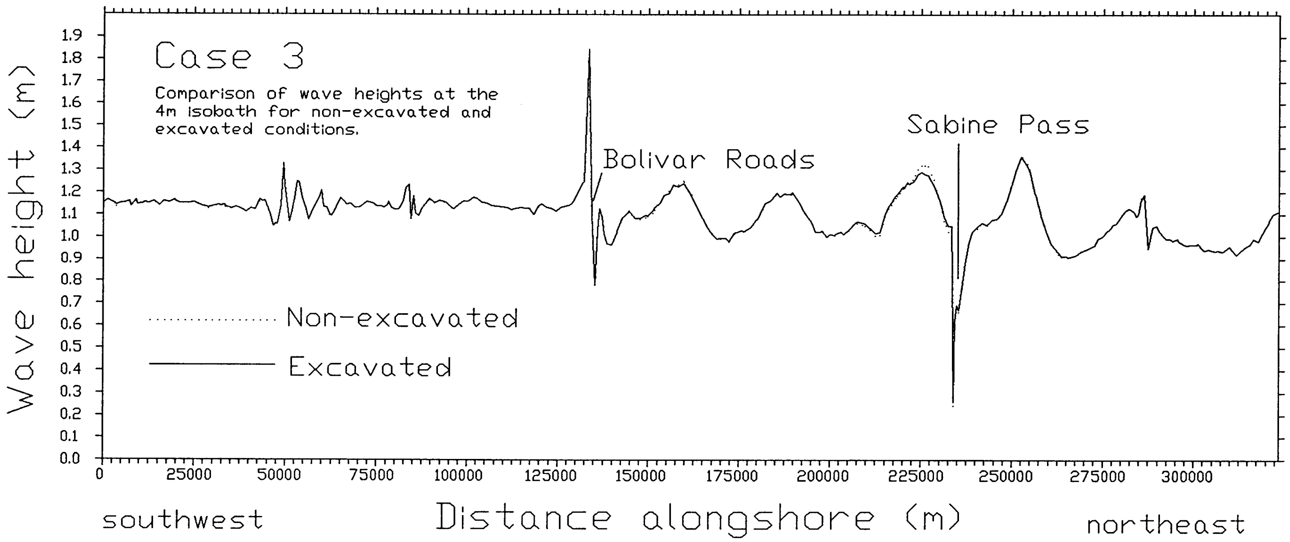


Figure 21. Wave heights along the landward 4-m isobath. Comparison of excavated and nonexcavated conditions for wave conditions of case 3: height= 1.2 m; period= 6.1 s; direction= 135°.

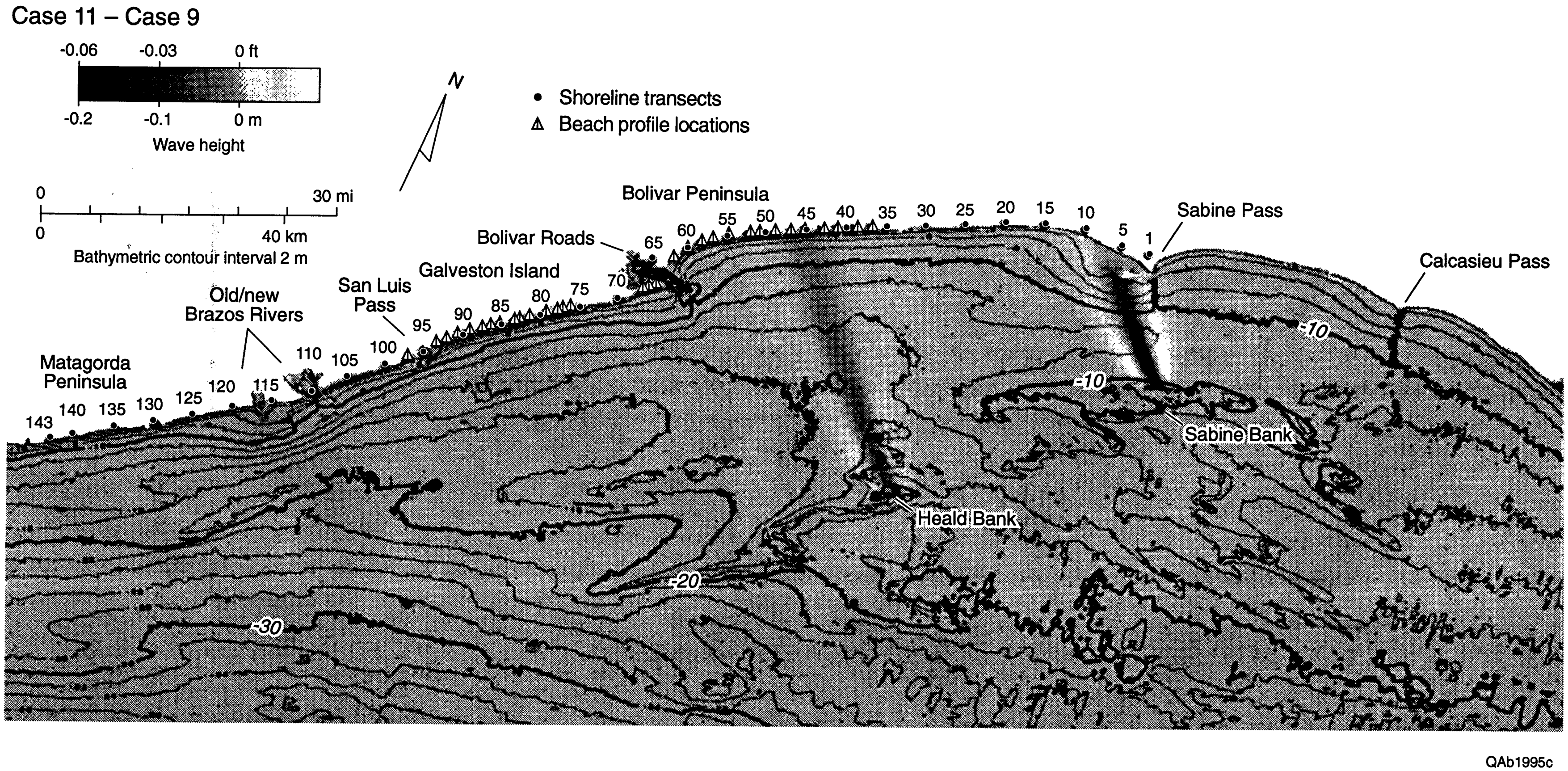


Figure 22. Wave-height difference map for excavated and nonexcavated conditions for storm wave conditions of case 9. Lighter shades indicate where higher wave heights are predicted for excavated condition relative to nonexcavated condition. Darker shades indicate the opposite.

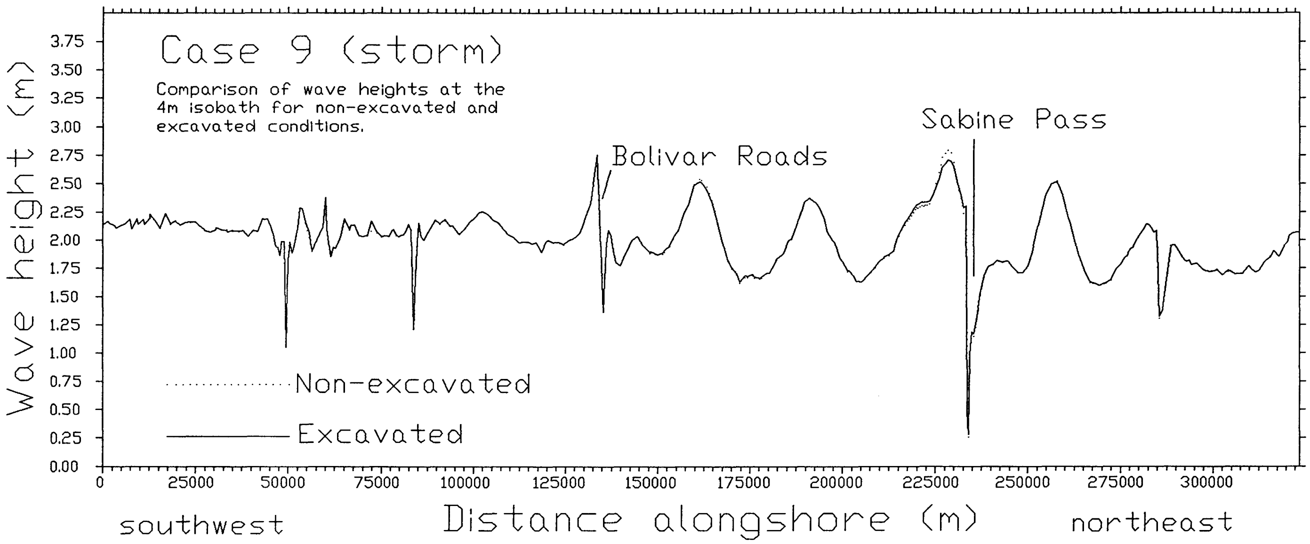


Figure 23. Wave heights along the landward 4-m isobath. Comparison of excavated and nonexcavated conditions for storm wave conditions of case 9: height= 2.0 m; period= 8.5 s; direction= 135°.

To measure the effects of mining sand, we used a dredging scenario that would result in the maximum effects on wave propagation. Excavated conditions were simulated by subtracting two rectangular solids from the bathymetric grid, thereby increasing water depths. Each solid measured 4,000 m in the alongshore direction, 1,000 m in the shore normal direction, and 2.5 m deep. The hypothetical sand volume was removed from the shallowest portions of Sabine and Heald Banks to simulate dredging of 10 million m^3 from each bank. The model was run with excavated and non-excavated conditions for comparison.

Wave parameters are from the Coastal Engineering Research Center's Wave Information Study for the Gulf of Mexico (Hubertz and Brooks, 1989). This data set is a hindcast of wave conditions for coastal and offshore locations for the period from 1956 to 1975. Tropical storm and hurricane conditions are excluded from the hindcast. Data from station number 12, located 70 km offshore of Bolivar Peninsula and in 20 m water, was used in this study. Station 12 is about 20 km seaward of Heald and Sabine Banks. The Wave Information Study provides 20 years of hindcast wave conditions computed every three hours and compiled in percent occurrence tables for specified directions of wave propagation. For wave cases one through seven in this study, the mean significant wave height (Hs) and period were used for each onshore wave direction interval spanning an arc of 22.5° (Table 2). Case eight uses a mean Hs, period, and direction for all onshore directions, and case nine estimates Hurricane Alicia conditions in 1983 based on data presented in Garcia and Flor (1984).

Results of Wave Refraction Analysis

The influence of offshore shoals on wave refraction is readily apparent when contour maps of wave height are viewed (Figures 11-19). Minimum water depths are 6 to 10 m over Heald and Sabine Banks and related smaller shoals. Waves focus landward of the shoals causing zones of relatively high and low wave heights along the shoreline (Figures 11-19). These zones of constructive and destructive interference shift along the coast as wave directions change. For the more common wave directions (Figures 12-16 and 18-19), the variance in alongshore wave heights caused by the shoals only occurs east of Bolivar Roads. West of Bolivar Roads (Galveston Island, Follets Island, and Matagorda Peninsula), wave heights are relatively constant except for local variations caused by ebb-tidal deltas at Bolivar Roads and San Luis Pass and at the Brazos River delta.

Cases 3 and 9 both have a wave direction of 135° but case 9 represents high long-period waves associated with storm conditions (Figures 13 and 19). The variance in alongshore wave height along Bolivar Peninsula is about 1.0 m for hurricane conditions or 50% of the initial wave height of 2 m. Wave heights for case 3, on the other hand, range about 0.3 m, or 25% of the initial wave height of 1.2 m. Wave-height zones are also shifted about 4 km to the east for long-period hurricane conditions compared with nonstorm conditions.

Cases 3 and 9 were run with the bathymetric grid reflecting post-extraction conditions as described above. For each case, a wave-height difference map was created by subtracting wave heights computed for the excavated condition from the wave heights computed for the non-excavated condition. Figure 20 shows the wave-height difference grid for the modal wave condition of case 3. The simulated dredging caused wave heights to change less than 3 cm landward of the Heald Bank dredge site and less than 10 cm landward of the Sabine Bank site in the direction of initial wave propagation. Wave heights are lower in the landward "shadow" of the excavated sites, but higher on each end. Wave heights along the landward 4-m isobath were also plotted, and excavated versus nonexcavated scenarios compared (Figure 21). For case 3, the only measurable change at the 4-m isobath is produced by dredging Sabine Bank, which predicts lowering of wave heights by 5 cm just southwest of Sabine Pass.

The storm condition of case 9 was also run with and without excavated bathymetry; Figure 22 is the wave-height difference map for the two scenarios. Changes in wave heights caused by dredging are less than 10 cm at Heald Bank and less than 20 cm at Sabine Bank. The pattern of change in the lee of each bank is the same as described for case 3. For case 9, the greatest predicted change at the 4-m isobath is produced by dredging Sabine Bank. The model predicts lowering of wave heights by 10 cm just west of Sabine Pass (Figure 23). Similarly, the model predicts that dredging Heald Bank will cause a lowering of wave heights by less than 5 cm northeast of Bolivar roads.

Implications of Results

As waves propagate across the shallowest portions of Sabine and Heald Banks, they converge and wave heights increase landward of shoals. This wave-focusing effect of the offshore shoals causes variation in the distribution of wave heights arriving at the shoreline east of Bolivar Roads. These offshore shoals, therefore, are expected to have a significant effect on shoreline change. West of Bolivar Roads, variation of alongshore wave heights is caused by the more local effects of wave refraction around tidal inlets and river deltas, which would not be influenced by dredging at Heald or Sabine Banks.

Dredging the crests of Heald and Sabine Banks probably would decrease their wave-focusing effect only slightly. The wave propagation model predicts that during average wave conditions, wave heights will be lowered by less than 10 cm in the lee of the banks and by less than 5 cm at the 4-m isobath. During storm conditions, lowering of wave heights probably would be less than 20 cm in the lee of Sabine Bank and less than 10 cm at the 4-m isobath. The borrow scenario used in this analysis is for a volume of sand that is approximately 10 times the amount used in a typical beach nourishment project. If Sabine and Heald Banks become offshore mining sites, it is conceivable that this volume could be dredged over several years because of the initial needs of several projects and continued maintenance nourishment. Based on the wave refraction analysis, the effects of dredging Heald Bank on wave propagation and coastal sedimentation are negligible. The effect of dredging Sabine Bank is greater, but also small, and is not expected to alter sedimentation patterns away from the dredge site.

POTENTIAL WEATHER-RELATED DREDGING RESTRICTIONS

Successful offshore mining operations depend on understanding the physical processes in the Gulf of Mexico near the Banks and the potential influence of those processes on sand extraction operations. The preliminary work by Morton and Gibeaut (1993) only reported average conditions for waves and tides. Those statistical averages provide some limited information about wave heights and periods, but they are inadequate with regard to planning a sand extraction operation. More important than averages are the distributions of wave heights, wave periods, wave directions, current speeds, and current directions as well as the seasonality of all these processes. An analysis of inner shelf processes was conducted to determine if dredging equipment would be able to operate uninterrupted throughout the year or if mining operations would be suspended during certain months when wave energy is greatest. This analysis indicates how the mining operations might be effected by weather patterns and meteorological factors (wind, barometric pressure, rain, and fog) and how the offshore physical oceanographic conditions are linked to the meteorological forces. Another possible application of the physical processes analysis has to do with predicting the direction and distance that suspended sediment will be transported away from the mining site. Movement and dispersion of the suspended sediment plume will depend on the sea state and shelf currents at the time of dredging.

The results of this task provide a better understanding of offshore mining conditions and the annual cycle of environmental energy that would be encountered in the western Gulf of Mexico. It also provides a basis for determining the annual durations of mining, which are needed for the economic analysis.

The physical processes task was accomplished by examining historical records of tides, waves, and weather patterns. A primary objective of this task is developing a summary of seasonal characteristics of the critical offshore parameters including wind directions, wind speeds, wave directions, wave heights, and identifying unusual circumstances (water spouts, hurricanes) that might disrupt mining activities. Because offshore weather data are sparse or difficult to obtain (proprietary data), we used available National Weather Service records either from nearby coastal sites such as Port Arthur and Galveston or offshore monitoring buoys.

Oceanographic records for coastal tide gauges and wave gauges or hindcast wave data were ordered from the National Ocean Survey and the Corps of Engineers and examined. Principal investigators for the MMS-funded Louisiana-Texas Shelf Circulation program (LATEX) were contacted to see if any of their monitoring stations and data sets would be suitable for our analysis of oceanographic conditions near Sabine and Heald Banks. Each data set was analyzed independently using time-series methods that reveal trends in the data such as seasonal variability and yearly maximums. The data sets were also examined to see if they cover the same time periods. Because the data sets coincide temporally, additional statistical analyses were performed to investigate the relationships among the measured variables. The results of this work could be used to determine the optimal periods of mining and the duration of uninterrupted mining activities. This type of mining restriction analysis is needed before an economic analysis of the operation can be conducted.

A practical approach to understanding offshore mining conditions was also included in this task. We contacted marine operators working in the Gulf of Mexico to determine what conditions currently alter or interrupt offshore activities such as dredging, laying pipelines, or towing barges. We also discussed with dredging companies the potential mining problems associated with changing weather while working in the Gulf of Mexico.

Wind and Wave Analysis

Wind and wave data from several sources in the vicinity of Heald and Sabine Banks (Table 3) were analyzed to describe the likely sea conditions that a dredging operation would encounter. Both measured and hindcast data are presented. The hindcast data are from the Wave Information Study (WIS) conducted by the U.S. Army Corps of Engineers (Hubertz and Brooks, 1989). For the hindcast, a wind field is computed from an atmospheric pressure field and merged with observed wind data (Resio et al., 1982). A discrete spectral model then uses the merged wind field to determine the generation of waves (Resio, 1982). The results of the hindcast are time series of directional wind and wave data for discrete locations, including a location near Heald Bank presented in this study (Figure 24).

Measured wind and wave data are available from moored buoys and coastal stations operated by the National Data Buoy Center (NDBC) of the National Oceanographic and Atmospheric Administration (NOAA). Coastal stations are referred to as Coastal-Marine Automated Network (CMAN) stations. A CMAN station west of Sabine Pass at Sea Rim State Park provided directional wind data for this report (Figure 24). A moored sea buoy offshore of Galveston Island

Table 3. Selected sources of wind and wave data in the Sabine and Heald Banks area.

Identification	Description	Latitude/Longitude	Data	Period
42035	moored buoy, National Data Buoy Center (NDBC)	29 14' 47"N/ 94 24' 35"W 30 km ESE of Bolivar Roads, 25 km NW of Heald Bank	hourly directional winds and nondirectional waves	5/93 to present
SRST2	Coastal-Marine Automated Network (CMAN) station, NDBC	29 40' 12"N/ 94 03' 00"W Sea Rim State Park on coast 20 km W of Sabine Pass, 35 km landward of Sabine Bank	hourly directional winds	1985 to present
41-4300 or 996830	National Weather Service first order weather station	29 58'N/ 95 21'W Houston Intercontinental Airport, 100 km inland	less than hourly directional wind	before 1983 to present
WIS-11	Wave Information Study (WIS) hindcast data, U.S. Army Corps of Engineers	29 00' 00"N/ 94 30' 00"W 35 km SW of Heald Bank	3 hourly directional winds and waves	1956 to 1975
WIS-12	Wave Information Study (WIS) hindcast data, U.S. Army Corps of Engineers	29 00' 00"N/ 94 00' 00"W 20 km SE and seaward of Heald Bank	3 hourly directional winds and waves	1956 to 1975
WIS-13	Wave Information Study (WIS) hindcast data, U.S. Army Corps of Engineers	29 30' 00"N/ 93 30' 00"W 25 km E of Sabine Bank	3 hourly directional winds and waves	1956 to 1975

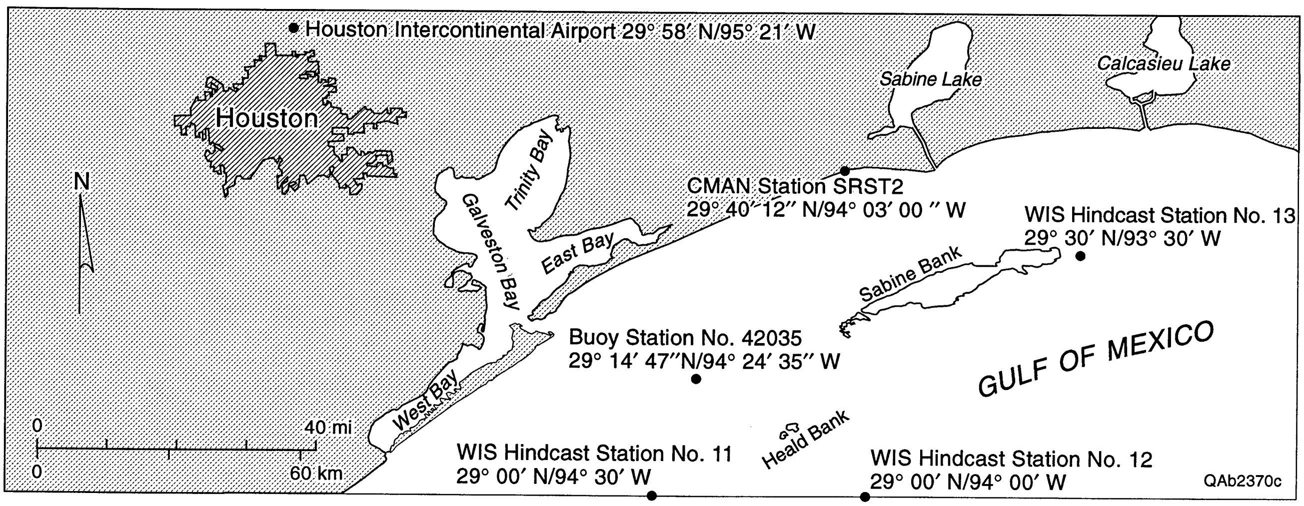


Figure 24. Map showing locations of wind and wave recording and hindcast stations in the vicinity of Heald and Sabine Banks.

provided directional wind and nondirectional wave data. In addition, wind data from the National Weather Service's station at the Houston Intercontinental Airport provided directional wind data (Figure 24).

Waves

The longest time series of wave data in the area is the hindcast data. These directional data are computed at three hourly intervals for the 20-year period from 1956 to 1975. Tropical cyclones are excluded from the hindcast. Figure 25 is a reproduction of the summary percent occurrence table and wave rose diagram for WIS station 12 as they appear in the WIS report number 18 (Hubertz and Brooks, 1989). Station 12 is located 20 km southeast and seaward of Heald Bank in 20-m water depth.

Hindcast data indicate that nearly half of the time waves come from the southeast and that the most common significant wave height (Hs, average height of the upper one-third highest waves) is between 1.00 m and 1.49 m, which occurs 45% of the time. The most common peak wave period (Tp) is between 5.4 and 6.5 s which occurs 28% of the time. The overall mean Hs is 1.2 m and the mean Tp is 5.8 s. The monthly mean Hs as computed over the 20-year period varies from 0.9 m in July and August to 1.4 m in December, January, February, March, and April.

Table 4 is a cumulative percent table of Hs and may be used to approximate weather delays for dredging operations caused by high waves. This table indicates the fraction of time that waves were equal to or less than a particular Hs for all wave directions. When considering all the data for the 20-year period, waves with heights of 1.5 m or less occurred 80% of the time. Table 4 also presents cumulative data for each month. January is the stormiest month with wave heights of 1.5 m or less occurring 66% of the time, whereas July and August are the calmest months with wave heights of 1.5 m or less occurring 98% of the time. The Hs of 1.5 m is used in this discussion because most dredging operations are delayed or hindered when waves exceed this height. Table 4, however, may be used to approximate dredging delays for a variety of wave heights. It is important to note that Hs is spectral, and for conditions when there is a large variation in wave height, some waves may be considerably higher than the stated Hs. In addition, the wave refraction analysis in this report shows that waves tend to be higher on and in the lee of the crests of the banks. And finally, the hindcast data exclude tropical storms and hurricanes, and even though August, September, and October are relatively low-Hs months, the chances for a major storm are greater then than at other times of the year.

Two years of nondirectional wave data from May 1993 through April 1995 were collected by NDBC buoy mooring number 42035 located in 15-m water depth 25 km northwest of Heald Bank and 45 km northwest and landward of WIS station number 12. These data are hourly and nearly

STATION 12 29.00N 94.00W FOR ALL DIRECTIONS
PERCENT OCCURRENCE(X1000) OF HEIGHT AND PERIOD FOR ALL DIRECTIONS

HEIGHT(METERS)	PERIOD(SECONDS) <4.2	4.2-5.3	5.4-6.5	6.6-7.4	7.5-8.7	8.8-9.5	9.6-10.5	10.6-11.8	11.9-13.3	13.4-LONGER	TOTAL
0. - 0.49	330	629	573	3	.	.	.	.	.	.	1535
0.50 - 0.99	3875	17754	4729	807	191	11	13	.	.	.	27380
1.00 - 1.49	41	11406	27765	5092	936	49	11	.	.	.	45300
1.50 - 1.99	.	195	7989	9295	1666	41	13	3	.	.	19202
2.00 - 2.49	.	11	626	2161	2210	63	.	.	.	.	5071
2.50 - 2.99	.	.	13	135	785	210	3	.	.	.	1146
3.00 - 3.49	.	.	.	5	29	167	80	.	.	.	281
3.50 - 3.99	.	.	.	.	.	8	30	11	.	.	49
4.00 - 4.49	.	.	.	.	.	.	.	13	.	.	13
4.50 - 4.99	.	.	.	.	.	.	.	.	1	.	1
5.00+	.	.	.	.	.	.	.	.	.	.	0
TOTAL	4246	29995	41695	17498	5817	549	150	27	1	0	

MEAN HS(M) = 1.2 LARGEST HS(M) = 4.6 MEAN TP(SEC) = 5.8 TOTAL CASES = 58440.

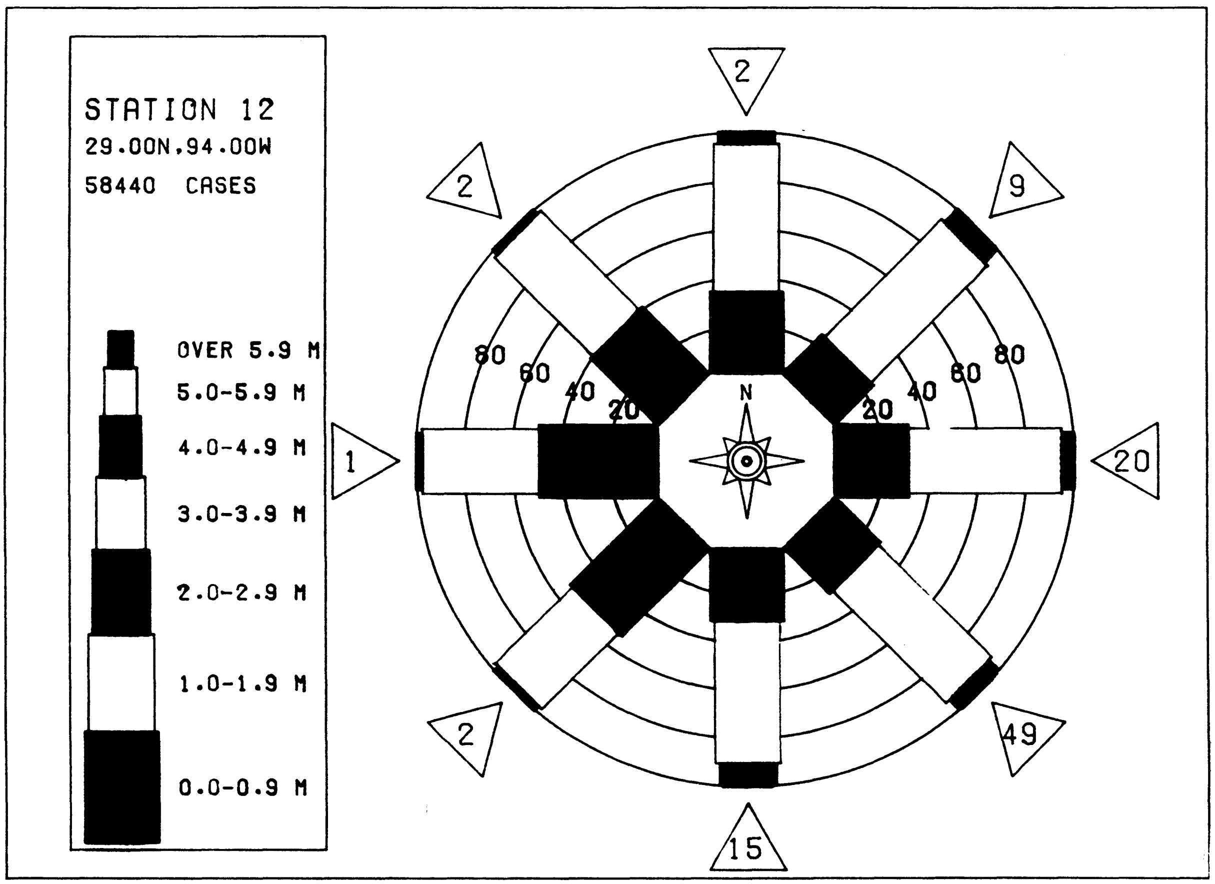


Figure 25. Wave rose diagram and percent occurrence of wave height and period for WIS hindcast station 12, from Hubertz and Brooks (1989).

Table 4. Cumulative percent of significant wave heights for WIS station 12 (20 years hindcast data: 1956 to 1975). Percent values are percent of time with significant wave heights (Hs) less than or equal to the height given in column one.

Hs (m)	All Data cum. %	Jan cum. %	Feb cum. %	Mar cum. %	Apr cum. %	May cum. %	Jun cum. %	Jul cum. %	Aug cum. %	Sep cum. %	Oct cum. %	Nov cum. %	Dec cum. %
0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.3	0.1	0.1	0.0	0.0	0.0	0.8	0.1	0.0	0.1	0.0	0.0	0.0	0.1
0.4	1.5	0.3	0.4	0.4	0.5	2.8	3.5	4.7	3.1	1.1	0.8	0.5	0.4
0.5	4.4	1.2	1.0	0.9	1.5	5.6	8.5	14.1	9.8	4.6	2.6	1.5	1.1
0.6	7.9	2.6	2.5	2.0	2.5	9.7	14.2	23.0	17.4	9.6	5.2	3.3	2.2
0.7	12.4	4.6	5.0	4.4	4.5	14.2	20.5	32.7	27.8	15.5	8.7	5.5	4.2
0.8	18.8	8.1	8.9	8.2	8.0	20.4	29.3	44.7	39.6	24.6	15.4	9.3	7.8
0.9	28.9	13.5	15.6	14.8	13.9	29.7	43.2	63.4	56.6	37.9	26.7	16.1	14.5
1.0	40.1	22.0	23.2	23.5	21.3	39.9	56.2	78.2	71.9	51.5	41.2	26.3	24.1
1.1	50.6	31.5	32.4	33.6	30.5	50.5	67.5	87.4	82.8	63.6	54.6	37.1	34.6
1.2	59.6	41.1	42.7	44.0	39.6	59.3	76.0	92.4	90.1	73.0	64.4	46.5	44.3
1.3	67.4	49.9	52.0	54.0	49.5	67.6	82.2	95.8	94.0	80.1	72.7	55.8	53.8
1.4	74.2	58.3	60.9	63.4	59.0	74.8	86.7	97.7	96.2	85.9	79.8	64.2	62.8
1.5	79.7	66.1	69.1	71.0	67.5	80.1	89.5	98.4	97.8	89.5	85.4	71.4	70.1
1.6	84.8	73.4	76.4	77.7	75.4	85.7	92.6	99.1	98.9	92.2	90.0	79.3	76.6
1.7	88.3	79.1	81.5	82.3	81.1	89.3	94.3	99.5	99.3	94.2	92.8	84.4	81.6
1.8	91.5	84.1	86.3	86.8	86.0	92.5	95.9	99.8	99.6	95.9	95.3	89.3	85.9
1.9	93.4	87.6	89.8	89.7	88.4	94.2	96.7	99.9	99.7	97.0	96.7	92.3	89.0
2.0	95.2	90.9	92.5	92.4	90.8	96.1	97.3	99.9	99.8	97.9	98.0	94.8	91.9
2.1	96.6	93.8	94.8	94.4	93.1	97.4	97.9	100.0	99.9	98.5	98.8	96.3	94.2
2.2	97.3	95.2	95.9	95.5	94.3	98.1	98.3	100.0	100.0	98.9	99.2	97.1	95.2
2.3	98.0	96.9	97.2	96.5	95.5	98.7	98.7	100.0	100.0	99.0	99.4	98.0	96.4
2.4	98.5	97.9	98.1	97.3	96.3	99.0	98.8	100.0	100.0	99.2	99.6	98.8	97.2
2.5	98.9	98.6	98.6	98.1	97.0	99.3	99.1	100.0	100.0	99.3	99.8	99.2	97.9
2.6	99.1	99.0	98.9	98.5	97.5	99.5	99.3	100.0	100.0	99.4	99.9	99.4	98.4
2.7	99.4	99.3	99.2	98.8	98.1	99.7	99.6	100.0	100.0	99.5	99.9	99.6	98.8
2.8	99.5	99.4	99.4	99.1	98.5	99.7	99.8	100.0	100.0	99.5	100.0	99.7	99.1
2.9	99.7	99.6	99.6	99.4	98.8	99.8	99.9	100.0	100.0	99.5	100.0	99.9	99.4
3.0	99.7	99.7	99.7	99.4	99.2	99.9	100.0	100.0	100.0	99.5	100.0	99.9	99.6

continuous over the 2 years. The average Hs measured for the 2 years was 0.91 m, and the average period was 5.6 s. Table 5 is a cumulative percent table of Hs in the same format as Table 4 discussed above. When considering all the data for the 2-year period, waves with heights of 1.5 m or less occurred 92% of the time. January was the stormiest month with wave heights of 1.5 m or less occurring 85% of the time, whereas July and August are the calmest months with wave heights of 1.5 m or less occurring nearly 100% of the time.

Figure 26 is a plot of the cumulative wave heights computed from buoy and hindcast data. The buoy data measured the Hs lower than the hindcast data, and there are three possible causes for this: (1) average wave heights were lower from 1993 to 1995 than from 1956 to 1975; (2) the hindcast routine is biased toward higher wave heights; and (3) waves at the hindcast location tend to be higher than those at the buoy location. The WIS hindcast station number 11 is 48 km to the west of station 12 and has an average Hs of 1.1 m, which is 0.1 m lower than at station 12. WIS station 11 is closer to shore than station 12 and 20 km closer to the buoy than station 12. The buoy location is also closer to shore than station 12. Spatial variability, therefore, can explain part but probably not all of the difference in Hs. Average wave periods between the two data sets agree well.

Winds

Wind rose diagrams and tables of wind speed summaries are presented in Figures 27 through 30. Winds hindcast at WIS station 12 (Figure 27) and measured at NDBC buoy mooring 42035 (Figure 28) show the prevailing winds to be from the southeast. The hindcast shows winds with speeds greater than 10 kts occurring 80% of the time, but for the 2 years of buoy data, winds exceeded 10 kts only 51% of the time. The same possible reasons for the discrepancies in wave height between the hindcast and buoy data sets discussed above apply to wind speed. Six years of hourly data from the coastal CMAN station at Sea Rim State Park (Figure 29) show a more southerly component to the winds and calmer conditions than at the offshore sites. At the coast, wind speeds exceeded 10 kts only 37% of the time. Houston Intercontinental Airport is 100 km from the coast, and wind speeds for the same 6-year period (1985 to 1991) as the CMAN time series are lower with speeds exceeding 10 kts only 15% of the time (Figure 30). The directional distribution of winds at the Houston airport is also more even than at the coastal and offshore sites.

Winds out of the northwest, north, and northeast occur less frequently than from other directions, but they tend to be strong. These strong northerly winds are associated with the passage of winter cold fronts. Because northerly winds generally blow offshore, they do not generate large waves nearshore, and thus their potential effect on dredging operations is not represented in the wave data. Based on the hindcast and buoy data, northerly winds that exceed

Table 5. Cumulative percent of significant wave heights for NOAA buoy #42035 (May 1993 through April 1995). Percent values are percent of time with significant wave heights (Hs) less than or equal to the height given in column one.

Hs (m)	All Data cum. %	Jan cum. %	Feb cum. %	Mar cum. %	Apr cum. %	May cum. %	Jun cum. %	Jul cum. %	Aug cum. %	Sep cum. %	Oct cum. %	Nov cum. %	Dec cum. %
0.1	0.3	2.3	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.4	0.1	0.0	0.3
0.2	2.8	6.0	3.8	5.4	0.0	1.0	1.3	0.0	2.5	6.7	1.9	1.3	2.7
0.3	7.3	8.9	10.9	9.6	2.9	4.1	5.7	0.9	7.5	20.1	5.2	2.6	8.0
0.4	14.7	14.5	18.8	19.8	7.9	14.8	10.5	5.2	21.2	31.7	13.5	4.3	13.7
0.5	22.1	21.2	25.8	24.9	14.7	24.0	14.7	11.5	38.3	40.4	21.8	8.7	20.5
0.6	31.4	26.2	33.7	32.9	24.6	34.7	22.9	23.9	56.5	47.6	30.2	19.5	29.0
0.7	40.8	31.9	40.6	41.7	33.5	49.4	29.8	38.1	68.8	56.6	39.0	30.2	37.7
0.8	50.1	38.5	51.5	48.7	42.7	60.5	39.2	51.5	74.4	66.5	51.2	37.4	46.8
0.9	59.0	46.0	62.9	57.0	51.0	68.4	49.0	63.4	80.8	76.9	58.8	44.9	56.9
1.0	67.5	53.9	73.7	63.9	64.4	76.1	56.7	73.5	86.9	83.3	65.4	54.3	66.4
1.1	75.1	60.9	82.2	71.0	74.1	82.2	68.0	81.2	92.3	87.1	71.7	63.1	75.5
1.2	81.6	68.1	88.9	77.1	79.6	88.9	76.3	88.9	96.3	89.6	76.6	72.2	83.9
1.3	86.1	75.0	92.6	81.2	83.9	93.2	82.8	93.1	98.6	92.8	80.0	78.0	88.8
1.4	89.6	80.5	94.9	85.7	88.5	95.0	86.7	95.9	99.2	95.1	84.1	82.8	92.5
1.5	92.5	84.7	96.2	89.5	91.6	97.1	90.4	96.9	99.7	96.2	89.3	87.4	95.3
1.6	94.6	87.6	97.8	92.7	93.9	97.9	93.1	98.6	100.0	96.8	92.4	91.1	96.7
1.7	96.1	90.2	99.2	94.4	95.6	98.6	95.1	99.9	100.0	97.1	94.9	93.4	97.4
1.8	97.1	92.9	99.5	95.9	96.7	98.9	96.5	100.0	100.0	97.5	96.2	95.4	97.6
1.9	98.0	94.9	99.9	97.4	98.2	99.4	97.1	100.0	100.0	97.7	97.8	96.8	98.0
2.0	98.6	96.8	99.9	98.7	98.6	99.7	97.5	100.0	100.0	97.8	98.6	97.7	98.4
2.1	98.9	98.0	99.9	99.0	99.4	99.9	97.8	100.0	100.0	98.0	98.9	98.3	98.4
2.2	99.3	98.6	100.0	99.5	99.7	100.0	98.3	100.0	100.0	98.3	99.4	99.1	98.9
2.3	99.5	98.9	100.0	99.7	99.8	100.0	98.4	100.0	100.0	98.7	99.7	99.5	99.4
2.4	99.6	99.1	100.0	99.9	99.9	100.0	98.5	100.0	100.0	99.1	99.8	99.7	99.5
2.5	99.8	99.4	100.0	100.0	99.9	100.0	98.7	100.0	100.0	99.4	100.0	99.9	99.9
2.6	99.9	99.7	100.0	100.0	99.9	100.0	99.1	100.0	100.0	99.5	100.0	100.0	100.0
2.7	99.9	99.9	100.0	100.0	100.0	100.0	99.2	100.0	100.0	99.6	100.0	100.0	100.0
2.8	99.9	100.0	100.0	100.0	100.0	100.0	99.2	100.0	100.0	99.8	100.0	100.0	100.0
2.9	99.9	100.0	100.0	100.0	100.0	100.0	99.4	100.0	100.0	99.9	100.0	100.0	100.0
3.0	100.0	100.0	100.0	100.0	100.0	100.0	99.5	100.0	100.0	100.0	100.0	100.0	100.0

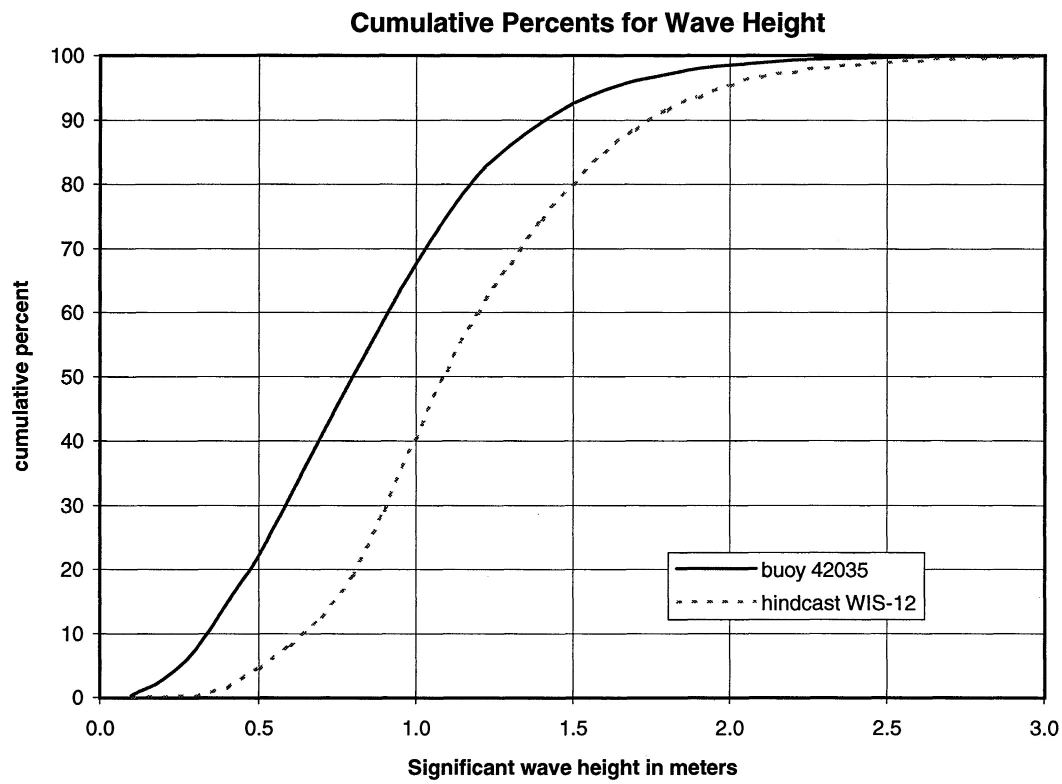
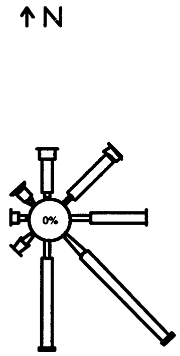


Figure 26. Cumulative percent occurrence for significant wave heights at buoy mooring 42035 and WIS hindcast station number 12. Buoy data cover the 2-year period from May 1993 through April 1995. Hindcast data cover the 20-year period from 1956 to 1975.

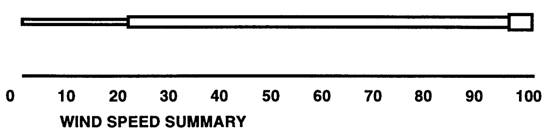
WIS Hindcast Station 12
Winds from January 1956 through December 1975

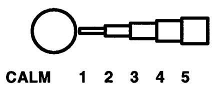


CUMULATIVE WIND SPEED SUMMARY (PERCENT)

MAGNITUDE	1	2	3	4	5	TOTAL
NORTH	1.0	6.5	1.8	0.0	0.0	9.3
NORTHEAST	1.9	10.8	1.5	0.0	0.0	14.1
EAST	3.9	10.9	.1	0.0	0.0	14.8
SOUTHEAST	5.3	23.3	.4	0.0	0.0	29.0
SOUTH	3.5	17.2	.8	0.0	0.0	21.5
SOUTHWEST	2.2	2.2	0.0	0.0	0.0	4.5
WEST	1.4	1.3	0.0	0.0	0.0	2.7
NORTHWEST	1.0	2.7	.4	0.0	0.0	4.1
TOTAL	20.1	74.9	5.0	0.0	0.0	

WINDS	100.0
CALM	0.0
TOTAL	100.0

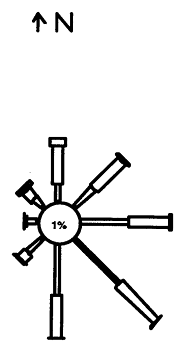




MAGNITUDE:CALM - S = 0 : 1 - 0<S<=10 : 2 - 10<S<=21 :
(S=KNOTS) 3 - 21<S<=33 : 4 - 33<S<=47 : 5 - S>47

Figure 27. Wind rose diagram and wind speed summary for WIS hindcast station number 12.

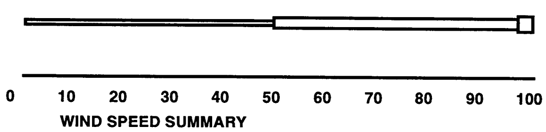
Buoy #42035
Winds from May 1993 through April 1995

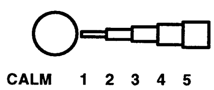


CUMULATIVE WIND SPEED SUMMARY (PERCENT)

MAGNITUDE	1	2	3	4	5	TOTAL
NORTH	3.3	7.6	1.4	0.0	0.0	12.3
NORTHEAST	5.3	8.0	.3	0.0	0.0	13.6
EAST	9.3	8.3	.2	0.0	0.0	17.8
SOUTHEAST	12.4	10.4	.2	0.0	0.0	23.1
SOUTH	10.0	8.2	.1	0.0	0.0	18.3
SOUTHWEST	3.9	2.2	0.0	0.0	0.0	6.1
WEST	1.8	.8	0.0	0.0	0.0	2.6
NORTHWEST	2.3	2.5	.8	0.0	0.0	5.6
TOTAL	48.3	48.1	3.2	0.0	0.0	

WINDS	99.5
CALM	.5
TOTAL	100.0

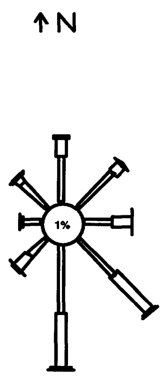




MAGNITUDE:CALM - S = 0 : 1 - 0<S<=10 : 2 - 10<S<=21 :
(S=KNOTS) 3 - 21<S<=33 : 4 - 33<S<=47 : 5 - S>47

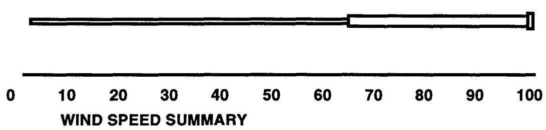
Figure 28. Wind rose diagram and wind speed summary for buoy mooring number 42035.

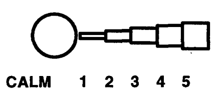
Sea Rim State Park, CMAN Station SRST2
Winds from January 1985 through December 1991



CUMULATIVE WIND SPEED SUMMARY (PERCENT)

MAGNITUDE	1	2	3	4	5	TOTAL
NORTH	9.0	3.6	.1	0.0	0.0	12.7
NORTHEAST	9.6	2.3	0.0	0.0	0.0	12.0
EAST	5.4	3.9	.1	0.0	0.0	9.5
SOUTHEAST	10.0	9.8	.5	0.0	0.0	20.3
SOUTH	13.3	10.5	.3	0.0	0.0	24.1
SOUTHWEST	4.5	3.6	.1	0.0	0.0	8.1
WEST	3.6	.4	0.0	0.0	0.0	4.0
NORTHWEST	6.6	1.6	0.0	0.0	0.0	8.3
TOTAL	62.1	35.7	1.1	0.0	0.0	
WINDS	99.0					
CALM	1.0					
TOTAL	100.0					

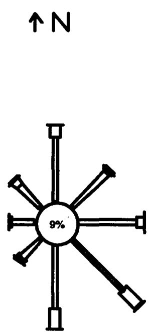




MAGNITUDE:CALM - S = 0 : 1 - 0<S<=10 : 2 - 10<S<=21 :
(S=KNOTS) 3 - 21<S<=33 : 4 - 33<S<=47 : 5 - S>47

Figure 29. Wind rose diagram and wind speed summary for CMAN station SRST2 at Sea Rim State Park.

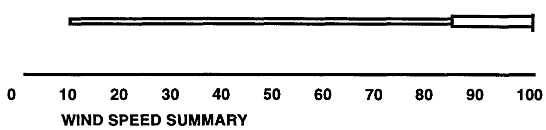
Houston Intercontinental Airport
Winds from January 1985 through December 1991

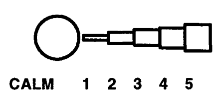


CUMULATIVE WIND SPEED SUMMARY (PERCENT)

MAGNITUDE	1	2	3	4	5	TOTAL
NORTH	12.3	2.5	0.0	0.0	0.0	14.8
NORTHEAST	9.5	.8	0.0	0.0	0.0	10.3
EAST	11.3	1.7	0.0	0.0	0.0	13.0
SOUTHEAST	14.0	4.3	0.0	0.0	0.0	18.4
SOUTH	12.5	3.6	0.0	0.0	0.0	16.2
SOUTHWEST	5.1	.9	0.0	0.0	0.0	5.9
WEST	4.3	.6	0.0	0.0	0.0	4.9
NORTHWEST	5.8	1.6	0.0	0.0	0.0	7.4
TOTAL	74.9	16.1	.1	0.0	0.0	

WINDS	91.0
CALM	9.0
TOTAL	100.0





MAGNITUDE:CALM - S = 0 : 1 - 0<S<=10 : 2 - 10<S<=21 :
(S=KNOTS) 3 - 21<S<=33 : 4 - 33<S<=47 : 5 - S>47

Figure 30. Wind rose diagram and wind speed summary for the Houston Intercontinental Airport.

10 kts occur about 23% of the time, and northerly winds that exceed 20 kts occur about 3% of the time in the vicinity of Sabine and Heald Banks. Strong northerly winds occur less frequently near the shoreline as shown by the CMAN data from Sea Rim State Park.

First Quarter 1995 Weather Conditions

Approximately 535,500 m^3 of sand were dredged from a site 1.5 km offshore of East Beach on the eastern end of Galveston Island Texas from January through April 1995. Table 6 presents cumulative Hs data for this time period recorded by NDBC buoy mooring 42035. The buoy wave data are nondirectional; however, the wave periods, which averaged 5.6 s during this time, indicate that the waves were locally generated and that wind direction recorded by the buoy may be used to infer wave direction. Onshore-directed waves had an average Hs of 0.96 m and average period of 5.8 s for the 4-month period. Because the dredge site was nearshore, the cumulative wave-height data in Table 6 were computed by assigning a wave height of 0.0 m during times of offshore directed winds. Table 6 shows that about 95% of the time waves were either directed offshore or were equal to or less than 1.5 m high.

The buoy position is 30 km east-southeast of the dredge site in 15 m of water, and the borrow site is in 6 m of water. Qualitative inspection of wave refraction maps presented in this report indicates that, for the common wave directions, wave heights are expected to be 0.2 to 0.3 m higher at the dredge site than at the buoy site. Therefore, the Hs values should be conservatively revised up by 0.3 m. After this revision, we estimate that the Hs at the borrow site was less than or equal to 1.5 m about 85% of the time during the dredging operation.

ESTIMATED COSTS OF DREDGING

Before leasing of offshore sand resources in the western Gulf commences, an economic analysis of offshore mining will need to be conducted. An economic analysis of offshore sand extraction has not been conducted for the Sabine-Heald Bank trend for several reasons. First, the physical and environmental issues regarding quality of the sand resource and possible environmental impacts need to be resolved before an economic analysis is conducted. Second, economic analyses are ephemeral because of the transient nature of supply and demand as well as externalities that determine economic climate. An economic analysis would need to be conducted before the near-term leasing phase is achieved but after specific mining objectives have been determined. A third reason why an economic analysis of Sabine and Heald Banks has been postponed is that an economic analysis of mining sand in the Gulf of Mexico at Ship Shoal was favorable (Kelly and Crawford, 1991). Furthermore, mining of sand off the Atlantic coast and

Table 6. Cumulative percent of inshore significant wave heights (Hs) inferred from NOAA buoy #42035. Period is January 1995 through April 1995. Percent values are percent of time with Hs less than or equal to the height given in column one. During times of offshore winds, Hs was assigned to 0 to infer inshore conditions.

Hs (m)	cum. %
0.1	38.2
0.2	40.4
0.3	42.1
0.4	46.0
0.5	50.6
0.6	53.7
0.7	57.3
0.8	62.1
0.9	68.1
1.0	74.5
1.1	80.7
1.2	84.9
1.3	88.4
1.4	92.0
1.5	94.6

Hs (m)	cum. %
1.6	96.1
1.7	97.1
1.8	97.8
1.9	98.8
2.0	99.2
2.1	99.5
2.2	99.6
2.3	99.8
2.4	99.8
2.5	99.9
2.6	99.9
2.7	100.0
2.8	100.0
2.9	100.0
3.0	100.0

along the west coast of Florida for beach replenishment is currently economical, and the economics of offshore sand mining in the Gulf of Mexico should improve as demand increases. In the first quarter of 1995, sand for beach replenishment at Galveston, Texas, was mined from the Gulf of Mexico.

A preliminary summary of costs associated with extracting and delivering offshore sand for beach replenishment was prepared for areas where erosion is critical, such as at Galveston and along the southeastern Texas coast (Jefferson County). This aspect of the economic analysis focused on the estimated costs of mining sand resources associated with Sabine and Heald Banks. This information is needed to assess the potential of near-term leasing of hard minerals in the Federal waters of offshore Texas. The cost analysis considered parameters used in simulation models, but did not involve actual model runs.

Local geological and engineering data (water depths, sand thickness, areal extent, percent sand, haul distances, dredge methods, fill requirements) were compiled from prior work and the results presented by Byrnes and Groat (1991), Morton and Gibeaut (1993), Morton (1994), Kraus et al. (1995), and Morton et al. (1995). The results of this task provide a basis for comparing the relative economic differences between mining sites and extraction technologies even if the cost estimates are not highly accurate.

Galveston Beach Nourishment Project

The first large-scale nourishment of a Gulf beach in Texas was completed during the spring of 1995 on a 6.4-km stretch of Galveston Island extending from 10th Street to 61st Street. The project, which was funded by the City of Galveston, was designed to restore the recreational beach along the seawall where the density of commercial development is highest.

Sand for the nourishment project came from the shoreface off East Beach, which is immediately east of the beach fill area. The mining site was 1.5 to 2.0 km offshore and in 5 to 6 m of water (Table 7). Significant wave heights at the borrow site are about 1.2 m. Textural analyses from the borrow area indicate that the mined sediments were 95% sand and the average grain size was fine to very fine sand, which is slightly finer than the native beach sand (Morton et al., 1995).

A hydraulic cutterhead dredge excavated 535,500 m^3 in four months, and the most significant mining delays were due to inclement weather. In December 1994, the dredge was only able to operate 40% of the time because high waves in the Gulf either caused or threatened separation of the pipeline connections. During rough weather, the dredge left the borrow site and moved to protected water in Galveston Bay.

Large-diameter (1 m) pipes and pumps were used to transport the sand onshore from the dredge. Additional pipe was laid along the beach, and pumps were added to transfer the sand in a

Table 7. Completed, proposed, and potential beach fill projects utilizing sand deposits from the Gulf of Mexico.

Parameter	Galveston[a]	South Padre Island[b]	Ship Shoal[c]	Sabine Bank[d]	Heald Bank[d]
Sand Source	Shoreface	Channel Maintenance	Offshore Shoal	Offshore Shoal	Offshore Shoal
Offshore Distance	2 km	3 km	15-30 km	30-35 km	50-60 km
Water Depths	5-6 m	12 m	3-7 m	8-12 m	10-16 m
Signif. Wave Height	1.2 m	<1 m (between jetties)	1.4 m	1.2 m	1.2 m
Areal Extent of Sand	3.4 km^2	1 km^2 (along channel)	250 km^2	450 km^2	100 km^2
Percent Sand	95%	75-90%	75-90%	85-100%	80-100%
Fill Requirement	535,500 m^3	417,000 m^3	764,000 m^3	1,000,000 m^3	1,000,000 m^3
Pumping Distances	3-17 km	9-11 km	2-15 km	3-15 km	3-15 km
Dredge Method	Cutterhead	Pipeline	Hopper	Hopper	Hopper
Est. Dredging Costs	\$7.65/m^3	\$3.62/m^3	\$8.14-16.35/m^3	\$10-18/m^3	\$10-18/m^3

a Source Morton et al. (1995)

b Source Kraus et al. (1995) and Galveston District, Corps of Engineers

c Source Byrnes and Groat (1991)

d Source This Report

slurry to the diffuser where the sand was deposited from the slurry. Pumping distances ranged from 3 to 17 km depending on proximity of the beach fill to the borrow site. According to the consulting engineering firm on the project, dredging and pumping the sand cost $7.65/m^3$. Mobilization and demobilization costs added another $1,000,000 to the cost of the project.

Comparing the costs of dredging at Galveston with those expected at Sabine and Heald Banks indicates that costs are lower at the Galveston site despite greater water depths, similar sand quality, and similar wave climate. This is primarily because the Galveston project involved a single-step pumping operation rather than a more expensive hopper dredge or two-step sand transfer operation, which is required at Sabine or Heald Banks to overcome the long offshore distances.

Proposed Ship Shoal Project

A major barrier island restoration project has been proposed for southwestern Louisiana that would excavate sand from Ship Shoal and place it on Isle Dernieres (Byrnes and Groat, 1991). The purpose of the project is to partly mitigate rapid coastal land loss in Louisiana and to provide protection for the wetland resources located on the adjacent delta plain and associated estuaries. A Feasibility Study and an Environmental Impact Statement (EIS) are currently (1995) being prepared to ensure that the project would be cost effective and to assure that it would not cause environmental degradation.

Ship Shoal is a large sand deposit located approximately 15 km offshore of the Isle Dernieres in 3 to 7 m of water (Table 7). Significant wave heights vary around the shoal because variable water depths influence wave heights. Seaward of the shoal, significant wave heights in the Gulf of Mexico are about 1.4 m, whereas wave heights are lower where the shoal provides a sheltering effect. The shoal contains an estimated 1.2 billion m^3 of sand-rich sediment that would be suitable for barrier restoration and beach nourishment.

In 1991, the estimated costs of dredging sand from Ship Shoal for replenishment of nearby barriers ranged from $8.14 to $16.35 (Byrnes and Groat, 1991). It is expected that mining sand at Heald and Sabine Banks using similar techniques and for similar purposes would be slightly more expensive because offshore distances and water depths are greater. Other factors such as nearshore sand quality, wave climate, and weather conditions are similar in Texas and Louisiana.

Proposed South Padre Island Project

South Padre Island is another Texas barrier resort community that depends on beach-related tourism to sustain its economy. In the developed area about 10 km north of Brazos Santiago Pass, the beaches are eroding and there is a need for a major beach replenishment project that would widen the beach and rebuild the dunes (Kraus et al., 1995). Current plans call for dredging approximately 417 million m^3 of sand from between the jetties at Brazos Santiago Pass by the Corps of Engineers for maintenance of the navigation channel to Brownsville. Estimated costs for this project are relatively low (Table 3) because the pumping distances are relatively short, the dredging site is protected from open Gulf waves, and a pipeline dredge can be used.

Morton (1994) identified two potential sand deposits offshore of South Padre Island. The most likely nearshore source of beach-quality sand is the former ebb-tidal delta and post-jetty sand deposits that occur at water depths of 5 to 8 m. If other sand sources were not available, these offshore deposits would be a primary target for beach replenishment sand because the material is close to the proposed beach replenishment area, the material is compatible with the existing beach sediments, and there appears to be a large volume of sand-rich sediment trapped by the north jetty (more than 3 million m^3).

Comparison of grain size analyses of surface sediments of the inner continental shelf reported by White et al. (1986) with grain size analyses of beach sediments from South Padre Island indicates that beach-quality material is present in the nearshore zone offshore of South Padre Island. The water depths and distances offshore to the most probable sand deposits are well within the range of available dredging equipment. Descriptions of borings taken along South Padre Island indicate that sand layers about 6 m thick occur in water depths ranging from 5 to 18 m. These sand deposits occur at the seafloor, and there appears to be very little, if any, mud covering the sand deposits (overburden).

Mining sand offshore at South Padre Island is not economically competitive with sand periodically available from maintenance dredging of the ship channel. Pumping the sand onto the beach solves two problems; it mitigates the beach erosion and eliminates or greatly reduces the need for offshore disposal of dredged material.

CONCLUSIONS AND RECOMMENDATIONS

The present and prior geological investigations of the inner continental shelf of the southeastern Texas offshore area have demonstrated that a large volume of sand-rich sediments are associated with Sabine and Heald Banks. The total volume of sandy sediments, estimated at more than 1.8 billion m^3, constitutes a large hard-mineral resource suitable for uses such as beach replenishment and other construction activities. Compared to Sabine Bank, Heald Bank is in deeper water, contains less shell material, and is closer to potential markets such as Galveston Island where projects requiring beach-quality sand are currently being conducted or planned.

The sand deposits are located in water depths ranging from 4.5 m to about 17 m, and the greatest thickness of beach-quality sand coincides with the shallowest water depths on Sabine Bank. Several petroleum pipelines, production platforms, and a lighthouse are located within the trend of high-quality sand deposits, but they would not necessarily prevent mining of sand from either of the banks. Offshore mining of the sand resource would require equipment designed for open-water dredging (moderate wave climate). Also it is anticipated that dredging and sand transportation would be separate operations because of the distances between the sand deposits and their potential market. Based on current offshore mining technology, costs of operation, and mining efficiencies, it appears that a hydraulic sidecast dredge or bucket dredge would be appropriate for sand extraction, and a system of tugs and scowls would be needed to move the sand between the Banks and beach fill sites. Alternatively, a hopper dredge with pumpout capability or a combination of hopper dredge and cutterhead dredge could be employed to convey the sand from the mining site to the beach.

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APPENDIX A. LOCATIONS OF CORES

Latitude and Longitude of Sabine Bank and Heald Bank Vibracores

Core I.D.	Latitude (degrees min.)	Longitude (degrees min.)
	Sabine Bank	
SBV - 1	29 27.726	93 42.867
SBV - 2	29 28.327	93 43.511
SBV - 3	29 27.059	93 45.498
SBV - 4	29 28.379	93 46.889
SBV - 5	29 28.618	93 51.448
SBV - 6	29 26.772	93 50.641
SBV - 7	29 25.790	93 50.241
SBV - 8	29 24.589	93 49.818
SBV - 9	29 38.090	94 03.449
SBV - 10	29 29.722	93 48.413
SBV - 11	29 31.177	93 35.648
SBV - 12	29 30.007	93 35.307
SBV - 13	29 28.729	93 34.872
SBV - 14	29 29.283	93 38.052
SBV - 15	29 25.341	93 44.381
SBV - 16	29 26.139	93 44.899
SBV - 17	29 28.318	93 45.257
SBV - 18	29 27.692	93 48.413
SBV - 19	29 26.411	93 47.782
SBV - 20	29 25.035	93 41.144
SBV - 21	29 23.800	93 46.506
SBV - 22	29 25.163	93 52.618
SBV - 23	29 24.610	93 54.689
SBV - 24	29 23.378	93 58.237
SBV - 25	29 20.895	94 03.237
	Heald Bank	
HBV - 1	29 07.646	94 11.265
HBV - 2	29 06.357	94 10.097
HBV - 3	29 07.373	94 13.163
HBV - 4	29 08.993	94 11.565
HBV - 5	29 08.131	94 11.005
HBV - 6	29 08.630	94 09.949
HBV - 7	29 08.672	94 08.193

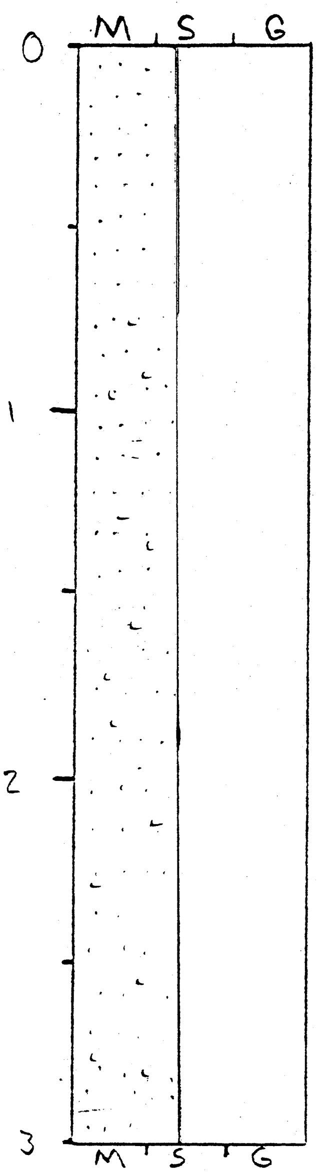
APPENDIX B. CORE DESCRIPTIONS SABINE BANK

CORE LOG

CORE # HBV-1(A) TYPE Vibracore LOCATION Heald Bank
LATITUDE 29° 07.646' LONGITUDE 94° 11.265' SURFACE ELEVATION -28.5'
DEPTH PENETRATED ? LENGTH RECOVERED 9' 2" %COMPACTION ?

OBTAINED BY Gibeaut /R/V Kit Jones DATE 10-12-94
DESCRIBED BY White DATE

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Fine quartz sand (99%)
very well sorted
sub rounded to rounded

scattered (granule & smaller size) shell fragments (<2%) more apparent below 0.6'

1.1 - 1.4' grayer in center of core

1.4 - 1.6 back to yellowish gray to light olive gray fine sand

1.6 - 2.8

fine sand - - medium dark gray with hint of light olive gray
Light olive gray along margins next to core.
Scattered granule size & smaller shell fragments

fine, well to very well sorted, sand

Light olive gray fine sand

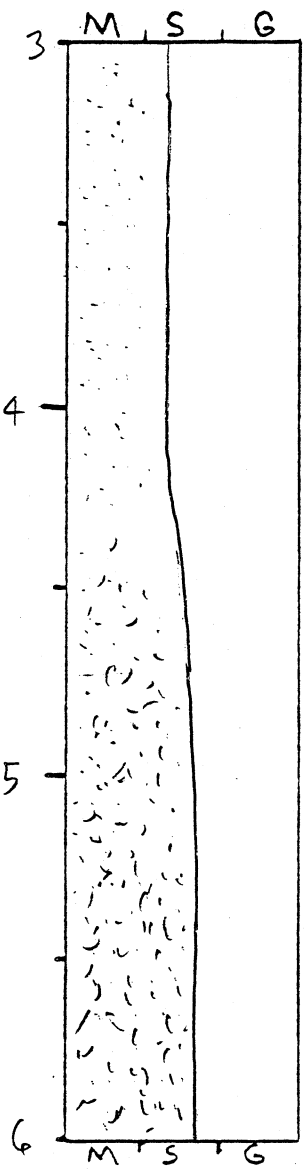
Remarks: Light olive gray to yellowish gray

General Comments:

CORE LOG

CORE # HBV-1 (B) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
3–6		Fine, very well sorted rounded to sub rounded, sand 99% quartz sand Fine sand with increasing shell flakes (coarse to very coarse sand) below 3.5' ≈ 5% shell Gradational increase in shell flake increasing to ≈ 30% below 4.4' Fining upward Fine sand mixed with coarse to very coarse sand-size shell fragments (& granule size) ≈ 50% shell frag. below 4.7' shell increasing with depth		Light olive gray Light olive gray fine sand mixed with light & darker gray shell fragments speckled appearance

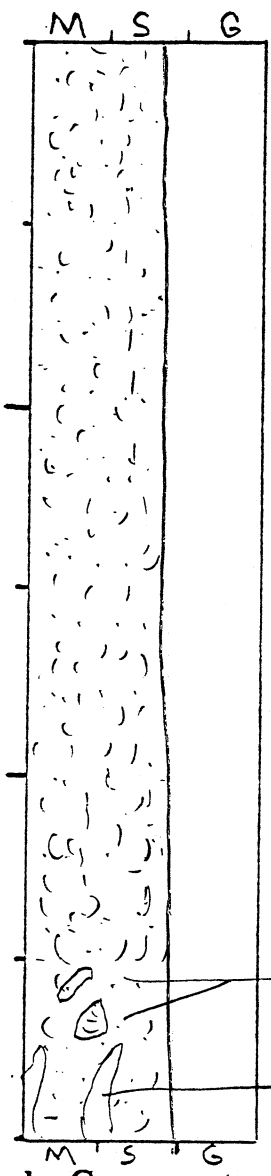
General Comments:

CORE LOG

CORE # HBV-1(C) TYPE______ LOCATION______
LATITUDE______ LONGITUDE______ SURFACE ELEVATION______
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION______

OBTAINED BY______ DATE______
DESCRIBED BY______ DATE______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
6		shelly sand or sandy shell ≈ 50% shell fragments granule to pebble size mixed with fine sand		Light olive gray sand peppered with darker & lighter shell fragments
7		fining upward Shells becoming more abundant than sand at depth		
8		shell fragments becoming coarser Sandy shell shell fragments 2-3 cm long. core catcher		
9				

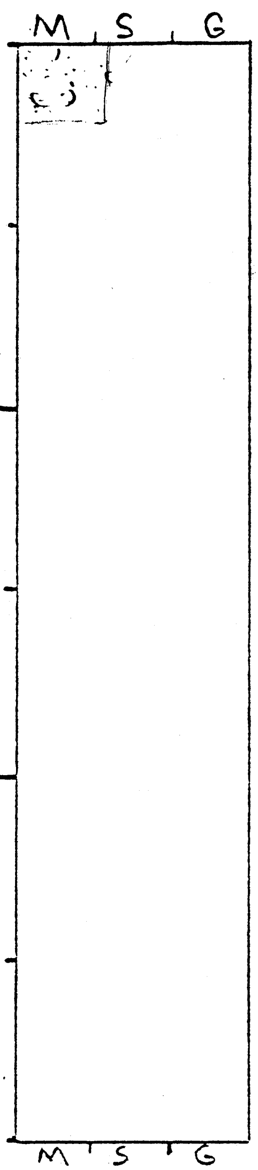


General Comments:

CORE LOG

CORE # HBV-1 (D) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
9 Bottom		Predominantly fine quartz sand (95%) scattered shells		yellowish gray

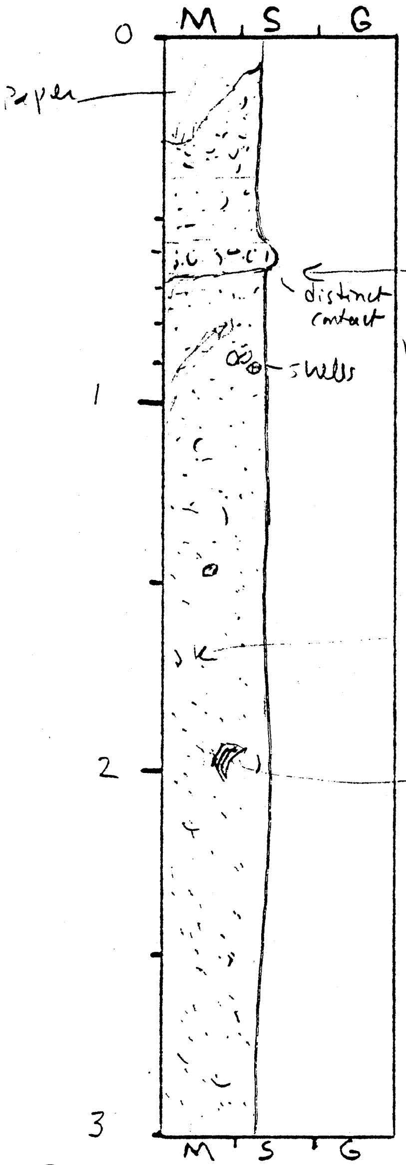
General Comments:

CORE LOG

CORE # HBV-2(A) **TYPE** Vibracore **LOCATION** Heald Bank
LATITUDE 29°06.357' **LONGITUDE** 94°10.097' **SURFACE ELEVATION** -52.5'
DEPTH PENETRATED ? **LENGTH RECOVERED** 14' 7'' (14.6') **% COMPACTION** ?

OBTAINED BY Gibeaut / R/V Kit Jones **DATE** 10-12-94
DESCRIBED BY White **DATE**

DEPTH (ft, m) | **SKETCH** | **LITHOLOGY** | **STRUCTURE** | **REMARKS**



very fine quartz sand, well sorted subangular, with scattered shell fragments (≈ 10%) — Light olive gray

very fine sand, few shells ≈ 1%

0.57-0.65' shelly sand — Yellowish gray to Lt olive gray

color change from yellowish gray to medium dark gray or Olive gray (5Y 3/2)

very fine sand, scattered shells — Olive gray to med. drk gray
shell frags ≈ 5%
most very coarse sand to granule in size
a few pebble size

color line — darker gray (Olive gray) on right
Light olive gray (appears slightly oxidized) to Lt olive brown on left side

shell frag >2cm — running down length of core

silty very fine sand

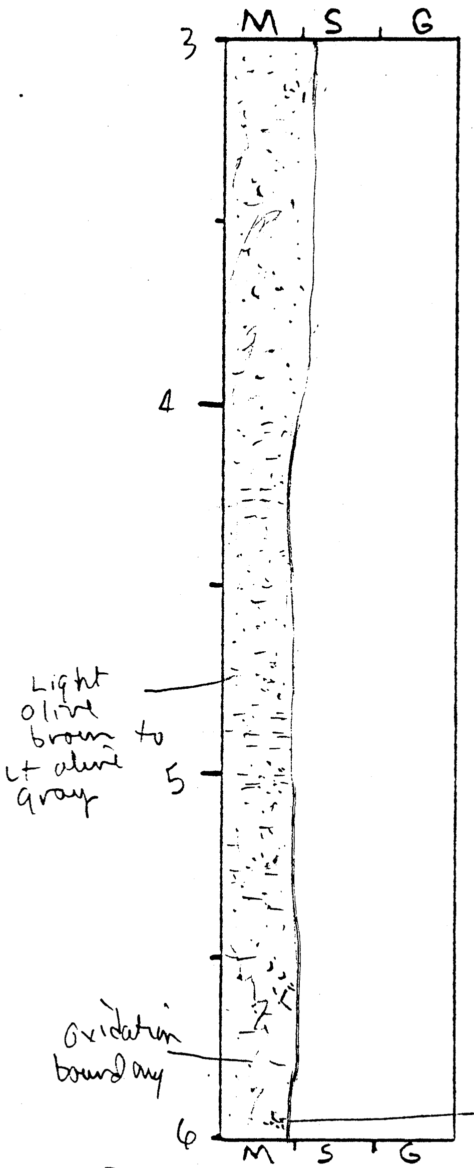
General Comments:

CORE LOG

CORE # HBV-2(B) TYPE ________ LOCATION ________________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ____

OBTAINED BY ______________________ DATE ________
DESCRIBED BY ______________________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



silty very fine sand
scattered shell frag.
local small shell pockets

mod. drk gray to olive gray

muddy sand
(muddier sediment becomes apparent at about 4.2')

med. dark gray

"interbedded" with silty very fine sand

Color along margins of left side light olive brown indicating slight oxidation.

some-what mottled with medium dark gray mud & sand
Indistinct mud layers
scattered shell fragments mostly granule to very coarse sand size
muddy very fine sand or sandy mud
shells more abundant 5.3–5.7' (med. drk gray color)
7–10% shell fragments (granule to very coarse)
shells decrease below 5.7' < 1%
possible organic traces (specks)

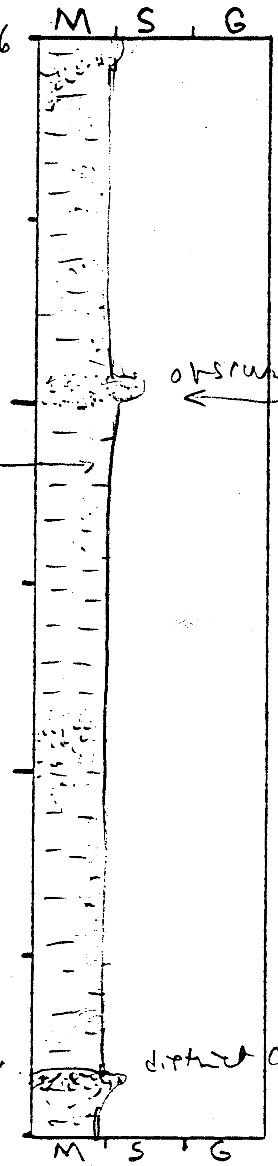
General Comments:

CORE LOG

CORE # HBV-2(C) TYPE ________ LOCATION ____________________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ____

OBTAINED BY ______________________________ DATE ________
DESCRIBED BY ______________________________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



overall: Gradationally coarsening upward from shell layer at 8.75'

6 — very fine sand muddy sand near top
shell fragments up to 25% in tilted layer at 6.2'.
shell fragments decrease to less than 2%

sandy mud

Mottled

Olive gray on right side of core

obscure contacts

7 — very fine sand, muddy

Color boundary

brownish on left side

Med. dark gray on right

Light olive gray on left side

mud with abund. silt
appears to be
silty clay; few shell frags (<1%)

clay with shell fragments (15%)

Light Olive gray across most of core

8 — mostly clay

rare shell frag <1% (v. coarse sand size)

8.75' — distinct contact
shelly mud (shell frags mostly granule size)
shells decrease to less than 5% toward bottom

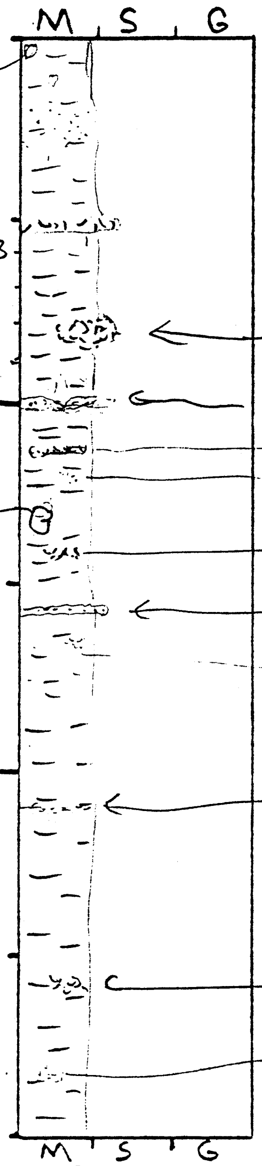
General Comments:

CORE LOG

CORE # HBV-2(D) TYPE________ LOCATION____________________
LATITUDE________ LONGITUDE________ SURFACE ELEVATION________
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION___

OBTAINED BY______________________________ DATE________
DESCRIBED BY______________________________ DATE________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



DEPTH	LITHOLOGY / STRUCTURE	REMARKS
9	mud with some slightly silty zones; rare shell *Mulinia lateralis*	Olive gray 5Y 4/2 to med drk gray
	traces of organics	
9.5 – 9.53	muddy shell layer ≈ 1cm thick	
	clay	Olive gray
9.8	shell pocket granule to pebble size	
10	silty zone, broken or interrupted	
	thin shelly mud (v. crse sand size)	
	scattered organic carbon traces	
	small shell fragments	
	thin very fine sand layer – discrete, continuous	
	organic carbon traces	Olive gray
	clay	
11	organic carbon trace	
	shell fragments	
	organic carbon traces	
12		

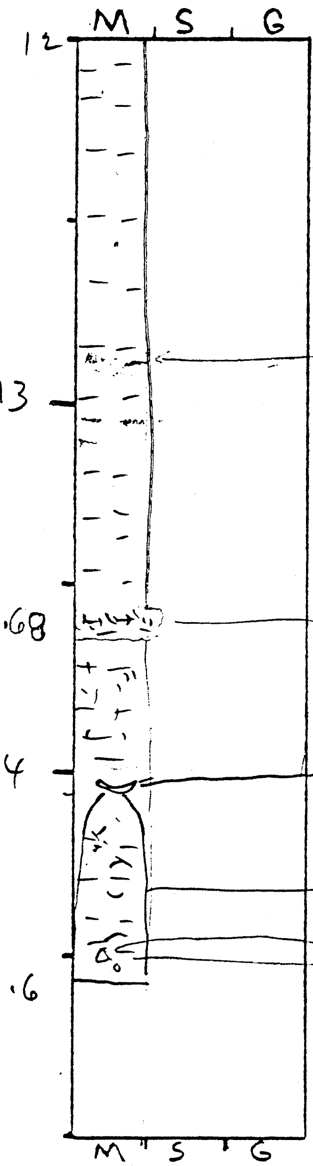
General Comments:

CORE LOG

CORE # HBV-2(E) TYPE______ LOCATION______
LATITUDE______ LONGITUDE______ SURFACE ELEVATION______
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION______

OBTAINED BY______ DATE______
DESCRIBED BY______ DATE______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Clay

Med. dark gray clay to Olive gray

organic carbon specks
no shells

organic carbon traces

muddy shell (very coarse to granule)

Mud
scattered small shell fragments

medium dark gray to Olive gray

Large shell fragment
scattered shells

core catcher

shells

color brownish gray to brown
color possibly due to oxidation near core catcher

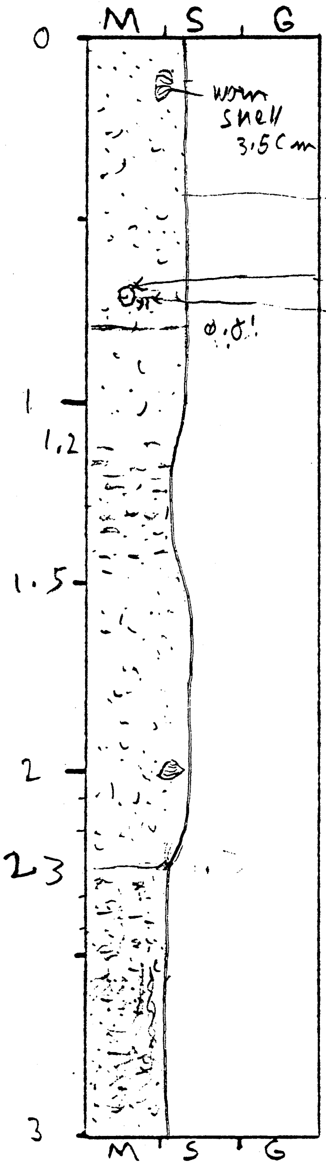
General Comments:

CORE LOG

CORE # HBV-3 (A) **TYPE** Vibracore **LOCATION** Heald Bank
LATITUDE 29° 07.373 **LONGITUDE** 94° 13.163 **SURFACE ELEVATION** -43.5'
DEPTH PENETRATED ? **LENGTH RECOVERED** 20' **%COMPACTION** ?

OBTAINED BY Gibeaut – R/V Kit Jones **DATE** 10-12-94
DESCRIBED BY White **DATE** ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Fine quartz sand (90%) well sorted, sub rounded very coarse to occasional pebble size and granule size shells & fragments (shells 10-15%)
– color change gradational from brownish above to grayer below
very worn shell frag. (1.5cm across)
– shell frag. portal
color gray below 0.8' except along margins of core where it is yellowish gray
v.f. to fine sand with 30% small mud clasts ≥ 3mm to 5mm in size scattered small shells (very coarse sand)
fine to v. fine sand, scattered small shell frag. less mud than above & below
muddy sand -- (discrete clay or mud clasts increasing in size & coalescing with depth).
mud has vertical component to it.
possibly from burrowing

Light olive gray

olive gray ↓

General Comments:

CORE LOG

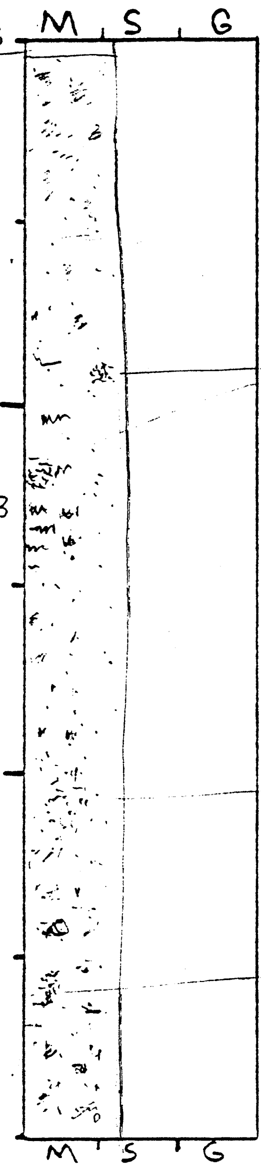
CORE # HBV-3(B) TYPE ________ LOCATION ________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ___

OBTAINED BY ________ DATE ________
DESCRIBED BY ________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS

void space

3



Olive gray muddy sand
V. fine quartz sand
discrete mud clasts

Olive gray (5Y 3/2)

V. fine sand, scattered mud clasts

shell fragment pockets (yellowish gray) very coarse sand size

4

4.3

v. fine sand to muddy sand with ≈ 25% mud clasts

4.5

v. fine sand scattered mud clasts

5

25% shell fragments (gray coarse sand size)

shell pocket

muddy sand (mud clasts more abundant than above)

6

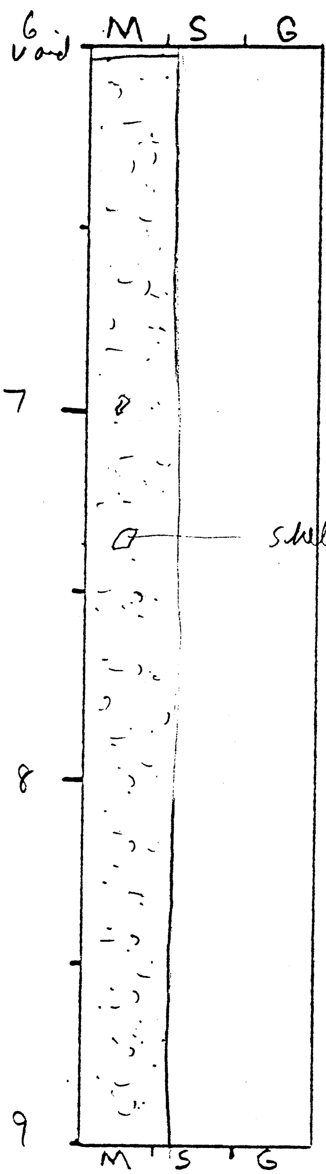
General Comments:

CORE LOG

CORE # HBV-3 (C) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



v fine sand slightly muddy — olive gray

scattered small (coarse to very coarse) shell fragments; ≈ 10% fragments
rare larger fragments

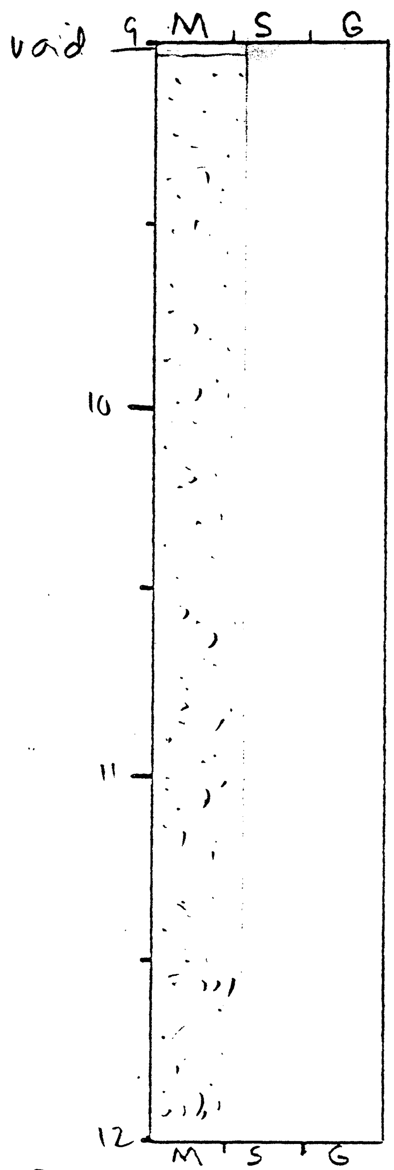
General Comments:

CORE LOG

CORE # HBV-31(D) TYPE ________ LOCATION ____________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ____

OBTAINED BY ______________________________ DATE ________
DESCRIBED BY ______________________________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



slightly muddy v. fine sand
scattered small shell fragments (< 5%)

shell fragments increase in abundance and size below ~ 10.5' comprising ~ 10%, locally concentrated ≥ 20%

Olive gray with light olive gray to light olive brown mottling from left side of core (and right side near bottom).

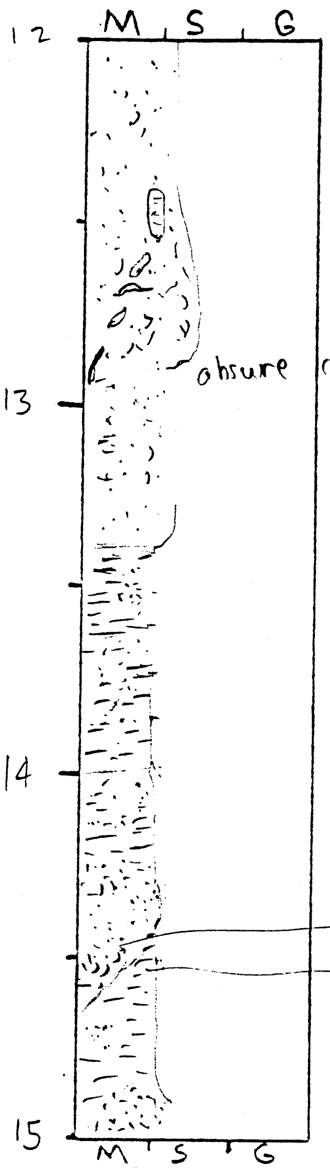
General Comments:

CORE LOG

CORE # HBV-3 (E) TYPE______ LOCATION______
LATITUDE______ LONGITUDE______ SURFACE ELEVATION______
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION______

OBTAINED BY______ DATE______
DESCRIBED BY______ DATE______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



v. fine sand
slightly muddy
scattered shells
<10%

Olive
gray
(5Y 3/2)

Increase in shells (same gravel size)
>25% shelly sand

v. fine sand
Increase in mud with depth
scattered shells
muddy sand to sandy mud

(Mottling & irregular contacts possibly due to burrowing)

13.7'–14'
mud becomes dominant
(sandy mud)

muddy sand
shell pocket muddy shelly sand
dipping contact
mud dominant (sandy mud)
sand dominant scattered shells

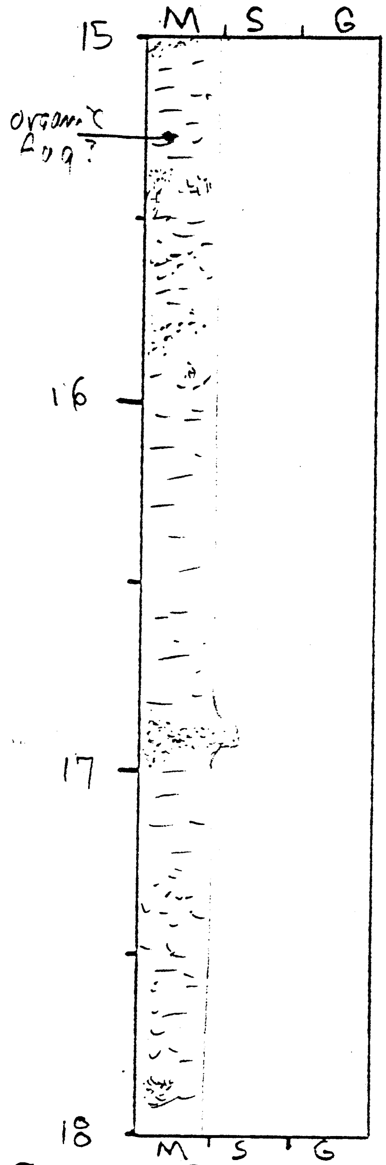
General Comments:

CORE LOG

CORE # HBV-3(F) TYPE ________ LOCATION ________________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ____

OBTAINED BY ______________________________ DATE ________
DESCRIBED BY ______________________________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
15–16		mottled clay with pockets of shell frag. & sand		mottled down length of core from light olive gray to olive gray
17		sand (very fine) stringer		



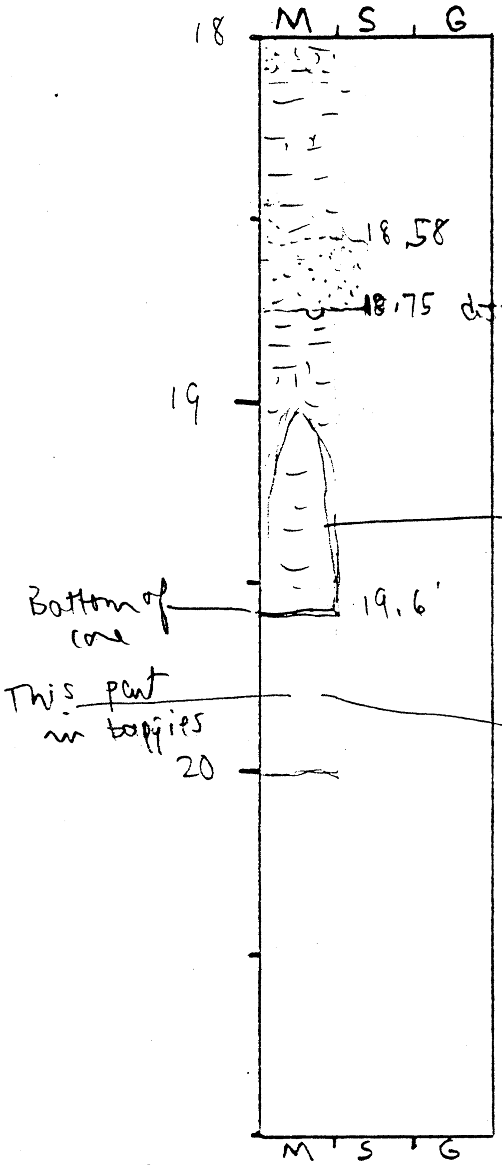
General Comments:

CORE LOG

CORE # HBV-3(G) TYPE ________ LOCATION ________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ________ LENGTH RECOVERED ________ %COMPACTION ________

OBTAINED BY ________ DATE ________
DESCRIBED BY ________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



olive gray mud scattered small shells

olive gray mud (clay)

very fine sand Light olive gray to dusky yellow

olive gray mud (clay)
very scattered shell fragments

core catcher oxidized mud
(apparently due to core catcher)
Light olive brown to moderate brown

Soft olive gray mud
in 2 baggies

General Comments:

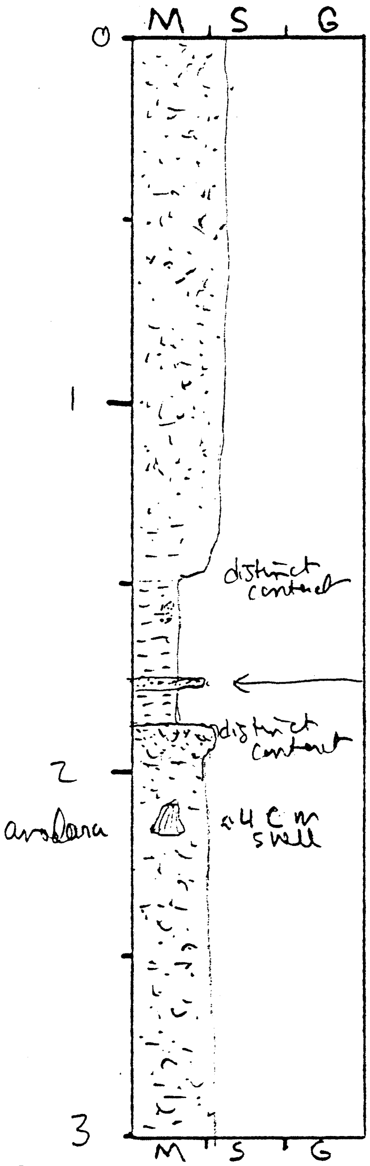
Photographed 1-25-95

CORE LOG

CORE # HBV-4(A) **TYPE** Vibracore **LOCATION** Heald Bank
LATITUDE 29° 08.993 **LONGITUDE** 94° 11.565' **SURFACE ELEVATION** -52.5'
DEPTH PENETRATED ? **LENGTH RECOVERED** 15' 8½" 15.7' **% COMPACTION** ?

OBTAINED BY Gibeaut - R/V Kit Jones **DATE** 10-12-94
DESCRIBED BY White **DATE** ____

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Depth	Lithology	Remarks
0	fine sand trace of mud; Shell fragments (10%) very coarse; well sorted sand; sub rounded	Olive gray color (5Y 3/2)
~1	mud increasing slightly with depth	
~1.4	mud "clasts" appear at 1.4' in fine sand	
~1.6	Olive gray mud (clay); fine sand pocket	olive gray (5Y 3/2) to dark greenish gray
1.76	thin fine sand stringer 1.76'	
1.87'	fine sand, shell fragments very coarse to granule size (25%) higher percentage in pockets; slightly muddy	
~2.3	fine sand; scattered shell very coarse to granule in size (10% shell); slightly muddy	Olive gray (5Y(3/2) to dark greenish gray

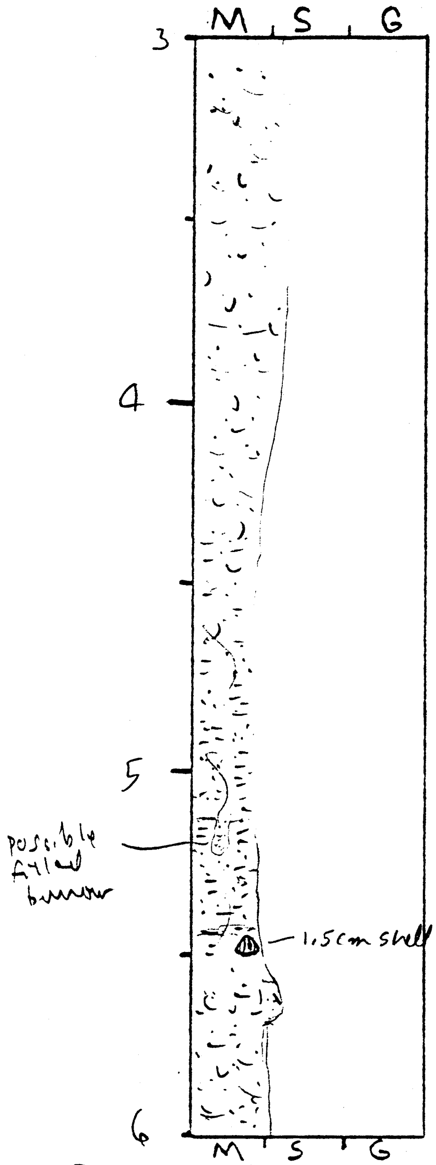
General Comments:

CORE LOG

CORE # HBV-4(B) TYPE______ LOCATION______
LATITUDE______ LONGITUDE______ SURFACE ELEVATION______
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION______

OBTAINED BY______ DATE______
DESCRIBED BY______ DATE______

DEPTH (ft, m) | SKETCH | LITHOLOGY | STRUCTURE | REMARKS



Lithology:

slightly muddy fine sand with scattered (10%) shell fragments up to granule in size and slightly larger

fine sand; mud becoming more apparent below 4.4'
scattered shells up to small pebble in size
15% shell

mud increasing with depth
muddy sand

obscure mud "clasts"
most abundant mud between 5.25'–5.42'

concentration of shell material in fine sand ≈ 40%

fine sand, slightly muddy
scattered shell fragments

Remarks:

dark greenish gray to olive gray (5Y 3/2)

dark greenish gray to olive gray (5Y 3/2)

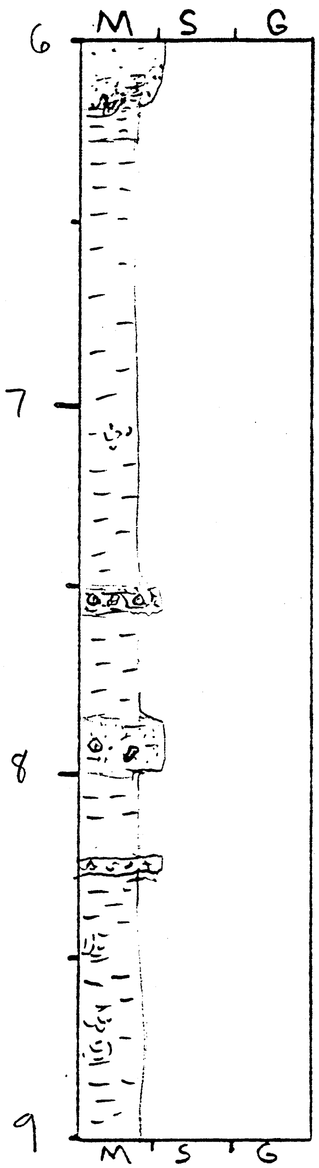
General Comments:

CORE LOG

CORE # HBV-4(C) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



fine sand, slightly muddy, scattered shell
distinct contact at 6.25' but irregular surface. possibly from coring or burrowing.

Olive gray (5Y 3/2) to dark greenish gray

Clay
few shell fragments

Local shell pockets

shelly muddy sand stringer

fine sand scattered shells (up to small pebble in size) muddy

(5Y 3/2) Olive gray to dark greenish gray

shell stringer at 8.25'-8.30' granule size

clay or mud, slightly sandy
shell pockets, granule in size.

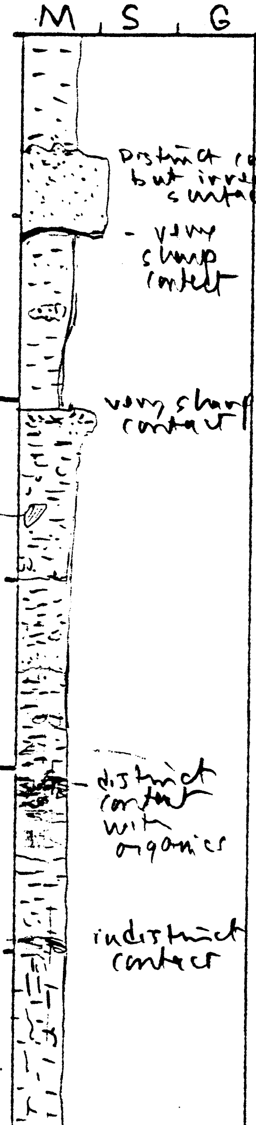
General Comments:

CORE LOG

CORE # HBV-4 (D) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
9	M S G	clay		Medium dark gray clay to olive gray 5Y 3/2
9.32'	Distinct contact but irregular surface	very fine sand well to very well sorted sub rounded		olive gray sand
9.55'	very sharp contact	slightly sandy mud down to 9.75' (medium dark gray clay)		
		Medium dark gray clay disseminated organic traces shells rare		
10	very sharp contact	shells & shell fragments (mostly) granule (mostly) locally small pebble size. This unit appears to be predominantly mud with shells more abundant at top slightly sandy		
broken shell 1.5cm				
		predominantly mud or clay w/ small pockets of very fine quartz sand		
lighter gray clay		medium dark gray clay with elliptical and irregular shapes of light gray clay; organic traces;		
11	distinct contact with organics	organic layer from 11.07' - 11.25		grayish black at top grading downward into medium dark gray and medium light gray
		Organic Clay Medium light gray clay increasing organic traces.		
	indistinct contact	At about 11.45' vertical organic traces (roots?) (traces brownish black) in olive black clay (5Y 2/1) to olive gray clay		Olive black clay
12	M S G			



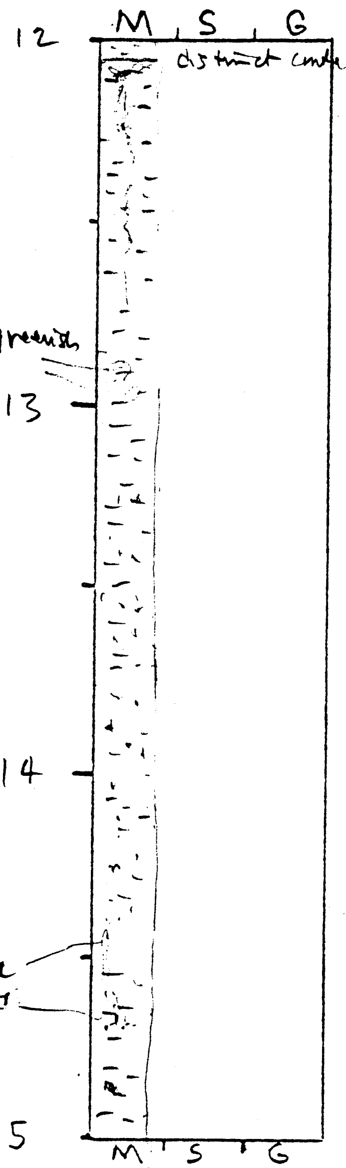
General Comments:

CORE LOG

CORE # HBV-4(E) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



distinct contact clay — olive gray to olive black

organic rich clay 12.05 - 12.3' — Grayish black

clay with organic (grayish black) streak down center — olive gray to brownish gray

(No shells in this section)

traces of organics in clay — specks of organics

At about 13.5 sediments become lighter in color gradationally (olive gray to more brownish gray) (slightly silty) traces of dark organics (disseminated in clay) — brownish gray

brownish gray

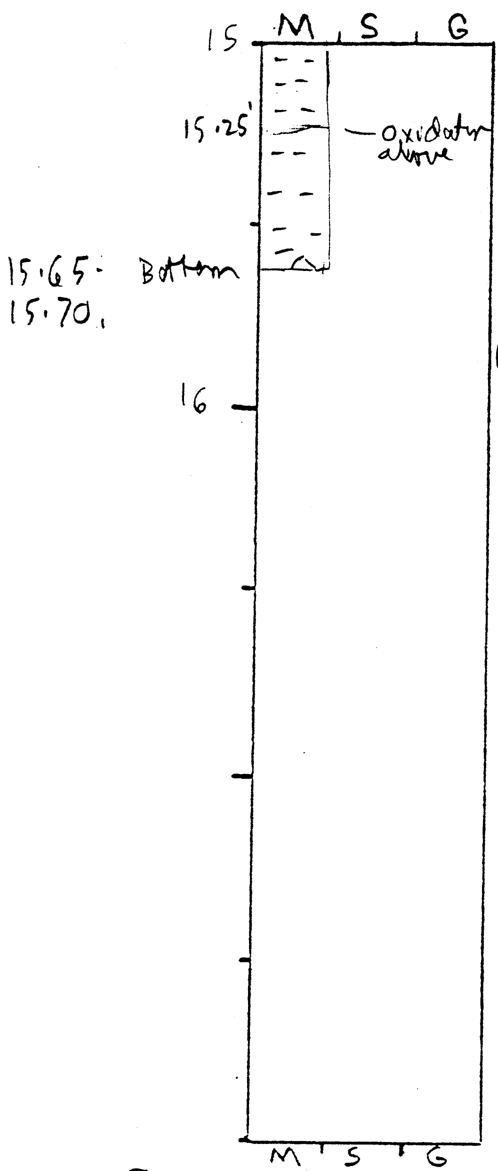
General Comments:

CORE LOG

CORE # HBV-4 (F) TYPE______ LOCATION______
LATITUDE______ LONGITUDE______ SURFACE ELEVATION______
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION______

OBTAINED BY______ DATE______
DESCRIBED BY______ DATE______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
		relatively stiff clay mottled some oxidation organics disseminated in clay oxidation traces at base (Core catcher was removed but may have caused some rust) stiff clay probably prevented deeper penetration of sediment by core.		rusty color over medium gray above 15.25'. Light olive gray with patches of medium dark gray organics



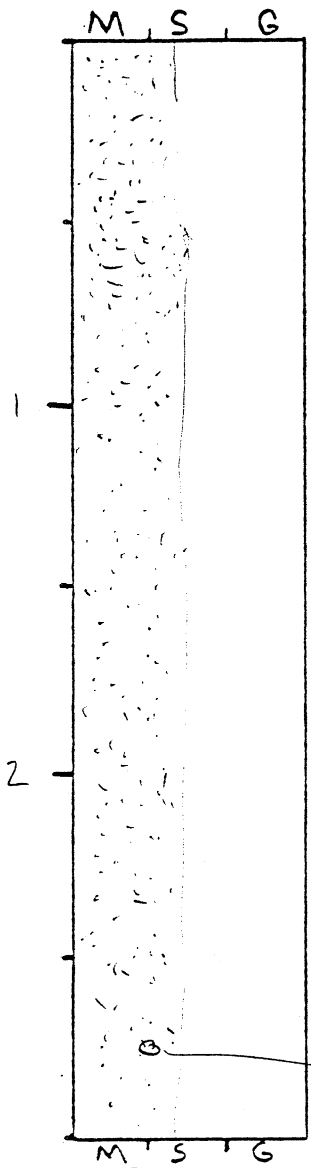
General Comments:

CORE LOG

CORE # HBV-5 (A) TYPE Vibracore LOCATION Heald Bank
LATITUDE 29° 08.131 LONGITUDE 94° 11.005 SURFACE ELEVATION -35'
DEPTH PENETRATED ? LENGTH RECOVERED 19'10" %COMPACTION ?

OBTAINED BY Gibeaut - R/V Kit Jones DATE 10-12-94
DESCRIBED BY White DATE

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



very well sorted subrounded fine sand, 99% quartz grains, shell fragments increasing with depth

Fining upward graded contact between 0.6-0.9 Ft with coarse-sand size shell fragments bimodal (fine sand & coarse-sand fm shell fragments)

10-25% shell (coarse sand) fragments

5mm shell

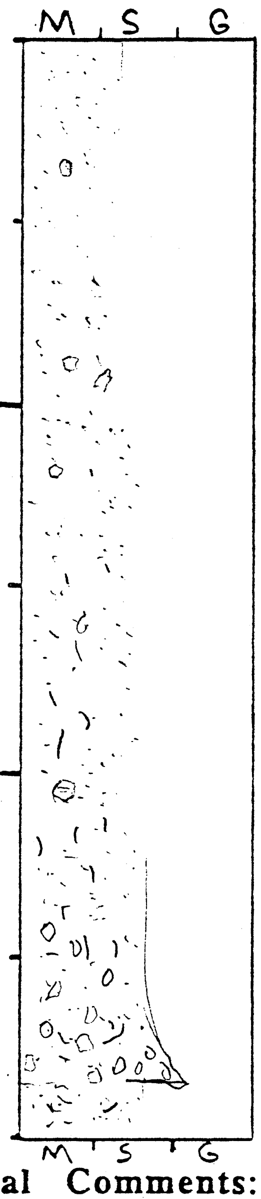
Greenish gray to Light Olive gray

General Comments:

CORE LOG

CORE # HBV-5 (B) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
3		Fine, predominantly quartz sand (subrounded) (very well sorted) with scattered shell & shell fragments		Light olive gray
		Increase in shell with depth. Obscure contact at ≈ 3.8' (graded) fine well-sorted sand & increasing shell fragments very coarse		
4				
5		fine quartz sand with coarse sand sized shell fragment and scattered gravel size shell increasing to depth of 5.75'		
6		5.75' obscure contact with decrease in shell below. fine sand with scattered shell		

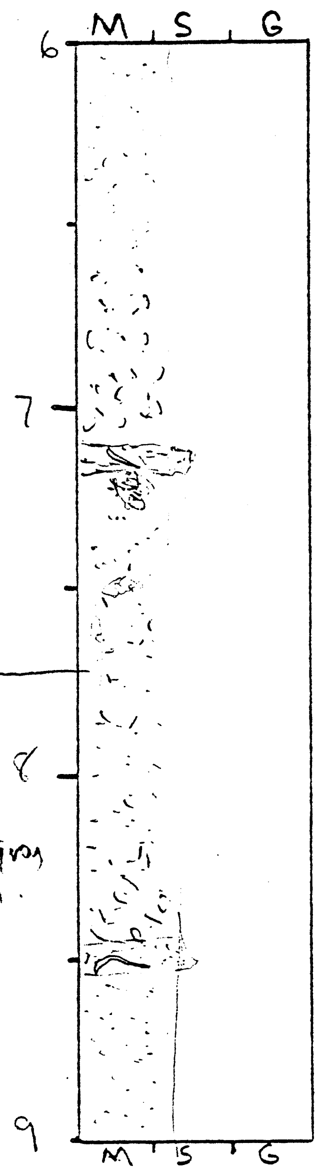
General Comments:

CORE LOG

CORE # HBV-5(C) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



fine quartz sand
moderately well sorted
sub rounded
scattered to abundant
shell fragments up to
25% or more increasing
with depth
Shelly sand

Light olive gray

Shelly pocket
sandy shell or shelly sand

Possible sand filled burrow

fine sand
with scattered
shells (coarse
sand to granule size)

slightly darker gray in color.

Increase in shell (mostly sand but possibly shelly sand)
(Large shell fragment)

fine sand

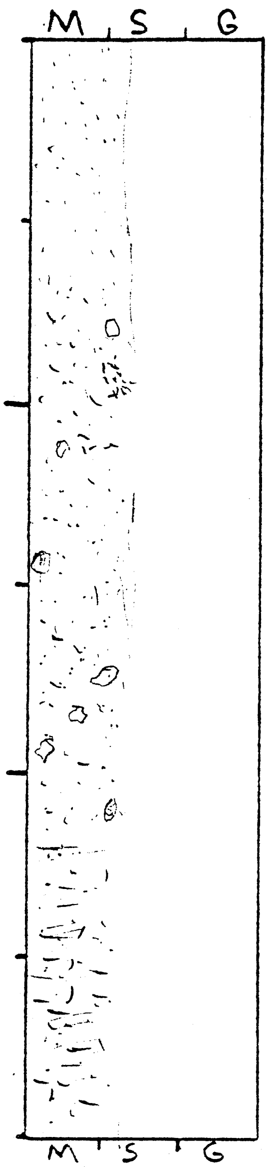
General Comments:

CORE LOG

CORE # HBV-5(D) TYPE________ LOCATION________
LATITUDE________ LONGITUDE________ SURFACE ELEVATION________
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION______

OBTAINED BY________ DATE________
DESCRIBED BY________ DATE________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
9	M S G	fine quartz sand well sorted, subrounded		Light olive gray
10		Shell hash pockets and occassional large fragment (>1 cm)		
		Scattered gravel-size shell fragments in fine quartz sand		
11		Traces of mud below 11.3' (gradational contact) still predominantly fine sand but mud produces darker colored gray; scattered coarse-sand shell fragments		Dark greenish gray
12	M S G			



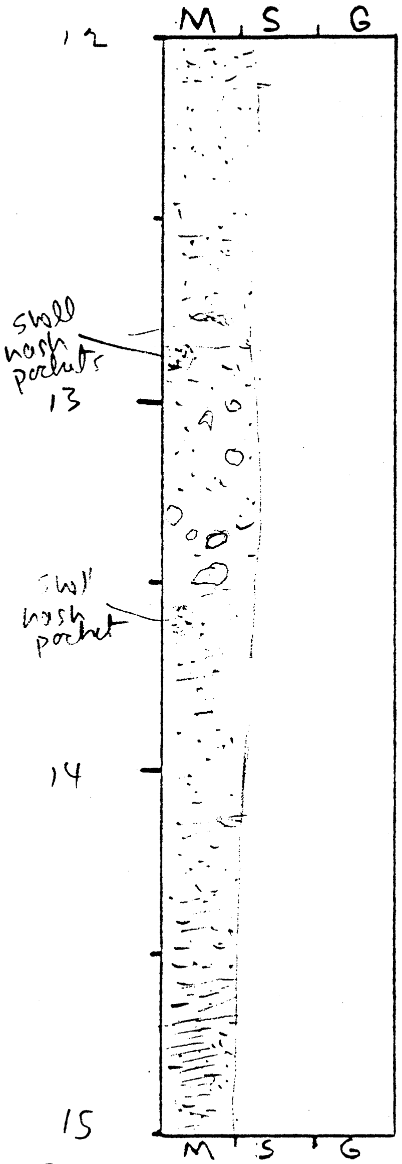
General Comments:

CORE LOG

CORE # HBV-5 (E) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
12		fine sand with coarse to granule size shell fragments (bimodal grain size) Distinct contact with fine sand below; Quartz subrounded Traces of mud below 12.5'		olive gray to light olive gray in color
13		Predominantly fine quartz sand with scattered shells and shell hash pockets (very-coarse in grain size) traces of mud	mud becoming more abundant with depth	
14		Mottled color with lighter sand pockets in darker sand with traces of mud. Shell fragments less abundant below 14.3' fine sand and possibly muddy sand mud more abundant near base of section		Dark gray to Light olive gray (Mottled) Streaks of Dark yellowish brown on right margin
15				

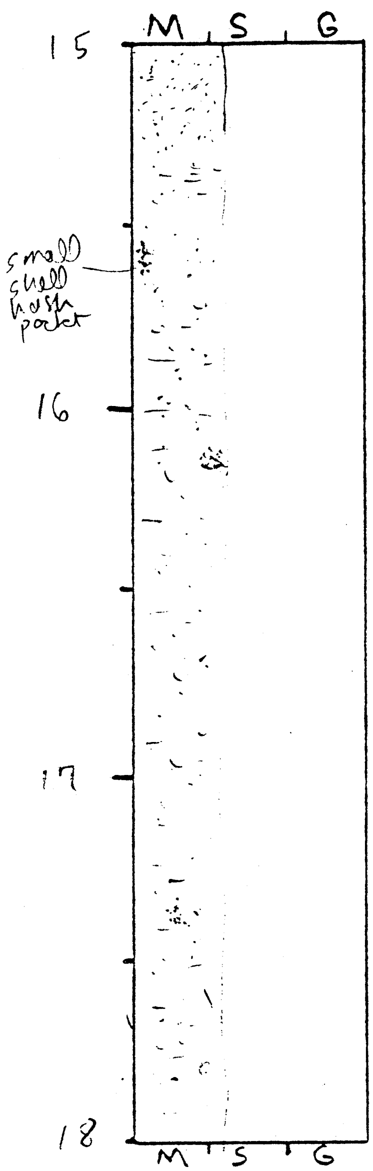


General Comments:

CORE LOG

CORE # HBV-5 (F) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
15–18		fine quartz sand well sorted		olive gray becoming dark greenish gray to dark gray below 15.4'
		Traces of mud more apparent below 15.4'.		
		fine quartz sand scattered shell fragments & occassional small (1-2 cm) shell hash pockets and more concentrated sand pockets slightly muddy		Dark greenish gray to Dark gray

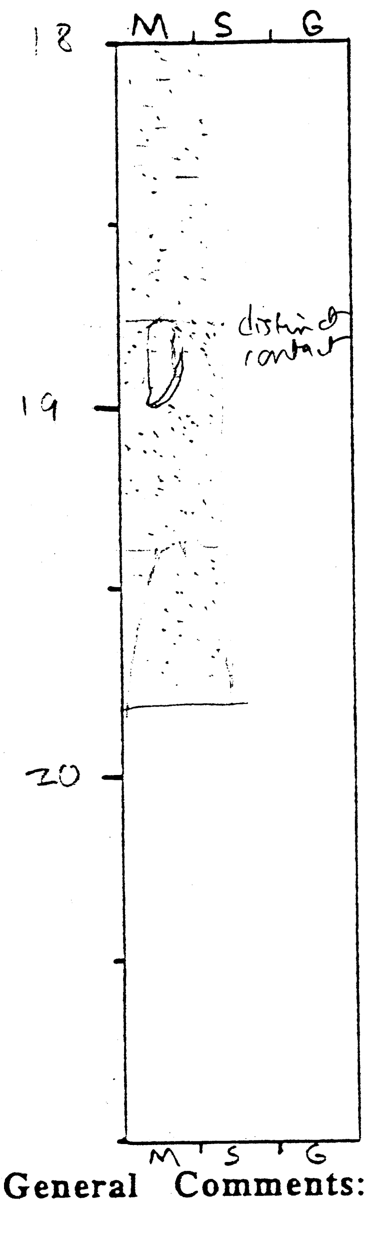
General Comments:

CORE LOG

CORE # HBV-51(G) TYPE______ LOCATION______
LATITUDE______ LONGITUDE______ SURFACE ELEVATION______
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION______

OBTAINED BY______ DATE______
DESCRIBED BY______ DATE______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
18		fine sand (quartz) slightly muddy		Dark gray color
	distinct contact	Large gastropod 8-9 cm long		Gastropod cut in half by saw (chambers showing)
19		color change below gastropod; fine sand with scattered shell frags. (less muddy)		Olive gray
		color change oxidation (possibly due to core catcher)		Moderate yellowish brown (core catcher) (rusty)
		19.8' Bottom		
20				

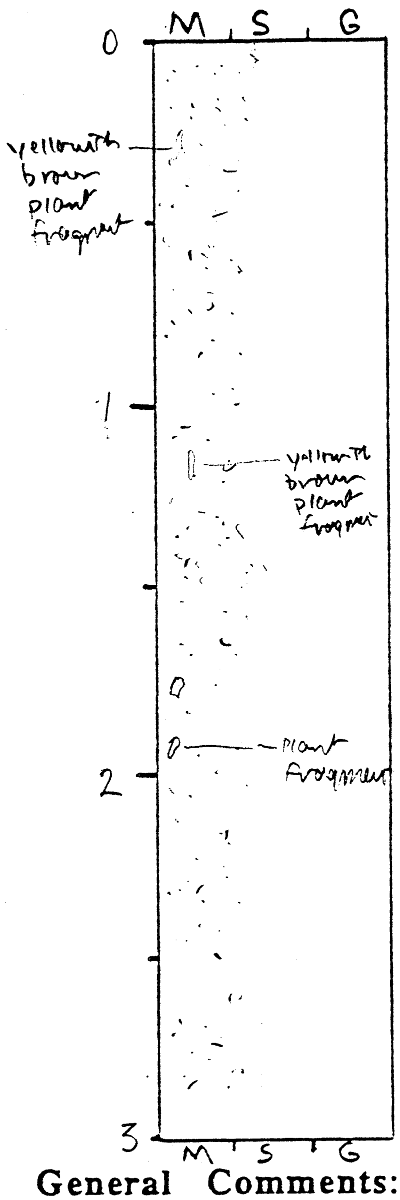


General Comments:

CORE LOG

CORE # HBV-6(A) TYPE Vibracore LOCATION Heald Bank
LATITUDE 29° 08.630' LONGITUDE 94° 09.949 SURFACE ELEVATION -34'
DEPTH PENETRATED ? LENGTH RECOVERED 10.6 %COMPACTION ?

OBTAINED BY Gibeaut - R/V Kit Jones DATE 10-12-94
DESCRIBED BY White DATE

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
0–3		fine sand (quartz) with scattered shell fragments, possibly 20% shell. Locally, plant fragments	granule & very coarse sand size	Light olive gray color

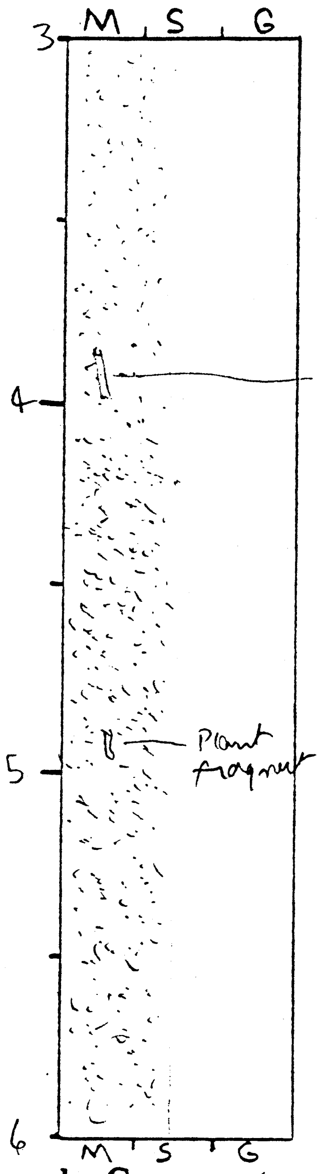
General Comments:

CORE LOG

CORE # HBV-6(B) TYPE_____ LOCATION_____
LATITUDE_____ LONGITUDE_____ SURFACE ELEVATION_____
DEPTH PENETRATED_____ LENGTH RECOVERED_____ %COMPACTION_____

OBTAINED BY_____ DATE_____
DESCRIBED BY_____ DATE_____

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



fine sand (quartz)
scattered shell fragments
granule to coarse grained.
quartz well sorted
sub-rounded

Light olive gray in color
with dark specks (shell frags) and some heavies

Brownish plant fragment

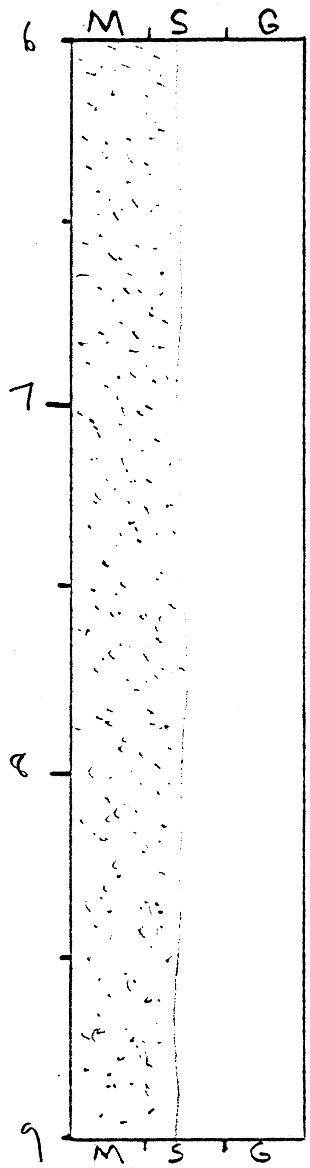
fine sand
Coarsening becomes more apparent below 4.3' but is gradational.
Coarsening downward as shell material becomes more abundant
≈ 25%

General Comments:

CORE LOG

CORE # HBV-6(C) TYPE______ LOCATION______
LATITUDE______ LONGITUDE______ SURFACE ELEVATION______
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION______

OBTAINED BY______ DATE______
DESCRIBED BY______ DATE______

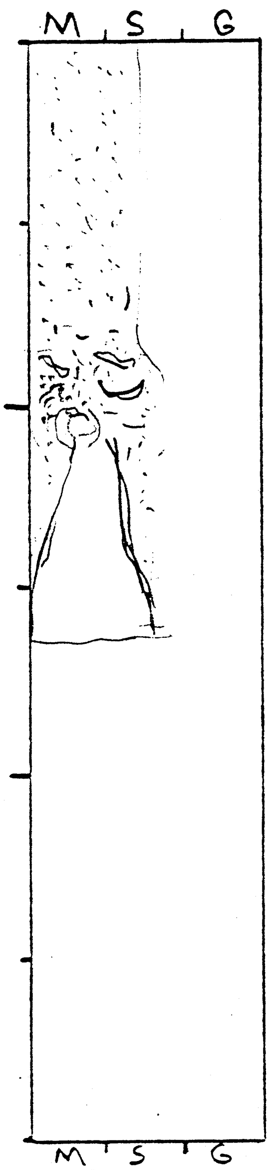
DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
6–9		fine quartz sand with shell fragments coarse sand to granule in size quartz well sorted, sub rounded. Appears to be slight coarsening with depth as shell fragments compose ≈ 25% of sediment. Occasional shell fragment up to 6 mm in length		Light olive gray with black sprinkles from shell fragments & heavy mineral

General Comments:

CORE LOG

CORE # HBV-6 (D) TYPE______ LOCATION______
LATITUDE______ LONGITUDE______ SURFACE ELEVATION______
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION______

OBTAINED BY______ DATE______
DESCRIBED BY______ DATE______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
9		fine sand (quartz) coarse to granule shell fragments ~25% qtz sand sub-rounded well sorted		Light olive gray with darker speckles of shell fragments
10		Shelly sand to sandy shell most granule size or finer but some gravel size shells.		

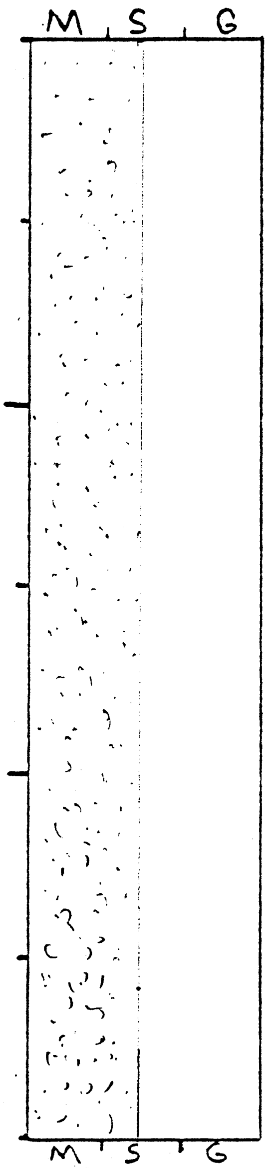
General Comments:

CORE LOG

CORE # HBV-7 (A) TYPE Vibracore LOCATION Heald Bank
LATITUDE 29° 08.672 LONGITUDE 94° 08.193 SURFACE ELEVATION -50'
DEPTH PENETRATED ? LENGTH RECOVERED 15' %COMPACTION ?

OBTAINED BY Gibeaut - RN Kit Jones DATE 10-12-94
DESCRIBED BY White DATE

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
0		Lt olive gray to light olive brown Fine quartz sand with scattered shell fragments very coarse to granule in size becoming coarser toward bottom of core.		trace of clay in upper part of core.
1				Lt olive gray to Lt olive brown in color.
2		becomes coarser at depth (increase in very coarse to granule size shell frags. Gradational		
		shell ≈ 25% near bottom		
3				



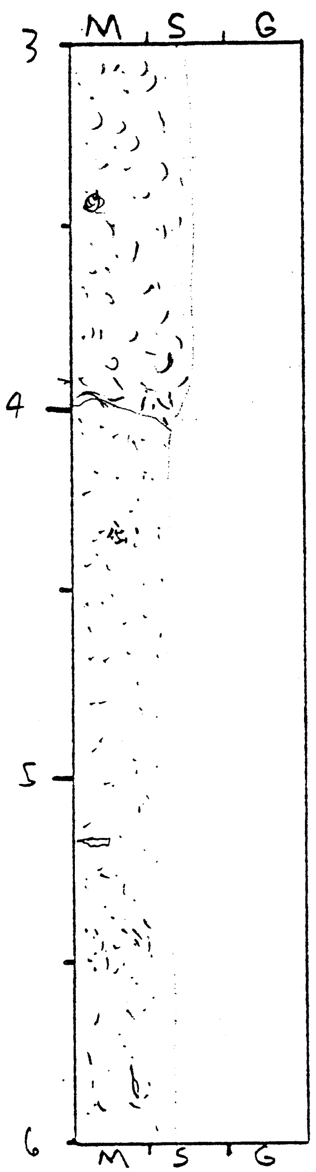
General Comments:

CORE LOG

CORE # HBV-7 (B) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Lt Olive gray shelly fine sand to medium & coarse (from shell fragments)

Shell fragments & whole shells (7 mm long)

sediments become grayer
< 10% shell fragments except for local pockets
v. fine sand with scattered shells

Lt Olive gray
to
Olive gray

Increase in shells locally 10-15%

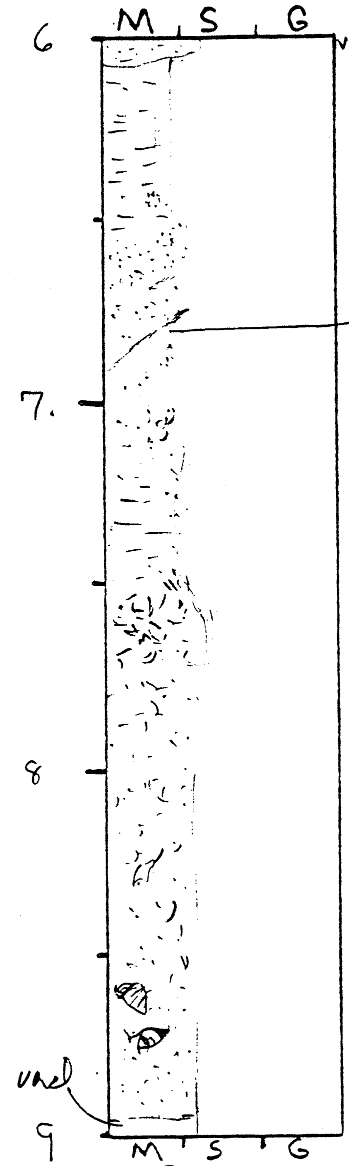
General Comments:

CORE LOG

CORE # HBV-7(C) TYPE______ LOCATION______
LATITUDE______ LONGITUDE______ SURFACE ELEVATION______
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION______

OBTAINED BY______ DATE______
DESCRIBED BY______ DATE______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



v. fine muddy sand at top.

sandy clay or mud (few shells)
Lt olive gray

mottly.
Lt olive gray
but some mottling
(possible burrow)
on right side
Olive gray

muddy sand

color change
from Lt Olive gray (brownish) to
olive gray – dark gray.
muddy sand

increase in mud in this area
muddy sand or sandy mud

mud sand & shell
very shelly

fine sand, slightly muddy
Scattered shells

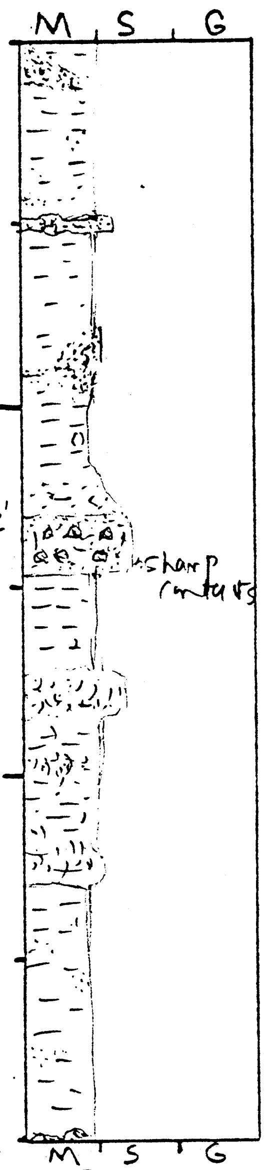
2 Large shells (2.5cm long)
in fine sand

General Comments:

CORE LOG

CORE # 14BV-7 (D) TYPE______ LOCATION______
LATITUDE______ LONGITUDE______ SURFACE ELEVATION______
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION______

OBTAINED BY______ DATE______
DESCRIBED BY______ DATE______



DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
9		Olive gray mud with pockets of very fine sand (olive gray) 5Y 3/2 Some burrowing		
		thin sand layer		
		sand pocket in mud		
10				Some light olive gray mottling (brownish)
		muddy sand zone above shell zone		
10.32'		shelly sand or sandy shell, shell fragments & whole shells up to 1cm wide		
10.48		mud (rare shells)		
		sandy shelly mud or muddy shell (fragments & whole shells 1cm wide)		
11		mixture of mud, sand & scattered shells		
		shelly mud or muddy shell, some sand		
		Mostly olive gray mud, some sand pockets few shells		
12		small pockets of brown sand in bottom, small whole shells		

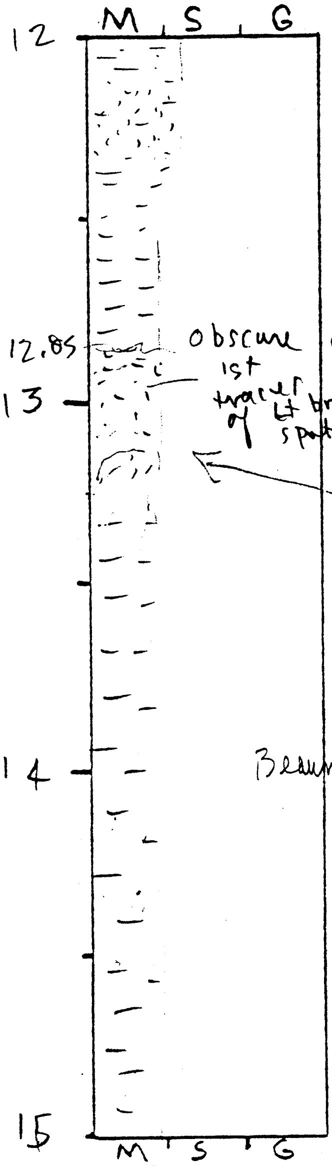
General Comments:

CORE LOG

CORE # HBV-7(E) TYPE ________ LOCATION ________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ________ LENGTH RECOVERED ________ %COMPACTION ________

OBTAINED BY ________ DATE ________
DESCRIBED BY ________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



12 — sandy, slightly shelly mud; shell frags v. coarse to granule (≈ 20%, shell frags) — mottled Lt olive gray and olive gray

olive gray mud

12.85 — obscure contact

1st traces of Lt brown spots

13 — mottled color changing from Lt olive grey to yellowish gray & Dusky yellow mud / clay
scattered shell frags (12.85' – 13.3')

yellowish gray color dominates below 13.1' (No shell fragments below 13.3')

yellowish gray with mottled area of Lt olive gray & spots (< 5mm dia.) of Lt brown

14 — Beaumont

rel. stiff yellowish gray clay

15

General Comments:

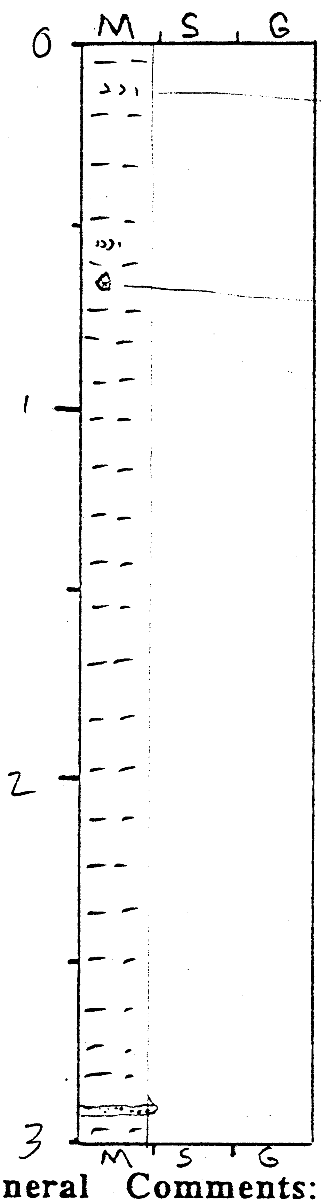
APPENDIX C. CORE DESCRIPTIONS HEALD BANK

CORE LOG

CORE # SBV-9 (A) TYPE Vibracore LOCATION Sabine Bank
LATITUDE 29° 38.090' LONGITUDE 94° 03.449' SURFACE ELEVATION 18'
DEPTH PENETRATED ? LENGTH RECOVERED 7' 2" (7.2') %COMPACTION ?

OBTAINED BY Gibeaut, R/V Kit Jones DATE 10-10-94
DESCRIBED BY WWh DATE 2-3-95

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
0		soft mud; a few small shells		Olive gray 5Y 4/1, hint of brown
		a few scattered shells; whole shell		
1		No shells		
2				
3		thin muddy sand layer		



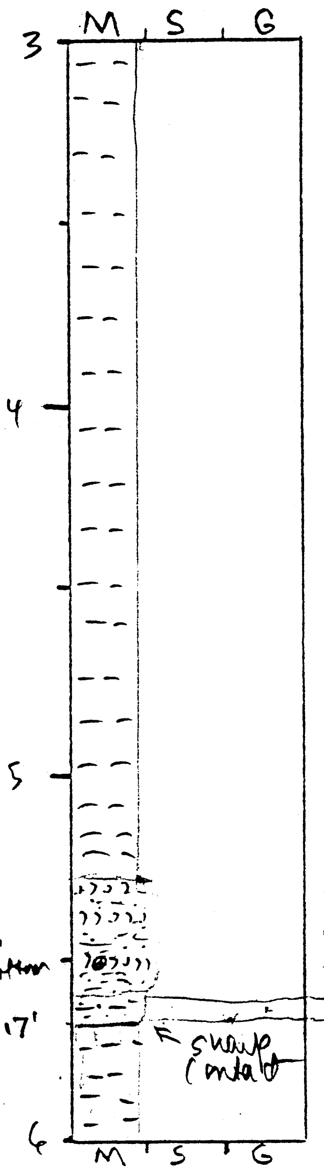
General Comments:

CORE LOG

CORE # SBV-9 (B) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Soft mud

Olive gray 5Y 4/1 hint of brown

shells decrease toward bottom

Shelly muddy sand (whole shells & frags up granule & small pebble)

medium dark gray to olive gray (5Y 3/2)

muddy sand

stiff clay (Beaumont)

Lt gray with dark yellowish orange streaks

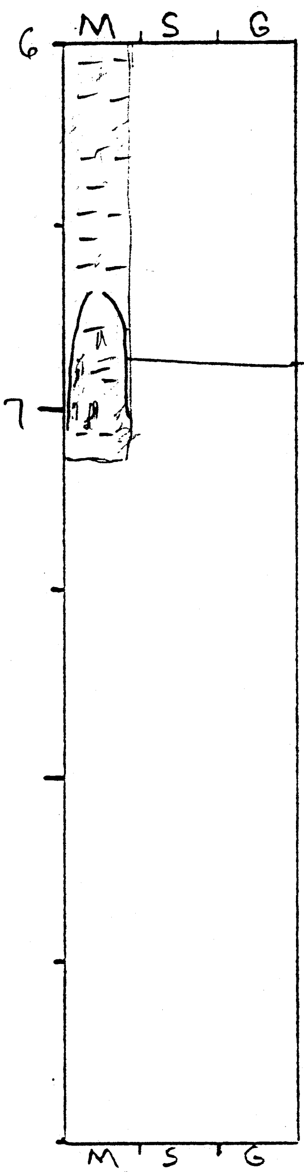
General Comments:

CORE LOG

CORE # SBV-9(C) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



stiff clay (mottled)

(Beaumont)

No shells

light gray to pale olive with dark yellowish orange streaks (vertical)

core catcher

mottled lt gray, dark yellowish orange, and small streaks of dark gray

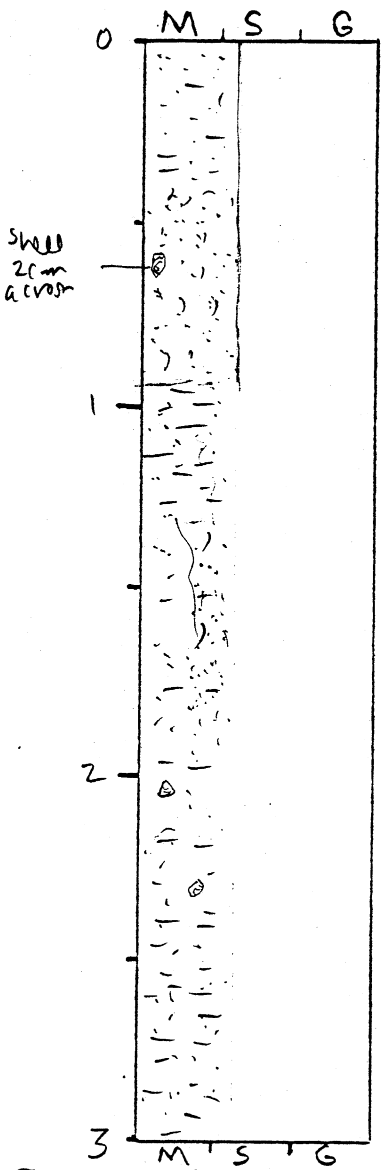
General Comments:

CORE LOG

CORE # SBV-10(A) TYPE Vibracore LOCATION Sabine Bank
LATITUDE 29° 29.722' LONGITUDE 93° 48.413' SURFACE ELEVATION -42'
DEPTH PENETRATED ? LENGTH RECOVERED 18.5' (18' 6") %COMPACTION ?

OBTAINED BY Gibeaut & R/V Kit Jones DATE 10/11/94
DESCRIBED BY White DATE 2/3/95

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



muddy sand (v. fine qtz sd) — Drk yellowish Brown

scattered shell frags & whole shells granule & pebble in size
shells more concentrated (≈ 10%) from 0.4'–0.9' (higher conc. of sd also)
appears to be heavily burrowed based on sand & mud relationships

muddier (muddy sand), and more olive gray in color from 0.9' – 1.4

burrows

Drk yellowish brown to olive gray

muddy sand but mud appears to be increasing at depth

color becoming more olive gray toward bottom (less brownish)

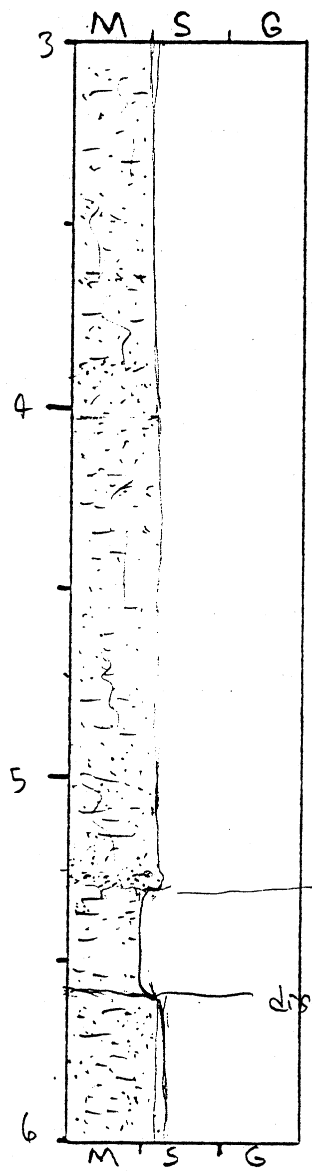
General Comments:

CORE LOG

CORE # SBV-10(B) TYPE ________ LOCATION ________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ________ LENGTH RECOVERED ________ %COMPACTION ________

OBTAINED BY ________ DATE ________
DESCRIBED BY ________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
3		muddy sand to sandy mud few shells	heavily burrowed	Olive gray (5Y 4/1) hint of brown
4		thin dark yellowish brown line (grayer below slightly brownish above) (fluid mud?)		
		muddy sand scattered small shell frag (few)	heavily burrowed	Olive gray (5Y 3/2)
5		higher conc. of sand in this zone.		
		sandy mud	traces of organics	
		distinct contact (especially on sample half of core) muddy sand		Olive gray (5Y 3/2)
6				



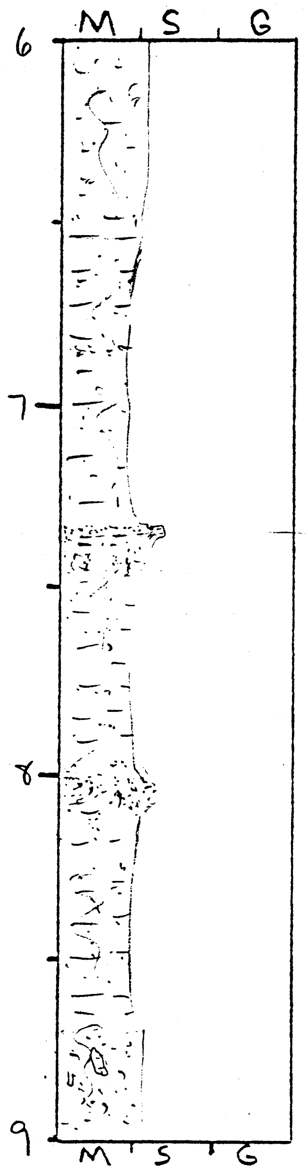
General Comments:

CORE LOG

CORE # SBV-10(9) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



muddy sand — burrowed — olive gray (5Y 3/2)
v. few shells

sandy mud
small sand pockets

sand (slightly muddy) — burrowed

Sandy mud
v. few shells

sand (slightly muddy) a few small shells

Sandy mud
(small sand pockets) (v. few shells)

muddy shelly sand (burrowed) — Olive gray (5Y 3/2)
(a couple of shell frag gravel size)

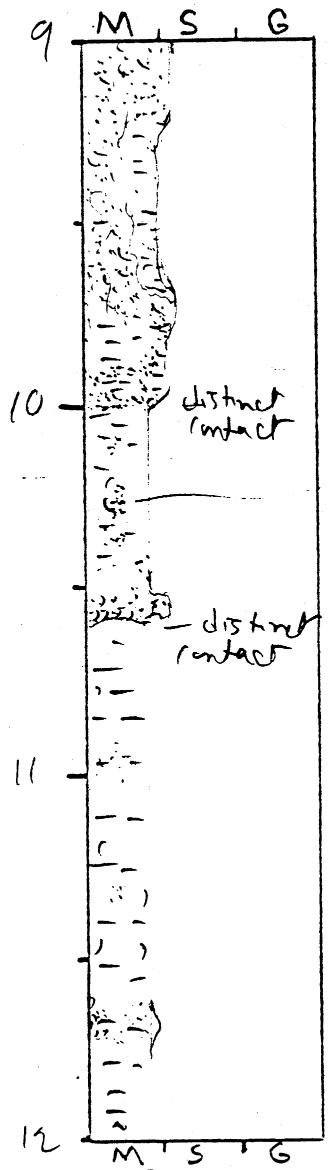
General Comments:

CORE LOG

CORE # SBV-10(D') TYPE________ LOCATION________
LATITUDE________ LONGITUDE________ SURFACE ELEVATION________
DEPTH PENETRATED________ LENGTH RECOVERED________ %COMPACTION________

OBTAINED BY________ DATE________
DESCRIBED BY________ DATE________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



muddy sand (v. fine sand) — olive gray

slightly shelly < 10%

sand filled burrow — burrowed

discrete mud & sand zone

slightly sandy mud

sandy pockets; v. scattered shells in sand

muddy shelly sand (shell frags granule)

organic mud or clay traces of sand or silt (olive gray clay or mud with organic traces)

mud (traces of silt & sand in pockets)

scattered small shell frags (v. coarse to granule)

slightly more sand, (sandy mud) (scattered small shell frags)

mud (organic traces) — olive gray

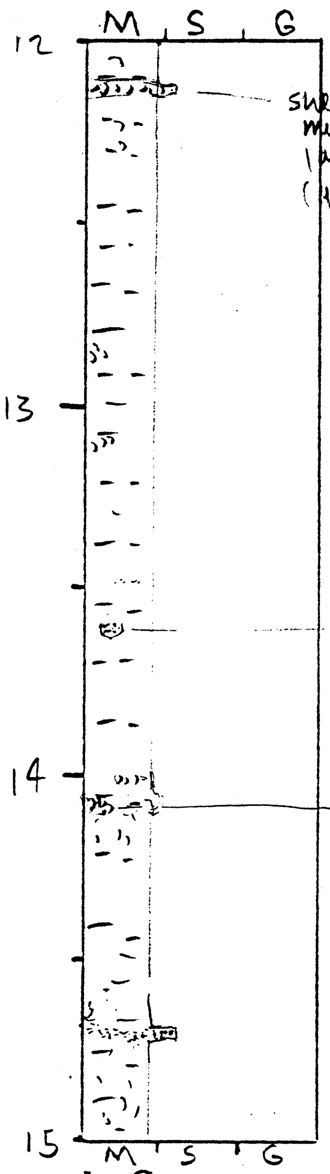
General Comments:

CORE LOG

CORE # SBV-10(E) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



shelly mud layer (granule size frags) — mud traces of organics — Olive gray
very scattered small shell frags except in layers or pockets where more concentrated

mud (traces of sand in pockets)

sand pocket

muddy shell zone (granule to v. coarse sd size)

mud — Olive gray

thin sand layer (irregular)

General Comments:

CORE LOG

CORE # SBV-10 (F) TYPE________ LOCATION________

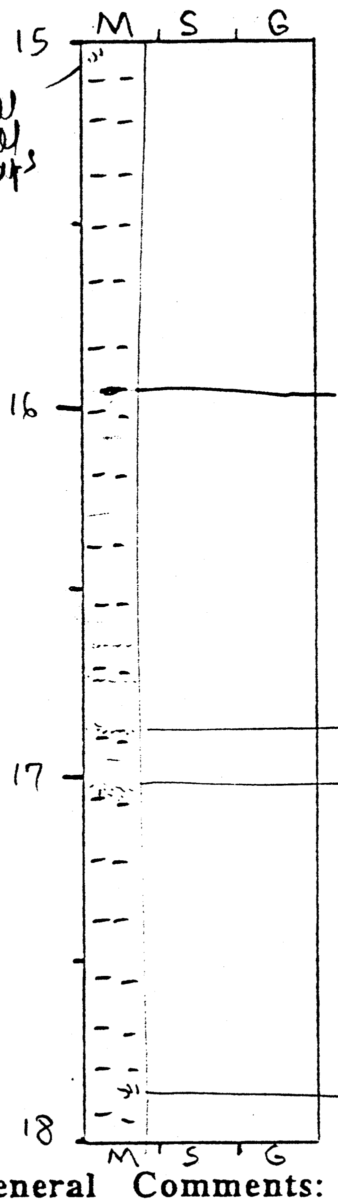
LATITUDE________ LONGITUDE________ SURFACE ELEVATION________

DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION____

OBTAINED BY________________ DATE________

DESCRIBED BY________________ DATE________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Organic clay or mud (traces of organics)
shells absent except at very top and near bottom

Medium dark gray to olive gray

thin organic concentration — small wood fragment possibly 2mm x 1.2 cm (at 16)

discrete although somewhat faint organic lines and possibly silt.

organics

silty (at 17)

medium gray

pocket of small shell frags

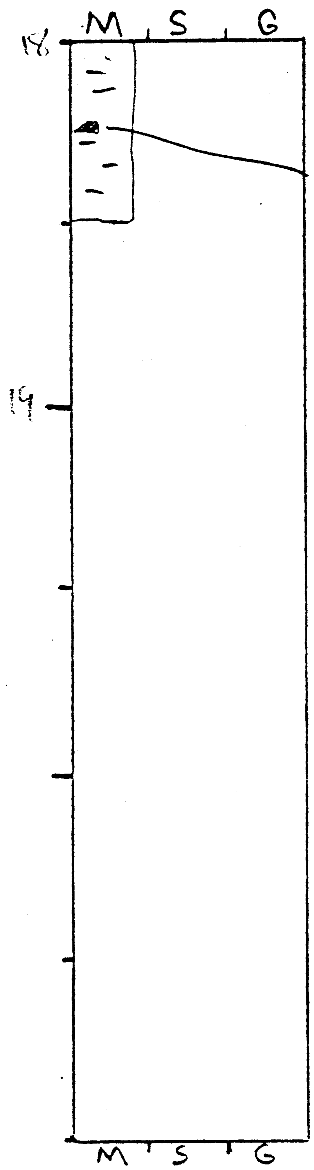
General Comments:

CORE LOG

CORE # SBV-10(G) TYPE________ LOCATION____________________
LATITUDE________ LONGITUDE________ SURFACE ELEVATION________
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION____

OBTAINED BY____________________________ DATE________
DESCRIBED BY___________________________ DATE________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



soft mud (no shells) medium gray

organic fragment (possibly could be dated)

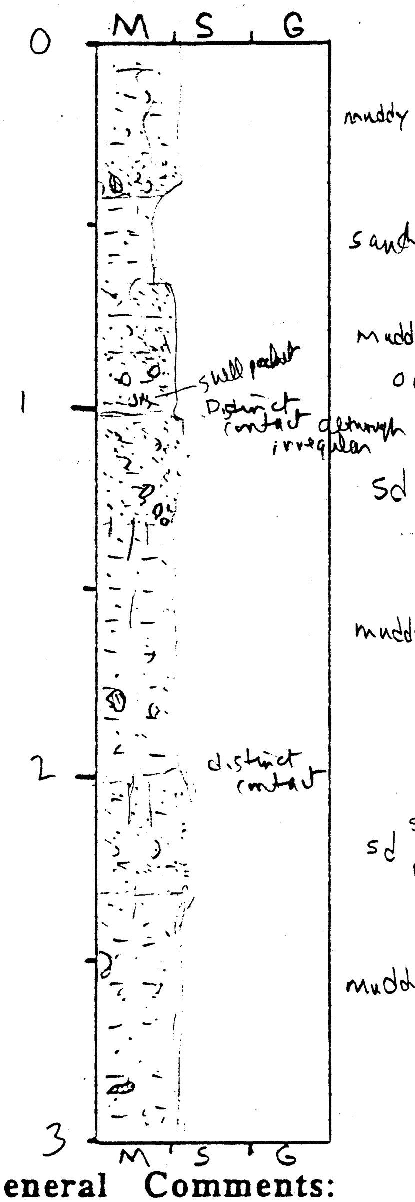
General Comments:

CORE LOG

CORE # SBV-11(A) **TYPE** Vibracore **LOCATION** Sabine Bank
LATITUDE 29° 31.177' **LONGITUDE** 93° 35.649 **SURFACE ELEVATION** -37'
DEPTH PENETRATED ? **LENGTH RECOVERED** 11'3/4" **% COMPACTION** ?

OBTAINED BY Gibeaut - R/V Kit Jones **DATE** 10-13-94
DESCRIBED BY White **DATE** 3-6-95

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



muddy sd — intensely burrowed — color - medium dark gray to olive gray
scattered shells near base

sandy mud

muddy sd
occassional small (pebble) whole shells

sd, slightly muddy, scattered shell frags (granule to pebble)

muddy sd, scattered shells

sd, slightly muddy, scattered small shells

muddy sd, scattered shells

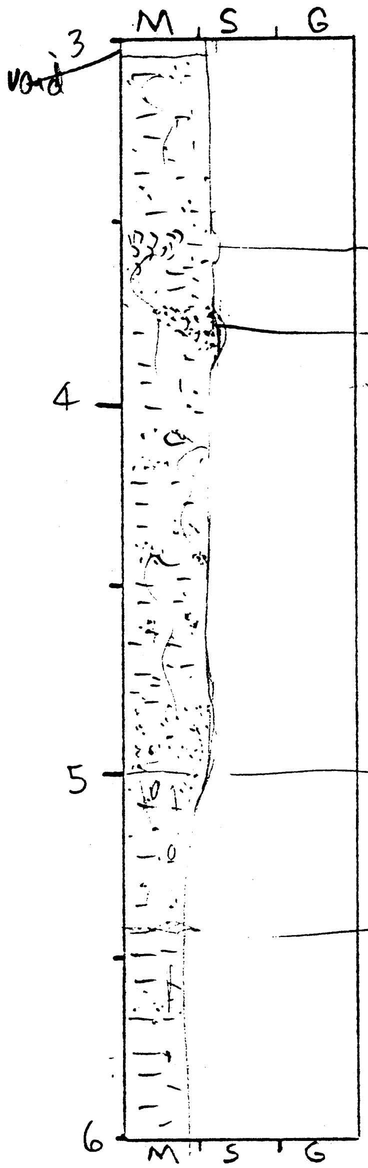
General Comments:

CORE LOG

CORE # SBV-11(B) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



muddy sand — burrowed — Olive gray to med. drk gray (5 Y 3/2)

shell pocket shell frags & whole shells granule to pebble size

sand pocket & scattered small shells

appears to be muddy sand — burrowed
a few scattered shells
(possibly sandy mud) — Olive gray to med drk gray
discrete sand pockets -- possibly filled burrows

more sand in this zone

1st traces of Beaumont clay (mottled lt gray & Lt olive brown)
(with dark gray muddy sand
(clay clasts in muddy sand)

Beaumont clay become dominant below 5.4'
a little mixing of Gray sand from above — mottled Lt olive gray & Lt olive brown

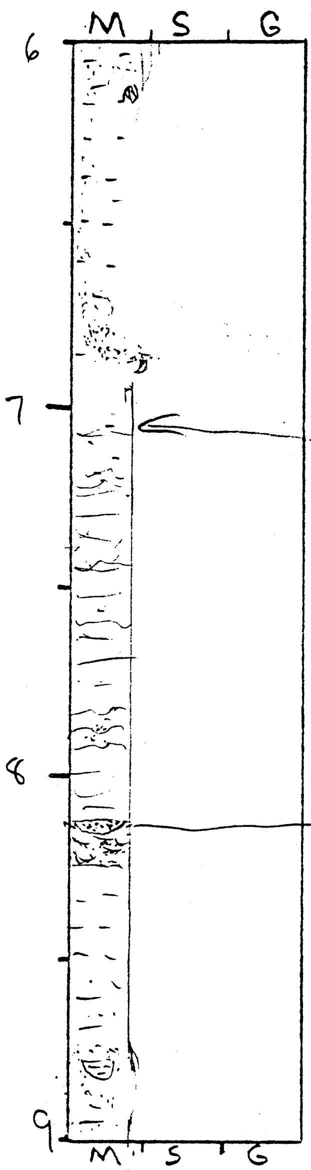
General Comments:

CORE LOG

CORE # SBV-11 (C) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



medium gray muddy sand at top
mixed below with - Lt olive brown
Beaumont clay with mod. yellowish brown area

Burrow filled light to mod. gray muddy sand
Lt gray with some brownish yellow layers

color becomes mottled & more brownish yellow below 7.1'

some organics slightly distorted
NO shells horizontal laminae

Beaumont clay traces of sand in pockets
traces of organics

Lt gray sand lens at 8.2'
possible ripples

yellowish gray with yellowish orange mottling

clay

silty clay to Clayey silt Lt gray to

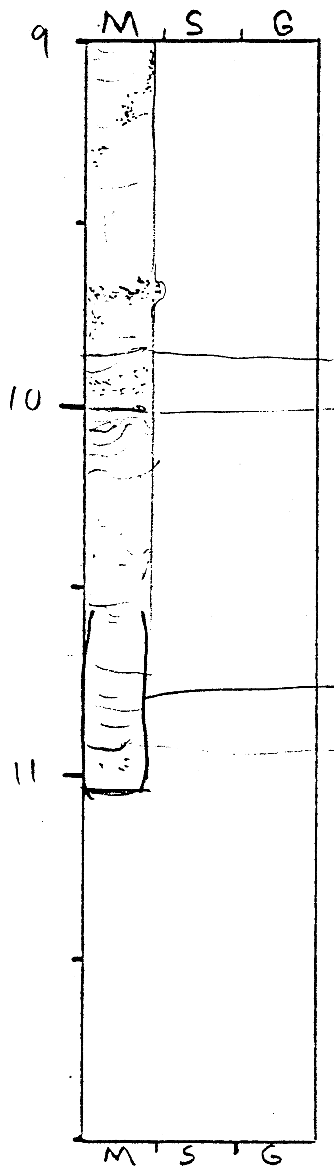
General Comments:

CORE LOG

CORE # SBV 11 (D) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Beaumont clay
occassional thin v. fine sand or silt layers & organic layers

mottled colors from Lt olive gray to drk yellowish orange and grayish orange

organics — slightly distorted laminae

thin Dark brown organic layer

core catcher

organics

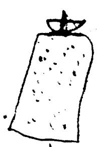
General Comments:

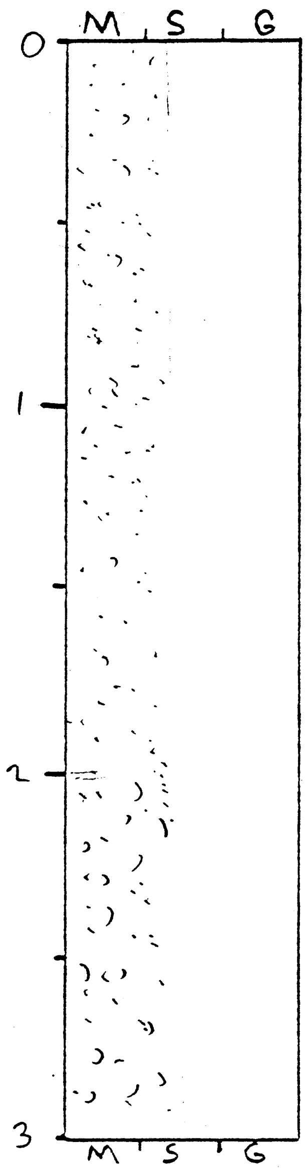
CORE LOG

CORE # SBV-12(A) **TYPE** Vibracore **LOCATION** Sabine Bank
LATITUDE 29° 30.027 **LONGITUDE** 93° 35.307' **SURFACE ELEVATION** -25'
DEPTH PENETRATED ? **LENGTH RECOVERED** 16' 9" **% COMPACTION** ?

OBTAINED BY Gibeaut - R/V Kit Jones **DATE** 10-13-94
DESCRIBED BY White **DATE**

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS


Bag of fine sand from top of Core 12



Fine quartz sand, subrounded, well sorted
.5-10% shell frags - coarse to very coarse sand size

Lt olive gray (5Y 5/2) to olive gray hint of brown

Fining upward sequence

Fine quartz sand with increasing amounts of shell fragments, also coarsening of shell fragments -- granule in size
fragments approaching 25% below ≈ 2'

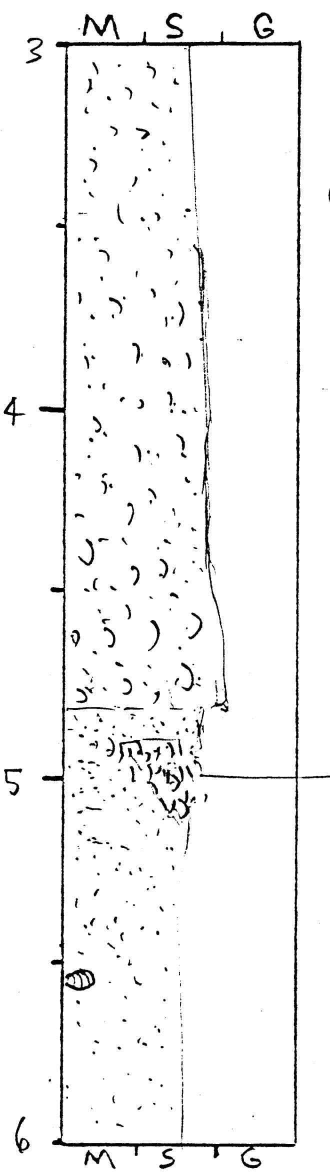
General Comments:

CORE LOG

CORE # SBV 12 (B) TYPE_________ LOCATION__________________
LATITUDE_________ LONGITUDE_________ SURFACE ELEVATION_________
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION____

OBTAINED BY______________________________ DATE_________
DESCRIBED BY______________________________ DATE_________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



shelly sand

Lt Olive gray (5Y 5/2) to Olive gray (5Y 4/1)

gradational increase in shell frags. quanty & size with depth

Fining upward

sandy shell

coarsening of shells pebble size some whole shells

shell pocket

Fine sand, scattered small shell frags.

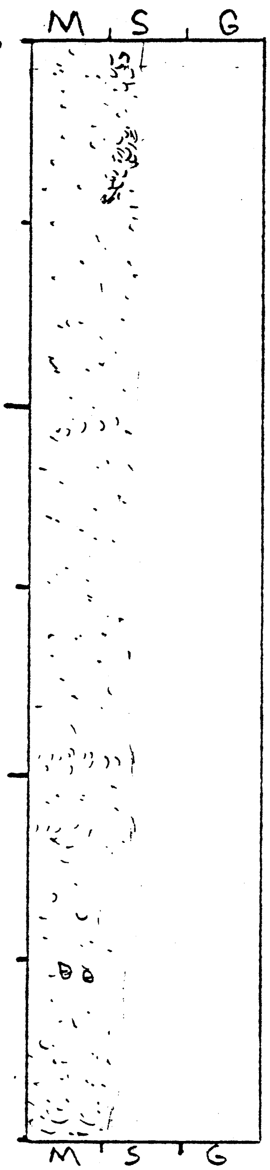
Olive gray sd (5Y 5/2)

General Comments:

CORE LOG

CORE # SBV-12(C) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
6		Fine quartz sand, sub rounded well sorted except for local shell pockets, very coarse to granule shell frags		Olive gray 5Y 4/1 to 5Y 5/2
7				
		Fine quartz sand		
8		Local increases of shell frags mostly very coarse sand size < 10% shell frags		
9		slightly muddy sand		Olive gray 5Y 3/2

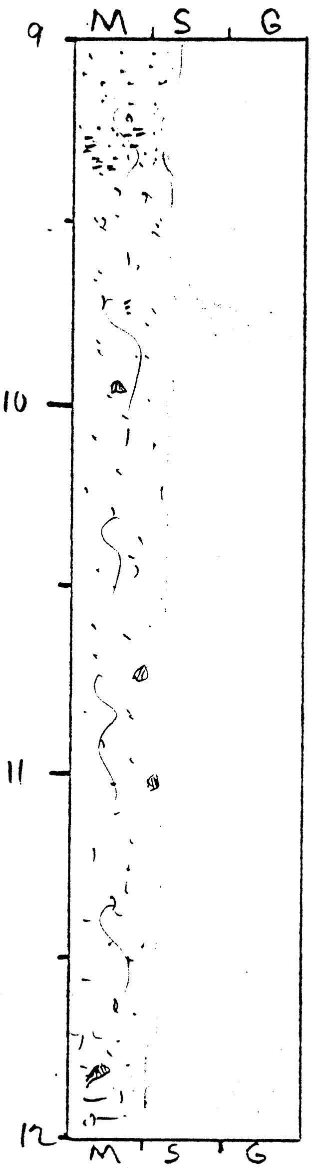
General Comments:

CORE LOG

CORE # SBV-12(D) TYPE_________ LOCATION_________
LATITUDE_________ LONGITUDE_________ SURFACE ELEVATION_________
DEPTH PENETRATED_________ LENGTH RECOVERED_________ %COMPACTION_________

OBTAINED BY_________ DATE_________
DESCRIBED BY_________ DATE_________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Fine to v. fine quartz sand

muddy very fine sand (Burrowed)

discrete mud & sand

Olive gray (5Y 3/2)

becoming darker gray than above section

slightly muddy sand

scattered shell fragments (small)

very coarse to granule size

mud clasts?

occasional whole (small) shell

Burrowed

v. fine sand, slightly muddy

mud clasts?

mud seems to increase near bottom

muddy sand

Olive gray (5Y 3/2

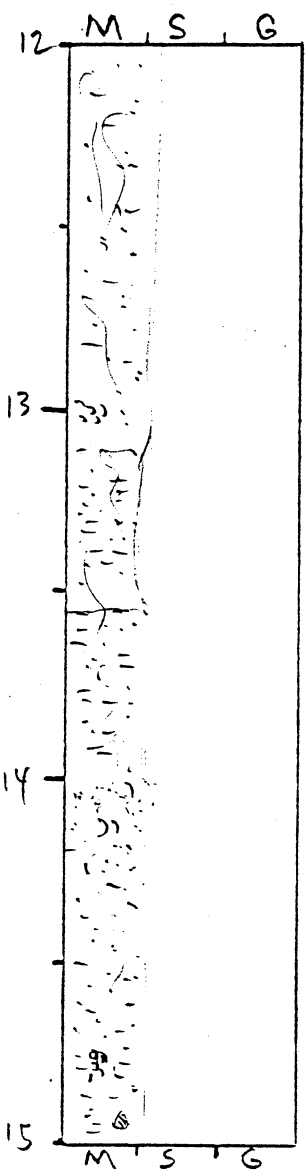
General Comments:

CORE LOG

CORE # SBV-12(E) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
12		muddy sand	intensely Burrowed	Olive gray (5Y 3/2)
		a few scattered shell frags ≤ 1 or 2%		becoming darker gray from above section
13		discrete sand and mud (clay) zones. slightly muddier from 13.1 – 13.6	Intensely Burrowed	
14		Lt Olive gray (brownish) sd layer a few larger shells (pebble size)		
		muddy sand occasional shell pocket		
15				Olive gray (5Y 3/2)



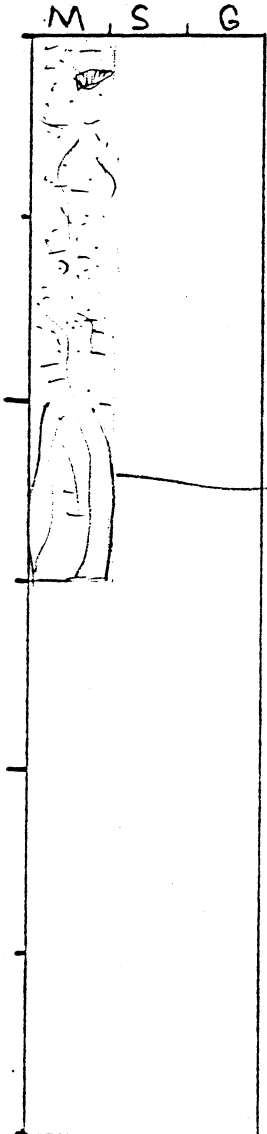
General Comments:

CORE LOG

CORE # SBV-12 F TYPE________ LOCATION____________________
LATITUDE__________ LONGITUDE__________ SURFACE ELEVATION________
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION____

OBTAINED BY__________________________________ DATE________
DESCRIBED BY__________________________________ DATE________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
15	M S G	muddy sand to sandy mud whole shell ≈ 2 cm long < 1 % shell frags		Olive gray (5 Y 3/2) darker than above
		discrete sand pockets & clay zone	Intensely burrowed	
16		core catcher		



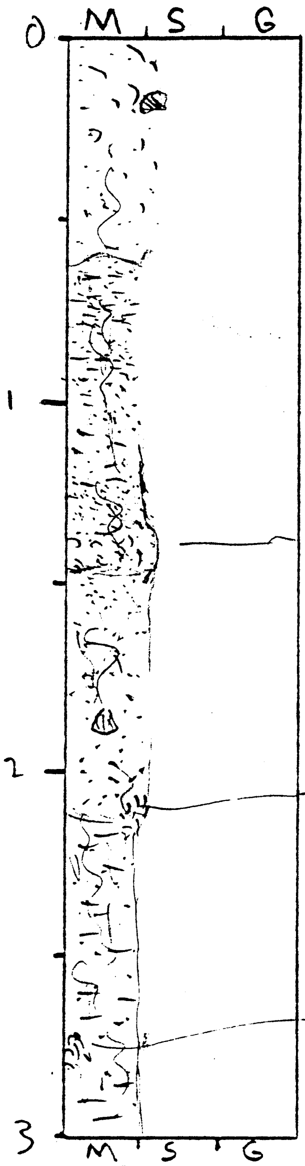
General Comments:

CORE LOG

CORE # SBY-13 (A) TYPE Vibracore LOCATION Sabine Bank
LATITUDE 29° 28.729 LONGITUDE 93° 34.872 SURFACE ELEVATION -37'
DEPTH PENETRATED ? LENGTH RECOVERED 19'4½" % COMPACTION ?

OBTAINED BY Gibeaut - R/V Kit Jones DATE 10-13-94
DESCRIBED BY White DATE 2-7-95

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



shelly fine sand, fragmented whole up to pebble size — Olive gray (5Y 3/2 to 5Y4/1)

larger shell fragments near top, decrease below

muddy sand to sandy mud — intensely burrowed

muddy shelly sand

sand, scattered shell frags, slightly muddy

shell pocket

becomes muddier — intensely burrowed

muddy sand

shell pocket

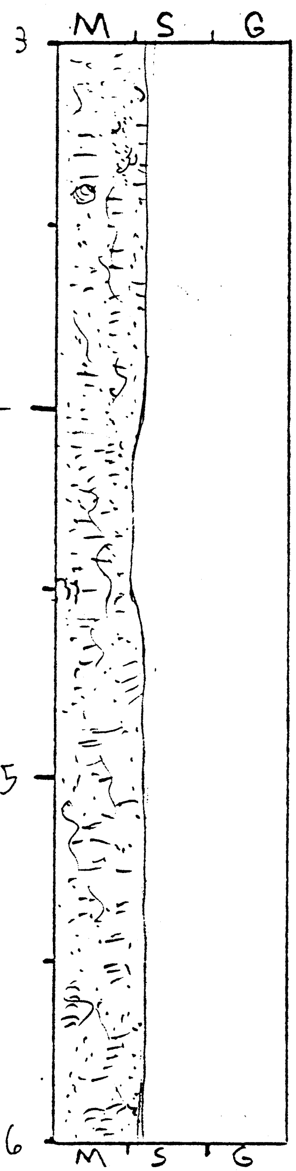
Olive gray (5Y 3/2)

General Comments:

CORE LOG

CORE # SBV-13(B) TYPE________ LOCATION________________
LATITUDE________ LONGITUDE________ SURFACE ELEVATION________
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION____

OBTAINED BY________________________ DATE________
DESCRIBED BY________________________ DATE________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
3		muddy sand		Olive gray (5Y 3/2)
		Very scattered shells <1%	Intensely Burrowed	
4		muddier muddy sand to sandy mud	Intensely Burrowed	
5		Muddy sand	Intensely Burrowed	
		discrete mud & sand areas		
6				Olive gray (5Y 3/2)

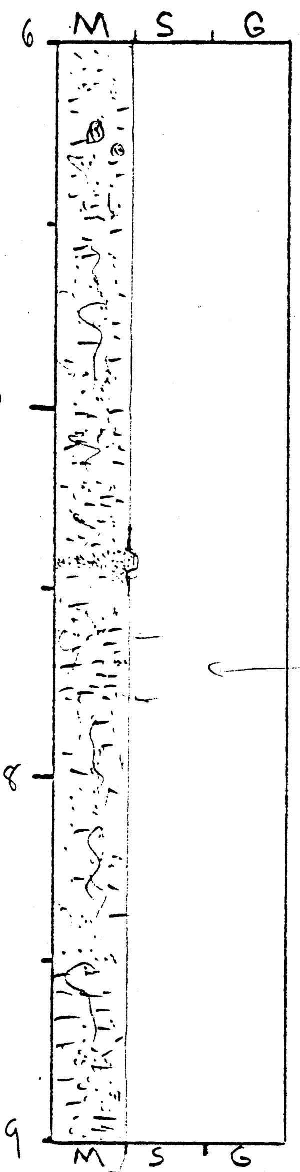
General Comments:

CORE LOG

CORE # SBV-13(C) TYPE______ LOCATION______
LATITUDE______ LONGITUDE______ SURFACE ELEVATION______
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION______

OBTAINED BY______ DATE______
DESCRIBED BY______ DATE______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



muddy sand to sandy mud
mud becomes more abundant in this section, still lots of fine sand
a few scattered shells
discrete sand and mud areas

Intensely Burrowed

Olive gray 5Y 3/2

discrete mud & sand zone

thin sand layer (light olive gray to Olive gray)

sandy mud

Intensely Burrowed

muddy sand to sandy mud
very scattered shell frags
<1%

Olive gray (5Y 3/2)

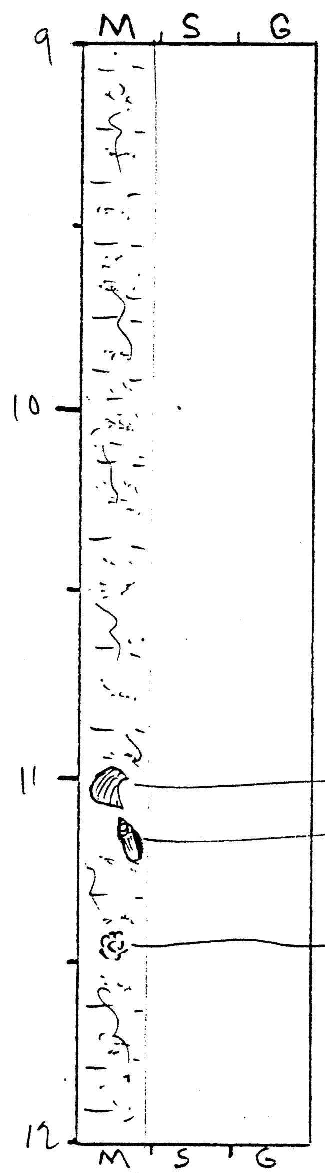
General Comments:

CORE LOG

CORE # SBV-13(D) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
		Sandy mud, few shell	Intensely Burrowed	Olive gray (5Y 3/2)
		small sand filled burrows?		
			Intensely burrowed	
		Dinocardium (Both halfs) (whole shell)		
		Large gastropod (whole)		
		shell packet, small whole shells		
				Olive gray 5Y(3/2)



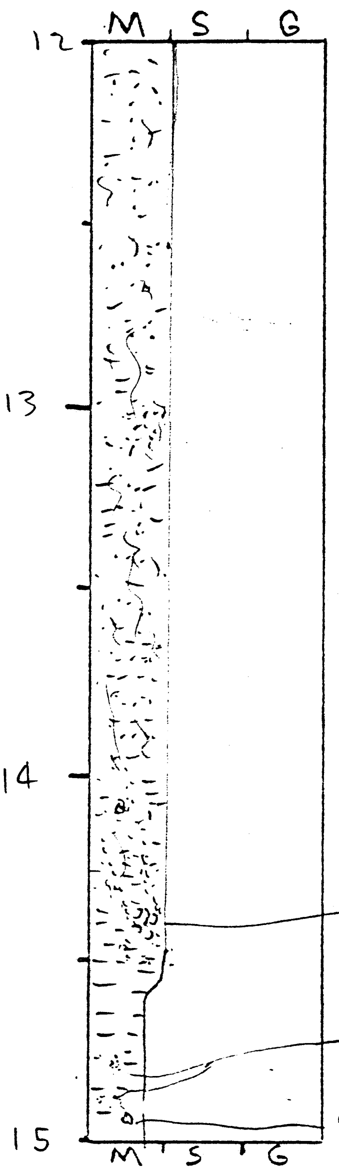
General Comments:

CORE LOG

CORE # SBV-13(E) TYPE ________ LOCATION ____________________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ___

OBTAINED BY ______________________________ DATE ________
DESCRIBED BY ______________________________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
12	M S G	muddy sand to sandy mud; few shell fragments <1% except for pockets near bottom	Intensely burrowed	Olive Gray 5Y 3/2
		muddy sand to sandy mud		
13		discrete mud & sand		
14		shell pocket (granule size shell frags)		
		sand filled burrows; Clay	few burrows	medium gray
15	M S G	shell frag		



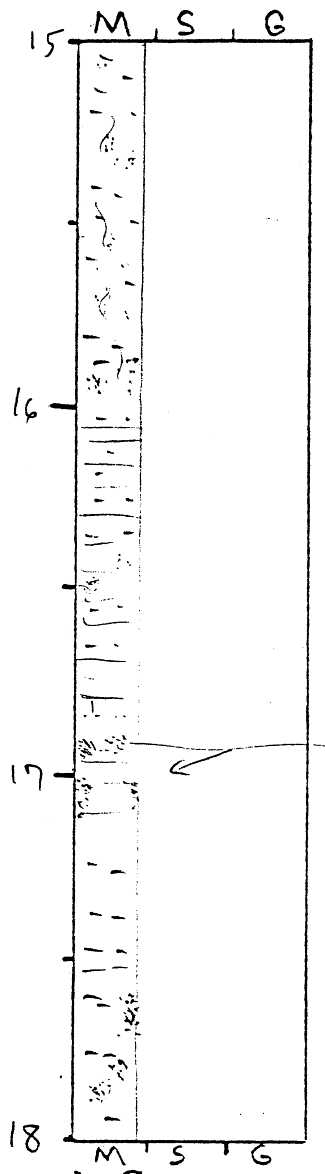
General Comments:

CORE LOG

CORE # SBV-13 (F) TYPE_____ LOCATION_____
LATITUDE_____ LONGITUDE_____ SURFACE ELEVATION_____
DEPTH PENETRATED_____ LENGTH RECOVERED_____ %COMPACTION_____

OBTAINED BY_____ DATE_____
DESCRIBED BY_____ DATE_____

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



mud or silty clay — burrowed — medium dark gray to olive gray

silt & v.fine sand pockets (burrows) — medium gray below 19.6'

silty clay — fine horizontal silty laminae

v. few shells - mostly restricted to sand pockets

sand pockets

some burrows — medium gray to olive gray (5Y 3/2)

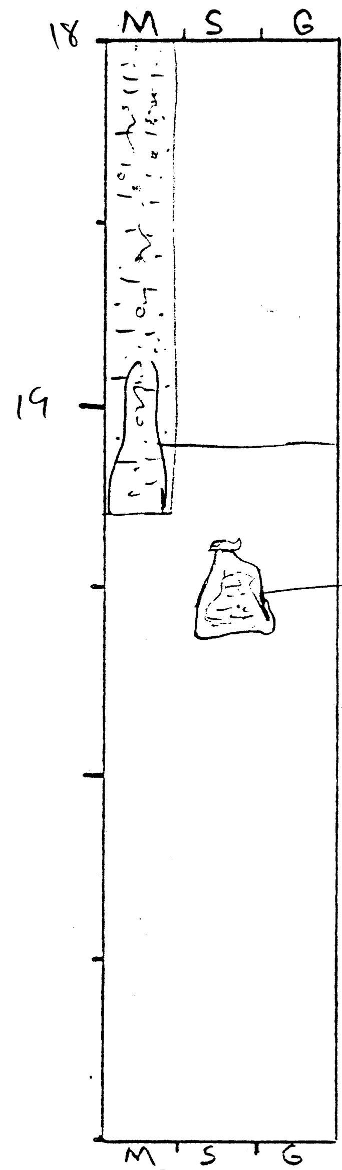
General Comments:

CORE LOG

CORE # SBK-13(G) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
18		silty clay or possibly sandy mud	burrowed	medium gray to Olive gray 5Y 3/2
		small silt or sand filled burrows		
19		core catcher		
		soft Olive gray, slightly gritty mud in baggie from bottom of corer		



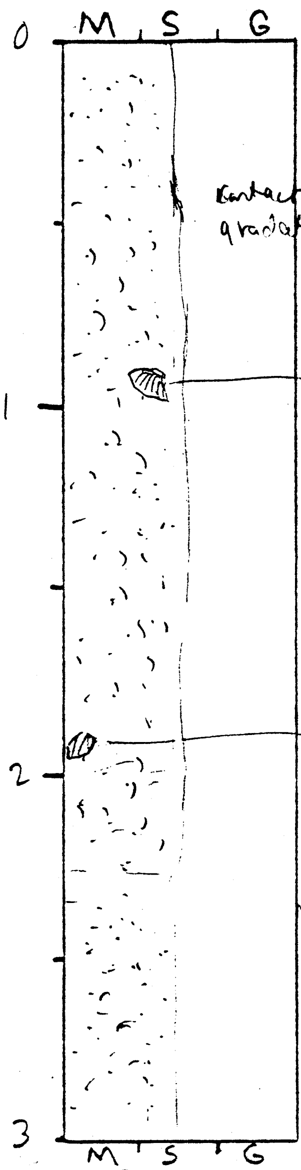
General Comments:

CORE LOG

CORE # SBV-14(A) TYPE Vibracore LOCATION Sabine Bank
LATITUDE 29° 29.283 LONGITUDE 93° 38.052 SURFACE ELEVATION -32'
DEPTH PENETRATED ? LENGTH RECOVERED 19'9¼" % COMPACTION ?

OBTAINED BY Gibeaut - R/V Kit Jones DATE 10-13-94
DESCRIBED BY White DATE 2-7-95

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



fine to v fine sand, some shells
shell fragments & whole shells
most granule or small
a few pebble size

contact gradational

shelly v. fine sand, slightly muddy

whole shell (3 cm across)

large shell fragment

v. fine sand; shells less abundant below about 2.3'.
slightly muddy

Olive gray 5Y 3/2

Core interrupted in this area leaving some void space.

Olive gray 5Y 3/2

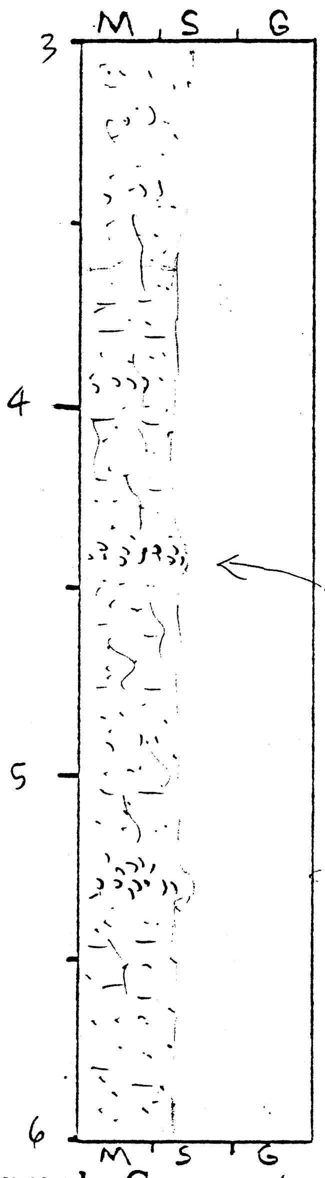
General Comments:

CORE LOG

CORE # SBV-14(B) TYPE________ LOCATION________________
LATITUDE________ LONGITUDE________ SURFACE ELEVATION________
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION____

OBTAINED BY________________________ DATE________
DESCRIBED BY________________________ DATE________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
3		sand slightly muddy shells ≃ 5% frags & whole local concentrations	burrowed	Olive Gray
		becomes slightly more muddy below 3.6'		
4		possibly muddy sand		
		Granule size shell concentration muddy shelly sandy		
5		shell pocket - muddy shelly sand		
		muddy sand v few shells		Olive Gray
6				

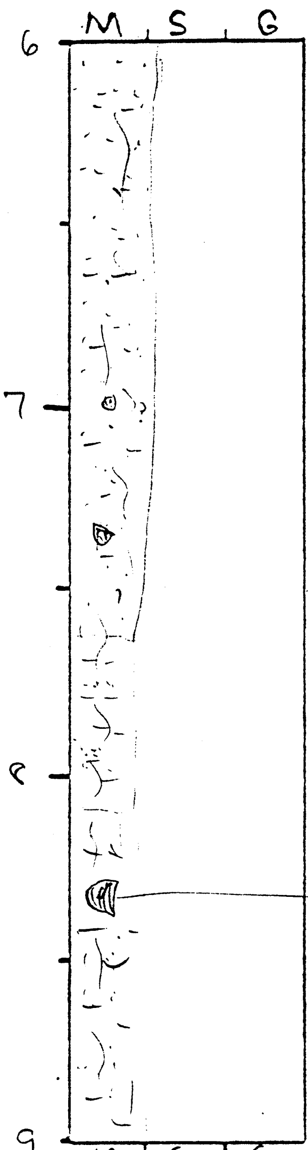


General Comments:

CORE LOG

CORE # SBV-14(C) TYPE ________ LOCATION ________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ______ LENGTH RECOVERED ______ % COMPACTION ____

OBTAINED BY ________________________ DATE ________
DESCRIBED BY ________________________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
6–9		muddy sand, a few shells & shell frag., to sandy mud	burrowed	Olive gray 5Y 3/2
			burrowed	
		mud, some sand in burrows		
		large shell	Intensely burrowed	
		sandy mud		Olive gray 5Y 3/2

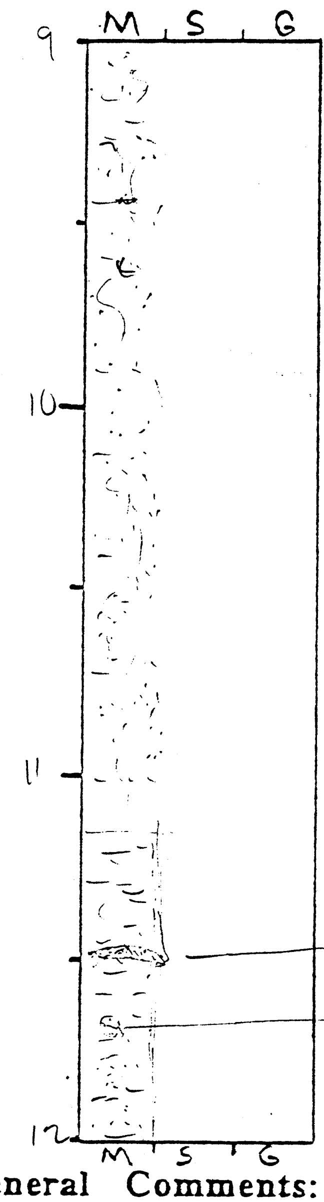
General Comments:

CORE LOG

CORE # SBV-14(D) TYPE________ LOCATION________________
LATITUDE________ LONGITUDE________ SURFACE ELEVATION________
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION____

OBTAINED BY________________________ DATE________
DESCRIBED BY________________________ DATE________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
9		sandy mud	Intensely Burrowed	Olive Grey (5Y 3/2)
		a few shells (very scattered < 1%)		
10		(slightly more sand from 10 - 11.2')		
		sandy mud		
		discrete sand & mud areas		
11				
		sandy mud		Olive gray (5Y 3/2)
		sandy unit not well defined		
		sand filled burrows		
12				



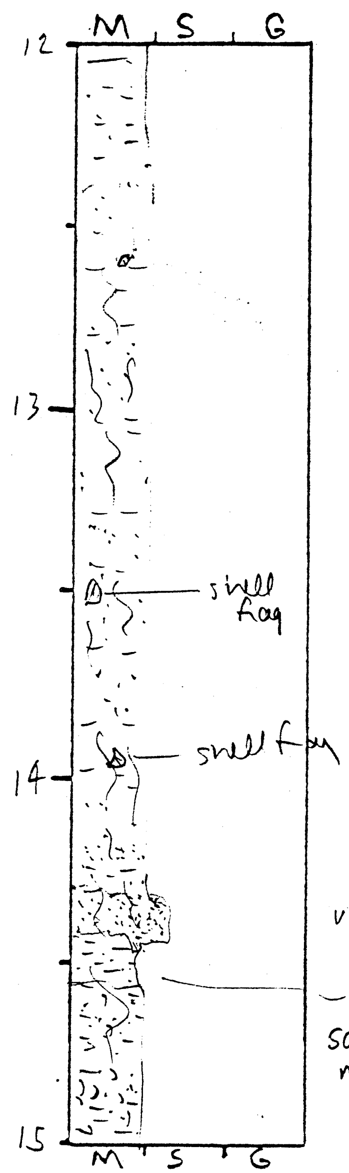
General Comments:

CORE LOG

CORE # SBV-14(E) TYPE ________ LOCATION ________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ______ LENGTH RECOVERED ______ % COMPACTION ______

OBTAINED BY ________________________ DATE ________
DESCRIBED BY ________________________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
12		sandy mud v. scattered shell frags < 1%		Olive gray (5Y 3/2)
		sand increases below ≃ 12.4'	Intensely burrowed	
13		sandy mud to muddy sand		
		discrete pockets of sand in burrows		
14			Intensely burrowed	
		v. fine sand horizon		
		Sandy mud		
		sandy mud to muddy sand more shell frags. ≥ 10% below 14.7' shells granule size		Olive gray (5Y 3/2)
15				



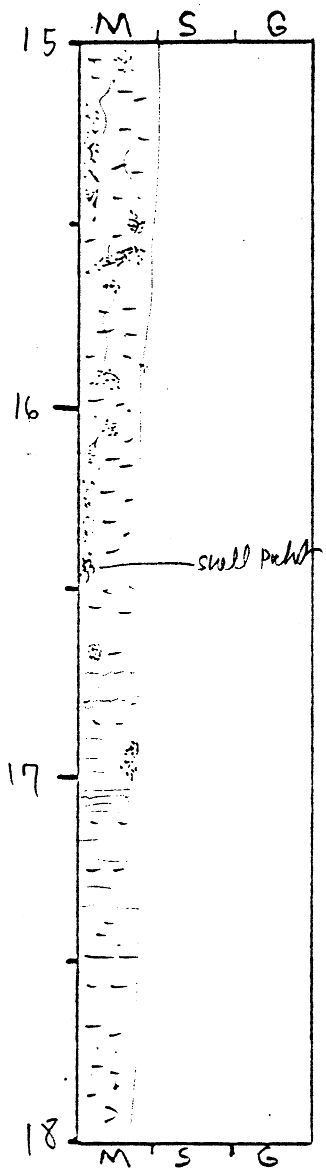
General Comments:

CORE LOG

CORE # SBV-14F) TYPE______ LOCATION______
LATITUDE______ LONGITUDE______ SURFACE ELEVATION______
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION______

OBTAINED BY______ DATE______
DESCRIBED BY______ DATE______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
15		sandy mud	(sand filled burrows)	Olive gray (5Y 3/2) to medium gray
		discrete sand filled burrows a few v. coarse shell frags in sandy areas		
16			Occasional burrows	
		clay		
			few burrows	medium gray
17		thin silty horizontal laminae in clay		
			no burrows	medium gray
18		clay	some organic specks	



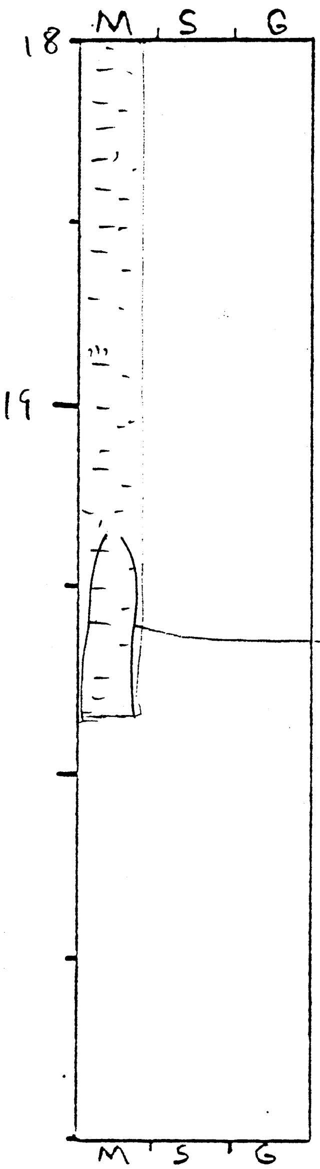
General Comments:

CORE LOG

CORE # SBV-14 (G) TYPE_______ LOCATION_______
LATITUDE_______ LONGITUDE_______ SURFACE ELEVATION_______
DEPTH PENETRATED_______ LENGTH RECOVERED_______ %COMPACTION_______

OBTAINED BY_______ DATE_______
DESCRIBED BY_______ DATE_______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
18		Clay some organic specks very scattered shell frags v coarse sand size		medium gray to olive gray
19		core catcher		



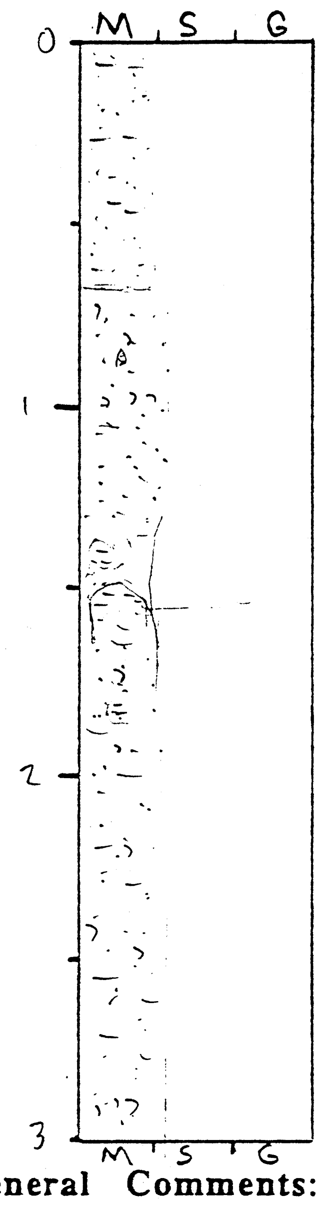
General Comments:

CORE LOG

CORE # SBV-15(A) TYPE Vibracore LOCATION Sabine Bank
LATITUDE 29° 25.341 LONGITUDE 93° 44.381 SURFACE ELEVATION -42'
DEPTH PENETRATED ? LENGTH RECOVERED 5' 10¾" % COMPACTION ?

OBTAINED BY Gibeaut - R/V Kit Jones DATE 10-15-94
DESCRIBED BY White DATE 2-8-95

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



muddy sand
scattered shells < 5%

medium dark gray to olive gray (5Y 3/2)

Sand, scattered shells ≈ 5% up to granule size
slightly muddy

clasts of Beaumont clay

mottled
Lt olive gray & Lt olive brown in medium gray sand

clayey sand
v. scattered shell frags

mottled

Greenish gray (5GY 6/1) to medium gray

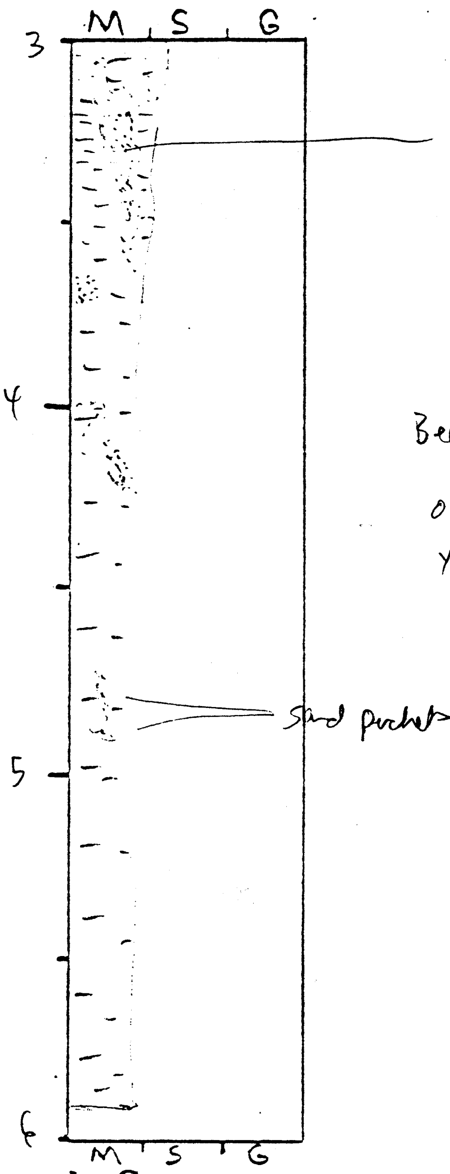
General Comments:

CORE LOG

CORE # SBV-15(B) TYPE________ LOCATION__________
LATITUDE________ LONGITUDE________ SURFACE ELEVATION________
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION____

OBTAINED BY________________ DATE________
DESCRIBED BY________________ DATE________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
3		clayey sand sand filled burrows down into Beaumont clay		mottled greenish gray with some yellowish gray sand and med gray Beaumont clay Lt Olive brown to Drk yellowish orange
4		Beaumont Clay occassional sand pocket mostly yellowish orange sand but some Lt gray sand in pockets No shells		mottled greenish gray with oxidized sand pockets Lt brown to Drk yellowish orange
5				
6				Lt Olive gray with local Lt brown to Drk yellowish orange spots



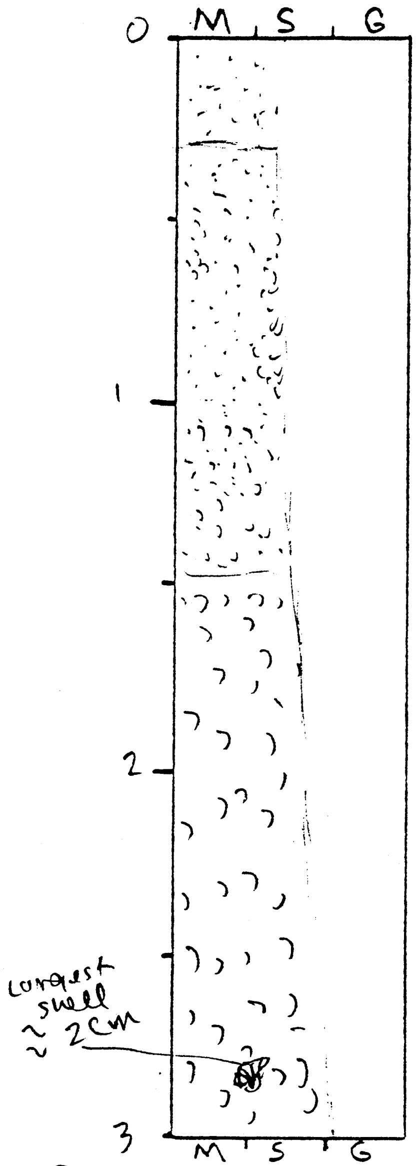
General Comments:

CORE LOG

CORE # SBV-16(A) **TYPE** Vibracore **LOCATION** Sabine Bank
LATITUDE 29° 26.139' **LONGITUDE** 93° 44.899 **SURFACE ELEVATION** -33'
DEPTH PENETRATED ? **LENGTH RECOVERED** 15' 3 3/4" **% COMPACTION** ?

OBTAINED BY Gibeaut - R/V Kit Jones **DATE** 10-13-94
DESCRIBED BY White **DATE** 2-8-95

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



F quartz sand with ≈ 10% v. coarse sd size! shell frags subrounded

Olive gray (5Y 4/1)

mixed quartz sand & v coarse to granule size shell frags.

F sd & shell. (v. coarse) bimodal 25% shell

Excellent fining upward sequence

V. coarse sand (predominantly shell hash)

Noticeable increase in shell hash quantity & size at about 1.5'

Increase in size (gradual) shell gravel

Dk yellowish brown to Pale yellowish brown

Very speckled in color

granule to pebble size shell hash

General Comments:

CORE LOG

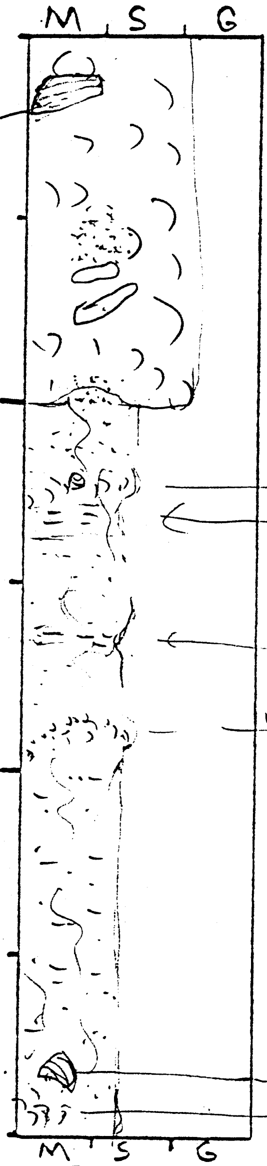
CORE # SB11-16 (B) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS

3

4.5cm shell frag



shell gravel

Brownish gray to Lt Olive gray

some sand mixing from below

4

slightly muddy sd.

shelly sand (granule size, some whole shells)

muddier

slightly muddy sand

muddier — discrete mud "clasts"

Intensely burrowed

Olive gray to medium gray

muddier shelly sand (granule size shells) some whole shells

5

muddy sand

Dinocardium (probably)

shell pocket

6

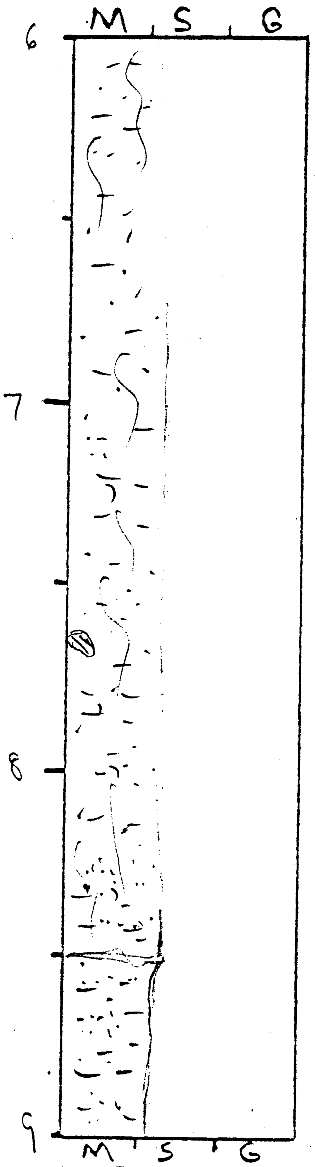
General Comments:

CORE LOG

CORE # SBV-16(C) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



muddy sand (more mud than in previous section). (Intensely burrowed)

v. scattered small shells occasional larger frag (< 2%

Olive gray

muddy sand

discrete mud clasts? in sand

sandy mud

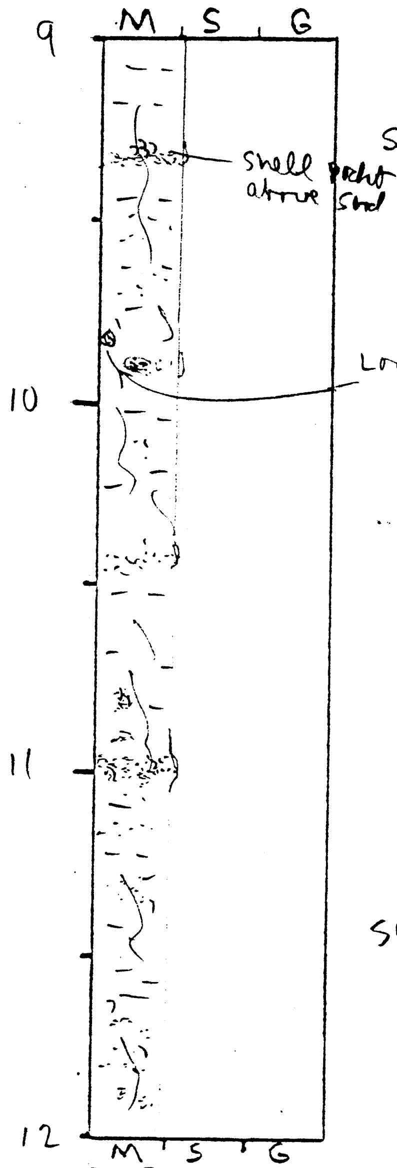
General Comments:

CORE LOG

CORE # SBV-16(D) TYPE______ LOCATION______
LATITUDE______ LONGITUDE______ SURFACE ELEVATION______
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION______

OBTAINED BY______ DATE______
DESCRIBED BY______ DATE______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Sandy mud — intensely burrowed — Olive gray (5 Y 3/2)

v. scattered shell frags. mostly in sand pockets

Local whole shell (granule size) — Looks like Mulinia

discrete sand pockets (filled burrows) in mud

Sandy mud — Olive gray

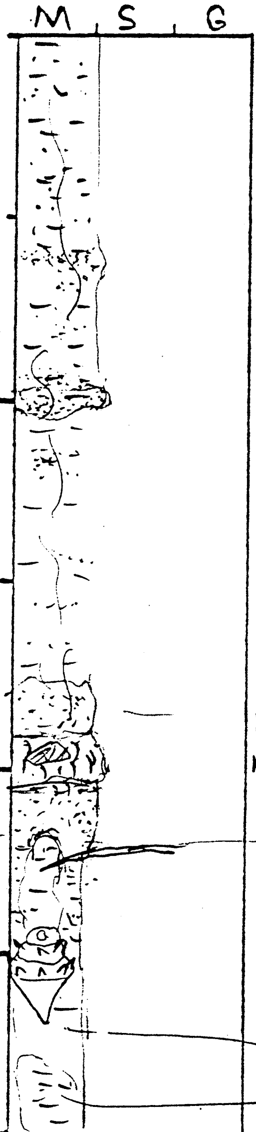
General Comments:

CORE LOG

CORE # SBV-16(E) TYPE______ LOCATION______
LATITUDE______ LONGITUDE______ SURFACE ELEVATION______
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION______

OBTAINED BY______ DATE______
DESCRIBED BY______ DATE______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
12	M S G	sandy mud v scattered shell frag.	burrowed	Olive gray
		sand conc. in pockets & thin distorted layers		
13		distorted (Thin sand layers interbedded with thin mud layers)		
		sandy mud		
		muddy sand		
14		muddy shelly sand		
		muddy sand		
14.2		Beaumont clay clast		Pale Olive with mottled dusky yellow in Beaumont clay surrounded by Olive gray muddy sd.
		clayey sand		
		Large gastropod		
		void space from core catcher		
15	M S G	Beaumont clay		dusky yellow mottled in Pale Olive



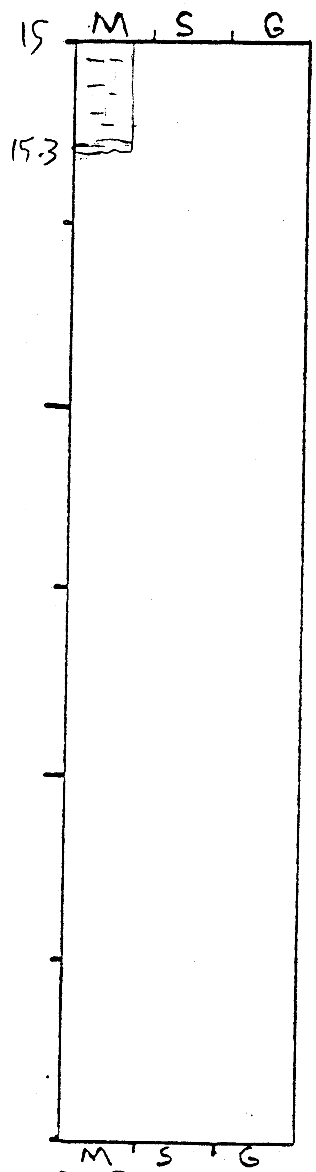
General Comments:

CORE LOG

CORE # SBV-16 (F) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
15 – 15.3		Beaumont clay		Pale Olive mottled with dusky yellow to Lt Olive brown.



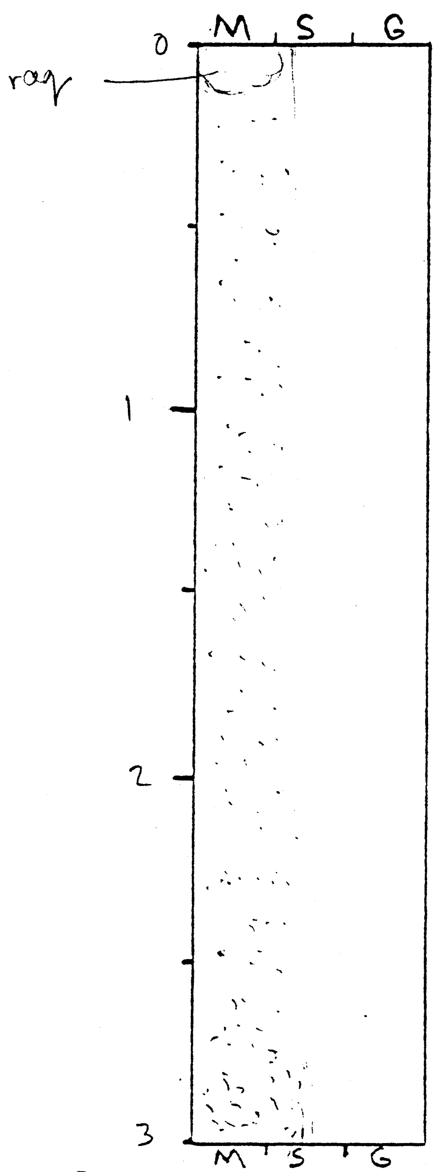
General Comments:

CORE LOG

CORE # SBV-17 (A) TYPE Vibracore LOCATION Sabine Bank
LATITUDE 29° 28.318 LONGITUDE 93° 45.257 SURFACE ELEVATION -23.5'
DEPTH PENETRATED ? LENGTH RECOVERED 4' 7¼" % COMPACTION ?

OBTAINED BY Gibeaut - R/V Kit Jones DATE
DESCRIBED BY White DATE 2-8-95

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Fine quartz sand with v. coarse sand size shell frags. ≈ 10-20%, quartz sub rounded, well sorted

Light Olive gray 5Y 5/2

Part of fining upward sequence

Lt Olive Gray 5Y 5/2

increase in shell frags near base to ≈ 20%-25%, v. coarse sd. grain size

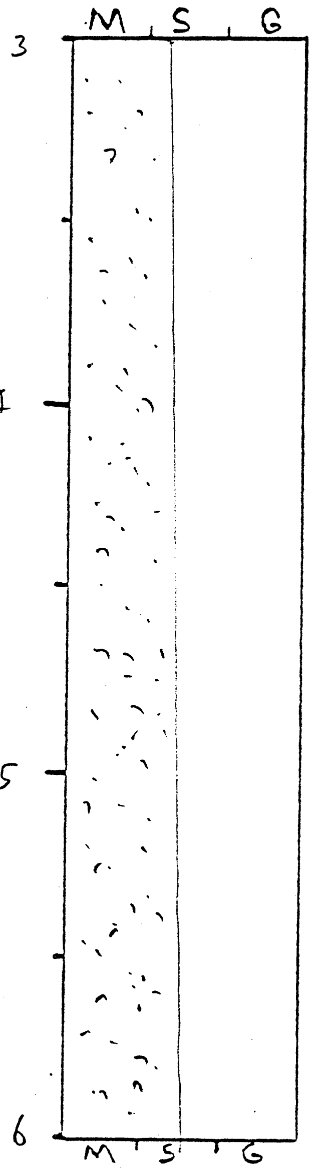
General Comments: bimodal with fine qtz sand

CORE LOG

CORE # SBV-17 (B) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ % COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Fine (quartz) to v. coarse sand (shell)

Light Olive gray
5Y 5/2

shell fragments increase in quantity with depth mostly v coarse sand to granule in size

Occasional pebble size shell frag.

Part of fining upward sequence

Lt Olive gray
5Y 5/2

Fine (quartz) to v. coarse sd & granule in size (shell)
≈ 30% shells

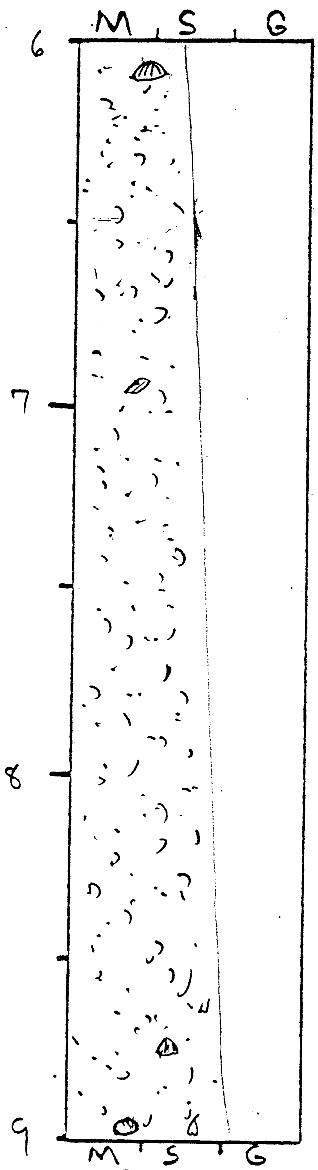
General Comments:

CORE LOG

CORE # SBV-17(C) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Fine quartz sand & shell frags
V coarse to granule in size
local pebble size shell,
Bimodal grain size

Lt Olive gray

part of
Fining upward
sequence

shell fragments become more abundant
& slight larger with depth

Shelly sand
≈ 40% shell fragments

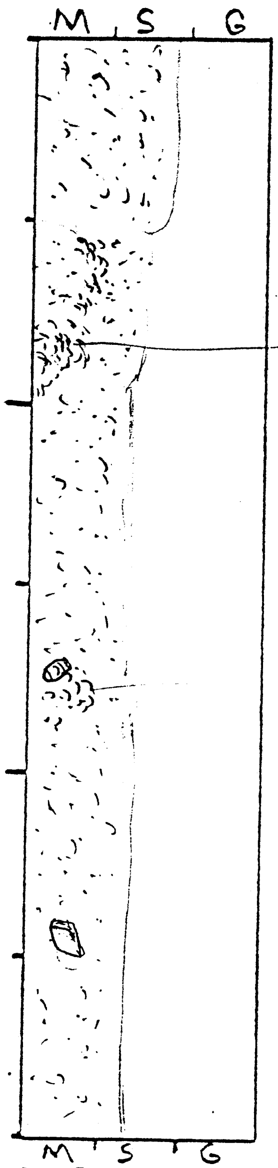
Lt Olive gray

General Comments:

CORE LOG

CORE # SBV-47 (D) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
9		shelly sand ≈ 50% shell		Lt Olive gray to olive gray
		sand with 40% shell		
		sandy shell pocket		
10		Fine sand with ≈ 25% v. coarse to granule shell frags		Lt Olive gray
		shell pocket		
11		fine quartz sand with 20-25% shells v. coarse sd to granule size.		Lt Olive gray
12				

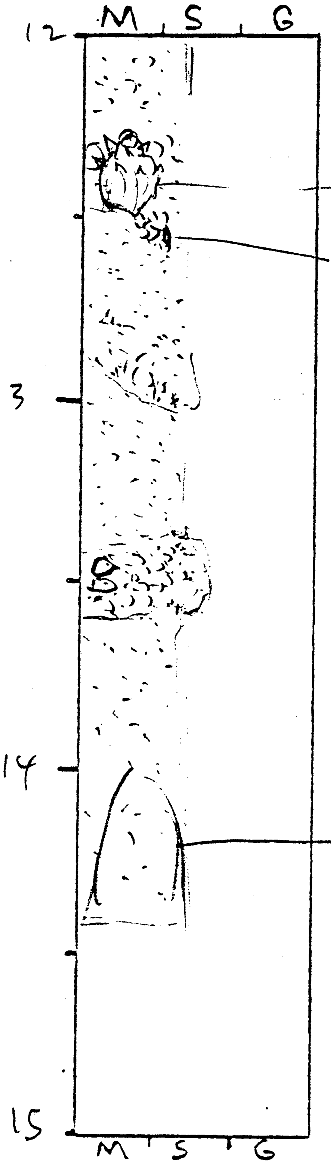
General Comments:

CORE LOG

CORE # SBV-17(E) TYPE ________ LOCATION ________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ________ LENGTH RECOVERED ________ % COMPACTION ________

OBTAINED BY ________ DATE ________
DESCRIBED BY ________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



fine sand w/ ≈ 20-25% shell frags — LT Olive gray

large gastropod (encrusted with worm tubes)

shell pocket

Shelly sand zone (mixed not horizontal)

Fine sand (few shells)

Sandy shell (whole & fragments)
fine sand to v coarse sd & granule size shells

Fine sand
scattered shells — LT Olive gray

core catcher

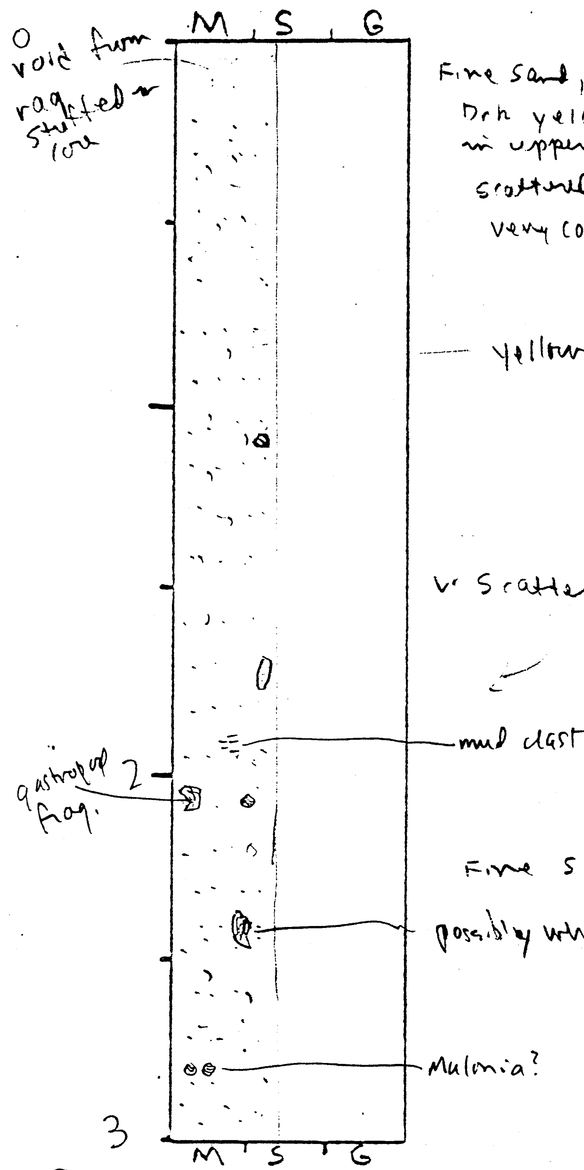
General Comments:

CORE LOG

CORE # SBV-18 (A) TYPE Vibracore LOCATION Sabine Bank
LATITUDE 29° 27.692' LONGITUDE 93° 48.413' SURFACE ELEVATION -30.5'
DEPTH PENETRATED ?. LENGTH RECOVERED 19'4½' 19.4' % COMPACTION ?

OBTAINED BY Gibeaut - R/V Kit Jones DATE 10-14-94
DESCRIBED BY Wilson DATE 2-9-95

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Fine sand, well sorted, sub rounded
Drk yellowish orange oxidation streaks in upper 0.4'.
scattered small shell frags (≈ 5%) very coarse sand size to granule

Lt Olive gray 5Y 5/2 to Olive gray 5Y 4/1
yellowish gray on drying

yellowish tint to sand in this area

v. scattered gravel size shell frags below 1.7'

Fine sand

Lt Olive gray
yellowish gray on drying

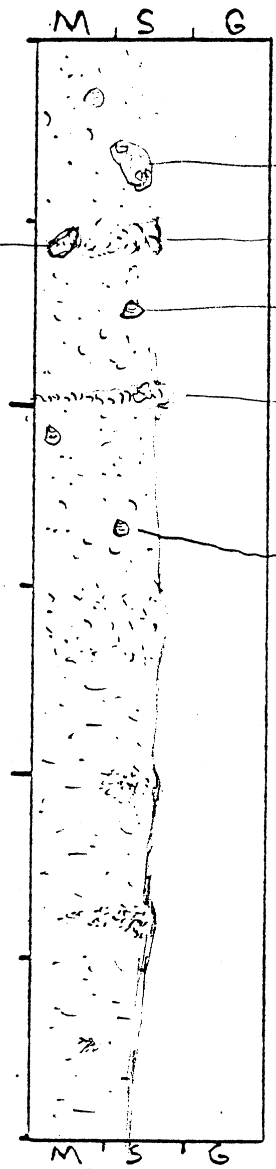
General Comments:

CORE LOG

CORE # SBV-K (B) TYPE ____ LOCATION ____
LATITUDE ____ LONGITUDE ____ SURFACE ELEVATION ____
DEPTH PENETRATED ____ LENGTH RECOVERED ____ % COMPACTION ____

OBTAINED BY ____ DATE ____
DESCRIBED BY ____ DATE ____

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



3 cm oyster shell frag

Fine sand scattered shell frags. — Lt olive grey 5Y 5/2 to olive grey 5Y 4/1

oyster shell frag (≥ 4cm)

shell pocket (frags mostly v coarse sand size)

mulinia?

shelly sand layer (mostly v coarse sand size one up to pebble size)

(coarsening upward (becoming slightly muddy near base))

possibly mulinia

≥ 20% shell frag (v. coarse sand size in the area 4.5–4.7')

fine sand with local shell hash (coarse to v coarse sand size) pockets
slightly muddy below 4.7'

Olive grey 5Y 3/2

slightly muddy fine sand with scattered shell frags local pockets
Mud increasing in abundance near base

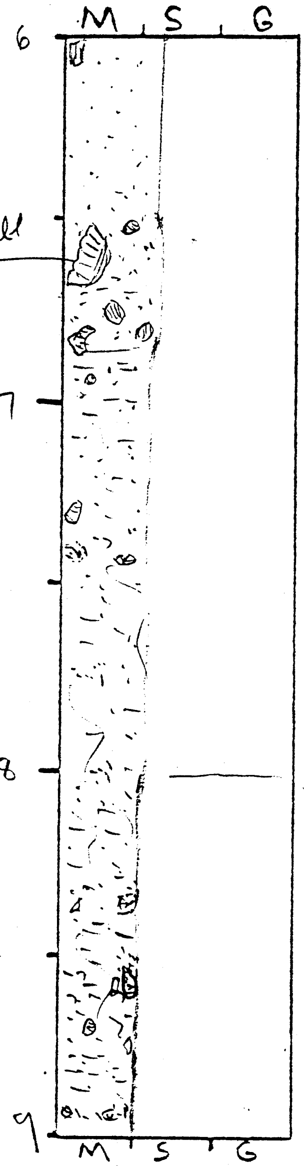
General Comments:

CORE LOG

CORE # SBV-18(C) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ % COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
6		Fine sand, a few shells V. slightly muddy		Olive green 5Y 3/2 to 5Y 4/1
	large shell frag 4 cm across	Increase in shells 10-20%.		
7		sand Mud increasing below 6.81		
		slightly muddy sand scattered shell frags	burrowed	mud increase with depth
8		very gradational contact	Intensely burrowed	
		muddy sand, scattered shell frags, and small whole shells & pockets of v coarse sand size shell frags discrete mud & sand zones Local gravel size shell shell ≈ 10%.		Olive grey 5Y 3/2 (darker than near top)
9				

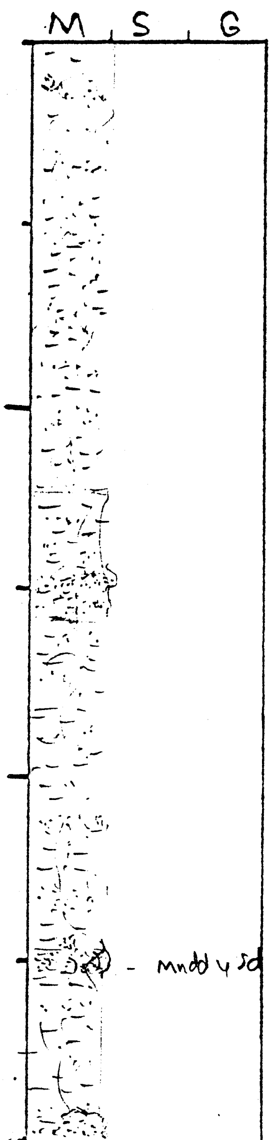


General Comments:

CORE LOG

CORE # SBV-18(D) TYPE______ LOCATION______
LATITUDE______ LONGITUDE______ SURFACE ELEVATION______
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION______

OBTAINED BY______ DATE______
DESCRIBED BY______ DATE______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
9		muddy sand sand in pockets and irregular layers include v coarse sand size shell hash locally	Intensely burrowed	Olive gray, (5Y 3/2) to dark gray
		Discrete mud & sand zon		
10		sandy mud	Mud increases with depth	Color change in this core to darker gray
		muddy sand		Overall mud appears to become more abundant than sand below 10.2'
11		sandy mud to muddy sand scattered small shell frags associated with sand pockets	Intensely Burrowed	
12		muddy sand to sandy mud		Drk gray to Olive grey 5Y 3/2

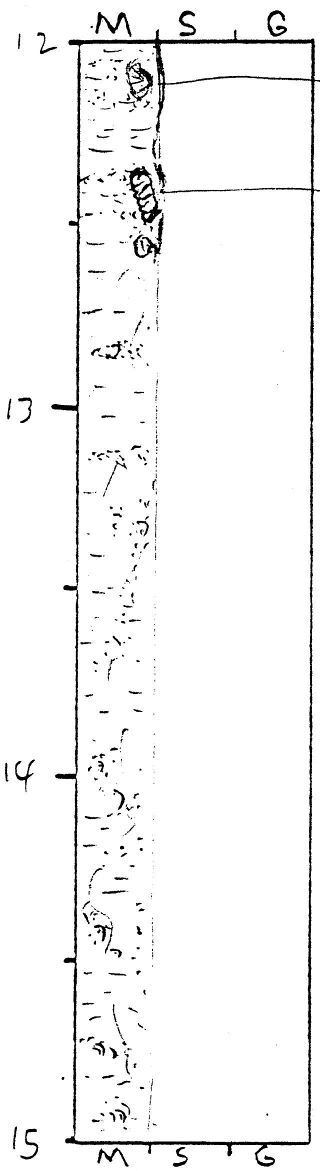
General Comments:

CORE LOG

CORE # SBV-18 (E) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



muddy sand
cardium 2.5cm

→ 4cm (large shell frag)

Intensely Burrowed

Sandy mud
scattered shell frags associated with sand pockets

?. Intimate mud & sand zones.

mud appears to be slightly more abundant than sd.

Drk gray to Olive gray 5Y 3/2

Drk gray to Olive gray 5Y 3/2

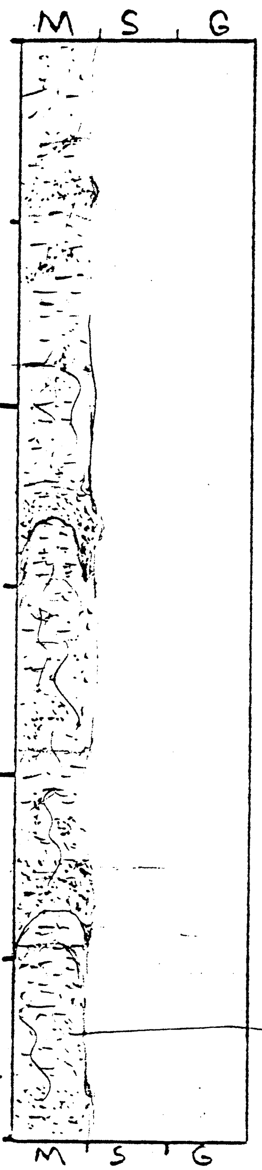
General Comments:

CORE LOG

CORE # SBV-18 F TYPE ____ LOCATION ____
LATITUDE -- LONGITUDE ____ SURFACE ELEVATION ____
DEPTH PENETRATED ____ LENGTH RECOVERED ____ % COMPACTION ____

OBTAINED BY ____ DATE ____
DESCRIBED BY ____ DATE ____

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
15		sandy mud		Dark gray to Olive gray 5Y 3/2
		muddy sd	discrete sand & mud zone; scattered shell frags associated with sand pockets	
		sandy mud		
16		muddy sand		
		disturbed sand (coring)	(distorted by coring)	
		muddy sand to sandy mud	Intensely Burrowed	
17		sandy mud	Indistinct contacts	
		sand to muddy sand	(distorted by coring)	
		sandy mud		
		fluid (wet) sand mud to muddy sand zone		
18		muddy sand		Olive gray 5Y 3/2



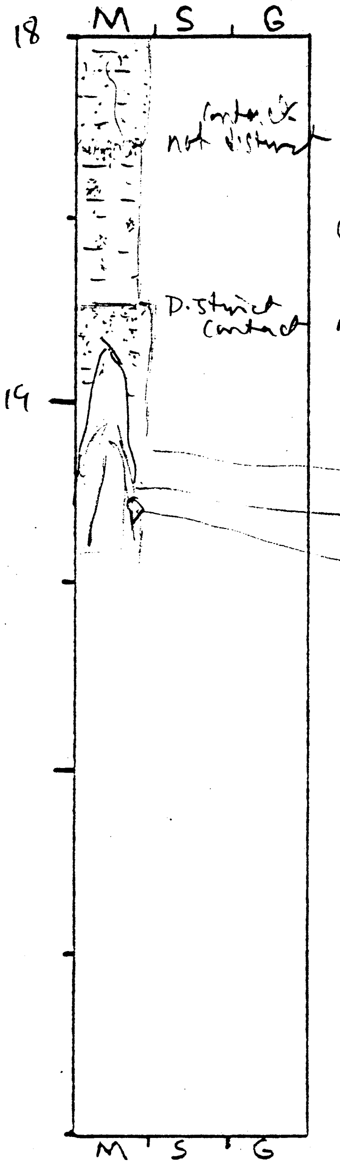
General Comments:

CORE LOG

CORE # SBV-18(G) TYPE Vibracore LOCATION Sabine Bank
LATITUDE 29° 27.692 LONGITUDE 93° 48.413 SURFACE ELEVATION -37.5'
DEPTH PENETRATED ? LENGTH RECOVERED 19'4½" 19'4' % COMPACTION ?

OBTAINED BY Gibeaut - R/V Kit Jones DATE 10-14-94
DESCRIBED BY White DATE

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



muddy sand to sandy mud (olive gray 5 Y 3/2) to 5 Y 4/1
w. scattered shell frags (<1%) Burrowed

Lt olive gray no shells
Clay traces of organics & silt pockets (olive gray)
Little disturbance except near top (burrowed near top)

muddy sand to sandy mud
Olive gray 5Y 4/1

chunks of stiffer clay in bottom core catcher

Possible organic fragments (upward) in sampling half of core

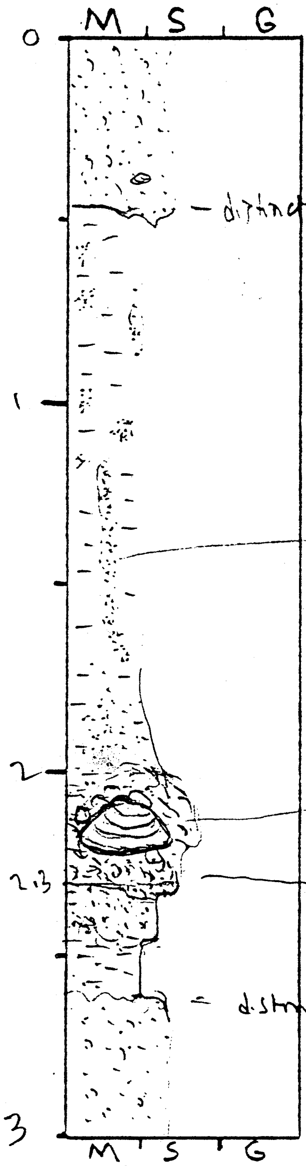
General Comments:

CORE LOG

CORE # SBV-19(A) **TYPE** Vibracore **LOCATION** Sabine Bank
LATITUDE 29° 26.411' **LONGITUDE** 93° 47.782 **SURFACE ELEVATION** -31.5'
DEPTH PENETRATED ? **LENGTH RECOVERED** 19' 4½" **% COMPACTION** ?

OBTAINED BY Gibeaut - R/V Kit Jones **DATE** 10-14-94
DESCRIBED BY White **DATE** 2-9-95

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Fine sand (to v fine) scattered shell shells & frags most granule to v-coarse sd size (5-10% shell frags)

Olive gray (5Y4/1) More Brownish tint than below 2.3' which become grayer

- distinct contact

Sandy mud

sand filled burrow

Increase in sand possible due to burrow

Noticeable color change darker gray below shell zone

Large blk. Clam

Slightly muddy shelly sand to sandy shell very coarse sand size to granule size whole & shell frags.

muddy sand (no shell frags visible)

sandy mud (few to no shell frags)

Medium drk gray to Olive gray

- distinct but somewhat irregular contact

Sand (v fine) 5-10% shell frags v coarse & granule size

5Y 3/2

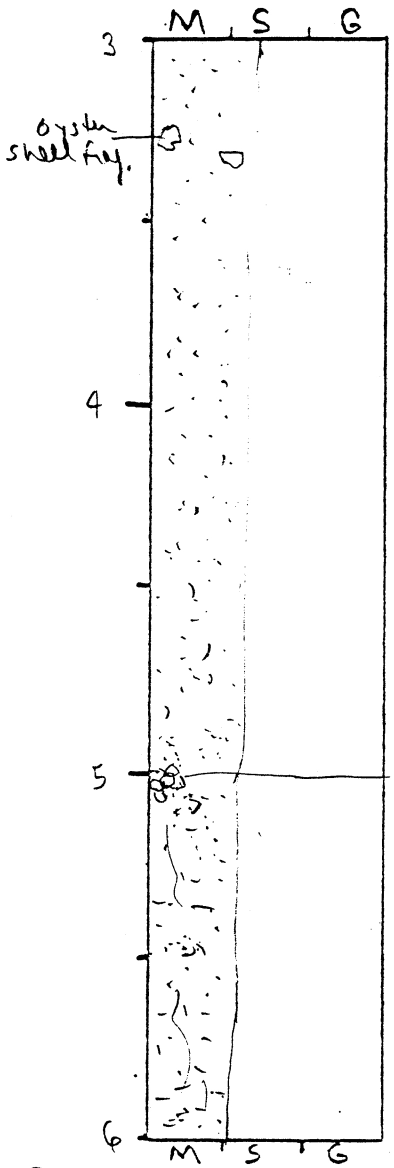
General Comments:

CORE LOG

CORE # SBV-19(B) TYPE ________ LOCATION ____________________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ______ LENGTH RECOVERED ______ % COMPACTION ____

OBTAINED BY ______________________________ DATE ________
DESCRIBED BY ______________________________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



v Fine sand slightly muddy scattered shell frags most very coarse to granule 10% mud increasing with depth — Olive gray (5Y 3/2) to med dark gray

coarsening upward in terms of decreasing mud content

shell pocket many whole shells granule to small pebble in size
mud increase noticeable at about 5'

muddy sand
scattered shell frags
<5% shell frag
burrowed
mud increases near base — med. dark gray to Olive gray 5Y 3/2

General Comments:

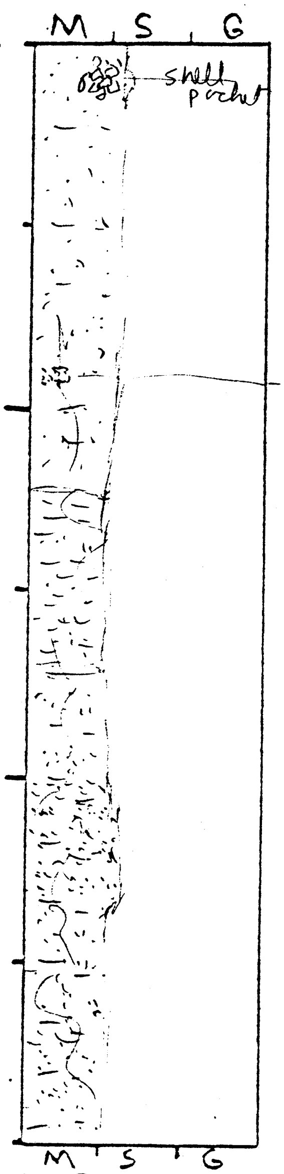
CORE LOG

CORE # SBV-19(C) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS

6



muddy sand
↓ scattered shell frags -- < 5% except in shell pockets

Olive gray 5Y 3/2 to med dark gray

shell frag pocket (v coarse sand size)

7

mud increase noticeable below 7.3'

wetter zone 7.3 – 7.8' Intensely burrowed

sandy mud to muddy sand

Discrete pockets of sand & mud

< 1% shell frags

8

sand increase slightly below 8'
Muddier sand

Muddy sand to sandy mud

Intensely burrowed Olive gray 5Y 3/2 to med dark gray

9

General Comments:

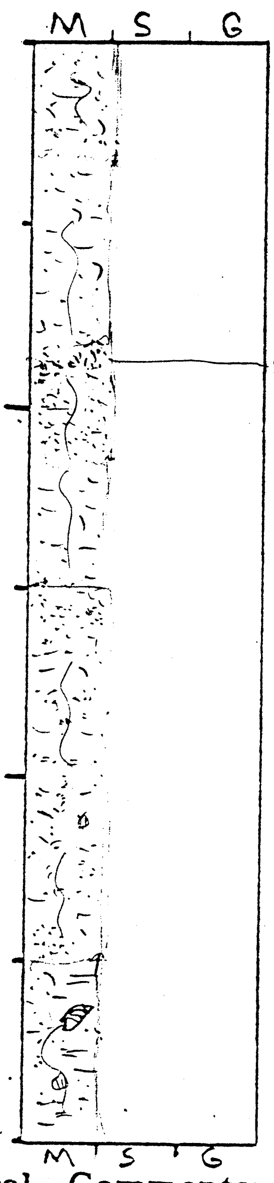
CORE LOG

CORE #SBV-19 (D) TYPE______ LOCATION______
LATITUDE______ LONGITUDE______ SURFACE ELEVATION______
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION______

OBTAINED BY______ DATE______
DESCRIBED BY______ DATE______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS

9



10

11

12

muddy sand to sandy mud

≈1% shell frag

Intensely burrowed

sandy mud to muddy sand

discrete sand & mud units churned by organisms

shell pocket

muddy sand to sandy mud

sandy mud to muddy sand

muddy sand to sandy mud

sandy mud

(5Y 3/2) Olive gray to med dark gray. Intensely burrowed with almost equal portions of mud & sand difficult call about where sand is most abundant & mud is most abundant

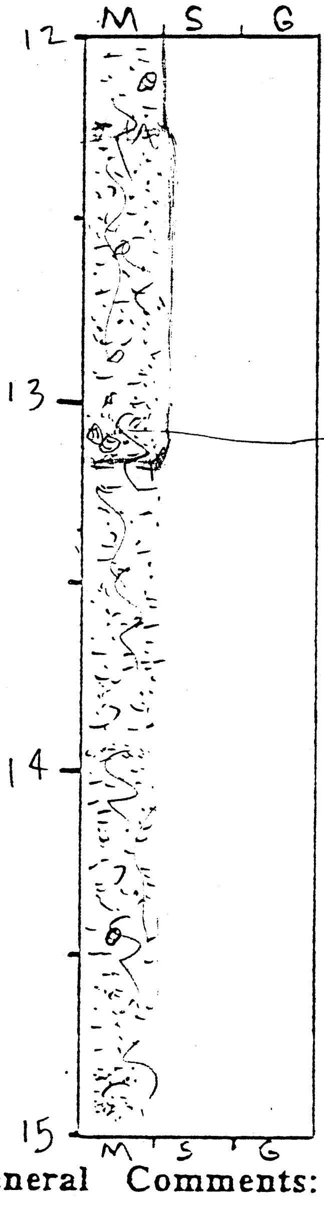
General Comments:

CORE LOG

CORE # SBV-19 (E) TYPE______ LOCATION______
LATITUDE______ LONGITUDE______ SURFACE ELEVATION______
DEPTH PENETRATED______ LENGTH RECOVERED______ % COMPACTION______

OBTAINED BY______ DATE______
DESCRIBED BY______ DATE______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



sandy mud
scattered shells - some whole and up to small pebble size

olive gray to med. dark gray

shell frags associated with sand
≈ 1% shell frags

muddy sand to sandy mud

Intensely Burrowed
sand filled burrows

whole shells

sandy mud overall below ≈ 13.2'
with local concentration of sand where it is more abundant than mud

Olive gray 5Y 3/2 to med dark gray

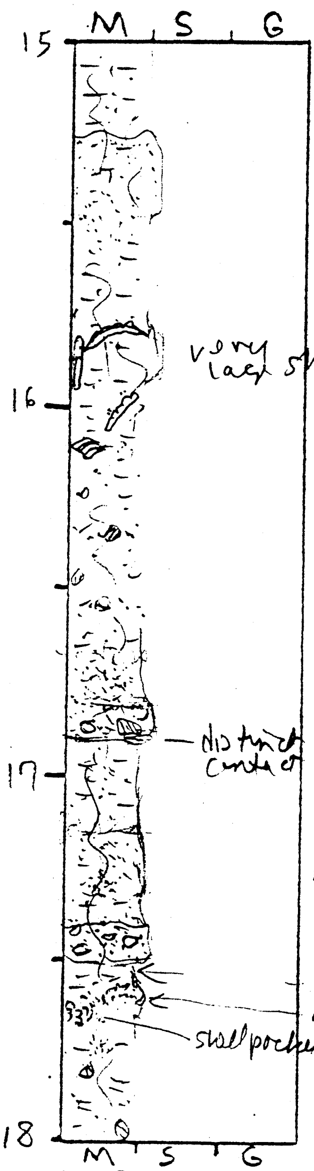
General Comments:

CORE LOG

CORE # SBV-19 (F) TYPE ________ LOCATION ________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ________ LENGTH RECOVERED ________ %COMPACTION ________

OBTAINED BY ________ DATE ________
DESCRIBED BY ________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



sandy mud — Intensely burrowed — Olive gray 5Y 3/2 to med dark gray

muddy sand

shells ≈ 1% except in pockets

very large shells — shelly sandy mud? (shells scattered)

sandy mud

muddy sand — Complex intensely burrowed with sand filled burrows & pockets

muddy shelly sand

distinct contact

sandy mud

muddy sand — Intensely burrowed

muddy shelly sand

sandy mud

muddy sand (shells)

shell pocket

sandy mud

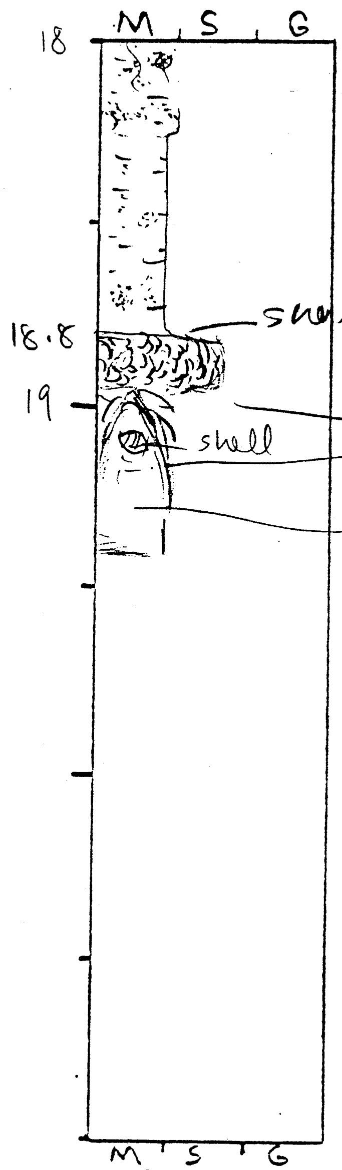
General Comments:

CORE LOG

CORE # SBV-19 (G) TYPE ________ LOCATION ________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ________ LENGTH RECOVERED ________ % COMPACTION ________

OBTAINED BY ________ DATE ________
DESCRIBED BY ________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



sandy mud scattered shells in sand pockets

mud or clay ; sand & silt scattered in burrows
Little burrowing compared to
to above
some organics

Olive gray
down to
med-warm gray
above shell
zone,

sharp contact

muddy shell granule to small pebble size

bottom contact obscured by core catcher

core catcher

void

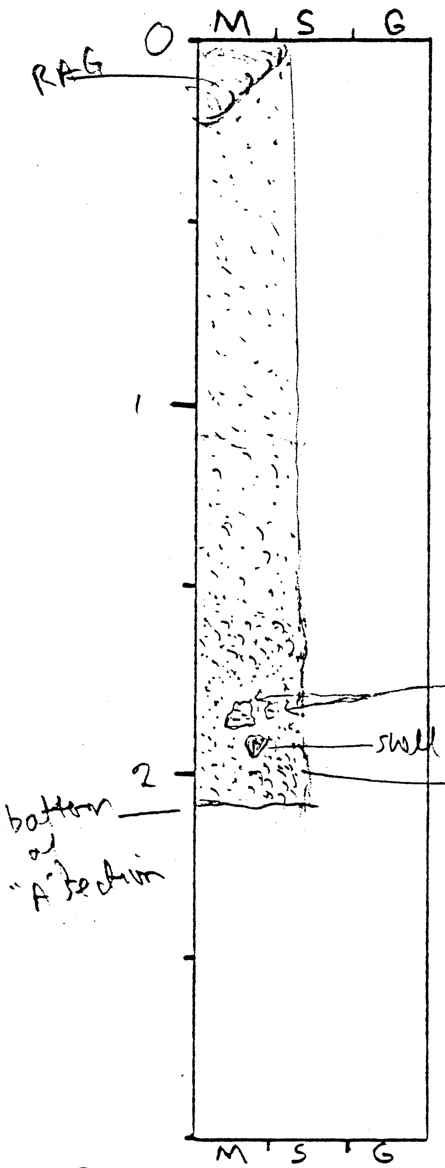
General Comments:

CORE LOG

CORE # SBV-20(A) TYPE Vibracore LOCATION Sabine Bank
LATITUDE 29° 25.035 LONGITUDE 93° 47.144 SURFACE ELEVATION -35.5'
DEPTH PENETRATED ? LENGTH RECOVERED 5'2" %COMPACTION ?

OBTAINED BY Gibeaut - R/V Kit Jones DATE 11-14-94
DESCRIBED BY White DATE 2-22-95

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Fine quartz sand well sorted, sub rounded

· yellowish gray to Olive gray in center of core -- drys yellowish gray

Fining upward

increase in shell frags (granule size) below about 1.1'

v. coarse to small granule size shells (30% shell frags)

clay or mud clasts

fine sand with shell frags, locally concentrated in pockets

shell hash pocket v coarse sand size to granule size

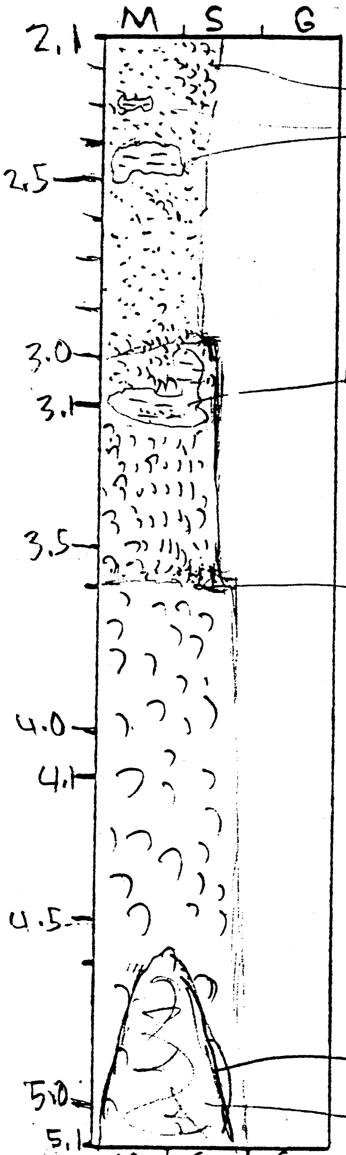
General Comments:

CORE LOG

CORE # SBV-20 (B) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
2.1		fine quartz sand with granule size shell, shell pocket; shells concentrated in pocket		
		mud clasts (olive gray)		
2.5		fine sand with increase of v. coarse to granule size shell hash near base; well sorted		yellowish gray to lt olive gray sand
3.0 – 3.1		mud or clay clast (olive gray clasts)		
		shell hash granule size; well sorted		
3.5		distinct contact between granule size shell hash above & pebble size below		
4.0 – 4.1		Relatively clean shell gravel pebble size; well sorted		Drk gray to yellowish gray depending on shell colors
4.5				
5.0		core catcher		
5.1		Rag		



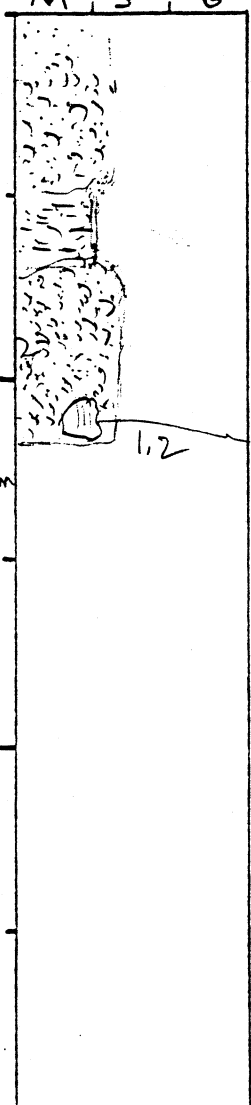
General Comments:

CORE LOG

CORE # SBV-21(A) TYPE Vibracore LOCATION Sabine Bank
LATITUDE 29° 23.800' LONGITUDE 93° 46.506' SURFACE ELEVATION -42.5'
DEPTH PENETRATED ? LENGTH RECOVERED 7'2½" % COMPACTION ?

OBTAINED BY Gibeaut - R/V Kit Jones DATE 10-14-94
DESCRIBED BY White DATE 2-22-95

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
0	M S G	fine sand, scattered granule size shell frags increasing near base to 50%		Lt Olive gray (5Y 5/2)
		shelly sand, muddy near base		
		muddy sand with scattered shells		Olive gray (5Y 3/2)
		muddy shelly sand, some whole shells, small pebble size		
1		muddy shelly sand; slight decrease in shells relative to above		Olive gray
Bottom of "A" section	1.2	Large shell		



M S G

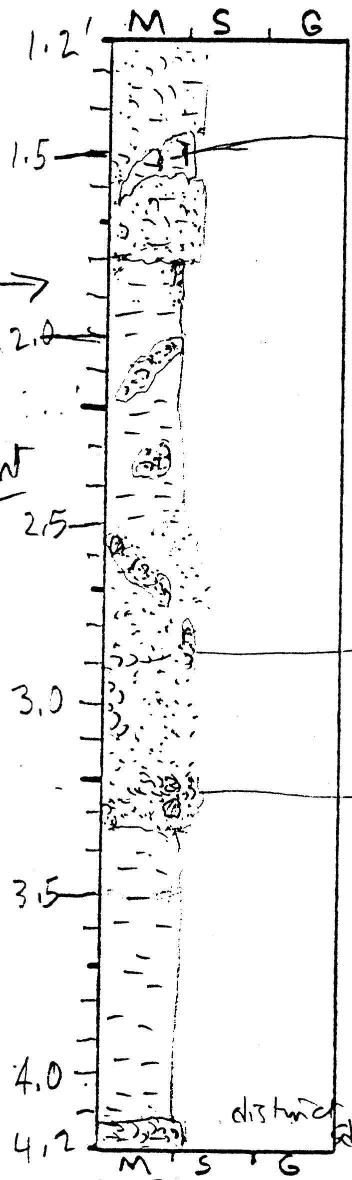
General Comments:

CORE LOG

CORE # SBV-21(B) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Hint of oxidation 2.0 → possibly top of Pleistocene [?]

1.2' – muddy shelly sand — Olive gray 5Y 3/2

organic streaks in clay
medium gray clay clast with organics

muddy shelly sand — Olive gray

clay, mottled color: medium gray mottled with Lt Olive gray and Dusky yellow (Dark gray organics disseminated)
NO shells in clay except in clayey shelly sand pockets

2.5 – increase in sand
Clayey sand
some whole shells in pockets
Lt Olive gray (5Y 6/1) with dusky yellowish oxidation hue

shell pocket

3.5 – Lt Olive gray clay with dusky yellow layer at 3.5'

Lt Olive gray to pale Olive clay no shells (5Y6/1 to 10Y 6/2)

4.0 – distinct contact
4.2 – silty clayey shell, granule size or silty shelly clay

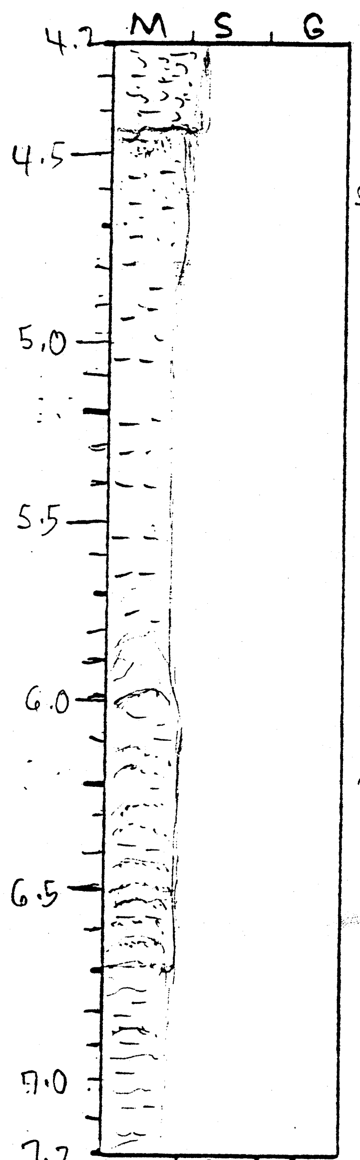
General Comments:

CORE LOG

CORE # SBV-21(C) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m) | SKETCH | LITHOLOGY | STRUCTURE | REMARKS



clayey sand, shell or sandy shelly clay
Lt Olive gray (5Y 6/1) to pale Olive
hint of yellowish gray, to Olive gray layers

slightly sandy or silty clay Lt Olive gray to pale Olive

mottled clay, yellowish gray with dusky yellow mottling

Beaumont

Lt Olive gray (Dusky yellow to dark yellowish orange)
Clay with thin Oxidized layers – distorted by coring
horizontal sand layers (v. thin)

Lt Olive gray clay with Dusky yellow to dark yellowish orange layers

General Comments:

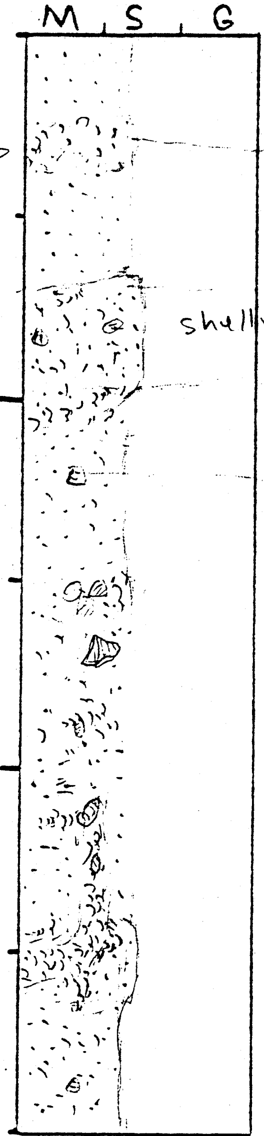
CORE LOG

CORE # SBV-22 (A) **TYPE** Vibracore **LOCATION** Sabine Bank
LATITUDE 29° 25.163 **LONGITUDE** 93° 52.618 **SURFACE ELEVATION** -31.5'
DEPTH PENETRATED ? **LENGTH RECOVERED** 19' 3½" **% COMPACTION** ?

OBTAINED BY Gibeaut - R/v Kit Jones **DATE** 10-14-94
DESCRIBED BY White **DATE** 2-17-95

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS

0 M S G



Shells →

Fine quartz sand — Olive gray 5Y 4/1
scattered whole (granule) & shell & frags
concentrated shells locally in pockets

— Dusky yellow in this area (0.2 - 1')
shelly sand (≈ 25% granule size shells, whole & frags)

1

sand, shell frags ≈ 5%
— mud clast

sand, to locally shelly sand (increase in shells in pockets)

2

mud clasts, small, scattered

shellysand (from shell filled burrow) to sandy shell — Olive Gray 5Y 4/1 to local patch of LT Olive gray

sand, scattered shell

3

M S G

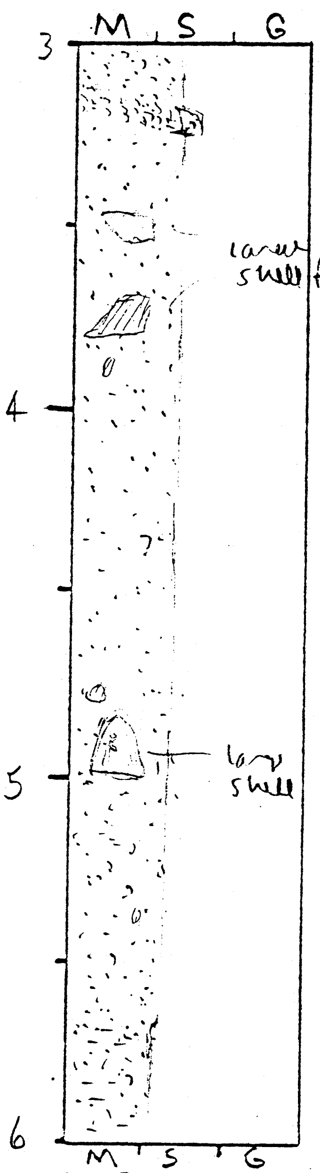
General Comments:

CORE LOG

CORE # SBV-22 (B) TYPE ________ LOCATION ________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ________ LENGTH RECOVERED ________ %COMPACTION ________

OBTAINED BY ________ DATE ________
DESCRIBED BY ________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Fine quartz sand, slightly muddy, ≈ 10% shell frags, small, sandy shell, small granule size shell hash

Olive gray
5Y 3/2

sand, slightly muddy, scattered shell frags, (< 5%)

mud appears to increase with depth

Sand,
slightly muddy
scattered shell frags ≈ 5%

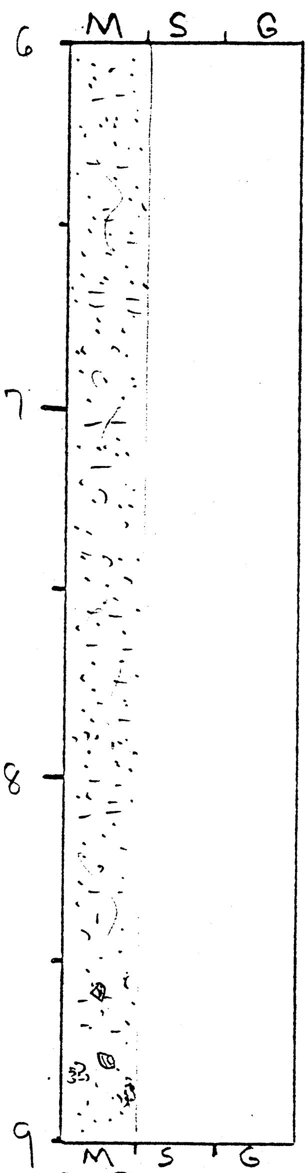
muddy sand, scattered shell frags
mud clasts

General Comments:

CORE LOG

CORE # SBV-22(C) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
		muddy sand mud clasts scattered shells, whole & frag, 5% locally 10% mostly granule in size	Burrowed	Olive gray 5Y 3/2

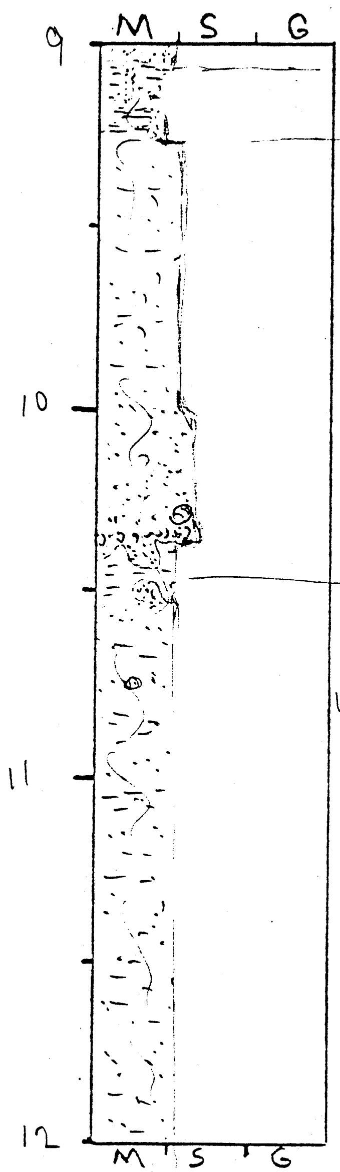
General Comments:

CORE LOG

CORE # SBV-22 (D) TYPE____ LOCATION____
LATITUDE____ LONGITUDE____ SURFACE ELEVATION____
DEPTH PENETRATED____ LENGTH RECOVERED____ %COMPACTION____

OBTAINED BY____ DATE____
DESCRIBED BY____ DATE____

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



muddy sand — Burrowed

Sandy mud, shellfrags associated with sd — Olive gray 5Y 3/2

Muddy sand scattered shell frags ≈ 5%

sand, only slightly muddy

Increase in shell frags at base of sand unit (≈ 20% shell)

mudclast Olive gray to medium gray

VSN-1 muddy sand
scattered shell frags ≈ 5%
mud clasts
burrowed

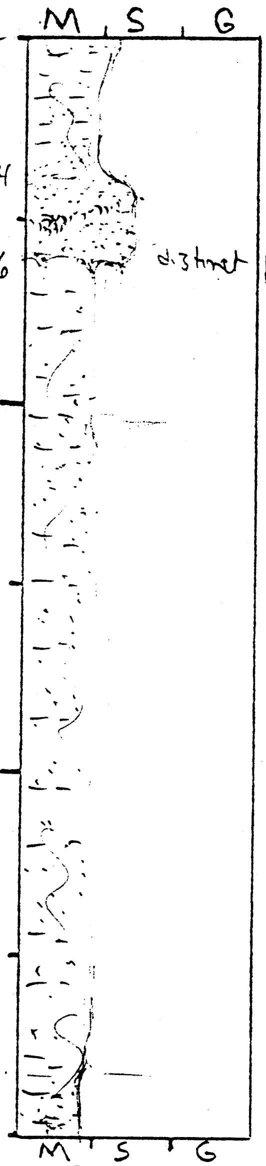
General Comments:

CORE LOG

CORE # SBV-22(E) TYPE____ LOCATION____
LATITUDE____ LONGITUDE____ SURFACE ELEVATION____
DEPTH PENETRATED____ LENGTH RECOVERED____ %COMPACTION____

OBTAINED BY____ DATE____
DESCRIBED BY____ DATE____

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
12	M S G	v muddy sand		
		sandy mud	Intensely burrowed	Olive grey 5Y 3/2
12.4		sand, with thin shell hash lens (pocket)		
12.6	distinct	but burrowed contact		
		Sandy mud to very muddy sand		
13		scattered small shell frags associated with sand		Intensely Burrowed
		Muddy sand to sandy mud		
14				
15	M S G	Sandy mud to muddy sand		



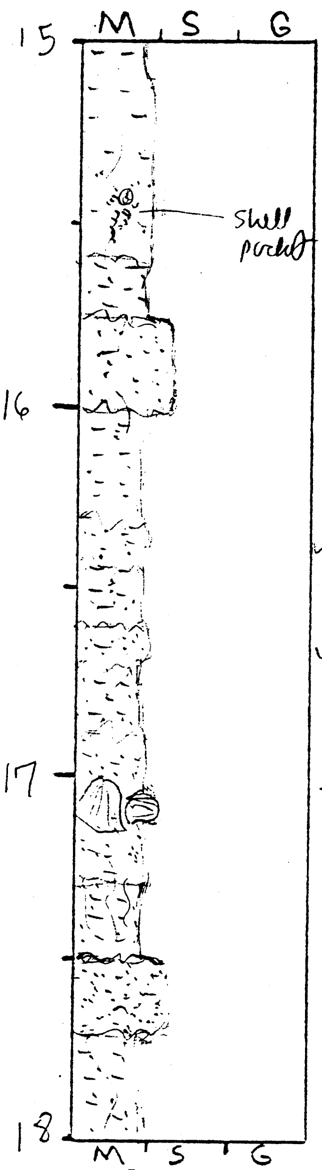
General Comments:

CORE LOG

CORE # SBV-22(F) TYPE ________ LOCATION ____________________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ____

OBTAINED BY ______________________________ DATE ________
DESCRIBED BY ______________________________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



sandy mud to muddy sand

muddy sand

sandy mud

sand, slightly muddy

sandy mud

v. muddy sand

sandy mud

v. muddy sand

sandy mud

2 large shells v muddy sand with shells

sandy mud

sand slightly muddy

sandy mud

Structure: Intensely burrowed; Discrete mud & sand zone

Remarks: Olive gray 5Y 3/2 to Olive gray 5Y 4/1

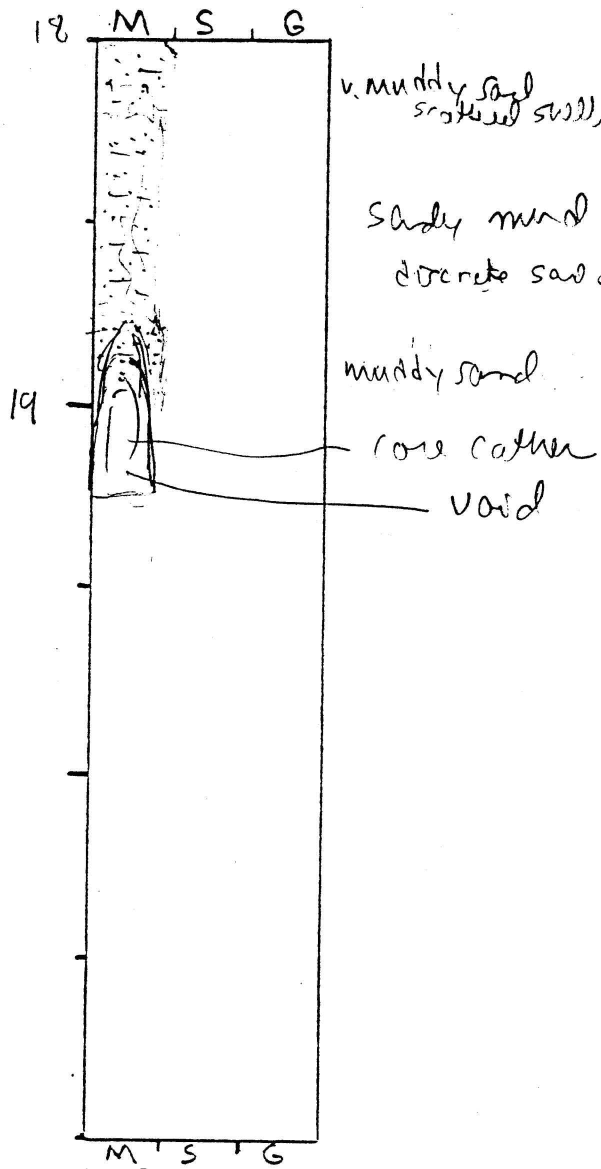
General Comments:

CORE LOG

CORE # BBV-22(G) TYPE ____ LOCATION ____
LATITUDE ____ LONGITUDE ____ SURFACE ELEVATION ____
DEPTH PENETRATED ____ LENGTH RECOVERED ____ %COMPACTION ____

OBTAINED BY ____ DATE ____
DESCRIBED BY ____ DATE ____

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
18		v. muddy sand; scattered shells (3%)	Intensely burrowed	mostly Olive Gray 5Y 3/2
		Sandy mud; discrete sand & mud areas		
19		muddy sand		
		core catcher		
		void		



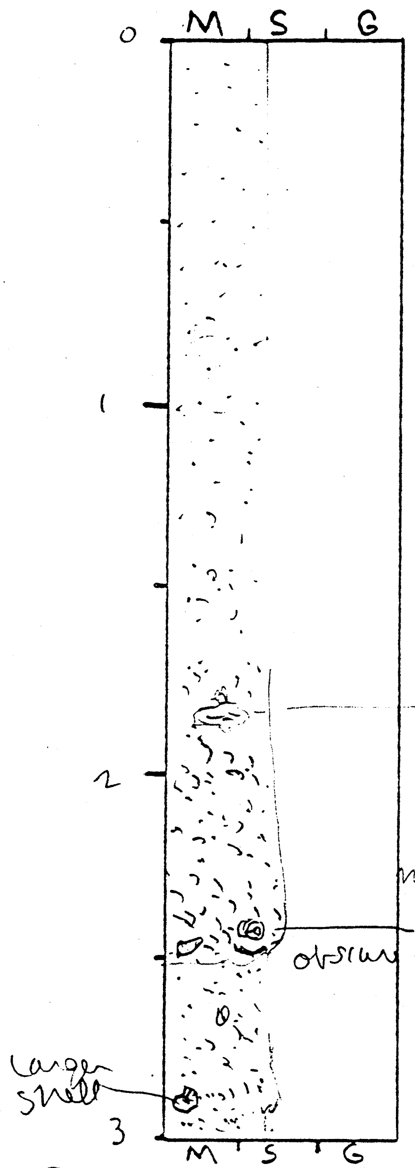
General Comments:

CORE LOG

CORE # SBV-23(A) TYPE Vibracore LOCATION Sabine Bank
LATITUDE 29° 24.610 LONGITUDE 93° 54.621 SURFACE ELEVATION -32'
DEPTH PENETRATED ? LENGTH RECOVERED 12' 11 1/2" % COMPACTION ?

OBTAINED BY Gibeaut - R/V Kit Jones DATE 10-14-94
DESCRIBED BY Dante DATE

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Fine Quartz sand, scattered small (v crse sd size) shell frags — yellowish gray

Fining upward sequence

Lt Olive gray to 5Y 5/2 to Olive gray 5Y4/1

shell frags increase with depth

mud clast (Olive gray)

shelly sand, shell frags ≈ 30% to locally 50% most granule in size, some pebble size

whole gastropod > 0.1' long -- perfectly preserved

sand -- mixture of fine quartz to v crse shell frags. 20% shell frags

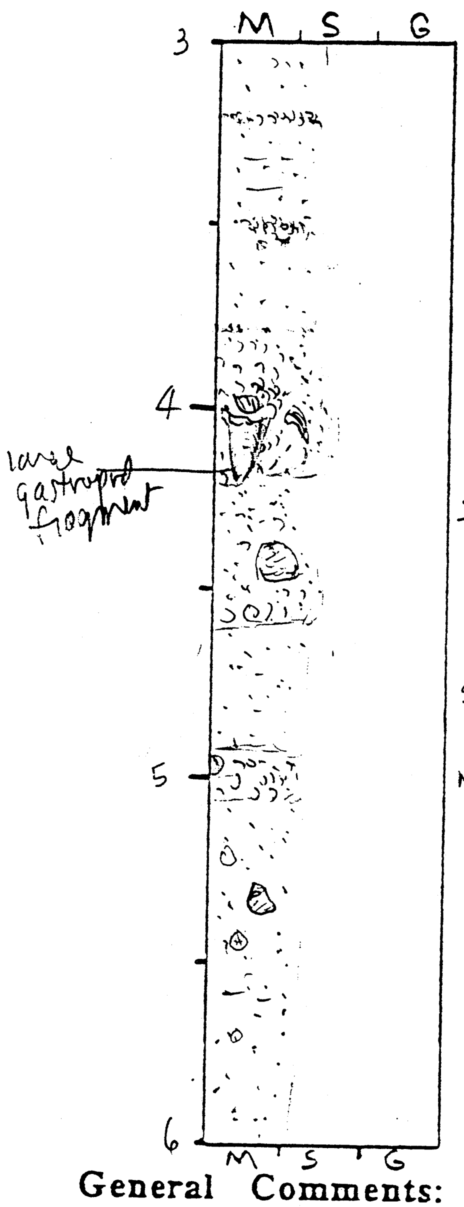
General Comments:

CORE LOG

CORE # SBV-23 (B) TYPE______ LOCATION______
LATITUDE______ LONGITUDE______ SURFACE ELEVATION______
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION______

OBTAINED BY______ DATE______
DESCRIBED BY______ DATE______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



fine sand scattered v. crse & granule size shell frags -- concentrated locally

yellowish gray to Lt Olive gray sand

slightly muddy sand Olive gray 5Y 3/2

slightly muddy shelly sand

Sand

Shelly sd

slightly muddy sand

muddy shelly sd

mud increasing with depth

muddy sand
small mud clasts
scattered shells (< 5%)

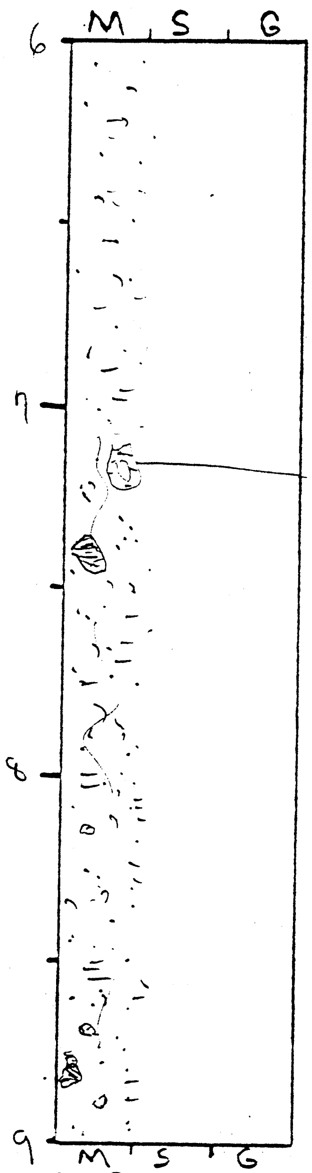
Olive gray
5Y 3/2

General Comments:

CORE LOG

CORE # SBV-23(c) TYPE ____ LOCATION ____
LATITUDE ____ LONGITUDE ____ SURFACE ELEVATION ____
DEPTH PENETRATED ____ LENGTH RECOVERED ____ %COMPACTION ____

OBTAINED BY ____ DATE ____
DESCRIBED BY ____ DATE ____

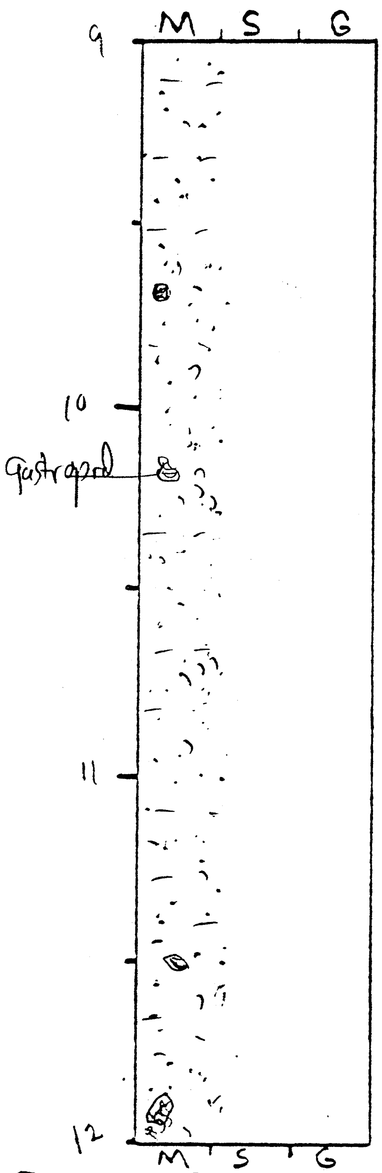
DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
6–9		muddy sand scattered shells & frags ≥10% shell frags mud clast discrete mud clasts mud appears to be increasing with depth		Olive gray 5Y 3/2

General Comments:

CORE LOG

CORE #SBV-23(D) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
9–12		muddy sand scattered small shells & frags granule to small pebbles < 10% probably burrowed discrete clay clasts		Olive gray 5Y 3/2

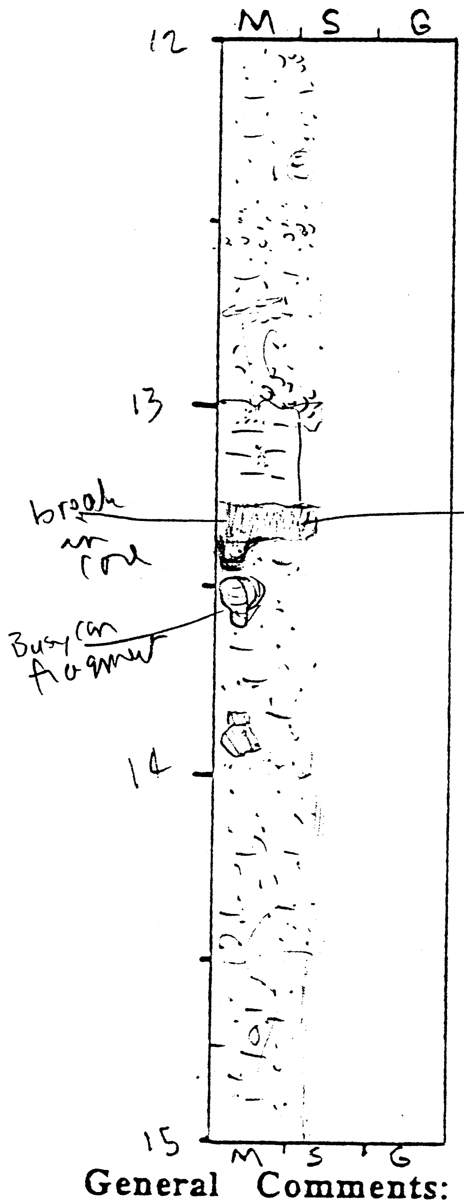
General Comments:

CORE LOG

CORE # SBV-23(E) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



muddy sand — Olive grey 5Y 3/2
scattered shell frags
granules burrow
increase in pockets
discrete clay clasts
Burrowed

Clay or mud (sand or silt locally) Olive grey to med. gray
void space (0.1' wide)
muddy sand

slightly muddy sand

Burrowed
muddy sand

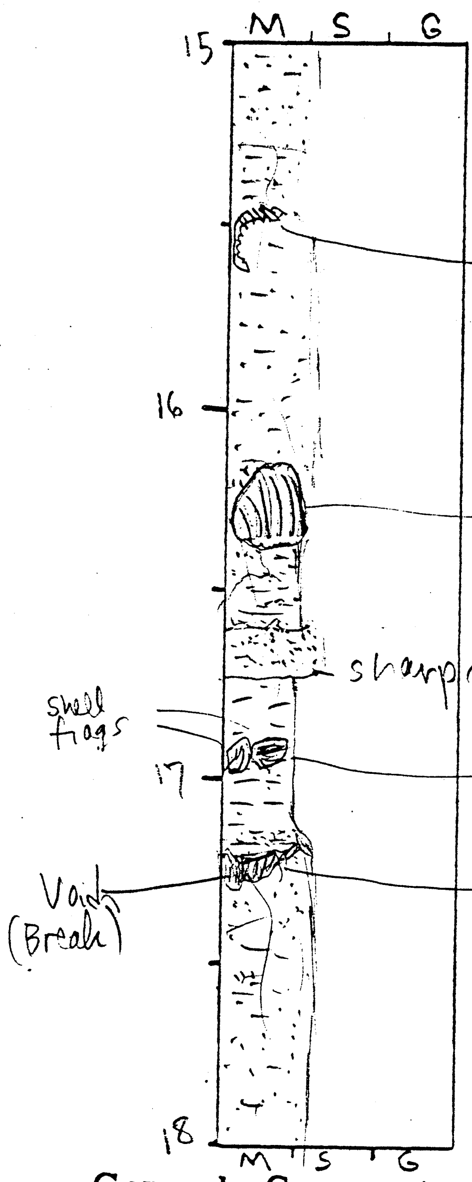
General Comments:

CORE LOG

CORE # SBV-73(F) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



muddy sand (few v. small shell frags) — Olive gray 5Y 3/2

Burrowed

sandy mud

Large Dinocardium? shell frag

muddy sand

large Dinocardium shell frag may have been displaced

sandy mud — burrowed

sand

sharp contact

mud

shell frags in mud may have been moved during splitting

* [This may be the area from which the shell fragments above at 16.25 & 16.9' came]

muddy sand

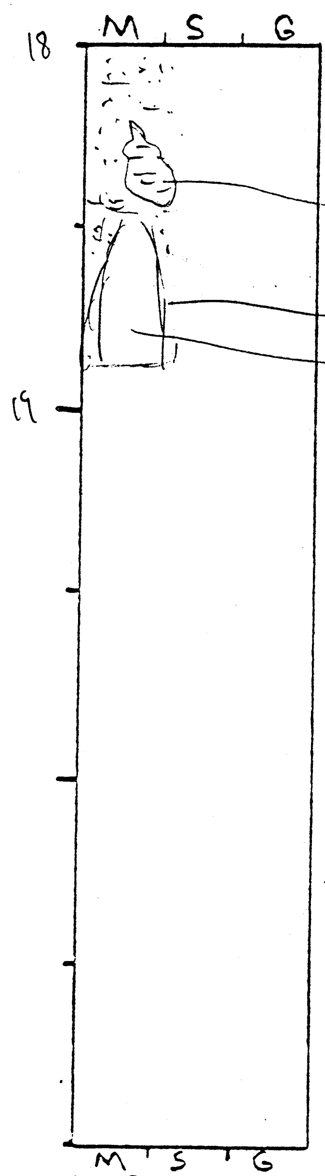
General Comments:

CORE LOG

CORE # SBV-23(G) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
18		muddy sand	burrowed	Olive gray 5Y 3/2
19				



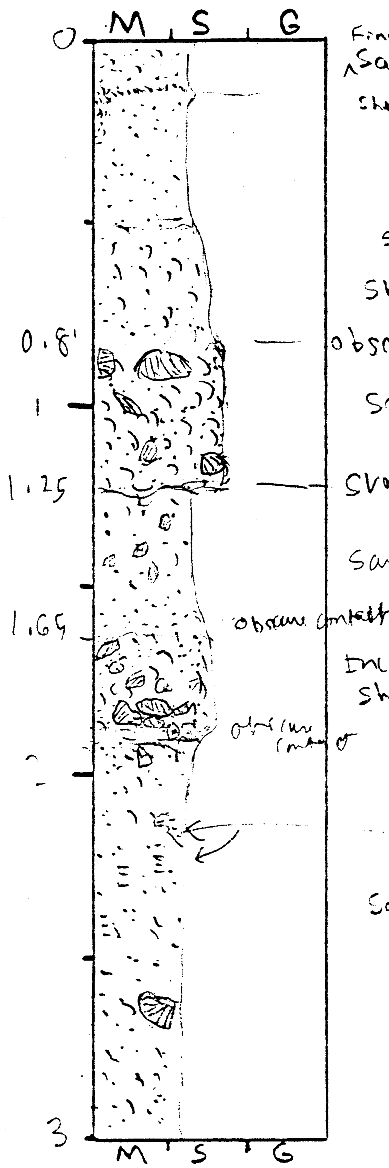
General Comments:

CORE LOG

CORE # SBV-24(A) TYPE Vibracore LOCATION Sabine Bank
LATITUDE 29° 23.378' LONGITUDE 93° 58.237' SURFACE ELEVATION -35'
DEPTH PENETRATED ? LENGTH RECOVERED 20' %COMPACTION ?

OBTAINED BY Gibeaut - R/V Kit Jones DATE 10-14-94
DESCRIBED BY White DATE

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Fine to v fine Sand 95% quartz 5% shell frags (v. coarse snd size)

Olive grey 5Y 4/1

Shell frags granule in size

Shells (whole & fragments increase below 0.5')

Shelly sand

obscure contact

Sandy shell (granule to pebble size shell)

Sharp contact

Sand scattered shells (whole & frags) 5-10% shell

Increase in shells (whole & frags) granule to pebble size

Shelly sand

mud clasts

Sand, slightly muddy ≈ 5% shell fragments (most small granule size)

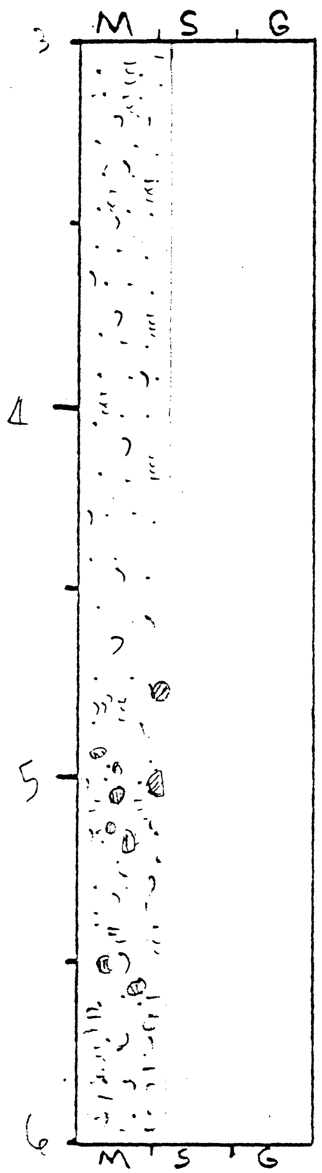
General Comments:

CORE LOG

CORE # SBY-24(B) TYPE_____ LOCATION_____
LATITUDE_____ LONGITUDE_____ SURFACE ELEVATION_____
DEPTH PENETRATED_____ LENGTH RECOVERED_____ %COMPACTION_____

OBTAINED BY_____ DATE_____
DESCRIBED BY_____ DATE_____

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Sand, slightly muddy (small scattered mud clasts) Olive gray 5Y 4/1 to 5Y 3/1
scattered shell, whole & frags, mostly granule in size

≈ 10 % shell fragments

Appears to be slight increase of mud with depth.

Much of this section could probably be called Muddy Sand

scattered mud clasts

Shells more abundant in this section ≈ 20%

Mud more abundant than above

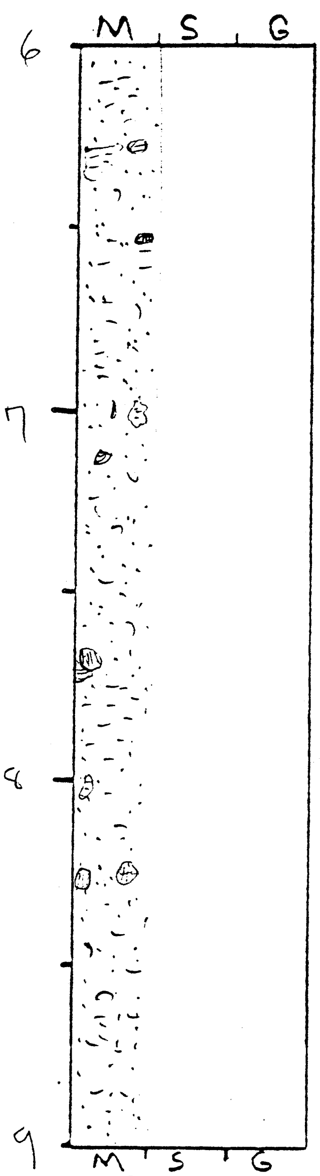
General Comments:

CORE LOG

CORE # SBV-24(C) TYPE ________ LOCATION ________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ________ LENGTH RECOVERED ________ %COMPACTION ________

OBTAINED BY ________ DATE ________
DESCRIBED BY ________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



muddy sand (mud clasts larger than in above section)

Olive gray 5Y 3/2

scattered shell frags and whole shell, granule to small pebble in size ≈ 10-15%

discrete mud clasts

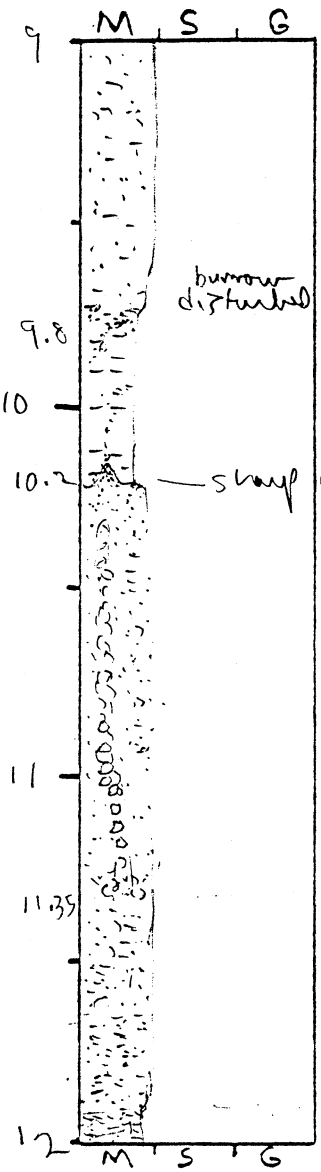
General Comments:

CORE LOG

CORE # SBV-24(D) TYPE ________ LOCATION ________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ________ LENGTH RECOVERED ________ %COMPACTION ________

OBTAINED BY ________ DATE ________
DESCRIBED BY ________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



(5Y 3/2) Olive gray to med drk gray

muddy sand, scattered small shell frags <5%, discreet mud clasts

burrow disturbed contact

Clay or mud, sand in pockets, only one shell frag.

Clay medium gray to medium Lt gray

— sharp contact

muddy shelly sand, Numerous whole mulinia shells < 1cm in size apparently in burrow extending from about 10.3' to 11.35

shelly component [illegible]

muddy Sand
mud more abundant than above in this section, v. few shells frag
muddy sand to sandy mud

Olive Gray 5Y 3/2 to med drk gray

General Comments:

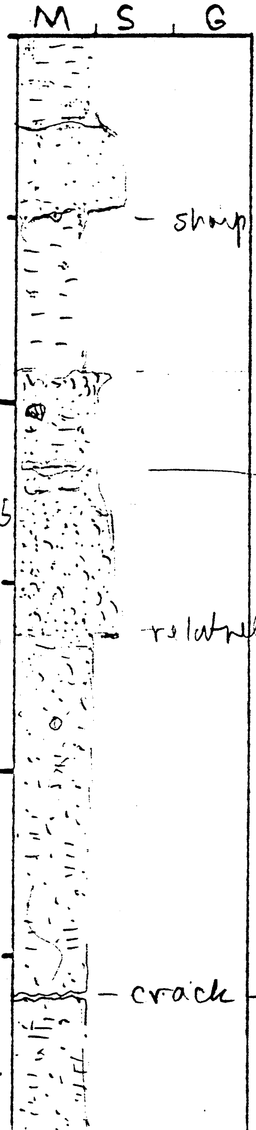
CORE LOG

CORE # SBV-24(E) TYPE ________ LOCATION ________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ________ LENGTH RECOVERED ________ %COMPACTION ________

OBTAINED BY ________ DATE ________
DESCRIBED BY ________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS

M S G



12 — sandy mud or clay, no shell, — med gray to med Lt gra

sand, few scattered shell frags. (≈1%) — Olive gray sd (5Y4/1)

— sharp lithologic contact although burrowed

clay or mud (very homogeneous), sand in small burrows only — med to med Lt gray clay

sandy shell horizon, small shell frags, granule

13 — muddy sand

— mud clasts, v. few shell frags (<1%)

13.35

sand, shell frags 10-20% — Olive gr sand (5Y 4/1)

13.7 — relatively sharp contact

14

Muddy sand, very scattered shell frags
abundant mud clasts burrowed

— crack in core

Olive gray 5Y 3/2 to med drk gray

15

M S G

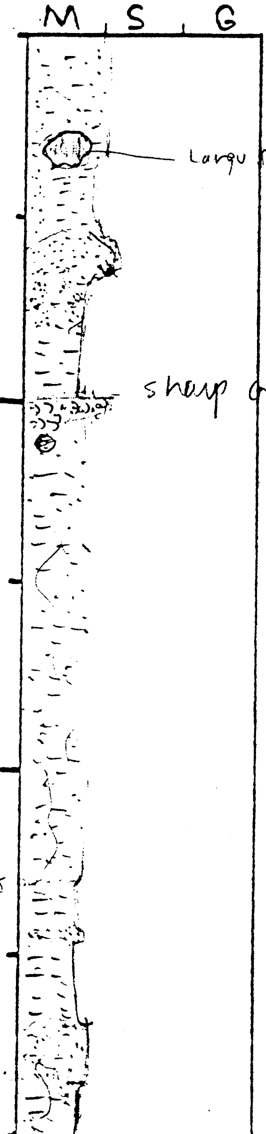
General Comments:

CORE LOG

CORE # SBV-24(F) TYPE____ LOCATION____
LATITUDE____ LONGITUDE____ SURFACE ELEVATION____
DEPTH PENETRATED____ LENGTH RECOVERED____ %COMPACTION____

OBTAINED BY____ DATE____
DESCRIBED BY____ DATE____

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
15	M S G	v muddy sand		
	Large shell frag (4cm across)	sandy mud	burrowed	Color mottled Olive gray 5Y 4/1
		sand (distorted margins by coring)		
		sandy mud (mud becomes more pure near base)		
16	sharp contact	muddy shelly sand or muddy sandy shell		
		Primarily muddy sand, but sandy mud in places & scattered shell frags; mud very abundant in places	Intensely burrowed	
17				
17.35		sandy mud		
		muddy sand		
		sandy mud (no shell frags)		
		muddy sand		
18	M S G	sandy mud (no shell frags) to mud at base		



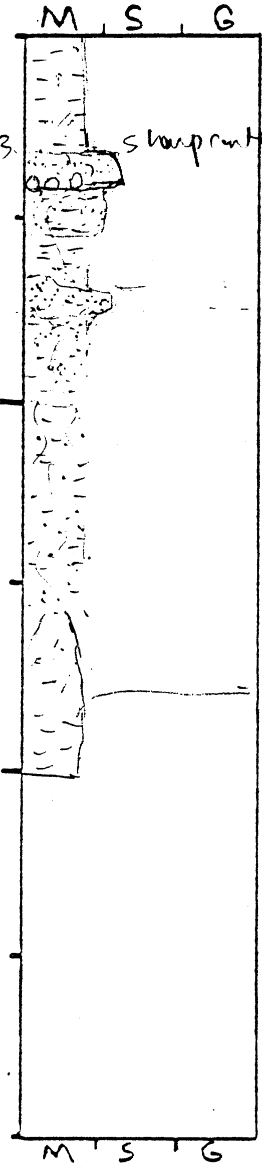
General Comments:

CORE LOG

CORE # SBV-24(G) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
18		mud or clay	small isolated sand filled burrow	
18.3	sharp contact	sand, slightly muddy, shells whole & frag	burrowed	Olive gray (5Y 4/1)
		muddy sand		
		sandy mud		
		sand, slightly muddy		Olive gray with some yellowish gray sd.
		sandy mud		
19		muddy sand to sandy mud; discrete mud & sand areas	Intensely burrowed	Olive gray (5Y 4/1)
		core catcher		
		sandy mud		
20				



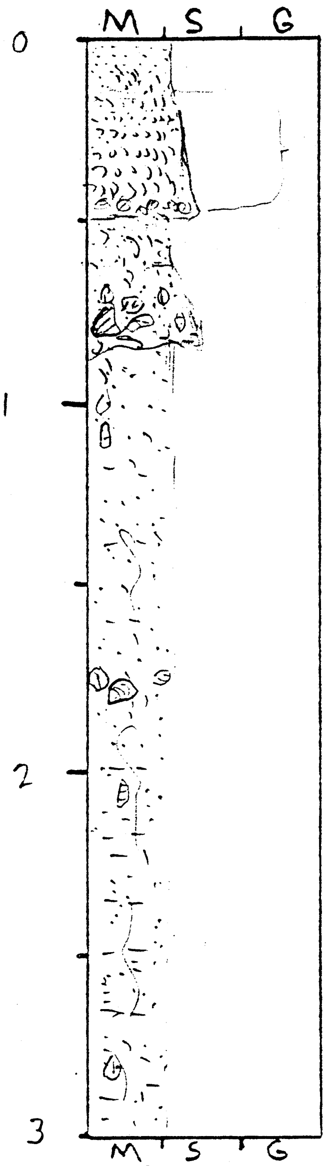
General Comments:

CORE LOG

CORE # SBV-25(A) **TYPE** Vibrocore **LOCATION** Sabine Bank
LATITUDE 29° 20.895 **LONGITUDE** 94° 03.237 **SURFACE ELEVATION** - 38.5'
DEPTH PENETRATED ? **LENGTH RECOVERED** 18' 11 3/4" **% COMPACTION** ?

OBTAINED BY Gibeaut - R/V Kit Jones **DATE** 10-14-94
DESCRIBED BY White **DATE**

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



Fine quartz sand grading down into coarser shell hash — Olive gray sand (5Y 4/1)

Drk gray, includes whole shells
Shell hash; fining upward; granule to v. coarse sand size

shelly sand — Lt olive gray (5Y 4/1)

sandy shell — Olive gray (5Y 4/1)

muddy sand, scattered small shell frags
occasional whole shell
mud increasing with depth

Burrowed

discrete small mud clasts
2'-3 ft.

Olive gray
(5Y 3/2)

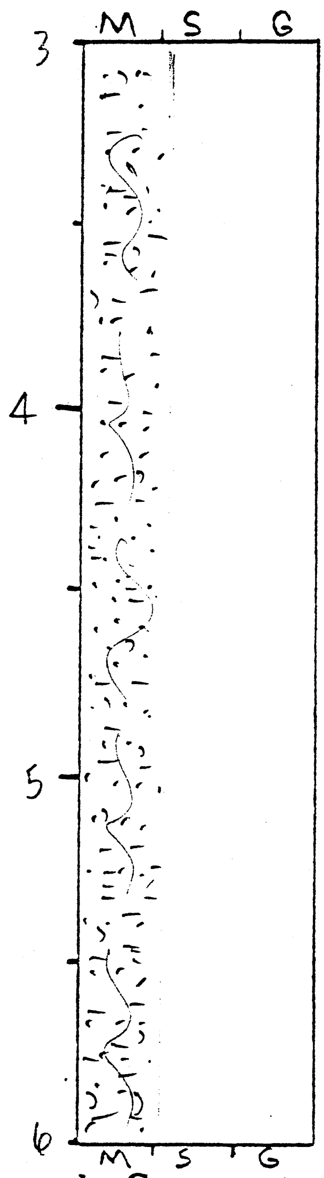
General Comments:

CORE LOG

CORE # SBV-25(B) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
		muddy sand scattered shells granule in size (5-10%) muddier than previous section (above) Discrete clay or mud	intensely burrowed	olive grey (5Y 3/2

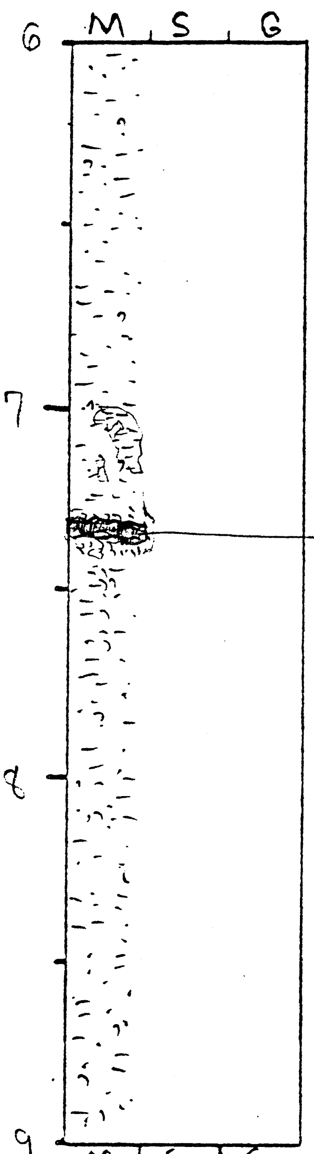


General Comments:

CORE LOG

CORE # SBY-25 (C) TYPE______ LOCATION______
LATITUDE______ LONGITUDE______ SURFACE ELEVATION______
DEPTH PENETRATED______ LENGTH RECOVERED______ %COMPACTION______

OBTAINED BY______ DATE______
DESCRIBED BY______ DATE______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
		V. muddy sand scattered small shell frags < 5% Discrete mud clast break in core (void) shelly muddy sand	Intensely burrowed	Olive gray (5Y 3/2)

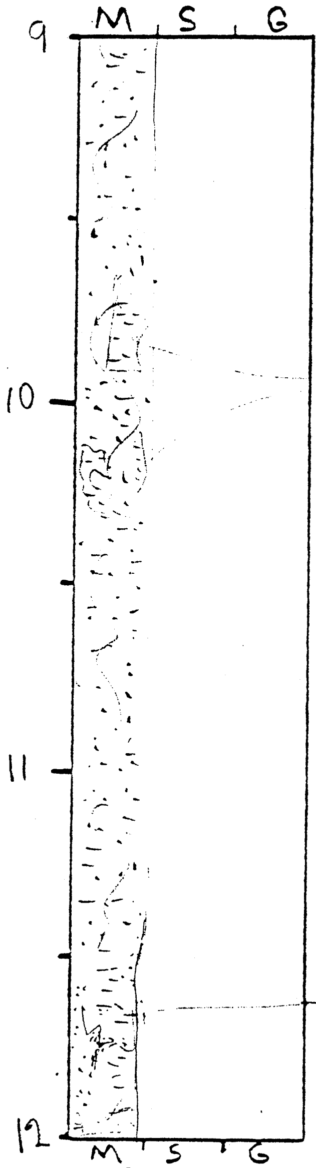
General Comments:

CORE LOG

CORE # SRY-25 (D) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
9		V. muddy sand to locally sandy mud; scattered small shell frags < 5%	± intensely burrowed	Olive gray (5Y 3/2)
		discrete mud clast		
10				
11				
		mud clast; approaching sandy mud in composition		
12				

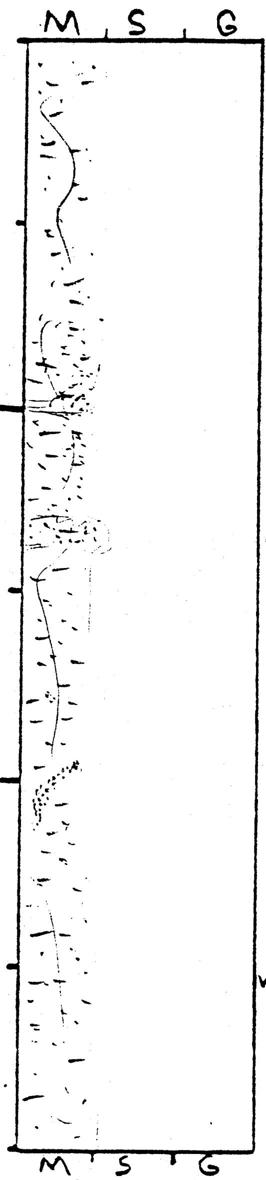


General Comments:

CORE LOG

CORE # SBV-25(E) TYPE ________ LOCATION ________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ____

OBTAINED BY ________________________ DATE ________
DESCRIBED BY ________________________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
12		v muddy sand	Intensely burrowed	Olive gray (5Y 3/2)
13		sand mud		
		muddy sand	discrete mud & sand	
		sandy mud		
14				
		v muddy sand to sandy mud		Olive gray (5Y 3/2)
15				

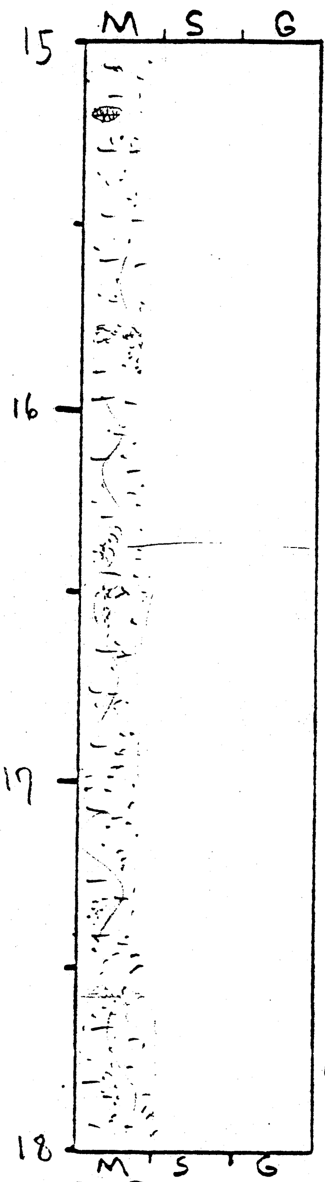
General Comments:

CORE LOG

CORE # SBV-25(E) TYPE ______ LOCATION ______
LATITUDE ______ LONGITUDE ______ SURFACE ELEVATION ______
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ______

OBTAINED BY ______ DATE ______
DESCRIBED BY ______ DATE ______

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS



v muddy sand to sandy mud — intensely burrowed — Olive gray (5Y 3/2)

scattered shell frags < 1% except for local pockets

shell pocket (small shell frags 10% v coarse to granule)

Intensely burrowed

sandy mud (mud appears dominant in this area)

muddy sand

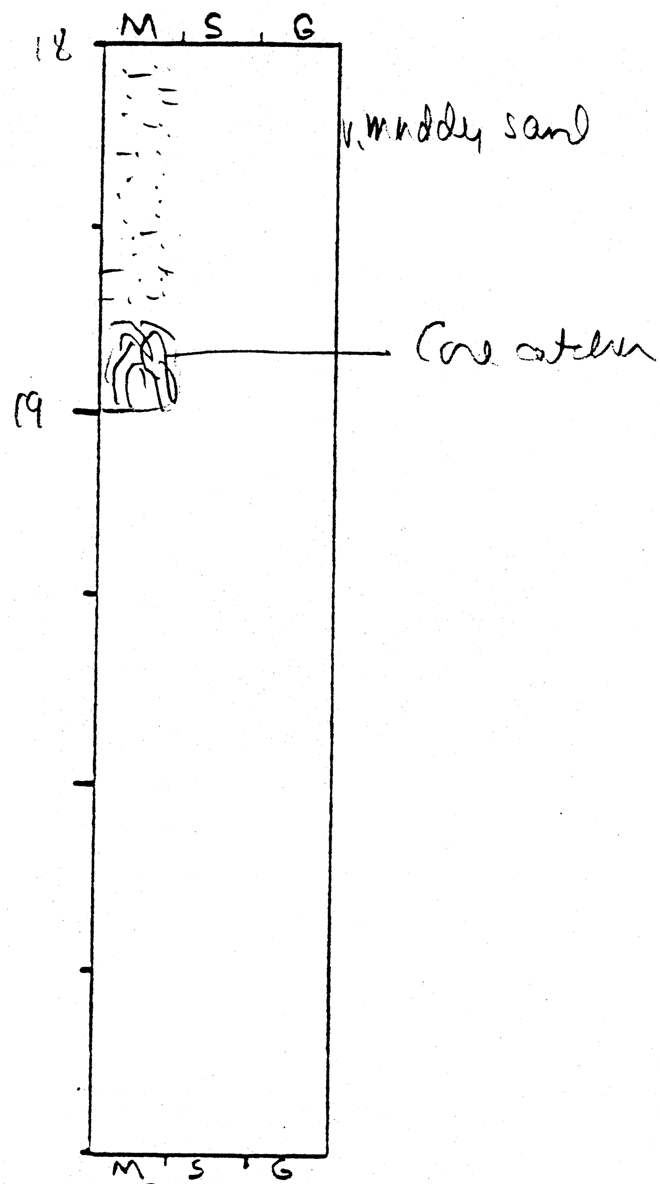
General Comments:

CORE LOG

CORE # SBV-75(G) TYPE ________ LOCATION ________
LATITUDE ________ LONGITUDE ________ SURFACE ELEVATION ________
DEPTH PENETRATED ______ LENGTH RECOVERED ______ %COMPACTION ____

OBTAINED BY ________________________ DATE ________
DESCRIBED BY ________________________ DATE ________

DEPTH (ft, m)	SKETCH	LITHOLOGY	STRUCTURE	REMARKS
18		v. muddy sand		Olive gray (5Y 3/2)
	Core catcher			
19				



General Comments:

APPENDIX D. SEDIMENT TEXTURES

Gravel, Sand, Mud

Hydrometer Analyses

Sieve Analyses

Cumulative Curves (Sieve Analyses)

Gravel, Sand, Mud Analyses
Heald Bank and Sabine Bank samples

Sample ID	Gravel %	Sand %	Mud %
HBV-1-1.5	0.6	99.3	0.1
HBV-1-5.5	20.3	79.5	0.2
HBV-1-8.0	38.6	61.1	0.3
HBV-2-1.5	0.0	81.4	19.0
HBV-2-4.5	0.0	34.2	66.0
HBV-2-7.5	0.0	12.4	87.0
HBV-2-10.2	0.0	6.3	94.0
HBV-3-1.8	6.1	91.5	2.4
HBV-3-2.6	0.0	71.5	28.0
HBV-3-4.5	0.0	73.8	26.0
HBV-3-6.5	0.0	76.8	23.0
HBV-3-12.75	0.0	73.7	26.0
HBV-4-1.0	1.1	94.1	4.8
HBV-4-5.0	9.2	79.6	11.2
HBV-4-6.5	0.0	18.4	82.0
HBV-5-2.0	2.6	97.2	0.2
HBV-5-5.75	9.7	90.0	0.3
HBV-5-14.75	5.0	89.9	5.1
HBV-5-19.1	3.4	91.0	5.6
HBV-6-1.0	3.2	96.4	0.4
HBV-6-4.5	6.1	93.6	0.3
HBV-6-9.8	19.4	80.3	0.3
HBV-7-2.5	20.5	79.3	0.2
HBV-7-6.25	0.0	24.4	76.0
HBV-7-9.3	0.0	14.6	86.0
SBV-10-0.7	0.0	67.6	16.0
SBV-10-3.2	0.0	54.2	46.0
SBV-10-7.0	0.0	24.7	76.0
SBV-10-11.2	0.0	6.1	94.0
SBV-11-0.25	0.0	67.3	32.0
SBV-11-4.5	0.0	44.1	56.0
SBV-12-1.0	2.4	97.5	0.1
SBV-12-4.5	36.7	63.2	0.1
SBV-12-7.0	1.7	97.7	0.6
SBV-12-11.0	0.0	76.1	24.0
SBV-13-0.4	16.1	79.8	4.1
SBV-13-0.75	0.0	66.2	34.0
SBV-13-5.5	0.0	60.1	40.0
SBV-13-14	0.0	68.4	32.0
SBV-14-1.5	24.5	72.8	2.7
SBV-14-4.2	8.5	75.9	15.6
SBV-14-8.6	0.0	44.5	56.0
SBV-15-0.5	0.0	67.7	33.0

SBV-15-0.95	0.0	67.7	33.0
SBV-16-0.2	3.3	95.4	1.3
SBV-16-2.5	69.2	30.4	0.4
SBV-16-4.5	0.0	78.4	21.0
SBV-17-1.0	4.9	94.9	0.2
SBV-17-5.8	15.4	84.4	0.2
SBV-17-9.2	21.5	78.3	0.2
SBV-17-14.0	5.7	94.1	0.2
SBV-18-0.5	4.2	95.4	0.4
SBV-18-5.7	12.5	82.5	5.0
SBV-18-8.25	18.5	74.9	6.6
SBV-19-0.8	0.0	20.0	80.0
SBV-19-2.8	7.1	88.2	4.7
SBV-19-5.5	0.0	67.7	33.0
SBV-19-8.5	0.0	52.6	48.0
SBV-20-0.5	0.2	99.5	0.3
SBV-20-2.7	0.6	99.3	0.1
SBV-20-4.1	84.0	15.7	0.3
SBV-21-1.0	26.9	64.3	8.8
SBV-22-2.0	10.6	88.0	1.4
SBV-22-5.75	5.2	89.8	5.0
SBV-22-10.95	9.6	69.2	21.2
SBV-22-13.5	3.0	71.8	25.5
SBV-23-0.5	1.9	93.0	5.1
SBV-23-5.5	5.3	88.0	6.7
SBV-23-12.4	6.9	73.4	19.7
SBV-23-17.8	0.0	49.0	51.0
SBV-24-2.2	3.0	91.5	5.5
SBV-24-5.6	5.3	82.7	12.0
SBV-24-7.0	6.5	80.6	12.9
SBV-24-16.5	0.0	40.9	59.0
SBV-25-0.4	56.4	42.9	0.7
SBV-25-1.5	7.8	86.6	5.6
SBV-25-11.2	3.7	63.5	32.8

Hydrometer Analyses
Heald Bank and Sabine Bank samples

Lab #	Sample ID	Sand %	Silt %	Clay %
1	HBV-1-1.5	sieve		
2	HBV-1-5.5	sieve		
3	HBV-1-8.0	sieve		
4	HBV-2-1.5	81	8	11
5	HBV-2-4.5	34	40	26
6	HBV-2-7.5	12	60	27
7	HBV-2-10.2	6	28	66
8	HBV-3-1.8	sieve		
9	HBV-3-2.6	72	7	21
10	HBV-3-4.5	74	6	20
11	HBV-3-6.5	77	6	17
12	HBV-3-12.75	74	9	17
13	HBV-4-1.0	sieve		
14	HBV-4-5.0	sieve		
15	HBV-4-6.5	18	32	50
16	HBV-5-2.0	sieve		
17	HBV-5-5.75	sieve		
18	HBV-5-14.75	sieve		
19	HBV-5-19.1	sieve		
20	HBV-6-1.0	sieve		
21	HBV-6-4.5	sieve		
22	HBV-6-9.8	sieve		
23	HBV-7-2.5	sieve		
24	HBV-7-6.25	24	36	40
25	HBV-7-9.3	15	44	42
26	SBV-12-1.0	sieve		
27	SBV-12-4.5	sieve		
28	SBV-12-7.0	sieve		
29	SBV-12-11.0	76	12	12
30	SBV-11-0.25	67	16	16
31	SBV-11-4.5	44	29	27
32	SBV-10-0.7	68	16	16
33	SBV-10-3.2	54	26	20
34	SBV-10-7.0	25	42	34
35	SBV-10-11.2	6	28	66
36	SBV-13-0.4	sieve		

37	SBV-13-0.75	66	17	17
38	SBV-13-5.5	60	21	19
39	SBV-13-14	68	16	16
40	SBV-14-1.5	sieve		
41	SBV-14-4.2	sieve		
42	SBV-14-8.6	44	36	20
43	SBV-15-0.5	68	16	17
44	SBV-15-0.95	68	16	17
45	SBV-16-0.2	sieve		
46	SBV-16-2.5	sieve		
47	SBV-16-4.5	78	9	12
48	SBV-17-1.0	sieve		
49	SBV-17-5.8	sieve		
50	SBV-17-9.2	sieve		
51	SBV-17-14.0	sieve		
52	SBV-18-0.5	sieve		
53	SBV-18-5.7	sieve		
54	SBV-18-8.25	sieve		
55	SBV-19-0.8	20	42	38
56	SBV-19-2.8	sieve		
57	SBV-19-5.5	68	20	13
58	SBV-19-8.5	53	29	19
59	SBV-20-0.5	sieve		
60	SBV-20-2.7	sieve		
61	SBV-20-4.1	sieve		
62	SBV-21-1.0	sieve		
63	SBV-22-2.0	sieve		
64	SBV-22-5.75	sieve		
65	SBV-22-10.95	sieve		
66	SBV-22-13.5	sieve		
67	SBV-23-0.5	sieve		
68	SBV-23-5.5	sieve		
69	SBV-23-12.4	sieve		
70	SBV-23-17.8	49	34	17
71	SBV-24-2.2	sieve		
72	SBV-24-5.6	sieve		
73	SBV-24-7.0	sieve		
74	SBV-24-16.5	41	40	19
75	SBV-25-0.4	sieve		
76	SBV-25-1.5	sieve		
77	SBV-25-11.2	sieve		

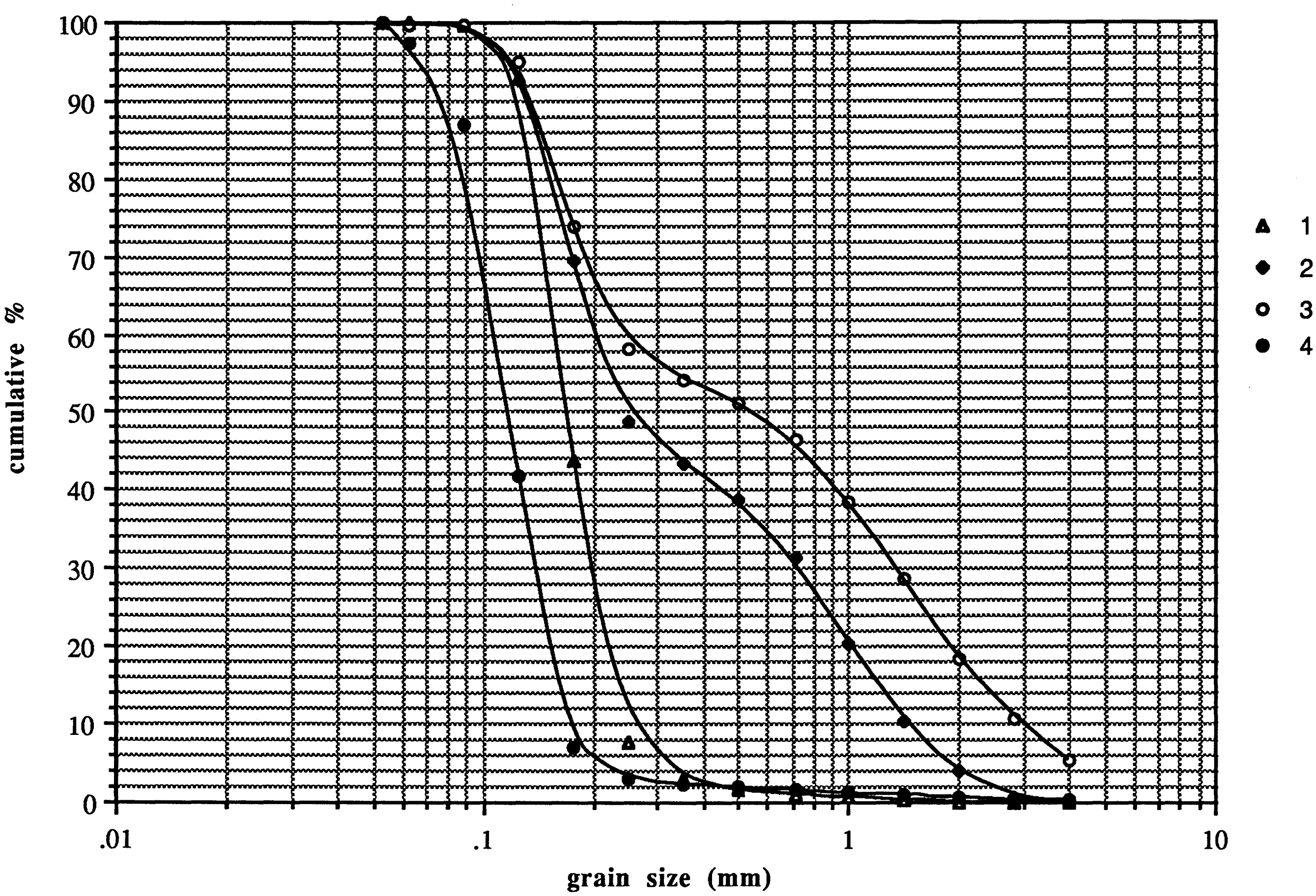
Sieve Analyses

Heald Bank and Sabine Bank samples

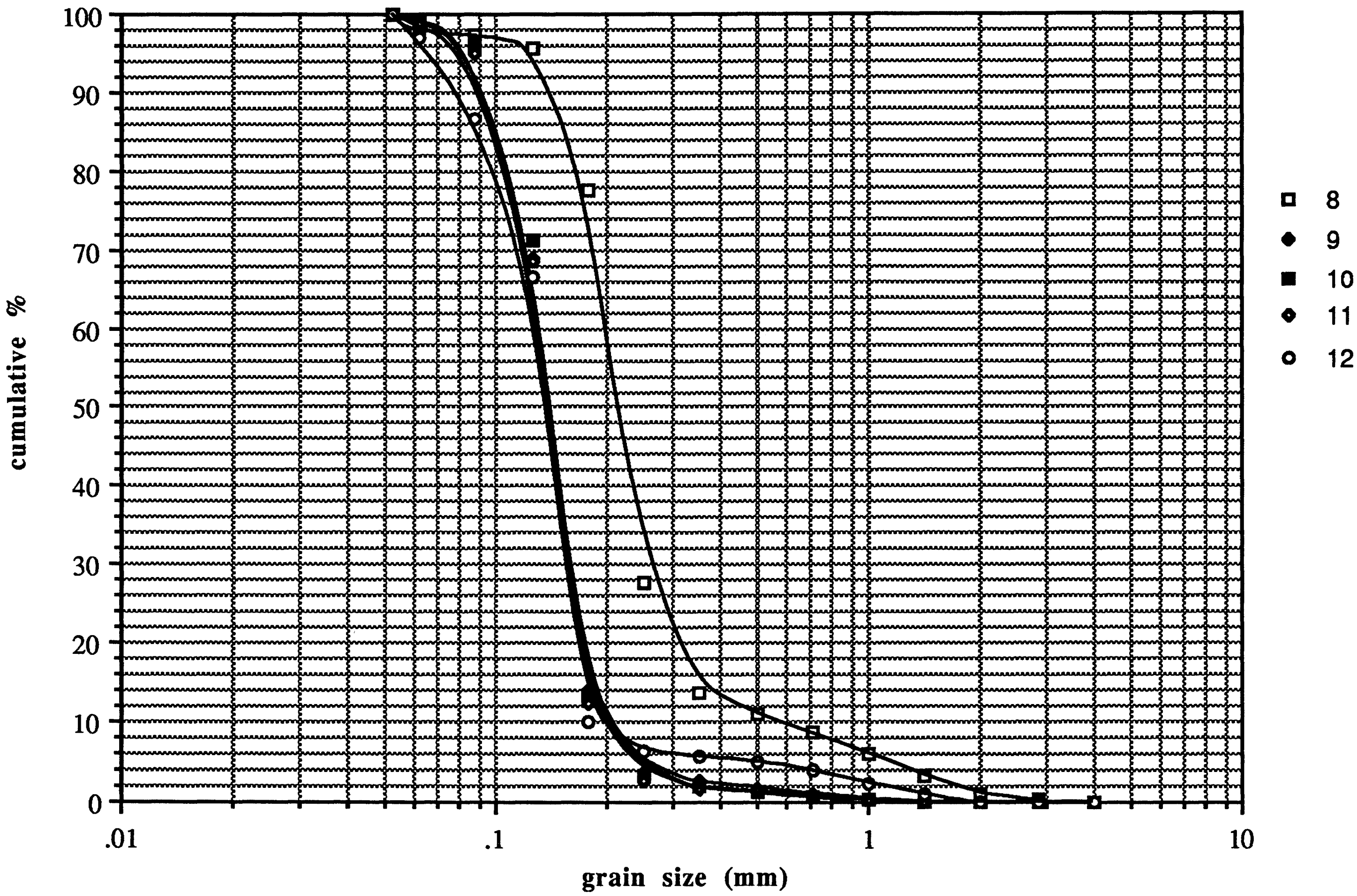
Lab	Sample	cumulative %'s -2.0ø	-1.5ø	-1.0ø	-0.5ø	0ø	0.5ø	1.0ø	1.5ø	2.0ø	2.5ø	3ø	3.5ø	4.0ø	pan
#	ID	%	%	%	%	%	%	%	%	%	%	%	%	%	%
1	HBV-1-1.5	0.0	0.0	0.1	0.4	0.6	1.0	1.7	2.9	7.7	43.9	93.0	99.7	99.9	100.0
2	HBV-1-5.5	0.0	0.8	4.0	10.5	20.3	31.3	38.9	43.4	48.7	69.4	94.9	99.5	99.8	100.0
3	HBV-1-8.0	5.2	10.7	18.5	28.7	38.6	46.4	51.2	54.3	58.3	73.8	95.1	99.5	99.7	100.0
4	HBV-2-1.5	0.3	0.4	0.7	0.9	1.2	1.6	2.0	2.3	2.9	7.0	41.9	87.0	97.4	100.0
5	HBV-2-4.5	hydrometer													
6	HBV-2-7.5	hydrometer													
7	HBV-2-10.2	hydrometer													
8	HBV-3-1.8	0.0	0.2	1.1	3.2	6.1	8.6	11.0	13.7	27.7	77.5	95.8	97.2	97.6	100.0
9	HBV-3-2.6	0.0	0.0	0.0	0.1	0.5	1.0	1.8	2.6	3.8	14.1	68.8	96.8	99.2	100.0
10	HBV-3-4.5	0.0	0.0	0.0	0.1	0.3	0.8	1.4	1.9	3.2	13.5	71.3	96.1	99.1	100.0
11	HBV-3-6.5	0.0	0.0	0.0	0.1	0.2	0.6	1.2	1.7	2.8	12.3	68.7	95.1	98.6	100.0
12	HBV-3-12.75	0.0	0.0	0.0	0.9	2.4	3.9	5.0	5.7	6.3	10.1	66.6	86.7	97.1	100.0
13	HBV-4-1.0	0.0	0.1	0.5	0.7	1.1	1.8	4.0	8.3	16.6	48.4	81.8	93.0	95.2	100.0
14	HBV-4-5.0	2.0	3.2	4.9	6.7	9.2	12.8	16.4	20.4	25.6	37.4	60.2	80.5	88.8	100.0
15	HBV-4-6.5	hydrometer													
16	HBV-5-2.0	0.0	0.1	0.2	1.0	2.6	5.8	9.8	13.8	22.6	55.0	93.1	99.5	99.8	100.0
17	HBV-5-5.75	2.3	2.8	4.0	6.2	9.7	14.8	19.5	23.4	30.1	58.7	93.2	99.3	99.7	100.0
18	HBV-5-14.75	0.3	0.5	1.0	2.4	5.0	8.5	11.8	15.2	19.3	38.4	79.5	93.3	94.9	100.0
19	HBV-5-19.1	0.0	0.0	0.2	1.2	3.4	6.5	9.4	12.5	16.4	28.5	69.9	91.0	94.4	100.0
20	HBV-6-1.0	0.0	0.1	0.4	1.2	3.2	6.9	11.0	15.2	24.9	64.2	95.3	99.3	99.6	100.0
21	HBV-6-4.5	0.0	0.1	0.6	2.3	6.1	12.3	18.4	23.7	33.8	70.3	96.0	99.4	99.7	100.0
22	HBV-6-9.8	8.6	9.6	11.2	14.3	19.4	25.9	31.9	36.5	45.3	76.4	97.2	99.5	99.7	100.0
23	HBV-7-2.5	1.3	2.4	4.8	10.6	20.5	34.1	47.8	54.7	68.2	84.8	97.2	99.7	99.8	100.0

24	HBV-7-6.25	hydrometer													
25	HBV-7-9.3	hydrometer													
26	SBV-12-1.0	0.1	0.2	0.6	1.3	2.4	4.7	9.7	14.7	29.4	73.5	98.3	99.8	99.9	100.0
27	SBV-12-4.5	20.2	23.8	28.1	32.5	36.7	40.2	43.5	46.6	55.4	81.0	98.7	99.8	99.9	100.0
28	SBV-12-7.0	0.4	0.5	0.8	1.1	1.7	2.7	4.5	7.1	17.2	62.4	95.6	99.0	99.4	100.0
29	SBV-12-11.0	0.0	0.0	0.0	0.0	0.0	0.5	1.2	2.3	7.2	35.8	86.3	92.5	95.6	100.0
30	SBV-11-0.25	hydrometer													
31	SBV-11-4.5	hydrometer													
32	SBV-10-0.7	hydrometer													
33	SBV-10-3.2	hydrometer													
34	SBV-10-7.0	hydrometer													
35	SBV-10-11.2	hydrometer													
36	SBV-13-0.4	2.7	4.9	7.7	11.5	16.1	20.6	25.2	29.0	35.8	54.7	84.1	93.2	95.9	100.0
37	SBV-13-0.75	hydrometer													
38	SBV-13-5.5	hydrometer													
39	SBV-13-14	hydrometer													
40	SBV-14-1.5	8.5	12.2	16.0	20.5	24.5	28.0	31.5	35.1	42.0	59.4	89.0	95.6	97.3	100.0
41	SBV-14-4.2	0.3	0.4	1.3	4.3	8.5	12.8	16.6	19.9	25.9	42.2	67.2	76.7	84.4	100.0
42	SBV-14-8.6	hydrometer													
43	SBV-15-0.5	hydrometer													
44	SBV-15-0.95	hydrometer													
45	SBV-16-0.2	0.0	0.0	0.4	1.4	3.3	5.7	9.3	13.1	21.0	37.0	80.8	97.5	98.7	100.0
46	SBV-16-2.5	24.6	35.5	48.6	60.5	69.2	75.5	79.5	82.8	87.5	91.6	97.6	99.5	99.6	100.0
47	SBV-16-4.5	0.0	0.0	0.0	0.5	1.1	2.0	3.9	4.7	7.5	19.4	58.8	93.6	98.8	100.0
48	SBV-17-1.0	0.1	0.5	1.5	2.9	4.9	7.4	10.3	13.7	25.3	60.6	95.4	99.6	99.8	100.0
49	SBV-17-5.8	2.1	3.9	6.6	10.5	15.4	20.1	24.2	27.8	38.2	66.3	95.7	99.6	99.8	100.0
50	SBV-17-9.2	2.8	5.0	9.1	14.9	21.5	27.6	32.5	36.9	46.9	70.8	96.3	99.6	99.8	100.0
51	SBV-17-14.0	0.9	1.7	3.1	4.4	5.7	7.4	9.6	11.9	23.4	58.4	94.7	99.4	99.8	100.0
52	SBV-18-0.5	0.0	0.1	1.2	2.6	4.2	5.7	8.0	10.5	21.4	51.7	93.4	99.2	99.6	100.0
53	SBV-18-5.7	2.4	3.7	5.7	8.9	12.5	16.3	20.3	24.3	30.7	50.8	84.4	92.7	95.0	100.0
54	SBV-18-8.25	4.9	7.3	9.9	14.0	18.5	23.3	27.9	32.5	39.2	53.5	80.6	90.8	93.4	100.0
55	SBV-19-0.8	hydrometer													
56	SBV-19-2.8	0.4	0.8	1.9	4.2	7.1	10.3	13.8	17.8	24.5	41.5	78.3	92.8	95.3	100.0

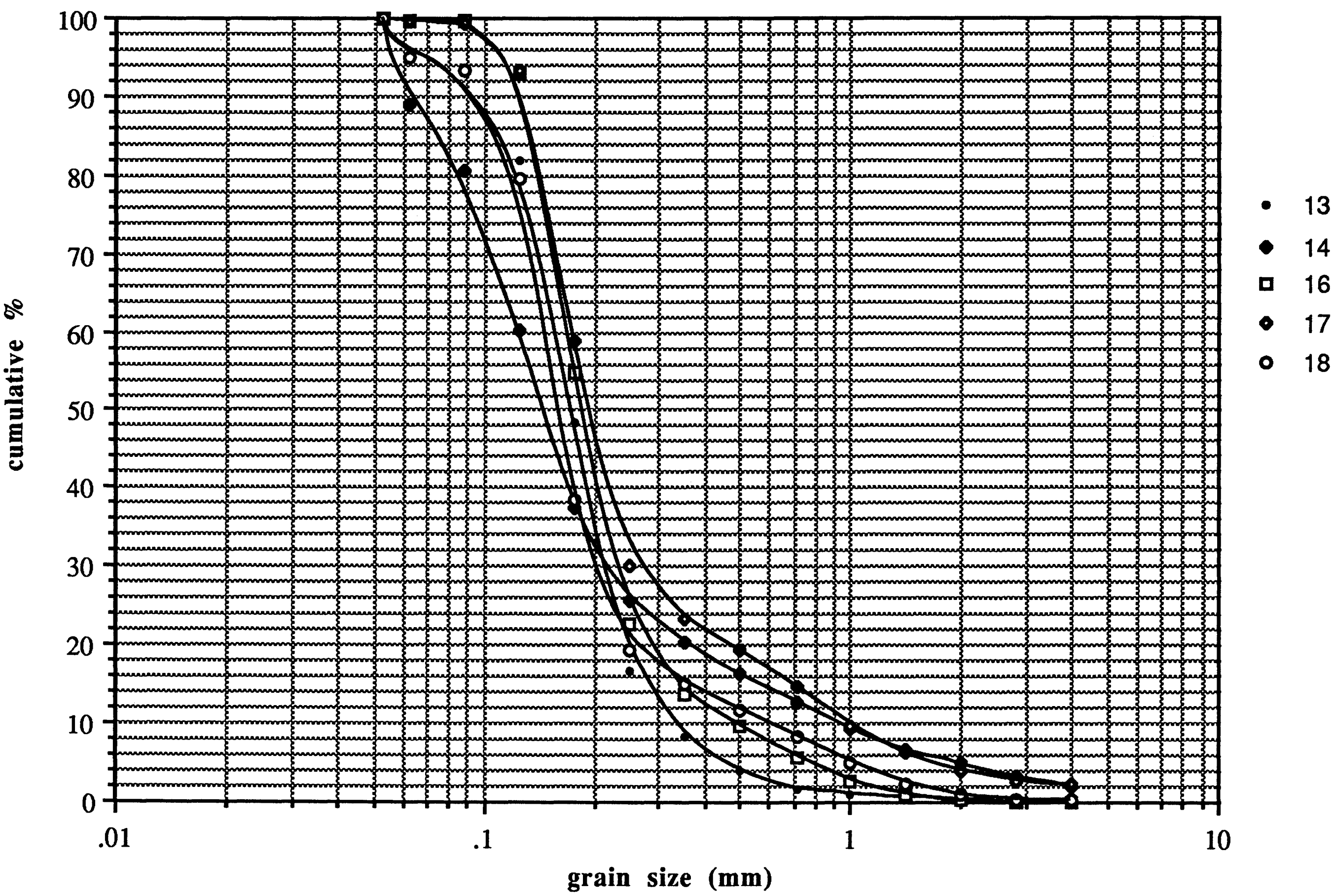
57	SBV-19-5.5	hydrometer													
58	SBV-19-8.5	hydrometer													
59	SBV-20-0.5	0.0	0.0	0.0	0.1	0.2	0.7	2.0	3.5	8.2	41.2	87.9	99.0	99.7	100.0
60	SBV-20-2.7	0.1	0.1	0.2	0.3	0.6	1.6	4.4	8.7	33.6	77.9	97.2	99.7	99.9	100.0
61	SBV-20-4.1	32.7	56.9	71.0	79.0	84.0	87.4	89.3	90.3	92.6	96.6	99.1	99.6	99.7	100.0
62	SBV-21-1.0	3.3	8.4	15.2	21.4	26.9	31.2	34.8	38.8	45.6	54.1	66.0	82.8	91.2	100.0
63	SBV-22-2.0	1.6	2.3	4.1	6.9	10.6	14.4	17.9	21.5	32.0	55.3	86.6	97.4	98.6	100.0
64	SBV-22-5.75	0.0	0.2	0.5	1.9	5.2	9.8	13.9	16.6	23.5	52.8	82.3	92.0	95.0	100.0
65	SBV-22-10.95	1.4	2.6	3.8	6.3	9.6	13.8	18.0	21.7	27.3	39.5	58.6	70.6	78.8	100.0
66	SBV-22-13.5	0.1	0.1	0.1	0.8	3.0	7.5	12.8	17.1	21.0	28.5	43.7	63.6	74.8	100.0
67	SBV-23-0.5	0.1	0.2	0.5	1.1	1.9	3.2	5.2	7.4	20.5	51.0	81.7	91.9	94.9	100.0
68	SBV-23-5.5	1.3	1.7	2.1	3.2	5.3	8.1	11.4	15.2	23.9	50.5	74.9	87.5	93.3	100.0
69	SBV-23-12.4	0.1	0.3	0.9	2.7	6.9	12.5	17.6	21.5	26.7	41.4	61.7	72.9	80.3	100.0
70	SBV-23-17.8	hydrometer													
71	SBV-24-2.2	0.4	0.4	0.8	1.5	3.0	5.6	8.8	12.1	17.8	41.2	80.3	91.8	94.5	100.0
72	SBV-24-5.6	0.4	0.6	1.2	2.5	5.3	9.4	13.4	16.7	21.2	35.7	65.8	80.7	88.0	100.0
73	SBV-24-7.0	0.0	0.9	1.4	3.1	6.5	11.1	15.2	18.4	22.8	37.0	65.1	80.7	87.1	100.0
74	SBV-24-16.5	hydrometer													
75	SBV-25-0.4	5.9	16.6	31.5	45.3	56.4	66.3	73.6	77.8	83.5	92.7	98.0	99.0	99.3	100.0
76	SBV-25-1.5	1.8	2.2	2.9	4.8	7.8	11.7	15.4	18.6	23.2	39.2	76.8	91.2	94.4	100.0
77	SBV-25-11.2	0.0	0.0	0.1	1.1	3.7	8.3	13.6	17.9	21.4	26.0	40.4	56.9	67.2	100.0



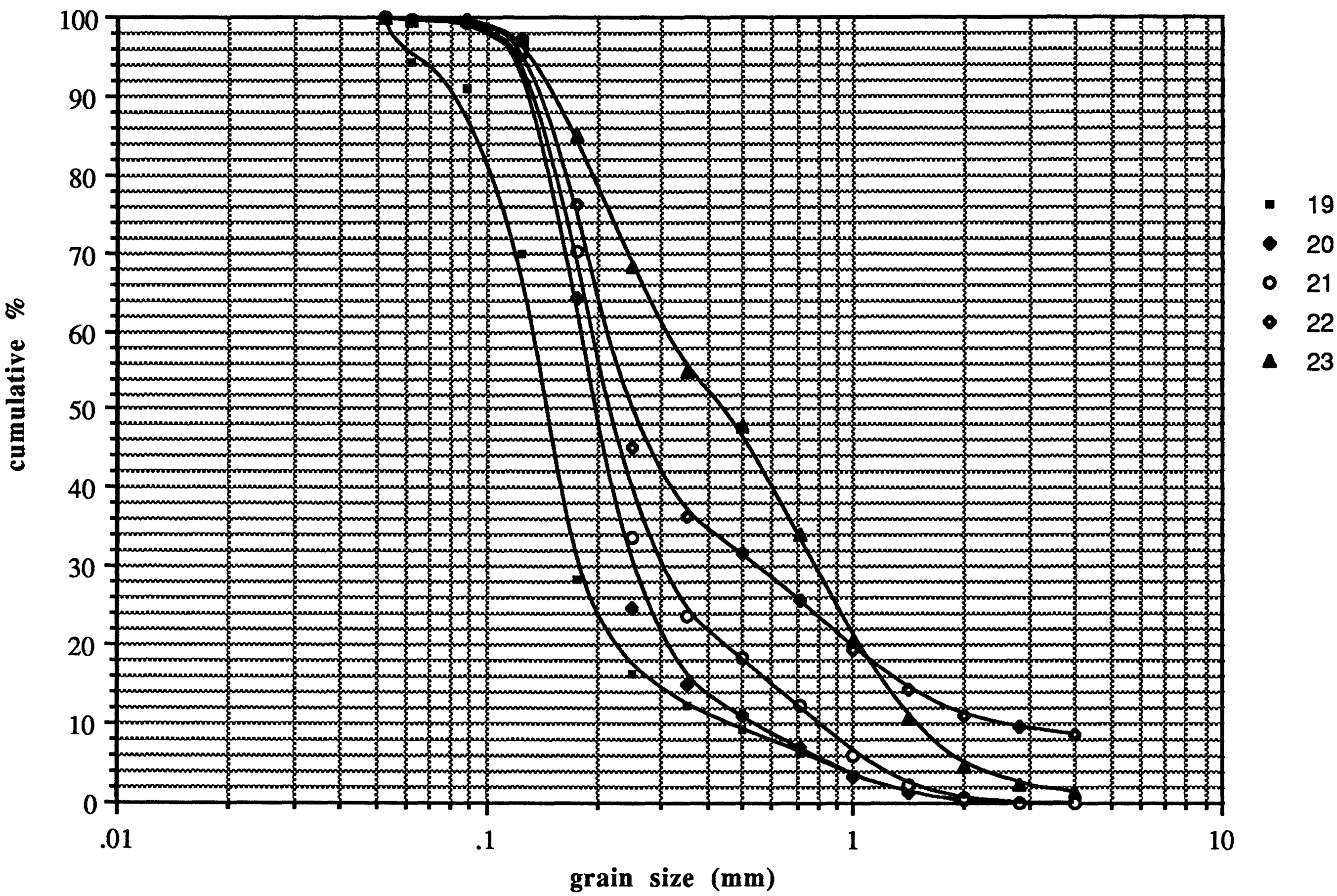
cumulative %
100
90
80
70
60
50
40
30
20
10
0
.01
.1
1
10
grain size (mm)
1
2
3
4



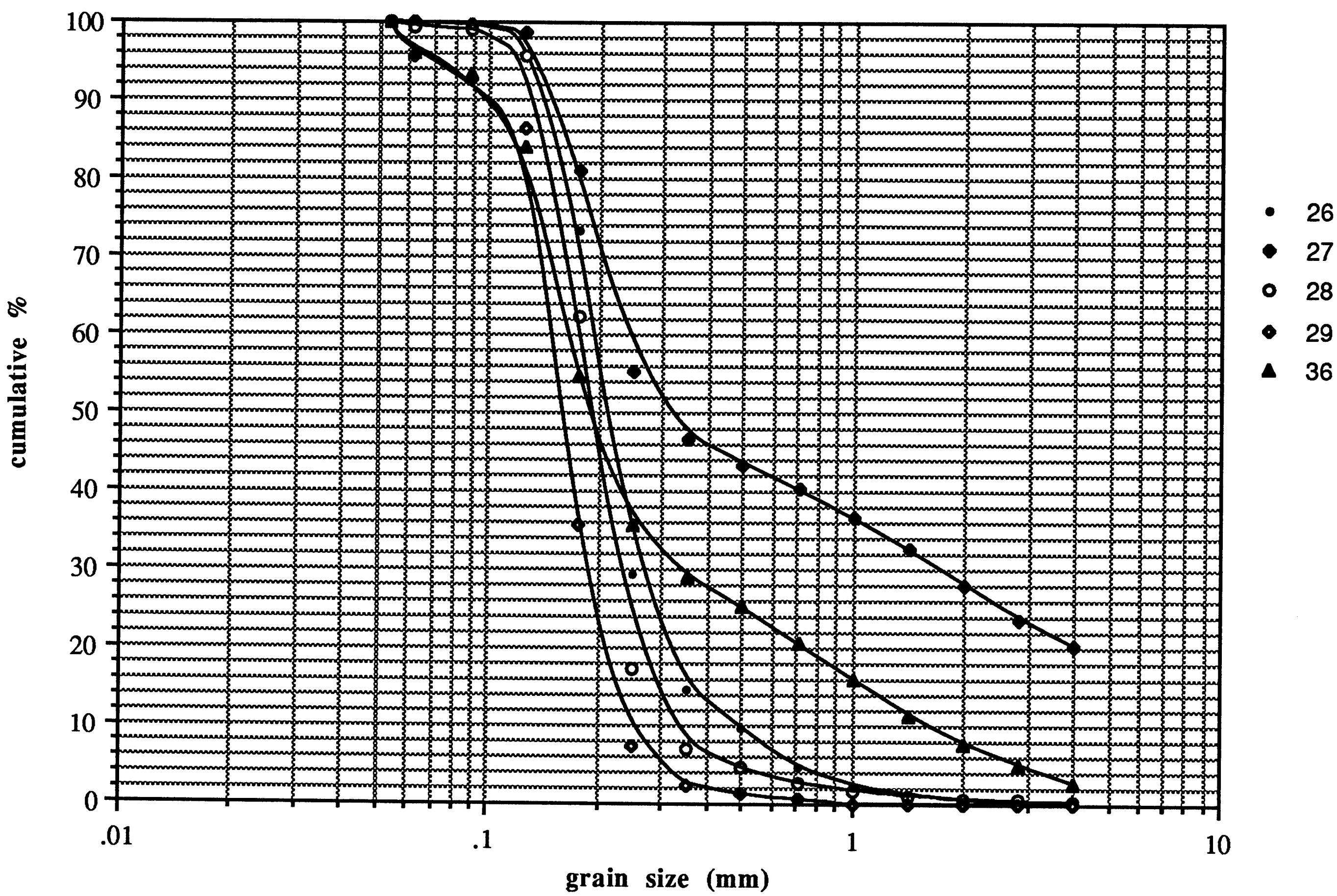
100
90
80
70
60
50
40
30
20
10
0
cumulative %
.01
.1
1
10
grain size (mm)
8
9
10
11
12



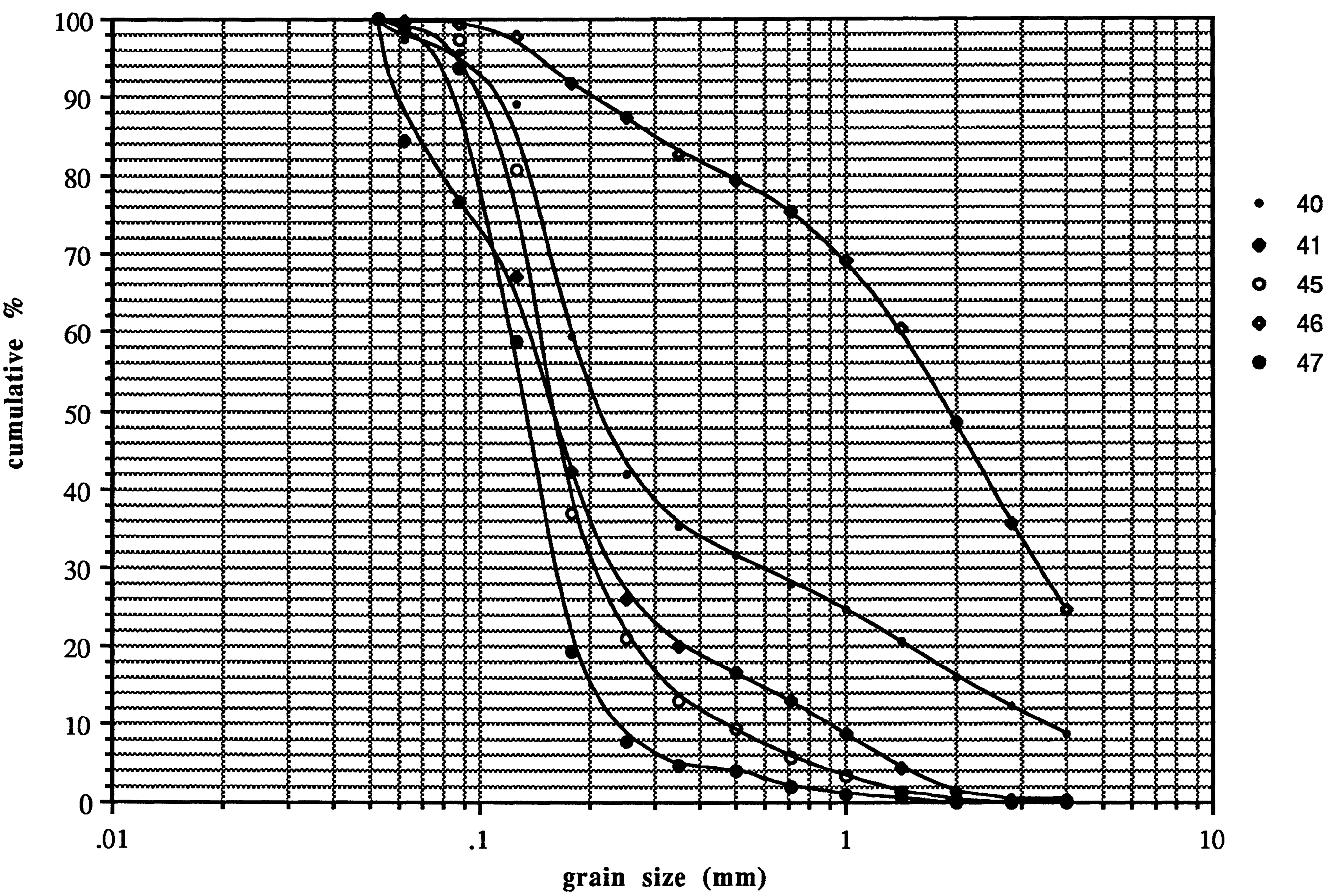
100
90
80
70
60
50
40
30
20
10
0
cumulative %
.01
.1
1
10
grain size (mm)
13
14
16
17
18



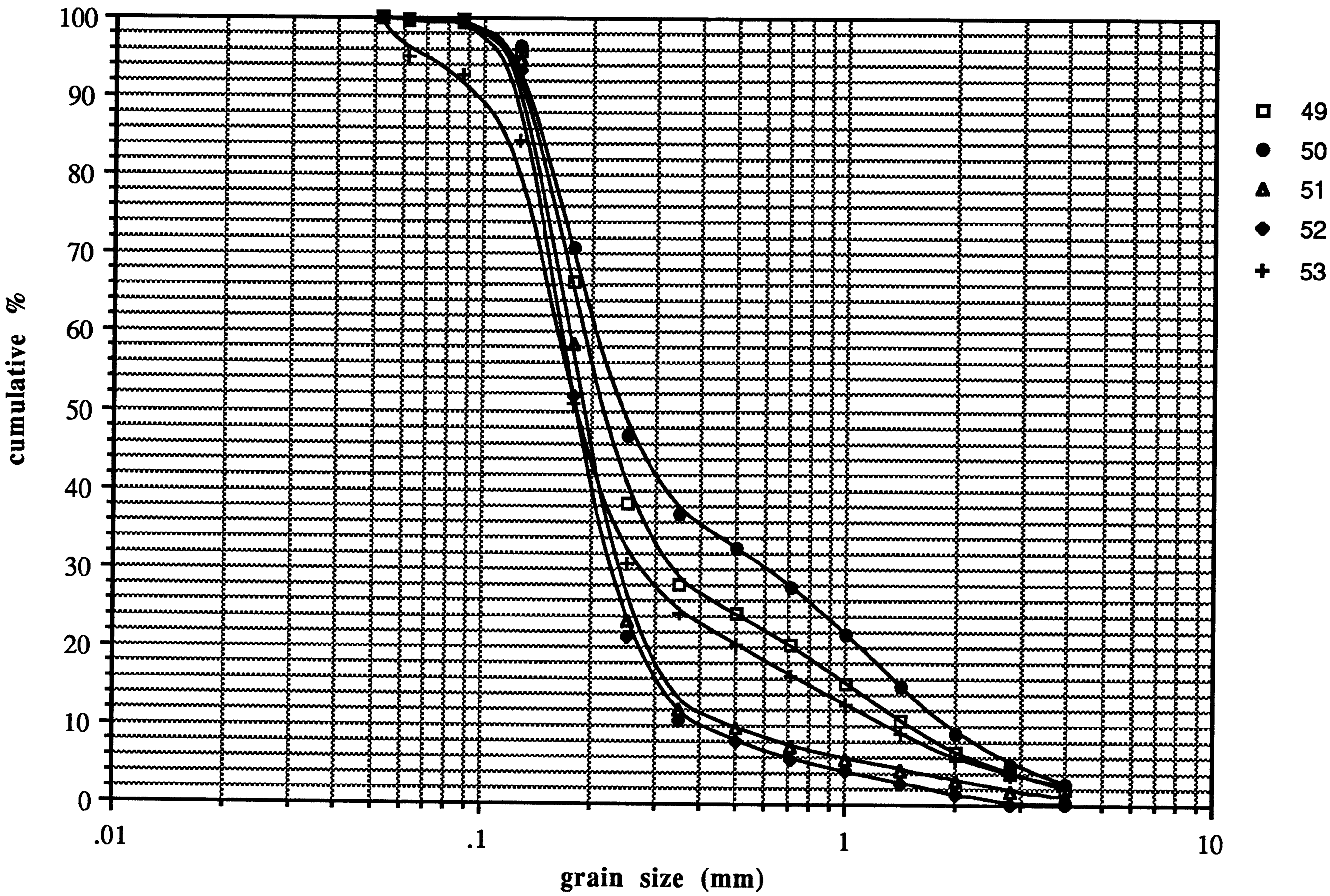
100
90
80
70
60
50
40
30
20
10
0
cumulative %
.01
.1
1
10
grain size (mm)
19
20
21
22
23



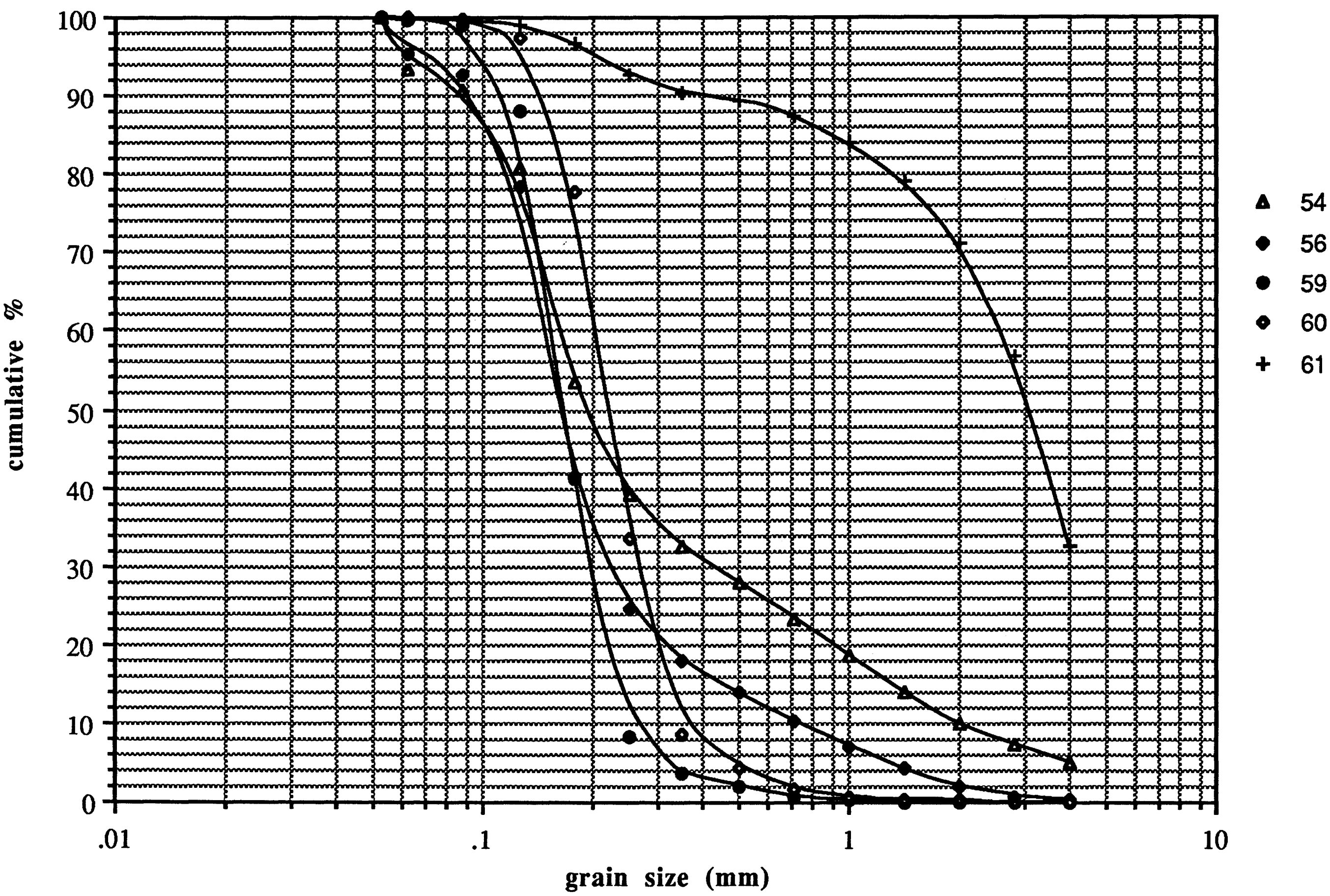
100
90
80
70
60
50
40
30
20
10
0
cumulative %
.01
.1
1
10
grain size (mm)
26
27
28
29
36



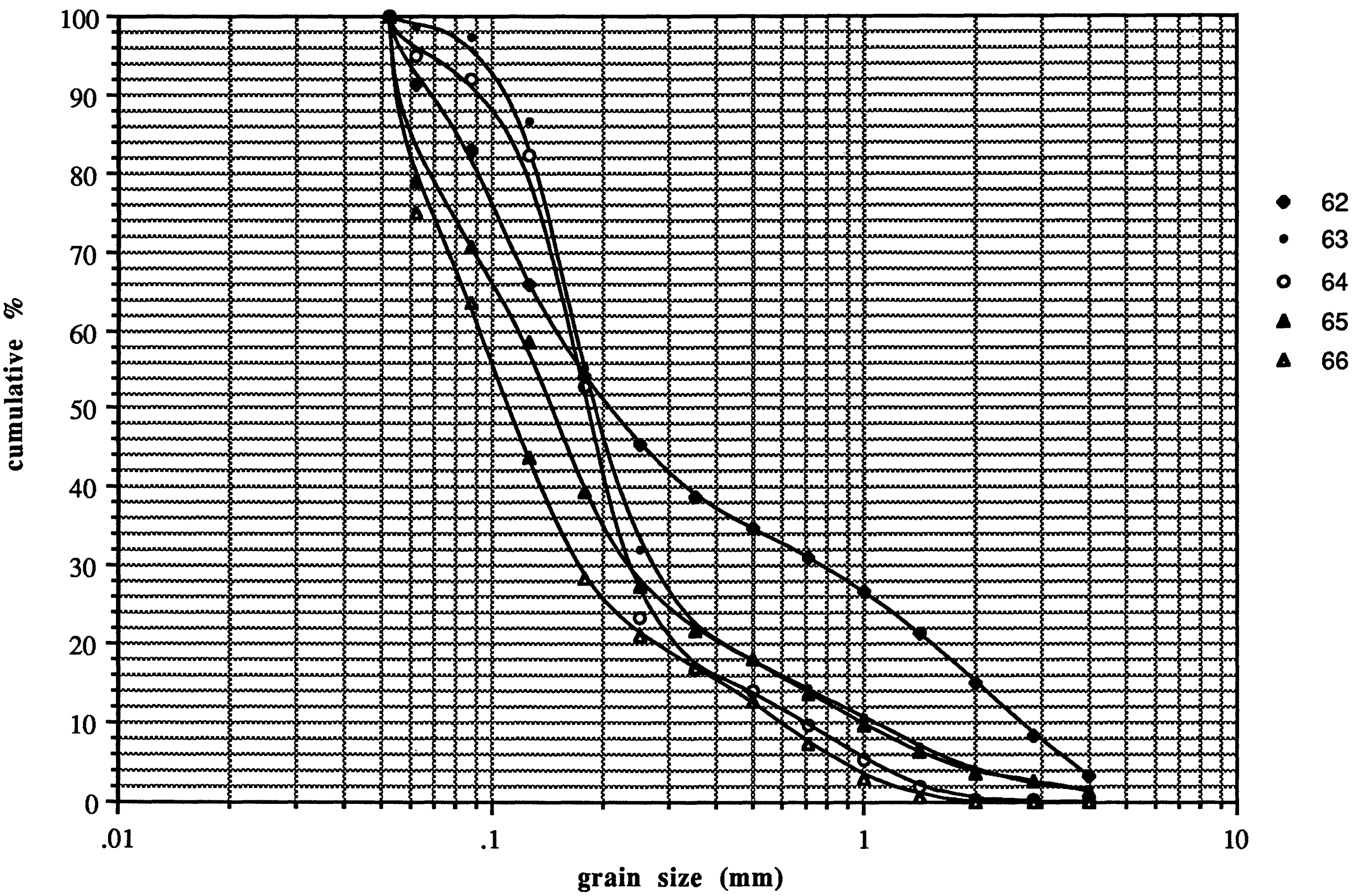
100
90
80
70
60
50
40
30
20
10
0
cumulative %
.01
.1
1
10
grain size (mm)
40
41
45
46
47



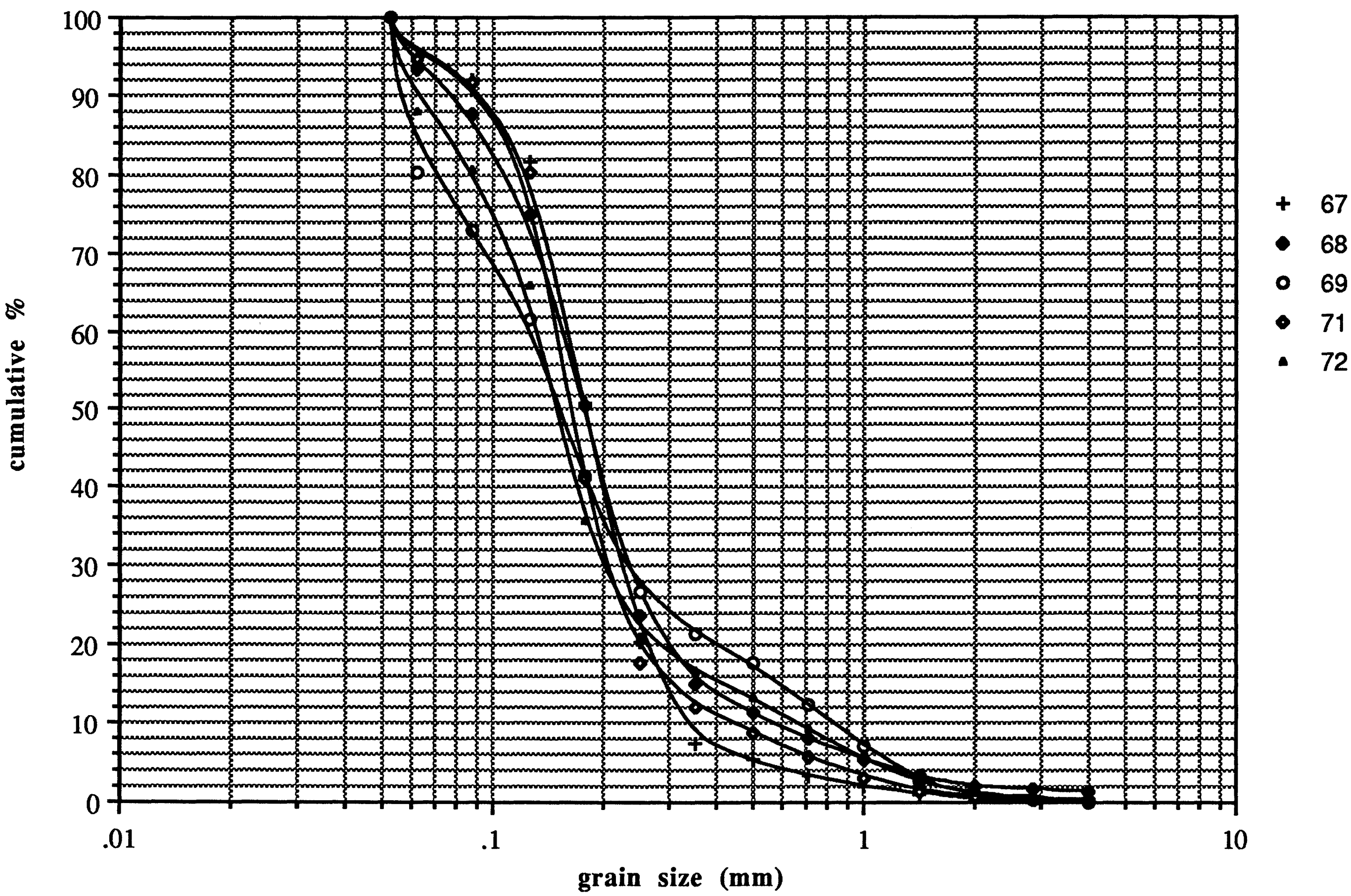
100
90
80
70
60
50
40
30
20
10
0
cumulative %
.01
.1
1
10
grain size (mm)
49
50
51
52
53



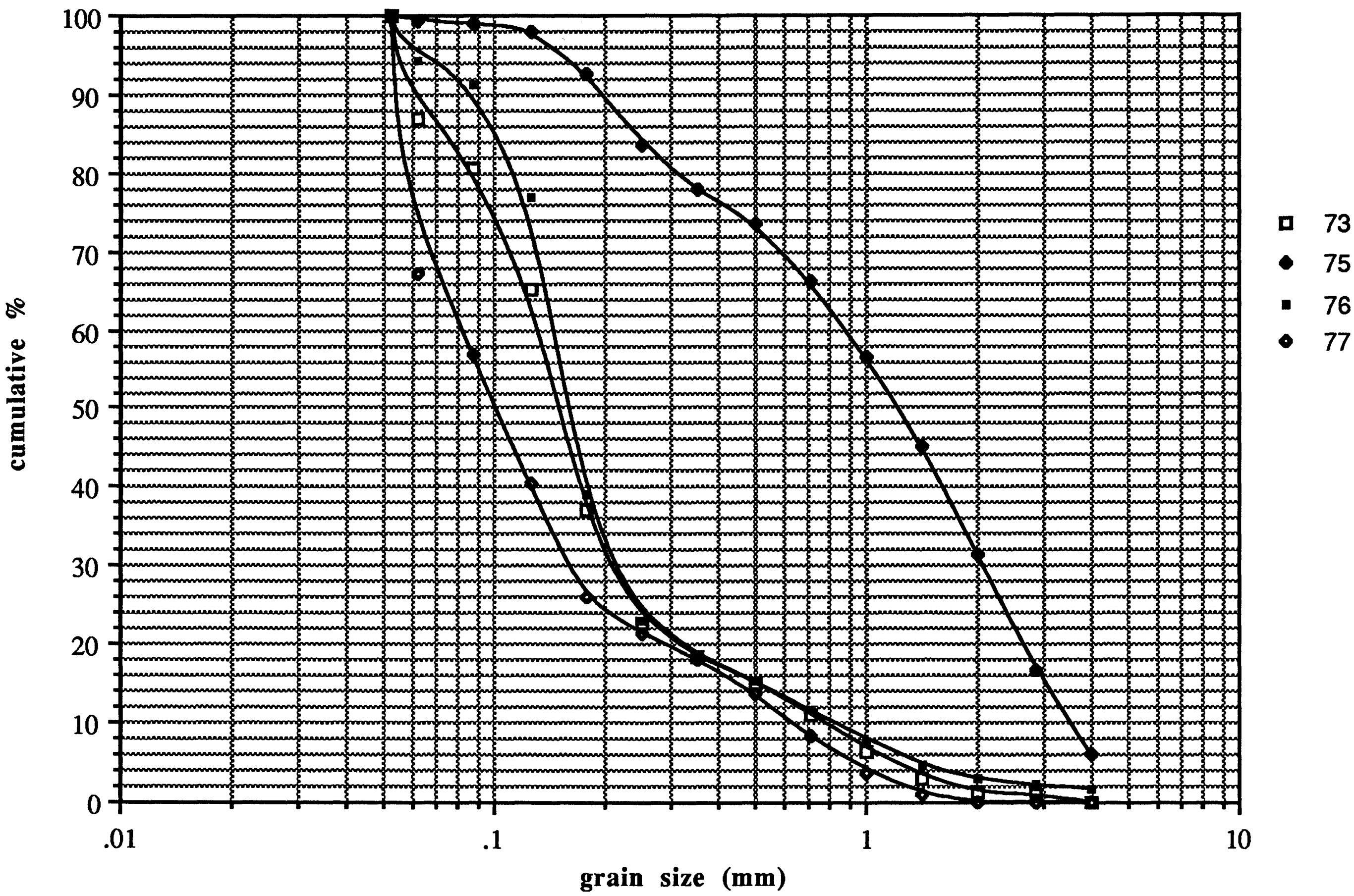
100
90
80
70
60
50
40
30
20
10
0
cumulative %
.01
.1
1
10
grain size (mm)
54
56
59
60
61



100
90
80
70
60
50
40
30
20
10
0
.01
.1
1
10
cumulative %
grain size (mm)
62
63
64
65
66

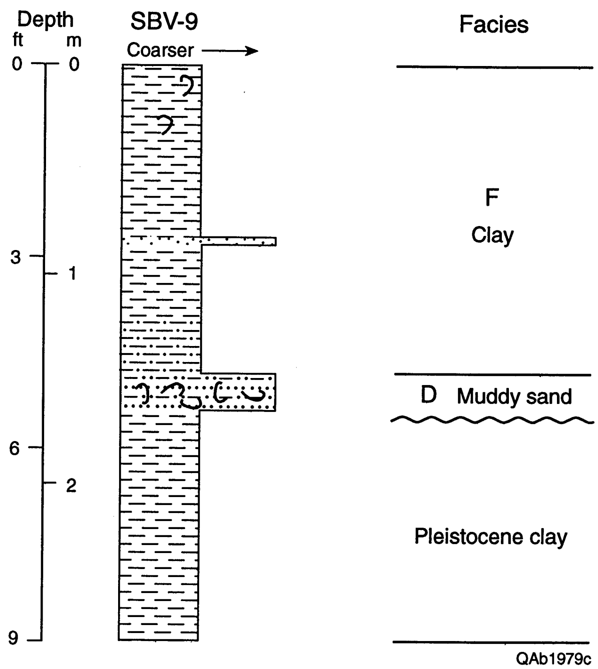


100
90
80
70
60
50
40
30
20
10
0
cumulative %
.01
.1
1
10
grain size (mm)
67
68
69
71
72

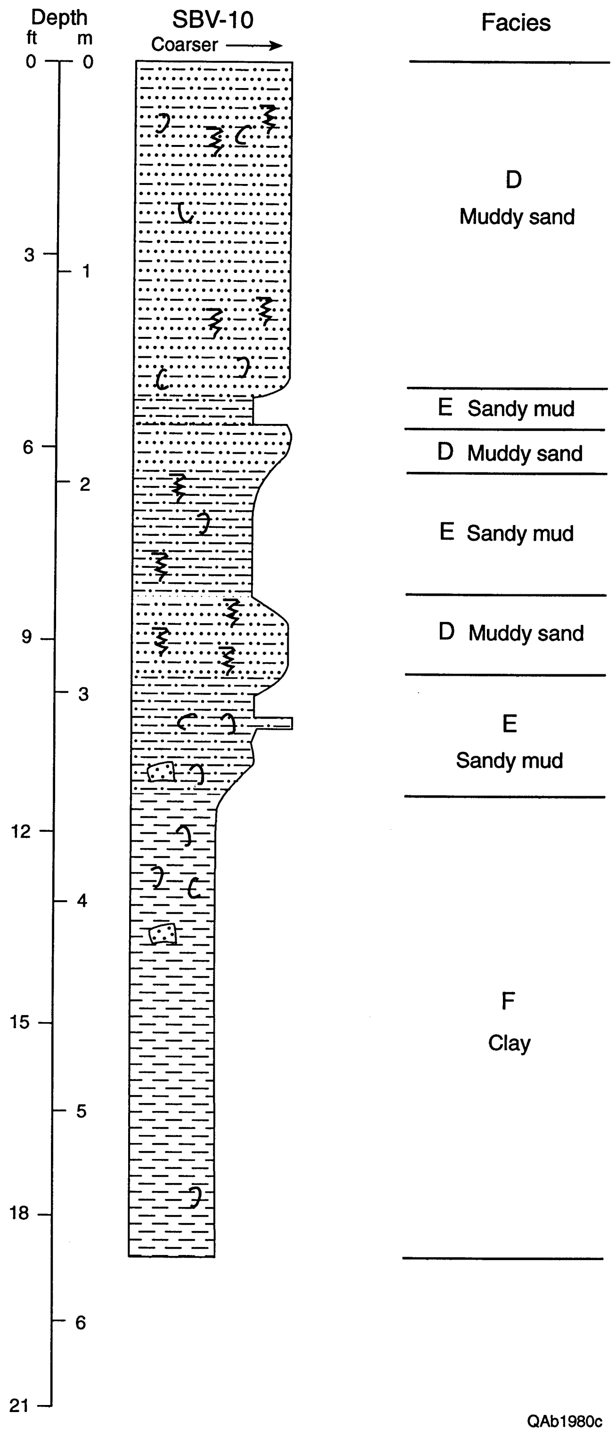


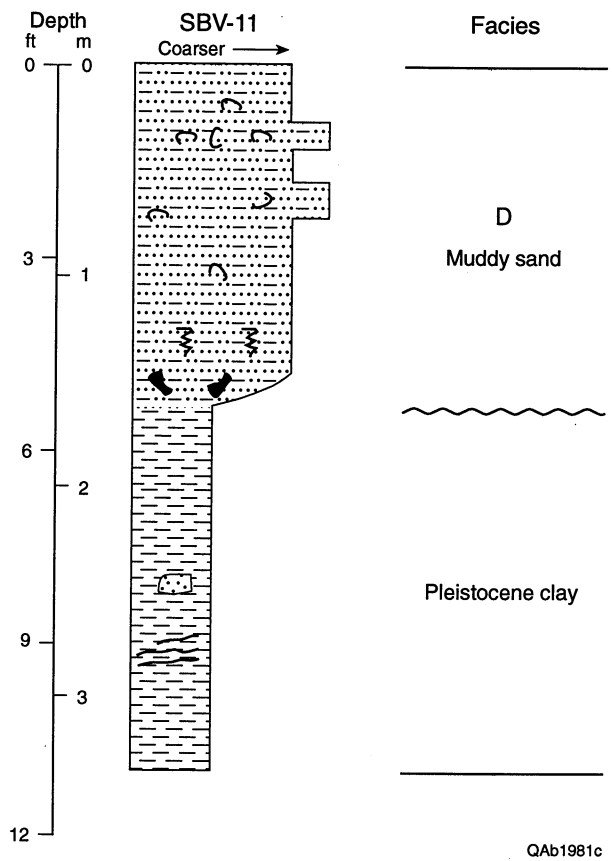
100
90
80
70
60
50
40
30
20
10
0
cumulative %
.01
.1
1
10
grain size (mm)
73
75
76
77

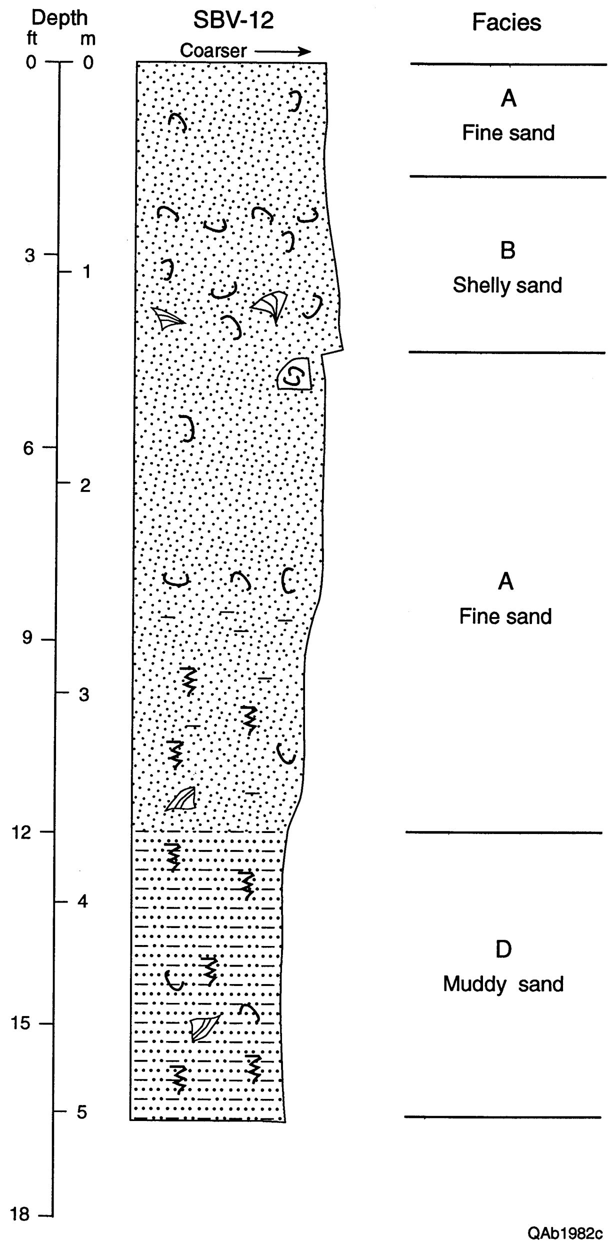
APPENDIX E. LITHOLOGIC PROFILES OF VIBRACORES

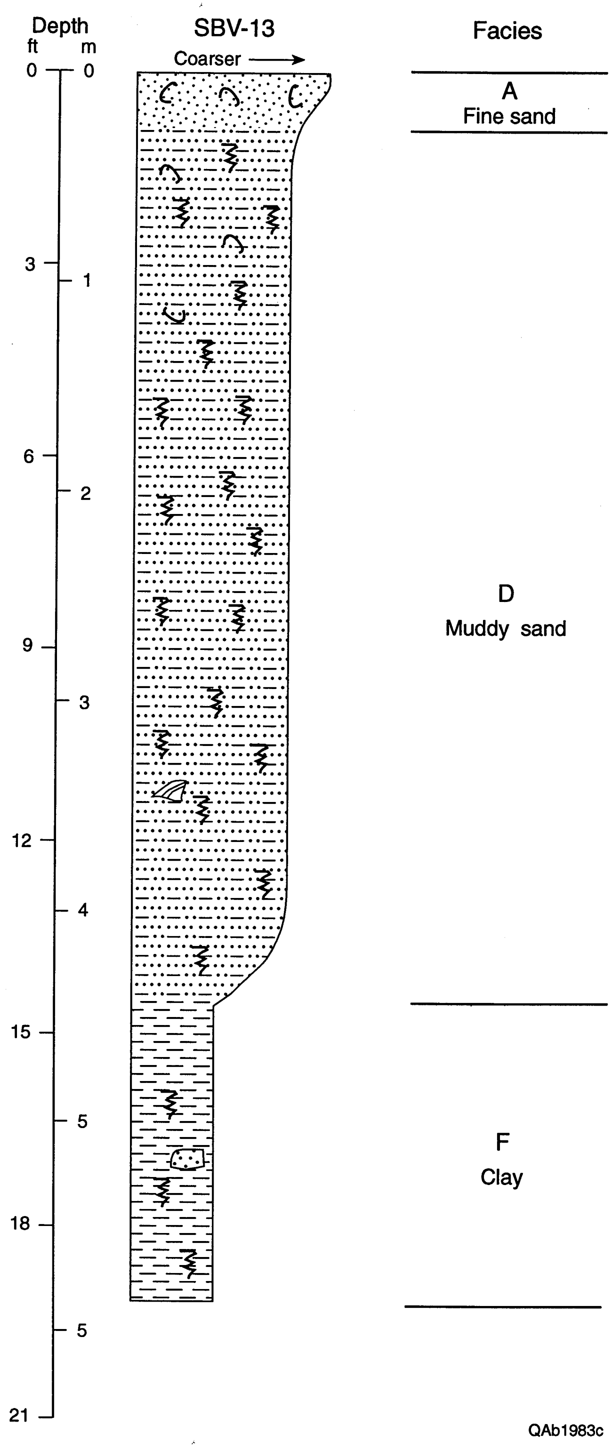


Depth
ft
m
0
0
3
1
6
2
9
SBV-9
Coarser
Facies
F
Clay
D
Muddy sand
Pleistocene clay
QAb1979c

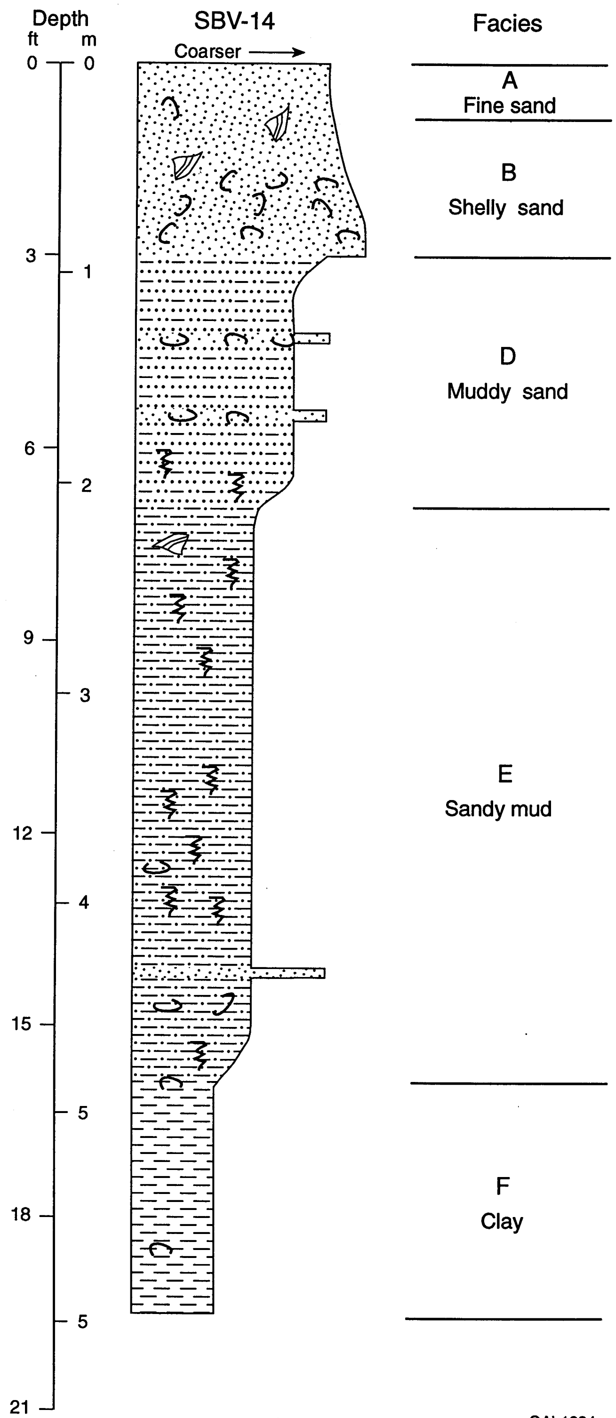

Depth
ft m
0 0
3 1
6 2
9 3
12 4
15 5
18 6
21
SBV-10
Coarser
Facies
D
Muddy sand
E Sandy mud
D Muddy sand
E Sandy mud
D Muddy sand
E
Sandy mud
F
Clay
QAb1980c


Depth
ft m
SBV-11
Coarser
Facies
0
0
3
1
6
2
9
3
12
D
Muddy sand
Pleistocene clay
QAb1981c


Depth
ft m
0 0
3 1
6 2
9 3
12 4
15 5
18
SBV-12
Coarser
Facies
A
Fine sand
B
Shelly sand
A
Fine sand
D
Muddy sand
QAb1982c

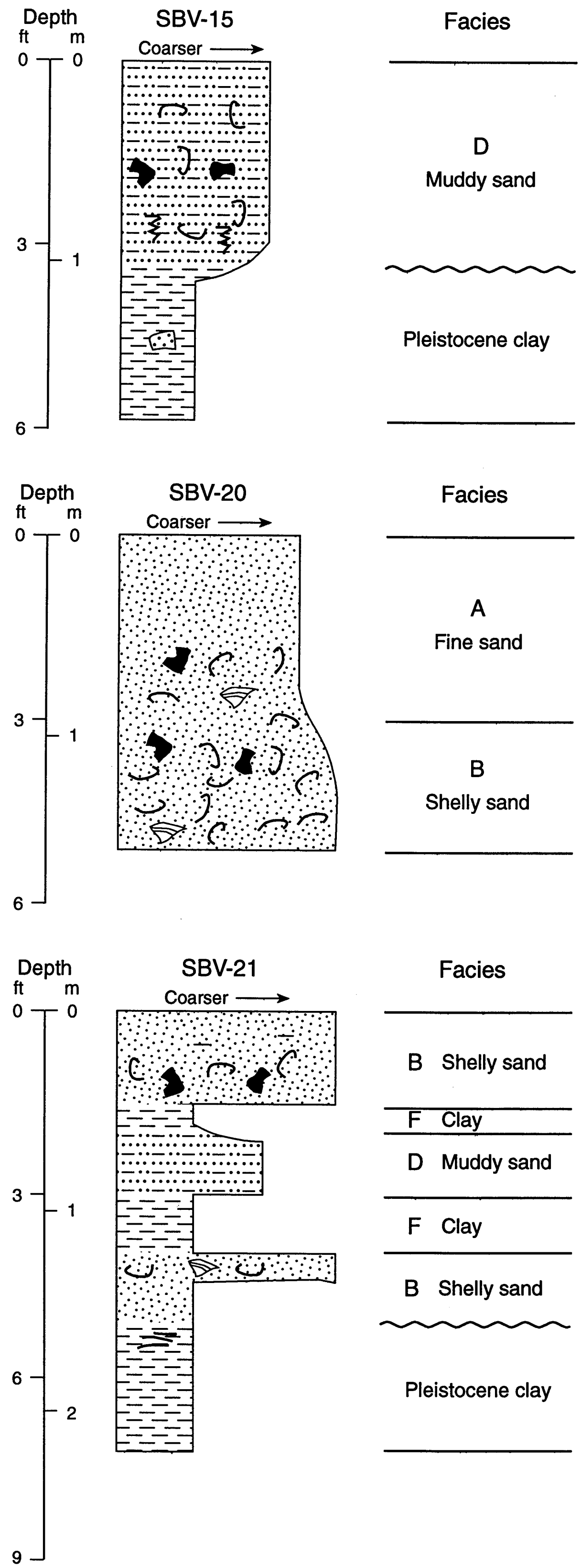


Depth
ft m
0 0
3 1
6 2
9 3
12 4
15 5
18 5
21
SBV-13
Coarser
Facies
A
Fine sand
D
Muddy sand
F
Clay
QAb1983c

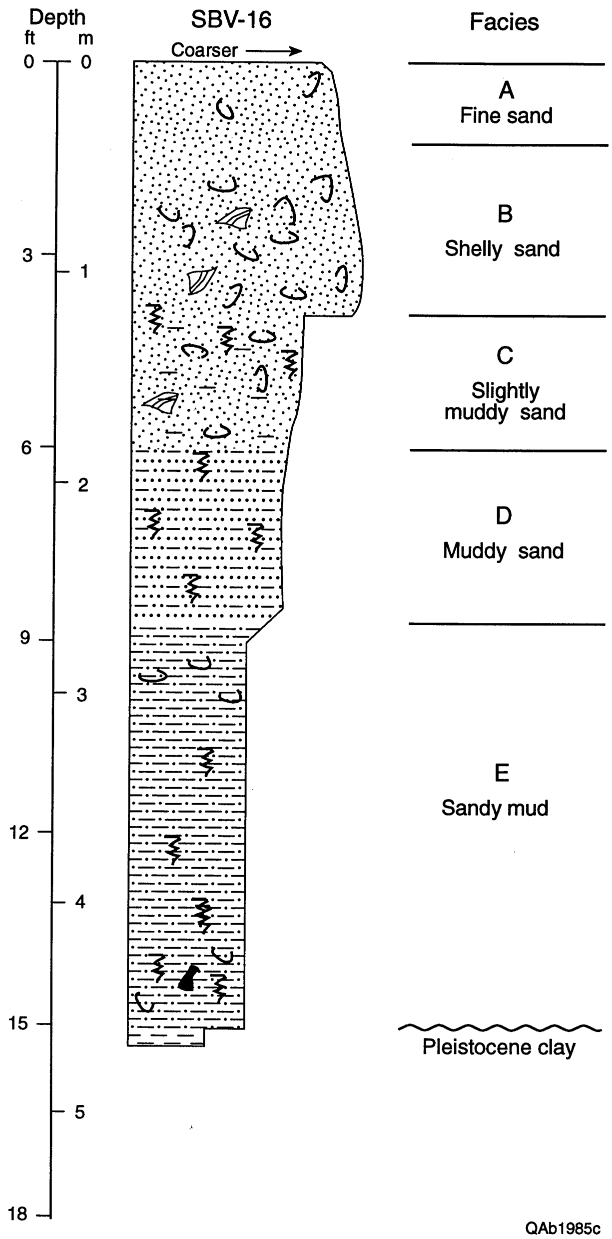


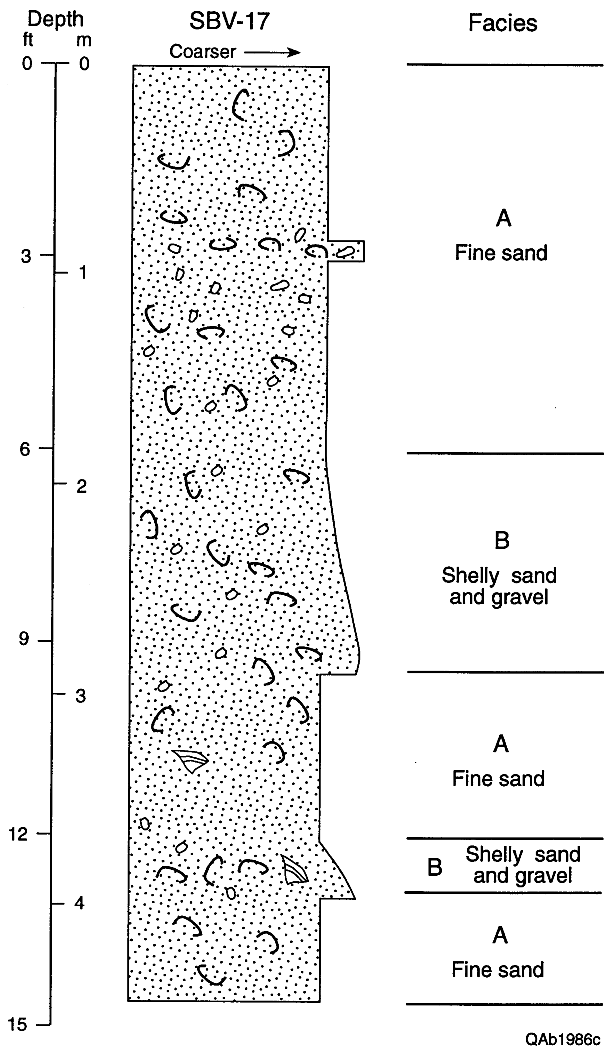
Depth
ft m
SBV-14
Coarser
Facies
0
0
3
1
6
2
9
3
12
4
15
5
18
5
21
A
Fine sand
B
Shelly sand
D
Muddy sand
E
Sandy mud
F
Clay

QAb1984c

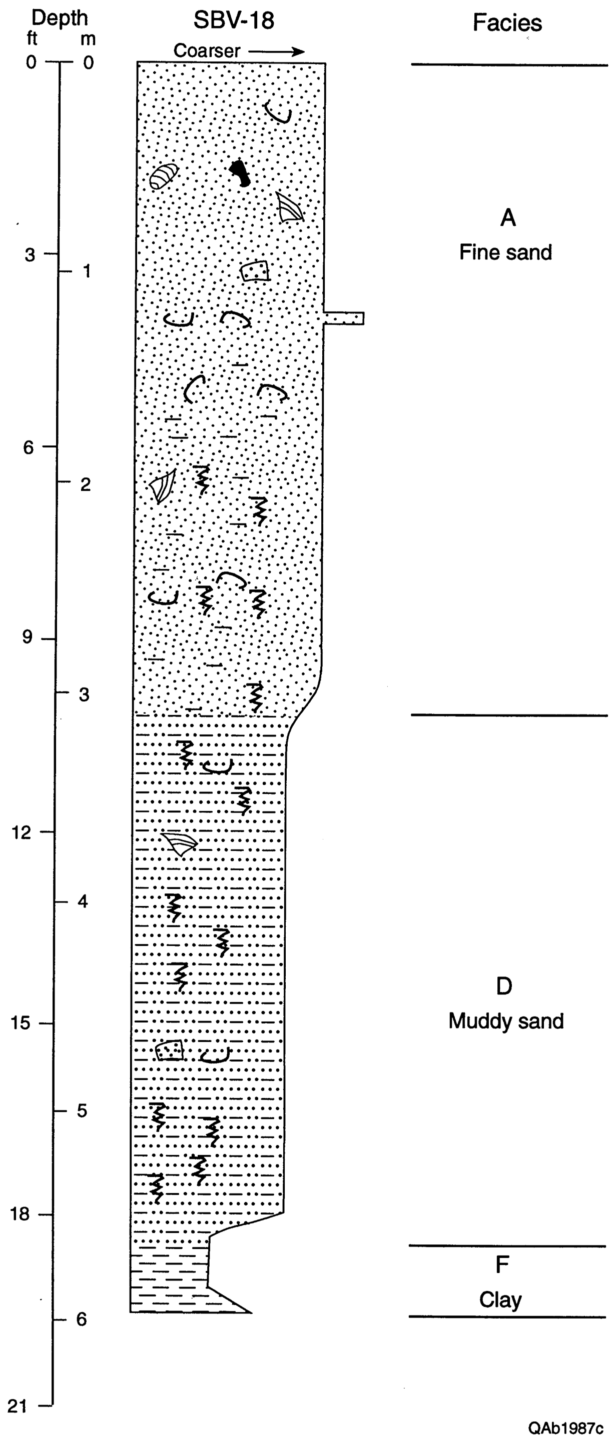

Depth
ft m
SBV-15
Coarser
Facies
D
Muddy sand
Pleistocene clay
0 0
3 1
6
Depth
ft m
SBV-20
Coarser
Facies
A
Fine sand
B
Shelly sand
0 0
3 1
6
Depth
ft m
SBV-21
Coarser
Facies
B Shelly sand
F Clay
D Muddy sand
F Clay
B Shelly sand
Pleistocene clay
0 0
3 1
6 2
9

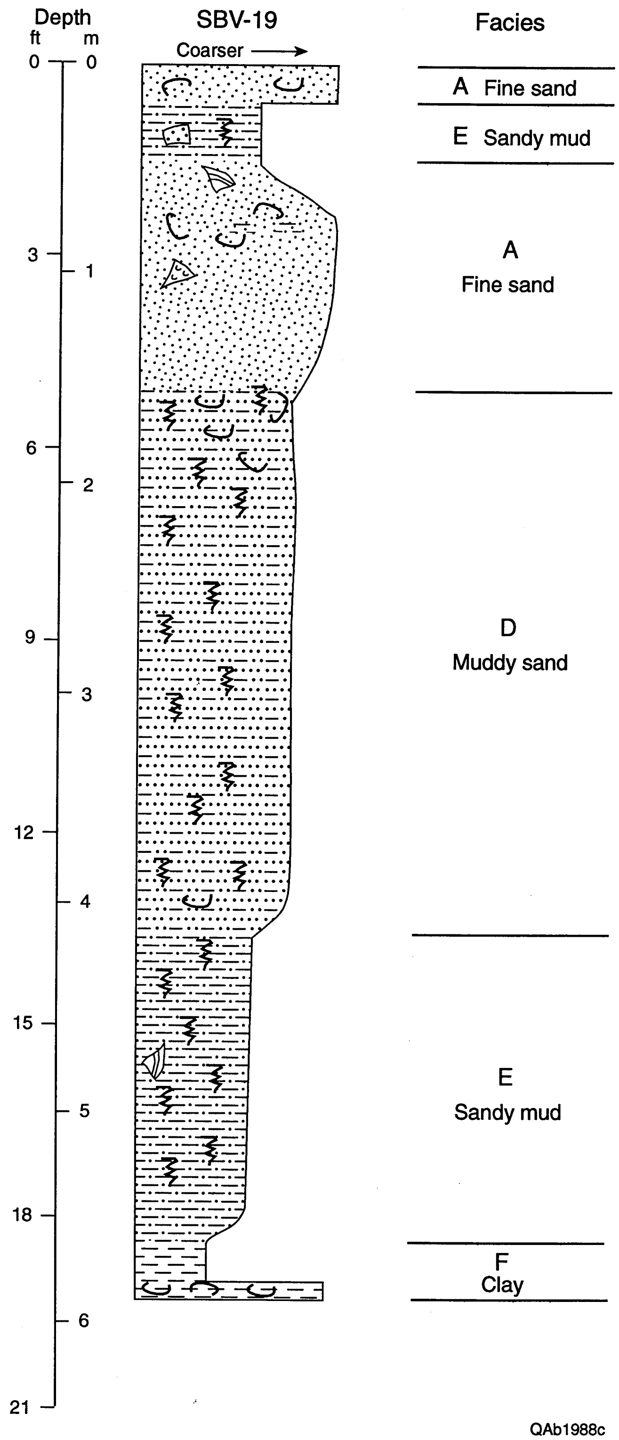
QAb1989c


Depth
ft m
SBV-16
Coarser
Facies
0
3
6
9
12
15
18
0
1
2
3
4
5
A
Fine sand
B
Shelly sand
C
Slightly muddy sand
D
Muddy sand
E
Sandy mud
Pleistocene clay
QAb1985c

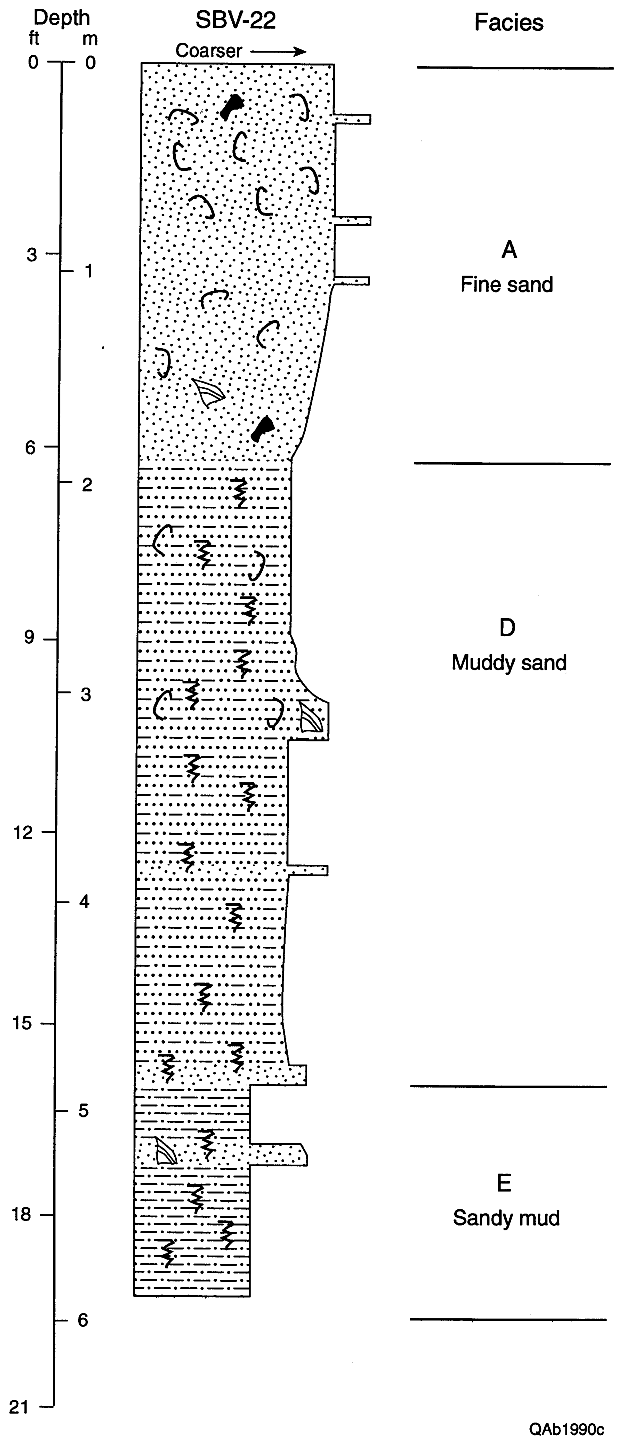


Depth
ft
m
0
0
3
1
6
2
9
3
12
4
15
SBV-17
Coarser
Facies
A
Fine sand
B
Shelly sand
and gravel
A
Fine sand
B
Shelly sand
and gravel
A
Fine sand
QAb1986c

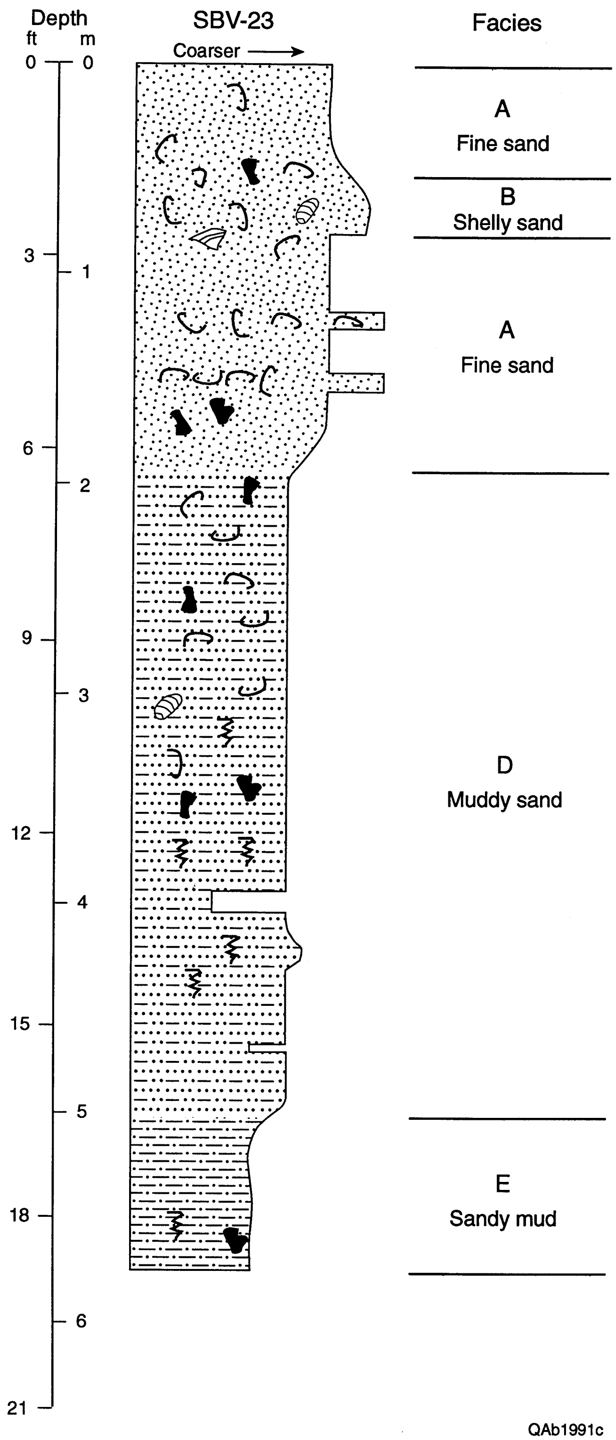

Depth
ft
m
0
0
3
1
6
2
9
3
12
4
15
5
18
6
21
SBV-18
Coarser
Facies
A
Fine sand
D
Muddy sand
F
Clay
QAb1987c

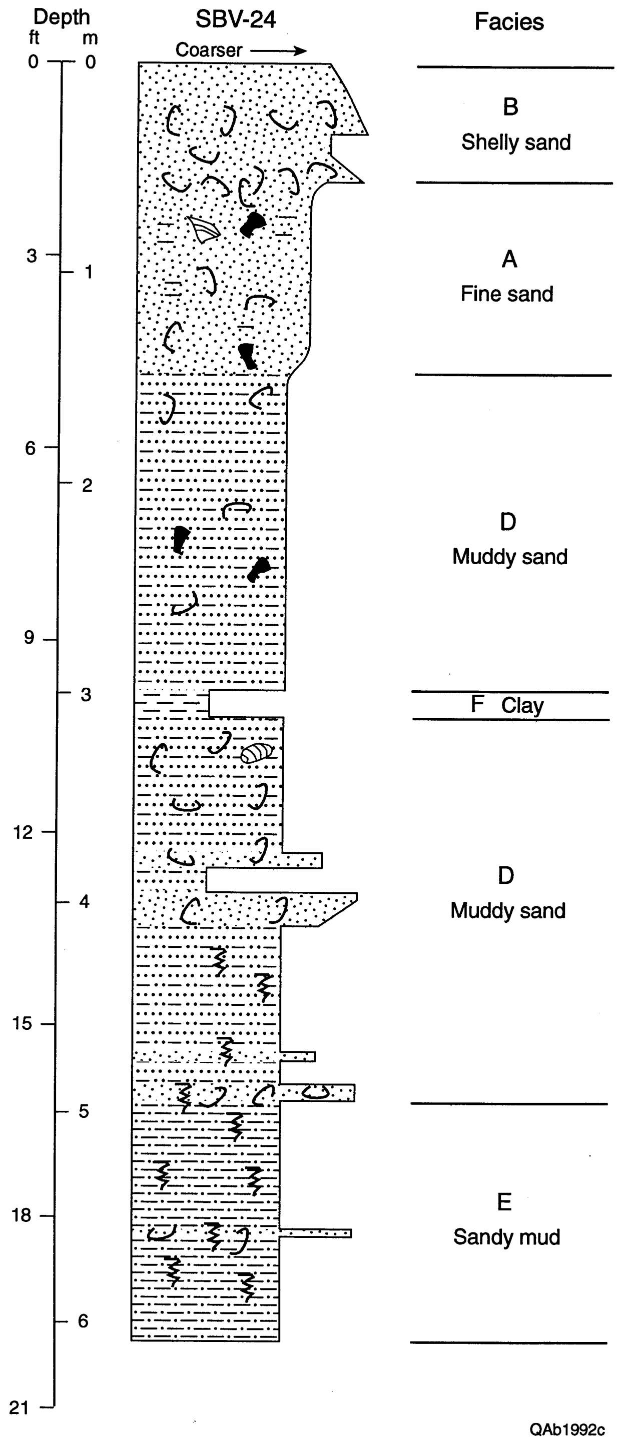


Depth
ft m
0 0
3 1
6 2
9 3
12 4
15 5
18 6
21
SBV-19
Coarser
Facies
A Fine sand
E Sandy mud
A
Fine sand
D
Muddy sand
E
Sandy mud
F
Clay
QAb1988c

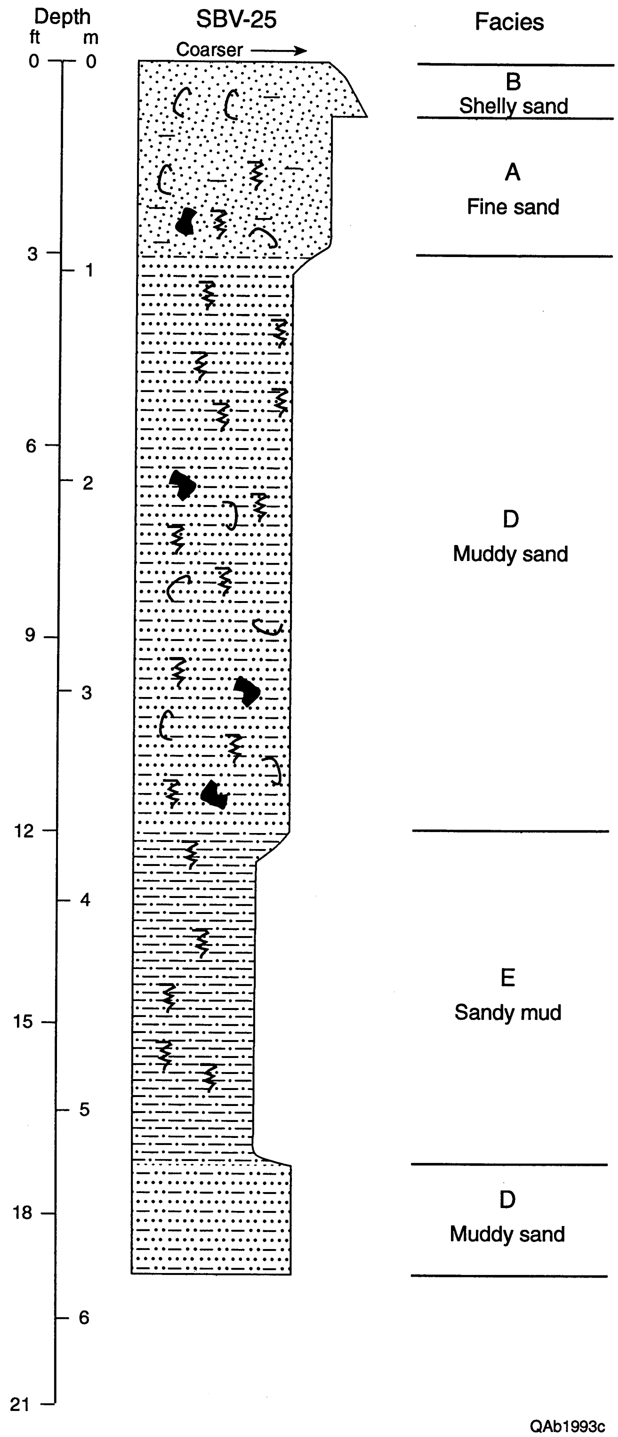


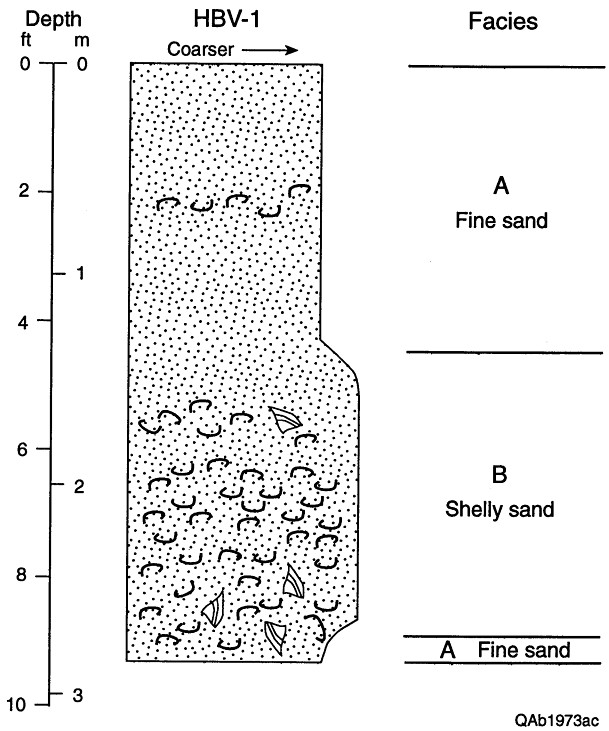
Depth
ft
m
0
0
3
1
6
2
9
3
12
4
15
5
18
6
21
SBV-22
Coarser
Facies
A
Fine sand
D
Muddy sand
E
Sandy mud
QAb1990c

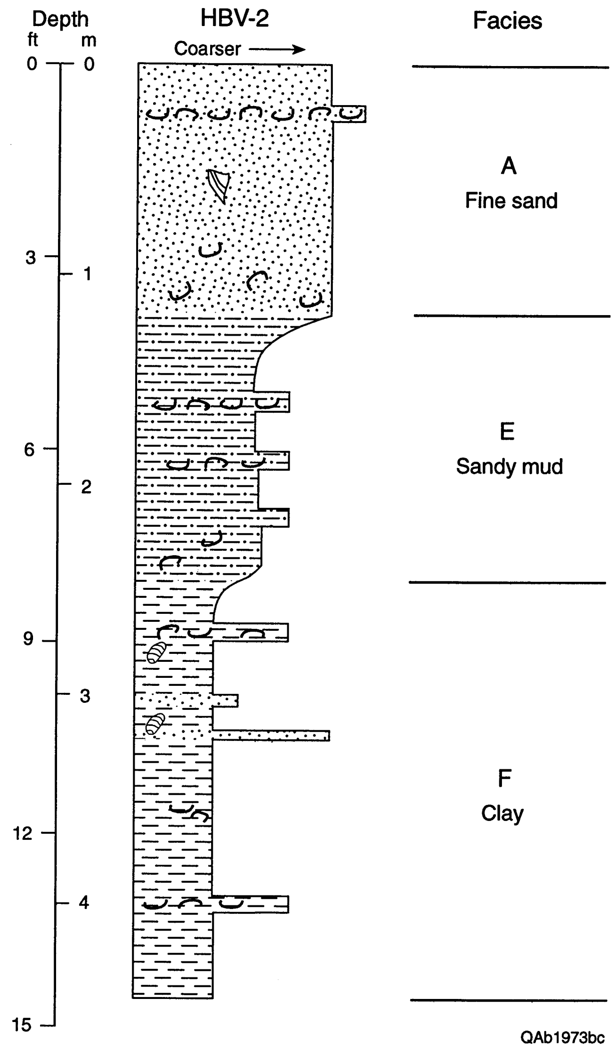

Depth
ft
m
0
3
6
9
12
15
18
21
1
2
3
4
5
6
SBV-23
Coarser
Facies
A
Fine sand
B
Shelly sand
A
Fine sand
D
Muddy sand
E
Sandy mud
QAb1991c



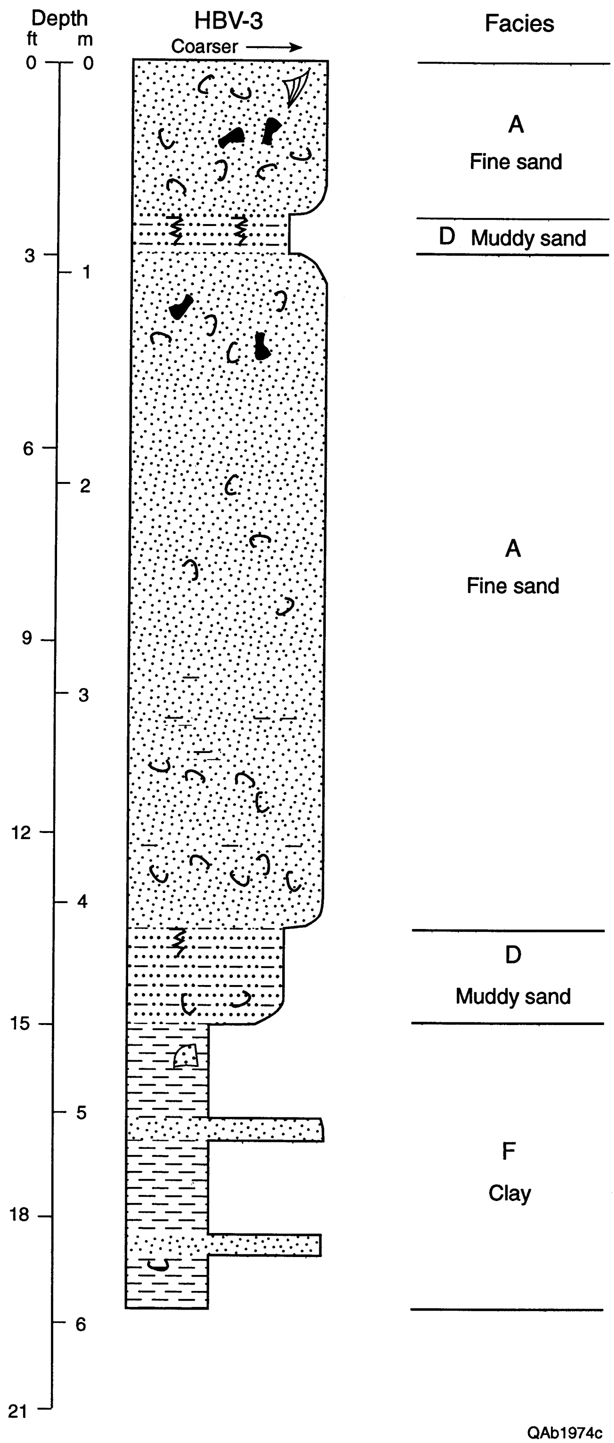
Depth
ft
m
0
3
6
9
12
15
18
21
0
1
2
3
4
5
6
SBV-24
Coarser
Facies
B
Shelly sand
A
Fine sand
D
Muddy sand
F Clay
D
Muddy sand
E
Sandy mud
QAb1992c

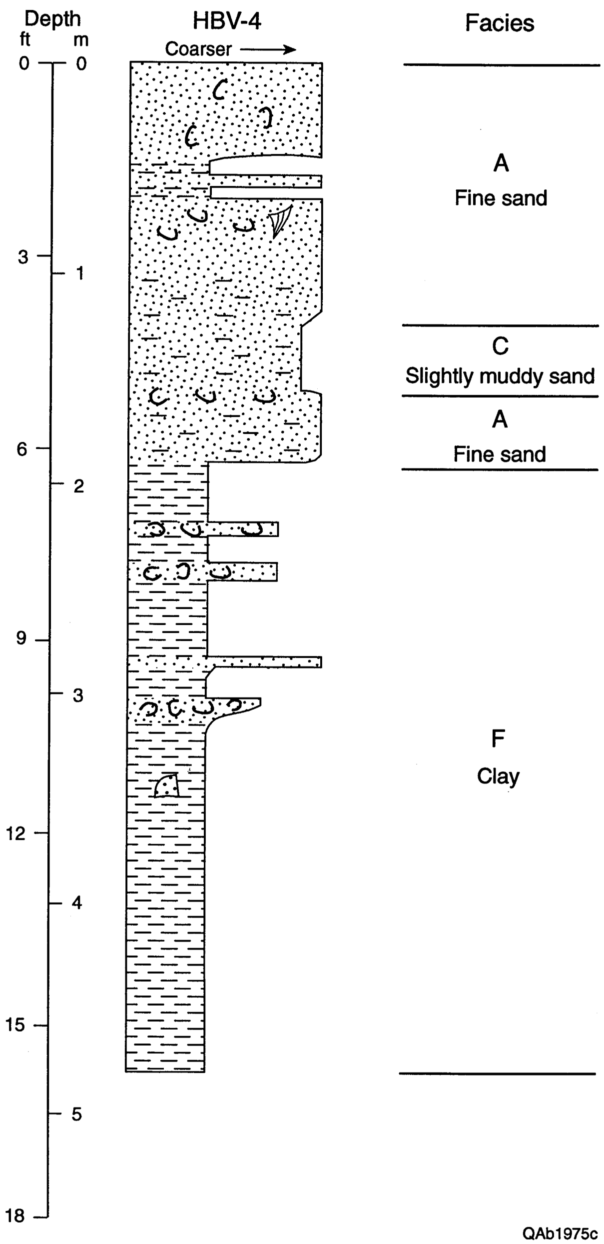

Depth
ft m
0 0
3 1
6 2
9 3
12 4
15 5
18 6
21
SBV-25
Coarser
Facies
B
Shelly sand
A
Fine sand
D
Muddy sand
E
Sandy mud
D
Muddy sand
QAb1993c


Depth
ft
m
0
0
2
1
4
6
2
8
10
3
HBV-1
Coarser
Facies
A
Fine sand
B
Shelly sand
A Fine sand
QAb1973ac

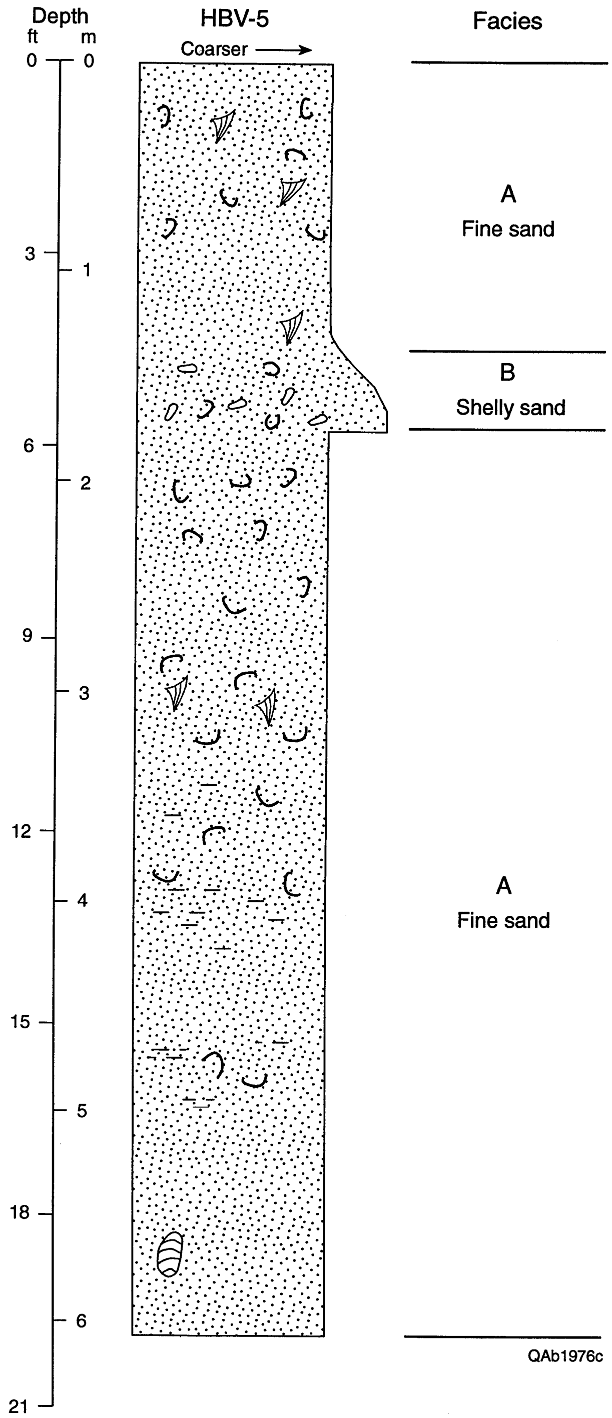


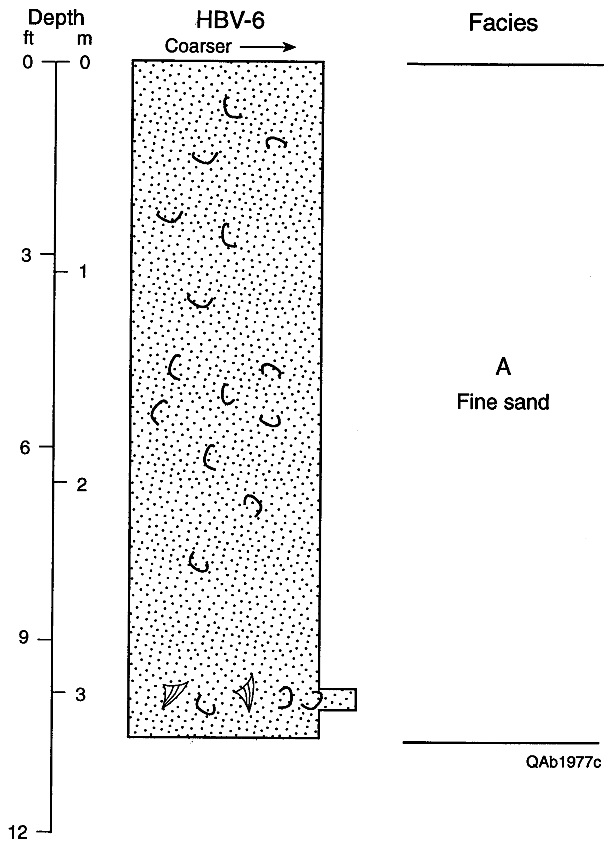
Depth
ft m
0 0
3 1
6 2
9 3
12 4
15
HBV-2
Coarser
Facies
A
Fine sand
E
Sandy mud
F
Clay
QAb1973bc

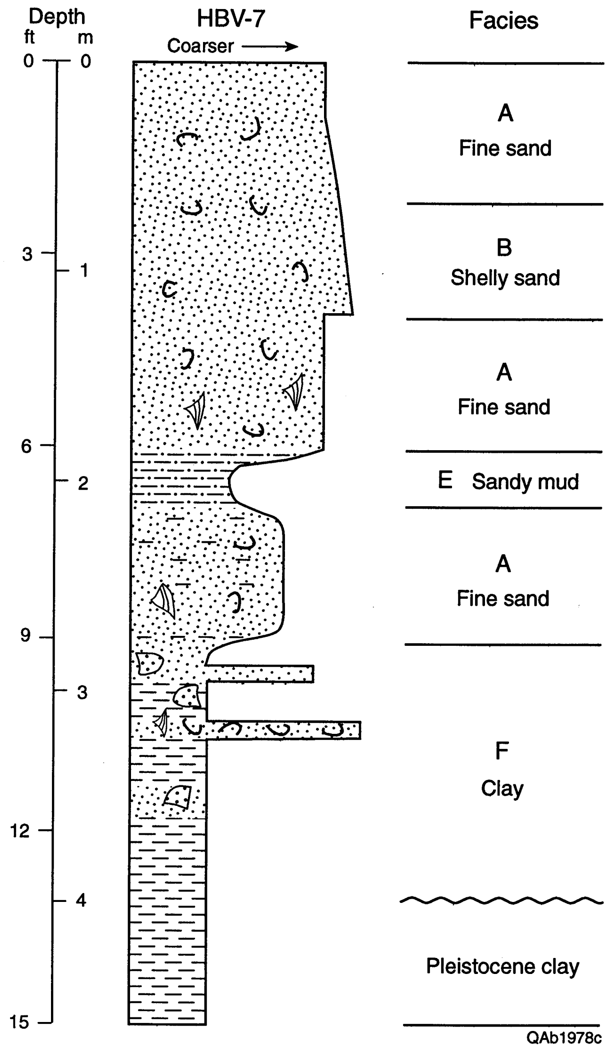

Depth
ft
m
0
3
6
9
12
15
18
21
0
1
2
3
4
5
6
HBV-3
Coarser
Facies
A
Fine sand
D Muddy sand
A
Fine sand
D
Muddy sand
F
Clay
QAb1974c



Depth
ft
m
0
3
6
9
12
15
18
0
1
2
3
4
5
HBV-4
Coarser
Facies
A
Fine sand
C
Slightly muddy sand
A
Fine sand
F
Clay
QAb1975c


Depth
ft m
0 0
3 1
6 2
9 3
12 4
15 5
18 6
21
HBV-5
Coarser
Facies
A
Fine sand
B
Shelly sand
A
Fine sand
QAb1976c


Depth
ft m
0 0
3 1
6 2
9 3
12
HBV-6
Coarser
Facies
A
Fine sand
QAb1977c



Depth
ft m
0 0
3 1
6 2
9 3
12 4
15
HBV-7
Coarser
Facies
A
Fine sand
B
Shelly sand
A
Fine sand
E Sandy mud
A
Fine sand
F
Clay
Pleistocene clay
QAb1978c