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JOSEPH T. SINGEWALD, JR., *Director*

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THE SEDIMENTS OF CHESAPEAKE BAY

by J. Donald Ryan

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PREFACE

The Maryland Board of Natural Resources first called attention to the lack of knowledge concerning the nature of the sediments that have been deposited upon the bottom of the Chesapeake Bay, despite the effect these sediments might have upon the natural resources of the Bay. A committee of the Board was appointed to formulate a plan for carrying out an investigation of these sediments. The plan required facilities for securing core samples from the bottom of the Bay and facilities for a petrographic study of the material of the cores. Fortunately an investigation of the waters of the Bay had been initiated at that time under the Chesapeake Bay Institute. The Director of the Institute, Donald W. Pritchard, Assistant Professor of Oceanography at The Johns Hopkins University, very generously cooperated in the project by equipping the Institute with the necessary sampling apparatus and having the crews on the Institute's boats do the sampling. The study of the cores was an investigation in the field of sedimentary petrography. The facilities and personnel for such an investigation were available to the Department of Geology, Mines and Water Resources. The investigation was undertaken for the Department under the supervision of Associate Professor Judson L. Anderson by Dr. J. Donald Ryan, of the Department of Geology of The Johns Hopkins University. Dr. Anderson was no longer available soon after the work started and the project was carried on ably by Dr. Ryan alone. However, in the interpretation of the results and the preparation of the report, Dr. Ryan had the valuable advice and guidance of Dr. Francis J. Pettijohn, an outstanding authority in the field of sedimentary petrology, who in the meantime had been appointed Professor of Geology at The Johns Hopkins University. Others who cooperated with Dr. Ryan in various aspects of his investigation were Professor Pritchard and Mr. Maurice Powers of the Chesapeake Bay Institute, Dr. Robert M. Overbeck of the Department of Geology, Mines and Water Resources, Mr. Druid Wilson of the Department of Geology of The Johns Hopkins University, and Mr. Carl Supp, geologist for the J. E. Greiner Construction Company.

The cost of the coring and sampling was borne entirely by the Chesapeake Bay Institute. The funds for the petrographic investigation and preparation of the report were provided by the Maryland Department of Tidewater Fisheries.

The contribution of Bulletin 12 to the hitherto practically unknown sedimentology of the Chesapeake Bay has been possible, therefore, through the voluntary scientific, technical, and financial cooperation of those agencies and persons in carrying through the project for the Board of Natural Resources.

JOSEPH T. SINGEWALD, JR., DIRECTOR

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THE SEDIMENTS OF CHESAPEAKE BAY

BY

J. DONALD RYAN

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INTRODUCTION

Chesapeake Bay, long famous for its role in the colonial and maritime development of eastern United States, is the main stem of a great drowned estuarine system in the Atlantic Coastal Plain of Maryland and Virginia (Figure 1). The bay, 180 miles long and from 3 to 30 miles wide, extends from the mouth of the Susquehanna River, its northernmost tributary, south to Cape Charles, Virginia, where it enters the Atlantic Ocean. In addition to the Susquehanna, the Potomac River and numerous other streams are tributary to the bay. The bay and its tributaries form one of the largest estuarine bodies of water on the surface of the globe.

This huge body of water is a dominant influence in the economic and cultural development of the surrounding region. The important ports and shipbuilding centers of Baltimore and Norfolk are located on two of its tributaries, and Washington, D. C., is located on a third. More seafood is taken from Chesapeake Bay than from any other comparable area (Radoff, 1952, p. 9).

Rapid accumulation of mud in parts of the bay has been a serious problem for many years. Navigation in some of the tributaries has been curtailed, and even the main ports are kept in operation only by constant dredging. It has been suggested that "siltation" adversely affects the life processes of the Chesapeake Bay oyster.

The objective of this study was to determine the mechanism of siltation in Chesapeake Bay. This required study of the sediments with regard to (1) their source, (2) their behavior during transportation and (3) the places and conditions under which they are deposited. Only a part of the siltation story is revealed, however, through such sedimentological study. Detailed oceanographic, chemical, and biological studies are also required.

Bottom samples were collected during the summers of 1950 and 1951 by the Chesapeake Bay Institute. The laboratory and analytical work was done during the period April 1950 to April 1952 at the Department of Geology of The Johns Hopkins University.

FIGURE 1. Sketch Map Showing the Location of Chesapeake Bay

METHODS OF STUDY

Collection of Samples

A total of 213 stations was visited, but only 209 samples of bottom sediments were collected (Plate 1). Four stations were not sampled because adequate sampling gear was not available when they were visited. Most of the stations are along traverses crossing the bay above and below the mouths of major tributaries. The distance between stations in a traverse varies from one to two miles. Shorter traverses were made across the channels of Eastern Bay, Tangier Sound, and Pocomoke Sound, and across the mouths of the Chester and Choptank Rivers on the Eastern Shore and the Susquehanna, Patapsco, Potomac, Rappahannock, York, and James Rivers on the Western Shore. Isolated stations were spotted near peculiar topographic features such as deep holes or islands which are rapidly being eroded.

Whenever possible, a modified Dietz-Emery gravity coring tube (Emery and Dietz, 1941) was used for sampling. The sample obtained by this instrument is a cylindrical core about three inches in diameter. If bottom sediments are fine-grained (silt and/or clay) and conditions of drop are ideal, cores up to nine feet in length are recovered. Sandy sediments are unfavorable for coring and frequently are impossible to sample with the Dietz-Emery tube. Most of the stations over sand bottom were sampled with a "snapper type" clam-shell sampler of about 250 grams capacity (LaFond and Dietz, 1948). Core samples were collected from 127 stations and snapper samples were collected from 82 stations.

Records kept during sampling include location (longitude and latitude), depth of penetration, length of core, depth of water, and remarks concerning any peculiarities of sampling or bottom conditions. These data are presented with the description of the samples.

Megascopic Examination of Samples

All samples were examined and described, and the core samples were logged in order to (1) gain some idea of the mass properties, (2) determine the presence of primary structures and changes in depth and (3) provide a basis for further analysis. For this examination, the core samples were removed from their acetate core liners and split lengthwise with a knife. This is important because the outside of the core is usually badly distorted and contaminated.

The samples were examined and described both in the wet and in the dry states. Oxidation during drying masks color differences which are visible in the wet core. Changes in grain size, however, are best studied in the dry core because such changes may be masked by even a small amount of wet silt and clay.

Fine primary structures show up more clearly if surfaces are scraped clean with a razor blade and coated with glycerine.

Size Analysis

To classify the sediments and to determine their size frequency distributions, 258 mechanical analyses were made. The whole of each snapper sample and the top six to eight inches of each core were analyzed to permit comparison of a uniform surface layer throughout the bay. Many of the stratified and some of the non-stratified cores were also sampled below the surface layer.

All samples were washed through 250-mesh screen, and the loss in weight was recorded as the content of silt and clay. After drying, the residue was graded using a nest of screens and a Rotap shaker (Krumbein and Pettijohn, 1938). The screens had openings which decreased in size according to $\sqrt{2}$, each screen giving the lower limit of the next smaller Wentworth (1922) grade size. Intermediate-size screens were generally used to provide additional points on which to base the cumulative curve.

In the samples containing more than 25 percent silt, the wet sieving was preceded by dry sieving the sediment on 250-mesh screen to obtain a small quantity of dry silt and clay for further analysis. Five grams of this material was briskly agitated in a peptizing solution of 100-Normal sodium oxalate and then stored overnight to disperse individual particles as fully as possible. This fraction was then separated into "equivalent" size grades which vary as the $\sqrt{2}$ using the bottom withdrawal tube described by the government agency group at the University of Iowa Hydraulic Laboratory (1943). Weight percentages obtained from this operation were multiplied by the percentage of total silt and clay in the entire sample in order to express the size distribution in terms of the entire sample. These data are shown in Table 3.

A cumulative size frequency curve was constructed for each sample, and the median diameter (Md), first quartile (Q_1) and third quartile (Q_3) were recorded. From these values statistical measures originally proposed by Trask (1932, p. 70-75) were derived to study the size, sorting, and skewness of the sediments. Geometric measures were used to reduce the effects of size on sorting and skewness values (Krumbein and Pettijohn, 1938, p. 260).

The average spread of the cumulative curve can be expressed as the quartile deviation or the ratio between the first and third quartiles. Since this is essentially a measure of the sorting of the sediment, Trask proposed that the geometric quartile deviation be called the "coefficient of sorting (So)". That is:

$$So = \sqrt{Q_3/Q_1}$$

Q_3 is always the larger number. The values of So increase geometrically and therefore individual values cannot be directly compared. This is remedied by converting So to $\log_{10}$ So.

A geometric measure of the asymmetry or skewness of the curve is from the equation (Krumbein and Pettijohn, 1938, p. 235):

$$SK_g = \sqrt{Q_1Q_3/Md^2}$$

If Sk_g is greater than 1, the normal distribution is skewed toward the coarse; if Sk_g is less than 1, the normal distribution is skewed toward the fine. This measure also yields values which cannot be directly compared. Comparisons can be made if Sk_g is converted to $\log_{10} Sk_g$. In this case a positive value indicates that the curve is skewed toward the coarse; a negative value indicates that the curve is skewed toward the fine. Statistical data are given in Table 4.

Mineralogical Analysis

To locate and evaluate the sources of Chesapeake Bay sands and to describe the changes in relative abundance of the minerals during transport, the heavy minerals of 78 sand samples were separated and studied. Heavy minerals are usually more diagnostic than light minerals.

Sands derived from the same source often show considerable variation in mineral composition due to the sorting effects of the transporting medium. Most petrographers agree that sorting is largely a function of size, specific gravity, and to a lesser extent shape of the mineral grains (Van Andel, 1950, p. 19). Based on preliminary work and the recommendation of Rittenhouse (1943, pp. 1772 to 1775), heavy mineral separations were made on one size grade only (.125 mm.–.246 mm.), and ratios between pairs of minerals of about the same specific gravity were constructed. Sorting should affect both minerals of a pair to the same degree, so that any significant change in the ratio between them would indicate a probable difference in source.

Separations were made in the standard manner (Krumbein and Pettijohn, 1938, pp. 343–344 and Fig. 153) using tetrabromoethane (specific gravity = 2.95 at 20° C.). Approximately 1000 grains were split from each separate, using the Otto microsplit (Otto, 1933), and mounted in Canada balsam. A minimum of 300 grains was counted on each slide. If less than 100 of these grains were non-opaque minerals, counting was continued until at least 100 non-opaques had been counted. Although the probable error for this number of grains is still relatively large (Dryden, 1931), it is impractical to count more.

A number of light fractions were also examined.

Topographic Analysis

Bottom topography and shoreline configuration studies were made using U. S. Coast and Geodetic Survey Chesapeake Bay charts, 1950, Nos. 1222 to 1226 and Cape May to Cape Hatteras chart, 1934, No. 1109.

U. S. Geological Survey topographic maps were used to analyze the physiography of the adjacent land mass.

GEOLOGIC AND PHYSIOGRAPHIC CONSIDERATIONS

Regional Geology and Physiography

Chesapeake Bay is located wholly within the Atlantic Coastal Plain, but part of its western and northern watershed extends into the Piedmont Plateau (fig. 1). The Piedmont Plateau is underlain by structurally complex Pre-Cambrian and early Paleozoic crystalline rocks which, because they are hard and generally resistant, impart to the landscape a rolling and hilly character. Altitudes in the Piedmont at places exceed 500 feet.

Coastal Plain rocks are soft, commonly unindurated gravels, sands, clays, and marls of Cretaceous (Lower and Upper), Paleocene, Eocene, Miocene, Pliocene (?), and Pleistocene age. These deposits strike northeast and dip gently southeast. The oldest (Cretaceous) beds crop out in a belt adjacent to the Piedmont and the outcrops of successively younger formations lie in roughly parallel belts to the southeast. The picture is modified somewhat by a series of terrace deposits of Pleistocene gravel, sand, and clay. These terraces, especially over the greater part of the Eastern Shore, cover much of the older Tertiary rock. Most of the formations thicken to the southeast. Thus, the Coastal Plain sediments form a wedge-shaped body lapping over the ancient crystalline rocks.

No Triassic rocks crop out between the Cretaceous and the crystalline rocks on the Western Shore, but Anderson (1948, pp. 13 and 83) described Triassic rocks of the Newark series from deep wells on the Eastern Shore.

A generalized geologic section of the Coastal Plain formations is given in Table 1.

Because Coastal Plain rocks are soft and easily eroded, altitudes rarely exceed 300 feet and are usually less. Where streams draining the higher Piedmont enter the Coastal Plain, they have steeper gradients and rapids. These rapids mark the Fall Line, a natural boundary between the two provinces.

Elevation and topographic development within the Coastal Plain are closely related to the regional geology. The areas where Cretaceous or Tertiary rocks crop out are relatively high and show moderate relief, but where Pleistocene deposits are preponderant, elevations are low and relief is practically nil. Thus, southeastward across the regional strike the height of the landmass decreases.

Pleistocene deposits cover much of the Eastern Shore which is predominantly low and flat. Altitudes of 25 feet or more are rare except in the extreme northern area of Cretaceous outcrop. There are few major Eastern Shore rivers and none of them are equal in size to the larger Western Shore rivers.

Remnants of Pleistocene rocks are widespread on the Western Shore on the interstream areas. Most of this region is comparatively high and deep dissection exposes the underlying rocks along the hillslopes. A late dendritic drainage pattern of small stream valleys has maturely dissected the regions between the major stream valleys. Landforms are generally rounded, but a few flat-topped summits remain. A number of large tributaries drain the Western Shore. The

TABLE 1

Geologic Formations Cropping Out in the Chesapeake Bay Region

Series	Formation	Member
Recent	—	
Pleistocene	Pamlico Wicomico Sunderland	
Pliocene (?)	Brandywine Bryn Mawr	
Miocene	Yorktown St. Marys Choptank Calvert	 Plum Point marl Fairhaven diatomaceous earth
Eocene	Nanjemoy Aquia	Marlboro clay
Paleocene	Brightseat	
Upper Cretaceous	Monmouth Matawan Magothy Raritan Patapsco Arundel	
Lower Cretaceous	Patuxent	

largest are the Susquehanna River which enters Chesapeake Bay at its northern tip and the Potomac River which forms the Maryland-Virginia boundary. Both originate outside the Coastal Plain. Between the Susquehanna and the Potomac, no large tributaries (with the possible exception of the Patuxent River) enter the bay, but south of the Potomac are successively the Rappahannock, York and James Rivers.

Geologic History of Chesapeake Bay

According to Stephenson, Cooke and Mansfield (1932, p. 11–13) the drowned valleys of Chesapeake Bay and its tributaries date back to Pliocene time which appears to have been a period of "differential upwarping" and erosion in this area. During Pleistocene time, the valleys and part of the land areas of the region were alternately submergent and emergent due to the great fluctuations of sea level caused by the alternate advance and retreat of continental glaciers. According to Flint (1947, p. 427) the level of the Atlantic Ocean during the fourth (last) glacial stage was reduced 230 to 330 feet. The terraces and terrace deposits of the region are thought by Stephenson *et al.* to represent the Pleistocene intervals of high water. It is further postulated that low water marks in the form of now submerged channels should be present.

Although later workers doubt that all the terraces are marine (Wentworth, 1930, and others), there can be little question concerning Pleistocene channeling below the level of the present Chesapeake Bay floor. A geologic section based on cores of the Chesapeake Bay bottom between Sandy Point and Kent Island (J. E. Greiner Construction Co., 1948, Plate 6) is shown on Plate 2. Two well-defined channels cut the Tertiary rocks. The largest is unquestionably an ancient river canyon. It is relatively close to the Eastern Shore and lies directly below the present main channel of the bay. Chesapeake Bay is an ancient drainage system which has been drowned by a later rise in sea level. Furthermore, the older river channels probably underlie the present channel of the bay throughout much of its length. The present form of Chesapeake Bay and its major tributaries should be closely related to the regional pattern of the ancient drainage.

Beyond the western lip of the canyon, the bedrock surface forms a gentle slightly concave curve as it rises to meet the distant western shoreline. This curve is broken only by the notch of the smaller channel. East of the main channel, the bedrock surface forms a gentle approximately convex curve and thus attains a higher elevation rather rapidly. Submerged bedrock east of the channel, therefore, is at a considerably higher level than that west of the channel. The reasons for this asymmetry are discussed on page 13.

Evidence of Continuing Rise of Sea Level

Marmer (1943, 1948) has plotted the yearly means of high tide levels measured at a number of tide stations along the Atlantic Coast. Some of these stations are in the Chesapeake Bay. According to Marmer's figures, since 1930 sea level has been rising at the geologically rapid rate of .02 feet per year. Older records show that during the 35 years preceding 1930, sea level was also rising but at about one-seventh the rate during the later period.

The Form of Chesapeake Bay

"The most striking physiographic feature of the Chesapeake Bay region is the great and intricate dendritic system of navigable waterways that ramify through it. Chesapeake Bay, which is really an estuary, is the main trunk of this system" (Stephenson, Cooke and Mansfield, 1932, p. 3). An estuary is "a passage where the tide meets the river current" (Webster's Collegiate Dictionary, 1940).

Rising sea level since the end of the last Pleistocene glacial stage has modified an older topography and produced the present "drowned" character of the bay. Many of the smaller tributaries, such as the Patapsco River (Pl. 1), no longer resemble rivers but are large indentations along the shoreline. An intricate arrangement of smaller indentations has been produced by flooding of smaller tributary valleys and lowlands. Island remnants of older more extensive land areas are numerous; and in many parts of the bay, such as Tangier and Pocomoke Sounds, wave-eroded and drowned land surfaces form large portions of the bay floor. In general, the bay widens as one approaches the Atlantic Ocean, although the inlet is comparatively narrow due to the projection of Cape Henry.

The pre-drowned Pleistocene drainage pattern of the entire Chesapeake Bay region may be readily inferred from an analysis of the course of the bay and its major tributaries. Clearly, a geometric relationship exists between the regional pattern of the bay and its major tributaries and the attitude of Coastal Plain rocks (fig. 2).

The Susquehanna and Potomac Rivers, the two major tributaries of Chesapeake Bay, are consequent streams entering the Coastal Plain through the Piedmont in courses normal to the trend of the Piedmont axis and the regional strike of Coastal Plain sediments. Immediately southeast of the Fall Line, within the belt of outcropping Cretaceous formations, both abruptly shift course to flow parallel to the regional strike. This portion of the Susquehanna forms that part of Chesapeake Bay between Havre de Grace and the mouth of the Patapsco River. Apparently in these areas, the Susquehanna and the Potomac follow the courses of ancient *subsequent* streams; that is, streams that have developed valleys upon a belt of underlying weak rock.

In sharp contrast the large Western Shore rivers which course mainly through the wide belt of Tertiary formations are important consequent streams throughout their entire lengths, flowing parallel to the regional dip. The area of Tertiary outcrop is the area within which Coastal Plain elevations gradually diminish to the southeast. The rivers of this region must have developed from streams flowing down the back slope of a large cuesta formed by erosion of the Tertiary rocks. Within this same belt, the modern Potomac River and Chesapeake Bay both bend sharply southeast. In each case, headward working consequent

FIGURE 2. Trends of Chesapeake Bay

streams within the Tertiary belt must have captured the subsequent streams which cut valleys for the Potomac and the Chesapeake in the Cretaceous belt.

In contrast, the trend of Eastern Shore rivers throughout most of their course is roughly parallel to the regional strike. These streams must follow old subsequent stream valleys. The two major rivers within the Tertiary belt, the Chester and the Choptank, before entering the bay bend sharply and for a short distance flow north. Probably, *resequent* streams form these parts of the river valleys.

Within the Tertiary belt, Chesapeake Bay proper remains narrow. As would be expected, considering the arcuation of the bay in this region and the differences in drainage pattern and elevation of the land masses, the eastern shoreline is in striking contrast to the western shoreline. Low marshy land, numerous islands, and small embayments are characteristic of the Eastern Shore. On the concave western bank, the famous Calvert Cliffs tower 100 feet above the water and the coastline is smooth, broken only by occasional spits or small stream valleys.

The largest area of Pleistocene outcrop is the part of the Eastern Shore below Salisbury. Within the Pleistocene belt, Chesapeake Bay widens and again slightly changes its course. Tangier and Pocomoke Sounds, broad drowned Eastern Shore stream valleys, are part of the bay in this region. The stream valley of Pocomoke Sound, like other Eastern Shore stream valleys, is subsequent and must have extended from the present Pocomoke River nearly to the mouth of the James River of the Western Shore. A large part of Chesapeake Bay below the mouth of the Potomac River follows this subsequent stream valley although post-Pleistocene flooding has somewhat distorted the pattern. Cape Henry is apparently an outer cuesta (Lobeck, 1939, p. 457). At its mouth, the bay resumes its southeastward course and enters the Atlantic Ocean following a consequent stream valley.

On the basis of its form, then, Chesapeake Bay can be subdivided into four major parts (fig. 2):

(1) *The Northern Bay Area.* Between Turkey Point and the mouth of the Patapsco River, within the belt of Cretaceous rocks, Chesapeake Bay follows a subsequent stream valley. The Susquehanna River is the only large tributary which enters this part.

(2) *The Mid-Bay Area.* Between the Patapsco River mouth and the mouth of the Potomac River, within the Western Shore belt of Tertiary rocks, the bay bends southeast and eventually follows a consequent stream valley. The largest tributaries of this part are the Patuxent River of the Western Shore and the Chester and Choptank Rivers of the Eastern Shore. All are relatively small.

(3) *The Southern Bay Area.* Between the mouth of the Potomac River and the entrance to the bay, Chesapeake Bay follows the trend of Pocomoke Sound, a drowned Eastern Shore subsequent stream valley cut in Pleistocene

rocks. The Potomac, Rappahannock, York and James Rivers drain the Western Shore and enter this part of the bay. In addition to Pocomoke Sound, Tangier Sound enters from the Eastern Shore.

(4) *The Bay Entrance Area.* The bay enters the Atlantic Ocean following a consequent stream valley.

This type of development appears to be typical of the Atlantic Coastal Plain (Lobeck, 1939, p. 457).

Bottom Topography of Chesapeake Bay

CROSS SECTION PROFILES

A close correlation exists between the profiles of cross sections of the bay bottom and the form of the bay (Pls. 3 to 16).

Northern Bay Area: Plate 3 is a typical cross section of the Northern Bay. The channel is far to the east of center and close to the Eastern Shore. West of the channel, the bay floor slopes gently upward to the shoreline; east of the channel, the slope is steep. This asymmetrical development is likely due entirely to the strike trend of this portion of Chesapeake Bay. The gentle slope of the bay floor west of the channel is simply the slope of sediments deposited on the dip slope (back slope) of the old inner lowland of Pleistocene times; the steep east side of the channel follows the inface of a cuesta along which the ancient consequent stream valley formed (fig. 2). Little change in this profile since Pleistocene times is suggested.

Mid-Bay Area: Cross section profiles in the narrow Mid-Bay part which curves across the regional strike are also usually asymmetrical (Pls. 4 to 10). In this area, however, the western flank of the channel is often initially steep although not as steep as that of the eastern side. The explanation for asymmetry in the Mid-Bay area cannot be the same as that for asymmetry in the Northern Bay area because this portion of the bay cuts across the regional strike. Deep drilling at the Chesapeake Bay bridge in this area showed that the surface of bedrock west of the old river canyon slopes gently upward to the Western Shore and is generally at a much lower elevation than bedrock east of the channel. But, originally, bedrock west of the channel should have been slightly higher than that east of the channel since the regional dip of Coastal Plain formations is southeast. Therefore, rock west of the channel must have been eroded at a faster rate than rock east of the channel. The reason for this seems apparent. The western shoreline is the concave shoreline of the bend, the shoreline which should be cut back most rapidly. The greater part of this cutting back process must have taken place after the old river canyon was partially flooded because the gentle concave slope of bedrock west of the old channel begins at the top of a vertical canyon wall nearly 100 feet high. Rock above this canyon edge could not have been eroded until water had reached that level.

Subsequent sedimentation has smoothed out the profile but the original form is retained. The relatively greater depth of the present channel in this area compared to that of other parts of the bay is probably related to its narrowness. The old river channel has been kept relatively free of mud by comparatively swift currents.

Along the Calvert Cliffs just below water level, a prominent terrace rims the shoreline. Several spits are building outward in this area.

Southern Bay Area: In the broad Southern Bay area, the flooded valleys of Tangier and Pocomoke Sounds complicate the profile (Pls. 11 to 16). Generally, the bay proper is relatively shallow, but Tangier and Pocomoke Sounds are deep throughout much of their lengths. Probably the greater depth of the Sounds is related to their narrowness. The Southern Bay area follows a subsequent pattern and like the Northern Bay area, often shows the effect of cuesta development (Pl. 12). Thus, Pocomoke Sound, the deepest part of the Southern Bay area, is immediately adjacent to the Cape Henry cuesta.

Bay Entrance Area: The channel of the bay again deepens as it passes into the Atlantic Ocean. East of the channel, prominent sand bars, widest at their northern ends, indicate the development of a large tidal delta (Pl. 1).

Longitudinal Profile

The bottom sediments of Chesapeake Bay have been deposited over land surfaces dissected by an older drainage system, the ancient river valleys having been more or less filled with detritus. Variations in water depth within the channel in different parts of the bay have been described. These variations are believed to represent variations in thickness of the sediments which have accumulated and filled the underlying ancient stream valleys.

Plate 17 is a longitudinal profile of the main Chesapeake Bay channel. To compare thicknesses of fill in the various parts of the bay, a curve representing the hypothetical gradient of the Pleistocene (fourth glacial stage) drainage system has been drawn. Three points have been used to control the curve: (1) the stream bed in the mouth of the Susquehanna River at the Fall Line which is probably at essentially the same level today as at the close of the Pleistocene, (2) the top of Pleistocene gravel in the channel at the Chesapeake Bay Bridge as shown in the Greiner Company report (Pl. 2), and (3) the nearest point on the Continental Shelf at which the Atlantic Ocean is 300 feet deep which is approximate sea level during the last great ice advance of the Pleistocene (Flint, 1947, p. 427).

This profile shows at least three natural divisions of the channel based on depth of fill. These divisions correspond to three of the divisions based on topographic form.

In the Northern Bay area, the profile is smooth, and deep holes do not exist. At its southern boundary, about 80 per cent of the Pleistocene valley (the space between the Pleistocene valley floor and modern water level) is filled with sediment. A subdivision of this unit is the small catchment basin at the mouth of the Susquehanna River (Pl. 1). In this area, the accumulation of sediment has nearly filled the valley.

Where the bay begins its southeastward swing, the channel depth increases sharply and the channel remains deep throughout the Mid-Bay area. In places the bay is extremely narrow, as along Kent Island or opposite Cove Point. In these places deep holes occur. The channel is also deeper near the entrance of some of the tributaries. Overall, only about 50 percent of the Pleistocene valley has been filled with sediments. Topography suggests that the reason for this relatively low percentage of fill is the absence of large tributary streams draining into this area. The Patuxent River, entering from the Western Shore near the southern end of this area, is the largest and it seems minor. The immediate cause for the sharp break in profile at the northern boundary of this area is probably the narrowness of the bay at that point. Currents through these narrows must be rather swift.

Approximately at the mouth of the Potomac River, the channel again becomes relatively shallow and, except for local deepening below the mouth of the Potomac and at the point of entry of Pocomoke Sound, remains shallow to the entrance of the bay. This would seem anomalous because this is the deepest part of the ancient Pleistocene valley. The only possible explanation is that sedimentation in this area has been very rapid. Excluding the areas where tributary channels are present, slightly more than 90 per cent of the Pleistocene valley in this section has been filled. Furthermore, the total volume and sediment in the Southern Bay area is tremendously greater than in any other part of the bay. It seems highly significant that this is the area of Chesapeake Bay in which all of the large Western Shore tributaries except the Susquehanna River drain into the bay. The two large Eastern Shore tributaries, Pocomoke Sound and Tangier Sound, also enter the bay in this area. At its southern end, the bay meets the Atlantic Ocean and at rising tide, the Atlantic is also a tributary of the bay. The presence of a tidal delta extending from the Bay Entrance area into the Southern Bay area indicates that sand from the Atlantic Ocean is swept into Chesapeake Bay. It seems likely that this movement has long continued and is responsible for at least a part of Southern Bay sedimentation.

The deepening of the channel as it passes through the Bay Entrance suggests a fourth smaller unit based on profile change that corresponds to the fourth unit based on the change in bay form. Here the bay is narrow and tidal currents are strong. Beyond the Bay Entrance on the open Continental Shelf, the channel soon disappears. The old stream valley has been completely erased.

Estimated Volume and Rate of Sedimentation

Assuming that the hypothesis regarding the pre-drowned topography of the ancient stream valleys is correct, the shape and volume of the sediment mass which now partially fills the valleys and forms the bottom of Chesapeake Bay can be determined. This mass is bounded by the floors of the ancient valleys and the present bottom of the bay. A cross section of the mass has approximately the shape of an inverted triangle with its altitude many times shorter than its base. The area of the triangle is a function of the distance of the cross-section from the northern tip of the bay. At least in the Mid-Bay area the triangle is modified by the presence of the ancient steep-walled part of the canyon.

The volume of this mass in the three main areas of the bay is approximately:

Northern Bay area	2,750,000,000 cubic yards
Mid-Bay area	12,000,000,000 cubic yards
Southern Bay area	46,400,000,000 cubic yards
Total	61,150,000,000 cubic yards

Recent estimates of the time which has elapsed since the close of the Pleistocene epoch vary, but according to carbon isotope studies, 10,000 years is a good approximation. If this figure is correct, the average rate of sedimentation in Chesapeake Bay during this period has been about 6,115,000 cubic yards per year.

HYDROGRAPHIC CONSIDERATIONS

Since Chesapeake Bay is an estuary, both fresh water currents from the tributary streams and tidal movements are present.

Tidal movement is a continuation of the Atlantic tidal wave which sweeps up and down the bay and its tributaries (Haight, Finnegan and Anderson, 1930). The northward movement is stopped only by the Fall Line or other sharp change in elevation. High tide in the upper reaches of the bay is a full cycle behind high tide at the mouth, and it is not uncommon for currents in different parts of the bay to be opposing.

Observations on salinity distribution (Chesapeake Bay Institute, 1949–1951) show a tongue of highly saline water moving along the eastern side of the bay. Water west of the channel is much less saline. This indicates that the ocean-derived water moves up and down the channel, whereas fresh water, mostly from the large western tributaries, moves along the western side of the bay. Flood tide in the channel is slightly stronger than ebb tide (Pritchard, personal communication).

Salinity decreases from about 31 parts of salt per 1,000 parts of water at the mouth of the bay to 0 parts of salt per 1,000 parts of water approximately at Turkey Point in the extreme northern reaches of the bay. Salinity also drops rapidly up the tributaries.

Current velocity data are incomplete, but, in general, currents in the channel are slightly stronger than those elsewhere in the bay (Pritchard, personal communication). Where the channel curves sharply, the currents may be strongest close to the concave shoreline. Strong currents may also be present where the bay is narrow. Surface currents in most of the bay average about one knot per hour during ebb or flood tide (Haight, Finnegan and Anderson, 1930). Very little information is available concerning currents below the surface. It is thought that channel currents attain their maximum velocity near the bottom except in the deeper holes where only slight currents can be detected (Pritchard, personal communication).

Oxygen content of the water varies with the seasons, being slightly higher during winter (Chesapeake Bay Institute, 1949–51). As might be expected, oxygen content is slightly higher in the water of the tributaries and northern parts of the bay.

Temperature also varies with the seasons. Water in the upper part of the bay is usually a few degrees warmer than that in the lower bay (Chesapeake Bay Institute, 1949–51).

pH is normally slightly alkaline averaging about 8.0 (Chesapeake Bay Institute, 1949–51).

SHORE EROSION STATISTICS

Present Rate of Erosion

Of great concern to the inhabitants of the Chesapeake Bay region is the large and continuing loss of shoreline acreage due to erosion. A recent survey by Singewald and Slaughter (1949) shows that during the past 90 years, Tidewater Maryland lost 29,371 acres by erosion, an annual loss of 326 acres. Small quantities of the lost sediment are redeposited to form spits or at places actually extend the shoreline bayward. The total net loss, the difference between the number of acres lost due to erosion and the number of acres accumulated due to deposition (ibid p. 19), during the same period was 24,712 acres, or 274 acres annually.

Singewald and Slaughter have also prepared figures concerning "rate of erosion" defined as "the number of acres of land per mile lost during a given period of time" (ibid p. 19). Table 2, compiled from a number of their tables, shows annual rates of erosion of the mainland along Chesapeake Bay (tributary shoreline not included) and other measurements for those counties which border the bay.

Rate of loss along the bay shoreline in the Mid-Bay area is almost exactly double that in the Northern Bay area (31.9 acres against 15.4 acres). This contrast would seem to be in harmony with the contrasting trends and longitudinal profiles of the two areas. The channel is deeper in the Mid-Bay area than in the Northern Bay area, and shore erosion is more rapid in the former area.

The low rate (16.9 acres) for Calvert County is accounted for by the high unbroken coastline of the Calvert Cliffs. The volume of material in 16.9 eroded acres there is far greater than the volume in 16.9 acres eroded on a low area of the coast such as the Eastern Shore. For example, the annual rate of loss of Dorchester County on the Eastern Shore is .64 acres. The elevation of the land surface near the bay in this area averages less than 10 feet. Assuming the *maximum* elevation of 10 feet, then, .64 acres annual rate of loss is equivalent to an annual rate of loss of 10,325 cubic yards. In Calvert County, where the average shoreline elevation is about 100 feet and the annual rate of loss is only .17 acres, a total of 27,427 cubic yards is lost. Thus Calvert County loses at least three times the volume of material per mile of shoreline lost by Dorchester County.

Although the annual rate of loss of the entire eastern shoreline bordering the bay (.34 acres) is double the average annual loss of the entire western shoreline bordering the bay (.17 acres), the volume of sediments lost by the higher Western Shore is considerably greater than that lost by the low Eastern Shore.

Erosion statistics for the Southern area in Tidewater Virginia are not available.

Ancient Shore Erosion

During the existence of Chesapeake Bay as a drowned estuary, only two areas of coastline in the bay proper could have contributed significant quantities of shore eroded material to the mass of bottom sediments. These areas are regions of the western shoreline where the trend of the bay is normal to the regional strike of Coastal Plain formations and the western floor of the bay is not a dip slope.

TABLE 2

Shore Erosion Statistics of Mainland Bordering Chesapeake Bay, Maryland Tidewater Counties

County	Time Interval	Miles Measured	Erosion	Deposition	Net Loss	Loss per Mile	Annual Rate of Loss per Mile
	years		*acres*	*acres*	*acres*	*acres*	*acres*
Northern Bay Area							
*Cecil	94	15.6	209	14	195	12.5	.13
*Kent	97	36.9	611	33	578	15.6	.16
Harford	95	24.0	405	22	383	15.9	.16
Baltimore	90	9.3	178	14	164	17.6	.19
Totals		85.8	1403	83	1320	15.4	.17
Mid-Bay Area							
*Queen Annes	97	17.6	688	96	592	33.0	.34
*Talbot	90	11.3	301	15	286	25.3	.28
*Dorchester	94	29.5	1874	65	1809	61.0	.64
Anne Arundel	91	40.3	1155	114	1041	25.8	.30
Calvert	96	31.3	645	115	530	16.9	.17
St. Marys	94	22.5	672	72	600	26.6	.28
Totals		152.5	5335	477	4858	31.9	.34

* Eastern Shore.

One such region of the bay is the entire Mid-Bay area. If we assume that the profile shown on Plate 2 is representative of the entire area, a tremendous portion of the Western Shore has been eroded since sea level began to rise. Furthermore, the material removed by shore erosion must now form part of the bottom sediments in Chesapeake Bay. Since nothing is known of the hydrographic regimen of the bay during most of this period, it cannot be definitely stated exactly where within the bay this material was deposited nor where it lies today. If conditions were near those of the present, most of it must have been deposited in the Mid-Bay area.

The ancient topography of this region is not sufficiently well known to make an accurate estimate of the volume of sediment contributed to the bay from this source. If the land mass filled all of the area between the bedrock surface under the western floor of the bay and a horizontal surface extending out from the elevation of the present shoreline, approximately 28,000,000,000 cubic yards of the Western Shore would have been lost. Since a mass of that geometry could not have existed when sea level began to rise, this figure is probably at least two or three times too high. Nevertheless, an enormous amount of material has been lost from the shoreline and must lie somewhere among the bottom sediments of the bay.

A lesser volume of sediment must have been removed from the area along the western shoreline between the mouths of the James and York rivers, an area very close to the bay entrance. Much of this material was swept into the nearby Atlantic Ocean. It is impossible to determine how much of it was deposited within the Bay.

CHARACTER AND DISTRIBUTION OF THE BOTTOM SEDIMENTS

General Description

In Chesapeake Bay, the channel and large areas west of the channel are floored with a homogenous mass of gray or black mud (Pl. 1). The mud consists of silt, of varying amounts of kaolinitic or montmorillonitic clay (Powers, personal communication), and, especially near the surface, of water. The upper portion of mud cores cannot support its own weight and during drying commonly shrinks more than 50 per cent.

Within the Coastal Plain tributaries, mud also forms the channel bottoms. These muds extend into the bottom muds of the bay. This alone is evidence that the tributaries must discharge silt and clay into Chesapeake Bay. There is probably some movement of tributary muds into the bay by bottom creep.

The asymmetrical distribution of mud in the bay proper is due to the asymmetric bottom topography. Since the deepest parts of the ancient valley are the channel and the sloping bottom west of the channel, these are the areas of greatest sediment accumulation.

Sand and, at places, gravel occur in areas extending outward from the shoreline. Sand also occurs in the bay entrance section where it forms the bars in the tidal delta.

Stratification

With some exceptions, the cores were in material homogeneous in grain size throughout. Several of the silt cores were sampled in depth in order to check the megascopic examination by means of mechanical analysis. No significant difference was noted that could not be picked up by eye.

Fine laminae occur in most of the cores from the upper bay (Stations 3 to 16) and in cores from deep holes further south. Some cores from other environments are also laminated. A typical example of laminated core is shown in Plate 18 (p. 55). The laminae resemble varves in that sequences occur in which a light-colored silt or very fine-grained sand grades upward into normal dark-colored finer clayey silt. Usually the dark portion of the layer is much thicker than the light portion. Many of the laminae split and in some cores tiny lenses occur. In many cores, this may be due to distortion from the coring tube or differential shrinkage during drying; but in some cores, lenses and split laminae occur among perfectly flat normal laminae. In one core, a layer of grass about one-eighth inch thick was found parallel to the lamination.

These laminations represent fluctuations in the size of material deposited. It does not seem likely that these fluctuations are seasonal since seasonal laminations are usually regular and non-lenticular. The presence of very fine-grained sand in these laminae suggests that the currents in these areas are at times somewhat stronger than normal channel currents, a proposition that has already been stated in connection with the origin of the deep holes in narrow parts of the channel.

South of Sharps Island (Station 80), a core was taken in which sand overlay silt. Apparently rapid shore erosion has caused the encroachment of relatively coarse sand on the silt bottom.

Near the mouth of the bay, stratification in the channel mud is common. Thick partings of silty sand, varying greatly in grain size from one layer to the next, are commonly intercalated with layers of clayey silt. In the deeper portions of the channel, very fine laminae may occur. A number of samples in the bay mouth and in the channel just outside of the bay mouth are composed of similar layers, but the surface layer consists of medium to coarse-grained sand and well rounded gravel (Stations 203, 204, 205, 208, 209, 211). The mechanical characteristics of these samples are described more fully in the next section.

At places, a layering effect is produced by the presence of thick beds of large oyster shells in sands. Partings of small thin-shelled pelecypods are sometimes found in the muds.

Color banding is discussed on pages 45 to 49.

Size Analysis

Measurements

Size

Classification by size of Chesapeake Bay bottom sediments is shown in Table 3 (page 24). Statistical data are shown in Table 4 (page 34).

A considerable variation in grain size is evident. Particle sizes range through all grades from clay (<.0039 mm.) to pebbles (4 mm. to 8 mm.), but pebbles and granules are relatively rare. Total silt and clay content ranges from 0 per cent in some of the near shore sands to a maximum of 99 per cent in channel mud. The average total silt and clay content of 92 mud samples was about 84 per cent. Clay content varies from 0 per cent in near shore sands to a maximum of 43 per cent in channel muds. The average clay content of 74 mud samples was about 24 per cent. Channel muds, then, are clayey silts. The cleaner sands are classified according to Wentworth grade.

Sorting

The log of the coefficient of sorting has been plotted against median diameter (fig. 3) to show the relation between sorting and particle size. In most cases, the coefficient of sorting becomes smaller (that is the sediments become better sorted) with increasing median diameter. In the fine grade sizes, however, the coefficient of sorting remains about constant.

The muds show the poorest sorting and the greatest deviation in sorting. Part of this deviation may be due to the less reliable wet methods of size analysis.

The above relationship is in agreement with that found by other workers (Hough, 1940, 1942; Krumbein and Aberdeen, 1937). Inman (1949) observed

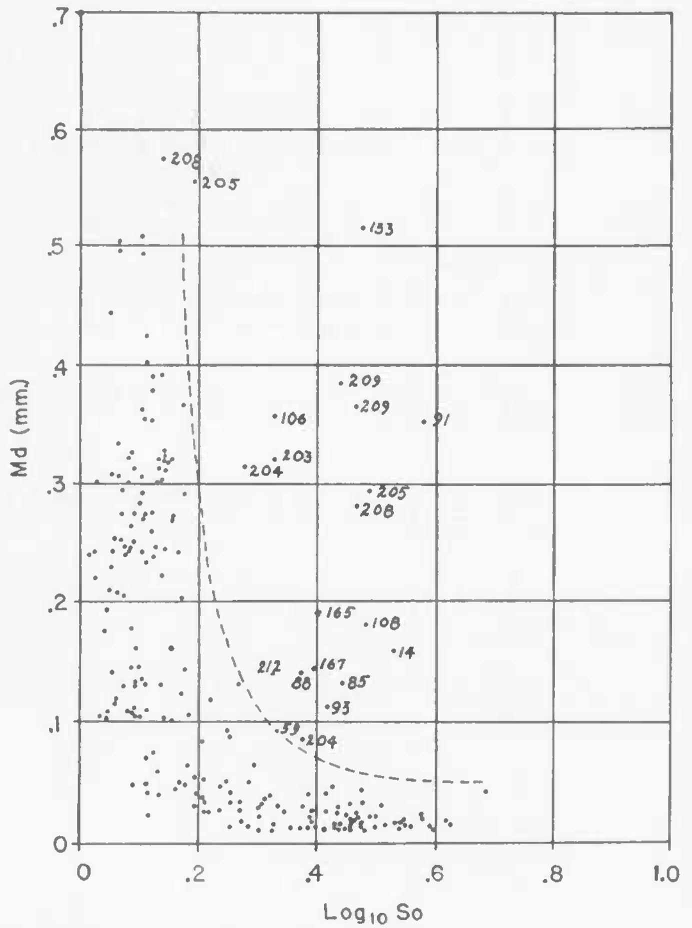


FIGURE 3. Graph of the Log of the Coefficient of Sorting Plotted Against Median Diameter

that it is usual for sediments with a median diameter of .18 mm. to be the best sorted of all sediments. He showed that in light of fluid mechanics this should be expected since theoretically particles of this diameter are easiest for currents to handle.

A number of exceptions to the usual rule show on the graph. These points represent samples located where mixing of sediments seems certain. Two are

TABLE 3

Classification by Size: Chesapeake Bay Sediments

Depth of sample refers to position of sample in core measured from the top. s = snapper sample

Station No.	Depth of sample (inches)	Percentages by Weight: Screen Analysis: Pebble >4mm	Granule 4mm–2mm	Sand: Very Coarse 2mm–1mm	Coarse 1mm–.5mm	Medium .5mm–.246mm	Fine .246mm–.125mm	Very Fine .125mm–.062mm	Wet Analysis: Silt .062mm—.0312mm	.0312mm—.0156mm	.0156mm—.0078mm	.0078mm—.0039mm	Clay <.0039mm	Total Silt and Clay
1	0–8			.09	.67	14.13	74.4	7.87						2.9
	8–19			.02	.33	2.96	17.38	41.21						38.1
	19–28	1.15	1.34	4.27	24.25	37.27	10.6	7.76						13.31
2	0–6				.1	.86	2.82	5.12	16.5	41.9	15.9			54.39
4	18–20			.03	.33	1.99	11.54	23.09	33.5	18.				63.02
5	41–48			.46	1.29	6.58	9.15	14.73	14.3	26.9				68.79
6	0–11½	.18	.07	.13	.42	3.42	4.3	3.69	12.7	30.3	22.1			87.79
	11½–26½			.32	.49	2.59	3.56	1.15	5.	28.1	28.9	13.9	16.	91.9
	26½–64½			.05	.22	16.25	58.35	6.71						18.58
8	0–6			.04	.13	.32	.75	3.72	36.	29.5	14.5			95.04
10	0–8		.51	.51	1.64	8.42	8.63	6.24	29.4	21.1	11.2			74.05
11	0–57½					.24	.36	.97	41.9	30.	12.2			98.43
12	0–75			.04	.15	.32	.62	4.61	45.	24.5	11.8			94.26
13	0–7			.25	.49	1.3	2.59	10.33	9.9	23.9	23.9	13.8	13.4	85.04
14	26–28½					27.93	36.37	1.48	4.6	8.6				34.23
16	0–76				.05	.12	.2	.96	9.4	22.2	35.9	14.2	17.1	98.67
17	0–12				.08	.16	.7	3.45	22.4	30.	20.2	11.6	11.4	95.61
19	0–9				.11	.31	.27	1.14	8.6	25.9	30.	15.1	18.9	98.17
20	0–8			.04	.09	.4	.85	9.	10.	20.7	24.3	13.4	21.9	89.62
21	0–10			.1	.19	.4	.35	.3	13.7	24.8	20.2	16.5	23.6	98.62
22	0–48				.14	.49	.39	.33	11.8	25.6	21.	16.5	23.9	98.65

25	4–40½					1.2	1.4	10.3	11.6	11.2	14.2	15.8	34.3	87.1
26	0–3½			4.5	2.6	2.6	6.3	12.6	15.1	13.	13.1	10.4	19.8	71.4
	40–46			4.	2.6	2.8	4.4	9.7	12.6	13.8	15.3	11.	23.8	76.5
27	0–9			1.5	.8	.5	2.3	8.6	14.7	12.2	13.8	14.4	31.2	86.3
28	0–7			.01	.16	.23	.42	.66	13.9	25.1	21.6	14.3	23.3	98.42
29	0–5½					.16	.23	.83	14.7	23.9	21.	15.3	23.9	98.78
30	0–9		.32	.41	1.61	6.7	3.51	2.9	8.6	20.5	19.1	14.2	22.1	84.55
	72–78½			3.5	2.4	3.9	5.8	11.5	12.1	8.5	14.3	13.3	24.7	72.9
31	0–18					.4	.9	7.8	14.4	4.7	16.4	15.3	40.1	90.9
32	(s)	1.12	.33	.95	6.31	65.8	12.57	.26						12.7
33	0–7½					.16	.21	1.99	12.3	20.8	18.4	14.3	31.8	97.64
34	(s)	1.69	.83	2.76	8.53	42.48	34.7	6.23						2.85
36	(s)			.02	1.5	30.52	65.4	1.28						1.27
37	0–25½						.4	6.8	12.	20.	10.6	13.5	36.7	96.8
39	(s)			.51	8.51	52.8	37.55	.42						.2
41	(s)			.04	15.09	57.57	25.92	.37						.99
42	0–8			1.5	1.	5.3	13.4	17.3	19.5	32.				61.5
	8½–13½			8.5	5.3	2.7	7.6	15.6	17.7	15.5	9.6	6.8	10.7	60.3
	13½–63½				.5	1.8	4.1	15.	20.3	16.9	13.8	7.	20.6	78.6
43	0–6				.5	1.8	3.9	11.4	16.5	12.1	16.1	13.6	24.1	82.4
	6–15			1.5	2.	3.	6.	11.9	13.4	12.6	15.5	10.3	23.8	75.6
	15–77				.8	.8	3.6	12.2	16.7	15.3	15.1	11.	24.5	82.6
44	0–13			6.5	1.	2.6	6.4	12.3	13.3	10.5	12.4	11.3	23.7	71.2
	13–20			2.5	1.1	2.7	5.8	13.8	14.4	13.3	12.7	10.3	23.4	73.1
	20–59			3.	1.2	2.	6.2	17.2	18.4	14.6	11.4	8.3	17.7	70.4
	59–76			10.	9.5	4.3	5.4	13.9	13.2	10.5	10.4	7.2	15.6	56.9
	76–83			13.5	15.	6.1	13.6	8.2	9.	9.9	6.3			43.6
45	0–10			3.5	1.5	3.1	7.6	8.1	12.1	9.	13.8	12.5	28.8	76.2
	10–20				2.	1.2	5.7	11.5	14.	13.4	14.2	11.4	26.6	79.6
	20–70½					2.5	5.6	11.8	15.2	14.8	14.4	9.8	25.9	80.1
46	0–51				2.6	1.8	4.8	10.1	11.5	16.7	15.1	11.7	25.7	80.7
	51–56½			1.5	1.3	1.7	6.2	11.3	14.7	13.6	13.7	11.5	24.5	78.

TABLE 3—*Continued*

Station No.	Depth of sample (inches)	Percentages by Weight												
		Screen Analysis							Wet Analysis					
		Pebble	Granule	Sand					Silt				Clay	Total Silt and Clay
		>4mm	4mm–2mm	Very Coarse 2mm–1mm	Coarse 1mm–.5mm	Medium .5mm–.246mm	Fine .246mm–.125mm	Very Fine .125mm–.062mm	.062mm — .0312mm	.0312mm — .0156mm	.0156mm — .0078mm	.0078mm — .0039mm	<.0039mm	
47	(s)		.02	.2	6.08	70.87	19.93	0.22						2.62
48	(s)				.48	45.68	48.05	2.02						3.86
51	44–52			.11	.4	2.64	13.45	35.38	19.5	13.9				48.02
52	0–11½		.07	.21	1.78	16.57	41.22	24.7						15.37
53	0–39½					1.2	2.6	7.4	9.4	15.3	15.6	15.2	33.3	88.8
54	(s)				.04	6.63	86.9	4.7						.7
55	0–8							8.4	9.3	10.4	15.3	13.4	43.2	91.6
56	0–81½							4.4	14.1	11.7	14.5	13.1	42.2	95.6
57	0–43½						.5	3.3	8.7	15.3	15.8	15.5	40.9	96.2
58	0–7				2.	2.2	5.2	10.4	12.8	12.1	12.9	13.2	29.2	80.2
	7–20	.12	.04	.1	.52	29.64	37.33	7.72						24.6
59	0–6	.4	.2	.34	2.13	20.36	13.82	27.06	22.9	7.4				35.69
60	(s)				.24	17.89	75.65	4.91						1.32
61	(s)				1.52	57.82	34.75	1.98						4.03
62	(s)				.18	3.54	87.4	4.92						3.84
63	0–76					1.	1.4	10.8	18.7	22.3	15.2	11.7	18.9	86.8
65	0–20			6.5	2.5	3.1	5.7	5.9	18.3	18.3	13.7	9.8	16.2	86.3
	37–58				.21	3.28	56.45	16.27						23.83
66	0–12					.5	1.7	8.	16.7	19.4	16.9	13.1	23.7	89.8
67	s)				4.14	77.12	11.76	.07						6.89
68	0–4			.12	1.11	10.23	63.4	15.34						9.72
	11½–15½			.11	.23	5.24	53.28	21.85						19.32
70	0–20							6.1	14.	20.3	18.1	12.3	29.2	93.9

71	(s)		.04	.12	.19	.36	28.88	44.68						25.78
73	(s)		.24	.61	9.55	44.89	42.25	1.03						1.54
74	(s)	1.39	.43	.72	3.04	16.51	74.15	.98						2.75
75	(s)				2.8	56.55	39.75	.36						.59
76	0-4				.5	1.	3.6	8.8	16.	13.4	11.6	12.	33.1	86.1
	4-10					.5	1.2	4.7	13.8	14.7	14.1	15.4	35.6	93.6
	54-61½		.05	.1	.46	13.32	33.39	24.42						28.28
77	0-7						.3	5.1	14.4	14.7	13.6	16.	35.9	94.6
78	0-3						.2	5.	14.9	18.4	16.2	15.9	29.4	94.8
79	0-12						.3	4.5	13.9	17.8	17.2	16.3	30.	95.2
80	0-4	3.06	4.09	2.66	14.58	55.8	18.57	.22						.21
81	0-8					.2	.5	3.7	13.	20.8	15.1	19.6	27.1	95.6
	21-28					1.	2.	5.8	13.9	20.4	16.6	13.9	26.4	91.2
	47-53				.5	.3	1.3	9.5	17.5	19.4	13.5	14.9	22.8	88.4
82	(s)		.1	1.2	16.88	46.96	33.3	.79						.83
83	0-12			2.5	1.	1.4	7.6	10.1	22.2	13.8	19.2	9.4	12.8	77.4
84	(s)				1.29	45.59	51.57	.49						1.14
85	0-5		.05	.1	.82	16.29	21.47	2.29	15.3	16.4	13.8			58.98
	17-25	.30	.15	.29	1.46	17.38	32.8	2.72	18.	8.7				44.9
	36½-42½	.69	1.32	2.49	5.72	20.2	38.	4.81						26.78
86	0-8				2.5	1.2	4.2	5.3	15.	16.	15.9	14.7	25.2	86.8
87	0-8					.7	1.6	5.3	14.9	19.2	15.6	13.7	29.	92.4
88	0-8		.03	.01	.12	3.82	49.4	5.55	13.2	14.1				41.07
89	(s)			.26	5.12	64.31	29.68	.26						.67
90	(s)		.05	.41	3.54	46.48	46.2	2.06						1.31
91	(s)	20.48	11.5	2.73	2.77	41.02	16.88	1.04						3.66
92	0-9			4.5	.9	1.9	4.3	6.1	12.9	15.7	14.	13.9	25.8	82.3
93	0-8					.1	.5	4.4	12.1	16.3	16.5	15.3	34.8	95.
	71-79		.55	2.15	7.1	18.34	19.45	13.92	18.3	10.7				38.49
94	0-8					.2	1.	1.2	17.	16.5	16.9	14.1	34.1	97.6
	76-82		.04	.73	9.63	55.26	22.88	.8						10.63
95	(s)				.11	7.89	28.93	40.18						22.87

TABLE 3—*Continued*

Station No.	Depth of sample (inches)	Percentages by Weight												
		Screen Analysis							Wet Analysis					
		Pebble	Granule	Sand					Silt				Clay	Total Silt and Clay
		>4mm	4mm–2mm	Very Coarse 2mm–1mm	Coarse 1mm–.5mm	Medium .5mm–.246mm	Fine .246mm–.125mm	Very Fine .125mm–.062mm	.062mm — .0312mm	.0312mm — .0156mm	.0156mm — .0078mm	.0078mm — .0039mm	<.0039mm	
96	(s)			.05	.49	23.35	69.8	5.19						.94
97	0–6				.15	.3	.93	18.2	42.	21.8				80.42
98	0–6						.6	7.1	19.9	23.3	12.8	12.1	24.2	92.3
99	0–8							3.1	21.	21.5	17.5	12.5	24.4	96.9
100	(s)		.21	2.32	30.2	56.17	9.79	.49						.83
101	(s)			.03	4.37	83.04	10.03	.14						2.33
102	0–7					1.	2.1	12.6	24.	21.4	15.4	7.2	16.3	84.3
103	0–8					1.1	2.4	9.5	14.1	18.5	15.7	13.7	25.	87.
104	(s)	.27	.04	.81	17.26	48.72	24.39	6.05						2.5
105	(s)		.45	1.83	10.14	34.42	50.09	2.46						.64
106	(s)	14.75	5.05	5.47	12.8	28.5	30.22	2.32						.94
107	0–8					.2	1.2	3.4	14.3	20.6	17.7	14.4	28.2	95.2
108	0–5		.08	.19	2.84	46.57	37.	2.19						11.08
	5–44½		.08	.27	3.62	30.82	23.23	2.84	15.1	11.9				39.14
109	0–7					.4	.5	3.2	10.7	19.4	18.7	15.2	31.9	95.9
	10½–66½						.3	3.7	16.	17.5	16.2	14.5	31.8	96.
110	0–7			2.2	1.1	1.7	3.8	7.7	12.8	16.8	16.1	14.	23.8	83.5
111	(s)			.13	3.92	56.23	39.08	.43						.28
112	(s)			.05	1.37	61.52	36.45	.44						.27
113	(s)				.45	33.36	65.7	.34						.27
114	(s)		.1	1.05	12.95	60.45	21.65	3.09						.61
115	0–8			.1	.38	5.67	14.52	36.85	20.1	12.2				42.48
116	0–8				.36	.55	1.36	9.1	33.8	24.4	15.2			88.63

117	(s)	.15	.2	3.69	47.8	45.76	1.32	.04						.97
118	(s)		.07	1.79	11.71	65.04	21.38	.23						.02
119	(s)	.27	.9	.7	2.03	60.2	35.5	.54						—
120	0–7			.2	1.8	3.9	5.7	12.8	16.8	16.1	19.2	9.3	14.2	75.6
121	0–5½	.29	1.42	2.82	23.41	56.87	8.5	1.82						4.94
122	4–15			1.	.5	1.9	5.1	10.2	15.2	13.3	12.7	12.	28.1	71.3
123	(s)		.05	.76	6.13	65.75	26.87	.43						—
124	(s)			.08	1.36	44.4	51.8	2.16						.18
125	(s)	.15	.38	3.95	45.4	48.08	1.05	.14						.66
126	0–7		.17	.41	2.44	8.42	1.67	12.88	31.4	22.1	9.7			74.01
	23½–45	.11	1.04	2.74	12.42	54.63	11.03	2.52						15.56
127			.31	.91	9.98	57.09	25.55	1.44						4.62
128	(s)			.02	7.59	47.17	30.22	2.37						12.58
129	0–7					.9	1.7	8.	20.8	21.5	16.2	12.5	18.4	89.4
130	0–7	1.5	3.04	8.42	40.25	36.63	4.03	1.28						4.73
	7–12½	3.58	6.88	9.12	27.35	39.47	5.69	1.39						6.58
131	0–7				.17	.34	13.39	39.33	27.1	11.1				46.76
	7–9				.17	.55	14.49	61.6						23.91
	9–10				.01	.03	.82	3.66	36.6	28.2	17.3			95.48
132	0–7						.9	11.7	20.4	20.1	15.1	12.3	19.5	87.4
133	0–7		.1	.24	1.79	22.27	67.7	2.17						5.82
	9–14½	9.48	11.07	17.07	12.63	13.5	29.89	1.36						4.97
134	(s)				2.67	79.58	16.78	.1						.79
135	0–7				.28	.49	13.77	54.17	19.5	7.1				31.29
136	0–7		.03	.15	2.58	29.74	42.08	6.59						18.82
137	(s)	.44	.15	.74	15.02	53.67	22.87	4.						3.34
138	(s)		.15	3.81	27.83	61.31	6.27	.13						.51
139	(s)			.5	12.1	53.99	31.12	.94						1.31
140	0–7						.2	1.5	19.8	22.	17.9	13.	25.6	98.3
	14½–19						.9	5.8	18.9	21.7	16.6	11.7	24.4	93.3
	19–25					.5	1.4	6.4	19.6	20.5	16.6	12.8	22.2	91.7

TABLE 3—*Continued*

Station No.	Depth of sample (inches)	Percentages by Weight												
		Screen Analysis							Wet Analysis					
		Pebble	Granule	Sand					Silt				Clay	Total Silt and Clay
		>4mm	4mm–2mm	Very Coarse 2mm–1mm	Coarse 1mm–.5mm	Medium .5mm–.246mm	Fine .246mm–.125mm	Very Fine .125mm–.062mm	.062mm — .0312mm	.0312mm — .0156mm	.0156mm — .0078mm	.0078mm — .0039mm	<.0039mm	
141	0–3		.04	.43	8.45	58.18	24.63	2.99						5.41
142	(s)				.7	56.18	41.6	.7						.86
143	(s)				.68	41.76	55.25	.87						1.32
144	(s)			.02	.47	50.8	46.6	1.17						.88
145	(s)			.33	17.75	75.3	5.33	.26						1.11
146	0–6				.07	.24	5.64	32.89	27.8	19.2	7.9			61.16
147	0–6½				.1	.31	.81	25.08	28.9	34.5	11.1			74.7
148	(s)			.67	23.23	65.31	9.19	.24						1.3
149	(s)		.19	.7	15.54	66.4	15.68	.66						.89
150	(s)			1.05	12.34	60.81	21.15	.55						4.16
151	0–9				.15	.17	1.14	19.7	38.7	21.6				78.84
152	0–10					1.7	2.6	9.8	17.3	19.7	14.1	12.8	22.	85.9
153	(s)				1.11	37.39	45.3	7.15						9.04
154	(s)		.26	3.53	28.28	58.02	5.89	.51						3.49
155	0–10					1.	2.	15.4	30.4	16.8	8.1	7.5	18.8	81.6
156	0–6						.5	4.3	18.2	30.3	13.9	11.7	21.1	95.2
157	(s)		.02	1.06	21.64	54.35	16.55	2.43						4.08
158	(s)	.2	2.09	2.74	19.75	60.47	12.68	1.59						.47
159	(s)		.12	1.34	9.35	48.63	36.58	3.43						.52
160	(s)			.23	3.61	75.8	19.47	.78						.11
161	(s)			.32	3.9	65.72	27.5	1.88						.67
162	(s)		1.	2.04	9.92	35.82	44.92	4.33						1.84
163	(s)	.09	.21	1.55	6.59	70.91	20.2	.23						.19

164	0–8			.05	.07	1.22	2.69	6.74	52.8	23.5				89.33
165	0–7		.05	.16	1.93	34.51	26.12	2.63	18.3	8.9				34.6
166	0–7				.04	.09	.39	21.2	57.6	11.9				78.28
167	0–7			.01	.06	0.46	3.02	17.04	58.6	9.5				79.41
	45–50	.21	1.23	2.22	3.76	25.69	22.83	8.99	20.6	9.6				37.05
168	(s)			.08	.57	7.68	59.25	10.01						22.35
169	(s)				1.26	47.51	40.9	4.6						5.79
170	(s)			.22	1.08	8.6	53.75	20.54						15.87
171	(s)			.07	1.28	22.78	71.95	3.31						—
172	(s)			.15	.73	3.58	84.	10.82						.7
173	(s)		.08	.23	5.9	43.39	25.86	11.56						13.01
174	(s)		.03	2.3	25.83	55.85	11.67	.89						3.44
175	0–7		.05	.23	.55	1.9	1.75	22.91	46.7	13.9				72.61
176	0–7			.03	.1	.17	.63	42.97	41.	7.2				56.1
177	0–7				.01	.24	.66	23.78	46.	15.				75.31
	61–68				.01	.1	.39	19.96	49.7	15.5				79.54
178	0–6					.32	.15	83.52						16.03
	25–31				.04	.21	29.68	48.87						21.18
179	(s)		.54	2.28	11.31	71.8	13.48	.33						.29
180	(s)		.55	9.89	21.9	42.68	14.85	5.12						5.02
181	(s)				1.81	35.47	49.04	2.78						10.85
182	(s)			.04	3.6	46.3	42.45	2.38						5.21
183	0–6						.6	3.8	17.5	23.	13.6	13.2	28.3	95.6
184	0–7				.7	.8	2.7	12.8	23.9	18.	11.9	9.4	19.8	83.
	41–48					.7	1.2	10.5	24.9	19.8	10.7	9.6	22.6	87.6
	72–79						1.	11.4	28.	17.6	10.7	9.2	22.1	87.6
185	(s)			.2	7.4	54.49	37.	.76						.15
186	0–6	.06	.21	.76	3.56	7.68	3.32	31.86						52.45
	24–30	.12	.67	3.24	14.43	26.12	9.98	12.36						33.1
	44–50	.04	.14	0.67	2.13	8.4	32.37	5.05	8.1	17.3	13.1	5.3	7.5	51.2
187	(s)				.12	3.64	29.37	50.86						16.04

TABLE 3—*Concluded*

Station No.	Depth of sample (inches)	Percentages by Weight												
		Screen Analysis							Wet Analysis					
		Pebble	Granule	Sand					Silt				Clay	Total Silt and Clay
		>4mm	4mm–2mm	Very Coarse 2mm–1mm	Coarse 1mm–.5mm	Medium .5mm–.246mm	Fine .246mm–.125mm	Very Fine .125mm–.062mm	.062mm — .0312mm	.0312mm — .0156mm	.0156mm — .0078mm	.0078mm — .0039mm	<.0039mm	
188	(s)				.01	.12	26.8	69.2						3.92
189	(s)				.07	.31	34.07	59.58						5.92
190	(s)			.01	.06	.34	11.71	81.03						6.82
191	(s)			.11	.64	5.41	44.17	46.09						3.58
192	(s)			.18	1.27	1.57	31.28	60.59						5.05
193	(s)	15.19	3.15	1.55	2.34	24.97	32.57	6.5						13.73
194	(s)	.46	.54	5.23	42.8	44.6	5.75	.59						—
195	0–5			.08	.35	.86	10.21	61.84	15.9	6.8				26.7
	6½–12½			.05	.24	1.78	15.42	65.08						17.45
	13–19			.04	.29	2.33	16.79	59.21						21.29
196	½–5		.12	.68	2.48	2.45	6.45	19.82	25.3	22.9				68.1
	34–40			.01	.13	.18	2.55	12.49	33.6	22.6				84.64
	61–64				.03	.5	3.89	12.51	19.2	31.3				83.07
	65½–66½			.48	2.55	6.84	21.65	54.04						13.46
	66½–68½		.23	.93	4.39	6.84	20.18	52.79						14.65
	68½–76½			.2	.74	1.22	3.44	17.24	26.9	22.9				77.16
197	(s)		.96	1.88	5.19	11.64	33.38	22.05						24.8
198	(s)				.05	.92	74.9	22.83						1.39
199	(s)				.06	.37	29.85	56.2						14.
200	(s)				.04	.37	28.43	44.06						27.1
201	(s)			.13	2.5	17.65	8.04	15.37						56.35
202	(s)				.02	.22	53.8	35.64						10.34
203	0–4		.5	2.01	17.66	35.78	12.78	26.22						5.06

	29½–32½			.07	1.09	3.04	9.01	30.1	38.	12.		56.8
	60–73		.14	.21	1.07	1.33	3.94	17.61	36.	21.		65.7
204	0–2½	1.24	4.88	6.91	14.62	37.41	12.13	4.15				18.79
	2½–4½		1.29	3.58	8.96	11.71	7.53	24.98	22.3	13.6		41.9
	4½–6½	.19	.25	.75	1.27	1.57	17.62	35.48	28.	9.		42.87
	21–25½		.1	.42	1.07	1.04	5.36	20.22	40.8	17.4		71.79
205	0–6½	2.39	3.49	16.24	35.42	26.25	3.42	6.21				6.53
	6½–33	4.2	4.7	9.49	15.9	18.65	5.79	18.54				22.78
206	(s)	2.	4.51	5.08	5.4	6.02	3.2	9.44	27.2	17.8		64.35
207	0–8			.05	.21	1.13	14.75	58.8				24.95
	8–12				.03	.15	2.6	28.28	35.6	22.		68.94
	12–20½				.13	.3	2.18	23.39	36.9	21.5		74.
208	0–6		.62	9.04	35.77	43.8	4.08	3.				3.52
	6–30	1.22	1.79	9.66	20.2	21.35	9.15	13.01				23.67
209	0–3½	2.03	2.89	11.82	24.2	15.58	4.19	27.93				11.23
	3½–9	1.24	4.48	10.78	20.21	20.11	6.08	15.05				22.05
	21–33		.49	.84	1.75	2.06	1.92	8.56	41.7	28.9		84.3
212	0–5	34.5	7.58	14.45	13.49	7.21	5.58	14.2				3.04
	5½–15	2.77	1.23	2.1	6.15	16.05	25.39	21.44				24.88

TABLE 4

Statistical Data of Chesapeake Bay Sediments

Depth of sample refers to position of sample in core measured from the top.
s = snapper sample

Station No.	Depth of sample (inches)	Md (mm.)	Q_1 (mm.)	Q_3 (mm.)	So ($\sqrt{Q_3/Q_1}$)	$Log_{10}So$	Skg ($\sqrt{Q_1Q_3/Md^2}$)	$Log_{10}Skg$
1	0–8	.178	.148	.216	1.21	.083	1.01	+.004
	8–19	.089		.120				
	19–28	.374	.164	.560	1.22	.086	.81	−.092
2	0–6	.025	.012	.032	1.64	.215	.78	−.108
4	18–20	.050	.027	.101	1.94	.288	1.05	+.021
5	41–48	.029	.014	.102	2.70	.431	1.39	+.143
6	0–11½	.018	.009	.031	1.86	.270	.93	−.032
	11½–26½	.013	.006	.022	1.92	.283	.89	−.051
	26½–64½	.210	.164	.236	1.06	.025	.94	−.027
8	0–6	.028	.013	.039	1.73	.238	.78	−.108
10	0–8	.035	.017	.070	2.03	.308	1.24	+.093
11	0–57½	.028	.015	.038	1.59	.201	.86	−.065
12	0–75	.032	.016	.042	1.62	.210	.81	−.092
13	0–7	.014	.007	.031	2.10	.322	1.05	+.021
14	26–28½	.160	.023	.261	3.37	.528	.48	−.319
16	0–76	.011	.006	.024	2.00	.301	1.09	+.037
17	0–12	.020	.008	.032	2.00	.301	.80	−.097
19	0–9	.012	.005	.022	2.10	.322	.87	−.060
20	0–8	.012	.005	.028	2.37	.375	.99	−.004
21	0–10	.012	.004	.026	2.55	.407	.85	−.071
22	0–48	.012	.004	.023	2.40	.380	.80	−.097
25	4–40½	.008		.032				
26	0–3½	.024	.006	.083	3.72	.571	.93	−.032
	40–46	.016	.005	.057	3.38	.529	1.05	+.021
27	0–9	.010	.004	.036	3.00	.477	1.20	+.079
28	0–7	.012	.004	.025	2.50	.398	.84	−.076
29	0–5½	.014	.004	.070	4.18	.621	1.20	+.079
30	0–9	.011	.004	.025	2.50	.398	.91	−.041
	72–78½	.013	.005	.031	2.49	.396	.96	−.018
31	0–18	.006		.028				
32	(s)	.302	.244	.358	1.21	.083	.98	−.009
33	0–7½	.009	.003	.024	2.83	.452	.95	−.023
34	(s)	.269	.186	.378	1.42	.153	.99	−.004
36	(s)	.229	.195	.255	1.14	.057	.98	−.009
37	0–25½	.008		.024				
39	(s)	.283	.214	.373	1.32	.121	1.02	+.009
41	(s)	.293	.244	.400	1.28	.107	1.07	+.029
42	0–8	.041	.020	.119	2.44	.387	1.27	+.104
	8½–13½	.044	.014	.124	2.98	.474	.95	−.023
	13½–63½	.023	.007	.059	2.91	.464	.88	−.056
43	0–6	.014	.004	.048	3.46	.539	.99	−.004
	6–15	.017	.005	.061	3.49	.543	1.03	+.013
	15–77	.015	.004	.049	3.51	.545	.94	−.027

TABLE 4—*Continued*

Station No.	Depth of sample (inches)	Md (mm.)	Q_1 (mm.)	Q_3 (mm.)	So ($\sqrt{Q_3/Q_1}$)	$Log_{10}So$	Skg ($\sqrt{Q_1Q_3/Md^2}$)	$Log_{10}Skg$
44	0–13	.018	.005	.085	4.13	.616	1.15	+.061
	13–20	.019	.005	.072	3.80	.579	1.00	0.000
	20–59	.031	.008	.083	3.22	.508	.83	−.081
	59–76	.042	.010	.230	4.80	.681	1.15	+.061
	76–83	.120	.017	.880	2.28	.358	1.02	+.009
45	0–10	.012	.004	.061	3.91	.592	1.30	+.114
	10–20	.014	.004	.052	3.61	.558	1.03	+.013
	20–70½	.016	.004	.050	3.54	.549	.88	−.056
46	0–51	.015	.004	.048	3.46	.539	.92	−.036
	51–56½	.016	.004	.059	3.84	.584	.96	−.018
47	(s)	.298	.255	.346	1.16	.064	.99	−.004
48	(s)	.246	.207	.292	1.19	.076	1.00	0.000
51	44–52	.065	.026	.100	1.96	.292	.79	−.102
52	0–11½	.142	.095	.215	1.50	.176	1.01	+.004
53	0–39½	.009		.027				
54	(s)	.206	.167	.234	1.18	.072	.96	−.018
55	0–8	.054		.020				
56	0–81½	.006		.022				
57	0–43½	.006		.018				
58	0–7	.012	.004	.047	3.42	.534	1.15	+.061
	7–20	.122	.076	.274	1.49	.173	1.19	+.076
59	0–6	.091	.049	.229	2.16	.334	1.17	+.068
60	(s)	.160	.136	.217	1.26	.100	1.07	+.029
61	(s)	.271	.205	.333	1.27	.104	.97	−.013
62	(s)	.174	.158	.194	1.11	.045	1.01	+.004
63	0–76	.020	.005	.042	2.90	.462	.73	−.143
65	0–20	.025	.008	.058	2.70	.431	.86	−.065
	37–58	.130	.080	.153	1.38	.140	.86	−.065
66	0–12	.014	.004	.033	2.84	.453	.82	−.086
67	(s)	.298	.269	.334	1.11	.045	.95	−.022
68	0–4	.144	.124	.188	1.23	.090	1.06	+.025
	11½–15½	.132	.093	.155	1.29	.111	1.20	+.079
70	0–20	.012	.004	.028	2.72	.435	.88	−.056
71	(s)	.106	.057	.133	1.53	.185	.83	−.071
73	(s)	.260	.209	.364	1.32	.121	1.06	+.025
74	(s)	.240	.230	.244	1.06	.025	.99	−.004
75	(s)	.252	.219	.301	1.17	.068	1.02	+.009
76	0–4	.013		.041				
	4–10	.008		.026				
	54–61½	.119		.191				
77	0–7	.007		.025				
78	0–3	.010		.027				
79	0–12	.010		.025				
80	0–4	.321	.256	.493	1.39	.143	1.11	+.045

TABLE 4—*Continued*

Station No.	Depth of sample (inches)	Md (mm.)	Q_1 (mm.)	Q_3 (mm.)	So ($\sqrt{Q_3/Q_1}$)	$Log_{10}So$	Skg ($\sqrt{Q_1Q_3/Md^2}$)	$Log_{10}Skg$
81	0–8	.010		.026				
	21–28	.013		.029				
	47–52	.014	.004	.036	3.00	.477	.70	−.155
82	(s)	.312	.217	.419	1.39	.143	.97	−.013
83	0–12	.026	.010	.059	2.43	.386	.93	−.032
84	(s)	.243	.214	.279	1.14	.057	1.01	+.004
85	0–5	.039	.012	.205	1.31	.117	1.27	+.104
	17–25	.132	.029	.220	2.76	.441	.61	−.215
	36½–42½	.203		.273				
86	0–8	.033	.004	.036	3.00	.477	1.15	+.061
87	0–8	.012	.004	.029	2.69	.430	.90	−.046
88	0–8	.142	.029	.162	2.37	.375	.63	−.201
89	(s)	.299	.228	.340	1.22	.086	.93	−.032
90	(s)	.246	.210	.326	1.24	.093	1.06	+.025
91	(s)	.354	.261	3.75	3.78	.577	2.86	+.456
92	0–9	.014	.004	.042	3.24	.511	.93	−.032
93	0–8	.008		.023				
	71–79	.113	.040	.275	2.62	.418	.93	−.032
94	0–8	.009		.024				
	76–82	.303	.207	.381	1.36	.134	.93	−.032
95	(s)	.102	.076	.157	1.44	.158	.76	−.119
96	(s)	.209	.190	.242	1.13	.053	1.03	+.013
97	0–6	.041	.023	.057	1.58	.199	.89	−.051
98	0–6	.016	.004	.032	2.83	.452	.71	−.149
99	0–8	.013	.004	.030	2.74	.438	.84	−.076
100	(s)	.400	.315	.570	1.35	.130	1.06	+.025
101	(s)	.303	.287	.335	1.08	.033	1.03	+.013
102	0–7	.031	.009	.051	2.38	.377	.69	−.161
103	0–8	.015	.004	.035	2.96	.471	.79	−.102
104	(s)	.321	.209	.419	1.42	.152	.92	−.036
105	(s)	.237	.196	.346	1.33	.124	1.10	+.041
106	(s)	.358	.225	1.03	2.13	.328	1.34	+.127
107	0–8	.012	.004	.026	2.55	.407	.85	−.071
108	0–5	.245	.166	.324	1.40	.146	.95	−.023
	5–44½	.184	.032	.292	3.02	.480	.53	−.276
109	0–7	.009		.024				
	10½–66½	.010		.028				
110	0–7	.013	.004	.039	3.12	.494	.96	−.018
111	(s)	.273	.219	.363	1.29	.111	1.03	+.013
112	(s)	.275	.227	.356	1.25	.097	1.04	+.017
113	(s)	.242	.219	.251	1.07	.029	.97	−.013
114	(s)	.354	.244	.428	1.32	.121	.92	−.036
115	0–8	.087	.036	.114	1.78	.250	.74	−.131
116	0–8	.028	.012	.048	2.00	.301	.86	−.065
117	(s)	.503	.452	.621	1.17	.068	1.05	+.021
118	(s)	.313	.259	.400	1.24	.093	1.03	+.013

TABLE 4—*Continued*

Station No.	Depth of sample (inches)	Md (mm.)	Q_1 (mm.)	Q_3 (mm.)	Skg ($\sqrt{Q_3/Q_1}$)	$Log_{10}So$	Skg ($\sqrt{Q_1Q_3/Md}$)	$Log_{10}Skg$
119	(s)	.275	.222	.322	1.20	.079	.98	−.009
120	0–7	.025	.009	.061	2.60	.415	.77	−.114
121	0–5½	.425	.305	.509	1.29	.111	.93	−.032
122	4–15	.013		.049				
123	(s)	.298	.237	.350	1.22	.086	.97	−.013
124	(s)	.233	.185	.315	1.30	.114	1.04	+.017
125	(s)	.499	.468	.621	1.15	.061	1.08	+.033
126	0–7	.035	.020	.064	1.79	.253	1.03	+.013
	23½–45	.323	.211	.411	1.40	.146	.92	−.036
127	0–6½	.304	.224	.415	1.36	.134	1.01	+.004
128	(s)	.270	.172	.351	1.43	.155	.91	−.041
129	0–7	.018	.005	.040	2.83	.452	.79	−.102
130	0–7	.507	.404	.650	1.27	.104	1.01	+.004
	7–12½	.490	.346	.740	1.46	.164	1.04	+.017
131	0–7	.064	.041	.095	1.53	.185	.98	−.009
	7–9	.103	.065	.127	1.40	.146	.88	−.056
	9–10	.026	.013	.045	1.86	.270	.93	−.032
132	0–7	.019	.005	.042	2.90	.462	.76	−.119
133	0–7	.212	.192	.245	1.13	.053	1.03	+.013
	9–14½	.515	.185	1.65	2.97	.473	1.07	+.029
134	(s)	.309	.267	.346	1.14	.057	.97	−.013
135	0–7	.072	.055	.099	1.34	.127	1.03	+.013
136	0–7	.203	.122	.274	1.50	.176	.90	−.046
137	(s)	.327	.218	.430	1.39	.143	.94	−.027
138	(s)	.392	.312	.558	1.34	.127	1.06	+.025
139	(s)	.315	.219	.409	1.37	.137	.95	−.023
140	0–7	.013	.004	.013	1.80	.255	.56	−.252
	14½–19	.014	.004	.035	2.96	.471	.84	−.076
	19–25	.015	.005	.037	2.72	.435	.90	−.046
141	0–3	.323	.215	.402	1.37	.137	.91	−.041
142	(s)	.264	.205	.315	1.24	.093	.97	−.013
143	(s)	.244	.218	.275	1.22	.086	1.01	+.004
144	(s)	.250	.202	.305	1.23	.090	.99	−.004
145	(s)	.395	.350	.450	1.14	.057	1.01	+.004
146	0–6	.049	.025	.077	1.76	.246	.90	−.046
147	0–6½	.033	.018	.062	1.86	.270	1.01	+.004
148	(s)	.364	.304	.492	1.27	.104	1.06	+.025
149	(s)	.329	.283	.429	1.23	.090	1.06	+.025
150	(s)	.307	.242	.393	1.28	.107	1.01	+.004
151	0–9	.037	.022	.056	1.59	.201	.95	−.023
152	0–10	.016	.005	.040	2.83	.452	.88	−.056
153	(s)	.222	.159	.300	1.38	.140	.99	−.004
154	(s)	.403	.325	.552	1.30	.114	1.05	+.021
155	0–10	.031	.007	.056	2.83	.452	.64	−.194
156	0–6	.018	.005	.030	2.45	.389	.68	−.167

TABLE 4—*Continued*

Station No.	Depth of sample (inches)	Md (mm.)	Q_1 (mm.)	Q_3 (mm.)	So ($\sqrt{Q_3/Q_1}$)	$Log_{10}So$	Skg ($\sqrt{Q_1Q_3/Md^2}$)	$Log_{10}Skg$
157	(s)	.393	.259	.493	1.38	.140	.91	−.041
158	(s)	.362	.299	.498	1.29	.111	1.07	+.029
159	(s)	.291	.189	.424	1.50	.176	.98	−.009
160	(s)	.336	.267	.368	1.17	.068	.93	−.032
161	(s)	.295	.232	.329	1.19	.076	.94	−.027
162	(s)	.243	.172	.379	1.48	.170	1.05	+.021
163	(s)	.308	.264	.359	1.17	.068	1.00	0.000
164	0–8	.044	.024	.052	1.47	.167	.80	−.097
165	0–7	.192	.045	.283	2.51	.400	.59	−.229
166	0–7	.048	.035	.059	1.29	.111	.95	−.023
167	0–7	.048	.037	.058	1.25	.097	.97	−.013
	45–50	.146	.045	.275	2.48	.394	.76	−.120
168	(s)	.162	.093	.192	1.44	.158	.83	−.081
169	(s)	.243	.182	.300	1.28	.107	.97	−.013
170	(s)	.134	.105	.173	1.28	.107	1.01	+.004
171	(s)	.208	.182	.243	1.16	.064	1.01	+.004
172	(s)	.192	.160	.199	1.12	.049	.93	−.032
173	(s)	.243	.128	.358	1.21	.083	.88	−.056
174	(s)	.380	.298	.530	1.33	.124	1.05	+.021
175	0–7	.050	.030	.076	1.59	.201	.95	−.023
176	0–7	.058	.045	.082	1.35	.130	1.05	+.021
177	0–7	.048	.027	.061	1.51	.179	.85	−.071
	61–68	.048	.027	.060	1.50	.176	.84	−.076
178	0–6	.102	.089	.108	1.10	.041	1.01	+.004
	25–31	.102	.083	.134	1.27	.104	1.04	+.017
179	(s)	.318	.285	.402	1.41	.149	1.07	+.029
180	(s)	.367	.246	.600	1.51	.179	1.05	+.021
181	(s)	.238	.188	.268	1.20	.079	.94	−.027
182	(s)	.246	.189	.332	1.33	.124	1.02	+.009
183	0–6	.012	.004	.030	2.74	.438	.91	−.041
184	0–7	.024	.006	.047	2.80	.447	.71	−.149
	41–48	.021	.005	.048	3.10	.491	.74	−.131
	72–79	.022	.005	.049	3.13	.495	.72	−.143
185	(s)	.273	.212	.364	1.31	.117	1.02	+.009
186	0–6	.045		.093				
	24–30	.181		.411				
	44–50	.055	.015	.169	3.36	.526	.92	−.041
187	(s)	.108	.082	.141	1.31	.117	.99	−.004
188	(s)	.113	.095	.126	1.15	.061	1.06	+.025
189	(s)	.116	.096	.132	1.17	.068	.98	−.009
190	(s)	.104	.094	.111	1.09	.037	.99	−.004
191	(s)	.126	.106	.151	1.19	.076	1.01	+.004
192	(s)	.112	.098	.135	1.17	.068	1.03	+.013
193	(s)	.241	.151	.380	1.59	.201	.81	−.092

TABLE 4—*Continued*

Station No.	Depth of sample (inches)	Md (mm.)	Q_1 (mm.)	Q_3 (mm.)	So ($\sqrt{Q_3/Q_1}$)	$Log_{10}So$	Skg ($\sqrt{Q_1Q_3/Md^2}$)	$Log_{10}Skg$
194	(s)	.493	.390	.640	1.28	.107	1.02	+.009
195	0–5	.098	.059	.108	1.35	.130	.81	−.092
	6½–12½	.105	.092	.114	1.12	.049	.98	−.009
	13–19	.103	.074	.115	1.25	.097	.90	−.046
196	½–5	.037	.021	.091	2.08	.318	1.19	+.076
	34–40	.031	.013	.052	2.00	.301	.84	−.076
	61–64	.025	.010	.049	2.22	.346	.88	−.056
	65½–66½	.107	.095	.138	1.21	.083	1.08	+.033
	66½–68½	.107	.093	.144	1.25	.097	1.09	+.037
	68½–76½	.031	.013	.060	2.15	.332	.90	−.046
197	(s)	.131	.062	.207	1.83	.262	.87	−.060
198	(s)	.140	.126	.165	1.14	.057	1.03	+.013
199	(s)	.108	.087	.133	1.24	.093	1.00	0.000
200	(s)	.108		.131				
201	(s)			.150				
202	(s)	.128	.103	.157	1.24	.093	.99	−.004
203	0–4	.322	.108	.478	2.10	.322	.71	−.149
	29½–32½	.055	.041	.101	1.57	.196	1.17	+.068
	60–73	.040	.022	.071	1.79	.253	.99	−.004
204	0–2½	.315	.156	.568	1.89	.276	.79	−.102
	2½–4½	.085	.045	.250	2.36	.373	1.25	+.097
	4½–6½	.085	.047	.118	1.59	.201	.88	−.056
	21–25½	.051	.027	.087	1.79	.253	.95	−.023
205	0–6½	.565	.380	.930	1.56	.193	.92	−.041
	6½–33	.295	.079	.735	3.05	.484	.82	−.086
206	(s)	.041	.021	.145	2.62	.418	1.35	+.130
207	0–8	.100	.062	.110	1.33	.124	.83	−.081
	8–12	.021	.050	.086	1.31	.117	.99	−.004
	12–20½	.046	.022	.069	1.72	.235	.85	−.071
208	0–6	.575	.404	.760	1.37	.137	.97	−.013
	6–30	.283	.070	.605	2.94	.468	.73	−.137
209	0–3½	.385	.101	.760	2.74	.438	.72	−.143
	3½–9	.366	.083	.705	2.92	.465	.66	−.180
	21–33	.038	.027	.051	1.37	.137	.98	−.009
212	0–5	1.37	.35					
	5½–15	.137	.062	.279	2.12	.326	.96	−.018

from the terrace off the Calvert Cliffs; six are from coarse layers below the surface in dominantly mud cores and thus subject to sampling error; most of the remainder are from the coarse surface layer of channel sediments just outside the bay entrance. The co-efficients of sorting for these samples are all larger than usual for their respective grade sizes. These points are haphazardly distributed and do not fall into well-defined areas according to their respective environments.

Skewness

The log of skewness (geometric) plotted against the median diameter (fig. 4) shows that in general skewness is also a function of median diameter. Within the bounded area on the graph, the largest skewness values are in the silt class. Although the deviations are again great the median log of skewness in this class is negative. The median log skewness of very fine-grained sand is smaller that that of the silt class but still negative. Fine and medium-grained sands have relatively small log skewness values with the median being close to 0. A few samples with median diameters on either side of the boundary between the medium and coarse-grained sand classes all have small positive log skewness values. Inman (1949, pp. 64 and 68) has also reviewed the relationship between skewness values and median diameter. According to him, empirical studies indicate that the relationship is complex and may go through several cycles. A frequent observation though is that grains with median diameters near 1 mm. are generally skewed toward the coarse grades (positive log skewness). Grains with median diameters between 1 mm. and .18 mm. are nearly symmetrical (log skewness approaches 0). Inman suggests that finer particles far from their source should be negatively skewed. These observations are in good agreement with Chesapeake Bay sedimentological data.

A number of points fall outside the area defining the usual trend. On the positive side, two points with large skewness values are from samples collected from the terrace off the Calvert Cliffs. On the negative side, the points representing median diameters in the coarse and medium-grained sand range are all from the coarse surface layer of channel sediments outside the bay mouth. The fine-grained exceptions on the negative side are almost all from samples on the east bank of the channel below the Patuxent River mouth.

Skewness is as yet a relatively unexplored property of sediments. It can be simply a manifestation of sampling error "either if more than one size frequency distribution is included in the sample due to improper selection of samples, or if the sample of a single population is too small to reflect the attributes of the original distribution" (Krumbein and Pettijohn, 1938, p. 220). However, the virtual restriction of Chesapeake Bay samples with exceedingly large skewness values to certain environments seems significant. Gripenberg (1934, p. 203–205) has suggested that skewness may have an environmental or areal significance. This question will be reexamined in the following section.

Western Shore Sands

Graphs showing the change in median diameter have been superimposed on a number of bottom profiles across the bay (Plates 3 to 16).

From the western shoreline to the main channel, there is almost everywhere an initial progressive decrease in median diameter. Nearshore sands grade outward into progressively finer sands and eventually into the muds. Thereafter, gradation into finer sediment is less pronounced or absent. Where the usual gentle slope of this side of the bay floor is broken by a smaller secondary channel (as in traverse M–M′, Pl. 14), very fine-grained sand or mud occurs in the small channel even though sand may be present on either side of it.

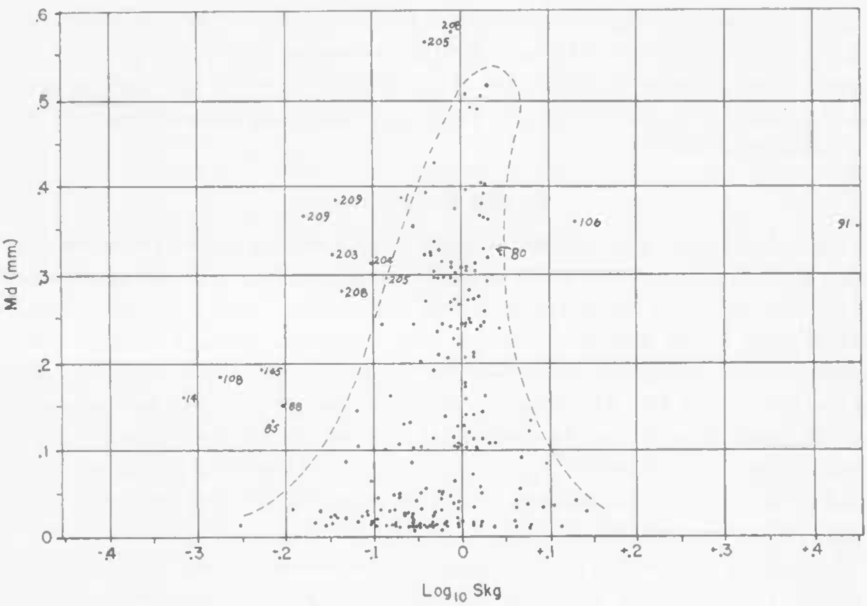


FIGURE 4. Graph of the Log of Skewness Plotted Against Median Diameter

No trend in median diameter can be observed for the sediments west of the channel in traverse J–J′ (Pl. 10). This may be related to the proximity of the Potomac River mouth just to the south. Complex currents possibly could erode and destroy the progressive change.

Data on the distribution of sediments in the tributaries are meager, but it appears that sands on either side of the tributary channels grade into the channel mud.

Pettijohn and Ridge (1932) attributed progressive decrease in median diameter of sediments along Cedar Point spit in Lake Erie to selective action of the current producing separation of the material into progressively finer grades in the direction of transport. As the sediments are moved by currents of water, the fine material simply outruns the coarse. This same mechanism of differentiation is probably responsible for the progressive gradation of sediments west of the channel and in the tributaries of Chesapeake Bay. Sediment removed from the shoreline by erosion is carried away from the beach by littoral currents. The coarser sand drifts along the shoreline and in places forms spits or builds the shoreline outward. Finer grades are carried closer to the channel and progressive deposition according to size takes place.

The two samples taken from the submerged terrace off the Calvert Cliffs are poorly sorted and have exceptionally large positive log skewness values. These are difficult to interpret, but possibly the high skewness is related to poor sorting due to unusually rapid accumulation. In this connection, sand samples from the core taken at Station 80 below the rapidly disappearing Sharps Island, have positive log skewness values (Table 3) which fall just inside the bounded area on the positive side of the graph. Thus these skewness values might also be considered unusually large.

Eastern Shore Sands

East of the main channel, the sediments are medium to fine-grained sands, even at stations where the depth of water is equivalent to that of stations west of the channel where clayey silt covers the bottom. On the east side of the channel, at least in the Mid-Bay and Southern Bay areas, median diameter may either increase or decrease away from the shoreline, especially in the lower half of the bay (Pls. 3–16). At places, a particularly sharp increase in median diameter is noted in sediments located as far out from the shoreline as the steep eastern slope of the channel. Furthermore, many of these samples taken on the eastern slope of the channel show unusually large negative log skewness values (page 39).

A skewness value of less than 1 (negative log skewness) means that the sample consists predominantly of coarse material with decreasing amounts of fine material. According to Inman (1949, p. 63), such a condition is commonly indicative of a lag concentrate. Although most of the samples taken from the east bank of the channel are fine-grained, the tremendous skewness in this direction characteristic of some of them suggests a condition of this sort.

The presence of these features in sediments occurring in connection with a topographic break which closely resembles what must have been the original eastern profile of the drowned stream valley suggests that bedrock is exposed in certain places along this side of the channel. The volume of sediment eroded from the Eastern Shore is small and probably insufficient to cover completely the bay floor on this side of the channel. Furthermore, this is the side of the bay along which the relatively strong tidal currents move. Apparently, these currents have actually removed some of the finer material from the soft bedrock and left a lag concentrate. Under such conditions, the finer material derived by erosion of the shoreline could not be deposited. Sedimentation in these areas, therefore, has been absent or slight.

Hough (1935) has described a somewhat similar distribution along the shore of Southern Lake Michigan. Median diameters of the sands first decrease away from the shore, then increase, then decrease again. The zone of coarser sand is interpreted as outcrop of bedrock (ibid, p. 68).

The sand flats occurring under shallow water in the vicinity of Tangier and Pocomoke Sounds appear to be large areas of submerged mainland. In this part of the bay, tidal currents are split by the flats and travel *around* them. Sands on the flats are medium to fine-grained and nearly all of the same size. They are well sorted and have log skewness values close to 0.

Bay Entrance Sands

The unusually high negative log skewness values and poor sorting of the coarse-grained surface layer in the channel just beyond the Bay Entrance also suggest lag concentrates. Apparently complex currents constantly shift the sediments of the area. The coarse gravelly surface material was probably derived in this manner from sands originally deposited somewhere along the Atlantic Coast. After emplacement of the material in its present position, later removal of some of the finer grains could produce the skewness values observed. Considerable mixing of bay sediments and continental shelf sediments is indicated by the presence of the many layers of sediment which vary considerably in size and sorting.

Samples of sand from the tidal delta are fine-grained and well sorted with low skewness values.

Muds

In most traverses little variation in median size or size distribution of the mud samples is apparent, although in occasional traverses there is some tendency for a slight decrease toward the channel.

In contrast a slight but quite discernible trend of variation in median diameter and size distribution is observed in longitudinal profile. Table 5 shows the average total silt and clay content of mud samples from each of the three major areas of the bay and the tributaries. Although the few samples available preclude far reaching conclusions, the silt and clay content of the tributary muds is uniformly high. Northern Bay area muds average slightly higher in silt and clay content than do the Mid-Bay muds. Southern Bay muds have the lowest silt and clay content and the highest range in variation among the samples. The increase in sand content becomes perceptible at traverse M–M′ and continues to the south. This change cannot be related to change in sand content of sediment derived from the tributaries since the total silt and clay content of the tributary bottom muds remains high. The most obvious source of the sand is the Atlantic Ocean. This confirms the hypothesis based on the presence of a large tidal delta in the bay entrance and complex stratification in channel sediments nearby that considerable sand from the continental shelf is swept into the Southern Bay area.

Variations in sorting and skewness of the muds are so wide that little significance can be attached to individual or group differences. The sorting and skewness values for laminated sediments are apparently not unusual.

Summary of Chesapeake Bay Sediment Types

Based on size distribution, Chesapeake Bay sediments can be divided into at least six types, each more or less characteristic of a given environment. Histograms of representative selected samples are shown in Figure 5.

TABLE 5

Average Total Silt and Clay Content of Chesapeake Bay Mud Samples

Area	Number of samples	Average total silt and clay	Range
		Per cent	*Per cent*
Northern Bay Area	26	87	54–99
Tributaries (Eastern Shore)	1	97	—
Mid-Bay Area	35	84	57–98
Tributaries (Eastern Shore)	4	89	86–94
Southern Bay Area	13	78	51–98
Tributaries (Eastern Shore)	5	89	86–89
Tributaries (Western Shore)	8	88	82–97
Entire Bay	92	84	51–99

Normal Western Shore Sands: Typically, these are well-sorted, coarse to fine-grained sands which decrease in size between the western shore-line and the zone of mud bottom. The shoreline is the source of these sediments. Some Eastern Shore sands are probably of the same type.

Western Shore Terrace Sands: These are medium to coarse-grained sands that form the terrace extending bayward from the Calvert Cliffs. They are also derived by erosion of the western shoreline but deposition has been unusually rapid. Poor sorting and high positive log skewness are characteristic.

Eastern Shore Near-Channel Sands: These sands show considerable variation in grain size and may increase in median diameter away from the shoreline. Samples from the steep eastern slope of the channel often have high negative log skewness values but are not particularly poorly sorted.

Eastern Shore Drowned Flats Sands: Sands occurring on broad flat portions of the bay floor near Tangier and Pocomoke Sounds are not subject to the full power of tidal currents. These sands are typically fine to medium-grained and nearly all samples have the same median diameter. They are well sorted and show log skewness values close to one.

Chesapeake Bay Muds: Little variation in Wentworth grade among mud samples is apparent, but total silt and clay content varies considerably. Sand content is highest near the mouth of the bay. Sorting and skewness values cover a wide range.

Bay Entrance Coarse Clastics: Gravels and coarse-grained sands occurring in the uppermost layers of highly stratified cores are poorly sorted and have high negative log skewness values. They are probably shifting continental shelf sediments and lag concentrates.

Color and Organic Content

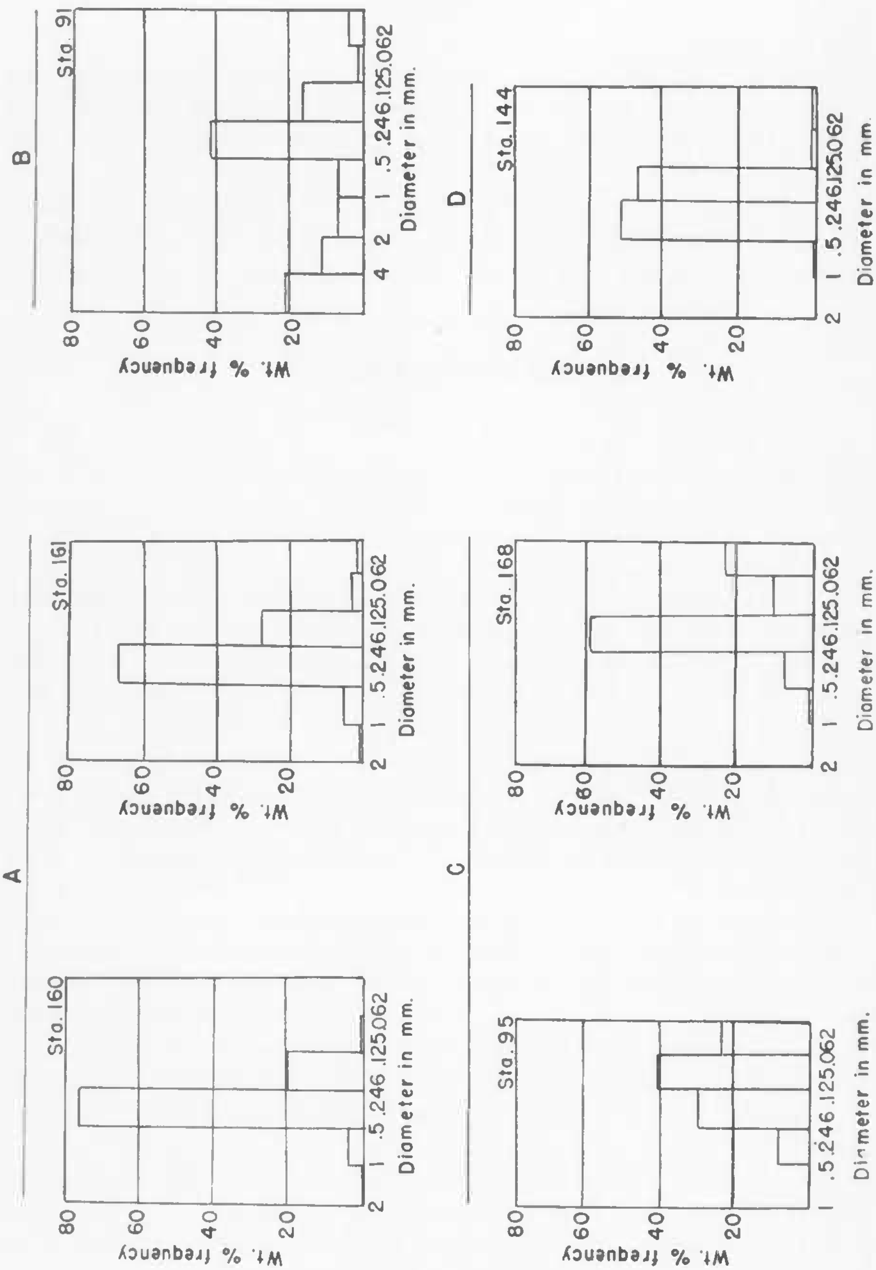
OBSERVATIONS

Chemical analyses of Chesapeake Bay bottom sediments are lacking and complete hydrographic data are not yet available. Nevertheless, a few observations and certain tentative conclusions concerning the color of Chesapeake Bay sediments can be stated.

A monotonously similar color distribution is characteristic of nearly all of the clay cores. When wet, an upper black layer is commonly present. It grades downward into a soft gray layer. Both layers have similar size distributions. The black layer is usually thickest in the channel of the Mid-Bay area. Frequently, a six-foot core here is black throughout its length. Outside of the channel, in the same traverse, the thickness of the black layer is gradually reduced and in shallow water it is absent in many cores. In the Southern Bay area, the black layer is seldom thick even in the channel. At only one station (167) is the layer thicker than 15 inches. The upper portions of cores taken in the Northern Bay area and in some stations in Tangier and Pocomoke Sounds consist of alternating bands of black and gray or brownish-gray mud, varying in thickness from 2 to 6 inches. Usually the black layers are slightly thicker than the gray layers. The banded portion of the core tends to be thicker in the channel, but this is not certain since it is difficult to establish a lower boundary. However, change in thickness of the banded layer across the bay is not at all as apparent as change in thickness of the black layer further south. For example, a core taken from Station 10, the most westerly station in traverse B–B′, had a banded layer at least 35 inches thick.

When dry, all cores except those that are banded are uniformly light gray throughout their length. The banded cores usually dry tan.

Most of the sands are some shade of gray when wet. Some containing small living molluscs are gray with black halos surrounding the shells. Others, with or


A
B
C
D
Sta. 91
Sta. 144
Sta. 160
Sta. 161
Sta. 168
Sta. 95
Wt. % frequency
Diameter in mm.

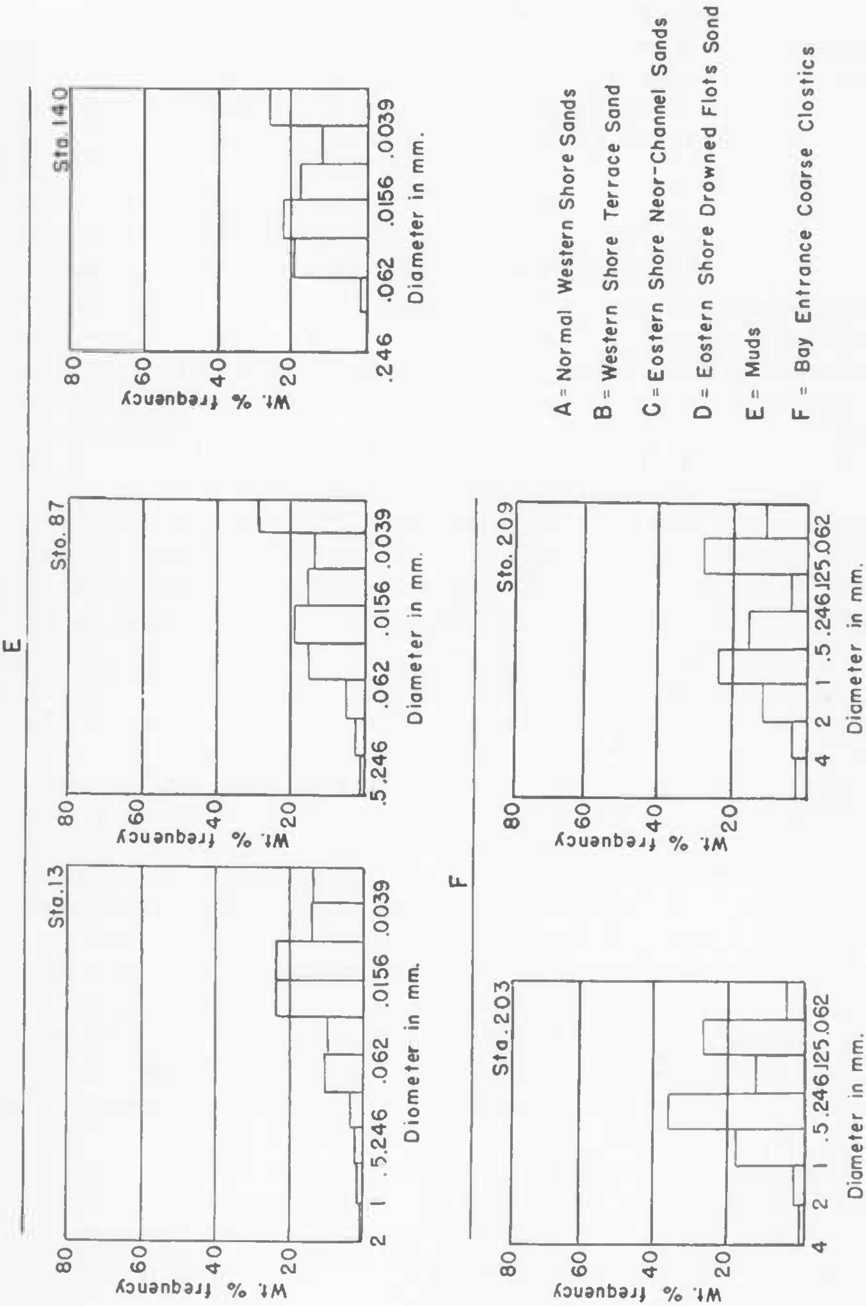


FIGURE 5. Histograms of Chesapeake Bay Sediments

without living molluscs, are jet black throughout. In all cases, the black color disappears very rapidly on contact with air. Possibly, the black color is due to a low concentration of organic material which is easily oxidized.

When dry, the sands vary from yellow to brown to grayish white depending largely on the amount of iron stain or silt present.

INTERPRETATIONS

According to Trask and Patnode (1936) the color of sediments varies with organic content, the lighter sediments containing less organic material than the darker sediments. This material accumulates in sediments largely through settling of dead planktonic organisms which commonly occur by the billions in the overlying water. Normally a large proportion of the planktons never settle to the bottom for a vast array of scavenger life subsists on them. In certain areas of the world, however, toxic conditions below the surface layers of water do not permit the development of the scavenger and other forms of life and the rain of falling planktons is uninterrupted, so that large quantities of the planktons accumulate in the bottom sediments. In the Black Sea and in certain of the Norwegian fjords, conditions are ideal for this development (Ström, 1939). These bodies of water fill basins which are separated from the sea by narrow comparatively shallow inlets or straits which effectively block circulation and allow the formation of toxic hydrogen sulfide. Bottom life except for certain anaerobic bacteria is absent. In the Black Sea, the bottom sediments contain as much as 35 per cent organic material. According to Trask (1932), the average organic content of recent sediments is about 2.5 per cent.

The text with Plate 2 gives the average organic content of the black clayey silt at the Chesapeake Bay Bridge as approximately 15 per cent; the average organic content of the underlying soft gray clayey silt varies from 6 per cent to 9 per cent. These figures seem high, but it is likely that the organic content of Chesapeake Bay muds is considerably greater than the worldwide average.

In many respects, the channel of the Mid-Bay area is a poorly developed replica of the Black Sea or of the Norwegian fjords, in that it is somewhat of a shallow basin. There are no large tributaries entering the bay in this region, and at least in some of the deeper holes currents are sluggish (p. 17). Lacking more positive data, it is believed that the more extensive development of black muds in this area results from slightly poorer circulation and consequently a more toxic environment.

Differences in color with depth are probably due to differences in organic content. Trask (1932, p. 217) found that normally the organic content of subaqueous sediments decreases with depth, the average loss in 30 centimeters being 15 per cent. This loss is thought to be the result of action by anaerobic bacteria (Trask, 1939, p. 444) which according to ZoBell (1939, p. 417) occur only in the top few centimeters of mud. After burial, the decomposition of organic material ceases and the organic content no longer changes.

In samples from the eastern United States, including six from the Potomac River (Trask, 1932, Table A, pp. 249 and 251), organic content alternately increased and decreased with depth. In some cores this behavior continued to a point as far as 4.5 meters below the surface. Trask concludes (p. 212) that the "rate of accumulation of organic matter in the deposits now forming in this area (eastern United States) is slower than it was in the not remote past." This implies climatic fluctuations during post-Pleistocene times. Such fluctuations could explain the banding of cores from the bottom of the Northern Bay area.

Why the northern bay muds are banded and the middle and lower bay muds are not is unknown. Possibly, physical or chemical conditions (such as salinity, temperature, or oxygen content) at the place of deposition affect the relative sensitivity of sediments to climatic change. Presumably, since these muds dry tan in contrast to the gray of unbanded muds, ferric oxide is more abundant in the banded type. This suggests incomplete reduction of the ferric oxide and lower organic content. The need for detailed chemical study of the problem is evident.

Reworked Fossils

Reworked Miocene mollusc shells were found in at least one core (Station 68)·

At Station 55, the bottom four inches of core was composed of highly diatomaceous cream-colored clayey silt. This is overlain by 55 inches of the usual soft gray clayey silt. It seems likely that the diatoms are derived by reworking of the Fairhaven diatomaceous earth member of the Calvert formation which outcrops just opposite this station along the Western Shore.

Comparison of Chesapeake Bay Sediments with Sediments of Other Bays

CAPE COD BAY AND BUZZARDS BAY

Cape Cod Bay and Buzzards Bay are deep Atlantic Coast embayments protected by Cape Cod and Martha's Vineyard. The sediments of both bays have been described by Hough (1940, 1942) and according to him are similar (1942, p. 27). In Cape Cod, coarse sediments "occur in areas exposed to wave and current action as in shallow water near shore or on shoals, and in the deep channel north of the tip of Cape Cod which is swept by tidal currents. Fine sediments are restricted to the deeper water in the central portion of the bay and to the small, well protected embayments of the shores" (1942, p. 10). Hard bottom near the mouth consists of a concentrate of glacial pebbles which has been produced by wave and current erosion. The fine sediments of both bays are black when wet and dark gray when dry. Organic content of the Buzzards Bay fine sediments is about 2 per cent.

Sediment distribution in these bays is apparently much like that of Chesapeake Bay. The hard bottom near the mouth of Cape Cod Bay produced by the concentration of glacial pebbles is somewhat comparable to the occurrence of bedrock on the steep eastern flank of the Chesapeake Bay channel. In both instances currents have prevented deposition and possibly removed some material. In all three areas, wave erosion of the shoreline has produced near shore sands. Fine material is in the central portion of each basin but Chesapeake Bay muds are finest. Although exact chemical data on Chesapeake Bay sediments are lacking, organic content appears to be somewhat higher. The finer size of particles and higher organic content of Chesapeake Bay muds are probably related to the more protected position of Chesapeake Bay.

BARATARIA BAY

Barataria Bay is a small tidal lagoon in Louisiana with a narrow passage opening southward into the Gulf of Mexico. According to Krumbein and Aberdeen (1937), sediments in the southern part of the bay are generally fine-grained sands or smaller. The coarser material is found in the channels and grain size decreases toward the shore. This behavior is in strong contrast to that of Chesapeake Bay sediments. "In a broad way, however, we may picture an environment in which periodic currents sweep the material back and forth, leaving, perhaps, a lag sediment within the most pronounced channels, and selecting out the finer material which is disseminated throughout the bay by slow drifts. Likewise, the organic matter that tends to accumulate in the bay is swept out of the channels and is moved over to regions of quieter water where it is deposited with the fine sediments" (ibid, p. 13). No parallel of such conditions is apparent in Chesapeake Bay.

Organic content of Barataria Bay muds does not exceed about 2 per cent (Krumbein, 1939, p. 191). This is not surprising since tidal currents are so effective in circulating the waters of the lagoon.

SAN FRANCISCO BAY

San Francisco Bay is a T-shaped body of water, connected to the Pacific Ocean by the leg of the T. According to Louderback (1939), there are two types of sediment distribution. Swift tidal currents sweep through the inlet and into the central part of the bay. Near the shoreline tidal currents are weaker and consequently not as effective. Eroded material deposited near the shoreline is coarse. Progressively finer sizes are deposited through deeper water until a certain still relatively shallow depth is reached. Below this depth, sediments become coarser with increasing depth. Apparently, at this deeper level tidal movements transport and deposit sediments carried into the bay by fresh water tributaries which usually carry quite coarse material.

The first distribution type is entirely similar to the distribution of Chesapeake Bay Western Shore sands. Chesapeake Bay tidal currents are not nearly as swift as those of San Francisco Bay and sediment entering Chesapeake Bay from the tributaries is uniformly fine and sticky. These factors would not seem to permit a distribution of sediments in Chesapeake Bay similar to the second type in San Francisco Bay.

Louderback also suggests an explanation for siltation of small reëntrants and tributaries along the shoreline of San Francisco Bay. During high water, some of the finer particles held in suspension by swift tidal currents are carried into the reëntrants and small tributaries where the hydraulic environment is one of quieter water. The fine particles would drop out and accumulate on the bottom at an unusually rapid rate. This general process may contribute to excessive siltation in some of the smaller drowned tributaries and reëntrants in the Chesapeake Bay system.

OYSTER DISTRIBUTION

One of the largest and oldest of Chesapeake Bay industries is the oyster industry. John Smith and the early Virginia colonists found large tribes of Algonquin Indians inhabiting the region and subsisting largely on fish and oysters from the bay (Radoff, 1952, p. 9). Today, the oyster crop is world famous.

The Maryland Shell Fish Commission in cooperation with the U. S. Coast and Geodetic Survey and the U. S. Bureau of Fisheries (1906–1907) published a series of charts showing the distribution of natural oyster bars in Chesapeake Bay. Comparison of these charts with Plate 1 shows that the oyster beds are restricted to the sandy areas of the bay bottom where silt and clay are practically absent. Most of the large areas of sand bottom within the bay include extensive areas where oysters breed. Consequently, the largest production is from the Eastern Shore, especially in the Mid-Bay and Southern Bay areas.

Molluscs of various types, especially pelecypods and small gastropods, were found in many of the sand samples. Arenaceous foraminifera were found in a few sand samples near the mouth of the Susquehanna River, and a few crustacea occur in Southern Bay samples. Shell life of any type is rare in the channel muds. Only occasional thin layers of small pelecypods occur.

Ordinarily, as pointed out in the section on color and organic content, an environment in which black, highly carbonaceous muds form is toxic and not conducive to life. Hence the absence of oyster bars in channel muds is probably due more to the poor environment than to the silt and clay-size particles. Similar toxic conditions are not present in the favored areas of shallow water and sand bottom. It does not seem likely, therefore, that a mere increase in quantity of the fine material in suspension would have much of an adverse effect on the oyster crop. Rapid encroachment of mud over oyster bars might cause gradual readjustment in the location of the bars, but no such encroachment was observed in this investigation.

MINERALOGY OF THE SEDIMENTS

Minerals of the Supply Area

The crystalline rocks of the Piedmont are largely metamorphosed and altered sedimentary and igneous rocks. Included are acid and basic intrusives, several types of schists, gneisses, quartzites, and marbles. These rocks are characterized by the usual metamorphic suite of minerals.

Most of the Coastal Plain formations are derived from the crystalline rocks of the Piedmont (Stephenson, Cooke and Mansfield, 1932). Most Coastal Plain rocks are composed primarily of quartz and clay. Some of the Upper Cretaceous and Eocene formations and the Yorktown formation contain abundant glauconite. Heavy minerals in Coastal Plain formations are dominantly of the metamorphic type.

Anderson (1948) collected very complete data on heavy minerals in the cuttings from deep oil wells on the Eastern Shore of Maryland. The following information concerning dominant mineral zones is taken from his report.

The Lower Cretaceous is classified as a garnet-staurolite-zircon zone. Epidote minerals begin to appear near the top of the formation.

Abundant epidote minerals are characteristic of Upper Cretaceous rocks. Staurolite and garnet are less abundant above the Lower Cretaceous. Siderite is abundant on both sides of the Upper Cretaceous-Eocene contact.

Information on the rest of the Eocene is incomplete. Apparently, zircon, pyrite and some siderite are abundant.

Heavy mineral frequencies in the Miocene are sporadic. The minerals most frequently encountered are zircon, staurolite, garnet, hornblende, epidote, sillimanite, and kyanite.

Data on the Pleistocene are also incomplete. The most abundant minerals are zircon and epidote with lesser amounts of staurolite, garnet, hornblende and sillimanite.

Minerals in Chesapeake Bay Sediments

Light Minerals

General

Quartz is by far the most abundant mineral in Chesapeake Bay sands. A little feldspar is usually present. Commonly quartz grains from near shore samples are stained with limonite, but the stain is absent in samples taken closer to the channel. The feldspars are cloudy with alteration products.

Glauconite is only rarely found. As this mineral is also rare in the heavy fraction, it must be very unstable since greensands are very common in some of the Coastal Plain formations.

Micas are rare. Most micas occur with the heavy mineral fraction.

Detrital Coal in the Northern Bay Area

North of the Patapsco River entrance, detrital coal is present in the bottom sediments. Typically, the coal is jet-black in color, has a high luster, and is ignited with great difficulty. It occurs in silt-size, frequently scallop-shaped flakes which indicate conchoidal fracture. These properties suggest that the coal is anthracite.

The coal is sparsely disseminated throughout the length of most cores from the area, but is highly concentrated close to the surface in some. At several coring stations, surface layers are composed almost entirely of coal. Some of the cores have coal-rich subsurface layers and lenses intercalated between layers of nearly normal mud, but these layers are always relatively close to the surface. The thicknesses of the coal-rich layers or alternating layers of coal and mud vary considerably, but there is a progressive thinning away from the channel and to the south. In muds near the mouth of the Patapsco and further south, particles of coal are rare.

The anthracite basin of northeastern Pennsylvania is the only possible source for detrital coal in Chesapeake Bay. From 1830 when anthracite mining began until the recent passage of the Stream Pollution Act by the Pennsylvania State Legislature, the anthracite mines of Pennsylvania discharged their washings and tailings into the streams of the region, many of which are tributary to the Susquehanna. Some of the coal has been carried as far south as Chesapeake Bay and in sufficient quantity to form discrete layers of coal in the sediments of the Northern Bay area.

If the immediate source of detrital coal in the Northern Bay area is the Susquehanna River, then it seems reasonable to assume that the immediate source of the largest portion of the associated normal mud is also the Susquehanna River. Suspended particles in the Susquehanna are carried over the Fall Line into the more sluggish water of the Northern Bay area. Because of the reduced competency of the carrying medium, the suspended particles settle and accumulate on the bay bottom. This process is especially rapid in the basin at the Susquehanna River mouth which is nearly filled with detritus (Pl. 17). A large proportion of the Susquehanna derived sediments is doubtless deposited within the Northern Bay area.

At the southern boundary of the Northern Bay area, the bay is constricted and its water passes through the narrows between Kent Island and Sandy Point (Pl. 1). The velocity of the currents must increase and consequently, suspended particles of silt and clay which would otherwise be deposited in this area remain in suspension through the narrows. The result is a sharp deepening of the channel (Pl. 17). Above this natural boundary, the bottom sediments are mostly derived from the Susquehanna River.

The spotty and irregular distribution of the coal precludes any attempt to estimate volume and rate of coal deposition in this area.

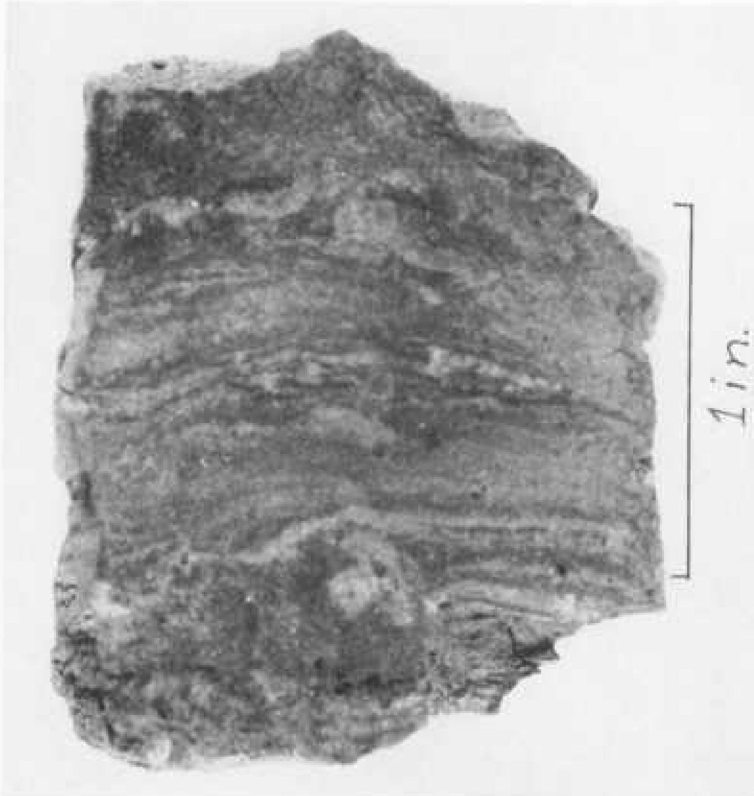


PLATE 18. Laminations in Silt (Station No. 131)

HEAVY MINERALS

Description

Heavy minerals in Chesapeake Bay sands are predominantly of the metamorphic type. The distribution of these minerals is shown in Table 6.

The various species are as follows:

Andalusite. A relatively rare mineral. Usually colorless and non-pleochroic, but some grains are pleochroic and pink. Carbonaceous inclusions may be present. Grains fairly well rounded.

Augite. Not a common mineral but usually occurs with diopside. Light green

TABLE 6

Heavy Mineral Composition of Chesapeake Bay Sands

(0.125–0.246 mm. grade)

Depth refers to position of sample in core measured from the top. *s* = snapper sample. *x* = mineral present (less than 1 per cent).

Station No.	1	1	1	6	32	34	41	47	48	54	58	59
Depth (inches)	(0–8)	(8–19)	(19–28)	(26–64)	(s)	(s)	(s)	(s)	(s)	(s)	(7–20)	(0–6)
Weight, per cent of heavy minerals	.6	.1	1.9	.5	3.3	3.9	1.5	.9	2.9	2.8	3.	1.6
Mineral	Number frequency percentage											
Andalusite	x	x	x	—	—	—	1	1	1	1	1	—
Augite	1	1	3	x	—	2	—	2	1	1	2	—
Biotite	3	1	1	2	x	1	2	3	4	7	3	1
Chlorite	6	12	5	x	x	x	—	1	x	1	x	1
Chloritoid	1	—	1	1	1	x	1	x	3	1	1	—
Corundum	—	—	—	—	—	—	x	—	—	x	x	—
Diopside	3	1	1	1	x	4	1	1	1	1	5	6
Enstatite	1	—	x	—	—	1	—	—	—	—	x	—
Epidote	7	4	5	x	3	5	x	2	3	3	2	2
Garnet	8	3	8	x	2	13	1	5	1	4	11	31
Glaucophane	—	—	—	—	—	—	—	—	x	x	—	—
Hornblende	13	6	8	3	3	16	2	9	7	8	17	22
Hypersthene	2	1	x	—	—	2	—	2	2	x	2	4
Kyanite	—	—	x	5	2	1	3	2	1	2	x	1
Muscovite	2	20	4	x	x	x	—	—	—	—	—	3
Rutile	x	x	—	1	x	—	—	—	—	—	—	—
Siderite	3	2	—	x	1	—	—	—	—	—	—	—
Sillimanite	x	1	1	2	2	3	1	2	4	5	6	3
Staurolite	—	—	—	10	15	5	26	8	18	13	6	2
Titanite	x	—	—	—	x	—	—	x	—	—	—	—
Tourmaline	2	1	1	7	3	4	9	6	9	8	3	3
Tremolite	x	x	x	1	—	—	—	—	—	—	—	—
Zircon	x	—	1	1	1	2	1	x	x	1	1	1
Zoisite	1	x	x	x	x	x	—	—	—	1	1	—
Black Opaque	8	7	23	44	55	27	43	34	23	27	28	15
White Opaque	9	11	4	20	7	10	5	15	16	15	10	4
Miscellaneous	28	28	30	—	x	x	x	6	2	x	—	1
Mineral ratios												
Sillimanite/Epidote	.04	.1	.2	2.5	.6	.5	4.	.7	1.4	1.4	3.6	1.3
Garnet/Staurolite				.03	.1	2.5	.04	.6	.05	.3	1.8	19.8

TABLE 6—*Continued*

Station No.	60	61	73	74	75	76	80	82	85	85	91	94
Depth (inches)	(s)	(s)	(s)	(s)	(s)	(54–61)	(0–4)	(s)	(17–25)	(36–42)	(s)	(76–82)
Weight, per cent of heavy minerals	.3	.5	2.5	.9	2.8	3.6	8.	6.6	3.3	3.7	3.1	2.9
Mineral	Number frequency percentage											
Andalusite	1	x	—	—	x	1	—	—	1	1	x	—
Augite	3	1	1	1	x	2	x	x	2	3	—	1
Biotite	3	1	1	x	2	2	1	1	2	4	x	4
Chlorite	1	1	—	1	—	x	x	x	1	—	—	1
Chloritoid	1	1	—	1	—	—	x	—	—	—	x	—
Corundum	x	—	—	—	x	—	—	—	—	—	—	—
Diopside	3	3	2	2	x	2	2	2	3	4	—	2
Enstatite	—	—	1	x	—	1	x	—	—	1	—	1
Epidote	1	2	2	4	3	x	2	1	2	5	x	3
Garnet	3	2	31	9	2	16	20	16	11	13	x	7
Glaucophane	—	—	—	—	x	x	—	x	—	—	—	x
Hornblende	12	12	14	8	1	21	10	9	35	27	1	16
Hypersthene	1	1	3	2	—	3	4	2	6	2	—	5
Kyanite	2	1	x	1	1	2	x	2	1	1	4	2
Muscovite	x	1	—	x	—	x	—	—	—	x	—	—
Rutile	1	—	—	1	—	—	x	—	—	—	x	—
Siderite	x	—	—	x	—	—	—	—	—	—	—	—
Sillimanite	4	4	1	2	4	3	x	3	2	3	2	2
Staurolite	4	7	1	5	14	3	4	3	3	3	12	8
Titanite	—	—	—	—	—	—	—	x	x	—	x	—
Tourmaline	7	6	1	6	3	2	1	1	3	2	2	3
Tremolite	—	—	—	—	—	x	—	—	1	1	x	x
Zircon	1	1	1	1	4	1	2	4	—	—	5	x
Zoisite	—	1	—	x	—	—	—	—	—	x	—	—
Black Opaque	22	22	33	30	54	29	47	48	14	15	64	27
White Opaque	29	25	4	22	10	6	3	6	5	9	4	12
Miscellaneous	—	7	4	1	x	5	1	1	4	4	2	4
	Mineral ratios											
Sillimanite/Epidote	3.3	2.2	.4	.5	1.1	8.	.2	3.3	1.	.5	3.5	.7
Garnet/Staurolite	.6	.4	24.7	1.3	.1	5.2	5.5	5.	3.4	5.3	.02	.9

TABLE 6—*Continued*

Station No.	95	96	100	101	104	105	106	108	108	111	112	113
Depth (inches)	(s)	(s)	(s)	(s)	(s)	(s)	(s)	(0–5)	(5–44)	(s)	(s)	(s)
Weight, per cent of heavy minerals	1.7	2.1	4.2	3.3	3.8	2.4	2.5	1.2	1.5	.9	.9	?
Mineral	Number frequency percentage											
Andalusite	—	1	x	—	x	x	x	1	x	—	x	x
Augite	—	1	—	—	—	—	—	1	1	x	x	1
Biotite	2	3	—	2	1	1	1	2	2	2	2	3
Chlorite	3	1	—	x	—	x	x	x	x	—	—	—
Chloritoid	x	1	x	—	x	—	—	x	—	x	x	x
Corundum	—	x	—	—	—	—	—	—	—	—	—	—
Diopside	2	2	—	1	—	x	x	2	1	1	1	1
Enstatite	x	x	—	—	—	—	x	x	—	x	—	x
Epidote	2	4	1	3	7	9	7	3	4	8	4	5
Garnet	3	2	x	2	1	x	x	13	10	10	5	2
Glaucophane	x	—	—	x	—	—	—	—	x	—	x	—
Hornblende	16	12	2	4	1	3	3	20	19	17	11	28
Hypersthene	3	1	x	—	—	—	—	1	x	4	x	2
Kyanite	x	2	1	2	1	1	1	1	1	1	2	x
Muscovite	—	—	x	—	—	—	x	—	—	—	—	—
Rutile	x	x	1	1	x	—	1	—	x	1	x	—
Siderite	—	—	—	—	1	29	22	1	x	—	2	x
Sillimanite	3	4	4	5	3	2	1	4	2	5	3	3
Staurolite	5	6	10	13	4	3	3	6	7	5	7	5
Titanite	—	—	—	x	x	—	x	—	—	—	—	—
Tourmaline	6	3	1	2	4	1	1	4	4	3	1	3
Tremolite	1	x	—	—	—	—	x	—	x	—	x	1
Zircon	x	1	2	1	3	1	5	1	1	x	4	1
Zoisite	—	x	—	—	x	—	x	—	—	1	x	x
Black Opaque	27	22	69	52	56	40	40	30	33	27	39	22
White Opaque	20	29	5	6	11	7	9	7	8	10	11	17
Miscellaneous	4	4	1	4	5	1	2	2	3	3	4	3
Mineral ratios												
Sillimanite/Epidote	1.5	.9	4.3	1.7	.4	.2	.2	1.4	.6	.6	.6	.6
Garnet/Staurolite	.7	.4	.05	.2	.3	.1	.1	2.2	1.6	1.2	.8	.3

TABLE 6—*Continued*

Station No.	118	119	121	124	126	136	138	139	141	143	145	146
Depth (inches)	(s)	(s)	(0–5)	(s)	(23–45)	(0–7)	(s)	(s)	(0–3)	(s)	(s)	(0–6)
Weight, per cent of heavy minerals	.2	6.4	9.6	2.8	3.8	2.6	3.9	3.9	2.4	2.1	1.5	.2
Mineral	Number frequency percentage											
Andalusite	—	—	x	2	x	—	—	x	—	—	—	x
Augite	—	—	—	1	—	—	—	—	3	8	—	—
Biotite	2	x	—	4	1	1	1	1	—	1	1	2
Chlorite	—	—	—	1	x	1	—	—	—	—	—	19
Chloritoid	x	—	—	x	x	x	x	x	—	—	x	x
Corundum	x	—	—	x	x	x	—	x	x	—	—	1
Diopside	x	—	x	1	—	x	—	—	1	4	x	—
Enstatite	—	—	x	—	—	—	—	—	1	x	1	x
Epidote	5	2	x	6	2	4	3	2	2	2	1	x
Garnet	1	1	11	5	5	1	4	5	16	13	3	x
Glaucophane	—	—	—	—	—	—	—	—	x	—	—	—
Hornblende	3	1	7	16	9	6	7	6	18	36	10	9
Hypersthene	—	—	2	2	1	x	—	x	4	10	1	1
Kyanite	4	1	1	1	1	3	1	1	1	x	3	1
Muscovite	—	—	—	—	x	1	—	—	1	—	—	41
Rutile	—	1	—	—	x	x	1	1	—	—	x	—
Siderite	1	x	11	x	x	—	1	x	9	—	2	—
Sillimanite	8	2	x	5	4	11	5	1	1	5	8	2
Staurolite	8	6	3	7	4	6	8	5	1	2	12	x
Titanite	—	—	—	—	—	—	—	—	—	—	—	—
Tourmaline	3	2	1	4	1	3	1	2	2	3	4	1
Tremolite	—	—	—	x	x	1	—	—	—	x	—	1
Zircon	1	4	2	x	2	2	1	2	1	—	2	x
Zoisite	x	—	—	—	—	—	—	—	—	—	—	—
Black Opaque	46	77	56	25	58	51	60	67	29	8	37	9
White Opaque	11	2	2	14	4	5	7	4	5	2	12	12
Miscellaneous	6	x	1	3	4	x	—	1	4	5	2	x
	Mineral ratios											
Sillimanite/Epidote	1.8	1.2	1.	.7	2.2	2.7	2.	.5	.4	2.6	6.3	6.
Garnet/Staurolite	.1	.2	3.6	.7	1.2	.2	.5	.9	15.7	7.7	.3	1.

TABLE 6—*Continued*

Station No.	148	149	153	154	157	158	160	162	163	165	169	170
Depth (inches)	(s)	(s)	(s)	(s)	(s)	(s)	(s)	(s)	(s)	(0–6)	(s)	(s)
Weight, per cent of heavy minerals	2.9	1.9	.4	8.2	1.9	6.3	4.9	2.1	2.8	2.3	1.4	1.6
Mineral	Number frequency percentage											
Andalusite	—	—	1	—	x	—	x	1	—	—	—	—
Augite	x	—	1	—	—	1	—	—	—	1	1	1
Biotite	1	2	x	—	2	x	1	—	1	—	1	—
Chlorite	—	—	—	—	x	—	—	x	—	x	1	x
Chloritoid	—	x	1	—	x	x	—	x	x	—	—	—
Corundum	—	—	2	—	—	x	—	x	—	x	—	—
Diopside	—	—	—	—	x	x	—	—	x	1	1	3
Enstatite	—	—	x	—	—	—	—	—	—	—	—	—
Epidote	3	1	4	1	4	2	2	2	2	7	5	4
Garnet	6	5	3	2	10	8	1	4	3	7	10	5
Glaucophane	—	—	—	—	x	—	—	—	—	x	x	x
Hornblende	6	8	10	—	4	5	1	5	6	9	36	41
Hypersthene	2	1	—	—	1	1	—	1	—	1	3	3
Kyanite	1	2	1	1	x	2	x	2	1	2	1	2
Muscovite	—	—	2	—	x	—	—	—	—	1	—	—
Rutile	—	x	1	—	—	—	x	—	—	—	—	—
Siderite	x	—	—	—	1	1	1	2	x	—	3	1
Sillimanite	5	6	12	2	4	3	3	5	4	6	4	7
Staurolite	6	6	2	6	7	2	9	2	10	12	4	1
Titanite	—	—	—	—	—	—	—	—	—	—	x	1
Tourmaline	2	2	3	1	2	1	1	1	2	4	1	4
Tremolite	—	—	x	x	—	—	—	—	—	1	—	1
Zircon	3	4	1	4	3	6	3	4	3	1	—	1
Zoisite	—	—	—	—	x	—	—	—	—	—	—	—
Black Opaque	60	54	37	79	58	64	74	64	62	41	19	19
White Opaque	3	8	12	3	2	2	2	4	4	3	6	3
Miscellaneous	1	x	5	1	—	x	1	1	1	2	3	3
	Mineral ratios											
Sillimanite/Epidote	1.6	4.3	2.2	1.6	1.	1.3	1.9	2.3	1.7	.8	.8	1.7
Garnet/Staurolite	1.1	.8	1.1	.3	1.6	3.7	.2	2.2	.3	.6	2.6	4.

TABLE 6—*Continued*

Station No.	172	174	179	180	185	187	188	189	190	191	192	195
Depth (inches)	(s)	(s)	(s)	(s)	(s)	(s)	(s)	(s)	(s)	(s)	(s)	(0–5)
Weight, per cent of heavy minerals	?	1.5	1.4	2.6	.6	.8	.5	.5	1.1	1.2	.7	.7
Mineral	Number frequency percentag											
Andalusite	x	x	1	x	x	—	x	—	—	x	—	—
Augite	x	—	—	—	—	2	x	2	x	3	1	x
Biotite	1	2	1	1	x	1	11	12	19	3	10	22
Chlorite	x	—	x	1	—	4	32	27	38	11	17	22
Chloritoid	x	—	x	x	—	1	1	—	x	x	1	—
Corundum	—	—	x	—	—	—	—	—	—	—	—	—
Diopside	1	1	x	1	1	2	2	2	1	2	1	3
Enstatite	—	—	—	—	—	—	—	—	1	—	—	—
Epidote	5	3	4	2	13	13	1	4	3	5	4	6
Garnet	4	4	10	5	1	2	1	1	4	6	6	1
Glaucophane	—	—	—	—	—	—	—	x	—	—	x	x
Hornblende	40	5	11	15	9	31	32	30	19	47	26	20
Hypersthene	2	—	—	1	x	2	2	1	2	3	3	2
Kyanite	1	3	3	1	3	2	1	—	—	1	—	1
Muscovite	—	—	—	x	1	2	3	2	1	x	—	6
Rutile	—	—	—	x	x	x	—	—	—	—	—	—
Siderite	1	1	x	—	—	—	—	—	—	—	—	—
Sillimanite	8	11	8	2	7	6	3	2	1	3	3	3
Staurolite	4	14	9	4	9	4	1	1	1	2	3	x
Titanite	x	—	x	—	—	x	—	—	—	x	—	—
Tourmaline	3	7	1	1	2	2	—	1	—	3	1	—
Tremolite	2	—	—	1	—	x	4	4	1	1	2	x
Zircon	1	1	2	1	1	x	x	x	—	1	1	—
Zoisite	—	—	—	—	—	—	—	—	—	—	—	x
Black Opaque	13	40	42	34	49	15	3	1	3	4	13	7
White Opaque	8	4	3	3	2	7	1	6	5	4	5	3
Miscellaneous	3	4	2	26*	x	3	2	4	x	—	1	1
	Mineral ratios											
Sillimanite/Epidote	1.5	3.5	2.4	1.2	.6	.4	4.	.6	.3	.6	.8	.5
Garnet/Staurolite	.9	.3	1.1	1.2	.2	.6	1.5	1.5	3.	3.	1.8	2.

TABLE 6—*Concluded*

Station No.	198	199	200	202	207	212
Depth (inches)	(s)	(s)	(s)	(s)	(0–8)	(0–5)
Weight, per cent of heavy minerals	1.7	.4	.5	.8	2.1	2.4
Mineral			Number frequency percentage			
Andalusite	x	—	x	—	x	—
Augite	2	2	x	2	1	—
Biotite	x	4	5	4	20	6
Chlorite	2	18	17	12	21	7
Chloritoid	x	x	1	—	x	—
Corundum	—	—	—	—	—	—
Diopside	4	5	2	4	4	1
Enstatite	—	—	—	—	—	x
Epidote	5	2	5	7	5	4
Garnet	5	2	7	3	4	9
Glaucophane	x	x	x	—	—	—
Hornblende	52	41	35	42	20	18
Hypersthene	2	1	2	3	3	1
Kyanite	—	—	x	—	—	2
Muscovite	—	1	2	x	6	6
Rutile	—	—	—	—	x	—
Siderite	—	—	—	—	—	x
Sillimanite	6	4	4	5	2	3
Staurolite	4	1	x	1	1	3
Titanite	—	—	—	1	—	—
Tourmaline	2	—	—	2	—	x
Tremolite	—	1	2	1	1	—
Zircon	x	—	—	—	—	2
Zoisite	—	x	—	—	—	—
Black Opaque	8	5	3	3	3	29
White Opaque	2	5	6	7	3	4
Miscellaneous	5	6	6	3	5	3
			Mineral ratios			
Sillimanite/Epidote	1.1	1.8	.9	.8	.5	.8
Garnet/Staurolite	1.3	3.	22.	5.	3.	2.8

* Consists almost entirely of limonite including replacements of seeds, root cavity fillings and hardpan.

to brownish green in color. Usually occurs as prismatic cleavage fragments. A few grains of diallage are occasionally noted.

Biotite. The least abundant of the micaceous minerals. It is found only in the very fine-grained sands and silts. Occurs as brown or occasionally green basal cleavage flakes commonly nearly isotropic. Some grains are altering to chloritic material.

Chlorite. Abundant only in very fine-grained sands and silts. It occurs as light-green cleavage flakes with very low birefringence and is sometimes almost isotropic. Some grains contain black opaque inclusions which are probably iron oxide.

Chloritoid. A rare mineral. The grains are pleochroic (blue to green) prismatic-cleavage flakes usually fairly well rounded. Dispersion is very marked.

Corundum. A rare mineral. It is found as blue or colorless angular grains which yield good uniaxial interference figures.

Diopside. In most of the samples but is more abundant in the finer sands. It occurs as colorless, stubby, prismatic-cleavage fragments usually with the corners well rounded. Occasionally the grains are frayed.

Enstatite. An unimportant mineral usually found with hypersthene. Light-green, stubby and somewhat irregular prisms are characteristic.

Epidote (pistacite). Fairly common throughout the bay. Usually the grains are lemon-green and well rounded or spherical, but occasionally only slightly rounded cleavage fragments occur.

Garnet (almandine). A very important mineral. Most grains are shades of pink, but colorless grains are common and, rarely, brown grains are found. Almost always very angular. A few grains have botryoidal markings on the surface similar to those described by Anderson (1948, p. 26). A few grains contain needlelike inclusions of a colorless unidentified mineral. Rarely biotite inclusions are present.

Glaucophane. Relatively rare. Markedly pleochroic (blue to yellow green). Usually the grains are elongate and more or less irregular.

Hornblende. An important mineral especially abundant in the finer-grained sands. The common variety is by far the most abundant. Occurs as green to yellowish-green grains some being very dark and almost black. Occasional grains of brown basaltic hornblende are encountered. Typical grains are elongate platy-cleavage fragments usually well rounded but occasionally with frayed ends. Some grains are partly altered to chloritic-looking material.

Hypersthene. Usually present mostly in the finer sands. Characterized by very marked pleochroism (red to green). Occurs in frayed stubby cleavage fragments.

Kyanite. Fairly common throughout but never in large quantity. Typically colorless. Occasionally pale-green rectangular plates with characteristic cleavage and parting are found. Usually the grains are only slightly rounded, but some grains are short and extremely well rounded.

Muscovite. As in the case of the other micaceous minerals, muscovite is abundant only in the very fine-grained sands and some silts. Colorless cleavage flakes with low birefringence are typical.

Rutile. Ubiquitous, but always in trace proportions. All of the grains are deep-brown rounded prisms, occasionally striated.

Siderite. Usually in small quantities but more abundant near the mouth of the Potomac River. The grains are stained brown with limonite and may be wholly or partially replaced by limonite. Characteristically opaque (due to limonite) except around the edges where the grains are translucent and reddish. Attacked by warm hydrochloric acid.

Sillimanite. A fairly common mineral throughout the bay. It occurs as colorless prisms usually with longitudinal striations. Most of the prisms are fairly well rounded although some are fractured. The variety fibrolite is rare.

Staurolite. An abundant mineral. It occurs in brown to reddish-brown grains most of which are hackly and angular. Many of the grains are striated. Carbonaceous inclusions and bubbles are common often imparting the typical "swiss cheese" appearance.

Titanite. Found only occasionally and then in trace proportions. The grains are brownish yellow, slightly rounded and euhedral.

Tourmaline. An ubiquitous mineral but usually not in large quantities. Always strongly pleochroic, most grains are shades of brown varying from deep brown to the color of honey. Brown to green grains are less common and blue to green grains are rare. Usually occurs in slightly rounded prisms or rounded basal parting fragments. Frequently carbonaceous inclusions are present but overgrowths are rare.

Tremolite. A few characteristically elongate fibrous cleavage fragments occur. These are colorless or occasionally very pale green (some grains placed here may be actinolite).

Zircon. A relatively minor constituent of the coarser sands. Most grains are colorless, but rarely the mauve variety is encountered. Usually occurs as fairly well rounded prisms, but some grains are nearly spherical.

Zoisite. Common only in the samples near the mouth of the Susquehanna River. It occurs as colorless to pale-green cleavage fragments.

Black Opaque. Abundant throughout the bay but rapidly diminishes in amount with decrease in grain size. Magnetic grains are practically absent. A strong positive test for titanium was obtained using the phenol method described by Raeburn and Milner (1927, p. 398). Usually the grains are rounded and many are striated. Some grains are partially altered to leucoxene. Undoubtedly, ilmenite is the major constituent.

White Opaque. Mostly leucoxene. Some grains enclose appreciable quantities of ilmenite. Usually the white opaques are rounded and have a dull luster.

Miscellaneous. This category consists mostly of irregular lumps and fragments of limonite which appear to be soil hardpan. Clusterlike stringers of authigenic pyrite occasionally occur. Nearly opaque detrital glauconite also occurs but is surprisingly rare. A few grains of green, isotropic spinel were observed. Minerals too heavily altered to be identified and some rock fragments are also placed in this group.

Sorting Effects

Figure 6 is a mineral variation diagram from the sand samples along traverse F–F′ across the bay. Only the most abundant minerals are shown. It is apparent that heavy mineral composition varies according to grain size of the samples. The quantity of opaque minerals (mostly ilmenite and leucoxene) in the samples decreases greatly as median diameter of the samples becomes smaller. The quantity of staurolite also decreases but to a lesser extent. The amphiboles and garnet are much more abundant in the finest sample of this series. The pyrox-

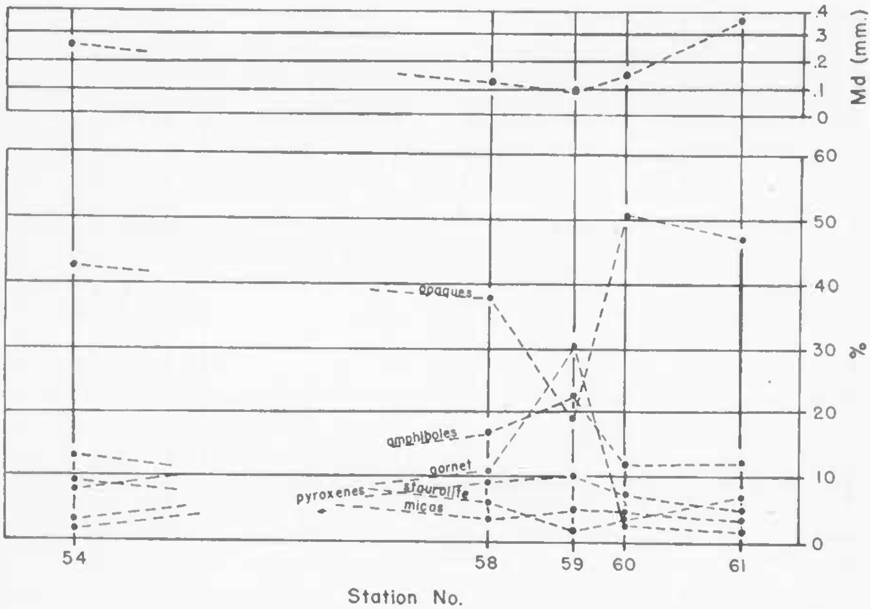


FIGURE. 6 Graph Showing Mineral Variations With Change in Grain Size Along Traverse F-F′

enes are slightly more abundant and the micas (muscovite, biotite, chlorite) are sporadic.

The median diameter of the finest samples shown in Figure 6 is about .1 mm. In still finer samples, hornblende and the micaceous minerals are usually the only minerals present in any quantity. Thus below .1 mm., the relative abundance of these minerals greatly increases.

With one exception, the abundance of the minerals shown in the series varies according to specific gravity—that is, the heavier minerals dropping out first are more abundant in the coarser sands and the lighter minerals, being carried farther, are more abundant in the finer sands. The increase in abundance of garnet with decreasing grain size down to sands with a median diameter of about .1 mm., is surprising. In sands with median diameters of less than .1 mm., garnet is less abundant. Variation of this type, in opposition to the requirements of specific gravity, has been attributed to incompatibility of original size distribution (Van Andel, 1950, p. 27).

Because of these sorting effects it is not possible to compare the percentages by number of minerals in samples of different grain size and make correlations regarding source. Accordingly, some method which employs ratios of two minerals of nearly the same specific gravity and probably with the same original

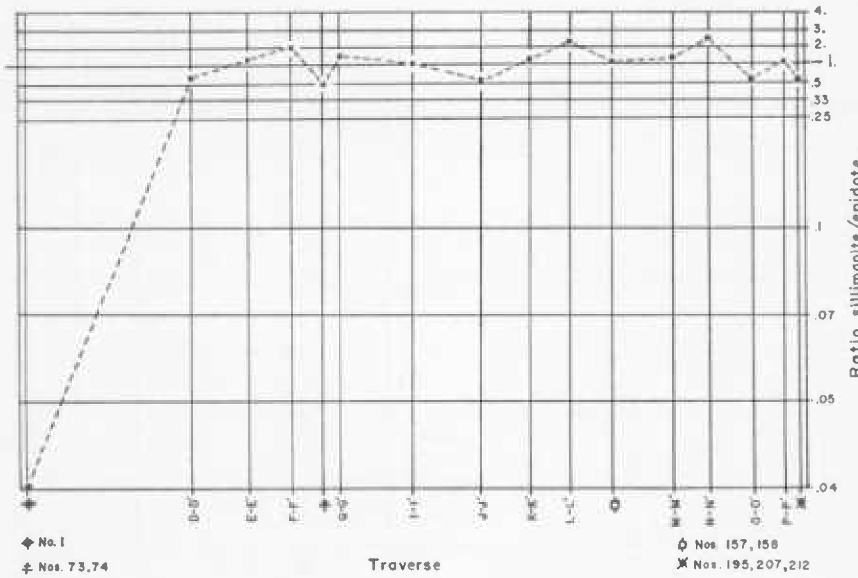


FIGURE 7. Graph Showing Variation in the Sillimanite-Epidote Ratio Along the North-South Trend of Chesapeake Bay

size distribution must be used. Any changes in mineral composition due to sorting should affect both of these minerals to the same degree. Such a method is recommended by Rittenhouse (1943, pp. 1772 to 1775). A preliminary study of the heavy mineral fractions of the fine-grained sand grade (.125 mm. to .246 mm.), showed the minerals epidote and sillimanite to be most suitable for correlation studies in Chesapeake Bay.

Sillimanite-Epidote Ratio

Figure 7 shows the variation in the sillimanite-epidote ratio along the north-south trend of the bay. The value of each point on the graph has been computed from all samples in the traverse crossing the bay at that point.

There is little change in the ratio throughout the length of the bay except at

Station 1 in the mouth of the Susquehanna River where the channel sands are extremely rich in epidote. This station is located just southeast of the Fall Line within the belt of Lower Cretaceous rocks. Anderson (1948) has reported high concentrations of epidote in Upper Cretaceous rocks from the deep wells on the Eastern Shore (page 53) but near Station 1 the closest Upper Cretaceous rocks are to the southeast. Since the movement of detrital coal in this area is down the Susquehanna from the northwest, it seems unlikely that epidote bearing sands would move in the opposite direction. The epidote must be derived from crystalline rocks of the Piedmont, just as was that of the Upper Cretaceous rocks.

The sillimanite-epidote ratios of sands east of the channel are no different than the sillimanite-epidote ratios of sands west of the channel.

Since the strike of Coastal Plain formations crosses the bay, one would expect differences in mineralogy of the bay sands along the trend of the bay. Such differences would probably be masked to some extent by the dominance of Pleistocene terrace deposits on much of the shoreline. Nevertheless, the strong similarity (exclusive of differences due to change in grain size) in mineralogy of all the samples must indicate rather complete mixing of the sands.

Siderite

Siderite is sporadically present throughout the bay in trace amounts. At three stations located on the spit which is forming where the northern shore of the Potomac River meets the bay shore, siderite is very abundant, composing as much as 29 per cent of the sample at Station 105 on the bay side of the spit. At Station 104 along the Potomac side, the frequency percentage is only 1 per cent. The difference in abundance of siderite at these two stations may be a result of difference in grain size of the sands (Md at Station 104 = .321 mm.; Md at Station 105 = .237 mm.), concentration of siderite having taken place in the finer sample. In relatively coarse samples taken from the other side of the Potomac at Stations 100 (Md = .400 mm.) and 101 (Md = .303 mm.), siderite is absent.

To the south in the next two traverses across the bay, siderite again appears in higher than usual proportions in some of the very fine-grained sands although less than at Station 105 on the spit.

It is difficult to determine the source of this siderite since only a few stations are involved. Thick Pleistocene sediments which outcrop near the spit and along much of the Potomac usually contain little siderite. Large quantities of siderite are known to occur only at the Upper Cretaceous-Eocene contact which crosses the Potomac far upstream near Washington, D. C. Siderite from this contact is similar in every respect to that of the bay sands except that siderite in the bay is more fully replaced by limonite. The Cretaceous-Eocene contact may be the source.

Regardless of the ultimate source, the occurrence of a train of siderite extending from the Potomac River mouth into the bay and continuing south for at least 10 miles is additional strong evidence that the Potomac River is a source of Southern Bay area sediments.

HEAVY MINERALS IN SAMPLES BEYOND THE BAY ENTRANCE

Heavy minerals from three stations (195, 207, 212) in this area were studied. The sediments of the area are peculiar in that a coarse highly skewed layer of sediments overlies silts and dirty sands.

The mineralogy of these samples indicates extreme mixing of the sediments. Approximately equal percentages of hornblende, micas, opaques, garnet, staurolite, and zircon occur together. In samples within the bay, high percentages of garnet, hornblende and the micaceous minerals are found only in the very fine-grained sands and silts near the channel; the remaining minerals (opaques, staurolite and zircon) are found in quantity only in coarser sands nearer the shoreline. The distribution of heavy minerals on the continental shelf is not known but the species present should resemble those of the bay since Tertiary and Pleistocene rocks form much of the Atlantic Coast.

These relations again suggest that shifting sands from the continental shelf mix with bay sediments near the bay mouth.

SUMMARY—SEDIMENTATION IN CHESAPEAKE BAY

In Chesapeake Bay, it is everywhere evident that sediment type and distribution are closely related to the currents, topography, and geological history of the region.

The entire Chesapeake Bay estuarine system is a drowned system of stream valleys which evolved during the last glacial stage of the Pleistocene epoch. The bay proper follows the master valley which developed from two consequent valleys and two subsequent valleys. This permits a natural classification of the bay into four parts, (1) the Northern Bay area, (2) the Mid-Bay area, (3) the Southern Bay area, and (4) the Bay Entrance area. Modern bay sediments partially fill these valleys so that the bottom topography of Chesapeake Bay is simply a modification of the ancient valley topography. The accumulation of muds has been in the channel and over the gentle slope west of the channel. Sedimentation east of the channel has been minor and muds are absent. Large flat areas of sand bottom east of the channel are simply drowned mainland. Exposures of bedrock probably occur along the steep eastern slope of the channel and even in places east of the channel.

Siltation of the minor tributaries and reëntrants is probably related to the tidal movement. Suspended silt and clay are driven into these areas during high tide. Because these are areas of relatively stagnant water, deposition takes place and mud accumulates.

Since the close of the Pleistocene epoch, the rate of sedimentation has not been uniform throughout the bay. The Southern Bay valley has been about 90 per cent filled, the Mid-Bay valley has been about 50 per cent filled, and the Northern Bay valley has been about 80 per cent filled.

The main source of sediments in the Northern Bay area is the Susquehanna River. The limit of effective sedimentation of Susquehanna derived sediments is the southern boundary of the area.

During the past, an enormous volume of shore-eroded material has been removed from the Western Shore of the Mid-Bay area and probaby makes up a large portion of Mid-Bay bottom sediments. Sediments in this area are also derived from the Choptank, Chester, and Patuxent Rivers. Probably the Susquehanna River also contributes minor amounts.

The Atlantic Ocean and the large Western Shore rivers discharging into the Southern Bay area are the main sources of Southern Bay sediments. Probably, the largest quantities are from the Atlantic Ocean and the Potomac River.

The total volume of sediment which has been deposited in Chesapeake Bay proper since the close of the Pleistocene epoch is probably about 61,150,000,000 cubic yards. Assuming that the last glaciers began their retreat about 10,000 years ago, an average of 6,115,000 cubic yards of sediment has been deposited in the bay each year.

DESCRIPTION OF SAMPLES OF CHESAPEAKE BAY BOTTOM SEDIMENTS

Station—CB-1 (core sample).
Longitude—76° 05′ 10″ West. *Latitude*—39° 33′ 03″ North.
Depth of water—70 feet.
Sampler penetration—unknown.
Core length—wet 28 inches, dry 27 inches.

Description:	*Thickness (inches)*
Fine-grained sand, well sorted, structureless; dark gray when wet, light gray when dry; subangular quartz with minor feldspar and coal flakes; a little woody material.	0 –8
Alternating, poorly-defined layers of silty very fine-grained sand and sandy silt, poorly sorted; layers approximately 2 inches thick; dark gray and homogeneous in appearance when wet; when dry, silt layers are light gray, sand layers are light gray, almost white; sand is primarily subangular quartz; minor wood and coal throughout.	8 –19
Coarse sand with some gravel, well sorted, unconsolidated, structureless; yellowish gray; pebbles well rounded; sand subangular, primarily quartz, some feldspar, a little coal.	19 –28

Station—CB-2 (core sample).
Longitude—76° 04′ 50″ West. *Latitude*—39° 33′ 03″ North.
Depth of water—42 feet.
Sampler penetration—108 inches.
Core length—wet 50½ inches, dry 40 inches.

Description:	*Thickness (inches)*
Clayey silt, homogeneous and structureless; black when wet, light gray when dry; a little woody material.	0 – 4½
Clayey silt, homogeneous and structureless; transition zone, color when wet grading from black at top to soft gray downward, tannish gray when dry; abundant cellulose and woody material. Very fine-grained sand parting (¼ inch thick) at base.	4½–18½
Clayey silt, with occasional thin partings and lenses of very fine-grained sands; soft gray when wet, light gray when dry; minor cellulose.	18½–50½

Station—CB-3 (core sample).
Longitude—76° 03′ 42″ West. *Latitude*—39° 25′ 36″ North.
Depth of water—10 feet.
Sampler penetration—96 inches.
Core length—wet 65 inches, dry 56 inches.

Description:	*Thickness (inches)*
Very fine-grained sand with some silt and clay, fairly well sorted, structureless; dark gray when wet, dark gray speckled with black when dry; coal with abundant quartz and woody material; wood fragments completely carbonized.	0 – 3½
Very fine-grained sand with some silt and clay, fairly well sorted; fine laminae occasionally visible, much disturbed; brownish dark-gray when wet, soft gray when dry; primarily quartz with pink accessories, a little coal and mica.	3½–65

Station—CB-4 (core sample).
Longitude—76° 03′ 06″ West. *Latitude*—39° 25′ 03″ North.
Depth of water—16 feet.
Sampler penetration—96 inches.
Core length—wet 62 inches, dry 53 inches.

Description:	*Thickness (inches)*
Silt and very fine flakes of coal; coarse alternate bands of black and dark brownish-gray when wet, when dry black bands are seen to be coal, dark brownish-gray bands composed of alternating lamellae of coal and very fine-grained buff sand and silt; a little wood throughout.	0 –38
Silt and very fine-grained sand, structureless, firm; dark brownish-gray when wet, grayish tan when dry; abundant wood and traces of coal.	38 –51
Slightly sandy silt, structureless, firm; dark brownish-gray when wet, light gray with occasional specks of limonite-yellow when dry; occasional fragments of coal and wood.	51 –62

Station—CB-5 (core sample).
Longitude—76° 02′ 50″ West. *Latitude*—39° 24′ 42″ North.
Depth of water—22 feet.
Sampler penetration—108 inches.
Core length—wet 60 inches, dry 48 inches.

Description:	*Thickness (inches)*
Slightly sandy silt, firm; coarse alternate bands of black and gray-brown when wet, homogeneous grayish-brown when dry; a little woody material, one clinker fragment (½ inch in diameter) near top.	0 – 8½
Clayey silt, firm; coarse alternate bands of black and gray-brown when wet, light brown to tan, homogeneous when dry; occasional thin laminae of very fine-grained sand; a few small pelecypod shells.	8½–26
Clayey silt, firm; dark gray-brown when wet, brownish gray when dry; occasional thin laminae of very fine-grained sand; a few small pelecypod shells.	26 –60

Station—CB-6 (core sample).
Longitude—76° 02′ 20″ West. *Latitude*—39° 24′ 20″ North.
Depth of water—31 feet.
Sampler penetration—114 inches.
Core length—wet 64½ inches, dry 58½ inches.

Description:	*Thickness (inches)*
Clayey silt, firm; coarse alternate bands of black and gray when wet, tan throughout when dry; occasional lenses of very fine-grained sand scattered throughout; fairly abundant coal; a few small gastropod and arenaceous foraminifera tests.	0 –11½
Clayey silt, firm; coarse alternate bands of black and gray when wet, tan throughout when dry; very occasional flakes of coal.	11½–26½
Fine to medium-grained sand with occasional lenses of silt and clay, sand well sorted; dark gray when wet, light gray when dry; primarily quartz with occasional coal and wood; grades into unit above.	26½–64½

Station—CB-7
Longitude–76° 02′ 06″ West. *Latitude*—39° 24′ 09″ North.
Depth of water—14 feet.
Sampler penetration—none.

Description:
Presumably sand bottom.

Station—CB-8 (core sample).
Longitude-76° 05′ 09″ West. *Latitude*—39° 22′ 30″ North.
Depth of water—20 feet.
Sampler penetration—120 inches.
Core length—wet 58 inches, dry 45 inches.

Description:	*Thickness (inches)*
Clayey silt, top 6 inches watery, remainder of unit firm; coarse alternate bands of black and gray when wet, when dry gray throughout; abundant coal increasing toward top.	0 –13
Clayey silt, firm; coarse alternate bands of black and gray when wet, tan throughout when dry; occasional flakes of coal; a few small scattered shells.	13 –26
Clayey silt, firm, numerous partings and thin laminae of very fine-grained sand; dark gray when wet, light gray when dry; occasional flakes of coal; a few small scattered shells.	26 –58

Station-CB-9.
Longitude—76° 09′ 58″ West. *Latitude*—39° 22′ 39″ North.
Depth of water—12 feet.
Sampler penetration—none.
Description:
Presumably sand bottom.

Station—CB-10 (core sample).
Longitude—76° 09′ 18″ West. *Latitude*—39° 22′ 17″ North.
Depth of water—20 feet.
Sampler penetration—108 inches.
Core length—wet 35½ inches, dry 29 inches.

Description:	*Thickness (inches)*
Clayey silt, firm; coarse alternate bands of black and gray when wet, tannish gray when dry; many distorted laminae of very fine-grained sand throughout; a little coal.	0 –35½

Station-CB-11 (core sample).
Longitude—76° 08′ 39″ West. *Latitude*—39° 21′ 56″ North.
Depth of water—25 feet.
Sampler penetration—96 inches.
Core length—wet 58½ inches, dry 47 inches.

Description:	*Thickness (inches)*
Clayey silt, firm; coarse alternate bands of black and dark brownish-gray when wet, when dry light tannish-gray throughout; many thin laminae of very fine-grained sand throughout; a little wood, coal and mica throughout. Band of yellow to buff clay at 23½ to 24 inches.	0 –58½

Station—CB-12 (core sample).
Longitude—76° 08′ 12″ West. *Latitude*—39° 21′ 42″ North.
Depth of water—25 feet.
Sampler penetration—102 inches.
Core length—wet 75 inches, dry 63 inches.

Description: *Thickness (inches)*

Description	Thickness (inches)
Clayey silt, firm, finely laminated throughout; laminae composed of thin layers of light-colored silt and very fine-grained sand and slightly thicker layers of darker silt; dark brownish-gray when wet, gray when dry; a little wood and coal.	0 –75

Station—CB-13 (core sample).
Longitude—76° 07′ 42″ West. *Latitude*—39° 21′ 24″ North.
Depth of water—15 feet
Sampler penetration—108 inches.
Core length—wet 64 inches, dry 49 inches.
Description:

Description	Thickness (inches)
Clayey silt, firm; coarse alternate bands of black and gray when wet, gray-brown throughout when dry; a little wood and coal; small shells sparingly present.	0 – 7½
Clayey silt, firm; coarse alternate bands of black and gray when wet, light tan throughout when dry; a little wood and coal; small shells sparingly present.	7½–15
Clayey silt, firm, structureless; soft gray when wet, light gray when dry; small shells sparingly present.	15 –64

Station—CB-14 (core sample).
Longitude—76° 19′ 57″ West. *Latitude*—39° 15′ 13″ North.
Depth of water—17 feet.
Sampler penetration—48 inches.
Core length—wet 28½ inches, dry 25 inches.
Description:

Description	Thickness (inches)
Shell zone; approximately 75 per cent by volume of zone is composed of large mollusc (mostly oyster) shells, remaining 25 per cent is clayey silt, black when wet, light gray when dry.	0 –26½
Shells as above compose approximately 40 per cent of zone; remaining material is medium to fine-grained sand and clayey silt, soft gray when wet, light gray when dry.	26½–28½

Station—CB-15 (core sample).
Longitude—76° 18′ 33″ West. *Latitude*—39° 15′ 03″ North.
Depth of water—18 feet.
Sampler penetration—102 inches.
Core length—wet 70½ inches, dry 59 inches.
Description:

Description	Thickness (inches)
Clayey silt, firm, coarse alternate bands of black and dark brownish-gray when wet, light gray throughout when dry; a little coal.	0 –30
Clayey silt, firm, coarse alternate bands of black and dark brownish-gray when wet, tannish gray throughout when dry; a little coal. Upper and lower limits gradational and arbitrary.	30 –52
Clayey silt, firm, coarse alternate bands of black and dark brownish-gray when wet, light tan throughout when dry; a little coal; scattered small shells.	52 –70½

Station—CB-16 (core sample).
Longitude—76° 17′ 24″ West. *Latitude*—39° 14′ 55″ North.
Depth of water—20 feet.

Sampler penetration—114 inches.
Core length—wet 76 inches, dry 64 inches.
Description:

	Thickness (inches)
Clayey silt, watery, homogeneous except for very occasional thin laminae of very fine-grained sand; black when wet, tan-gray when dry.	0 –76

Station—CB-17 (core sample).
Longitude—76° 15′ 45″ West. *Latitude*—39° 14′ 48″ North.
Depth of water—13 feet.
Sampler penetration—108 inches.
Core length—wet 73 inches, dry 59 inches.
Description:

	Thickness (inches)
Clayey silt with a little very fine-grained sand, fairly firm, structureless; black when wet, light brown when dry; wood sparingly present.	0 –12½
Clayey silt, firm, structureless; black when wet, tan-gray when dry, abundant woody material.	12½–57½
Clayey silt, firm, structureless; soft-gray when wet, light gray when dry (upper 4 inches grades into tan-gray).	57½–73

Station—CB-18 (core sample).
Longitude—76° 14′ 40″ West. *Latitude*—39° 14′ 40″ North.
Depth of water—21 feet.
Sampler penetration—114 inches.
Core length—wet 73 inches, dry 58 inches.
Description:

	Thickness (inches)
Clayey silt, watery, many gas bubbles, structureless; black when wet, tannish gray when dry; a few scattered small shells. Lower boundary gradational and arbitrary.	0 –28½
Clayey silt, watery, many gas bubbles, structureless; black when wet, light chocolate-brown when dry; a few scattered small shells.	28½–73

Station—CB-19 (core sample).
Longitude—76° 14′ 15″ West. *Latitude*—39° 14′ 36″ North.
Depth of water—40 feet.
Sampler penetration—102 inches.
Core length—wet 69½ inches, dry 57½ inches.
Description:

	Thickness (inches)
Clayey silt, watery, coarse alternate bands of black and dark brownish-gray when wet, light gray throughout when dry; a little coal.	0 – 9½
Clayey silt, fairly firm, many gas cavities, coarse alternate bands of black and dark brownish-gray when wet, gray throughout when dry; fairly abundant coal.	9½–30
Clayey silt, fairly firm, many gas cavities; coarse alternate bands of black and dark brownish-gray when wet, tan throughout when dry; occasional limonite stains. Upper boundary is gradational and arbitrary.	30 –69½

Station—CB-20 (core sample).
Longitude—76° 13′ 51″ West. *Latitude*—39° 14′ 36″ North.
Depth of water—18 feet.
Sampler penetration—84 inches.
Core length—wet 20½ inches, dry 17 inches.

Description:	*Thickness (inches)*
Clayey silt, watery, structureless; black when wet, tannish gray when dry.	0 – 4½
Clayey silt, firm, structureless; soft gray when wet, light tannish-gray when dry. From 10 to 20½ inches unit is approximately 75 per cent oyster shells.	4½–20½

Station—CB-21 (core sample on edge of *Brewerton Channel*, a dredged channel in the Patapsco Estuary).
Longitude—76° 30′ 12″ West. *Latitude*—39° 11′ 54″ North.
Depth of water—36 feet.
Sampler penetration—111 inches.
Core length—wet 77½ inches, dry 58½ inches.

Description:	*Thickness (inches)*
Clayey silt, watery, structureless; black when wet, tan when dry.	0 –48½
Clayey silt, firm, structureless; dark gray when wet, tannish gray when dry.	48½–54½
Clayey silt, firm, structureless; soft gray when wet, light gray when dry.	54½–77½

Station—CB-22 (core sample).
Longitude—76° 26′ 54″ West. *Latitude*—39° 09′ 45″ North.
Depth of water—17 feet.
Sampler penetration—102 inches.
Core length—wet 67 inches, dry 48 inches.

Description:	*Thickness (inches)*
Clayey silt, firm, structureless; soft-gray when wet, light gray when dry; a few scattered small shells.	0 –67

Station—CB-23 (core sample).
Longitude—76° 26′ 27″ West. *Latitude*—39° 10′ 42″ North.
Depth of water—42 feet.
Sampler penetration—108 inches.
Core length—wet 67½ inches, dry 48½ inches.

Description:	*Thickness (inches)*
Clayey silt, watery, many gas cavities, structureless; black when wet, light gray when dry; a few scattered small shells; lower limit sharp.	0 –25
Clayey silt, firm, structureless; soft gray when wet, light gray when dry; a few scattered small shells throughout and one large (approximately 2 inches in diameter) oyster shell at 45 inches.	25 –67½

Station—CB-24 (core sample).
Longitude—76° 25′ 46″ West. *Latitude*—39° 11′ 38″ North.
Depth of water—13 feet.
Sampler penetration—108 inches.
Core length—wet 80 inches, dry 56 inches.

Description:	*Thickness (inches)*
Clayey silt, firm, structureless; soft gray when wet, light gray when dry; rare scattered small shells.	0 –80

Station—CB-25 (core sample).
Longitude—76° 24′ 54″ West. *Latitude*—39° 04′ 04″ North.
Depth of water—18 feet.
Sampler penetration—96 inches.
Core length—wet 53 inches, dry 40½ inches.

Description:	*Thickness (inches)*
Clayey silt with small amount of very fine-grained sand slightly increasing in quantity upward, firm, structureless; black when wet, light gray when dry; a few scattered small shells; bottom boundary gradational and arbitrary.	0 –11½
Clayey silt, firm, structureless; soft gray when wet, light gray when dry; a few scattered small and medium-sized shells.	11½–43½
Zone of abundant large oyster shells; approximately 5 per cent by volume clayey silt, soft gray when wet, light gray when dry.	43½–53

Station—CB-26 (core sample).
Longitude—76° 23′ 35″ West. *Latitude*—39° 04′ 06″ North.
Depth of water—30 feet.
Sampler penetration—132 inches.
Core length—wet 56 inches, dry 46 inches.

Description:	*Thickness (inches)*
Clayey silt, firm, structureless; light gray when dry; clusters of marcasite and pyrite disseminated throughout but more abundant toward bottom (visible only when core is painted with glycerin); small shells fairly abundant. (Core not logged when wet.)	0 –46

Station—CB-27 (core sample).
Longitude—76° 22′ 18″ West. *Latitude*—39° 04′ 06″ North.
Depth of water—24 feet.
Sampler penetration—102 inches.
Core length—wet 63½ inches, dry 45 inches.

Description:	*Thickness (inches)*
Clayey silt, watery, structureless; black when wet, light gray when dry; a few scattered small shells.	0 – 9
Clayey silt, firm, structureless; soft gray when wet, light gray when dry; a few scattered small shells.	9 –63½

Station—CB-28 (core sample).
Longitude—76° 21′ 15″ West. *Latitude*—39° 04′ 06″ North.
Depth of water—25 feet.
Sampler penetration—132 inches.
Core length wet 65 inches, dry 46½ inches.

Description:	*Thickness (inches)*
Clayey silt, watery at top becoming firmer downward; coarse alternate bands of black and soft gray when wet, light gray throughout when dry; a few scattered small shells.	0 –41
Clayey silt, firm, structureless; soft gray when wet, light gray when dry; a few scattered small shells.	41 –65

Station-CB-29 (core sample).
Longitude—76° 20′ 00″ West. *Latitude*—39° 04′ 09″ North.
Depth of water—37 feet.
Sampler penetration—102 inches.
Core length—wet 68 inches, dry 50 inches.

Description:	*Thickness (inches)*
Clayey silt, watery, homogeneous; black when wet, light gray when dry; a few small scattered shells.	0 –5½
Clayey silt, fairly firm, structureless; black when wet, grayish tan when dry; lens of soft-gray clayey silt from 7 to 11 inches; a few scattered small shells.	5½–42
Clayey silt, firm, structureless; soft-gray when wet, light gray when dry; a few scattered small shells.	42 –68

Station—CB-30 (core sample).
Longitude—76° 19′ 20″ West. *Latitude*—39° 04′ 09″ North.
Depth of water—51 feet.
Sampler penetration—132 inches—180 inches.
Core length—wet 78½ inches, dry 60 inches.

Description:	*Thickness (inches)*
Clayey silt, watery, many cavities, structureless; black when wet, light gray when dry.	0 –63
Clayey silt, firm, structureless; soft gray when wet, light gray when dry.	63 –72
Flat fragments of peaty and lignitic material in matrix of sandy silt; topped by lens of pink silt and very fine-grained sand; whole is stained by limonite.	72 –74
Very sandy silt, firm, structureless; brownish gray when wet, light gray when dry; whole is stained by limonite.	74 –78½

Station—CB-31 (core sample).
Longitude—76° 18′ 06″ West. *Latitude*—39° 04′ 09″ North.
Depth of water—28 feet.
Sampler penetration—108 inches.
Core length—wet 73 inches, dry 57 inches.

Description:	*Thickness (inches)*
Clayey silt, watery, structureless; black when wet, light gray when dry; a few scattered small shells; bottom contact gradational and arbitrary.	0 –24½
Clayey silt, firm, structureless; soft gray when wet, light gray when dry; a few scattered small shells throughout, zone of very abundant small shells from 29 to 31 inches.	24½–73

Station—CB-32 (snapper sample).
Longitude—76° 16′ 54″ West. *Latitude*—39° 04′ 12″ North.
Depth of water—26 feet.
Description:
Medium-grained sand with some silt, well sorted; black when wet, tan-gray when dry; subangular quartz with rare black accessories; a few small, thin shells.

Station—CB-33 (core sample).
Longitude—76° 15′ 33″ West. *Latitude*—39° 04′ 12″ North.
Depth of water—25 feet.
Sampler penetration—110 inches.
Core length—wet 74 inches, dry 53 inches.

Description:	*Thickness (inches)*
Clayey silt, watery becoming firmer downward, structureless; black when wet, light gray when dry; odor unusually strong.	0 –18½
Clayey silt, firm, structureless; soft gray when wet, light gray when dry.	18½–70
Clayey silt with a little very fine-grained sand, firm, structureless; soft gray when wet, light gray when dry; very abundant small shells.	70 –74

Station—CB-34 (snapper sample).
Longitude—76° 14′ 30″ West. *Latitude*—39° 04′ 12″ North.
Depth of water—17 feet.
Description:
Medium to fine-grained sand, fairly well sorted; dark gray when wet, yellowish tan-gray when dry; primarily quartz with some feldspar; a few small shells.

Station—CB-35 (core sample).
Longitude—76° 10′ 54″ West. *Latitude*—39° 04′ 27″ North.
Depth of water—28 feet.
Sampler penetration—110 inches.
Core length—wet 73 inches, dry 49 inches.

Description:	*Thickness (inches)*
Clayey silt, watery becoming firmer downward, structureless; black when wet, light gray when dry; a few living pelecypods at top; lower contact transitional.	0 –26
Clayey silt, firm, structureless; soft gray when wet, light gray when dry; a few scattered small shells.	26 –73

Station—CB-36 (snapper sample).
Longitude—76° 17′ 15″ West. *Latitude*—39° 01′ 09″ North.
Depth of water—12 feet.
Description:
Fine to medium-grained sand, well sorted; tannish gray when wet, yellowish tan when dry; primarily quartz with fairly abundant feldspar; a few small shells.

Station—CB-37 (core sample).
Longitude—76° 16′ 30″ West. *Latitude*—39° 01′ 20″ North.
Depth of water—42 feet.
Sampler penetration—120 inches.
Core length—wet 79½ inches, dry 59½ inches.

Description:	*Thickness (inches)*
Clayey silt, watery becoming firmer downward, structureless; black when wet, light gray when dry.	0 –25½
Clayey silt, fairly firm, structureless; dark gray when wet, tan when dry; both contacts gradational.	25½–53½
Clayey silt, firm, structureless; soft gray when wet, light gray when dry; scattered small shells throughout, zone of medium-size shells from 71 to 79½ inches.	53½–79½

Station—CB-38 (core sample).
Longitude—76° 15′ 57″ West. *Latitude*—39° 01′ 25″ North.
Depth of water—27 feet.
Sampler penetration—108 inches.
Core length—wet 76 inches, dry 54 inches.
Description:

	Thickness (inches)
Clayey silt, watery, structureless; black when wet, light gray when dry.	0 – 3
Clayey silt, firm, structureless; soft gray when wet, light gray when dry; scattered small shells.	3 –76

Station—CB-39 (snapper sample).
Longitude—76° 15′ 25″ West. *Latitude*—39° 01′ 30″ North.
Depth of water—14 feet.
Description:
Medium to fine-grained sand, well sorted; tannish gray when wet, yellowish tan when dry; primarily quartz with fairly abundant feldspar; a few small shells.

Station—CB-40 (core sample).
Longitude—76° 23′ 48″ West. *Latitude*—38° 59′ 38″ North.
Depth of water—30 feet.
Sampler penetration—60 inches.
Core length—wet 51 inches, dry 41 inches.
Description:

	Thickness (inches)
Clayey silt, structureless; tannish gray when dry; a few coal fragments in top 12 inches; fairly abundant small shells.	0 –32½
Clayey silt, structureless; light gray when dry; fairly abundant shells. (Core not logged when wet.)	32½–51

Station—CB-41 (snapper sample).
Longitude—76° 28′ 36″ West. *Latitude*—38° 53′ 02″ North.
Depth of water—12 feet.
Description:
Medium-grained sand, fairly well sorted; tannish gray when wet, grayish tan when dry; primarily quartz with some feldspar; a few large mussel shells.

Station—CB-42 (core sample).
Longitude—76° 27′ 51″ West. *Latitude*—38° 52′ 57″ North.
Depth of water—18 feet.
Sampler penetration—116 inches.
Core length—wet 63½ inches, dry 48 inches.
Description:

	Thickness (inches)
Clayey silt, watery, structureless; black when wet, light gray when dry; abundant medium pelecypods.	0 –13½
Clayey silt, firm, structureless; soft gray when wet, light gray when dry; abundant medium and large pelecypods.	13½–63½

Station—CB-43 (core sample).
Longitude—76° 26′ 42″ West. *Latitude*—38° 52′ 50″ North.
Depth of water—23 feet.

Sampler penetration—114 inches.
Core length—wet 92 inches, dry 70 inches.
Description:

	Thickness (inches)
Clayey silt, watery becoming firmer downward, structureless; black when wet, light gray when dry; a few scattered small shells; lower contact gradational and arbitrary.	0 –15
Clayey silt, firm, structureless; soft gray when wet, light gray when dry; fairly abundant scattered small shells.	15 –92

Station—CB-44 (core sample).
Longitude—76° 25′ 30″ West. *Latitude*—38° 52′ 47″ North.
Depth of water—41 feet.
Sampler penetration—unknown.
Core length—wet 83 inches, dry 61 inches.
Description:

	Thickness (inches)
Clayey silt, watery, structureless; black when wet, light gray when dry; lower contact gradational and arbitrary.	0 –20
Clayey silt, firm, structureless except for a few thin laminae of very fine-grained sand; soft gray when wet, light gray when dry; a few scattered small shells.	20 –59
Sandy silt, firm, structureless; soft gray when wet, light gray when dry.	59 –76
Very fine-grained sand and silt, occasional lenses and streaks of clayey silt; soft gray when wet, light gray when dry.	76 –83

Station—CB-45 (core sample).
Longitude—76° 24′ 54″ West. *Latitude*—38° 52′ 42″ North.
Depth of water—44 feet.
Sampler penetration—108 inches.
Core length—wet 70½ inches, dry 51½ inches.
Description:

	Thickness (inches)
Clayey silt, watery becoming firmer downward, structureless; black when wet, light gray when dry; a few scattered small shells; lower contact gradational and arbitrary.	0 –20
Clayey silt, firm, structureless; soft gray when wet, light gray when dry; a few scattered small shells.	20 –70½

Station—CB-46 (core sample).
Longitude—76° 23′ 55″ West. *Latitude*—38° 52′ 39″ North.
Depth of water—86 feet.
Sampler penetration—108 inches.
Core length—wet 56½ inches, dry 41½ inches.
Description:

	Thickness (inches)
Clayey silt, watery, structureless; black when wet, gray-brown when dry; fairly abundant small shells; lower contact exceptionally sharp.	0 –51½
Clayey silt, firm, structureless; soft gray when wet, light gray when dry.	51½–56½

Station—CB-47 (snapper sample).
Longitude—76° 23′ 04″ West. *Latitude*—38° 52′ 36″ North.
Depth of water—23 feet.
Description:

Medium-grained sand, well sorted; dark gray when wet, light gray when dry; primarily quartz; rare small shells.

Station—CB-48 (snapper sample).
Longitude—76° 22′ 37″ West. *Latitude*—38° 52′ 34″ North.
Depth of water—11 feet.
Description:

Fine to medium-grained sand, well sorted; tannish gray with black streaks near shells when wet, light gray throughout when dry; primarily quartz; abundant small shells.

Station—CB-49 (core sample).
Longitude—76° 13′ 53″ West. *Latitude*—38° 53′ 18″ North.
Depth of water—32 feet.
Sampler penetration—unknown.
Core length—wet 60 inches, dry 39 inches.

Description:	*Thickness (inches)*
Clayey silt, fairly firm, structureless; dark gray when wet, light gray when dry; scattered small shells; lower contact gradational and arbitrary.	0 – 7
Clayey silt, firm, structureless; soft gray when wet, light gray when dry; scattered small shells.	7 –60

Station—CB-50 (core sample).
Longitude—76° 13′ 35″ West. *Latitude*—38° 53′ 12″ North.
Depth of water—22 feet.
Sampler penetration—120 inches.
Core length—wet 55 inches, dry 38 inches.

Description:	*Thickness (inches)*
Clayey silt, watery, structureless; black when wet, tannish gray when dry; a few scattered small shells; lower contact gradational and arbitrary.	0 –14½
Clayey silt, firm, water content appears exceptionally low, structureless; gray-brown when wet, light gray when dry; a few scattered small shells.	14½–55

Station—CB-51 (core sample).
Longitude—76° 13′ 35″ West. *Latitude*—38° 51′ 04″ North.
Depth of water—40 feet.
Sampler penetration—120 inches.
Core length—wet 65 inches, dry 45 inches.

Description:	*Thickness (inches)*
Clayey silt, watery becoming firmer downward, structureless; black when wet, light gray when dry; lower contact gradational and arbitrary.	0 –26
Sandy silt, firm, structureless; soft gray when wet, light gray when dry; a few scattered small shells.	26 –65

Station—CB-52 (core sample).
Longitude—76° 17′ 18″ West. *Latitude*—38° 51′ 16″ North.
Depth of water—50 feet.
Sampler penetration—unknown.
Core length—wet 27½ inches, dry 27 inches.

Description:	*Thickness (inches)*
Fine to very fine-grained sand with some silt, relatively poorly sorted, structureless; black when wet, gray to light gray when dry; lower contact sharp.	0 – 2
Fine to very fine-grained sand with some silt, relatively poorly sorted, structureless; dark gray when wet, light gray when dry; lower contact sharp.	2 –11½

	Thickness (inches)
Zone of large shells and shell fragments; estimate 90 per cent shell material, 10 per cent sand as in unit above.	11½–20½
Zone of large broken shells continuing from unit above; matrix is green clay and silt; estimate 90 per cent shell material, 10 per cent green clay and silt.	20½–27½

Station—CB-53 (core sample).
Longitude—76° 24′ 46″ West. *Latitude*—38° 47′ 42″ North.
Depth of water—117 feet.
Sampler penetration—108 inches.
Core length—wet 82½ inches, dry 55 inches.
Description:

	Thickness (inches)
Clayey silt, watery at top, firm below; coarse alternate bands of black and soft gray when wet, black bands are thicker in upper part of core, gray bands are thicker in lower part; light gray throughout when dry; scattered shells throughout, and shell partings approximately ½ inch thick at 32 to 32½ inches and 62½ to 63 inches, foraminifera especially abundant.	0 –82½

Station—CB-54 (snapper sample).
Longitude—76° 30′ 15″ West. *Latitude*—38° 43′ 36″ North.
Depth of water—14 feet.
Description:

Fine-grained sand, well sorted; grayish tan when wet, light gray when dry; primarily quartz; rare small shells.

Station—CB-55 (core sample).
Longitude—76° 28′ 54″ West. *Latitude*—38° 43′ 33″ North.
Depth of water—35 feet.
Sampler penetration—84 inches.
Core length—wet 59 inches, dry 49 inches.
Description:

	Thickness (inches)
Very clayey silt, firm, structureless; black when wet, light gray when dry; upper part of this unit broken off; sharp lower contact.	0 – 1
Very clayey silt, firm, structureless; soft gray when wet, light gray when dry; fairly abundant scattered small shells.	1 –29½
Fine-grained sand, silty and poorly sorted, occasional lenses of silt and clay; soft gray when wet, light gray when dry; rare scattered small shells.	29½–55
Silty diatomite, dense, structureless; creamy tan when wet, cream-colored when dry; a little limonite stain; non-calcareous; upper contact sharp.	55 –59

Station—CB-56 (core sample).
Longitude—76° 27′ 24″ West. *Latitude*—38° 43′ 30″ North.
Depth of water—38 feet.
Sampler penetration—unknown.
Core length—wet 81½ inches, dry 60 inches.
Description:

	Thickness (inches)
Silt and clay, firm, structureless; soft gray with slight greenish tinge when wet, light gray when dry; a few scattered small shells.	0 –81½

Station—CB-57 (core sample).
Longitude—76° 26′ 00″ West. *Latitude*—38° 43′ 26″ North.
Depth of water—85 feet.

Sampler penetration—120 inches.
Core length—wet 77½ inches, dry 54 inches.

Description:	*Thickness (inches)*
Clayey silt, watery near top becoming firmer downward; predominantly black when wet with a few dark-gray bands averaging about 2 inches thick, light gray throughout when dry; lower boundary sharp.	0 –43½
Clayey silt, firm, structureless; soft gray when wet, light gray when dry.	43½–77½

Station—CB-58 (core sample).
Longitude—76° 24′ 40″ West. *Latitude*—38° 43′ 24″ North.
Depth of water—44 feet.
Sampler penetration—unknown.
Core length—wet 31 inches, dry 28 inches.

Description:	*Thickness (inches)*
Clayey silt, watery, structureless; black when wet, light gray when dry.	0 – 3
Clayey silt, firm, structureless; soft gray when wet, light gray when dry; lower contact sharp.	3 – 7
Silty fine to medium-grained sand, poorly sorted, structureless; dark gray when wet, light gray when dry; both contacts sharp.	7 –20
Clay, firm when wet, very hard when dry, structureless; greenish blue mottled yellow by limonite when wet, light green to gray mottled yellow when dry.	20 –31

Station—CB-59 (core sample).
Longitude—76° 23′ 31″ West. *Latitude*—38° 43′ 20″ North.
Depth of water—30 feet.
Sampler penetration—unknown.
Core length—wet 6 inches, dry 6 inches.

Description:	*Thickness (inches)*
Silty fine-grained sand, structureless, poorly sorted; dark gray when wet, light gray when dry; sand almost entirely quartz, a little mica.	0 – 6

Station—CB-60 (snapper sample).
Longitude—76° 22′ 44″ West. *Latitude*—38° 43′ 20″ North.
Depth of water—24 feet.
Description:
Fine-grained sand, well sorted; tannish gray when wet, gray when dry; primarily quartz; a few small shells.

Station—CB-61 (snapper sample).
Longitude—76° 21′ 33″ West. *Latitude*—38° 43′ 18″ North.
Depth of water—15 feet.
Description:
Medium-grained sand, well sorted; grayish brown when wet with black halos around shells, gray when dry; primarily quartz; a few small shells.

Station—CB-62 (snapper sample).
Longitude—76° 16′ 53″ West. *Latitude*—38° 40′ 50″ North.
Depth of water—14 feet.
Description:
Fine-grained sand, very well sorted; dark gray to black when wet, light gray when dry; a few fragments of plant material.

Station—CB-63 (core sample).
Longitude—76° 17′ 48″ West. *Latitude*—38° 40′ 45″ North.
Depth of water—16 feet.
Sampler penetration—unknown.
Core length—wet 76 inches, dry 60½ inches.
Description:

Description	Thickness (inches)
Clayey silt, fairly firm, structureless; black when wet, light gray when dry; a few scattered small shells; lower contact sharp but irregular with tongues of black silt projecting downward into the zone below.	0 – 5
Clayey silt, firm, structureless; soft gray when wet, light gray when dry; a few scattered small shells.	5 –76

Station—CB-64 (core sample).
Longitude—76° 17′ 42″ West. *Latitude*—38° 40′ 00″ North.
Depth of water—22 feet.
Sampler penetration—126 inches.
Core length—wet 79½ inches, dry 58 inches.
Description:

Description	Thickness (inches)
Clayey silt, watery becoming firmer downward, structureless; black when wet, light gray when dry; lower contact gradational and arbitrary.	0 –30
Clayey silt, firm, water content lower than usual, structureless; grayish brown when wet, light gray when dry; a few scattered small shells.	30 –79½

Station—CB-65 (core sample).
Longitude—76° 17′ 38″ West. *Latitude*—38° 39′ 22″ North.
Depth of water—58 feet.
Sampler penetration—108 inches.
Core length—wet 58 inches, dry 48 inches.
Description:

Description	Thickness (inches)
Slightly sandy silt, fairly firm, structureless; black when wet, light gray when dry.	0 –33
Slightly sandy silt, firm, structureless; soft gray when wet, light gray when dry; lower boundary fairly sharp.	33 –37
Silty fine-grained sand, firm, poorly sorted, structureless; soft gray when wet, light gray when dry; sand primarily quartz.	37 –58

Station—CB-66 (core sample).
Longitude—76° 17′ 46″ West. *Latitude*—38° 39′ 00″ North.
Depth of water—47 feet.
Sampler penetration—108 inches.
Core length—wet 61½ inches, dry 46½ inches.
Description:

Description	Thickness (inches)
Clayey silt, watery, structureless; black when wet, light gray when dry.	0 –12½
Clayey silt, firm, structureless except for a few light-colored silt laminae; brownish gray when wet, light gray when dry.	12½–61½

Station—CB-67 (snapper sample).
Longitude—76° 17′ 32″ West. *Latitude*—38° 38′ 40″ North.
Depth of water—10 feet.

Description:

Medium-grained sand, extremely well sorted; dark gray to black when wet, light gray slightly greenish when dry; primarily quartz with some dark accessories; very abundant small shells.

Station—CB-68 (core sample).
Longitude—76° 12′ 52″ West. *Latitude*—38° 40′ 13″ North.
Depth of water—16 feet.
Sampler penetration—unknown.
Core length—wet 15½ inches, dry 15½ inches.

Description: (core friable, measurements approximate)	*Thickness (inches)*
Silty fine-grained sand, fairly well sorted, structureless; black when wet, light gray when dry; fairly abundant small shells; lower contact sharp.	0 – 4
Zone of abundant large shells (mostly oysters); estimate 90 per cent shell material, 10 per cent fine-grained sand.	4 –10½
Silty fine-grained sand, fairly well sorted, occasional bedding planes defined by slightly higher silt content; dark gray streaked with black when wet, light gray when dry; fairly abundant shells; upper contact fairly sharp.	10½–15½

Station—CB-69 (core sample).
Longitude—76° 13′ 07″ West. *Latitude*—38° 40′ 00″ North.
Depth of water—22 feet.
Sampler penetration—108 inches.
Core length—wet 72½ inches, dry 52 inches.

Description:	*Thickness (inches)*
Clayey silt, firm, structureless; soft gray (slightly darker at top) when wet, light gray when dry; fairly abundant scattered small shells.	0 –72½

Station—CB-70 (core sample).
Longitude—76° 13′ 47″ West. *Latitude*—38° 39′ 09″ North.
Depth of water—35 feet.
Sampler penetration—102 inches.
Core length—wet 57½ inches, dry 42 inches.

Description:	*Thickness (inches)*
Clayey silt, watery becoming firmer downward, structureless; black when wet, light gray when dry; a few scattered small shells.	0 –24
Clayey silt, firm, less water than usual, structureless; brownish gray when wet, light gray when dry; a few scattered small shells.	24 –57½

Station—CB-71 (core sample).
Longitude—76° 14′ 10″ West. *Latitude*—38° 38′ 36″ North.
Depth of water—14 feet.
Sampler penetration—30 inches.
Core length—wet 12 inches, dry 12 inches.

Description:	*Thickness (inches)*
Silty very fine to fine-grained sand, relatively poorly sorted, structureless; bluish black mottled with green and yellow when wet, light tan-gray when dry; primarily quartz, traces of mica; a few large shells.	0 – 6
Silty very fine to fine-grained sand, relatively poorly sorted, structureless; greenish gray when wet, light tan-gray when dry.	6 –12

Station—CB-72 (core sample).
Longitude—76° 04′ 46″ West. *Latitude*—38° 35′ 39″ North.
Depth of water—49 feet.
Sampler penetration—114 inches.
Core length—wet 56 inches, dry 43½ inches.

Description:	*Thickness (inches)*
Clayey silt, watery, structureless; black when wet, light gray when dry; zone of small shells at top.	0 – 9
Clayey silt, firm, structureless; soft gray when wet, light gray when dry; a few scattered small shells throughout and partings of small shells at 11 to 12 inches and 17 to 28 inches.	9 –56

Station—CB-73 (snapper sample).
Longitude—76° 23′ 48″ West. *Latitude*—38° 37′ 04″ North.
Depth of water—17 feet.
Description:
Medium to fine-grained sand, fairly well sorted; dark gray to black when wet, light gray when dry; primarily quartz; extremely abundant shells, small and medium.

Station—CB-74 (snapper sample).
Longitude—76° 22′ 46″ West. *Latitude*—38° 37′ 04″ North.
Depth of water—12 feet.
Description:
Fine-grained sand, extremely well sorted; dark brownish-gray with black halos around shells when wet, gray with slight greenish tinge when dry; primarily quartz with some black accessories; very abundant small shells.

Station—CB-75 (snapper sample).
Longitude—76° 30′ 06″ West. *Latitude*—38° 33′ 25″ North.
Depth of water—10 feet.
Description:
Medium to fine-grained sand, well sorted; dark brownish-gray when wet, gray with slightly greenish tinge when dry; primarily quartz with some dark accessories; fairly abundant small shells.

Station—CB-76 (core sample).
Longitude—76° 29′ 42″ West. *Latitude*—38° 33′ 27″ North.
Depth of water—32 feet.
Sampler penetration—132 inches.
Core length—wet 61½ inches, dry 47½ inches.

Description:	*Thickness (inches)*
Clayey silt, slightly watery, structureless; black when wet, light gray when dry.	0 – 4
Slightly sandy clayey silt, firm, occasional thin laminae of very fine-grained sand; soft gray when wet, light gray when dry; lower contact fairly sharp.	4 –54
Silty fine-grained sand, very poorly sorted, structureless; soft gray when wet, light gray when dry; primarily quartz, slightly micaceous.	54 –61½

Station—CB-77 (core sample).
Longitude—76° 28′ 36″ West. *Latitude*—38° 33′ 27″ North.
Depth of water—35 feet.

Sampler penetration—144 inches.
Core length—wet 59 inches, dry 43 inches.
Description:

	Thickness (inches)
Clayey silt, firm, structureless; soft gray (slightly darker top 2 inches) when wet, light gray when dry; rare scattered small shells.	0 –59

Station—CB-78 (core sample).
Longitude—76° 26′ 58″ West. *Latitude*—38° 33′ 27″ North.
Depth of water—45 feet.
Sampler penetration—156 inches.
Core length—wet 63 inches, dry 48 inches.
Description:

	Thickness (inches)
Clayey silt, firm, structureless; dark gray when wet, light gray when dry.	0 – 3
Clayey silt, firm, structureless; soft gray when wet, light gray when dry.	3 –63

Station—CB-79 (core sample).
Longitude—76° 26′ 12″ West. *Latitude*—38° 33′ 27″ North.
Depth of water—85 feet.
Sampler penetration—156 inches.
Core length—wet 75½ inches, dry 55 inches.
Description:

	Thickness (inches)
Clayey silt, watery, many cavities, structureless except for rare thin laminae of light-colored silt; black when wet, light tannish-gray when dry; lower boundary fairly sharp.	0 –38
Clayey silt, firm, many cavities but considerably fewer than in unit above, occasional thin laminae of light-colored silt and very fine-grained sand; soft gray when wet, light gray when dry.	38 –75½

Station—CB-80 (core sample).
Longitude—76° 24′ 54″ West. *Latitude*—38° 33′ 27″ North.
Depth of water—35 feet.
Sampler penetration—unknown.
Core length—wet 28½ inches, dry 27 inches.
Description:

	Thickness (inches)
Medium-grained sand, fairly well sorted; dark gray when wet, light gray when dry; primarily quartz, some black accessories.	0 – 7
Silty clay, firm, very hard and brittle when dry, structureless except for lens of clean medium-grained sand from 16½ to 17 inches; light green when wet, grayish green when dry; heavily stained with limonite; upper contact sharp but irregular.	7 –28½

Station—CB-81 (core sample).
Longitude—76° 22′ 48″ West. *Latitude*—38° 33′ 27″ North.
Depth of water—25 feet.
Sampler penetration—unknown.
Core length—wet 53 inches, dry 40 inches.
Description:

	Thickness (inches)
Clayey silt, watery, many cavities throughout, structureless; black when wet, light gray with slight tannish tinge when dry.	0 –53

Station—CB-82 (snapper sample).
Longitude—76° 21′ 48″ West. *Latitude*—38° 33′ 27″ North.
Depth of water—14 feet.
Description:
Medium to fine-grained sand, fairly well sorted; tannish gray when wet, very light gray when dry; predominantly quartz.

Station—CB-83 (core sample).
Longitude—76° 20′ 33″ West. *Latitude*—38° 33′ 27″ North.
Depth of water—30 feet.
Sampler penetration—156 inches.
Core length—wet 54½ inches, dry 42 inches.

Description:	*Thickness (inches)*
Clayey silt, watery, structureless; black when wet, light gray when dry; lower contact sharp.	0 –12
Clayey silt, firm, structureless; soft gray when wet, light gray when dry.	12 –54½

Station—CB-84 (snapper sample).
Longitude—76° 19′ 32″ West. *Latitude*—38° 33′ 27″ North.
Depth of water—12 feet.
Description:
Fine to medium-grained sand, extremely well sorted; grayish brown when wet, greenish gray when dry; primarily quartz with some dark accessories; abundant small shells.

Station—CB-85 (core sample).
Longitude—76° 21′ 57″ West. *Latitude*—38° 23′ 09″ North.
Depth of water—47 feet.
Sampler penetration—66 inches.
Core length—wet 44 inches, dry 39 inches.

Description:	*Thickness (inches)*
Silt and medium to fine-grained sand, poorly sorted, structureless; black when wet, light gray when dry.	0 – 1½
Silt and fine to medium-grained sand, proportion of sand gradually increasing with depth, poorly sorted, many lenses of silt or sand, haphazard bedding; soft gray when wet, light gray when dry; sand is primarily quartz with abundant dark accessories; a few scattered shells; lower contact is sharp.	1½–42½
Very fine to fine-grained *sandstone*; rock separates along bedding planes; buff to light pink; sand is primarily quartz with abundant dark minerals.	42½–44

Station—CB-86 (core sample).
Longitude—76° 21′ 00″ West. *Latitude*—38° 23′ 13″ North.
Depth of water—60 feet.
Sampler penetration—120 inches.
Core length—wet 81½ inches, dry 63 inches.

Description:	*Thickness (inches)*
Clayey silt, firm, structureless; soft gray when wet, light gray when dry.	0 –81½

Station—CB-87 (core sample).
Longitude—76° 20′ 20″ West. *Latitude*—38° 23′ 15″ North.
Depth of water—103 feet.

Sampler penetration—222 inches.
Core length—wet 87½ inches, dry 64 inches.
Description: *Thickness (inches)*

Clayey silt, firm, entire length of core except for top 8 inches is laminated, laminae are alternate layers of dark silt and lighter slightly coarser silt, also many tiny lenses of light silt and very fine-grained sand, both laminae and lenses are much distorted and in some places two or more join; soft gray when wet, light gray when dry.	0 –87½

Station—CB-88 (core sample).
Longitude—76° 19′ 28″ West. *Latitude*—38° 23′ 18″ North.
Depth of water—65 feet.
Sampler penetration—120 inches.
Core length—wet 64 inches, dry 61 inches.
Description: *Thickness (inches)*

Sandy silt, watery, structureless; black when wet, light gray when dry; abundant grass probably growing in place.	0 – 3½
Medium-grained sand and silt, poorly sorted, heterogeneous patches and lenses of clayey silt and silty very fine-grained sand occur haphazardly throughout; soft gray when wet, light gray when dry.	3½–64

Station—CB-89 (snapper sample).
Longitude—76° 18′ 42″ West. *Latitude*—38° 23′ 21″ North.
Depth of water—21 feet.
Description:
Medium to fine-grained sand, well sorted; tan-gray when wet, yellowish gray when dry; primarily quartz with some feldspar, black accessories; rare small shells.

Station—CB-90 (snapper sample).
Longitude—76° 18′ 22″ West. *Latitude*—38° 23′ 22″ North.
Depth of water—16 feet.
Description:
Medium to fine-grained sand, well sorted; brownish gray when wet, tan-gray when dry; primarily quartz, a few black accessories.

Station—CB-91 (snapper sample).
Longitude—76° 21′ 45″ West. *Latitude*—38° 17′ 53″ North.
Depth of water—28 feet.
Description:
Medium-grained sand and gravel, poorly sorted; dark gray when wet, brownish gray when dry; pebbles primarily rounded quartz, some feldspar, some granite, a few subangular black rock fragments; sand is primarily quartz with some feldspar, black accessories.

Station—CB-92 (core sample).
Longitude—76° 20′ 43″ West. *Latitude*—38° 17′ 53″ North.
Depth of water—44 feet.
Sampler penetration—72 inches.
Core length—wet 41½ inches, dry 36 inches.

Description:	*Thickness (inches)*
Slightly sandy silt, fairly firm, structureless; black when wet, light gray when dry.	0 – 9
Medium to coarse-grained sand, silt and clay, very poorly sorted, heterogeneous with numerous lenses of fine material; soft gray when wet, light gray when dry; zone of large oyster shells from 29 to 30½ inches.	9 –33½
Coarse to medium-grained sand and silt with some gravel, very poorly sorted, heterogeneous; pebbles are subangular quartz; soft gray when wet, light gray when dry; upper contact gradational, lower contact sharp.	33½–35½
Clayey silt, firm, structureless; brick-red; boundaries sharp but thinner on one side than the other—probably a lens.	35½–36½
Medium-grained sand and clayey silt, poorly sorted, structureless; soft gray when wet, light gray when dry; abundant shells including some pectens; silt is calcareous, probably due to comminuted shells.	36½–41½

Station—CB-93 (core sample).
Longitude—76° 19′ 12″ West. *Latitude*—38° 17′ 57″ North.
Depth of water—53 feet.
Sampler penetration—120 inches.
Core length—wet 79 inches, dry 63½ inches.

Description:	*Thickness (inches)*
Clayey silt, watery, structureless; black when wet, light gray when dry.	0 9½
Clayey silt, bottom 12 inches slightly sandy, firm, structureless; soft gray when wet, light gray when dry.	9½–71
Zone of abundant large oyster shells; matrix of silty fine-grained sand as in unit below.	71 –74½
Silty fine-grained sand, poorly sorted, structureless; soft gray when wet, light gray when dry; a few scattered medium-size shells.	74½–79

Station—CB-94 (core sample).
Longitude—76° 17′ 18″ West. *Latitude*—38° 18′ 10″ North.
Depth of water—110 feet.
Sampler penetration—132 inches.
Core length—wet 82 inches, dry 73½ inches.

Description:	*Thickness (inches)*
Clayey silt, watery becoming firmer downward; coarse alternate bands of black and soft gray (black predominate) when wet, light gray throughout when dry; occasional thin laminae of light silt or very fine-grained sand.	0 –31
Slightly silty medium-grained sand, fairly well sorted but sand is irregularly distributed in lenses and patches throughout; soft gray when wet, light gray when dry; a few small shells.	31 –82

Station—CB-95 (snapper sample).
Longitude—76° 16′ 30″ West. *Latitude*—38° 18′ 18″ North.
Depth of water—25 feet.
Description:

Very fine to fine-grained sand, silty, poorly sorted; dark gray when wet, light gray when dry; primarily quartz, mica and black accessories.

Station—CB-96 (snapper sample).
Longitude—76° 16 24″ West. *Latitude*—38° 18′ 21″ North.
Depth of water—10 feet.
Description:

Fine-grained sand, extremely well sorted; gray when wet, light gray when dry; primarily quartz with a few black and yellow accessories.

Station—CB-97 (core sample).
Longitude—76° 07′ 07″ West. *Latitude*—38° 13′ 16″ North.
Depth of water—45 feet.
Sampler penetration—126 inches.
Core length—wet 72 inches, dry 60 inches.

Description:	*Thickness (inches)*
Clayey silt, watery, many cavities in lower half, structureless; black when wet, light gray when dry.	0 – 8
Clayey silt, upper portion contains many cavities, lower portion dense, structureless; soft gray when wet, light gray when dry.	8 –72

Station—CB-98 (core sample).
Longitude—75° 56′ 43″ West. *Latitude*—38° 12′ 49″ North.
Depth of water—25 feet.
Sampler penetration—138 inches.
Core length—wet 69 inches, dry 52 inches.

Description:	*Thickness (inches)*
Clayey silt, many cavities throughout; coarse alternate bands of black and dark-gray when wet, tannish gray throughout when dry; fine laminations of lighter-colored silt throughout.	0 –69

Station—CB-99 (core sample).
Longitude—75° 56′ 42″ West. *Latitude*—38° 12′ 36″ North.
Depth of water—30 feet.
Sampler penetration—132 inches.
Core length—wet 68 inches, dry 50 inches.

Description:	*Thickness (inches)*
Silty clay, many cavities throughout; coarse alternate bands of black and dark gray when wet, tannish gray throughout when dry; fine laminations of lighter-colored silt throughout; rare small shells.	0 –68

Station—CB-100 (snapper sample).
Longitude—76° 21′ 22″ West. *Latitude*—37° 56′ 09″ North.
Depth of water—18 feet.
Description:

Medium to coarse-grained sand, fairly well sorted; black when wet, light tan when dry; primarily quartz with some feldspar, many grains appear angular; abundant small shells.

Station—CB-101 (snapper sample).
Longitude—76° 21′ 03″ West. *Latitude*—37° 56′ 52″ North.
Depth of water—30 feet.
Description:

Medium-grained sand, extremely well sorted; tan when wet, tan-gray when dry; primarily quartz.

Station—CB-102 (core sample).
Longitude—76° 20′ 39″ West. *Latitude*—38° 00′ 00″ North.
Depth of water—42 feet.
Sampler penetration—120 inches.
Core length—wet 80 inches, dry 61 inches.

Description:	*Thickness (inches)*
Clayey silt, firm, structureless; soft gray when wet, light gray when dry; very rare small shells.	0 –80

Station—CB-103 (core sample).
Longitude—76° 20′ 09″ West. *Latitude*—38° 01′ 02″ North.
Depth of water—60 feet.
Sampler penetration—48 inches.
Core length—wet 35½ inches, dry 31 inches.

Description:	*Thickness (inches)*
Clayey silt, firm, structureless; soft gray (top 8 inches slightly darker) when wet, light gray when dry.	0 –17
Medium to fine-grained sand, silt, a few large rounded pebbles, poorly sorted, heterogeneously distributed; soft gray when wet, light gray when dry; both contacts gradational and arbitrary.	17 –24
Clayey silt, firm, structureless; light gray when wet, creamy-gray when dry.	24 –35½

Station—CB-104 (snapper sample).
Longitude—76° 19′ 48″ West. *Latitude*—38° 01′ 57″ North.
Depth of water—17 feet.
Description:
Medium to fine-grained sand, sorting fair; brownish gray mottled with black when wet, yellowish gray when dry; predominantly quartz with some feldspar, abundant black accessories; rare small shells.

Station—CB-105 (snapper sample).
Longitude—76° 18′ 42″ West. *Latitude*—38° 03′ 06″ North.
Depth of water—17 feet.
Description:
Fine to medium-grained sand, fairly well sorted; yellow-brown with reddish tinge when wet, yellow when dry; primarily quartz, probably more than usual amount of feldspar, many black, white, orange and red accessories; rare small shells.

Station—CB-106 (snapper sample).
Longitude—76° 18′ 05″ West. *Latitude*—38° 03′ 09″ North.
Depth of water—22 feet.
Description:
Sand and gravel, very poorly sorted; yellowish brown mottled with gray when wet, light tannish gray speckled with yellow when dry; pebbles are rounded quartz and subangular black fine-grained rock; sand is primarily quartz with some feldspar; a few small shells.

Station—CB-107 (core sample).
Longitude—76° 15′ 28″ West. *Latitude*—38° 03′ 20″ North.
Depth of water—42 feet.

Sampler penetration—132 iches.
Core length—wet 87 inches, dry 65 inches.

Description:	*Thickness (inches)*
Clayey silt, firm, structureless; soft gray when wet, light gray when dry.	0 -87

Station—CB-108 (core sample).
Longitude—76° 13′ 12″ West. *Latitude*—38° 03′ 48″ North.
Depth of water—65 feet.
Sampler penetration—60 inches.
Core length—wet 44½ inches, dry 44 inches.

Description:	*Thickness (nches)*
Slightly silty medium to fine-grained sand, fairly well sorted, poorly consolidated; black when wet, light gray when dry; primarily quartz, abundant black accessories.	0 - 5
Medium to fine-grained sand and silt, very poorly sorted, heterogeneous mixture of patches and lenses of sand and silt; soft gray when wet, light gray when dry.	5 -44½

Station—CB-109 (core sample).
Longitude—76° 12′ 26″ West. *Latitude*—38° 03′ 55″ North.
Depth of water—75 feet.
Sampler penetration—132 inches.
Core length—wet 66½ inches, dry 56 inches.

Description:	*Thickness (inches)*
Clayey silt, watery, slight development of cavities, structureless; black when wet, light gray when dry; lower contact gradational and arbitrary.	0 -10½
Clayey silt, firm, slight development of cavities; occasional thin laminae of light silt; soft gray when wet, light gray when dry.	10½-66½

Station—CB-110 (core sample).
Longitude—76° 11′ 55″ West. *Latitude*—38° 04′ 04″ North.
Depth of water—53 feet.
Sampler penetration—132 inches.
Core length—wet 96 inches, dry 74 inches.

Description.	*Thickness (icnhes)*
Clayey silt, watery, structureless; black when wet, light gray when dry.	0 - 6½
Clayey silt, firm, structureless; soft gray when wet, light gray when dry.	6½-96

Station—CB-111 (snapper sample).
Longitude—76° 00′ 57″ West. *Latitude*—38° 04′ 16″ North.
Depth of water—21 feet.
Description:
Medium to fine-grained sand, well sorted; gray when wet, light gray almost white when dry; primarily quartz with numerous dark accessories.

Station—CB-112 (snapper sample).
Longitude—76° 09′ 33″ West. *Latitude*—38° 04′ 32″ North.
Depth of water—24 feet.
Description:
Medium to fine-grained sand, well sorted; yellowish brown when wet, light yellowish-tan when dry; primarily quartz with some feldspar; black accessories abundant; a few small shells.

Station—CB-113 (snapper sample).
Longitude—76° 07′ 33″ West. *Latitude*—38° 05′ 03″ North.
Depth of water—15 feet.
Description:

Fine to medium-grained sand, extremely well sorted; gray when wet, light gray when dry; primarily quartz with abundant black accessories; a few small shells.

Station—CB-114 (snapper sample).
Longitude—75° 55′ 07″ West. *Latitude*—38° 00′ 00″ North.
Depth of water—15 feet.
Description:

Medium-grained sand, fairly well sorted; tannish gray when wet, tannish gray when dry; primarily quartz with abundant yellow and black accessories.

Station—CB-115 (core sample).
Longitude—75° 54′ 53″ West. *Latitude*—38° 00′ 00″ North.
Depth of water—65 feet.
Sampler penetration—54 inches.
Core length—wet 31 inches, dry 30 inches.

Description:	*Thickness (inches*
Very fine-grained sand and silt, poorly sorted, structureless; black when wet, light gray when dry.	0 – 8
Very fine-grained sand and silt, poorly sorted, structureless; dark gray when wet, light gray when dry; a few scattered small shells; lower boundary gradational and arbitrary.	8 –20
Fine to medium-grained sand with some silt, poorly sorted, structureless; dark gray when wet, light gray when dry; contacts gradational and arbitrary.	20 –25
Very fine-grained sand and silt, poorly sorted, structureless; dark gray when wet, light gray when dry.	25 –31

Station—CB-116 (core sample).
Longitude—75° 54′ 30″ West. *Latitude*—37° 59′ 54″ North.
Depth of water—102 feet.
Sampler penetration—48 inches.
Core length—wet 27 inches, dry 23 inches.

Description:	*Thickness (inches)*
Clayey silt, slightly sandy, fairly firm; occasional fine laminations; black when wet, light gray when dry; scattered small shells; lower boundary gradational and arbitrary.	0 –17½
Clayey silt, slightly sandy, fairly firm; occasional fine laminations; soft gray when wet, light gray when dry; scattered small shells.	17½–19
Medium to coarse-grained sand with some gravel in a matrix of silt, poorly sorted, structureless; soft gray when wet, light gray when dry; pebbles granitic and well rounded.	19 –27

Station—CB-117 (snapper sample).
Longitude—75° 54′ 03″ West. *Latitude*—38° 00′ 00″ North.
Depth of water—11 feet.

Description:

Coarse to medium-grained sand, very well sorted; black when wet, very light tan-gray when dry; primarily quartz but with considerable feldspar especially in the coarser fragments.

Station—CB-118 (snapper sample).
Longitude—76° 11′ 54″ West. *Latitude*—37° 53′ 15″ North.
Depth of water—12 feet.
Description:

Medium-grained sand, well sorted; gray mottled yellow when wet, very light gray when dry; primarily quartz with abundant dark accessories.

Station—CB-119 (snapper sample).
Longitude—76° 11′ 18″ West. *Latitude*—37° 53′ 12″ North.
Depth of water—25 feet.
Description:

Medium- to fine-grained sand, well sorted; tannish gray when wet, very light gray when dry; primarily quartz with numerous dark accessories, a few coarse-grained fragments of leucoxene; rare small shells.

Station—CB-120 (core sample).
Longitude—76° 00′ 15″ West. *Latitude*—37° 53′ 09″ North.
Depth of water—70 feet.
Sampler penetration—120 inches.
Core length—wet 74 inches, dry 60½ inches.

Description:	*Thickness (inches)*
Slightly sandy silt, fairly firm; laminated throughout by thin layers of lighter silt or very fine-grained sand; black when wet, light gray when dry; lower contact gradational and arbitrary.	0 – 2
Slightly sandy silt, fairly firm; laminated throughout by thin layers of lighter silt or very fine-grained sand; soft gray when wet, light gray when dry; thin parting of small shells at 8 inches.	2 –74

Station—CB-121 (core sample).
Longitude—76° 08 30″ West. *Latitude*—37° 53′ 06″ North.
Depth of water—70 feet.
Sampler penetration—unknown.
Core length—wet 18 inches, dry 18 inches.

Description:	*Thickness (inches)*
Medium-grained sand, fairly well sorted, structureless; black when wet, light gray when dry; primarily quartz with abundant black and yellow accessories.	0 – 5½
Coarse-grained sand with some gravel, poorly sorted, structureless; gray when wet, light gray (sand) when dry; pebbles granitic.	5½– 8½
Zone of abundant broken shells; 70 to 75 per cent shells, 25 to 30 per cent coarse-grained sand and gravel.	
Coarse-grained sand with some gravel, poorly sorted, structureless; gray when wet, light gray (sand) when dry; pebbles granitic.	12 –18

Station—CB-122 (core sample).
Longitude—76° 07′ 16″ West. *Latitude*—37° 53′ 05″ North.
Depth of water—40 feet.
Sampler penetration—24 inches.
Core length—wet 15 inches, dry 15 inches.

Description:	*Thickness (inches)*
Gravel and coarse sand, friable, structureless; sand is brown-gray; pebbles are very large (up to 1½ inches in diameter), granitic; sand composed of quartz and feldspar; a few large shell fragments; lower boundary sharp.	0 – 4
Sandy clayey silt, poorly sorted with occasional lenses of gravel, finely laminated with both silt and sand beds; dark olive-drab when wet, very dark gray when dry.	4 –15

Station—CB-123 (snapper sample).
Longitude—76° 05′ 24″ West. *Latitude*—37° 53′ 02″ North.
Depth of water—22 feet.
Description:
Medium to fine-grained sand, well sorted; gray, mottled tan when wet, light tan-gray when dry; primarily quartz with black and yellow accessories.

Station—CB-124 (snapper sample).
Longitude—76° 03′ 58″ West. *Latitude*—37° 53′ 00″ North.
Depth of water—17 feet.
Description:
Fine to medium-grained sand, fairly well sorted; buff-gray when wet, light gray when dry; primarily quartz with abundant black accessories; rare small shells.

Station—CB-125 (snapper sample).
Longitude—75° 57′ 45″ West. *Latitude*—37° 53′ 50″ North.
Depth of water—15 feet.
Description:
Medium to coarse-grained sand, very well sorted; dark gray to black when wet, yellowish brown when dry; primarily quartz with feldspar especially in coarser fractions; rare small shells.

Station—CB-126 (core sample).
Longitude—75° 57′ 14″ West. *Latitude*—37° 53′ 54″ North.
Depth of water—98 feet.
Sampler penetration—72 inches.
Core length—wet 45 inches, dry 39 inches.

Description:	*Thickness (inches)*
Sandy clayey silt, poorly sorted, laminae and lenses of very fine-grained sand fairly abundant throughout; black when wet, light gray when dry; lower contact gradational and arbitrary.	0 – 8½
Sandy clayey silt, poorly sorted, laminae and lenses of very fine-grained sand fairly abundant throughout; soft gray when wet, light gray when dry; a few broken shells at 20 inches; lower contact gradational.	8½–23½
Medium-grained sand, silty, poorly sorted, structureless; dark gray when wet, light gray when dry; a few broken shells.	23½–45

Station—CB-127 (core sample).
Longitude—75° 56′ 42″ West. *Latitude*—37° 53′ 57″ North.
Depth of water—46 feet.
Sampler penetration—36 inches.
Core length—wet 30 inches, dry 27 inches.

Description:	*Thickness (inches)*
Medium-grained sand, fairly well sorted, structureless; black when wet, brownish yellow when dry; primarily quartz with some feldspar.	0 – 4½
Medium-grained sand, fairly well sorted, structureless; light greenish-gray when wet, brownish yellow when dry; primarily quartz with some feldspar.	4½– 6½
Sequence of alternating layers of clayey silt and coarse-grained sand with a little gravel; silt layers are faintly laminated with light slightly coarser silt or fine-grained sand; whole is dark olive-drab when wet, light gray when dry; pebbles are granitic and well rounded; sequence is:	6½–30

Sand and gravel	6½–11
Silt	11 –16
Sand and gravel	16 –16½
Silt	16½–18
Sand and gravel	18 –18½
Silt	18½–23
Sand and gravel	23 –23½
Silt	23½–30

Station—CB-128 (snapper sample).
Longitude—75° 48′ 42″ West. *Latitude*—37° 53′ 21″ North.
Depth of water—15 feet.
Description:
Medium to fine-grained sand, fairly well sorted; dark gray mottled with black when wet, gray when dry; primarily quartz.

Station—CB-129 (core sample).
Longitude—75° 48′ 30″ West. *Latitude*—37° 53′ 10″ North.
Depth of water—30 feet.
Sampler penetration—108 inches.
Core length—wet 54½ inches, dry 40½ inches.

Description:	*Thickness (inches)*
Clayey silt, slightly sandy, watery becoming firmer downward, many cavities, structureless; black when wet, tannish gray when dry; lower contact gradational and arbitrary.	0 –29
Clayey silt, slightly sandy, firm; occasional fine laminations of light silt or very fine-grained sand; soft gray when wet, light gray when dry.	29 –50½
Medium to coarse-grained sand, silty, poorly sorted; soft gray when wet, light gray when dry.	50½–54½

Station—CB-130 (core sample).
Longitude—75° 48′ 20″ West. *Latitude*—37° 53′ 00″ North.
Depth of water—15 feet.
Sampler penetration—unknown.
Core length—wet 12½ inches, dry 12½ inches.

Description:	*Thickness (inches)*
Coarse-grained sand, fairly well sorted throughout but more poorly sorted with depth, structureless; gray when wet, light gray when dry; primarily quartz with some feldspar; abundant fragments of large shells.	0 –12½

Station—CB-131 (core sample).
Longitude—75° 58′ 06″ West. *Latitude*—37° 47′ 45″ North.
Depth of water—30 feet.
Sampler penetration—54 inches.
Core length—wet 33 inches, dry 32 inches.

Description:	*Thickness (inches)*
Sequence of alternating layers of clayey silt (slightly sandy) and silty very fine-grained sand; clayey silt layers are faintly laminated with light slightly coarser silt; coarse alternate bands of black and dark gray when wet; when dry, black bands are seen to be the sand layers and the dark gray bands the silt layers; sequence is:	0 –33

Sand	0 – 9
Silt	9 –10
Sand	10 –13½
Silt	13½–14½
Sand (with a few laminae)	14½–26½
Silt	26½–27
Sand	27 –29
Silt	29 –29½
Sand	29½–30½
Silt (with a few laminae)	30½–33

Station—CB-132 (core sample).
Longitude—75° 57′ 51″ West. *Latitude*—37° 47′ 45″ North.
Depth of water—115 feet.
Sampler penetration—72 inches.
Core length—wet 55 inches, dry 40 inches.

Description:	*Thickness (inches)*
Clayey silt, watery becoming firmer downward, many cavities; coarse alternate bands of black and soft gray when wet, light gray throughout when dry; finely laminated throughout by paper thin partings of light silt or very fine-grained sand; a few scattered small shells; partings of dried grasses with roots extending downward at 21½ and 38 inches.	0 –55

Station—CB-133 (core sample).
Longitude—75° 57′ 12″ West. *Latitude*—37° 47′ 45″ North.
Depth of water—40 feet.
Sampler penetration—unknown.
Core length—wet 14½ inches, dry 14½ inches.

Description:	*Thickness (inches)*
Slightly silty fine-grained sand, extremely well sorted, structureless; black when wet, light gray when dry; primarily quartz; lower contact gradational and arbitrary in respect to color, grain size and sorting.	0 – 9
Sand and gravel, poorly sorted, structureless; gray when wet, light gray when dry; primarily quartz with some feldspar and granite; a few thick shell fragments.	9 –14½

Station—CB-134 (snapper sample).
Longitude—75° 56′ 50″ West. *Latitude*—37° 47′ 55″ North.
Depth of water—20 feet.
Description:
Medium-grained sand, extremely well sorted; dark gray mottled black when wet, tan when dry; primarily quartz; one medium-sized shell.

Station—CB-135 (core sample).
Longitude—75° 51′ 52″ West. *Latitude*—37° 47′ 03″ North.
Depth of water—18 feet.
Sampler penetration—72 inches.
Core length—wet 49½ inches, dry 43½ inches.

Description:	*Thickness (inches)*
Very fine-grained sand and silt, firm, apparently structureless; black when wet, light gray when dry; a few medium-sized shells; lower contact gradational and arbitrary.	0 – 7½
Very fine-grained sand and silt, firm; numerous laminae of light silt and very fine-grained sand; soft gray when wet, light gray when dry; zone of large oyster shell fragments from 46 to 49½ inches.	7½–49½

Station—CB-136 (core sample).
Longitude—75° 51′ 03″ West. *Latitude*—37° 47′ 03″ North.
Depth of water—80 feet.
Sampler penetration—108 inches.
Core length—wet 69 inches, dry 62½ inches.

Description:	*Thickness (inches)*
Silty fine to medium-grained sand, sorting fair; dark gray when wet, light gray when dry; many scattered small shells.	0 –29
Silty medium to coarse-grained sand, poorly sorted, heterogeneous mixture of patches and lenses of varying grain size; dark gray when wet, light gray when dry.	29 –42½
Clayey silt, firm; occasional laminae and small lenses of very fine-grained sand; soft gray when wet, light gray when dry.	42½–69

Station—CB-137 (snapper sample).
Longitude—75° 50′ 46″ West. *Latitude*—37° 47′ 03″ North.
Depth of water—21 feet.
Description:
Medium-grained sand, slightly silty, fairly well sorted; greenish gray mottled with black when wet, light gray when dry; primarily quartz with a little feldspar; one medium-sized gastropod shell.

Station—CB-138 (snapper sample).
Longitude—76° 15′ 06″ West. *Latitude*—37° 44′ 58″ North.
Depth of water—19 feet.
Description:
Medium to coarse-grained sand, fairly well sorted; gray mottled black when wet; yellowish gray when dry; primarily quartz with some feldspar; one small gastropod shell.

Station—CB-139 (snapper sample).
Longitude—76° 13′ 48″ West. *Latitude*—37° 44′ 58″ North.
Depth of water—30 feet.
Description:

Medium-grained sand, fairly well sorted; greenish gray mottled black when wet, gray when dry; primarily quartz with numerous black accessories.

Station—CB-140 (core sample).
Longitude—76° 11′ 48″ West. *Latitude*—37° 44′ 58″ North.
Depth of water—90 feet.
Sampler penetration—132 inches.
Core length—wet 97 inches, dry 76 inches.

Description:	*Thickness (inches)*
Clayey silt, watery, structureless; black when wet, light gray when dry.	0 –14½
Clayey silt, firm, structureless; soft gray when wet, light gray when dry.	14½–97

Station—CB-141 (core sample).
Longitude—76° 10′ 00″ West. *Latitude*—37° 44′ 58″ North.
Depth of water—54 feet.
Sampler penetration—30 inches.
Core length—wet 16 inches, dry 16 inches.

Description:	*Thickness (inches)*
Slightly silty medium-grained sand, fairly well sorted, structureless; dark gray mottled black when wet, light gray when dry; primarily quartz.	0 – 3
Very silty medium-grained sand with a few pebbles, poorly sorted, structureless; dark gray mottled black when wet, light gray when dry.	3 –16

Station—CB-142 (snapper sample).
Longitude—76° 08′ 23″ West. *Latitude*—37° 44′ 55″ North.
Depth of water—30 feet.
Description:

Slightly silty medium to fine-grained sand, fairly well sorted; black when wet, grayish tan when dry; primarily quartz with numerous black accessories.

Station—CB-143 (snapper sample).
Longitude—76° 06′ 54″ West. *Latitude*—37° 44′ 57″ North.
Depth of water—30 feet.
Description:

Fine to medium-grained sand, very well sorted; gray mottled black when wet, grayish tan when dry; primarily quartz with black accessories.

Station—CB-144 (snapper sample).
Longitude—76° 04′ 57″ West. *Latitude*—37° 44′ 58″ North.
Depth of water—30 feet.
Description:

Medium to fine-grained sand, very well sorted; gray mottled black when wet, grayish tan when dry; primarily quartz with black accessories; one small pelecypod shell

Station—CB-145 (snapper sample).
Longitude—76° 03′ 42″ West. *Latitude*—37° 44′ 58″ North.
Depth of water—24 feet.

Description:

Medium-grained sand, extremely well sorted; black when wet, yellowish tan when dry; primarily quartz; rare small shells.

Station—CB-146 (core sample).
Longitude—76° 01′ 36″ West. *Latitude*—37° 44′ 58″ North.
Depth of water—40 feet.
Sampler penetration—120 inches.
Core length—wet 71 inches, dry 60½ inches.

Description:	*Thickness (inches)*
Clayey silt and very fine-grained sand, firm; laminated throughout by light silt or very fine-grained sand; dark gray to black when wet, light gray when dry; a few small shells.	0 – 6
Clayey silt and very fine-grained sand, firm; laminated throughout by light silt or very fine-grained sand; soft gray when wet, light gray when dry.	6 –71

Station—CB-147 (core sample).
Longitude—76° 00′ 32″ West. *Latitude*—37° 44′ 58″ North.
Depth of water—60 feet.
Sampler penetration—120 inches.
Core length—wet 85 inches, dry 72½ inches.

Description:	*Thickness (inches)*
Clayey silt and very fine-grained sand, fairly firm, many cavities; laminated throughout by light silt or very fine-grained sand; dark gray to black when wet, light gray when dry.	0 –62
Clayey silt and very fine-grained sand, firm, laminae and distorted lenses of light silt and very fine-grained sand; soft gray when wet, light gray when dry.	62 –85

Station—CB-148 (snapper sample).
Longitude—75° 59′ 15″ West. *Latitude*—37° 44′ 58″ North.
Depth of water—26 feet.
Description:

Medium-grained sand, fairly well sorted; black when wet, light tannish-gray when dry; primarily quartz with a few black and yellow accessories.

Station—CB-149 (snapper sample).
Longitude—75° 57′ 27″ West. *Latitude*—37° 44′ 58″ North.
Depth of water—19 feet.
Description:

Medium-grained sand, very well sorted; dark gray mottled black when wet, light tannish-gray when dry; primarily quartz with a few black and yellow accessories.

Station—CB-150 (snapper sample).
Longitude—75° 55′ 45″ West. *Latitude*—37° 44′ 55″ North.
Depth of water—16 feet.
Description:

Medium-grained sand, with a little silt, very well sorted; yellowish gray mottled black when wet. gray slightly greenish when dry; primarily quartz with a few black accessories.

Station—CB-151 (core sample).
Longitude—75° 53′ 36″ West. *Latitude*—37° 44′ 55″ North.
Depth of water—44 feet.
Sampler penetration—120 inches.
Core length—wet 79½ inches, dry 66 inches.

Description:	*Thickness (inches)*
Sandy clayey silt, firm; occasional lenses and partings (up to ½ inch thick) of very fine-grained sand throughout; black when wet, light gray when dry.	0 –17½
Sandy clayey silt, firm; occasional lenses and partings (up to ½ inch thick) of very fine-grained sand throughout; soft gray when wet, light gray when dry.	17½–46½
Clayey silt, firm, structureless; soft-gray when wet, light gray when dry.	46½–79½

Station—CB-152 (core sample).
Longitude—75° 52′ 06″ West. *Latitude*—37° 44′ 55″ North.
Depth of water—52 feet.
Sampler penetration—132 inches.
Core length—wet 88½ inches, dry 71 inches.

Description:	*Thickness (inches)*
Slightly sandy clayey silt, sand content decreasing gradually with depth, fairly firm, structureless except for a very few laminae of light silt and very fine-grained sand; black when wet, light gray when dry; a few scattered small shells; lower contact gradational and arbitrary.	0 –16½
Slightly sandy clayey silt, sand content gradually decreasing with depth until absent, firm, structureless; soft gray when wet, light gray when dry.	16½–88½

Station—CB-153 (snapper sample).
Longitude—75° 51′ 06″ West. *Latitude*—37° 44′ 55″ North.
Depth of water—22 feet.
Description:
Slightly silty fine to medium-grained sand, fairly well sorted; black when wet, light gray when dry; primarily quartz; a few small shells.

Station—CB-154 (snapper sample).
Longitude—75° 50′ 44″ West. *Latitude*—37° 44′ 55″ North.
Depth of water—11 feet.
Description:
Medium-grained sand, well sorted; dark gray to black when wet, tannish gray with slight green tinge when dry; primarily quartz with many dark accessories.

Station—CB-155 (core sample).
Longitude—76° 17′ 30″ West. *Latitude*—37° 35′ 00″ North.
Depth of water—30 feet.
Sampler penetration—unknown.
Core length—wet 101½ inches, dry 85 inches.

Description:	*Thickness (inches)*
Clayey silt, slightly sandy, top 30 inches (approximately) watery, remainder of core firm; structureless; soft gray when wet, light gray when dry.	0 –101½

Station—CB-156 (core sample).
Longitude—76° 17′ 21″ West. *Latitude*—37° 35′ 50″ North.
Depth of water—42 feet.
Sampler penetration—84 inches.
Core length—wet 63 inches, dry 53 inches.

Description:	*Thickness (inches)*
Clayey silt, watery, structureless; black when wet, light gray when dry.	0 – 7½
Clayey silt, firm, structureless; soft gray when wet, light gray when dry.	7½–37
Clayey silt and very fine-grained sand, numerous irregular lenses of medium to coarse-grained sand or clayey silt; soft gray when wet, light gray when dry; entire zone is transitional.	37 –48
Medium-grained sand and silt, poorly sorted, structureless; soft gray when wet, gray when dry.	48 –63

Station—CB-157 (snapper sample).
Longitude—75° 58′ 12″ West. *Latitude*—37° 35′ 48″ North.
Depth of water—25 feet.
Description:
Slightly silty medium-grained sand, sorting fair; dark gray to black when wet, light gray when dry; predominantly quartz; a few stalks of grass.

Station—CB-158 (snapper sample).
Longitude—75° 57′ 32″ West. *Latitude*—37° 35′ 42″ North.
Depth of water—19 feet.
Description:
Medium-grained sand, fairly well sorted; light tannish-gray almost white when wet, very light tannish-gray when dry; predominantly quartz.

Station—CB-159 (snapper sample).
Longitude—75° 57′ 00″ West. *Latitude*—37° 35′ 39″ North.
Depth of water—15 feet.
Description:
Medium to fine-grained sand, sorting fair; light tannish-gray when wet, very light gray almost white when dry; predominantly quartz.

Station—CB-160 (snapper sample).
Longitude—76° 13′ 18″ West. *Latitude*—37° 23′ 24″ North.
Depth of water—10 feet.
Description:
Medium-grained sand, very well sorted; gray mottled yellow and black when wet, tannish gray when dry; primarily quartz with a little feldspar, a few black accessories.

Station—CB-161 (snapper sample).
Longitude—76° 12′ 36″ West. *Latitude*—37° 23′ 24″ North.
Depth of water—20 feet.
Description:
Medium-grained sand, very well sorted; tan when wet, light tannish-gray when dry; predominantly quartz; a few small shells.

Station—CB-162 (snapper sample).
Longitude—76° 12′ 00″ West. *Latitude*—37° 23′ 24″ North.
Depth of water—28 feet.
Description:

Fine to medium-grained sand, sorting fair; gray-black mottled yellow when wet, dark tan when dry; predominantly quartz with a little feldspar; fairly abundant small shells.

Station—CB-163 (snapper sample).
Longitude—76° 11′ 24″ West. *Latitude*—37° 23′ 24″ North.
Depth of water—17 feet.
Description:

Medium-grained sand, very well sorted; gray when wet, light tannish-gray when dry; predominantly quartz with a few black and many yellow accessories.

Station—CB-164 (core sample).
Longitude—75° 59′ 58″ West. *Latitude*—37° 23′ 24″ North.
Depth of water—55 feet.
Sampler penetration—108 inches.
Core length—wet 67 inches, dry 60 inches.

Description:	*Thickness (inches)*
Clayey silt, fairly firm; numerous partings of silty very fine-grained sand up to ½ inch thick; black when wet, light gray when dry; a few small shells on top.	0 – 9½
Clayey silt, fairly firm; numerous partings of silty very fine-grained sand up to ½ inch thick; dark gray to soft gray when wet, light gray when dry.	9½–20
Clayey silt and sand, numerous lenses and irregular patches of varying grain size, sand content gradually increases downward; lower contact gradational and arbitrary.	20 –44
Medium to coarse-grained sand, silty, structureless; soft gray when wet, light gray when dry; zone of abundant small shells from 51 to 56 inches.	44 –63
Slightly sandy clayey silt, firm, structureless; soft gray when wet, light gray when dry.	63 –67

Station—CB-165 (core sample).
Longitude—76° 08′ 24″ West. *Latitude*—37° 23′ 24″ North.
Depth of water—39 feet.
Sampler penetration—108 inches.
Core length—wet 63½ inches, dry 60½ inches.

Description:	*Thickness (inches)*
Medium to fine-grained sand and silt, poorly sorted; structureless except for small lens of slightly cleaner sand; black slightly mottled gray when wet, light gray when dry; predominantly quartz.	0 – 4
Medium to fine-grained sand and silt, poorly sorted; occasional small lenses of slightly cleaner sand; dark gray when wet, light gray when dry.	4 –32½
Silty medium-grained sand, poorly sorted; numerous distorted lenses of clayey silt; dark gray when wet, light gray when dry.	32½–63½

Station—CB-166 (core sample).
Longitude—76° 06′ 48″ West. *Latitude*—37° 23′ 24″ North.
Depth of water—42 feet.

Sampler penetration—114 inches.
Core length—wet 56 inches, dry 53½ inches.

Description:	*Thickness (inches)*
Sandy clayey silt, poorly sorted, structureless; dark gray to black when wet, light gray when dry.	0 – 8½
Sandy clayey silt, poorly sorted, structureless; soft gray when wet, light gray when dry.	8½–56

Station—CB-167 (core sample).
Longitude—76° 04′ 57″ West. *Latitude*—37° 23′ 24″ North.
Depth of water—82 feet.
Sampler penetration—114 inches.
Core length—wet 59 inches, dry 55 inches.

Description:	*Thickness (inches)*
Very sandy silt, poorly sorted; numerous partings from paper thin to 2 inches thick of fine to very fine-grained sand throughout; black when wet, light gray when dry; a few scattered small shells; lower contact gradational and arbitrary.	0 –26½
Very sandy silt, poorly sorted; numerous partings from paper thin to 2 inches thick of fine to very fine-grained sand throughout; dark gray when wet, light gray when dry; a few scattered small shells.	26½–35
Medium-grained sand and clayey silt, poorly sorted; irregular patches and lenses of medium-grained sand; dark gray when wet, light gray when dry; a few small shells.	35 –44½
Medium to coarse-grained sand and silt, poorly sorted, structureless; dark gray when wet, light gray when dry; a few small shells; both contacts gradational.	44½–50
Slightly sandy clayey silt, firm, structureless; soft gray when wet, light gray when dry; a few small shells.	50 –59

Station—CB-168 (snapper sample).
Longitude—76° 04′ 18″ West. *Latitude*—37° 23′ 24″ North.
Depth of water—55 feet.
Description:
Very silty fine-grained sand, relatively poorly sorted; black when wet, light gray when dry; predominantly quartz, micaceous accessories.

Station—CB-169 (snapper sample).
Longitude—76° 03′ 03″ West. *Latitude*—37° 23′ 24″ North.
Depth of water—43 feet.
Description:
Medium to fine-grained sand, a little silt, fairly well sorted; gray mottled black when wet, light gray when dry; predominantly quartz.

Station—CB-170 (snapper sample).
Longitude—76° 01′ 45″ West. *Latitude*—37° 23′ 24″ North.
Depth of water—45 feet.
Description:
Silty fine to very fine-grained sand; fairly well sorted; black when wet, light gray when dry; predominantly quartz, micaceous accessories; a few small shells.

Station—CB-171 (snapper sample).
Longitude—76° 00′ 45″ West. *Latitude*—37° 23′ 24″ North.
Depth of water—21 feet.
Description:
Fine-grained sand, extremely well sorted; dark gray when wet, tannish gray when dry; predominantly quartz, a few black accessories; a few small shells.

Station—CB-172 (snapper sample).
Longitude—76° 00′ 13″ West. *Latitude*—37° 23′ 24″ North.
Depth of water—12 feet.
Description:
Fine-grained sand, extremely well sorted; black when wet, very light gray when dry; primarily quartz, abundant black accessories.

Station—CB-173 (snapper sample).
Longitude—76° 12′ 55″ West. *Latitude*—37° 20′ 13″ North.
Depth of water—33 feet.
Description:
Silty fine-grained to medium-grained sand, well sorted; black when wet, light gray when dry; primarily quartz, micaceous accessories.

Station—CB-174 (snapper sample).
Longitude—76° 14′ 15″ West. *Latitude*—37° 17′ 30″ North.
Depth of water—21 feet.
Description:
Medium to coarse-grained sand, sorting fair; black when wet, tan when dry; predominantly quartz.

Station—CB-175 (core sample).
Longitude—76° 10′ 48″ West. *Latitude*—37° 15′ 54″ North.
Depth of water—39 feet.
Sampler penetration—unknown.
Core length—wet 70½ inches, dry 65 inches.

Description:	*Thickness (inches)*
Sandy clayey silt, poorly sorted; occasional laminae and lenses of finer material decreasing in persistance downward; dark to soft gray when wet, light-gray when dry; thin shell horizon at 15 inches.	0 –70½

Station—CB-176 (core sample).
Longitude—76° 08′ 36″ West. *Latitude*—37° 15′ 54″ North.
Depth of water—39 feet.
Sampler penetration—84 inches.
Core length—wet 61½ inches, dry 59½ inches.

Description:	*Thickness (inches)*
Very sandy silt, poorly sorted, structureless except for a few fine laminae of light-colored coarser material; mottled black and gray when wet, light gray when dry; primarily quartz, slightly micaceous.	0 – 7
Very sandy clayey silt, poorly sorted; a few fine laminae of lighter-colored coarser material and occasional lenses of finer material; soft gray when wet, light gray when dry; primarily quartz, slightly micaceous.	7 –61½

Station—CB-177 (core sample).
Longitude—76° 06′ 36″ West. *Latitude*—37° 15′ 54″ North.
Depth of water—54 feet.
Sampler penetration—120 inches.
Core length—wet 68 inches, dry $63\frac{1}{2}$ inches.
Description:

Description	*Thickness (inches)*
Sandy clayey silt, relatively poorly sorted; finely laminated by lighter-colored coarser material, numerous lenses of finer material; grain size increases slightly and gradually downward; mottled gray and black when wet, light gray when dry.	0 – $7\frac{1}{2}$
Sandy clayey silt, relatively poorly sorted; finely laminated by lighter-colored coarser material, numerous lenses of finer material; grain size increases slightly and gradually downward; soft gray when wet, light gray when dry.	$7\frac{1}{2}$–68

Station—CB-178 (core sample).
Longitude—76° 05′ 24″ West. *Latitude*—37° 15′ 54″ North.
Depth of water—106 feet.
Sampler penetration—unknown.
Core length—wet 31 inches, dry 30 inches.
Description:

Description	*Thickness (inches)*
Slightly silty very fine-grained sand, extremely well sorted, structureless; dark gray to black when wet, light gray when dry; primarily quartz, slightly micaceous; a few small shells.	0 – 9
Sandy silt, structureless; dark gray to black when wet, light gray when dry; topped with thin parting of small shells.	9 –12
Silty very fine to fine-grained sand; poorly sorted, structureless; dark gray to black when wet, light gray when dry; a few scattered small shells.	12 –31

Station—CB-179 (snapper sample).
Longitude—76° 04′ 42″ West. *Latitude*—37° 15′ 54″ North.
Depth of water—30 feet.
Description:

Medium-grained sand, sorting fair; very light gray almost white when wet, white when dry; primarily quartz; a few small shells.

Station—CB-180 (snapper sample).
Longitude—76° 03′ 42″ West. *Latitude*—37° 15′ 54″ North.
Depth of water—25 feet.
Description:

Medium to coarse-grained sand, sorting relatively poor; a few lumps of silt; dark brown when wet, brownish gray when dry; primarily quartz with some feldspar; extremely abundant shells.

Station—CB-181 (snapper sample).
Longitude—76° 15′ 18″ West. *Latitude*—37° 13′ 57″ North.
Depth of water—26 feet.
Description:

Silty fine to medium-grained sand, well sorted; black when wet, light gray when dry; primarily quartz; rare small shells.

Station—CB-182 (snapper sample).
Longitude—76° 23′ 20″ West. *Latitude*—37° 15′ 08″ North.
Depth of water—24 feet.
Description:

Slightly silty medium to fine-grained sand, fairly well sorted; black when wet, gray when dry; primarily quartz; a few small and medium shells.

Station—CB-183 (core sample).
Longitude—76° 23′ 15″ West. *Latitude*—37° 04′ 42″ North.
Depth of water—65 feet.
Sampler penetration—126 inches.
Core length—wet 82 inches, dry 63½ inches.

Description:	*Thickness (inches)*
Clayey silt, watery, structureless; black when wet, light gray when dry; lower boundary gradational and arbitrary.	0 –11
Clayey silt, firm; finely laminated by lighter silt and very fine-grained sand throughout most of length; soft gray when wet, light gray when dry.	11 –80½
Silty medium-grained sand, poorly sorted, structureless; soft gray when wet, light gray when dry; primarily quartz.	80½–82

Station—CB-184 (core sample).
Longitude—76° 23′ 12″ West. *Latitude*—37° 04′ 19″ North.
Depth of water—40 feet.
Sampler penetration—120 inches.
Core length—wet 79 inches, dry 63 inches.

Description:	*Thickness (inches*
Slightly sandy clayey silt, watery, structureless; black when wet, light gray when dry; a few scattered shells; lower contact gradational and arbitrary.	0 – 8½
Slightly sandy clayey silt, firm, structureless except for a few poorly developed laminae of very fine-grained sand; soft gray when wet, light gray when dry.	8½–79

Station—CB-185 (snapper sample).
Longitude—76° 13′ 00″ West. *Latitude*—37° 04′ 55″ North.
Depth of water—22 feet.
Description:

Medium to fine-grained sand, fairly well sorted; dark gray to black when wet, light yellowish-tan when dry; primarily quartz, a few black accessories; rare small shells; a little peaty material.

Station—CB-186 (core sample).
Longitude—76° 08′ 42″ West. *Latitude*—37° 06′ 08″ North.
Depth of water—42 feet.
Sampler penetration—90 inches.
Core length—wet 55 inches, dry 53 inches.

Description:	*Thickness (inches)*
Silt and very fine-grained sand, firm, poorly sorted, structureless; dark gray when wet, light gray when dry; lower contact gradational and arbitrary.	0 –15½
Silty medium-grained sand, poorly sorted, structureless; dark gray when wet, light gray when dry.	15½–38½

	Thickness (inches)
Peat flakes and silt, poorly sorted; well bedded due to flaky character; dark gray to black when wet, peat black when dry, silt light gray when dry; a little wood.	38½–40
Fine-grained sand and silt, poorly sorted; many laminae and partings of black peaty material (as in unit above) increasing in frequency upward; dark gray when wet, light gray when dry.	40 –55

Station—CB-187 (snapper sample).
Longitude—76° 07′ 18″ West. *Latitude*—37° 06′ 30″ North.
Depth of water—44 feet.
Description:

Silty very fine to fine-grained sand, well sorted; black when wet, light gray when dry; primarily quartz, slightly micaceous; a few small black shells.

Station—CB-188 (snapper sample).
Longitude—76° 05′ 57″ West. *Latitude*—37° 06′ 51″ North.
Depth of water—19 feet.
Description:

Very fine-grained sand, extremely well sorted; dark gray to black when wet, light tannish-gray when dry; primarily quartz, slightly micaceous; a few small shells.

Station—CB-189 (snapper sample).
Longitude—76° 04′ 40″ West. *Latitude*—37° 07′ 15″ North.
Depth of water—27 feet.
Description:

Slightly silty very fine to fine-grained sand, very well sorted; dark gray to black when wet, light tannish-gray when dry; primarily quartz, slightly micaceous; a few small shells.

Station—CB-190 (snapper sample).
Longitude—76° 04′ 12″ West. *Latitude*—37° 07′ 24″ North.
Depth of water—32 feet.
Description:

Slightly silty very fine-grained sand, extremely well sorted; dark gray to black when wet, light tannish-gray when dry; primarily quartz, slightly micaceous; a few small shells.

Station—CB-191 (snapper sample).
Longitude—76° 02′ 09″ West. *Latitude*—37° 07′ 58″ North.
Depth of water—22 feet.
Description:

Very fine to fine-grained sand, well sorted; gray when wet, light tannish-gray when dry; primarily quartz, slightly micaceous.

Station—CB-192 (snapper sample).
Longitude—76° 01′ 43″ West. *Latitude*—37° 08′ 06″ North.
Depth of water—23 feet.
Description:

Very fine to fine-grained sand, very well sorted; dark gray to black when wet, light tannish-gray when dry; primarily quartz, slightly micaceous; a few small shells.

Station—CB-193 (snapper sample).
Longitude—76° 19′ 34″ West. *Latitude*—36° 59′ 32″ North.
Depth of water—62 feet.
Description:

Fine to medium-grained sand with a few pebbles, relatively poorly sorted; also a large lump of very white clayey silt; sand is light gray mottled black when wet, light tan to gray when dry; primarily quartz.

Station—CB-194 (core sample).
Longitude—76° 03′ 00″ West. *Latitude*—36° 57′ 36″ North.
Depth of water—41 feet.
Sampler penetration—unknown; extremely poor recovery; only about 30 grams of sand extruded from sampler.
Description:

Coarse to medium-grained sand, fairly well sorted; yellow to buff when wet, buff when dry; primarily quartz with abundant feldspar; a few large shell fragments.

Station—CB-195 (core sample).
Longitude—76° 00′ 48″ West. *Latitude*—36° 56′ 40″ North.
Depth of water—72 feet.
Sampler penetration—unknown.
Core length—wet 19 inches, dry 19 inches.

Description:	*Thickness (inches)*
Silty very fine-grained sand, well sorted, structureless; black (top 5 inches streaked and stained yellow) when wet, light gray when dry; primarily quartz, slightly micaceous; rare scattered small shells.	0 –19

Station—CB-196 (core sample).
Longitude—76° 00′ 45″ West. *Latitude*—36° 57′ 14″ North.
Depth of water—70 feet.
Sampler penetration—84 inches.
Core length—wet 76 inches, dry 70 inches.

Description:	*Thickness (inches)*
Fine-grained sand, silty, poorly sorted; dark gray when wet, light gray when dry; primarily quartz.	0 – ½
Sandy silt, firm; occasional partings of very fine-grained sand; soft gray when wet, light gray when dry; occasional shells, worm (*Nerius*) boring at 10 inches.	½–65
Silty very fine to fine-grained sand, well sorted, structureless; soft gray when wet, light gray when dry; primarily quartz; shell fragments abundant.	65 –68½
Sandy silt, poorly sorted; structureless; soft gray when wet, light gray when dry; rare small shell fragments; small clinker at top of zone.	68½–76

Station—CB-197 (core sample).
Longitude—76° 00′ 40″ West. *Latitude*—36° 58′ 00″ North.
Depth of water—56 feet.
Sampler penetration—unknown; extremely poor recovery; only about 75 grams of sand extruded from sampler.
Description:

Very silty fine-grained sand, poorly sorted; brownish gray when wet, light gray when dry; many broken shells, some tan-colored.

Station—CB-198 (snapper sample).
Longitude—76° 01′ 42″ West. *Latitude*—37° 02′ 46″ North.
Depth of water—23 feet.
Description:
Fine-grained sand, extremely well sorted; gray when wet, light tannish-gray when dry; primarily quartz.

Station—CB-199 (snapper sample).
Longitude—76° 01′ 21″ West. *Latitude*—37° 03′ 46″ North.
Depth of water—29 feet.
Description:
Slightly silty very fine-grained sand, well sorted; gray when wet, light tannish-gray when dry; primarily quartz.

Station—CB-200 (snapper sample).
Longitude—76° 01′ 02″ West. *Latitude*—37° 05′ 23″ North.
Depth of water—26 feet.
Description:
Silty very fine to fine-grained sand, poorly sorted; gray when wet, light gray when dry.

Station—CB-201 (snapper sample).
Longitude—76° 00′ 26″ West. *Latitude*—37° 07′ 18″ North.
Depth of water—31 feet.
Description:
Sandy clayey silt, poorly sorted; soft gray when wet, light gray when dry.

Station—CB-202 (snapper sample).
Longitude—75° 58′ 50″ West. *Latitude*—37° 07′ 14″ North.
Depth of water—28 feet.
Description:
Fine to very fine-grained sand, well sorted; gray when wet, light tannish-gray when dry; primarily quartz.

Station—CB-203 (core sample).
Longitude—75° 59′ 14″ West. *Latitude*—36° 56′ 32″ North.
Depth of water—72 feet.
Sampler penetration—90 inches.
Core length—wet 73 inches, dry 63 inches.

Description:	*Thickness (inches)*
Alternating layers of sandy silt and silty sand, all poorly sorted; the dominantly silt layers contain fine laminae of lighter silt and very fine-grained sand, the dominantly sand layers are usually structureless but may contain a few partings of silt; entire core is soft gray to dark gray when wet, light gray when dry; a few shells and shell fragments (including some crustacea) scattered throughout; sequence is:	0 –73
Sand, slightly silty, structureless	0 – 4
Sandy silt, laminated	4 – 8
Sandy silt	8 –11½
Sandy silt, laminated	11½–16½
Sandy silt	16½–29½
Silty sand	29½–32½

Sandy silt, laminated	32½–37½
Silty sand	37½–38½
Sandy silt, laminated	38½–40½
Silty sand, laminated	40½–52
Sandy silt, laminated	52 –53½
Silty sand	53½–60
Sandy silt, laminated	60 –73

Station—CB-204 (core sample).
Longitude—75° 58′ 58″ West. *Latitude*—36° 57′ 16″ North.
Depth of water—91 feet.
Sampler penetration—60 inches.
Core length—wet 25½ inches, dry 25½ inches.
Description:

	Thickness (inches)
Alternating layers of sandy silt and silty very fine to fine-grained sand (top layer coarser), poorly sorted throughout; silt layers are usually laminated, sand layers are essentially structureless; soft gray to brownish gray throughout when wet, light gray when dry; scattered shells and shell fragments throughout but more abundant in the sand; sequence is:	0 –25½

Sand (medium-grained)	0 – 2½
Sand	2½– 6½
Silt, laminated	6½–10
Sand	10 –11½
Silt, laminated	11½–18½
Sand	18½–21
Silt, laminated	21 –25½

Station—CB-205 (core sample).
Longitude—75° 57′ 42″ West. *Latitude*—36° 55′ 42″ North.
Depth of water—60 feet.
Sampler penetration—unknown.
Core length—wet 33 inches, dry 33 inches.
Description:

	Thickness (inches)
Coarse to medium-grained sand with a little gravel, sorting fair, structureless; dark gray to brownish gray when wet, light gray when dry; pebbles rounded and granitic, sand predominantly quartz; abundant shell fragments.	0 – 7
Silty sand and gravel, very poorly sorted practically all size grades present, structureless; dark gray to brownish gray when wet, light gray when dry; pebbles rounded and granitic, sand primarily quartz; rare scattered shells.	7 –33

Station—CB-206 (core sample).
Longitude—75° 57′ 24″ West. *Latitude*—36° 56′ 18″ North.
Depth of water—68 feet.
Sampler penetration—unknown; extremely poor recovery; only about 50 grams of material extruded from sampler.
Description:

Very sandy silt with a few pebbles, poorly sorted; soft gray when wet, light gray when dry; a few large shell fragments.

Station—CB-207 (core sample).
Longitude—75° 57′ 09″ West. *Latitude*—36° 56′ 51″ North.
Depth of water—85 feet.

Sampler penetration—unknown.
Core length—wet 20½ inches, dry 20½ inches.
Description:

	Thickness (inches)
Very silty very fine-grained sand, fairly well sorted; structureless; brownish gray when wet, light gray when dry; primarily quartz; a few small shells including crustacea.	0 – 8
Sandy silt with numerous lenses and partings of very fine-grained sand, poorly sorted; brownish gray when wet, light gray when dry; rare small shells; a transition zone.	8 –12
Sandy silt, poorly sorted, structureless; brownish gray when wet, light gray when dry; a few small shells.	12 –20½

Station—CB-208 (core sample).
Longitude—75° 56′ 09″ West. *Latitude*—36° 55′ 00″ North.
Depth of water—54 feet.
Sampler penetration—unknown.
Core length—wet 30 inches, dry 30 inches.
Description:

	Thickness (inches)
Medium-grained sand grading upward into coarse-grained sand, fairly well sorted, structureless except for gradation in size; yellowish gray when wet, slightly lighter when dry; scattered shell fragments; lower contact gradational and arbitrary.	0 – 6
Silty medium to coarse-grained sand with some gravel, very poorly sorted, structureless; brownish gray when wet, light gray when dry; a few scattered shell fragments.	6 –30

Station—CB-209 (core sample).
Longitude—75° 55′ 48″ West. *Latitude*—36° 55′ 24″ North.
Depth of water—65 feet.
Sampler penetration—54 inches.
Core length—wet 33 inches, dry 33 inches.
Description:

	Thickness (inches)
Slightly silty sand and gravel, poorly sorted, all grade sizes present, structureless; dark gray to black when wet (except for pebbles), light gray when dry; predominantly quartz with much feldspar.	0 – 3½
Very silty sand, poorly sorted, all grade sizes present, a few pebbles, structureless; brownish gray when wet, light gray when dry; lower contact lenticular and gradational.	3½–21
Sandy silt, fairly well sorted, structureless; brownish gray when wet, light gray when dry.	21 –33

Station—CB-210 (core sample).
Longitude—75° 55′ 24″ West. *Latitude*—36° 55′ 48″ North.
Depth of water—65 feet.
Sampler penetration—none.
Description:
Presumably sand or gravel bottom.

Station—CB-211 (core sample).
Longitude—75° 54′ 36″ West. *Latitude*—36° 53′ 50″ North.
Depth of water—54 feet.

Sampler penetration—unknown; extremely poor recovery; only about 5 grams of material extruded from sampler.

Description:

Coarse-grained sand and pebbles; pebbles are mostly granitic and well rounded, a few appear to be a dense black siltstone; sand is primarily quartz; a few grains of garnet and one of epidote; one medium-sized shell.

Station—CB-212 (core sample).
Longitude—75° 54′ 09″ West *Latitude*—36° 54′ 05″ North.
Depth of water—57 feet.
Sampler penetration—unknown.
Core Length—wet 15 inches, dry 15 inches.

Description:	*Thickness (inches)*
Gravel and coarse sand, structureless except that material becomes finer downward; pebbles are rounded and granitic, sand is primarily quartz.	0 – 5½
Silty sand, poorly sorted, all grade sizes present, structureless; brownish gray when wet, light gray when dry.	5½–15

Station—CB-213 (core sample).
Longitude—75° 53′ 45″ West. *Latitude*—36° 54′ 21″ North.
Depth of water—52 feet.
Sampler penetration—none.
Description:

Presumably sand or gravel bottom.

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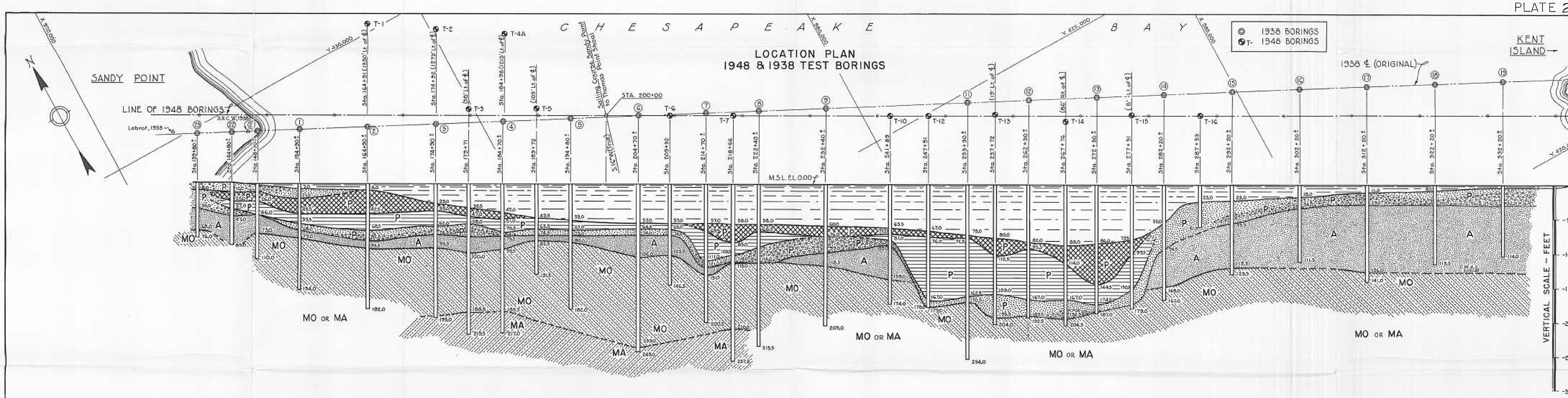
PLATE I


RECONNAISSANCE MAP
SHOWING THE
SEDIMENTS OF CHESAPEAKE BAY
CONTOUR INTERVAL 30 FEET
SCALE
0 5 10 15 20 25
NAUTICAL MILES
EXPLANATION:
GRAVEL & COARSE-GRAINED SAND
MEDIUM-GRAINED SAND
FINE & VERY FINE-GRAINED SAND
CLAYEY SILT
O72 STATION NUMBER
SEDIMENT DISTRIBUTION BASED ON SAMPLES COLLECTED DURING 1950-51.
BOTTOM TOPOGRAPHY SKETCHED FROM U.S.C.&G.S. CHARTS 1222 - 1226.
GEOLOGY OF LAND AREA SKETCHED FROM PLATE I, XVI INTERNATIONAL GEOLOGICAL CONGRESS, GUIDE BOOK 5, "CHESAPEAKE BAY REGION," STEPHENSON, COOKE AND MANSFIELD (1932).
77° 30′
77° 00′
76° 30′
76° 00′
75° 30′
39° 30′
39° 00′
38° 30′
38° 00′
37° 30′
37° 00′
BALTIMORE
WASHINGTON
ANNAPOLIS
EASTON
SALISBURY
NORFOLK
NEWPORT NEWS
HAVRE DE GRACE
SUSQUEHANNA
TURKEY POINT
CRYSTALLINES
CRETACEOUS
EOCENE
MIOCENE
PLEISTOCENE
CALVERT CLIFFS
EASTERN BAY
CHOPTANK
PATUXENT RIVER
POTOMAC RIVER
TANGIER SOUND
POCOMOKE SOUND
RAPPAHANNOCK RIVER
MOBJACK BAY
YORK RIVER
JAMES RIVER
CAPE CHARLES
CAPE HENRY

PLATE 2



HORIZONTAL SCALE

500 0 500 1000 1500 2000 2500

FEET

PRELIMINARY GEOLOGIC SECTION
SANDY POINT TO KENT ISLAND

FROM

CHESAPEAKE BAY BRIDGE ENGINEERING REPORT

J. E. GREINER COMPANY, CONSULTING ENGINEERS

1948

-EXPLANATION-

P — RECENT AND PLEISTOCENE "SEMI-LIQUID" TO VERY SOFT, BLACK SILT AND CLAY. Laboratory analyses of undisturbed samples disclose composition of a typical sample to be: SILT, COARSE TO FINE (55%), CLAY (43%), trace Fine Sand (2%). Material has considerable Organic fraction (est. approx. 15%).

P — RECENT AND PLEISTOCENE SOFT, GRAY, SILT AND CLAY. Laboratory analyses of undisturbed samples indicate that composition and physical characteristics are somewhat variable. SILT fraction predominates and in some samples CLAY fraction drops to 10-15%. Where determined, Organic content ranges from 6-12%.

P — RECENT AND PLEISTOCENE SAND AND/OR GRAVEL DEPOSITS. These deposits form old terraces, now submerged, and the terraces currently in process of being built up. They also occupy former stream channels.

A — AQUIA FORMATION - GLAUCONITIC SAND. Glauconite is a soft green mineral, essentially a hydrous silicate of iron and potassium, originally formed under marine conditions. It gives to the sands, where they are comparatively unweathered, a greenish, greenish blue, or greenish gray color ("Greensand"). In this area, the Aquia has been subjected to more or less weathering, with consequent alteration of some or all of the Glauconite to Iron Oxide (Limonite), causing the characteristic coloration of the sands - yellowish green, greenish brown, reddish brown, mottled and variegated reddish brown, orange, green, gray, etc. Over restricted areas, the Limonite has been dissolved and redeposited, forming thin crusts, ledges, and layers of iron-cemented Sandstone. Occasionally a gray, hard, silica-cemented Sandstone, also purely local in occurrence, is encountered. Sand is predominantly Medium to Fine, with varying amounts of Inorganic Silt and Clay from trace to approx. 20%; occasional trace of Mica.

MO — MONMOUTH FORMATION - GLAUCONITIC SAND. A uniformly Medium to Fine Sand, color generally dark greenish gray, greenish black, or dark brownish or yellowish green. Glauconite is mostly dark green to greenish black, with occasionally some altered to greenish brown, and varies in amount from a trace to approx. 40% of the sand. Inorganic Silt fraction varies from a trace to approx. 15%, with an occasional very slight trace of Mica.

MA — MATAWAN FORMATION - GLAUCONITIC SAND. Very similar in character to the Monmouth. Generally greenish black in color. Usually somewhat finer than Monmouth, and carries less Glauconite in smaller grains, more Silt and clayey material, and usually considerably more Mica.

NOTES - GEOLOGY

1. Geologic Section is based primarily on 1948 borings from which samples are available for thorough study. Logs of 1938 borings, from which samples are no longer available, were carefully correlated with the 1948 data and used to extend the section and provide additional detail.

2. In this vicinity, the Monmouth and Matawan Formations are quite similar in character. The location of the contact between them as shown is probably somewhat approximate and is based entirely on slight lithologic differences. The line of contact has not been extended beyond the point where identification from samples is reasonably certain. For engineering purposes the slight differences in character between the two formations are considered to be relatively unimportant.

NOTES - GENERAL

1. Profile of Bay bottom is based on sonic soundings by J. E. Greiner Co. and has been verified by direct measurements at boring locations.

2. All surveys are referred to the Maryland State Coordinate System.

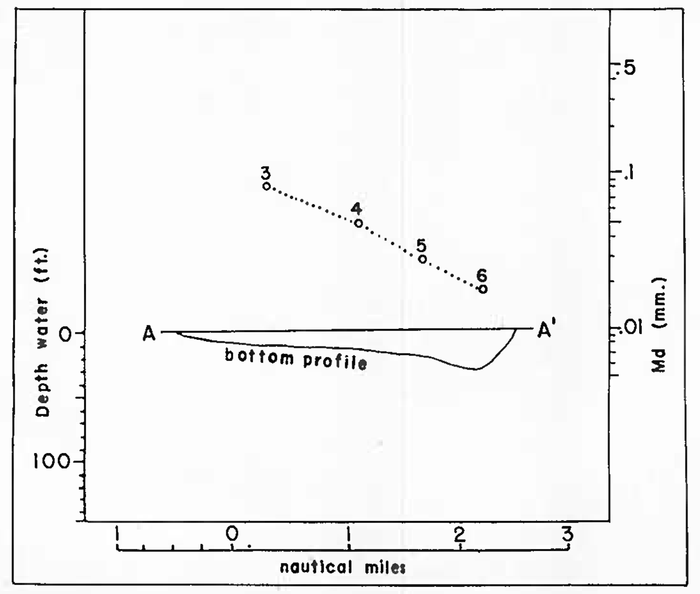


Plate 3. Graph of Median Diameter Changes and Bottom Profile of Bay at Traverse A-A′

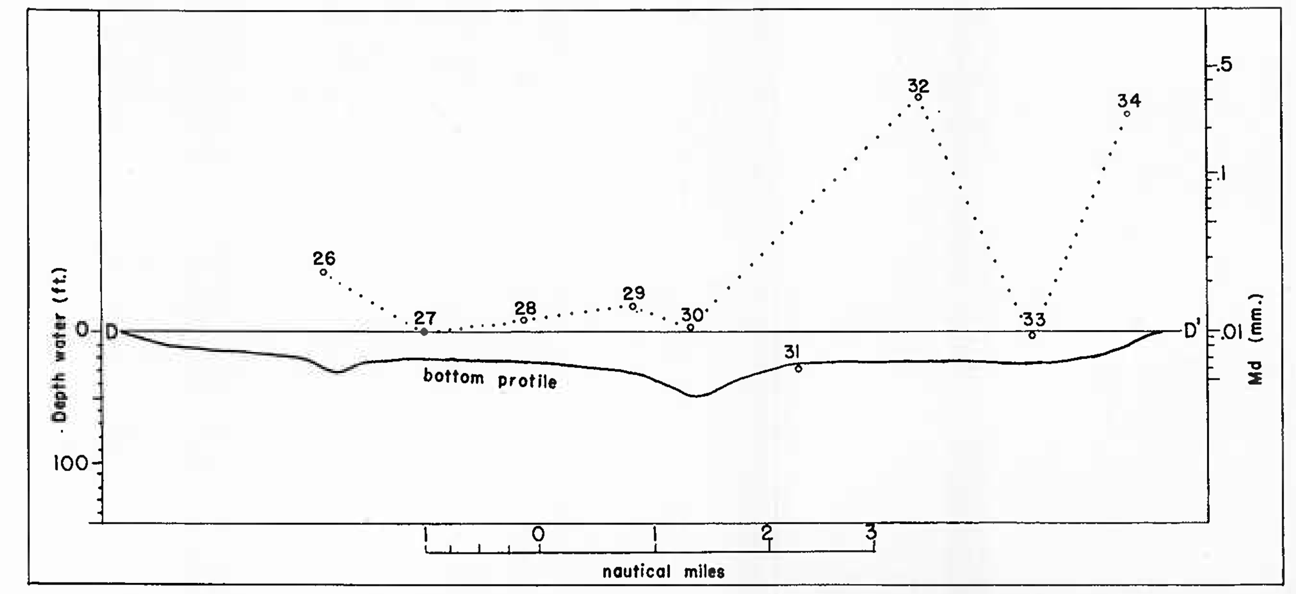


Plate 4. Graph of Median Diameter Changes and Bottom Profile of Bay at Traverse D-D′

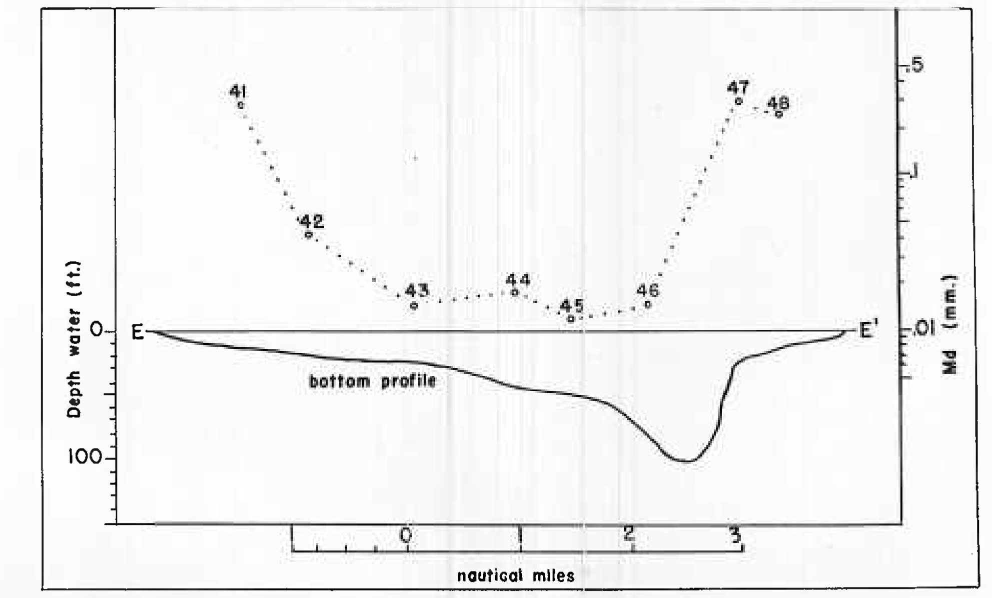


Plate 5. Graph of Median Diameter Changes and Bottom Profile of Bay at Traverse E-E′

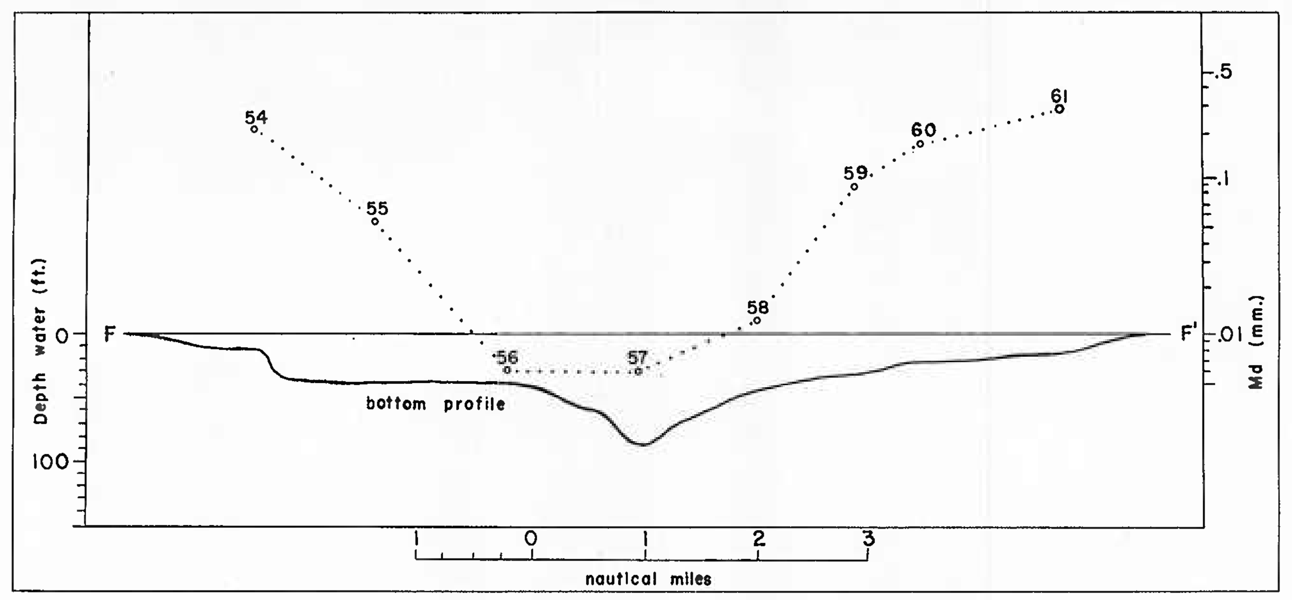


Plate 6. Graph of Median Diameter Changes and Bottom Profile of Bay at Traverse F-F′

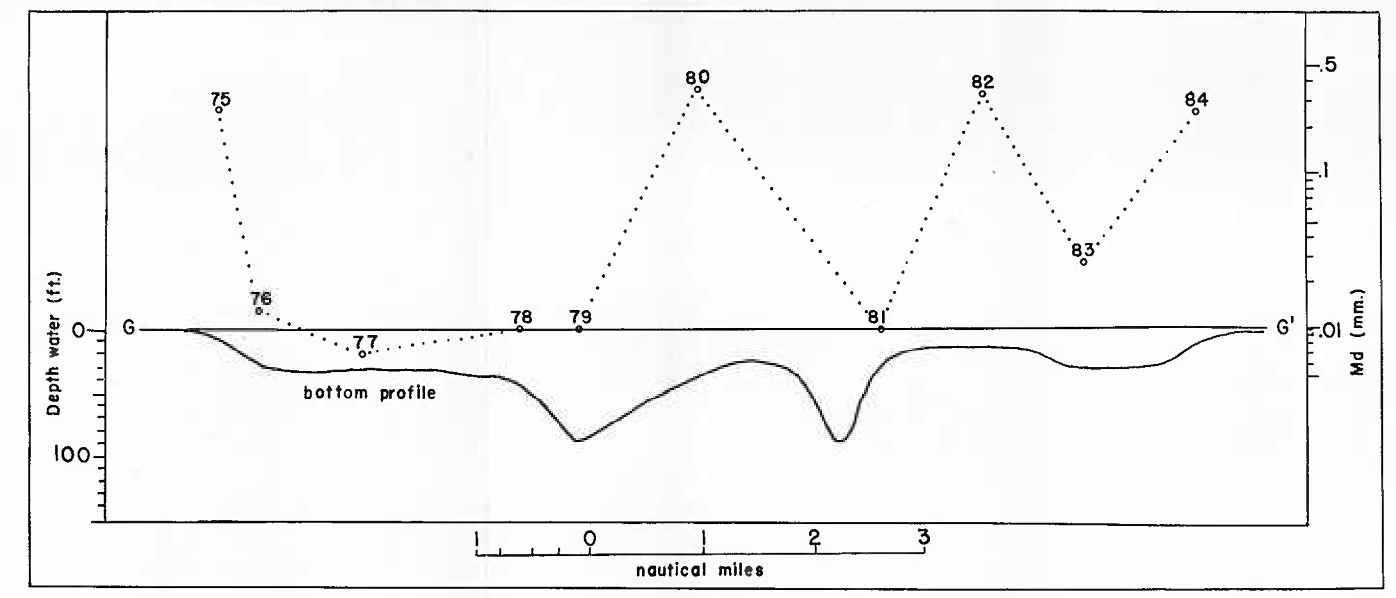


Plate 7. Graph of Median Diameter Changes and Bottom Profile of Bay at Traverse G-G′

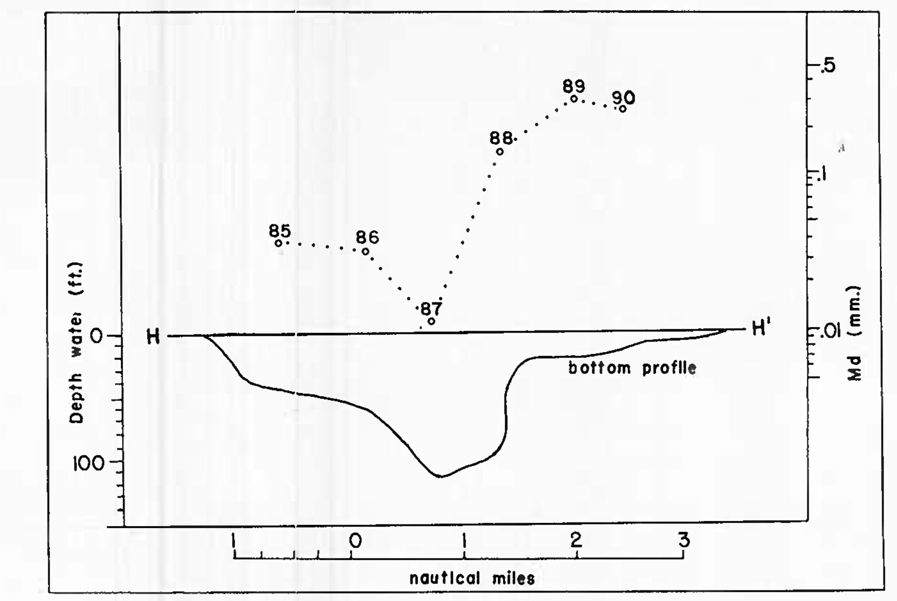


Plate 8. Graph of Median Diameter Changes and Bottom Profile of Bay at Traverse H-H′

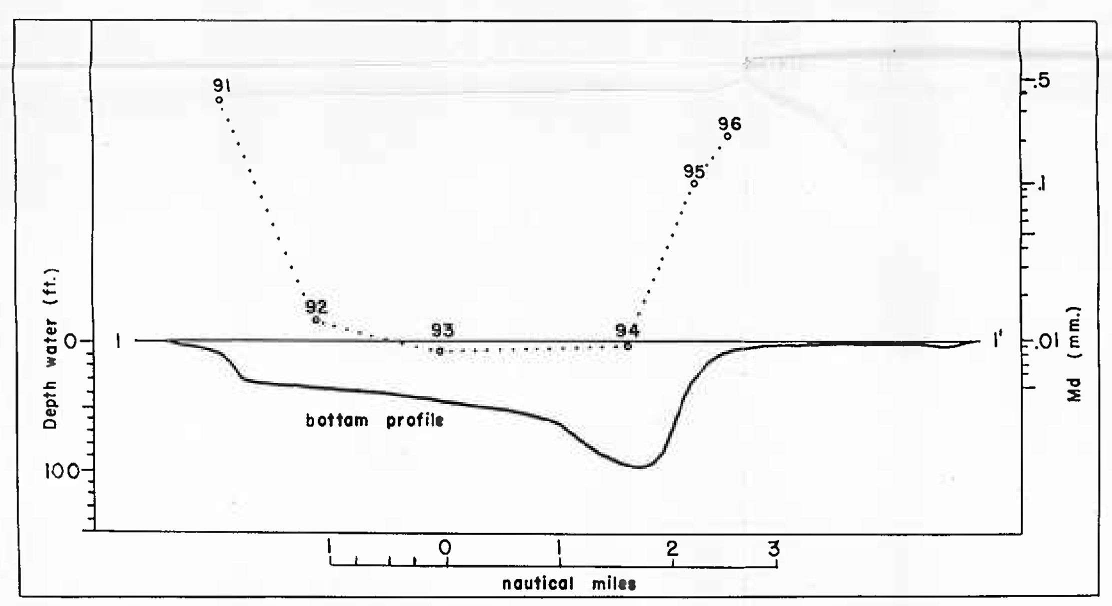


Plate 9. Graph of Median Diameter Changes and Bottom Profile of Bay at Traverse I-I′

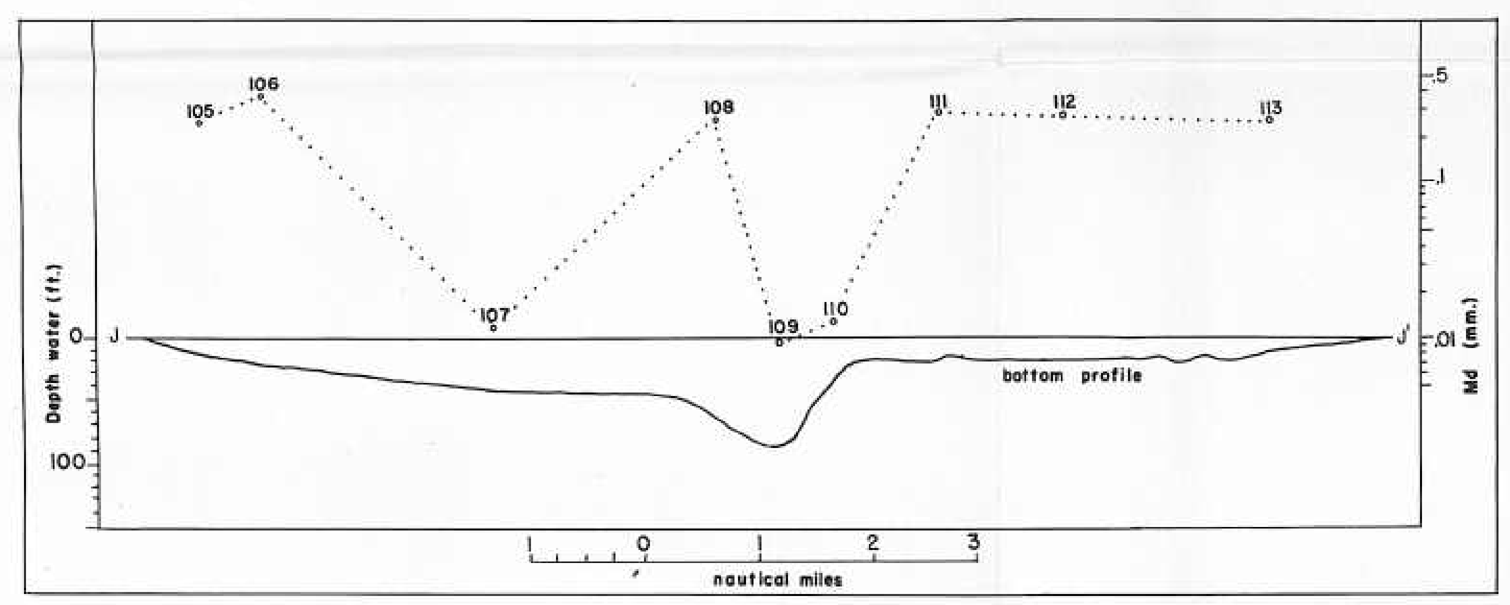


Plate 10. Graph of Median Diameter Changes and Bottom Profile of Bay at Traverse J-J′

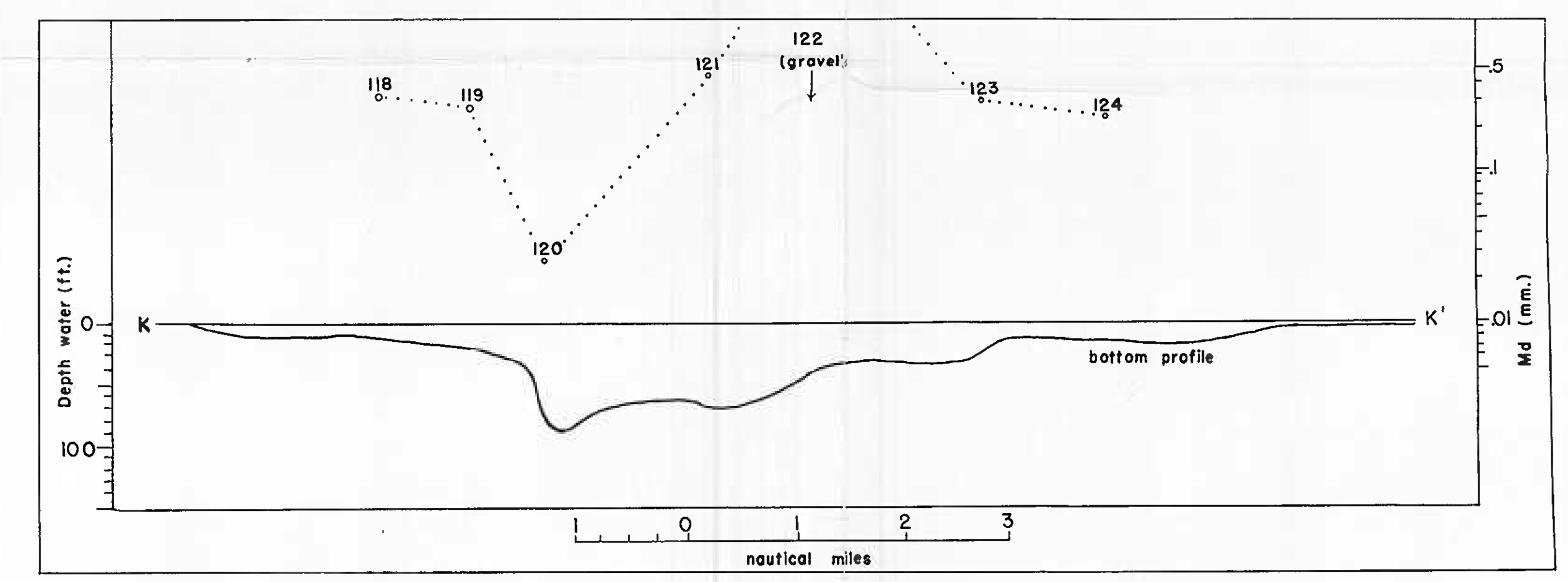


Plate 11. Graph of Median Diameter Changes and Bottom Profile of Bay at Traverse K-K′

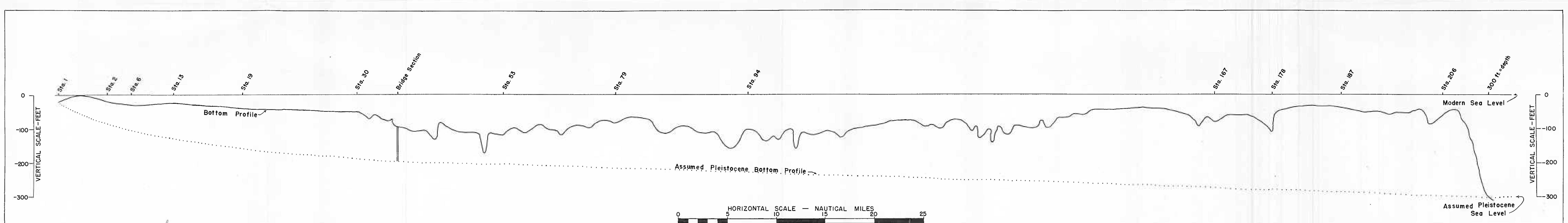


Plate 17. Longitudinal Profile of Chesapeake Bay Channel Bottom

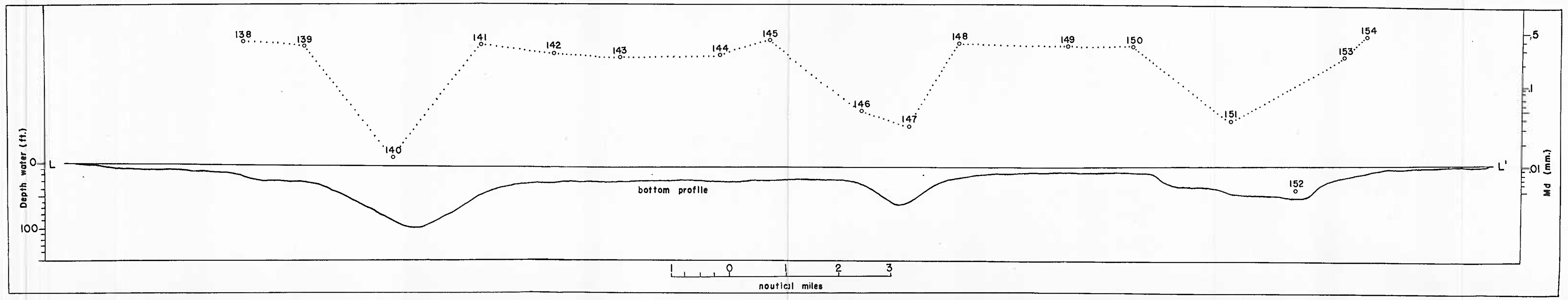


Plate 12. Graph of Median Diameter Change and Bottom Profile of Bay at Traverse L-L′

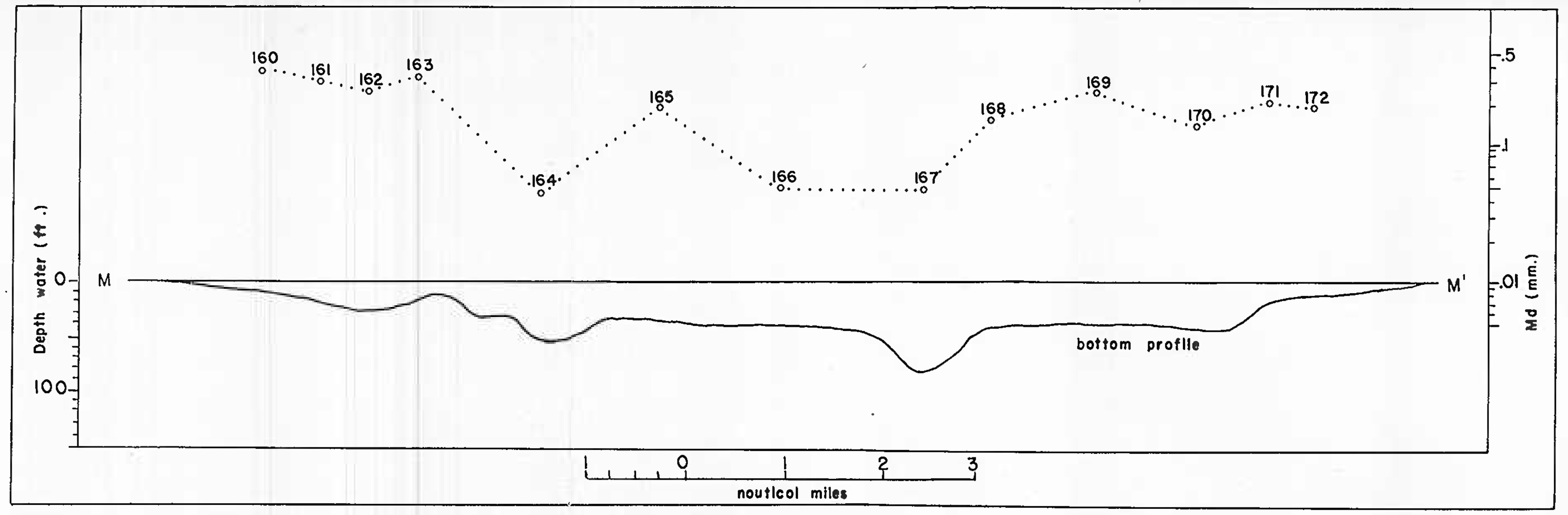


Plate 13. Graph of Median Diameter Changes and Bottom Profile of Bay at Traverse M-M′

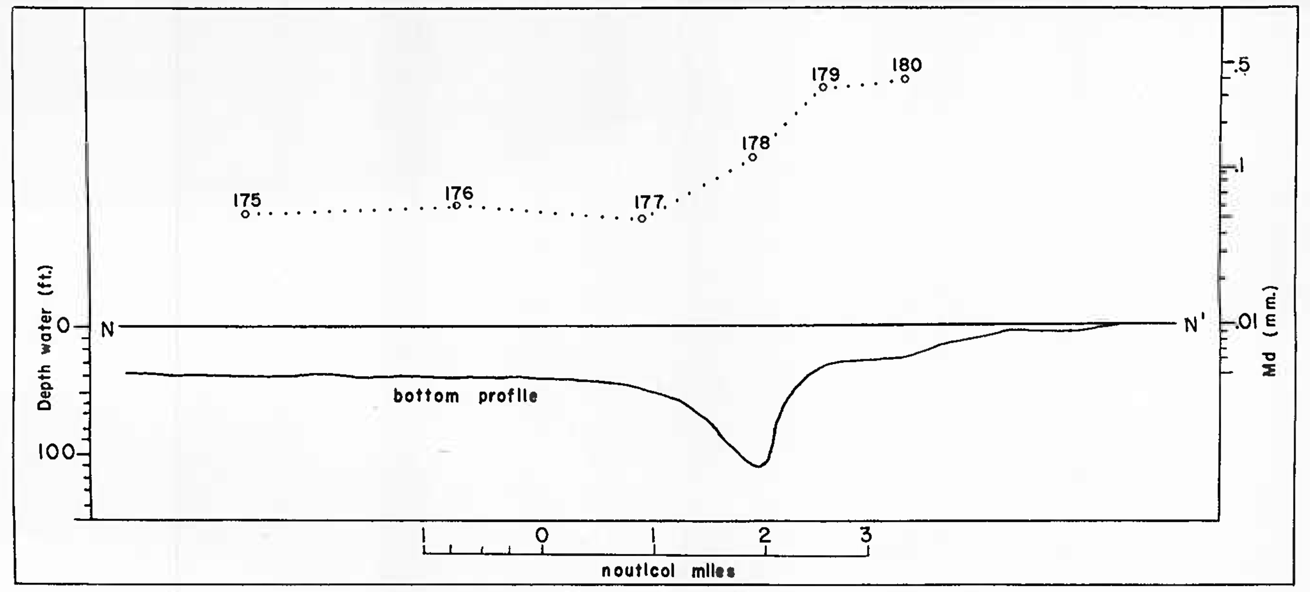


Plate 14. Graph of Median Diameter Changes and Bottom Profile of Bay at Traverse N-N′

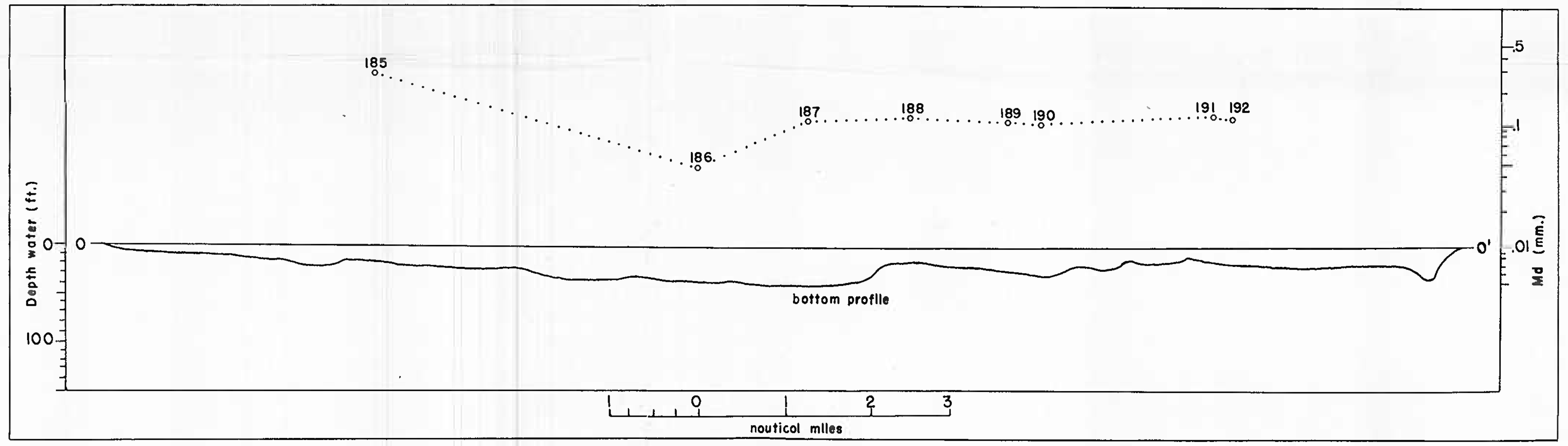


Plate 15. Graph of Median Diameter Changes and Bottom Profile of Bay at Traverse O-O′

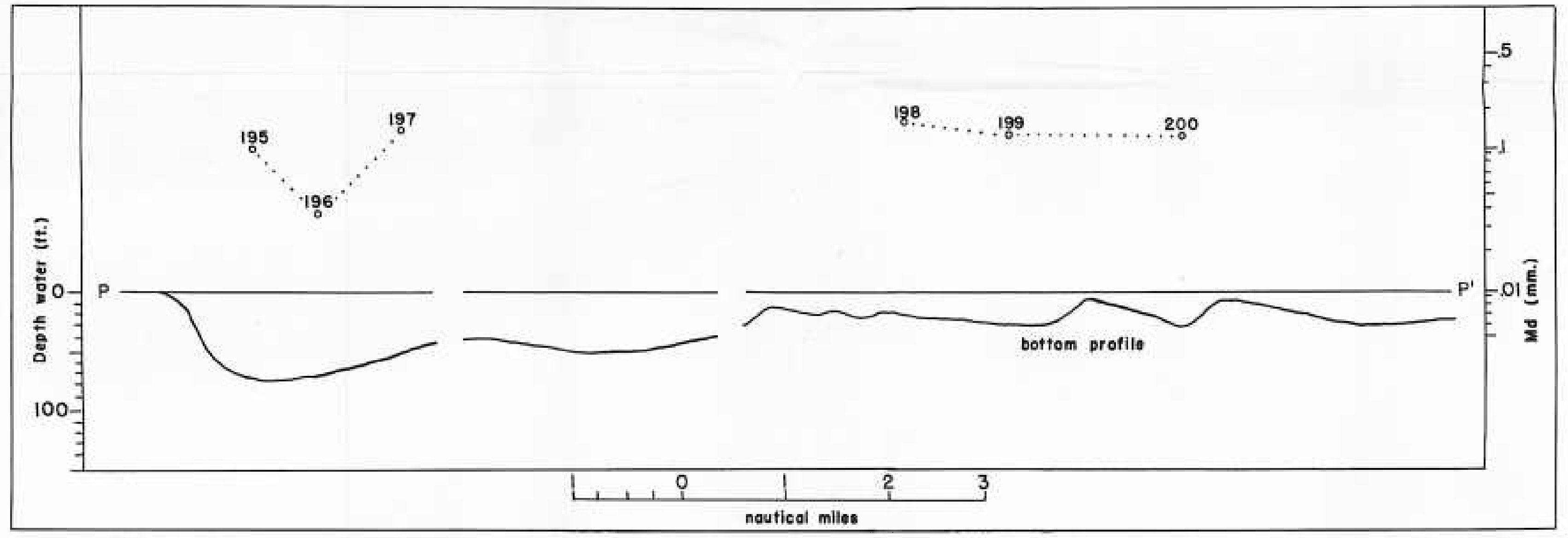


Plate 16. Graph of Median Diameter Changes and Bottom Profile of Bay at Traverse P-P′