CHESAPEAKE BAY
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MAP 4–2

SEDIMENT DISTRIBUTION

BY

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CHESAPEAKE BAY

CHOPTANK RIVER AND HERRING BAY

Mercator Projection
Scale 1:60,000 at Lat. 38°30'
North American 1927 Datum

SEDIMENT DISTRIBUTION

Introduction

Many interrelated and complex factors such as estuarine circulation, wave activity, sediment availability and biogenic activity contribute to the distribution of sediments in Chesapeake Bay. Our knowledge of these controlling factors is limited, but even less has been known about the characteristics of the bottom sediments in the Chesapeake Bay estuary. Recent efforts to map the distribution of surficial sediments, study of bottom sediments and expanded knowledge beyond the pearly nicrement that made occur in the channels and sands along the margins. However, a more detailed knowledge of the bottom sediments is necessary to provide the basic and necessary geological information needed to adequately interpret the processes leading to the distribution of these sediments and help to solve the host of complex problems facing managers of the Bay.

Previously, the sediments are defined and classified in the Chesapeake Bay Earth Science Study by the relative proportions of SAND, SILT, and CLAY. SAND consists of particles with diameters ranging from 2 millimeters to 0.063 millimeters (1/4 to 4ϕ). SILT from 0.063 millimeters to 0.004 millimeters (4ϕ to 8ϕ), and CLAY finer than 0.004 millimeters (8ϕ). A minor amount of sediment contains particles greater than 2 millimeters, termed GRAVEL.

All samples were prepared according to a systematic procedure before undergoing analysis for particle size distribution. These procedures represent careful standardization and are derived from those commonly used in sedimentological research today. Before each sample was analyzed, it was completely dispersed to separate the individual sediment particles. Removal of the cementing agents that naturally bind the particles together with the dispersion of the particles, such as soluble salts, carbonates and organic matter. Following sample preparation, the sediments were analyzed with a Rapid Sediment Analyzer, Coulter Counter, and pipette techniques, as required.

Grain size distribution of the sand fraction was determined with a Rapid Sediment Analyzer (RSA) (Halka, et al., 1981). The silt-clay fraction was analyzed by the pipette technique (Folk, 1968) and a Coulter Counter particle analyzer. The results from the RSA, pipetting technique, and Coulter Counter were then combined, defining a grain-size distribution ranging from coarse sand through very fine clay. Each sediment sample was then typed into one of ten categories according to the percentages of sand, silt, and clay (see legend) using the classification scheme designed by Shepard (1954).

Distribution

The areal distribution of sediment types suggests that sediment type is related to basin geometry or the boundary conditions of the basin. In the mouth of the bay, the bottom sediments are predominantly SAND, SILTY SAND and CLAYEY SAND. Near the shoreline the sediments are largely SAND. This change in sediment types reflects the energy conditions and processes operating in the mouth of the bay. The high energy waves and currents of the open bay have continued processes which consistently rework the sediments and selectively remove the finer-grained components. The central portion or channel area is a lower energy zone dominated by processes of estuarine tidal mixing and circulation. The lower energy processes allow the accumulation of finer-grained sediments, the SILTY CLAYS and CLAYEY SILTS, and CLAYS.

Local sediment sources also are important in determining the type of sediment found in an area. This is particularly noticeable for the Choptank River sub-estuary where silt sized sediments are much more evident than in the mouth of the bay. Sediment sources for the Choptank River. The dominant sediment types are shifted toward the SILT corner of the Shepard classification diagram. In the deeper portions of the subestuary CLAYEY SILTS, SILTY CLAYS and CLAYS are found. The SILTY CLAYS and CLAYEY SILTY CLAY to dominate. The Choptank River also contains large areas of SANDY SILTS, SILTY SAND, and SAND-SILT-CLAYS. Shoreline erosion of the Kent Island Formation in the Choptank River mouth is apparently contributing much silt sized material to the system. It is also believed that sediments in the deeper portions of the Choptank River are being reworked from the bottom of the Choptank River. These exposures serve as sources for nearby areas of deposition and also explain much of the patchy discontinuous character of the sediment types in the area.

Within the main bay itself the presence of many patches of other sediment types within the larger SILTY CLAY and SAND areas apparently represent exposures of pre-Holocene "bedrock" material. Along the western shore of the bay, the Calvert and Choptank Formations are the predominant of Miocene materials of the Calvert or Choptank Formations or nearby depositional areas for which these Formations serve as a local source. On the eastern side of the main channel these Formations may also be contributing to these sediment types as may the Kent Island Formation of Pleistocene age. The SILTY CLAY and CLAYEY SILT areas are separated by a transitional sediment type between the nearshore SAND and the deeper water SILTY CLAYS and may represent fluctuating energy conditions in these areas or areas where mass movement of materials has resulted in an admixture of sediment (e.g., slumping along steep slopes).

A plot of the samples (Figure 1) indicates that a wide variety of sediment types are found in the map area, but that the majority of samples fall in the SAND, SILTY SAND, SILTY CLAY and CLAY fields. These three fields account for over 80% of the sediments. In summary the sediments in which silt sized material predominates are found largely in the Choptank River sub-estuary while the SAND-SILT-CLAY admixture represents gradational areas between nearshore SANDS and deeper water SILTY CLAYS and CLAYS. The CLAYEY SAND, SANDY CLAY, and SANDY SILT fields are the remainder of the fields on the diagram nor represent gradational sediment types also but are more likely exposures of pre-Holocene materials on the bay floor, or have been derived from nearby pre-Holocene sediments.

REFERENCES

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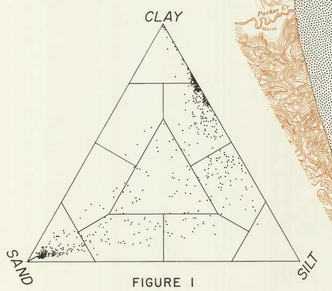
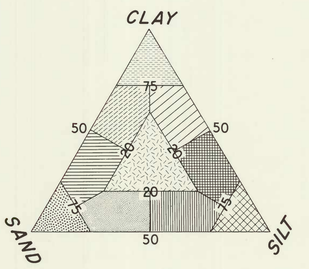


FIGURE 1

EXPLANATION

- SAND
- SILTY SAND
- CLAYEY SAND
- CLAY
- SILTY CLAY
- SANDY CLAY
- SILT
- CLAYEY SILT
- SANDY SILT
- SAND - SILT - CLAY



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