CHESAPEAKE BAY
EARTH SCIENCE ATLAS NO. 2

MAP 2-2

SEDIMENT DISTRIBUTION

BY

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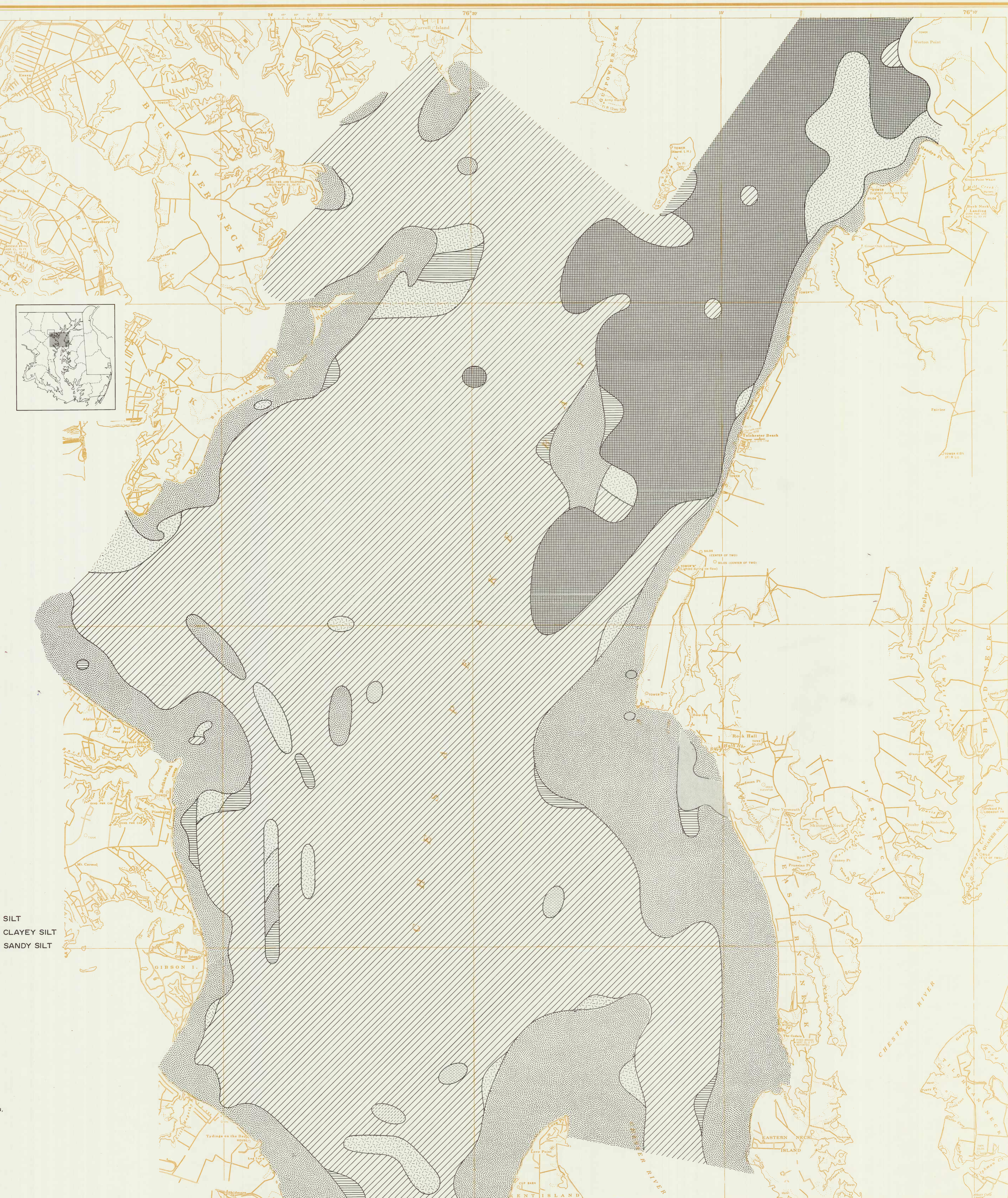

EXPLANATION

Introduction

Many interrelated and complex factors such as estuarine circulation, wave activity, sediment availability, and biogenic activity contribute to the distribution of sediments in the 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. Ryan (1953) provided a general picture of the characteristics of the bottom sediments and expanded knowledge beyond the general statement that muds occur in the channels and sands along the margins. However, a more detailed characterization of the bottom sediments has been required to provide the necessary geological information needed to adequately interpret the processes leading to the distribution of these sediments and to help solve the host of complex problems facing managers of the Bay.

Physically, 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 (-1ϕ 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 in diameter, 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. Each of the samples was cleaned to remove any substance which could interfere 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., 1980). The silt-clay fraction was analyzed using a combination of the pipetting technique (Krumbein and Pettijohn, 1938) 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 based upon 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 particle size is related to basin geometry or the boundary conditions of the basin. In the central portion of the main Bay, the sediments are predominantly SILTY CLAYS. Near the shoreline the sediments are largely SAND. This change in sediment types reflects the energy conditions and processes operating in these zones. The SAND in the shallower nearshore areas is a result of high energy wave dominated processes which constantly rework the sediments and selectively remove the finer-grained components. Along the Eastern Shore and Kent Island, these SAND areas are quite broad in contrast to the narrow field along the Western Shore. The central portion or mid-bay 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. SILTY CLAYS are the dominant sediment type in this portion of the Bay. However, north of Tolchester Beach, CLAYEY SILTS replace SILTY CLAYS as the dominant mid-bay sediment type. This transition marks the southern extent of the zone of maximum turbidity which is a result of the mixing of fresh water from the Susquehanna River and the more saline water of the Chesapeake Bay. Within this zone of maximum turbidity, resuspension and resedimentation of particles are the dominant sedimentation processes. CLAYEY SILT and SAND/SILT/CLAY which are slightly coarser than SILTY CLAY, are the predominant sediment types in this zone. South of the maximum turbidity zone, the influence of the Susquehanna River is diminished and estuarine circulation predominates.

Several other sediment types are found in the map area, particularly at the boundaries between SAND and SILTY CLAY or CLAYEY SILT fields. The areas of CLAYEY SAND and SAND/SILT/CLAY may represent transitional zones between energy regimes or exposures of pre-Holocene "bedrock" material. The exposures are also marked by erosion as is the case in the areas at the mouth of Back River and off of Tolchester Beach. Other areas where there are patches of other sediment types within the SILTY CLAY field, such as near Gibson Island, are due to open water dredge material disposal.

A plot of the samples (Figure 1) indicates that a variety of sediment types are found in the map area, but that the majority of samples fall in the SAND (185) and SILTY CLAY (269) fields. together, these two fields account for 71% of the 639 samples collected in the map area.

References

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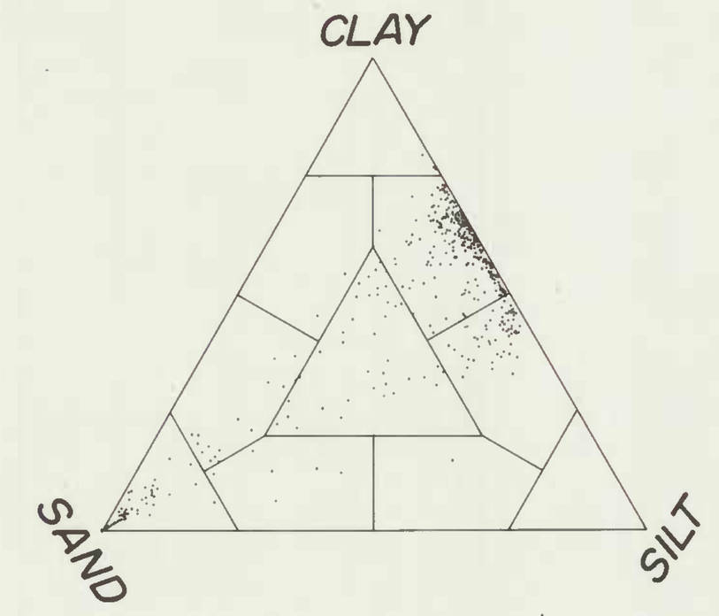
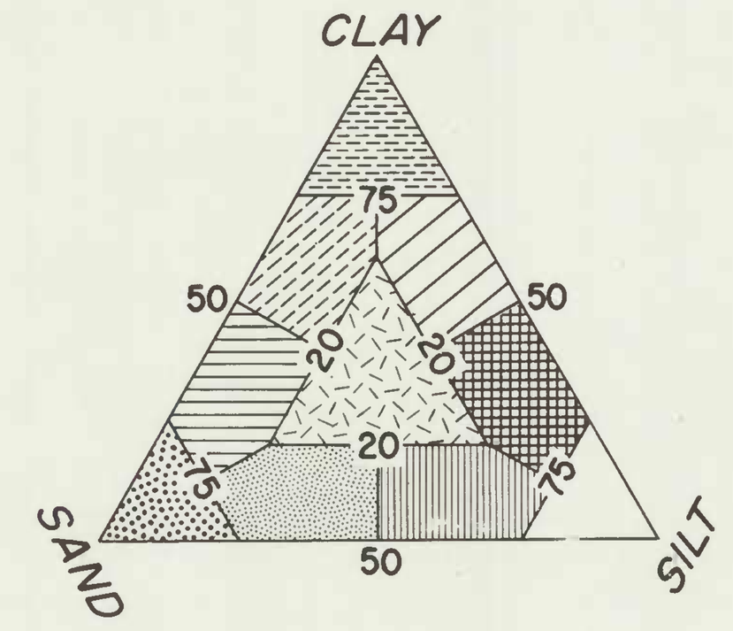


Figure 1

LEGEND



SHEPARD'S CLASSIFICATION

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