CHESAPEAKE BAY
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MAP 5-2

SEDIMENT DISTRIBUTION

BY

DARLENE V. WELLS, JEFFREY P. HALKA, RANDALL T. KERHIN,
OWEN P. BRICKER, LAMERE HENNESSEE,
AND PATRICIA J. BLAKESLEE

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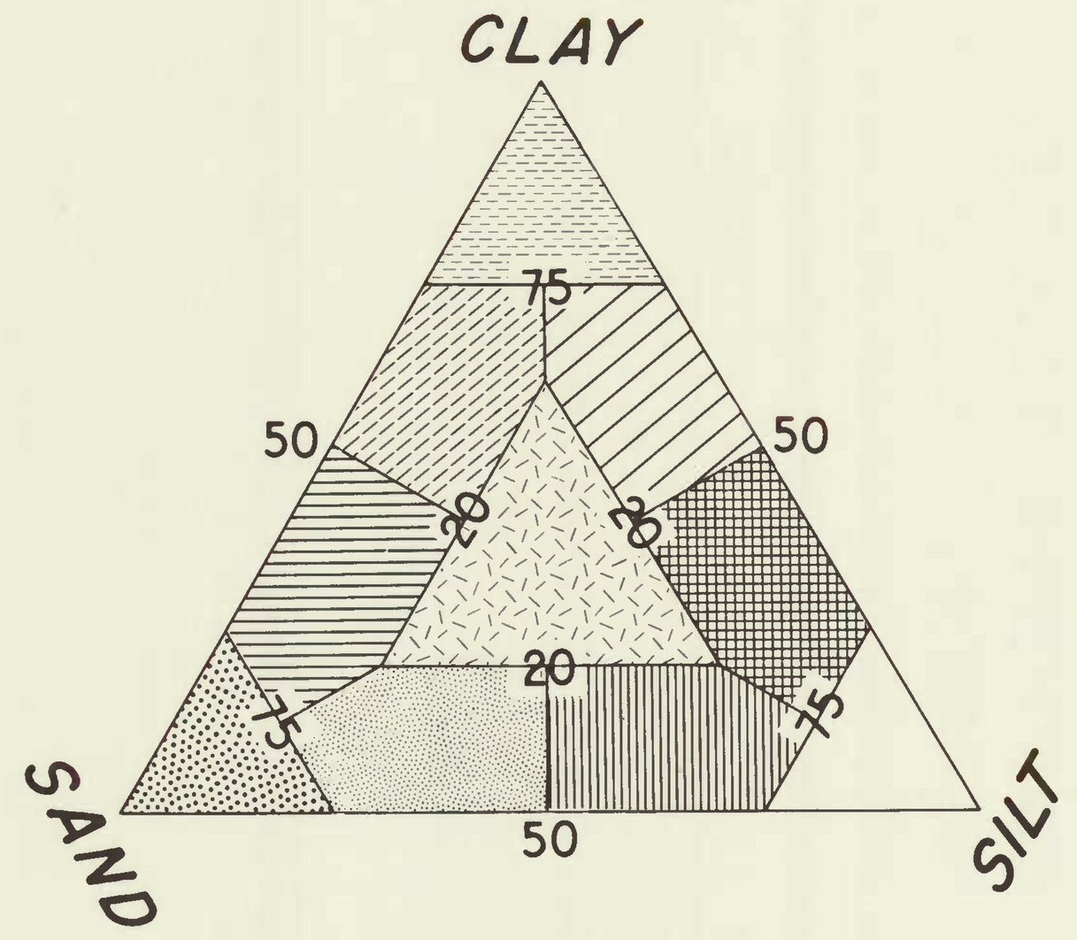
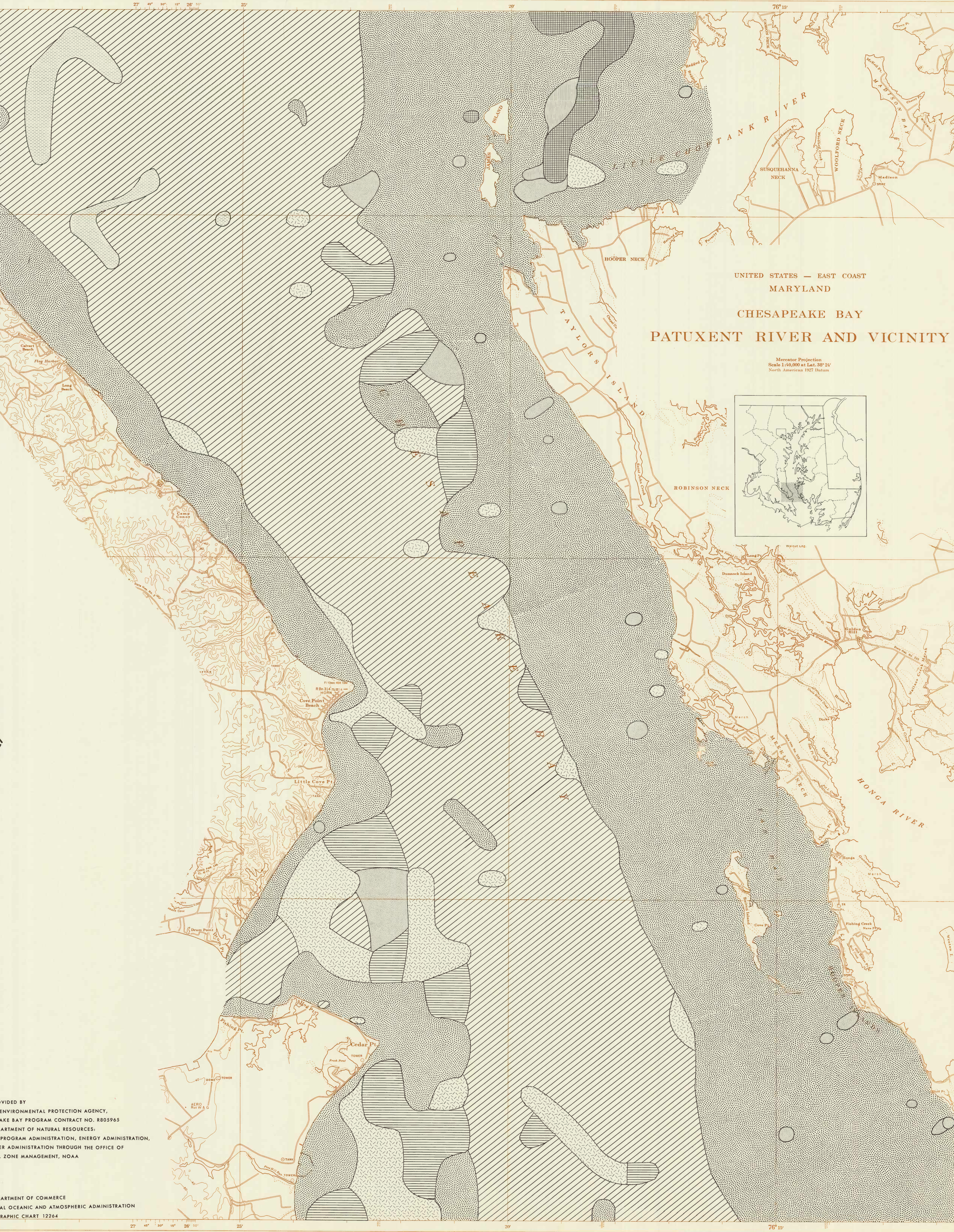
KENNETH N. WEAVER, Director

EXPLANATION

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





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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 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., 1981). 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 sediment type 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 nearshore areas is a result of high-energy wave dominated processes which constantly 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 the finer-grained sediments.

Within the main Bay, 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. To the west of the Bay centerline, the CLAYS, CLAYEY SANDS, SAND-SILT-CLAYS probably represent exposures of Miocene materials of the Choptank and St. Marys Formations or nearby depositional areas for which these formations serve as a local source. To the east, these formations may also be contributing to these sediment types along the steep eastern wall of the axial channel. The Pleistocene Kent Island Formation also is likely to be subaqueously exposed and is being actively winnowed. This formation is probably represented by the isolated SILTY SANDS and SAND-SILT-CLAYS occurring within the SAND sheet bordering the eastern shore. The contribution of silt sized materials from exposure and erosion of this formation is evidenced by the accumulation of CLAYEY SILTS in the deeper portion of the Little Choptank River.

The SAND-SILT-CLAY fields occurring in the main Bay may also represent in places exposures of pre-Holocene materials, or may occur as a gradational sediment type between the nearshore SANDS and the deeper water SILTY CLAYS. In these areas, the SAND-SILT-CLAY fields represent fluctuating energy conditions 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 (404) and SILTY CLAY (179) fields. Together, these two fields account for over 80% of the sediments.

In summary, SANDS occur around the margins of the area while finer grained SILTY CLAYS accumulate in the deeper waters of the channel, a fact which has been noted in earlier reconnaissance studies of the Bay (Ryan, 1953). The new information which has been produced as a result of this study and its dense sampling pattern is the identification of large areas of the Bay floor in which pre-Holocene "bedrock" materials outcrop, and the importance of local sediment sources for determining the textural characteristics of the sediments of a particular area in the Bay.

REFERENCES

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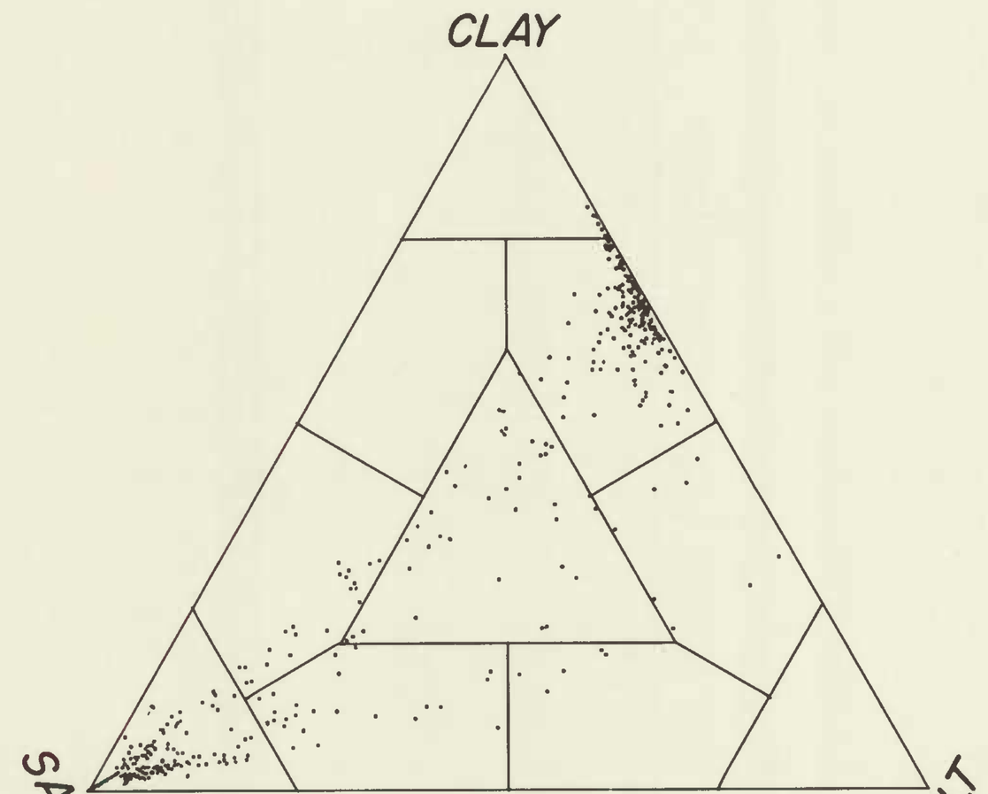

FIGURE 1