CHESAPEAKE BAY
EARTH SCIENCE ATLAS NO. 5

MAP 5-4

CARBON CONTENT (ORGANIC AND TOTAL)

BY

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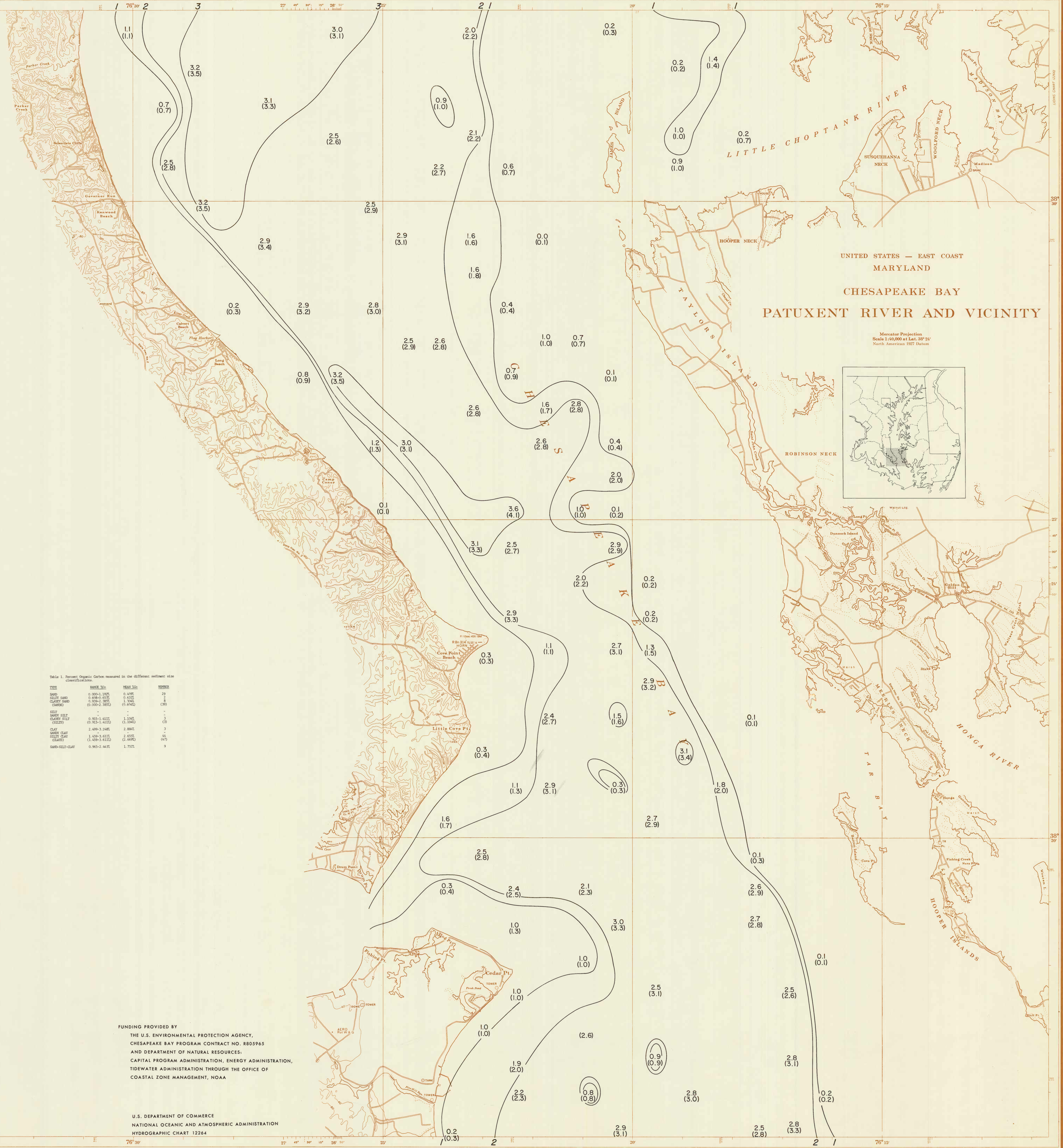
EXPLANATION

1.5 - ORGANIC CARBON % DRY WEIGHT
(1.7) - TOTAL CARBON % DRY WEIGHT
CONTOUR INTERVAL 1% ORGANIC CARBON



ORGANIC AND TOTAL CARBON CONTENT

Introduction

Many chemical reactions occurring in the Chesapeake Bay estuary depend upon the availability of organic carbon. In addition, the concentration of this element serves as a pollution level indicator and aids in the location of sites with the potential for high concentrations of heavy metals and other polluting substances.

Carbon is the primary food source for organisms in the Chesapeake Bay. Carbon, as organic material or living organisms, is taken from the water column and sediment for utilization by organisms. In the presence of oxygen, the carbon is "burned" to provide energy. Unless there is a constant supply, this process eventually depletes the environment of oxygen. The environment then becomes anoxic and the consumption of organic carbon materials decreases dramatically. Many of the fine grained sediments of the Bay bottom become anoxic within a few centimeters of the sediment surface. Within these anoxic sediments, reactive metals, such as iron and manganese, combine with sulfur to form metal sulfides. These remain in the sediment where they are stable as long as the environment remains anoxic. However, if these sediments are disturbed and introduced to an oxidizing environment, the following could occur: 1) the creation of an oxygen demand proportional to the concentration of organic carbon and reduced compounds in the sediments; 2) the formation of oxidation products analagous to those found in acid mine drainage, as a result of oxidation of iron sulfide phases; or 3) the release of nutrients and trace metals to the environment. Knowing the organic carbon content of the sediments can play a key role in identifying areas of anoxic sediments and estimating the deleterious effects should these sediments be disturbed.

Carbon is also present in the sediments as mineralic skeletal parts, such as shell, teeth, and bones. These materials are not viewed as organic because they cannot be utilized as an energy or food source by organisms, nor do they contribute to the potential oxygen demand of anoxic sediments. They do, however, contribute to the total amount of carbon present in the sediment.

The amount of total carbon in any particular sediment sample is largely controlled by the amount of organic carbon in that sample; mineralic carbon contributes little to the total carbon of the sediments in this area. For this reason, the remainder of the discussion concerns the organic carbon distribution in the sediments, and the contour lines of equal carbon content shown on the map refer to organic carbon.

Carbon analysis was done on approximately one out of every four samples collected from the deeper waters of the Bay. Sediments consisting predominantly of sand, which generally occur in shallower depths, contain amounts of organic carbon close to or below the detection level of the analytical equipment. Therefore, these samples were not analyzed for their carbon content. Both total and organic carbon content were determined for 98 sediment samples using a Leco Gasometric Analyzer (Model 572-100) and a Leco Induction Furnace (Model 521-000).

Distribution

Areas of high organic carbon content tend to correspond to areas of deep water and fine-grained sediment. The nearshore and beach areas are high energy, wave dominated zones in which constant reworking of the sediments results in the removal of the fine-grained materials including the organics. In addition, high energy conditions stir up the bottom, aerating the sediments and preventing anoxic conditions from developing. In contrast, the deep areas tend to be low energy environments in which fine-grained materials, including organics, accumulate. Anoxic conditions develop quickly in these materials because their fine-grained nature inhibits the passage of oxygen into the sediment from the overlying water. Because anaerobic decomposition of organic materials is a much slower process than aerobic decomposition, organic carbon material is preserved in these sediments. This relationship between organic carbon and grain size is utilized in extrapolating the contour lines of equal carbon content between those samples for which analysis was performed. Interpolation between points was based upon the sediment distribution (Map 5-2).

Organic carbon ranges from less than 1.0% in the higher energy, oxygenated, coarser grained sediments of the nearshore zone to greater than 3.0% in the deeper portions of the Bay where finer-grained material accumulates. Within the Little Choptank River sub-estuary, the maximum organic carbon values are only slightly over 1.0% due to the somewhat shallow depths and the general coarser grained nature of the sediments in this area. Whereas the deeper portions of the Bay are characterized by SILTY CLAY sediments, the Little Choptank River sediments show much higher percentages of silt sized materials with CLAYEY SILT sediments predominating.

Within the central portions of the main Bay, the variability in organic carbon contents shown can be largely attributed to the variability in the grain size and depositional history of the sediments exposed on the Bay floor. Many of the sediments occurring in this portion of the Bay are apparently either pre-Holocene materials exposed in place, or have as their immediate source pre-Holocene sediments. These sediments may be expected to have somewhat lower organic carbon values than would be encountered in an estuarine Holocene sediment of similar grain size. Overall, there appears to be a slight decrease from north to south as sediments with 3.0% or greater organic carbon become less evident and patchy.

Table 1 shows the values for organic carbon as percent of dry sample weight determined for the various sediment size classes listed on the left. The number of samples analyzed for each size class and the mean and range of organic carbon values are listed. The mean value for all samples is 1.715%, ranging from a low of 0.604 for all sands to a high of 2.669 for the clays.

Table 1. Percent Organic Carbon measured in the different sediment size classifications.

TYPE	RANGE %Co	MEAN %Co	NUMBER
SAND	0.000-1.182%	0.409%	29
SILTY SAND	0.608-0.653%	0.631%	2
CLAYEY SAND	0.939-2.385%	1.304%	8
(SANDS)	(0.000-2.385%)	(0.604%)	(39)
SILT	-	-	-
SANDY SILT	-	-	-
CLAYEY SILT	0.915-1.411%	1.104%	3
(SILTS)	(0.915-1.411%)	(1.104%)	(3)
CLAY	2.499-3.248%	2.884%	3
SANDY CLAY	-	-	-
SILTY CLAY	1.459-3.611%	2.655%	44
(CLAYS)	(1.459-3.611%)	(2.669%)	(47)
SAND-SILT-CLAY	0.965-2.443%	1.752%	9

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