Sediment geochemical records of eutrophication in the mesohaline Chesapeake Bay

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ABSTRACT: An organic geochemical analysis of sediments in three cores from the mesohaline Chesapeake Bay was carried out to reconstruct the progression of eutrophication and anoxia/hypoxia over the past five centuries. Evidence of eutrophication was found in the stable isotopic and lipid biomarker signatures of organic matter in sediments of these cores beginning in the late 18th and early 19th centuries and continuing to the present. Enrichments in the carbon and nitrogen isotopic signature of these sediments likely result from enhanced primary productivity and nitrogen recycling, respectively, and occur, coincidentally, with increased fluxes of total organic carbon (TOC) and episodic enrichments (relative to TOC) of algal and bacterially derived lipid biomarker compounds. More extreme and enduring changes from the late 19th century to the present are indicated by up to fivefold increases in TOC accumulation and 2- to 10-fold enrichments (relative to TOC) in algal and bacterially derived lipid biomarker compounds. Increased dinoflagellate and other nondiatom algae relative to diatom production is indicated by lipid biomarker compound ratios. Increases in the ratio of acid-volatile sulfur to chromium-reducible sulfur in sediment indicate the first occurrence of anoxia/hypoxia in 1790 at the deepest site (26 m), and in 1915 at a site 15 m deep. The history of Chesapeake Bay productivity is reconstructed using a diagenetic model to estimate the amount of TOC and biomarker compounds lost to degradation. It is estimated that both TOC delivery and algal and bacterial production have increased by 150% or more relative to pre-Colonial times with a temporal progression similar to anthropogenic alteration of the watershed.

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