

Application of phosphate oxygen isotope ratios to identify sources and biogeochemical cycling of phosphorus in the Chesapeake Bay

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Chesapeake Bay is the largest and one of the most biologically productive estuaries in the United States. Excessive nutrient input has caused environmental problems such as eutrophication in the Bay. Speciation of sedimentary phosphorus (P) and phosphate oxygen isotopic composition ($\delta^{18}\text{O}_p$) may provide information about hypoxia related effect and attendant biogeochemical changes in the bottom water as well in the sediment column. We sequentially extracted sedimentary P from lower, middle, and upper sections of Bay that covers up to about 60 years of sedimentation history to quantify P fractions into loosely sorbed, iron oxides-bound, authigenic and detrital P pools and analyzed isotopic composition of each P pool. Our results suggest that the precipitation as authigenic P was the highest in the middle site. The $\delta^{18}\text{O}_p$ values of authigenic P vary mostly within 13.2–14.2 ‰ VSMOW indicating strong indication of P released from hydrolysis of organic phosphorus and immediate precipitated as authigenic P. Similarly, $\delta^{18}\text{O}_p$ values of iron oxide-bound P range between 17.9‰ to 21.1 ‰ VSMOW indicating that this P was potentially derived from terrestrial P sources. These results provide strong evidence that the hydrolysis of organic P is the dominant source of authigenic P precipitation as well as potentially refueling eutrophication in the Chesapeake Bay.