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Chromium isotope fractionation in the redox-stratified Chesapeake Bay

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Chromium (Cr) stable isotopes have been used to track the oxygenation history of Earth's ocean-atmosphere system. However, lack of clear understanding of the Cr isotope fractionation during deposition of reducing sediments hinders the application of this paleo-proxy to quantify the extent of reducing conditions in paleo-marine environments. The Chesapeake Bay is a seasonally redox-stratified estuary (oxic surface water overlying euxinic, or sulfide-bearing, deep water) and thus provides a good opportunity for investigating Cr isotope fractionation in euxinic systems. Here we report total dissolved Cr concentrations and stable isotope compositions (δ^{53}Cr) for a water column in this estuary. As salinity increased from 7.51 in the oxic surface water to 19.22 in the euxinic deep water, total dissolved Cr concentration decreased from 1.21 nmol kg^{-1} to 0.51 nmol kg^{-1} while δ^{53}Cr decreased from 0.60 ‰ to -0.41 ‰. These observations can be explained by a model coupling two-endmember mixing, partial reduction of Cr(VI), and partial scavenging of Cr(III). Substantial Cr isotope fractionation during sequestration of Cr from euxinic seawater should be considered when interpreting Cr isotope data of euxinic sedimentary archives.