Deciphering the unexpected response of the Cr isotope proxy to OAE 2

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The response of the Cr isotope proxy to increased anoxia during OAE 2 did not meet expectations for a tracer that is soluble in its higher oxidation state and relatively insoluble in its lower oxidation state. We expected a decrease in sedimentary Cr concentrations reflecting drawdown of the oceanic Cr reservoir. Associated with this drawdown, we expected sedimentary δ^{53}Cr values to increase due to isotopic fractionation that occurs when Cr(VI) is reduced to Cr(III), scavenged by particles, and exported to the sediment. This fractionation has been pegged at –0.80 ±0.03‰ based on studies of the modern ocean Cr cycle. At three sites in the proto-North Atlantic region, δ^{53}Cr values decrease during OAE 2, and at two of these sites, Cr concentrations increase. The increased concentration of Cr is associated with other positive trace metal anomalies of basaltic affinity. Some workers attribute these trace metal anomalies to hydrothermal superplumes created during Caribbean LIP eruptions in the eastern Pacific, with increased metal solubility attributed to organic complexation in anoxic waters. Others have noted that the main stratigraphic interval of metal enrichment coincides with the Plenus Cold Event, which is interpreted to reflect a hiatus in LIP activity during OAE 2, a return to more oxygenated deep waters in some parts of the proto-North Atlantic, and the release of metals from the re-oxidized sea floor. According to this hypothesis, the deep ocean trace metal inventory is higher during re-oxygenation than it is during de-oxygenation at the peak of LIP activity. The sediment release hypothesis explains the stratigraphic distribution of trace metal anomalies and the associated negative excursion in δ^{53}Cr, but it raises the question, where is the positive δ^{53}Cr excursion that reflects the build-up of seawater-derived Cr in anoxic marine sediment? In this talk, we present a new δ^{53}Cr profile from a site in the southern hemisphere (ODP Site 1138) to determine whether the decrease to low sedimentary δ^{53}Cr values in the proto-North Atlantic is a global or regional response of the Cr isotope proxy to increased ocean anoxia during OAE 2.