

Cr reduction in the Eastern Tropical North Pacific oxygen deficient zone revealed by Cr isotope signatures

TIANYI HUANG^{1,2}, EDWARD A. BOYLE¹, SIMONE MOOS^{1,2}

¹Massachusetts Institute of Technology, Cambridge, MA 02139, USA

²MIT/WHOI Joint Program in Chemical Oceanography, Cambridge, MA 02139, USA

The global linear relationship between seawater chromium concentration [Cr] and its stable isotope ratio ($\log \delta^{53}\text{Cr}$) indicates a preferential uptake/reduction of isotopically lighter Cr(VI) near the ocean surface followed by removal onto particles, leaving the remaining dissolved Cr pool heavier.

Here, we report [Cr] and $\delta^{53}\text{Cr}$ data on seawater samples from the Eastern Tropical North Pacific (ETNP) oxygen deficient zone (ODZ) collected from cruise Roger Revelle 1805 to unravel Cr cycling in extremely low oxygen environments. Cr(III) was separated from Cr(VI) by Mg-hydroxide co-precipitation at sea on freshly filtered seawater and in the lab on thawed samples frozen at sea. Among the seven samples in the ODZ analyzed for Cr(III) isotopes and concentration, $\delta^{53}\text{Cr(III)}$ ranges from -0.14‰ to 0.31‰ and [Cr(III)] ranges from 0.85 to 2.16 nmol/kg, respectively, with the heaviest $\delta^{53}\text{Cr(III)}$ and highest [Cr(III)] concentration observed in the upper core of the ODZ (~175-250m) at station P2 (17°N, 107°W). This depth is also where total dissolved Cr has the heaviest $\delta^{53}\text{Cr}$ and lowest [Cr] (1.24‰; 2.5nmol/kg). Analysis of the Cr(VI) remaining in the (filtered) supernatant from the Mg(OH)₂ Cr(III)-precipitations gives $\delta^{53}\text{Cr(VI)}$ as high as 2.98‰. These Cr isotope signatures are consistent with reduction and scavenging of isotopically light Cr. The depth where the most prominent Cr reduction was observed coincides with the secondary nitrite maximum, which implies a link between Cr reduction and microbial denitrification. Comparing our total dissolved Cr and $\delta^{53}\text{Cr}$ data with that from near-coastal station P1 (20°N, 106°W) from the same cruise, and two total dissolvable Cr (unfiltered, acidified) profiles from cruise New Horizon 1410 (2T: 18.9°N, 108.8°W; 7T: 18.2°N, 104.2°W), we see little horizontal spatial variability for [Cr] and $\delta^{53}\text{Cr}$. The comparison between dissolved and total dissolvable [Cr] indicates that there was very little particulate Cr in the water column.