Cr speciation & isotope composition in seawater

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Chromium (Cr) stable isotopes are fractionated during redox reactions between the two naturally occuring species, Cr(III) and Cr(VI). Manganese oxides are required for the production of Cr(VI), which themselves are produced by reaction with oxygen. Cr isotopes are thus a powerful paleo redox proxy. Cr is subject to extensive redox cycling between weathering and eventual burial in sedimentary deposits, and the effects of this cycling on Cr isotope compositions is currently hard to predict. A large area of uncertainty is the effect of Cr redox reactions within seawater itself.

Several studies of Cr isotopes in seawater in recent years are shedding new light on Cr isotope behaviour in the well-oxygenated, open ocean water column. Most of these studies have focused on measurements of total Cr [e.g. 1]. More information exists, however, in combined analyses of Cr isotopes in both species [2, 3], though these measurements remain challenging and with little basis for cross-comparison owing to scarcity in data.

Here, we present a series of species-specific Cr isotope measurements in seawater from coastal British Columbia, Canada, using a new $Mg(OH)_2$ coprecipitation method [3]. These measurements reveal how Cr speciation and the isotopes of each species change under a broad range of geochemical conditions. $\delta^{53}Cr(III)$ is consistently more negative than $\delta^{53}Cr(tot)$, and thus the calculated $\delta^{53}Cr(VI)$ is more positive, as would be predicted based on the known directionalty of fractionation during reduction. There is, however, a wealth of structure in the species-specific isotope profiles, which may provide new information on the controls on $\delta^{53}Cr$ in the oceans and the Cr isotope record in marine sediments.

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