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Measurement of Chromium concentration and stable isotopic ratios in marine particles

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Chromium (Cr) has become an element of interest in paleoceanography for its potential as a tracer of past changes on oxygen levels in the ocean and on land [1] and/or the biological carbon pump [2].

Cr is present in seawater as Cr(VI) and particle-reactive Cr(III) species. The reduction of Cr(VI) to Cr(III) occurs naturally in surface waters. It is observed when measuring the Cr isotopic ratios ($\delta^{53}Cr$), where the high particle–reactivity of Cr(III) species leads to its swift removal , leaving the residual pool of Cr to become isotopically–enriched.

So far, studies on the marine Cr cycling have mostly focussed on measuring the total dissolved concentration ($[Cr]_T$) and isotopic composition ($\delta^{53}Cr$) of chromium (Cr) in seawater. However, measurements of $[Cr]_T$ and $\delta^{53}Cr$ in Oxygen Depleted Zones (ODZ) have shown that despite the evidence for high rates of Cr(VI) reduction in ODZs, only a small fraction of the Cr(III) produced in the water column is exported [3]. This is surprising given the high export fluxes of biogenic particles in ODZs. Additionally, in situ reduction of Cr(VI) and/or accumulation of Cr(III) have not been observed in Oxygen Minimum Zones (OMZ, $O_2 < 60$ μmol.kg^{-1}) [4], which has been attributed to the higher oxygen concentrations in OMZs that preclude nitrate reduction at intermediate depths.

Despite the increasing availability of $[Cr]_T$ and $\delta^{53}Cr$ data across all oceans, it becomes evident that measuring Cr isotopic ratios on marine particles is needed to investigate the hypotheses brought forth from the observations based its dissolved fraction. However, measurements of Cr in marine particles have so far received little attention in the literature .

We have been developing a chemical leaching procedure to measure Cr concentrations and stable isotope composition in marine particles. We present the first measurements on seawater and particulate samples collected from the Strait of Georgia (British Columbia, Canada) and the numerous challenges these measurements present.

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