Reducing the role of contaminant phases for metal isotopes in carbonates

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Novel metal isotope systematics (e.g. U, Mo, Zn, Ni, Cd) are increasingly being used to understand environmental change in geological history. On a global scale, the isotopic budgets of these metals respond to a range of environmental processes, allowing them to trace complex changes in the global climate system and carbon cycle. For example, uranium and molybdenum isotopes have proven to be useful tools to reconstruct the global extent of oceanic anoxia and euxinia respectively.

The oceanic signature of these metals is recorded in contemporaneous marine sediments. Traditionally, organic-rich anoxic 'black shales' provide an excellent archive of these metals. However, carbonate sediments are increasingly being used as a passive recorder of ocean chemistry. The benefits of carbonates include their ubiquitous presence in the geological record and lesser impact of local geochemical conditions on the recorded isotopic signatures. Despite their advantages, carbonates are a complex archive, containing multiple 'contaminant' components such as Mn-oxides, detrital minerals and diagenetic cements. Each of these phases have drastically different metal concentrations and isotopic signatures, giving the potential to distort or bias the true oceanic signature recorded by the carbonate.

Reductive cleaning procedures and selective leaching protocols can be used to avoid these contaminant phases. Here we undertake a series of chemical cleaning and leaching experiments on modern and ancient samples in order to identify the source of the contamination and the efficacy of techniques used to isolate the 'carbonate fraction'. We focus on the extraction of U, Mo, Zn and Ni isotopes from carbonate rich sediments with the aim of identifying a standardized best practice protocol. The sources of contaminant metals vary with isotope system and are highly sample dependant. Because of this, traditional screening techniques (e.g. Al abundances) may not provide a consistent and robust method for identifying the influence of contaminants. As such, similar tests can be used on new sample types to better understand the fidelity and preservation of ancient isotope records.