Quantifying oceanic trace-element fluxes with U-series isotopes

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The distribution of trace-elements in the ocean is controlled by their input, removal and internal biogeochemical cycling. Assessing the rates at which these process move trace metals is fundamental to understanding the modern distribution, the supply of trace metals to photic surface waters, and the response of ocean biogeochemistry to change (in the past and future).

The differential solubility of the isotopes in the U and Th decay chains, coupled to their wide range of half-lives, provide a wide range of tools with potential to quantify the rates of processes involved in trace-metal cycling. We will overview developments in the application of these U-series rate-meters.

Insoluble Th, for instance, has recently been suggested as a tracer for dust input, combining long-lived ^{232}Th with shorter-lived ^{230}Th to quantify the rates of modern dust addition averaged over a few years. We will summarize recent results for this tracer, augmenting with new data for the South Atlantic, and test the application of this proxy using an ocean model of thorium isotopes.

Ra-isotopes have seen recent appication to assess lateral and vertical mixing, though the relative impact of mixing in 2-dimensions can be difficult to separate. We will use existing and new data from the South Atlantic to demonstrate the use of this approach and the impact of 2D mixing on 1D calculations.

We will also over-view a range of other potential U-series tracers, such as ^{234}Th to assess downward fluxes of trace metals, ^{230}Th to assess sediment inputs from dissolution, and ^{231}Pa to assess advection. Recent and new data will be used to illustrate the power of such tools to elucidate the operation of global trace-element cycles in the ocean.