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What controls the marine Zn isotope distribution? Insights from data-constrained modelling

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Zinc (Zn) is a crucial micronutrient involved in various key processes in marine phytoplankton. While there is general agreement on the first-order significance of Southern Ocean physical and biological processes for setting the global oceanic Zn distribution [1, 2], no consensus exists regarding the (relative) importance of mechanisms leading to the isotopically light Zn prevalent in the low-latitude upper ocean. Suggested explanations are as different as (i) removal by reversible scavenging of heavy Zn associated with sinking particles [3], and (ii) addition of isotopically light Zn from the atmosphere or the sediment-water interface [4, 5].

We quantitatively assess the relative importance of these two processes with a model framework that allows a data-constrained view of the marine Zn cycle. Using a global parameter optimisation algorithm [6], we objectively constrain a global marine Zn-cycling model with dissolved Zn concentration and stable isotope data from the GEOTRACES Intermediate Data Product 2021. Preliminary results suggest that these two processes have remarkably different regional fingerprints in the Zn stable isotope distribution.

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