Fe, Zn, and Cd isotopes: Extrapolating from modern ocean models to the geological record

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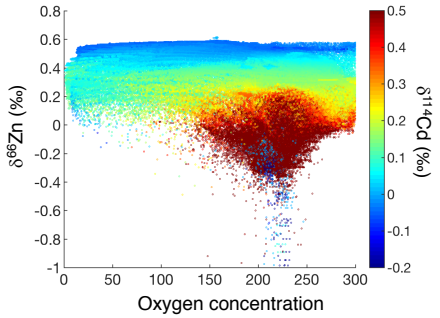
Iron, zinc, and cadmium stable isotopes (δ^{56}Fe, δ^{66}Zn, and δ^{114}Cd) have previously been used to explore various Earth processes such as nutrient availability, biological productivity, and oxygenation of the oceans. Interpretation of these tracers in the geological record requires that their biogeochemical cycling is properly understood. However, in many cases it is not known which processes are most important to the cycling of these elements in the modern ocean, putting a correct interpretation of δ^{56}Fe, δ^{66}Zn, and δ^{114}Cd in the geological record beyond reach.

New global models of Zn and Cd isotope cycling in the modern oceans have been developed using the Awesome OCIM framework, which combines a data-constrained steady-state circulation with simple, flexible biogeochemical cycling. These models have been used to determine the few key processes which are necessary to predict the global distributions of Zn, δ^{66}Zn, Cd and δ^{114}Cd in the modern ocean.



While these models represent only the modern ocean, correlations between various tracers within the models can provide a unique framework for interpretation of signals within the geological record. Examples include the correlation between δ^{66}Zn, δ^{114}Cd, and [O_2] in the modern ocean (pictured), hypothetical relationships between sulfide δ^{56}Fe, δ^{66}Zn, and δ^{114}Cd, and paired analyses of δ^{66}Zn and δ^{114}Cd in post-Snowball Earth cap carbonates.