A new modelling framework to investigate trace metal dynamics during carbon cycle perturbations

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The isotopic compositions of metals (e.g. Os, Sr, Li) derived from continental crust weathering and Earth's mantle differ significantly, which makes them essential proxies for quantifying terrestrial weathering rates and volcanic activity. So far, box models and equilibrium-state equations have been the only method to quantitatively relate weathering-derived and magmatic input fluxes to trace metal concentrations and isotopic ratios preserved in ancient marine sediments. This approach relies on a variety of assumptions about marine sinks and the associated residence time of these metals in the ocean, often derived from modern observations. However, these assumptions may not be applicable to past oceans with different redox conditions or a non-analogue biological pump. Here, we present the first representation of isotope-enabled trace metal dynamics in a 3D Earth system model of intermediate complexity. We show our modelling approaches, as well as experiments to investigate the effects of carbon cycle perturbations on marine trace metal cycling.