The output of nickel from the ocean to reducing sediments

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Nickel (Ni) is a bio-essential and redox-sensitive trace metal in the modern ocean. Moreover, recent hypotheses link Ni limitation in the Archean ocean to characteristics of the early Earth biosphere and ocean redox chemistry [1]. Therefore, it has been suggested that Ni stable isotope fractionation associated with biological uptake and redox transition could trace the evolution of ocean biogeochemistry over deep time. To establish the Ni isotope system as a paleo-ocean proxy, the modern budget must be understood. The dissolved Ni isotope signature for the modern ocean (δ^{60}Ni ~ +1.4‰) is heavier than the known inputs (~ +0.8‰), while the sinks studied to date are similar to or heavier than seawater, requiring an unknown isotopically light sink [2, 3].

Here, we extend the isotope database and study the associated Ni isotope signatures for one of the important sinks from the modern ocean [3], that into reduced organic-rich sediment (TOC of 1.4 to 12.6 wt. %) at the northeast Pacific upwelling margin. A stepwise acid-digestion methodology is used to separate the bulk sample into an 'Organics + pyrite' fraction (OPF) and an 'HF digestible' fraction (HFD) [3]. We present a comparative analysis of the abundance and isotope signatures of Ni in the two fractions. We find a strong correlation between TOC vs OPF Ni concentration and TOC vs Ni/Al in the HFD, consistent with a previous study on the Peru margin [3]. However, the TOC content and bulk Ni abundance (22-115ppm) are lower, and the isotopic composition of both the HFD (~ +0.9‰) and the OPF fraction (~+0.7 ‰) are lighter, than the Peru sediments [3]. We will discuss these in the context of the oceanic mass balance.

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