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The oceanic budget of nickel: new concentration and isotope data from Mn-rich pelagic sediments

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The development of nickel (Ni) isotopes (δ^{60}Ni) as a tracer of past ocean environments requires a good understanding of the modern oceanic budget and biogeochemical cycling of Ni [1-3].

Ni isotope compositions of known inputs are lighter (+0.8‰) than Ni in the oceanic dissolved pool (+1.3‰), while most of the sedimentary outputs are isotopically similar to or heavier than seawater, implying an imbalance in the Ni budget of the ocean. Given steady-state, balancing the Ni budget requires an isotopically heavy Ni input or an isotopically light output flux, or both [1,2]. So far, the heavy Ni sorbed to Fe-Mn crusts (+1.6‰) has been used as a proxy for the isotopic composition of the Fe-Mn oxide output flux of Ni in the ocean, creating the budgetary problem mentioned above. However, new data [2] for Mn-rich oxide sediments from the eastern Pacific show very light Ni isotopes (-0.2 to -0.8‰) compared to Fe-Mn crusts. These light signatures are attributed to diagenetic remobilization of isotopically heavy Ni, which could possibly lead to the missing heavy benthic Ni flux.

In order to assess the extent to which this proves to be general, we present new Ni data from Mn-rich pelagic sediments from 8 sites at different depths across the Pacific. Nickel is enriched in these samples (~100-500 ppm), with little variation in data from the same site, and concentrations are of the same magnitude as the data presented previously [2]. The Ni isotope compositions of our samples are lighter (δ^{60}Ni = -0.2 to +1.0‰) than seawater, but heavier than those in [2]. There is also little variation in Ni isotopes with depth at the same site: rather each site shows one single Ni isotope value, with variations from site to site. Further analyses will investigate these site-specific δ^{60}Ni, including their relationship with diagenetic conditions driven by variable carbon oxidation rates.

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