



Platinum stable isotopes in ferromanganese crust and nodules

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Hydrogenetic ferromanganese (Fe-Mn) crust and nodules are slow-growing chemical sediments that form by direct precipitation from seawater, resulting in a record of changing seawater chemistry. These sediments are the primary sink for platinum in the modern oxic marine environment, hosting well-documented enrichments over other platinum-group elements (PGEs): the Pt anomaly ^[1].

Platinum is a non-bio-essential, highly siderophile, transition metal with six stable isotopes (¹⁹⁰Pt, ¹⁹²Pt, ¹⁹⁴Pt, ¹⁹⁵Pt, ¹⁹⁶Pt, and ¹⁹⁸Pt) with several oxidation states (Pt⁰, Pt²⁺ and Pt⁴⁺). Platinum is generally considered to exist in the hydrosphere as Pt²⁺ although its behaviour in the marine environment is poorly constrained, and Pt⁴⁺ may also be present. Variations in ocean redox state, together with changes in source fluxes to the oceans, may therefore lead to small variations (< ±1%) in the stable isotopic composition of marine platinum, raising the potential of adding platinum to the growing arsenal of paleoceanographic tracers.

A method has been developed to measure the platinum isotopic composition using double spike MC-ICPMS analysis ^[2] and applied to a global suite of modern Fe-Mn crust and nodules. Combining synchrotron XAFS analyses of platinum adsorbed onto Fe-Mn oxide and oxyhydroxide surfaces to determine oxidation state and bonding environment, with platinum stable isotopic measurements allowing us to evaluate both platinum incorporation onto these sediments and the associated degree of platinum isotopic fractionation. Leaching experiments conducted on platinum rich terrestrial materials underwent platinum stable isotopic measurement as an analogue for the Pt isotopic fractionation associated with continental weathering.

[1] Hodge, V.F. et al. (1985) *Earth and Planetary Science Letters*, **72**, 158-162.

[2] Creech, J. et al. (2013) *Journal of Analytical Atomic Spectrometry*, **28**, 853-865.