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The manganese oxide sink for oceanic trace metals: self-consistent budgets for trace metal isotope systems

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Sequestration to particulate manganese (Mn) oxide constitutes an important sedimentary sink from the oceanic dissolved pool for many trace metals. The isotope composition of the Mn oxide sink is also often the key lever that explains both the modern ocean as well as redox-related changes in the past [e.g., 1-3]. Often, however, modern imbalances suggest complexities and uncertainties in this important sink, hindering applications to the past. Here, we use constraints on the Mn budget itself, along with information from early studies that mapped Mn accumulation rates, to arrive at self-consistent budgets for Mn and some key trace metals and their isotope systems.

Observations and modelling suggest that the Mn input to the ocean is dominated by hydrothermalism [4-6]. This hydrothermal input of Mn requires much higher sedimentary accumulation rates of Mn oxide than those measured in the abyssal pelagic ocean, conventionally used with their metal/Mn ratios to estimate the Mn oxide-associated output of trace metals and their isotopes. Early mapping of Mn oxide outputs to marine sediments, however, document Mn oxide accumulation rates in sediments proximal to spreading centres that are up to two orders of magnitude higher than in the abyssal pelagic setting [e.g., 7]. Further, the metal/Mn ratios of these deposits are around two orders of magnitude higher than hydrothermal fluids [e.g., 6-9], demonstrating that the Mn oxides scavenge trace metals from seawater. All of this suggests a hitherto unappreciated role for proximal hydrothermal sediments in the quantitative oceanic budgets of metals like Mo and Ni, leading to substantially improved modern elemental and isotope budgets.

[1] Kendall et al. (2017) Rev. Mineral. Geochem. 82, 683-732.
[2] Cameron, V. and Vance, D. (2014) GCA 128, 195-211.
[3] Nielsen, S.G. et al. (2017) Rev. Mineral. Geochem. 82, 759-798.
[4] Elderfield, H. (1976) Mar. Chem. 4, 103-132.
[5] van Hulten, M. et al. (2017) Biogeosciences 14, 1123-1152.
[6] Edmond, J.M. et al. (1979) EPSL 46, 19-30.
[7] Boström, K. et al. (1973) Chem. Geol.11, 123-148.
[8] Kraemer, T. and Schornick, J.C. (1974) Chem. Geol. 13, 187-196.
[9] Corliss, J.B. et al. (1978) EPSL 40, 12-24.