

Marine precipitates as a significant source of REEs in the Mackenzie River

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Marine sediments are known to host a significant amount of iron (Fe), manganese (Mn), trace and rare earth elements (REEs) in the form of loosely bound (oxy)hydroxide coatings and crusts originally precipitated from seawater and pore fluids [e.g. 1-2]. Marine shales and sedimentary rocks on land may retain these characteristics, providing a geochemically distinct source of preformed Fe-Mn oxides [3]. This geochemically distinctive component within the source rock which is more reactive and concentrated in REEs and other trace metals [3] may explain why shale dominated catchments have a neodymium isotopic signature ($^{143}\text{Nd}/^{144}\text{Nd}$, expressed as ϵNd) in the “dissolved” load ($<0.2\mu\text{m}$) that is more radiogenic than the bulk source rock or bulk suspended sediment [3][4].

The Mackenzie River is the largest supplier of suspended sediment to the Arctic Ocean, and this sediment is sourced almost exclusively from sedimentary rocks (ranging Proterozoic to Mesozoic) with substantial marine shales [5]. Using ϵNd in the Mackenzie to trace source on coupled suspended sediment and dissolved load, it is shown that a significant amount of Nd, REEs and probably other trace metals, in the dissolved load and suspended sediment is likely derived from these preformed precipitates. Using sequential leaching of suspended sediment during peak discharge the concentrations and isotopic composition of different components within the sediment are characterised.

The Mackenzie will be put in a global context, with comparison to similar datasets. Our data highlight the importance of sedimentary recycling in controlling the flux and isotopic composition of Nd, and likely associated trace metals, in both major rivers and a diverse range of weathering environments.

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