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Elemental release from estuarine particulates traced using iron and neodymium stable isotopes

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Rivers are the dominant source of many elements in the ocean, but the dissolved input from the continents is not balanced by hydrothermal or sedimentary exchange with the ocean crust, often taken to indicate that the oceans are not in steady-state. Riverine flux estimates are, however, based on dissolved species alone and neglect the impact of continued weathering of riverine particulates in seawater. Recent studies indicate that element release from such particulates in seawater is significant, and for many elements may be equal to or greater than the dissolved riverine flux.

Radiogenic isotopes of Sr and Nd in estuarine waters point to release from particulates but these isotopes are dominated by mixing, and cannot identify the particular source [1, 2]. Here we present Nd and Fe stable isotope data for estuarine particulates and water from from the Borgarfjörður estuary in W Iceland. These river waters possess low elemental concentrations, and are thus highly sensitive to loss or gain during estuarine transfer. Nd and Fe show variations in water that are inconsistent with simple conservative mixing with seawater, or colloidal flocculation. Rather the dissolved concentrations of both Nd and Fe show a substantial increase at the maximum turbidity zone (MTZ) in the low salinity region of the estuary. Particulate concentrations are hgher in the MTZ where the longer residence time of particulates leads to enhanced breakdown of organic material. Isotope and elemental shifts in the waters are consistent with particulates being the elemental source, where release is dominated by the breakdown of organic material and Fe-oxyhydroxides, rather than basaltic particulates. Increased particulate concentrations at the MTZ are a common feature of many rivers [e.g. 3], and mineralisation of organic matter is thought, for example, to account for elemental release in the Gironde estuary [e.g. 4], it remains to be seen how widespread this elemental release is in other rivers.

[1] Jones et al. (2014) *Earth Planet. Sci. Letts.* 395, 91-100; [2] Rousseau et al. (2015) *Nature Comms.* DOI: 10.1038/ncomms8592; [3] Herman & Heip (1999) *J Mar. Syts.* 22, 89-104; [4] Petit et al. (2013) *Chem. Geol.* 359, 125-135