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Molybdenum behaviour in the low salinity zone during estuarine mixing

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Molybdenum is the most abundant trace metal in the oceans (∼10 ppb) [1], with a residence time of ∼800 ka, and an almost uniform isotope composition of 2.1 ‰ [2] and it has been thought to behave conservatively upon mixing between rivers and oceans [3]. However, more recent studies have shown examples of non-conservative behaviour in estuaries [4], [5]. In order to improve the quantitative interpretation of the Mo palaeo-proxy for redox conditions this study presents preliminary data from two estuaries, with a view to understanding the potential for estuarine modification of rivers, the most dominant source of Mo to the oceans.

The Kalix and Råne rivers, drain into the Bothnian Bay, Sweden. Samples are from three locations along each estuary at 0.5, 5.0 and 10.0 m depths, collected under ice conditions. The salinity range was 0.1-2.3 PSU (Kalix) and 0.04-2.5 PSU (Råne). Mo concentrations increase with salinity from 0.3 to 1.0 ppb (Kalix) and 0.4 to 0.9 ppb (Råne) (±10%). In the Kalix, the measured [Mo] values fit closely with the theoretical conservative mixing line between the river and sea water endmembers (measured R^2=0.93) whilst in the Råne estuary the measured [Mo] have a poor fit (measured R^2=0.25). The dissolved load was analysed for Mo isotopes relative to NIST 3134 with the Kalix δ^{98}Mo of 1.07-1.97 ‰ (2s.e. 0.02 %¸) with an R^2=0.51 (against 1/[Mo]) and Råne δ^{98}Mo of 1.54-2.16 ‰ (2s.e. 0.05%¸) with an R^2=0.01 (against 1/[Mo]). It is clear from concentration and isotope data that non conservative behaviour is observed in these estuaries with isotope exchange that has not greatly altered Mo concentration. This is especially notable in the Råne estuary. Similar non-conservative behaviour has been observed in Li isotopes in the same estuaries [6]. This work explores the interactions between the dissolved and suspended phases, and processes controlling Mo input to the oceans.

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