

A Zn-Pb Isotopic Approach to Quantify Riverine Metal Source Variation During Changing Hydrological Conditions

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Dissolved trace metal concentrations in rivers are influenced by natural processes and anthropogenic activities. Moreover, a variety of anthropogenic sources can contribute these metals to the dissolved load (e.g. wastewater effluents, mine tailing leachates, urban runoff). Standards set by the UK Water Framework Directive suggest safe limits on the freshwater concentrations of pollutants such as zinc (Zn) and lead (Pb), which many river systems exceed. Catchment studies have shown that source contributions vary temporally and spatially resulting in time-varying concentrations of metals and other contaminants in river systems. To formulate effective remediation strategies, it is critical to quantify contributions from the multitude of potential sources and how those contributions vary with time and hydrological conditions.

The Zn and Pb isotopic composition of rivers has a potential use in investigating the source and extent of anthropogenic pollution in river catchments [e.g.1,2]. The Zn isotope composition of water can be influenced by in-stream processes such as biological uptake and adsorption onto particulates - in contrast to Pb isotopes which are immune to in-stream processes. Pairing Zn-Pb isotope measurements with trace element, cation, DOC and hydrological parameters will enhance our ability to quantify and distinguish metal sources and catchment processes, their variation with time and their response to changing hydrological conditions.

We present an initial study of the River Wear in northeast England. Legacy mine wastes dominate dissolved metal concentrations in the headwaters, with an increase in urban (wastewater treatment plant effluents, road runoff) and agricultural inputs going downstream. We sample a 70km transect of the river, and our initial results show large variations in Zn (29.5-291.6ppb) and Pb (0.3-11.45ppb) concentrations. An additional time series measured at an urban downstream location indicates strong variations in concentration with hydrological conditions (flow rates of 2-62m³/s). We will present initial Zn-Pb isotopic measurements targeting conditions of variable metal flux in the Wear to assess changing source(s) in this metal-contaminated catchment. Their spatial and temporal variations will be used to identify temporally changing source contributions.

[1] Chen et al. 2008, *Environmental Science and Technology* 42, 6494-6501