

Lead isotopes in South Atlantic seawater: insights on anthropogenic inputs and ocean circulation

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Trace elements and their isotopes play an essential role in biological processes in the marine environment. Like many micronutrient elements, lead (Pb) is mainly supplied to the remote parts of the ocean by atmospheric deposition. Unlike nutrients, however, its behaviour in seawater is dominated by passive scavenging onto particles. As Pb is one of the elements which is heavily influenced by anthropogenic contamination, its isotope composition in seawater can give us key information on (i) anthropogenic vs. natural sources affecting the modern oceans, and (ii) the movement of water masses within the global oceans [1,2]

To better exploit the potential of Pb isotopes for research in marine geochemistry, we have developed a new method for accurate high precision analyses of Pb isotopes in seawater. The methodology involves pre-concentration of Pb using Mg(OH)₂ co-precipitation [3] and further purification by ion exchange chromatography on two successive columns of AG1X8 100-200 resin. Samples are then loaded on single Re filaments with a mixture of silica gel and phosphoric acid. The isotopic analyses are carried out on a TRITON TIMS instrument at Imperial College London, using a ²⁰⁴Pb/²⁰⁷Pb double spike for the correction of instrumental mass fractionation [4].

Using our newly installed and tested technique, we analyzed several depth profiles of seawater from the South Atlantic Ocean collected in the framework of the UK-GEOTRACES program. More precisely, the samples are derived from a transect along 40°S between Cap Town (South Africa) and Montevideo (Uruguay). The key feature of this remote and little studied part of the Atlantic Ocean is a high productivity band in an otherwise nutrient-poor region, which may be due to a number of potential sources of nutrients. Our lead isotope data will help to constrain anthropogenic and natural dust inputs from both South Africa and South America and their migration within the vertical water column. In addition, intermediate and deep water analyses will reveal the presence of Southern Ocean and North Atlantic waters.

[1] Reuer, M.K and D.J. Weiss (2002) *Phil. Trans. of the Royal Society of London Series A: Math., Phys. and Engineering Sciences* **306** (1801), 2889-2904

[2] Von Blanckenburg, F. and H. Igel (1999) *EPSL* **169** (1-2), 113-128.

[3] Wu, J. and E.A. Boyle (1997) *Anal. Chem.* **69**, 2464-2470

[4] Hamelin B., Mahnes G. et al. (1985) *GCA* **49**, 173-182

Characterization of Hg leaching from the riverbank sediments of the South River, VA

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A large portion of Hg found in the natural environment originates from sediment and soils that are transported and dispersed by runoff and erosion. The associated particle-facilitated transport depends on the mineralogy and pore-water chemistry of the sediment and can impact the bioavailability and toxicity of Hg [1]. In this study, freshwater river sediments and bank soils that contained elevated concentrations of Hg were collected along two vertical transects perpendicular to the South River, Virginia, USA. The South River system accumulated Hg from industrial processes along the river during the early part of the 20th century. The sediment samples were analysed using a variety of techniques, including sequential chemical extractions and synchrotron-based X-ray absorption spectroscopy (XAS). Column transport experiments were conducted to evaluate Hg leaching from the sediment and bank soils. Specific issues addressed are the extent that Hg leaches from the sediment under varying geochemical conditions, which develop in the frequently inundated riverbanks, and the role of particle-facilitated and colloidal transport of Hg from the bank sediments.

Sediment samples from both transects contained both soluble (up to 32%) and less soluble forms of Hg (up to 94%), as determined by sequential chemical extractions [2]. Micro-XAS analysis produced spectra that were consistent with the mineral phase metacinnabar [HgS]. Column transport experiments conducted with the two sediment samples that contained the elevated concentrations of Hg indicated nearly identical leaching of Hg. These sediments contained similar concentrations of total Hg (280 µg g⁻¹ total Hg for a sample collected from the unsaturated zone near the top of the river bank and 187 µg g⁻¹ for a sample collected from an elevation just above the base flow level of the river), but contained markedly different fractions of extractable Hg. The effluent concentrations of Hg initially ranged from 1.5 to 3 µg L⁻¹ for the 0.45 µm filter fraction for both columns and the unfiltered samples ranging from 2 to 5.3 µg L⁻¹. After 80 pore volumes, the concentrations decreased. Calculated cumulative masses of Hg leached from the sediments reached a plateau at < 2% of the water soluble fraction of Hg, suggesting a diminishing availability of Hg for leaching under saturated flow conditions. These results suggest that there is potential for leaching of elevated concentrations of Hg in both dissolved and particulate forms, that the mass available for leaching under saturated conditions appears to much less than predicted using standardized sequential extraction analyses, and that a portion of the Hg had remained in a relatively stable sulfide phase even after many decades of atmospheric exposure.

[1] Lowry et al. (2004) *Environ. Sci. Technol.* **38**, 5101-5111.

[2] Bloom et al. (2003) *Anal. Chim. Acta.* **479**, 233-248.