

Benthic nutrient fluxes and iron-phosphorus cycling in sulfidic estuarine muds

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Estuaries are crucial geochemical filters at the land-ocean interface that have been widely impacted by human activities. We investigated sediment biogeochemistry and benthic nutrient fluxes in the shallow, eutrophic Peel-Harvey Estuary in Western Australia. Our results reveal localized deposition of organic-rich, fine-grained surface sediments characterized by high sulfate reduction rates and abundant accumulation of metastable iron (Fe) monosulfides. Core incubations showed high rates of nitrogen and phosphate release from these sulfidic surface sediments, even though they are reworked and overlain by a well-mixed, oxygenated water column. This suggests decoupling between bottom water oxygenation and sedimentary phosphorus (P) retention. Phosphate sorption experiments emphasized the stark contrast in phosphate binding capacity between the 'normal' estuarine sediments and the strongly reducing muds.

In addition, we observed rapid and extensive sulfidization of reactive Fe within centimeters of the sediment surface below the oxygenated water column, indicating that Fe speciation may not necessarily reflect bottom water oxygenation, at least under the investigated environmental conditions. These findings may be of importance to the use of Fe-based paleoredox-proxies.

Despite strongly reducing conditions, our results suggested that Fe-associated P may be an important P sink in the investigated muds. Using a combination of sequential chemical Fe and P extractions, Fe Extended X-ray Absorption Fine Structure (Fe EXAFS) and micron-scale multi-energy X-ray element mapping, we examine the nature of this Fe-P association.

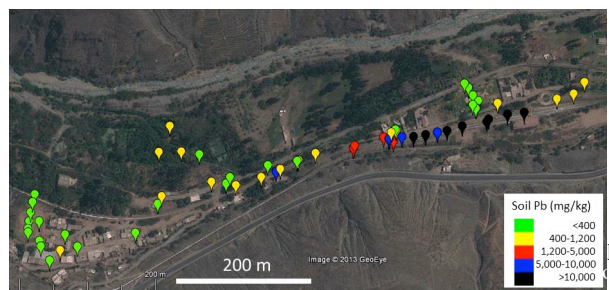
Overall, our detailed geochemical results and benthic flux measurements challenge some of the existing paradigms regarding the links between bottom water oxygenation and the cycling of essential elements such as Fe and P.

Mapping lead contamination of soil due to mining in Peru

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An estimated 1.6 million people live within 5 km of an active mine, ore processing plant, smelter, or former mining site in Peru [1]. In a country with such a long mining history, towns have often been built on top of former mine tailings contaminated with Pb. The health consequences of allowing children to play in soil contaminated with Pb have been well documented. What is less widely known is that the distribution of Pb in soil contaminated by mining activities can be spatially highly heterogeneous. One such example along the railroad track that links the capital Lima to the main mining centers in the Andes is illustrated below.



The data show concentrations exceeding 10,000 mg/kg Pb along a 200 m section of the railroad while other sites along the rail road generally are well within the current US EPA standard of 1,200 mg/kg for residential soil where children do not play. The particularly contaminated area is a turning point for railroad cars containing ore concentrate and this has been associated with contamination of an area commonly used as a walkway. Additional examples of Pb hot-spots will be included in the poster, typically from older mining sites. Results of soil surveys around modern mining operations showing little Pb contamination will also be shown.

Handheld XRF analysers are relatively expensive and their deployment requires training. We have therefore also been testing the soils collected in Peru with a simple Pb extraction and detection protocol relying on citric acid and rhodizonate. The poster will include results from this alternative approach.

[1] van Geen *et al.* (2012) *Bull. WHO* **90**, 878–886.