

Phosphorus retention in sediments of a eutrophied lake: Role of organic phosphorus

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Phosphorus (P) cycling in aquatic sediments has traditionally been described from an abiotic viewpoint: following Mortimer's classical model, phosphate release from sediments is controlled largely by the oxidation-reduction cycle of iron (Fe). However, biotic processes and organic P (org-P) phases could play an important, if not more important, role. To analyze the fate of P, sediment cores were collected in the oxygenated epilimnion and the anoxic hypolimnion from Lake 227 of the Experimental Lake Areas (ELA) in Ontario, Canada. This experimental lake has been artificially fertilized with P since 1969. Lake 227 is a unique lake, as it has undergone a rapid transition from oligotrophic to eutrophic conditions. ²¹⁰Pb dating and chemical extractions were complemented by ³¹P NMR spectroscopy to elucidate sediment P speciation.

The sediment cores contain an historical record of in what extent and in what form P is retained while sediments were subjected to different prevailing conditions. A comparison is made between oxic and anoxic conditions under oligotrophic and eutrophic conditions. The results show that under eutrophic conditions, org-P plus humic-metal-phosphate complexes represent the major pool of reactive sediment P in Lake 227. The formation of the humic complexes is one of the mechanisms accounting for the high retention of P in the sediments since artificial fertilization started. The role of redox dependent Fe-bound P seems to be of secondary importance. Our work highlights the power of whole-lake manipulation to gain a mechanistic understanding of the role of sediment processes in phosphorus cycling.

Oxyanion adsorption on schwertmannite and iron precipitates from acid mine drainage

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The formation of acid mine drainage implies the weathering and oxidation of the iron sulphide minerals present in mining areas and the formation of large amounts of secondary iron precipitates. The presence of these secondary iron precipitates can be considered of great importance, since they are naturally occurring scavengers for the arsenate and other anionic species found in these highly polluted aquatic systems and their presence controls the mobility and availability of the contaminants[1]. Due to the abundance of arsenate species in AMD environments and the high retention capacity of schwertmannite at acidic pH, many studies have focused on the retention of As(V) or As(III). However, the number of adsorption studies carried out with other oxyanions of environmental interest, such as chromate or molybdate, is limited

The adsorption of different oxyanions has been studied on synthetic schwertmannite and on natural iron precipitates obtained from AMD waters. The adsorption of arsenate, phosphate, chromate and molybdate was examined in relation to pH, and anion exchange between these oxyanions and the sulphate ions present in the crystalline structure of the schwertmannite or the iron precipitates was also analysed. The affinity sequence for the different oxyanions is similar in both the synthetic and natural samples: $\text{AsO}_4 \approx \text{PO}_4 > \text{MoO}_4 > \text{CrO}_4$.

Evidence of anion exchange reactions in schwertmannite was obtained, since sulphate ions are released from the iron minerals following oxyanion adsorption. The oxyanion adsorption process for these secondary iron minerals is controlled by two mechanisms: surface complexation with iron hydroxyl groups and anion exchange with the sulphate groups present in the crystalline structure.

[1] Burton, Bush, Traina, Johnston, Watling, Hocking, Sullivan & Parker (2009), *Environ. Sci. Technol* **43**, 9202-9207.