Phosphorus dynamics in coastal marine sediments: New insights in the role of Fe-P phases

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Phosphorus (P) is a key and often limiting nutrient for phytoplankton in the marine environment. Increased availability of P can contribute to elevated productivity and the development of low oxygen zones in coastal systems. Phosphorus associated with Fe-oxides is traditionally thought to play a key role as both a temporary and permanent sink for P in such areas.

Here, we summarize recent findings for sediments from the Baltic and Black Sea demonstrating that Fe(II)-phosphates should also be considered as a potential temporary and permanent sink for P in coastal marine environments. First, we show how the operational SEDEX extraction procedure for phosphorus in sediments [1] can be complemented with micro-XRF, XANES, SEM and XRD analyses to identify and quantify Fe(II)-P phases in marine sediments. Second, we discuss various mechanisms that contribute to formation of Fe(II)-P phases in surface sediments. In the Baltic Proper, for example, basin-scale variations in oxygen conditions and productivity over the past century are suggested to drive changes in Fe-oxide and reactive P input to deep basin sediments and control Fe(II)-P formation and burial. In the Bothnian Sea, in contrast, changes in organic matter input on a decadal time scale are suggested to act as the key driver of Fe(II)-P formation. In this setting, vivianite is formed below a shallow sulfate methane transition zone (SMTZ) in the upper 10 cm of the sediment. The Fe(II)-P acts as a major burial sink for P in the Bothnian Sea and its burial may provide a negative feedback on further eutrophication. Finally, we discuss the enigmatic results of SEDEX extractions [2] and XANES suggesting the presence of Fe-P phases in highly-sulphidic surface sediments of the Black Sea.

[1] Ruttenberg (1992) *Limnol Oceanogr* **37**, 1460-1482. [2] Dijkstra *et al*. (2014) *PloSONE* **9(7):** e101139.