Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.7648

Controls on phosphorus burial in marine sediments

CAROLINE P. SLOMP

Utrecht University

Presenting Author: c.p.slomp@uu.nl

Phosphorus (P) is a key nutrient for phytoplankton in the marine environment. An increased availability of P can contribute to elevated productivity and the development of low oxygen zones in coastal and open ocean systems. Sediments are the main sink for P in the marine environment. This makes it pivotal to understand in what forms P is buried and what processes control that burial.

Typically, organic P and authigenic carbonate fluorapatite (CFA), and, to a lesser extent, Fe-oxide bound P are seen as the major permanent burial sinks of “reactive”, i.e. biologically available P. Detrital P, which refers to the P that is unreactive in the marine environment, such as P in clays, is generally also present. In many marine systems, organic P is the dominant source of P to sediments, with Fe-oxide-bound P and CFA forming in the sediment upon release of dissolved phosphate from degrading organic matter. In brackish systems, a range of other P minerals can form instead of CFA. These include vivianite-type minerals, Mn carbonate-bearing P and Mn(II) phosphates. Mixing of sediments through bioturbation and changes in solute transport linked to bioirrigation can modulate the “sink-switching” from, for example, organic P to CFA. The net effect on P burial depends strongly on the environmental conditions. For example, bioturbation, can enhance the burial of P by bringing P deeper into the sediment, thereby promoting CFA formation. However, at sites where no P minerals such as CFA or vivianite form, and Fe-oxide bound P does not persist at depth because of the presence of hydrogen sulfide, bioturbation will generally not enhance long-term P burial.

In my presentation, I will illustrate these points with examples from our recent field studies and discuss additional controls on P burial in marine sediments, including bottom water deoxygenation and rates of sedimentation. I will also discuss whether we can easily predict the P speciation of sediments based on general sediment and environmental characteristics.