Microbial-driven Impact of the Topmost Bed Sediment Layer on Aquatic Phosphate Fluxes

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There is a longstanding principle that the uppermost layer of aquatic sediment is the primary regulator of nutrient loads in the bottom water zone, pertaining to the fact that it is significantly biological in nature and thus the site of a myriad of biota-associated processes. Nevertheless, although this principle is seemingly obvious, there is unusually scant literature corroborating the impact of the uppermost sediment layer on water column nutrient fluxes, in particular soluble reactive phosphorus (SRP). It has also been theorized that in certain environments, large bacteria play a major role in phosphorus cycling in the sediment. This challenges the prevailing dogma that the control of bottom water phosphate (PO$_4^{3-}$) is mainly attributed to the SRP flux contribution from iron (Fe) oxide-bound P in sediment or remineralisation under anoxia and warming conditions respectively. In this study, elevated temperature as well as anoxic incubation treatments were set up to demonstrate that in response to an increased level of PO$_4^{3-}$ being released under stressful conditions, the topmost bed sediment layer (TBSL) has an unmistakable impact on P sequestration and stabilisation of the bottom water PO$_4^{3-}$ fluxes. Likewise, we also show that large filamentous microorganisms residing in the TBSL were seemingly active in polyphosphate (polyP) accumulation during these stress-inducing conditions. This therefore strongly points to a new and important biological sink for the SRP flux at the benthic layer of an aquatic environment.