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Impacts of a changing global phosphorus cycle on coastal ocean deoxygenation

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Phosphorus (P) is an essential element for all life on Earth due to its presence in critical intracellular compounds such as adenosine triphosphate (ATP) and nucleic acids. Hence the global distribution of bioavailable P strongly controls the distribution of life. In the oceans, P is regarded as the ultimate limiting nutrient for phytoplankton production, thus changes in the supply of P from the continents on geological timescales influence marine productivity, with impacts on the biogeochemical cycles of carbon, nitrogen and oxygen.

The global P cycle today is rapidly changing due to human activities, including the exploitation of mineral P reserves for fertilizer production and the subsequent dissipation of this P into the environment, the widespread damming of rivers, and the effects of climate change. All these factors may impact on the net flux of P from the continents to the oceans, as well as the forms in which P enters the oceans and the spatial distribution of P inputs.

Coastal regions in particular have experienced direct eutrophication as a consequence of enhanced recent inputs of P, as well as nitrogen, leading to the expansion of hypoxic and anoxic zones in near-shore areas. This talk will focus on the cycling of P in coastal regions impacted by human activities, highlighting the current state of knowledge and the key focus areas for future research. Special attention will be given to feedbacks in the cycling of P between sediments and the water column, which introduce strong non-linearities in the relationship between external P loading and coastal hypoxia. Understanding these feedbacks is critical to predicting – and managing – the future development of low-oxygen conditions in the coastal oceans.

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