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Pacific phosphorus burial over geological time

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The biogeochemistry of phosphorus (P) in the seabed of the open ocean has not received much attention over the last decades. Processes controlling P sequestration and regeneration, and the P budgets of these environments are poorly constrained. But in fact, the sediments underlying the vast ocean basin are major players in the global P cycle alone for their sheer extent. Here, we present data from the seafloor beneath the ultra-oligotrophic South Pacific Gyre (SPG), characterized by ultra low primary production, inferior sedimentation rates, and barely detectable microbial activity and biomass.

We have investigated the bulk elemental geochemistry and binding forms of iron (Fe) and P in sediment samples retrieved by IODP Expedition 329. The cores cover a productivity transect from the ultra-oligotrophic center of the SPG to the mesotrophic waters east of New Zealand, and extend up to 100 millions of years back in time. The sedimentary P contents were exceptionally large, and P was mainly bound in rather stable mineral phases. The highest P contents were located beneath the center of the gyre, and the depth trends of P speciation were highly variable across the productivity transect.

In our contribution, we will discuss (1) the contemporary balance of P burial vs. regeneration in seabed beneath the SPG, (2) the close coupling of the cycles of P and Fe cycles, and (3) the concept that a continuous inorganic flux of hydrothermal Fe bypasses the contemporary P cycle and controls P burial over geological time in the ultra-oligotrophic South Pacific.