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Phosphorus burial in ultra-oligotrophic sediments of the South Pacific Gyre

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Marine phosphorus (P) biogeochemistry has a certain affection towards continental margins and shallow oceans. There, ocean currents re-cycle the major share of the standing P stock, and the formation of phosphate mineral phases and their burial is most intense. The seabed below the open ocean has received considerably less attention, but in fact is a major player in global P cycling alone for its sheer extent. Processes controlling P sequestration and regeneration in these environments remain to be explored, and P budgets of these oceanic provinces are yet poorly constrained. Here, we present data from the seafloor beneath the nutrient-depleted South Pacific Gyre (SPG), characterized by ultra low primary production, inferior sedimentation rates, and barely detectable microbial activity and biomass.

We have investigated P phases and binding forms in surface-near samples from sediment cores retrieved by IODP Expedition 329, covering a productivity transect from the ultra-oligotrophic center of the SPG to the mesotrophic waters east of New Zealand, employing different sequential extraction protocols for sedimentary phosphate and bulk elemental analysis by X-ray fluorescence spectroscopy. In these samples, we find sedimentary P contents that are unexpectedly large and in an order of magnitude as values known from upwelling sediments. Furthermore, the highest P contents are located beneath the center of the gyre, and the depth trends of P speciation are highly variable across the productivity transect.

In our contribution, we will discuss (1) the balance of P burial vs. regeneration in the SPG seabed, (2) the contribution of biogenic P to the overall P pool and the formation of stable burial phases, (3) the potential of zeolitic phases to efficiently retain P and represent an alternative burial pathway for P in these ultra-oligotrophic sediments.