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Iron limitation of microbial phosphorus acquisition in the tropical North Atlantic

Thomas Browning (1), Eric Achterberg (1), Jaw Chuen Yong (1), Insa Rapp (1), Caroline Utermann (1), Anja Engel (1), and Mark Moore (2)

(1) GEOMAR Helmholtz Centre for Ocean Research, Kiel, Germany (tbrowning@geomar.de), (2) Ocean and Earth Science, National Oceanography Centre Southampton, University of Southampton, Southampton, England

Growth-limitation of marine phytoplankton by fixed nitrogen (N) has been demonstrated for most of the low-latitude oceans; however, in the (sub)tropical North Atlantic enhanced N2 fixation leads to secondary/(co-)limitation by phosphorus (P). The dissolved organic P pool is rarely fully depleted in the modern ocean and potentially represents a substantial additional P source. Microbes can use a variety of alkaline phosphatase enzymes to access P from a major fraction of this pool. In contrast to the relatively well studied PhoA family of alkaline phosphatases that utilize zinc (Zn) as a cofactor, the recent discovery of iron (Fe) as a cofactor in the more widespread PhoX[1] and PhoD[2] enzymes imply potential for a complex, biochemically-dependant interplay between oceanic Zn, Fe and P cycles. Here we demonstrate enhanced natural community alkaline phosphatase activity (APA) following Fe amendment within the low Zn and moderately low Fe western tropical North Atlantic. In contrast, beneath the Saharan dust plume in the Eastern Atlantic no APA response to trace metal addition was observed. This is the first demonstration of intermittent Fe limitation of microbial P acquisition, providing an additional facet in the argument for Fe control of the coupling between oceanic N and P cycles.

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