Marine polyphosphate: Linking the global phosphorus cycle over modern and geologic timescales

Julia M. Diaz[1], Yuanzhi Tang[2], Rixiang Huang[2], Biao Wan[2], James G. Sanders[1], Karrie Bulski[1], Douglas Mollett[3]

[1]Skidaway Institute of Oceanography, Department of Marine Sciences, University of Georgia, Savannah GA 31411
[2]School of Earth and Atmospheric Sciences, Georgia Institute of Technology, Atlanta GA 30332
[3]Georgetown College, Georgetown KY 40324

Phosphorus (P) is considered the ultimate limiting nutrient to marine productivity over geologic timescales, yet abundant evidence collected over the last two decades has revealed that P cycling also profoundly shapes the ecology and biogeochemistry of the modern ocean. This paradigm shift has been ushered, in part, by the discovery and recognition of key P-containing compound classes in seawater, sediments, and marine biota, including polyphosphate. Polyphosphate is a ubiquitous and versatile biopolymer of up to thousands of phosphate anions, which is involved in biological energy transduction and stress response. Although historically overlooked in the marine environment, polyphosphate is now recognized as a dynamic and quantitatively substantial fraction of total dissolved and particulate P in a variety of ocean areas. In seawater, polyphosphate is a labile P source that may potentially support microbial P nutrition and influence community structure and productivity, depending on prevailing biogeochemical conditions. Furthermore, polyphosphate has been implicated in the authigenic (or in situ) formation of enigmatic calcium phosphate minerals, a principal long-term sink for bioavailable P. Thus, polyphosphate may play a key role in geologic P availability, primary productivity, carbon dioxide uptake by the ocean, and therefore climate. Despite the multifaceted importance of polyphosphate to short- and long-term marine P cycling and ocean-Earth system functioning, however, the mechanisms and magnitude of key polyphosphate transformations in the ocean remain poorly understood. Here, recent investigations into marine polyphosphate dynamics that may link the fate of P across modern and geologic timescales will be discussed.