Combining *in situ* and Culture-based Approaches to Characterize the Physiological Ecology of Blooming and Sinking Diatoms

Harriet Alexander
University of California, Davis

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Abstract

Diatoms are distinct from many other photosynthetic protists in that they lack structures associated with motility, which, combined with their silica frustule, may limit their ability to stay in the euphotic zone and bloom. Yet, defying what might be their inescapable descent into darkness, diatoms are estimated to be responsible for approximately 40% of the oceans. The precise molecular mechanisms that underpin both the sinking and blooming of these organisms, however, remain uncertain. The characterization of the metabolic profiles of individual species in natural mixed communities is becoming increasingly tractable with the application of 'omic approaches *in situ.* In the spring of 2013, a large centric diatom of the genus *Coscinodiscus* was observed in a mesohaline region of the Amazon River plume at high abundance relative to other diatoms both in the surface low salinity lens and in sediment traps deployed in this region. Using a combination of physiological, biogeochemical, rate, and 'omic measurements, the metabolic state of the blooming *Coscinodiscus* species was examined both *in situ* and in incubation experiments designed to characterize the physiological response to changes in the supply ratios of nitrogen, phosphorus, and silicic acid. In addition to field measurements, an isolate of the blooming *Coscinodiscus* species was brought into uni-algal culture and used to generate a transcriptome assembly spanning gene sets expressed over a range of physiological conditions. Taken together, the data from this multi-faceted approach indicate the strong control of nitrogen on *Coscinodiscus* physiology in this system, as evidenced by the modulation of key marker genes. Future work that combines field- and culture-based approaches stands to be a valuable path forward in discerning the physiological ecology of key species in other systems.