Geophysical Research Abstracts
Vol. 14, EGU2012-12080, 2012
EGU General Assembly 2012

The influence of iron limitation on the growth and activity of Crocosphaera watsonii, an unicellular diazotrophic cyanobacterium

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Diazotrophic cyanobacteria are able to use atmospheric dinitrogen (N2) dissolved in seawater as source of nitrogen for primary production. This metabolic function confers an ecological advantage for such organisms in N-limited environments, such as tropical oligotrophic regions. There, N2 fixation represents a significant source of new nitrogen in the euphotic zone which is available for the non diazotrophic phytoplankton community. Thus, diazotrophic cyanobacteria contribute significantly to new production and play a key role in the global cycling of carbon and nitrogen. The filamentous diazotrophic cyanobacterium Trichodesmium is the best known and most studied marine diazotroph. However, recent research has highlighted the biogeochemical importance of unicellular diazotrophic cyanobacteria (UCYN), such as Crocosphaera watsonii. The factors that control N2 fixation have been intensively studied. Due to the high iron content of the nitrogenase enzyme complex, N2 fixation and growth of diazotrophic cyanobacteria can be controlled by iron bioavailability. Many studies have been conducted on the impact of iron limitation on Trichodesmium, but less is known for UCYN. Here, for the first time, we address the issue of iron limitation on the N2 fixation and growth of UCYN, namely Crocosphaera watsonii. We have designed a study on cultures of Crocosphaera watsonii strain WH8501 grown under a range of dissolved iron, from 2 nM to 400 nM, with a constant EDTA concentration of 2 μM. Our experiment encompasses low iron concentrations (2 nM), representative of those measured in the field. Preliminary findings demonstrate a major control of iron availability on the biomass and growth of Crocosphaera watsonii. These results, complemented with data on photosynthetic and diazotrophic activities, significantly contribute to our understanding of the dynamics of N2 fixation by unicellular diazotrophic cyanobacteria and of the role of iron in controlling this process.

Keywords: N2 fixation, unicellular cyanobacteria, iron limitation.