The Response of Calcifying Cyanobacteria to Ocean Alkalinity Enhancement

S.J.GORE[1]*, S.J.GILL[2], P.RENFORTH[3], R.G.PERKINS[1] AND R.E.M.RICKABY[2]

[1]School of Earth & Ocean Sciences, Cardiff University, Park Place, Cardiff, CF11 3AT
[2]Department of Earth Sciences, Oxford University, South Parks Road, Oxford, OX1 3AN
[3]School of Engineering & Physical Sciences, Institute of Mechanical, Process & Energy Engineering, Heriot-Watt University, Edinburgh, EH14 4AS
*correspondence: goresj@cardiff.ac.uk

Ocean Alkalinity Enhancement (OAE) aims to store atmospheric carbon dioxide (CO_2) in the ocean by increasing total alkalinity (TA), consequently increasing calcium carbonate saturation state (Ω_{CaCO3}) and pH. Very little is known about the impact of such manipulations on oceanic calcifiers. Cyanobacteria are widespread in the marine environment. Although there are currently no calcifying species of cyanobacteria in the modern ocean, there are some strains that can calcify under experimental conditions. We tested the response of a calcifying strain of a marine cyanobacteria, *Synechococcus* PCC 8806, to elevated TA. An increase in TA of 1000 µEq L^{-1} and 2000 µEq L^{-1} (over a background concentration of ~2400 µEq L^{-1}) led to a ~22% and ~82% increase in net calcification rate respectively when compared to ambient alkalinity experiments. However, TA enhancement did not significantly influence the photophysiology nor cell growth rates. This has implications for carbon cycling in the past, but also constrains the environmental impact and efficiency of OAE. One theory for why there are no calcifying cyanobacteria in the modern ocean is because present-day Ω_{CaCO3} is too low. Therefore, it may be possible for *Synechococcus* to begin calcifying if OAE causes a global increase in ocean Ω_{CaCO3} and pH. An increase in carbonate production could reduce the efficiency of CO_2 removal. Additional work is required to understand the impact of OAE under different alkalinity scenarios, on other organisms, whole ecosystems, and the global carbon cycle.