EGU22-10967
https://doi.org/10.5194/egusphere-egu22-10967
EGU General Assembly 2022

Ammonium sensitivity of biological nitrogen fixation by anaerobic diazotrophs in cultures and benthic marine sediments.

Romain Darnajoux, Linta Reji, Xinrei Zhang, Katja Luxem, and Xinning Zhang
Princeton University, Department of Geosciences, Princeton, United States of America (romaind@princeton.edu)

Biological nitrogen fixation (BNF) is a critical process for the N budget and productivity of marine ecosystems. Nitrogen-fixing organisms typically turn off BNF when less metabolically costly N sources, like ammonium (NH_4^+), are available. Yet, several studies have reported BNF in benthic marine sediments despite high porewater NH_4^+ concentrations (10-1,500 µM). These activities were generally linked to anaerobic sulfate-reducing bacteria (SRB) and fermenting firmicutes.

To better understand the regulation and importance of benthic marine BNF, we evaluate the sensitivity of BNF to NH_4^+ in benthic diazotrophs using incubations of increasing complexity. We conduct our experiment with cultures of model anaerobic diazotrophs (sulfate-reducer *Desulfovibrio vulgaris* var. Hildenborough, fermenter *Clostridium pasteurianum* strain W5), sulfate-reducing sediment enrichment cultures, and slurry incubations of sediments from three Northeastern salt marshes (USA).

All our samples demonstrate high sensitivity to external NH_4^+. BNF is inhibited by NH_4^+ beyond an apparent threshold [NH_4^+] of 2 µM in liquid cultures and 9 µM in sediment slurries. Consistent with other studies, we find SRB-like nitrogenase (*nifH*) gene and transcripts are prevalent in sediments. We compare our inhibition threshold value with a survey of porewater NH_4^+ data from diverse sediments, suggesting the confinement of benthic BNF to surficial sediments.

Variations in the timing to onset BNF inhibition, NH_4^+ uptake rate, and sediment composition and biophysics could affect measurements of the apparent sensitivity of benthic BNF to NH_4^+. We propose a simple model based on NH_4^+ transporter affinity as a fundamental mechanistic constraint on NH_4^+ control of BNF to improve biogeochemical models of N cycling.