Nitrogen cycling in microbial mats

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Microbial mats are thought to have originated around 3.7 billion years ago, and have been an important force in the maintenance of Earth's ecosystems. While most microbially mediated biogeochemical transformations have been shown to occur within microbial mats, the nitrogen cycle in the microbial mats has received very little study. This is despite the fact that nitrogen usually limits growth in marine environments.

To fill this gap, we developed a series of experiments to determine a complete nitrogen budget for photosynthetic microbial mats in Elkhorn Slough, CA, USA, and Guerrero Negro, Mexico. Both *in situ* sources (N fixation, mineralization of organic nitrogen) and sinks (ammonium and nitrate assimilation, nitrification, denitrification, dissimilatory nitrate reduction, and anaerobic ammonium oxidation) of nitrogen in photosynthetic microbial mats including temporal (diel and seasonal) variations are being measured using stable isotope techniques. These results are being combined with molecular biological methods (qPCR, metagenomic sequencing) targeting most functional genes of the nitrogen cycle.

The first results of this research demonstrate incomplete denitrification to nitrous oxide in microbial mats in Elkhorn Slough. It is possible that these characteristically thin (5-10 mm) mats are not attaining sufficiently reducing conditions. Anammox was under detection limit, i.e. of no importance in those mats. The next step is to quantify other nitrogen transformations in order to complete a nitrogen balance in microbial mat ecosystems. This research will help us to improve our understanding of the cycle of the element most responsible for limiting the production of biomass on Earth.