A molecular, isotopic, and organic geochemical analysis of freshwater microbialites

A. NITTI[1*], M. BREITBART[1], D. HOLLANDER[1], J. SIEFERT[2], V. SOUZA[3]

[1]USF College of Marine Science, St. Petersburg, FL (*Corespondence: anitti@mail.usf.edu)
[2]Department of Statistics, Rice University, Houston, TX
[3]Department Ecologia Evolutiva, Instituto de Ecologia, UNAM, Coyoacan, Mexico

Actively forming modern microbialites in the phosphorus-limited waters of the Cuatro Ciénegas Basin in northern Mexico provide a unique analogue to the ancient stromatolites of early Earth. Initial petrographic observation of these modern microbialites reveals 5 visually distinct layers within the surface structure, relating to changes in microbial community composition and increasing carbonate abundance with depth. This research utilizes stable isotopic, organic geochemical, and genomic techniques preformed on the 5 individual layers to develop an understanding of the microbial community and how it directly relates to carbonate accretion within these freshwater microbialites.

Culture independent metagenomic and 16S rRNA gene analyses of both bacterial and archaeal organisms have enabled us to construct a well-developed representation of the microbial community structure and function. Results depict a community dominated by cyanobacteria and proteobacteria, whose coordinated metabolic activities create microenvironments suitable for calcium carbonate accretion.

Stable isotopic analysis of the intracrystalline organic matter reveals C, N, and S profiles that support the genomic work and suggest the co-occurrence of autotrophic and heterotrophic as well as aerobic and anaerobic nutrient cycling processes. The coupling of these processes and the remineralization of photoautotrophic carbon can be observed in the isotopic profile of inorganic carbonate, which depicts the incorporation of increasing amounts of respired carbon (increasingly depleted $\delta^{13}C$) with depth.