Measuring N_2 Pressure Using Cyanobacteria
Discipline: Geomicrobiology
Abstract ID 299364

SILVERMAN, Shaelyn N, Molecular Cellular and Developmental Biology, University of Colorado Boulder, Boulder, CO 80309,

KOPF, Sebastian, Geological Sciences, University of Colorado Boulder, Boulder, CO 80309,

GORDON, Richard, Gulf Specimen Aquarium & Marine Laboratory, USA & Wayne State University, Detroit, MI 48202,

BEBOUT, Brad M., Exobiology Branch, NASA Ames Research Center, Moffett Field, CA 94035,

SOM, Sanjoy, Blue Marble Space Institute of Science, Seattle, WA 98154

silverman.shaelyn@gmail.com

The evolution of Earth's atmosphere has been governed by biological evolution. Dinitrogen (N_2) has been a major constituent of Earth's atmosphere throughout the planet's history, yet only a few constraints exist for the partial pressure of N_2 (pN_2). In this study we evaluate two new potential proxies for pN_2: the physical spacing between heterocysts and the isotopic signature of nitrogen fixation in filamentous cyanobacteria. Heterocyst-forming filamentous cyanobacteria are some of the oldest photosynthetic microorganisms on Earth, and debated fossilized specimens have been found in sedimentary rocks as old as 2 Ga. These organisms overcome nitrogen limitation in their aqueous environment through cellular differentiation along their filaments. The specialized cells that develop, known as heterocysts, fix the nitrogen and laterally distribute it to neighboring cells along the filaments. Because the concentration of the dissolved N_2 available to the filaments correlates directly with pN_2, any preservable physiological response of the organism to the changed N_2 availability constitutes a potential proxy for pN_2. In the laboratory, we have examined how pN_2 is reflected in the heterocyst spacing pattern and in the isotopic signature of nitrogen fixation by subjecting the representative species *Anabaena cylindrica* and *Anabaena variabilis* to different N_2 partial pressures during growth at constant temperature and lighting (in media free of combined nitrogen). We show experimentally that the distance between heterocysts and the nitrogen isotope fractionation measured in bulk biomass reflect the pN_2 experienced by *Anabaena cylindrica*. Current work is investigating these responses in *Anabaena variabilis*. When heterocystous cyanobacteria fossilize, these morphological and isotopic signatures should preserve information about pN_2 at that time. Application of this relationship to the rock record may provide a paleoproxy to complement the two existing geobarometers.