Fungal growth on bare rock surfaces – Where does the carbon come from?

ANNA A. GORBUSHINA

Geosciences, Free Universtiy & BAM, Berlin
(anna.gorbushina@bam.de)

Primary successions in terrestrial ecosystems usually involve microbial growth on bare rock surfaces. In these extremely stressed environments complex microbial communities must adapt to high solar irradiation, low water and nutrient availability, extremes of temperature as well as atmospheric composition. The term 'Subaerial biofilm' (SAB) has been used to describe microbial communities that develop on solid surfaces exposed to the atmosphere. SAB are ubiquitous, self-sufficient, miniature microbial ecosystems that are found on buildings, bare rocks in deserts, mountains, and at all latitudes where direct contact with the atmosphere and solar radiation occurs. SAB on exposed terrestrial surfaces are characterised by patchy growth that is dominated by associations of fungi, algae, cyanobacteria and heterotrophic bacteria. Although microbial members of rock-inhabiting communities vary, the presence of yeast-like micro-colonial fungi is common in SAB. Despite being ubiquitious, the role and symbiotic relations of heterotrophic micro-colonial fungi in natural and model SAB systems has not been thoroughly examined. To assess the importance of carbon inputs, we simulated growth of a single fungal micro-colony on a solid rock surface. Analysis of this model showed that the continued lack of organic nutrition is a major environmental factor in limiting growth of MCF on exposed rock surfaces. We suggest that fungi either use an atmospheric source of organic carbon which can be particulate and/or volatiles, or associate with phototrophic components of the subaerial microbial community. In a novel simulation laboratory approach we examine model bipartite biofilms (fungus/cyanobacterium) growing under different atmospheric CO_2 concentrations. The results will be discussed in the context of the terrestrial carbon cycle, climate change and establishment of SAB.

Electronic and biogeochemical properties of bacterial nanowires

Y. GORBY[1]*, G. WANGER[1], T. YUZVINSKI[2], M. FIELDS[3] AND M. EL-NAGGAR[2]

[1]J. Craig Venter Insitute, San Diego, CA 92121
(*correspondence: ygorby@jcvi.org, gwanger@jcvi.org)
[2]Univerisity of Southern California, Los Angeles, CA
(mnaggar@usc.edu, yuzvisnk@usc.edu)
[3]Montana State University, Bozeman, MT
(matthew.fields@erc.montana.edu)

Many organisms, including including dissimilatory bacteria such as *Geobacter* and *Shewanella* produce electrically conductive appendages called bacterial nanowires. Catalytic transformation of hydrous ferric oxide into nanocrystalline magnetite was reported over 5 years ago [1, 2]. Nanowires and partially characterized extracellular polymeric substances have also been implicated in the reductive transformation of dissolved uranium into nanoparticulate uraninite particles [3, 4]. For the past several years our collaborative team—with funding from the Air Force Office of Science, J. Craig Venter Institute, and the Legler Benbough Foundation—has developed and applied approaches for characterizing the molecular and electronic properties of bacterial nanowires using the metal reducing bacterium *S. oneidensis* as our model organism. Recent funding from the Department of Energy will be used to investigate the composition, conductivity and biogeochemical reactivity of nanowires from metal- and sulfate-reducing isolates from subsurface sediments from the Oak Ridge Field Research Center. This presentation provides an update on our current knowledge of electronic properties of nanowires and their role in reductive transformation of iron and uranium in subsurface sediments.

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