

Report on NASA Astrobiology Institute Support of the
Gordon Research Conference (GRC) on Metals in Biology
January 22-27, 2017, Ventura, CA
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The role of metals in the biological chemistry of life on earth, including the changes in these roles over the earth's long history, is certainly a fascinating one, and we chose to make this one of the themes of the 2017 Metals in Biology Gordon Research Conference. This meeting traditionally has strong representation for chemists and biologists working in metallobiochemistry, but often not a lot of representation from people coming from the bio/geo/astrobiology perspective, so a big goal was to make that a larger focus of this meeting, and to try to bridge these communities a bit more, at least in part to foster new thinking and possible collaborations. Key talks in this area included:

Dan Rothman (Massachusetts Institute of Technology, USA) "Nickel-Driven Methanogenic Burst Accompanying Earth's Greatest Extinction"

Thomas Spiro (University of Washington, USA) "How Bacteria Use a Multicopper Oxidase to Close the Environmental Mn Cycle by Producing MnO₂ Biomineral"

Woodward Fischer (California Institute of Technology, USA) "A Geobiological Perspective on the Role of Mn in the Evolution of Photosynthesis"

In addition, we had Dianne Newman, historically a strong player in the bio/geo/astrobiology metals community, showing how she is bridging this science over into medically related topics:

Dianne Newman (California Institute of Technology / Howard Hughes Medical Institute, USA) "Selective Degradation of an Extracellular Electron Shuttle Abrogates Biofilm Development"

We also had Alison Butler provide a nice link between biomineralization to the important practical area of bio adhesion to wet surfaces:

Alison Butler (University of California, Santa Barbara, USA) "Biological Wet Adhesion to Mineral Surfaces: Mussels, Siderophores and the Catechol-Cation Synergy"

Our Thursday night keynote address was by Harry Gray at Cal Tech, who following the lovely talk by his colleague Woody Fisher, explained to us the complications of organisms dealing with the new toxic oxygen in the atmosphere and his ideas of how redox enzymes effectively deal with the complications of working in an oxygenic environment:

Harry Gray (California Institute of Technology, USA) "Living with Oxygen"

The NASA fund was used to provide partial support of conference registration fees of invited speakers mentioned above (Dan Rothman, Thomas Spiro, Woodward Fischer, Dianne Newman and Alison Butler), as well as 14 early career investigators (assistant professors and postdoctoral researchers) and 2 graduate students, including 10 women scientists.

The above invited talks have stimulated most attendees of this GRC, who have been addressing research problems at molecular levels or microscopic levels, to think much deeper at macroscopic levels, which widens the perspective much more broadly. Many attendees have ranked the talks on Mn(II) photooxidation (by Woody Fisher) and Ni biogeochemistry (by Dan Rothman) among their favorite talks in this year's GRC. One attendee commented that "Fisher's talk was an eye opener to me and changed the way I thought about one of my own projects".

As a result, the invited talks and interactions between the invited speakers and other attendees, several collaborations with special theme of bio/geo/astrobiology have been discussed. For example, meeting Woody Fisher and learning about his hypothesis as to the origin of photosynthetic water oxidation has led to a collaboration between my lab and Fisher lab on using electron paramagnetic resonance (EPR) spectroscopy, which is highly informed by parallel work we are doing with Tom Spiro and Brad Tebo (who also attended) on Mn biomineralization using atmospheric oxygen and multicopper oxidase enzymes. The bio/geo/astrobiology theme is also playing an important role for some attendees to prepare proposals for grant agencies, including the Department of Energy's Energy Frontier Center.