# MEETING

## Advancing Geomicrobiology and Microbial Geochemistry

***2013 Geomicrobiology and Microbial Geochemistry Workshop; Chicago, Illinois, 11–12 October 2013***

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By examining microbial and geochemical processes together, scientists have been able to gain a vastly clearer picture of how microorganisms shape their surrounding environment and vice versa. This was the central theme of a 2-day workshop held in October 2013 in Chicago, Ill., that brought together 30 leading scientists from the rapidly growing field of geomicrobiology and microbial geochemistry (GMG).

GMG is a relatively young discipline in the Earth sciences that takes an interdisciplinary approach toward investigating the role of microorganisms in the cycling of elements through time. Scientists attending the workshop had expertise in a range of areas, including microbial physiology, aqueous geochemistry, mineralogy, microbial "-omics" (including genomics, transcriptomics, and proteomics), computational biology, chemostratigraphy, isotope geochemistry, environmental engineering, marine microbiology, and organic geochemistry. The workshop was organized to review GMG advances over the past 15 years, identify key factors leading to that success, and discuss challenges ahead.

Workshop participants reviewed the rapid progression of the science, including advances in understanding ways microbes control elemental cycling in the environment; the establishment of a record of the coevolution of microbes and geochemistry; and the use of new techniques in -omics, geochemistry (including sensors and techniques to measure elements and isotopes at increasingly refined scale and concentration), and computation (large database management and model development).

Participants discussed how progress on the coupling of advanced -omics approaches with robust descriptions of the geochemical surroundings of microbial populations is revolutionizing scientists' understanding of how microorganisms affect their environment. This coupling is particularly key to deciphering so-called cryptic cycles, where knowledge of the genetic potential and expression of specific enzymes helps reveal previously unrecognized pathways of elemental cycles. The information can have important implications for global carbon, nutrient, and metal cycling.

Another key topic of discussion was the development of the infrastructure for probing complex biogeochemical systems. Participants identified crucial elements of the existing infrastructure and critical resource gaps. Resources for education and training in the GMG field include the development of an international geobiology course offered in the summer at the University of Southern California (https://dornsife.usc.edu/wrigley/geobiology/), regional geobiology symposia, and international conferences. Current needs identified by workshop participants include the maintenance and development of a large-scale analytical and computational infrastructure to gather, assemble, and interpret massive data sets of integrated microbial and geochemical information.

Group discussions focused on identifying future basic research challenges and opportunities of broad societal relevance, including the impacts of human activities on global biogeochemical cycles, the search for life through deep time and on other planets, provision of Earth materials critical for sustaining industry and agriculture, and the impacts of metals and minerals on human health.

As powerful new tools offer insight into microbial-geochemical processes on ever-finer scales, new opportunities are emerging for understanding ecosystem and global geobiological processes, workshop participants agreed. Exciting frontiers ahead include revealing new pathways and players that underpin biogeochemical cycles, understanding the feedbacks between life and Earth processes, and investigating the coevolution of life and the Earth environment in the past as a guide to the future.

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