Meet the Authors

Karim Benzerara is a director of research at the Centre National de la Recherche Scientifique's Institut de Minéralogie, Physique des Matériaux et Cosmochimie (IMPMC) at Sorbonne Universités in Paris (France). He received an MS in geology at École Normale Supérieure, Paris, a PhD at the Université Denis Diderot – Paris 7, and was a postdoctoral investigator at Stanford University (California, USA). His research focuses on the interactions between microorganisms and minerals, specializing in biomineralization and fossilization. His approach combines electron and X-ray microscopies, fieldwork and microbiology. He currently studies the formation of intracellular carbonates by some cyanobacteria species, work that is funded by the European Research Council.

Eric Boyd is an assistant professor and NASA Early Career Fellow in the Department of Microbiology and Immunology at Montana State University (USA). After receiving a BS in biology at Iowa State University (USA), he moved to Bozeman (Montana) where his doctoral work focused on the geomicrobiology of hydrothermal environments. As a NASA Astrobiology Institute postdoctoral fellow, Boyd expanded his work to include subglacial and hypersaline environments and investigated the interplay between geochemical variation and the diversification of microbial life and the metabolic processes that support it. His current research focuses on the ecology and physiology of extremophile microorganisms, as viewed through the lens of evolutionary biology.

Gregory J. Dick is an associate professor in the Department of Earth and Environmental Sciences at the University of Michigan (USA). He received his PhD from the Scripps Institution of Oceanography (California, USA) in 2006 and was a postdoc at the University of California, Berkeley (USA) from 2007 to 2008. Greg has long been interested in the interplay between microbes and geochemistry, including the geomicrobiology of deep-sea hydrothermal vents. Recently, he has become intrigued by cyanobacteria and their influence on Earth and the environment. He is now studying modern microbial mats (as analogues of ancient ecosystems) and harmful cyanobacterial algal blooms.

Gregory Druschel is an associate professor at Indiana University–Purdue University Indianapolis (IUPUI) (USA). He earned a BS in geology at Muskingum University (Ohio, USA) in 1995, an MS in geology from Washington State University (USA) in 1998, and a PhD in geology from the University of Wisconsin (USA) in 2002. He was a postdoc at the College of Marine Studies at the University of Delaware (USA) between 2002 and 2004 and was an assistant, then associate, professor at the University of Vermont (USA) before moving to IUPUI in 2012. His research centers on the redox chemistry of biogeochemical systems past and present, with interests focused on sulfur cycling and the biotic and abiotic controls on intermediate S chemistry, the role of Fe and Mn cycling on nutrient fluxes that drive harmful algal blooms, and on the fundamental reactivity of particles in lung fluids.

Tim Ferdelman is a senior scientist in the Biogeochemistry Department at the Max Planck Institute (MPI) for Marine Microbiology in Bremen (Germany). Prior to joining the MPI in 1992, Tim received his BS from Miami University (Ohio, USA) and his MSc and a PhD in oceanography from the University of Delaware (USA). His research concerns the cycling of bioactive elements in marine environments, and he has sailed on numerous oceanographic and ocean drilling expeditions. Tim employs radiochemical and liquid chromatography methods to investigate the marine sulfur cycle.

David A. Fike is an associate professor in the Department of Earth and Planetary Sciences and Director of the Environmental Studies program at Washington University in St. Louis (WUSTL) (Missouri, USA). He received his PhD in isotope geochemistry in 2007 from the Massachusetts Institute of Technology (USA) by investigating Ediacaran biogeochemical cycling, after which he did a postdoc at the California Institute of Technology (USA) where he applied high-resolution isotopic analyses to microbial ecology. He joined the WUSTL faculty in 2009 and now focuses on understanding the biological, sedimentological, and diagenetic processes that generate and alter isotopic signatures in modern marine sedimentary phases and, ultimately, how these are preserved in the rock record.

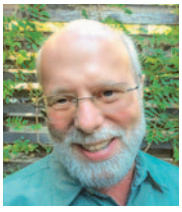
Colleen Hansel is an associate scientist in the Department of Marine Chemistry and Geochemistry at the Woods Hole Oceanographic Institution (Massachusetts, USA). Colleen received her BS in geology from California State University, Sacramento (USA), her MS in soil chemistry from the University of Idaho (USA), and her PhD in biogeochemistry from Stanford University (California, USA) where she stayed on for postdoctorate research in molecular microbial ecology. She is broadly interested in the role of microbial activity and physiology in shaping geochemical and mineralogical landscapes. More specifically, she integrates laboratory experiments and marine field measurements to identify the biogenic metabolites and reactive intermediates that are involved in coupled elemental cycling and mineralization.

Andreas Kappler is a professor of geomicrobiology at the University of Tübingen (Switzerland). He received his MSc in chemistry and PhD in environmental microbiology from the University of Konstanz (Germany) and held postdoc positions at the Eidgenössische Anstalt für Wasserversorgung, Abwasserreinigung und Gewässerschutz [Swiss Federal Institute of Aquatic Science and Technology, of EAWAG/ETH] (Zürich, Switzerland) in environmental chemistry, and in geobiology at the California Institute of Technology (USA). The major focus of his research is the biogeochemical cycling of iron and humic substances and the environmental fate of toxic metals and nutrients. Kappler also investigates the role that microbial iron oxidation played in the deposition of Precambrian banded iron formations, biochar (charcoal) as a soil amendment, and how to recover precious metals from incineration waste.

Phyllis Lam is lecturer of marine microbial biogeochemistry at the University of Southampton (UK). Her research focuses on the roles of microorganisms in biogeochemical cycling: specifically, in environments ranging from deep-sea hydrothermal vents, to the subsurface biosphere, to the suboxic water columns of oceans and lakes, to oligotrophic subtropical ocean gyres and in desert crusts. Lam combines molecular biological methods with biogeochemical measurements and has been the first to report on chemolithoautotrophic ammonia oxidation in deep-sea hydrothermal plumes, to demonstrate that there is a deep subseafloor biosphere, and to disentangle the closely coupled microbial N-cycling processes in oxygen-minimum zones where up to half of global marine N loss takes place.

Timothy W. Lyons is a distinguished professor of biogeochemistry at the University of California, Riverside (USA). His primary research themes are astrobiology, marine geochemistry, geobiology, and biogeochemical cycles through time. His career-long interests in anoxic marine environments, early biosphere oxygenation, and coevolving life have inspired the development and refinement of diverse geochemical tracers in modern settings for the "exploration" of ancient oceans and atmosphere. Much of this research revolves around the recognition of elemental and isotopic fingerprints of ancient microbial activity. Lyons is currently leading the NASA Astrobiology Institute's "Alternative Earths" team—designed with the mission of using the many diverse chapters of persistent habitability on a dynamic early Earth to inform the search for life elsewhere.

Everett Shock grew up in the heart of Orange County (California, USA), two miles from Disneyland. He received his BS in earth sciences from the University of California, Santa Cruz, where he met his wife Allison. After working for a couple years at the US Geological Survey, he entered graduate school at the University of California, Berkeley, where he earned his PhD in geology. He taught at Washington University in St Louis (USA) for 15 years before moving to Arizona State University (USA). Much of Shock's current research converges on understanding how planets become habitable: this is done through fieldwork in extreme environments, hydrothermal experiments, and thermodynamic interpretations of planetary geochemical processes.



Brad Tebo is a distinguished professor of marine and biomolecular systems in the Institute of Environmental Health at Oregon Health & Science University (USA). He investigates how metal transformations by microbes influence the living world at levels from planetary biogeochemical cycles to enzymatic reactions in living organisms. Tebo aims to comprehensively understand the mechanisms by which microbes transform soluble metals to insoluble forms by weaving together data from oceanographic field studies, laboratory microbiology, and high-energy X-ray spectroscopy. His particular focus has been on manganese because of its profound influence on other metals, and its crucial role in photosynthesis and carbon cycling.

Alexis Templeton is an associate professor in the Department of Geological Sciences at Colorado University, Boulder (USA). During her career, she has worked in active geo-hydro-biological systems in the western USA, New Zealand, Hawaii, Samoa, Oman, and the Canadian High Arctic. Currently, she leads a geomicrobiology and geochemistry research group specialized in the development and application of scattering and spectroscopic approaches capable of interrogating the redox reactions that occur at the interfaces between mineral surfaces, microorganisms, and fluids. Her research integrates mechanistic studies, in well-controlled experimental systems, with intensive fieldwork in settings where there are strong connections between the subsurface and the surface rock–hosted biosphere.

Aubrey L. Zerkle is a lecturer in geobiology at the University of St Andrews in Scotland (UK). A diverse research career has taken her from the geomicrobiology of modern Caribbean corals to the microbial modulation of the Archean atmosphere. Her current interests focus on understanding the coevolution of life with the evolution of Earth's surface environment over geologic timescales. Zerkle utilizes a multidisciplinary approach, combining microbiology, stable isotopes and trace metal geochemistry to examine biogeochemical cycling in modern and ancient ecosystems, with special focus on calibrating the isotope biosignatures of microbial activity and on investigating geosphere–atmosphere–biosphere feedbacks during important transitions in Earth's history.

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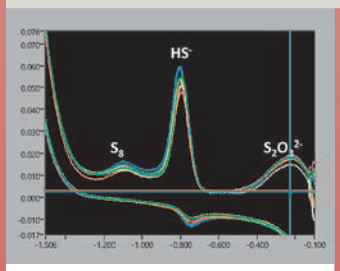
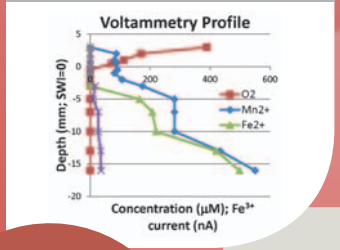
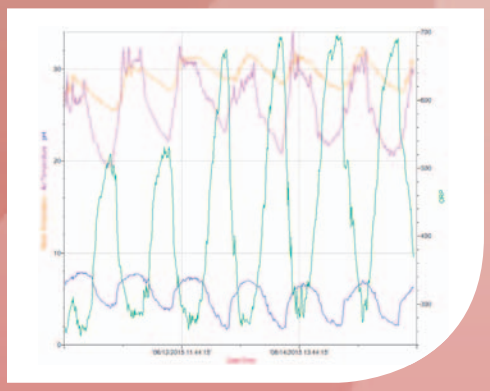


Typical voltammetric scan of microbial mat from Guerrero Negro.



Core collected from Missisquoi Bay, Lake Champlain and profiled using AIS DLK-70 and auto-manipulator.

This instrument can collect data from any type of sensor. The instrument has multiple electrometers, conductivity, amperometric and thermocouple inputs up to 25 in all.



Data was collected over 6 days in a local pond in New Jersey showing the interaction of pH, ORP, air, and water temperatures, during diurnal cycling.
blue = pH, green = ORP
purple = air temp, orange = water temp

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