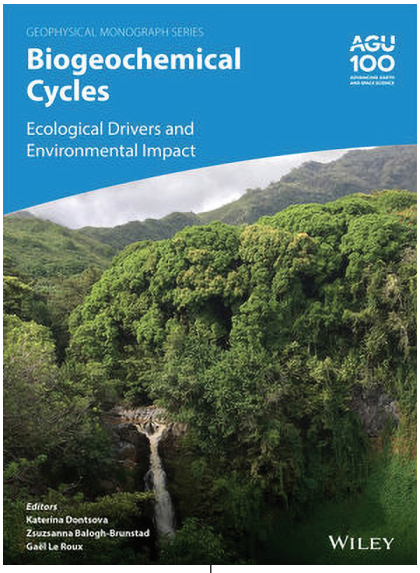
BIOGEOCHEMICAL CYCLES: ECOLOGICAL DRIVERS AND ENVIRONMENTAL IMPACT[1]



Volume 251 of the Geophysical Monograph series is dedicated to the role of living organisms in critical zone processes. It is co-edited by three researchers in environmental sciences: Katerina Dontsova (University of Arizona, USA), Zsuzsanna Balogh-Brunstad (Hartwick College, New York, USA) and Gaël Le Roux (CNRS, University of Toulouse, France). The book *Biogeochemical Cycles: Ecological Drivers and Environmental Impact* emerged from the session "Ecological Drivers of Biogeochemical Cycles under Changing Environments" at the 2016 Goldschmidt conference in Yokohama (Japan).

The critical zone forms a thin veneer "between the rocks and the sky" on the surface of our planet. It is where living organisms – from bacteria and fungi to animals and trees – play a major, if not dominant, role in transforming barren rocks into what we term "the habitable zone". The concept of the "critical zone" came from the geological community and the need to explain why laboratory mineral dissolution rates were orders of magnitude higher than those deduced from natural data. From this, it has become increasingly apparent that a large number of processes, and their associated fluxes of matter, result, at least in part, from biological activity. Thus, the study of the critical zone has evolved to integrate ideas from very disparate fields, including microbiology, astrobiology, ecology, geology, ecotoxicology, geochemistry, and geomorphology. This broader perspective, and the now worldwide development of critical zone observatories, is enabling researchers from these disciplines to engage at common sites, something that will, without a doubt, facilitate a much-needed reunification of scientific disciplines that have largely developed on separate trajectories since the pioneering work of Russian mineralogy and geochemistry polymath Vladimir Vernadsky (1863–1945).

The book has been edited by three scientists, each from three different scientific backgrounds: soil sciences, geology and biogeochemistry. This scientific convergence helps reframe how we think of critical zone processes, previously deemed "geochemical" but now better understood as "biogeochemical". The book compiles 14 short chapters organized in three sections: biological weathering, elemental cycles, and frontiers and managed ecosystems. The final chapter is a synthesis that summarizes the ideas developed in each chapter and proposes new avenues of research. As for all volumes of the AGU Geophysical Series, the papers are nicely presented and easy to read even for non-experts. Sixty-eight scientists from around the world contributed to the volume, and the papers range from fundamental to applied environmental sciences. The volume contains interesting review papers, including an evolutionary perspective on the role of organisms in weathering, plus papers on plants and microbes as agents of weathering. It also includes very focused papers on the new innovative tools used to study the critical zone, such as molybdenum isotopes, the use of remote sensing data for vegetation mapping, and micro-scale techniques for the exploration of bacteria–fungi interactions. The papers address geochemical cycles of carbon as well as many other elements, including "potential harmful trace elements" that affect the health of humans as well as all the other living organisms in the critical zone. The book highlights the importance of models as a way of investigating the new notions of "Earthcasting" and "Hindcasting" the critical zone and the crucial need for better modeling microbial decomposition of organic matter in soils. Finally, and in line with other critical zone–based publications, there is a focus on some particularly well-instrumented "critical zone observatories" where knowledge accumulation has allowed scientists to break the walls between disciplines. Thus, the Strengbach catchment in the Vosges Mountaina (France), catchments in the Pyrenees (France/Spain), the Shale Hills catchment (Pennsylvania, USA), areas of permafrost, and farms in India are all presented as key natural laboratories where modern interdisciplinary tools and models are combined to produce cutting-edge scientific knowledge.

I enjoyed reading this book. It provides breath of fresh air for Earth and life scientists by bridging the spatial and temporal scales through a wider biogeochemical perspective. This book is perfectly adapted for anyone who needs to prepare general lectures on the role of biological weathering; for master and graduate students it can act as an introduction to biogeochemical cycles. There is no doubt that this book will act as a milestone for the geological community, forcing a lot of us to realize, or to start to realize, that biotic and abiotic processes are but two sides of the same coin.

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1 Dontsova K, Balogh-Brunstad Z, Le Roux G (eds) (2020) *Biogeochemical Cycles: Ecological Drivers and Environmental Impact*. American Geophysical Union. 336 pp, ISBN: 978-1-119-41331-8, US$199.95 (print), US$160.00 (e-book).