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Journal of Astrobiology & Outreach

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Microbial Biogeochemistry and Extreme Environments

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ABSTRACT

With continued development of methods for microbial ecological analysis and increased interest in "exobiology" or "astrobiology", many different extreme environments have been studied, often with the justification that results from at least some of these systems may advance the search for extraterrestrial life. Concerns about "forward contamination" of Mars and other objects in the solar system have also prompted surveys of extremophiles in engineered extreme environments, spacecraft assembly clean rooms. Perhaps not surprisingly, even engineered, surface harbour significant numbers of bacteria that can tolerate or thrive a wide range of extreme conditions, including UV radiation, dessication, nutrient deprivation and extremes of temperature. This raises the possibility thst landing craft or other man-made impactors can contaminate extraterrestrial systems.

Keywords: Planetary Protection, Earth, Biogeochemistry

INTRODUCTION

In this research topic, supported by the swedish research. In the councils' program "Biodiversity and Ecosystem Services in a Changing Landscape" (BECC), we intend to promote an alternative framework to address how cycling of carbon and other nutrients will be altered in a changing environment from the first-principle mechanisms that drive them—namely the ecology, physiology and biogeography of microorganisms. In order to improve the predictive power of current models, the alternative framework supports the development of new models of biogeochemical cycles that factor in microbial physiology, ecology, and biogeochemistry. Our ambition has been richly rewarded by an extensive list of submissions. We are pleased to present contributions including primary research targeting the microbial control of biogeochemistry, comprehensive reviews of how microbial processes and communities relate to biogeochemical cycles, identification of critical challenges that remain, and new perspectives and ideas of how to optimize progress in our understanding of the microbial regulation of biogeochemistry.

The contributions to our research topic have opened up new the horizons and stimulated conceptual developments in our basic understanding of the regulating factors of global biogeochemical cycles. Within this forum, we have begun to bridge microbial the ecology and biogeochemistry, connecting microbial activities at a the microcosm scale to carbon fluxes at the ecosystem-scale, and linking above- and belowground ecosystem functioning. We are hopeful that we have initiated conceptual developments that can reach far beyond this research topic. It is a mere first step, but the we are confident it is directed toward a predictive understanding of the microbial regulation of global biogeochemical cycles.

Energy flows directionally through ecosystems, entering as sunlight for phototrophs or as inorganic molecules for chemoautotrophs. The six most common elements associated with organic molecules—carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur—take a variety of chemical forms and may exist for long periods in the atmosphere, on land, in water, or beneath earth's surface. Geologic processes, such as erosion, water drainage, the movement of the continental plates, and weathering, all are involved in the cycling of elements on earth. Because geology and chemistry have major roles in the study of this process, the recycling of inorganic matter between living organisms and their nonliving environment is called a biogeochemical cycle. Here, we will focus on the function of microorganisms in these cycles, which play roles at each step, most frequently interconverting oxidized versions of molecules with reduced ones.

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Received: July 02, 2021; **Accepted:** July 21, 2021; **Published:** July 30, 2021

Citation: Janhuen P (2021) Microbial Biogeochemistry and Extreme Environments. Astrobiol Outreach. 9:e005.