1.5 Geomicrobiology of volcanic caves

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Abstract

The interest in geomicrobiology is clearly raising due to its important applications in biomining, bioremediation of metal-rich waters and soils, mineral transformations, astrobiology, or space exploration activities. This emerging field of science studies the interactions of microorganisms with geological substrates. Caves provide an excellent habitat for extremely specialized microorganisms able to interact with minerals, where we can understand the role of microorganisms in biogeochemical cycles and biomineralization processes. These priceless subterranean resources are found worldwide and remain one of the least explored habitats on Earth. Yet, lava caves, such as those in Hawaii (USA), Canary (Spain), Azores and Madeira Islands (Portugal) have recently received particular attention due to the detection of numerous volcanic cave entrances on the Moon and Mars. Such subsurface geological settings may host microbial activity over geological timescales, offering a unique opportunity to study highly specialized microorganisms, their novel metabolic strategies, and their interactions with igneous rocks that are relevant for a wide range of disciplines.

Implementing portable cutting-edge DNA-based analysis, complemented with in-depth metagenomics, as well as high resolution microscopy techniques, the diversity and function of microbial communities in speleothems from Selvagens Islands (Madeira, Portugal) and Lanzarote (Canary Islands, Spain) lava tubes have been investigated to understand which microorganisms grow in these extreme ecosystems, which functional properties they have, and their role in constructive and/or destructive mineralization processes.

Characterizing cave microbiota and the stressors (e.g., tourism, agriculture, and human habitation) threatening these subterranean environments represents a crucial step toward robustly exploring and protect these unique underground resources, allowing for implementation of future protection policies.

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