Chemosynthesis based cave ecosystems at liquid:gas and gas:gas redox interfaces

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Similarly to the deep ocean, caves and other hypogean environments are characterized by lack of sunlight, absence of photoautotrophic carbon fixation, scarcity of food resources, low biodiversity, and small population sizes for the animal communities inhabiting them. We discuss two types of cave ecosystems that are based on chemosynthesis. In 1986, a land based hydrothermal discharge was discovered in Movile Cave, Romania. Chemoautotrophic bacteria use the redox interface between reduced compounds (H2S, CH4 and NH4+) in the water and oxygen in the cave atmosphere. Organic molecules produced in situ support a rich and diverse invertebrate community consisting of 34 endemic species. We present data regarding the fauna living in Movile Cave, its adaptations to sulfidic conditions, the mechanisms of cave colonization, and the structure of the subterranean food web, as well as the microorganisms present in the cave: species composition, physiology, interactions between species, and symbiosis. Since 1986, other chemosynthesis-based underground ecosystems were discovered in Italy, Israel, Mexico, Greece, and in the USA. The second example are chemosynthetic microbial communities growing in a volcanic cave in Romania. Gas emissions rich in CO2 (96%) and H2S (0.3%) form aerial gas:gas redox interfaces with H2S below and atmospheric O2 above. On the mineral substrate of the cave's walls we found robust communities of microorganisms dominated by species of: Mycobacterium and Acidithiobacillus (Bacteria), and Ferroplasma (Euryarchaeota). The most remarkable features observed in this cave are: extensive nanowire-like structures in the microbial mats that connect cells with sulfur crystals, as well as a microbial community that uses water vapor as the sole water source.