

The fascinating biology of stinky caves

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Abstract

The discovery of Movile Cave in 1986, similarly to the discovery of the deep-sea vents 9 years earlier, showed that, when redox interfaces are present in subsurface ecosystems, diverse and abundant biological communities can thrive based primarily on autochthonous food produced in situ by chemosynthesis. Additional caves, partially flooded by sulfidic water have been discovered, i.e. the Frasassi caves in Italy, Ein-Nur Cave and Ayyalon Cave in Israel, Melissotrypa Cave in Greece, Tashan Cave in Iran, caves in the Sharo-Argun Valley in the Caucasus Mountains, etc. All of these are inhabited by numerous endemic cave-adapted organisms present in dense populations sustained by a rich food base generated within the subterranean environment by microorganisms that use atmospheric oxygen to oxidize the reduced chemical compounds present in the water (H_2S , NH_4^+ , CH_4). Stable isotope data has shown that the biological communities found in sulfidic caves are not dependent on carbon fixation in green plants that use light energy in the process of photosynthesis. Special adaptations have been identified in some of these inhabitants that allow them to cope with the adverse environmental conditions such as toxicity of H_2S , hypoxia, and extreme pH values. Symbiotic associations between crustaceans, protozoa, and sulfide oxidizing bacteria were discovered in several sulfidic caves. New species of microorganisms have also been described from these unusual subsurface environments.

Unusual microbiomes have recently been discovered in dry caves that contain chemoclines between heavy volcanic gasses dominated by CO_2 , but also containing H_2S and CH_4 , and atmospheric air that floats on top of the volcanic gas emissions. Unique sulfur mineralization, microbial biofilms containing new species of bacteria that thrive at extremely pH values, symbiotic relationships between bacteria and fungi have been discovered in Sulfur Cave in Romania, Bosoletto Cave in Italy, and Sousaki caves in Greece. The extreme life conditions encountered in these caves are of special interest to astrobiologists using these caves as a model for better understanding conditions that life may be present in on other planets and celestial bodies in our Solar System and beyond.

Keywords

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