

Workshop on the subsurface biosphere at mid-ocean ridges


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A workshop was held in Washington, DC from 17-19 March 1997 to examine the evidence for a subsurface biosphere associated with mid-ocean ridges and to identify the key questions that need to be addressed in order to test the existence of a spatially extensive biosphere that is not dependent on nutrients derived from photosynthesis. More than 100 microbiologists, biologists, geologists, geophysicists, geochemists, biochemists, biotechnologists and engineers attended the workshop. Because of the large group and diversity of topics, the format of the meeting consisted of invited talks and panel discussions on broad ranging topics, as well as contributed posters. The talks and panel discussions focused on the physical, geophysical and geochemical characteristics of the subsurface, the microbial diversity and biogeochemistry issues, and research strategies for sampling and modeling the subsurface.

A diverse body of recent evidence supports the idea of a subsurface microbial biosphere associated with mid-ocean ridges. This includes the detection of microorganisms in drill cores from deep ocean sediments obtained through the Ocean Drilling Program (ODP), the isolation of hyperthermophiles from deep oil wells and diffuse flow fluids from new eruption sites, and the detection of microorganisms in basaltic glass. Many of the talks and panel discussions focused on the geophysical and geochemical characteristics of these environments and the sources and kinds of carbon, nitrogen, phosphorus, and electron acceptors and donors that would be available to support a microbial community. Some of the highlights of the invited talks included: 1) seismic evidence pointing to active cracking and consequently hydrothermal circulation to depths of 5 km along the Endeavour Segment in the NE Pacific Ocean; 2) high porosity of the extrusive layer at mid-ocean ridges; 3) the presence of microorganisms in deep-sea cores that might have extremely slow reproduction rates; 4) the possibility that iron may be the most important electron acceptor and donor for subsea-

floor bacteria; 5) models for abiotic synthesis of organic compounds under hydrothermal conditions; 6) the possibility that new deep-sea eruption events eject deep subsurface microorganisms; and 7) the implications of a subsurface biosphere associated with hydrothermal activity to life on other planets and moons and to the origin and early evolution of life on Earth. The lively panel discussions focused on subsurface spatial dimensions, the sources and kinds of carbon and other nutrients needed to support life in the subsurface, and the diversity of microorganisms that could exploit these available nutrients.

It was clear from this workshop that many questions exist regarding the physical, chemical and biological nature of the subsurface habitat and that answers to these questions will require interdisciplinary measurements, experiments and models. Some of the key issues to be resolved which were identified at the workshop include: 1) the vertical and horizontal dimensions of the subsurface biosphere; 2) the importance of hydrothermal circulation to the subsurface microbial community; 3) the sources and kinds of carbon, nitrogen, phosphorus and energy sources for subsurface microbial communities; 4) whether or not new eruptive events, including diking episodes, release indigenous subsurface microorganisms; 5) how microorganisms affect the geochemistry of the subsurface; 6) the phylogenetic and physiological diversity of subsurface microbial communities; and 7) the fate of subsurface microbial carbon. The workshop also concluded that rapid response to new sea-floor eruptions, time series measurements, and drilling were among the important approaches needed to facilitate further study of the issues listed above.

One of the most rewarding aspects of the workshop was that so many insightful and enthusiastic researchers turned their attention to this subject and promising new collaborations were born. 

Workshop Report

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