New approach opens window into life below the seafloor

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Source: Bigelow Laboratory for Ocean Sciences

Summary: Scientists studied microorganisms from an underwater mountain in the Atlantic Ocean, pioneering a method that could open new windows into our understanding of how life survives deep under the sea -- or in space.

FULL STORY

New research may provide a breakthrough for scientists to understand life in the harshest of environments. Scientists from Bigelow Laboratory for Ocean Sciences studied microorganisms from an underwater mountain in the Atlantic Ocean, pioneering a method that could open new windows into our understanding of how life survives deep under the sea -- or in space.

The crustal rock beneath the ocean floor is one of the largest regions on Earth that can support life. Inside the pores and fractures of rocks are little-understood microorganisms that influence global-scale nutrient cycles. Now, researchers have developed and demonstrated a new method to study them. They recently published their results in *mBio*, an online journal of the American Society of Microbiology.

"Most microbial life on Earth is in the subsurface," said Senior Research Scientist Beth Orcutt, the senior author on the paper. "In order to understand how life has evolved on Earth, how organisms have survived for millennia, you have to look at the subsurface: a huge reservoir of life."

The researchers looked at microbes from Atlantis Massif, a 2.5-mile-high underwater mountain near the Mid-Atlantic Ridge. The region is thought to be an analog for how life may exist on other planets and moons, such as Europa and Enceladus. On top of Atlantis Massif, there is a region called Lost City, which teems with life feeding off of activity from hydrothermal vents. NASA and other institutions are interested in these systems as a model for the origin of life and how organisms survive in harsh environments.

Away from the busy ecosystem of Lost City, life still exists in the rock. There, microbes are spread out in low concentrations, which makes them difficult to study by examining a few rock samples at a time.

"Even though there is low biomass in crustal rock, its sheer volume makes it one of the most significant biological habitats of the planet," said lead author Jacqueline Goordial, who completed the research as a postdoctoral scientist at Bigelow Laboratory.

Traditionally, researchers would examine microorganisms by removing them from rock samples with chemicals. However, that method can be problematic and is difficult to carry out when there is a low abundance of life. So, the team came up with a new method.

Working with the Single Cell Genomics Center and the Center for Aquatic Cytometry, both part of Bigelow Laboratory, the team was able to develop a method using a tool called flow cytometry. Flow cytometry allows researchers to examine and sort cells quickly and accurately. It also makes it possible to study a cell's genetic information, opening up a world of research opportunities.

"This approach provides a way to access the genomes of organisms that are very difficult to study," said Goordial, now an assistant professor at the University of Guelph. "Being able to access sites with low biomass is huge! It can teach us about the nature of microbial life on our planet and allows us to answer fundamental questions about how they survive and what they eat."

The team studied microbes from crustal rocks excavated up to 50 feet beneath the ocean floor. They found that the ecology represented by the rocks from Atlantis Massif was distinct from the Lost City hydrothermal vents, but comparable to other similar settings. This meant that the system, while unusual for our planet, is not one of a kind. The microbes appear to survive mostly off of carbon from seawater, much like organisms that live in the water at the bottom of the ocean. In addition, some microbes might also be able to use carbon monoxide for energy.

The results of the research show that the new method could be useful for studying other environments where the microbes are limited, such as in permafrost, other deep-sea locations, or even other planets.

"We're demonstrating methods that could be used for samples taken by a NASA rover that can only collect a couple of tiny fragments," Orcutt said. "We are pushing the limits of how you would look for life in those places."

Story Source:

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Journal Reference:

1. J. Goordial, T. D’Angelo, J. M. Labonté, N. J. Poulton, J. M. Brown, R. Stepanauskas, G. L. Früh-Green, B. N. Orcutt. **Microbial Diversity and Function in Shallow Subsurface Sediment and Oceanic Lithosphere of the Atlantis Massif**. *mBio*, 2021; DOI: 10.1128/mBio.00490-21

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