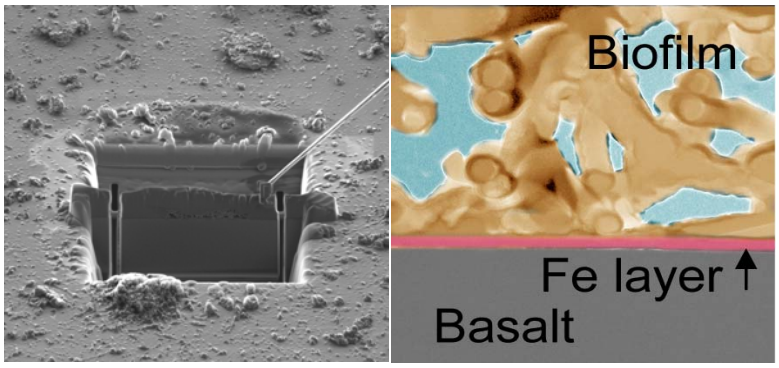
Growing Up Next to a Volcano

Evidence shows iron, manganese help seafloor biofilms thrive in extreme environment

Using resources at the Department of Energy's EMSL and the Stanford Synchrotron Radiation Lightsource, scientists found that very low concentrations of dissolved metals in seawater may be the energy source microbial communities use to colonize seafloor rocks, presenting insights into how microbial communities thrive in the Earth's crust. The current hypothesis is that these communities derive the energy needed to grow by dissolving and oxidizing volcanic-created basalt.



Focused ion beam technology allows preparation of a precise cross-section into the basalt sample covered with a newly formed iron layer and biofilm. A thin section is used for imaging and analyses by transmission electron microscopy.

The team began with samples of young pillow basalts from the Loihi seamount, an underwater volcano known as the youngest in the Hawaiian chain. They determined the chemical changes that occurred on the basalt surfaces as the microbes colonized and grew. The analyses showed little evidence of basalt dissolution. Rather, biofilm growth was intimately tied to the oxidation of iron and manganese from the seawater, leading to the deposition of highly reactive Fe(III) and Mn(IV) oxide layer on the basalts surfaces. High-resolution imaging at EMSL on polished basalt glasses left near the volcano for a year also showed that volcanic glasses rapidly obtained an iron layer during biofilm growth. Over time, these mineral layers are likely to exert an enormous influence on the environmental chemistry of the seafloor.

Microscopy experts at EMSL were significant contributors on the team from the University of Colorado at Boulder, SSRL, Scripps Institution of Oceanography, and the Oregon Health & Sciences University. This study was the first user project to apply EMSL's focused ion beam/scanning electron microscope.

Scientific impact: This research offers a new hypothesis regarding the growth of microbial organisms in the ocean crust, and their key role in creating biominerals during dynamic biogeochemical processes in the seafloor ecosystem. This is part of EMSL's efforts to characterize complex environmental interfaces with unprecedented spatial resolution.

Societal impact: These insights into the real-time evolution of the biosphere show how the Earth and its environmental processes function.

For more information, contact EMSL Communications Manager Mary Ann Showalter (509-371-6017).

Reference: Templeton, AS, EJ Knowles, KL Eldridge, BW Arey, AC Dohnalkova, SM Webb, BE Bailey, BM Tebo, and H Staudigel. 2009. "A Seafloor Microbial Biome Hosted Within Incipient Ferromanganese Crusts." *Nature Geoscience.* DOI: 10.1038/NGE0696.

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