

Extreme habitats: Microbial life in Old Faithful Geyser

October 12 2023, by Arianna Soldati



Old Faithful geyser and the surrounding splash pools. Steam can be seen coming out of the conduit of Old Faithful. Credit: Lisa M. Keller

An eruption of Old Faithful Geyser in Yellowstone National Park is a sight to behold. Indeed, millions of tourists flock to the park each year to see it. Hot water and steam are ejected in the air to a height of 100–180 feet approximately every 90 minutes. Many adjectives come to mind to describe it: powerful, mesmerizing, unique, otherworldly . . . homey? Not so much.

Yet new research by Lisa M. Keller, published in [PNAS Nexus](#) earlier this year and to be presented on Sunday at the [Geological Society of America's GSA Connects 2023 meeting](#), shows that for some microbial life forms, Old Faithful Geyser is exactly that: home.

Meet *Thermocrinis ruber* and *Thermus aquaticus*. *Thermocrinis ruber* is the most abundant bacterium residing in Old Faithful, making up over 60% of the microbial population. As a chemoautotroph, it makes its own energy, not only for its own sustenance, but also to the benefit of the rest of the microbial community.

But how? Old Faithful is a dark, hot place, which makes photosynthesis impossible. Instead, *Thermocrinis ruber* takes CO₂ outgassing from the [geyser](#) and turns it into carbon forms that are potentially cross-feeding heterotrophs in the community, such as *Thermus aquaticus*.

Both bacteria are extremophiles—[life forms](#) that thrive where most would not survive. Whatever the challenging environmental factor, there are microbes adapted to overcome it. Hypersaline pools? Check. Lack of oxygen? You bet. Scorching [hot water](#)? Not a problem.



Eruption of Old Faithful geyser taken between sampling trips. Credit: Lisa M. Keller

Geysers present a unique challenge: they are extremely dynamic environments. As if being thrown hundreds of feet in the air every 90 minutes isn't disruptive enough, the microbes are subject to fluctuating steam and [water temperatures](#) that constantly change throughout the eruption cycle.

In every challenge there is an opportunity, and Old Faithful's thermal excursions and eruptions are no exception. More strains of *Thermocrinis* are found in Old Faithful than in any other non-geysing hot spring in

Yellowstone. "We think that the highly dynamic geyser environment creates many different ecological niches that Thermocrinis can occupy, causing increased sub-species level diversity," says Keller. These findings show not only that Old Faithful Geyser is habitable, but also that its dynamic environment promotes genomic diversity.

In order to prevent any possible sample contamination, Keller collected geysed water as it was falling from the eruption in weighted sterile bins. Ten minutes after the end of the eruption she would walk out to the cone with a National Park Service escort and retrieve the precious samples. Additionally, she sampled a pool fed exclusively through Old Faithful's eruptions.

Once back in the laboratory, Keller incubated the samples at different temperatures representative of geyser and pool conditions. The objective? Monitor the microbial activity to verify that the sampled bacteria would really be active at those extreme temperatures. And active they were, to Keller's delight. "They immediately showed signs of activity, suggesting there is active microbial life in Old Faithful waters," says Keller.



The conduit of Old Faithful geyser where steam is rising up (left of picture) and splash pool sampled during this study immediately to the right of the opening. Tubing can be seen extending from where we were sampling in the splash pool. Permit number #5544. Credit: Lisa M. Keller



Filtering mechanism used to pump water from the splash pool for analysis of microbial communities within the pool. Old Faithful geyser cone can be seen directly behind the filtration setup. Permit number #5544. Credit: Lisa M. Keller



Plastic catch tub with weights used to collect plume water during Old Faithful eruption. Permit number #5544. Credit: Lisa M. Keller

Beyond Earth, geysers are of extreme interest to the planetary community, as active geyser eruptions have been observed on the moons Enceladus and Europa. "Everybody gets excited about sampling Enceladus plumes," says Keller, "but prior to this work we didn't even have terrestrial geysers microbial samples. I thought, let's take a step back and figure it out on our own planet first."

Sampling planetary geysers may still be a long way off, as the current methodology requires filtering liters and liters of water—something that

would certainly be challenging away from Earth—but now that we know for sure that terrestrial geysers can host life, the race to find it on planetary geysers is on too.

More information: Lisa M Keller et al, An active microbiome in Old Faithful geyser, *PNAS Nexus* (2023). [DOI: 10.1093/pnasnexus/pgad066](https://doi.org/10.1093/pnasnexus/pgad066)

Provided by Geological Society of America

Citation: Extreme habitats: Microbial life in Old Faithful Geyser (2023, October 12) retrieved 22 June 2024 from <https://phys.org/news/2023-10-extreme-habitats-microbial-life-faithful.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.