# Extreme life discovery in Yellowstone bodes well for astrobiologists

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***pH value in rock pores where organisms live acidic enough to dissolve nails, say researchers***

University of Colorado at Boulder researchers say a bizarre group of microbes found living inside rocks in an inhospitable geothermal environment at Wyoming's Yellowstone National Park could provide tantalizing new clues about ancient life on Earth and help steer the hunt for evidence of life on Mars.

The CU-Boulder research team reported the microbes were discovered in the pores of rocks in a highly acidic environment with high

concentrations of metals and silicates at roughly 95 degrees F in Yellowstone's Norris Geyser Basin. The new study shows the microbe communities are subject to fossilization and have the potential to become preserved in the geologic record.

Scientists believe similar kinds of geothermal environments may once have existed on Mars, where astrobiologists have intensified the search for past and present life forms in recent years.

A paper by CU-Boulder doctoral student Jeffrey Walker, postdoctoral fellow John Spear and Professor Norman Pace of CU-Boulder's molecular, cellular and developmental biology department and the Center for Astrobiology appears in the April 21 issue of Nature.

The research was funded by the National Science Foundation and NASA.

"This is the first description of these microbial communities, which may be a good diagnostic indicator of past life on Mars because of their potential for fossil preservation," said Walker. "The prevalence of this type of microbial life in Yellowstone means that Martian rocks associated with former hydrothermal systems may be the best hope for finding evidence of past life there."

Located about 20 miles northwest of Yellowstone Lake, Norris Geyser Basin is considered to be the hottest and most active geyser basin in Yellowstone and perhaps the world. It also is extremely acidic, according to the researchers.

"The pores in the rocks where these creatures live has a pH value of one, which dissolves nails," said Pace. "This is another example that life can be robust in an environment most humans view as inhospitable."

The process used to identify the organisms developed by Pace is much more sensitive than standard lab-culturing techniques that typically yield a small, biased fraction of organisms from any environment, said Walker. In this method, the researchers detected and identified organisms by reading gene sequences.

"Each kind of organism has a unique sequence, which is used to map its position in the tree of life," said Walker. "It's a family tree of sorts that describes the genetic relationship between all known organisms."

Walker discovered the new microbe community in 2003 after breaking apart a chunk of sandstone-like rock in the Norris Geyser Basin. "I immediately noticed a distinctive green band just beneath the surface," he said. "It was one of those 'eureka' moments."

An analysis determined the green band was caused by a new species of photosynthetic microbes in the Cyanidium group, a kind of alga that is among the most acid-tolerant photosynthetic organisms known, said Walker. Cyanidium organisms made up about 26 percent of the microbes identified in the Norris Geyser Basin study by the CU-Boulder team, Walker said.

Surprisingly, the most abundant microbes identified by the team were a new species of Mycobacterium, a group of microbes best known for causing human illnesses like tuberculosis and leprosy, Walker said. Extremely rare and never before identified in such extreme hydrothermal environments, Mycobacterium made up 37 percent of the total number of microbes identified by the CU-Boulder team.

Pace described the new life form in the Norris Geyser Basin as "pretty weird." "It may well be a new type of lichen-like symbiosis," said Pace, who won a MacArthur Fellowship, or "genius grant," in 2001. "It resembles a lichen, but instead of being comprised of a symbiosis

between a fungus and an alga, it seems to be an association of the Mycobacterium with an alga."

While photosynthesis appears to be a key energy source for most of the creatures, at least some of Yellowstone microbes are believed to get energy from the dissolved metals and hydrogen found in the pore water of the rock, Walker said. A study by the CU-Boulder team published in January 2005 by the National Academy of Sciences indicated Yellowstone microbe populations living in hot springs at temperatures more than 158 degrees F use hydrogen as their primary fuel source.

The research effort in the Norris Geyser Basin shows that rock formation processes occurring in the hydrothermal environment under study make very real fossil imprints of the organisms embedded in the rock at various stages, showing how the distinctive fossils develop over time, according to the research team.

"Remnants of these communities could serve as 'biosignatures' and provide important clues about ancient life associated with geothermal environments on Earth or elsewhere in the Solar System," the authors wrote in Nature.

Source: University of Colorado

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