NEWS RELEASE
University of Massachusetts Amherst

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# Microbe Survives At Temperatures Above Sterilization Standard

*Findings have implications for origins-of-life and extraterrestrial-life searches*

AMHERST, Mass. – Life can survive and thrive at higher temperatures than previously thought, remaining stable at 130°C (266°F) and reproducing at temperatures as high as 121° C (250°F), according to research conducted by two University of Massachusetts Amherst microbiologists. The information gathered by Professor Derek Lovley and postdoctoral researcher Kazem Kashefi has implications not only for understanding when and where life evolved on Earth and how deep in the planet's subsurface life exists, but also for determining the potential for life on other, hotter planets, particularly Mars. Their work was funded by the National Science Foundation through a Life in Extreme Environments grant and will appear in the Aug. 15 issue of Science.

Prior to this research, the upper temperature known to support life had been 113°C (235°F) and the gold standard in sterilization had been 121°C, the temperature used in autoclaves to sterilize medical equipment and in canning to keep foods from growing toxic microorganisms. "Strain 121," as Lovley and Kashefi have temporarily named the heat-loving organism, would thrive in an autoclave.

"If we threw this organism in a pot of boiling water it would be happy," Lovley said. "Our finding changes the concept of adequate heat for sterilization that has been in place for more than 100 years."

But don't reschedule your surgery or throw out that creamed corn yet. He adds, "We have to actually grow it in ovens to make it grow its best. Organisms that grow in extreme temperatures probably won't grow at body temperature or room temperature."

Besides challenging a long-held belief about sterilization, the discovery of Strain 121 adds to knowledge about the location of life on Earth and could help to find it on Mars. Lovley said: "Scientifically, just knowing the upper temperature of life is significant because it has a lot of implications for where life will be found on Earth. In terms of biomass, the total amount of life below the Earth's surface is greater than what we see on the surface. If life can thrive at higher temperatures, then that's just that much deeper in the Earth life can exist, so it's likely

that the below-surface biomass is even greater than we previously suspected."

"It's also thought that if there were life on Mars, it's almost certainly at the subsurface," Lovley said. "This information can contribute to design strategies for how you would look for it."

Lovley and Kashefi's work points to a form of iron, Fe(III), as a key to discovering life at high temperatures.

Strain 121 was isolated at 100°C from a water sample from an active hydrothermal vent in the northeast Pacific Ocean, located near the Endeavor segment of the Juan de Fuca Ridge. Using formate as an electron donor and Fe(III) oxide as an electron acceptor, the researchers found the strain grew at temperatures between 85°C and 121°C.

The organism's use of iron for respiration and its tolerance of high temperatures may provide clues to the origins of life on Earth, including pushing back estimates of the time at which life could have evolved. Lovley said: "Geological evidence suggests that microoganisms that use Fe(III) as an electron acceptor are key components of the deep, hot biosphere. These organisms use iron the way we use oxygen. The byproduct of such microbial respiration is magnetite, and magnetite is found on very old rocks. Early Earth was a lot hotter than now, and life probably evolved at very high temperatures."

Strain 121 may hold industrial value, as well. "There's a lot of interest in enzymes that can tolerate high temperatures," Lovley said. "Such enzymes may prove useful in cleaning up 'hot' contaminated waste."

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Images of work on strain 121 are available at www.geobacter.org
(User name: press Password: press2003)

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