This Story
Home

- Related Sites & Stories

- E-mail this story

Heat-Loving Microbes Offer Clues to Life's Origins

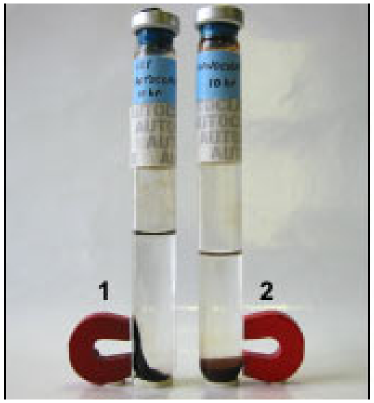
John Roach
for National Geographic News

Over the past 20 years scientists have warmed up to the idea that the majority of life on our planet lives not on Earth's surface but beneath its crust. The theory has spurred new ideas about life's origins on Earth and where to look for life on other planets.

Earth's crust gets warmer the closer it is to the molten iron-nickel believed to be at our planet's core. One question that scientists who study life beneath Earth's crust face is, at what temperature is it too hot for life to survive?

Since scientists believe Earth at one point was mostly molten, the answer to the question may shed light on how early life could have first evolved on our planet.

Read the full story >>



The microbe known as Strain 121, which was discovered on undersea superheated hydrothermal vents, thrives at temperatures near 121° Celsius (250° Fahrenheit) and breathes rust. In the left test tube, a magnet attracts magnetite, the byproduct of Strain 121's respiration of iron oxide and offers a tell-tale sign of life in the tube. The microbe is absent from the right test tube.

Photograph courtesy Derek Lovley, University of Massachusetts, Amherst.

Funding for this Earth-systems science story was provided by the National Science Foundation. This special series of news stories is produced as a complement to

Pulse of the Planet, a daily sound portrait of the Earth broadcast on radio.

Listen to this and other *Pulse of the Planet* programs in streaming audio.

"If Earth had to cool to a certain temperature at which life was possible, maybe the high-temperature life could have existed that much sooner," said Derek Lovley, a microbiologist at the University of Massachusetts, Amherst.

Much of this life beneath the crust, which scientists refer to as biomass, are microbes that use hydrogen and minerals like iron to get energy from food sources in the same way that humans use oxygen to obtain energy from our food.

Lovley is at the forefront of research into such microbes. He has discovered dozens of different species, including Strain 121, a microbe that grows at 121° Celsius (250° Fahrenheit)—the highest temperature currently known for life.

The ability to grow at 121° Celsius is significant because for over a century it has been the temperature used to sterilize medical equipment. Scientists thought that such temperatures would kill all life-forms.

More News
Adventure & Exploration
Archaeology & Paleontology
Kids News
Animals & Nature
Science & Technology
People & Culture
The Environment
Travel
National Geographic Channel

Special Series
Emerging Explorers
TravelWatch

National Geographic Out There

Oceans

Pulse of the Planet

"It's kind of a benchmark," Lovley said. "This is like breaking the four-minute mile."

Strain 121, which goes dormant at temperatures below 80° Celsius (176° Fahrenheit), lives in environments known as hydrothermal vents on the ocean floor. The vents spew hydrogen- and mineral-rich hot water from deep in the Earth's crust to the surface.

For several years scientists have known that other microbes survive in and around hydrothermal vents at temperatures above 100° Celsius (212° Fahrenheit). Strain 121 just "opens that window where life can exist a little bit wider," Lovley said.

Jack Farmer, an astrobiologist at Arizona State University in Tempe, said that opening this window for life on Earth expands the potential for life to develop and persist elsewhere in the solar system and beyond.

"As the upper temperature limit for life has increased, new opportunities for habitable environments have opened up, and subsurface hydrothermal environments are among the most important," Farmer said.

"Poor Man's Drill"

John Delaney, a marine geologist at the University of Washington in Seattle, led the expedition that brought to the surface the chunk of hydrothermal vent from which Strain 121 was isolated.

Delaney said that examining such environments gives researchers a snapshot of what life is like deeper in the Earth's crust, where temperatures are higher. "Our way of doing it was a 'poor man's drilling program,'" he said.

The expedition team used a remotely operated submarine to cut out and bring to the surface a chunk of hydrothermal vent from the Juan de Fuca Ridge, which lies about 200 miles (322 kilometers) offshore from Washington's Puget Sound and nearly 1.5 miles (2.4 kilometers) deep in the Pacific Ocean.

The seafloor at the Juan de Fuca Ridge is cold, about 2° Celsius (36° Fahrenheit). But down beneath the seafloor the temperature warms gradually until, eventually, it is scalding hot.

"If you telescope those conditions by having hot water coming out along a fissure it will build a sulfide chimney," Delaney said. "And this sulfide chimney is very cold on the outside—two or three degrees—but on the inside it might be as much as 300° centigrade."

A chunk of one of these chimneys, or hydrothermal vents, is what Delaney and his team brought to the surface.

"We figured we would see different kinds of microbes in the wall as it got to hotter and hotter temperatures, and [that] pretty soon microbes wouldn't be there ... [which would] indicate a limit to life under those conditions," he said.

Limits and Origins

Microbes like Strain 121 that live in environments lacking organic carbon are known as archaea, which literally means "ancient." Archaea are genetically different from seemingly similar bacteria, which need organic matter and photosynthesis to survive.

The discovery of Strain 121 bolsters the theory held by some scientists that Earth's first life-forms were archaea that could thrive at high temperature via chemical reactions with hydrogen and iron.

"They appear to be the branches closest to what is the last common ancestor of existing life," Lovley said. "All are hyperthermophiles that live at high temperatures."

Early in Earth's history, according to Delaney, volcanic eruptions occurred on the ocean floor as the planet's core separated from its crust. These eruptions could have allowed the mixing of hydrogen and minerals like iron and sulfur, upon which microbes could thrive.

"That may be one of the paths the origins of life takes," Delaney said. If that's the case, he added, then studying hydrothermal vents is a step in the process of understanding how the dynamics of such a system might work.

And understanding how such a system works on Earth may help in the search for life on other planets.

Farmer, the Arizona State University astrobiologist, said, "At the bottom line, hydrothermal systems were widespread in the early solar system and are thought to still be present in the subsurface of many other solar system objects, like Mars, Europa, and even the interiors of large asteroids."

So perhaps the question for scientists isn't is there life on other planets, but is there life inside them.

Related Stories

- Rust-Breathing Bacteria—Miracle Microbes?
- Microorganisms Cleans Up Toxic Groundwater
- Mud Batteries: Power Cells of the Future

Related Websites

- Pulse of the Planet
- Geobacter Project
- University of Washington: School of Oceanography
- Arizona State University: Astrobiology

Comments? Contact the news desk.

News Home

Write the Editor | Advertise with Us | Masthead | nationalgeographic.com E-mail Updates | Press Room | Privacy Policy

More to see at **nationalgeographic.com**

NATIONAL GEOGRAPHIC NEWS LOADING