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'Terraforming in a bottle' on Mars

Future human explorers working in the harsh climes of Mars could find easy breathing and comfy living inside biodomes — that is, if research by a small Indiana company succeeds.

Scientists at Techshot, Inc., of Greenville, Ind., want to test the concept of ecopoiesis, in which specialized bacteria generate oxygen from soil and create a mini-ecosystem. In an experiment on Mars, Techshot's sensor-laden container would corkscrew into the landscape and release ecosystem-pioneering organisms inside the container. These cyanobacteria and other microorganisms that live in extreme conditions on Earth would interact with a soil sample of Mars drawn into the container to make metabolic byproducts, especially oxygen for human explorers to breathe.

The scientists hope such an experiment can hitch a ride on a future NASA rover sent to Mars.

Eugene Boland, chief scientist at Techshot, is working on the idea with grant money from the NASA Innovative Advanced Concepts Program, under the space agency's Space Technology Mission Directorate.

Techshot exposed microbes to simulated Mars conditions for five weeks earlier this year, Boland says.

"We're impressed that our microbes still survived under the atmospheric pressure of Mars, the full solar radiation that reaches the planet's surface, along with the day-night temperature swings," Boland said. Using simulated Mars soil provided by NASA's Jet Propulsion Laboratory, water was injected into the sample of Mars dirt to mimic subterranean ice already shown to exist on the planet.

Once planted on Mars, perhaps 1 1/2 inches to 2 inches deep, the hardware would use Martian ice as its phase changes into liquid water, Boland says.

Mars is not completely devoid of oxygen. So the test bed equipment would be outfitted with a sensor to assure that the transplanted-from-Earth microbes are indeed churning out oxygen. Data gleaned by the experiment would be relayed to a Mars orbiting spacecraft for transmission to Earth.

Boland says, "The two biggest challenges we have right now [are] building the device small enough that we can drill into sandy Martian regolith" and using "a low-torque drill that can be mounted on a rover's robot arm, one that doesn't take up too much space or power."

"This idea of terraforming in a bottle is pretty ambitious…but I think it's a good idea," says Chris McKay, an astrobiologist at NASA Ames Research Center in California. McKay is part of an advisory team on the project.

"If we want to know how life can survive on Mars, we have to use life as the probe," McKay says. "No amount of chemical or geological 'context' is a substitute for actually growing life forms. This seems like a good way to start it," Boland stated by email.

Boland says his goal is limited and achievable: Make biodomes housing bacterial or algae-driven systems that convert Martian regolith into useful oxygen.

"I think we can actually use biological oxygen factories on Mars, essentially to grow the supplemental oxygen that will be needed," Boland said. "That's what my vision of this system really becomes…kickstarting it with microbes."

Eugene Boland/Techshot, Inc.

In a test chamber that simulates Mars conditions, scientists at Techshot, Inc. examine how Earth-sent microbes interact with Mars soil to create an ecosystem capable of supporting life.

Leonard David
NewsSpace@aol.com