Researchers hone technique for finding signs of life on Mars

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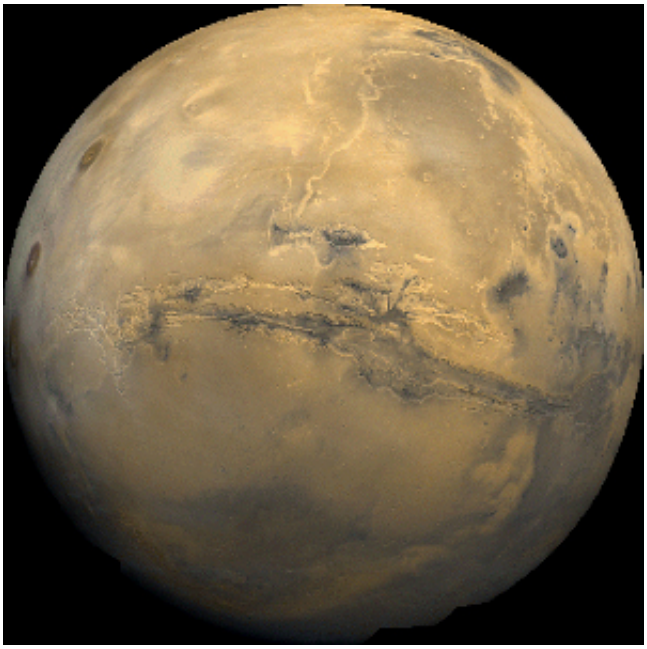

Valles Marineris, Mars. Credit: NASA

For centuries, people have imagined the possibility of life on Mars. But long-held dreams that Martians could be invaders of Earth, or little green men, or civilized superbeings, all have been undercut by missions to our neighboring planet that have, so far, uncovered no life at all.

Yet visits to the Red Planet by unmanned probes from NASA and the European Space Agency have found evidence that a prime condition for life once may have existed: water.

"There has been a tremendous amount of very exciting findings this year that Mars once contained actively flowing, low-saline, near-neutral-pH water—pretty much the type of water where you find life on Earth today," said Alison Olcott Marshall, assistant professor of geology at the University of Kansas. "This has made people think that it's possible that life could have existed on Mars, although most researchers agree it's unlikely to exist today—at least on the surface—as conditions on the surface of Mars are incredibly harsh."

Olcott Marshall is working with her colleague and husband, Craig Marshall, associate professor of geology at KU, to improve the way scientists detect condensed aromatic carbon, thought to be a chemical signature of astrobiology.

"If we're going to identify life on Mars, it will likely be the fossil remnants of the chemicals once synthesized by life, and we hope our research helps strengthen the ability to evaluate the evidence collected on Mars," Craig Marshall said.

Craig Marshall is an expert in using Raman spectroscopy to look for carbonaceous materials, while Alison Olcott Marshall is a paleontologist interested in how the record of life gets preserved on Earth, especially when there is no bone or shell or tooth or other hard part to fossilize.

The pair is known recently for overturning the idea that 3.5 billion-year-old specks found in rocks in Australia were the oldest examples of life on Earth. (Rather than ancient bacteria fossils, the researchers showed the shapes were nothing more than tiny gaps in the rock that are packed with minerals.)

If traces if ancient biology are detected in Mars, the KU researchers want to make sure the evidence is more conclusive.

According to a recent paper by the Marshalls in the peer-reviewed *Philosophical Transactions of the Royal Society A*, by itself Raman spectroscopy is able to screen for carbonaceous material, but it can't determine its source—thus the technology needs to be supplemented in order to determine if life exists on Mars.

"Raman spectroscopy works by impinging a laser on a sample so the molecules within that sample vibrate at diagnostic frequencies," Craig Marshall said. "Measuring those frequencies allows the identification of inorganic and organic materials. It's insufficient because however the carbonaceous material is made, it will be the same chemically and structurally, and thus Raman spectroscopy cannot determine the origin."

The Marshalls call for the use of gas chromatography/mass spectroscopy to supplement Raman spectroscopy and develop more conclusive evidence of ancient extraterrestrial life.

"Much like the search for ancient life on Earth, though, one strand of evidence is not, and should not be, conclusive," said Alison Olcott Marshall. "This is a vast puzzle, and we want to make sure we are examining as many different pieces as we can."

Currently, the KU researchers are extending this line of investigation by using Raman spectroscopy to analyze rocks from Earth that are similar to those on Mars. They hope to publish their findings in the near future.

"If you were to pick up a typical rock on Mars it would look quite different, chemically, from a typical rock here on Earth, not to mention the fact that it would be covered in rusty dust," Alison Olcott Marshall said. "Previous research into how Raman spectroscopy would fare on Mars was mainly done on pure salts and minerals, often ones synthesized in a lab. We identified field sites on the Kansas-Oklahoma border with a chemical content more like what could be found on Mars, right down to

the rusty dust, and we've been exploring how Raman spectroscopy fares in such an environment."

More information: Raman spectroscopy as a screening tool for ancient life detection on Mars, *Philosophical Transactions of The Royal Society A Mathematical Physical and Engineering Sciences*, 12/2014; 372(2030). DOI: 10.1098/rsta.2014.0195

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