Potential signs of life on Mars might be easier to find than first thought

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The experiment rose to the edge of space before plummeting back to Earth, simulating Mars' atmosphere. Credit: Thales Alenia Space

A school science experiment is answering questions that are out of this world. While there had been concerns that any evidence of organic matter on Mars might be obscured by the planet's geology, new research suggests this might not be the case.

A group of budding young researchers has helped to demonstrate how evidence of life on Mars could be found.

Students from St Bernard's Convent High School in Westcliff-On-Sea, Essex, assisted scientists from the Natural History Museum and University College London in an experiment to see what evidence any potential ancient life may have left on the red planet.

Pupils from the all-girls school, whose alumni include Dame Helen Mirren, prepared samples of a microbial mat that were flown to the edge of space in a balloon to mimic the conditions on Mars. This allowed the researchers to examine any changes that the cold, dry atmosphere caused to the signs of life.

Connor Ballard, a Ph.D. student who led the study, says, "We wanted to get the students involved in as many aspects as possible with this research, and they were really engaged throughout."

"We know that science suffers from a lack of diversity, so being able to work with these young women was a pleasure. I know a lot of them want to pursue a science career, so we really hope this will help them in their futures."

Dr. Louisa Preston, a scientific associate at the Natural History Museum and co-author, adds, "It's really brilliant for these young women to already have a paper out with their name on to celebrate their work."

"Getting kids involved in science is really important, and so we hope this will inspire other students too."

The findings of the study were published in the journal *Research Notes of the AAS*.

Markers on Mars

Since the 1990s, six rovers have successfully touched down on the surface of Mars to learn more about our neighboring planet. Many of these missions have tried to answer one big question—has there ever been life on Mars?

It's not as outlandish at it might seem. While a human would not survive on Mars' surface, there are many microbes on Earth that could find its carbon dioxide rich, dry atmosphere very hospitable.

It is hoped that if it ever existed, Martian life left some traces behind in the form of physical or chemical markers known as biosignatures. But identifying these signs could prove tricky. High levels of radiation, temperature extremes and Mars' weather might have damaged or obscured the markers making them hard to detect.

To account for this, researchers wanted to know what tell-tale signs are left behind as biosignatures break down. The team were particularly interested in the effect gypsum might have on these signs.

On Earth, this mineral is found in dry lakes, and it has been suggested that on Mars the mineral might have preserved the organic molecules of any life that could have lived in any liquid water. But there are problems with this.

"While gypsum might be good at preserving organics, it might also make them harder to find," Connor explains. "Working in infrared, the issue is that a lot of the core characteristics of gypsum have absorption features which obscure organic peaks in the spectrum. It's a bit of a catch-22."

In collaboration with the students, the team decided to simulate what the signs of ancient life might look like on the red planet by making use of

the Natural History Museum's collections.

Fly high

To simulate any potential Martian biosignatures, the team faced two challenges: to find a proxy for Martian life, and to simulate the conditions on the planet.

If life existed on Mars, it's thought that it might have been in the form of microbial mats. These are collections of bacteria and other microbes that created some of the oldest evidence of life on Earth, so it's not unreasonable to assume that life on Mars might have taken a similar path.

As part of her research, Louisa has been working with samples of microbial mats from the Natural History Museum's collection.

"I've been working with microbial mats collected during the Discovery expedition, led by the polar explorer Robert Falcon Scott in the early 1900s," she says. "These mats are well-preserved and, despite their age, still show strong biosignatures."

"This made them a good option to use here, and I think Robert Falcon Scott would be pleased that, over a century later, a sample from his expedition would still be breaking new ground."

Now they had found their proxy, the team needed to simulate the conditions of Mars. To solve this problem Louisa and the team turned to a company called Thales Alenia Space, which has been launching weather balloons carrying school science experiments to the edge of space since 2014.

By taking the specimens up to the edge of space, it was hoped they

would experience conditions similar to those found on the red planet.

With the balloon set for launch, the school students were able to mix together minute samples of the microbial mat with gypsum in different proportions before sealing the samples into plastic containers. Half were left on Earth as a control, while the others were raised to around 30 kilometers above the Earth before parachuting safely to the ground.

The returned samples were then scanned using infrared spectroscopy, a technique that identifies the makeup of a sample by looking at how it absorbs infrared radiation. The scans of the control samples found that higher levels of gypsum in the mixture obscured the biosignatures in the microbial mat.

However, for the samples that had traveled to the edge of space it was a different picture. Exposure to high altitude had caused the gypsum to dry out, meaning that certain aspects of the mat were highlighted in the resulting analysis.

This suggests that rovers on Mars equipped with infrared spectrometers, like NASA's Perseverance and Curiosity, should be able to detect biosignatures even if preserved in gypsum.

Connor hopes that future tests might be able to shed light on how other minerals affect biosignature detection, giving researchers the best possible opportunity to find any signs of organic material on Mars.

More information: Connor J. Ballard et al, Testing the Limits of Biosignature Detection in Ca-sulphate Mixtures Through a Simulated Martian Environment, *Research Notes of the AAS* (2023). DOI: 10.3847/2515-5172/ad103f