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SCIENCE NEWS BY AGU

The Mental Toll of Climate Change

Volcanoes on Venus

Dusting Off Climate Models

SPEEDING UP

THE SCIENCE OF ADVANCED ACCELERATION, FROM ICE BLOCKS TO BOW SHOCKS.

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The model calculated the monthly change in Earth's energy balance caused by the eruption and showed that water vapor could increase the average global temperature by up to 0.035°C over the next 5 years. That's a large anomaly for a single event, but it's not outside the usual level of noise in the climate system, Jenkins said. But in the context of the Paris Agreement, it's a big concern.

"If we're only a quarter of a degree from 1.5°C, those four hundredths of a degree do actually make a tangible difference," he said. The planet was already 50% likely to warm past 1.5°C in the next 5 years, and the presence of HTHH's water vapor increased the odds of temporarily exceeding that threshold to 57%, according to the simulation.

What About 1.5°C?

The volcano launched an "unprecedented" amount of water vapor into the stratosphere, said Patrick Sheese, a climate physicist at the University of Toronto who was not involved in the study. But the event's impact can't compare with that of human emissions, he said. Even if the eruption increases temperatures as the simulation predicted, that's only a small, temporary lift toward the 1.5°C threshold.

Decades of research have shown that humans are still responsible for most of the warming.

The study "is just another reminder that nature isn't going to help us out of climate change."

But as the study showed, part of that warming will have been caused by natural anomalies. Any number of phenomena can sway global temperatures, from El Niño conditions in the Pacific Ocean to wildfires in Siberia.

The HTHH eruption may nudge the temperature past 1.5°C of warming, but that doesn't mean the Paris Agreement has failed; the event demonstrated how close the world is to its agreed-upon tipping point.

The study "is just another reminder that nature isn't going to help us out of climate change," Sheese said. "This clearly is up to us to fix."

By **J. Besl** (@J_Besl), Science Writer

We (Probably) Can't Tell Whether Mars Has Life

The Perseverance rover snapped a photo of an escarpment known as "Scarp a" in Jezero crater. Credit: NASA/JPL-Caltech/ASU/MSSS

Many features on the surface of Mars look similar to features right here on Earth—from towering volcanoes to weathered rock outcrops to clear traces of dried-up lakes and riverbeds. The similarities have led many—including noted space oddity David Bowie—to ask, Is there life on Mars?

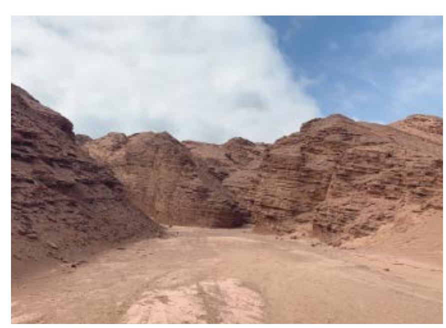
Although robotic landers have found evidence for water and organic molecules, the answer so far seems to be no. A study published in *Nature Communications,* however, may give reason to hope the issue isn't settled (bit.ly/detecting-life-Mars). Researchers showed that even with the most advanced laboratory equipment we have, it's difficult to identify life on Earth, much less on another planet.

"It will be harder than expected to find evidence of life on Mars with the current generation of instruments that we're sending," said Armando Azua-Bustos, a microbiologist at Saint Louis University Madrid in Spain and lead author of the study.

Azua-Bustos and his collaborators concluded this from experiments performed in the Red Stone region of the Atacama Desert in Chile. As the oldest and driest desert on the planet, the Atacama is frequently cited as the closest terrestrial analogue to Mars. The Red Stone region is an ancient alluvial delta (between 100 million and 163 million years old) that bears strong geological similarities to the 3.5-billion-year-old delta at the edge of Jezero crater on Mars, where NASA's Perseverance rover now is collecting samples.

The Right Equipment

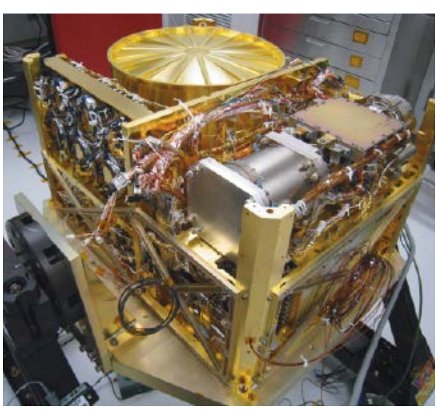
In practice, searching for life involves chemical experiments, such as gas chromatography-mass spectrometry (GCMS), in which Martian soil samples are vaporized and their components are analyzed for organic molecules or chemicals known to be inimical to known life. Many planetary missions have carried GCMS instruments, including the 1970s Viking landers on Mars, the Cassini Saturn orbiter—which found organic molecules in jets of water from the moon Enceladus—and the currently operating Martian rovers, Curiosity and Perseverance.



No, this isn't Mars. The Red Stone alluvial delta site in Chile's Atacama Desert strongly resembles the edge of Jezero crater on Mars. Credit: Armando Azua-Busto

NASA's Perseverance rover is currently exploring Jezero Crater (shown here) with a suite of scientific instruments designed to detect evidence of ancient life. Credit: ESA/DLR/FU-Berlin

Azua-Bustos and his colleagues used GCMS, DNA/RNA sequencing, and optical microscopes to search for evidence of both living and fossil microorganisms in Red Stone rocks. The GCMS they used was more sensitive than anything carried on Mars missions, yet it detected only trace evidence of life.



The Sample Analysis at Mars (SAM) instrument inside the Curiosity rover includes a gas chromatograph–mass spectrometer, which analyzes soils collected from the surface. Credit: NASA-GSFC

In addition, the genetic sequencing—which Mars landers currently are not capable of—couldn't identify 9% of the organisms at all and could make only broad classifications for an additional 40% of the samples. The researchers referred to these unidentified organisms as the dark microbiome, which may be analogous to any Martian life scientists might find, if it resembles life on Earth at all.

Amy Williams, an organic geochemist at the University of Florida who was not involved in the study, said future planetary missions would need broader approaches like those used at the Red Stone site. "The next step is to do an extraction on [Martian] samples to pull the organics out and concentrate them," she said. "That's what we do on Earth with very lean samples that don't have a lot of organics in them."

Both Azua-Bustos and Williams, who works on the Curiosity rover and the design of the proposed Mars Life Explorer, emphasized the need to return Martian samples to Earth for analysis because laboratories here will always be more advanced than anything we can send on a spacecraft.

"For me, the easiest way is to see something crawling, but that probably will not be the case.

Even confirming fossil microbes on Earth is fraught, Azua-Bustos pointed out. "I would expect that it will be even harder on Mars to see anything, given the extreme environment," he said. "For me, the easiest way is to see something crawling, but that probably will not be the case."

By **Matthew R. Francis** (@DrMRFrancis), Science Writer