PROSPECTS FOR LIFE ON VENUS FADE — BUT AREN'T DEAD YET

Reanalysis suggests a fainter signal of phosphine gas in the planet's atmosphere than originally reported.

By Alexandra Witze

Signs of a potential marker of life in Venus's atmosphere have faded — but they're still there, according to a new data analysis.

In September, an international team of astronomers made headlines when it reported finding the gas phosphine — a potential marker of life — in the planet's atmosphere[1]. Several studies questioning the observations and conclusions quickly followed. Now, the same team has reanalysed part of its data, citing a processing error in the original data set. The researchers confirmed the phosphine signal, but say that it's fainter than before.

The work is an important step forward in resolving the most exciting Venus debate in decades. "I've waited all my life for this," says Sanjay Limaye, a planetary scientist at the University of Wisconsin–Madison, who says the debate has reinvigorated the field.

The reanalysis[2], based on radio-telescope observations at the Atacama Large Millimeter/submillimeter Array (ALMA) in Chile, concludes that average phosphine levels across Venus are about one part per billion — approximately one-seventh of the earlier estimate. Unlike in their original report, the scientists now describe their discovery of phosphine on Venus as tentative.

In its September report, the team used data from ALMA and the James Clerk Maxwell Telescope (JCMT) in Hawaii to make its discovery. Team leader Jane Greaves, an astronomer at Cardiff University, UK, says she and her colleagues redid the work because they had learnt that the original ALMA data contained a spurious signal that could have affected the results. ALMA posted the corrected data on 16 November, and Greaves and her team ran a fresh analysis that night and posted it ahead of peer review on the preprint server arxiv.org. "We've been working like crazy," she told a meeting of the Venus Exploration Analysis Group, a NASA community forum, on 17 November.

According to Greaves and her colleagues, the ALMA data show the spectral signature of phosphine, a molecule made of one phosphorus and three hydrogen atoms. They say no other compound can explain the data. Finding phosphine on Venus would be tantalizing because microbes produce the gas on Earth. If the signal is real and indeed due to phosphine, it's possible that microbes living in and drifting among the planet's clouds could be producing the gas[3,4] — but it's also possible there might be a non-living source that scientists have yet to identify. Before they can determine whether either of these scenarios is true, researchers first need to confirm phosphine's presence.

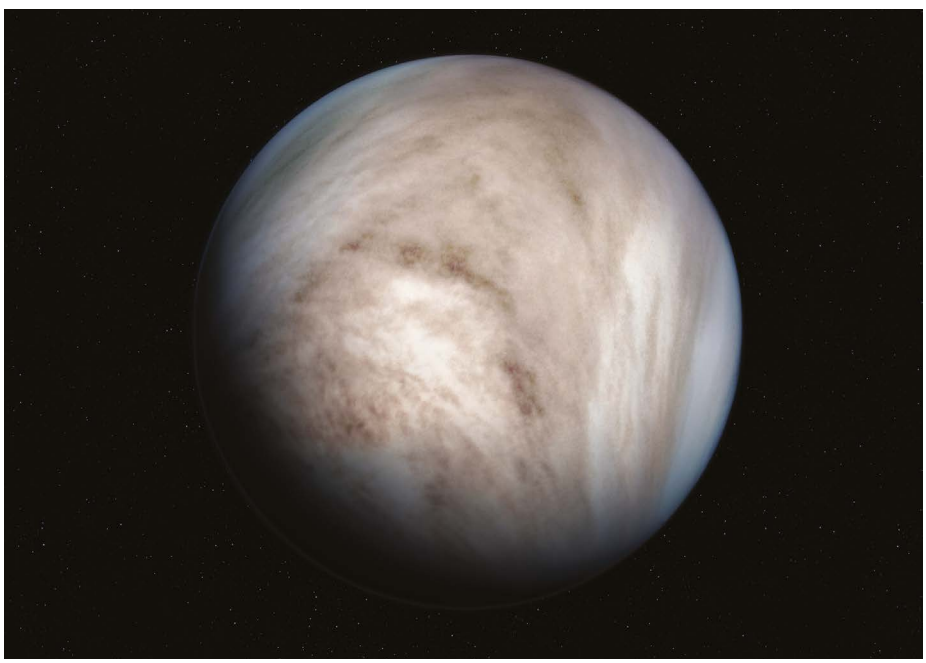
In one critique of the original study, researchers suggested[5] that the signal reported as phosphine might really be coming from sulfur dioxide, a gas that is common in Venus's clouds but is not produced by life there. Greaves and her team fired back in their latest report that that can't be the case, because of how the phosphine fingerprint appears in data collected by the second telescope they used, the JCMT. Other critiques have focused on the difficulty of extracting a phosphine signal out of complicated data.

Solving the mystery

One other new strand of evidence supports phosphine on Venus. Inspired by Greaves's original report, a team led by Rakesh Mogul, a biochemist at California State Polytechnic University in Pomona, dug through decades-old data from NASA's 1978 Pioneer Venus mission. This spacecraft dropped a probe that measured the chemistry of clouds in the planet's atmosphere as it fell. It detected a phosphorus signal that could be attributed to phosphine or another phosphorus compound[6]. But "we believe the simplest gas that fits the data is phosphine", Mogul said at the meeting on 17 November.

Where the phosphine comes from remains a mystery. The only spacecraft currently orbiting Venus, Japan's Akatsuki, does not carry instruments that could help settle the debate. The Indian Space Research Organisation is planning a Venus mission that would launch in 2025 and could potentially carry instruments capable of looking for phosphine. In the meantime, Greaves and other researchers are applying for more time on Earth-based telescopes, including ALMA.

Researchers are investigating many other aspects of Venus, says David Grinspoon, an astrobiologist at the Planetary Science Institute who is based in Washington DC. "There are 1,001 reasons to go back to Venus, and if the phosphine 'goes away' through further observations and analysis, there will still be 1,000 reasons to go."



DETLEV VAN RAVENSWAAY/SPL

Venus has a thick, acidic atmosphere, once thought unsuitable for life.

1. Greaves, J. S. *et al. Nature Astron.* https://doi.org/10.1038/s41550-020-1174-4 (2020).
2. Greaves, J. S. *et al.* Preprint at https://arxiv.org/abs/2011.08176 (2020).
3. Bains, W. *et al.* Preprint at https://arxiv.org/abs/2009.06499 (2020).
4. Seager, S. *et al. Astrobiology* https://doi.org/10.1089/ast.2020.2244 (2020).
5. Villanueva, G. *et al.* Preprint at https://arxiv.org/abs/2010.14305 (2020).
6. Mogul, R., Limaye, S. S., Way, M. J. & Cordova, J. A. Jr Preprint at https://arxiv.org/abs/2009.12758 (2020).

© 2020 Springer Nature Limited. All rights reserved.