# Venus resurgent

After years of relative neglect, Venus is enjoying renewed interest, with several missions bound to reach it in the next decade. Many questions about its nature still need to be answered, including regarding the highly debated presence of phosphine.

Phosphine is an unlikely headliner. This chemical compound, which has the same structure as ammonia just with phosphorus in place of nitrogen, is hardly on the A-list of astronomically significant molecules. Even though it has been proposed as a promising biosignature, it has not received the attention of, for example, methane or oxygen. Venus too suffered from an 'image deficit', particularly compared to our other planetary neighbour, Mars. Maybe it's the hellish conditions at its surface, or the fact that planet-wide clouds do not allow us to look at the surface with our own eyes, but the numbers are clear: since 2000, 15 missions were sent to Mars (14 of which were successful), but only two towards Venus. Even some basic properties of the planet, such as the moment of inertia, have only recently been discovered. And yet, when we published the paper by Jane Greaves and colleagues that found evidence of phosphine in the cloud deck of Venus in September 2020, it attracted immediate and intense attention. Its Altmetric score, which tracks the overall impact of scientific publications in the media, is a staggering 10,650, one of highest among the papers published in 2020 across all fields — an impressive feat for a year dominated by a pandemic!

At its roots, the presence of phosphine on Venus is a mystery. According to our knowledge of chemistry, Venus's atmosphere shouldn't be able to sustain it. Thus, either we have an incomplete or incorrect view of Venus's chemistry, or there is a source we do not know about. It is the latter option that attracted so much attention, following a reasoning that recalls the 'methane on Mars' one: on Earth, such trace gases are produced almost in their entirety by living organisms. Seemingly, phosphine has even fewer abiotic pathways to production than methane in terrestrial planets.

The post-publication path of the Greaves et al. paper has been as interesting as the immediate aftermath. It has generated a thriving discussion among scientists, at various levels. The result was scrutinized intensely from both technical and scientific points of view. Several publications have appeared since the paper was published, raising various points and proposing alternative scenarios to the one of life or disputing the actual detection. At *Nature Astronomy* we understand the value of post-publication debate and have a specific format that encourages it within our pages. This Matters Arising format frames the discussion in a formal setting by allowing the community to voice their concerns and the authors to reply within a full peer-reviewed and editorially controlled process. In this issue we present the Matters Arising from Geronimo Villanueva and colleagues that raised a comprehensive series of questions about the results and methodology, together with the reply from Greaves et al.

We also appreciate that fresh information that might have a significant impact on the results could come out after publication. For instance, this month's issue also presents a paper from Hallsworth et al. arguing that the clouds of Venus are uninhabitable even for terrestrial extremophile microbes. In addition, it was found that the calibration of one of the ALMA (Atacama Large Millimeter/submillimeter Array) datasets used by Greaves et al. had been carried out incorrectly. While the authors waited for the recalibration, an Editor's note was attached to the paper. With their re-analysis complete, Greaves et al. published an Addendum that presents the results with the new calibration. In this way, we preserve the integrity of the publication record in an open and transparent way.

The issue of communicating the results within the right frame and with a healthy degree of caution is also paramount when extraterrestrial life is mentioned, even in passing. Journals, researchers, scientific institutions and journalists all need to work to convey the correct information to the public. This approach is all the more important for high-impact papers such as the phosphine one. From our side as a journal, we act at different levels: in this case, we worked with the authors and reviewers at the editorial stages to refine the message in the paper itself and we issued a press release centred around the scientific facts that clarifies what is speculation and what is not at publication. The phosphine paper was generally well received by the community, which appreciated the authors' efforts to clearly state that the biotic source of the molecule was just one possible explanation among many. We strive to avoid misinterpretation in this delicate field and we will work similarly for any future papers on the topic.

The question of the detection of phosphine and where it comes from is still open. New dedicated observations are forthcoming, but we will probably get a clear answer only by going back to the planet. Happily, it seems that Venus is finally getting the spotlight it deserves. June 2021 has been a dream come true for the Venusian community, which was awarded three new missions in the space of ten days. NASA selected the VERITAS (Venus Emissivity, Radio Science, InSAR, Topography, and Spectroscopy) orbiter and the DAVINCI+ (Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging, Plus) probe as its next Discovery missions, and the European Space Agency chose the EnVision spacecraft for its new M-class mission. All these will be launched around 2030, so we will be able to advance our knowledge of our still poorly understood neighbour by leaps and bounds in the not-too-distant future. ❐

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