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Space exploration

Venus fly-by may confirm potential signs of life

Leah Crane

ON 14 September, researchers announced that two telescopes had spotted signs of phosphine in Venus's clouds, and no known non-biological processes could have made the gas in such large amounts. The BepiColombo spacecraft may be able to confirm that the phosphine is indeed there.

BepiColombo, a joint mission by the European Space Agency and the Japan Aerospace Exploration Agency, launched in 2018. Before it arrives at Mercury in 2025, it will pass near Venus twice, using the planet's gravitational pull to adjust its trajectory.

The first pass should occur on 15 October, and the team had already planned to test the craft's instruments by observing Venus. Now, the researchers are working out how to use them to check the phosphine finding.

This is important because the phosphine discovery isn't entirely certain. When light goes through gas in Venus's atmosphere, some of its wavelengths are absorbed, leaving dark lines in the light's spectrum called absorption lines. Phosphine absorbs light at thousands of wavelengths, but the telescopes that spotted the gas only caught it absorbing one wavelength in Venus's skies.

"The discovery was like getting a partial fingerprint and we want lots of fingerprints"

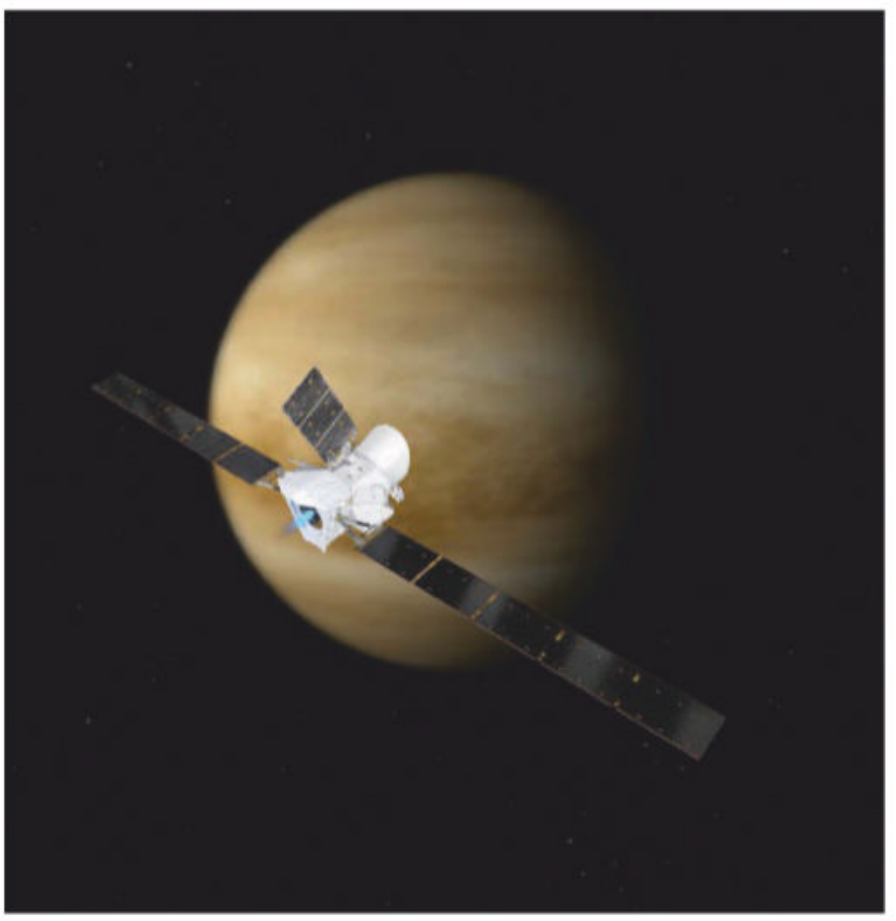
"The discovery was only one line – that would be like getting a partial fingerprint, and we want lots of fingerprints," says Sara Seager at the Massachusetts Institute of Technology, who is part of the team behind the detection. The researchers are now working on plans to examine the light further with Earth-based telescopes and potentially even new missions to Venus.

BepiColombo may be equipped to get a phosphine fingerprint before the planned observations. Preliminary calculations have shown that two of phosphine's absorption lines are in the wavelength range of one of the instruments, the Mercury Radiometer and Thermal Infrared Spectrometer (MERTIS), that was already due to take images of Venus as the spacecraft hurtles by, says team member Jörn Helbert at the German Aerospace Center.

MERTIS has two cameras, but their configuration may complicate efforts to get a good shot of Venus: during its voyage to Mercury, the main camera is folded inwards and unable to capture images. The second MERTIS camera is a calibration tool designed to take images of space to capture ambient light and remove its effects on the main camera's data. As BepiColombo passes Venus, this poorer quality calibration camera might be able to search for phosphine, says David Rothery at the Open University in the UK.

Luckily, there will be another chance. "We have a second fly-by coming up in August 2021 where we are even closer to Venus," says Helbert.

Without the main MERTIS camera and with no time to alter the October fly-by plans, it isn't certain whether BepiColombo can confirm there is phosphine in Venus's atmosphere next month. If it does, we will then be left to figure out whether the gas is truly is a sign of life. ▮



ESA/ATG MEDIALAB

The BepiColombo spacecraft depicted passing Venus

Environment

Air pollution may be behind millions of deaths in China

Donna Lu

UP TO 30.8 million adults in China and Taiwan are estimated to have died prematurely as a result of air pollution during a 17-year period.

Yang Liu at Emory University in Atlanta, Georgia, and his colleagues used satellite imagery to quantify the amount of air pollution over mainland China, Hong Kong, Macao and Taiwan between 2000 and 2016. The team used imagery taken by NASA satellites to estimate the concentrations of PM2.5 – particulate matter of less than 2.5 micrometres in diameter.

One measurement the team used is the amount of sunlight scattered or absorbed by particles in the air. Combining these readings with PM2.5 measurements from ground monitoring stations, as well as information about meteorological conditions and road networks, the researchers trained a machine-learning algorithm to predict PM2.5 exposure.

To estimate the total mortality linked to air pollution, the team then used historical data from a study of 116,821 adults in 15 Chinese provinces, which quantified the link between long-term PM2.5 exposure and non-accidental death. There was a roughly linear relationship between PM2.5 exposure and mortality, up to a certain point (*PNAS*, doi.org/d9n5).

"The people who live in the most polluted regions get disproportionally harmed," says Liu.

The highest per-capita deaths due to air pollution were found in the north-eastern Chinese provinces of Hebei, Henan, Shandong and Tianjin.

To date, most air pollution monitoring has been done from stations on the ground. In China, these are concentrated in urban areas, which doesn't account for some 600 million people in rural areas. In addition, measurements before 2013 are scarce. ▮