

**ONE NIGHT ONLY:**  
Dash Through the Messiers

PAGE 20

**TEST REPORT:**  
Airy Disk's 106-mm Refractor

PAGE 68

**OBSERVING:**  
The Major Lunar Standstill

PAGE 48

# SKY & TELESCOPE

THE ESSENTIAL GUIDE TO ASTRONOMY

APRIL 2025

## Primordial Black Holes

# ARE THEY OUT THERE?

Page 34



[skyandtelescope.org](http://skyandtelescope.org)

\$9.99US \$10.99CAN

A  
A  
S  
04>

6 20058 02207 8

## INNER PLANETS

## Ancient Venus Didn't Have Oceans After All

ASTRONOMERS HAVE CONDUCTED a long and fierce debate about whether Venus was always a dry hellscape with oven-like temperatures. Now, as published December 2, 2024, in *Nature Astronomy*, three researchers from the University of Cambridge, UK, offer support for that idea.

Of two rival theories of Venus's past, one argues that Venus was once temperate and hosted oceans of water — enough to cover the surface to a depth of 500 meters (1,600 feet). But then, more recently, volcanoes released vast quantities of carbon dioxide and sulfur dioxide, greenhouse gases that trapped the Sun's heat. The water first evaporated, then escaped into space. Alternatively, Venus may always have been too hot and dry to support liquid water.

Tereza Constantinou and her colleagues utilized the Venusian atmosphere — largely the product of volcanic gases from within the planet — to probe the interior and examine how dry the planet really is.

The team calculated the current rate at which water, carbon dioxide,

and carbonyl sulfide (COS) molecules are destroyed in the planet's atmosphere. They also considered chemical reactions occurring between Venus's air and surface, weathering that can cause these molecules to be stored in the planet's crust.

Constantinou and her team conclude that Venus's volcanic gases are at most 6% water. This implies the planet's interior is too dry to ever have brought large quantities of water to the surface.

"This is an intriguing study," says James Holmes (Open University, UK), who was not involved in the research. However, he adds, "There still remain uncertainties that are likely to influence the results, such as the precise chemical composition of the deep atmosphere and the current rate of active volcanism."

Not everyone is convinced by these new calculations. "They make two

▼ This computer-generated 3D model of Venus's surface (with a vertical scale exaggerated 10 times) shows the summit of Maat Mons, a site of past and perhaps current volcanic activity.

assumptions that I would question," says Richard Ghail (Royal Holloway, University of London), who was also not involved in the research. "Their assumption about Venus surface weathering is, I suspect, wrong." If the team overestimated the amount of carbonyl sulfide and carbon dioxide that chemical reactions deposit into the planet's crust, then there would be fewer of those molecules relative to water. Then, to keep the atmosphere in balance, the amount of water ejected from the planet's interior would need to be higher than the team estimated.

"I think they [also] significantly underestimate the importance of the sulfur cycle," Ghail adds. For example, as sulfur-rich minerals break down on the surface, carbonyl sulfide could be put back in the air, providing another way to shift the ratio of that molecule relative to water. The team admits the story for sulfur is "more nuanced."

Perhaps it will take future missions — including NASA's VERITAS and DAVINCI, and the European Space Agency's Envision — to settle the debate on Venus's past once and for all.

■ COLIN STUART

