

EOS

VOL. 106 | NO. 6
JUNE 2025

SCIENCE NEWS BY AGU

CREVASSES IN GREENLAND

AN OCEAN ON CALLISTO

RIVERS IN BRAZIL

Illuminating the Abyss

A New Generation
of ROVs Is Taking Us
Deeper into the Ocean



Buried Sediments Point to an Ancient Ocean on Mars

From alluvial fans to lake beds, Mars has no shortage of surface features that were clearly sculpted by flowing water. But evidence of a planetary-scale body of water on the Red Planet—that is, an ocean—has been comparatively lacking.

Now, researchers have analyzed radar data collected by a Mars rover and found buried sediments arranged much in the same way as terrestrial coastal deposits. The discovery is evidence that an ancient ocean once persisted over much of the Red Planet's northern hemisphere, according to the team.

In 2021, China's Tianwen-1 spacecraft touched down on Mars's northern hemisphere in the Utopia Planitia region. Its payload, the 250-kilogram Zhurong rover, spent the next 12 months making a 1,921-meter traverse of Mars's northern lowlands.

Some of the data the rover collected included ground-penetrating radar measurements. Ground-penetrating radar works by directing electromagnetic waves into the ground and measuring at what depths they're reflected by boundaries between different materials.

It's commonly used by geoscientists on Earth to map buried layers of sediment and is also used by archaeologists to find buried artifacts.

"It allows us to see beneath the Martian surface," said Hai Liu, a geophysicist at Guangzhou University in China. "We can generate a profile of the subsurface structure." Liu and his graduate student Jianhui Li, also a geophysicist at Guangzhou University, coled the new research.

A Layer Cake, but Tilted

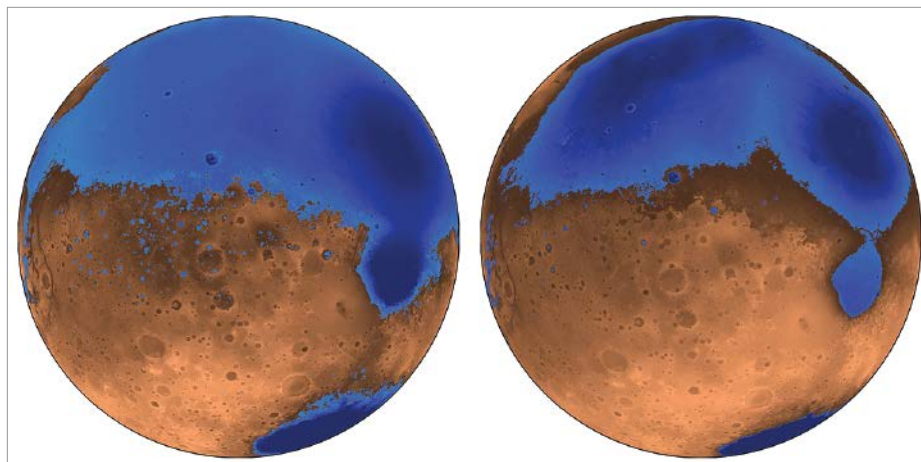
The team used the radar method to probe tens of meters below the Martian surface.

The data revealed layers of sedimentary deposits that were tilted, like a partially collapsed layer cake. The tilt ranged from about 6° to 20°, sloping down to the north.

The level of tilting and its consistent orientation, similar to coastal sedimentary deposits on Earth, suggests that the region was once home to a coastline, the researchers concluded.

Shorelines Here and There

The idea that Mars once hosted an ocean isn't new—data from spacecraft orbiting the planet have revealed surface features consistent with shorelines roughly 300 kilometers south of Zhurong's location. (Some research has called those findings into ques-



Mars may once have hosted a large ocean covering much of its northern hemisphere. Credit: Robert Citron

tion, however.) And one way of explaining the so-called Martian dichotomy—the stark difference in elevation, cratering, and crustal thickness between the planet's northern lowlands and southern highlands—is that much of the northern hemisphere was once under water.

If an ocean did once cover Mars's north, it must have retreated over time given that the Red Planet is a dry and dusty world today. That shrinking ocean would have left imprints of successive generations of coastlines north of its southernmost reach, said Abdallah Zaki, a geomorphologist at the Jackson School of Geosciences at the University of Texas at Austin who was not involved in the research.

Because Zhurong explored an area that might have once been a shoreline, it's logical for the rover to have spotted coastal deposits, said Zaki, who studies landscapes shaped by water on both Earth and Mars. "It makes sense."

It's unlikely that a smaller body of water such as a lake could have produced these deposits, Li, Liu, and their colleagues concluded. Lakes experience only limited tides, and their waves tend to be much smaller than those in oceans. The tilted sediments around lakes therefore tend to be significantly shallower than what the team measured.

These results were published in the *Proceedings of the National Academy of Sciences of the United States of America* (bit.ly/Mars-shoreline).

Going Underground

If there was once an ocean on Mars, future datasets could answer an important question: Where did all the water go? It's likely that some evaporated and was lost to space, but some of it could still be lurking under the Martian surface.

"A lot of it could have moved underground," said Michael Manga, a planetary scientist at the University of California, Berkeley and a member of the research team.

Last year, Manga and his colleagues published a study in which they used seismic data from the InSight lander on Mars to constrain the amount of water potentially permeating subsurface rocks. The team concluded that it was a lot, enough to cover the entirety of Mars to a depth of 1–2 kilometers.

Continuing to explore what lies beneath Mars's surface is critical to understanding how the Red Planet was influenced by water, Zaki said. "We need to get more subsurface data."

Zaki and other researchers are looking forward to the European Space Agency's upcoming launch of the ExoMars mission, which will include a rover known as Rosalind Franklin. The roughly 300-kilogram rover will be equipped with ground-penetrating radar and a 2-meter drill.

By Katherine Kornei (@KatherineKornei), Science Writer