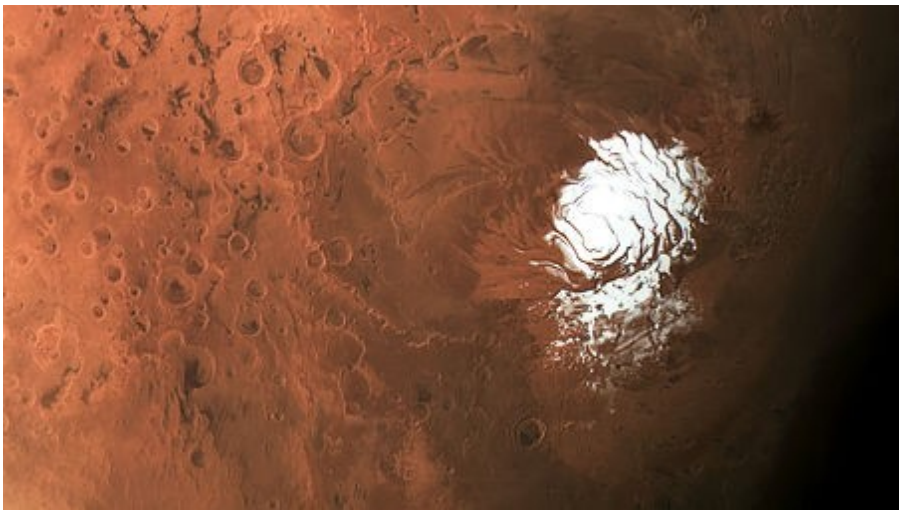
Liquid water spied deep below polar ice cap on Mars | Science

By Daniel CleryJul. 25, 2018 , 10:00 AM



Liquid water lies unseen under ice (white) at Mars's south pole in an image from Mars Express.

ESA/DLR/FU Berlin/CC BY-SA

Far beneath the deeply frozen ice cap at Mars's south pole lies a lake of liquid water—the first to be found on the Red Planet. Detected from orbit using ice-penetrating radar, the lake is probably frigid and full of salts—an unlikely habitat for life. But the discovery, reported online today in *Science*, is sure to intensify the hunt for other buried layers of water that might be more hospitable. "It's a very exciting result: the first indication of a briny aquifer on Mars," says geophysicist David Stillman of Southwest Research Institute in Boulder, Colorado, who was not a part of the study.

The lake resembles one of the interconnected pools that sit under several kilometers of ice in Greenland and Antarctica, says Martin Siegert, a geophysicist at Imperial College London, who heads a consortium trying to drill into Lake Ellsworth under West Antarctica. But the processes that gave rise to a deep lake on Mars are likely to be different. "It will open up a very interesting area of science on Mars," he says.

Water is thought to have flowed across the surface of Mars billions of years ago, when its atmosphere was thicker and warmer, cutting gullies and channels that are still visible. But today, low atmospheric pressures mean that any surface water would boil away. Water survives frozen in polar ice caps and in subsurface ice deposits. Some deposits have been mapped by the Mars Advanced Radar for Subsurface and Ionospheric Sounding (MARSIS), an instrument on the European Space Agency's Mars Express orbiter, which launched in 2003. MARSIS beams down pulses of radio waves and listens for reflections. Some of the waves bounce off the surface, but others

penetrate up to 3 kilometers and can be reflected by sharp transitions in the buried layers, such as going from ice to rock.

Several years into the mission, MARSIS scientists began to see small, bright echoes under the south polar ice cap—so bright that the reflection could indicate not just rock underlying the ice, but liquid water. The researchers doubted the signal was real, however, because it appeared in some orbital passes but not others.

Later the team realized that the spacecraft's computer was averaging across pixels to reduce the size of large data streams—and in the process, smoothing away the bright anomalies. "We were not seeing the thing that was right under our noses," says Roberto Orosei, a principal investigator (PI) for MARSIS at the Italian National Institute for Astrophysics in Bologna.

To bypass this problem, the team commandeered a memory chip on Mars Express to store raw data during short passes over intriguing areas. Between 2012 and 2015, the spacecraft confirmed the existence of the bright reflections during 29 passes over the south polar region. The brightest patch, offset 9° from the pole, lies 1.5 kilometers under the ice and spans 20 kilometers, Orosei and his colleagues report.

The radar brightness alone isn't enough to prove that liquid water is responsible. Another clue comes from the permittivity of the reflecting material: its ability to store energy in an electric field. Water has a higher permittivity than rock and ice. Calculating permittivity requires knowing the signal power reflected by the bright patch, something the researchers could only estimate. But they find the permittivity of the patch to be higher than anywhere else on Mars—and comparable to the subglacial lakes on Earth. Although the team cannot measure the thickness of the water layer, Orosei says it is much more than a thin film.

Not everyone on the MARSIS team is convinced. "I would say the interpretation is plausible, but it's not quite a slam dunk yet," says Jeffrey Plaut, the other MARSIS PI at NASA's Jet Propulsion Laboratory in Pasadena, California, who is not an author on the study.

After all, it isn't easy to explain the presence of water at Mars's south pole. In Earth's polar regions, the pressure of the overlying ice lowers its melting point, and geothermal heat warms it from below to create the subglacial lakes. But there's little heat flowing from the geologically dead interior of Mars, and under the planet's weak gravity, the weight of 1.5 kilometers of ice does not lower the melting point by much. Orosei suspects that salts, especially the perchlorates that have been found in the planet's soils, could be lowering the ice's melting point. "They are the prime suspects," he says.

High levels of salt and temperatures dozens of degrees below zero do not bode well for any microbes trying to live there, Stillman says. “If martian life is like Earth life, this is too cold and too salty.” But he says researchers will want to look for other lakes under the ice and find out whether they are connected—and whether they point to an even deeper water table.

Lakes might even turn up at lower, warmer latitudes—a location more suitable for a martian microbe, says Valèrie Ciarletti of the University of Paris-Saclay, who is developing a radar instrument for Europe’s ExoMars rover, due to launch in 2020. “The big, big finding would be water at depth outside the polar cap.”