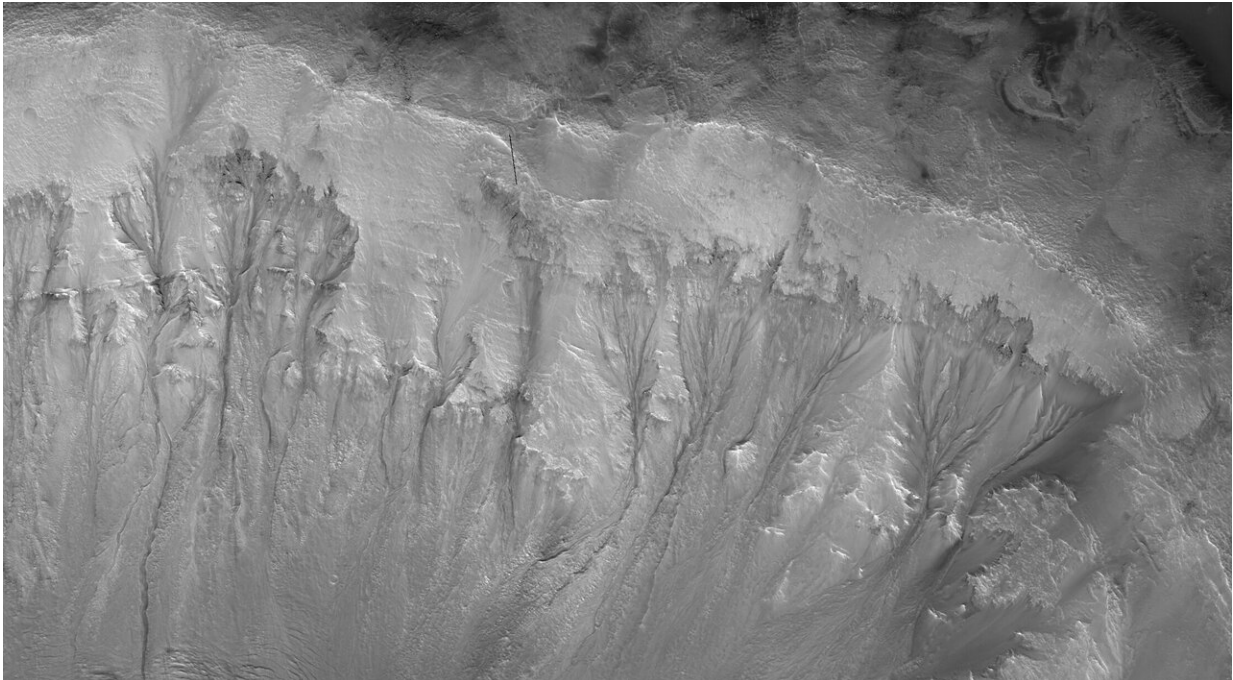


New evidence of deep groundwater on Mars

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Recurrent Slope Lineae on the Palikir Crater walls on Mars. Credit: NASA/JPL/University of Arizona

In mid-2018, researchers supported by the Italian Space Agency detected the presence of a deep-water lake on Mars under its south polar ice caps. Now, researchers at the USC Arid Climate and Water Research Center (AWARE) have published a study that suggests deep groundwater could still be active on Mars and could originate surface streams in some near-equatorial areas on Mars.

The researchers at USC have determined that [groundwater](#) likely exists in a broader geographical area than just the poles of Mars and that there is an active system, as deep as 750 meters, from which groundwater comes to the surface through cracks in the specific craters they analyzed.

Heggy, who is a member of the Mars Express Sounding radar experiment MARSIS probing Mars subsurface, and co-author Abotalib Z. Abotalib, a postdoctoral research associate at USC, studied the characteristics of Mars Recurrent Slope Linea, which are akin to dried, short streams of water that appear on some crater walls on Mars.

Scientists previously thought these features were affiliated with surface water flow or close subsurface water flow, says Heggy.

"We suggest that this may not be true. We propose an alternative hypothesis that they originate from a deep pressurized groundwater source which comes to the surface moving upward along ground cracks," Heggy says.

"The experience we gained from our research in desert hydrology was the cornerstone in reaching this conclusion. We have seen the same mechanisms in the North African Sahara and in the Arabian Peninsula, and it helped us explore the same mechanism on Mars," said Abotalib Z. Abotalib, the paper's first author.

The two scientists concluded that fractures within some of Mars' craters, enabled water springs to rise up to the surface as a result of pressure deep below. These springs leaked onto the surface, generating the sharp and distinct linear features found on the walls of these craters. The scientists also provide an explanation on how these water features fluctuate with seasonality on Mars.

The study, to be published on March 28, 2019, in *Nature Geoscience*,

suggests that groundwater might be deeper than previously thought in areas where such streams are observed on Mars. The findings suggest that the exposed part of these ground fractures associated with these springs as the primary location candidates to explore Mars' habitability. Their work suggests that new probing methods should be developed to study these fractures.

Method:

Previous research to explore groundwater on Mars relied on interpreting the returned electromagnetic echoes sent from the radar-probing experiments from orbit onboard Mars Express and Mars Reconnaissance Orbiter. These experiments measured the reflection of the waves from both the surface and the subsurface whenever penetration was possible. However, this earlier method did not yet provide evidence of groundwater occurrence beyond the 2018 South Pole detection.

The authors of this current *Nature Geoscience* study used hi-resolution optical images and modeling to study the walls of large impact craters on Mars. The goal was to correlate the presence of fractures with the sources of streams that generate short water flows.

Heggy and Abotalib, who have long studied subsurface aquifers and groundwater flow movement on Earth and in desert environments, found similarities between the groundwater moving mechanisms in the Sahara and on Mars.

"Groundwater is strong evidence for the past similarity between Mars and Earth—it suggest they have a similar evolution, to some extent," says Heggy.

He says this deep source of groundwater is the most convincing evidence of similarities between the two planets—it suggest both may have had

wet periods long enough to create such an active groundwater system.

For Heggy, an advocate for water science and water science education in arid areas, this particular study is not about colonization. But he says these rare and puzzling water flows on Mars are of big interest to the science community.

"Understanding how groundwater has formed on Mars, where it is today and how it is moving helps us constrain ambiguities on the evolution of climatic conditions on Mars for the last three billion years and how these conditions formed this groundwater system. It helps us to understand the similarities to our own planet and if we are going through the same climate evolution and the same path that Mars is going. Understanding Mars' evolution is crucial for understanding our own Earth's long-term evolution and groundwater is a key element in this process. "

The new study suggests that the groundwater that is the source of these water flows could be at depths starting at 750 meters deep. "Such depth requires us to consider more deep-probing techniques to look for the source of this groundwater versus looking for shallow sources of water, " says Heggy.

More information: A deep groundwater origin for recurring slope linea on Mars, *Nature Geoscience* (2019).

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