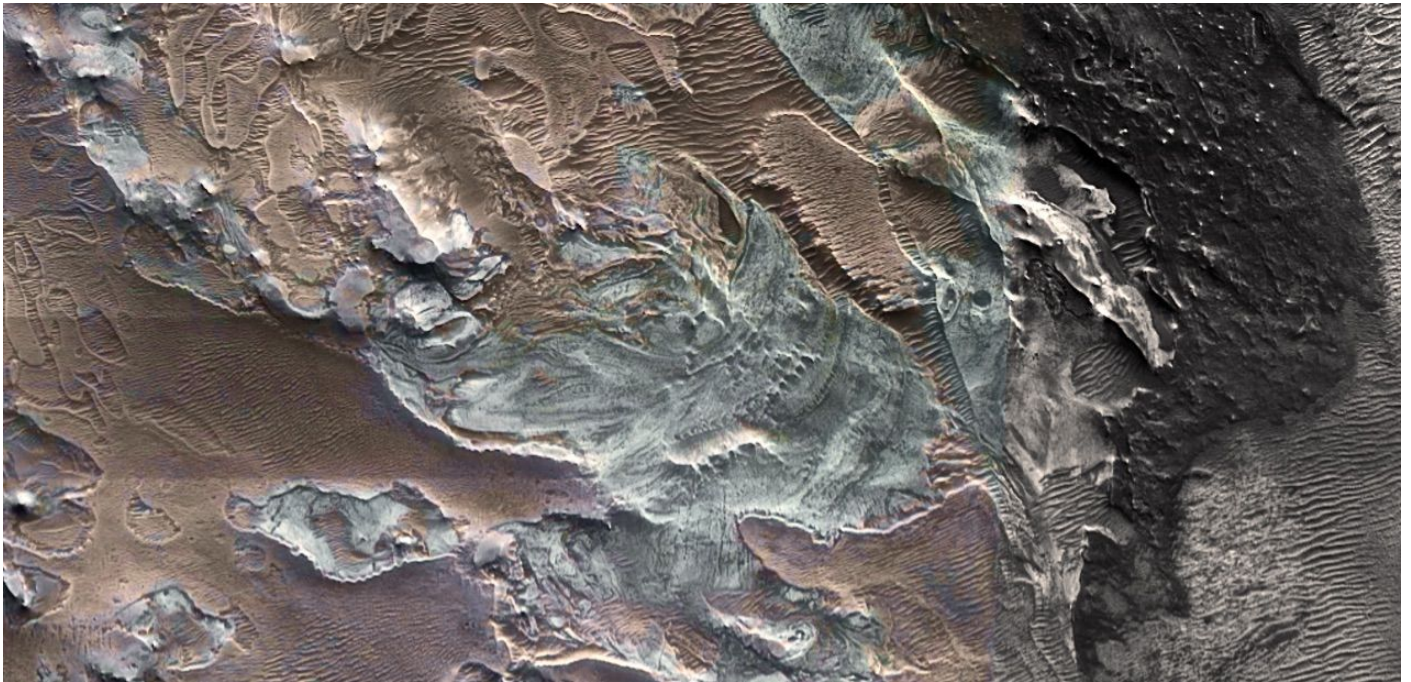




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This image shows what scientists believe is a relict glacier near Mars' Equator. Image Credits: NASA MRO HiRISE and CRISM false color composite. Lee et al. 2023

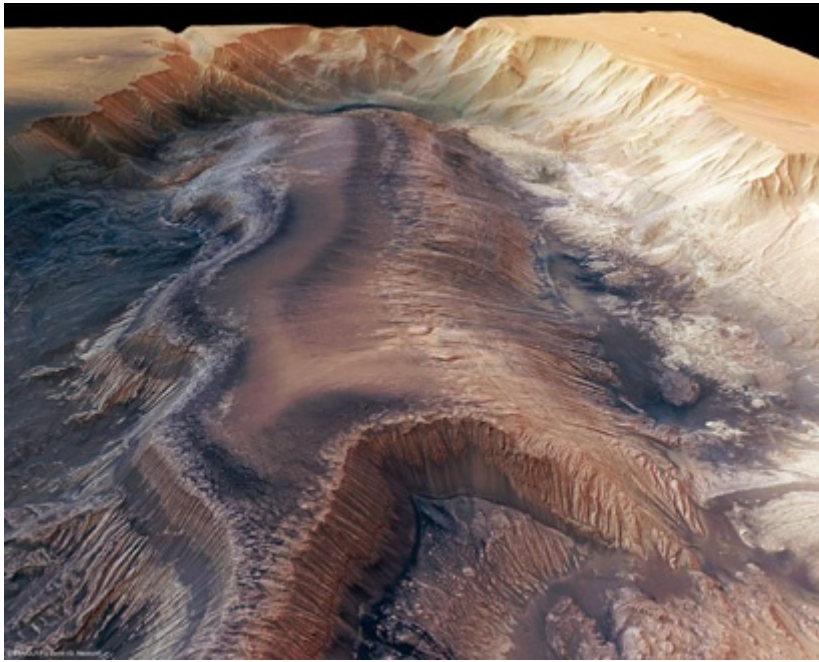
MARCH 20, 2023 BY EVAN GOUGH

Remnants of a Relict Glacier Found Near the Equator on Mars

New results presented at the 54th Lunar and Planetary Science Conference could change our approach to Mars exploration. Scientists studying the surface of Mars discovered a relict glacier near the planet's equator. The relict glacier could signal the presence of buried water ice at the planet's mid-latitudes.

Some areas of the Martian surface are known for light-toned deposits (LTDs.) NASA's Viking spacecraft spotted them in the late 1970s. Since then, scientists have found them in Valles Marineris, Hebes Chasma, and in other locations on Mars. Their unusual features have captured the attention of researchers who want to understand

how they formed.



This image shows Hebes Chasma, an isolated part of the Valles Marineris. It's an enclosed trough almost 8000 metres deep that contains light-toned deposits. Image Credit: ESA/DLR/FU Berlin (G. Neukum)

While LTDs are named for their colour, that's not the only way they differ. Their surfaces can set them apart from their surroundings, too. The top of LTDs can be rough, in contrast to their smooth-surfaced surroundings.



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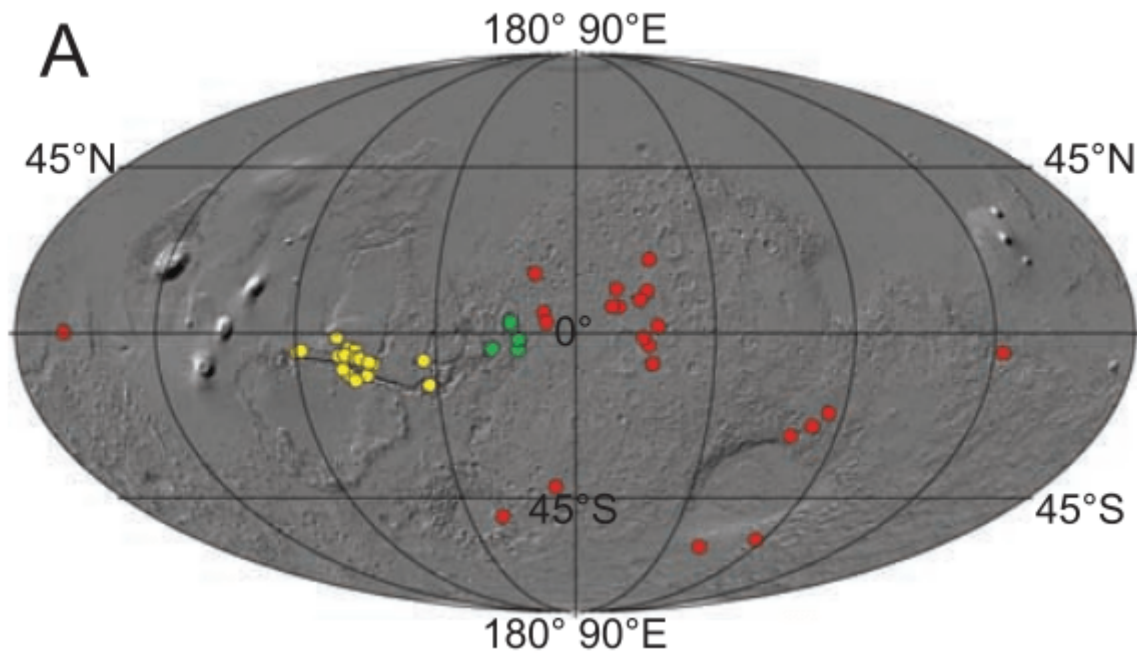
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This is a High-Resolution Imaging Science Experiment (HiRISE) image of an LTD in Aureum Chaos, another part of Valles Marineris. The top of the LTD appears rough, while the surroundings are smooth. Image Credit: NASA/JPL/University of Arizona

As scientists have worked to piece together Mars' geological history, they've tried to understand what exactly LTDs are and where they fit in the timeline. In a 2008 paper, researchers presented evidence that some LTDs are vestiges of large-scale spring deposits.

Different teams of researchers have examined the LTDs and reached different conclusions. Some concluded that they're lacustrine deposits, some suggested they're made of deposits eroded from walls, some thought they're aeolian deposits, and some even suggested that they're volcanic deposits.

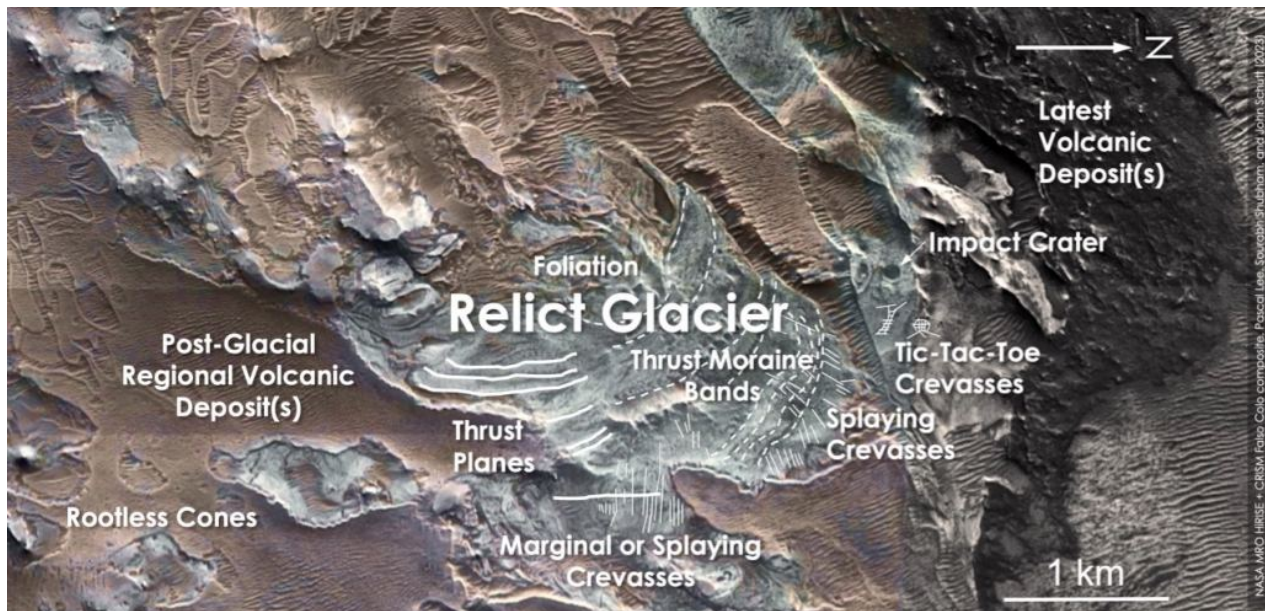


This figure from the 2008 paper shows LTDs in three different terrain types: yellow shows LTDs in Valles Marineris, green shows LTDs in chaotic terrain, and red shows LTDs in crater bulges. Image Credit: Rossi *et al.* 2008.

But as time has passed, scientists learned that LTDs typically consist of lightly-coloured sulphate salts, which means water was involved with their formation. In the newly-released paper, the authors focused on an LTD in Eastern Noctis Labyrinthus. That LTD has some intriguing surface features similar to a glacier, including moraine bands and crevasse fields.

The new paper is “A RELICT GLACIER NEAR MARS’ EQUATOR: EVIDENCE FOR RECENT GLACIATION AND VOLCANISM IN EASTERN NOCTIS LABYRINTHUS.” It’s published by the SETI Institute, and the lead author is Dr. Pascal Lee, a planetary scientist at the SETI Institute.

“What we’ve found is not ice, but a salt deposit with the detailed morphologic features of a glacier. What we think happened here is that salt formed on top of a glacier while preserving the shape of the ice below, down to details like crevasse fields and moraine bands,” said Dr. Lee.



This image shows the authors' interpretation of the features in the LTD in Eastern Noctis Labyrinthus. According to the researchers, the LTD is a relict glacier. Image Credit: NASA MRO HiRISE and CRISM false colour composite. Lee *et al.* 2023

The region is blanketed in volcanic material, and that's a clue to what happened here. When pyroclastic materials, including ash, pumice, and lava, erupted from volcanoes, they landed on top of the ancient glacier. When they contacted the ice, chemical reactions would've occurred that formed a thick layer of sulphate salts like the ones in Mars' LTDs. The sulphate salts would've formed a hardened layer moulded to the surface of the ice.

Over long periods of time, the volcanic material covering the glacier eroded. What's left is the layer of sulphate salts, preserving the form of the original underlying glacier.

"This region of Mars has a history of volcanic activity. And where some of the volcanic materials came in contact with glacier ice, chemical reactions would have taken place at the boundary between the two to form a hardened layer of sulphate salts," explains Sourabh Shubham, a graduate student at the University of Maryland's Department of Geology, and a co-author of the study. "This is the most likely explanation for the hydrated and hydroxylated sulphates we observe in this light-toned deposit."

That explains the chemistry behind the formation of the sulphate layer. And the morphology of the layer points to an underlying glacier at the time the sulphate layer formed.

“Glaciers often present distinctive types of features, including marginal, splaying, and tic-tac-toe crevasse fields, and also thrust moraine bands and foliation. We are seeing analogous features in this light-toned deposit in form, location, and scale. It’s very intriguing,” said John Schutt, a geologist at the Mars Institute, experienced icefield guide in the Arctic and Antarctica, and a co-author of this study.

Over time, craters have impacted the region, but only lightly. That means the features are geologically young, likely from Mars’ Amazonian Age, the most recent age that also includes modern Mars.

“We’ve known about glacial activity on Mars at many locations, including near the equator in the more distant past. And we’ve known about recent glacial activity on Mars, but so far, only at higher latitudes. A relatively young relict glacier in this location tells us that Mars experienced surface ice in recent times, even near the equator, which is new,” said Lee.

There’s no surface ice here. The ice in the glacier may have all sublimated, or some of it might persist under the sulphate cap.

“Water ice is, at present, not stable at the very surface of Mars near the equator at these elevations. So, it’s not surprising that we’re not detecting any water ice at the surface. It is possible that all the glacier’s water ice has sublimated away by now. But there’s also a chance that some of it might still be protected at shallow depth under the sulphate salts,” said Lee.

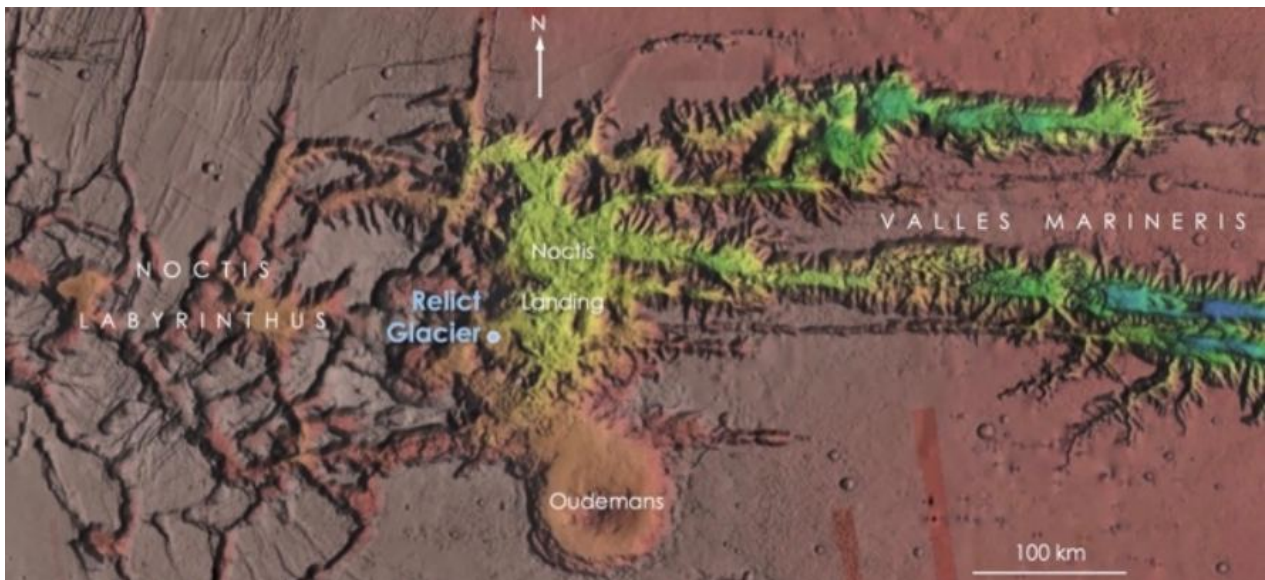
The idea is not without precedent. There are places on Earth where a sulphate cap has protected ice underneath it. The Altiplano Flats in South America contain ancient buried glacier ice sheltered from evaporation, sublimation, and melting by a thick layer of bright salts called salars, according to the authors.



This is the Quisquiro salt flat in South America's Altiplano. The salt flats, or salars, in the Altiplano contain thick layers of bright salt that have protected glacier ice buried underneath. The Altiplano is often considered an analog of ancient Mars. Image Credit: NASA/Maksym Bocharov

This work isn't only about unlocking some of the secrets of Mars' past. It's also about a future human mission to Mars and where one might land. The authors describe a broad region on Mars between Valles Marineris and Noctis Labyrinthus and north of Oudemans crater, where the relict glacier is located. It's a topographically depressed region that so far has no official name but contains rich geology. The region has "... a complex aqueous, volcanic, and glacial evolutionary history," according to the authors.

The region containing the relict glacier has an unofficial name: *Noctis Landing*. That's because it's a potential landing site for a future mission. Because of its rich geological diversity, *Noctis Landing* is also a potential exploration zone.



This image from the research shows the unofficially-named Noctis Landing region and the Relict Glacier. Image Credit: Lee et al. 2023

The unofficially-named *Noctis Landing* is situated in a desirable area for exploration. A mission to Noctis Landing could put the Valles Marineris region within reach and expose its extensive geological history to in-situ science. It could also put the Tharsis Montes region within reach, with its volcanic features and its many lava caves.

This highlights the importance of the findings, and it all comes down to water. Water is the key to any human presence on Mars.

In recent years, scientists have uncovered evidence of sub-surface water or water ice on Mars. Radar signals suggest the presence of buried lakes under the planet's south pole. Follow-up studies suggested that the signals might not be from buried water. Other research suggested that there's so much water available we wouldn't have to dig far to access it. The topic of Martian water is still debated.

But if there is water ice under the LTD at Noctis Landing, it could be a very significant finding.

“The desire to land humans at a location where they might be able to extract water ice from the ground has been pushing mission planners to consider higher latitude sites. But the latter environments are typically colder and more challenging for humans and robots. If there were equatorial locations where ice might be found at shallow depth, then we'd have the best of both environments: warmer conditions for human exploration and still access to ice,” said Lee.

If the team's results are correct and the LTD is a layer of sulphates once married to a

glacier, it doesn't necessarily mean there's still frozen water somewhere underneath. That has yet to be determined. Studying more LTDs from orbit might find other instances where sulphate has capped glaciers and potentially left behind an icy substrate. Finding more would strengthen these initial results.

There's a lot more work to do, according to Lee. "We now have to determine if, and how much, water ice might actually be present in this relict glacier, and whether other light-toned deposits might also have, or have had ice-rich substrates."

A proposed future mission could play an important role in the work yet to be done. The Canadian Space Agency, the Italian Space Agency, the Japanese Aerospace Exploration Agency, and NASA are all developing a mission that would specialize in ferreting out Martian water ice in the planet's non-polar regions. It's called the International-Mars Ice Mapper (I-MIM), and at this juncture, it's only a proposal. The agencies involved call it a "pre-exploration mission," and it would help pave the way for missions to Mars in the same way that other reconnaissance orbiters have paved the way for MSL Curiosity and the Perseverance Rover.

But the I-MIM would be directly focussed on finding ice in Mars' middle latitudes. It would search in areas that are less than 2 km in elevation to enable entry, descent, and landing. The mission would focus on latitudes between 25 and 40, both north and south. Solar arrays are more efficient away from the poles, while the increased solar insolation at the equator contra-indicates ice. Its goal would be to find water ice that's within 5 to 10 meters of the surface and is accessible to astronauts.

There's no set date or timeline for the I-MIM. But if and when it launches and starts scanning Mars for buried water ice, it'll be a significant development. It'll signal a new level of determination to get humans to Mars.

More:

- Press Release: [Remains of a Modern Glacier Found Near Mars' Equator Implies Water Ice Possibly Present at Low Latitudes on Mars Even Today](#)
- Research: [A RELICT GLACIER NEAR MARS' EQUATOR: EVIDENCE FOR RECENT GLACIATION AND VOLCANISM IN EASTERN NOCTIS LABYRINTHUS](#)
- Universe Today: [Want to Live on Mars? Here's Where the Water is](#)

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