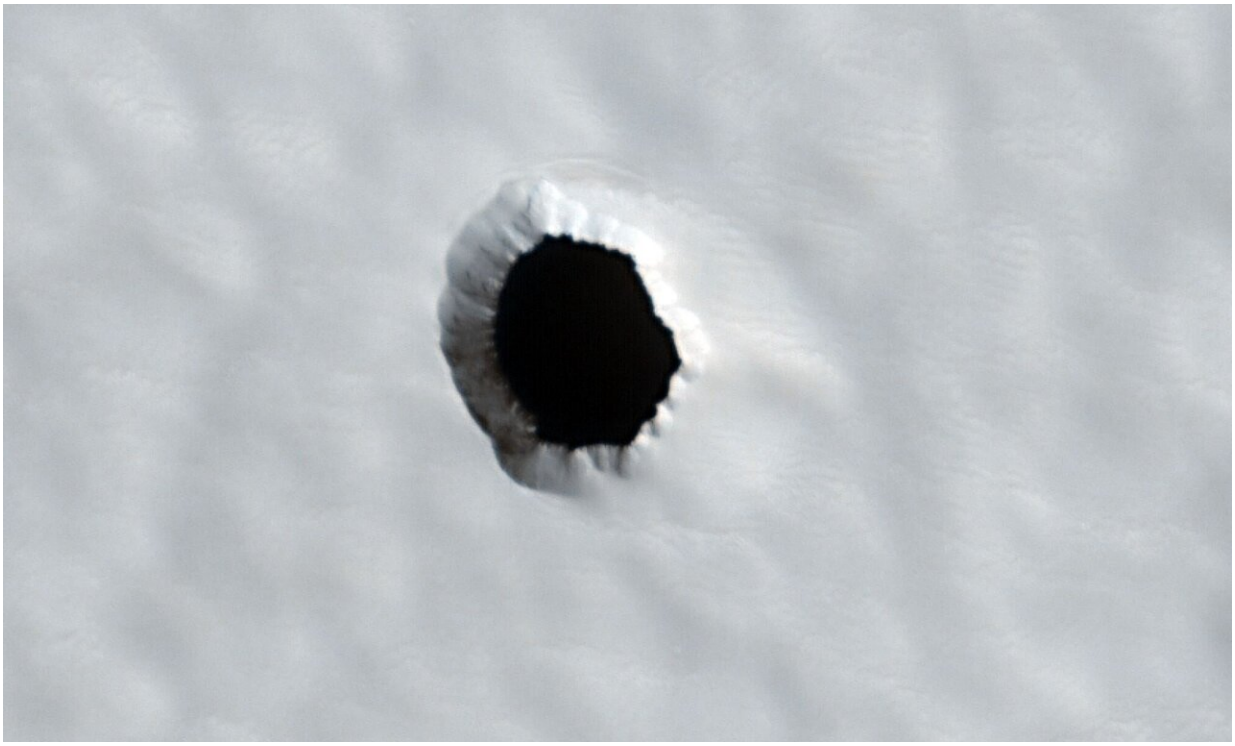
What's under this hole on the surface of Mars?

May 30 2024, by Evan Gough

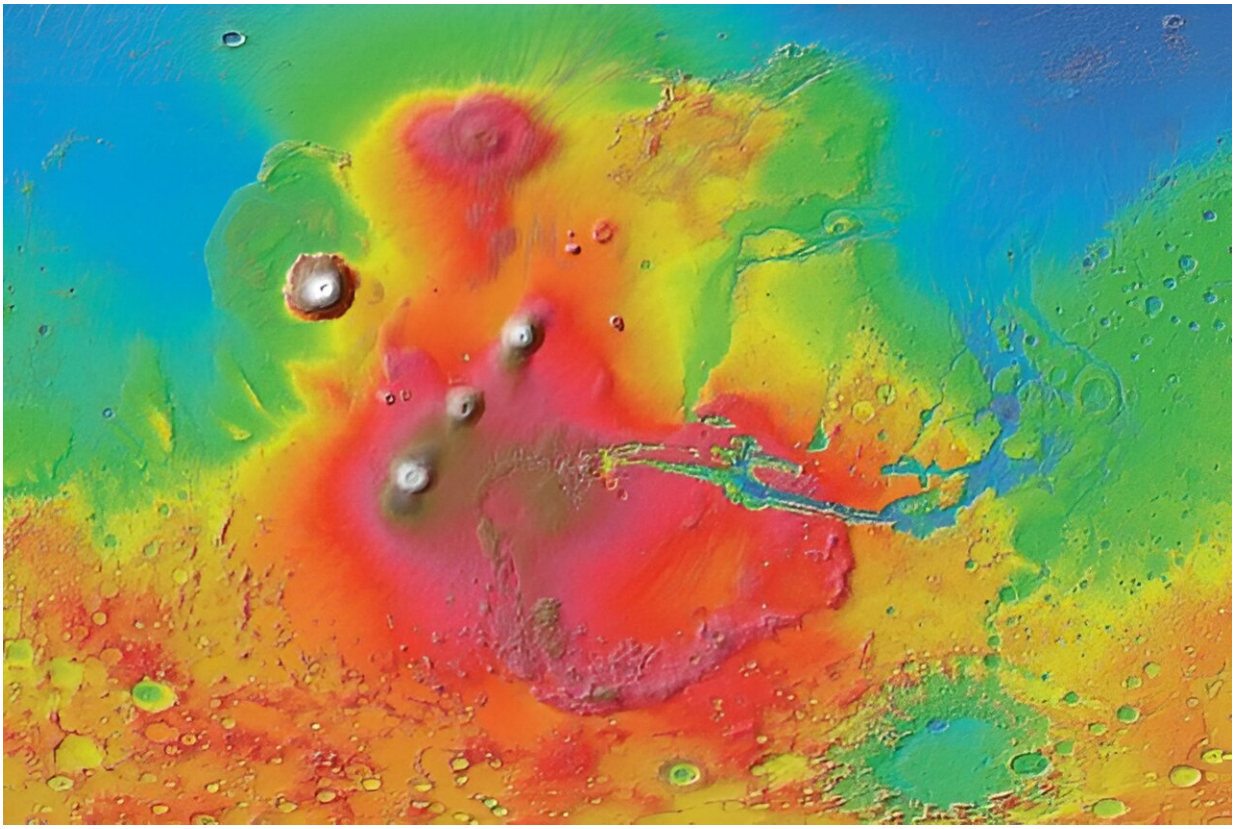


The HiRISE camera on NASA's Mars Reconnaissance Orbiter captured this image to determine if any underlying voids or associated faults can be observed in this part of Arsia Mons. Pits like this can be caused by recent geologically-recent volcanic or tectonic activity. If there are caves under the pit, they could one day act as shelter for astronauts. The caves could also be targets for future robotic exploration. The pit is only a few meters across. Credit: NASA/JPL-Caltech/UArizona

Human visitors to Mars need somewhere to shelter from the radiation, temperature swings, and dust storms that plague the planet. If the planet is anything like Earth or the moon, it may have large underground lava tubes that could house shelters. Collapsed sections of lava tubes, called skylights, could provide access to these subterranean refuges.

Does this hole on Mars lead to a larger underground cavern?

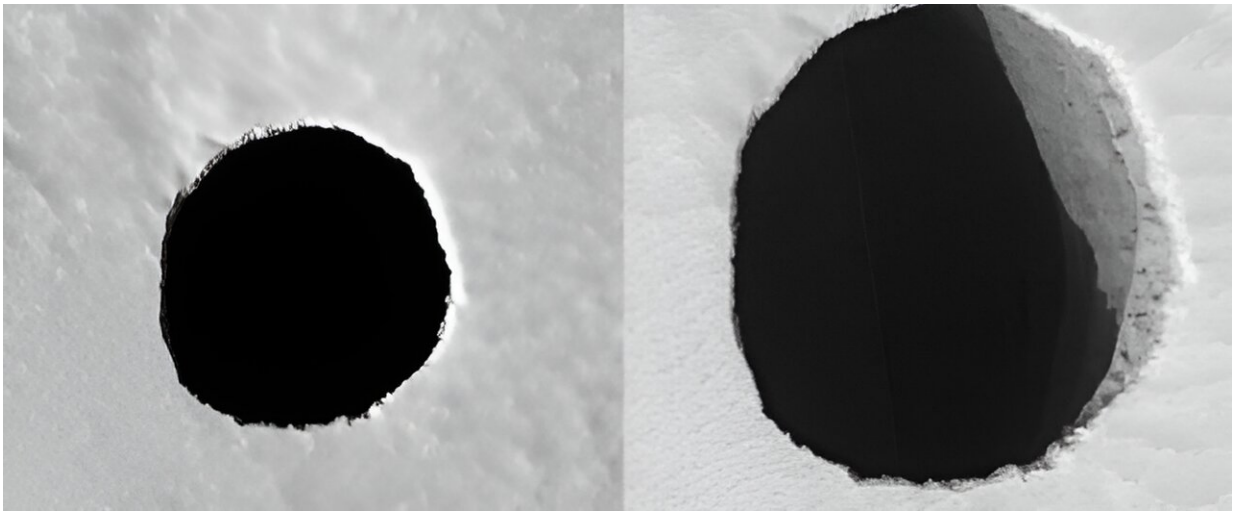
This image was captured by the High-Resolution Imaging Science Experiment (HiRISE) camera on NASA's Mars Reconnaissance Orbiter (MRO). The pit is only a few meters across and is in the Arsia Mons region of Mars. Arsia Mons is one of the three dormant volcanos in the Tharsis Montes group of three volcanos.



This colourized image of the surface of Mars was created with data from the Mars Reconnaissance Orbiter. The line of three volcanoes is Tharsis Montes, with Olympus Mons to the northwest and Valles Marineris to the east. Arsia Mons is the southernmost volcano of the three that comprise Tharsis Montes. Credit: NASA/JPL-Caltech/ Arizona State University

The Tharsis Region of Tharsis Bulge is a vast volcanic plain that's thousands of kilometers across. It's elevated compared to the rest of Mars and averages about 10 km (33,000 ft) above the planet's mean elevation. The region was volcanically active in the past, obviously, and features like the pit are a direct result of ancient volcanic activity.

Several pits in the Arsia Mons region may be collapsed skylights or openings into subterranean lava tubes. However, there is much uncertainty. An image of one of them shows an illuminated sidewall, which could indicate that it's just a cylindrical pit.

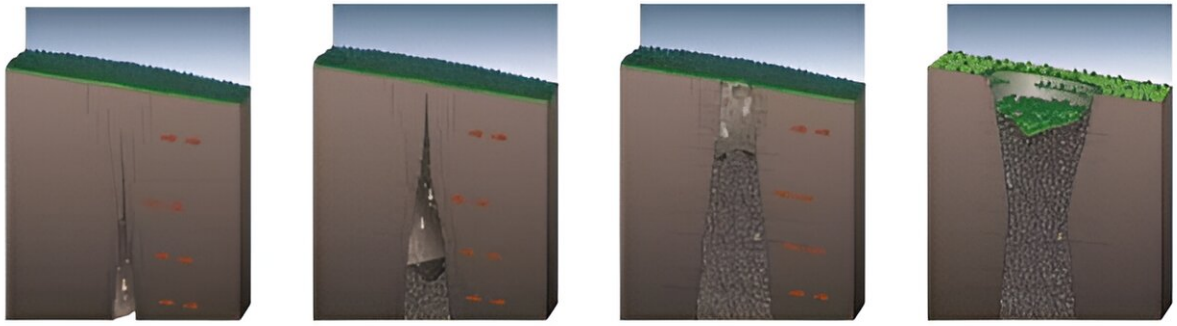


These images of a pit near Arsia Mons were captured several years ago. The image on the left was captured first, and scientists wondered if it could lead to a

lava tube or cave. Then, the image on the right, showing a side wall, was captured. The side wall could indicate that there's no tube or cave. Credit: NASA/JPL/University of Arizona

The hole in the featured image could only be a pit or shaft and not an entrance to a cave or lava tube. They're found on Hawaiian volcanos, where they're called pit craters. They don't connect to long caves or lava tubes. They're the result of a collapse that happened much deeper underground.

In Hawaii, the pit craters range from 6 to 186 m (20 to 610 feet) deep and from 8 to 1140 m (26 to 3,740 feet) wide. The Arsia Mons pit in the leading image is only about 178 m (584 feet) deep.



These four sequential images show how pit craters form. As volcanos erupt and settle, cracks form. They slowly migrate upwards, and rocks above them start to fall into them. Eventually, the upward migrating crack reaches the surface, and the roof caves in. On Earth, plants will eventually colonize the crater. On Mars, they stay much the same as when they collapsed. Credit: US National Park Service.

We have a much better understanding of lava pits and tubes on the moon than we do on Mars. We know some of them are thermally stable at about 17°C (63°F.) We also have better images of them, with intriguing glimpses of boulder-covered floors.

Lots of thinking is going into how to explore these lunar caves and lava tubes, including conceptual designs for robots that could explore them. Maybe on the moon, astronauts could take shelter in inflatable habitats inside these tubes, where they're protected from temperature swings, radiation, and micrometeorites.

But Mars is another question. There's no reason that lava tubes shouldn't exist on Mars. In fact, Mars' gravity is much weaker than Earth's, and that should allow for much larger tubes. Images of Mars show rilles, which are collapsed tubes. It seems likely that not all of these tubes have collapsed to form rilles.

One pit on the Martian volcano, Pavis Mons, is particularly intriguing. There's some kind of void under the pit, but the nature of the pit is difficult to ascertain. Is it a lava tube? If it is, it dwarfs most tubes on Earth.

Martian lava tubes are still a mystery. Scientists have found plenty of morphological evidence suggesting that they're plentiful. But in science, you can't assume they're there, even though it seems likely that they are. There's no clear reason why they wouldn't be. Could they one day provide shelter for astronauts? Maybe.

We need a robotic mission to explore them first.

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