

## Holes on Mars

All of us here at the Spitzer Science Center are rightfully proud of the accomplishments of our space telescope, but it's worth mentioning that many other NASA missions are making amazing discoveries using infrared observations. Infrared instruments on the Cassini Spacecraft, for example, helped identify active geysers that shoot liquid water out many miles above the surface of Saturn's moon Enceladus. And recently, infrared observations from NASA's fleet of Mars-orbiting spacecraft have helped us remotely explore the mysterious "holes on Mars." Hello, I'm Michelle Thaller.

*This Spitzer Space Telescope podcast is part of a series highlighting recent discoveries in infrared astronomy. It's produced by NASA's Spitzer Science Center at the California Institute of Technology in Pasadena. The Spitzer mission is managed by NASA's Jet Propulsion Laboratory.*

Earlier this year, the Mars Odyssey spacecraft began to find a series of what appeared to be almost circular, completely black spots on Mars. The holes found so far are about 100-200 yards across, and so dark that nothing inside can be seen. They can't be impact craters, as there is no impact debris around them and they penetrate almost vertically into the Martian ground. When the Mars [Reconnaissance Orbiter](#) took a closer look, it still couldn't see the bottom of these holes, some of which are at least 100 meters deep.

So where does the infrared come in? Even if we can't see the bottom of these holes, observing how the Martian air acts inside them can give us some idea of how big an area we're talking about. To do this, Scientists used Mars Odyssey's infrared camera to check the daytime and nighttime temperatures of the holes, and they concluded that they could be windows into larger underground spaces. As of today, NASA's Mars Odyssey spacecraft has discovered entrances to seven possible caves on the slopes of a Martian volcano.

Evidence that the holes may be openings to cavernous spaces comes from the temperature differences detected from infrared images taken in the afternoon and in the pre-dawn morning. From day to night, temperatures of the holes change only about one-third as much as the change in temperature of the surrounding ground.

If you've ever been in a cave on Earth, you may have noticed a similar effect: caves stay cooler in the day and warmer in the evening, as there is a large isolated volume of air that doesn't heat up or cool off as quickly as open surface air.

The discovery of a possible cave system on Mars got a lot of people's attention, as caves might provide a more protected environment for Martian life. But these particular caves might not be quite as homey as you'd think. For one thing, there is no reason to believe that the caves were formed by water. All of the holes we've found so far are on an ancient volcano called Arsia Mons. Volcanism is probably the key, as you can find similar holes around Earth volcanoes too. Geologists call these pit craters, which are formed by the sinking or collapse of the ground. They are common along rift zones of

shield volcanoes; for example, Mauna Loa and Kilauea volcanoes in Hawai`i. No one has observed the formation of a large pit crater, but they are thought to form when underground magma flows away from an area, removing support and causing the ground to collapse, sort of like a sink hole.

Another problem is that these holes are at some of the highest altitudes on the planet, making them less suitable for life and very difficult for any future Mars mission to explore on the surface. Still, the observations have inspired scientists to keep looking. The goal is to find other holes at lower elevations that might be a better habitat for life and are more accessible to future missions to Mars. And once again, infrared is going to be the key. Wherever the holes are, they should create temperature anomalies at night, so using infrared to look for hot spots in the Martian darkness will lead us, hopefully, to more of these possible caves.

Personally, whenever I imagined the first humans exploring Mars, I pictured them in their spacesuits walking over breezy deserts or standing on the rims of huge canyons. But now maybe they'll also be lowering themselves carefully down these dark shafts, using flashlights to illuminate the bottom and very possibly, the entrance to a world of underground wonders. For the Spitzer Science Center, I'm Michelle Thaller.

*To find out more about this topic, visit our website at [www.spitzer.caltech.edu](http://www.spitzer.caltech.edu). You can browse our image galleries, read about the latest results, and subscribe to our newsletter. On behalf of NASA's Spitzer Science Center, thanks for listening.*