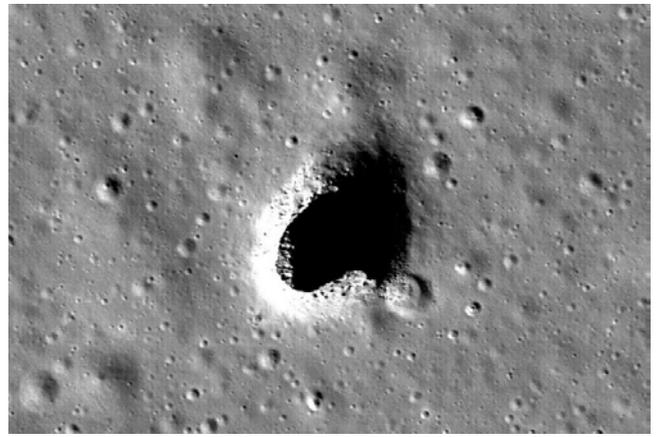


A POTENTIAL HUMAN HABITAT ON THE MOON

A new study says a hole in the Moon's Marius Hills region is the skylight of an underground lava tube large enough to house a city.

A study published in *Geophysical Research Letters* on October 17, 2017 says that the hole could be used to protect astronauts from hazardous conditions on the surface. In fact, it could be large enough, the researchers say, to house a complete underground lunar city.



The Marius Hills Skylight, as observed by the Japanese SELENE/Kaguya research team

No one has ever been on the Moon longer than three days, largely because space suits alone can't shield astronauts from its elements: extreme temperature variation, radiation, and meteorite impacts. Unlike Earth, Moon has no atmosphere or magnetic field to protect its inhabitants. The safest place to seek shelter is the inside of an intact lava tube, according to the study.

Lava tubes are naturally-occurring channels that form when a lava flow develops a hard crust, which thickens and forms a roof above the still-flowing lava stream. Once the lava stops flowing, the tunnel sometimes drains, forming a hollow void. Lava tubes exist on Earth, but the ones on the moon are much larger.

The Marius Hills hole was first discovered by the Japanese SELENE and Engineering Explorer (SELENE), and has been the subject of much research and speculation. The new study, the scientists say, confirms that the opening is a skylight of a large underground lava tube.

Junichi Haruyama, a senior researcher at JAXA, Japan's space agency, said in a statement:

It's important to know where and how big lunar lava tubes are if we're ever going to construct a lunar base.

For the study, the researchers analysed data from the SELENE spacecraft, and consulted scientists from the GRAIL mission, a NASA effort to collect high-quality data on the Moon's gravitational field. The researchers say that, if the gravity results are correct, the lava tube near the Marius Hills is spacious enough to house one of the largest U.S. cities. Near the entrance to the tube they found a distinctive echo pattern, a decrease in echo power followed by a large second echo peak, which they believe is evidence of a tube. The two echoes correspond to radar reflections from the Moon's surface and the floor and ceiling of the open tube. The team found similar echo patterns at several locations around the hole, indicating there may be more than one.

SELENE's radar system wasn't designed to detect lava tubes – it was built to study the origins of the Moon and its geologic evolution. For these reasons, it didn't fly close enough to the Moon's surface to get extremely accurate information on what is (or isn't) underneath. When the JAXA team decided to use the data to try and find lava tubes, they surveyed the areas where GRAIL had identified mass deficits, or less mass under the surface, they narrowed down the data they needed to analyse.

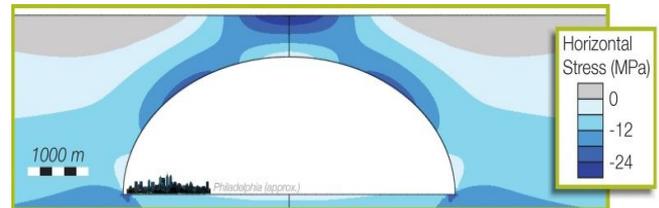
Jay Melosh, a GRAIL co-investigator, said:

Our group at Purdue used the gravity data over that area to infer that the opening was part of a larger system. By using this complimentary technique of radar, we were able to figure out how deep and high the cavities are.

This information might be more useful than previously expected. At the first meeting of the National Space Council in decades, Vice President **Mike Pence** announced that the Trump administration will redirect America's focus in space to the moon:

We will return NASA astronauts to the moon – not only to leave behind footprints and flags, but to build the foundation we need to send Americans to Mars and beyond.

AK, with EarthSky Notes



The city of Philadelphia is shown inside a theoretical lunar lava tube