

Existence of A Lava Tube on the Moon suggested by SELENE Lunar Radar Sounder

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Intact lava tubes on the Moon are potentially the most favorable sites for constructing lunar bases, where people and instruments are protected from micrometeorites and cosmic radiation, and the thermal conditions are stable. In 2009, a vertical hole (skylight) along rille A at Marius Hills was discovered in the lunar surface image data acquired by the high-resolution Terrain Camera onboard SELENE (Kaguya). The hole is possible an entrance to a subsurface lava tube. However, whether lava tubes really exist underground on the Moon is still unknown.

Recently, developing methods of gradiometry and cross correlation to isolate the target signal of mass deficits from the twin GRAIL gravity data, Chappaz et al. (2017) detected several locations of horizontally extended mass deficits. Some of them could be caused by intact lava tubes. One of the identified mass deficit is in an area containing the rille A at Marius Hills in which a skylight hole has been discovered. Kaku et al. (2017) investigated radar data from Lunar Radar Sounder (LRS) onboard SELENE (Kaguya) for the mass deficit area and found a double-peaked echo pattern suggesting the existence of an intact lava tube. The Lunar Radar Sounder (LRS), an active radar sounder, was installed on SELENE. The operation frequency of the LRS is 4–6 MHz (around 60 m wavelength), and transmission power is 800 W. Subsurface structures at depths of a few hundreds of meters to a few kilometers have been investigated using LRS data.

We report the results from our investigation of the LRS data employed to detect subsurface intact lava tubes in an area (35.00–37.00°N, 312.50–314.50°E) south of Rima Sharp and west of Rima Mairan. Several locations exhibit the characteristic features of double-peaked echo pattern, similar to those found in the vicinity of the Marius Hills Hole. These locations are candidate sites for the presence of underground lava tubes or cavernous voids. We note that most of these candidate sites are at locations consistent with a mass deficit on the cross-correlation Bouguer anomaly map based on GRAIL data.

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