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Are pit craters habitable? Geological analysis and description of their structural potential as lunar bases.

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Abstract

Pit craters, also known as subsidence or collapse craters, are circular-shaped holes in the terrain found throughout the Solar System. Their formation does not relate to any impact, in some planetary bodies, the surface collapses over a lava tube [1], [2], [3] or magma chamber, generating a natural entrance of a planetary cave. The presence of these lava tubes on the Moon has been proposed since the sixties [4], using as evidence the sinuous rilles. More recently, attempts have been made to evaluate the dimensions of lava tubes using the Lunar Radar Sounder of Kaguya [5] and gravimetry data from GRAILS, to detect huge mass deficits under the surface [6]. These studies give strong indications that sublunarean caves might exist, and they could be related to pit craters [5], also known as skylights. Caves could become the first human settlements on the Moon because they provide a natural and safe refuge for astronauts, technology and resources [7]. However, the connection between pit craters and caves is not demonstrated.

We located the best skylight candidates by overlaying pit crater locations from the LROC atlas to the global geologic map of the Moon (USGS), getting information on the properties of the lunar regions (material type and age); the Kaguya (SELENE) mission maps, covering latitudes from -60° to 60°; and the north and south pole LOLA LRO lunar topographic maps. A wrinkle ridges layer is also added to find some clues about how the pit craters in an area might be connected and how large the subsurface caves would be.

A sublunarean lava cave accessible from one of these four skylight candidates would be a promising astrobiological region due to its own microclimate preservation capabilities and its shielding against radiation [8] and meteorites. Additionally, a pristine lava tube would be helpful to better understand the Lunar geological history.

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