

## **Longitudinal variation of the morphology of the Geomunoreum lava cave system in Jeju Island, Republic of Korea**

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Morphology and dimension of lava tubes change continuously because of accretion and erosion of lava during the course of lava tube system formation. In this study, we investigate the pattern and cause of lava accretion and erosion from the morphological changes inside the Geomunoreum lava cave system extending ca. 13 km from source to shoreline in the northeastern part of Jeju Island, Korea. We used an electronic total station and 3D laser scanning device for a detailed and quantitative survey of six lava caves of the cave system from upstream to downstream.

The survey shows that (1) the upstream portion of the cave system has three- or four-story passages with severe collapse of the ceilings and walls above the floors that have larger slope gradients than the other portions, (2) the relatively long midstream portion typically has two-story passages with little collapse of the ceilings and walls and very gentle floors, and (3) the downstream portion is smaller and has simple and single-story morphology with several lava falls and gentle floors.

The longitudinal variation of lava cave morphology suggests that thermal erosion by lava was an important process in the upstream portion of the cave system whereas lava accretion was more important than erosion in the downstream portion. The longitudinal variation of lava accretion and erosion is attributed to 1) longer duration of lava flows in the upstream reach, resulting in more erosion of the bottom of tube, and 2) sluggish movement or stagnation of lava in the downstream reach, allowing more time for lavas to accrete on the ceilings and walls. We infer that the longer lava storage in downstream tube is related primarily with the profile of a shield volcano, which commonly becomes gentler downstream and can cause deceleration of lava flow. The detailed and quantitative documentation of the morphological changes reported in this study can help understand the development and evolution for other lava cave systems common in gently sloping shield volcanos worldwide.