A New Genetic Type of Tafoni: the Mount Laoshan Bubble-like Cave Granite as an Example

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Abstract: Tafoni refers to the negative microgeomorphology state of bedrock surface. It is an important geological phenomenon in earth critical zone. The important information that can be extracted from a variety of geological processes and Quaternary environment has attracted attention in academic circles. From academic debates, it can be seen that the different genesis of tafoni are often confused in form, and without a careful distinction. Tafoni is often confused with “weathering pit”, and the latter may only be part of the former. In China, most scholars believe that tafoni is produced by external geologic forces, including weathering and erosion. Among them, Wang Wei thought that the weathering pit was mainly affected by chemical weathering, and Lu Hongbo considered that the salt weathering in physical weathering was dominant. Erosion includes pothole and sea erosion groove formed by running water erosion, deflation pit formed by wind sand erosion, “glacial pothole” formed by ice water erosion, and so on. Among the many species of tafoni, there is a circular opening, upward, shaped like a negative microgeomorphology of a tamping mortar, which named as natural-mortar in our study. In recent years, there has been a heated debate between “glacial pothole” and “pot hole” (including weathering pit, wind erosion hole, sea erosion hole, etc.), which has pushed the discussion of Quaternary glaciers in eastern China to a new peak. We believe that the natural-mortar is formed by the weathering of the miarolitic cave.

However, there is another view abroad, such as Spanish geomorphologist Vidal Romani believes that granitetafoniare endogenous structure formed during magma condensation, and then finally formed by weathering. With the establishment of a large number of national geological parks and the promotion of the development of tourism geomorphology, remarkable progress has been made in the study of granitic geomorphology in China. It is worth noting that the study of miarolitic granite in eastern China has not been applied to geomorphology. Miarolitic granite in the MountLaoshan, Qingdao and the Mount Tailaoshan, Fujian Province are especially development. Therefore, this important factor must be taken into account in the study of the genesis of Tafoni in these areas.

In the process of studying the natural-mortars of the Mount Laoshan granite, some scholars classified it as “glacial pothole”, while another part of scholars considered it to be a “weathering pit”. Through the investigation and study of the MountLaoshan granitic geomorphology, we have found not only a large number of natural-mortars(Fig.1(a), (b)), but also a large number of granitic primary caves. Most of them are several centimeters in diameter, which is commonly reported by scholars. In addition, we found a number of granitic primary caves, the cave body is ellipsoid, similar to bird eggs, exposed on the cliff, completely embedded in the bedrock, the mouth of a small cavity, the wall of the cave is round and smooth, the rock surface is fresh, mineral crystals are intact. In addition to cutting the joints of the ellipsoid of the wall, there is no trace of manual excavation or external force erosion of surface (Fig.1(c), (d)). They are about 2 meters in diameter, including Yuhuang Cave, Huangshi Cave, Xianguang Cave, Ciguang Cave, Hulu Cave, Laojun Cave, Xuanzhen Cave, Sanfeng Cave, Dashiweng Cave, Nameless Cave and so on. The diameters of the largest ellipsoids in YuhuangCave are 3.1 m, 2.6 m and 2.4 m. These primary caves are of the same origin as themiarolitic caves, and they are bubble-like cave formed by the volatile matter did not escape in time during magma condensation. It is not reported in classical geology, which named as “bubble-like cave” in our study.

The existence of the Mount Laoshan granitic bubble-likecave (miarolitic cave) is not only a type of micro-geomorphology on graniticbedrock surface, but also has an important influence on the formation of secondary pit on granitic surface. It is particularly noteworthy that many natural-mortars are very close to larger bubble-like caves (miarolitic caves) in morphology and scale. Our field investigation found that many natural-mortars developed at Lingqipeak the Mount Laoshan were associated with a large number of miaroliticcaves, and a large number of bubble-like caves (miaroliticcaves) were developed around the bedrock of Yao Chi in Taiping Palace scenic spot. Therefore, it can be considered that natural-mortars are formed by weathering and denudation after the bubble-like caves (miarolitic caves) are exposed, and some of them are even the direct product of the destruction of the bubble-like caves (miarolitic caves), rather than the “glacial pothole”. Of course, natural-mortar is only part of the Mount Laoshantanfo, there are other weathering pits, or erosion pits.

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This study reveals a new genetic type of Laoshan granitic tafoni. Such large bubble-like caves are rarely observed in geological records. It has ornamental, scientific and tourism value.

Key words: Mount Laoshan, miarolitic granite, primary cave, naturel-mortar, glacial pothole, bubble-like cave

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References


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