

Investigation on Lava Tube Caves in Manno lava flow of Mt.Fuji

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[Introduction]

Manno lava flow of Mt.Fuji is a very old lava flow and the eruption is said to be before BC 10000, the silicic acid weight fraction is as low as 49.7%¹⁾. Manno lava flow is known to have Manno Fuketsu lava cave (another name is Dainichi Ana lava cave), Yasiki Ana lava cave, Kobou Ana lava cave, Mado Ana lava cave, Ginga Fuketsu lava cave, Kannon Ana lava cave (already buried)^{2, 3)}. These are thought to be a series of lava tube cave systems and considered the oldest lava caves in Mt. Fuji. Among them, Manno Fuketsu lava cave is the longest lava tube cave in Manno lava flow with a total distance of 908 m in Manno lava flow^{2, 3)}. The yield strength and the surface tension of Manno lava flow were estimated by referring to the Manno Fuketsu lava cave survey maps^{2, 3)}.

[Manno Fuketsu lava tube cave and lava yield strength]

A photograph inside the Manno Fuketsu lava cave (Dainichi Ana lava cave) is shown in Photo 1, and a survey map in the horizontal section and longitudinal section is shown in Fig.1. A cave slope angle $\alpha = 2.5^\circ$ is obtained from the height difference (30 m) in the longitudinal sectional view and the cave length (700 m). The cave height is approximately 5 m. The lava yield strength f_B is estimated from $f_B = H (\rho g \sin \alpha) / 4$ by the flow limit condition of the Bingham fluid flowing in the inclined circular tube⁴⁾. When the lava density is 2.5 g / cm^3 , $f_B = 1.32 \times 10^4 \text{ dyne / cm}^2$ can be obtained from the above conditions. It is considered to be a reasonable value for basalt lava having a silicic acid weight fraction of 49.7%.

[Lava stalactite and surface tension value]

Many lava stalactite are found in the ceiling of Manno Fuketsu lava cave (Dainichi Ana lava cave). When the lava is drained through the lava tube, the residual molten lava stagnated on the ceiling is hanging down from the ceiling by forming the lava stalactite. The surface tension of lava can be estimated from the pitch of this lava stalactite⁵⁾. From the stability limit condition of the liquid film adhering to the ceiling, the specific pitch $P = 2\pi (\gamma / g\rho)^{1/2}$ of the wave motion of the liquid film is obtained. Here, γ is the surface tension of the lava, g is the gravitational acceleration, and ρ is the density of the lava. Therefore, we can obtain the surface tension $\gamma = P^2 g\rho / 4\pi^2$ of the lava by measuring the pitch P of the periodic position of the lava stalactite descent from the ceiling⁵⁾. The pitch measured in the Manno Fuketsu lava cave is roughly $P = 3$ to 4 cm (see Photo 2), and $\gamma = 560$ to 990 dyne / cm as the surface tension is obtained. The surface tension is considered to be a reasonable value⁵⁾.

[Conclusion]

The yield strength and the surface tension of the Manno lava flow were estimated by the tube shape and internal structure of Manno Fuketsu lava cave (Dainichi Ana lava cave). Both values obtained are considered to be reasonable values for basalt. Yield strength and surface tension are the same as other examples of lava flows of Mt. Fuji^{4, 5)}. We are planning to continue to investigate other lava tube cave of Mt. Fuji which has not been studied yet.

References:

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Keywords: Fuji, lava tube, lava flow, lava staractite



写真1 万野風穴内部



写真2 万野風穴天井の溶岩鍾乳

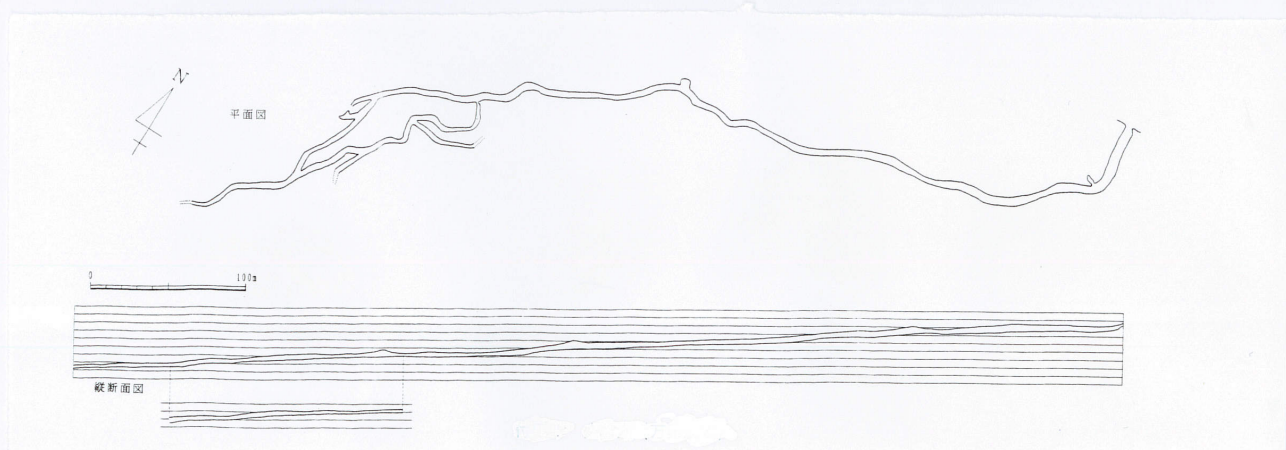


図1 万野風穴の水平及び縦断面図