

**Title:**

Mapping lava flow textures using three-dimensional measures of surface roughness

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**Abstract**

Lava flow emplacement conditions are reflected in the surface textures of a lava flow; unravelling these conditions is crucial to understanding the eruptive history and characteristics of basaltic volcanoes. Mapping lava flow textures using visual imagery alone is an inherently subjective process, as these images generally lack the resolution needed to make these determinations. Our team has begun mapping lava flow textures using visual spectrum imagery, which is an inherently subjective process involving the challenge of identifying transitional textures such as rubbly and slabby pāhoehoe, as these textures are similar in appearance and defined qualitatively. This is particularly problematic for

interpreting planetary lava flow textures, where we have more limited data. We present a tool to objectively classify lava flow textures based on quantitative measures of roughness, including the 2D Hurst exponent, RMS height, and 2D:3D surface area ratio. We collected aerial images at Craters of the Moon National Monument (COTM) using Unmanned Aerial Vehicles (UAVs) in 2015 and 2016 as part of the FINESSE (Field Investigations to Enable Solar System Science and Exploration) and BASALT (Biologic Analog Science Associated with Lava Terrains) research projects. The aerial images were stitched together to create Digital Terrain Models (DTMs) with resolutions on the order of centimeters. The DTMs were evaluated by the classification tool described above, with output compared against field assessment of the texture. Further, the DTMs were downsampled and reevaluated to assess the efficacy of the classification tool at data resolutions similar to current datasets from other planetary bodies. This tool allows objective classification of lava flow texture, which enables more accurate interpretations of flow characteristics. This work also gives context for interpretations of flows with comparatively low data resolutions, such as those on the Moon and Mars. Textural maps based on quantitative measures of roughness are a valuable asset for studies of lava flows on Earth and other planetary bodies.