

Title:

Decoding the Margins: What Can the Fractal Geometry of Basaltic Flow Margins Tell Us?

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Publication:

American Geophysical Union, Fall General Assembly 2016, abstract id.P33D-2187

Publication Date:

12/2016

Origin:

AGU

Keywords:

4558 Sediment transport, OCEANOGRAPHY: PHYSICALDE: 6281 Titan, PLANETARY SCIENCES: SOLAR SYSTEM OBJECTSDE: 6295 Venus, PLANETARY SCIENCES: SOLAR SYSTEM OBJECTSDE: 5405 Atmospheres, PLANETARY SCIENCES: SOLID SURFACE PLANETS

Bibliographic Code:

2016AGUFM.P33D2187S

Abstract

Studying lava flows on other planetary bodies is essential to characterizing eruption styles and constraining the bodies' thermal evolution. Although planetary basaltic flows are common, many key features are not resolvable in orbital imagery. We are thus developing a technique to characterize basaltic flow type, sub-meter roughness, and sediment mantling from these data. We will present the results from upcoming fieldwork at Craters of the Moon National Monument and Preserve with FINESSE (August) and at Hawai'i Volcanoes National Park (September). We build on earlier work that showed that basaltic flow margins are approximately fractal [Bruno et al., 1992; Gaonac'h et al., 1992] and that their fractal dimensions (D) have distinct 'a' and pāhoehoe ranges under simple conditions [Bruno et al., 1994]. Using a differential GPS rover, we have recently shown that the margin of Iceland's 2014

Holuhraun flow exhibits near-perfect ($R^2=0.9998$) fractality for ≥ 24 km across dm to km scales [Schaefer et al., 2016]. This finding suggests that a fractal-based technique has significant potential to characterize flows at sub-resolution scales. We are simultaneously seeking to understand how margin fractality can be modified. A preliminary result for an *a'ā* flow in Hawaii's Ka'ū Desert suggests that although aeolian mantling obscures the original flow margin, the apparent margin (i.e., sediment-lava interface) remains fractal [Schaefer et al., 2015]. Further, the apparent margin's D is likely significantly modified from that of the original margin. Other factors that we are exploring include erosion, transitional flow types, and topographic confinement. We will also rigorously test the intriguing possibility that margin D correlates with the sub-meter Hurst exponent H of the flow surface, a common metric of roughness scaling [e.g., Shepard et al., 2001]. This hypothesis is based on geometric arguments [Turcotte, 1997] and is qualitatively consistent with all results so far.