EMPLACEMENT OF A LONG LAVA FLOW NEAR ASCRAEUS MONS VOLCANO, MARS.

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Introduction: Channeled lava flows on Mars commonly extend several 10s to 100s of kilometers [1,2], significantly longer than documented channeled lava flows on Earth, which are only extend up to 10s of kilometers long [3]. Although channeled lava flows on Mars are typically longer than terrestrial flows, both exhibit similar features in their final morphology. We present a study of a particular channeled lava flow, ~365 km long, in the saddle region between Ascraeus Mons and Pavonis Mons on Mars (Figure 1) [1].

Using data from Mars Orbiter Laser Altimeter (MOLA) [4], Mars Orbiter Camera (MOC) [5], and Thermal Emissions Imaging System (THEMIS) [6], we detail the lava flow's dimensions, morphology, and surface features. We compare our results with simulated channeled flows using polyethylene glycol wax (PEG) and channeled lava flows on Hawaii to better understand what the final flow features indicate about the emplacement. This study builds on and refines previous work [1,7,8] and provides insight into the emplacement history of a long channeled lava flow on Mars.

Observations: The martian lava flow extends along the southwestern perimeter of Ascraeus Mons (Figure 1). Gridded MOLA data suggest a regional underlying slope averages 0.3º. The flow length measured (~365 km) is a minimum because the source area for the lava flow is not known; therefore, flow length is measured from the first recognizable location of the flow. The flow width ranges from 1.7-7.2 km and channel width ranges from 0.2-2.0 km, but is typically <1.0 km. Thickness of the flow is measured between 8-43 m using MOLA gridded data. The flow covers an area of ~1900 km^2, measured in Canvas 7.0, and using an average thickness of 23 m, the volume is ~44 km^3.

Morphology of the flow changes downstream, exhibiting erratic changes in levee and channel widths in some locations while others display consistent channel and flow margin widths.

Surface features are visible in high-resolution THEMIS VIS (19 m/pixel) and MOC (4.6-6.15 m/pixel) images. A suite of THEMIS images reveal that the channel disappears and reappears down the flow length, changes width, and shows the interaction of the lava flow with the margin of an adjacent lava flow (Figure 2).

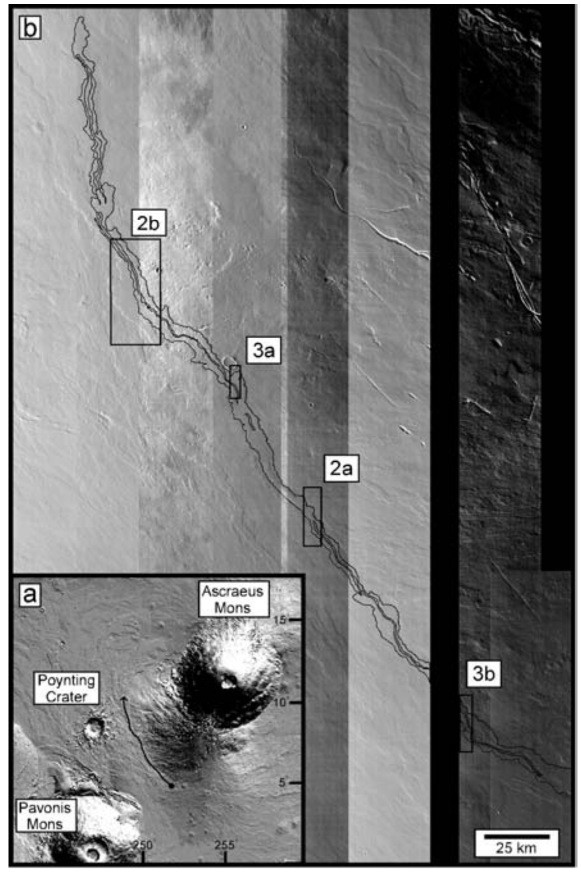

Figure 1. a) Location of the lava flow in relation to Ascraeus Mons volcano, Mars. b) Outline of flow margin and channel in a mosaic of THEMIS IR. Locations of images in Figures 2 and 3 are labeled (2a, 2b, 3a, and 3b). THEMIS images courtesy of NASA/JPL/ASU.

Cross-sections from MOLA gridded data reveal that the left levee (when looking downstream), which interacts with the other flow, increases in thickness to >40 m, whereas the right levee remains at a moderate thickness of ~10 m.

MOC images reveal a rougher surface along the flow margins characterized with angular topographic highs and a relatively smoother channel (Figure 3a), "islands" within the channel and windstreaks across the flow surface (Figure 3b).

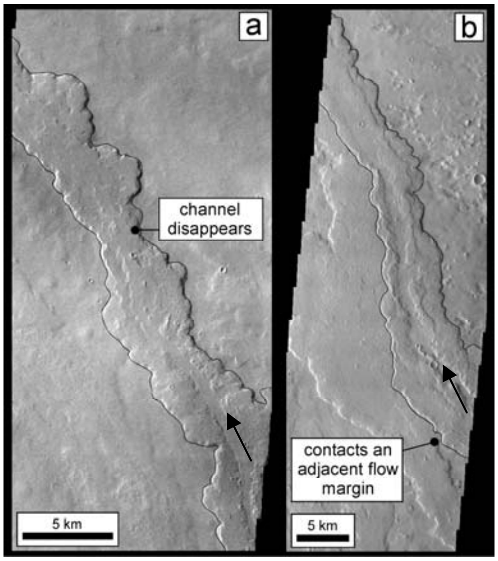

Figure 2. a) THEMIS V11712007. The channel disappears along this section of the flow, but reappears 74 km downstream (not shown). b) THEMIS V14495018. The flow interacts with the margin of an adjacent flow. Arrows indicate flow direction. Images courtesy of NASA/JPL/ASU.

Discussion: We used a combination of image interpretation, quantitative analysis, and comparisons with both simulated and terrestrial analogs are used to piece together the emplacement history of this particular Martian lava flow. To distinguish the downstream changes in morphology, we mapped the flow according to characteristics of morphologic zones (stable, transitional, zone of dispersed flow) originally used to describe a 27-km long, channeled a'a flow from the 1984 eruption of Mauna Loa volcano, Hawaii [9]. Our criteria for the morphologic zones on Mars can be found in [10]. The mapped pattern of the morphologic zones reveals a complex alternating pattern of stable and transitional zones that has not been documented in terrestrial channeled lava flows. This pattern indicates changes in flow dynamics down the channel during emplacement that may be the result of dams, overflows, surges, increase/decrease of effusion rate, and changes in rheologic properties of the lava itself.

Polyethylene glycol (PEG) wax has been used to simulate lava flows in subaerial, submarine, and extraterrestrial environments [11,12]. Channeled PEG flows also show similar morphologic zones as observed in the 1984 Mauna Loa eruption [9,10]. Due to constraints on tank size, we are not able to conduct simulations on slopes >12º and longer than 70 cm, limiting our observation of how PEG channels evolve over long distances. Our observations of channeled PEG flows will be used to understand the eruption parameters required for a channel to be established. We will also compare the morphology of the Martian flow to channeled lava flows (1907 and 1984) on Mauna Loa volcano and a pre-historic flow on Mauna Kea.

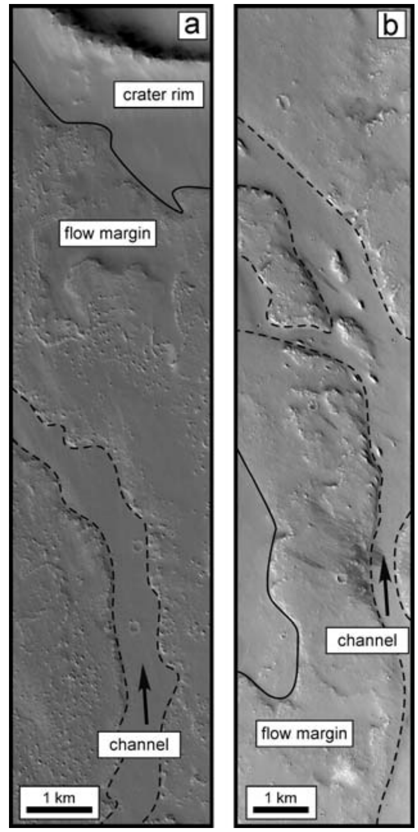

Figure 3. a) MOC E12-02381. Lava flow near the rim of an impact crater. b) MOC R14-01618. Islands in the channel and where the channel forks. Arrows indicate flow direction. Images courtesy of NASA/JPL/Malin Space Science Systems.

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