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TITLE: A volcanic origin for sinuous and branching channels on Mars: Evidence from Hawaiian analogs

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ABSTRACT BODY: Observations of sinuous and branching channels on planets have long driven a debate about their origin, fluvial or volcanic processes. In some cases planetary conditions rule out fluvial activity (e.g. the Moon, Venus, Mercury). However, the geology of Mars leads to suggestions that liquid water existed on the surface in the past. As a result, some sinuous and branching channels on Mars are cited as evidence of fluvial erosion. Evidence for a fluvial history often focuses on channel morphologies that are unique from a typical lava channel, for instance, a lack of detectable flow margins and levees, islands and terraces. Although these features are typical, they are not necessarily diagnostic of a fluvial system. We conducted field studies in Hawai'i to characterize similar features in lava flows to better define which characteristics might be diagnostic of fluvial or volcanic processes. Our martian example is a channel system that originates in the Ascraeus Mons SW rift zone from a fissure. The channel extends for ~300 km to the SE/E. The proximal channel displays multiple branches, islands, terraces, and has no detectable levees or margins. We conducted field work on the 1859 and 1907 Mauna Loa flows, and the Pohue Bay flow. The 51-km-long 1859 Flow originates from a fissure and is an example of a paired 'a'ā and pāhoehoe lava flow. We collected DGPS data across a 500 m long island. Here, the channel diverted around a pre-existing obstruction in the channel, building vertical walls up to 9 m in height above the current channel floor. The complicated emplacement history along this channel section, including an initial 'a'ā stage partially covered by pāhoehoe overflows, resulted in an appearance of terraced channel walls, no levees and diffuse flow margins. The 1907 Mauna Loa flow extends > 20 km from the SW rift zone. The distal flow formed an 'a'ā channel. However the proximal flow field comprises a sheet that experienced drainage and sagging of the crust following the eruption. The lateral margins of the proximal sheet, past which all lava flowed to feed the extensive channel, currently display a thickness of < 20 cm. Were this area covered by a dust layer, as is the Tharsis region on Mars, the margins would be difficult to identify. The Pohue Bay flow forms a lava tube. Open roof sections experienced episodes of overflow and spill out. In several places the resultant surface flows appear to have moved as sheet flows that inundated the preexisting meter scale features. Here the flows developed pathways around topographic highs, and in so doing accreted lava onto those features. The results are small islands within the multiple branched channels that display steep, sometimes overhanging walls. None of these features alone proves that the martian channel networks are the result of volcanic processes, but analog studies such as these are the first step towards identifying which morphologies are

truly diagnostic of fluvial and volcanic channels.
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Additional Details

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