WHAT LIES BENEATH: LAVA INFLATION PLATEAUS ON EARTH AND MARS.
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Summary: On Mars and Earth smooth, level surfaces of lava inflation plateaus show little subsurface positive relief. Pitted inflation plateaus indicate a rugged buried surface. Subsurface relief beneath pitted plateaus exceeds the initial thickness of sheet flows, but is considerably less than that of the inflated flow.

Introduction: One of the goals of geology is to discern the rock and structure beneath the surface. To that end we may excavate or drill; make use of natural excavations; or use remote geophysical methods. Vast areas of planetary surfaces are covered with volcanic flows. Partially-buried craters are employed to determine lava thickness and subsequently the basin configuration into which the lava ponded [1]. Craters which excavate through the flows to eject subjacent materials are used examine the nature of buried material [2]. On Mars pseudocraters provide evidence of a wet substrate beneath a lava flow [3].

Inflation plateaus: Lava flows on Mars exhibit a variety of surface morphologies related to flow temperature, rate of extrusion, viscosity, and slope of surface. Lava channels and lava tubes are observed on flanks of volcanoes with surface slopes exceeding ten degrees. Lobate flows and sheet flows occur on surfaces of lesser slopes. Inflation of sheet flows is a common occurrence on Earth and Mars. Initial sheet flows a few meters thick form crusts and further injections within the sheet and thicken the flow by inflation [4]. The upper surface is stretched and fractured as the flow inflates. The flow margins, under compression, are relatively strong and resist outflows. Inflated flows reach thicknesses of several times that of the initial flow lobe. The upper surface is relatively smooth and flat. Flow edges are steep. Peripheral fractures outline the margins.

Sheet flows emplaced on featureless surfaces inflate to produce inflation (lava-rise) plateaus with smooth, uninterrupted, upper surfaces. On the other hand, where sheet flows are emplaced on an irregular surface, local topographic rises that are not blanketed with lava become inflation depressions as lava rises around the local topographic high [5]. The upper surface of the inflation plateau becomes pocked with pits. Each inflation pit corresponds to a positive relief feature on the sublava surface. Subsurface relief exceeds the initial thickness of sheet flows, but is considerably less than that of the inflated flows.

Earth and Mars: On Earth, smooth lava-rise plateaus are common in pahoehoe flows of both shield cones and flood basalts. Heavily pitted lava plateaus are seen at the Bandelier-McCarthy's flow [6] in northwestern New Mexico and in the Aden flow in southern New Mexico [7]. The pits are evidence of hummocks on the subflow surface. At Aden, the irregularities are probably a caused by emplacement of the initial lava sheet flow in and around dunes.

On Mars, extensive smooth, unpitted lava plateau in the vicinity of Daedalia Planum are an indication of a relatively smooth sublava surface (Fig. 1A). In contrast, the pitted flow surface in southeast Utopia Planum (Fig. 1B) is suggestive of an extremely irregular buried surface. Inflation pits become windows to subjacent materials. Likewise, the concave inward, scalloped edges of the flow are indicative of a flow margin shaped by surface irregularities as the flow front advanced around them.

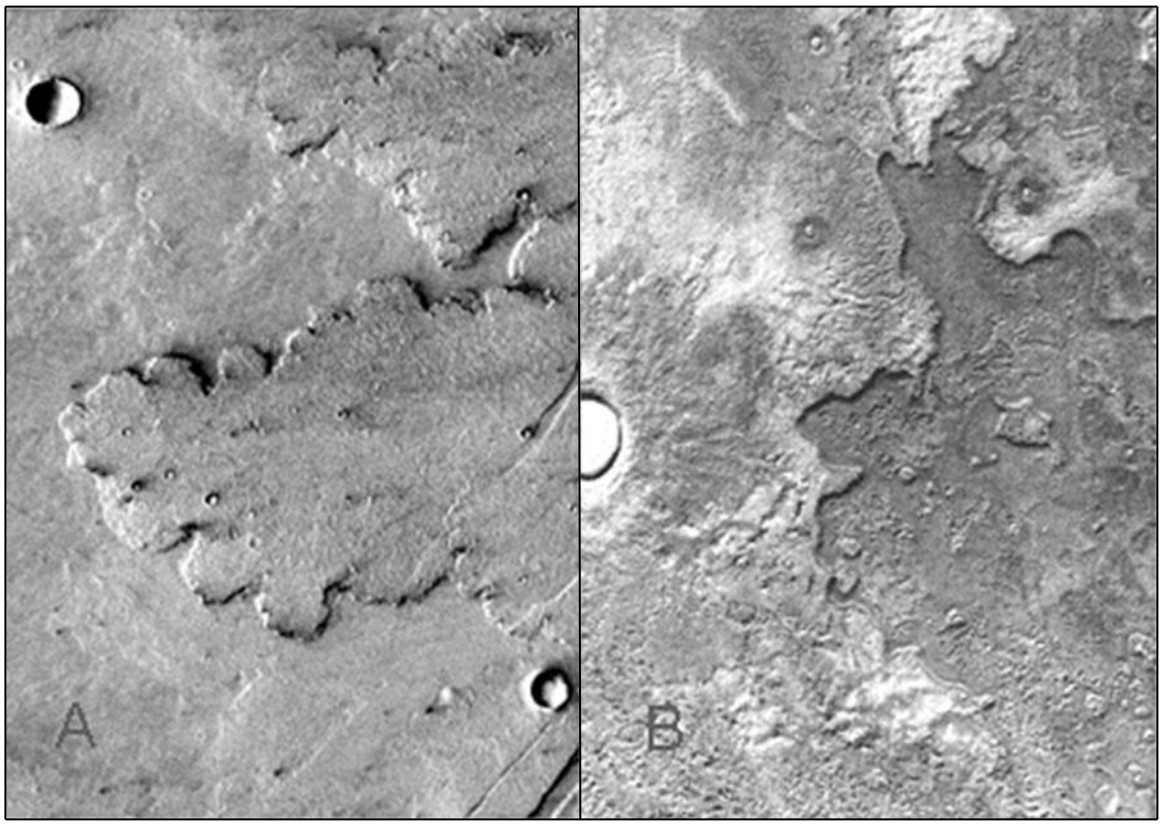

Figure 1. (A) Smooth surfaced lava inflation plateau in Daedalia Planum, and (B) Pitted inflation plateau in Utopia Planum.

References:

[1] DeHon, R.A. and J.D. Waskom (1976), Proc. Lunar Sci. Conf., 7th, 2729.
[2] Tornabene L. (2006), Lunar Planet. Sci. Conf. 37th, Abstract. 1739.
[3] Jaeger, W.L. and others (2008), Planet. Sci. Conf. 39, Abstract 2428.
[4] Hon, K., and others (1994), Geol. Soc. Am. Bull., 106, 351–370.
[5] Walker, G. P. (1991), Bulletin of Volcanology, 53(7), 546-558.
[6] Scheidt, SP and others (2014), Lunar Planet. Sci. Conf. 45, Abstract. 1491.
[7] De Hon, R.A. and R.A. Earl, 2014, Geol. Soc. Amer. Annual Meeting, Abstract. 137-42.