VOLCANO-ICE INTERACTIONS AT PAVONIS MONS, MARS: NEW INSIGHTS FROM CTX AND HIRISE. K. E. Scanlon and J. W. Head, Department of Earth, Environmental, and Planetary Sciences, Brown University, Providence, RI, USA. <kathleen_scanlon@brown.edu>

Introduction: On the windward sides of Olympus Mons and the Tharsis Montes lie fan-shaped deposits (FSDs) of late Amazonian glacial origin [1-5; Figure 1]. Steep-sided lobate flows, arcuate scarps, and radial ridges within the Pavonis Mons FSD are interpreted to have originated from volcano-ice interactions [2]. However, the types of volcano-ice interactions, the size and longevity of any aqueous environments generated by heat transfer from lava to ice, the effect of glaciovolcanism on the Pavonis Mons ice cap, and the glacial conditions recorded by the glaciovolcanic edifices have not been assessed in detail for the Pavonis Mons FSD, and previous geomorphological interpretations [2] should be revisited with the benefit of Mars Reconnaissance Orbiter Context Camera (CTX) [6] and HiRISE data [7]. Our previous work documented glaciovolcanic processes in detail in the Arsia Mons FSD [8-10]. We are extending this work to the Pavonis Mons FSD, where glaciovolcanic edifices are less obscured by mantling material than in the other FSDs and can therefore provide more specific insight into the volcano-ice interactions that formed them.

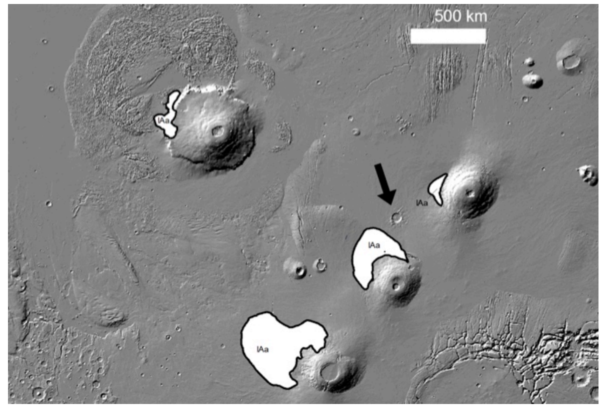

Figure 1. The windward sides of the Tharsis Montes and Olympus Mons are marked by fan-shaped glacial deposits (white, as mapped by [11]). Black arrow denotes Poynting Crater, north of Pavonis Mons FSD. MOLA basemap.

Styles of glaciovolcanism: The steep sides and leveed edges of flows within the Tharsis Montes FSDs implicate volcano-ice interactions of some form. However, the unconsolidated material that mantles most of all three FSDs obscures both any underlying

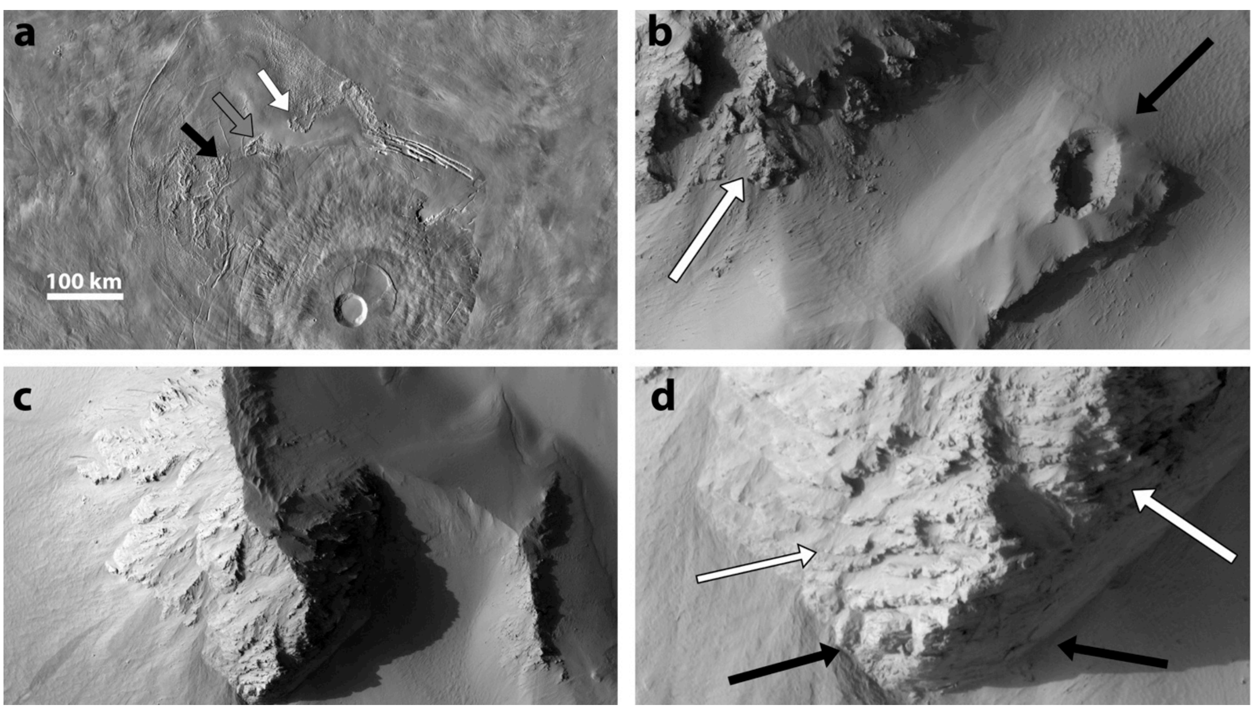

Figure 2. (a) The Pavonis Mons FSD includes several well-exposed steep-sided flows (arrows; white arrow denotes Fig. 2b-d and gray arrow Fig. 3); THEMIS daytime IR basemap. (b) Subset of PSP_002104_1845 showing partially collapsed, blocky wall (white arrow) and possible vent (black arrow). Image ~1.2 km wide. (c) Another outcrop of the same flow; image ~1.3 km wide. (d) Close-up of Fig. 1c showing layering (white arrows) and coarse fractures (black arrows); image ~340 m wide.

features (e.g. cooling joints, superposed subaerial flows) in these edifices and their true slope angles. Several of the steep-sided flows within the Pavonis Mons FSD show large outcrops from beneath this mantle, and so far outcrops on two of them have been imaged by HiRISE (Figures 2 and 3).

The easternmost of these two flows (Figure 2) outcrops in several areas, one of which (Figure 2b) includes a collapsed wall of blocky material and a vent-like structure embedded in an elongate mound with sheer walls. Another outcrop (Figure 2c-2d) shows clear layering (white arrows); coarse, blocky fractures (black arrows); and a sheer upslope (southern) wall with gentler slopes on its downslope faces. Our preliminary interpretation is that the structure and morphology of this edifice is most consistent with a tindur, i.e. a mound of subglacially erupted tephra that never reached the surface of the ice and water above it [e.g. 12]. A digital elevation model created using the Ames Stereo Pipeline [13] indicates that both outcropping sections are ~200m high.

The westernmost of the two flows imaged by HiRISE (Figure 3) also consists of horizontally layered material (Figure 3a, arrows) with locally sheer slopes that have failed in some areas (Figure 3b).

Glaciovolcanic aqueous environments: Lava-ice heat transfer during construction of the glaciovolcanic landforms within the Pavonis Mons FSD would have melted a substantial volume of ice. Glaciovolcanic melting of a thick, cold-based ice sheet would not necessarily have resulted in fluvial erosion due to the limited avenues for drainage of the meltwater vault surrounding a volcanic edifice [e.g. 12]. Earlier workers have proposed that the braided channels at the northern margin of the FSD (Figure 4) may have been eroded by the drainage of glaciovolcanic meltwater from the ice sheet margin [2]. We are reevaluating this hypothesis with the benefit of CTX images.

The primary evidence against a glaciovolcanic origin for the channels is the fact that they are restricted to the ejecta of Poynting Crater, making it plausible that melting of ground ice by hot ejecta could have carved the channels before the FSD ice sheet existed. However, the ejecta may simply have been more erodible than the lava flows that surround the rest of the FSD. Furthermore, the "knobby facies" within the FSD, which has been interpreted as a sublimation till whose distribution may be affected by the flow of glacial melt [2], is much denser within the part of the FSD from which the channels originate. Ongoing work includes reevaluating the relationship of the knobby facies in all three FSDs to proposed glaciovolcanic edifices, as well as numerical modeling to constrain the size and longevity of englacial meltwater bodies.

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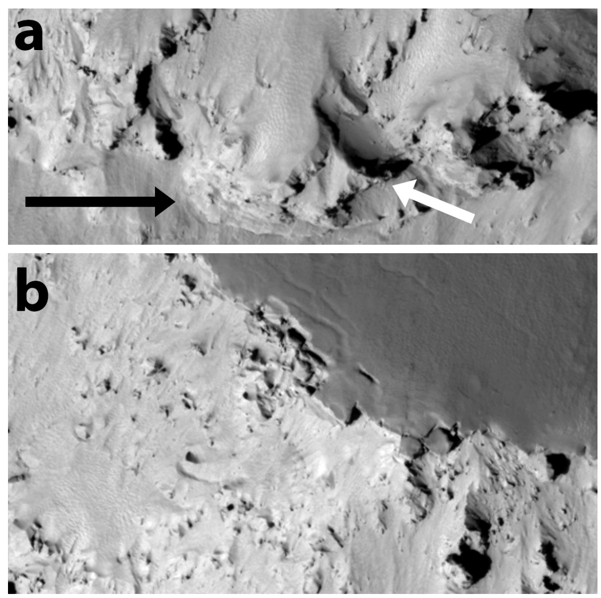

Figure 3. Upslope edge of edifice shown with grey arrow in Fig. 2. (a) Section of HiRISE [7] image ESP_066744_1840 showing horizontal layers within the edifice. (b) Section of the same image showing partial collapse of the structure.

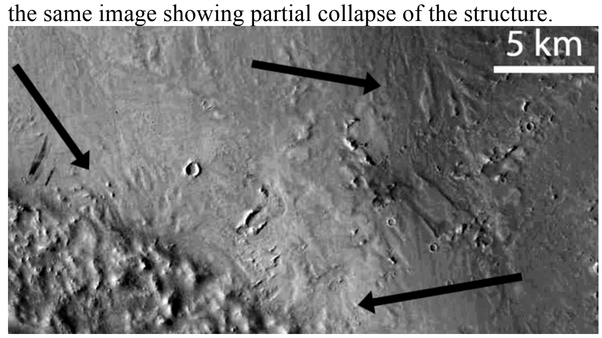

Figure 4. Potentially fluvial channels at the northern edge of the FSD (Murray Lab CTX Global Mosaic; [6, 14]).