DISTRIBUTION AND MORPHOLOGY OF LAVA TUBE SYSTEMS ON THE WESTERN FLANK OF ALBA MONS, MARS. David A. Crown, Stephen P. Scheidt, and Daniel C. Berman, Planetary Science Institute, 1700 E. Ft. Lowell Rd., Suite 106, Tucson, Arizona 85719 (crown@psi.edu).

Introduction: Numerous lava tubes are found within the extensive lava flow fields that dominate Alba Mons' western flank. In conjunction with 1:1M-scale geologic mapping of the summit region (245-255°E, 32.5-47.5°N) and western flank (230-245°E, 37.5-47.5°N) of Alba Mons [1-3], we are using imaging and topographic datasets to analyze the observed lava tube systems. Here, we present mapping results regarding the distribution, morphologic and morphometric characteristics, and geologic/volcanic context of Alba Mons' lava tubes.

Background: Alba Mons is a large, low-relief volcano (1015 × 1150 km in planform; ~6 km relief) with low flank slopes (~1°) [e.g., 4-8]. Viking Orbiter studies described the summit caldera complex, lava flow fields, dendritic valley networks, and prominent sets of circumferential graben [9-22]. The different lava flow morphologies described include tube-fed flows, termed crested [13] to emphasize the prominent volcanic ridges observed.

Geologic Mapping: CTX and THEMIS IR images have been used to produce a preliminary geologic map of the western flank study region that shows the distribution and types of volcanic, tectonic, fluvial, and impact features [1-3]. Analyses to-date suggest tectonic deformation post-dates both volcanic and fluvial activity and that fluvial dissection generally post-dates but overlaps in time with lava flow emplacement.

Mapped volcanic features include lava flow margins and lava tube segments. Their distribution is consistent with the broad shape of the volcano and local slopes (at 50 km scale), although flow paths have been deflected by local obstacles including pre-existing impact craters and volcanic flows. Although local relationships are complex, lava flows generally post-date adjacent lava tube systems.

Lava flows are typically elongate with relatively constant widths, although variations in width, flow branching, and broader lobes are also observed. Typical flow widths are ~2-10 km and numerous flow lobes extend for 100+ km. Distinct source vents have not been identified, presumably due to burial on the flanks and because numerous flows appear to originate outside the map area. The preservation of flow margins varies both along individual lobes and across the region. Some flow margins exhibit distinct lobate scarps with preserved fine-scale sinuosity that reflects differential lateral spreading during emplacement.

Lava tube systems also occur throughout the western flank, are concentrated in some locations, and are generally radial in orientation to Alba Mons' summit. Lava tubes are typically discontinuous and delineated by sinuous chains of elongate depressions, which in many cases are located along the crests of prominent sinuous ridges. Lava tube systems occur as both these ridged forms with lateral flow textures and more subtle features denoted by a central distributary feature within the flat-lying flow field surface. Significant parts of the sinuous volcanic ridges show no collapse features, indicating a distinctive topographic signature for Alba Mons' lava tubes. Future work will examine in detail correlations between cross-sectional shape, collapse features, and lateral flow textures to characterize topographic signatures associated with lava tube collapse and breakouts from lava tube systems.

We have integrated imaging and topographic (MOLA DEM, slope maps, and derived planform convexity) datasets for systematic mapping of lava tubes on the western flank of Alba Mons [23-24], given the morphologic signatures of collapse and topographic signatures as ridges that characterize various segments (Figure 1). A total length of ~12,000 km for 331 lava tube systems has been determined for the study region, with 47.3% defined by collapse features. Further mapping may link some of the currently mapped systems together, increasing maximum lengths from the current ~400 km (and reducing the total number of lava tube systems). The currently mapped population of lava tube systems has a mean length of 36.2 km, mean relief of 0.31 km, and mean surface slope of 0.51°.

To assess how lava tubes correlate to regional slope, we have compared a MOLA regional slope map using a 50 km grid to 786 segments of the mapped lava tube systems defined by that grid. Both the orientations and slope values of lava tube system segments typically show small deviations from those of 50-km-scale regional slope vectors (Figure 2). This suggests a strong coupling of lava tubes to the current slopes of Alba Mons (at 50 km scale). The few lava tube segments with significant deviations in orientation from regional slope will be subject to further analyses and may indicate deflection by local topography, structural control of flow paths, or tectonic readjustment.

References: [1] Crown DA et al. (2019) this volume. [2]Scheidt SP et al. (2019) this volume. [3] Crown DA et al.

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Figure 1. *Map of lava tube systems in Alba Mons western flank map area; red = collapsed lava tube segment, maroon = collapsed lava tube segment on ridge, and yellow = volcanic ridge). Base is THEMIS IR mosaic. Note that lava tube systems can consist of multiple segments with different morphologies.*

Figure 2. *Histograms that show comparison between orientation and magnitude of regional slope vectors based on 50 km MOLA grid and lava tube segments (N = 786) using 50 km grid to subdivide 331 mapped lava tube systems. Red vertical lines indicate mean values (orientation: 4.42°; slope: 0.03°). Shaded ranges represent standard deviations. Regional slope mean orientation = 306° and regional slope mean = 0.91°.*