GEOLOGIC MAPPING OF THE SUMMIT AND WESTERN FLANK OF ALBA MONS, MARS. David A. Crown[1], Daniel C. Berman[1], Thomas Platz[1,2], Stephen P. Scheidt[3], Ernst Hauber[4], and Catherine M. Weitz[1], [1]Planetary Science Institute, 1700 E. Ft. Lowell Rd., Suite 106, Tucson, Arizona 85719 (crown@psi.edu); [2]Max Planck Institute for Solar System Research, Göttingen, Germany; [3]Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona 85721; [4]Institute of Planetary Research, German Aerospace Center, Berlin, Germany.

Introduction: This investigation employs imaging and topographic datasets to produce two 1:1M-scale geologic maps covering the Alba Mons summit (245-255°E, 32.5-47.5°N) and western flank (230-245°E, 37.5-47.5°N). Age constraints are being derived from detailed mapping of stratigraphic and cross-cutting relationships combined with compilation and assessment of crater size-frequency distributions.

Background: Alba Mons is a large, low-relief volcano (1015 × 1150 km in planform; ~6 km relief) with low flank slopes (~1°) [e.g., 1-5]. Studies of Alba Mons using Viking Orbiter data described the summit caldera complex, extensive lava flow fields on its flanks and in the surrounding plains, and prominent sets of graben that extend around the volcano from the south and into the northern plains [6-15]. Dendritic valley networks are observed on Alba Mons' northern flank; coupled with the volcano's low relief, the valley networks have been interpreted to indicate pyroclastic deposits at the volcano's base, suggesting that Alba Mons may be a transitional form from the ancient highland paterae to the prominent shield volcanoes of the Tharsis region [8].

Data Sets and Mapping Methodology: Geologic mapping of Alba Mons utilizes THEMIS, HRSC, CTX, and HiRISE images supported by HRSC and MOLA topography and compositional constraints from CRISM. GIS software and analysis tools are being used for the production of digital and hard copy USGS map products. The map bases each include 6 1:500,000-scale Mars Transverse Mercator (MTM) quadrangles. The geologic maps are being compiled at 1:1M scale; digitial map layers at 1:200,000-scale will include detailed representations of volcanic, tectonic, and erosional features and include point features that indicate intersections between lava flows, valleys, and faults.

Geologic Mapping-Objectives: Science objectives for the Alba Mons summit region map area include documenting the collapse and tectonic history of the summit region and caldera complex, assessing sequences of lava flow emplacement, and a search for eruptive vents and pyroclastic deposits. Science objectives for mapping the western flank include expanding the total area and geologic settings over which cross-cutting relationships between volcanic, tectonic, and erosional features will be analyzed and characterizing the types, ages, and sequences of lava flows in order to document the volcanic evolution of Alba Mons.

Geologic Mapping-Results: Initial mapping has examined the caldera region in order to develop a preliminary unit and symbol scheme [16-18], focusing on intra-caldera flows and flows on the upper flanks of the volcano extending from the caldera complex (Figure 1). Alba Mons' summit region exhibits several overlapping depressions [9, 13]. The caldera complex is 190 × 110 km across and contains a distinct smaller (~65 km across) depression to the southeast with a well-defined but scalloped rim [3]. The main caldera rim is well-defined on its western side as prominent terraced scarps and subdued to the east where it is distinguished by arcuate graben. Differences in the morphologic expression of depression rims within the caldera complex and their floor deposits [see also 8-9] suggest a complicated history of eruptive activity, collapse, and modification. The SE collapse depression appears to represent the last stage of collapse. Based on recently mapped flow lobe patterns [17-18], multiple sequences of lava flow emplacement have occurred from a series of vents within the summit region (Figure 1a).

Diversity in Alba Mons' lava flows was recognized in Viking Orbiter images, with a series of different morphologies described [6-7, 14-15]. Preliminary mapping analyses using modern datasets show a diversity in flow morphology consistent with Viking studies and the potential for systematic characterization of flow types and their spatial and temporal relationships [19]. Mapping the locations of discrete flow lobes (by observed flow fronts or the distal extents of parallel lateral margins) demonstrates that lava flows can be identified across the vast extent of the western flank of Alba Mons (Figure 1c). Adjacent flank surfaces have morphologic characteristics that indicate the presence of additional smaller lava flows with poorly defined margins.

Lava tube systems also occur throughout the western flank, are concentrated in some locations, and can extend for hundreds of kilometers (Figure 1c). They are typically discontinuous and delineated by sinuous chains of elongate depressions. Lava tube systems include both prominent ridges with central distributary features and lateral flow textures and more subtle features denoted by a central distributary feature within the flat-lying flow field surface.

Preliminary mapping of erosional valleys indicates that the northern flank of Alba Mons has been significantly modified by fluvial processes, including the formation of dendritic valley networks. Relationships between individual valley segments, lava flows, and graben are being used to assess the timing of episodes of fluvial erosion.

Relative and absolute model age constraints for individual lava flows and flow sequences are being derived from mapping analyses through systematic evaluation of stratigraphic and cross-cutting relationships in combination with assessment of crater size-frequency distributions [16-19]. Results to-date using craters ~300 m and larger demonstrate that distinct ages can be identified for different parts of the western flank of Alba Mons (Figure 1b).

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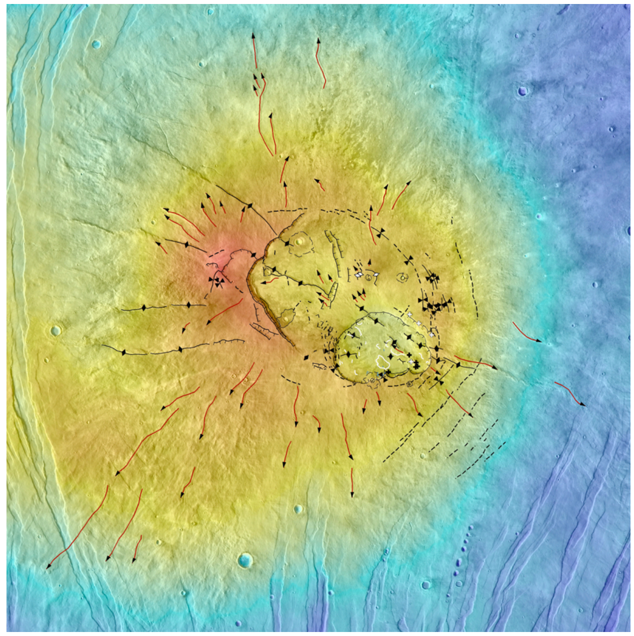

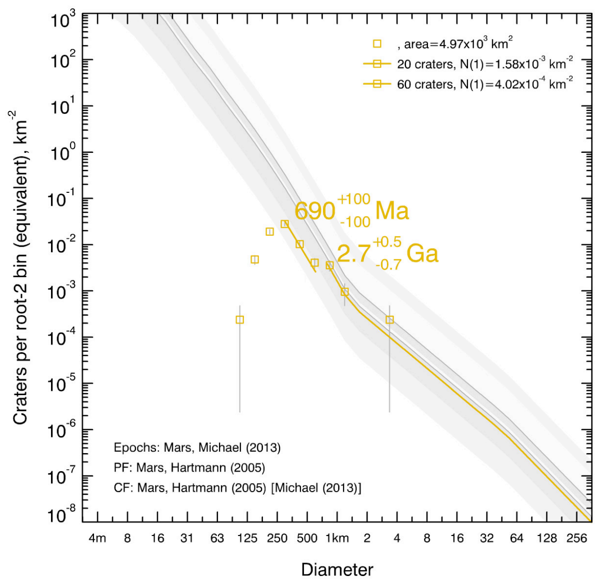

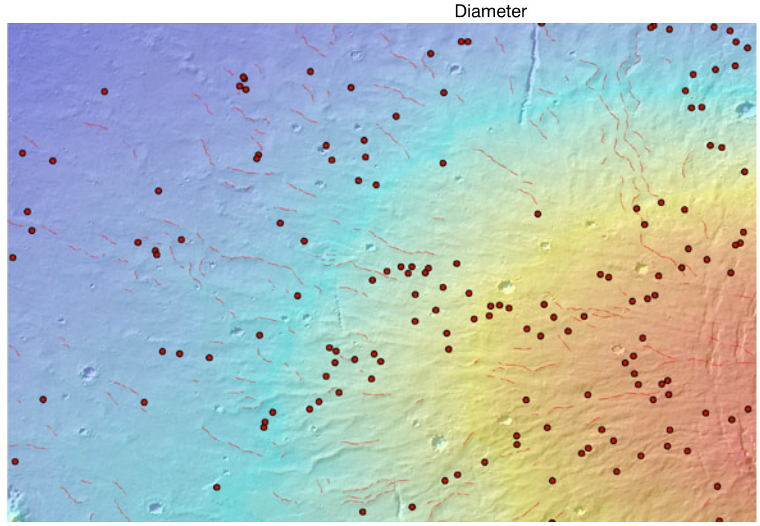

Figure 1. a, top) Initial geologic mapping for Alba Mons summit region. Note flow lobe orientations (as indicated by red lines with arrowheads) suggest multiple eruptive sources in caldera region. Base is MOLA (128 pixel/deg) topography merged with THEMIS IR daytime mosaic. Image width is ~425 km; b, middle) Crater size-frequency distribution for a ~500 km^2 test region on western flank of Alba Mons that includes distinctive tabular lava flows and lava tube systems. Fit segments attributed to flow emplacement (~2.7 Ga) and younger resurfacing (~690 Ma); c, bottom) Colored MOLA hillshade of Alba Mons western flank map area (230-245°E, 37.5-47.5°N) showing lava tube systems (red lines) and discrete flow lobes (red circles).