GEOLOGIC MAPPING OF ALBA MONS, MARS. David A. Crown[1], Daniel C. Berman[1], and Thomas Platz[1,2], [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.

Introduction: Geologic mapping of Alba Mons using a suite of recent high-resolution orbital datasets has been initiated to provide new constraints on the distribution, styles, and timing of volcanism in the northern Tharsis region of Mars. This investigation includes generation of a 1:1M-scale geologic map of the Alba Mons summit region (245-255°E, 32.5-47.5°N) and includes analyses of lava flows/flow fields and interactions between erosional, tectonic, and volcanic features. Age constraints will be derived from detailed mapping of cross-cutting relationships combined with compilation and assessment of crater size-frequency distributions.

Background: Alba Mons is located at the northern margin of the Tharsis region, and its northernmost deposits extend into the northern plains. Alba Mons is a large, low-relief volcano with a planform (1015 x 1150 km) exceeding that of Olympus Mons but the volcano exhibits only ~6 km relief with extremely low flank slopes (~1°) [e.g., 1-3]. Its unusual shape makes it a unique feature on Mars [4] that has drawn comparisons to Venusian coronae [5]. Viking-era studies show that Alba Mons has a summit caldera complex, extensive lava flow fields on its flanks and in the surrounding plains, and prominent sets of graben (Tantalus and Alba Fossae) that extend around the volcano from the south and into the northern plains [6-12]. A series of dendritic valley networks is found on Alba Mons' flanks; coupled with the volcano's low relief, the valley networks have been interpreted to indicate pyroclastic deposits at the base of the volcano, suggesting that Alba Mons may be a transitional form from the ancient highland paterae to the prominent shield volcanoes of the Tharsis region [13].

Data Sets and Mapping Methodology: Geologic mapping is based on a combination of THEMIS, HRSC, CTX, and HiRISE images supported by HRSC and MOLA topography. GIS software and analysis tools will be used for the production of digital and hard copy map products. The map base includes 6 1:500,000-scale Mars Transverse Mercator (MTM) quadrangles (45112, 45107, 40112, 40107, 35112, and 35107). The geologic map will be compiled at 1:1M scale but digitial map layers at 1:200,000-scale will include detailed representations of volcanic, tectonic, and erosional features. Initial mapping is being done on the caldera region to develop a preliminary unit and symbol scheme, focusing on the intra-caldera flows and flows on the upper flanks of the volcano extending from the caldera complex. Continued geologic mapping will progressively extend down the flanks to incorporate additional units and features.

Alba Mons Caldera Region: Alba Mons' summit region exhibits several overlapping depressions (8 per Cattermole [9]; 3-5 per Crumpler et al. [13]), suggesting a complex history of eruptive activity and collapse (Figure 1). The caldera complex as a whole is 190 x 110 km with variable preservation of its rim; an 85 x 50 km depression with a well-defined but scalloped rim is contained within the larger feature [3]. Depression depths are <500 m [3], significantly less than observed for other Tharsis volcanoes [e.g., 14]. 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. Lava flows are evident on parts of the depression floors, and Mouginis-Mark et al. [8] identified a shield, several hundred meters high, in the eastern part of the largest caldera, suggesting it may have been a vent for late-stage eruptions. Cattermole [9] mapped a number of volcanic features within or near the summit caldera, including sinuous rilles, volcanic pits, linear spatter ridges, and a low shield.

CTX images are being used to map the Alba Mons caldera region. Geologic and feature mapping are being used to examine a) the number, ages and sequences of collapse depressions, b) the types, sequences, and ages of lava flows flooring the caldera complex, and c) the distribution and relative ages of local and regional structural features.

Alba Mons Lava Flows: Diversity in Alba Mon's lava flows was recognized in Viking Orbiter images (Figure 2). Tube-fed, sheet, tube-channel, and undifferentiated morphologies were identified on the volcano's flanks and were attributed to various styles of basaltic volcanism [6, 7, 15, 16]. Cattermole [9] describes four flow types, with a general progression in age, dominant morphology, and flow volume from the flanks to the summit region (where younger, shorter, and narrower flows are observed). Observed flow lengths were typically 100-250 km long, with some flows reaching almost 400 km in length. Schneeberger and Pieri [10] systematically mapped lava flows in the summit region and on parts of the flanks of Alba Mons and describe five different flow types, with tabular (comparable to sheet or flat-topped) and crested (comparable to tube-fed) being the dominant morphologies. Their synthesis of volcanic activity

included four main eruptive phases, with emplacement of lava flows dominating all but the second phase, which may have deposited pyroclastic materials near the base of the volcano.

CTX images are being used to map and characterize lava flows in the caldera and on the flanks of Alba Mons. Geologic and feature mapping are being used to assess the types, distribution, and ages of lava flows. Spatial and temporal patterns revealed by mapping may indicate progressions in volcanic development, eruptive style, and/or lava composition.

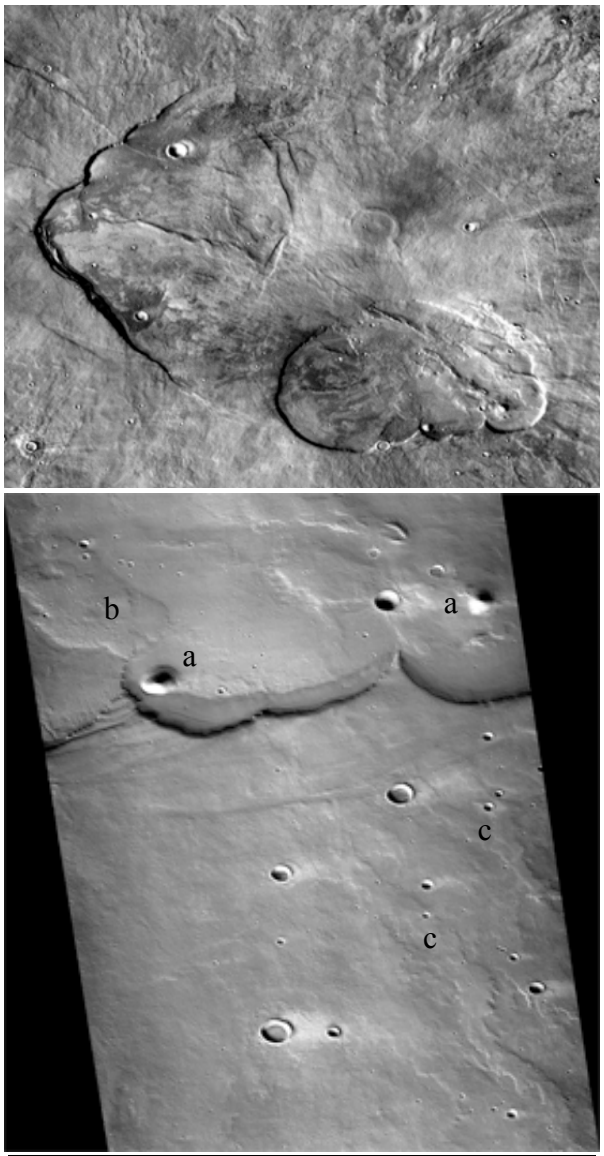

Figure 1. Top) THEMIS mosaic (100 m/pixel) of Alba Mons caldera complex; SE depression is 85 km across. Bottom) CTX image (P10_005031_2197; 5.9 m/pixel) showing scalloped margin of SE collapse depression, small volcanic edifices (a), and flows (b) on caldera floor and (c) extending down flanks. Image width is 29 km.

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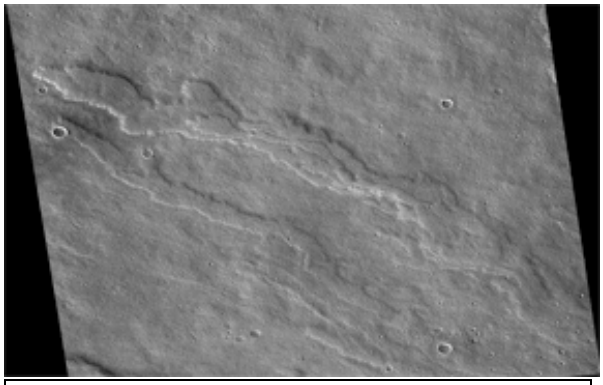

Figure 2. CTX images of Alba Mons lava flows. Top) Elongate, sinuous flows in Alba Mons summit region (B05_011505_2218; 5.91 m/pixel). Bottom) Segmented, discontinuous channel at crest of elongate ridge extends diagonally across image and is cut by graben (B09_013219_2171; 5.88 m/pixel). Channel is interpreted to represent path of lava channel/tube system. Image widths are ~29 km.