HIGH-RESOLUTION GEOLOGIC AND GEOMORPHOLOGIC MAPPING OF THE ARSIA MONS FAN-SHAPED DEPOSITS. K. Krohn, S. van Gasselt and G. Neukum, Institute of Geosciences, Planetary Sciences and Remote Sensing, Freie Universitaet Berlin, 12249 Berlin, Germany (k.krohn@fu-berlin.de)

Introduction and Background: Arsia Mons is the southernmost of the three Tharsis Montes shield volcanoes, located at 9°S/240°E and a large center of volcanism and tectonic stresses. The volcano is constructed of explosive and effusive volcanic deposits and is characterized by an unusual fan deposit at its base extending approximately 500 km towards the west and which has been described by in detail by, e.g., [1, 2, 3, 4]. The fan is considered to consist of essentially three facies: a ridge facies, the knobby terrain and the smooth facies [2]. Hypotheses regarding with the development of the Arsia Mons fan-shaped deposit range from rock glaciers [1], pyroclastic deposits or lahars [2, 5] to piedmont-like debris-covered, and cold-based glaciers [4, 3].

The deposits originate from the Amazonian age and are mostly developed simultaneously with the last phases of Arsia Mons volcanism [3]. Most recent research focusses on the formation of the fan-shaped deposits through multiple stages, i.e., advances and retreats of cold-based glacial systems [4, 3]. They state that the ridged facies is a series of drop moraines where each of these represents a period of standstill of a glacier followed by a phase of retreat. They compared the morphology of the Antarctic Dry Valley debris-covered glaciers with the knobby facies and interpreted it as a sublimation till possibly developed from a sublimated debris covered glacier [4, 3].

Motivation: In the context of ongoing geologic and geomorphologic mapping work conducted on high-resolution data, we are currently focussing on mapping sites of special scientific interest. In order to characterize specific units of the Arsia Mons fan-shaped deposits more precisely and within their regional context and due to the fact that past mapping efforts are based on low resolution Viking VIS data [5] we conduct a combined geological and geomorphological mapping in order to not only characterize the lithology and stratigraphic relationships, i.e., assess the geological context, but also to focus on formation process and landscape evolution as derived from High-Resolution Stereo Camera (HRSC) and Mars Reconnaissance Orbiter Context Camera (CTX) image data as well as by means of terrain-model data and morphometry.

The time-stratigraphic relationships are derived from geological mapping and analysis of crater-size frequency distributions in order to be able to differentiate not only between the three main facies mentioned above but also to be able to introduce/subdivide additional subsets of units.

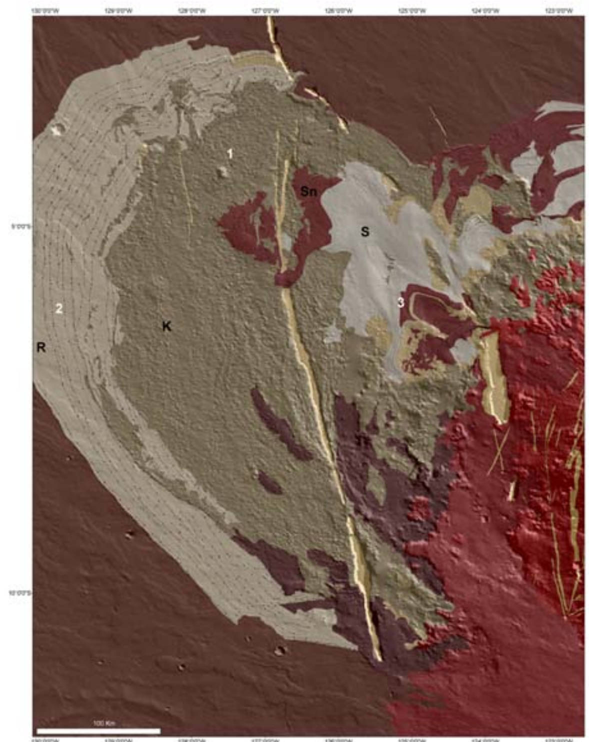

Figure 1: Preliminary map superimposed on shaded relief base map (fan-shaped deposits: K - knobby facies, R - ridged facies, S - smooth facies, striated, Sn - smooth facies #2.

Data and Methodology: The investigation area is located in the western part of the Arsia Mons plains between -12°N to 0°N and 229°E to 238°E covering an area of 370,000 km^2. The mapping scheme is based on the map-scale definition of 1:200,000 as suggested for HRSC data [6] and is furthermore refined at several places for closer inspection to make use of the high-resolution CTX data allowing to map at scales of up to 1:50,000. Mapping is conducted on 9 HRSC image observations at a scale of 12.5 m/px (h1023, h1034, h1045, h1056,

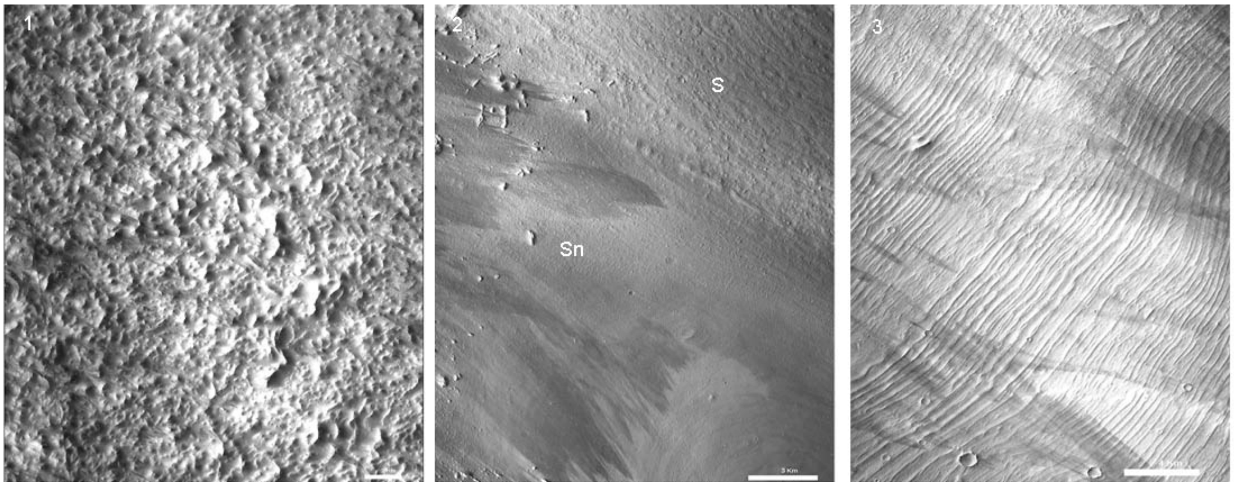

Figure 2: Facies of the fan-shaped deposits, based on CTX images: (1) knobby facies, K; (2) boundary of the *two* smooth facies, S; (3) ridged facies, R.

h1078, h1970, h1981, h1992, h5344) and derived topography data from quadrangle-based bundle-block adjustments as well as 88 CTX image scenes with a scale of 5 m/px which form a gapless image mosaic covering the Arsia Mons FSD.

For the chronostratigraphic context we apply GIS-based impact-crater size counting of homogeneously-cratered units and conduct diameter-size frequency analysis applying the recent production function coefficients [7] and the chronology model by [8] including resurfacing correction [9, 10] by making use of the ArCGIS-integrated CraterTools extension [11] and the CraterStats analysis package [12].

Preliminary Results and Future Work: The mapping work conducted thus far includes the differentiation of the main fan-shaped deposit units [13, 2, 3] on the basis of HRSC and CTX data. The picture remains essentially the same – at least for the ridged (R) and knobby (K) facies as in earlier work although a more precise delineation of geologic boundaries allow constraining the stratigraphic and formational context in more detail. Several isolated and deformed outliers of the knobby (hummocky [13]) facies (K, figure 1, also mapped by Scott:1995) located within the ridged (striated [13]) facies (R, figure 1) need closer inspection in order to explain their stratigraphic relationships. The smooth terrain (S, figure 1), however, is more complicated to assess and the current mapping differs significantly from the picture drawn in previous work [13]. Different surface morphologies in terms of roughnesses of the smooth facies (K, figure 1) suggest that they should be seperated into two sub units (S and Sn, figure 1, also (2) in figure 2). The extent of the smooth facies also extends further towards the north in [5] when compared to our mapping approach where it is to be distinguished into at least two sub units.

References

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