GEOLOGIC MAPPING OF ASCRAEUS MONS, MARS. K.J. Mohr[1], D.A. Williams[1], and W.B. Garry[2] [1]School of Earth & Space Exploration, Arizona State University, Tempe, AZ 85282, kyle.mohr@asu.edu, [2]Planetary Geodynamics Laboratory, Code 698, NASA Goddard Space Flight Center, Greenbelt, MD 20771.

Introduction/Background: Ascraeus Mons (AM) is the northeastern most large shield volcano residing in the Tharsis province on Mars. We are funded by NASA's Mars Data Analysis Program to complete a digital geologic map based on the mapping style defined by [1,2]. Previous mapping of a limited area of these volcanoes using HRSC images (13-25 m/pixel) revealed a diverse distribution of volcanic landforms within the calderas, along the flanks, rift aprons, and surrounding plains [1,3]. The general scientific objectives for which this mapping is based is to show the different lava flow morphologies across AM to better understand the evolution and geologic history.

Data and Methods: We have begun preliminary geologic mapping of Ascraeus Mons at a 1:1,000,000 scale using ArcMap™ 10.3. A CTX mosaic is used as the primary basemap, supplemented by HRSC, THEMIS daytime IR, HiRISE, and MOLA data.

Geologic Observations: Our main objectives this year were to map the contacts between different volcanic features on the main shield, rift apron, and surrounding plains, then define and characterize the morphologic units on each edifice (Fig. 1).

Main Shield. The main shield has been divided into 9 different units, more units may still be added and/or some units may be combined. These units include the large summit caldera complex, collapsed features such as depressions, channel-fed flows, tube-fed flows, raised ridges, impact crater cavities, and crater ejecta. The flanks of the shield are dominated by mottled and channel-fed flows. Lava fans are prominent on the NW and SE flanks of AM, similar to the orientation of lava fans found on Olympus Mons [4]. This could lead to a similar NW/SE spreading of AM hypothesized for Olympus Mons [5].

Lava tubes found on the main shield radiate outward from the summit caldera complex with no preferred orientation and have been mapped as linear features based on characteristics developed by [6]. Several of these lava tubes lead to a lava fan (fan apex's are marked as a location feature on Fig. 1), however not all lava fans are associated with a known lava tube. Some lava tubes are the source of flows on the flank and make up the tube-fed flow unit [1,2].

Lava fans are positive topographic, delta-like features [1,6]. The apex of a fan marks its highest topographic point and consists of a hill or cluster of hills from which flows radiate downslope [6]. These lava fans appear further down the main shield >20 km from the caldera complex. Lava fans are cross-cut by arcuate graben indicating that these features were

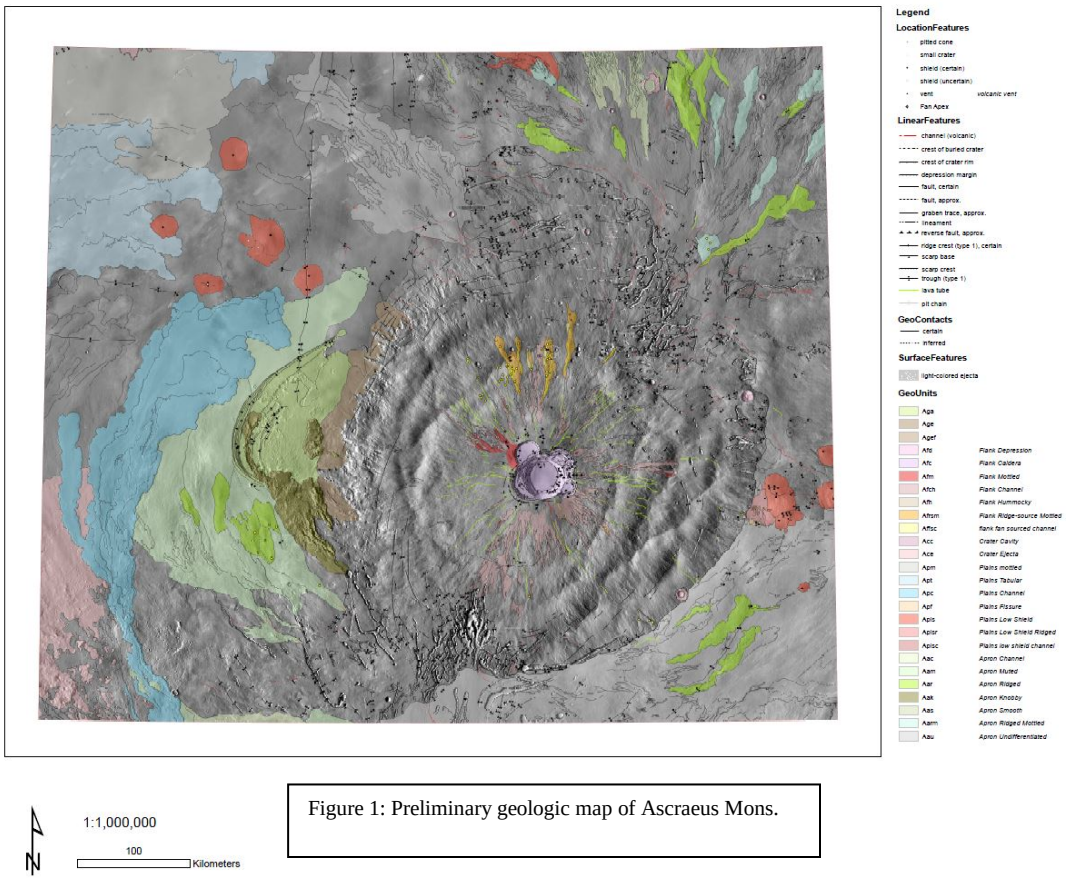

Figure 1: Preliminary geologic map of Ascraeus Mons.

formed during the main shield building phase.

The mottled unit is typified by a rough surface thought to be covered by dust or ash making it difficult to determine distinct surface features [1,2]. This unit is found near the summit of AM, as well as on the west flank where imagery is poor.

Channel-fed flows are distinguished by subparallel linear channels often displaying levees [1,2]. These flows dominate the main shield and are found beginning at the caldera complex and in the lava fan unit further downslope.

The raised ridge unit is similar to the tube-fed flow unit, but lacks collapse of the lava tube and consists of a sinuous to linear ridge or group of adjacent hills [1,2].

Rift Aprons. Ascraeus Mons has two large rift aprons on the NE and SW flanks (Fig. 1). These rift aprons are the main source for the large amount of lava flows seen on the plains surrounding AM. These flows have been divided into 7 different units: channel, muted, knobby, smooth, undifferentiated, and ridged. The channel and ridged apron units are comparable to the channel-fed and ridged units found on the main shield.

The muted apron unit is similar to the mottled unit found on the main shield. This unit is heavily mantled by dust making it extremely difficult to distinguish surface features.

The knobby unit is typified by almost karst-like topography and is only found on the west side of AM where the base is heavily modified by possible glacial processes (the Aureole unit), potentially suggesting lava/ice interaction or previous emplacement of the lava flow that was later eroded by glacial ice.

The smooth unit is distinguished by flow features that have a smooth surface without a distinct change in topography. This unit is found on the floor of the rift aprons and on the northwest area of the map and is assumed to be heavily mantled by dust or has experienced less erosion.

The undifferentiated unit has been added for flows from the rift aprons that are difficult to see due to poor image resolution. This unit is undergoing more study and may not be on the finished map.

Plains. The plains surrounding Ascraeus Mons have been subdivided into 6 units: aureole, mottled, tabular, channel-fed, fissure-fed, and low shield. The Aureole and low shield unit can be divided up into three separate units each. The mottled and channel-fed units are characterized by the same distinctions found on the main shield and rift apron units.

The Aureole unit is located on the base on the west side of AM. This unit characterizes where potential glaciation altered the flank/base of AM. Long horseshoe shaped ridges are seen at the western edge of the Aureole unit resembling glacial moraines found on Earth. The western flank has been heavily eroded and shows steep cliff face accompanied by a very low sloped deposit, this makes up the aureole scarp unit. Associated with this unit is an Aureole fan unit that resembles alluvial fans found on Earth.

The tabular unit is defined by large lobate flows whose source is not located in the mapping area. This unit overlies the rift apron and other plains units and is believed to be the youngest flows found in the map area.

The fissure-fed flow unit is typified by flows originating from a fissure found on the plains surround AM.

The low shield unit is distinguished by small shield volcanoes located on the plains NW and East of AM. This unit has been subdivided into two separate flow units based on superposition of flows extruded from a small shield.

Discussion: Mapping reveals a similar sequence of events for the evolution of Ascraeus Mons that agrees with [1,2,3,7]: 1) main shield forms, 2) eruptions from the NE/SW rifts emplace long lava flows that surround main shield, 3) eruptions wane and build up the rift aprons and shield fields, 4) glaciers deposit aureole deposit material, and 5) localized recent eruptions along the main flanks, in the calderas, the small-vent field, and possibly within the glacial aureole deposits. Further mapping will reveal the relative geologic timing of eruptive units on and surrounding Ascraeus Mons and provide a more complete analysis of the spatial distribution of lava flows.

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