GEOLOGIC MAPPING OF ASCRAEUS MONS, MARS. K.J. Mohr[1], D.A. Williams[1], W.B. Garry[2], and Jacob E. Bleacher[2] [1]School of Earth & Space Exploration, Arizona State University, Tempe, AZ 85282, kyle.mohr@asu.edu, [2]Planetary Geology, Geophysics, and Geochemistry 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 objective 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 finished geologic mapping of Ascraeus Mons at a 1:1,000,000 scale using ArcMap 10.3. A CTX mosaic and a THEMIS daytime IR mosaic were used as the primary basemaps, supplemented by HRSC, HiRISE, and MOLA data.

Geologic Observations: Geologic units were defined and characterized by looking at flow morphologies across the main shield, rift aprons, and the surrounding plains. A total of 27 units have been observed on the main shield, rift aprons, and plains; some of these units have facies changes, but are lumped together to best fit the 1:1,000,000 mapping scale.

Main Shield. The main shield (labeled as *Flank* in the legend, Fig. 1) has been divided into 9 different units which includes the large summit caldera complex, collapsed features, such as depressions, channel-fed flows, raised ridges, impact crater cavities, and crater ejecta. The flanks of the shield are dominated by a mottled (Afm) unit surrounding the caldera and channel-fed flows (Afch), which cover the majority of the main shield. The mottled unit is typified by a rough surface thought to be covered by dust, ash, or volatiles making it difficult to determine distinct surface features [1,2]. This unit is found at the summit of AM, and covers a large portion of the western flank.

The western flank of AM is more degraded than the other flanks. This degradation begins at the summit and

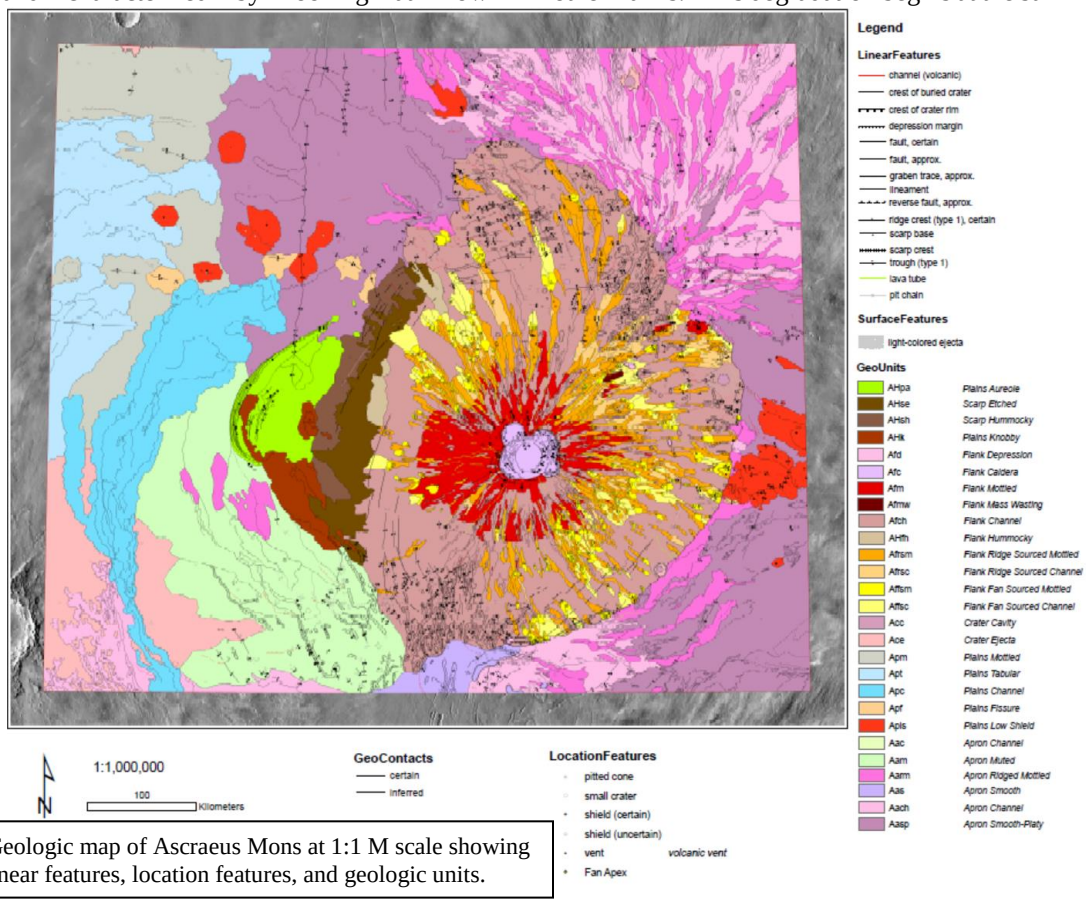

Figure 1. Geologic map of Ascraeus Mons at 1:1 M scale showing contacts, linear features, location features, and geologic units.

is observed as far as 77 km down the flank. This mottled unit has covered or eroded away pre-existing flows and structures. Very few distinct flow lobes, ridges, channels, or fans can be seen on the upper western flank. The western flank of AM has been suggested to have undergone higher atmospheric precipitation, contributing to the formation of glaciers, possibly altering the surface [7].

Channel-fed flows (Afch) are distinguished by subparallel linear channels often displaying levees [1,2]. These flows dominate the main shield with no preferred orientation and are found beginning at the caldera complex as well as in the lava fan units located further downslope.

Flank ridges (Afrsm, Afrsc) are 'raised' positive relief constructs found on the main shield and radiate outward from the summit caldera complex, but are not well-developed on the SW flank. We have subdivided ridges into two unique units based on their origin in mottled or channeled unit. Many of these ridges exhibit a collapsed lava tube, mapped as a linear feature based on characteristics developed by [4].

Lava fans (Affsm, Affsc) are positive topographic, delta-like features [1,4], commonly observed at the distal end of raised ridge. However not all lava fans are associated with a known raised ridge (lava tube). The apex of a fan marks its highest topographic point and consists of a hill or cluster of hills from which flows radiate downslope [4] (fan apex's are marked as a location feature on Fig. 1). Lava fans are prominent on the NW and SE flanks of AM, >20 km from the caldera complex, and have a similar orientation to lava fans found on Olympus Mons [5]. Lava fans are cross-cut by arcuate graben indicating that these features were formed during the main shield building phase. This could lead to a similar NW/SE spreading of AM as hypothesized for Olympus Mons [6].

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 and have been divided into 7 different units: channel (Aac), muted (Aam), knobby (Aak), smooth (Aas), and ridged (Aarm). The channel and ridged apron units are comparable to the channel-fed and ridged units found on the main shield. The muted apron is heavily mantled by dust and is typically located off the SW flank.

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 to platy surface with no 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 mantled by dust or has experienced less erosion.

Plains. The plains surrounding Ascraeus Mons have been subdivided into 6 units: aureole (AHpa), mottled (Apm), tabular (Apt), channel-fed (Apc), fissure-fed (Apf), and low shield (Apls). The Aureole unit is divided up into three separate units. 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 a 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 plains flows found in the mapping area.

The low shield unit is distinguished by small shield volcanoes located on the plains NW and East of AM.

Discussion: Mapping reveals a similar sequence of events for the evolution of Ascraeus Mons that agrees with [1,2,3,8]: 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 unit material, and 5) localized recent eruptions along the main flanks, in the calderas, the small-vent field, and possibly within the glacial aureole deposits.

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