

Geologic Mapping of Ascraeus Mons, Mars

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Abstract

New mapping of Ascraeus Mons on Mars using higher resolution imagery has allowed for a more dynamic understanding of the complex history of building the large shield volcano and the surrounding Tharsis Province.

1. 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 [1,4]. 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.

2. 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.

The THEMIS daytime IR mosaic was used to look at larger scale structures on the flanks, rift aprons, and plains surrounding AM. Once an area of interest was found using the THEMIS mosaic we used the CTX mosaic and supplemental images to look at smaller scale features, such as: surface textures, contacts, depressions, collapse features, small lava flows, erosional features, aeolian deposits, and tectonics. Where CTX images were poor we supplemented with HRSC and HiRISE images. All images and mosaics were tied together with MOLA data to determine accurate points of reference.

Contacts and linear features were mapped generally using CTX data, this allowed for the best visual scale for the 1:1M mapping scale for the finished map product. Contacts and geologic units were defined by looking at the morphology of the surface on the flanks, rift aprons, and plains of AM.

Linear features were mapped first, followed by contacts, then surface features, and lastly geologic units.

3. Geologic Observations

A total of 27 units have been observed on the flanks, rift aprons, and the surrounding plains; some of these units have facies changes, but are lumped together to best fit the 1:1,000,000 mapping scale.

3.1. 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.

3.2. Rift Apron

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), undifferentiated (Aau), and ridged (Aar, 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.

3.3. 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.

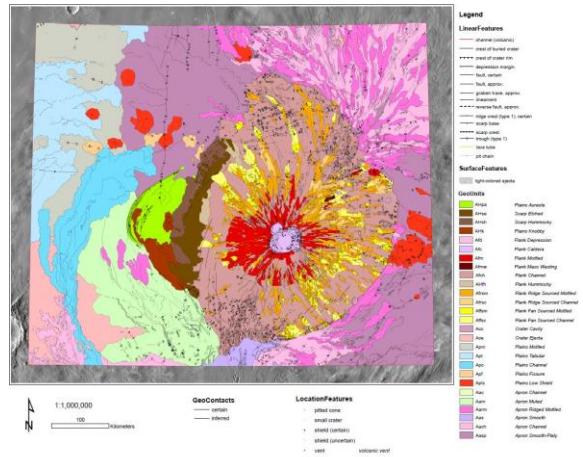


Figure 1. Geologic map of Ascraeus Mons, Mars at 1:1M scale.

4. Summary and Conclusions

Mapping reveals a similar sequence of events for the evolution of Ascraeus Mons that agrees with [1,2,3,4]: 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. Higher resolution images allow for a better understanding of the evolution of the large shield volcano. Whereas previously very few map units were observed, now 27 map units can be found to show the dynamic evolution of Ascraeus Mons and give new insights into the history of the Tharsis Province on Mars.

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References

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