Continued Mapping of Apollinaris Mons, Mars. A. K. Farrell[1] and N. P. Lang[2]. Geology Department, Mercyhurst College. 501 E 38th St., Erie, PA 16546. [1]afarre87@mercyhurst.edu [2]nlang@mercyhurst.edu.

Introduction: Highland paterae are the complex craters of large, low relief Martian volcanoes [1]. These craters are characterized by very low slopes of < 1° to ~1.5° that are deeply incised by channel complexes which are radial to a prominent central caldera. Highland paterae represent some of the oldest central vent volcanoes on Mars [2] and may signify a transition from flood lava eruptions, which dominated the early volcanic history of Mars, to more localized eruptions [3]. Here, we are focusing on Apollinaris Mons (AM; 8°S, 174° E), the central depression of which is Apollinaris Patera (AP) [4], one of five highland paterae on Mars. We build upon our previous work on AM and elaborate upon our proposed geologic history of the volcanic construct.

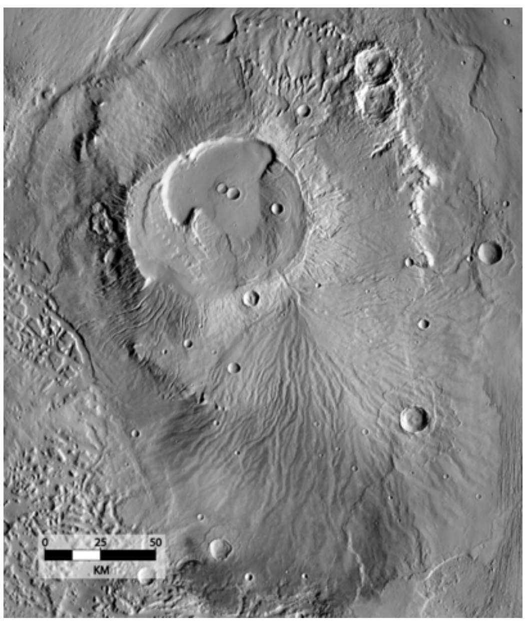

Figure 1: *Themis daytime IR image of Apollinaris Mons and Apollinaris Patera. Image centered at 9˚ 01' 22.25"S and 174˚ 44' 44.16"E.*

Methodology: Our analysis of AM has involved the use of images from the Mars Odyssey (MO) and Mars Reconnaissance Orbiter (MRO) missions. Image sets included THEMIS Vis (~20 m/pixel) and THEMIS daytime infrared (IR; ~100 m/pixel) images from MO and CTX images (~6 m/pixel) from MRO. The JMars java applet, a geospacial information system created by the Mars Space Flight Facility at Arizona State University, also provided images as well as dust cover and Mars Orbiter Laser Altimeter (MOLA) data. Normalized THEMIS daytime IR imagery from JMars has served as a base layer from which we have superimposed THEMIS Vis imagery for mapping in the Adobe Illustrator drawing program. CTX images were viewed using IAS Viewer. We followed the methodology of [3] in differentiating between effusive and explosive deposits to identify units and map unit boundaries.

We used used JMars to view topographic profiles, as derived from the MOLA gridded data set (1/128th degree, which translates to ~500 m/pixel). We utilized this dataset to help determine where we would draw the unit contacts. Specifically, distinct topographic breaks along the Apollinaris' flanks may reflect lithologic or rheologic changes that potentially exist between or within units.

Our proposed geologic history of AM was deduced using superposition, cross-cutting, and topographic relationships. Using the Crater Counting layer in JMars, we have determined the crater density of each unit relative to each other unit.

Geologic Overview: AM is located slightly north of the boundary between the northern lowlands and the southern highlands and is ~200 km north of Gusev crater. The volcano is approximately 150 km in width, 6 km in height, and is Hesperian in age [5]. AP is composed of an inner caldera (~48 km wide) and outer caldera (~83 km wide). The inner caldera contains an effusive deposit, whereas explosive deposits comprise the outer caldera and flank materials. Graben only cut the pyroclastic deposits within the outer caldera, whereas channels frequently cut those that were emplaced both upon the volcano's flanks and within the outer caldera. Much of the volcano's base is characterized by extensive, steep scarps.

We have differentiated six geologic units at AM. These units are the undifferentiated caldera materials, undifferentiated flank materials, higher standing caldera materials, effusive deposit, higher standing flank materials, and fan deposit (Figure 2).

The undifferentiated caldera materials compose most of the outer caldera of AP. We found no distinguishable units within these materials, and there is no evidence of layering within these deposits. The rock making up the undifferentiated caldera materials appears to be easily erodible, as this material is profusely modified by graben and scarps. Impact craters upon this surface appear to be highly weathered. We interpret the materials which comprise this unit as having been emplaced through pyroclastic activity.

The undifferentiated flank materials compose a majority of the flanks of AM. Similar to the undifferentiated caldera materials, these deposits show no signs of being layered. They are also easily erodible and mechanically weak, as evidenced by extensive scarping and the abundance of channels cut into this unit. Impact craters contained within this unit are very well-modified by erosion and weathering. Due to their easily erodible nature, we have classified this unit as a result of pyroclastic activity.

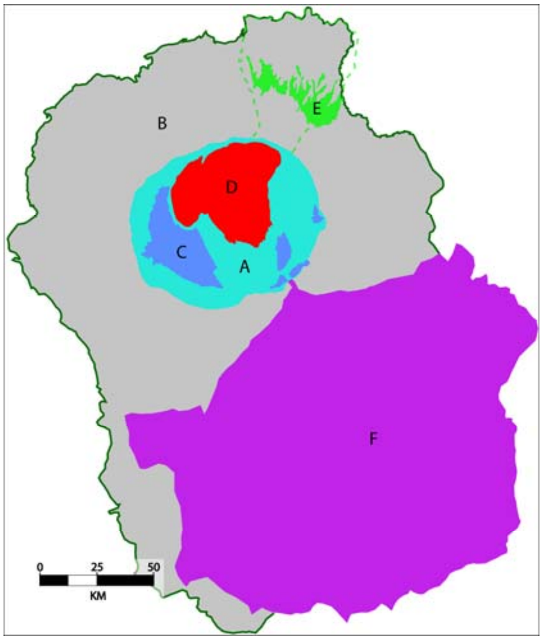

Figure 2: *Mapped deposits at Apollinaris Mons and Apollinaris Patera.* A *is the undifferentiated caldera materials,* B *is the undifferentiated flank materials,* C *is the higher standing caldera materials,* D *is the effusive deposit,* E *is the higher standing flank materials, and* F *is the fan deposit. The dark green line represents our interpretation of the basal scarp trace. Image centered at 9˚ 01' 22.25"S and 174˚ 44' 44.16"E.*

The higher standing caldera materials overly the undifferentiated caldera materials and occur within the AP crater. They also overly the graben which cut the undifferentiated caldera materials. The edges of outcrops of this unit are mostly feathery, and there is no evidence of layering in this unit. Impact craters which appear on this unit appear to have been heavily weathered and eroded. Similar to the aforementioned pyroclastic units, we interpret this unit as the result of pyroclastic processes.

Unlike any of the other deposits present at AM, the effusive unit is characterized by a relatively smooth surface which contains ridges. The floor of this deposit, which occurs within the inner caldera of AP, slopes downward from the southeast to the northwest. This unit is only overlain by materials which seem to have been emplaced through mass wasting of the scarp bounding the inner caldera. This unit appears to have considerable mechanical strength, as the majority of impact craters have not been extensively weathered and eroded. Also, more small (<1 km in diameter) impact craters are preserved upon the effusive unit than upon any other unit present on the AM edifice. Due to its considerable mechanical strength, we interpret this unit as the result of effusive activity.

The higher standing flank materials constitute a roughly fan-shaped unit on AM's northeastern flank. They have feathery edges and overly the undifferentiated flank materials and the basal scarp. However, distinct layers can be seen within a scarp in the northeast part of this unit. Though this unit appears to have more mechanical strength than the material it overlies, its erosional patterns point toward a pyroclastic origin rather than an effusive one.

The fan deposit occurs in the southeast of AM's flank. It overlies the undifferentiated flank materials and the basal scarp. Channels cut this unit and highlight its fan shape. Evidence for layering within the fan deposit can be seen in the walls of a few impact craters, which don't show much evidence of being heavily weathered or eroded. We interpret this unit to be a pryoclastically-emplaced unit.

Conclusions: We propose the following as the geologic history of AM. Early in AM's formation, volcanism was predominantly explosive, forming the outer caldera. Following this was a brief period of repose, characterized by the formation of the basal scarp. Then, explosive activity renewed, overlaying the two fan-shaped deposits upon the basal scarp. After this ceased, the eruptive style became effusive. The inner caldera subsided, and the effusive unit was emplaced. Finally, erosion and mass-wasting worked the edifice to its present appearance. We are working on crater-derived dates to support our proposed geologic history of AM. We will also use the MOLA topographic data to estimate the volume of each of the six units at AM and the edifice as a whole.

References: [1] Schultz, P. H. (1984), *LPS* , 728-729. [2] Scott, D. H. and Carr, M. H. (1978) *U.S. Geol. Surv. Misc. Invest. Ser., Map I-1083.* [3] Greeley, R. and Crown, D. A. (1990) *JGR*, *95*, 7133-7149. [4] USGS. *Gazetteer of Planetary Nomenclature.* <http://planetarynames.wr.usgs.gov>. [5] Robinson, M.S., Mouginis-Mark, P.J., Zimbelman, J.R., Wu, S.S.C., Ablin, K.K., and Howington-Kraus, A.E. (1993) *Icarus*, *104*, 301-323.