GEOLOGIC MAPPING OF OLYMPUS MONS AND THE THARSIS MONTES, MARS. W.B. Garry[1], D.A. Williams[2], J.E. Bleacher[1], and A.M. Dapremont[1] [1]Planetary Geodynamics Laboratory, Code 698, NASA Goddard Space Flight Center, Greenbelt, MD 20771, [2]School of Earth and Space Exploration, Arizona State University, PO Box 871404, Tempe, AZ 85287, brent.garry@nasa.gov.

Introduction: Olympus Mons and the Tharsis Montes are some the largest volcanoes on Mars and in our Solar System. Our team is funded by NASA's Mars Data Analysis Program (MDAP) to complete a set of 1:1,000,000 geologic maps of Olympus, Arsia, Pavonis, and Ascraeus based on the mapping style defined by **[1,2]**. **Figure 1** shows the area around each volcano that we are funded to map, including additional sections that cover the rift aprons and small vent fields. Detailed mapping of a limited area of these volcanoes revealed a diverse distribution of volcanic landforms within the calderas, and along the flanks, rift aprons, and surrounding plains **[1]**. Here, we report on the progress of each map.

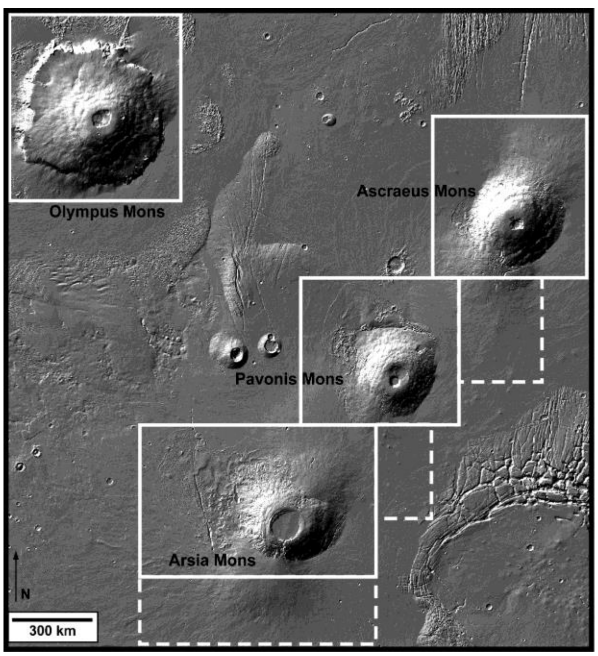

Figure 1. MOLA shaded relief map with the boundaries (solid lines) for each map and extensions (dashed lines) to cover rift aprons and small vent fields.

Data and Methods: We are mapping each volcano in ArcMap 9 and 10.2 to produce digital geologic maps at 1:1,000,000 map scale for the USGS. A Context Camera (CTX) mosaic serves as the primary basemap, supplemented by High Resolution Stereo Camera (HRSC), THEMIS daytime IR, HiRISE, and Mars Orbiter Laser Altimeter (MOLA) data. To address our science questions we have conducted our mapping at ~1:300,000 to ~1:100,000 on the CTX basemap. This scale enables us to distinguish between different morphologic features like sinuous rilles, leveed channels, low shields, and surface textures (hummocky, mottled, smooth), plus we are able to determine flow margins, flow directions, and stratigraphic relationships between different eruption sequences. Our primary objective for each map is to show the areal extent, distribution, and stratigraphic relationships of the different volcanic morphologies to better understand the changes in effusive style across each volcano and provide insight into the similarities and differences in their evolution.

Mapping Progress: Each map is in a different stage of the geologic mapping process. The Ascraeus Mons map is the most recently funded project and we will begin preliminary mapping in 2015. The maps of Arsia and Pavonis Montes are also nearing completion and should be ready to submit for publication by mid to late 2015 **(Fig. 2)**. The Olympus Mons map has complete line work and is being prepared for submission to the USGS for publication **(Fig. 3)**. For the Tharsis Montes, our objective this year is to map the contacts between different volcanic provinces on each volcano (e.g., main shield, rift aprons, and lava plains). We have mapped the surficial fan deposits on Pavonis and Arsia Mons using sketch maps from **[4-6]** as guides for mapping similar units (e.g., smooth, ridged, knobby). See *Dapremont et al*., this meeting [Abstract #1605] for detailed mapping of the Arsia Mons fan shaped deposit.

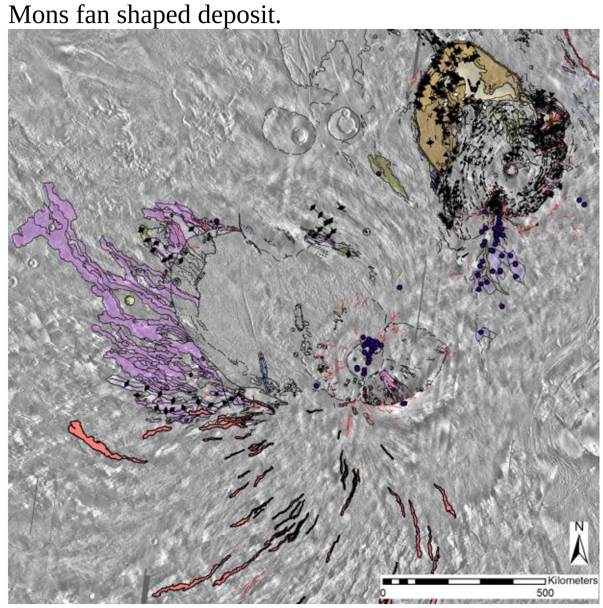

Figure 2. Maps of Arsia and Pavonis Montes

Discussion: Our current progress has provided several insights into the eruption processes and evolution of these volcanoes.

Geologic Units: The current mapping units have evolved from the original proposed mapping units to correspond with units used for the recent geologic map of Olympus Mons **[6] (Fig. 3)**. Detailed imagery from CTX has allowed us to diversify the units based on various eruption styles. The units are distinguished primarily by morphology and are grouped for each edifice (main shield, rift apron, fan deposit, lava plains).

General Formation Sequence: Mapping reveals a similar sequence of events for the evolution of the three Tharsis Montes volcanoes **[1,2,8]**: 1) main shield forms, 2) eruptions from the NE/SW rifts emplace long lava flows that surround the main flank, 3) eruptions wane and build up the rift aprons and shield fields, 4) glaciers deposit surficial fan deposit material **[9]**, and 5) localized recent eruptions along the main flanks, in the calderas, and within the fan-shaped deposits. Further mapping will reveal the relative geologic timing of eruptive units on the main shields and provide a more complete analysis of the spatial distribution of tube-fed versus channel-fed flows for each volcano and how they compare with Olympus Mons as originally discussed by **[1]**.

References: **[1]** Bleacher J. E. et al. (2007) *JGR, 112*, E04003, doi:10.1029/2006JE002826. **[2]** Bleacher J. E. et al. (2007) *JGR, 112,* E09005, doi:10.1029/2006JE002873. **[3]** Shean D.E. et al. (2005) *JGR, 110,* E05001, doi:10.1029/2004JE002360. **[4]** Shean D.E. et al. (2007) *JGR,112,* E03004, doi:10.1029/2006JE002761. **[5]** Scanlon K.E. et al. (2014) *Icarus* 237, 315-339. **[6]** Bleacher J.E. et al., (2013) LPSC 44, Abstract 2074. **[7]** Richardson P.W. et al., (2009) *LPSC 40*, Abstract 1527. **[8]** Crumpler L.S. and Aubele J.C. (1978) *Icarus, 34,* 496-511. **[9]** Head J.W. and Marchant D. R. (2003) *Geology, 31*, 641-644.

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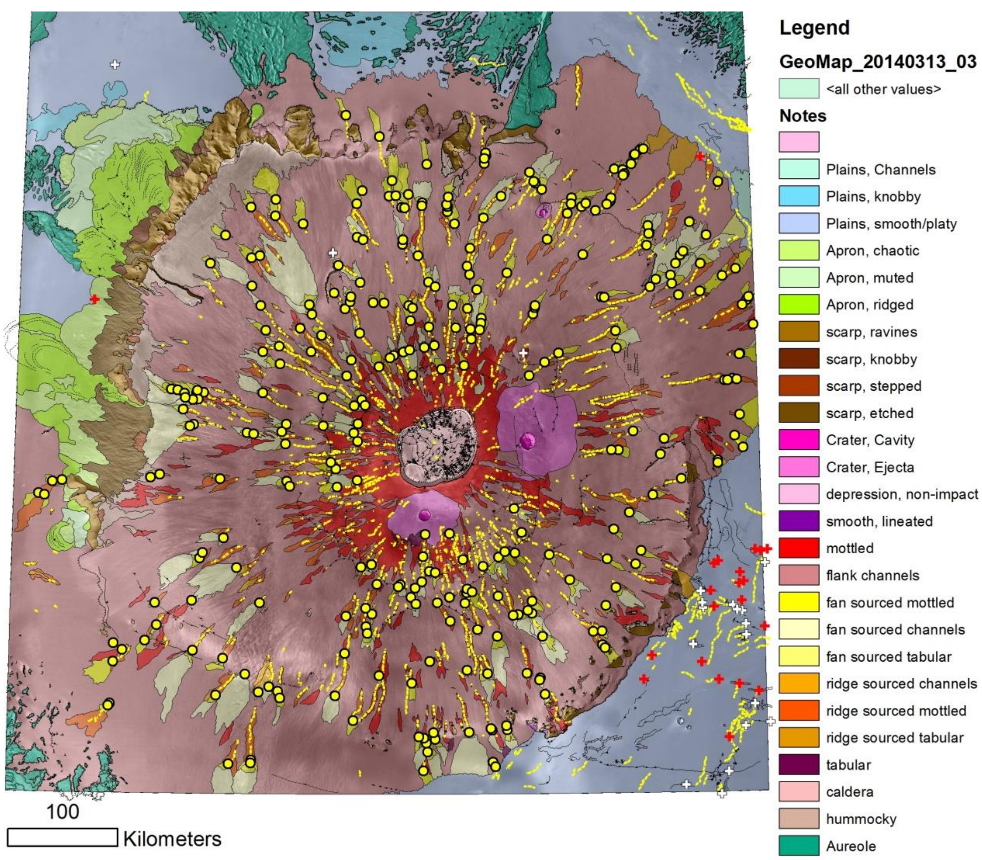

Figure 3. Line work and map units for the Olympus Mons Geologic Map. Yellow dashed lines are sinuous that mark the path of lava tubes on the main flank and rilles of questionable origin on the plains. Yellow circles are rootless vents associated with lava tube breakouts. Red crosses represent low shield volcanoes and fissures and white crosses represent source regions for plains channels.