COMPLETING THE GEOLOGIC MAPPING OF ATHABASCA VALLES, MARS. L. P. Keszthelyi and A. E. Huff, USGS Astrogeology Science Center, 2255 N. Gemini Dr., Flagstaff, AZ. 86001 (laz@usgs.gov).

Introduction: The geologic mapping of the Athabasca Valles region of Mars (MTM quads 05202, 05207, 10202, 10207) was largely completed in 2009. This mapping work pushed the early usage of ArcGIS templates and CTX data, requiring significant unplanned effort (and cost) leaving inadequate resources to produce the four proposed 1:500,000 scale USGS Scientific Investigation Maps (SIM). Instead, the most important scientific insights from the mapping were incorporated into Jaeger et al. [1] and several LPSC abstracts [2-4]. However, NASA's push to resolve "delinquent" maps has provided the opportunity to return to this map. A decade of technological advancements in GIS usage [5] and increased understanding of mapping with HiRISE [6] and CTX data enable this mapping to be completed with only modest effort. The map will be published as a SIM with a single sheet at 1:1M scale.

Mapping Methodology: The scientific focus of this mapping effort is on the latest Amazonian volcanism in Athabasca Valles that borders the southern flank of Elysium Mons. The THEMIS IR basemap used in 2005-2009 had significant location errors when compared to MOLA that are corrected in the new THEMIS IR dataset controlled to MOLA. Consequently, the original linework will need to be cross-referenced with the new base for location accuracy. Mapping on the THEMIS IR basemap was augmented by supplemental data sets, especially MOLA, CTX, and HiRISE. Many of the key lava flow contacts are not resolved in the THEMIS data and are ambiguous even at CTX resolution. Therefore, we used HiRISE data to determine the nature of flow contacts and CTX data to follow them. The bulk of the original mapping linework was done at a 1:50,000 scale on CTX data. However, to produce the 1:1,000,000-scale map we are updating that linework using a more appropriate digital mapping scale of 1:250,000. When a controlled CTX mosaic of the region becomes available, the mapping could be revised at about an order of magnitude higher spatial resolution (1:100,000). However, such detailed mapping is justifiable only for select portions of the map area and is outside the scope of the current effort.

Remaining Work: The nine geologic units we identified and mapped are defined, described, and interpreted below. The stratigraphic correlation of these units is straightforward but new crater counts to place absolute age constraints have not been done as part of this mapping project. Instead, crater statistics from a number of publications [e.g., 7-9] are available. Map symbols adhere to USGS standards.

Map Units. The map units are listed in chronologic order. Minor surficial cover in the form of a patchy dust mantle, areas of sand accumulation, and local talus scarps were mapped at 1:50,000 scale but are not expected to be retained in the 1:1,000,000 scale map. Similarly, we treat unnamed impact craters as structures that modify the target geologic units instead of mapping them as a lithochronostratigraphic unit.

Aav: Amazonian Athabasca Valles Basalt. Turbulently emplaced flood lava detailed in Jaeger et al. [1]. This is the youngest major unit in the map area.

$Ath_{a\text{-}d}$: Lavas from four Amazonian unnamed Tholi. These are designated "A" through "D" with central vent areas and radial flows. The relative ages of the tholi are difficult to determine because their lavas generally do not overlap each other.

$Aff_{1\text{-}4}$: Fissure fed sheet flows. Most fissure vents are oriented parallel to the Cerberus Fossae but some follow wrinkle ridges approximately perpendicular to the Cerberus Fossae. In some cases discrete point sources, i.e., breached lava ponds, have formed along the fissures. While some superposition relations can be made between the fissure-fed flows and those of the different tholi, they are insufficient to construct a complete stratigraphic sequence.

$Asf_{1\text{-}4}$: Sheet lavas with no identifiable source. The vents are buried under lavas from the tholi or fissures. These flows are marginally older than the flows that have visible vents but superposition relations are too sparse to determine a unique stratigraphic order.

AHmf: Amazonian-Hesperian Medusae Fossae Formation. Equivalent to Aam in Tanaka et al. [11] and AHtu and Htu in Tanaka et al. [10]. Subunits with different styles of aeolian erosion are not mapped out.

AHpc: Persbo Crater. As the only named crater in the map area, it seemed appropriate to map its deposits separately.

AHer: Elysium Rise lavas. Equivalent to Tanaka et al. [10] AHEe and Tanaka et al. [11] AHv. This unit is composed of a large number of different lava flows with no good basis by which they can be separated by age or source.

AHp: Amazonian-Hesperian plains. Smooth plains with occasional wrinkle ridges oriented approximately perpendicular to the Cerberus Fossae. These were largely mapped as the Utopia Planitia 2 Unit by Tanaka et al. [5] but are not resolved in the global map [6]. The nature of this unit is uncertain but it is likely to consist largely of colluvium from the erosion of highlands materials.

HNn: Hesperian-Noachian knobs. Equivalent to Nepenthes Mensae Formation of Tanaka et al. [10, 11]. Interpreted as eroded remnants of the ancient heavily cratered southern highlands.

References: [1] Jaeger W. L. et al. (2010) *Icarus, 205*, 230-243. [2] Keszthelyi L. et al. (2017) LPSC 48, Abstract #1755. [3] Keszthelyi L. et al. (2015) LPSC 46, Abstract #2547. [4] Keszthelyi L. et al. (2014) LPSC 45, Abstract #1683. [5] Hare T. et al. (2015) 2nd Planetary Data Workshop, Abstract #1846. [6] Okubo C. H. (2014) USGS SIM 3309. [7] Burr D. M. et al. (2002) *Icarus, 159*, 53-73. [8] Berman D. C. and Hartmann W. K. (2002) *Icarus, 159*, 1-17. [9] Vaucher J. et al. (2009) *Icarus, 204*, 418-442. [10] Tanaka K. L. et al. (2005) *USGS SIM* 2888. [11] Tanaka K. L. et al. (2014) *USGS SIM* 3292.

Figure 1. Current draft of the geologic map of the Athabasca Valles region of Mars. This mapping suggests that the Athabasca Valles Basalt (Aav) followed the contact between the Elysium Rise Unit (AHer) and the Amazonian-Hesperian Plains (AHp, mislabelled as Hp in this figure). This hypothesis will be revisited as the linework of the southernmost portion of the AHer is revisited.