1:75K-SCALE GEOLOGIC MAPPING OF SOUTHWESTERN MELAS CHASMA, MARS. L. A. Edgar and J. A. Skinner, Jr. Astrogeology Science Center, U. S. Geological Survey, 2255 N. Gemini Drive, Flagstaff, AZ, 86001 (ledgar@usgs.gov).

Introduction: The Valles Marineris canyon system contains some of the thickest, most laterally continuous, and diverse exposures of sedimentary rocks on Mars [e.g. 1-4]. Understanding the processes that led not only to the accumulation of these diverse deposits, but also the tectonic environment that provided the accommodation space for their deposition, is critical to understanding currently unresolved geologic problems on Mars. Sub-basins within the broader Valles Marineris system provide unique insight into the diverse tectonic, depositional and erosional processes that have occurred throughout the canyon [e.g. 4-7]. The informally named Melas basin, located in southern Melas Chasma in central Valles Marineris, is one such location. Melas basin is an enclosed basin that contains geologic units, dispersed landforms, and hydrated minerals that are indicative of punctuated episodes of aqueous activity spanning from the Hesperian to Early Amazonian [8-10]. However, despite being the focus of multiple historical and modern geologic investigations – including consideration as high priority landing site for the Mars 2020 mission [11] – this region has not yet been placed into a broader geologic, structural, and stratigraphic context.

The primary objectives of this work are to (1) document the geologic evolution of deposits located within the Melas basin by investigating the character of plateau, wall, and floor units at 1:75K-scale, and (2) place localized observations from previously-published science investigations into a broader, standardized context for cross-comparison to other similar regions within the Valles Marineris basin system. Here, we provide mapping methods, initial results, and next steps for a mapping investigation focused on resolving the geologic history of southwest Melas Chasma.

Geologic Setting and Background: The Melas basin is a ~30 km long enclosed basin located in southern Melas Chasma. The basin is bounded to the north by an east-west trending ridge that rises ~ 1.8 km above the basin floor deposits, and to the south by the chasma wall which rises more than 5 km above the floor. Early mapping efforts divided southwest Melas Chasma into Amazonian age rough floor material (including eolian mantle, possible landslides, and rugged landforms), and Hesperian age canyon walls showing crude layering [2]. More recent studies of southwestern Melas Chasma have identified geologic units, landforms, and hydrated minerals that are inferred to represent an extensive history of aqueous processes [8-10, 12-13]. As such, this region has been the target of numerous studies focusing on localized geologic and geomorphologic mapping [14-17]. However, despite all of these efforts, there does not currently exist a map of appropriate size and scale to correlate the history of the Melas basin with the broader evolution of Valles Marineris, and to provide the necessary context for this proposed landing site.

Datasets and Methods: This investigation focuses on constructing a 1:75K-scale geologic map of southwestern Melas Chasma. This scale was chosen to complement the existing detailed mapping of the proposed Mars 2020 landing ellipse [17], and because it allows for important contextual examination of geologic relationships. The study region covers an area from approximately -77 to -75.8 E and -9.4 to -10.3 S. Uncontrolled Context Camera (CTX) images provide a basemap for all mapping. Topographic information is provided by a High Resolution Stereo Colour Imager (HRSC) DEM that covers the study area (**Fig. 1A**). Mapping is being conducted at a digital scale of 1:15,000 using ArcGIS.

Results: Initial mapping has resulted in the identification of a variety of geologic units, which can be divided into three distinct groups: wall rocks, basin-floor deposits, and surficial deposits.

Wall rocks: The wall rocks are characterized by weakly-stratified, erosion-resistant ridgelines (**Fig. 1B)**, that weather into blocky cliffs and retain impact craters. Continuous exposures are only a couple hundred meters thick due to surficial cover, but wall rocks crop out at multiple elevations. To the northwest, several wall rock units are exposed on a relatively flat plateau, and are expressed as smooth units that retain a high density of impact craters. Here, two massive wall rocks units are defined: one that is smoother and lighter-toned and one that is rougher and darker-toned. Interpretation: With the limited resolution of CTX and poor exposure of wall rocks across most of the Melas basin, a definitive interpretation for the origin of the wall rocks cannot be reached. The weakly stratified nature of the outcrops could be interpreted as either sedimentary and/or igneous in origin. However, wall rocks exposed on the northwest side of Melas basin have a more massive and heavily cratered expression that may suggest an origin as crystalline basement rocks.

Basin Floor Deposits: The Melas basin floor records complex stratal geometries (**Fig. 1C)** that can be divided into several units: a convolutely bedded unit, a planar bedded unit, a clinoform unit, and a channel and fan unit. The northern portion of the basin floor records convoluted beds that extend across an area of nearly 20 km^2. Convoluted beds are also present in the southern portion of Melas Chasma, and are cross-cut by numerous faults, many of which trend northwest-southeast. Within Melas basin, convoluted beds are truncated by light-toned well-stratified planar deposits that can be traced around much of the basin. On the western side of the basin, a clinoform unit is observed, which can be traced laterally into planar-bedded deposits. Multiple fans are identified throughout the basin, but differences in fan morphology point to different depositional environments. Interpretation: Basin floor deposits record a complex aqueous history. Consistent with previous work [2-5], we interpret the basin floor deposits to record fluvial, deltaic and lacustrine environments. Laterally extensive light-toned deposits are inferred to be the deposits of a persistent lacustrine system. Clinoform geometries are interpreted as either a channel-levee complex or a delta complex [12]. The multilobe fan-shaped deposits on the western side of the basin are interpreted as a deep subaqueous fan [13], while other fans are interpreted as deltas and alluvial fans [9]. Convoluted beds lie at the outlet of valley networks, and may be the result of subaqueous landsliding and liquefaction [18].

Surficial Deposits: The Melas basin is buried by a variety of surficial units. Surficial deposits include bedforms, resistant bedforms, and smooth units located on eroded slopes (**Fig. 1D**). Bedforms are evenly spaced and occur mostly in topographic lows and are bounded by topographic barriers. Resistant bedform units retain small impact craters and show evidence for erosion. Interpretation*:* Surficial units are interpreted as the product of eolian and mass-wasting processes. The absence of impact craters in most surficial units suggests that these are the product of relatively young and potentially still active processes. However, the presence of impact craters in one eolian unit suggests a more competent substrate, perhaps as the result of induration and at least partial lithification.

Summary: Preliminary mapping work reveals diverse geologic units exposed on the plateau, wall rock, and basin floor. The mapping work described here provides a foundation for linking localized observations and previous studies to the larger-scale evolution of the Valles Marineris system.

Future Work: The next steps include:

- Complete 1:15,000-scale geologic mapping.
- Identify geologic type localities and construct stratigraphic sections.
- Compile geologic history that places localized observations into a broader, standardized context for cross-comparison to other similar regions within the Valles Marineris basin system.
- Continue efforts to support southwestern Melas Chasma as a Mars 2020 landing site.

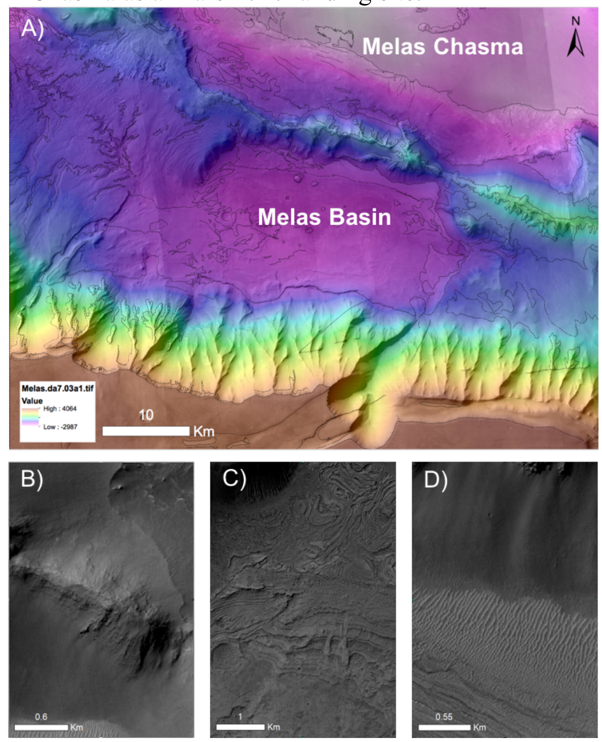

Figure 1. (A) Preliminary mapping displayed on HRSC DTM. Map area includes the Melas basin as well as the surrounding wall rocks that likely contribute material to the basin. Map area also includes a portion of Melas Chasma, which will help to tie the geologic history of the Melas basin to the broader evolution of the Valles Marineris system. (B) – (D) are examples of wall rocks, basin floor deposits, and surficial deposits.

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