GEOLOGIC MAPPING TO CONSTRAIN THE SOURCES AND TIMING OF FLUVIAL ACTIVITY IN WESTERN LADON BASIN, MARS.
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Introduction: The western section of Ladon basin and its bounding basin ring structures to the west hold numerous clues to understanding the long history of drainage across the Margaritifer Terra region of Mars [1-7]. We are mapping two quadrangles in Margaritifer Terra (–15032 and –20032, Fig. 1) to define the evolution of the western Ladon basin region as it relates to fluvial/alluvial events occurring on surrounding surfaces. As part of this mapping, we are also evaluating the morphology, stratigraphy, mineralogy, and distribution of newly identified sedimentary deposits in small inter-ring basins in the highlands west of Ladon basin. We hope to determine how they may relate to either a past discharge out of Argyre basin along the Uzboi-Ladon-Morava mesoscale outflow system, a possible lake in Ladon basin, deposition in Holden crater and(or) Ladon and Uzboi Valles to the south, or relatively late-occurring alluvial-fan-forming events recognized in the region [6].

Mapping Progress: We have completed mapping of all structures and geologic units within our two quadrangles, many of which correlate with those mapped to the east and south of our two quadrangles [8]. The current status of our map is shown in Figure 1. The primary map base is the controlled daytime THEMIS IR mosaic, supplemented with CTX images where available. Mapping is being done at 1:200,000, with an expected map publication scale of 1:1,000,000. The following units are defined:

Mountainous Unit (Nm): The Mountainous Unit contains remnant high-standing bedrock promontories from the Ladon and Holden basin ring structures that date to the Middle Noachian [8].

Terra Unit (HNt): The Late Noachian to Early Hesperian Terra Unit is a widespread, smooth to rolling, cratered and variably dissected surface between degraded impact craters [8]. It covers much of the terrain outside of Ladon basin in the western portion of our mapping region.

Channel Units ($HNch_1$, $HNch_2$): The formation of Ladon Valles produced both an early flooded surface ($HNch_1$) and a later flow that coalesced into a single channel ($HNch_2$) during the Late Noachian to Early Hesperian [8].

Basin Fill Units (HNb_1, HNb_2 and AHb_3): Ladon basin accumulated fill materials that could be older sediments from Ladon Valles, later fluvial deposits from centripetally draining valleys, and possibly

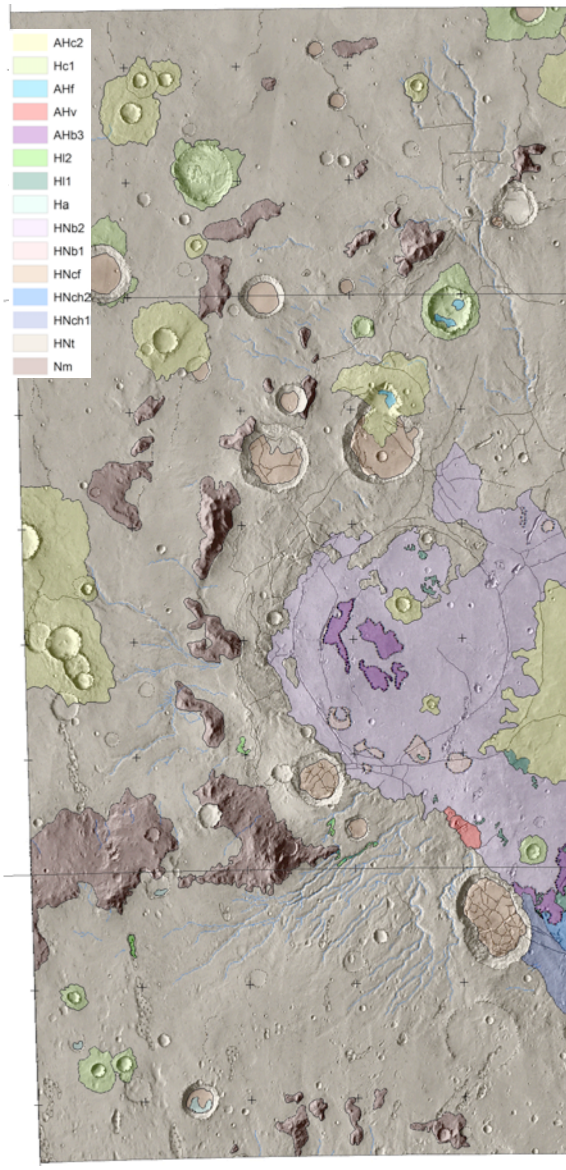

Figure 1. Geologic map of western Ladon basin and surrounding uplands.

volcanic flows. Unit AHb_3 was mapped based upon CTX images that showed a smooth, dark, lithified surface with few well-preserved small craters. The unit is stratigraphically above the other two basin units and Hl_1. The deposit may have formed by volcanism, eolian, or lacustrine processes within Ladon Valles and Ladon basin.

HNb_2 consists of mixtures of rough, bright surfaces with numerous preserved craters and smoother darker surfaces with fewer craters. We interpret the differences in morphology and crater populations to be variable thicknesses of eolian debris that mantles the unit. Crater age dating analyses for this unit yield a Late Noachian/Early Hesperian age, consistent with previous mapping [8].

HNb_1 is best mapped when viewed in THEMIS IR data. It appears brighter in daytime IR and darker in nighttime IR (lower thermal inertia) compared to HNb_2. The morphology of HNb_1 is similar to HNb_2, but it appears to be slightly lower in stratigraphy, suggesting it represents a basin fill material with different thermophysical properties than HNb_2.

Volcanic Unit (Hv): This unit was not previously mapped by [8] in eastern Ladon. The unit consists of two volcanic cones and associated lava flows found along the southern edge of Ladon basin. The age of the unit is Amazonian based upon crater counts, although the area is not very large for calculating reliable statistics.

Crater Units: All clearly delineated ejecta blankets and crater rims for craters >5 km in diameter have been mapped. These include Noachian-aged craters that have heavily modified crater rims with little to no preserved ejecta. The Late to Early Hesperian craters are moderately degraded craters with relatively continuous ejecta (H_{c1}). Late Hesperian to Late Amazonian craters (AH_{c2}) have well-preserved ejecta, with little rim modification and/or infilling.

Light-toned Layered Units (Hl_1 and Hl_2): A Hesperian light-toned layered unit within Ladon Valles and Ladon basin (Hl_1) consists of medium- to light-toned, phyllosilicate-bearing beds with meter to sub-meter thickness and traceability of kilometers (Fig. 2). This unit is sometimes overlain by a dark-toned, more resistant capping layer that preserves small craters (in some locations mapped as Hb_3). Light-toned layered deposits along the Ladon basin floor appear to be locally superposed deposits. The largest exposures of light-toned layered deposits are observed at the distal end of Ladon Valles. Hl_1 deposits could have resulted from discharge associated with flooding that created Ladon Valles or, alternatively, from lacustrine sediment that accumulated in Ladon basin.

Along the western Ladon uplands, we mapped similar light toned deposits (Hl_2) that are associated with lower-lying topography along crater floors or within valleys. We interpret the phyllosilicate-bearing layered deposits to have formed by fluvial erosion of Nm and/or HNt that was subsequently transported by valleys and deposited within craters or upland basins.

Light-toned Altered Unit (Ha): This unit represents light-toned, possibly layered, deposits along crater floors. These craters have no obvious valley system that flows into the crater. For this reason, and due to the lack of CRISM data to determine mineralogy, we are uncertain if the unit consists of detrital sediments like Hl_2 or represents in situ alteration of pre-existing crater floor deposits.

Figure 2. Example of finely layered light-toned deposit in unit Hl_2. HiRISE PSP_010342_1600.

Geologic History: In all, we observe the following sequence of events: (i) Formation of Ladon and Holden impact basins in the middle Noachian, producing the mountainous unit Nm; (ii) Landscape degradation and infilling during the Midde/Late Noachian with the terra unit HNt; (iii) Formation of Ladon Valles in the Late Noachian to Early Hesperian by catastrophic flooding to produce channel units $HNch_1$ and $HNch_2$; (iv) In the Late Noachian to Early Hesperian, Ladon basin floor accumulated sediments that resulted in units HNb_1 and HNb_2; (v) Deposition of light-toned layered deposits (Hl_1 and Hl_2) during the Hesperian within Ladon Valles, Ladon basin, and other smaller valley networks along the western uplands, as well as aqueous alteration along some crater floors (Ha); (vi) Deposition of unit AHb_3 within Ladon basin and Ladon Valles; (vii) Eruption of volcanic unit Hv in the Amazonian. Aeolian erosion of friable sedimentary deposits and aeolian deposition on other surfaces during the Amazonian. Craters formed throughout the geologic history of the mapping region.

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