SEDIMENTARY DEPOSITS ASSOCIATED WITH SMALL UPLAND BASINS AROUND LADON BASIN.

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Introduction: More than a dozen outcrops of light-toned layered deposits, including clays, occur in the uplands to the west of Ladon basin (Fig. 1). We are evaluating the morphology, mineralogy, and distribution of these sedimentary deposits associated with valley systems that dissect the local Noachian bedrock in order to understand how they reflect source materials and record environmental and climatic conditions during their emplacement. Several craters, including secondary craters from the Holden impact event, also contain sedimentary deposits. These deposits were likely more extensive than what we observe today because eolian material has filled in much of the valleys and other depressions, thereby obscuring their full extent. Our focus is on deposits that have HiRISE and/or CRISM coverage in order to evaluate mineralogy and fine-scale morphology. HRSC and HiRISE DTMs were also utilized to understand stratigraphic relationships and derive elevations and bed thicknesses.

Observations: Several deposits within Arda Valles may have been blocked at the eastern end by topography associated with two unnamed craters. Valleys sourcing these deposits head along an ancient ridge to the west forming one of the eroded rings of the ancient Holden impact basin [1,2] that likely exposes rocks weathered during an early wetter period on Mars [3]. Such a "source-to-sink" setting on Mars where clay-bearing sediments can be traced to specific source outcrops is rare. CRISM spectra extracted from the largest exposures within the deposits have absorption features at 1.93 and 2.29 μm, consistent with clays such as nontronite (Fig. 2). Deposition within these valleys emplaced the clay-bearing layered sediments before an outlet was established, enabling drainage onto the lower-lying floor of Ladon basin. An associated ~15 m high inverted channel within one of the valleys (Fig. 2) is consistent with deposition when a closed basin existed, followed by erosion once an outlet valley was established.

Sedimentary deposits further north also appear to represent sites where drainage along valleys trending eastward became obstructed by topographic barriers (Fig. 1). Deposits within these basins show numerous beds with variable lithologies (Fig. 3), suggesting multiple episodes of deposition and/or changing aqueous conditions over time. The more westward deposits are confined to crater floors, including secondaries from Holden (Fig. 4). There are no CRISM images of these western deposits yet, but HiRISE images show similar layered deposits to those in the east. Small valley systems drain into these craters, consistent with erosion of older crustal materials as the source of sediment.

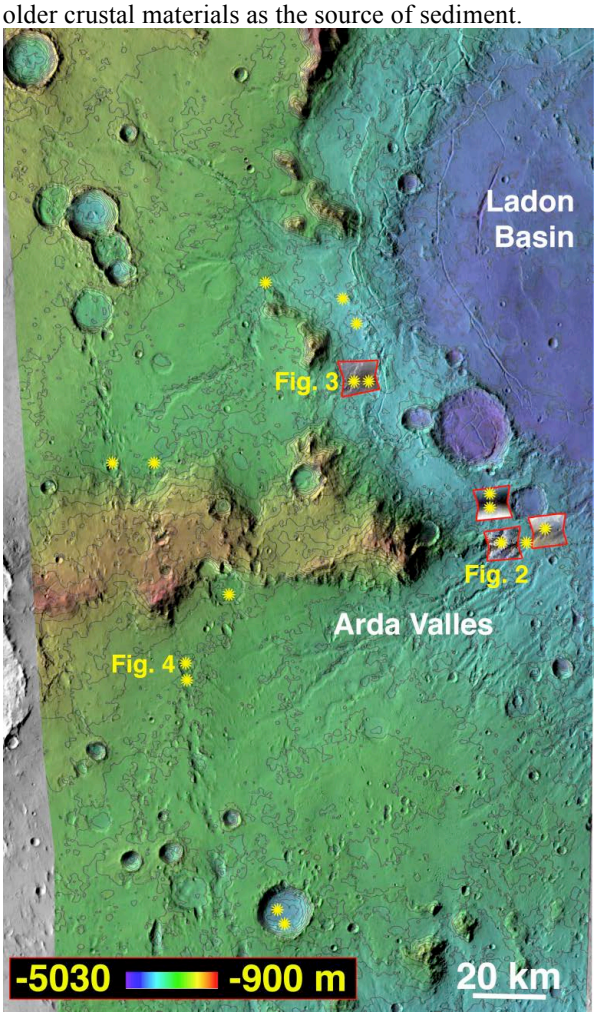

Figure 1. HRSC-derived elevations in color with 200-m contours of western Ladon basin and surrounding uplands. Yellow asterisks identify locations of sedimentary deposits, with later figures noted. Red outlines are CRISM images analyzed in this study.

Conclusions: Newly identified sedimentary deposits in small basins between structural rings of the Ladon impact basin are located well above other similar appearing clay deposits found down on the impact basin floor [4,5]. Their sources appear to be more local and associated with the rim materials of the ancient impact structures whereas those within Ladon basin may reflect lacustrine conditions within the basin or late-stage discharge from Ladon Valles [6], although

any relation in timing remains uncertain. Some of the upland deposits may have formed concurrently with deposits found to the south in Eberswalde [7] and Holden craters [8], indicating precipitation and/or snow melt across much of Margaritifer Terra. One of these basins has been identified as a possible future MSL-class rover landing site (327.60°E, 19.61°S).

References: [1] Schultz P. et al. (1982) *J. Geophys. Res.,* 87, 9803-9820; [2] Grant J.A. (1987) *Advances in planetary geology*, NASA Technical Memorandum 89871, p. 1-268. [3] Bibring J-P. et al. (2006) *Science 312*, 400-404, doi:10.1126/science.1122659. [4] Milliken R.E. and Bish D.L. (2010) *Philosophical Magazine*, 1-16. [5] Weitz C.M. and Bishop J. (2012) *Lunar Planet. Sci. Conf., XXXXIII*, Abstract 1243. [6] Grant J.A. and Parker T.J. (2002) *J. Geophys. Res*., *107*, 10.1029/2001JE001678. [7] Malin M. and Edgett K. (2003) *Science*, *302*, 1931-1934. [8] Grant J.A. et al. (2008) *Geology*, *36*, 195-198, doi: 10.1130/G24340A.

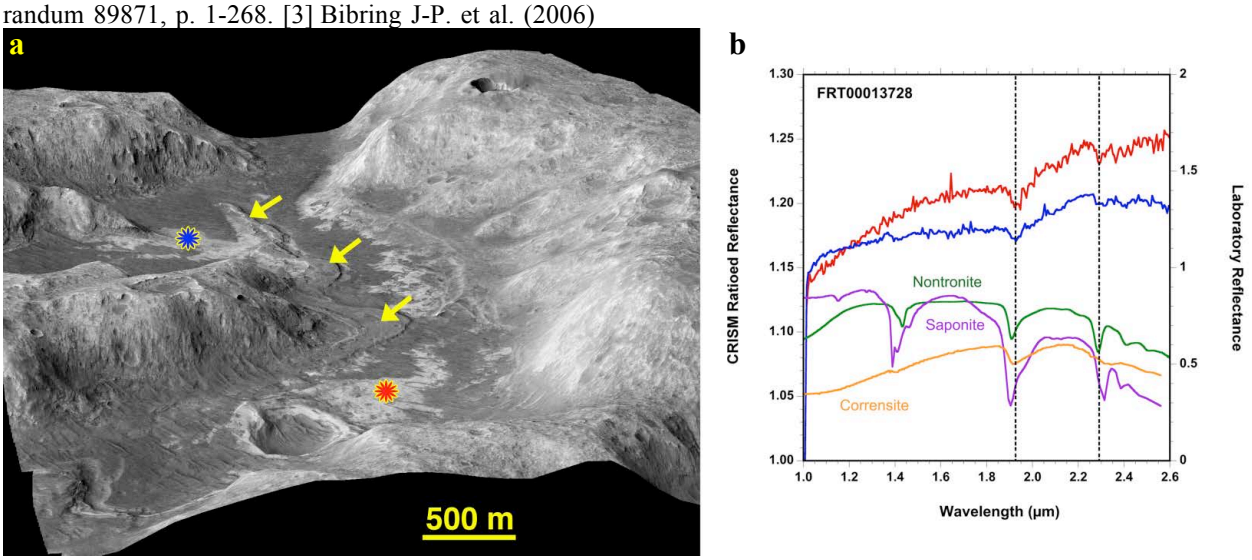

Figure 2. (a) HiRISE DTM at 5x vertical exaggeration showing one of the sedimentary deposits in the uplands west of Ladon basin where a ~15 m high inverted meandering channel (yellow arrows) occurs in a ~150 m deep valley. Red and blue asterisks indicate where CRISM spectra shown in (b) were extracted. (b) Examples of CRISM spectra taken from light-toned layered units with absorption features most consistent with Fe/Mg-smectites (i.e., nontronite).

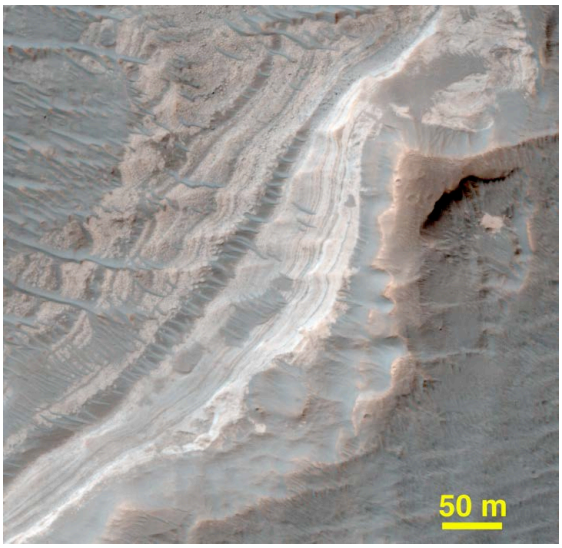

Figure 3. Portion of HiRISE enhanced color image showing variably toned layered deposits in the uplands west of Ladon basin. Brightness heterogeneities appear to be due to compositional changes.

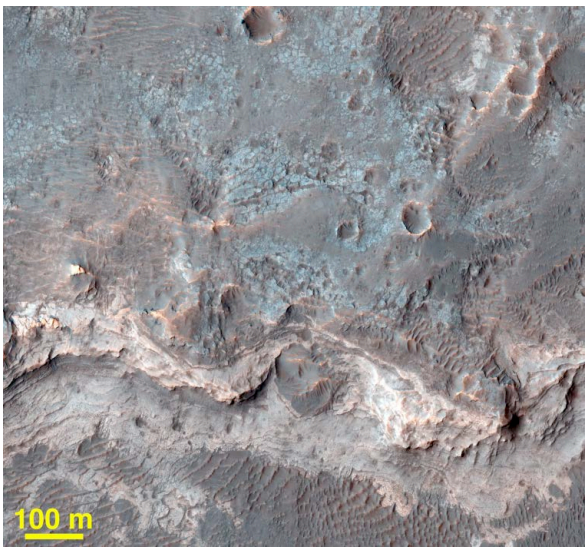

Figure 4. Portion of HiRISE enhanced color image showing altered and desiccated darker materials (blue) above light-toned layered deposits within a Holden secondary crater.