

CHARACTERIZATION OF AEOLIAN AND SEDIMENTARY FEATURES IN THE MAWRTH VALLIS REGION, MARS. D. R. Lowe¹, J. L. Bishop^{2,3}, R. A. Beyer^{2,3}, M. B. Wilhelm^{3,4}, J. J. Wray⁴, D. Loizeau⁵, ¹Stanford University (Stanford, CA, drlowe@stanford.edu), ²SETI Institute (Mountain View, CA), ³NASA-Ames Research Center (Moffett Field, CA), ⁴GeorgiaTech (Atlanta, GA), ⁵LGLTPE, Univ. Lyon (Lyon, France).

Introduction: Characterization of layered units at Muara Crater in Mawrth Vallis provides information about the surface processes forming and shaping the upper stratigraphy in this region. This study is part of a larger investigation with the goal of understanding how sedimentary processes have contributed to the composition and morphology present at Mawrth Vallis [1] and builds off earlier studies of morphology of the region [e.g. 2-3]. Mineralogical analyses indicate several compositionally different strata representing changing geochemical environments [4]. Previous analyses of strike and dip measurements showed that the impact that created Muara Crater played a dominant role in shaping the strike and dip directions [5]. In this study we seek to characterize the types of sedimentary rocks and processes that formed the bedrock in the Muara Crater and Mawrth Vallis area (Fig. 1).

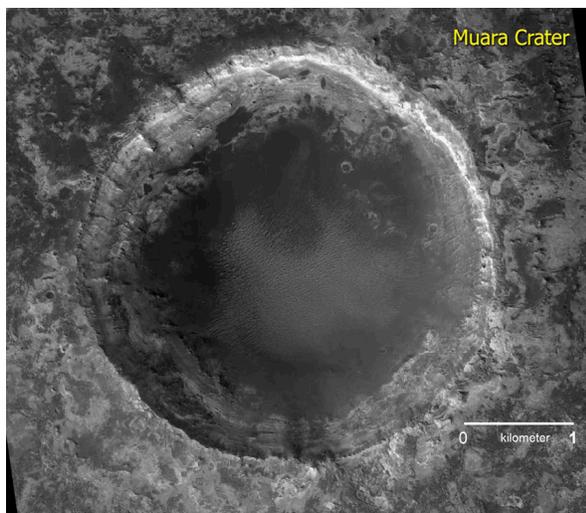


Fig. 1 HiRISE mosaic of Muara Crater, Mawrth Vallis.

Methods: A HiRISE mosaic and DTM were prepared from images ESP_012873_2045 and PSP_004052_2045 that enabled analysis of the layered units throughout the crater. CRISM image FRT000094F6 covering Muara Crater was analyzed for this study using mineral parameters as in [4]. HiRISE images from the wider Mawrth Vallis area were examined to assess the distribution of units, their regional properties, and possible lateral changes.

Results: Multiple processes distributed material and sculpted the surface at Mawrth Vallis. Recent and ancient aeolian processes contributed to dune for-

mation and deposition of dark patches of younger windblown sand and silt occur on and in the walls and on the floor of Muara Crater (Fig. 2). The light-toned rock units in Figs. 1-2 are correlated with phyllosilicates detected in CRISM imagery (Fig. 3) and are present along the crater rim. Features characteristic of sedimentary processes are indicated in Fig. 2 and illustrated in an expanded view in Figs. 4 and 5. It seems likely that much of the bedrock in the Mawrth Vallis area is composed of bedded sedimentary deposits in excess of 300 m thick. They show large-scale dunes in the dark layers, internal unconformities, and layering at a very fine scale. They contrast with the crude layering seen in most Mars basalt and volcanic sequences.

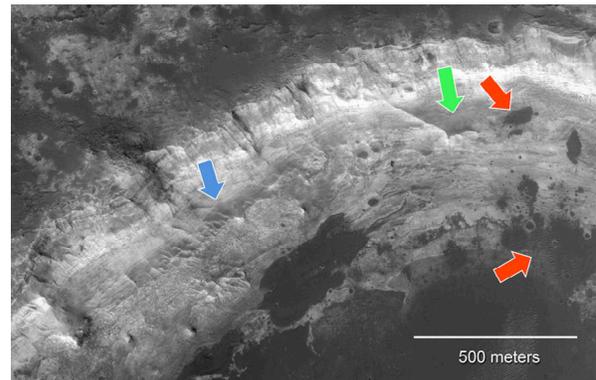


Fig. 2 Expanded view of crater wall illustrating regions of younger windblown sand and silt (red arrows), and areas where dunes (green arrow) and other sedimentary features (blue arrow) are present in the crater wall.

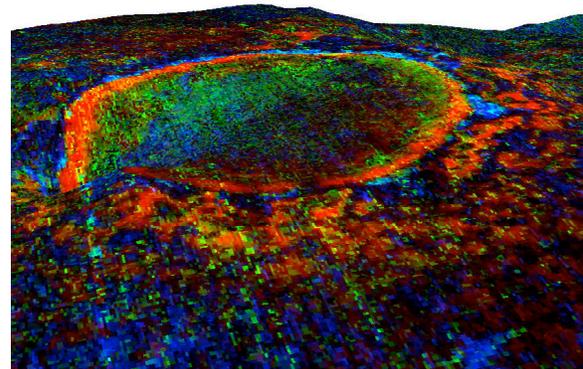


Fig. 3 A 3D view of Muara Crater captured by CRISM, where Al/Si-rich clays are mapped in blue, Fe²⁺-bearing clays are mapped in green, and Fe³⁺/Mg-smectite is mapped in red. N is towards the top left and the vertical enhancement is 5X MOLA elevation.

There are at least 2 and perhaps 3 different types of sedimentary units that are finely interlayered, probably at the cm to meter scale. These include a) black to dark gray, b) very light gray, and c) medium-gray layers.

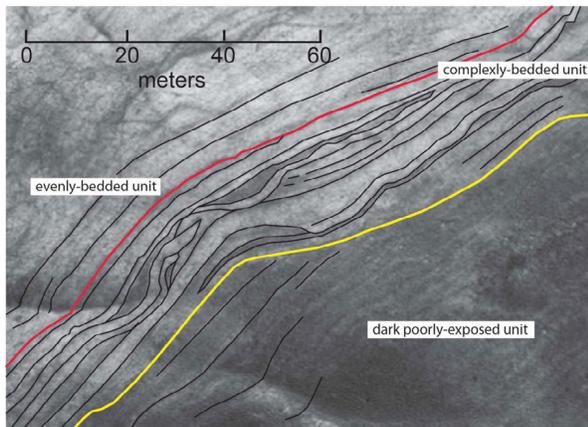


Fig. 4 View of bedded sedimentary deposits showing finely interlayered dark, medium, and light gray sedimentary layers.

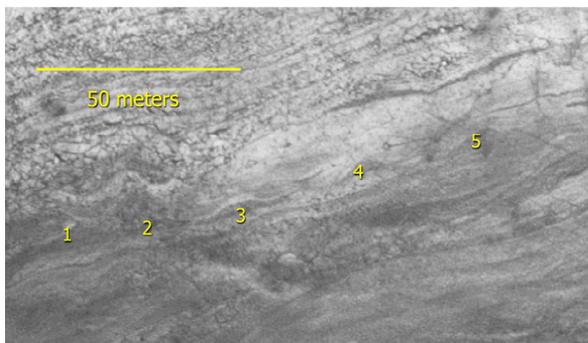


Fig. 5 Probable windblown dunes, numbered 1-5, composed of dark gray sediment in wall of Muara Crater.

The **black to dark gray** layers show every indication that they are composed of fine granular material and represent parent rocks that readily break down into sand- and gravel-sized debris. These materials also form talus slopes below dark outcrops and dark particulate material has been extensively reworked to form younger sand dunes (Fig. 5 and 6). Locally it also seems to have been transported as sand-sized debris by running water.

The black to dark gray layers within the sedimentary sequence in the Mawrth Vallis area are probably composed of basaltic sand and silt. Traced laterally, these are locally interbedded with more massive units that appear to be basalt flows. Basalt flows and pyroclastic units on the modern earth similarly yield abundant sand- to gravel-sized debris that make up local

talus slopes, windblown sand dunes, and water-worked sediments.

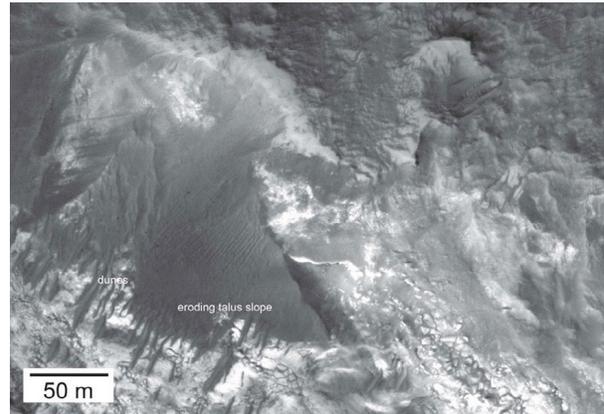


Fig. 6 Dark gray talus slope and sand dunes (left) partially cover and contrast with the very coarse blocky rubble (lower right center) derived from light gray outcrops in the Mawrth Vallis area.

The **light gray** layers appear to consist of sediments that do not readily break down into sand- and gravel-sized debris. Virtually no talus slopes are composed mainly of light materials and few dunes are composed of light gray sediment. Rather, light gray material breaks up into large, angular blocks, commonly meters across, bounded by fractures or joint surfaces and forms many debris flow and landslide deposits in the area (Fig. 6). This material is likely associated with the phyllosilicates identified using CRISM imagery and is under continued study. It may represent either well-compacted clays or clay-bearing deposits.

Summary: Mawrth Vallis bedrock and surface materials have been classified according to color, morphology and geologic features. The intimate, fine interlayering of dark and light layers in the Mawrth Vallis area indicates very repetitive, cyclic changes in depositional conditions. These may reflect either subaerial aeolian and alluvial deposition and/or subaqueous deposition of finer sand, silt, and clay.

References: [1] Bishop J. L. et al. (2011) *LPSC XLII*, Abstract #2374. [2] Michalski J.R. & Noe Dobra E.Z. (2007) *Geology*, **35**, 951-954. [3] Loizeau D. et al. (2010) *Icarus*, **205**, 396-418. [4] Bishop J. L. et al. (2013) *PSS*, **86**, 130-149. [5] Wilhelm M. B. et al. (2013) *LPSC XLIV*, Abstract #2440.

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