CHARACTERISTICS AND THE ORIGIN OF THE VERA RUBIN RIDGE, GALE CRATER, MARS, E. Heydari[1], T. J. Parker[2], F. J. Calef[2], J. F. Schroeder[2], J. Van Beek[3], S. K. Rowland[4], and A. G. Fairen[5], [1]Dept. of Physics, Atmospheric Science, and Geoscience, Jackson State University, P.O. Box 17660, Jackson, MS 39217, (ezat.heydari@jsums.edu), [2]Jet Propulsion Laboratory, Pasadena, CA 91109, [3]Malin Space Science Systems, P.O. Box 90148, San Diego, CA 92191-0148, [4]Dept. of Geology and Geophysics, University of Howaii, Honolulu, HI 96822, [5]Centro de Astrobiología (CSIC-INTA), Madrid, Spain, and Dept. of Astronomy, Cornell University, Ithaca, NY 14853.

Introduction. The Vera Rubin Ridge (VRR), also known as the Hematite Ridge, is a linear topographic feature that parallels the northern foothill perimeter of Mt. Sharp in Gale crater, Mars (Fig. 1). It is about 250 m wide and its best exposure extends for nearly 7 km (1).

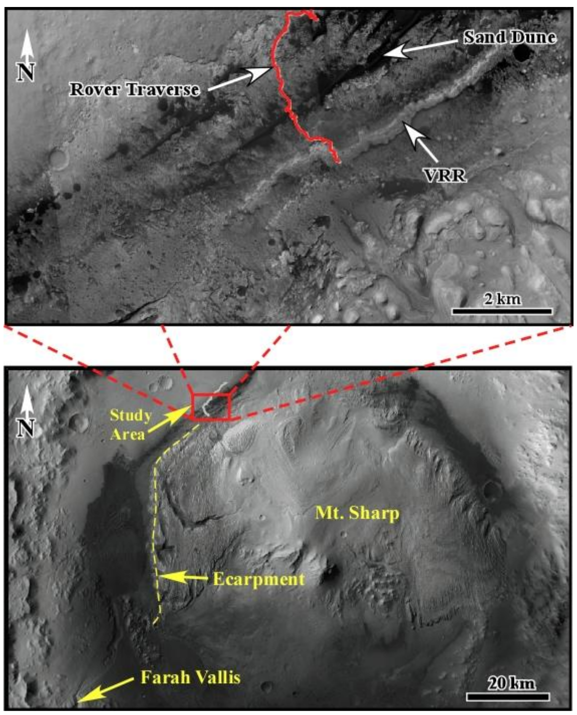

Fig. 1. Bottom: Image of Gale crater shows the location of the Vera Rubin Ridge (VRR) in the red rectangle. The VRR appears to be the continuation of a 700 m escarpment that begins at the southern part of the Gale crater and follows the lower perimeter of Mt. Sharp. Top: Enlarged map of the study area shows the physiography of the VRR.

The VRR was originally identified based on high concentration of hematite revealed by the analysis of data from the Compact Reconnaissance Imaging Spectromert for Mars (CRISM) on board the Mars Reconnaisance Orbiter (2-3). Litholgic, sedimentologic, and diagenetic characteristiscs of the VRR as well as its origin have remained unknow. The Curiosity Rover landed in Gale crater in August of 2012. Soon after, it followed a southerly path reaching the VRR on Sol 1720 and began a systematic study of its rocks.

Observations. Crucial data for the understanding of the VRR are provided by the Mars Hand Lens Imager (MAHLI) instrument: a 2-megapixel camera mounted on the Curiosity Rover's robatic arm capable of resolving grains as small as coarse silt at its closest working distance (4). MAHLI images show two important features of the VRR. The first is that the VRR does not consist of new rock unit. Rather, it is composed of the Murray formation (5): a 260 meters of dominantly mudstone that occurs at the foohill of Mt. Sharp and has been examined since Sol 750. Lithologic and geochemical characteristics of the Murray formation on the VRR and away from it are identical (5). Figures 2 and 3 show this lithologic similarity.

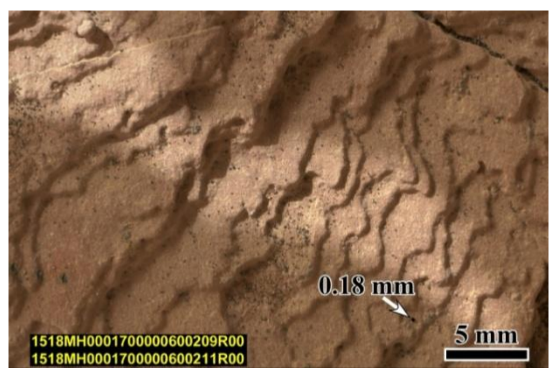

Fig. 2. MAHLI image shows excellent lamination in the Folly Island target (Sol 1518) of the Murray formation acquired 1.2 km north of the VRR.

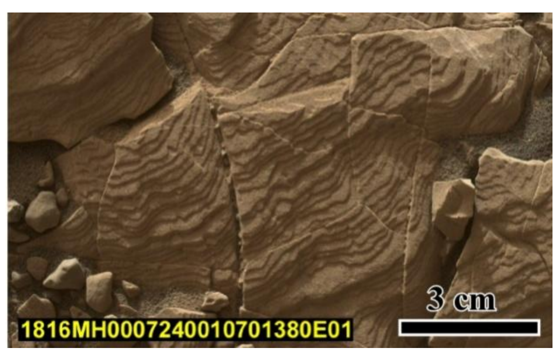

Fig. 3. MAHLI image shows excellent lamination in the F181610 target (Sol 1816) occurring on the VRR.

The second point revealed by MAHLI is the enhanced preferential lithification of the Murray formation at the VRR. Targets away from the VRR are relatively soft (Fig. 4); those on the VRR are very hard (Fig. 5).

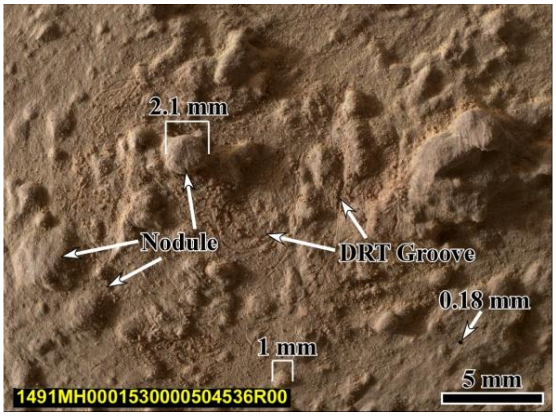

Fig. 4. MAHLI image shows the Sebina target (Sol 1491): a nodular mudstone of the Murray formation 1.5 km north of the VRR. The Dust Removal Tool (DRT) left behind deep grooves suggesting that the target is soft.

Fig. 5. MAHLI image of the Hexriver target (Sol 1879): a red mudstone from the VRR. DRT brushing did not leave any grooves suggesting that the target is very hard.

The difference in hardness is revealed by the effect of the dust removal tool (DRT): a pair of steel brushes used to remove dust to examine fresh surfaces of samples. This process indicates that the Murray formation is much more lithified at the VRR than elsewhere in Gale crater. The variation in lithification is attributed to increased cementation of the Murray formation at the VRR.

Preliminary Interpretations. Our observations indicate that the VRR is not a distinct rock unit with specific depositional setting. Instead, it consists of the Murray formation that experienced enhanced cementation resulting in its preservation as a ridge. However, the timing of cementation is not clear at this time. One possibility is that the Murray formation experienced preferential early, synsedimentary cementation at this location. This retarted the subsequent erosion causing the formation of the VRR. Alternatively, a high topographic feature formed by erosion of the Murray formation first and subsequent preferential cementation maintained that morphology as the VRR. Interestingly, the VRR lines-up along an escarpment (possibly produced by river erosion) that begins at the southern margin of Gale crater and follows the northern perimeter of Mt. Sharp (Fig. 1). The process that created this escarpment could have produced a topographic high in the study area. Subsequent cementation of that topographic high created to the VRR. As such, the VRR may have initially been an escarpment produced by erosive action of rivers that originated from the Farah Vallis (Fig. 1). In fact, an unsorted, black sandstone overlies the Murray formation with an erosional contact near the VRR (Fig. 6). The unsorted sandstone could have been deposited by rivers that passed through this area.

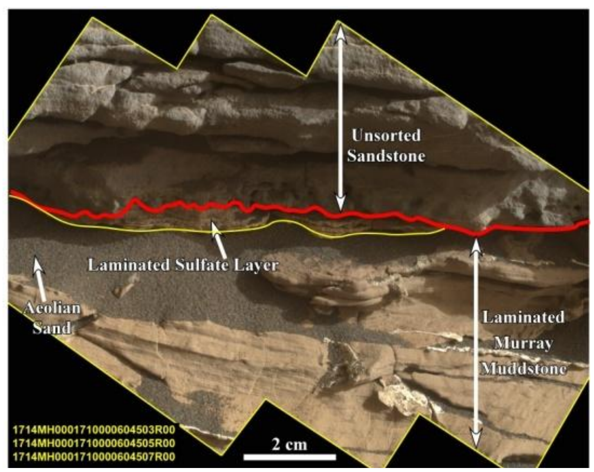

Fig. 6. MAHLI image of the Prays Brook target (Sol 1714) shows an unsorted black-colored sandstone deposited over the laminated mudstone of the Murray formation. The sandstone is interpreted as fluvial in origin. It was deposited over the Murray formation via and unconformable contact (red line in the middle image).

References: [1] A.A. Fraeman et al., 2013, Geology, v. 41, P. 1103 – 1106; doi:10.1130/G34613.1; [2] R. E. Milliken, et al., 2010, Geophysical Research Letters, v. 37, L04201, p. doi:10.1029/2009GL041870; [3] B.J. Thomson et al., 2011, Icarus, v. 214, p. 413–432, doi:10.1016/j.icarus.2011.05.002; [4] K. S. Edgett, et al., 2012, Space Sci. Rev. v. 170, p. 259 –317, doi: 10.1007/s11214-012-9910-4; [6] A.A. Fraeman et al., 2018, LPSC (this volume).