GEOLOGIC MAP OF THE MSL CURIOSITY ROVER EXTENDED MISSION TRAVERSE OF AEOLIS MONS, GALE CRATER, MARS. K. M. Stack,[1] S. M. Cofield[2], and A. A. Fraeman,[1] [1]Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA 91109, (kathryn.m.stack@jpl.nasa.gov), [2]Old Dominion University, Norfolk, VA 23529.

Introduction: Orbital-based geologic mapping of Gale crater has played an important role in planning hypothesis-driven surface science operations for the Mars Science Laboratory (MSL) Curiosity rover mission. Upon arriving at the base of Aeolis Mons, informally named Mount Sharp, at the start of the first extended mission phase in September 2014, the rover reached the edge of the geologic map compiled and used by the team during the first two years of the mission [1]. This study extends the coverage of the landing ellipse map to include the lower strata of Mount Sharp. The map presented here is the most detailed geologic map to-date of this interval of the Gale mound and represents a significant improvement upon previous mapping efforts, providing new insights into the geologic context of rover observations and the stratigraphy of lower Mount Sharp.

Methods: The map presented here covers an ~36 km^2 area around the planned Mount Sharp ascent route (Figure 1). Mapping was performed at a scale of 1:500 using 25 cm/pixel High Resolution Imaging Science Experiment (HiRISE) color and gray scale base maps and a 1 m HiRISE digital elevation model. Geologic units were defined in gray scale and color HiRISE images primarily by differences in tone, brightness, surface texture, and interpreted stratigraphic position. Where informal formation names have already been assigned to units observed by the rover, those names were employed here (e.g., Murray and Stimson formations).

Units: Mapped units and subunits were classified into three groups. Surficial units including modern eolian dunes and mantling material were also mapped, but are not described here in detail.

Bradbury group. The Bradbury group includes units mapped north of the ~10 m high, east-west trending topographic scarp separating the plains of Aeolis Palus from the basal Murray formation of Mount Sharp. This group also includes isolated mesas south of the scarp interpreted to be erosional remnants of the Bradbury group. Units within the group include the capping unit (B-Cap), an intermediate-toned unit that is relatively resistant to erosion and retains craters well compared to the underlying blocky slope-forming unit (B-Sf) and the layered bedrock units (B-Blb and B-Plb). The striated unit (B-Str) mapped here is equivalent to the Orbital Striated Outcrop (OSO) of [2]. Although outcrops of the Bradbury group generally overlie surrounding Murray formation rocks of the Mount Sharp group at the map scale, an inter-fingering relationship between these two groups has been interpreted from ground-based Curiosity rover observations [2].

Mount Sharp group. The Mount Sharp group is a thick sequence composed primarily of intermediate to light-toned layered bedrock that comprises the majority of the mapping area. The Murray formation is the basal unit of the Mount Sharp group; the lower Murray is bright and rarely exhibits layering, while the upper Murray is intermediate in tone, contains abundant m-scale polygonal fractures, and internal layering is commonly traceable on scales of meters to hundreds of meters.

The Upper Murray is overlain by the ridge units, which are divided into lower, middle, and upper units. The lower ridge unit is distinguished from underlying Murray formation rocks by a distinct increase in brightness and the appearance of decameter-scale fracture networks. The contact between the lower ridge unit is quite distinct near the center of the ridge, but becomes gradational to the east and west. The middle ridge unit is distinguished by a mottled texture of variable tone. The upper ridge unit is characterized by a smooth, uniform texture and an intermediate tone. Strong crystalline hematite signals [5] are associated with portions of the middle and upper ridge units, but not the lower unit. The ridge units were not mapped further up-section as might be expected if these units were through going and laterally extensive within the Mount Sharp stratigraphy. Although there is uncertainty in the stratigraphic context of the ridge units, the map is most consistent with a model in which the ridge represents local diagenesis and preferential cementation of Mount Sharp group Murray bedrock, an interpretation also supported by the gradational contact between the lower ridge unit and underlying upper Murray formation.

Up section from the Murray formation and the ridge units is Mount Sharp Group unit 2, defined at the base by the first mappable bed of the smooth ridged subunit (MS-2sr). MS-2sr appears to be inter-bedded with polygonally fractured bedrock (MS-2pb) [3], which is similar in texture and outcrop expression to the Murray formation. The interval composed of MS-2sr and MS-2pb is associated with CRISM Fe/Mg clay signatures [2, 4, 5]. Units 3-5 of the Mount Sharp group are bright, layered, commonly polygonally fractured bedrock intervals distinguished primarily in the HiRISE images by variations in tone and textures exposed along bedding planes exposed in plan view. The marker bed described by [4] is mapped here as MS-5mb and marks the base of Unit 5.

Siccar Point group. The Siccar Point group contains units exhibiting a distinct corrugated, ridged texture. The Stimson formation (SP-Stu and SP-Stl) crops out near the boundary between the Bradbury and Mount Sharp Groups, and is distinguished by northeast-southwest trending ridges [6]. The range of elevations covered by this unit suggests that it is unconformably overlain on both the Bradbury and Mount Sharp groups [7]. A fan-shaped deposit exhibiting NW-SE trending ridges located upslope from the Stimson fm is mapped as part of the Siccar Point group, although it is unclear whether this fan-shaped deposit and the Stimson fm are time-equivalent. The ridged fan is overlain by a NW-SE trending elongate deposit exhibiting blocks resolvable in HiRISE and coarse-layering that forms the positive-relief terminal end of a channel deposit that crosscuts Unit 5 of the Mount Sharp group.

Discussion: Although Gale crater is one of the best-studied and most-mapped locations on Mars, **o**rbital image-based maps of lower Mount Sharp are still largely constrained by lower resolution mineral parameter mapping from the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM, ~18 m/pixel). The large-scale texture- and morphology-based geologic mapping presented here reveals that the "hematite" and "clay" units of Mount Sharp, are each composed of distinct mappable morphologic units and subunits that will be encountered and examined by the Curiosity rover during its extended mission phase. This map also shows the relative stratigraphy and crosscutting relationships of the ridged fan and overlying channel deposit relative to underlying units of Mount Sharp.

References: [1] Calef, III F. J. et al. (2013) *LPS XLIV,* Abstract #2511. [2] Grotzinger J. P. et al. (2015) *Science, 350,* 6257. [3] Cofield S. et al. (2017) LPSC XLVIII. [4] Milliken R. E. et al. (2010) *GRL, 37* L04201. [5] Fraeman A. A. et al. (2016) *JGR-Planets, 121(9)*, 1713-1736. [6] Banham, S. et al. (2017) LPSC XLVIII. [7] Watkins, J. et al. (2016) LPSC XLVII, Abstract #2939.

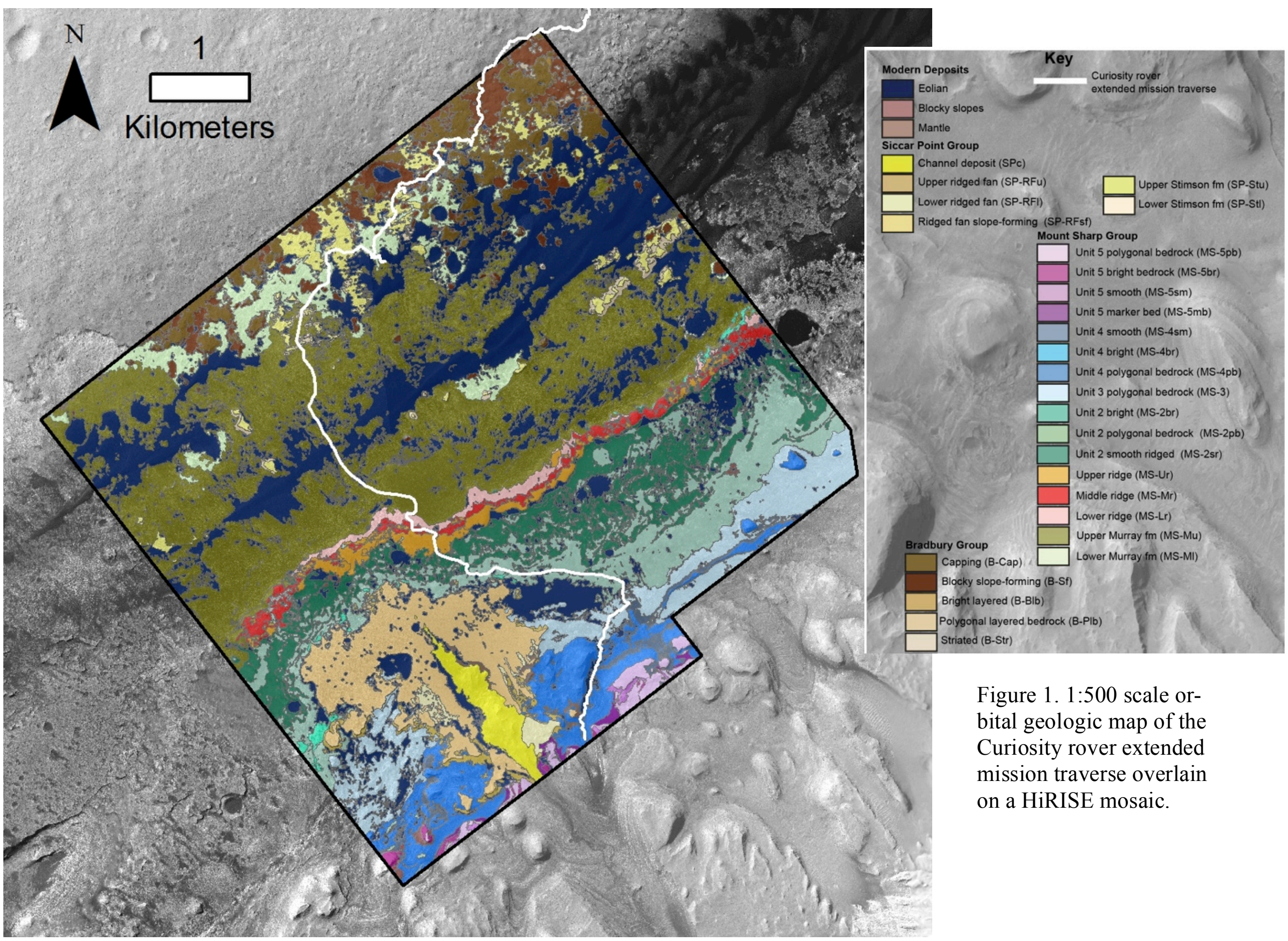

Figure 1. 1:500 scale orbital geologic map of the Curiosity rover extended mission traverse overlain on a HiRISE mosaic.