THE MARS DESCENT IMAGER (MARDI) SIDEWALK IMAGING CAMPAIGN IN MARKER BAND VALLEY, GALE CRATER, MARS. A. C. Cowart[1], M. E. Minitti[2], M.M. Lewis[3], J.P. Tuggle[3], K.A. Bennett[4], K.E. Herkenhoff[4], D.M. Fey[5], N. Moore[5], [1]Planetary Science Institute, College Park, MD (acowart@psi.edu). [2]Framework, Silver Spring, MD. [3]The University of Tennessee Department of Earth and Planetary Sciences, Knoxville, TN. [4]U.S. Geological Survey, Astrogeology Science Center, Flagstaff, AZ. [5]Malin Space Science Systems, San Diego, CA.

Introduction: Marker Band Valley (MBV) in Gale crater is located at a major transition in bedrock morphology and geochemistry. It lies across the contact between the orbitally defined Lower Sulfate (LSu) and Upper Sulfate (USu) units. The LSu (~eq. to the Mirador fm. in MSL team surface mapping) is typified by cross-stratification, and the USu is typified by planar stratification and decametric-scale tonal banding [1, 2]. Additionally, the eponymous Marker Band (MB), an enigmatic, thin outcrop of resistant material unique to the Gale crater stratigraphic sequence, forms the valley lip [3]. Geochemically, MBV marks the lowermost spatially contiguous orbital detection of magnesium sulfates in the Gale crater mound [4]. These features suggest a major environmental change within Gale crater. Exploring the nature of this change (gradual, oscillatory, or abrupt?), the mode of magnesium sulfate emplacement in the upper Gale crater mound, and the formation environment of the MB are major motivating questions of Curiosity's extended mission.

Maximizing scientific return from rover traverses requires balancing time spent acquiring contextual data along the traverse route against reaching waypoints identified as having high scientific priority [5]. Travel between waypoints is generally characterized by high-tempo, long-distance drives. In this operational mode, range, terrain occlusion, viewing geometry, and rover resource limits may reduce observable stratigraphic detail (e.g. interbedding, diagenetic contacts, and stratigraphic contacts) from the rover's primary imaging payload. As a result, these observations may be sparse along segments of the traverse.

Opportunistic imaging with MARDI helps address this observational gap. MARDI is a nadir-pointed camera located on the forward port side of Curiosity [6]. Camera software allows for drive video acquisition, providing a unique opportunity for high-resolution, constant-scale imaging data collection between end-of-drive observation points. MARDI frames contain an ~80 x 60 cm field of view with a ~1.5 mm resolution. Video frames can be mosaicked to construct a "sidewalk" view of terrain along the drive path. MARDI sidewalks have been previously used to characterize the distribution of bedding and diagenetic structures in the Pahrump Hills outcrop [7]. Depending on lighting conditions, overlapping video frames may also be used to construct digital outcrop models of terrain features [8].

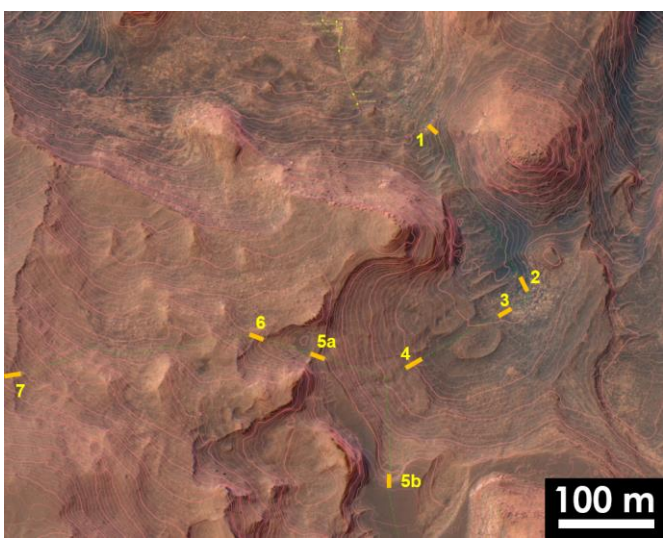

Figure 1. *HiRISE context map of the the region of Marker Band Valley. Green line indicates Mount Sharp Ascent Route. Yellow lines and numerals indicate strategically planned locations of textural contacts targeted for MARDI sidewalk imaging; actual collection sites differ slightly.*

Imaging Locations and Preliminary Analysis: The sidewalk campaign in MBV was developed to target significant transitions in HiRISE surface texture. Eight sites of interest were identified along the Mount Sharp Ascent Route (MSAR), with the decision to proceed with imaging made tactically when it was determined the rover would cross the textural contact (**Figure 1**). As of this writing, five sidewalks (Locations 1, 3, 4, 5a and 6) have been collected and fully downlinked to Earth. Operational considerations prevented collection of sidewalks at Locations 2 and 7. Below we describe the rationale and mission date of sidewalk observations, and preliminary observations from each.

Location 1 (Sol 3546): Targets a region characterized by interspersed patches of rubbly and intact bedrock. We found rubbly rock to consist of small, sub-meter blocks of nodular rock (**Figure 2a**). Intact blocks appear to be more indurated and express planar laminations. Some

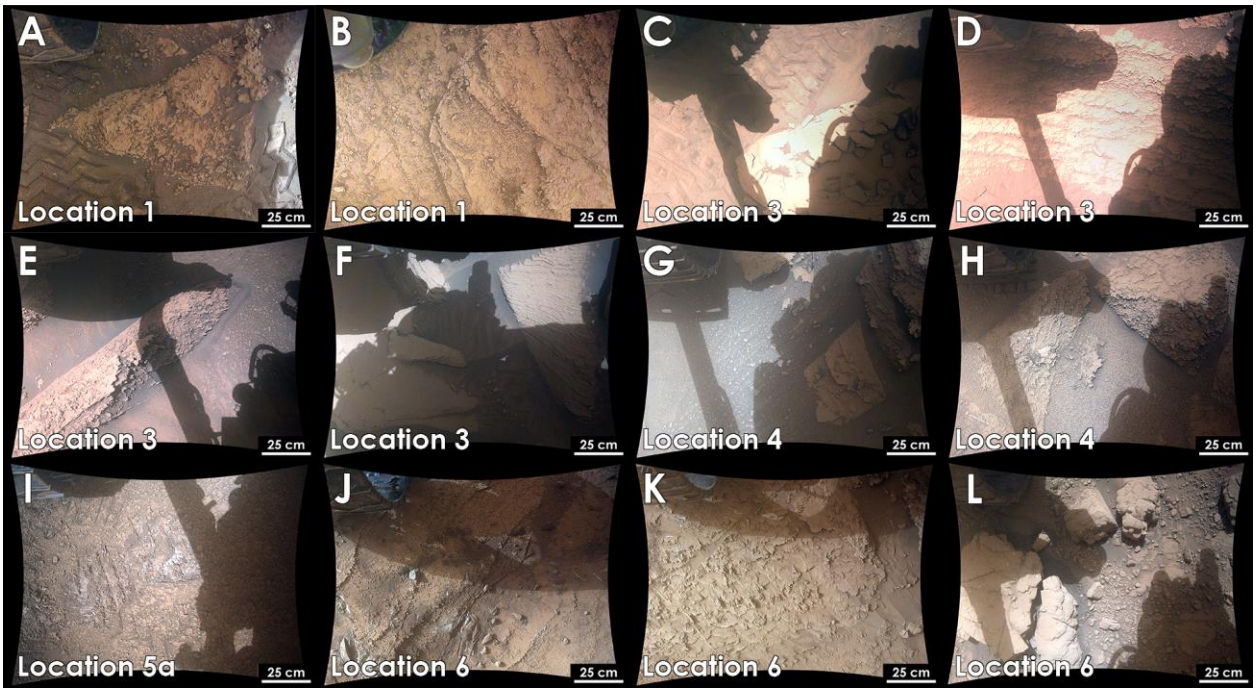

Figure 2. *Selected MARDI images acquired during the campaign. See text for description. Note scale bar is approximately equivalent to one full-resolution HiRISE pixel.*

laminae appear to be more strongly cemented than others (**Figure 2b**). Cross-cutting veins, predominantly at shallow angles to bedding, are also observed. These observations suggest the orbit-scale textures observed in this area result from patchy diagenetic modification of the rock.

Location 3 (Sol 3597/3601): Targets a transition from large, light-toned bedrock blocks to a thin platform of darker-toned, rubbly bedrock. Imaging documented bedding style changes, including thin gray sheets of polygonally-fractured material (**Figure 2c**) and possible rhythmic bedding (**Figure 2d**). Diagenetic style changes from bedding disruptive nodular growth and limited induration along laminae (**Figure 2e**) to more uniform cementation of the rock (**Figure 2f**).

Location 4 (Sol 3631): Targets a transition in rubbly bedrock texture to a more resistant expression which is accompanied by a slope break. The textural transition appears to be associated with a change in both bedding structure and diagenetic style. Rocks associated with the recessive texture are finely laminated with thin, platy interbeds (**Figure 2g**). The resistant texture is more coarsely bedded and has a somewhat nodular appearance (**Figure 2h**). Regolith associated with nodular bedrock contains more coarse material; locally reduced regolith mobility may play a role in apparent bedrock resistance.

Location 5a (Sol 3687) and 5b: Targets the contact between the MB and immediately underlying materials. The MSAR path allows MB imaging at two locations to compare lateral variation. Images show abundant light-toned material disturbed by the rover immediately underlying the Marker Band and a coarsely nodular appearance to the rock (**Figure 2i**).

Location 6 (Sol 3648/3651): Targets a transition from recessive to resistant rock surfaces. This sidewalk documented a gradational contact. Rocks near the start of the sidewalk are laminated and contain numerous rounded concretions (**Figure 2j**). Concretions decrease in number and bedding thickness increases along the drive path, ending in rock with cm-scale bedding and orthogonal jointing (**Figure 2k, l**).

Acknowledgments: We would like to thank the MSL team for their support of this project, particularly the MSL Mobility Team for their tactical input and assistance with sidewalk planning. We would also like to thank the MARDI Development and Operations team for instrument support during this imaging campaign.

References: [1] Milliken et al. (2010), GRL, 37. [2] Rapin, W. et al. (2021) *Geology*, 49(7), 842-846. [3] Weitz, C.M. et al. (2022) *JGR Planets*, 127(4). [4] Fraeman, A.A. et al. (2023), *LPSC LIV*. [5] Vasavada A.R. (2022) *Space Sci. Rev.*, 218 (14). [6] Malin, M.C. et al. (2017) *Earth and Space Sci.*, 4(8), 506-539. [7] Minitti, M.E. et al. (2019) *Icarus*, 328, 194-209. [8] Garvin, J.B. et al. (2015), *LPSC XLVI.*