DEBRIS DEPOSITS WITHIN THE UPPER GEDIZ VALLIS AND GRAND CANYON OF GALE CRATER.
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Introduction: The Curiosity rover in 2019 will be commanded to finish observations on the Vera Rubin Ridge [1] and start exploration of the smectite-bearing rocks to the south, i.e., within the clay unit [2]. Next the rover will investigate the Greenheugh pediment and sulfate-bearing strata as she continues the ascent of Mount Sharp (Fig. 1). The ascent will include exploring Gediz Vallis and the relationship with the ridge that extends onto the pediment [6]. Of interest will be the nature of the upper portion of the ridge, which is dominated by debris (Fig. 2). In this abstract we pursue similarities between the morphology and mineralogy of the upper Gediz Vallis ridge and debris deposits within the Grand Canyon on the SW side of Mount Sharp (Figs. 3,4). Comparisons of these features from orbital data, followed by rover-based observations of the upper ridge in Gediz Vallis, will be synergistic and extend our understanding of formation of these deposits.

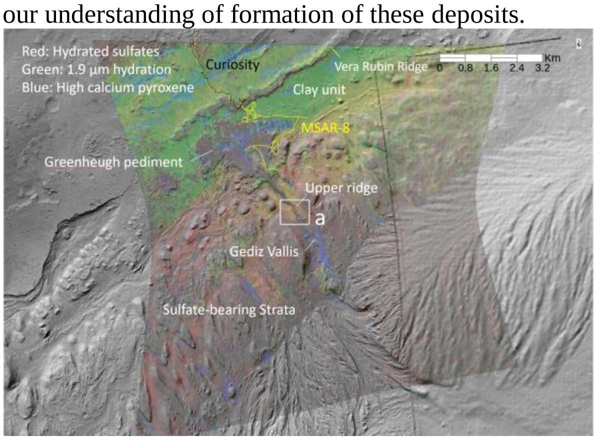

Figure 1: CRISM scene FRT0000B6F1 covering a northern area on Mount Sharp, processed to single scattering albedo [3] and is overlain onto a HiRISE-based shaded relief mosaic. Color-coded with mineral absorption parameters from [4]. MSAR-8 is the strategic path Curiosity will take after leaving the Vera Rubin Ridge. White box shows location of image in Fig. 2. See [5] for a description of the geologic units inferred from CRISM and HiRISE data.

Upper Gediz Vallis: Gediz Vallis is U-shaped and begins in the “small yarding unit” [7] and extends ~12 km through sulfate strata (Fig. 1) to the Greenheugh pediment. The vallis is ~0.9 km wide and ~100 m deep as measured along the axis of the sharp ridge shown in Fig. 2. The sharp ridge is ~10 m high, ~50 m wide, and extends down the eastern valley wall. The ridge meets another ridge of debris (~5 m high) extending down the vallis, sitting within a previously carved channel, that is ~90 m wide for a transect on the northern edge of the area shown in Fig. 2. The down-valley trending ridge has a polyhydrated sulfate-dominated spectral signature all the way to the Greenheugh pediment. The signature becomes subdued in a downhill direction. Blocks of various sizes are evident in HiRISE data down to the resolution limit of several times the projected pixel size of 0.25 m.

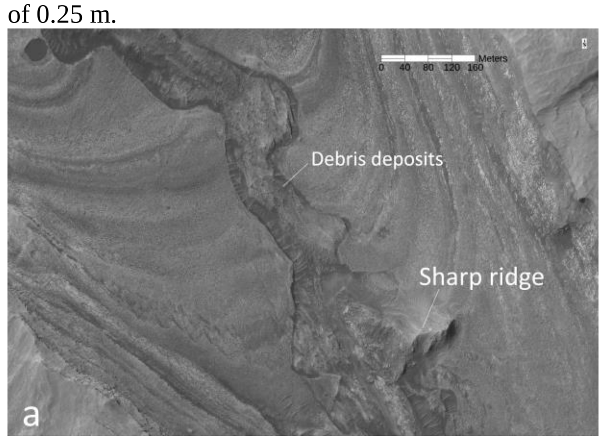

Figure 2: HiRISE view of area a in Fig. 1, showing the downhill trending debris ridge within upper Gediz Vallis. The sharp ridge extends down the eastern valley wall to join the downhill trending ridge.

Grand Canyon: This canyon is located on the SW flank of Mount Sharp and begins in the “small yardang unit”, extending downhill for ~35 km, cutting though the sulfate strata first in a westerly, and then in a NW direction (Fig. 3). The canyon is ~1.8 km wide with a depth of ~250 m across the area shown in Fig. 4. A ridge is evident that trends down the side of the eastern canyon wall. This ridge connects to a low relief (~1 to 3 m high) debris-filled ridge extending down the canyon floor. CRISM data show a spectral dominance of polyhydrated sulfates within the debris filled ridge (Figs. 3, 5). Blocks of various sizes are evident in HiRISE data (Fig. 4). The downhill-trending ridge is a ubiquitous component of the canyon floor, with variable relief, and numerous connections with ridges and alcoves trending down the canyon walls to meet the downhill-trending ridge.

Discussion: Based on observations of the debris ridges presented in this abstract, and examination of data covering other parts of both Gediz Vallis, and the

Grand Canyon, we have formulated a working hypothesis to explain the spatial, textural, and mineralogic patterns. For the Grand Canyon there are several examples of ridges extending downhill from canyon walls, in addition alcoves (not shown here) on the walls that are above the canyon floor ridge deposits. There is also evidence for mass failures events (not shown here) extending from the walls of the Grand Canyon.

Collectively these observations imply a connected system of wall-related failures and downhill transport. Evidence is much better preserved in the Grand Canyon than in Gediz Vallis, where only one ridge is observed extending down the wall and meeting the debris-dominated ridge. For both settings we hypothesize that the ridges record local significant deposition of coarse debris across the canyon floors, adding to transport and deposition that occurred down the pre-exiting canyon floors. Subsequent exhumation, likely by wind, has stripped the adjacent sulfate-bearing strata and exposed further the debris deposits. In the Grand Canyon, bordered by steep walls with local tributary alcoves, has more extensive coarse debris deposits along the valley floor and in the tributaries.

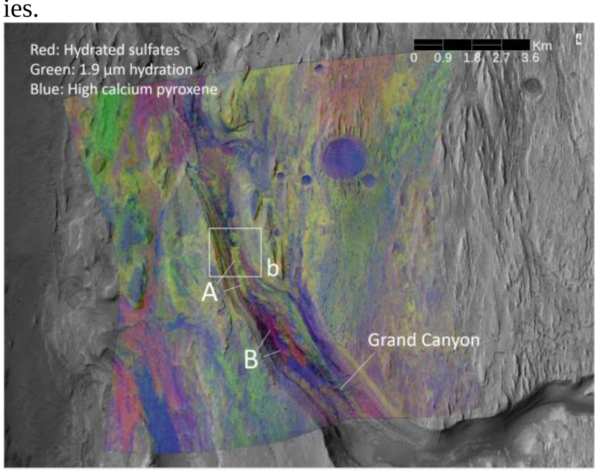

Figure 3: CRISM scene FRT000095EE processed to single scattering albedo [4] covering the Grand Canyon and overlying a HiRISE mosaic. Mineral absorptions color-coded as in Fig. 1. White box denotes the location of the HiRISE image shown in Fig. 4. Spectra for areas A and B shown in Fig. 5.

Future Work: It is impossible to know at this point the extent to which water was involved in generating the debris deposits evident in the canyon and valley. Were these materials eroded and transported by fluvial deposits, by debris flows, or by some combination of processes? When were these systems active and why? Why do the deposits have a propensity to have polyhydrated spectral signatures, even though for the Grand Canyon there is an abundance of monohydrated sulfate strata exposed? Were the polyhydrated strata weaker? Did hydration and dehydration under various climatic conditions play a role? We are investigating these questions and others using a combination of detailed mapping and process modeling. The prospect of characterizing the Gediz Vallis ridge by Curiosity as she continues her ascent of Mount Sharp will add immensely to our understanding of the timing and nature of emplacement and modification of the deposits evident in Gediz Vallis and, by association, with those exposed in the Grand Canyon.

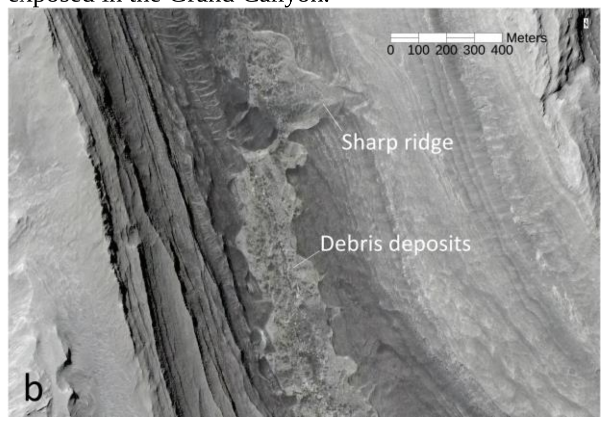

Figure 4: HiRISE view showing details within the Grand Canyon, including debris deposits and a ridge extending from the eastern wall and connecting to the downhill trending ridge and debris deposits.

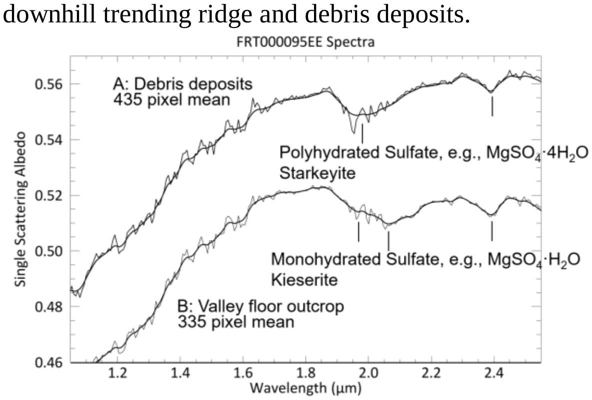

Figure 4: SSA spectra of the units indicated in Fig. 3. A is consistent with a polyhydrated sulfate. B is consistent with a monohydrated sulfate.

References: [1] Fraeman A. A. et al. (2019) *LPS L*, these abstracts. [2] Fox V. K. et al. (2019) *LPS L*, these abstracts. [3] Politte D. V. et al. (2019) *LPS L*, these abstracts. [4] Viviano-Beck C. E. et al. (2014) *JGR:P*, *119*, 1403-1431. [5] Fraeman A. A. et al. (2016) *JGR:P*, *121*, 1713-1736. [6] Bryk A. et al. (2019) *LPS L*, these abstracts. [7] Le Deit L. et al. (2013) *JGR:P*, *118*, 2439-2473.