GALE CRATER: CURIOSITY ROVER AND THE CANDIDATE BASAL SULFATE UNIT. R. E. Arvidson, Department of Earth and Planetary Sciences, McDonnell Center for the Space Sciences, Washington University in St. Louis, St. Louis, MO (arvidson@wunder.wustl.edu).

Introduction: The Curiosity Rover landed in August 2012 and since then has been making measurements and traversing up the northern side of Aeolis Mons, informally named Mount Sharp [e.g., 1, 2, 3]. The rover is currently finishing its characterization of the phyllosilicate-bearing fluvial-lacustrine-aeolian strata encountered within Glen Torridon (Figure 1). Curiosity will next ascend onto the section of Mount Sharp dominated by hydrated sulfate-bearing strata [4, 5]. The intent is to characterize these outcrops, thereby retrieving information on the paleoclimatic and alteration regimes locked in the sulfate rock record. Part of the science team's strategic route planning effort has focused on where to make the initial ascent onto the sulfate-bearing strata, and what orbital data provide in terms of expected mineralogy and other properties of a candidate basal sulfate outcrop. This abstract is a summary of the work done by the working group charged with this route planning effort.

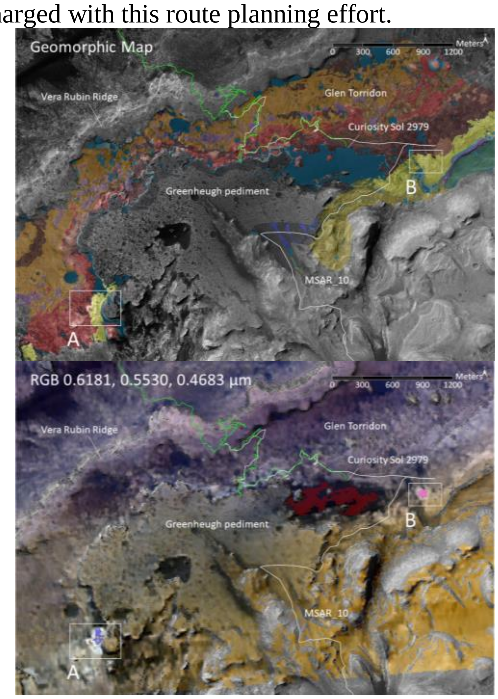

Figure 1: Top: Geomorphic units within Glen Torridon overlain onto a HiRISE image mosaic. Units described in [6]. Of interest for this abstract is the yellow-colored unit (Smooth Fractured Unit, SFU), specifically the areas shown in boxes A and B. Bottom: False color image from CRISM observation FRT00021C92, with regions of interest (ROI) shown for extraction of spectra for the Sands of Forvie sand sheet (red ROI) and western and eastern SFU outcrops (pink ROI). Curiosity's traverses through sol 2979 (location as of 12/30/20) are shown, along with MSAR_10, the current strategic route.

Geomorphology and Stratigraphy: We conducted geomorphic mapping to support the strategic planning using color HiRISE image data at a pixel scale of 0.25m/pixel, and based on color, relative albedo, and texture [6]. Mapping enabled identification of candidate basal sulfate outcrops (SFU) interpreted to overlie the uppermost rocks of the Murray formation (Figure 1). These outcrops are evident to the west and east of the Greenheugh pediment, and associated overlying cap rocks, indicating that the SFU is regional in extent.

Mineralogy: CRISM along-track oversampled observation FRT00021C92 was reduced to surface single scattering albedo spectral maps at 12 m/pixel using procedures described in [7, 8]. We used spectra from the Sands of Forvie ripple field to evaluate the extent to which the methodology denoised and regularized the data. Results show no residuals that could be masquerading as absorption features (Figure 2, top). Spectra for the western and eastern SFU outcrops exhibit subtle spectral features that were hence examined using continuum-removed spectral plots (Figure 2, bottom). In addition to spectral evidence in the SFU spectra for the presence of hydrated sulfates (SINDEX2 parameter, [9], and 2.4 µm absorption, Figure 2 bottom), the results also indicate the presence of an amorphous phase (Figure 2, bottom). In addition, short wavelength spectral data indicate a deficiency in iron oxide phases relative to surrounding outcrops.

Physical Properties: We also examined HiRISE color images to evaluate the textural characteristics of the SFU outcrops, both the western and eastern exposures (Figure 3). SFU outcrops in both locations exhibit relatively smooth surfaces cut by sand-filled fractures. The smooth or "polished-looking" outcrops suggest wind-induced shaping and smoothing of indurated rocks. In addition, [10] showed using the long wavelength data from FRT00021C92 that the apparent thermal inertias for these outcrops exceed ~500 SI units. An absolute value retrieval was not possible because the outcrops were too cold for the afternoon observation to have produced a measurable thermal emission signal.

Curiosity: The SFU outcrop located to the east of the Greenheugh pediment has a hydrated sulfate spectral signature in CRISM data, together with evidence for one of more hydrated or hydroxylated amorphous phase(s), and a reduced iron oxide signature relative to surrounding rocks. CRISM data also show that this outcrop has a relatively high thermal inertia. It is free of sand, except within fractures. It appears to be wind-polished. Finally, it directly overlies what is likely the upper strata of the Murray formation. These characteristics are distinctly different from the Mg-sulfate bearing strata that lie above the SFU [e.g., 4, 5]. This SFU outcrop is thus a prime target for Curiosity traverses and measurements to evaluate the nature of the contact with the underlying rocks, and to characterize what is likely the basal unit of the thick section of sulfate-bearing strata that underlie Mount Sharp (Figure 4).

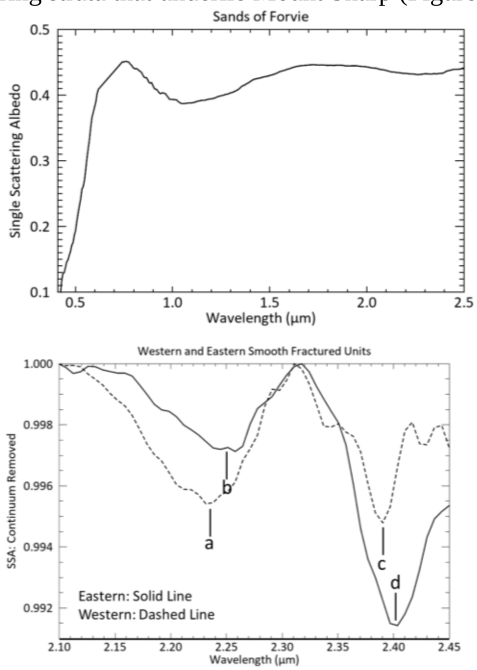

Figure 2: Top: Reflectance spectrum for the Sands of Forvie ROI (Figure 1) showing the broad absorption features associated with ferric oxides at the shortest wavelengths, together with crystal field transitions associated with ferrous silicates centered at ~1.2 and 2.3 µm. Bottom: Continuum removed spectra for the western and eastern SFU ROIs showing broad absorption features a and b associated with a hydroxylated and/or hydrated amorphous phase(s), and c, d associated with one or more hydrated sulfate phase(s).

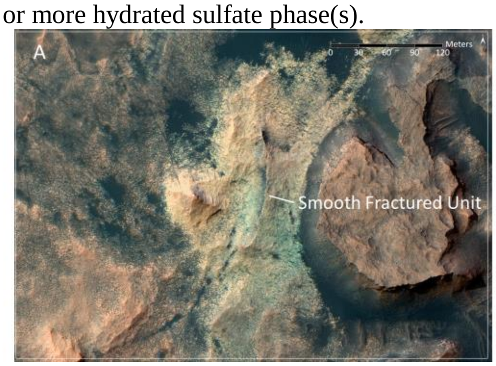

Figure 3: Top: HiRISE image for location denoted by Box A in Figure 1. Note the relatively smooth and bright characteristics associated with this SFU outcrop. Bottom: Same description but for the SFU outcrop located in the area denoted by Box B in Figure 1, i.e., to the east of the Greenheugh pediment.

Figure 4: HiRISE based perspective view, with no vertical exaggeration, of the candidate basal sulfate unit (SFU) showing the eastern MSAR_10 arm. Ascent onto this unit would provide good exposure of the contact with the underlying rocks and would access high thermal inertia, likely wind polished outcrops exposing a unique ensemble of mineral phases relative to other rocks examined by Curiosity.

References: [1] Grotzinger J. P. et al. (2015) *Science*, doi:10.1126/science.aac7575. [2] Vasavada A. R. et al. (2014) *JGR-Planets*, doi:10.1002/2014JE00462. [3] Fraeman A. A. et al. (2020) *JGR-Planets*, doi: 10.1029/2020JE006527. [4] Milliken R. E. (2010) *GRL*, doi:10.1029/2009GL041870. [5] Sheppard R. Y. et al. (2020) *JGR-Planets*, doi:10.1029/2020JE006372. [6] Hughes M. N. et al. (2021) *LPS LII*, these abstracts. [7] Kreisch C. D. et al. (2016) *Icarus*, doi:10.1016/j.icarus.2016.09.033. [8] He L. et al. (2019) *IEEE*, doi:10.1109/JSTARS.2019.2900644. [9] Viviano-Beck C. et al. (2016) *JGR*, doi:10.1002/2014JE004627. [10] Christian J. C. et al. (2021) *LPS LII*, these abstracts.