AN UPDATE ON MARTIAN DUST COVERAGE AND CONTRIBUTION TO APXS ELEMENTAL CONCENTRATION AND BEDROCK COMPOSITION FOR ROCK TARGETS IN GALE CRATER . T.L.J. Henley[1]. M.E. Schmidt[2], S.L. Bray[3], J.J. Zheng[4]. Earth Sci, Brock Univ, St. Catharines, ON L2S 3A1, Canada, th18is@brocku.ca

Introduction: Airfall dust (1.3-1.7 µm) is widespread on the Mars surface and hinders our ability to interpret the textural and geochemical properties of rock targets analyzed by the Mars Science Laboratory (MSL) Curiosity rover. The Alpha Particle X-ray spectrometer (APXS) measures elemental abundances in the outermost 2-200 µm of soil and rock surfaces [1] making it more susceptible to dust, particularly affected are the lighter elements (Na, Mg) and volatiles (S, Cl), which are enriched in the dust [2]. Rock surfaces observed in Gale may be brushed by the Dust Removal Tool (DRT), but it does not completely remove dust [3]. ChemCam utilizes Laser Induced Breakdown Spectroscopy (LIBS) to gradually ablate into target surfaces with a secondary effect of unevenly moving dust away from the laser point [4]. Yet, the dust is discontinuous and bedrock characteristics are always discernable, even for the dustiest rock targets.

To address the effect of dust on APXS, we use Mars Hand Lens Imager (MAHLI) images to estimate dust coverages and have found correlations with elemental concentrations [1]. We here present recent results up to sol 2471. We additionally estimate areal coverages of Ca-sulfate veins and their contributions to bedrock chemistry. We focus here on a comparison between the Sheepbed mudstone (Yellowknife Bay) and Blunts Point Member of the Murray formation (Vera Rubin Ridge).

Methodology: Adapted from methods detailed by [1], MAHLI images of APXS targets were used to analyze dust coverages, vein abundance, and bedrock composition. Focus merge images were opened in a free online photo-editor called BeFunky.com [5]. The image was sharpened and enhanced to greater enhance the visual contrast between dust and bedrock. If shadows were present in the image, such as the cast by the rover's arm, they were removed during the initial editing process. After editing, the *Replace Color* in Adobe Photoshop was used to gradually replace every colour value of dust with white. The same process was performed again to target vein material. ImageJ was next used to convert the image to 8-bit greyscale and the *Threshold* tool was used to target the now white dust pixels. The percent dust coverage and percent vein abundances were determined within a 1.7 cm-diameter circle centered on the MAHLI image to represent the APXS Field of View (FOV). APXS chemical abundances, dust coverage and vein abundance were then compared to estimate dust- and vein-free bedrock composition by mass balance. APXS placement, including horizontal position relative to the MAHLI image as well as vertical standoff distance contribute uncertainty [6].

Results: Analysis of 528 rock targets (to sol 2471) was performed to understand dust behaviour on the surface of Mars, as well as its influence on APXS data. Of the 528 targets, 307 are 'As Is' (i.e., not brushed by the DRT), 141 DRT, and 80 were targeted by the Chem-Cam prior to analysis (Fig. 1). As-Is targets ranged in dust coverage from 0.2% to 79.1% with a median value of 39.7%. DRT targets ranged from 1.2% to 60.9% with a median value of 23.3%. Chem-Cam targets had dust coverages that ranged from 1.3% to 67.9% with a median value of 32.0%. These results demonstrate how the Chem-Cam is not an effective dust-clearing tool.

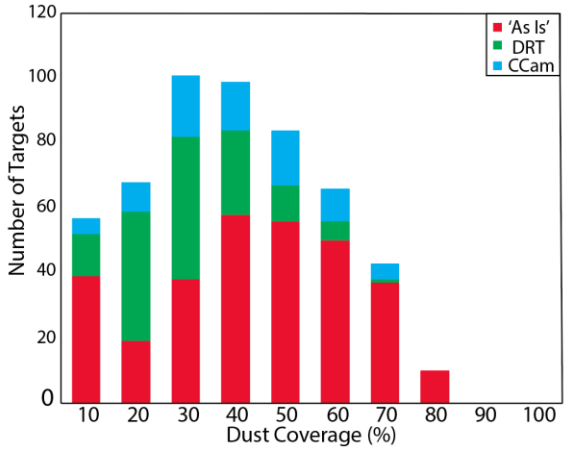

Fig. 1. Distribution of all analyzed rock targets, separated into 'As Is', DRT, and Chem-Cam targets.

Comparison with APXS: The Sheepbed mudstone (sols 129-291) and the Blunts Point member of the Murray formation are compared by plotting determined dust coverages against the elemental concentrations of MgO and SO_3 (Fig. 3). Earlier work has demonstrated that the Sheepbed mudstone is relatively homogenous and exhibits clear correlations between the dust coverage and bed-rock compositions [4]. In contrast, MgO and SO_3 in Blunts Points rock do not correlate with dust coverage, even when taking Ca-sulfate veins into account. The Blunts Points is much more varied in composition than Sheepbed and SO_3 occurs within the bedrock as either a primary precipitate, detrital grains, or as a later cement [7, 8].

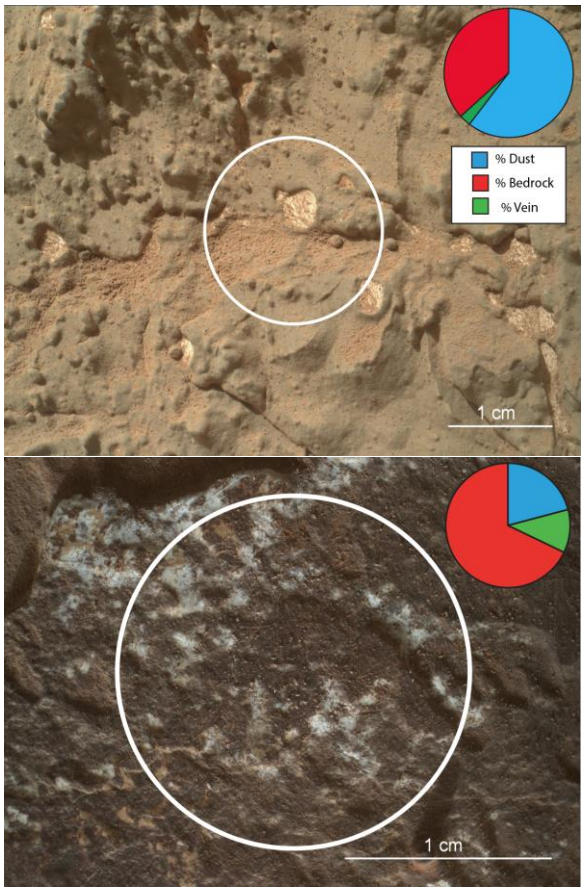

Fig 2. MAHLI images of APXS targets where the circle in the center of each image represents the assumed APXS field of view of 17mm. Top: Persillon, sol 154 (0154MH0001710000101526R01_DXXX), dust coverage=60.8%, vein abundance=2.33%. Bottom: Bilibert, sol 2048 (2048MH0001530000801727R00_DXXX), dust coverage = 20.99%, vein abundance = 11.11%.

Conclusions: Since dust is so abundant on the Mars surface, it is important that it be continually taken into account when analyzing data collected by Curiosity. Dust noticeably impacted all APXS targets, including those that were cleared by the DRT and Chem-Cam.

While contributions from dust and veins are significant in APXS rock targets, we here demonstrate how this accounts for only some of the variability for some rock groups, including the Blunts Point member of the Murray formation. For other, more uniform groups, such as the Sheepbed mudstone, dust and veins may account for the majority of the compositional variability.

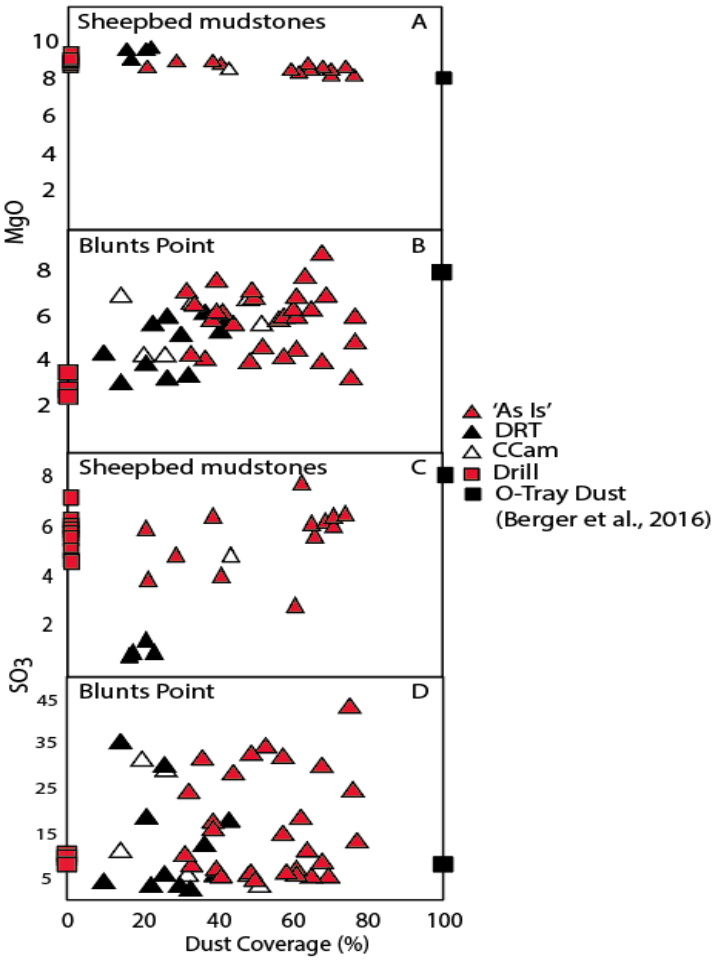

Fig 3. Measured dust coverage plotted against compositions as measured by APXS. A and C: Sheepbed mudstones MgO and SO_3 (wt%) vs. Dust Coverage %, B and D: Blunts Points Targets MgO and So_3 (wt%) vs Dust Coverage %.

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