CHLORINE ENRICHMENT AT GALE CRATER AS INVESTIGATED BY THE APXS.

M. A. McCraig[1], R. Gellert[1], M. E., Schmidt[2], L. M. Thompson[3], C. D. O'Connell-Cooper[3], J. A. Berger[4], S. J. VanBommel[5], A. S. Yen[6], N. I. Boyd[1], [1]University of Guelph, Department of Physics, 50 Stone Rd E, Guelph, Ontario, Canada, N1G 2W1 (mmccraig@uoguelph.ca), [2]Brock University, St. Catherines, ON, Canada, [3]Univeristy of New Brunswick, Fredericton, NB, Canada, [4]NASA Johnson Space Center, Houston, TX, USA, [5]Washington University in St. Louis, St. Louis, MO, USA, [6]JPL-California Institute of Technology, Pasadena, CA, USA.

Introduction: The Alpha Particle X-ray Spectrometer (APXS) [1] aboard the Mars Science Lab (MSL) [2] Curiosity rover has been on Mars for ~7 years and in that time has investigated ~860 targets. Herein we are highlighting 26 drill targets (including mini-drill holes) and 81 paired as-is/unbrushed and brushed (via the Dust Removal Tool, DRT) rock targets to characterize the distribution of chlorine. The presence and nature of chlorine on the surface of Mars has been a significant topic of discussion for some time. Chlorine, and the oft discussed perchlorates, are of particular importance for landed human missions to Mars.

Methods: The APXS is an arm-mounted instrument which employs six ^{244}Cm sources to irradiate a spot ≥1.5 cm in diameter. The MSL APXS can collect X-ray spectra of sufficient statistics in 10 to 20 minutes per integration, at modest temperatures, to allow for robust quantitative determination of major, minor and several trace element abundances [1, 3]. Chlorine (Z=17) has an 90% interrogation depth of approximately 8 µm [4]. Data herein are shown grouped in triplets for the drill-hole targets, Figure 1, with no DRT targets available for the 1st and 24th groupings of 3, drill-holes John Klein and Kilmarie, respectively, and in pairs for the 81 as-is rock and DRT targets shown in Figure 2. There were 156 MAHLI imaged DRT'd targets (as of sol 2601). Within the APXS data, appropriate as-is rock geochemical matches can be found for all of the DRT/brushed targets, but for the purposes of this analysis, only as-is rock targets in the same rover workspace, of similar rock type (i.e., not Ca-sulfate veins of obviously different composition) were chosen for unbrushed/brushed rock pairings. In instances where there was more than one plausible as-is rock target (a target and an offset for example), those with the best data quality were chosen (best FWHM), and for those sites where two as-is rock targets existed, the target closest to the DRT target was chosen.

Discussion: Chlorine is distinctly enriched upon the removal of dust in 62% of unbrushed/brushed targets and 38% of unbrushed/brushed targets in the drilled target set. The expectation, should chlorine be largely confined to the mobile-dust, would be for chlorine content to fall, and among the set of 81 as-is rock/DRT pairs – this only occurs in excess of the Cl precision error in 7% of pairs. The pattern for the as-is rock and DRT pairs (62% increasing, 31% decreasing within error, and 7% decreasing in a manner that exceeded the measurement error) is telling as we know the DRT is removing some, but not all of the dust in the FOV, and it agrees with the lack of complete dust coverage observed for as-is rock targets demonstrated previously [5] and in continuing work [see Henley et al., this conf.]. We do not yet know the estimated amounts of as-is/pre-brush or post-brush extant dust coverage for all of the as-is rock and DRT targets, or how effective the DRT might be at removing a salt coating, but we can confidently say that the DRT is removing some amount of dust, in 61% of the pairs that dust removal has exposed more chlorine, in 31% of the pairs as much chlorine as was exposed as was removed within error, and in 7% of the pairs chlorine content decreased in a meaningful manner.

Equally of importance, are the changes in chlorine content in the drill-hole as-is rock, DRT, and tailings targets. Chlorine content increased from as-is rock to DRT for 38% of the groupings with DRT's performed, and decreased from rock measurement to DRT'd surface for 33% of the measurements in a manner exceeding the content error as measured for the as-is rock targets. While the number of targets where chlorine content either increased or decreased does not correlate well between the as-is rock/DRT/tailings and as-is rock/DRT sets, telling among the grouped triplets is the fraction of tailings piles (92%) and the degree to which the chlorine content in those tailings piles decreased.

Conclusion: The observed APXS data suggest chlorine in Gale crater, for the majority of targets, is not enriched in the bulk rock, or in the dust, but rather, exists as surface rinds. This is also consistent with observations at Meridiani/Gusev [6].

Acknowledgements: The MSL APXS is managed and financed by the Canadian Space Agency (CSA), with MDA as the prime contractor for the instrument. Science team funding is provided by the CSA and NASA.

References: [1] Gellert R. and Clark III B. C. (2015) *Elements*, 11, 39–44. [2] Grotzinger J. P. et al. (2012) *Space. Sci. Rev.*, 170, 5-56. [3] Gellert R. et al. (2006) *JGR*, 111, E02S05. [4] Rieder et al. (2003), *JGR-Planets*, 108, E12-8066. [5] Schmidt et al. *JGR-Planets*, 123, 1649-1673. [6] Clark et al. (2005), *EPSL*, 240, 73-94.

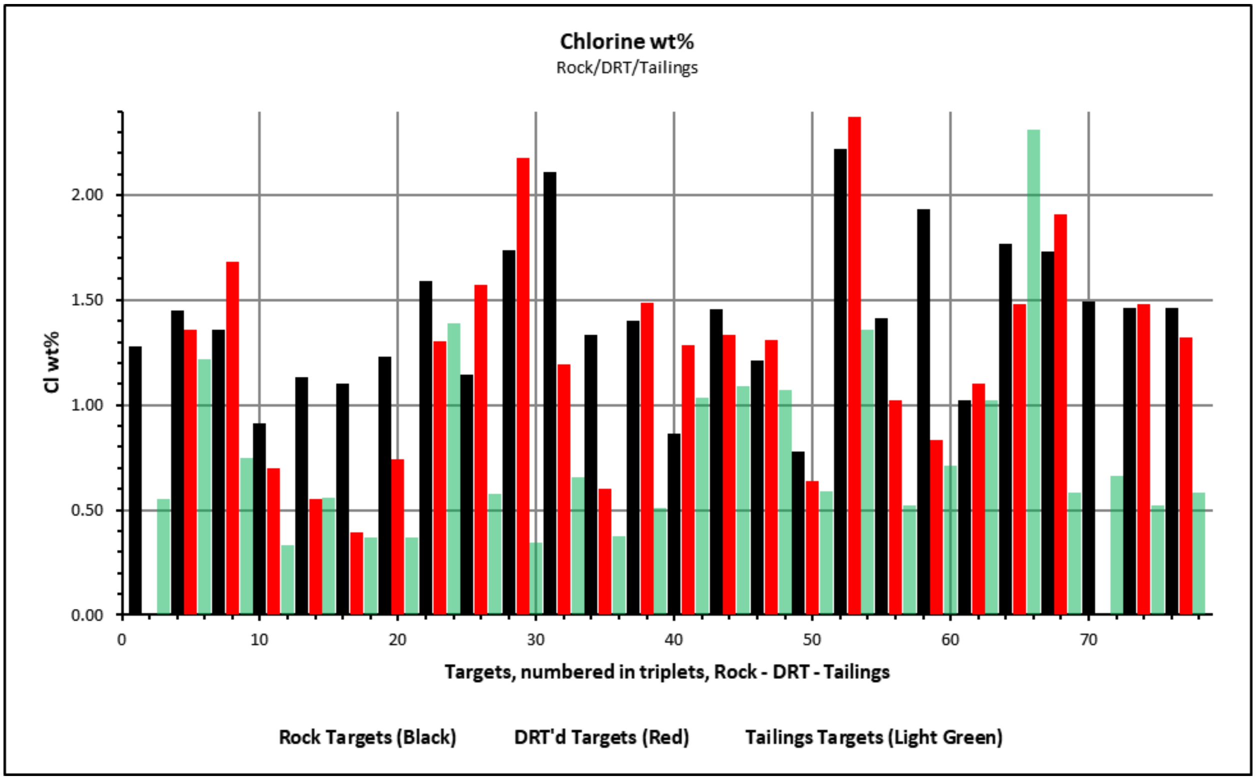

Figure 1: Chlorine weight percent for the 26 drill-hole targets. Paired in groups of three, Rock, DRT, and Tailings, in black, red and light green respectively. Included in the set are mini-drill holes Lake Orcadie, Voyageurs and Ailsa Craig, sets of three targets beginning with black bars at 46, 52 and 54, respectively.

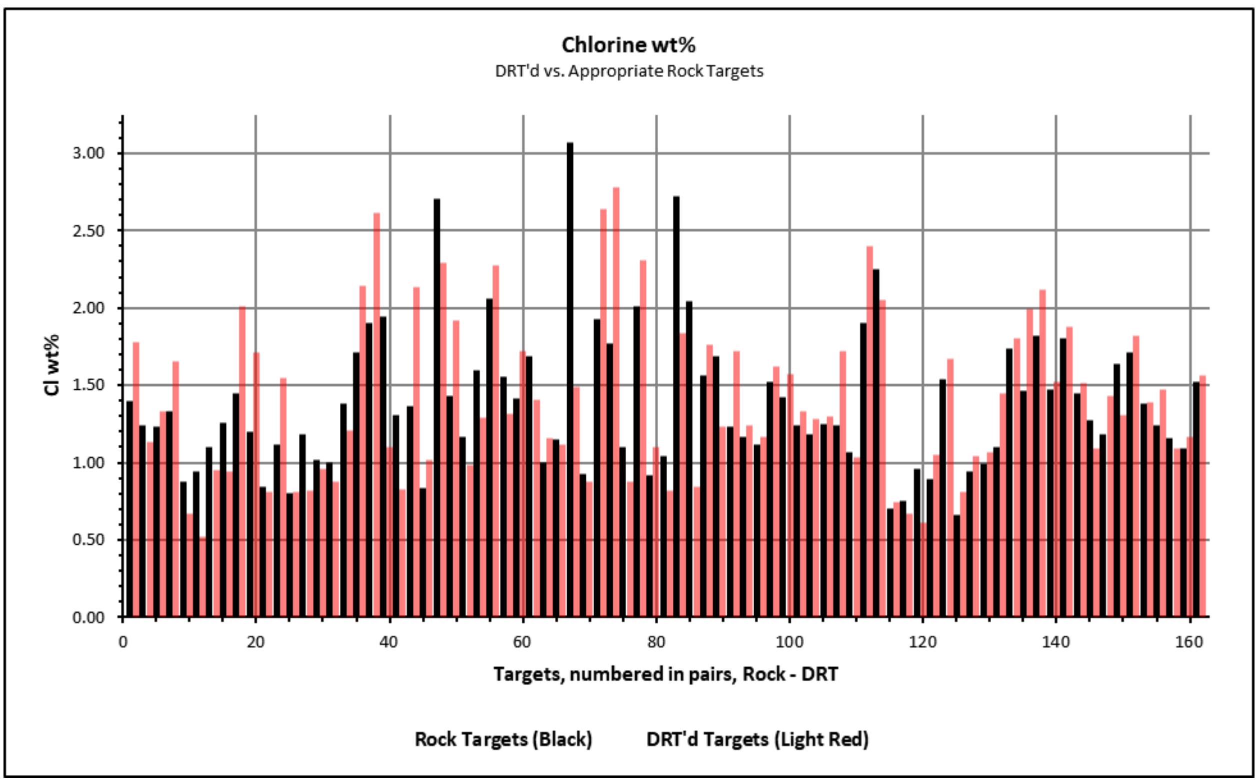

Figure 2: Chlorine weight percent for the 81 paired Rock and DRT targets.