Geophysical Research Abstracts
Vol. 19, EGU2017-10652-1, 2017
EGU General Assembly 2017

Representative composition of the Murray Formation, Gale Crater, Mars, as refined through modeling utilizing Alpha Particle X-ray Spectrometer observations

Scott VanBommel (1), Ralf Gellert (1), Jeff Berger (2), Elstan Desouza (1), Catherine O'Connell-Cooper (3), Lucy Thompson (3), and Nicholas Boyd (1)

(1) University of Guelph, Department of Physics, Guelph, ON, Canada, (2) University of Western Ontario, London, ON, Canada, (3) University of New Brunswick, Fredericton, NB, Canada

The Murray formation[1] in Gale Crater is distinctly characterized by depleted MgO and CaO, an elevated Fe/Mn ratio, and enrichments in SiO_2, K_2O, and Ge, compared to average Mars. Supported by observations with *Curiosity*'s Alpha Particle X-ray Spectrometer[2], this pattern is consistent over several kilometers. However, intermixed dust, Ca-, and Mg-sulfates introduce chemical heterogeneities into the APXS field of view. Better constraints on the composition of what is characteristic of the Murray formation is achieved by applying a least-squares deconvolution[3] to a selection of APXS Murray targets. We subtract the composition of known additions (dust[4], $MgSO_4$, $CaSO_4$) to derive a more-representative Murray composition. Slight variations within Murray are then probed by modeling each target as a mixture of dust, sulfates and the derived representative Murray.

The derived composition for what is representative of Murray has several key deviations from the straightforward average of Murray targets. The subtraction of known dust, Mg-, and Ca-sulfate additions suggests further depletion in MgO and CaO in Murray and also suggests a significant decrease in SO_3 concentration compared to the average of Murray targets. While veins and concretions are contaminants when considering the composition of the bulk rock, the subtraction of Mg- or Ca-sulfate is independent of sulfate form. Sulfates within the bulk rock (detrital or cements) have been observed in the Murray formation. These sulfates are important and discussed further in [5].

Modeling APXS Murray targets as a mixture of dust, $MgSO_4$, $CaSO_4$, and representative Murray, provides insight into potential subtle variations within the surprisingly consistent Murray formation. For example, the high SiO_2 in Buckskin, (sol 1057-1091) is not simply a mixture of representative Murray with sulfates and dust. The elevated Ni (and $MgSO_4$) of Morrison (sol ~775), the elevated Al_2O_3 of Mojave (sol ~800-900), and the gradually increasing Fe/Mn ratio (by decreasing Mn with near-constant FeO) all stand out from this modeling. The constant CaO, after the impact of $CaSO_4$ is removed, as well as the steady SiO_2, TiO_2, and FeO, aside from Buckskin, are also clearly visible. Along the traverse up Mount Sharp, there also is an apparent downward trend in Mn and Zn and an increasing trend in Cl and Br.

The chemical homogeneity of the Murray formation encountered at Gale Crater provides an opportunity to test existing algorithms in new ways. This homogeneity along the traverse is a major finding in itself, however, removing signals of known additions and deriving a composition representative of the Murray formation, is important as it permits the potential to detect and quantify faint variations within the Murray formation as *Curiosity* continues up Mount Sharp.

References:

[1] Grotzinger et al. (2015) *Science*, 350 (6257). [2] Gellert and Clark (2015) *Elements*, 11, 39-44. [3] VanBommel et al. (2016) *XRS,* 45(3), 155-161. [4] Berger et al. (2016) *GRL,* 43 67-75. [5] Thompson et al. (2017) *LPSC XLVIII* 3020.

Acknowledgements:

This work has been supported by the Canadian Space Agency (CSA) under contract 9F052-14-0592. The MSL APXS is financed and managed by the CSA with MacDonald Dettwiler and Associates as the primary contractor to build the instrument. Funding is provided by the CSA and NASA. Much appreciation goes to JPL for their support, dedication, and invaluable expertise.