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Millimeter-Scale Chemistry of Observable Endmembers with the Mars Science Laboratory Alpha Particle X-Ray Spectrometer and Mars Hand Lens Imager

Scott VanBommel (1), Ralf Gellert (1), Lucy Thompson (2), Jeff Berger (3), Iain Campbell (1), Ken Edgett (4), Marie McBride (4,5), Michelle Minitti (6), Elstan Desouza (1), and Nick Boyd (1)

(1) University of Guelph, Guelph ON, Canada (svanbomm@uoguelph.ca), (2) University of New Brunswick, Fredericton NB, Canada, (3) University of Western Ontario, London ON, Canada, (4) Malin Space Science Systems, San Diego CA, USA, (5) Purdue University, West Lafayette IN, USA, (6) Planetary Science Institute, Tucson AZ, USA

The Alpha Particle X-ray Spectrometer (APXS) is a bulk chemistry instrument conducting high-precision in-situ measurements of Martian rocks and soils onboard both active NASA rovers [1]. Mounted at the end of the Curiosity rover arm, the APXS can conduct multi-spot (raster) investigations in a single morning or evening. Combining APXS raster spectra and Mars Hand Lens Imager (MAHLI) images, a modeled terrain is developed in which the positions of APXS field of views (FOV) can be localized, thereby mitigating arm placement uncertainty.

An acquired APXS spectrum is the result of the weighted sum of the signals from within the FOV. The spatial sensitivity of the APXS consists of an off-nadir contribution in addition to a vertical separation (standoff with respect to the APXS detector) contribution [2, 3]. MAHLI images and focus merge (MFM) products facilitate a 3D surface model of the target [4] compensating for the effects of sample relief in an APXS spectrum. Employing a MFM relief map, APXS placement is modeled in three-dimensions, permitting variable APXS docking (standoff, deployment angle). Through minimization, we arrive at millimeter-scale chemistry of veins, diagenetic features and dust-free rock endmembers of Martian targets.

Several rasters have been conducted with Curiosity's APXS on Mars including a study of the Garden City outcrop. The area is characterized by its contrasting light and dark veins of cm-scale surface relief. Three-dimensional localization and minimization indicated calcium sulfate as the major component of the light vein while the dark vein is enriched in CaO (without accompanying SO_3), MnO, Ni and Zn, with respect to average Mars composition.

References: [1] Gellert et al. (2014), LPSC XLV, #1876. [2] VanBommel et al. (2015), LPSC XLVI, #2049. [3] VanBommel et al. (2016), XRS #2681. [4] Edgett et al. (2015), MAHLI Tech Rept 0001.

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