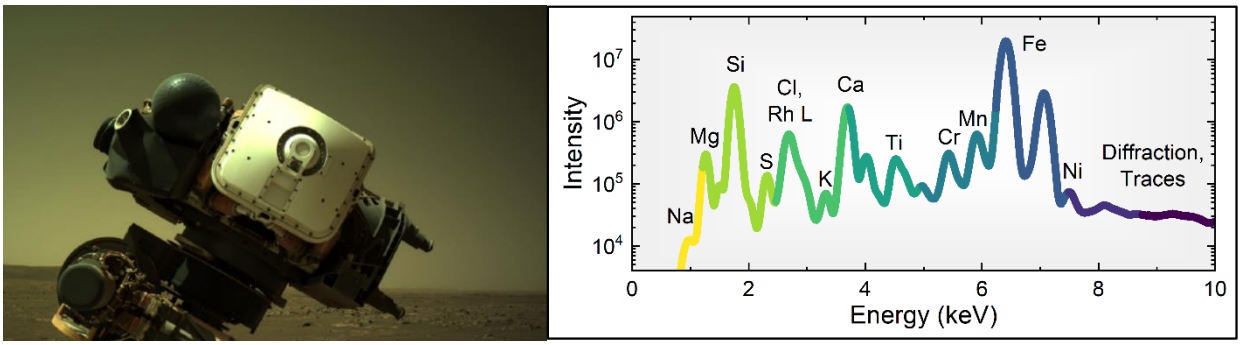
PIXL's Recent X-Ray Data and Findings from the Red Planet

Chris Heirwegh
Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena CA 91109 USA
christopher.m.heirwegh@jpl.nasa.gov

Over the past year, the Planetary Instrument for X-ray Lithochemistry[1] (PIXL), seen in the left figure, has aided NASA's Mars 2020 Science Team in their campaign to explore the Jezero Crater Floor fractured unit on the planet Mars. PIXL is a compact sub-mm focused beam, raster scannable X-ray fluorescence spectrometer installed on the arm of Perseverance Rover, a device designed to carry out geo-chemical exploration of the Martian terrain. The capacity for PIXL to produce two-dimensional information of rock textures has led to the rapid and definitive characterization of the crater floor's igneous nature and assisted with the conclusion of this campaign.



Figures: (left) Rover Mastcam-Z image of PIXL sensor head and (right), PIXL spectrum recorded from Dourbes target on sol 257 of the Mars 2020 mission with major element peak labels indicated within.

Presently, Mars 2020 scientists rely upon PIXL's existing elemental calibration in their analyses of PIXL data.[2] An example bulk summed spectrum acquired from a PIXL scan of the Dourbes rock target, taken on sol 257 into the mission, is shown in the right figure. Despite being well characterized for constraints on elemental accuracy, PIXL spectroscopists have identified several weak areas of the calibration to target for improvement efforts. Many of these areas will be the subjects of new technical research investigations conducted within the scope of quantitative analysis using XRF. The output of this work will also be implemented as upgrades to the PIQUANT XRF Quantification software engine[3] that is used by the science team to process PIXL data. New work includes: 1) assessing elemental spatial interrogation of the rock as a function of beam diameter and incident photon energy, 2) improving calculations of the rhodium L X-ray scatter line intensities and energies as a means to improve fits to neighboring elemental peaks of Cl , K and Ar scatter, 3) addressing background subtraction related issues found currently to impede fitting and subsequent analytical analysis of elements: Na, Cl and Ni, 4) refining elemental quantification for trace (Z > 26) elements, and 5) deriving the PIXL polycapillary optic transmission profile as accurately as possible.

In this invited talk, I will provide a brief introduction to the PIXL instrument and highlight the contributions PIXL has made to discovering the nature of the Jezero crater floor. I will then shift focus to the spectroscopy side of our planned future work and discuss the aforementioned quantitative technical items that will be subject to a new round of PIXL analytical work.

References:

[1] A. C. Allwood, et al. (2020) PIXL: Planetary Instrument for X-Ray Lithochemistry, *Space Science Reviews*, 216, Article #134.
[2] C. M. Heirwegh, W. T. Elam, Y. Liu, C. Hummel, K. Sinclair, L. O'Neil, M. C. Foote, B. C. Clark, A. Das et al. (Forthcoming) PIXL Calibration for Elemental Quantification, *Journal TBD*.
[3] C.M. Heirwegh, W.T. Elam, L.P. O'Neil, K. Sinclair. (Forthcoming) The Focused Beam X-ray Fluorescence Elemental Quantification Software Package PIQUANT, *Spectrochimica Acta B*.