QUANTITATIVE ANALYSIS USING PIXL, THE PLANETARY INSTRUMENT FOR X-RAY LITHOCHEMISTRY

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The Planetary Instrument for X-ray Lithochemistry (PIXL) is a MicroXRF spectrometer to be deployed on the arm of the next Mars rover, slated for launch in 2020. It will utilize a miniature X-ray tube, a polycapillary optic, and a silicon drift detector to obtain fast, high quality XRF spectra with about 100 micrometer spatial resolution. The design details and scientific goals will be covered in other talks. This paper will focus on quantitative analysis of the spectra it will obtain.

The basic approach for quantification will utilize the fundamental parameters (FP) method with net intensities from linear least squares fits using Voigt peakshapes. This will be augmented by element correction factors obtained from spectra on standard reference materials. Compton and Rayleigh scatter will also be included in the FP model for normalization and to get information on any invisible part of the matrix.

MicroXRF produces a large number of spectra and, for Mars rover operations, they must be analyzed in a relatively short time (a few hours at most) to guide tactical operations during the next Mars sol. We will take dual approaches to this problem. The first approach will be to develop fully automated procedures for element identification, spectrum processing, and quantitative analysis to deliver fully quantitative results quickly without human intervention. The second approach will utilize non-parametric and/or image processing methods to select (possibly disconnected) regions over which to sum or otherwise generate a small set of spectra to get more detailed analysis with human input. The use of Principal Component Analysis (PCA) and t-distributed Stochastic Neighborhood Embedding (t-SNE), for example, will be covered in the talk by Flannery.