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Overview Of 100 Sols Of Chemcam Operations At Gale Crater

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The Curiosity rover carries the ChemCam instrument suite, a Laser-Induced Breakdown Spectroscopy (LIBS) instrument that can analyze the chemical composition of geological samples at distances up to 7 meters from the rover, and a high resolution camera for context imaging (RMI). In the first 100 sols after landing, ChemCam performed 343 single point measurements on approximately 50 different rocks or soil areas, for over 12,000 laser shots. Each time at least two RMI images are acquired before and after the laser shots to visualize the area of investigation and the geological context. LIBS lines are identified using primarily a martian dedicated database; to date, ChemCam has detected unambiguously major elements (Si, Al, Fe, Mg, Ca, Na, K, O), minor/trace elements of interest (Li, Cr, Mn, Rb, Sr, Ba, Ti, S, C, H). These observations allow a qualitative/quantitative assessment of the presence of dust (first few shots), the sample surface composition and chemical heterogeneity with depth.
Several techniques have been developed to analyze ChemCam's data: (1) Univariate analysis refers to peak height studies of well-chosen LIBS lines and a training dataset to build calibration curves. Peak ratios K/Si, Na/Si, Al/Si, Fe+Mg/Si, or Mg/Mg+Fe have been calculated from the onboard calibration targets. The technique also applies to minor and trace elements which yield low intensity emission lines, such as Lin, Rb, H, C. (2) Multivariate methods give better results in terms of elemental composition, since they examine simultaneously and statistically several peaks of the same elements. A Partial Least Squares (PLS) regression algorithm is used for rapid major-element abundance determination. (3) Composition trends, clusters and end-members can also be identified using component analysis methods. Independent Component Analysis (ICA) identifies components that are directly related to Chemical elements: Al, Ca, Fe, H, K, Mg, Na, O, Si, Ti, but also mixture like a "soil" component. On top of this classification, clustering methods such as k-means and hierarchical clustering allow the differentiation and filation of different geochemical populations encountered so far at Mars. The ChemCam instruments are performing very well. The 100-sol dataset is rich of thousands of spectra and hundreds of images. We will present a status of the data set acquired during that period, a review of the analysis techniques and an introduction to the results which have been obtained so far.