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Overview of the composition of the Gale Crater lacustrine sediments from Chemcam onboard Curiosity

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The Curiosity rover has crossed 18 km from its landing to the layered rocks of Mt. Sharp (also named Aeolis Mons), spending >1900 sols (Martian days) at the surface of Mars. On sol 750, the rover entered into continuous light-toned layers named the Murray Formation marking the base of Mt. Sharp (Grotzinger et al., Science, 2015). This formation is dominated by mudstones and fine-grained sandstones, interpreted to be predominantly lacustrine deposits. The ChemCam instrument onboard Curiosity rover is a package of a Laser-Induced Breakdown Spectrometer (LIBS) providing elemental chemical analyses coupled to a Remote Micro-Imager (RMI) enabling textural analyses. In this overview, we provide a summary of the results of the ChemCam instrument along the Murray formation, from the location named "Hartmann's Valley" (∼sol 1100) to the so-called "Vera Rubin Ridge" (VRR, previously referred to as "Hematite Ridge") (∼sol 1800). Because ChemCam provides local chemistry at a scale of ∼0.5 mm, the bulk chemistry is derived from the average of all points of a given target, after removal of points on soils and diagenetic veins. Along the whole section, the bulk chemistry of Murray Formation is Si-rich (50-55wt.% SiO_2) relative to usual Martian rocks (45-50wt.% of SiO_2) and relatively alkali-rich (4-5wt.% of Na2O+K2O). In contrast, calcium is detected in proportion as low as 1-2wt/% CaO, thus well below its abundances in previously analyzed sediments (4-8wt.%). Plotted in a A-CN-K diagram, the chemistry displays a relative increase in aluminum that cannot be attributed to an increase in any igneous minerals. This diagram can be used to determine the Chemical Index of Alteration (CIA), which reaches 63 for these sediments, thus suggesting a substantial weathering (as is the case for CIA>50). The lowest abundances of calcium are correlated to the highest CIA values, suggesting that this element was leached due to dissolution of either clinopyroxene or plagioclase. These observations indicate a weathering in an open system with liquid water, at or near the surface. At sol 1550, the rover passed along a series of well-organized cracks, forming polygonal networks similar in geometry to desiccation cracks, showing a consistent variability in chemistry, including possible local brine deposits. At sol 1750, Curiosity reached the VRR, which has been shown to be enriched in hematite from orbital data. ChemCam, at this location, does not display a significant enhancement in bulk FeO abundance. Passive reflectance spectra (no laser shots) indicate the presence of hematite, but similar spectra with hematite were collected before reaching the VRR. Apart from diagenetic features, the Mt Sharp fine-grained sediments display (1) minor chemical variations indicative of a continuity in the depositional context over >200 m of thickness, and (2) substantial weathering in an open system.