MSL Chemistry and Mineralogy of the Bagnold Dunes, Gale Crater

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The MSL Curiosity rover performed CheMin and SAM measurements of active Bagnold dune field aeolian sediments sieved to <150μm and SAM of a 150μm-1mm fraction, along with APXS, MAHLI and remote sensing of disturbed and undisturbed sands and dump piles (>150 μm; 150μm-1mm; >1mm), created by sample processing. Dune sediments have low P, S, Cl, Ti, Mn, and Zn compared to other Martian fines. Coarser fractions are enriched in Mg, Fe, Ni, and Mn but lower in K, Al, suggesting coarser sands are mafic. Bulk chemical composition of unsieved materials is similar to the finest fraction. ChemCam data of the upper 100s-μm that are higher in Mg and Fe suggest surface armoring by mafic grains. VNIR spectra of coarser fractions are darker, flatten near 600-700nm, and have prounced absorptions at longer wavelengths, suggesting the presence of olivine or pyroxenes, in line with CheMin determination of abundant olivine, augite, and pigeonite. Overall, grains are typically rounded very fine to medium sands. In contrast to previous measurements of aeolian sands at Rocknest, Bagnold sands are darker, less red, with less small particle clumping. Sediment H_2O and S content are among the lowest so far in Gale crater. H_2O release upon SAM heating occurs at >~300°C, substantially higher than at Rocknest. The temperature of SO_2 release in the SAM coarse fraction was lower than the fine fraction. Collectively, data indicate depletion of select volatiles in sands and size partitioning of composition with enhancement of mafics in the coarsest fraction.