American Geophysical Union Fall Meeting, 6-9 December 2011
Abstract #P33C-1776.

Mafic Silicate and Ferric Oxide Mineralogy of Gale Crater and the Mars Science Laboratory Rover Field Site

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Gale, a 155 km diameter impact crater on the boundary of the Martian southern highlands near 5S, 222W, has been selected as the field site for NASA's Mars Science Laboratory (MSL) rover, Curiosity. Several published studies have focused on the discovery, mapping, and analysis of hydrated or hydroxylated minerals (*e.g.,* sulfates, phyllosilicates) in Gale as exciting potential targets for *in situ* exploration. Less attention has generally been paid to the anhydrous mafic (ferrous) silicates and ferric oxides which have also been detected in Gale from orbital remote sensing studies and which may be the precursor parent materials that weathered into the observed aqueous phases. Here we review previous and new observations regarding the presence and spatial distribution of anhydrous ferrous silicates and ferric oxides in Gale and discuss the scientific implications for the close-up study of these materials with the MSL payload.

Despite a common misconception that Gale is a "dusty" site, visible to near-IR observations from the Mars Express OMEGA and Mars Reconnaissance Orbiter CRISM and thermal infrared observations from Mars Global Surveyor TES and Mars Odyssey THEMIS provide evidence for olivine and pyroxene and the anhydrous ferric oxide, hematite, associated with distinct geologic materials in Gale. Olivine-bearing mafic (likely basaltic) materials have been interpreted to occur in low albedo aeolian dunes near and around the base of the 5 km high mound of sedimentary rock in the crater. Both low and high calcium pyroxene (LCP, HCP) have been identified in and around the crater, with CRISM data showing HCP-bearing material occurring primarily within a "cap rock" on the relatively flat crater floor and within the relatively dust-free units of the lower few km of the sedimentary rock mound. Potentially more mobile (via wind) LCP-bearing material occurs throughout the crater and the lower few km of the mound and into the low albedo wind streak that extends ~200 km to the south. Models of TES spectral data are consistent with the presence of LCP+HCP, high silica phases, feldspar, olivine, and possibly sulfate in the low albedo surfaces exposed in the crater, central mound, and southern wind streak. VNIR data reveal that a ferric oxide phase, potentially fine-grained (red) hematite, occurs in association with both HCP and LCP units in a so-called "mound skirting unit" within the Curiosity field site. THEMIS and CRISM imaging both display compositional layering within mound materials that will be accessible to the rover.