Laboratory visible to infrared spectral investigations with hematite and iron-bearing phyllosilicates to help decipher spectral data taken by the Mars Science Laboratory Curiosity rover along the Vera Rubin ridge in Gale Crater

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Laboratory studies provide the opportunity to establish important validation and ground truth benchmarks for both orbital and *in situ* remote sensing observations of planetary bodies. For example, lab data and modeling have suggested that other ferric minerals, besides hematite, could be the driving factor behind the strength of the 860 nm absorption feature measured by the Mastcam instrument along Vera Rubin ridge (VRR). VRR is of extreme interest because of the strong 860 and 530 nm absorption features in orbital spectroscopy data that suggest the presence of crystalline hematite. The strength of these absorption features is typically associated with increased hematite abundance and/or changing grain size. However, multispectral data from Mastcam and quantitative mineralogy from the CheMin instrument suggest that the strength of the ~860 nm absorption feature is not dependent on the abundance of hematite. Comparisons between Mastcam and CheMin data show a strong positive correlation between 860 nm band depth and phyllosilicate abundance, but a negative correlation between 860 nm band depth and crystalline hematite abundance. These trends were unexpected based on the lack of correlation between 860 nm band depth and phyllosilicate abundance in previous lab studies. Using a simple linear mixing model, we show that varying the abundance of nontronite (USGS sample NG-1) and plagioclase (USGS sample HS66.1B) + pyroxene (USGS sample WS592), while holding the abundance of hematite (USGS sample GDS27) constant can produce similar trends as those found in data from Curiosity. This is likely because the broad absorption feature of nontronite, while centered at ~920 nm, also affects the 867 nm Mastcam filter. Therefore, the 860 nm absorption feature in Mastcam observations is likely the result of two main factors: 1) the presence of crystalline hematite, and coarse spacing between Mastcam filters, dictates the wavelength of the absorption feature (~860 nm), but 2) the combination of the ~920 nm band in ferric phyllosilicates and ~1000 nm band in pyroxene is controlling the strength of the ~860 nm absorption feature. We are conducting laboratory studies on physical mixtures of these four phases, that mimic mineral abundances in the CheMin data, to see if the same trends are reproduced under more realistic observations.

Modeling and laboratory studies using ferric minerals to understand multispectral data from Vera Rubin Ridge. Results highlight the contribution and importance of ferric phyllosilicates in controlling spectral properties.