Determination of synthetic olivine optical constants for analysis of airless body spectra

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Mineral optical constants (n, k) are critical for radiative transfer spectral modeling and analysis techniques pioneered by Bruce Hapke. Building upon [1, 2], Trang et al. [3] published optical constant regression coefficients for natural and synthetic pyroxenes and naturally occurring olivines. The samples used include synthetic pyroxene samples created by [4, 5] and natural olivine samples previously characterized by [6-8]. This analysis was performed using a combination of MGM and statistical regression analysis techniques. In this way, regression coefficients are determined that allow a computation of optical constants with changing composition.

This study noted an apparent influence of Mn^{2+} on absorption strengths of natural olivine spectra [3]. As the abundance of Mn^{2+} increases and Mg^{2+} decreases, the compositional relationship between Fe^{2+}-Mg^{2+} becomes a non-linear relationship; the strength of all three of olivine absorptions is curbed when fit, and increases the scatter of k variance with composition. However, neither olivine absorption centers nor widths show any changes in their systematic variation with Fe^{2+}-Mg^{2+} composition. Interestingly, a recent study by Lucey et al. [9] effectively constrained optical constants for silicates directly from near-infrared spectra of lunar soils. While this method and optical constants appear to be effective, it is unclear exactly why lunar mineral optical properties would be different and result in underestimating feldspar and overestimating mafic silicates in spectral models of the lunar surface. However, likely influences upon these measurements include trace elements, shock, melting, and devitrification. Here we compare synthetic olivine relative to naturally occurring olivine.

References: [1] Lucey (1998) *JGR*, **103**, 1703; [2] Denevi et al. (2007) *JGR*, **112**, doi:10.1029/2006JE002802; [3] Trang et al. (2013) *JGR*, **118**, 708; [4] Turnock et al. (1973) *AmMin*, **58**, 50; [5] Menzies et al. (2001) *LPSC*, XXXII, 1622; [6] Sunshine and Pieters (1998) *JGR*, **103**, 13675; [7] Cloutis et al. (1986) *JGR*, **91**, 1641; [8] King and Ridley (1987) *JGR*, **92**, 11457; [9] Lucey et al. (2014) *AmMin*, **99**, 2251; [10] Dyar et al. (2009) *AmMin*, **94**, 883; [11] Cahill et al. (2016) *JGR*, in preparation.