Discrete spectral absorption bands in 4-8 μm infrared region: New tool for remote assessment of Fe content in olivine

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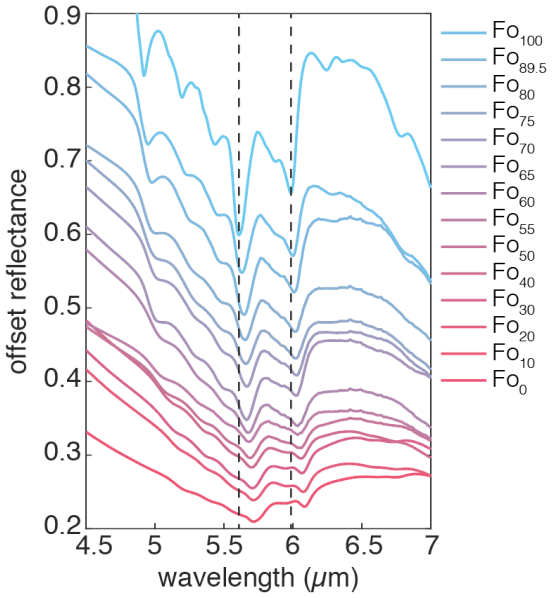
Abstract. Remote visible-near infrared (VNIR, ~0.5 to ~2.6 μm) spectral data of planetary surfaces have generally yielded qualitative estimates of olivine composition[1], since the electronic transitions of Fe^{2+} in olivine's crystal structure produce three overlapping spectral bands near 1 μm [2]. Meanwhile, detectors are becoming available that measure spectra in the largely unexplored 4-8 μm wavelength region, making the region potentially attractive for lunar remote sensing. We assessed the spectral character of 14 synthetic olivine samples described by [3], with compositions ranging from Fo_0 to Fo_{100} and grain sizes of <45 μm. We compiled data from the RELAB database measured with a biconical off-axis FT-IR[4].

We find that the centers of the ~5.6 and ~6.0 μm absorptions, proposed to arise from overtones of molecular vibrations at longer wavelengths[5], shift systematically by about 0.1 μm from Fo_0 to Fo_{100}, increasing approximately linearly toward longer wavelengths with decreasing Fo# (Fig. 1). With decreasing Fo#, these absorptions exhibit decreasing spectral contrast, and absorptions in the 4-8 μm region exhibit lower spectral contrast than those in the VNIR. Discrete absorption bands whose positions and shapes are associated with olivine composition make this region of the infrared highly attractive for future lunar exploration.



[1] e.g., P. J. Isaacson et al., *J. Geophys. Res.*, 116 (2011)
[2] J. M. Sunshine and C. M. Pieters, *J. Geophys. Res.*, 103 (1998)
[3] M. D. Dyar et al., *Am. Min.*, 94 (2009)
[4] C. M. Pieters and T. Hiroi, *LPS XXXV,* Abstract #1720
[5] J. W. Salisbury, D. M. D'Aria, E. Jarosewich, *Icarus*, 92 (1991)