

Overtone of silicate and aluminate minerals and the 5–8- μm ice bands of deeply embedded objects

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Abstract. The distinct patterns, relatively low intensities, and peak positions of overtone-combination bands of silicates and oxides suggest that the 5–8- μm spectral region can provide clues for the dust composition when near optically thick conditions exist for the 10- μm silicate feature. We will present 1000–2500 cm^{-1} room temperature laboratory spectra obtained from powders of silicate, aluminate and nitride minerals and silicate glasses. The spectra exhibit overtone absorption bands with mass absorption coefficients ~ 100 times weaker than the fundamentals. These data are compared with the 5–8- μm spectra of deeply embedded young stellar objects observed with the short wavelength spectrometer on the Infrared Space Observatory. Fits of the laboratory data to the observations after subtraction of the 6.0- μm H₂O ice feature and the 6.0- μm feature identified with organic refractory material indicate that crystalline melilite (a silicate) or metamict hibonite (a radiation-damaged crystalline aluminate) may be responsible for much of the 6.9- μm absorption feature in the observations, with melilite providing the best match. A weaker 6.2 μm absorption in the YSO spectra is well-matched by the spectra of hydrous crystalline amphibole silicates (actinolite and tremolite). No astronomical feature was matched by the overtones of amorphous silicates since these bands are too broad and peak at the wrong wavelength. Hence, this analysis is consistent with the 10- μm features of these objects being due to a mixture of crystalline and amorphous silicates, rather than only amorphous silicates.
