INFRARED EMISSION SPECTRA OF LUNAR SOILS

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Our work with lunar soil samples has continued with measurements of the infrared emission spectra of 10 samples. They are 10084, 12071, 15531, 61221, 61241, 67711, 69961, 71061, 74001, and 74220. The samples were found to produce a minimum of four spectral features in plots of brightness temperature vs. frequency in the region between 300 and 1400 cm^{-1}. The spectra of the samples show considerable variations, some of which correlate with the mineralogy of the soil samples.

A few conclusions are immediately evident from the data. First, the principal diagnostic frequency that shows up for those samples having high feldspar content occurs near 820 cm^{-1}. Previous work[1] has shown that this emission feature is related to a transparent region in feldspar spectra but only shows in relatively fine-particle samples. There is a second feldspar characteristic frequency near 1160 cm^{-1}. A feature correlated with pyroxene content occurs near 1100 cm^{-1}, but it is considerably weaker than the principal feldspar feature referred to above. In general ferromagnesian silicates show a broad band centered between 850 and 950 cm^{-1} with the details of the feature being somewhat dependent on the precise mix. A peak centered near 900 cm^{-1} together with a relative weakness of the 1100 cm^{-1} pyroxene feature indicates olivine. In general the contrast in the spectra is enhanced by a high percentage of crystalline material since glasses tend to produce rather flat spectra. Agglutinate glasses produce lower contrast than other glasses presumably due to the enhanced absorption by free metal. The data below 400 cm^{-1} is somewhat questionable as some features occurred from run to run that were not completely reproducible. Instrumental difficulties that may have affected our previous work[1] were remedied and all samples rerun.

We are currently in the process of carrying out a more detailed analysis of the data using the optical constants of minerals[1,2] with the emittance theory previously developed[3,4] as well as CIPW norms[5] and FMR values[6] (representative of glass content) for the various samples.

In addition, this year's program has resulted in improved optical constants for ilmenite, obtained from a single crystal of that mineral, and optical constants for the orthopyroxene, enstatite. The enstatite results indicate that the subtle differences between ortho- and clinopyroxenes would be difficult to measure given the signal-to-noise ratios applicable in remote lunar soil measurements.

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