BASIC REFLECTANCE EXPERIMENTS: SCATTERING, ABSORPTION, PARTICLE SIZE, ETC. C.M. Pieters¹, D. Sandlin², C. Wells², T.V.V. King³, ¹Brown Univ. Providence, RI, ²Lockheed, Houston, ³U. of Hawaii

The Laboratory. The Reflectance Experiment Laboratory (RELAB) is designed to measure the primary optical properties of surface reflection (reflectance, albedo, polarization) with high precision (~1/2%) and high spectral resolution (≥10Å; .4 - 2.7μm) under geometric conditions comparable to those for earth-based or spacecraft reflectance measurements. The computer controlled instrument is a swinging arm goniometer with a practical range of phase angles from 10° to 120°. A phone line modem for long distance remote users has been installed. A summary of current basic research experiments is presented below. All data were taken at i = e = 15°.

Transmitted Component of Reflectance. Characteristic mineral absorption features in a reflectance spectrum are carried by a component of light transmitted through the particles of the surface. Quantification of this transmitted component and its relation to a scattered component of reflectance was performed using an isotropic glass (Schott BG-36) with multiple absorption bands. The transmission spectrum (T) for 1 mm of this glass is shown in Fig. 1 (courtesy of R.L. Huguenin, U. of Mass.). Extinction coefficients for the continuum and absorption features relative to the continuum were measured for a strong band near .802μm (κ = 7.01 mm⁻¹) and a weak band near 1.07μm (κ = 0.091 mm⁻¹). The glass was ground and sieved to clean particle sizes. Directional reflectance spectra for four particle sizes are shown in Fig. 2. The mean optical path length (MOPL) through the particles was measured using an iterative process with the three extinction coefficients for each sample. This process also allows an estimation of the reflected scattered light and the relative proportion of the transmitted and scattered components of light interacting with such a particulate surface. The results are summarized below. Although the relative proportion of the transmitted component varies, the MOPL appears to vary regularly with particle size.

<table>
<thead>
<tr>
<th>Part. Size</th>
<th>Transmitted Component</th>
<th>Scatter Reflected</th>
<th>Lost</th>
<th>mm MOPL</th>
<th>Absorption Strength 1.07μm feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>.554</td>
<td>.304</td>
<td>.142</td>
<td>.52</td>
<td>.046</td>
</tr>
<tr>
<td>B</td>
<td>.559</td>
<td>.242</td>
<td>.099</td>
<td>1.11</td>
<td>.097</td>
</tr>
<tr>
<td>C</td>
<td>.581</td>
<td>.159</td>
<td>.060</td>
<td>1.75</td>
<td>.148</td>
</tr>
<tr>
<td>D</td>
<td>.593</td>
<td>.094</td>
<td>.113</td>
<td>2.35</td>
<td>.194</td>
</tr>
</tbody>
</table>

Particle Size Mixtures. For controlled particle size separates we have previously shown (King et al., LPS XII, 1981) that particle size has a strong (and once though dominant) effect on the strength of absorption features in mineral mixtures involving orthopyroxene, ilmenite, and plagioclase. Since real soils contain a particle size distribution, we created samples from the same particle size range but in greatly different proportions. Some of the results are shown in Fig. 3 and Table 1. For such more realistic soils the range of parameter values (absorption strength, albedo, etc.) is considerably reduced. Large particles in a mixture do not dominate the spectral characteristics.

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Reflectance Experiments
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Figure 1

% TRANSMISSION
BG-36 GLASS
1 mm THICK

Figure 2

"Lost" Scatter
Absorption Strength
Transmitted Component
Reflected Scatter

Figure 3. Reflectance of 4 particle size separates of enstatite (data points) and of mixtures of these separates with two different size distributions (connected data points).

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