DIFFUSE REFLECTANCE SPECTRA OF ORTHOPYROXENE, OLIVINE, AND
PLAGIOCLASE AS A FUNCTION OF COMPOSITION AND STRUCTURE
M.E. Zolensky, L. Le, C. Galindo, R. Morris, V. Lauer and F. Vilas;
1Solar System Exploration Division, NASA Johnson Space Center, Houston, TX 77058; 2Lockheed ESCO,
2400 NASA Rd. 1, Houston, TX 77058.

Although many similarities exist between meteorite spectra and "primitive" asteroids, there
are unexplained discrepancies [1]. These discrepancies do not appear to arise from grain size
effects [2&3]. Assuming that primitive meteorites did in fact originate from the "primitive"
esteroids, we believe that there are two testable explanations for the observed spectral
discrepancies: compositional or structural differences. We have begun to synthesize and collect
reflectance and Mossbauer spectra of pertinent materials, beginning with olivine, pyroxene and
plagioclase (all found in primitive meteorites), and to assess the possible effects composition
may have on spectral features. Our study focuses on the combination of composition and structural effects.

We have synthesized olivines, pyroxenes, plagioclases and related glasses in gas-mixing
furnaces (with controlled oxygen fugacities) at variable melting and quench-rate conditions.
Typically, non-crystalline or structurally disordered materials are promoted by elevated melt
temperatures, increased time held at the peak temperature, and high quench rates. Diffuse
reflectivity spectra (350-2100 nm) were obtained at room temperature using a Cary-14
spectrophotometer configured with a 9-inch diameter integrating sphere, and are shown for
olivines and orthopyroxenes in Figure 1. The identity of all synthesis products was established
by powder X-ray diffraction, and some by Mossbauer spectroscopy.

Olivines have been synthesized at only two compositions, because of the high temperature
required for melting of Fo100, and difficulty in quenching same under these conditions. Our
ttempts to quench non-crystalline olivine were unsuccessful, as expected. Note that water-
quenched runs (vs. slower air quenched) yielded olivines characterized by reflectivity spectra
with less spectral contrast for their 1.0 \( \mu m \) Fe\(^{2+} \) bands. However, the interpretation of these
spectra is complicated by the presence of optically-opaque magnetite particles (detected in
Mossbauer spectra). We are now attempting to synthesize olivines without accompanying
magnetite or metal.

Pyroxenes were synthesized at En\(_{50}\), En\(_{75}\) and En\(_{100}\). The crystalline Fe-bearing pyroxenes all
displayed spectra typical of orthopyroxenes, i.e., 1.0 and 2.0 \( \mu m \) Fe\(^{2+} \) bands. Glasses with
pyroxene compositions were successfully fabricated in the water-quenched runs. In addition to
the two bands discussed above, these spectra appear to have a third, broad band centered near 1.2
\( \mu m \). In the few pyroxenes so analyzed to date, Mossbauer spectra provided no evidence for the
presence of magnetite or metal. Synthesized enstatites (En\(_{100}\)), of course, had flat reflectance
spectra; some with a slightly negative slope.

Plagioclase was synthesized at meteoritically appropriate compositions An\(_{100}\), An\(_{15}\) and
An\(_{10}\)Ab\(_{85}\)Or\(_{5}\). In all cases the reflectance spectra were flat (because they contain no iron), with
slightly negative slopes.

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Figure 1 Spectral Reflectance Spectra of Synthesized Orthopyroxenes, Glasses of Orthopyroxene Compositions and Olivines