Visible Spectroscopy Under Solar Illumination with Olivine and Pyroxene as a Function of Grain Size

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Introduction- Understanding the origin of the solar system is one of the most fundamental goals of planetary science. Although many details remain to be clarified, one theory suggests that the solar system began with the collapse of a gravitationally unstable interstellar cloud of gas and dust to form the solar nebula, forming a flattened disk with a center bulge. The sun formed in the dense central condensation of the nebula and planetesimals were formed. Volatile-poor rocky planetesimals formed the terrestrial planets. Icy and rocky planetesimals with nebular gases formed the Jovian planets. Asteroids represent rocky inner solar system planetesimals or fragments of the bodies accreted. Asteroids are composed of non-volatile rocky or metallic materials which follow independent orbits about the sun, located between 1.52 AU and 5.20 AU. Investigations of asteroid compositions can identify potential parent bodies of specific meteorites or meteorite types or identify objects which have experienced similar evolutionary histories to known meteorite types. Asteroids can provide a "map" to complement the meteorite "clock" providing better understanding of the early solar system.

This research is to look at terrestrial rocks that are compositionally similar to meteorite type rocks and eventually comparing these findings with asteroid spectra. In order to collect terrestrial rocks compositionally similar to meteorites it is necessary to know the chemical make up of meteorites. Although there are many meteorite types the three major silicate minerals found in meteorites are, olivine, pyroxene and feldspar. In Gaffey (76) he states that physical properties of a surface material (particle size, packing, illumination angle) do not significantly affect the normalized spectral reflectance curve measured for that material. This research will encompass looking at grain size to see if there is any relationship to the reflectance spectrum.

Procedure of Experiment- Experiments were done on the vacuum tight lid of the Andromeda science rack with solar illumination. Using a spectrometer spectra were taken of individual samples as a function of grain size. There were five different rock samples: Albite, Anorthosite, Diabase Granophyre (pyroxene dominant), Diorite (pyroxene dominant), and Olivine Syenite which were crushed into samples sizes of 850nm, 300nm and 100nm. Spectra were also taken with Albite, Diorite and Olivine as a mixture. These samples were taken with different ratios. Albite was always 10% of the 10g sample. Diorite and Olivine were 20%, 30%, 45%, 60% and 70% respectively.

Results- In conducting these experiments the spectra show that there is no significant affect due to grain size differences. As shown in Figure 1. Reflectance Spectrum the only difference between grain sizes is the intensity level. There is no relationship among the grain sizes. According to the graph the only difference in shape for wavelength readings would be among the olivine rock samples. There is a maximum peak for each sample around the 550nm mark. Olivine Syenite has a maximum around the 588nm mark.

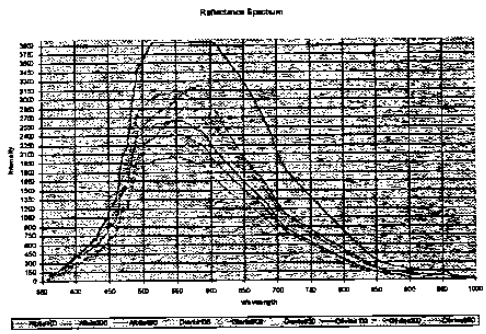

Figure 1. Reflectance Spectrum

In Figure 2. Olivine/Pyroxene Mixed Samples The samples with 20%, 30% and 45% all resemble the graphs of Diorite and Albite with maximums around 550nm range. The 60% and 75% are in the 560 and 570nm range resembling closer to the Olivine Spectra.

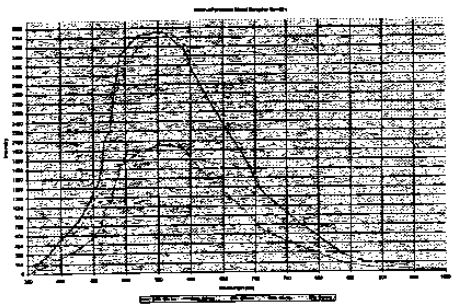

Figure 2. Olivine/Pyroxene Mixed Samples

Conclusions- The purpose for this research was to see if there was any relationship between grain sizes and the reflectance spectrum from each material. As Gaffey stated in (1976) there was no significant affect and by doing the experiments it shows there is no alteration in the spectra or quantitative relation in the varying grain sizes. The intensities change from grain size to grain size but not by any function. There were several trials for each sample taken to rule out any uncertainties. Each time the samples were run there were no significant differences. The next steps for these spectra are to be compared to work already done on asteroids. A broad understanding of meteorite and asteroidal studies is necessary for the progress of understanding the origin and evolution of the solar system.

References

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