SPECTRAL REFLECTANCE(250-2500nm) OF POWDERED SAMPLES OF OLIVINES AND SOME METEORITES. Masamichi Miyamoto and Akihiro Mito, Dept. of Pure and Appl. Sci., College of General Education, Univ. of Tokyo, Komaba, Meguro-ku, Tokyo 153, and Hiroshi Takeda, Mineralogical Institute, Faculty of Science, Univ. of Tokyo, Hongo, Tokyo 113, Japan.

In the last decade, spectral reflectance measurements of asteroids have progressed rapidly and the resolution and wavelength coverage(visible-near-IR) increased. The comparison between these astronomical data and the laboratory spectral reflectance data of meteorites or various mineral assemblages was made by Gaffey and McCord(1) and others(2,3). Their works provided us with a method to identify meteorite classes and enabled us to interprete asteroidal surface materials in terms of the mineral assemblages of meteorites.

The spectral reflectance curve of the mineral mixture is ideally a function of the relative abundance of the mineral species present. However, as pointed out by Adams and Filice(4), spectral reflectance properties depend strongly on particle-size, -packing, -shape and illumination geometry. Because it is possible that the surface of small bodies such as asteroids or meteorite parent bodies are covered with the very thin layer(a regolith layer) of fine-grain materials(5), we need to examine the spectral reflectance changes due to the particle size of sample.

In order to obtain the data of powdered samples of minerals and meteorites, the spectral reflectance measurements were made with a Beckman UV 5240 spectrophotometer. This instrument is equiped with an integrating sphere and $BaSO_4$ is used as a standard. The spectra(250-2500nm) was recorded on a chart and in digital form on a micro-disc(floppy disc) for computer processing. Preliminary examination was made of olivine(San Carlo, Arizona), Yamato-75258 (LL6), ALHA77231(L6) and Yamato-7308(howardite) meteorites. All samples were crushed and sifted after powdering. Eight fractions of olivine($<46\mu$ to 1190 μ) were prepared to see the detailed effects by grain sizes. Powder samples were set on both side of adhesive tape and measured using a black-cone at the back. The representative results for the powder samples of the sized olivine and of Y-75258 and Y-7308($<46\mu$) are shown in Figs. 1-4.

It has been known that the albedo increases by pulverization of the sample(4), but the amount of this change with particle size is dependent on the mineral assemblages contained in the sample. It is well known that whether the absorption feature becomes deep or not with the diminution of particle size depends on the mineral species contained in the sample(4). These changes of the reflection spectra curve is evaluated quantitatively for the fine-grain powder from our data.

Our results of the sized olivines revealed that the depth of the characteristic absorption band(ca. 1000nm) becomes shallow and the curvature of the spectral reflectance around ca.400nm is raised with the diminution of particle size. Therefore, the shape of the reflectance spectra gradually becomes 'flat' in the range of ca.400-1000nm with the diminution of particle size. The absorption feature in the range of ca.1000-2500nm varies slightly with the size of the olivine powder. These features are enhanced for the very fine-grain($<46\mu$) fraction.

The results of the powder samples($<46\mu$) of two ordinary chondrites from Antarctica(Y-75258, ALHA77231) show changes similar to the case of the olivine powder. Namely, the reflectance spectra curve of the powdered meteorite sample becomes more flat than that of its bulk rock sample, and only minor changes of the absorption feature in near-IR region are observed. The changes observed in ALHA77231 are almost identical to those of Y-75258. Though a similar change goes for Y-7308, the slope of the spectral reflectance curve in

the range of ca.400-500nm is steep. This seems to be due to weathering which produces Fe^{3+} as was pointed out by McFadden et al.(6). In fact, the powder sample of Y-7308 looks reddish with the naked eye.

The reflectance spectra of 1 Ceres (or 2 Pallas) reported by Feierberg et al.(7) shows the flat curve in the region of ca.500-2500nm, and shows a small broad peak at ca.400-500nm, and steep drop off at wavelength less than ca.400nm (According to asteroidal spectral types(CMZ) defined by Chapman et al.(8), 'C' or 'U'). The spectral reflectances of these asteroids seem to have some resemblances (e.g. its flatness and drop off less than 400nm) to those of powder samples of meteorites (e.g. ordinary chondrites). Though the albedo of these asteroids is lower than that of the powder sample, we note that a small amount of opaque minerals or low reflectivity materials (e.g. carbon black) is effective on lowering the albedo and depressing other spectral features(9)(an analogue is powdered ureilite). When the samples were pulverized, the spectral reflectance curve also seems to be influenced by a small amount of opaque minerals or metallic components or carbon contained in the meteorites. As shown in the spectral reflectance curve of Y-75258(LL6)(Fig.3) in visible region, the color of its powder sample($<46\mu$) resembles that of Allende(C3) meteorite with the naked eye.

It is necessary to examine in more detail the effect of pulverization of meteorites(including very fine-grain fractions $<$ca.50μ) in order to identify exactly the surface materials of the asteroids which show 'C' or 'U' type spectral curves. Our data on the effect of pulverization will be of some use to unravel this problem.

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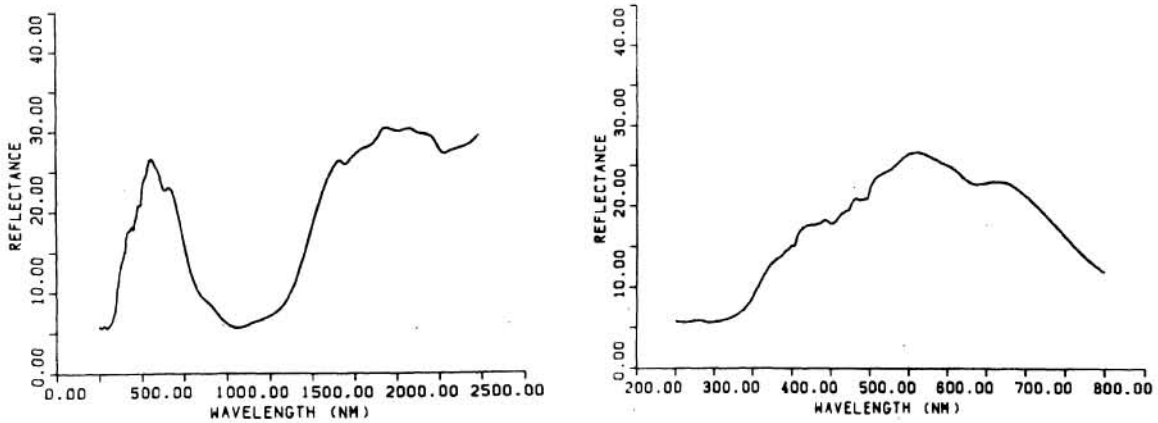

Fig.1 Spectral reflectance curve(%) of olivine(1190-590μ particle size).

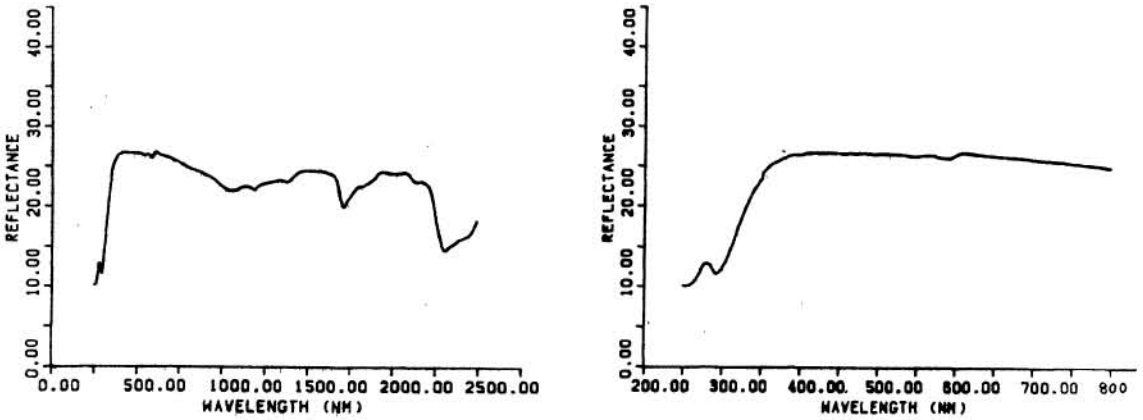

Fig.2. Spectral reflectance curve(%) of powdered olivine($<46\mu$ particle size)

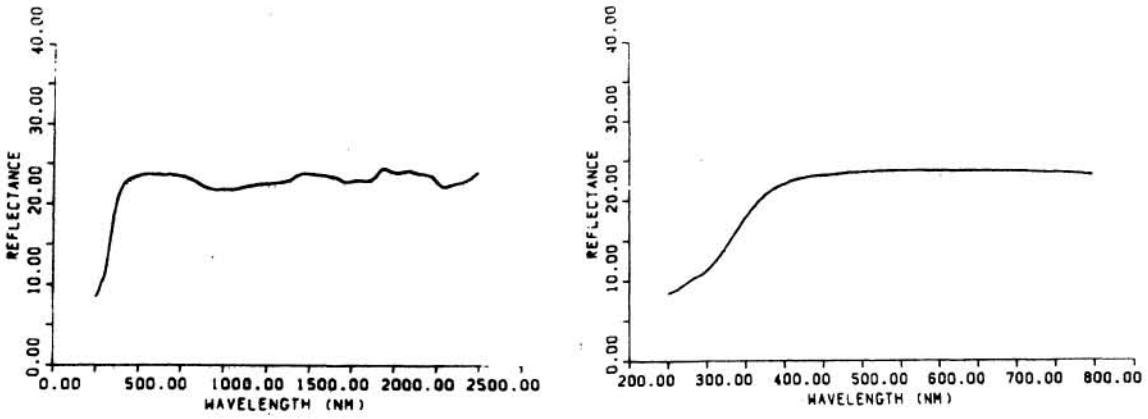

Fig.3. Spectral reflectance curve(%) of powdered sample($<46\mu$) of Y-75258.

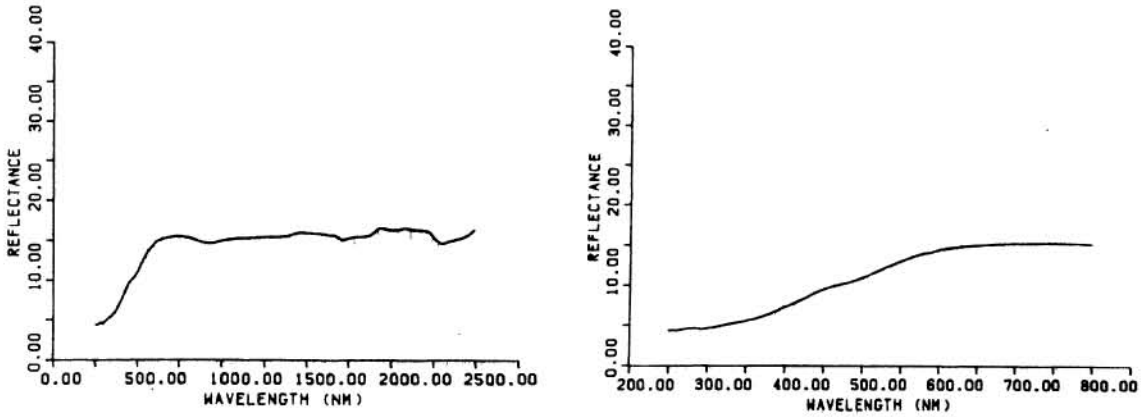

Fig.4. Spectral reflectance curve(%) of powdered sample($<46\mu$) of Y-7308.