Expanded Modified Gaussian Model: Incorporation with the Space Weathering Effects.

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Olivine is one of the most important rock-forming minerals for the remote sensing analysis. The reflectance spectrum of olivine at visible-NIR wavelength range shows a characteristic feature around 1 micrometer, where three absorption bands overlap with one another. From this distinct feature, it is thought that there exists olivine to some extent on the surface of many asteroids, such as S-type, Q-type and A-type.

Although majority of meteorites are believed to derive from the asteroids, there are few asteroids whose reflectance spectra resemble those of meteorites well. The reflectance spectra of ordinary chondrites, the largest group of meteorites, look like the spectra of Q-type asteroids. However, this asteroid type is quite minor among the main belt asteroids and near earth asteroids (NEAs). This difference is now thought to be caused by certain processes such as micrometeorite bombardment and/or solar wind in the space environment. The term space weathering is the cumulative effects of processes acting on materials in such environment, especially on airless bodies. Recently, many observations have been discovering asteroids having intermediate spectra of S-type and Q-type among the main belt asteroids and NEAs. Therefore optical properties of asteroidal regoliths are possibly altered by the space weathering.

The Apollo missions recovered many lunar rock samples, including lunar regoliths, and studies of the space weathering effects are based on these lunar regolith samples. The mineral grains in lunar regoliths are coated with layers containing nanophase reduced iron particles. This leads to the optical changes: albedo decrease, spectral reddening (the shorter the wavelength, the lower the reflectance) and absorption band weakening.

The modified Gaussian model (MGM) is a tool for deconvolving reflectance spectra (Sunshine et al. 1990). Because this meodel does not contain any term that corresponds to the space weathering effects, another term is required to compensate them. Hapke (2001) introduced the absorption coefficient of nanophase reduced iron particles based on the Maxwell-Garnett model. We report the incorporation of this absorption coefficient into the MGM, and the application to the reflectance spectra of asteroids, using the pulse-laser treated olivine samples (Yamada et al, 1999).