Quantitative modal analysis using visible to near-infrared spectrum for anorthositic reglith

Masamichi Hoashi[1], Makiko Ohtake[2], Munetomo Nedachi[3]

[1] Phys, Kagoshima Univ, [2] NASDA, [3] Space Sci., Kagoshima Univ.

Introduction: On the remote sensing using visible - near infrared reflection spectrum, the accurate quantitative method to estimate the mineral content of regolith and rocks rich in plagioclase has not been developed yet in spite of its importance on the Lunar survey. The reason is that there is no distinctive absorption range on the reflection spectrum from plagioclase, differing from those of olivine and pyroxene. As the flat shape itself of the reflection spectrum is regarded as obvious character of plagioclase, however, we have constructed the method to estimate the mineral content of anorthositic regolith or rock.

Experiment: Plagioclase, olivine, pyroxene (augite and hypersthene) and ilmenite, which are major minerals on the lunar highland area, were crushed into small particles with the size of 75 to 105 micrometer in diameter, because this size is regarded as the average of lunar regolith. We prepared 29 samples of four kinds of mineral assemblage; plagioclase-pyroxene, plagioclase-olivine, plagioclase-ilmenite and plagioclase-pyroxene-olivine, mixing rate of each assemblage are expressed by weight fraction. The reflection lights were measured using MIRAI (Mineral Reflectance Analyses Instrument). The measurement conditions are as follows. The measured wavelength was from 250 to 2600nm. The resolution of wavelength was about 6nm. The angles of incident rays on a sample was 30 degree and the detection angle of reflection ray was 0 degree (vertical). Spectraron of Labsphere Co. was used as standard of reflection.

Results: Each spectrum was normalized by the intensity of 1730nm reflectance, because there is no any absorption on or near 1730nm, except for hypersthene. Curve fitting method was applied on the measured reflection spectrum.

It was confirmed that olivine and pyroxene have the distinct characteristic absorption lines (1065nm and 2260nm, respectively), and the intensities of absorption correlate well with the mineral content, if the assemblage is binary such as plagioclase-olivine and plagioclase-pyroxene assemblages.

In the case of plagioclase-pyroxene-olivine assemblage, the intensities of two absorption lines were used to estimate the modal ratio. The wavelength of about 1020nm is situated to the shoulder of the absorption lines of both olivine and pyroxene, and the intensity of absorption correlates with the summation of the contents of olivine and pyroxene. On the other hand, the intensity of absorption line of 2260nm is not affected by the olivine content. Hence the content of pyroxene was estimated using the absorption line of 2260nm at first, and then olivine content could be calculated from the intensity of 1020nm. Now we are trying to construct the new method to estimate mixing rate of four minerals including ilmenite. Because ilmenite is important component in the lunar regolith and rock, although ilmenite has not any distinct absorption lines.