Influence of the specular reflection on spectroscopic identification of the lithology of central peaks of lunar craters

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The comparison between spectroscopic observation of the lunar surface from satellites and spectroscopic measurement of mineral powders at laboratory derives a global estimate of lunar lithologies. Central peaks are believed to have exposed rock material from deep crust, therefore they have been regarded as very important targets to be observed. However, central peak"s lithologies have been discussed based on laboratory spectra of mineral powders.

This study was performed in order to examine whether reflectance spectra of rocks change against emission angle or not, using olivine-bearing basalt in Hawaii.

Firstly, three samples with different roughness, 16 mm x 16 mm x 4 mm in dimension, was made using the olivine-bearing basalt. All samples had been polished to have mirror surface. Then, one of them was polished with #1000 sandpaper to have ca. 1000 nm roughness and another was polished with #80 sandpaper to have ca. 2000 nm roughness. An Atomic force microscope (Nanopics1000) was used for evaluating the surface roughness of these samples.

To measure the emission angle dependency of reflectance spectra of rock surface, a variable-viewing-geometry device, which can changes incident and emission angle, was developed. The device is equipped with a cooling CCD Camera (ALTA U260), a Liquid Crystal Tunable Filter (VariSpec SNIR), and a Lens (Nikkor 50mm). The samples were measured with 650, 750, 900, 950, and 1000 nm in wavelength in changing emission angle from 0 to 90 degrees.

The results show that the light with shorter wavelength is less reflected around specular reflection angle. It means that basalt rocks with absorption band near 950nm looks as if having no absorption band in some cases.

In Clementine UVVIS images we found such cases in some central peaks. Sunny side of central peaks could have a slope near specular reflection angle. Iron-bearing silicate minerals such as pyroxene and olivine have characteristic Fe2+ electronic transition absorption bands around 1000 nm. In spectroscopic classification of lunar lithologies, the depth of absorption is diagnostic of the amount of mafic mineral. We found some central peaks whose sunny side is more anorthositic than shadow side. Moreover the sunny side looks Fe-poor in FeO map (Lucey et al.,2000). Using topographic data of Terrain Camera onboard SELENE (KAGUYA) exploring the moon now, we could point out the area of misclassification of rock types. Such kind of filtering is useful for us to select the landing site of our next lunar probe SELENE-2 planned to launch around 2015.