Mg-number Mapping of the Lunar Mare with a Hyper-spectral Imaging Telescope

Hideaki Okuno[1]; Kimiko Saito[2]; Yuta Yamanoi[3]; Kazuto Saiki[1]

[1] Earth and Space Sci., Osaka Univ.; [2] Earth and Space, Osaka Univ.; [3] Earth and Space Sci., Univ. Osaka

Mg-number (Mg#=atomic Mg/(Mg+Fe)) serves as an important petrologic discriminator when analyzing and understanding lunar rocks and crustal evolutionary models. It is also useful for interpreting the subsurface structure of the moon. Mg# variation shifts the wavelength of the absorption spectra of ferrous iron with their peaks at around 1000 nm and 2000 nm. However, the shift had not been detected by remote sensing because it is limited to a very small range.

The spectral data of the lunar surface were obtained by Advanced Lunar Imaging Spectrometer (ALIS). ALIS is a ground-based telescopic imaging spectrometer, which consists of a cassegrain telescope with 200 mm aperture and 800 mm focal length, and two spectroscopic cameras (VIS and NIR) (Saiki et al, 2004). It can obtain a hyper-spectral image cube of the lunar nearside covering the visible (380-1100 nm) and near-infrared (1000-1700 nm) regions at high spectral resolutions (VIS: 5 nm and NIR: 9 nm). The location of the observation was Science City at the peak of Mt. Haleakala, Maui, Hawaii, USA. The dates of observation were from 15 Aug., 2005 to 26 Aug., 2005 and from 12 Dec., 2005 to 18 Dec., 2005. The observation was carried out by ALIS users group including authors. ALIS and its peripheral devices were transported from Japan. An observation dome, which had been constructed by Okano Lab at Tohoku University, and the observation supporting facilities were served by Mees Solar Observatory at University of Hawaii.

In order to detect the slight shift of the wavelength of absorption spectrum of ferrous iron with the peak at around 1000 nm, we analyzed the image cube of the moon by taking the following steps; (1) dark and flat field correction was conducted. (2) All mare spectra was normalized by the same standard highland spectrum to reduce the influence of the atmospheric absorption and the difference of relative sensitivity of each wavelength. (3) Baseline, which starts from 700 nm and end at 1050 nm, was subtracted from the normalized spectra to reduce the influence of space weathering. Comparing the resultant spectra, we detected the slight shift of the absorption spectra. The range of the shift is from 970 nm to 980 nm. Except for some of exceptions, this shift can be regarded as Mg# change. Using the amount of shift of each point, we tried to make a Mg# map of Mare Serenitatis.

As a result, even in the same lava flow, Mg# variation was detected. Chemical compositions of parent rock of basalt and its degree of partial melting can be estimated by using this Mg# map.