Diversity of the lunar crusts: Petrological characteristics of the nearside of the moon

Takamitsu Sugihara[1]; Makiko Ohtake[2]; Junichi Haruyama[2]; Tsuneo Matsunaga[3]; Yasuhiro Yokota[2]; Tomokatsu Morota[2]; Chikatoshi Honda[4]; Yoshiko Ogawa[3]; Naru Hirata[5]; Hirohide Demura[5]; Noriaki Asada[5]; Ryosuke Nakamura[6]; Haruyama Jun-ichi LISM Working Group[7]

[1] CDEX, JAMSTEC; [2] ISAS/JAXA; [3] NIES; [4] JAXA; [5] Univ. of Aizu; [6] AIST; [7] -

Procellarum KREEP terrain (PKT) covers wide area in the near side of the moon and apparently associated with Oceanus Procellarum and Mare Imbrium. Since the PKT is characterized by significant Th-enrichment (i.e., KREEPy), this crustal terrain has been considered to have distinct crustal structure from the feldspathic crust prominently observed in the northern hemisphere of the farside moon, and it is indicated formation process of the PKT would be strongly related with solidification process of the lunar magma ocean (LMO) since the KREEPy materials are dregs of residual liquid of the LMO. In addition, inside of some craters with different diameters in the PKT region shows the most significant Th-enrichment (e.g., Aristarchus, Aristillus, and Kepler) in this terrain, indicating essential materials of the PKT crust would be observed in those craters.

In order to investigate characteristics of the PKT materials and its three dimensional distribution, Aristarchus and Aristillus craters were studied by using multi band image data acquired by MI/LISM aboard Kaguya. The MI image is composed of 8 band images (415, 750, 900, 950, 1000, 1050, 1250, and 1550 nm) in VIS to NIR wavelength range. Therefore we can understand dominant mineral phases in a surface material by image processing since main rock forming minerals often observed in the lunar materials (Low-Ca pyroxene, High-Ca pyroxene, Olivine, and Plagioclase) have absorption band around 1000 nm and each mineral has different band center of absorption band from those of other minerals. On the basis of analyses using false color image (R: 950nm, G: 750nm, B: 415nm) and band ratio image (R: 950/750, G: 1050/750, B: 1250/750), southern wall, crater floor, and central peak in the Aristarchus crater show feldspathic spectral feature with spectral features indicating occurrence of small amount of olivine and/or high-Ca pyroxene. Though the feldspathic feature in the Aristarchus central peak have been pointed out by the previous study, its distribution would be wider spread than that previously considered. Therefore this feature is not local characteristic but actually expanded to southern region in the Aristarchus crater. In a small crater which is located at north of the Aristarchus crater, we can also observe the feldspathic feature as well. Therefore, those observations indicate that this feldspathic feature is spread in a broad area under mare basalts of the northern Oceanus Procellarum. Since the feldspathic feature seems to be associated with weak olivine-like spectral feature and Th-rich chemical composition as observed in the LP-Th map, this feature is not derived from FAN-like or alkali anorthosite-like lithology but lunar granite or felsite-like lithology.

In Aristillus crater which is located in the eastern Mare Imbrium, crater wall of the Aristillus crater shows feldspathic spectral feature, but the associated mineral feature is gradually changed from the northern east part to the southern west part, showing association with small amount of olivine and low-Ca pyroxene, respectively. The Aristillus crater floor and central peak show remarkable absorption around 1 um in wavelength due to effect of Fe^{2+} ion in mafic minerals, while the wall has the feldspathic spectral feature. The crater floor and central peak are especially enriched in high or low-Ca pyroxene, but olivine feature is not observed. Those observations indicate that shallower portion around the Aristillus crater is composed of more feldspathic materials with small amount of olivine or low-Ca pyroxene, whereas deeper portion more predominantly consists of two pyroxenes.

The petrological characteristics mentioned above suggest feldspathic materials are widely distributed in the PKT region unlike as shown by the previous studies, and lithology of the feldspathic materials in the PKT region is not FAN-like rocks but Th-rich granite or felsite. This result is so important to understand the PKT evolution.