Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

PPS003-11 Room: 201A Time: May 24 11:21-11:33

Geology of lunar Copernicus crater explored by Kaguya Multiband Imager

Tomoko Arai[1*], Makiko Ohtake[2], Takamitsu Sugihara[3], Aya Yamamoto[4], Ryosuke Nakamura[5], Takahiro Hiroi[7], Tsuneo Matsunaga[6], Satoru Yamamoto[6], Junichi Haruyama[2]

[1]PERC, Chiba Institute of Technology, [2]ISAS, JAXA, [3]JAMSTEC, [4]RESTEC, [5]AIST, [6]NIES, [7]Brown University

Copernicus is a 95 km-diameter crater, located on the central nearside of the Moon (9.5°N, 20.0 °W). The formation age of the fresh and bright-rayed crater is estimated to be about 800 Ma. It is located near the center of the Ocean Procellarum and 100 km south of the crater ring of the Imbrium basin. The area where the Ocean Procellarum and Imbrium basin are located is called Procellarum KREEP Terrane (PKT), which is characterized by an enrichment of K, Th, U, and Fe on its surface. While about 70% of the lunar surface is covered by the highly feldspathic crust, rocks rich in K and Th, and Fe-rich mare basalts are instead present in the PKT. It has been suggested that the PKT lacks the feldspathic crust. The PKT is the most thermally active region due to internal heat sources derived from the decay of radioactive isotopes and external heat sources provided by basin-forming meteoritic impacts. It is considered that the presence of abundant heat sources may have resulted in the long-lived mare volcanism and the extensive remelting of early-formed crust and mantle.
Because of its location, Copernicus plays an important role in deciphering the geology and the geologic history of the PKT, which experiences the highest degree of thermal evolution and magmatic differentiation of the Moon. The ejecta materials around the Copernicus are fresh, thanks to the relatively recent formation age. The massive central peaks likely represent uplifts from the original depth of about 10 km. Thus, the Copernicus serves as the most suitable window into the deep interior of the PKT, in order to understand the vertical stratigraphy of the crust. According to the previous studies based on the ground-based telescope and the Clementine reflectance spectra, the Copernicus target site consists of complex lithologies, including thin mare basalt, the crater ejecta of the Imbrium basin, and the Pre-Imbrium crustal materials. It should be noted that olivine-rich rocks are exposed exclusively on the central peaks, whereas olivines are rarely found in most of the lunar surface. The origin of the olivine-rich rocks are still under debate with several options, such as a derivation either from the crust, or from layered intrusions into the crust, or even from the mantle.
Here, we investigated the detailed geology of the Copernicus, using the visible to near-infrared reflectance spectra of Kaguya Multiband Imager. Plagioclase, olivine and pyroxene, which are three major minerals constituting the lunar crust. They respectively show diagnostic absorption in the visible to near-infrared reflectance spectra, associated with divalent Fe in their crystal structures. Band depths at 900, 950, 1050, and 1250 nm are used to map the distribution of the each mineral. The 2D mineral maps are further coupled with the digital elevation model to generate the 3D mineral maps.
The central peaks are composed not only of olivine-rich rocks, but also of highly feldspathic rocks with nearly 100% plagioclase (called Purest Anorthosite, PAN), with only locally present, low-Ca pyroxene-rich rocks. The PAN is also widely present in the eastern crater floor. The pyroxene-rich rocks (with both low-Ca and high-Ca pyroxenes) are found in the northern crater floor, which is about 100 m lower than the eastern floor.
The presence of co-existing PAN with olivine-rich rocks in the central peaks is in contrast with the

previous studies, and likely rules out the possible mantle origin. The abundant PAN in the crater floor suggests the initial feldspathic crust generated from the magma ocean could be present in the PKT, unlike the previous assumption. Utilizing the spectral data of Kaguya Spectral Profiler, we will further constrain the modal abundance and mineral composition of the each lithology, in order to understand the petrogenesis and the geologic history of the PKT.

Keywords: Moon, Kaguya, Multiband Imager, Copernicus, PKT