Studies for the source region of lunar basaltic brecciated meteorites, Northwest Africa 773 group on the geochemical, mineralogical and petrological analyses

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Lunar meteorites originate from craters that are randomly distributed on the surface and thereby provide valuable information on geochemistry, mineralogy, and petrology of the source regions that are not obtained from the Apollo and Lunar mission samples. The recent-improved remote sensing data (e.g., Kaguya, LRO, Chandrayaan-1) are very powerful tool to interpret their source regions. Identification of the source region of lunar meteorite could be almost equivalent to the sample return from that region. Lunar meteorites, Northwest Africa (NWA) 773 clan consist of a group of paired meteorites with different lithologies (NWA 773, 2727, 2977, 3160, 3333, 6950, and more). Some of them contain olivine cumulate gabbro (OC) as lithic clasts in a basaltic breccia, while NWA 2977 and NWA 6950 entirely consist of OC. Furthermore, NWA 773 clan contains a variety of clasts other than OC: olivine phyric basalt, pyroxene phyric basalt, pyroxene gabbro, ferroan symplectite, alkali-rich phase ferroan rocks, and silicic rock. Such a variable lithological types indicated the complex igneous petrogenesis and subsequent brecciation of the source region of NWA 773 clan. In this work, the geochemical, mineralogical and petrological characteristics of their source region were discussed by comparing the lunar sample and Kaguya observational data.

Lunar meteorites, Northwest Africa 773 clan were investigated with geochemical, mineralogical and petrological microanalyses: 1) the bulk chemical compositions were obtained by neutron-induced prompt gamma-ray analysis (PGA) and instrumental neutron activation analysis (INAA) in the Japan Atomic Energy Agency; 2) mineralogical and petrological data of NWA 773 clan were investigated by Scanning Electron Microscope (SEM) and Electron Prove Micro-Analyzer (EPMA) at Waseda Univ., visible and near-infrared reflectance spectra obtained by a JASCO reflectance spectrometer at JAXA; 3), where their radiogenic ages were discussed by references of several literatures.

Rare Earth Element (REE) compositions from NWA 773 breccia have similar KREEP-enriched patterns of their light-REE-enriched and heavy-REE-depleted patterns, and negative Eu anomaly. The NWA 773 clan breccias show the wide range REE values among each portion of NWA 773 clan breccias (La = 40 –170 × CI chondrite), which probably reflects variable abundances of KREEP-rich clasts in the breccia. In fact, we observed an evolved igneous clast (high-silica) in NWA 2727 breccias. Silica-rich rocks (e.g., felsite, granite) from the Apollo missions are highly enriched in incompatible elements (REE, K, Th).

NWA 773 clan represents the following characteristics: 1) the included igneous clasts derived from basaltic to rhyolitic magma composition on the Moon, 2) NWA 773 clan breccias represent high-Th (max 5.15 μg/g), -FeO (>15wt%), and very-low-Ti (<1wt%) composition, 3) the included OC lithologies represent one of youngest crystallization ages (3 Ga) among lunar samples. The first suggests that the silica-rich rocks in NWA 773 clan could be associated with putative silicic volcanism observed by the recent remote sensing data. The above features of NWA 773 clan were permitted in Procellarum KREEP Terrane (PKT), as putative silicic volcanism mostly occurs in PKT. NWA 773 clan allows us knowledge of complex igneous activities in PKT. Furthermore, the source region of NWA 773 clan will be narrowed down within PKT region by comparing with the following data: 1) bulk FeO, CaO, TiO_2, K, Th contents of NWA 773 clan breccia vs. elemental distribution maps obtained by Kaguya gamma-ray spectrometer; 2)

visible and near-infrared reflectance spectra of NWA 773 clan vs. reflectance spectra obtained by Kaguya spectral profiler, 3) the crystallizaition ages of NWA 773 clasts vs. the eruption ages obtained by Kaguya Terrain Camera. As described here, the source regions can be well interpreted on the basis of the combination of data from lunar meteorite and remote sensing observations.

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