GLOBAL DISTRIBUTIONS OF LARGE EXPOSED AREAS OF LUNAR MAJOR MINERALS AND ITS IMPLICATIONS.

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Introduction: Recent hyperspectral remote sensing observations of the Moon have revealed the existence of large exposed areas (LEAs) of end-members of various lunar minerals [e.g.1,2]. The identifications of the LEAs are based on diagnostic absorption bands at 1 μm and 2 μm in continuous reflectance data (hyperspectral data) obtained by remote sensing observations. The material at each LEA is dominated by a pure lunar mineral, and its exposure areas span several km wide sites.

In the last six years, survey studies to reveal the global distributions of LEAs for various lunar minerals have been conducted using all the data measured by Spectral Profiler (SP) onboard SELENE/Kaguya, which has obtained hyperspectral data for about 70 million points on the Moon [2]. These survey studies use a data mining approach, in which the survey program picks up spectra that exhibit diagnostic absorption bands of target minerals among all the SP data. Here, we review the global distributions of the various lunar major minerals revealed by the SP global surveys, and their implications.

Global Distributions: Fig. 1 shows the global distributions of the LEAs for olivine-rich sites [3], purest anorthosite (PAN) sites [1,4,5], low-Ca pyroxene-rich (LCP) sites [6,7], high-Ca pyroxene-rich (HCP) sites [8], spinel-rich sites [9], and glass-rich sites [10]. These distributions have been revealed by the SP global surveys, but they include most of the LEAs found by other studies based on spectral data by the Moon Mineralogy Mapper (M^3) and Multiband Imager [e.g. 1].

The olivine-rich sites are distributed around the impact basins located in thinner crust regions, especially on the nearside of the Moon. On the other hand, PAN sites are widely distributed over the Moon, and many PAN-sites are found in thicker crustal regions. Based on the relation between the olivine-rich and PAN sites, it has been proposed that there is a massive PAN layer below the uppermost mixing layer in the Feldspathic Highland Terrane (FHT) [4].

The LCP-rich sites are distributed around the South Pole-Aitken (SPA), Imbrium, and Procellarum basins, while there is no LCP-rich site in the FHT, which is covered by the mixing layer including LCP. One of the most intriguing is that the smaller impact basins do not possess LCP-rich sites. For example, the Moscoviense and Crisium basins, which have the thinnest crust on the Moon, possess the olivine-rich sites, but not LCP-rich sites. This may require the existence of the olivine-rich layer below the PAN crust. Only the huge impact events such as SPA basin could excavate the deep mantle region to expose the LCP-rich materials on the lunar surface [6,7].

The HCP-rich sites in the highlands are found at fresh, small craters, but not huge impact basin in the FHT. In each crater, the HCP-rich sites are distributed at ejecta, rim and floor, while the central peaks are dominated by PAN [8]. This indicates that a HCP-rich zone overlying the PAN layer, which may be a residue of mafic-rich melt during the flotation of plagioclase, exists below the mixing layer in the FHT [8].

Contrary to the above minerals, most of the LEAs for the spinel [9] and glass-rich sites [10] are found at the lunar pyroclastic deposits (LPD). However, they are found at limited LPDs, and most of the other LPDs do not possess the spinel and glass-rich sites. This suggests that there is a variation in the composition and volatile contents of source magmas from the deep lunar interior.

A comprehensive model that treats all the data sets of the global distributions of the LEAs is highly needed. This would provide new insight into the structures and evolution of the lunar crust and mantle.

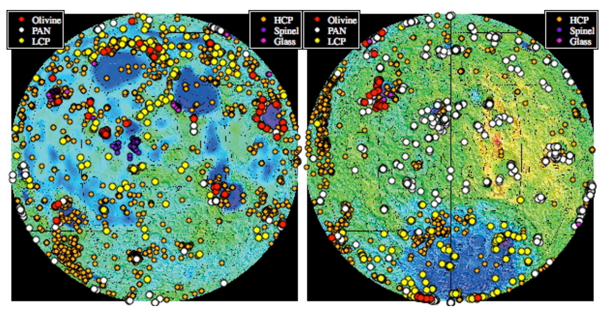

Fig.1: Global distributions of the LEAs of various lunar minerals and glasses revealed by SP for (left) the nearside and (right) farside of the Moon. The background map is the total crustal thickness map by SELENE.

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