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# Geological structure of lunar SPA basin

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SPA is one of the biggest basins (2500 km in diameter) on the lunar far side. Previous studies have suggested that most of the crustal material of this basin was excavated and that the mantle materials have been exposed [1]. Therefore, most of the anorthosite composing the crust may have been excavated and ejected from the basin. However, the basin formation process and consequent mineralogy of this basin are still unclear because of the degradation after the supposedly ancient SPA basin-generated impact. For example, Pieters et al. (2001) and Ohtake et al. (2009) reported that the central part of the SPA basin contains anorthosite which is crustal material[2][3]. Additionally, Ishihara et al. (2009) estimated the anorthositic crust in the SPA basin to be 20 to 30 km thick based on data derived from the SELENE Relay satellite, its Main Orbiter transponder, and the Laser Altimeter [4]. These observations are apparently inconsistent with the theory of previous studies. In this study, we estimated the cause of this disagreement by investigating the distribution of anorthosite within the SPA basin and compared the results with topographic data. And we speculated the geological structure of this large impact basin.

We used the SELENE Multiband Imager (MI) to estimate the lunar mineralogy of SPA basin. MI is a high-resolution spectral imager with both visible and near infrared coverages at spectral bands of 415, 750, 900, 950, 1000, 1050, 1250 and 1550 nm. In all MI images, spatial resolution is adjusted to 20 m x 20 m per pixel. Mineral phases have diagnostic absorption features depending on the minerals. Plagioclase has an absorption band at around 1250 nm; olivine, at around 1050 nm; and pyroxene, at around 1000 nm. These minerals are the three commonest minerals on the Moon. We detected a peak shoulder at around 1250 nm compared to the line between 1050 nm to 1550 nm to select anorthosite spectra. Locations without this peak shoulder are categorized as other rocks.

We made a color-composite image in which red is assigned to a continuum-removed absorption depth at 950 nm; green, to that at 1050 nm; and blue, to that at 1250 nm to display the distribution of these minerals. We also used topographic data derived from the SELENE Laser Altimeter (LALT) to compare the mineralogy with topography. Its spatial resolution is finer than 0.5 degrees. We identified rings within the SPA basin based on the topographic features.

In the result of this study, we found anorthosite in 20 locations within the SPA basin. Particularly, 16 locations of them located near the fringe region within the SPA basin. Other four locations located near the center of this basin and recognized in the northwest area of this region.

The second topographic ring counted from the outside was matched the boundary of the anorthosite distribution derived from mineralogical data. In other words, few anorthosites present inside of the second topographic ring. This result suggests that the crustal material is excavated within the SPA basin, and that the second ring corresponds to a transient cavity of this basin.

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[3] Ohtake et al., (2009)Nature461(7261):236-40
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