Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

PPS23-05 Room:413 Time:May 2 10:00-10:15

Volcanic activity of lunar maria: Verification of super hot plume event at 2.0 Ga ago

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Because the Moon is an endmember of terrestrial planetary bodies, to understand the thermal evolution of the Moon is necessary for understanding that of terrestrial planetary bodies. However, the process of magma ocean solidification and the thermal and structural evolution of the lunar mantle are still unknown.

Lunar mare basalts provide insights into compositions and thermal history of lunar mantle. Using image data from orbital satellites, a considerable number of maria have been dated by various techniques such as crater degradation measurement, crater size?frequency measurement, and stratigraphic relationship. Mare basalt ages indicate that eruptive activity has a second peak at the end of lunar volcanism (∼2 Ga), and the latest eruptions were limited in the Oceanus Procellarum and Mare Imbrium regions.

Using multiband images data obtained by SELENE/Kaguya, we have reinvestigated the relationship between titanium contents and eruption ages of mare basalts. Although the systematic relationship is not observed globally, an obvious increase in mean titanium content occurred at 2.3 Ga in the Oceanus Procellarum and Mare Imbrium regions, suggesting that the magma source changed at that time (hereafter, we call the volcanism before 2.3 Ga as Phase 1 volcanism, the volcanism after 2.3 Ga as Phase 2 volcanism.) The high-titanium basaltic eruption, which occurred at the late stage of mare volcanism, can be correlated with the second peak of volcanic activity at ∼2 Ga. The latest volcanic activity can be explained by the occurrence of a super hot plume originated from the core-mantle boundary.

To verify the super hot plume hypothesis, we calculate the difference between topography and selenoid in the mare region. We found a plateau structure around the center of the PKT region, whose the diameter is 1,000 km from southwest to northeast and 1,200 km from northwest to southeast and the altitude is 700 m. This plateau structure may be formed with ascending of super hot plume. Then, Phase 2 basaltic lava flows formed. If the ascending of super hot plume occurred ∼2.0 Ga ago, most mare formation had finished at that time and some transitional structures may have been left. In this presentation, we will discuss the relationship between Phase 2 high-titanium volcanisms and the super hot plume.

Keywords: Moon, lunar mare, titanium content, the Procellarum KREEP Terrane, super hot plume, selenoid