

Relationship between topography and latest mare volcanism at 2.0 Ga of the moon

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Lunar mare basalts, the most common volcanic feature on the Moon, provide insights into compositions and thermal history of lunar mantle. According to the radiometric ages of the lunar basalt samples and the model ages of mare basalt units determined by crater counting with remote sensing data, the great extent of mare basalts was formed at 3.2 to 3.8 Ga. Temporal variation of the mare basalt eruptions also indicates that magma activity has a second peak at the end of mare volcanism (~ 2 Ga), and the latest eruptions were limited in the Procellarum KREEP Terrane (PKT), which is characterized by high abundances of heat-producing elements. In order to understand the magma source of the latest volcanism and mechanism for causing the second peak, we examined the correlation between the titanium contents and eruption ages of mare basalt units using compositional and chronological data updated by SELENE/Kaguya. Although the systematic relationship is not observed globally, a rapid increase in mean titanium (Ti) content occurred at 2.3 Ga in the PKT, suggesting that the magma source of mare basalts changed at that time. The high-Ti basaltic eruptions can be correlated with the second peak of volcanic activity at ~ 2 Ga. The latest volcanic activity can be induced by a high-Ti super hot plume originated from the core-mantle boundary. If the super hot plume was occurred, the topographic features formed by the super hot plume may be remained. Then, we calculated the difference between topography and selenoid and found the circular feature like a plateau in the center of the PKT, which scale is ~ 1000 km horizontal and ~ 500 m vertical. Moreover, mare ridges in this region seem to connect with the plateau. Using detailed models of the flexural response of the lunar elastic lithosphere, we estimated the elastic thickness at the time of occurrence of the super hot plume. From our results, the effective elastic thickness at the period of latest volcanism is estimated 20 – 30 km, which is thinner than that of the period before ~ 2 Ga. These results suggest that the up lift of lithosphere caused by the super hot plume.

Keywords: titanium content, super hot plume, selenoid, effective elastic thickness, lunar mantle, the Procellarum KREEP Terrane