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Copernican tectonic activities in the northwestern Imbrium region of the Moon

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Mare ridges and lobate scarps are the manifestations of horizontal compression in the shallow part of the Moon. Conventionally, tectonism within mascon basins has been thought to originate from mascon loading which is syndepositional tectonics (e.g., Solomon and Head, 1980). However, Ono et al. (2009) have pointed out that the subsurface tectonic structures beneath some mare ridges in Serenitatis appeared to be formed after the deposition of mare strata. Watters et al. (2010) also reported Copernican lobate scarps. Those young deformations cannot be explained by the mascon loading and are possibly ascribed to global cooling, orbital evolution and/or regional factors. Since mare ridges are topographically larger than lobate scarps, they might have large contribution to the recent contraction. In this study, we estimated until when the tectonic activities of mare ridges lasted in the northwestern Imbrium region.

In order to infer the timing of the latest ages of tectonic activities, we used craters dislocated by the thrust faults that run along to the mare ridges in the study area. The ages of dislocated craters indicate the oldest estimate of the latest tectonic activity of the faults, because those craters must have existed during the tectonic activities. The ages of craters are inferred by the degradation levels classified by Trask (1971).

We found ∼450 dislocated craters in the study area. About 40 of them are smaller than 100 meter in diameter. Sub-hundred-meter-sized craters that still maintain their morphology sharp are classified into Copernican Period. Those small dislocated craters are interspersed all over the region, indicating that the most of the mare ridges in the study area were tectonically active in Copernican Period. In addition, we also found two sub-hundred-meter-sized craters dislocated by a graben at the west of Promontorium Laplace, indicating horizontal extension existed at Copernican Period.

Consequently, tectonic activities in the study area lasted until recently. Those young tectonic activities are too young to be explained by mascon loading hypothesis. Tectonism induced by global cooling or orbital evolution are possible origins for the young horizontal compression. However, they cannot explain the recent extension. Our study area is located in PKT region where the heat-producing elements are more abundant than surrounding areas. Therefore, regional cooling would be a reasonable explanation for the young extensional tectonics.

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