

雨の海北西部に位置するリッジの形成および再活動時期の制約 The formation and reactivation of a mare ridges in northern Imbrium

嵩由美子^{1*}, 山路敦¹, 佐藤活志¹, 諸田智克², 春山純一³, 大竹真紀子³, 松永恒雄⁴

Yuko Dake^{1*}, Atsushi Yamaji¹, Katsushi Sato¹, Tomokatsu Morota², Junichi Haruyama³, Makiko Ohtake³, Tsuneo Matsunaga⁴

¹ 京都大学理学研究科, ² 名古屋大学大学院環境学研究科, ³ 宇宙航空研究開発機構/宇宙科学研究本部, ⁴ 国立環境研究所環境計測研究センター

¹Kyoto University, ²Graduate School of Environmental Studies, Nagoya University, ³Japan Aerospace Exploration Agency / Institute of Space and Astronautical Science, ⁴Center for Environmental Measurement and Analysis, National Institute for Environmental Studies

Mare ridges are the manifestations of horizontal compressions in the shallow part of the lunar crust. They have been interpreted as the folds that determined the basaltic lava layers in mare basins. Since the distribution of the ridges is usually concentric with respect to basin centers, the compressional stress is thought to be originated from the flexure of lithosphere caused by the loading of mare basalts, which is called mascon tectonics. Possible mantle viscosity allowed such deformations to have had delay time of the order of 0.1 Gyr from the deposition of the basalt, which means the deformation was almost syndepositional. However, recent investigations on the underground structures showed that there is no lateral change of thickness of basalt lava around ridges, and this fact supports the post-depositional formation of ridges. On the lunar surface, the majority of mare basalts deposited before 3.0 Ga. Thus, the most of the ridge formation should have occurred before 3.0 Ga. The timing of the formation will be the clue to distinguish their origin, among global cooling, orbital evolution of the Earth-Moon system and mascon tectonics. This study found a crosscutting relationship between a ridge and a basalt unit, then constrained the formation age of the ridge using depositional ages of basalt lava units derived from the crater-size frequency distribution (CSFD).

By means of optical data taken by the cameras onboard SELENE (Kaguya), an ENE-WSW trending mare ridge that dammed up a relatively high-Ti basaltic unit was found near Sinus Iridum, northern Imbrium. The ridge is 300–400 m high, ~30 km wide and ~150 km long. Relatively high-Ti unit is dammed up by the ridge and relatively low-Ti unit made up the ridge. It was also found that the lowermost part of the ridge is partially covered by high-Ti unit, that is, a part of the ridge was uplifted after the deposition of the high-Ti basalt. In addition, there is a smaller ridge of ~50 m in the younger unit. The smaller ridge runs roughly parallel to the ridge mentioned above. The reactivation and the formation of the small ridge showed that a compressional deformation occurred in the area after the deposition of high-Ti basalt. This study determined the depositional ages of high-Ti unit and low-Ti unit by performing CSFD measurements. The estimated ages were 3.0 Ga and 2.1 Ga for low-Ti unit and for high-Ti unit, respectively. The cross-cutting relationship showed that the major formation age of the ridge was between 3.0 to 2.1 Ga. Furthermore, it was revealed that the reactivation and the smaller ridge formation occurred after ~2.1 Ga. Since most of the mare basalts were deposited before 3.0 Ga in the Imbrium basin and the ridge is a part of concentric ridges of the basin, the formation of the ridge was possibly induced by the latest stage of the mascon loading. However, the reactivation of the large ridge and the formation of the small ridge were too young for the mascon, requiring some mechanisms other than the loading. Global cooling and the increasing Earth-Moon distance are possible explanation.

Keywords: mare ridge, chronology, formation age