A new method to constrain the termination ages of lunar tectonic structures

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Mare ridges, lobate scarps, and straight rilles are representative tectonic structures on the Moon. Mare ridges are interpreted as the surface expressions of thrusts and folds. Lobate scarps and straight rilles are interpreted as tectonic structures formed by thrusts and normal faults, respectively. Their formations are thought to have resulted from the subsidence of massive mare basalt fills, which has been the most popular hypothesis of the origin of lunar tectonics since the 1970's. The subsidence should have occurred syndepositionally. Since major volcanic activities on the Moon are thought to have ceased around 3.0 Ga, tectonic activities should have ceased simultaneously. However, recently found some structures are inconsistent with the hypothesis. In order to clarify the origins of the tectonic structures on the Moon, their formation ages would be a clue, although they have been only obscurely constrained.

In this study, we developed a new technique, which was named “one-dimensional crater chronology”, to constrain the termination ages of tectonic structures quantitatively. The craters superposed on a thrust indicate that they were formed after the thrust activities ceased. Therefore, the linear number densities of the superposed craters indicate the elapsed time after the thrust activities ceased. We simulated lunar surface to derive the crater size frequency distributions of craters on linear fault traces and to derive the linear number densities of craters as a function of time. The one-dimensional crater chronology requires the linear number density of superposed craters to estimate the termination age.

We applied the newly developed technique to a mare ridge in the northwestern Imbrium region. The termination age of the formation was estimated as young as ~0.2 Ga. This young ridge formation is inconsistent with the conventional hypothesis. The global cooling of the Moon or the cooling of the PKT region are possible origins.

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