

Correction term for the lunar cratering chronology due to the asymmetrical cratering rate

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Absolute ages of various lunar geological units can be determined from crater frequencies, using the cratering chronology curve obtained by correlation between crater frequencies at Apollo and Luna landing sites and radiometric ages of returned rock samples. The hitherto technique is based on an assumption that the cratering rate is spatially uniform on whole Moon. However, it is expected that the lunar synchronous rotation causes a spatial variation in cratering rate. We investigate an influence of the cratering asymmetry upon the age determination by the crater counting technique. Morota and Furumoto [2003, Earth Planet. Sci. Lett., 206] identified 222 rayed craters larger than 5 km in diameter mainly on the lunar farside. The distribution for the rayed craters shows that the cratering rate decreases with increasing angular distance from the apex. The cratering rate at the apex is 1.5 times higher than that at the antapex.

Because in region near the apex the cratering rate is high, the age determined from the crater frequency is overestimated. Reversely, crater frequency in the region near the antapex denotes age younger than actual. When age of a geological unit is determined from crater frequency with the cratering chronology curve, it is necessary to redetermine cratering chronology curve suited for location of the geological unit. The differences between the chronology curves of each geological units lead units with a same crater frequency to be different ages, although the difference is nonsignificant for areas older than 3.5 Gyr. For example, consider a case that two geological units near the apex and antapex have same crater frequency $N(D=1) = 1.7 \times 10^{-3}$. The crater frequency is equivalent with 2.0 Gyr on mean chronology curve. However, actual ages must be estimated to be 1.6 and 2.5 Gyr from the respective chronology curves. In spite of the same crater frequency, there is difference of approximately 1 Gyr between the ages! In summary, we conclude that the correction for the cratering asymmetry should be applied to the age determination, in order to further understand the absolute ages of geological units on the whole Moon and the evolution of the lunar surface.