Testing hypotheses for the origin of steep slope of lunar size-frequency distribution for small craters

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The crater size-frequency distribution of lunar maria is characterized by the change in slope of the population between 0.3 and 4 km in crater diameter. The origin of the steep segment in the distribution is not well understood. Nonetheless, craters smaller than a few km in diameter are widely used to estimate the crater retention age for areas so small that the number of larger craters is statistically insufficient. Future missions to the moon, which will obtain high resolution images, will provide a new, large data set of small craters. Thus it is important to review current hypotheses for their distributions before future missions are launched. We examine previous and new arguments and data bearing on the admixture of endogenic and secondary craters, horizontal heterogeneity of the substratum, and the size-frequency distribution of the primary production function. The endogenic crater and heterogeneous substratum hypotheses are seen to have little evidence in their favor, and can be eliminated. The primary production hypothesis fails to explain a wide variation of the size-frequency distribution of Apollo panoramic photographs. The secondary craters are likely the major source of the steepening of the distribution. It is ambiguous, however, which primary craters can produce sufficiently numerous secondary craters. The regional variation of the size-frequency distributions shows that few large impacts produce enough secondary craters to affect the distributions of in the surrounding area. We emphasize that a crater size-frequency distribution of small craters on the moon should not be taken as an indication of the surface age. More data obtained from future lunar missions should be viewed in this context, and continued to be examined for further insight into the possible formation mechanism for secondary craters.