Topographic degradation of craters on the moon of Mars, Phobos

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The origin of the two Mars satellites Phobos and Deimos is controversial and evolution thereafter is also unclear. A numerical study showed that nearly all impact fragments ejected from the inner moon Phobos remain trapped in Mars orbits until re-impact with Phobos and produce new generations of ejecta. The suggesting process seems consistent with the observed thick regolith of Phobos. Such re-accumulation may also affect the shape of craters on Phobos. Thus, the crater morphology is expected to give us a key to read out the geological history of this enigmatic satellite. Contrary to rimmed craters on the Moon, craters on the low-gravity satellite Phobos have no clear rims, so that a new method of crater morphology applicable to low-gravity satellites should be developed.
On the Moon, the degradation of craters is controlled by the accumlation of smaller later impacts and follows topographic diffusion process. However, old lunar craters tend to be inconsistent with topographic diffusion model because ejecta deposits of larger later impacts effect crater degradation. On the Phobos, on the other hand, the crater degradation is expected to be consistent with topographic diffusion model in the longer time scale than that on the Moon because impact fragments spread all over the Phobos surface and large later impacts have a smaller effect on the shape of craters than the Moon.
So, I propose a crater shape analysis based on a topographic diffusion model, applicable to craters on a small body, and estimate the model ages of Phobos craters from the degree of crater degradation. I made averaged topographic profiles of twenty craters with radii larger than 1km and compared each of them with a diffusion-model profile having the same flection-point radius.
I find that the topographic profiles of most of the craters are consistent with corresponding diffusion profiles. Further, in each crater, the maximum angle of slope is proportional to depth normalized by the flection-point radius, which is consistent with the prediction of the topographic diffusion model, and the model age kt (where k is the topographic diffusivity and t is the crater age) can be determined. The distribution of kt of the craters is, however, concentrated in lower values, which is inconsistent with the topographic diffusion model with k correlated to crater-forming impact flux. These results suggest that Phobos experienced some unique erosion process incompatible with simple topographic diffusion models.

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