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Surface and near surface dynamics on Phobos: conditions for grooves formation by impact ejecta.

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Abstract

Phobos is orbiting around Mars close to the Roche limit. Therefore the surface material is loosely bounded and easily ejected by impactors. Whereas dynamics in the close vicinity of Phobos has been studied for both geophysical and navigation reasons, the dynamics on the surface itself has not been studied to the same extent.
Among many hypotheses about the formation of grooves on the surface of Phobos, it has been suggested that they could have been plowed by impact ejecta, but this was questioned using the arguments that blocks were not observed at the end of the grooves and that the grooves do not run down slope. Then the study of surface and near surface dynamics on Phobos can clarify the soundness of these controversial arguments.
The gravitational field used is the ellipsoidal model of Davis, 1981, that describes as well the past and future Phobos as it gets closer to Mars. The trajectory of a gliding test mass for any initial position and velocity is computed. Depending on initial conditions a gliding mass stay gliding or can take off after some distance. Generally the trajectories are not 'down hill' as the motion is strongly dependent on the velocity. Then the two above controversial arguments fail but the question remains. It is clearly proven that the sets of high latitude grooves cannot have been dug by rolling ejecta. On the contrary the set of grooves issued from the Stickney crater shows some similarities with the computed trajectories. The comparison between the observed grooves and the computed damped trajectories leads to a very low solid damping coefficient of ~0.1, not inconsistent with other surface motion observations.

Davis, D.R., Housen, K.R., Greenberg, R., 1981. The unusual dynamical environment of Phobos and Deimos. Icarus 47, 220-233.