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Geological study on the formations of grooves on Phobos: Results of image analysis

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Phobos and Deimos have been imaged by Viking orbiter, HRSC onboard Mars Express, and HiRISE onboard Mars Reconnaissance orbiter.About 3000 high-resolution images of Phobos have been acquired, which indicates that Phobos becomes one of the most densely-imaged small solar system bodies. The purpose of our study is to understand formational and evolutionary processes of small bodies though image analysis.

One of the most distinguished features on the surface of Phobos is the lineally surface structure, which is most commonly called as a groove. Grooves are found on many small solar system bodies, however, their formational processes has not been explained.

Some formational processes of grooves on Phobos have been proposed, such as (1) the faults vents caused by tectonic forces [1] and (2) the secondary craters due to a large impact on either Phobos or Mars [2]. However, neither hypothesis satisfies findings from all of the observational or theoretical studies.

In this study, we carefully analyze high-resolution images of Phobos and identified 515 grooves, whose locations are carefully mapped out on the numerical shape-model of Phobos.At a result, we find that many grooves have rims, which support the view that the grooves on Phobos are related to impact events. We also make a histogram of the lengths of the grooves, where those more than 5km can produce reliable information.

We also map the locations of craters more than 20km in diameter on three regions to determine the crater densities, which are below geometric saturation at any regions. In particular the high-latitude region has a low crater density. We find that the crater size frequency on sub-Mars is similar to that on Anti-Mars. We also map the distributions and the size of boulders on the surface. As a result, the size of many boulders is about 20m diameter, and many boulders can be identified on the equatorial region. Additionally we discover ridges whose formative factor cannot be explained.These analysis results deny existing hypotheses. In this presentation, we will show our new hypothesis that the origin of grooves is the impact from asteroids can explain these analysis results coherently.

Reference

[1]Soter, S. and Harris, A., 1978. Nature 268, 421-422
[2]Murray, J.B., Iliffe, J.C., 2011. Geomorphology. Geol, Soc, Spec, Publ., London, pp.21-41
[3]Kenneth, R.R., James, W. H., 2013. Planetary and Space Science, 69-95