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Cratering experiments on layered crusts

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We can obtain a lot of information on the cratered surface by means of analyzing these impact craters. In particular, the complex craters formed in the strength regime are important to investigate the subsurface structure and their physical properties. Their characteristic morphology could be made by the effect of the surface layered structure. In order to clarify the effect of layered structure on the cratering process, we conducted impact experiments on two-layered targets consisting of mortar and basalt, which have different mechanical strength. The thickness of the mortar layer was varied from 1mm to 30mm to investigate the dependence of crater depth on the upper layer thickness. In addition, impact energy was changed in 50J, 400J, and 2400J to investigate the dependence of crater on the impact energy. The projectiles were accelerated by two-stage light gas gun in Nagoya University and JAXA. The crater morphologies are classified into three groups (concentric, flat-bottomed and bowl-shape). The variation of the crater depth depending on the mortar thickness shows the same tendency in all impact energy ranges. The crater depth reaches a peak and drops suddenly at the boundary between the flat-bottomed crater and the bowl-shaped crater. This feature can be explained by shock wave reflection at the interface between the mortar and basalt. In the concentric crater, the dependence of the depth of the basalt pit on the mortar thickness is showed as db/db0=(1-T/dm)^1.62 by constructing simple physical model. By using this equation and the image of the concentric crater observed on lunar surface, we estimate the combination of the surface and the subsurface materials of the moon.

Keywords: impact crater, regolith, sedimentary rock, basement rock, flat floor crater, concentric crater