

## Experimental study on gravitational effects on crater size formed by low-velocity impacts into granular media

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Craters on regolith surface can be formed at various impact velocities. When secondary craters form on the surface of small bodies, such as asteroids and comets, the impactors have very low-velocities of several  $\text{m s}^{-1}$  or less due to the small escape velocity of the bodies. These secondary collisions can increase the number of small craters on the surface and will affect the surface topography of small bodies. Therefore, it is important to investigate low-velocity impacts on granular materials that simulate regolith particles to understand the low-velocity cratering process on the surface of small bodies.

Low-velocity impact experiments with velocities in the range of several  $\text{m s}^{-1}$  and granular targets have been conducted to investigate crater size and develop empirical relationships between impact conditions and crater size under 1 G (e.g., Uehara et al., 2003; Walsh et al., 2003). However, it was found that the impact velocity dependence of crater diameter was inconsistent between the hypervelocity impact experiments conducted at low and high-gravity conditions (Gault and Wedekind, 1977; Schmidt and Housen, 1987) and the low-velocity impact experiments conducted under 1 G (Kiuchi et al., 2018, JpGU meeting).

We collected data of crater diameter on granular materials with impact velocities ranging from 1 to 4.6  $\text{m s}^{-1}$  under a gravity range of 0.20 to 1 G to investigate the effects of gravity on crater diameter using a drop system developed for reduced gravity impact experiments (Kiuchi and Nakamura, 2015 JpGU meeting). Most of our experiments were conducted under  $10^5$  Pa for comparison with the low-velocity experiments under 1 G reported in previous studies, but we also conducted several experiments under 7 Pa according to the atmosphere-less condition of small bodies.

This time we newly organized our experimental results in which the gravity was changed using the atmospheric pressure dependence. As a result, the exponent values of gravity became close to that obtained by the high-velocity experiment (Gault and Wedekind, 1977). We compared our results with high-velocity experiments reported in previous studies. Our results for the glass projectile and the sand target almost agreed with the previous high-velocity crater-size scaling-law (Housen and Holsapple, 2011) when the atmospheric effect was taken into account, but the crater diameter for the steel projectile and the sand target was lower than that for the glass projectile. This result shows that the crater-size scaling-law obtained for high-velocity impact can be applied to low-velocity impacts of several  $\text{m s}^{-1}$  under reduced pressure when the density ratio of the projectile to the target is close to unity. The same scaling applies over a very wide range of impact velocities.

Keywords: Impact experiments at low-velocity, Gravitational effects on crater size