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# Water content of small body surfaces: Effects of mutual collisions

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Small bodies in the Solar System transported water from outer region beyond the snowline to the Earth and other terrestrial planets. These small bodies experienced mutual collisions since their formation through their evolution. Consequently, craters were formed on the surfaces, rubble-pile bodies, i.e., once collisionally disrupted and re-accumulated bodies, such as asteroid Itokawa were formed, and asteroid families, groups of asteroids with similar orbital elements, were created.

In order to understand the evolution of small bodies from the early Solar System to the present, with focusing on the role of small bodies as the transporter of water, the present orbital and size distributions of dry and wet small bodies are ones of key clues. The presence of hydrated minerals and water ices are detected by visible and infrared spectra observations.

In this presentation, we discuss on the relationship between water content of small body surfaces and their mutual collisions. Even if hydrated minerals or water ices were lost from the surfaces due to some processes, the interior of the bodies may be still wet. Impact-induced dehydration is one of possible processes that release water from the surface. On the contrary, erosive collision may expose fresh wet materials from the interior. On the other hand, collision brings wet materials on the surfaces of dry small bodies.

Impact-induced dehydration rate has been studied by analysis of shock-recovered hydrated minerals or detection of impact-induced water vapor (e.g., Sekine et al., 2015). The dehydration ratio is dependent on not only peak shock pressure but also the initial porosity. Meteorite texture was found to be comminuted due to vapor released from hydrated minerals in porous carbonaceous chondrite materials in shock recovery experiments, and fine fragments were expected to be explosively dispersed from hydrated, porous asteroids (Tomeoka et al., 2003). We prepared dunite and serpentinite blocks as dry and wet targets and gypsum and hemihydrate blocks as porous samples for impact experiments. Projectiles accelerated to the velocity of about 5 km/s, which is the average collision velocity in the asteroid belt, were impacted to the targets. No clear difference was observed in the ejecta patterns, i.e., fragment velocity fields, for non-porous dunite and serpentinite targets. The similar cone-shaped ejecta were observed for the hemihydrate targets, while hemispherical vapor clouds were observed from gypsum targets. How the dehydration, comminution and ejection of fragments depend on impact angle and porosity and water content of targets have not been fully addressed.

On the other hand, impact-delivery of exogenic materials on the surface of small bodies was visualized by the discovery of carbonaceous materials on the surface of asteroid Vesta by Dawn space mission. We performed impact experiments of projectiles of rocks, meteorites and porous ceramic projectiles into targets of various materials in order to investigate the degree of disruption of projectiles and penetration depth of projectiles into the targets. We found that fragments of rock projectiles are mixed and consolidated with simulated regolith particles. We also showed that impactors with large porosity can survive with larger fraction owing to local microscopic collapse of pores that inhibits growth of overall fracture of the impactors and thus can penetrate deeper into targets. We will discuss on the effect of volatile materials in impactors based on the results of impact experiments conducted using plastic projectiles.

Keywords: impact, dehydration, ejecta, fragments, porosity, small bodies