[EE] Evening Poster | P (Space and Planetary Sciences) | P-PS Planetary Sciences

[P-PS03]Small Bodies in the Solar System: Current Understanding and Future Prospects

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In this session, we welcome presentations regarding small bodies in the Solar System from a variety of approaches (i.e., laboratory experiments, observations, explorations, theoretical modeling, and sample analyses). Especially this year, the Hayabusa2 spacecraft is about to rendezvous with its mission target (Ryugu, C-type asteroid), and ready to make remote-sensing observations for acquiring detailed information of the primordial body. Taking account of the situation, we aim to organize our current understanding of these primordial bodies and further discussing future prospects in this research field.

[PPS03-P19]Impact cratering experiments on quartz sand block consolidated by porous gypsum: Implication for crater scaling law in low strength regime

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In the begging of 2019, Hayabusa-2 plans to conduct an impact experiment on the asteroid Ryugu by using a small carry-on impactor and this dramatic phenomenon will be observed by a deployable camera 3. In order to maximize the scientific outcome, we should make earth-based laboratory experiments on the impact crater scaling laws for speculated asteroid surfaces of asteroid Ryugu. Our group has conducted impact experiments on the various target changing the physical properties systematically. In this study, we suppose a very weak surface layer including hard small grains consolidated by a porous hydrated mineral such as carbonaceous chondrite, which includes chondrules surrounded by porous matrix.

The very weak porous layer was simulated by quartz sands with the size of 100 mm consolidated by porous gypsum and the strength of the target was controlled by changing the amount of the porous gypsum among quartz sands. The tensile strength of the target with the different porous gypsum matrix from 0.5 to 10 vol.% was measured by using a Brazilian test method and the strength was found to decrease from 1 MPa to 0.001 MPa with the decrease of the gypsum content. The impact experiments were conducted at the impact velocity at 2 and 4kmk/s by using an Al projectile with the size of 2 mm, and the cratering process was observed by a high-speed video camera at the framing speed of 10^5 fps.

We found that the crater morphology changed from a carrot shape to a dish shape with the decrease of the strength and more the boundary between the pit and the spall became fuzzy with the decrease of the strength. The ejecta curtain was observed by a high-speed video camera, and it was found that the high-speed ejecta was recognized just after the impact and they formed the conical shape ejecta curtain. Then, the low speed ejecta was observed to form the pillar type ejecta curtain. The growth rate of the pillar type curtain depended on the strength, so that the pillar did not grow so much in the case of the high strength target.

The crater size scaling law was obtained for this target with the strength changed more than 2 orders of magnitude at the impact velocity of 2 and 4 km/s. All the data was scaled by the following equation,π$_R$=0.79π$_Y^{-0.17}$, where π$_R$ is the scaled crater radius and π$_Y$ is the scaled strength in the conventional scaling laws. We compared this scaling law with the previous results with the same π$_Y$ in the strength regime experiments, then we found that our π$_R$ was smaller than the π$_R$ of frozen sand but larger than the π$_R$ of porous gypsum. Therefore, the crater size could be controlled not only by the material strength but also the micro-porosity of the matrix included in the porous gypsum among quartz sands.