Oral | Symbol P (Space and Planetary Sciences) | P-PS Planetary Sciences

[P-PS21_29AM2]Planetary Sciences

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We call for general interest papers for Planetary Sciences. Planetary Sciences consist of a variety of studies on the past, present, and future of our solar system and exoplanetary systems. Discussions based on various backgrounds are encouraged.

12:30 PM - 12:45 PM

[PPS21-P14_PG]High velocity impact cratering experiments on ice-sand mixture simulating the surface of icy satellites

3-min talk in an oral session

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Keywords:icy satellites, ice-sand mixture, impact crater, high velocity impact experiments

It is well known that ice-rock mixtures could be a main component of icy satellites, the surface crust of asteroid Ceres. Ceres' icy crust could be impacted by various asteroids with different components and physical properties will affect the crater morphology. Therefore, we would obtain various information from the investigation of the observed craters such as material properties of impacted asteroids and the internal structures of the icy crust and so on. To conduct these investigation, the laboratory experiments would be necessary to derive such information from the observed crater. Then, we should carry out the cratering experiments on ice, ice-rock mixtures and the layered target. Impact experiments on ice has been conducted systematically under various conditions. However, the cratering experiments on ice-rock mixture were limited in the impact velocity range and the rock contents. It is necessary to experiment at the velocity higher than 4km/s to apply to craters on Ceres, but it is not done now. Therefore, we made cratering experiments on ice?rock mixtures at the impact velocity higher than 1km/s using the several types of the projectile, and compared them with the pure ice to clarify the effects of rock inclusion on the crater morphology and crater scaling law. We installed and used a new two-stage light gas gun at Kobe University in 2013. We prepared ice-rock mixture targets simulating Ceres crust which consisted of water ice and quartz sand having a particle size of about 500μ m, and the quartz content was regulated to be 81±2wt%. The ice-sand mixture was made in a cylindrical metal container with the height of 5～10cm and the diameter of 15cm. The water-sand mixture was frozen in a freezer with the temperature from -23℃ to -15℃. Used spherical projectiles were made of aluminum (2.7g/cm3), titanium (5g/cm3), and zirconium (5.7g/cm3), respectively. We lunched projectiles at 1.6～5.1km/s with nylon sabots to use various types of projectiles. To prevent targets from melting, the vacuum chamber was evacuated for insulation. The chamber pressure during the experiments was from 200 to 230Pa. A crater formation process was taken by an image-converter camera every 5μ s, and 18 successive images were obtained for each shot. From these images, we examined the characteristics of impact eject such as the growth rate, and the shape, and it was compared with that of pure ice. We measured the crater shapes by a caliper.We found that the spallation was difficult to occur on the ice-rock mixture targets compared to pure ice targets. So, the depth-diameter ratio of the crater for ice-

rock mixtures, these dependencies on the velocities, and the projectile densities was different from that of pure ice targets. We found that the crater diameter on the ice-rock mixture is about a half of that on pure ice at the same impact energy. Hiraoka et al. (2004) made the cratering experiments on ice-rock mixture with the rock contents from 0 to 50 wt% at the constant impact energy. We compared their results with our results obtained for 80 wt% and found that our result is almost consistent with their results of 50 wt% content. This means that the crater size stop decreasing at 50 wt%, then it becomes almost constant until 80 wt%. We speculate that the crater size might drastically change to be small between 80 to 100 wt% corresponding to rock itself. It might be possible that the crater size could be controlled by the ice strength from 0 to 80wt% and by the rock strength at the range of content near 100 wt%. The crater scaling law proposed by Housen and Holsapple (2012) was applied, and the scaled crater radius π_R and the scaled strengthπ_Y were investigated in our results. Our results were compared with that of pure ice and the ice-rock mixture's dynamic tensile strength was supposed to be 100MPa if the ice-rock mixture was scaled by the same parameter as that of pure ice.