

Particle size of Ryugu's subsurface layer inferred from observation of SCI crater's ejecta curtain.

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The particle size of subsurface layers of asteroids would result from the formation and the surface evolution processes of the asteroids. It is difficult, however, to reveal the properties of subsurface particles with remote sensing observations from spacecraft and telescopes. Hayabusa2, the second asteroid explorer mission led by Japan Aerospace Exploration Agency (JAXA), succeeded in forming an artificial crater on the asteroid Ryugu with Small Carry-on Impactor (SCI). In the course of the crater formation process, an ejecta curtain was observed by Deployable Camera 3 (DCAM3) that was separated from the spacecraft to take time-lapse optical images of the ejecta curtain. Since particles that compose the ejecta curtain emerged from a certain depth of the subsurface layer (~ 1 m deep), we are able to extract physical properties of the subsurface particles from the analysis of the ejecta curtain images.

We constructed a theoretical model of the ejecta curtain based on the crater scaling laws and compared it with the images in terms of optical depth. We found that the typical size of the ejecta particles lies in the range from several centimeters to decimeters, indicating a deficit of particles smaller than ~ 1 mm in the subsurface layer. The lack of minute particles suggests that Ryugu might have experienced some kind of surface flow process such as mass wasting to sink small particles into a deeper region or that small particles would have been eliminated by solar radiation pressure during the formation of a rubble pile asteroid Ryugu. We expect laboratory analysis of the size distribution and the interparticle adhesion of Ryugu returned samples to help elucidate the possibility of these processes.

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