What if Ryugu hits on Earth?

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ABSTRACT

Hayabusa2 successfully conducted remote sensing exploration and sample recovery of C-type asteroid Ryugu and returned samples to Earth. So far, remote sensing exploration and analysis of the samples have yielded much information on the origin and evolution of Ryugu, and data analysis and analysis are still ongoing. These results have also provided beneficial insights into planetary defense. The three most important results of remote sensing exploration for the planetary defense field are as follows;

1) Bulk density was determined from spacecraft orbit data (Watanabe et al., 2019). From this, Ryugu was determined to be a rubble pile, and porosity was estimated to be greater than 50%,

2) Infrared observations indicate that the surface thermal inertia is about 200-300 ($Jm^{-2}K^{-1}s^{-1/2}$), even in meter-order rocks. This suggests that the rocks are porous and have a strength as low as 200-280kPa (Grott et al., 2019).

3) An impactor weighing about 2 kg was successfully impacted on the planetary surface at a velocity of about 2 km/s. This SCI experiment produced a crater of about 20 m in diameter, indicating that the cohesivity near the surface is very low (130-300Pa) (Arakawa et al., 2020).

Furthermore, Hayabusa2 successfully returned to Earth on December 6, 2020, and recovered a 5.6 g sample. Mechanical, thermal, electrical, and magnetic properties were measured on one of the largest collected samples. (Nakamura et al., 2022, Tanaka et al.,2022). The results of the analysis showed that the physical properties were quite different from those inferred from remote sensing observations. For example, the mechanical strength data was more than ten times higher than the data estimated from thermal inertia. This suggests that more than the knowledge obtained from remote sensing exploration alone is required.

From these data, it is possible to estimate with a high degree of accuracy what would happen if such an object were to impact the Earth, although this is not a realistic expectation.

References:

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