Experimental study on impact strength of ordinary chondrite parent body simulated in a laboratory

Minami Yasui[1]; Masahiko Arakawa[1]

[1] Grad. School Env. Studies, Nagoya Univ.

It is expected that small asteroids are impact fragments produced by high speed impact among parent bodies. Many small asteroids observed currently are correlated with the meteorites recovered on the earth, and it is natural that the meteorites are also the fragments of these small asteroids. Most recovered meteorites among them is an ordinary chondrite. Therefore, the impact disruption plays a very important role in the origin of small asteroids followed by the formation of the ordinary chondrite. Thus, we did impact experiments to clarify the impact strength of ordinary chondrite parent body.

Impact experiments were conducted by using one-stage light gas gun set at Nagoya University. We prepared the target sample of gypsum mixed with glass beads having three different sizes. The mass content of glass beads is a constant of 60wt.%. We used glass beads with a diameter of 100micron, 1mm, and 3mm. All samples have the diameter of 30mm, and the length from 20 to 30mm to change the energy density, Q. The projectile is made of nylon, and has a spherical shape with a diameter of 10mm, and a mass of 0.5g. The impact velocity was from 80 to 180 m/s. Disrupted fragments were directly observed by using a high speed video camera to examine the size and velocity of disrupted fragments.

In this study, we defined the normalized fragment mass, $f_{0.5}$, which was the cumulative mass of 0.5 on the mass distribution referred to Arakawa et al.(2002). The relationship between $f_{0.5}$ and Q can be fitted by the power law equation, $f_{0.5}$=$q_0 Q^p$. As a result, we found that the power law index, p, of 100micron and 1mm samples was almost same, from -1 to -1.3. However, the p of 3mm sample was smaller than those of 100micron and 1mm samples, about -4. Also, we defined the impact strength $Q_{0.5}*$as Q for $f_{0.5}$=0.5. As a result, the $Q_{0.5}*$of 100micron sample was 25 J/kg, 1mm sample was 36 J/kg, and 3mm sample was 62 J/kg. From these above results, in the case of 100micron and 1mm samples, the impact strength was smaller than that of 3mm sample, but these fragments didn't become so small when the energy density increased. On the other hand, in the case of 3mm sample, the impact strength was larger than others, but the disruption progressed abruptly as the energy density increased.