COMPACTION OF SMALL POROUS BODIES AT LOW VELOCITY IMPACT. Y. Fujii[1] and A. M. Nakamura[2], [1]Graduate School of Science and Technology, Kobe University, 1-1 Rokkodai, Nada, Kobe, 657-8501, Japan, [2]Graduate School of Science, Kobe University (amnakamu@kobe-u.ac.jp).

Introduction: Porosity of small bodies changes with time through their evolution from the phase of planetesimal growth in the early solar nebula. Impact is one of key processes that determine the internal structure of the small bodies. The porosity increases or decreases by impact processes. Catastrophic disruption and re-accumulation of the fragments of small bodies generated by high-velocity impact produces porous rubble-pile bodies. On the other had, high-velocity cratering impact onto the surface of porous bodies compresses the material under the impact point and thus decreases the porosity of the impacted bodies [1].

In this study, we focus on compaction of porous bodies at low velocity impact. Low velocity collision is relevant to the phase of planetesimal growth [2, 3] or among ring particles [4]. Low velocity impact process also plays a role during the re-accumulation of ejecta owing to self-gravity of the parent body, in any ejection processes such as impact cratering or catastrophic disruption of small bodies. For example, whether or not the re-accumulated pieces break up at the re-impact on the surface of asteroids can influence the population of boulders on the surface [5]. The re-accumulation velocity, that is the impact velocity onto the surface, is less than the escape velocity, therefore, of the order of m/s - tens m/s for asteroids of tens km in diameter.

Laboratory experiments: In order to study the compaction of porous bodies at low velocity impact, we performed laboratory analogue experiments using gypsum as the target material. Gypsum spheres of porosity from 31 to 61 % and diameter from 25 to 70 mm were impacted upon a stainless steel plate with impact velocities from 0.2 to 22 m/s. Impact experiments of non-porous gypsum (Satin spar) spheres was also conducted for a comparison.

The outcome of porous gypsum spheres ranged from intact, compaction at the impact point, and to fragmentation into a few to several pieces according to the impact velocity. This is totally different from the non-porous gypsum and ice spheres [6], for which crack initiation and growth were observed in between the intact and the fragmentation modes instead of compaction. Figure 1 shows examples of the intact, compacted, and fragmented porous gypsum targets. The rightmost fragment in Fig.1c is from the impact point and has less porosity than the original one. The degree of the compaction indicated by the diameter of the compacted flat surface monotonically increased with impact velocity. No clear dependence on the porosity was detected in the diameter-velocity relation.

Implication: Previous high-velocity impact disruption experiments of gypsum target showed that the typical ejection velocity of the largest pieces was of the order of m/s [7]. These low-velocity ejecta would gravitationally re-accumulate onto parent bodies of tens km or larger in diameter. Upon re-accumulation, they may lose the micro-porosity [8] by compaction. The ratio of the macro- and micro-porosity in porous small bodies thus changes in the collisional evolution of small bodies.

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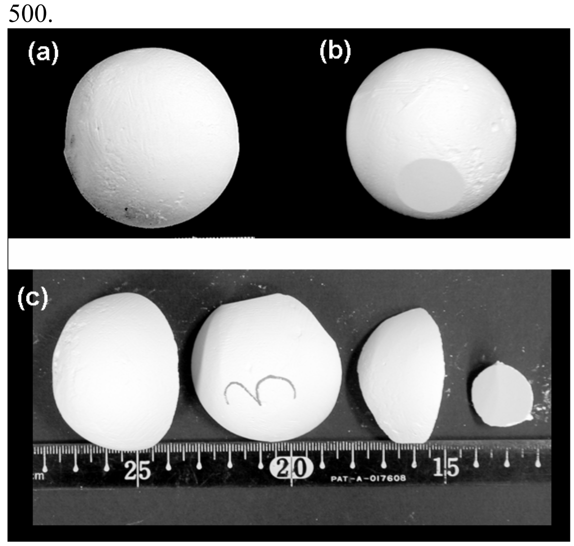

Fig. 1 Porous gypsum targets. (a) Original, (b) compacted, and (b) fragmented spheres of 50 mm in diameter. The impact velocities were (b) 10.2 m/s and (c) 22 m/s.