EXPLOSIVE CRATER EXPERIMENTS OF POROUS GYPSUM TARGETS.

A. M. Nakamura[1], K. Ogawa[1], Y. Murakami[1], Y. Yamasaki[1], Y. Nagaashi[1], K. Nomura[1], T. Kadono[2], R. Suetsugu[2], N. Kawai[3], S. Tanaka[3], and T. Okamoto[4], [1]Department of Planetology, Kobe University (1-1 Rokkodai-cho, Nada-ku, Kobe, 657-8501, Japan), [2]School of Medicine, University of Occupational and Environmental Health (1-1 Isei-gaoka, Yahata, Kitakyusyu, 807-8555, Japan), [3]Institute of Pulsed Power Science, Kumamoto University (2-39-1, Kurokami, Chuo-ku, Kumamoto City, 860-8555, Japan), [4]The Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency (3-1-1 Yoshinodai, Chuo-ku, Sagamihara, Kanagawa, 252-5210, Japan).

Introduction: Crater size on the surface of a planetary body generally depends on the gravity acceleration and target properties such as density and mechanical strength [1]. Crater size on porous meteorite parent bodies is determined by material strength as well as porosity when an impact excavates the solid interior of the body under the regolith on the surface. Laboratory impact experiments have shown that the cratering efficiency decreases as the bulk porosity of the target increases. On the other hand, explosive events were considered to be effective for simulating large craters that are impossible in impact experiments. In the development of crater scaling relationship in the gravity regime, data of explosive events were used in addition to those of the impact events[2]. We performed explosive crater experiments using porous gypsum targets to examine the similarity between the outcomes of explosive events and impact events on porous targets.

Experiments: We prepared twenty-seven cylindrical gypsum targets with diameter of 15–40 cm, height of 7–33 cm, and density of $1.0–1.1\times10^3$ kg/m^3 (porosity of 52–57%). We used a detonator (No. 6 electric detonator produced by Kayaku Japan Co., Ltd.) and a SEP explosive (Kayaku Japan Co., Ltd.), density of 1.3×10^3 kg/m^3, detonation velocity of 6.97 km/s, and mass of 0–6 g. The explosives were buried at a depth between 0 and 4.5 cm from the top of the cylinder. The energy density of the SEP explosive is 4.158×10^6 J/kg. This value of energy density is equivalent to the kinetic energy of an impactor with the same mass as the SEP explosive and with 2.9 km/s in velocity. The explosion was monitored by a high-speed imaging camera at 6400 fps.

Results: Targets were engulfed to form a circular crater. Targets with small diameter were partially destructed with the bottom surface of the target was essentially unbroken, or totally destructed. The degree of destruction depended on the diameter of the target, the amount of explosives, and the depth of burial of the explosives or the detonator. The deeper the explosives were buried, the more damage and the larger the crater volume tended to be. We reconstructed the partially destructed targets. The crater had a spherical deep depression (pit) in the center of the larger shallow depression (spall). Pit diameter, spall diameter, and crater depth were measured. The volume of the crater was measured by pouring glass beads into the crater cavity. The ratio of the spall diameter to the pit diameter was approximately 1.5, which corresponds to the lower limit of values for craters formed in impact experiments using a two-stage light-gas gun [3]. We will discuss a detailed comparison with the literature data of laboratory impact crater experiments on gypsum targets [4, 5].

Acknowledgements: We are grateful to T. Omura for helping us of fabricating gypsum targets. This study was conducted as the joint research of Pulse Power Science Laboratory, Kumamoto University, and the explosive experiments were conducted at the explosion experiment facility in Kumamoto University.

References: [1] Holsapple K. (1980) *Proc. Lunar Planet. Sci. Conf.* 11, 2379-2401. [2] Holsapple K. (1993) *Annual review of earth and planetary sciences* 21, 333-373. [3] Nakamura A. M. 2017. *Planetary and Space Science* 149:5-13. [4] Yasui M. et al. (2012) *Icarus* 221, 646-657. [5] Okamoto T. and Nakamura A. (2017) *Icarus* 292, 234-244.