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Sub-surface Grain Comminution in Experimentally Produced Impact Craters in Sandstone

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The aim of our investigation is a better description and understanding of impact-induced rock damaging, grain crushing, and comminution beneath the crater floor in dry and water-saturated porous targets. For this purpose samples were taken from the pilot study of the MEMIN-Project (Kenkmann et al., 2011, Schäfer et al., this conference). In this impact study two meter-sized blocks, a dry sandstone and a wet sandstone saturated with water to $\sim$40% were impacted with 1 cm steel spheres at 5.3 km/s. The acceleration was achieved by the use of a two-stage light gas gun at the Fraunhofer Ernst-Mach-Institute (EMI) (Schäfer et al., 2006). As a part of this project this study gives a first insight into the structural modification and the subsurface fracturing and comminution processes in the target. Porosity and particle size distribution beneath the crater floor were determined by means of digital image analysis of BSE photomicrographs. Photos were taken from a series of thin-sections obtained beneath the craters at increasing distances from the point of impact. For the identification of pore space a greyscale-based image analysis software (ImageJ) was used. As a preliminary result of the porosity analysis an increase in pore space can be seen in the vicinity of the crater floor. The reduction in primary pore space by grian crushing is counterbalanced by dilatancy along impact fractures. Water saturation does not appear to affect this behaviour. For the particle size analysis an object extraction software (JMicrovision) was used for the determination of the occurrence per surface area for particles >5μm. With these measurements it can be shown that grain crushing is more far-reaching with water saturated pore space. For example similar damaging is developed at 1.3 cm and 5.9 cm distance to the crater floor in dry and wet sandstone. These observations are confirmed by numerical hydrocode models (Güldemeister et al., 2011).

Kenkmann T. et al. (2011) MAPS, in press.
Schäfer et al., this conference
Schäfer F. et al. (2006) ESA SP-612
Güldemeister N. et al. (2011) LPS, XLII, abstract