HYPERVELOCITY IMPACT EXPERIMENTS OF IRON PROJECTILES ON DRY AND WATER-BEARING SANDSTONES.

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Introduction: To analyze strength dominated cratering processes on an experimental scale the interdisciplinary project MEMIN was recently established. The rationale of this project is to fully describe and constrain impact cratering processes by recording petrographic-petrophysical properties and physical parameters of the projectile and target before, during, and after a hypervelocity impact. The objective is to better understand processes of crater damage, the role of fluids, the nature of geophysical anomalies of craters, and to create a well documented data base that can be used to validate numerical simulations of impact cratering.

Experiments: Two vertical impact experiments (*2808*, *2809*) were carried out using a two-stage light gas gun. The main axis of the gun was horizontal. Spherical steel projectiles of 1 cm diameter (4.1 g) were impacted on blocks (1.0 x 1.0 x 0.5 m) of sandstone ("Seeberger Sandstein") enclosed in a steel frame. The target material has an average grain size of 0.17 mm and ~18 % porosity. One of the blocks was put in a water basin for four month and reached a water saturation of 44 vol.% (*2809*). The strength and elastic modulus is 62.4 +/- 2.8 MPa and 14.8 +/- 1.4 GPa for the dry sandstone (*2808*) and 47.0 +/- 3.7 MPa and 12.1 +/- 1.0 GPa for a fully water saturated equivalent. The blocks were positioned vertically to simulate a vertical impact on flat lying sediments. Ejecta catchers consisted of fiber boards that were placed 56 cm above the target surface. A high speed camera recorded the excavation in 12 photographs and gauges recorded shock pressure at the rear surface and the sidewall of the blocks.

Results: The projectiles reached a speed of 5338 ms^{-1} (*2808*) and 5269 ms^{-1} (*2809*), respectively. The resulting craters have average diameters of 23.8 cm (2808) and 28.7 cm (2809) and depths of 5.5 cm (*2808*) and 4.8 cm (*2809*), respectively. The catchers collected only a subordinate amount of the ejecta. Ejected material was partly recovered from a console below the sandstone block and amounts to 178 g (*2808*) and 301 g (*2809*), respectively. The ejecta comprises a wide spectrum of fragment sizes from <160 µm to >3 cm. The size distribution has a maximum in the interval 160-310 µm corresponding to the initial grain size of the sandstone, and in the interval >2,5 cm. The latter fragments are spall fragments. In experiment *2808* 2.84 g of the projectile (69%) stuck in the catcher, but in exp. *2809* no larger projectile remnants were found. The mean ejecta velocity perpendicular to the target surface decreases from 2.3-2.4 kms^{-1} after 0-20 µs to 0.2-0.3 kms^{-1} after 230-470 µsec.

Discussion: The analysis of the experiments is not completed yet. However, our first and preliminary inspection shows that the presence of fluids seems to have influenced the cratering process. A wider spall zone, a shallower crater depth, the lack of projectile remnants, and a smaller amount of shocked ejecta characterize the wet target compared to the dry sandstone.

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