**GRAIN SIZE REDUCTION AS A STRAIN RATE INDICATOR FOR DEFORMATION IN EXPERIMENTAL IMPACTS.**

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**Introduction:** Investigations of major fault zones like the San Andreas Fault revealed the occurrence of pulverized rock within their damage zones. This pulverized rock can be distinguished from fault gouge by the absence of significant shear strain [1]. The particle size reduction is supposed to develop independent of shear, by brittle in-place fragmentation [2]. The resulting particle size is described to be mainly controlled by the applied strain rate [2, 3]. A first attempt to apply these observations to impact related deformation was published by Key & Schultz (2011) for Upheaval Dome, Utah [4]. Hypervelocity impact experiments on porous sandstone, conducted within the MEMIN research unit [5, 6], revealed localized deformation zones with reduced grain size beneath the impact crater [7]. Our goal was to analyze the fragment size distribution within the deformed zones to test if the relationship between fragment size and strain rate is also applicable for experimental impacts.

**Method** SEM micrographs in BSE mode were taken from thin sections beneath the crater floor. Automated image analysis software (JMicroVision) was used to determine the fragment size reduction within the deformed zones. The measured fragment sizes were compared to the empirical relationship between strain rate and fragment size, given by [3] as:

$$d = \left[\frac{\sqrt{20}K_{IC}}{\rho C_d \dot{\varepsilon}}\right]^{2/3}$$

where $d$ is the diameter of the fragments, $K_{IC}$ is the Mode I fracture toughness of the unfractured grain, $\rho$ is the rock density, $C_d$ is the compressive wave velocity and $\dot{\varepsilon}$ is the applied strain rate.

**Results:** A log-log plot of occurrence (n) against fragment size shows that the fragment size distribution can be approximated by a power-law slope of ~1.4. This is in reasonable agreement with the power-law slope of 1.55 reported by Key & Schultz (2011) Using a fracture toughness $K_{IC}$ = 1MPa*$m^{1/2}$, a rock density of 2050 kg/m³ and a p-wave velocity of 2915 m/s [8] the strain rate is calculated to be in a range of 1.7 to 5.6*10² $s^{-1}$.

**Conclusion:** First results for the strain rate determination by fragment size reduction suggest relatively slow strain rates for the development of localized deformation zones in experimentally impacted sandstone. Further investigations will be performed to validate these preliminary results.

**References:** [1] Wilson B. et al. 2005. *Nature* 434:749-752 [2] Dor O. et al. 2009. *Pure and Applied Geophysics* 166:1747-1773 [3] Grady D. E. and Kipp M. E. 1987. *In* Atkinson B. K. ed., *Fracture Mechanics of Rock*: Academic Press, p. 429–475. [4] Key W. R. O. and Schultz R. A. 2011. *GSA Bulletin* 123:1161-1170 [5] Deutsch A. et al. 2012, *this conference* [6] Kenkmann T. et al. 20XX. Submitted to *Meteoritics & Planetary Science*, special issue. [7]° Buhl et al. 20XX. Submitted to *Meteoritics & Planetary Science*, special issue. [8] Moser D. et al. 20XX. Submitted to *Meteoritics & Planetary Science*, special issue.