CHARACTERISTICS AND EXTENT OF FRAGMENTATION STRUCTURES AROUND AN IMPACT CRATER

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Impact-induced brittle deformation structures within Malm limestone and lower basement rock in and around the Ries crater are recorded, measured and quantified. Quantifications are mainly done by methods, based on structural geology, classical spatial statistics and fractal geometry. A variety of deformation structures are observed, which include prominent fractures [1], zones of intense fragmentation [2], fracture branching [3], and near-surface target-rock delamination [4]. The characteristics of the prominent fractures as well as their principal orientation show systematic changes with distance from the impact centre. Beyond certain distance, their characteristics are not well recognizable, and their orientations are mainly controlled by pre-given structures of regional tectonics.

The decimeter- to meter-wide zones of intense fragmentation occur as systematical repetitions in horizontal direction and in the vertical Ries Research Bore Hole [5]. The repetition interval is ~3-4 m in horizontal direction, and ~34 m in vertical direction. These periodicities appear typical of impact fragmentation. In horizontal direction, these zones are observed up to a distance of ~1.2 times crater diameter away from the Ries impact centre.

The fracture branching structures on the centimetre- to decimetre-scale are symmetrical as well as strongly anisotropic with preferred fracture orientation roughly parallel to the symmetry plane. The structures show unimodal distribution of branching angles and unequivocally indicate the direction of fracture opening away from the impact centre.

The near-surface delamination is evident by a variety of brittle-plastic structures in the upper layers of the target rocks. Displacements within the delamination zone range from decimeters-to decameters and decrease with increasing depth and distance from the crater centre. Thickness of this zone exponentially decrease with distance from the impact centre. Distance-related presence of brittle deformation structures and changes of their characteristics most likely result from interaction of rapidly varying impact-induced shock and rarefaction waves, evolved in horizontal and vertical direction from the point of impact. In general, fragmentation structures developed during this type of dynamic deformation are different from that of quasi-static regional tectonic deformation.

References: [1] Hossain M. S. and Kruhl J. H. 2014. *GeoFrankfurt2014-Earth System Dynamics conference* SDGG, issue 85, pp. 76-77. [2] Hossain M. S. and Kruhl J. H. 2014. *Pure and Applied Geophysics* DOI:10.1007/s00024-014-0922-8. [3] Sagy A. et al. 2001. *Journal of Structural Geology* 23:1223-1239. [4] Kenkmann T. and Ivanov B. A. 2006. *Earth and Planetary Science Letters*. 252:15-29. [5] Ernstson V. K. and Pohl J. 1974. *Geologica Bavarica* 72, 81-90.