THE FIRST THREE DIMENSIONAL MODELS OF SHATTER CONES.

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Introduction: Shatter cones are used as a macroscopic diagnostic evidence for impact. Various models [1-4] or combination of models have been proposed over the last 50 years for their formation, but additional work is necessary to determine which model is correct. In particular, geometrical parameters may offer critical tests. We report here the first 3-D models of 30 shatter cones from 16 different impact structures obtained from two techniques.

Methods: The first one uses a commercial digital camera and combines typically 30 to 100 images taken in the field or in the laboratory, whereby the focus point is varied in regular steps. The second technique uses a 3-D laser scan. It offers a better resolution, but requires the transport of (necessarily smaller) samples back into the laboratory.

Results: Mathematical parameters of quadric surfaces are extracted from each shatter cone 3-D models by a least-squares optimization [5]. Each shatter cone specimen may be then classified as having a planar, conical, parabolic, or hyperbolic surface using the surface invariants with respect to rotation and translation. Standard parameters for the different types of quadric surfaces are then calculated and these results may be directly confronted to model's predictions. Preliminary results indicate that the studied shatter cones have the characteristics of hyperboloid surfaces.

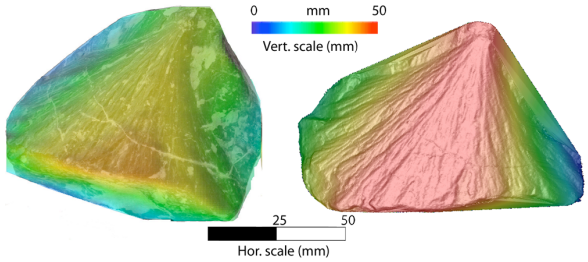

Fig. 1. *Left: 3-D Model from 45 pictures of a shatter cone specimen from Haughton impact crater processed with the Helicon Focus software (picture of the specimen displayed by transparency). Right: Color-coded shaded-relief image from the 3-D model calculated from 8573487 points acquired with a laser scan. Diverging striations are visible on the digital model (same specimen, orientation is slightly different).*

References: [1] Sagy et al. (2004) JGR, 109, B10209. [2] Baratoux and Melosh (2003) EPSL 216, 43-54. [3] Dawson (2009), DYMAT. [4] Wieland et al. (2006) MAPS, 41(11). [5] Dai et al. (2007) Patter Recognition, 40, 504 - 515