DIAGNOSTIC CRITERIA FOR THE RECOGNITION OF SHATTER CONES.

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Shatter cones are commonly described as being conical striated fracture surfaces formed due to hypervelocity impact. Other structures having similar, but not identical morphological elements include blast fractures and natural percussion marks, slickensides, wind abrasion structures and cone-in-cone structures. Precise identification of shatter cones is necessary to prevent confusion with these similar structures. A criteria for the identification of shatter cones is based on elements of their morphology combined with field habit.

Three basic criteria must met for structure to be considered a valid shatter cone: (1) The structure must be a conical, or part conical, fracture surface; (2) ridge and groove striations diverging from an apex or central striae must be present; and (3) the structure must be pervasive and not surficial.

Blast fractures are true fracture surfaces, but do not display a conical fracture surface. Most commonly they consist of a radiating array of planar fractures. Percussion marks result from the impact of boulders in a rapid flow, fluvial setting. They comprise a conical fracture surface that may include crude striations, so their morphology is superficially similar to that of a shatter cone. However, their occurrence is restricted to the outcrop surface and, as such, they do not form a pervasive fracture system throughout the rock. Slickensides have ridge and groove striations similar to those of a shatter cone. However, the fracture surface is planar, or occasionally curviplanar, and lacks the conical shape and divergent striations of shatter cones. Cone-in-cone structures are not fracture surfaces, but are displacive growths of calcite within a carbonate-rich sediment. As such they possess a characteristic internal structure that is distinct from that found in shatter cones. Conical structures formed as a result of wind abrasion lack a fracture surface and are spatially restricted to outcrop surfaces and prevailing wind direction at the time of formation.

If care is taken, the above evidence can be used to distinguish true shatter cones formed by hypervelocity impact from other conelike structures at the mesoscopic scale (i.e., in the field). At the microscopic scale, shatter cones may be further distinguished by the localization of planar deformation features (PDFs) in the vicinity of the cone surfaces, as well as by the presence of spherules (vapor condensates) and high-pressure polymorphs indicative of shock.