

Robert Edie

Advisor: Dr. Jarred Morrow

Using XRD peak broadening analysis on quartz to identify shatter cones of the Santa Fe Impact Structure in New Mexico.

Abstract:

In addition to such large-scale features as craters and remote sensing anomalies, evidence for meteorite impact events is abundant at both micro- and mesoscopic scales. Micro-structural damage, planar deformation features, and planar fractures within quartz and other silicate mineral grains all give direct, supportive petrographic evidence for the existence of shock-metamorphic conditions associated with impact events. Planar deformation features and planar fractures can be difficult to identify. They can also be easily confused with other natural geologic patterns and misinterpreted. A diagnostic mesoscopic shock-metamorphic feature found at many impact sites are shatter cones, which are distinctive, meter-scale, horsetail-shaped, striated conical surfaces that develop at low to moderate shock pressures (i.e., ~5–25 GPa). This project investigates a new technique for identifying quartz grains along the surfaces of shatter cones that have been affected by shock metamorphism. As previously shown in laboratory and naturally shocked quartz-rich samples, peak broadening within quartz X-ray diffraction (XRD) spectra can give evidence for shock-driven sub-microscopic alteration of mineral crystal lattice structures. Well-developed shatter cones developed within quartz-rich crystalline host rocks collected from the Santa Fe Impact Structure in New Mexico were analyzed with XRD to detect evidence of shock-related spectral peak broadening. This evidence is identifiable and repeatable with the chosen data set of the project. Although highly variable, peak broadening was detected for all samples tested at specific crystal orientations. This peak broadening further supports the shock-metamorphic origin of the shatter cones. The XRD method may provide an important new tool for identifying the shock origin of possible shatter cones present at other suspected impact sites.