Geophysical Research Abstracts, Vol. 8, 06359, 2006
SRef-ID: 1607-7962/gra/EGU06-A-06359


# Shock-induced crystal-plastic deformation and post-shock annealing of quartz: microstructural evidence from crystalline target rocks of the Charlevoix impact structure, Canada

**C.A. Trepmann** (1), J.G. Spray (2)

(1) Institut für Geologie, Mineralogie und Geophysik, Ruhr-Universität Bochum, Germany, Collaborative Research Center 526.

(2) Planetary and Space Science Centre, Department of Geology, University of New Brunswick, Canada.

Two distinct types of quartz microstructure in charnockitic target rocks and quartz veins of the Charlevoix impact structure are compared and contrasted in order to distinguish shock-induced microstructures that indicate a high hydrostatic stress component of the shock wave-associated stress from those that indicate a high deviatoric component, as well as associated microstructures that were generated during post-shock relaxation. The dominant shock effects in the type 1 microstructure in charnockites at ∼2-4 km from the centre of the structure are planar deformation features (PDFs) parallel to rhombohedral planes of quartz. The abundance of different sets of these PDFs indicates a high hydrostatic component of the shock wave-associated stress (∼10-15 GPa). Evidence of crystal-plastic deformation due to high deviatoric stresses is absent. In contrast, PDFs parallel to the basal plane are predominant in the type 2 microstructure developed in rocks at ∼4-9 km from the centre of the structure, whereas rhombohedral PDFs are rare. This indicates a lower hydrostatic stress component (∼7-8 GPa), which correlates with a radial decrease in recorded peak shock pressure. The basal PDFs are revealed by transmission electron microscopy to represent mechanical Brazil twins, which give evidence for crystal-plastic deformation at high deviatoric stresses. These findings imply that the deviatoric component of the shock wave-associated stress increases relative to the hydrostatic component with increasing distance from the centre of the impact structure. In the type 2 microstructure,

numerous deformation bands, strong undulose extinction and cataclastic zones at the optical scale, as well as glide-dislocations and microcracks at the TEM scale, occur in association with basal PDFs, and are therefore also interpreted to be shock-induced. This is consistent with the observation that quartz from the outer part of the impact structure is devoid of similar features. Thus, the highly heterogeneous and localized glide-controlled deformation including mechanical twinning and accompanied by microcracking recorded by the type 2 microstructure is suspected to be induced by the high deviatoric stresses and high loading rates during shock. Post-shock recovery is indicated in the type 1 microstructure by the actual microstructure of rhombohedral PDFs, dislocations in climb configuration and well-ordered low angle grain boundaries, as well as in the type 2 microstructure by the occurrence of small elongate subgrains with low angle grain boundaries paralleling low-index planes. This has probably taken place during annealing shortly after the impact event at quasi-static conditions and still sufficiently high post-shock temperatures, rather than during a separate regional thermal event.