Transient states of reconstructive phase transitions captured in shock recovery experiments

O. Tschauner[a], S.N. Luo[b,c], P.D.Asimow[d], T.J.Ahrens[b], J. Mosenfelder[d], D.C. Swift[c], T.E. Tierney[c], D.L. Paisley[c], S.J. Chipera[c]

[a] High Pressure Science and Engineering Center, Department of Physics, University of Nevada, Las Vegas, NV 89154-4002, USA;

[b] Lindhurst Laboratory of Experimental Geophysics, Seismological Laboratory, California Institute of Technology, Pasadena, CA 91125, USA;

[c]Plasma Physics (P-24) and Earth and Environmental Sciences (EES-11), Los Alamos National Laboratory, Los Alamos, NM 87545, USA;

[d] Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA 91125, USA

Upon compression many materials undergo major reconstruction of their structure and bonding involving an increase in coordination of constituting atoms and change in bonding-character. While transforming, the materials pass through intermediate states, which are usually to fugitive to be captured and examined. Shock experiments allow in many cases for quenching such intermediates structural states. Recent developments in techniques of X-ray diffractometry allow for quantitative examination of structures of even very small amounts of shock-retrieved crystalline phases.

We discuss carbon and silica as examples of systems where we succeeded in quenching such interesting intermediate states of structure from shock-experiments. We present the structures of the retrieved new phases of carbon and silica and discuss them with respect to the transformation mechanisms. Further, we discuss states of disorder in some of these phases as being intrinsic to these transformation mechanisms.