Shock wave treatment of calcite up to 116 GPa

THOMAS SCHLOTHAUER[1], ULF KEMPE[2], EDWIN KROKE[1], GERHARD HEIDE[2]

[1] TU Bergakademie Freiberg, Institute of Inorganic Chemistry, Leipziger Strasse 29, D-09599 Freiberg/ Germany

[2] TU Bergakademie Freiberg, Institute of Mineralogy, Brennhausgasse 14, D-09599 Freiberg/ Germany

Most investigations addressing the high pressure behavior of carbonates in the Mbar-range over the last decades relied on experiments with diamond anvil cells (DAC). Shock wave synthesis, which is an alternative and complementary approach, was rarely used and often restricted to investigation of impact events. The main problems encountered in shock wave methods are degassing of carbonates along the release path and a complete sample loss for experiments at very high pressures. These problems result in a low reproducibility and make it difficult to compare experiments.

The requirements to obtain carbonate-HP-phases with shock waves are quite different from the impact research. For this reason several methodological developments were performed in the Shock Wave Laboratory of the FHP (Freiberg High Pressure Research Centre) during the past seven years. This concerns the “Impedance Corrected Sample Container”, the “self sealing sample holder with halides as impedance powder”, the determination of the role of adiabatic decompression for the melting behavior and finally the application of W/Cu-alloys for shock synthesis experiments. For all EoS-calculations self developed algebraic ecuations based on the linear Up-Up-relationship were used. These equatuions are valid only for the solid state of all involved materials (flyer, container sample, pressure medium etc.). .

This allows shock experiments on carbonates in the Mbar-range for the first time concerning possible recoverable HP-phases of carbonates (upper pressure limit currently ~2 Mbar).

In a first set of experiments synthetic calcite was shocked to pressures up to 116 GPa under different T/p-ratios. The samples were analysed with XRD, IR- and Raman-spectroscopy and ^{13}C-MAS-NMR. An overview over the results will be given. Novel phases were not found but the calcite shows very intense internal twinning and indications of chemical reactions inside the cristallites. Any degassing of the carbonate was excluded. These invetsigations show that the new FHP-methods are usable for carbonates also in the Mbar-range.