

A quartz-to-coesite solid-state transformation pathway: Experimental evidence

Langbein*, J., Pollok, K., Fazio, A., Langenhorst, F.
*Institute of Geosciences/CEEC II, Friedrich Schiller
University, Lessingstr. 14, D-07743 Jena
(jessica.langbein@uni-jena.de)

Shock-experiments with a modified setup were conducted at the Ernst-Mach Institute, Freiburg, using an ARMCO container and crystallographically oriented single-crystal discs of Quartz. The sample discs were inserted at 45°, resulting in variable pressures (19 - 10 GPa) within an oriented sample and maximum shear. Nanometer sized, uniformly oriented coesite crystals were formed along common amorphous planar deformation features (PDFs), indicating a lamellar transformation mechanism. The coesite crystals are defect-free, but show enlarged lattice parameters. The uniform orientation and lack of defects in coesite provide evidence for a solid-state transformation pathway from quartz to coesite, which apparently only occurs under strong shear conditions. Recent molecular dynamics calculations and investigations of impact coesite are in line with our observations and support the existence of an formation of coesite by a direct solid-state mechanism [1,2], rather than by liquidus crystallization.
[1] Campanale et al. (2021) Scientific reports 11:16011. [2] Schaffrina et al. (2024) Scientific reports 14:3760.