Riesite, a new high pressure polymorph of TiO_2 that forms upon shock-release - comparison to $(Zr,Ti)O_2$ in pseudotachylites

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High-pressure polymorphs in shocked meteorites and terrestrial impactites provide valuable information about shock pressure, -temperature, and -duration. Among the increasing number of shock-generated high-pressure polymorphs in nature, there has been none that constraints conditions of shock-release through structure and conditions of formation: clinopyroxenes, magnetite-wüstite intergrowth, potentially wadsleyite reflect P-T conditions below peak shock conditions but they do not well constrain pressures and time-intervalls of release. Shock release is rather poorly understood in general and for natural impact events in particular. Thus, the discovery of a mineral that only forms upon shock-release provides for the first time a set of constraints on pressure-temperature-time evolution during release from an impact

We discuss occurrence, conditions of formation, and structural features of the newly approved shock-metamorphic mineral, riesite (IMA2015-110a), which has been discovered in shock-melt veins in bedrock xenoliths from the Ries impact structure in Germany.

Results

We show that riesite is result of a retrograde transformation of akaogiite (baddeleyite-type TiO_2) at fast time scales via the subgroup-chain $P2_1/c \rightarrow P1c1 \rightarrow P12/c$. Riesite replaces akaogiite at temperatures between 1000 and 1500K at pressures below 6 GPa.

In comparison $(Zr_{0.86},Ti_{0.14})O_2$ in an earthquake-related pseudotachylite assumes the baddeleyite-type structure indicating formation at > 1400K and sub GPa-pressure.

This work was supported by DOE-NNSA award DE-NA0001974, by NSF-EAR-1128799, DOE-Geosciences DE-FG02-94ER14466, and DOE-BES contract DE-AC02-06CH11357