MARTENSITIC MECHANISM OF THE ZIRCON-TO-REIDITE TRANSFORMATION.

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Introduction: Zircon transforms at high-pressure to the scheelite-structured polymorph reidite. This high-pressure polymorph has so far only been discovered in various impact craters, where it apparently formed in solid state.

The only plausible type of reconstructive solid-state mechanism that can operate at the short time scale of impact events is a martensitic transformation [1]. Such a rapid transformation mechanism has been proposed previously [2] but the details of this transformation process have so far not been addressed in the light of the defect microstructure of shocked zircon [3].

Results and discussion: Shock experiments have revealed abundant planar defects parallel to {100} planes of zircon and an epitaxial relationship between zircon (Zr) and reidite (Rei) with {100}Zr ‖ {112}Rei and [001]Zr ‖ <110>Rei [3]. Close inspection of the zircon structure shows that the cation positions of Zr and Si in zircon can be displaced into the positions expected in reidite by a glide system operating on the {100} planes with a displacement vector of ¼ <010>.

After this martensitic shear mechanism displasive rotations of oxygens around the cations fully convert the zircon structure into the scheelite structure. This two-stage transformation mechanism is similar to that described by [2], but additionally introduces a glide system that enables martensitic shearing.

Altogether the transformation model provides a consistent explanation for the conversion of chains of edge-sharing alternating SiO_4 tetrahedra and ZrO_8 dodecahedra in zircon to chains of only corner-sharing polyhedra in reidite.

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