MICROSTRUCTURAL ANALYSIS OF THE ZIRCON TO REIDITE TRANSFORMATION

T. M. Erickson[1], N. E. Timms[1], A. J. Cavosie[1], M. A., Pearce[2], J. Bourdet[2], W. D. Rickard[1], A. A. Nemchin[1], S. M. Reddy[1], [1]Curtin University, Perth, GPO Box U1987, Western Australia 6845, Australia, *Corresponding author: Timmons.erickson@gmail.com, [2] CSIRO, Australian Resources Research Centre, 26 Dick Perry Avenue, Kensington, WA, 6151, Australia.

Introduction: Zircon ($ZrSiO_4$) is used to study impact structures because it responds to shock loading and unloading in distinct, crystallographically-controlled manners [1,2]. One such phenomenon is the transformation of zircon to the high-pressure polymorph reidite [1,3]. This study aims to quantify the geometric and crystallographic orientation relationships between the two phases using naturally shocked zircon from clasts in suevite breccia which experienced shock stage II and III conditions from the Nördlingen 1973 borehole, near the center of the 14.4 Ma Ries impact crater, Bavaria, Germany [4].

Reidite-bearing shocked zircon have been characterized, using a combined electron backscatter diffraction (EBSD) and focused ion beam (FIB) cross-sectional imaging approach. Reidite (r) occurs as cross-cutting lamellae (Fig. 1), in up to four sets of non-rational habit planes within individual zircon (z) grains. However, EBSD mapping demonstrates that all occurrences of lamellar reidite have a consistent interphase misorientation relationship with the host zircon that is characterized by alignment of a {100}z with a {112}r and alignment of a {112}z with a conjugate {112}r. A compilation of data from multiple zircon grains show eight orientation variants of reidite, which is consistent with the total possible variants of the interphase relationship for reidite transformation given the tetragonal symmetry of both zircon and reidite. Furthermore, laser Raman mapping of one reidite-bearing zircon shows that moderate metamictization at time of impact inhibited reidite lamellae formation, which highlights that the intrinsic crystallinity of the host zircon exerts some control on the phase transformation [5].

In addition to lamellar reidite, submicrometer-scale granules of reidite were observed in one zircon. The majority of reidite granules have a topotaxial alignment that is similar to lamellar reidite, with some additional orientation dispersion [6]. We propose that lamellar reidite likely forms exclusively in highly crystalline zircon, probably via a displacive transformation mechanism. In contrast, in radiation damaged zircon, granular reidite can nucleate, probably via a reconstructive transformation, and grow while zircon is within the reidite stability field. The results of this study further refine the orientation relationship of the zircon to reidite transformation and further constrain the formation mechanisms and conditions of this transformation in naturally shocked zircon.

[1] Leroux et al. 1999. *EPSL* 169:291–301. [2] Timms et al. 2012. *MAPS* 47:120– 141. [3] Wittmann et al. 2006. *MAPS* 41:433– 454. [4] Bauberger et al. 1974. *Geologica Bavarica* 72:33– 34. [5] Reddy et al. 2015. *Geology* 43:899– 902. [6] Cavosie et al. 2015. *Geology* 43:315–318.

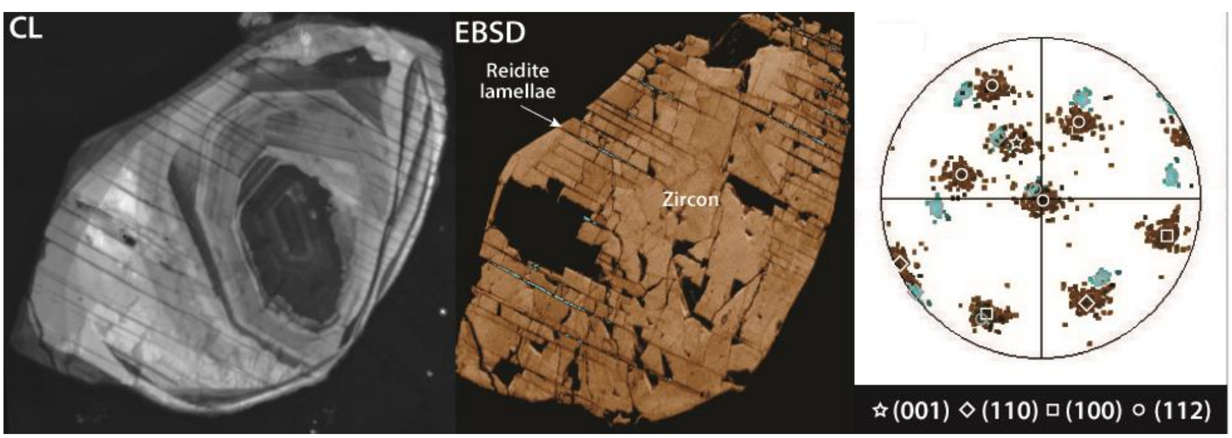

Figure 1. Cathodoluminesce image (left) and EBSD map (center) with pole figure (right) of a lamellar reidite-bearing shocked zircon from the Ries impact structure. In the EBSD map and pole figure, zircon is brown, and reidite lamellae are blue.