Monazite as a tectonic and shock deformation chronometer – linking EBSD and U-Pb analyses

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Monazite is an important mineral for P-T-t studies of igneous and metamorphic rocks. Monazite has recently been used to directly date high temperature deformation in crustal rocks from the Sandamata Complex, India [1]. EBSD analysis identified a variety of microstructures, including deformation twins in three orientations: 180°/ <100>, 180° / <001> and 95° / <201>. The monazites also contain dynamic recrystallization textures including low-angle boundaries formed by subgrain rotation, and neoblasts that nucleated in high strain domains and grew via grain-boundary migration. SHRIMP U-Th-Pb analysis identified partial Pb-loss associated with the low-angle boundaries, and complete age resetting in the neoblast domains.

Shocked monazites have been investigated from the Araguainha (Brazil), Ries (Germany) and Vredefort Dome (South Africa) impact structures. Previous studies of shocked monazite report complex U-Pb systematics [2, 3, 4, 5], however these studies did not target specific shock microstructures. EBSD analysis of shocked monazites identifies a large number of deformation features including low-angle boundaries, planar deformation bands, shock microtwins and neoblasts. In addition to the three orientations of twins reported from tectonic deformation [1], we find the following 7 twin disorientation relationships in shocked monazite: 180° / <101>, 180° / <201>; 110° / <10-1>; 147 / <10-1>, 110° / <111>, 107°/ <41-1> and 55° / <001>. SHRIMP U-Th-Pb analyses of neoblastic domains in monazites from Araguainha and Vredefort record the impact age. Correlating *in situ* U-Th-Pb analyses with specific monazite microstructures identified by EBSD mapping provides a new method for determining the age of different types of deformation events that are typically challenging to date.

[1] Erickson et al. 2015 Geology; [2] Schärer and Deutsch 1990 GCA; [3] Moser 1997 Geology; [4] Flowers et al. 2003 J. of Geology; [5] Tohver et al. 2012 GCA