Resolving shock features in monazite using EBSD and their effects on SHRIMP U-Pb systematics

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Monazite is an important mineral for P-T-t studies of igneous and metamorphic processes. Impact-shocked monazite has been identified at the Vredefort Dome, South Africa [1, 2, 3] and at the Araguainha structure, Brazil [4]. Shocked monazite can also survive distal fluvial transportation >750 km from the source impact crater [5]. Crystallographic orientations of planar shock microstructures and the corresponding deformation mechanisms responsible for their development have not yet been described; this is in part due to difficulties encountered for EBSD analysis of monazite [6].

In this study, EBSD maps of shocked monazite grains sourced from the Vredefort impact structure were sucessfully acquired using a Zeiss Ultra Plus FEG-SEM with Bruker E-Flash detector and Espirit software and match units with $P2_1/n$ space group. Impact microstructures are dominated by low-angle (<10°) grain boundaries, planar fractures, and polysynthetic twin lamellae in up to 5 different orientations within a single grains, similar to twins in shocked zircon [7]. Twin composition planes and their symmetry relationships (expressed as misorientation angles/axes) include (100) with 180°/<001>, (001) with 180°/<100>, (101) with 180°/<-101>, (-101) with 180°/<101>, (12-1) with 97°/<201> and (-121) with 97°/<-201>.

Preliminary SHRIMP analysis of shocked monazite shows that some domains record pre-impact crystallization ages (e.g. 3100 Ma), whereas other domains are discordant and record a complex array of ages including Proterozoic and modern resetting. The complexity of U-Pb ages requieres further investigation, however these results indicate that impact generated microstructures may give rise to isotopic resetting and facilitate subsequent resetting during younger thermal events.

[1] Moser 1997 *Geology* [2] Flowers *et al* 2003 *J. of Geology*. [3] Cavosie *et al*. 2010 *GSA* Bulletin [4] Tohver *et al* 2012 *GCA* [5] Erickson *et al* 2013 GCA [6] Reddy *et al* 2010 Mineralogy Magazine [7] Erickson *et al* 2013 *Am Min*.