Geochronology of *ex situ* shocked zircons: Towards dating impacts

AARON J. CAVOSIE[123], STEVEN M. REDDY[1], NICHOLAS E. TIMMS[1], TIMMONS M. ERICKSON[1] AND MAYA R. PINCUS[3]

[1]TIGeR, Dept. of Applied Geology, Curtin Univ., Perth, Australia. aaron.cavosie@curtin.edu.au

[2]NASA Astrobiology Institute, Dept. of Geoscience, Univ. of Wisconsin-Madison, USA

[3]Dept. of Geology, Univ. Puerto Rico-Mayagüez, USA

Recreating the early Solar System impact chronology may be advanced through study of shock-deformed zircons, which are present on the Moon [1-3] and are actively being sought in ancient detrital populations on Earth [4]. Detrital shocked zircons lack petrographic context, similar to those within lunar impact breccia; identification of diagnostic impact evidence, such as microtwins [1] [5-7] and/or the presence of reidite [8] [9] confirms shock deformation. Electron backscatter diffraction (EBSD) analysis facilitates targeted *in situ* geochronological analysis of shock-deformed domains which may yield an impact age.

Correct interpretation of U-Pb ages from *ex situ* shocked zircons critically relies on characterizing the microstructure. Grains with planar microstructures (PFs, PDFs, microtwins), generally do not yield impact age [c.f., 5]. Highly deformed shocked zircons with curved microtwins from the Moon [10] and Vredefort Dome [this study] are evidence of continued deformation by crystal plasticity following the shock wave, however age resetting is not detectable within 20 um diameter spot analyses. Grains with granular textures record impact ages due to Pb mobility during grain boundary migration associated with the growth of strain-free neoblasts. However, granular textures can also form during high-grade metamorphism, and so are not unique to impacts. Determining impact ages for *ex situ* shocked zircons on the Earth or Moon requires identifying evidence of diagnostic shock deformation, such as microtwins or reidite, followed by targeted U-Pb analysis at scales that avoid volume-averaging of variably reset age domains. Application of new instrumentation-enabled approaches to nanogeochronology, such as atom probe tomography [11], may permit dating of early Solar System impact events recorded in shocked zircon.

[1] Timms et al. 2012 MAPS [2] Grange et al. 2013 GCA [3] Valley et al. 2014 CMP [4] Cavosie et al., 2010 GSAB [5] Moser et al. 2011 CJES [6] Erickson et al. 2013 Am Min [7] Thomson et al. 2014 GSAB [8] Wittmann et al. 2006 MAPS [9] Cavosie et al. 2015 Geology [10] Crow et al., 2015 LPSC [11] Valley et al. 2015 Am Min