WHERE ARE THE SHOCKED GRAINS IN THE HADEAN ZIRCON RECORD? INSIGHTS ON THE PRESERVATION OF SHOCKED ZIRCON AND THEIR U–Pb SYSTEMATICS. T. M. Erickson[1,2,3,4] A. J. Cavosie[2,3], N. E. Timms[2,3], S. M. Reddy[2,3], A. A. Nemchin[2,3], M. A. Cox[2,3], M. Schmieder[3,4], D. A. Kring[3,4], [1]Jacobs – JETS, ARES division, NASA JSC, Houston, TX 77058, USA (timmons.m.erickson@nasa.gov), [2]School of Earth and Planetary Sci., Curtin Uni., Perth, WA 6102, Australia, [3]NASA Solar System Exploration and Research Virtual Institute [4]Center for Lunar Science and Exploration, LPI, USRA, 3600 Bay Area Blvd., Houston TX 77058 USA

Introduction: While the earliest history of many planetary bodies within the inner Solar System is dominated by intense bombardment, this record is missing from Earth due to active tectonics and erosion. Whereas rocks from the earliest history of Earth are absent, mineral relics, such as ancient detrital zircon concentrated in sediments within the Jack Hills, Narryer, Illara and Maynard Hills greenstone belts of the Yilgarn Craton in Western Australia preserve a record of this time.

Shock in zircon: During shock deformation, resulting from hyper-velocity impact, zircon can be modified in crystallographically-controlled ways. This includes the development of planar and subplanar low-angle grain boundaries, the formation of mechanical {112} twins [2], transformation to the high pressure polymorph reidite [3], development of polycrystalline microtexture [4], and dissociation to its dioxide constituents SiO_2 and ZrO_2 [5].

Shock Effects on U-Pb systematics: Shock microstructures can also variably affect the U–Pb isotopic systematics of zircon (e.g., [6, 7, 8]) and, in some instances, be used to constrain the impact age. While shocked zircon containing planar microstructures including (100) deformation bands, {112} shock twins, and curvi-planar fractures can be partially reset such that the lower intercept Concordia age is consistent with the impact event [6], this record is often obscured by subsequent tectonothermal events [7, 8]. The U-Pb ages of granular zircon neoblasts [9, 10] are completely reset during impact event, whereas other polycrystalline textures may be partially to completely reset.

Longevity of shocked zircon: Although zircon is extremely refractory and can survive multiple tectonothermal reworking events, erosion and deposition, shocked zircon is pervaded by defects and grain boundaries. Nevertheless, detrital shocked zircon derived from the Vredefort Dome in South Africa has been shown to survive long distances of transport within the Vaal River [7, 11], deposition in paleo fluvial terraces [12] and delivery to the Atlantic coast >2000 km from the crater [13]. Detrital shocked zircon grains have also been found in sediments from the highly tectonized Santa Fe impact structure [14] and within fluvial and glacio-fluvial sediments of the Sudbury impact structure [15]. While shocked zircon derived from the target bedrock of Vredefort Dome is found throughout the Vaal basin, the U-Pb systematics of the grains do not record an impact age [7, 9].

Hadean shocked zircon (or lack thereof): Despite thousands [this study] to tens of thousands of grains surveyed [16] no convincing shocked zircon grains have yet been reported. This may in part be due to the limitation of these studies to only surveying the Eranondoo Hill W74 discovery site in the Jack Hills. However, it suggests that the surviving Hadean zircon population is biased against shocked grains. Although shocked zircon grains with planar microstructures including twins and reidite lamellae can survive long distances of transport, it is still unclear whether polycrystalline aggregates can survive transport, sedimentation and diagenesis, or moderate metamorphic overprinting. Furthermore, while the volume of U-Pb shock-reset zircon from ancient craters may be large [17], these grains may be susceptible to subsequent age resetting, so caution should be used when interpreting U–Pb data from any future shocked grains discovered.

References: [1] Wilde S. A. et al. (2001) *Nature, 409,* 175–178. [2] Erickson T. M. et al. (2013) *Am. Min., 98,* 53–65. [3] Glass B. P. & Liu S. (2001) *Geology, 29,* 371 – 373. [4] Cavosie A. J. et al. (2016) *Geology, 44,* 703–706. [5] Timms N. E. et al. (2017) *EPSL, 477,* 52–58. [6] Moser D. E. et al. (2011) *Can. J. Earth Sci., 48,* 117–139. [7] Erickson T. M. et al. 2013. *GCA, 107,* 170–188. [8] Schmieder M. et al. (2015) *GCA, 161,* 71–100. [9] Cavosie A. J. et al. (2015) Geology, 43, 999–1002. [10] Kenny G. G. et al. 2017, Geology, 45, 1003–1006. [11] Cavosie A. J. et al. (2010) *GSAB, 122,* 1968–190. [12] Cavosie A. J. et al. (2018) *AGU monograph, 232,* 203–224. [13] Montalvo P. E. et al. (2017) Am. Min., 102, 813–823. [14] Montalvo P. E. et al. (2018), *GSAB,* in press. [15] Thomson O. A. et al. (2014) *GSAB, 126,* 720–737. [16] Cox M. A. et al. 2018, *LPSC Ab.* 1402 [17] Abramov O. et al. (2013) *Chem. Erde.,* 73, 227–248.

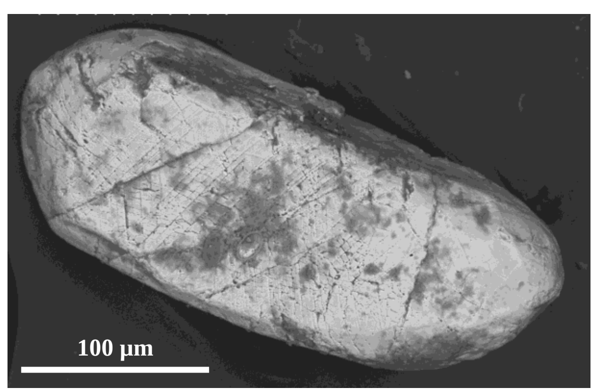

Figure 1. Scanning electron BSE image of Vredefort-derived shocked zircon from the Vaal River after [7].