**NANO-SCALE RECORDS OF SHOCK DEFORMATION: EBSD IDENTIFICATION OF REIDITE AND SHOCKED ZIRCON IN SANDSTONE AT THE ORDOVICIAN ROCK ELM IMPACT STRUCTURE.**

A. J. Cavosie1,2,3, T. M. Erickson1, and N. E. Timms1 1Dept. of Applied Geology, Curtin Univ., 2Dept. of Geoscience, Univ. of Wisconsin-Madison, 3Dept. of Geology, Univ. of Puerto Rico-Mayagüez

**Introduction:** The terrestrial record of meteorite impacts is difficult to decipher because unequivocal evidence of impact is increasingly destroyed with time by erosion, burial and tectonics. Zircon survives these processes as a shocked mineral, and above 30 GPa transforms to reidite, a high pressure ZrSiO$_4$ polymorph diagnostic of impact shock. However, the utility of reidite has been limited by its identification; it has only been reported from three relatively young (<36 Myr) impact craters globally. Here we report EBSD results that document a new occurrence of reidite in brecciated sandstone from the Ordovician Rock Elm impact crater in Wisconsin, USA.

**Background:** Rock Elm is a 6.5 km diameter impact crater in western Wisconsin, USA. The complex crater is formed in Upper Cambrian and Early Ordovician sedimentary rocks, with an impact age of 470-450 Ma [1,2]. The central uplift exposes the Mt. Simon sandstone and rare blocks of breccia. The breccia is comprised of lithic clasts of variable size and composition within a matrix of sand-sized particles. Shocked quartz grains with planar fractures in the breccia indicate pressures of 5-10 GPa [2,3], confirming an impact origin.

**Methods and Samples:** Electron backscatter diffraction (EBSD) mapping of a polished section of breccia sample 13RE07 using a Tescan Mira3 at Curtin University revealed the presence of reidite in two zircon grains, and a zircon with diagnostic shock microtwins.

**Results:** In zircon 36, EBSD mapping using 50 nm step size identified five parallel sub-µm wide microtwin lamellae (Fig. 1A) [4]. In zircon 9, two sets of parallel sub-µm reidite lamellae were identified (Fig. 1B). Reidite crystallographic poles show tight clusters, such that each lamellae set shares its (001) with a different {110} in the host zircon, and a {110} for each reidite set aligns with (001) of the host zircon. A previously undescribed nanoparticulate form of reidite is also present within vugs and fringing the rim of zircon 9. These neoblasts are weakly and/or randomly crystallographically aligned with the host zircon.

**Conclusion:** Reidite provides the first diagnostic evidence for ultra-high-pressure shock metamorphism at Rock Elm, and is also the oldest reported occurrence worldwide. Considering its small size, and the ubiquitous presence of detrital zircon in siliciclastic rocks, reidite may be more common in the impact record but has potentially gone undetected. This work was supported by the National Science Foundation (EAR-1145118), NASA Astrobiology, and Curtin University.

**References:**

![Figure 1](image-url) Shocked minerals from breccia 13RE07. (A) EBSD map of zircon 36 showing microtwins (green). (B) Map of zircon 9 showing intergrown reidite lamellae (green) and nanoparticulate reidite. Both maps show an inverse pole figure color scheme.