The Search for Shocked Zircon at Spider Impact Structure, Western Australia.

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Introduction: Impact cratering is an important and widespread geological process throughout the solar system, and shocked minerals provide diagnostic criteria used in confirming an impact event [1].

Spider impact structure is located ~430 km NE of Broome, Western Australia, and is a confirmed meteorite impact structure through identification of shatter cones and shocked quartz [2,3], both diagnostic criteria used to confirm impact events. Shocked zircon, however, has yet to be reported at the Spider structure. Here, we report preliminary results of our search for shocked zircon at the Spider impact structure.

Shock microstructures in zircon, such as planar fractures and planar deformation features, form from high pressures due to hypervelocity impact as shock waves travel through target rocks [4]. Zircon is a important mineral used in deciphering impact structures, as it is resistant to post-impact processes [5-10], and forms shock microstructures above 20 GPa [5]. More recently, the phosphate mineral xenotime (YPO_4) has been found to form shock microstructures at pressures below 20 GPa [11], and thus has great potential for recording impact evidence.

Figure 1. Shatter cones in the Warton sandstone from the central uplift at the Spider impact structure. (Scale card= 10 cm)

The central uplift at Spider crater exposes the Warton sandstone (1704±7 to 1786±14 Ma) and Pentecost sandstone (1704±14 to 1774±9 Ma) [2,12], both of which underwent diagenesis pre-impact [12,13]. This resulted in formation of ubiquitous diagenetic xenotime overgrowths around detrital zircon grains, both of which would have been shocked during the impact. Identification of shocked zircon with shocked xenotime overgrowths would thus allow for the first empirical cross-calibration of the shock response of xenotime co-existing and in contact with zircon during impact metamorphism.

Results and Discussion: A total of 10 samples were collected from the central uplift of the Spider impact structure. Samples include shatter cones in both the Warton and Pentecost sandstones, along with monomict sandstone breccia. Outcrops where samples were collected contain abundant shatter cones with cones sizes ranging in length from ~5 cm to 30 cm (Fig. 1).

Samples were cut and made into thin sections, and analysed using optical and scanning electron microscopy. Sections contain abundant grains of shock-deformed quartz, which have planar fractures (PFs) and planar deformation features (PDFs). Zircon grains

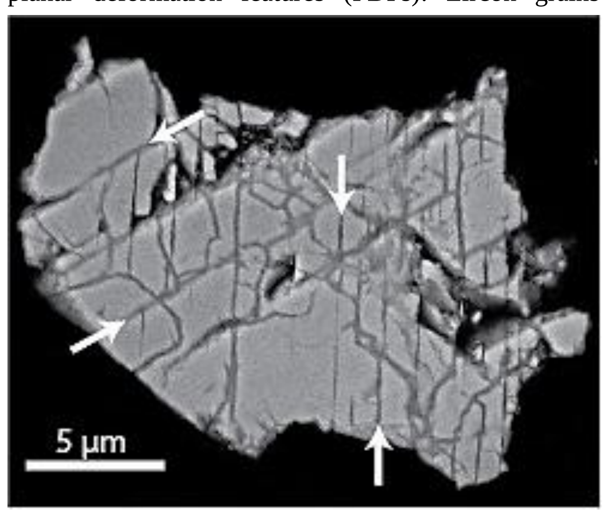

Figure 2. Backscatter electron image of a zircon exhibiting planar microstructures from a thin-section of sandstone breccia from the Spider structure.

within the sections are heavily fractured and deformed; a total of 5 zircon grains exhibiting planar microstructures were identified in one thin section of breccia analyzed to date (Fig. 2).

The zircon planar microstructures are cross-cutting, with multiple parallel fractures that occur across and throughout the grains. Similar-appearing planar microstructures have been reported in shock-deformed zircon grains from many impact structures such as Vredefort and Sudbury [5,7-10]. The zircon grains examined in our preliminary survey did not contain xenotime overgrowths, however, our survey is ongoing. Zircon grains with planar microstructures will next be analyzed by electron back-scattered diffraction (EBSD) to search for evidence of diagnostic shock features (e.g., {112} deformation twins and reidite).

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Acknowledgements: We gratefully acknowledge support provided by the Eugene Shoemaker Impact Cratering Award (to M. A. Cox) , and funding provided by TiGER, Curtin University.