FIRST REPORT OF SHOCKED ZIRCON AT THE SANTA FE IMPACT STRUCTURE (USA).

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Introduction: The documentation of shocked minerals provides a diagnostic criteria for the identification and confirmation of an impact structure. Studies of detrital shocked minerals in South Africa (Vredefort Dome), and Canada (Sudbury) have demonstrated that they can survive post-impact metamorphism, erosion, and distal sedimentary transport [1-3]. The presence of shatter cones and shocked quartz were used to confirm the Santa Fe impact structure near Santa Fe, New Mexico as having an impact origin [4]. Here we report the first occurrence of shocked zircon at the Santa Fe Impact structure, which were found as detrital grains, rather than in bedrock.

Santa Fe impact structure: The age of impact is poorly constrained, but is believed to have occurred between ~1200 and ~350 Ma [4]. The structure is highly tectonized and deeply eroded; based on shatter cone distribution, the estimated original diamter is from ~6 to 13 km [4].

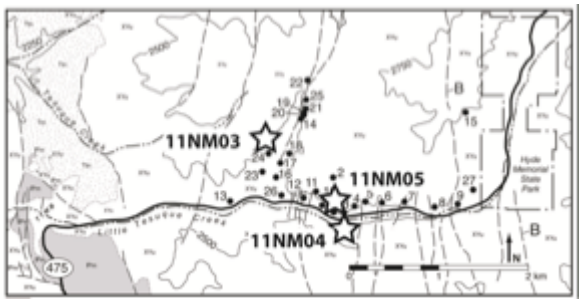

Figure 1. Location of Santa Fe impact structure, after [4]. Stars are locations of sediment samples. Black dots show the location of shatter cones outcrops identified previously [4].

Samples/methods: Three ~ 1.5 kg sediment samples were collected near the Santa Fe impact structure (Fig. 1). Sample 11NM03 is mixed colluvium/alluvium; 11NM04 is modern alluvium from Little Tesuque Creek; 11NM05 is colluvium. Detrital zircons from each sample were hand-picked and imaged with a scanning electron microscope (SEM).

SEM results: Backscattered electron imaging (BSE) was used to search for shock microstructures. A total of 400 detrital zircon grains were examined from sample 11NM05; planar microstructures were identified in two grains (2/400, or 0.5%). Planar fracture [5] sets consisting of open, parallel fractures with 1-10 µm spacing are visible on both exterior and interior surfaces (Fig. 2).

Discussion: These results are the first report of shocked zircons at the Santa Fe impact structure, and represent the third impact structure where detrital shocked zircons have been documented [1-3,5]. The detrital shocked zircons documented here contain planar fractures, which record shock pressures of ~20 GPa [6]; this pressure record is substantially higer than previous reports of ~10 GPa based on PDFs in quartz from bedrock [4]. The host rocks of the detrital shocked zircons have not been identified, but are probably nearby granite or supracrustal rocks [4].

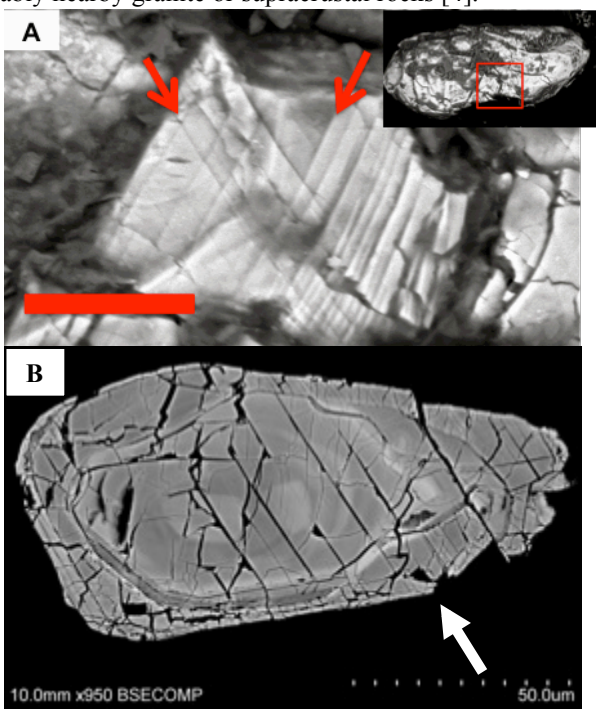

Figure 2. BSE images showing planar fractures (PFs) in detrital zircons from the Santa Fe impact structure. (A) BSE image showing two PF orientations on the exterior surface of grain 11NM05-13. (B) BSE image showing one PF orientation in the polished interior of grain 11NM05-16. Scale bar in (A) is 10µm. Arrows indicate the orientation of planar fractures.

References: [1] Cavosie A. J. et al. (2010) *GSA Bull.*, *122*, 1968-1980. [2] Erickson T. M. et al. (2013) *GCA*, *107,* 170-188. [3] Thompson O. A. et al. (2014) *GSA Bull.*, in press. [4] Fackelman, S. P. et al. (2008) *EPSL, 270,* 290-299. [5] Erickson, T. M. et al. (2013) *Am Min, 98,* 53-65. [6] Leroux H. et al. (1999) *EPSL, 169,* 291-301.