

SHOCKED APATITE FROM THE SANTA FE IMPACT STRUCTURE (USA): A NEW ACCESSORY MINERAL FOR STUDIES OF SHOCK METAMORPHISM

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Introduction: We report the occurrence of detrital apatite crystals with planar microstructures from the Santa Fe impact structure, New Mexico. Apatite grains were collected as colluvium at previously reported shatter cone outcrops [1]. Individual apatite crystals contain up to three sets of parallel, planar microstructures with variable spacing, but mostly from 5-10 μm . Orientations of planar microstructures are distinct from $\{0001\}$ and $\{hki0\}$ apatite cleavages, and form conjugate sets that appear to be in $\{10\bar{1}1\}$ orientation. The microstructures are open (dark in BSE), and are thus interpreted as fractures. The appearance and spacing of the planar microstructures are strikingly similar to planar fractures reported in shocked zircon [2]. The same colluvium samples contain detrital shocked muscovite [3], quartz, and zircon [4], the latter recording impact pressures of at least 20 GPa.

The Santa Fe impact structure: Santa Fe impact structure is a highly tectonized and eroded structure located near Santa Fe, New Mexico, with a loosely constrained age of 1200- 350 Ma [1]. Estimates of original diameter based on shatter cone distribution range from 6 to 13 km.

Samples/methods: Detrital apatite grains were hand-picked from two colluvium samples collected near shattercone outcrops, and also from modern alluvium in Little Tesuque Creek. Samples were analyzed using backscattered electron imaging (BSE) with a scanning electron microscope (SEM).

Results: A total of 166 apatite grains were investigated by examining grain exteriors on SEM stubs and later in polished section in epoxy mounts. Of these, 61 grains were identified that contained planar microstructures ($61/166 = 37\%$). Most grains analyzed were from the two colluvium samples, which averaged 37% (17/46) and 41% (43/105). Only 15 grains were analyzed from the modern alluvium, of which one was shocked ($1/15 = 7\%$).

Discussion: Microstructures in detrital apatite from the Santa Fe structure are remarkably similar to planar fractures reported in shocked zircon [2]. The common occurrence of apatite, ubiquitous in igneous, metamorphic, and siliciclastic sedimentary rocks, highlights the potential of using apatite in studies of shock metamorphism. The presence of detrital shocked zircons in the sample sample [4] indicates the apatite grains experiences shock pressures of at least 20 GPa.

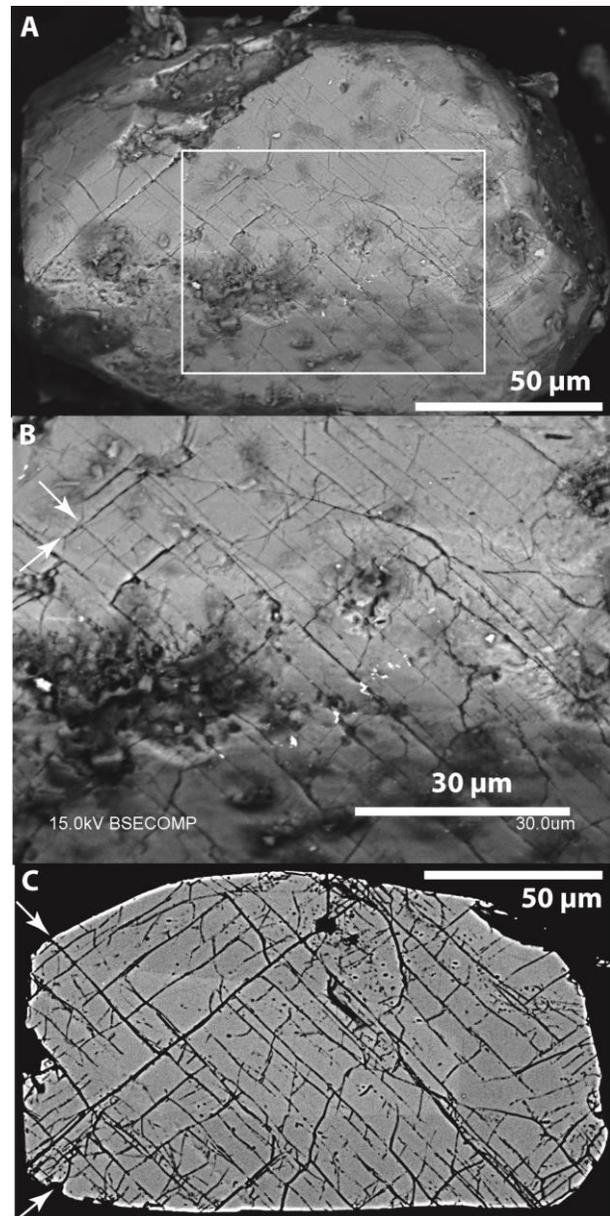


Figure 1. BSE images showing planar microstructures in a detrital apatite from the Santa Fe structure. A, B: exterior surface. C: interior, same grain. Arrows show two orientations of planar microstructures.

References: [1] Fackelman, S. P. et al. (2008) *EPSL*, 270, 290-299. [2] Erickson, T.M. et al. (2013) *Am. Min.*, 98, 53-65. [3] Colon D. and Cavosie A. J. (2014), *LPS*, this volume. [4] Lugo Centeno C. and Cavosie A. J. (2014), *LPS*, this volume.