# Shocked Chicxulub titanite records new twins and impact age

NICHOLAS TIMMS[1]*, CHRISTOPHER KIRKLAND[1], AARON CAVOSIE[1], AURIOL RAE[2], MARK PEARCE[3], TIMMONS ERICKSON[1,4], JOHN WHEELER[5], JOANNA MORGAN[6], GARETH COLLINS[6], LUDOVIC FERRIÈRE[7], MICHAEL POELCHAU[2], AXEL WITTMANN[8], SEAN GULICK[9]

[1] Curtin University, GPO Box 1984, Perth, WA, 6845, Australia, *correspondence: n.timms@curtin.edu.au
[2] Albert-Ludwigs-Universität, Freiburg, Albertstraße 23b, 79104 Freiburg, Germany
[3] CSIRO Mineral Resources, ARRC, 26 Dick Perry Avenue, Kensington, WA 6151, Australia
[4] Jacobs – JETS, ARES division, NASA JSC, 2101 NASA Parkway, Houston, TX, 77058, USA
[5] University of Liverpool, Liverpool, L69 3GP, UK
[6] Imperial College London, London SW7 2AZ, UK
[7] Natural History Museum, Vienna, Austria
[8] Arizona State University, Tempe, AZ, USA
[9] University of Texas at Austin, Austin, TX, USA

This study investigates the effects of hypervelocity impact on the microstructure, U-Pb isotope, and trace elements of titanite ($CaTiSiO_5$) in shocked granitoid target rocks from the peak ring of the ~66 Ma Chicxulub impact structure, Mexico, recovered by IODP-ICDP Expedition 364. Electron backscatter diffraction analysis of four titanite grains within these rocks reveals multiple sets of polysynthetic twins along ~{-111} and {130}, and deformation bands along {130}, which have not been described in titanite previously [1]. Based on shock pressure constraints from quartz, we hypothesize that these microstructures are indicative of ~12–17 ± 5 GPa shock pressure conditions [1]. LA-ICPMS U-Pb analyses (n = 157) of a >1 mm long, shock twinned titanite grain define a mixing array between common Pb (determined from analyses of surrounding K-feldspar), radiogenic Pb acumulated since magmatic crystallization, and radiogenic Pb loss. The seven apparently youngest $^{207}Pb$-corrected analyses define a free-fitted regression that yields a lower intercept age of 67 ± 12 Ma, in agreement with the established age for the Chicxulub impact event. Contour maps of LA-ICPMS data reveal that young ages are spatially restricted to microstructurally-complex domains that correlate with depletion in trace elements (REE-Y-Zr-Nb-Mo-Sn-Th), consistent with the localised removal of radiogenic Pb from these domains via a fluid-mediated element transport process associated with the impact event.

[1] Timms *et al*. (2019), *Contrib*. *Min*. *Pet*., in press.