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Petrography and shock metamorphism of granitoid samples from the Chicxulub peak-ring IODP-ICDP expedition 364 drill core

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The ∼200 km diameter and ∼66 Ma, K-Pg boundary, Chicxulub crater (Mexico) is the only known terrestrial impact structure with a well-preserved peak-ring. In 2016, an IODP and ICDP drilling campaign resulted in the recovery of a core into its peak-ring (505.7–1334.7 mbsf). Three main lithological units were identified in the core [1], namely, from top to bottom, a "post-impact" section of Paleogene sediments, an "upper peak ring" section of suevites and impact melt rocks, and a "lower peak ring" section of granitoid rocks intruded by different types of sub-volcanic dikes, and intercalations of suevite and impact melt rock units.

We studied granitoids from the "lower peak ring" section (747.0–1334.7 mbsf) by optical microscopy, followed by a universal stage (U-stage) investigation of shock metamorphic features in quartz, such as planar fractures (PFs), feather features (FFs), and planar deformation features (PDFs). The indexing of PDFs was completed manually and also by using the WIP web-based program [2].

Our samples mainly consist of pervasively deformed, locally micro-brecciated and sheared, coarse-grained leucogranite, with crystals ranging from ∼0.5 to 4 cm in size. The mineral assemblage consists mainly of K-feldspar, plagioclase (2-4 cm), quartz (1-3 cm), and, to a lesser extent, biotite ($<$ 0.5 cm). Phase abundances vary at the sample scale. The main accessory minerals are muscovite, apatite, sphene, epidote, zircon, and opaque minerals. Most of the minerals show signs of shock metamorphism. In the case of quartz, PFs are locally visible at the macroscopic scale as a result of preferential hydrothermal alteration (i.e., filling of PFs with calcite). Almost all quartz grains in the investigated thin sections are shocked ($>$ 99%) and most show a strong undulose extinction; some crystals are also sheared, toasted, and/or kinked. PFs, mainly oriented parallel to (0001) and $\{10\bar{1}1\}$, FFs, and/or (decorated) PDFs are abundant. A total of 334 PDF sets were measured in 143 grains (on average 2.4 sets/grain) in four different samples selected throughout the core. PDFs are preferentially oriented along the $\{10\bar{1}3\}$ and $\{10\bar{1}4\}$ orientations (i.e., 69 to 82 % of the measured PDFs). Shock features were also observed in alkali-feldspar and plagioclase (i.e., PFs filled with opaque minerals and PDFs), sphene and apatite (with different types of planar microstructures). Biotite and chlorite are generally kinked.

Based on our U-stage results we estimate shock pressures between 12 and 15 GPa (using the method from [3]), consistent with preliminary observations [4], and little to no attenuation of shock pressure with depth.

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