The Chicxulub impact crater cores recovered by IODP-ICDP Expedition 364: Status Report

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The Chicxulub impact structure in the northern Yucatan Peninsula, Mexico, formed at the Cretaceous-Paleogene boundary (66.0 Ma), was drilled by the joint IODP-ICDP Expedition 364 in April-May 2016. This is the first attempt to obtain materials from the topographic peak ring within the crater previously identified by seismological observations. Major objectives of Exp. 364 are to understand (1) the nature and formation mechanism of peak rings, (2) how rocks are weakened during large impacts, (3) the nature and extent of post-impact hydrothermal circulation, (4) the deep biosphere and habitability of the peak ring, and (5) the recovery of life in a sterile zone.

A continuous core was successfully recovered from the peak ring in the depths between 505.7 and 1334.7 mbsf. After the initial observation on a Mission Specific Platform, the up to 1.5 m-cores were transported to MARUM, University of Bremen, for further analysis at the onshore science party (OSP) held in September-October 2016, where visual core description as well as biostratigraphic (foraminifera and calcareous nannofossil assemblages), geophysical (density, P-wave velocity, paleomagnetism), geochemical (major and minor elements, carbon contents), and petrological analyses (optical microcopy and XRD) of the cores were performed.

The uppermost part of the core (505.7–617.3 mbsf) is post-impact sediments, including PETM, that are mainly composed of carbonate with intercalation of siliciclastic materials that are occasionally rich in organic carbon. Below is a transitional zone that shows a drastic change into impactites (suevite and impact melt rock) with lithologically diverse clasts composed of sedimentary and basement rocks (617.3–747.0 mbsf). We found uplifted, fractured, and shocked granitic basement rocks forming the peak ring below the impactite unit (747.0–1334.7 mbsf). The granitic basement is intruded by mafic and felsic subvolcanic dikes as well as impact melt-breccia dikes. The lithological and physical properties of the Chicxulub cores confirmed the dynamic collapse of an overheightened central uplift of the crater as a favored model for the peak-ring formation [1].

Four Japanese OSP participants have been working on sedimentological, geochemical and mineralogical aspects of the allocated samples to understand various impact and post-impact events: resurge process and tsunami generation, search for projectile component using platinum group elements, elemental and isotopic evolution in the Eocene and Paleocene seawater, shock metamorphism of impactites and basement rocks, hydrothermal alteration of the basement rocks, and the deep biosphere and habitability of the peak ring.

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