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Proposed IODP/ICDP drilling of the Chicxulub impact crater

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The Chicxulub impact crater, Mexico, is unique. It is: 1) the only known terrestrial impact structure that has been directly linked to a mass extinction event, 2) the only one of the three largest impact structures on Earth that is well-preserved, 3) the only terrestrial crater with a global ejecta layer, and 4) the only known terrestrial impact structure with an unequivocal topographic "peak ring". Chicxulub's role in the K-Pg mass extinction and its exceptional state of preservation make it an important natural laboratory for the study of both large impact crater formation on Earth and other planets, and the effects of large impacts on the Earth's environment and ecology.

We propose to drill Chicxulub at two sites. Site Chicx-03A will sample the material that forms a topographic peak ring (670 – 1500 m), with respect to the lithological and physical state, including porosity, fracturing and degree of shock. It will test the working hypotheses that peak rings are formed from: 1) overturned and uplifted upper, mid, or lower crustal basement rocks, 2) mega-breccias, or 3) some other material. One intrinsic feature of the peak ring is that it is a seismic low-velocity zone, despite some models predicting it consists of lithologies from the formerly deeply buried basement of the Yucatán. Sampling these lithologies will test the hypothesis that peak rings consist of lithologies that are deeply sourced but heavily brecciated and, hence, have higher porosities than surrounding impact and target rocks. This hypothesis, if correct, has consequences for questions of peak rings serving as habitat for exotic microbiology, due to the potential existence of macro-porosity, in the presence of significant hydrothermal circulation.

Site Chicx-04A will penetrate the enigmatic dipping reflectors (1200 – 1400 m) that run from the outer edge of the peak ring and dip inwards. It will test whether the dipping reflectivity beneath the peak ring is: 1) a lithologic boundary between uplifted basement lithologies and younger Mesozoic sediments, 2) is a thrust fault formed during peak ring emplacement, 3) is the result of vigorous hydrothermal circulation in the wake of peak ring emplacement. This site will sample an expanded section of Paleocene to potentially as late as Oligocene strata (600 – 1000 m) within the crater fill, providing a high-resolution record of the PETM and earliest Paleocene faunal recovery.