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548-Full3

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IODP Proposal Cover Sheet

☐ **New** ☑ **Revised** ☐ **Addendum**

Please fill out information in all gray boxes

Title:	Chicxulub: Drilling the K-T Impact Crater
Proponent(s):	Joanna Morgan, Sean Gulick, Penny Barton, Gail Christeson, Philippe Claeys, Charles Cockell, Gareth Collins, Kazuhisa Goto, Richard Grieve, Christian Koeberl, David Kring, Takafumi Matsui Jay Melosh, Clive Neal, Elisabetta Pierazzo, Mario Rebolledo-Vieyra, Uwe Reimold, Ulrich Riller, Peter Schulte, Jaime Urrutia-Fucugauchi and Michael Whalen.
Keywords: *(5 or less)*	Chicxulub, cratering, K-T impact — Area: Gulf of Mexico

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Permission to post abstract on IODP-MI Web site: ☐ X Yes ☐ No

Abstract: (*400 words or less)*

The Chicxulub impact crater, Mexico, is unique. It is the only known terrestrial impact structure that has been directly linked to a mass extinction event. It is the only one of the three largest impact structures on Earth that is well-preserved. It is the only terrestrial crater with a global ejecta layer. It is the only known terrestrial impact structure with an unequivocal topographic "peak ring." Chicxulub's role in the K-T 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 to address several questions, including: 1) what is the nature of a peak ring, 2) how are rocks weakened during large impacts to allow them to collapse and form relatively wide, flat craters, and 3) what caused the environmental changes that led to a mass extinction? Our understanding of the impact process is far from complete, and the first two questions represent fundamental gaps in our knowledge. Despite nearly 30 years of intense debate, we are still striving to answer the third question.

This revised full proposal updates 548-Full2, which was submitted to ODP in Fall 2000. Since the last submission, we have acquired new site survey data as part of a $2 million seismic reflection and refraction experiment, progressed in our numerical modeling efforts of the Chicxulub impact, expanded our proponent group in terms of expertise and international representation, and held a community workshop in Potsdam Germany in September 2006 to reach a consensus on scientific objectives achievable by drilling at the Chicxulub impact crater. We have devised a logistical plan of drilling two 1500-m-deep holes into the peak ring that will meet our scientific objectives but at a significant cost savings in comparison to our originally proposed single 3000-m-deep peak ring hole. The proposed drilling transect directly contributes to IODP goals in the: *Deep Biosphere and the Subseafloor Ocean* and *Environmental Change, Processes and Effects*, in particular the *environmental and biological perturbations caused by Chicxulub*.

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Scientific Objectives: (*250 words or less*)

Hole Chicx-03A will sample the material that forms a topographic peak ring, and reveal the lithological and physical state of the peak-forming material, including porosity, fracturing and degree of shock. We will, thus, be able to test the working hypotheses that peak rings are formed from: *1) overturned and uplifted basement rocks, 2) megabreccias, or 3) some other material.* If the peak ring is formed from uplifted basement rocks, we will be able to distinguish whether the rocks have been uplifted from the upper crust or deeper and whether the rocks are highly fractured, porous, and/or contain thick zones of pseudotachylitic breccia, as seen in outcrops and drill core at Vredefort and Sudbury**.**

Hole Chicx-04A will penetrate the enigmatic dipping reflectors that run from the outer edge of the peak ring and dip inwards. We suggest three working hypotheses for the cause of the dipping reflectivity: *1) The dipping reflectivity beneath the peak ring at Chicxulub is a lithologic boundary between uplifted basement lithologies and younger Mesozoic sediments; 2) the dipping reflectivity is a thrust fault formed during peak ring emplacement; 3) the dipping events are the result of vigorous hydrothermal circulation in the wake of peak ring emplacement that deposited hydrothermal minerals with this reflectivity marking a former hydrothermal conduit.* The origin of this reflectivity could well be some combination of these origins, such as a fault formed during peak ring emplacement that then served as a conduit for fluids post-impact.

Please describe below any non-standard measurements technology needed to achieve the proposed scientific objectives.

Proposed Sites:

Site Name	Position	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
Chicx-04A	21 28.6578 N 89 57.4404 W	17 m	1500 m			Peak ring formation processes. Origin of dipping reflectivity. Size of transient cavity (energy of impact)
Chicx-03A	21 27.0846 N 89 57.0648 W	17 m	1500 m			Peak ring formation processes. Document lithology and physical state of peak ring forming material. Document microbiology and hydrothermal processes.
Chicx-02A	21 27.33 N 89 57.09 W	17 m	1500 m			Contingency site for Chicx-04A