IODP-ICDP drilling of Chicxulub (IODP-548 Full3)

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Drilling will be on a mission specific platform (MSP)
ESO is scoping a hazard survey for 2012 and drilling in 2013
Drilling target: peak ring
Chicx-04a and Chicx-03a

Model of crater, derived from reflection and refraction data, onshore drill holes, and observations at other large craters. Not known what rocks form the peak ring.
Peak rings are common features of large impacts on silicate bodies. Chicxulub is the only terrestrial crater with an intact peak ring. IODP-ICDP drilling of Chicxulub aims to investigate what a peak ring is, how it forms, and from what lithologies it is made. The drill peak ring where closest to the surface.
Crater size increasing

Simple crater

Central peak crater

Peak ring crater

Widely accepted that peak rings are formed from collapsed central peaks

Precise kinematics unknown
Weakening mechanism unknown
Numerical models of ring formation: two extremes

Model 1
Uppermost peak ring formed from relatively intact basement above sediments.

Model 2
Uppermost peak ring formed from highly fractured mixed melts and basement-rich breccias.

Wünnemann et al. 2005

The rocks that form the peak ring in model 2 originate from deeper in the crust than in model 1.
Low-velocity rocks in peak ring correlate with high shock pressures in numerical model.

Are the dipping reflectors the boundary between sediments and collapsed central uplift?

Color = velocity, plotted behind reflection data

Color = Max. shock pressures from numerical model of Collins et al. (from last slide)
Plan to drill two 1.5 km holes at Chicx-03A (peak ring rocks) and Chicx-04A (dipping reflectors)
Chicx-03A is a 1.5 km deep hole that will drill 900 m of peak ring material.

Full-wave tomographic velocity models (color) and reflection data:

Uppermost peak ring formed from 100 - 200 m of low velocity rocks (3 - 3.2 km/s)

Peak ring is formed from rocks with velocity 4 – 5 km/s (i.e. lower velocity than for the intact sediments and basement)

This hole will tell us what lithologies form topographic peak rings, where they originate from and their physical state.
Chicx-04A is a 1.5 km deep hole that will drill through the outer edge of the peak ring, intersecting the dipping reflectors. This hole will tell us what lithologies are above and below the dipping reflectors, what causes the dipping reflectivity, as well as provide an expanded section of the PETM boundary and Paleocene.
Scientific goals

**Fundamental knowledge about impacts**

- Determine what rocks form the peak ring
- Are they allogenic breccias/melts, or parautochthonous?
- Are they formed from sediments, upper or mid-crustal rocks?
- Are they overturned?
- What is their physical state, degree of shock, degree of brecciation, and does this provide evidence for the weakening mechanism?
- Do the dipping reflectors represent a boundary (discontinuity), or something else?

**Other**

- Post-impact recovery (micropaleontology)
- Microbiology – were peak rings a niche for early life?
- Are there some exotic species?
- Hydrothermal circulation, duration, mineralization
- PETM boundary
- Post-impact sediments – low or high energy?