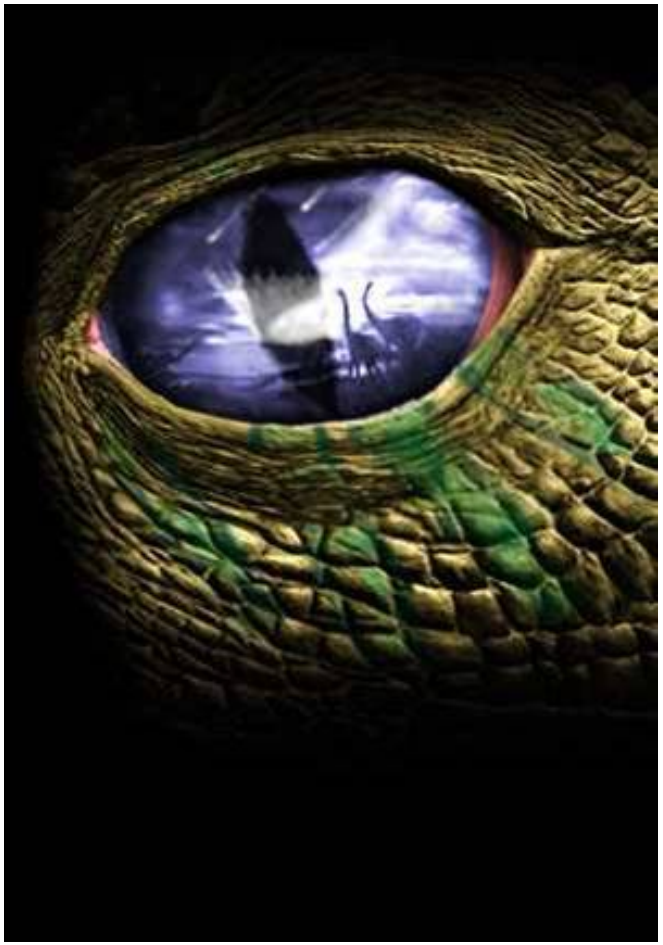
IODP-ICDP drilling of Chicxulub (IODP-548 Full3)



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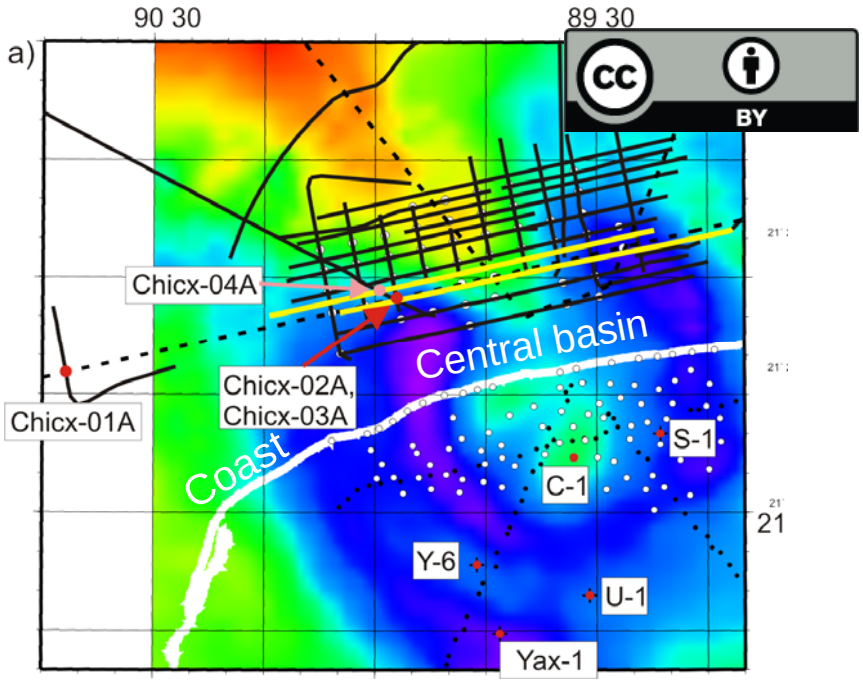
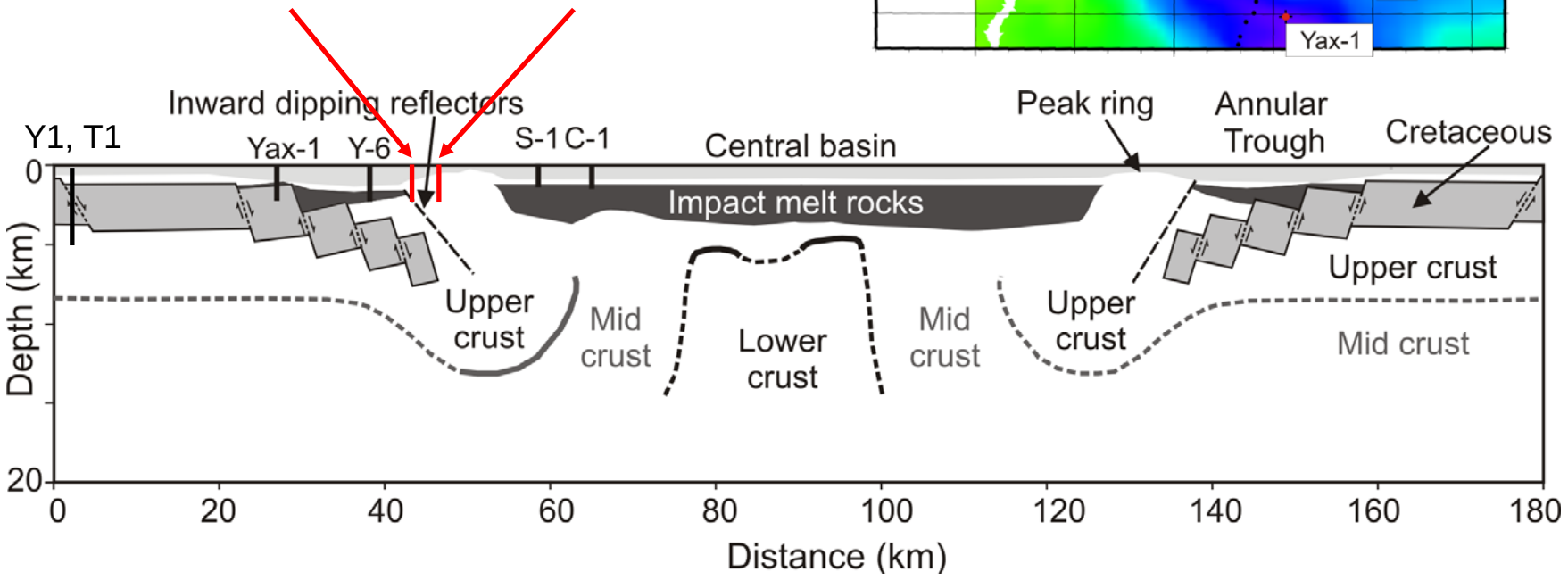
Jose Arz (Sp), Laia Alegret (Sp), Ignacio Arenillas (Sp)
Penny Barton (UK), Gail Christeson (US)
Philippe Claeys (Belgium), Charles Cockell (UK)
Gareth Collins (UK), Alex Deutsch (Germany)
Kazuhisa Goto (Jap), Richard Grieve (Can),
Christian Koeberl (Austria), David Kring (US),
Takafuma Matsui (Jap) Jay Melosh (US),
Ken Miller (US), Clive Neal (US), Richard Norris (US)
Betty Pierazzo (US), Mario Rebolledo (Mex)
Uwe Reimold (Ger) Ulrich Riller (Can)
Peter Schulte (Ger), Jaime Urrutia (Mex)
Mike Whalen (US)

Drilling will be on a mission specific platform (MSP)
ESO is scoping a hazard survey for 2012 and drilling in 2013

IODP-ICDP drilling of Chicxulub



Drilling target: peak ring
Chicx-04a and Chicx-03a

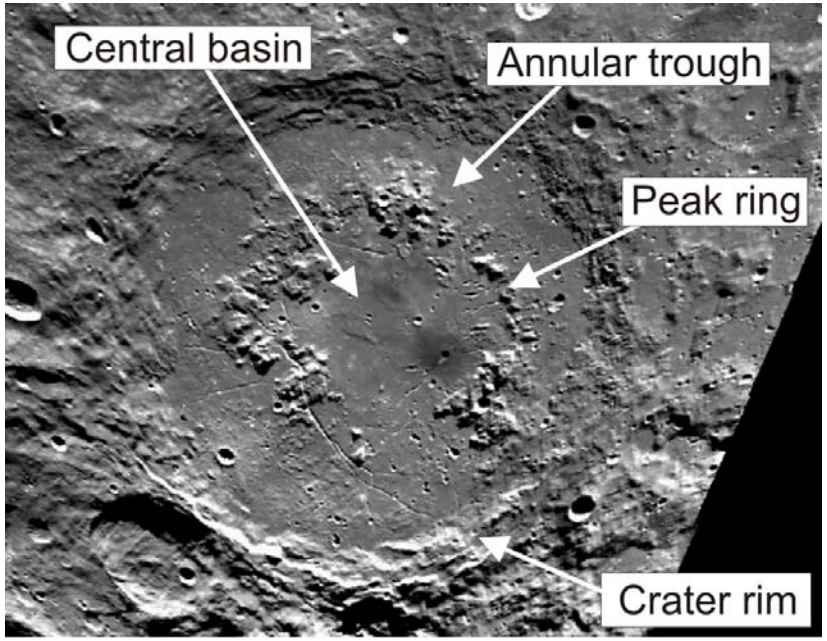


Model of crater, derived from reflection and refraction data, onshore drill holes, and observations at other large craters. Not known what rocks form the peak ring

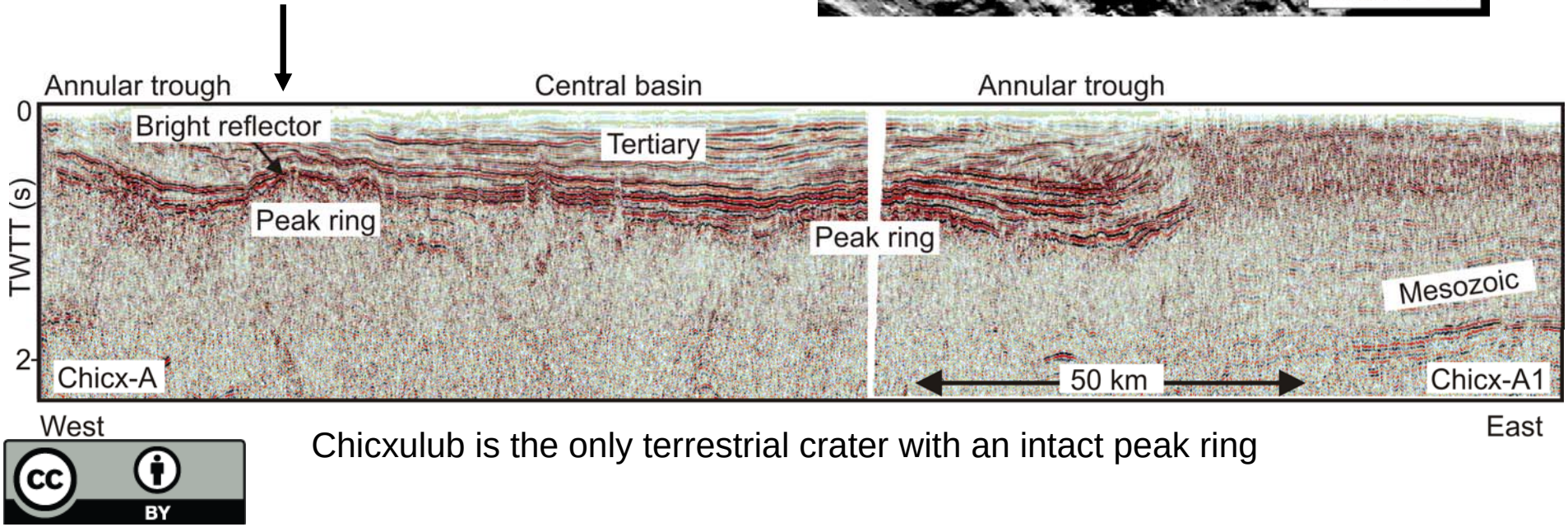
IODP-ICDP drilling of Chicxulub

Aims: what is a peak ring, how is it formed and from what lithologies?

Peak rings are common features of large impacts on silicate bodies

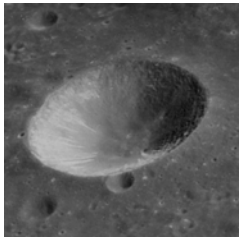


Drill peak ring where closest to surface

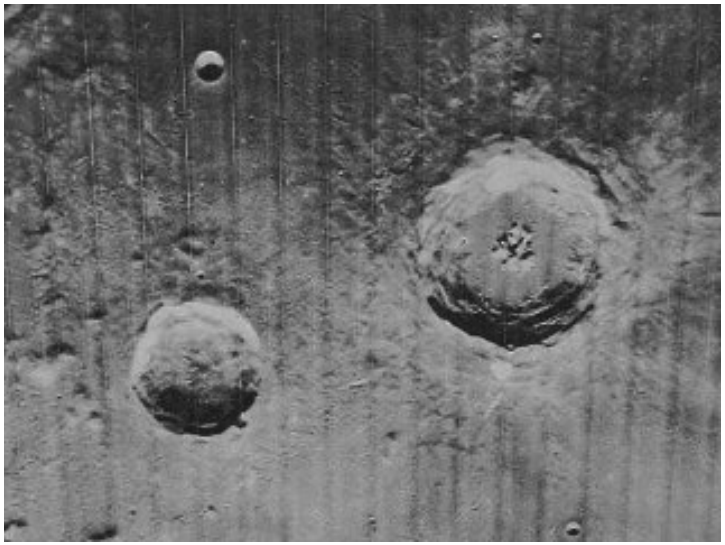


Chicxulub is the only terrestrial crater with an intact peak ring

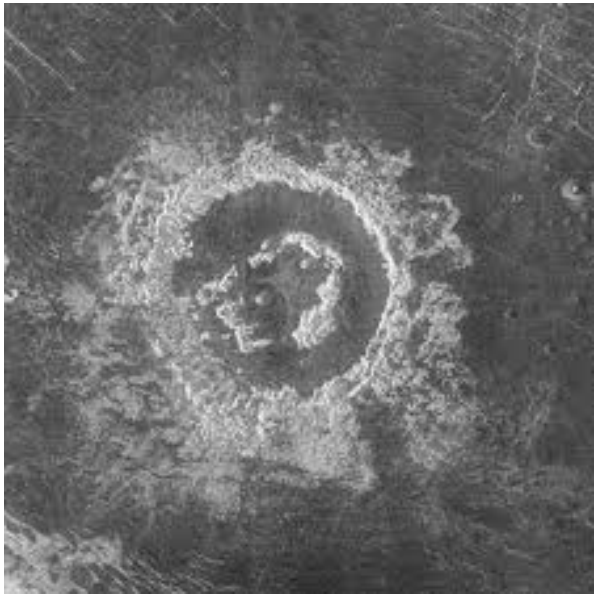
Crater size increasing →



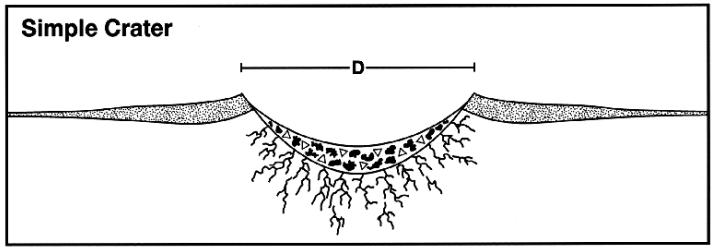
Simple crater



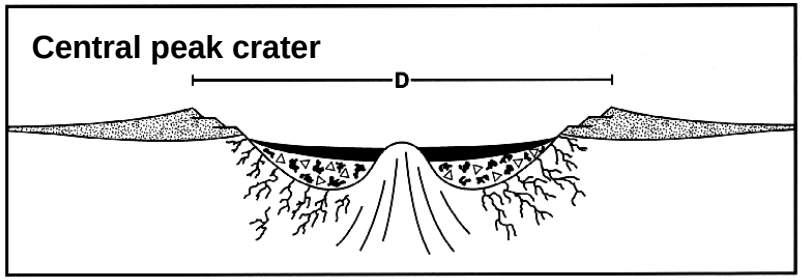
Central peak crater



Peak ring crater



Widely accepted that peak rings are formed from collapsed central peaks

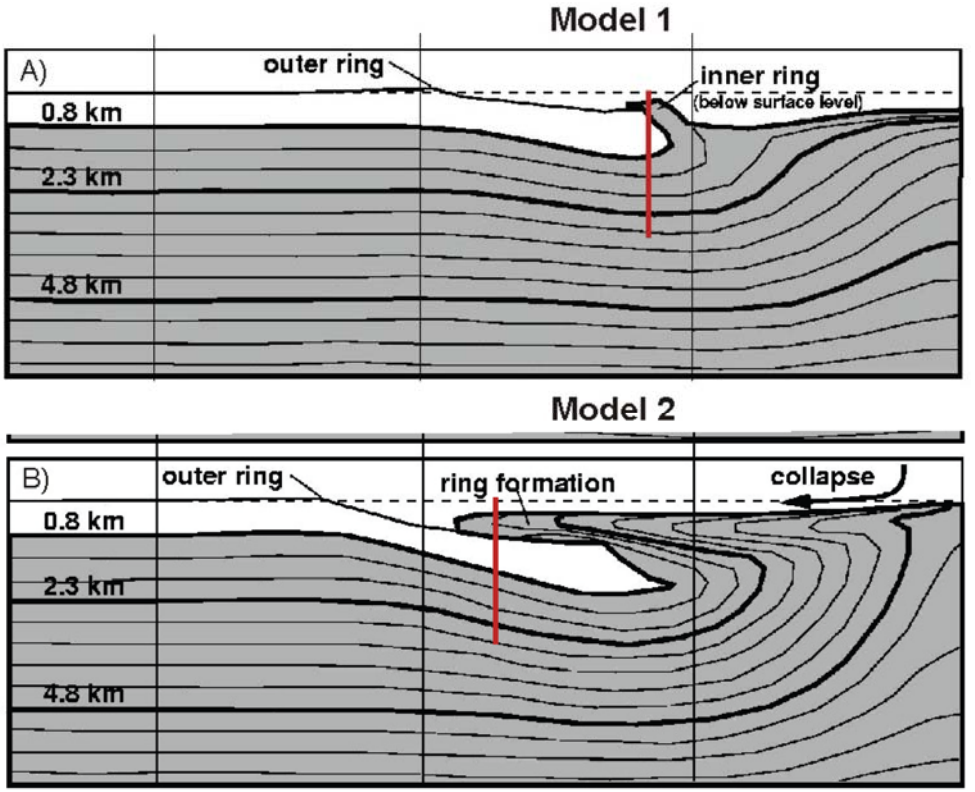


Precise kinematics unknown
Weakening mechanism unknown

Numerical models of ring formation: two extremes

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

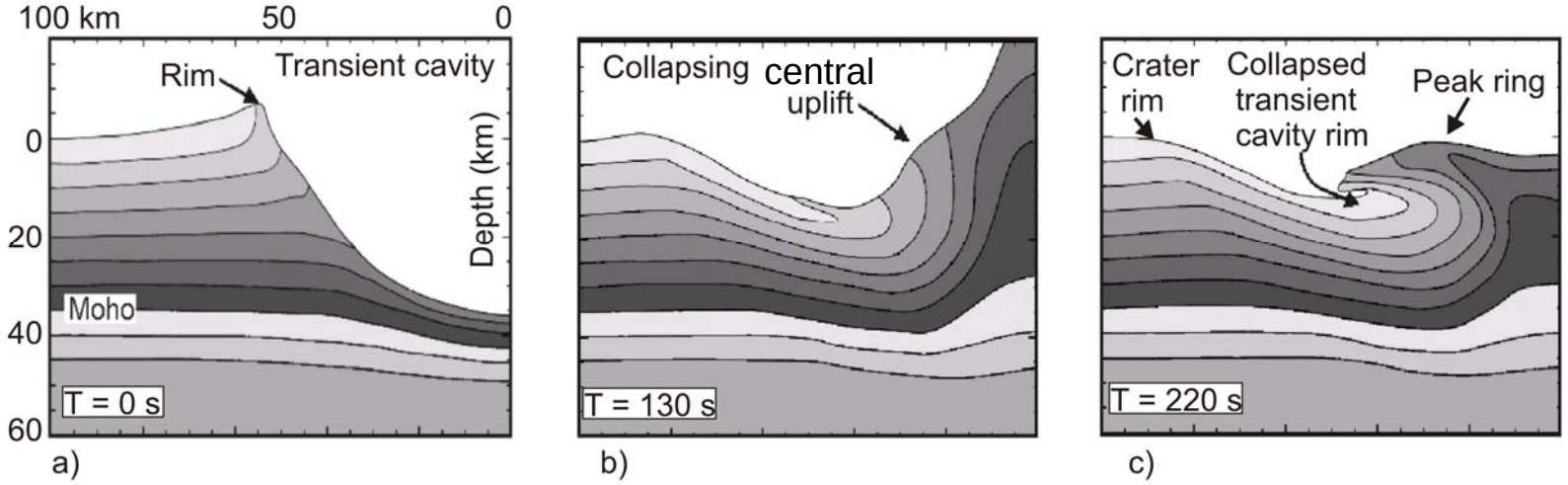
Model 2
Uppermost peak ring formed from highly fractured mixed melts and basement-rich breccias.

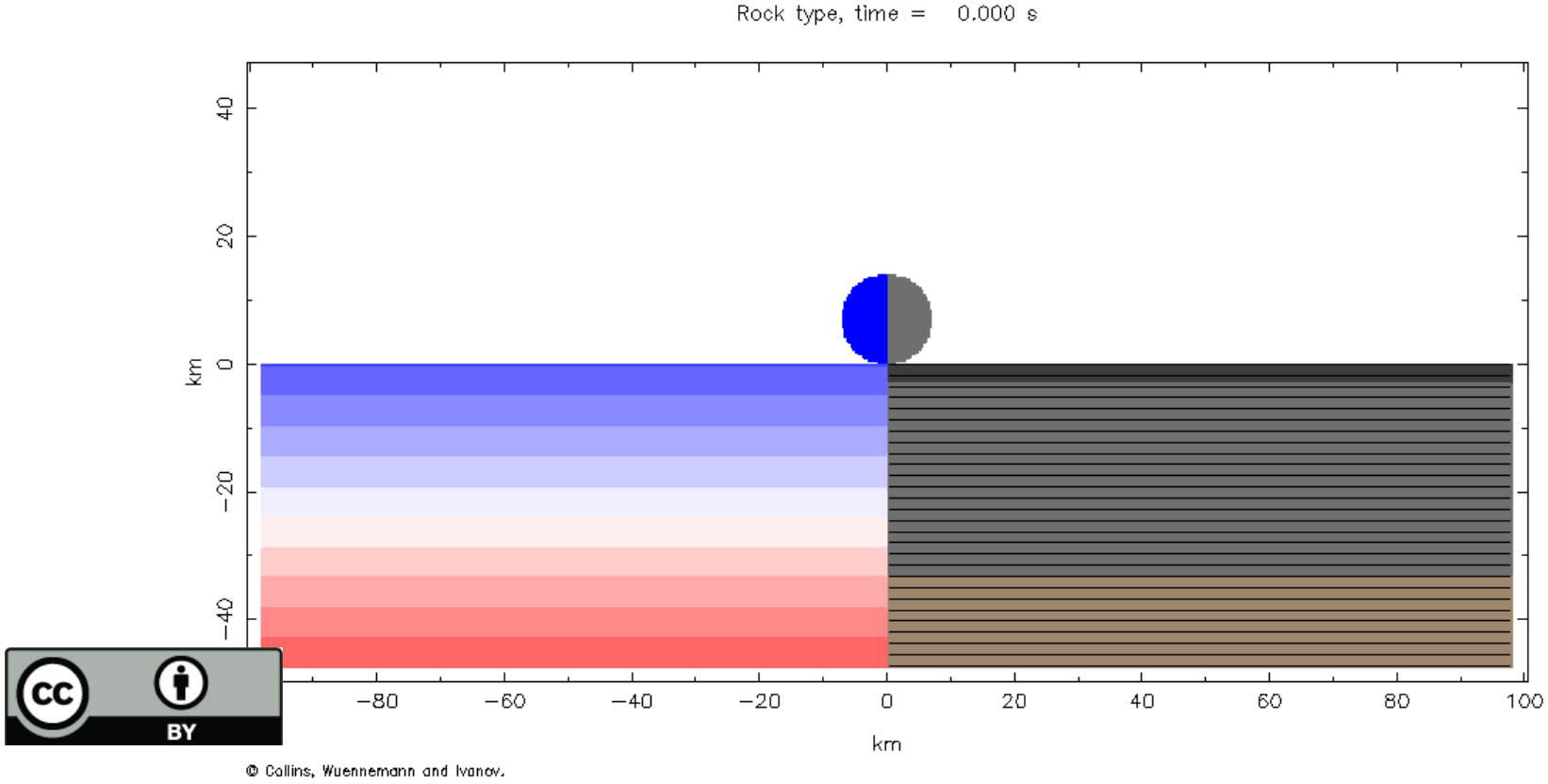


Wünnemann et al. 2005

The rocks that form the peak ring in model 2 originate from deeper in the crust than in model 1

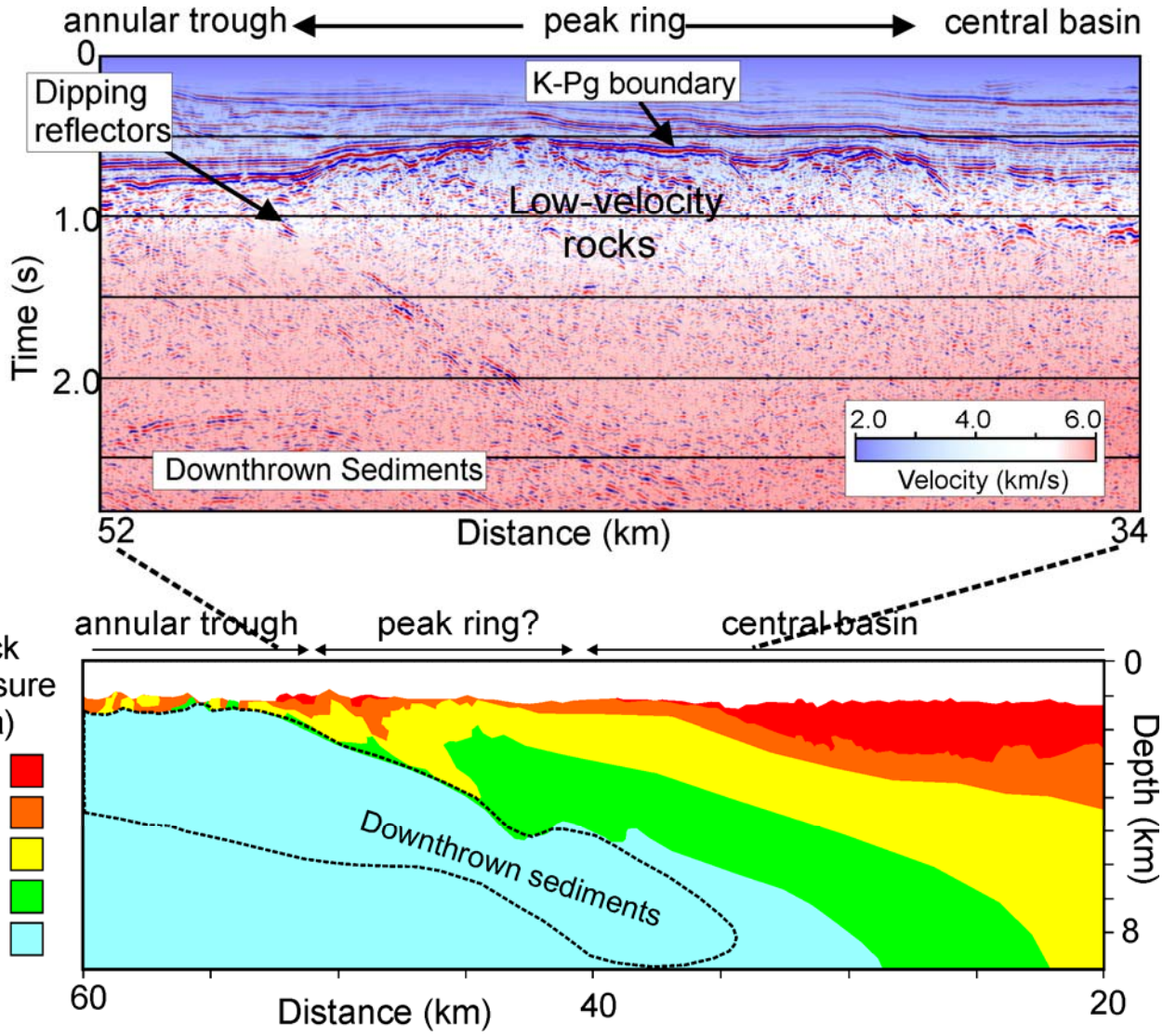
Collins et al





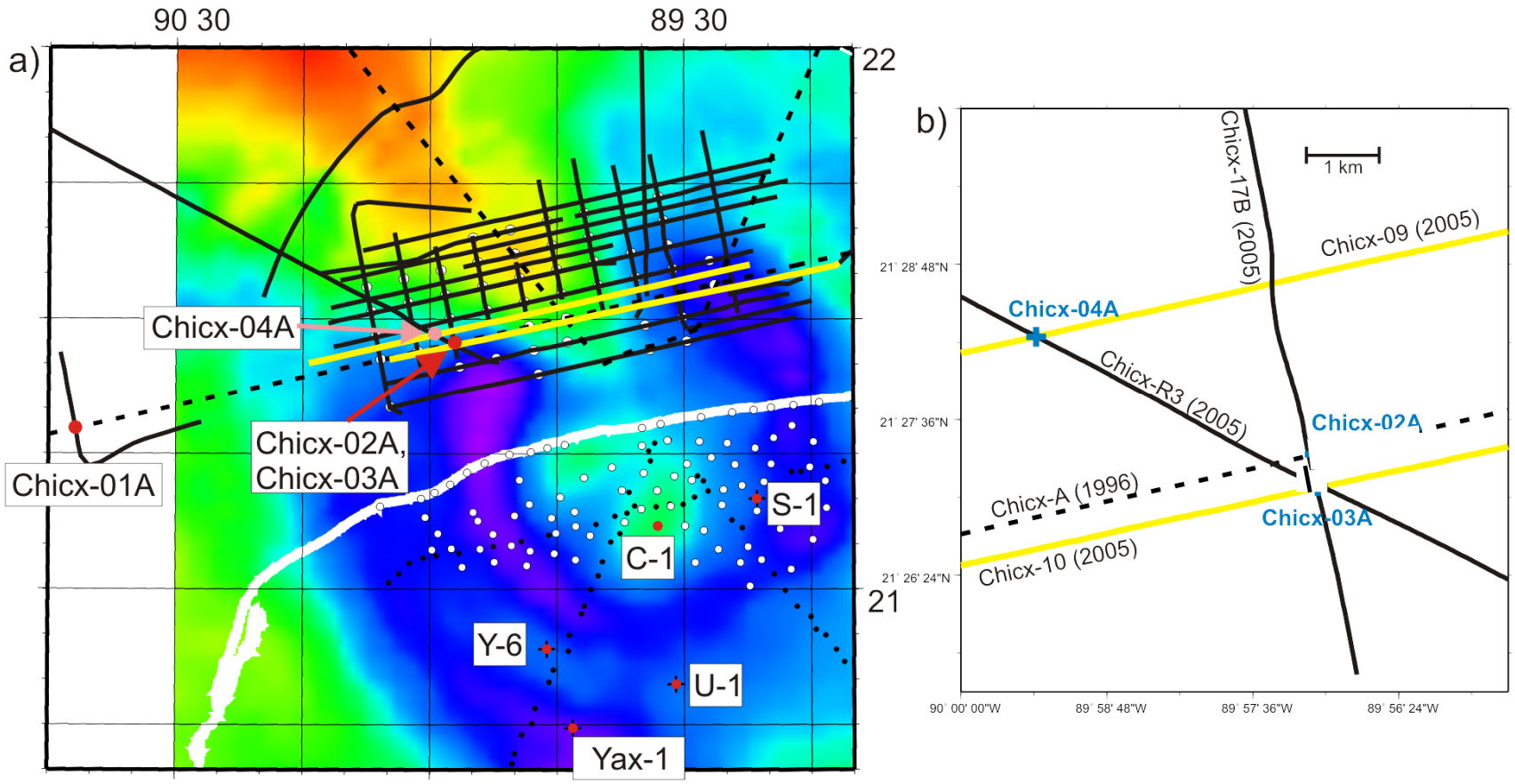
Color = velocity, plotted behind reflection data

Low-velocity rocks in peak ring correlate with high shock pressures in numerical model



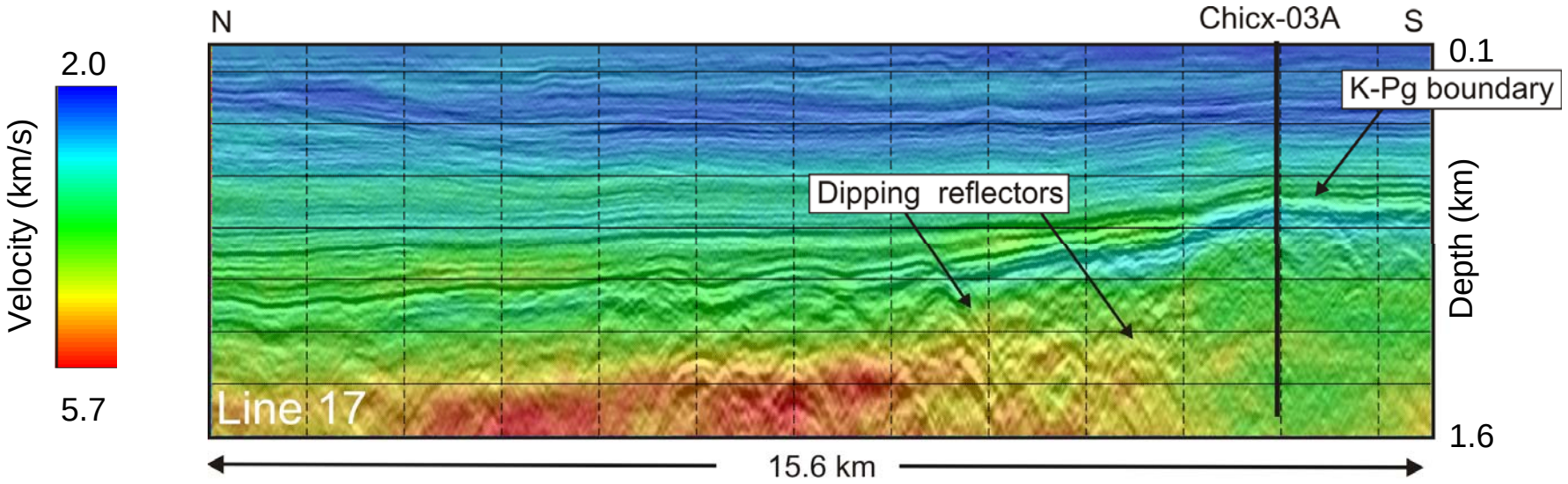
Are the dipping reflectors the boundary between sediments and collapsed central uplift?

Color = 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



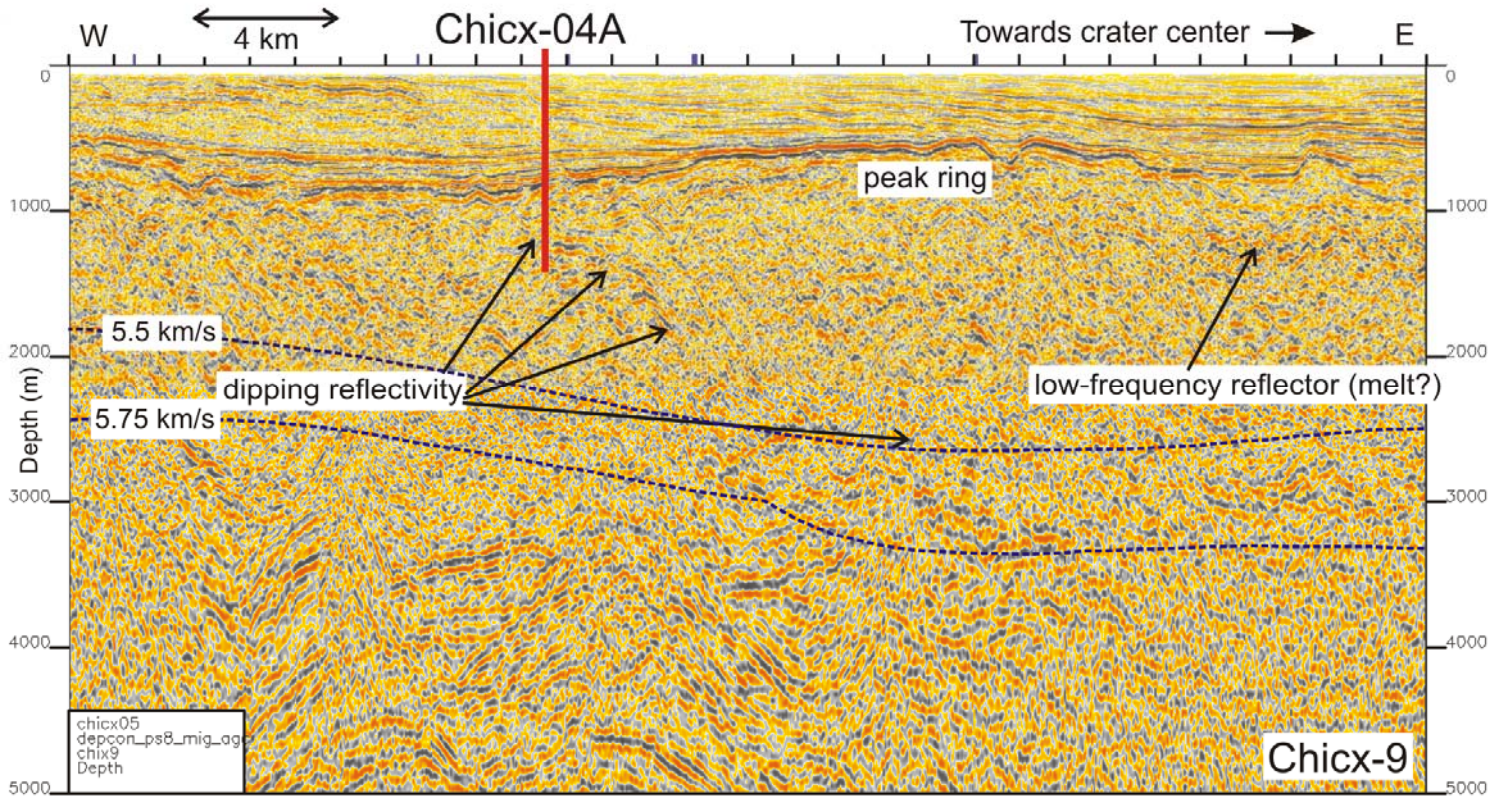
Full-wave tomographic velocity models (color) and reflection data

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 parauthocthonous?
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?