Fault-slip analysis of the Chicxulub IODP-ICDP Expedition 364 drill core unravels peak-ring formation

Louisa Bahr, Ulrich Riller & IODP-ICDP Expedition 364 Scientists

EPSC Conference 2026

Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

IODP
INTERNATIONAL OCEAN DISCOVERY PROGRAM

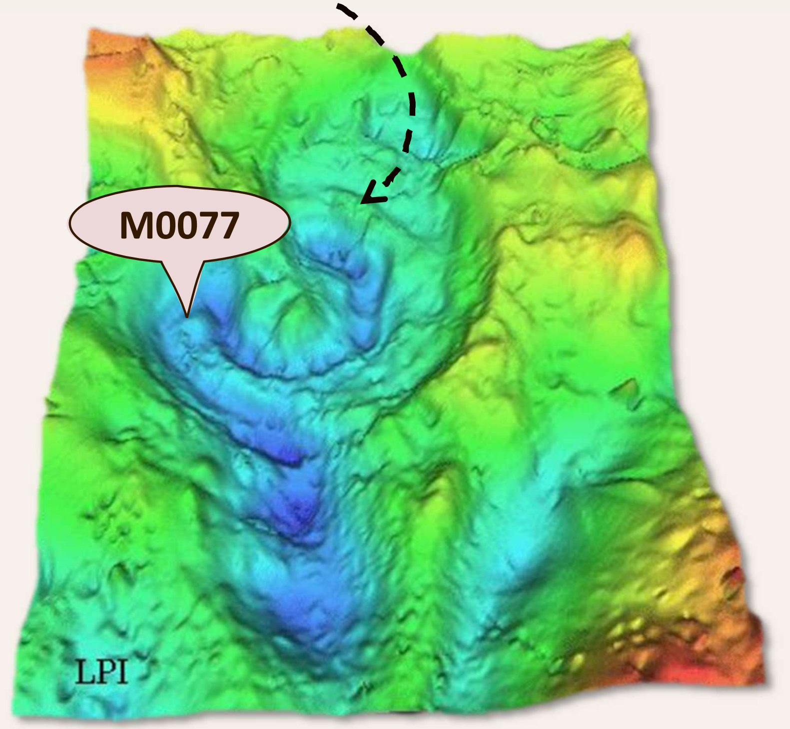
icdp

louisa.bahr@uni-hamburg.de

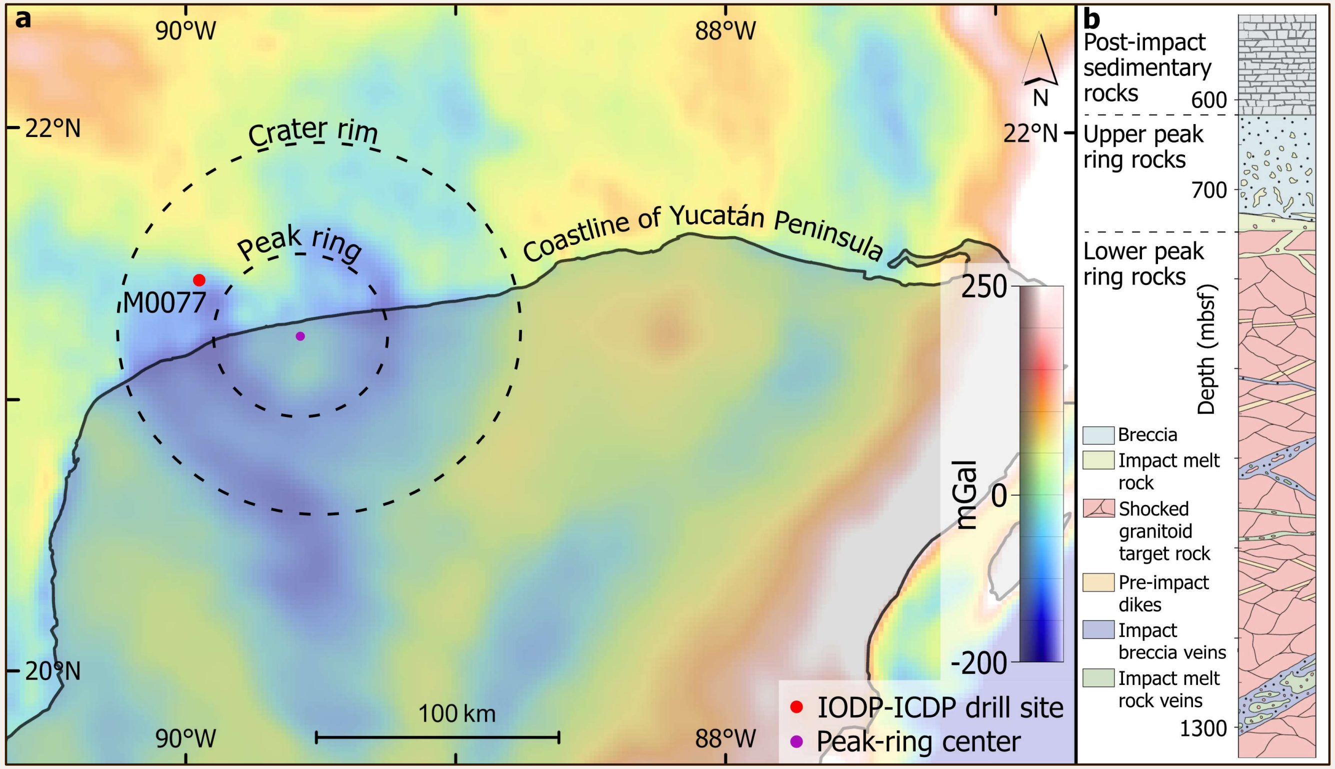
ECORD
European Consortium for Ocean Research Drilling

Funded by
DFG Deutsche Forschungsgemeinschaft
German Research Foundation

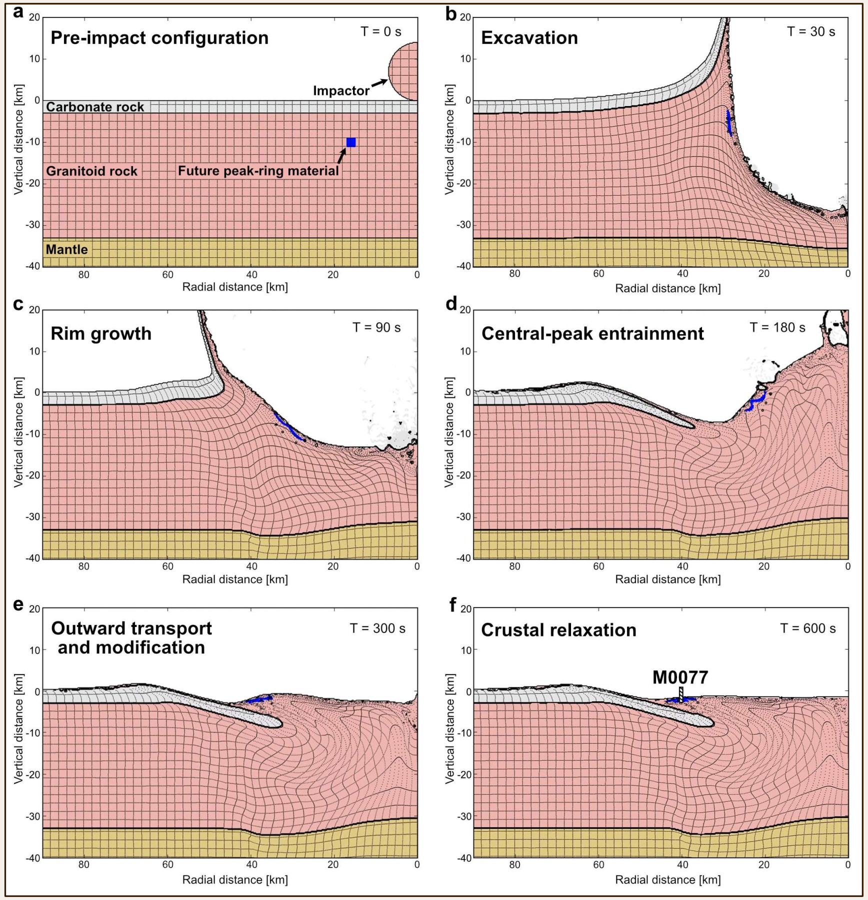
Peak-ring crater

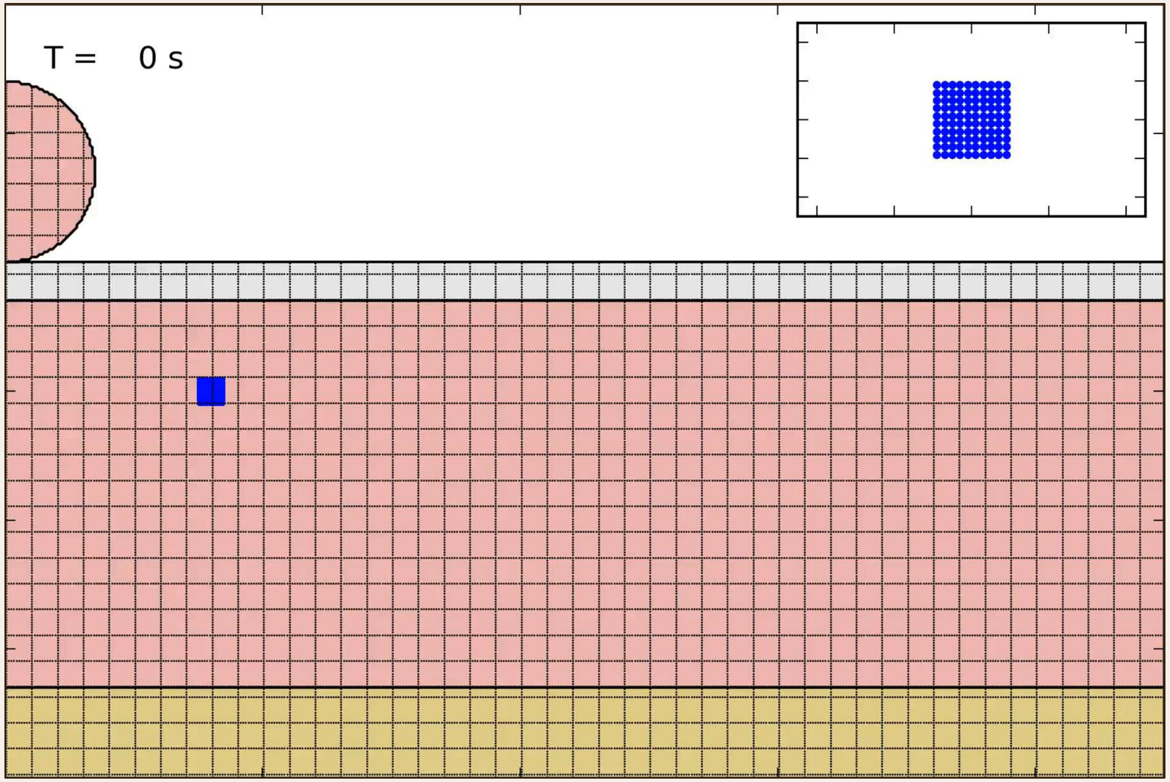


Urrutia Fucugauchi et al. 2011, from Sharpton et al. 1993



Stages of crater formation (Dynamic collapse model)



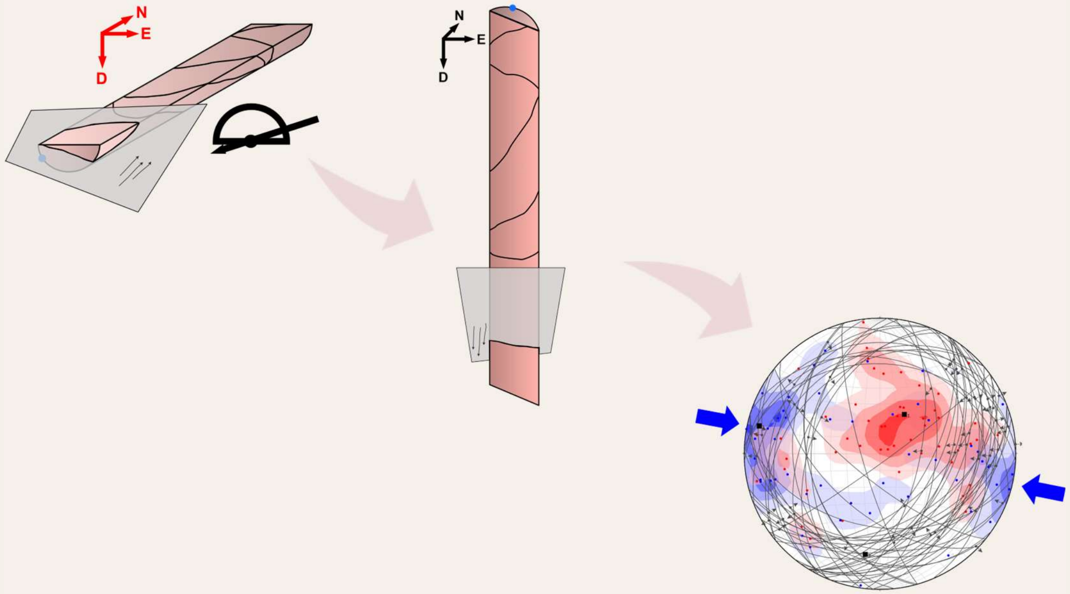


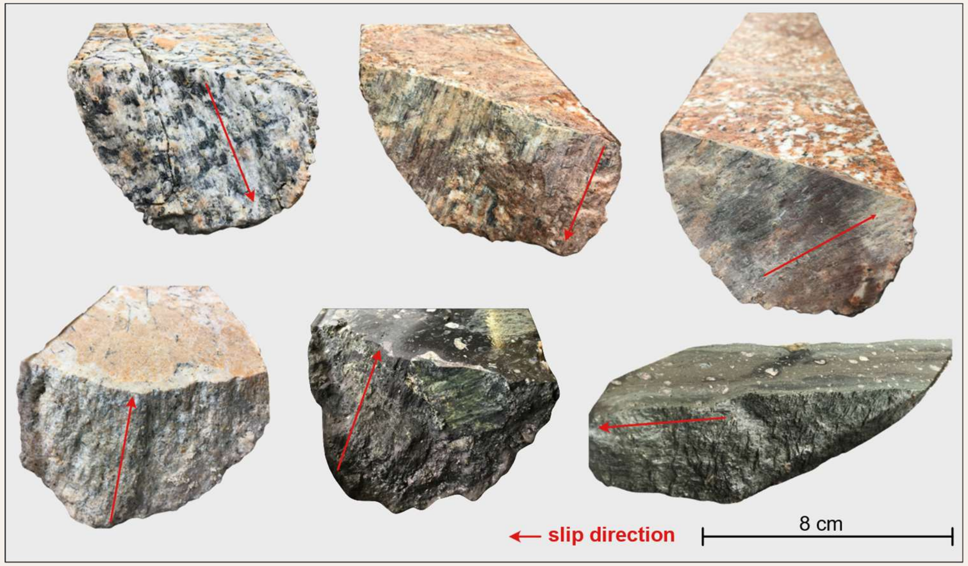
Collins et al. 2008

Aim of the study:

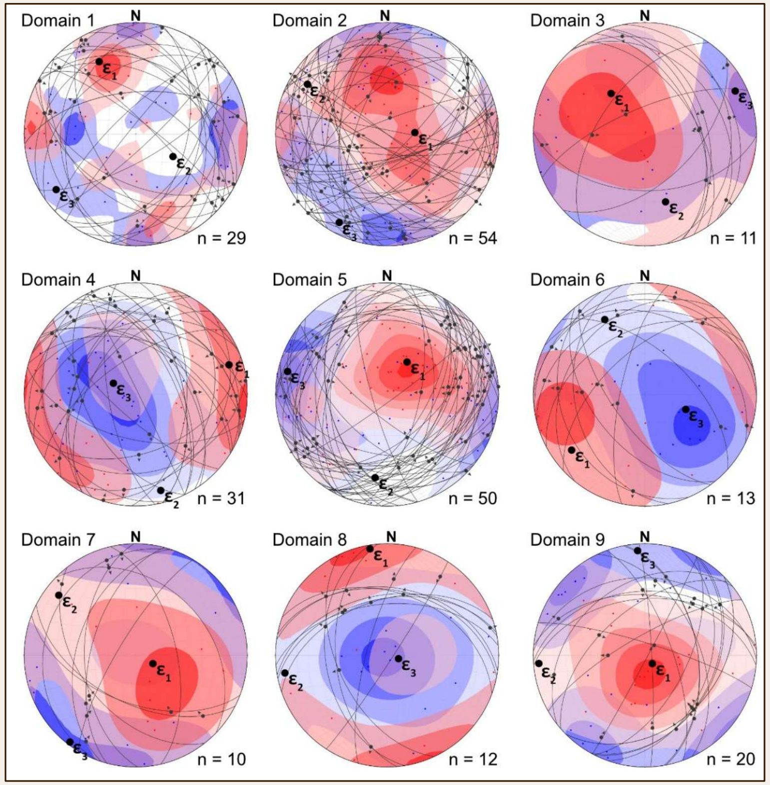
➢ <u>Understand the kinematics of peak-ring formation</u>

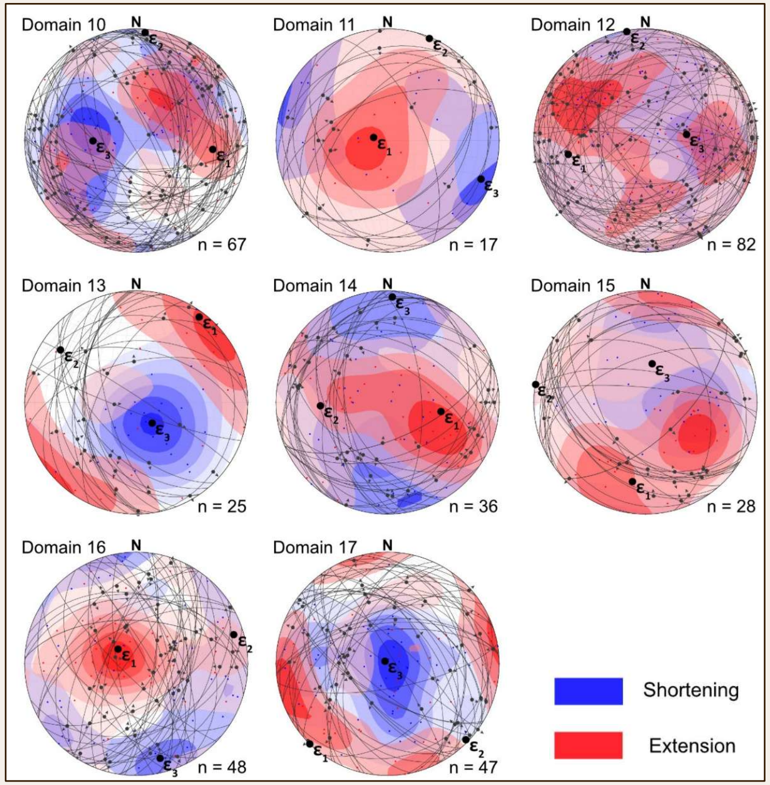
- Measurement of 602 brittle shear faults on the drill core
- Raw data treatment
  - Line plane compatibility check
  - Rotation of measurements to fit original spatial & geographical directions
- Kinematic fault-slip inversion using *FaultKin*
- Identification of kinematically homogeneous fault sets



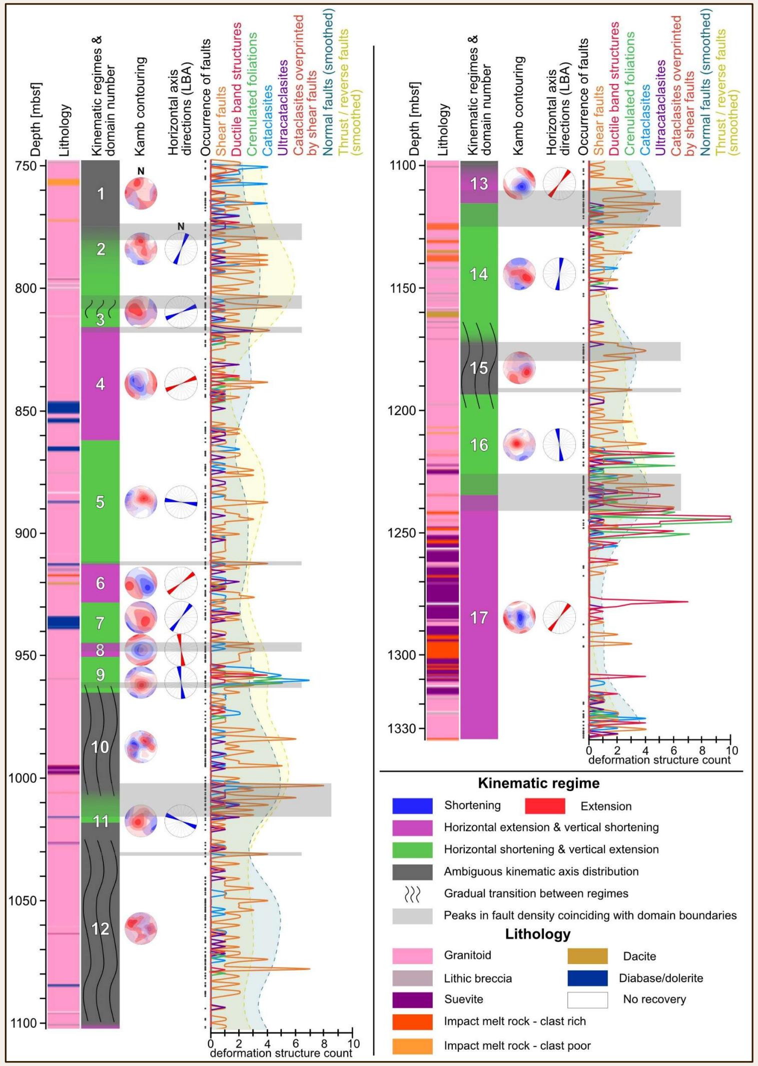


- Identification of 17 depth-dependent domains
- Kinematic heterogeneity among domains
- 13 domains exhibit either subvertical or subhorizontal extension or shortening axis orientations





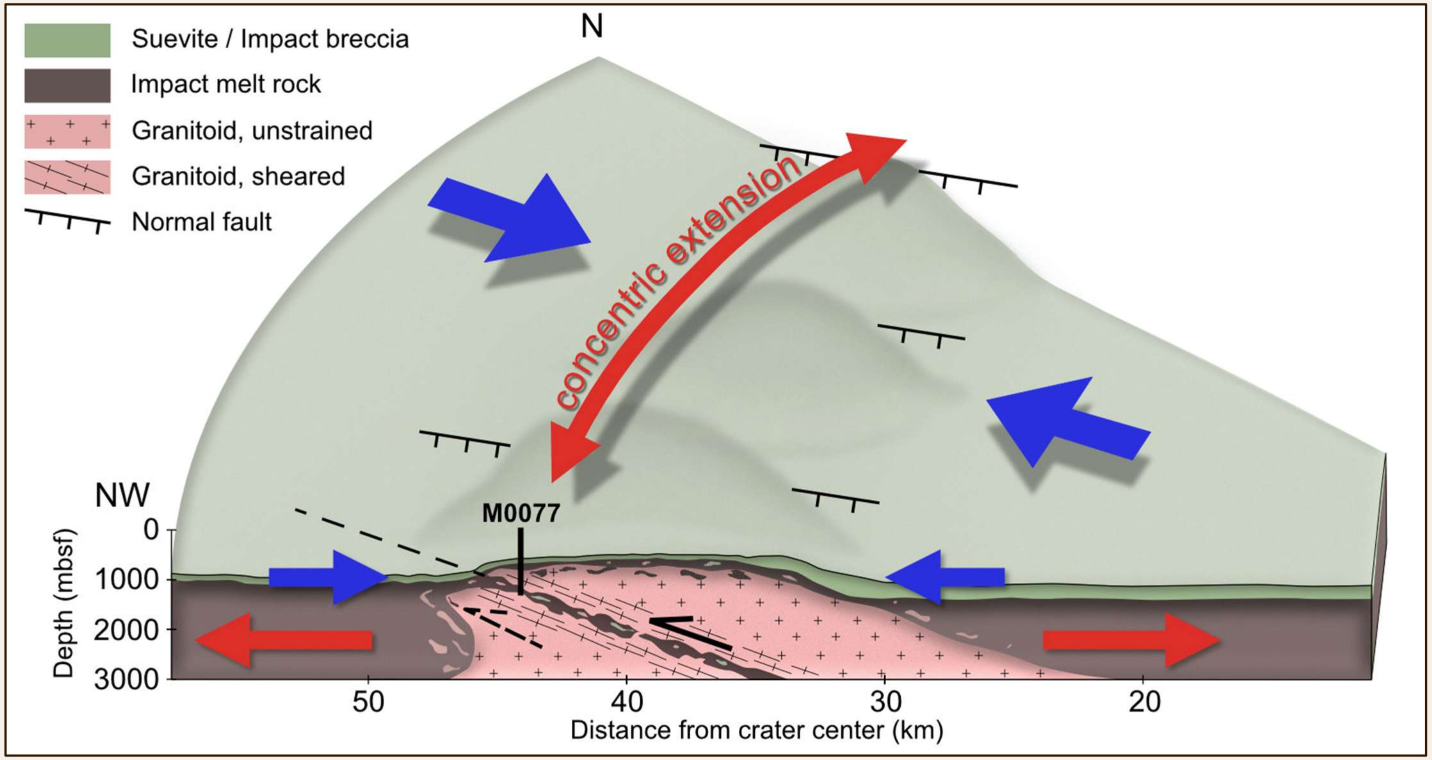
- **Upper & middle drill core**: horizontal shortening; reverse faulting
- **Lower drill core**: horizontal extension; normal faulting
- Some domains are confined by distinct boundaries, some by gradual transitions
- Peaks in fault density partly coincide with domain boundaries



Two depth-dependent kinematic regimes active toward the end of cratering

Upper regime:

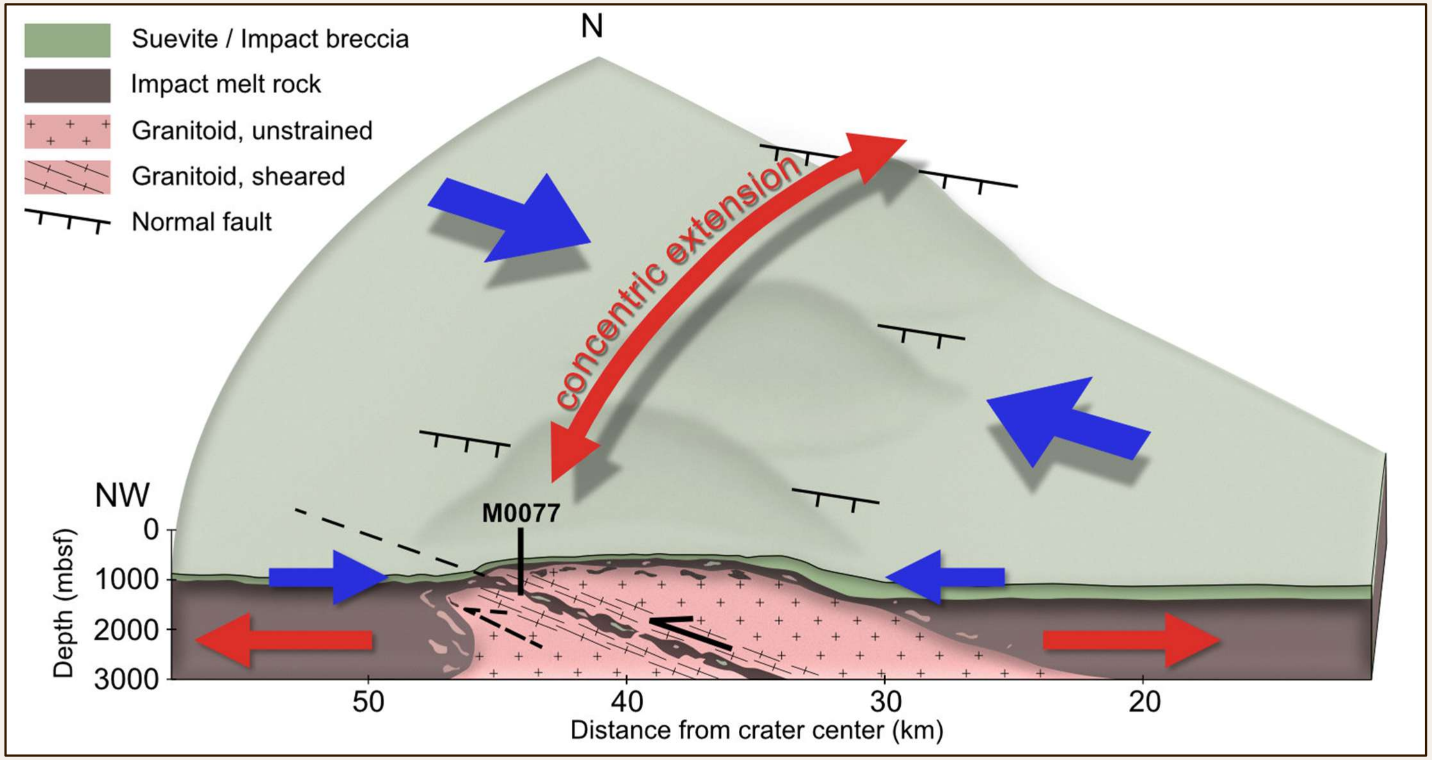
- Mostly NNW-SSE and WNW-ESE horizontal shortening with vertical and NE-SW directed extension
- Radial shortening caused by fast outward displacement of rocks overriding the crater floor
- Considered as hanging wall rocks of a thrust zone
- Compartmentalization of peak ring due to concentric extension



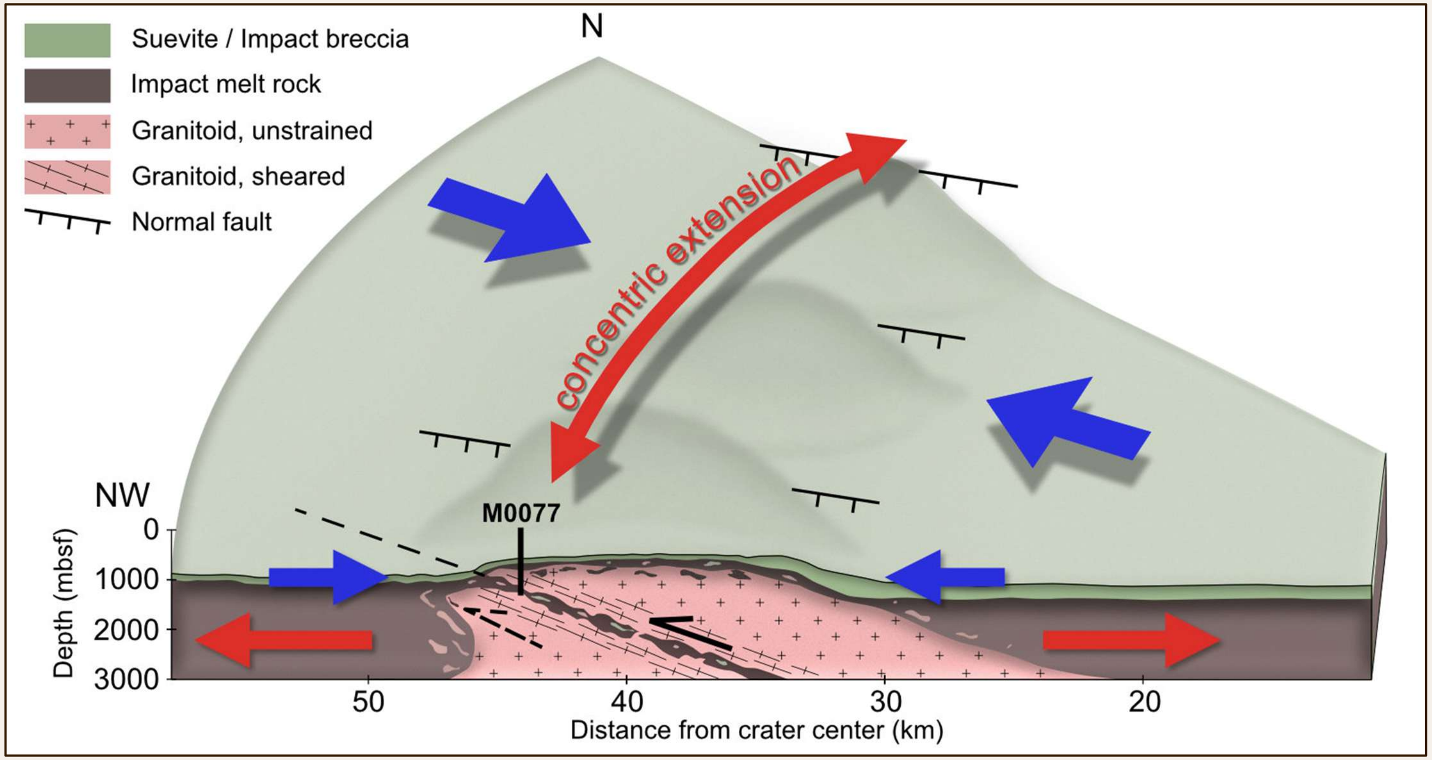
Two depth-dependent kinematic regimes active toward the end of cratering

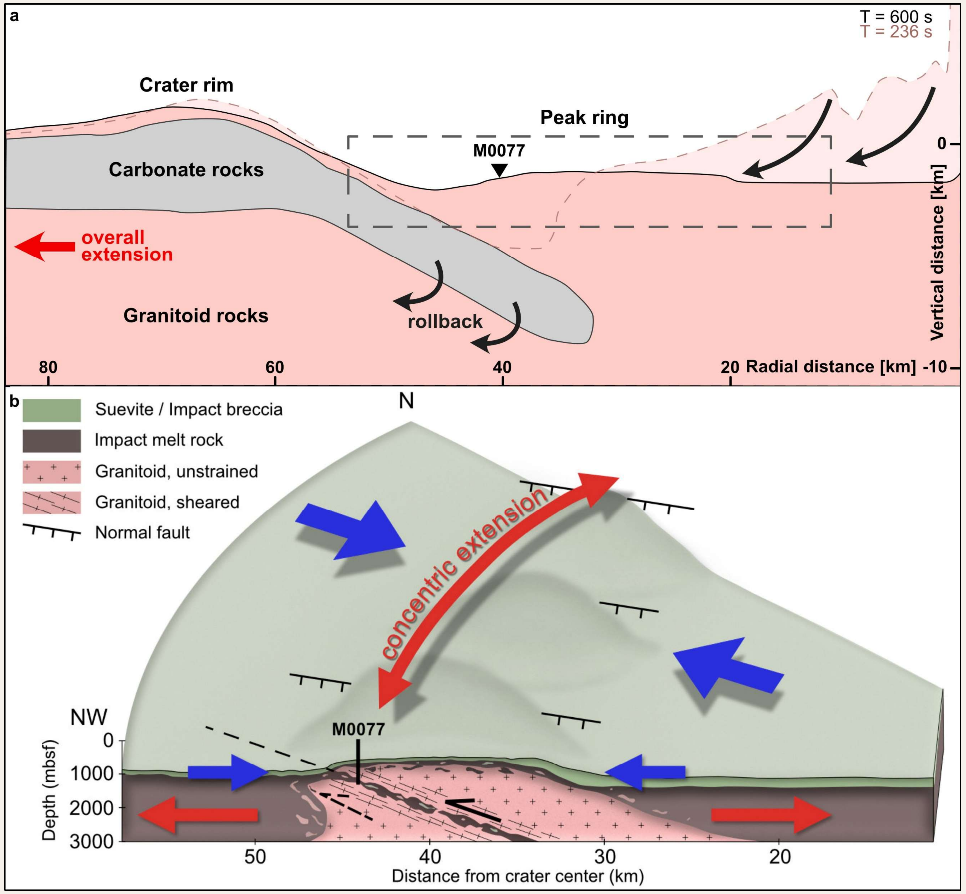
Lower regime:

- Overall horizontal extension and vertical shortening
- Accounts for horizontal crater growth followed by immediate to long-term relaxation of crust below the crater floor
- Horizontal crater growth by rollback of the crater margin
- Considered as footwall of a thrust zone



- Rocks of both kinematic regimes were displaced radially outward toward the end of cratering
  BUT: they were likely at different velocities
- This causes a velocity discontinuity characterized by shearing, affecting the border zone of the kinematic regimes
- Shear stress build-up caused the radial displacement of hanging wall rocks to decelerate and was converted into radial shortening and piling up of the rocks above the thrust to form the peak ring
- These results support the dynamic collapse model

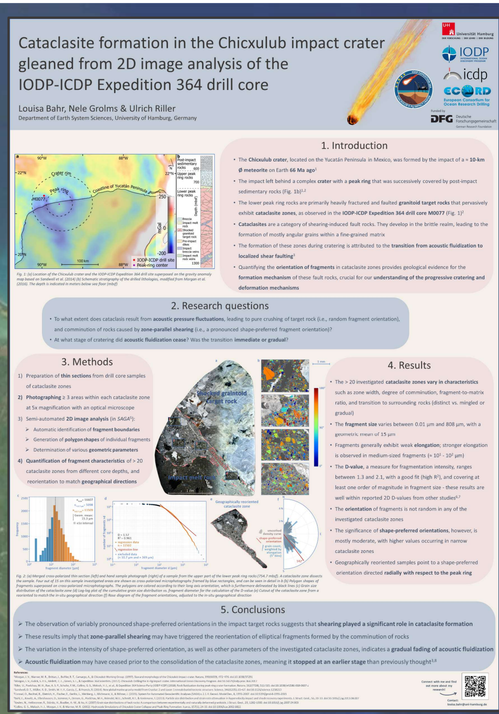




1) Identification of **17 depth-dependent domains**
2) The domains portray **two different kinematic regimes**
   - Upper regime: characterized by **radial shortening**
   - Lower regime: agrees with **horizontal crater growth**
3) A **velocity discontinuity** formed by fast outward displacement of collapsed material above target rocks
4) Local thrusting and concentric extension explain the **dissected morphology** of peak rings
5) Compartmentalization of the upper kinematic regime portrays **kinematic partitioning of brittle deformation** accomplishing peak-ring formation
6) Our results support the **dynamic collapse model** of large impact crater formation

THANK YOU!

..and don't forget to check out my poster →



Find me on LinkedIn

Fault-slip analysis of the Chicxulub IODP-ICDP Expedition 364 drill core unravels peak-ring formation

Louisa Bahr, Ulrich Riller & IODP-ICDP Expedition 364 Scientists

EPSC Conference 2026

Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

IODP INTERNATIONAL OCEAN DISCOVERY PROGRAM

icdp

louisa.bahr@uni-hamburg.de

ECORD European Consortium for Ocean Research Drilling

Funded by
DFG Deutsche Forschungsgemeinschaft
German Research Foundation