



# Cráter Chicxulub y la extinción de los dinosaurios

Jaime Urrutia Fucugauchi

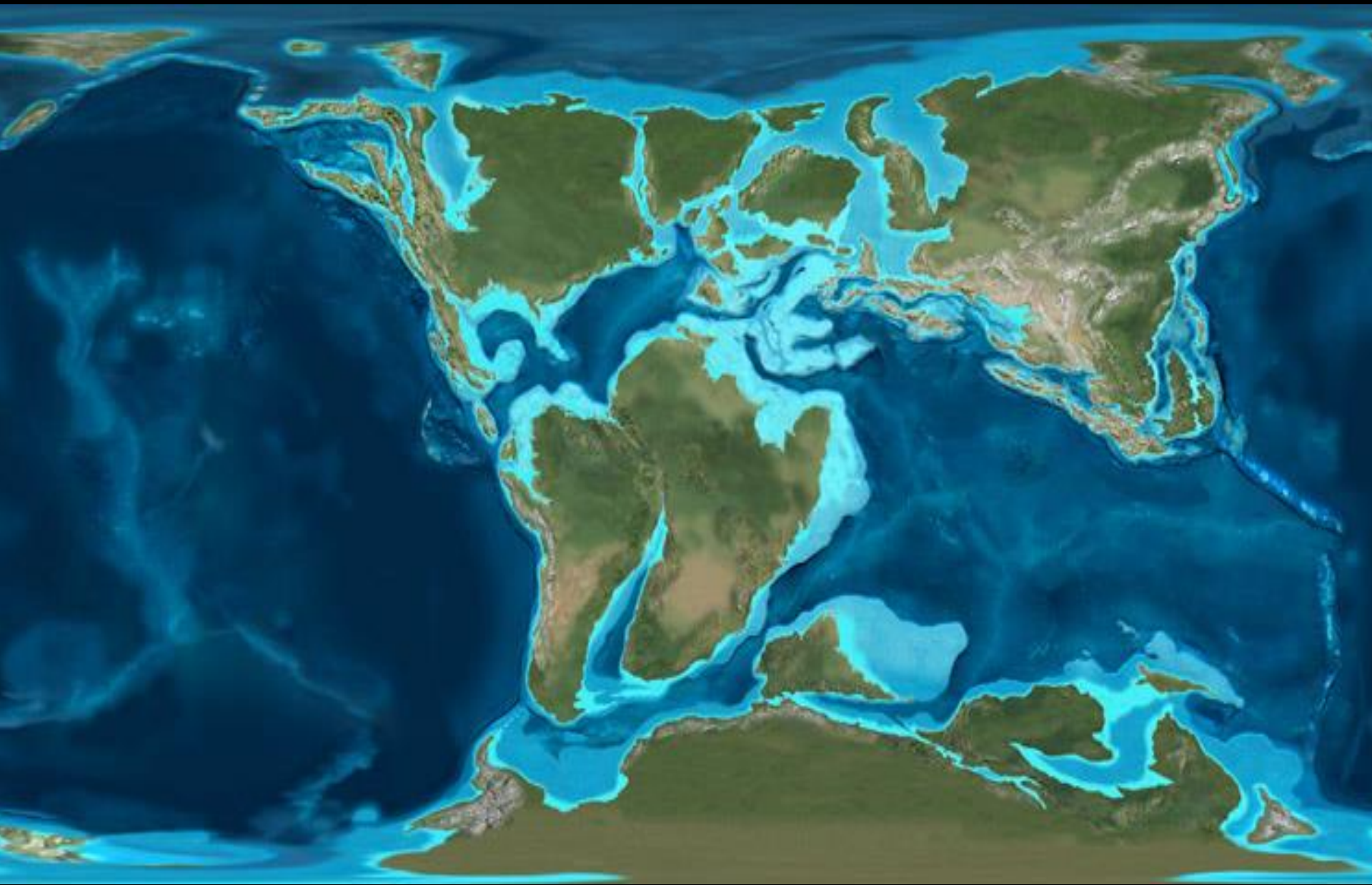
Academia Nacional de Medicina  
24 de agosto de 2016













Efectos del impacto en  
los sistemas de soporte  
de vida del planeta

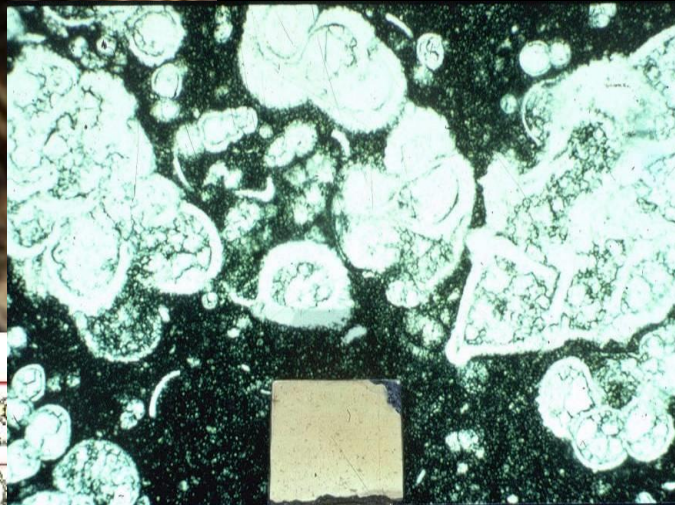
*DON  
DAVIS*

Límite Cretácico/Paleogeno

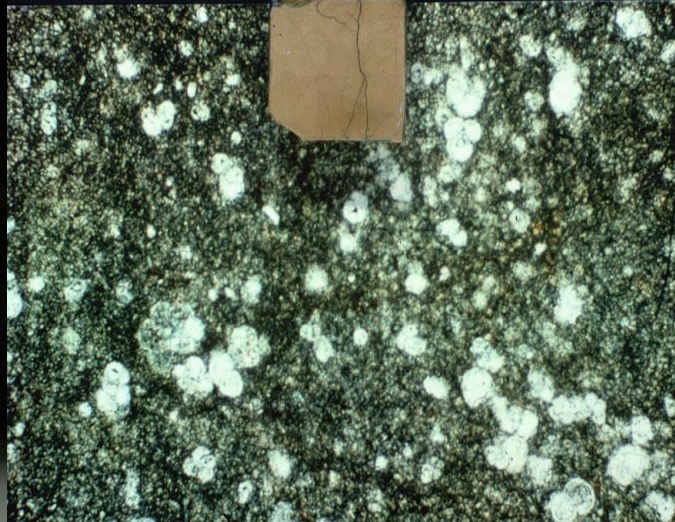
Atmosfera, oceanos, clima...

# Impacto Chicxulub

Mesozoico



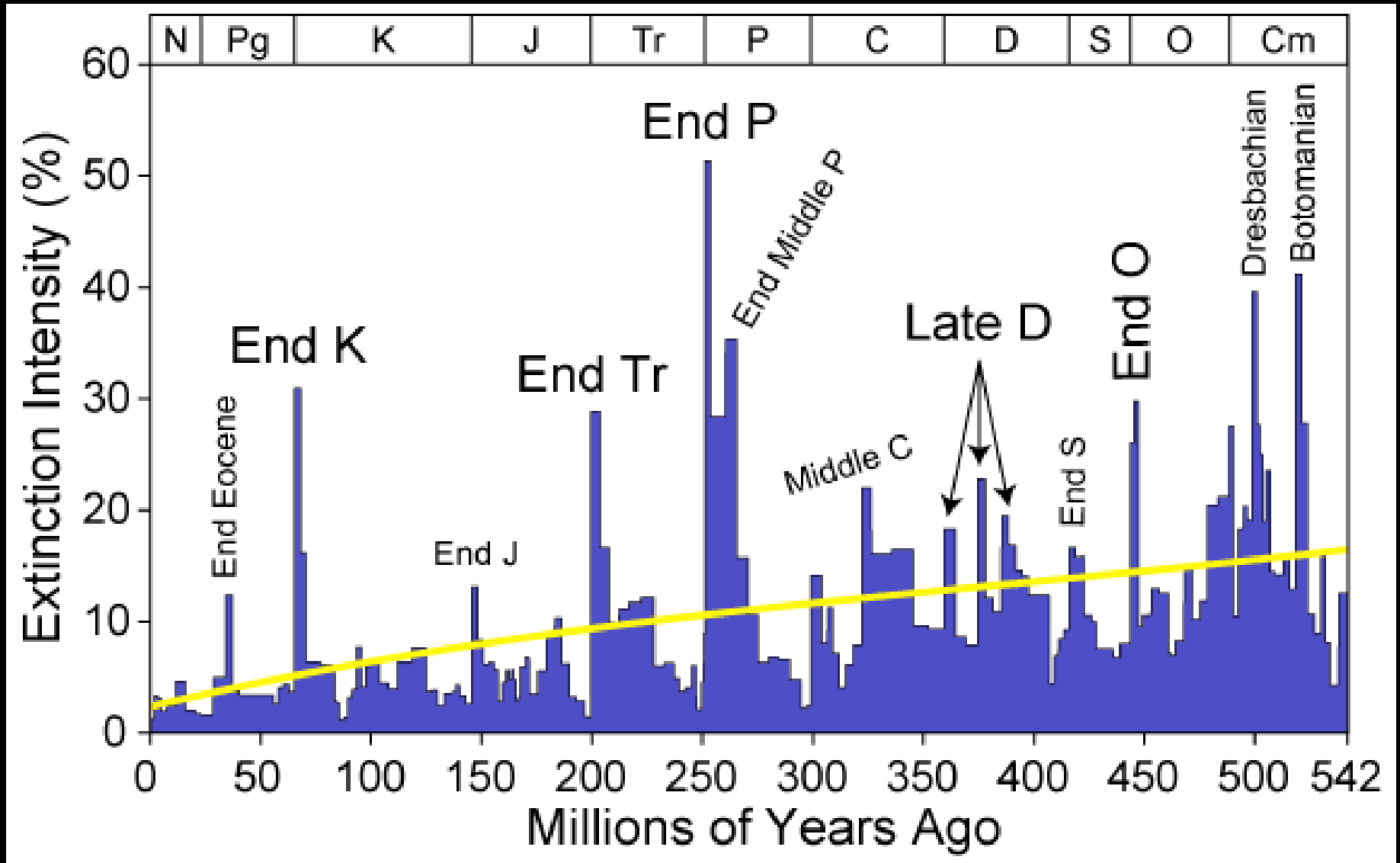
Límite K-Pg

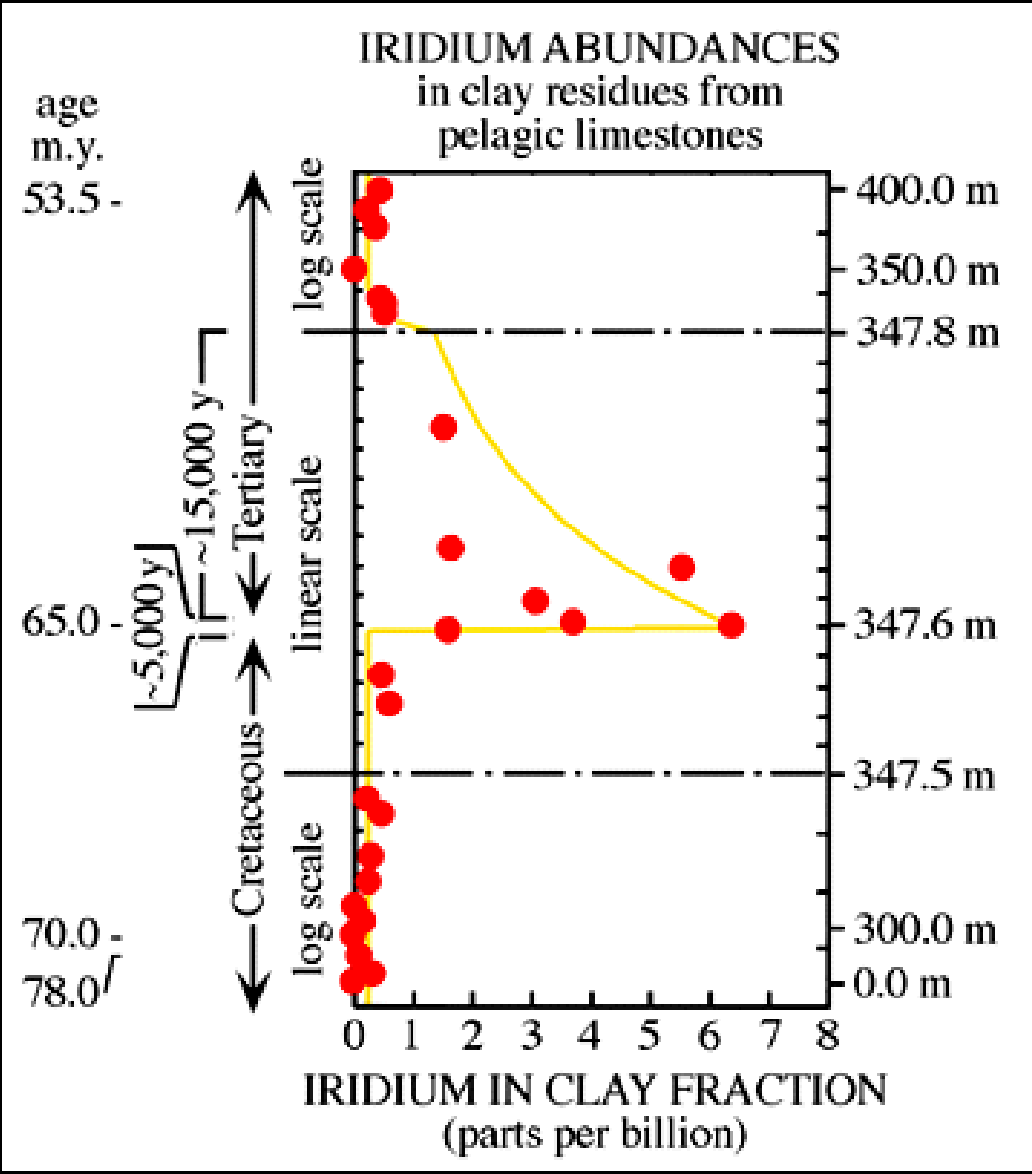


Cenozoico



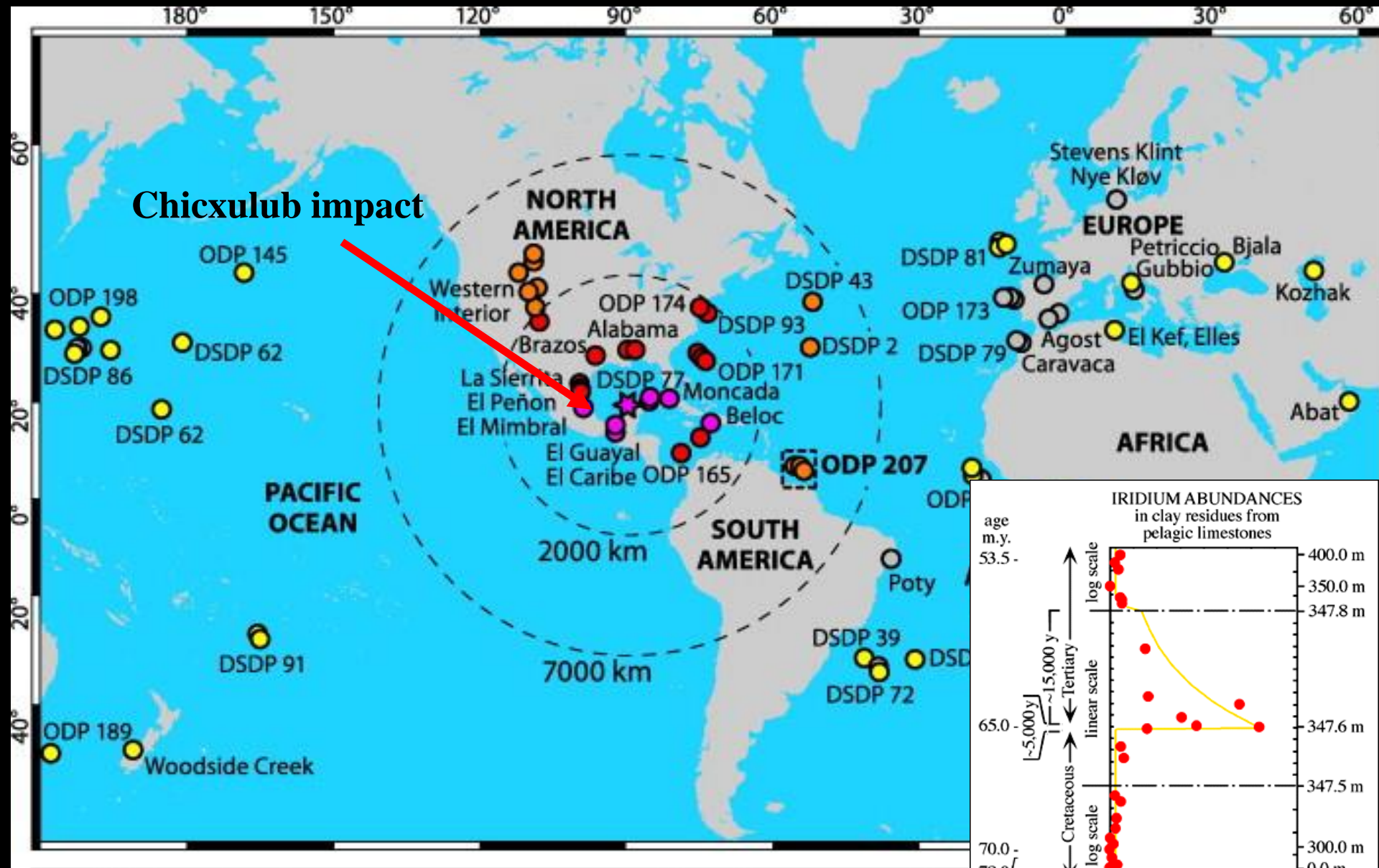
# Extinciones en el registro fósil





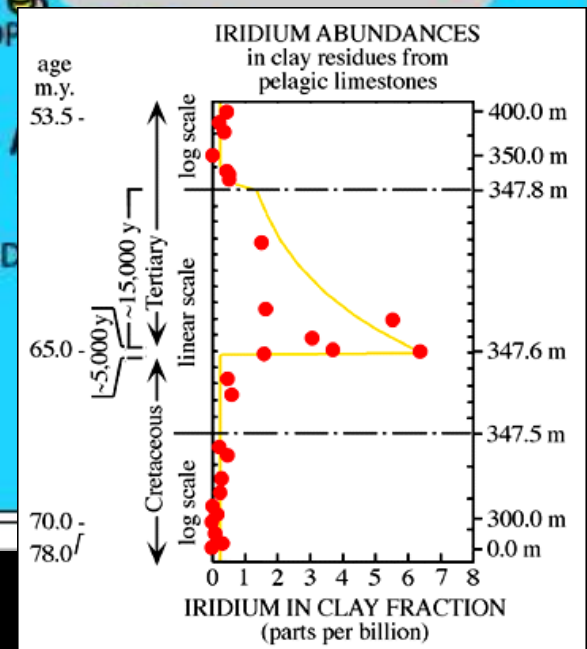
**Sección K/Pg section  
Gubbio, Italia**

# Capa de eyecta K/Pg – distribución global

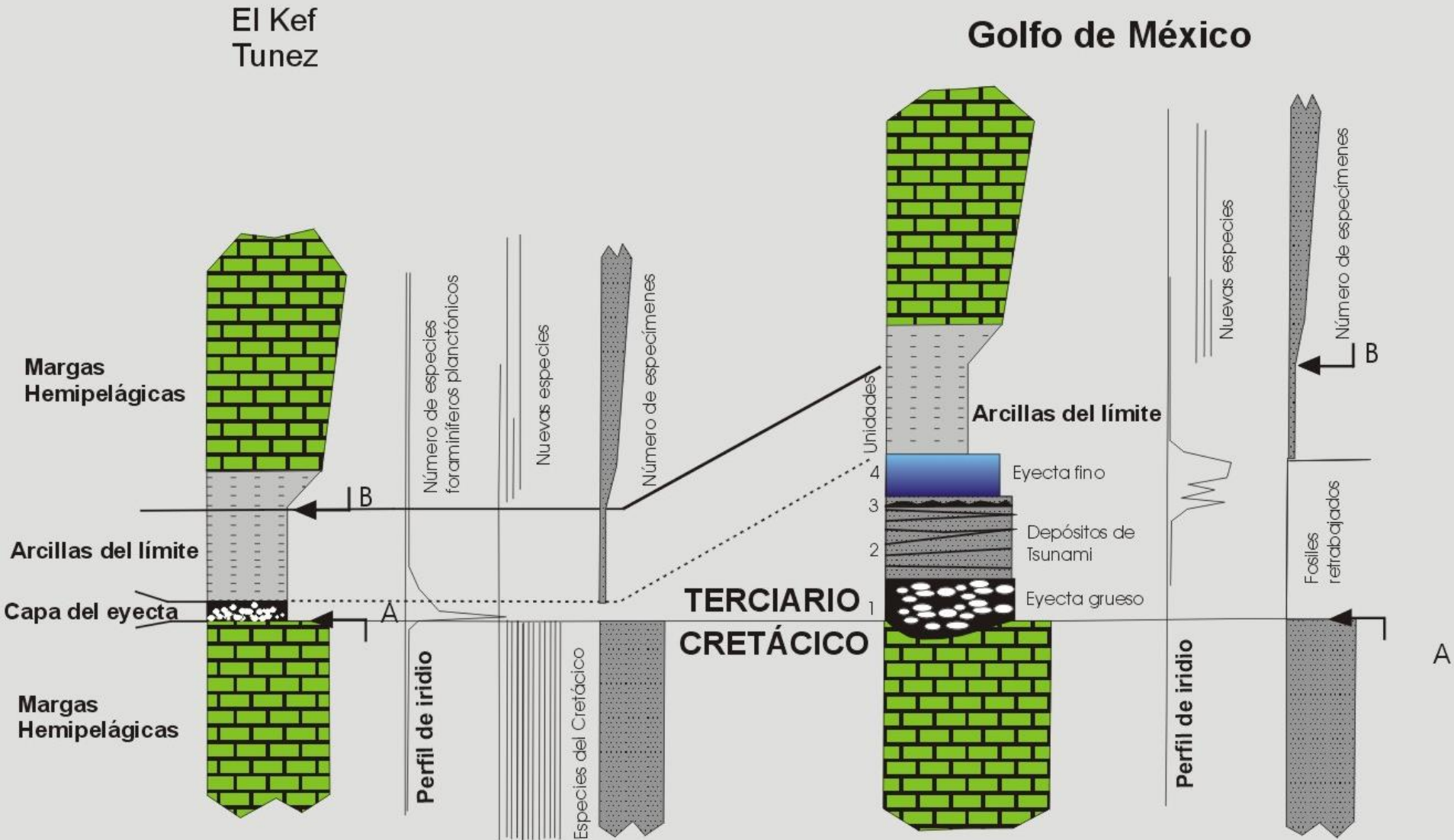


Schulte et al., Science 2010

Anomalía de iridio



# Impact record – globally distributed K/Pg layer



# End-Cretaceous mass extinction

22.25: The effects of the late Cretaceous mass extinctions. Animals and plants that became extinct are uncoloured, whereas groups that survived the mass extinction are coloured. The extinct groups include the reptiles (1) Plesiosaurus, (2) Mosasaurus, (3) Deinonychus, (4) Tyrannosaurus, (5) Edmontosaurus, (6) Brachiosaurus, (7) Triceratops, (8) Pteranodon; other animals such as (9) ammonites, (10) some types of sea-urchin and (11) peculiar molluscs known as rudists, and plants such as the Bennetiales.



Extinctions

Survivors

Secondary extinctions

Biodiversity



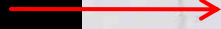
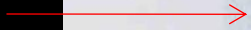
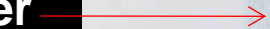


# Registro impactato Chicxulub

Empty seas layer

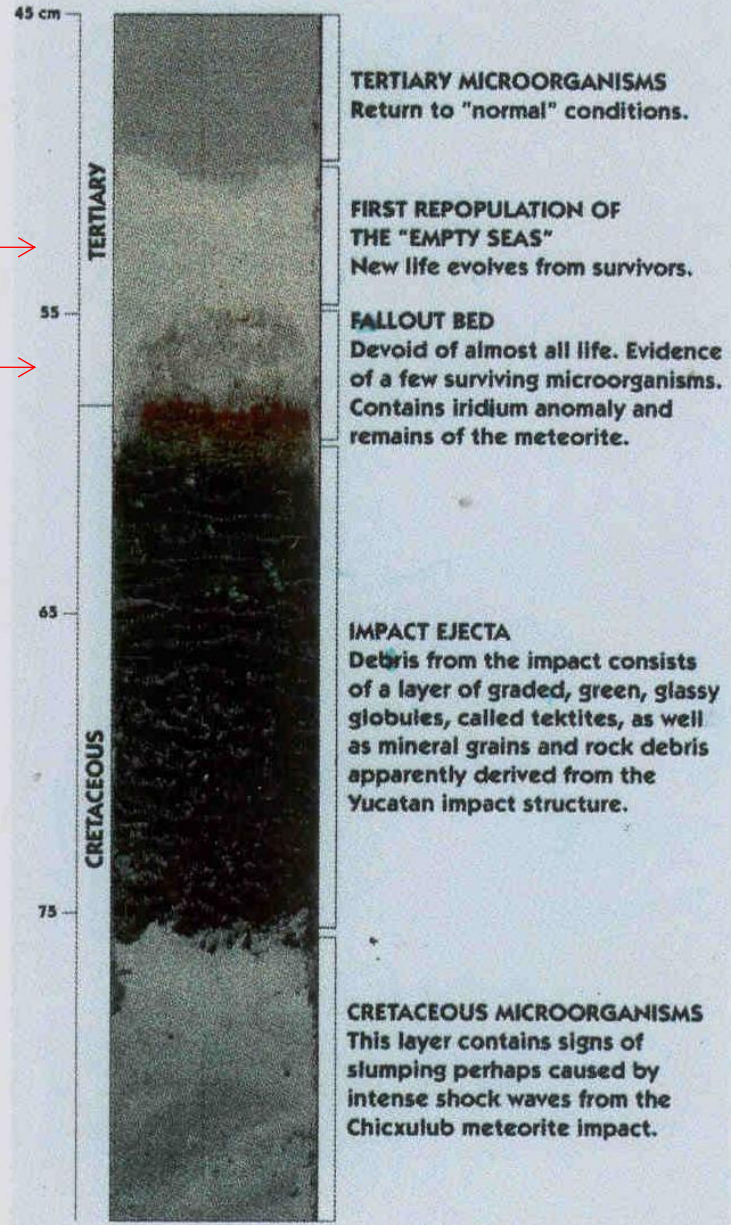
Fireball layer

Ejecta layer



## Cretaceous/Tertiary Boundary meteorite impact

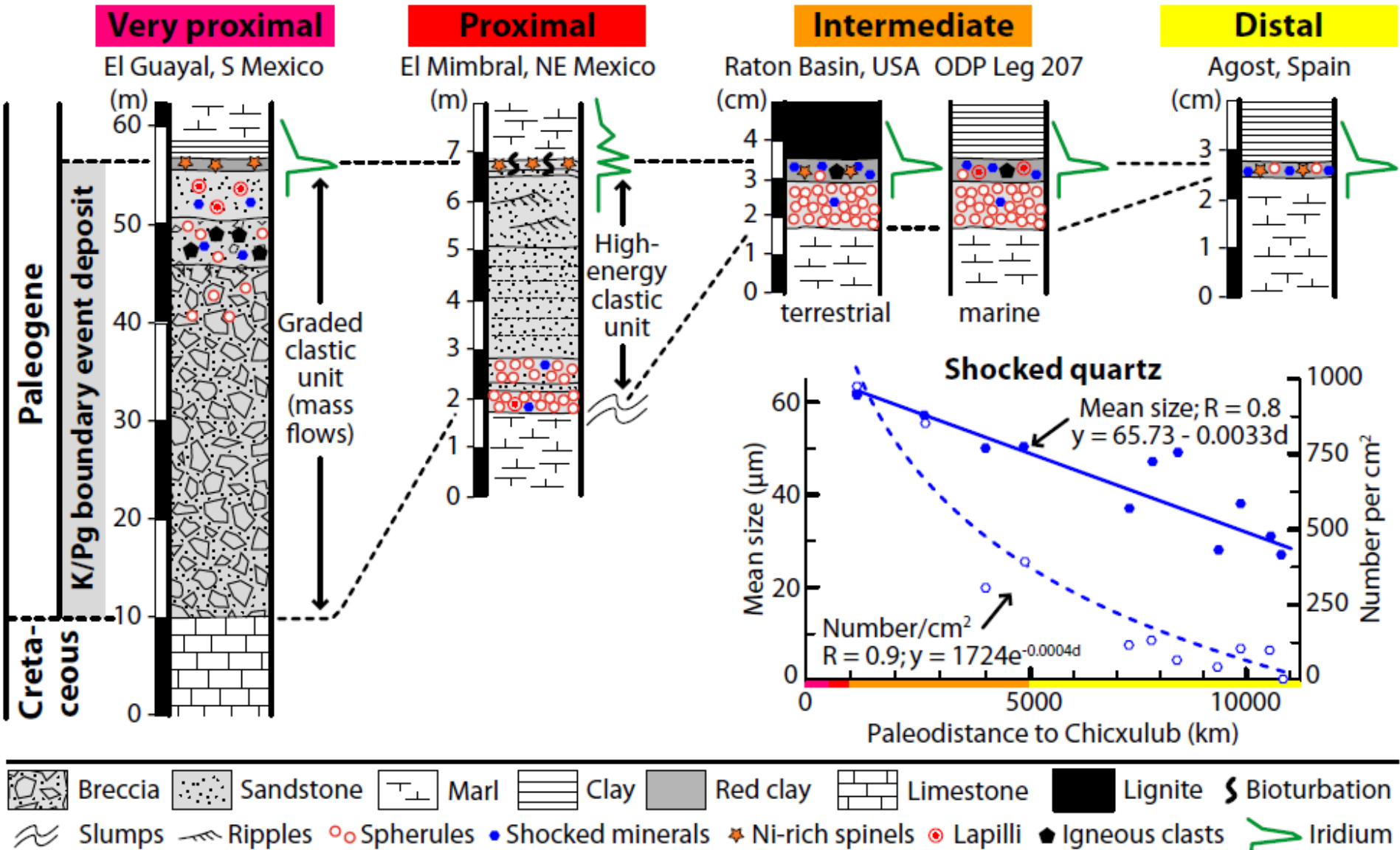
ODP Leg 171B, Site 1049, Core 1049A, Section 17X-2

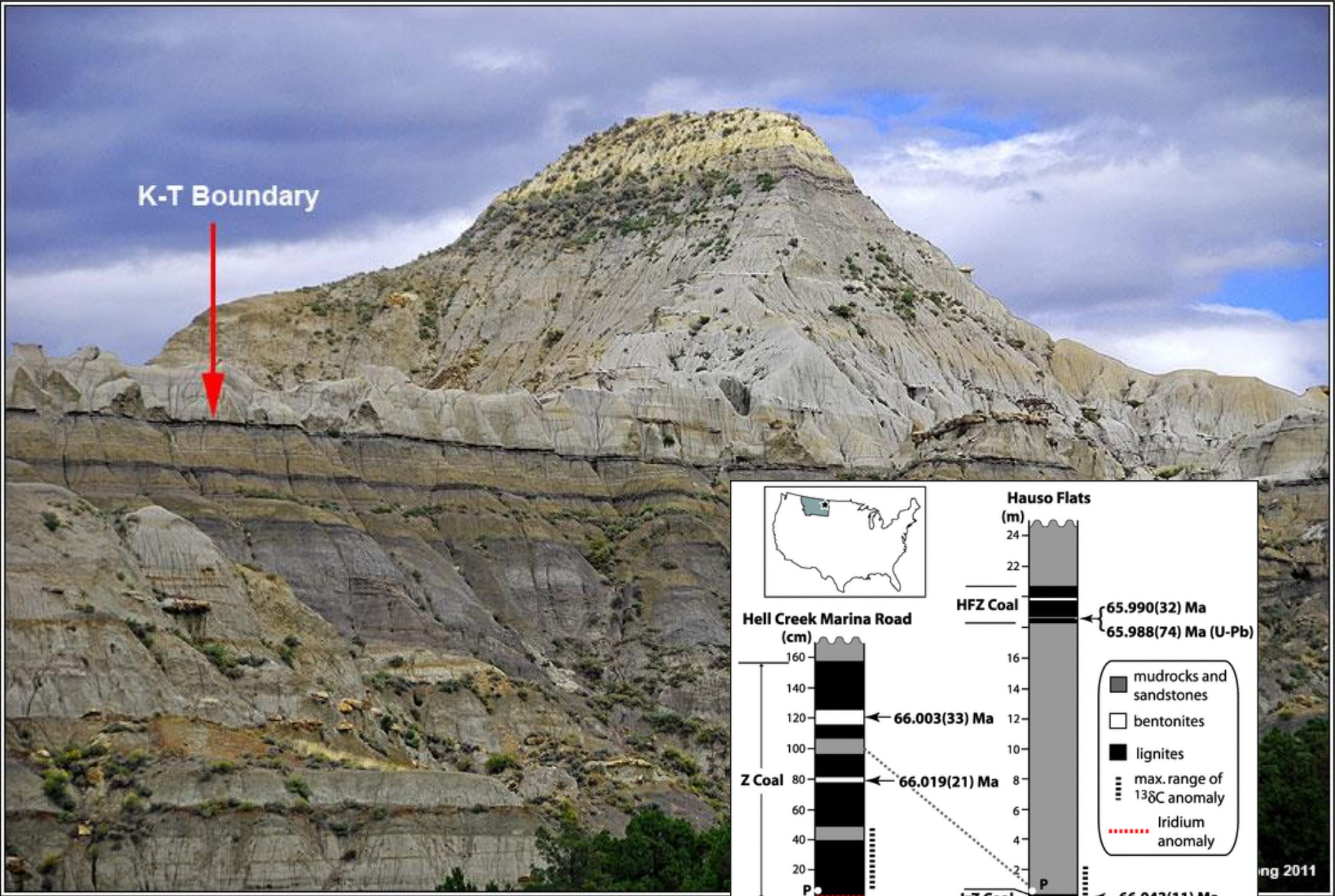


K/Pg boundary marine sediment record  
ODP Leg 1718  
Atlantic Ocean

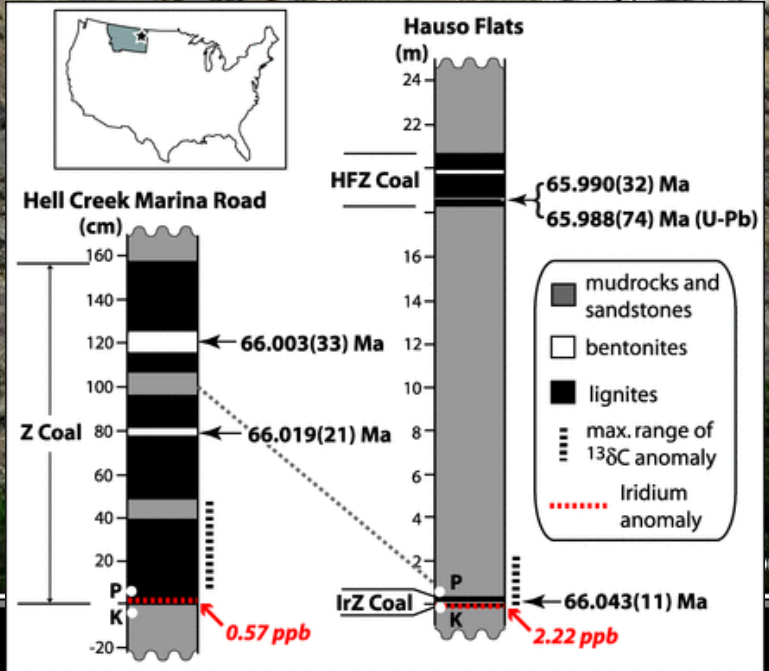


# Secciones límite Cretácico/Paleogeno





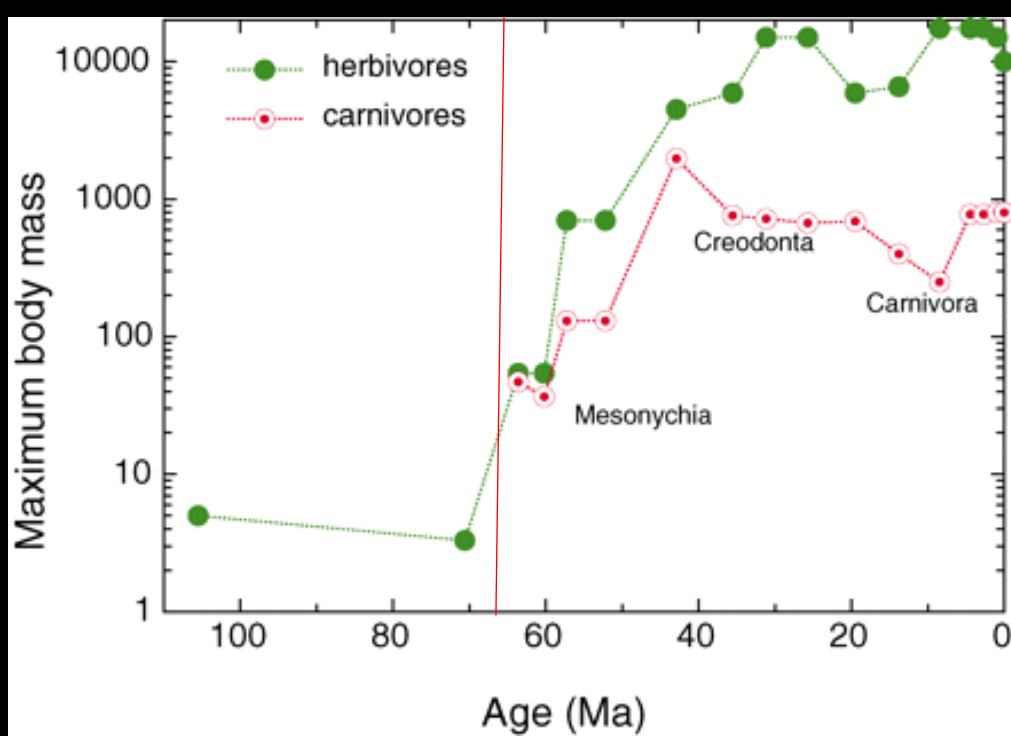
K-T Boundary



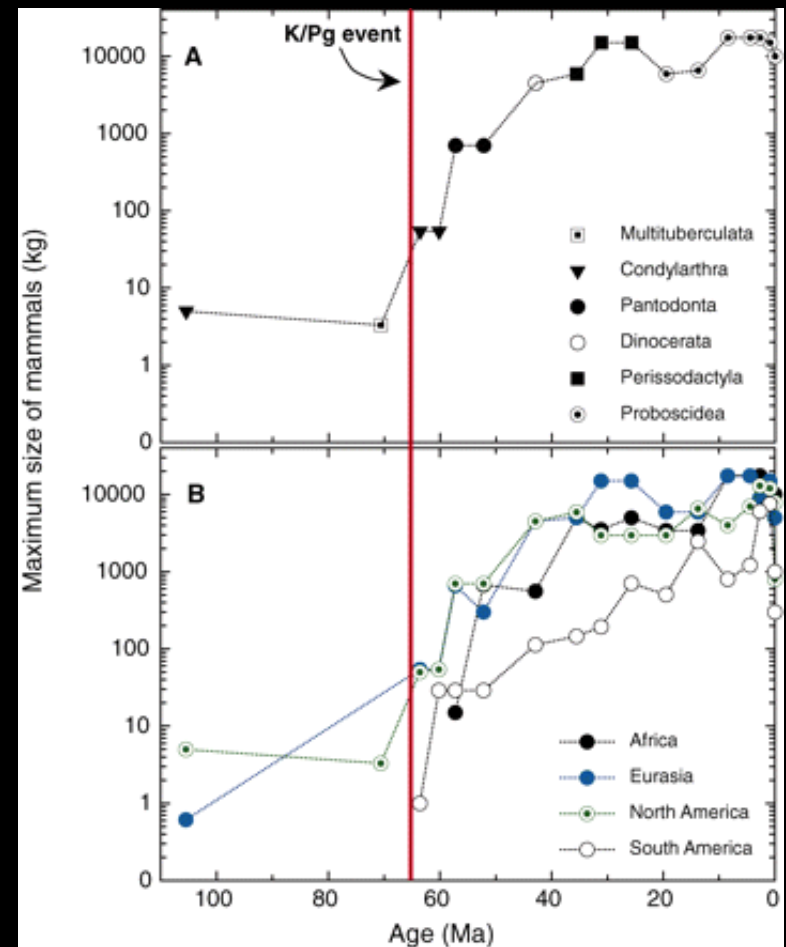
Edad límite K/Pg: 66.038 +/- 0.049 Ma

Renne et al., 2013 Science

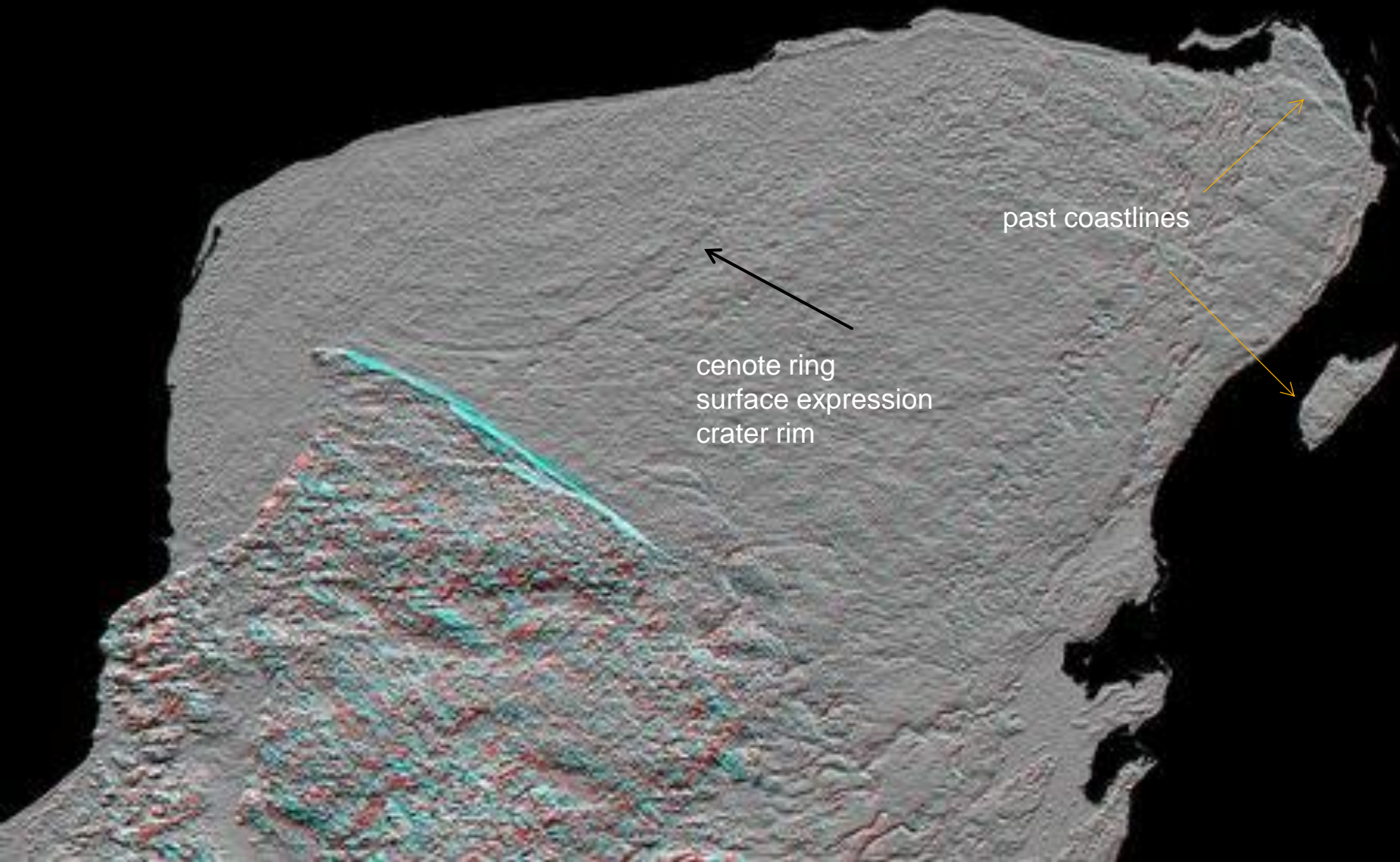




Smith et al., 2010

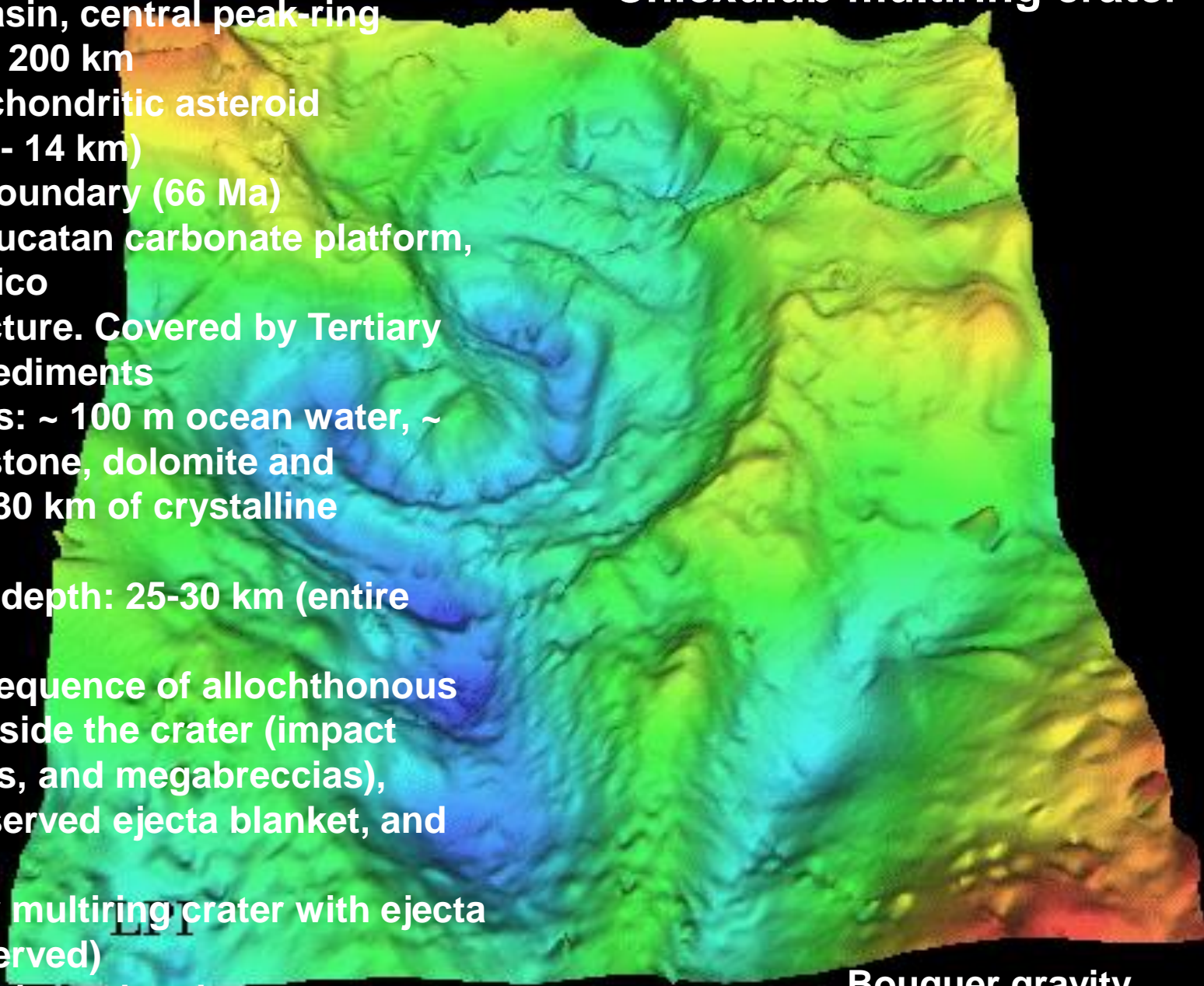


# Imagen satelital de interferometría de radar de Yucatan

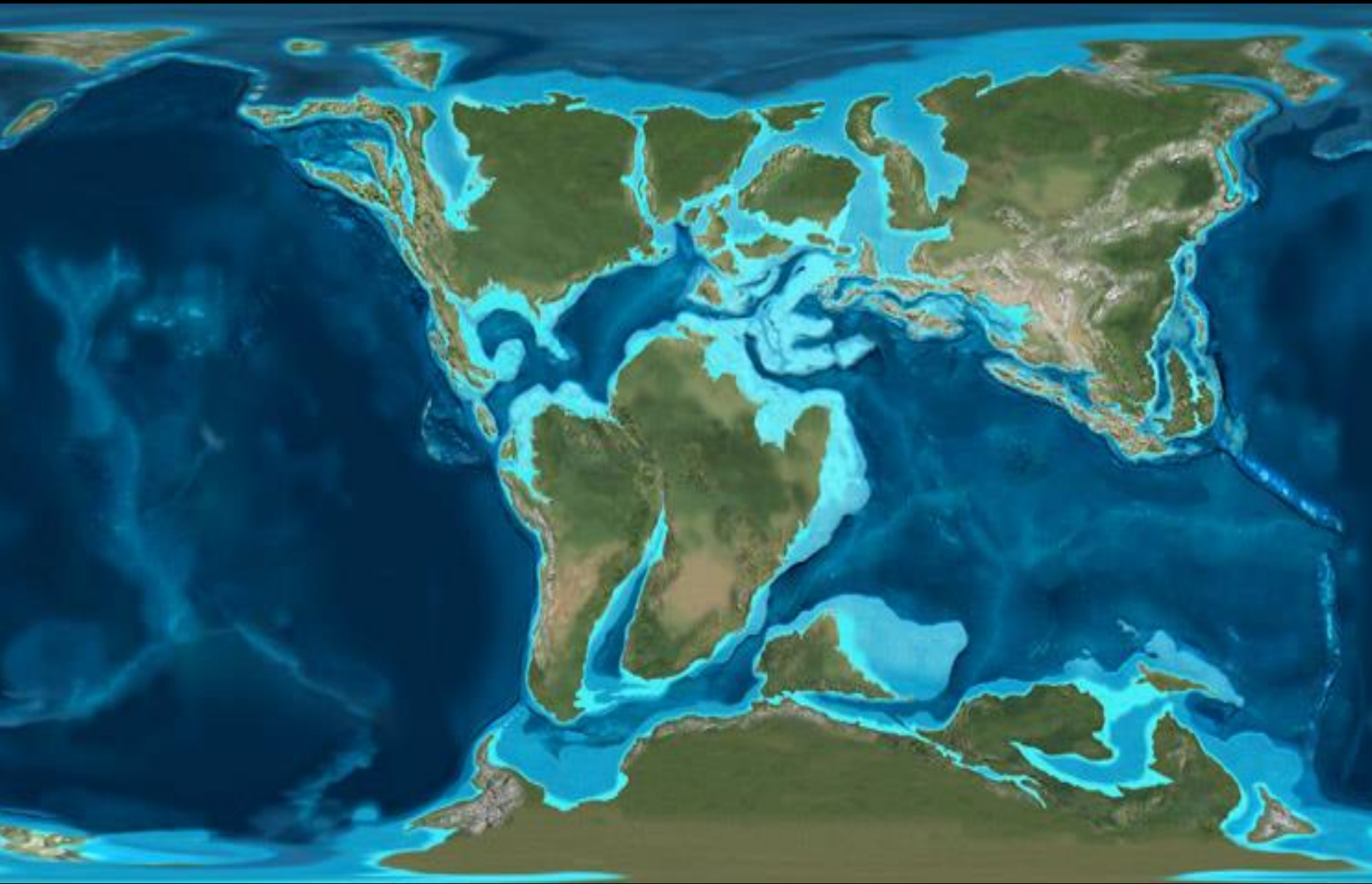


# Chicxulub multiring crater

- Multiring basin, central peak-ring
- Diameter: ~ 200 km
- Projectile: chondritic asteroid (diameter 12 - 14 km)
- Age: K/Pg boundary (66 Ma)
- Location: Yucatan carbonate platform, Gulf of Mexico
- Buried structure. Covered by Tertiary carbonate sediments
- Target rocks: ~ 100 m ocean water, ~ 3000 m limestone, dolomite and anhydrite, ~ 30 km of crystalline basement
- Excavation depth: 25-30 km (entire crust)
- Complete sequence of allochthonous impactites inside the crater (impact melt, suevites, and megabreccias), partially preserved ejecta blanket, and distal ejecta
- It is the only multiring crater with ejecta blanket preserved)
- Global K/Pg boundary layer

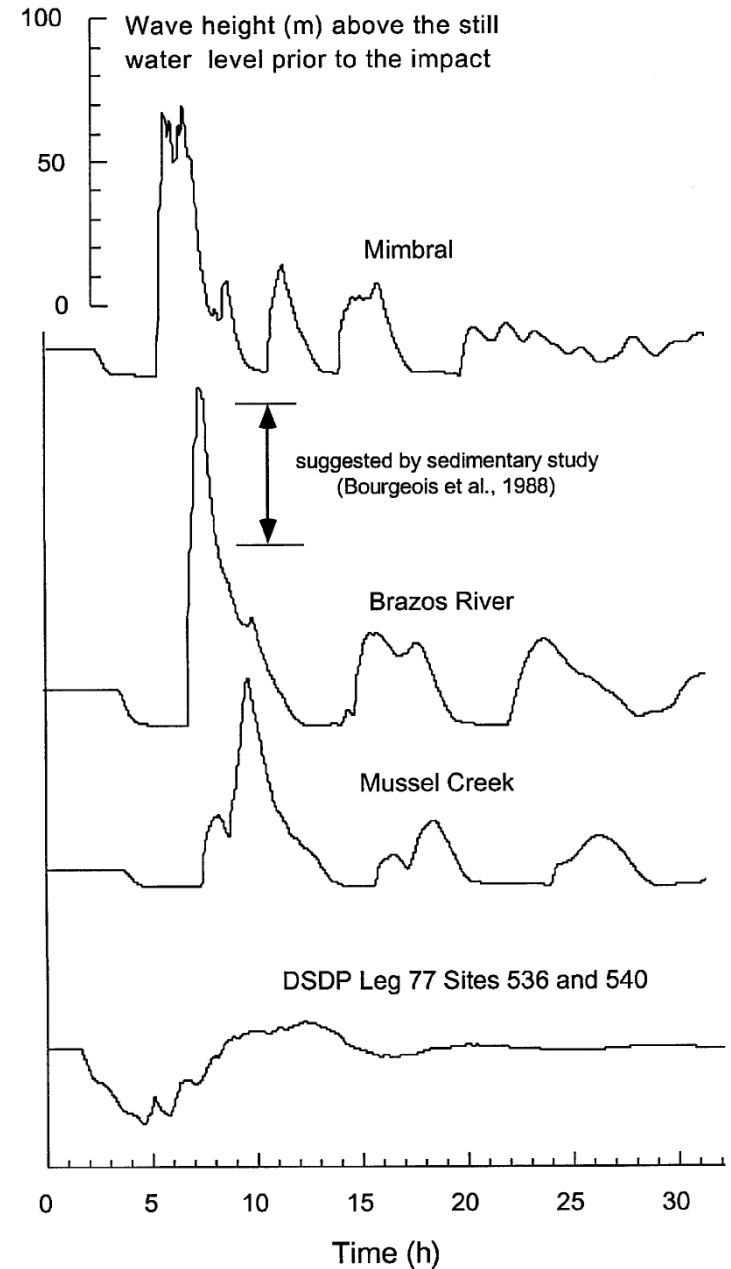
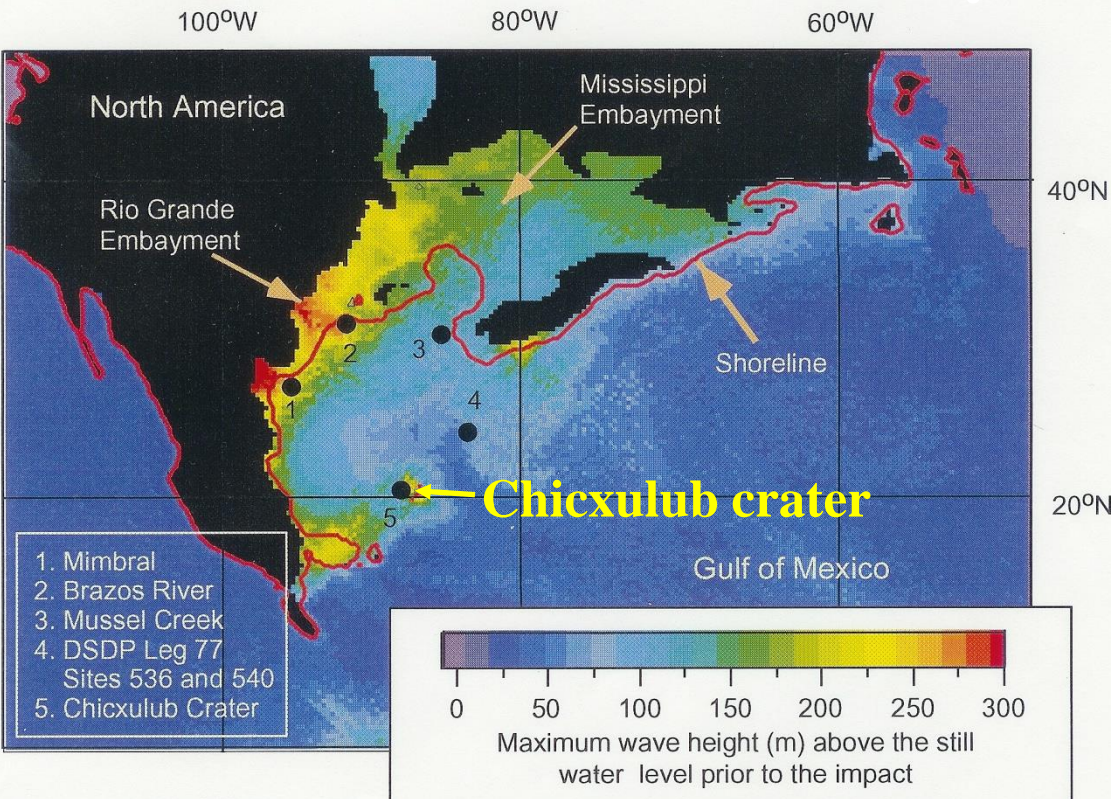


Bouguer gravity anomaly Chicxulub

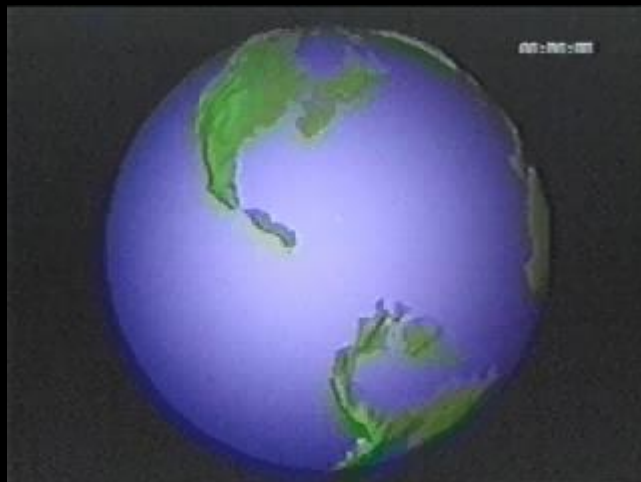


Paleogeografía a fines del Cretácico e inicios del Paleógeno

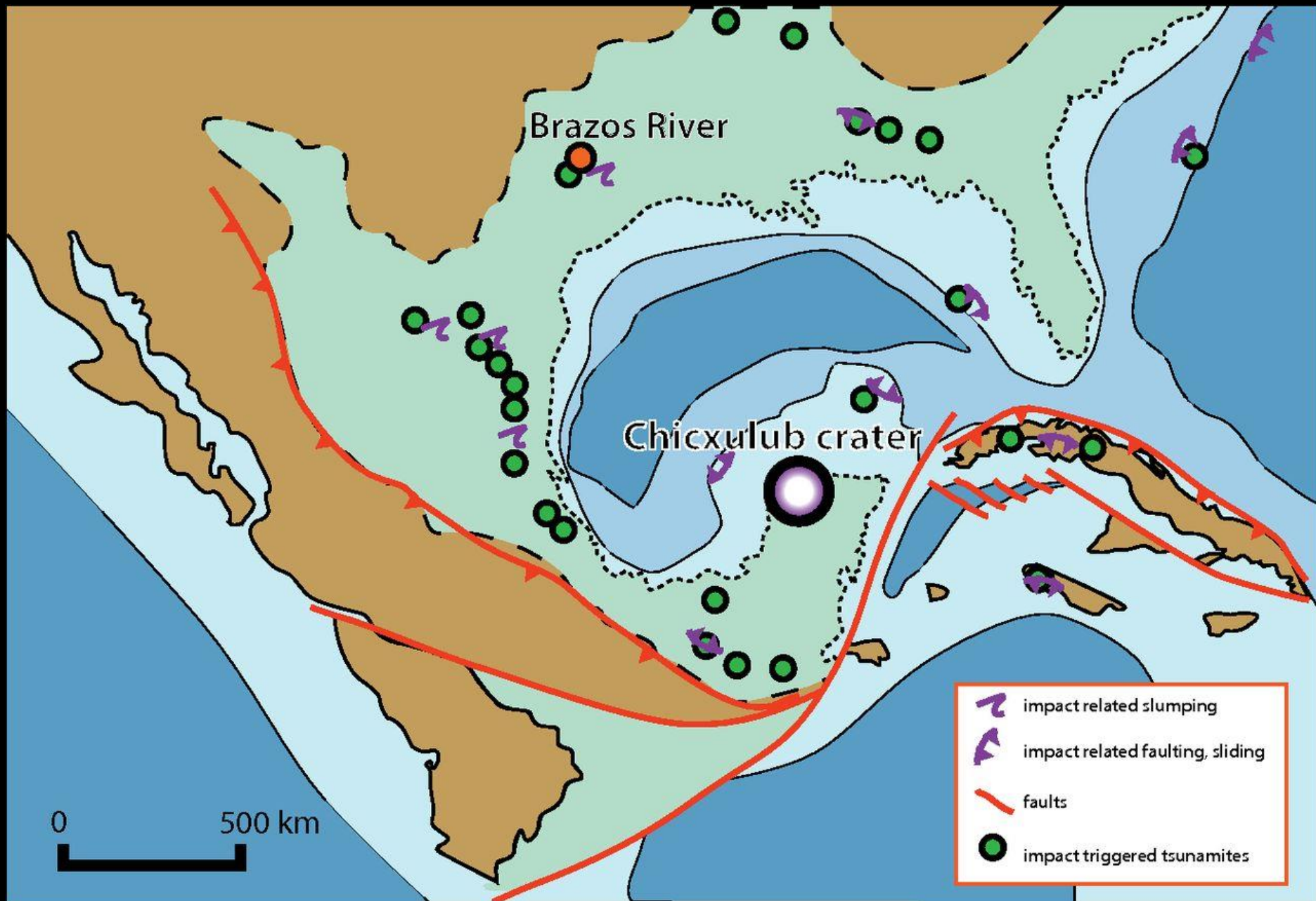
# Tsunamis en el Golfo de México y Caribe

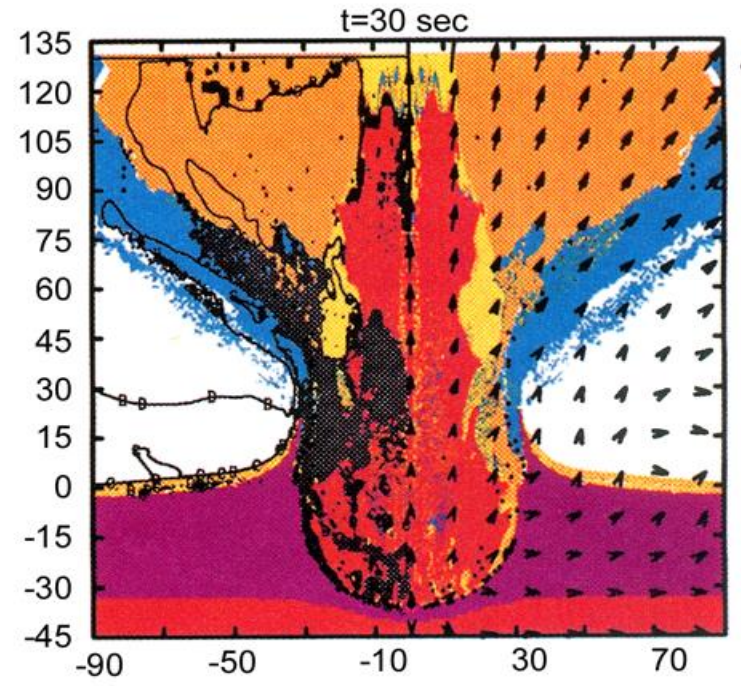
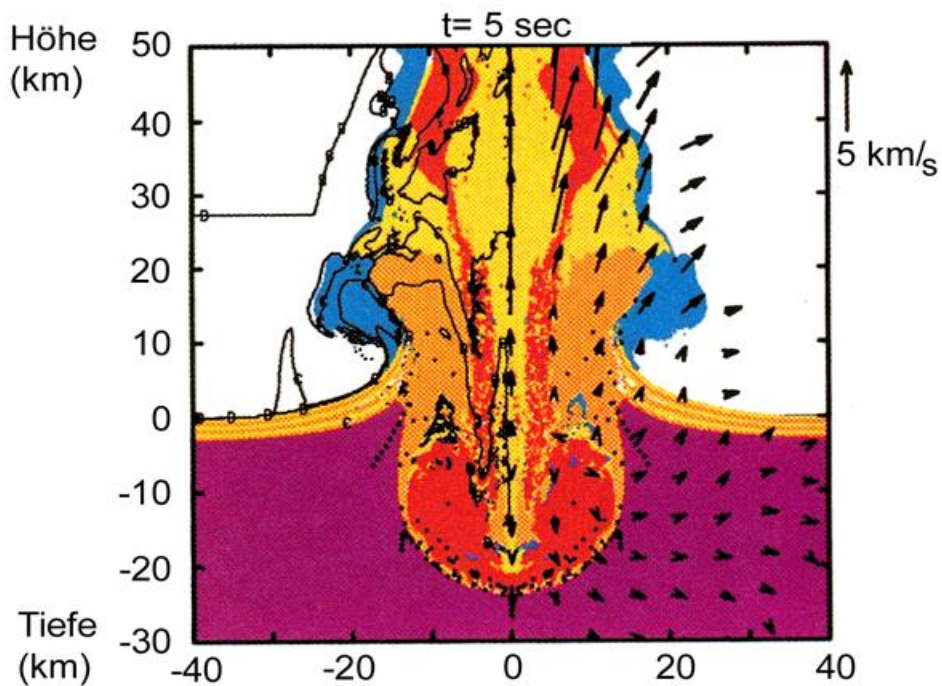
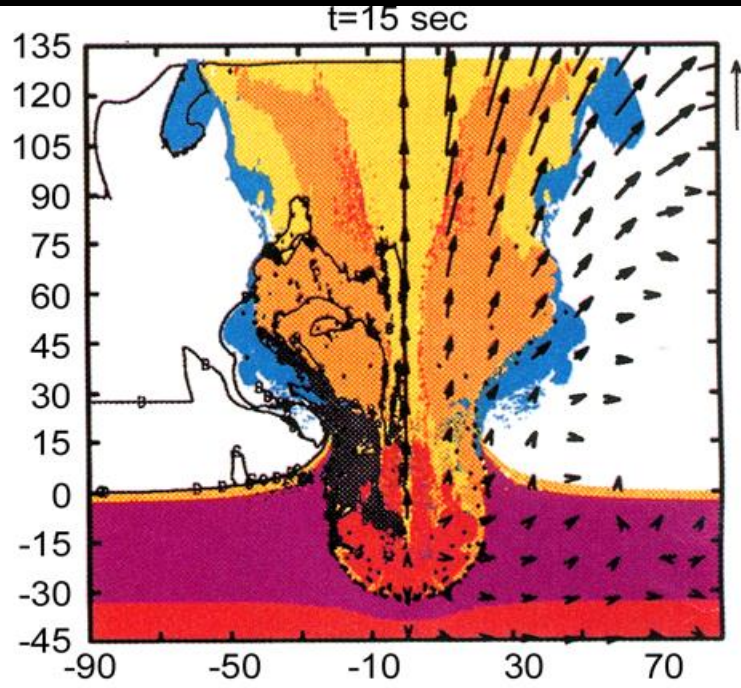
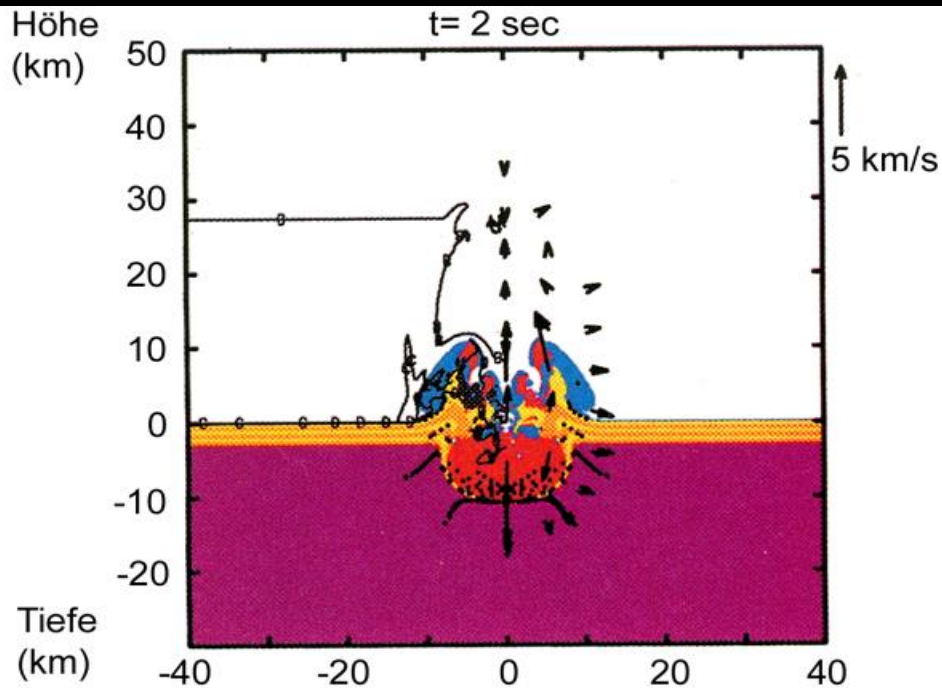


**Maximum period: 10 hours, Maximum run up height: 300 m**

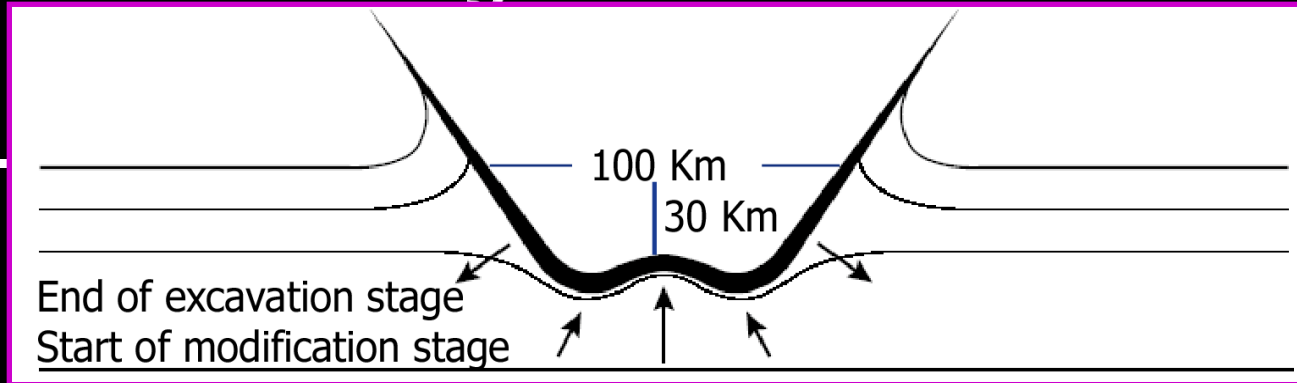






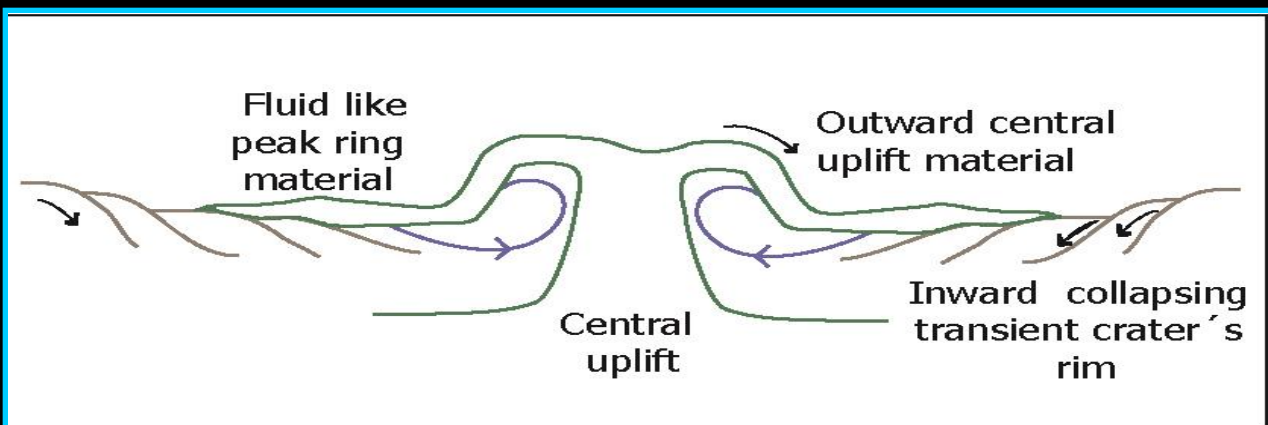
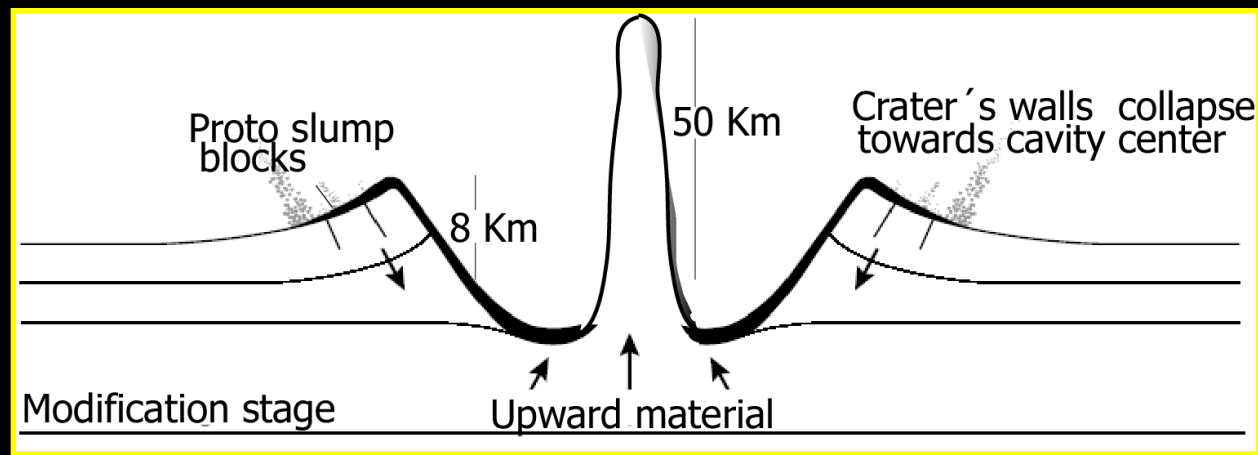


# Complex Crater Formation Stages



**Excavation**

**Central uplift lithospheric re-bond**



**Collapse**

Chicxulub Marine Drilling Project  
IODP Expedition 364  
Drilling Phase April-June 2016



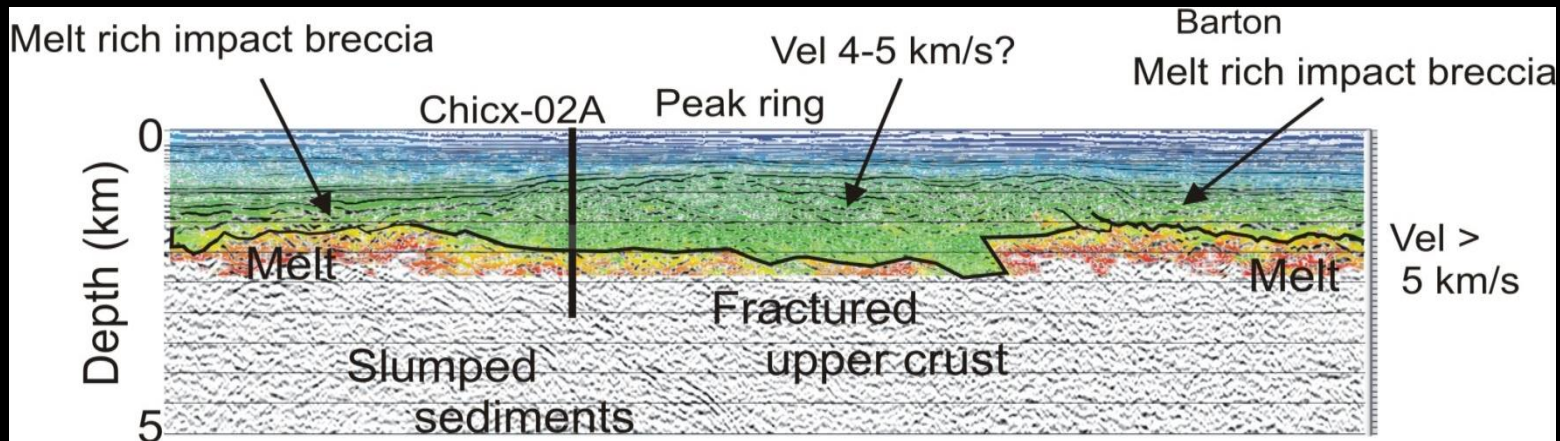
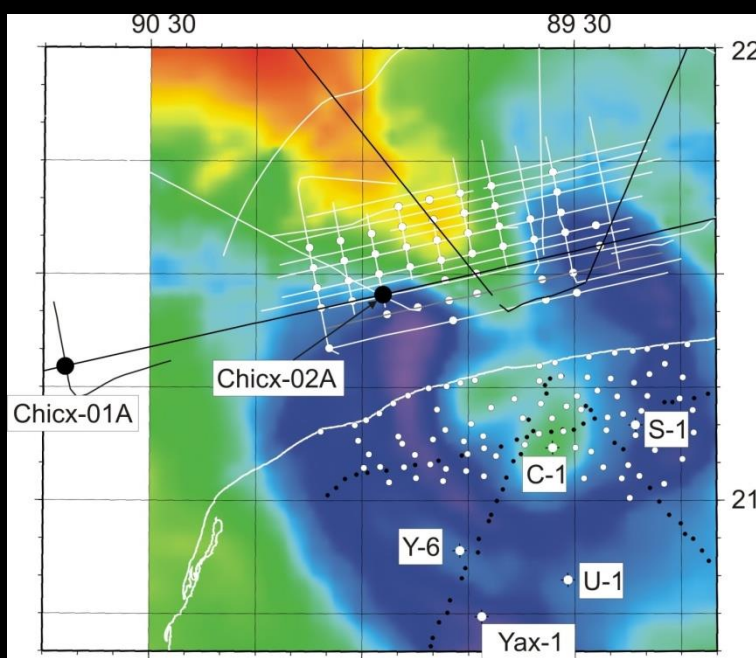
Next Stop: Science Party  
University of Bremen  
September-October 2016

## New studies - ongoing projects

# Chicxulub marine drilling project

Chicxulub peak ring project

Chicxulub is the only large terrestrial crater with a peak ring preserved



What rocks comprise a topographic peak ring and how do peak rings form?

How are rocks weakened during large impacts to allow them to collapse and form relatively wide, flat craters?

What caused the environmental changes that led to a mass extinction and what insights arise from biologic recovery in the Paleogene?

What effect does a large impact have on the deep subsurface biosphere and can impacts generate habitats for chemosynthetic life?

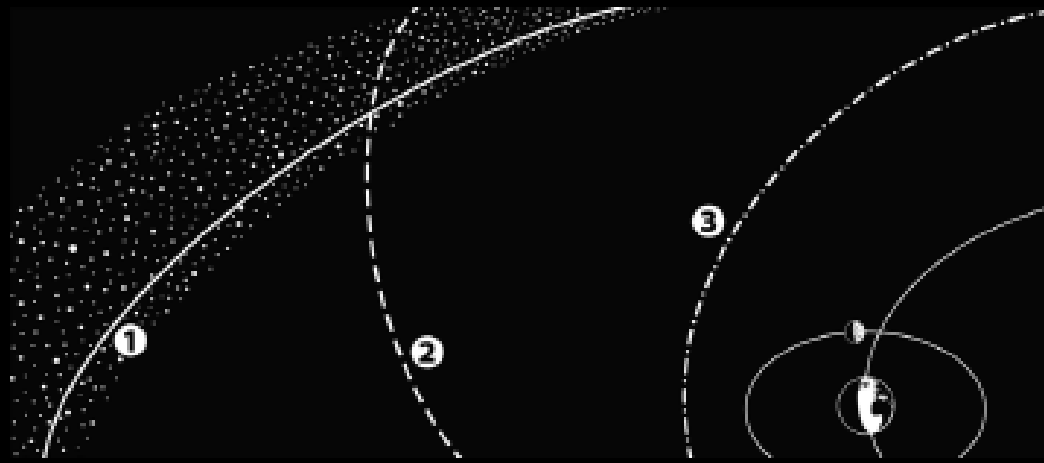


**Muchas gracias**

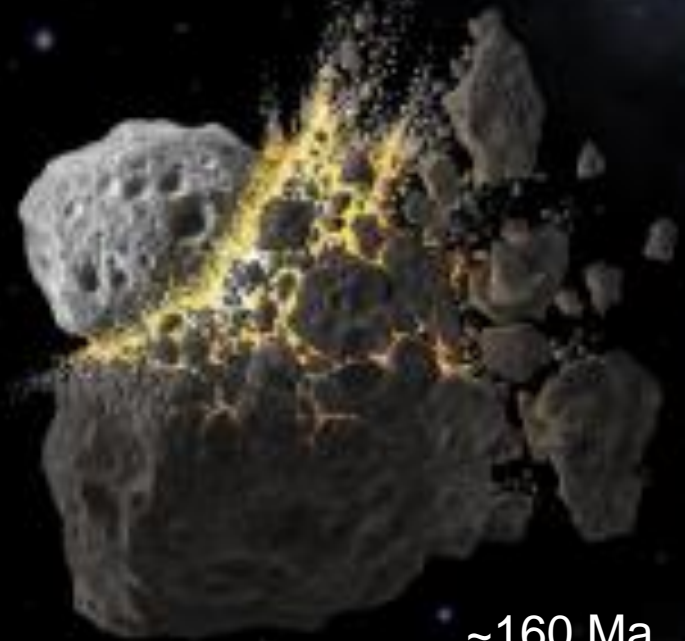




# Origin and pre-collision history of Chicxulub asteroid



Baptistina ~170 Km Carbonaceous Chondrite Asteroid



~160 Ma

Baptistina Break-up



~109 Ma

Tycho D ~85 km



~65.5 Ma

Chicxulub D ~200 km





Studies of asteroid belt dynamics

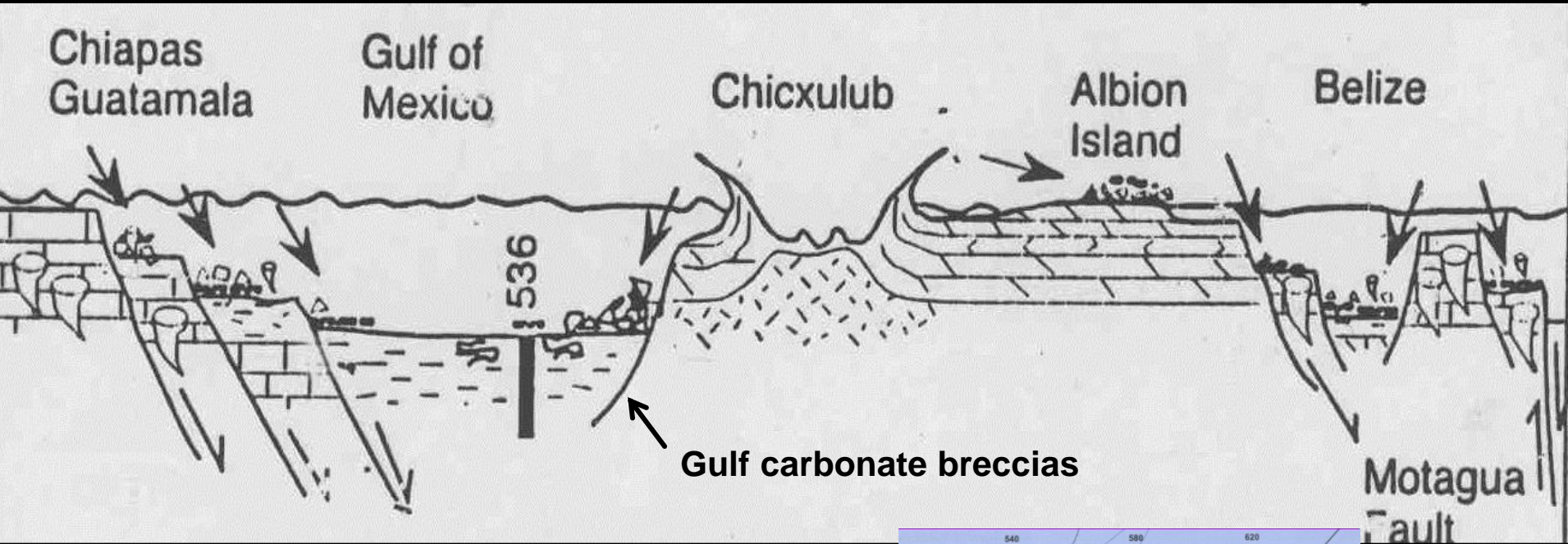
Collisions

# Regional deformation effects in Gulf of Mexico Caribbean Sea

Collapse of carbonate platform

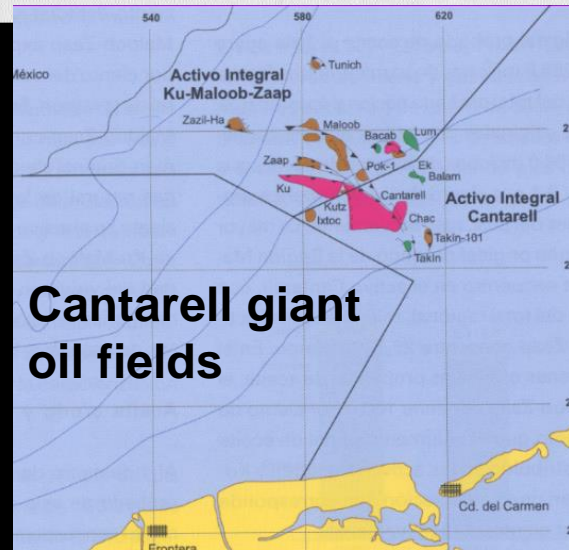
Margin collapse breccias

Tsunami and gravity flow deposits



Earthquake magnitude  $M > 13-15$

Oil reservoirs in impact breccias –  
Sonda de Campeche Cantarell



Cantarell giant  
oil fields