

# Collisions in the solar system

Collisions have played a major part in both the formation and the evolution of the solar system

**Q:** Can you give a number of pieces of evidence for collisions and impacts

(a) In the early solar system?

(b) Ongoing impacts?

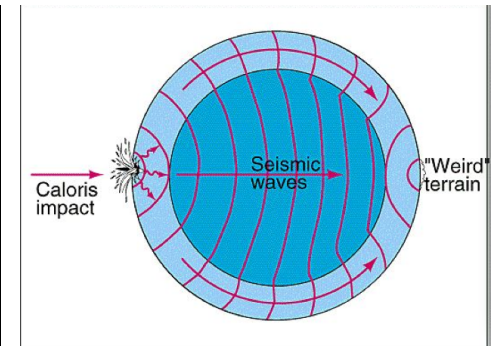
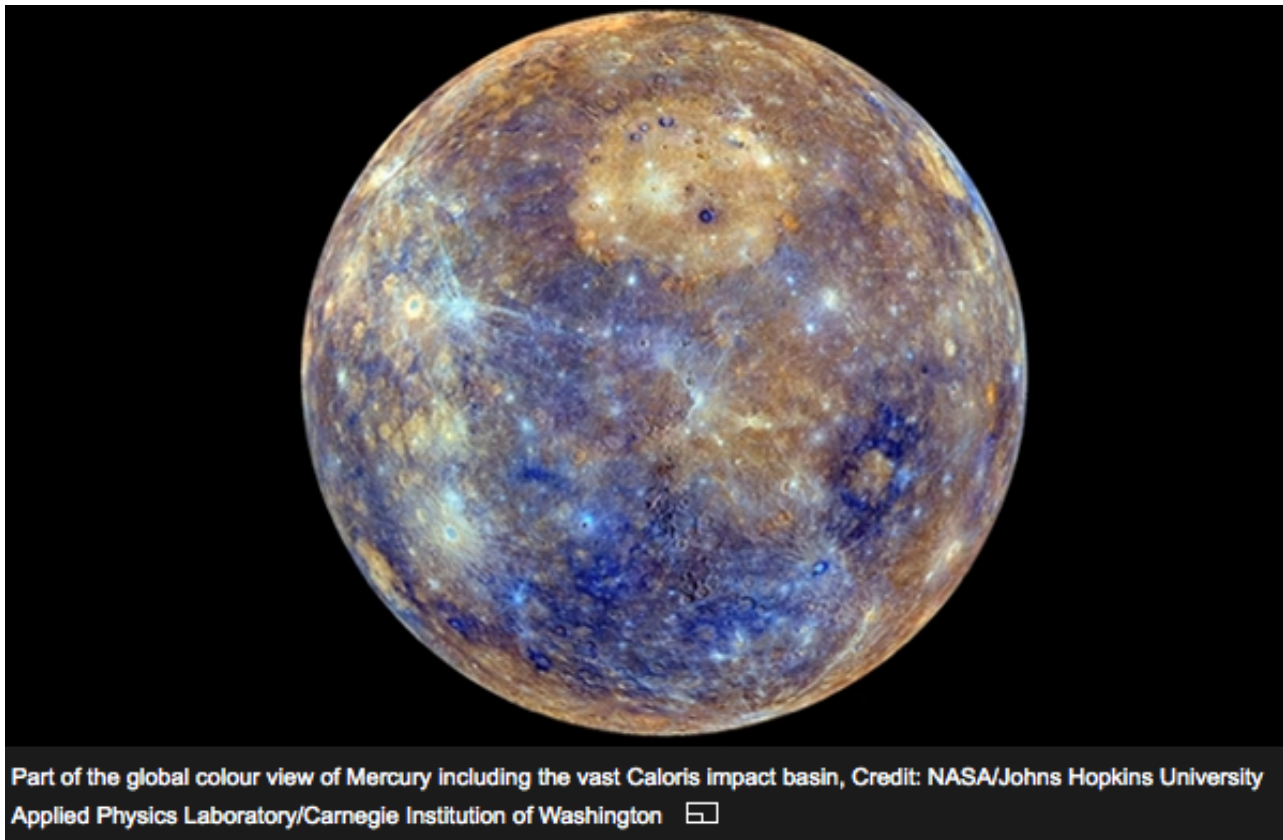
# Collisions early in solar system history

- The differing tilt of planetary rotation axes is best explained by a period of giant collisions



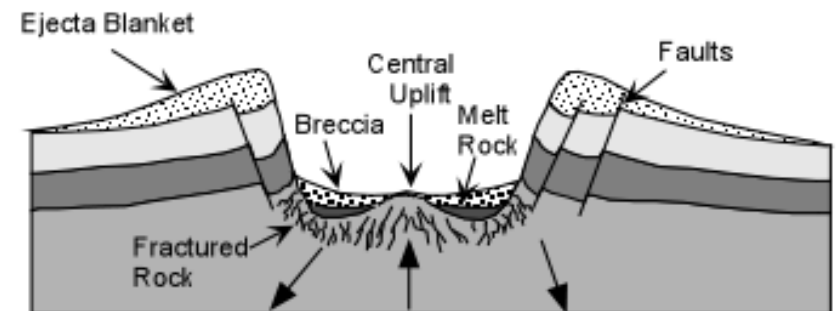
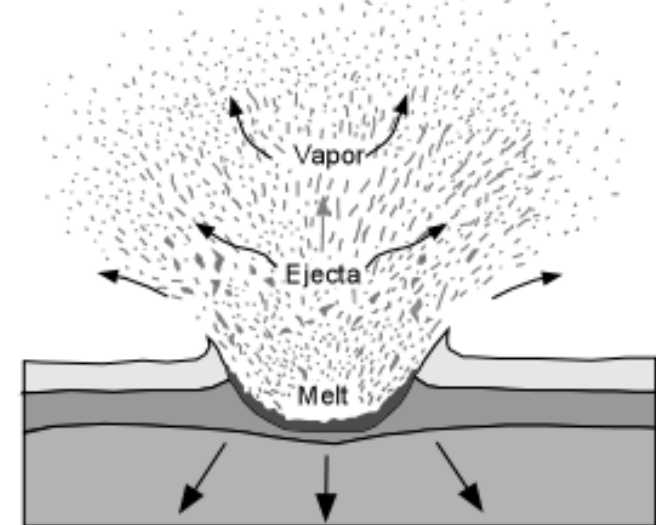
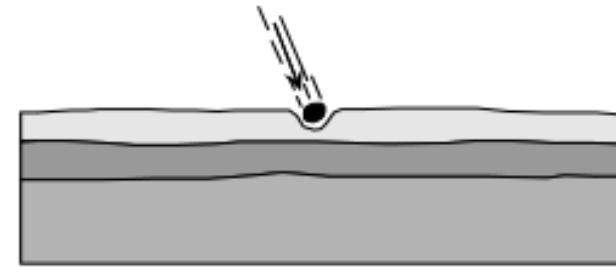
# Evidence for early collisions:

- Craters and other features on Moon and Mercury (no tectonics to resurface)



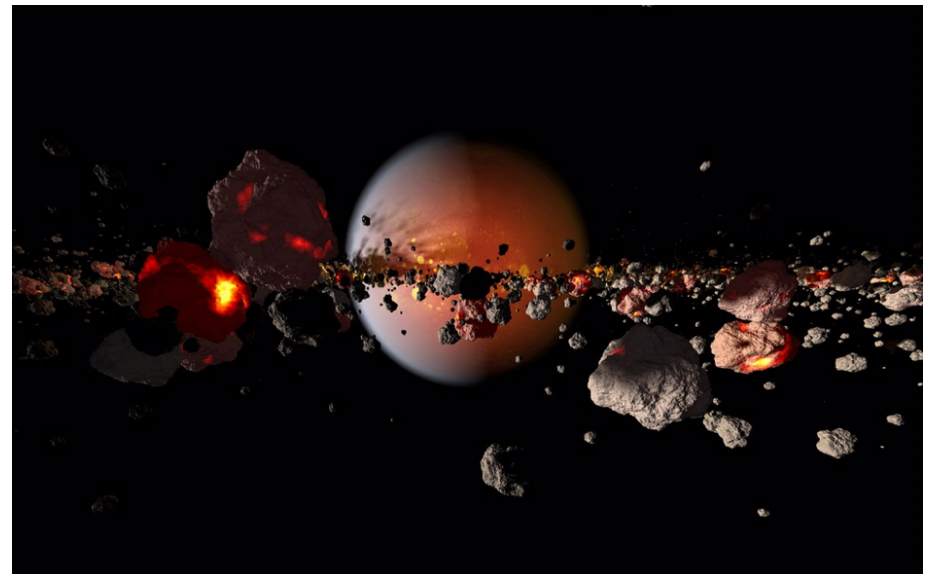
# Crater formation

- Shock reflection can form peak in center of crater
- Rocks can be crushed (breccia) or even melted if impact is energetic enough



# The Moon's composition

- Apollo astronauts brought back samples of Moon rocks. They are *\*very\** similar to rocks found on the surface of the Earth
- Current theory is that the Moon was formed from debris left from a giant collision between a Mars-sized object and the Earth



# Ongoing/recent collisions:

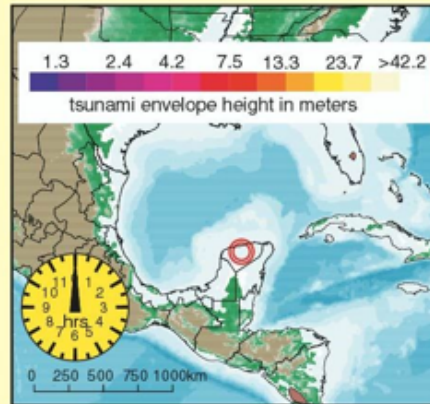
- Mass extinction (which included the dinosaurs) 65 million years ago could have been caused by the impact of an object about 10 km in diameter near the Yucatan peninsula



# Chicxulub Impact Tsunami

Impactor Diameter:  
10 km

Water Depth at  
Impact: 140 m

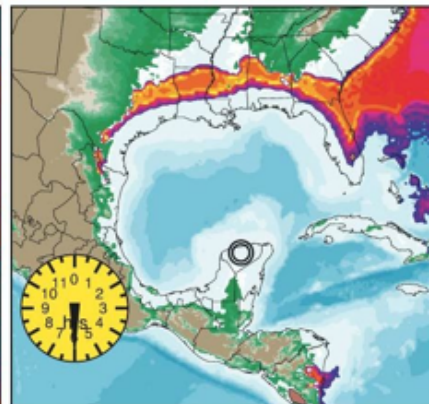
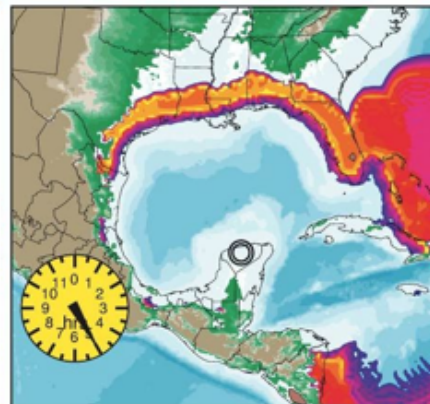
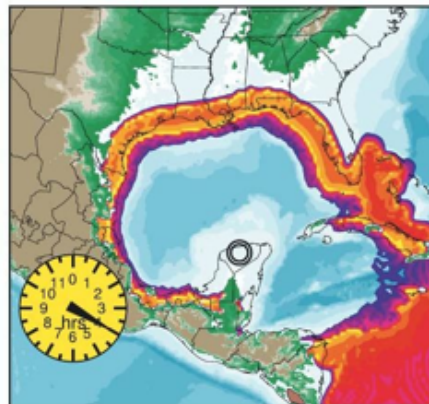
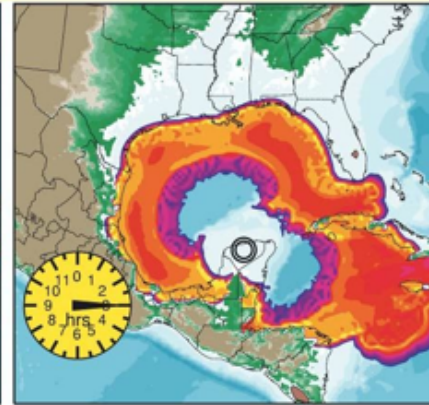
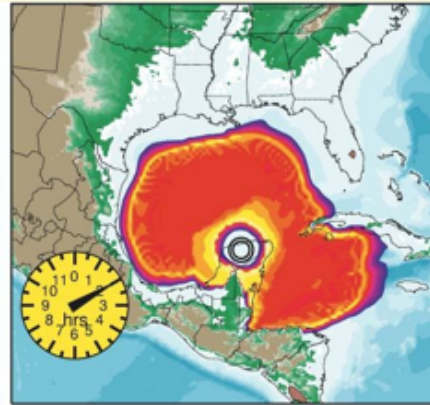


Impactor Energy:

$$3.1 \times 10^{23} \text{ J}$$

Tsunami Energy:

$$7.6 \times 10^{17} \text{ J}$$

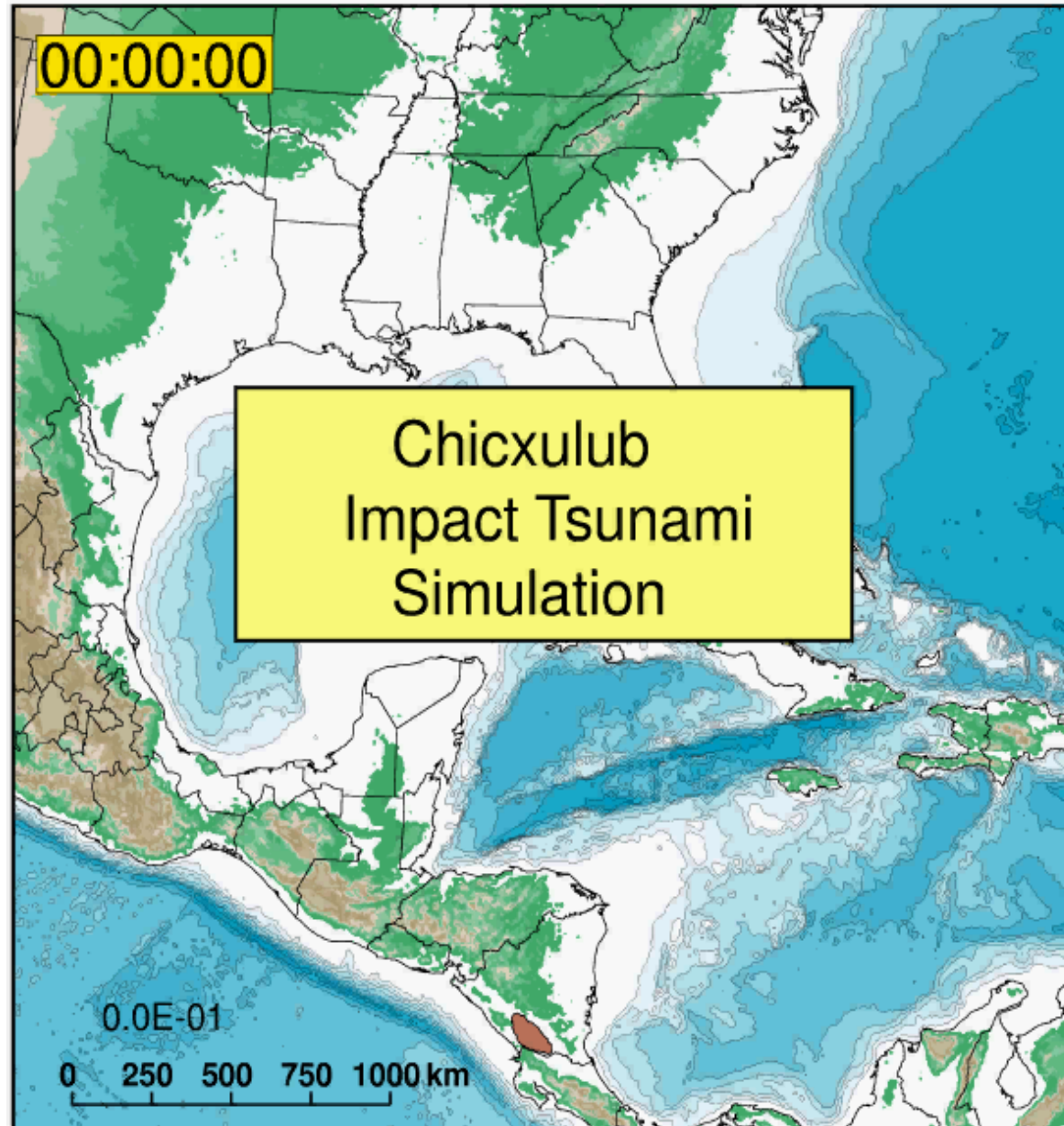


# North America 66 Million years ago

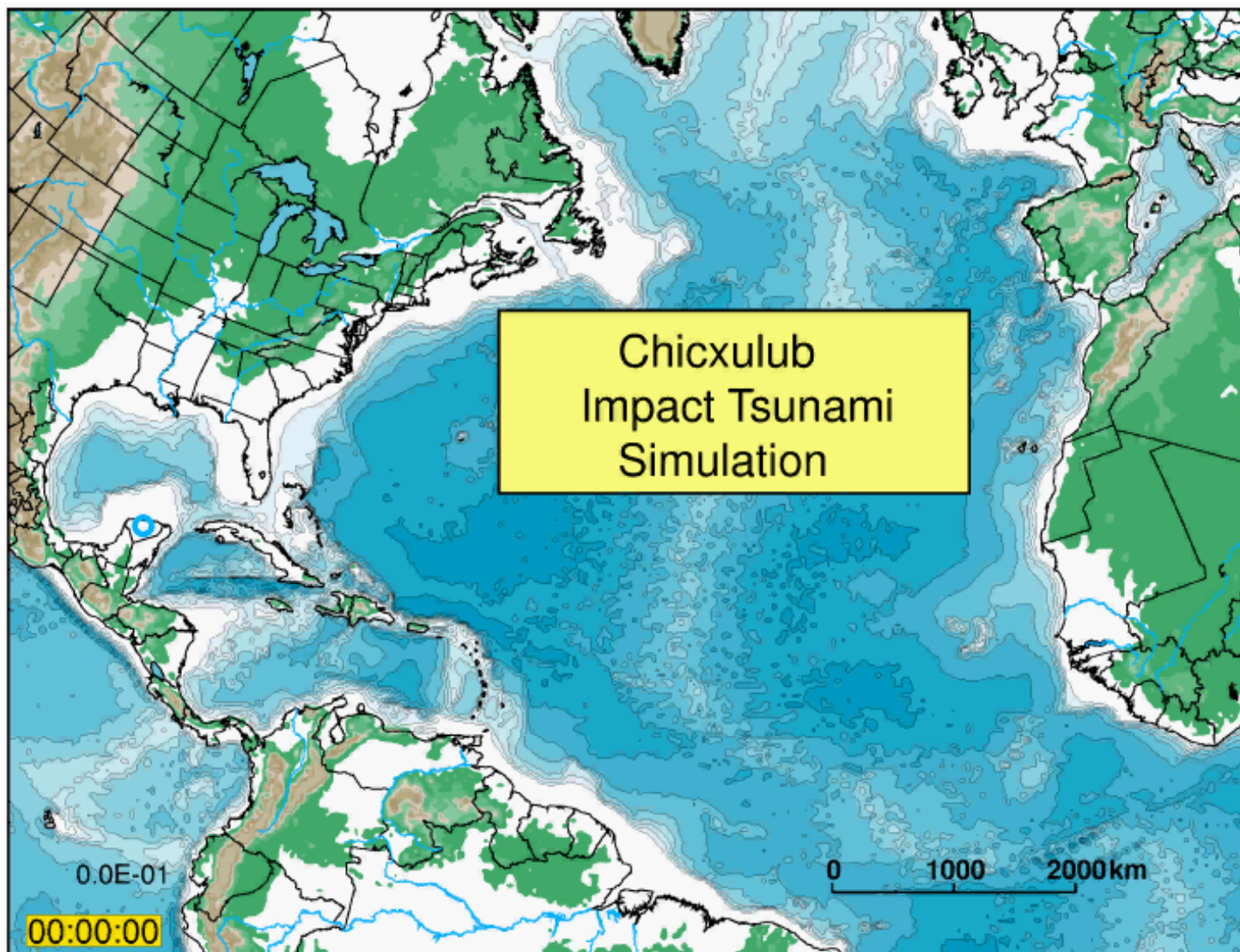


Ron Blakey NAU





Yellow circles show estimated peak height in meters



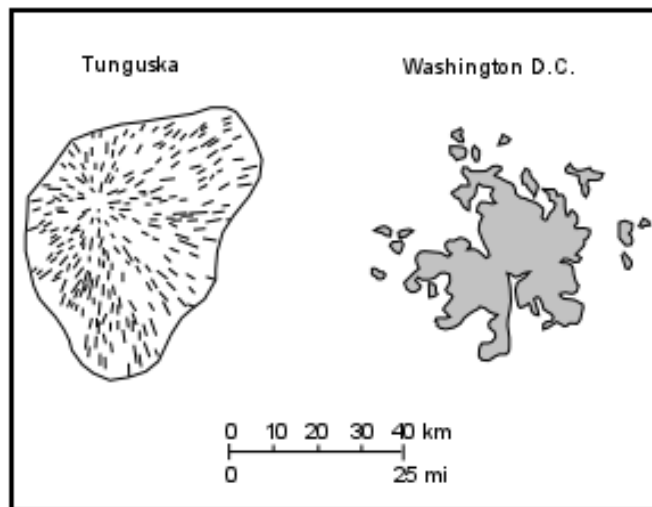
# Ongoing collisions:

- Arizona meteor crater: 1 km wide, 50,000 years old

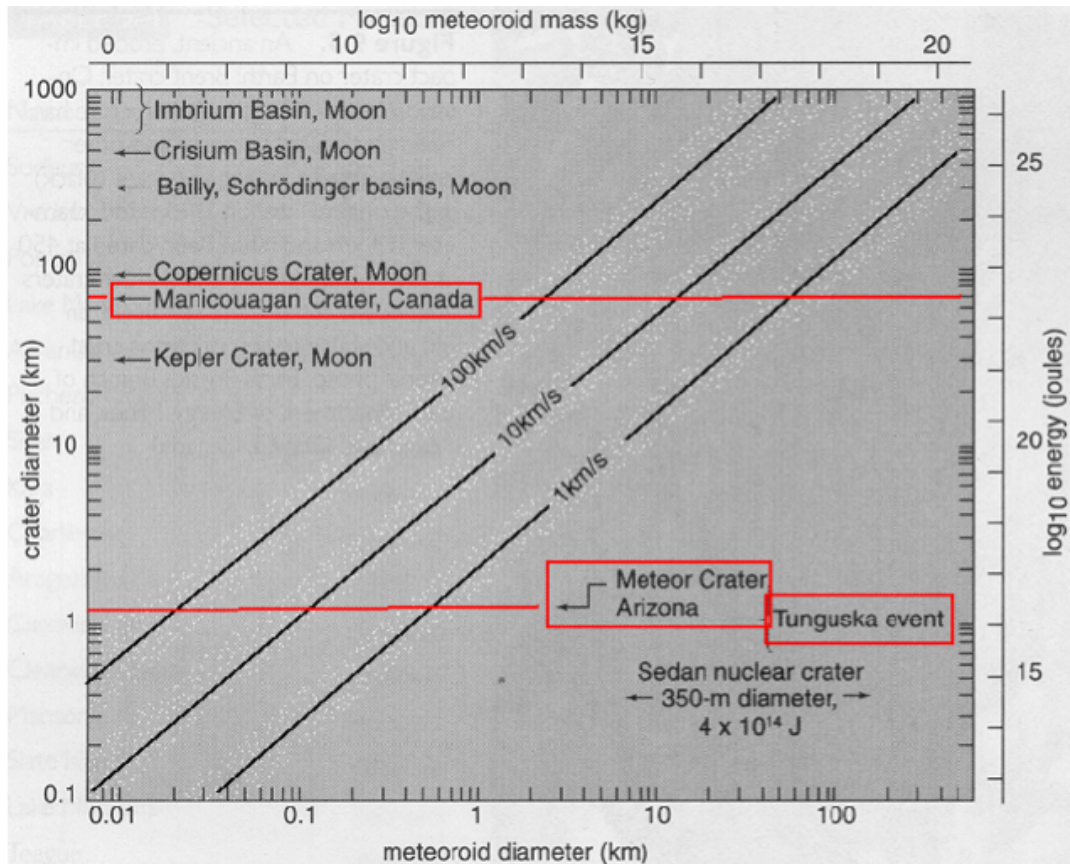
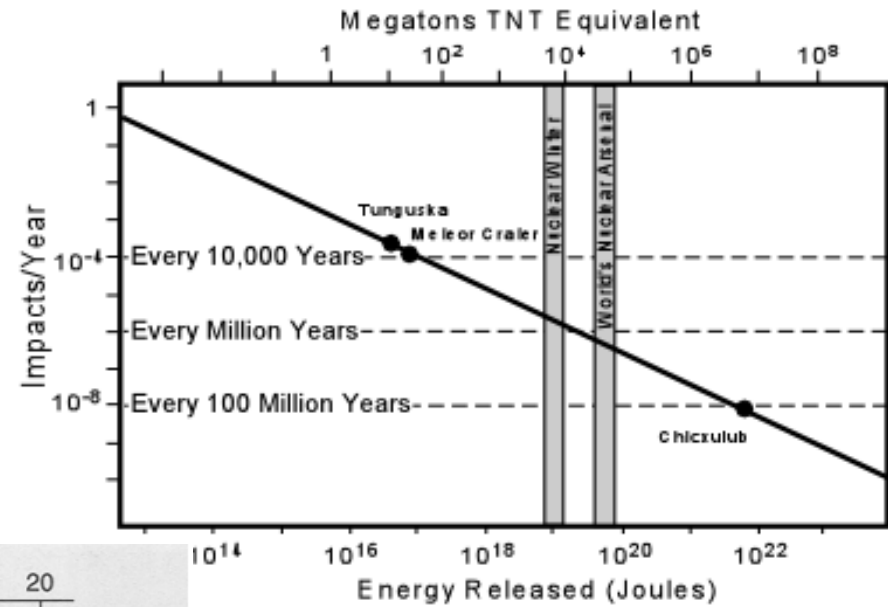


# More recent collisions:

- Tunguska, Siberia, 1908: (no crater) large cometary fragment thought to have exploded in atmosphere just above Earth's surface



# Energy released in impacts



Sedan nuclear test  
(shallow underground  
test in Nevada 1962)