

# NASA Facts

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## COSMIC IMPACTS ON EARTH

Like the other planets in the solar system, the Earth is constantly pelted with impacting debris. The debris ranges in size from tiny particles of interplanetary dust to larger comets and asteroids that cause catastrophic events. There is evidence that asteroids, comets and a constant rain of interstellar dust particles brought life-forming elements and compounds to the Earth. Early in Earth's history, comets may have formed the oceans.

Cosmic impacts are a natural part of geologic history. Large impacts on Earth are extremely rare, but they can do tremendous damage, exceeding that of any other known natural disaster. The atmosphere effectively shields us from most impact that have less energy than 10 megatons of TNT, which corresponds to the impact of a 100 foot diameter comet or asteroid. Larger objects penetrate to the lower atmosphere or



illustration by Don Davis

*This rendering shows a roughly spherical body, left over from the formation of the planets, colliding with Earth at about 40,000 miles per hour.*

surface where they explode, causing great local damage.

If the impact is large enough, approximately one mile diameter, it can lead to global environmental damage. The damage is primarily caused by vast amounts of dust lofted into the atmosphere, but damaging chemical changes in the atmosphere and oceans also occur and hot ejecta can ignite large-scale fires. The largest impacts, by objects up to 10 miles in diameter, have led to mass extinctions.

There have been from ten to twenty mass extinctions on Earth in the past billion years. In a mass or major species extinction, at least 25 percent of marine fauna vanish.

Unusually high amounts of the element iridium, thought to be deposited by the cosmic impactor, are associated with several of these events.

The best documented record of a mass extinction caused by an impact occurred 65 million years ago in what is now the Mexican state of Yucatan. The impact formed the Chicxulub Crater and led to the



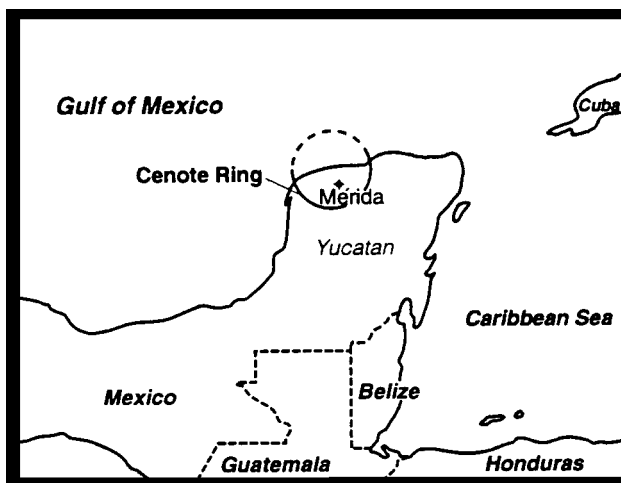
Illustration by Don Davis

*An asteroid or comet is shown slamming into tropical, shallow seas in what is now the coastline of the northern Yucatan peninsula in Mexico. Pterodactyls, flying reptiles with wingspans of up to 50 feet are seen gliding above low tropical clouds.*

extinction of the dinosaurs and more than half of all marine species. The event also created an opportunity for an “explosion” of new species, including mammals.

The Earth’s impact history can be derived from the lunar crater record. The Earth and Moon share the same part of space and have identical impact histories. The Moon, however, has been geologically inactive for the past three billion years and preserves the impact record much better than Earth. The current impact rate can also be estimated from studies of the comets and Earth-crossing asteroids that astronomers discover and track.

Many scientists now think that the Moon was formed when a Mars-sized object hit the Earth early in its formation. The impact thrust enough crustal debris into orbit to coalesce and form Earth’s orbiting satellite. In the first billion years of Earth’s existence, colossal bodies crashing into it may have delayed the origin of life. The largest and most rare bodies would have destroyed any



*The Chicxulub Crater formed by the extraterrestrial impact 65 million years ago is more than 150 miles in diameter.*

life which had already begun by entirely vaporizing the early oceans and melting the upper layers of Earth's crust. Early giant impacts may also explain the later separation of the continents and Earth's widespread volcanic activity.

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