How an Asteroid Impact Causes Extinction

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Special to space.com
posted: 06:07 pm ET
05 November 1999

Imagine: NASA scientists announce they have detected a 10-mile-wide asteroid on a collision course with the Earth. They calculate it will hit Southeast Asia in two weeks. There is no chance of Bruce Willis being sent on a beefed-up space shuttle to blow up the asteroid. Earthlings will have to ride out the impact.

The Tunguska event in 1908 flattened 800 square miles of Siberian forest -- and the object didn't even reach the ground.

The world economy grinds to a halt as people take to the hills. Anarchy sets in, civilization breaks down. Accusations fly over the lack of warning -- where was Spaceguard, the proposed international search effort for large asteroids?

People in Brazil feel less vulnerable than most of the world's population. They are on the opposite side of the Earth from the predicted impact point. But one hour after the impact Brazilians notice some brilliant meteors. Then more meteors. Soon the sky gets brighter and hotter from the overwhelming number of meteors. Within a few minutes trees ignite from the fierce radiant heat. Millions of fragments of rock, ejected into space by the blast, are making a fiery return all over the planet.

Only people hiding underground survive the deadly fireworks display. Within three hours, however, massive shock waves from the impact travel through the Earth's crust and converge on Brazil at the same time. The ground shakes so violently that the ground fractures and molten rock spews from deep underground. Maybe Brazil wasn't the best place to be after all.

The survivors of the firestorms, tsunami and massive earthquakes emerge to a devastated landscape. Within a few days the Sun vanishes behind a dark thick cloud -- a combination of soot from the firestorms, dust thrown up by the impact and a toxic smog from chemical reactions. Photosynthesis in plants and algae ceases and temperatures plummet. A long, sunless Arctic winter seems mild compared to the new conditions on most of the planet.

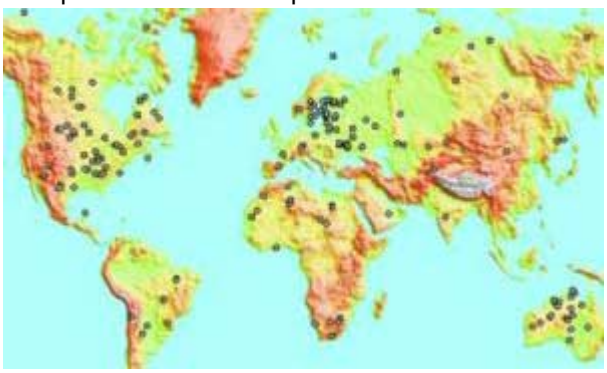
After a year or so the dust settles and sunlight begins to filter through the clouds. The Earth's surface starts warming up. But the elevated carbon dioxide levels created by the fires (and, by chance, vaporization of huge quantities of limestone at the impact site) results in a runway greenhouse effect. Those creatures that managed to survive the deep freeze now have to cope with being cooked.

Many species of plants and animals vanish. The few hundred thousand human survivors find themselves reverting to a Stone Age existence.

Is it fiction?

Computer modeling of asteroid impacts and climatic effects suggest that this devastating sequence of events could happen. Fortunately it is extremely unlikely that this scenario will occur in our time. No known asteroids are on a collision course with Earth. However, every 50 to 100 million years the Earth collides with a comet or asteroid of sufficient size to cause planet-wide devastation.

Evidence of past impacts has only been recognized in recent decades and is pointing to the conclusion that big impacts have caused major disruptions to the development of life on Earth.



Known impact craters.
IMAGE: Canadian Geological Survey

The end of the dinosaurs

In 1980 Scientists Luis and Walter Alvarez claimed they had found evidence of a huge impact event 65 million years ago. This age corresponded with the demise of the dinosaurs at the end of the Cretaceous Period. The evidence included a worldwide layer of clay with high levels of the rare element iridium, usually the signature of an impact.

The search was on for a giant crater associated with this impact. Hopes weren't high because in 65 million years the Earth's surface has changed dramatically -- nearly all of the present ocean floor is younger than 50 million years.

Some great scientific detective work pointed to an impact somewhere in Central or North America. Finally, in 1990, the buried remains of a 150-mile-diameter crater were discovered near the town of Chicxulub on the Yucatan Peninsula in Mexico. A crater this size would have been blasted out by a 10-mile-wide comet or asteroid colliding with the Earth at some 50,000 mph. The "smoking gun" had been found.

Impact, volcanoes, or both?

The debate continues on whether the Chicxulub impact caused the mass extinction at the end of the Cretaceous Period or whether it was one of a sequence of disasters. The Deccan Traps of India are the remnants of a massive upwelling of molten rock from deep within the Earth 65 million years ago. The toxic fumes and dust from the eruption have been put

forward as a possible alternative cause of climate change that led to the extinction of the dinosaurs.

A possible link between impacts and volcanism became evident in 1974 when the Mariner 10 spacecraft flew past the innermost planet Mercury. The planet was found to be covered with impact craters like the moon. One giant impact crater on Mercury was particularly interesting. Directly opposite the impact point, on the other side of the planet (called the "antipodal point") was a region of highly disrupted terrain with no evidence of an impact. The shock waves from the impact on one side of Mercury had traveled around the surface and met simultaneously at the antipodal point to create the chaotic features. Similar features have since been detected on several moons of the giant planets.

Astronomer Duncan Steel has suggested that the same occurred with the Chicxulub impact and that the shock waves caused the Deccan Traps. Taking into account millions of years of continental drift, this region would have been at the antipodal point to Mexico at the time of the impact. Although the eruption may have contributed to the suffering, it now seems more likely that the Deccan Traps were just a consequence of the catastrophic initial event, the Chicxulub impact.

More craters are there to be found

A meteorite dug the misnamed Meteor Crater in Arizona.

IMAGE: NASA

As a tourist destination, impact craters on Earth are virtually unknown. Americans might know of Meteor Crater in Arizona. Australians planning an Outback tour may have heard of Wolfe Crater in Western Australia. American geologist/astronomer Gene Shoemaker (of Comet Shoemaker-Levy 9 fame) spent many "holidays" touring the Australian Outback looking for impact craters. He and his wife Carolyn helped to identify some of the twenty or so Australian impact craters that are now known. Tragically, in 1997, Gene died in a car crash during one of these searches.

It is only in the past few decades that scientists have learnt how to clearly identify impact craters on the surface of the Earth. In that time they have found more than 150 craters. Most are heavily disguised by siltation, erosion and vegetation.

There are relatively few places on Earth where any geological features can be expected to survive beyond tens of millions of years. Impact craters have been found on most of the rare ancient landforms. In several cases the estimated age of a large crater appears to match that of a mass extinction event, as told in the fossil record. Although the picture is still fuzzy -- due to the time scales involved -- massive impacts by comets and asteroids deserve serious consideration as an explanation for some of these extinction events.

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