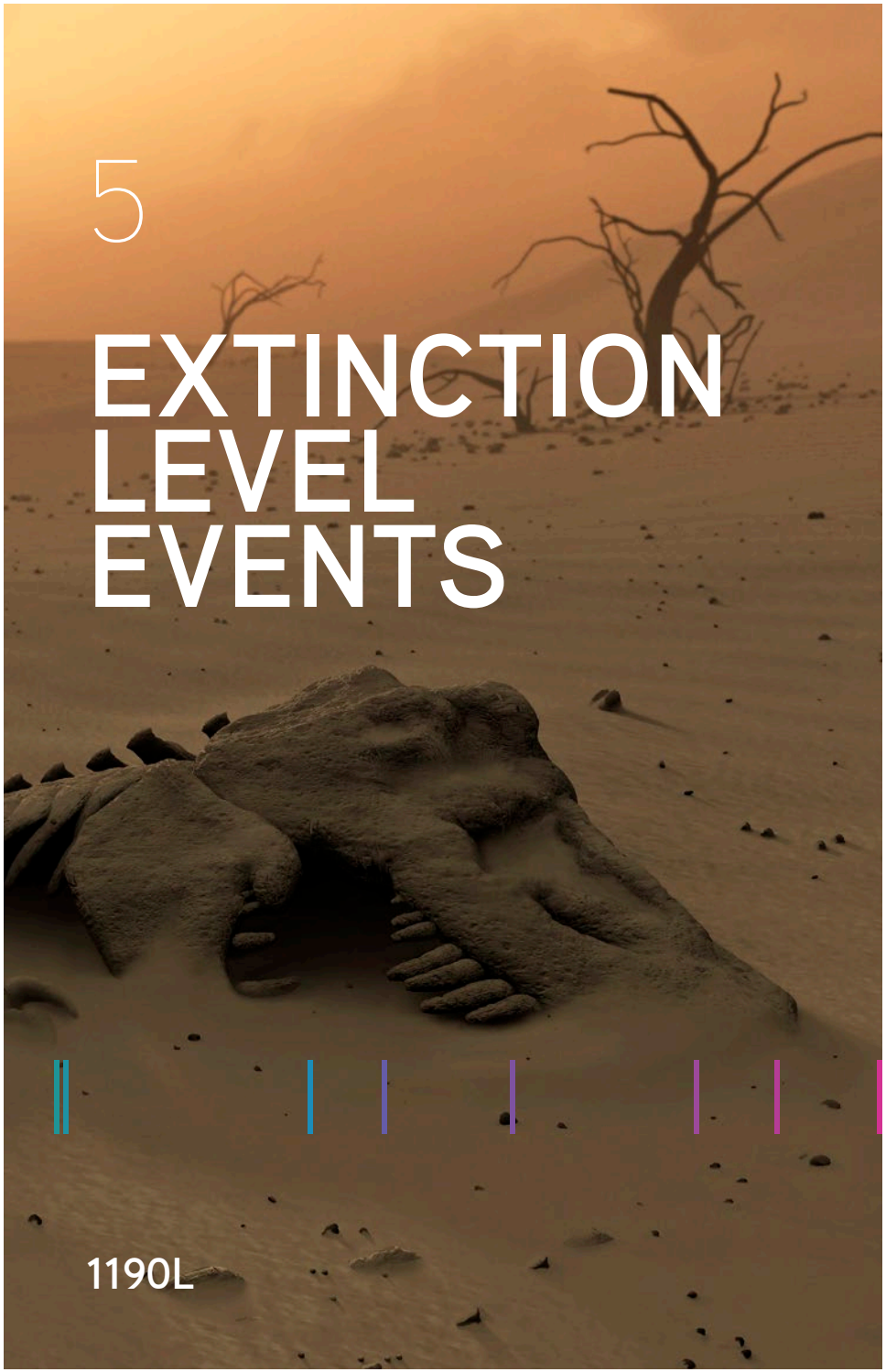

5

EXTINCTION LEVEL EVENTS

BIG HISTORY PROJECT

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EXTINCTION LEVEL EVENTS

By Cynthia Stokes Brown, adapted by Newsela

Life on Earth has experienced repeated periods when a large portion of its species died off, followed by a recovery and the emergence of a newly shaped tree of life.

Volcanic activity is thought to have contributed to many of Earth's extinction events

Five major extinction events

Extinction events are periods in Earth's history during which a sharp decrease in the diversity and abundance of living organisms occurs. This is measured by the easily observable life forms, and does not include the bacterial ones (which constitute a great portion, perhaps even the majority, of Earth's bio-diversity and biomass). During these periods, the rate of extinctions greatly exceeds the normal, slow pace that regularly occurs as new species emerge.

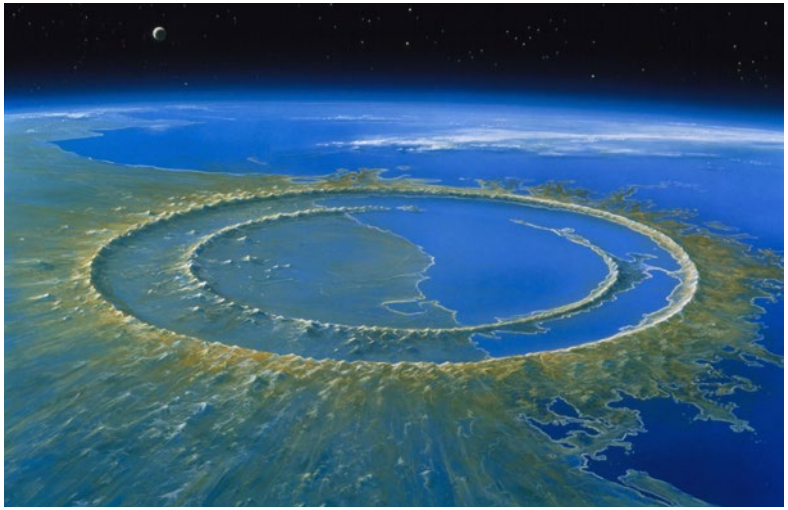
The people who study extinctions are geologists and paleontologists; they examine the history of our planet as recorded in sedimentary rocks. They use fossils as evidence, especially marine fossils, since those are the most abundant. Only since the 1970s have scientists agreed that numerous extinction events have occurred, and only since the early 1980s have they agreed on what the five major ones were.

The "crater of doom"

One fine day about 65.5 million years ago, while dinosaurs were grazing and hunting around the world, an object the size of Mount Everest came hurtling through space. Only a seven-minute window existed during which the object's path could intersect with Earth's orbit around the Sun.

Although the chances seem to have been slight, the object hit Earth. (It may have been a comet, made of dirty ice, or an asteroid, made of rock.) The object landed just off the coast of what is now the Yucatán Peninsula in Mexico, at an estimated velocity 150 times the speed of a jet airliner.

The impact made a hole the size of Belgium, throwing up debris that rose high into the atmosphere and circled around the Earth. The collision generated so much initial heat that continental forests burned, putting more particulates in the atmosphere. With the Sun's rays blocked by smoke and debris, photosynthesis slowed or stopped, the temperature cooled, and the amount of



An illustration of the K-T impact crater

rainfall decreased significantly for a few months at least. Plants and animals died. All the dinosaurs, except some avian dinosaurs, which were on their way toward evolving into birds, died. An estimated 75 percent of all species disappeared. Among the survivors were crocodiles, turtles, and small, rodent-like mammals, which were our ancestors.

Geologists call this extinction event the "K-T event" because it marked the end of one geologic period, the Cretaceous (spelled with a "K" in German), and the beginning of the next, the Tertiary.

The story of the K-T event is quite well understood after years of patient detective work. It began in the mid-1970s with a young geologist, Walter Alvarez, in the mountains of Italy, near the town of Gubbio. There he found a thin layer of clay a centimeter thick between the layers of Cretaceous and Tertiary limestone; the Cretaceous layer contained many fossilized single-celled marine organisms, while very few appeared in the Tertiary layer. In the stratum between, Alvarez's associates found iridium, an element extremely rare in the Earth's crust but more common in meteorites. This suggested an impact by an asteroid or comet around the date of the extinction. In 1980, the Alvarez team presented its hypothesis that an asteroid/comet had hit and had caused massive, rapid extinction by altering the air and water. Further research around the world showed that high levels of iridium existed in the rock record at other K-T boundary sites.

Within two years the evidence persuaded most geologists to accept this hypothesis. Others were unsure. If a massive asteroid/comet had hit, where was the crater? No known depression on land seemed large enough for such a massive object; hence, the crater must be under water. Large objects that hit water create huge tsunami waves, which leave telltale signs in the rock record, sometimes well inland from the coast. A worldwide search turned up evidence of such a large tsunami on the shores of Texas, across the Gulf of Mexico from the Yucatán Peninsula.

Much earlier, in 1950, geologists working for the Mexican national oil company, PEMEX, had mapped a 120-mile crater underwater, off the coast of the Yucatán Peninsula. To find this crater, they had charted tiny variations in the pull of gravity, which reflected variations in rock density. From these maps, geologists could tell where the dense and light rocks were located beneath the sea. But not until 1991 did the K-T researchers get together with the PEMEX geologists, who tended not to publish their information, and realize that the "crater of doom" had been found. They named it Chixculub (a Mayan word pronounced cheek-shoe-lube), after the small coastal town nearby.

MASS EXTINCTIONS

THE FIVE MAJOR MASS EXTINCTION EVENTS

Other extinction events

Paleontologists and geologists have identified four other major extinction events, all of which predate the K-T extinction. Named for the geologic times they correspond to, they are the End-Triassic, the End-Permian, the Late Devonian, and the Ordovician.

Of the five major extinctions, the End-Permian proved to be the most massive — the mother of all extinction events. An estimated 95 percent of marine species and 70 percent of land species were lost. This dying-off lasted for about 165,000 years and included both gradual and sudden environmental changes that greatly altered conditions on the Earth.

Very few creatures made it through the End-Permian extinction. Cockroaches did — and ginkgo trees and horseshoe crabs. So did our ancestors, small protomammals that had evolved from reptiles: they were furry and warm-blooded, but still laid eggs.

Possible causes of extinctions

Once most geologists and paleontologists agreed that the cause of the K-T extinction was an asteroid/comet hitting Earth, many of them first hypothesized that objects from space had caused all the major extinctions. That proved false when studies of fossil layers from the times of earlier extinctions showed that life forms had disappeared gradually, not suddenly as they did in the layers of sediment dated 65.5 million years ago.

The discussion about what causes mass extinctions continues. Scientists do not yet fully understand the reasons for them. Some possible explanations are:

- Sudden massive volcanic activity, as evidenced by vast areas of lava plains that date to coincide with extinction events. Volcanoes emit carbon dioxide, which results in global warming; they also emit dust and aerosols that inhibit photosynthesis, causing food chains to collapse.
- Rapidly changing climate.
- Impact or multiple-impact events.
- Anoxic events (the middle or lower layers of ocean becoming deficient or lacking in oxygen).
- Ever-changing position of oceans and continents (plate tectonics).

It seems likely that some combination of these possible causes may have taken place at certain times. One reputable paleontologist, Peter Ward, made the following hypothesis in 2006 to explain the four major extinctions other than the K-T event:

A “sudden” increase of carbon dioxide and methane in the atmosphere occurred, caused by vast volcanic lava beds. The warmer world disrupted ocean circulation patterns and the position of the currents that convey downward warm surface water with oxygen and upward the cold bottom water with less oxygen. Without the mixing of the ocean layers, the bottom water became anoxic, without oxygen. This allowed green sulfur bacteria, which live on sulfur not oxygen, to expand. They produced hydrogen sulfide, which bubbled up, killing much of life and destroying the ozone layer, which protected life against ultraviolet rays from the Sun.

Ward’s discussion, and the conclusions of some other scientists, suggests that humans must reduce the carbon dioxide that we are emitting, or we may set off a similar chain of events.

A sixth major extinction?

Many biologists agree that a sixth major extinction is currently underway. This one is unique because it is the result of humans degrading and destroying the habitats of other life forms. This extinction apparently began about 50,000 years ago when humans moved into Australia and the Americas, causing the disappearance of many species.

No one knows how many species currently exist on Earth. The best estimate is about 8.7 million, not counting microorganisms. To date, only a small fraction of these estimated species have been identified, but new ones are constantly discovered and named.

This gives the impression that new species are appearing as fast as old ones are disappearing. A 2003 study by the World Conservation Union suggested that one in four known mammal species is threatened with extinction in the next several decades, while one in eight known bird species is at risk.

If the present trend continues, biologists fear that we could lose 50 percent of all known living species by the end of this century.

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