Mass Extinctions

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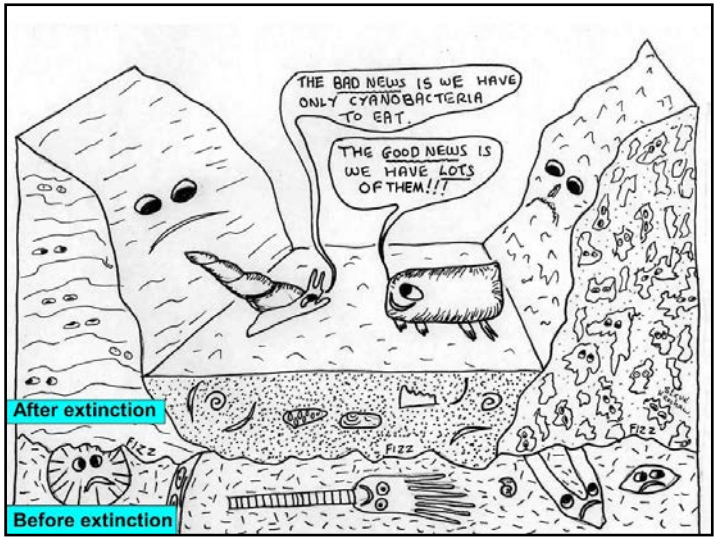
Extinction occurs when the last existing member of a given species dies. Mass Extinction (event) is a widespread and rapid decrease in the amount of life on earth.

Types of extinction: There are two main types of extinction:

(1) **Background extinction:** Background extinction refers to extinction that is normal and ongoing occurring at a relatively stable rate throughout geologic time. This type of extinction occurs from environmental or ecological factors including changes in climate, disease, competition with other animals, or loss of their habitat.

(2) **Mass extinction:** Mass extinctions are events with substantial losses of life. There have been five documented mass extinctions in the rock record, some being more severe than others.



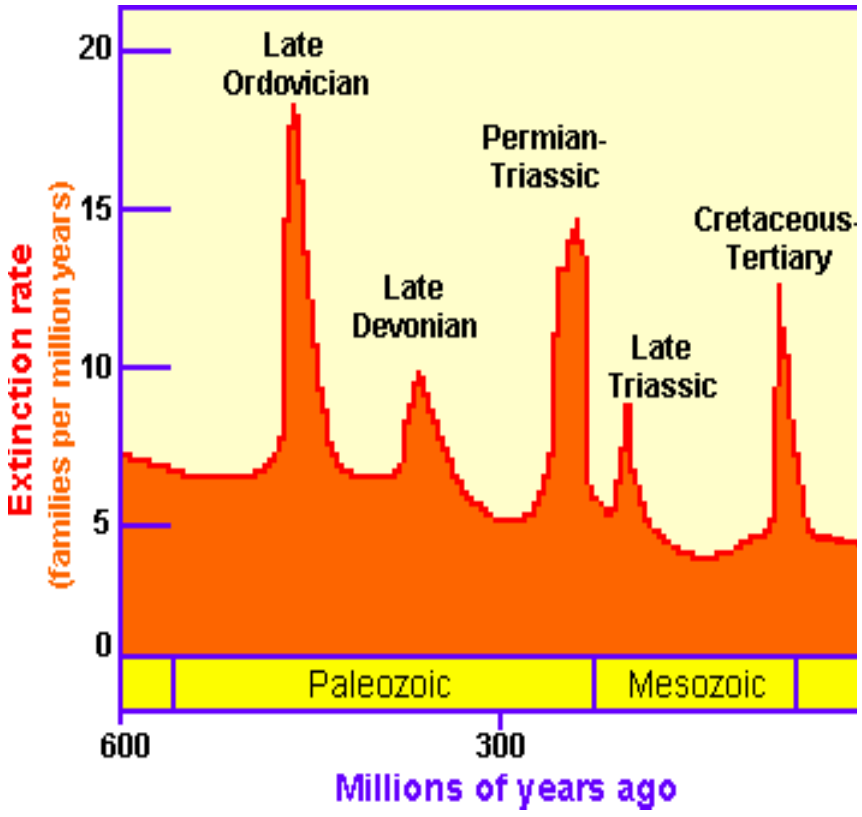
Extinction plays an important role in the evolution of life because it opens up opportunities for new species to emerge.

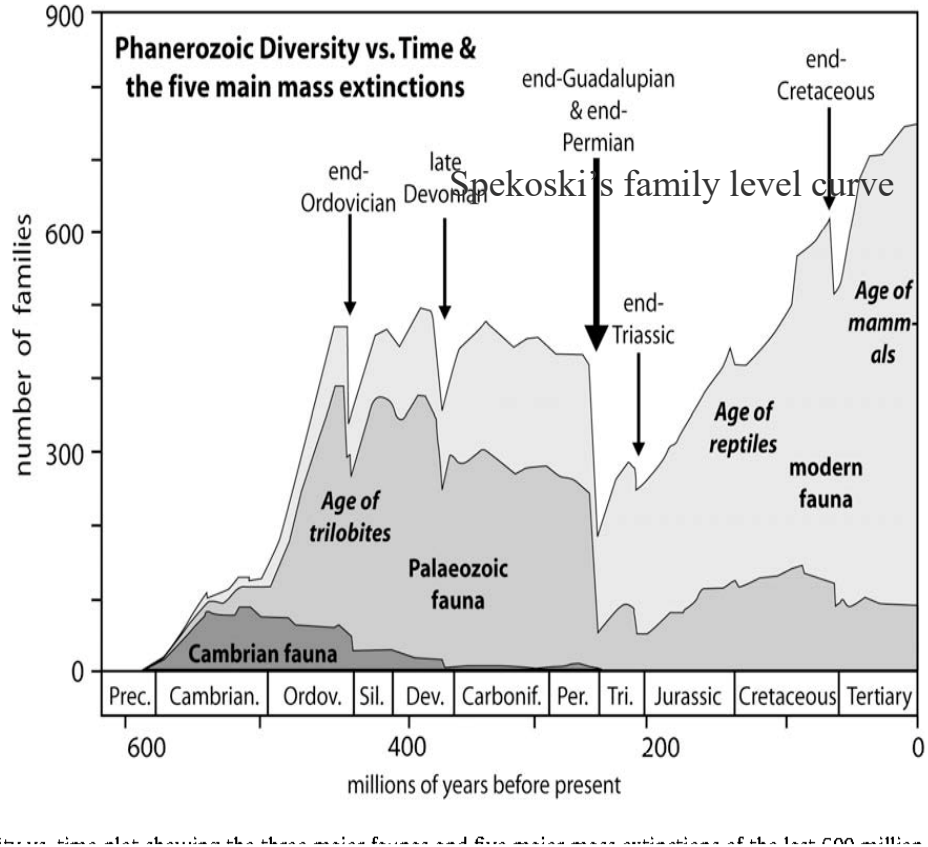
Many species have gone extinct throughout history and all that marks their presence on Earth are fossils, such as this one of a **Dinogorgon**.

Dinogorgon

Mass extinctions

Mass extinctions are episodes in which a large number of plant and animal species become extinct within a relatively short period of geologic time, from possibly a few thousand to a few million years.





Spekoski's family level curve

Based on evidence in the fossil record, scientists have identified major extinction events at the end of these geologic periods:

First major extinction (c. 440 my): work at the first of the end-Ordovician (Ordovician- Silurian extinction events), as the results of climate change (relatively severe and sudden global cooling).
Second major extinction (c. 370 my): near the end of the Devonian Period (Late Devonian extinction events), may the result of global climate change.
Third major Extinction (c. 245 my): (Permian- Triassic extinction events) as the results of climate change, perhaps rooted in plate tectonics movements.
Fourth major extinction (c. 210 my): The event at the end of the Triassic Period (Triassic-Jurassic extinction events).
Fifth major extinction (c. 65 my): Most of these events at the end-Cretaceous (Cretaceous- Paleogene extinction events), caused by collisions between Earth and an extraterrestrial body or great volcanic.
Holocene Extinction: Extinctions have occurred at over 100 times the background extinction rate since 1900. The mass extinction is considered a result of human activity.

1. Ordovician-Silurian extinction

The Ordovician period, from 485 to 444 million years ago, was a time of dramatic changes for life on Earth. Over a 30-million-year stretch, species diversity blossomed, but as the period ended, the first known mass extinction struck.

At that time, massive glaciation locked up huge amounts of water in an ice cap that covered parts of a large south polar landmass. The icy onslaught may have been triggered by the rise of North America's Appalachian Mountains.

The large-scale weathering of these freshly uplifted rocks sucked carbon dioxide out of the atmosphere and drastically cooled the planet. This event killed an estimated 85% of all species.

Trilobites are a group of marine arachnomorph arthropods that disappeared in the mass extinction at the end of the Ordovician-Silurian about 440 million years ago.

2. Late Devonian extinction

Late Devonian extinction 383-359 million years ago, this extinction event eliminated about 75 percent of all species on Earth over a span of roughly 20 million years. The Devonian is a very important time in Earth's history as this time marks the large migration from water to land.

End Devonian crisis was restricted to the marine realm and was not one, but several pulses of extinction over quite a long interval of time rather than one single event.

The worst of these pulses, called the Kellwasser event, came about 372 million years ago. The eruption would have spewed greenhouse gases and sulfur dioxide, which can cause acid rain.

During the Devonian, plants including the stem-strengthening compound lignin structure. These traits allowed plants to get bigger, and for their roots to get deeper than ever before, which would have increased the rate of rock weathering.

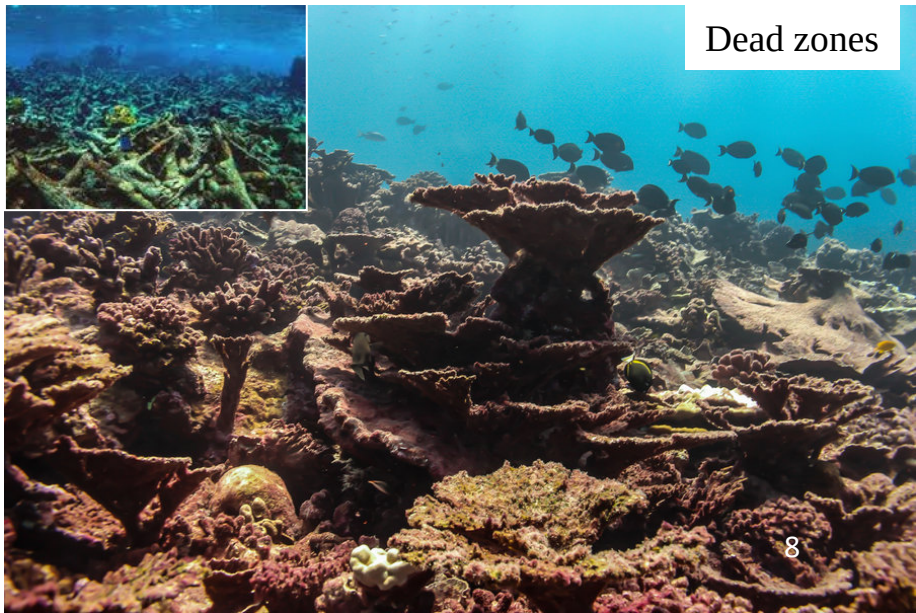
Root wedging of an exfoliation slab, Yosemite National Park, California

The faster rocks weathered, the more excess nutrients flowed from land into the oceans. The influx would have triggered algae growth, and when these algae died, their decay removed oxygen from the oceans to form what are known as dead zones.

In addition, the spread of trees would have sucked CO_2 out of the atmosphere, potentially ushering in global cooling.

The Late Devonian period was not the most hospitable time on Earth, and then came one or more supernovae explosions whose resulting ionizing radiation. The major ionization of the lower atmosphere may have led to a lot of lightning, which could start fires and change the climate.

Supernovae explosions

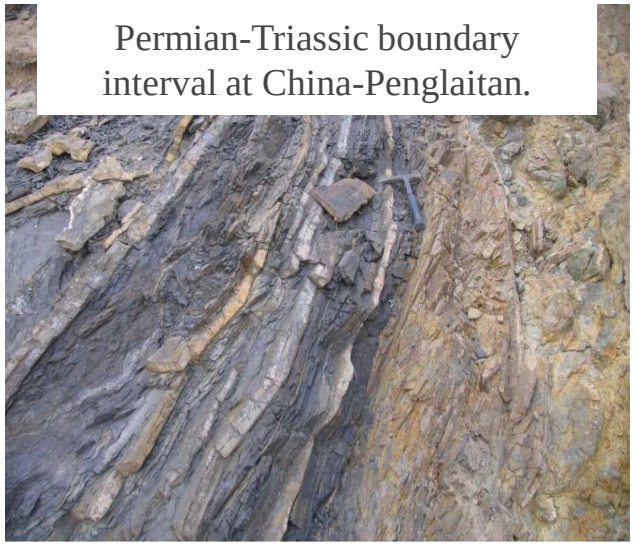


Dead zones

3. Permian- Triassic extinction

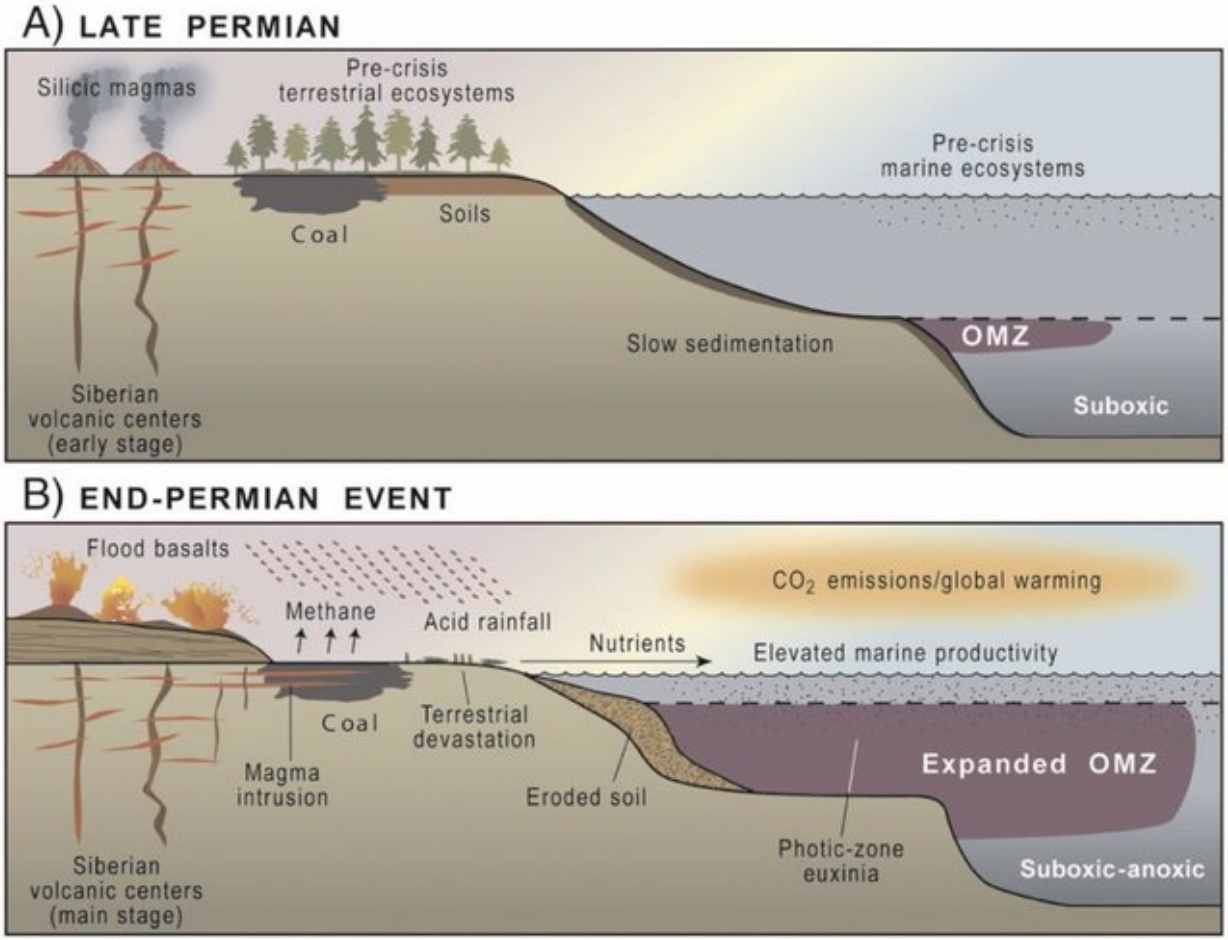
The third period of extinction, around 251 million years ago. The formation of the giant continent **Pangea** caused immense changes in geology, climate and the environment. Volcanic eruptions that continued for one million years released around 300 million Km^2 of lava while more than 1750m of sediment was formed in the Siberian Traps.

The eruptions burned forests (four times the size of Korea), it produced large volumes of carbon dioxide that caused global warming. As a result, frozen methane below the sea melted, producing a global warming effect 20 times more powerful than carbon dioxide.



Permian-Triassic boundary interval at China-Penglaitan.

Siberian flood-basalt eruptions



Terrestrial-marine caused inter-connections during the Late Permian to Early Triassic. Three stages of Siberian Traps volcanism (A-C) with differentiated environmental effects are shown.