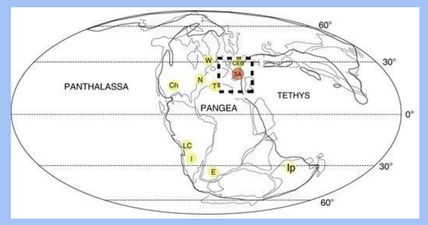

The Carnian-Pluvial Event (CPE)

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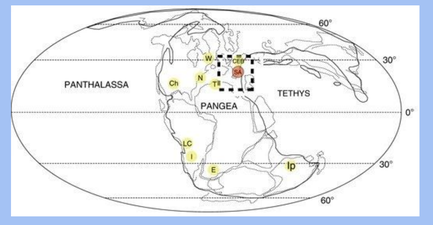
GEOL 204 The Fossil Record Spring 2019 Section 0102



Why did it Happen?

- During the Carnian, large amounts of flood basalts erupted to form the Wrangellia Large Igneous Province (LIP) [2]. The Wrangellia flood basalts are dated back to 230-220 Ma [1].
- These eruptions caused immense amounts of CO_2 to enter the atmosphere [2].
- Global warming would soon follow which then led to an acceleration in the water cycle, possibly causing heavy flooding, continental weathering, and rainfall [2]. This in turn, increased the humidity [2].
- This influx in greenhouse gases could have also caused acidification in the sea water and led to carbonate precipitation [2].
- Validity of theory:
  - Radiometric dating has revealed that the CPE and the basalts are of similar age [2].
  - Organic material and biomarkers dated to the beginning of the CPE display a negative $\delta^{13}C$ excursion [2]. Currently, it is thought this abrupt shift in carbon isotope levels is linked to the LIP above [2].

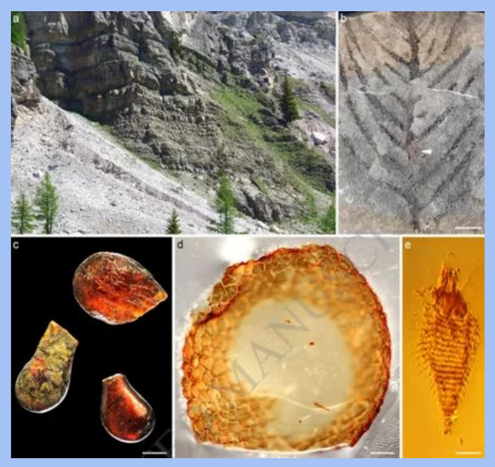


Figure 2. Amber deposits not common in the fossil record but appear concurrent with CPE.

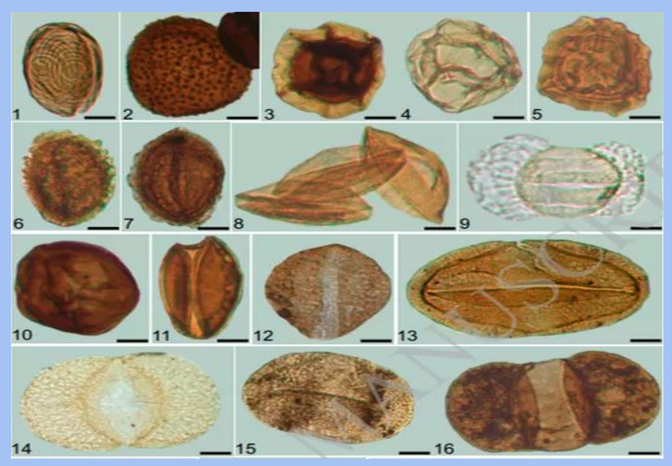


Figure 3. Pollen grains reveal wet phase of CPE and also serve as indicators of paleoclimate trends and changes in vegetation

What was it

The CPE is a period of global climate change that occurred during the Late Triassic [3]. It corresponds to a period of major biological turnover both in the oceans and on land [1]. It is an important phase of climate destabilization when environments shifted from arid to humid to arid again [1]. The CPE itself is characterized as the time of increased humidity [6]. During the CPE there was intense global warming, ocean acidification, monsoons, and an increase in rainfall [1].

Figure 2. Artistic representation of what CPE may have looked like.

On one hand it is remembered as one of the most severe biodiversity crises to date, with increased extinction rates among vital marine groups like ammonoids and conodonts [3]. However, it is also characterized as one of the most important evolutionary phases in the history of life, with the appearance of several species and adaptive radiation of others [6]. The CPE is often overshadowed by other such extinction and turnover events, so there is still much to discover [6]!

Taxa Affected

Extinctions due to climate change:

- Ammonoids [7]
- Conodonts [7]
- Bryozoa [7]
- Large herbivores [7]

Other species adaptively radiate to replace:

- Dinosaurs become dominant [1].
- Origins of modern reptiles [1].

Reef communities affected:

- Old reef builders replaced by corals [7]
- Crinoids thrive [7]
- Plankton/algae/bacteria upheaval.
- Seas become anoxic [7]
  - Fossil laegerstatten show new marine forms

Evidence

A large amount of the evidence comes from carbon isotope ratios found in plants and animals, especially from clams and corals [4]. These ratios are proportional to temperature and can help support how humid it was [4].

There is also some geological evidence:

- Paleosols. These are ancient “soil horizons” that require increased weathering in order to form [4].
- Fossil spores. These indicate that there were more humid-adapting plants forming due to the increased humidity levels [4].
- Large amounts of sand and silt on a global scale indicating an increase in erosion and runoff at the time due to the weathering and rainfall [4].
- Amber become present

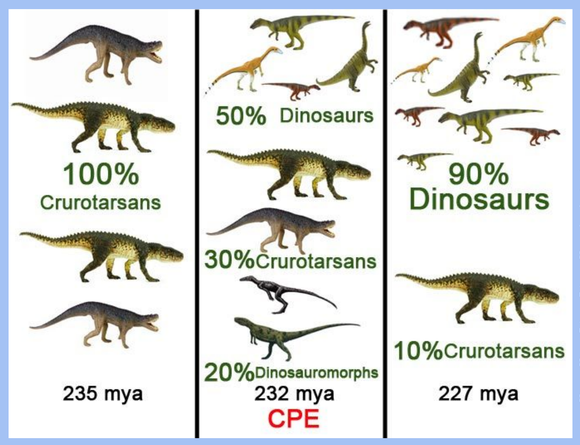


Figure 4. Diagram depicting adaptive radiation and increase of dinosaur species during CPE.