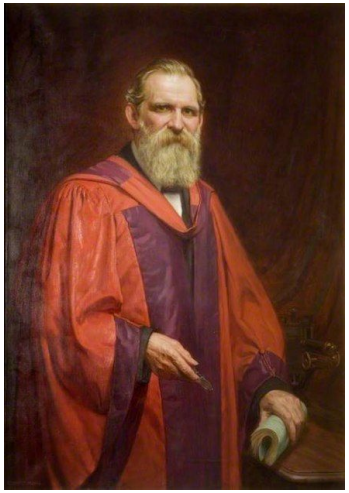
The End-Ordovician Mass Extinction

University of Maryland AOSC 680 Fall 2024
Kyle Hall | Professor Ross Salawitch
26 November 2024

“Ordovician”?

You would literally never guess



Source: [25]

When was the End-Ordovician ME within geological history?

Where did it happen? What did the world look like?

Who exactly was it that went extinct?

What were the “kill mechanisms”?

Why did the extinction event happen? (climate drivers)

When

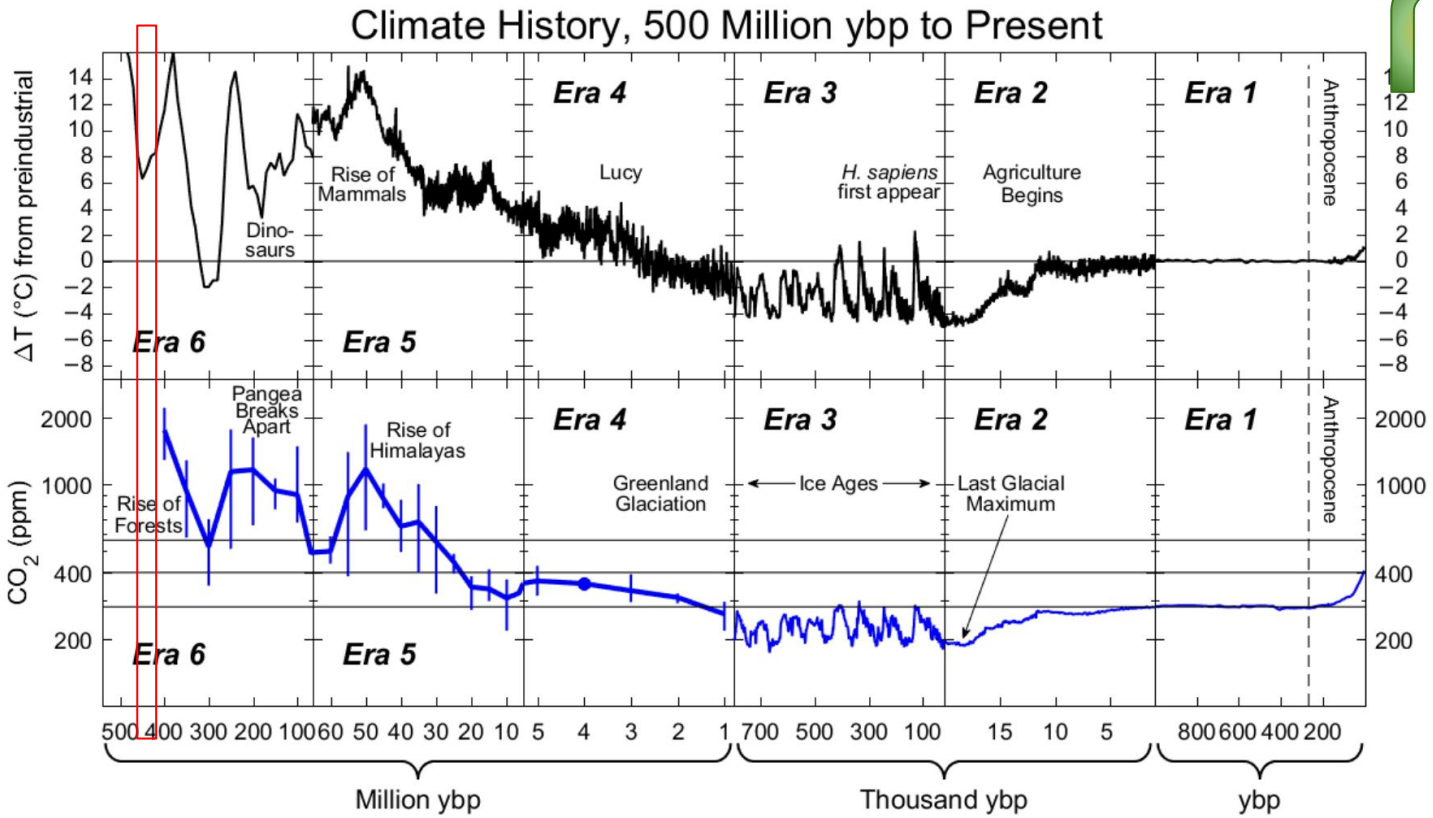


Fig 1.1, *Paris Beacon of Hope*

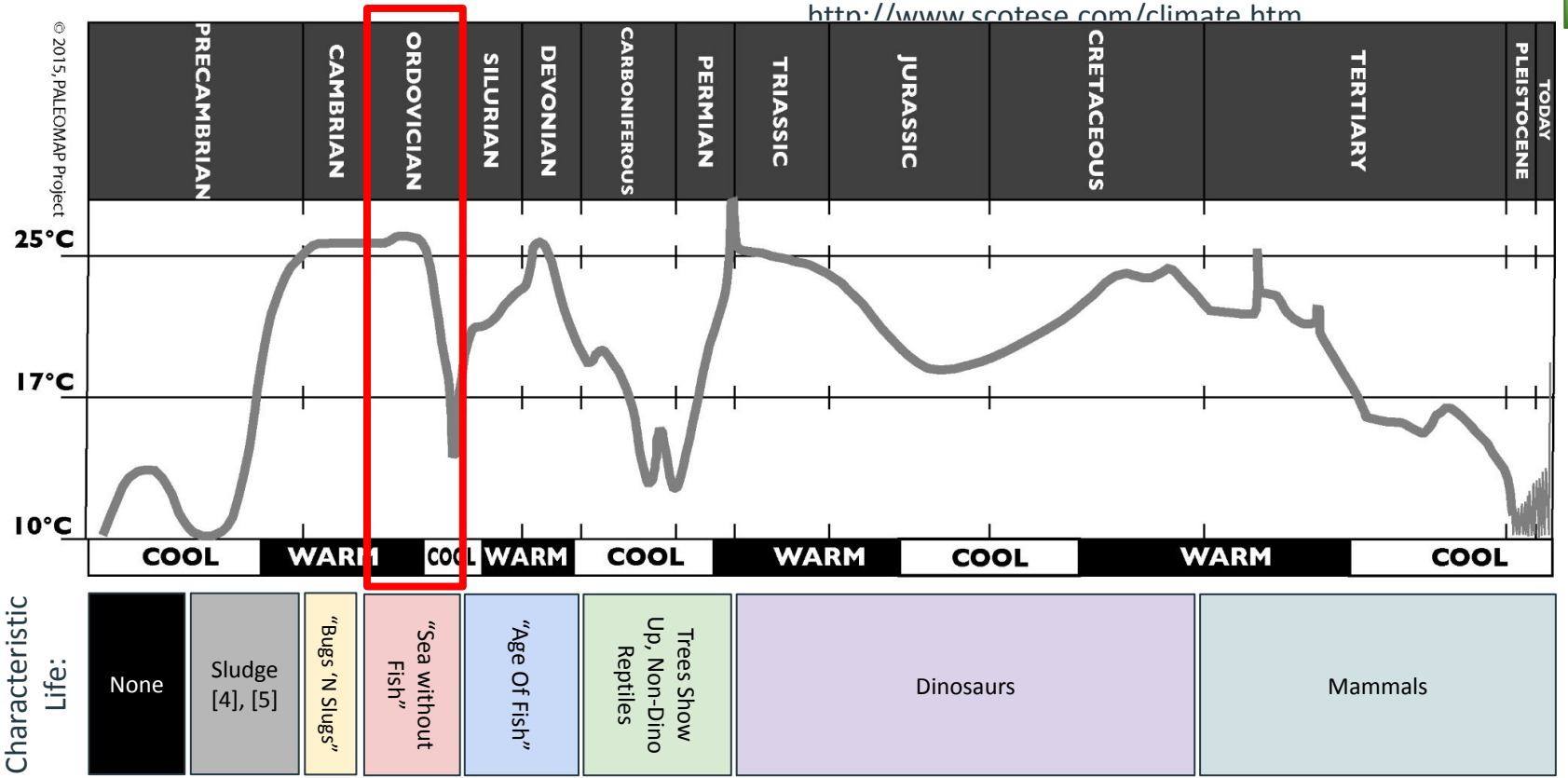
When

Ordovician: ___ - ___ Ma

"_____" - end of ordovician

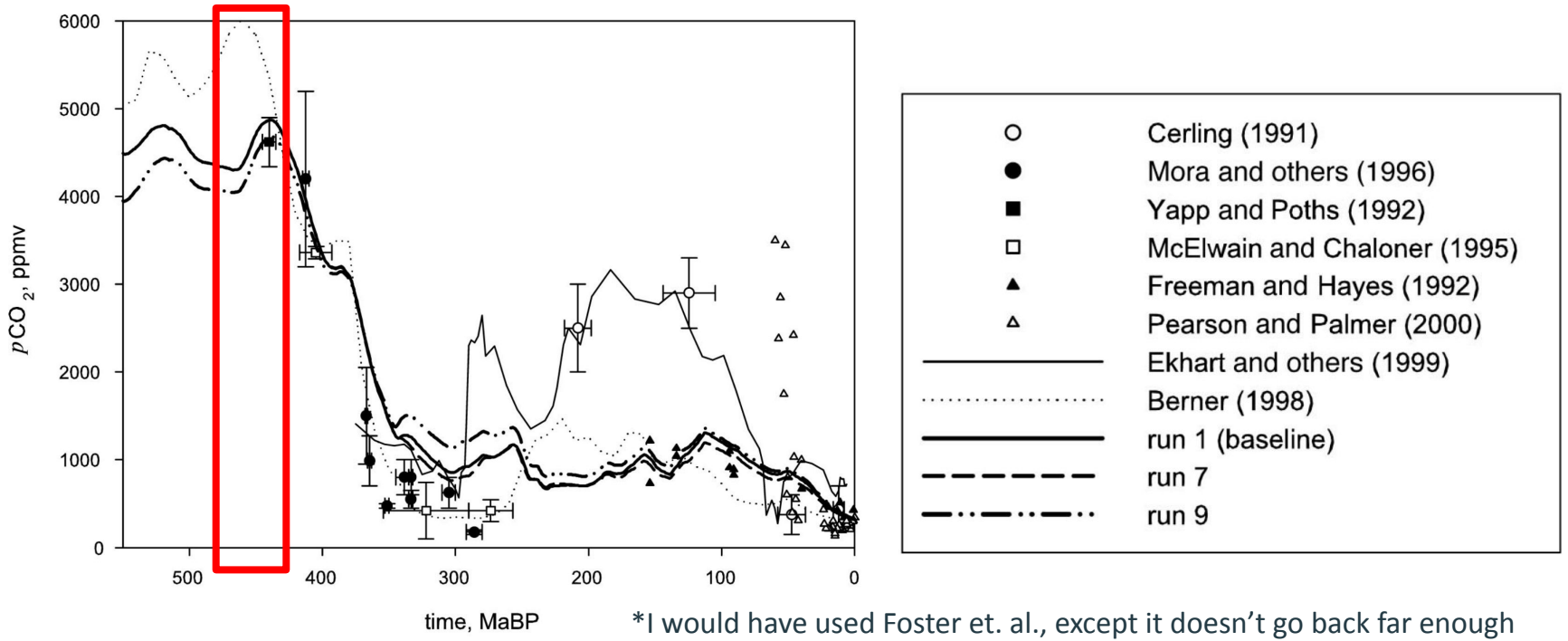
Image Source:

http://www.scotese.com/climate.htm



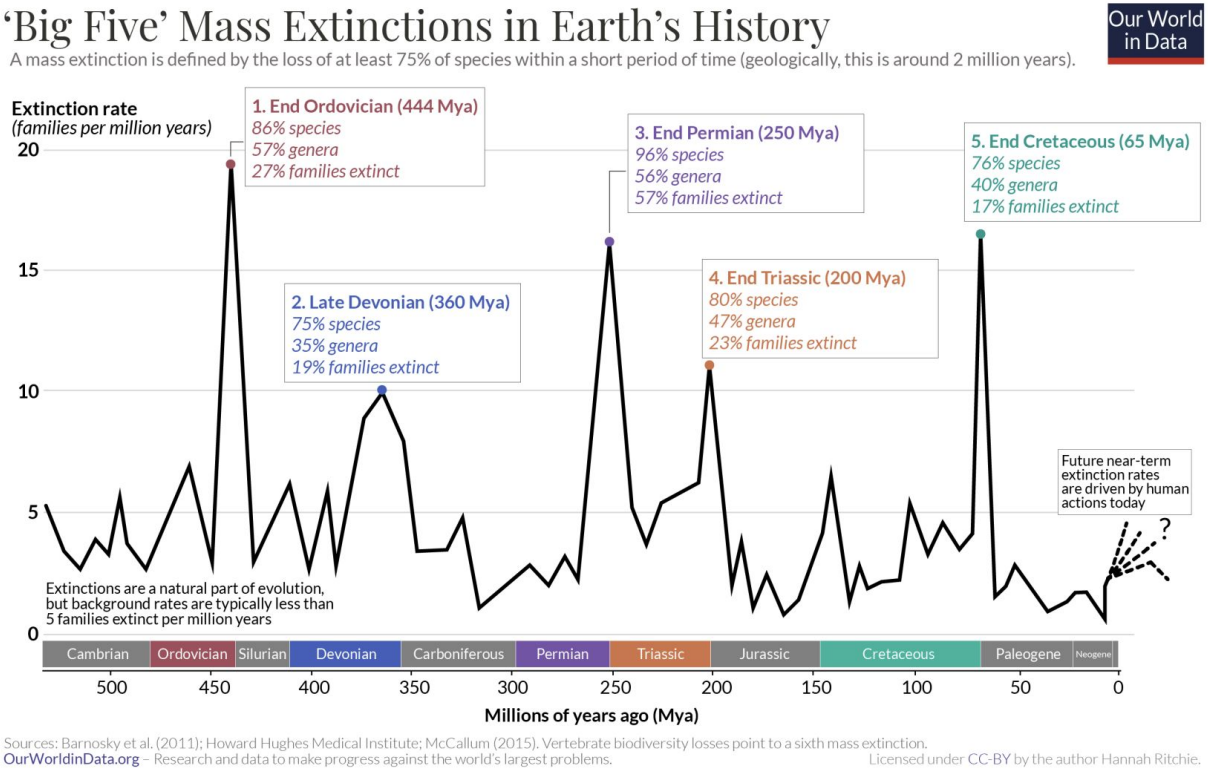
When

Source: [5]



*I would have used Foster et. al., except it doesn't go back far enough

When



https://ourworldindata.org/mass-extinctions

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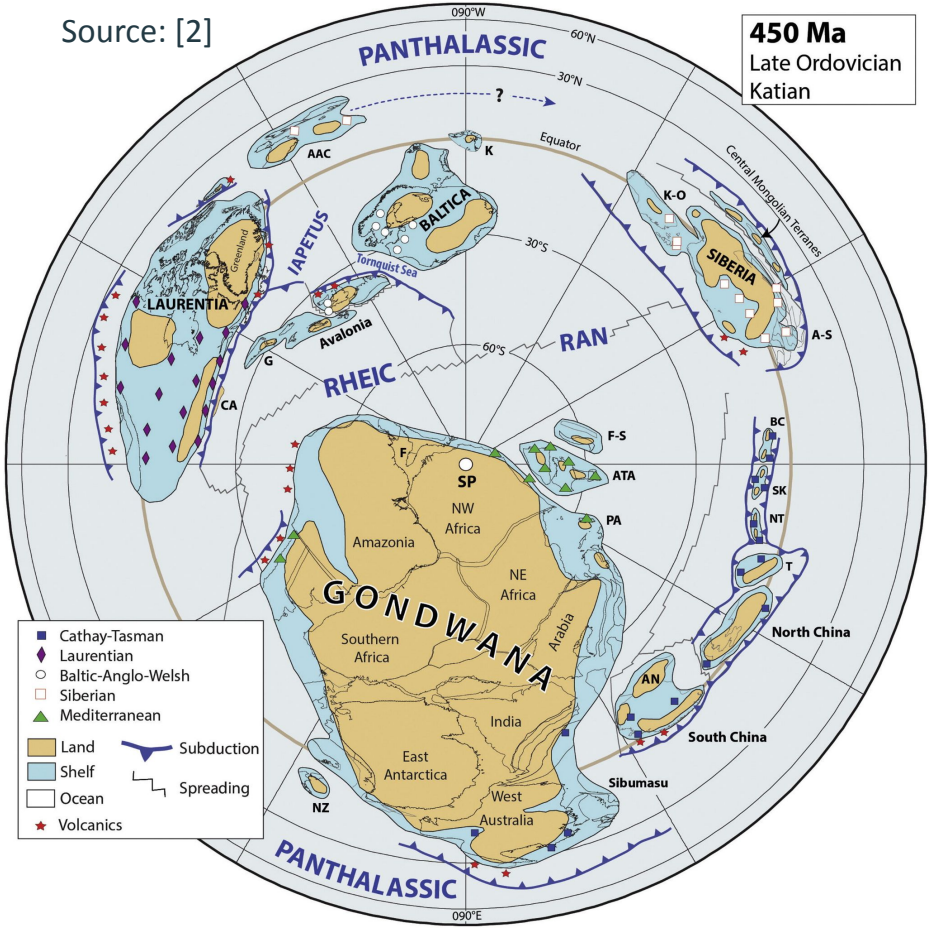
Why did the extinction event happen? (climate drivers)

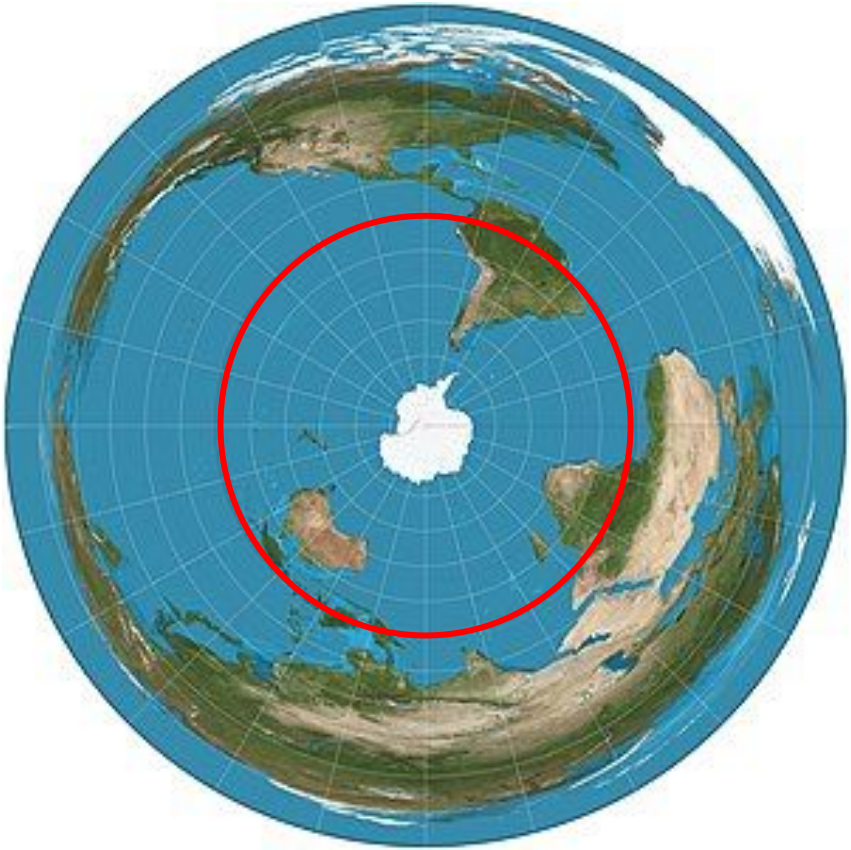
Where

Source: [2]



Where

Source: [3]



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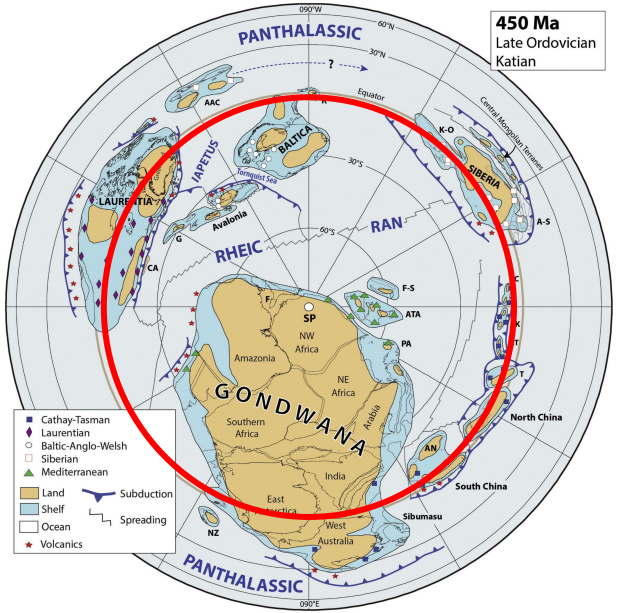
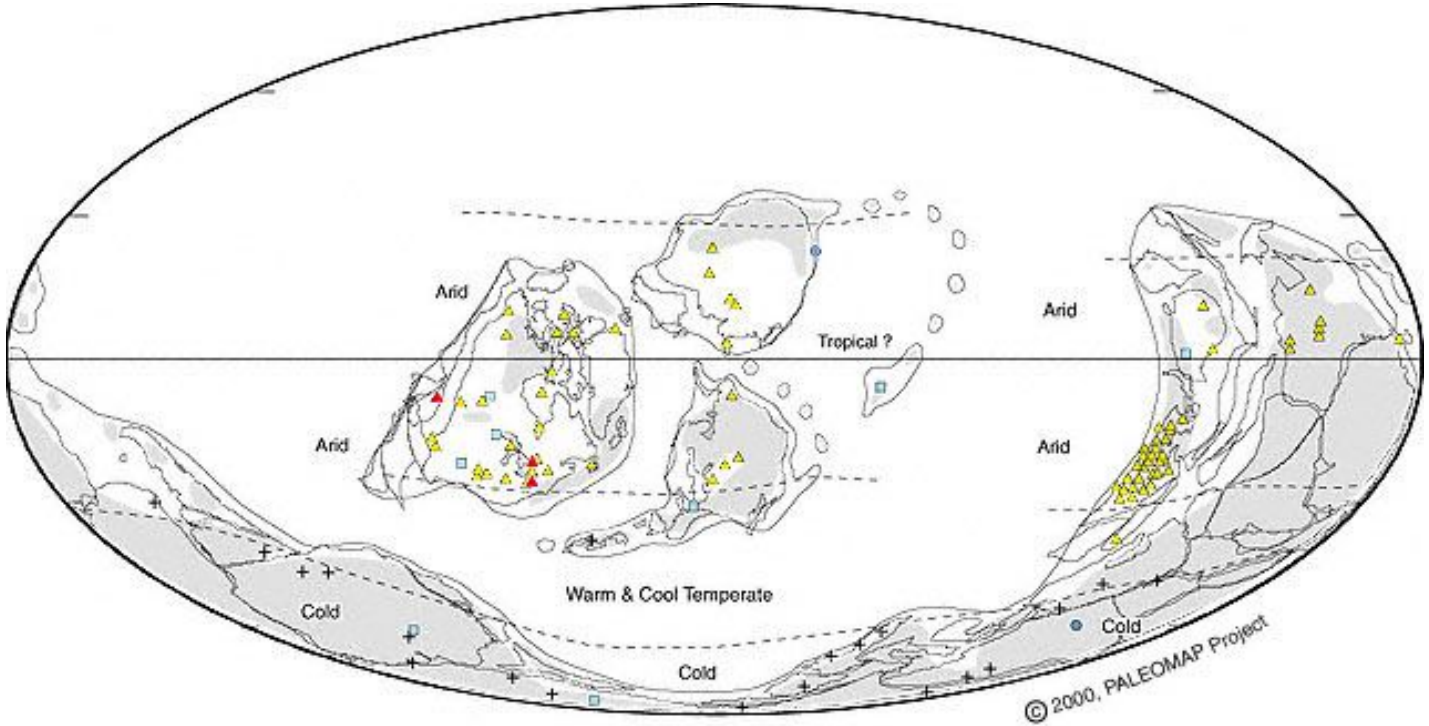


Where

Source: http://www.scotese.com/eordclim.htm



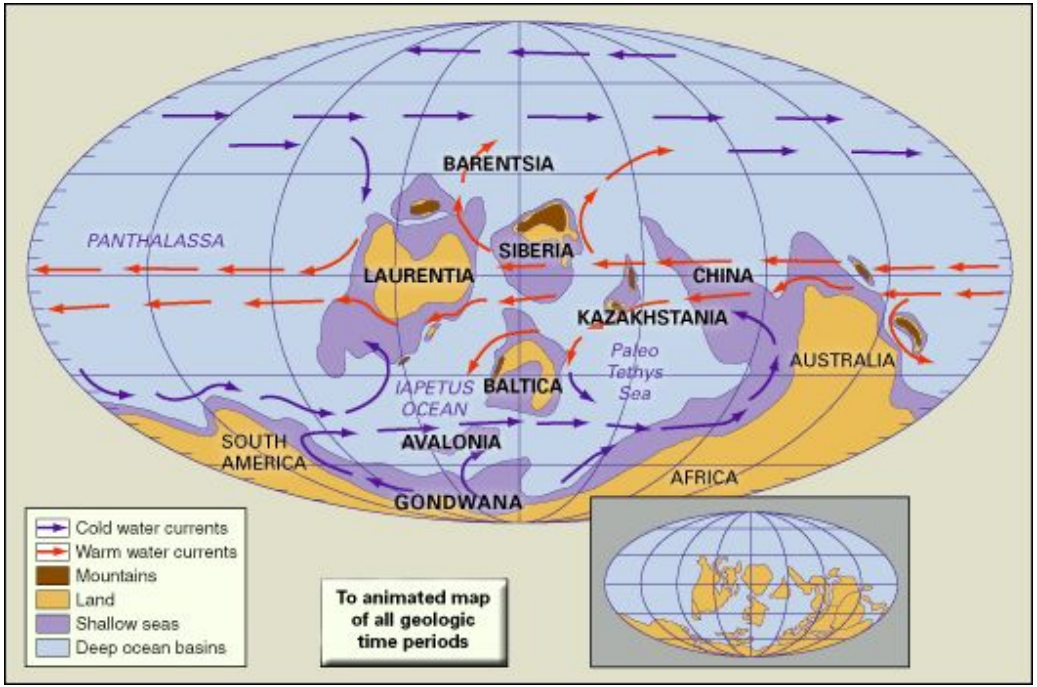
440 million years ago

Middle & Upper Ordovician

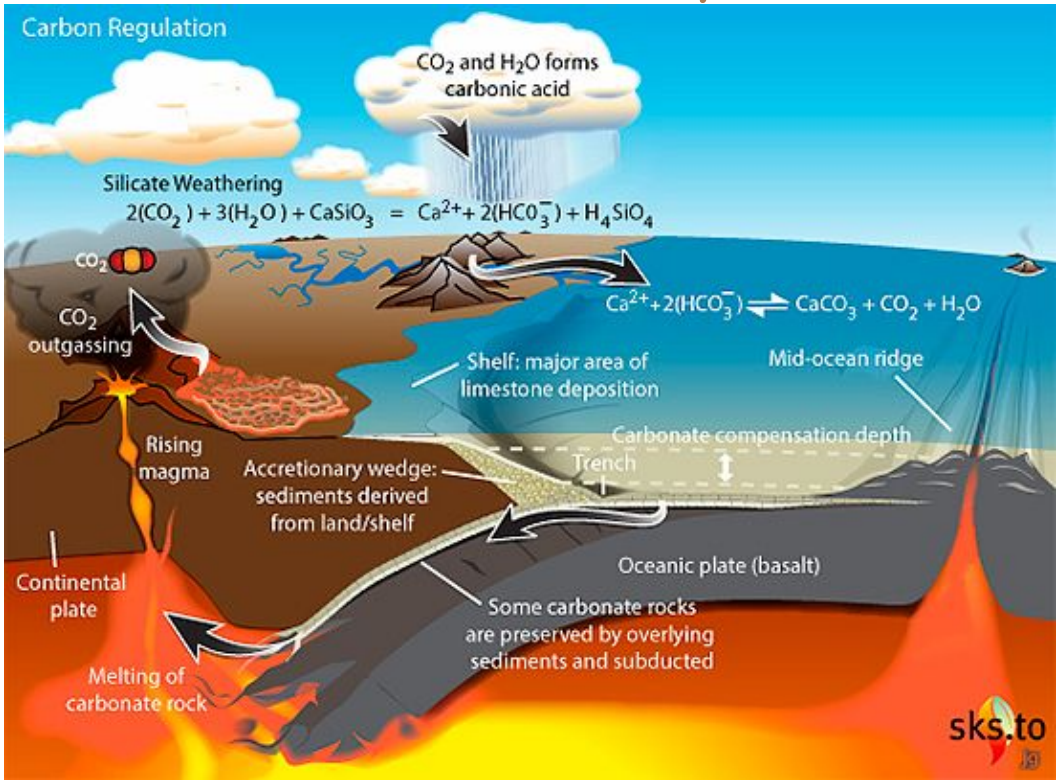
Where

Source: https://www.britannica.com/science/Ordovician-Period/

- __ Hour Days
- Hotter
- Higher CO2
- dimmer sun
- “Largely Ice-Free”
- Highest Sea Levels seen by complex life
- Low oxygen in water



Context: Carbonate-Silicate Cycle



Source: [24]

Who

When was the End-Ordovician ME within geological history?

Where did it happen? What did the world look like?

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Why did the extinction event happen? (climate drivers)

Who: “_____ ___ _____”

Great Ordovician Biodiversity Event

Content Warning:
Horrifying Mollusks

Who: GOBE

Why was biodiversity exploding?

- Asteroid Collision
- Oxygen Increasing

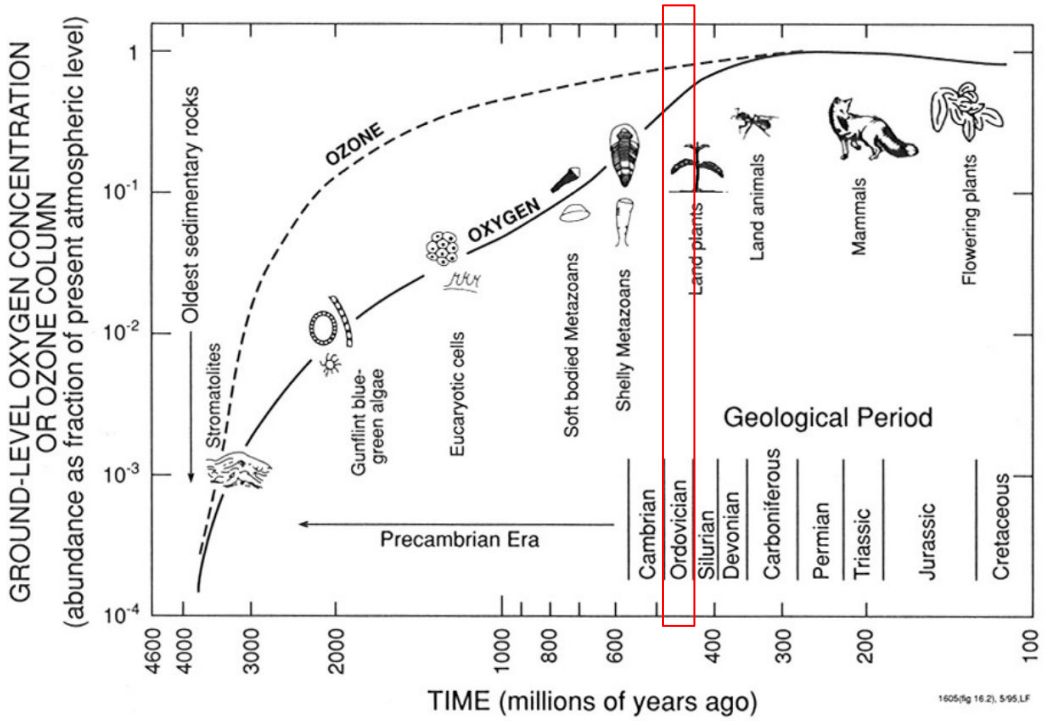


Figure 16.3. *Probable evolution of the oxygen and ozone abundance in the atmos (fraction of present levels) during the different geological periods of the Earth's history (W 1991; reprinted by permission of Oxford University Press).*

"___ _____ _____" - ___Bya

Who

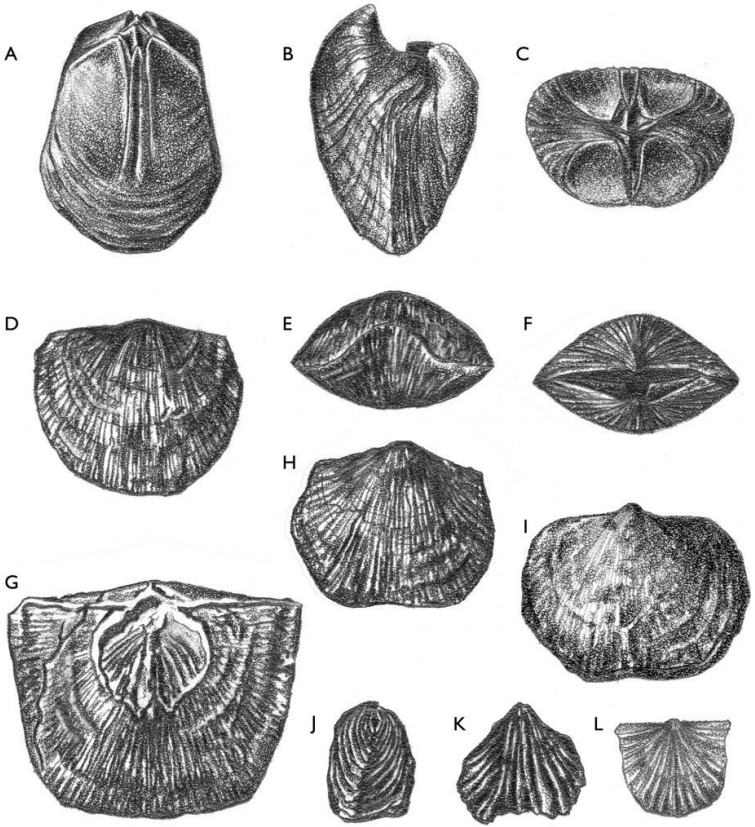
Source: [6]

Who: Brachiopods

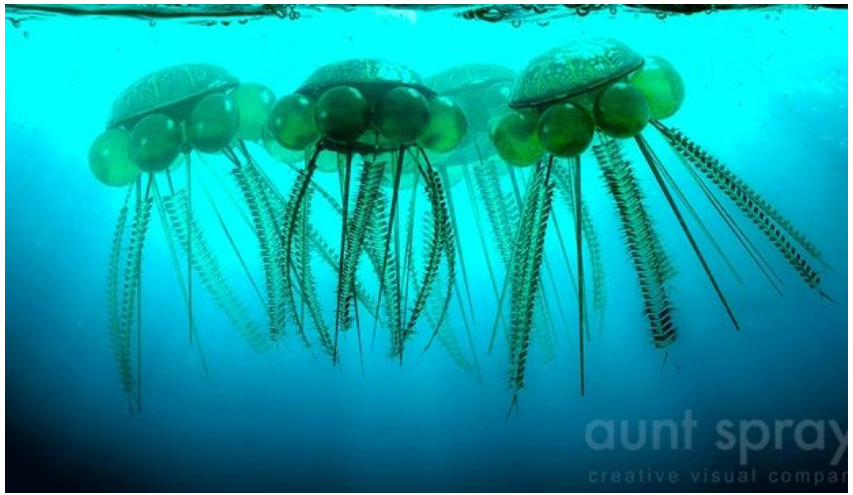
Source: [10]

Source: [6]

Source: [11]

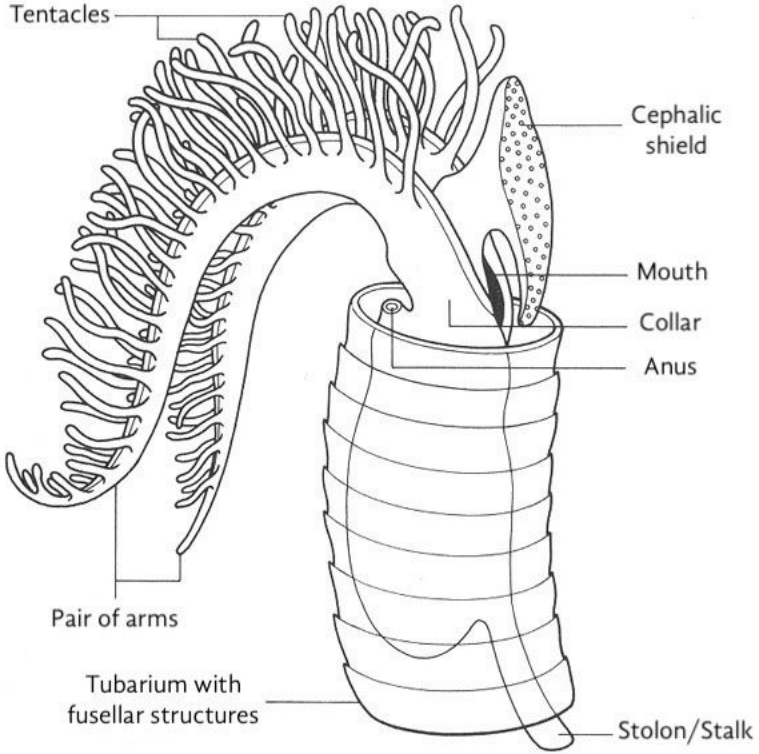


Who



Source: [9]

Source: [7]



Who: Graptolites

Source: [8]

For Sale: £1.25 – £2.95

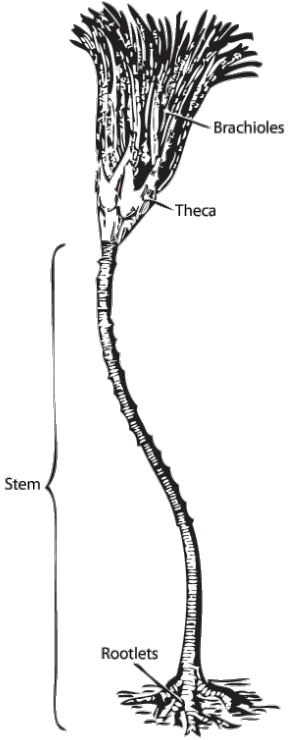
Who: Pentremites

Source: [12]

"Rolls Royce of Brachiopods"

Who: Pentremites; Blastoids

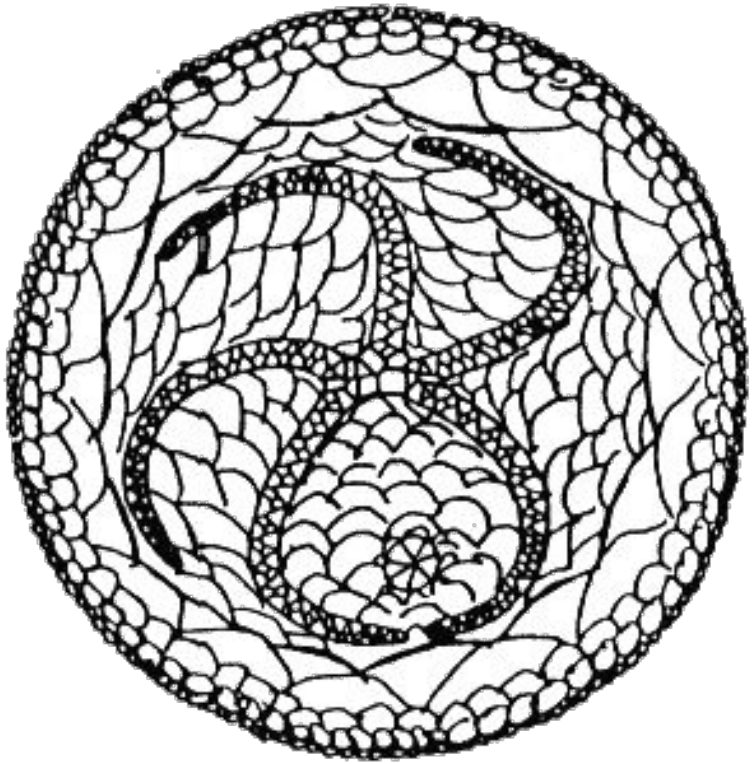
"*Pentremites godoni*, a blastoid from the Lower Carboniferous of Illinois."
Source: [13]



"Generalized diagram of blastoid morphology with regions of interest labeled. Modified from Beaver (1967)."

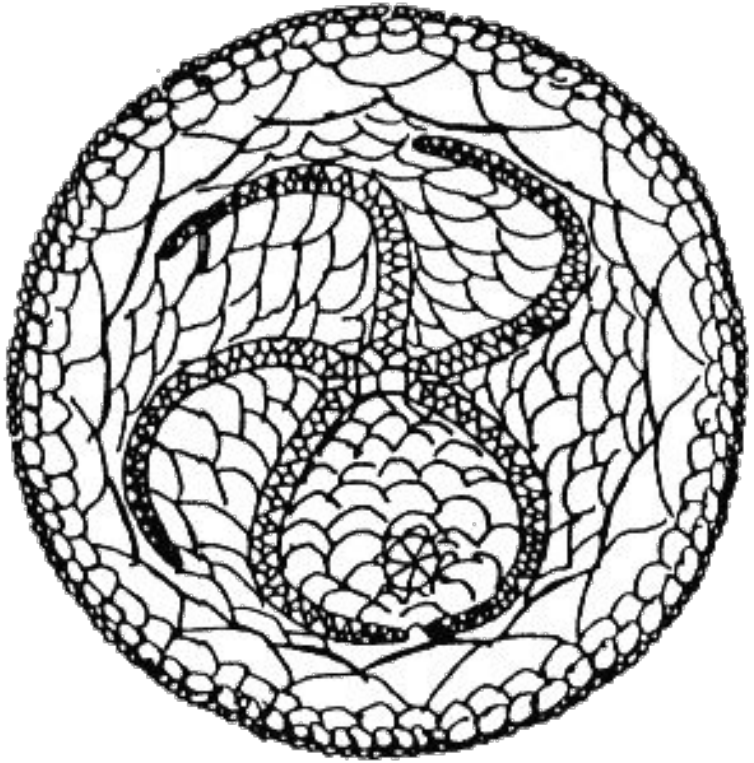
Source: [14]

Who



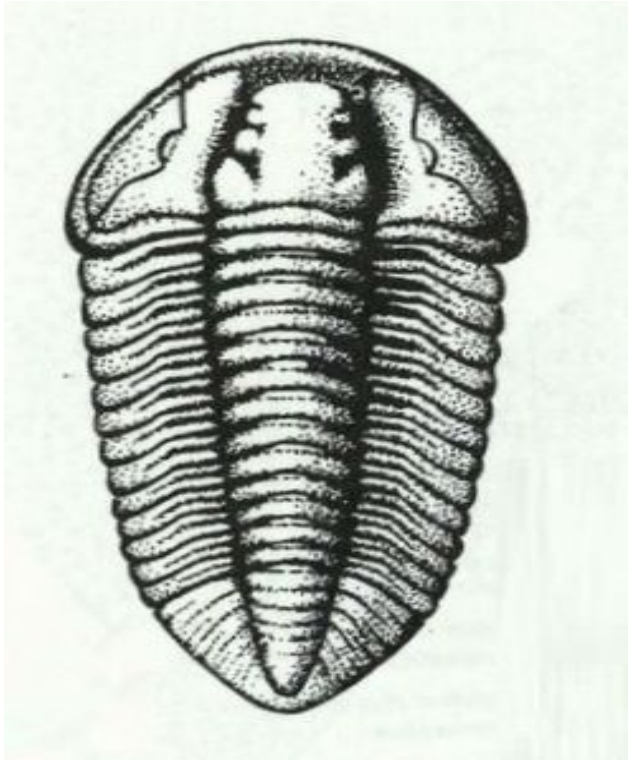
Source: [15]

Who: Isophorus Cincinnatiensis



Source: [15]

Who



Source: [16]

Who: Flexicalymene Meeki

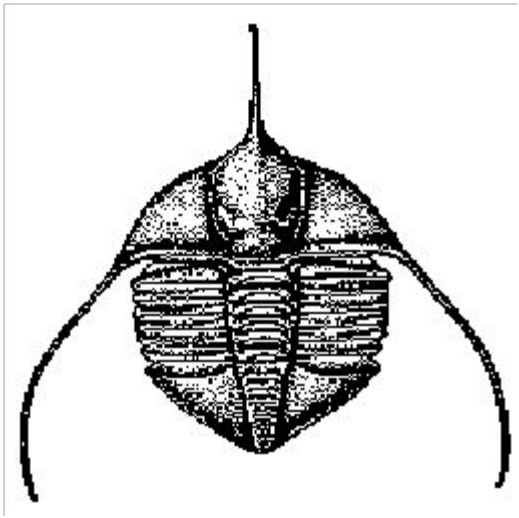
Source: [17]

"Benthic Roomba"

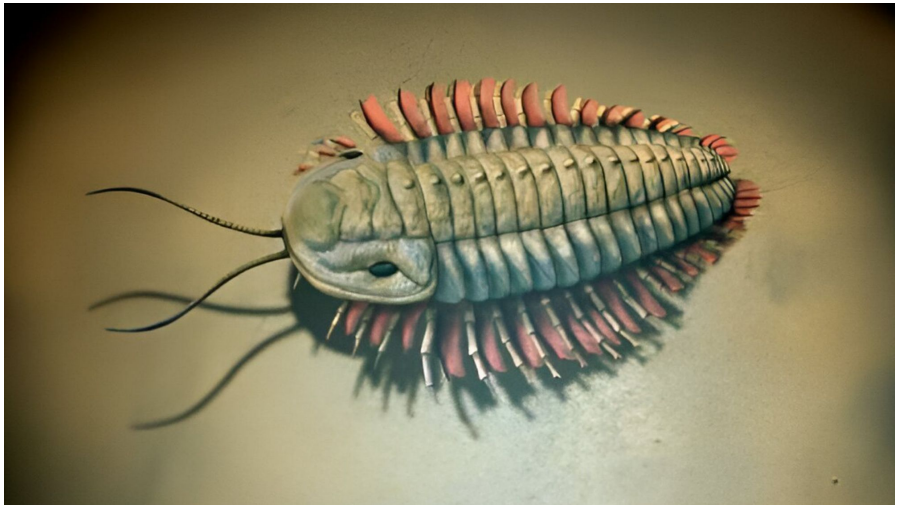
Who

Source: [20]

Who: Ampyx; Trilobites; Isotelus Rex

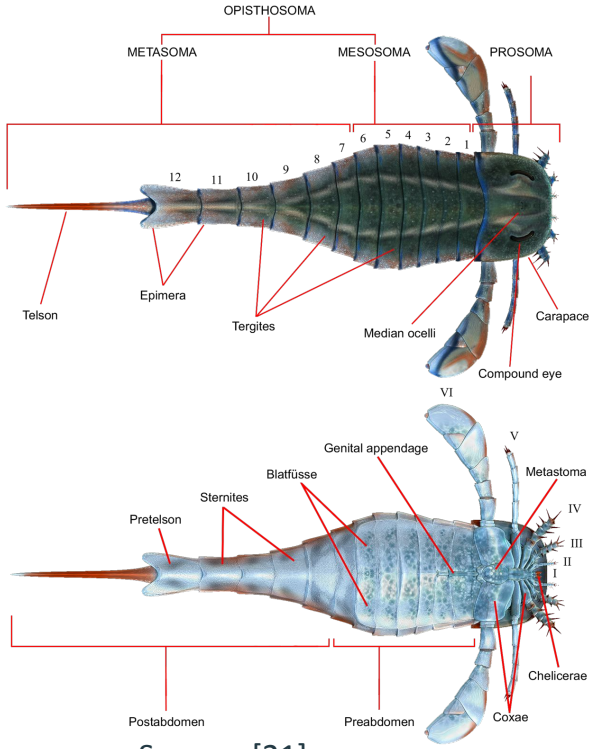


Source: [18]

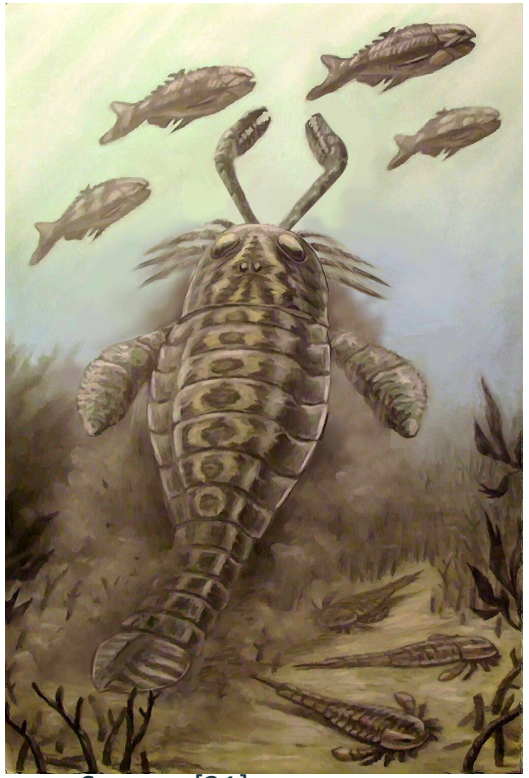


Source: [19]

Who: Eurypterids

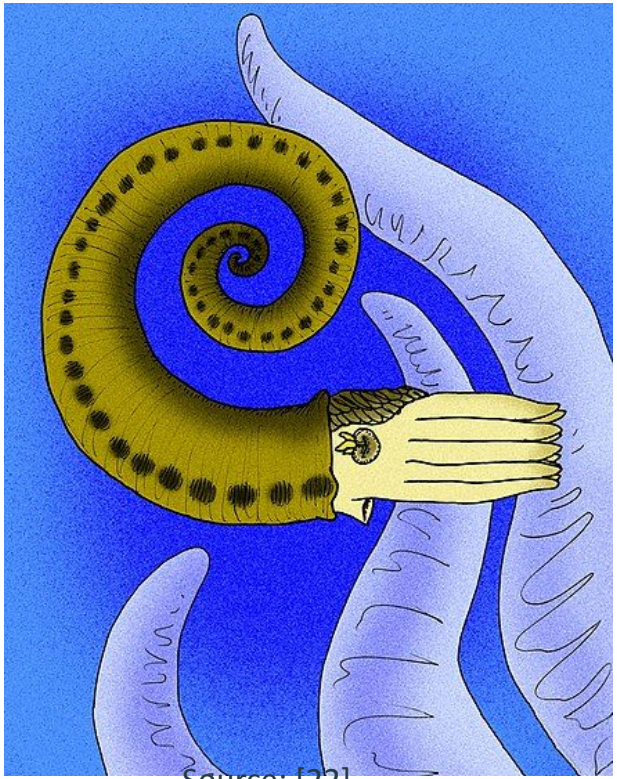


Source: [21]



Source: [21]

Who: Cephalopods



Source: [22]

Source: [22]

When was the End-Ordovician ME within geological history?

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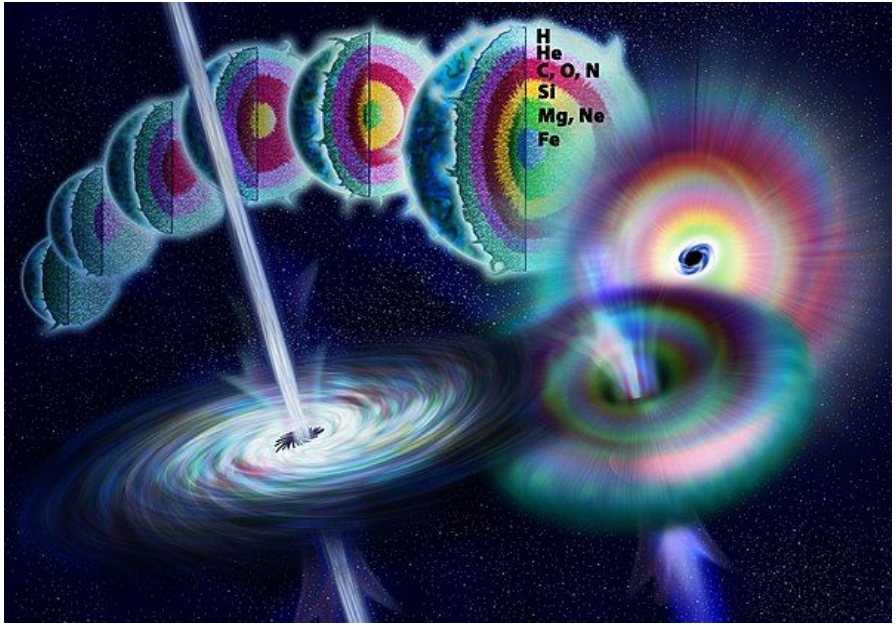
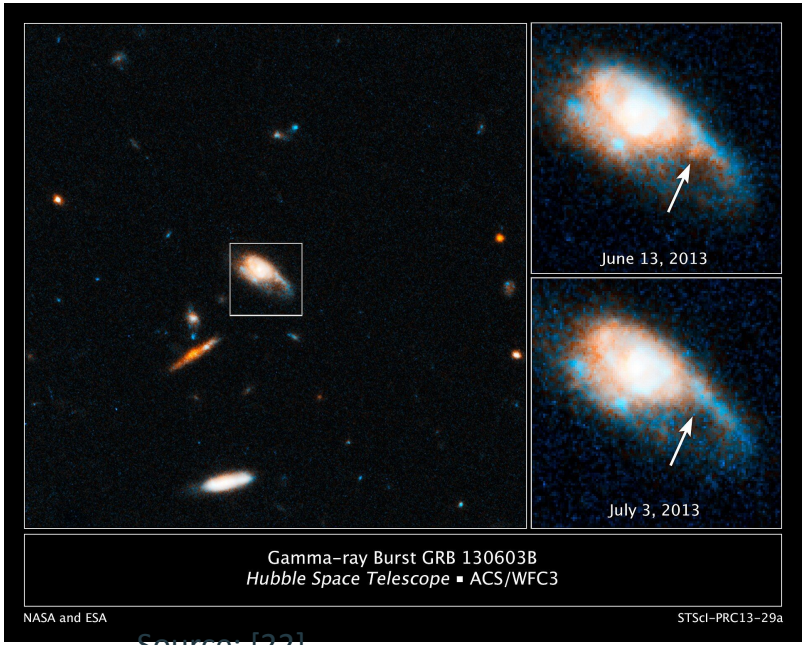
Why did the extinction event happen? (climate drivers)

What/Why: Gamma Ray Burst???



Source: [22]



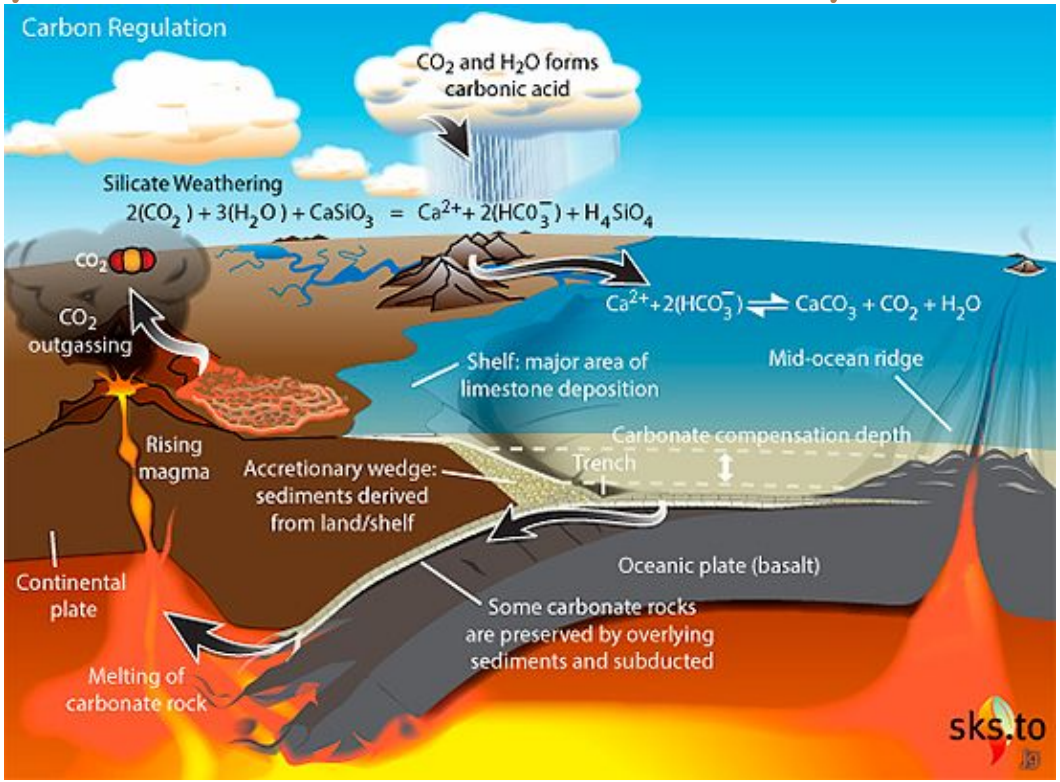
Source: [22]

What/Why: Gamma Ray Burst (no)

- Everything would have died:
  - _____
  - _____

  yet, that's not what happened
- _____

What/Why: Carbonate-Silicate Cycle

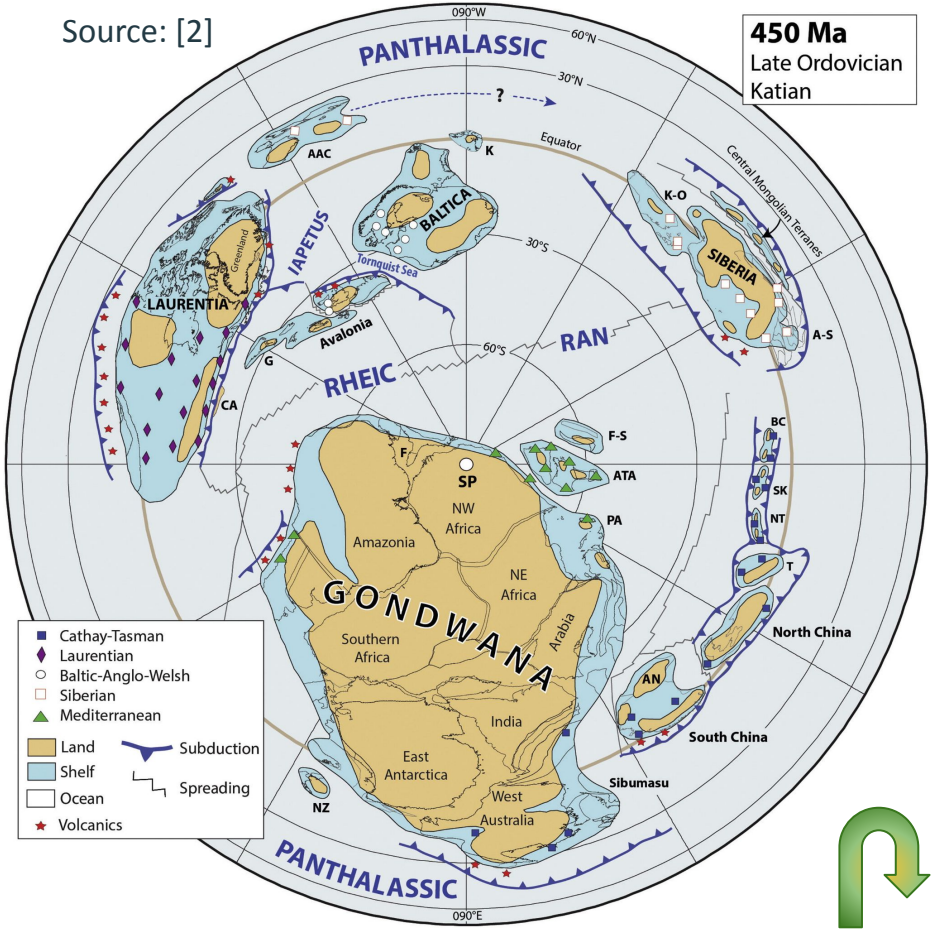


Source: [24]

What/Why: Volcanism

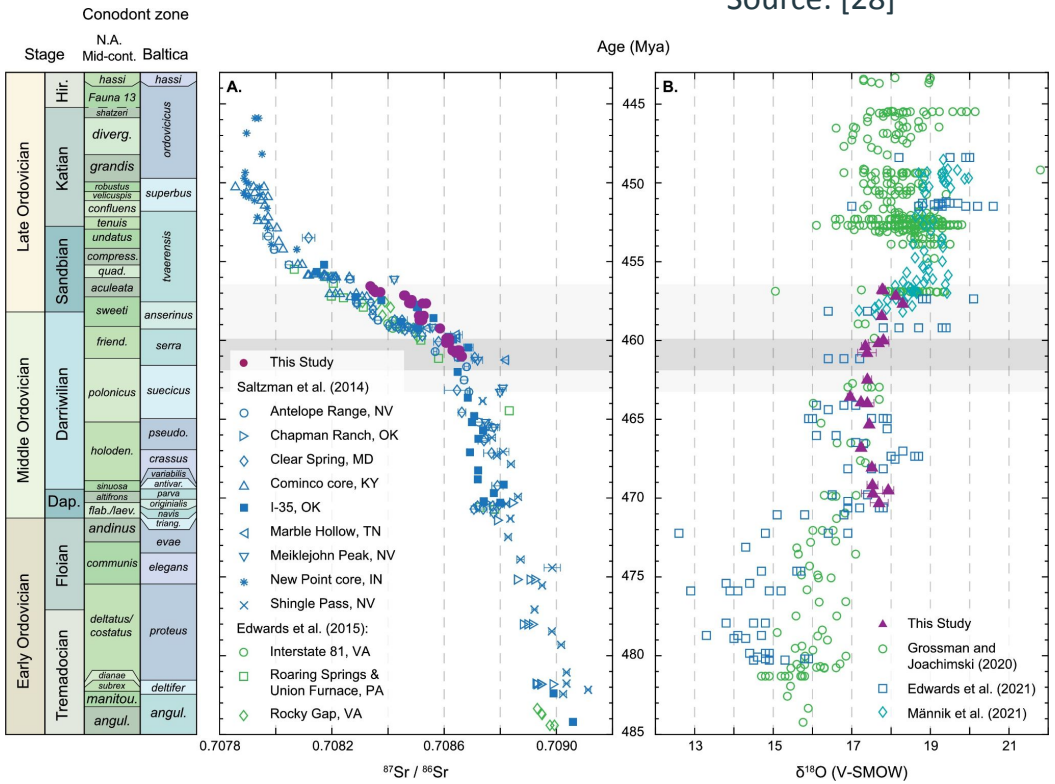
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

Source: [2]



How do we know? (Strontium Isotope Ratios)

Source: [28]



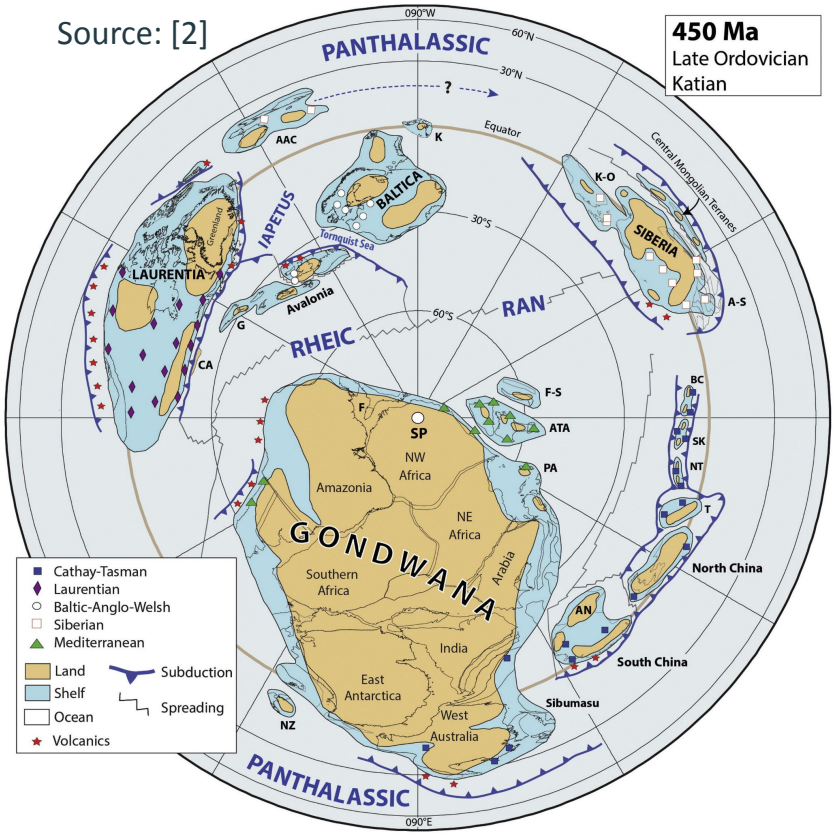
What: Two-Phase Extinction

1. Habitat Loss (___-___Ma)

2. Starvation (___-___Ma)

86% Extinction

Source: [2]



What: Temperature Rebound

Why might temperature rebound?

- Glacial ice covers silicate rocks; reduced weathering Source: [27]
- Volcanic activity restarts Source: [27]
- Biological CO2 removal slows (extinction)

Key Points

- Ordovician Era: __-___ Ma
- Most land in southern hemisphere
- Life confined to ocean, largely shallow seas
- “Great Ordovician Biodiversity Event” - _____ __ _____
  - Structure of continents may have facilitated speciation, like the Galapagos
  - Number of species tripled - most of which went extinct and we are not related to
- Sun Dimmer, CO2 Higher due to Volcanism
- New silicate rocks formed, enabling weathering
  - Balance between weathering and CO2 emission from volcanism
- Balance upset by cessation of volcanic activity - less CO2; glaciation; sea level rise; starvation; habitat loss; Ocean temp decreases 5 deg C
  - Overturning circulation starts, oxygenates ocean, kills phytoplankton, food source gone
- 85% of species die out
- Volcanic activity restarts; CO2 returns, temperatures rise

Works Cited

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[25] https://en.wikipedia.org/wiki/Carbonate%E2%80%93silicate_cycle
[26] https://en.wikipedia.org/wiki/Charles_Lapworth
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[28] https://doi.org/10.1016/j.epsl.2022.117641