

3.1.5 [HL] Mass Extinction and Anthropocene

Part 1: The geological timescale – eons and epochs

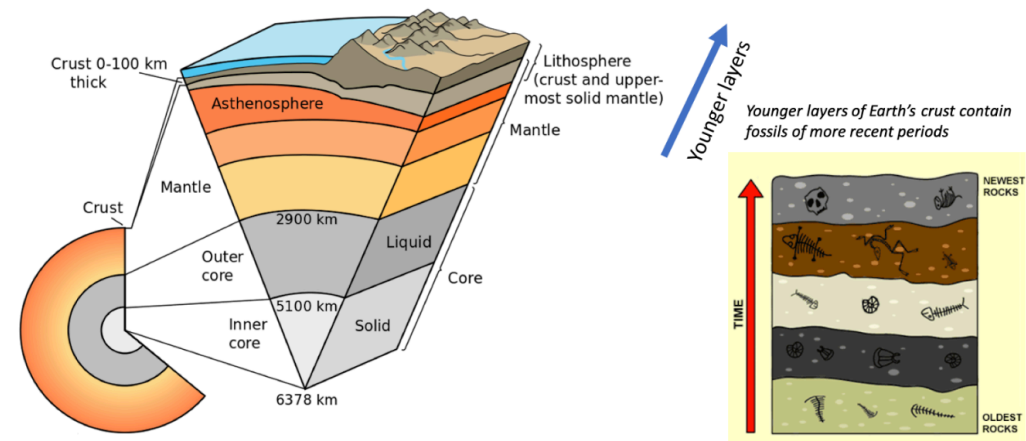
- Outline the meaning of eons and epochs
- Outline the process of fossil formations
- Outline the relative age of the Earth's age based on it's layers

Fossilisation

The geological timescale is divided into eons, which are further classified in

Key terminologies

- Eon = A unit of time
- Era = A unit of time. Shorter than eon but longer than a period
- Period = A unit of time. Shorter than era but longer than epoch
- Epoch = A unit of time. Shorter than period but longer than an age



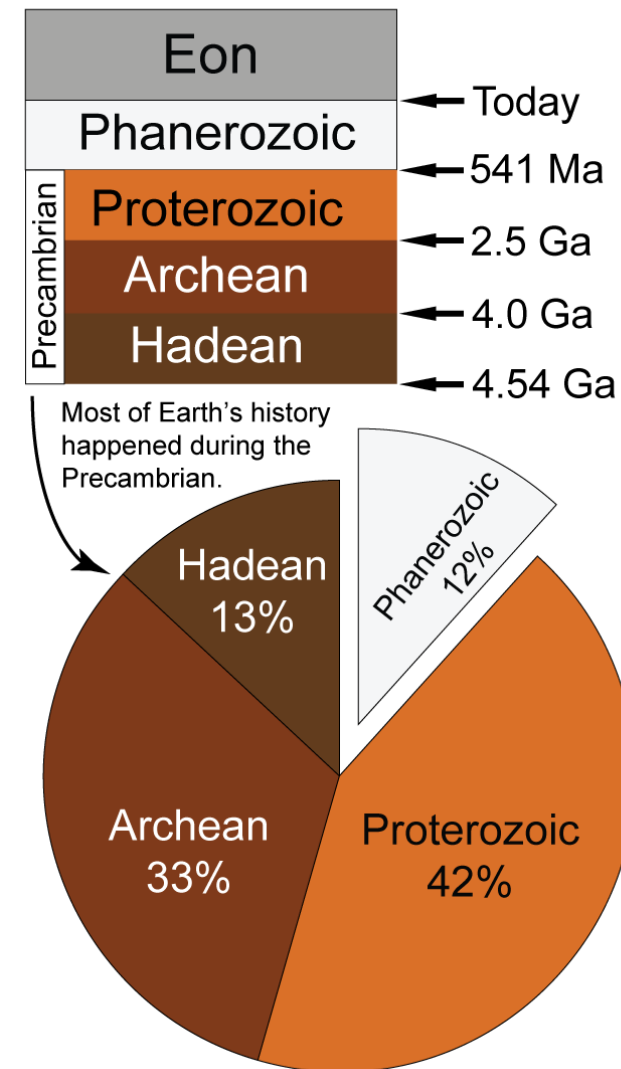
- Evolution of life on Earth started 4.5 billion years ago.
- Previous organisms died and become part of the Earth's crust layers.
- The inner layers of the earth crust contain older fossils



Younger ↑

Eon	Era	Period	Epoch	
Phanerozoic	Cenozoic	Quaternary	Holocene	← Today
			Pleistocene	← 11.8 Ka
		Neogene	Pliocene	
			Miocene	
		Paleogene	Oligocene	
			Eocene	
			Paleocene	← 66 Ma
	Mesozoic	Cretaceous	~	
		Jurassic	~	
		Triassic	~	
	Paleozoic	Permian	~	← 252 Ma
		Carboniferous	Pennsylvanian	~
			Mississippian	~
		Devonian	~	
		Silurian	~	
		Ordovician	~	
		Cambrian	~	← 541 Ma
	Proterozoic	~	~	← 2.5 Ga
	Archean	~	~	← 4.0 Ga
	Hadean	~	~	← 4.54 Ga

Older ↓

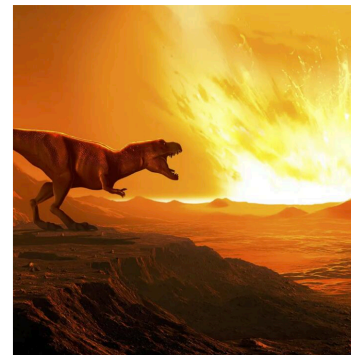
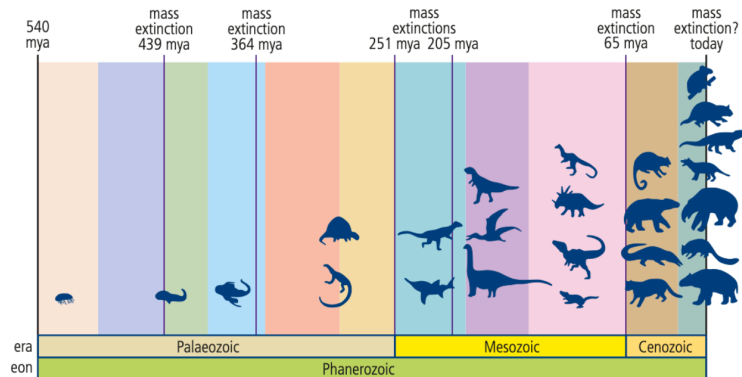


Part 2: Mass Extinction

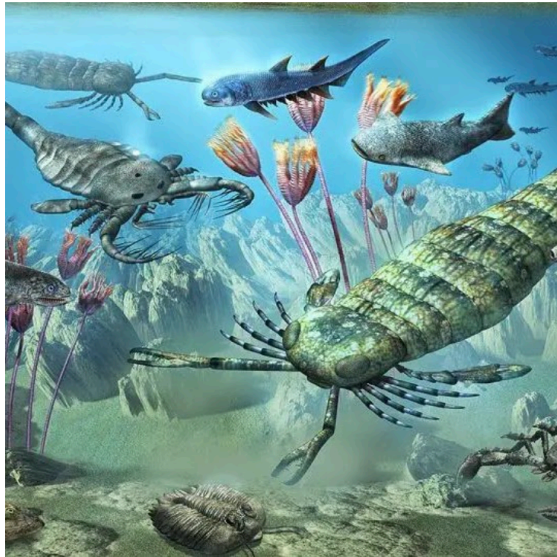
- Outline how mass extinction events increase biodiversity [4]
- Summarise the events of mass extinction [4]

Mass Extinction

- Approximately only 1% of the species from the previous era still exist today.
- Although the mass extinction events killed many species, each event gave new direction for biodiversity
- The large-scale loss of species led to new opportunities for surviving populations, with many groups undergoing adaptive radiation



Mass Extinction



THE ORDOVICIAN– SILURIAN EXTINCTION

439 mil years ago

- Glaciers formed - dropping sea level
- Killed 86% species



THE PERMIAN–TRIASSIC EXTINCTION

251 mil years ago



THE LATE DEVONIAN EXTINCTION

364 mil years ago



THE ORDOVICIAN– SILURIAN EXTINCTION

439 mil years ago



SIXTH MASS EXTINCTION?

?



THE CRETACEOUS– TERTIARY EXTINCTION

65 mil years ago



THE END TRIASSIC EXTINCTION

199 - 214 mil years ago

Mass Extinction



THE LATE DEVONIAN EXTINCTION

364 mil years ago

- Global cooling
- Diversification of plants dropping the level of CO₂
- Killed 75% of all species



THE PERMIAN–TRIASSIC EXTINCTION

251 mil years ago



THE LATE DEVONIAN EXTINCTION

364 mil years ago



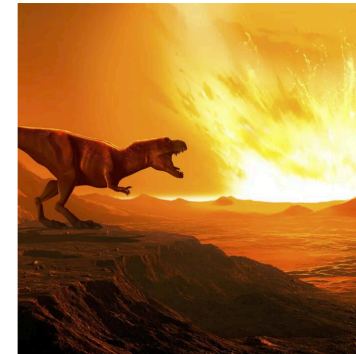
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Mass Extinction



THE PERMIAN–TRIASSIC EXTINCTION

251 mil years ago

- Largest extinction event
- May be due to an asteroid (but not evidence yet) and may also be due to the tectonic movement (Pangaea formation)
- Others believe the cause was volcanic activity, as with the End Triassic extinction, from the Siberian Traps
- Algae and plants died causing drop in O₂ level



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251 mil years ago



THE LATE DEVONIAN EXTINCTION

364 mil years ago



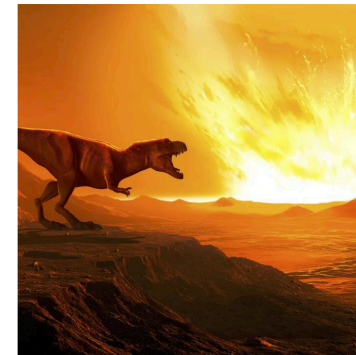
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THE END TRIASSIC EXTINCTION

199 - 214 mil years ago

Mass Extinction



THE END TRIASSIC EXTINCTION

199 - 214 mil years ago

- Widespread of volcanic eruptions
- Huge emission of CO₂ and CH₄
- CO₂ acidified the ocean
- 80% of species went extinct



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251 mil years ago



THE LATE DEVONIAN EXTINCTION

364 mil years ago



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Mass Extinction



THE CRETACEOUS– TERTIARY EXTINCTION

65 mil years ago

- Caused by the impact of a several-mile-wide asteroid that created a huge crater, which is now hidden beneath the Gulf of Mexico.
- Reduced sunlight
- Drop in temperature
- Flood-like volcanic eruptions
- Climate change
- Tectonic rearrangement
- 76% of species went extinct



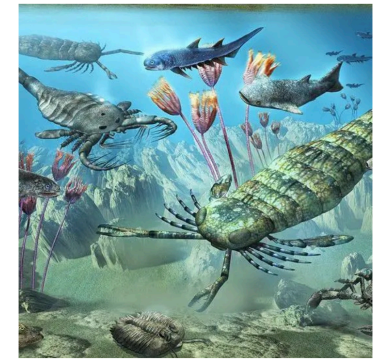
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Mass Extinction



SIXTH MASS EXTINCTION?

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- Phase 1: began when the first modern humans began to disperse to different parts of the world about 100,000 years ago
- Phase 2: began about 10,000 years ago when humans turned to agriculture.



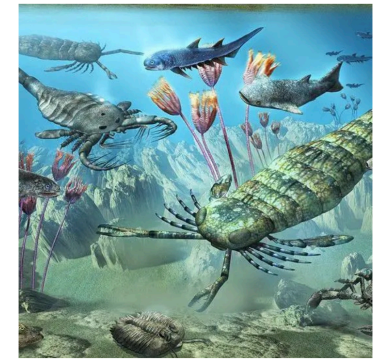
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Part 3: Anthropocene

- Outline the meaning of Anthropocene and Holocene
- Outline the evidences of Anthropocene

Anthropocene and Holocene

- **Holocene** - quaternary period - which existed for about 2 million years, was distinguished by regular shifts into and out of glacial and inter-glacial phases
- Scientists believe that we have entered a new epoch called the **Anthropocene**
 - Great Acceleration = dramatic, continuous, approximately simultaneous and rapid increase of factors across a large range of measures of human activity
 - first recorded in the mid-20th century and continue to this day

Evidence of Anthropocene

- signals from chemical pollution are currently accumulating in geological strata, with the potential to be preserved into the far future
- mixing of native and non-native species, which will be represented in the fossil record
- deposits from nuclear testing
- modification of terrestrial and marine sedimentary systems
- minerals created solely or primarily from human activity

Anthropocene

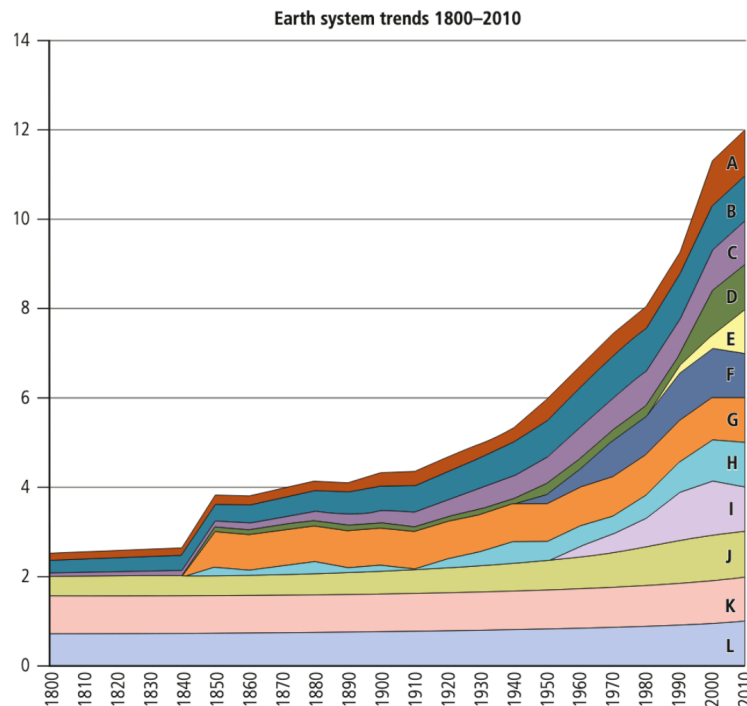
- The Anthropocene is characterized by widespread changes to global and local physical systems.
- There are now 'human fingerprints' all over almost everything in the natural world.
- In particular, it is the unprecedented rapid change in atmospheric CO₂ witnessed since the onset of the industrial revolution – and resulting carbon cycle changes – that underpins the Anthropocene argument

Anthropocene

- The term **Great Acceleration** refers to a dramatic, continuous, approximately simultaneous and rapid increase of factors across a large range of measures of human activity, which were first recorded in the mid-20th century and continue to this day
- The Great Acceleration forms the basis for the Anthropocene as a new geological epoch in Earth history, where humans have caused fundamental changes to Earth systems

Earth system trends category of the Great Acceleration

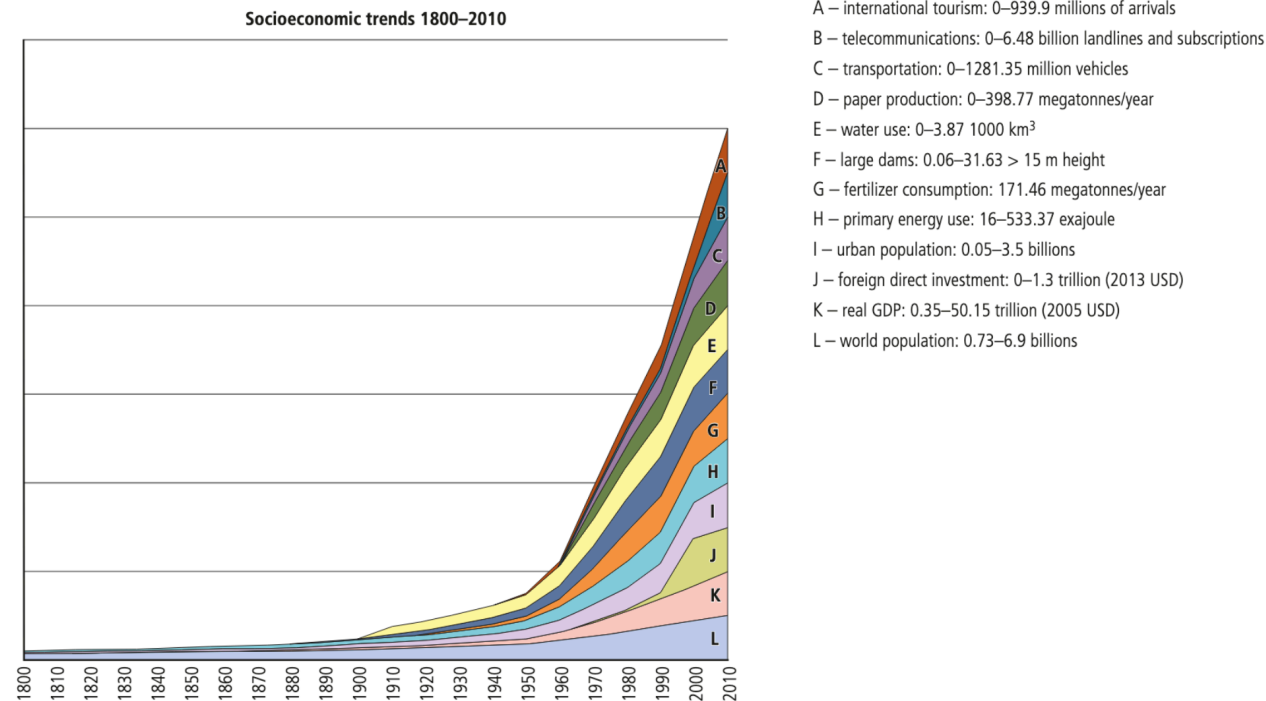
of the Anthropocene from 1800 to 2010. The data graphically displayed is scaled for each subcategory's 2010 value



- A – terrestrial biosphere degradation: 3.53–28.57% decrease of mean species abundance
- B – domesticated land: 0.08–0.38% of total land area
- C – tropical forest loss: 0.96–27.6% of total land area compared to 1700
- D – coastal nitrogen: 0–79.7 megatonnes/year
- E – shrimp aquaculture: 3.77 megatonnes/year
- F – marine fish capture: 64.14 megatonnes/year
- G – ocean acidification: 8.21 nmol kg⁻¹
- H – temperature anomaly: 0.47 Celsius
- I – O₃: 54.09% lost
- J – CH₄: 705.34–1744.07 PPB
- K – nitrous oxide: 271.39–322.46 PPB
- L – CO₂: 276.81–384.27 PPM

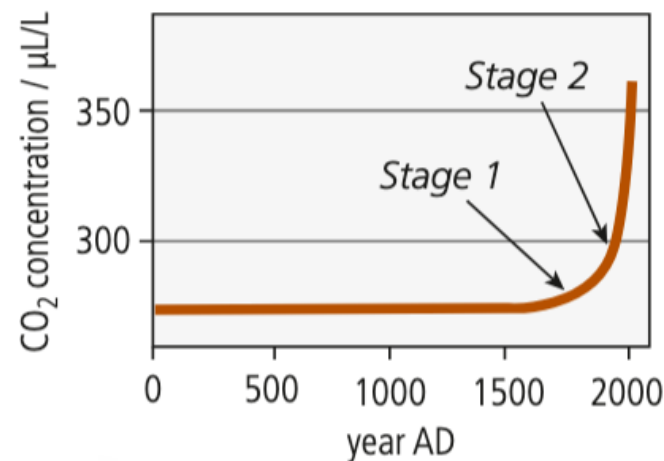
Socio-economic trends category of the Great Acceleration

of the Anthropocene from 1800 to 2010. The data graphically displayed is scaled for each subcategory's 2010 value



Anthropocene

- Studies suggest that a sixth mass extinction caused by humans will likely resemble the Permian–Triassic and Cretaceous–Tertiary extinctions.
- Analysis of the marine fossil record suggests that this will be the case and that recovery will take tens of millions of years



Pre-Anthropocene events:

Fire-stick farming, mega fauna extinctions, forest clearing

Anthropocene Stage 1 (ca 1800–1945)

Internal combustion engine, fossil fuel energy, science & technology

Anthropocene Stage 2 (1945–2010 or 2020)

The Great Acceleration, new institutions and vast global networks

Anthropocene Stage 3 (2010 or 2020–?)

Sustainability or collapse?