

# Biogeography. Lecture 5

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# Outline

## Palaeogeography

### Plate tectonics

## Most important eras and periods

Cryogenian period (850–635 Mya) and Snowball Earth

Ediacarian period: 635–550 Mya

Cambrian period

Ordovician, Silurian and Devonian: three ages of fishes



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# Palaeogeography

## Plate tectonics

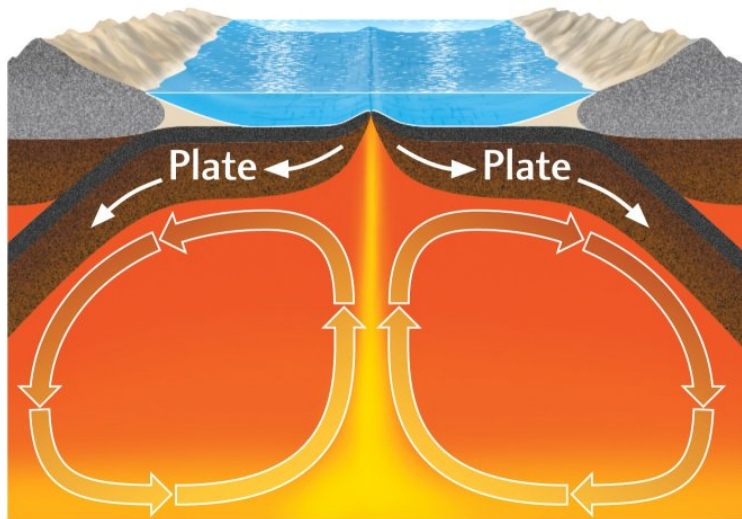


# Mantle convection

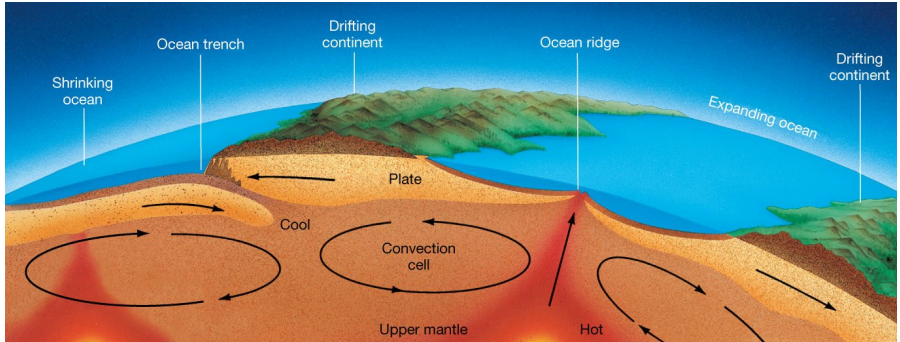
- ▶ The driving force of floating continents is a **mantle convection**
- ▶ In ocean ridges, new ocean cortex is constantly forming and expanding
- ▶ In ocean trenches and continental ridges, different plates are colliding and often forming mountains



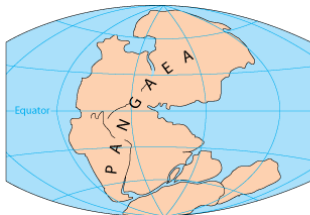
# Mantle convection



# Mantle convection



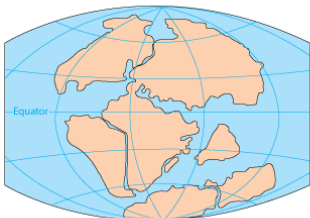
# The result of mantle convection



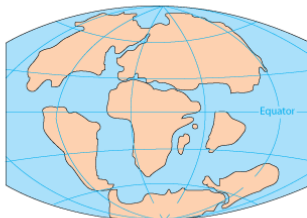
PERMIAN  
250 million years ago



TRIASSIC  
200 million years ago



JURASSIC  
145 million years ago

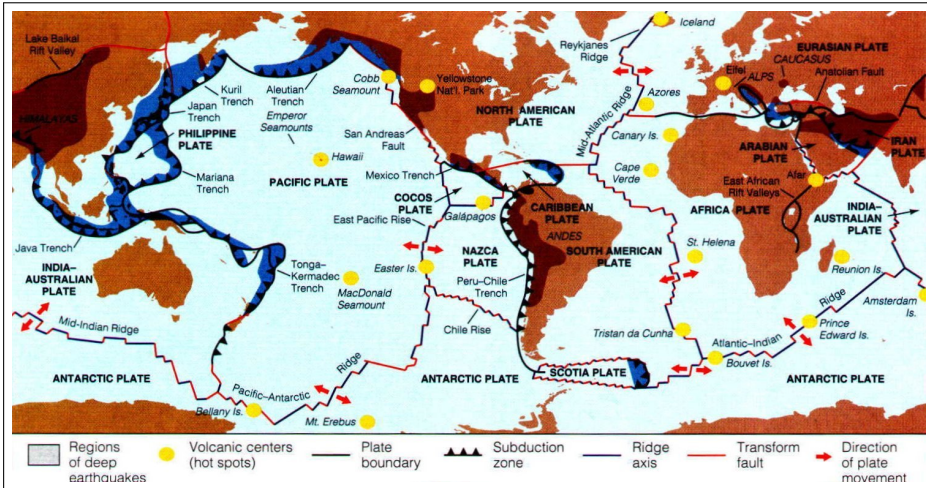


CRETACEOUS  
65 million years ago





# What is going on now

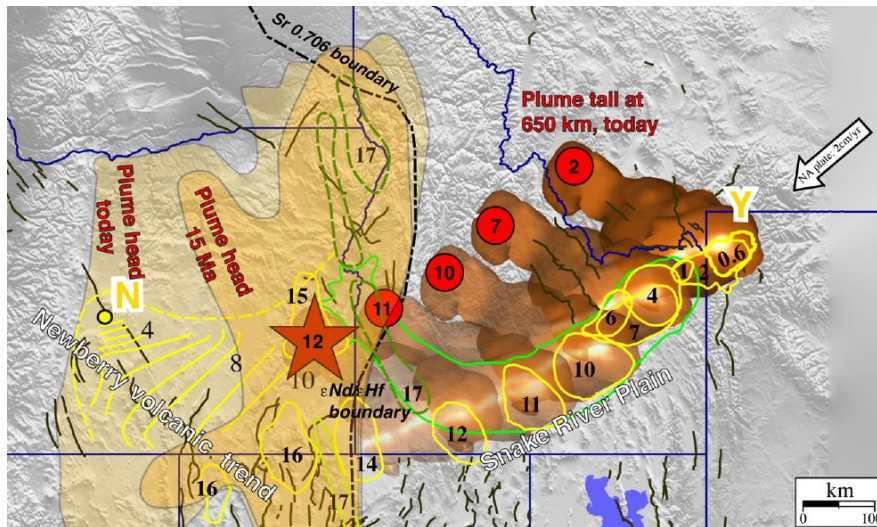


# Two living examples of continental drift on U.S. territory

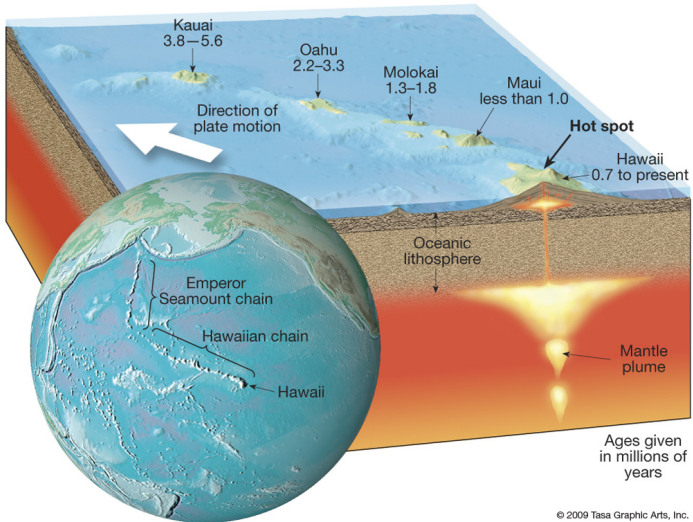
- ▶ Yellowstone hotspot
- ▶ Hawaiian hotspot



# Yellowstone hotspot



# Hawaiian hotspot



# Most important eras and periods

## Cryogenian period (850–635 Mya) and Snowball Earth



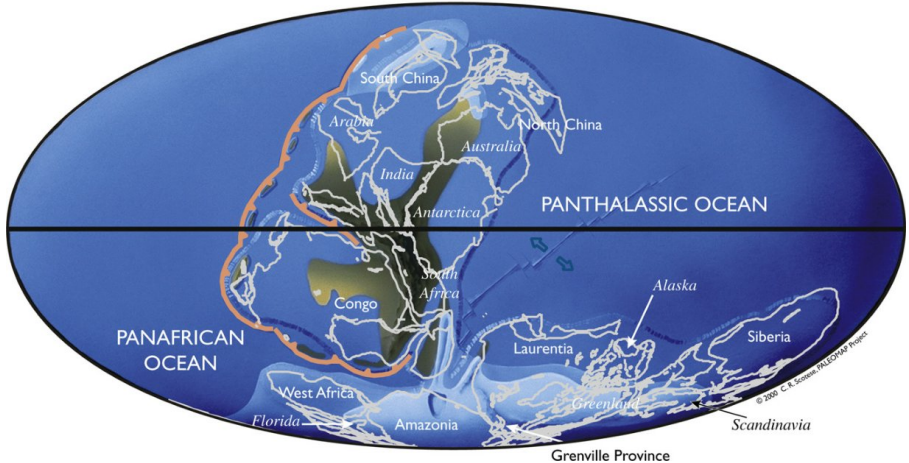
# Rodinia—the first super-continent

- ▶ Tectonic plates formed (and will form) one continent several times
- ▶ 650 Mya this continent—Rodinia was formed right over the South Pole



# Cryogenian continents which formed Rodinia

650 Ma Cryogenian



## Rodinia: view from South Pole



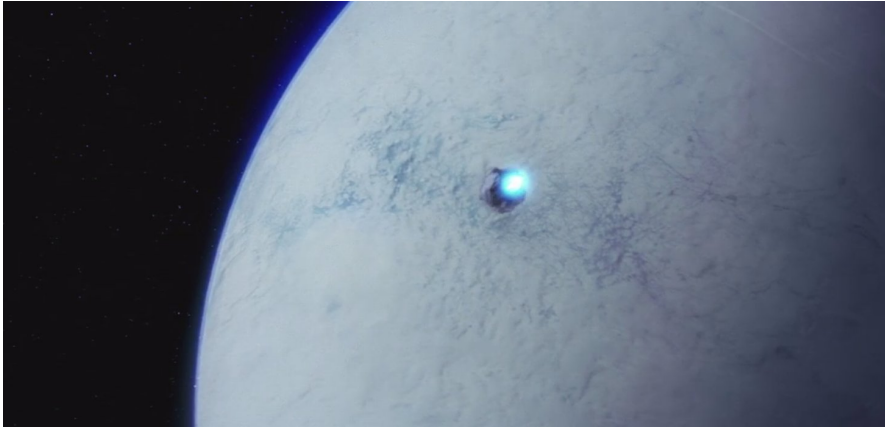


## Marionan glaciation: Snowball Earth

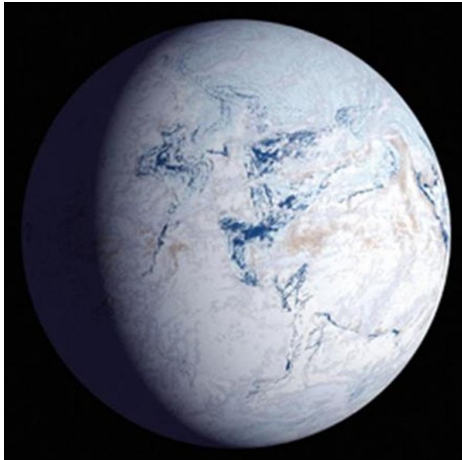
- ▶ First global glaciation was started because ice started to concentrate over the pole and increase Earth albedo (this is the positive feedback)
- ▶ And because the configuration of continents blocked the equatorial warm current
- ▶ And because concentration of oxygen was high but greenhouse gases (like CO<sub>2</sub>)—small
- ▶ As a result, from time to time Earth was completely covered with ice sheet 1 km tall!



# Star Wars Hoth—ice planet



# Snowball Earth

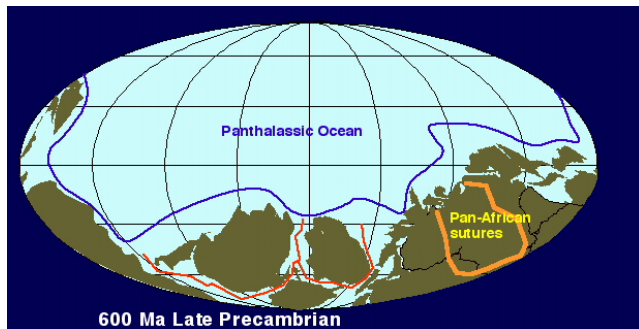


# Most important eras and periods

Ediacarian period: 635–550 Mya



# Rodinia breaks



# Ediacarian continents

600 Ma Ediacaran

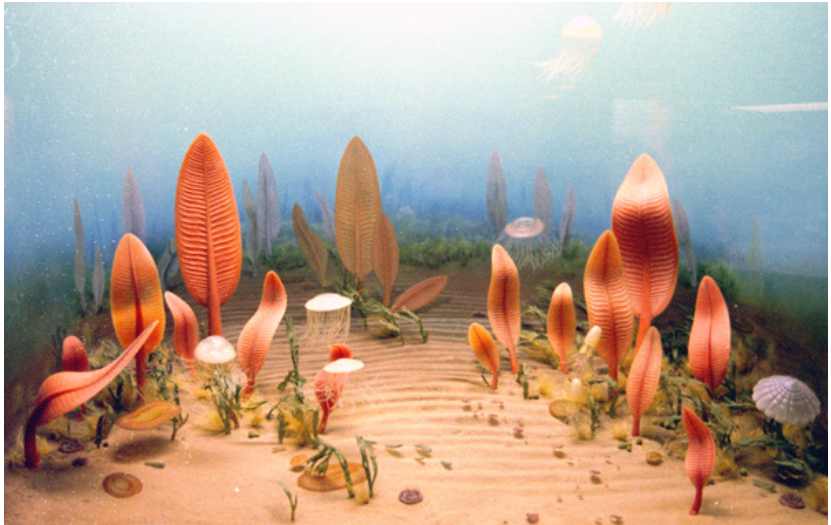


# Life in Cryogenian and Ediacarian

- ▶ Before: prokaryotes, included photosynthetic (cyanobacteria), then unicellular eukaryotes
- ▶ Cryogenian: multicellular eukaryotes, e.g. algae
- ▶ Ediacarian: first animals



## Ediacarian life





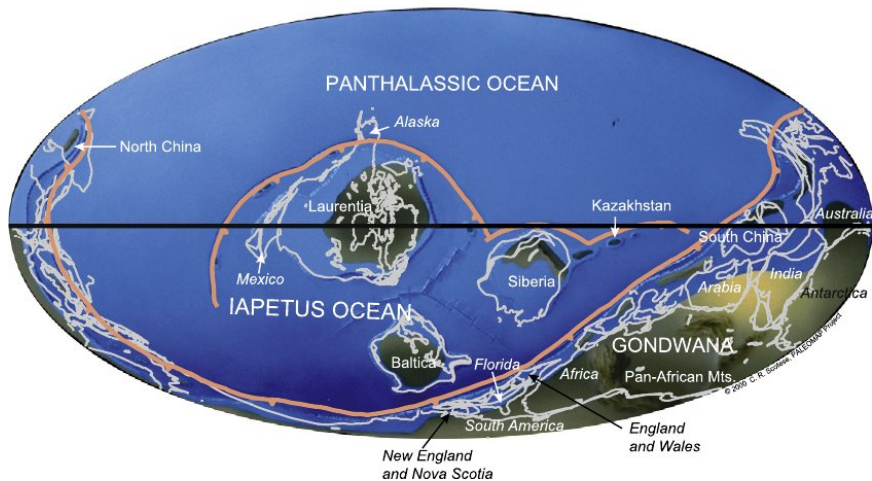
# Most important eras and periods

## Cambrian period



# Cambrian map

514 Ma Cambrian



# Cambrian climate and life

- ▶ Gradually changed from colder to warmer
- ▶ Cambrian explosion: appearance of most of animal phyla with skeleton
- ▶ Little or no terrestrial life
- ▶ The main driver of animal evolution during Cryogenian–Cambrian was probably oxygenation of water
- ▶ One theory states that pre-Cambrian ocean water was muddy and rich of organic compounds, animal filtration changed this condition



# Cambrian life



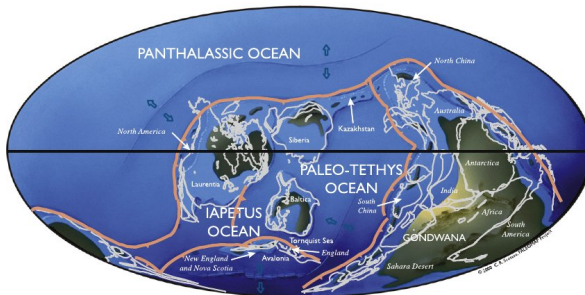
# Most important eras and periods

Ordovician, Silurian and Devonian:  
three ages of fishes



# Ordovician period

458 Ma Ordovician

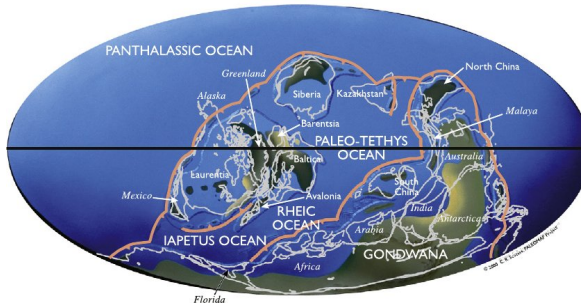


- ▶ Climate changed from hot to glaciated (Gondwana hits the South Pole)
- ▶ Marine fauna spread out, especially cephalopods, conodonts and graptolites
- ▶ In the end, the first great extinction: 85% of marine species extinct



# Silurian period

425 Ma Silurian



- ▶ Fluctuating climate
- ▶ Prospering of marine fauna again
- ▶ Land colonization started from plants and arthropods!
- ▶ South Pole still in the Gondwana

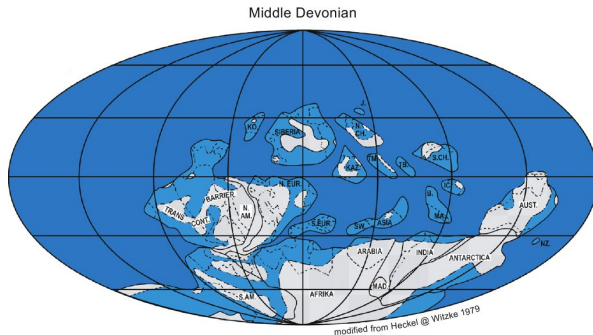


## Silurian sea





# Devonian period



- ▶ Moderate climate becoming warmer
- ▶ Exceptionally high sea level
- ▶ Greatest diversity of marine fauna in Paleozoic (especially fishes)
- ▶ Terrestrial vertebrates: tetrapods appeared!



# Summary

- ▶ Continents of Earth are constantly changing their position due to the mantle convection (“plate tectonics”)
- ▶ From Cryogenian to Ordovician, super-continent Rodinia broke and climate on Earth became milder
- ▶ Most of water-inhabiting animal groups appeared by Ordovician



# For Further Reading



A. Shipunov.

*Biogeography* [Electronic resource].

2014—onwards.

Mode of access:

[http://ashipunov.info/shipunov/school/biol\\_330](http://ashipunov.info/shipunov/school/biol_330)



Plate tectonics.

[http://en.wikipedia.org/wiki/Plate\\_tectonics](http://en.wikipedia.org/wiki/Plate_tectonics)

