

Biogeography. Lecture 5

Alexey Shipunov

Minot State University

January 29, 2014



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



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



Palaeogeography

Plate tectonics

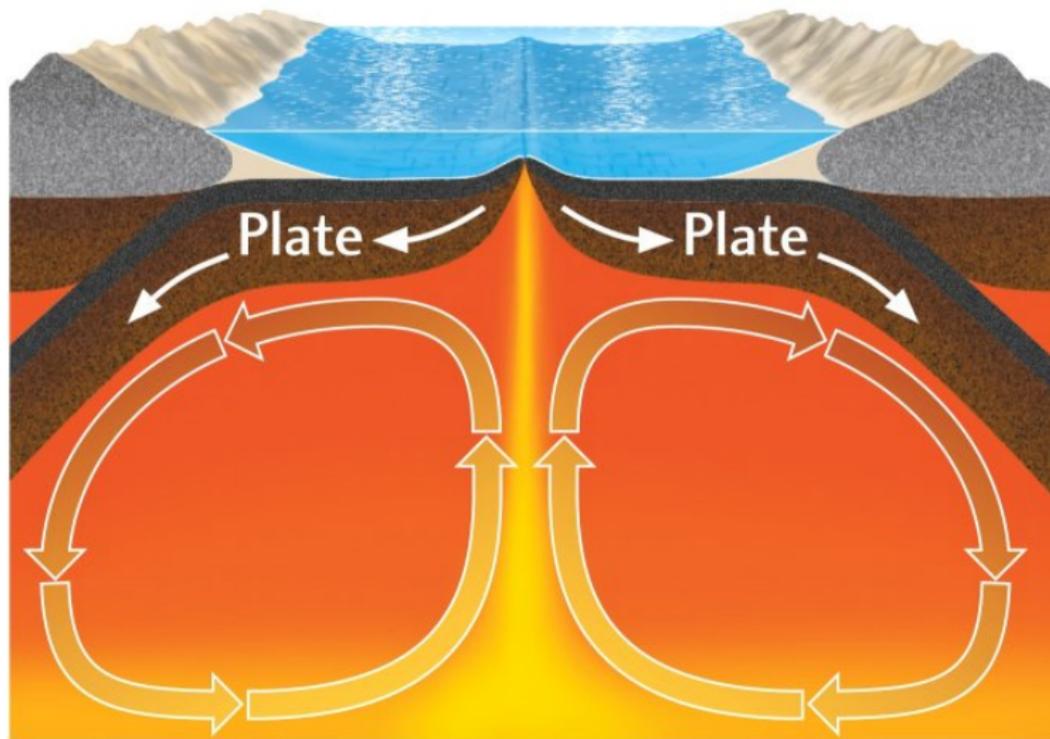


Mantle convection

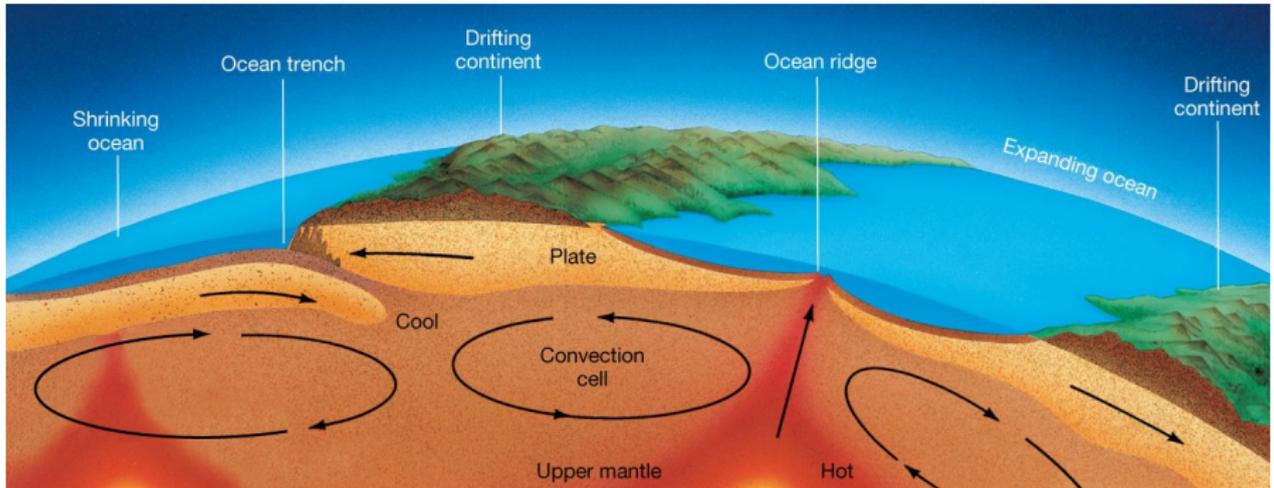
- ▶ The driving force of floating continents is a **mantle convection**
- ▶ In ocean ridges, new ocean cortex is constantly forming and expanding
- ▶ In ocean trenches and continental ridges, different plates are colliding and often forming mountains



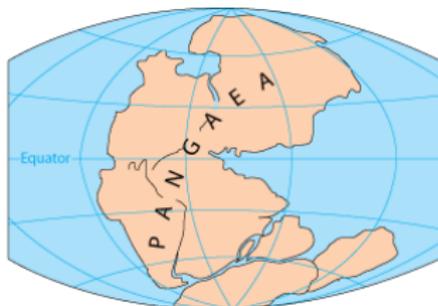
Mantle convection



Mantle convection



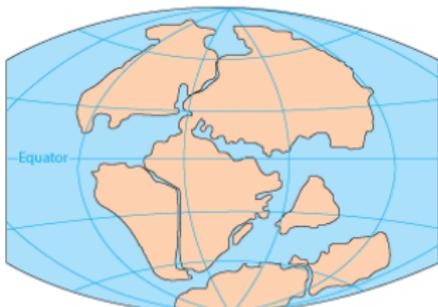
The result of mantle convection



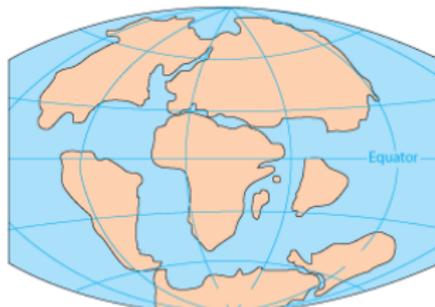
PERMIAN
250 million years ago



TRIASSIC
200 million years ago



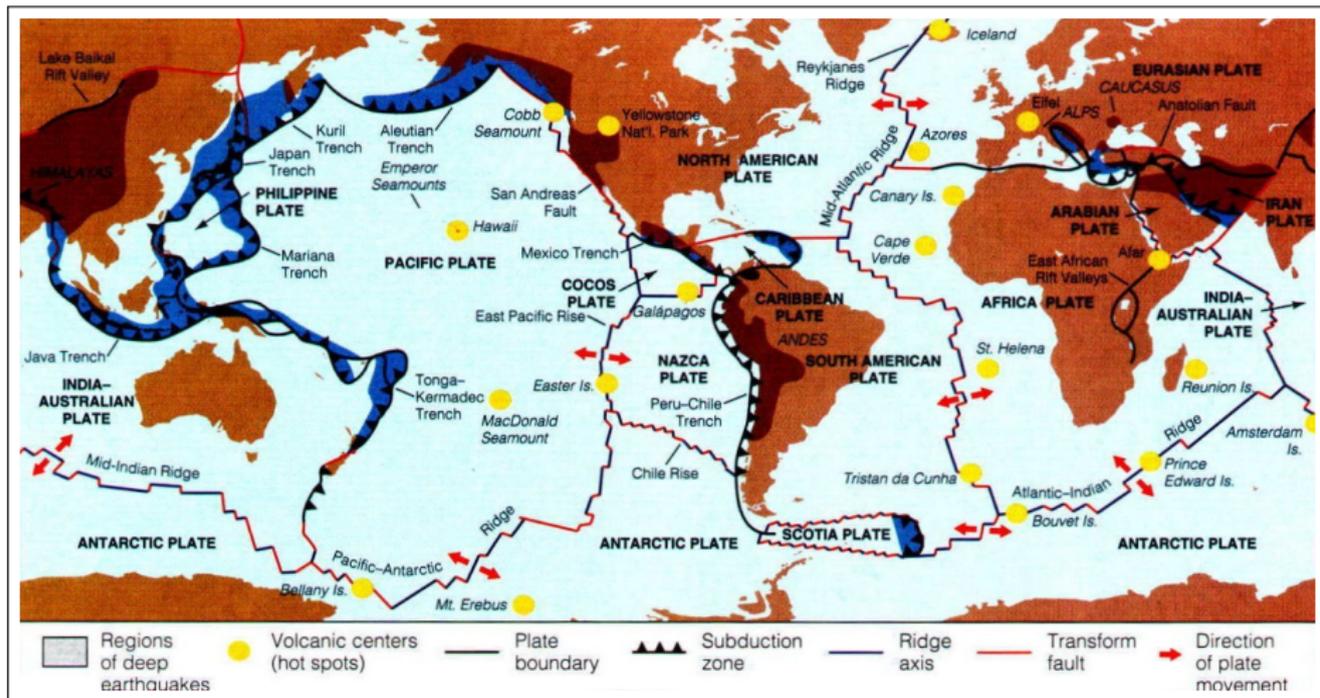
JURASSIC
145 million years ago



CRETACEOUS
65 million years ago



What is going on now

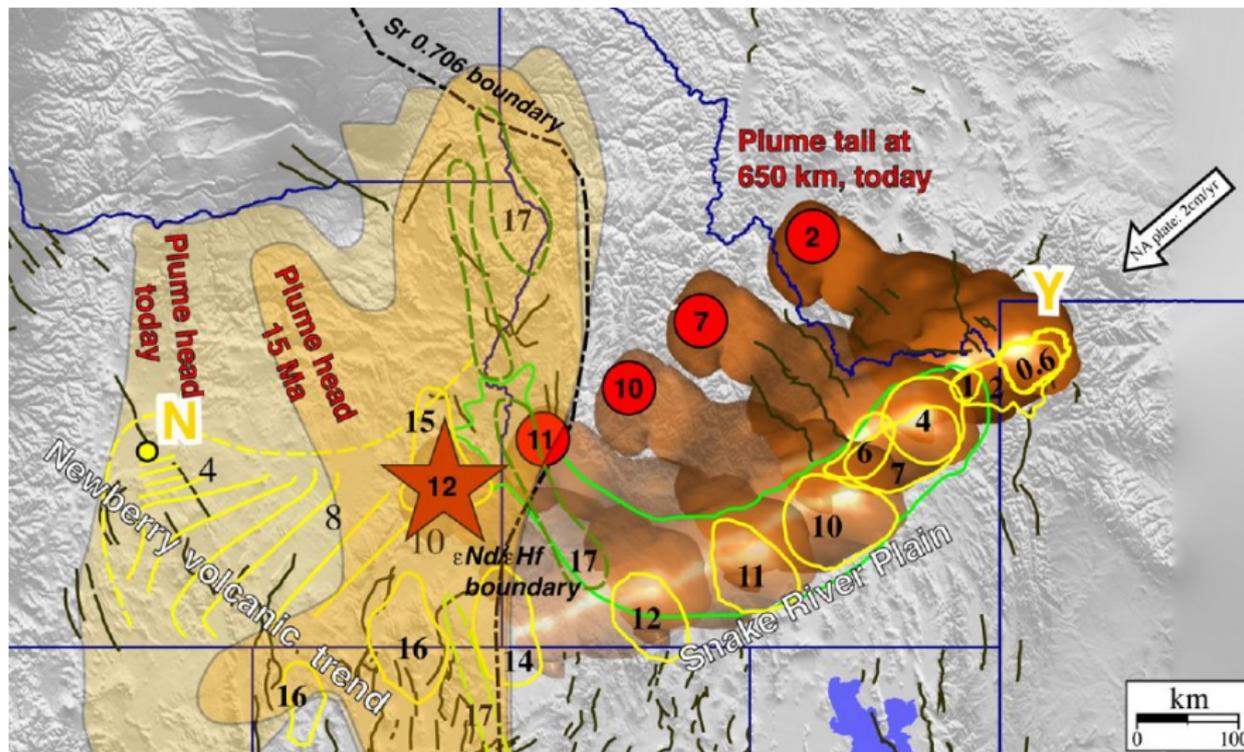


Two living examples of continental drift on U.S. territory

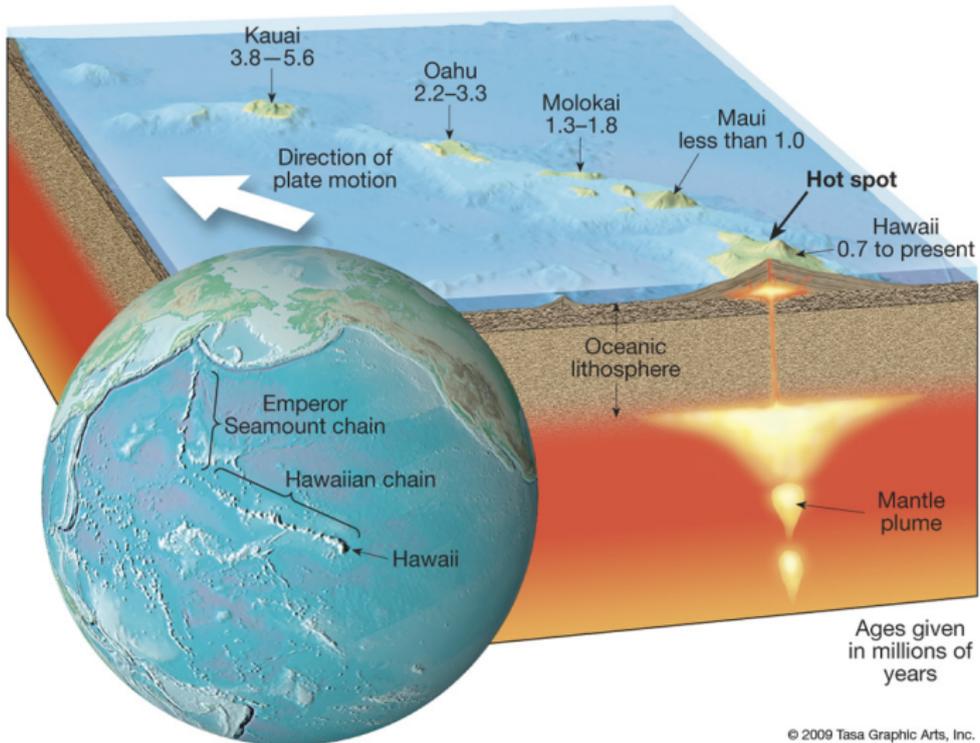
- ▶ Yellowstone hotspot
- ▶ Hawaiian hotspot



Yellowstone hotspot



Hawaiian hotspot



Most important eras and periods

Cryogenian period (850–635 Mya) and Snowball Earth



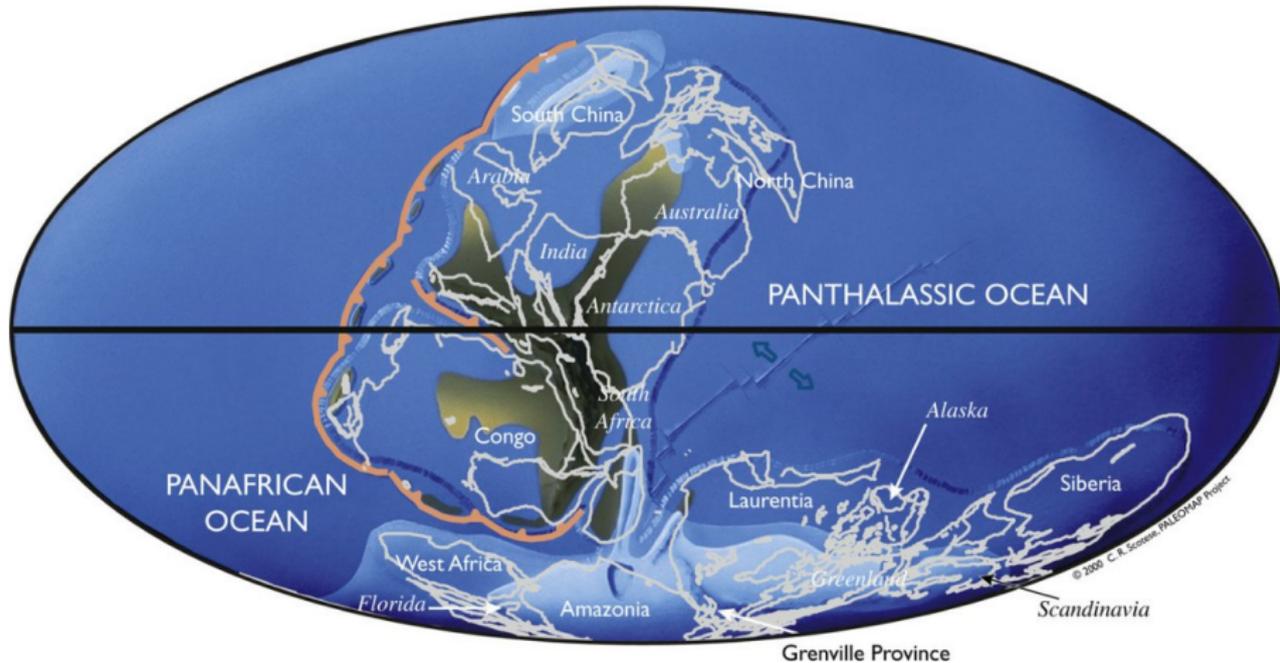
Rodinia—the first super-continent

- ▶ 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

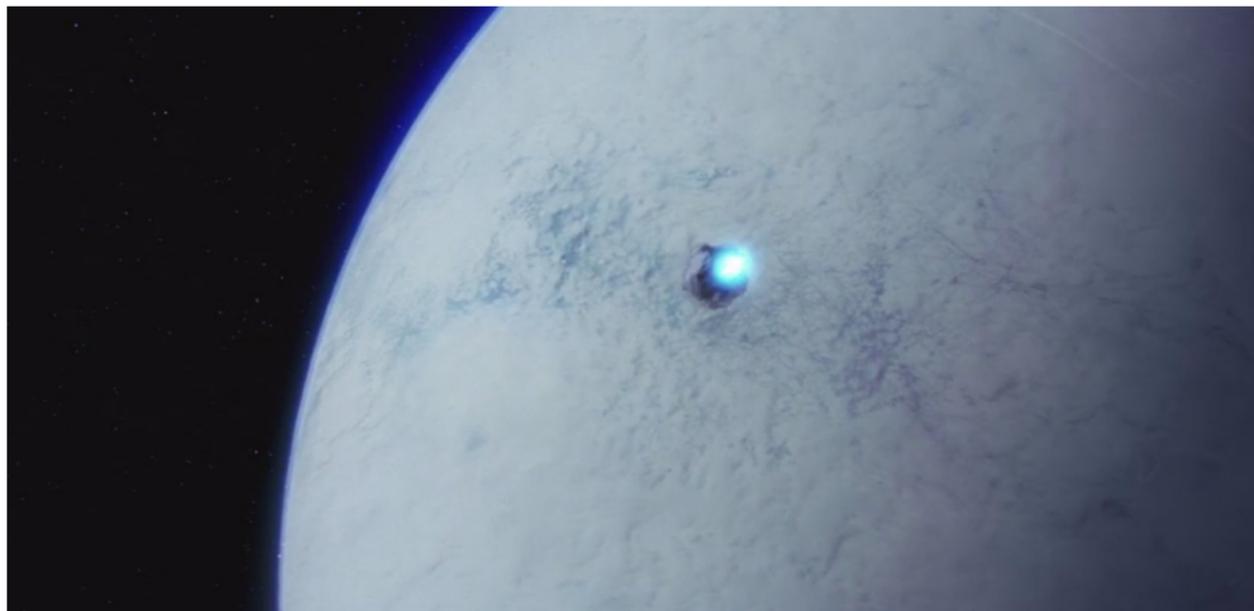


Marionan glaciation: Snowball Earth

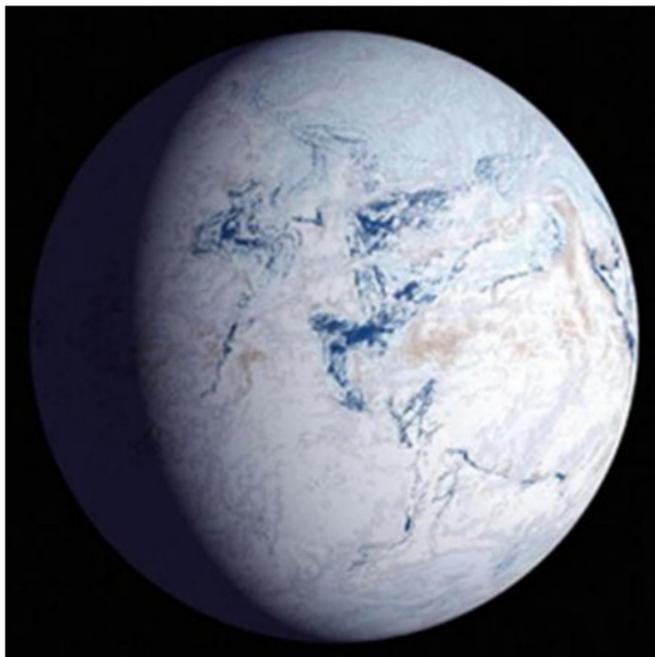
- ▶ First global glaciation was started because ice started to concentrate over the pole and increase Earth albedo (this is the positive feedback)
- ▶ And because the configuration of continents blocked the equatorial warm current
- ▶ And because concentration of oxygen was high but greenhouse gases (like CO₂)—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

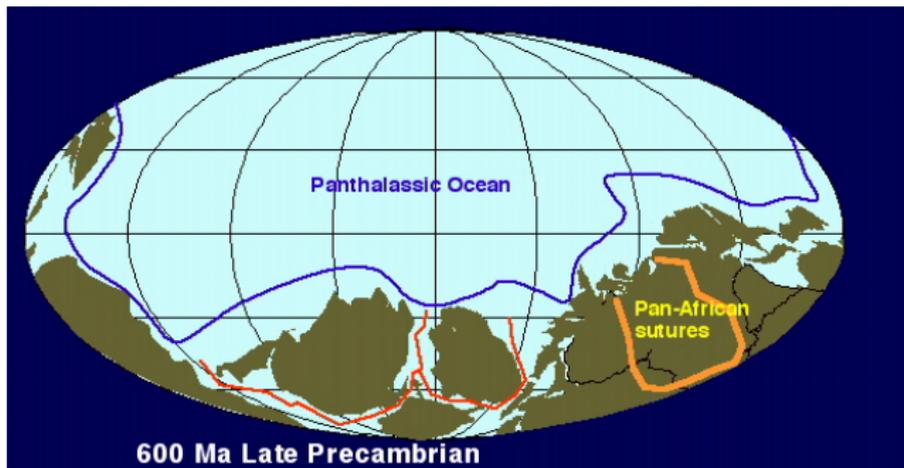


Most important eras and periods

Ediacarian period: 635–550 Mya

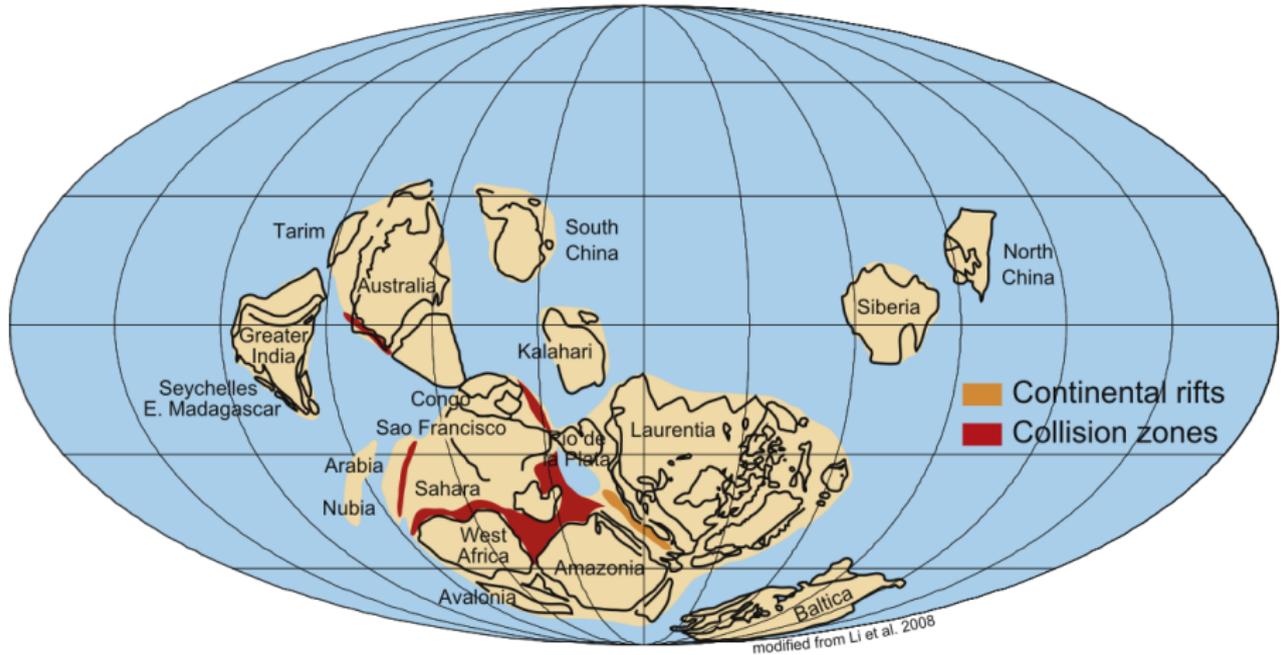


Rodinia breaks



Ediacarian continents

600 Ma Ediacaran

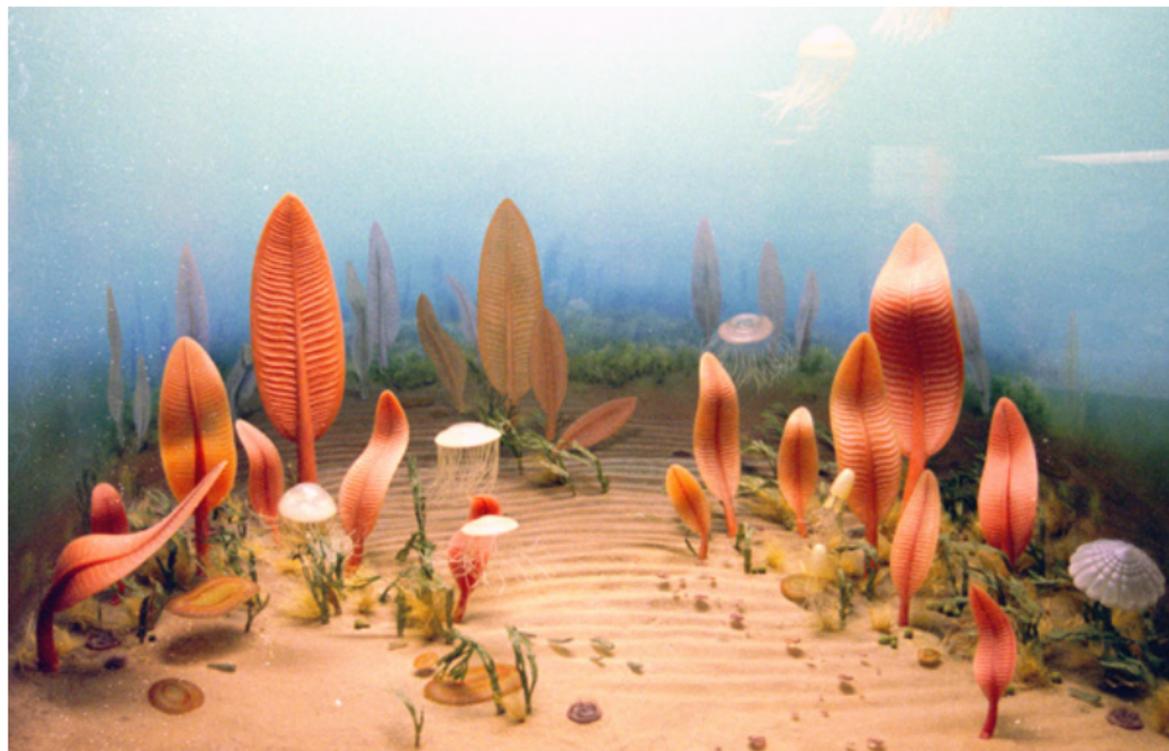


Life in Cryogenian and Ediacarian

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



Ediacarian life



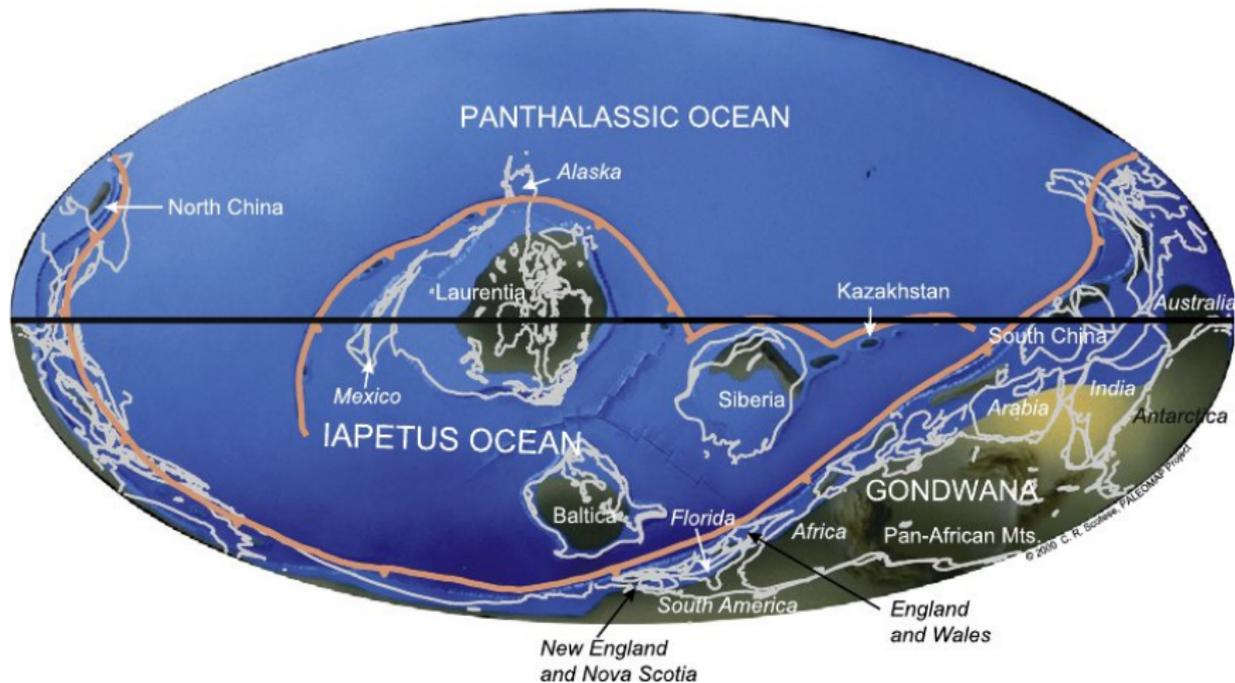
Most important eras and periods

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



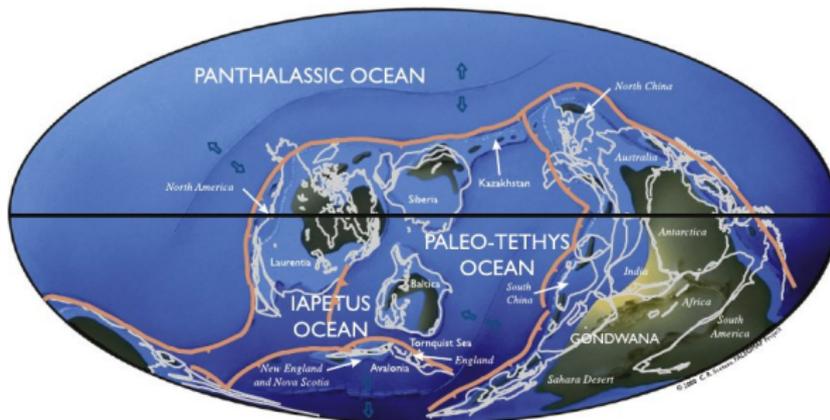
Most important eras and periods

Ordovician, Silurian and Devonian:
three ages of fishes



Ordovician period

458 Ma Ordovician

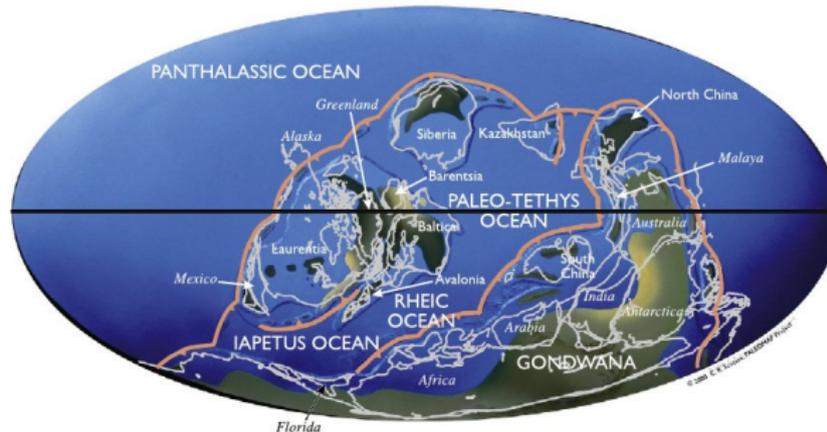


- ▶ Climate changed from hot to glaciated (Gondwana hits the South Pole)
- ▶ Marine fauna spread out, especially cephalopods, conodonts and graptolites
- ▶ In the end, the first great extinction: 85% of marine species extinct



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



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



Plate tectonics.

http://en.wikipedia.org/wiki/Plate_tectonics

