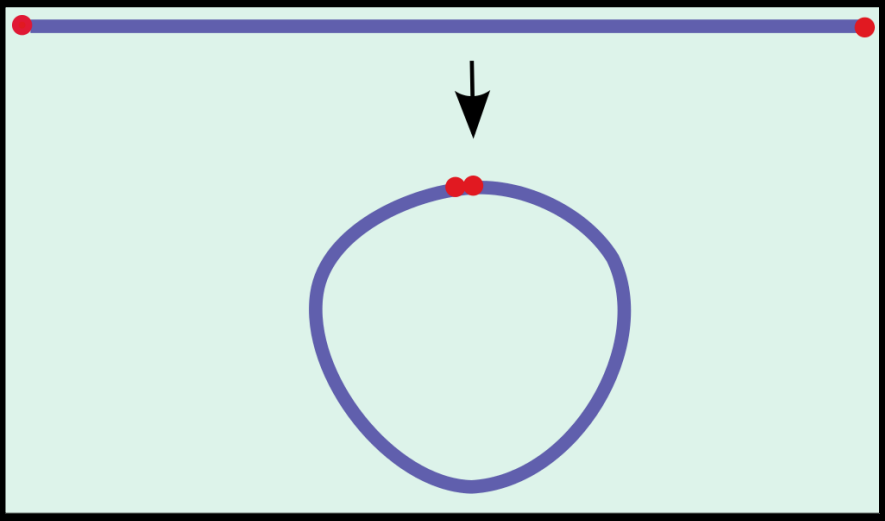
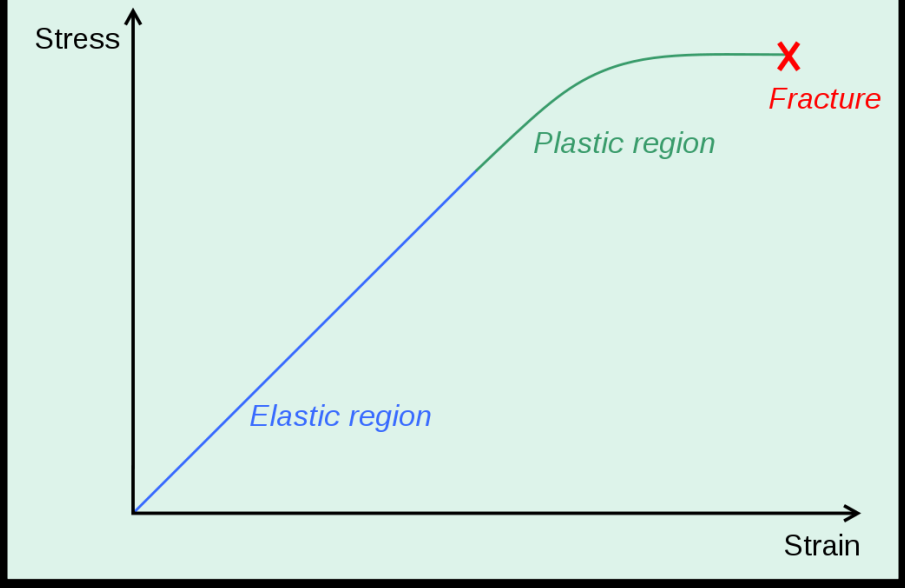
Stress & Strain

Structural geology & Plate tectonics

Stress & Strain



Applied force & deformation



Increasing strain with increasing stress

Rock deformation

Key factors:

- Composition
- Temperature
- Stress duration
- Stress rate

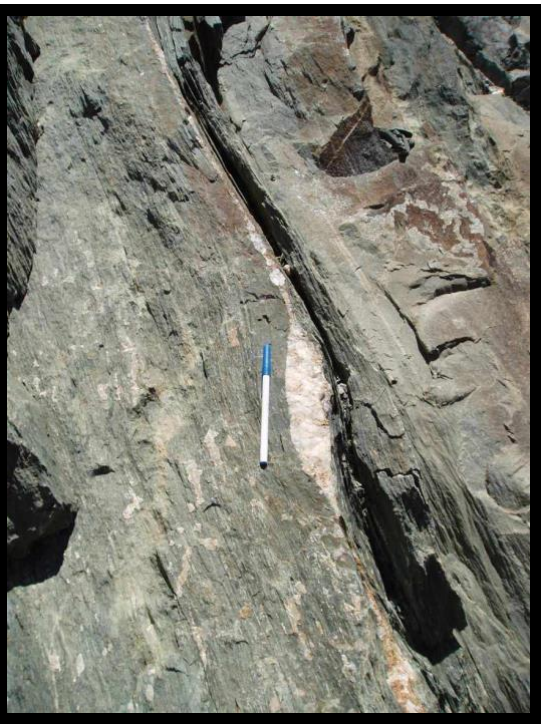


Plate choctonics

Joints (tectonic)

Brittle fracturing with little displacement

Joints (igneous)

Contraction during cooling

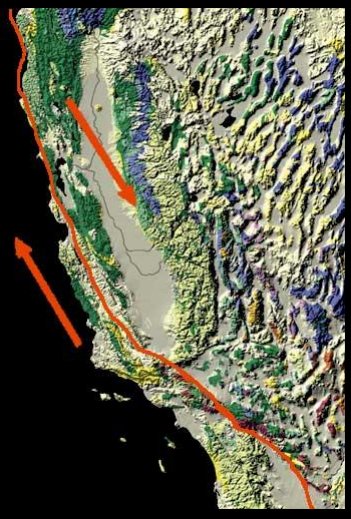
Faults

Brittle deformation with displacement

Extension = 'normal' faults

Faults

Compression = 'reverse' faults



Strike-slip faults

Lateral movement

San Andreas Fault, western USA

Ductile (plastic) deformation

= Folding

King Oscar Fjord, Greenland

Mainly at depths >10 km, and T >300° C

Low-grade strain

'Delabole butterflies', Cornwall

University of Exeter

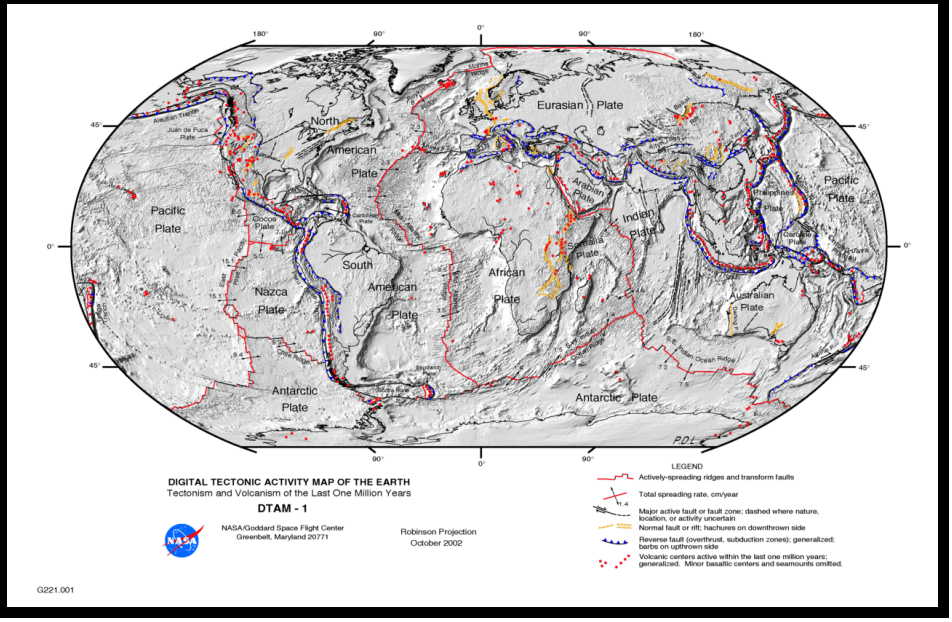
Tyne & Wear Museums

Fossil rich mudstone strained into slate

High-grade strain

Gneiss, Aguanish, Quebec

Mapping out the structures

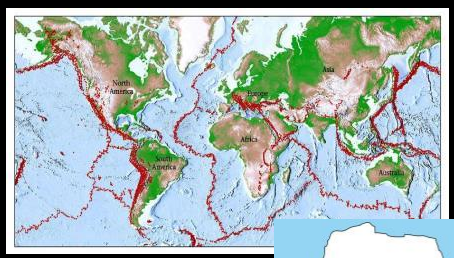


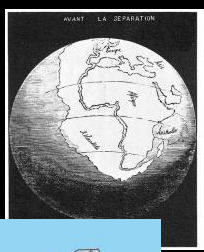
Old Lost Seas

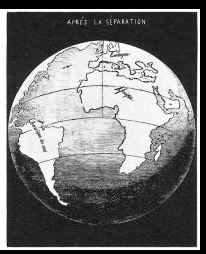
The Theory of Plate Tectonics

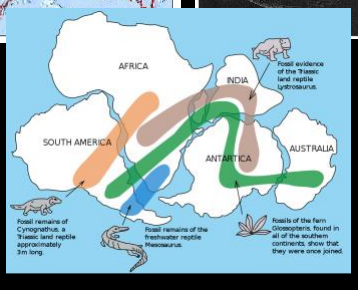
Earth Puzzles

* Fossil distributions
* Volcanoes and earthquakes
* Continental margins
* Compositions

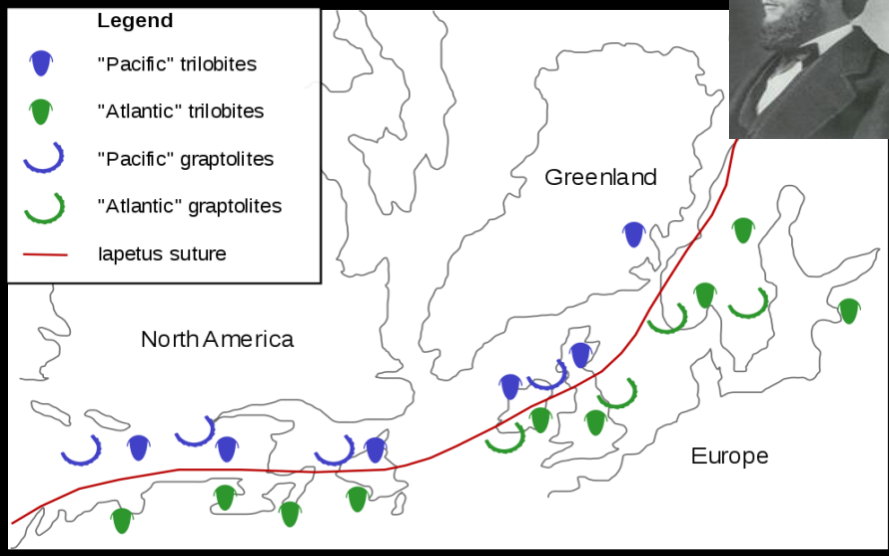








W is for Walcott



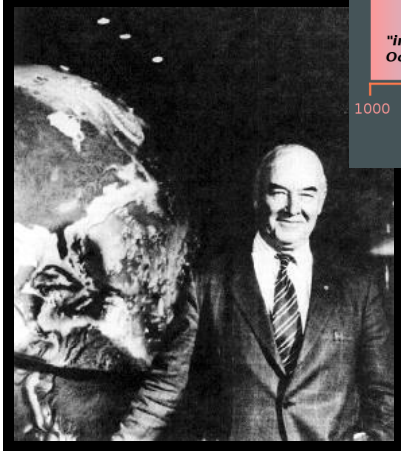
W is for Wegener

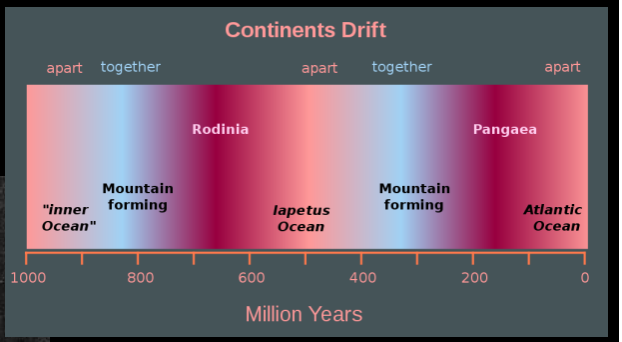
* Continental drift
* Gondwanaland & Pangaea

= “near-universal and near-perpetual ridicule”

W is for Wilson

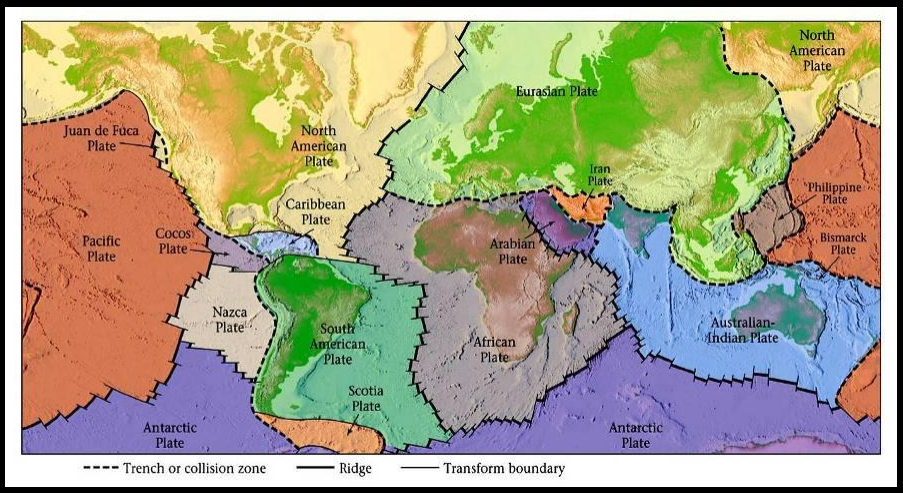
- Geophysicist
- Hotspots



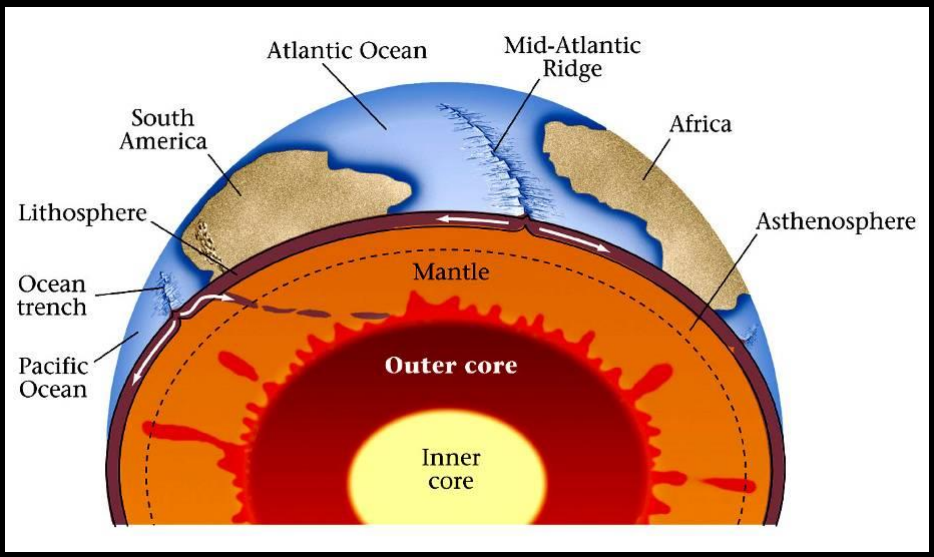


- 'Proto-Atlantic'
- Wilson Cycles

Plate tectonics



Earth interior



Terms

Crust (chemical) = mafic-felsic rocks overlying ultramafic mantle

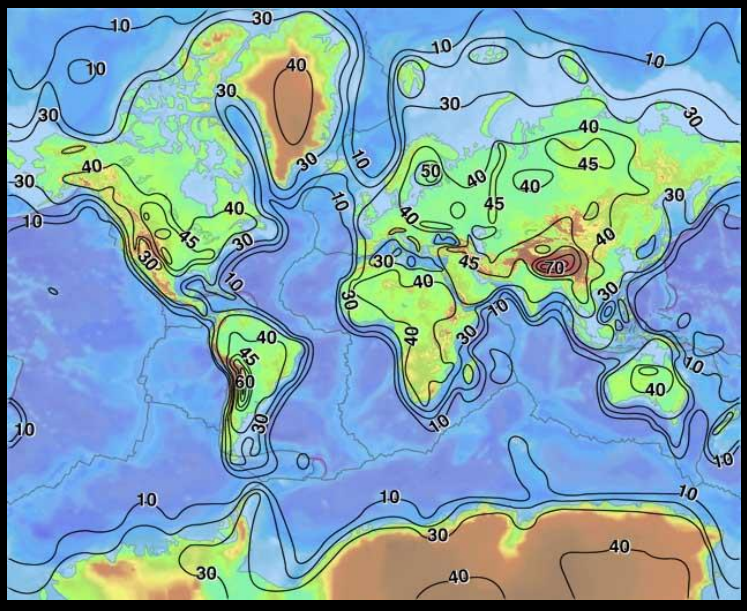
(0-70 km thick)

Lithosphere (mechanical) = brittle upper layers (crust + upper mantle)

(0-300 km thick)

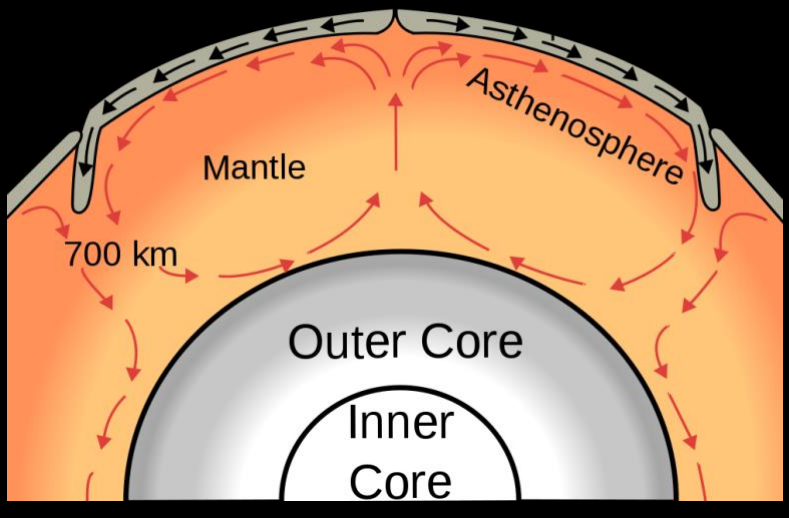
Aesthenosphere (mechanical) = ductile part of upper mantle

How thick do you like your crust?

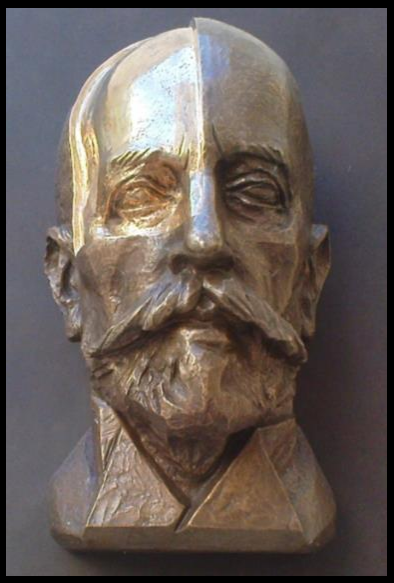


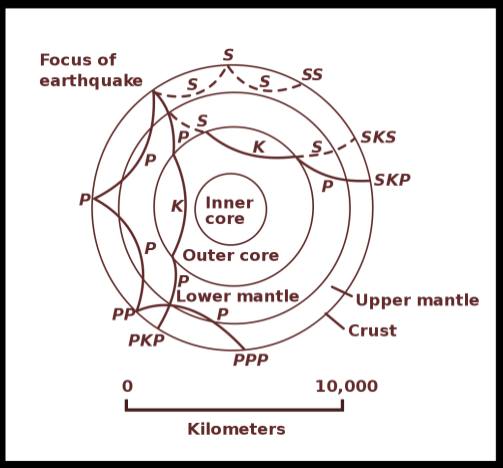
Making the Earth move

Mantle convection



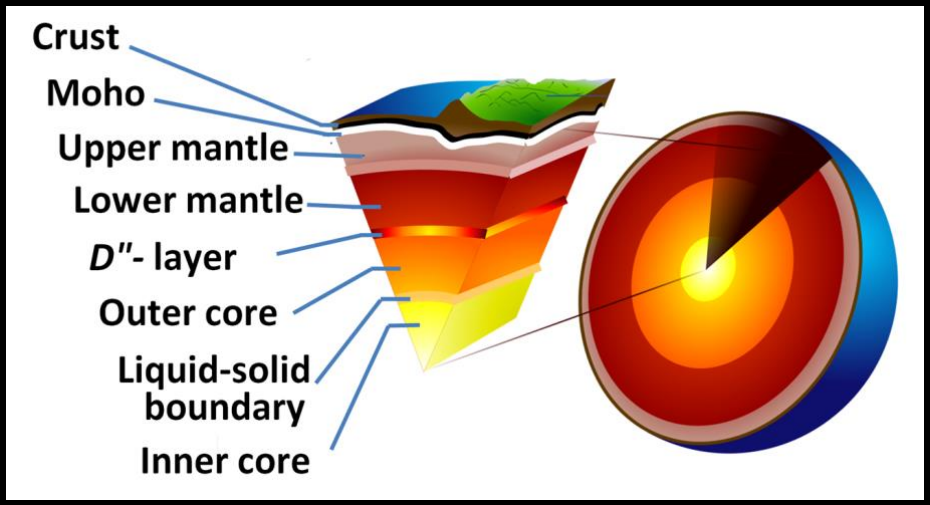
Seismology and the Moho





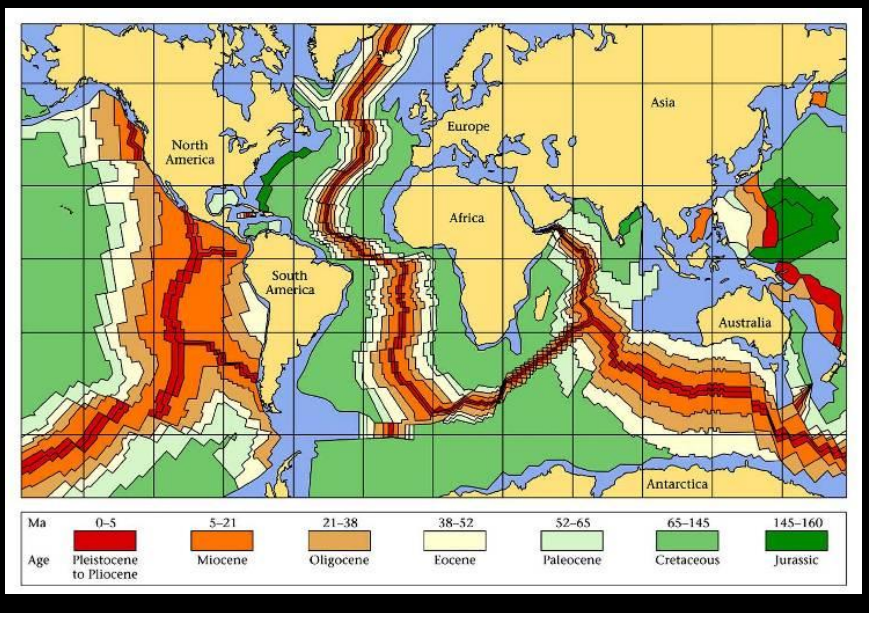
Andrija Mohorovicic, seismologist

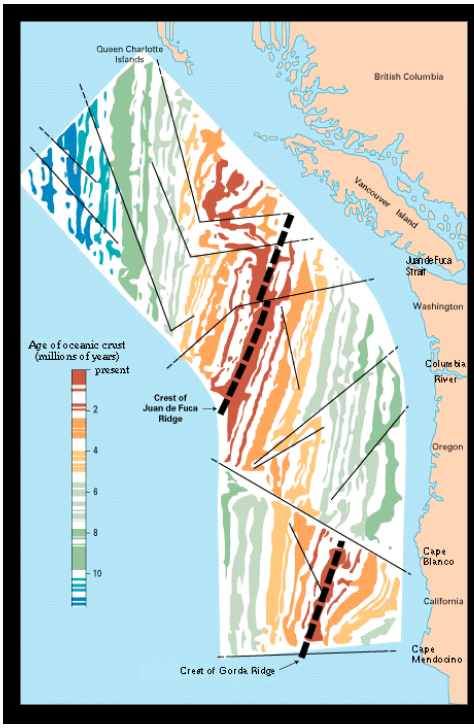
Seismology and the Moho



Base of brittle lithosphere at ~1300° C

Thin, young oceans

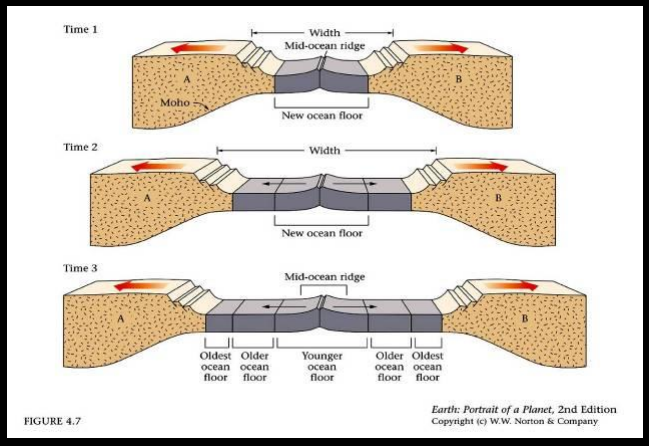




Geomagnetic oceans

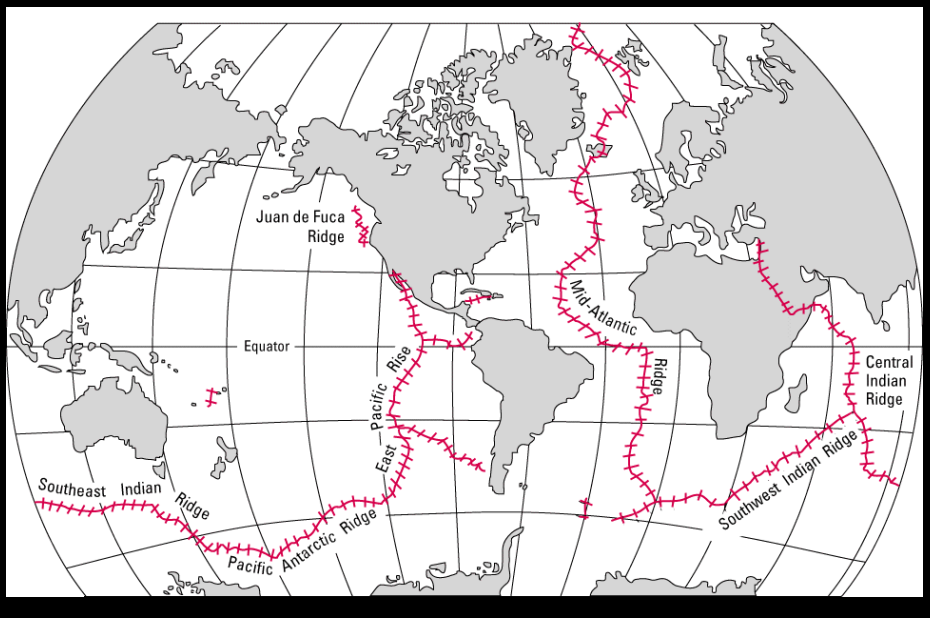
Symmetric bands of magnetized minerals in ocean crust

Spreading ridges

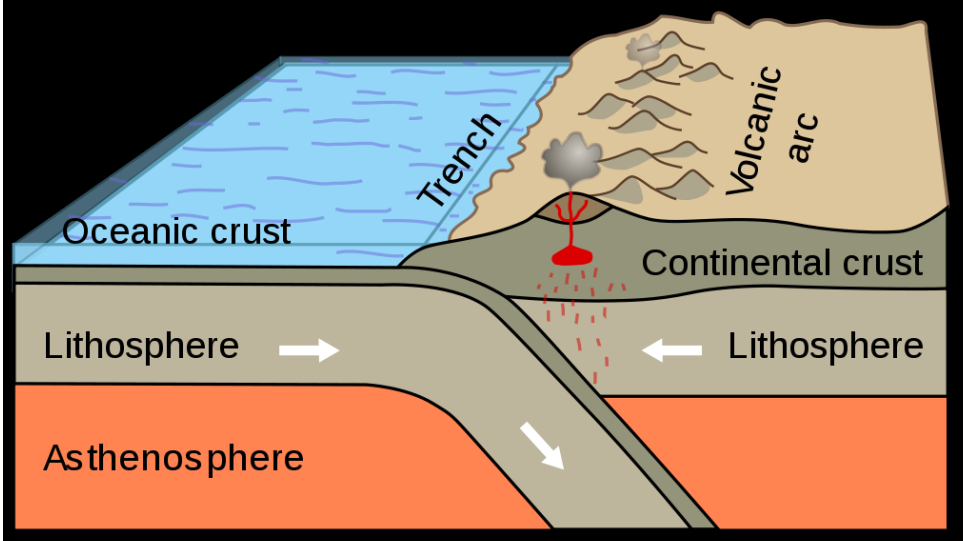


Oceanic crust formed by extension;
Upwelling of mafic magma

Spreading ridges

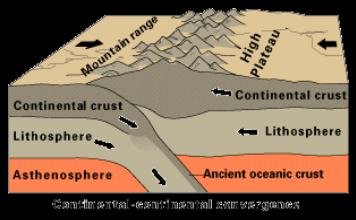


Convergence

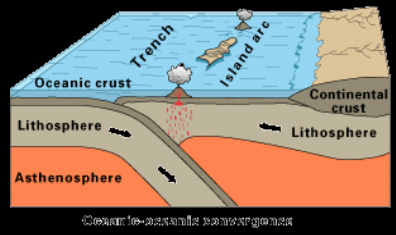


Oceanic-continental (e.g. Andes)

Convergence

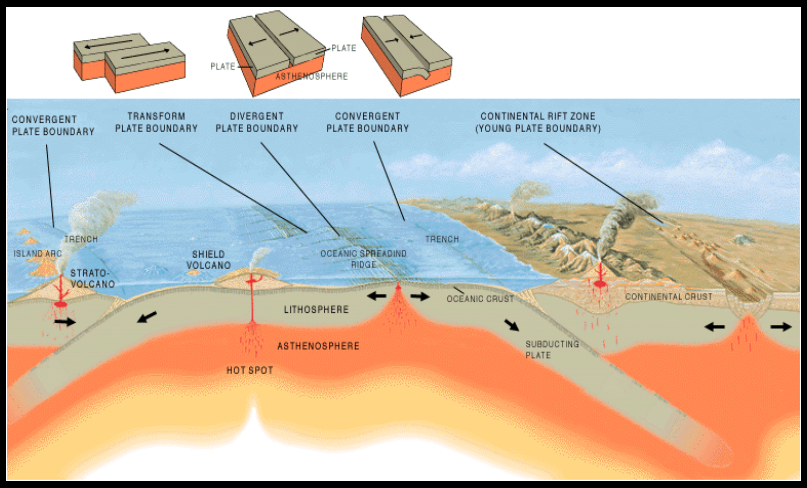


Continental-continental (e.g. Himalayas)



Oceanic-oceanic (e.g. Japan)

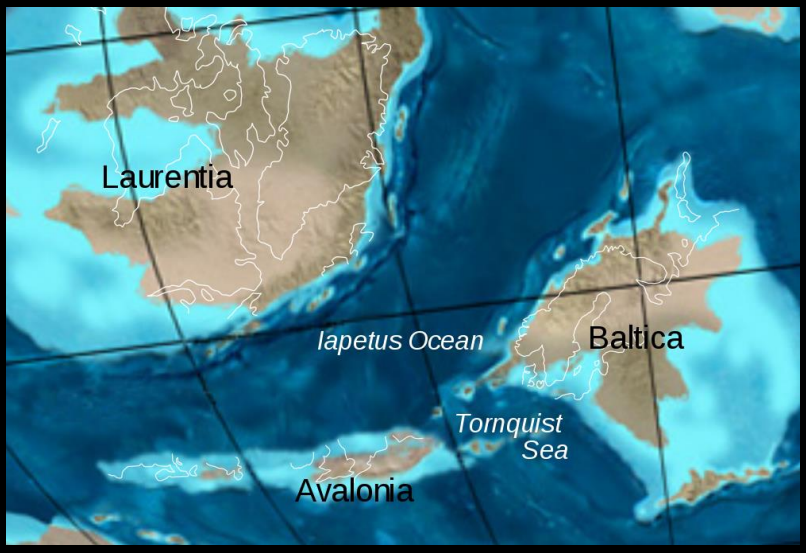
The full picture



Ocean birth to death = Wilson Cycle

Iapetus - the Old Lost Sea

The Ordovician Atlantic

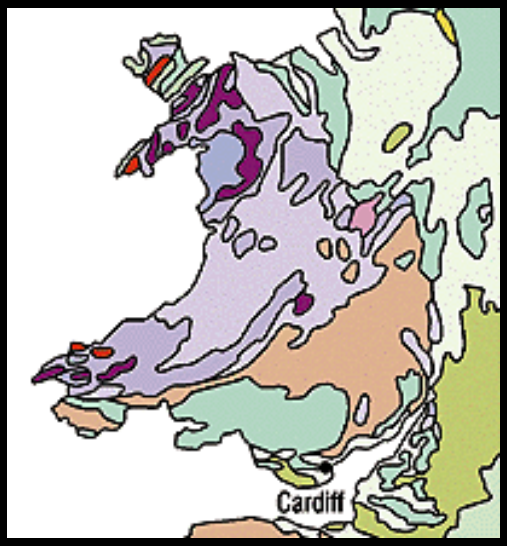


Iapetus in Wales

The Welsh Basin

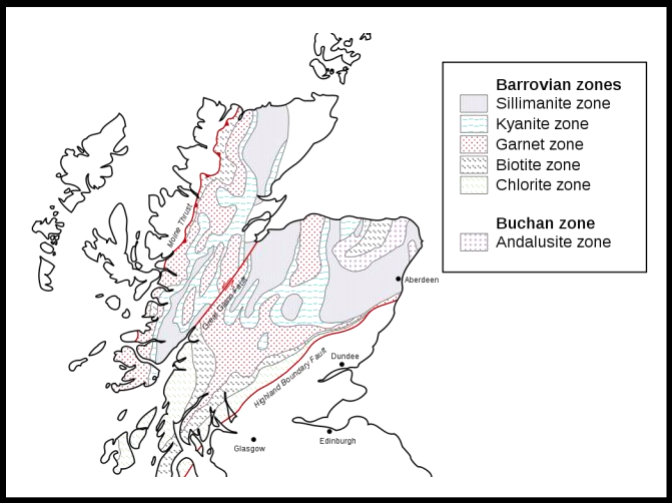
Palaeozoic marine mudstones

(Many now slate)

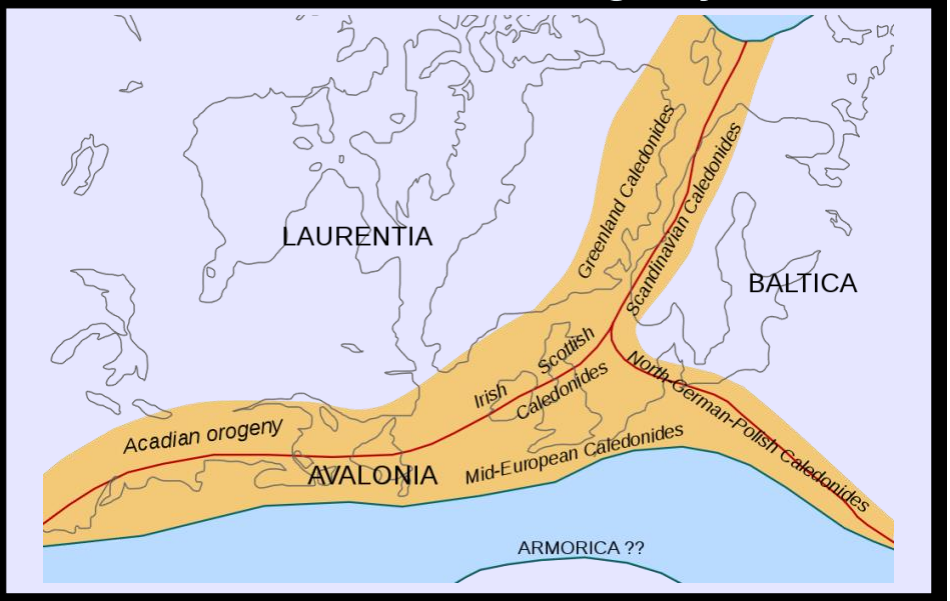


Iapetus in Scotland

Glens and highlands

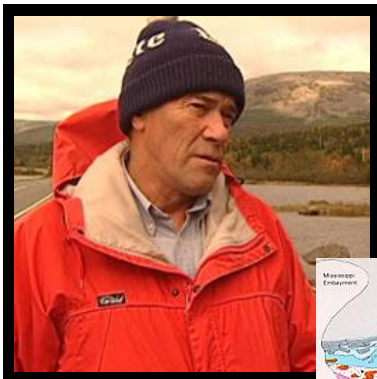


Caledonian orogeny



Old Lost Sea in Newfoundland

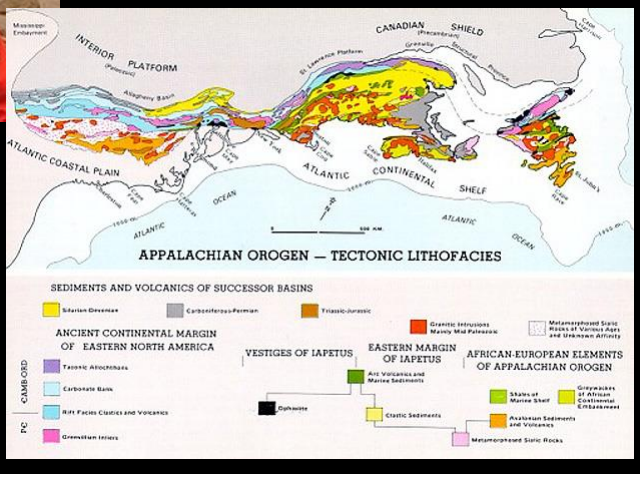
An Iapetan slice of upper mantle



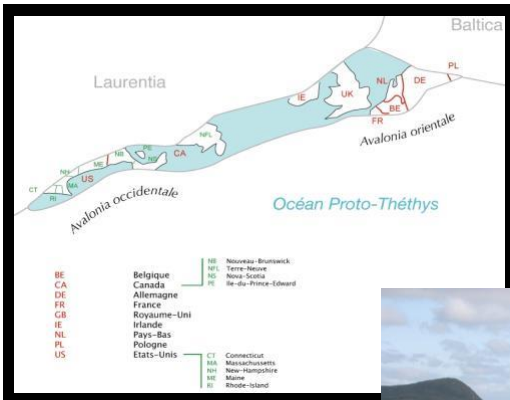
W is for Williams

Appalachians-Caledonides

Gros Morne National Park



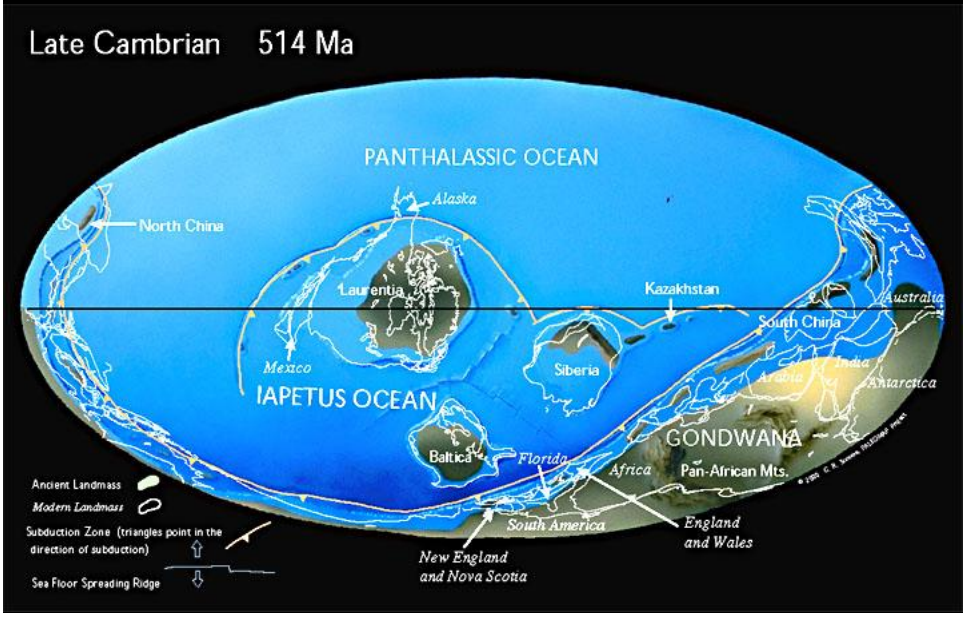
Avalonia



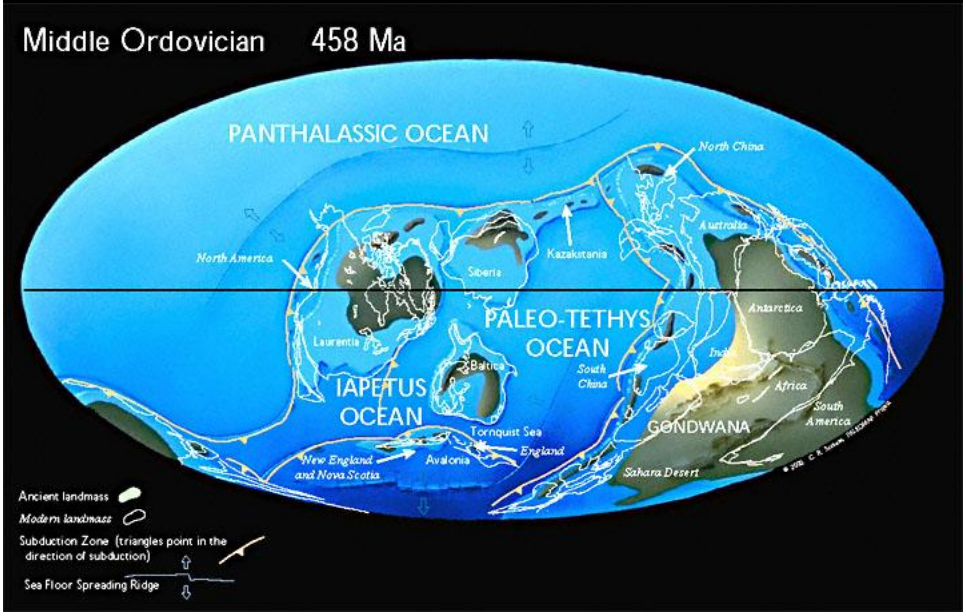
A micro-continent of the Iapetus Ocean

Colony of Avalon, Newfoundland

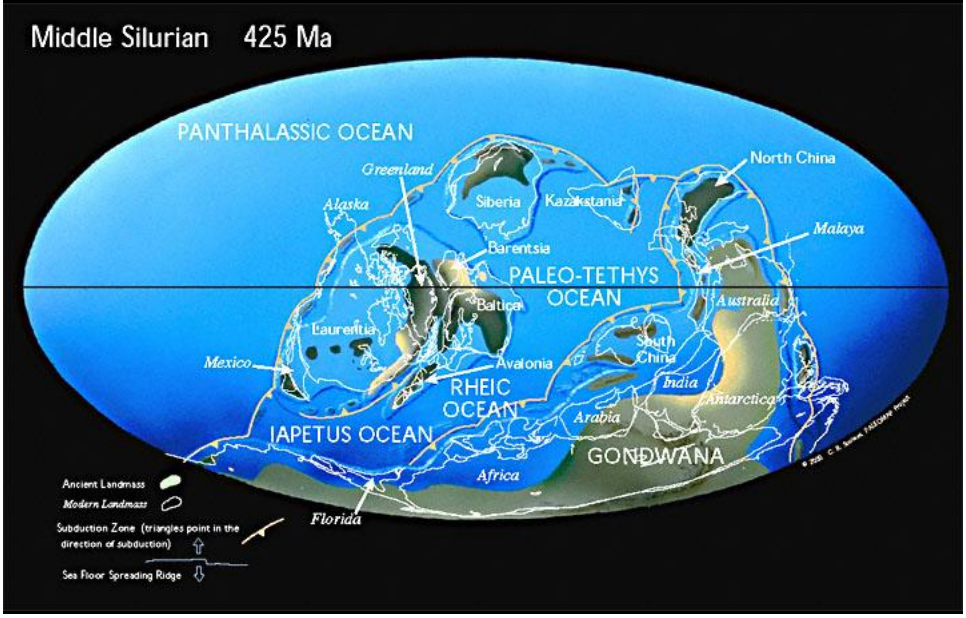
Iapetus (1)



Iapetus (2)



Iapetus (3)



The Iapetus of Man

Niarbyl Fault, nr Dalby, south-west Isle of Man

The Iapetus of Man

Next week