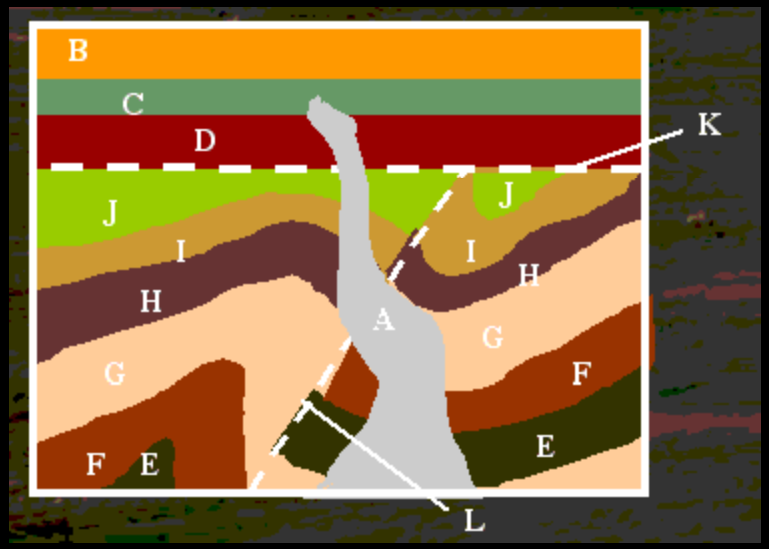
Earth Science
The Changing Earth

Geology

- The scientific study of the origin, history, and structure of the earth.
- Study of the earth and the processes that shape it
- Topics: mountains, earthquakes, volcanoes, history of earth and rocks

Relative Dating



- Relative dating: way to put events in the order in which they happened. *Not an exact age!*
- This technique is used by geologists and paleontologists (those who study fossils).
- Also used by forensic investigators: the basic idea is to use clues to reconstruct the order of events.

Fundamentals of Geology

- Superposition
- Original Horizontality
- Lateral continuity
- Uniformitarianism
- Faunal succesion
- Cross-cutting relationships
- Inclusions

Superposition

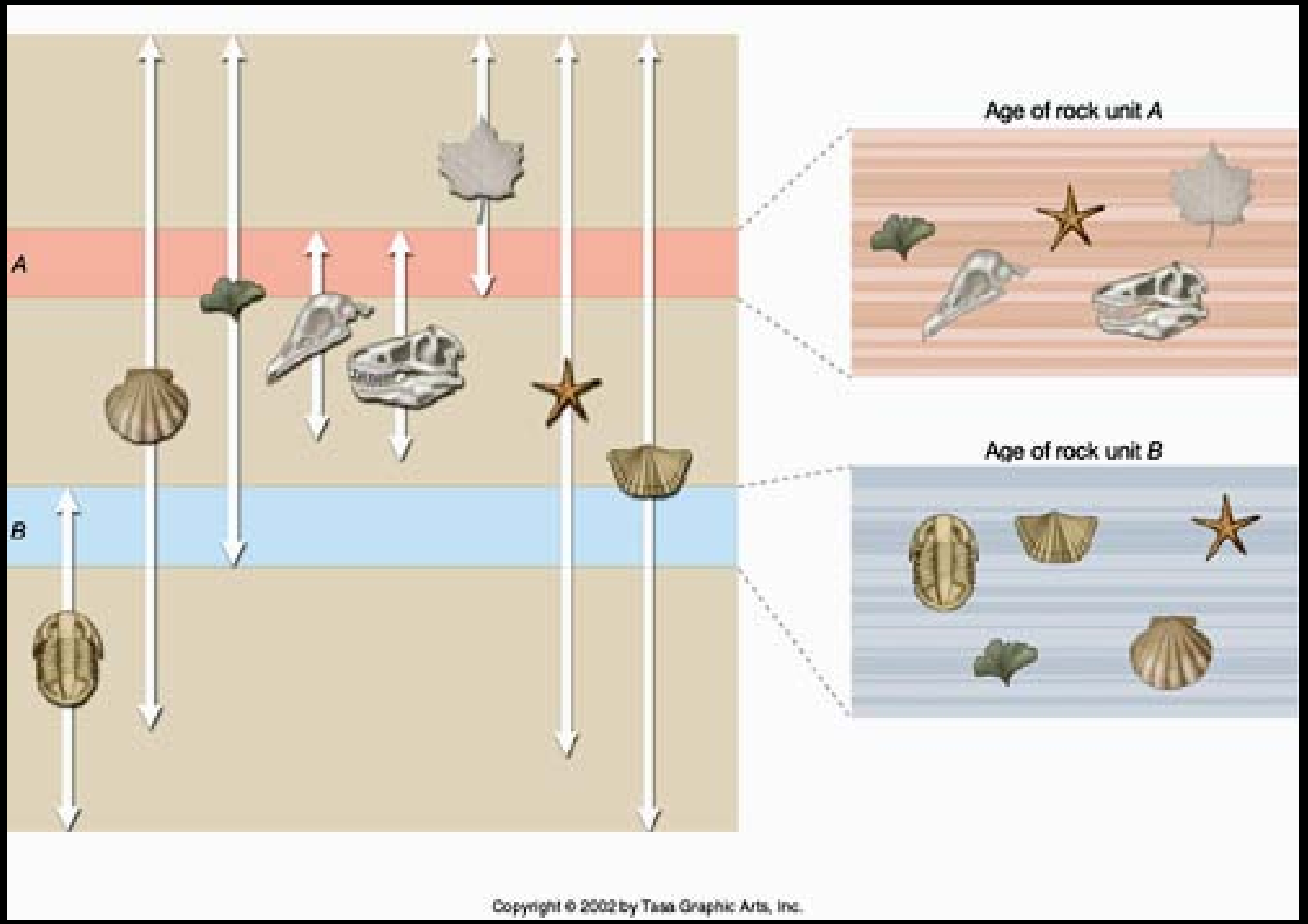
Superposition: the bottom layer of a rock formation is older than the layer on top because the one on the bottom formed first.

Original Horizontality

- Sediment particles fall to a bottom of a basin due to gravity
- Form horizontal layers
- Over time, these layers become rock
- Sometimes these layers are found in the vertical position
- Slow movements of the Earth could move horizontal rock layers into vertical position

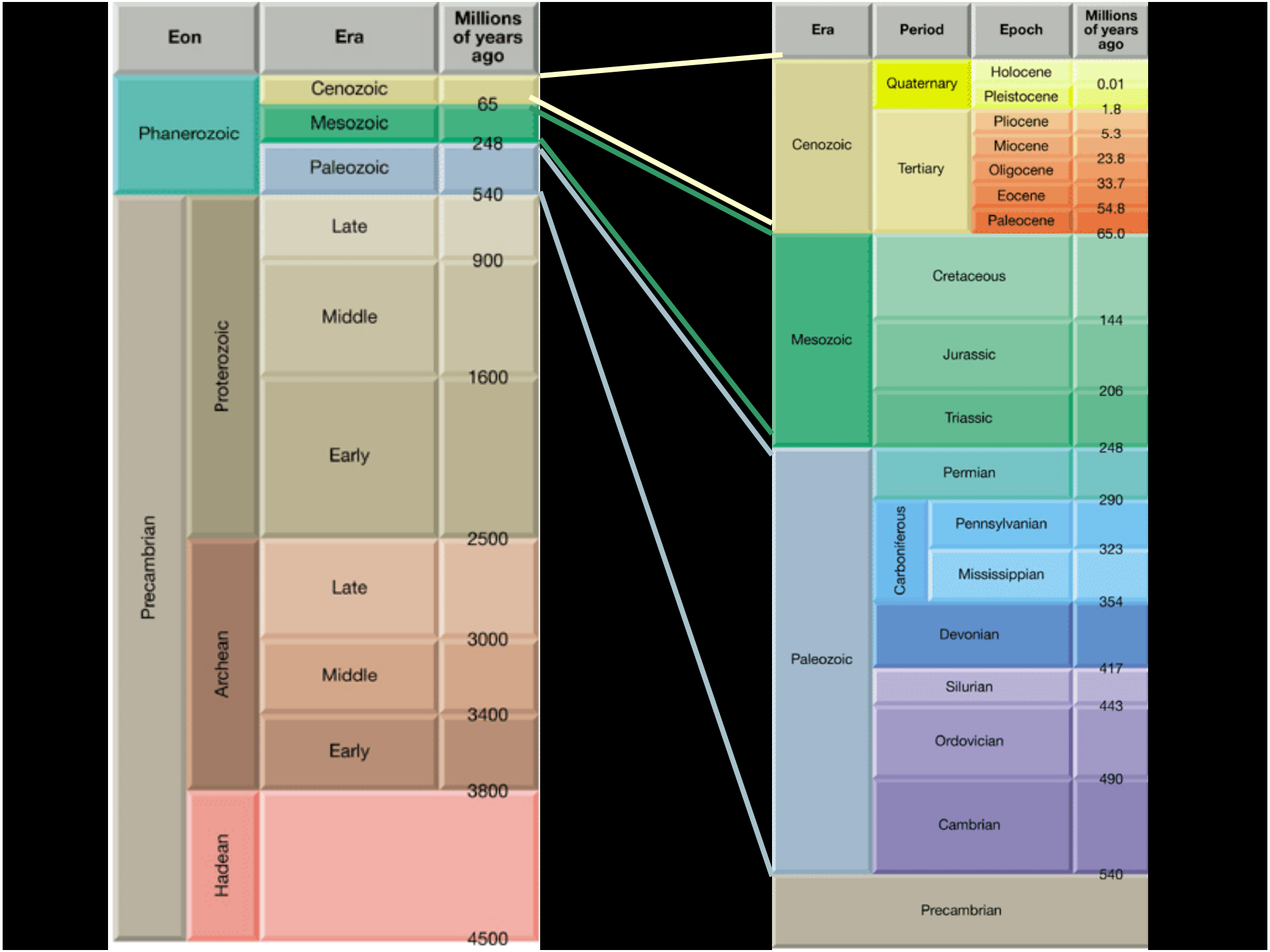
Lateral Continuity

Faunal Succession

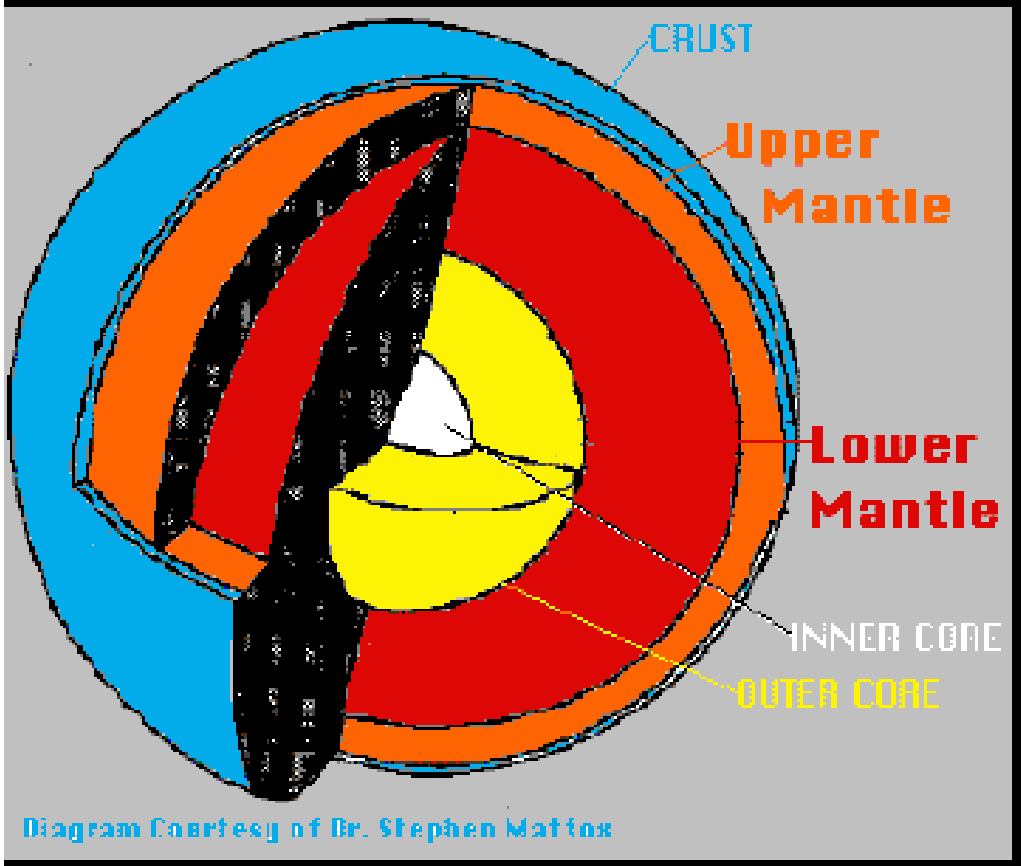


Geologic Time

- In 1907, an estimate of the age of the earth was determined (4.6 billion years)
- It was determined through the radioactive decay of Uranium to lead
- Other events in the timescale were determined using tree rings, glacier cores, and fossils

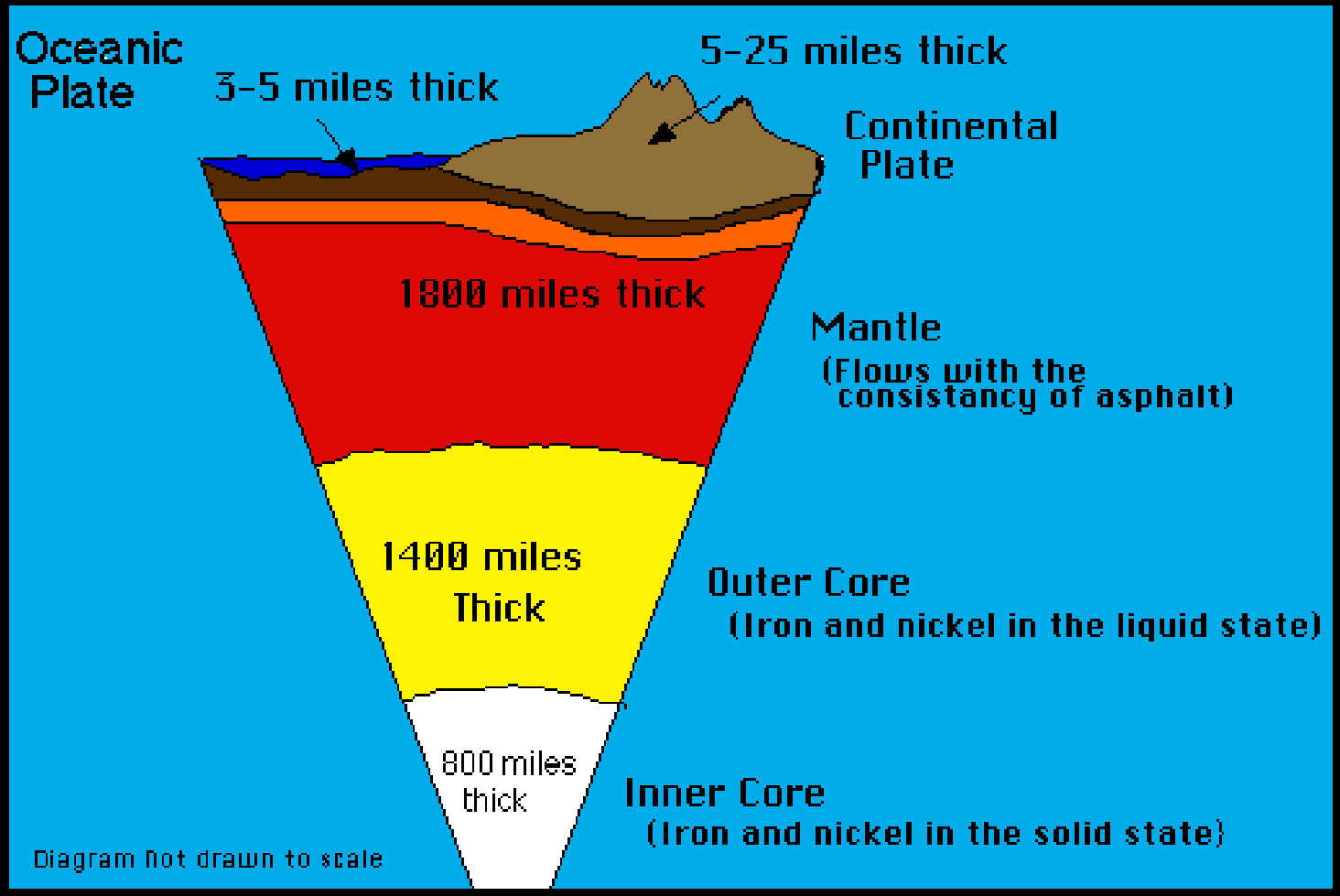

Eon
Era
Millions of years ago
Phanerozoic
Cenozoic
Mesozoic
Paleozoic
65
248
540
Precambrian
Proterozoic
Late
Middle
Early
900
1600
2500
Archean
Late
Middle
Early
3000
3400
3800
Hadean
4500
Era
Period
Epoch
Millions of years ago
Cenozoic
Quaternary
Holocene
Pleistocene
0.01
1.8
Tertiary
Pliocene
Miocene
Oligocene
Eocene
Paleocene
5.3
23.8
33.7
54.8
65.0
Mesozoic
Cretaceous
Jurassic
Triassic
144
206
248
Paleozoic
Permian
Carboniferous
Pennsylvanian
Mississippian
290
323
354
Devonian
417
Silurian
443
Ordovician
490
Cambrian
540
Precambrian

Layers of the Earth

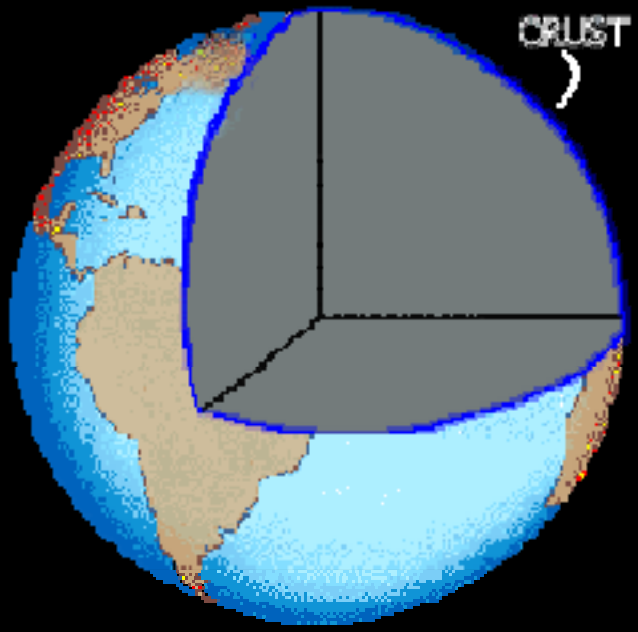


- Earth is comprised of
  1. crust
  2. Mantle (upper and lower)
  3. Core (inner and outer)
- Geologists believe Earth cooled the heavier, denser materials sank to center and lighter materials rose to top.
- The crust is made of the lightest materials and the core consists of heavy metals.

Layers of the Earth

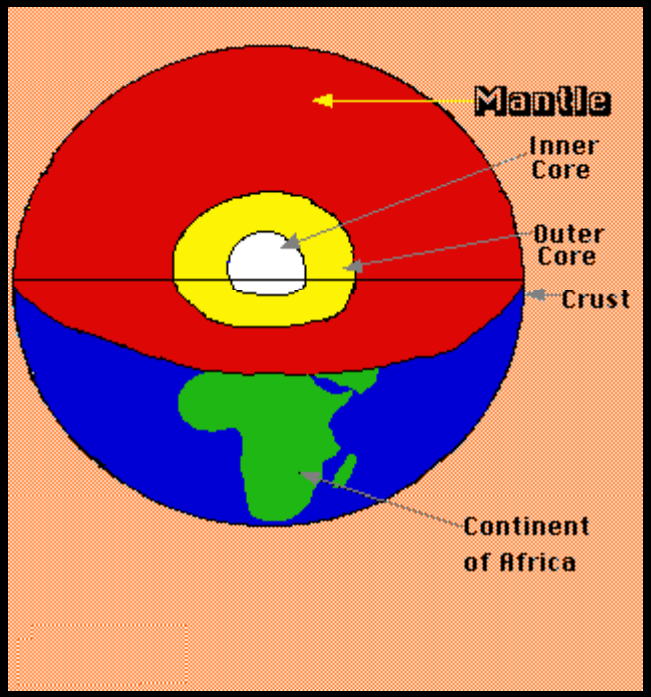


Crust



- The crust is composed of two types: oceanic and continental
- Two different rock types (granite and basalt).
- The continental crust is granite.
- The oceanic crust consists of basalt (volcanic lava).
- Basalt is heavier and denser than granite

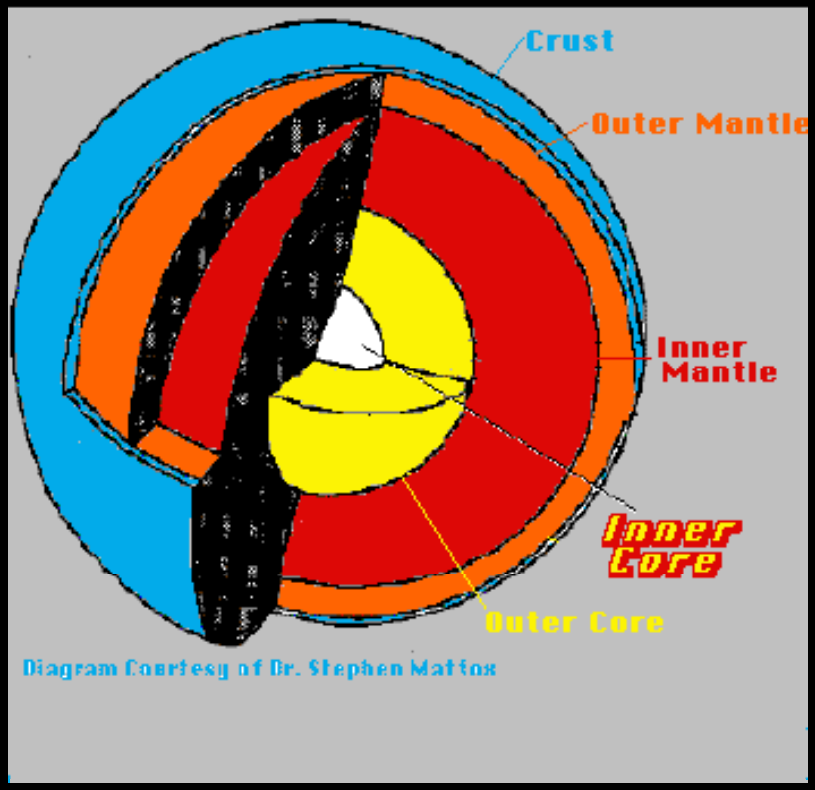
Mantle



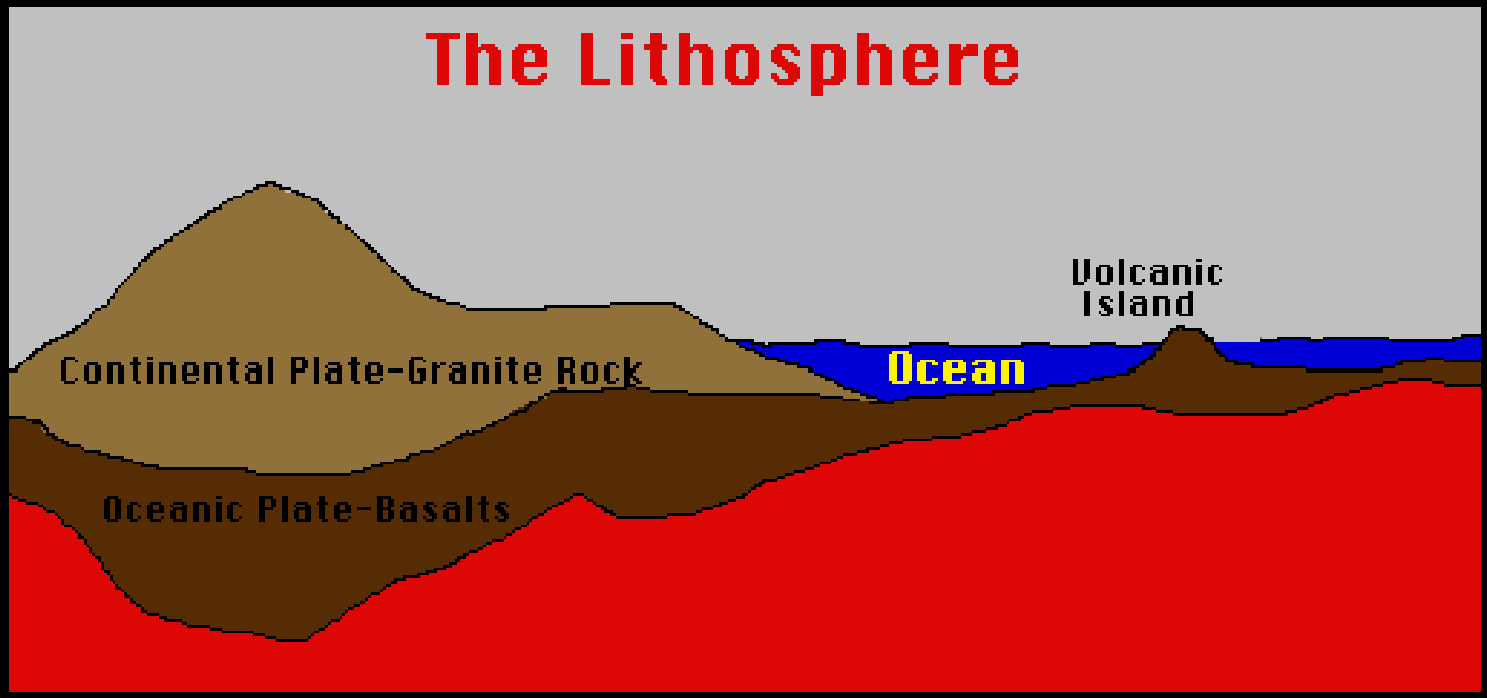
- 1800 miles thick
- Hot, dense rock
- Movement of the mantle causes plate motions
- Range of temperatures 1600 F to 4000 F

Core

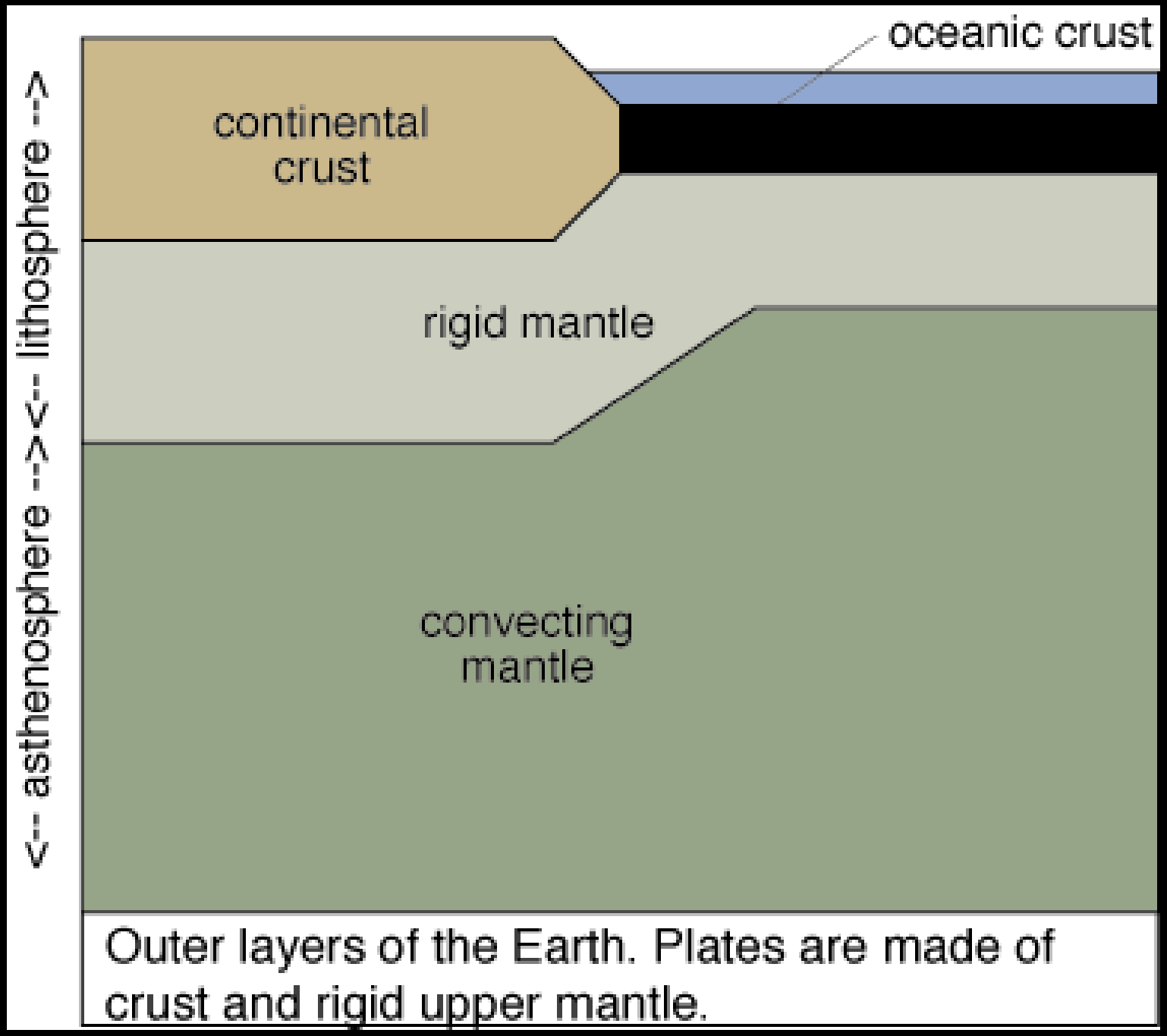
Outer Core and Inner Core



- The *outer core* is so hot that the metals in it are all in the liquid state
- The outer core is composed of the melted metals nickel and iron.
- The *inner core* of the Earth has temperatures and pressures so great that the metals are squeezed together and are not able to move about like a liquid, but are forced to vibrate in place as a solid.

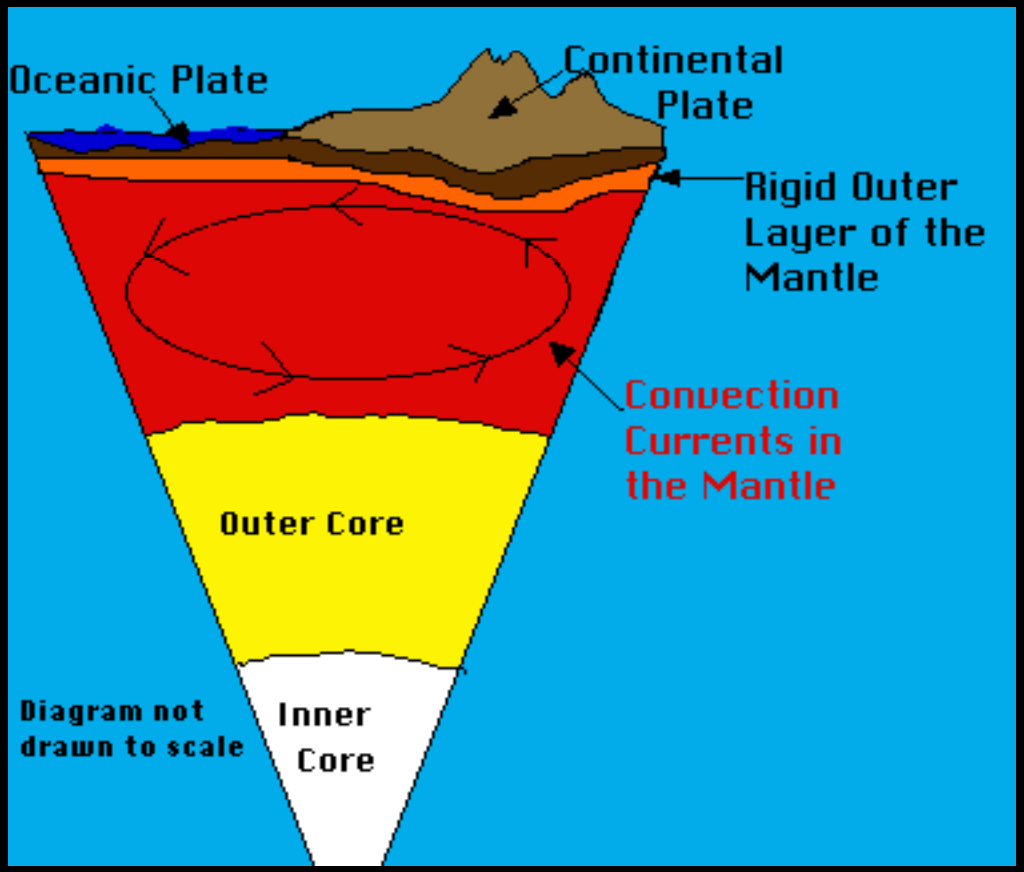


- Basalts are much denser and heavier.
- Because of this the continents ride on the denser oceanic plates.
- The crust and the upper layer of the mantle together make up a zone of rigid, brittle rock called the Lithosphere.
- The layer below the rigid lithosphere is Asthenosphere (the part of the mantle that flows and moves the plates of the Earth).



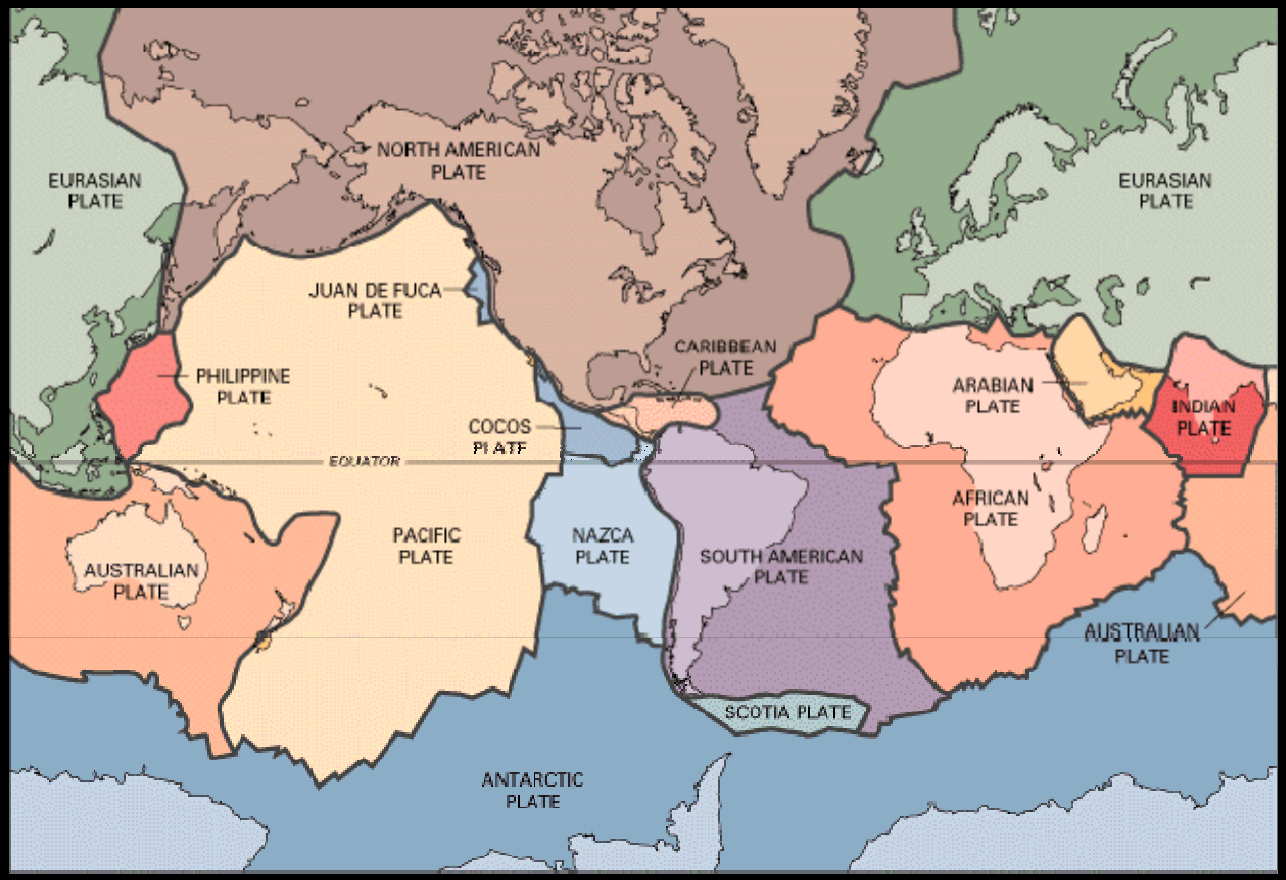
Outer layers of the Earth. Plates are made of crust and rigid upper mantle.

Convection Currents



- Caused by the very hot material at the deepest part of the mantle rising, then cooling, sinking again and then heating, rising and repeating the cycle over and over.
- When the convection currents flow in the mantle they also move the crust

Plate tectonics



- Convection currents in the mantle (*asthenosphere*) drag the crust with it
- This causes the lithosphere (crust) to move
- The crust is broken up in pieces called plates.