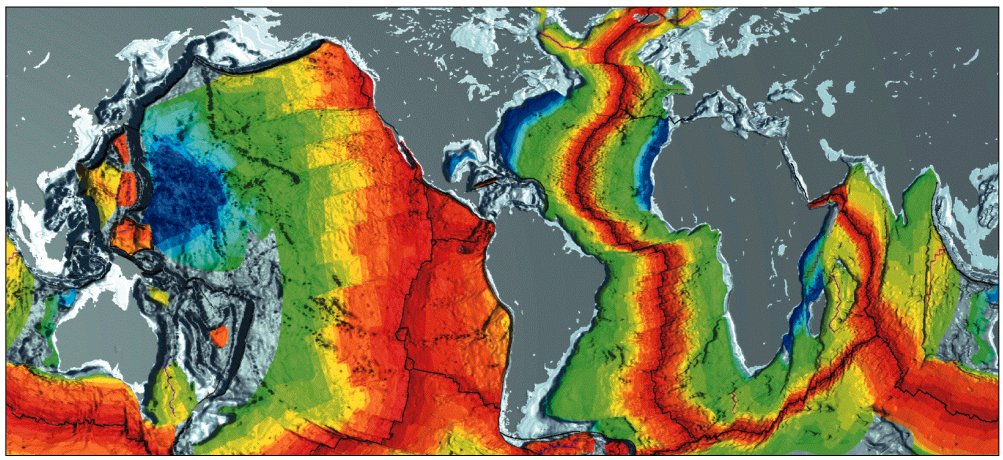
EPSC240: GEOLOGY IN THE FIELD

INTRODUCTION TO PLATE TECTONICS



TODAY

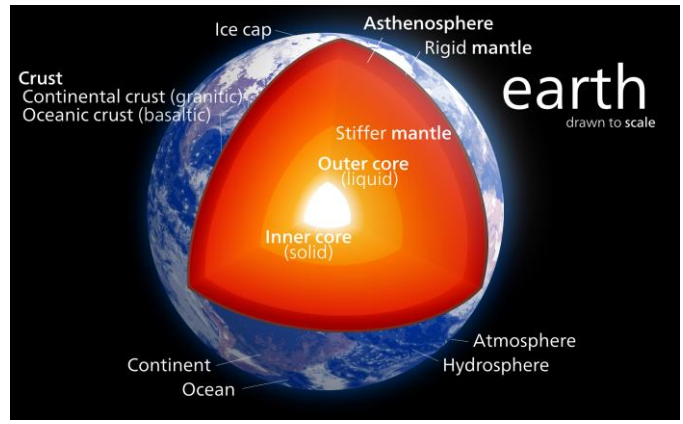
- Sketches
- Compasses: 713, 729, 736, and 6677
- Hand in stereonets lab
- Geology of Québec topics

WEDNESDAY

- Seismics lab. Not raining!
- Meet in FDA 348 at 2 pm

EARTH'S INTERNAL STRUCTURE

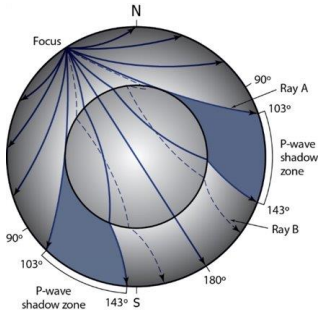
- Crust
- Mantle
- **Lithosphere**
- Asthenosphere
- Outer core
- Inner core



Wikipedia

HOW DO WE KNOW?

- Seismology! Seismic wave speed depends on P, T, mineralogy, chemical composition, orientation, degree of partial melting ➔ behave according to SNELL'S LAW



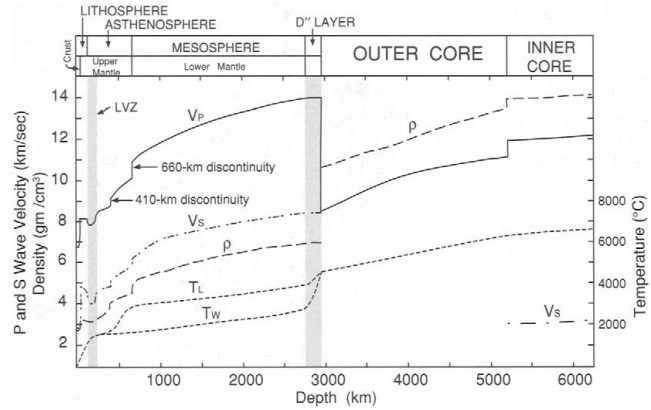
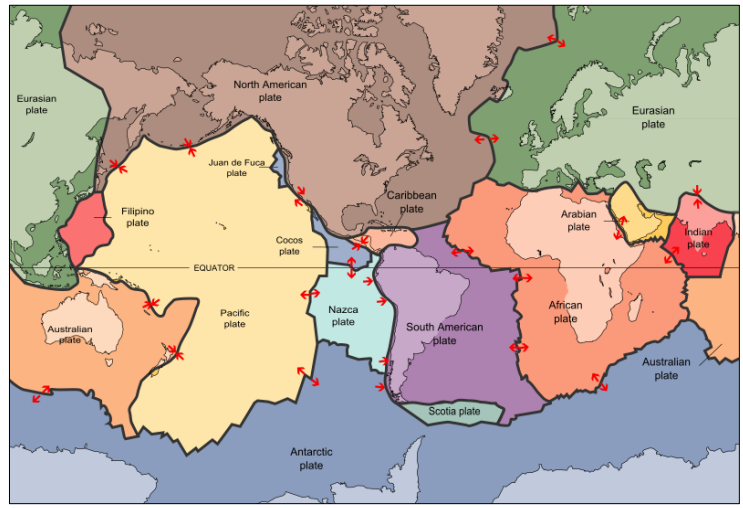


PLATE MOTIONS

- Map of major tectonic plates (there are 52 in total)



Wikipedia

HOW DO WE KNOW?

- GPS measurements are made continuously - different parts of the world travel in different directions. 0-100 mm/year.

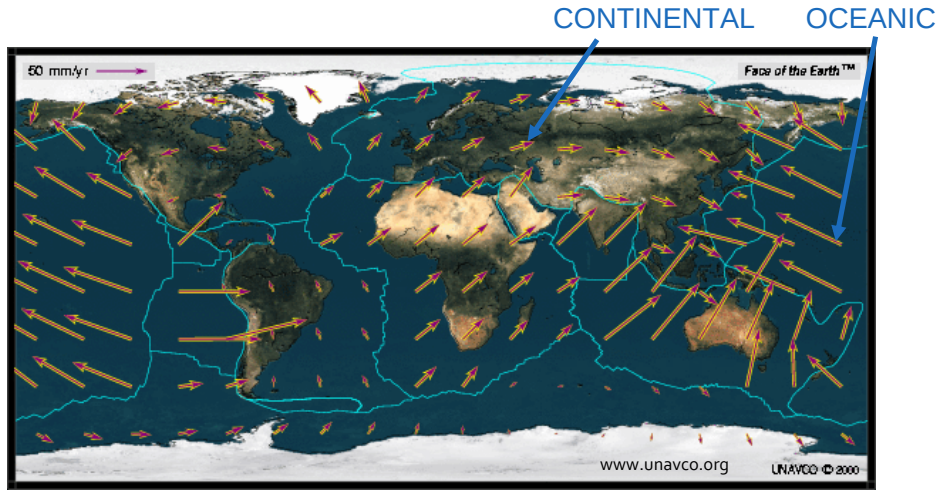
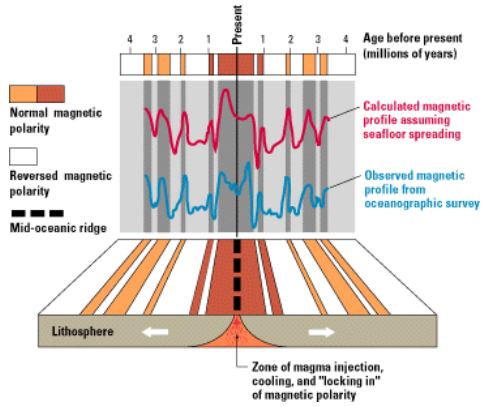
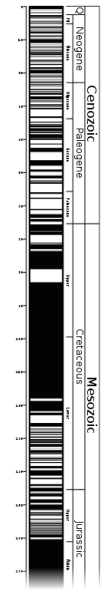


PLATE MOTIONS - GEOLOGIC TIME

- When rocks form, minerals with iron “trap” the orientation of the magnetic field at that time.
- Basalts contain lots of iron!



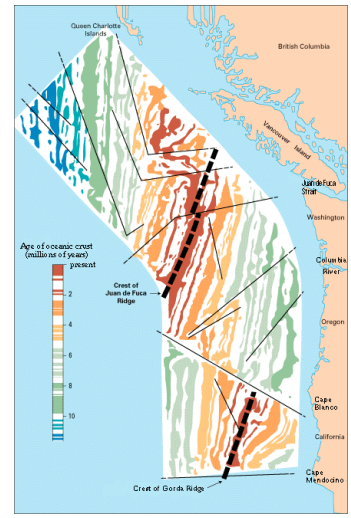


Images: Wikipedia

VINE-MATTHEWS HYPOTHESIS

- 1963: Seafloor spreading

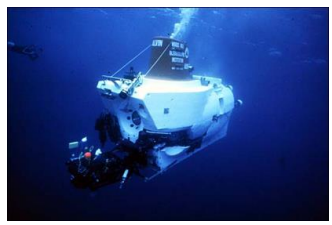
https://www.youtube.com/watch?v=CRx66ZpEhOg

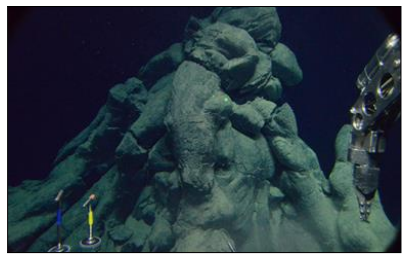


Wikipedia

NEW SEAFLOOR

- Direct observation: submersibles
- On land: ophiolite contain similar rock assemblages





SUBDUCTION

- If new plate area is created at spreading centre, some plate must be destroyed somewhere (the radius of the Earth is not increasing)

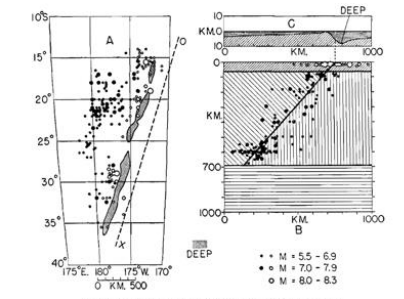
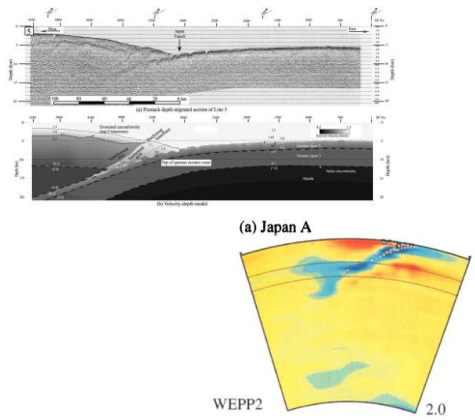


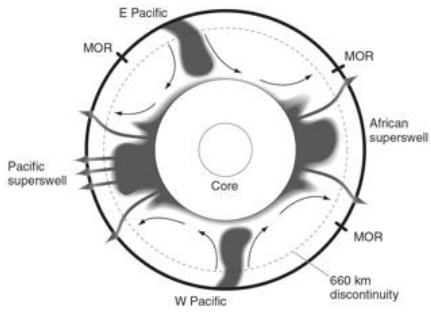
FIGURE 4.—TONGA-KERMADEC EARTHQUAKES AND OCEANIC DEEPS
The plane of the great fault intersects the earth's surface along the line of oceanic deeps. The slanting line in *B* represents the intersection of the fault with a vertical plane perpendicular to the line of oceanic deeps.

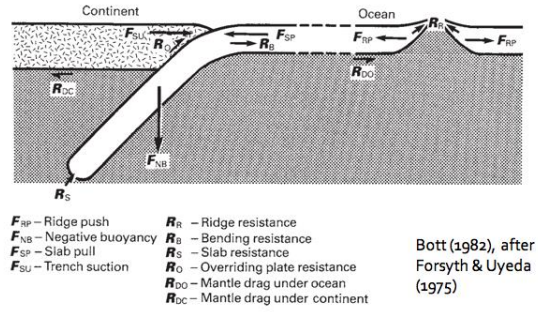


Geophysical imaging

WHY DO PLATES SUBDUCT?

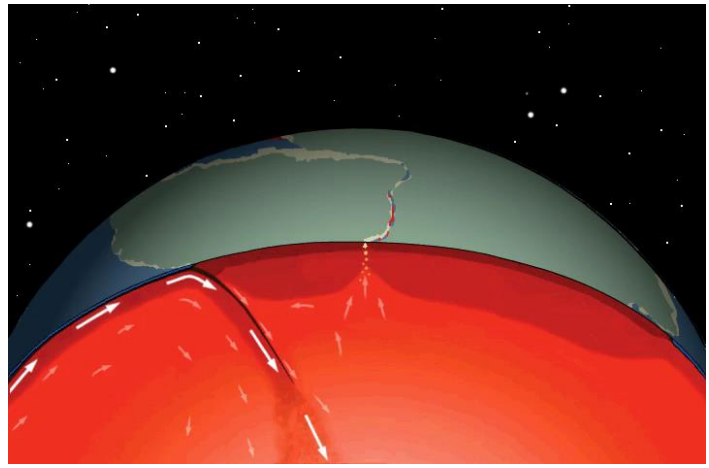
- Oceanic lithosphere cools and densifies away from spreading centre - buoyantly unstable
- Instabilities derived from core-mantle boundary drive convection from below



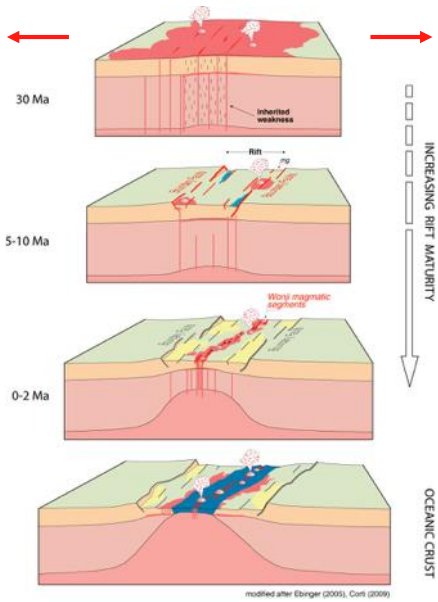


Bott (1982), after Forsyth & Uyeda (1975)

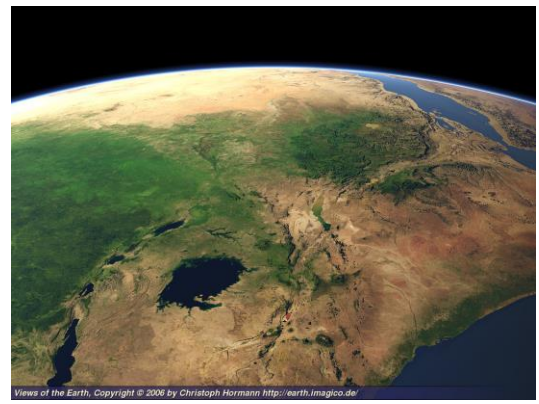
PLATE TECTONICS



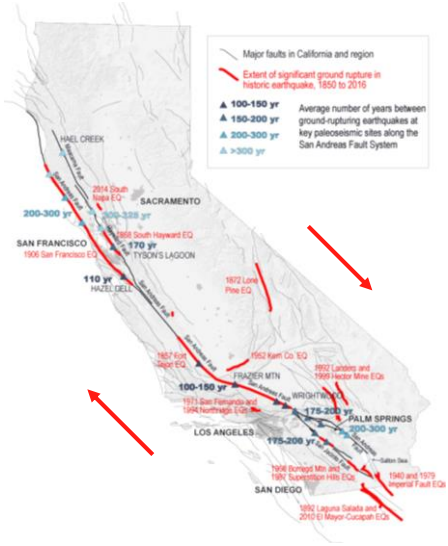
TECTONIC SETTINGS: RIFTS



- Plates move away from each other and are pulled apart



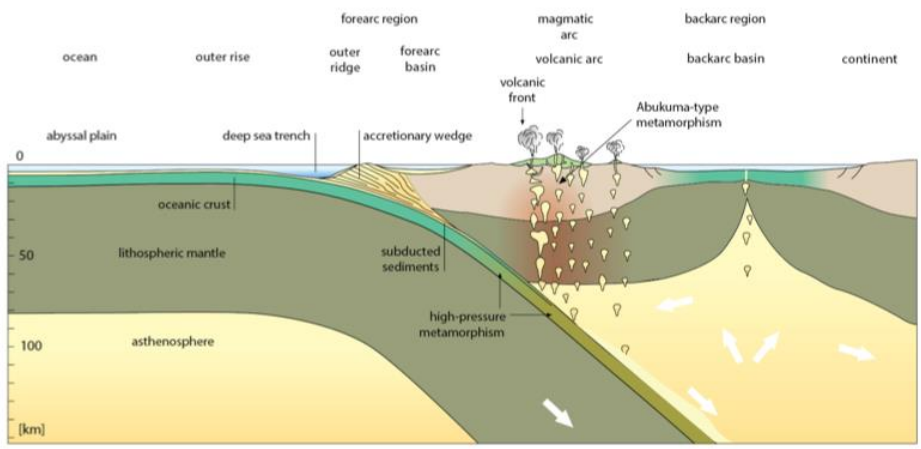
TECTONIC SETTINGS: TRANSFORM



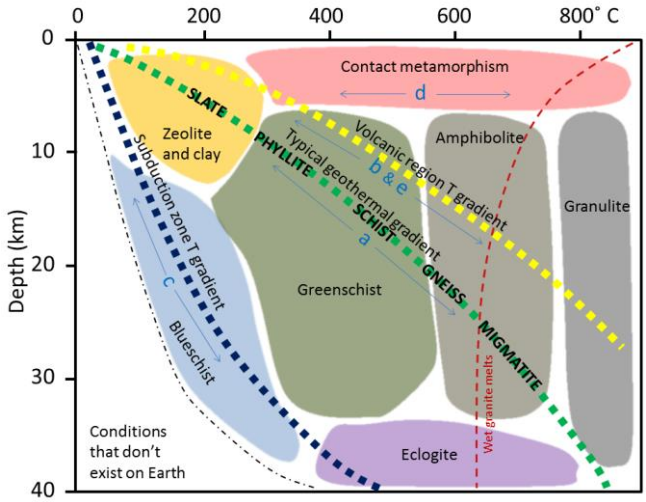
- Strike slip relative motion as plates slide past each other laterally

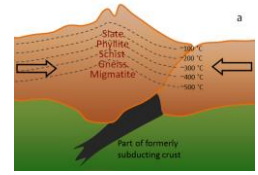
TECTONIC SETTINGS: CONVERGENT MARGINS (SUBDUCTION ZONES)

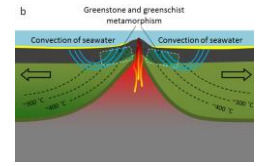
- Oceanic plate is subducted into the mantle beneath a continental plate or oceanic plate

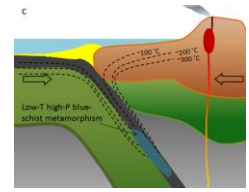


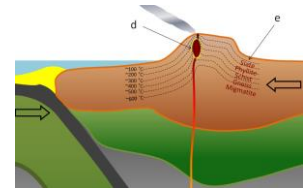
METAMORPHIC FACIES

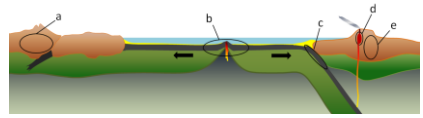






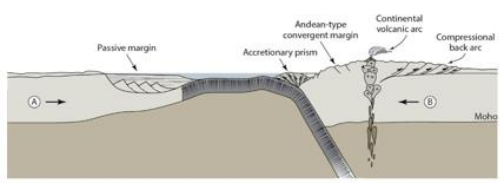


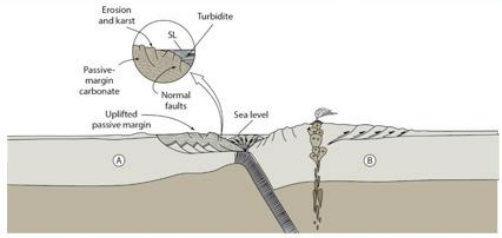


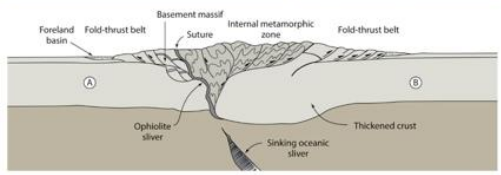


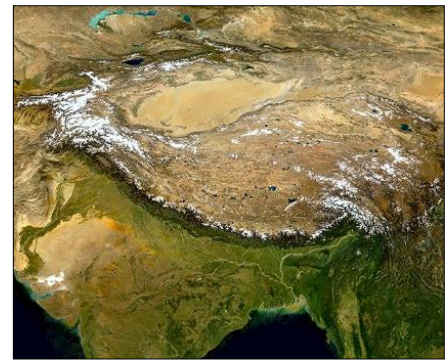
Images: opentextbc.ca

TECTONIC SETTINGS: OROGENY









WILSON CYCLE

East African Rift

Red Sea

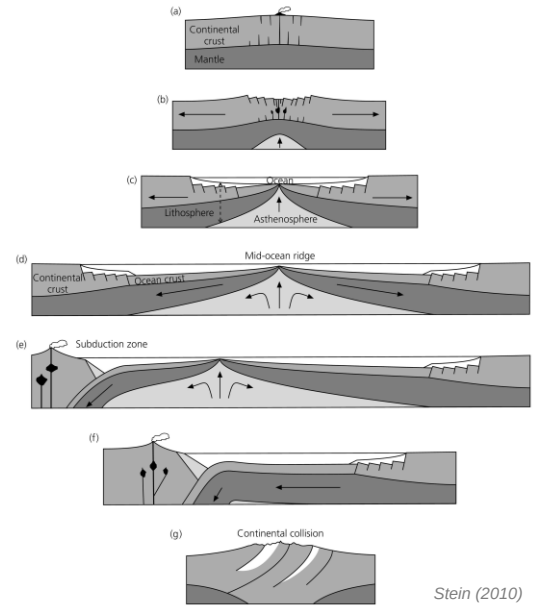
Mediterranean

Atlantic

South America/Andes

Himalayas

Figure 5.6-1: Schematic diagram of the Wilson cycle.



Stein (2010)

PLATE TECTONICS: TOPOGRAPHY

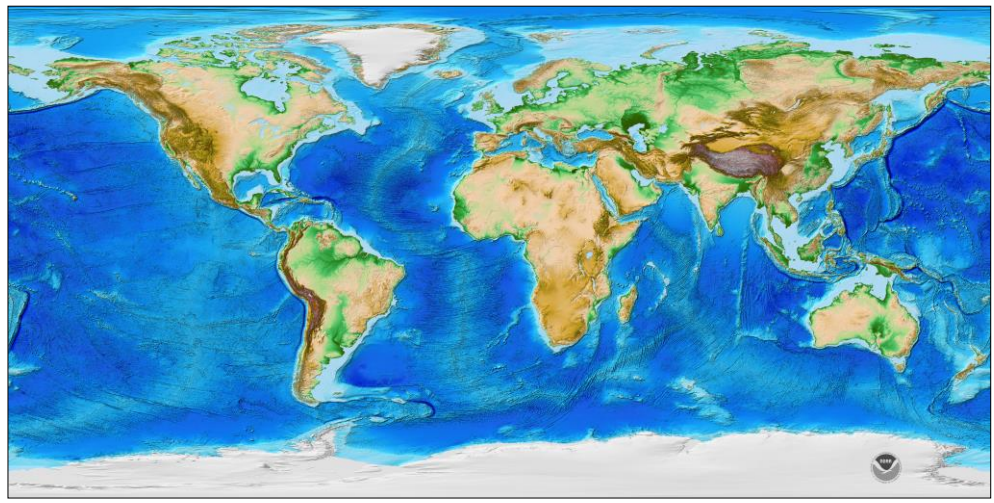


PLATE TECTONICS: EARTHQUAKES

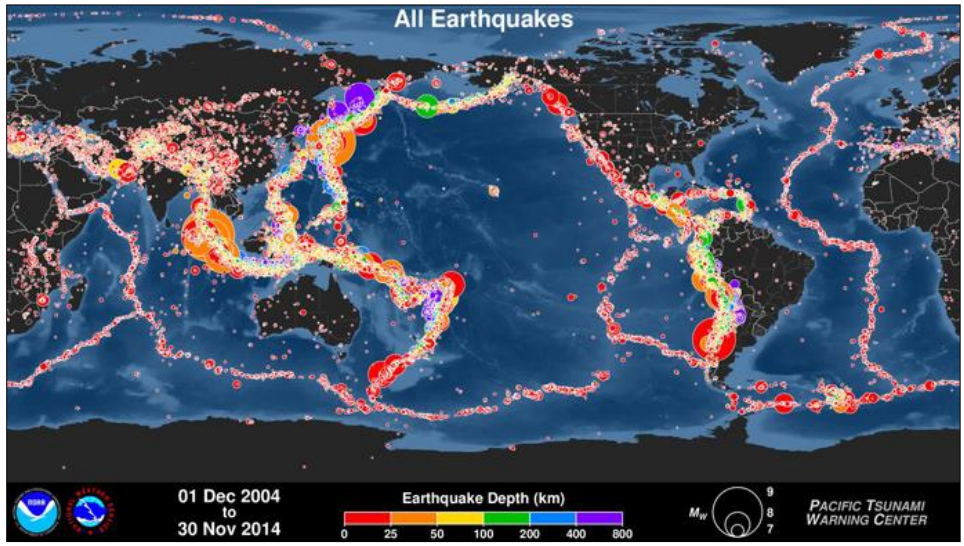


PLATE TECTONICS: VOLCANOES

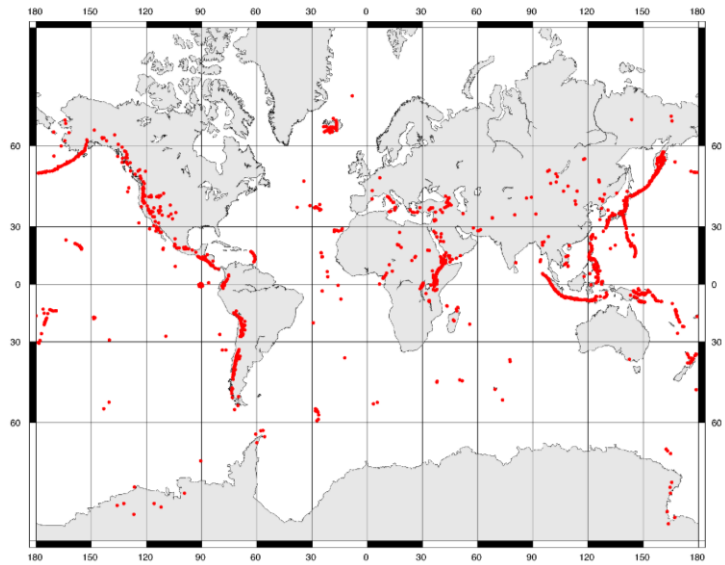


PLATE TECTONICS: EVOLUTION OF LIFE

- When and where can migrations occur?

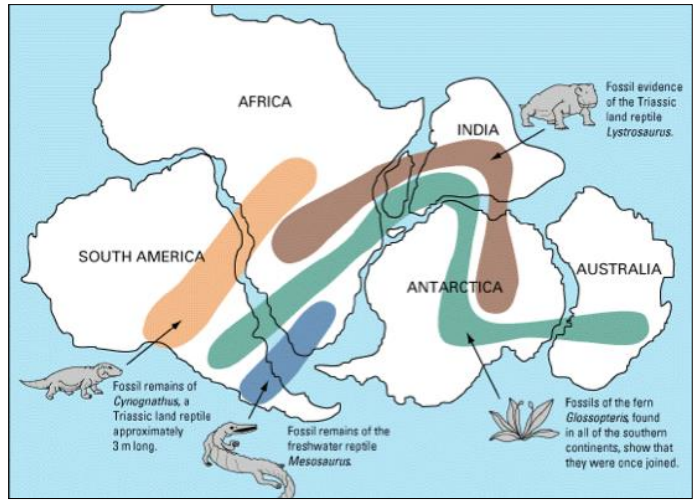
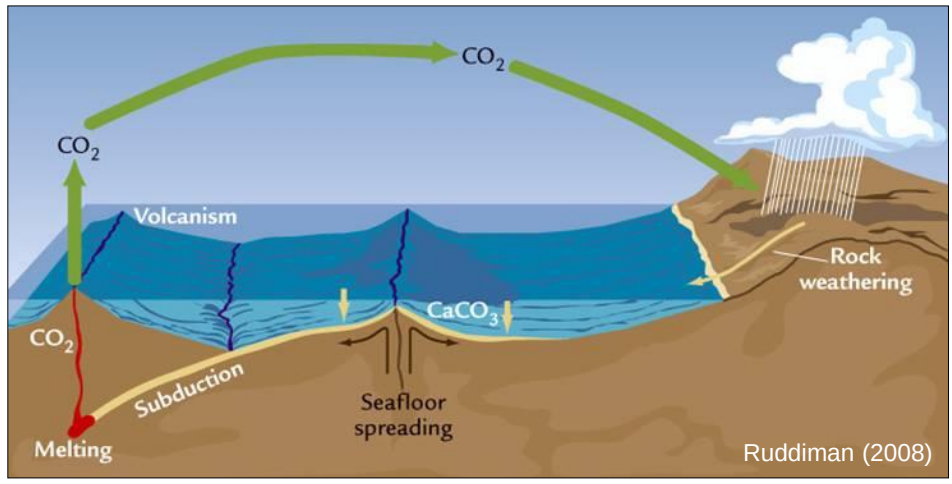


PLATE TECTONICS: CLIMATE CHANGE

- Ocean circulation, weathering (CO_2), burial of $CaCO_3$



SUMMARY

- Plate tectonics is a fundamental paradigm in the earth sciences
- Tectonic motions today and in the past shape the modern world
- Characteristic settings can be identified and used to demonstrate how plate tectonics works