

# AP Environmental Science

Earth Systems: Part 3

# **Earth's Major Geography -Geomorphology-**

# River Deep, Mountain High

- **Geomorphology**-the scientific study of landforms and the processes that shape them



# Water, water everywhere..

- Oceans
  - Arctic Ocean
    - Smallest and most shallow, Partially covered in sea ice, temp and salinity vary, least salty of all oceans
  - Atlantic Ocean
    - Second largest, 25% of water area, currently growing, Divided into north and south Atlantic by equator
  - Indian Ocean
    - Third largest, 20% of water area, begins at the 20°E meridian

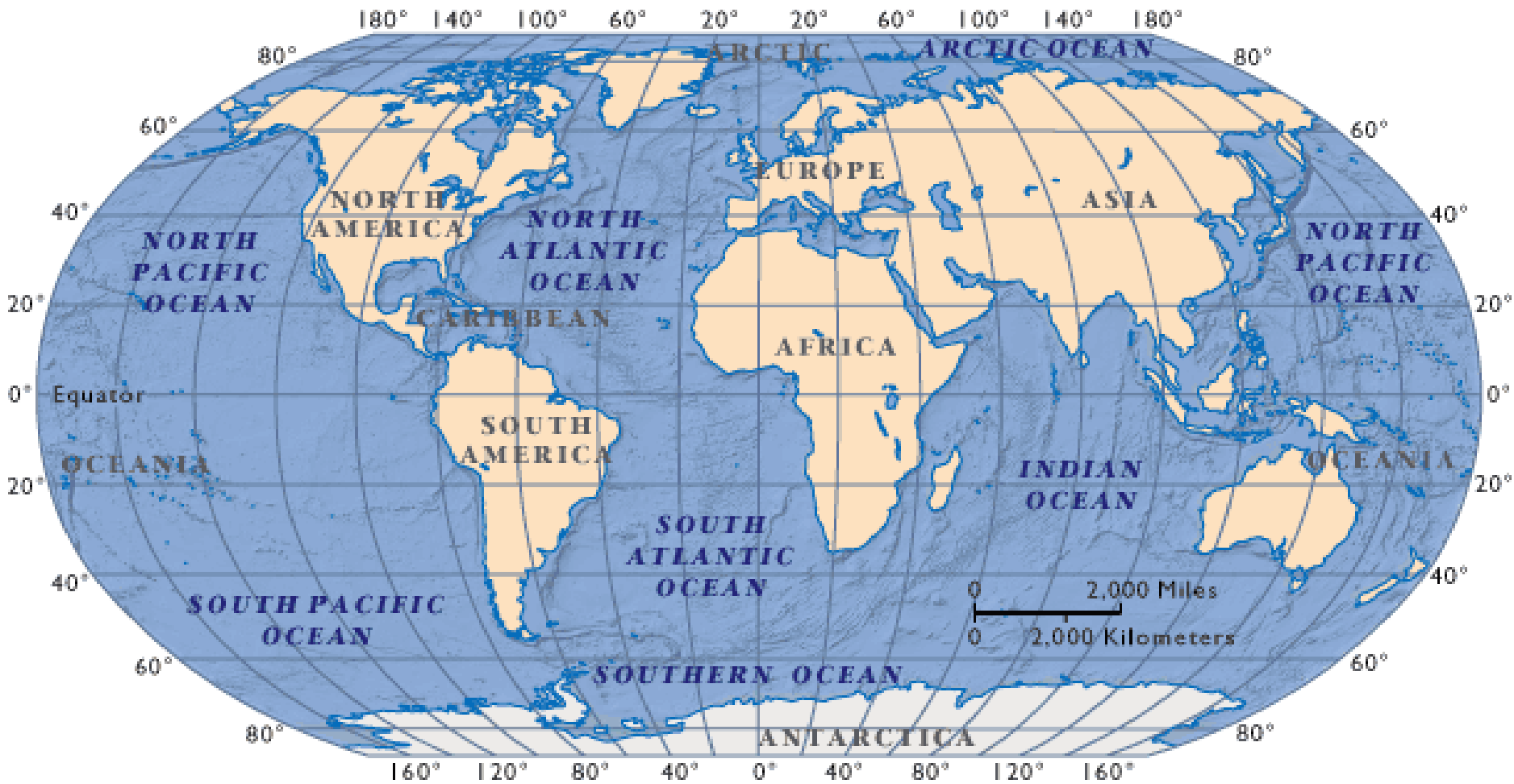
## ▫ Pacific Ocean

- Divided up into the north and south pacific
- Largest ocean, and deepest ocean
- Currently shrinking

## ▫ Southern/ Antarctic Ocean

- Fourth largest ocean, completely surrounds Antarctica

# Oceans



# Major Seas

- South China Sea
- Caribbean Sea
- Mediterranean Sea
- Bering Sea
- Gulf of Mexico
- Arabian sea
- Sea of Okhotsk
- Sea of Japan
- Hudson Bay
- East China
- Andaman
- Black Sea
- Red Sea



**1** South China

**2** Caribbean

**3** Mediterranean

**4** Bering

**5** Gulf of Mexico

**6** Arabian Sea

**7** Sea of Okhotsk

**8** Sea of Japan  
(East Sea)

**9** Hudson Bay

**10** East China

**11** Andaman

**12** Black Sea

**13** Red Sea



# Major Mountain Ranges

- Himalayas
  - Highest mountain range, “land of snow”, located in southern Asia, between India and southern Asia, one of the youngest mtn ranges- Mt Everest- 29,029ft tall
- Alps
  - Located in south central Europe, one of the largest and highest mtn ranges, 750 miles long- Mont Blanc 15,771 ft

- Andes

- Located in South America, runs north to south along western edge of continent

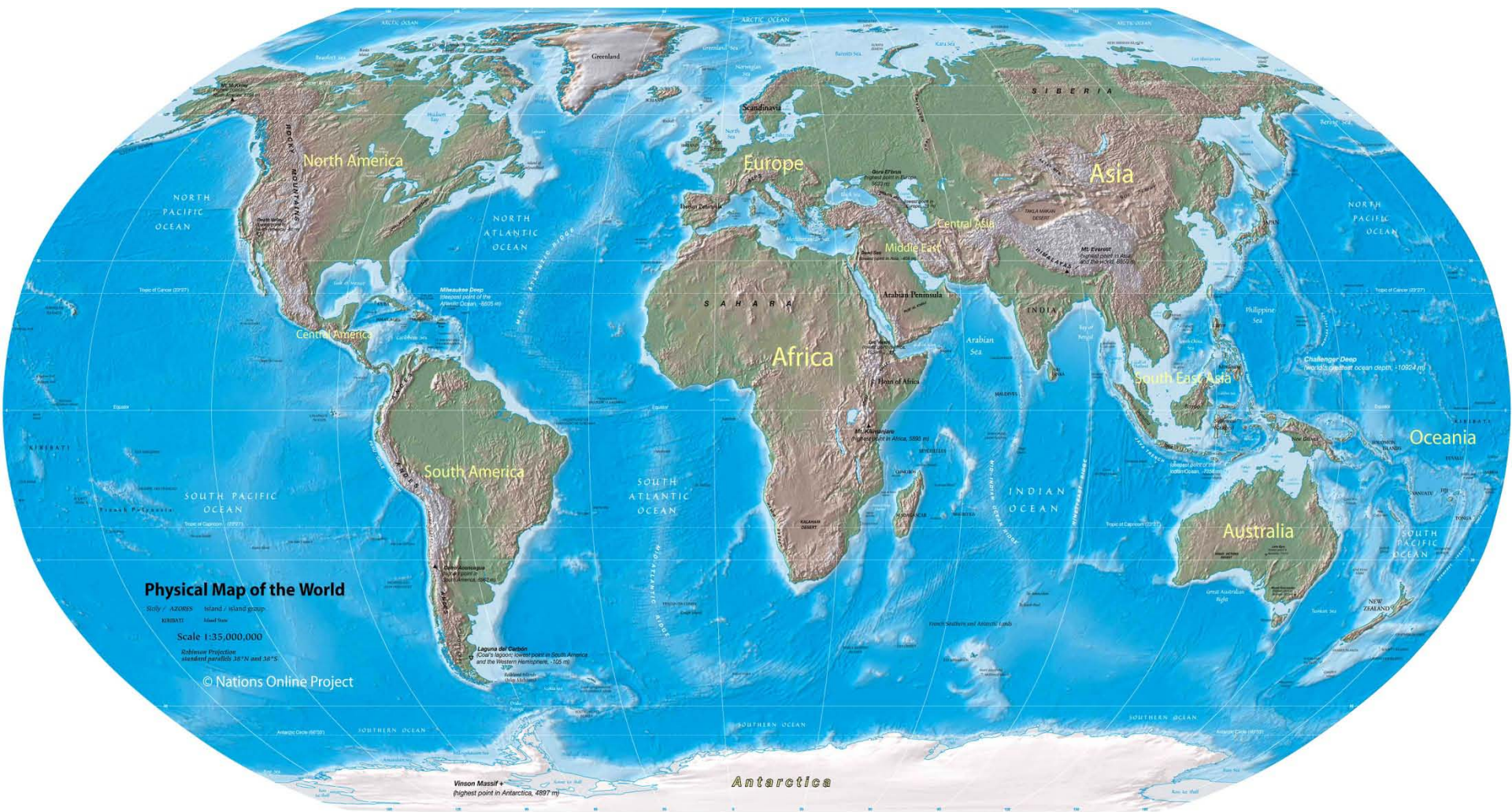
- Rockies

- Vast system in western North America, stretches from Canada to New Mexico, about 3000 miles long-Mount Elbert-14,440 ft

# Mtn Ranges by Continent (don't copy)

- **Antarctica:**
  - Antarctic Peninsula, Transantarctic Mountains
  - The highest mountain, Vinson Massif in the Ellsworth Mountains, peaks at 4897 m.
- **Africa:**
  - Atlas, Eastern African Highlands, Ethiopian Highlands
- **Asia:**
  - Hindu Kush, Himalayas, Taurus, Elburz, Japanese Mountains
- **Australia:**
  - MacDonnell Mountains
- **Europe:**
  - Pyrenees, Alps, Carpathians, Apennines, Urals, Balkan Mountains

- **North America:**
  - Appalachians, Sierra Nevada, Rocky Mountains, Laurentides
- **South America:**
  - Andes, Brazilian Highlands



### Physical Map of the World

Style / AZ0055 Inland / Inland group  
EURESAT Inland blue  
Scale 1:35,000,000  
Robinson Projection  
standard parallels 38°N and 38°S

© Nations Online Project

Vinson Massif \*  
highest point in Antarctica, 4897 m

Antarctica

# EUROPE





Appalachian Mountains

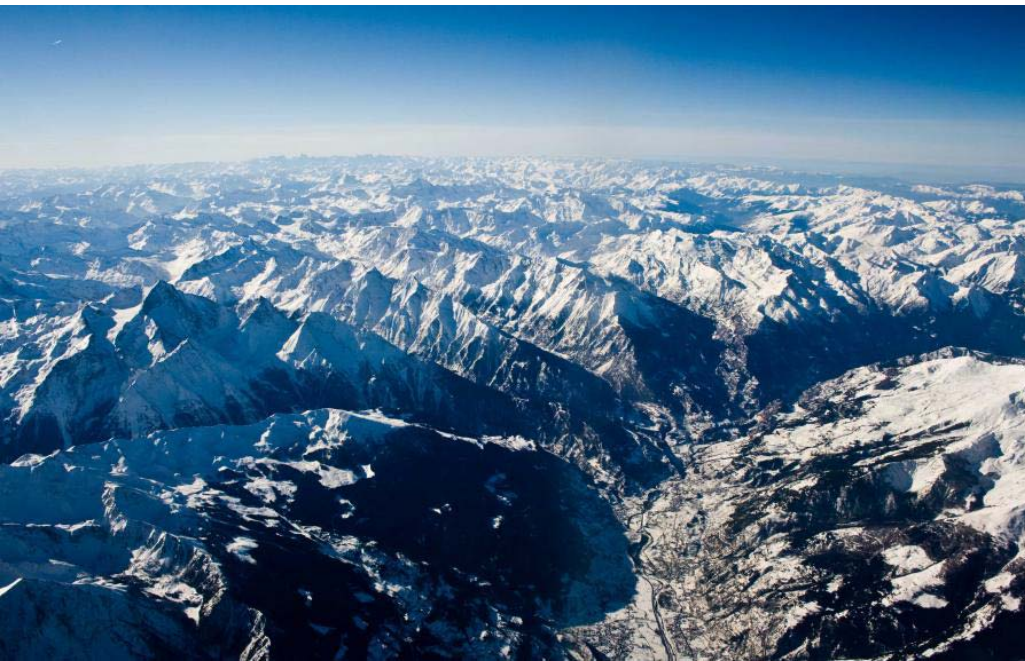






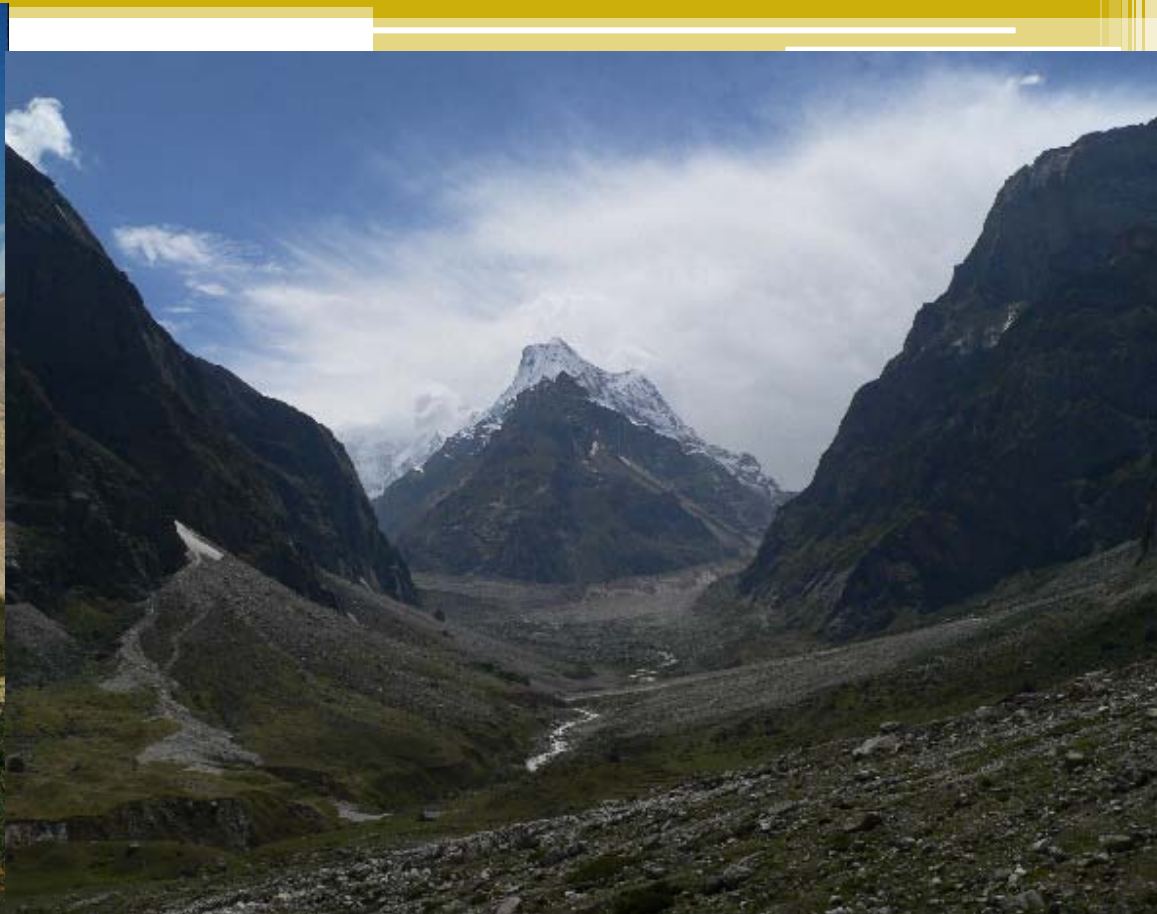
Rocky Mountains





The Alps





Himalayan Mountains



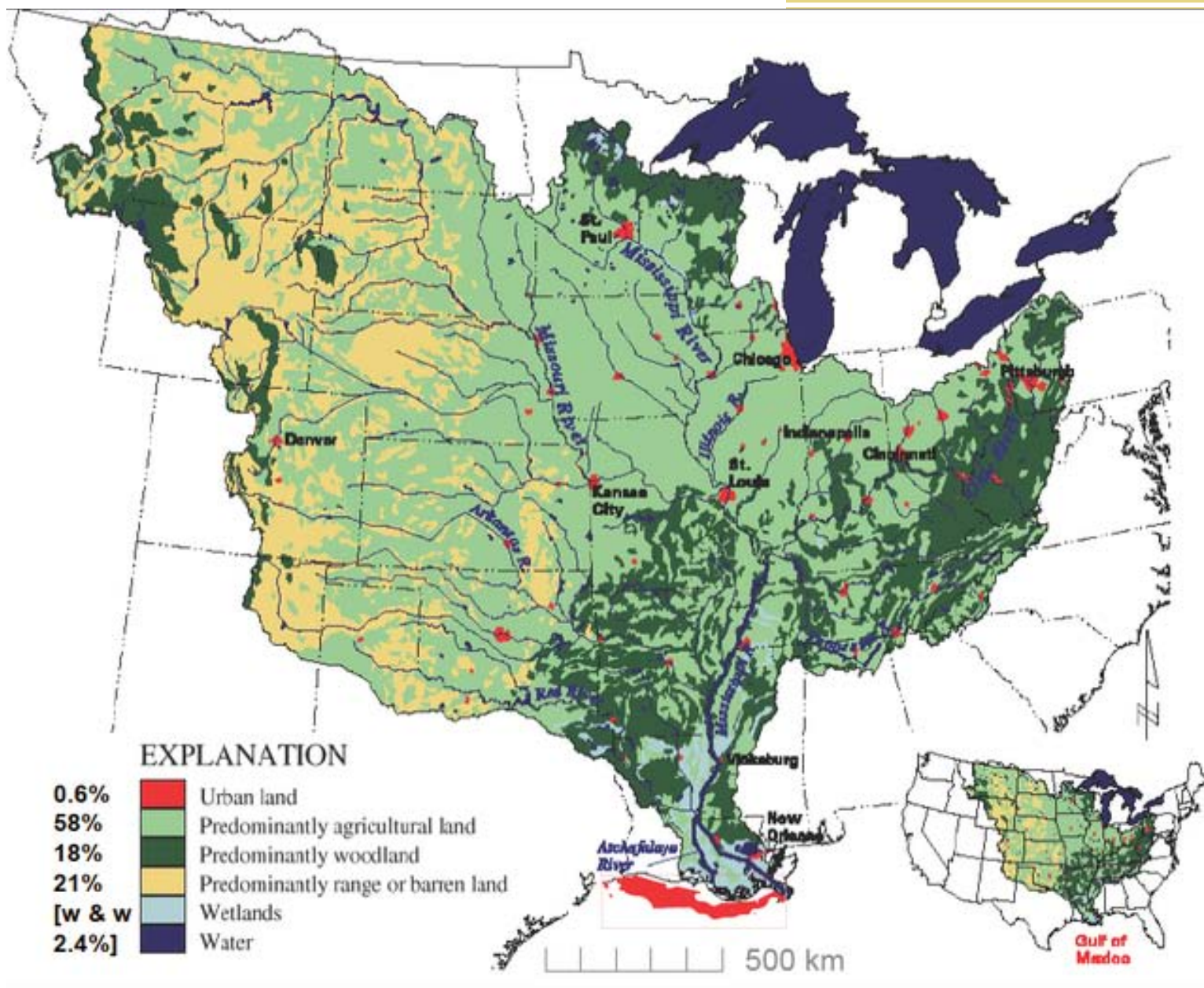
Mt. Everest 29,029 ft / 8,848 m



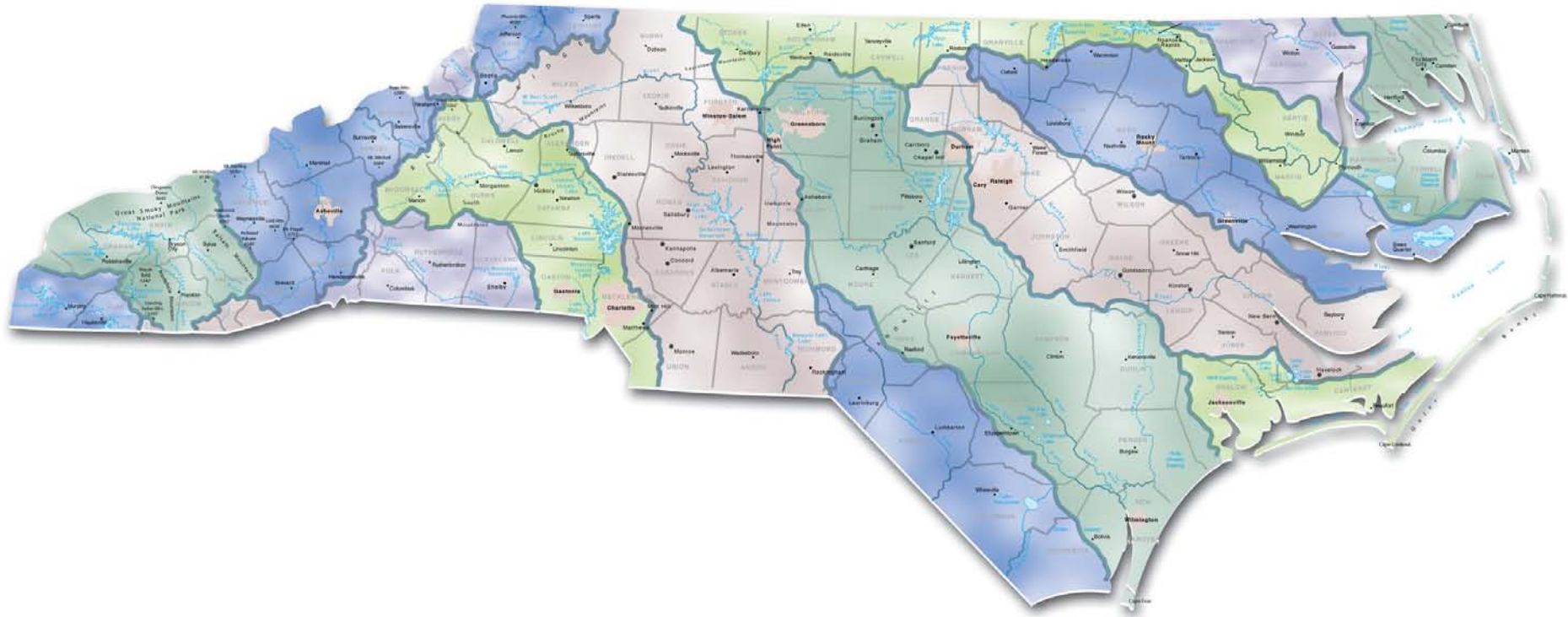
# Major River Systems

- North American
  - **St Lawrence**-2350 mi long, follows a fault line and drains the Great Lakes
  - **Rio Grande**
  - **Colorado**- 1450 miles long, cut the largest canyon system in the world including the Grand Canyon
  - **Hudson**- 315 mi long, serves New York and can be navigated beyond the mtns
  - **Mississippi River** – 3,870 miles long, 1.25 million mi<sup>2</sup> drainage, longest river flowing southward, 25 major cities located on it banks



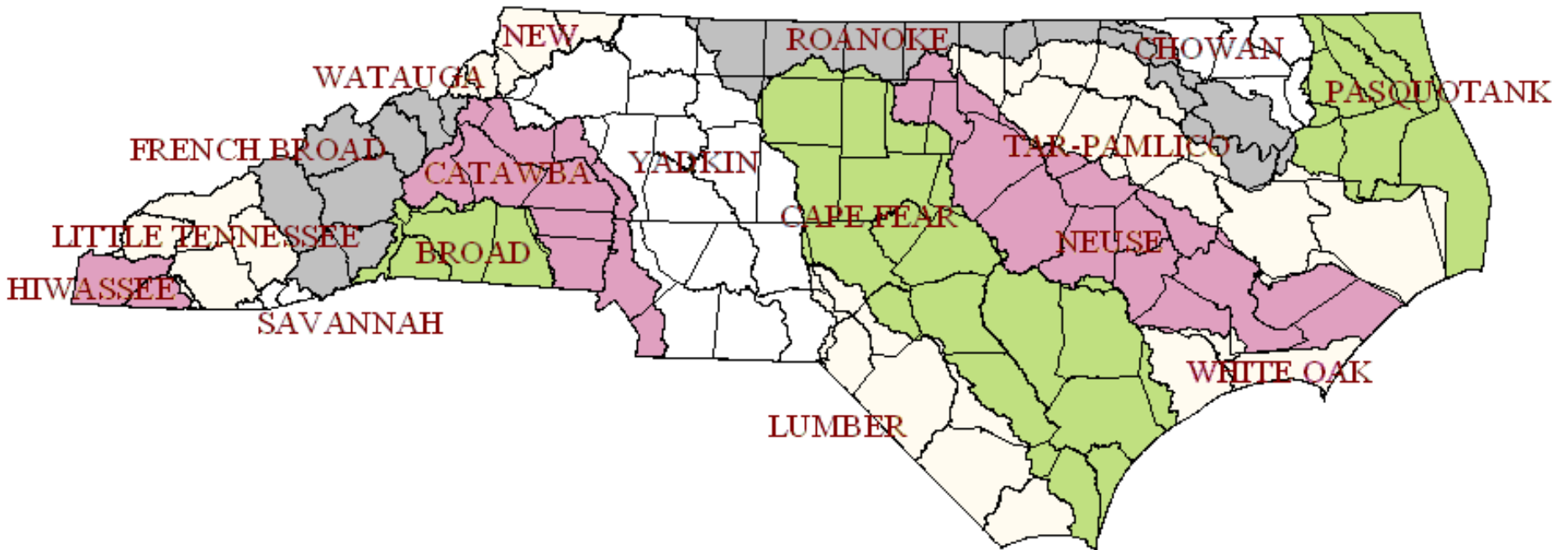


- North Carolina



North Carolina River Basins

# North Carolina's River Basins



November 1999

- South America

- **Amazon** – 3,920 miles long, 2.3 mi<sup>2</sup> drainage, largest basin in the world, greatest flow (180,000 m<sup>3</sup>)

# HydroSHEDS

## Amazon Basin

River network derived  
from SRTM elevation data  
at 500 m resolution

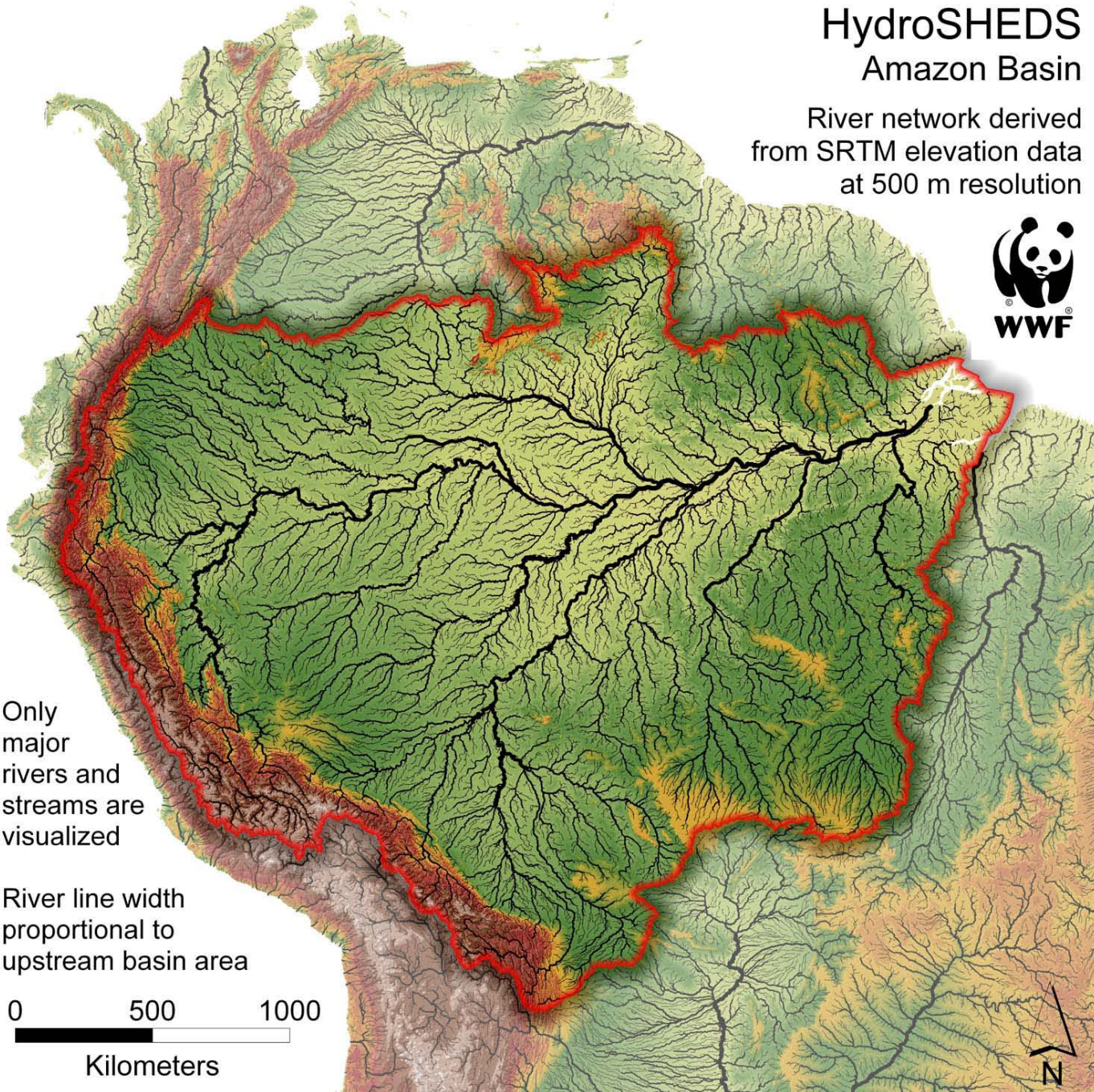


Only  
major  
rivers and  
streams are  
visualized

River line width  
proportional to  
upstream basin area

0 500 1000

Kilometers

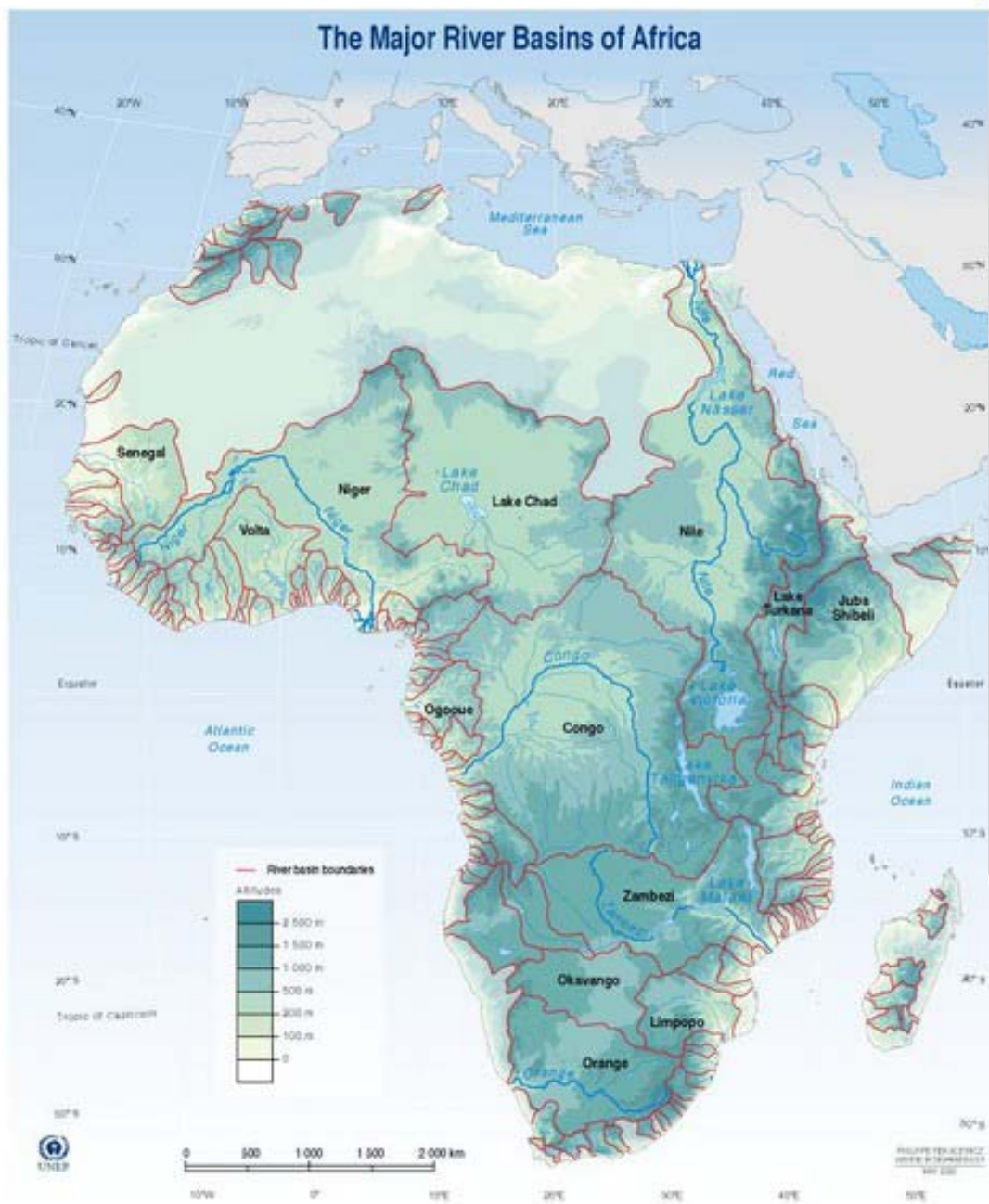




- African

- **Nile**- 4,180 mi long, 1.7 million mi<sup>2</sup> drainage, White and Blue Nile tributaries, Egyptians Agricultural is dependent upon seasonal flooding, flows north
- **Congo** – 2900 mi long, 1.4 mil mi<sup>2</sup> drainage, longest river flowing westward, crosses the equator twice
- **Zambezi** – 2,200 mi long, 548,000 mi<sup>2</sup> drainage, flows over Victoria falls



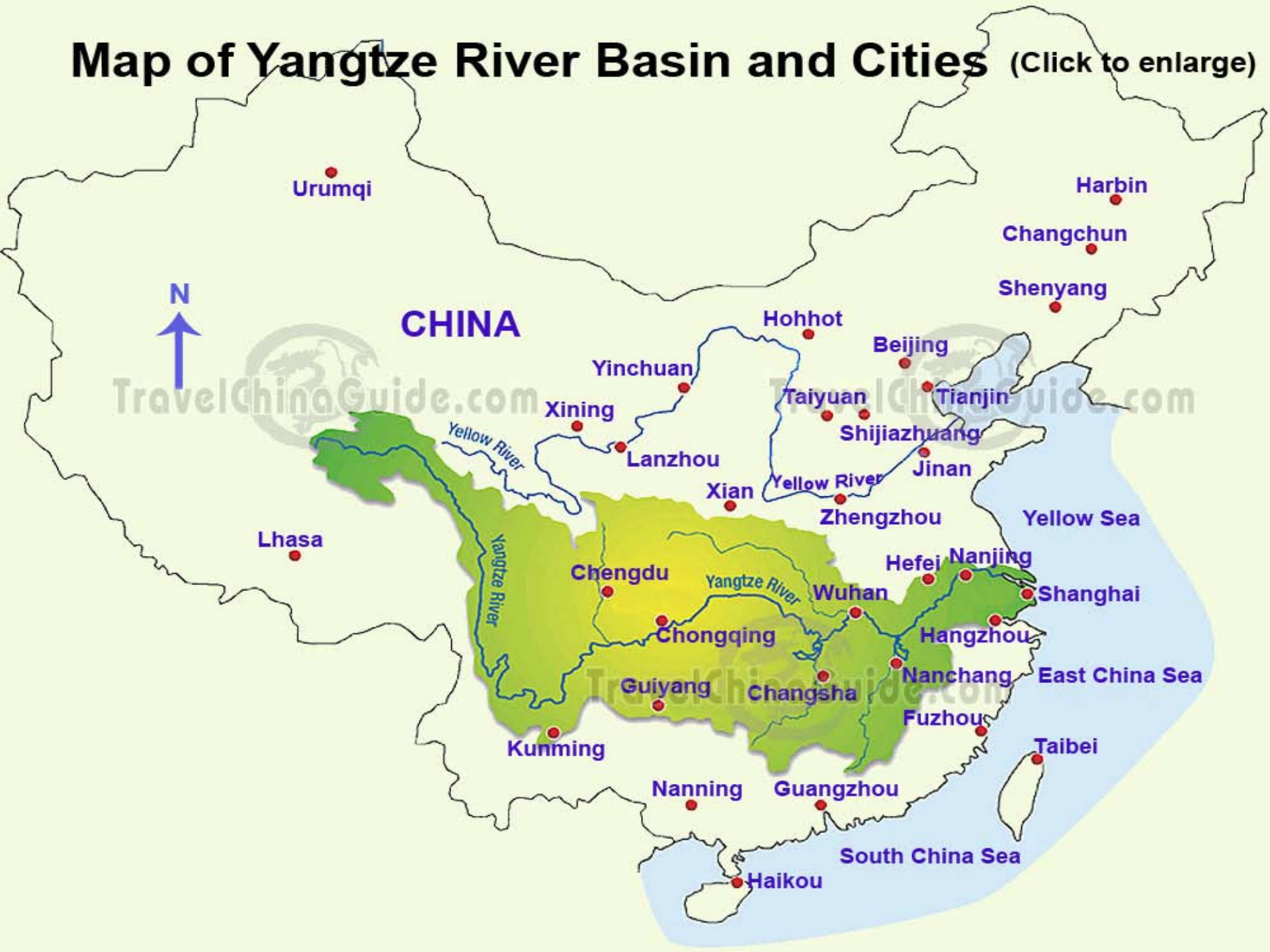


Source: Aaron T. Wolf et al., 1999; Revenga et al., Watersheds of the World, World Resources Institute (WRI), Washington DC, 1998; Philippe Rakawicz, Atlas de poche, Livre de poche, Librairie générale française, Paris, 1996 (revised in 2001).

- Asian

- **Tiger & Euphrates** -1795 mi long, home of ancient Mesopotamia, serves major Iraqi cities
- **Yangtze (Chang Jiang)** – 3964 mi long, 698,000 mi<sup>2</sup> drainage, the lifeline of China
- **Yellow (Huang He)** -3,395 miles long, 290,000 mi<sup>2</sup> drainage, some of the river is higher than the surrounding area
- **Ganges**- 1560 mi long, sacred river of India

# Map of Yangtze River Basin and Cities (Click to enlarge)





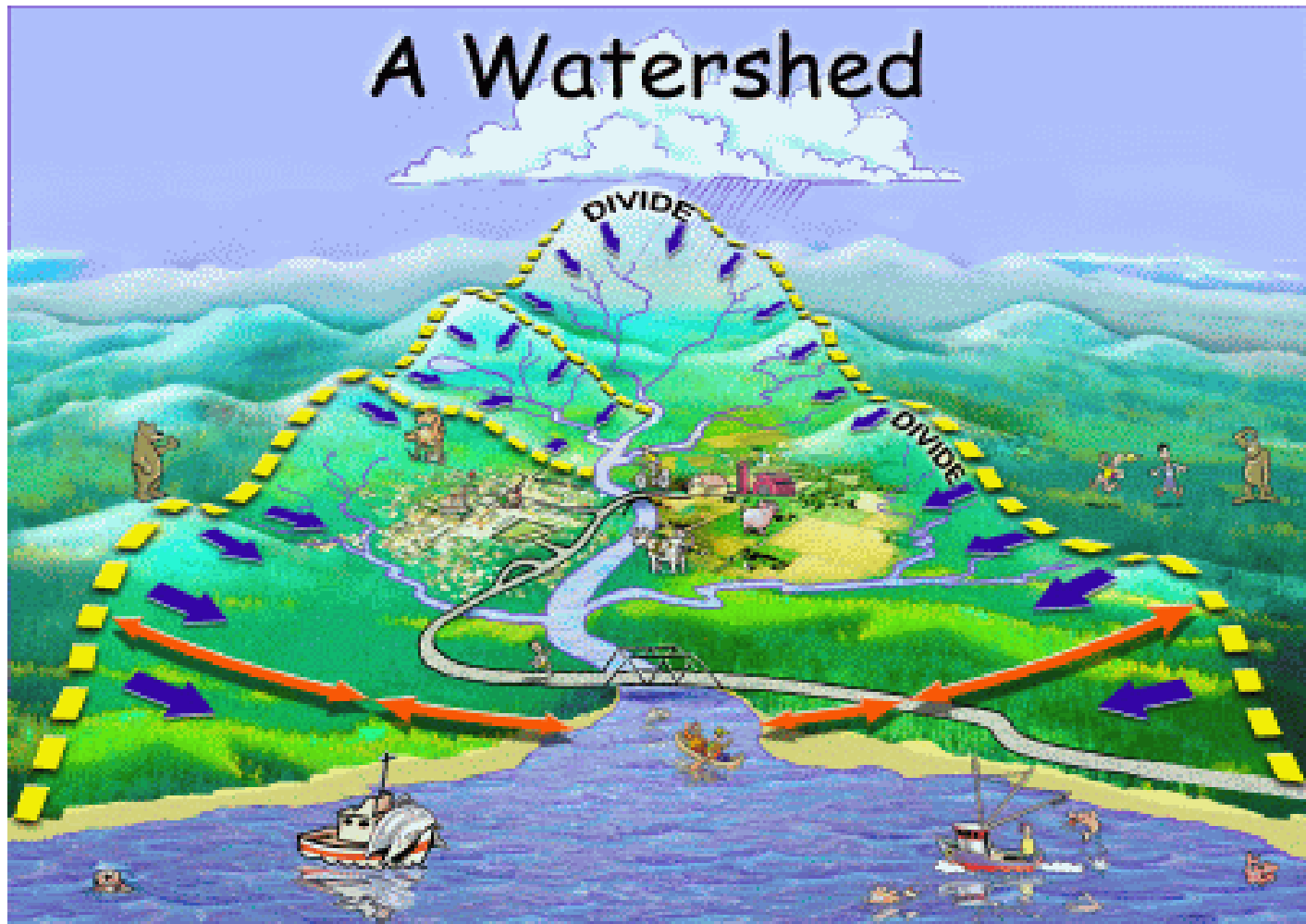
- European

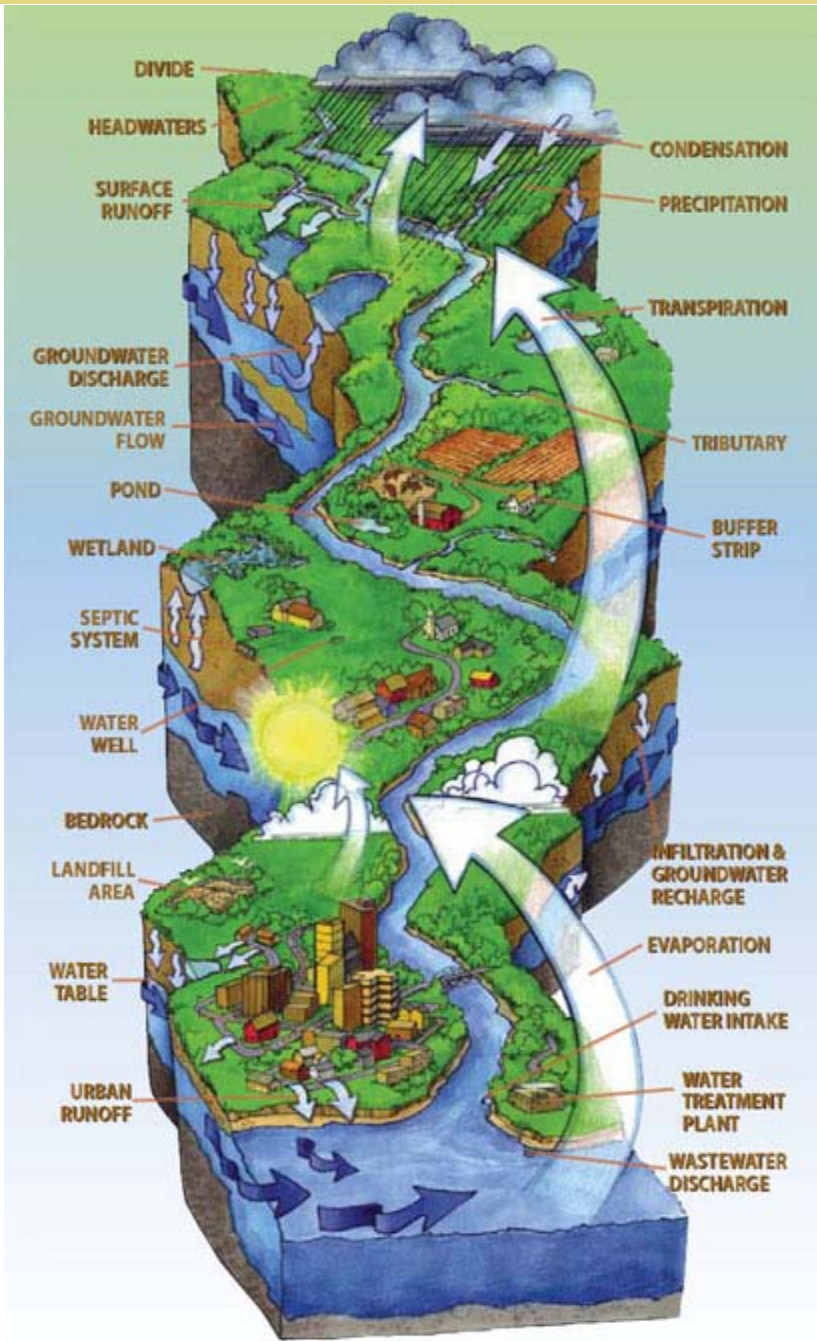
- **Danube** – 1,176 mi long, 320,000 mi<sup>2</sup> drainage

- **Rhine**- 820 mi long, commercially the most important river of Europe

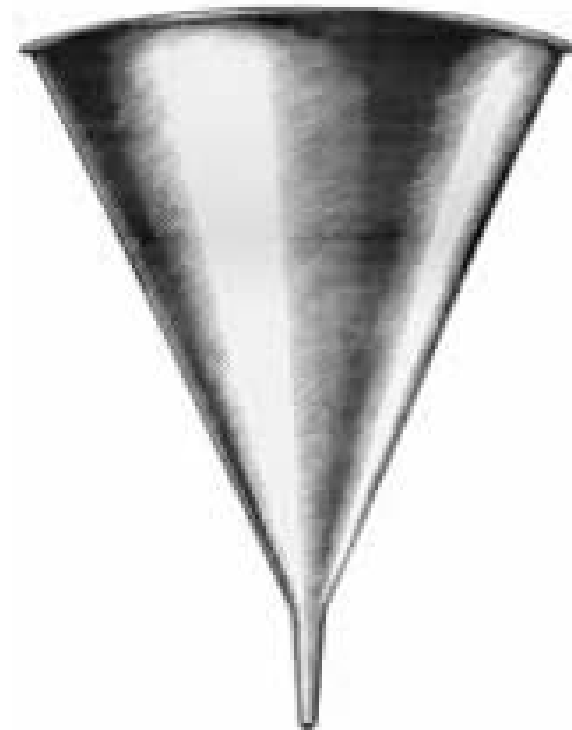


# Structure of a Watershed System- Hydrology



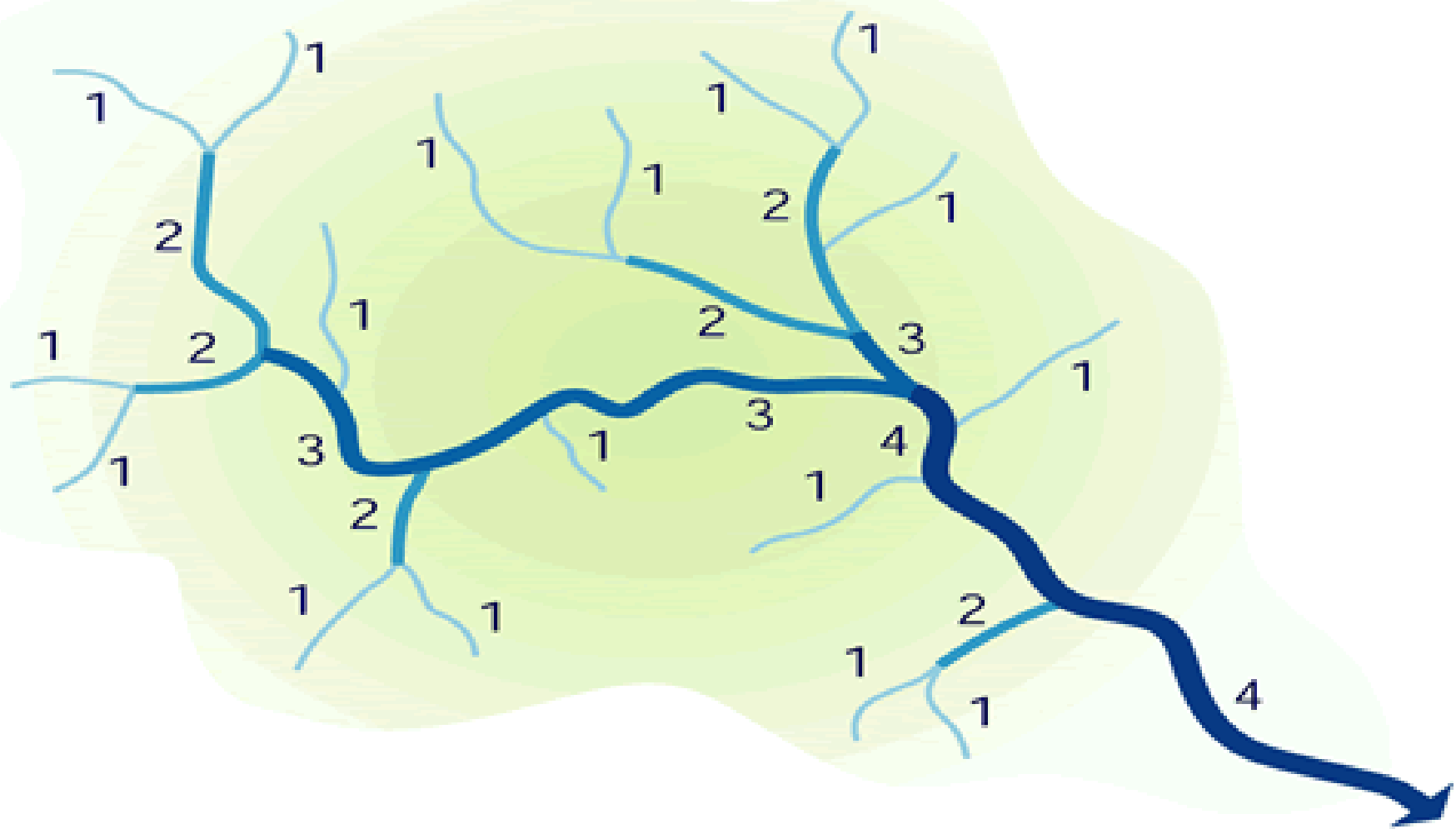


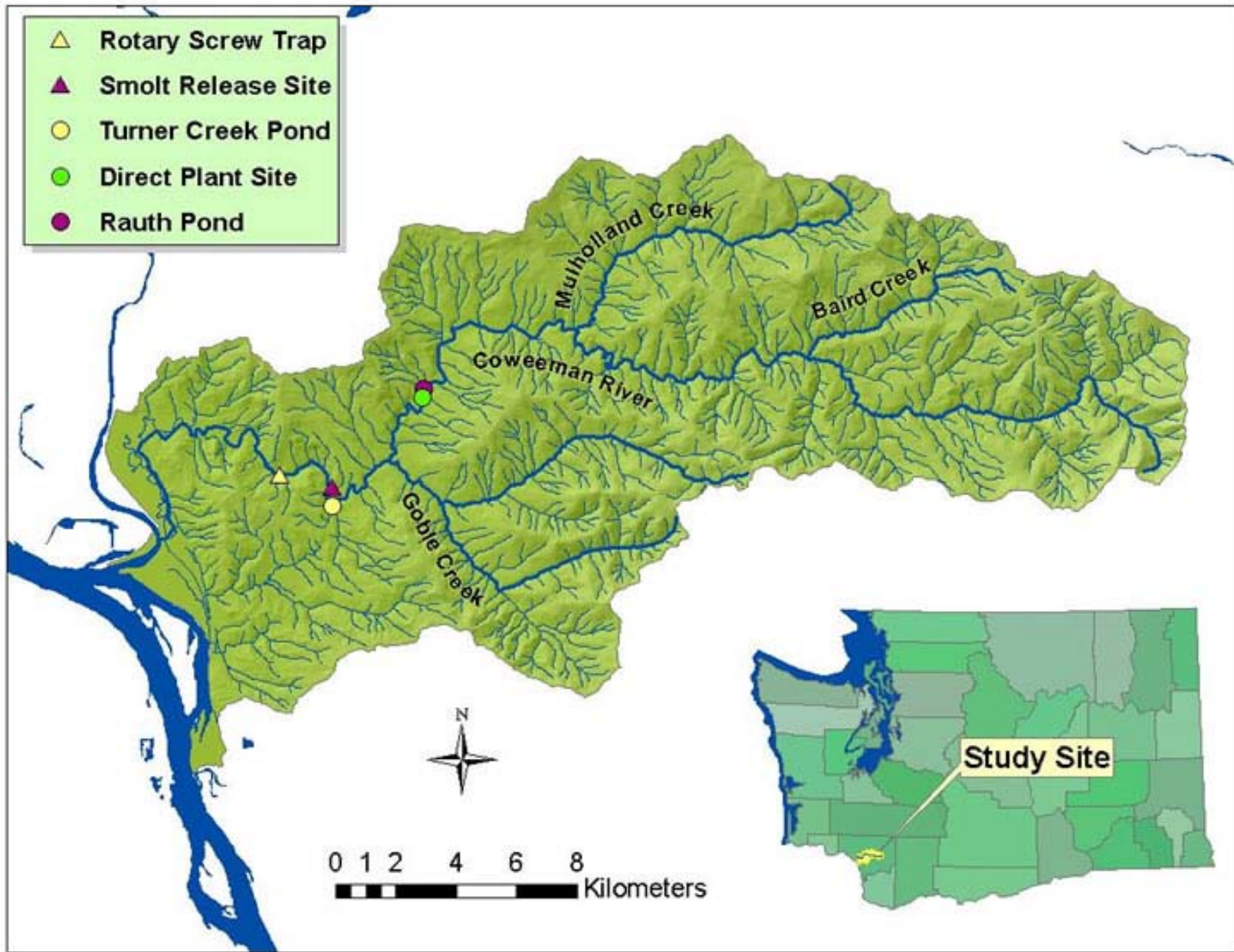
A watershed is like a funnel-  
 collecting all water within  
 the drainage area  
 and channeling it  
 into a stream,  
 river,  
 or lake.





- Inside the geographic divide, all of the water in an area will eventually flow into one river channel
- The very small streams that first collect water at the source of the river are called headwaters
- Headwater tributaries are ranked by size, 1<sup>st</sup> order are the smallest, when they combine they form 2<sup>nd</sup> order streams, that will eventually come together and form 3<sup>rd</sup> order streams, so on and so on...



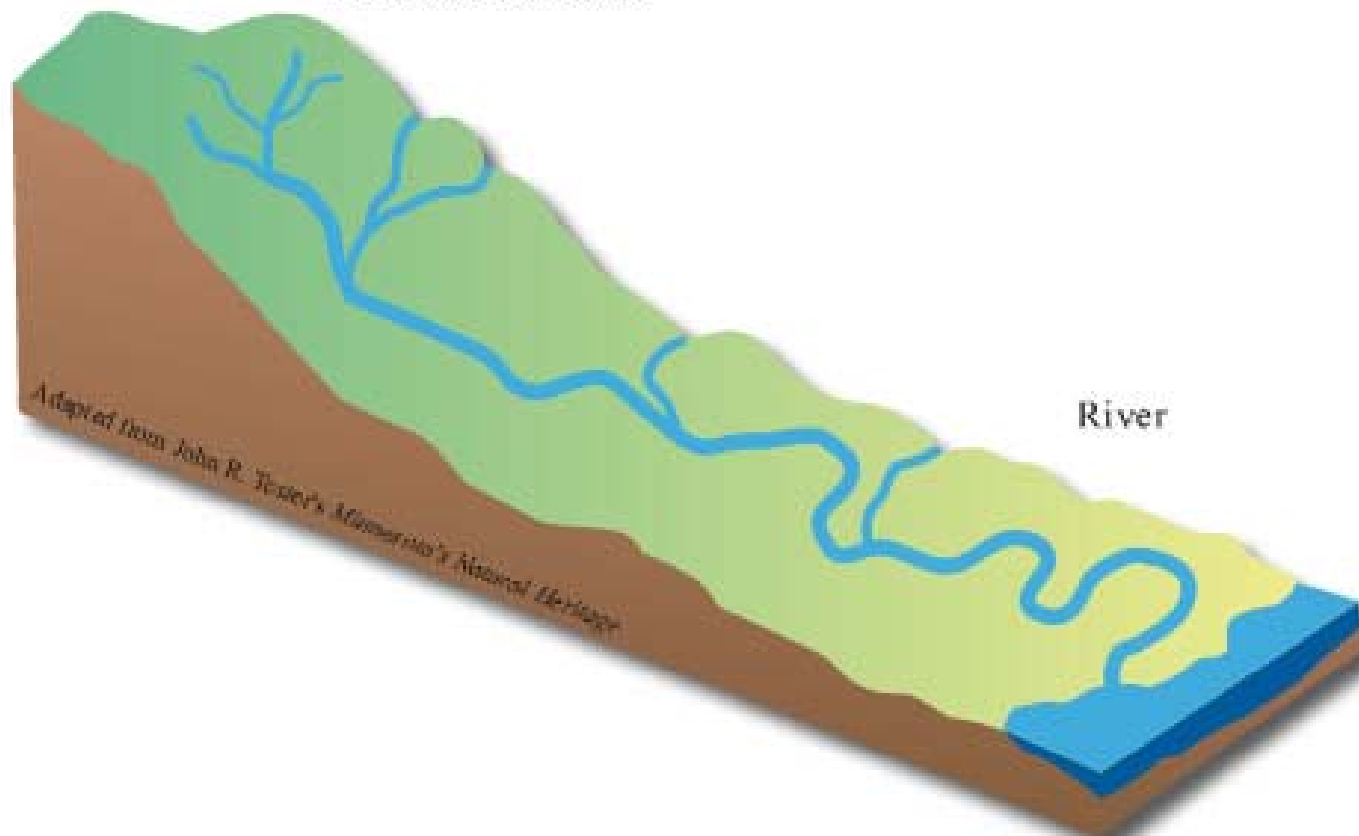


Drainage divide

Headwater streams

River

Confluence with larger river



*Adapted from John R. Taper's Minnesota's Natural Heritage*

- Rivers channels are typically made up of a stream bed, with banks on either side, outside of the river banks are called flood plains
- The edge of the floodplain where the land and the stream meet is called a riparian zone or area
- It is usually lined with riparian vegetation, characterized by hydrophilic plants.
- These areas are important because they help prevent erosion, aiding in soil conservation. This is because they buffer the effects of fast moving flood waters



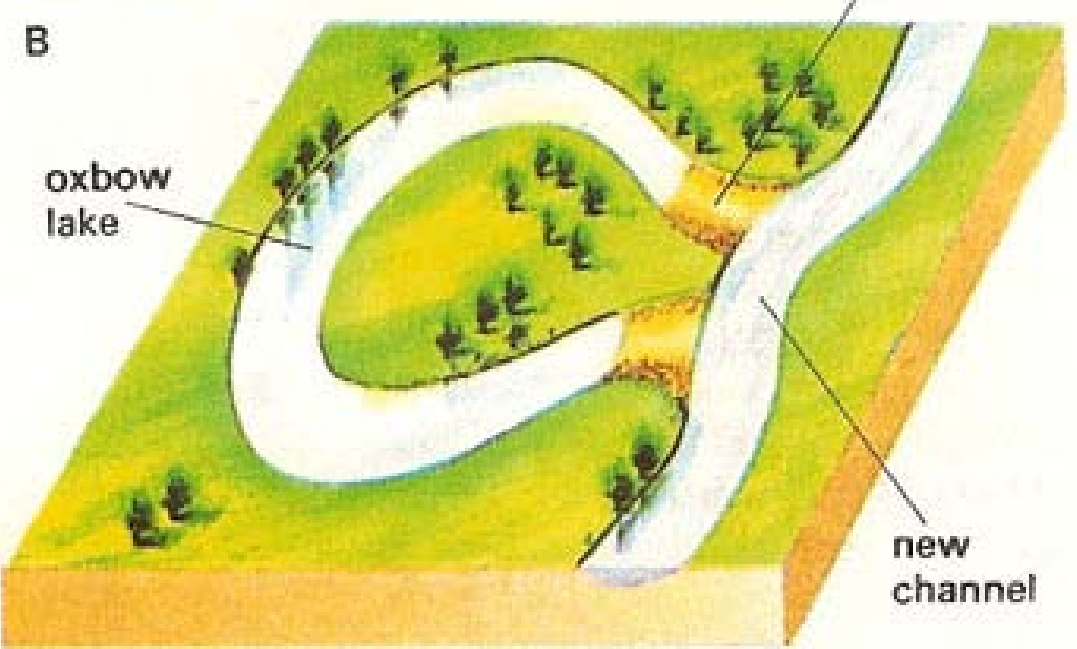
Meanders of the Rio Cuato



Braided River, multiple channels, New Zealand

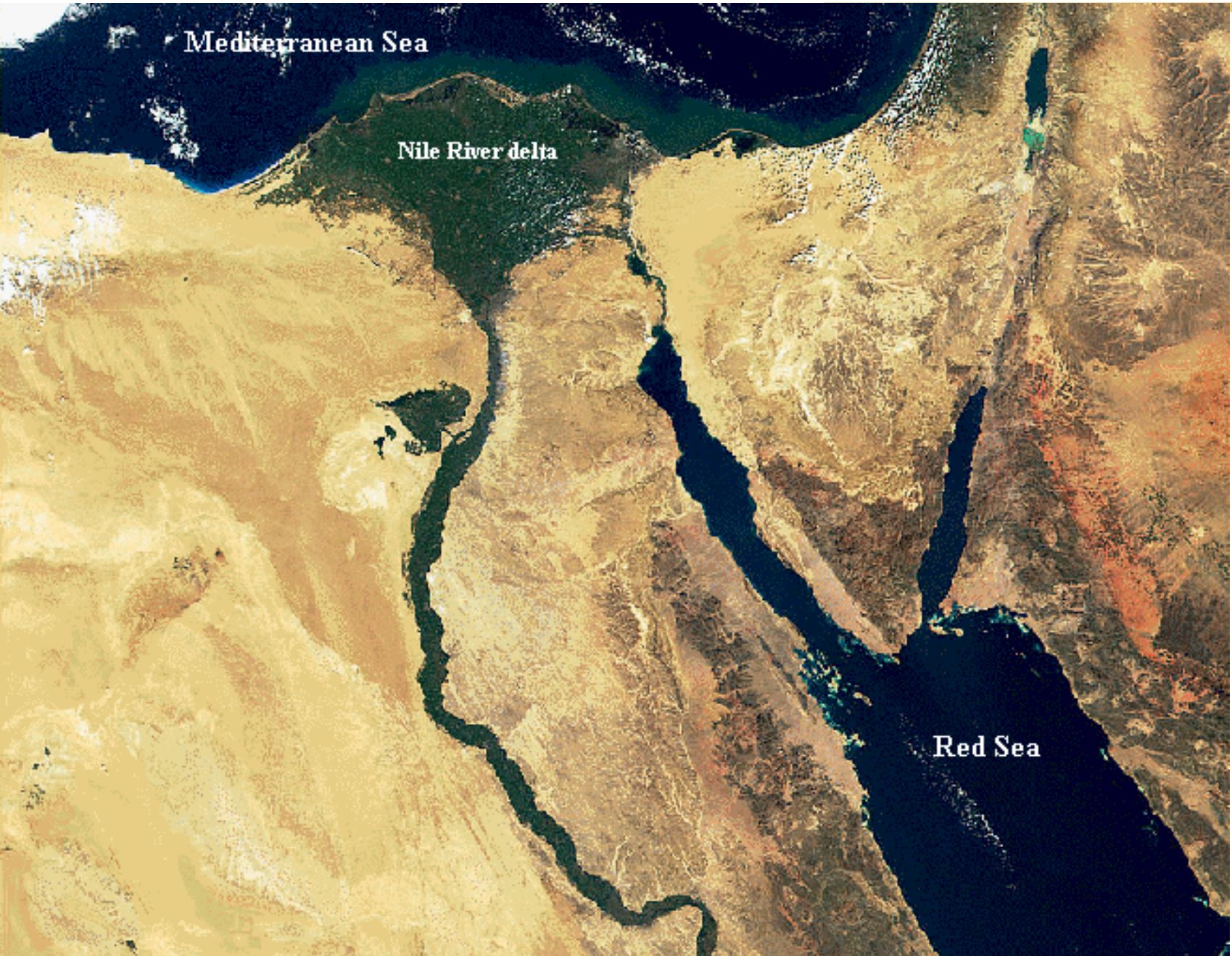


Formation of an Oxbow Lake



- Where the water pours out of a river channel into a larger body of water is called a delta
- The delta is where all of the sediment that is suspended in a stream dumps out, as the water slows





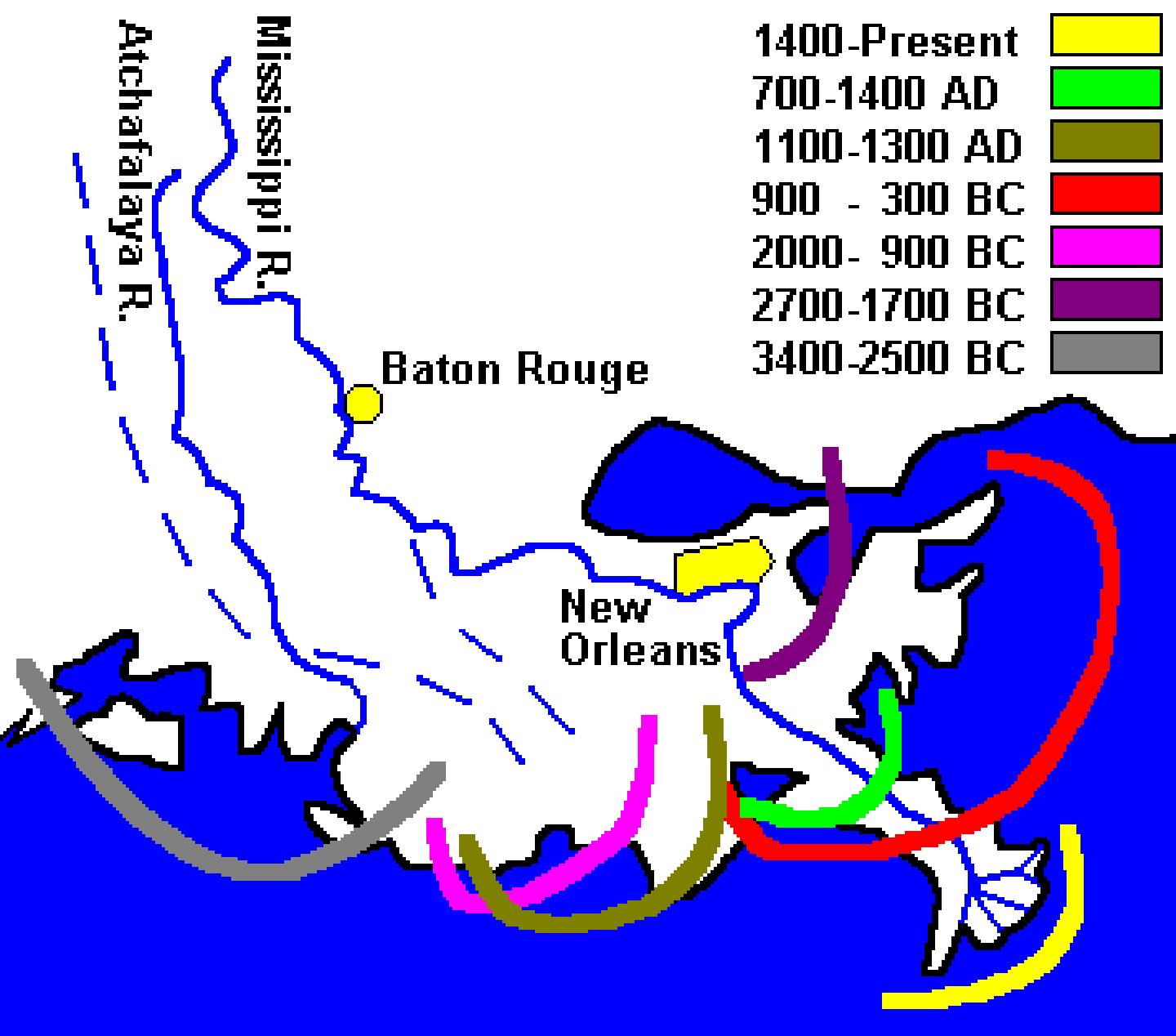
Mediterranean Sea

Nile River delta

Red Sea

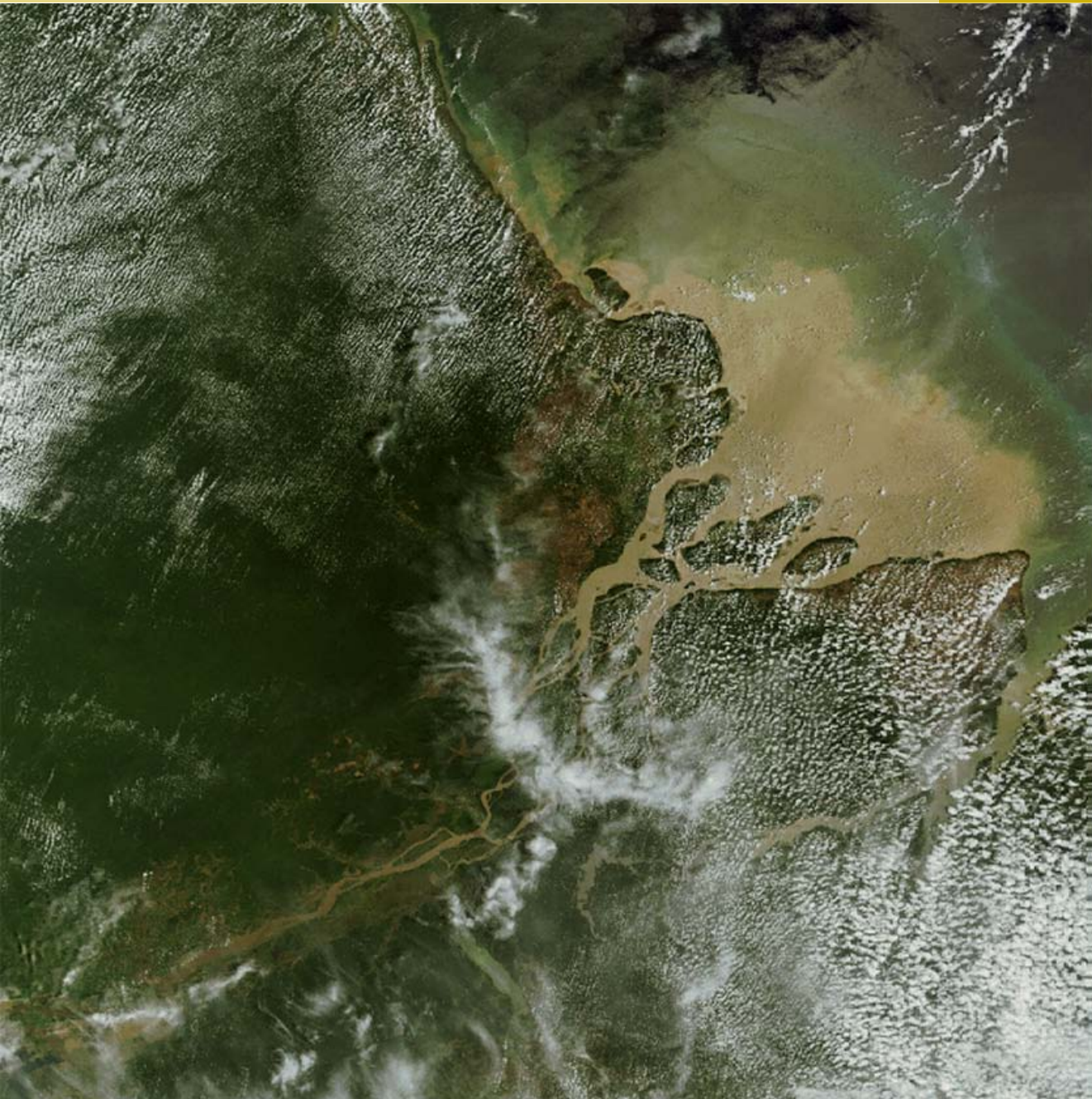


Mississippi River Delta



- 1400-Present
- 700-1400 AD
- 1100-1300 AD
- 900 - 300 BC
- 2000- 900 BC
- 2700-1700 BC
- 3400-2500 BC

Migration of the Mississippi river channel and Delta



Amazon River Delta

# Types of Rivers

## ▫ Youthful Rivers

- A river with steep gradient, few tributaries and a rapid flow, the channel is usually deep and narrow

## ▫ Mature Rivers

- Less steep gradient, flows more slowly. Many tributaries and higher discharge. Channel becomes wider with time

## ▫ Old Rivers

- River with a low gradient and very little erosion, usually have extensive flood plains

## ▫ Rejuvenated Rivers

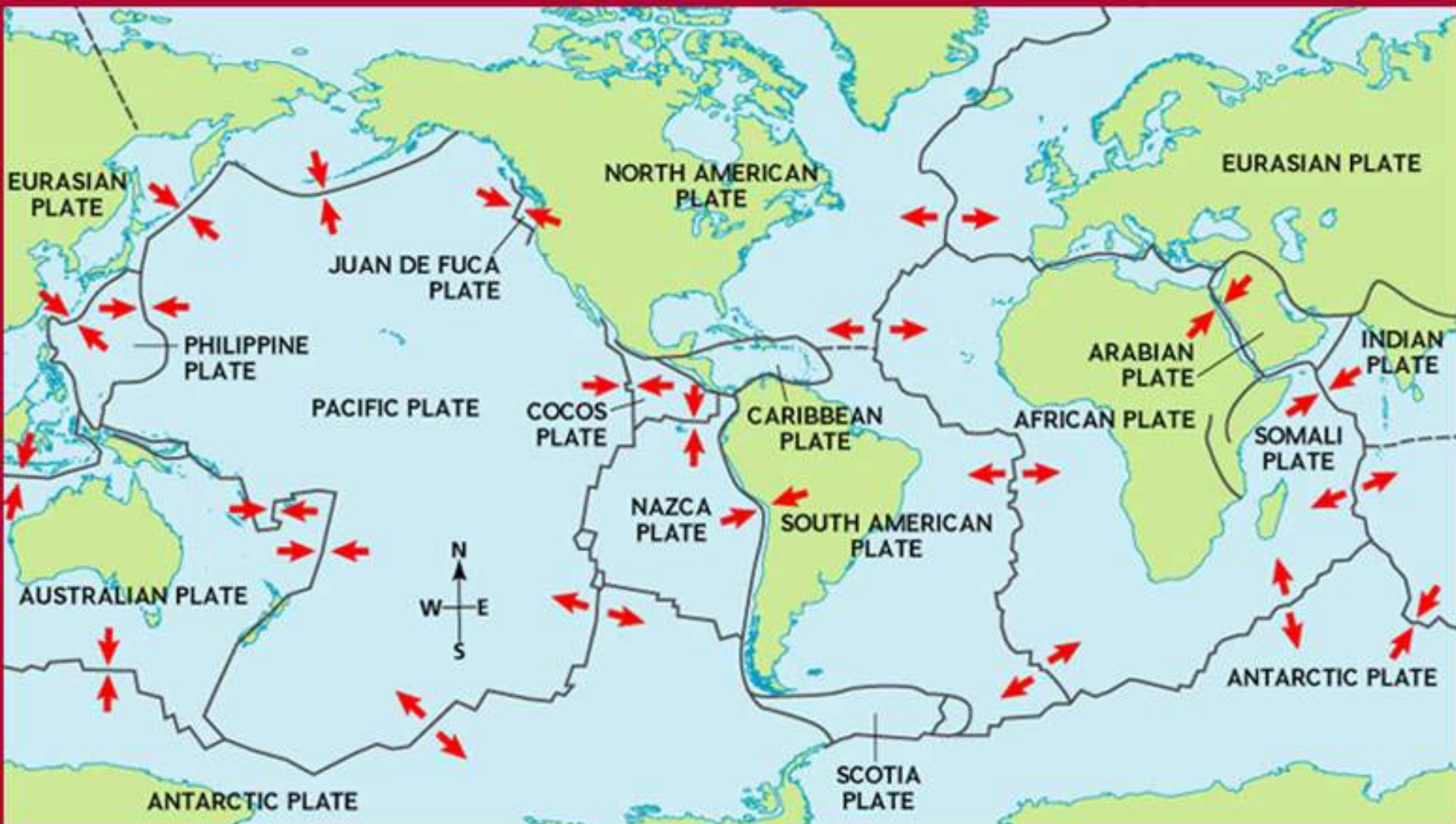
- A river that has been lifted by tectonic uplift

# **Plate Tectonics & Rock Cycle**

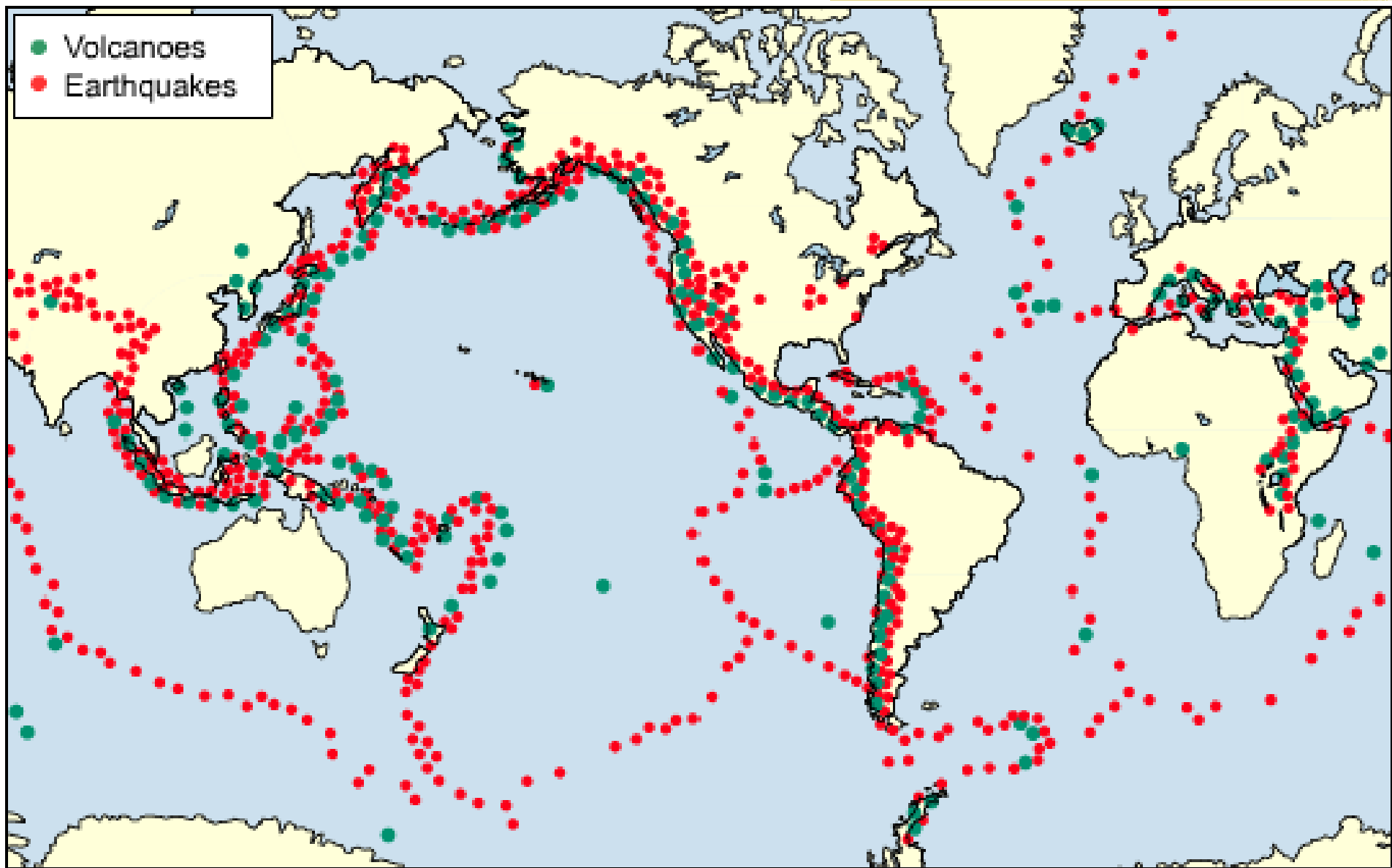
# Plate Tectonics

- Theory was developed to explain large scale motions of Earth's lithosphere
- Developed by Alfred Wegener
- Very important because it maintains the balance of carbon in the environment
- Earth's crust is broken up into several major plates(7-8) and various secondary plates
- Continental Drift + Sea Floor Spreading + data = Theory of Plate Tectonics

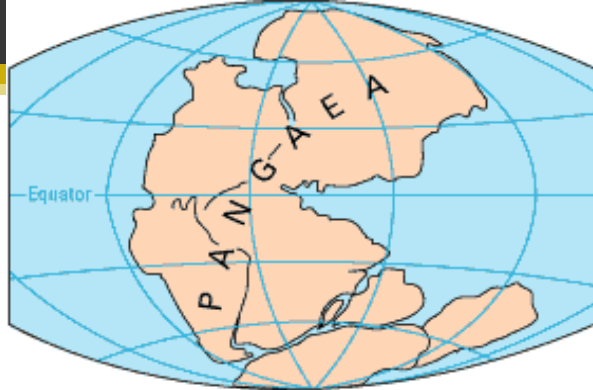
# Plates and Plate Movement



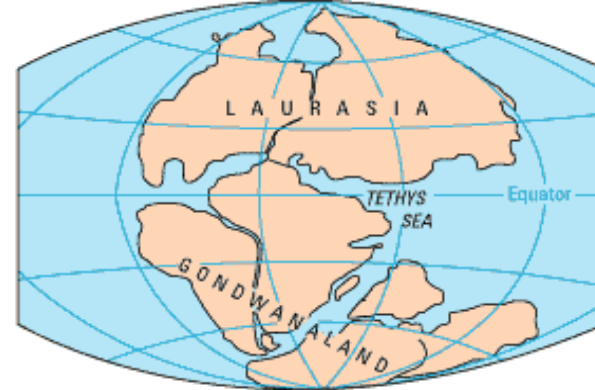




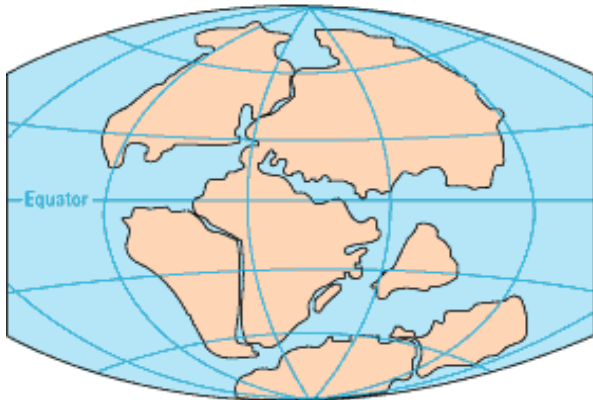
Tectonic Plate boundaries marked by volcanic and seismic activity



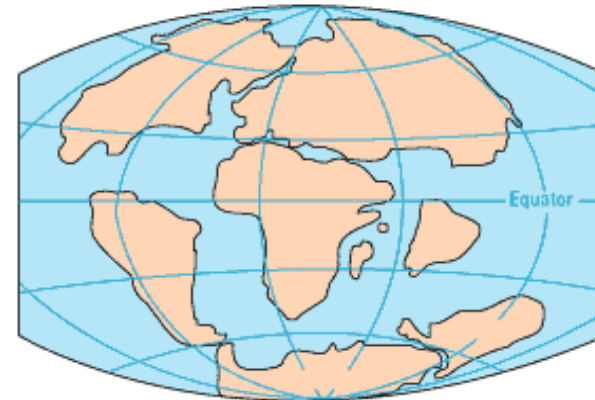
**PERMIAN**  
225 million years ago



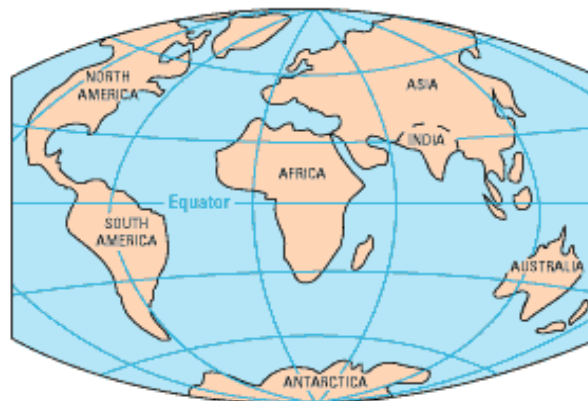
**TRIASSIC**  
200 million years ago



**JURASSIC**  
135 million years ago



**CRETACEOUS**  
65 million years ago



**PRESENT DAY**

# Evidence for Plate Tectonics

- Puzzle like fit of the continents
- Fossil Distribution, Geologic similarities on opposing shores
- Sea-Floor Polarity patterns
- Age of sea floor

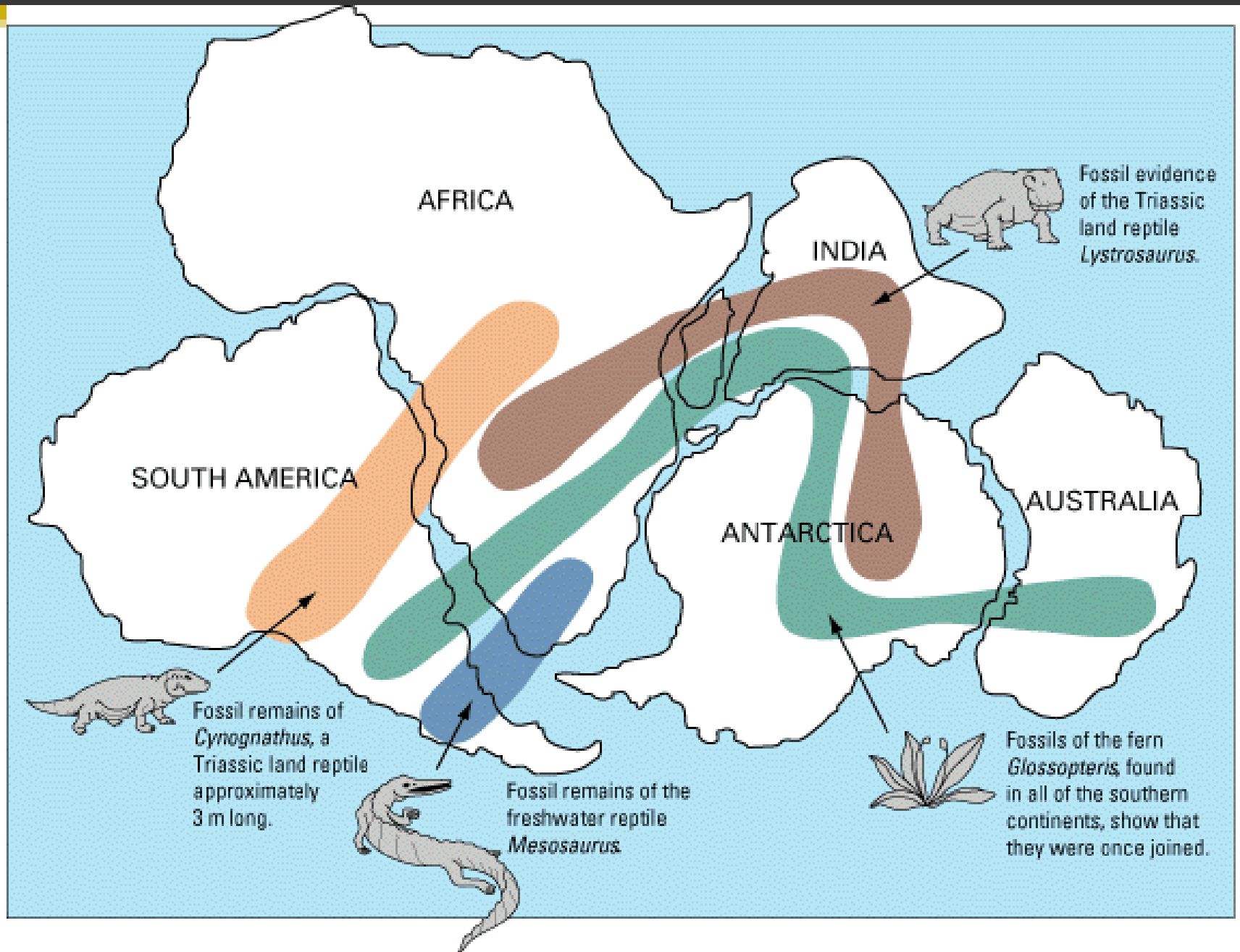


South  
America

Africa

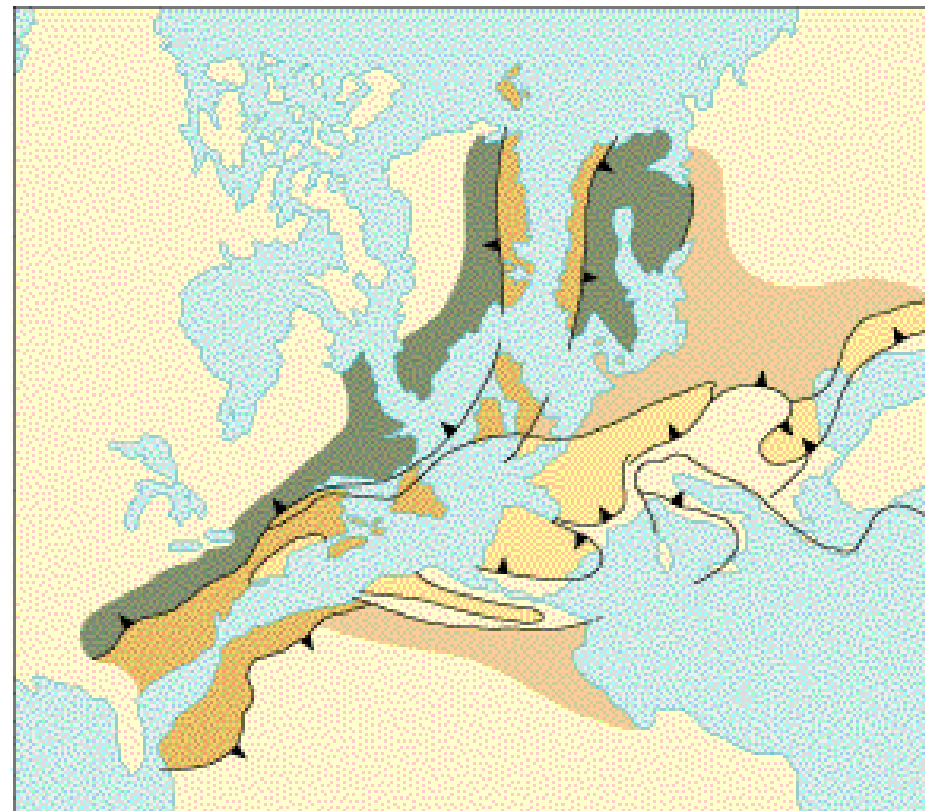
Areas of plate  
overlap

Continental  
shelf



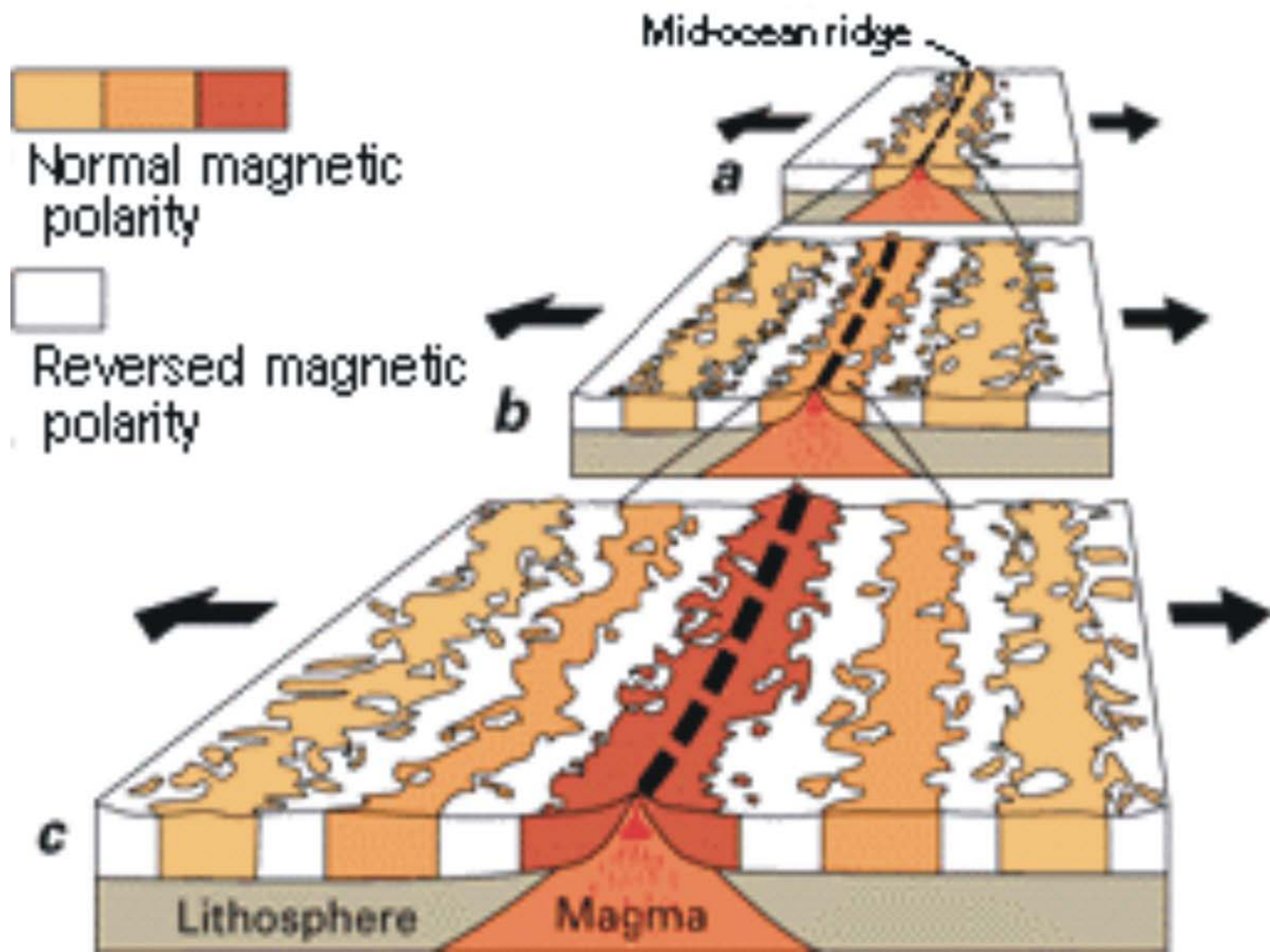


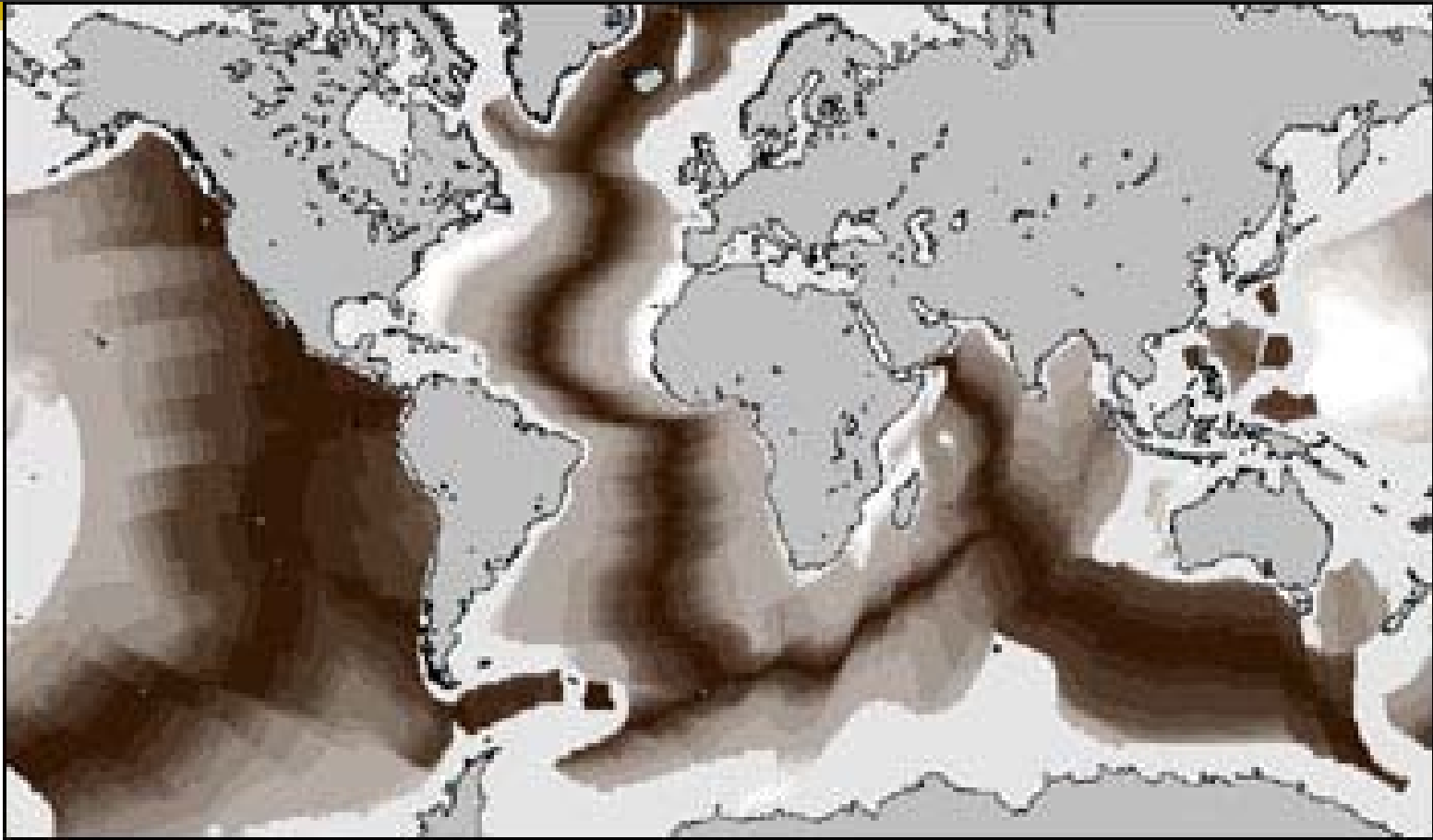
(a)



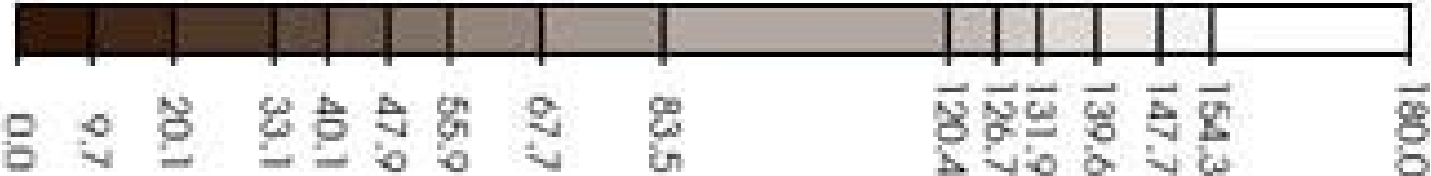
(b)

Similarities of Geological Formation



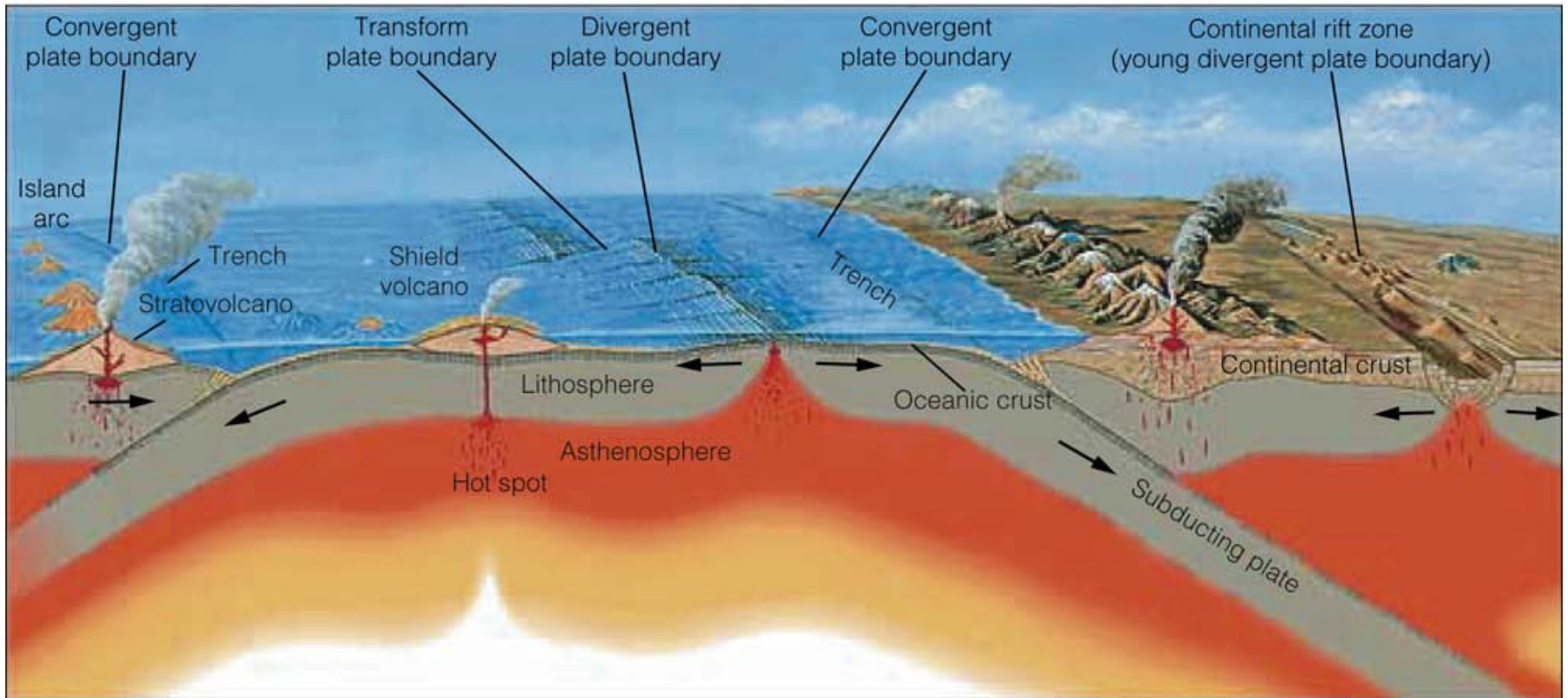
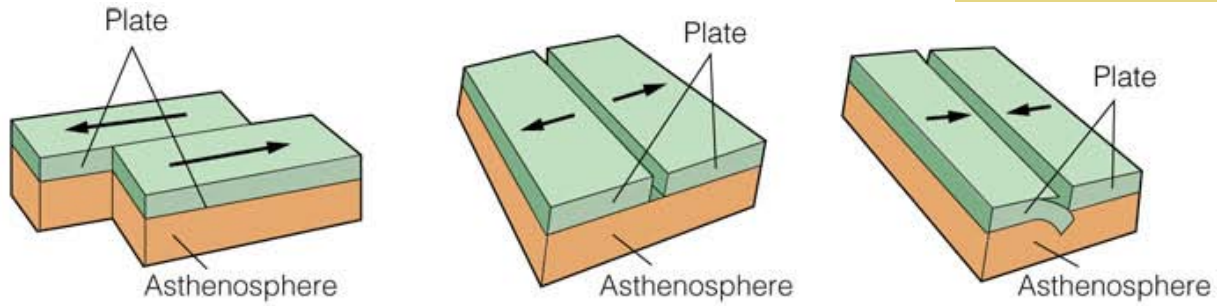


**Age of Ocean Crust**  
(Millions of Years Before Present)



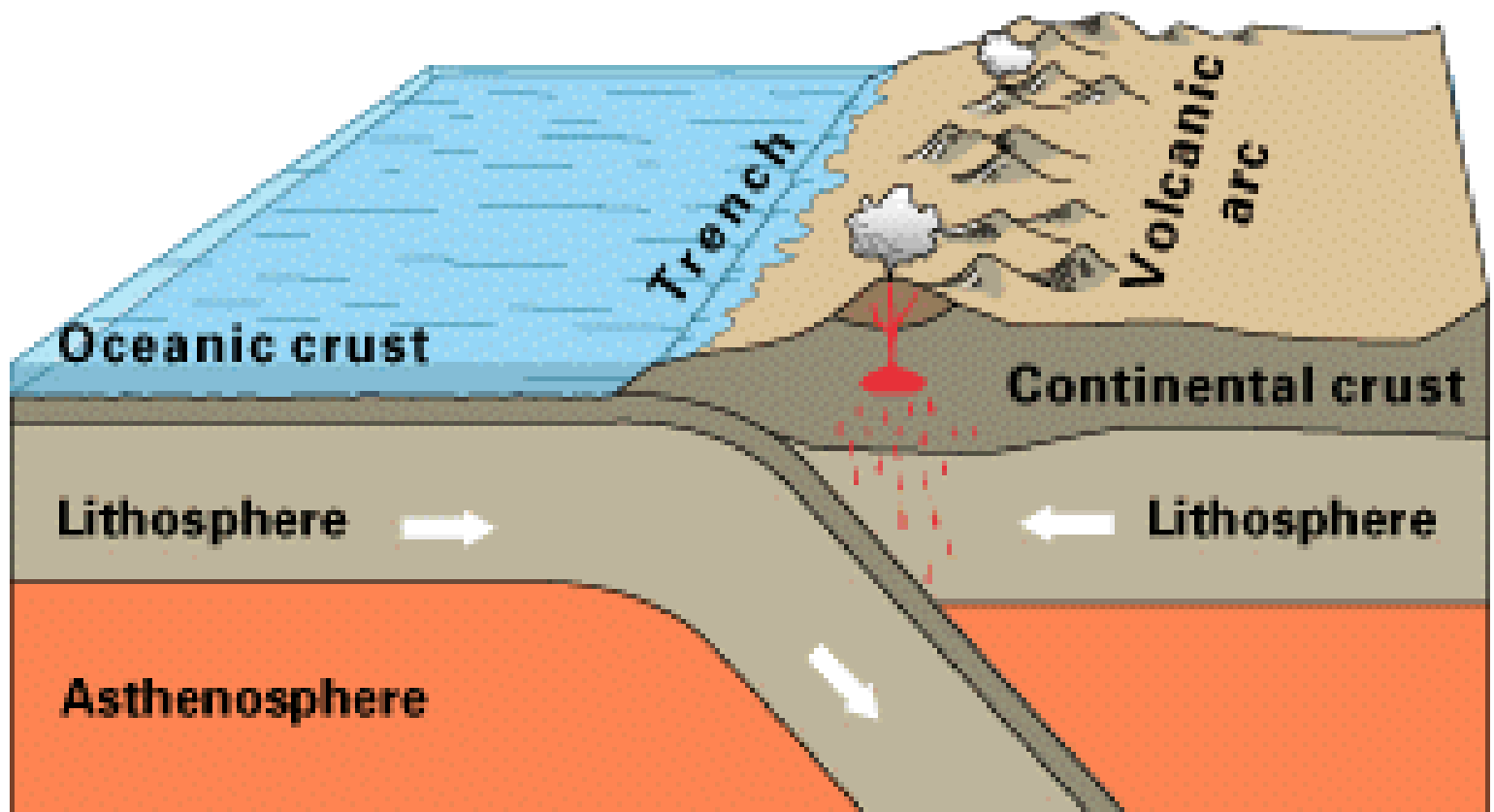


- The lithospheric plates ride around on the asthenosphere- plastic-like layer of the upper mantle
- Plates interact with one another at 1 of 3 types of plate boundaries
  - **Convergent** –collision boundaries where plates move toward each other
  - **Divergent** –where the plates are moving away from one another
  - **Transform** boundaries- where plates slide past each other, side to side



# Plate Boundaries

- Convergent Boundaries
  - Ocean-Ocean
    - one plate (typically the older one) will subduct under the other → volcanic island arc
  - Ocean-Continental
    - The oceanic plate will subduct under the continental plate → melt → volcanic arc & trench
  - Continental-Continental
    - Neither plate will subduct → plates begin to fold and crumble → mountain ranges





**Mariana Trench** – deepest part of the world's oceans

2550 km long, 70 km wide

Challenger Deep  
11,033 meters deep (36,000 ft)

If Mt. Everest was set in the bottom it would be covered by 6000 ft of water