



ECIV 3302  
Engineering Geology

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# Chapter 9

# PLATE TECTONICS

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The materials are adapted from the presentation of Stan & Cindy Hatfield

# Continental drift: An idea before its time

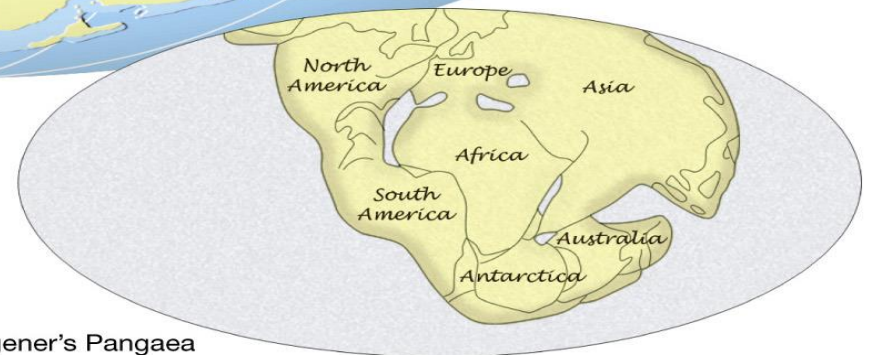
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- Alfred Wegener
  - First proposed his continental drift hypothesis in 1915
  - Published *The Origin of Continents and Oceans*
- Continental drift hypothesis
  - Supercontinent called **Pangaea** began breaking apart about 200 million years ago

# Pangaea approximately 200 million years ago



A. Modern reconstruction of Pangaea

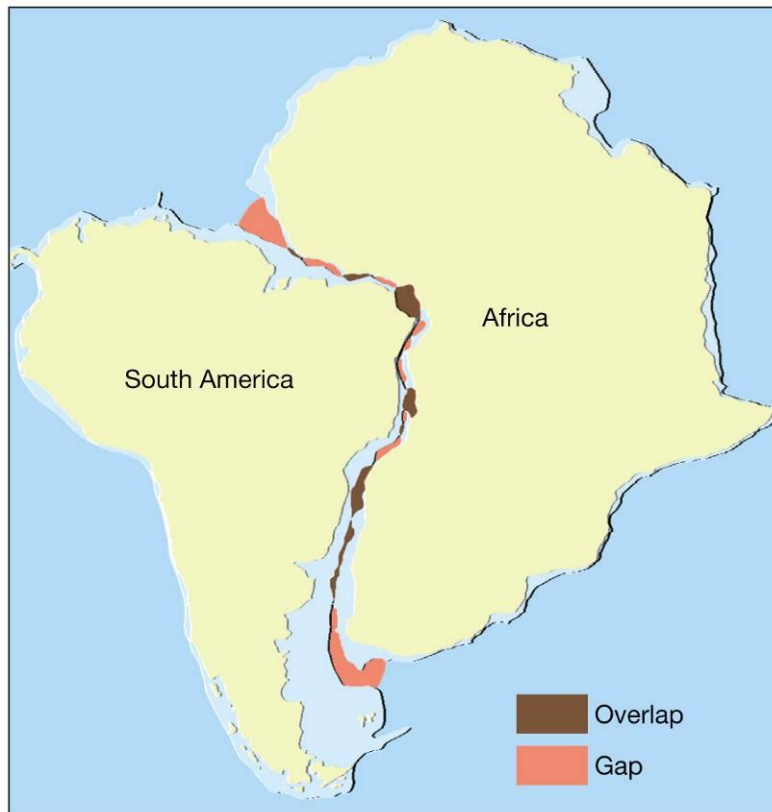


B. Wegener's Pangaea

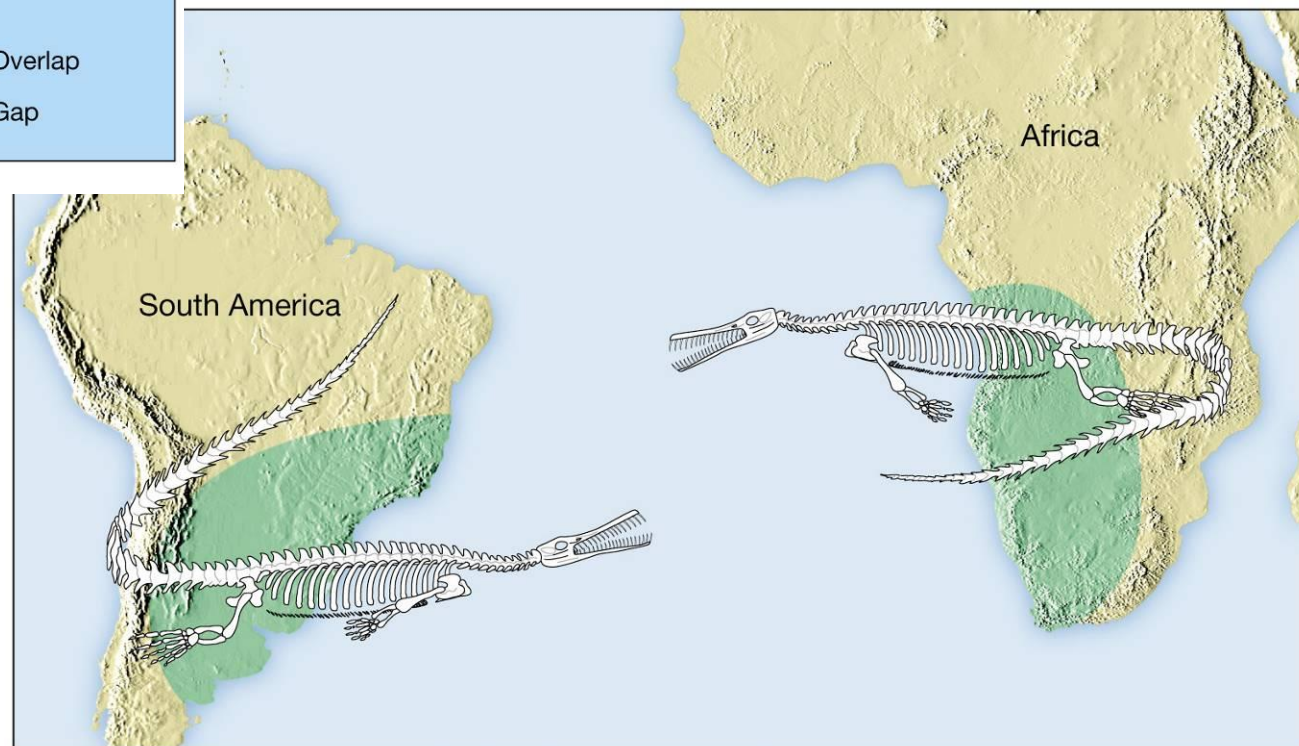
# Continental drift: An idea before its time

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- Continental drift hypothesis
  - Continents "drifted" to present positions
- Evidence used in support of continental drift hypothesis
  - Fit of the continents
  - Fossil evidence
  - Rock type and structural similarities
  - Paleoclimatic evidence



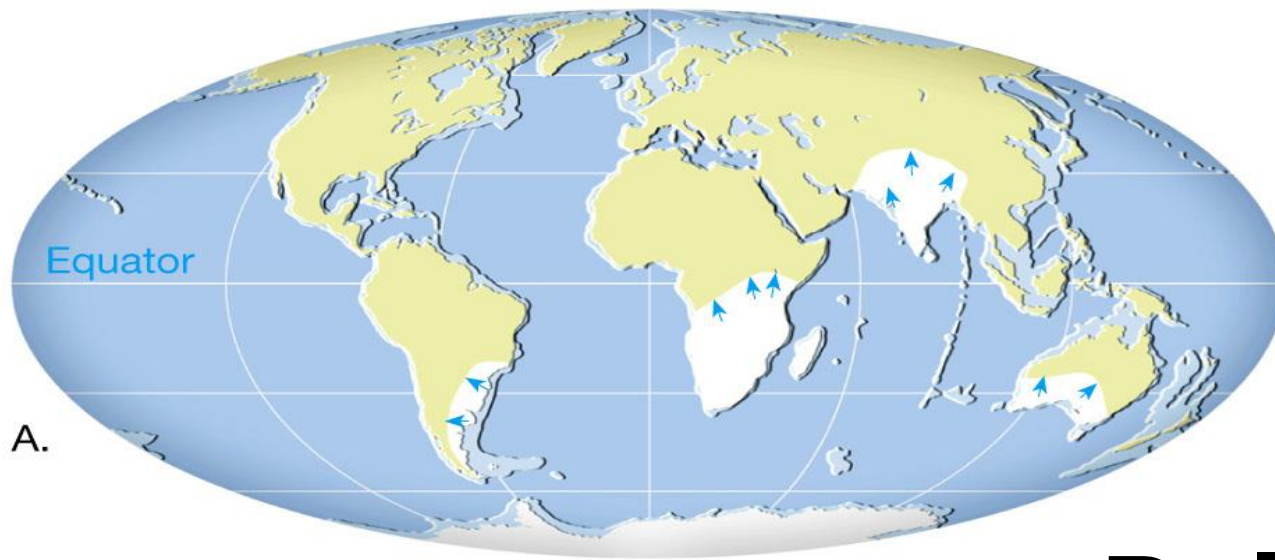
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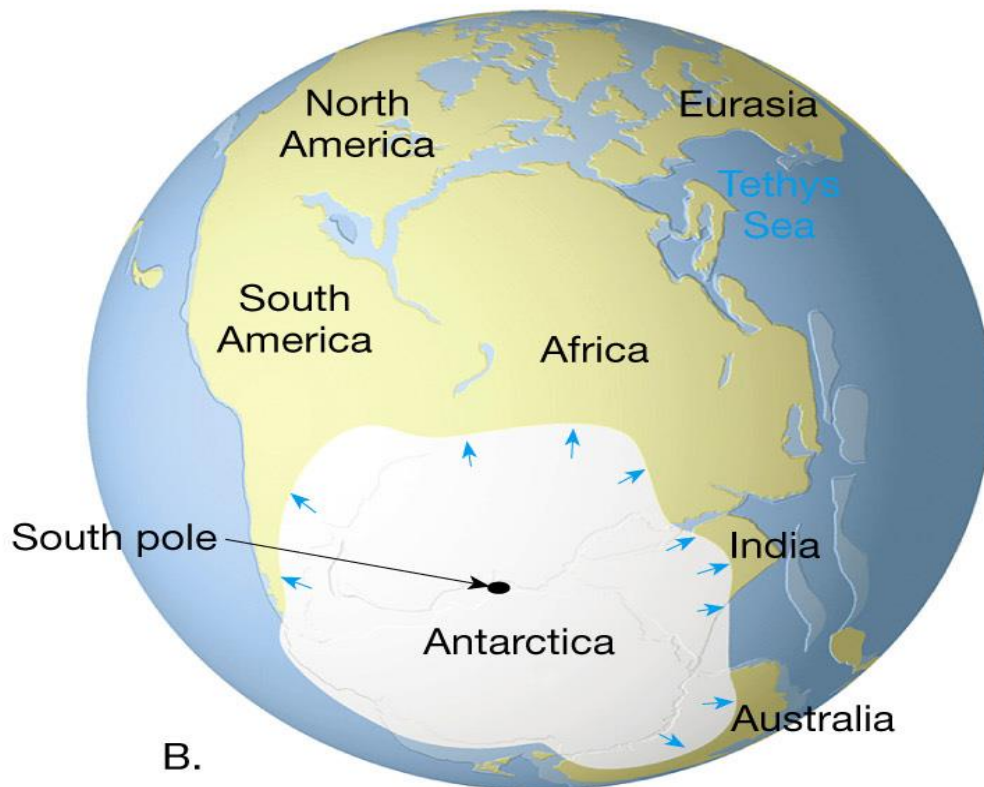


# Matching mountain ranges



A.

# Paleoclimatic evidence

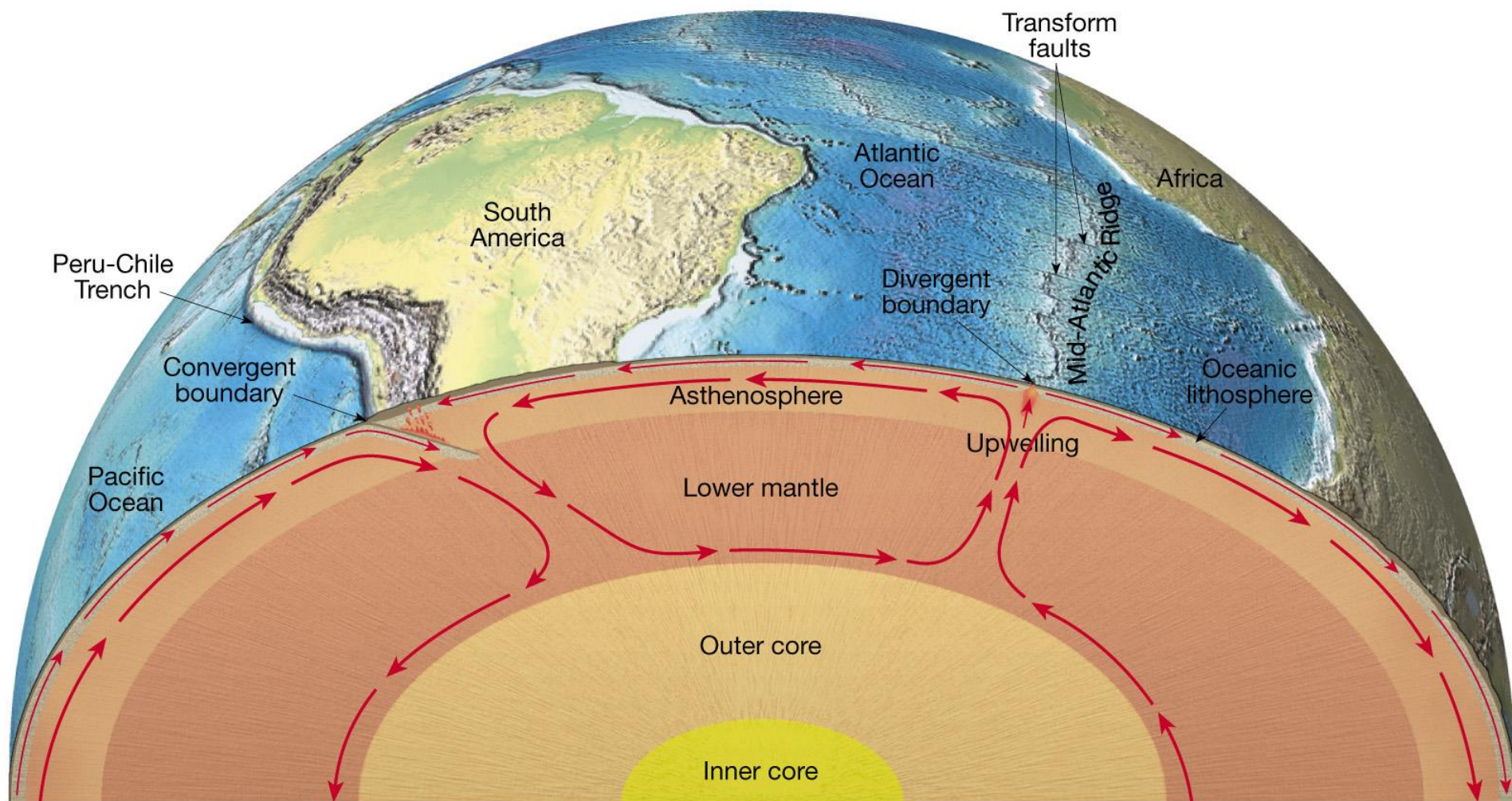


B.

# A scientific revolution begins

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- During the 1950s and 1960s technological strides permitted extensive mapping of the ocean floor
- **Seafloor spreading hypothesis** was proposed by Harry Hess in the early 1960s



# Plate tectonics: The new paradigm

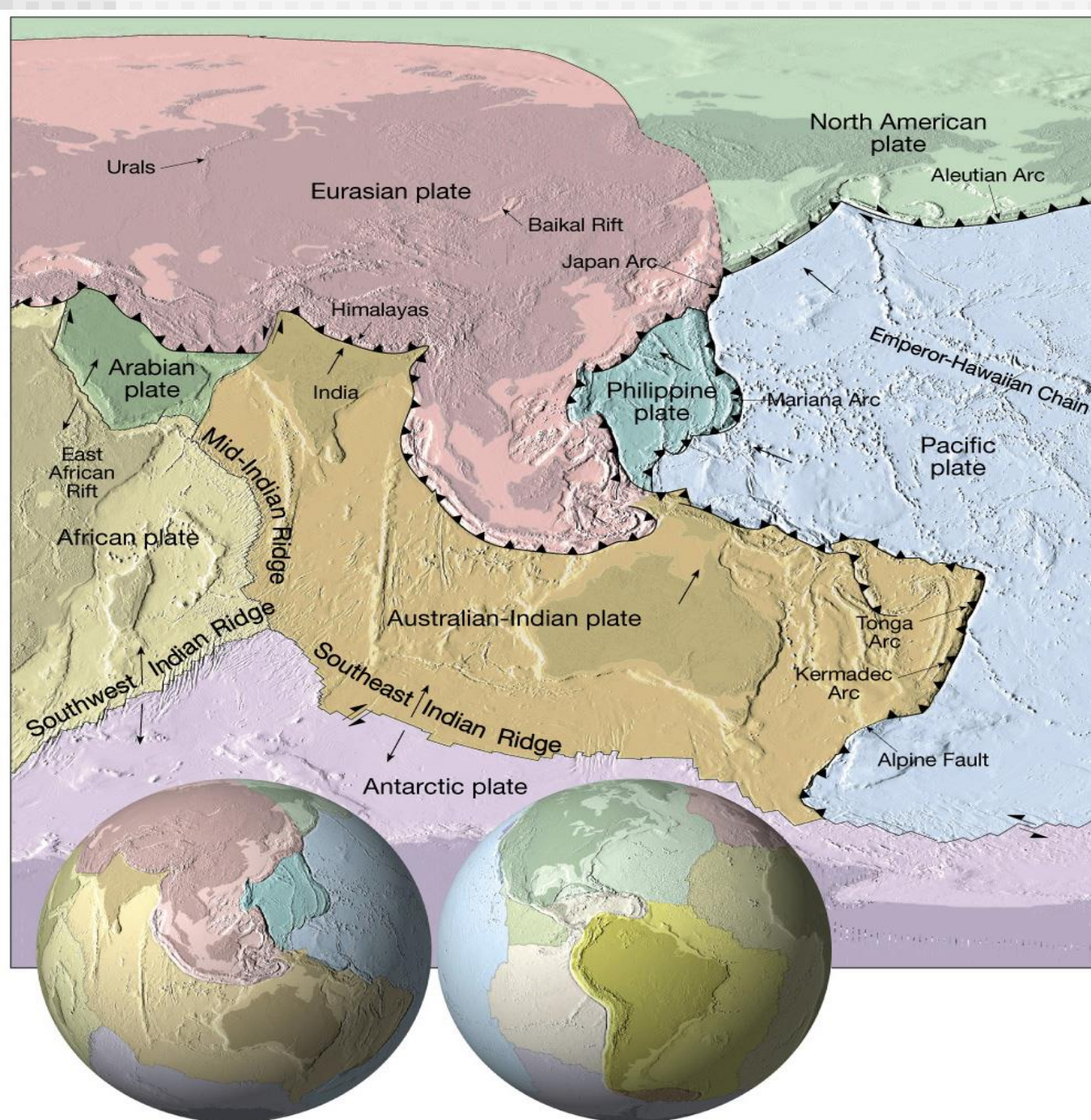
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- Earth's major plates are associated with Earth's **Lithosphere**:
  - A strong, rigid outer layer;
  - Broken into pieces called Plates
  - Consists of uppermost mantle and overlying crust
  - Overlies a weaker region in the mantle called the **asthenosphere**

# Plate tectonics: The new paradigm

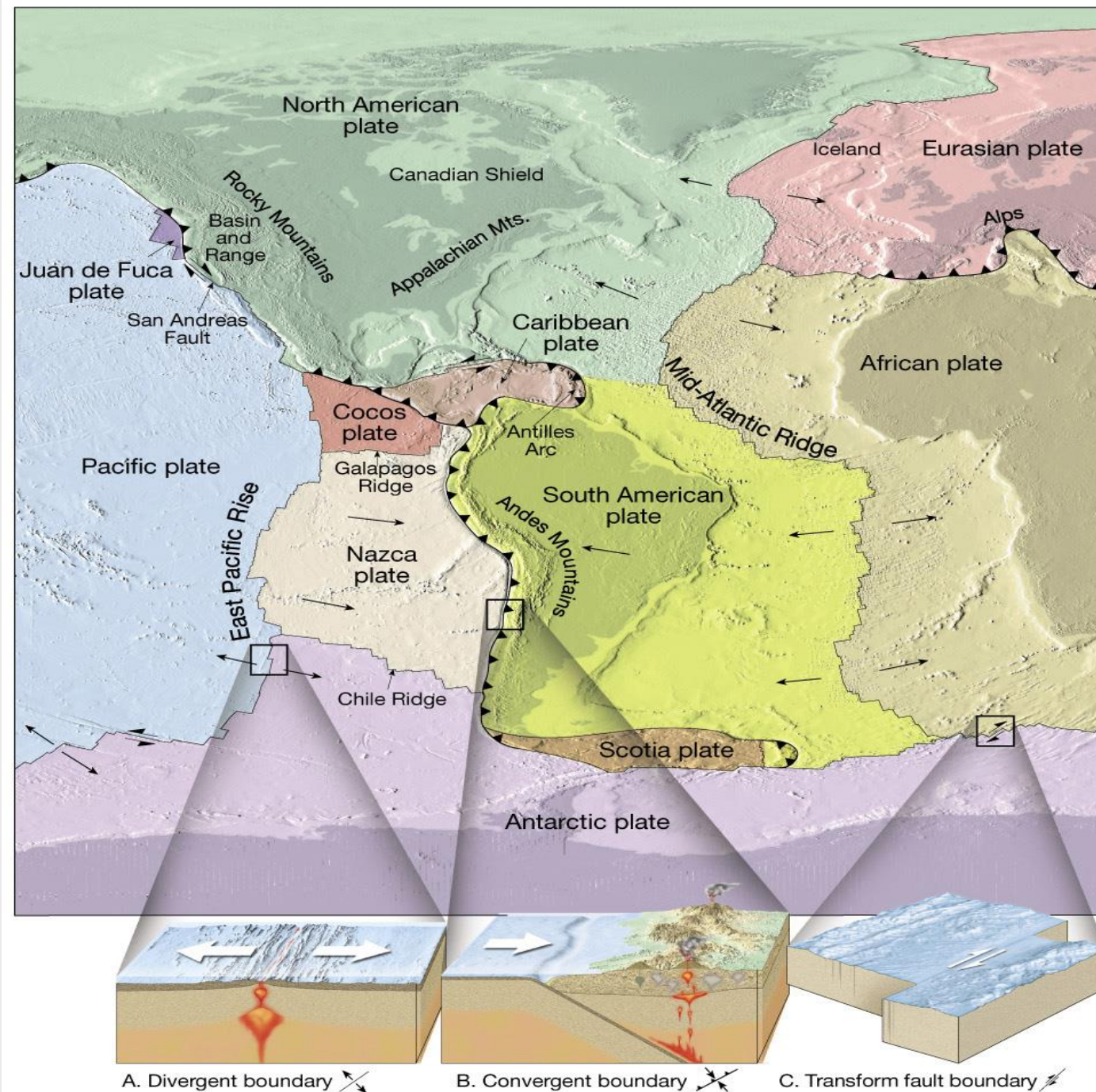
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- Earth's major plates
  - Seven major lithospheric plates
  - Plates are in motion and continually changing in shape and size
  - Largest plate is the Pacific plate
  - Several plates include an entire continent plus a large area of seafloor



# Earth's plates

# Earth's plates



# Plate tectonics: The new paradigm

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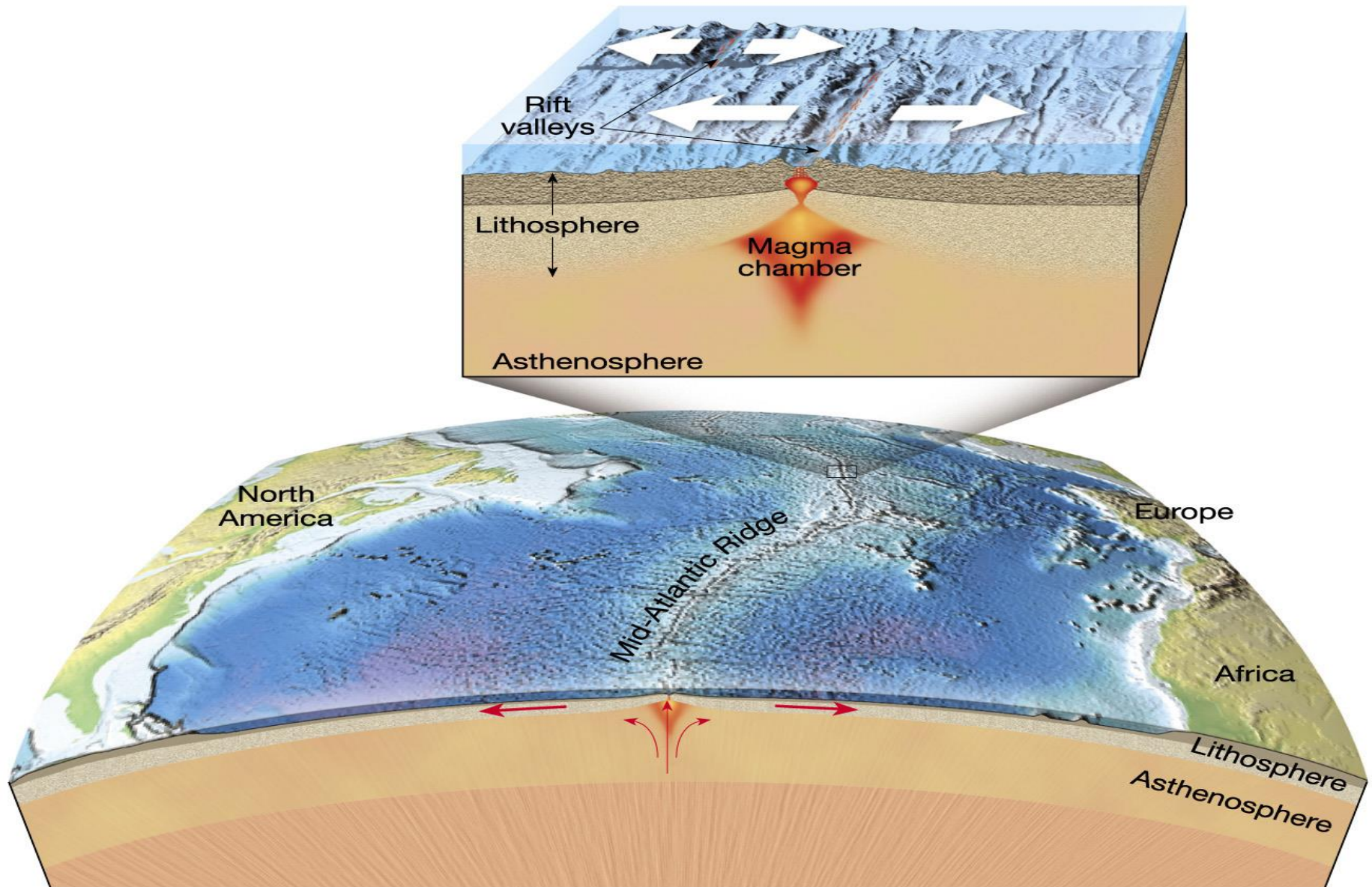
- Earth's major plates
  - Plates move relative to each other at a very slow but continuous rate
    - About 5 centimeters (2 inches) per year
    - Cooler, denser slabs of oceanic lithosphere descend into the mantle

# Plate tectonics: The new paradigm

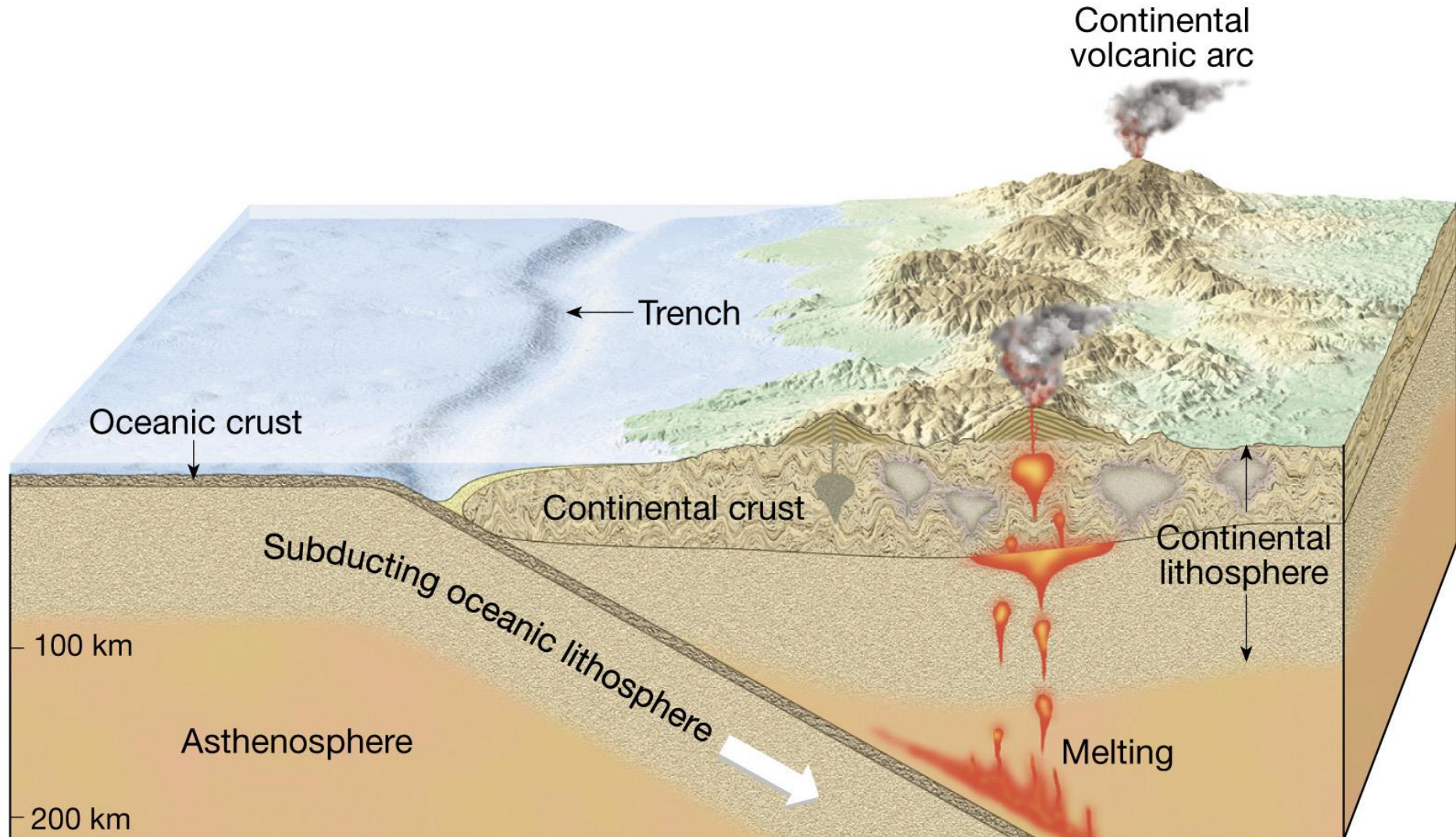
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- Plate boundaries
  - Interactions among individual plates occur along their boundaries
  - Types of plate boundaries
    - Divergent plate boundaries (constructive margins)
    - Convergent plate boundaries (destructive margins)
    - Transform fault boundaries (conservative margins)

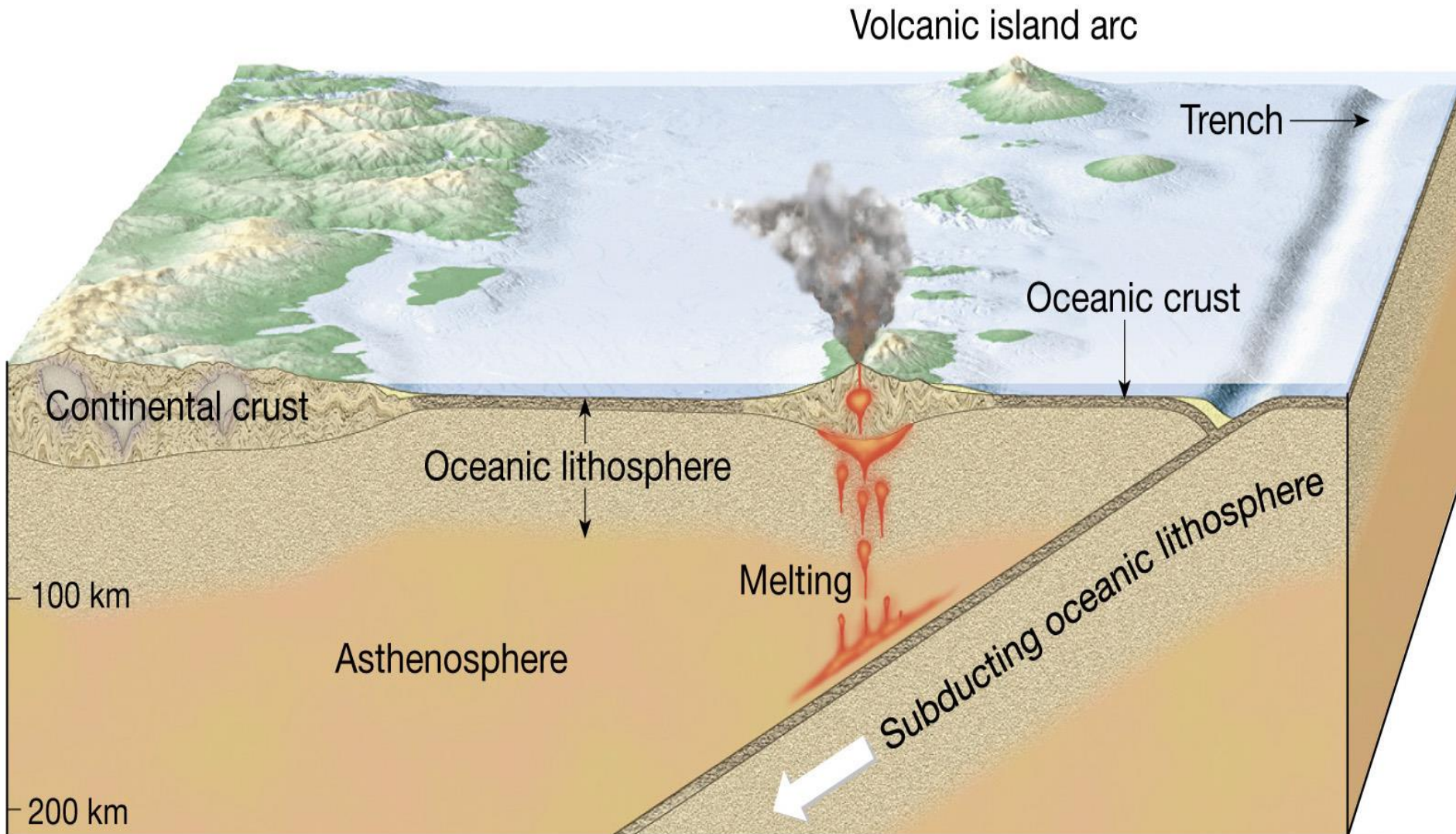
# Divergent plate boundary



# Oceanic-continental convergence



# Oceanic-oceanic convergence

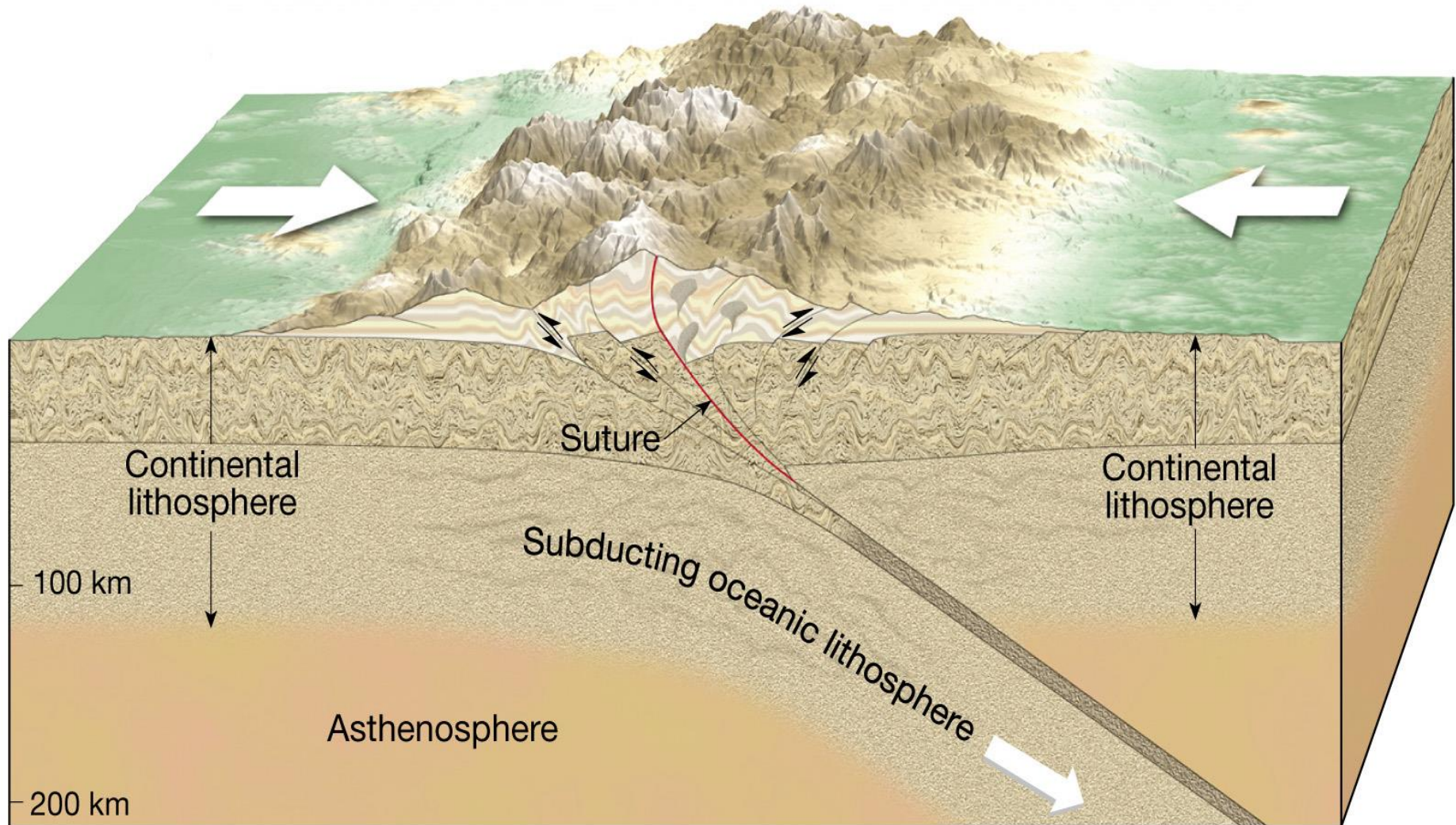


# Convergent plate boundaries

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- Types of convergent boundaries
  - Continental-continental convergence
    - Continued subduction can bring two continents together
    - Less dense, buoyant continental lithosphere does not subduct
    - Resulting collision between two continental blocks produces mountains (Himalayas, Alps, Appalachians)

# Continental-continental convergence

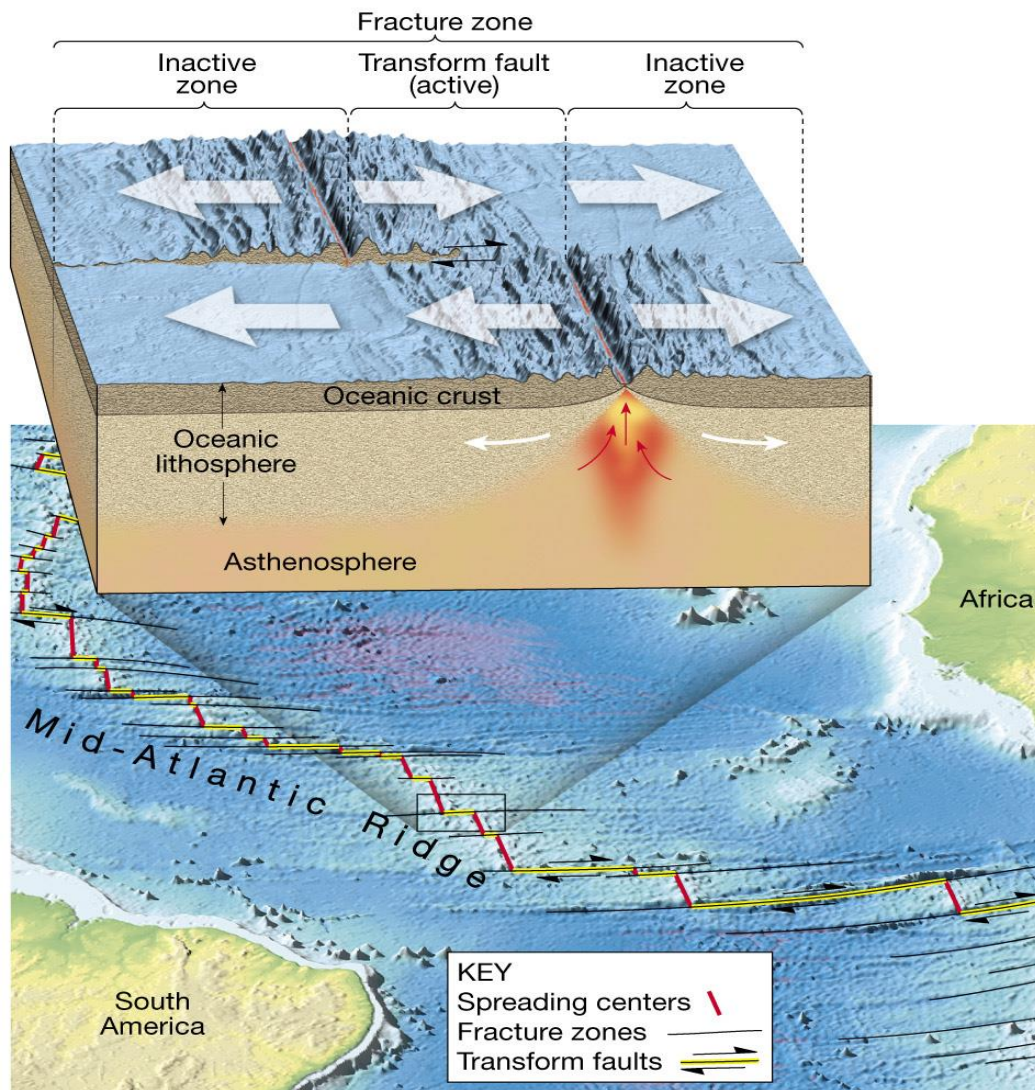


# Transform fault boundaries

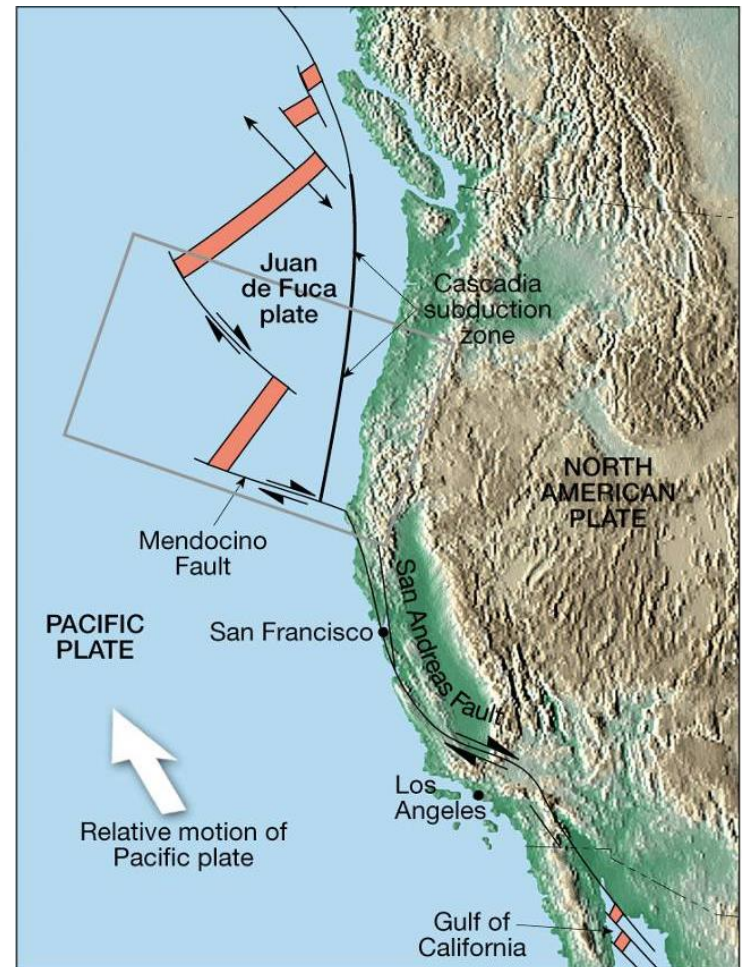
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- Plates slide past one another and no new lithosphere is created or destroyed
- Transform faults
  - Most join two segments of a mid-ocean ridge along breaks in the oceanic crust known as fracture zones
  - A few (the San Andreas fault and the Alpine fault of New Zealand) cut through continental crust

# Transform faults



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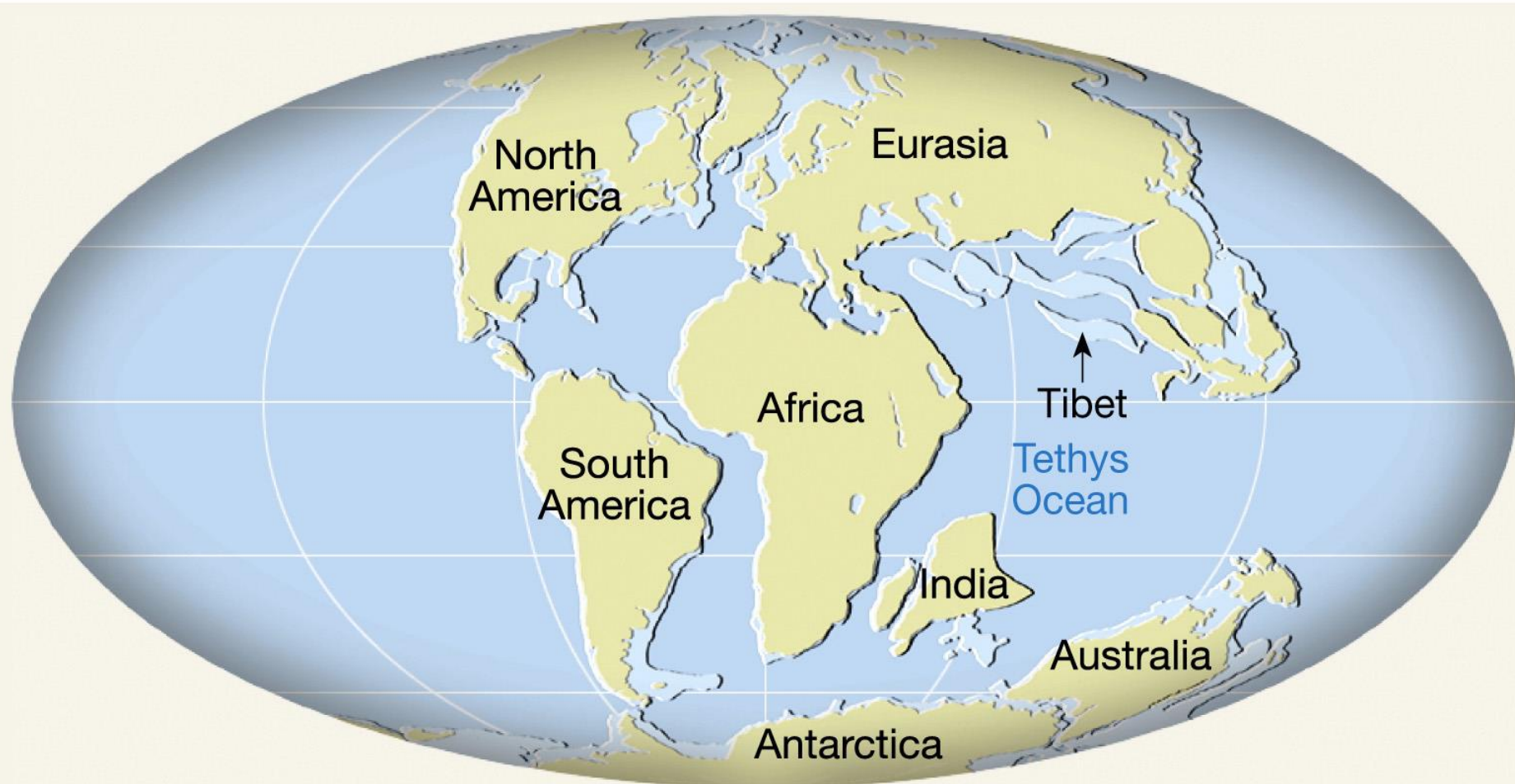
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A. 200 Million Years Ago (Early Jurassic Period)



**B. 150 Million Years Ago (Late Jurassic Period)**



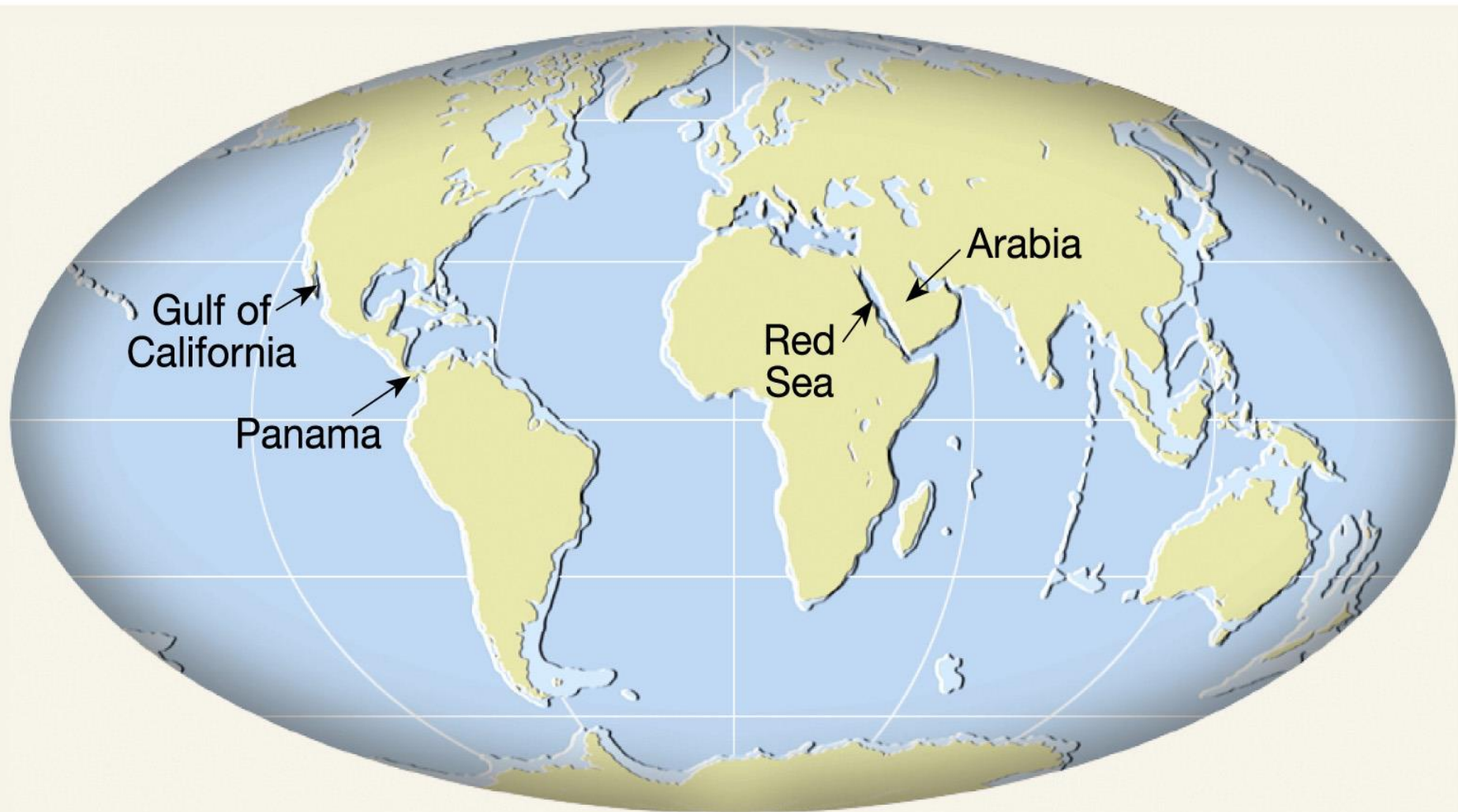
C. 90 Million Years Ago (Cretaceous Period)



**D. 50 Million Years Ago (Early Cenozoic)**



**E. 20 Million Years Ago (Late Cenozoic)**



F. Present