# ENVIRONMENTAL GEOLOGY

## *Plate tectonics*

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# Plate Tectonics: The Beginning

## Background

❖ At the beginning of the 20th Century, scientists realized that that they could not explain many of the Earth's structures and processes with a single theory. Many scientific hypotheses were developed to try and support the conflicting observations. One hypotheses was ***continental drift,*** which was proposed by Alfred Wegener in a series of papers from 1910 to 1928.

❖ The principal thought of continental drift theory is that the continents are situated on slabs of rock, or plates, and they have drifted across the surface of the Earth over time; however, originally, they were all joined together as a huge super-continent at one time.

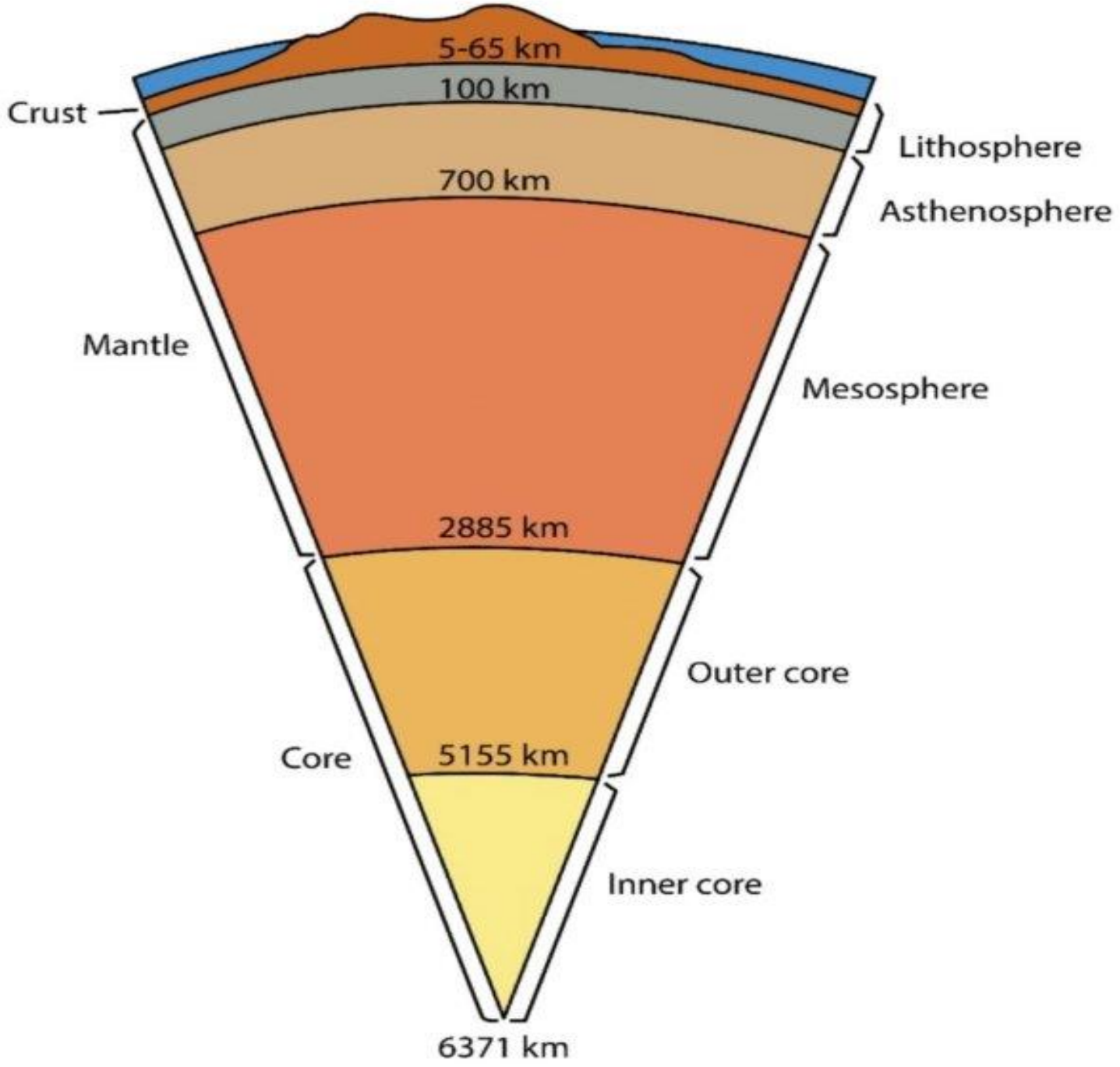
❖ In the 1960's, the theory of continental drift was combined with the theory of sea-floor spreading to create the theory of plate tectonics.

**Alfred Lothar Wegener (1880-1930)**

*(Photograph courtesy of the Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany.)*

# Plate tectonics

Plate tectonics is a scien
explains the movement
lithosphere, which is made u
the uppermost part of t
lithosphere is divided into s
move on the asthenosphere,
solid layer of the mantle. The
plates is responsible for
phenomena, such as earthq
and mountain formation.



# Evidence Supporting the Theory of Plate Tectonics

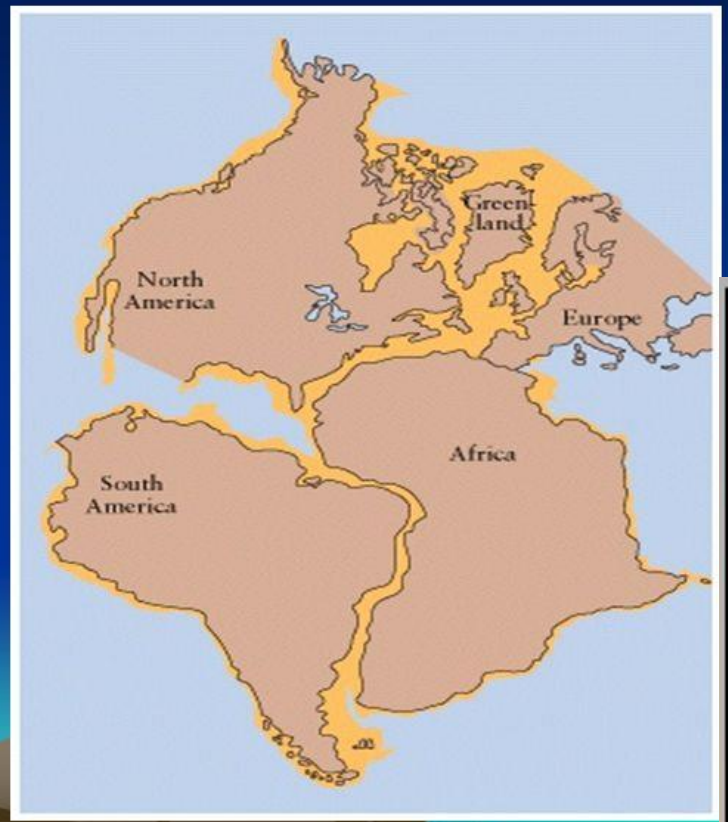
## The Matching Coastlines:

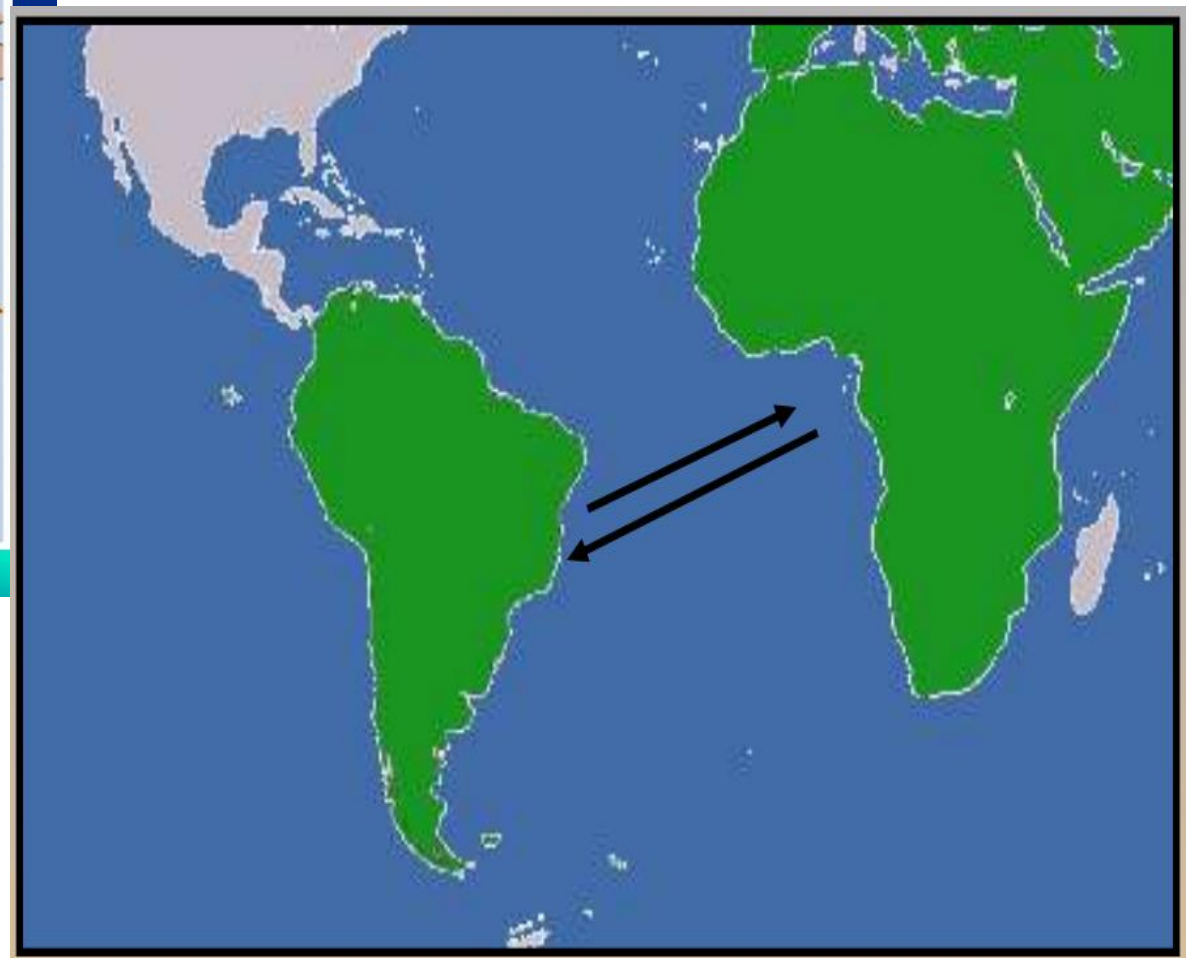
- **What was observed?** It was observed that the coastlines of continents like South America and Africa fit together like pieces of a puzzle.
- **Explanation:** Scientists initially noticed this resemblance and hypothesized that the continents were once connected in a supercontinent called **Pangaea**, which later split and moved to their present locations.

# 1. "Puzzle Pieces"

- Continents coastlines fit together like puzzle pieces.

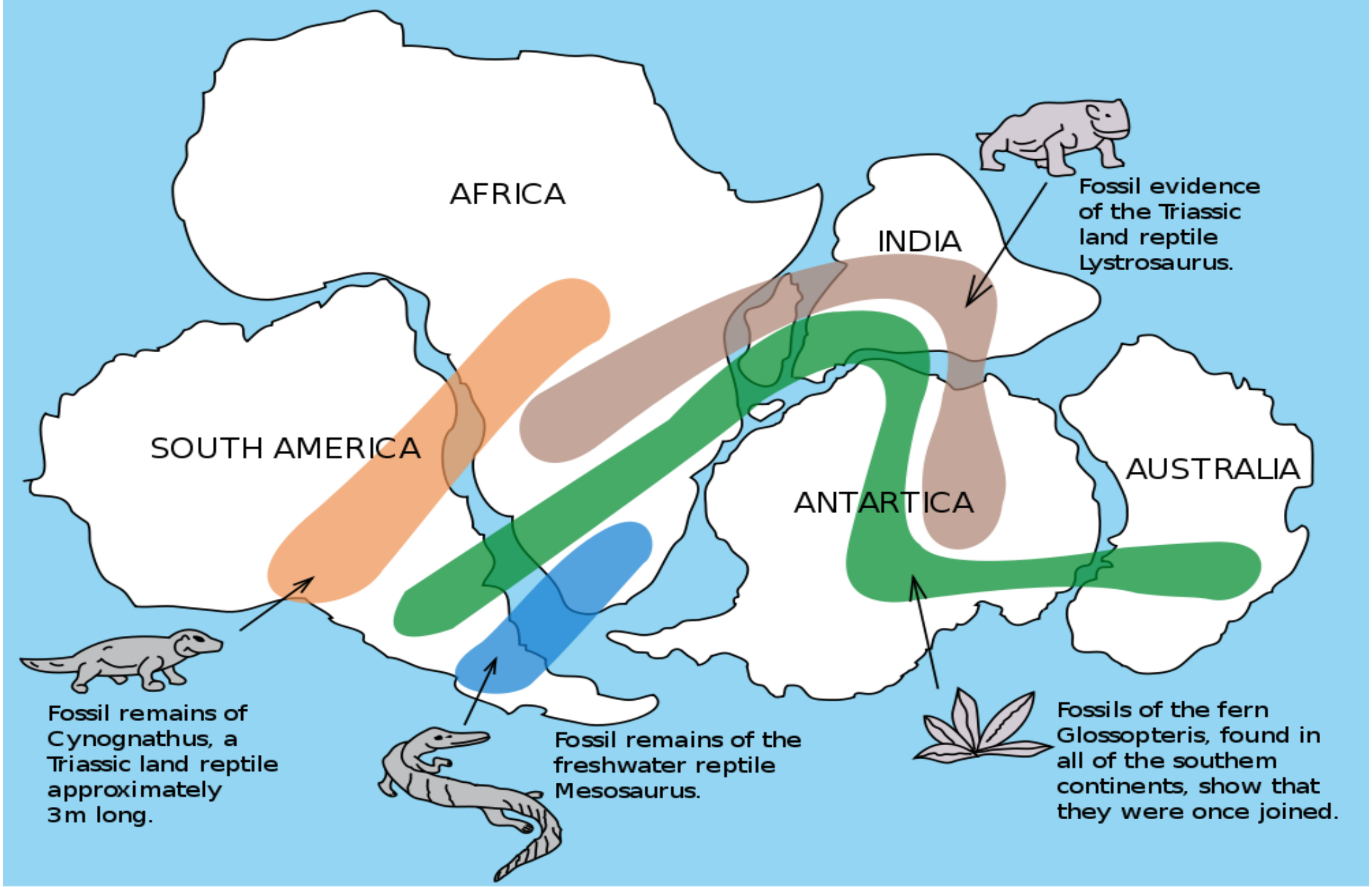
Click here & try!



## Fossil Evidence:

- **What was observed?** Similar fossils of plants and animals were found on continents now separated by large oceans (for example, fossils of the extinct reptile *Mesosaurus* found in both South America and Africa).
- **Explanation:** This indicates that these continents were once part of a single landmass, allowing these species to spread across them before they split apart.

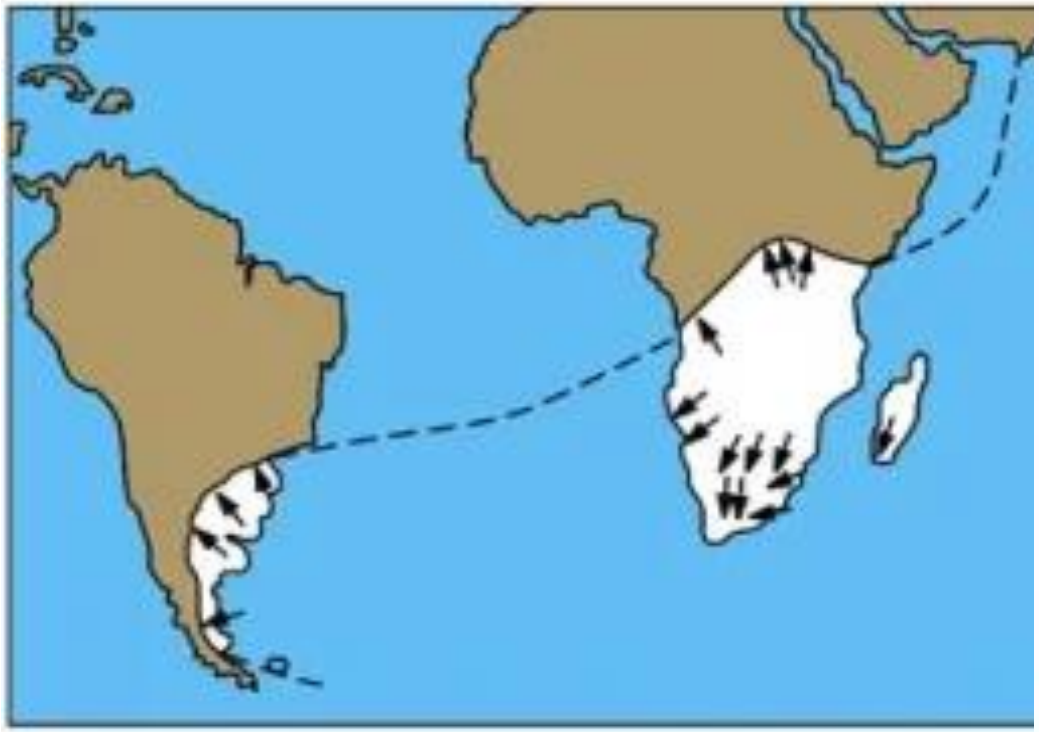

AFRICA
INDIA
SOUTH AMERICA
ANTARTICA
AUSTRALIA
Fossil evidence of the Triassic land reptile Lystrosaurus.
Fossil remains of Cynognathus, a Triassic land reptile approximately 3m long.
Fossil remains of the freshwater reptile Mesosaurus.
Fossils of the fern Glossopteris, found in all of the southem continents, show that they were once joined.

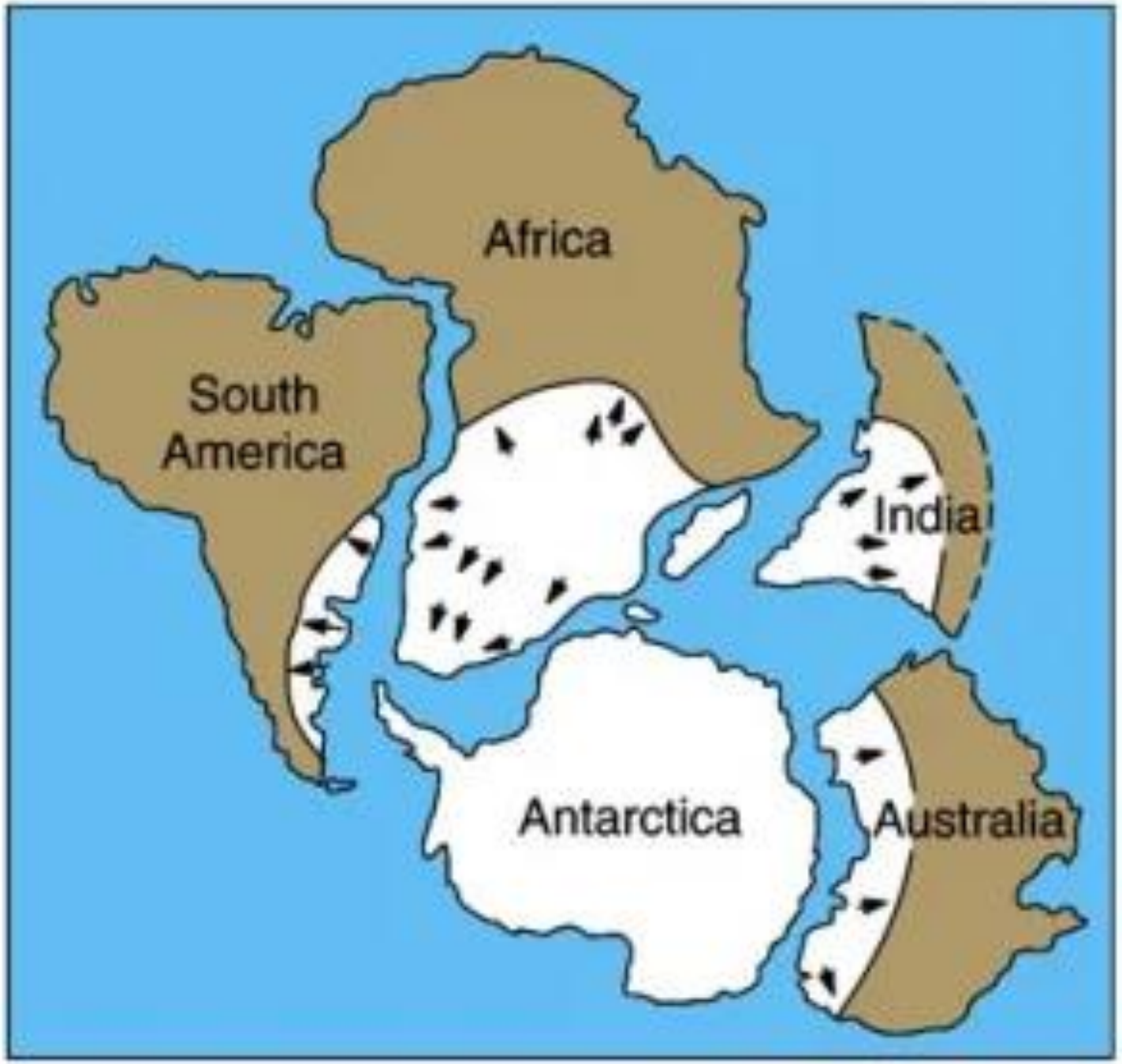
## Geological Features:

- **What was observed?** Similar rocks and mountain formations are found on continents now separated by vast oceans. For example, the rocks of the Appalachian Mountains in North America are similar to those in the Scottish Highlands.
- **Explanation:** These similarities support the idea that the continents were once connected and then separated, leaving these rock formations and mountains in different places.

## Glacial Evidence:

- **What was observed?** Evidence of ancient glaciers was found in now warm regions like India, Africa, and South America.
- **Explanation:** This suggests that these continents were once near the South Pole, where glaciers could have formed, and then moved to their current positions.




Africa
South America
India
Antarctica
Australia

## Seafloor Spreading:

- **What was observed?** The discovery of **mid-ocean ridges**—underwater mountain chains—and the fact that the oceanic crust is youngest near these ridges and oldest farther away.
- **Explanation:** When tectonic plates move apart at mid-ocean ridges, magma rises to create new oceanic crust. This process, known as **seafloor spreading**, causes new rocks to form near the ridges and older rocks to move away, providing evidence of plate movement.

## Age of the Ocean Floor:

- **What was observed?** The ocean floor gets older as we move away from the mid-ocean ridges.
- **Explanation:** Younger rocks are found closer to the mid-ocean ridges, while older rocks are farther away. This supports the idea that new crust is constantly being formed at the ridges, pushing older crust outward and demonstrating the movement of tectonic plates.

## Magnetic Stripes on the Ocean Floor:

- **What was observed?** Ocean floor rocks contain minerals that align with Earth's magnetic field. Over time, Earth's magnetic field has reversed, and these reversals are recorded in the rocks.
- **Explanation:** As new oceanic crust forms at mid-ocean ridges, it records the Earth's magnetic field at the time. The alternating magnetic stripes, which are parallel to the ridges on both sides, support the idea of seafloor spreading and plate movement.

## Polar Wandering Curves:

- **What was observed?** Studies of magnetic minerals in rocks revealed that Earth's magnetic poles have shifted over time.
- **Explanation:** These **polar wandering curves** suggest that the continents have moved over time. The magnetic data indicate that the continents themselves have shifted rather than the Earth's magnetic poles shifting.

# Thank You for Listening

# Any Questions?