

# PALAEOGEOGRAPHY

## Lecture 1 & 2



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&  
Paleontology  
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# PALAEOGEOGRAPHY

- How were the land masses and seas distributed on this planet in the past?
- Did the big continents of the world occupy the same position in relation to each other in the past as we see them on the map today?
- In 1960 three prominent theories were presented to answer these questions.

# THEORIES OF PALAEOGEOGRAPHY

- Theory of permanence of continents.
- Theory of land bridges.
- Theory of continental drift.
- During the last a few decades new discoveries have led to the formulation of much more convincing theory- the theory of **plate tectonics**.

# THEORY OF PERMANENCE OF CONTINENTS

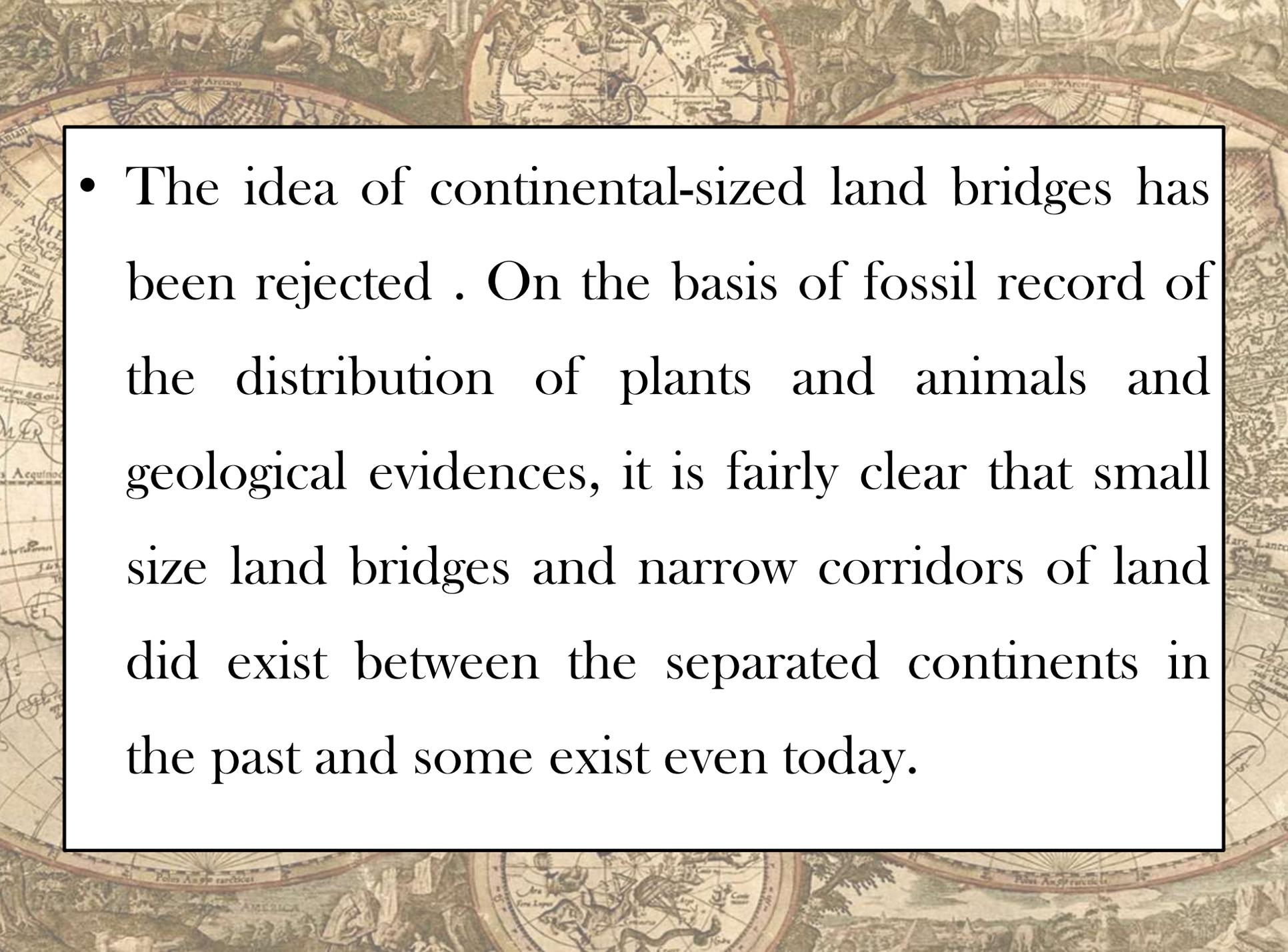
- This theory was proposed by a geologist, **Dr. Lyell** in 1830.
- According to this theory the present continents are fixed portions of earth crust and have occupied the same relative position in the past as they have today.



*Charles Lyell*

# THEORY OF LAND BRIDGES

- The theory of land bridge demands bridges of continental size stretching across deep oceans serving as means of communication. In the Cenozoic age, these bridges were supposed to have sunk leaving no trace of their existence.
- 3 major land bridges were:
  - i. **South Atlantic bridge** (between Africa and South America)
  - ii. **Lemuria** (between Africa and India)
  - iii. **Antarctic bridge** (between S, America & Australia through Antarctica)

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- The idea of continental-sized land bridges has been rejected . On the basis of fossil record of the distribution of plants and animals and geological evidences, it is fairly clear that small size land bridges and narrow corridors of land did exist between the separated continents in the past and some exist even today.

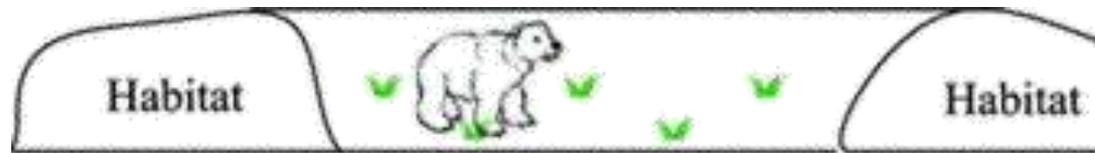
# EXAMPLES OF NARROW LAND BRIDGES

- North and South America are today connected by **Isthmus of Panama**.
- Eurasia and Africa are joined by **Isthmus of Suez**.
- **Sunda platform** between Australia and South East Asia.
- **Channel bridge** between France and England.
- **Bering Strait** , one of the best known land bridge that existed between Alaska and Siberia in the recent past.

# TYPES OF DISPERSAL ROUTS

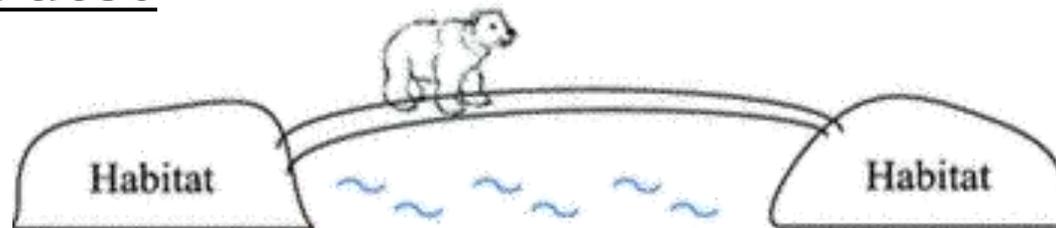
- C.G. Simpson recognized 3 types of dispersal routes:

## 1. Corridors



(a) Corridors

## 2. Filter routes



(b) Filter bridges

## 3. Sweepstake routes



(c) Sweepstakes routes

# CORRIDORS

- A land bridge that provides a suitable migratory route (i.e., existence of abundant food, shelter and favorable climatic conditions along the entire route) is referred to as a **Corridor**.
- Such routes allows a free passage of most animals and plants in both directions.

# FILTER ROUTE

- If the land bridge is narrow, have an unfavorable climate, lacks food and suitable niches, has too many competitors then only some animals may be able to pass over it, while it may be impassable for others.
- This means that a route which **filters out or screens out some organisms** is termed as a filter route.

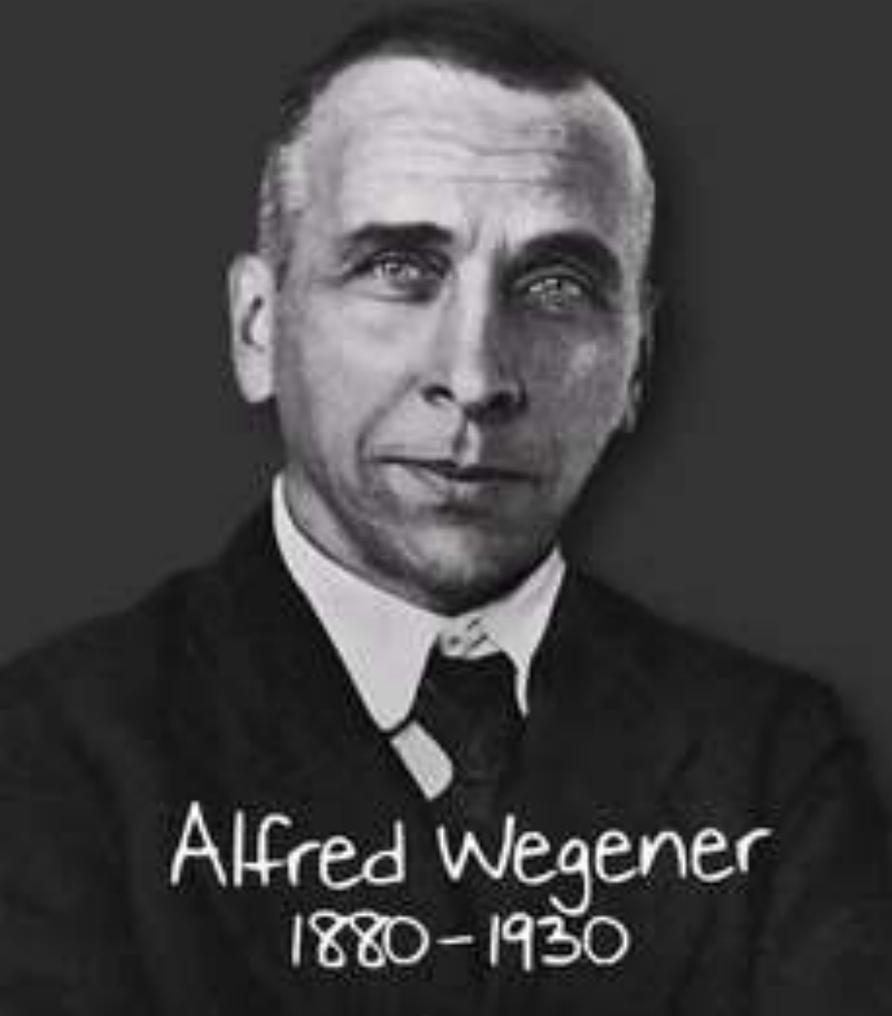
# SWEEPSTAKE ROUTE

- It includes route across hostile territories that make migration difficult.
- A sweepstake route of dispersal is one over which only a few species pass more or less **by chance** and it is generally a “**one way traffic**”.
- Drifting of organisms across a narrow sea on natural drifting wood or sweeping of insects and birds by strong wind or tornadoes are good examples of sweepstake routes.

# CONTINENTAL DRIFT THEORY

- Alfred Wegner proposed this theory in 1915.
- The excellent jigsaw puzzle of the shorelines of Africa and South America forced him to propose this theory.
- Wegner was a meteorologist and he was working on the past climate.
- He found that at present the climate of many places is not the same as it was in the past.

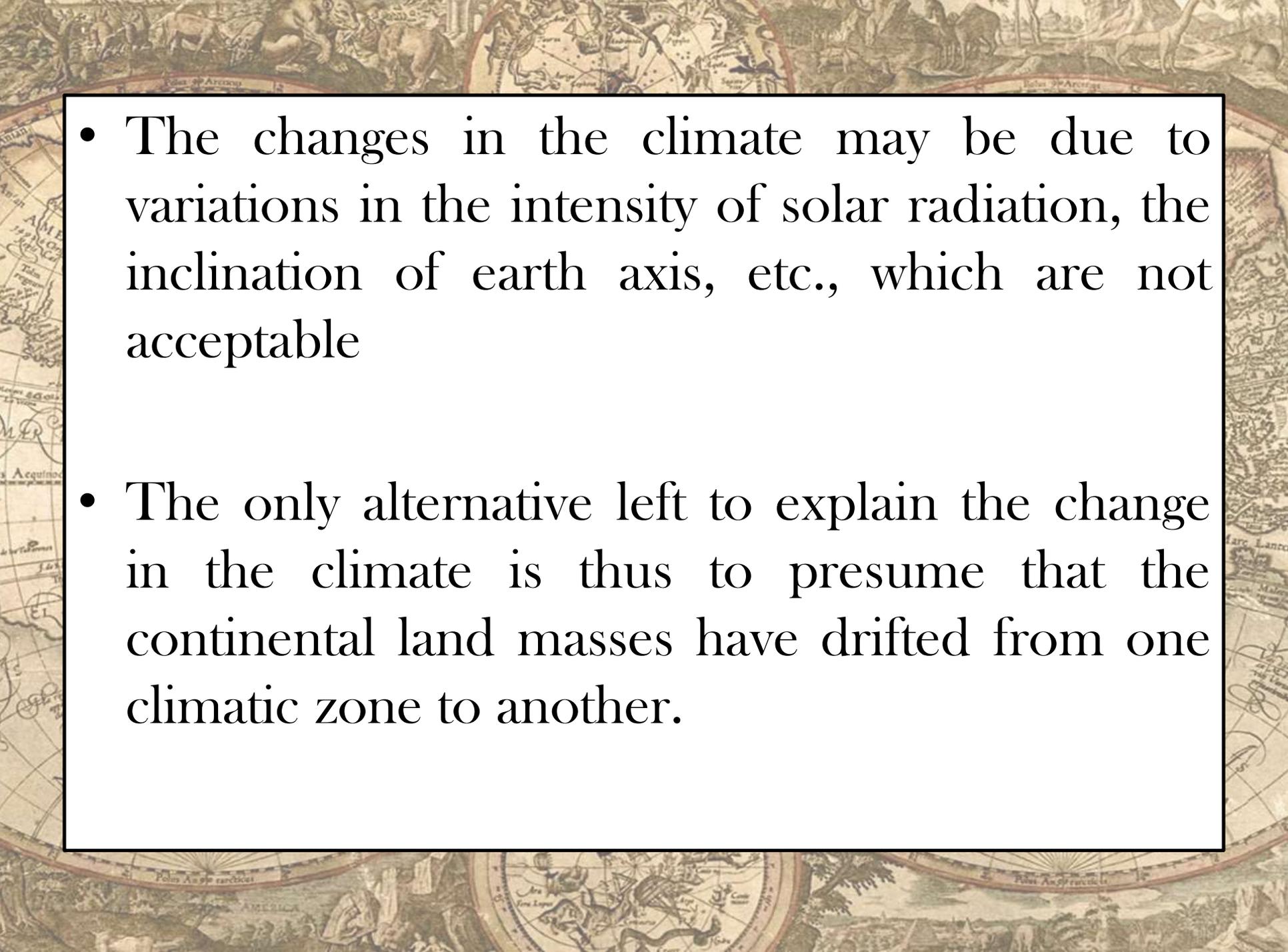
# CONTINENTAL DRIFT THEORY

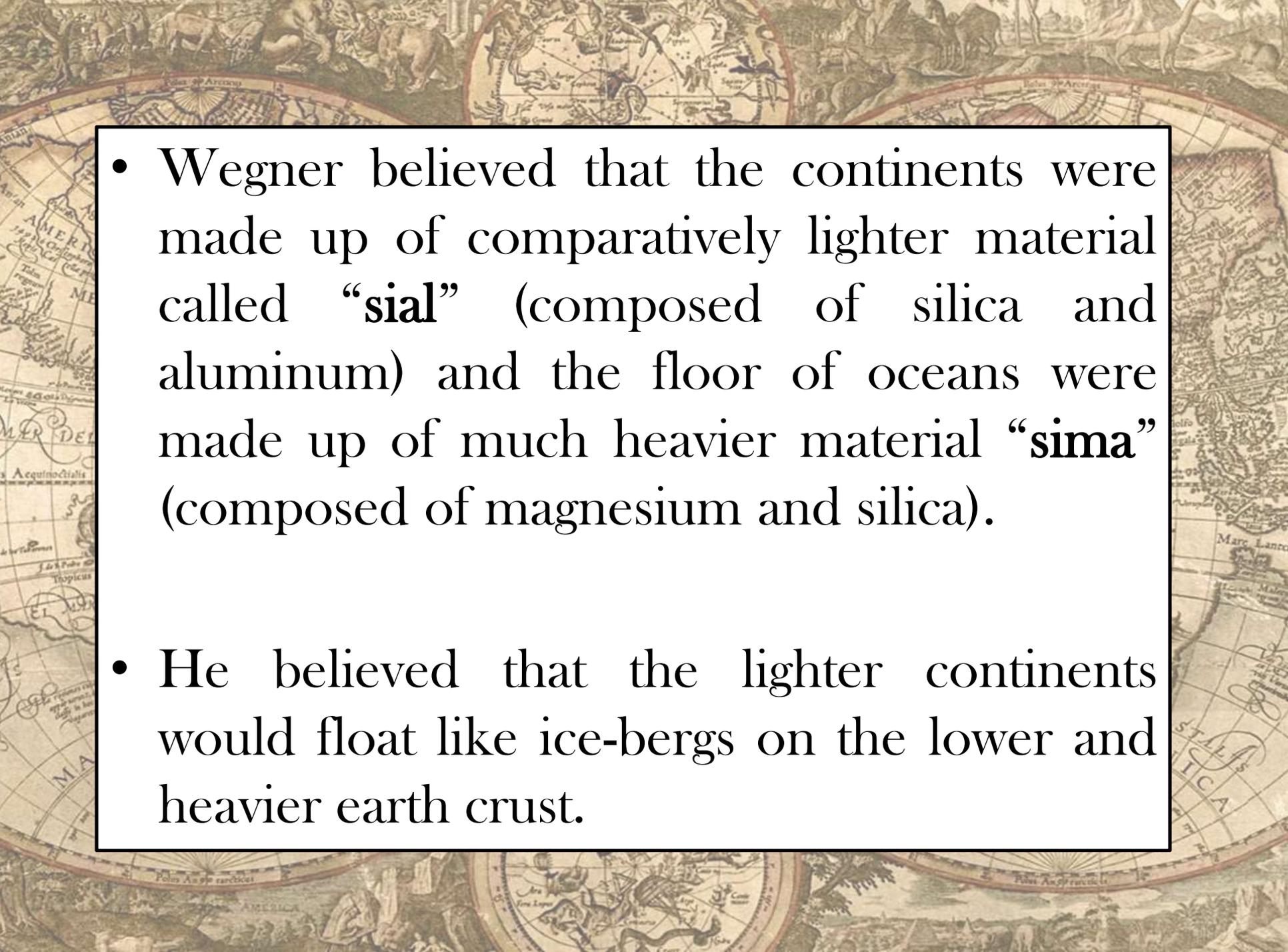


200 million years ago



- Wegner deducted that difference in the past and present climate of a region may be due to two reasons:
  - a) Either the climate has changed.
  - Or
  - b) The position of continent or a place has been changed.

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- The changes in the climate may be due to variations in the intensity of solar radiation, the inclination of earth axis, etc., which are not acceptable
  - The only alternative left to explain the change in the climate is thus to presume that the continental land masses have drifted from one climatic zone to another.

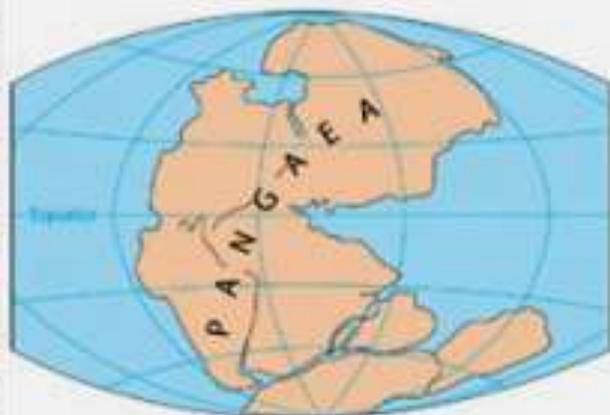
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- Wegner believed that the continents were made up of comparatively lighter material called “**sial**” (composed of silica and aluminum) and the floor of oceans were made up of much heavier material “**sima**” (composed of magnesium and silica).
  - He believed that the lighter continents would float like ice-bbergs on the lower and heavier earth crust.

- According to Wegner, in the early Palaeozoic times all the continents were joined together to form a great land mass called **Pangaea**.
- It was surrounded by a vast ocean called **Panthalassa**.





- By the end of the Triassic period, Pangea divided into two super-continent, the northern **Laurasia** and the southern **Gondwanaland**.
- These super-continent began to break apart into fragments and drifted away from one another to form the present day continents.



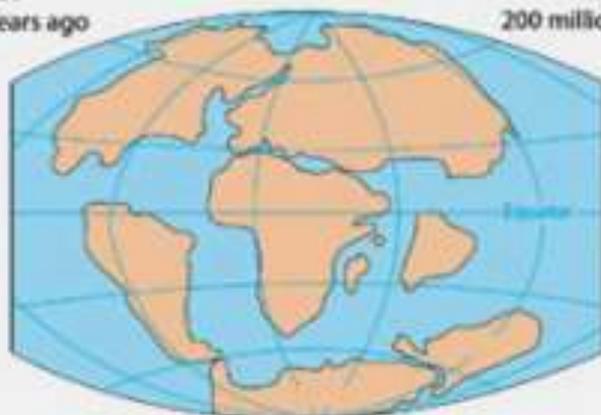
**PERMIAN**  
250 million years ago



**TRIASSIC**  
200 million years ago



**JURASSIC**  
145 million years ago

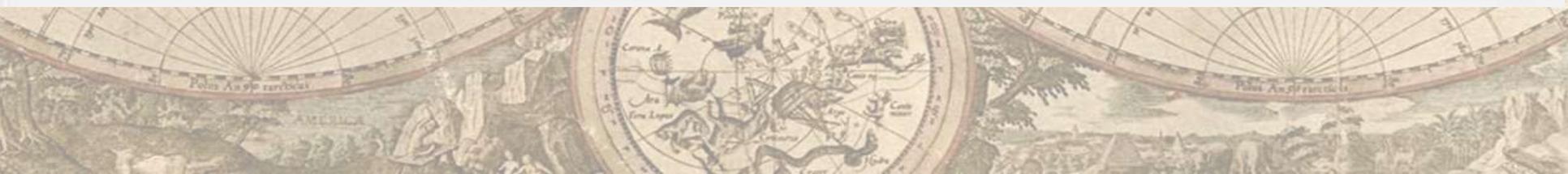


**CRETACEOUS**  
65 million years ago



**PRESENT DAY**

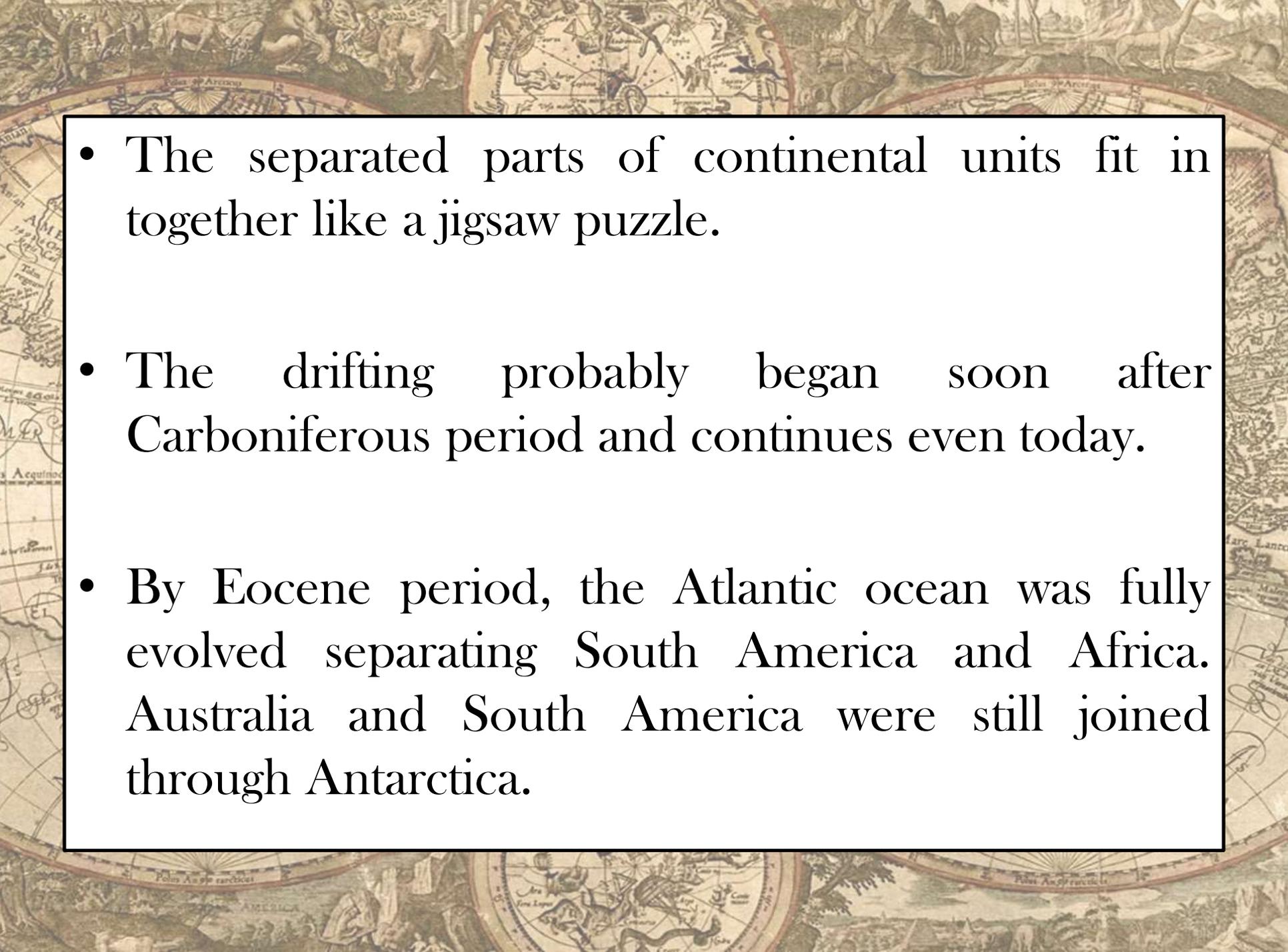
Illustration by USC



**225 million years ago**





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- The separated parts of continental units fit in together like a jigsaw puzzle.
  - The drifting probably began soon after Carboniferous period and continues even today.
  - By Eocene period, the Atlantic ocean was fully evolved separating South America and Africa. Australia and South America were still joined through Antarctica.

# OBSERVAIONS FAVORING THE CONTINENTAL DRIFT THEORY

## 1. FIT OF CONTINENTS

- A remarkable fit of East coast of South America and west coast of Africa was observed.
- Similarly the outlines of Antarctica, Australia and India may be grouped together into a cluster that fits in the outlines of Africa.



## 2. FOSSIL EVIDENCE

- Similar fossils are found in the continents that are now far apart.
- Wegner cited the distribution of fossil fern *Glossopteris* as an evidence of existence of super-continent Pangaea .
- *Glossopteris* was widely dispersed in Africa, India, Australia and South America during the late Palaeozoic era.
- Fossils of **Mesosaurus**, an aquatic dinosaur, are found in Africa and South America.

### 3. IDENTICAL GEOLOGICAL STRUCTURES

- If the continents were once together, the rocks found in a particular region on one continent should closely match in age and type with those found in adjacent positions on the matching continent.
- Identical rocks and coal deposits are found in the Carboniferous rocks found in Antarctica, India, Australia, and South America.
- These deposits were first studied in Orissa (West Bengal, India) inhabited by “**Gond**” tribes, hence the name **Gondwanaland** is given to the group of these continents.

## 4. VARIATION OF CLIMATES IN THE PAST

- Wegner found coral reefs and coal deposits in the ancient rocks of Arctic and Antarctic region, which are found only in tropics today.
- On the basis of these finding Wegner proposed the theory of Continental Drift.

- The main objection to Wagner's theory was his inability to explain the mechanism for continental drift.
- The theory does not account for the absence of large number of mammals and reptiles from South America that are otherwise abundant in Africa.
- One important argument in the favor of this theory was a remarkable fit of shorelines of South America and Africa.
- In the last decades new discoveries have confirmed Wagner's general ideas and have led to the formulation of theory of **Plate Tectonic**.