HARTAI ÉVA,

GEOLOGY

4

A Műszaki Földtudományi Alapszak tananyagainak kifejlesztése a
TÁMOP 4.1.2-08/1/A-2009-0033 pályázat keretében valósult meg.

IV. The theory of continental drift

1. Introduction

Global tectonics includes the structural movements that affect the whole lithosphere, shape the earth's surface, change the area of the continents, and create mountain chains and oceanic basins.

Global tectonics has had fundamental consequences for the inhabitants of our planet, guiding the development of weather and climatic systems, and even influencing the course of the evolution of species. The power of tectonic forces is most evident in the great mountainous regions of the world.

The first step for the theory of plate tectonics was the theory of continental drift.

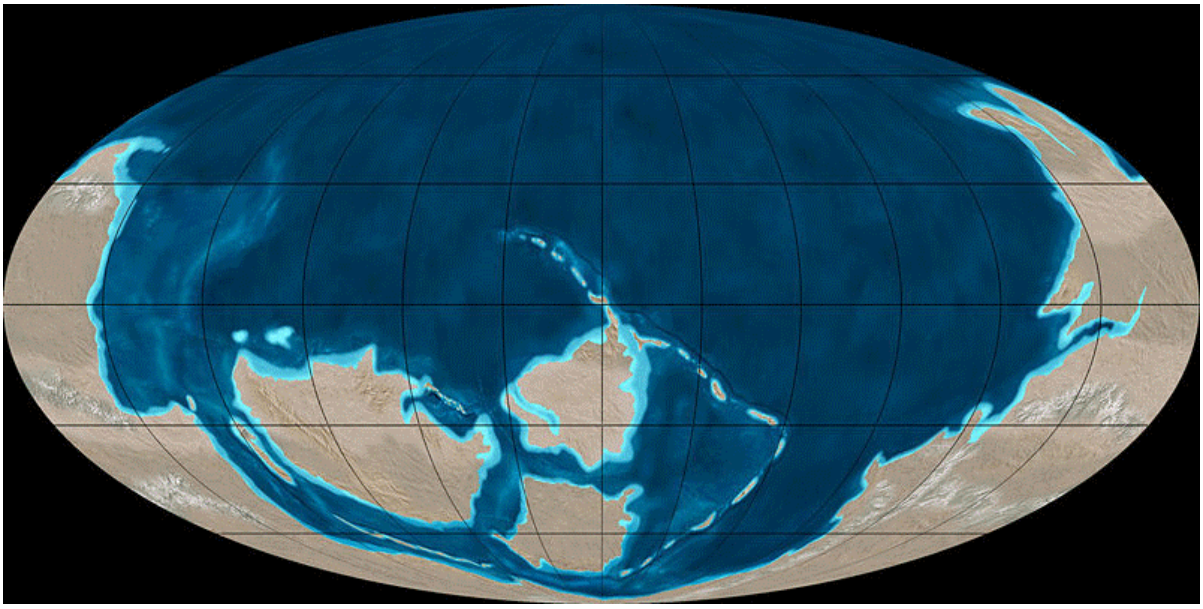


Plate tectonics

2. The early interpretations

People have wondered for a long time why continents have such irregular shapes and why ocean basins, mountain ranges, earthquake belts, and many other features occur where they do. When the first maps were made of the coastlines on each side of the Atlantic Ocean in the sixteenth century, it became apparent that the coasts were approximately parallel. People started to speculate why.

First they thought about a flood having cut an immense canyon – maybe the great *biblical flood*. No realistic answers were forthcoming, but such speculations did get people thinking about why the Earth is the way it is. Scientists eventually began to think that there might be a single, underlying cause.

During the nineteenth century, people favored the idea that Earth, originally a molten mass, had been *cooling and contracting* for centuries, with the crust gradually compressed. These theorists pointed to mountain ranges full of folded strata as the places where past contraction had occurred and to seismic regions as places where contraction might be happening in the present. Contraction did explain some features but did not help with questions about the shape and distribution of continents.

The discovery of radioactivity was the basis of the new suggestions that the Earth is not cooling but *heating up*

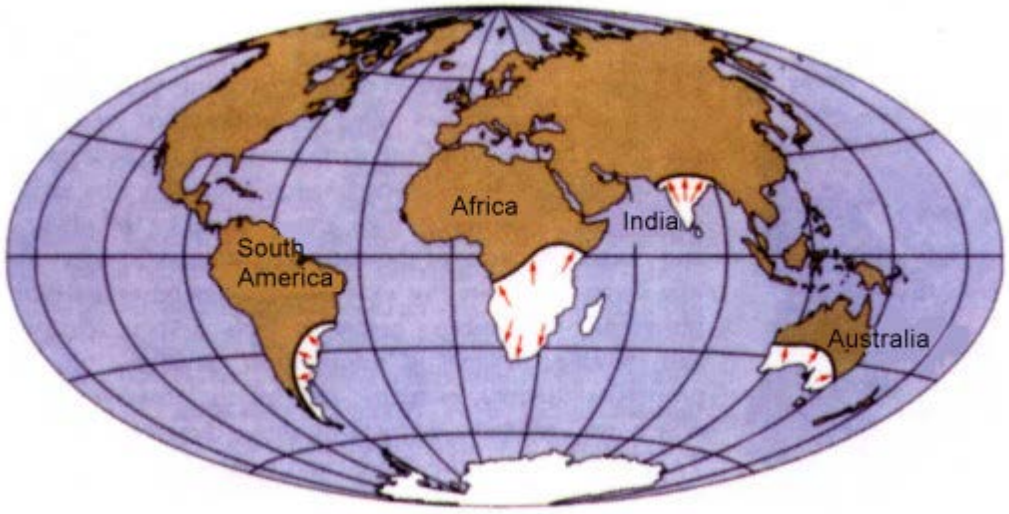
and therefore expanding. Because of the expansion, the continental crust cracks into fragments. As expansion continued, the cracks would penetrate into oceanic basins and through the cracks basaltic lava would rise up from the mantle to built new oceanic crust. This theory offered a plausible explanation for the parallel coastlines but did not account for mountain ranges formed by compression.

3. Wegener's theory

***Alfred Wegener**, the German meteorologist who created the "theory of continental drift" on his expedition to Greenland.*

Plate tectonic theory had its beginnings in 1915 when ***Alfred Wegener*** proposed his theory of "continental drift."

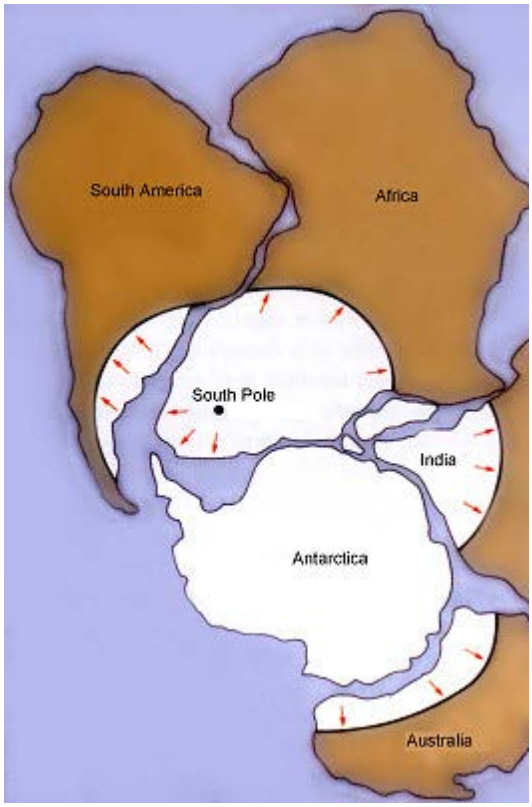
Wegener was a German meteorologist and polar explorer and he also dealt with the climate changes of the geological past. He focused on the Late Carboniferous ice age. His paleoclimatic studies revealed that glaciers covered large areas of the world which are now separated by great geographic distances. These observations seemed to indicate that the Earth's crust had been moving over geologic time.



The extent of the ice cover in the Late Carboniferous ice age
The formerly ice-covered areas can be recognized by glacial sediments. The arrows show the direction of movement of the ice cover.

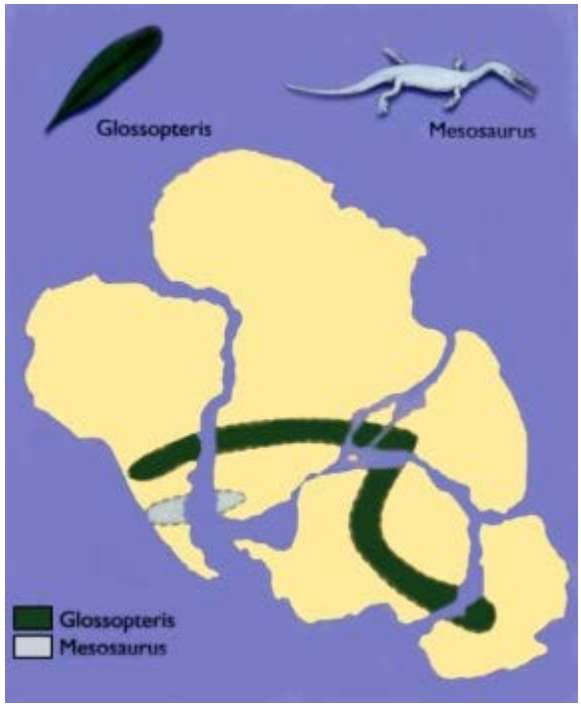
Based on his observations he suggested that a supercontinent he called Pangaea had existed in the past, had broken up starting 200 million years ago, and that the pieces had "drifted" to their present positions. He cited the fit of South America and Africa, ancient climate similarities, fossil evidence (such as the fern Glossopteris and the reptile Mesosaurus), and the similarity of rock structures.

Wegener proposed that the continents plowed through the crust of ocean basins, which would explain why the outlines of many coastlines look like they fit together like a puzzle.



By fitting the continents together the Late Carboniferous ice cover can be interpreted as a whole

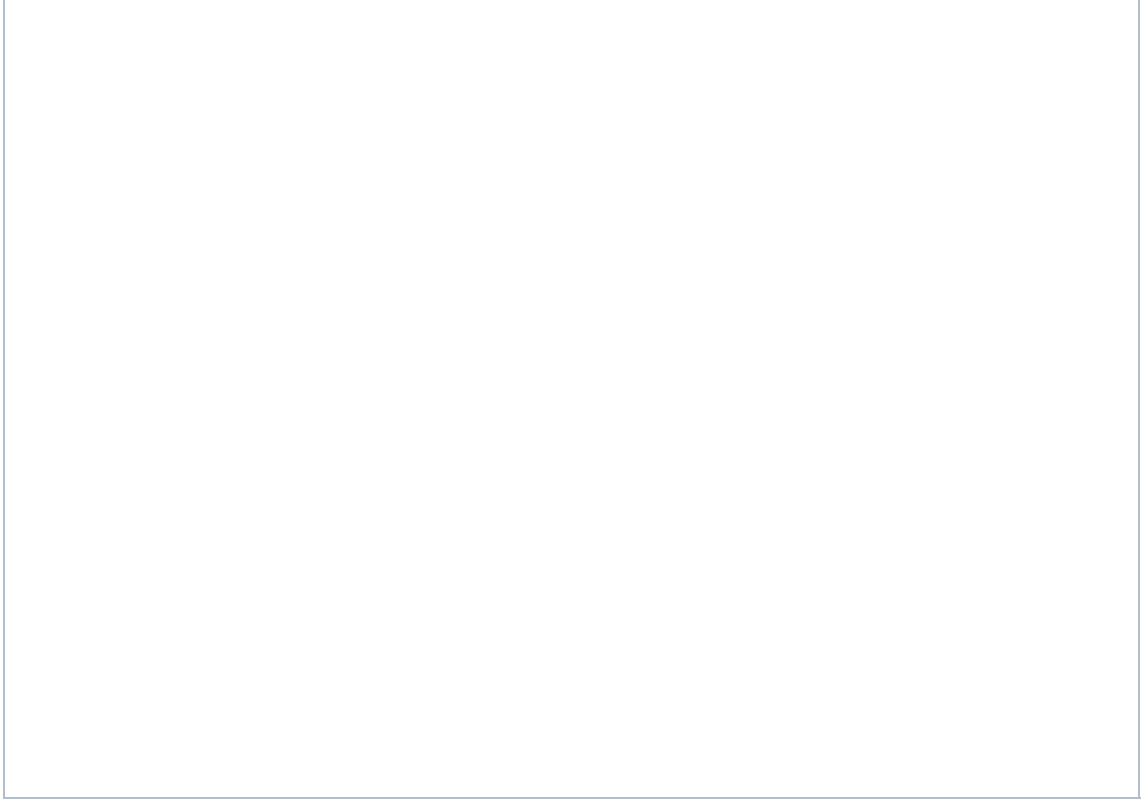
Widespread distribution of Permo-Carboniferous glacial sediments in South America, Africa, Madagascar, Arabia, India, Antarctica and Australia was one of the major pieces of evidence for the theory of continental drift. The continuity of glaciers, inferred from oriented glacial striations and deposits called tillites, suggested the existence of the supercontinent of Gondwana, which became a central element of the concept of continental drift. Striations indicated glacial flow away from the equator and toward the poles, in modern coordinates, and supported the idea that the southern continents had previously been in dramatically different locations, as well as contiguous with each other.



Distribution of the Glossopteris (A) and Mesosaurus (B) fossils
The contours of the distribution of the fossils supports the idea of a unified supercontinent.

Wegener was not the first to notice this puzzle-like fit of the continents (Magellan and other early explorers also noticed this on their maps), but he was one of the first to realize that the Earth's surface has changed through time, and that continents that are separated now may have been joined together at one point in the past.

WEGENER'S CONTINENTS



Paleontologists had also found that there were fossils of similar species found on continents that are now separated by great geographic distance.

Wegener's ideas were very controversial because he didn't have an explanation for why the continents moved, just that there was observational evidence that they had. At the time, many geologists believed that the features of the Earth were the result of the Earth going through cycles of heating and cooling, which causes expansion and contraction of the land masses.

Despite the impressive evidence supporting continental drift, many scientists remained unconvinced by Wegener’s ideas, largely because no one could explain how the solid rock of a continent could possibly overcome friction and slide across the oceanic crust.