Plate Tectonics

• In 1912 Alfred Wegener (1880-1930) proposed that:

the continents were once compressed into a single protocontinent which he called Pangaea (meaning "all lands"),

and over time they have drifted apart into their current distribution.

Pangaea

He believed that Pangaea was intact until the late Carboniferous period, about 300 million years ago,

when it began to break up and drift apart.
Plate Tectonics

The main features are:

• The Earth's surface is made up of a series of large plates.

• These plates are in constant motion travelling at a few centimetres per year.

• The ocean floors are continually moving, spreading from the centre and sinking at the edges.
The edges of these plates, where they move against each other, are sites of intense geologic activity, such as:

- earthquakes,
- volcanoes, and
- mountain building.

How Plates Move

(Convection Currents)

- **Convection currents** beneath the plates move the plates in different directions.
- The **source of heat** driving the convection currents is radioactive decay which is happening deep in the Earth.
**Convection Current**

Convection occurs because the density of a fluid is related to its temperature.

Hot rocks lower in the mantle are less dense than their cooler counterparts above.

The hot rock rises and

the cooler rock sinks due to gravity.

Consider what happens to the water in a pot as it is heated over an open camp stove.
CONVECTION CURRENT

How Plates Move

• This movement of warmer and cooler mantle rocks, in turn, creates pockets of circulation within the mantle called convection cells.

• The circulation of these convection cells could very well be the driving force behind the movement of tectonic plates over the asthenosphere.
Why do the plates move?

(CONVECTION CURRENT)

Outer layers of the Earth. Plates are made of crust and rigid upper mantle.
The Earth’s outer layer is called the lithosphere. It is made of the rigid upper mantle and the crust. The lithosphere moves on the asthenosphere, part of the mantle that flows.
CONTINENTAL DRIFT
The idea that continents can drift about is called, not surprisingly, CONTINENTAL DRIFT (Wegener in 1912).

The rest of the Earth’s surface was covered by a single ocean known as PANTHALASSA.
Did you ever wonder why elephants are only found in Africa and Asia?

- With plate tectonics as a guiding principle, the answer becomes moderately clear.

- As India broke away from Africa 20 million years ago it very likely ferried some elephants (along with many other organisms) northward to Asia.

- The Asian and African elephants have slight physical variations, but they are clearly cut from the same genetic mold.
Three types of plate boundaries:

- **Divergent boundaries** -- where new crust is generated as the plates pull away from each other.

- **Convergent boundaries** -- where crust is destroyed as one plate dives under another.

- **Transform boundaries** -- where crust is neither produced nor destroyed as the plates slide horizontally past each other.
Divergent plate boundary:

Two plates move away from each other forming a gap in between.

Convergent boundaries

- plates are moving toward each other,

- and sometimes one plate sinks (is subducted) under another.

- The location where sinking of a plate occurs is called a subduction zone.
Convergent boundaries

Cross-section

Map view

Convergent plate boundary

Convergent boundaries

Oceanic crust
Trench
Volcanic arc

Continental crust
Lithosphere
Asthenosphere

Oceanic-continental convergence
Convergent boundaries

Transform boundaries

- The zone between two plates sliding horizontally past one another is called a *transform-fault boundary*, or

- simply a *transform boundary*. 

**Transform boundaries**

Most transform faults are found on the ocean floor.

The San Andreas is one of the few transform faults exposed on land.
Some Future Consequences of Plate Tectonics

Plate tectonics is still an active process, and will drastically reshape the face of the Earth over the next 50 million years or so. A few consequences of plate tectonics based on projections of present motion include:

• Portions of California will separate from the rest of North America.

• The Italian "boot" will disappear.

• Australia will become linked to Asia.

• Africa will separate from the Near East.

100 million years into the Future

- a prediction of what the plates might possibly look like

Note the wider Atlantic Ocean, the compression of Africa into Europe in the Mediterranean Sea, the compression of India and other plates northward into Asia, and the northward movement of Australia to northern Asia.