

## Continental Drift and Plate Tectonics



<http://www.freeschools.com/teachingresources/photos.htm> [atienzajunior9.blogspot.com](http://atienzajunior9.blogspot.com)

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## The Science of Geology

Geologists are scientists who study the forces that make and shape planet Earth. They study the chemical and physical characteristics of Earth's surface and describe the features (landforms) formed in rock and soil by water, wind, and waves.



Alfred Wegener

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## Constructive and Destructive Forces

### Constructive Forces



Shape the surface by building up mountains and landmasses.

### Destructive Forces



Slowly wear away mountains and every other feature on the surface.

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### Continental Drift



- 1910- German scientist Alfred Wegener curious about the relationship of the continents.
- Formed hypothesis
- Hypothesis: All the continents had once been joined together in a single land mass and have since drifted apart.
- Super continent PANGAEA “all lands”
- Over tens of millions of years ago Pangaea began to break apart and pieces slowly moved toward present day locations known as continents.
- [Continental Drift Theory](#)

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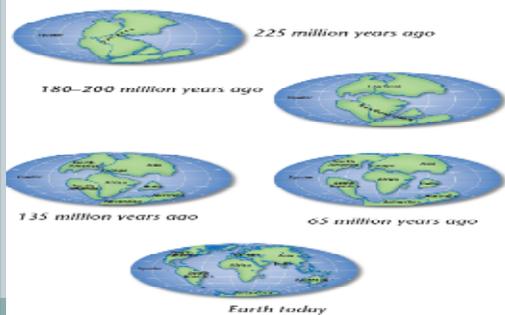
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### Continental Drift Since Pangaea



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### Evidence of Continental Drift



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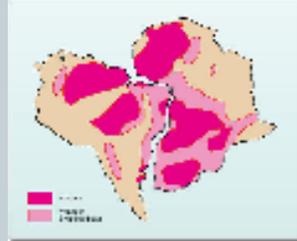
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### Evidence from Landforms

When Wegener pieced together maps of Africa and South America, he saw a **mountain range** running from east to west in south Africa that with a mountain range in Argentina.



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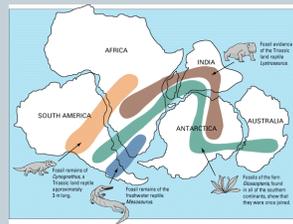
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### Evidence from Fossils

- A **fossil** is a trace of an organism that has been preserved in rock.
- Fossil leaves of a species of plant were found in Africa, South America, Australia, India, and Antarctica.
- The seeds could not have been carried by wind or waves.



about.com

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### Evidence from Climate

Knowing the type of plants, animals, insects and single celled organisms that are associated with the climate can help determine the previous locations of the continents.

- Move toward the equator, climate becomes warmer.
- Move toward the poles, climate becomes colder.



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### What's Inside Earth?

- Can we dig to China?
- South African gold mine reaches 3.8 km
- 6000 km to Earth's center
- Geologists use indirect methods to study the interior.
- Seismic waves during earthquakes.

The image shows an aerial view of a large, circular mine shaft, likely the Mponeng mine in South Africa, which is the deepest in the world, reaching 3.8 km.

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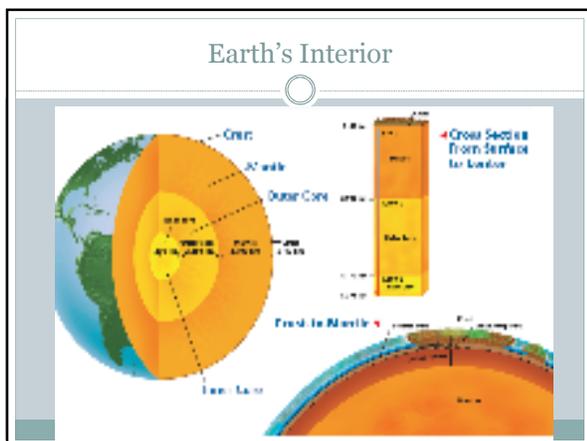
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### The Layers

- Crust: Layer of rock that forms Earth's outer layer.
- Mantle: Layer of hot rock.
  - Crust and upper most part of mantle very similar and together form a rigid layer called the **lithosphere**.
  - The layer just beneath this that is less rigid, somewhat soft, can bend like plastic and flow slowly is known as the **asthenosphere**.
  - The lithosphere **floats on top** of the asthenosphere.
- Core: Consists of two parts made of iron and nickel
  - Outer core: thick liquefied metal
  - Inner core: dense ball of solid metal

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### Plate Tectonics

**Plate Tectonics is a scientific theory which describes the large scale motions of Earth's lithosphere.**

- The lithosphere is a fluid mosaic of irregular segments known as (tectonic) plates.
- Cool, solid rock 4-40 miles thick
- Vary in size and shape
- Definite borders that cut through continents and oceans.

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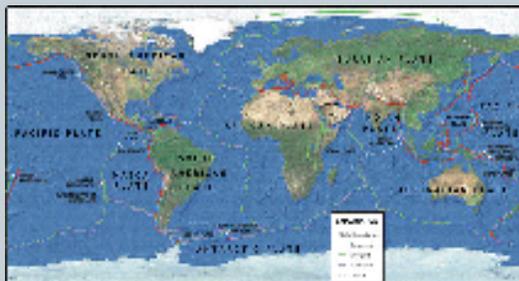
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### Tectonic Plates



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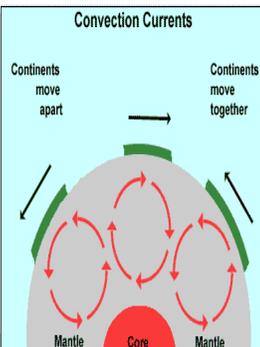
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### How Plates Move

- Powered by forces in Earth's iron inner core.
- Plates move atop the asthenosphere.
- Convection currents:
  - Rocks near the core are heated and become less dense than the cool upper mantle rocks
  - The warmer rocks rise while the cooler rocks sink creating slow vertical currents within the mantle
  - This creates pockets of circulation within the mantle forcing the movement of the plates
- Convection currents move the plates only a few cm/yr.



The diagram, titled 'Convection Currents', shows a cross-section of the Earth's mantle and core. The core is at the bottom, labeled 'Core'. Above it is the mantle, labeled 'Mantle'. Red arrows indicate convection currents: they rise from the core towards the surface and then sink back down. On the left, a green arrow points away from the center, labeled 'Continents move apart'. On the right, a green arrow points towards the center, labeled 'Continents move together'.

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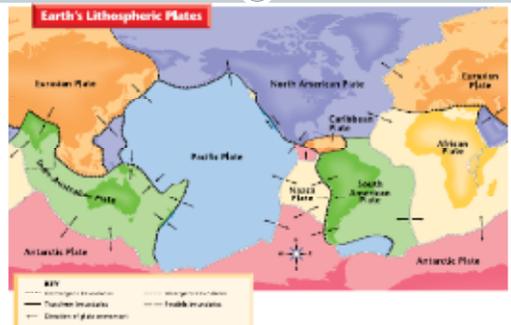
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### Earth's Lithospheric Plates and Boundaries



The map, titled 'Earth's Lithospheric Plates', shows the world's tectonic plates. Labeled plates include the Eurasian Plate, North American Plate, Caribbean Plate, African Plate, South American Plate, Antarctic Plate, Pacific Plate, and Australian Plate. A legend at the bottom left defines symbols for: Divergent boundaries (dashed line), Transform boundaries (solid line with arrows), Convergent boundaries (solid line with triangles), and Direction of plate movement (arrow).

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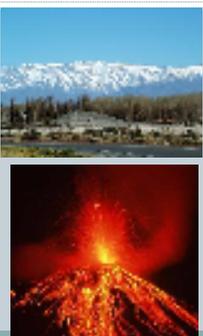
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### Types of Plate Boundaries

#### Convergent Boundaries

- When two plates come together.



The top image shows a mountain range with snow-capped peaks. The bottom image shows a volcano erupting with bright orange and red lava.

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### 3 Types of Convergence

**Continental – Continental**

- Neither is subducted because the rock is light and resist downward motion
- Crust tends to buckle and push upward or sideways

**Continental-continental convergence**

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### 3 Types of Convergence

**Oceanic – Continental**

- Oceanic plate subducts under the continental plate.
  - Known as a Subduction Zone
- Continental plate is lifted and a mountain range is created.
- Sinks smooth and continuously into the subduction trench and recycled back into the earth.
- Breaks into smaller pieces, is locked in place for long periods of time then sudden movement generates large earthquakes.

**Oceanic-continental convergence**

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### 3 Types of Convergence

**Oceanic – Oceanic**

- One is subducted under the other. (the younger of the two because it is less dense)
- A deep oceanic trench is formed.
  - Ex. Marianas Trench, deepest location of Earth itself (36,201 ft.)
- An undersea volcano is formed.
- Over years, erupted lava and debris pile up until a submarine volcano forms an island volcano.
  - Strung out in chains called island arcs.
  - Ex. Marina Islands south of Japan

**Oceanic-oceanic convergence**

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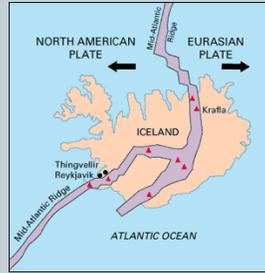
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### Types of Plate Boundaries

#### Divergent Boundaries

- Two or more plates pull away from each other.
- New crust is created.
  - Oceans born and grow wider known as **Sea Floor Spreading**.
  - Land separates to form a 'rift'
  - Eventually break apart into distinct land masses and surrounding water will fill the space.



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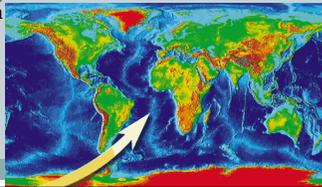
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### Sea Floor Spreading

- Oceanic plates moving apart creates mid ocean ridges.
- Molten material rises and erupts then spreads out, pushing older rock to the side, eventually towards a deep ocean trench.
- As it cools, forms a strip in the center.
- Continuous cycle

Earth's longest mountain range is underwater known is the Mid-Ocean Ridge system. It is more than 35,000 mi. long.



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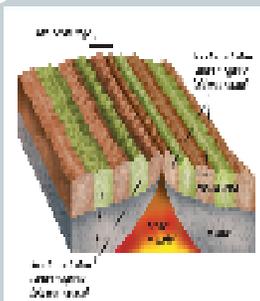
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### Evidence from Magnetic Stripes

- Ocean floor rock lies in a pattern of magnetized stripes.
- The rock (containing iron) began as molten material.
- As it cooled, the iron aligned in the direction of the magnetic poles.
- It hardened and "locked" it into place giving it a "magnetic memory"



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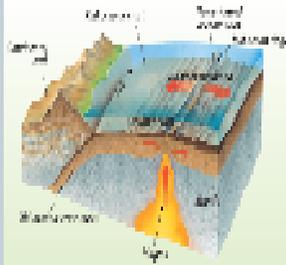
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### How can the ocean floor keep getting wider?

- It doesn't.
- It will plunge into deep underwater canyons called deep ocean trenches.
- Forms where oceanic crust bends downward.
- Again, subduction is the process by which one plate sinks beneath another and back into the mantle.



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### Types of Plate Boundaries

#### Transform Boundaries

- Two plates slide, shear, or grind horizontally past one another.
- Commonly known as faults.
- Mostly found on the ocean floor.
  - Offset active spreading ridges producing zig-zag plate margins
  - Defined by shallow earthquakes.
- **Can occur on land**
  - Ex. San Andreas Fault



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### Faults and Fault Movements

- Stress is a force that adds potential energy to rock until it changes shape or breaks and moves.
- Stress leads to deformation: a change in the rocks shape or volume due to plate movement.
- When stress builds up in the lithosphere, it causes the rock to break (deformation), creating a fault.
- This occurs typically along a boundary where plate motion compresses, pulls, or shears the crust.
- When the rock along the fault breaks and slides it causes an earthquake.

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## Types of Faults

### [Fault Animations](#)

- Normal fault: occurs when rocks are pulled apart causing one side to move downward.
- Reverse fault: occurs when rocks crack and are compressed, thrusting upward and forming an overhang.
- Thrust fault: a special type of reverse fault with a very low angle fault plane, typically <15 degrees
- Strike-Slip fault: occurs when rocks on either side slide past each with relatively no vertical motion.

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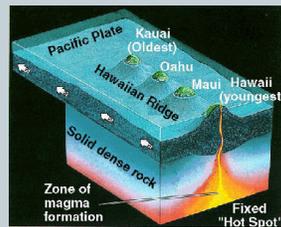
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## Hot Spots

- A huge column of upwelling lava (plumes) lies at fixed position
- This fixed position is under the Pacific Plate.
- As the ocean floor moves over this "hot spot" at about 5 in. per year.
- The upwelling lava creates a steady series of new volcanoes.
- They migrate along with the plate like a veritable conveyor belt of volcanic islands.




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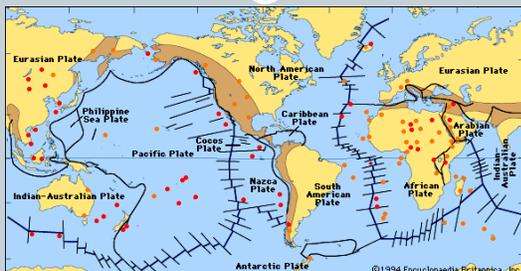
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## Hot Spots




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