

SCIENCE: INTRODUCTION TO EARTH SCIENCE - GEOLOGY

ROCKS, MINERALS, FOSSILS, AND TECTONIC PLATES

The **three rock types** are **sedimentary**, **igneous**, and **metamorphic**.

The three types of rocks are sedimentary, igneous, and metamorphic. Rock types are named based on how they formed. **Sedimentary rocks** are **formed from sediments** of both non-living pieces (sand, clay, etc.) and remains of living things (plants and animals). The compacted sediment turns into sedimentary rock, which is called **lithification**.



Layers of sedimentary rock in Israel.

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Igneous rock.

Rocks form from **compacted sediment (sedimentary)** or **hardened lava or magma (igneous)**, and **transform by pressure and/or heat (metamorphic rocks)**. **Paleontologists** study **fossils**. The **geologic record** is the **rock and fossil history** of the earth.

Igneous rocks are formed when **magma or lava crystallizes**. **Magma** is made of melted sedimentary or igneous rocks which come out of volcanoes. **Lava** is magma that comes from cracks in the earth's crust. **Metamorphic rocks** are sedimentary or igneous rocks that are hardened and changed by pressure and/or heat (without melting). Rocks are aggregates of minerals and can have any shape or structure. Unlike rocks, minerals have very specific crystalline structures. A rock's hardness is rated on the Mohs hardness scale.

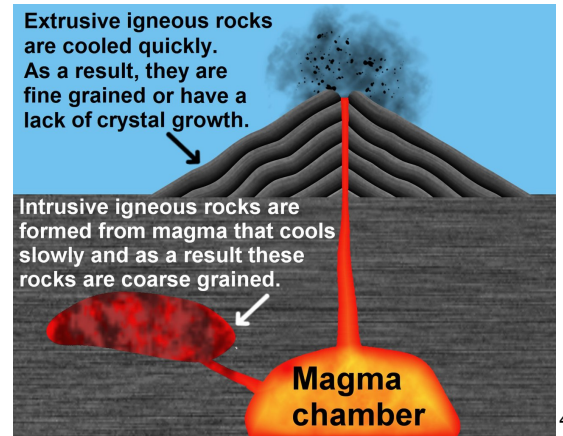
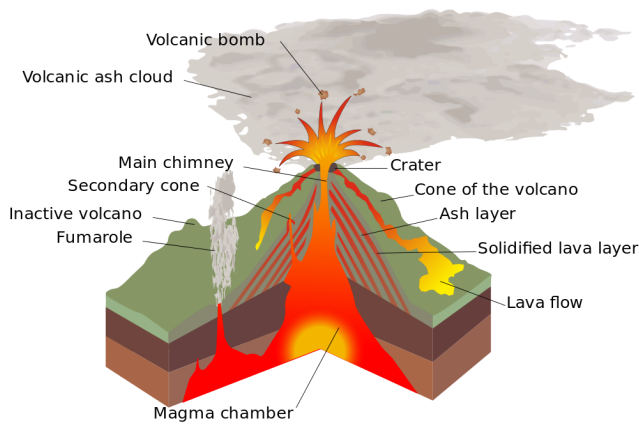
Paleontologists study fossils. Fossils are made when substances like mud, wood, or sap harden around or in plants and/or animals. Fossils preserved the history of the earth and the life that existed on earth. Rocks and fossils contain records of the earth's history, called the **geologic record**. Marine fossils have been found in rocks and rock beds at the Grand

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¹ [https://commons.wikimedia.org/wiki/File:Layers_of_sedimentary_rock_in_Makhtesh_Ramon_\(50749\).jpg](https://commons.wikimedia.org/wiki/File:Layers_of_sedimentary_rock_in_Makhtesh_Ramon_(50749).jpg)

² <https://www.flickr.com/photos/jsjgeology/16540710327>

Canyon (7,500 feet above sea level) and even at the top of Mount Everest. This means both locations have been underwater at some point in the earth's history.



The **earth's crust** is made of **segments** called **tectonic plates** that fit together like a puzzle. The **three types of boundaries** of tectonic plates are **convergent**, **divergent**, and **transform**. **Convergent** plates **collide**. **Divergent** plates **move apart**. **Transform plates slide in opposite directions**.

The earth's crust (the outer layer of the earth) is made up of **about 20 segments called tectonic plates**. The tectonic plates fit together like a puzzle and are always moving very slowly. **Earthquakes and volcanoes are both caused by interactions on the borders of the tectonic plates**.

The place **where the plates meet** is called the **fault line** or the fault plate. The plates of the earth's crust have **three types of boundaries**: **convergent**, **divergent**, and **transform**. **Convergent plates collide with each other** and **buckle up** into mountains, or **one plate will slide under the other** and create a subduction zone.

Divergent plates move away from each other and a gap forms between them. Divergent plates result in either rift valleys or new mountains as magma comes through the gap and makes a new crust as it cools. **Transform plates slide in opposite directions**. Transform plates are the most likely plate boundary to cause earthquakes.

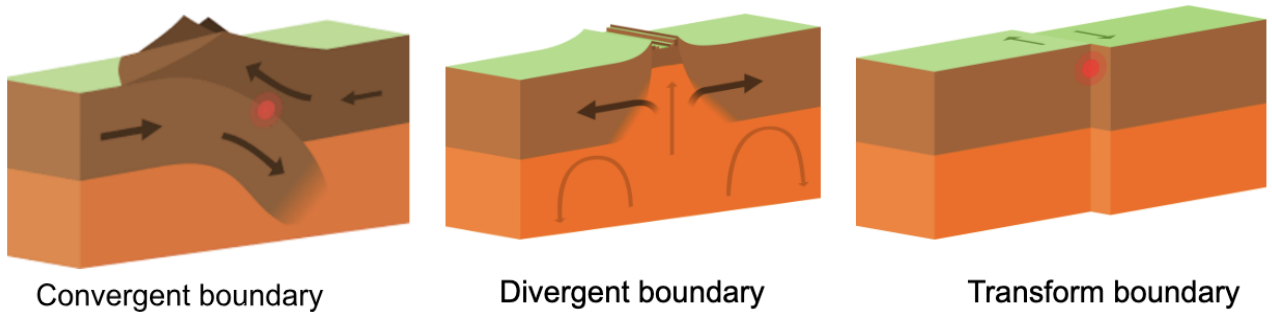
"When Noah was 600 years old, on the seventeenth day of the second month, **all the underground waters erupted from the earth**, and the rain fell in mighty torrents from the sky." (Genesis 7:11 NLT)



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³ https://commons.wikimedia.org/wiki/File:Structure_volcano-en.svg

⁴ https://commons.wikimedia.org/wiki/File:Igneous_rock_eng_modified.jpg

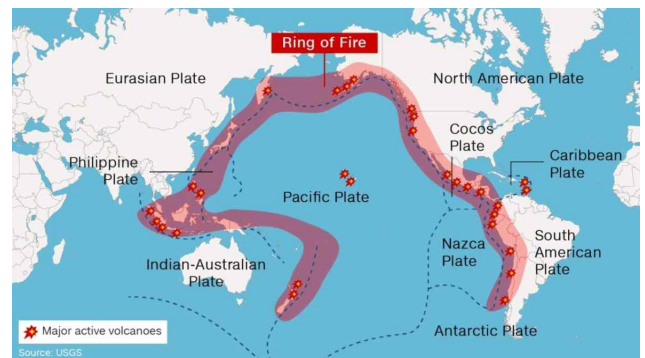


Tsunamis are giant waves caused by underwater earthquakes and volcanoes. **Radiometric dating** is based on the rate at which one element decays into another element.

The **hypocenter** is the location where an **earthquake originates** (under the earth). The **epicenter** is the location on the earth's surface where the earthquake starts. A **seismograph** is used to measure the intensity of an earthquake.

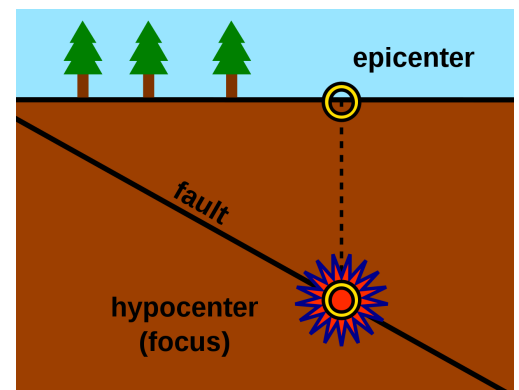
Intra-plate hot spots are a type of volcano where magma melts the earth's crust and comes through.

Tsunamis are giant waves from underwater earthquakes or volcanoes. Two thirds of all volcanoes are in the **Ring of Fire** in the Pacific Ocean.



Geologists try to date the earth by using relative dating and absolute dating. **Relative dating** is figuring out the order that things happened (what happened first, second, etc.). **Absolute dating** is giving specific dates to events.

Geologic dates are based on radiometric dating, which measures the rate at which certain elements decay into other elements. One type of radiometric dating is comparing the ratio of rubidium to strontium. Since rubidium slowly decays into strontium, some scientists believe that rocks started as 100% rubidium and the current level of strontium tells us the number of years of decay. The current estimate of earth's age based on radiometric dating is about 4.5 billion years. They also assume that these rocks started as 100% rubidium, which cannot be proven or known.



10-12 Since many geologists believe that the earth is billions of years old, they refer to billions of years of time as "deep time." They divide deep time by eons, eras, periods, and epochs.