

Rocks are made of minerals but minerals are not rocks. If a rock is likened to a car, minerals can be likened to the steel, glass, and plastic that make up the car. The study of minerals is called mineralogy. A **mineral** is an element or chemical compound (two or more chemically joined elements) that is normally crystalline (highly ordered structure that forms symmetric patterns) and has been formed as a result of geological processes.



A **crystal** is a mineral with a regular pattern of faces. This shape is due to an orderly arrangement of atoms.

Amethyst, a variety of quartz



The **silicate minerals** are rock-forming minerals, constituting approximately 90 percent of the crust of the Earth. They are classified based on the structure of their silicate group, which contain different ratios of silicon and oxygen. They make up the largest and most important class of rock-forming minerals.

Some of the most valuable minerals are ores — minerals that contain metals such as gold, iron, and aluminium. Of these, gold is the most precious because it is soft and easy to work and does not tarnish. Other minerals are prized as gemstones.

Gold ore



Copper silicate mineral, chrysocolla

Stones and Stuff

The Earth's crust is made up of 1,000s of different types of rocks and minerals. The ocean floor crust is basalt, while the continental crust is mostly granite. Through studying rocks we find out the reactions and processes that helped shape the world as it is today. The study of solid Earth, the rocks of which it is composed, and the processes by which they change, is called geology (greek, ge:earth, logia:study of discourse).



Slate

Petrology (from Greek, petra:rock, logos:study) is the branch of geology that studies the origin, composition, distribution and structure of rocks.

A **rock** is a solid material that forms on or under the Earth's surface and is made up of grains of **minerals**. It can be made from a single mineral (monomineralic), such as, marble (calcite (CaCO₃)), or like most rocks, contain crystals of several different minerals, such as slate. Within rocks we may find minerals, gems, fossils and metals.

Marble. The swirling patterns often found in marble are due to impurities.

Case study: 2004 Boxing Day Tsunami

The **2004 Indian Ocean megathrust** (earthquakes that occur on convergent boundaries and are the most powerful) **earthquake** occurred at 00:58:53 UTC on 26/12/2004, with an epicentre off the west coast of Sumatra, Indonesia. The resulting tsunami (AKA seismic sea wave) killed over 220,000 people.

Boxing Day tsunami: 10 years on, the scars are not hard to find in Aceh [Indonesia] 25/12/2014 Kate Lamb



'In the decade since Nusa residents descended the hill to survey the carnage – the dead and half-dead floating through what remained of their village – life has slowly been pieced back together.'
'These days most in Nusa say they are worse off than they were 10 years ago.'

'In a country prone to earthquakes, landslides and volcanic eruptions, the tsunami has also forced the government to take preventive action. Since the disaster, tsunami warning towers have been built along Aceh's coastline and a sophisticated tsunami warning system is now in place.'



Tsunamis explained and other links: <http://news.bbc.co.uk/1/hi/4136289.stm>
<http://www.coolgeography.co.uk/GCSE/AQA/Restless%20Earth/Tsunamis/Tsunamis.htm>
<http://www.theguardian.com/world/2014/dec/25/sp-boxing-day-tsunami-scar-acces>
village-nusa-indonesia

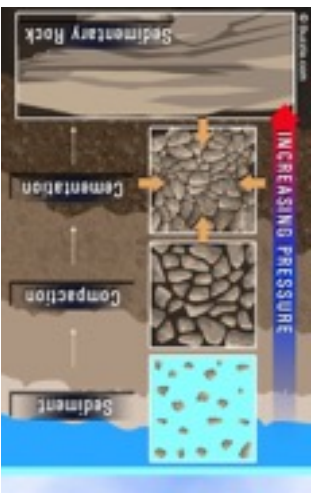
'In villages where the demographics were turned upside down, where disproportionate numbers of women and children were lost, there is no quick way to restore the social fabric.'



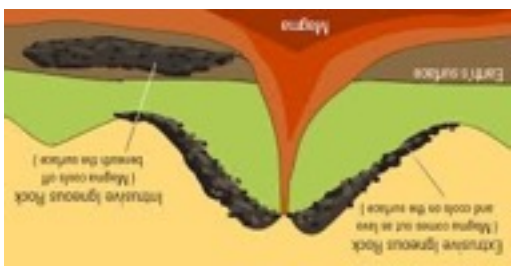
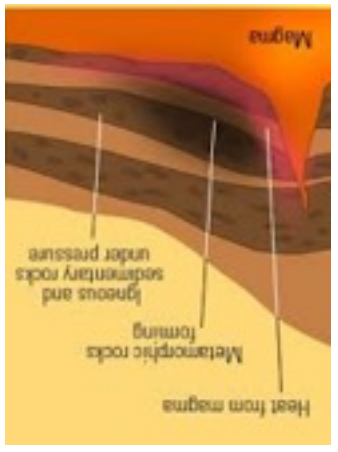
GLOSSARY

Core (of the Earth): Mainly made of iron and nickel, solid at the inner core (very centre) and molten (liquid) metal at the outer core.
Crust (of the Earth): The solid, rocky outer surface/shell of the Earth.
Fault: A fracture or zone of fractures (fault zone) in the Earth's crust, resulting in movement.
Fracture: A crack or split in the Earth's rocks, or the texture of the broken surface of a mineral.
Igneous: 'fire'; Rock made from cooled magma or lava.
Lava: molten rock that comes from a volcano.
Lithosphere: The outer shell of the Earth, comprising of the crust and the upper most, solid mantle.
Magma: Liquid or molten rock deep within the Earth.
Mantle: The layer between the Earth's core and crust. Predominantly solid but over a geological timeframe, behaves like viscous liquid.
Metamorphic: 'change in form'. Rocks that have 'changed' due to heat and pressure.
Pangaea: The hypothetical single land mass that separated about 200m years ago.
Plate boundaries: Margins that divide up the Earth's surface.
Plate tectonics: The theory that the world is divided into moving 'plates' with new plate material being made all the time at spreading ridges and old being recycled at subduction zones.
Rock cycle: The continuous action or renewal of the Earth's surface, by wind or rain.
Sedimentary: Rocks formed within water bodies from matter deposited due to earthquakes, explosions and some volcanoes.
Subduction zone: An area where the ocean floor 'subducts' (is pushed and sinks down) into the Earth's mantle.
Thrust fault: A fracture in the Earth along which movement has occurred: often formed where tectonic plates collide.
Volcano: A vent in the Earth's crust through which molten rock, ash, gas and rock fragments are ejected from the interior.
Weathering: The physical and chemical effects of the forces of weather on rock surfaces.

Sedimentary (e.g. sandstone, mudstone, flint and chalk



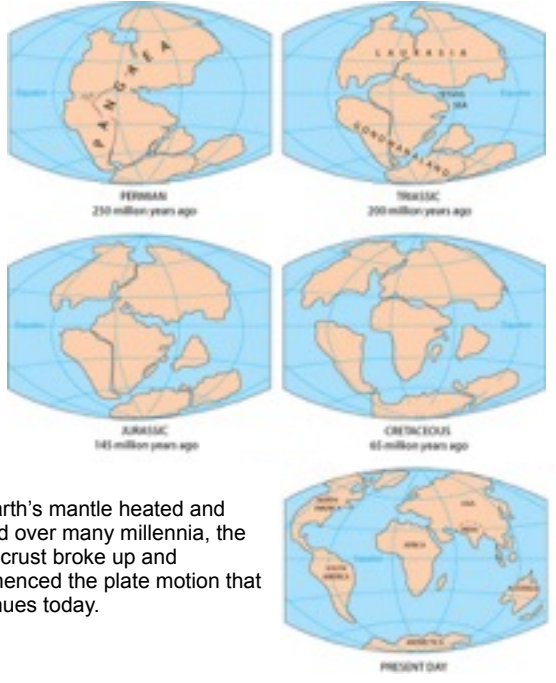
The continuous process by which **rocks** are created, changed from one form to another, destroyed, and then formed again, is called the **rock cycle**.



There are three different types of rocks based on the way they form:
Igneous (e.g. granite, basalt and pumice)
Metamorphic (e.g. marble, quartzite and slate)
Sedimentary (e.g. sandstone, mudstone, flint and chalk)

Continental Drift

Continental drift is the theory that all continents at one time were joined together as one. This theory was first proposed by Alfred Wegener (1912) based on several pieces of evidence:
 •the fit of the continents
 •same type of rocks/ mountain chains on different continents
 •fossils of the same organisms have been found on different continents
 •the climates of the continents were different in the past than they are now.



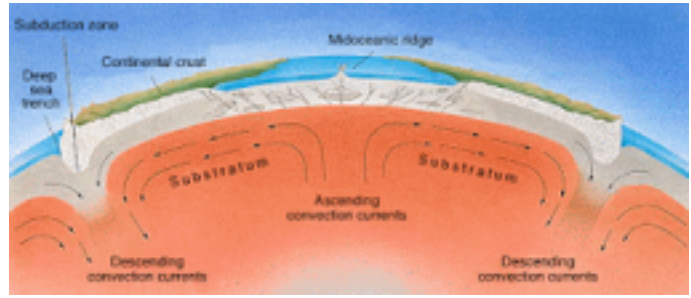
As Earth's mantle heated and cooled over many millennia, the outer crust broke up and commenced the plate motion that continues today.

Tectonic Plates

The Earth is in a constant state of change. Earth's crust, called the lithosphere, consists of 15 to 20 moving tectonic plates.

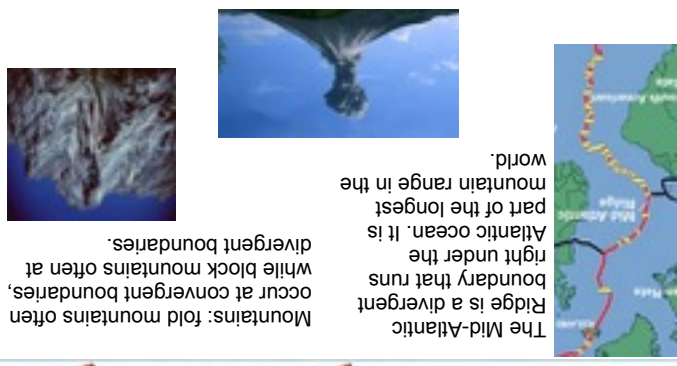


The plates can be thought of like pieces of a cracked shell that rest on the hot, molten rock of Earth's mantle and fit snugly against one another.



These tectonic plates, which consist of the upper mantle and crust, move an average of 5cm per year (the same rate as human nails grow). This movement is called plate motion or tectonic shift and has been attributed to the convection currents in the mantle.

Volcanoes occur at divergent or convergent boundaries. When the plates pull apart the eruptions are quite gentle, but when they collide, immense heat and pressure cause violent explosions.



At plate boundaries...

- Convergent boundary:** when two plates collide, one plate is pushed under the other. The crust often rise through underneath melts, then rise through the gap, forming the new crust. **Divergent boundary:** when two plates pull apart, blocks of land fall into the gap. Molten rock may cause them to stick together eventually become unstuck with a violent jolt, causing an earthquake.
- Transform fault:** when two plates slide past each other, friction may cause them to stick together eventually become unstuck with a violent jolt, causing an earthquake.
- Transform:** when two plates slide past each other, friction may cause them to stick together eventually become unstuck with a violent jolt, causing an earthquake.
- Divergent:** when two plates pull apart, blocks of land fall into the gap. Molten rock may cause them to stick together eventually become unstuck with a violent jolt, causing an earthquake.
- Convergent:** when two plates collide, one plate is pushed under the other. The crust often rise through underneath melts, then rise through the gap, forming the new crust.

Sources

Science Kids <http://www.sciencekids.co.nz/sciencefacts/earth/rocksandminerals.html>

Rocks for Kids <http://www.rocksforkids.com/RFK/identification.html#difference>

Kids Love Rocks <http://www.kidsloverocks.com/html/serpentine.html>

BBC BiteSize http://www.bbc.co.uk/bitesize/ks3/science/environment_earth_universe/rock_cycle/revision/1/

The Geological Society <http://www.geolsoc.org.uk/ks3/gsl/education/resources/rockcycle.html>

Oxford University Museum of Natural History <http://www.oum.ox.ac.uk/thezone/rocks/cycle/>

Mineralogical Society of America http://www.minsocam.org/msa/collectors_corner/id/rock_key.htm

Encyclopedia.com <http://www.encyclopedia.com/doc/1013-monomineralic.html>

<http://www.infoplease.com/dk/encyclopedia/rocks.html>

http://therunningscientist.blogspot.co.uk/2012_03_01_archive.html

National Oceanic and Atmospheric Administration <http://oceanservice.noaa.gov/facts/tectonics.html>

eSchool Today <http://www.eschooltoday.com/rocks/what-are-igneous-rocks.html>

Buzzle.com <http://www.buzzle.com/articles/sedimentary-rock-formation.html>

Kids Geo <http://www.kidsgeo.com/geology-for-kids/0044-plate-boundaries.php>

The Dynamic Earth http://www.mnh.si.edu/earth/text/4_3_1_0.html

Cool Geography <http://www.coolgeography.co.uk/GCSE/AQA/Restless%20Earth/Tsunamis/Tsunamis.htm>

Books:

Eyewitness: Earth

Eyewitness: Volcano

Rocks and Minerals Dan Green