Rock cycle

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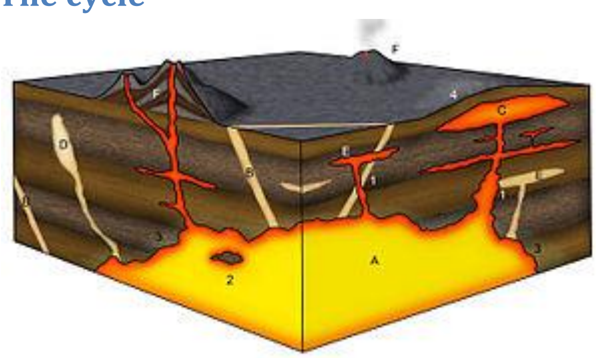
A diagram of the rock cycle. Legend: 1 = magma; 2 = crystallization (freezing of rock); 3 = igneous rocks; 4 = erosion; 5 = sedimentation; 6 = sediments & sedimentary rocks; 7 = tectonic burial and metamorphism; 8 = metamorphic rocks; 9 = melting.

The **rock cycle** is a fundamental concept in geology that describes the dynamic transitions through geologic time among the three main rock types: sedimentary, metamorphic, and igneous. As the diagram to the right illustrates, each of the types of rocks are altered or destroyed when it is forced out of its equilibrium conditions. An igneous rock such as basalt may break down and dissolve when exposed to the atmosphere, or melt as it is subducted under a continent. Due to the driving forces of the rock cycle, plate tectonics and the water cycle, rocks do not remain in equilibrium and are forced to change as they encounter new environments. The rock cycle is an illustration that explains how the three rock types are related to each other, and how processes change from one type to another over time.

The cycle



Structures of Igneous Rock. Legend: A = magma chamber (batholith); B = dyke/dike; C = laccolith; D = pegmatite; E = sill; F = stratovolcano; **processes**: 1 = newer intrusion cutting through older one; 2 = xenolith or roof pendant; 3 = contact metamorphism; 4 = uplift due to laccolith emplacement.

Transition to igneous

When rocks are pushed deep under the Earth's surface, they may melt into magma. If the conditions no longer exist for the magma to stay in its liquid state, it will cool and solidify into an igneous rock. A rock that cools within the Earth is called intrusive or plutonic and will cool very slowly, producing a coarse-grained texture. As a result of volcanic activity, magma (which is called lava when it reaches Earth's surface) may cool very rapidly while being on Earth's surface exposed to the atmosphere and are called extrusive or volcanic rocks. These rocks are fine-grained and sometimes cool so rapidly that no crystals can form and result in a natural glass, such as obsidian. Any of the three main types of rocks (igneous, sedimentary, and metamorphic rocks) can melt into magma and cool into igneous rocks.

Post-volcanic changes

Rock masses of igneous origin have no sooner cooled than they begin to change. The gases with which the magma is charged are slowly dissipated, lava flows often remain hot and steaming for many years. These gases attack the components of the rock and deposit new minerals in cavities and fissures. The zeolites are largely of this origin. Even before these "post-volcanic" processes have ceased, atmospheric decomposition or weathering begins as the mineral components of volcanic and igneous rocks are not stable under surface atmospheric conditions. Rain, frost, carbonic acid, oxygen and other agents operate continuously, and do not cease until the whole mass has crumbled down and most of its ingredients have been resolved into new products or carried away in aqueous solution. In the classification of rocks these secondary changes are generally considered unessential: rocks are classified and described as if they were ideally fresh, though this is rarely the case in nature.

Secondary changes

Epigenetic change (secondary processes) may be arranged under a number of headings, each of which is typical of a group of rocks or rock-forming minerals, though usually more than one of these alterations will be found in progress in the same rock. Silicification, the replacement of the minerals by crystalline or crypto-crystalline silica, is most common in felsic rocks, such as rhyolite, but is also found in serpentine, etc. Kaolinization is the decomposition of the feldspars, which are the most common minerals in igneous rocks, into kaolin (along with quartz and other clay minerals); it is best shown by granites and syenites. Serpentinization is the alteration of olivine to serpentine (with magnetite); it is typical of peridotites, but occurs in most of the mafic rocks. In uralitization secondary hornblende replaces augite; this occurs very generally in diabases; chloritization is the alteration of augite (biotite or hornblende) to chlorite, and is seen in many diabases, diorites and greenstones. Epidotization occurs also in rocks of this group, and consists in the development of epidote from biotite, hornblende, augite or plagioclase feldspar.

Transition to metamorphic

This diamond is a mineral from within an igneous or metamorphic rock that formed at high temperature and pressure.

Rocks exposed to high temperatures and pressures can be changed physically or chemically to form a different rock, called metamorphic. Regional metamorphism refers to the effects on large masses of rocks over a wide area, typically associated with mountain building events within orogenic belts. These rocks commonly exhibit distinct bands of differing mineralogy and colors, called foliation. Another main type of metamorphism is caused when a body of rock comes into contact with an igneous intrusion that heats up this surrounding country rock. This *contact metamorphism* results in a rock that is altered and re-crystallized by the extreme heat of the magma and/or by the addition of fluids from the magma that add chemicals to the surrounding rock (metasomatism). Any pre-existing type of rock can be modified by the processes of metamorphism.

Transition to sedimentary

Rocks exposed to the atmosphere are variably unstable and subject to the processes of weathering and erosion. Weathering and erosion break the original rock down into smaller fragments and carry away dissolved material. This fragmented material accumulates and is buried by additional material. While an individual grain of sand is still a member of the class of rock it was formed from, a rock made up of such grains fused together is sedimentary. Sedimentary rocks can be formed from the lithification of these buried smaller fragments (clastic sedimentary rock), the accumulation and lithification of material generated by living organisms (biogenic sedimentary rock - fossils), or lithification of chemically precipitated material from a mineral bearing solution due to evaporation (precipitate sedimentary rock). Clastic rocks can be formed from fragments broken apart from larger rocks of any type, due to processes such as erosion or from organic material, like plant remains. Biogenic and precipitate rocks form from the deposition of minerals from chemicals dissolved from all other rock types.