

# Sedimentary rock essay sample



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Sedimentary rock formation begins with igneous, metamorphic, or other sedimentary rocks. When these rocks are exposed at the earth's surface they begin the long slow but relentless process of becoming sedimentary rock. Weathering

All rocks are subject to weathering. Weathering is anything that breaks the rocks into smaller pieces or sediments. This can happen by the forces of like wind, rain, and freezing water. Deposition

The sediments that form from these actions are often carried to other places by the wind, running water, and gravity. As these forces lose energy the sediments settle out of the air or water. As the settling takes place the rock fragments are graded by size. The larger heavier pieces settle out first. The smallest fragments travel farther and settle out last. This process of settling out is called deposition. Erosion

The combination of weathering and movement of the resulting sediments is called erosion. Lithification

Lithification is the changing of sediments into rock. There are two processes involved in this change. They are compaction and cementation. Compaction

Compaction occurs after the sediments have been deposited. The weight of the sediments squeezes the particles together. As more and more sediments are deposited the weight on the sediments below increases. Waterborne sediments become so tightly squeezed together that most of the water is pushed out. Cementation happens as dissolved minerals become deposited in the spaces between the sediments. These minerals act as glue or cement to bind the sediments together. The process of sedimentary rock formation

takes millions of years to complete only to begin a new cycle of rock formation. Sedimentary rock can be formed in various ways, and is classified by the method of formation or content. Broadly, sedimentary rock is classified as being clastic, organic, or chemical. Following are the three types and how they are formed.

#### Clastic sedimentary rock:

The majority of sedimentary rock on Earth is formed from particles of pre-existing rocks. This route begins with the weathering and erosion of sedimentary, igneous, or metamorphic rocks. Through these processes, larger rock is broken up into smaller particles which are transported by moving water, ice, gravity or wind, and deposited at the bottom of a lake, a river delta, an ocean, or similar location where further movement is restricted or slowed down. The rock particles can range in size from boulders to clay particles less than .002 mm in diameter. If these rock particles are covered by additional particles, eventually the weight from above will start the process of lithification. Lithification is the compaction and cementing together of sediment particles which form rock. Compaction squeezes out the fluids and space that exist between the particles, and cementation results when minerals form from the migrating solution. Once cementation occurs, the new sedimentary rock has been formed. Rocks formed in this manner include sandstone, shale, mudstone, breccia, and conglomerate.

#### Organic sedimentary rock:

Chalk and other fossiliferous limestones are formed from the skeletons of marine organisms. Coal is formed from vegetation that originated and was deposited in swampy and marshy waterlogged soils which prevented their

full decay after their death. As their remains piled up and were covered by more and more deposits, they were compacted and cemented in the same manner as clastic rock.

Chemical sedimentary rock:

Sedimentary rock can also form when minerals in a body of water have so saturated the water that they precipitate out, like a cloud that is so full of moisture that it pours out rain. Some limestones are formed in this manner as the mineral calcite precipitates out of a saturated solution and undergoes the process of compaction and cementation. The supersaturated solutions can also be caused by evaporation of a body of water high in mineral solution content. As the water evaporates, the mineral percentage of the remaining solution becomes higher and higher, until the mineral crystallizes. Rocks such as rock salt and rock gypsum are formed in this manner.

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. [edit]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.

## [edit]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. [edit]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. [edit]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 recrystallized 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. [edit]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.

Forces that drive the rock cycle

Plate tectonics

Main article: Plate Tectonics

In 1967, J. Tuzo Wilson published an article in Nature describing the repeated opening and closing of ocean basins, in particular focusing on the current Atlantic Ocean area. This concept, a part of the plate tectonics revolution, became known as the Wilson cycle. The Wilson cycle has had profound effects on the modern interpretation of the rock cycle as Plate tectonics became recognized as the driving force for the rock cycle. [edit]Spreading ridges

The start of the cycle can be placed at the mid-ocean divergent boundaries where new magma is produced by mantle upwelling and a shallow melting zone. This new or juvenile basaltic magma is the first phase of the igneous portion of the cycle. It should be noted that the least dense magma phases tend to be favored in eruptions. As the ridge spreads and the new rock is carried away from the ridge, the interaction of heated circulating seawater through crevices starts the initial retrograde metamorphism of the new rock. [edit]Subduction zones

The Juan de Fuca plate sinks below the North America plate at the Cascadia subduction zone. Main article: Subduction



The new basaltic oceanic crust eventually meets a subduction zone as it moves away from the spreading ridge. As this crust is pulled back into the mantle, the increasing pressure and temperature conditions cause a restructuring of the mineralogy of the rock, this metamorphism alters the rock to form eclogite. As the slab of basaltic crust and some included sediments are dragged deeper, water and other more volatile materials are driven off and rise into the overlying wedge of rock above the subduction zone which is at a lower pressure.

The lower pressure, high temperature, and now volatile rich material in this wedge melts and the resulting buoyant magma rises through the overlying rock to produce island arc or continental margin volcanism. This volcanism includes more silicic lavas the further from the edge of the island arc or continental margin, indicating a deeper source and a more differentiated magma. At times some of the metamorphosed downgoing slab may be thrust up or obducted onto the continental margin. These blocks of mantle peridotite and the metamorphic eclogites are exposed as ophiolite complexes. The newly erupted volcanic material is subject to rapid erosion depending on the climate conditions. These sediments accumulate within the basins on either side of an island arc. As the sediments become more deeply buried lithification begins and sedimentary rock results. Continental collision

On the closing phase of the classic Wilson cycle, two continental or smaller terranes meet at a convergent zone. As the two masses of continental crust meet, neither can be subducted as they are both low density silicic rock. As the two masses meet, tremendous compressional forces distort and modify the rocks involved. The result is regional metamorphism within the interior of

the ensuing orogeny or mountain building event. As the two masses are compressed, folded and faulted into a mountain range by the continental collision the whole suite of pre-existing igneous, volcanic, sedimentary and earlier metamorphic rock units are subjected to this new metamorphic event.

#### Accelerated erosion

The high mountain ranges produced by continental collisions are immediately subjected to the forces of erosion. Erosion wears down the mountains and massive piles of sediment are developed in adjacent ocean margins, shallow seas, and as continental deposits. As these sediment piles are buried deeper they become lithified into sedimentary rock. The metamorphic, igneous, and sedimentary rocks of the mountains become the new piles of sediments in the adjoining basins and eventually become sedimentary rock. [edit]An evolving process

The plate tectonics rock cycle is an evolutionary process. Magma generation, both in the spreading ridge environment and within the wedge above a subduction zone, favors the eruption of the more silicic and volatile rich fraction of the crustal or upper mantle material. This lower density material tends to stay within the crust and not be subducted back into the mantle. The magmatic aspects of plate tectonics tends to gradual segregation within or between the mantle and crust. As magma forms, the initial melt is composed of the more silicic phases that have a lower melting point. This leads to partial melting and further segregation of the lithosphere. In addition the silicic continental crust is relatively buoyant and is not normally subducted back into the mantle. So over time the continental masses grow larger and larger. The role of water

## Main article: Water cycle

The surface pattern on this pedestal rock is honeycomb weathering, caused by salt crystallization. This example is at Yehliu, Taiwan. The presence of abundant water on Earth is of great importance for the rock cycle. Most obvious perhaps are the water driven processes of weathering and erosion. Water in the form of precipitation and acidic soil water and groundwater is quite effective at dissolving minerals and rocks, especially those igneous and metamorphic rocks and marine sedimentary rocks that are unstable under near surface and atmospheric conditions. The water carries away the ions dissolved in solution and the broken down fragments that are the products of weathering. Running water carries vast amounts of sediment in rivers back to the ocean and inland basins. The accumulated and buried sediments are converted back into rock.

A less obvious role of water is in the metamorphism processes that occur in fresh seafloor volcanic rocks as seawater, sometimes heated, flows through the fractures and crevices in the rock. All of these processes, illustrated by serpentinization, are an important part of the destruction of volcanic rock. The role of water and other volatiles in the melting of existing crustal rock in the wedge above a subduction zone is a most important part of the cycle. Along with water, the presence of carbon dioxide and other carbon compounds from abundant marine limestone within the sediments atop the downgoing slab is another source of melt inducing volatiles. This involves the carbon cycle as a part of the overall rock cycle.

When it pours out on Earth's surface, magma is called lava. Yes, the same liquid rock matter that you see coming out of volcanoes. On Earth's surface, wind and water can break rock into pieces. They can also carry rock pieces to another place. Usually, the rock pieces, called sediments, drop from the wind or water to make a layer. The layer can be buried under other layers of sediments. After a long time the sediments can be cemented together to make sedimentary rock. In this way, igneous rock can become sedimentary rock. All rock can be heated. But where does the heat come from? Inside Earth there is heat from pressure (push your hands together very hard and feel the heat).

There is heat from friction (rub your hands together and feel the heat). There is also heat from radioactive decay (the process that gives us nuclear power plants that make electricity). So, what does the heat do to the rock? It bakes the rock.

Baked rock does not melt, but it does change. It forms crystals. If it has crystals already, it forms larger crystals. Because this rock changes, it is called metamorphic. Remember that a caterpillar changes to become a butterfly. That change is called metamorphosis. Metamorphosis can occur in rock when they are heated to 300 to 700 degrees Celsius. When Earth's tectonic plates move around, they produce heat. When they collide, they build mountains and metamorphose (met-ah-MORE-foes) the rock. The rock cycle continues. Mountains made of metamorphic rocks can be broken up and washed away by streams. New sediments from these mountains can make new sedimentary rock. The rock cycle never stops.