

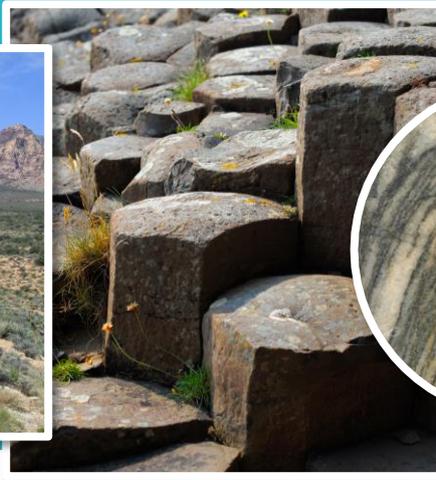
# THE ROCK CYCLE

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From left to right: Red Rock Canyon, Nevada, basalt columns on the Isle of Mull, folding in gneiss (Image: British Geological Survey, P521289), lava from Kilauea, Hawaii.

The outermost layer of the Earth, called the crust, is made from rocks. All of the mountains, ocean floors, volcanoes, valleys and cliffs on our planet are made from rocks, but what exactly are rocks? How do they form and what are the different types? How can rocks change over time?

## THE ROCK CYCLE

No rock stays the same forever. Over thousands and millions of years rocks are broken down, moved around and deposited in different places. Rocks can be compacted together and pushed deep into the Earth where they are **melted** or **deformed** by intense **heat** and **pressure** only to be **uplifted** again to the surface. All of these processes combine to make the **rock cycle**.

## WHAT ARE ROCKS?

**Rocks** are made from a mixture of different **minerals**; these are solid **chemical compounds** that occur naturally on Earth. Some rocks are made from **interlocking mineral crystals** that fit tightly together whereas others are made up from broken fragments, or **grains**, of older rocks and minerals which have been **cemented** together.

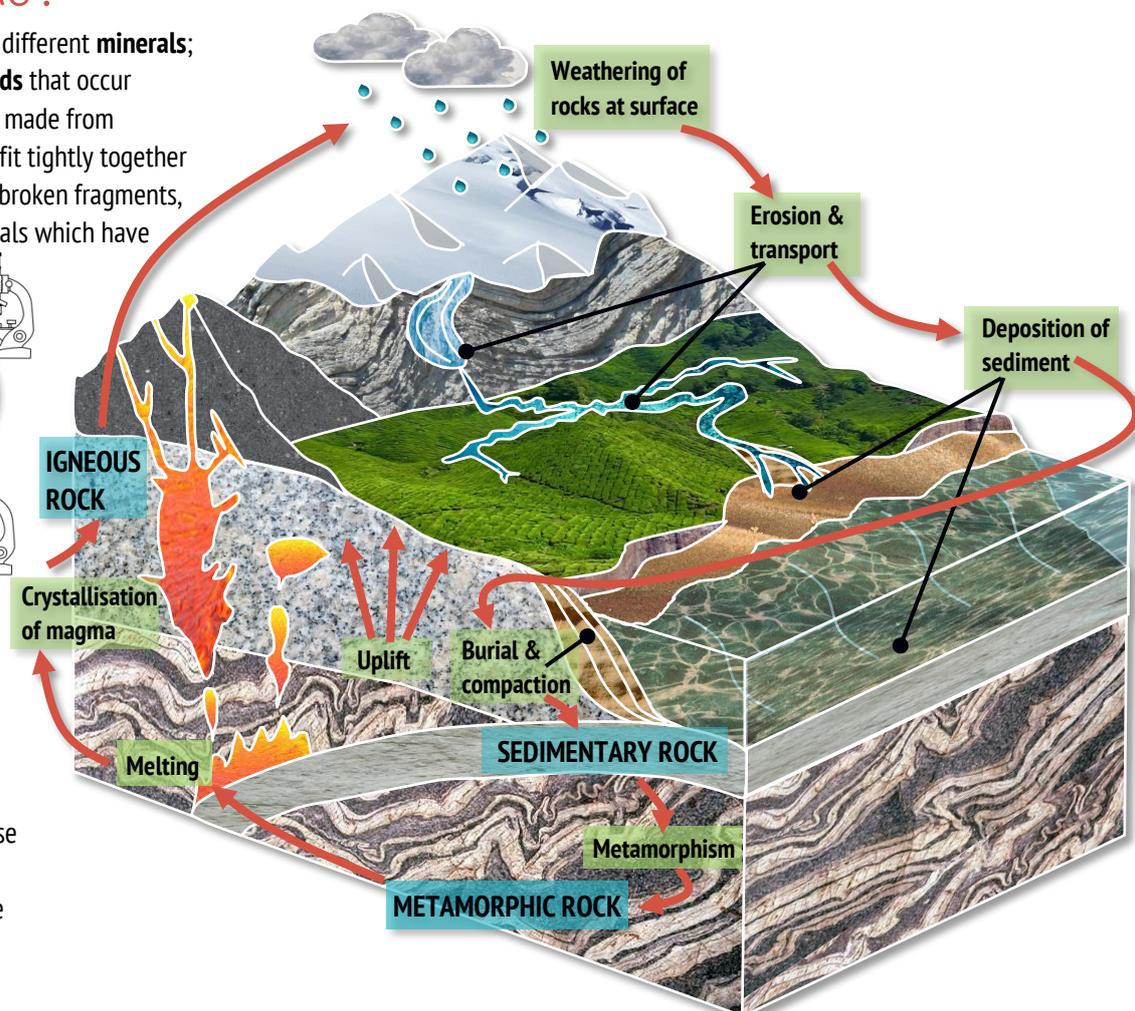


Gabbro - a rock with interlocking crystals



Sandstone - a rock made from fragments of older rocks

Depending on the way a rock has formed it will belong to one of these groups: **igneous**, **sedimentary** or **metamorphic** (find out more on the next page!).



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## SEDIMENTARY

Rocks on the Earth's surface are gradually broken down into smaller pieces by water, ice, wind, plants and animals (known as **weathering**). These broken up pieces are called **sediment** and are transported away, or **eroded**, by rivers, glaciers and wind. Sediments often collect at the bottom of lakes and oceans. Over time they are squashed and compacted together to become a **sedimentary rock** such as **sandstone, limestone** or **mudstone**.

Sedimentary rocks are laid down in layers. They can contain **fossils** from animals and plants that become trapped in the sediment before it becomes a rock.



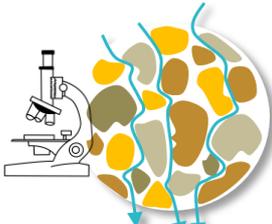
Beds of sandstone, mudstone and limestone in the Grand Canyon



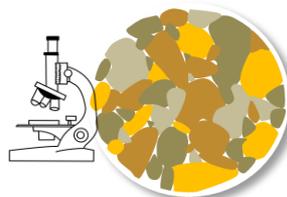
Ammonite fossil in a sedimentary rock

Sedimentary rocks are made up of **grains** which can be **rounded** or **angular**. Under the microscope we can sometimes see gaps between the different grains – these gaps are called **pores**.

If the pores connect together, water, air or oil can flow through the rock, and the rock is called **permeable**. If a permeable rock is put in water you will see bubbles coming out as water pushes the air out.



Porous & permeable



Non-porous & impermeable

## IGNEOUS

When rocks are pushed deep enough down into the Earth, they can melt to form **molten rock**. Below the surface of the Earth, molten rock is called **magma** but when erupted above the ground, usually through **volcanoes**, it is called **lava**.

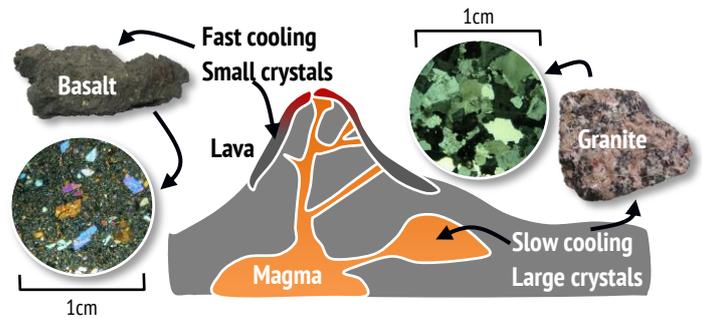
**Igneous rocks** form when either magma or lava cools down and turns from liquid to solid. When this happens, igneous rocks form **crystals** and are said to **crystallise**.

Lava cools down very quickly because the surface of the Earth is cold. This means that igneous rocks formed from cooling lava, such as **basalt**, only have time to grow tiny crystals. Often gas bubbles can get trapped in these rocks too. **Obsidian**, or volcanic glass, cools so quickly that you cannot see any crystals at all!



Obsidian

Magma deep within the Earth takes thousands of years to crystallise because it is much hotter below the surface. Crystals have more time to grow, so they grow larger. If you look closely at an igneous rock that has formed deep within the Earth, for example **granite** or **gabbro**, you will be able to see the different coloured mineral crystals.



Rock & thin section images: © 2013 Imperial College London

## METAMORPHIC

**Metamorphic rocks** are rocks that have been **changed** over time. When rocks are pushed deep down into the Earth, grains and minerals can become stretched, squashed and slightly melted from the extreme **pressure** and **heat**. This is called **metamorphism** and it causes new metamorphic rocks with different textures and/or minerals to form.

Metamorphic rocks are **crystalline** like igneous rocks however the minerals in metamorphic rocks tend to line up to form layers like in this gneiss from NW Scotland.



Image © Robert Stalham /CC-BY-SA 2.0

The metamorphic rock you end up with depends on 1: the **type of rock** you start with, and 2: the **amount of heat and pressure** the rock is put under. Here are a few examples of metamorphism that can occur:



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