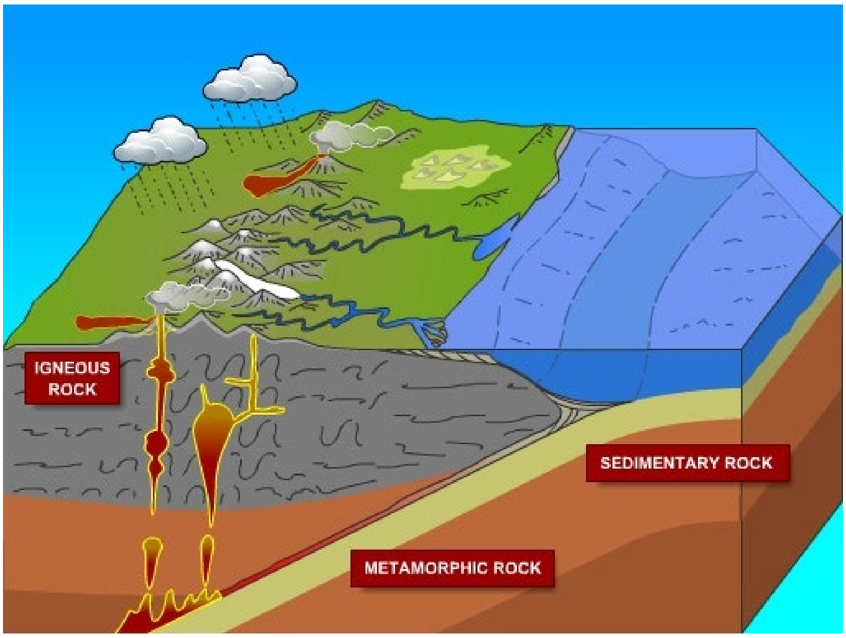
The three main types of rock

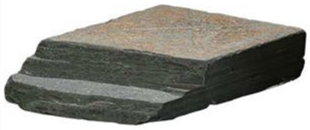


The Earth's crust contains three main types of rock: Igneous rock, formed from cooled magma either below or above the Earth's surface, Sedimentary rock, that has formed from smaller rock particles that bind together, and Metamorphic rock, that originated from other sources but has been changed by the heat and pressure underground.

Rocks can be further distinguished by the type and composition of minerals and rock particles, and the method by which they have been formed.

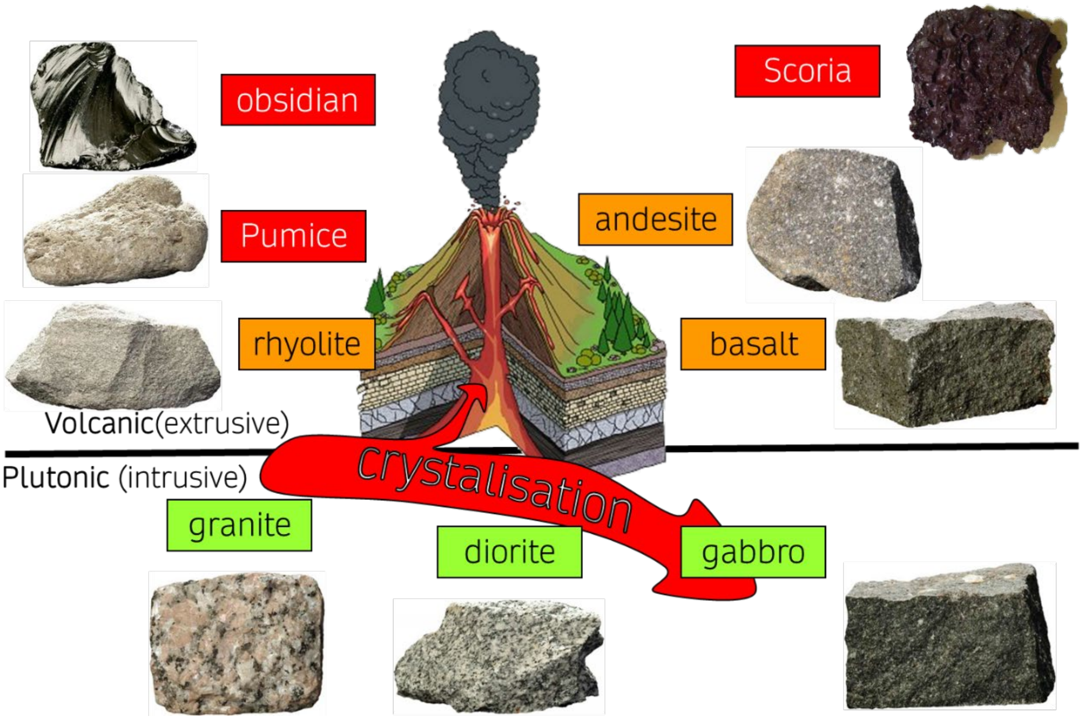
Main groups of Rocks

Igneous	pumice 	rhyolite 	andesite 	basalt 	obsidian 
	scoria 	granite 	diorite 	gabbro 	

Metamorphic	gneiss 	marble 	slate 	schist 

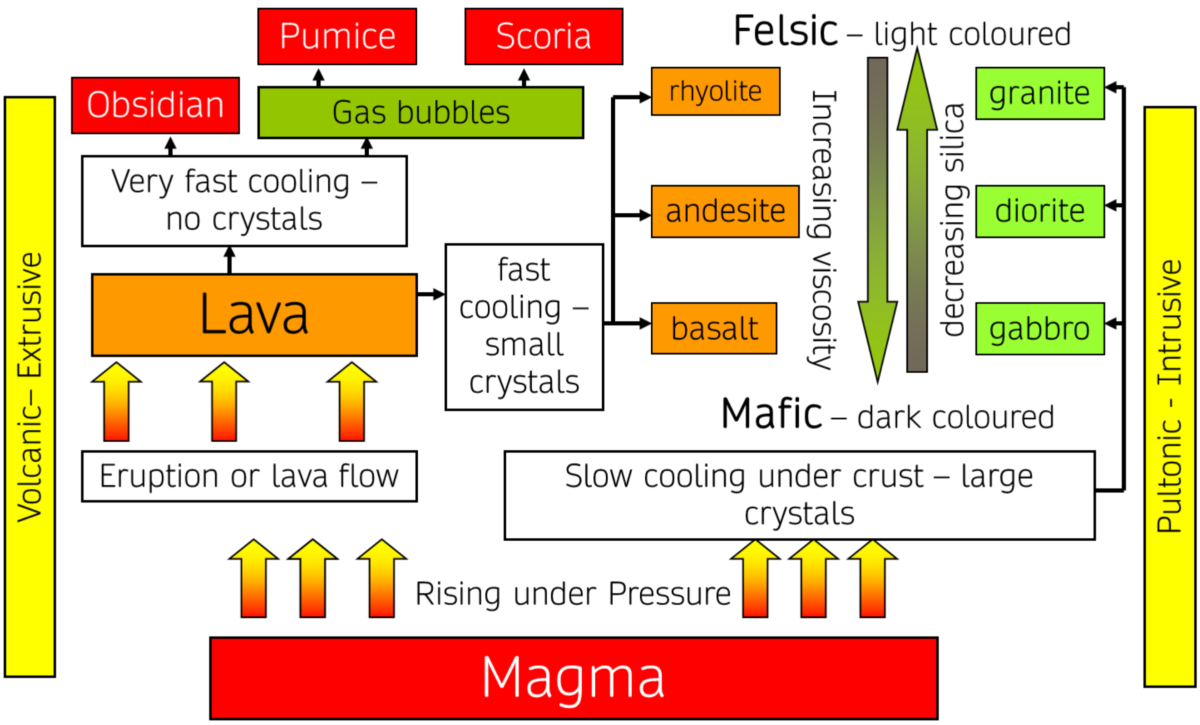
Sedimentary	conglomerate 	sandstone 	siltstone 
	mudstone 	coal 	limestone 

Igneous rock formation



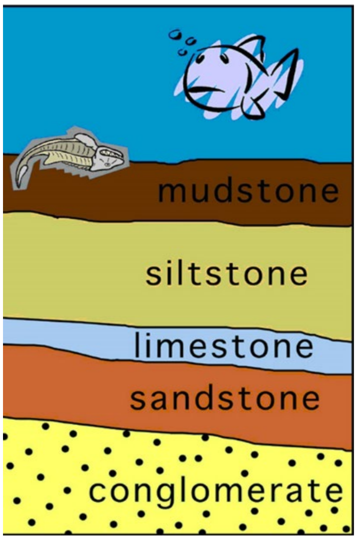
Volcanic (or Extrusive) igneous rocks form when molten rock reaches the Earth's surface and cools. Air and moisture cool the lava rapidly. The quick cooling doesn't allow the formation of large crystals, so most volcanic rocks have small crystals or none at all. In some volcanic rocks, like pumice and scoria, air and other gases are trapped in lava as it cools. We can see holes remaining in the rock where the bubbles of gas were located.

In Plutonic (Intrusive) igneous rocks, the molten rock cools before it reaches the surface. Molten rock that is still underground is called magma. Magma originates from the melting of the Earth's crust and upper mantle. This melting occurs about a depth of 60 to 200 km. because the plutonic rock has more time to cool, it develops large crystals in its structure.



Sedimentary rock formation

Sedimentary rock can be further divided into those types that have been formed due to water flow and those formed from once living organic particles – related to the environment.



Mudstone is a fine-grained rock whose original particles were clays or muds. Mud rocks, such as mudstone and shale (that show layers) comprise some 65% of all sedimentary rocks. Mudstone may show cracks or fissures, like a sun-baked clay deposit.

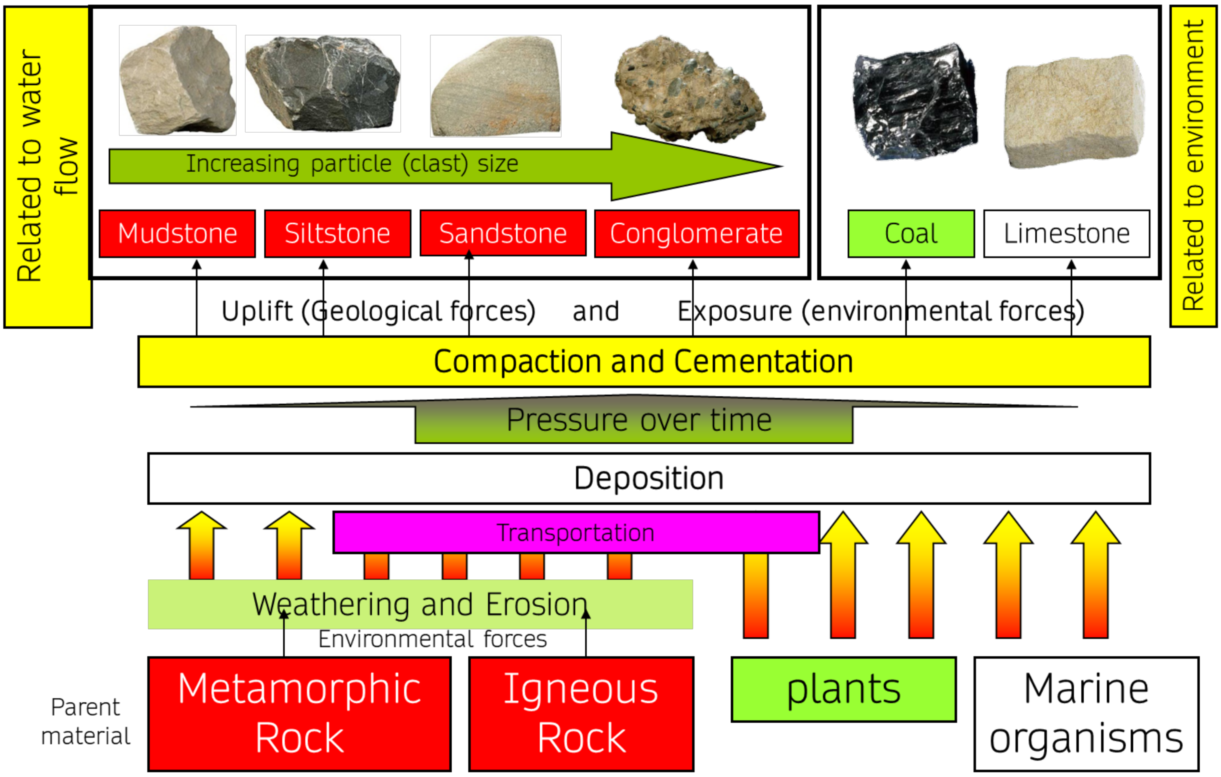
Siltstone is a sedimentary rock which has a composition intermediate in grain size between the coarser sandstones and the finer mudstones.

Sandstone is composed mainly of sand-size grains. Sandstone may be any colour. Because of the hardness of the individual grains, uniformity of grain size, sandstone is an excellent material for building and paving

A **conglomerate** is a rock consisting of individual stones that have become cemented together. Conglomerates consist of rounded fragments.

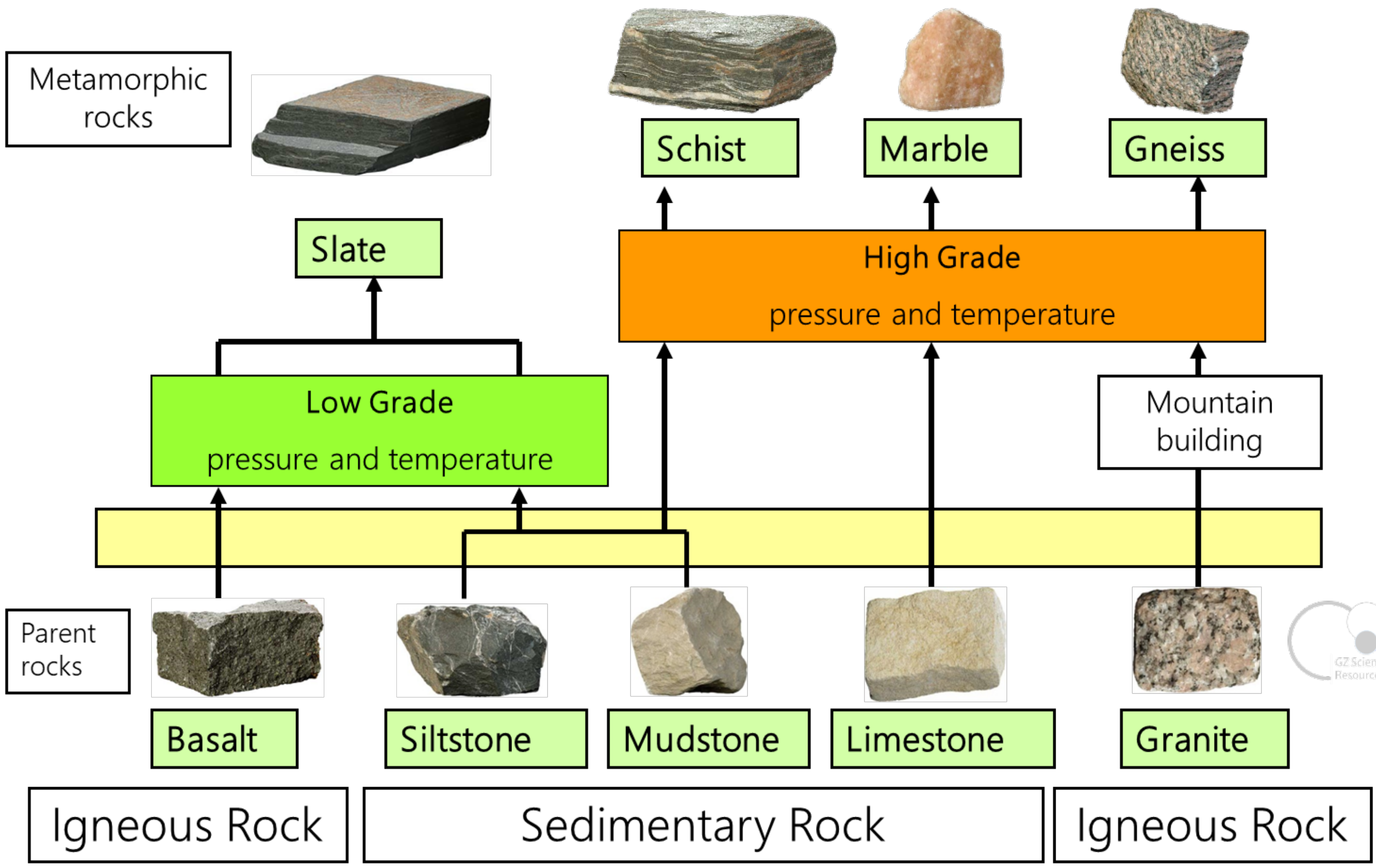
Limestone composed largely of calcium carbonate. The primary source of limestone is most commonly marine organisms. These organisms secrete shells that are deposited on ocean floors. This layer of sediments is covered by further sediments, which over time with heat and pressure is changed into limestone. Limestone is revealed when Earth movements uplift the rock.

Coal is a fossil fuel formed in swamps where plant remains decay slowly without oxygen. It is composed primarily of carbon. It is the largest single source of fuel for the generation of electricity world-wide, as well as the largest source of carbon dioxide emissions. Coal is extracted from the ground by coal mining either underground mining or open cast mines.

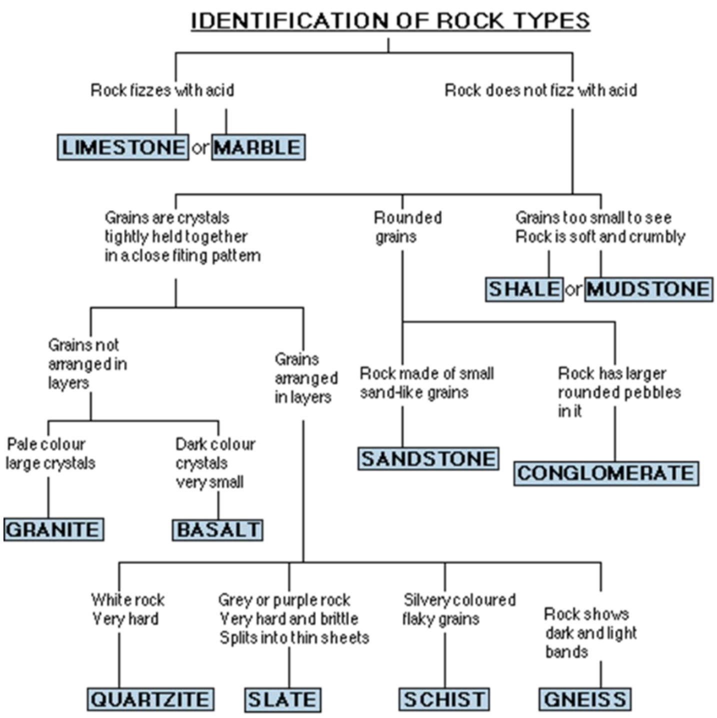


Metamorphic rock formation

The classification of metamorphic rock is determined by the original (parent) rock source, and the grade of heat and pressure it undergoes during the rock transformation.



Rock keys

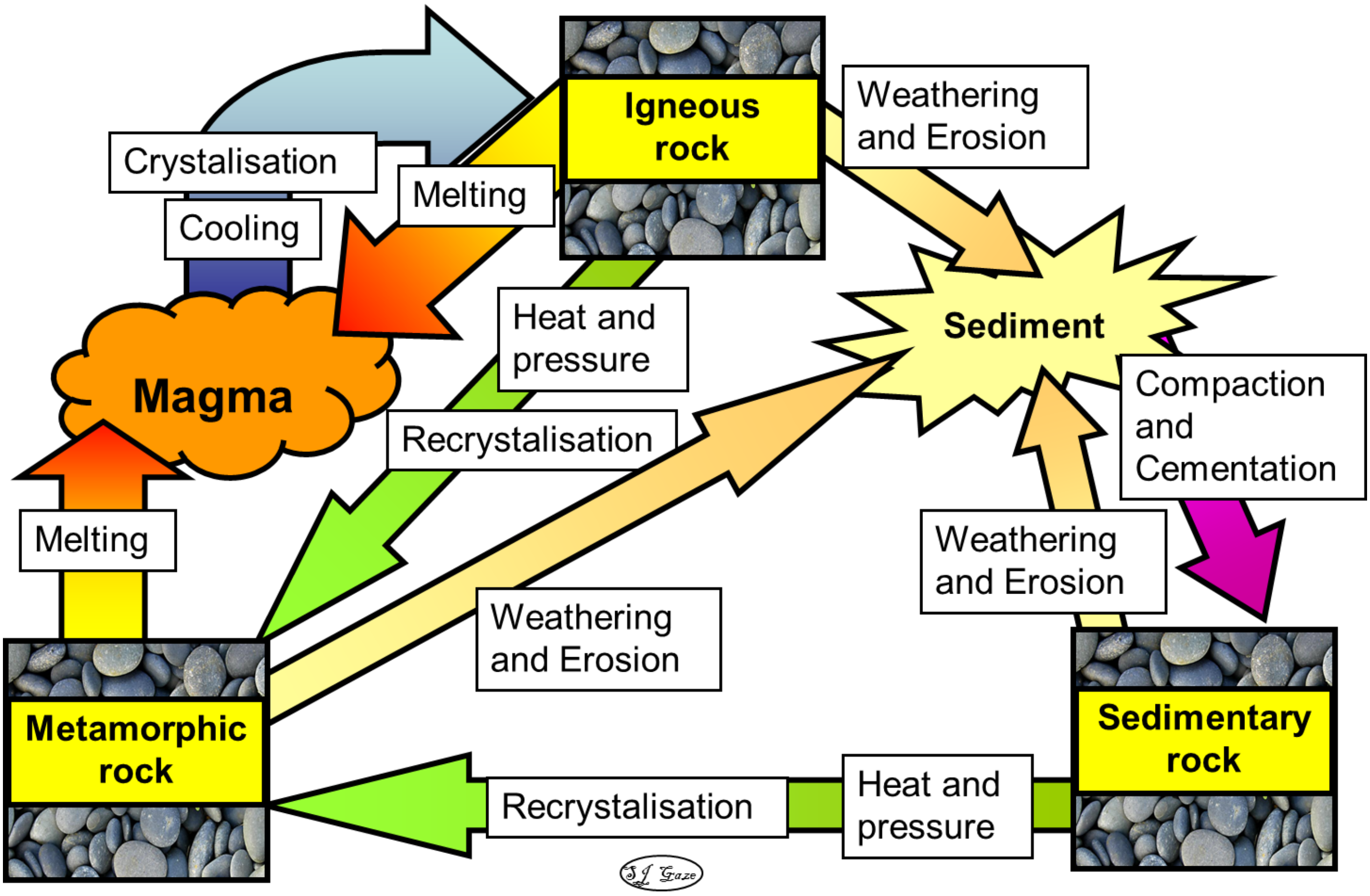


A rock key can be used to identify unknown rocks by observing the rocks physical features and its reaction to acid. Physical features include hardness, colour and presence of bands or sediments within the rock.

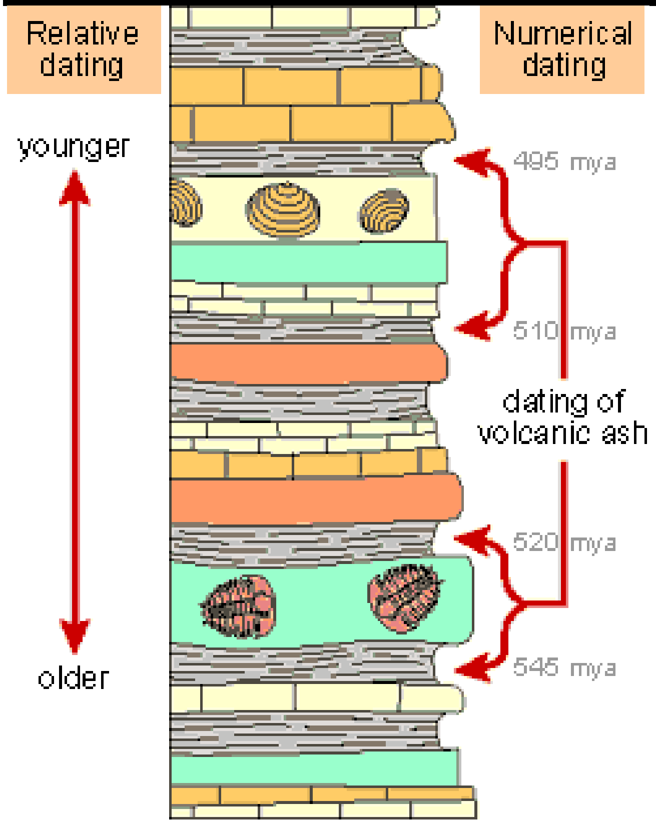
Many books and online guides are available to assist with identification of unknown rocks.

The Rock Cycle

The rock cycle describes how rocks gradually change in form over a very long period of time.



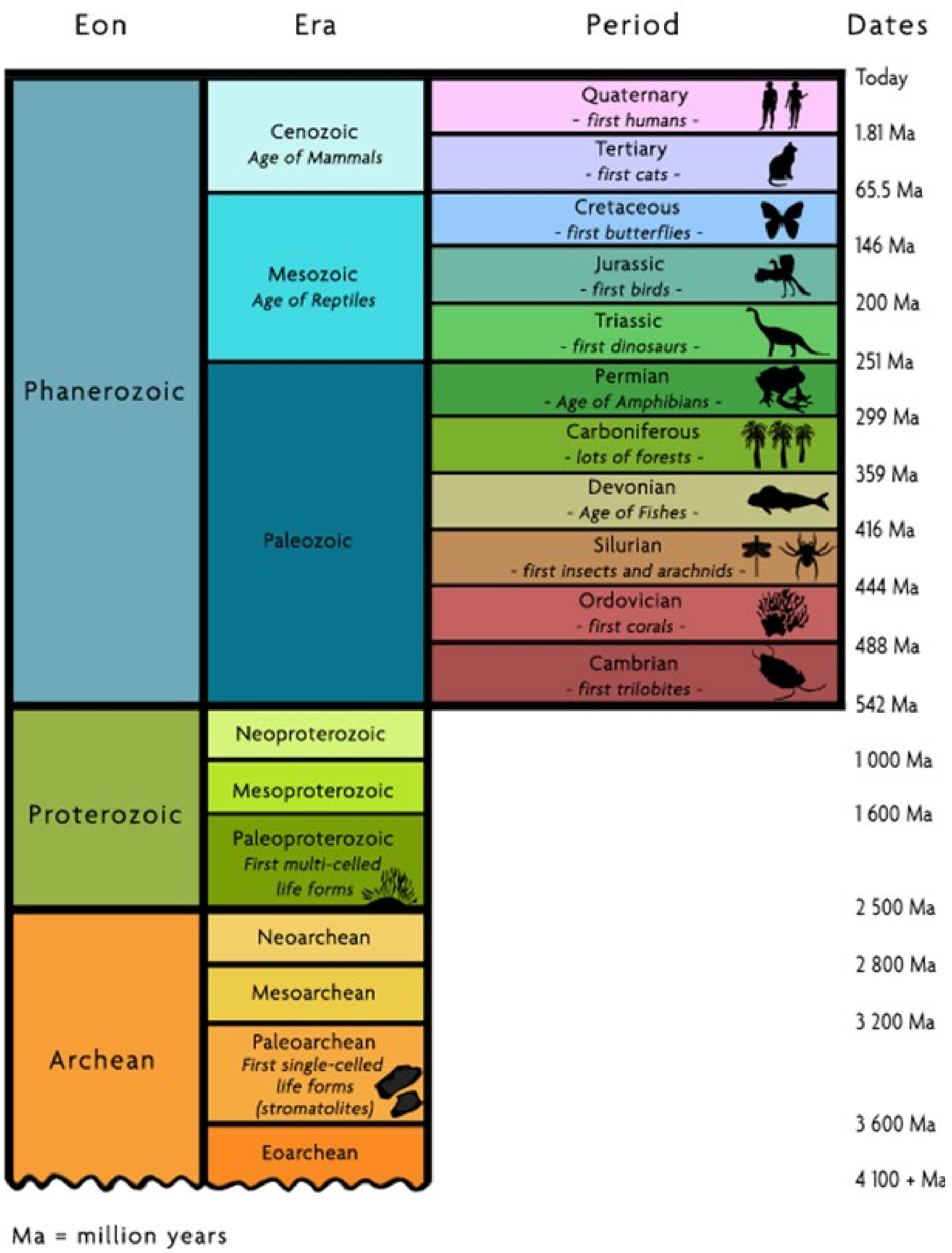
Some rocks contain fossils that are evidence for evolution



Fossils are the remains of long dead organisms that have been covered by sediments before they had a chance to decompose and are then **compressed**. Minerals from the rock material replace the organic material of the dead organism and a cast or fossil is created. **Uplift** and **erosion** of the rocks over time reveals the fossils.

Scientists can date rock, called **radiometric** dating, where the rate of decay of certain radioactive elements in minerals tells us how long ago the rock was first formed. Any fossils found within that same rock can reasonably be given that same date – how long ago they lived, died and were buried by sediments. Scientists can show that different types of living organisms were present on Earth at different times in the past. In fact, around 99% of all living species ever to have evolved on Earth are now extinct.

Geological time chart

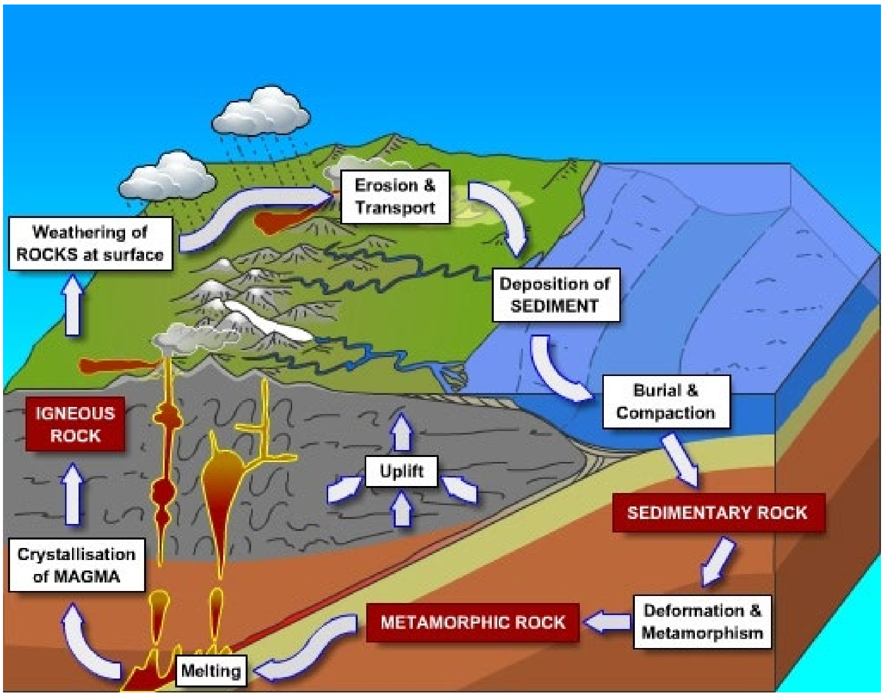


Scientists have divided the 4,550 million years of Earth's history into geological periods, each defined by the type of species present. The longest period was the Precambrian. In this time only bacteria and single celled organisms were found to have existed. There is not much evidence of any remains due to geological processes and earth movement occurring during and since this time.

Weathering and Erosion shape the landscape

Plate tectonic movement is the **internal** force responsible for pushing land upwards and building mountains. Weathering and Erosion are the **external** forces responsible for wearing and breaking the surface features back down.

Weathering is the natural wearing down of objects by elements like water, wind and ice in the environment. **Erosion** is the process of transporting weathered material. This wearing down of objects can be either mechanical, biological or chemical.



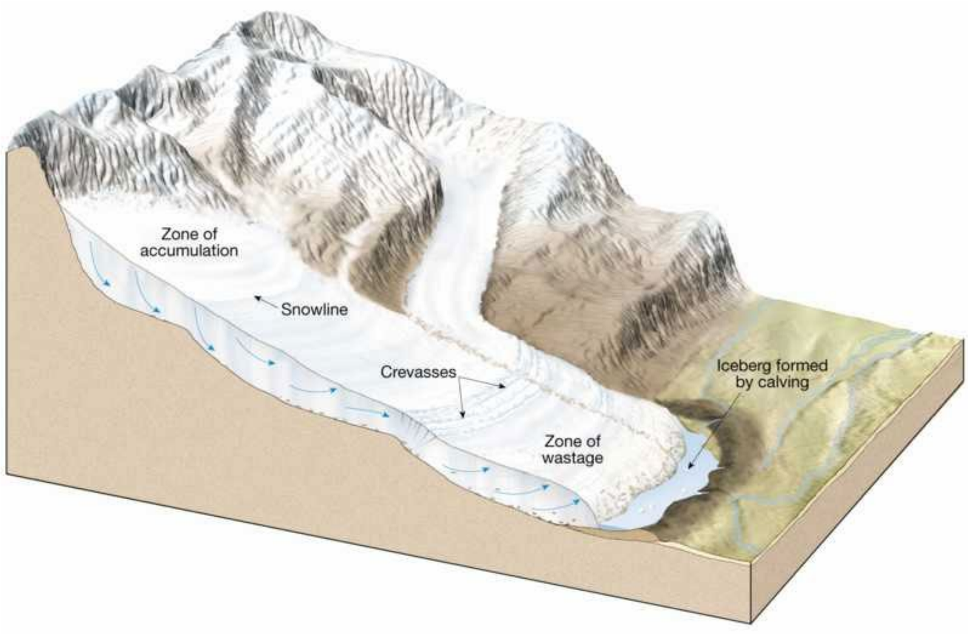
Chemical weathering causes the breakdown of surface features into particles with a different chemical composition. Water can dissolve many kinds of rocks into a solution that has a different chemical makeup than the original substance.

Acid rain can rapidly dissolve calcium carbonate-based rocks such as limestone and create vast networks of caves.

Natural processes that weather rocks

Mechanical weathering is the physical breakdown of an object into smaller pieces. Changes in temperature with the freezing and thawing of water, are forces of mechanical weathering.

Rain may move soil directly if the rain falls with sufficient strength. Soil particles are moved a short distance. Rainfall may also move soil indirectly and create gullies. As time passes small gullies are made larger and larger.



In high altitude or cold areas **snow and ice** can build up in mountains to form glaciers. The weight of the glacier and gravity cause it to move very slowly down-hill. Underlying rocks are ground away by the weight of the glacier and U-shaped valleys are formed.

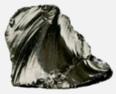
In some areas, such as the Milford Sounds at the bottom of the South Island, most of the glaciers have disappeared and only the valleys remain.

Waves can shape and change the coastline due to erosion. The action of the waves breaks away the rocks to form bays, caves and sea stacks. Sediments can be dropped far out to sea. The waves also break apart the rock into smaller particles to form pebble or sandy beaches

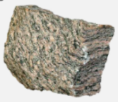
Biological weathering is a form of weathering caused by the activities of living organisms, for example, the growth of roots or the burrowing of animals. Tree roots are probably the most common method of biological weathering as they are capable of prising apart rocks by growing into cracks and joints.

1. Use the information below to make a rock key – use at least 6 different rocks (EXTENSION – use all rocks)

Igneous

Pumice Very light weight Light coloured 	Rhyolite Soft, light—coloured pink or grey 	Andesite fine-grained, light to dark grey in colour. 	Basalt Dark grey heavy hard 	Obsidian Dark, glass-like Hard, shiny 
Scoria Air pockets seen Dark coloured 	Granite Multiple flecks of coloured crystals seen. hard 	Diorite Black and whited peppered rock hard 	Gabbro coarse-grained, dark-coloured, grey/green 	

Metamorphic

Gneiss Hard Multiple layers of rock twisted together 	Marble Reacts with acid Hard, sometimes translucent 	Slate Dark in colour Hard Sheets of flat rock can come apart 	Schist Hard rock Obvious layers of different colours seen 

Sedimentary

Conglomerate Larger stone particles can be seen Embedded in finer rock 	Sandstone Soft Grainy sand particles can often be seen 	Siltstone Light coloured Particles smaller than sand 
Mudstone Soft Particles too small To see 	Coal Dark black Soft Often has distinctive smell 	Limestone Reacts with acid Soft, often white or yellowish 

Does the rock....

YES

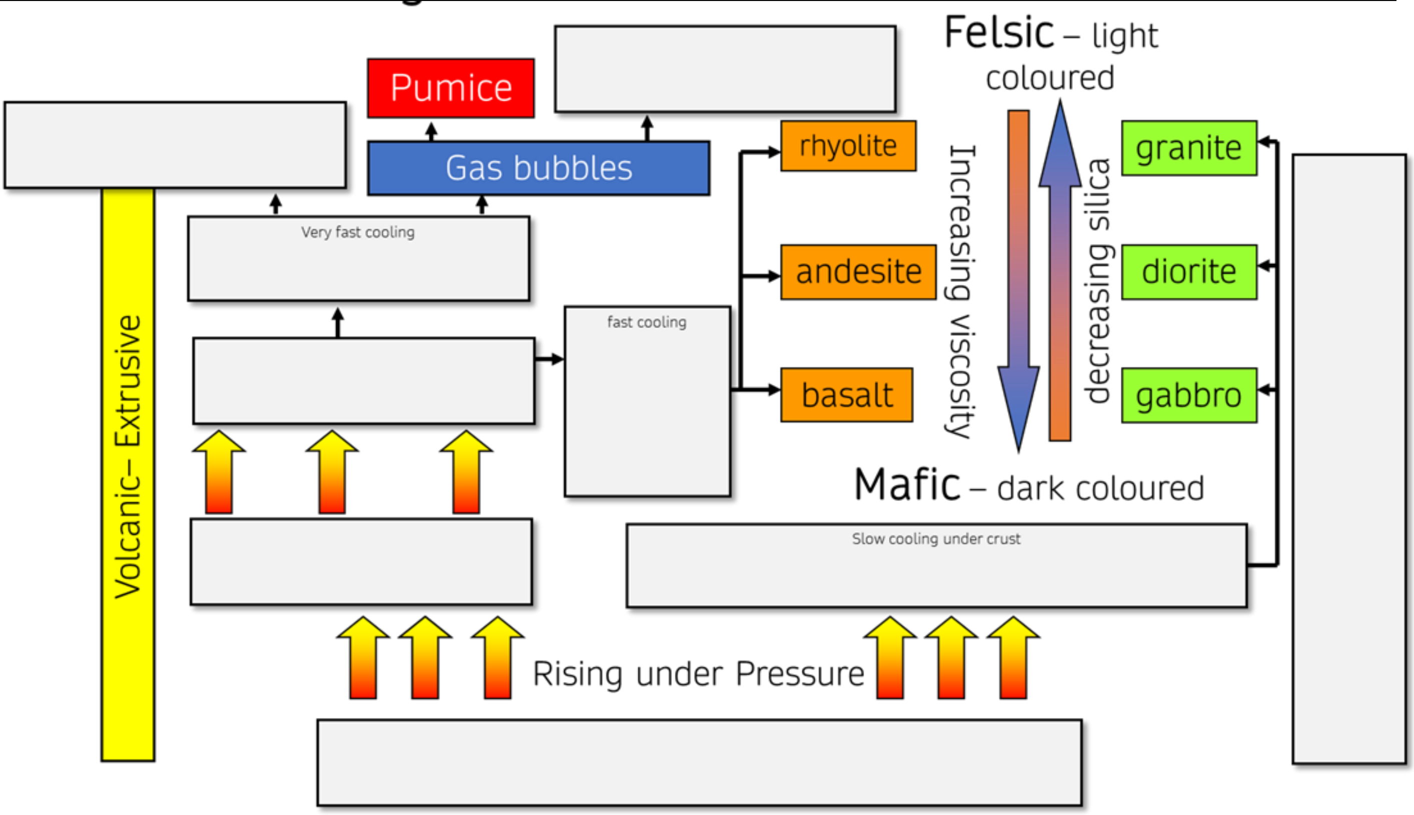
start

NO

Does the rock....

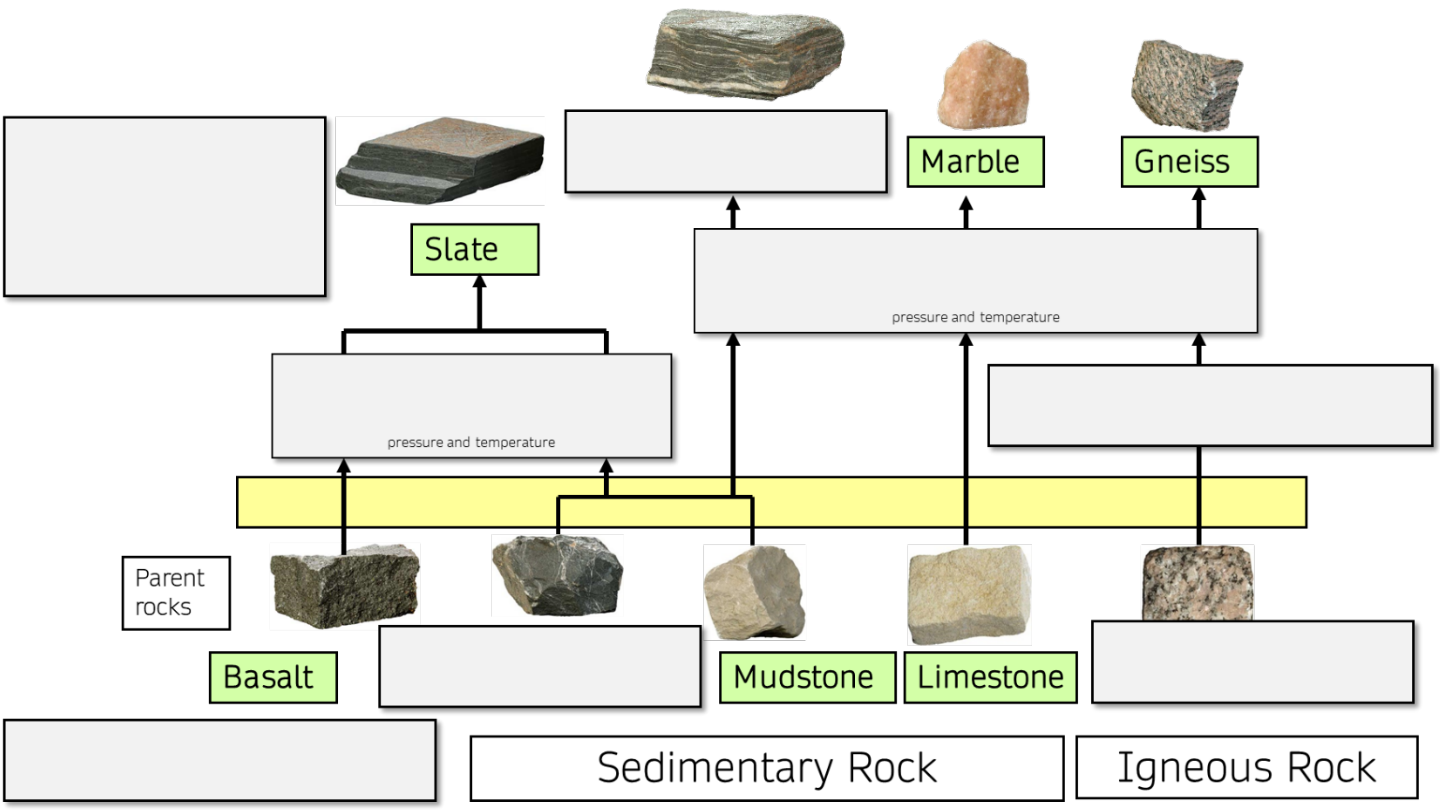
2. Complete the following chart on **igneous rock formation**

Magma lava large crystals small crystals no crystals scoria obsidian plutonic-intrusive eruption



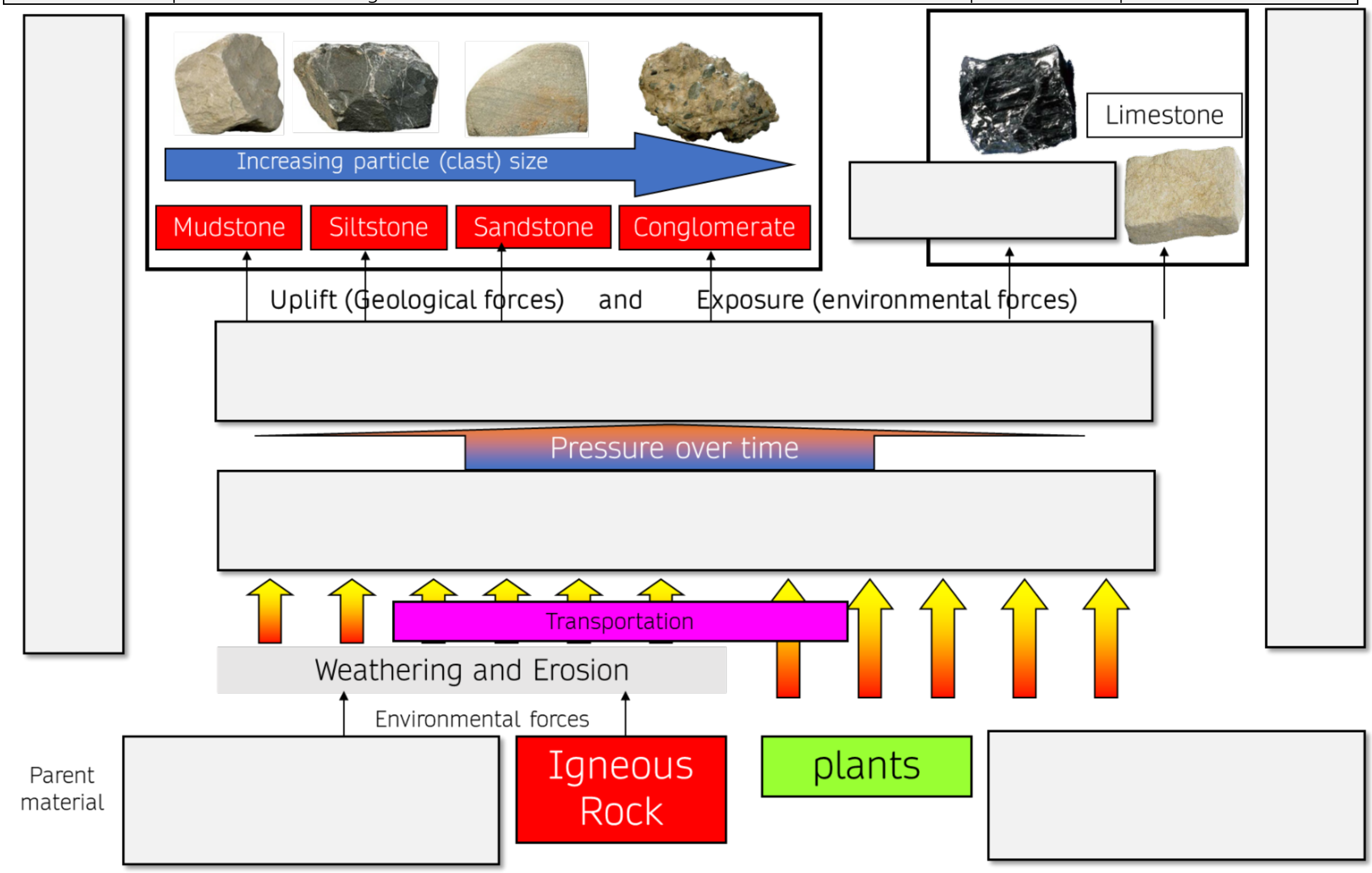
3. Complete the following chart on **metamorphic rock formation**

Low grade high grade schist metamorphic rocks mountain building siltstone granite igneous rock



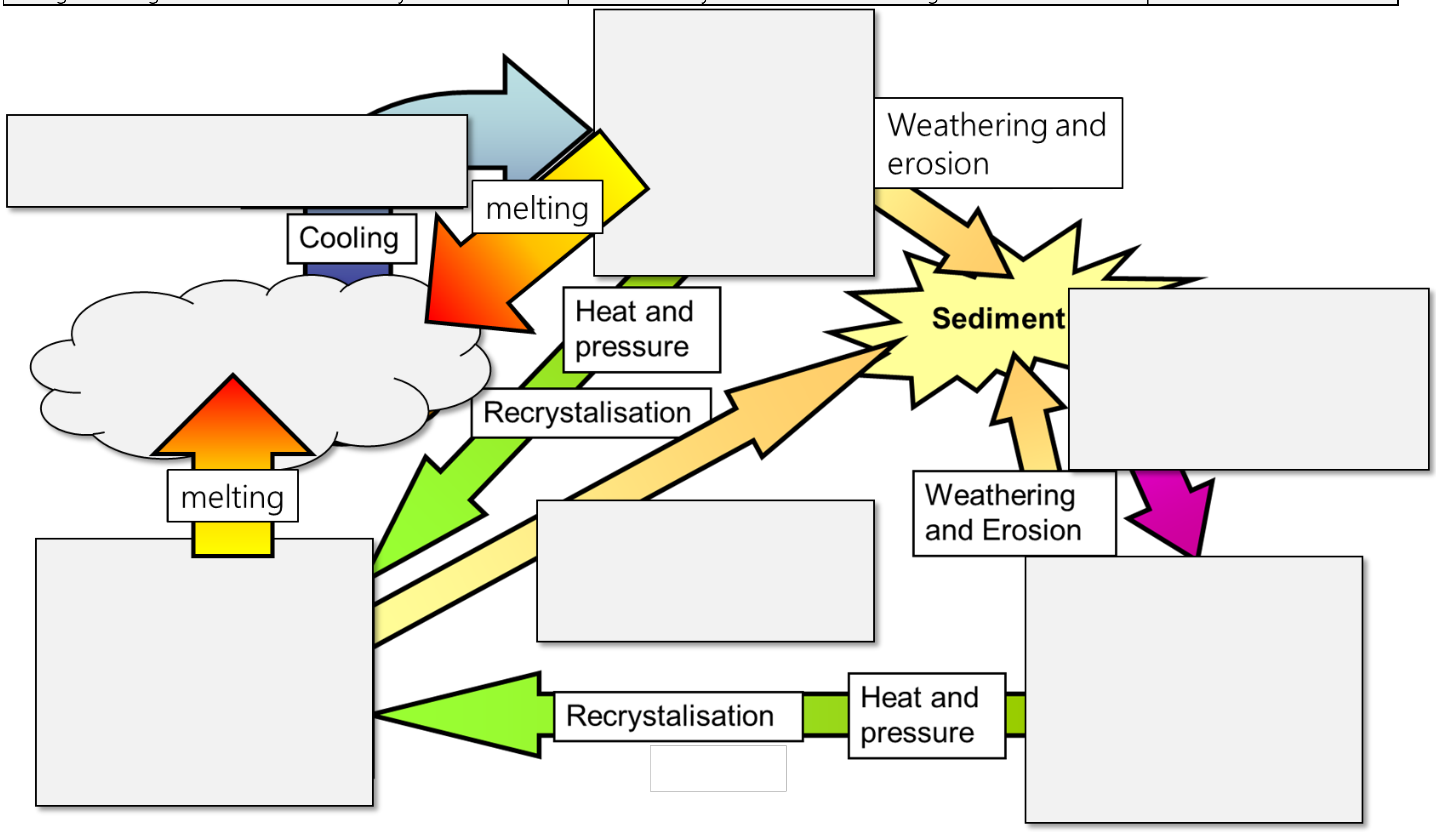
4. Complete the following chart on **sedimentary rock formation**

coal	metamorphic rock	marine organisms	related to water flow	related to environment	deposition	compaction and cementation



5. Complete the **Rock Cycle**

Magma	igneous rock	sedimentary rock	metamorphic rock	crystalisation	weathering and erosion	compaction and cementation



6. Research Time! Using valid sources, search for information about when different types of life form emerged, Earth conditions or major events occurred and add them to the right-hand side of the geological time scale.

Eon	Era	Period	Million years ago - start	Life form emerged / Main events
Phanerozoic	Cenozoic	Quaternary	2.6	
		Tertiary	65.5	
	Mesozoic	Cretaceous	145.5	Meteorite impact – most dinosaurs became extinct
		Jurassic	200	
		Triassic	251	
	Paleozoic	Permian	299	
		Carboniferous	359	
		Devonian	416	
		Silurian	434	
		Ordovician	488	
		Cambrian	542	
Proterozoic			2300	
Archaean			4000	
Hadean			4600	Earth formed at beginning of this Eon