

GCSE Science (Modular) - Module 6 Revision Guide (Chemistry)

Higher Tier Part One

Uses of Limestone

Limestone is a commonly occurring rock, which can be used not only for building but also for making many other useful materials including lime, cement and glass. Limestone, which is mainly calcium carbonate, can be quarried and used as a building material. Powdered limestone can be used to neutralise acidity in lakes and soils. When limestone is heated in a kiln quicklime (calcium oxide) is produced. Quicklime reacts with water to produce slaked lime (calcium hydroxide) which is used to reduce soil acidity. Roasting powdered limestone with powdered clay in a rotary kiln produces cement. When cement is mixed with water, sand and crushed rock, a slow chemical reaction produces a hard, stone-like building material called concrete. Heating a mixture of limestone, sand and soda (sodium carbonate) makes glass.

Rock Types

New rocks are formed as molten material from below the Earth's crust moves nearer to the surface and cools down. High pressure and temperature can change existing rocks into different forms. The pieces formed when existing rocks are broken down may also become part of different types of rock.

Sedimentary rocks are formed from layers of sediment deposited one on top of the other. Their weight squeezes out water and the sediment particles become cemented together by salts crystallising out of this water. This process often takes millions of years.

Rocks composed of layers of cemented grains or fragments are usually sedimentary. Sedimentary rocks include sandstones made from grains of sand and limestones made from calcium carbonate, often in the form of shelly remains of living organisms. Sedimentary rocks sometimes contain fossils. As sediments are laid down, fragments of plants and animals may be trapped and preserved as fossils in the resulting sedimentary rock. Each layer of rock usually contains fossils of plants and animals that lived at the time that the sediment was laid down. This means that fossils can be used to identify rocks of the same age in different places and to decide which rocks are younger or older than others.

Igneous rocks are formed from molten rock (magma). When molten rock is forced into the Earth's crust, intrusive igneous rocks are formed (e.g. granites). When molten rock erupts from volcanoes it forms extrusive igneous rocks (e.g. basalts).

Rocks composed of randomly arranged interlocking crystals of a variety of different minerals are likely to be igneous. If the crystals are small, the magma from which the rock was formed cooled quickly and was probably erupted from a volcano. If the crystals are larger and easily visible, the magma from which the rock was formed cooled more slowly, probably within the Earth's crust.

Metamorphic rocks are associated with present-day and ancient mountain belts. They are evidence of the high temperatures and pressures created by mountain-building processes.

Earth movements (tectonic activity) can cause rocks of all types to become buried deep underground, where they are compressed and heated. This may change the texture and mineral structure of the rock without melting it. Rocks, which have been changed in this way, are called metamorphic rocks.

Examples of metamorphic rocks are marble, which is formed from limestone, and slate, which is formed from mudstone. Rocks composed of bands of interlocking crystals are likely to be metamorphic. Schist is an example of this type of banded rock.

Structure of the Earth

Though the land masses on Earth seem to us to be very fixed they are, in fact, slowly moving about. This movement causes parts of the Earth's crust to rise and so form mountains.

The Earth is nearly spherical and has a layered structure comprising:

- a thin crust;
- an extremely viscous mantle, extending almost halfway to Earth's centre; and
- a core, with just over half of the Earth's radius, made of nickel and iron the outer part of which is liquid and the inner part of which is solid.

The overall density of the Earth is much greater than the mean densities of the rocks which form the crust. This indicates that the interior of the Earth is made of material different from the crust and denser than it. At the surface of the Earth younger sedimentary rocks usually lie on top of older rocks. Sedimentary rock layers are often found tilted, folded, fractured (faulted) and sometimes even turned upside down. This shows that the Earth's crust is unstable and has been subjected to very large forces. Large scale movements of Earth's crust can cause mountain ranges to form very slowly over millions of years. These replace older mountain ranges worn down by weathering and erosion.

Plate Tectonics

At one time it was believed that the major features of the earth's surface were the result of the shrinking of the crust as the Earth cooled down following its formation. However, the edges of land masses (continents) which are separated by thousands of kilometres of ocean (e.g. the east coast of South America and the west coast of Africa):

- have shapes which fit quite closely; and
- have similar patterns of rocks and fossils.

This suggests that they were once part of a single land mass which has split and moved apart.

The Earth's crust is cracked into a number of large pieces (tectonic plates) which are constantly moving at relative speeds of a few centimetres per year as a result of convection currents within the Earth's mantle driven by heat released by natural radioactive processes.

Tectonic plates:

- may **slide past** each other. This is happening along the Californian coast giving rise to earthquakes;
- may **move towards** each other. As this happens, the thinner, denser oceanic plate is driven down (subducted) beneath the thicker granitic continental plate where it eventually melts. The continental crust is forced upwards. Earthquakes are produced and magma may rise through the continental crust to form volcanoes. This is happening along the western side of South America (the Andes);
- may **move apart** from each other. Magma rises to fill the gap and produces new, basaltic, oceanic crust. This is known as sea floor spreading and is happening along oceanic ridges, including the mid-Atlantic ridge. The iron-rich minerals in the magma record the direction of the Earth's magnetic field at the time when the rising magma solidified. Magnetic reversal patterns in oceanic crust occur in stripes parallel to oceanic ridges, matching the periodic reversals of the Earth's magnetic field and so supporting the concept of sea floor spreading. [See Data Book for diagram]

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Foundation Tier Part One

Summary

This part of the module includes the following:

- investigating the uses of limestone both as a building material and as a raw material for producing a range of other useful materials.
- examining a range of different types of rock and the processes by which they were formed.
- considering the effects on the Earth's atmosphere of burning fossil fuels, including those derived from oil.
- the Earth's structure and a consideration of tectonics.

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In the exam you should be able to use the Data Book and/or supplied information to identify rock types.

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