Formation of sedimentary rocks

How they are formed

Rocks on or near the Earth's surface are exposed to physical, chemical and/or biological breakdown. The action of water, ice, wind and temperature changes and living organisms such as plants and bacteria are important in this process, which is known as weathering.

Rocks, apart from those such as limestone, which can be dissolved in water, are broken down into smaller and smaller pieces. These pieces, carried away by erosion involving transport by ice, water or wind, are eventually deposited as a sediment in a river or on its flood plain, in a lake, or in the ocean. Sediment carried by wind can be deposited anywhere, as we well know from the dust storms that sometimes disturb our every-day life.

After sediments have formed, the grains comprising them can slowly become cemented to form sedimentary rocks. Rocks of this type are commonly highlighted by the contrasting layers (strata), which are formed when different sediments are deposited on top of one another.

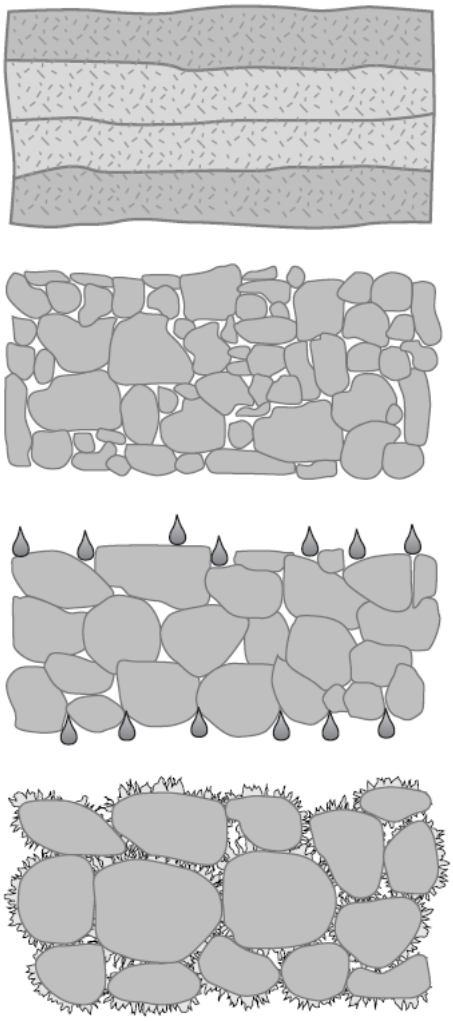

Figure 1. The processes involved in the formation of sedimentary rocks
Source: Ash, M., Lofts, G., and Evergreen, M. J., 1999, Jacaranda Science 2, Jacaranda Wiley Ltd, Brisbane. © John Wiley & Sons Australia

Examples of sedimentary rocks

NAME OF SEDIMENTARY ROCK	SEDIMENTS IT IS MADE FROM
Sandstone	Grains of sand
Shale	Fine grains of mud
Mudstone	Fine grains of mud
Conglomerate	Mud, sand and pebbles of rock of varying sizes
Limestone	Mostly remains of dead sea organism
Coal	Remains of dead plants

Limestone and coal are commercially valuable sedimentary rocks. They are both mined in Queensland and contribute many millions of dollars to the State's economy each year.

Limestone is formed mainly from deposits of the remains of sea organisms such as shellfish and corals, which are often evident in such rocks. The hard parts of these animals contain a chemical called calcium carbonate ($CaCO_3$).

Coal is formed when plant material is buried quickly before it is changed very much by decay. This happens when sediment is deposited and covers the plant debris. The sediment excludes oxygen and prevents the plant material from decaying. Over millions of years, the weight of overlying sediment squashes the plant debris and squeezes out contained water, with increased temperatures from depth of burial helping to convert the plant material into coal. The longer the time involved and the greater the pressure, the higher is the energy value of the coal produced. This process of plant material being turned into coal is called coalification.

Coal deposits are usually found in sequences (layers) of sedimentary rocks. The coal bed often occurs between beds of shales, siltstones and fi ne sandstones. The bed of coal may also be referred to as a coal seam. Some coal deposits might consist of thick seams of almost pure coal. Others might have many thinner coal seams separated by layers of shale.

Sequences of sedimentary rocks containing coal seams occur in basins. The basins might be elongated or rounded with their deepest parts near the centre. The coal lying at the centre of the basin has usually been subjected to the greatest pressure from overlying sediments and is therefore of higher grade. Nearer the basin's edges, the coal might be of lower grade, not having been subjected to the same degree of pressure.

After the basins have been uplifted and eroded, the best-quality coals can stick out or outcrop at the surface. Sometimes, this is what coal explorers look for.

Test your knowledge

Using the information on pages 1 and 2, answer the following questions.

Remember

1. What is a sediment?

2. Where do sediments come from?

3. What is coalification?

4. How does the formation of coal differ from the formation of limestone?

5. During the formation of coal, the plant material becomes covered by other sediments which prevent the plants from rotting completely. What element, which would usually cause the plants to rot, is being blocked from reaching them?

Think

1. Sometimes you can see layers of sedimentary rocks in the walls of road cuttings. Would you expect these layers to be horizontal? Why/why not?

2. Why are limestone and coal sometimes referred to as biological rocks?

3. Limestone is mostly formed on the ocean floor. Explain how Riversleigh in northern Queensland, a very dry area, came to be riddled with limestone caves and fossils of sea organisms.

4. Read about the formation of coal again using the information of pages 1 and 2. Produce a flow chart to summarise the process.

5. In 1669, Nicolaus Steno stated that the layers of sediments on the sea floor will form rocks. Why would the youngest layers of rock be formed at the top of the sediments?

Research

1. What do peat, brown coal and black coal have in common? How do they differ from each other?

2. Limestone is broken up to produce a chemical called lime, which has many uses. Find at least four different uses of lime.

3. What are the main uses of coal?

4. Name the major basins in Queensland and New South Wales from which coal is mined. Where are they located?

5. Find the value of the limestone and coal mined in Australia for the last year.

Extension

In 1895, William Sollas estimated that it takes 300 years to form one metre of sedimentary rock. The Grand Canyon in the United States is 1600 metres deep and is formed from sedimentary rock. Calculate the approximate age of the rocks on the bottom of the Grand Canyon, according to William Sollas.

This information sheet is an extract of the publication *The Science of Mining*, published by the Queensland Resources Council and the Queensland Department of Natural Resources, Mines and Energy, 2004.