

# 15.3

## KEY CONCEPT

# Sedimentary rocks form from earlier rocks.

### BEFORE, you learned

- Most rocks are made of minerals
- Some ocean organisms build their shells from minerals
- Dissolved minerals re-form as water evaporates

### NOW, you will learn

- What kinds of materials make up sedimentary rocks
- What the processes that form sedimentary rocks are
- How sedimentary rocks record past conditions

## VOCABULARY

sediment p. 517

### EXPLORE Particle Layers

#### What happens as rock particles settle in water?

#### PROCEDURE

- 1 Pour 2 cups of water into the jar.
- 2 Add the gravel and sand to the water.
- 3 Shake the jar for a few seconds and then set it down on a counter. Observe and record what happens to the materials in the water.

#### MATERIALS

- jar
- measuring cup
- water
- 1/3 cup gravel
- 1/3 cup sand

#### WHAT DO YOU THINK?

- What determines how the materials settle to the bottom of the jar?
- In a lake, how would a mixture of different-sized rock particles settle to the bottom?



## Some rocks form from rock particles.

If the sand grains on a beach become naturally cemented together, they form a sedimentary rock called sandstone. Most sedimentary rock forms as sandstone does—from loose material that gets pressed together or cemented into rock. Sedimentary rock forms in other ways, too.

Sedimentary rock takes its name from the word *sediment*, which means “something that settles.” **Sediments** are materials that settle out of water or air. In addition to loose pieces of rocks and minerals, pieces of plant and animal remains can also make up sediments. Sedimentary rocks develop from layers of sediments that build up on land or underwater.

### CHECK YOUR READING

What types of material can make up sediments?

#### VOCABULARY

Add a magnet word diagram for *sediment* to your notebook.



## Forming and Transporting Rock Particles

A sandy ocean beach, a gravel bar in a river, and a muddy lake bottom all consist mainly of rock particles. These particles were broken away from rocks by the action of water or wind or a combination of both. Such particles may vary in size from boulders to sand to tiny bits of clay.

Just as water washes mud off your hands as it runs over them, rainwater washes away rock particles as it flows downhill. The water carries these rock particles to streams and rivers, which eventually empty into lakes or oceans. Strong winds also pick up sand and rock dust and carry them to distant places.

As winds or water currents slow down, rock particles settle on the land or at the bottom of rivers, lakes, and oceans. The sediments form layers as larger particles settle first, followed by smaller ones.



Find information on sedimentary rocks.

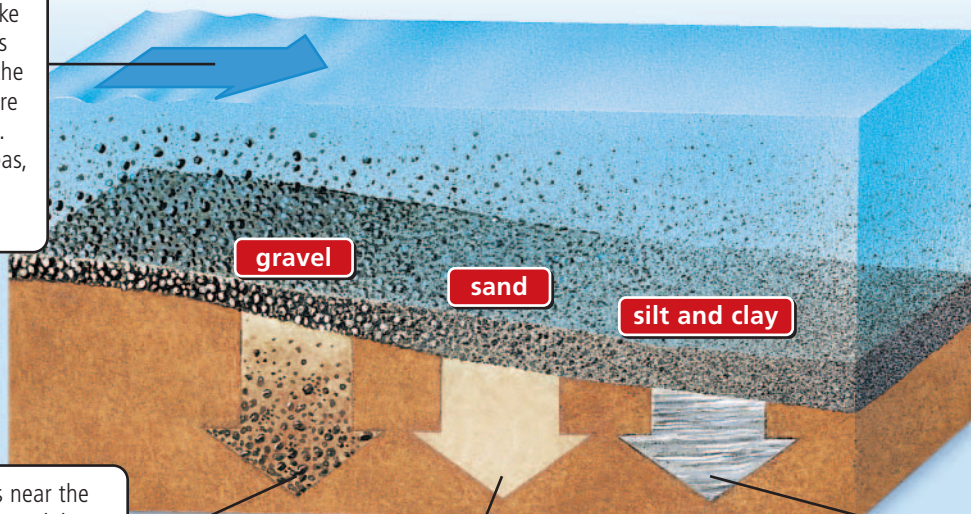
## Forming Loose Sediments into Rocks

If you have ever watched workers building a road, you know that they first put down layers of gravel and other materials. Then they press the layers together, using a huge roller. In a similar way, layers of sediments

### Sorting Sediments by Size

Fast-moving water can move large particles of sediment. As the water slows, the sediment particles settle from it by size.

**1** Water in a lake usually moves fastest near the shore or where a river enters. In deeper areas, water moves slower.



**2** Gravel settles near the shore. Rock containing large sediment particles, such as gravel, is known as conglomerate.

**3** Sand is carried farther from shore. Rock that forms from sand-sized particles is known as sandstone.

**4** Silt and clay are carried into deep water. Rock that forms from silt- and clay-sized particles is known as shale.



Is shale more likely to form near the shore or near the middle of a big lake or ocean?

composed of rock particles may get pressed together to form rock. One layer gets buried by another, and then another. The overlying layers apply pressure to, or press down on, the sediments underneath.

Small particles of sediment, such as silt and clay, may be formed into rock by pressure alone. In other sedimentary rocks the particles are held together by minerals that have crystallized between them, acting as cement. Over a long time, these processes transform loose sediments into sedimentary rocks.

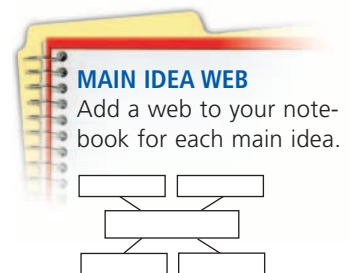


CHECK YOUR READING

What are two processes that can change sediments into rocks?

## Some rocks form from plants or shells.

Processes similar to the ones that produce sedimentary rocks from rock particles also produce rocks from shells or plant remains. These remains are fossils. A fossil is the remains or trace of an organism from long ago.



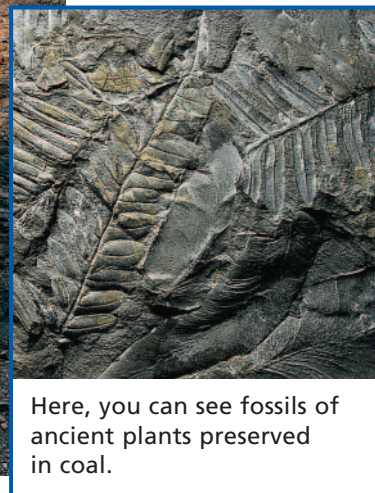
## Coal

If you look at a piece of coal through a magnifying glass, you may be able to make out the shapes of bits of wood or leaves. That is because coal is made up of remains of plants—dead wood, bark, leaves, stems, and roots. Coal is an unusual sedimentary rock because it forms from plants instead of earlier rocks.

The coal people use today started forming millions of years ago in swamps. As plants died, their remains fell upon the remains of earlier plants. Then layers of other sediments buried the layers of plant remains. The weight of the sediments above pressed the plant material into coal.



The dark layer in these rocks is coal.



Here, you can see fossils of ancient plants preserved in coal.

## Limestone

Limestone is made up of carbonate minerals, such as calcite. The shells and skeletons of ocean organisms are formed of these minerals. When the organisms die, the shells and skeletons settle on the ocean floor as layers of sediment. Over time, the layers become buried, pressed together, and cemented to form limestone. The photographs below show how loose shells can become limestone.



These shells were made by ocean organisms.



**1** The shells get cemented together into limestone as some of their minerals dissolve and re-form.



**2** Individual shells become harder to see as minerals in the limestone continue to dissolve and re-form.



**3** Over time, what was once loose sediment becomes limestone with no recognizable shells.

### READING Tip

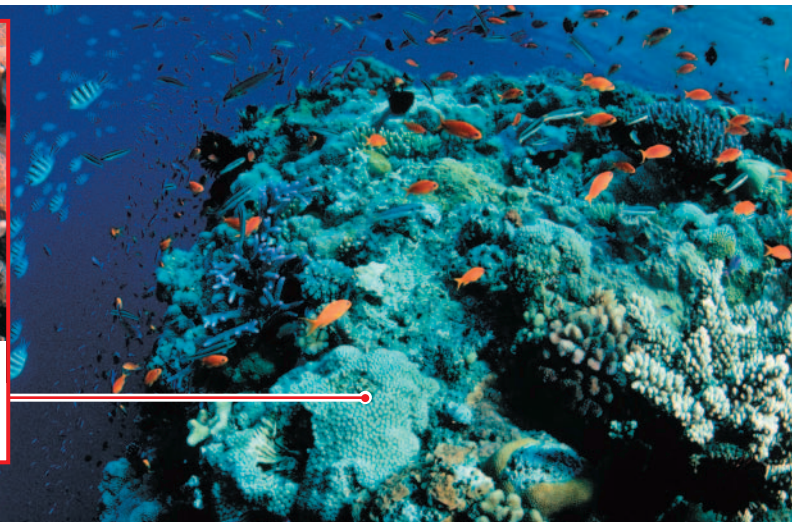
Notice that limestone made up of cemented shells and the limestone in coral reefs were both formed by ocean organisms.

The famous white cliffs of Dover, England, consist of a type of limestone called chalk. The limestone began to form millions of years ago, when the land was under the ocean. The rock developed from shells of tiny organisms that float in the ocean. Most limestone comes from shells and skeletons of ocean organisms. The materials the organisms use to build their shells and skeletons are present in ocean water because they were dissolved from earlier rocks. Like almost all sedimentary rock, limestone forms from material that came from older rocks.

Coral reefs also consist of limestone that comes from organisms. However, in the case of reefs, the limestone is produced directly as coral organisms build their skeletons one on top of another. In the formation of coral, the rock does not go through a loose-sediment stage.



The skeletons of these tiny coral organisms eventually make huge coral reefs.



## Some rocks form when dissolved minerals re-form from water.

If you have grown crystals in a container, you know that some substances can dissolve in water and then re-form as the water evaporates. The same process happens in nature. Some sedimentary rocks are made up of minerals that crystallized as water dried up.

The water in oceans, lakes, rivers, and streams contains minerals that came from rocks. Some of these minerals are in solid form. As rainwater washes over rocks, it picks up pieces of minerals and rock particles and carries them into streams and rivers, where many of them settle to the bottom. However, some of the minerals dissolve in the water and are carried along with it.

Water often flows through cracks in rock that is near Earth's surface. As water moves through limestone, some of the rock dissolves. A large open space, or cave, can be left in the rock. As the water flows and drips through the cave, some of it evaporates. The new limestone that forms can take many odd and beautiful shapes.

Sometimes minerals crystallize along the edges of lakes and oceans where the climate is dry and a lot of water evaporates quickly. Over time, the minerals build up and form layers of sedimentary rock. Rock salt and gypsum form in this way. Under the city of Detroit, for example, is a large bed of rock salt that developed when part of an ancient ocean dried up.



Water is shaping this limestone cavern. Water dissolves and transports minerals, then leaves the minerals behind as it evaporates.



How are the origins of rock salt and some limestone similar?

These limestone towers in Mono Lake, California, formed underwater. They are now above the surface because the lake level has dropped.



# INVESTIGATE Rock Layers

## How do sedimentary rocks form in layers?

### PROCEDURE

- 1 Prepare the plaster of Paris by mixing it with the water.
- 2 Mix 2 tablespoons of the gravel with 2 tablespoons of the plaster of Paris and pour the mixture into the paper cup.
- 3 Mix the sand with 2 tablespoons of the plaster of Paris and the food coloring. Add the mixture to the paper cup, on top of the gravel mixture.
- 4 Mix the rest of the gravel with the rest of the plaster of Paris. Add the mixture to the paper cup, on top of the sand mixture.
- 5 After the mixtures harden for about 5 minutes, tear apart the paper cup and observe the layers.

### WHAT DO YOU THINK?

- How is the procedure you used to make your model similar to the way sedimentary rock forms?
- Describe how similar layers of real rock could form.

**CHALLENGE** How would you create a model to show the formation of fossil-rich limestone?

**SKILL FOCUS**  
Modeling

### MATERIALS

- 1 paper cup
- 3 mixing cups
- 6 tbs plaster of Paris
- 3 tbs water
- 4 tbs gravel
- 2 tbs sand
- 3 drops food coloring

**TIME**  
20 minutes



## Sedimentary rocks show the action of wind and water.

### READING TIP

Notice that sedimentary rocks are laid down in layers. As conditions in an area change, so do the characteristics of the layers.

Sedimentary rocks are laid down in layers, with the oldest layers on the bottom. A geologist studying layers of sedimentary rocks can tell something about what conditions were like in the past. For instance, fossils of fish or shells in a layer of rock show that the area was covered by a lake or an ocean long ago.

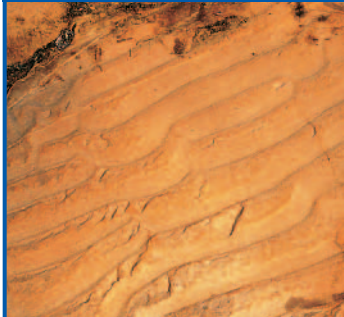
Fossils are not the only way to tell something about what past conditions were like. The sediments themselves contain a great deal of information. For example, a layer of sedimentary rock may contain sediment particles of different sizes. The largest particles are at the very bottom of the layer. Particles higher in the layer become increasingly smaller. A layer like this shows that the water carrying the sediment was slowing down. The largest particles dropped out when the water was moving quickly. Then smaller and smaller particles dropped out

### Crossbeds



The tilted layers in these sandstone rocks are called crossbeds. The layers were once moving sand dunes.

### Ripples



The surface of this sandstone preserves ancient sand ripples.

### Mud Cracks



As wet silt and clay dry out, cracks develop on the surface of the sediment.

as the water slowed. This type of layer is often created by a flood, when a large amount of water is at first moving quickly.

Sedimentary rocks can give information about the directions in which long-ago wind or water currents were traveling when sediments settled from them. Sand can be laid down in tilted layers on the slopes of sand dunes or sandbars. Sand can also form ripples as water or wind moves over its surface. If the sand has been buried and cemented into sandstone, a geologist can examine it and tell the direction in which the water or wind was moving.

Some rocks made of clay or silt have cracks that developed when the mud from which they formed dried out. Mud cracks show that the rocks formed in areas where wet periods were followed by dry periods.



#### CHECK YOUR READING

What could a geologist learn by finding rocks that have ripples or mud cracks?

## 15.3 Review

### KEY CONCEPTS

1. What types of material can make up sediments?
2. Describe the three processes by which sedimentary rocks form.
3. Describe how a sedimentary rock can show how fast water was flowing when its sediments were laid down.

### CRITICAL THINKING

4. **Infer** Why is coal called a fossil fuel?
5. **Analyze** How could the speed of flowing water change to lay down alternating layers of sand and mud?

### CHALLENGE

6. **Synthesize** How is it possible for a single sedimentary rock to contain rock particles, animal shells, and minerals that crystallized from water?