

Sedimentary Rocks

Reading Focus

Key Concepts

- How do sedimentary rocks form?
- What are the three major types of sedimentary rocks?
- How are sedimentary rocks used?

Key Terms

- sediment • erosion
- deposition • compaction
- cementation • clastic rock
- organic rock • chemical rock

Target Reading Skill

Outlining As you read, make an outline about sedimentary rocks. Use the red section headings for the main topics and the blue headings for the subtopics.

Sedimentary Rocks

- I. From sediment to rock
 - A. Erosion
 - B.
- II.
 - A.

Lab zone

Discover Activity

How Does Pressure Affect Particles of Rock?

1. Place a sheet of paper over a slice of soft bread.
2. Put a stack of several heavy books on top of the paper. After 10 minutes, remove the books. Observe what happened to the bread.
3. Slice the bread so you can observe its cross section.
4. Carefully slice a piece of fresh bread and compare its cross section to that of the pressed bread.

Think It Over

Observing How did the bread change after you removed the books? Describe the texture of the bread. How does the bread feel? What can you predict about how pressure affects the particles that make up sedimentary rocks?

Visitors to Badlands National Park in South Dakota see some of the strangest scenery on Earth. The park contains jagged peaks, steep cliffs, and deep canyons sculpted in colorful rock that is layered like a birthday cake. The layers of this cake are red, orange, pink, yellow, or tan. These rocks formed over millions of years as particles of mud, sand, and volcanic ash were deposited in thick layers. The mud and sand slowly changed to sedimentary rock. Then, uplift of the land exposed the rocks to the forces that wear away Earth's surface.

From Sediment to Rock

If you have ever walked along a stream or beach you may have noticed tiny sand grains, mud, and pebbles. These are particles of sediment. **Sediment** is small, solid pieces of material that come from rocks or living things. In addition to particles of rock, sediment may include shells, bones, leaves, stems, and other remains of living things. Sedimentary rocks form when sediment is deposited by water and wind. Most sedimentary rocks are formed through a series of processes: erosion, deposition, compaction, and cementation. Figure 9 shows how sedimentary rocks form.



Badlands National Park ▲

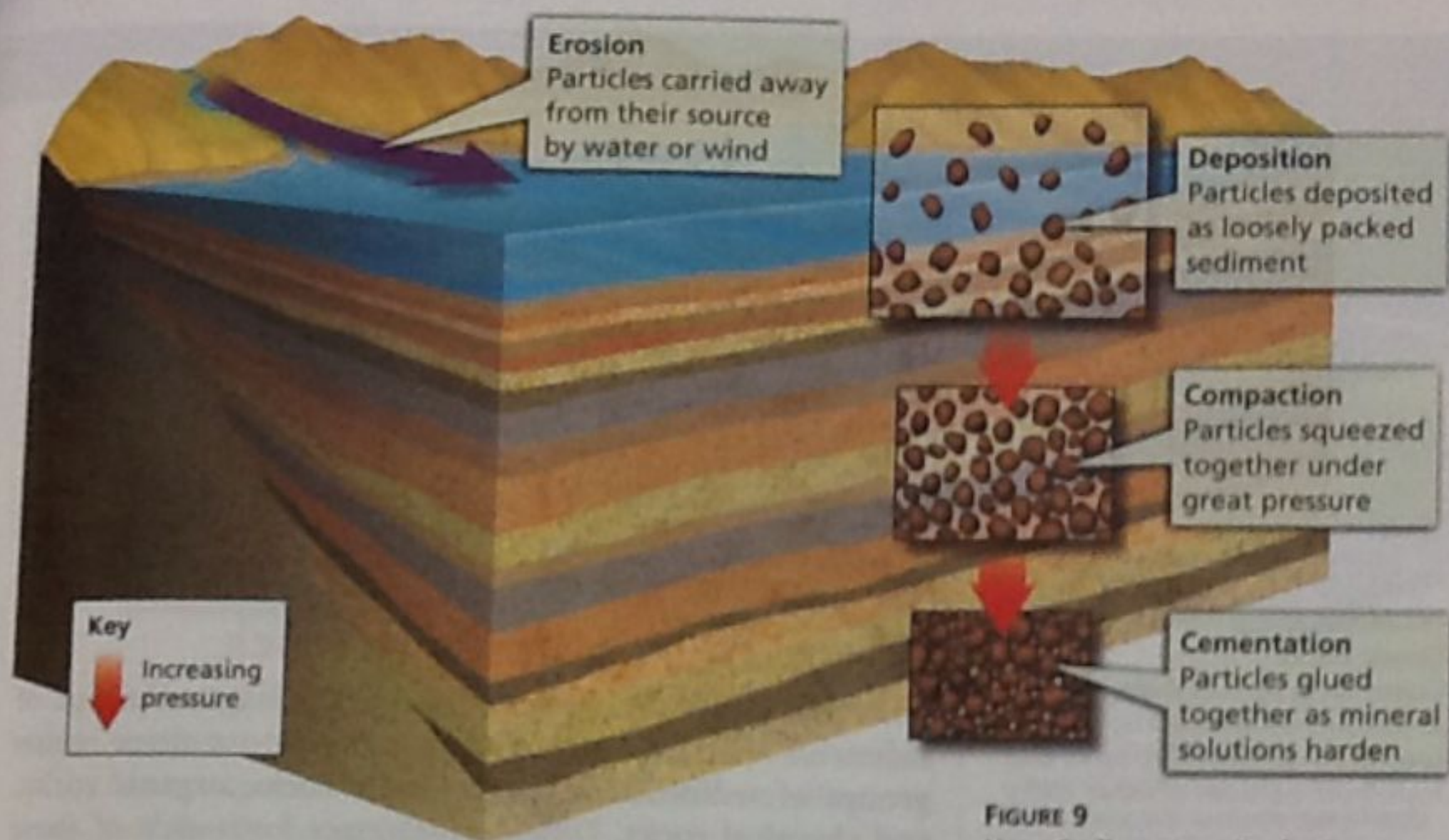


FIGURE 9

How Sedimentary Rocks Form

Sedimentary rocks form through the deposition, compaction, and cementation of sediments over millions of years.

Relating Cause and Effect What conditions are necessary for sedimentary rocks to form?

Erosion Destructive forces are constantly breaking up and wearing away all the rocks on Earth's surface. These forces include heat and cold, rain, waves, and grinding ice. The forces of erosion form sediment. In **erosion**, running water, wind, or ice loosen and carry away fragments of rock.

Deposition Eventually, the moving water, wind, or ice slows and deposits the sediment in layers. If water is carrying the sediment, rock fragments and other materials sink to the bottom of a lake or ocean. **Deposition** is the process by which sediment settles out of the water or wind carrying it.

Compaction The process that presses sediments together is **compaction**. Thick layers of sediment build up gradually over millions of years. These heavy layers press down on the layers beneath them. The weight of new layers further compacts the sediments, squeezing them tightly together. The layers often remain visible in sedimentary rock.

Cementation While compaction is taking place, the minerals in the rock slowly dissolve in the water. **Cementation** is the process in which dissolved minerals crystallize and glue particles of sediment together. In cementation, dissolved minerals seep into the spaces between particles and then harden.

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Reading Checkpoint

What is deposition?

Clastic



Shale
Fossils are often found in shale, which splits easily into flat pieces.



Sandstone
Many small holes between sand grains allow sandstone to absorb water.



Conglomerate
Rock fragments with rounded edges make up conglomerate.

FIGURE 10

Clastic Rocks

Clastic rocks such as shale, sandstone, conglomerate, and breccia are sedimentary rocks that form from particles of other rocks.

Lab
zone

Try This Activity

Rock Absorber

Here's how to find out if water can soak into rock.

1. Using a hand lens, compare samples of sandstone and shale.
2. Use a balance to measure the mass of each rock.
3. Place the rocks in a pan of water and watch closely. Which sample has bubbles escaping? Predict which sample will gain mass.
4. Leave the rocks submerged in the pan overnight.
5. The next day, remove the rocks from the pan and find the mass of each rock.

Drawing Conclusions How did the masses of the two rocks change after soaking? What can you conclude about each rock?

Types of Sedimentary Rock

Geologists classify sedimentary rocks according to the type of sediments that make up the rock. There are three major groups of sedimentary rocks: clastic rocks, organic rocks, and chemical rocks. Different processes form each of these types of sedimentary rocks.

Clastic Rocks Most sedimentary rocks are made up of broken pieces of other rocks. A **clastic rock** is a sedimentary rock that forms when rock fragments are squeezed together. These fragments can range in size from clay particles that are too small to be seen without a microscope to large boulders that are too heavy for you to lift. Clastic rocks are grouped by the size of the rock fragments, or particles, of which they are made. Common clastic rocks include shale, sandstone, conglomerate, and breccia (BRECH ee uh), shown in Figure 10.

Shale forms from tiny particles of clay. Water must deposit the clay particles in thin, flat layers. Sandstone forms from the sand on beaches, the ocean floor, riverbeds, and sand dunes. Most sand particles consist of quartz.

Some sedimentary rocks contain a mixture of rock fragments of different sizes. If the fragments have rounded edges, they form a clastic rock called conglomerate. A rock made up of large fragments with sharp edges is called breccia.

Organic Rocks Not all sedimentary rocks are made from particles of other rocks. **Organic rock** forms where the remains of plants and animals are deposited in thick layers. The term "organic" refers to substances that once were part of living things or were made by living things. Two important organic sedimentary rocks are coal and limestone, shown in Figure 11.

Organic

Breccia

Rock fragments with sharp edges form breccia.



Coal

Swamp plants that formed millions of years ago slowly changed to form coal.



Limestone

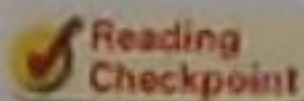
Coquina is a form of limestone in which the shells that make up the rock are easy to see.



Coal forms from the remains of swamp plants buried in water. As layer upon layer of plant remains build up, the weight of the layers squeezes the decaying plants. Over millions of years, they slowly change into coal.

Limestone forms in the ocean, where many living things, such as coral, clams, and oysters, have hard shells or skeletons made of calcite. When these animals die, their shells pile up on the ocean floor. Over millions of years, these layers of sediment can grow to a depth of hundreds of meters. Slowly, compaction and cementation change the sediment to limestone.

Chemical Rocks When minerals that are dissolved in a solution crystallize, **chemical rock** forms. For example, limestone can form when calcite that is dissolved in lakes, seas, or underground water comes out of solution and forms crystals. This kind of limestone is considered a chemical rock. Chemical rocks can also form from mineral deposits left when seas or lakes evaporate. For example, rock salt is made of the mineral halite, which forms by evaporation.



Reading
Checkpoint

How does coal form?

FIGURE 12

Chemical Rocks

These rock "towers" in Mono Lake California, are made of tufa, a form of limestone. Tufa is a chemical rock that forms from solutions containing dissolved materials. **Classifying** What type of sedimentary rock is tufa?

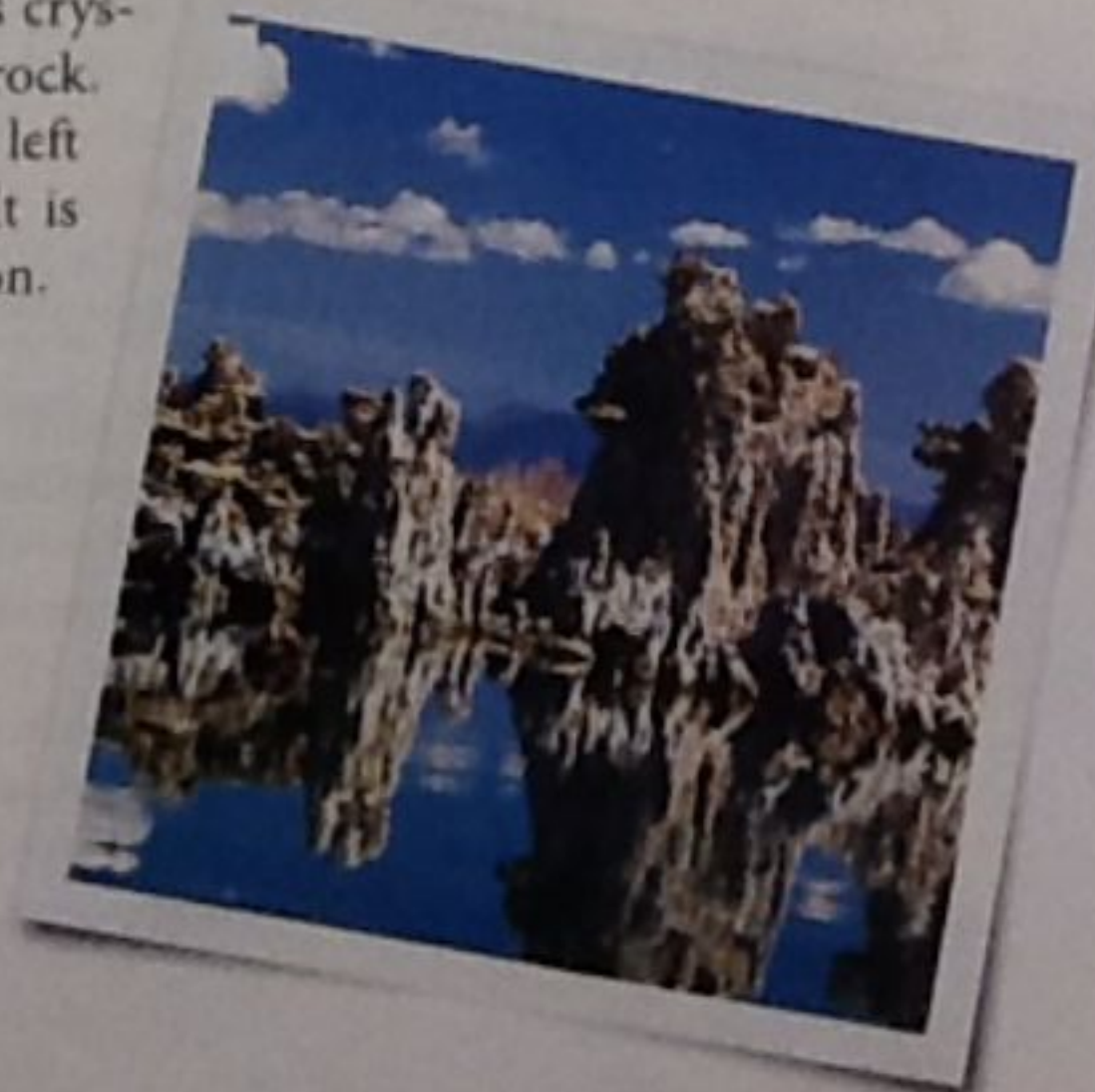


FIGURE 11

Organic Rocks

Organic rocks such as coal and limestone are sedimentary rocks that form from the remains of living things.

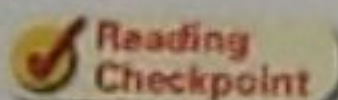


FIGURE 13
Carving Limestone
 This stone carver is sculpting designs on a sphere of white limestone.

Uses of Sedimentary Rocks

People have used sedimentary rocks throughout history for many different purposes, including building materials and tools. For example, people made arrowheads out of flint for thousands of years. Flint is a hard rock, yet it can be shaped to a point. Flint is formed when small particles of silica settle out of water.

Sedimentary rocks such as sandstone and limestone have been used as building materials for thousands of years. Both types of stone are soft enough to be cut easily into blocks or slabs. You may be surprised to learn that the White House in Washington, D.C., is built of sandstone. Builders today use sandstone and limestone on the outside walls of buildings. Limestone also has many industrial uses. For example, limestone is used in making cement and steel.



Reading Checkpoint

Why are sandstone and limestone useful as building materials?

Section 3 Assessment

Target Reading Skill Outlining Use the information in your outline about sedimentary rocks to help you answer the questions below.

Reviewing Key Concepts

- Defining** What is sediment?
 - Sequencing** Place these steps in the formation of sedimentary rock in the proper sequence: compaction, erosion, cementation, deposition.
 - Inferring** In layers of sedimentary rock, where would you expect to find the oldest sediment? Explain your answer.
- Listing** What are the three main types of sedimentary rock?
 - Explaining** Which type of sedimentary rock forms from the remains of living things? Explain how this sedimentary rock forms.
 - Relating Cause and Effect** What process causes deposits of rock salt to form? What type of sedimentary rock is rock salt?

- Listing** What are some uses of sedimentary rocks?
 - Predicting** The particles of sediment that make up shale are not usually well cemented. Would shale be a good choice of building material in a wet climate?

Writing in Science

Explaining a Process Suppose that a large mass of granite lies exposed on Earth's surface. Explain the steps in the process by which the granite could become sedimentary rock. Your answer should also state which of the main types of sedimentary rock will result from this process.