

CHAPTER 4 Rocks: Mineral Mixtures

SECTION

3

Sedimentary Rock

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- How do sedimentary rocks form?
- How do geologists classify sedimentary rocks?
- What are some sedimentary structures?

**National Science
Education Standards**
ES 1c, 1d

How Does Sedimentary Rock Form?

Remember that wind, water, ice, and gravity can cause rock to break down into fragments. These fragments are called *sediment*. During erosion, sediment is moved across the Earth's surface. Then the sediment is deposited in layers on the Earth's surface. As new layers are deposited, they cover older layers. The weight of the new layers *compacts*, or squeezes, the sediment in the older layers.

Water within the sediment layers can contain dissolved minerals, such as calcite and quartz. As the sediment is compacted, these minerals can crystallize between the sediment pieces. The minerals act as a natural glue and hold the sediment pieces together. As the loose sediment grains become bound together, a kind of sedimentary rock forms.

Unlike igneous and metamorphic rocks, sedimentary rock does not form at high temperatures and pressures. Sedimentary rock forms at or near the Earth's surface. ✓

Sediment is deposited in layers. Therefore, most sedimentary rocks contain layers called **strata** (singular, *stratum*).



These "monuments" in Monument Valley, Arizona, formed as sedimentary rock eroded over millions of years.

STUDY TIP

Reading Organizer As you read this section, create an outline of this section using the headings from this section.

Say It

Infer and Discuss In what kinds of areas are you likely to find sediment? Write down four places that sediment can be found. Think about the size of the sediment pieces that may be found at each place. Then, discuss your ideas with a small group.

READING CHECK

1. Describe Where does sedimentary rock form?

SECTION 3 Sedimentary Rock *continued*

How Do Geologists Classify Sedimentary Rock?

Like other kinds of rock, sedimentary rock is classified by how it forms. Some sedimentary rock forms when rock or mineral fragments are stuck together. Some forms when minerals crystallize out of water. Other sedimentary rock forms from the remains of plants and animals.

CLASTIC SEDIMENTARY ROCK

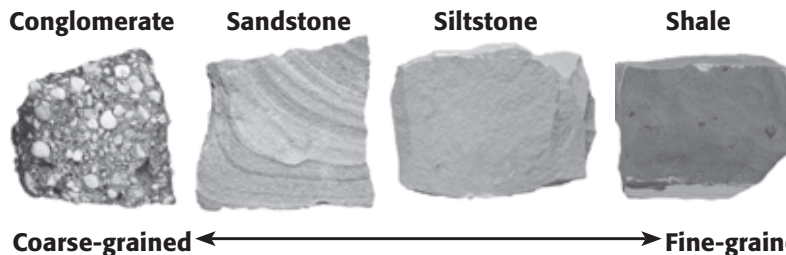
Most sedimentary rock is clastic sedimentary rock. *Clastic sedimentary rock* forms when fragments of other rocks are cemented together. In most cases, the cement is a mineral such as calcite or quartz. The sediment pieces in different rocks can be of different sizes. Geologists group clastic sedimentary rocks by the sizes of the sediment pieces in them. ✓

READING CHECK

2. Identify Give two minerals that can act as cement in sedimentary rocks.

TAKE A LOOK

3. Describe What is the texture of conglomerate?



Coarse-grained sedimentary rocks, such as conglomerate, contain large sediment pieces. Fine-grained rocks, such as shale, are made of tiny sediment pieces.

CHEMICAL SEDIMENTARY ROCK

Chemical sedimentary rock forms when minerals crystallize out of water. Water moves over rocks on the Earth's surface. As the water moves, it dissolves some of the minerals in the rocks. When the water evaporates, the dissolved minerals can crystallize to form chemical sedimentary rocks. ✓

Many chemical sedimentary rocks contain only one or two kinds of mineral. For example, evaporite is a chemical sedimentary rock. Evaporite is made mainly of the minerals halite and gypsum. These minerals crystallize when water evaporates.

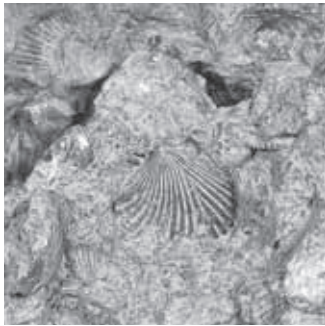
READING CHECK

4. Explain How do chemical sedimentary rocks form?

SECTION 3 Sedimentary Rock *continued***ORGANIC SEDIMENTARY ROCK**

Organic sedimentary rock forms from the remains of plants and animals. Coal is one type of organic sedimentary rock. Coal forms from plant material that has been buried deep underground. Over millions of years, the buried plant material turns into coal.

Some organic sedimentary rock forms from the remains of sea creatures. For example, some limestone is made from the skeletons of creatures called *coral*. Coral are tiny creatures that make hard skeletons out of calcium carbonate. These skeletons and the shells of other sea creatures can be glued together to form *fossiliferous limestone*.



The shells of sea creatures can be cemented together to form fossiliferous limestone.

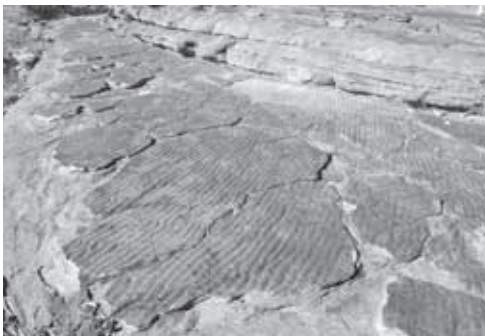
TAKE A LOOK

5. Define What is fossiliferous limestone?

What Are Some Features of Sedimentary Rock?

The features of sedimentary rocks can give you clues about how the rocks formed. For example, many clastic sedimentary rocks show **stratification**. This means that they contain strata. Clastic sedimentary rocks show stratification because sediment is deposited in layers. ✓

Some sedimentary rock features show the motions of wind and water. For example, some sedimentary rocks show ripple marks or mud cracks. *Ripple marks* are parallel lines that show how wind or water has moved sediment. *Mud cracks* form when fine-grained sediment dries out and cracks.



These ripple marks show how sediment was moved by flowing water.

READING CHECK

6. Explain Why do many clastic sedimentary rocks show stratification?

Section 3 Review

NSES ES 1c, 1d

SECTION VOCABULARY

strata layers of rock (singular, <i>stratum</i>)	stratification the process in which sedimentary rocks are arranged in layers
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1. Define Write your own definition for stratification.

2. List Give three examples of clastic sedimentary rocks.

3. Compare How are clastic and organic sedimentary rocks different?

4. Describe How does evaporite form?

5. Describe How does fossiliferous limestone form?

6. Infer Imagine that a geologist finds a sedimentary rock with ripple marks in it. What can the geologist guess about the environment in which the sediment was deposited? Explain your answer.

- In the box: sediment
Above the arrow: pressure
- texture, composition
- how fast the magma cools
- Different minerals form under different conditions. The minerals in a rock determine its composition.

SECTION 2 IGNEOUS ROCK

- increasing temperature, decreasing pressure, addition of fluids
- Magma contains many minerals that solidify at different temperatures.
- Most felsic rocks are light-colored and rich in Na, K, and Al. Most mafic rocks are dark-colored and rich in Fe, Mg, and Ca.
- rhyolite
- gabbro
- rock that forms when melted rock cools slowly underground
- dike, stock, sill, batholith
- The lava cools very quickly.

Review

- Intrusive rock forms below the surface and has a coarse-grained texture. Extrusive rock forms above the surface and has a fine-grained texture.
- basalt, rhyolite
- A stock or dike forms. Then, the rock around it erodes away. The igneous rock is left over as a volcanic neck.
- A dike cuts across rock layers, but a sill is parallel to other, previous layers.
- It probably has a coarse-grained texture because it cooled slowly (or because it is an intrusive rock).
- extrusive, intrusive, intrusive, extrusive

SECTION 3 SEDIMENTARY ROCK

- at or near the Earth's surface
- calcite, quartz
- coarse-grained
- Minerals crystallize from water.
- Rock made from the shells of sea creatures.
- Sediment is deposited in layers.

Review

- the arrangement of rocks in layers

- sandstone, shale, siltstone, conglomerate
- Clastic sedimentary rock forms when rock or mineral fragments are cemented together. Organic sedimentary rock forms from the remains of once-living organisms.
- Evaporite forms when halite and gypsum crystallize as water evaporates.
- Fossiliferous limestone forms from the fossils of animals in the ocean. Skeletons of sea animals collect on the ocean floor. These animal remains become cemented together to form limestone.
- The sediment was probably deposited in an area with steady winds or running water. Wind and water produce ripples in sediment. These ripples can be preserved as ripple marks in sedimentary rock.

SECTION 4 METAMORPHIC ROCK

- Minerals react to produce new minerals.
- Mineral molecules moved together during metamorphism.
- metamorphism that happens when rock is heated by nearby magma
- where rock is deeply buried or where pieces of crust collide
- squeezing
- Sillimanite is more likely to be found in a metamorphic rock because it forms under high temperatures and pressures.
- Minerals like quartz form under a range of temperatures and pressures.
- chlorite
- a metamorphic rock in which the minerals are arranged in bands
- gneiss
- They can change.

Type of metamorphic rock	Description	Example
Foliated	Minerals are arranged in bands or stripes.	gneiss
Nonfoliated	Minerals are not arranged in bands or stripes.	quartzite

Review

- Foliated rocks have minerals arranged in bands. Nonfoliated rocks do not.
- Regional metamorphism happens when high temperatures and pressures cause rock in a large area to change.

- An index mineral is a mineral that forms only at certain temperatures and pressures. Chlorite, muscovite, and garnet are index minerals for metamorphic rocks.
- Because index minerals form only at certain temperatures and pressures, they can be used to estimate the temperature and pressure or depth at which a rock forms.
- Quartzite is a metamorphic rock. It forms when quartz sandstone is exposed to heat and pressure. The quartz crystals grow larger during metamorphism.
- The rock with garnet probably formed at a greater depth, because garnet is an index mineral for greater depths than chlorite.

- In most cases, wood can be replaced at the rate at which it is consumed. If people use it faster than it can grow back, it is a nonrenewable resource.
- Conserving resources means using only what you need and protecting resources, even when you are not using them.
- They take millions of years to form.

Chapter 5 Energy Resources

SECTION 1 NATURAL RESOURCES

- any natural material that people use to fulfill their needs
- Possible answers: water, air, coal, metal
- a resource that cannot be replaced as fast as it is used
- Many renewable resources are renewable only if people do not use them too quickly. If they are used too quickly, they become nonrenewable resources.
- Possible answer: Nonrenewable resources should be conserved so that we don't use them up. Renewable resources should be conserved so that they have time to regenerate.

6. Instead of...	You can...
...keeping your home very warm in the winter and very cool in the summer,	...use less heat and air conditioning.
...taking long, hot showers,	...take shorter showers and use less hot water.

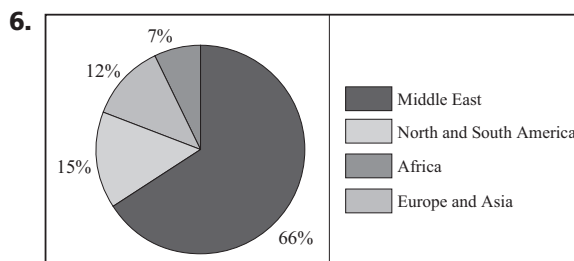
- Fewer natural resources and less energy are needed to make recycled objects than to make new objects.

Review

- A renewable resource can be replaced as fast as it is consumed. A nonrenewable resource cannot.
- Turn off the water when you brush your teeth. Wash only full loads of laundry. Turn the lights out when you leave a room. Use both sides of a piece of paper.

SECTION 2 FOSSIL FUELS

- from fossil fuels
- mostly in Texas and Oklahoma
- heating
- Tiny sea creatures die and are buried in sediment. Over time, their remains become natural gas.
- Petroleum occurs naturally as a liquid.



- lignite, bituminous coal, and anthracite
- anthracite
- Fossil fuels are fairly cheap and are very compact sources of energy. We now rely on fossil fuels.
- rain, sleet, snow that contains a lot of acid

Review

- Petroleum exists as a liquid in its natural state. Natural gas exists as a gas in its natural state.

Kind of fossil fuel	What it is	How it forms
Coal	a solid fuel made from plant matter	Partly decomposed plant matter is put under heat and pressure.
Natural Gas	a mixture of gases containing carbon, hydrogen, and oxygen	Tiny sea creatures die and are buried in sediment.
Petroleum	a mixture of liquids containing carbon, hydrogen, and oxygen	Tiny sea creatures die and are buried in sediment.