ROCKS

CHAPTER 6

STANDARDS

- SES2d. Associate specific plate tectonic settings with the production of particular groups of igneous and metamorphic rocks and mineral resources
- SES3e. Explain the processes that transport and deposit material in terrestrial and marine sedimentary basins, which result, over time, in sedimentary rock.

Three Major Types of Rock

- The material that makes up the solid parts of Earth is known as *rock*.
- Based on the processes that form and change the rocks of Earth's crust, geologists classify rocks into three major types by the way the rocks form.
- Igneous rock forms when magma, or molten rock, cools and hardens.

Three Major Types of Rock, *continued*

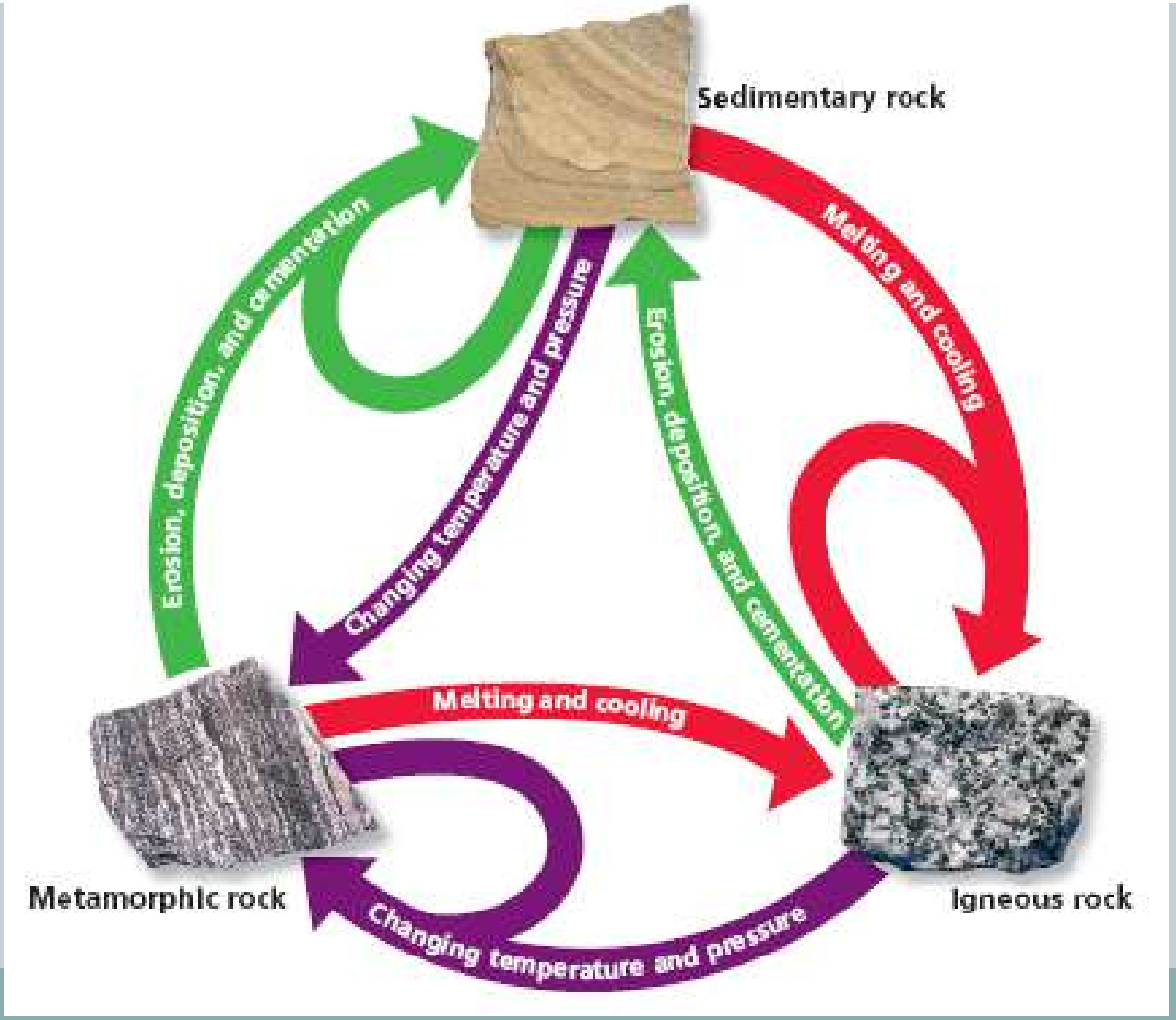
- Sedimentary rock forms when sediment deposits that form when rocks, mineral crystals, and organic matter have been broken into fragments, called *sediments*, are compressed or cemented together.

- Metamorphic rock forms when existing rock is altered by changes in temperature, by changes in pressure, or by chemical processes.

The Rock Cycle

- Any of the three major types of rock can be changed into another of the three types.
- Geologic forces and processes cause rock to change from one type to another.
- **rock cycle** the series of processes in which rock forms, changes from one form to another, is destroyed, and forms again by geological processes

The Rock Cycle, *continued*



Properties of Rocks

- All rock has physical and chemical properties that are determined by how and where the rock formed.
- The rate at which rock weathers and the way that rock breaks apart are determined by the chemical stability of the minerals in the rock.

Properties of Rocks, *continued*

Chemical Stability of Minerals

- The rate at which mineral chemically breaks down is dependent on the chemical stability of the mineral.

Properties of Rocks, *continued*

Physical Stability of Rocks

- Rocks have natural zones of weakness that are determined by how and where the rocks form.

Section 2

The Formation of Magma

- **igneous rock** forms when magma cools and solidifies
- The three factors that affect whether rock melts include temperature, pressure, and the presence of fluids in the rock.

Section 2

Textures of Igneous Rocks

- Igneous rocks are classified according to where magma cools and hardens.
- **intrusive igneous rock** rock formed from the cooling and solidification of magma beneath Earth's surface
- **extrusive igneous rock** rock formed from the cooling and solidification of lava at Earth's surface
- The texture of igneous rock is determined by the size of the crystals in the rock. The size of the crystals in determined mainly by the cooling rate of the magma.

Textures of Igneous Rocks, *continued*

Coarse-Grained Igneous Rock

- Because intrusive igneous rocks cool slowly, they commonly have large mineral crystals.
- Igneous rocks that are composed of large, well-developed mineral grains are described as having a *coarse-grained texture*.

Fine-Grained Igneous Rock

- Because extrusive igneous rocks cool rapidly, they are commonly composed of small mineral grains.
- Igneous rocks that are composed of small crystals are described as having a *fine-grained texture*.

Pumice

- Pumice rocks are igneous rocks which were formed when lava cooled quickly above ground. You can see where little pockets of air had been. This rock is so light, that many pumice rocks will actually float in water. Pumice is actually a kind of glass and not a mixture of minerals. Because this rock is so light, it is used quite often as a decorative landscape stone. Ground to a powder, it is used as an abrasive in polish compounds and in Lava© soap.

Granite

- Granite rocks are igneous rocks which were formed by slowly cooling pockets of magma that were trapped beneath the earth's surface. Granite is used for long lasting monuments and for trim and decoration on buildings.

Scoria

- Scoria rocks are igneous rocks which were formed when lava cooled quickly above ground. You can see where little pockets of air had been. Scoria is actually a kind of glass and not a mixture of minerals.

Obsidian

- Obsidian rocks are igneous rocks that form when lava cools quickly above ground.
- Obsidian is actually glass and not a mixture of minerals. The edges of this rock are very sharp.

Section 3

Formation of Sedimentary Rocks

- Most sedimentary rock is made up of combinations of different types of sediment, which is loose fragments of rock, minerals, and organic materials.
- Two main processes convert loose sediment into sedimentary rock—compaction and cementation.
- **compaction** the process in which the volume and porosity of a sediment is decreased by the weight of overlying sediments as a result of burial beneath other sediments
- **cementation** the process in which minerals precipitate into pore spaces between sediment grains and bind sediments together to form rock

Section 3

Formation of Sedimentary Rocks, *continued*

- Geologists classify sedimentary rocks by the processes by which the rocks form and by the composition of the rocks.
- There are three main classes of sedimentary rocks—chemical, organic, and clastic.
- These three classes contain their own classifications of rocks that are grouped based on the shape, size, and composition of the sediments that form the rocks.

Section 3

Chemical Sedimentary Rock

- **chemical sedimentary rock** sedimentary rock that forms when minerals precipitate from a solution or settle from a suspension
- Some chemical sedimentary rock forms when dissolved minerals precipitate out of water because of changing concentrations of chemicals.
- When water evaporates, the minerals that were dissolved in the water are left behind. Eventually, the concentration of minerals in the remaining water becomes high enough to cause minerals to precipitate out of the water.
- Rocks that form through evaporation are called *evaporites*. Gypsum and halite are common evaporites.

Gypsum

- Gypsum rocks are sedimentary rocks made up of sulfate mineral and formed as the result of evaporating sea water in massive prehistoric basins. It is very soft and is used to make Plaster of Paris, casts, molds, and wallboards.

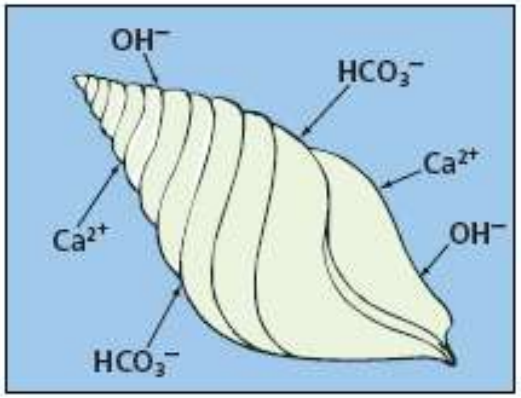
Section 3

Organic Sedimentary Rocks

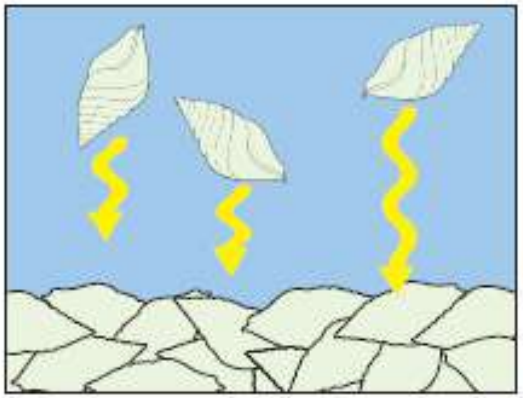
- **organic sedimentary rock** sedimentary rock that forms from the remains of plants or animals
- Coal and some limestones are examples of organic rocks.
- Organic limestones form when marine organisms, such as coral, clams, oysters, and plankton, remove the chemical components of the minerals calcite and aragonite from sea water.
- The organisms make their shells from these minerals, and when the organisms die, their shells settle to the bottom of the ocean, accumulate, and are compacted to form limestone.

Organic Sedimentary Rocks, *continued*

The diagram below shows the formation of organic limestone.



Organisms that live in lakes or oceans take chemicals from the water and produce the mineral calcium carbonate, $CaCO_3$. They use the $CaCO_3$ to build their shells or skeletons.



When the organisms die, the hard remains that are made of $CaCO_3$ settle to the lake or ocean floor.

The shells of the dead organisms pile up. Eventually, the layers are compacted and cemented to form limestone.

Limestone

- Limestone rocks are sedimentary rocks that are made from the mineral calcite which came from the beds of evaporated seas and lakes and from sea animal shells. This rock is used in concrete and is an excellent building stone for humid regions.

Section 3

Clastic Sedimentary Rock

- **clastic sedimentary rock** sedimentary rock that forms when fragments of preexisting rocks are compacted or cemented together
- Clastic sedimentary rocks are classified by the size of the sediments they contain.
- Rock that contains large, rounded pieces is called *conglomerate*. Rock that contains large, angular pieces is called *breccia*.
- Rock that is composed of sand-sized grains is called *sandstone*. Rock that is composed of clay-sized particles is called *shale*.

Section 3

Characteristics of Clastic Sediments

- The physical characteristics of sediments are determined mainly by the way sediments were transported to the place where they are deposited.

- Sediments are transported by four main agents: water, ice, wind, and the effects of gravity.

Conglomerate

- Conglomerate rocks are sedimentary rocks. They are made up of large sediments like sand and pebbles. The sediment is so large that pressure alone cannot hold the rock together; it is also cemented together with dissolved minerals.

Sandstone

- Sandstone rocks are sedimentary rocks made from small grains of the minerals quartz and feldspar. They often form in layers as seen in this picture. They are often used as building stones.

Shale

- Shale rock is a type of sedimentary rock formed from clay that is compacted together by pressure. They are used to make bricks and other material that is fired in a kiln.

Section 4

Formation of Metamorphic Rocks

- **metamorphism** the process in which one type of rock changes into metamorphic rock because of chemical processes or changes in temperature and pressure
- During metamorphism, heat, pressure, and hot fluids cause some minerals to change into other minerals.
- Minerals may also change in size or shape, or they may separate into parallel bands that give the rock a layered appearance.
- Hot fluids may circulate through the rock and change the mineral composition of the rock by dissolving some materials and by adding others.

Formation of Metamorphic Rocks, *continued*

- The type of rock that forms because of metamorphism can indicate the conditions under which the original rock changed.
- The composition of the rock being metamorphosed, the amount and direction of pressure, and the presence or absence of certain fluids cause different combinations of minerals to form.
- Two types of metamorphism occur in Earth's crust—contact metamorphism and regional metamorphism.

Formation of Metamorphic Rocks, *continued*

Contact Metamorphism

- **contact metamorphism** a change in the texture, structure, or chemical composition of a rock due to contact with magma

Regional Metamorphism

- **regional metamorphism** a change in the texture, structure, or chemical composition of a rock due to changes in temperature and pressure over a large area, generally are a result of tectonic forces

Section 4

Classification of Metamorphic Rocks

Foliated Rocks

- **foliation** the metamorphic rock texture in which minerals grains are arranged in planes or bands
- Extreme pressure may cause the mineral crystals in the rock to realign or regrow to form parallel bands.
- Foliation also occurs as minerals that have different compositions separate to produce a series of alternating dark and light bands.
- Foliated metamorphic rocks include the common rocks slate, schist, and gneiss.

Gneiss

- Gneiss rocks are metamorphic. These rocks may have been granite, which is an igneous rock, but heat and pressure changed it. You can see how the mineral grains in the rock were flattened through tremendous heat and pressure and are arranged in alternating patterns.

Schist

- Schist rocks are metamorphic. These rocks can be formed from basalt, an igneous rock; shale, a sedimentary rock; or slate, a metamorphic rock. Through tremendous heat and pressure, these rocks were transformed into this new kind of rock.

Classification of Metamorphic Rocks, *continued*

Nonfoliated Rocks

- **nonfoliated** the metamorphic rock texture in which minerals grains are not arranged in planes or bands
- Many nonfoliated metamorphic rocks contain grains of only one mineral or contain very small amounts of other minerals. Thus, the rock does not form bands of different minerals.
- Other nonfoliated metamorphic rocks contain grains that are round or square. These grains are unlikely to change shape or position when exposed to directed pressure.
- Nonfoliated metamorphic rocks include the common rocks marble and quartzite.

REVIEW

1. A rock that contains a fossil is most likely

   A. igneous
   B. sedimentary
   C. metamorphic
   D. felsic

REVIEW

1. A rock that contains a fossil is most likely

A. igneous
B. sedimentary
C. metamorphic
D. felsic

REVIEW

2. The large, well-developed crystals found in some samples of granite are a sign that

   A. the lava from which it formed cooled rapidly.
   B. the magma contained a lot of dissolved gases.
   C. the lava from which it formed cooled slowly.
   D. water deposited minerals in the rock cavities.

REVIEW

2. The large, well-developed crystals found in some samples of granite are a sign that

A. the lava from which it formed cooled rapidly.
B. the magma contained a lot of dissolved gases.
C. the lava from which it formed cooled slowly.
D. water deposited minerals in the rock cavities.

REVIEW

3. How does the order in which igneous rocks form relate to their ability to resist weathering agents?

   A. Rocks that form last weather faster.
   B. Rocks that form first are the most resistant.
   C. Rocks that form last are the most resistant.
   D. There is no relationship between the order of igneous rock formation and weathering.

REVIEW

3. How does the order in which igneous rocks form relate to their ability to resist weathering agents?

   A. Rocks that form last weather faster.
   B. Rocks that form first are the most resistant.
   C. Rocks that form last are the most resistant.
   D. There is no relationship between the order of igneous rock formation and weathering.

REVIEW

4. What occurs when heat from nearby magma causes changes in the surrounding rocks?

   A. contact metamorphism
   B. fluid metamorphism
   C. intrusive metamorphism
   D. regional metamorphism

REVIEW

4. What occurs when heat from nearby magma causes changes in the surrounding rocks?

A. contact metamorphism
B. fluid metamorphism
C. intrusive metamorphism
D. regional metamorphism

REVIEW

5. What type of rock forms when heat, pressure, and chemical processes change the physical properties of igneous rock?

REVIEW

5. What type of rock forms when heat, pressure, and chemical processes change the physical properties of igneous rock?

metamorphic rock

REVIEW

6. Is igneous rock or sedimentary rock more likely to contain fossils? Explain your answer

REVIEW

6. Is igneous rock or sedimentary rock more likely to contain fossils? Explain your answer

sedimentary rock; Sedimentary rocks are made up of pieces of older rocks and may contain fossils. Fossils in the original material of an igneous rock would have been destroyed when melted.