

7.3

Families of Rocks

There are many different minerals, but they are usually found mixed together in rocks. For example, granite contains mica, quartz, and feldspar.

Geologists classify rocks into three families based on how they are formed. These are igneous, sedimentary, and metamorphic rock.

Igneous Rock

▶ LEARNING TIP

The word “igneous” comes from the Latin word *ignis*, meaning “fire.”

Hot molten rock under Earth’s surface is called **magma**. Rock that forms from the hardening of liquid magma is called **igneous rock** [IG-nee-us]. Most of Earth’s surface is composed of igneous rock, and igneous rock is still being formed today.

If the magma cools underground, the rock that is formed is called **intrusive** igneous rock. This type of igneous rock is seen on Earth’s surface only after years of erosion have worn away the layers of rock over it. Stawamus Chief near Squamish, British Columbia is one of the world’s largest chunks of granite, a common intrusive igneous rock (**Figure 1**).

If the magma is forced out onto Earth’s surface, it is called **lava**. Igneous rock that is formed on Earth’s surface when the lava cools is called **extrusive** igneous rock. Basalt is extrusive igneous rock that is common in British Columbia.

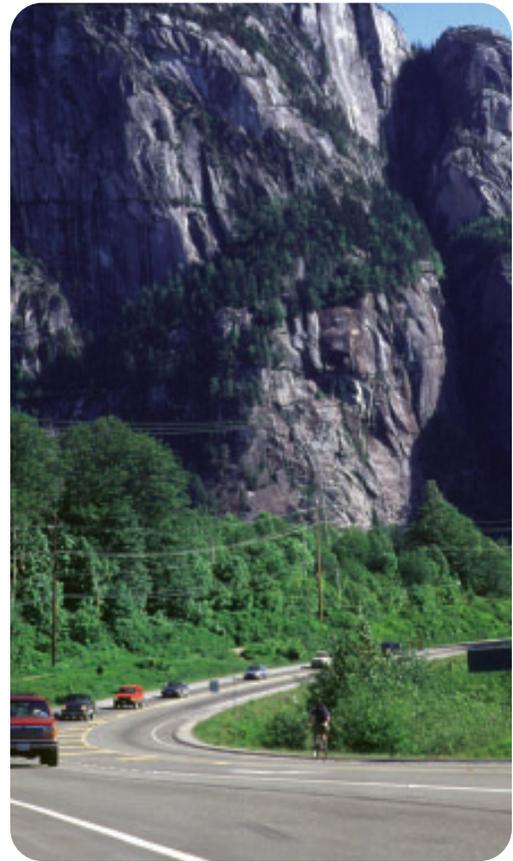


Figure 1

The Stawamus Chief is popular with climbers. Many Aboriginal groups have special stories and legends about unique features like the Stawamus Chief.

The formation of both intrusive and extrusive igneous rock is shown in **Figure 2**.

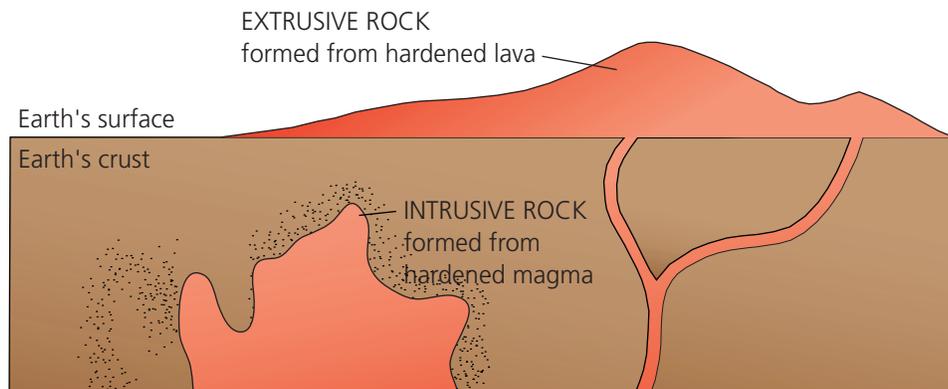


Figure 2
Two types of igneous rock

LEARNING TIP

Are you able to explain the difference between intrusive and extrusive igneous rocks in your own words? If not, ask yourself, "What do I need to figure out? What don't I understand?" Then re-read the explanation, and re-examine **Figure 2**.

The rate at which the molten material cools determines the size of the crystals in the rock. Granite (**Figure 3**) is intrusive rock that is formed when magma cools very slowly within Earth. Granite has a mottled appearance and it contains crystals that can be seen with the unaided eye. Obsidian (**Figure 4**) is an extrusive igneous rock that is formed when lava cools very quickly, forming very tiny crystals that cannot be seen without magnification.

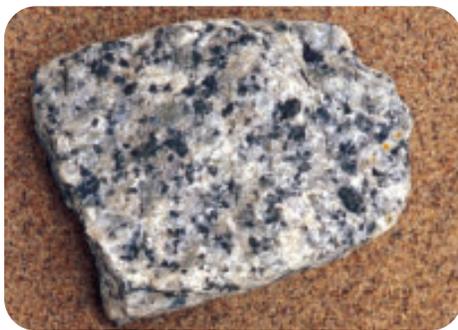


Figure 3
Granite



Figure 4
Obsidian

Some igneous rock even floats. Off certain South Pacific islands, small pieces of pumice can be found floating in the ocean (**Figure 5**). Small pockets of volcanic gases, which are trapped as frothy lava quickly cools, allow this rock to float.



Figure 5
Pumice is a type of igneous rock that floats.



Sedimentary Rock

When bare rock is exposed at Earth's surface, it may be broken into smaller pieces, or particles, in many different ways. These small rock particles are moved from one place to another. Rain and melted snow wash the rock particles into streams and rivers, which then carry the rock particles for many kilometres. The rock particles, along with clay, mud, sand, gravel, and boulders, are called **sediment**. As the water approaches a lake or ocean, and the current slows, the sediment gradually sinks to the bottom (Figure 6).

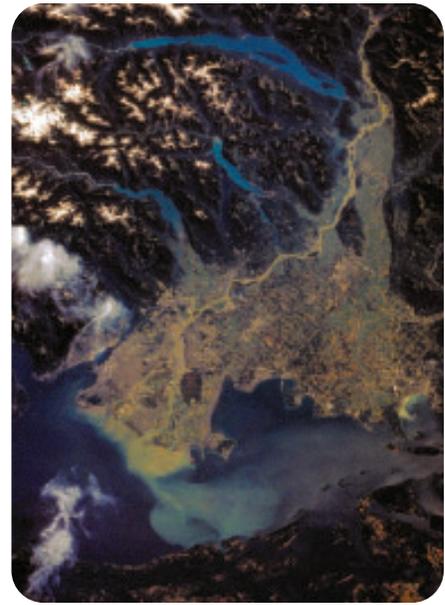


Figure 6

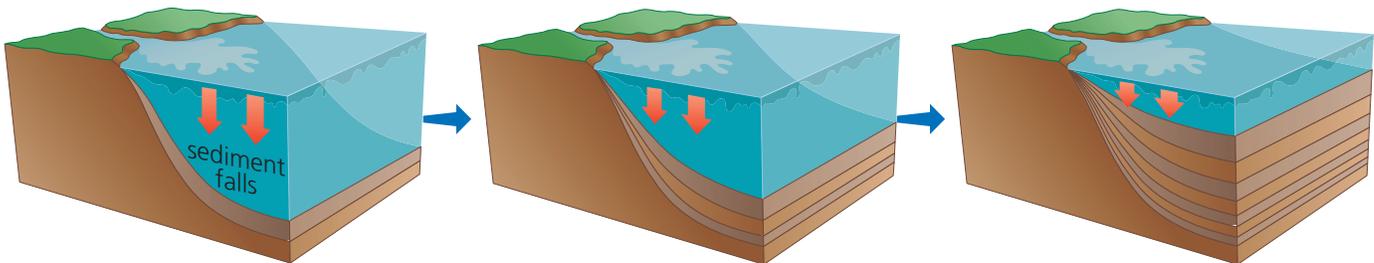
As this satellite photo shows, sediment carried by the Fraser River pours out into the sea.

▶ LEARNING TIP

As you study **Figure 7**, ask yourself, "What is the purpose of this illustration? What am I supposed to notice and remember?"

Figure 7

Sedimentary rock is formed as layers of sediment are added by a river.



Rock and soil particles and gravel are carried by the river. They sink to the bottom, forming a layer of sediment.

Each new layer puts pressure on the layers below.

Eventually, the lower layers cement into rock.

Figure 8



Shale is a smooth sedimentary rock that is formed from layers of tiny particles of clay or silt.



Sandstone, a rougher rock, is formed from layers of compressed sand.



Conglomerate is made from sediment that contains rounded pebbles and small stones.

As the layers are compressed, they form different kinds of rock, depending on the nature of the particles in the sediment (**Figure 8**).

The appearance and properties of a sedimentary rock can tell you what the original sediment was like. The size of the rock particles that settle to the bottom of a river, lake, or ocean depends on the speed of the water that carried the particles. For example, a narrow, swift-flowing mountain stream on a steep slope can move large rocks.

A wide, slow-moving river on flat land can carry only fine clay particles. By studying the layers of sediment in different places today, geologists can understand what the land was like in the past (**Figure 9**).

Although most of Earth's surface is made up of igneous rock, much of the rock you see on the surface is sedimentary rock. New sedimentary rock is being formed all the time as additional layers of sediment are deposited by wind and water.



Figure 9

The layered appearance of these sedimentary rocks is a clue to how they were formed.

TRY THIS: MAKE YOUR OWN SEDIMENT

Skills Focus: observing, creating models

Fill a jar with a screw-on lid half full of water. Add some clay, sand, and fine gravel or pebbles. Cap the jar tightly and shake it gently until all the sediment is moving. Put down the jar and observe the sediment settling. What do you notice about the sizes of the particles in each layer?



▶ LEARNING TIP

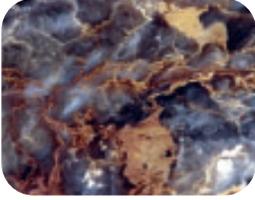
The word “metamorphic” means “changed in form.” It comes from the Greek words *meta*, meaning “after,” and *morphe*, meaning “form.” The root “metamorph” is used in other areas of science as well. For example, the change in form of a caterpillar into a butterfly is called “metamorphosis.”

Metamorphic Rock

When igneous or sedimentary rock becomes buried at a great depth, it is subjected to increased temperature and pressure. As well, magma moving through Earth heats and squeezes the neighbouring rock. As a result, the rock may change. The changed rock is different from the original rock in appearance or in the minerals it contains. Rock formed below Earth’s surface, when heat and pressure cause the properties of existing rocks to change, is called **metamorphic rock**.

Some metamorphic rocks have been changed so much that they no longer resemble the original rock, or parent rock. Often, however, geologists can trace the relationship between a metamorphic rock and its parent rock. For example, slate is a metamorphic rock that is formed from the sedimentary rock shale. Gneiss [NICE] is a metamorphic rock that is formed from the igneous rock granite. **Table 1** shows some types of metamorphic rocks and their parent rocks.

Table 1 Metamorphic Rocks

Parent rock	Metamorphic rock
shale (sedimentary) 	slate 
granite (igneous) 	gneiss 
limestone (sedimentary) 	marble 
sandstone (sedimentary) 	quartzite 

The cycle does not always stop here, however. With more heat and pressure, metamorphic rock can change into other types of metamorphic rock. For example, with additional heat and pressure within Earth, the metamorphic rock slate can change into phyllite, and phyllite can change into schist (Figure 10). Schist is one of the strongest rocks in the world. New metamorphic rocks are being formed all the time, deep within Earth.



Slate



Phyllite



Schist

Figure 10

CHECK YOUR UNDERSTANDING

- Copy and complete Table 2.

Table 2 How Rocks Are Formed

Type of rock	How it is formed	Examples
igneous		
sedimentary		
metamorphic		

- What is the difference between intrusive and extrusive igneous rock?
- How are minerals different from rocks?
- A rock that contains a cavity filled with crystals is called a geode. Look at the photograph at the beginning of this chapter. Why are the crystals in the middle of the geode larger than the crystals toward the outside?