

HOW CAN PHYSICAL PROCESSES AFFECT SETTLEMENTS?

Earth's physical processes, such as volcanoes, desertification, and earthquakes, can have major impacts on human settlements. As populations grow and population densities increase, the impacts from these processes will affect more and more people.

VOLCANOES

Most of Earth's volcanoes are found in the Ring of Fire, an area that circles the Pacific Ocean, as shown in the map in **Figure 2.5**. Most volcanoes are dormant (temporarily inactive) or extinct, so those volcanoes are considered safe to live on. Volcanoes that are active are not safe. When they erupt, they release lava, gas, and ash that can damage settlements and cause injury or death. **Figure 2.6** shows lava flowing from Mount Kilauea, United States, toward the small town of Pahoa in October 2014.

FIGURE 2.5 Many large cities are in or near the Ring of Fire and along the Pacific plate boundary. (Plates are sheets of rigid rock that form Earth's crust.)

Major Settlements Near the Ring of Fire

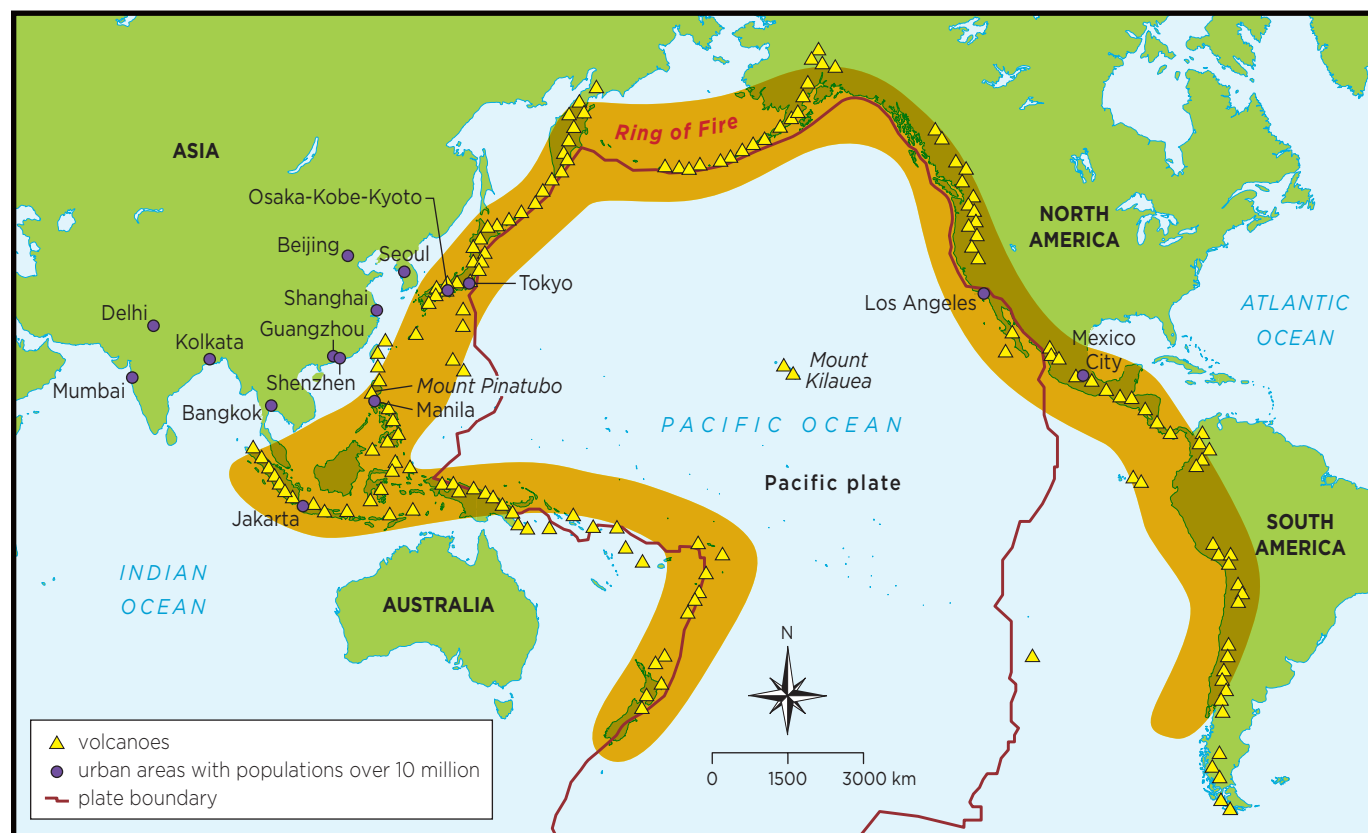


FIGURE 2.6 Many residents of Pahoa, Hawaii, did not know whether they should evacuate or stay as the lava flowed closer to their homes and farms.

I wonder how often people living here are affected by eruptions?

Why do people decide to settle on or near volcanoes?

LIVING NEAR VOLCANOES

Half a billion people live on or near a volcano, as you can see in the map in **Figure 2.5**. Why would many people choose to do this, despite the danger? Many metals, such as gold, silver, and copper, are found in volcanic rock. As a result, these regions are good for mining, providing jobs. In addition, the soils around volcanoes are rich in minerals, making them good for farming. Many farmers grow crops around Mount Pinatubo in the Philippines and Mount Kilauea in the United States. Both of these volcanoes have erupted in the last 25 years. The lava from Mount Kilauea shown in **Figure 2.6** also flowed through an agricultural area where farmers grow papaya.

There are other benefits to living near volcanoes. Homes near volcanoes can have a natural hot-water supply from geothermal energy, which is thermal energy from within Earth. The rock underground near volcanoes can be warm enough to heat water for homes.

In addition, people are fascinated by volcanoes. Tourism is an important part of local economies. Countries with active volcanoes, such as Iceland and Ecuador, are year-round attractions.

It is possible to help reduce damage to settlements and populations caused by a volcanic eruption. Early-warning systems are the best way. A volcano that has been quiet for a long time may start to rumble and vent gas, good indicators that it may erupt in the future.



FIGURE 2.7 A tsunami hit northeastern Japan in March 2011. About 300 000 people were evacuated, but the disaster still killed over 15 000 people.

I wonder which causes more damage to people and property—an earthquake or a tsunami?

EARTHQUAKES AND TSUNAMIS

Settlements in areas that have major earthquakes face challenges different than those settlements located near volcanoes. The map in **Figure 2.5** shows that many large urban areas are on or near plate boundaries. As urban areas grow, more people are at risk during earthquakes.

Many earthquakes occur below oceans and can cause devastating tsunamis, or huge surface waves. All coastal settlements in earthquake zones are in danger. In March 2011, an earthquake approximately 150 km northeast of Japan caused a tsunami. The tsunami struck northeastern Japan and washed away many settlements, destroying entire communities (**Figure 2.7**). Some of the debris from that tsunami has washed up on Canada's west coast.

The largest earthquakes do not always cause the most damage and loss of life. The amount of damage depends on whether the area affected is densely populated. Other factors include the strength of the structures in the area and emergency measures in place to minimize damage to people and property. For example, a 7.0 magnitude earthquake in Haiti in 2010 resulted in up to 300 000 deaths. An 8.8 magnitude earthquake off the coast of Chile in 2010 resulted in over 700 deaths. There were more deaths in Haiti because the structures there are not built to withstand earthquakes.

Scientists cannot predict earthquakes. People living in areas prone to earthquakes, such as California and Japan, practise earthquake drills. They set up shelters and make evacuation plans. Governments develop building codes to make sure that buildings are earthquake-proof. In Los Angeles, California, buildings cannot be higher than 13 storeys. Newer buildings must be designed to better absorb the shocks.

desertification the unwanted process of turning arable land into desert due to factors such as reduced rainfall and poor agricultural practices

drylands areas with a long growing season and a semi-desert to moist climate; includes grassland and semi-desert scrub

DESERTIFICATION

Desertification is the gradual process of turning drylands into desert. **Drylands** have semi-desert to moist climates and long growing seasons. These areas make up 41 percent of Earth's land area. However, over 100 countries are losing their drylands to desertification. The map in **Figure 2.8** shows deserts as well as areas around the world that are at risk of desertification.

Drought worsens desertification because it directly affects soil quality. Long-term drought reduces the moisture in soil, causing the soil to become dry and thin. The soil then becomes loose and blows away, changing the area into desert.

Desertification is widespread and affects hundreds of millions of people worldwide. The loss of arable land in an area can change settlement patterns there. As you read in the Unit 1 Global Concern, long-term drought is threatening food production in Africa's Sahel region. This problem is so severe that people are leaving their homes.

Deserts and Areas at Risk of Desertification

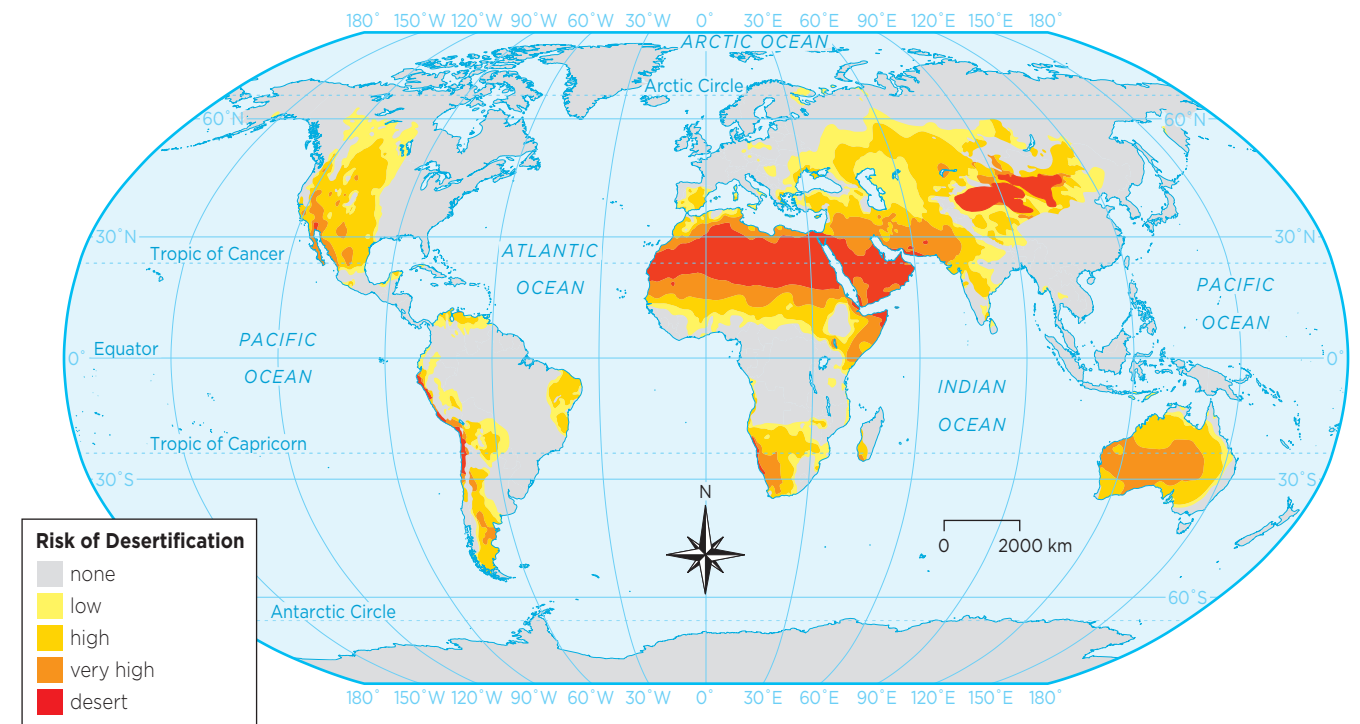


FIGURE 2.8 This map shows existing deserts and areas that are at risk of becoming deserts.

THE GREAT GREEN WALL PROJECT

Long-term drought has caused China's large deserts—the Taklamakan and Gobi deserts—to expand. The map in Figure 2.9 shows levels of soil degradation (reduced soil quality) in China. Over 400 million people have settled around the edges of these deserts. These settlements are now at risk.

To slow desertification, the Chinese government has planted shrubs, grasses, and trees along the edges of the deserts as part of their Great Green Wall project. These plantings, called shelterbelts, prevent the soil from eroding away. The project has slowed the rate of desertification by about 40 percent since the 1990s, but will take several decades to complete. A similar project is underway in Africa's Sahel region.

DUST STORMS

Dust storms are a consequence of desertification (Figure 2.10). Dust storms are common in the Sahara Desert in Africa and the deserts in China. The dust raised during a dust storm can blow up to 8 km high, adding dust to the atmosphere. The strong, dusty winds damage equipment and buildings, as well as human skin and eyes. For people living in areas with dust storms, the dust may cause breathing problems.

Dust storms can also have a positive impact. Winds can drop the dust thousands of kilometres from where it was picked up. The soils in Central and South American rainforests get most of their mineral nutrients from dust that came from the Sahara Desert in Africa.

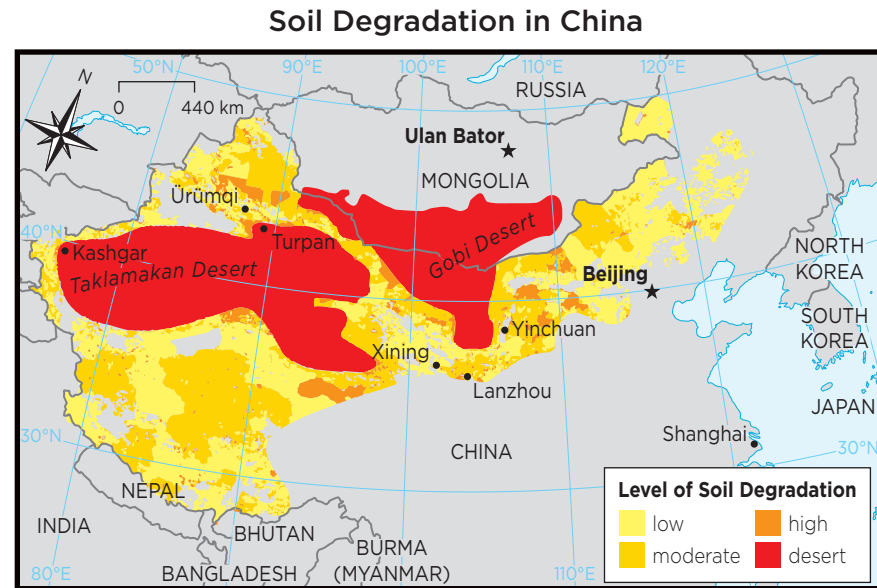


FIGURE 2.9 This map shows areas in China with degraded soil. Higher levels of soil degradation increase the risk of desertification. Although most Chinese live farther east of the threatened areas, millions live near the deserts in drylands.

FIGURE 2.10 A dust storm approaches the village of Merzouga, Morocco.

I wonder how people can protect settlements from dust storms?



FOCUS ON

INTERRELATIONSHIPS

When studying an area, geographers want to understand the interrelationships between the physical environment and the human environment.

To do this, they identify the characteristics of each environment by describing what they can observe or research. Then they try to understand the relationships between the characteristics of the two environments. To think like a geographer, ask questions like the following:

- Does the physical environment impact the human environment? If so, how?
- How do humans adapt to survive in the physical environment?

Sometimes, geographers wish to extend their study. They might ask questions like these:

- Do the same interrelationships occur in other parts of the world with similar characteristics?
- Are the human responses the same?

CASE STUDY: SAUDI ARABIA

Saudi Arabia, in the Middle East, is located between the Red Sea and the Persian Gulf. Approximately 95 percent of the country is desert, with no lakes or rivers and no significant rainfall. In the past, settlements were often located in *wadis*, or valleys, where there was access to underground water. Settlements were small, and people were able to grow crops and tend herds of camels or goats. The nomadic lives of the settlers ensured a balance between the physical and human environments.

Today, the population of Saudi Arabia is growing, and the relationship between the physical and human environments has changed. Most people live in urban areas. Access to food is an ongoing challenge in the desert, because water is needed to grow crops. Their solution is to create arable land in the desert through irrigation projects to grow their own crops and reduce food imports.

Figure 2.11 shows how the landscape of Saudi Arabia has changed from 1987 to 2012.

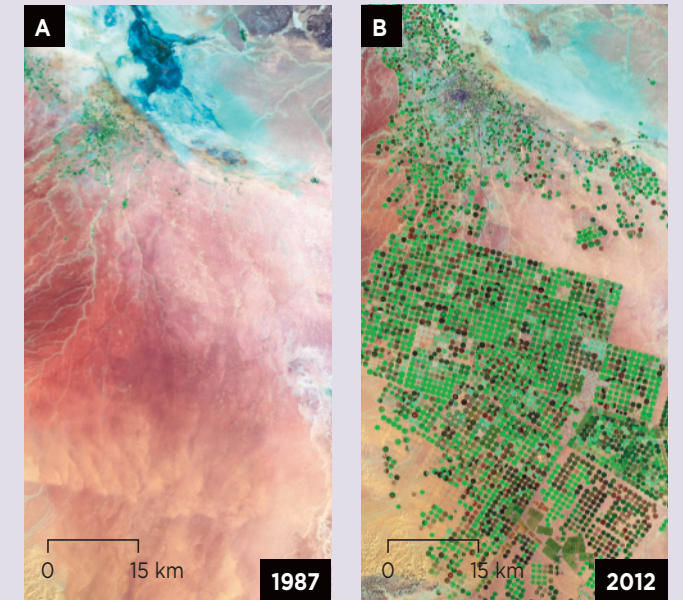


FIGURE 2.11 Satellite images of Saudi Arabia show a changing landscape between 1987 (A) and 2012 (B). The bright-green areas are vegetation.

The water used for agriculture in Saudi Arabia comes from an underground source. However, once the underground water runs out, it is gone forever. Less moisture in the soil leads to increased desertification. Less moisture also leads to higher-than-normal levels of different salts, which can harm the crops.

TRY IT

1. How has the physical environment impacted the people of Saudi Arabia? How have the people of Saudi Arabia impacted the physical environment?
2. Research farming in Saudi Arabia. Are there other ways to access water?
3. Do you think that Saudi Arabia should continue to farm? Why or why not? Show your ideas in a graphic organizer.
4. Research another area where desert is being turned into farmland. What characteristics does this area share with Saudi Arabia?

LANDSLIDES

When there is too much water on a slope, the land can slide or flow down the slope, creating a landslide or a mudslide. Settlements near steep slopes covered by clay, sand, or silt are in the most danger. Landslides can result from natural causes, such as heavy rains, melting snow, and earthquakes.

Human activities can also lead to landslides. For example, tree roots help keep land in place on slopes. When people clear away too many trees in forested areas, the roots are also removed. Without the roots holding land in place on slopes, landslides can occur more easily.

Another human activity that can cause landslides is construction. When roads are built on slopes, the supporting land is sometimes removed. The earth becomes unstable. During rainy seasons, the heavy rain and lack of supporting land can cause a landslide.

When landslides and mudslides hit settlements, destruction and loss of life can be high. A massive landslide after extremely heavy rain in Nepal in August 2014 resulted in over 150 deaths (Figure 2.12).

To help reduce the risk of landslides, communities must keep dangerous areas off-limits for settlement and activities. Communities can also try to direct water away from these areas.

FIGURE 2.12 Heavy rains led to a landslide in western Nepal in August 2014.

I wonder if people knew landslides could happen before they settled here?

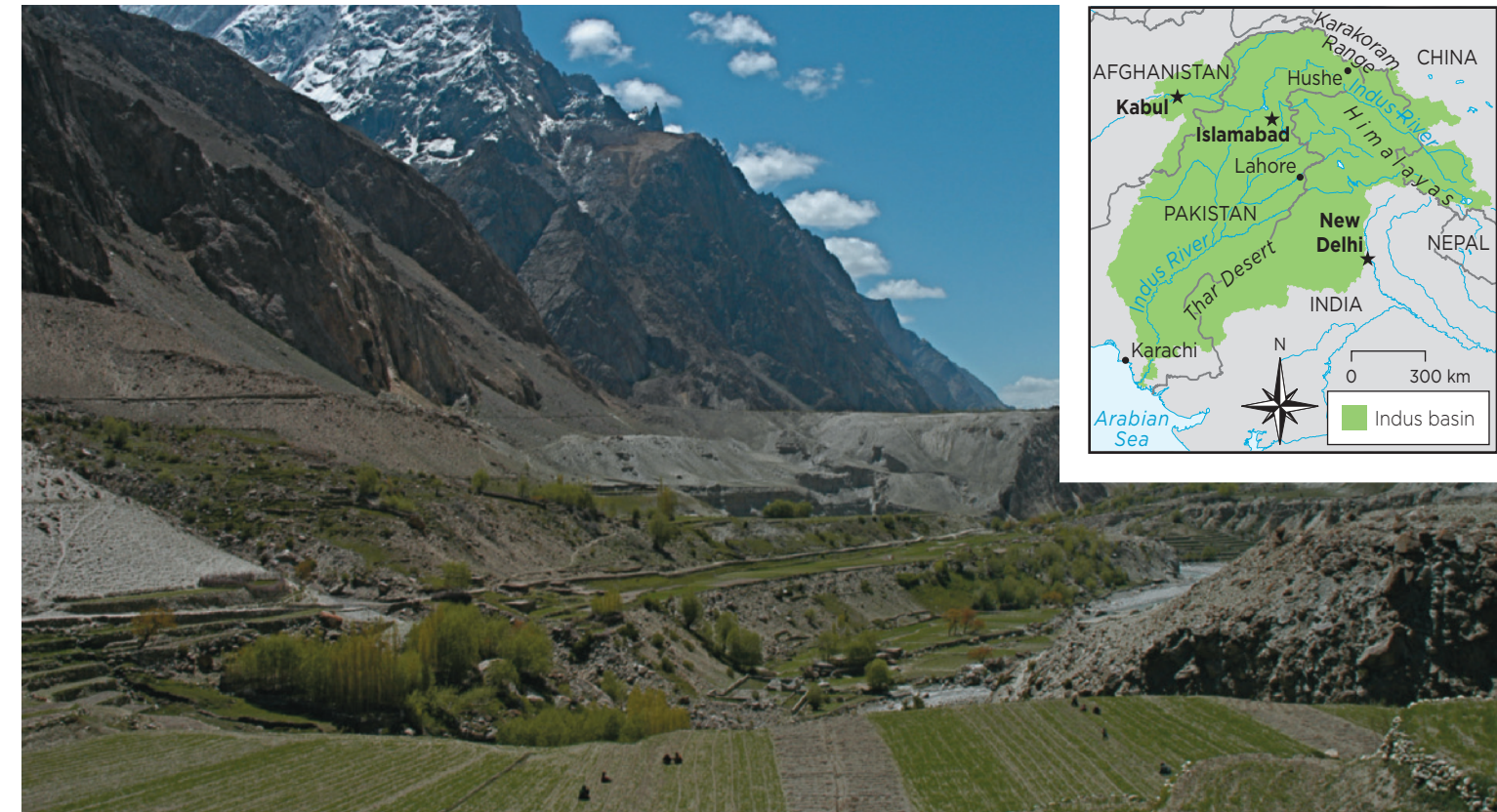


FIGURE 2.13 This area in the Indus River basin (inset) near Hushe, Pakistan, was formed as a result of rockslides.

I wonder if there are other settlements formed as a result of landslides?

Can landslides ever be beneficial? The Indus River basin, shown in the map in Figure 2.13, covers areas in China, India, Pakistan, and Afghanistan. Much of the Indus River basin is not suitable for settlement. The upper part of the basin contains glacial ice and is very cold and mountainous. Over time there have been many landslides. Fallen rocks from the landslides sometimes form a dam, allowing the area behind the dam to fill up with sediment. As a result, areas that are very suitable for settlement are created. The area near Hushe, Pakistan, shown in Figure 2.13, was formed by a rockslide.

After huge rocks fall from the mountain, the slopes are no longer vertical, which is more suitable for agriculture. Some of the crushed rock from the rockslides and sediments from the river have improved the soil, allowing people to grow crops and raise livestock. While the climate is still cool, people have been able to form new settlements where they could not have done so before.

CHECK-IN

- SPATIAL SIGNIFICANCE** Why do some people settle near volcanoes despite the dangers?
- GATHER AND ORGANIZE** Create a chart to show the measures that people could take to help them prepare for volcanoes, earthquakes, or tsunamis.
- PATTERNS AND TRENDS** Examine Figure 2.8, the map showing areas at risk of desertification. What patterns can you identify?
- INTERPRET AND ANALYZE** Imagine that the area where you live became a desert. List three ways that this might affect your community. Discuss the impact of each effect.