Case Study: Earthquake!

Shortly before 5 p.m. on January 12, 2010, a massive earthquake measuring 7.0 on the Richter scale struck the Caribbean island of Haiti. The earthquake’s epicenter was only about 16 km (10 mi) southwest of the capital, Port-au-Prince. It was the worst earthquake in the region in more than 200 years. Huge swaths of Port-au-Prince lay in ruins. Schools, hospitals, commercial buildings, and even the Presidential Palace collapsed. It’s estimated that 230,000 people were killed and 300,000 injured. At least 1 million people were left homeless, and more than 3 million suffered contaminated water supplies, food shortages, lost jobs, or missing family members. The Inter-American Development Bank estimated the economic losses could be (U.S.) $15 billion.

Port-au-Prince sits on the coastline where two huge geological features—the Caribbean tectonic plate and the Gonave microplate—slide slowly past each other (fig. 14.1). As the plates grind along what’s called a strike-slip fault, strain builds up over centuries until the plates suddenly jerk forward to trigger seismic activity. Two fault systems intersect under the island of Hispaniola, the Caribbean Island Haiti shares with the Dominican Republic. The 2010 quake occurred along the Enriquillo-Plantain Garden Fault, an east-west crack in the earth’s crust that runs from Hispaniola through Jamaica and the Cayman Islands.

These faults trace their origins to a broader interaction between the North American plate and the Caribbean plate. The North American plate is diving beneath the Caribbean plate, but one piece of the North American plate, called the Bahamas Platform, is too buoyant to make the plunge easily. The resulting collision deforms and shakes Hispaniola.

Nearly every island in the Caribbean has experienced earthquakes. Although major quakes occur only every few centuries, they can be extremely catastrophic. In 1692 a 7.5 magnitude megakake hit the town of Port Royal, Jamaica, which sits on the same fault as Port-au-Prince. Much of the town, which was unusually rich with pirate plunder, sank below the sea with a great loss of life.

The damage in Haiti in 2010 was especially severe because the quake was close to the city center and shallow (only 10 to 15 kilometers below the surface), and more importantly because many homes and buildings in the economically depressed country weren’t built to withstand seismic forces. Building codes in Haiti are poorly enforced, and building supplies are expensive, so most concrete is made with too much sand, too little cement, and not enough reinforcing metal. Furthermore, after the catastrophe occurred, the dysfunctional government was unprepared to offer much assistance to victims. Public services in Haiti are minimal even in the best of times. Port-au-Prince may be the largest city in the world without a public sewer system. A year after the quake, having suffered a major cholera outbreak that sickened more than 100,000 people and killed at least 2,000, as well as torrential rains from Hurricane Tomas that flooded ragged tent cities and added more misery to the grim situation, more than a million suffering Haitians remain homeless.

By contrast, a much larger earthquake hit Chile just six weeks after the one in Haiti. With a magnitude of 8.8 on the Richter scale, the Chile quake was 500 times larger than the one in the Caribbean. But its epicenter was 35 km (21.7 mi) deep, offshore along a relatively remote area of the country, and 105 km (65 mi) from Concepcion, the largest city in the region. Because Chile experiences frequent earthquakes, building codes are far more advanced and more rigorously enforced than in many other countries. Only about 700 people died in Chile compared to about 300 times as many in Haiti.

Geological hazards, such as earthquakes, volcanic eruptions, tsunamis, floods, and landslides, are major threats. Devastating events have altered human history many times in the past, sending geopolitical, economic, genetic, and even artistic repercussions around the planet. In this chapter we’ll look at the processes that shape the earth and how rocks and minerals are formed, as well as what we might do to reduce our geological risks and our impacts on our environment as we extract resources.

For related resources, including Google Earth™ placemarks that show locations discussed in this chapter, visit EnvironmentalScience-Cunningham.blogspot.com.