Chapter 8 Earthquakes and Earth’s Interior

Summary

8.1 What Is an Earthquake?

Faults are fractures in Earth where movement has occurred.
- An earthquake is the vibration of Earth produced by the rapid release of energy within the lithosphere.
- Earthquakes are caused by slippage along a break in the lithosphere, called a fault.
- The point within Earth where an earthquake starts is called the focus.
- The energy released by an earthquake travels in all directions from the focus in the form of seismic waves.
- The movement that occurs along faults during earthquakes is a major factor in changing Earth’s surface.
- The epicenter is the location on the surface directly above the focus.

According to the elastic rebound hypothesis, most earthquakes are produced by the rapid release of energy stored in rock that has been subjected to great forces. When the strength of the rock is exceeded, it suddenly breaks, releasing some of its stored energy as seismic waves.
- Forces inside Earth slowly deform the rock that makes up Earth’s crust, causing rock to bend.
- Elastic rebound is the tendency for the deformed rock along a fault to spring back after an earthquake.
- An aftershock is an earthquake that occurs sometime soon after a major earthquake.

8.2 Measuring Earthquakes

Earthquakes produce two main types of seismic waves—body waves and surface waves.
- There are two types of body waves: P waves and S waves.
- P waves are push-pull waves that push (or compress) and pull (or expand) particles in the direction the waves travel.
- S waves shake particles at right angles to the waves’ direction of travel.
- When body waves reach the surface, they produce surface waves. Surface waves are the most destructive seismic waves.

Scientists have developed an instrument to record seismic waves—the seismograph.
- A seismograph produces a time record of ground motion during an earthquake called a seismogram. A seismogram shows all three types of seismic waves.
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The Richter scale and the moment magnitude scale measure earthquake magnitude. The Modified Mercalli scale is based on earthquake intensity.

- The **moment magnitude** is derived from the amount of displacement that occurs along a fault. Scientists today use the moment magnitude scale to measure earthquakes.

- A travel-time graph, data from seismograms made at three or more locations, and a globe can be used to determine an earthquake’s epicenter.

8.3 Earthquake Hazards

**Earthquake-related hazards include seismic shaking, liquefaction, landslides and mudflows, and tsunamis.**

- The ground vibrations caused by seismic waves are called seismic shaking.

- **Liquefaction** is a process earthquakes can cause in which soil and rock saturated with water turn into liquid and can no longer support buildings.

- A **tsunami** is a wave formed when the ocean floor shifts suddenly during an earthquake.

- Earthquakes can cause landslides and mudflows, two destructive events that can quickly bury entire towns under debris.

**Earthquake damage and loss of life can be reduced by determining the earthquake risk for an area, building earthquake-resistant structures, and following earthquake safety precautions.**

- A **seismic gap** is an area along a fault where there has not been any earthquake activity for a long period of time.

8.4 Earth’s Layered Structure

Earth’s interior consists of three major layers defined by their chemical composition—the crust, mantle, and core.

- The **crust**, the thin, rocky outer layer of Earth, is divided into oceanic and continental crust.

- Under the crust is the **mantle**—a solid, rocky shell that extends to a depth of 2890 kilometers.

- The **core** is the innermost layer of Earth. The core is divided into an outer core and an inner core.

**Earth can be divided into layers based on physical properties—the lithosphere, the asthenosphere, the lower mantle, the outer core, and the inner core.**

- Earth’s outermost layer consists of the crust and uppermost mantle and forms a relatively cool, rigid shell called the **lithosphere**.
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- Beneath the lithosphere lies a soft, comparatively weak layer known as the asthenosphere.
- Near the base of the mantle lies a more rigid layer called the lower mantle.
- The outer core is a liquid layer beneath the mantle that is 2260 kilometers thick. The outer core generates Earth’s magnetic field.
- The inner core is the solid innermost layer of Earth, which has a radius of 1220 kilometers.

During the twentieth century, studies of the paths of P and S waves through Earth helped scientists identify the boundaries of Earth’s layers and determine that the outer core is liquid.

- The boundary that separates the crust from the underlying mantle is known as the Moho.

To determine the composition of Earth’s layers, scientists studied seismic data, rock samples from the crust and mantle, meteorites, and high-pressure experiments on Earth materials.