

Section 12.2.

Features of Plate Tectonics.

Textbook pages 518 to 537.

Before You Read.

Earthquakes frequently occur in British Columbia. What do you already know about earthquakes?

What lies below Earth's surface?

Earth is made of four layers with distinct characteristics. The **crust** is Earth's outermost layer. It is made from solid, brittle rock and is five to seventy kilometers thick. The **mantle** is Earth's thickest layer. The upper mantle (six hundred and sixty kilometers thick) is composed of partly molten rock that flows like thick toothpaste. A transition zone separates it from the lower mantle (about two thousand three hundred kilometers thick), which is made of solid, dense material including magnesium and iron. Below the mantle lies the liquid **outer core** (about two thousand three hundred kilometers thick and mostly nickel and iron). The **inner core** with a radius of one thousand two hundred kilometers lies at Earth's centre. The incredible pressure at Earth's centre keeps the iron and nickel in the inner core solid. Scientists believe that the inner and outer cores rotate at different speeds, producing Earth's magnetic field.

What are tectonic plates?

Tectonic plates are large, rigid, but mobile plates of rock. There are about twelve major tectonic plates and many smaller ones. Made up of the crust and the uppermost mantle, they form the **lithosphere**. Oceanic plates contain dense basalt rock. Continental plates contain large amounts of granite. Below the lithosphere lies the **asthenosphere**, a partly molten layer in the upper mantle.

Radioactive decay in some parts of the asthenosphere heats the mantle in these regions. Convection currents result as these hotter, and therefore less dense, regions of the mantle rise, cool, and sink again, only to be reheated. This **mantle convection** is one of the driving forces behind plate movement.

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How do tectonic plates interact?

A region where two tectonic plates are in contact is known as a **plate boundary**. The way in which tectonic plates interact depends on the type of plates and the direction the plates are moving relative to one another.

There are three main types of plate interactions:.

1. Divergence. : **Divergent plate boundaries** mark the areas where tectonic plates are spreading apart. Such plates, for example, the East African Rift, are known as **diverging plates**. Rising currents of magma cool as they reach the surface and become “new” rock, resulting in spreading centres. A spreading centre in the ocean is called a spreading ridge or oceanic ridge. On land, it is called a **rift valley**. As new material at a ridge or rift pushes older material aside, the tectonic plates move away from the ridge. This process is called **ridge push**. **Rift eruptions** may occur when magma erupts at divergent plate boundaries. The Juan de Fuca ridge is an example.
2. Convergence. : A **convergent plate boundary** occurs where tectonic plates collide. Such plates are known as **converging plates**. If a dense oceanic plate collides with a continental plate, the heavy oceanic plate will dive under the lighter continental plate in an event known as **subduction**. A deep underwater valley, called a **trench**, forms where the plates make contact. As the edge of a tectonic plate subducts, it pulls the rest of the plate with it. This process is called **slab pull**. Along with convection currents and ridge push, slab pull helps keep tectonic plates in motion. As subduction occurs, magma can break through to the surface, forming volcanoes. A long chain of volcanoes, called a **volcanic belt**, may form as a result. The force of the collision between oceanic and continental plates also creates mountain ranges as the continental rock crumples and bends. British Columbia’s Coast Mountains and Cascade Mountain Range were produced by such collisions.

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- Most volcanoes in volcanic belts are **composite volcanoes**, such as Mount Garibaldi, in British Columbia. Their cone shape results from repeated eruptions of ash and lava. **Shield volcanoes** are the world’s largest, and their shape resembles a shield. They are not formed when plates collide, but when weaker areas of the lithosphere move over a “hot spot”. The Anahim Belt is a chain of shield volcanoes in British Columbia. **Rift volcanoes**, like the Krafla volcano in Iceland, are formed when magma erupts through long cracks in the lithosphere. Subduction also occurs where two oceanic plates converge. Cooling causes one plate to become denser. The denser plate slides deep into the mantle. Such convergence may produce a long chain of volcanic islands known as a **volcanic island arc**. The Aleutian islands and the islands of Japan are examples of a volcanic island arc. Subduction does not occur when two continental plates collide since the plates have similar densities. As continental plates collide, their edges fold, forming large mountain ranges, such as the Himalayas.
3. Transform. : Convection currents in the mantle often cause tectonic plates to slide past each other. Such regions are known as **transform plate boundaries**. Earthquakes and **faults** (breaks in rock layers due to movement on either side) may result. A fault that occurs at a transform plate boundary is known as a **transform fault**. The San Andreas Fault is an example of a transform plate

boundary.

How are tectonic plates linked to earthquakes?

Friction between moving tectonic plates often works against convection currents, producing stress (the build-up of pressure). When the plates can no longer resist the stress, there is an earthquake—a massive release of energy that shakes the crust. The **focus** is the location inside Earth where an earthquake starts. The **epicentre** is the point on Earth's surface directly above the focus. An earthquake with a shallow focus (zero to seventy kilometers) typically creates more damage than one with an intermediate focus (seventy to three hundred kilometers), or a deep focus (greater than three hundred kilometers), as energy release occurs closer to the surface.

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Energy released by an earthquake produces vibrations known as **seismic waves**. **Seismology** is the study of earthquakes and seismic waves. There are three types of waves: **primary waves (P. waves)** and **secondary waves (S. waves)**, both of which travel underground, and **surface waves (L. waves)**, which roll along Earth's surface.

Scientists use a seismometer to measure seismic waves. With each one-step increase on the magnitude scale, the seismic waves are ten times larger. Earthquakes can be felt if they are over magnitude two. Over magnitude six, they can damage buildings. P. waves are the fastest and stretch in the direction of the wave, like a spring. They can travel through solids, liquids, and gases. S. waves are slower, and move perpendicularly to the direction of the wave. They travel through solids but not liquids. L. waves are the slowest and cause a rolling motion like ripples on the ground.

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