Plates on the Move 9.1

Some of Earth's plates are being pulled apart, some are colliding, some are being pulled under others, and some are sliding past each other. The areas where plates meet are called plate boundaries. There are three types of plate boundaries:

1. divergent boundaries, where plates are being pulled apart
2. convergent boundaries, where plates are being pushed together
3. transform fault boundaries, where plates are sliding past each other

LEARNING TIP

Preview this section and look at the headings. There are three main headings, one for each type of plate movement. Under one of the headings are three subheadings. Use this structure for taking point-form notes as you read the section. Your notes should always answer two questions:

- What is happening at this type of boundary?
- Where in the world is an example of this type of boundary?

Divergent Boundaries

The boundaries between plates that are moving apart are called **divergent boundaries.** As plates separate, hot molten magma rises to Earth's surface to form new crust. On the ocean floor this separation of plates and production of new crust is called sea-floor spreading (**Figure 1**).

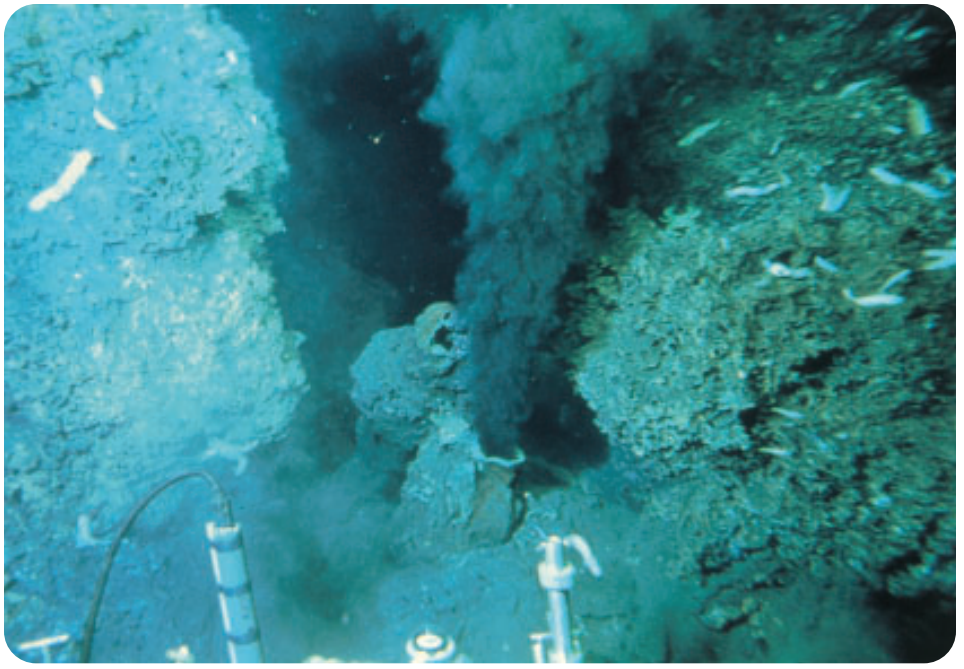

Figure 1
This photo of the sea floor was taken by the deep-sea submersible seen at the bottom of the photograph. As plates move apart and create a crack in the crust, seawater seeps into the crack and becomes heated by the magma that is being pushed up from below.

The magma cools and hardens, forming ridges of new rock. These ridges can rise a kilometre above the ocean floor. The entire length of the Atlantic Ocean has a ridge in the middle where the North American and Eurasian plates are separating. This is known as the Mid-Atlantic Ridge (**Figure 2**). The rate of sea-floor spreading along the Mid-Atlantic Ridge is about 2.5 cm per year. Although this seems slow, it is gradually widening the Atlantic Ocean.

Figure 2
The Mid-Atlantic Ridge marks where the North American and Eurasian plates are separating.

On land, divergent boundaries create valleys called rifts. In Iceland, the divergent boundary between the North American Plate and the Eurasian Plate is visible on land (**Figure 3**).

Figure 3
A divergent boundary between separating plates is clearly visible as a rift near Thingvellir, Iceland.

Another divergent boundary is found in East Africa. Here the spreading between the African Plate and the Arabian Plate has already separated Saudi Arabia from the rest of the African continent and formed the Red Sea (**Figure 4**). It has also created the East African Rift system on land.

Figure 4
The divergent boundaries between plates in East Africa

Convergent Boundaries

Since there is no evidence that the size of Earth has changed significantly, old crust must be destroyed, or recycled, at the same rate that new crust is being formed at divergent boundaries. The recycling of old crust takes place at boundaries where plates move toward each other. These boundaries are called **convergent boundaries.**

The collisions that occur when plates come together are very slow and can last millions of years. When plates come together, one plate sinks below the other. The place where this occurs is called a **subduction zone** [sub-DUC-shun]. You can think of subduction as nature's way of recycling Earth's crust.

The landforms created at a convergent boundary depend on whether an oceanic plate is converging with a continental plate, two oceanic plates are converging, or two continental plates are converging.

Oceanic Plate Converging with Continental Plate

When an oceanic plate collides with a continental plate, the oceanic plate is subducted under the continental plate (**Figure 5**). This creates deep ocean trenches along the edge of a continent. Along the coast of British Columbia, this happens where the Juan de Fuca Plate is being subducted under the North American Plate.

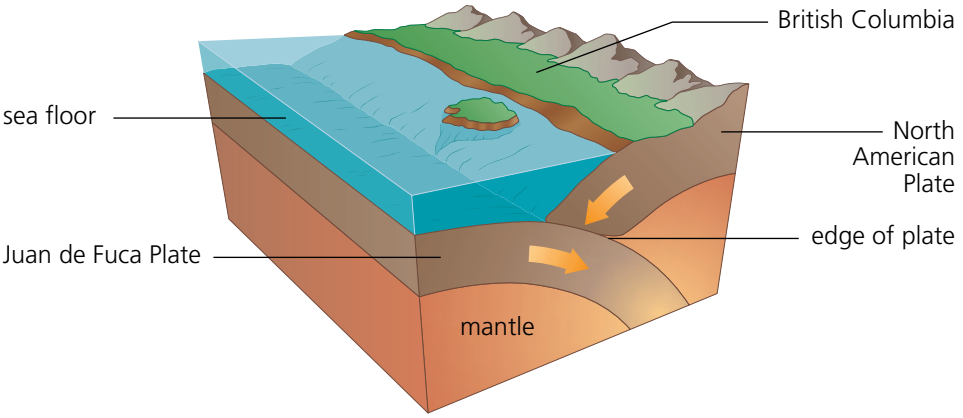

Figure 5
The Juan de Fuca Plate is being subducted under the North American Plate, which is moving west.

Off the coast of South America, the oceanic Nazca Plate is being subducted under the continental South American Plate. The South American Plate is being pushed up, creating the Andes Mountains. A **mountain** is any landmass that rises significantly from the surrounding level of Earth's surface. This type of mountain building is common where an oceanic plate is converging with a continental plate.

Oceanic Plate Converging with Oceanic Plate

When two oceanic plates converge, one plate sinks below the other. As with the convergence of oceanic and continental plates, trenches are formed at the subduction zone. Challenger Deep, the deepest part of the oceans, is part of the Mariana Trench in the subduction zone between the Pacific and Philippine Plates (**Figure 6**). Challenger Deep is so deep that even Mount Everest could not fill it in (**Figure 7**)!

Figure 6
The Mariana Trench is being formed at a subduction zone.

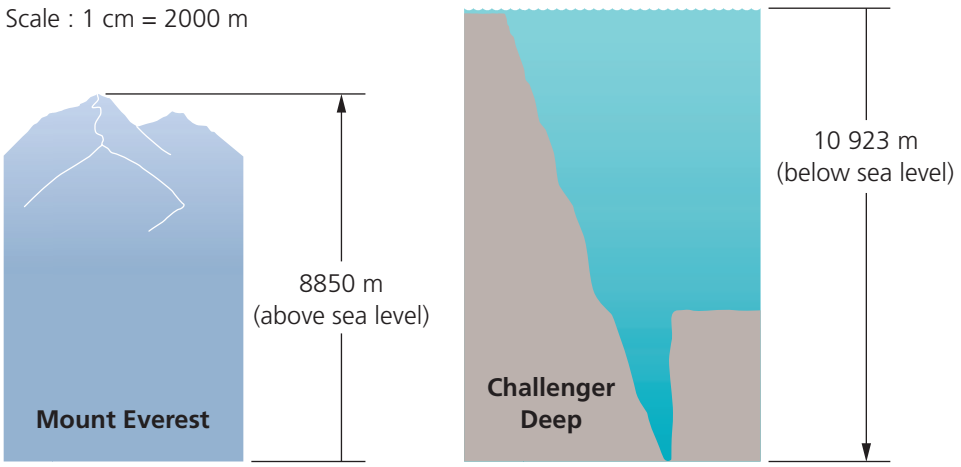

Figure 7
If you put Mount Everest into Challenger Deep, there would still be more than two kilometres of water over the top of Mount Everest!

LEARNING TIP

Visualize turning Mount Everest upside down into Challenger Deep.

Continental Plate Converging with Continental Plate

When two continental plates meet, neither is subducted. Instead, the crust buckles and crumbles, pushing up mountains or areas of high level ground called **plateaus.** When the Indian Plate converged with the Eurasian Plate 50 million years ago, the slow uplift over millions of years pushed up the highest continental mountains in the world, the Himalayas (**Figure 8**). It also pushed up the Tibetan Plateau. Although the Tibetan Plateau is fairly flat, it is higher than the Alps mountain range in Europe.

Figure 8
The Himalayas

Transform Fault Boundaries

J. Tuzo Wilson, a Canadian geophysicist, made models of plate boundaries with paper and scissors. He discovered a new kind of plate boundary, which he called a fault. A fault is an area where rocks are being broken by movement in the crust. Wilson also discovered that divergent and convergent plate boundaries could end abruptly and "transform" into faults. He therefore called the zone between plates that are slipping past each other **transform fault boundaries.**

Most transform fault boundaries are found on the ocean floor. The most famous of the few on land is the San Andreas Fault (**Figure 9**) in California. At the San Andreas Fault, the Pacific Plate, which carries part of California, is moving north past the North American Plate, which carries the rest of California. Shallow earthquakes are very common along transform fault boundaries, such as the San Andreas Fault.

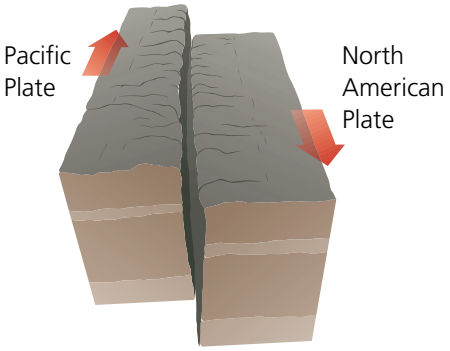

Figure 9
The San Andreas Fault is a transform fault boundary. Major earthquakes have often occurred along this fault.

CHECK YOUR UNDERSTANDING

1. Copy and complete **Table 1**.

1. Table 1 Types of Plate Boundaries

Type of plate boundary	Description of plate movement	Places on Earth where this type of plate boundary is found

2. Where would you expect to find the newest rocks on the ocean floor? Where would you expect to find the oldest rocks?