SECTION 3

The Theory of Plate Tectonics

It takes an incredible amount of force to move a tectonic plate! But where does this force come from?

What You Will Learn

- Describe the three types of tectonic plate boundaries.
- Describe the three forces thought to move tectonic plates.
- Explain how scientists measure the rate at which tectonic plates move.

Vocabulary

plate tectonics
convergent boundary
divergent boundary
transform boundary

READING STRATEGY

Brainstorming The key idea of this section is plate tectonics. Brainstorm words and phrases related to plate tectonics.

As scientists' understanding of mid-ocean ridges and magnetic reversals grew, scientists formed a theory to explain how tectonic plates move. **Plate tectonics** is the theory that the Earth's lithosphere is divided into tectonic plates that move around on top of the asthenosphere. In this section, you will learn what causes tectonic plates to move. But first you will learn about the different types of tectonic plate boundaries.

Tectonic Plate Boundaries

A boundary is a place where tectonic plates touch. All tectonic plates share boundaries with other tectonic plates. These boundaries are divided into three types: convergent, divergent, and transform. The type of boundary depends on how the tectonic plates move relative to one another. Tectonic plates can collide, separate, or slide past each other. Earthquakes can occur at all three types of plate boundaries. The figure below shows examples of tectonic plate boundaries.

Convergent Boundaries

When two tectonic plates collide, the boundary between them is a **convergent boundary.** What happens at a convergent boundary depends on the kind of crust at the leading edge of each tectonic plate. The three types of convergent boundaries are continental-continental boundaries, continental-oceanic boundaries, and oceanic-oceanic boundaries.

Divergent Boundaries

When two tectonic plates separate, the boundary between them is called a **divergent boundary.** New sea floor forms at divergent boundaries. Mid-ocean ridges are the most common type of divergent boundary.

Transform Boundaries

When two tectonic plates slide past each other horizontally, the boundary between them is a **transform boundary.** The San Andreas Fault in California is a good example of a transform boundary. This fault marks the place where the Pacific and North American plates are sliding past each other.

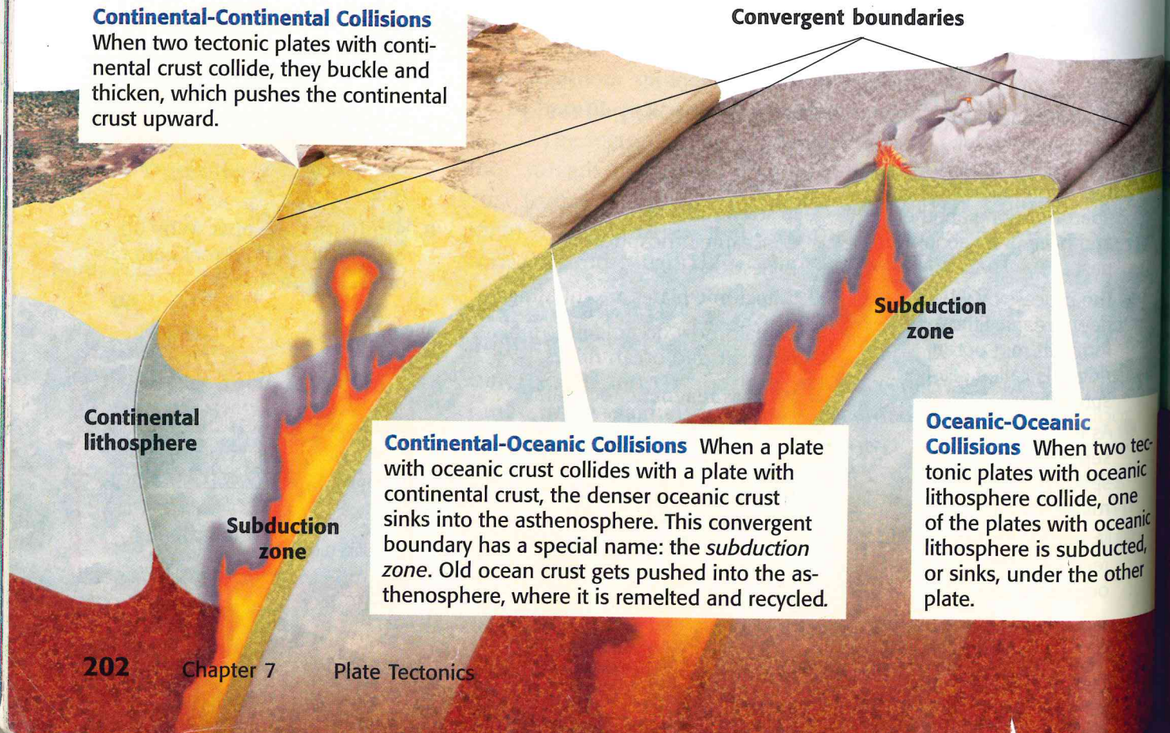
Reading Check **Define the term *transform boundary*.** (*See the Appendix for answers to Reading Checks.*)

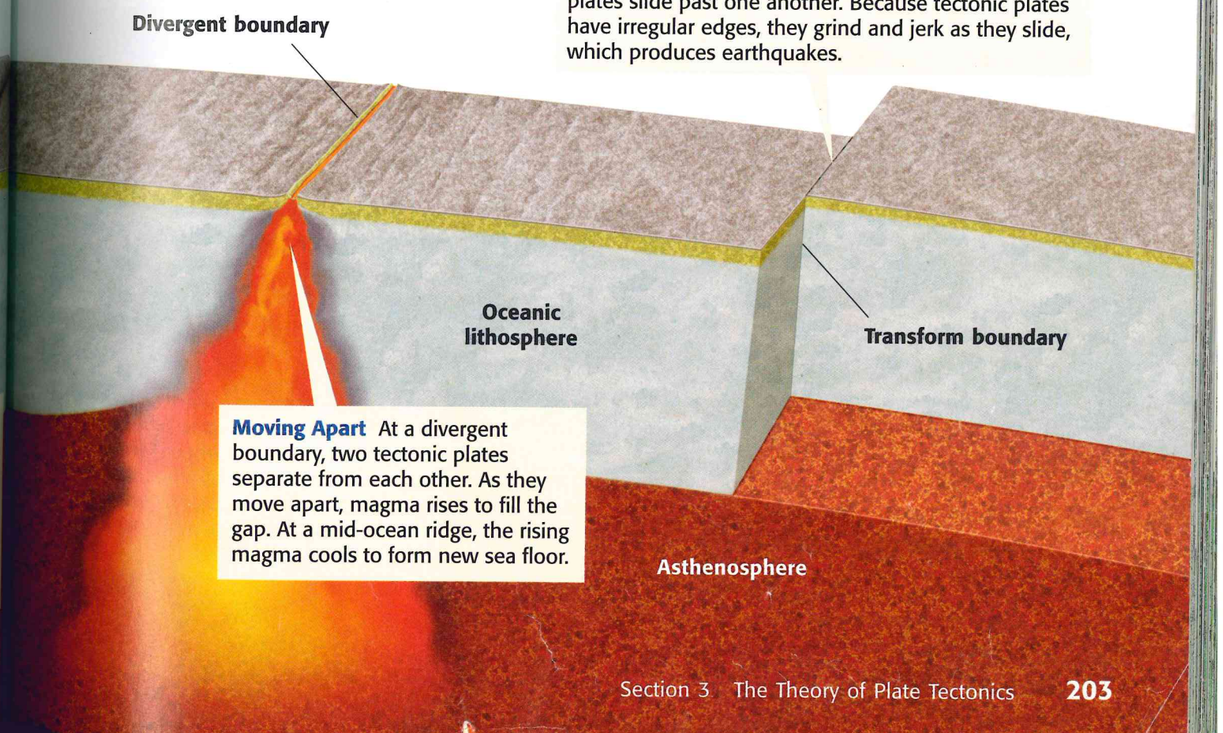
plate tectonics the theory that explains how large pieces of the Earth's outermost layer, called *tectonic plates,* move and change shape

convergent boundary the boundary formed by the collision of two lithospheric plates

divergent boundary the boundary between two tectonic plates that are moving away from each other

transform boundary the boundary between tectonic plates that are sliding past each other horizontally



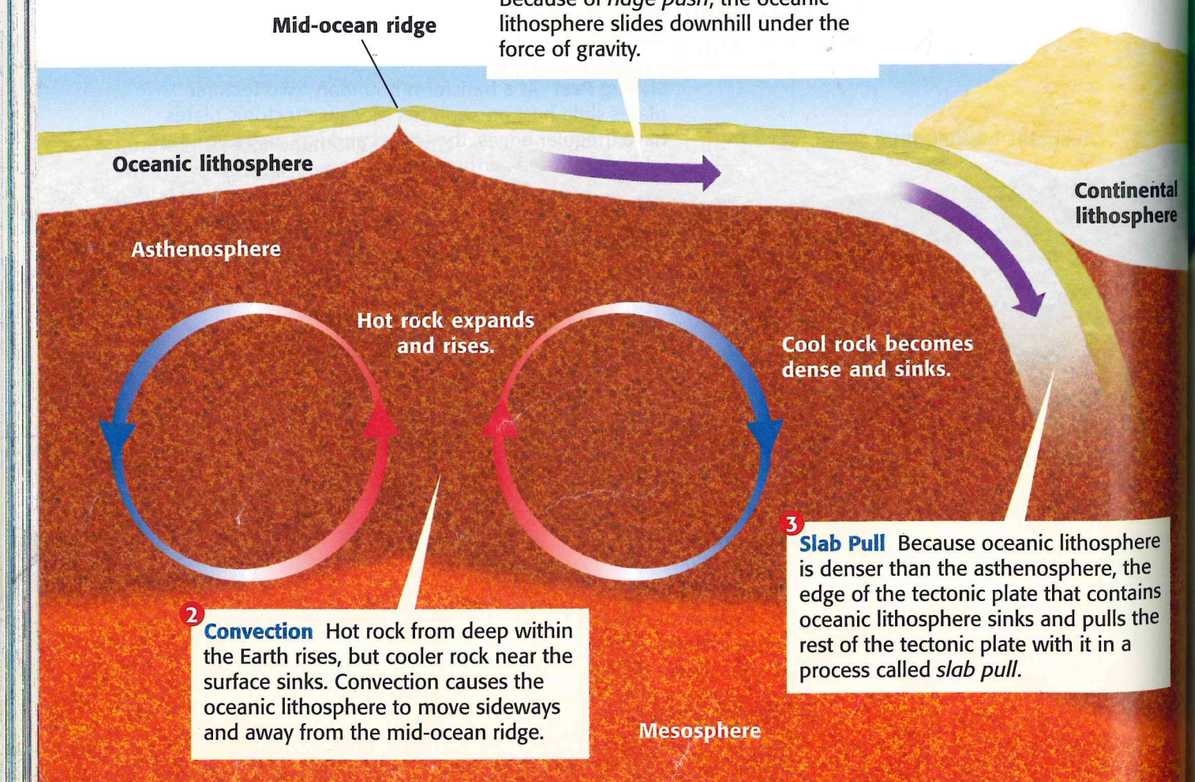


Possible Causes of Tectonic Plate Motion

You have learned that plate tectonics is the theory that the lithosphere is divided into tectonic plates that move around on top of the asthenosphere. What causes the motion of tectonic plates? Remember that the solid rock of the asthenosphere flows very slowly. This movement occurs because of changes in density within the asthenosphere. These density changes are caused by the outward flow of thermal energy from deep within the Earth. When rock is heated, it expands, becomes less dense, and tends to rise to the surface of the Earth. As the rock gets near the surface, the rock cools, becomes more dense, and tends to sink. **Figure 1** shows three possible causes of tectonic plate motion.

Reading Check **What causes changes in density in the asthenosphere?**

Figure 1 **Three Possible Driving Forces of Plate Tectonics**



Tracking Tectonic Plate Motion

How fast do tectonic plates move? The answer to this question depends on many factors, such as the type and shape of the tectonic plate and the way that the tectonic plate interacts with the tectonic plates that surround it. Tectonic plate movements are so slow and gradual that you can't see or feel them—the movement is measured in centimeters per year.

The Global Positioning System

Scientists use a system of satellites called the *global positioning system* (GPS), shown in **Figure 2,** to measure the rate of tectonic plate movement. Radio signals are continuously beamed from satellites to GPS ground stations, which record the exact distance between the satellites and the ground station. Over time, these distances change slightly. By recording the time it takes for the GPS ground stations to move a given distance, scientists can measure the speed at which each tectonic plate moves.

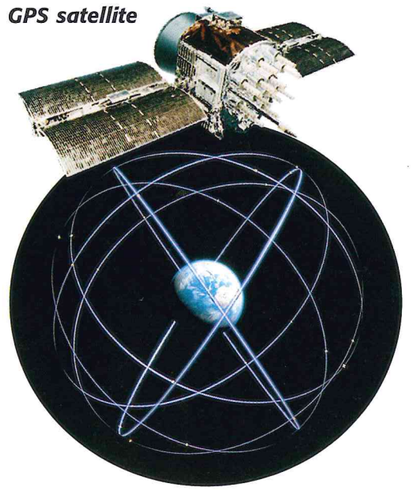


Figure 2 *The image above shows the orbits of the GPS satellites.*

SECTION Review

Summary

- Boundaries between tectonic plates are classified as convergent, divergent, or transform.
- Ridge push, convection, and slab pull are three possible driving forces of plate tectonics.
- Scientists use data from a system of satellites called the global positioning system to measure the rate of motion of tectonic plates.

Using Key Terms

1. In your own words, write a definition for the term *plate tectonics*.

Understanding Key Ideas

2. The speed a tectonic plate moves per year is best measured in
   - **a.** kilometers per year.
   - **b.** centimeters per year.
   - **c.** meters per year.
   - **d.** millimeters per year.
3. Briefly describe three possible driving forces of tectonic plate movement.
4. Explain how scientists use GPS to measure the rate of tectonic plate movement.

Math Skills

5. If an orbiting satellite has a diameter of 60 cm, what is the total surface area of the satellite? (Hint: *surface area* = $4\pi r^2$)

Critical Thinking

6. **Identifying Relationships** When convection takes place in the mantle, why does cool rock material sink and warm rock material rise?
7. **Analyzing Processes** Why does oceanic crust sink beneath continental crust at convergent boundaries?

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