

Earth Dynamics

Landforms at Plate Boundaries

..... Before You Read

What do you think? Read the two statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you've read this lesson, reread the statements to see if you have changed your mind.

Before	Statement	After
	3. New landforms are created only at plate boundaries.	
	4. The tallest and deepest landforms are created at plate boundaries.	

Key Concepts

- What features form where two plates converge?
- What features form where two plates diverge?
- What features form where two plates slide past each other?

..... Read to Learn

Landforms Created by Plate Motion

Tectonic plates move slowly, only 1–9 cm per year. But these massive, slow-moving plates have so much force they can build tall mountains, form deep valleys, and rip Earth's surface apart. ✓

Compression, tension, and shear stresses are at work at plate boundaries. Each type of stress produces different types of landforms. For example, the San Andreas Fault on the west coast of the United States is the result of shear stresses where plates move past each other. Compression stresses where plates collide create tall mountains. The Ural Mountains in western Russia began forming 250 million years ago as landmasses began to collide.

Landforms Created by Compression

Compression at convergent plate boundaries produces the largest landforms on Earth. The types of landforms that form depend on whether the plates are oceanic or continental.

Mountain Ranges

A collision between two continental plates can produce tall mountains. But the mountains form slowly and in stages over millions of years. Three stages in the formation and growth of the Himalayas are shown on the next page.

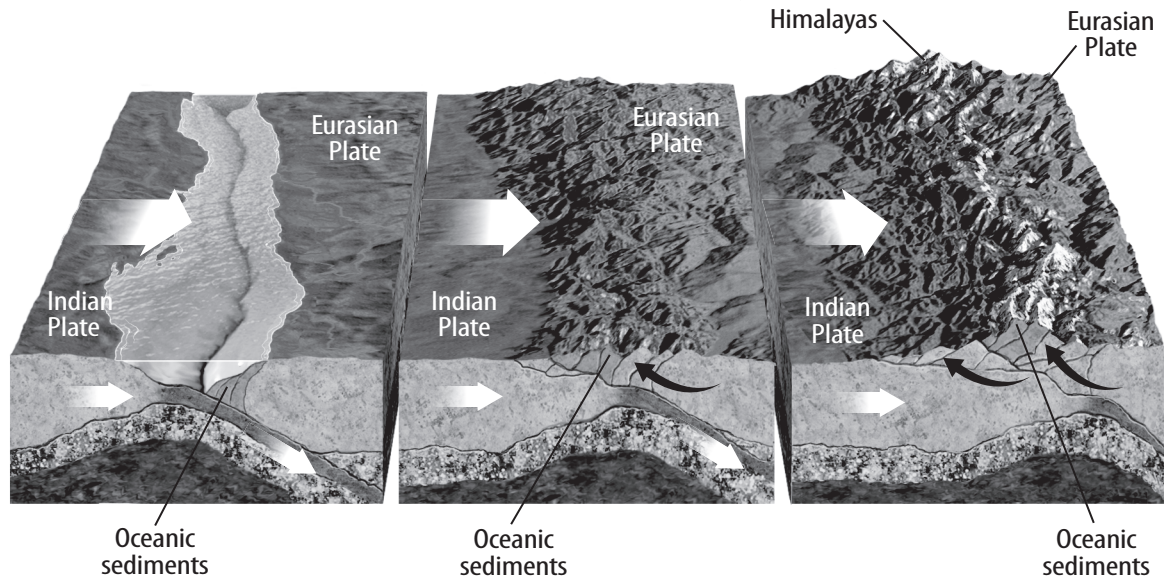
Study Coach

Make an Outline as you read to summarize the information in the lesson. Use the main headings in the lesson as the main headings in your outline. Use your outline to review the lesson.

Reading Check

1. State How fast do tectonic plates move?

Formation of the Himalayas



Visual Check

2. Name Which two landforms collided?

The figure above shows how the Himalayas formed. The plate beneath India and the plate beneath Asia started colliding almost 50 million years ago. They are still colliding today. Compression from the collision pushes the Himalayas a few millimeters higher each year. Although the plates move horizontally, the collision also causes the crust to move vertically.

Ocean Trenches

When two plates collide, one plate can go under the other and be forced into the mantle. This process is called subduction. As shown below, a deep trench forms where the two plates meet. **Ocean trenches** are deep, underwater troughs created by one plate subducting under another plate at a convergent plate boundary. Ocean trenches are the deepest places in the oceans.

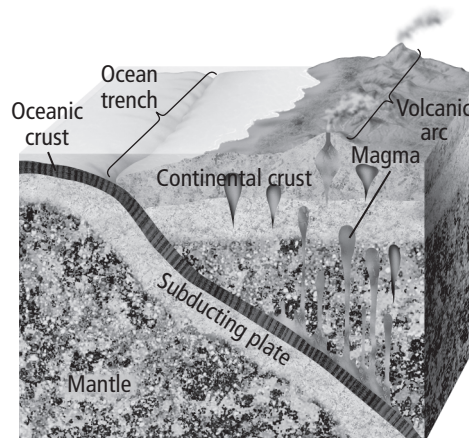
Key Concept Check

3. Identify What are two landforms that can form where two plates converge?

Visual Check

4. Illustrate Highlight the part of the crust that is subducting under another plate.

Ocean Trench



Volcanic Arcs

Volcanic mountains can form in the ocean where plates converge and one plate subducts under another plate. These volcanoes emerge as islands. *A curved line of volcanoes that forms parallel to a plate boundary is called a **volcanic arc**.* Most of the active volcanoes in the United States are part of the Aleutian volcanic arc in Alaska. About 40 active volcanoes are found there. They formed as a result of the Pacific Plate subducting under the North American Plate.

Volcanic arcs in the ocean are also called island arcs. But a volcanic arc can also form where an oceanic plate subducts under a continental plate. Because the continent is above sea level, the volcanoes will sit on top of the continent. ✓

Landforms Created by Tension

Tension stresses stretch Earth's crust where plates move apart. This tension produces distinct landforms.

Mid-Ocean Ridges

Tension stresses under the ocean can produce long mountain ranges more than 2 km tall. These ranges form under water at divergent boundaries as oceanic plates move away from each other. As tension stresses cause oceanic crust to spread apart, the less dense hot rock from the mantle rises. The hot mantle pushes the seafloor upward. In this way, long, high ridges form in Earth's oceans. A long, tall mountain range that forms where oceanic plates diverge is called a mid-ocean ridge.

Continental Rifts

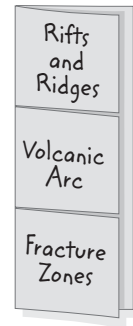
When divergent boundaries occur within a continent, they can form continental rifts. Continental rifts are enormous splits in Earth's crust. Tension stresses in the cold, upper part of the crust create faults. At these faults, large blocks of crust move downward, forming valleys between two ridges.

The East African Rift is an active continental rift that is beginning to split the African continent into two parts. Each year, the two parts move 3–6 mm farther from each other. One day, millions of years from now, the divergent boundary will have created two separate landmasses. Water will fill the space between them.

The valley at this rift also is subsiding. The warm, lower part of the crust acts like putty. As the crust stretches, it becomes thinner and subsides. ✓

FOLDABLES®

Make a three-tab book to describe how different features form at plate boundaries.



✓ Reading Check

5. Locate Where do volcanic arcs form?

✓ Key Concept Check

6. Identify What features form at divergent boundaries?

Landforms Created by Shear Stresses

Recall that as plates slide horizontally past each other, shear stresses produce transform boundaries. Landforms created by shear stresses are not as obvious as landforms created by tension or compression.

Transform Faults

Transform faults form where tectonic plates slide horizontally past each other. Some transform faults form perpendicular to mid-ocean ridges, as shown in the figure below.

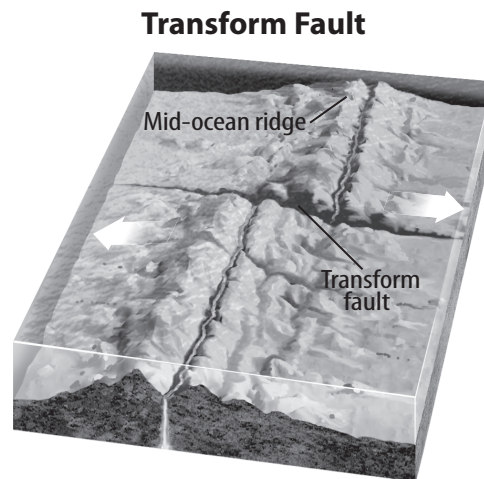
Although tension produces mid-ocean ridges at divergent boundaries, parts of the plates also slide past each other as they separate. Because of this sliding motion, transform faults can separate sections of mid-ocean ridges. The figure below shows transform faults along the Pacific Ridge. ✓

Key Concept Check

7. Identify What features form where plates slide past each other?

Visual Check

8. Illustrate Use a highlighter to point out that the transform fault is perpendicular to the mid-ocean ridge.



Fault Zones

Some transform faults can be seen at Earth's surface. However, below the surface there might be many other faults that are part of the same fault system. For example, the San Andreas Fault in California is visible in many places. But below the surface lies an extensive series of underground faults and fractures that are also part of the San Andreas Fault system. *An area of many fractured pieces of crust along a large fault is called a **fault zone**.* ✓

Reading Check

9. Apply Why is the San Andreas Fault considered a fault zone?

..... After You Read

Mini Glossary

fault zone: an area of many fractured pieces of crust along a large fault

ocean trench: deep, underwater trough created by one plate subducting under another plate at a convergent plate boundary

transform fault: a fault that forms where tectonic plates slide horizontally past each other

volcanic arc: a curved line of volcanoes that forms parallel to a plate boundary

1. Review the terms and their definitions in the Mini Glossary. Write a sentence that describes how a volcanic arc can form.

2. Place a checkmark in the correct column to identify the force that creates each landform.

Landform	Forces		
	Compression	Tension	Shear
Continental rift			
Ocean trench			
Volcanic arc			
Transform fault			
Mountain range			
Mid-ocean ridge			

3. Explain how the Himalayas formed.

What do you think **NOW?**

Reread the statements at the beginning of the lesson. Fill in the After column with an A if you agree with the statement or a D if you disagree. Did you change your mind?



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**END OF
LESSON**