

## Lesson 2

# Development of a Theory

## Key Concepts

- What is seafloor spreading?
- What evidence is used to support seafloor spreading?

## Lesson 2

# Development of a Theory

## Vocabulary

- mid-ocean ridge
- seafloor spreading
- normal polarity
- magnetic reversal
- reversed polarity



## Mapping the Ocean Floor

- During the late 1940s scientists were able to determine the depth of the ocean using a device called an echo sounder.
- Once ocean depths were determined, scientists used these data to create a topographic map of the sea floor that revealed vast mountain ranges, called **mid-ocean ridges**, that stretch for many miles deep below the ocean's surface.

# Seafloor Topography



# Seafloor Spreading

- By the 1960s, scientists discovered the process of seafloor spreading.
- **Seafloor spreading** is the process by which new oceanic crust forms along a mid-ocean ridge and older oceanic crust moves away from the ridge.
- When the seafloor spreads, the mantle below melts and forms magma.

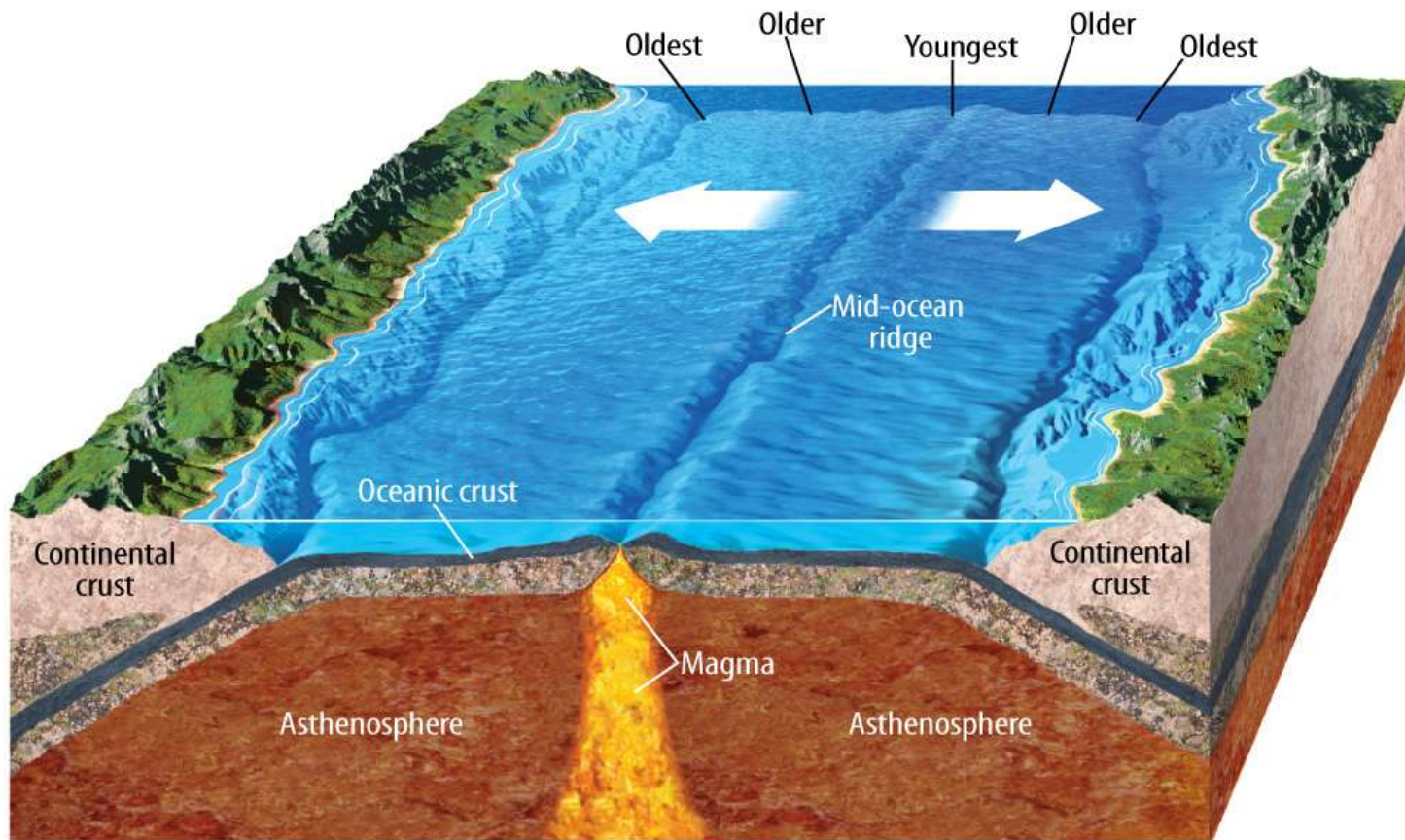


## Seafloor Spreading (cont.)

- Magma erupts on Earth's surface as lava, which cools and crystallizes on the seafloor, forming rock.
- Because the lava erupts into water, it cools rapidly and forms rounded structures called pillow lavas.
- As the seafloor continues to spread apart, the older oceanic crust moves away from the mid-ocean ridge.



# Seafloor Spreading (cont.)



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## Seafloor Spreading (cont.)

Scientists argued that if the seafloor spreads, the continents must also be moving.



### KEY CONCEPT CHECK

What is seafloor spreading?





## Seafloor Spreading (cont.)

- The rugged mountains that make up the mid-ocean ridge system can form in two different ways.
- Large amounts of lava can erupt from the center of the ridge, cool, and build up around the ridge.

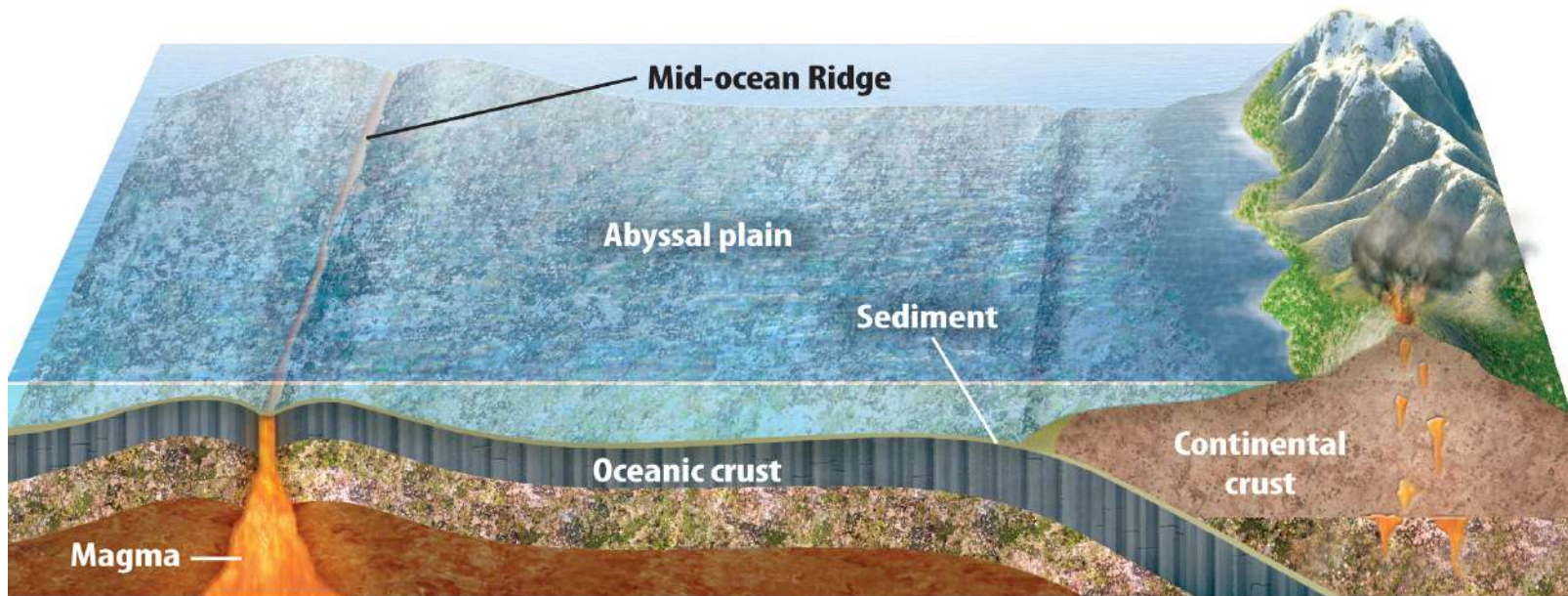


## Seafloor Spreading (cont.)

- Or, as the lava cools and forms new crust, it cracks and the rocks move up or down along these cracks in the seafloor, forming jagged mountain ranges.
- The abyssal plain, the smooth part of the seafloor, is made when the layer of sediment that accumulates far from the mid-ocean ridge becomes thick enough.



Continents move as the seafloor spreads along a mid-ocean ridge.



## Development of a Theory

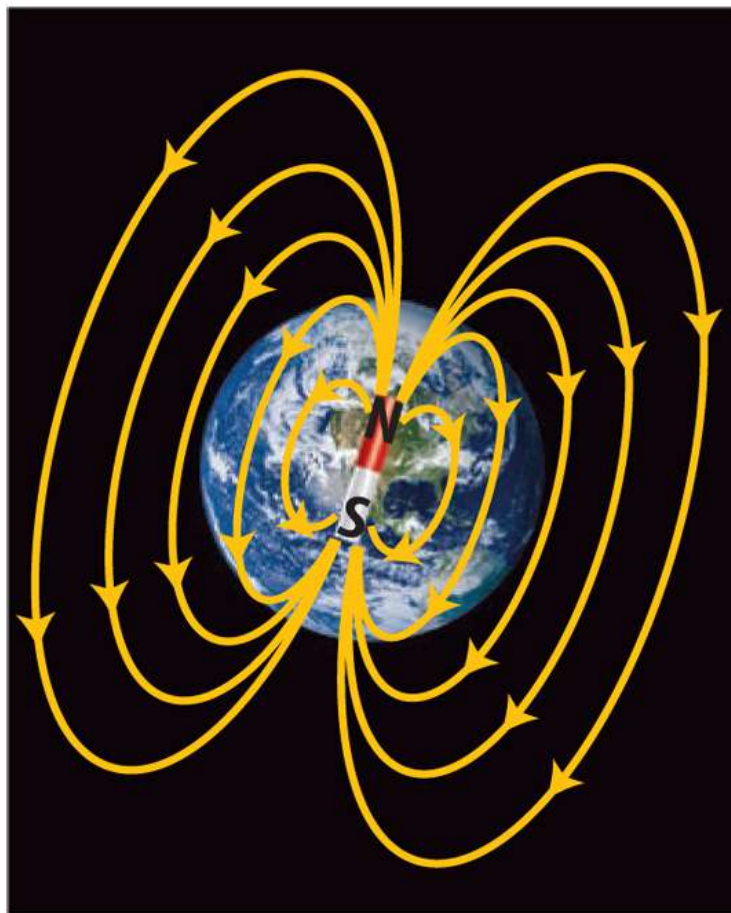
- The first evidence used to support seafloor spreading was discovered in rocks on the seafloor.
- Scientists studied the magnetic signature of minerals in these rocks.
- Earth's magnetic field today is described as having **normal polarity**—a state in which magnetized objects, such as compass needles, will orient themselves to point north.

## Development of a Theory (cont.)

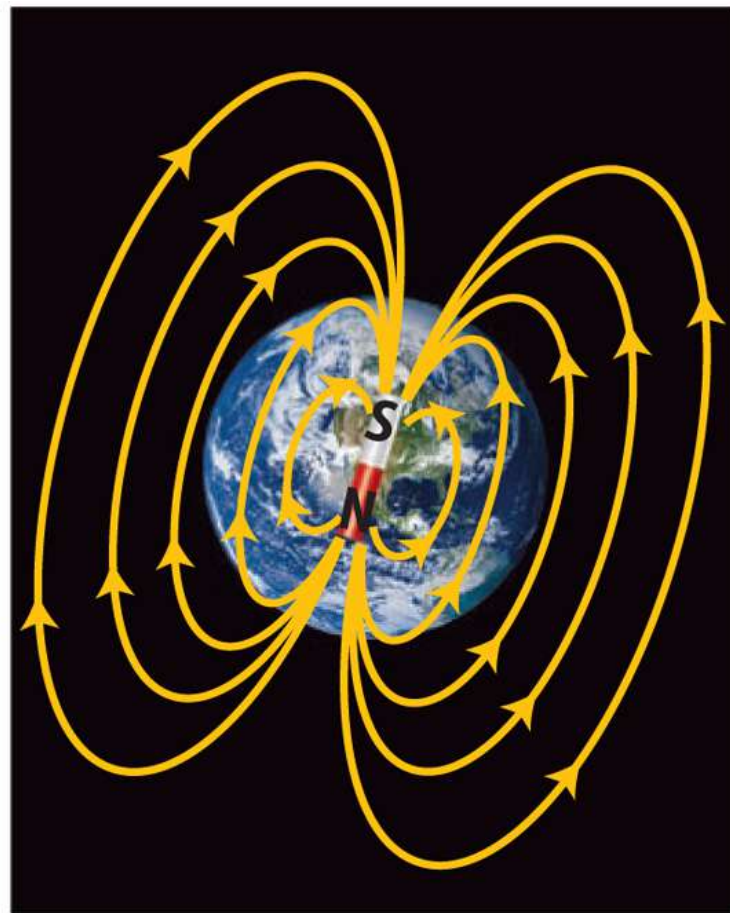
- Sometimes a **magnetic reversal** occurs and the magnetic field reverses direction.
- The opposite of normal polarity is **reversed polarity**: a state in which magnetized objects reverse direction and orient themselves to point south.







Reversed magnetic field



Normal magnetic field

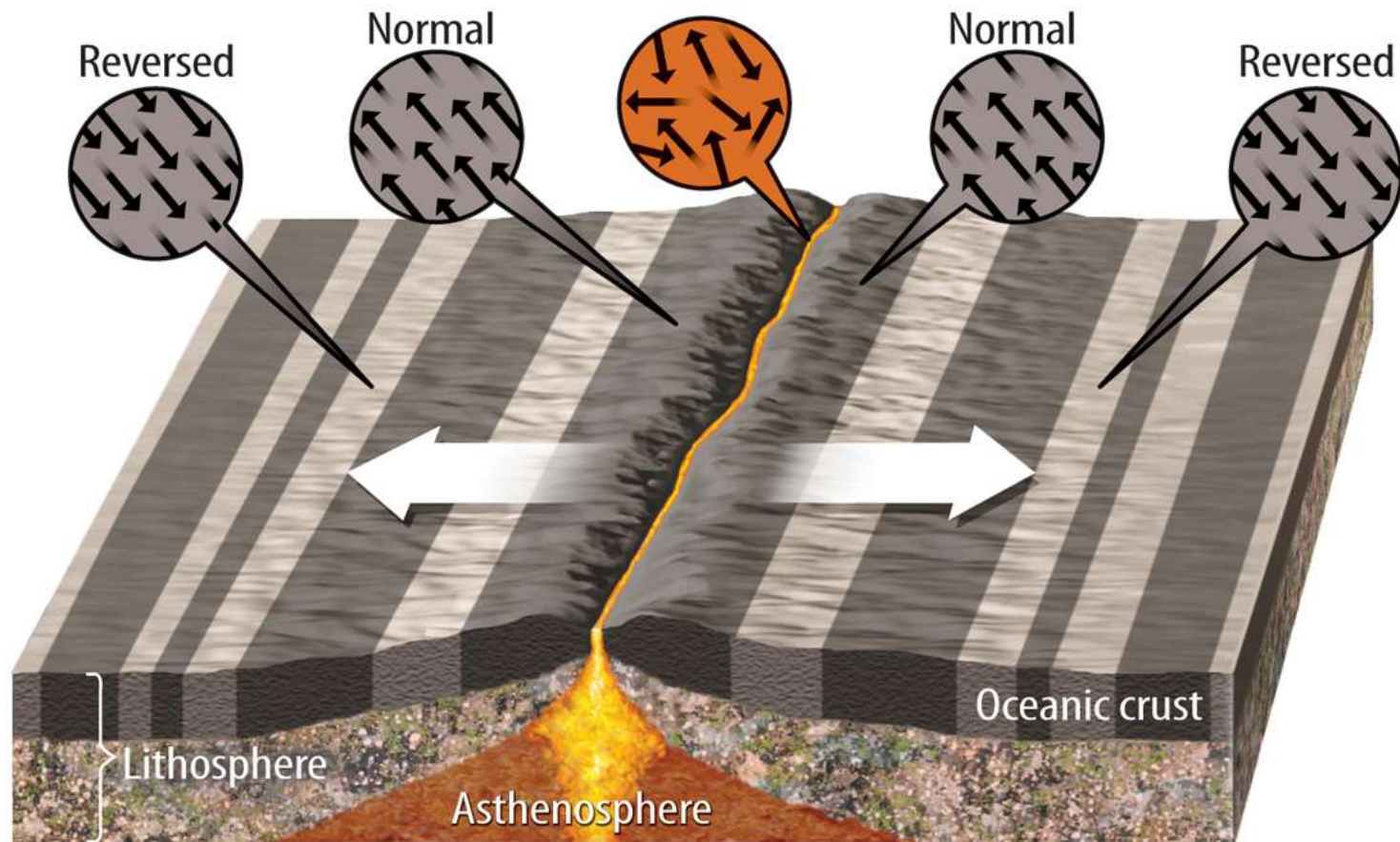


## Development of a Theory (cont.)

- Volcanic rock on the seafloor contains iron-rich minerals that are magnetic.
- Magnetic minerals in cooling lava from the mid-ocean ridge record the direction of Earth's magnetic field.
- Scientists have discovered parallel patterns in the magnetic signature of rocks on either side of a mid-ocean ridge.



Minerals in fresh lava record Earth's magnetic signature.



## Development of a Theory (cont.)

- Scientists studied magnetic minerals in rocks from the seafloor using a magnetometer to measure and record the magnetic signature.
- They discovered parallel magnetic stripes on either side of the mid-ocean ridge.



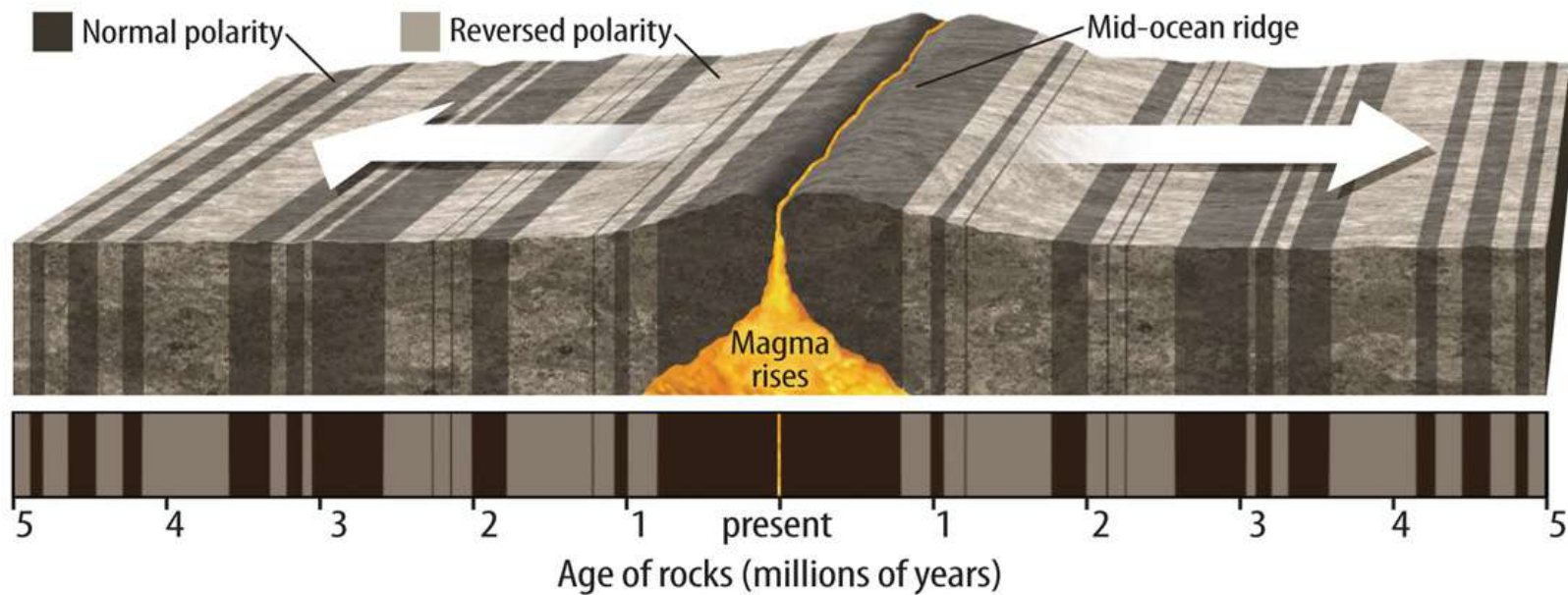
## Development of a Theory (cont.)

- Each pair of stripes has a similar composition, age, and magnetic character.
- The pairs of magnetic stripes confirm that the ocean crust formed at mid-ocean ridges is carried away from the center of the ridges in opposite directions.





# Seafloor Spreading Theory



## Development of a Theory (cont.)

- Other measurements made on the seafloor confirm seafloor spreading.
- Measuring the amount of thermal energy leaving the Earth shows that more thermal energy leaves Earth near mid-ocean ridges than is released from beneath the abyssal plains.



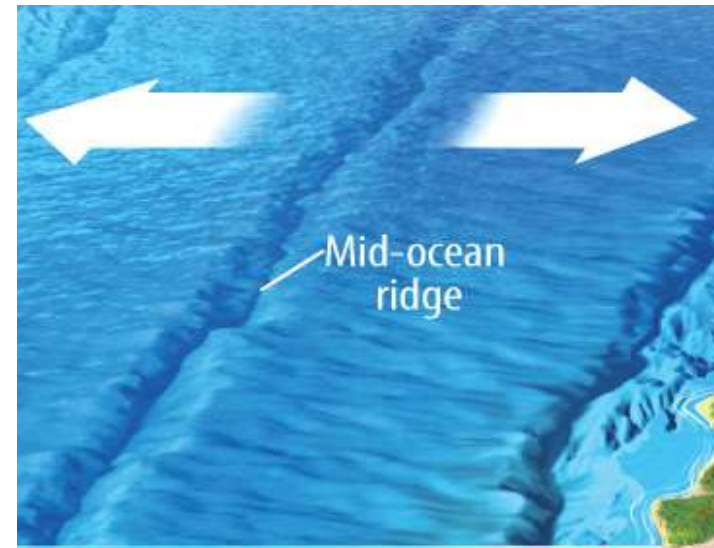
## Development of a Theory (cont.)

Sediment collected from the seafloor can be dated to show that the sediment closest to the mid-ocean ridge is younger than the sediment farther away from the ridge.



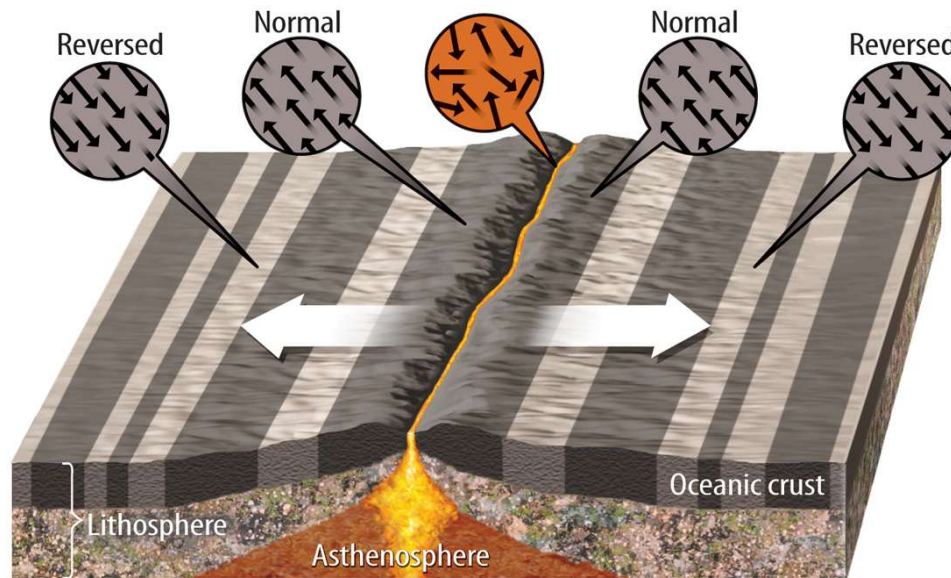
## Summary

- New ocean crust forms along mid-ocean ridges.
- Mid-ocean ridges are large mountain ranges that extend throughout Earth's oceans.



## Summary

- A magnetic reversal occurs when Earth's magnetic field changes direction.





## Lesson Review

**As the seafloor continues to spread apart, the older oceanic crust moves in which direction with respect to the mid-ocean ridge?**

- A.** toward it
- B.** above it
- C.** away from it
- D.** under it

## Lesson Review

Today's magnetic field is described as having which of these?

- A. reversed polarity
- B. normal polarity
- C. magnetic reversal
- D. no polarity



## Lesson Review

In which state do magnetized objects reverse themselves to point south?

- A.** reversed polarity
- B.** normal polarity
- C.** seafloor spreading
- D.** magnetic polarity

## Lesson Review

**What do you think** **NOW?**  
**Do you agree or disagree?**

3. The seafloor is flat.
4. Volcanic activity occurs only on the seafloor.

