

Evidence for Continental Drift

Textbook pages 506–517

Before You Read

Scientists did not accept the continental drift theory for a long time. Why do you think this was the case? Write your ideas in the lines below.



Mark the Text

In Your Own Words

After you read this section, explain the evidence for the continental drift theory in your own words.



Reading Check

Millions of years ago, all the continents were joined as a “supercontinent.” What was it called?

What is continental drift?

In the early 20th century, German scientist Alfred Wegener proposed the **continental drift theory**, which argues that the continents “drifted” to their present locations over millions of years. On a world map, the curves of South America’s eastern coastline and Africa’s western coastline seemed to match, giving Wegener his first piece of evidence for continental drift. The fit suggested that, millions of years ago, all the continents were joined as a “supercontinent” named Pangaea (from the Greek words *pan*, meaning all, and *gaea*, meaning Earth). Wegener also noted that regions of some continents that are far apart have similar rocks, mountain ranges, fossils, and patterns of **paleoglaciation** (evidence of ancient glaciers and the rock markings they left behind). ✓

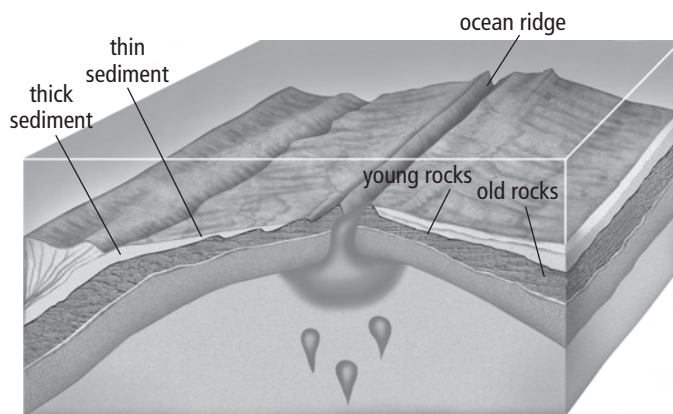
How do continents move?

After Wegener’s death, scientists discovered that the surface of Earth is broken into **tectonic plates**, large, movable slabs of rock that slide over a layer of partly molten rock. According to **plate tectonic theory**, when tectonic plates move across Earth’s surface, they carry the continents with them. Many volcanoes and earthquake zones on a map reveal the boundaries between the plates. Chains of volcanic islands, such as the Hawaiian Islands, reveal where tectonic plates have passed over geological **hot spots**—areas where molten rock has risen to Earth’s surface. This idea was first suggested by Canadian scientist J. Tuzo Wilson.

The process of **sea floor spreading**, first proposed by Harry Hess, provides a mechanism for continental drift. This process involves magma, molten rock from beneath Earth's surface. Because it is molten, magma is less dense than the surrounding rock. Thus, magma rises and breaks through Earth's crust in certain weak areas. One such place is a **spreading ridge**, a gap in the sea floor that is gradually widening as tectonic plates move apart. Magma cools and hardens as it intrudes into this gap, pushing older rock aside as it creates new sea floor. The largest of all spreading ridges, and the first one discovered, is the **Mid-Atlantic Ridge**, a mountain range running north to south down the length of the Atlantic Ocean. ✓

The evidence for sea floor spreading includes the following:

1. **Age of ocean rocks:** The youngest rocks are found closest to the ridge, indicating that new rock is being formed.
2. **Sediment thickness:** The layer of ocean sediment—the small particles of silt and organic debris deposited on the ocean floor—becomes thicker the farther it is from the ridge. This indicates that the sea floor is older and farther away from the ridge.



✓ **Reading Check**

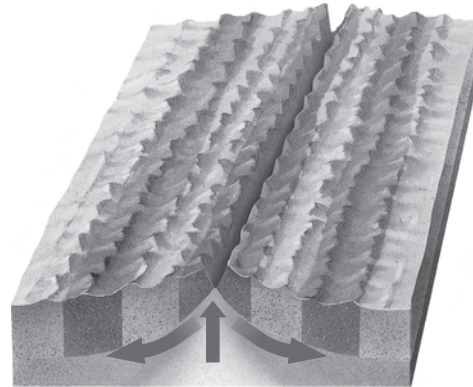
List one observation that provides evidence for sea floor spreading.

continued

3. **Magnetic striping:** At a spreading ridge, iron-containing minerals in the magma align themselves with Earth's magnetic field as the magma cools. Because the orientation of Earth's magnetic field has switched many times over history, rocks on the sea floor exhibit both normal polarity and reverse polarity, depending on when they cooled. When scientists used a magnetometer, a device that detects variations in magnetic fields, they found a pattern of alternating polarity repeated on both sides of the Mid-Atlantic Ridge, as shown below.

This phenomenon, known as **magnetic striping**, indicates that new rock is being laid down on the sea floor. ✓

- Normal magnetic polarity
- Reverse magnetic polarity



Name _____

Date _____

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Evidence for continental drift

Vocabulary

ancient glaciers	mountain ranges
fossils	Pangaea
geological structures	plate tectonic theory
hot spot	spreading ridge
magma	supercontinent
magnetic reversal	tectonic plates
Mid-Atlantic Ridge	

Use the terms in the vocabulary box to fill in the blanks. Each term may be used only once.

- Alfred Wegener proposed that, millions of years ago, all the continents were joined as a _____.
- The name given to this giant land mass is _____.
- Wegener compared _____, _____ and evidence of _____ on different continents.
- Since rocks found in Newfoundland are the same type and age as rocks found in Greenland, Ireland, Scotland, and Norway, it would appear that the world's major _____ were continuous when the continents were joined.
- The surface of the Earth is broken into large, rigid, movable _____ that move over a layer of partly molten rock.
- In the _____, scientists found that as distance increases from the centre of the ridge, the rocks are older and the ocean sediment is thicker.
- Using a magnetometer, scientists found a pattern of _____ in the iron-containing minerals on both sides of the Mid-Atlantic Ridge.
- Harry Hess suggested that _____ rises because it is less dense than the material that surrounds it.
- At a _____ the magma breaks through the Earth's surface, where it cools and hardens, forming a new sea floor.
- J. Tuzo Wilson suggested that chains of volcanic islands were formed when a tectonic plate passed over a stationary _____.
- The _____ is the unifying theory of geology.

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Theories related to continental drift

Various pieces of evidence have been gathered by scientists to explain the underlying theories of geology. Alfred Wegener, Harry Hess, and J. Tuzo Wilson are some of the scientists who proposed explanations of phenomena they had observed.

Fill in the following table comparing the main points of evidence presented by each theory.

<p>Continental drift Proposed by: _____ Main points:</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	<p>Paleomagnetism Main points:</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>
<p>Sea floor spreading Proposed by: _____ Main points:</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	<p>Plate tectonic theory Proposed by: _____ Main points:</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>

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Visual observations supporting continental drift

Illustrations can demonstrate some of the major points related to the concepts presented in this chapter.

Refer to the diagrams on the left, when answering the questions below.

1.

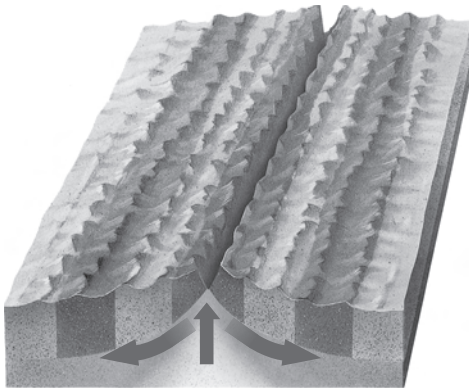


Pangaea

What evidence did Wegener use for his explanations of the existence of Pangaea?

2.

- Normal magnetic polarity
- Reverse magnetic polarity

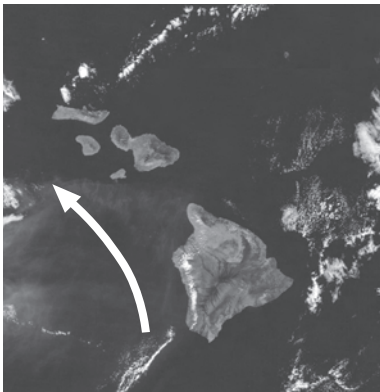


Orientation of Earth's Magnetic Field

(a) How were these magnetic patterns measured?

(b) What do these patterns show?

3.



Hawaiian Islands

How were the Hawaiian Islands formed?

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Evidence for continental drift

Match each Term with the best Descriptor below. Each Descriptor may be used only once.	
Term	Definition
1. _____ Continental drift theory	A. the large slabs of rock that form Earth's surface and, move over a layer of partly molten rock B. the theory that the lithosphere is broken up into large plates that move and then rejoin C. an opening in Earth's surface that, when active, spews out gases, chunks of rock, and melted rock D. an area where molten rock rises to Earth's surface E. a pattern of alternating stripes of different directions of magnetic polarity in rock on the sea floor F. a sudden, ground-shaking release of built-up energy at or under Earth's surface G. the theory that the continents have not always been in their present locations but have moved over millions of years H. the region where magma breaks through Earth's surface, continually forcing apart old rock and forming sea floor I. the extent of ancient glaciers; also the rock markings they left behind
2. _____ Earthquakes	
3. _____ hot spot	
4. _____ magnetic reversal	
5. _____ paleoglaciation	
6. _____ plate tectonic theory	
7. _____ spreading ridge	
8. _____ tectonic plates	
9. _____ volcanoes	

Multiple Choice

Circle the letter of the best answer.

10. When the term Pangaea is translated from Greek, it means
- zig-zag, continents
 - stationary, plates
 - all, Earth
 - moving, plates
11. Which of the following would be considered part of Wegener's continental drift theory?

I.	Discovery of continents previously being part of a supercontinent.
II.	Matching fossils found on many continents.
III.	Discovery of reversal theories related to Earth's magnetic field.

- I only
 - I and II only
 - I and III only
 - I, II, and III
12. A chain of volcanic islands, such as the Hawaiian Islands, were formed by which of the following processes?
- erosion
 - subduction
 - hot spots
 - ocean ridges
13. J. Tuzo Wilson used which of the following to explain the theory of continental drift?

I.	sea floor spreading
II.	paleomagnetism
III.	formation of Pangaea

- I and, II only
- I and, III only
- II and, III only
- I, II, and III