

## Chapter 2

### PLATE TECTONICS AND PHYSICAL HAZARDS

#### MULTIPLE-CHOICE QUESTIONS

1. What direction is the Pacific Plate currently moving, based on the chain of Hawaiian Islands with only the easternmost island active?
  - a. to the northeast
  - b. to the northwest
  - c. to the southeast
  - d. to the southwest
  - e. It is not moving; the chain of islands is not related to the active one.

ANSWER: b

2. Before people understood plate tectonics, what evidence led some scientists to believe in continental drift?
  - a. Rocks on the ocean floor are oldest in the center, becoming progressively younger toward each continent.
  - b. Rocks on the continents can be traced through the ocean floor to the other side.
  - c. Anthropologists have found human carvings in Africa that match those in Brazil.
  - d. Glaciers near the mouth of the Amazon River in Brazil carried distinctive rocks into South Africa, demonstrating that those countries were once connected.
  - e. Ages of bedrock formations match across the Atlantic Ocean.

ANSWER: e

3. Which of the following was NOT used as early evidence for continental drift?
  - a. ages of bedrock formations that match across the Atlantic Ocean
  - b. match of coastlines across the Atlantic Ocean
  - c. match of rock formations across the Atlantic Ocean
  - d. match of ages of continental rocks across the Atlantic Ocean
  - e. the fact that the magnetic pole shifts from north to south

ANSWER: e

4. Which of the following is true?
  - a. The mantle is denser than the lithosphere.
  - b. The lithosphere is denser than the mantle.
  - c. The asthenosphere is the more rigid equivalent of the mantle.
  - d. The asthenosphere is the more plastic part of the mantle.
  - e. The mantle is everywhere more rigid than the crust.

ANSWER: d

5. Which of the following is true?
- a. Oceanic rift zones are found only in the center of the oceans.
  - b. Rift zones are found only in the ocean basins.
  - c. Rift zones are areas where oceanic crust is formed.
  - d. Rift zones are the oldest parts of the oceanic crust.
  - e. Rift zones mark the boundaries between oceanic and continental crust.

ANSWER: c

6. Which of the following is NOT true?
- a. Subduction zones are areas where ocean floor descends into the mantle.
  - b. Subduction zone activity includes very large earthquakes.
  - c. Subduction zone activity leads to active volcanoes.
  - d. Subduction zones are areas where ocean floor rocks are formed.
  - e. Subduction zones are marked as the deepest parts of the oceans.

ANSWER: d

7. Which of the following is true?
- a. Transform faults show dominantly vertical movement.
  - b. Transform faults are only in the ocean basins.
  - c. Transform faults are areas of spreading and new crustal generation.
  - d. Transform faults change with time from horizontal to vertical motion.
  - e. Transform fault motion typically ends abruptly at both ends.

ANSWER: e

8. What does oceanic lithosphere consist of?
- a. basalt on top of peridotite
  - b. only basalt
  - c. only peridotite
  - d. basalt and peridotite in layers of variable thickness, in some places above, in others below
  - e. partly basalt and partly granite

ANSWER: a

9. Along which type of lithospheric plate boundaries are earthquakes common?
- a. only convergent (subduction zones)
  - b. only divergent (spreading zones)
  - c. only transform
  - d. only divergent and transform
  - e. convergent, divergent, and transform

ANSWER: e

10. Near which type of lithospheric plate boundary are andesite stratovolcanoes most common?
- a. rift zones on continents
  - b. collision zones between continental plates
  - c. subduction zones between oceanic and continental plates
  - d. subduction zones between two continents
  - e. transform fault boundaries between oceanic and continental plates

ANSWER: c

11. Why does oceanic lithosphere almost always sink beneath continental lithosphere at convergent plate boundaries?
- a. Oceanic lithosphere moves so slowly that it can only sink.
  - b. Oceanic lithosphere is at the bottom of the ocean, so it can't float high enough to ride over a continent.
  - c. Oceanic lithosphere is almost twice as dense as the underlying mantle.
  - d. Oceanic lithosphere is denser than continental lithosphere.
  - e. Oceanic lithosphere is partly liquid, so it floats on the solid continental lithosphere.

ANSWER: d

12. If the Atlantic Ocean floor is getting wider, why is the Earth not becoming larger?
- a. Actually, the Atlantic Ocean floor is not getting wider.
  - b. Old ocean floor sinks at subduction zones (trenches).
  - c. It is becoming denser, so it takes up no more space.
  - d. It becomes part of the edge of the adjacent continent.
  - e. It melts at oceanic transform faults.

ANSWER: b

13. Which of the following is true?
- a. Earth's crust is denser than the mantle.
  - b. Earth's crust is thicker than the mantle.
  - c. Earth's crust is part of the asthenosphere and equivalent to it in composition.
  - d. Earth's crust is part of the mantle and forms the upper part of it.
  - e. Earth's crust is less dense than the mantle.

ANSWER: e

14. Why do many oceanic volcanoes occur as long lines of volcanoes that are active at only one end?
- a. The lithosphere moves over a stable hotspot in the mantle.
  - b. The mantle convection cell under the crust carries the magma source from one end of the line of volcanoes to the other.
  - c. The mantle plume that feeds the volcano rotates around the Earth's core, tracing new volcanoes as it does.
  - d. The spreading lithosphere pushes the underlying magma source across the ocean floor.
  - e. The active volcanoes are gradually moving away from the oceanic ridge.

ANSWER: a

15. The San Andreas Fault is:
- a. a normal fault.
  - b. the subduction zone bordering the Pacific Plate.
  - c. a rift zone running the length of California.
  - d. a reverse fault.
  - e. a transform fault.

ANSWER: e

16. Along which type(s) of lithospheric plate boundary are basalt-flow eruptions abundant?
- a. oceanic rift zones
  - b. continental rift zones
  - c. continental collision zones
  - d. transform faults
  - e. mantle plumes

ANSWER: a

17. What is a transform fault characterized by?
- a. lithospheric plates sliding past each other
  - b. the movement of one plate over another
  - c. the movement of plates away from each other
  - d. the movement of one plate down against another
  - e. earthquakes but no plate movement

ANSWER: a

18. The magnetic stripes of the seafloor are considered evidence of seafloor spreading and:
- subduction in the rift valleys.
  - spreading centers in the trenches.
  - changes in the Earth's axis of rotation.
  - periodic reversals in the polarity of Earth's magnetic field.
  - periodic collapses of Earth's gravitational field.

ANSWER: d

19. How does rhyolite magma form in the line of arc volcanoes like the Cascades?
- Rhyolite is not found in the Cascades volcanoes.
  - Basalt magma rising from above the subducted slab rises to melt continental crust to form the rhyolite.
  - The subducted slab gets hot enough at depth that it melts to form rhyolite.
  - Friction at the top of the subducted slab heats the mantle to form rhyolite.
  - Water rising from the subducted slab causes melting of the Earth's mantle to form rhyolite.

ANSWER: b

20. Why do the Hawaiian Islands form a chain of volcanoes?
- The mantle below flows slowly to the east, creating new volcanoes as it goes.
  - The Hawaiian Islands are not part of a chain. They are over a stationary hotspot in the lithosphere.
  - The crack in the lithosphere is progressively splitting eastward, permitting magma to rise along a line.
  - The top of the basalt plume in the deep mantle is dragged eastward by moving lithosphere.
  - The lithosphere carrying Hawaii slowly moves over a hotspot feeding basalt magma to the overlying volcano.

ANSWER: e

### SHORT ANSWER QUESTIONS

1. Distinguish between Earth's crust and mantle.

ANSWER: Crust overlies mantle. It is basalt composition under the ocean basins and granitic composition in the continents.

2. Do tectonic plates consist of crust, mantle, or some combination of crust and mantle, and if so, what part or parts of each?

ANSWER: All of the crust and part of the upper mantle.

3. What keeps the Appalachians standing as a mountain range even though they have been continuously eroding since they formed hundreds of millions of years ago?

ANSWER: Isostasy. As material is eroded off the range, it floats higher, just as removing ice from the top of an iceberg causes it to float higher.

4. Why do many oceanic volcanoes occur as long lines of volcanoes that are active at only one end? How does the process work?

ANSWER: They are hotspot volcanoes. A hot plume of magma rising through the mantle burns through the overlying lithosphere to erupt as a volcano. Since the lithosphere moves over the deeper mantle, new volcanoes form progressively in a line over the deep plume.

5. Distinguish between Earth's lithosphere and asthenosphere in terms of both location and properties.

ANSWER: The lithosphere overlies the asthenosphere. It is rigid, and the asthenosphere deforms plastically.

6. Along which type(s) of lithospheric plate boundary are basalt-flow eruptions abundant? Provide a real example (name or location).

ANSWER: Spreading (Iceland/oceanic ridge).

7. In what tectonic environment that is not at a plate boundary are major volcanoes found? Identify one of these in an ocean basin and one on a continent.

ANSWER: Hotspots or mantle plumes, Hawaii (in ocean basin) and Yellowstone (on a continent).

8. List the three main tectonic environments for large earthquakes in western North America and name a specific example of each.

|         |                                    |                                         |
|---------|------------------------------------|-----------------------------------------|
| ANSWER: | <b><u>Tectonic environment</u></b> | <b><u>Name or specific location</u></b> |
|         | Subduction zone                    | Pacific Coast trench (Cascadia trench)  |
|         | Spreading zone                     | Basin and Range                         |
|         | Transform fault                    | San Andreas Fault                       |

9. What was the primary reason why Alfred Wegener's theory of continental drift was rejected?

ANSWER: He had no mechanism for moving continental crust through strong basaltic oceanic crust.

10. In the line of arc volcanoes, like the Cascades of Washington and Oregon, over an active subduction zone, a series of events leads to the magmas that erupt at the surface. What magma forms first, and where and how does it form?

ANSWER: Basalt magma forms at (just above) the subduction zone below the volcano, when water forming by dehydration of hydrous minerals in the descending slab causes melting of the mantle peridotite above.

## CRITICAL THINKING ESSAY QUESTIONS

1. Discuss the evidence that proves that continental drift exists.

ANSWER: Similar fossil life forms, ancient rocks, and mountain ranges across the Atlantic Ocean, grooves from glaciers that match up across Antarctica, India, eastern South America, and Australia, and magnetic reversals.

2. How did scientists use the scientific method to support Wegener's hypothesis of continental drift?

ANSWER: They used data and analysis of that data to prove the hypothesis.

3. Why do volcanoes occur near some plate boundaries but not near others?

ANSWER: Different processes occurring at different types of boundaries cause volcanoes. Volcanoes occur along divergent boundaries such as rift zones as basaltic magma rises to the surface. They also occur along convergent boundaries such as subduction zones as oceanic crust subducts, becomes molten, rises through the crust, and creates stratovolcanoes.

4. Discuss the three types of plate boundaries included in this chapter and provide examples of each.

ANSWER: Convergent (Himalayas), divergent (Mid-Atlantic Ridge), and transform (San Andreas Fault).

5. Explain why people living near the San Andreas Fault are at a huge risk of experiencing a natural disaster.

ANSWER: The San Andreas Fault is a transform fault, so it has a high potential to create large numbers of earthquakes. In the past, earthquakes in the San Francisco area have caused many casualties and a lot of property damage. Today, given the increasing population in this area, an earthquake would be even more disastrous and damaging than past ones.