

Chapter 2 – Volcanoes

Practice Exam and Study Guide

Plate tectonic setting is the principal control on where volcanoes form. For example, they are common along convergent and divergent margins, and occur in intraplate hotspot settings. Along convergent margins they develop primarily as stratovolcanoes that lie within island or volcanic arcs while in intraplate hotspot settings like Hawaii they develop as large shield volcanoes. Though undersea volcanoes are common along divergent margins, they do not appear to have much effect on the sea or land surface, and, as a result, they are not considered in Perilous Earth. In this section, you should focus on understanding the settings for shield and stratovolcanoes.

1. The leading edge occurs on which side of a large lithospheric plate?
2. The trailing edge occurs on which side of a large lithospheric plate?
3. What is an island arc?
4. How do intra-oceanic island arcs differ from continental-margin island arcs?
5. Are there portions of an island arc located in California? If so, then where?
6. What are the three prominent types of volcanoes?
7. Stratovolcanoes are composed of mixed layers of _____ and _____ material.
8. How would you describe the composition of most stratovolcanoes?
9. Shield volcanoes are built up primarily from highly fluid, low viscosity _____ lava.
10. Where would you find a classic example of a shield volcano?
11. Of the three prominent types of volcanoes, which is the smallest?

12. What types of volcanoes are common in island arc settings?
13. What is the average dip of subducting plates?
14. The trench is a deep bathymetric furrow marking the location where one plate descends or subducts beneath another. If the dip of the subducting plate is less than 45° , then what happens to the distance between the locus of volcanic arc activity in the island arc and the trench?
15. If the dip of the subducting plate is greater than 45° , then what happens to the distance between the locus of volcanic activity and the trench?
16. If water and other types of volatiles are introduced to the lower lithospheric mantle, then what happens?
17. What is the Mohorovicic discontinuity?
18. Geologists describe the accumulation of magma at the Moho as (pick all that apply)
 - a. Accumulations
 - b. Gathering
 - c. Ponding
 - d. Underplating
 - e. Streaming
19. After leaving the Moho magma may eventually accumulate in a large chamber lying beneath a volcano. What is the chamber called?
20. Hotspots are known to occur in
 - a. Convergent margins
 - b. Big cities like New York
 - c. Intraplate settings
 - d. Subduction zones
 - e. Where abundant oil wells have been drilled
21. Relatively well known hotspots are located in (pick all that apply)
 - a. California
 - b. Texas
 - c. Yellowstone
 - d. Hawaii
 - e. New York City

22. Where hot spots exist hot plumes of mantle rock rise without significant loss of heat to areas of lower confining pressure. What would happen to the head of the plume if it rises to just a few kilometers beneath the sea bed or land surface?
23. Rifts are _____ basins produced by the stretching or pulling apart of the crust.
24. From the following list, select the plates and microplates that make up the East African Rift System.
- Indian-Australian plate
 - African plate
 - Arabian microplate
 - Eurasian plate
 - Somalian microplate
25. Is the East Africa Rift System considered to be an old or a young rift?
26. Pick from the following list all of the processes associated with volcanism in the East African Rift System.
- Magma effuses out of fissures to form flood basalts
 - Magma effuses out of a central vent to form large shield volcanoes
 - Magma explosively erupts to form large stratovolcanoes
 - Magma effuses out of a mid-ocean ridge forming pillow lava
 - Magma cools beneath the Earth's surface to form a pluton
27. What will eventually happen to the East African Rift System?

In the next section focus on understanding what happens to magma in a sub-volcanic magma chamber, and remember that the major factor that determines if a volcano will erupt explosively or not is the viscosity of the erupting magma.

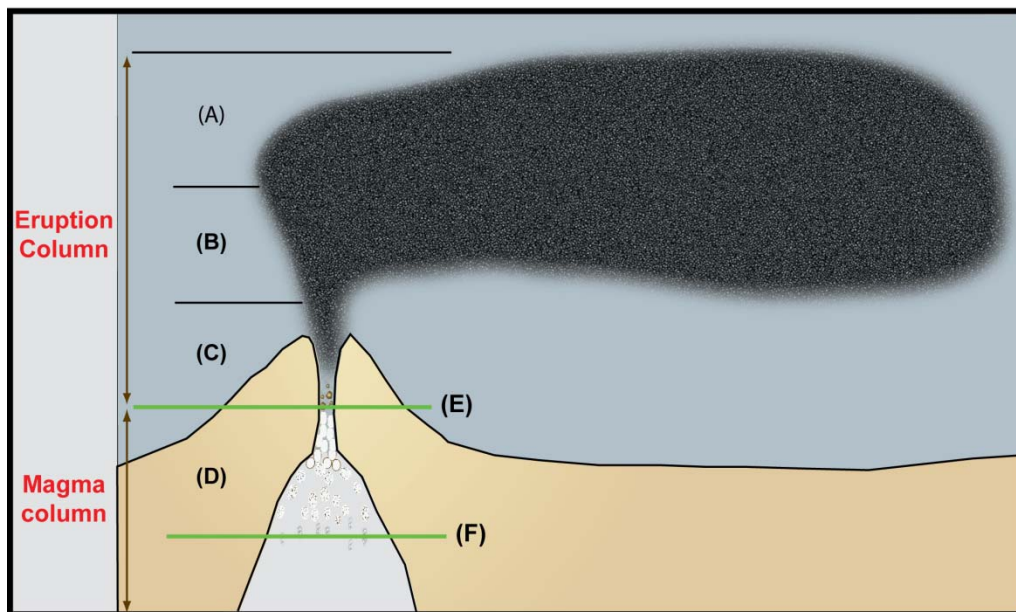
28. Viscosity is the internal resistance to _____ when a shear stress is applied.
29. What happens to the viscosity as magma cools?
30. The proportion of SiO₂ in magma exerts a major control on its viscosity. For example, silicic magma is more viscous than mafic magma. Are rhyolitic magmas more or less viscous than basaltic ones? How about rhyolitic as compared to andesitic magma?
31. Another important control over viscosity is the amount of dissolved water in the magma. Given magma of a certain composition, if you split it into two parcels and dissolve water in one parcel but not in the other, which parcel will be less viscous?

32. Confining pressure controls to a large degree if water and other volatiles (e.g., CO_2) can be dissolved in magma, i.e., whether or not it is soluble or insoluble. What is confining pressure? Does it increase or decrease with depth within the crust?
33. What does the term solubility refer to?
34. Does the solubility of the volatile phase increase or decrease with depth in the crust?
35. What is meant by the phrase “*the volatile phase, i.e., primarily H_2O and CO_2 exsolved*”?
36. The *vapor pressure* is the pressure produced by the volatile phase separating from the magma at a given temperature under equilibrium conditions. Under such conditions the rate at which the volatile phase separates from the magma is _____ the rate at which it is dissolves back into it.
37. Exsolution of the volatile phase will occur when the _____ equals the _____.
38. If the exsolution of the volatile phase is a result of lowered confining pressure then it is called
- Crystallization
 - Vaporization
 - First boiling
 - Second boiling
 - None of the above
39. When anhydrous minerals crystallize from a magma, they leave the remaining liquid richer in volatiles. This result in turn increases the vapor pressure, and if it rises to that of the confining pressure, then exsolution of the volatile phase can occur. If the exsolution of the volatile phase is brought on by the crystallization of anhydrous minerals like olivine, pyroxene, or the feldspars, then it is called
- Crystallization
 - Vaporization
 - First boiling
 - Second boiling
 - None of the above

40. The general process of exsolution of volatiles from a magma is called
- Crystallization
 - Vaporization
 - Air blowing
 - Vesiculation
 - None of the above
41. If magma is degassed without an explosive eruption then it will effuse from the volcano as lava. Pick from the following list where this process commonly occurs.
- Yellowstone
 - Mount Shasta
 - Kilauea, Hawaii
 - Mount Rainier
 - Mount St. Helens

You should now be ready to tackle the nuisances of an explosive volcanic eruption. As you work through the section that follows, keep in mind that vesiculation must occur for a volcano to erupt explosively. However, the viscosities of intermediate to silicic magmas generally prevent the exsolving volatile phase from migrating through them, and hence they have a greater likely hood of erupting explosively than does a mafic magma where exsolving gases move through the liquid phase more easily.

42. In the following illustration of an explosively erupting volcano what are the names of the regions and surfaces labeled (A) through (F)?



43. The fragmentation surface forms when the volume of bubbles is about what percentage of the total volume of the magma column?
- 80%
 - 75%
 - 70%
 - 65%
 - 50%
44. The point source from which all material blasted out of the volcano is derived separates the exsolving magma below from the eruptive column above. What is the name of this surface?
45. What is the eruption column?
46. Tephra, and gases driven from the vent into the atmosphere through expansion make up the
- Umbrella region
 - Convective thrust region
 - Eruption column
 - Gas thrust region
 - Magma column
47. In the region where pyroclastic materials fall out of the eruption column, the remaining mixture of tephra and gases becomes less dense than the surrounding atmosphere, and, as a result, it is driven upward by convection. This region is called the
- Umbrella region
 - Convective thrust region
 - Eruption column
 - Gas thrust region
 - Magma column
48. This region is strongly influenced by the prevailing wind direction and occurs at the top of the eruption column. This region is the
- Umbrella region
 - Convective thrust region
 - Eruption column
 - Gas thrust region
 - Magma column
49. Tephra that is pulled by gravity out of the eruption column commonly blankets the landscape. Such deposits are called
- Nuees ardentes
 - Flows
 - Pyroclastic flows
 - Ash-fall deposits
 - Rain

50. If an air-fall deposit is consolidated to form a rock, then it is classified on the basis of the dominant size of tephra contained in the deposit. If the tephra is dominantly ash, then what is the rock called? What if it is composed predominantly of lapilli sized tephra?
51. Mixtures of hot gas, tephra, and rock fragments that form as the eruption column collapses or as a directed lateral blast are called _____. They also are sometimes referred to as _____.
52. The Volcanic Explosivity Index (VEI) is used to classify eruptions into 8 different varieties. Which of the following are used to determine the VEI.
- Volume of material erupted
 - Height of the eruption column
 - Duration of eruption
 - Number of deaths associated with the eruption
 - Number of buildings, roads, and other structures destroyed during the eruption
53. The scale of the VEI is
- Exponential
 - Geometrical
 - Logarithmic
 - Additive
 - Holistic
54. The VEI for an Hawaii type eruption is (pick all that might apply)
- 0
 - 1
 - 2
 - 3
 - 4
 - 5
 - 6
 - 7
 - 8

55. The VEI for a Strombolian type eruption is (pick all that might apply)

- a. 0
- b. 1
- c. 2
- d. 3
- e. 4
- f. 5
- g. 6
- h. 7
- i. 8

56. The VEI for a Volcanian type eruption is (pick all that might apply)

- a. 0
- b. 1
- c. 2
- d. 3
- e. 4
- f. 5
- g. 6
- h. 7
- i. 8

57. The VEI for a Plinian type eruption is (pick all that might apply)

- a. 0
- b. 1
- c. 2
- d. 3
- e. 4
- f. 5
- g. 6
- h. 7
- i. 8

58. The VEI for an Ultraplinian type eruption is (pick all that might apply)

- a. 0
- b. 1
- c. 2
- d. 3
- e. 4
- f. 5
- g. 6
- h. 7
- i. 8

59. Hawaiian type eruptions typically involve highly _____ low _____ basaltic lava.

60. In what types of eruptions would you expect to see lava fountaining?

61. In what type of eruption would you expect to hear intermittent explosions sometimes called burps.

62. Which of the following types of eruptions typically involve andesitic to dacitic magma and result in explosive eruptions with columns reaching 5 to 10 kilometers in height?

- a. Hawaiian
- b. Strombolian
- c. Volcanian
- d. Plinian
- e. Ultraplinian

63. Which of the following types of eruptions are characterized by large explosive events that form dark eruption columns of tephra and gas that extend into the stratosphere and can last from hours to days? They commonly form from volatile-rich dacitic to rhyolitic magma, and involve the wide spread dispersal of tephra, and pyroclastic flows or nuees ardentes.

- a. Hawaiian
- b. Strombolian
- c. Volcanian
- d. Plinian
- e. Ultraplinian

64. Which of the following produces an eruption column that reaches 45 kilometers or more into the atmosphere?
- Hawaiian
 - Strombolian
 - Volcanian
 - Plinian
 - Ultraplinian

Answers

- The converging side
- The diverging side
- They are long linear chains of volcanoes lying along the leading edge of lithospheric plates
- Intra-oceanic island arcs develop on the leading edges of oceanic lithosphere while continental-margin island arcs develop on the leading edges of continental lithosphere
- Yes, northernmost California forms part of a continental-margin island arc system. Mount Shasta is an example of a stratovolcano within that island arc system.
- Strato (or composite), shield, and cinder cone
- lava, pyroclastic
- Stratovolcanoes are composed mostly of intermediate (andesitic) composition lava and pyroclastic layers though flows and pyroclastic layers of mafic (basaltic) to rhyolitic (silicic) composition also occur.
- Basaltic
- Hawaii
- Cinder cones
- Stratovolcanoes. A synonymous term is composite volcano.
- 45 degrees
- It will lengthen
- It will shorten
- It melts
- The boundary between the mantle and the crust
- c. Ponding and d. Underplating
- Subvolcanic magma chamber
- c. Intraplate settings
- c. Yellowstone and d. Hawaii
- It would melt
- Elongate
- b. African plate, c. Arabian microplate, and e. Somalian microplate
- young
- a. Magma effuses out of fissures to form flood basalts, b. Magma effuses out of a central vent to form large shield volcanoes, and c. Magma explosively erupts to form large stratovolcanoes

27. Eventually, the land of the East African Rift System will subside beneath the Indian Ocean, and will be replaced by a mid-ocean ridge.
28. Flow
29. It increases
30. Rhyolitic magma is more viscous than both basaltic and andesitic magma
31. The hydrated parcel
32. Confining pressure is the pressure produced by the weight of the overlying column of rock. It will increase with depth.
33. The ability of a material to dissolve into a solution
34. It increases with depth, i.e., confining pressure
35. This phrase means that the volatiles came out of solution as an independent separable component. In other words they did not remain dissolved in the solution.
36. Equal to
37. Vapor phase, confining pressure
38. c. First boiling
39. d. Second boiling
40. d. vesiculation
41. c. Kilauea, Hawaii
42. (A) Umbrella region, (B) Convective thrust region, (C) Gas thrust region, (D) Vesiculation region, (E) Fragmentation surface, (F) Exsolution surface
43. b. 75%
44. fragmentation surface
45. The cloud of tephra, gas, and rock fragments blasted out of a volcano
46. d. Gas thrust region
47. b. Convective thrust region
48. a. Umbrella region
49. d. Ash-fall deposits
50. Ash-fall tuff. Ash-fall lapillistone.
51. Pyroclastic flow / nuees ardentes
52. a. Volume of erupted material, b. Height of the eruption column, and c. Duration of eruption
53. c. Logarithmic
54. a. 0
55. b. 1 and c. 2
56. c. 2, d. 3, and e. 4
57. d. 3, e. 4, f. 5, and g. 6
58. g. 6, h. 7, and i. 8
59. fluid, viscosity
60. Hawaiian and strombolian
61. Strombolian
62. c. Volcanian
63. d. Plinian

64. e. Ultraplina