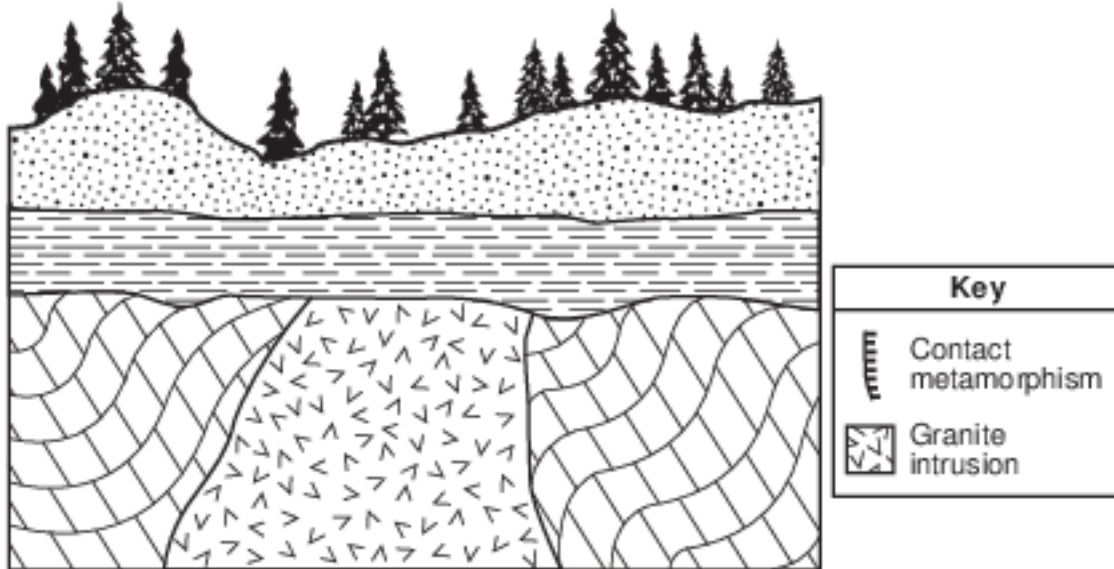


## Rock Cycle

1 The cross section below represents four different rock units. The symbol for contact metamorphism has been omitted from the cross section.

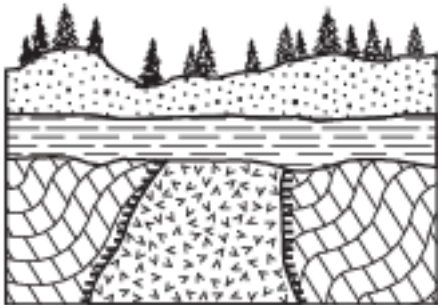


The sequence below represents the relative ages of the rock units from oldest to youngest.

limestone → granite → shale → sandstone

Which cross section below represents where the symbol for contact metamorphism would be located, based on the relative age sequence?

(1)



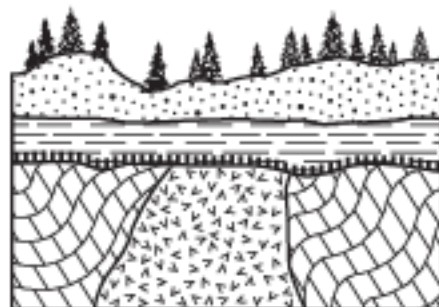
(3)



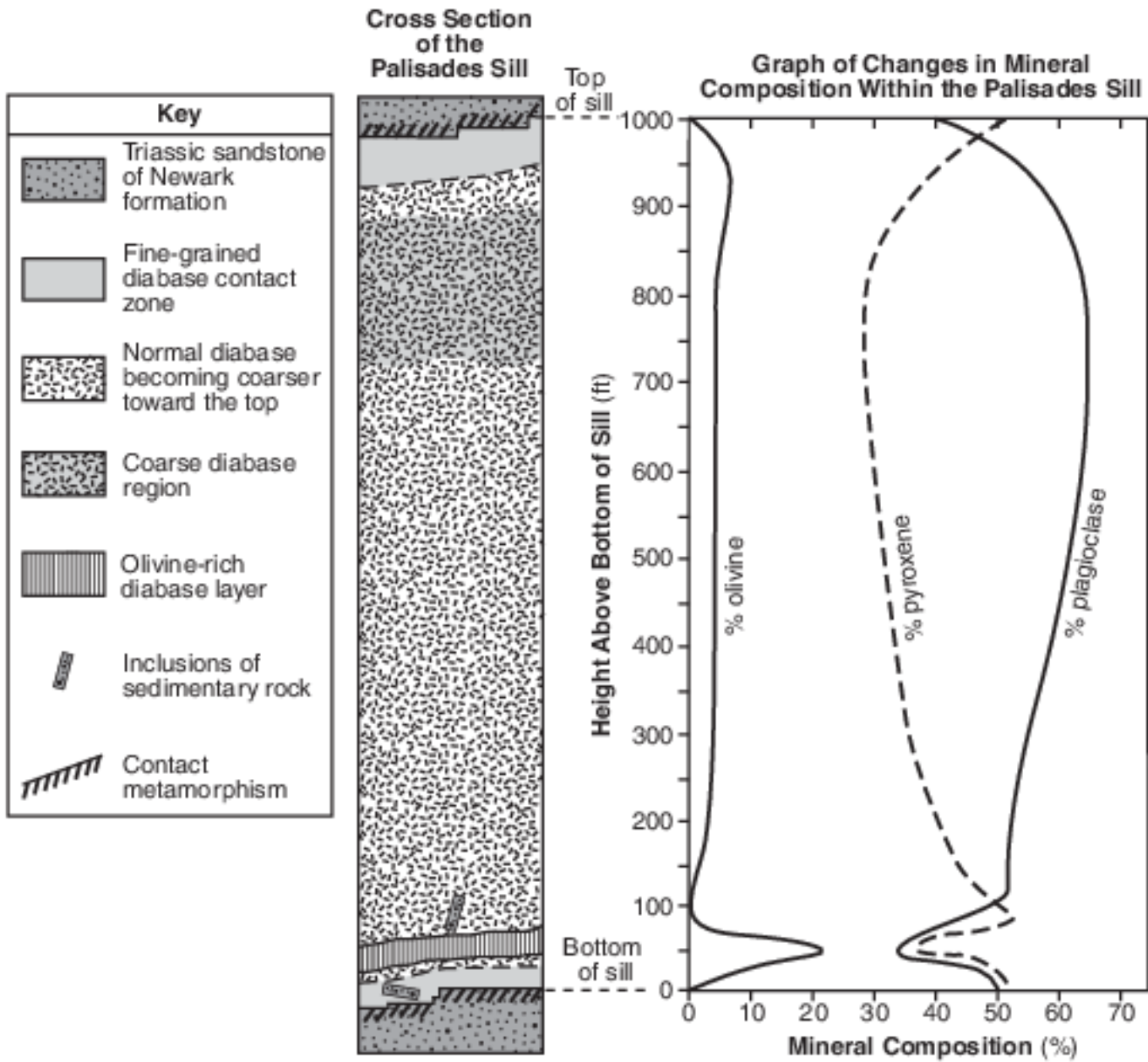
(2)



(4)



Base your answers to questions 2 on the geologic cross section and graph below, and on your knowledge of Earth science. The cross section represents the intrusive igneous rock of the Palisades sill and surrounding bedrock located on the west side of the Hudson River across from New York City. The graph indicates changes in the percentages of the major minerals found in the sill.

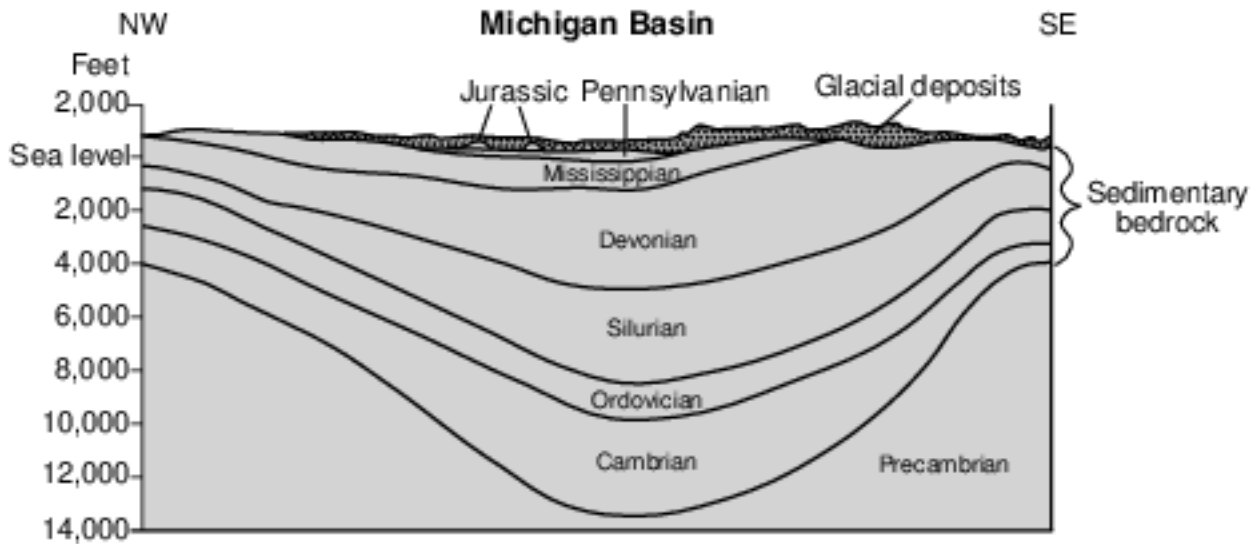


- 2 The inclusions shown near the bottom of the Palisades sill are pieces of the Triassic sandstone that
- (1) formed from deposits of minerals within the sill
  - (2) crystallized within the sill and were cemented together
  - (3) were part of the olivine-rich layer that broke apart
  - (4) broke off from the surrounding bedrock during the intrusion

3 What is the color and type of rock that forms oceanic crust at mid-ocean ridges?

- (1) light colored and igneous
- (2) light colored and sedimentary
- (3) dark colored and igneous
- (4) dark colored and sedimentary

4 The cross section below indicates the geologic ages of the bedrock beneath the state of Michigan. These rocks formed from sediments deposited in an ancient depositional basin. This region is called the Michigan Basin. Glacial deposits cover most of the surface.

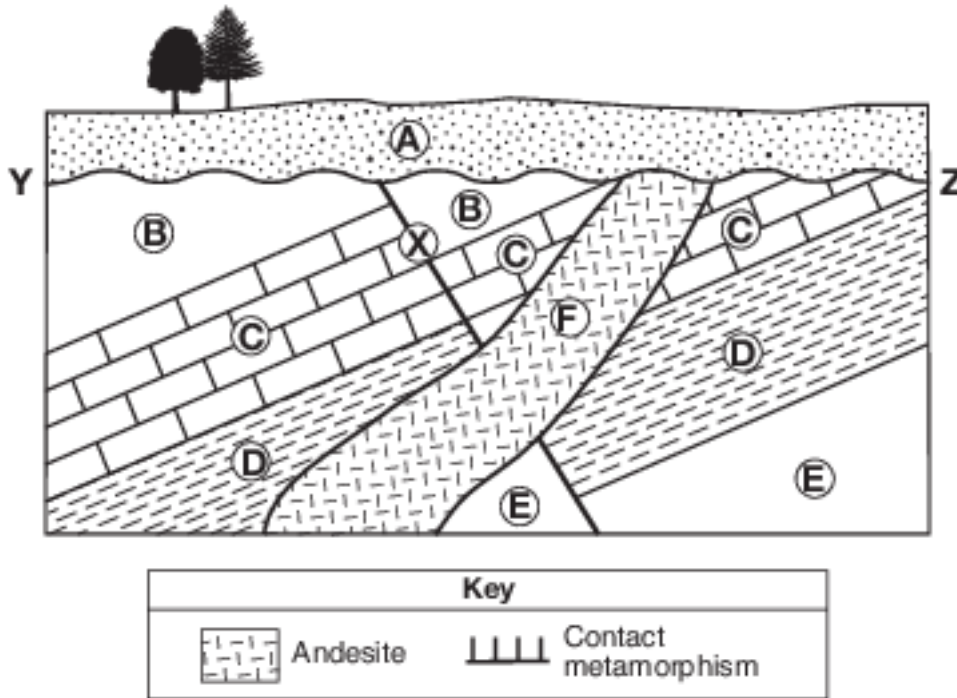


Which process most likely caused the formation of the Michigan Basin?

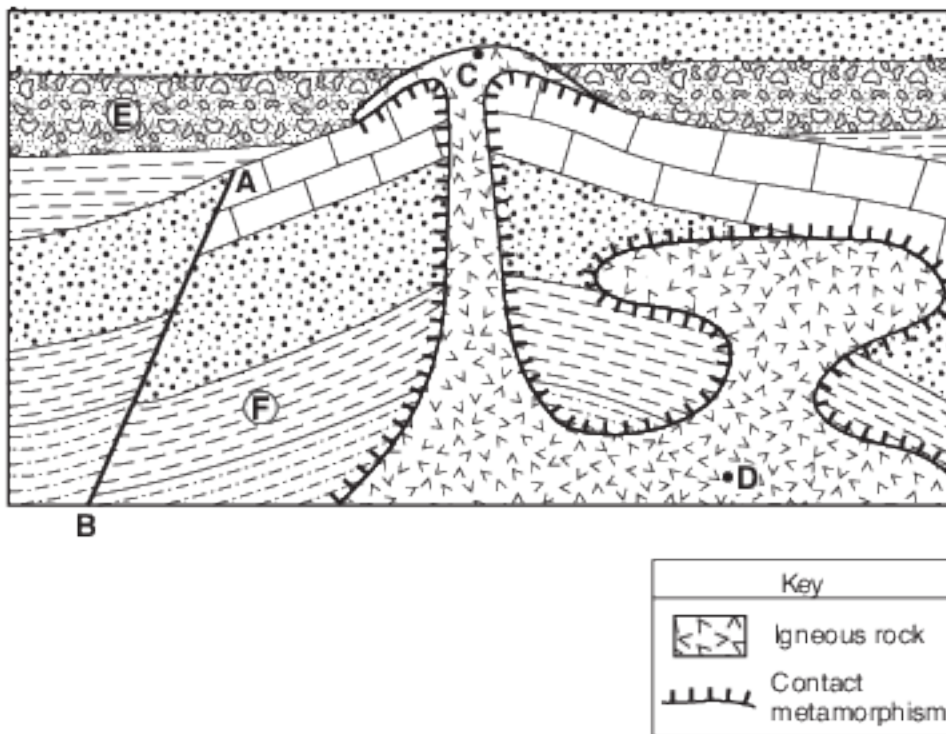
- (1) uplift
- (2) faulting
- (3) metamorphism
- (4) downwarping

Base your answers to questions 5 on the geologic cross section of Earth's crust in image provided and on your knowledge of Earth science. Letters A through F identify rock units. Letter X identifies a fault. Wavy line YZ represents an unconformity. The locations of contact metamorphism and the map symbols for sedimentary rock layers B and E have been omitted.

5 On the cross section in the image provided, draw the contact metamorphism symbol to indicate allocations where contact metamorphism has occurred. [1]

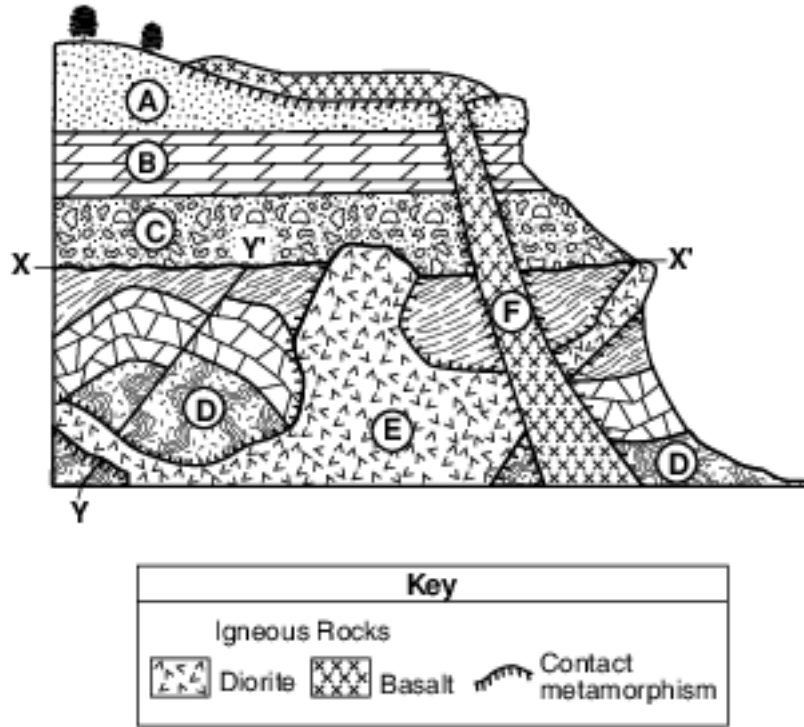


Base your answers to questions 6 on the cross section below and on your knowledge of Earth science. The cross section shows several rock units. Line AB indicates a fault. Points C and D are locations within the igneous rock unit. Circled letters E and F represent two of the sedimentary rock layers.



- 6 Describe one piece of evidence in the cross section indicating that the igneous rock at location C is extrusive. [1]

Base your answers to questions 7 on the cross section below and on your knowledge of Earth science. On the cross section, letters A through F represent rock units. Line XX■ indicates an unconformity and line YY■ indicates a fault. No overturning of rock layers has occurred.

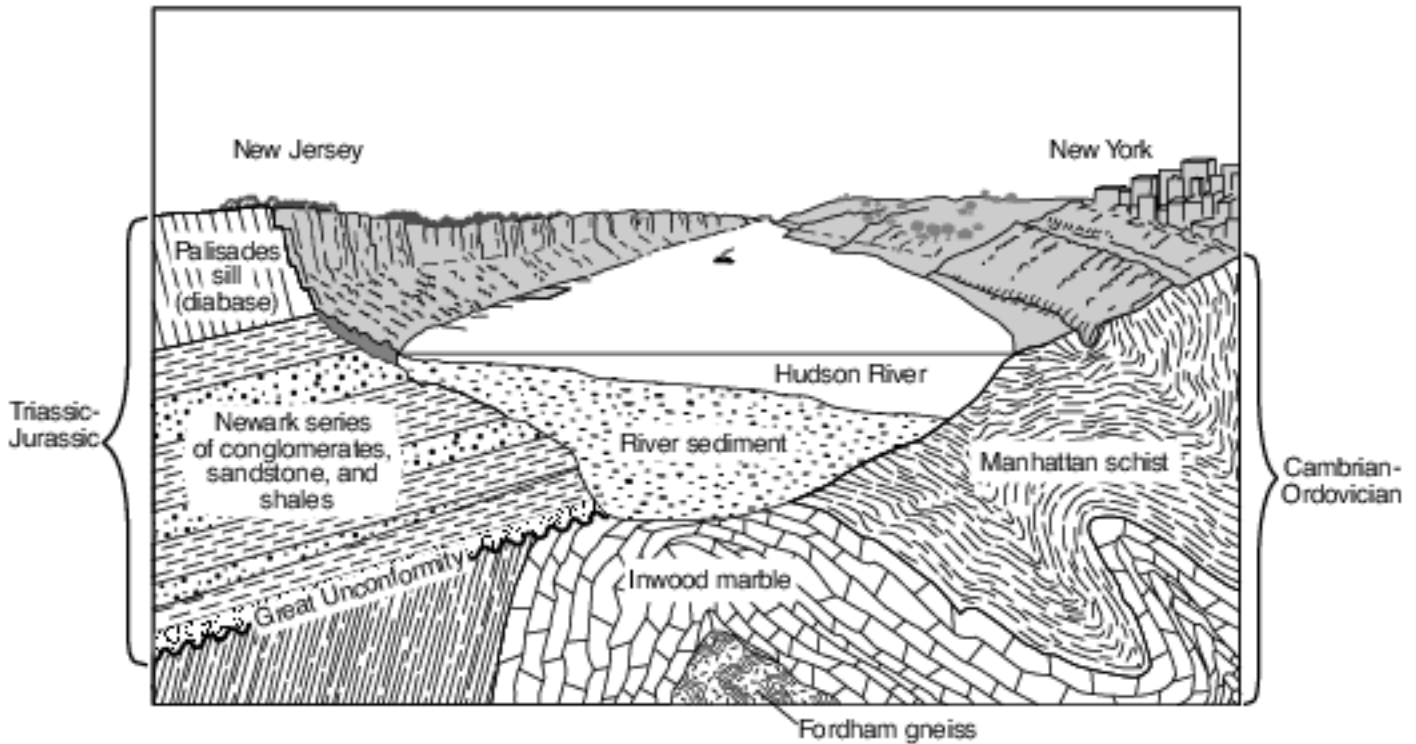


- 7 List two processes that produced unconformity XX■. [1]

Process 1:

Process 2:

Base your answers to questions 8 on the cross section below showing the underlying bedrock of New York and New Jersey along the Hudson River.



- 8 Describe one piece of evidence shown in the cross section that indicates that the Inwood marble was formed by regional metamorphism. [1]

Base your answers to questions 9 on the information below, on the map in image provided, and on your knowledge of Earth science. The map shows a portion of the tectonic plates map from the 2011 Edition Reference Tables for Physical Setting/Earth Science. Letters A and B represent locations on the ocean floor.

The area between North America and South America is a tectonically active region of Earth. This region contains all of the types of tectonic plate boundaries, and it has frequent earthquake and volcanic activity. The tectonic plates on either side of the East Pacific Ridge move at an average rate of 7.5 cm/year.

- 9 Identify the type of mafic igneous bedrock that is most likely to make up the oceanic crust at location A, and state the average density of this oceanic crust. [1]

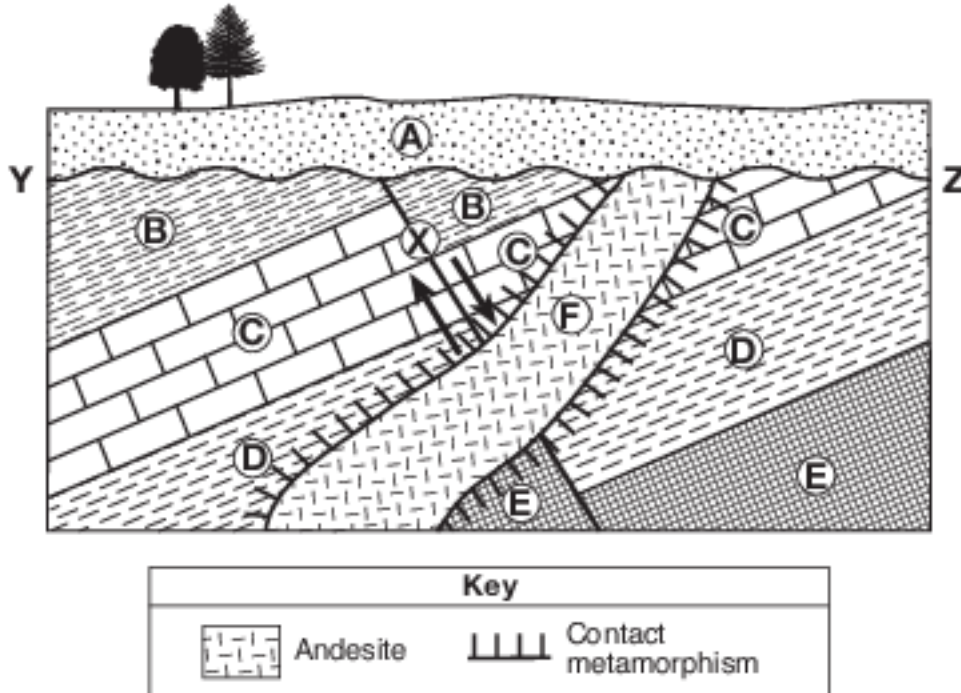
Type of bedrock:

Density: g/cm<sup>3</sup>



## Answer Keys

- 1 1  
2 4  
3 3  
4 4  
5 Allow 1 credit for the contact metamorphism symbol drawn on only the two sides of F, as shown below.
- Example of a 3-credit response for questions 56, 57, and 58:
  -



- 6 Allow 1 credit. Acceptable responses include, but are not limited to:
- — Rock units above letter C have not been metamorphosed.
  - — Contact metamorphism is missing above location C.
  - — Conglomerate and sandstone do not show contact metamorphism above letter C.
- 7 Allow 1 credit for two correct responses. Acceptable responses include, but are not limited to:
- — uplift/emergence
  - — weathering
  - — erosion
  - — subsidence/submergence
  - — deposition
  - — burial
- 8 Allow 1 credit. Acceptable responses include, but are not limited to:
- — The marble shows deformation.
  - — The rock formation is folded.
  - — The marble is located between two other regional metamorphic rocks.
- 9 Allow 1 credit for basalt/basaltic bedrock and a density of  $3.0 \text{ g/cm}^3$  or  $3 \text{ g/cm}^3$ .