

## Plate Tectonics

1 A ship is at a location of  $40^{\circ}$  S  $77^{\circ}$  W. Which type of surface ocean current and tectonic plate boundary are located beneath this ship?

- (1) warm ocean current and a transform boundary
- (2) warm ocean current and a convergent boundary
- (3) cool ocean current and a transform boundary
- (4) cool ocean current and a convergent boundary

2 Which table correctly matches the average density and composition of continental and oceanic crusts?

(1)

Type of Crust	Continental	Oceanic
Average Density	$3.0 \text{ g/cm}^3$	$2.7 \text{ g/cm}^3$
Composition	Felsic	Mafic

(2)

Type of Crust	Continental	Oceanic
Average Density	$3.0 \text{ g/cm}^3$	$2.7 \text{ g/cm}^3$
Composition	Mafic	Felsic

(3)

Type of Crust	Continental	Oceanic
Average Density	$2.7 \text{ g/cm}^3$	$3.0 \text{ g/cm}^3$
Composition	Mafic	Felsic

(4)

Type of Crust	Continental	Oceanic
Average Density	$2.7 \text{ g/cm}^3$	$3.0 \text{ g/cm}^3$
Composition	Felsic	Mafic

3 The photograph below shows a portion of the San Andreas Fault in the western United States.

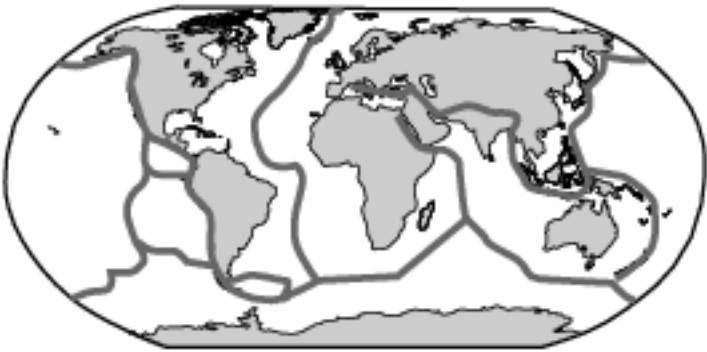



<http://education.nationalgeographic.com>

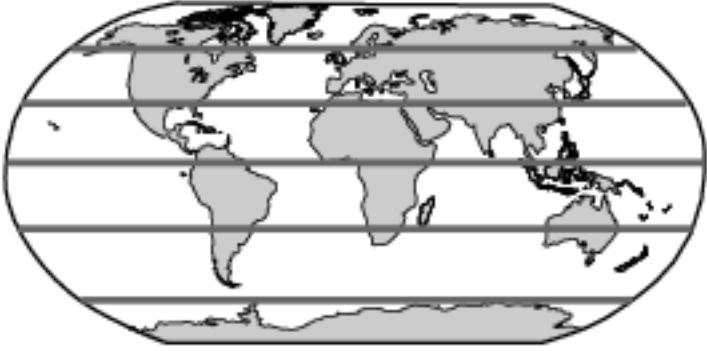
The San Andreas Fault is an example of a


- (1) transform plate boundary
- (2) divergent plate boundary
- (3) convergent plate boundary
- (4) complex plate boundary


4 Which world map shows the locations where most earthquakes and volcanoes occur on Earth?

(1) 

(2) 

(3) 

(4) 

Key	
	Location of most earthquakes and volcanoes

(1) 1

(2) 2

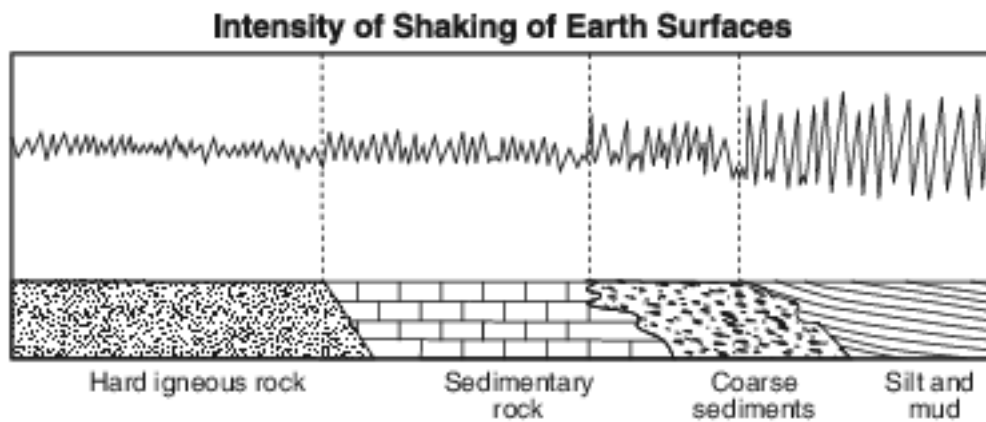
(3) 3

(4) 4

5 The arrival time of the first earthquake P-wave at a seismograph station was 10:11:20 (hours:minutes:seconds). If the epicenter of the earthquake is 8000 km away, what was the approximate arrival time of the first S-wave from this earthquake?

- (1) 10:02:00                      (3) 10:20:40  
 (2) 10:09:20                      (4) 10:32:00

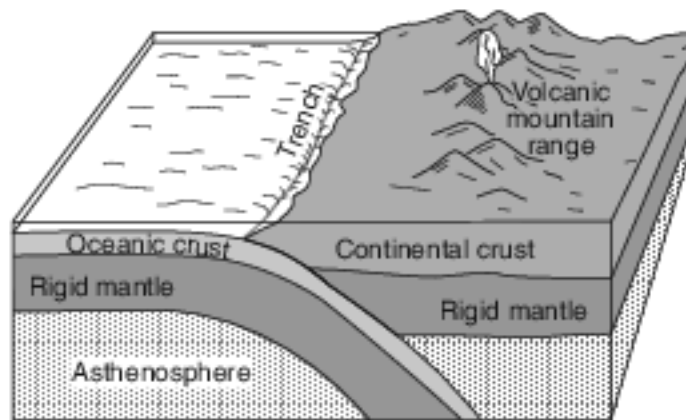
6 The diagram below represents the intensity of the shaking that occurs on different Earth surfaces during the same earthquake.



The greatest earthquake hazard to homes exists when they are built on

- (1) hard igneous rock                      (3) coarse sediments  
 (2) sedimentary rock                      (4) silt and mud

Base your answers to questions 7 on the block diagram below, which shows a tectonic plate boundary.



(Not drawn to scale)

- 7 Which tectonic plate boundary is best represented by this diagram?
- (1) Nazca Plate and Pacific Plate boundary
  - (2) Scotia Plate and South American Plate boundary
  - (3) Juan de Fuca Plate and North American Plate boundary
  - (4) Antarctic Plate and Indian-Australian Plate boundary
- 

Base your answers to questions 8 on the passage below.

#### Crustal Activity at Mid-Ocean Ridges

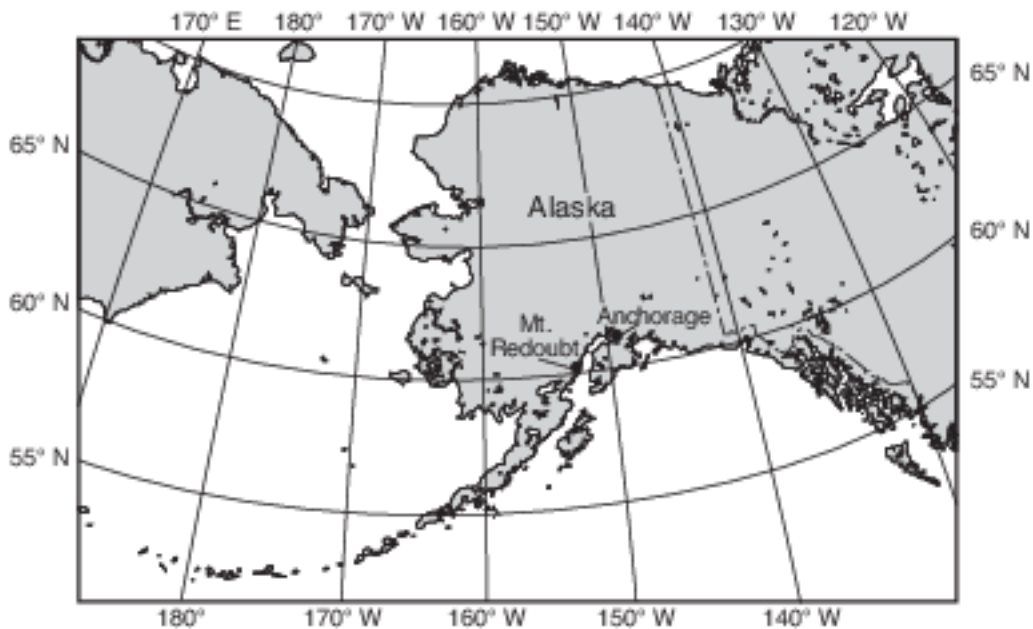
Mid-ocean ridges are found at one type of tectonic plate boundary. These ridges consist of extensive underwater mountain ranges split by rift valleys. The rift valleys mark places where two crustal plates are pulling apart, widening the ocean basins, and allowing magma from the asthenosphere to move upward. In some cases, mid-ocean ridges have migrated toward nearby mantle hot spots. This explains why mid-ocean ridges and mantle hot spots are found together at several locations.

- 8 Which type of tectonic plate boundary is located at mid-ocean ridges?
- (1) convergent
  - (2) transform
  - (3) divergent
  - (4) complex

Base your answers to questions 9 on the passage and map below and on your knowledge of Earth science. The map shows the locations of the Mt. Redoubt volcano and Anchorage, Alaska.

### Mt. Redoubt Volcano

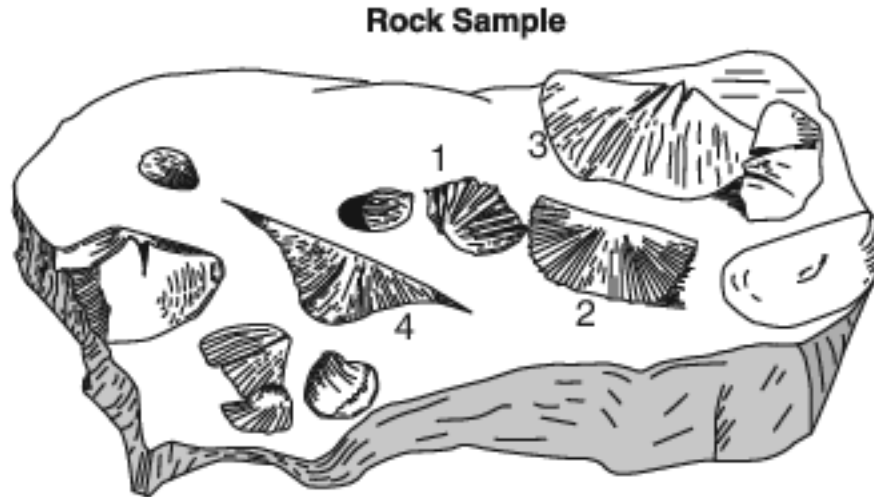
In Anchorage, Alaska, scientists are monitoring sensors located on nearby Mt. Redoubt. The sensors measure seismic activity at the top of the volcano. No one lives near the volcano itself, so there is no danger to humans from lava flows, but ash can be dangerous when breathed in, and can damage airplanes and automobiles if the ash is drawn into their engines. When Mt. Redoubt erupted in 1989, a huge ash cloud reached an approximate height of 7.6 miles above sea level, and spread ash across Alaska for five months. The ash was composed largely of silica, which cooled rapidly as the ash rose into the atmosphere. In March 2009, Mt. Redoubt erupted again.



9 Mt. Redoubt's seismic activity is due to the interaction of which two tectonic plates?

- (1) Pacific Plate and Eurasian Plate
- (2) Eurasian Plate and North American Plate
- (3) North American Plate and Pacific Plate
- (4) Philippine Plate and Eurasian Plate

Base your answers to questions 10 on the diagram and tables below. The diagram shows a rock sample containing fossils from a location in New York State at 42° N 78° 15' W. Fossils 1, 2, 3, and 4 are labeled. Table A lists the names and rock types of the New York State rock units from the Middle and Late Devonian in this area. The presence of fossil 1, 2, 3, or 4 in a rock unit is indicated by an X in the fossils column in the table. Table B identifies typical rocks formed within different marine (ocean) environments.



**Table A: New York State Rock Units in Area Where the Rock Sample was Found**

Geologic Age: Devonian	Name of Rock Unit	Type of Rock Found in Unit	Fossils			
			1	2	3	4
Late	Conewango	shales and sandstones	X	X		X
Late	Conneaut	shales and sandstones	X	X		X
Late	Canadaway	shales and sandstones	X	X	X	X
Late	West Falls	shales and sandstones	X	X	X	
Late	Sonyea	shale	X	X	X	
Late/Middle	Genesee	shale	X	X		
Middle	Tully	limestone	X	X		
Middle	Hamilton	limestone	X	X		
Middle	Onondaga	limestone (includes volcanic ash bed)		X		

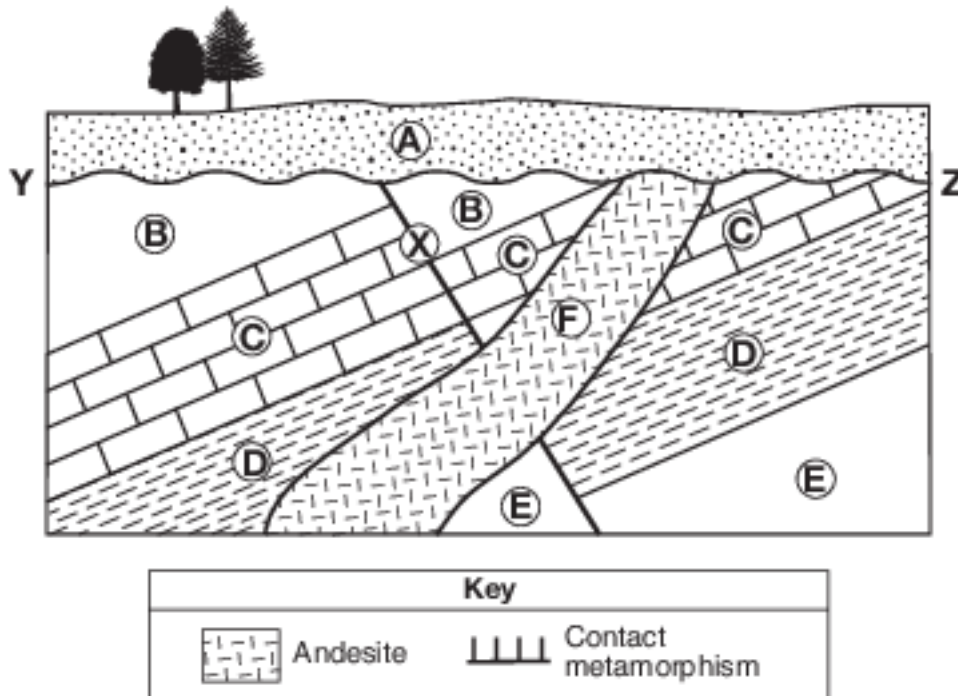
**Table B: Sedimentary Rock Types Formed in Different Marine Environments**

Sedimentary Rocks	Marine Environment
limestones	clear, shallow water
gray shales	muddy, oxygen rich
black shales	muddy, oxygen poor
siltstones and sandstones	silty to sandy bottom
evaporites	very salty, shallow seas
coarse-grained sandstones and conglomerates	tidal shores and deltas

- 10 Identify the landmass that collided with the eastern coast of North America to create the Acadian mountain range and the basin for the deposition of the Devonian rock units in table A. [1]

Base your answers to questions 11 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.

- 11 On the cross section in the image provided, draw two arrows, one on each side of fault X, to show the relative direction of movement of the rock units that occurred during faulting. [1]

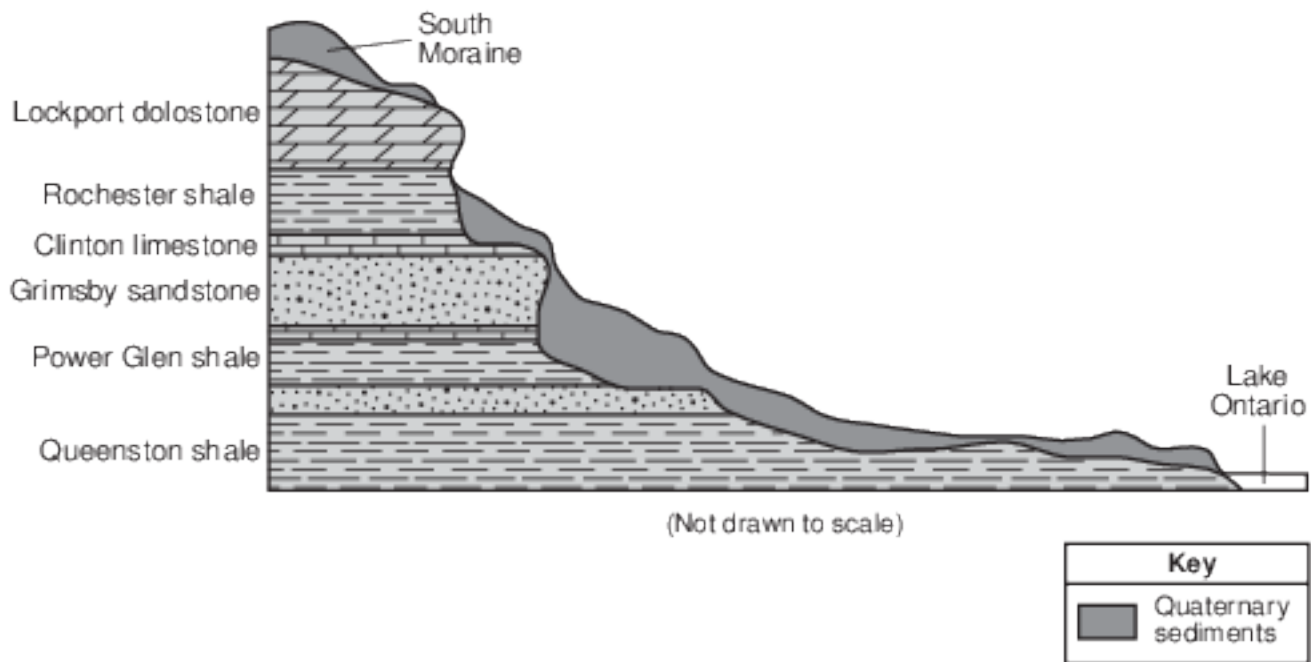


Base your answers to questions 12 on the passage and geologic cross section below and on your knowledge of Earth science. The geologic cross section represents rock layers of a portion of the Niagara Escarpment, and landscape features that are found in the Niagara region. The rock layers have not been overturned.

### The Niagara Escarpment

A prominent feature found along the shore of Lake Ontario in western New York State is the Niagara Escarpment. This escarpment is the remains of an ancient seabed that was formed when the area was covered by a warm, shallow sea from approximately 450 to 430 million years ago. Erosion of the Taconic Mountains to the east provided

the sediments deposited in this basin area. From these sediments, rock layers such as shale, sandstone, and limestone formed. Later, magnesium replaced some of the calcium in the top layer of limestone, turning it into a dolostone layer. When the high ocean levels of the Ordovician Period dropped, the draining of this inland sea caused unequal erosion of the exposed layers. The South Moraine was deposited on the top of the Niagara Escarpment in this region.

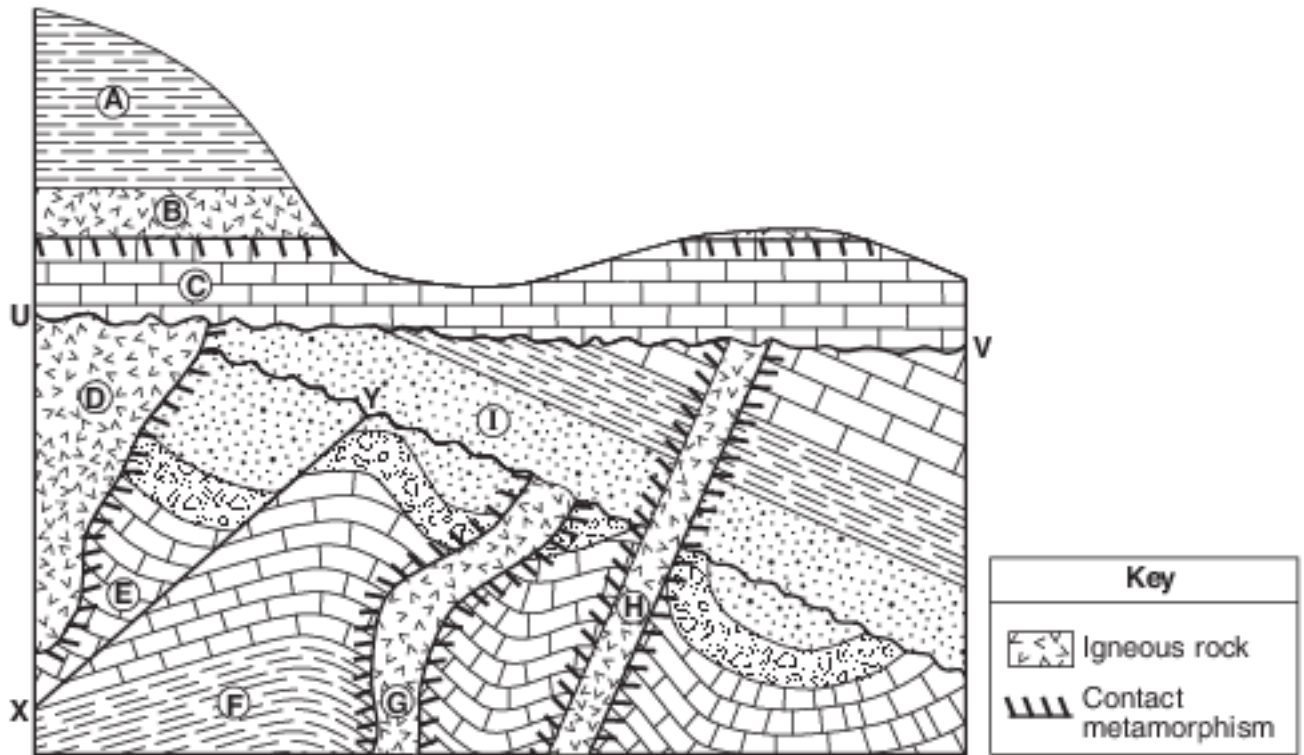


12 Describe the tectonic event that caused the Taconian orogeny. [1]

Base your answers to questions 13 on the cross section of part of Earth's crust in image provided and on your knowledge of Earth science. On the cross section, some rock units are labeled with letters A through I. The rock units have not been overturned. Line XY represents a fault. Line UV represents an unconformity.



13 On the cross section in the image provided, draw two arrows, one on each side of line XY, to show the direction of relative movement that has occurred along the fault. [1]



Base your answers to questions 14 on the map in image provided, on the table below, and on your knowledge of Earth science. The map shows a portion of the Nazca Plate under the southeastern Pacific Ocean. Plate A represents another tectonic plate. The table shows some data for islands and seamounts (undersea volcanoes that do not rise above the ocean surface) that originally formed at the Easter Island Hot Spot.

**Islands and Seamounts Formed By the Easter Island Hot Spot**

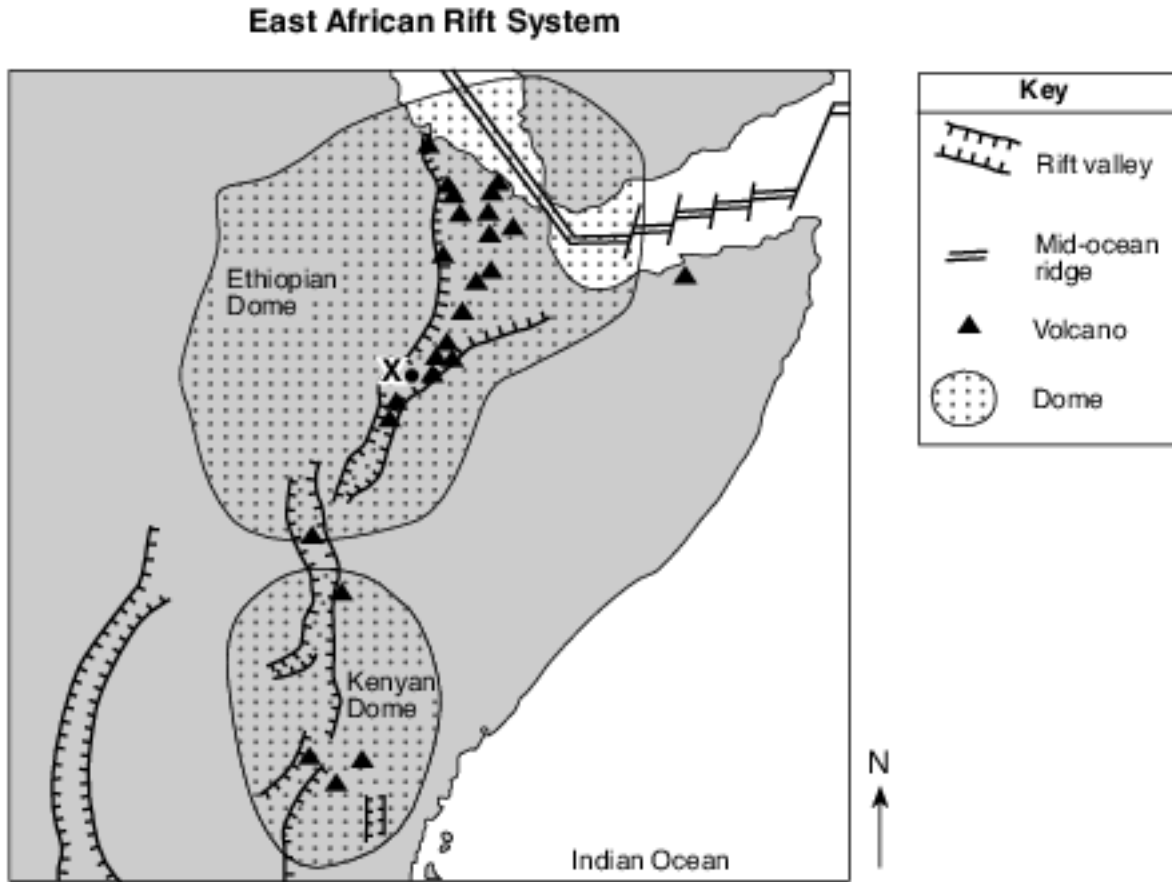
Name	Island or Seamount	Latitude (° S)	Longitude (° W)	Distance from East Pacific Ridge (km)	Age of Oceanic Bedrock (million years)
Easter Island	island	27	109	360	0.3
Sala y Gomez	island	26	105	750	1.7
GS57202-70	seamount	25	98	1500	7.9
18DS	seamount	26	93	2000	11.5
17DS	seamount	25	88	2500	14.9
12DS	seamount	23	83	3100	22.0

14 Identify the name of tectonic plate A. [1]  
Plate

Base your answers to questions 15 on the passage and map of a portion of the East African Rift system shown below. Point X represents a location on Earth's surface within a rift valley on the Ethiopian Dome.

The Great Rift Valley

Rifting of Earth's crust in eastern Africa began during the Neogene Period as the Ethiopian and Kenyan Domes formed. These two huge domes were created as Earth's mantle pushed up the overlying crust. As the crust was forced upward, the resulting tension cracked the crust, resulting in the eruption of volcanoes and the formation of large rifts. The crust continued to pull apart, forming rift valleys. These valleys have become deeper and are currently becoming filled with sediments, igneous rock, and water.



15 Which two lithospheric plates are separated by a mid-ocean ridge in the northeastern portion of the Ethiopian Dome? [1]

Plate and \_\_\_\_\_ Plate

## Answer Keys

1 4

2 4

3 1

4 1

5 3

6 4

7 3

8 3

9 3

10 Allow 1 credit for Avalon.

11 Allow 1 credit if two arrows are correctly drawn approximately parallel to the fault, showing the relative motion, as shown.

- Note: Allow credit even if the arrows extend through rock F.
- Do not allow credit for any arrow in layer A, only.

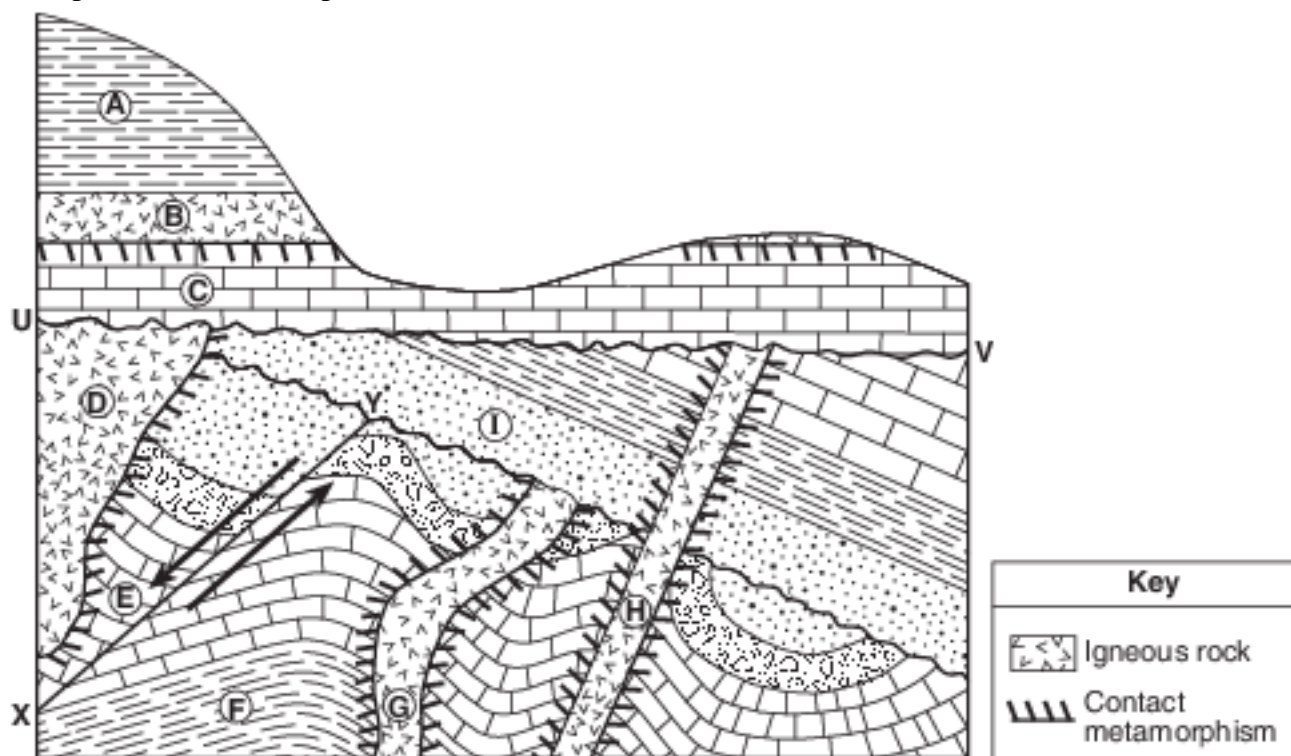
12 Allow 1 credit. Acceptable responses include, but are not limited to:

- — the collision between North America and a volcanic island arc
- — closing of the western part of the Iapetus Ocean
- — crustal uplift
- — convergence

13 Allow 1 credit for one arrow pointing downward on the left side of line XY and one arrow pointing upward on the right side of line XY.

- Example of a 1-credit response:

- 



14 Allow 1 credit for Pacific Plate.

15 Allow 1 credit for Arabian Plate and African Plate.