Unit 4 Workbook

Name:_____ Block:_____

Questions to Section K: Internal Processes and Structures (Plate Tectonics)

1. Outline evidence for lithospheric plate motion and continental drift.

2. Describe convergent, divergent, and transform types of plate boundaries.

3. Suggest possible causes for the movements of the plates.

4. Describe the origin of magma formed during plate tectonic processes.

5. Relate volcanic activities and features to convergent, divergent, and intraplate settings.

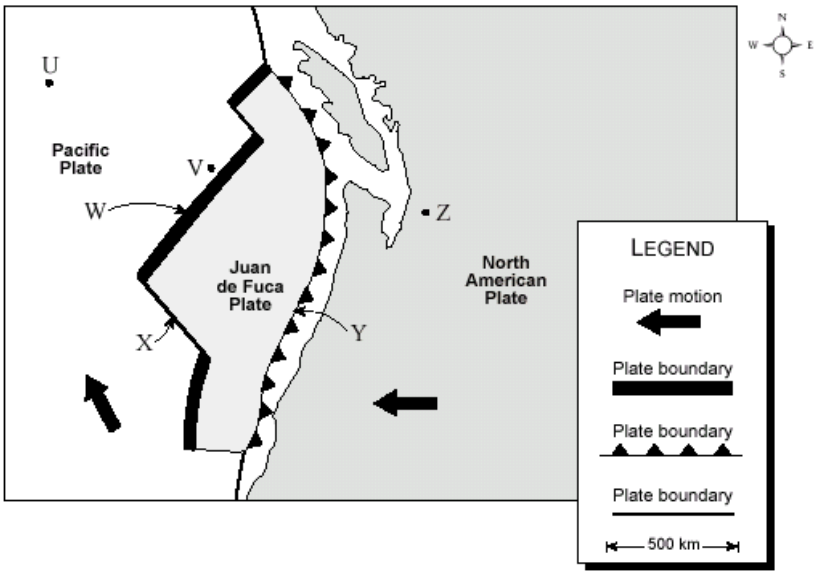
6. Describe the geologic activities that occur at lithospheric plate boundaries.

7. Relate the rock cycle to plate tectonics

8. Compare oceanic crust and continental crust in terms of composition, thickness, etc.

Use the map below to answer questions 9 to 13. The map shows an area of western North America and the sea floor off that coast. Several plate boundaries are shown.

9. The feature labelled **W** is a(n)
   a) island arc.
   b) ocean trench.
   c) oceanic ridge
   d) transform fault.



10. The relative plate motion at feature **X** is best shown as

A.


B.


C.


D.


11. An earthquake along feature **X** would **most likely** have a(n)
    a) shallow focus (depth less than 100 km).
    b) deep focus (depth greater than 400 km).
    c) intermediate focus depth (from 100 - 400 km).
    d) wide range of possible focus depths (from 0 - 700 km).

12. Composite (strato) volcanoes would **most likely** be found at
    a) U
    b) W
    c) Y
    d) Z

13. A rock sample taken at feature **V** is found to have an age of 2 000 000 years. Feature **V** is located 80 km away from the centre of feature W. (Note: 1 km = 100 000 cm.) The rate of plate motion in this area is
    a) 0.25 cm/y
    b) 2.0 cm/y.
    c) 4.0 cm/y.
    d) 8.0 cm/y.

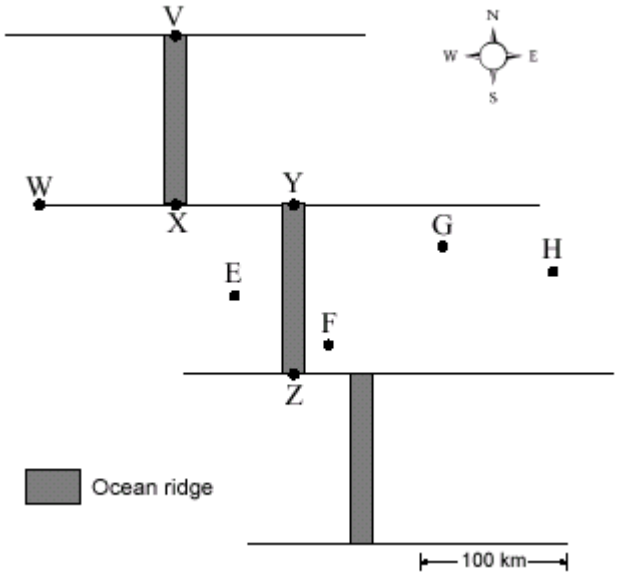
14. The most common igneous rock type found at a divergent plate boundary is
    a) basalt.
    b) granite.
    c) rhyolite.
    d) andesite.

Use the following map of plate boundaries in oceanic lithosphere to answer questions 15 to 17.

15. The type of plate boundary shown between **X** and **Y** is
    a) diverging.
    b) transform.
    c) subduction.
    d) converging.

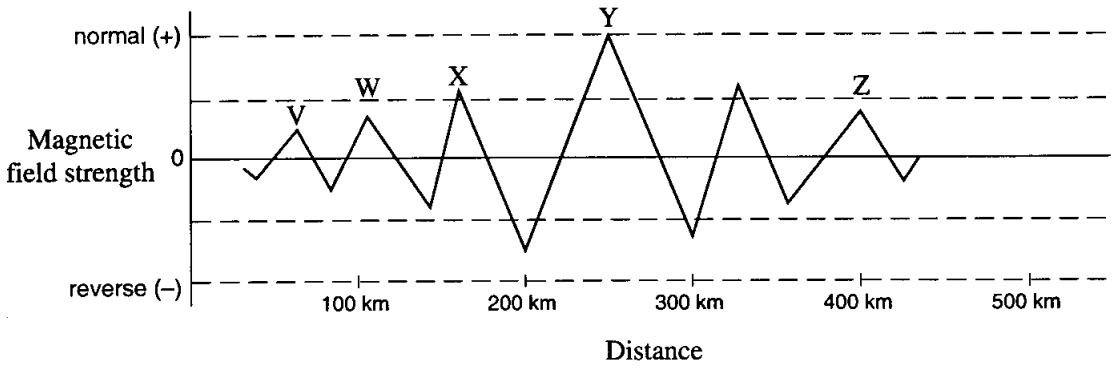
16. Which of the following rock types is **most likely** found at the centre of the ridges?
    a) rhyolite tuff
    b) organic shale
    c) basalt pillows
    d) organic limestone

17. Ocean floor sediments have been drill-sampled down to bedrock at locations E, F, G and H. The **most likely** location to have the **thickest sediment** deposit is
    a) E
    b) F
    c) G
    d) H



18. Some of the world's mountain belts, such as the Rockies, are not along active earthquake belts. This observation seems to contradict the idea that plate collisions can create mountains. A likely explanation of this observation is that these mountains
    a) are thick deposits of basalt.
    b) were formed by layers of sediment.
    c) are the sites of ancient collision boundaries.
    d) are points where new plate boundaries are forming.

Use the following graph of magnetic field strength and distance across an ocean basin to answer questions 19 to 22



19. At which location is new rock being formed?
    a) W
    b) X
    c) Y
    d) Z

20. Rock with the same age as rock at Z would also be found at
    a) V
    b) W
    c) X
    d) Y

21. If the difference in the ages of rocks at W and X is 2 000 000 years, and locations W and X are 60 km apart, the rate of sea floor spreading is
    a) 1 cm/y
    b) 3 cm/y
    c) 6 cm/y
    d) 9 cm/y

22. Which of the following best records magnetic field direction on the ocean floor?
    a) Igneous rock
    b) Sedimentary rock
    c) Metamorphic rock
    d) Sea floor sediments

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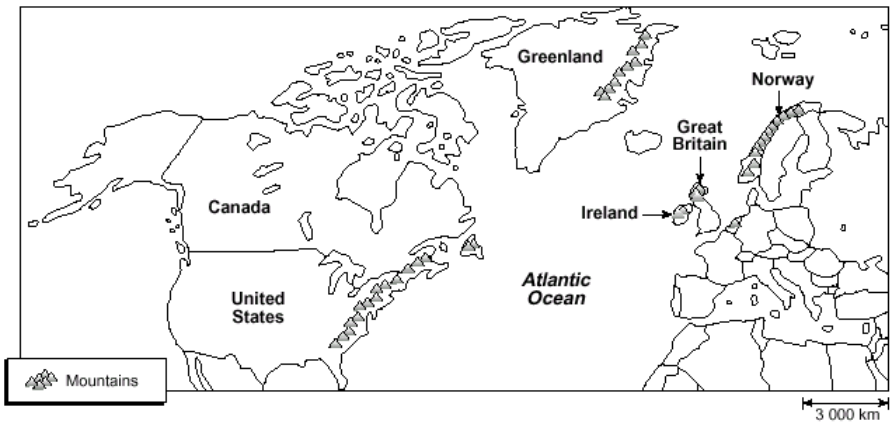
23. The most likely energy source driving plate tectonic is
    a) friction
    b) ocean heat
    c) magnetism
    d) radioactivity

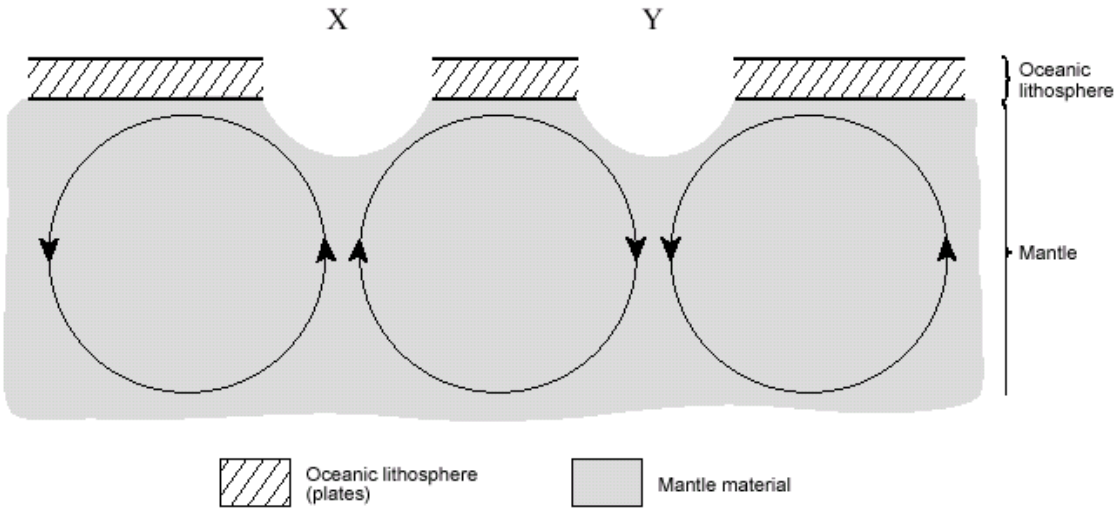
24. The large scale apparent wandering of the Earth's magnetic north pole as recorded in continental volcanic rocks is a result of changes in the
    a) tilt of the Earth's axis
    b) location of the pole star
    c) positions of the continents
    d) position of the geographic north pole

Use the following map to answer question 25.



25. The Appalachian Mountains in North America and the Caledonian Mountains in Europe contain very similar rock types, structures and fossils. This observation suggests that North America and Europe
    a) were once together.
    b) are moving closer together.
    c) are on the same lithospheric plate.
    d) were joined by mountains extending across the Atlantic Ocean.

Use the following cross section of three mantle convection currents and part of the oceanic lithosphere to answer question 26.

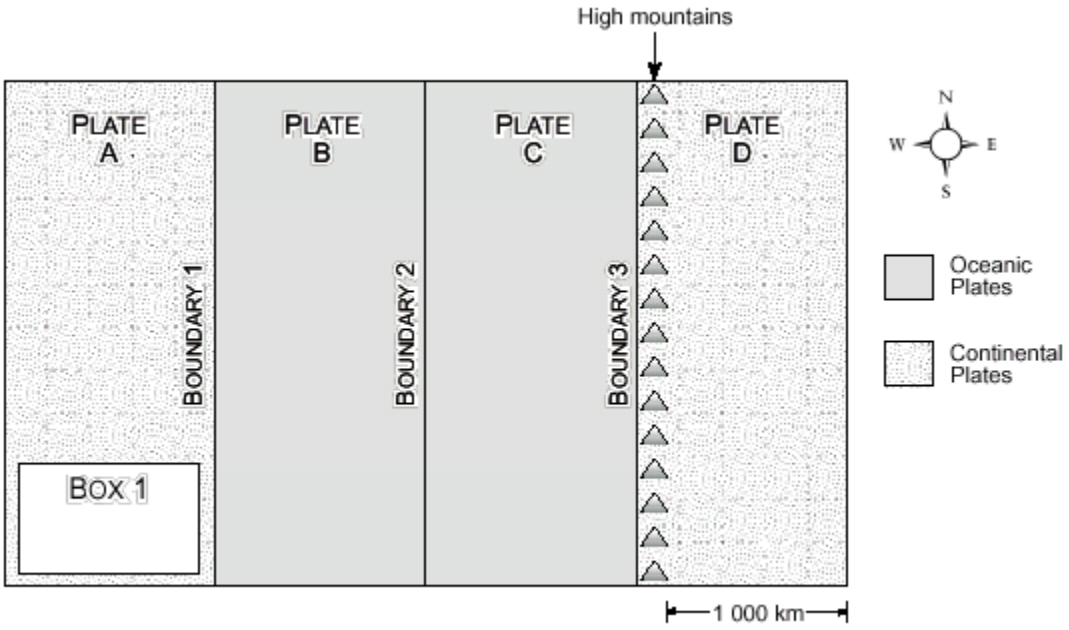


26. a) Explain what causes the mantle convection currents to rise and then fall.

b) Complete the oceanic plates appropriately in the gaps below X and Y. Label with arrows showing the direction of movement.

c) On the completed diagram, label an ocean trench and a rift valley.

Use the following diagram of four lithospheric plates to answer question 27. All the plates are moving.



27. a) Boundary 1 is a convergent boundary. Indicate with an arrow in Box 1 on the diagram the direction that Plate A must be moving relative to Plate B.

b) A chain of high mountains lies on Plate D. Name two geologic processes which could contribute to the formation of this mountain chain on Plate D.

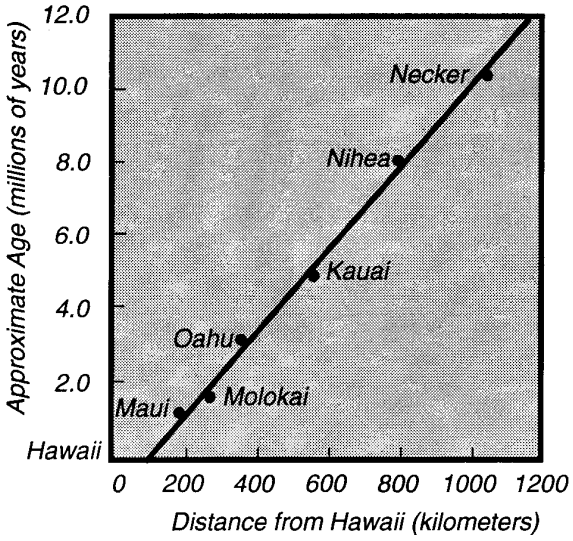
Geologic Process 1:

Geologic Process 2:

c) What geologic feature would need to be located at Boundary 2 to account for the relative motion of these four plates?

Use the following graph to answer question 28.

28. The graph shows some of the Hawaiian Island chain. The vertical axis of the graph gives the approximate age of the volcanic rocks found on each island, and the horizontal axis shows the distance of each island from Hawaii.



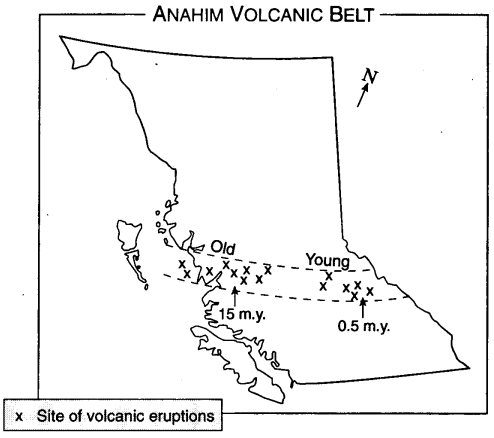
a) Assuming an age of 8.0 million years for the rocks of Nihea, determine the rate of motion in centimetres per year, of the Pacific Plate in this region.

b) With reference to the concept of mantle hot spots, explain the relationship between age and distance from Hawaii for the islands in the Hawaiian chain. Draw a cross-sectional diagram to help illustrate your answer.

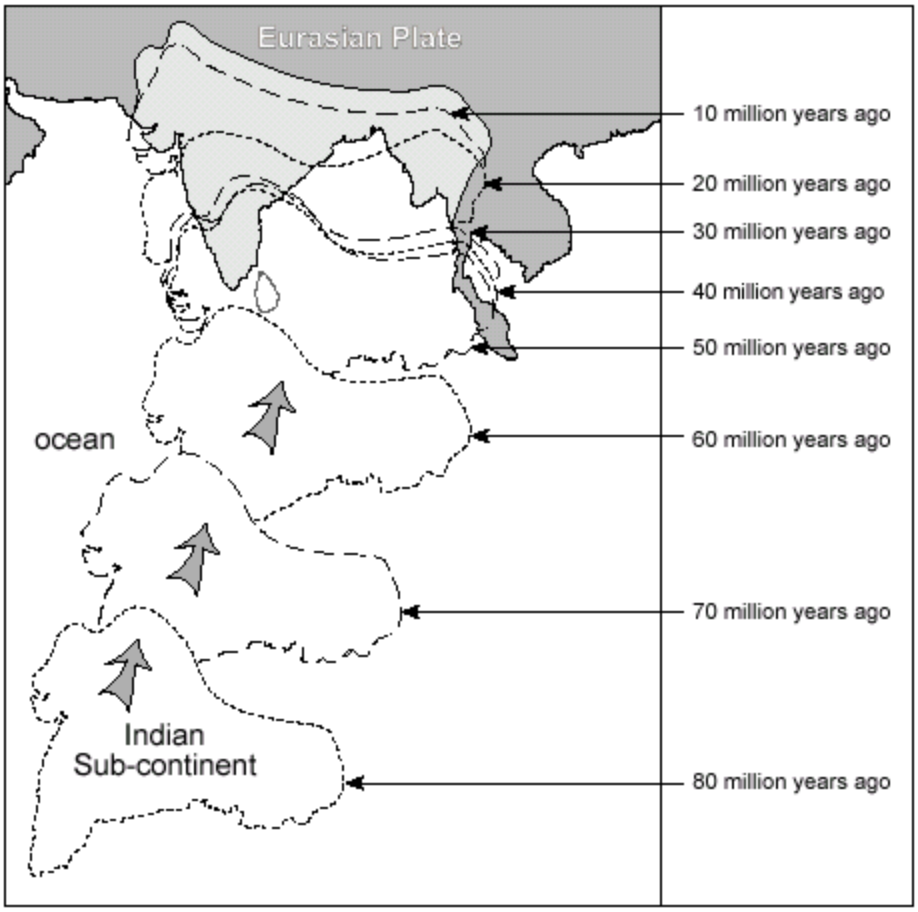
Place diagram here

c) The oldest islands in the Hawaiian chain are also the lowest in elevation and the smallest. Give two geologically reasonable explanations why this is so.

29. Observe the diagram to the right. Use your knowledge of plate tectonics to explain the occurrence of the volcanic belt.



Use the following diagram to answer question 30 to 32.



30. What geologic feature resulted from the collision of the Indian sub-continent with the Eurasian plate?

31. Describe the process within the Earth's interior to explain the motion of the Indian sub-continent.

32. Jurassic ammonites (ancient sea creatures) fossils have been found high in the mountains. Using your knowledge of plate tectonics, give a possible explanation.

Questions to Section L: Internal Processes and Structures (Seismology)

1. Describe fault creep and elastic rebound as they relate to seismic activity.

2. Distinguish between magnitude and intensity.

3. Compare and contrast the Richter and Mercalli scales.

4. a) Describe in detail how to locate an epicenter of an earthquake using seismograph data.

   b) What represents magnitude on a seismograph?

5. Assess the seismic risks for a particular area using:
   - geographic location (on Earth)
   - topography (mountains, plains, etc.)
   - ground strength
   - rock types
   - proximity to faults
   - construction design

6. Evaluate various methods of earthquake prediction (e.g. seismic gap, animal behaviour, etc.)

7. Describe the differences between P, S and L waves.

P	S	L

8. Define the terms epicentre, focus, liquefaction, tsunami.

9. Explain how dilatancy data is related to earthquakes.

10. Describe how a seismograph works.

11. A low energy earthquake that caused most of the buildings in a town to collapse would be rated
    a) low on the Richter scale and low on the Mercalli scale.
    b) low on the Richter scale and high on the Mercalli scale.
    c) high on the Richter scale and low on the Mercalli scale.
    d) high on the Richter scale and high on the Mercalli scale.

12. Which of the following is the **least** useful for predicting earthquakes?
    a) Height of sea level
    b) Amount of ground tilt
    c) Degree of micro-seismic activity
    d) Percentage of radon in ground water

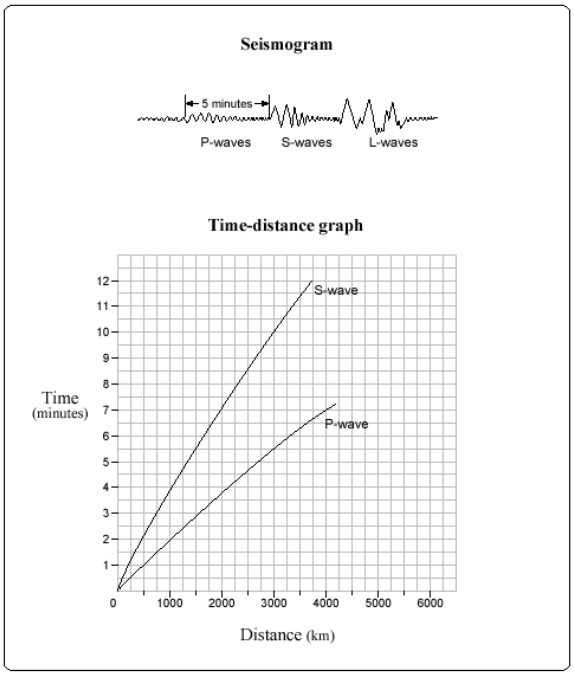
13. A magnitude 8 earthquake located 20 kilometres off the west coast of Vancouver Island would likely produce all of the following except
    a) a tsunami.
    b) landslides.
    c) a volcanic eruption.
    d) liquefaction of sediments.

14. Movement along a fault without the buildup of significant amounts of stress is known as
    a) creep.
    b) strain.
    c) stress rupture.
    d) elastic rebound.

15. Which of the following is the **most likely** cause of the largest magnitude earthquakes?
    a) Rift eruptions.
    b) Isostatic adjustment of the crust.
    c) Stress buildup between lithospheric plates.
    d) Major temperature changes in surface rocks.

16. Slow, continuous slip along a fault zone is called
    a) fault creep.
    b) ground slump.
    c) rock dilatancy.
    d) elastic rebound.

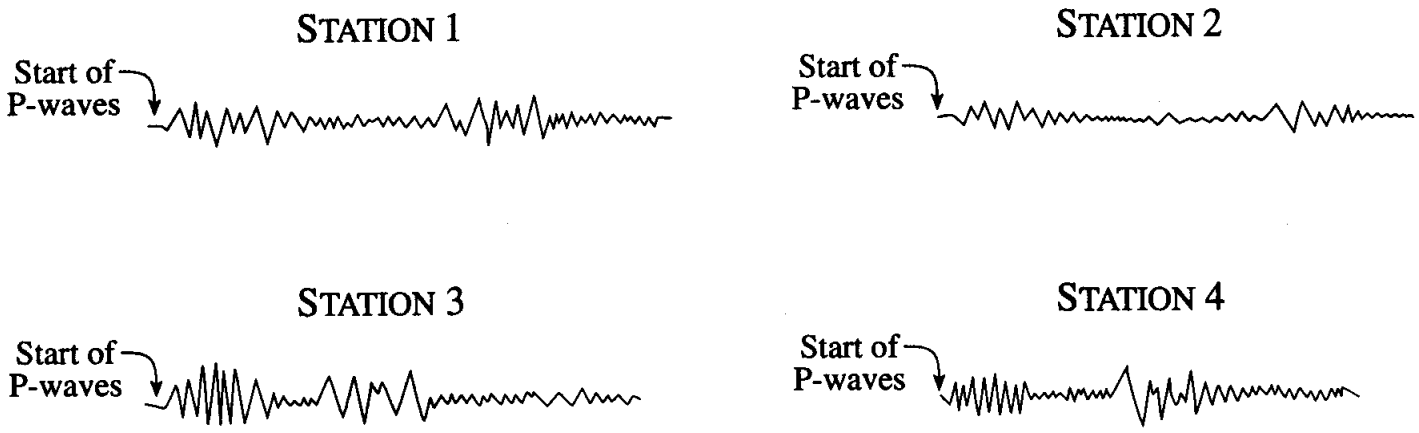
Use the following seismogram and time-distance graph for P- and S-waves to answer questions 17 and 18



17. The distance from the seismometer to the epicentre of the earthquake is
    a) 1 300 km.
    b) 2 000 km.
    c) 2 750 km.
    d) 3 400 km.

18. The two curves on the Travel Time graph have different average slopes because
    a) P-waves travel faster than S-waves.
    b) S-waves have a side-to-side shaking motion.
    c) S-waves change velocity and P-waves do not.
    d) P- and S-waves travel through different materials.

Use the following seismographs to answer question 19.



19. The seismographs above were recorded for one earthquake by using similar seismographs at four different stations. What is the correct order, from closet to farthest, in terms of distance from the epicentre to each station?
    a) 2,1,3,4
    b) 2,3,4,1
    c) 3,4,1,2
    d) 3,2,1,4

20. Which of the following would **least** affect the Mercalli intensity rating of an earthquake?
    a) Direction to the focus.
    b) Local geologic conditions.
    c) Distance from the epicentre.
    d) Magnitude of the earthquake.

21. How could you tell from a seismograph that an earthquake was closer to station A than station B?
    a) The difference in arrival times of the P and S waves was less at station B.
    b) P waves arrived earlier at station B than station A.
    c) Amplitude of the waves on the seismograph at station A were larger.
    d) All of the above.

22. During an earthquake, minimum damage to a structure would most likely occur if the structure was located on
    a) delta deposits
    b) granitic bedrock
    c) unconsolidated fill
    d) tilted sedimentary beds

23. Any one earthquake can have
    a) one magnitude and one intensity
    b) many magnitudes and one intensity
    c) one magnitude and many intensities
    d) many magnitudes and many intensities

24. A seismograph will record the
    a) depth of a focus
    b) distance to an earthquake
    c) time an earthquake occurred
    d) time at which waves arrive at the device

25. The minimum number of seismograph stations usually required to give the location for an epicentre is
    a) 1
    b) 2
    c) 3
    d) 4

26. A seismograph cannot be used to
    a) predict earthquakes
    b) record time of wave arrivals
    c) calculate distance to the epicentre
    d) calculate magnitude of the earthquake

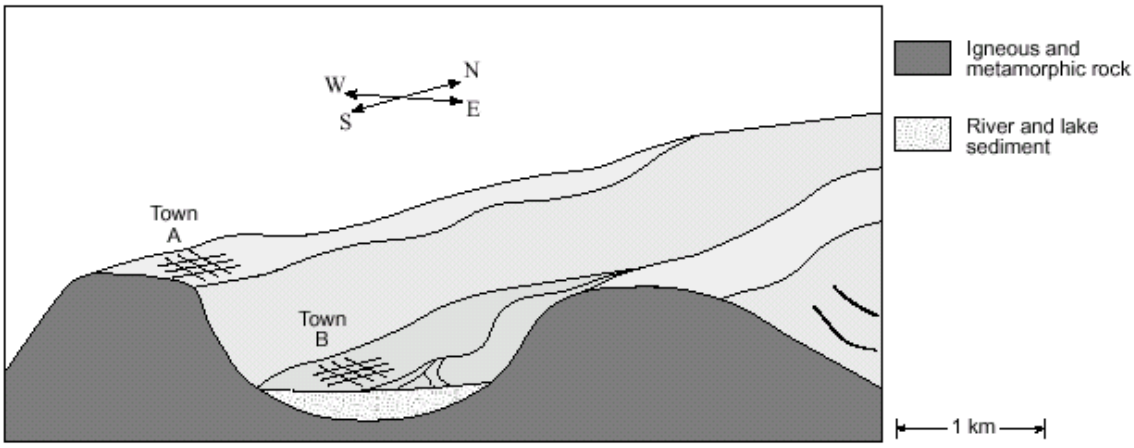
27. How much more energy does an earthquake of Richter magnitude 5 compared to one of Richter magnitude 3 release?
    a) 30 times
    b) 900 times
    c) nearly twice as much
    d) 100 times

28. The earthquakes which occur the most frequently also
    a) cause damage to cities
    b) have small magnitudes
    c) generate large tsunamis
    d) occur in the middle of tectonic plates

29. Which of the following strategies would be most effective in reducing the possible damage to buildings due to soil liquefaction?
    a) Building large concrete retaining walls around structures
    b) Building earthquake resistant buildings that could withstand vigorous ground shaking
    c) Not building structures near coastal areas
    d) Not building structures on wet or unstable soils

30. There is geological evidence that the West Coast of Canada is an active earthquake zone, although this region has not experienced a large earthquake in a long time. Explain why a large earthquake may occur in the near future.

Use the following cut-away diagram of an area that has experienced a magnitude 6 earthquake to answer question 31



31. The area shown in the diagram above experienced a magnitude 6 earthquake. The focus was located 30 km beneath Town B. Town B was more extensively damaged than Town A, even though both towns have the same construction standards, and have similar populations.

    a) Which town is likely to have a higher Mercalli Scale rating?

    b) What is the **most likely** reason for the extensive damage to Town B?

    c) The P-wave and S-wave travel-time difference at Town B is slightly less than at Town A. Explain why this travel-time difference would occur.

    d) The people of Town B did not act on the advice of a local seismologist who noticed a variety of earthquake warning signs (precursors) prior to the earthquake. Describe **one** such precursor that the seismologist may have detected.

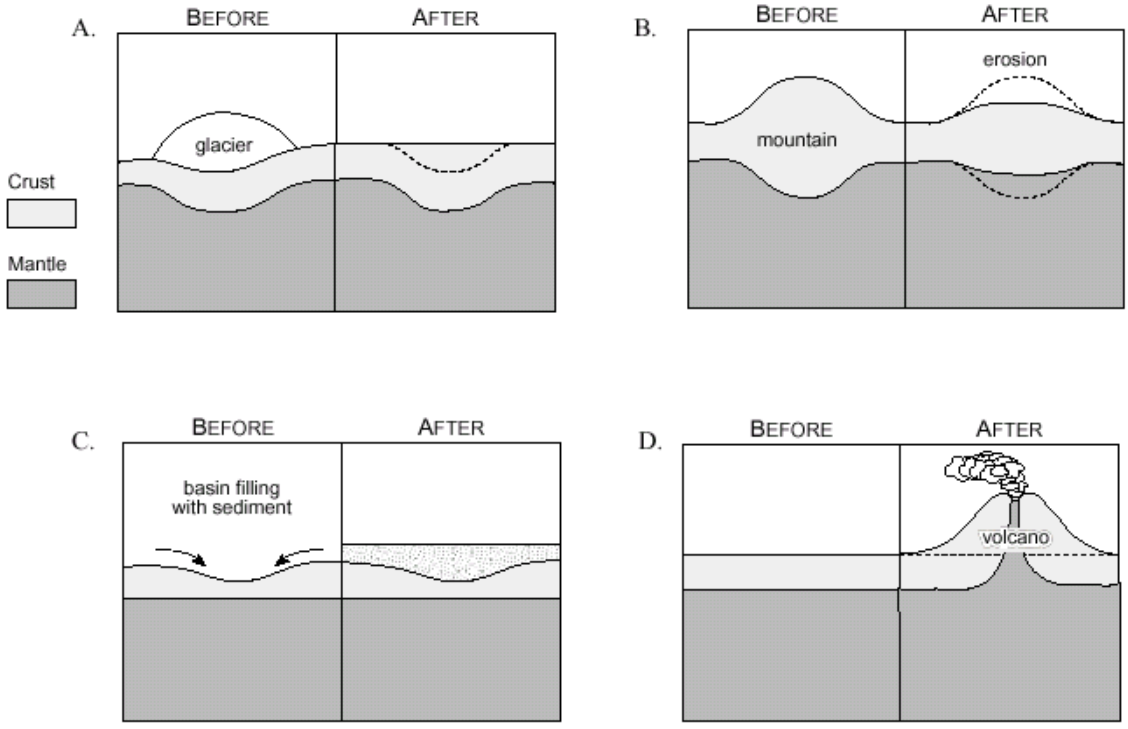
Questions to Section M: Internal Processes and Structures (Isostasy)

1. Analyse the adjustment of the crust to changes in loads associated with volcanism, mountain building, erosion, and glaciation by using the concept of isostasy.

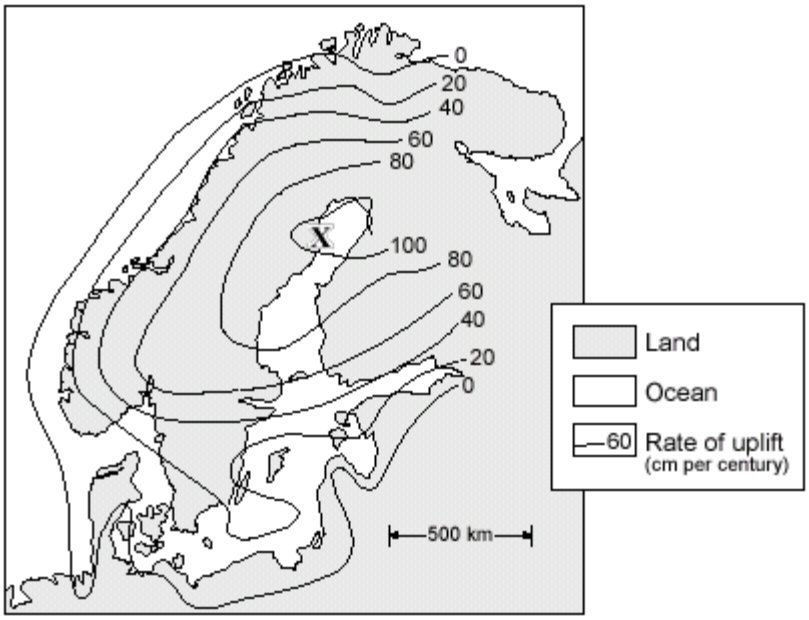
2. Explain how mountains can rise even though they are eroding.

3. Which of the following is a result of isostatic adjustment?
   a) Glacial flow down a valley
   b) Crust sinking beneath a delta
   c) Displacement along a transform fault
   d) Mountain building at a convergent plate boundary

4. Which of the following "before and after" sequences shows the correct isostatic response?

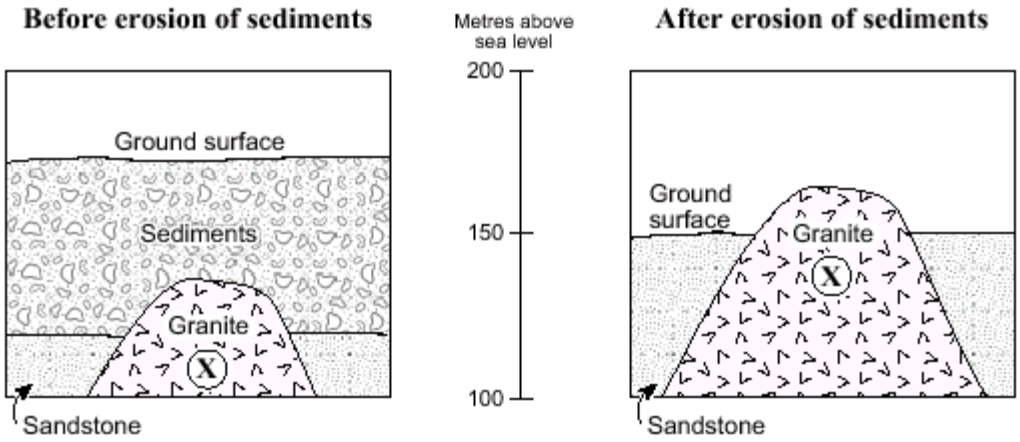


Use the following map that shows rates of crustal uplift in Scandinavia to answer question 5. The numbered lines join points of equal crustal uplift.



5. At location X, the crust is rising
   a) fastest because this is where the Pleistocene ice cap was the thickest.
   b) fastest because this is where the Pleistocene ice cap was the thinnest.
   c) slowest because this is where the Pleistocene ice cap was the thickest.
   d) slowest because this is where the Pleistocene ice cap was the thinnest.

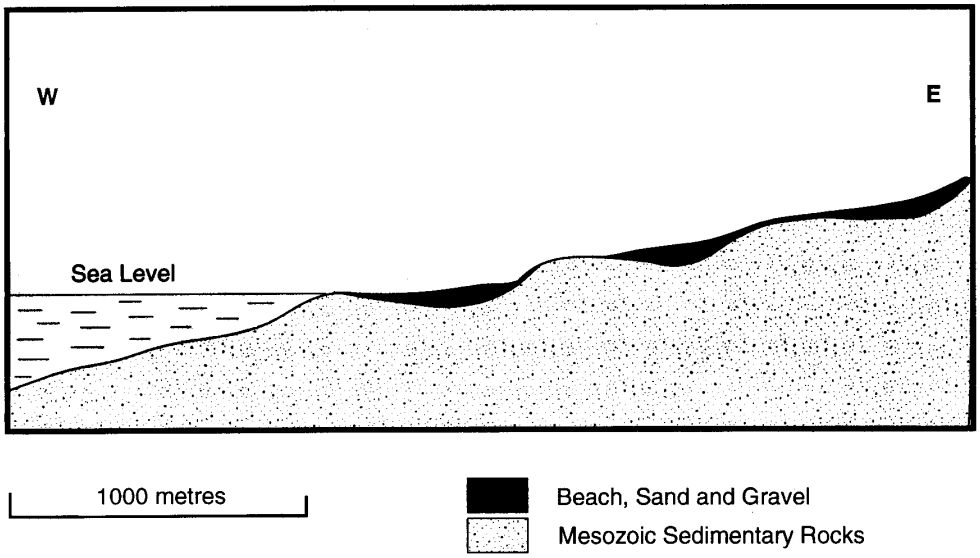
Use the following diagram to answer question 6 and 7



6. After the sediments have been eroded, location **X** in the granite will be at a higher elevation above sea level. What is the name given to this process.

7. Describe why the granite is now above sea level.

Use the following cross-section of part of the coast of western Vancouver Island to answer question 8.



8. One prominent feature of the coastal section is the series of beaches at different heights above sea level. Give two geologically reasonable explanations for how the beaches could have formed. The first should involve plate tectonics, and the second explanation should involve glaciation. Draw diagrams to help illustrate your answer.

   a) Explanation 1 (Plate Tectonics)

Place diagram here

   b) Explanation 2 (Glaciation)

Place diagram here

Questions for Section N: Internal Processes and Structures (Earth's Interior)

1. Give evidence for the fact that the earth is layered.

2. Diagram or model the interior of the earth, labelling all principal parts and showing the approximate thickness of each layer.

3. Differentiate among the layers of the earth and describe their characteristics.

4. The layer of the earth that is solid, has the lowest seismic velocities and is composed of silicate material is the
   a) crust.
   b) mantle.
   c) outer core.
   d) inner core.

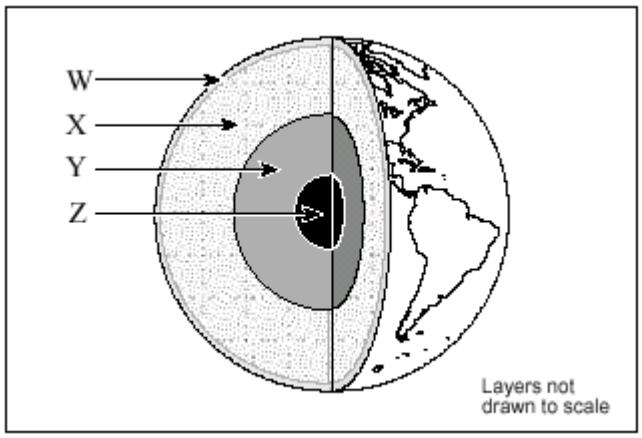
5. The study of seismic records shows that P- and S-waves speed up then slow down again as they pass through part of the earth. The **best** explanation for this suggests that the waves pass through
   a) plastic zone.
   b) solid, a liquid, then a solid.
   c) cool solid, a hot liquid, then a cooler solid.
   d) solid, a denser solid, then a less dense solid.

6. Which of the following is the **best** evidence that the earth has a layered internal structure?
   a) Xenoliths
   b) Drill core samples
   c) Composition of lavas
   d) Sudden changes in the velocity of P- and S-waves

Use the following diagram of the earth's interior to answer questions 7 and 8.

7. The layer that will absorb S-waves is
   a) W
   b) X
   c) Y
   d) Z

8. The layer that contains the lowest density silicate rocks is
   a) W
   b) X
   c) Y
   d) Z

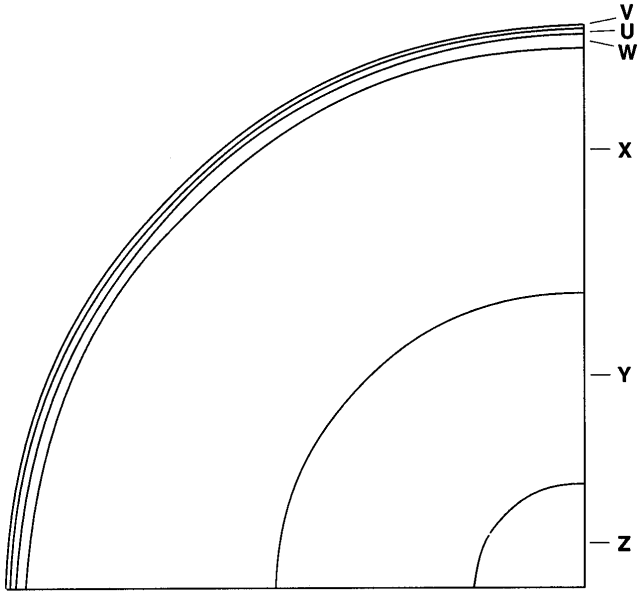


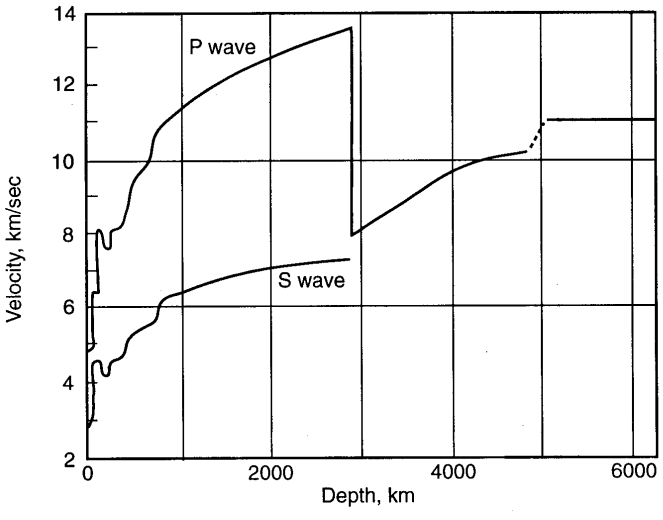
Use the following diagrams which show a cross-section of the Earth, and a graph of P and S wave velocities against depth in the Earth, to answer question 9-11.

9. The S waves have no velocity below a depth of about 2900 km. This is because the S waves
   a) have run out of energy
   b) are entering a liquid layer
   c) are entering a plastic layer
   d) are entering a super-dense layer

10. Both P and S wave velocities increase as they pass down through layer X. This increase in velocity is because with increasing depth, layer X becomes
   a) cooler
   b) denser
   c) richer in quartz
   d) less pressurized

11. A layer which is composed largely of iron and nickel is
   a) U
   b) W
   c) X
   d) Y



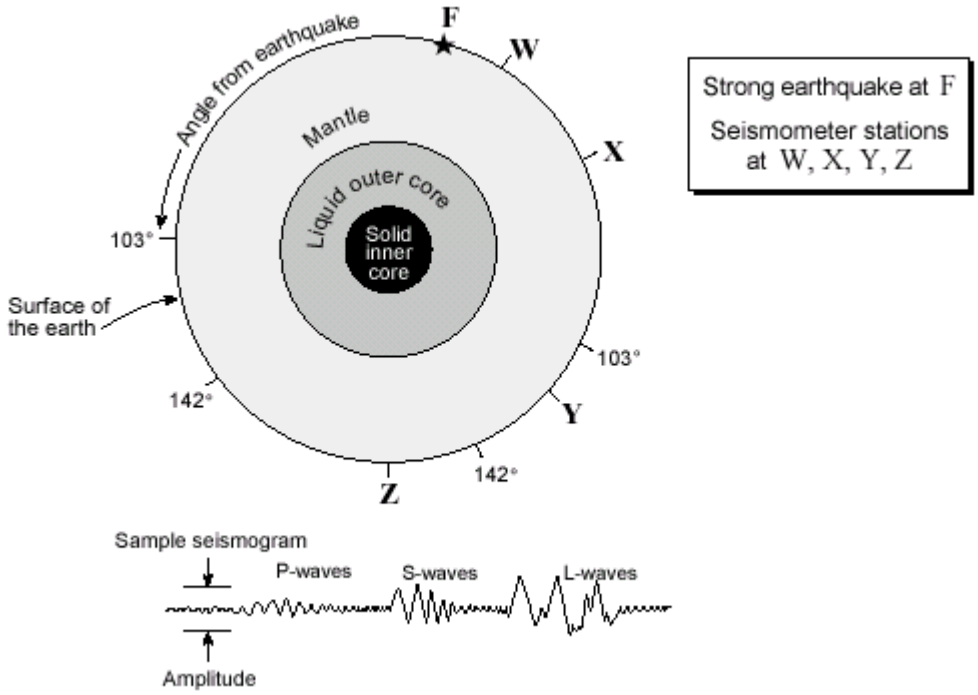


Remember to ask for help if you need it☺

12. The Earth's overall density is 5.5 g/cm^3, yet the density of the crust averages only 2.8 g/cm^3. This fact implies that
    a) the densities of the mantle and core must be greater than that of the crust
    b) the densities of the mantle and core cannot be determined
    c) the Earth was never homogeneous in composition
    d) the mantle and core probably have a density of 5.5g/cm^3

13. The P wave shadow zone occurs because
    a) P waves travel faster than S waves
    b) P waves refract at the outer core – mantle boundary
    c) P waves are shear waves
    d) S waves obstruct the path of P waves

Use the following sketch of the cross section of the earth to answer question 14.



14. A strong earthquake occurred at location F.
    a) The time difference between the arrival of P- and S-waves is known as the P- and S-wave interval. Describe how the P- and S-wave interval varies between stations **W** and **X**.

    b) Describe the difference in amplitude between direct path P-waves at station **W** and at station **X**.

    c) Explain why no direct path S-waves would be recorded at station **Z**.

    d) Explain why no direct path P-waves would be recorded at station **Y**.

Questions to Section O: Internal Processes and Structures (Structural Geology)

1. Describe the factors that determine if a rock will behave in a plastic or brittle manner when stressed.

2. Distinguish between faults and joints.

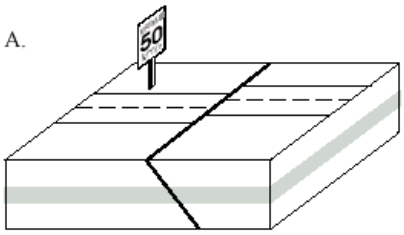
3. Draw dip-slip (normal, reverse, thrust), strike-slip (left lateral, right lateral), and transform faults. Include arrows showing appropriate forces associated with the various types of faults (compressional, tensional, and shear forces).

4. Draw a diagram to explain the dip and strike of a structure.

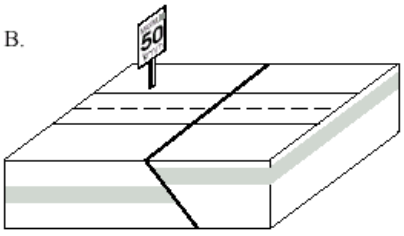
5. Draw a dome, basin, anticline, syncline, and overturned fold, and include arrows showing appropriate forces associated with these structures.

6. Which of the following block diagrams shows a left lateral strike-slip fault?

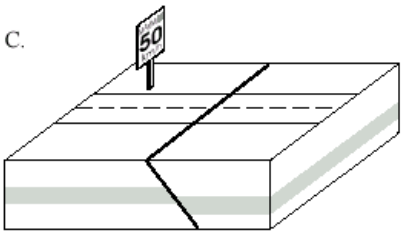
A.



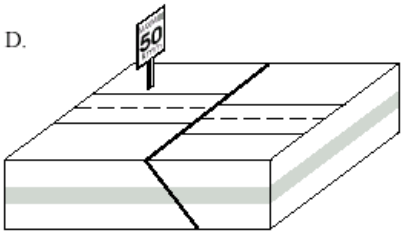
B.



C.

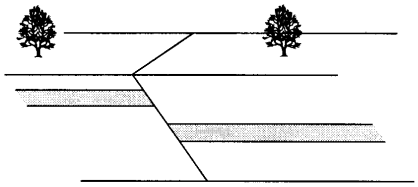


D.

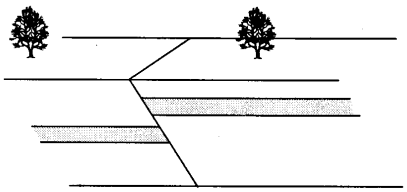


12. A fault that results from crustal stretching is represented in which diagram below?

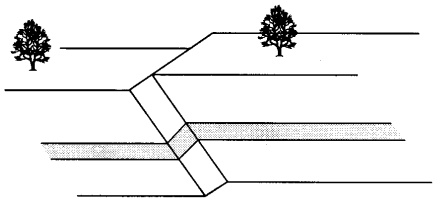
A.



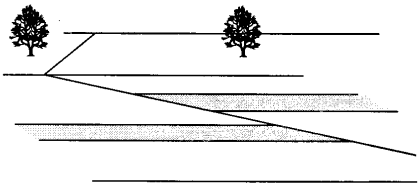
B.



C.



D.



13. Thrust faults would most likely occur at plate boundaries that are
    a) divergent
    b) transform
    c) convergent
    d) constructive

14. What type of faulting commonly occurs as a result of tensional stresses?
    a) Reverse fault
    b) Normal fault
    c) Thrust fault
    d) Strike – slip fault

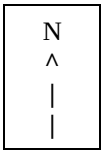
Use the following diagram to answer question 15.

15. The structures shown in the diagram **most likely** formed at a boundary where the plates were
    a) moving apart.
    b) rising upwards
    c) coming together
    d) sliding past each other.

16. Which of the geologic map symbols represent a tilted rock layer striking south and dipping 45 degrees east?

a) 

b) 

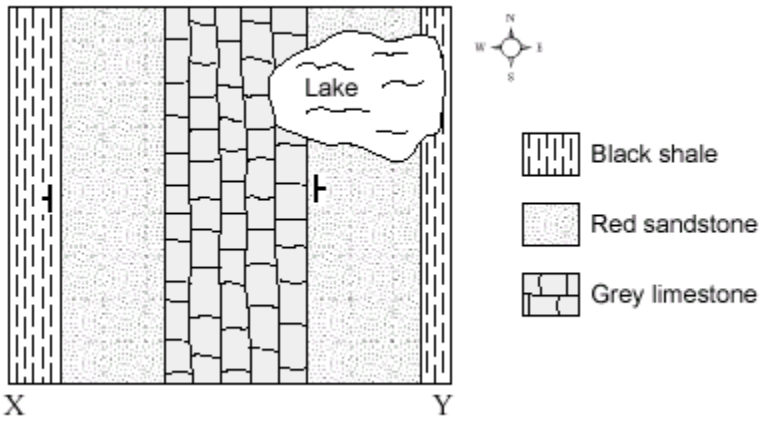


c) 

d) 

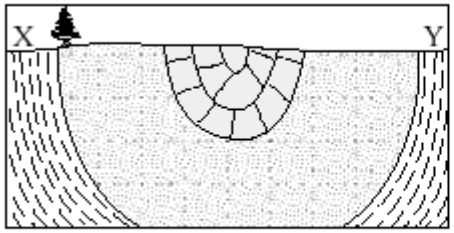
17. When excessive stress is applied to rocks at great depth where temperatures and confining pressures are higher, the rocks are likely to
    a) rupture in a brittle fashion
    b) deform in a plastic manner
    c) continue to behave elastically, without any permanent effects of strain
    d) rupture in a brittle fashion initially and then begin to deform or bend in a plastic fashion

Use the following map to answer question 18 to 20.

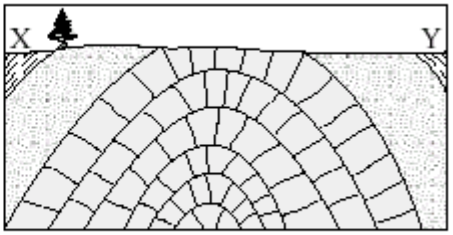


18. Which of the following sketches corresponds to the cross section along **X** and **Y** in the map above?

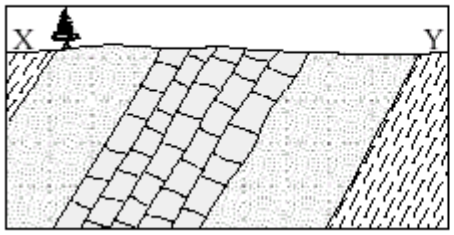
A.



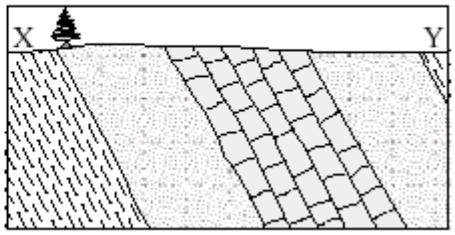
B.



C.



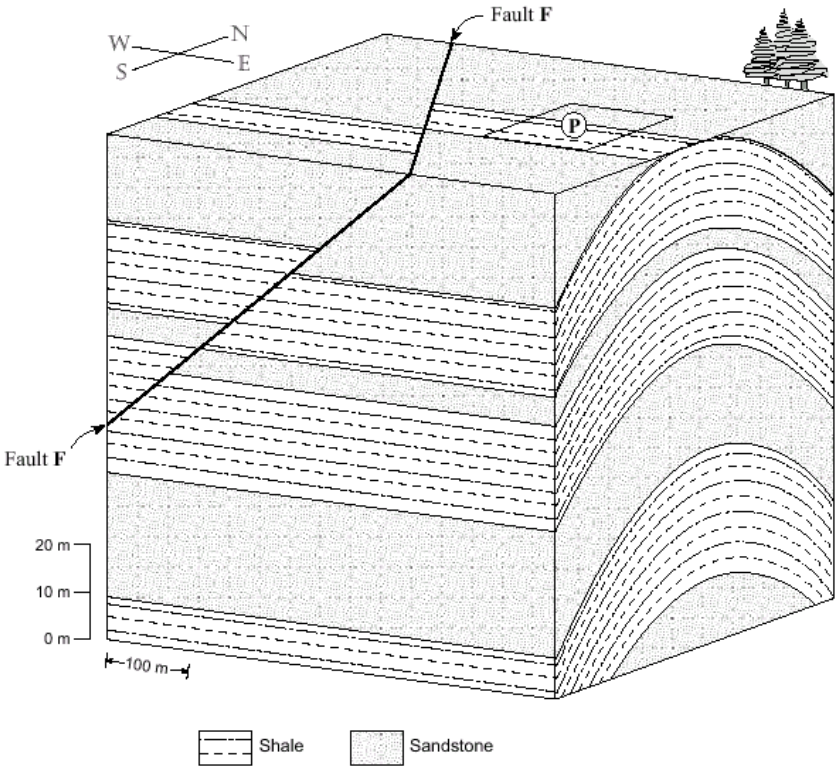
D.



19. The name given to this structure is
    a) anticline
    b) syncline
    c) thrust fault
    d) basin

20. Which layer is the oldest?
    a) Black shale
    b) Red sandstone
    c) Grey limestone
    d) Cannot be determined

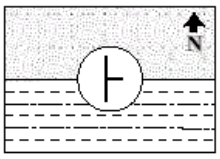
Use the following geologic block diagram to answer questions 21 to 23.

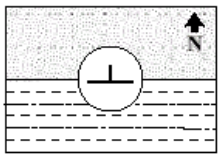


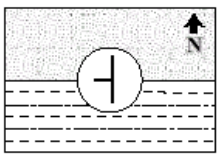
21. There has been no vertical movement on fault F. Fault **F** would be **best** classified as a
    a) normal dip-slip fault.
    b) reverse dip-slip fault.
    c) left lateral strike-slip.
    d) right lateral strike-slip.

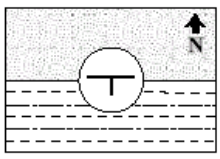
22. The fold shown on the block diagram would be **best** described as a
    a) plunging syncline.
    b) plunging anticline.
    c) non-plunging syncline.
    d) non-plunging anticline.

23. Location **P** lies on the contact between the shale and the sandstone. The correct strike and dip symbol at location **P** would be

A. 

B. 

C. 

D. 

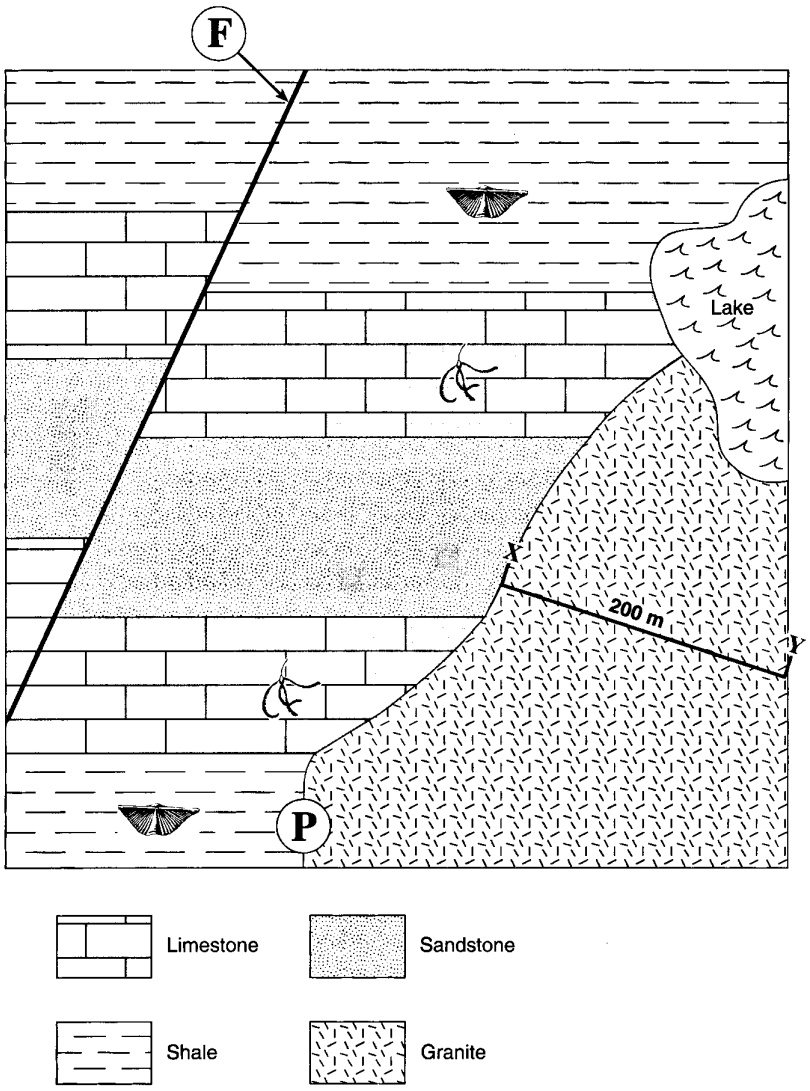
Use the following map to answer questions 24 to 29.

24. Fault F would be classified as
    a) thrust
    b) normal
    c) reverse
    d) strike slip

25. Which layer is the oldest?
    a) limestone
    b) sandstone
    c) shale
    d) granite

26. What is the name of the fold which has affected the sedimentary rocks?
    a) Syncline.
    b) Anticline.
    c) Plunging syncline.
    d) Plunging anticline.

27. Describe one change you would expect to see in the fossiliferous limestone due to contact metamorphism near the granite intrusion.



28. What changes in crystal size would be observed by a geologist as she walked the 200 metre section from **X** to **Y** across the granite?

29. The contact between the granite and the shale at position **P** is dipping to the west. The correct strike and dip symbol at position **P** is

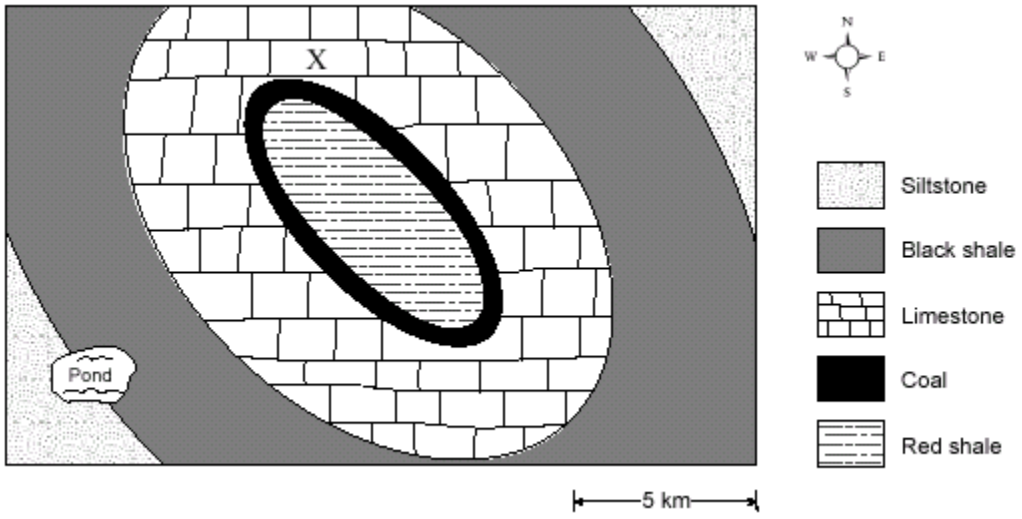
A. 

B. 

C. 

D. 

Use the following sketch map of a geological structure to answer question 30.



30. The geological structure shown in the sketch map is either a dome **or** a basin.

a) Give evidence involving:
i) the dip and strike of the strata, and
ii) the ages of the strata
that a geologist **could look for** to prove whether the structure is a dome or a basin.

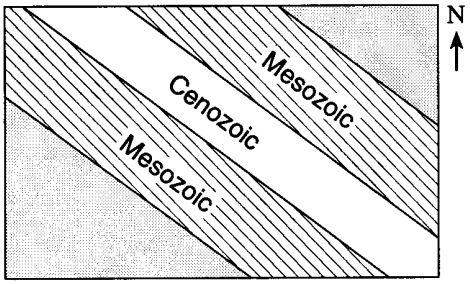
i) Evidence using the dip and strike of the strata:

ii) Evidence using the ages of the strata:

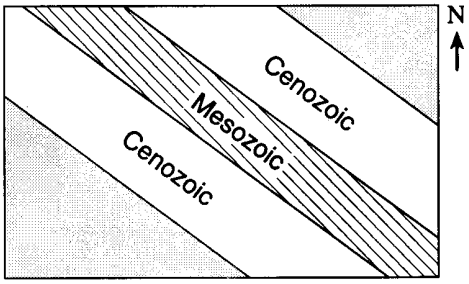
b) A vertical hole drilled at location **X** on the structure encountered three different rock strata. Assuming that the structure is a **dome**, sketch, in the space provided below, the first three strata that would be encountered in the drill hole.

31. Which sketch represents a map view of a plunging anticline?

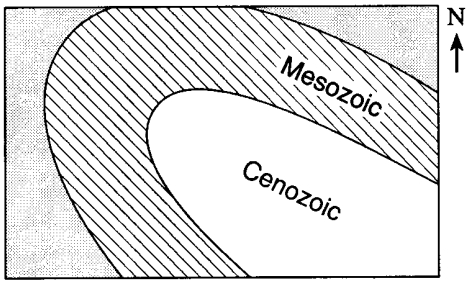
A



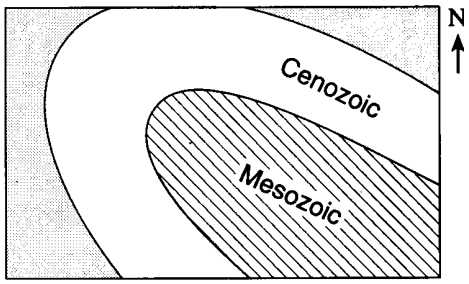
B



C

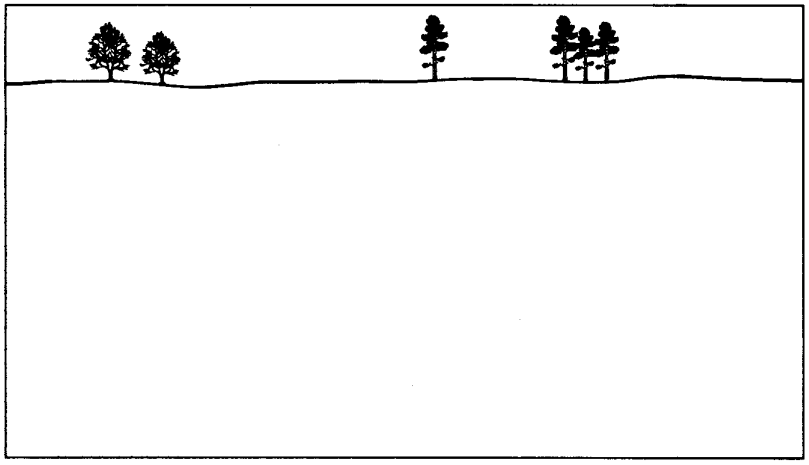


D

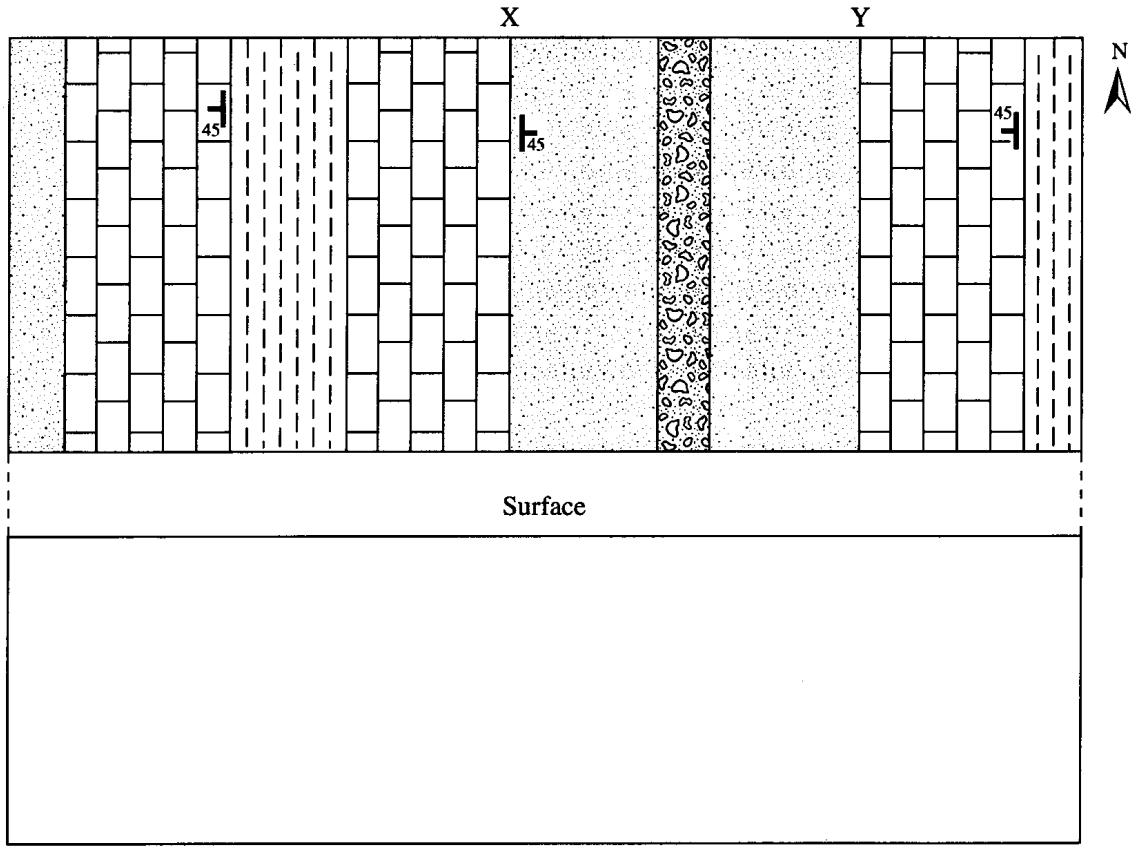


32. Explain how you made your choice for question 31.

33. In the space provided below, sketch and clearly label a cross section that contains an anticline cut by a reverse fault.



Use the following map of exposed sedimentary rock layers to answer question 34.



34. The map above has been constructed by sampling the surface rocks and measuring strike direction and dip angles.

a) Complete the blank cross section for the map area shown above.

b) Name the structure found between X and Y.

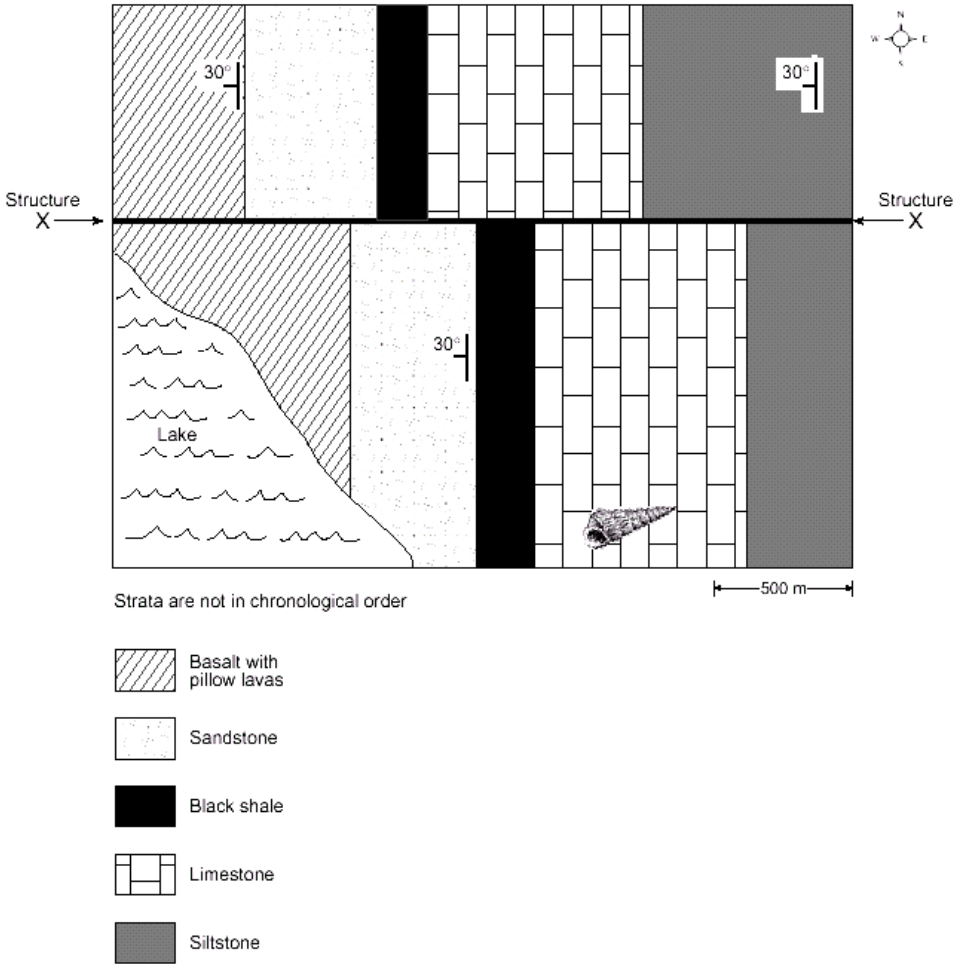
c) Label the oldest layers and youngest layer.

Use the geological map on this page to answer questions 35 and 36.

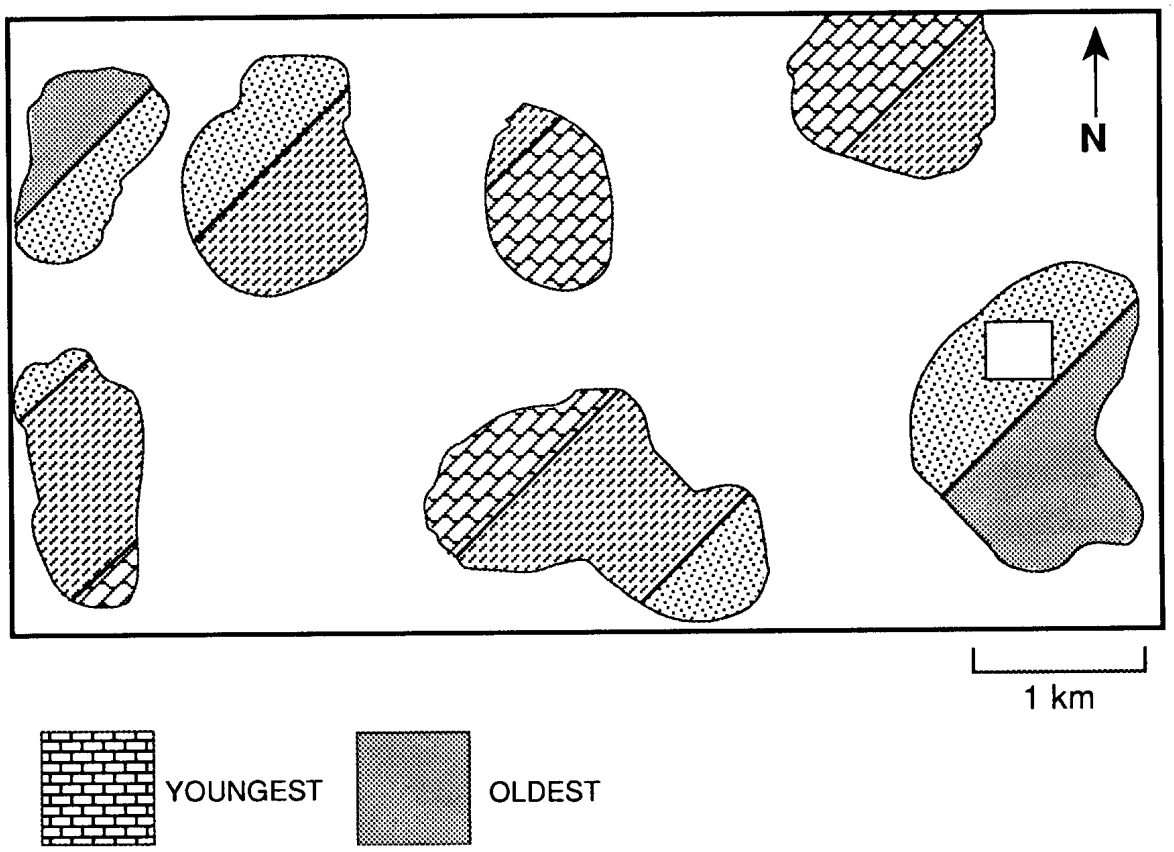
35. The orientation of the strata shown on the Geological Map is
    a) strike east, dip 30 degrees north.
    b) strike south, dip 30 degrees east.
    c) strike north, dip 30 degrees west.
    d) strike west, dip 30 degrees south.

36. The movement along structure **X** on the Geological Map is entirely **vertica**l. Structure **X** is **most likely** a
    a) joint.
    b) dip-slip fault.
    c) unconformity.
    d) strike-slip fault.

GEOLOGICAL MAP



Use the following map of outcrops to answer question 37.

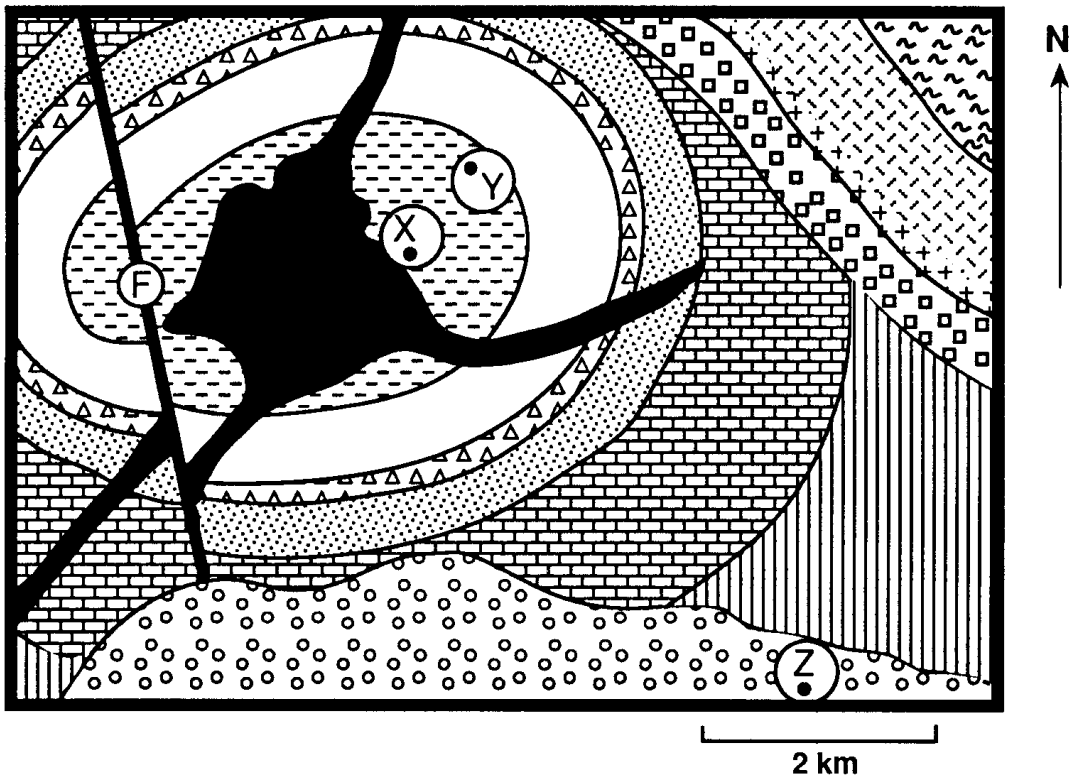


37. This map includes the geology of various outcrops in a small region. It reveals a geological structure.
    a) Complete the map view of the geologic structure on the diagram.

    b) Name the geological structure. Give evidence to support your answer.

    c) Draw the correct strike – dip symbol in the box on the diagram.

Use the following map to answer questions 38 to 43 on the next page.



KEY – Rocks Not in Order of Age

- Green Shale
- Precambrian Schist
- Limestone
- Cambrian Quartzite
- Jurassic Basalt
- Sandstone
- Triassic Shale
- Pleistocene sediment
- Diorite- radiometric age of 20 million years
- Gabbro-radiometric age of 380 million years
- Oligocene Siltstone
- Magnetite concentrations
- Fault

The map area is generally flat except for the northeast section where the land surface rises steeply in a hill formed from nearly horizontal layers of schist (*meta*), gabbro (*ig*) and quartzite (*meta*) units.

38. Name the type of fold which is shown on the flat part of the map and describe, with reference to the available geologic evidence, how the fold would likely have formed.

39. Would the type of stress that formed the fault have been compressive, tensional or horizontal shear?

40. Describe how the schist, gabbro and quartzite units may have come to be overlying the folded rocks and give evidence, from the geologic map, for your reasoning.

41. The gabbro unit has a rich concentration of magnetite towards its base. Describe how the magnetite was concentrated in this way.

42. Place the following events in correct order

Events in random order
Intrusion of the gabbro
Deposition of the limestone
Intrusion of the diorite
Formation of the fault
Metamorphism to form the schist

Events in correct order	
	Youngest
	Oldest

43. List in the correct order, the name and age of the first five rock units that would be encountered in a drill hole at point Z.

Order	Name of rock unit and age
1st	
2nd	
3rd	
4th	
5th	

Questions to Section E: Earth Materials (Metamorphic Rocks and Processes)

1. Relate the types and characteristics of metamorphic rocks to parent rock, temperature, pressure, and chemical conditions.

2. Describe the features of the following metamorphic rocks: slate, phyllite, schist, gneiss, metaconglomerate (stretched pebble), quartzite, marble.

3. Contrast the two major categories of metamorphic rocks: foliated and non-foliated.

4. Contrast the two types of metamorphism: contact and regional.

5. Describe changes that occur in the country rock and in the intrusion at a contact.

6. Relate metamorphic rock type to the concept of metamorphic grade.

7. What are the most distinguishing features of a metamorphic rock compared with those of an igneous rock or sedimentary rock?

8. What kinds of changes occur in a rock as it is metamorphosed?

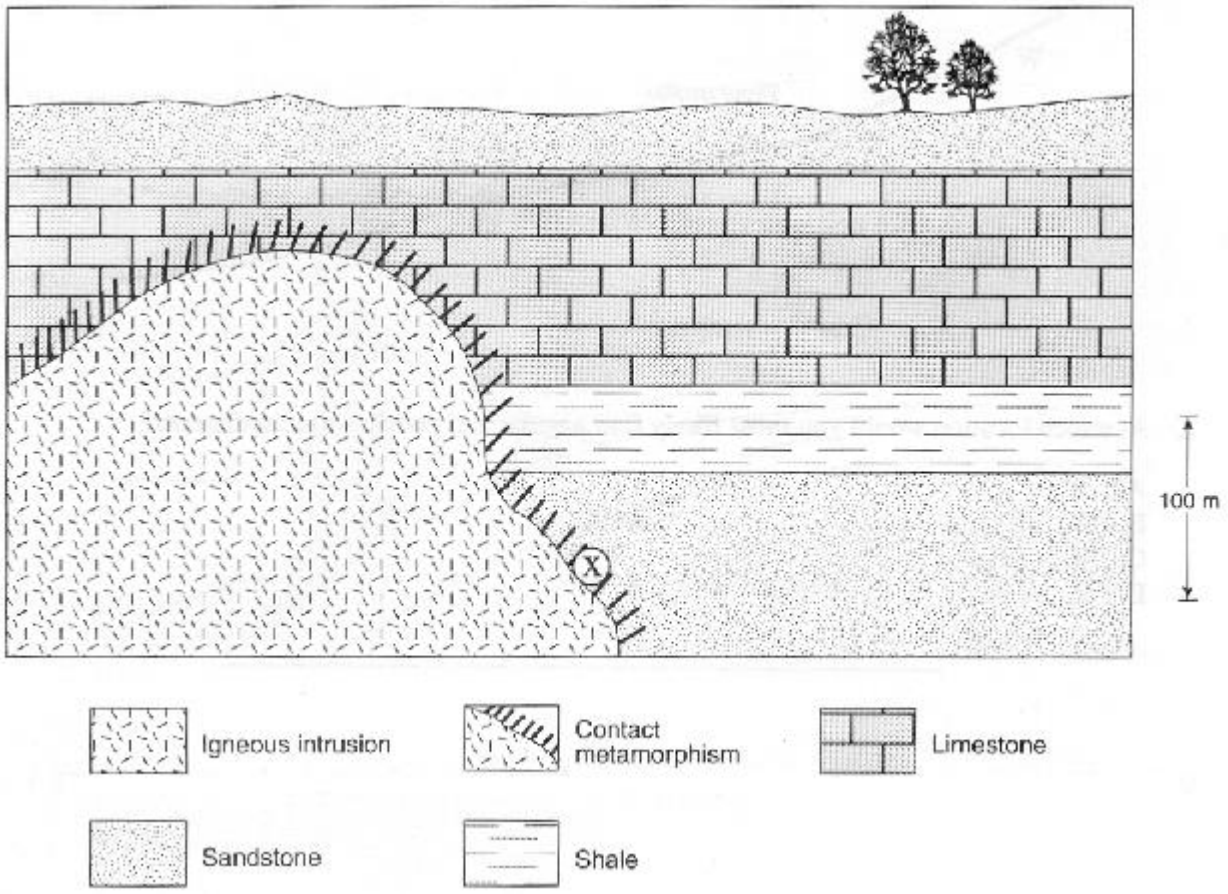
.

9. Why are fossils less likely to be found in metamorphic rocks than in the rocks from which they were derived?

10. Which of the following factors involved in metamorphism is likely to produce strong foliation in a metamorphic rock?
    a) Increased directed stress
    b) Increased confining pressure
    c) Presence on hot fluids passing through the rock
    d) Increased temperature

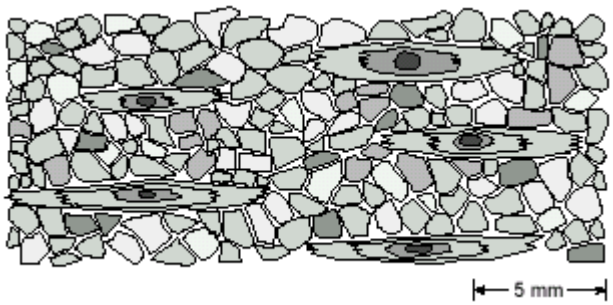
11. Which of the following causes a chilled margin of fine-grained igneous material to be found at the edges of plutons?
    a) Rapid cooling
    b) Partial melting
    c) Contact metamorphism
    d) Fractional crystallization

Use the following diagram to answer question #12



12. Which of the following rocks would you expect to find at location X in the diagram?
    a) Chert
    b) Schist
    c) Marble
    d) Quartzite

Use the following sketch of the texture of a metamorphic rock to answer question 13.



13. Which directions of maximum compressive stress **most likely** caused the alignment of the elongate crystals in the metamorphic rock?

a) $\Rightarrow \Leftarrow$ b) $\Leftarrow \Rightarrow$

c) $\Uparrow$ $\Downarrow$ d) $\Downarrow$ $\Uparrow$

14. Which of the following pairs shows the correct relationship between a metamorphic rock and its parent rock?

	Parent Rock	Metamorphic Rock
a)	shale	quartzite
b)	limestone	marble
c)	gypsum	phyllite
d)	sandstone	slate

15. Which of the following would be an **unlikely** result of regional metamorphism?
    a) Greater rock porosity
    b) Formation of foliation
    c) Increased rock density
    d) Formation of a new mineral

16. Contact metamorphism leads to nonfoliated rock types because the
    a) temperature is not high enough
    b) mineralogy is not correct
    c) pressure is not sufficient
    d) water content is not high enough

17. In a rock, metamorphism increases the
    a) volume
    b) density
    c) porosity
    d) solubility

18. Which of the following rocks represents the highest degree of metamorphism?
    a) Shale
    b) Phyllite
    c) Slate
    d) Schist

19. The chemical compositions of metamorphic rocks depend on the
    a) temperature to which they have been raised
    b) pressures to which they have been subjected
    c) effects of both pressure and temperature
    d) composition of the original rock

20. The most likely result of the metamorphism of granite is
    a) marble
    b) slate
    c) gneiss
    d) quartzite

21. In comparison with slates, schists have
    a) a deeper colour
    b) a lower mica content
    c) larger crystals
    d) no foliation

22. In which type of metamorphic rock are fossils most likely to be preserved?
    a) Slate
    b) Schist
    c) Gneiss
    d) Phyllite