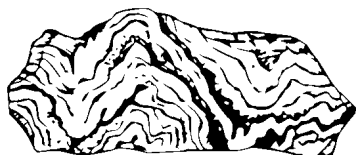


- 
1. Which metamorphic rock will have visible mica crystals and a foliated texture?  
A) marble                      B) quartzite  
C) **schist**                      D) slate
  2. The recrystallization of unmelted material under high temperature and pressure results in  
A) **metamorphic rock**  
B) sedimentary rock  
C) igneous rock  
D) volcanic rock
  3. The rock shown below has a foliated texture and contains the minerals amphibole, quartz, and feldspar arranged in coarse-grained bands.

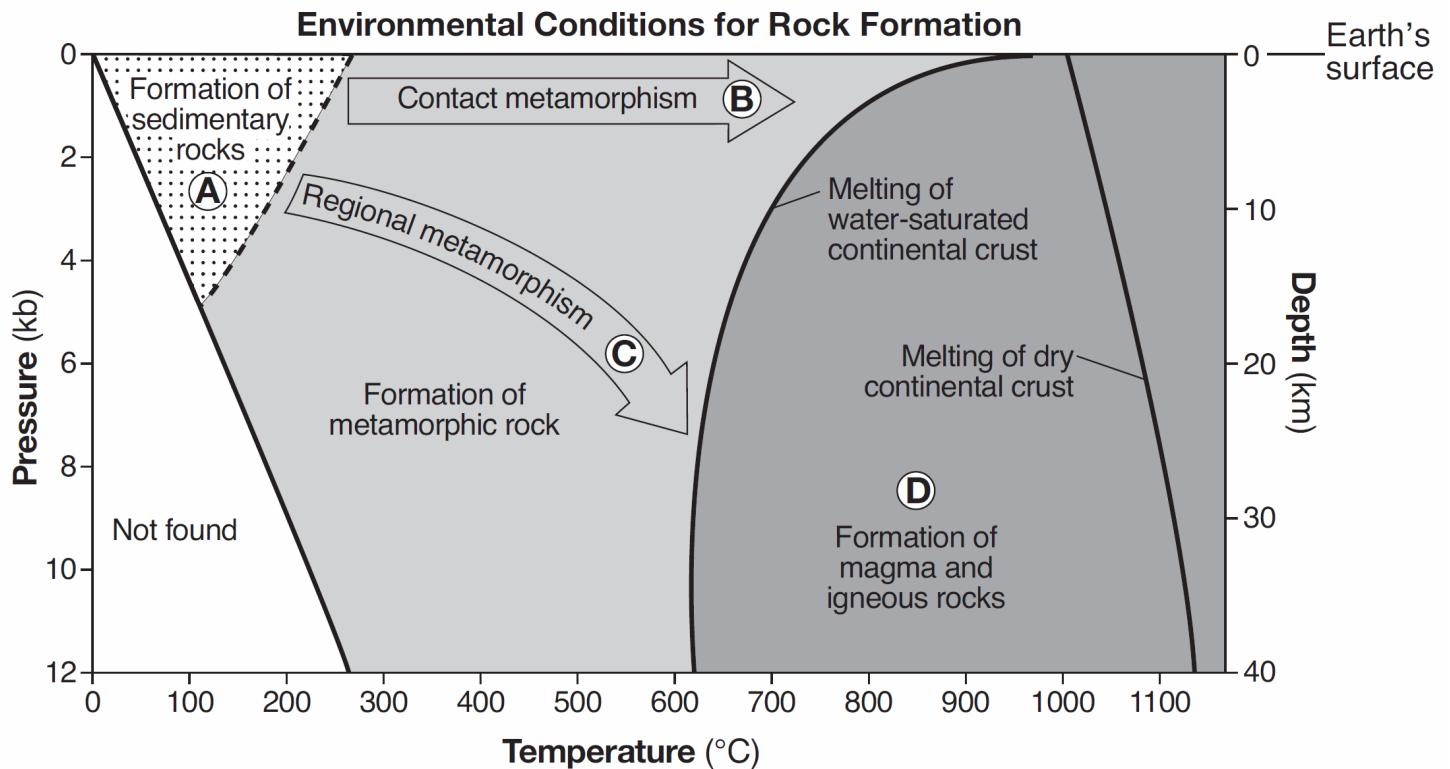


Which rock is shown?

- A) slate                      B) dunite  
C) **gneiss**                      D) quartzite
-

4. Base your answer to the following question on the graph below and on your knowledge of Earth science.

The graph shows the temperature, pressure, and depth environments for the formation of the three major rock types. Pressure is shown in kilobars (kb). Letters *A* through *D* identify different environmental conditions for rock formation.



At what pressure and temperature is sand most likely to be compacted into sandstone?

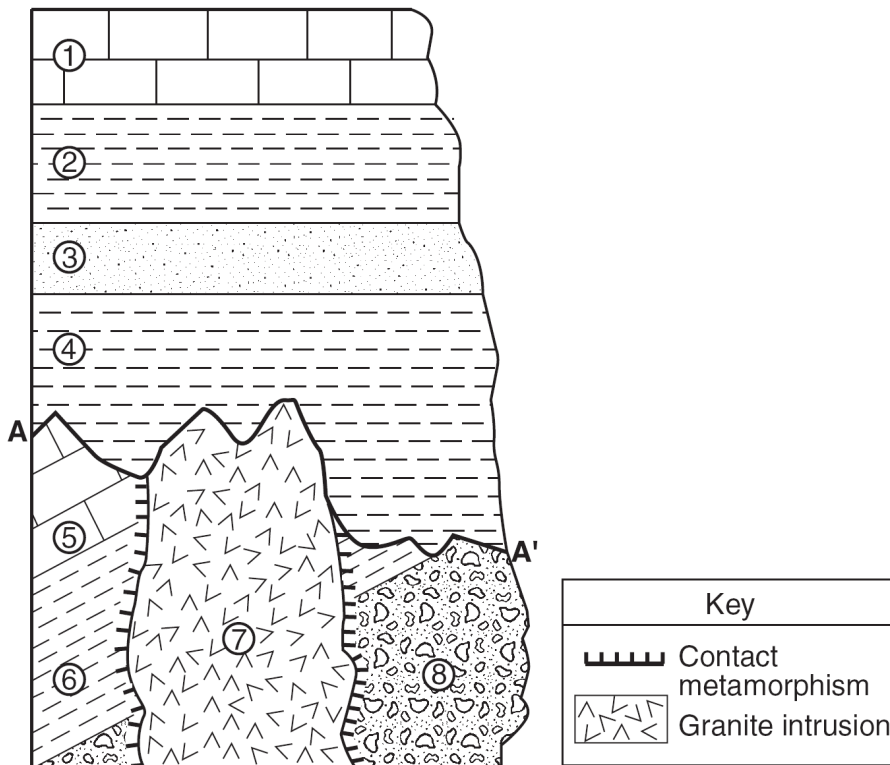
- A) 2 kb and 150°C
- B) 6 kb and 200°C
- C) 10 kb and 400°C
- D) 12 kb and 900°C

5. The photograph below shows a large outcrop of rock composed primarily of visible crystals of mica, quartz, and feldspar.



Based on the composition and foliated texture, this rock can best be identified as

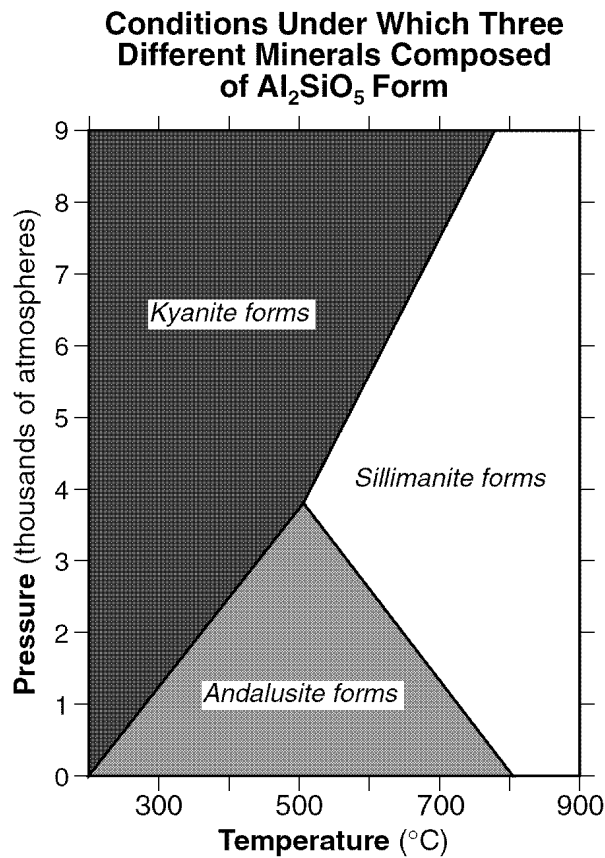
- A) marble                      **B) schist**  
 C) slate                         D) anthracite coal
6. Base your answer to the following question on the cross section below. Rock units are labeled 1 through 8. The line between *A* and *A'* indicates an unconformity.



Which rock most probably formed in the contact metamorphic zone within rock unit 6?

- A) marble                      B) basalt                      C) quartzite                      **D) hornfels**

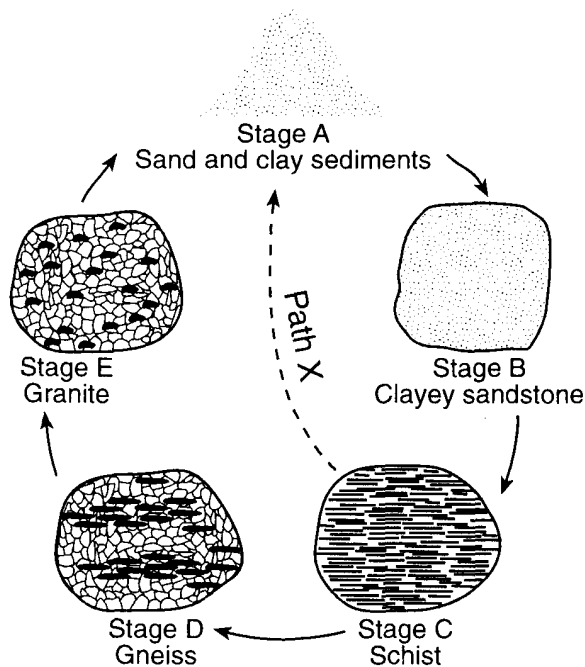
Base your answers to questions 7 and 8 on the graph below, which shows the crustal temperature and pressure conditions under which three different minerals with the same chemical composition ( $\text{Al}_2\text{SiO}_5$ ) crystallize.



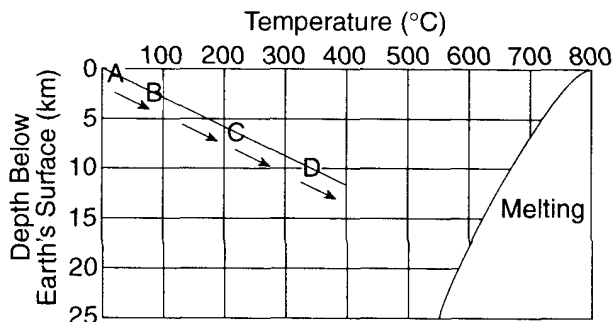
7. Under which crustal temperature and pressure conditions will andalusite form?
- A) 300°C and 6000 atmospheres      **B) 500°C and 2000 atmospheres**  
 C) 600°C and 4000 atmospheres      D) 700°C and 8000 atmospheres
8. If bedrock at a collisional plate boundary contains andalusite crystals, these crystals are changed into sillimanite and/or kyanite as temperature and pressure conditions increase. What is this process called?
- A) weathering      B) solidification  
**C) metamorphism**      D) cementation
- 
9. What is one difference between the metamorphic rocks quartzite and hornfels?
- A) Hornfels is foliated; quartzite is nonfoliated.  
**B) Hornfels contains plagioclase; quartzite does not contain plagioclase.**  
 C) Hornfels is produced by regional metamorphism; quartzite is produced by contact metamorphism.  
 D) Hornfels is medium grained; quartzite is fine grained.

Base your answers to questions 10 through 13 on the diagrams below which represents the same rock material at five stages of development. The graph below shows the temperature and depth of burial at which stages A through D develop. Stage E has intentionally been omitted from the graph.

### A Simple Rock Cycle



### Environment of Rock Stages



10. According to the graph, gneiss is formed at a depth of approximately
  - A) 10 km
  - B) 7 km
  - C) 3 km
  - D) 0 km
11. The rocks in stages C and D are both
  - A) noncrystalline
  - B) **foliated**
  - C) clastic
  - D) glassy
12. Clayey sandstone will form gneiss if the
  - A) temperature and pressure both decrease
  - B) **temperature and pressure both increase**
  - C) temperature decreases and the pressure increases
  - D) temperature increases and the pressure decreases
13. In the simple rock-cycle diagram, which processes along path X would change the schist (stage C) directly into a pile of sediments (stage A)?
  - A) **uplift, weathering, and erosion of the schist**
  - B) cementing of sediment grains followed by compaction
  - C) melting of the schist followed by cooling
  - D) heat and/or pressure applied to the schist
14. Base your answer to the following question on the information below.

A student on a field trip in New York State collected a sample of metamorphic bedrock containing bands of coarse-grained crystals of plagioclase feldspar, pyroxene, quartz, and mica.

Identify the metamorphic rock found by the student.

15. The cartoon below presents a humorous look at history.

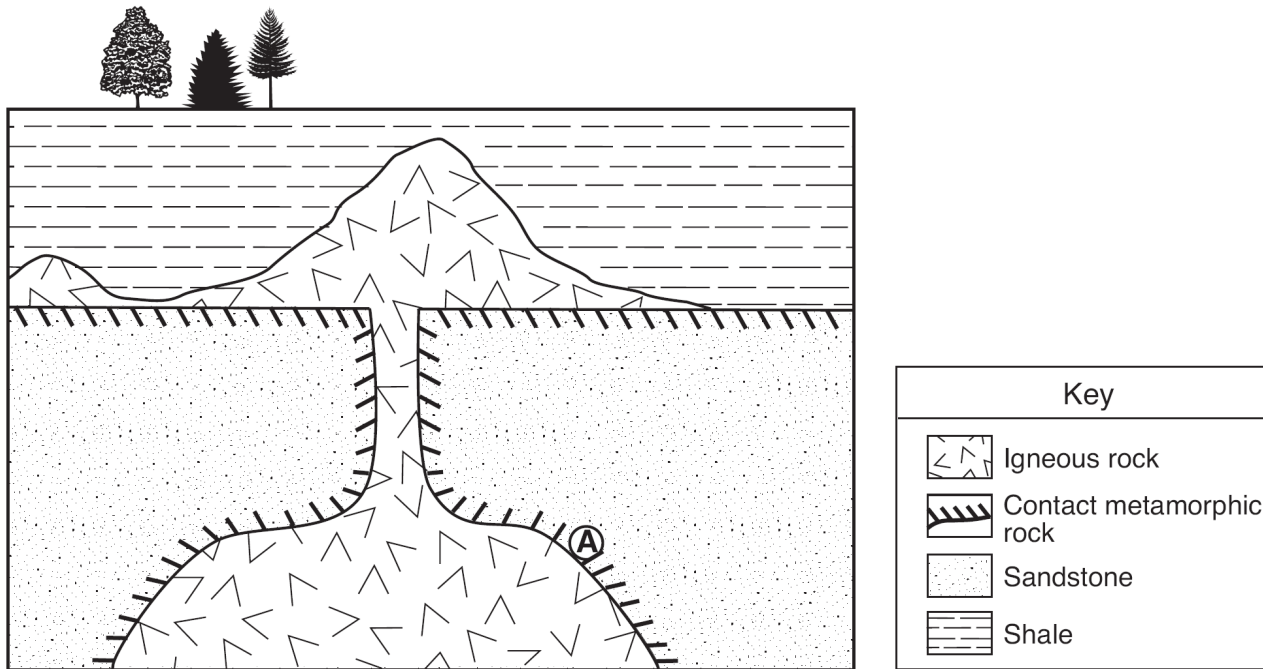


"You know, I like this hobby, too... But it seems like people from other communities have collected all the shiny mica rocks with foliated textures... There aren't any left for us!"

What kind of rocks does the complaining rock collector want?

- A) felsic volcanic rocks
- B) clastic sedimentary rocks
- C) inorganic sedimentary rocks
- D) regionally metamorphosed rocks**

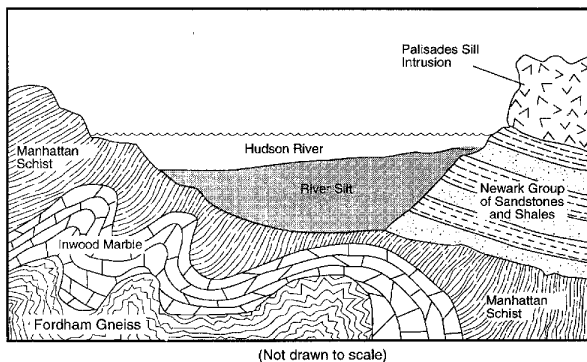
16. Base your answer to the following question on the geologic cross section below. Location *A* is within the metamorphic rock.



The metamorphic rock at location *A* is most likely

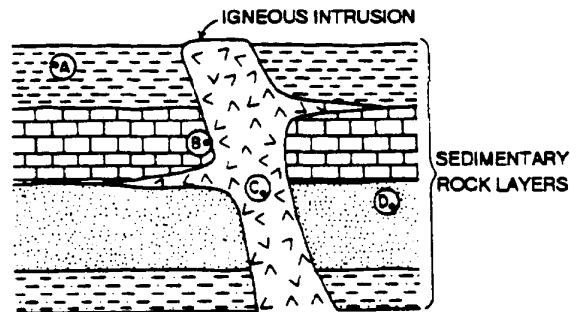
- A) marble      **B) quartzite**      C) phyllite      D) slate
17. Which rocks would most likely be separated by a transition zone of altered rock (metamorphic rock)?
- A) sandstone and limestone  
**B) granite and limestone**  
 C) shale and sandstone  
 D) conglomerate and siltstone
- Base your answers to questions 18 and 19 on the cross section below which shows the surface and subsurface rock formations near New York City.
19. The rock types shown on the left side of this geologic cross section were mainly the result of
- A) heat and pressure exerted on previously existing rock**  
 B) melting and solidification of crustal rocks at great depths  
 C) tectonic plate boundaries diverging at the mid-ocean ridge  
 D) compaction and cementation of sediments under ocean waters

Geologic Section Across the Hudson River



18. Which rock formation was originally limestone?
- A) Palisades sill      B) Fordham gneiss  
**C) Inwood marble**      D) Manhattan schist

20. The diagram below shows an igneous rock intrusion in sedimentary rock layers.



At which point would metamorphic rock most likely be found?

- A) *A*      **B) *B***      C) *C*      D) *D*

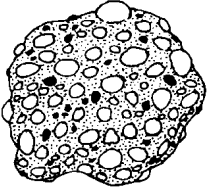
21. Base your answer to the following question on the diagrams below of five rock samples.



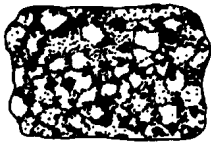
BASALT



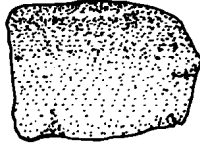
GNEISS  
(METAMORPHIC)



CONGLOMERATE



GRANITE



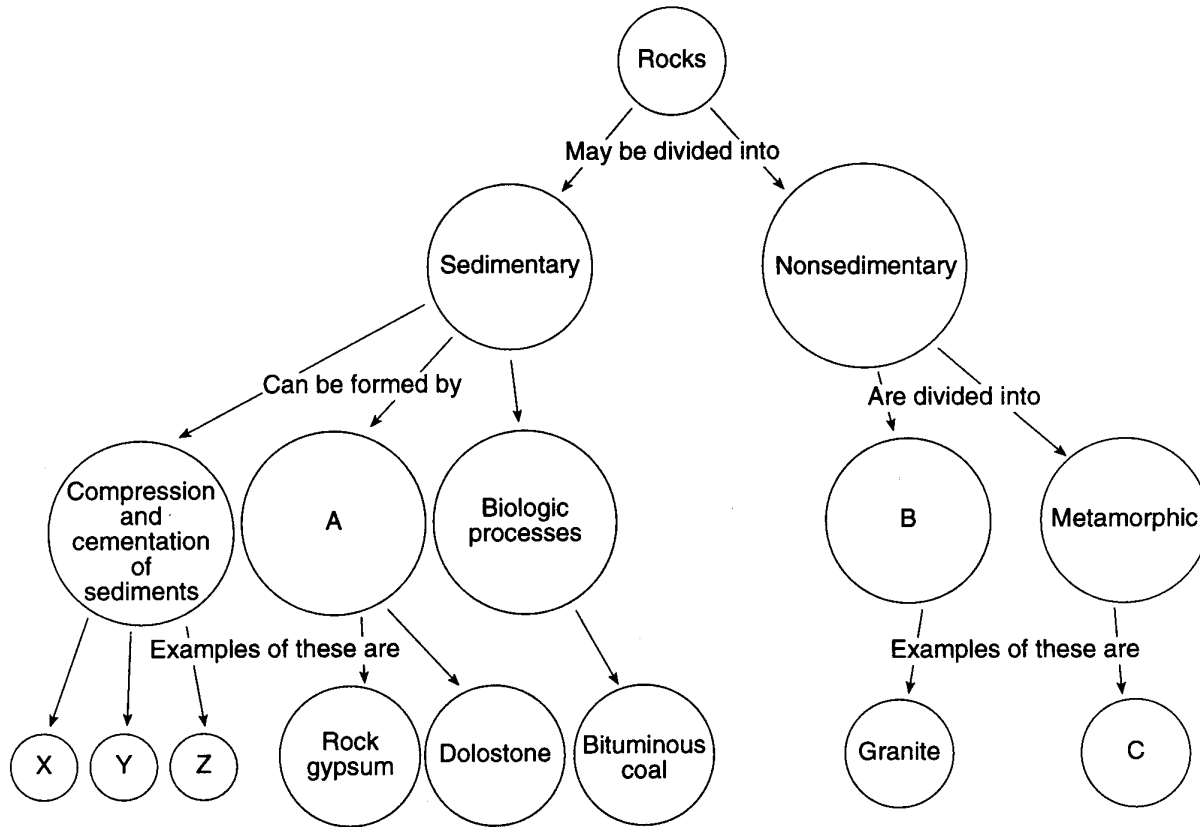
SANDSTONE

If granite were subjected to intense heat and pressure, it would most likely change to

- A) conglomerate      B) sandstone  
C) **gneiss**              D) basalt
22. Which rock forms by the recrystallization of unmelted rock material under conditions of high temperature and pressure?
- A) granite              **B) gneiss**  
C) rock gypsum      D) bituminous coal
23. Which characteristic of rocks tends to increase as the rocks are metamorphosed?
- A) **density**  
B) porosity  
C) permeability  
D) number of fossils present



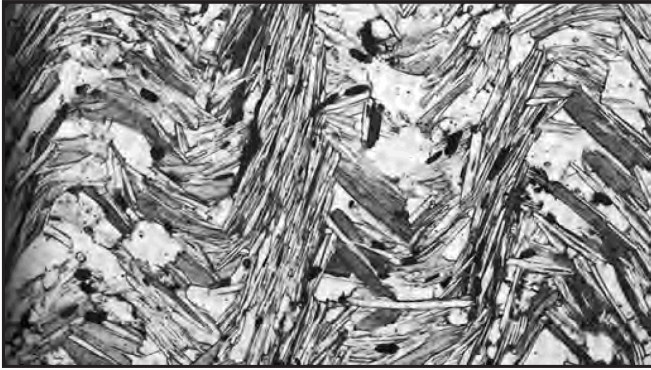
24. Base your answer to the following question on the diagram below, which represents a scheme for classifying rocks. The letters *A*, *B*, *C* and *X*, *Y*, *Z* represent missing labels.



If the rock in circle *C* formed from limestone, it would be called

- A) schist      B) anthracite coal    C) **marble**      D) slate
- 
25. Which sequence of change in rock type occurs as shale is subjected to increasing heat and pressure?
- A) shale → schist → phyllite → slate → gneiss  
**B) shale → slate → phyllite → schist → gneiss**  
 C) shale → gneiss → phyllite → slate → schist  
 D) shale → gneiss → phyllite → schist → slate
26. Which nonfoliated rock forms only in a zone of contact metamorphism?
- A) conglomerate      **B) hornfels**  
 C) pegmatite      D) quartzite
27. How do the metamorphic rocks schist and quartzite differ?
- A) Quartzite contains the mineral quartz and schist does not.  
 B) Quartzite forms from regional metamorphism and schist does not.  
 C) Schist is organically formed and quartzite is not.  
**D) Schist is foliated and quartzite is not.**
28. Wavy bands of light and dark minerals visible in gneiss bedrock probably formed from the
- A) cementing together of individual miner grains  
 B) cooling and crystallization of magma  
 C) evaporation of an ancient ocean  
**D) heat and pressure during metamorphism**
29. During the intrusion of the Palisades Sill, contact metamorphism changed sandstone and shale into
- A) diorite      B) marble  
 C) limestone      **D) hornfels**

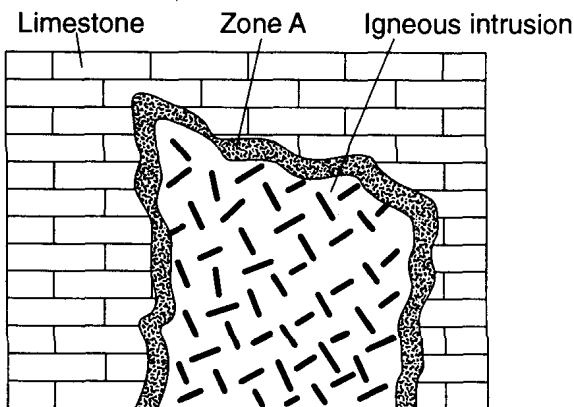
30. The photograph below shows the texture of a rock composed of various minerals as seen through a microscope.



(Magnified 20 times)

Which rock is most likely shown above?

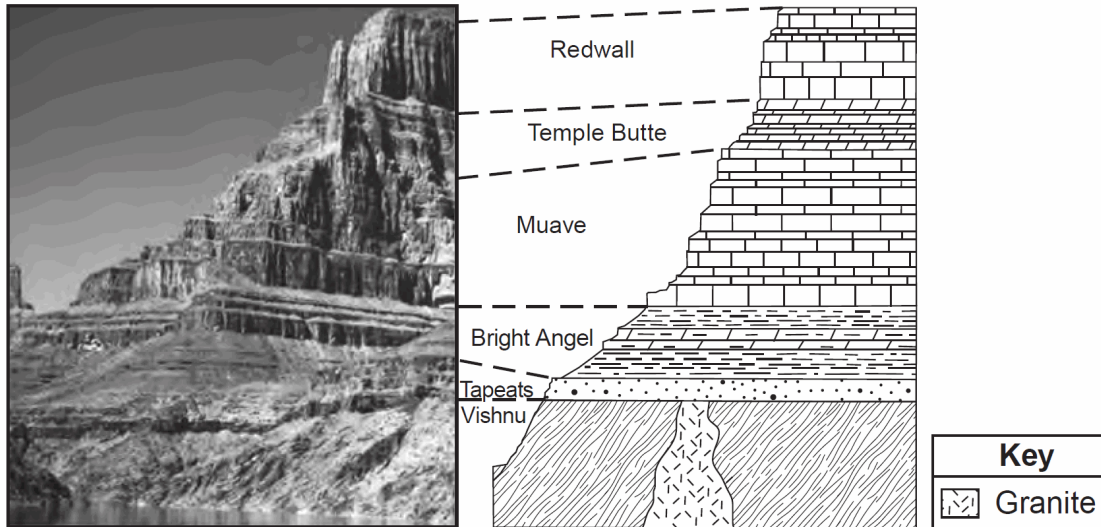
- A) sandstone                      B) anthracite coal  
C) dunite                          D) **schist**
31. The geologic cross section below shows limestone that was intruded. Part of the limestone (zone A) was heated intensely but was not melted.



Which type of rock most likely formed in zone A?

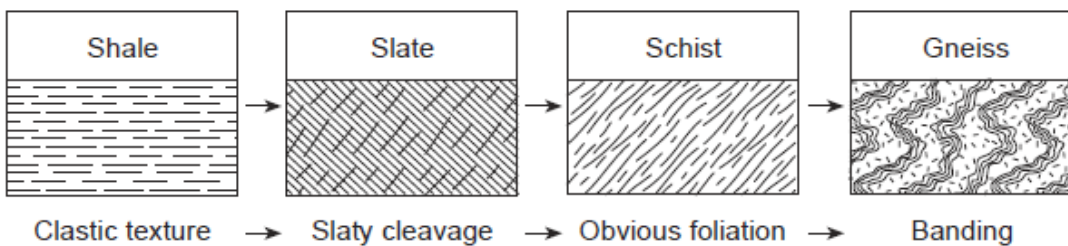
- A) gneiss                          B) slate  
C) **marble**                        D) obsidian
32. Which processes change sedimentary rocks into metamorphic rocks?
- A) erosion and deposition  
B) melting and solidification  
C) evaporation and condensation  
D) **temperature and pressure changes**

33. Base your answer to the following question on the photograph and cross section below and on your knowledge of Earth science. The sequence of rock types found in the walls of the Grand Canyon are shown. The names of rock formations are shown and the upper and lower boundaries of each formation are indicated by dashed lines. The rock layers have *not* been overturned.



The granite formation was primarily formed by

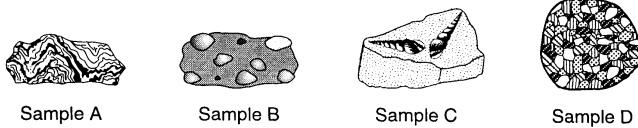
- A) metamorphism of layered sandstone      **B) solidification of felsic magma**  
 C) compaction of precipitated gypsum      D) cementation of clastic sediments
34. The diagram below indicates physical changes that accompany the conversion of shale to gneiss.



Which geologic process is occurring to cause this conversion?

- A) sedimentary layering      B) intrusion of magma  
**C) metamorphism**      D) weathering
- 
35. Which two kinds of adjoining bedrock would most likely have a zone of contact metamorphism between them?
- A) shale and conglomerate  
 B) shale and sandstone  
 C) limestone and sandstone  
**D) limestone and granite**
36. Which sedimentary rock is most likely to be changed to slate during regional metamorphism?
- A) breccia      B) conglomerate  
 C) dolostone      **D) shale**

37. The diagram below shows four rock samples.



Which sample best shows the physical properties normally associated with regional metamorphism?

- A) A    B) B    C) C    D) D

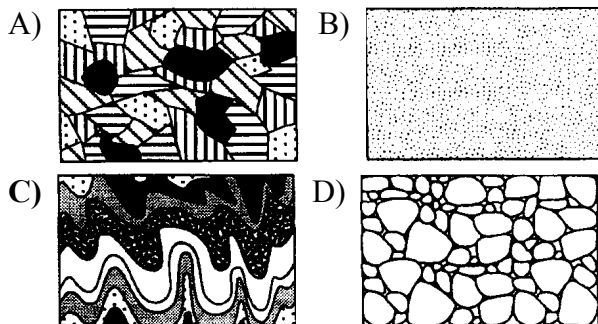
38. Metamorphic rocks form as the direct result of

- A) precipitation from evaporating water  
 B) melting and solidification in magma  
 C) erosion and deposition of soil particles  
**D) heat and pressure causing changes in existing rock**

39. Where is metamorphic rock frequently found?

- A) on mountaintops that have horizontal layers containing marine fossils  
 B) within large lava flows  
 C) as a thin surface layer covering huge areas of the continents  
**D) along the interface between igneous intrusions and sedimentary bedrock**

40. Which diagram best represents a sample of the metamorphic rock gneiss? (Diagrams show actual size.)



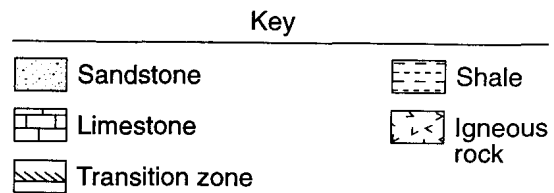
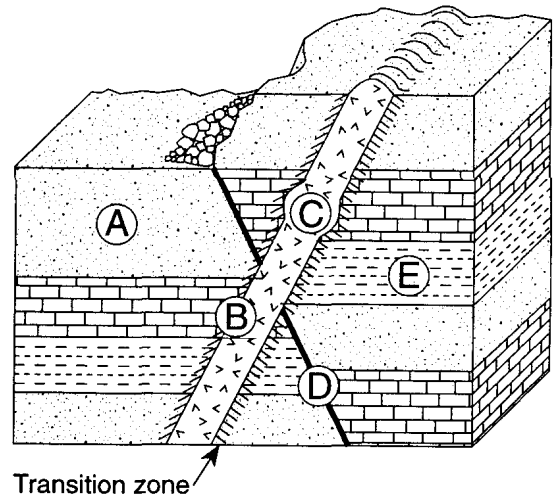
41. During the Permian Period, sedimentary bedrock in the Appalachian Region was subjected to high temperature and pressure. Calcite deposits that had existed in this environment would most likely have formed

- A) schist                      B) gabbro  
**C) marble**                    D) gneiss

42. Which rock is foliated, shows mineral alignment but not banding, and contains medium-sized grains of quartz and pyroxene?

- A) phyllite                      **B) schist**  
 C) gneiss                        D) quartzite

43. Base your answer to the following question on the geologic cross section shown below.



At which location is metamorphic rock most likely to be found?

- A) A    **B) B**    C) C    D) D

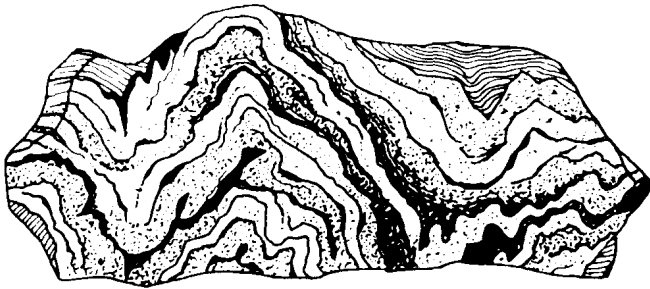
44. Which rock was subjected to intense heat and pressure but did *not* solidify from magma?

- A) sandstone                      **B) schist**  
 C) gabbro                         D) rhyolite

45. What is the main difference between metamorphic rocks and most other rocks?

- A) Many metamorphic rocks contain only one mineral.  
 B) Many metamorphic rocks have an organic composition.  
**C) Many metamorphic rocks exhibit banding and distortion of structure.**  
 D) Many metamorphic rocks contain a high amount of oxygen-silicon tetrahedra.

- 
46. Heat and pressure due to magma intrusions may result in
- A) vertical sorting
  - B) graded bedding
  - C) contact metamorphism**
  - D) chemical evaporites
47. Which physical characteristic best describes the rock phyllite?
- A) glassy texture with gas pockets
  - B) clastic texture with angular fragments
  - C) bioclastic texture with cemented shell fragments
  - D) foliated texture with microscopic mica crystals**
48. The diagram below represents a rock with a distorted layer structure.



The distorted structure of this rock is most likely the result of

- A) a long period of weathering
  - B) glacial activity
  - C) wind erosion
  - D) extreme pressure**
49. Most metamorphic rocks are formed when
- A) sediments are cemented and compacted
  - B) magma cools slowly, deep underground
  - C) flows of lava cool rapidly
  - D) rocks are subjected to heat and pressure**
50. Which rock is only formed by regional metamorphism?
- A) slate**
  - B) hornfels
  - C) dunite
  - D) marble
-

51. The data table below lists characteristics of rocks *A*, *B*, *C*, and *D*.

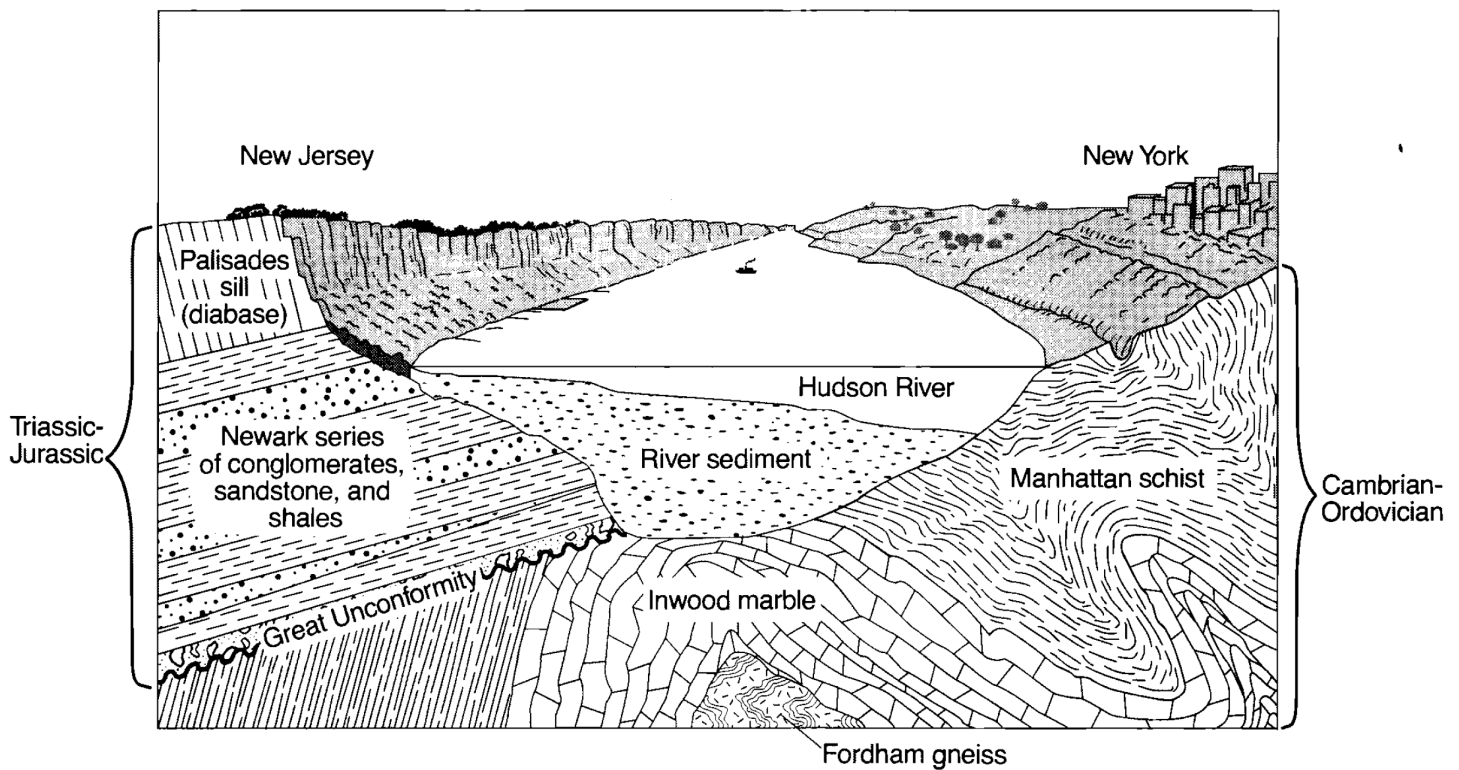
### Rock Characteristics

Rock	Texture	Grain Size	Mineral Composition
A	nonfoliated	fine to coarse	calcite, dolomite, carbon
B	banding	coarse	biotite, quartz, plagioclase feldspar
C	bioclastic	microscopic to coarse	carbon, pyroxene, mica
D	foliated	fine to medium	quartz, amphibole, garnet

Which rock is most likely phyllite?

- A) *A*                      B) *B*                      C) *C*                      D) *D*

52. Base your answer to the following question on the cross section below showing the underlying bedrock of New York and New Jersey along the Hudson River.



Describe *one* piece of evidence shown in the cross section that indicates that the Inwood marble was formed by regional metamorphism.

53. Metamorphic rocks result from the

- A) erosion of rocks  
B) **recrystallization of rocks**  
C) cooling and solidification of molten magma  
D) compression and cementation of soil particles