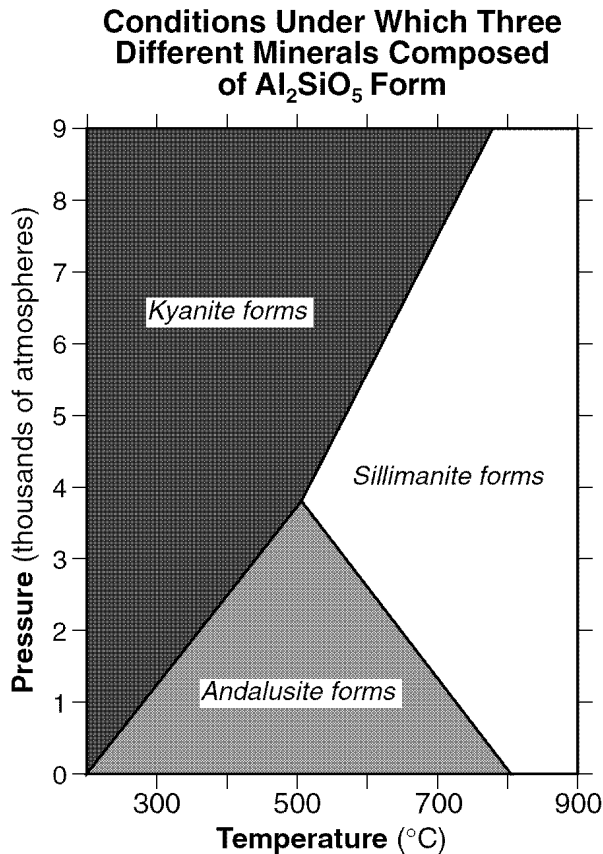


1. Base your answer to the following question on the graph below, which shows the crustal temperature and pressure conditions under which three different minerals with the same chemical composition ( $\text{Al}_2\text{SiO}_5$ ) crystallize.



Which mineral has a chemical composition most similar to andalusite, sillimanite, and kyanite?

- 1) pyrite                      2) gypsum                      3) dolomite                      4) potassium feldspar
- 
2. A nonvesicular rock is made entirely of green 2-millimeter-diameter crystals that have a hardness of 6.5 and show fracture, but *not* cleavage. The rock is most likely
- 1) shale    2) phyllite    3) dunite    4) schist
3. Which mineral shows no cleavage, has a hardness of 7, and a composition of  $\text{SiO}_2$ ?
- 1) Graphite    2) Garnet    3) Halite    4) Quartz
4. An unidentified mineral that is softer than calcite exhibits a metallic luster and cubic cleavage. This mineral most likely is
- 1) galena                      3) halite  
2) pyrite                      4) pyroxene
5. Which mineral is white or colorless, has a hardness of 2.5, and splits with cubic cleavage?
- 1) calcite    2) halite    3) pyrite    4) mica
6. Which mineral is commonly mined as a source of the element lead (Pb)?
- 1) galena                      3) magnetite  
2) quartz                      4) gypsum
7. Which of the following elements is not found in Plagioclase Feldspar?
- 1) Na    2) Al    3) Si    4) Pb
8. How are the minerals biotite mica and muscovite mica different?
- 1) Biotite mica is colorless, but muscovite mica is not.  
2) Biotite mica contains iron and/or magnesium, but muscovite mica does not.  
3) Muscovite mica scratches quartz, but biotite mica does not.  
4) Muscovite mica cleaves into thin sheets, but biotite mica does not.
9. The diagram below represents a basic atomic structure that forms when oxygen and silicon unite.
- Key**

Oxygen atoms

Silicon atom
- This structure is called a
- 1) tetrahedron                      3) sphere  
2) cube                              4) cylinder
10. Which bedrock would be most likely to contain fossils?
- 1) Precambrian granite  
2) Cambrian shale  
3) Pleistocene basalt  
4) Middle-Proterozoic quartzite

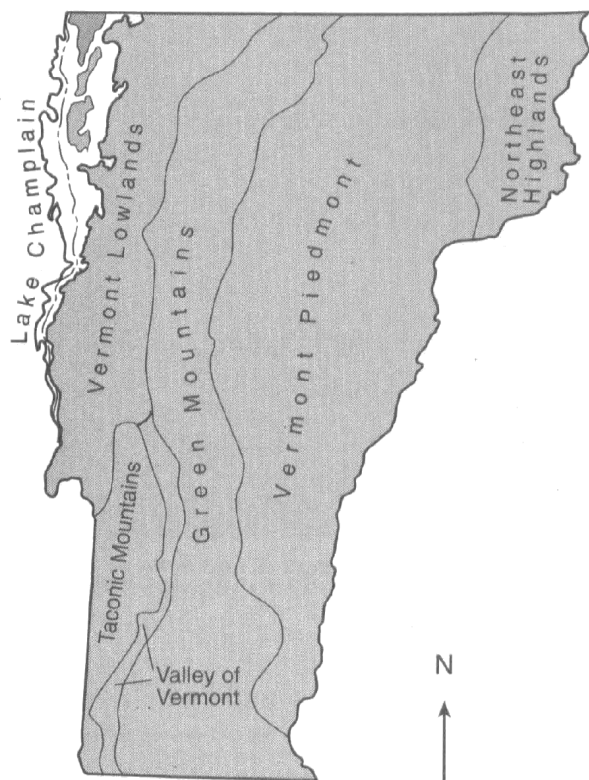
11. Base your answer to the following question on the passage and map below. The map shows the generalized landscape regions of Vermont.

### Landscape Regions of Vermont

Most of Vermont's landscape regions consist of ancient, weathered mountains that were covered by several ice sheets during the last ice age. When the ice melted, sand, cobbles, and boulders were deposited throughout the state, Vermont is divided into six landscape regions.

- (1) The Vermont Lowlands region has a mild climate, with Lake Champlain moderating its temperature.
- (2) The Green Mountains run the length of Vermont and were formed over 400 million years ago. Most of the bedrock is metamorphic and the region is known for its deposits of talc and asbestos.
- (3) The Taconic Mountains extend into New York State. Slate and marble are commonly mined in this region.
- (4) The Valley of Vermont is a narrow valley between two mountain ranges. Most of the bedrock in the region is limestone and marble.
- (5) The Vermont Piedmont covers the largest area of the state. This region consists of rolling hills and valleys. Granite mining is an important industry.
- (6) The Northeast Highlands is a mountainous region composed of granite bedrock.

### Generalized Landscape Regions of Vermont



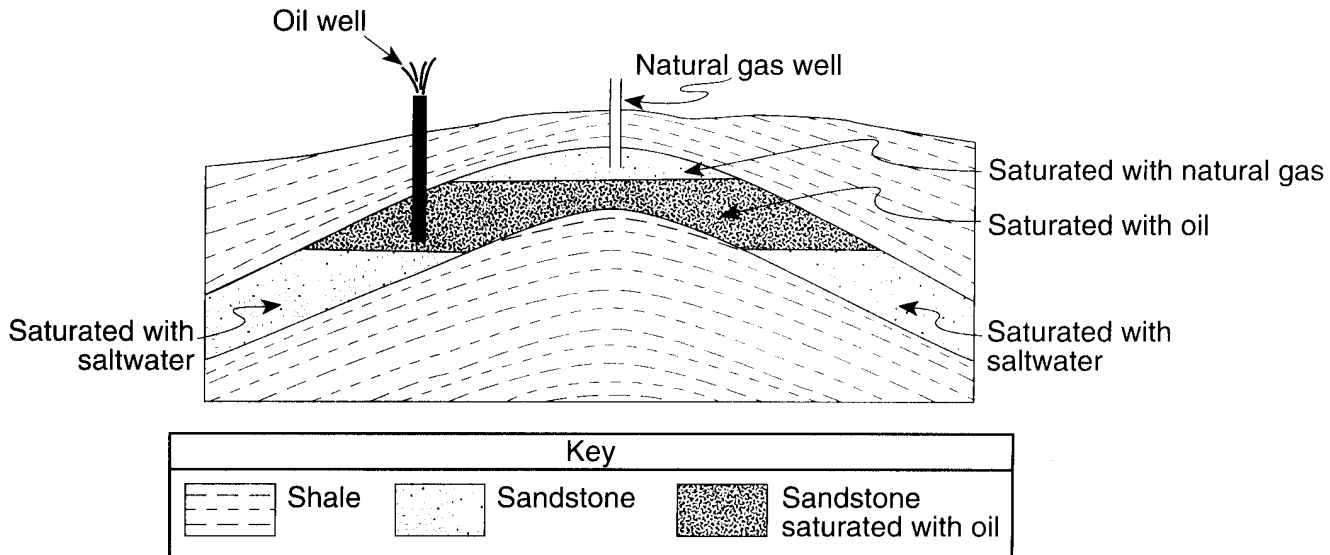
Some of the bedrock in the Green Mountains is actually green in color because of the presence of the mineral chlorite. Which other mineral can cause rocks to appear green?

- 1) sulfur                      2) magnetite                      3) olivine                      4) halite

12. Two minerals made of pure carbon are diamond and graphite. Which statement best explains why diamond is so much more resistant to scratching than graphite?
- 1) The atoms are lighter in graphite than in diamond.
  - 2) The atoms are heavier in graphite than in diamond.
  - 3) The atoms are bonded together more strongly in diamond than in graphite.
  - 4) The atoms are smaller in graphite than in diamond.

13. Large rock salt deposits in the Syracuse area indicate that the area once had
- 1) large forests
  - 2) a range of volcanic mountains
  - 3) many terrestrial animals
  - 4) a warm, shallow sea

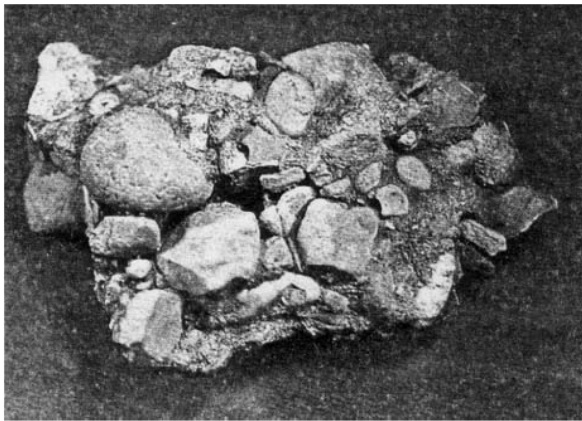
14. Base your answer to the following question on the cross section below, which shows a typical bedrock structure where oil and natural gas deposits are found.



The natural gas, oil, and saltwater have formed layers at different levels in the same rock layer due to the

- 1) principle of superposition
- 2) principle of original horizontality
- 3) differences in the density of the three materials
- 4) differences in the geologic age of the three materials

15. A student classified the rock below as sedimentary.



Which observation about the rock best supports this classification?

- 1) The rock is composed of several minerals.
- 2) The rock has a vesicular texture.
- 3) The rock contains fragments of other rocks.
- 4) The rock shows distorted and stretched pebbles.

16. Which type of rock is represented by the map symbol below?



- 1) clastic sedimentary rock formed from organic substances
- 2) chemically formed sedimentary rock that consists mainly of the mineral calcite
- 3) regional metamorphic rock with block like foliation
- 4) contact metamorphic rock that results from the alteration of limestone by contact with an igneous intrusion

17. The end product of the weathering of gabbro or basalt rocks is a solution of dissolved material that most likely would contain high amounts of

- 1) iron and magnesium
- 2) magnesium and potassium
- 3) aluminum and iron
- 4) aluminum and potassium

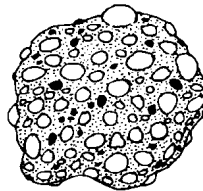
18. Base your answer to the following question on the diagrams below of five rock samples.



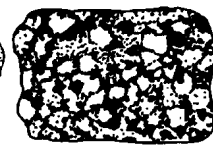
BASALT



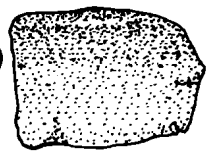
GNEISS  
(METAMORPHIC)



CONGLOMERATE



GRANITE



SANDSTONE

The basalt was most likely formed by

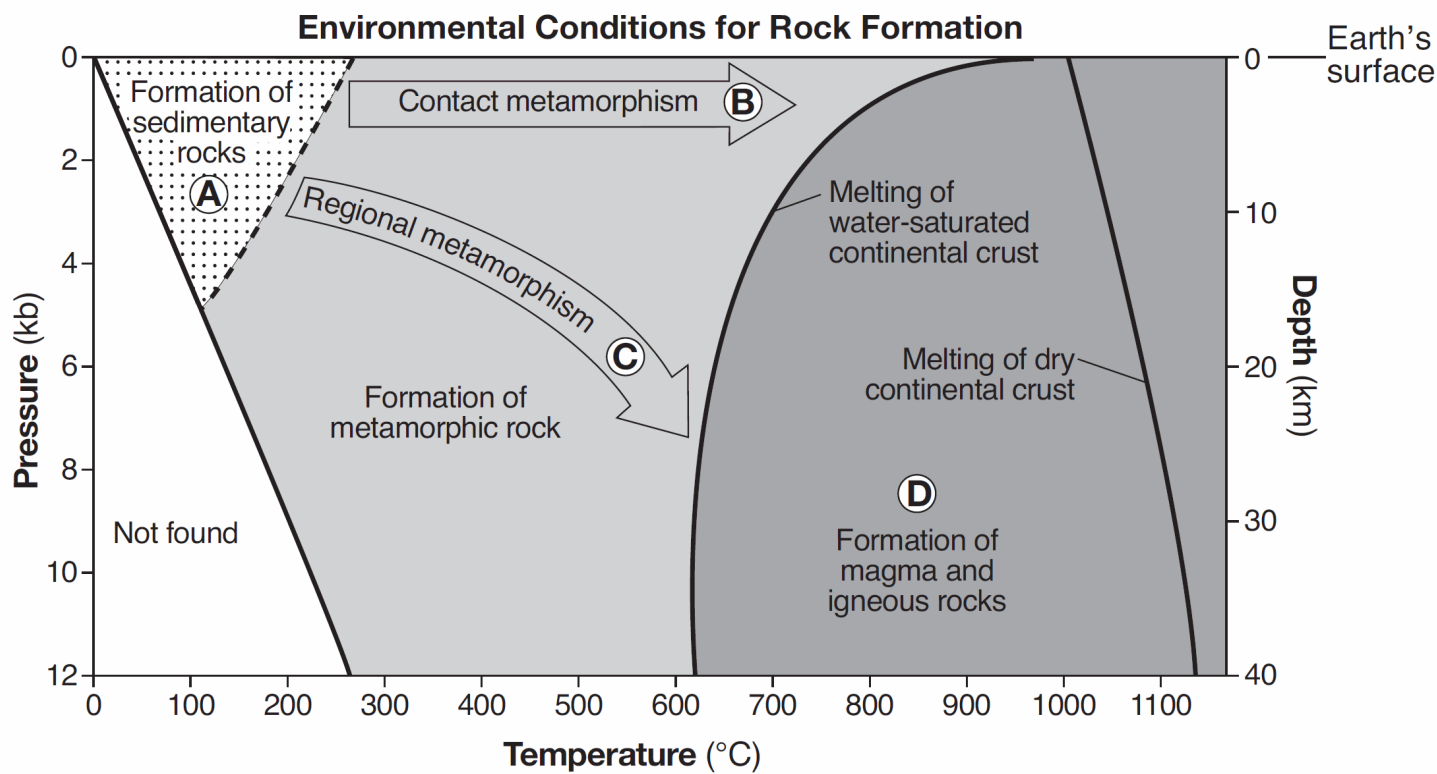
- 1) heat and pressure
- 2) melting and solidification
- 3) compaction and cementation
- 4) erosion and deposition

19. When granite melts and then solidifies, it becomes

- 1) a sedimentary rock
- 2) an igneous rock
- 3) a metamorphic rock
- 4) sediments

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

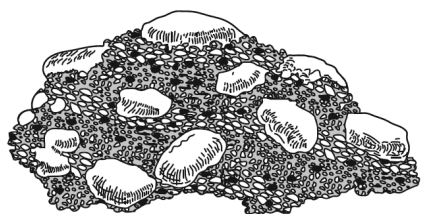
The graph shows the temperature, pressure, and depth environments for the formation of the three major rock types. Pressure is shown in kilobars (kb). Letters *A* through *D* identify different environmental conditions for rock formation.



Which letter represents the environmental conditions necessary to form gneiss?

- 1) *A*                      2) *B*                      3) *C*                      4) *D*

21. Base your answer to the following question on the diagram below, which represents a rock composed of cemented pebbles and sand.



Which change would most likely occur if this rock became buried deep within Earth's crust and was subjected to intense heat and pressure, but did *not* melt?

- 1) The density of the pebbles and sand would decrease.  
 2) The rock would become a plutonic rock composed mostly of quartz.  
 3) The rock would become more felsic with a higher concentration of magnesium.  
 4) The pebbles would become distorted and the sand would be recrystallized.

22. Compared to felsic igneous rocks, mafic igneous rocks contain greater amounts of

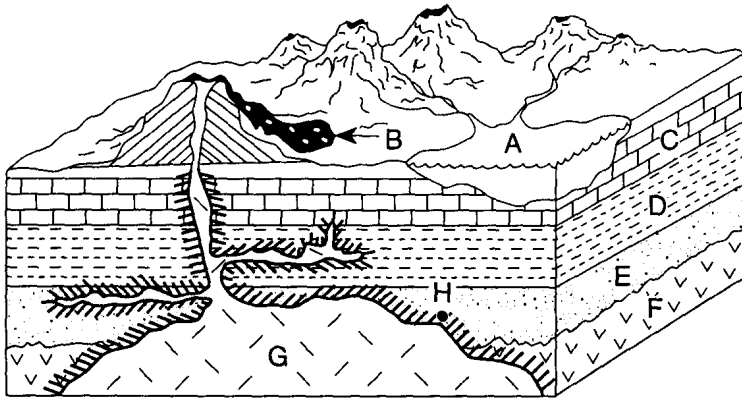
- 1) white quartz                      3) pink feldspar  
 2) aluminum                      4) iron

23. A fine-grained igneous rock was probably formed by

- 1) weathering and erosion  
 2) great heat and pressure that did not produce melting  
 3) rapid cooling of molten material  
 4) burial and cementation of sediment

Base your answers to questions 24 and 25 on

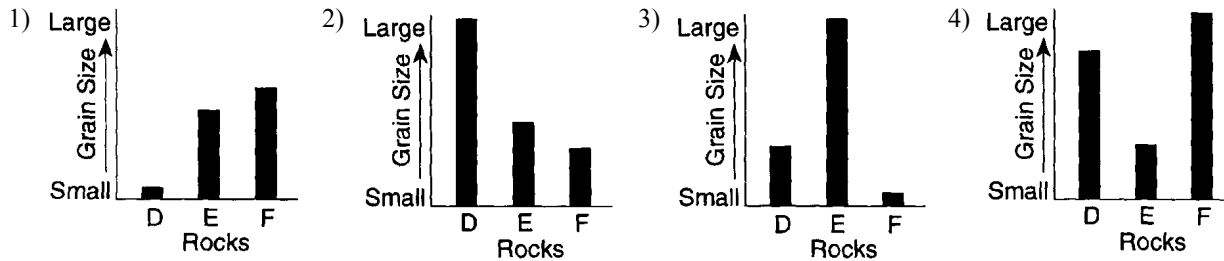
the block diagram below which shows a cross section of Earth's crust. Letter *A* identifies a lake, and letters *B* through *G* represent different types of bedrock.



Key:

- |                        |                          |
|------------------------|--------------------------|
| Limestone C            | Intrusive igneous rock F |
| Shale D                | Intrusive igneous rock G |
| Fine-grain sandstone E | Lava flow B              |
| Contact metamorphism   |                          |

24. Which graph best represents a possible comparison of the average grain sizes for rocks *D*, *E*, and *F*?



25. Rock *B* is a dark-colored crystalline rock that formed when a lava flow cooled and solidified quickly on the surface of Earth.

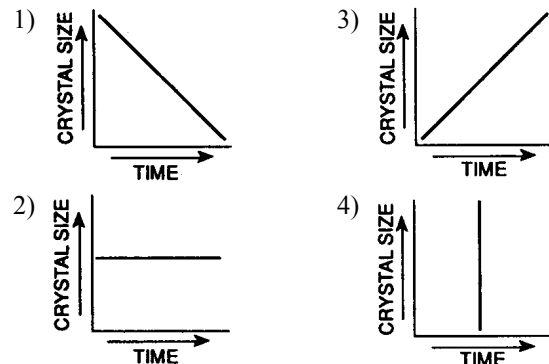
Rock *B* is classified as an

- 1) extrusive igneous rock with a coarse texture and felsic composition
- 2) extrusive igneous rock with a fine texture and a mafic composition
- 3) intrusive igneous rock with a coarse texture and a felsic composition
- 4) intrusive igneous rock with a fine texture and a mafic composition

26. Rhyolite is an example of a

- 1) monomineralic igneous rock
- 2) polymineralic igneous rock
- 3) monomineralic sedimentary rock
- 4) polymineralic sedimentary rock

27. Which graph best represents the relationship between the length of time molten magma takes to cool and the size of the crystals in the rock formed by the magma?



28. 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

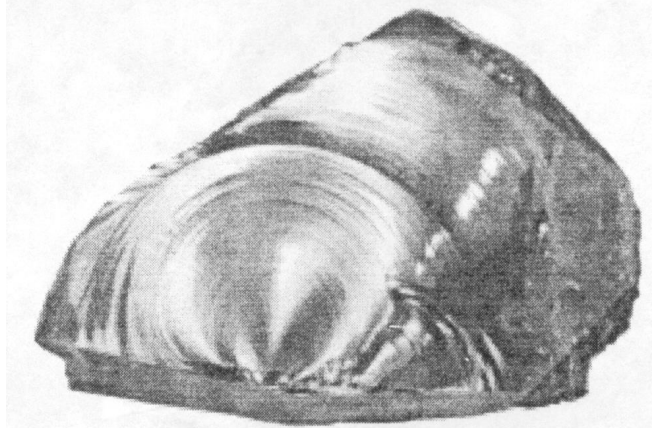
Which rock is most likely phyllite?

- 1) *A*                      2) *B*                      3) *C*                      4) *D*

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

- 1) *A*            2) *B*            3) *C*            4) *D*

30. The picture below shows the igneous rock obsidian.



The obsidian's glassy texture indicates that it formed from a magma that cooled

- 1) slowly, deep below Earth's surface
- 2) slowly, on Earth's surface
- 3) quickly, deep below Earth's surface
- 4) quickly, on Earth's surface

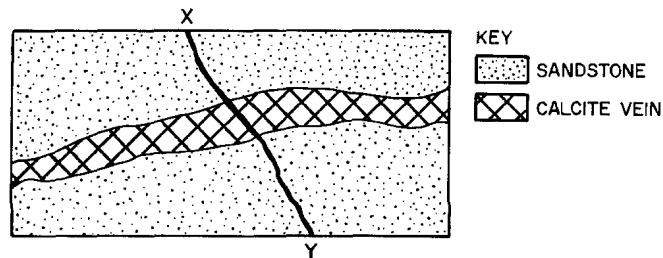
31. Wavy bands of light and dark minerals visible in gneiss bedrock probably formed from the

- 1) cementing together of individual miner grains
- 2) cooling and crystallization of magma
- 3) evaporation of an ancient ocean
- 4) heat and pressure during metamorphism

32. Which metamorphic rock will have visible mica crystals and a foliated texture?

- 1) marble    2) quartzite    3) schist    4) slate

33. The diagram below represents a layer of sandstone containing a vein of calcite and a crack labeled *XY*.

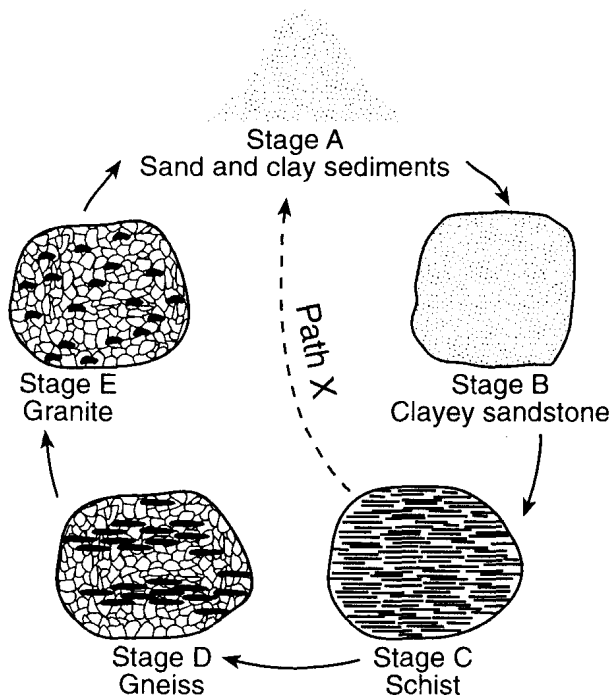


Which is oldest?

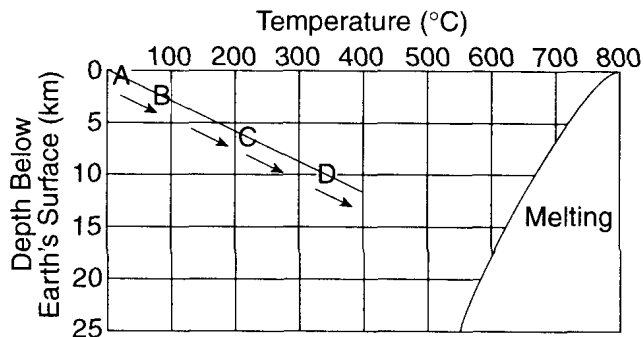
- 1) the calcite vein
- 2) the crack labeled *XY*
- 3) the sandstone layer
- 4) the individual sand grains in the rock

34. Base your answer to the following question 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



Clayey sandstone will form gneiss if the

- 1) temperature and pressure both decrease
- 2) temperature and pressure both increase
- 3) temperature decreases and the pressure increases
- 4) temperature increases and the pressure decreases

35. Base your answer to the following question on the table below which provides information about the crystal sizes and the mineral compositions of four igneous rocks, *A*, *B*, *C*, and *D*.

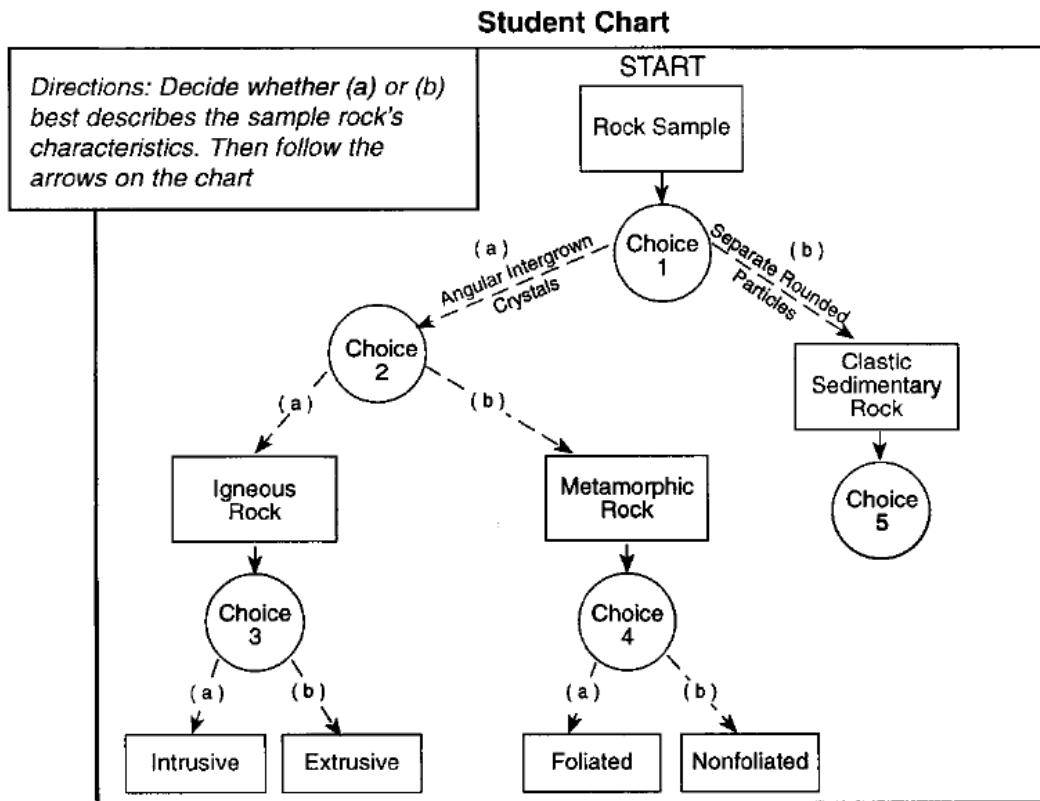
Mineral	Coarse Grained		Fine Grained	
	Rock <i>A</i>	Rock <i>B</i>	Rock <i>C</i>	Rock <i>D</i>
	Percent of Rock	Percent of Rock	Percent of Rock	Percent of Rock
Quartz	40	0	0	0
Pyroxene	0	25	0	70
Plagioclase feldspar	20	0	60	10
Potassium feldspar	20	0	0	0
Biotite	10	0	17	0
Hornblende	10	0	23	3
Olivine	0	75	0	17

Which two rocks most likely formed farthest below the surface of Earth?

- 1) *A* and *B*
- 2) *B* and *C*
- 3) *C* and *D*
- 4) *A* and *D*

Base your answers to questions 36 and 37 on

the diagram below which shows the structure of a student-developed chart for identifying some rock samples. The circles labeled choice 1 through choice 4 represent decision-making steps leading either to path (a) or path (b). Choice 5 has not been completed.



36. Before the student can select either path (a) or path (b) at choice 1, the student must make a decision about

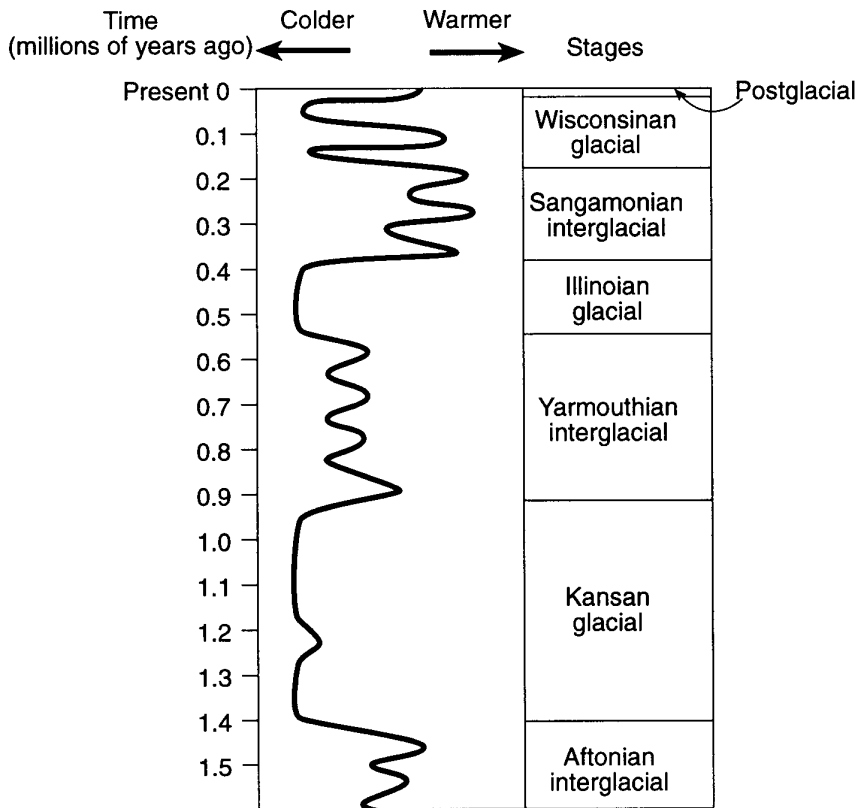
- |                        |  |
|------------------------|--|
| 1) mineral composition | 3) the temperature at which rocks form |
| 2) crystal size        | 4) the appearance of the rock grains   |

37. At choice 2, the student should generally select path (a) if the student observes

- |  |                                  |
|--|----------------------------------|
| 1) a random arrangement of mineral crystals  | 3) bands of mineral crystals     |
| 2) distorted structure and crystal alignment | 4) layers of same-sized crystals |



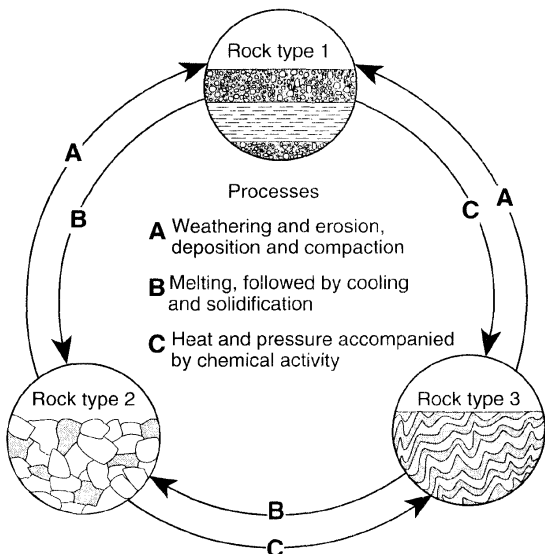
38. Base your answer to the following question on the chart below, which shows the changing climatic conditions that led to alternating glacial and interglacial periods.



The interglacial stages were most likely caused by

- 1) The interglacial stages were most likely caused by
- 2) an increase in average worldwide temperature
- 3) crustal plate movement
- 4) a large increase in the amount of snowfall

39. The diagram below represents geological processes that act continuously on Earth to form different rock types.



Which table correctly classifies each rock type?

1)

Rock Type	Classification
1	sedimentary
2	metamorphic
3	igneous

2)

Rock Type	Classification
1	sedimentary
2	igneous
3	metamorphic

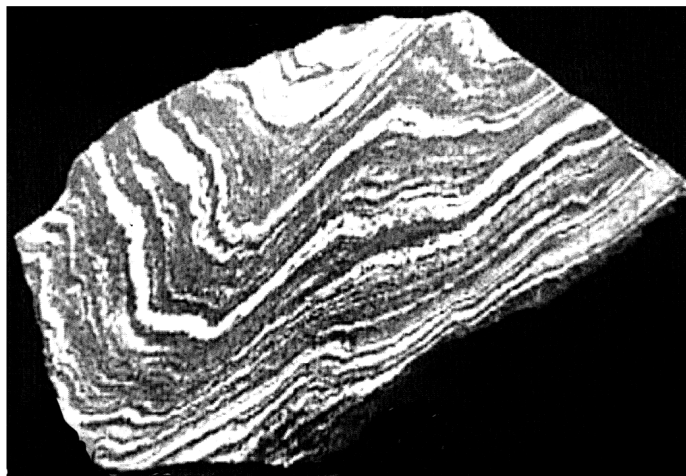
3)

Rock Type	Classification
1	metamorphic
2	igneous
3	sedimentary

4)

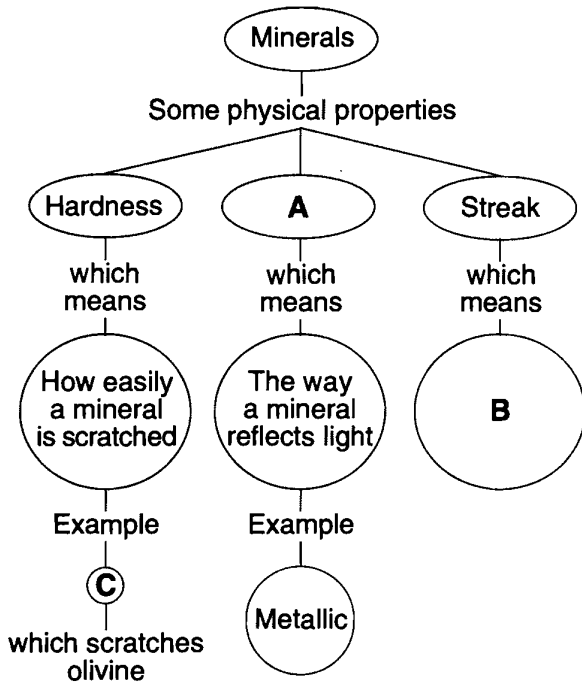
Rock Type	Classification
1	igneous
2	metamorphic
3	sedimentary

40. Base your answer to the following question on the photograph of a sample of gneiss below.



Identify *two* minerals found in gneiss that contain iron and magnesium.

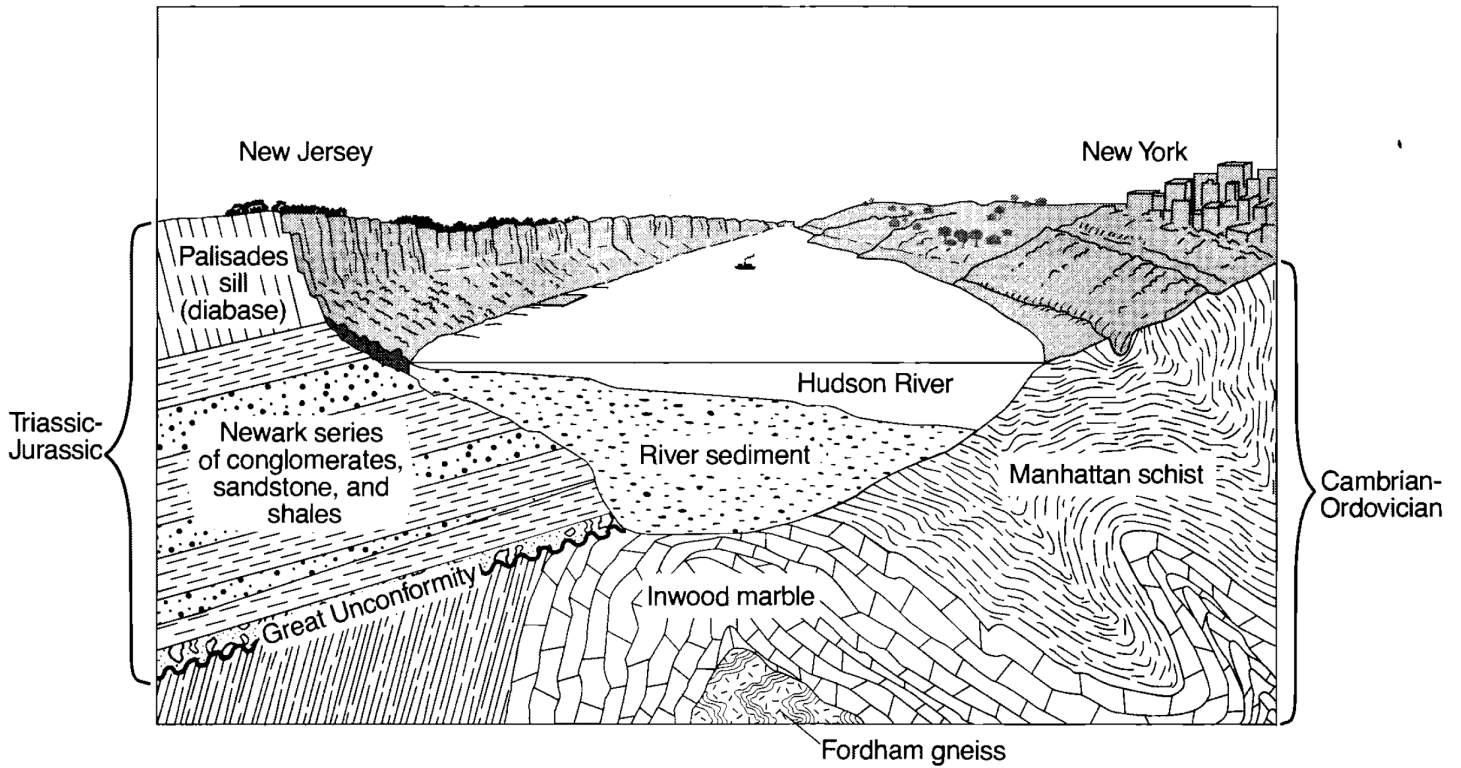
Base your answers to questions 41 and 42 on the chart below, which shows some physical properties of minerals and the definitions of these properties. The letters *A*, *B*, and *C* indicate parts of the chart that have been left blank. Letter *C* represents the name of a mineral.



41. Which physical property of a mineral is represented by letter *A*?

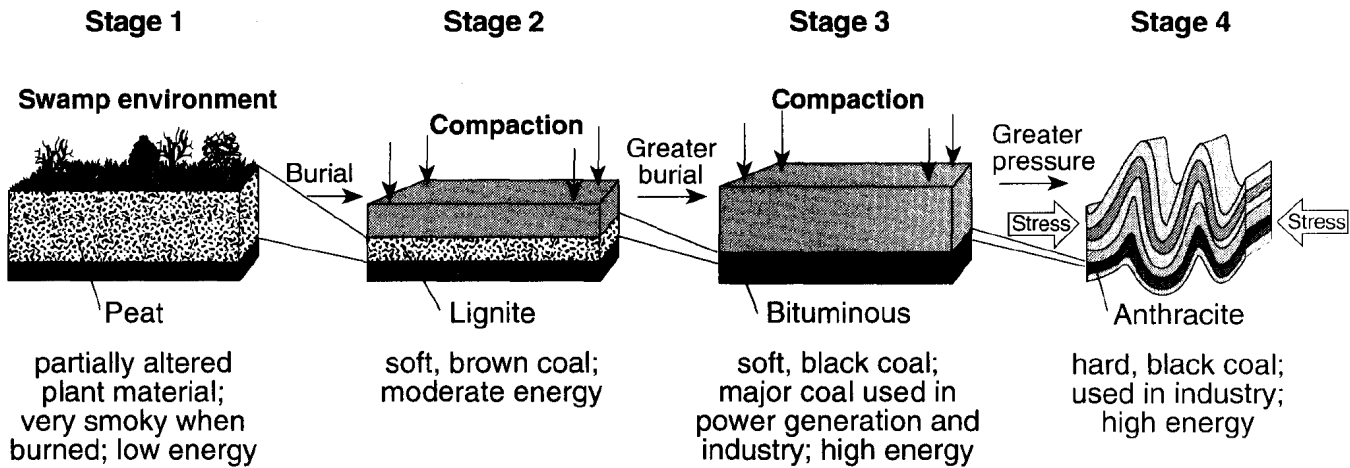
42. State the definition represented by letter *B*.

43. 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.



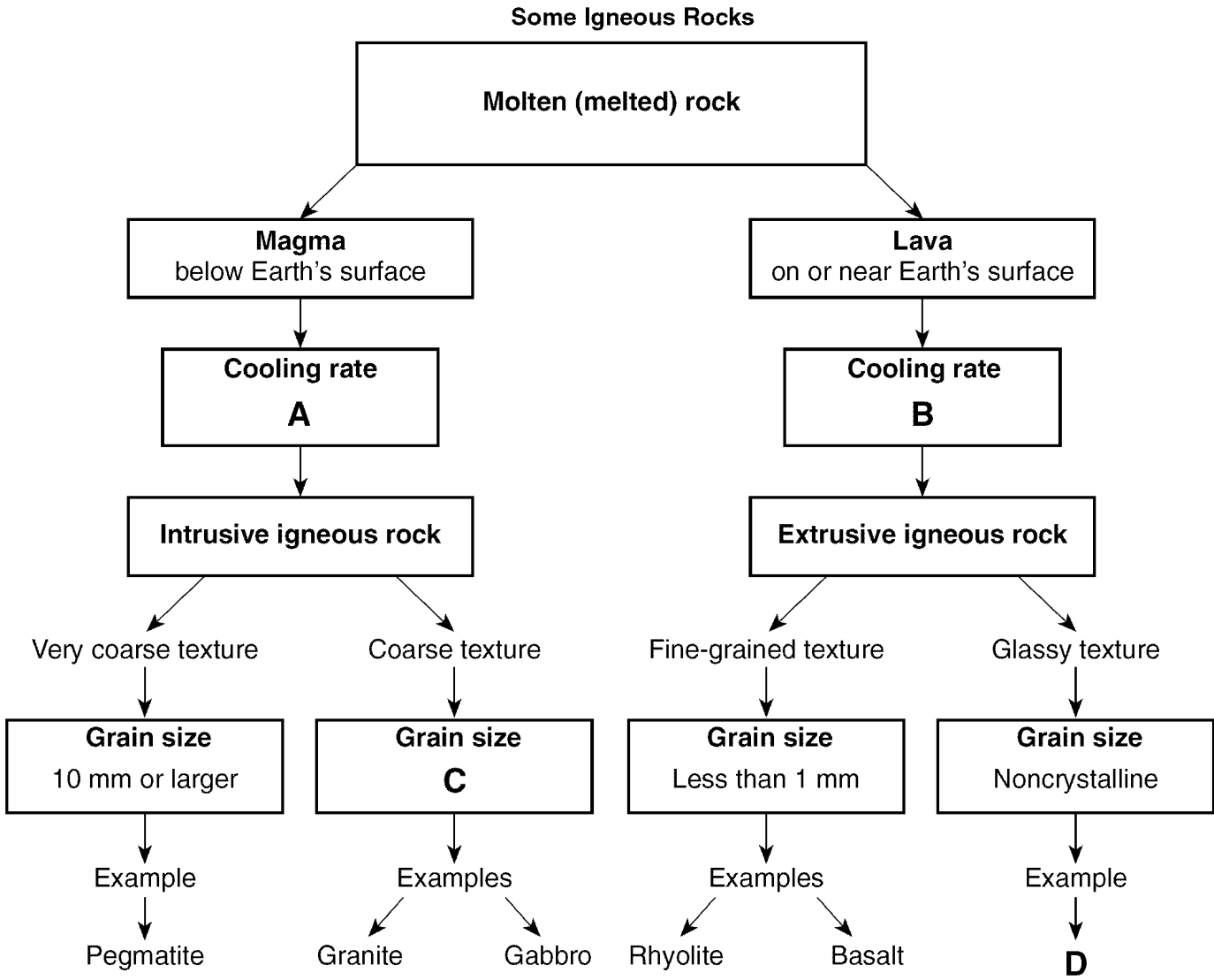
Identify the oldest bedrock shown in the diagram.

44. Base your answer to the following question on on the sequence of diagrams below, which shows four stages in coal formation.



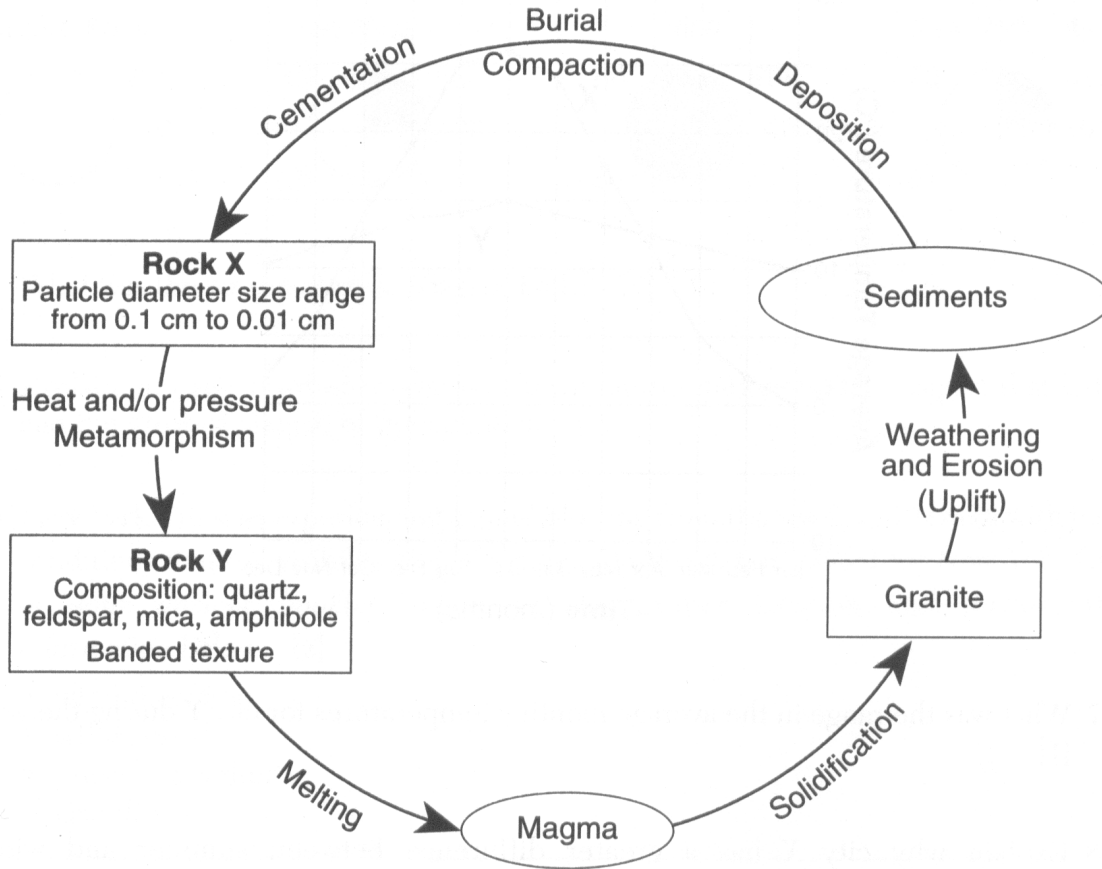
Which type of rock is forming above the coal material during stages 2 and 3?

45. Base your answer to the following question on the flowchart below and on your knowledge of Earth science. The flowchart shows the formation of some igneous rocks. The bold letters *A*, *B*, *C*, and *D* indicate parts of the flowchart that have not been labeled.



Give the numerical grain-size range that should be placed in the flowchart at *C*. Units must be included in your answer.

Base your answers to questions 46 and 47 on the diagram below, which represents a part of the cycle. The igneous rock, granite, and the characteristics of sedimentary rock X and metamorphic rock Y are shown.

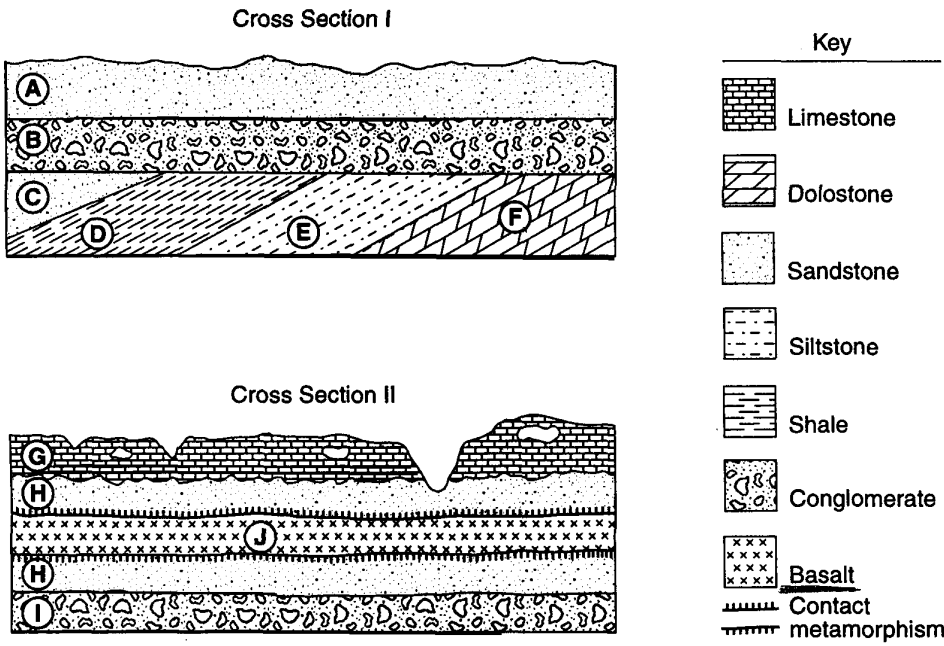


46. Complete the table below, with descriptions of the observable characteristics used to identify granite.

Characteristic of Granite	Description
Texture	
Color	
Density	

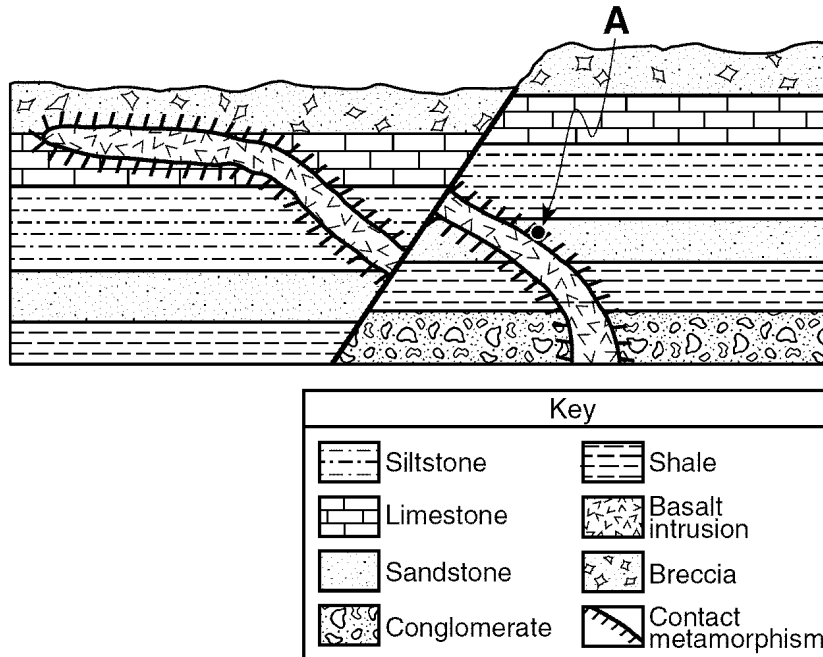
47. Identify sedimentary rock X.

48. Base your answer to the following question on cross sections I and II shown below. Letters *A* through *J* represent rock units. Rock units *B* and *I* are the same age. Overturning has not occurred in either cross section.



State the name of a metamorphic rock that would be found in the zone of contact metamorphism surrounding rock unit *J*.

49. Base your answer to the following question on the geologic cross section below. The rock layers have not been overturned. Point *A* is located in the zone of contact metamorphism.



Which metamorphic rock most likely formed at point *A*?

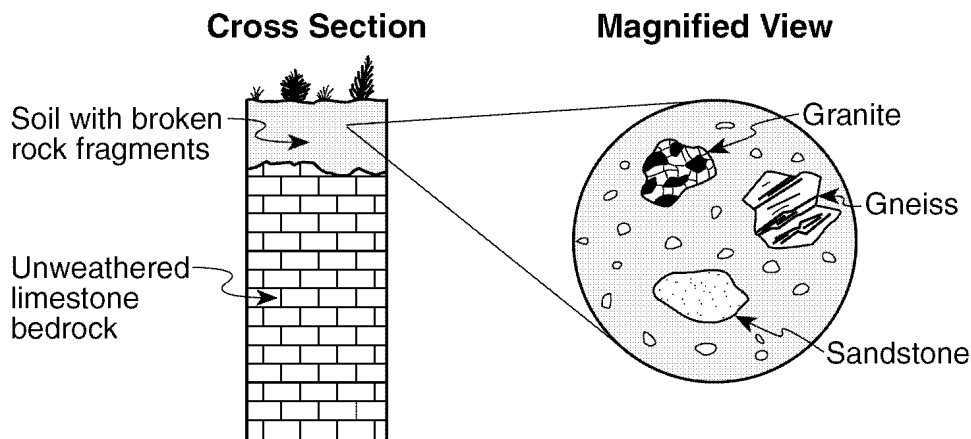
50. Base your answer to the following question on the diagram of Bowen's Reaction Series below, which shows the sequence in which minerals crystallize as magma cools and forms different types of igneous rocks from the same magma. The arrow for each mineral represents the relative temperature range at which that mineral crystallizes.

**Bowen's Reaction Series**

Temperature Conditions	Minerals that Crystallize from Magma as the Magma Cools	Igneous Rock Type
High temperature (first to crystallize)	Olivine	Ultramafic (peridotite)
Cooling magma	Pyroxene	Basaltic (basalt/gabbro)
	Amphibole	
Low temperature (last to crystallize)	Biotite mica	Andesitic (andesite/diorite)
	Plagioclase feldspar (More calcium rich)	
	Muscovite mica	Granitic (rhyolite/granite)
	Quartz	
	Potassium feldspar (More sodium rich)	

Describe the temperature conditions shown in Bowen's Reaction Series that explain why olivine and quartz are *not* usually found in the same igneous rock type.

51. Base your answer to the following question on the cross section below, which shows an area near Watertown, New York. The top layer of soil contains broken rock fragments. A representative sample of this layer has been magnified.



Identify *one* mineral that could be found in all three rock fragments shown in the magnified view.



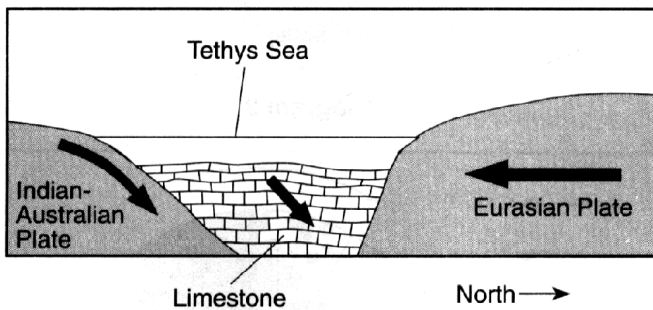
52. Base your answer to the following question on the passage and cross section below, which explain how some precious gemstones form. The cross section shows a portion of the ancient Tethys Sea, once located between the Indian-Australian Plate and the Eurasian Plate.

### Precious Gemstones

Some precious gemstones are a form of the mineral corundum, which has a hardness of 9. Corundum is a rare mineral made up of closely packed aluminum and oxygen atoms, and its formula is  $Al_2O_3$ . If small amounts of chromium replace some of the aluminum atoms in corundum, a bright-red gemstone called a ruby is produced. If traces of titanium and iron replace some aluminum atoms, deep-blue sapphires can be produced.

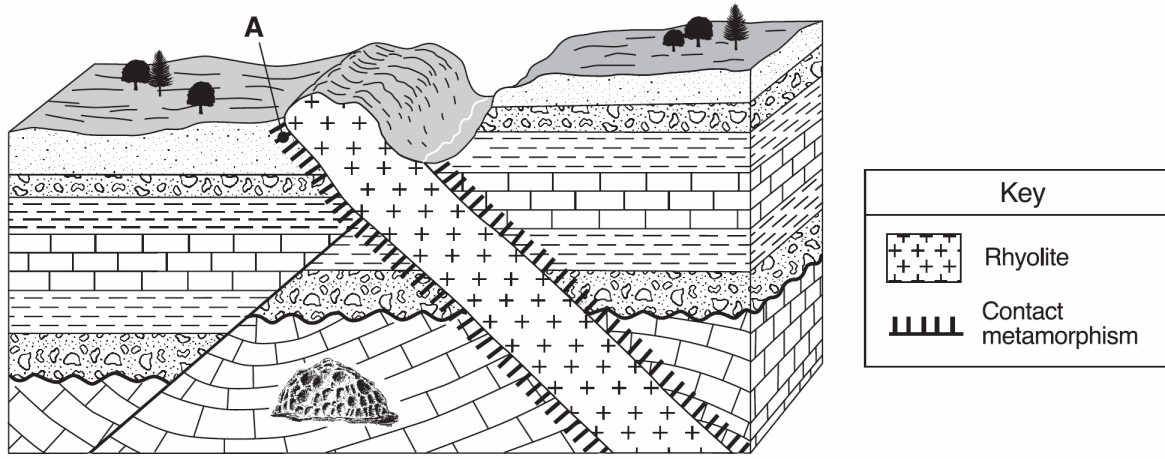
Most of the world's ruby deposits are found in metamorphic rock that is located along the southern slope of the Himalayas, where plate tectonics played a part in ruby formation. Around 50 million years ago, the Tethys Sea was located between what is now India and Eurasia. Much of the Tethys Sea bottom was composed of limestone that contained the elements needed to make these precious gemstones. The Tethys Sea closed up as the Indian-Australian Plate pushed under the Eurasian Plate, creating the Himalayan Mountains. The limestone rock lining the seafloor underwent metamorphism as it was pushed deep into Earth by the Indian-Australian Plate. For the next 40 to 45 million years, as the Himalayas rose, rubies, sapphires, and other gemstones continued to form.

**A Portion of the Tethys Sea 50 Million Years Ago**



Which element replaces some of the aluminum atoms, causing the bright-red color of a ruby?

Base your answers to questions 53 and 54 on the block diagram below, which shows rock units that have not been overturned. Point *A* is located in the zone of contact metamorphism. A New York State index fossil is shown in one of the rock units.



(Not drawn to scale)

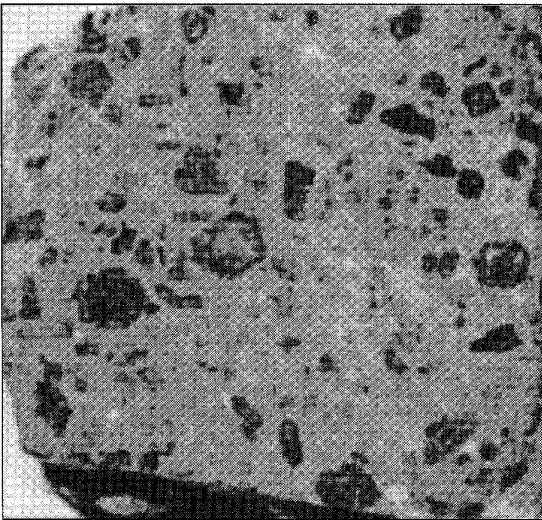
53. Identify the geologic time period when the index fossil shown in the block diagram was a living organism.

54. Identify the metamorphic rock that most likely formed at point *A*.

55. Base your answer to the following question on the passage and photograph below. The passage describes the properties of porphyritic rocks. The photograph shows a sample of andesite rock that has a porphyritic texture.

### Porphyritic Rocks

Igneous rocks that have two distinctly different crystal sizes have a porphyritic texture. They contain large, coarse-grained crystals called phenocrysts, which are visible to the naked eye. These crystals are surrounded by fine-grained crystals called groundmass.



Identify the evidence shown by the photograph that indicates that two different cooling events occurred during the formation of this rock.

Rocks mineral review

1. 4
2. 3
3. 4
4. 1
5. 2
6. 1
7. 4
8. 2
9. 1
10. 2
11. 3
12. 3
13. 4
14. 3
15. 3
16. 2
17. 1
18. 2
19. 2
20. 3
21. 4
22. 4
23. 3
24. 1
25. 2
26. 2
27. 3
28. 4
29. 1
30. 4
31. 4
32. 3
33. 4
34. 2
35. 1
36. 4
37. 1
38. 2
39. 2

40. *Examples:* — pyroxene (augite) — mica (biotite) — amphibole (hornblende)
41. Luster
42. - The color of the dust or powdered form of the mineral - The color of the mark left when a mineral is rubbed on an unglazed porcelain tile
43. Fordham gneiss *or* gneiss.
44. *Examples:*  
–sedimentary, –any clastic sedimentary rock *or* specific clastic sedimentary rock name
45. 1mm to 10 mm
46.

Characteristic of Granite	Description
Texture	coarse nonvesicular 1 mm to 10 mm
Color	light colored white pink gray
Density	low 2.7 g/cm <sup>3</sup>
47. Sandstone
48. quartzite or hornfels
49. quartzite or hornfels.
50. – The minerals crystallize at different temperatures. – Olivine is the first to crystallize and quartz is the last. – Quartz crystallizes at a lower temperature than olivine. – Olivine forms at a higher temperature.
51. *Examples:* – quartz – feldspar – amphibole – mica
52. chromium or Cr.
53. – Devonian Period
54. – quartzite *or* hornfels
55. — two different crystal sizes  
— Coarse and fine crystals are found together.