Scheme for Metamorphic Rock Identification

TEXTURE		GRAIN SIZE	COMPOSITION	TYPE OF METAMORPHISM	COMMENTS	ROCK NAME	MAP SYMBOL
FOLIATED	MINERAL ALIGNMENT	Fine	MICA, QUARTZ, FELDSPAR, AMPHIBOLE, GARNET, PYROXENE	Regional (Heat and pressure increases)	Low-grade metamorphism of shale	**Slate**	
		Fine to medium			Foliation surfaces shiny from microscopic mica crystals	**Phyllite**	
					Platy mica crystals visible from metamorphism of clay or feldspars	**Schist**	
	BAND-ING	Medium to coarse			High-grade metamorphism; mineral types segregated into bands	**Gneiss**	
NONFOLIATED		Fine	Carbon	Regional	Metamorphism of bituminous coal	**Anthracite coal**	
		Fine	Various minerals	Contact (heat)	Various rocks changed by heat from nearby magma/lava	**Hornfels**	
		Fine to coarse	Quartz	Regional or contact	Metamorphism of quartz sandstone	**Quartzite**	
			Calcite and/or dolomite		Metamorphism of limestone or dolostone	**Marble**	
		Coarse	Various minerals		Pebbles may be distorted or stretched	**Metaconglomerate**	

Overview:

Metamorphic rocks have been produced by the process of heat and/or pressure. There are two types of metamorphism: Regional and Contact metamorphism. Regional metamorphism is associated with a large area of metamorphism, formed by the pressure and heat of colliding plates. Contact metamorphism is when the heat of magma/lava touches rocks, causing a small area to change into metamorphic rocks. Contact metamorphism will be present on the outside edges of igneous intrusions. It is here where the heat of the molten material comes into contact with existing layers of rocks. In both types of metamorphism, the preexisting rock is changed to a new metamorphic rock, showing different properties.

The Chart:

This chart is divided into two sections based on texture type. The first upper section has a texture labeled Foliated, while the lower section of this chart is labeled Nonfoliated.

Upper Chart:

Foliated Texture column – Foliated texture is subdivided into Mineral Alignment and Banding. In Mineral Alignment texture, the pressure has caused the minerals to line up, thus the term mineral alignment. Banding texture, associated with the metamorphic rock gneiss, is where minerals are lined up in a "wavy band".

The Composition column – The shaded bars represent the different minerals found in the given four metamorphic rocks shown to the right. In this system, slate would have only mica in it, while gneiss would contain all the minerals shown in this composition section.

Type of Metamorphism column – All of the rocks listed in this upper chart were made by regional metamorphism. The downward pointing arrow indicates that as pressure and heat increases, the rocks change from slate to phyllite to schist, and finally changing schist to gneiss.

Comments column – Use these comments to help you identify an unknown metamorphic rock. Notice that slate originated from shale, a sedimentary rock. Also, banding is described in the Gneiss Comments section.

Map Symbols – These are the designated diagrammed symbols, for the given rocks.

Lower Chart:

Nonfoliated Texture column – Nonfoliated texture is when the minerals have not lined up due to metamorphism.

Composition column – Quartz is the dominant mineral found in quartzite. Calcite and/or dolomite is the main composition of marble.

Types of Metamorphism – Both types are listed here. Hornfels is associated only with contact metamorphism. The last three rocks are associated with both types of metamorphism: Regional and Contact metamorphism.

Comments – In the comment section for hornfels, a simple definition of contact metamorphism is given, "Various rocks changed by heat from nearby magma/lava." Sandstone, having much quartz, changes to quartzite. Limestone or dolostone changes to marble during metamorphism.

Additional information:

- Calcite is very reactive with hydrochloric acid. Calcite is the main mineral in limestone. When limestone undergoes metamorphism it changes to marble. Thus, both limestone and marble will react to hydrochloric acid since they both contain the mineral calcite.
- As a fuel, anthracite coal is superior to bituminous coal. Anthracite coal produces more heat and burns cleaner than other coal types.
- If too much heat is applied to a rock and it melts, eventually upon cooling the resulting rock will always be igneous.
- Recrystallization is the growth of new crystals from the minerals already present caused by the heat/pressure of metamorphism.

Set 1 — Scheme for Metamorphic Rock Identification

1. Wavy bands of light and dark minerals visible in gneiss bedrock probably formed from the
   (1) cementing together of individual mineral grains
   (2) cooling and crystallization of magma
   (3) evaporation of an ancient ocean
   (4) heat and pressure during metamorphism 1 _____

2. Which physical characteristic best describes the rock phyllite?
   (1) glassy texture with gas pockets
   (2) clastic texture with angular fragments
   (3) bioclastic texture with cemented shell fragments
   (4) foliated texture with microscopic mica crystals 2 _____

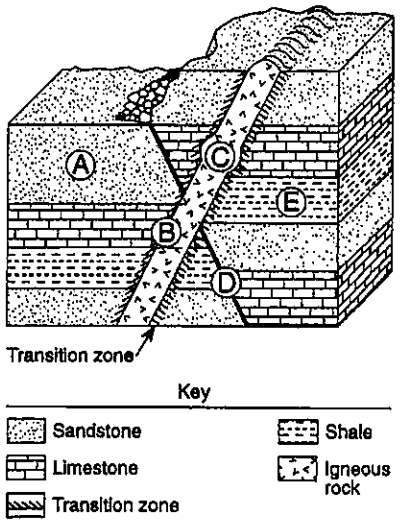
3. Which rock is foliated, shows mineral alignment but not banding, and contains medium-sized grains of quartz and pyroxene?
   (1) phyllite (3) gneiss
   (2) schist (4) quartzite 3 _____

4. Which rock can form in a contact metamorphic zone?
   (1) slate (3) gneiss
   (2) hornfels (4) phyllite 4 _____

5. How do the metamorphic rocks schist and quartzite differ?
   (1) Quartzite contains the mineral quartz and schist does not.
   (2) Quartzite forms from regional metamorphism and schist does not.
   (3) Schist is organically formed and quartzite is not.
   (4) Schist is foliated and quartzite is not 5 _____

6. Which rock would most likely be produced by the metamorphism of the grey limestone?
   (1) quartzite (3) marble
   (2) slate (4) gneiss 6 _____

7. The diagram below shows a portion of the Earth's crust. Letters *A*, *B*, *C*, and *D* indicate different types of rock.



At which location is metamorphic rock most likely to be found?
   (1) *A* (3) *C*
   (2) *B* (4) *D* 7 _____

8. Which rock forms by the recrystallization of unmelted rock material under conditions of high temperature and pressure?

(1) granite
(2) gneiss
(3) rock gypsum
(4) bituminous coal 8 _____

9. The crystals of many metamorphic rocks are aligned in bands as a result of

(1) earthquake faulting
(2) cooling and solidification
(3) mechanical weathering
(4) heat and pressure 9_____

10. Slate is formed by the

(1) deposition of chlorite and mica
(2) foliation of schist
(3) metamorphism of shale
(4) folding and faulting of gneiss 10_____

11. What metamorphic rock would react with hydrochloric acid?

(1) slate
(2) quartzite
(3) marble
(4) phyllite 11_____

12. Which rock sample is most likely metamorphic rock?


(1)


(2)

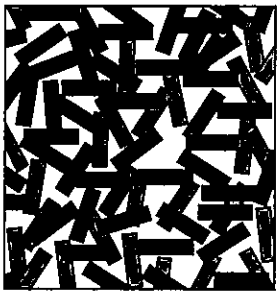

(3)

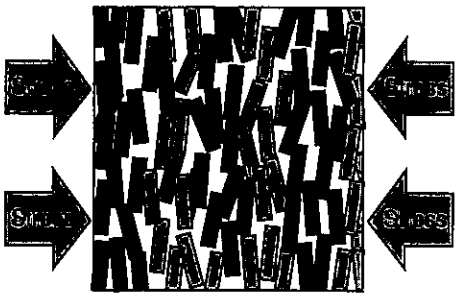

(4)

12_____

13. The accompanying diagram represents two magnified views showing the arrangement of minerals before and after metamorphism of a rock. State the name of Rock C.

_____


Mineral Arrangement Before Metamorohism

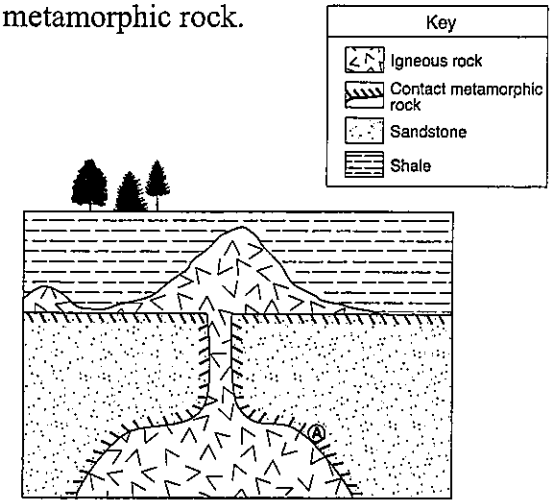

Rock C Showing Banding After Metamorohism

14. Name the processes needed to cause the banding of minerals as shown in the second diagram.

_____

15. An igneous intrusion entered a layer of sandstone. The contact metamorphism of the sandstone would produce what metamorphic rock? _____

16. The diagram below shows the geologic cross section. Location *A* is within the metamorphic rock.



The metamorphic rock at location *A* is most likely

(1) marble
(2) quartzite
(3) phyllite
(4) slate 16_____

17. The heat and pressure of regional metamorphism might effect a conglomerate layer by distorting or stretching the pebbles. The resulting rock would be

(1) hornfels
(2) granite
(3) phyllite
(4) metaconglomerate 17_____

18. Which rock is foliated, shows mineral alignment but not banding, and contains shiny microscopic mica crystals?

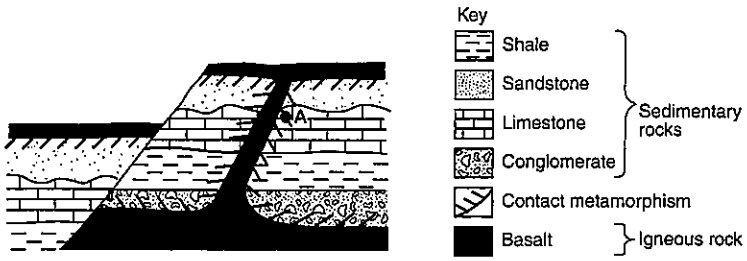
(1) phyllite
(2) schist
(3) gneiss
(4) quartzite 18_____

---

19. Which sequence of change in rock type occurs as shale is subjected to increasing heat and pressure?

(1) shale → schist → phyllite → slate → gneiss
(2) shale → slate → phyllite → schist → gneiss
(3) shale → gneiss → phyllite → slate → schist
(4) shale → gneiss → phyllite → schist → slate 19_____

20. State the name of the rock, formed by contact metamorphism, located at *A*.



20_____