CLASS NOTES

• Metamorphic Rocks

• Parent Rock - preexisting rock from which metamorphic rocks are formed

• Methods to classify sedimentary rocks:

  1. Texture - the description of its minerals along with their arrangement and size
     • Foliation -
     • Examples: Slate and Gneiss
     • Banding -
     • Examples: Gneiss
     • Nonfoliated -
     • Examples: Marble and Quartzite

  2. Grain Size - size of the individual \( \text{__________} \) in the rock

  3. Composition -

4. **Type of Metamorphism** - the different conditions which exist for a metamorphic rock to form
   - **Regional Metamorphism** - ________________________________
     - Heat from geothermal gradient and/or magma causes minerals to flow [not break] and cause the minerals to rearrange, realign and become elongated
     - Pressure from overlying rock squeezes the pore spaces out between the minerals within the rock and cause it to become more dense
   - **Contact Metamorphism** - ________________________________
     - Heat from magma or lava causes minerals to rearrange
     - No ____________________________

### Scheme for Metamorphic Rock Identification

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

1. Where is metamorphic rock frequently found?
   a. Along the interface between igneous intrusions and sedimentary bedrock
   b. Within large lava flows
   c. On mountaintops that have horizontal layers containing marine fossils
   d. As a thin surface layer covering huge areas of the Continents

2. What is the main difference between metamorphic rocks and most other rocks?
   a. Many metamorphic rocks contain a high amount of oxygen-silicon tetrahedra
   b. Many metamorphic rocks contain only one mineral
   c. Many metamorphic rocks have an organic composition
   d. Many metamorphic rocks exhibit banding and distortion of structure

3. The metamorphism of a sandstone rock will cause the rock
   a. To occupy a greater volume
   b. To be melted
   c. To become more dense
   d. To contain more fossils

4. Metamorphic rocks result from the
   a. Erosion of rocks
   b. Compression and cementation of soil particles
   c. Cooling and solidification of molten magma
   d. Recrystallization of rocks

5. The recrystallization of unmelted material under high temperature & pressure results in
   a. Volcanic rock
   b. Rock
   c. Metamorphic rock
   d. Sedimentary rocks

6. Which rock has never melted, but was produced by great heat and pressure, which distorted and rearranged its minerals?
   a. Siltstone
   b. Breccia
   c. Pegmatite
   d. Metaconglomerate

7. 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
8. During the intrusion of the Palisades Sill, contact metamorphism changed limestone into
   a. diorite
   b. marble
   c. sandstone
   d. hornfels

9. Which mineral is commonly found in the three metamorphic rocks slate, schist, and gneiss?
   a. pyroxene
   b. feldspar
   c. quartz
   d. mica

10. Slate is formed by the
    a. deposition of chlorite and mica
    b. foliation of schist
    c. metamorphism of shale
    d. folding and faulting of gneiss

11. Which nonfoliated rock forms only in a zone of contact metamorphism?
    a. conglomerate
    b. hornfels
    c. pegmatite
    d. quartzite

12. If a metamorphic rock bubbles when a drop of acid is placed on its surface, the rock is most likely
    a. schist
    b. slate
    c. marble
    d. quartzite

The diagram below indicates physical changes that accompany the conversion of shale to gneiss.

13. Which geologic process is occurring to cause this conversion?
    a. sedimentary layering
    b. intrusion of magma
    c. metamorphism
    d. weathering
14. Which rock is likely to form from rock material at a depth of 30 km and a temperature of 1000°C?
   a. quartz
   b. scoria
   c. shale
   d. granite

15. Which letter represents the environmental conditions necessary to form gneiss?
   a. A
   b. B
   c. C
   d. D

16. 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

17. Which letter represents the environmental conditions necessary to form hornfels?
   a. A
   b. B
   c. C
   d. D