# LAB 5: TEXTURES AND IDENTIFICATION OF METAMORPHIC ROCKS

## OBJECTIVES:

1) to become familiar with textures characteristic of metamorphic rocks;
2) to become familiar with properties important in recognizing and classifying metamorphic rocks;
3) to become familiar with the mineralogy of common metamorphic rocks.

## INTRODUCTION:

**Metamorphic rocks** are formed from pre-existing rocks by *recrystallization in the solid state* under the effects of heat, pressure, shearing (grinding), or replacement by materials (ions) dissolved in water. They are classified on the basis of **texture** (foliated vs. non-foliated), **grain-size**, and **mineral composition**.

### Texture:

Metamorphic rocks may have either **foliated** (layered) or **non-foliated** texture. **Foliated texture** is a pervasive layering caused by compositional layering or by the parallel orientation of platy (e.g, mica) or elongate (e.g., amphibole) mineral grains. Foliation is caused by recrystallization under directed (compressional) stress. However, if the rock lacks platy or elongate minerals, it will not develop foliation even though it recrystallized under very great pressure (examples are marble and quartzite).

### Grain size:

Grain size reflects pressure and temperature conditions of metamorphism. Generally, higher temperatures and pressures (higher grades of metamorphism) favor larger grains, and lower temperatures and pressures favor smaller grains.

### Mineral composition:

Mineral composition reflects the composition of the parent rock and the pressure and temperature conditions under which the metamorphism occurred. See Marshak p. 241-244 for discussion of metamorphic grades and for the index minerals used to identify them.

## Classification:

### Foliated metamorphic rocks:

Grain size is the main basis for classification of foliated metamorphic rocks.

**Slates** are very fine-grained, well-foliated (very well-layered) rocks. Grains are too fine to see with the unaided eye but are usually quartz and mica

**Phyllite** is a foliated, fine-grained rock with a glossy or silvery metallic luster and a wavy foliation with a wrinkled appearance (phyllitic texture)

**Schists** are coarser grained and well-foliated; individual grains are large enough to identify without a microscope. The foliation in schists may be wavy or crinkled. Mica is commonly a prominent mineral in schist. Quartz and feldspar are also common in schists. The names of minerals present may be used as modifiers for " schist" (i.e. "biotite schist", or "garnet-muscovite schist").

**Gneiss** is coarse-grained, with a foliation defined by alternating light and dark-colored bands. These layers are commonly very wavy or contorted in larger specimens. The light-colored bands are typically quartz and feldspar, while the dark-colored bands are hornblende.

**Non-foliated metamorphic rocks:**

Non-foliated metamorphic rocks are usually classified on the basis of mineral composition.

**Marble** is metamorphosed limestone or dolomite. It has a crystalline texture, with the grains all being about the same size; fine grained marble often looks sugary. The physical properties (hardness, fizzing in acid) are those of calcite or dolomite.

**Quartzite** is metamorphosed quartz sandstone or chert. It has a crystalline texture and can be distinguished from sandstone by its greater density and the interlocking of the grains. It is hard and has the physical properties of quartz.

**Greenstone** is slightly metamorphosed submarine basalt. The texture may look similar to basalt (fine-grained, and perhaps even some pillows), but the rock is medium-green to dark-greenish colored due to the presence of chlorite and other green metamorphic minerals.

**Serpentinite** is composed of the mineral serpentine, and is formed by metamorphism of peridotite. This rock is dark-green (almost black) to light-green, with a smooth, slick feel. It commonly shows irregular foliation or slick, polished surfaces (slickensides) due to shearing in fault zones. When pulverized and weathered, it becomes "blue goo."

**WHAT YOU ARE EXPECTED TO KNOW**

You should be able to recognize these minerals:

chlorite
serpentine
quartz (Pellant p. 86-87)
feldspar (Pellant p. 167-171)
amphibole (hornblende) (Pellant p. 153-154)
pyroxene (augite) (Pellant p. 150-151)
biotite mica (Pellant p. 161)
muscovite mica (Pellant p. 160)
calcite (Pellant p. 99)

You should be able to identify these metamorphic rocks:

slate (Pellant p. 208-209)
schist (Pellant p. 210-212)
gneiss (Pellant p. 213-214)
quartzite ("metaquatrzite", Pellant, p.220)
marble (Pellant p, 216-217)
serpentinite (Pellant p. 194)
greenstone

You should know the *general* mineralogy of each of the above rocks (i.e., what minerals are most common in each of the rocks?)

You should have a general idea of what the parent rock(s) of each of these metamorphic rocks are. (For example, you should know that marble is metamorphosed limestone or dolomite).

**WHAT TO DO IN THIS LAB**

This lab is divided into three sections. In the first section, you will review and identify minerals characteristic of common metamorphic rocks. In the second section, you will learn to recognize metamorphic textures. Finally, in the third section, you will identify a variety of common metamorphic rocks.

## PART I IDENTIFICATION OF COMMON METAMORPHIC MINERALS

Specimens 1 - 6 are common metamorphic minerals.

| Number | Name | Properties you used to identify sample |
|---|---|---|
| **1** | | |
| **2** | | |
| **3** | | |
| **4** | | |
| **5** | | |
| **6** | | |

## PART II IDENTIFICATION OF METAMORPHIC TEXTURES

Determine the grain size (coarse-grained, fine-grained, or very fine-grained) and texture (foliated or non-foliated) of specimens 7 - 12.

### METAMORPHIC TEXTURES

| Number | Metamorphic texture (foliation and grain size) |
|---|---|
| **7** | |
| **8** | |
| **9** | |
| **10** | |
| **11** | |
| **12** | |

## PART III IDENTIFICATION OF COMMON METAMORPHIC ROCKS

Examine the metamorphic rock specimens labeled 7 through 16. For each specimen determine:

a) the rock's *texture* (foliated or non-foliated, fine-grained or coarse-grained)
b) the rock's *mineralogy* (if you can identify the minerals)
c) the *name* of the rock.

| Number | Texture (foliation and grain size) | Chief mineral components (that you can see) | Rock name |
|---|---|---|---|
| **7** | | | |
| **8** | | | |
| **9** | | | |
| **10** | | | |
| **11** | | | |
| **12** | | | |
| **13** | | | |
| **14** | | | |
| **15** | | | |
| **16** | | | |