# GEO 2: Historical Geology with Lab
# Lab 3: Sedimentary and Metamorphic Rocks

**Name: _____ Date: _____**

## Part I. ROCKS

**A. Rocks:**

1. Draw a Rock Cycle Diagram on the back of this sheet. Include the three major rock types and the processes required to form each rock type.

2. Draw arrows to indicate the process that each rock type must go through to be formed into a new rock type.

# GEO 2: Historical Geology with Lab
# Lab 3: Sedimentary and Metamorphic Rocks

## Part II. SEDIMENTARY ROCKS AND MINERALS

### A. Sedimentary Minerals

1. Sedimentary rocks may include some additional minerals that we did not see in the igneous rock lab. These include calcite, dolomite, evaporates (halite and gypsum), and clay minerals.

a. Can Calcite and Dolomite be scratched with steel (nail, wire, or knife)?

b. Describe how these two minerals react to hydrochloric acid (HCl)

c. Does calcite or dolomite cleave along defined planes? Describe the nature of the cleavage planes (how many and angles).

d. What are some of the distinguishing properties of halite and gypsum (look at how they cleave and consider the hardness of the samples).

e. Describe the general appearance of the clay minerals

f. What does it mean to say the clay samples are “aggregates”? Hint: can we see individual clay minerals?

# GEO 2: Historical Geology with Lab
# Lab 3: Sedimentary and Metamorphic Rocks

## B. Clastic Sedimentary Rocks (particles cemented together)

| Sediment Name / Size | Rock Name | Characteristics |
|---|---|---|
| Boulders to granules (>2mm) | **Conglomerate**<br>**Breccia** | Rounded particles<br>Angular Particles |
| Sand (2mm-.063mm) | **Sandstones** – visible grains<br>**Quartz-rich** –Arenite<br>**Feldspar-rich** – Arkose<br>Mud-rich - **Graywacke** | <br>almost all quartz grains<br>abundant feldspar grains (pink)<br>mud, dirt, rock fragments |
| Silt and Clay (<.063mm) | **Mudstone / Shale**<br>Shale has fine layering | Mixture of silt and clay |

**Examine the "known" Clastic Sedimentary Rock samples and using the table above answer the following questions:**

1. How do Conglomerate and Breccia differ from Sandstone?

2. How does Conglomerate differ from Breccia?

    a. What do all of the types of sandstone have in common?

    b. List the three types of sandstone and describe how they differ.

3. How does shale/mudstone differ from sandstone

## C. Chemical and Biochemical rocks (categorized based on composition)

**Carbonate rich (contain calcite/dolomite) Sedimentary Rocks**: These rocks can be scratched with steel and they react to acid. Dolomite needs to be powdered for acid reaction.

Limestone – with or without fossils (calcite rich shells)

Dolostone – similar to limestone (with or without fossils), but only reacts to acid if scratched.

Chalk – powdery Limestone. Made from the calcite rich shells of microorganisms

**Silica-Rich Sedimentary Rocks**: These rocks do not react to acid. Chert is harder than steel

Chert - made of microscopic quartz crystals, so it is hard and has no cleavage.

Diatomite – powdery silica-rich rocks. Made from diatoms (a type of phytoplankton - algae)

**Evaporite Rocks**

Halite – Rock Salt

Gypsum – massive or clear Selenite

**Examine the "known" Chemical and Biochemical Sedimentary Rock samples and above and answer the following questions**:

1. How does Limestone differ from Chert?

2. Describe some of the different types of limestone observed in the lab

3. How can one distinguish Dolostone from Limestone?

4. How does Diatomite differ from Chalk?

5. What are some of the defining characteristics of Chert?

6. What characteristics do Halite and Gypsum Share?

7. How do Halite and Gypsum Differ?

## D. Sedimentary Rocks and the Geologic Environment

- The size of grains in clastic rocks is an indication of the energy of the environment. Larger grains imply a higher energy environment (steeper, faster stream or high-energy wave zones).
- Sandstone type is an indicator of environment. Well-sorted, quartz sandstone indicate long transport of sediment and are often associated with a Passive Tectonic Margin (not convergent). Feldspar-rich and Mud-rich sandstones indicate a location near mountains (often near a convergent plate boundary).
- Fossiliferous Limestones are commonly formed in shallow depth marine environments.
- Layered chert can be formed in deep marine environments (but can also form from precipitation).
- Halite and Gypsum are evaporite minerals and they form in arid regions with high rates of evaporation.

**Use what you have learned about sedimentary rocks to describe the geologic settings that would have existed when the following rocks were formed. What can you infer about the geologic history of these regions?**

1. **The Queenston Clastic Wedge** is composed of Ordovician sedimentary rock that extends from the Catskill mountains (east coast) to the Great Lakes. It is a wedge-shaped deposit of conglomerate, sandstone, and shale that coarsens (larger grains) and thickens toward the east and becomes finer-grained toward the west.

2. **The Fernvale Limestone Formation** is a Late Ordovician fossil-rich limestone that is exposed in Northern Arkansas, western Tennessee, northwestern Alabama, southwestern Illinois, southeastern Missouri, and central, eastern, and northeastern Oklahoma.

3. T**he Paradox Formation** of Utah and Colorado is a Pennsylvanian age formation consisting of abundant evaporites.

## Part III. METAMORPHIC ROCKS

### A. Terminology:

Protolith (or precursor): the preexisting rock (prior to metamorphism).

Grade: The degree of metamorphism; the amount of heat and pressure required to produce the rock.

Foliation: parallel planar orientation of minerals.

**Types of Foliation:**

Slaty Cleavage: near perfect, planar fractures resulting from alignment of very fine-grained minerals

Schistosity: new visible minerals

Gneissic Banding: parallel to subparallel foliation of medium- to coarse-grained platy minerals in alternating layers of different composition.

**Nonfoliated Metamorphic Rocks**:

Crystalline: mass of crystals

**Classification of Metamorphic Rocks:**

**Foliated Rocks** (in order of increasing grade):

Slate, Schist, Gneiss, Serpentine

**Nonfoliated Rocks**

Quartzite, Marble, Greenstone

## B. Exercise #1

How can you distinguish slaty cleavage from schistosity?

How can you distinguish schistosity from gneissic texture?

What is the hardness of the two crystalline texture samples?

## C. Exercise #2

List the protoliths for the following rocks

- Slate:
- Marble:
- Quartzite:
- Serpentinite:
- Greenstone:

## E. Metamorphic Rocks and the Geologic Environment

Many metamorphic rocks (particularly foliated rocks) form due to the pressure, heat and processes associated with convergent plate boundaries. Higher degrees of metamorphism are associated with deeper burial and more extreme conditions.

Use what you have learned about metamorphic rocks to describe the geologic settings that would have existed when the following rocks were formed. What can you infer about the geologic history of these regions?

1. **The Winding Stair Gap** within the Blue Ridge province of North Carolina consists of abundant schist and gneiss that were metamorphosed approximately 450 million years ago.

2. **The Grouse Ridge Formation** of the Central Klamath province is a mica-schist formed during Paleozoic deformation.