Laboratory 5. Sedimentary and Metamorphic Rocks

- LAB 5 provides samples of all three principal groupings of rocks including:

1) Igneous (plutonic and extrusive felsic, intermediate, and mafic varieties)

2) Sedimentary (detrital and chemical) and

3) Metamorphic (low, medium, and high grade)

- **Because we studied igneous rocks in LAB3, this will serve as a review for those, but our focus in this lab will be the different types and subtypes of sedimentary and metamorphic rocks and how they compare to igneous rocks, to one another, and with respect to the rock cycle.**

The three primary groups of rocks

- Igneous

- Intrusive (plutonic)
- Extrusive (volcanic)

- Ultramafic
- Mafic
- Intermediate
- Felsic

- Sedimentary

- Detrital
- Chemical

- Conglomerate
- Breccia
- Sandstone
- Siltstone
- Mudstone
- Limestone
- Dolomite

- Metamorphic

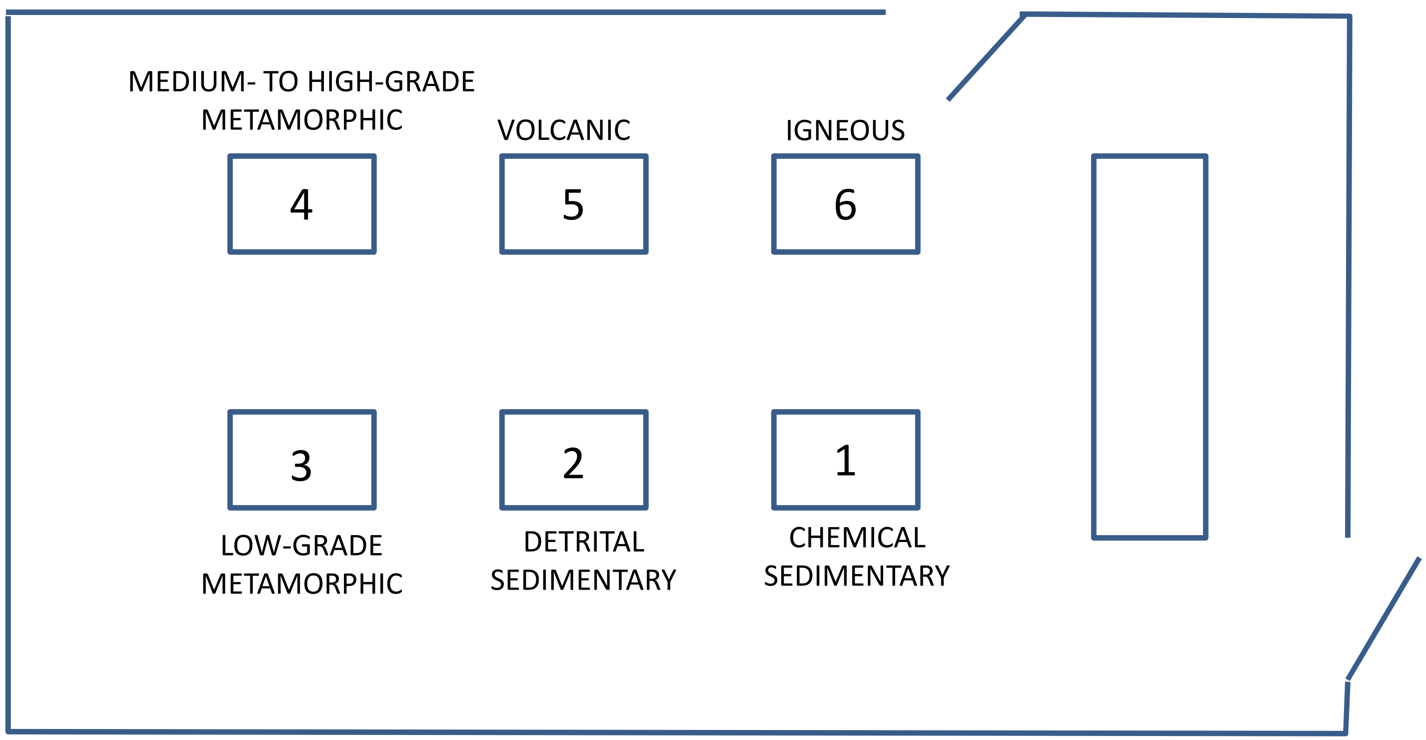
- Granulite
- Gneiss
- Schist
- Marble
- Greenstone

- Slate
- Phyllite
- Amphibolite
- Migmatite

Laboratory 5. Sedimentary and Metamorphic Rocks

- LAB 5 is set up with all three groups of rocks arranged on laboratory tables 1 to 6.

- Each group will systematically move to adjacent tables in a clockwise rotation to study the rocks at each station for ~20-minute intervals.



Laboratory 5. Sediment and Sedimentary Rocks

•The two primary types of sediment are ***chemical*** (table 1) and ***detrital*** (table 2)

•***Sediment*** *becomes lithified into sedimentary rocks by cementation and compaction.*

•***Chemical sediment*** consists of minerals precipitated from solution by inorganic processes and by the activities of biological organisms.

•**Chemical sedimentary rocks** (limestone, coal, microcrystalline quartz) are formed from chemical sediment.

•***Detrital sediment*** consists of solid particles, products of mechanical weathering.

•**Detrital sedimentary rocks** are formed by the *compaction* and *cementation*, or *lithification* of detrital sediment.

Laboratory 5. Table 1, Chemical Sedimentary Rocks

Chemical sedimentary rocks are:

a) Precipitated directly from fresh or sea water by biological accumulation,
b) Precipitated from saturated water (fresh, marine, and hydrothermal), or
c) Formed in bogs or swamps from the accumulation of dead organic matter (animal and vegetation)

Laboratory 5. Table 1, Chemical Sedimentary Rocks

Checklist:

- ☐ Limestone ($CaCO_3$ in it's pure form) is generally soft, gray to cream colored, will react with HCL, and is softer than metal, and can contains marine fossils.
- ☐ Dolomite is similar to limestone but is commonly has some Mg^{+2} replacing Ca^{+2}, can have an orange tint from also having some Fe^{+2}, is slightly harder than limestone, is less reactive to HCL
- ☐ For coal, recognize the peat → lignite → coal transition and the bituminous versus anthracite types. Bituminous is lower grade, has more sulfur (yellow mineral) and is not as shiny. Antracite of higher 'grade' as it burens cleaner and gives off more energy.
- ☐ Differentiate among cryptocrystalline quartz and limestone that are precipitated out of hydrothermal solutions or saturated waters.

Laboratory 5. Table 2, Detrital Sedimentary Rocks

Detrital sedimentary rocks are transported and deposited by running water, wind, or glacial ice.

Most are composed of silica grains and/or mineral and rock fragments, and are therefore differentiated using grain size.

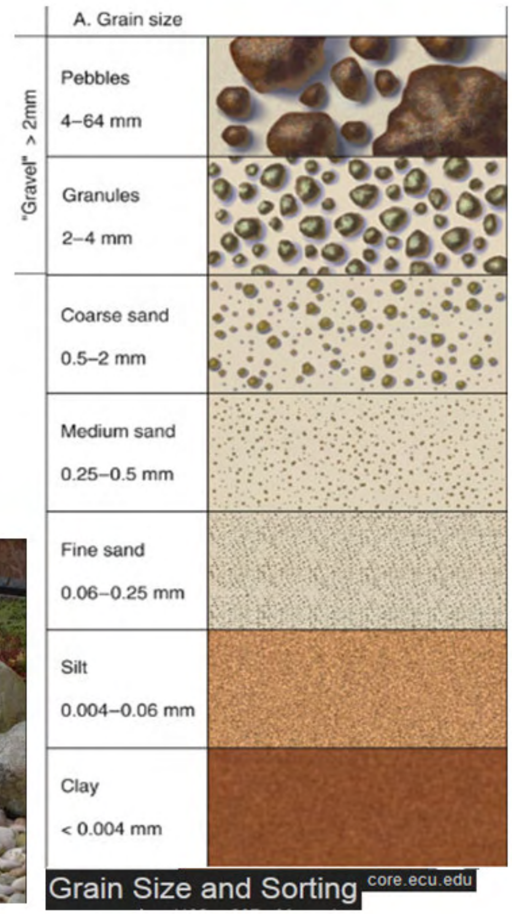
Common cementing agents are silica and calcium carbonate.

Laboratory 5. Table 2, Detrital Sedimentary Rocks

Sediment Particle Sizes

Sedimentary particles are classified according to grain (particle) sizes, in decreasing diameter:

1. Gravel, includes boulders (> 256 mm or ~10 in.), cobbles (64-256 mm or ~2.5 –10 in.), and pebbles
2. Sand
3. Silt, and
4. Clay (or mud).



Laboratory 5. Table 2, Detrital Sedimentary Rocks

Checklist:

- ☐ Recognize increasing grain size of mudstone → siltstone → sandstone → conglomerate.
- ☐ Mudstone and shale differ because the latter has initial layering, or fissility, by the preferred alignment of play minerals during early phases of burial and compaction.
- ☐ The degree of rounding and sorting of grains in the various samples and discuss the significance with respect to transport distance.
- ☐ Conglomerate contains rounded grains whereas breccia contains angular grains
- ☐ Those cemented with calcium carbonate are commonly more friable and can react with dilute HCL whereas silica-cemented ones are harder and nonreactive to HCL.

Laboratory 5. Sedimentary and Metamorphic Rocks

Note:

- Metamorphic rocks form when minerals in a sedimentary or igneous rocks rock begin to recrystallize into ne mineral forms when it is subjected to changes (usually increases) in temperature and pressure from burial or through interaction with groundwater.
- The transition from sedimentary rocks into low-grade metamorphic rocks is gradual as rocks become more deeply buried and heated through time, therefore it is sometimes difficult to tell if a mudrock is sedimentary or low-grade metamorphic without microscopy. Similarly the transition from limestone into a marble sometimes requires microscopic work.
- Generally speaking, metamorphic rocks are more compact and dense than their sedimentary precursor rocks, have foliation caused by mineral banding or layering that can be seen with the naked eye. But this isn’t the case for pure quartz or limestone rocks that can be mono-minerallic and therefore locally lack visible foliation.

Laboratory 5. Table 3, Low-grade Metamorphic Rocks

Metamorphic rocks are a result of new mineral growth as a result of changing temperature and temperatures during burial, tectonism, and plutonic igneous activity.

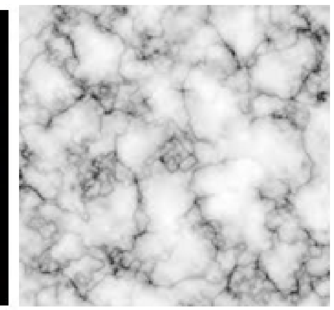
Mostly foliated to non-foliated silica and lime rocks that are more dense, hard, and mineralized than sedimentary rocks.

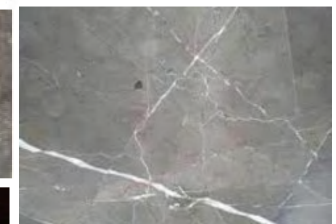
Do not ordinarily include plutonic igneous rocks because igneous minerals form at relatively high T & P's.

Laboratory 5. Table 3, Low-grade Metamorphic Rocks

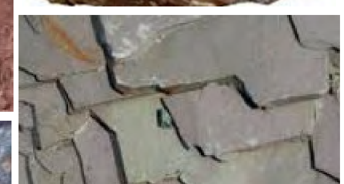
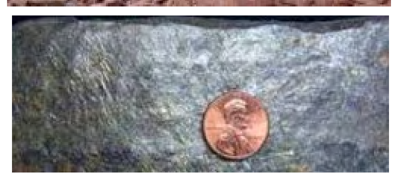
Checklist:

- ☐ Hornfels are sedimentary rocks that have been altered and mineralized by hydrothermal solutions percolating through them.
- ☐ The transition of lime rocks to different types of marble (foliated and non-foliated)
- ☐ Those cemented with calcium carbonate are commonly more friable, are softer than steel, and react with weak acid, whereas silica-cemented ones are harder than metal and don’t react with acid.
- ☐ The transition from sandstone to quartzite (foliated and non-foliated).
- ☐ Quartzite and marble can look very similar, but metal scratches marble but not quartzite.
- ☐ The transition of mudrock from mudstone → argillite → phyllite





Laboratory 5. Table 4, Medium-grade Metamorphic Rocks

☐ **Schist** is a medium-grade metamorphic rock with medium to large, flat, sheet-like grains in a preferred orientation (nearby grains are roughly parallel). It is defined by having more than 50% platy and elongated minerals, often finely interleaved with quartz and feldspar.

Laboratory 5. Table 4, High-grade Metamorphic Rocks

Gneiss is a high grade metamorphic rock, meaning that it has been subjected to higher temperatures and pressures than schist. It is formed by the metamorphosis of granite, or sedimentary rock. **Gneiss** displays distinct foliation, representing alternating layers composed of different minerals.

Migmatite is a rock that is a mixture of metamorphic rock and igneous rock. It is created when a metamorphic rock such as gneiss partially melts, and then that melt recrystallizes into an igneous rock, creating a mixture of the un-melted metamorphic part with the recrystallized igneous part.

Laboratory 5 Crustal rocks

A.

B.

C.

www.sandatlas.org/composition-of-the-earths-crust/

Common rocks in the crust. Igneous rocks in the first row: granite, gabbro, basalt. Metamorphic rocks in the second row: gneiss, schist, amphibolite. Sedimentary rocks in the third row: sandstone, shale, limestone.