Laboratory 5a. Sedimentary Rocks

- The two primary types of sediment are ***chemical*** and ***detrital.***

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

- ***Chemical sediment*** consists of minerals precipitated from solution by inorganic processes and from accretion by 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 from detrital sediment

- *Both chemical and detrital sediment and sedimentary rock can contain fossils, some being macroscopic (visible to the naked eye) and microscopic (viewable to humans only through magnification).*

Laboratory 5a. Sedimentary Rocks

- The primary exercise for this lab is to study and become familiar with 12 sedimentary rock types included in a Ward's scientific rock kit including those of detrital and chemical origin.

- A secondary exercise will be to examine the loose samples of detrital and chemical sediment and rocks held by RVCC, discuss them among your peers and professor, and categorize them.

- A third exercise will quiz you as to some common and primary sedimentary features seen in sedimentary rocks

- By the end of this lab you should have an introductory familiarity with the principal types of sedimentary rocks, including the terminology and methods of discriminating between clastic (detrital) and chemical varieties, including microcrystalline forms of quartz and calcium carbonate.

Laboratory 5a. Chemical Sedimentary Rocks

Chemical sedimentary rocks are:

a) Precipitated directly from fresh or sea water by biological accretion,

b) Precipitated directly from chemically saturated water in fresh, marine, and hydrothermal environments, or

c) Formed in bogs or swamps from the accumulation of dead organic matter (animal and vegetation)

Laboratory 5a. 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 (coquinas, sea shells, coral, etc.)*
- ☐ 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. Anthracite of higher 'grade' as it burns cleaner and gives off more energy.
- ☐ Differentiate among cryptocrystalline quartz and limestone that are precipitated out of hydrothermal solutions or saturated waters.

Laboratory 5a. Detrital Sedimentary Rocks

Common cementing agents are silica and calcium carbonate.

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

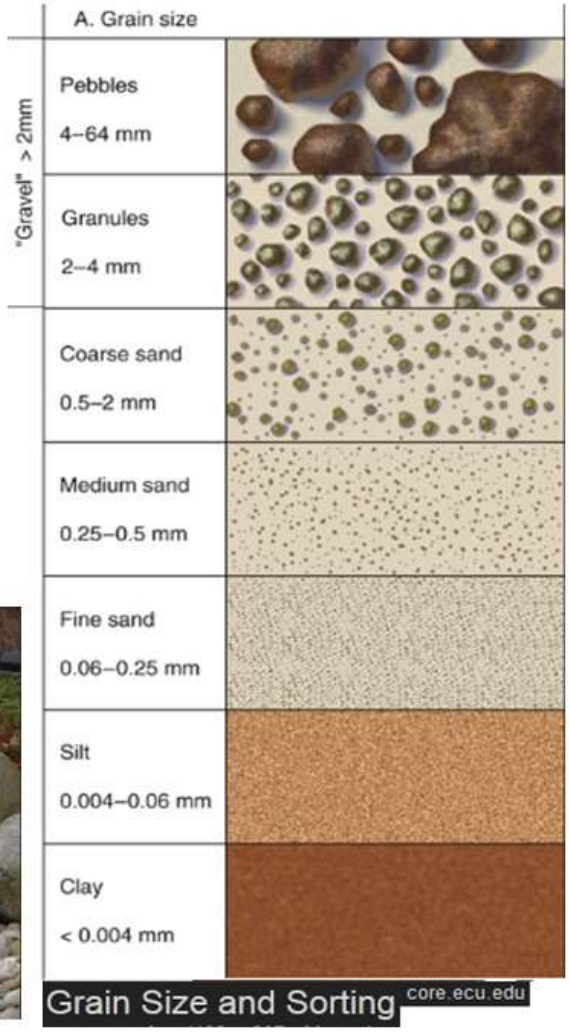
b) Most are composed of silica grains and/or mineral and rock fragments, and are therefore differentiated using grain size.

Laboratory 5a. 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).



Exercise 1.
A Sedimentary Rock Collection by Ward's Scientific

13 White chert

14 Siltstone

15 Coquina

16 Qtz conglomerate

17 Red sandstone

18 Very-fine gray sandstone

19 Gray limestone

20 Black shale

21 Shell limestone

22 Dolomite

23 Travertine (dripstone)

24 Gypsum

Laboratory 5. 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 5b. Metamorphic Rocks

- Metamorphism is the change of minerals or geologic texture (distinct arrangement of minerals) in pre-existing rocks (protoliths), without the protolith melting into liquid magma (a solid-state change). The change occurs primarily due to heat (Temperature), pressure (P), and the introduction of chemically active fluids (F).

- New mineral growth results from changing geological conditions (F-T-P) accompanying burial, tectonism, and plutonic igneous activity.

- Three categories of metamorphic rocks are identified by their minerals, fabrics, textures, weight, and color.

- Low-grade metamorphic rocks like quartzite, slate, and low-grade marble may or may not be foliated are more dense, hard, and mineralized than sedimentary protoliths. Low-grade metamorphic rocks can have remnant primary, sedimentary structures and grains still visible.

- The preservation of primary sedimentary structures (like bedding, ripple marks, and mud cracks) *decreases* with metamorphic grade because the degree of recrystallization increases from medium-grade **schist**, through high-grade **gneiss** into partially melted **migmatite,** the latter resembling igneous plutonic rocks, and containing many of the same mineral assemblages. Gneisses more than schists have distinct mineral banding between iron-rich (dark) and silica-rich (light) mineral layers.

PRIMARY GEOLOGICAL STRUCTURES

- Sedimentary bedding and features (like fossils)

- Crystalline (igneous and metamorphic) compositional layering

- Mineral foliation in crystalline rocks

Laboratory 5b. Metamorphic and Crustal Rocks

- The first exercise for this lab is to study and become familiar with 12 metamorphic rock types included in a Ward's scientific rock kit including those of low-, medium-, and high-grade varieties.

- A second exercise is to examine the loose samples of metamorphic rocks held by RVCC, discuss them among your peers and professor, and categorize them.

- A third exercise is to examine the various loose collections of crustal rocks as a review before the exam.

- By the end of this lab you should have a working familiarity with the principal types of crustal rocks, including the names of the principle sediment and rock types.

Exercise 1.
A Metamorphic Rock Collection by Ward's Scientific

25. Gneiss
26. Pink gneiss
27. Schist
28. Garnet schist
29. Hornblende gneiss
30. Red quartzite
31. Red slate
32. Gray slate
33. White marble
34. Pink marble
35. Serpentinite
36. Soapstone

Laboratory 5b. Low-Grade Metamorphic Rocks

Laboratory 5b. 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 mudrocks from mudstone → argillite → phyllite

Laboratory 5b. 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 5b. 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 unmelted metamorphic part with the recrystallized igneous part.

Laboratory 5b. Medium to High-Grade Metamorphic Rocks

Laboratory 5b. High-Grade Metamorphic Rocks

Note:

- Metamorphic rocks form when minerals in a sedimentary or igneous rocks rock begin to recrystallize into new 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 5b. 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.