I. Objectives

1. Identify common igneous rocks based on texture and composition
2. Identify common sedimentary rocks based on texture and composition
3. Understand linkages between environment and rock type.

II. Introduction

Texture and composition play key roles in identifying rocks and also provide clues to the environmental conditions under which the rock formed.

Igneous Rock Texture

Igneous rocks are identified and classified based on textural and compositional properties. The various textures of igneous rocks are directly related to the rate of cooling magma. For example, magma that cools very slowly will allow mineral crystals to form producing coarse-grained textures that can be observed with the naked eye. Coarse-grained igneous textures are produced below the earth's surface, where magma cools slowly, and are referred to as *intrusive* igneous rocks. Magma that cools very quickly will produce fine-grained textures in which mineral grains typically cannot be observed with the naked eye. Fine grained igneous textures are produced above the earth's surface, where magma cools quickly, and are referred to as *extrusive or volcanic* igneous rocks.

Igneous Rock Textural Terms

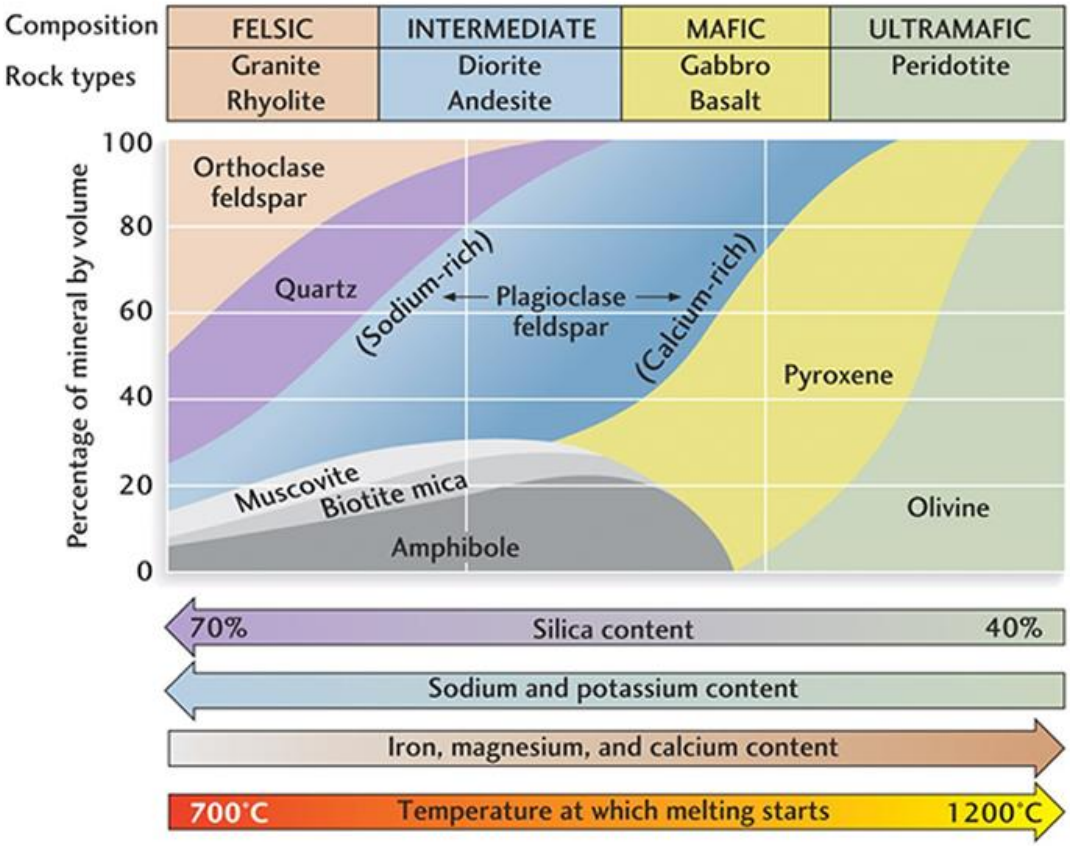
Geologists use the following terms to describe the type of igneous grain textures that are commonly observed. You should learn these terms!

- phanaritic – minerals are visible to the naked eye and form a "mosaic" of interlocking crystal aggregates. Typically, mineral grains are greater than 1 mm.
- aphanitic – mineral grains are too small to see without a hand lens and generally cannot be observed with an unaided eye. Mineral grains are less than 1 mm.
- vesicular – "sponge-like appearance" textures that contain numerous cavities or holes.
- pyroclastic – textures created by volcanic material that cooled rapidly as it was hurled through the air, picking up various rock fragments.
- glassy – a texture created by extremely fast cooling or quenching of magma. Appears as glass or similar to the end of a broken bottle.

Igneous Rock Composition

Composition of igneous rocks is related to the various observed mineral assemblages. Depending on the chemical make-up of the cooling magma, igneous rocks will form groups of mineral assemblages that represent the igneous rock's composition, mineral make-up, or chemistry. For example, igneous rocks that form at higher temperatures contain mineral assemblages that are rich in iron (Fe), magnesium (Mg), and calcium (Ca), creating a dark-colored rock or a *mafic* composition. Mafic igneous rocks lack quartz and orthoclase and possess high concentrations of ferromagnesian minerals such as olivine, pyroxene, and amphibole.

Igneous rocks that form at lower temperatures contain mineral assemblages rich in potassium (K), aluminum (Al), and sodium (Na), creating light-colored rocks or a ***felsic*** composition. Felsic igneous rocks are abundant in quartz, orthoclase, and sodium-rich plagioclase minerals. However, most felsic rocks will have small percentages of ferromagnesian minerals such as hornblende (amphibole) and biotite (mica mineral).



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Sedimentary Rock Textures

Sedimentary rock textures are typically characterized by observing lithified (cemented) inorganic grains, minerals, organic material, or fossil fragments. The wide range of textures common in sedimentary rocks is separated into *clastic*, *chemical*, and *bioclastic (biochemical)* groups.

- Clastic rocks - Clastic textures are composed of cemented inorganic particles (clasts) that typically range in size from 1/256 mm (very fine) to grains measuring > 2 mm (coarse-grained). Particle size is described in three major categories, gravel (all particles > 2 mm in diameter), sand (particles < 2 mm but > 1/16 mm), and mud (particles < 1/16 mm). The proper classification (rock name) of clastic sedimentary rocks is dependent on particle (grain) size and composition.

- Chemical rocks - Chemical sedimentary rocks are directly precipitated from bodies of aqueous solutions such as an ocean or lake environment through inorganic processes. The

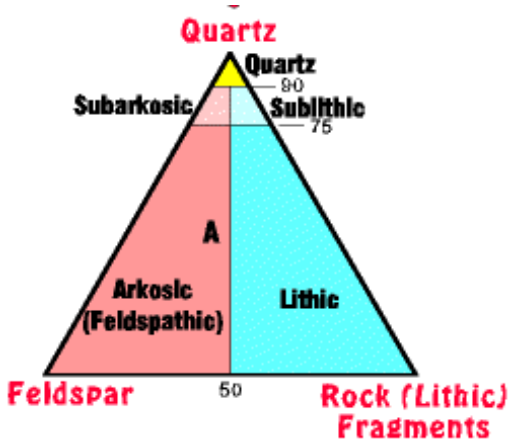
formation of chemical rocks is not dependent on currents or energy, and particle size is not as important in classification as in clastic rocks; instead, chemical sedimentary rocks are classified based on the chemical make-up of dominant minerals. Carbonates, evaporites, and chert form the three common chemical groups. In most cases, chemical rock textures lack the "clastic" nature of the other two sedimentary rock groups.

- Bioclastic (biochemical) rocks - Biochemical rocks result from the weathering, transportation, and lithification of animal and plant parts as well as from animal and plant secretions. Bioclastic sedimentary rocks will typically display their "clastic" nature by revealing particles of lithified shell fragments, plant material, or fossil parts.

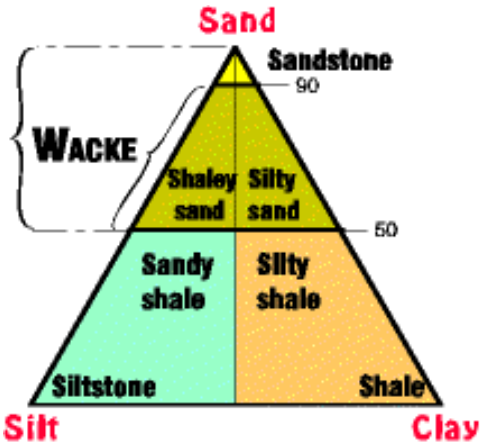
Sedimentary Rock Composition

A sedimentary rock composition is dependent on varying mineral assemblages produced from the duration of weathering and transportation of sediment. For example, quartz is much more resistant to weathering than are feldspar minerals, and, therefore, the presence of quartz sandstone (chiefly composed of quartz grains) indicates the rock is mature and spent a long time in its depositional environment. However, sandstones rich in feldspar (arkosic sandstone) indicate the rock is immature and has spent less time in its depositional environment. Typically, feldspars will quickly weather to clay.

Common minerals associated with clastic sedimentary rocks are quartz, feldspar, and rock fragments. Common minerals associated with chemical and bio-clastic sedimentary rocks are calcite ($CaCO_3$) and various forms of quartz.



Sedimentary Composition Classes, from: csmres.jmu.edu/geollab/fichter/SedRx/



Sedimentary Textural Classes, from: csmres.jmu.edu/geollab/fichter/SedRx/

III. Materials

Igneous and sedimentary sample bags for each group, hand lens, scratch plate

IV. Prelab Definitions

1. mafic

2. felsic

3. intrusive

4. extrusive

5. clastic

V. Lab Procedure

Each group will have a collection of rocks to share. With your partner, fill out the following two charts to classify the rock samples at your table.

Table 1: Igneous Rock Samples							
Sample	Texture	Composition	Primary minerals	Secondary minerals	Diagnostic clues	Igneous rock name	Extrusive or intrusive?

Table 2: Sedimentary Rock Samples							
Sample	Texture class	Composition class	Grain size class	Secondary minerals	Diagnostic clues	Sedimentary name	Origin

VI. Lab Discussion

1. What rock characteristics do you find easiest to identify and use for this naming activity?

2. Select one igneous rock, describe it and write a short narrative describing its geologic history.

3. Select one sedimentary rock, describe it and write a short narrative describing its geologic history.

Lab courtesy of Dr. Jim Washburne