

GEOLOGY 17.01: Mineralogy

LAB 4: COMMON MINERALS IN SEDIMENTARY ROCKS

Part 2

Learning Objectives:

- Students will be able to classify sandstones based on their mineral content
- Students will be able to identify hands samples of carbonate, sulfate, oxide and clay minerals that are common in sedimentary rocks
- Students will be able to identify glauconite, calcite, dolomite, and gypsum in thin-section

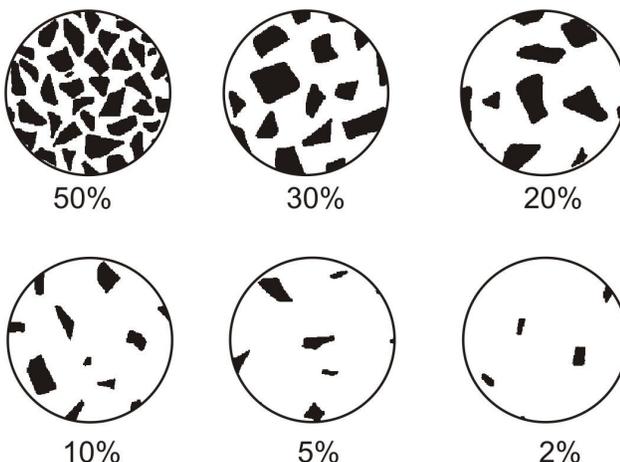
New Minerals: Kaolinite, Bentonite, Glauconite*, Calcite*, Aragonite, Dolomite*, Gypsum*, Anhydrite, Halite, Sylvite, Hematite, Limonite, Bauxite

Review Minerals: Quartz, Plagioclase, Microcline

CLASSIFYING SANDSTONES

The Folk classification scheme for sandstones is used commonly and is based upon the relative proportion of three components: quartz, feldspar (both plagioclase and alkali feldspars) and rock fragments (multi-grain clasts, including chert).

Examine thin-section SANDSTONE. Estimate the percentage of quartz, feldspar and rock fragments that comprise this sample. Use the figure to the right to help you to estimate the percentage of the various components. Recast these percentages relative to the total of these three components. Use this information to classify the sandstone using the Folk Classification diagram.



% Quartz _____ % Feldspar _____ % Lithic Fragments _____
 Total (Quartz + Feldspar + Lithic Fragments) = _____

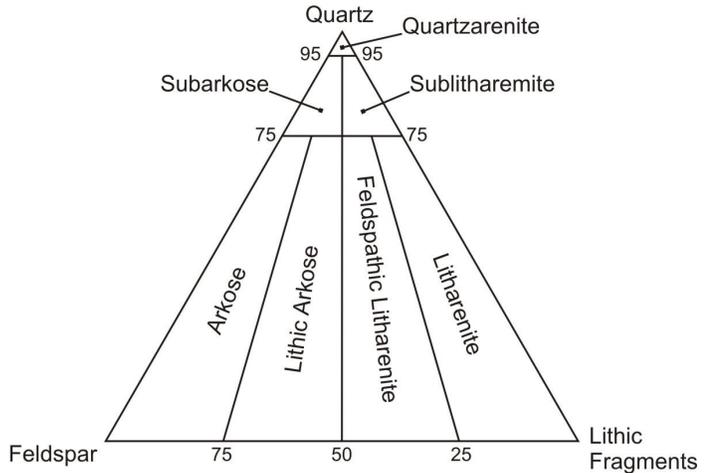
% Quartz/Total = _____

% Feldspar/Total = _____

% Lithics/Total = _____

Rock Name: _____

Folk Classification of Sandstones



CLAYS

Clays are a group of hydrous sheet silicates that minerals that are fine-grained (usually microscopic). Most clay is produced from chemical weathering of rocks. For example, **kaolinite** is formed from the hydrolysis of potassium feldspar:



Shales are composed predominantly of clays such as kaolinite. Clays may also occur as cement in sandstones. Because of their microscopic size, analytical methods such as x-ray diffraction are required to accurately identify most clay minerals.

Bentonite $[(\text{Na},\text{Ca})_{0.33}(\text{Al},\text{Mg})_2\text{Si}_4\text{O}_{10}(\text{OH})_2 \cdot (\text{H}_2\text{O})_n]$ absorbs water and expands when wet, and so is often referred to as a swelling clay. It is derived from the weathering of volcanic ash.

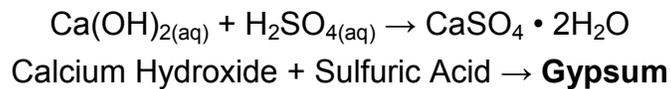
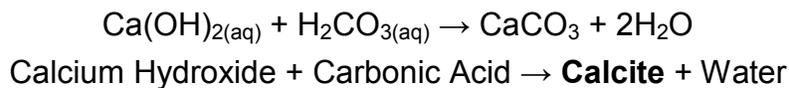
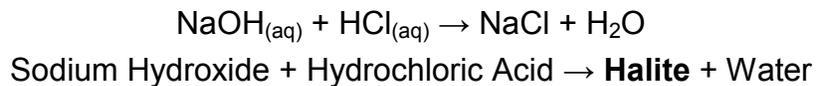
Glaucanite $([\text{K},\text{Na}][\text{Fe}^{3+},\text{Al},\text{Mg}]_2[\text{Si},\text{Al}]_4\text{O}_{10}[\text{OH}]_2)$ is a green clay that is found as rounded aggregates of very fine grained scaly particles. It is generally indicative of deposition on a continental shelf with slow rates of sediment accumulation.

Examine the hand-samples of KAOLINITE, BENTONITE, and GLAUCONITE. What physical properties to these clays share? What physical allow you to distinguish each of these clays?

Examine the thin-section GLAUCONITE, determine the optical properties of glauconite and complete a sample description form.

SALTS: CARBONATES, SULFATES and HALIDES

A salt is a substance formed from the anion of an acid (a proton donor) and the cation of a base (proton acceptor). Examples of reactions that form mineral salts that are relatively common in sedimentary rocks are:



A salt will precipitate if a solution becomes saturated with respect to that mineral. The carbonate mineral calcite (CaCO_3) precipitates commonly from seawater in shallow, tropical environments. Aragonite is a polymorph of calcite that may form cement in sedimentary rocks. The sulfate gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) and the halides halite (NaCl) and sylvite (KCl), precipitate from seawater that has become hypersaline due to extreme evaporation. Dolomite ($\text{CaMg}[\text{CO}_3]_2$) and anhydrite (CaSO_4) are minerals that commonly replace calcite and gypsum, respectively. Carbonates, sulfates and halides are ionic compounds. Accordingly, these minerals are relatively soft and soluble.

Examine the hand-samples CALCITE 1, CALCITE 2, CALCITE 3, ARAGONITE and DOLOMITE and document their physical properties. What physical properties do these carbonate minerals share? What physical properties allow you to distinguish calcite from dolomite?

Examine thin-sections CALCITE and DOLOMITE. Determine the optical properties of each, and complete a sample description form for each sample. What properties may allow you to distinguish calcite from dolomite?

Examine the hand samples of gypsum in its varied forms (selenite, 120; satin spar, 145x; alabaster, 179; desert rose, 129; blades, 166) and anhydrite, and document their physical properties. What physical properties are common to all forms of gypsum? What physical characteristics distinguish these forms from each other?

Examine thin-section GYPSUM and document its optical properties on a sample description form. Compare these optical properties with those of anhydrite that are documented in your textbook. What optical properties enable you to distinguish gypsum from anhydrite?

Examine the hand-samples HALITE and SYLVITE and document their physical properties. What physical properties do these halides share? What properties allow you to distinguish halite and sylvite?

What physical characteristics most readily allow you to distinguish calcite, gypsum, and halite?

OXIDES and HYDROXYOXIDES

When iron-bearing minerals (e.g., olivine, hornblende, pyrite) weather, they produce a variety of insoluble iron oxides (e.g., hematite Fe_2O_3) and iron hydroxyoxides (e.g., limonite, $\text{FeO}[\text{OH}] \cdot n\text{H}_2\text{O}$). Limonite is not a true mineral, but is composed by a mixture of similar hydrated iron oxide minerals. Limonite may coat clasts or occur as the cementing material in iron rich sandstones. Hematite and limonite are opaque minerals and so are dark under the PLM. A very thin coating of these iron oxide minerals on translucent minerals such as quartz can result in a deep red stain that is visible under the microscope.

Like limonite, the aluminum ore bauxite is a mixture of very fine-grained minerals (gibbsite $\text{Al}[\text{OH}]_3$, and diaspore AlOOH). It is produced by intense chemical weathering of silicate rocks (typically in tropical climates) during which all of the more mobile elements are removed in solution, leaving behind only aluminum compounds. Bauxites commonly contain iron oxides; such examples will have a rusty-red color.

Examine the hand samples of HEMATITE 1, HEMATITE 2 (specular hematite), HEMATITE 3 (oolitic hematite), LIMONITE, and BAUXITE (105) and document their physical properties.