Lab 1B: Siliciclastic Rock Classification

<u>Goal:</u> To become familiar with the classification of siliciclastic rocks and expand your understanding of the information they provide about sediment sources and depositional environments.

Sediments to Rocks

Sediments, such as those in Lab 1A, become consolidated into rocks through the processes of compaction and cementation. Cements are crystals that grow between grains and bind them together to make a sedimentary rock. It precipitates in void spaces in the sediment after deposition and can be composed of a number of different minerals. It is commonly only identifiable in rocks with little fine-grained matrix and lots of void space, but it is present in almost all sedimentary rocks. The four most common cements are:

Siliceous Cement: As you probably guessed, this cement is composed of silica, either in the form of quartz or chert (a microcrystalline variety of quartz). Rocks with abundant siliceous cement will be very hard to break or to cut with a rock saw.

Calcite Cement: Carbonate cement will react violently with the application of HCl. If you see a lovely quartz arenite, and you are asked to identify the cement, do not assume the cement is silica! Always check with acid.

Ferruginous Cement: Iron oxide cements color the sediments brown, yellow, red or orange.

Clay Cement: Clays can precipitate in void spaces as well as be deposited with the initial sediment. It can be extremely difficult to tell if a clay in a rock is depositional or formed as a later cement. For this lab, assume that any clay present was deposited with the other sediment and is not a cement.

Classification of Siliciclastic Rocks

Siliciclastic rocks are classified primarily by grain size and secondarily by the composition of the grains. There are several classification schemes, but we will use the ones in the text book, i.e. Figure 2.3 for the first order classification by grain size and Figure 2.6, the Pettijohn classification for sandstones. The following sections describe some additional classification terminology and concepts.

<u>Conglomerates</u>

The large framework clasts of conglomerates and breccias give a readily identifiable sample of nearby source terrains. Because of this, descriptive modifiers are often added to a conglomerate name. For example, a conglomerate composed of pebble-sized granitic framework clasts, it would be named a *granite pebble* conglomerate.

The *matrix* of a conglomerate or breccia is the finer-grained material between the framework clasts and can also be an indicator of the source terrain and aid in sedimentological interpretation. If there is little matrix, and the clasts support one another, the rock is termed a *framework-supported* conglomerate or an *orthoconglomerate*. Matrix-supported conglomerates, or *paraconglomerates* has a high enough amount of matrix, so that the clasts are "floating" without touching one another.

There are many environments in which a conglomerate might form, so it is important to examine all available data before determining the depositional environment. This would include outcrop information, which you will not have access to in this particular lab. For now, simply think about where you would likely find pebbles, gravels or cobbles such as the ones you will find in the conglomerates or breccias in the lab.

Sandstones

The overall volume of sandstones and the relative ease of study of their composition has made them heavily studied clastic rocks. This has led to an unfortunate abundance of classification schemes. The one by Pettijohn (1975) is the most commonly used classification scheme, and we will use it in lab.

Sandstones are classified using texture and composition. The first step in classifying a sandstone is to determine the abundance of *matrix* (in this case, clay-size material in the interstices of the framework grains and not the sandy material in a conglomerate). If there is less than 10-15% matrix, the rock is an *arenite*. Greater than 15% matrix, it is called a *wacke*.

Now, composition is examined. The compositional classification of sandstones is based on three components: *quartz, feldspar,* and *lithic fragments*. Lithic fragments are also called *unstable rock fragments* due to their inherent instability and low resistance to weathering. There are several categories of lithic fragments, all of which should be taken into consideration when classifying a rock.

IMPORTANT! When plotting the composition of sandstone on a triangle to determine its name, the percentage of the three mineral components must be normalized to 100%, thus ignoring the amount of matrix.

For example, a rock is determined to contain 20% matrix, 10% lithic fragments, 15% feldspar and 55% quartz, what would you call it? First, it has over 15% matrix, so it is a wacke of some kind. Recalculating the mineral percentages without the matrix, you now have 12% lithics, 19% feldspar, and 69% quartz. (Ask your TA if you are not sure how to do this.) Plotting these percentages on a sandstone classification triangle, it turns out to be a *feldspathic wacke*.

Occasionally, non-silicate grains will be incorporated into sandstone. For example, glauconite and phosphatic grains may occur in some abundance in marine sands. In general, if those grains are in abundance of greater than 5%, a modifier, like *glauconite-bearing arkosic arenite* is warranted. If greater than 15%, the rock would be called a *glauconite arkosic arenite*.

Siltstones and Mudrocks

Silt is small enough that it is difficult to see grains, but you can feel a slight grittyness as you brush the rock gently against your teeth. Silts are composed most often of tiny pieces of quartz and feldspar and some minor constituents. Mudrocks are composed of even finer clay minerals. The point is, you can not really see them, and laboratory techniques such as thin section analysis, x-ray diffraction mineral determinations, and geochemical analysis are most useful in classifying them. We are not going to do that, so if the grains are silt size, just use the name “siltstone”or “mudrock”.

General Check List for Description of Sedimentary Rocks in Hand Sample

1) Rock type, major and minor constituents:
   - Framework grain composition and %
   - Matrix content and %
   - Cement composition , crystallinity, %

2) Color on fresh surface

3) Texture
   - a. grain size
   - b. sorting
   - c. shape of grains - rounding, sphericity

4) Weathering characteristics

5) Fossils - treat as a mineral grain. What is it? %, etc.

Geology 109L
Lab 1B, Siliciclastic Rock Classification

Name:
TA:

1. T-1135
   T-1154

   a) What mineral forms the bulk of these rocks?

   b) Describe their textures.

   c) Where might you find similar sediments accumulating today?

   d) What is the reason for the difference in friability of T-1135 and T-1154?

   e) Name the rocks.

2. T-1969
   T-79

   a) What is the grainsize of each of these rocks?

   b) Name them.

3. T-278

   a) What is the composition and texture of this rock?

   b) What is a likely depositional environment?

   c) Name the rock using the conglomerate classification chart.

5. T-1223

   a) What is the texture and composition?

   b)What is a likely depositional environment?

   c) Name the rock.

7. T-1428

   Name this rock by either McBride (1963) or Folk et al. (1970).

8. T-237 Would you consider this rock to be texturally mature? Why?

9. T-1222 Give a complete hand sample description, depositional environment, and name the rock. Use the rock description check list to make sure you include everything.

10. T-304 Give a complete hand sample description and name the rock.

11. T-347 Give a complete hand sample description and name the rock.