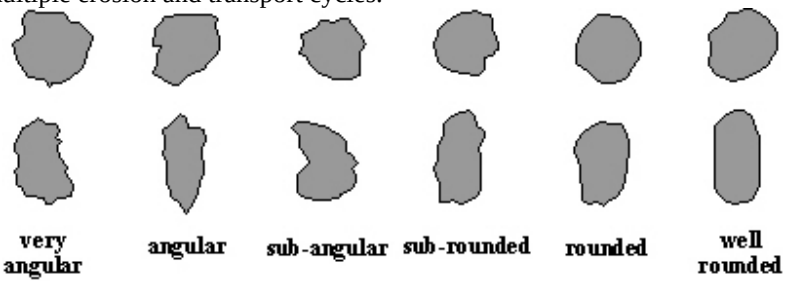
Lab III: Sedimentary Rocks
Geology and Art
Fall, 2004

- Clastic sedimentary rocks are formed from pre-existing rocks exposed at the Earth's surface that are subjected to weathering, erosion, transport and deposition.
- Most sedimentary rocks accumulate in strata (layers) on the Earth's surface; primarily in ocean basins.
- Sedimentary rocks are classified as clastic (formed from transported fragments), chemical (precipitated from solution), and biogenic (formed by organisms).
- Fossils are often contained in sedimentary rocks.
- Sediments make less than 5% of the Earth's crust, but since they are concentrated at the Earth's surface they make up over 75% of the exposed rock.
- Sediments are important pages in the "book" of geologic history because they contain important information about the local and regional environment at the time of their deposition.
- Sedimentary rocks are the source of certain commodities including oil and commercial clay deposits.

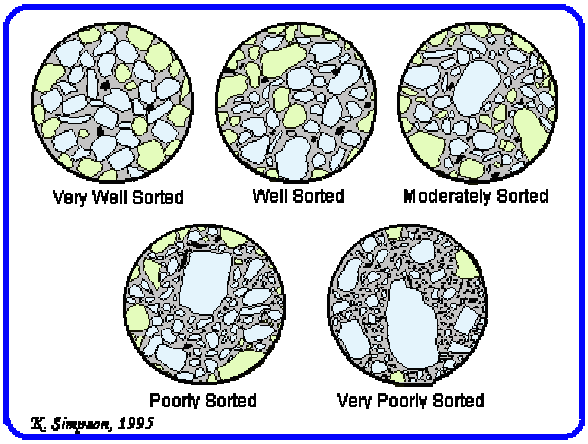
Clastic sediments
Classification of clastic sediment is based on grain-size, degree of sorting, roundness of particles, and composition of the clastic material. The table below shows the grain-size divisions (size is diameter).

Grain or particle size of clastic sedimentary rocks.		
Wentworth Size Scale Wentworth(1922)	***Grain Size Name***	***Rock Name***
>256 mm	Boulders	Conglomerate (rounded clasts) Breccia (angular clasts)
64 - 256 mm	Cobbles	
4 - 64 mm	Pebbles	
2 - 4 mm	Granules	
1 - 2 mm	Very coarse sand	Sandstone (e.g., quartz arenite, arkose, lithic sandstone)
0.5 - 1 mm	Coarse sand	
0.25 - 0.5 mm	Medium sand	
0.125 - 0.25 mm	Fine sand	
0.0625 - 0.125 mm	Very fine sand	
0.0039 - 0.0625 mm	Silt	Siltstone, shale, mudstone
<0.0039 mm	Clay	Claystone

The roundness of the clastic particles is an important characteristic. In general, the more round the particles, the more "mature" the sediment. This means they have experienced a lot of transport and abrasion, often multiple erosion and transport cycles.



Sorting is based on the range of particle sizes. A well sorted clastic sediment has grains approximately the same size and poorly sorted means there is a wide range in particle size.



Some special clastic sedimentary rocks

Quartz arenite (sandstone) is made up almost entirely of quartz. It is a very durable mineral that is insoluble in water. The lack of other minerals implies a very mature sediment, typical of a high-energy environment like a beach. Quartz arenites tend to be light in color (white, buff or yellow).
Arkose is composed of at least 25% feldspar. Although feldspars are the most abundant family of minerals in the crust, they are not very durable and tend to break down to clay minerals (chemical weathering). Arkose is commonly eroded from a relatively local granitic rock. Arkose is frequently red in color.
Greywacke is a sandstone that contains quartz, feldspar and rock particles (lithic fragments) and has a matrix of fine-grained silt or mud. It is often referred to as a "dirty" sandstone.

Chemical sediments

These sedimentary rocks contain minerals that crystallized directly from ions in solution, usually sea water. They are not transported like clastic particles, but accumulate in the basin that they crystallize. An example would be evaporates that are created when water containing dissolved salts evaporates, leaving the salts behind.

Some special chemical sedimentary rocks

Carbonates: carbonate rocks such as limestone ($CaCO_3$) can precipitate directly from upwelling sea water. Dolostone, $CaMg(CO_3)_2$, is produced by the alteration of limestone in shallow bays when solutions high in Mg^{2+} ions are present.
Evaporites: Evaporates are formed when sea water evaporates. This requires a hot and dry climate, little freshwater influx, and restricted access to open water. As sea water evaporates, the ions increase in concentration. When the water become over saturated, the salts precipitate. The order of precipitation is usually calcite, gypsum, halite, magnesium and potassium chlorides and finally sulfates.

Biogenic sediments

Organisms are responsible for removing ions from water, usually sea water, and secreting them as hard parts such as shells. As the organisms die, these shells accumulate and produce sedimentary rocks. Biogenic sediments are usually defined as those that contain at least 30% skeletal remains. Clay minerals generally make up the non-biogenic component of these rocks.

Some special biogenic sedimentary rocks

Carbonates: carbonate rocks can form from the accumulation of shells or tests, often microscopic plankton (foraminifera). Reef carbonates and invertebrate shells can make up limestones.
Siliceous sediments: Diatoms and radiolaria produce shells of silica (SiO_2). These fall to the ocean basin (or lake floor) and produce siliceous oozes that recrystallize into chert or flint. This is microcrystalline quartz. Diatoms can accumulate as diatomite.

Lab Assignment:

Select at least two sedimentary rock samples from the two classes (clastic and biogenic) and sketch it in your field notebook. Use your hand lens to look for details like sorting, roundness and clast size. Also, include your own interpretation of where a rock of this type might be found. Think about what type of environment the sediment might have accumulated.

Rock Samples

Clastic sediments	Biogenic sediments	Chemical sediments
44 Quartz pebble conglomerate	56 Chert	
45 Gray sandstone	57 Siliceous oolite	
46 Red sandstone	58 Diatomite	
47 Argillaceous sandstone	59 Encrinal limestone	
48 Glauconitic sandstone	60 Limestone	
49 Siltstone	61 Cherty limestone	
50 Arkose	62 Oolitic limestone	
51 Graywacke	64 Calcareous tufa	
52 Argillaceous shale	65 Dolomitic limestone	
53 Arenaceous shale		