Identifying Common Sedimentary Rocks and Depositional Environments

Objectives

- Identify the *texture* of sedimentary rock specimens
- Identify the *chemical composition* in sedimentary rock specimens
- Name sedimentary rock specimens using *texture* or *composition*
- Identify sedimentary structures
- Use texture and sedimentary structures to interpret depositional environments

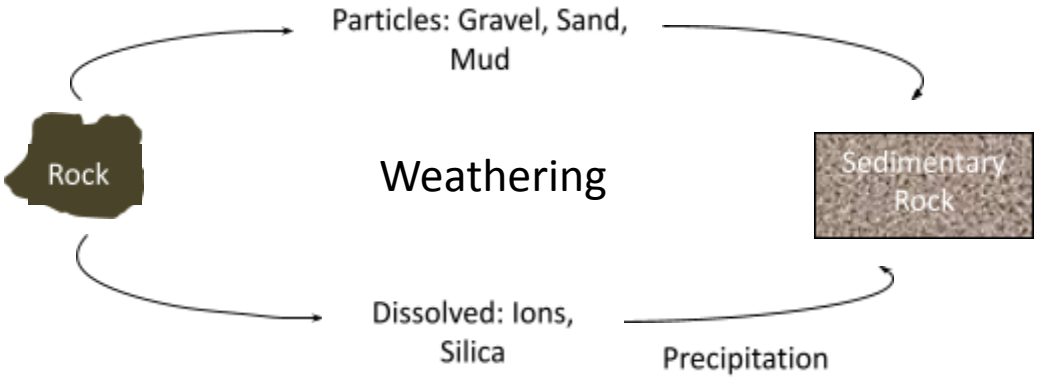
Sedimentary rocks are the byproducts of rocks that break down into clasts, a.k.a. sediment, by the destructive geologic processes of weathering, mass wasting, and erosion. Sedimentary rocks always form on or near Earth's surface, providing a record of paleogeography - ancient environmental conditions where the sedimentary rock formed. This makes sedimentary rocks especially useful to geologists, who know how to read the clues provided by the texture, composition, sedimentary structure, and fossils contained within the rock.

As sediment is deposited, it forms the definitive structure of sedimentary rocks, horizontal layers called **strata**. Strata can preserve **sedimentary structures** and fossils, making them especially useful for interpreting ancient environmental conditions (paleogeography).

Classification of Sedimentary Rocks

As with igneous rocks, sedimentary rocks are classified according to texture and composition into two primary groups, **clastic,** a.k.a. **detrital**, and nondetrital, a.k.a. **chemical**. Clastic/detrital rocks contain clasts, a.k.a. grains, mechanically weathered pieces of rock or minerals, and are named principally by the size of grains that make up the rock. Chemical/non-detrital rocks do not contain grains and are named according to their composition and secondarily by the type of organic material they may contain.

The diagram below is a simple illustration of rock weathering into sediment. Note the two types of materials are produced: particles produced by mechanical weathering that include grains and mud/clay particles from the chemical weathering of feldspars. These solid particles are deposited in layers that, when compacted and cemented (lithification), form **clastic** (detrital**) sedimentary rocks**. Chemically weathering produces ions (elements) and silica by dissolving them, so they are not present as particles. Before becoming a **chemical sedimentary rock** (nondetrital), this material must precipitate from the water (by either physical or biological means)**.** The third source of sediment, not represented on the diagram, forms directly from organic matter to make the non-detrital rock, coal.



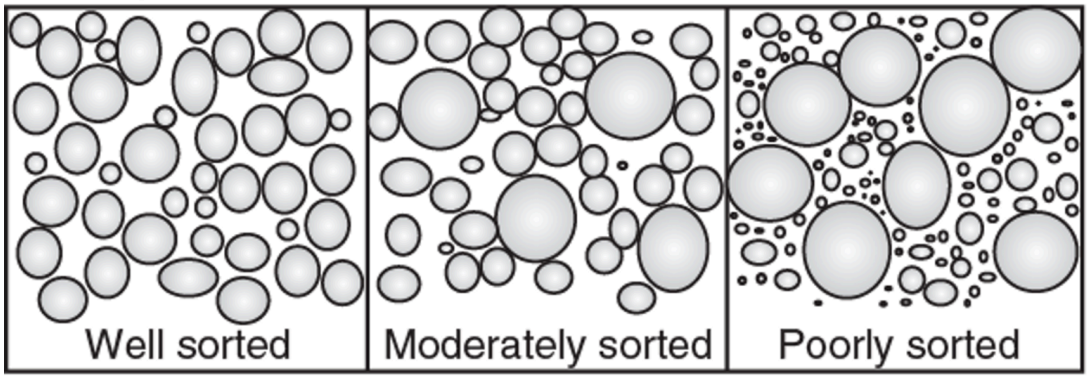
Clastic/Detrital Sedimentary Rocks

Detrital rocks are classified first by particle size, and second by composition. The larger particles present in clastic rocks are clasts/grains. These are held together by cement (the matrix) from groundwater flowing through pores between grains precipitates new mineral matter between the grains.

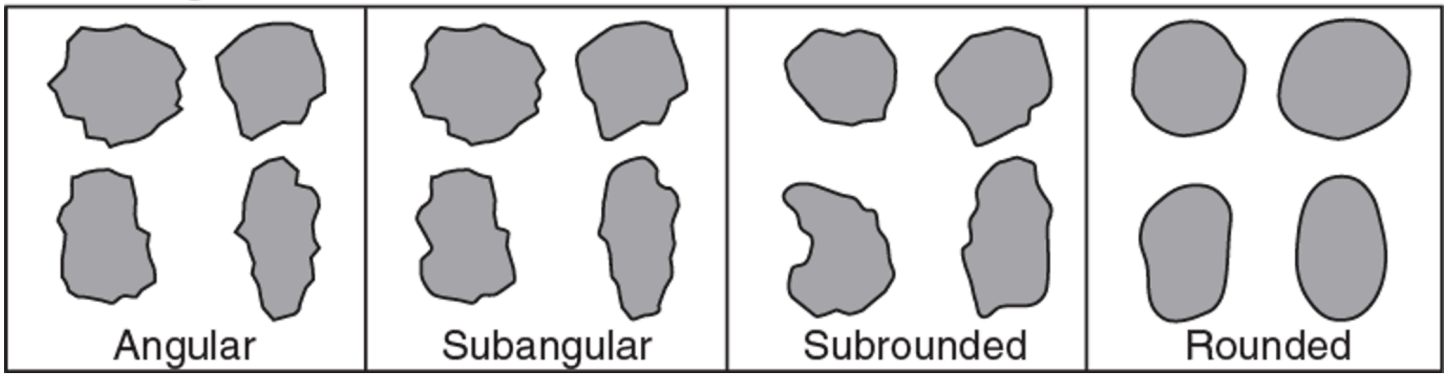
Examining detrital sedimentary rocks

1. Identify the particle size. In general, particles larger than 1/16 mm will feel rough to the touch, while smaller particles cannot be felt (a rock made of smaller particles will thus feel smooth).
2. Grain size is described as *coarse, medium, or fine*.
3. **Sorting** and **rounding** are described if the grains are medium or coarse. These textural features are summarized by the illustrations below.

Sorting:



Rounding:



Reagan et al. (2015) CC BY 3.0

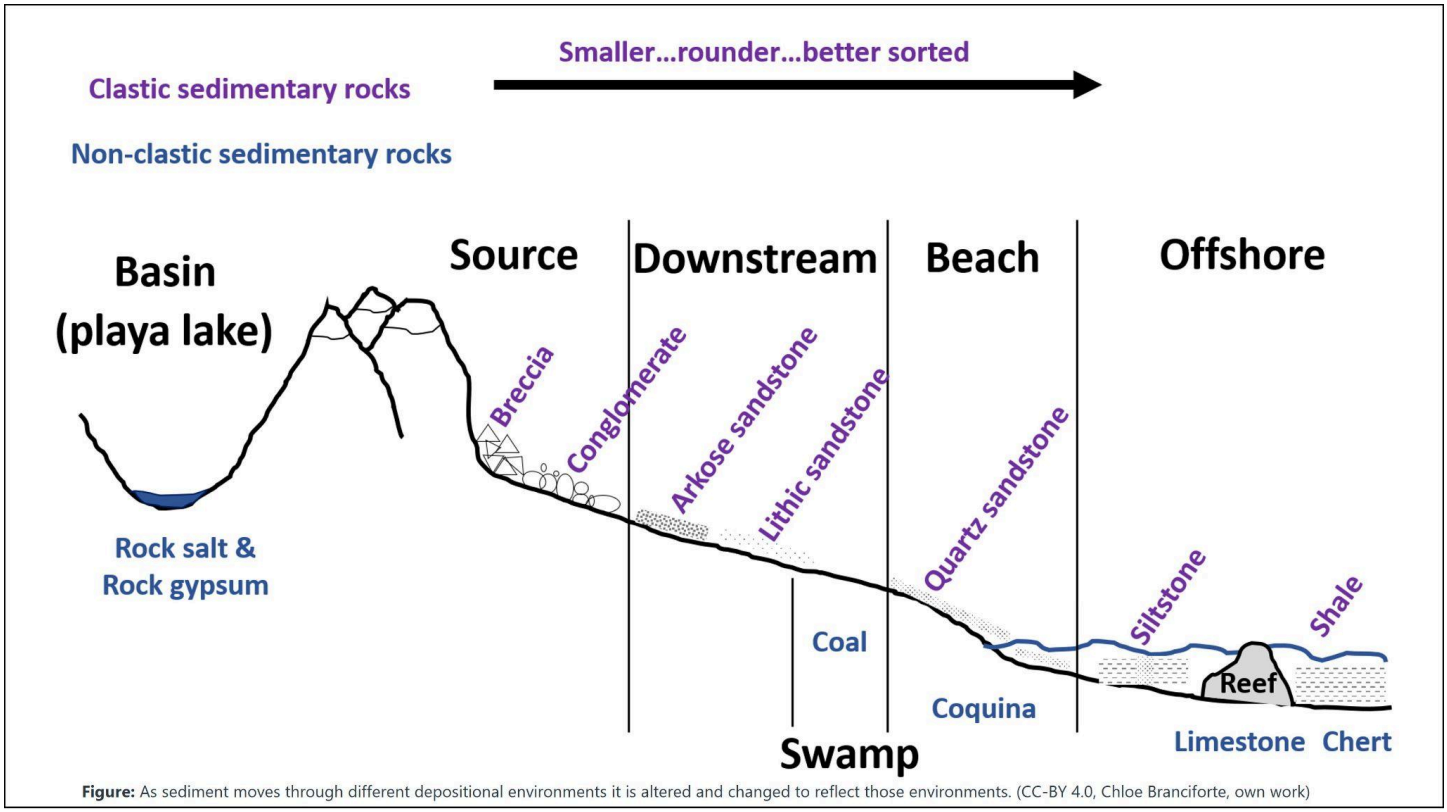


Figure: As sediment moves through different depositional environments it is altered and changed to reflect those environments. (CC-BY 4.0, Chloe Branciforte, own work)

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Examining chemical/nondetrital sedimentary rocks

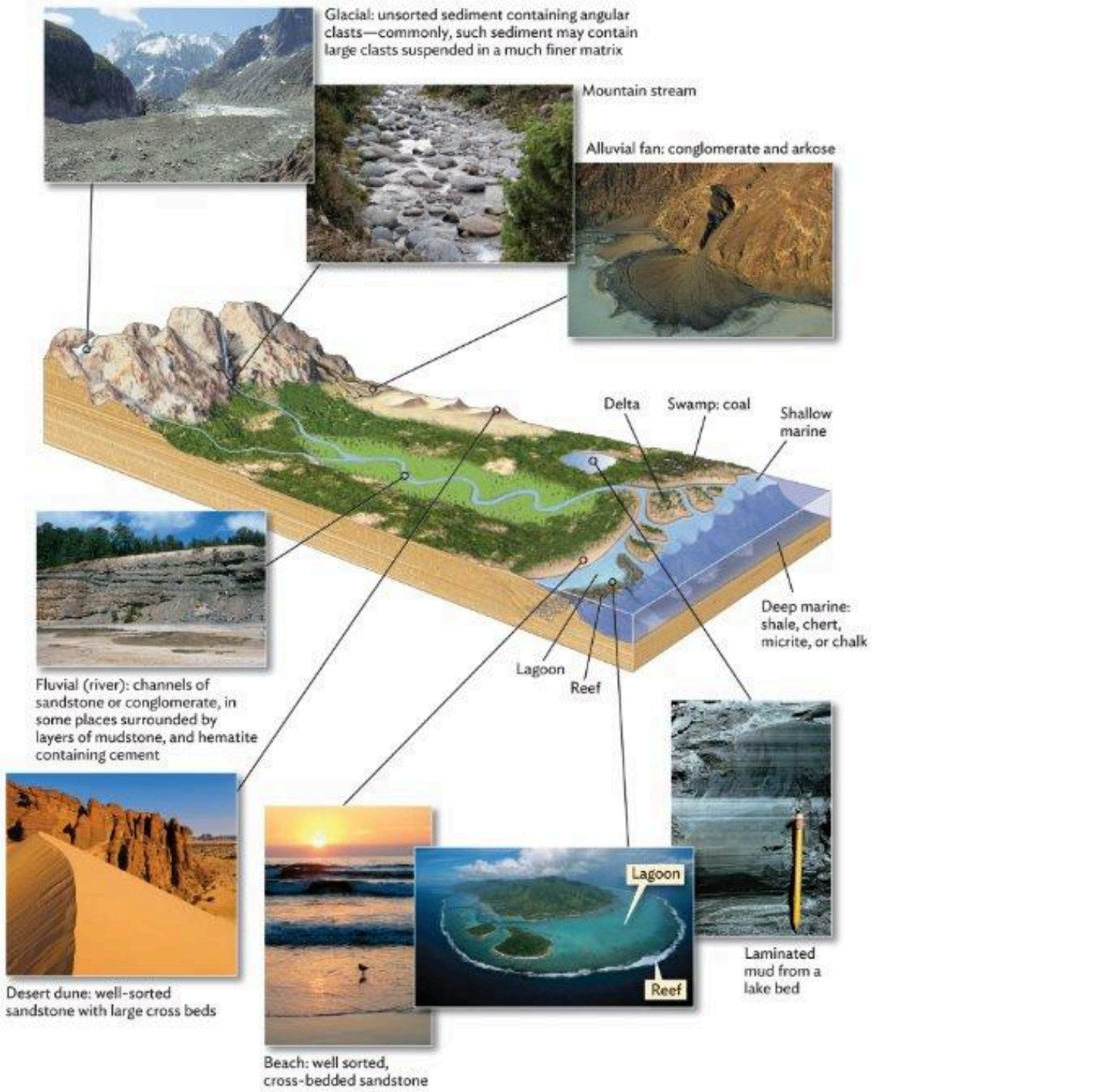
Nondetrital sedimentary rocks are named primarily by their composition; grain size isn't considered because they do not contain grains. The following clues will help to identify the composition:

- If the rock contains fossils, this will influence the name, e.g. ***fossiliferous*** *limestone*.
- **Calcite** readily reacts with dilute acid, causing it to bubble and fizz.
- **Dolomite** will not fizz on a fresh surface but may fizz if powdered.
- **Silica** will never bubble in acid. When present in the form of diatomite, the rock will be very soft and low in density. When the silica forms microcrystalline quartz (as in chert), the rock becomes very hard (H = 7) and can scratch glass.
- **Gypsum** will not bubble but is softer than a fingernail.
- **Halite** has a hardness of 3 and tastes salty.

Sedimentary Rocks Pre-Lab Assignment

After reading this lab and your textbook, complete the exercise below before starting the lab.

1. What are clastic sedimentary rocks made of? _____
2. How do chemical sedimentary rocks form? _____
   _____
3. How are clastic sedimentary rocks classified? _____
   _____
4. What is the difference between poorly sorted particles and well-sorted particles? _____
   _____
5. Why would a sandstone be classified as "arkose"? _____
   _____
6. Can one describe the sorting in a chemical sedimentary rock? _____
   Why or why not? _____
7. Why would the term fossiliferous be used to describe a rock? _____
8. How can you tell if the composition of a rock is calcite? _____
9. Use the Depositional Environments illustration from your lecture textbook to provide an example of a sedimentary rock that could form in each of the depositional environments listed below. **Also**, include any sedimentary structures that might also form in this environment.
10. The first one has been done for you to provide an example.
    a. Beach: *sandstone with cross-bedding*
    b. Alluvial fan _____
    c. Sand dune _____
    d. Glacier _____
    e. Lakebed _____
    f. Deep ocean _____
    g. Swamp _____



Sedimentary Rocks Identification Laboratory Exercise

Save a copy of this document. Using the tables on the following pages identify the sedimentary rock specimens provided in class. Fill in your observations in the blanks.

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Identification of Detrital/Clastic Sedimentary Rocks

Grain Size	Texture	Rock Names
Coarse/Gravel (>2 mm)	Poorly sorted; grains are angular Poorly sorted; grains are mostly rounded	**Breccia** **Conglomerate**
Medium/Sand (1/16 – 2 mm)	Well sorted grains > 90% quartz Mix of mineral grains, > 25% feldspar (pinkish) Moderately poorly sorted with sub angular/sub-rounded grains; gray	**Quartz Sandstone** **Arkose Sandstone** **Graywacke Sandstone**
Fine/silt (1/256 – 1/16 mm)	may have a slight "gritty" feel and lamination	**Siltstone**
Very fine/clay (< 1/256 mm)	smooth feel and may have lamination	**Shale**

Identification of Chemical & Biochemical (Non-Detrital) Sedimentary Rocks

Composition	Rock Name
Calcite	**Limestones** (all should react with acid): ● **Travertine**: banded cave limestone ● **Micritic Limestone**: typically earth-toned and fine-grained ● **Fossiliferous Limestone**: fossil/fossil fragments within a calcite matrix ● **Coquina**: entirely composed of loosely-cemented shell fragments ● **Calcarenite**: well-sorted, sand-sized calcite-based particles (i.e. ooids, shells, corals, etc.) ● **Chalk**: made of microfossils, light-colored
Dolomite	**Dolostone**: very similar to crystalline limestone, but should not react with acid
Halite	**Rock Salt**: clear to gray, can show crystalline texture,
Gypsum	**Gyprock** : clear to white, soft (can be scratched with fingernail)
Silica	**Diatomite**: porous, light, composed of diatom skeletons **Chert**: hard (cannot be scratched by steel and can scratch glass), dense, smooth, breaks conchoidally
Coal	**Coal**: three types are recognized -**Lignite**: brown coal -**Bituminous**: black, partially dull, may rub off on finger -**Anthracite**: shiny, dense

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Sedimentary Structures Identification and Interpretation

For rocks 1-4 along the countertop near the rear of the classroom identify the sedimentary structures and interpret it's likely depositional environment.

	Sedimentary Structure	Depositional Environment
Rock 1		
Rock 2		
Rock 3		
Rock 4		

Sedimentary Maturity

Rank the six detrital rocks you identified in terms of their grain maturity. List the number of rocks below with least mature on the left and most mature on the right. For example, if think rock #2 contains the most mature grains then you would write "2" first.

Most mature _____, _____, _____, _____, _____, and _____ Least mature.