

## ES202 Lab 3 - Sedimentary Rock Analysis and Classification

*Update Jan 21, 2012*

### Part 1 A. Cambridge Intro Rock Video Questions

*(ROCKSandMINERALS\_cambridge\_science.mpeg; Time Mark: 12:40)*

1. What is the definition of a “rock”
2. What are the three basic types of rocks?
3. How do igneous rocks form?
4. How do extrusive or volcanic igneous rocks form?
5. How do intrusive or plutonic igneous rocks form? Provide a common example of an intrusive rock?
6. What are sedimentary rocks? Where do they form and why?
7. List four types of surface environments in we find sediments that form sedimentary rocks?
8. What are the two types of sedimentary rocks?
9. In detrital sedimentary rocks, what is the difference between gravel, sand, silt and clay? What is the distinguishing characteristic?
10. Provide an example of biochemical or chemical sedimentary rocks. How are chemical rocks classified?

*(End Video on Time Mark 18:53)*

### Part 1B. Sedimentary Rock Video Exercise (Earth Revealed: Sedimentary Rocks)

Watch the video in the lab and answer the questions below.

1. Who first explored the geology of the Grand Canyon? How did the Grand Canyon form?
2. How many years of Earth history are contained in the sedimentary rocks of the Grand Canyon?
3. What is the general goal of sedimentary geology?
4. What is sediment? How is it formed?
5. List and describe 3 examples of loose sediment at the Earth’s surface.
6. How is loose sediment transformed into hard sedimentary rock?

7. True or False: sedimentary rocks most commonly occur inside the Earth, while igneous rocks are common at the Earth's surface. Explain your answer.
8. Define the term "clastic".
9. What is the smallest size of sediment particle called? What is the largest size of sediment particle called?
10. List and briefly describe 2 examples of how sediment may be transported at the Earth's surface.
11. List and describe 3 places at the Earth's where you would likely find sediment deposits. Why do you find deposits in these places?
12. Define the term "lithification". What are 2 processes that result in lithification of sediment?
13. List and describe 2 environments where chemical sediments may form.
14. What is the name of a sedimentary rock that forms from the skeletons and hard parts of dead sea animals?
15. Where does coal form? What is coal composed of?
16. What is the motto for the "principle of uniformitarianism"? What is the principle of uniformity and how is it used to interpret Earth history?

**End Video at Uniformitarianism.**

**Part 2. Recognition of Sedimentary Process** (refer to 9<sup>th</sup> Edition of AGI Lab Manual)

1-1. Based on your pre-lab questions and p. 130 of your lab manual, match the sedimentary process term on the right with the sedimentary rock on the left.

- |  |  |
|--|--|
| _____ 1. Sandstone                     | A. Detrital Origin (weathering / fragmental) |
| _____ 2. Conglomerate                  | B. Biochemical (biologically-derived rock)   |
| _____ 3. Shale                         | C. Chemical (Physical-Chemical Process)      |
| _____ 4. Rock Gypsum                   |  |
| _____ 5. Coral Reef Deposits           |  |
| _____ 6. Sand on the beach             |  |
| _____ 7. Bonneville Salt Flats of Utah |  |
| _____ 8. Shells on the beach           |  |
| _____ 9. Coal                          |  |
| _____ 10. Breccia                      |  |

**Part 3. General Questions on Sedimentary Texture**

2-1. Using the attached grain size chart and the Wentworth scale, determine the grainsize of the following detrital sedimentary rock samples (derive the grainsize to the level of fine sand, medium sand, etc.), and determine the sorting (well sorted, moderately sorted, poorly sorted).

| Sample No.      | Grainsize<br>(list ~diameter and term) | Sorting |
|-----------------|--|---------|
| 11              | _____                                  | _____   |
| 9B              | _____                                  | _____   |
| 15              | _____                                  | _____   |
| 4               | _____                                  | _____   |
| 6               | _____                                  | _____   |
| 14              | _____                                  | _____   |
| Sample Jar S2-1 | _____                                  | _____   |
| Sample Jar S2-7 | _____                                  | _____   |

2-2. Compare and contrast the sedimentary texture of sample 11 and sample 4. Which one do you think has sediment that was more greatly transported during it's formation?

2-3. Observe the characteristics of sample 35. Is this detrital or biochemical? What is this specimen?

2-4. Examine the deposit in the beaker labeled "2-4". Explain how this deposit formed. Is it chemical or detrital?

### Part 4. Sedimentary Rock Identification

Using the sedimentary rock analysis and identification key on **p. 129 and p. 131** of the lab manual, complete the table on the following page.

| Sample Number | Detrital, Chem., or Biochem? | Composition: choose all that apply: quartz, feldspar, clay, plant frags., calcite, halite, gypsum, iron minerals | Grain Size (for detrital) / Crystal Size (for chemical / biochemical) | Other Characteristics (e.g. fossils, grain shape, fizzes with HCl, scratchable, taste, etc.) | Rock Name |
|---------------|------------------------------|--|---|--|-----------|
| 30            |                              |  |   |  |           |
| 1B            |                              |  |   |  |           |
| 14            |                              |  |   |  |           |
| 9B            |                              |  |   |  |           |
| 11            |                              |  |   |  |           |
| 8             |                              |  |   |  |           |
| 3             |                              |  |   |  |           |
| 13            |                              |  |   |  |           |
| 31            |                              |  |   |  |           |
| 32            |                              |  |   |  |           |
| 20            |                              |  |   |  |           |
| 16            |                              |  |   |  |           |
| 2             |                              |  |   |  |           |
| 7             |                              |  |   |  |           |
| 15            |                              |  |   |  |           |
| 12            |                              |  |   |  |           |
| 10            |                              |  |   |  |           |
| 6             |                              |  |   |  |           |
| 37            |                              |  |   |  |           |
| 4             |                              |  |   |  |           |
|               |                              |  |   |  |           |

**TABLE 5.2 Methods of measuring sediment grain size**

| Type of sample             | Sample grade                     | Method of analysis                                 |
|----------------------------|----------------------------------|--|
| Unconsolidated sediment    | Boulders<br>Cobbles<br>Pebbles   | Manual measurement of individual clasts            |
|                            | Granules<br>Sand<br>Silt<br>Clay | Sieving or settling tube analysis                  |
|                            |                                  | Pipette analysis, photohydrometer, Coulter counter |
| Lithified sedimentary rock | Boulders<br>Cobbles<br>Pebbles   | Manual measurement of individual clasts            |
|                            | Granules<br>Sand<br>Silt<br>Clay | Thin-section measurement                           |
|                            |                                  | Electron microscope                                |

**TABLE 5.1 Grain-size scale for sediments, showing Wentworth size classes, equivalent phi ( $\phi$ ) units, and sieve numbers of U.S. Standard Sieves corresponding to various millimeter and  $\phi$  sizes**

| U.S. Standard sieve mesh |         | Millimeters | Phi ( $\phi$ ) units | Wentworth size class |                |
|--------------------------|---------|-------------|----------------------|----------------------|----------------|
| GRAVEL                   |         | 4096        | - 12                 | Boulder              |                |
|                          |         | 1024        | - 10                 |                      |                |
|                          |         | 256         | - 8                  |                      |                |
|                          |         | 64          | - 6                  | Cobble               |                |
|                          |         | 16          | - 4                  | Pebble               |                |
|                          | 5       | 4           | - 2                  |                      |                |
|                          | 6       | 3.36        | - 1.75               | Granule              |                |
|                          | 7       | 2.83        | - 1.5                |                      |                |
|                          | 8       | 2.38        | - 1.25               |                      |                |
|                          | 10      | 2.00        | - 1.0                |                      |                |
| SAND                     | 12      | 1.68        | - 0.75               | Very coarse sand     |                |
|                          | 14      | 1.41        | - 0.5                |                      |                |
|                          | 16      | 1.19        | - 0.25               |                      |                |
|                          | 18      | 1.00        | 0.0                  |                      |                |
|                          | 20      | 0.84        | 0.25                 | Coarse sand          |                |
|                          | 25      | 0.71        | 0.5                  |                      |                |
|                          | 30      | 0.59        | 0.75                 |                      |                |
|                          | 35      | 0.50        | 1.0                  |                      |                |
|                          | 40      | 0.42        | 1.25                 | Medium sand          |                |
|                          | 45      | 0.35        | 1.5                  |                      |                |
|                          | 50      | 0.30        | 1.75                 |                      |                |
|                          | 60      | 0.25        | 2.0                  |                      |                |
|                          | 70      | 0.210       | 2.25                 | Fine sand            |                |
|                          | 80      | 0.177       | 2.5                  |                      |                |
|                          | 100     | 0.149       | 2.75                 |                      |                |
|                          | 120     | 0.125       | 3.0                  |                      |                |
|                          | 140     | 0.105       | 3.25                 | Very fine sand       |                |
|                          | 170     | 0.088       | 3.5                  |                      |                |
|                          | 200     | 0.074       | 3.75                 |                      |                |
|                          | 230     | 0.0625      | 4.0                  |                      |                |
| MUD                      | SILT    | 270         | 4.25                 | Coarse silt          |                |
|                          |         | 325         | 4.5                  |                      |                |
|                          |         |             | 4.75                 |                      |                |
|                          |         |             | 5.0                  |                      |                |
|                          |         |             | 6.0                  |                      |                |
|                          | CLAY    |             | 0.0156               | 6.0                  | Medium silt    |
|                          |         |             | 0.0078               | 7.0                  | Fine silt      |
|                          |         |             | 0.0039               | 8.0                  | Very fine silt |
|                          |         |             | 0.0020               | 9.0                  | Clay           |
|                          |         |             | 0.00098              | 10.0                 |                |
|                          | 0.00049 | 11.0        |                      |                      |                |
|                          | 0.00024 | 12.0        |                      |                      |                |
|                          | 0.00012 | 13.0        |                      |                      |                |
|                          | 0.00006 | 14.0        |                      |                      |                |

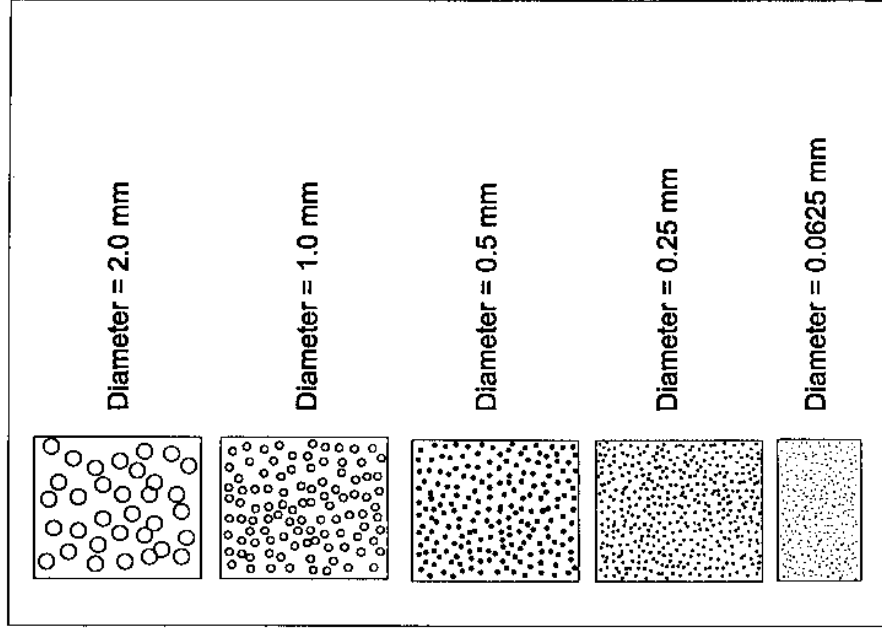
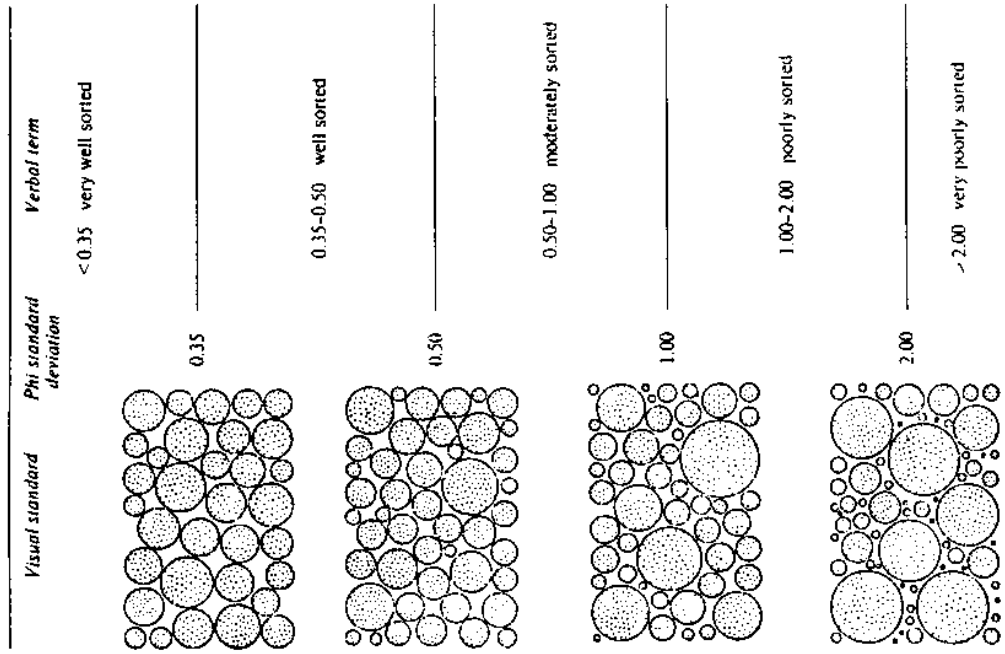


Figure 6.4 Chart for the field estimation of sorting (modified from Folk 1968).



## COMPOSITIONAL CLASSIFICATION OF SEDIMENTARY ROCKS

**A. DETRITAL (SILICICLASTIC)** — made mostly of rock fragments, quartz grains, feldspar grains, or clay minerals



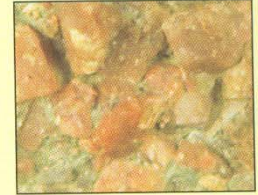
**Breccia:**  
made mostly of angular gravel  
(usually rock fragments)



**Mudstone and Shale:**  
made mostly of clay  
minerals



**Conglomerate:**  
made mostly of rounded gravel  
and sand grains  
(usually quartz grains)



**Arkose:**  
made mostly of  
feldspar grains

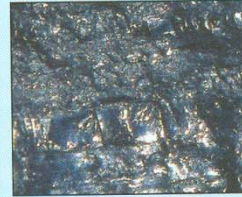
**B. BIOCHEMICAL (BIOCLASTIC)** — made mostly of grains that are fragments or shells of organisms (plants or animals)



**Biochemical/Bioclastic  
Limestone:**  
made mostly of shells  
and shell fragments



**Peat:**  
made mostly of plant  
fragments



**Coal:**  
made of carbon/charcoal  
from plants

**C. CHEMICAL** — made mostly of mineral crystals precipitated from aqueous solutions and/or chemical residues (e.g., rust)



**Rock Gypsum:**  
made mostly of gypsum  
mineral crystals



**Rock Salt:**  
made mostly of halite  
mineral crystals



**Ironstone:**  
made mostly of iron-bearing  
mineral crystals like this hematite



**Ironstone:**  
made mostly of iron-bearing  
residues like this limonite



**Chemical Limestone:**  
made mostly of calcite  
(or aragonite) mineral crystals



**Dolostone:**  
made mostly of dolomite  
mineral crystals



**Chert**  
made of microcrystalline  
quartz varieties

**FIGURE 6.2** Compositional classification of sedimentary rocks. Scale for all images is  $\times 1$