Name _____ Date _____

Sedimentary Rocks and Depositional Environments

The objectives of this lab are to:

- Understand how geologists look at sedimentary depositional environments in order to recreate the Earth's past.
- Identify sedimentary rocks, sedimentary structures within the rock (i.e. cross-beds, ripple marks, varves, etc.), and fossils.
- Sketch or write a description of the specimen and interpret the depositional environment for that rock.
- Plot latitude and longitude data on a map.

Exercise 1: Identifying, Sketching, and Locating Rock Samples

Materials:

- Pencil
- Lab manual - Chapter 6: Using Sedimentary Rocks To Interpret Earth History
- Rock specimens and sedimentary environment images (at stations)
- US map

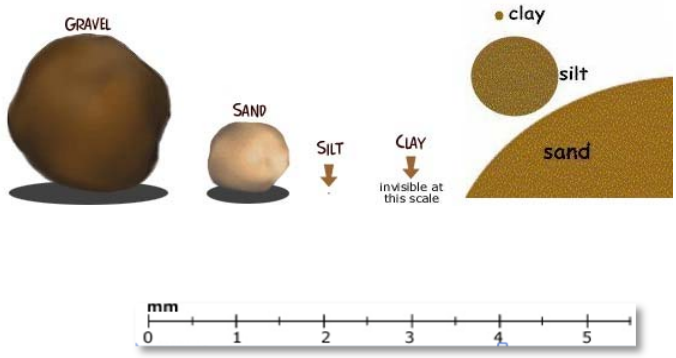
Instructions:

In this lab you will be moving from station to station, identifying specimens, sketching and/or describing them, finding their location on a map, and answering questions about how the location's climate has changed between the present and the past. Answer all of the station questions and make sure to check your answers with the TA or Instructor to be graded. Use your corrected answers to study from for next week's quiz.

Station 1

Shale, Siltstone, Conglomerate, Sandstone

1. Are these sedimentary rocks clastic, chemical, or organic? Circle one.
2. These sedimentary rocks are characterized by their texture, which includes grain size, shape, and sorting (arrangement). Grain sizes range from gravel to clay. In the boxes below, place the rocks in order largest grain to smallest. Use the figures below to estimate grain size. Then sketch.

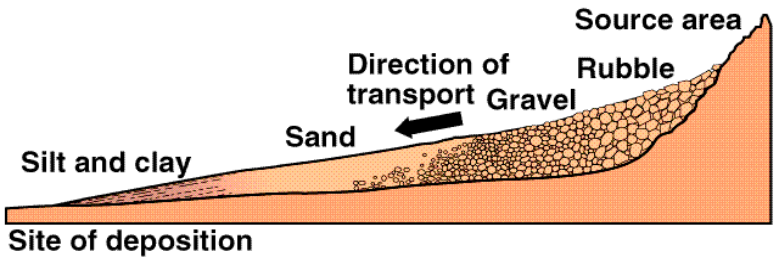


3. Using the information in your PPT handout and lab manual, identify rocks A-D and place their name below your sketches in the blanks provided.

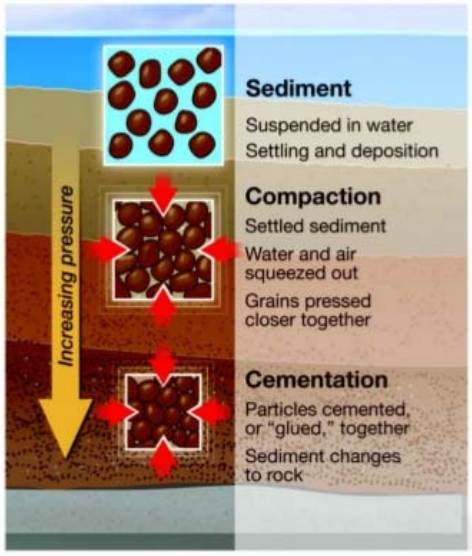
Grain size: >2mm	Grain size: ~1mm	Grain size: <1mm	Grain size: 'Invisible'
Rock Letter:	Rock Letter:	Rock Letter:	Rock Letter:
Rock Name:	Rock Name:	Rock Name:	Rock Name:
_____	_____	_____	_____

4. Illustrate the energy needed to transport the sediments of these rocks by drawing an arrow across all 4 images, labeled HIGH to LOW energy.
5. The uniformity of grain size within a clastic sedimentary rock is called sorting (see your lab manual for help).
    a. Which of the 4 rocks at this station has poorly sorted grains? _____
    b. Which has well sorted grains? _____
6. Draw another arrow across your sketches (and label from SHORTEST to LONGEST transport) showing relative distance traveled from the theoretical source rock/outcrop. Use the diagram on the following page for help.

Sediment Deposition around Source Area



Forming Sedimentary Rocks



7. What IS sediment? Based on the illustrations above, how do sediments become rocks?

   _____

   _____

   _____

   _____

8. Using the table of DEPOSITIONAL ENVIRONMENTS OF COMMON SEDIMENTARY ROCKS on page 5 in your lab manual, name a modern American sedimentary environment in which each of these rocks may have formed. *See siltstone for an example.*

   Shale: _____

   Siltstone: Shoreline of the Mississippi Delta

   Sandstone: _____

   Conglomerate: _____

Station 2

Flash Flood

Video: https://www.youtube.com/watch?v=_yCnQuILmsM

1. This flood occurred at 38ºN, 110ºW. Find this point on the map and label with the #2.
2. What state is this? _____
3. Watch the 5 minute video and answer the following questions:
    a. What is the energy level of this flood? _____
    b. Does a flash flood carry only large grains/large rocks? (Hint: is the water clear or murky?)

        _____

    c. Describe the grain size and sorting of the sediments at the very beginning of the flash flood

        _____

        Describe the grain size/sorting at the end of the flood, as the water slows down (very end of video).

        _____

4. This pattern of deposition with finer sediments on top and coarser on the bottom is called GRADED SEDIMENTS. Illustrate what a sample of the graded sediments left behind by a flash flood would look like in the box to the right. This pattern also occurs along continental slopes in the ocean, or anywhere you see a current that gradually slows – like a fast-moving river hitting a lake.

5. Look at the illustration of depositional environments provided here.
    a. Which best describes an area where a flash flood or debris flow would happen?

        _____

    b. What is the elevation (steep, moderate, flat)? _____
    c. What type of sedimentary rock is found there? _____
    d. What is the main difference between this rock when it is found in an alluvial fan and when it is found in a braided stream or river?

        _____

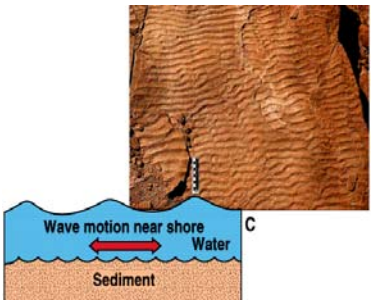
6. A sample of a graded sediment is provided here. Based on what you've learned, which is the top and which is the bottom of the sample?

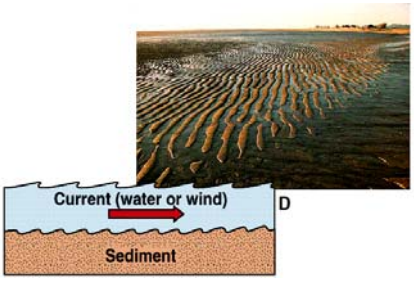
    X: _____
    Y: _____

Station 3

Sedimentary Structure: Ripple Marks

This sample has a sedimentary structure called ripple marks. A sedimentary structure is a variation in layering or form of the sediments in a rock that gives clues to the environment in which deposition occurred (paleoenvironment). Ripple marks can be symmetrical or asymmetrical. Symmetrical ripple marks often indicate a shoreline (lake or ocean) depositional environment because of the back and forth motion of the waves on the grains.





1. Are the ripples on the rock sample provided symmetrical or asymmetrical (one side noticeably steeper than the other)? _____
2. Using the images above, **circle** the image that most resembles your sample.
3. Now examine the rock sample. What is the grain size in this sample? What kind of rock is this?
   Grain size: _____Rock name:_____
4. What medium (wind, water, or ice) produced these ripple marks (pick only one!) _____
5. Name 2 possible depositional environments this rock could have formed in?
   _____ or _____
6. This sample was found at 36.5ºN 117ºW. Find this point on the map and label with the #3.
7. This sample came from Death Valley. What was the depositional environment like when this sample was formed in Death Valley? _____
8. How is that different from today's environment? _____

Station 4

Sedimentary Structure: Cross Bedding

Crossbeds are inclined angled beds formed in sedimentary rocks, and indicate the past flow of sedimentary material via some sort of current (wind or water). Crossbeds formed by water tend to have lower angles and are much smaller in size. Crossbeds formed by wind have steeper angles, and form into dunes. Beach and desert dunes migrate as wind blows grains to reach the peak of the dune, which then avalanche down, creating the crossbed structure. Desert dunes and their crossbeds can become much larger than beach dunes.

1. Sketch, label, and describe the distinguishing features of Sample #4A.
2. Using grain size, identify the sedimentary rock that these crossbeds have formed in. _____
3. What medium(s) (wind, water, or ice) could have produced this structure?
   _____ _____
4. This sample was found at 39ºN 113ºW. Find this ample on the map and label with the #4A. Make sure to label the point with the #4A. In what state was this sample found? _____
5. If this sample has traces of sea oat roots and ghost crab burrows and is found near a sandstone layer with seashells, from what depositional environment would you guess it came?
   Circle one: Desert dune or Beach dune?
6. What is the climate of the state where this sample is found today? _____
7. What was the climate like in this past, when this rock was forming? _____
8. If this sample lacks any traces of plant roots or animal burrows, but is found within many thick layers of crossbedded sandstone that also have asymmetrical ripple marks (see Station 2), from what depositional environment would you guess it came? **Circle one:** Desert dune or Beach dune?
9. What medium do you think the crossbeds in #4B were found in, and why?
   _____

Station 5

Sedimentary Structure: Varves

1. Sketch, label, and describe the distinguishing features of this sample. How do the layered beds in this rock (the varves) differ from the beds in a crossbedded sample? (See station #4)

   _____

   _____

2. Based on the grain size, what sedimentary rock did this structure form in?

   _____

3. What was the energy level of this environment? _____
4. This sample was taken from 42.5ºN 71ºW; find this point and label it with the #5 on your map. What state is this?

   _____

5. The alternating bands of silt (lighter) and clay (darker) in this rock represent two different types of depositional conditions in the lake. The silt is deposited in summer and clay in winter. Thinking of grain size, energy, and the climate in a glacial lake such as this, explain the difference in the depositional conditions during the summer and winter.

   _____

   _____

   _____

6. Each light and dark couplet represents one year of deposition. What significance then, do varves have to interpreting the geologic past?

   _____

7. Varves don't JUST form in glacial lakes. Thinking about the seasonal conditions needed to produce varves, where else do you think they can form? _____

Station 6

Types of Organic Limestone: Fossiliferous (A and B), Coquina (C) and Chalk (D)

Limestone is a general name for a wide range of sedimentary rocks that are composed primarily of calcium carbonate. Calcium carbonate, or $CaCO_3$, comes from many sources, most of which (but not all) are organic. Many marine organisms have skeletons or shells made of $CaCO_3$, and when the organisms die, the $CaCO_3$ accumulates on the seafloor and eventually cements together to form the rocks you see before you.

1. Sample #6A is a fossiliferous limestone made up of ancient coral.
2. Use pages 72-77 in Chapter 7 of the Lab Manual to find the phylum coral animals belong to.

   _____

   a. Where in the ocean do they live and what kind of water conditions do they need?

      _____

      _____

   b. Sample #6A came from northern Texas. What does this sample tell you about Texas millions of years ago?

      _____

3. Sample #6B is another **fossiliferous limestone**. Now, flip through pages 65-86 in the Lab Manual provided at the station. Then pick two of the fossils in the rock and identify the phylum (major group) these animals belong to. There are at least 5 possible phylums present – don't stress over these identifications! Then sketch them in the boxes below.

   Phylum: _____ Phylum: _____

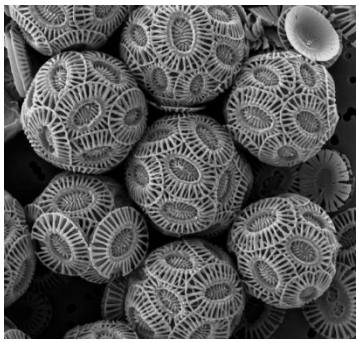
   a. Where did these creatures live? (AKA what is the depositional environment?)

      _____

   b. Sample #6B was found at 34ºN 81ºW, and is 5-10 million years old. Label this point with #6B. What state is this in? _____

   c. **Draw a line on your map showing where sea level used to be in this state.**

4. Sample #6C, **coquina**, is also known as shellhash, and is formed from the break-up of shells into fragments by wave action.
    a. What is the energy level (high vs low)? _____
    b. What is the water depth (shallow vs deep)? _____
    c. What is the depositional environment? _____



5. Sample #6D, **chalk** is powdery and can be used to write on your desks or folders. Give it a try. What you're writing with are the tiny fossils of microscopic plankton known as coccolithophores, shown magnified in this image to the right.
    a. So what is the grain size of this rock?

       _____
    b. Did this rock form in a high or low energy environment?

       _____
    c. Do you think this rock formed nearshore, shallow marine, or deep ocean?

       _____
    d. This sample is from the Late Cretaceous, and was found at 30ºN 90ºW. find this point on your map and label it with #6D. What does this tell you about sea level in this area 100 million of years ago?

       _____

6. What do samples A, B, C, and D all have in common?

   _____

   _____

Station 7

(Non-Limestone) Organic Sedimentary Rocks

1. Based on the fact that fossiliferous shale contains mud, peat is loosely compacted, and coal is well-compacted, identify the following rocks.

   A:_____

   B:_____

   C:_____

2. Which of the three rocks is most likely to be found in a MUDDY marsh environment? _____
3. Sample #7A was found at 40 ºN 79ºW. Find this point and label it on your map. In what state was this sample found? _____

4. What does this sample tell you about the depositional environment millions of years ago in this region?
   _____
   _____

5. Why do humans care about peat and coal? What use do these rocks have?
   _____

Station 8

Chemical Sedimentary Rocks: Halite (A), Gypsum (B), Stalactite/Stalagmite (C)

1. Pick up and feel these rocks, especially A and B. Describe the distinguishing features of these samples.

   A:

   B:

   C:

2. #8A and 8B are found at 34°N 115°W. Find this on your map and label with the #s.
3. How would you describe the climate in this region today? _____
   _____

4. These rocks need restricted evaporative basins in order to form. These basins have no outlet for water besides through evaporation. As the water evaporates, it leaves behind _____ that form these rocks.
5. How would you describe the climate in this region (see question 2 above) in the past?
   _____

6. Give the name of two specific modern geographic locations where evaporate rocks could be forming today (think areas with enclosed bodies of salty water that are hot AND dry).
   _____
7. Rock C is a **LIMESTONE** stalactite. A groundwater solution containing calcium carbonate travels through the rock until it drips through the roof of the cave. Upon hitting air, a chemical reaction occurs, causing the dissolved particles to be deposited as limestone. How would you describe the energy level of this process? _____
8. What are some differences between stalactites and chalk? What do they have in common?
   _____
   _____

Station 9

Sedimentary Structure: Mudcracks

1. Sketch, label, and describe the distinguishing features of this sample.
2. What kind of sedimentary rock (sandstone, shale, siltstone, or conglomerate) are these mudcracks found in? Look at the grain size!

   _____
3. Plot the location of sample #9 at 40ºN 105ºW. From what state was this sample taken? _____
4. How did these mudcracks form?

   _____

   _____
5. What is a possible depositional environment mudcracks could form in? _____

Station 10

Sedimentary Structure: Glacial Striations

1. Sketch, label, and describe the distinguishing features of this sample.
2. Plot sample #10 at 41°N, 74°W (aka CENTRAL PARK). From what state was this sample taken? _____
3. These parallel scratches, or STRIATIONS, formed as underlying rocks were scraped by debris carried in glaciers. While the features on our sample are small scratches, glaciers can also scour enormous grooves into the earth's surface as they move, leaving behind valleys that fill with glacial lakes. The largest examples of glacial lakes in the world are in the US – which of them border this state?

   _____
4. Give an example of a location where we find glaciers today.

   _____
5. What does this indicate about this state's past climate?

   _____

Station 11: Mystery Rocks

1. As you may remember from the Mineral lab in Geology 101/103, color is not a reliable defining characteristic. Same goes for sedimentary rocks. That is why we utilize other distinguishing features such as grain size, fossil content, sedimentary structures, layering, etc. to identify sedimentary rocks.

   You have three sedimentary rocks before you that are of similar color. Use distinguishing features to help identify these rocks. Determine the type (clastic, chemical, or organic) of each. Explain what distinguishing features each sample has that helped you identify it. Then give the depositional environment.

Rock A:

Name:

Type:

How did you identify it?

Depositional environment:

Rock B:

Name:

Type:

How did you identify it?

Depositional environment:

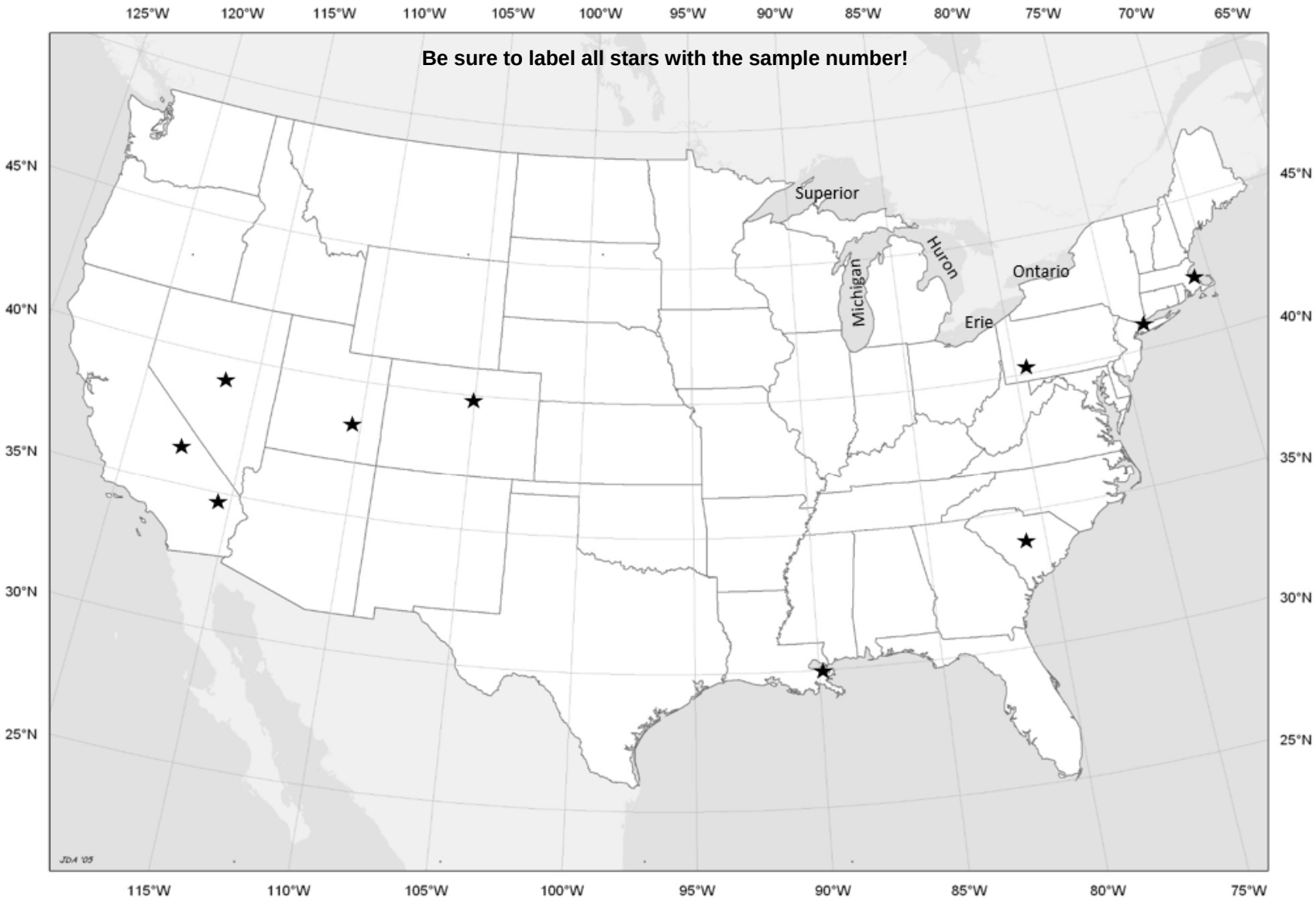
Rock C:

Name:

Type:

How did you identify it?

Depositional environment:


Be sure to label all stars with the sample number!
125°W
120°W
115°W
110°W
105°W
100°W
95°W
90°W
85°W
80°W
75°W
70°W
65°W
45°N
40°N
35°N
30°N
25°N
Superior
Michigan
Huron
Erie
Ontario
JDA '05