Amherst College
Department of Geology

INTERPRETING SEDIMENTARY ROCKS

In lab you were introduced to sedimentary rocks, both their physical characteristics and the system by which geologists identify (name) sedimentary rocks. (The sedimentary rock classification scheme is reproduced on the back of this page for your convenience.) This exercise continues from that foundation by helping you to develop your skills at interpreting sedimentary rocks. Geologists can use the grain size, composition, degree of compositional and grain size sorting (the "maturity"), and the nature of contained fossils to develop a picture of the source of the sediment, the depositional system responsible for transporting and depositing the sediment, and characteristics of the surface environment at the time of deposition.

The degree to which a sedimentary rock is sorted both by size and by composition reflects its "maturity". Rocks that are poorly sorted texturally include particles of many different sizes; rocks that are well sorted texturally have a limited range of particle size. Good size sorting is interpreted to reflect repeated or lengthy transport - since agents of transport carry or deposit particles based on size according to the energy of the transporting agent. Rocks that are poorly sorted compositionally include particles that are rock fragments (have > 1 mineral in them), are quartz, and/or are feldspar. Rocks that are well sorted compositionally are either made entirely of quartz grains, or entirely of clay (mud). This reflects complete chemical weathering - either due to lengthy transport in water, a humid environment, or both.

Trace amounts of an element or mineral can affect sedimentary rock color. In some cases this can be used to infer the oxidizing state of the water in which the sediment accumulated. Hematite gives a sedimentary rock a brick red color, and is produced by the oxidization and precipitation of iron in an oxygen rich environment typical of turbulent surface water such as a river. Carbon gives a rock a dark grey to sooty black color. It represents the accumulation of organic matter that is incompletely decayed due to a reducing environment such as might develop in bodies of stagnant water, like a swamp, or in deep parts of lakes and oceans.

Questions posed in this assignment follow directly from those you answered in the Sedimentary Rock Lab and use the same rock samples. You will want to review your corrected lab and have it with you when you work through these questions. The necessary sedimentary rock samples will be available in the lab room (Room 100) until this assignment is due.

CLASSIFICATION OF DETRITAL SEDIMENTARY ROCKS

		EXTRA-BASINAL		INTRA-BASINAL			
PARTICLE SIZE	Gravel > 2 mm	SILICICLASTIC	CONGLOMERATE	CARBONATE	"LIMESTONE"	CALCIRUDITE (carbonate conglomerate)	
	Sand 2 mm to 1/16 mm		SANDSTONE			CALCARENITE (carbonate sandstone)	
	Mud < 1/16 mm		MUDROCK		(carbonate mud) MICRITE	(silica mud) CHERT	CHERT
SOURCE OF PARTICLES IN THE ROCK		Particles derived from older rock that has broken down. Particles then transported to a basin, deposited, and lithified.		Particles derived from shells of animals that lived and died in an aqueous basin. Shells were broken down and deposited within that basin.			
DIAGNOSTIC CHARACTERISTICS IN HAND SAMPLE		Will scratch glass. Most will not react to HCl; although where cemented with $CaCO_3$, the cement and only the cement will react. Mudrock is commonly fissile.		Carbonate will not scratch glass; chert will. Will react to HCl, except where dolomitized. Chert and micrite are rarely fissile.			

INTERPRETING SEDIMENTARY ROCKS:

For each rock sample listed below, note that the first questions are identical to those you answered in lab. They are intended simply to remind you of observations you have already made and do not need to be answered again.

Consider the additional questions in **BOLD.** Use the observations you made in lab to develop responses that constrain the depositional environment at the time and place that each of these sedimentary rocks accumulated.

I. SRU 4

a. What is the average particle size of this rock?
b. How well rounded are the particles?
c. What are the two most prominent minerals in the particles?

d. What could you say about the probable conditions of transport and deposition of the sediments in this rock?

II. SRU 12

a. Into what range does the average particle size of this rock fall?
b. How does the size sorting of this sample compare with SRU 4?

c. What are the sand grains in this rock made of? Quartz? Feldspar? Rock fragments? A combination?

d. What conditions led to the formation of a deposit of sediment like this? How does this differ from the conditions for SRU 4?

III. SRU 11

a. What size are the particles in this rock?
b. What is the composition of the particles in this rock?
c. How well sorted, both compositionally and texturally, is this rock?

d. Compare SRU 11 to SRU 12. What important differences are there between these two rocks?

e. Do you know of a place where sand deposits similar in size and compositional sorting to SRU 11 occur today? (The present is the key to the past.) Provide a hypothesis as to the kind of environment that led to the deposition of SRU 11.

IV. SRU 7

a. Was this rock formed from extra- or intrabasinal sediment?
b. What is the principal mineral in this rock?
c. List the distinctive physical properties of this rock.

d. What can you say about the conditions of deposition for this rock? Develop as complete a picture as possible.

V. SRU 13

a. Into what range does the particle size fall?

b. Did this rock form from extra- or intrabasinal sediments?

c. What minerals or chemical elements do you think are principally responsible for the color of this rock

e. Does the color and grain size of SRU 13 give you any clue as to its environment of deposition?
Describe as fully as you can the conditions under which this sediment accumulated.

VI. SRU 2

b. What does the black color suggest concerning the rock chemistry? Mn rich? Fe rich? C rich? Ca rich?

c. Inspect your sample and those from other trays carefully. Is this rock fossiliferous?

d. What can you say about the conditions of deposition of this rock?
In what ways were they similar and in what ways were they different from the conditions of deposition of SRU 13?

VII. SRU 9

a. Is this rock detrital or non-detrital?

b. What chemical is principally responsible for the color of this rock?

c. What can you say about the conditions of deposition of this rock? How were they similar and how were they different from the conditions of deposition of SRU 2? Propose an environment of deposition for SRU 2 and one for SRU 9.

Finally, imagine you are studying a road cut of layered sedimentary rocks. The bottom layer in the roadcut is a rock much like SRU 7. Above that is a mudstone. This mudstone is unlike any in the rock tray. It is not red or black, but a plain light brown color. It contains shelly fossils. A layer of rock like SRU 11 overlies the mudstone. This is overlain by another layer of the brown mudstone, then a layer of a rock like SRU 7, again overlain by a brown mudstone. On top of all that, there is a layer of a rock like SRU 12. This sequence is capped at the top by a thin layer of rock like SRU 2. The figure below shows a vertical column representing this sequence of units.

Develop a geologic history of this locality during the time period that these sedimentary rocks accumulated. Characterize the surface environment at the time each layer was deposited and give reasons why the deposits (and, one presumes, the environment) would have changed over time.