Lab 11: SEDIMENTARY ROCK IDENTIFICATION 100 PTS

Introduction

Sedimentary rocks are derived either from pre-existing rocks through mechanical or chemical breakdown, or are composed of accumulations of organic debris. Rock weathering on land produces fragments of rocks and minerals that are transported by wind, water, or ice, and deposited elsewhere on the earth's surface. Weathering also dissolves rock material and makes it available in solution to streams and rivers that transport it to lakes and oceans where it may be deposited as a chemical precipitate.

After sediment has been deposited, it may be compacted and cemented into a coherent mass of sedimentary rock. The process or processes by which a soft mud or loose deposit of sand is transformed into a solid rock mass is called lithification. Lithification includes the processes of compaction, limited recrystallization of some of the minerals, and cementation. Cementation occurs when minerals are precipitated between the original grains of the sediment and bind them together. The most common cements are calcite, silica (chalcedony), and various iron oxides and hydroxides.

Sedimentary rock classification is based on texture and mineralogical composition. Both features are related to genesis of the original sediment. The texture can indicate the processes by which the rock was converted from unconsolidated sediment to solid sedimentary rock. Texture and composition can also reveal the environment in which the sediments were deposited. Fossils embedded in the rock can constrain the geologic age when deposition occurred. The mode of transportation of the sediment and even the general geology and geography of the area from which it was derived can sometimes be deduced from the resulting rock.

Identification of Sedimentary Rocks

The identification of sedimentary rocks depends upon their classification according to mineral composition and texture.

I. Mineral Composition - Sedimentary rocks consist of one or more minerals many of which you have seen in earlier mineral identification exercises. All the minerals identified in the rock should be listed in the mineral composition column of the sedimentary rock identification form.

II. Texture - The three modes of origin of sediments serve as the basis for identification and subdivision of sedimentary rocks into the following types:

1. clastic or detrital
2. chemical
3. organic.

A. Clastic sedimentary rocks are composed of ***fragments*** of minerals or rocks derived from pre-exisiting rock or formed during the weathering process. The composition, size, shape and sorting of these fragments and cementing agent that holds them together are significant characteristics of clastic rocks. Clastic rocks may consist of almost any assemblage of mineral or rock fragment. Most sandstone, for instance, is rich in quartz, but it may also contain considerable feldspar, ferromagnesian minerals, and even calcite. Shale is usually composed largely of clay, but may also contain considerable calcite or even quartz. Likewise, it is possible to have a shaly or silty sandstone or a sandy siltstone, whichever characteristic is predominate. This gradation relation is a perfectly moral and expected thing in nature. A classification scheme based on the average size of clastic particles in sedimentary rocks is listed in the table below.

Classification of Detrital Sediments by Grain Size

Grain size	Name of loose aggregate	Name of Rock
>2 mm	Gravel	Conglomerate (breccia if angular)
1/16 – 2 mm	Sand	Sandstone
1/256 – 1/16 mm	Silt	Siltstone
<1/256 mm	clay	Claystone

B. Chemical sedimentary rocks are deposited directly from a saturated solution. Such rocks are usually identified by their composition and/or texture. Common minerals in chemical sedimentary rocks are calcite, dolomite, gypsum, halite, hematite, and silica (chalcedony). Most rocks of this type are usually composed of only one mineral. The rock composition is therefore identical to the mineral composition in these rocks. Three textures of chemical sedimentary rocks are:

1. Crystalline - composed of closely intergrown crystals visible at least under the hand lens.

2. Dense - compact, uniform, microcrystalline mineral grains.

3. Oolitic or Pisolitic - made up of small spheres like shot or fish roe.

C. Organic sedimentary rocks are composed of material formed by organic processes such as animal shells or plant material. Frequently this organic material

is in fragments so that the rocks might be considered clastic, but they are distinctive enough to warrant a separate category.

Naming Sedimentary rocks

Names applied to sedimentary rocks are usually related to grain size in clastic rocks or composition in chemical and organic rocks. For instance, sandstone is a stone made up predominately of sand, siltstone is a rock composed of silt. Shale is a rock made up predominately of silt and clay that is fissile (fissility is the property of rocks splitting along closely spaced planes more or less parallel to the bedding). A conglomerate is a rock consisting of a conglomeration of gravel-sized matrix. Breccia is like a conglomerate except the pebbles are angular instead of rounded. Limestone consists mainly of the mineral calcite. Rock dolomite is mainly the mineral dolomite and likewise rock gypsum and rock salt are composed of gypsum and halite respectively.

It is quite common to encounter rocks which are predominately clastic or chemical in origin but which contain at least a few fossils. In these cases, one should always prefix the basic name of these rocks with the modifier "fossiliferous." For example, "fossiliferous shale, fossiliferous limestone," etc.

Use of the Sedimentary Rock Identification Chart

Your rock identification chart is arranged in the form of a flow chart in which you start in the left-hand column and choose which of the three textures applies to the unknown rock. When the choice has been made in the first column, move to the second column and decide which of the choices of grain size is the appropriate one for your sample. The third column gives a description of mineral composition while the last column gives the basic name of the rock.

Clastic or Detrital Sedimentary Rocks

Clastic Texture Particle Size	Compositional notes	Rock Name
Coarse (>2 mm) Gravel	Rounded rock or mineral fragments; typically poorly sorted	Conglomerate
	Angular rock or mineral fragments; typically poorly sorted	Breccia
Medium (0.062-2 mm) Sand	quartz grains & minor accessory minerals; typically well-sorted, rounded grains, cements of all types are common	Quartz Sandstone (mature)
	at least 25% feldspar; typically poorly sorted, poorly rounded grains, some granitic rock fragments	Arkose (immature)
	at least 20% clay minerals, some rock fragments & quartz & feldspar grains, poorly sorted, typically exhibits graded bedding	Graywacke (immature)
	< 10% feldspar; typically rich in quartz	Subgraywacke (immature)
Fine (0.004-0.062 mm) silt/mud	A massive rock of silt-size particles, dominantly quartz & accessory clay minerals	Siltstone
Very fine (<0.004 mm) mud/clay	A massive rock composed of clay particles	Claystone
	Laminated or fissile claystone	Shale

Chemical Sedimentary Rocks

Composition	Texture	Rock name	Origin
Calcite ($CaCO_3$)	fine to coarse crystalline	Crystalline limestone	Inorganic
	fine to coarse crystalline; banded appearance	Travertine	Inorganic
	Clastic; visible shells & shell fragments loosely cemented (poorly indurated)	Coquina	Organic
	Clastic; various size shells and shell fragments cemented with calcite cement; well indurated	Fossiliferous Limestone	Organic
	Clastic; microscopic shells and clay	Chalk	Organic
	Aggregates of oolites	Oolitic Limestone	Inorganic
Quartz (SiO_2)	very fine crystalline (cryptocrystalline; dense, hard	Chert (light colored) Flint (dark colored)	Inorganic
Gypsum $CaSO_4$-$2H_2O$	fine to coarse crystalline	Rock Gypsum	Inorganic
Halite NaCl	fine to coarse crystalline	Rock Salt	Inorganic
Altered plant fragments	fine-grained organic matter	Bituminous Coal	Organic
SiO_2	Clastic; Siliceous skeletons of microscopic organisms	Diatomite	Organic

Lab Procedure

Before trying to identify sedimentary rocks, you should be familiar with the sedimentary minerals (#11-22) in your mineral set, have read introductory material above, as well as the chapter on sedimentary rocks in your textbook.

To complete this lab you will need access to the sedimentary rock collection found in the classroom or in the geology study room. You will also need your handlens, access to a microscope and a small vial of dilute hydrochloric acid. A pocket knife may also be handy for scratch-testing minerals.

Part 1 (60 pts): Several rocks are available for you to identify in the lab. You should study these rocks one at a time, first listing the type of texture of the rock, secondly the sorting, rounding and grainsize (where applicable), thirdly the mineral composition, and finally the name of the rock as determined from the sedimentary rock identification chart. Be sure to fill out all of the features possible before naming the rock, even though a number of the rocks will be immediately obvious without going through all of the steps. Please identify all of your sedimentary rocks indicated by the instructor and ask your instructor to check your identification before continuing on to answer the following questions.

Part 2 (40 pts) Once you have successfully identified the unknown specimens, answer the questions that follow**.**

Questions

1. Study your specimen of pebble conglomerate.

   a) How might the pebbles have become rounded? **(2 pts)**

   _____

   _____

   b) Carefully examine the finer grains (sand) with your hand lens or a microscope. Are these grains as well-rounded as the pebbles? _____Why or why not? **(2 pts)**

   _____

   _____

   c) Do you think that the pebbles were transported a long distance? Explain **(2 pts)**

   _____

   _____

d) Describe the volume and velocity of the current that might have carried these pebbles. **(4 pts)**

_____

_____

2. Study your specimen of fossiliferous limestone.

a) How do fossils become part of sedimentary rocks? **(2 pts)**

_____

b) What was the environment of deposition for this rock?. Give reasons for your conclusion. **(4 pts)**

_____

_____

_____

3. Study a specimen of sandstone with your hand lens or a microscope.

a) Is there any evidence for crystalline cement in this rock? **(2 pts)**

_____

b) Sketch the texture of sandstone when magnified and compare it to that of the conglomerate above. **(4 pts)**

4. Select any specimen other than the ones you've used in the question above. #_____

   Name it:_____

   Deduce as much as you can about the area from which the sediment was derived, how it was transported, the environment in which it was deposited, and how it was lithified. Explain your reasoning. **(8 pts)**

5. Take out the tray of igneous rocks and compare them, in general, to the rocks in the sedimentary collection. If someone handed you an unknown rock sample and asked you to identify it, what clues would you look for to be able to tell whether it was a sedimentary rock or an igneous rock? **(10 pts)**

SEDIMENTARY ROCK IDENTIFICATION FORM ***Lab 11: Sed. Rock ID.***

#	Texture		Composition	Structure & other properties	Induration	Basic Name	Depositional Environment
	Clastic Size of clasts, matrix, etc	**Crystalline** Size of crystals, layering, density, etc	Of clasts, matrix or crystalline material	e.g. cross beds, grading, etc	Degree of firmness & kind of cement	From chart	

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