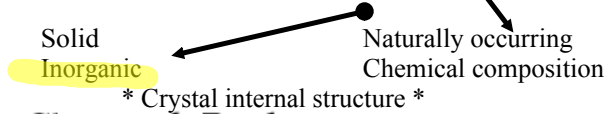


All minerals are rock, but not all rock is mineral



Chapter 6: Rocks

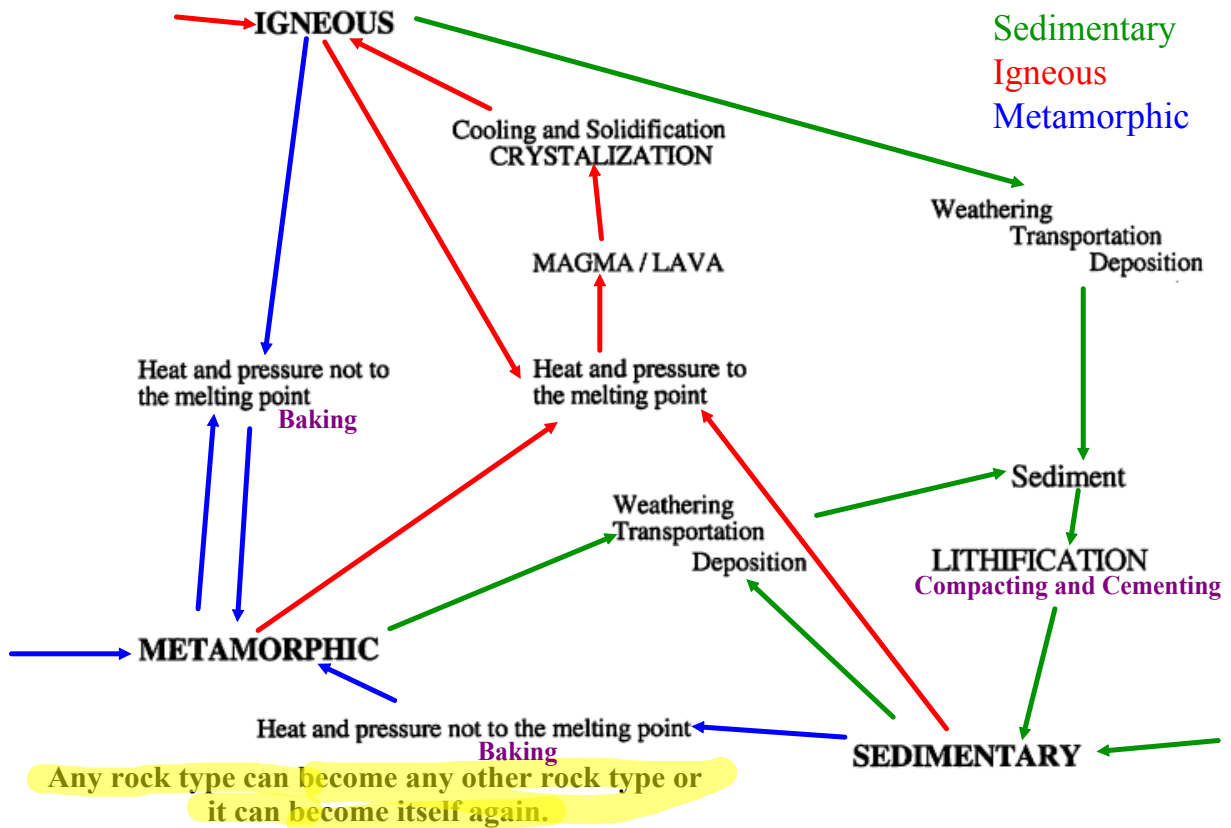
I. How Rocks Form

Coal

A. Rocks are minerals or mixtures of minerals.

1. Igneous rocks form by the cooling and hardening of hot, molten rock - lava (on the surface) or magma (inside the Earth)
2. Sedimentary rocks are formed from the compaction and cementing of layers of sediments (rock fragments)
3. Metamorphic rocks form from the effect of heat and pressure on other rocks.

B. The rock cycle is a process that describes how rocks change from one rock type into another over very long periods of time. The cycle is diagramed below:



II. Igneous Rocks

A. Igneous means "fire-formed."

B. Igneous rocks can be thought of as the parent rocks for all other rock types.

C. Igneous rocks form from magma or lava.

1. Magma is molten rock beneath the earth's surface.

a. The classification of magma has more to do with the percentages of dissolved gases than the location of the molten rock. Magma = lots of gas

b. Rocks which form and cool beneath the surface are called intrusive. In other words, intrusive rocks are solids that form from the liquid state within the earth. gases = water vapor carbon dioxide

c. Magma can be classified as felsic, mafic, or intermediate. Silica = silicon and oxygen 1000°F

1. Felsic magma is rich in silica making it a cooler, thicker and slow moving molten rock. This magma typically hardens into light colored silicate minerals such as quartz and feldspar. Light colored

Viscosity = thickness of a liquid

2. Mafic magma is hotter, thinner and more fluid containing large amounts of iron and magnesium and much less silica. Rocks formed from mafic magma usually contain mostly dark silicates such as olivine, augite and biotite. Dark colored

Part light part dark

3. Intermediate magma is partly between the two previous extremes.

2. Lava is molten rock that moves from out of the ground on to the surface.

Lava = low or no gases

a. Again, the classification of lava is more detailed than just the location of the molten rock.

b. Rocks which form and cool above the earth's surface are called extrusive. In other words, extrusive rocks are solids that form from the liquid state on the earth's surface.

C. Igneous rocks are classified by their location of formation and their texture.

1. Texture refers to the size of the mineral crystals in a rock.

How it LOOKS not how it feels

a. The size of the mineral crystals depends on the rate of cooling of the molten rock. Fast or slow

b. Crystals are a regular arrangement and definite ratio of atoms in a mineral.

Fast cooling = small or no crystals Slow cooling = large crystals

Cooling Time

Long cooling = large crystals
Short cooling = small / no crystals

- c. Crystals within a mineral form from the liquid state because within a liquid, the atoms are independent enough to move around but dependent enough not to disperse. In this state, the atoms can arrange into crystals
- d. The longer it takes magma or lava to cool, the larger the crystals become. The faster the magma cools, the smaller the crystals.
- e. Texture is classified in the following ways:

Porphyry-
rock having two
different crystal
sizes within it

Two different
cooling rates

Months / Years

- 1. **Coarse grained rocks** have crystals that are easily visible to the unaided eye. (10 millimeters ~ 2 millimeters) Long cooling
- 2. **Fine grained rocks** have crystals that are usually too small to be seen without the aid of some sort of microscope (<.5 millimeters) Short cooling Hours / Days
- 3. **Glassy texture rocks** cooled instantly and did not have time to develop crystals. (No crystals)
- 4. **Porous textured** rocks are full of holes from gases that bubbled out of the molten rock as it cooled (looks like Swiss cheese) Large or small bubble holes from thickness of molten rock.

Magma on
the surface

IV. Sedimentary Rocks

Some Igneous rocks contains fossils

A. Sedimentary means "settling."

Petrified wood -
mineralized wood

B. Sedimentary rocks form from sediments-- solid particles of various sizes that are moved from one place to another.

C. About 75% of the exposed rocks at the earth's surface are sedimentary. Sedimentary rocks are also the only rocks that contain fossils.

D. Sediments are transported by water, wind, gravity and glaciers. After long periods of time, most of the sediments end up in the shallow seas that border the continents. As sediments pile up on sediments that were deposited earlier, they form layers sometimes miles thick. Due to the heat and pressure that is a result of the weight of the overlying sediments, the bottom most sediments become cemented together into rock through the process known as lithification.

E. Sedimentary rocks are classified according to one of three categories:

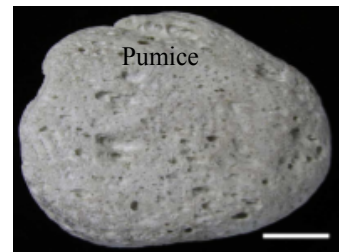
- 1. **Clastic Sedimentary Rocks**-- rock that are made from pieces of other rocks ranging in size from 1/4000 of a millimeter to several 100 millimeters in size. Clastic rocks are named according to the size of sediments that they contain.

Detrital



Texture - size of crystals

Mineral Composition



Igneous Rock Identification-

Color - Mafic, Felsic, Intermediate (minerals)

Texture (Size of Crystals)- Coarse, Fine, Glassy, Porous

Porphyry - 2 sized crystals

Classifying Common Igneous Rocks

For a rock to be classified as igneous, it must have been melted at some time and then hardened to become solid again. When melted rock material cools and hardens, it may form crystals, depending on how fast it cools. How fast the rock material cools depends on *where* it cools. If melted rock cools deep within the earth, the resulting rocks are referred to as *intrusive* igneous rocks. They cool very slowly, giving crystals long periods of time to grow. The more slowly they cool, the larger the crystals grow. Intrusive rocks have crystal sizes, or grain sizes, that are larger than sand-sized and, under rare circumstances, may be larger than a penny. If the melted rock materials cooled near or even on the earth's surface, the resulting rocks are called *extrusive* igneous rocks. If extrusive igneous rocks have crystals, they are smaller than sand-sized. However, some extrusive igneous rocks cool so fast that crystals don't have sufficient time to grow at all.

Sometimes when extrusive igneous rocks are cooling, volcanic gases bubble through the melted rock material much like water vapor bubbles through boiling water. When the rock hardens, these bubbles may become trapped to produce holes in the final product. The holes tend to make the rock light in weight.

		COMMON IGNEOUS ROCKS	
		Felsic (Aluminum)	Mafic (Iron and Magnesium)
		← Composition →	
		← Density →	High
		← Color →	Dark-colored or green
INTRUSIVE	CRYSTAL SIZE	Coarse (larger than sand-sized)	Gabbro
	Fine (smaller than sand-sized)	Rhyolite	Basalt
EXTRUSIVE	<p>NO CRYSTALS The material cooled too fast to allow time for the crystals to form.</p> <p>Obsidian (Resembles granite chemically)</p> <ul style="list-style-type: none"> • commonly called natural or volcanic glass • most commonly black but may be red, gray or brown • breaks in conchoidal or shell-like fractures <p>Pumice (Resembles granite chemically)</p> <ul style="list-style-type: none"> • very porous volcanic glass • color from white to yellowish gray to gray brown • made of silky glass fibers full of tiny pores. Millions of pores make pumice so light that some floats in water <p>Scoria (Resembles basalt chemically)</p> <ul style="list-style-type: none"> • color from reddish brown to dark gray to black • has many holes but they are larger and wider spaced than in pumice 		

Refer to the chart to complete the following table and answer the questions.

1. Igneous rocks may be classified on the basis of color and crystal size. Name the igneous rocks whose crystal size and color are listed in the following table.

Crystal Size	Color	Rock Name
a. Large	Generally light pink	
b. Large	Black	
c. Smaller than sand-sized	Blackish green	
d. Smaller than sand-sized	Generally light colored	

2. a. List two intrusive igneous rocks. _____

- b. Did these two types of igneous rocks cool relatively fast or slowly? _____
- c. Explain your answer. _____

3. a. Do all extrusive igneous rocks contain crystals? _____
- b. Explain your answer. _____

4. Why do some igneous rocks have bubble holes? _____

5. List two extrusive igneous rocks that contain crystals.
- a. _____
- b. _____
6. Granite and obsidian are similar chemically. How are they different? _____

7. What igneous rock may have cooled deep beneath the earth's surface and have a dark blackish-green color? _____



Conglomerate
Rounded



Breccia
Angular



Sandstone



Shale

CLASTIC

Large
↓
Small

**SEDIMENT
CATEGORY**

SEDIMENT

**LIMITING SIZE
(MILLIMETERS)**

**ROCK
TYPE**

GRAVEL

Boulder
Cobble
Pebble
Granular

256
64 - 256
4 - 64
2 - 4

**CONGLOMERATE
OR BRECCIA**

SAND

Medium sand

.175 - 2

SANDSTONE

MUD

Silt
Clay

0.004 - .175

SHALE

2. **Chemical Rocks**-- rocks which are not made up of other size rocks. Chemical rocks are classified by the minerals that they contain.

a. **Chemical Precipitates** rocks which form when minerals that are dissolved in water come out of solution or precipitate. The minerals come out of solution usually because of a water temperature change or chemical change in the water.

b. **Evaporate Deposits**-- places that were once covered by shallow seas or lakes and the water evaporated away may contain evaporate deposits. **Rock salt (halite) and gypsum** are two examples of evaporate rocks. The Great Salt Flats in Utah

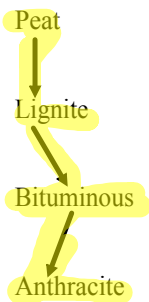
3. **Organic Sedimentary Rocks**-- rocks which are the result of biological interactions or activities.

a. **Biochemical Sediments**-- water dwelling animals extract dissolved minerals (usually calcite --CaCO₃) out of the water to make their shells. These shells become sediments on the ocean floor when these animals die. **Coquina is a type of limestone made up of broken shells cemented together. Chalk is a limestone made up of the shells of microscopic organisms.**

b. **Organic Sediments**-- rocks which are made of sediment which are the result of living things.

1. Plants that die, decay and become buried can be compacted and compressed over millions of years into **coal.**

Coal Formation



F. Features in Sedimentary Rocks

Bedding

1. **Stratification** - Visible layering found in rocks caused by a change in the type of sediment being deposited.

2. **Fossils** - evidence of past life and environments.

3. **Ripple Marks and Mud Cracks** - indicators of environmental change and or the presence of water in the past
4. **Nodules, Concretions, and geodes** - form almost like a pearl in an oyster. Masses of concentrated minerals and crystals in rock layers.

III. Metamorphic Rocks

A. Metamorphic means "changed - formed."

B. Metamorphic rocks form from igneous rocks or ^{other Metamorphic rocks} sedimentary rocks that have been placed under great heat and pressure but not to the melting point. ^{Bake}

C. The heat and pressure necessary for metamorphism is the result of radioactive decay, the weight of overlying sediments, and plate tectonics.

D. Metamorphism can take place on a small scale or on a large scale.

Small Scale
Valley / Volcano

1. **Contact Metamorphism** - occurs when igneous or sedimentary rocks comes in contact with magma, lava, or chemically active fluids.

Large Scale
Mountain ranges
Continents

2. **Regional Metamorphism** - occurs when large parts of the earth's crust are placed under enough pressure so that it begins to fault (break) or fold (bend). This type of metamorphism is usually associated with mountain building.

E. The following are the result of metamorphism as heat, pressure, and time increase.

1. The rock becomes more dense as more material is squeezed into a smaller area.
2. Crystals will begin to rearrange themselves as a result of the pressure.
3. Mineral crystals can increase in size as temperatures increase enough for the atoms (which are gaining energy) to begin to move around.
4. New minerals may begin to form.
5. Foliation may occur-- minerals line up in bands as a result of the intense pressure.

F. Metamorphic rocks may be placed into two categories:

1. **Foliated**-- those metamorphic rocks which show banding or striping.
2. **Nonfoliated**-- those metamorphic rocks that do not show banding or striping.

Granite -> Gneiss
Shale -> Slate
Shale -> Schist
Sandstone -> Quartzite
Limestone -> Marble

