

Ch. 3--Minerals

- What is a mineral?
 - Naturally occurring
 - Inorganic
 - Solid
 - Definite Structure
 - Definite Composition

5 Characteristics of Minerals

1. Formed by natural Processes
 - Cannot be man made
2. Inorganic
 - Usually doesn't contain carbon (some exceptions:
ex. Diamond)
3. All are solids
 - Definite shape and volume
 - Liquids cannot be crystals

5 Characteristics of Minerals

4. All are an element or compound with an unique composition.
 - Ex. Rock Salt
5. Arranged in a pattern that is repeated over and over again.
 - Ex. Graphite

6 Major Crystal Systems

Figure 3

- ❖ Hexagonal Example:
- ❖ Orthorhombic
- ❖ Monoclinic
- ❖ Tetragonal
- ❖ Triclinic
- ❖ Cubic Example:

3 Ways Minerals Form

1. Cooling of molten material
2. Evaporation
3. Precipitation

3 Ways Minerals Form

1. Cooling of Hot molten material.
 - Magma cools
 - Atoms lose energy
 - Atoms move closer together
 - Atoms begin to combine to form compounds
 - Compounds arrange into repeating pattern.
- What happens to the size of the crystals if the mineral cools quickly or slowly?

3 Ways Minerals Form

2. Formed from minerals dissolved in liquid. (Evaporation)

- Liquid evaporates
- Atoms in minerals stay behind
- Atoms combine and form crystals

3 Ways Minerals Form

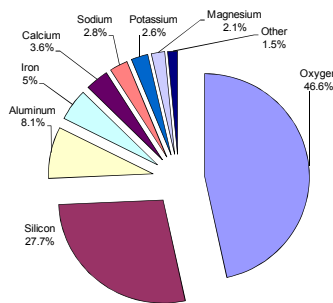
3. Precipitation

- A solution becomes saturated OR
- Another substance is added to a saturated solution.
- Crystals begin to precipitate out of solution.

Mineral Compositions

90 elements naturally occur in the Earth's crust.

- There are 4000 known minerals
- A few dozen are common.
- Most rock forming minerals are silicates—minerals containing oxygen and silicon



ID of Minerals--Hardness

- Hardness
 - Measure of how easily a rock is scratched by another rock.
- Mohs Hardness Scale
 - Developed by Frederick Mohs to compare the hardness of 10 minerals
 - We have minerals of known hardness, everything is compared to these 10.
 - Scale is 1 to 10
 - Softest Mineral
 - Hardest Mineral

A way to remember the order

The Geologist Can Find A Funky Quartz,
Tourists Call Diamond!

Mohs Hardness Scale

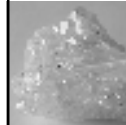
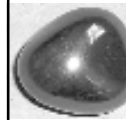
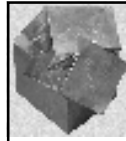
- Mohs Hardness Scale
 - 1—Talc
 - 2—Gypsum
 - 3—Calcite
 - 4—Fluorite
 - 5—Apatite
 - 6—Feldspar
 - 7—Quartz
 - 8—Topaz
 - 9—Corundum
 - 10—Diamond
- - Fingernail
 - Copper Penny
 - Iron Nail
 - Glass
 - Steel File
 - Streak Plate

Absolute Hardness Scale

- 1—Talc
- 3—Gypsum
- 9—Calcite
- 21—Fluorite
- 48—Apatite
- 72—Feldspar
- 100—Quartz
- 200—Topaz
- 400—Corundum
- 1600—Diamond

ID of Minerals--Luster

- Describes how light is reflected from a minerals surface.
 - Metallic
 - Non-Metallic



ID of Minerals--Color

- Color: The appearance of a mineral in it's non-powdered form.



ID of Minerals--Streak

- Streak: color of a mineral when it is powdered.
 - We use a streak plate (unglazed porcelain plate)
 - Ex. Pyrite



ID of Minerals--Breakage

- The way a mineral breaks.
 - Cleavage: if a mineral breaks along smooth, flat surfaces.
 - Fracture: if a mineral breaks rough and jagged.
 - Ex. Quartz
 - Ex. Halite

ID of Minerals—Magnetic

- Some minerals are magnetic.
 - Ex. Magnetite



ID of Minerals—React With Acid



- Calcite will react rapidly in contact with hydrochloric acid, causing effervescence (bubbles) and the release of carbon dioxide gas.
- $\text{CaCO}_3 + 2\text{H}^+ \rightarrow \text{Ca}^{+2} + \text{H}_2\text{O} + \text{CO}_2$ (a gas)
- **This is a Chemical Property!!!**

ID of Minerals—Ability to Bend Light

- Calcite can bend light.



ID of Minerals--Fluorescent

- The fluorescent minerals are minerals that emit visible light when activated by invisible ultraviolet light (UV), X-rays and/or electron beams. Certain electrons in the mineral absorb the energy from these sources and jump to a higher energy state. The fluorescent light is emitted when those electrons jump down to a lower energy state and emit a light of their own.

Fluorescent

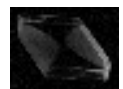
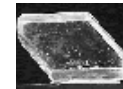
- Fluorite



- Gypsum



- Calcite

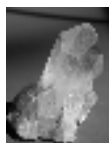


- Apatite



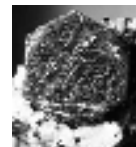
Uses of Minerals--gems

- Gems (gemstones)
 - Highly prized minerals because they are rare and beautiful.
 - Gem (brighter/colorful) vs. common form
 - The difference may be slight
 - May be color
 - Ex. Amethyst vs. Quartz



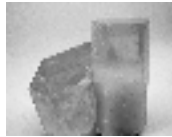
Uses of Minerals--gems

- Ruby vs. Sapphire vs. Corundum



Uses of Minerals—gems

Emerald vs. Beryl



Important Gems

- Hope Diamond—beginning in 1668, was part of the French crown jewels, associated with a curse—45.52 carats.



- Cullinan diamond—found in South Africa in 1905, the largest uncut diamond ever discovered on Earth—3,106.75 carats.



Uses of Minerals—Ores

- Minerals that contain a useful substances that can be mined for a profit.
- These products are worth more money than the cost of mining them.
- Must be processed or refined into a more useful form.
- Ex. Hematite (iron)



•Ex. Bauxite (aluminum)



Uses of Minerals—Titanium

- Durable, non-toxic, lightweight metal derived from minerals such as ilmenite or rutile.
- Do you own anything made of titanium?
- Uses:
 - Tennis Rackets
 - Golf Clubs
 - Racing Bikes
 - Hip Replacements
 - Aircraft Parts
 - Automobile parts (valves, suspensions)
 - Razor Blades

Refining Titanium

Ilmenite Ore

Ilmenite + Sulfuric Acid \rightarrow Titanium Dioxide + Iron Sulfate

- Note: Iron Sulfate is dangerous to the environment so this method is not preferred.



Rutile Ore

Rutile + chlorine + high temp \rightarrow Titanium Tetrachloride (TiCl_4)

Rutile contains a higher concentration of titanium.

