

Introduction to Minerals

I. Minerals and Basic Properties

- A. Mineral - naturally occurring inorganic solid, consisting of atoms combined together as chemical compounds, possessing a definable internal structure.
1. Rocks are composed of 1 or more mineral crystals combined together as aggregates.
 2. atoms---bonded----compounds/minerals----combined/lithified----rocks-----create structure of earth
- B. Physical Properties of Minerals - the unique chemical/atomic composition of minerals and the crystalline arrangement of the atoms within the mineral structure give a particular mineral a defineable and recognizable set of physical properties.
1. Crystal Form of a mineral - the external expression of a mineral that reflects the orderly internal arrangement of atoms.
 - a. E.g. quartz crystals - if a mineral is allowed to form without space restrictions, it will develop individual xls with well developed crystal faces.
 2. Luster - the appearance or quality of light reflected from the surface of a mineral.
 - a. E.g. metallic luster, submetallic, vs. non-metallic luster (includes glassy, pearly, silky, resinous, and dull)
 3. Color - colors can be helpful in identifying a mineral, but is generally useful as minor impurities in a mineral can cause wide color variation (e.g. quartz comes in pink, purple, white, gray)
 4. Streak - the color of a mineral in its powdered form obtained by rubbing it across a porcelain plate. Streak color can be very different from the mineral color.
 5. Hardness - resistance of a mineral to abrasion or scratching. Very diagnostic of a mineral. Mohs hardness scale developed as a frame of reference.
 6. Cleavage - tendency of of a mineral to break along planes of weak atomic bonding. Different minerals have different types and directions of cleavage.
 7. Fracture - minerals (e.g. quartz) do not have cleavage but instead break along uneven surfaces.
 - a. Conchoidal fracture = breaks like glass.
 - b. Others may break into splinters or irregularly.
 8. Specific Gravity - Ratio of the weight of a mineral relative to a similar volume of water.

- a. E.g. if a 1 cm³ piece of mineral weighs 3 x as much as 1 cm³ of water, its s.g. = 3.

C. Mineral Groups (over 2000 minerals types known to exist, only about 24 are most abundant)

- 1. Rock Forming Minerals - those minerals that are the most abundantly found on the earth and that most commonly comprise rocks.

- a. 8 Elements constitute 98% of the earth's crustal minerals

| | |
|-----------|-------|
| oxygen | 46.6% |
| Silicon | 27.7% |
| Aluminum | 8.1% |
| Iron | 5.0% |
| Calcium | 3.6% |
| Sodium | 2.8% |
| Potassium | 2.5% |
| Magnesium | 2.1% |
| Others | 1.5% |

Total 100%

- 2. Silicates- Most common mineral groups composed of silica and oxygen...known as the silicates
 - a. composed primarily of silica and oxygen with subordinate amounts of other elements to maintain electrical neutrality on the subatomic level).
- 3. Carbonates - Ca and CO₃ - next common
- 4. Oxides - consist of metallic elements and oxygen
- 5. Native Elements - Au, Ag, and C (diamond).
 - a. e.g. of mineral uses, quartz = glass, calcite = cement, gypsum = plaster.

D. Silicate Structures

- 1. Basic Building Block of Silicate Minerals is the silica-oxygen tetrahedron.
 - a. 4 Oxygen atoms surrounding a Si atom in between. The Si-O tetrahedron forms a complex anion with a net negative charge of -4 (Si = +4, 4(O -2) = -8; -8 + 4 = -4)
 - b. thus positively charged metal ions are commonly incorporated into the bonds of Si-tetrahedron to satisfy charge balancing.

2. Silica tetrahedra may be linked together to form
 - a. single chains
 - b. double chains
 - c. sheet structures

3. Silicate Minerals
 - a. Ferromagnesian Silicates - silicate minerals (compounds containing Si-O tetrahedron) that are linked together and include Fe and Mg.
 - (1) Typically dark in color, high specific gravity, and crystallize from magma at relatively high temperatures.
 - (2) e.g. Olivine, Pyroxene, Amphibole, Biotite, and Garnet)
 - b. Nonferromagnesian Silicates - silicate minerals that are linked together and do not include Fe and Mg.
 - (1) Typically lighter in color, less specific gravity, crystallize from magma at relatively lower temperatures
 - (2) e.g. quartz, feldspars, muscovite, clay)

- E. Nonsilicate Minerals - minerals that are compounds that do not have silica and oxygen in their structure
 1. carbonates,
 2. sulfates,
 3. oxides,
 4. native elements,
 5. halides,
 6. phosphates