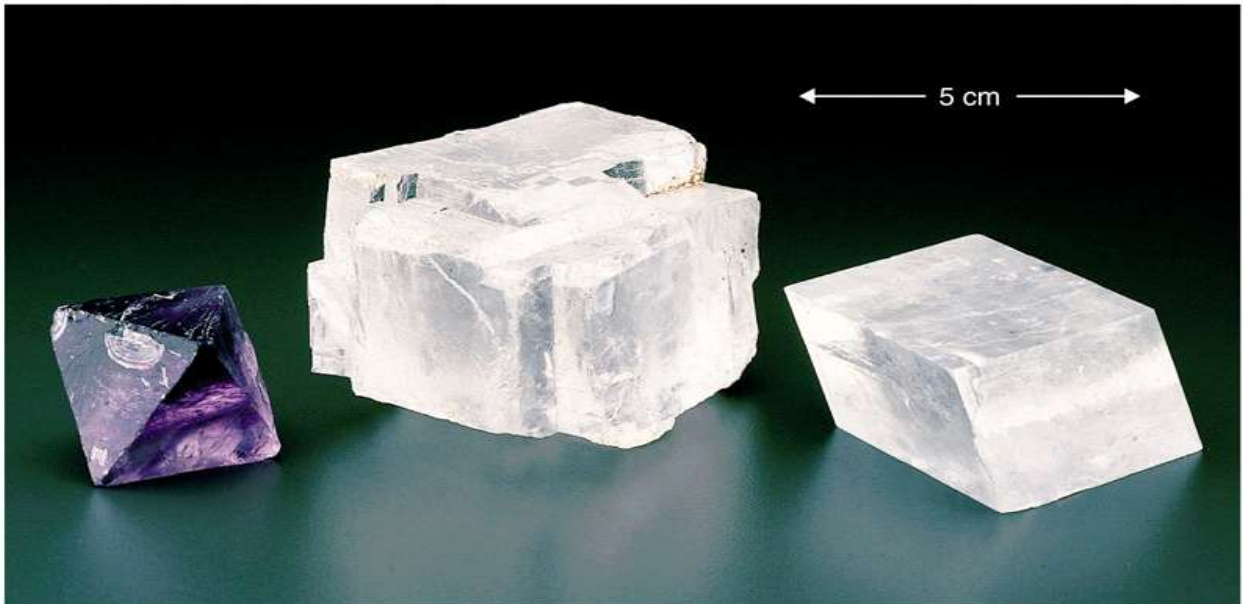


## ***Chapter 2: Minerals: Building Blocks of Rocks***



- I. Minerals: The building blocks of rocks
  - A. Mineral: definition
    1. Naturally occurring
    2. Inorganic
    3. Solid
    5. Orderly internal structure
    4. Definite chemical structure
  - B. Rock: a solid, natural mass of mineral, or mineral-like, matter
  
- II. Composition of minerals
  - A. Elements
    1. Basic building blocks of minerals
    2. Over 100 are known (92 naturally occurring)
  - B. Atoms
    1. Smallest particles of matter
    2. Retains all the characteristics of an element
  - C. Atomic structure
    1. Nucleus, which contains
      - a. Protons - positive electrical charges

- b. Neutrons - neutral electrical charges
    - 2. Electrons
      - a. Surround nucleus
      - b. Negatively charged zones called energy levels, or shells
    - 3. Atomic number is the number of protons in an atom's nucleus
  - D. Bonding
    - 1. Forms a compound with two or more elements
    - 2. Ionic bonds
      - a. Atoms give-up or gain valence electrons to form ions
        - 1. Anion - negatively charged due to a gain of an electron(s)
        - 2. Cation - positively charged due to a loss of an electron(s) ionic compounds consist of an orderly arrangement of oppositely charged ions
    - 3. Covalent bonds
      - a. Atoms share electrons
      - b. e.g., The gaseous elements oxygen (O<sub>2</sub>) and hydrogen (H<sub>2</sub>)
    - 4. Other bonds
      - a. Both ionic and covalent bonds may occur in the same compound
      - b. Metallic bonding – valence electrons are free to migrate
  - E. Isotopes and radioactive decay
    - 1. Mass number - the sum of the neutrons plus protons in an atom's nucleus
    - 2. Isotope - variants of the same element with more than one mass number
    - 3. Some isotopes have unstable nuclei and emit particles and energy in a process called radioactive decay
- III. Physical properties of minerals
- A. Crystal form
    - 1. External expression of the orderly internal arrangement of atoms

2. Crystal growth is often interrupted because of competition for space
- B. Luster
1. Appearance of reflected light
  2. Two basic types
    - a. Metallic
    - b. Nonmetallic
- C. Color
- a. Often an unreliable diagnostic property
  - b. Varieties of colors
    1. Exotic coloration
    2. Inherent coloration
- D. Streak
1. Color of a mineral in its powdered form
  2. Helps to distinguish metallic luster
- E. Hardness
1. Resistance of a mineral to abrasion or scratching
  2. Mohs scale of hardness
- F. Cleavage
1. Tendency to break along planes of weak bonding
  2. Described by
    - a. Number of planes
    - b. Angles at which the planes meet
- G. Fracture
1. Absence of cleavage when broken
  2. Types
    - a. Irregular
    - b. Conchoidal
- H. Specific gravity
1. Ratio of the weight of a mineral to the weight of an equal volume of water
  2. Can be estimated by “hefting” the mineral
- I. Other properties
1. Taste
  2. Smell

3. Elasticity
4. Malleability
5. Feel
6. Magnetism
7. Double refraction
8. Reaction to hydrochloric acid

#### IV. Mineral groups

##### A. General characteristics

1. Nearly 4000 minerals have been named
2. Rock-forming
  - a. No more than a few dozen
  - b. Make up most of the rocks of Earth's crust
    - c. Composed essentially of the eight elements that represent over 98 percent (by weight) of the continental crust
      1. Oxygen (O)
      2. Silicon (Si)
      3. Aluminum (Al)
      4. Iron (Fe)
      5. Calcium (Ca)
      6. Sodium (Na)
      7. Potassium (K)
      8. Magnesium (Mg)

##### B. Silicates

1. Most common mineral group
2. Contain silicon-oxygen tetrahedron
  - a. Four oxygen ions surrounding a much smaller silicon ion
  - b. Complex ion with a negative four (-4) charge
3. Other silicate structures
  - a. Tetrahedra join to form
    1. Single chains
    2. Double chains

3. Sheets, etc.
  - b. Negative structures are neutralized by the inclusion of metallic cations that bond them together
1. Ions of the about the same size are able to substitute freely
2. In some cases, ions that interchange do not have the same electrical charge
4. Common silicate minerals
  - a. Dark (ferromagnesian) silicates
    1. Olivine
      - a. High-temperature silicate
      - b. Black to olive green in color
      - c. Glassy luster
      - d. Conchoidal fracture
    2. Pyroxene group
      - a. Most common member – augite
      - b. Tetrahedron are arranged in single chains
      - c. Black, opaque
    3. Amphibole group
      - a. Most common member – hornblende
      - b. Tetrahedron are arranged in double chains
      - c. Similar in appearance to augite
    4. Biotite mica
      - a. Tetrahedron are arranged in sheets
      - b. Excellent cleavage in one direction
  - b. Light (nonferromagnesian) silicates
    1. Muscovite mica
      - a. Light color
      - b. Excellent cleavage
    2. Feldspar
      - a. Most common mineral group
      - b. Two planes of cleavage
      - c. Three-dimensional framework of

tetrahedron

- d. Two different varieties of feldspar
  1. Potassium feldspar
  2. Plagioclase (sodium and calcium) feldspar
3. Quartz
  - a. Composed entirely of silicon and oxygen
  - b. Three-dimensional framework of tetrahedron
4. Clay
  - a. Sheet structure
  - b. Term used to describe a variety of complex minerals
  - c. Most originate as products of chemical weathering

C. Important nonsilicate minerals

1. Major groups
  - a. Oxides
  - b. Sulfides
  - c. Sulfates
  - d. Native elements
  - e. Carbonates
  - f. Hydroxides
  - g. Phosphates
2. Carbonates
  - a. Two most common carbonate minerals
    1. Calcite (calcium carbonate)
    2. Dolomite (calcium/magnesium carbonate)
  - b. Primary constituents in the sedimentary rocks limestone and dolostone
3. Halite and gypsum
  - a. Evaporite minerals
  - b. Important nonmetallic resources
4. Many other nonsilicate minerals have economic value
  - a. Hematite (iron ore)

- b. Sphalerite (zinc ore)
- c. Galena (lead ore)

V. Mineral resources

- A. The endowment of useful minerals ultimately available commercially
- B. Mineral resources include
  - 1. Reserves – already identified deposits
  - 2. Known deposits that are not yet economically or technologically recoverable
- C. Ore
  - 1. A useful metallic mineral that can be mined at a profit
  - 2. Must be concentrated above its average crustal abundance
  - 3. Profitability may change because of economic changes
- D. The mechanisms that generate igneous, sedimentary, and metamorphic rocks play a major role in producing concentrated accumulations of useful elements