Chapter 2 Minerals

Summary

2.1 Matter

- An element is a substance that cannot be broken down into simpler substances by chemical or physical means.

- An atom is the smallest particle of matter that contains the characteristics of an element.
  - The central region of an atom is called the nucleus. The nucleus contains protons and neutrons.
  - The number of protons in the nucleus of an atom is called the atomic number.
  - Electrons are located in regions called energy levels.

- Atoms with the same number of protons but different numbers of neutrons are isotopes of an element.
  - The mass number of an atom is the total mass of the atom expressed in atomic mass units.
  - Many elements have atoms whose nuclei are unstable. These atoms disintegrate by radioactive decay.

- A compound is a substance that consists of two or more elements that are chemically combined in specific proportions.

- When an atom’s outermost energy level does not contain the maximum number of electrons, the atom is likely to form a chemical bond with one or more other atoms.
  - Chemical combinations of the atoms of elements are called compounds.
  - Chemical bonds are the forces that hold atoms together in a compound. There are three principal types of chemical bonds: ionic, covalent, and metallic.
  - An atom can gain or lose one or more electrons. The atom then has an electrical charge and is called an ion.

- Ionic bonds form between positive and negative ions.

- Covalent bonds form when atoms share electrons.

- Metallic bonds form when electrons are shared by metal ions.
Chapter 2  Minerals

2.2 Minerals

A mineral is a naturally occurring, inorganic solid with an orderly crystalline structure and a definite chemical composition.

- Minerals form by natural processes.
- Minerals are solids in normal temperature ranges on Earth.
- Minerals are crystalline. Their atoms or ions are arranged in an orderly and repetitive way.
- Minerals have definite chemical composition. They usually are compounds formed of two or more elements.
- Most minerals are inorganic chemical compounds.

There are four major processes by which minerals form: crystallization from magma, precipitation, changes in pressure and temperature, and formation from hydrothermal solutions.

- Magma is molten rock from deep in the Earth. As it cools, it forms minerals.
- Substances dissolved in water may react to form minerals.
- Changes in temperature and pressure can make new minerals form.
- When hot solutions touch existing minerals, chemical reactions take place and form new minerals.

Common minerals, together with the thousands of others that form on Earth, can be classified into groups based on their composition.

Silicon and oxygen combine to form a structure called the silicon-oxygen tetrahedron.

- Silicates are made of silicon and oxygen. They are the most common group of minerals on Earth.
- Most silicate minerals crystallize from cooling magma.

Carbonates are minerals that contain the elements carbon, oxygen, and one or more other metallic elements.

Oxides are minerals that contain oxygen and one or more other elements, which are usually metals.

Sulfates and sulfides are minerals that contain the element sulfur.

Halides are minerals that contain a halogen ion plus one or more other elements.

Native elements are minerals that only contain one element or type of atom.
2.3 Properties of Minerals

- Small amounts of different elements can give the same mineral different colors.

- Streak is the color of a mineral in its powdered form.

- Luster is used to describe how light is reflected from the surface of a mineral.

- Crystal form is the visible expression of a mineral’s internal arrangement of atoms.

- The Mohs scale consists of 10 minerals arranged from 10 (hardest) to 1 (softest).
  - **Hardness** is a measure of the resistance of a mineral to being scratched.
  - You can test hardness by rubbing a mineral against another mineral of known hardness. One will scratch the other, unless they have the same hardness.

- Cleavage is the tendency of a mineral to cleave, or break, along flat, even surfaces.
  - Minerals may have cleavage in one or more directions.

- Minerals that do not show cleavage when broken are said to fracture.
  - **Fracture** is the uneven breakage of a mineral.

- Density is a property of all matter that is the ratio of an object’s mass to its volume.

- Some minerals can be recognized by other distinctive properties.