Prentice Hall

EARTH SCIENCE

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Chapter

2 Minerals

2.1 Matter

Elements and the Periodic Table

- **Elements** are the basic building blocks of minerals.
- Over 100 elements are known.

2.1 Matter

Atoms

- Smallest particles of matter
- Have all the characteristics of an element
- The nucleus is the central part of an atom and contains
  - protons, which have positive electrical charges
  - neutrons, which have neutral electrical charges

2.1 Matter

Atoms

- **Energy levels**, or shells
  - surround the nucleus
  - contain electrons—negatively charged particles
- The **atomic number** is the number of protons in the nucleus of an atom.

Model of an Atom

2.1 Matter

Isotopes

- **Isotopes** of an element have the same number of protons but varying numbers of neutrons.
- Have different mass numbers: the sum of the neutrons plus protons
- Many isotopes are radioactive and emit energy and particles.
- The **mass number** is the number of neutrons and protons in the nucleus of an atom.

2.1 Matter

Why Atoms Bond

- 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 atoms.
  - A **compound** consists of two or more elements that are chemically combined in specific proportions.
  - An **ion** is an atom that gains or loses electrons.

2.1 Matter

Types of Chemical Bonds

1. **Ionic bonds** form between positive and negative ions.
2. **Covalent bonds** form when atoms share electrons.
3. **Metallic bonds** form when metal ions share electrons.

2.2 Minerals

Definition of a Mineral

1. Naturally occurring
2. Solid substance
3. Orderly crystalline structure
4. Definite chemical composition
5. Generally considered inorganic

2.2 Minerals

How Minerals Form

1. Crystallization from magma
2. Precipitation
3. Pressure and temperature
4. Hydrothermal solutions

Minerals Formed as a Result of Crystallization of Magma

2.2 Minerals

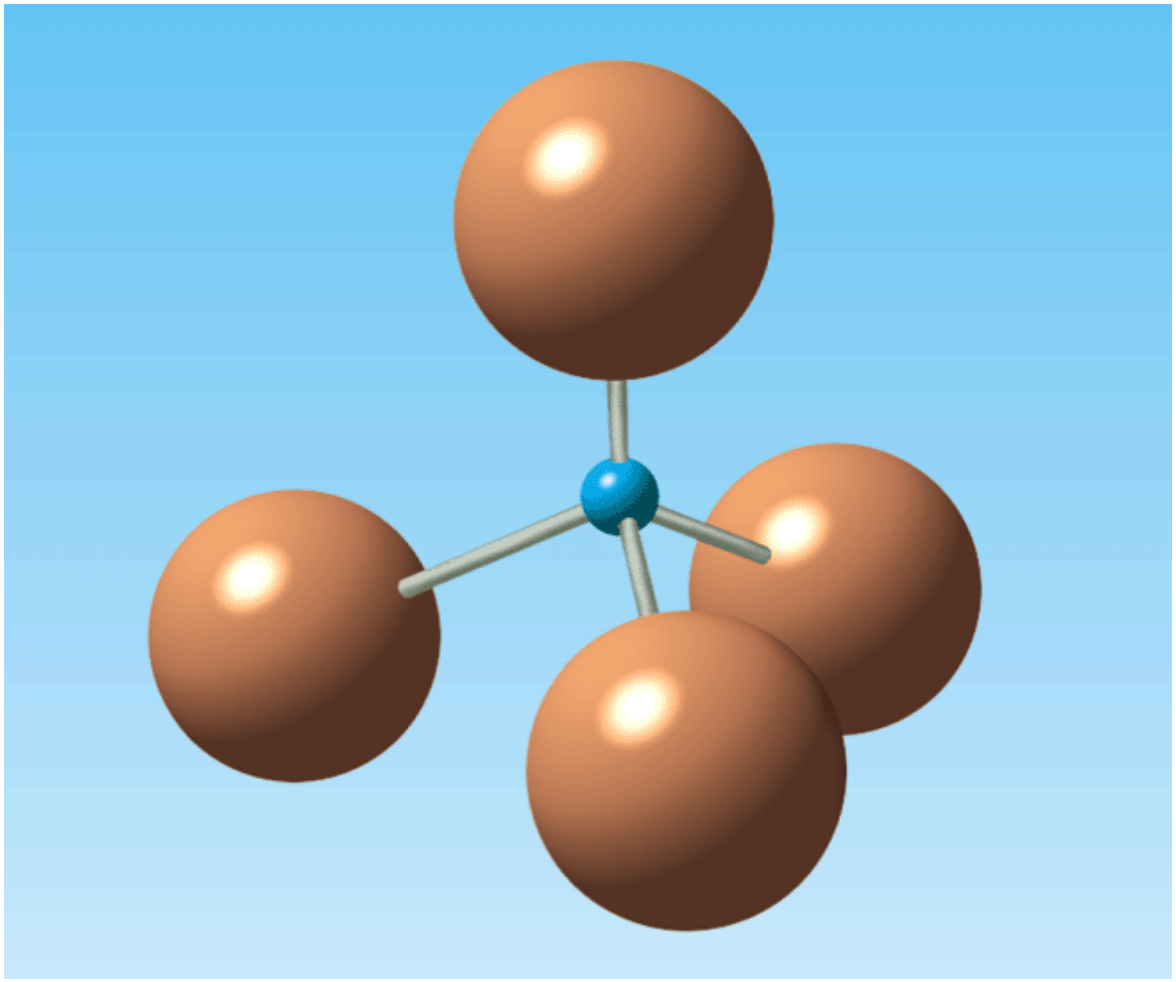
Mineral Groups

- Can be classified based on their composition

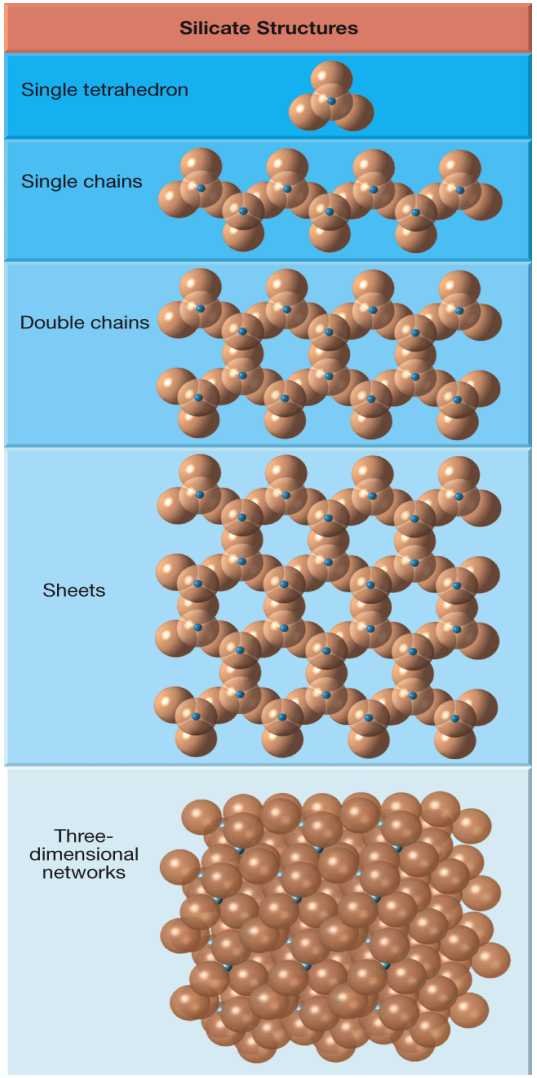
  1. **Silicates**

     - Silicon and oxygen combine to form a structure called the **silicon-oxygen tetrahedron.** This silicon-oxygen tetrahedron provides the framework of every silicate mineral.

The Silicon-Oxygen Tetrahedron



Silicon-Oxygen Chains, Sheets, and Three-Dimensional Networks



2.2 Minerals

Mineral Groups

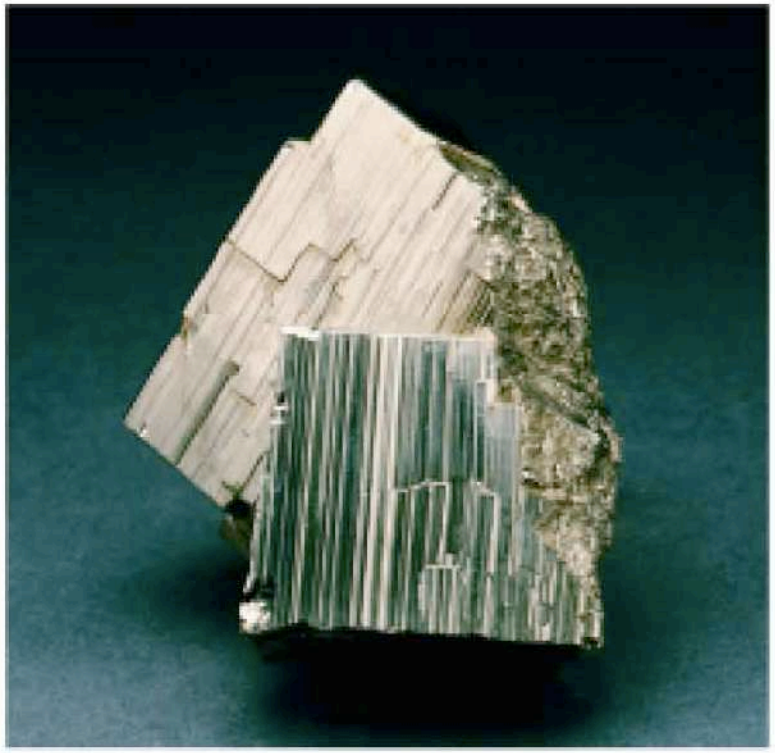
2. Carbonates
   - Minerals that contain the elements carbon, oxygen, and one or more other metallic elements
3. Oxides
   - Minerals that contain oxygen and one or more other elements, which are usually metals

2.2 Minerals

Mineral Groups

4. Sulfates and Sulfides
   - Minerals that contain the element sulfur
5. Halides
   - Minerals that contain a halogen ion plus one or more other elements
6. Native elements
   - Minerals that exist in relatively pure form

Sulfides



Native Copper

2.3 Properties of Minerals

Color

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

2.3 Properties of Minerals

Streak

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

2.3 Properties of Minerals

Luster

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

Pyrite (Fool's Gold) Displays Metallic Luster.

2.3 Properties of Minerals

Crystal Form

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

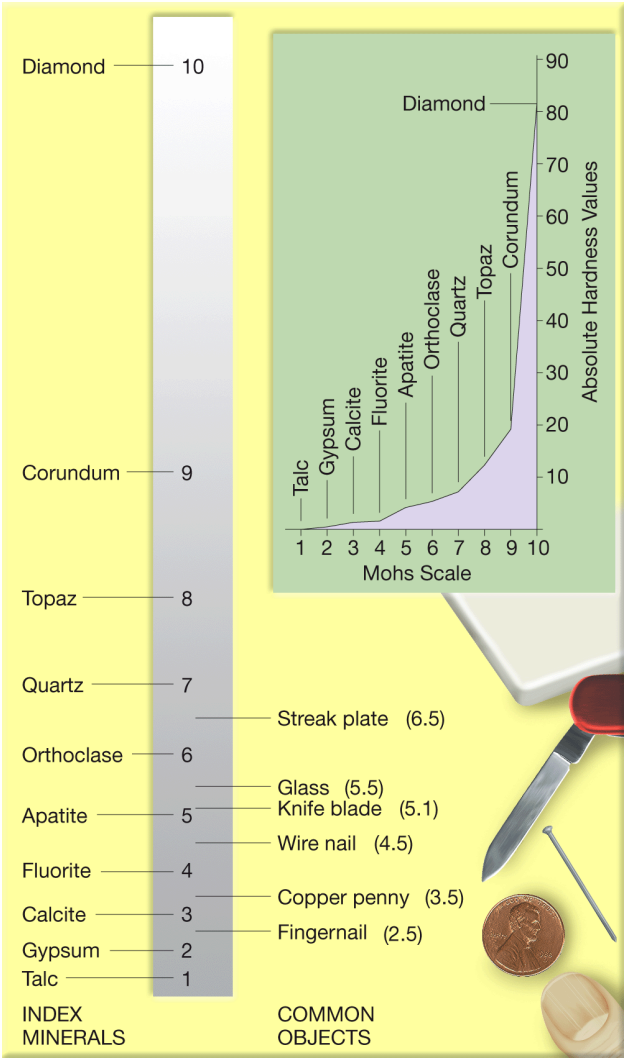
Quartz Often Exhibits Good Crystal Form.

2.3 Properties of Minerals

Hardness

- **Hardness** is a measure of the resistance of a mineral to being scratched.
- **Mohs scale** consists of 10 minerals arranged from 10 (hardest) to 1 (softest).

Mohs Scale of Hardness



2.3 Properties of Minerals

Cleavage

- **Cleavage** is the tendency of a mineral to cleave, or break, along flat, even surfaces.

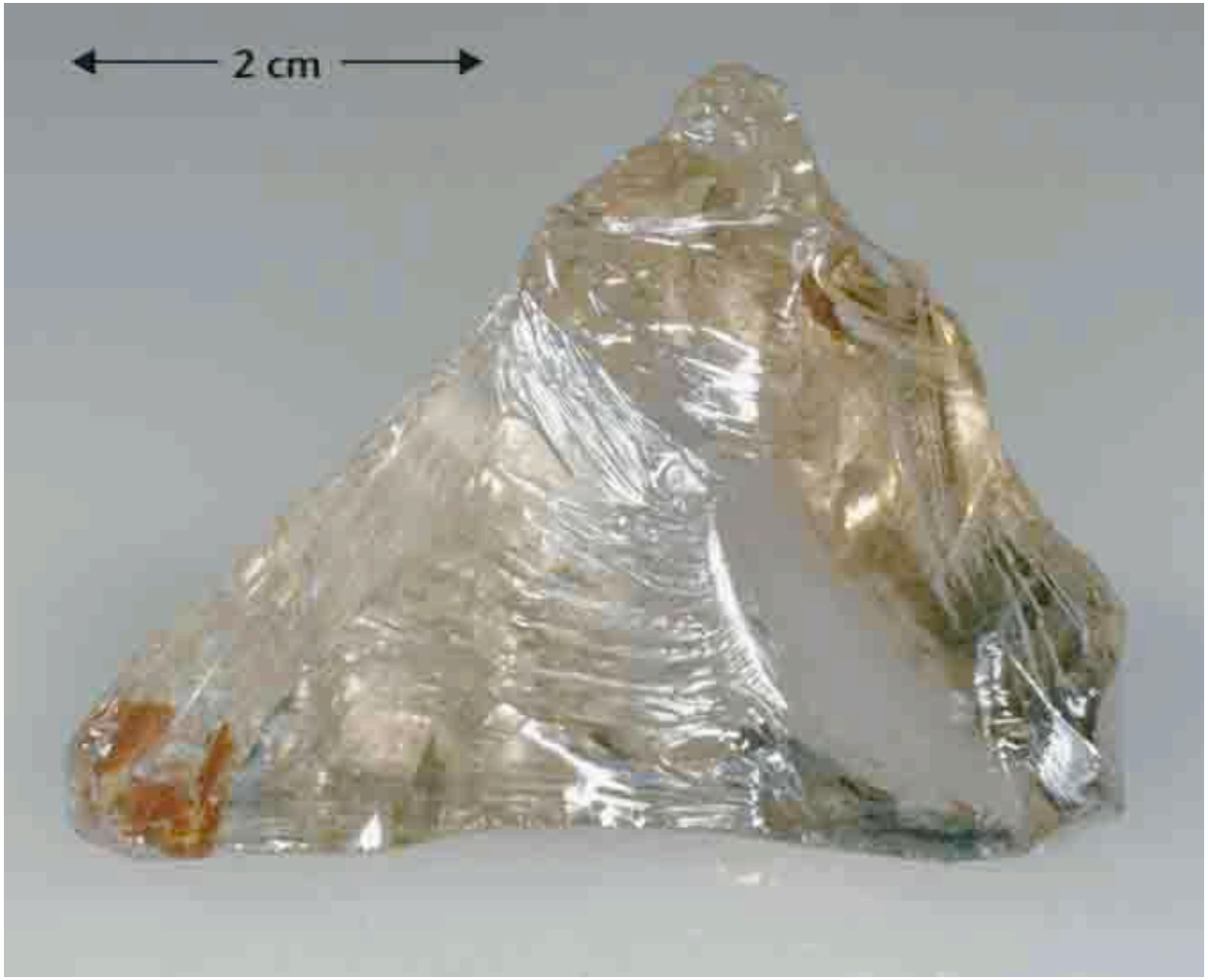
Mica Has Cleavage in One Direction

2.3 Properties of Minerals

Fracture

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

Conchoidal Fracture



2.3 Properties of Minerals

Density

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

2.3 Properties of Minerals

Distinctive Properties of Minerals

- Some minerals can be recognized by other distinctive properties.