Minerals: Formation and Groups

Formation from Magma

Study Tip

The longer the mineral is formed, the larger the crystals will be.

- **Magma** is the melted rock inside Earth.
  - Magma cools slowly inside Earth, giving mineral crystals enough time to grow large enough to be seen.
- When magma erupts, it is called **lava**.
  - Lava cools down faster than magma, thus crystals have little time to form and are very small.

Formation from Solutions

The Tufa Towers in Mono Lake were formed by calcium in the water.

- As water evaporates from solutions, it leaves behind mineral particles.
- Water can only hold a certain amount of dissolved particles. When there are too many minerals to stay dissolved in the water, the particles come together and form solids.
- Magma heats nearby underground water, which reacts with the rocks to pick up dissolved particles. As the water flows through the rock and cools, it deposits solid minerals.
  - The mineral deposits that form between cracks in rocks are called **veins**.

Formation from Pressure

Veins form when minerals are deposited into cracks in rock by water.

- Minerals can change form and even become entirely different minerals as pressure and temperature are changed.
- Each different form of a certain mineral is called a phase, and phase diagrams are used to describe the stability of phases as a function of temperature and pressure.

Mineral Groups

- Minerals are divided into groups based on their chemical composition.
- There are eight mineral groups:
    - **Silicate minerals** are the largest mineral group. The basic building blocks for these minerals are silica tetrahedrons.
        - Examples of silicate minerals are quartz and feldspar.
    - **Native elements** contain atoms of only one element. Only a small number of minerals are found in this category.
        - Examples of native elements are gold, silver, sulfur, and diamond.
    - **Carbonates** are formed when one carbon atom is bonded to three oxygen atoms.
        - An example of a carbonate is calcite ($CaCO_3$)
    - **Halide minerals** form when salt water evaporates. All halides are ionic minerals, and are soluble in water.
        - An example of a halide mineral is table salt.
    - **Oxides** contain one or two metal elements combined with oxygen.
        - An example of an oxide is magnetite (Fe_3O_4)
    - **Phosphates** have a similar atomic structure to silicate minerals. They are not particularly common.
        - An example of a phosphate is apatite, and it is one of the major components of the human bone.
    - **Sulfate minerals** contain sulfur atoms bonded to four oxygen atoms. They also form when salt water evaporates.
        - An example of a sulfate is gypsum.
    - **Sulfides** form when metallic elements combine with sulfur in the absence of oxygen.
        - An example of a sulfide is pyrite, also known as "fool's gold".

"Fool's gold", or pyrite, is a sulfide.

Concept Check

- What is the difference between magma and lava?
- What are the different ways that minerals can form?
- What are the eight main mineral groups?