Mineral

Mineralogy is one of the branches of geology, and it is one of the most important sources of geological inference. It deals with the study of the chemical composition, structure and properties of minerals, their appearance, stability and locations, and other accompanying minerals. We will present some of the minerals, which are the building blocks of rocks.

Geologists define a mineral: - It is a crystalline, inorganic solid, with a fixed or variable chemical composition that is found in nature. The mineral is the structural unit of rocks, which consists of groups of minerals that are homogeneous, and cannot be divided by mechanical means into smaller components. As for most rocks, they can be separated into their mineral components using appropriate means. A few rocks, such as limestone, contain one type of mineral, calcite, while there are other rocks, such as granite, that do not consist of one mineral, but rather a number of minerals. In order to know and classify the different types of rocks on Earth and how they were formed, we must study the minerals that make up them.

How metals are formed:

Minerals are formed by crystallization, where the components of atoms assemble with each other according to the correct chemical ratios and regular atomic arrangement, and the bonding of carbon atoms to each other appears in the diamond mineral, which is a mineral formed by covalent bonding - one of the examples of crystallization and crystal structure. The ions of sodium and chlorine that form sodium chloride, a metal formed by ionic bonding, which can also crystallize in regular rows in the three dimensions. The crystallization process begins when the temperature of the liquid drops to the freezing point of the liquid, and similarly when the magma, which is a molten rocky substance (hot and liquid), cools, solid minerals begin to crystallize from it. When the temperature of the magma drops below the melting point, which may be above 1,000 °C, crystals of silicate minerals such as olefin or feldspar begin to form.

There are also other processes that lead to crystallization of minerals during the sedimentation process, when liquids begin to evaporate from solutions. A solution is formed when a chemical is dissolved in another substance, such as salt in water. When the water begins to evaporate from the salt solution, the salt concentration increases until the solution becomes saturated with salt - that is, it cannot hold any more salt. If the evaporation continues, the salt begins to precipitate, meaning that it separates from the solution, forming crystals. The crystallization process begins with the formation of microscopic single crystals. Minerals are required to be made of inorganic materials, that is, they are not composed of organic materials that come from the bodies of plants and animals, as these organic materials are made up of organic carbon, which is one of the forms of carbon found in all organic materials.

The most common rock-forming minerals:

A - Silicates are the most common minerals in the earth's crust. They consist of oxygen and silicon, the two most common elements in the earth's crust and are combined with cations of other elements.

B - Carbonates, which are minerals composed of carbon and oxygen in the form of a carbonate ion combined with calcium and magnesium such as calcite.

C - Oxides, a group of oxygen compounds and metal cations such as hematite.

D - Sulfides, which are compounds of sulfide ion and metal cations, such as the mineral pyrite.

E - Sulfates, which are compounds of sulfate anion and metal cations, and include the mineral anhydrite.

Physical properties of minerals

Geologists use the chemical compositions and structure of minerals to understand the origin of the rocks these minerals are made of, and thus to understand the nature of the geological processes that operate within and above the Earth's surface. This understanding often begins in the field with attempts to identify and classify unknown minerals, where geologists rely on chemical and physical properties that can be observed fairly easily. Geologists from the nineteenth and early twentieth centuries used to carry the first chemical analysis tools for minerals in the field to help identify them. One such test is the use of dilute hydrochloric acid on the metal to see if it is fizzing. The effervescence indicates the escape of carbon dioxide, which means that the mineral is likely to be carbonate in composition.

1- Optical properties: These are properties that depend on light, such as luster, color, luminescence, transparency, and scratching.

2- Cohesive properties: These are properties that depend on the cohesion of the metal material and the duration of its elasticity, examples of which are hardness, cleavage, separation, brittleness, ductility and ductility.

3- Electromagnetic properties: electrical and magnetic properties, and these properties depend on electricity and magnetism, and examples are thermal electricity, piezoelectricity and magnetism.

4- Other properties: such as taste, texture, smell, and radioactivity.

Optical properties

1- **Luster**

It is the appearance shown by the surface of the mineral in the reflected light, or in other words it is the amount and type of light reflected from the surface of the mineral, and such minerals are opaque and heavy in weight like pyrite, while other types of luster are described as non-metallic. We note that minerals with nonmetallic luster are generally light in color. Examples of non-metallic luster are:

Vitreous of Glassy, such as the luster of glass, an example is the luster of quartz.

Diamond luster, like the luster of a flat diamond. Metals with high refractive indexes.

A resinous luster, similar to the mineral sulfur, sphalerite **Silky**,
like a type of gypsum known as satinbar.

Dull, depending on the amount of light reflected from the surface of the mineral, such as the luster of the mineral kaolin.

2- color

The color of the mineral results from the wavelength or light waves that are reflected from the mineral and affect the retina to give the sense of color. The color of the mineral is one of the first physical properties to be seen, and a very important means that helps to identify the mineral, despite what is known that the color is not an essential characteristic of the mineral. The color is often the result of strange impurities that happen to be present in the composition of the mineral. There are minerals that have a fixed color that helps in identification, such as sulfur (yellow), magnetite and malachite in (black), and cinnabar in (red).

3-**Luminescence**

The mineral is described as luminescent (gives light) and the luminescence results from exposure to heat, ultraviolet rays, X-rays, etc. The color of luminescence differs from the original color of the mineral, for example, some types of calcite give bright red colors when exposed to ultraviolet rays.

4- Transparency

This property expresses the ability of the metal to transmit light. The minerals that allow objects to be seen clearly and easily are known as transparent minerals. If the objects appear unclear, then the metal is considered translucent in this case. The opaque metal is the one that does not allow light to pass through it. Examples of opaque minerals are galena, graphite.

5- **Streak**

Streak the metal means the color of its fine powder. The color of the powder (Streak) can be easily known by rubbing the metal on the surface of a white matte porcelain plate known as the Streak plate, and noting the color of the resulting powder. Yellow, but with black Streak, black chromite with brown undertones.

Cohesive properties

1- Hardness

Hardness is a term that expresses the amount of resistance a mineral exhibits to scratching. The degree of hardness can be determined by noting the ease or difficulty with which the metal is scratched with a pin or the blade of a sharp knife. The hardness of the minerals ranges between that of the low grade of talc, which can be scratched by a fingernail, and that of the high grade of Diamond, which is the hardest known substance, whether it is natural or synthetic. Hardness is one of the important physical properties of metal, because it can be set quickly and thus helps identify the mineral. The hardness of the mineral can be determined by comparing it to the hardness of the minerals arranged according to the degree of their hardness in the hardness scale known as the Mohs's hardness scale, which contains ten minerals, starting with the least hard mineral, which is talc, and ending with the hardest mineral, which is diamond.

2- Cleavage

This is the property by which the mineral cleavages or cracks easily in certain directions, resulting in new surfaces known as cleavage levels, and these levels represent crystalline peaks, as the internal atomic arrangement of the crystal is what controls the formation and direction of these cleavage levels, It also controls the formation and orientation of the crystal faces. Cleavage always occurs at levels where the atoms are bound by a weak bond. The metal cleavages as a result of being knocked or pressed in a specific direction by the sharp blade of a knife.

There is, for example: 1- A cubic cleavage parallel to the faces of the cube, as in the minerals galita and halite.

Or 2- octahedral cleavage parallel to octahedral faces, as in the mineral fluorite.

or 3- cleavage parallel to the rhombic surfaces, as in the mineral calcite, or

4-a rhombic prismatic parallel to the surfaces of a prism as in augite,

Or 5- Alkaline parallel to the leading surfaces, as in mica minerals, and graphite minerals.

3- Separating

It is weak levels like cleavage, but it does not generally form as a result of the internal atomic structure of the metal, but rather as a result of other factors such as pressure or twinning. Since these levels, especially the twin levels, are parallel to the crystal levels, the separation is similar to schizophrenia. But the separation differs from cleavage in that the separation is not necessarily present in all samples of the same mineral, but is seen only in those crystals that are twin or have been subjected to appropriate pressure. An example of the basal separation in the minerals pyroxene and maknite.

4- Fracture

A fracture is defined as the type of surface resulting from the fracture of a mineral in a plane other than the level of cleavage. Where minerals that do not cleave easily give fracture, and the following adjectives are used to describe the different types of fracture.

Oyster: The broken surface resembles the inner shape of the conch shell, that is, it is in the form of stripes

Rough: When the resulting surface is dry and is diffuse among many minerals, such as barite.

Flat: When the crushed stone is almost smooth.

Serrated: When the surface resulting from the fracture has sharp, pointed teeth, such as the crushing of a piece of copper.

5- Tancity

It is the resistance shown by the metal towards knocking, breaking, grinding and bending, or in short, the cohesion of the metal. The following terms are used to describe the different types of metal cohesion.

BREAKABLE: The mineral breaks down into powder as easily as pyrite.

Malleable: When a mineral can be hammered into thin sheets, such as gold, copper, and silver.

Ductile: when a mineral can be drawn into wires, such as gold, copper, and silver.

Cutt able: When mineral can be cut into flakes it can be ground like gypsum.

Bendable: When the flakes of metal can be bent by pressure, in which case the metal does not return to its original form if the pressure is removed, such as chlorite, and graphite.

Flexible: When the flakes of metal can be bent by pressure, but as soon as the pressure is gone, the metal is restored. Its original form is biotite and muscovite.