

(2)Contact Metasomatic Ore Deposits:

Metasomatism: A process of alteration of rocks due to interaction with volatile-aqueous solutions resulting in the formation of new minerals that take the place of the older ones. The chemical composition of the rocks modify because new substance are transferred from the solution to the altered rocks and the originally present substances are partly or wholly removed from the rocks and dissolved in solution. This process occurs near igneous intrusion (**laccolith and dikes**) where large quantities of high-temperature fluid emanation (**concentrated during and after the last stage of magma consolidation**) may escape into the surrounding rocks.

- **Effects of the igneous emanation**: These effects divided into two types:

1- The effect of heat along giving rise to contact metamorphism, during which some non-metallic ores may form such as; sillimanite, apatite, kyanite, graphite.

Contact metamorphism manifests itself by:

a- Endogene (internal) effects upon the margins of the magmatic body itself. These effects consist of textural and mineral changes in the margin (epidote, tourmaline, garnets may be present).

- **b- Exogene (external) effects** upon the rocks surrounding the igneous body. This process causes hardening and transformation of the surrounding rocks. Old minerals are broken up, and their ions are recombine to form new minerals that are stable at the present temperature & pressure.

Example: In an impure limestone consisting of calcium carbonate with little Mg, Fe, quartz and clay. The **CaCO₃** break down into: **CaCO₃ → CaO + CO₂**↑ then the components recombined and recrystallized into silicate minerals as follow:

CaO + quartz → wollastonite ; **Dolomite + quartz + H₂O → tremolite**

Dolomite + quartz + H₂O + Fe → actinolite ; **Calcite + clay + quartz → garnet**

2- The effects of heat combined with accessions (usually metals, silica, sulfur, boron, chlorine, fluorine, K, Mg, and some Na) from the intruded igneous body giving rise to contact metasomatism, during which a valuable metallic ores may form in the alteration halo such as; **pyrite, chalcopyrite, magnetite, hematite, galena.**

- In this process, **new minerals** formed replacing the **old ones**, most of their constituents derive from the magma intrusion, and if the magma is rich with some economic variable elements, a **metasomatic ore will form**. The formed minerals arrange in zones reflecting the gradual decrease of temperature with increasing distance from the igneous intrusion.

- **Stages of Formation of Metasomatic ores:**

- The first stage give rise to a **complex silicate minerals**.

- Magnetite and hematite form with the silicates and sometimes later than them.

- The **sulfides formed later than the silicates** and oxides. They are arranged in common order starting with pyrite and ending with sulfo-salt as below:

- **Pyrite & arsenopyrite** (first)

- **Pyrrhotite**

- **Molybdenite**

- **Sphalerite**

- **Chalcopyrite**

- **Galena**

- **Sulfosalt** (last)