Definition of Minerals

Minerals are natural inorganic substances possessing definite chemical compositions and atomic structures.

However, many minerals exhibit isomorphism where substitution of atoms within the crystal structure by similar atoms takes place without affecting the atomic structure.

Example: Olivine has the chemical composition $(Mg, Fe)_2SiO_4$ but the ratio of Mg atoms to Fe atoms varies in different olivines. The total number of Mg and Fe atoms in all olivines, however, has the same ratio to that of the Si and O atoms.

Polymorphism

Minerals can also exhibit polymorphism, different minerals having the same chemical composition, but markedly different physical properties due to a difference in crystal structure.

Example: Graphite and diamond have exactly the same chemical composition, being composed entirely of carbon atoms, but have widely different properties due to the arrangements of carbon atoms within the crystal lattice.

The term ‘mineral’ is often used in a much more extended sense to include anything of economic value which is extracted from the earth.

Thus coal, chalk, clay and granite do not come under the definition of minerals, although details of their production are usually included in national figures for mineral production.

Such materials are in fact rocks which are not homogeneous in chemical and physical composition, as are minerals, but generally consist of a variety of minerals and form large parts of the earth's crust.

Example: Granite is an igneous rock formed by cooling of molten material, or magma, is composed of three main mineral constituents feldspar, quartz and mica. These three homogeneous mineral components occur in ranging proportions in different parts of the same granite mass.

Coal has various forms like peat, lignite, bituminous, sub-bituminous, anthracite.

Eight elements account for over 99% of the earth's crust; 74.6% is silicon and oxygen, and only three of the industrially important metals (aluminium, iron and magnesium) are present in amounts above 2%.

All the other useful metals occur in amounts below 0.1%; copper for example, which is the most important non-ferrous metal, occurring only to the extent of 0.0055%.

If the minerals containing the important metals were uniformly distributed throughout the earth, they would be so thinly dispersed that their economic extraction would be impossible.

However, the occurrence of minerals in nature is regulated by the geological conditions throughout the life of the mineral.

Due to the action of many natural agencies, mineral deposits are frequently found in sufficient concentrations to enable the metals to be profitably recovered.

It is these concentrating agencies and the development of demand as a result of research and discovery which convert a mineral deposit into an ore.

Most ores are mixtures of extractable minerals and extraneous rocky material described as gangue.

They are frequently classed according to the nature of the valuable mineral

Native ores- metal is present in the elementary form.

Complex ores- contain profitable amounts of more than one valuable mineral.

Sulphide ores- contain the metal as sulphides.

Oxidized ores- valuable mineral may be present as oxide, sulphate, silicate, carbonate, or some hydrated form of these.

Ores are also classified by the nature of their gangues, such as calcareous or basic (lime rich) and siliceous or acidic (silica rich).

Definition of Ores

An ore can be described as an accumulation of mineral in sufficient quantity as to be capable of economic extraction.

The minimum metal content (grade) required for a deposit to qualify as an ore varies from metal to metal.

Gold may be recovered profitably in ores containing only 5 parts per million (ppm) of the metal, whereas iron ores containing less than 15% metal are regarded as low grade.

A deposit will be economic to work and can be classified as an ore deposit if:

Contained value / t > (total processing costs + losses + other costs) / t

Total Processing Cost – geological exploration

mining

mineral Processing

metallurgical extraction