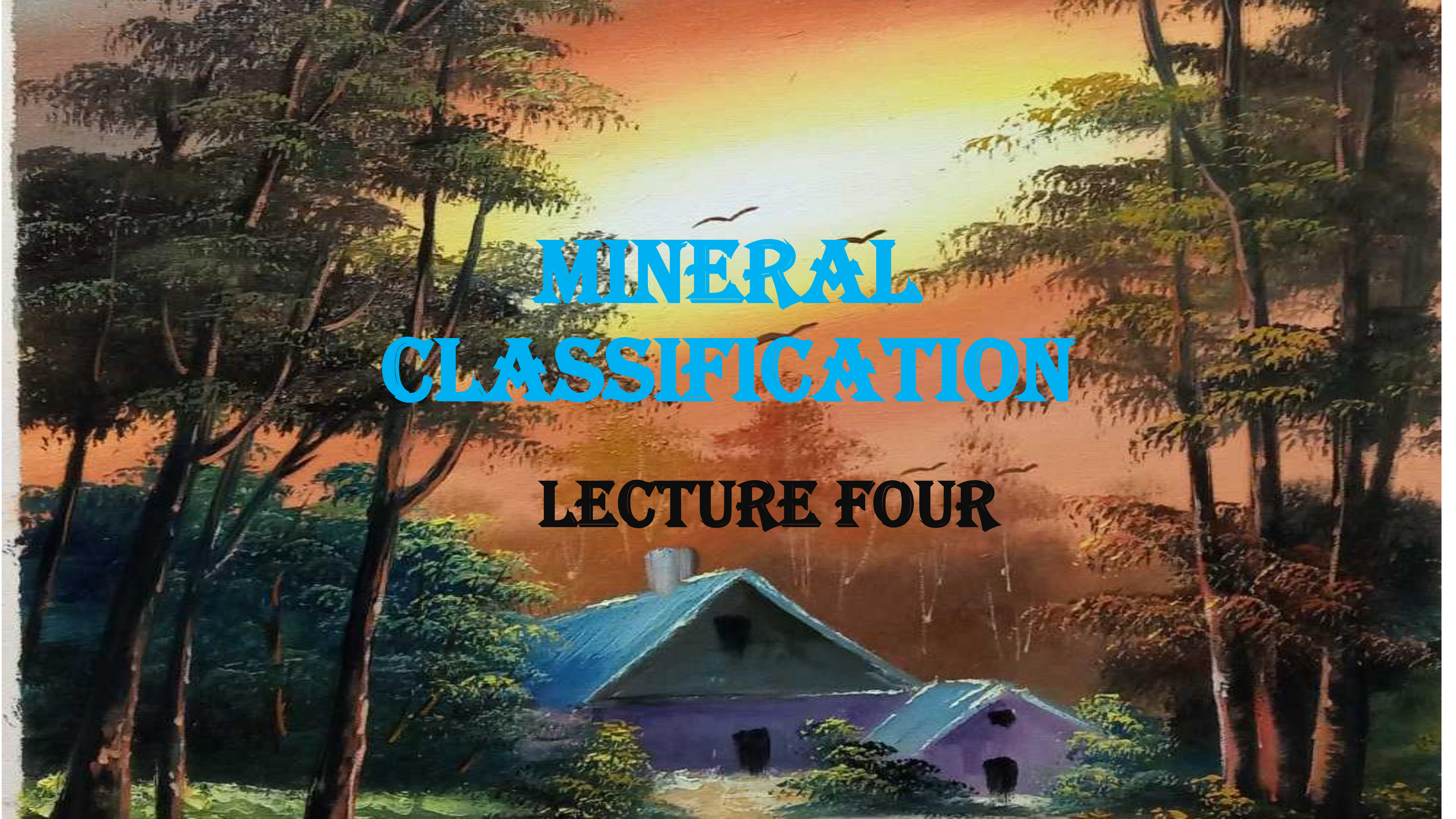
University of Anbar
Collage of Science
Department of Geology
Minerals / 1st stage.

MINERAL CLASSIFICATION

Assistant lecturer
Nazar Zaidan Khalaf



MINERAL CLASSIFICATION

LECTURE FOUR

• Classification Of Minerals

- Since the middle of the 19th century, minerals have been classified on the basis of their chemical composition. they are divided into classes according to their dominant anion or anionic group (e.g., halides, oxides, and sulfides). Several reasons justify use of this criterion as the distinguishing factor at the highest level of mineral classification. First, the similarities in properties of minerals with identical anionic groups are generally more pronounced than those with the same dominant cation. For example, carbonates have stronger resemblance to one another than do copper minerals.

- Secondly, minerals that have identical dominant anions are likely to be found in the same or similar geologic environments. Therefore, sulfides tend to occur together in vein or replacement deposits, while silicate-bearing rocks make up much of Earth's crust. Third, current chemical practice employs a nomenclature and classification scheme for inorganic compounds based on similar principles.

- Investigators have found, however, that chemical composition alone is insufficient for classifying minerals. Determination of internal structures, accomplished through the use of X rays, allows a more complete appreciation of the nature of minerals. Chemical composition and internal structure together constitute the essence of a mineral and determine its physical properties; thus, classification should rely on both. Crystallochemical principles—i.e., those relating to both chemical composition and crystal structure—were first applied by the British physicist W. Lawrence Bragg and the Norwegian mineralogist Victor Moritz Goldschmidt in the study of silicate minerals.

Mineral Classification

Minerals are classified by their chemical composition and internal crystal structure.

There are 7 Major Mineral Groups:

- Native Elements
- Halides
- Carbonates
- Oxides
- Sulfates
- Sulfides
- Silicate

Native Elements

- Native elements are minerals that are composed of a single element.
- Some examples are: Gold (Au), Silver (Ag), Copper (Cu), Iron (Fe), Diamonds (C), Graphite (C), and Platinum (Pt)

Gold mineral

diamond mineral

Halides

- Halides consist of halogen elements, chlorine (Cl), bromine (Br), fluorine (F), and iodine (I) forming strong ionic bonds with alkali and alkali earth elements sodium (Na), calcium (Ca) and potassium (K)
- Some examples include Halite (NaCl) and Flourite (CaF_2).

Carbonates

- Carbonates are anionic groups of carbon and oxygen. Carbonate minerals result from bonds between these complexes and alkali earth and some transitional metals
- Common carbonate minerals include calcite $CaCO_3$, calcium carbonate, and dolomite $CaMg(CO_3)_2$, calcium/magnesium carbonate
- Carbonate minerals react when exposed to hydrochloric acid. Geologist will often carry dilute hydrochloric acid in the field to test if a mineral contains calcium carbonate. If the mineral fizzes when it comes in contact with the hydrochloric acid it contains calcium carbonate. Some cola soft drinks can also be used for this test because it contains enough hydrochloric acid to react with calcium carbonate.

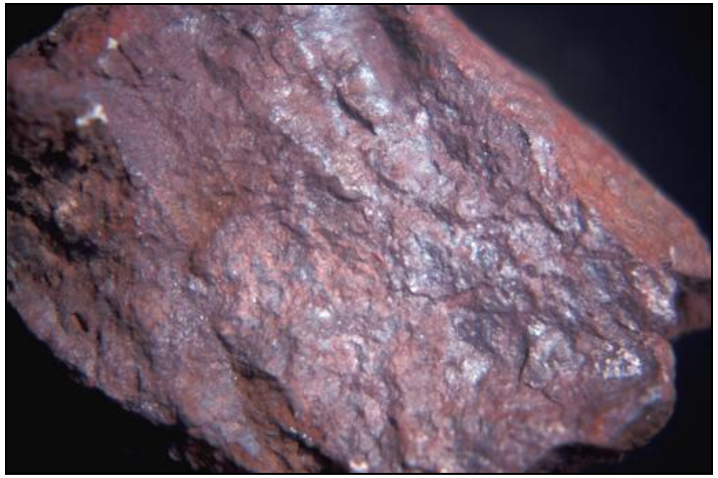
Dolomite

Calcite

Oxides

- Oxides are minerals that include one or more metal cations bonded to oxygen or hydroxyl anions.
- Examples of oxide minerals include: Hematite (Fe_2O_3), Magnetite (Fe_3O_4), Corundum (Al_2O_3), and Ice (H_2O)

Hematite



Sulfates

- Sulfates are minerals that include SO_4 anionic groups combined with alkali earth and metal cations.
- Anhydrous (no water) and hydrous (water) are the two major groups of Sulfates.
- Barite ($BaSO_4$) is an example of a anhydrous sulfate and Gypsum ($CaSO_4 \cdot 2H_2O$) is an example of a sulfate.

Table of Contents

Sulfides

- The sulfide minerals are a class of minerals containing sulfide (S^{2-})or persulfide (S_2^{2-})as the major anion. Some sulfide minerals are economically important as metal ores. The sulfide class also includes the selenides, the tellurides, the arsenides, the antimonides, the bismuthinides, the sulfarsenides and the sulfosalts. Common or important examples include: Galena PbS, Chalcopyrite CuFeS2 and Pyrite FeS2.

Galena

chalcopyrite

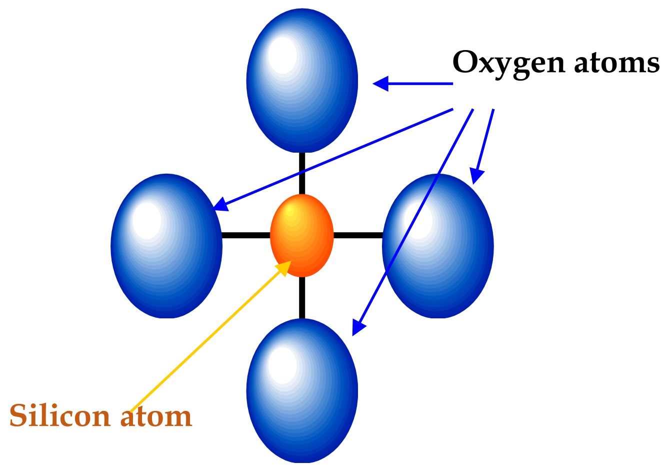
Pyrite

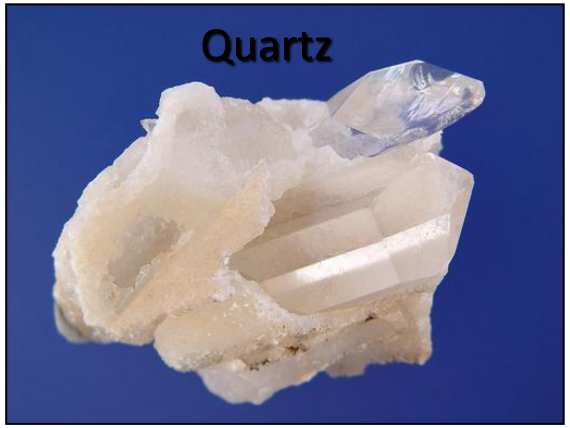
Silicates

- Silicates are composed of silicon-oxygen tetrahedrons, an arrangement which contains four oxygen atoms surrounding a silicon atom (SiO_4^{-4}).
- Silicates are often divided into two major groups: ferromagnesian silicates and non-ferromagnesian silicates
  - Ferromagnesian silicates contain iron or magnesium ions joined to the silicate structure. They are darker and have a heavier specific gravity than non-ferromagnesian silicate minerals.
  - Ferromagnesians include minerals such as olivine, pyroxene, hornblende, and biotite
  - Non-ferromagnesians include muscovite, feldspar, and quartz

- Silicates comprise the majority of minerals in the Earth's crust and upper mantle. Over 25% of all minerals are included in this group, with over 40% of those accounting for the most common and abundant minerals.
- Feldspar, Quartz, Biotite, and Amphibole are the most common silicates

Silicon-oxygen tetrahedron ($SiO4-4$)





REFERENCES

- S. K. HALDAR &JOSIP TISLJAR 2013, INTRODUCTION TO MINERALOGY AND PETROLOGY - Elsevier 225 Wyman Street, Waltham, MA 02451, USA Publishers . 341 p.
- Blackburn, W.H. and Dennen, W.H., 1988, Principles of Mineralogy: Iowa, WCB Publishers . 413 p.
- ابراهيم مضوي بابكر. ٢٠٠٤. علم المعادن، جامعة النيلين، كتاب منشور. ٢٣٢ ص