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

NATIVE ELEMENTS MINERALS

Assistant lecturer
Nazar Zaidan Khalaf

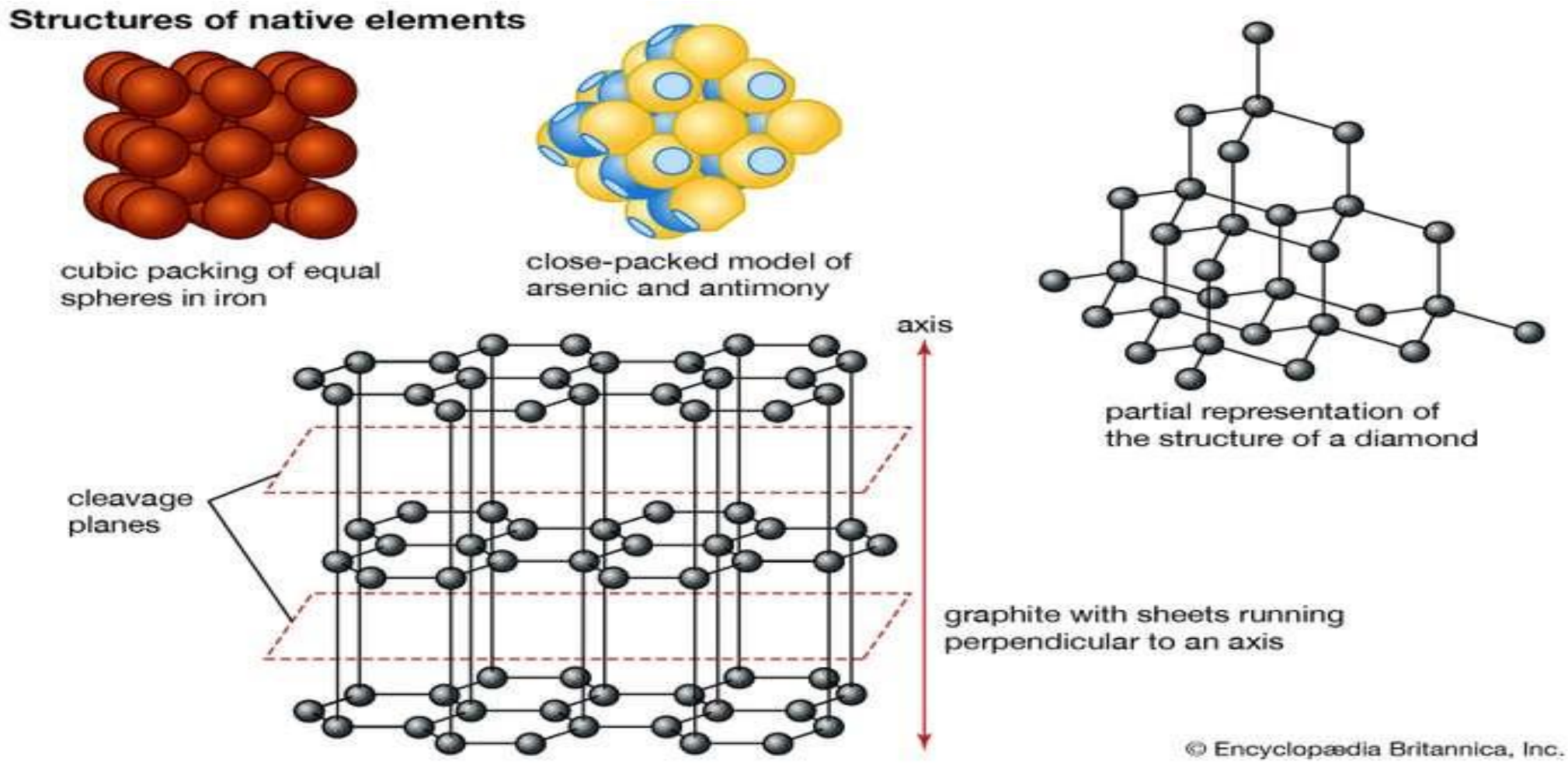
NATIVE ELEMENTS MINERALS

LECTURE FIVE

NATIVE ELEMENTS MINERALS

- Any of number of chemical elements that may occur in nature uncombined with other elements. The elements that occur as atmospheric gases are excluded.

Native element minerals.



Native Elements Minerals

- Apart from the free gases in Earth's atmosphere, some 20 elements occur in nature in a pure (i.e., uncombined) or nearly pure form. Known as the native elements, they are partitioned into three families:
- metals
- semimetals
- nonmetals .

- The most common native metals, which are characterized by simple crystal structures, make up three groups:

1-**The gold group**, consisting of gold, silver, copper, and lead;

2-**The platinum group**, composed of platinum, palladium, iridium, and osmium

3-**The iron group,** containing iron and nickel-iron. Mercury, tantalum, tin, and zinc are other metals that have been found in the native state.

Metals

Gold group

Gold	Au
Silver	Ag
Copper	Cu

Platinum group

Platinum	Pt

Iron group

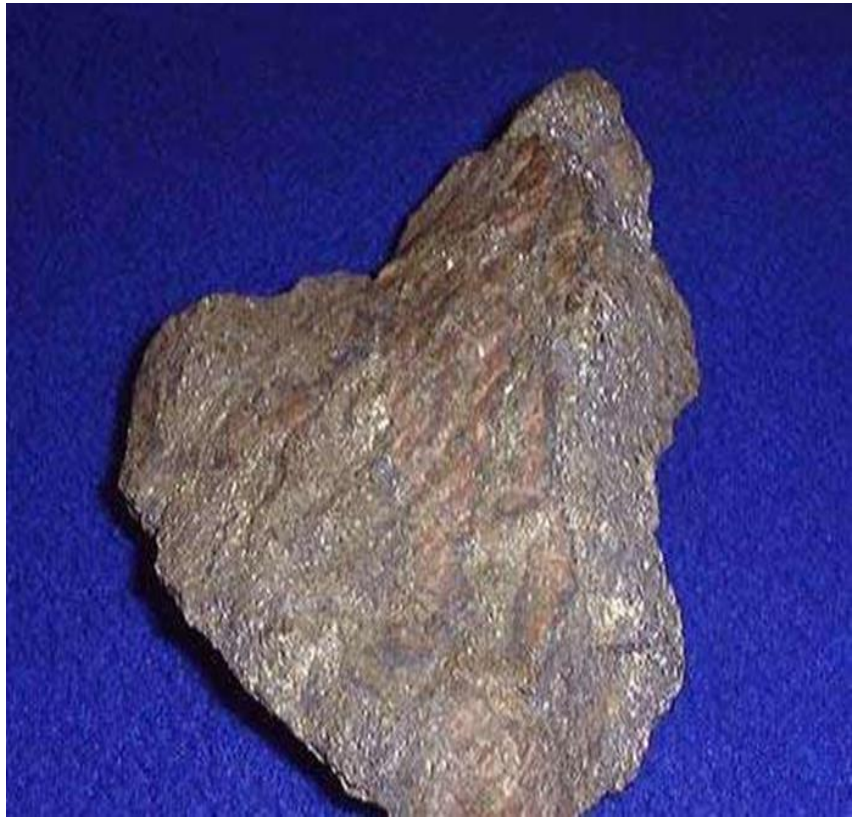
Iron	Fe
(kamacite	Fe, Ni)
(taenite	Fe, Ni)

- ***Semimetals***
- **Arsenic group**
- Arsenic As
- Bismuth Bi

- **Nonmetals**
- Sulfur S
- Diamond C
- Graphite C

• Metals

- Gold, silver, and copper are members of the same group (column) in the periodic table of elements and therefore have similar chemical properties. In the uncombined state, their atoms are joined by the fairly weak metallic bond. These minerals share a common structure type, and their atoms are positioned in a simple cubic closest-packed arrangement. Gold and silver both have an atomic radius of 1.44 angstroms (Å), or 1.44 × 10− 7 millimeter, which enables complete solid solution to take place between them. The radius of copper is significantly smaller (1.28 Å), and as such copper substitutes only to a limited extent in gold and silver. Likewise, native copper contains only trace amounts of gold and silver in its structure.



sample of gold ore

- Because of their similar crystal structure, the members of the gold group display similar physical properties. All are rather soft, ductile (capable of being drawn into wire), malleable (capable of being shaped by a hammer or rollers), and sectile (capable of being cut smoothly by a knife or other instrument); gold, silver, and copper serve as excellent conductors of electricity and heat and exhibit metallic luster and hackly fracture (a type of fracture characterized by sharp jagged surfaces). These properties are attributable to their metallic bonding. The gold-group minerals crystallize in the isometric system and have high densities as a consequence of cubic closest packing.
- In addition to the elements listed above, the platinum group also includes rare mineral alloys such as iridosmine. The members of this group are harder than the metals of the gold group and also have higher melting points.

- The iron-group metals are isometric and have a simple cubic packed structure. Its members include pure iron, which is rarely found on the surface of Earth, and two species of nickel-iron (kamacite and taenite), which have been identified as common constituents of meteorites. Native iron has been found in basalts of Disko Island, Greenland and nickel-iron in Josephine and Jackson counties, Oregon. The atomic radii of iron and nickel are both approximately 1.24 Å, and so nickel is a frequent substitute for iron. Earth's core is thought to be composed largely of such iron-nickel alloys

- **Semimetals**
  - The semimetals antimony, arsenic, and bismuth have a structure type distinct from the simple-packed spheres of the metals. In these semimetals, each atom is positioned closer to three of its neighboring atoms than to the rest. The structure of antimony and arsenic is composed of spheres that intersect along flat circular areas.

Arsenic (gray) with realgar (red) and orpiment (yellow)

- The covalent character of the bonds joining the four closest atoms is linked to the electronegative nature of the semimetals, reflected by their position in the periodic table. Members of this group are fairly brittle, and they do not conduct heat and electricity nearly as well as the native metals. The bond type suggested by these properties is intermediate between metallic and covalent; it is consequently stronger and more directional than pure metallic bonding, resulting in crystals of lower symmetry.

- **Nonmetals**
- The native nonmetals diamond, fullerene, graphite, and sulfur are structurally distinct from the metals and semimetals. The structure of sulfur (atomic radius = 1.04 Å), usually orthorhombic in form, may contain limited solid solution by selenium (atomic radius = 1.16 Å).

diamond

- The polymorphs of carbon—graphite, fullerene, and diamond—display dissimilar structures, resulting in their differences in hardness and specific gravity. In diamond, each carbon atom is bonded covalently in a tetrahedral arrangement, producing a strongly bonded and exceedingly close-knit but not closest-packed structure. The carbon atoms of graphite, however, are arranged in six-membered rings in which each atom is surrounded by three close-by neighbours located at the vertices of an equilateral triangle. The rings are linked to form sheets, called graphene, that are separated by a distance exceeding one atomic diameter. Van der Waals forces act perpendicular to the sheets, offering a weak bond, which, in combination with the wide spacing, leads to perfect basal cleavage and easy gliding along the sheets..

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