Benha University **Examination of the Rock Forming Minerals (230 G) for the** **Date: 29 / 5 /2019**

Faculty of science **2nd Level students (Biotechnology), June. 2019** **Time: Two Hours**

Geology Dept.

1- Write about the following points: (Each point 8 marks) (48 Marks)

1. Silicate structures.

A. The silicon tetrahedron: Silicon (Si^{+4}) is typically surrounded by four oxygen atoms (O^{-2}) to form a stable silicon tetrahedron (SiO_4). This geometric structure is very strong, because the tiny silica atom nestles perfectly between four large oxygens, covalently bonded to each. On the other hand, this structure results in an excess charge of -4.

One or more of the oxygens are often "shared" by adjacent silica tetrahedra, reducing the charge difference.

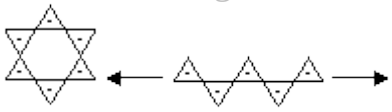
2 tetrahedra not sharing oxygen:	SiO_4	-8
2 tetrahedra sharing one oxygen:	Si_2O_7	-6
2 tetrahedra sharing two oxygens:	SiO_3	-4
2 tetrahedra sharing 3 oxygens:	Si_2O_5	-2
tetrahedra sharing all 4 oxygens:	SiO_2	charge balanced

To balance the remaining charge, metals cations, commonly Mg^{+2}, Fe^{+2}, Ca^{+2}, Na^{+1}, K^{+1}, and Al^{+3}, are added by ionic bonding.

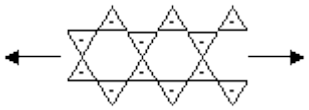
In the following list of structures I have "greyed-out" the ones that we are not talking about in GEOL-111. I have highlighted the structure terms that we are using.

B. Silicate structures: **basic unit:** **mineral examples:**

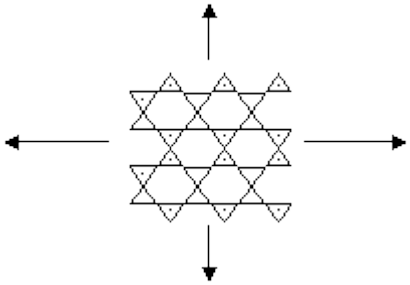
1. Nesosilicates: independent tetrahedra SiO_4 olivine, garnet
2. Sorosilicates: linked by one oxygen Si_2O_7 epidote
3. Cyclosilicates: rings of tetrahedra Si_xO_{3x} beryl



4. Inosilicates: single chains SiO_3 pyroxenes



double chains Si_4O_{11} amphiboles



5. Phyllosilicates: sheet silicates Si_4O_{10} micas, clays

6. Tectosilicates: framework silicates SiO_2 quartz
3-D (not draw-able) $AlSi_3O_8$ feldspars

2. Olivine group.

If the corner oxygens are not shared with other $SiO4^{-4}$ tetrahedrons, each tetrahedron will be isolated.

Thus, this group is often referred to as the island silicate group. The basic structural unit is then $SiO4^{-4}$.

In this group the oxygens are shared with octahedral groups that contain other cations like Mg^{+2}, Fe^{+2}, or Ca^{+2}.

Olivine is a good example: $(Mg,Fe)_2SiO4$.

The olivines consist of a complete solid solution between Mg_2SiO_4 (forsterite, Fo) and Fe_2SiO_4 (fayalite, Fa). There is limited substitution of the following end members:

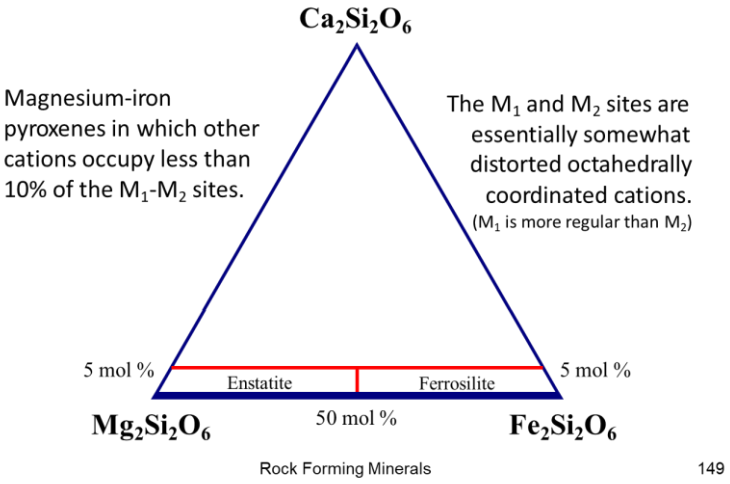
Ca_2SiO_4 – larnite

Mn_2SiO_4 – tephroite

$CaMgSiO_4$ - monticellite (which is commonly found in metamorphosed dolomites)

Also found substituting in octahedral sites are Ni^{+2} and Cr^{+3}, particularly in Mg- rich olivines.

3. Orthopyroxenes.



- Enstatite $MgSiO_3$
- Hypersthene $(Mg, Fe)SiO_3$
- Orthoferrosilite $Fe\ SiO_3$
- These consist of a range of compositions between enstatite - $MgSiO_3$ and
- ferrosilite - $FeSiO_3$

4. Silica minerals.

- Hexagonal, xtals commonly prismatic with prism faces and horizontal striated. Twins are common.
- Conchoidal fracture, vitreous lustre with some specimens greasy. Usually, colourless or white but frequently coloured by impurities →→ can be any colour.

• Microcrystalline varieties; Fibrous vs Granular

- Fibrous varieties

❖ Chalcedony → brown to grey, translucent, waxy, deposited from aqueous solution and found lining or filling cavities in rocks

D Carnelian → red that grades into brown sard

D Chrysoprase → apple green due to Ni-oxide

D Agate → alternating layers of chalcedony with different colour and porosity.

D Onyx → black & white agate

D Sardonyx → onyx with sard alternating

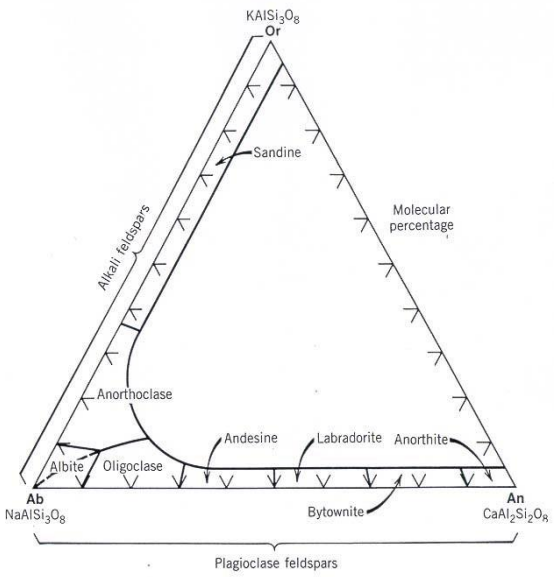
D Bloodstone → green chalcedony with red spots of jasper

D Petrified wood, silicified wood → SiO_2 replacement.

- Qtz is common and abundant minerals occuring in diversity of environment. Present in Igneous & metamorphic rocks, major constituent of granite pegmatites. It is the most common gangue mineral in HD and metal-bearing veins.
- Flint & chert → qtz deposits on sea floor with enclosing rock or SiO_2 solution replaced limestone to form chert horizon
- Use widely as gemstones. Qtz sands is used in mortar, concrete, as a flux, abrasive and manufacture of glass and silica brick. In powdered form, it is used in porcelain, paints, sandpaper, scouring soaps and as a wood filler. In quartzite form, it is used as a building stone and paving purposes
- Qtz is also used in scientific instruments → qtz lenses & qtz prism, qtz wedge in polarizing microscope
- Qtz has piezoelectricity property thus using as oscillators in radios, watches and pressure gague

5. Plagioclase feldspars.

- Plagioclases are triclinic
- Their a-b and b-c angles are a bit more oblique than microcline
- Hence the name: *plagio*-, oblique and *clase*, break
- **Albite**
  - An_{0-10} - Found only in very sodic rocks, hence usually metamorphic or formed in marine conditions as a sedimentary cement, or by ion exchange with more calcic plagioclase.
- **Oligoclase**
  - An_{10-30} - The dominant plagioclase in granitic rocks
- **Andesine**
  - An_{30-50} - Found in intermediate igneous rocks
- **Labradorite**
  - An_{50-70} - The dominant plagioclase in gabbro and basalt. Also, despite their name, most anorthosites are made up of labradorite.
- **Bytownite**
  - An_{70-90} - The rarest. Requires both a lot of calcium and also significant sodium. Most igneous settings have too much sodium, most calc-silicate metamorphic settings have too little sodium.
- **Anorthite**
  - An_{90-100} - Generally a metamorphic mineral in calc-silicate rocks.



- Since Na and Ca differ in valence, Al has to substitute for Si to compensate
- The Al-Si orderings of albite and anorthite are different, and at low temperatures, plagioclases in the middle of the composition range also exsolve, but on a submicroscopic scale
- These submicroscopic textures are probably responsible for the iridescence of some plagioclases.
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6. Halite group.

Commonly known as rock salt, is a type of salt, the mineral (natural) form of sodium chloride (NaCl). Halite forms isometric crystals. The mineral is typically colorless or white, but may also be light blue, dark blue, purple, pink, red, orange, yellow or gray depending on inclusion of other materials, impurities, and structural or isotopic abnormalities in the crystals. It commonly occurs with other evaporite deposit minerals such as several of the sulfates, halides, and borates. The name halite is derived from the Ancient Greek word for salt.

- **Sedimentary rock and sediment**
  - **Sedimentary rock**
    - **Biochemical and chemical sedimentary rock**
      - **Evaporite**
        - **Gypsum-stone**
          - Halite gypsum-stone
        - **Halite-stone**
        - **Sylvite-stone**

-Good Luck-

Prof. Dr. A. M. Mehanna

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Examination of the Principles of Petrology Rocks (232 G) for the 2nd Level students (Geology and Geophysics), June. 2019

Date: 2 /6 /2019
Time: Two Hours

(Principles of Igneous and Metamorphic Petrology)

1- Write about the following points: (Each point 4 marks) (32 Marks/80 minutes)

1. Pyrosphere.
2. Granularity.
3. Directive textures.
4. Genetic classification of igneous rocks.
5. Granitic rocks.
6. Ultramafic rocks
7. Metamorphic textures.
8. Metamorphism.

-Good Luck-

Prof. Dr. A. M. Mehanna

Part 2: Principles of Sedimentary petrology (40 minutes – 16 marks)

Question 1 # **(7 marks)**

Define the following

1- Rudite
2- Peloids
3- Fissility
4- Psammite
5- Sorting
6- Paraconglomerate
7- Hybrid sandstone

Question 2 # **(9 marks)**

Write on the following

A- The evaporites, their mineralogy and formation in sea water and saline lakes.
B- The commonest minerals found in sedimentary rocks.
C- The Folk's (1962) classification of limestones depending on the texture.

Best wishes