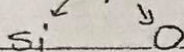


Minerals "building block of Rock"

Minerals: naturally occurring inorganic solid that possesses an orderly crystalline structure and a well-defined chemical composition



Rock: Solid mass of mineral (Aggregate of minerals)

* A few rocks are composed of one mineral (Mono)

ex: salt, Halite ex. limestone, which consist of mineral calcite

* Most Rocks occur as Aggregate of minerals (Poly)

ex. Granite

Minerals consist of several elements.

Ex: Gold, Sulphur consist from one element.

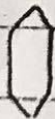
Properties of Minerals

Physical properties

* Crystal Forms: the external expression of orderly internal arrangement of atoms



cubic → ex. pyrite (fool's gold)



hexagonal with pyramid end → ex. Quartz

* Luster: the prop. of Reflection the light.

* metallic luster Galena, Hematite ex. (pyrite)

* non-metallic luster معدن لؤلؤ لم يعكس عليها الضوء

↳ (glassy, pearly, Silky, dull)
quartz (زجاجي), لؤلؤي, حريري, باهت
{ اري التراب والرفقة

* Colour: simply the colour of a sample.

Many Minerals varieties appear as different colours ⇒ not reliable prop.

* streak: the colour of minerals powder

في حالة البودر.

* Hardness: the resistance of minerals to be scratched by another mineral.

Moho's scale of Hardness:

Relative scale	Mineral
1	Talc → softest
2	Gypsum
2.5	Finger nail
3	calcite, copper penny (3-5)
4	Fluorite, limestone
5	Apatite
5.5	Glass and (knife blade)
6	potassium Feldspar
6.5	streak plate

7	Quartz SiO_2
8	Topaz
9	corundum
10	Diamond \rightarrow Hardest

Q: what are two ~~elements~~ minerals your finger nail can scratched?

Ans: Talc and Gypsum

* cleavage: tendency of a mineral to break along ~~rough~~ ^{smooth} even faces or surfaces.

very smooth \rightarrow ex. Mica [weak bonds \rightarrow form thin, flake sheet]

* Fracture: tendency of a mineral to break along rough, uneven faces or surface.

ex. Quartz cleavage just

* Specific Gravity: $\left(\frac{S.G}{G.S}\right)$ the ratio between a certain volume of mineral and water. for Rock it is (2.5 - 3)

$3 \times 9.81 \leftarrow$

Galena $\Rightarrow 7.5$

24-carat Gold $\Rightarrow 20 \rightarrow$

* Fluorite, Halite and calcite show a perfect cleavage.

* Quartz with a conchoidal fracture does not have cleavage (Fracture).

Some other properties :

* Taste of NaCl ملح

* Elasticity: Mica قابلة للشد والشد

* Malleability: Gold قابلة للطرق والشد بواسطة اليد
أو بالآلة

* Feel (الملمس): Talc → soapy

Graphite → (greasy) زلق

* chemical Reaction with HCl ex. limestone

* double refraction ex. calcite.

Questions :

* List five characteristics an Earth material should have in order to be considered a mineral.

* why might it be difficult to identify a mineral by its colour??

Mineral Groups:

There are more than (4000) minerals, but only (8) elements compose 98% by weight of the continent crust (Rock forming minerals)

* The most two abundant elements are:

oxygen (46.6%) silicon (27.7%)

which can combine together to form the most common mineral Group (silicate)

Form from magma or lava (molten rock) ←

* the next common mineral Group is (Carbonate)

in which Calcite is most prominent group.

* Other Groups: Gypsum, halite

Element	% by weight
O^{-2}	46.6
Si^{+4}	27.7
Al^{+3}	8.1
Fe^{+2}	5
Ca^{+2}	3.6
Na^{+1}	2.8
K^{+1}	2.6
Mg^{+2}	2.1
others	1.5

الظروف اللازمة للحفظ :-

إن معظم الأصداء القديمة تحفظت وتحتلت بعد موتها دون أن تترك أي أثر، بينما نسبة ضئيلة جداً (تصلح لها ظروف الحفظ وحفظتها بها إما في الصخور الرسوبية، وهناك شروط الحفظ الجيولوجية يجب توافرها حتى تتم عليه الحفظ "preservation" بآليات الكائنات الحية وحفظها :

① امتلاك الكائن الحي لأي شيء من الهيكل الصلب : يجب أن يحتوي جسم الكائن الحي على أجزاء صلبة تتصلل إما في هيكل داخلي مثل الهيكل العظمي للفقاريات أو هيكل خارجي مثل أصداف المحار البحرية. لأن جميع أجزاء جسم الكائن الحي الرطبة تتعفن وتتحلل بعد موته بسرعة بينما تبقى الأجزاء الجافة وتحفر الأجزاء الصلبة التي لا تتعفن أو تتحلل بسرعة، وتكون الأجزاء الصلبة من أصل الكائنات الحية إما من مواد جيرية أو سيليسية أو فسفورية أو لولوزية (الزئبقية فقط بتردد أقل حركته) عند

② الدفن السريع :- لأن الدفن السريع يحمي جسم الكائن الحي من التحلل الحيواني المتتمة وعزله عن تأثير الأوكسجين واليكترت من مسبب رطبة تعفن وتآكل وإعطاء أجزاء الصلبة فرصة للحفر بدلاً من التحلل والتعفن، وذلك دون أن تصل الأماكن التي تنهيها فيها فرصة الدفن السريع هي الأعوالفة الرسوبية البحرية دقيقت البطر ذلك لما تحمله مياه الجرار الأنهار والوديان من طحيات طخة من الفتات الأخرى التي تترسب بعد ذلك، لذلك فإن الجزء الأكبر من الأحافير وجد محفوظاً في الصخور الرسوبية البحرية "Marine Sed. R." أما الرسوبيات القارية فإنها فقيرة بالأحافير، لأنه لا تتوفر لها فرصة الدفن السريع ومعظم الكائنات البرية وجدت في رواسب سهول الأنهار ورواق البحيرات الداخلية.

Uses of Fossils :-

- To correlate between diff. strata far away

ليربط بين طبقتين مختلفتين بعيدتين

- To interpret the paleogeography of the area

يتم فلا معرفة كل ما أموره - عن - يتولى إن كان محله منطقة بحرية (مائية).

- To interpret the paleo-environment during their life.

عن طريق شري الحيوانات والنباتات المحفورة.

- To know the age of the rock

- Museum pieces.

Dating with Radioactivity :

Isotopic element : Is that having same protons number but diff. neutrons number in it's nucleus, but all behave the same in chem reaction.

Such elements having isotops are usually unstable their nuclei break apart releasing diff. types of radiation (β , γ , α) & giving up a new element.

The time an isotopic element needs to change half of its weight to another stable element is called Half life time, & this is fixed for a certain isotopic element.

parent mat
(X)

daughter
(Y)

20 g

Half-Life time
2 m years

10 g

↓
10 g

2 m years

5 g

بمقدار 1.25

5

2 m

2.5

بمقدار 0.5

2.5

2 m

1.25

8 m y

silicate structure :

All silicate have the same fundamental building block silicon + oxygen "tetrahedron" 4O, 1Si

ion $(SiO_4)^{-4}$ with (-) charge.

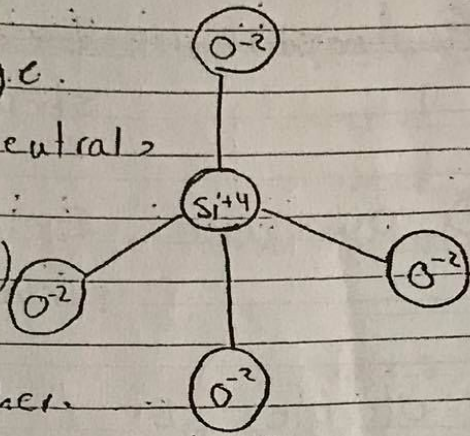
to make this tetrahedron neutral,

(+) ions should be added:

(a chem. stable structure produced)

the (+) ions act as glue (solid)

to link the tetrahedron together.



These tetrahedron may link together to form:

single chain or double chain or ^{sheet} structure

∴ silicate minerals described as having a "high" or "low" silicon content based on their ratio

of oxygen to silicon

Si : O	Si : O
1 : 4	1 : 2

Common silicate minerals :

silicate minerals are those that have the silicate $(SiO_4)^{-4}$ as basic building block

① Feldspars: composing 50% of earth crust.

Ex: orthoclase, plagioclase

Structure: Three dimensional network.

② Quartz: the second most abundant in the crust.

It is the only mineral made completely of Si and O

↳ SiO_2 ←

Structure: Three dimensional network

③ Mica : Ex: Biotite, Muscovite
structure: sheets.

④ Amphibol : Ex: Hornblende
structure: double chain

⑤ pyroxene: Ex: Augite
structure: single chain

⑥ olivine : Ex: Olivine
structure: single tetrahedron

Since the silicon-oxygen bond are strong, silicate minerals tend to cleave between the bond

⇒ Cooling for silicate mineral may occur:

- near earth surface (low temp and pressure) ex. Quartz
- great depth (high temp. and pressure) ex. Olivine
- at earth surface → from the weathering of older mineral

• Each silicate mineral has a structure and chemical composition which indicate the conditions under which it formed.

+ 5
19
13

Sil
major

1) D
dark
iron

a
s

→

•
①

②

A

③

Silicate Minerals can be divided into two major groups based on their chemical make up:
composition

1) Dark Silicate Minerals:

dark (ferro-magnesian) silicates contain ions of iron (ferro) and/or magnesium in their structure.

- * They are dark in colour due to presence of iron and mg.
- * has specific gravity (3.2-3.6)

→ most common types of dark silicate Minerals:

• Olivine: * black to olive green in colour.

- ① single tetrahedron
- ② structure
- ③ black
- * has glassy luster "non metallic"
- * major component of earth's upper mantle.

• Pyroxene: most common member: Augite → black mineral found in basalt

Amphibole Group:-

• Hornblende: * Most common member of amphibole group.

- ④ 2 cleavage planes
- ⑤ 60° & 120°
- * dark green to black in colour.
- * has similar appearance to augite.
- * found in Ig. R.

• Biotite: * Dark iron-rich member of Mica Family

- ⑥ has a shiny black appearance
- * it is common constituent of Ig. R. granite.

⑦ sheet structure

⑧ excellent cleavage in one direction

2) Light Silicate Mineral: ^{بترسب} Mg, Fe ^{في} SiO_2

light (non ferro ^{مغنيسيوم} magnesian) silicates are light ~~in~~ in colour

& having specific gravity about 2.7 ^{الوزن النوعي} SiO_2 ^{الوزن النوعي}

& contain amount of Al, K, Ca, Na ^{تحتوي على}

→ most common mineral group found ~~in~~ in the earth crust (non-ferro mag.) is Feldspars ^{البيروكسينات}

why? Because feldspars form (crystallize) over a wide ^{مدى واسع} range of pressure and temperature,

So it is a major constituent of most ig. R.

→ hard (6) , has glassy to pearly luster.

There are two different structure for feldspar:

* orthoclase feldspars: light cream to salmon pink in colour. and contain (K) ion in its structure

* plagioclase feldspars: white to medium gray in colour. contain (Na, Ca) ions.

② it has a multitude of fine parallel lines called striations on some cleavage planes.

• Quartz: Silicon + Oxygen SiO_2

① hard ② resistant to weathering

③ had no cleavage

* in pure form if it is allowed to solidify without interference it will form hexagonal crystal with pyramid end.

• Muscovite: light colour, pearly luster, member of Mica family, very shiny, it can be identified by the

sparkle it gives to rock

^{اللمعان}

None-Silicate Minerals :

* **Carbonate Minerals**: this group consists of carbonate ion (CO_3^{-2}) with one or more positive ions.

→ The two most common carbonate mineral are:

✓ calcite (CaCO_3) = calcium carbonate (3) hardness

✓ Dolomite ($\text{CaMg}(\text{CO}_3)_2$) = calcium mag. carbonate (4) hardness

They have glassy luster, hardness between 3 and 4.

To distinguish between the two: by using HCl (hydrochloric acid), calcite react very quickly while dolomite more slowly.

→ They found together as a major component

of the sedimentary Rock Limestone & dolostone

use as road aggregate, building stone, main ingredient in port land cement.

(dolomite) gray dark

* Other non silicate minerals found in Sed. R.

are halite (NaCl) and gypsum.

which are usually found in thick layers.

gypsum (calcite calcium sulfate $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$)

"with water bound" used in plastering

الجبس

rocks / الجبال