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You will be learning unit one.

Module name description of mineral

groups Olivine module number 21.

Outline of the topic.

Systematic study of silicate minerals.

Study of structure and chemical composition.

Study of physical and optical properties.

Learning outcomes students will be able

to distinguish and differentiate between

different silicate group minerals,

identify the physical and optical properties,

and use them in subdividing minerals.

Olivine Group.

This is one of the common

silicate group of minerals.

introduction,

It is the most common mineral within the

Earth and is a prime rock forming mineral.

It is also common in

mineral in Earth subsurface,

but when it is exposed to the surficial

conditions it weathers quickly.

It derives its name that is olivine from

the usual olive green color of the mineral.

Structure of the olivine group.

They're all nesosilicate that is

Each individual tetrahedra that

Is SiO_4 are linked to

one another through cations.

They are linked to one another through

cations and not by sharing of their oxygen.

So if you look at the image,

such individual tetrahedra

repeat throughout,

but they are not connected to

one another by the oxygens.

The corners or oxygens,

whether they're connected by different

cations that enters into the structure.

So therefore the unit of the structure

is the single SiO_4 tetrahedron

wherein this particular unit has a

residual negative charge of four.

Units which remains to be balanced by

Requisite cations

And most predominantly the cations

that balances these charges or

enters into the structure is Mg^{2+}

And Fe^{2+} and to a much smaller

extent Mn^{2+} and calcium also

enters into the structure.

All the members of olivine group

crystallizes in the orthorhombic system.

But although olivine is a

common mineral but well formed,

crystals are quite rare.

Chemical composition of the olivine group.

The olivine Group is an example of

a continuous solid solution series

of two components, or end members.

That is a forsterite having a

chemical composition Mg_2SiO_4

And fayalite having a chemical

composition Fe_2SiO_4.

And the composition of olivine

is continuously variable between

this pure forsterite

That is Mg_2SiO_4 and pure fayalite Fe_2SiO_4.

Such a series between these two.

May be subdivided arbitrarily into

a number of mineral species with

agreed ranges of composition.

Olivine solution series

Forsterite having around 0-10% Fe .

That means that the remaining

90-100% will be Mg content.

Similarly,

it goes with the chrysolite

wearing 10 to 30% is Fe,

and the remaining 70 to 90% is Mg.

Hyalosiderite when it has

30 to 50% iron,hortonolite when

it has 50 to 70% iron, ferrohortonolite,

when it is 70 to 90% iron

And fayalite when it has 90-100% iron,

Wherein incase of fayalite,

it may have 0 to 10% Mg.

But the composition of any natural

olivine generally corresponds

closely to $MgFe_2SiO_4$.

Since there is a very little

replacement by other elements,

substitution by Ca is

Strongly temperature dependent.

There is a virtual absence of aluminium.

Evidently replacement of Mg

and silica by aluminium is not

acceptable in the olivine structure.

Conditions of formation

Mg_2SiO_4 that is fosterites Melts at 1890 degrees Celsius,

whereas fayalite melts at 1205 degrees Celsius.

The Mg,Fe olivons illustrates the

effect on melting temperature in

a diadochic series as a result

of the replacing of smaller iron

That is Mg by a large iron Fe.

Cation oxygen bonds are weaker

for the larger cations.

Thus, as more and more of the

larger ions enters the structure,

there is a progressive reduction

in the melting point.

The first olivine crystallized from

a melt of a specific composition

are more enriched than those of

the later crystallization.

So consequently,

this leads to the larger Fe2+ ions

getting concentrated in the residual liquid.

Now the stability relationship.

Is all olivines except fayalite that is

Fe rich are incompatible with the

free SiO_2 because whenever the

free SiO_2 is available they will

react with it to produce a pyroxenes

which is a different mineral group.

As the consequences of this.

Olivine and quartz cannot

crystallize together in a rock,

Because quartz is a pure SiO_2.

But fayalite does not react in this way,

and thereafter fayalite occurs

in some granites and rhyolites.

Olivine alters readily.

Hydrothermal alteration generally results

in the formation of a Serpentine,

whereas surface or near surface alteration

results in oxidation of iron and removal

Of Mg and SiO_2.

Commonly leaving a Brown or

reddish brown pseudomorph,

which consist of goethite or haematite.

Physical and optical properties of olivine

group of minerals, crystals are uncommon.

Cleavages is distinct parallel

to 1010 specific gravities.

About 3.94 but it varies with the

composition that is and this variation

is continuous and uniform ranging

from 3.24 forsterite and 4.4 for fayalite and

this variation is observed due to the

higher atomic weight of iron which

is 56 compared to the Mg which is 24.

The refractive indices increase

continuously with increasing iron content.

But the birefringence also increases

from 0.035 to 0.052.

Most of the time the Mg rich members

are colorless and Fe rich members

are pale yellow in thin section.

All olivines except fosterites

are optically negative.

Paragenesis, it has been shown

experimentally that Mg rich olive

That is all except Fayalite are unstable

in the presence of free silica,

because since if the free silica

is available,

all those olivines that are formed,

they will react with the silica and will

lead to the formation of pyroxenes.

Therefore under normal conditions they

are not found in Association with quartz.

But olivine rich in iron

that is fayalite.

Can exist in the presence of free silica,

though even here the temperature

must be relatively low to bring it

within the rhyolitic magma range.

Iron rich olivine is sometimes found

in granophyres.

The olivines excluding Forsterite and

Fayalite are typically component of silica,

poor basic and ultrabasic igneous rocks.

The quantity is greatest in the

certain ultrabasic rocks like

peridotite and dunite wherein dunite

is a mono mineralic rock.

Having olivine as a only

Mineral only essential mineral.

And is only little less important in troctolites,

olivine gabbros and olivine basalts.

Olivine is also a common constituent

mineral in Stony and Stony iron meteorites.

Fayalite also occurs in thermally

metamorphosed sediments,

but is a more common constituent of

regionally metamorphosed iron rich sediments.

References.

The books that were referred

for this group of minerals,

that is olivine Group of

minerals is

Berry and Mason: Mineralogy CBS Publ. and Distr.

Deer W. A. Howie R.A. Zussman J. : Rock forming minerals, Longman

Dana’s Textbook of Mineralogy

Thank you