

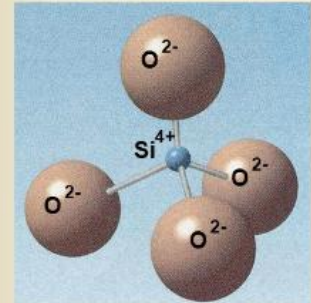
SILICATES - 1

There are hundreds of silicate minerals and they are the major rock building minerals in nearly all rock types, comprising about 90% of the earth's crust.

The basic building block for silicate minerals is the silicate ion $(\text{SiO}_4)^{-4}$ which is often referred to as the silicate tetrahedron.

Different elements bond to this to form silicate minerals.

An anion with charge of -4



I am changing the order presented here away from the alphabetical list to emphasis the structural similarities/differences in how these silicate tetrahedrons are combined. We will save the simplest (Quartz) in which the $(\text{SiO}_4)^{-4}$ anions are only bonded to themselves to form SiO_2 for a separate time.

Nesosilicates – isolated tetrahedral (**olivine, garnet, staurolite, topaz**)

Sorosilicates – paired tetrahedral (**epidote**)

Cyclosilicates – Rings of tetrahedron (**beryl, tourmaline**)

Inosilicates – Chained silicates

Single chains - Pyroxenes (i.e. **augite**), **rhodonite**

Double chains Amphiboles (i.e. **hornblende, tremolite**)

Phyllosilicates – Sheet silicates

Micas (**biotite, muscovite, lepidolite**), **kaolinite**

Tectosilicates or Framework Silicates – notably feldspars

Plagioclase Series (**albite**), Potassium series (**microcline/amazonite, orthoclase**), also **sodalite**

TABLE 2.2**Major Silicate Structures****GEOMETRY OF LINKAGE
OF SiO_4 TETRAHEDRA**

Isolated tetrahedra: No sharing of oxygens between tetrahedra; individual tetrahedra linked to each other by bonding to cation between them

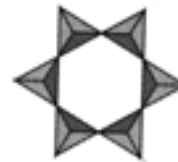
nesosilicates



*Sorosilicates
when paired*

Rings of tetrahedra: Joined by shared oxygens in three-, four-, or six-membered rings

cyclosilicates



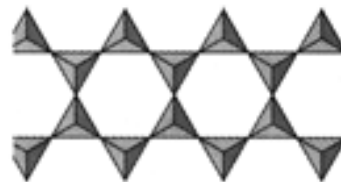
Single chains: Each tetrahedron linked to two others by shared oxygens; chains bonded by cations

inosilicates



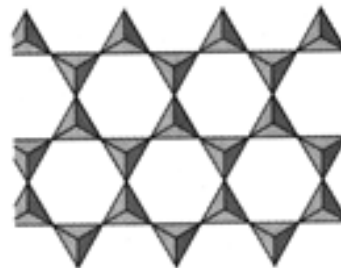
Double chains: Two parallel chains joined by shared oxygens between every other pair of tetrahedra; the other pairs of tetrahedra bond to cations that lie between the chains

inosilicates



Sheets: Each tetrahedron linked to three others by shared oxygens; sheets bonded by cations

phyllosilicates



Frameworks: Each tetrahedron shares all its oxygens with other SiO_4 tetrahedra (in quartz) or AlO_4 tetrahedra

tectosilicates



Nesosilicates – Isolated

Olivine - $(\text{Mg,Fe})_2\text{SiO}_4$

Color - _____
Crystal Habit - _____
Crystal System - _____
Cleavage - _____
Hardness - _____
Luster/Streak _____/
Use (if any) - _____
Other _____



Gem - peridot



in basalt



Staurolite - $\text{Fe}^{2+}_2\text{Al}_9\text{O}_6(\text{SiO}_4)_4(\text{O,OH})_2$

Color - _____
Crystal Habit - _____
Crystal System - _____
Cleavage - _____
Hardness - _____
Luster/Streak _____/
Use (if any) - _____
Other _____



Topaz – $\text{Al}_2\text{SiO}_4(\text{F,OH})_2$

Color - _____
Crystal Habit - _____
Crystal System - _____
Cleavage - _____
Hardness - _____
Luster/Streak _____/
Use (if any) - _____
Other _____



Can be blue



Nesosilicates – Isolated (cont.)

Garnet – (Almandine) - $\text{Fe}^{2+}_3\text{Al}_2\text{Si}_3\text{O}_{12}$

Color - _____

Crystal Habit - _____

Crystal System - _____

Cleavage - _____

Hardness - _____

Luster/Streak _____/_____

Use (if any) - _____

Other _____



in
schist

Sorosilicates – Paired tetrahedron

Epidote - $\{\text{Ca}_2\}\{\text{Al}_2\text{Fe}^{3+}\} [\text{O} | \text{OH} | \text{SiO}_4 | \text{Si}_2\text{O}_7]$

Color - _____

Crystal Habit - _____

Crystal System - _____

Cleavage - _____

Hardness - _____

Luster/Streak _____/_____

Use (if any) - _____

Other _____



With feldspar

Cyclosilicates – Rings of tetrahedron

Beryl - $\text{Be}_3\text{Al}_2\text{Si}_6\text{O}_{18}$

Color - _____

Crystal Habit - _____

Crystal System - _____

Cleavage - _____

Hardness - _____

Luster/Streak _____/_____

Use (if any) - _____

Other _____



Emeralds and aquamarines are both the mineral beryl

Tourmaline Group -- complex boron-silicate

Color - _____

Crystal Habit - _____

Crystal System - _____

Cleavage - _____

Hardness - _____

Luster/Streak _____/_____

Use (if any) - _____

Other _____

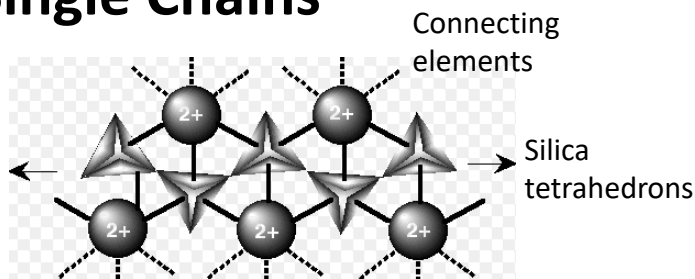


in pegmatite

Inosilicates – Single Chains

Pyroxenes are the most common group of single chain inosilicate with different cations connecting the chains.

Results in Si-O ratio of 1:3



Augite - $(\text{Ca})(\text{Mg,Fe})(\text{Si,Al})_2\text{O}_6$

Color - _____

Crystal Habit - _____

Crystal System - _____

Cleavage - _____

Hardness - _____

Luster/Streak _____/_____

Use (if any) - _____

Other _____

Solid Solution:

Mg endmember is diopside

Fe end member is hedenbergite



Crystal faces



cleavage

Rhodonite - MnSiO_3

Color - _____

Crystal Habit - _____

Crystal System - _____

Cleavage - _____

Hardness - _____

Luster/Streak _____/_____

Use (if any) - _____

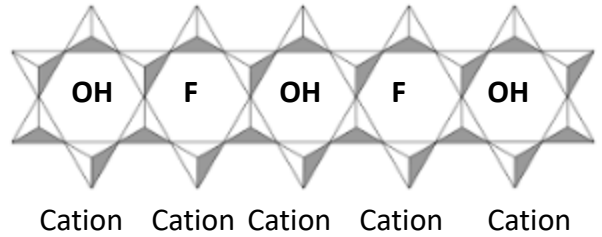
Other _____



Inosilicates – Double Chains

Amphiboles are the most common group of double chain inosilicate with different cations connecting the chains.

Results in Si-O ratio of 4:11



Hornblende - $(\text{Ca}, \text{Na})_{2-3}(\text{Mg}, \text{Fe}, \text{Al})_5(\text{Al}, \text{Si})_8\text{O}_{22}(\text{OH}, \text{F})_2$.

Color - _____
Crystal Habit - _____
Crystal System - _____
Cleavage - _____
Hardness - _____
Luster/Streak _____/
Use (if any) - _____
Other _____



Tremolite - $\text{Ca}_2\text{Mg}_5\text{Si}_8\text{O}_{22}(\text{OH})_2$

Color - _____
Crystal Habit - _____
Crystal System - _____
Cleavage - _____
Hardness - _____
Luster/Streak _____/
Use (if any) - _____
Other _____

