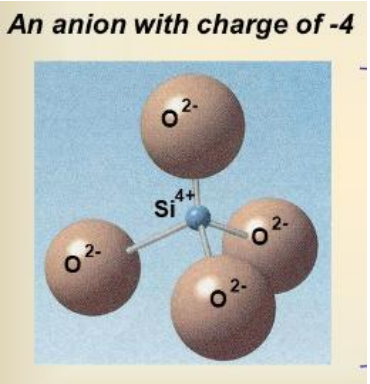
SILICATES - 1

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 $(SiO_4)^{-4}$ which is often referred to as the silicate tetrahedron. Different elements bond to this to form silicate minerals.

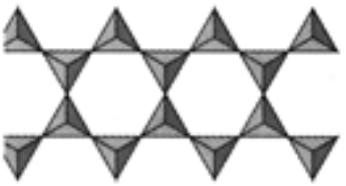
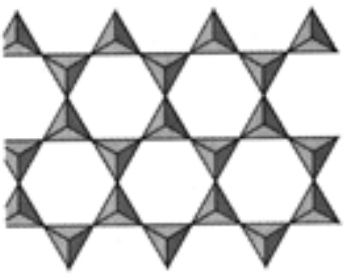


I am changing the order presented here away from the alphabetical list to emphasis the structural similarities/differences in how these silicate tetrahedrons are combined. We will save the simplest (Quartz) in which the $SiO_4)^{-4}$ anions are only bonded to themselves to form SiO2 for a separate time.

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

38. Olivine - $(Mg,Fe)_2SiO_4$

Gem - peridot

in basalt

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

_____

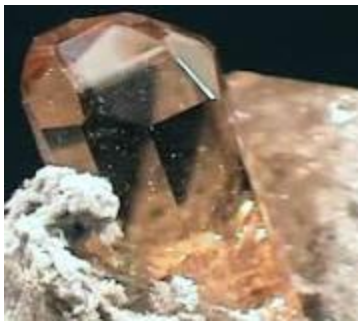
53. Staurolite - $Fe^{2+}_2Al_9O_6(SiO_4)_4(O,OH)_2$

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

_____

56. Topaz – $Al_2SiO_4(F,OH)_2$

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



Can be blue

_____

Nesosilicates – Isolated (cont.)

2. Garnet – (Almandine) - $Fe^{2+}_3Al_2Si_3O_{12}$

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

_____

in schist

Sorosilicates – Paired tetrahedron

20. Epidote - $\{Ca_2\}\{Al_2Fe^{3+}\}[O|OH|SiO_4|Si_2O_7]$

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

_____

With feldspar

Cyclosilicates – Rings of tetrahedron

10. Beryl - $Be_3Al_2Si_6O_{18}$

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

_____

Emeralds and aquamarines are both the mineral beryl

57. Tourmaline Group -- complex boron-silicate

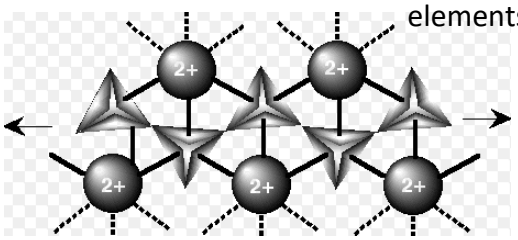
Color - _____
Crystal Habit - _____
Crystal System - _____
Cleavage - _____
Hardness - _____
Luster/Streak _____/_____
Use (if any) - _____
Other _____

_____

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



6. Augite - $(Ca)(Mg,Fe)(Si,Al)_2O_6$

Solid Solution:
Mg endmember is diopside
Fe end member is hedenbergite

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

Crystal faces

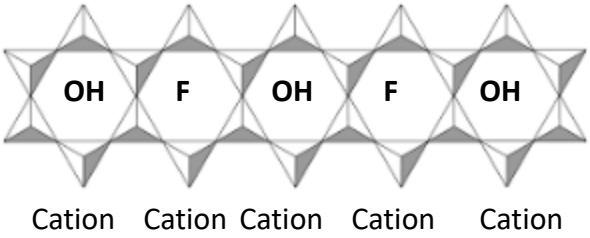
cleavage

49. 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



32. Hornblende - $(Ca,Na)_{2–3}(Mg,Fe,Al)_5(Al,Si)_8O_{22}(OH,F)_2$.

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

58. Tremolite - $Ca_2Mg_5Si_8O_{22}(OH)_2$

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