Lecture Notes - Mineralogy - Silicate Mineral Classification

- Silicate minerals form the largest fraction of most crustal rocks and, therefore, receive considerable attention from geologists and mineralogists. Nearly all of the silicates have structures based on the $[SiO_4]^{-4}$ tetrahedron. Each oxygen atom in a $[SiO_4]^{-4}$ tetrahedron has only half of its -2 charge satisfied by the Si-O bond (bond strength = 1) and so must be bonded to other cations. If an oxygen is bonded to two Si atoms, the coordination polyhedra of oxygens around those two Si atoms will share corners and the oxygen in common will have its charge fully balanced by the two Si-O bonds. The fact that $[SiO_4]^{-4}$ tetrahedra can share corners and fully balance oxygen charges locally makes a great number of silicate structures possible.

- Silicate minerals are classified on the basis of the degree of polymerization of the $[SiO_4]^{-4}$ tetrahedra. The main types of silicates are grouped in the following table based on the number of bridging oxygens (#BO) per $[SiO_4]^{-4}$ tetrahedron.

#BO	Formal Name	Informal Name	Si-O Group	Examples	Sample Formula
0	nesosilicates	island silicates	$[SiO_4]^{-4}$	forsterite almandine	$Mg_2(SiO_4)$ $Fe_3Al_2(SiO_4)_3$
1	sorosilicates	group silicates	$[Si_2O_7]^{-6}$	lawsonite epidote	$Ca_3Al_2(Si_2O_7)(OH)_2{\cdot}H_2O$ $Ca_2Fe_3(SiO_4)(Si_2O_7)O(OH)$
2	cyclosilicates	ring silicates	$[SiO_3]^{-2}$	beryl tourmaline	$Be_3Al_2(Si_6O_{18})$ $NaMg_3Al_6(BO_3)_3(Si_6O_{18})(OH)_4$
2	inosilicates	chain silicates	$[SiO_3]^{-2}$ $[Si_4O_{11}]^{-6}$	diopside tremolite	$CaMg(Si_2O_6)$ $[\ ]Ca_2Mg_5(Si_8O_{22})(OH)_2$
3	phyllosilicates	sheet silicates	$[Si_2O_5]^{-2}$	talc phlogopite muscovite	$[\ ]Mg_3(Si_4O_{10})(OH)_2$ $KMg_3(AlSi_3O_{10})(OH)_2$ $K[\ ]Al_2(AlSi_3O_{10})(OH)_2$
4	tectosilicates	framework	$[SiO_2]^o$	quartz orthoclase leucite	SiO_2 $K(AlSi_3O_8)$ $K(AlSi_2O_6)$