

Phyllosilicates – Sheets

Phyllosilicates, or sheet silicates, form parallel sheets of silicate tetrahedra with Si_2O_5 or a 2:5 ratio. All phyllosilicate minerals are hydrated with either water or hydroxyl (OH) groups attached. Bonds within the sheets are strong, but bonds between them are quite weak.

Fe, Mg
↓

11. Biotite - $\text{K}(\text{Mg,Fe})_3(\text{AlSi}_3)\text{O}_{10}(\text{OH})_2$

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



Al
↓

37. Muscovite - $\text{KAl}_2(\text{AlSi}_3)\text{O}_{10}(\text{OH})_2$

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



Phyllosilicates – Sheets (cont.)

Biotite, muscovite, and lepidolite are sheet silicates from a group of minerals called the MICA group.

↙ Li (lithium)

34. Lepidolite - $K(\text{Li},\text{Al})_{2-3}(\text{AlSi}_3)\text{O}_{10}(\text{OH})_2$

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



Most clay minerals are also phyllosilicates typically with microscopic clay sized crystals (less than 0.02 mm). You are responsible for only one aluminum rich variety.

33. Kaolinite - $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$

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



Phyllosilicates – Sheets (cont.)

55. Talc - $\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$

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



Phyllosilicates

Biotite - $\text{K}(\text{Mg},\text{Fe})_3(\text{AlSi}_3)\text{O}_{10}(\text{OH})_2$

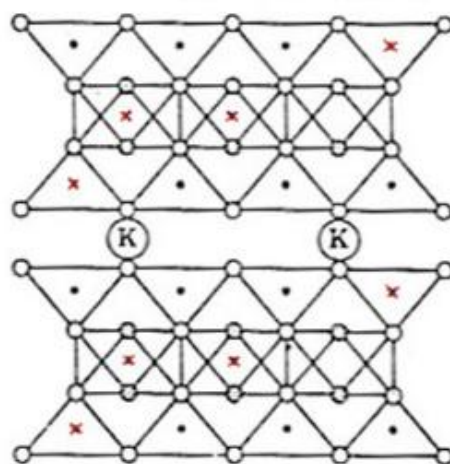
Muscovite - $\text{KAl}_2(\text{AlSi}_3)\text{O}_{10}(\text{OH})_2$

Kaolinite - $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$

Lepidolite - $\text{K}(\text{Li},\text{Al})_{2-3}(\text{AlSi}_3)\text{O}_{10}(\text{OH})_2$

Talc - $\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$

Muscovite $\text{KAl}_2(\text{AlSi}_3\text{O}_{10})(\text{F},\text{OH})_2$



○ = Oxygen
 ○ = Hydroxyl
 • = Silicon
 x = Aluminum
 ● = Magnesium

Framework silicates – Feldspars and more

In a framework silicate, or tectosilicate, each tetrahedron shares all 4 oxygen atoms with its neighbours, forming a 3D-4D structure. Feldspars carry a Si-O ratio of 3-8 except where Al substitutes for some Si. **Feldspars** make up as much as 60% of the earth's crust.

There are two main groups of feldspar

- 1) Plagioclase Group (with Na, Ca) --- you have 1 to learn
- 2) Microcline-Orthoclase Group (with K) -- you have 2 to learn

1. Albite - $\text{NaAlSi}_3\text{O}_8$

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



Note
lamellar
twinning



beryl
albite

3. Microcline - KAlSi_3O_8 variety - Amazonite

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



Framework silicates – (cont.)

21. Orthoclase - KAlSi_3O_8

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

Pink color in granite
is due to orthoclase



51. Sodalite - $\text{Na}_8(\text{Al}_6\text{Si}_6\text{O}_{24})\text{Cl}_2$

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



Framework silicates - QUARTZ

Quartz is the second most abundant mineral in the earth's continental crust, after feldspar. Its crystal structure is a continuous framework of SiO_4 (silicon tetrahedra) with each oxygen being shared between two tetrahedra, giving an overall chemical formula of SiO_2 .

There are many different varieties of quartz, several of which are semi-precious gems. Since antiquity, varieties of quartz have been the most commonly used minerals in the making of jewelry.

General	
Category	oxide mineral ^{[1][2]}
Formula (repeating unit)	SiO_2
Strunz classification	4.DA.05 (Oxides)
Dana classification	75.01.03.01 (tectosilicates)
Crystal system	α -quartz: trigonal β -quartz: hexagonal
Color	Colorless through various colors to black
Crystal habit	6-sided prism ending in 6-sided pyramid (typical), drusy, fine-grained to microcrystalline, massive
Twinning	Common Dauphine law, Brazil law and Japan law
Cleavage	{0110} Indistinct
Fracture	Conchoidal
Tenacity	Brittle
Mohs scale hardness	7 – lower in impure varieties (defining mineral)
Luster	Vitreous – waxy to dull when massive
Streak	White



Forms of Silica – SiO₂

Quartz- SiO₂ common crystalline form with all the properties of a mineral. Pure quartz is colorless and transparent. Inclusions and impurities can impart color.



Clear quartz



Rose quartz



Citrine



Amethyst



milky quartz

Chalcedony– general name for cryptocrystalline quartz

Agate/Onyx – variety of chalcedony with curved or angular banding, onyx has black and white banding



Jasper– red/orange variety of chalcedony where color is due to iron



Opal – hydrated (contains water) amorphous form of silica, the water in the structure causes light to be refracted in a multitude of colors. Opal is the gemstone of Australia

