SILICATES

- **Tectosilicates**

Name	***Idealized composition***	***Functional importance***
Quartz	SiO_2	Single most common mineral in soil, often accounting for 50% or more of the total dry weight. Normally sand and silt sized. No chemical charge, no shrink-swell. Surface area of 1 m^2/g
Opal	SiO_2*2H_2O	Hydrated form of silica. Normally sand and especially silt sized. No chemical charge, no shrink-swell. Surface area of 1 m^2/g. Prescence generally indicates either volcanic ash or plant-created phytoliths.
Orthoclase	KSi_3AlO_8	Weatherable feldspar that releases the macronutrient K^+. Normally sand and silt sized. No chemical charge, no shrink-swell. Surface area of 1 m^2/g.
Anorthite	$CaSi_3AlO_8$	Weatherable feldspar that releases the macronutrient Ca^{2+}. Normally sand and silt sized. No chemical charge, no shrink-swell. Surface area of 1 m^2/g.
Albite	$NaSi_3Al_2O_8$	Weatherable feldspar that releases Na^+. Normally sand and silt sized. No chemical charge, no shrink-swell. Surface area of 1 m^2/g.

- **Phyllosilicates**

Name	***Idealized composition***	***Functional importance***
Muscovite	$K(Si_{3.0}Al_{1.0})(Al_{2.0})O_{10}(OH)_2$	Weatherable dioctahedral mica that will convert into illite as it releases K^+. Often silt and sand sized, occasionally clay sized. No shrink-swell. Low surface area 3 m^2/g
Biotite	$K(Si_{4.0})(Mg_{3.0})O_{10}(OH)_2$	Weatherable trioctahedral mica releases K^+. Often silt and sand sized, occasionally clay sized. No shrink-swell. Low surface area 3 m^2/g
Illite	$K_{0.8}(Si_{3.2}Al_{0.8})(Al_{2.0})O_{10}(OH)_2$	Commonly coarse clay sized, especially coarse clay sized, with CEC in the range of 10 to 40 $cmol_c\ kg^{-1}$. No shrink-swell and moderate surface area (e.g., 50 m^2/g)
Vermiculite	$X_{0.7}(Si_{3.3}Al_{0.7})(Al_{2.0})O_{10}(OH)_2$	Commonly clay sized with CEC in the range of 100 to 200 $cmol_c\ kg^{-1}$. Moderate shrink-swell and very high surface area (e.g., 700 m^2/g). Can have K^+-fixation and/or NH^{4+}-fixation.
Smectite (Beidellite)	$X_{0.4}(Si_{3.6}Al_{0.4})(Al_{2.0})O_{10}(OH)_2$	Commonly fine clay sized with CEC in the range of 60 to 140 $cmol_c\ kg^{-1}$. Huge shrink-swell and moderate to high surface area (e.g., 250 m^2/g). Layer charge is in the tetrahedral sheet.
Smectite (Montmorillonite)	$X_{0.4}(Si_4)(Al_{1.6}Mg_{0.4})O_{10}(OH)_2$	Commonly fine clay sized with CEC in the range of 60 to 140 $cmol_c\ kg^{-1}$. Huge shrink-swell and moderate surface area (e.g., 250 m^2/g). Layer charge is in the octahedral sheet.
Chlorite	$X0.2(Si_{3.6}Al0_{.2})(Mg_3)O_{10}(OH)_2$	Commonly clay sized with CEC in the range of 10 to 40 $cmol_c\ kg^{-1}$. No shrink-swell. Moderate surface area (e.g., 30 m^2/g). Chlorite is a trioctahedral mineral akin to biotite.
Kaolinite	$Si_2Al_2O5(OH)4$	Commonly clay sized with CEC in the range of 1 to 10 $cmol_c\ kg^{-1}$. No shrink-swell. Moderate surface area (e.g., 30 m^2/g).

CARBONATES, SULFATES, & PHOSPHATES

Name	***Idealized composition***	***Functional importance***
Calcite	$CaCO_3$	Commonly sand and silt sized soluble mineral that readily releases the Ca^{2+}. Ground calcite (aka, "ag lime") is routinely added to acidic soils in order to raise the soil pH.
Dolomite	$CaMg(CO_3)_2$	Commonly sand and silt sized soluble mineral that readily releases the Ca^{2+} and Mg^{2+}. Ground dolomite (aka, "dolomitic lime") is routinely added to acidic soils in order to raise the soil pH.
Siderite	$FeCO_3$	Commonly sand and silt sized soluble mineral that readily releases the $Fe2^{+}$ or Fe^{3+} depending on redox conditions in the soil.
Gypsum	$CaSO_4*nH_2O$	Highly soluble sand and silt sized mineral that readily releases two critical plant nutrients, Ca^{2+} and $SO4^{2-}$. No shrink-swell. Little surface area.
Apatite	$Ca_5(PO_4)_3(F,Cl)$	Low solubility sand and silted sized mineral that is the only natural occurring mineral source of PO_4^{-3} in soils. No shrink-swell. Little surface area.

OXIDES & HYDROXIDES

Name	***Idealized composition***	***Functional importance***
Goethite	$FeO(OH)$	Goethite is the most common oxide mineral in soils. It is frequently a weathering product formed when free Fe^{+2} precipitates into Fe^{3+} during a soil oxidation reaction. Goethite can have pH-dependent CEC and AEC in the range of 0 to 5 $cmol_c\ kg^{-1}$. No shrink-swell. Moderate to high surface area (e.g., 60 to 200 m^2/g).
Hematite	Fe_2O_3	Hematite is a common oxide mineral in soils that forms during organic matter decomposition. Hematite can have pH-dependent CEC and AEC in the range of 0 to 5 $cmol_c\ kg^{-1}$. No shrink-swell. Moderate to high surface area (e.g., 100 to 200 m^2/g).
Ferrihydrite	$Fe_5O_8H*nH_2O$	Ferrihydrite is a poorly crystalized iron oxide that has poorly understood but significant ion exchange and surface area. No shrink-swell.
Corundum	Al_2O_3	Corundum is entirely inherited from parent materials and generally considered pedogenically non-reactive. No CEC, no shrink-swell, low surface area.
Gibbsite	$Al(OH)_3$	Gibbsite accumulates in soils that have weathering of aluminosilicates and extremely high leaching losses – i.e., the Al doesn't leave the soil even as other cations do. Gibbiste can have pH-dependent CEC and AEC in the range of 0 to 10 $cmol_c\ kg^{-1}$. No shrink-swell. Low surface area (e.g., 5 to 10 m^2/g).