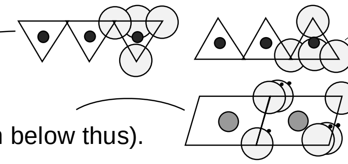
Clay Mineralogy I: Phyllosilicate minerals



The O^{2-}s and OH^{-}s are ommitted in the sketches below.

Most clay minerals can be viewed as combinations of layers of

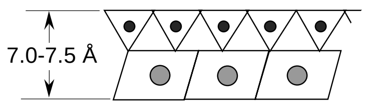
tetrahedral (T) cation sites occupied by Si^{4+} and lesser Al^{3+} or Fe^{3+} (shown below thus),

and octohedral (O) cation sites occupied by Al^{3+}, Fe^{3+}, Mg^{2+}, Fe^{2+}, or other cations (shown below thus).

Trioctohedral minerals are those in which three of three octohedral sites are filled with 2+ cations such as Mg^{2+} or Fe^{2+} for a net charge of 6+. "Trioctohedral" thus generally means "Mg^{2+}-and/or-Fe^{2+}-bearing".

Dioctohedral minerals are those in which two of three octohedral sites are filled with 3+ cations such as Al^{3+} or Fe^{3+} for a net charge of 6+. "Dioctohedral" thus generally means "Al^{3+}-and/or-Fe^{3+}-bearing".

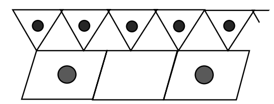
T-O minerals:



$Si_2O_5^{2-}$ — Formula dictated by sharing of three O^{2-}s by each SiO_4^{2-} tetrahedron. ($5 = 2 \cdot [1+\frac{1}{2}+\frac{1}{2}+\frac{1}{2}]$)

$+ Mg_3(OH)_6$ — Formula of brucite (hence the expression "brucite layer" in discussing phyllosilicates).

Serpentine: $Mg_3Si_2O_5(OH)_4$

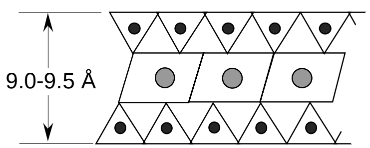


$Si_2O_5^{2-}$ — Formula dictated by sharing of three O^{2-}s by each SiO_4^{2-} tetrahedron.

$+ Al_2(OH)_6$ — Formula of gibbsite (hence the expression "gibbsite layer" in discussing phyllosilicates).

Kaolinite: $Al_2Si_2O_5(OH)_4$

T-O-T minerals:

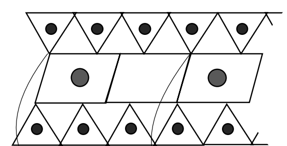


$Si_2O_5^{2-}$

$Mg_3(OH)_6$

$+ Si_2O_5^{2-}$

Talc: $Mg_3Si_4O_{10}(OH)_2$



$Si_2O_5^{2-}$

$Al_2(OH)_6$

$+ Si_2O_5^{2-}$

Pyrophyllite: $Al_2Si_4O_{10}(OH)_2$

Loss of OH^{-}s in the four additions of formulae on this page is because tetrahedral O^{2-} displaces octohedral OH^{-} here.

In T-O-T structures, subsitution of less charged cations in the tetrahedral layers (Al^{3+} or Fe^{3+} for Si^{4+}) or in the octohedral layers (Mg^{2+} for Al^{3+} or Li^{1+} for Mg^{2+}) results in a net negative charge on the combined T-O-T layer. That allows an interlayer cation to reside between T-O-T layers. See "Clay Minerals II: T-O-T phyllosilicate minerals".

Highly generalized T-O-T + interlayer structure: