Clay Mineralogy I: Phyllosilicate minerals

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

Trioctohedral minerals are those in which three of three octahedral 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 octahedral 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:

7.0-7.5 Å

Serpentine: Mg$_3$Si$_2$O$_5$(OH)$_4$

Formula dictated by sharing of three O$^2-$ by each SiO$_4^{2-}$ tetrahedron. (5 = 2 * [1 + 1/2 + 1/2])

T-O-T minerals:

9.0-9.5 Å

Talc: Mg$_3$Si$_4$O$_{10}$(OH)$_2$

In T-O-T structures, substitution 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$^{+}$ 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: