American Mineralogist, Volume 101, pages 2544–2553, 2016

Ideal wollastonite and the structural relationship between the pyroxenoids and pyroxenes

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Abstract

A hypothetical ideal wollastonite with regular octahedra and T3 tetrahedron is presented and used to compare and contrast the pyroxenes and pyroxenoids. While clinopyroxenes have close-packed arrangements of oxygen anions, several lines of evidence demonstrate that pyroxenoids do not. One such line is the number of tetrahedra in a single tetrahedral chain per octahedra in a single associated octahedral chain (interior to the octahedral band), referred to as the "single-chain T:O ratio," which is 1:1 in pyroxenes but 3:2 in wollastonite and always greater than 1:1 in other $MSiO_3$ pyroxenoids. Because the Si-tetrahedron is extremely resistant to distortion, this forces marked distortion in at least one pyroxenoid octahedral site.

The octahedral layers in pyroxenes and pyroxenoids are compared by placing them in the context of a fully occupied, closest-packed sheet of idealized octahedra, and it is shown that they are fundamentally different.

The new mineral yangite is analyzed from the perspective developed in this study. It is structurally similar to the pyroxenoids, but the structure is a new type because it contains double tetrahedral chains and mixed polyhedral layers containing double chains of tetrahedra and bands of octahedra of width two. The tetrahedral chains are wollastonite-type chains and the wollastonite-type double chain is shown to have important differences from the amphibole double chain. A possible explanation for the existence of this crystal structure based on a hydrogen bond between Pb and O is presented.

Keywords: Clinopyroxene, pyroxenoid, chain silicate, yangite, wollastonite, diopside, close-packing