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Comparison of the crystal chemistry of selected MSi_6O_{15}-based silicates

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Abstract

The structures of four $A_3MSi_6O_{15}(\cdot nH_2O)$ silicates (A = Na or K, M = Nd or Y) recently determined by the authors are compared with one another and with the structures of related silicates. The 2:5 Si:O ratio in these compounds (silicate tetrahedra linked by sharing three O atoms per tetrahedron plus one unshared O atom) permits layer, double-chain, or double-ring configurations. In α-$K_3NdSi_6O_{15}\cdot 2H_2O$, β-$K_3NdSi_6O_{15}$, and $Na_3NdSi_6O_{15}\cdot 2H_2O$, the linkage is found to result in a corrugated layered structure, in β-$Na_3YSi_6O_{15}$ a double-chain structure, and in α-$Na_3YSi_6O_{15}$ a unique double-ring structure. Although the factors that govern the stabilities of ring vs. chain vs. layered structures remain to be completely elucidated, it is apparent in the layered structures that larger M cations (such as Nd and Ce) produce a greater degree of corrugation than do Zr and Ti cations. The more open structures of neodymium and cerium silicates contain large channels that may serve as pathways for fast alkali ion transport.