

Topaz and Norbergite: Is Modular Twinning of Unique Topologies a Way for Building Stable Hp-Hydrous Silicates?

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Topaz, $\text{Al}_2\text{SiO}_4(\text{F}, \text{OH})_2$, and Norbergite, $\text{Mg}_3\text{SiO}_4(\text{F}, \text{OH})_2$, are chemically closely related, but topologically very different minerals. Nevertheless, they may be referred to as dioctahedral and trioctahedral species of somehow related, but principally differently close packed fluoro-hydro-orthosilicates. Topaz, known to be a prominent gem mineral, is accompanied by Humite group minerals, for example Norbergite, which form crystals of gem quality too, known from genetically closely related metamorphic Asian gem deposits (Pakistan, Vietnam, China etc.). Topaz, as a fluorine free, pure synthetic hydroxyl-silicate, is known to be stable only under elevated pressure. Its crystal structure may be described with a topology formed by the modular twinning of Al-Si-O-OH-building blocks which results in a not classically close packed array of high structural density with Al in octahedral and Si in tetrahedral voids and OH being connected to the Al-octahedra. Norbergite, having the closely related chemistry of the typical trioctahedral arrangement, usually used in the correlating description of sheet silicates, in general is described structurally as a composite crystal structure of $\text{Mg}(\text{OH}, \text{F})_2 \cdot \text{Mg}_2\text{SiO}_4$, a combination or stacking of Brucite-like and Forsterite-like slabs of close-packed anion-arrays. The appropriate modular twinning of fundamental building blocks of the Norbergite – chemistry under elevated pressure(exceeding the metamorphic parameters of the granulite-facies) results in an array of trioctahedral Topaz-topology which will produce a high-density polymorphic phase of $\text{Mg}_3\text{SiO}_4(\text{F}, \text{OH})_2$. This phase may act as a reservoir of structurally bound volatiles in the earth mantle under high pressure and may be a gem mineral of very special properties.