

REVIEW


Cancrinite-group minerals: Crystal-chemical description and properties under non-ambient conditions—A review

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ABSTRACT



This is a review of the thermal and compressional behavior of cancrinite-group minerals with a description of the mechanisms, at the atomic scale, that govern their *P-T*-induced structure evolution. The open-framework structure of this group of feldspathoids is characterized by the [CAN] topology, which contains large parallel channels (confined by 12-membered rings of tetrahedra), surrounded by columns of cages. At least two structural “subgroups” can be identified according to the nature of the constituents filling the cages, irrespective of the channel population. The minerals of the “cancrinite subgroup” show [NaH₂O]⁺ clusters into the cages and those of the “davynite subgroup” contains [CaCl]⁺ clusters. Beside a similar bulk compressibility and expansivity at room conditions for all the minerals of the group, a different elastic anisotropy, coupled with different deformation mechanisms of the tetrahedral framework, were found to be mainly controlled by the nature of the population filling the cages. The role played by the channel populations appears to be secondary. These experimental findings allow us to provide a model of the structure evolution in response to the different cage content, i.e., NaH₂O⁺ and CaCl⁺.

The high-temperature studies of the hydrous members of the cancrinite subgroup reveal a slow dehydration process, often irreversible at the timescale of the experiments and leading to quasi-anhydrous high-temperature forms that keep their crystallinity even up to 800–900 K (at room *P*). The experiments at high pressure on the cancrinite-group minerals show a high-*P* stability, at least up to 7–8 GPa (at room-*T*), which is quite surprising if we consider their microporous nature. The *P*-induced stability is the effect of a pronounced structural flexibility, which in turn is based mainly on tilting of rigid tetrahedra around O atoms that behave as hinges. The character and the mechanisms that govern the *P-T*-induced *P*6₃-to-*P*6₃/*m* phase transition in the compounds of davynite subgroup are also discussed.

Keywords: Feldspathoids, cancrinite, davynite, vishnevite, balliranoite, temperature, pressure, elastic behavior, host-guest interactions, framework deformation, Invited Centennial article, Review article