Hydrated borates at non ambient conditions: pivotal experiments in the production of neutron shielding concretes.

Lotti P.[1*], Gatta G. D.[1], Comboni D. [1], Battiston T. [1]

[1.] *Earth Sciences Department, University of Milan, Italy*
**Presenting author; E-mail: paolo.lotti@unimi.it*

Abstract text

Hydrated borates (*e.g.*, colemanite, kernite, ulexite, borax, tincalconite) are the most common ore minerals of boron, an important geochemical marker, in pegmatitic and granitic systems, for petrogenetic processes and a strategic element in a series of technological applications. Hydrated borates have been listed as critical raw materials by the EU [1], and they could be used as aggregate in neutron-shielding Sorel or Portland concretes, enhancing the adsorption of concrete towards thermal neutrons. The main structural units in hydrated borates are $B\varphi_x$ units (fundamental building blocks, *i.e.*, tetrahedra and planar trigonal group where φ is an anion, O^{2-} or OH^-), connected in such a way to form clusters of polyions connected to alkaline/Earth alkaline (mainly Na^+, K^+, Ca^{2+}, Mg^{2+}) polyhedra. In these structures, H_2O molecules and OH^- form a complex and pervasive hydrogen-bond network, which reinforce the connection between the polyions clusters and the cations-polyhedrons, playing a paramount role in the stability of the crystalline edifice [2, 3]. In the last 4 years, a number of studies have been performed at high temperature and pressure unveiling phase transition driving deformation mechanisms' that lead to the formation of their high-pressure polymorphs. Critically, the pressure at which hydrated borates undergo a phase transition is related to the water content of the mineral itself. The aim of this contribution is to provide insides on the high-pressure behavior and structure evolution of selected hydrate borate minerals. These studies at non ambient conditions are pivotal to produce neutron shielding tiles of Sorel concretes.

References

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