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ABSTRACT BOOK

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COVER IMAGE

Padua, Italy at Prato della Valle by Sean Pavone. Site: elements.envato.com

Hydrous Borates under extreme conditions: insights for neutron shielding concrete design

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Hydrous borates (e.g., colemanite, kernite, ulexite, borax, and tincalconite) are the primary mineral commodity of boron—an element of both geochemical significance in pegmatitic and granitic systems and strategic value in various technological applications. The crystal structure of these minerals is built up by the $B\varphi_x$ units (where φ represents O^{2-} or OH^-), forming tetrahedral or planar trigonal groups. These units are connected to form polyionic clusters, in turn connected to alkali and alkaline-earth metal polyhedra (mainly Na^+, K^+, Ca^{2+}, Mg^{2+}). A pervasive hydrogen-bonding network, involving H_2O molecules and OH^- groups, further stabilizes the crystalline edifices (Comboni et al., 2021; Pagliaro et al., 2021).

Recent experiments, performed over the last five years, have explored the behavior of hydrated borates under high-pressure and high-temperature conditions, unveiling phase transitions and deformation mechanisms leading to a number of high-pressure polymorphs. The non-ambient condition behavior, in response to perturbative parameters (i.e., temperature, pressure, and leaching), is now applied to design neutron-shielding materials, due to the exceptional neutron absorption cross section of B (in particular 10B). This contribution presents an overview of the current state of art on hydrated borates, highlighting their potential in the development of neutron-shielding components (in the form of tiles or panels) made by Sorel cements and borates aggregates.

Comboni D. et al. (2021) - Crystal structure of the high-P polymorph of $Ca_2B_6O_6(OH)_{10}\cdot 2(H_2O)$ (meyerhofferite). Acta Crystallogr. B, 6, 940-945, https://doi.org/10.1107/S2052520621009768.

Pagliaro F. et al. (2021) - Thermal and compressional behavior of the natural borate kurnakovite, $MgB_3O_3(OH)_5\cdot 5H_2O$. Constr. Build. Mater., 266, 121094, https://doi.org/10.1016/j.conbuildmat.2020.121094.