Impact of alkali in solution on glass alteration and water behavior in nanoporous altered layer

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Chemical durability of nuclear waste glass is a major field of study. Recent works have demonstrated that, in certain conditions, a nanoporous alteration layer could form on the surface of the glass [1]. This observation raised many interrogations on water behavior inside this layer. It is well known that, when confined in nanoporosity, water properties differ from that of bulk water [2].

Various leaching experiments were conducted in silica saturated solution, at 90°C and pH 7, on a simple six oxide borosilicate glass. Different alkali salts (LiCL, NaCl, KCl and CsCl) were introduced in solution and water properties within the layer were monitored by Nuclear Magnetic Resonance spectroscopy, Time-of-Flight Secondary Ion Mass Spectrometry and Thermogravimetric analysis. From these different techniques, the high impact of alkali in solution on glass alteration kinetics as well as water behavior was highlighted. When compared to a solution with no alkali, bigger cations, such as K and Cs, significantly lower glass alteration kinetic whereas smaller alkalis, in contrary, slightly increases glass alteration kinetic. Surprisingly, the impact of the tested cations on altered glass structure is minor. It appears that ions in solution impact water capacity to diffuse inside the altered glass nanoporosity.

This study provides key information that was previously missing on water behavior inside a nanoporous altered glass layer. This is a first promising step in refining glass alteration modeling taking into account water diffusion evolution in a changing material.

[1] Gin *et al.* (2015) *Nat. Commun*. **6**, 6360. [2] Y. Wang. (2014) *Chem. Geol.* **378-379**, 1-23.