Nuclear glass alteration: bridging the gap from surface reactivity description to reactive transport at the scale of the fractured block

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Problematics

The treatment of the long-lived high-level radioactive waste via its vitrification is a subject of prime importance for the nuclear industry and the science in general as it requires an in-depth understanding of the behavior of the glass dissolution and the amorphous layers development at the micro scale, as well as the effect of the diffusion, the thermo convection and certain parameters of modeled systems that govern the kinetics of the glass dissolution.

The glass matrix being highly fractured, as a result of stress release generated during the glass cooling, the treatment of such a medium demands the application of both the discrete fracture network modelling (DFN) and the geocellular (homogenized) modelling approaches.

Way of addressing the problem

This research starts with the study of the evolution of the amorphous layers (dense and porous) by executing the reactive transport modelling (HYTEC transport code[1,2]) in conjunction with the GRAAL geochemical model[3]. The behavior of specific groups of fractures is described explicitly, then upscaling relationships are elaborated for flow, transport, and chemical behavior. Eventually, we will carry out reactive transport modelling at the scale of the fractured block and explore the impact of the fracturing on the quantity of altered glass released out of the container.

Figure 1: Network of fractures, glass block scale

[1] Lagneau, V. (2013) *Géochimie Université ParisVI*. [2] van der Lee et al. (2002) *Developments in Water Science* **47**, 599-606. [3] Frugier, P.et al.(2008) *Journal of Nuclear Materials* **380**, 8-21.