Interest of large scale experiments to strengthen upscaling approach

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Many materials are studied in the context of nuclear fuel cycle and radioactive waste disposal. Host rocks and engineered materials are carefully analysed using laboratory experiments on small samples. These data help assessing long term and large scale behaviour assuming an implicit upscale approach. This assumption may be true in most cases but larger experiments are complementary to strengthen such an approach especially in the case of near-field perturbation. The Callovo-Oxfordian (COx) clay rock is investigated by the French radioactive waste management agency (Andra) in the context of the underground retrievable nuclear waste repository project (Cigéo). Numerous data are available on COx clay rock, including retention and diffusion of cations, anions and organic co-contaminants. A few large-scale and *in situ* studies are also available. For most of these experiments, the transport parameters obtained at various scales are mutually consistent and independent of the ratio between the volume of solution and the mass of solid (V/m). Such a behaviour is expected in the far-field environment where a steady state between both phases is reached.

Recently, other investigations were performed to study near-field perturbation. In the case of nuclear waste disposal or pollution by hazardous wastes, chemical or physical perturbations of the systems are expected. For example, wastes may release nitrate, sulfate or organic plumes, generate gases or induce heating of rocks. Transitory states are expected and affected by the ratio between the source term and the mass of rock enduring the pertubation. Four experiments were designed on pluridecimetric COx clay rock samples with low V/m ratio, close to *in situ* conditions. We will focus on the perturbation induced by an organic plume on ions diffusion and the effect of a thermal cure on uranium migration. The results are compared to parameters obtained on sound rock at smaller scales. Above all, large-scale experiments highlight the chemical processes governing systems under perturbation and seem a good compromise between a systematic acquisition on small sample and in situ experiments representing a more realistic behavior of the rock but with other sources of uncertainty (eg damage zone.)