Impact of temperature on mechanical and geochemical behavior of swelling clay minerals

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Abstract submitted for a **Poster** in **Topic 6**: Temperature-induced effects (Thermal-Hydraulic-Mechanical and Chemical coupled processes).

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The ubiquity of swelling clay minerals in surface and sub-surface geoscience systems, in sedimentary deposits, in fault zones or in their potential application in the context of nuclear waste disposal make the effect of temperature (> 60°C) on their hydrological, mineralogical and mechanical behaviour a major scientific issue. Therefore, we aim to assess the swelling behavior of clays when hydrated at temperature (≥ 60°C) under confined conditions. The swelling result from water-mineral interactions at different scales, from interlayer space within crystallite to pore space between particles, depending on the charge compensating cations. We are tackling these physical and chemical issues using a combined approach of experiments and geochemical modelling in order to apprehend the osmotic and crystalline contributions. Miniaturized oedometers were designed to acquire in-situ X-ray data (SAXS/WAXS, tomography) according to hydration and the swelling pressure monitoring over time (Figure 1). Such new devices allow to analyze both the evolution of the hydration state of clay and the swelling pressure over time, from dry to saturated state, under drained and confined conditions. Experiments were performed with homo-ionic clays with different solutes (cations and ionic strength) and at different dry densities from 1.4 to 1.6 g.cm^{-3}. Preliminary results were acquired at temperatures ranging from 25 to 80°C for Na and Ca-form (Figure 2). Complementary data of water adsorption gravimetry isotherms, in confined conditions, were obtained in the same conditions. This set of data will contribute to evaluate the effect of temperature on the swelling pressure and the water retention capacity of swelling clays. All of these results contribute to a better understanding of the thermo-hydro-mechanical-chemical behavior of bentonites and help in the parametrization of geochemical modelling by quantifying the different contributions of water-mineral interactions.

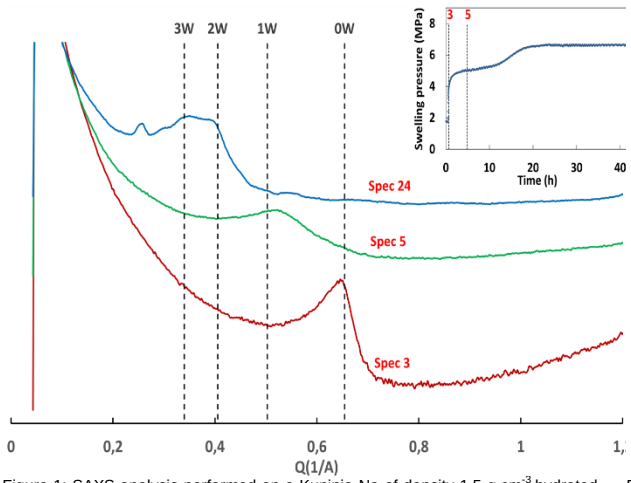

Figure 1: SAXS analysis performed on a Kunipia-Na of density 1.5 g.cm^{-3} hydrated by a NaCl solution of concentration 10^{-4}M.

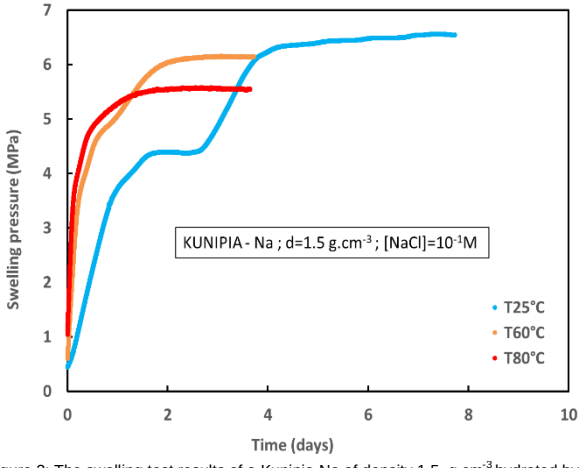

Figure 2: The swelling test results of a Kunipia-Na of density 1.5 g.cm^{-3} hydrated by a NaCl solution of concentration 10^{-1}M at temperatures of 25; 60 and 80°C.