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Large amounts of nuclear waste await final disposal worldwide. A combination of waste overpacks (e.g. metal canisters, concrete), engineered barriers such as bentonite, and natural barriers such as clay rocks, constitutes the elements of the so-called “multiple-barrier system” between the waste matrix and the biosphere. The number, types and assigned safety functions of these various barriers depend on the chosen repository concept, the waste form, the radionuclide inventory in the waste, the selected host rock, the hydrogeological and geochemical settings of the repository site, etc.(Apted and Ahn, 2010). These barrier properties will evolve with time in response to the physical and chemical interactions between the various constituents of the barriers and the surrounding environment. Consequently, predicting how these properties evolve is of prime importance for performance and safety evaluations of the repository concepts. As a prerequisite, initial properties of the materials used in the disposal have to be understood, to better predict their long term behavior. Although micro imaging techniques are more and more sophisticated and powerful (Gaboreau et al., 2016), few techniques allow in-situ characterization of both the evolution of the different phases’s mineralogy and their 3D spatial arrangement. To tackle this issue, X-Ray diffraction computed tomography (XRD-CT, see Fig1) that allows to record in each voxel of the recorded volume an X-ray diffraction pattern, has been successfully applied to investigate hydration and microstructural development in cements (Voltolini et al., 2013). Here we present results obtained by synchrotron XRD-CT on a cement paste formulation, which is constituted of blended Portland, fly ash, blast furnace slag cement (Chen et al., 2012), foreseen to be used for nuclear waste disposal application. The mineralogy (including spatial distribution) of a cured cement paste and of a cement paste undergoing in-situ and time-resolved hydration will be compared and discussed. In addition, special care will be taken to analyze the evolution of cement porosity as a function of time and of associated spatially- and time-resolved carbonation mechanism.

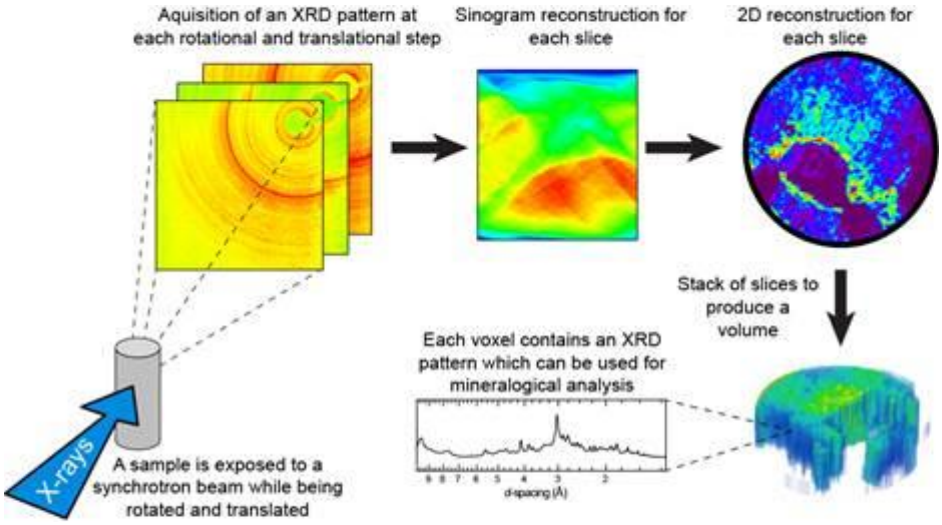

Fig1: Schematic representation of the in situ synchrotron XRD-CT experiment

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