Evaluation of reactive migration of hydrogen through sandstone: Application to geological storage

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The use of hydrogen as an alternative for electric energy storage has emerged rather recently though it was originally more identified as a secondary energy carrier and storage medium [1-3]. Being composed of small molecules, hydrogen has a strong ability to migrate in porous medium and can also be highly reactive with the rock minerals. In the case of storage in sedimentary rocks such as sandstone, changes of the porous structure of the rock are expected and may influence the storage properties.

In this study, we assess both experimentally and numerically the geochemical reactivity of hydrogen with sandstone. Experiments are performed to evaluate the possible change of the chemical composition of the rock mineralogy in contact with hydrogen and hydrogen-water mixtures. Two types of sandstones (containing different proportions of clay minerals) are reacted under mid-hydrothermal conditions (100 to 200 °C) and with hydrogen partial pressure ranging from 20 to 100 bar. In the Vosges sandstone, no reaction occur between pure hydrogen and the mineral phases present. The same conclusion applies when hydrogen is injected in the sandstone previously saturated with water (T=100°C).

Our experiments have been numerically simulated in terms of kinetic/equilibrium reactions and 1D-diffusion of hydrogen into our sandstones. Data of sandstone mineralogy from literature review have also been used for the simulations [4]. By comparing the results, we will obtain a consistent evaluation of reactive transport of hydrogen in underground sedimentary formation for large scale storage.

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