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REACTION MECHANISMS IN SWELLING CLAYS UNDER IONIZING RADIATION: IMPACT ON THE GEOLOGICAL STORAGE OF THE NUCLEAR WASTE

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The influence of ionizing radiation on clay minerals is poorly known, in spite of their use as a major component of the engineered barrier in High Level Nuclear Waste Repositories (HLNWR). In this context, the production of H_2 by clay minerals under ionizing radiation could be a real issue. It can, e.g., lead to the loss of radionuclide retention properties by creating cracks in the engineered barrier. It is thus important to determine H_2 formation reaction mechanisms and to understand the role of several parameters on this production, such as the water amount, the presence of impurities and the nature of the clay mineral.

We studied synthetic clay minerals (talc, which has no water molecules, montmorillonite and saponite which exhibit charge excess in different locations) [1-2] and also natural montmorillonites from Camp Berteau [3]. The reactivity under electron irradiation is deciphered thanks to H_2 production measurements at well-defined relative humidities together with electron spin resonance experiments that allow detecting the defects created upon irradiation. Comparing the reactivity induced in the synthetic samples enables understanding the impact of the presence of two-dimensionally confined water molecules and the influence of the charge location in the sheets of the clay mineral. Moreover, the comparison between synthetic and natural talc evidences the strong role played by impurities on the H_2 production yields [1]. We find that H_2 production is due to the presence of structural -OH groups and that the confinement of water molecules is a crucial factor. Moreover, the charge location in the sheets of the clay minerals plays only a marginal role [1-2]. All these results will be discussed and the corresponding reaction mechanisms will be presented. Lastly, the role of impurities in natural clay minerals such as Fe^{3+} that strongly decrease the H_2 production will be discussed.

References:

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