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Gas Generation and Migration in Safety Assessment of Deep Geological Repositories for Nuclear Wastes

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Deep geological repositories (DGR) in an appropriate host rock for the long term containment and isolation of nuclear wastes are currently being proposed and investigated in several countries (e.g., Canada, France, Germany, India, Switzerland). The safe long-term disposal of the waste in a repository and its isolation from the biosphere are guaranteed by a multi-barrier system consisting of a natural (host rock) and an engineered barrier. A key aspect of DGR safety is the integrity and long-term stability of the multi-barrier system to isolate nuclear waste (radioactive contaminants) at timeframes of 1 Ma. Before implementing geological repositories for nuclear waste their viability regarding containment and long-term safety for both humans and environment is crucial. Significant quantities of gas could be generated in underground repositories for radioactive waste from several processes, such as the degradation of waste forms or corrosion of waste containers. This gas and the radioactive contaminants it contains could migrate through engineered and natural geological barrier systems. The pressure in the generated gas would build up, and thus could affect the integrity of the barriers and geosphere as a long-term contaminant barrier. Thus, the assessment of the long term safety of a repository for nuclear waste in deep rock formations requires a good understanding of the process of gas generation and migration and its impact on the multi-barrier system (host rock, engineered barrier). In this keynote presentation, the key mechanisms of gas generation and migration in a DGR for nuclear wastes and their relevance in the assessment of a DGR will be discussed. Furthermore, the state-of-art of experimental tests and mathematical models for simulation of gas generation and transport in DGR will be presented. Finally, a case study of gas generation and migration in a potential Canadian DGR will presented.