Gas generation from organic waste over a 7 years period: implication for the management of low and intermediate level radioactive waste

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Deep geological repositories have been adopted in many countries for the permanent disposal of low and intermediate level radioactive waste (LILW). The primary focus when assessing long residence times of LILW in geologic facilities are: how gas pressure affect re-saturation with meteoric water of underground cavities and how these two forces affect the transport of aqueous radionuclides by groundwater and gaseous radionuclide migration through rock fractures or shaft seals; and how microbial processes affect both the waste and the speciation and transport of radionuclides present in the waste. Over long time scales, *in situ* anaerobic biodegradation of the non-radiological components of the waste is expected to produce: 1) gas and volatile compounds which could result in pressure build-up reducing the re-saturation rate of an underground cavity and delaying migration of soluble radionuclides and 2) acids which can affect the initial integrity of the host bedrock and shaft seals that isolate and contain the radioactive waste. Hydrogen, carbon dioxide, methane and other volatile compounds are the gasses expected to be generated by the biodegradable organic components of the waste. We monitored the gas pressure evolution, headspace gas composition, and microbiology of candidate organic waste spanning over a seven year period. The gas pressure evolution and changes in gas composition are interpreted according to the fungal, bacterial and archaeal composition of the candidate waste and in terms of the functional genes for methane and acetate formation, which are both processes that consume hydrogen and carbon dioxide, reducing pressure build-up in an underground cavity. In our experiment, methane formation appeared low while acetate formation was prevalent. The results obtained aid in the long-term predictions of soluble and gaseous radionuclide migration required in the development of long term safety cases for proposed deep geological repositories.

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