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Barium reactions on calcite-water interface

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High-level radioactive waste (HLW) and spent nuclear fuel (SNF) are planned to be disposed of in many countries in deep-lying geological multi-barrier systems. Groundwater intrusion into deep geological repositories represents a considerable risk of long-lived radionuclides being released from the deposited HLW and SNF. Therefore, the risk assessment of such a scenario plays an integral role in current research. Furthermore, flowing groundwater in fractures will be the primary medium for radionuclides transport into the surface environment in case of their release from the nuclear waste repository.

Thus, the primary solid/liquid interface reactions, such as sorption and co-precipitation on mineral surfaces, will affect the mobilization of radioactive contaminants from deep geological storage systems. In addition, groundwaters can consist of significant concentrations of dissolved compounds, for example, relatively high concentrations of carbonates or sulphates that affect the behavior of the radioactive contaminants. At the same time, relatively high salinity was also discovered.

Gamma emitter ^{133}Ba was used in our experiments as a chemical analogue to investigate ^{226}Ra behavior since they have similar properties and behavior. ^{226}Ra is a significant hazardous element in radioactive waste disposal due to its comparatively long half-life (1600 years), high radiotoxicity, and high solubility, and it is one of the contaminants in groundwater systems. It is also presented in the petrochemical, mining, and geothermal industries [1].

This research aimed to examine theoretically and experimentally the barium sorption and co-precipitation processes in model waters containing different concentrations of carbonates, sulphates, and calcium at pH 8 under saline and anoxic conditions. In addition, barium reactions on the calcite-water interface were studied by the batch sorption method. The activity of ^{133}Ba was measured with an HPGe detector. The SEM and zeta sizer-nano was used to examine the morphology and size of precipitates. We discovered significant removal of ^{133}Ba from the model waters, notably in sulphate pre-concentrated solutions. An interaction with calcite provided the effect of the solid phase on the model water system. Moreover, a geochemical model PHREEQC was used to assess the reaction mechanism of barium on calcite.

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References

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