Radium Abstract:

Radium (Ra) is a naturally occurring radioactive material that poses a significant hazard when released from the subsurface by anthropogenic activities (i.e. hydraulic fracturing), but can aslo mark groundwater movement in estuarine systems. Prediction of Ra transport in groundwater is instrumental toward mitigating these hazards and improving Ra tracer utility. Ra transport is known to be dominated sorption, particularly by iron and manganese (hydr)oxides, but there is limited mechanistic study of Ra binding to mineral surfaces. Here, we present results of batch sorption studies and surface complexation modeling of Ra to ferrihydrite, goethite, Na montmorillonite, and pyrite, in a low salinity groundwater solution at range of pH values. We find that Na montmorillonite, ferrihydrite, and goethite are major sorbents of Ra, while pyrite may play a key role during geochemical shifts common in natural aquifer systems. Transitions from anoxic conditions to oxic conditions will play a key role in retention or release of Ra from aquifer solids. The results here provide useful constants and reactions that can inform modeling of Ra transport in natural aquifer systems containing many different mineral phases.