SCM stuff: this can go in your thesis

Surface complexation modeling (SCM) employs mass action equations subject to thermodynamic and electrostatic constraints to describe solute-solid phase interactions. They are typically calibrated using adsorption isotherm/titration data collected across a range of geochemical conditions, sometimes with the aid of spectroscopic tools or *ab inito* modeling.12 In general, they are used to describe and validate surface chemical reactions for specific minerals and define and estimate important surface reactions for complex mineral mixtures (e.g. soil and sediment samples). These can then facilitate predictions of solute mobility in specific aquifer systems. Challenges associated with using and comparing results of SCMs within the scientific literature include the variety of experimental systems and conditions used for model calibration, and non-standard methodology for choosing model parameters and SCM chemical reactions.29

Several studies examine sorption of Ra to iron (hydr)oxides, including ferrihydrite and goethite, and report Kd values (or sufficient data for calculation) (table S2).9,11,16,34

Radium isotopes are also used as naturally occurring environmental tracers. The mass balance of Ra isotopes in estuarine/near shore systems can provide estimates of subterranean groundwater discharge (SGD).35 This method matches well with other SGD measurements, but is unable to resolve groundwater behavior within estuarine systems; non-conservative mixing and retardation may occur in these zones owing to sorption or fluctuations in pH, salinity or redox state.9,36 In addition to its use as a groundwater tracer, Ra has also been identified as a marker for historic spills associated with hydrocarbon extraction.7 This is possible if the Ra isotopic signature of produced water significantly differs from that of local groundwater, which is typical in many hydrocarbon bearing formations.37 Successful implementation of this method requires a comprehensive accounting of Ra fate in groundwater, as transport may be significantly non-conservative due to mixing of the highly saline, often anoxic waste waters with shallow, oxic, low salinity groundwater.

as providing constants and reactions to constrain Ra sorption. It also highlights areas in need of additional work to better quantify these transport processes.