

Interfacial reactivity between green rust sulfate and metal contaminants

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Metal contamination of groundwater resources remains a pressing environmental and public health concern. Although conventional remediation technologies (e.g., permeable reactive barriers) are extensively employed, they have various environmental (potential release of secondary contaminants) and/or economic (high cost) drawbacks. Furthermore, global environmental standard limits for metal contaminants in groundwaters are increasingly stringent. This affects remediation requirements and, in turn, implies changes in technological approaches. Adsorption-based technologies are promising alternatives for groundwater clean-up due to their versatility and effectiveness. However, in many subsurface environments, metal adsorption will affect or be affected by interactions with redox-active mineral phases.

One important, yet often unsolved problem for remediation, is the dearth of knowledge about the fate of toxic metals upon interaction with redox-active minerals in the subsurface. Moreover, an imminent challenge is the development and testing of adequate mineral phases that have high metal-specific uptake capacities, strong binding affinities and excellent stabilities.

In this study, we examined the Fe^{II}-Fe^{III} layered double hydroxide, green rust sulfate (GR_{SO4}), as a novel sustainable adsorbent for groundwater remediation. We investigated the interaction between freshly-precipitated GR_{SO4} and various metal cations (Cd, Co, Ni, Zn) and anions (As, Mo, V). We tested the effect of variable metal concentrations, ionic strength (0.005 to 0.5 M), pH (7 to 9) and adsorbent loading (2 to 6 g/L), and evaluated the performance of GR_{SO4} as an effective metal adsorption material. Our goal is to evaluate the stability and recyclability of the GR_{SO4} adsorbent, and its ability to reduce metal concentrations in groundwaters below environmental standard limits within a short time.