Contaminant Sorption to Mineral Surfaces: Linking Molecular Sorption Mechanisms to Complexity of Field-Scale Bioavailability

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The fate of contaminants in soils and sediments is a function of a diverse number of biogeochemical and hydrologic processes, including sorption and bioavailability. Sorption of organic contaminants may play an important role in limiting contaminant bioavailability and thereby decreasing rates of in situ biodegradation. Sorption of metals can also influence microbial processes through the impact of sorption on speciation and, thereby, on toxicity. While there have been many macroscopic studies which have quantified the influence of sorption on bioavailability, a relatively limited number of studies have characterized the specific mechanism(s) controlling organic or inorganic interactions with soils and sediments and the subsequent influence of sorption on contaminant bioavailability.

We have coupled NMR spectroscopy, macroscopic sorption experiments and microbial activity and the kinetics of substrate biodegradation in microcosms to explore the relationship between sorption and bioavailability of PAHs and cadmium in soils and sediments. We are linking these results to explain field-scale contaminant bioavailability based upon the complexity of spatial patterns of mineral surface chemistry. These patterns are likely due to the importance of non-linear fluvial processes that sort minerals and the hydrologic and biogeochemical processes that control inorganic and organic coatings on these minerals.

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