Mechanisms of Arsenic Mobilization during Managed Aquifer Recharge using Highly Purified Wastewater

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Managed Aquifer Recharge (MAR) is an increasingly popular method to augment local groundwater supplies and store water for later usage. However, MAR sites can alter native aquifer geochemistry and result in the mobilization of naturally occurring metal contaminants as has been observed at numerous MAR sites. Additionally, MAR projects can utilize various recharge water chemistries many of which have not previously been tested and can potentially have adverse interactions with aquifer sediments. Here, we investigate the effects of MAR using highly purified recycled water produced by advanced treatment processes. The treated effluent is of extremely low ionic strength (<0.01 M electrolyte concentrations) and highly oxidizing, containing disinfectant residuals including approximately 2.5 mg/L hydrogen peroxide. We focus on injection of this purified oxidizing water into a previously anoxic deep (>150 m) aquifer within the Orange County Groundwater Basin.

We present field data from monitoring wells located down gradient of the injection area. We focus on shifts in redox condition with particular emphasis on changes in pH, dissolved oxygen, total Mn, NO_3^-, SO_4^{2-}, total As and total V concentrations. We further study the redox shifts in the aquifer using field-scale reactive transport modeling of the injection site. Our results suggest that continuous injection of aerobic recharge water will not mobilize appreciable concentrations of As due to the repartitioning of As(V) oxyanions onto newly precipitated Fe (hydr)oxides. However, shifts in groundwater pH during injection can threaten the stability of adsorbed As and should be closely monitored. Additionally, oxidative dissolution of U(IV) and V(III) can result in elevated groundwater concentrations of these contaminants during injection.