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Editorial

Contaminant Transport and Fate

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This Special Issue highlights many of the predominant contaminant transport and fate processes that redistribute solutes through natural and engineered surface and subsurface environments. Contaminant transport in porous media is controlled by advection, dispersion, retardation, phase transfers, and transformation processes facilitated and mediated by biological, chemical, and physical agents. The articles in this issue attempt to elucidate these processes and the factors that control them through laboratory and field-scale studies. The incorporation of contaminant transport and mass transfer processes into computational and numerical models enables scientists and engineers to develop conceptual frameworks, which are essential for efficacious management of polluted sites. Innovative technologies that accelerate contaminant extraction, destruction, seclusion, or management either in situ or ex situ can be used to deal with environmental pollution problems. The repeated emergence of previously unknown or undetectable toxic chemicals amplifies the ongoing need for development of innovative technologies and approaches for contaminant characterization and remediation. The detection and quantification of emerging contaminants may be improved through deployment of advanced diagnostic tools or the implementation of enhanced amendment delivery techniques. Sustainable remediation technologies are sought to reduce the substantial costs and risks to human health and the environment associated with these sites. In response to these research challenges, this Special Issue is a collection of seven articles that span laboratory and field scales and include several novel important datasets and present several unique and noteworthy modeling efforts.

Kanno and McCray (2021) [1] evaluated the potential of groundwater contamination from surface spills associated with unconventional oil and gas production. Besides drawing attention to the type and volume of contaminants being introduced into the environment, their analysis highlights the influence of major storms on propagating those solutes into aquifers. The activation of persulfate (PS) oxidant through manganese amendment to subsequently degrade a recalcitrant groundwater contaminant, 1,4-dioxane was examined by Bridges et al. (2021) [2]. Their results showed that MnO_2 activated PS and increased contaminant degradation rate constants. These results have implications for applying in situ chemical oxidation technologies, especially for conditions wherein manganese exists naturally in groundwater or aquifer minerals to support possible PS activation. Silva et al. (2021) [3] simulated the transport of per- and polyfluoroalkyl substances (PFAS) within the vadose zone using a modified version of the widely employed HYDRUS model. With an emphasis on the air-water interface (AWI), the simulated examples demonstrate that while AWI adsorption of PFAS can be a significant source of retention within the vadose zone, it is commonly not the dominant source of retention. They specifically found that the level of PFAS sorption to the soil can be considerable in many vadose zone configurations. A novel application of a nonlinear autoregressive (NAR) neural network to estimate the fracturing fluid flow rate to shallow aquifers in the presence of an abandoned well is presented by Taherdangkoo et al. (2021) [4]. This study shows that NAR neural networks can hold considerable potential for assessing the groundwater impacts of unconventional gas development. Noh et al. (2021) [5] introduce a multi-gene programming regression algorithm for the prediction of transient storage model parameters in natural rivers. This type of approach can be an alternative option to direct calibration and the inverse modeling of initial parameters during an analysis of solute transport in natural rivers. Balerna et al. (2021) [6] delineate the "urban stream syndrome" in which pollutant-depended discharges to ground and surface waters are governed by concentration–discharge relationships. Their work underlines the importance of systematically monitoring both baseflow and stormflow pollution inputs. The impact of seasonally and spatially varying source water composition on the formation of N-nitrosodimethylamine (NDMA) disinfection by-product (DBP) is described by Meadows et al. (2021) [7], who report that NDMA formation was predominantly dependent on the monochloramine contact time but less so on the concentration of traditional DBP precursors, such as total organic carbon and total nitrogen.

Overall, the collection of articles presented herein highlights many facets of contemporary research on characterizing the transport and fate along with remediation of contaminants in the environment. While these works push forward the frontiers of knowledge in this field, they also serve as a foundation and inspire many additional directions for study. We thank all contributors to this Special Issue!

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