Groundwater remediation with nanoscale zero-valent iron (nZVI) is a promising alternative to ZVI permeable reactive barriers (PRB) or conventional pump-and-treat techniques. The nZVI water slurry can be injected into the contaminated subsurface without the excavation of aquifer material or the pumping of contaminated groundwater. Besides the transport behavior, the particle reactivity after its injection into the subsurface is a key factor for the successful application of nZVI. The objective of this study was the detailed characterization of the reactivity of Fe^0 nanoparticles after their deposition on sand grain surfaces in the subsurface.

The reactivity of nanoscale Fe^0 particles was investigated in batch and column experiments under varying experimental conditions. Dehalogenation kinetics, the formation of minerals in the presence of inorganic solutes and the behavior against competing reactions were the main aspects in this investigation. The experiments were conducted with commercially available core-shell Fe^0 particles and a new type of milled nZVI flakes.

The competition between contaminants and hydronium ions for reactive sites in long-term column experiments depends on the dehalogenation rate of the contaminant which was used in the experiments. Slower reaction kinetics of the contaminant degradation increases the rate of the competing reaction with hydronium ions. The high reactivity of the Fe^0 particles determined the conditions on the surface with regard to the formation of minerals. The results imply the availability of electrons for the decontamination reaction as long as the particles are reactive and can be considered as an advantage of nZVI in comparison to granular ZVI.