Insights into interaction of natural organic matter with nanoscale zero valent iron and magnetite

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Nanoscale zero valent iron particles (nano-Fe^0) are attractive for in-situ groundwater remediation due to their high reactivity and capability to degrade many environmental contaminants. In the environment, natural organic matter (NOM) is heterogeneous and typically has a wide molecular weight (MW) distribution. The amount of NOM and different MW fractionations adsorbed onto nano-Fe^0 may affect their reactivity and performance as a remediation agent. In this study, we used high performance size exclusion chromatography (HPSEC) to determine if there was preferential sorption of the high MW fraction of NOM onto nano-Fe^0 that have a Fe^0 core and Fe-oxide shell (predominantly magnetite). Adsorption of two types of NOM, Suwannee River Humic Acid (SRHA) and Fulvic Acid (SRFA), to nano-Fe^0 was compared to magnetite of similar size (nano-Fe_3O_4) to assess the effect of the Fe^0 core on adsorption of NOM. The results showed that the surface area normalized adsorbed mass (mg·m^{-2}) of both SRHA and SRFA onto nano-Fe^0 is almost three times than that of nano-Fe_3O_4. This is attributed to a greater number of reactive sites on nano-Fe^0 compared to nano-Fe_3O_4, and indicates that the surface properties of nano-Fe^0 are different that nano-Fe_3O_4 despite the shell of magnetite on nano-Fe^0. The sorption capacity of both SRHA and SRFA onto nano-Fe^0 were similar. However, the intermediate sized MW fractions (2~6 KDa) of SRHA were preferentially adsorbed onto the nano-Fe^0 surface, whereas the large MW fractions (>3.5 KDa) of SRFA were preferentially adsorbed. These results suggest that NOM interaction with nano-Fe^0 are a function of the MW distribution of the NOM in the system studied and indicate that the MW distributions of NOM should be taken into consideration when predicting fate and behavior nano-Fe^0 in environmental remediation.