Behavior of iron nanoparticles in wetland soil

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The engineered nanoparticles (NPs) promise immense improvements in manufacturing, electronics, health and environmental technologies. Their size, shape, chemical composition, density, level of aggregation, presence of an organic coating as well as their surface chemistry control their reactivity. Recently, the NPs have been suggested as an efficient, cost-effective and environmental friendly alternative to existing treatment materials for the environmental remediations. Development of iron oxide NPs as nanosorbent for heavy metals and organic pollutants is particularly promising in this respect. However, few studies examined the interactions of iron nanoparticles with metallic trace elements and organic matter in wetland soil.

Here we present a leaching wetland soil experiment where the impact of the presence of magnetite (Fe_3O_4) NPs on the distribution of the organic matter and metallic elements is investigated. NPsFe_3O_4 with average size of ~15 nm and a minimum magnetization above 45 emu/g are used. Dissolved metallic trace elements and dissolved organic carbon (DOC) were followed by ICP-MS and total organic carbon analyzer for 28 hrs. The surface waters were fractionated at 0.22 μm, 30 kDa, 5 kDa and 2 kDa by ultrafiltration. The aromaticity of the organic matter was followed by SUVA measurements. Finally, the migration of the NPsFe_3O_4 in a column soil were analyzed by magnetic susceptibility (SM). Our results show that the DOC concentration increase after 10 pore volumes for all fractions and the SUVA measurements present a low aromaticity. The SM recordings present a scavenging of NPsFe_3O_4 in the first 10 cm of the column. Thus, the results evidence a mobilization of small organic molecules and a scavenging of NPsFe_3O_4.