Colloid-affected transport processes in soils

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Colloids and even larger-sized suspended particles are involved in a multitude of biogeochemical and physicochemical processes in natural porous media like soils, sediments and aquifers. It has now been accepted that they act as mobile reactive sorbents, resulting in either reduced or enhanced mobility (Totsche & Kögel-Knabner, 2004). Major processes like sorption, partitioning, speciation and carrier-association are affected by interactions with colloids. Within the continuum of colloidal-sized particles, the nanoparticulate mineral-organic mixed phases which form from complex natural solutions are of particular importance (Fritzsche et al. 2011). They are in the size of 1-100nm (lower colloidal limit according to the IUPAC colloid definition) and are composed both of mineral and organic moieties, either by the way of sorption or co-precipitation (Eusterhues et al., 2011). Like locations of the formation of such mixed phases are microbially mediated redox-gradients. The presence of organic substances during the stage of formation may not only affect mineral formation and growth, but also effect colloidal stability by additional steric stabilization forces. Thus, colloidal mixed phases may be much more stable and mobile than classical mineral, organic, or biotic colloids. Still, colloid research in environmental sciences has the focus mainly on their role for the mobility enhancement of contaminants as a consequence of increased apparent solubility due to complexation, solubilization, carrier association and the solvophobic effect. Yet, interactions of colloids with themselves and with the immobile solid phase, i.e., by sorption, straining, flocculation, redispersion, coagulation and sedimentation, have more complicated consequences for the properties of and processes acting within a natural porous media: They affect (i) the structure, geometry and topology of the pore system and such the hydraulic properties, (ii) the topographic, geometric, mechanic and physicochemical properties of surfaces and interfaces, (iii) and the solution phase properties, e.g., surface tension, density, and viscosity. The scope of the presentation is to explore and discuss the diverse direct and indirect effects of colloidal particles on fluid flow and transport in natural porous media.