

The role of natural organic matter on the adsorption and availability of phosphate in the environment

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The anionic sites on natural organic matter (NOM) compete with phosphate (PO_4) ions for sorption on soil reactive surfaces. This talk will review the role of NOM on PO_4 sorption and will illustrate the environmental consequences for soil. The NOM- PO_4 competition is well known at the molecular scale and is also embedded in geochemical models. Examples will be given of that competition in both model systems and soils. The heterogeneity of NOM and its complex concentration dependent sorption, however, complicates a sound mechanistic description of the competition. Soluble NOM strongly binds to iron (Fe) oxyhydroxide colloids and increasing NOM concentration ensures a high stability of smaller organo-mineral colloids. This is shown by aFFF-ICP-MS analyses of model suspensions in which Fe(II) is oxidised in the presence of NOM. On such smaller colloids, natural organic matter outcompetes PO_4 whereas the reverse is true on larger colloids. That is confirmed when analysing the composition of organo-mineral colloids in soil solutions of a wide variety of soils. In addition, the NOM- PO_4 competition affects the sorption reversibility. In a long-term PO_4 desorption study on a wide range of agricultural soils, it was shown that increasing ratio of soil OM/Fe+Al oxyhydroxides ensures that PO_4 is more labile, i.e. a larger fraction of soil P is present in a pool with fast desorption kinetics. These PO_4 desorption kinetics, in turn, affect the bioavailability of soil P. Accelerated P mining from soils confirms this higher availability of soil P in soils with high OM/Fe+Al, unless the soil is P saturated. It is yet unknown to what extent PO_4 saturation of soils can affect the binding of NOM and the soil organic carbon sequestration potential.