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Primary Shape and Nanomechanical Properties of Colloids studied by AFM and SEM

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Colloids are involved in a multitude of biogeochemical and physicochemical processes in natural soil systems. They may act as mobile reactive carriers, resulting in either reduced or enhanced solute mobility [1]. Interactions of colloids with themselves and with the immobile solid phase not only affect the hydraulic properties, but severely change geometric, mechanic and physicochemical properties of interfaces. Particularly important are the mineral-organic mixed colloidal phases. They form from complex natural solutions either by the way of sorption or co-precipitation [2][3]. The presence of organic substances during development of colloid may not only affect mineral formation and growth, but also colloid stability by additional steric stabilization forces [4]. Thus, these nanoparticulate mixed phases may be much more stable and mobile than classical mineral, organic, or biotic colloids. To be able to understand complicated system of natural colloids it is necessary to understand the interactions between single elements of this system. Therefore, in this study artificial colloidal ferrihydrites were obtained through alkalization of Fe(III)-citrate and Fe(III)-nitrate solution and subjected to incremental addition of humic acid as organic substance. Thus created mixed colloidal phases were then thoroughly analyzed using Scanning Electron Microscopy (SEM), Energy-Dispersive X-ray Spectroscopy (EDX) and Atomic Force Microscopy (AFM). Comparison of changes between pure mineral and mineral-organic colloids in chemical composition and geometric features like particle size, shape, surface area and roughness, was possible. Furthermore, changes in nanomechanical properties of sample material including adhesion, elastic modulus, hardness and energy dissipation were observed and analyzed, using new features of our AFM system.

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[4] Fritzsche et al. (2011) Environmental Pollution 159, 1398-1405