



Differences in crystal habitus of natural and synthetic colloids

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The formation of colloids from natural aqueous solutions is influenced by a multitude of biogeochemical and physicochemical processes and the presence of a large diversity of geogen and biogen, inorganic and organic solution phase components. A thereby frequently neglected class of components is the dissolved and colloidal phase organic matter (DOM). As DOM will interact with other solution phase components, we hypothesize that nanosized and colloidal particles formed in DOM bearing solutions may differ from synthetic precipitates either by size, shape, crystal habitus, crystallinity, composition or combinations of that. To investigate this, we analyzed natural colloidal particles collected from a limestone aquifer of the Upper Muschelkalk formation at Hainich National Park, Thuringia, Germany. Major groundwater components are Ca^{2+} , Mg^{2+} , Na^+ , SO_4^{2-} , Cl^- , HCO_3^- , and about 1 ppm of total organic carbon (TOC) in dissolved and colloidal form. Synthetic nanoparticles were precipitated from a series of oversaturated solutions containing single or mixtures of the following salts CaSO_4 , MgSO_4 , $\text{Ca}(\text{HCO}_3)_2$ NaCl typical for limestone environments. The solutions were produced with both natural groundwater and pure water (milli-Q). Droplets of such produced colloidal suspension were pipetted on silicon wafers and subject to air drying. The wafers were then analyzed by scanning electron microscopy (SEM) with energy-dispersive X-ray spectroscopy (EDX) and atomic force microscopy (AFM).

We found that particles from oversaturated CaSO_4 solution in pure water precipitate as large needle shaped crystals, whereas precipitates from CaSO_4 solution in natural water were much smaller and showed a rosette like shape – similar in size and shape to gypsum crystals collected from the limestone formation water. Similar differences we found for other aqueous solution compositions. From this pilot study we presume that even minute amounts of dissolved and colloidal phase organic matter in natural waters interferes with the nucleation and crystallization processes, resulting in the found differences. Yet, which fractions of DOM and what mechanisms are responsible for the found differences remain unclear and is the objective of the ongoing research