



On the effects of organic and inorganic ligands at the carbonate-water interface

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The effects of organic and inorganic ligands are important in various different processes taking place in completely different length scales. i) Quantitative and predictive modelling of CO₂ sequestration in deep aquifers requires precise knowledge of carbonate mineral reactivity at conditions pertinent to CO₂ storage. Whereas the effect of temperature, salinity, pH, and pCO₂ on Ca- and Mg-carbonate dissolution is extensively studied, the understanding of the influence of organic and inorganic ligands, omnipresent in deep sedimentary basins, remains very limited. ii) Organic and inorganic molecules can exert various influences on the kinetics of crystal growth during biomineralisation. The ligands can promote or inhibit growth and can control crystal morphology.

Here, a combination of mixed-flow reactor experiments and in-situ hydrothermal atomic force microscopy experiments has been used to investigate the effect of various ligands on the surface morphology and the growth and dissolution kinetics of calcite and magnesite. Since AFM enables to observe monolayer step motion on the surface as well as the step formation frequency by pit nucleation, the effect of ligands e.g., on the rate of detachment at specific surface sites can be determined. Thus, AFM data can be interpreted towards a determination of the consequences of adsorption at specific sites on the dissolution kinetics of magnesite in a molecular scale. Comparisons of these data with the dissolution rates of the (104) surfaces and with the dissolution rates of entire crystals (obtained by mixed-flow reactor experiments) allow one to link the molecular-scale effects to the macroscopic effects of ligands on magnesite

dissolution.